MARINER OUTBOARDS

MERCURY OUTBOARDS

SERVICE MANUAL

MODELS
225 • 225 EFI • 250 EFI • 3.0 Litre Marathon • 3.0 Litre SeaPro

With Serial Numbers

United States . . . 0D280813 and Above

Printed in U.S.A.

90-822900R3 DECEMBER 1997

Notice

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

Notice to Users of This Manual

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

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

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

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

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

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

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

Cleanliness and Care of Outboard Motor

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

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

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

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

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

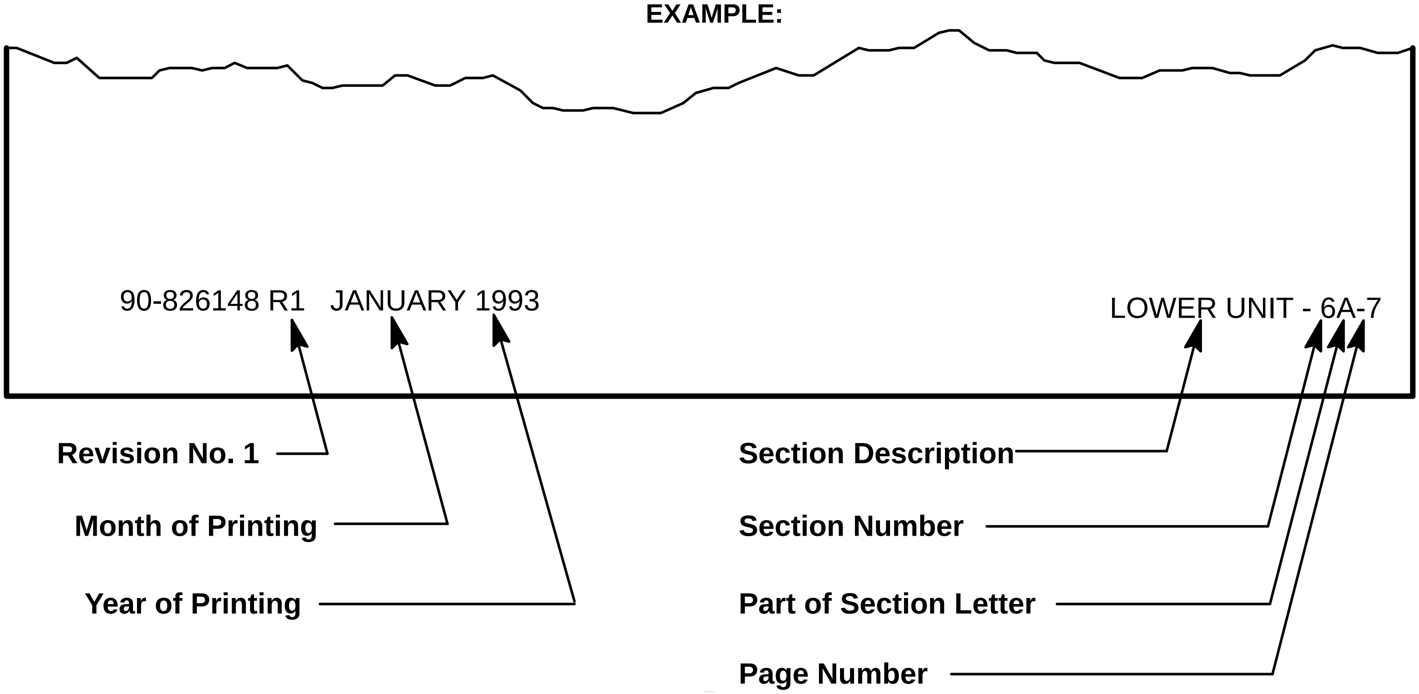
We reserve the right to make changes to this manual without prior notification.

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

Page Numbering

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

EXAMPLE:



Service Manual Outline

IMPORTANT INFORMATION

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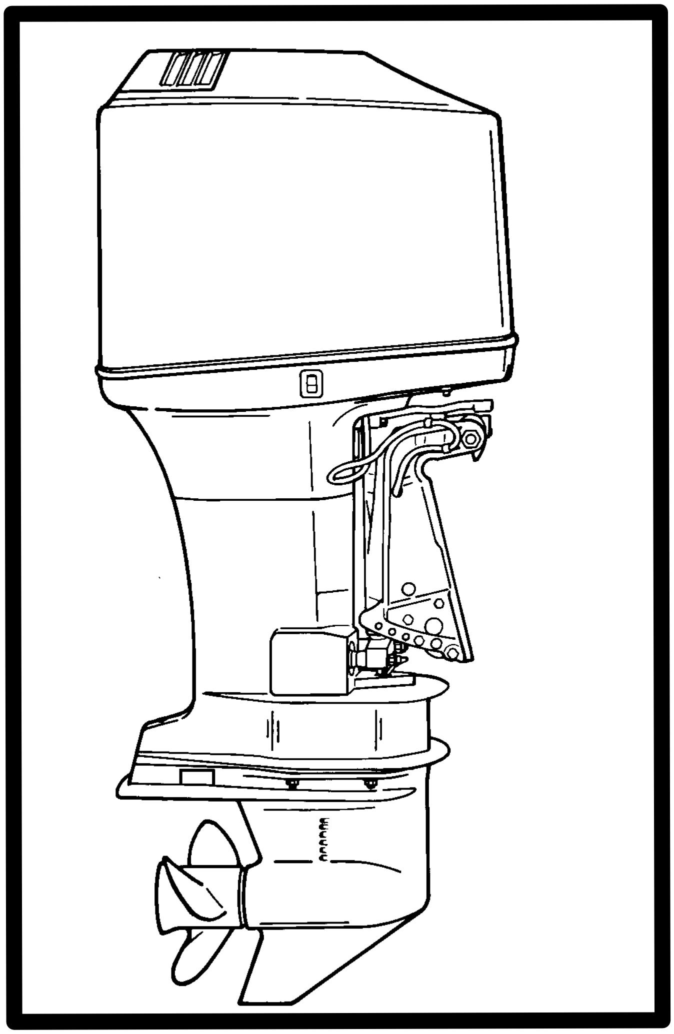

SPECIFICATIONS

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Master Specifications

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
HORSEPOWER (KW)	**Model 3 Litre** **Model 225 Carb** **Model 225 EFI** **Model 250 EFI**	225 (167.8) 225 (167.8) 225 (167.8) 250 (186.5)
OUTBOARD WEIGHT	**3 Litre/225 Carb** **– 20 in. (50.8cm) Shaft** **– 25 in. (63.5cm) Shaft** **– 30 in. (76.2cm) Shaft** **225 EFI/250 EFI** **– 20 in. (50.8cm) Shaft** **– 25 in. (63.5cm) Shaft** **– 30 in. (76.2cm) Shaft**	 440.0 lbs. (199.8kg) 445.0 lbs. (202.0kg) 461.0 lbs. (209.3kg) 450.0 lbs. (204.1kg) 455.0 lbs. (206.4kg) 471.0 lbs. (213.6kg)
CYLINDER BLOCK	**Type** **Displacement**	V–6 Cylinder, Two Cycle, Loop Charged 185.9 cu. in. (3047cc)
STROKE	**Length (All Models)**	3.00 in. (76.2mm)
CYLINDER BORE	**Diameter (Std)** **Taper/Out of Round/Wear Maximum** **Bore Type**	3.6265 in. (92.1131mm) 0.003 in. (0.076mm) Cast Iron
PISTON	**Piston Type** **Standard**	Aluminum 3.621 in. ± .0005 in. (91.973mm ± 0.0127mm)
COMPRESSION	**All Models – Using a fully charged battery, throttle shutters wide open and cylinder block warm**	90 – 110 psi (616.3 – 753.5 kPa) Variance between cylinders should not exceed 15 psi (102.7 kPa)
REEDS	**Reed Stand 0pen (Max.)**	0.020 in. (0.50mm)
MID SECTION	**Power Trim (Total Tilt Range)** **Power Trim (Tilt Range)** **Steering Pivot Range** **Tilt Pin Adjustment Positions** **Allowable Transom Thickness**	75° 20° 60° 5 2-3/8 in. (6.03cm) Maximum

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
GEAR HOUSING	**Gear Ratio** **1994 Standard Ratio All Models**	 1.64:1 17/28 Teeth Service Replacement Ratio for 1.64:1 is 1.62:1 13/21 Teeth
	1995/1996 Gear Ratios All Models **Optional High Altitude Ratio (Right Hand Rotation)** **3 Litre Work (All Shaft Lengths)** **225 Carb (20 in. Shaft Length)** **225 Carb (25 in./30 in. Length)** **225 EFI (All Shaft Lengths)** **250 EFI (All Shaft Lengths)**	 1.87:1 15/28 Teeth 1.75:1 12/21 Teeth 1.75:1 1.75:1 1.75:1 1.75:1
	Gearcase Capacity	28.0 fl. oz. (828.0ml)
	Pinion Height	0.025 in. (0.64mm)
	Forward Gear Backlash **– 1.75:1/1.87:1**	. 0.017 in. – 0.028 in. (0.43mm – 0.71mm)
	Reverse Gear Backlash **– Standard Rotation** **– Counter Rotation**	 0.028 in. to 0.052 in. (0.71mm to 1.32mm) 0.040 in. – 0.060 in. (1.0mm – 1.52mm)
	Water Pressure @ RPM **– @ Idle** **– @ 5000 RPM**	 1-1/2 – 4-1/2 psi (10.3 – 30.8kPa) 8 – 10 psi (54.8 – 68.5kPa) Minimum
FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Recommended Oil** **Gasoline/Oil Ratio** **Fuel Pressure – @ Idle** **– @ WOT**	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver TC-W3 2 Cycle Outboard Oil 50:1 2 psi (13.7kPa) 8 psi (54.8kPa)
STARTING SYSTEM	**Manual Start – All Models** **Electric Start – All Models** **Starter Draw (Under Load)** **Starter Load (No Load)** **Minimum Brush Length** **Battery Rating**	Emergency Start Rope 165 Amperes 25 Amperes 0.25 in. (65.4mm) 630 Marine Cranking Amps (MCA) or 490 Cold Cranking Amps (CCA)
IGNITION SYSTEM	**Type** **Spark Plug Type** **1994 – 1996 S/N 0D280813 - 0G437999 3 Litre Work/225 Carb** **1997 S/N 0G438000 and UP** **3 Litre Work/225 Carb** **1994/95/96/97 225 EFI/250EFI**	Capacitor Discharge NGK BPZ8H-N-10 Champion QL77CC Champion QL77CC
	Spark Plug Gap **NGK BPZ8H-N-10** **Champion QL77CC**	 0.040 in. (1.0mm) 0.035 in. (0.89mm)
CHARGING SYSTEM	**Alternator Output (Regulated)**	30 Amperes @ 750 RPM 60 Amperes @ 2000 RPM
	Brush Length	Std. Exposed Length: 0.413 in. (10.5mm) Min. Exposed Length: 0.059 in. (1.5mm)

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
FUEL INJECTION	**Idle RPM**	
	– Model 225 EFI/250 EFI	650 ± 50
	Wide Open Throttle (WOT) RPM	
	– Model 225 EFI	5000 – 5800
	– Model 250 EFI	5000 – 5800
	Float Adjustment (Vapor Separator)	
	Float Level	Preset @ Factory
	Injectors	
	– All Models (Quantity)	6
	– Fuel ECU Receives Signal from:	
	– #2 Primary Ignition Circuit	#1 and #2 Injectors (WHITE Lead)
	– #4 Primary Ignition Circuit	#3 and #4 Injectors (DARK BLUE Lead)
	– #6 Primary Ignition Circuit	#5 and #6 Injectors (YELLOW Lead)
	Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)
OIL INJECTION	**Recommended Oil**	Quicksilver TC-W3
	Oil Tank Capacity (in boat)	3 gal. (11.4Liter)
	Approx. Time	
	– Model 225/250	6.0 hrs. Approx.
	Reserve Capacity/Approx. Time	1.5 qt. (1.45 Liter) 30 – 35 min.
	Output @ 1500 RPM for 3 Minutes with Pump @ Full Open	31.5cc @ 1500 RPM

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
CARBURETOR	**Model 3 Litre Work**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 6	
	– Cylinder #1	
	– Main Jet	.078
	– Idle Jet	.042
	– Vent Jet	.080
	– Cylinder #2	
	– Main Jet	.078
	– Idle Jet	.042
	– Vent Jet	.080
	– Cylinder #3	
	– Main Jet	.080
	– Idle Jet	.056
	– Vent Jet	.080
	– Cylinder #4	
	– Main Jet	.078
	– Idle Jet	.018
	– Vent Jet	.080
	– Cylinder #5	
	– Main Jet	.088
	– Idle Jet	.056
	– Vent Jet	.080
	– Cylinder #6	
	– Main Jet	.078
	– Idle Jet	.018
	– Vent Jet	.080

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
CARBURETOR	**Model 3 Litre Work**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 11	
	– Cylinder #1	
	– Main Jet	.082
	– Idle Jet	.040
	– Vent Jet	.080
	– Cylinder #2	
	– Main Jet	.082
	– Idle Jet	.046
	– Vent Jet	.080
	– Cylinder #3	
	– Main Jet	.082
	– Idle Jet	.058
	– Vent Jet	.080
	– Cylinder #4	
	– Main Jet	.086
	– Idle Jet	.048
	– Vent Jet	.080
	– Cylinder #5	
	– Main Jet	.082
	– Idle Jet	.054
	– Vent Jet	.080
	– Cylinder #6	
	– Main Jet	.082
	– Idle Jet	.048
	– Vent Jet	.080

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
CARBURETOR	**Model 225**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 7	
	– Cylinder #1	
	– Main Jet	.086
	– Idle Jet	.038
	– Vent Jet	.080
	– Cylinder #2	
	– Main Jet	.086
	– Idle Jet	.038
	– Vent Jet	.080
	– Cylinder #3	
	– Main Jet	.088
	– Idle Jet	.070
	– Vent Jet	.080
	– Cylinder #4	
	– Main Jet	.088
	– Idle Jet	.020
	– Vent Jet	.080
	– Cylinder #5	
	– Main Jet	.088
	– Idle Jet	.070
	– Vent Jet	.080
	– Cylinder #6	
	– Main Jet	.088
	– Idle Jet	.032
	– Vent Jet	.080

Model 3 Litre Work/225 Carb/225 EFI/250EFI		
C	**Model 225**	
A	**Idle RPM**	650 ± 50
R	**Wide Open Throttle (WOT) RPM**	5000 – 5500
B	**Idle Mixture Screw Adjustment**	1-1/2±1/4
U	**Float Adjustment**	Float is Level with top of Bowl w/Bowl Inverted
R		
E	**WMV 13**	
T	**– Cylinder #1**	
O	**– Main Jet**	.084
R	**– Idle Jet**	.046
	– Vent Jet	.082
	– Cylinder #2	
	– Main Jet	.082
	– Idle Jet	.060
	– Vent Jet	.082
	– Cylinder #3	
	– Main Jet	.084
	– Idle Jet	.054
	– Vent Jet	.086
	– Cylinder #4	
	– Main Jet	.086
	– Idle Jet	.052
	– Vent Jet	.086
	– Cylinder #5	
	– Main Jet	.084
	– Idle Jet	.058
	– Vent Jet	.082
	– Cylinder #6	
	– Main Jet	.082
	– Idle Jet	.052
	– Vent Jet	.082
T	**Idle Timing**	4° – 8° ATDC
I	**Maximum BTDC**	
M	**@ W.O.T (5000 RPM or Above)**	
I		
N	**MODEL 3 LITRE WORK/225 CARB**	19° BTDC @ 5000 RPM
G		24° BTDC @ 5500 RPM
	MODEL 225 EFI	24° BTDC @ 5000 RPM
		24° BTDC @ 5800 RPM
	MODEL 250 EFI	24° BTDC @ 5000 RPM
		28° BTDC @ 5800 RPM

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

IMPORTANT INFORMATION

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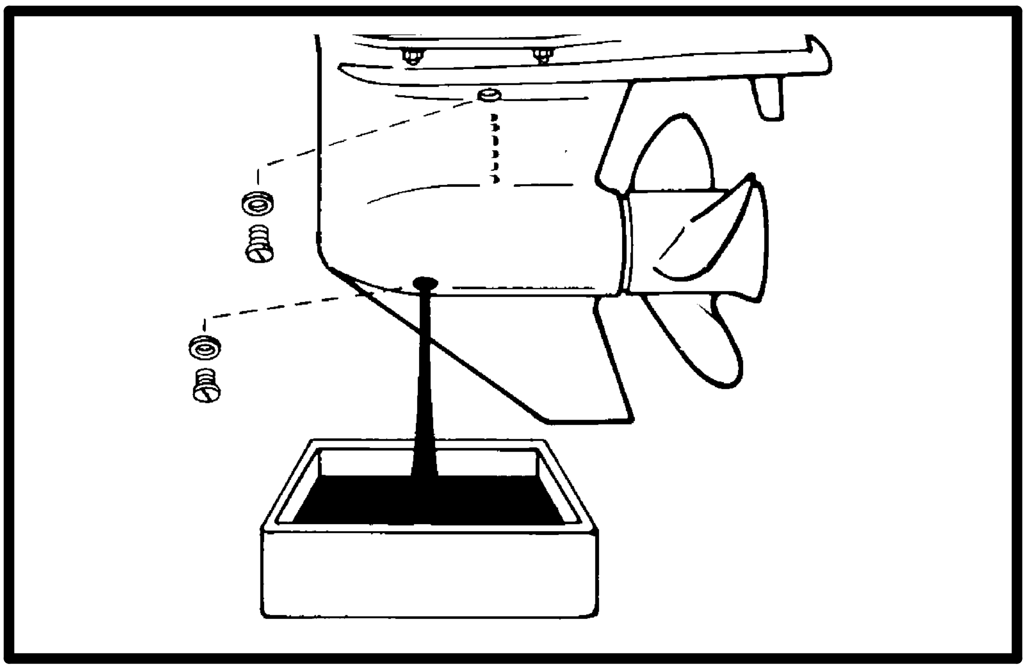

MAINTENANCE

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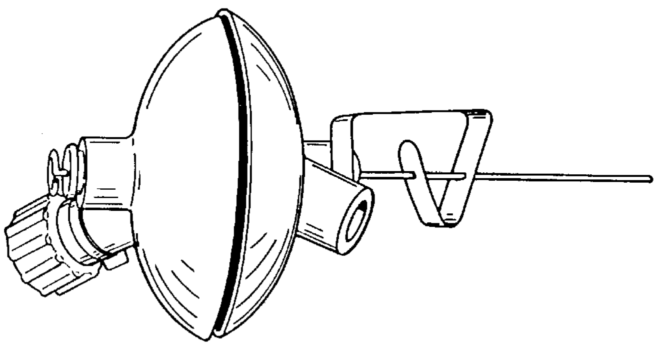
Specifications

Gear Case Lubricant Capacity

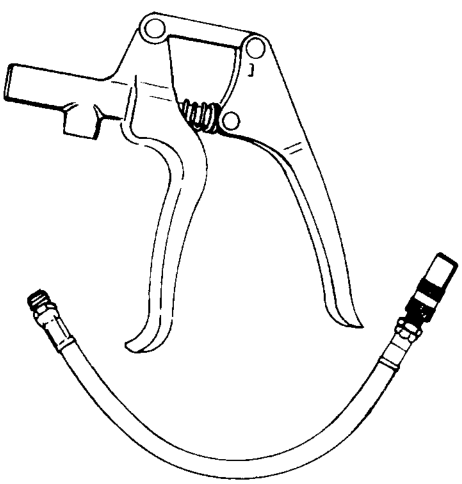
Gear Case Ratio	Capacity
1.64:1	28 fl. oz. (828ml)
1.75:1	28 fl. oz. (828ml)
1.87:1	28 fl. oz. (828ml)

Special Tools

1. Flushing Attachment 44357A2

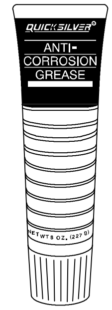


2. Grease Gun 91-37299A1

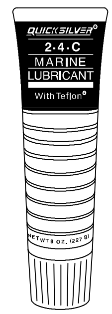


Quicksilver Lubricant/Sealant

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

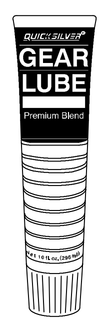


2. 2-4-C Marine Lubricant with Teflon P/N 92-825407A12



3. SAE 30W Motor Oil P/N 97959

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



Inspection and Maintenance Schedule

Before Each Use

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

After Each Use

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

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

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

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

Before Periods of Storage

FUEL SYSTEM

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

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

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

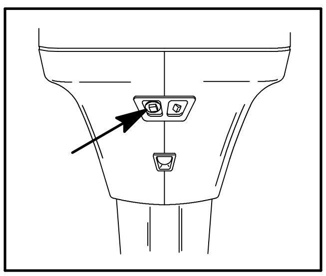
Flushing Engine

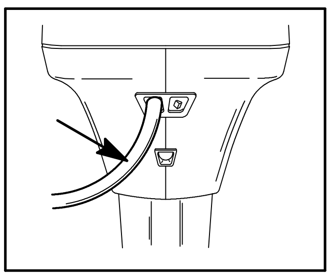
Flushing Cooling System with Engine NOT Running (Using Cowl Flush Plug)

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

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

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





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

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

⚠ WARNING

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

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

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

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

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

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

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

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

Fuel System

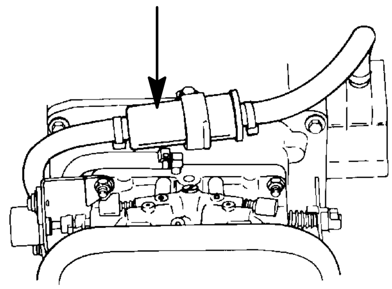
⚠ WARNING

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

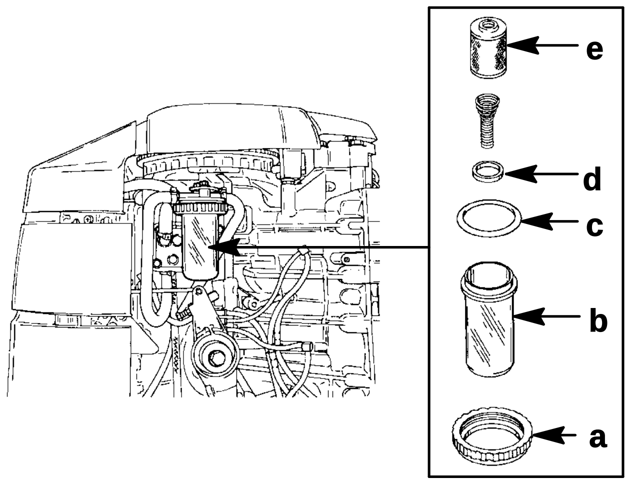
Before servicing any part of the fuel system, stop engine and disconnect the battery. Drain the fuel system completely. Use an approved container to collect and store fuel. Wipe up any spillage immediately. Material used to contain spillage must be disposed of in an approved receptacle. Any fuel system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

Fuel Line Filter

Model 225 Carburetor



Model 200 Work



FUEL LINE FILTER (WORK MODELS)

Inspect the sight bowl (b) for water accumulation. The sight bowl is equipped with a float (d) that floats on water. Also inspect the filter element (e) for sediment. Clean filter as follows.

REMOVAL

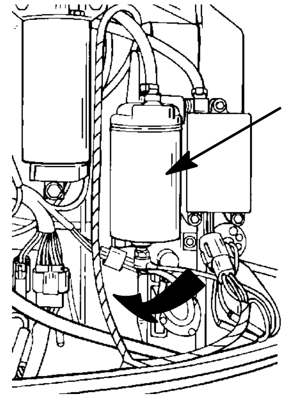
1. Turn the engine off.
2. Turn off cap (a) and remove the sight bowl.
3. Remove the filter element (e) and wash it with cleaning solvent.

INSTALLATION

1. Reinstall filter element (open end up).
2. Place the O-ring seal (c) onto the sight bowl and reinstall sight bowl with cap. Tighten cap securely.

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

WATER SEPARATING FUEL FILTER (MODELS WITH ELECTRONIC FUEL INJECTION)



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

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

Remove and replace filter as follows:

a. Turn ignition key switch to OFF position.

b. Disconnect wire at bottom of filter. Remove filter by turning the filter in the direction of the arrow (clockwise). Tip the filter to drain fluid in a suitable container.

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

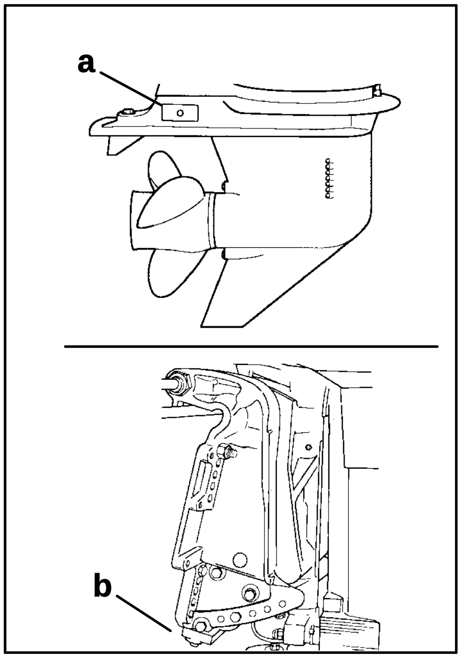
IMPORTANT: Visually inspect for fuel leakage from the filter by squeezing the primer bulb until firm, forcing fuel into the filter.

Fuel Line Inspection

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

Corrosion Control Anode

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



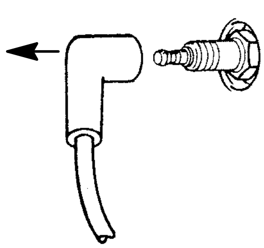
a - Gear Case Anodes (2)
b - Transom Bracket Anode

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

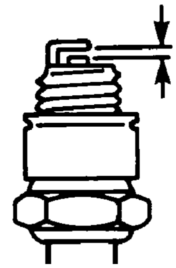
Spark Plug Inspection

Inspect spark plugs at the recommended intervals

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



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



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

Battery Inspection

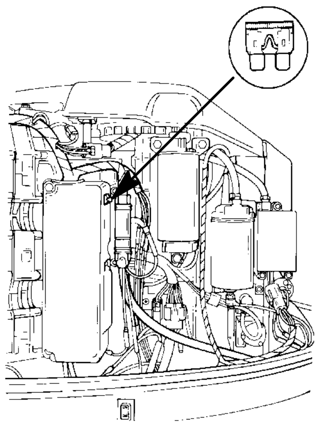
The battery should be inspected at periodic intervals to ensure proper engine starting capability.

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

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

Fuse Replacement

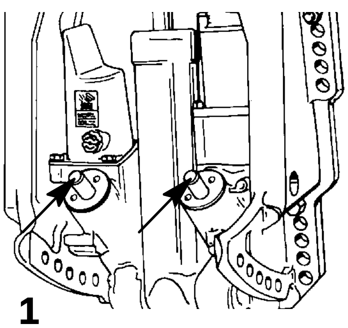
The electric starting circuit is protected from overload by an SFE 20 AMP fuse. If the fuse is blown, the electric starter motor will not operate. Try to locate and correct the cause of the overload. If the cause is not found, the fuse may blow again. Replace the fuse with a fuse of the same rating.



Lubrication Points

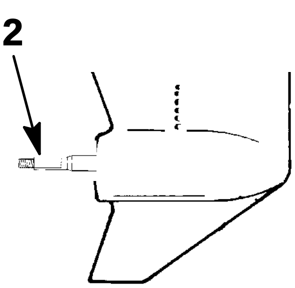
Lubricate Point 1 with Quicksilver Special Lubricant 101.

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



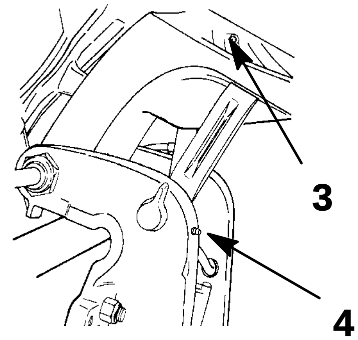
Lubricate Point 2 with Quicksilver Anti-Corrosion Grease or 2-4-C Marine Lubricant with Teflon.

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.

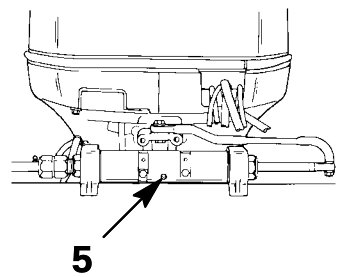


Lubricate Points 3 thru 6 with Quicksilver 2-4-C Marine Lubricant with Teflon or Special Lubricate 101.

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



5. Tilt Tube – Lubricate through fitting.



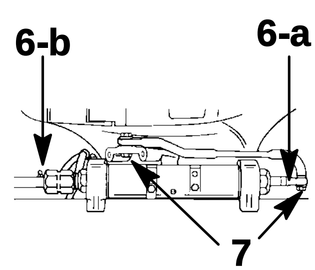
⚠ WARNING

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

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

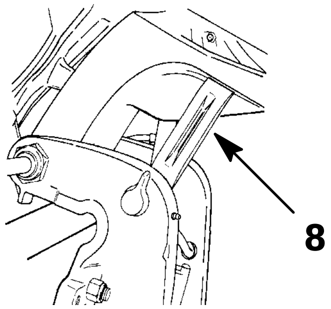
Lubricate Points 7 With Light Weight Oil.

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

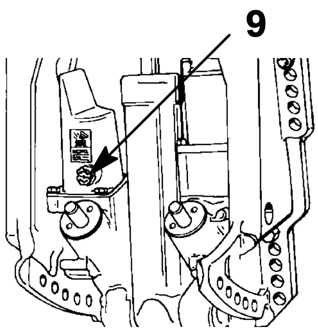


Checking Power Trim Fluid

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

Gear Case Lubricant Capacity

Gear Case Ratio	Capacity
1.64:1	28 fl. oz. (828ml)
1.75:1	28 fl. oz. (828ml)
1.87:1	28 fl. oz. (828ml)

Draining Gear Case

⚠ WARNING

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

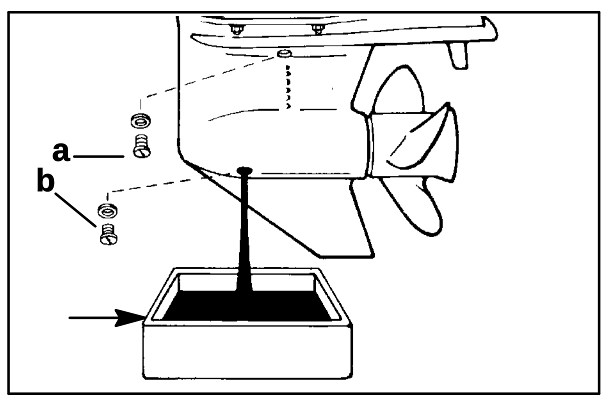
⚠ CAUTION

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

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

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

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



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

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

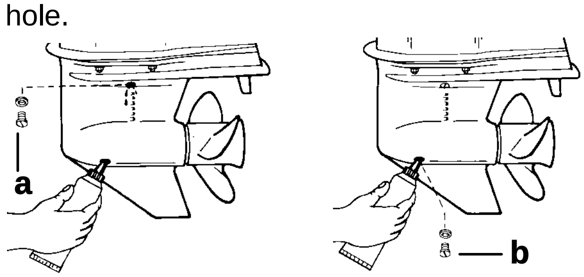
Checking Lubricant Level and Refilling Gear Case

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

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

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

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



87 Quicksilver Gear Lubricant (92-19007A24)

a - Vent Screw
b - Fill Screw

Storage

PROTECTING EXTERNAL OUTBOARD COMPONENTS

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

PROTECTING INTERNAL ENGINE COMPONENTS

Carburetor Models

1. Remove carburetor cover.

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

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

Electronic Fuel Injection (EFI) Models

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

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

GEAR CASE

Drain and refill the gear case lubricant.

POSITIONING OUTBOARD FOR STORAGE

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

CAUTION

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

BATTERY STORAGE

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

IMPORTANT INFORMATION

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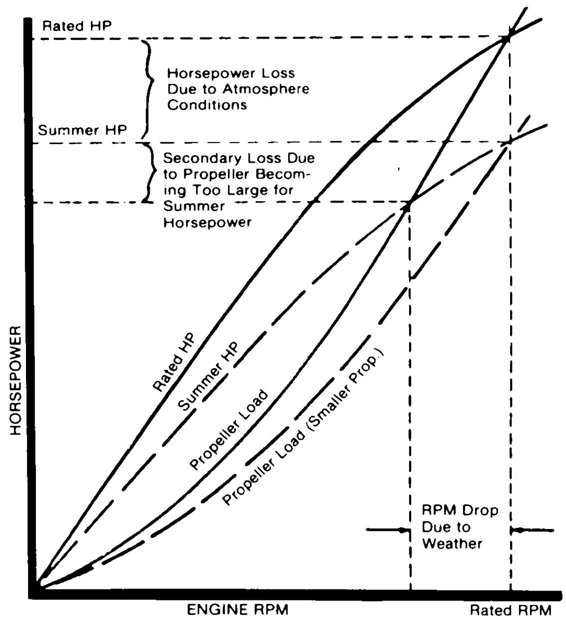

GENERAL INFORMATION

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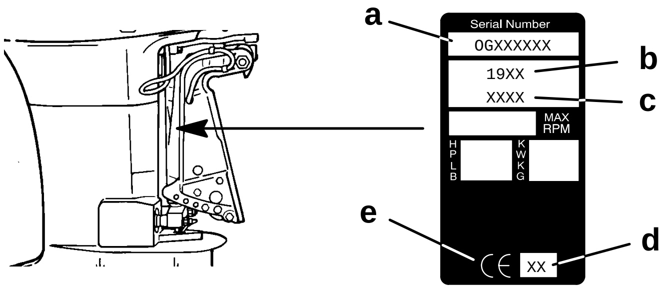
Serial Number Location

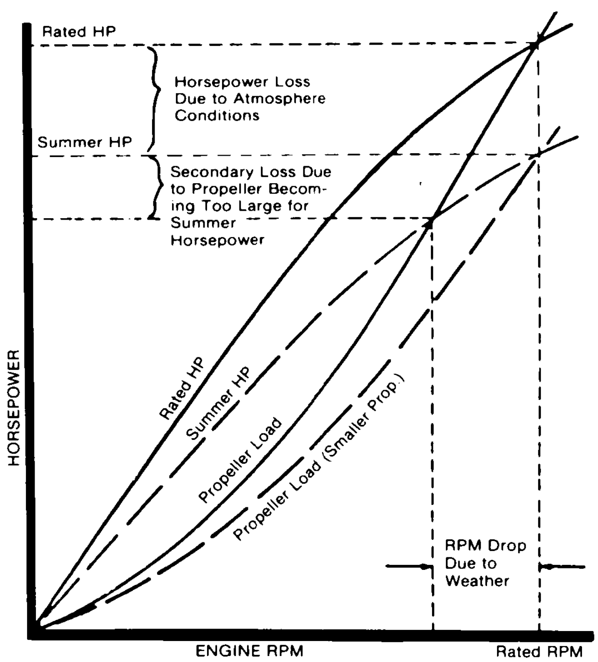
The engine serial number is located on the lower starboard side of the engine block. A serial number is also located on the starboard side of the swivel bracket.



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

Conditions Affecting Performance

Weather



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

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

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

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

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

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

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

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

Boat

WEIGHT DISTRIBUTION

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

BOTTOM

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

TRIM

TRIMMING OUTBOARD "OUT" ("UP")

⚠ WARNING

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

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

TRIMMING OUTBOARD "IN" ("DOWN") CHARACTERISTICS

⚠ WARNING

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

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

WATER ABSORPTION

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

CAVITATION

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

VENTILATION

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

Engine

DETONATION

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

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

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

a. Over-advanced ignition timing.

(1.) Use of low octane gasoline.

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

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

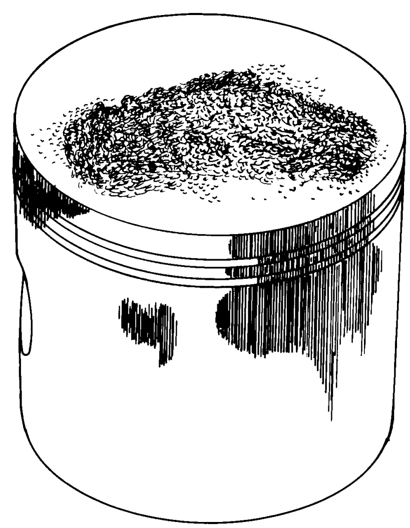
(4.) Spark plugs (heat range too hot – incorrect reach – cross-firing).

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

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

Detonation usually can be prevented if:

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



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Damaged Piston Resulting from Detonation

Following Complete Submersion

Salt Water Submersion

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

Submerged While Running

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

Submerged Engine (Fresh Water)

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

Propeller Selection

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

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

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

Propeller Replacement

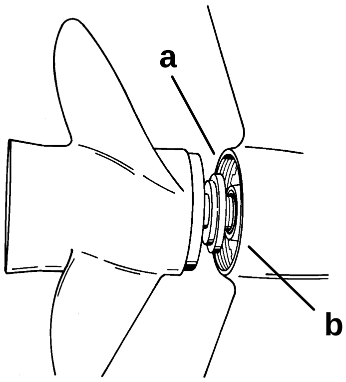
Removal

⚠ WARNING

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

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

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



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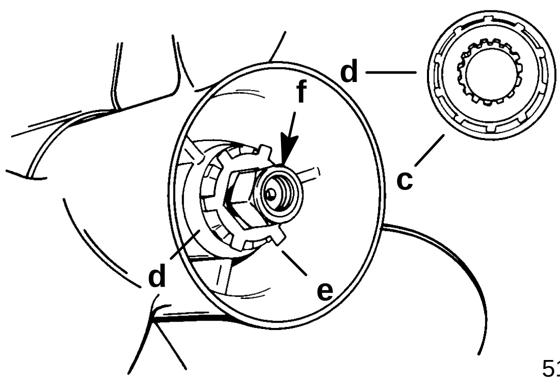

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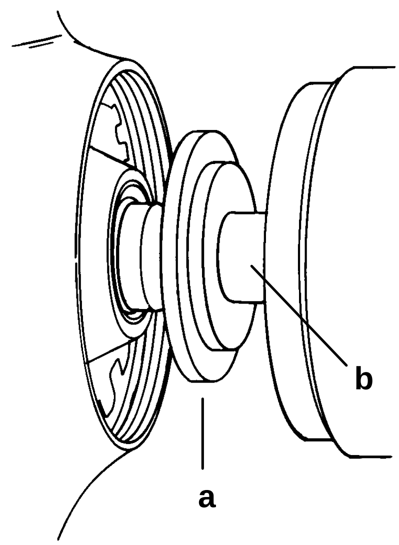
a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

Installation

WARNING

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

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



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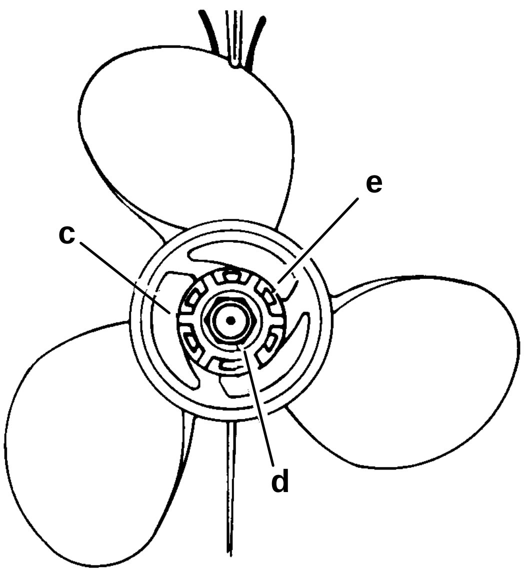
94 Anti-Corrosion Grease (92-78376A6)
95 2-4-C With Teflon (92-825407A12)
108 Special Lubricant 101 (92-13872A1)

a - Forward Thrust Hub
b - Propeller Shaft

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

CAUTION

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



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

Power Trim System

General Information

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

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

The trim system is pressurized and is not externally vented.

Power Trim Operation

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

WARNING

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

Consider the following lists carefully.

Trimming In or Down Can:

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

WARNING

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

Trimming Out or Up Can:

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

Trim "In" Angle Adjustment

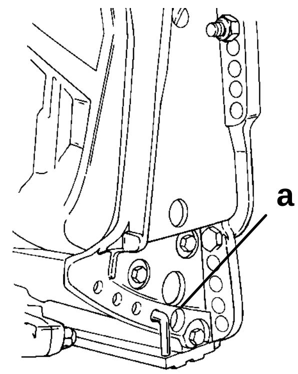
Some outboard boats, particularly some bass boats, are built with a greater than normal transom angle which will allow the outboard to be trimmed further "in" or "under". This greater trim "under" capability is desirable to improve acceleration, reduce the angle and time spend in a bow high boat attitude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

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

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

WARNING

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



a - Tilt Pin

Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

⚠ WARNING

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

PROPELLERS

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

GEAR HOUSINGS

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

Procedure:

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

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

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

⚠ CAUTION

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

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

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

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

Decal Application

Decal Removal

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

Instructions for “Wet” Application

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

TOOLS REQUIRED

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

* Automotive Body Filler Squeegee

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

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

TEMPERATURE

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

SURFACE PREPARATION

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

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

DECAL APPLICATION

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

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

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

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

IMPORTANT INFORMATION

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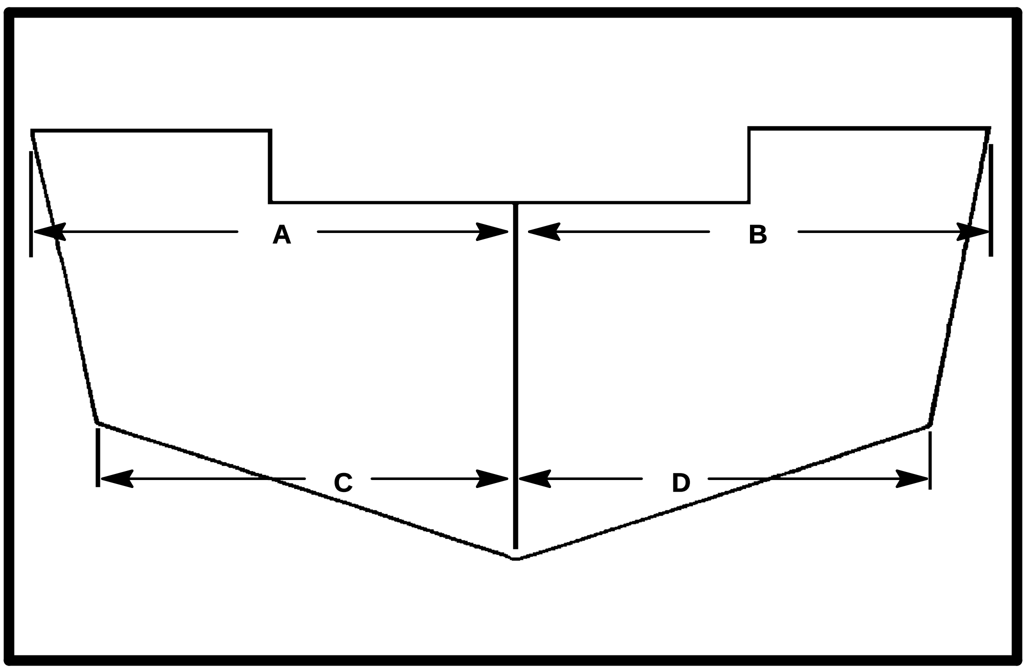


OUTBOARD MOTOR INSTALLATION

Table of Contents

Notice to Installer and Owner

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

⚠ WARNING

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

⚠ CAUTION

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

Boat Horsepower Capacity

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

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

⚠ WARNING

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

Outboard Remote Control

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

⚠ WARNING

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

Selecting Accessories For The Outboard

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

⚠ WARNING

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

Selecting Steering Cables and Remote Control Cables

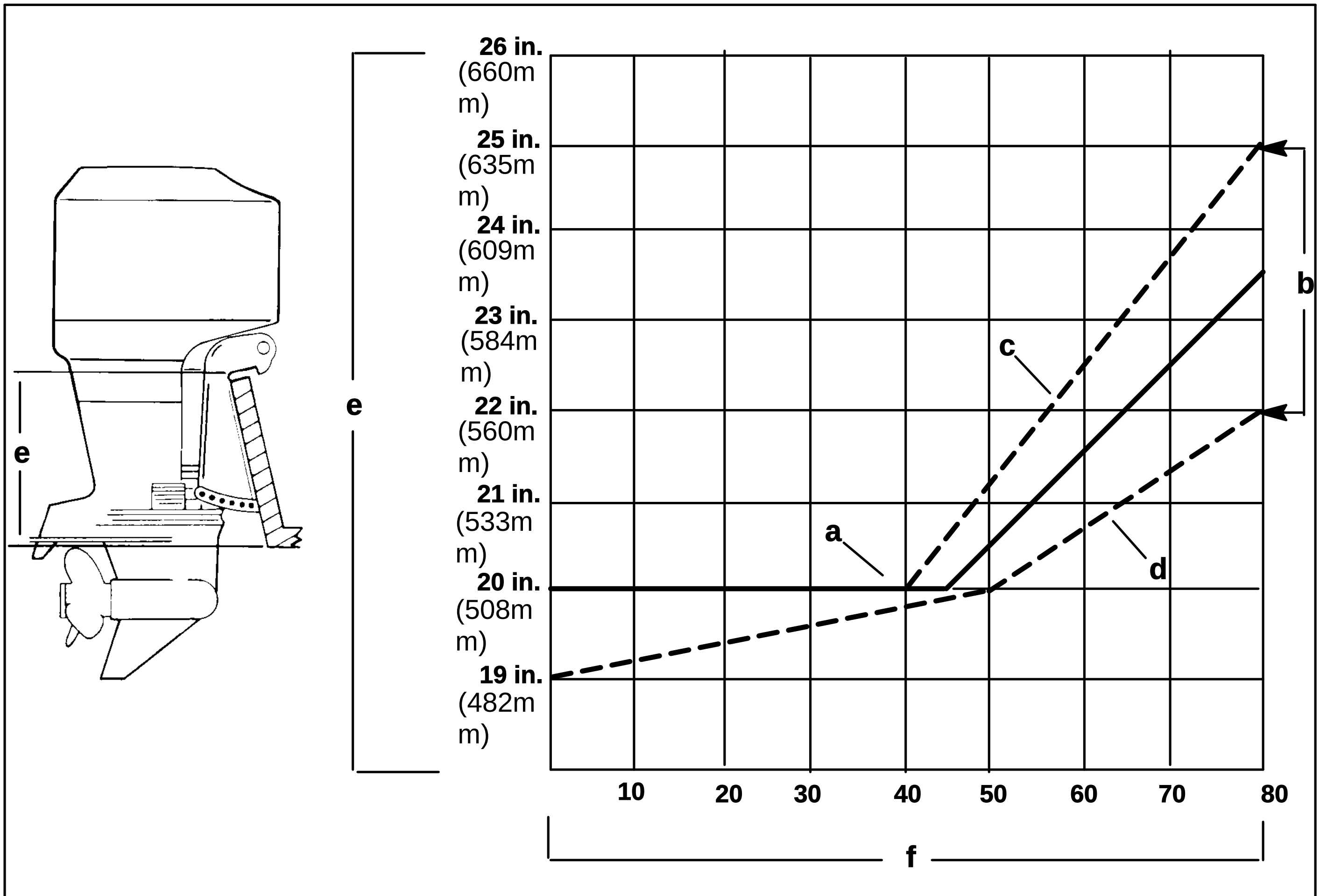
Refer to "Quicksilver Accessories Guide" to determine correct length of steering cables and remote control cables.

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

Determining Recommended Outboard Mounting Height

⚠ WARNING

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



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

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

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

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

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

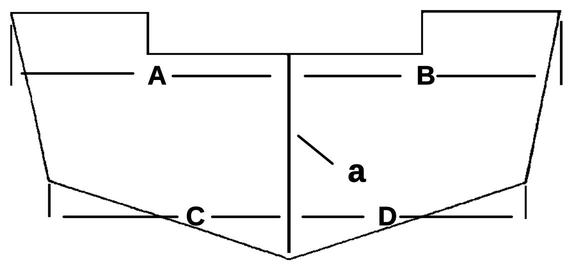
d. This line may be preferred to determine outboard mounting height dimension for dual outboard installation.

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

f. Maximum boat speed anticipated.

Locating Centerline of Boat Transom

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



a - Centerline of Transom

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

Drilling Outboard Mounting Holes

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

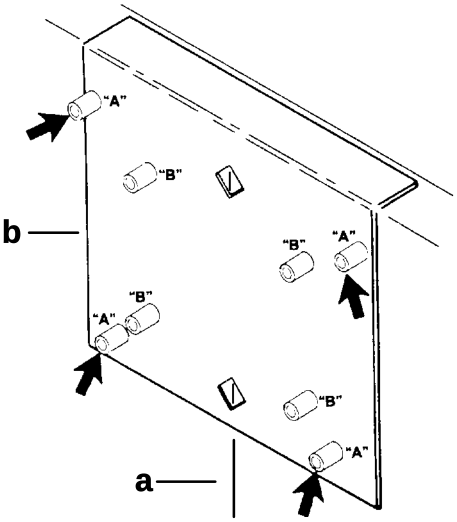
⚠ WARNING

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

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

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

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



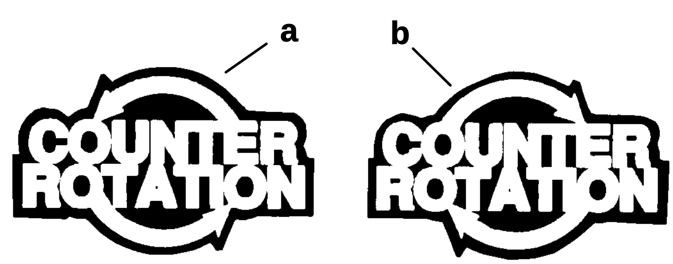
a - Centerline of Transom
b - Transom Drilling Fixture (91-98234A2)

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

Applying Counter Rotation Decals

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

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



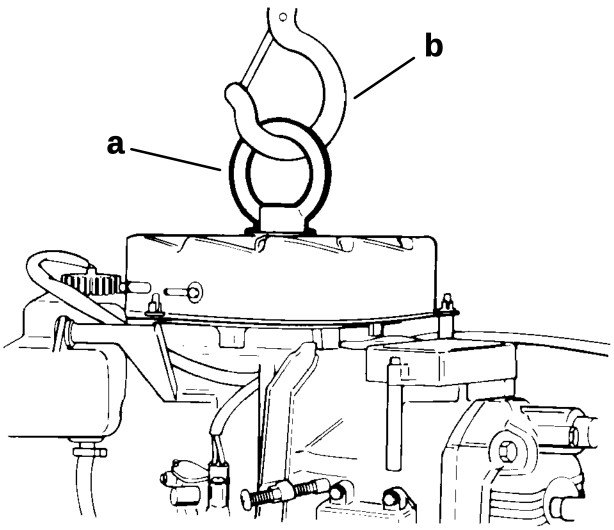
a - Counter Rotation Decal (Left-Hand Rotation Outboard)
b - Counter Rotation Decal (Right-Hand Rotation Outboard)

Lifting Outboard

⚠ WARNING

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

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



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

Installing Outboard To Boat Transom

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

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

⚠ CAUTION

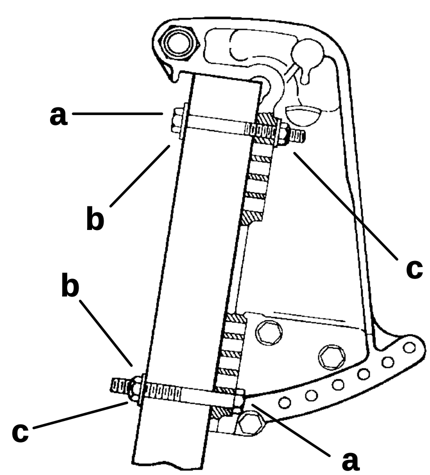
Marine sealer must be used on shanks bolts to make a water-tight installation.

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

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

⚠ WARNING

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



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

Single Steering Cable and Steering link Rod Installation

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

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

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

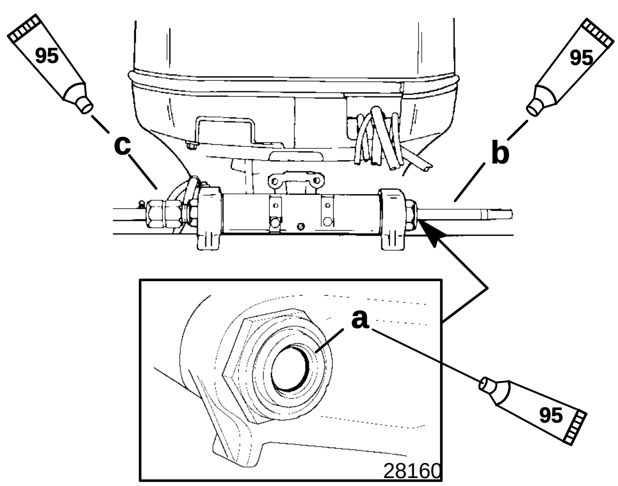
Install steering mount and steering wheel in accordance with installation instructions that accompany each.

Installing Ride Guide Cable to Outboard Tilt Tube

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

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

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



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

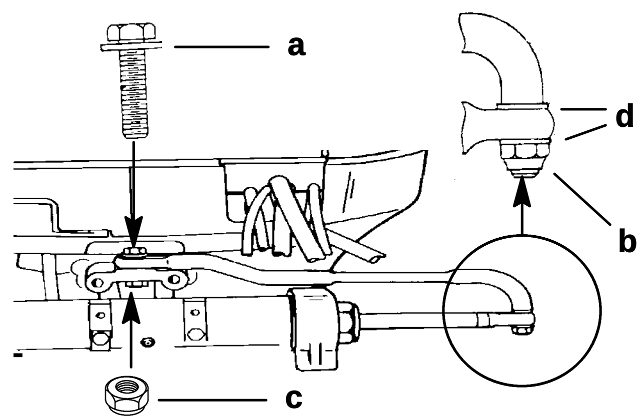
Steering Link Rod Installation

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

⚠ WARNING

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

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



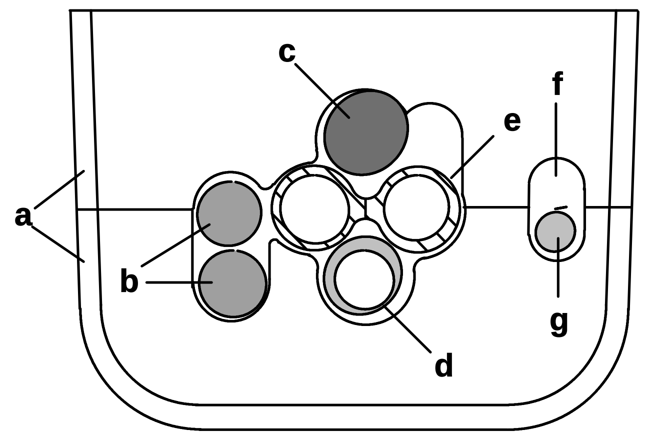
⚠ WARNING

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

Routing location for Wiring and Hoses thru Clamp in Bottom Cowl

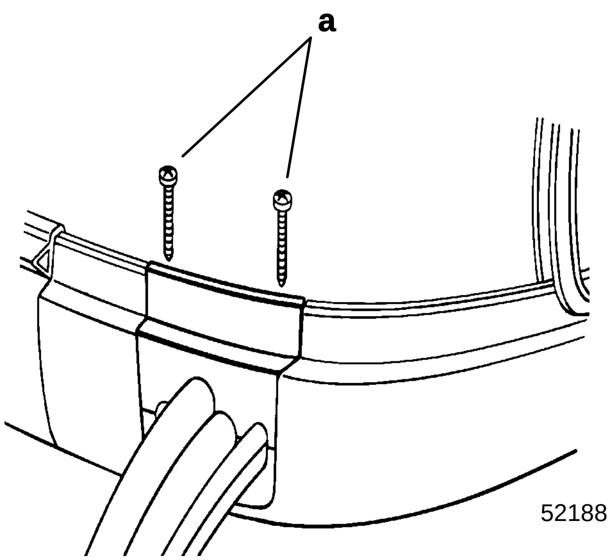
IMPORTANT: Sufficient slack must exist in engine wiring harness, battery cables, fuel hose, and oil hoses routed between clamp and engine attachment point, to relieve stress and prevent hoses from being kinked or pinched.

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



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

2. Secure clamp halves together with 2 screws.



a - Screws

Remote Control Installation

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

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

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

Counter (Left Hand) Rotation Outboards

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

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

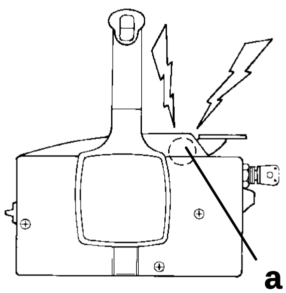
The Quicksilver Commander Series Dual Engine Console Mount Control, P/N 88688A22, is required to shift the counter rotation outboard. The installation instructions shipped with the control explain the procedure required to connect this control to a counter rotation outboard.

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

Required Side Mount Remote Control or Ignition Key Switch Assembly

Boats Equipped with Side Mount Remote Control

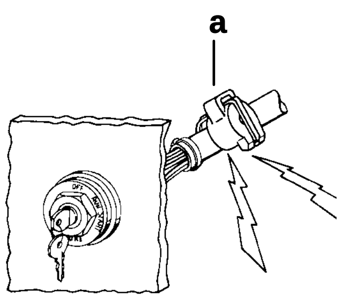
A Quicksilver Commander 2000 series Side Mount Remote Control equipped with a warning horn must be used with this outboard. This warning horn is necessary for the engine warning system.



a -Warning Horn

Boats Equipped with Panel or Console Mount Remote Control

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



a - Warning Horn

Shift and Throttle Cable Installation to the Outboard

Shift Cable Installation

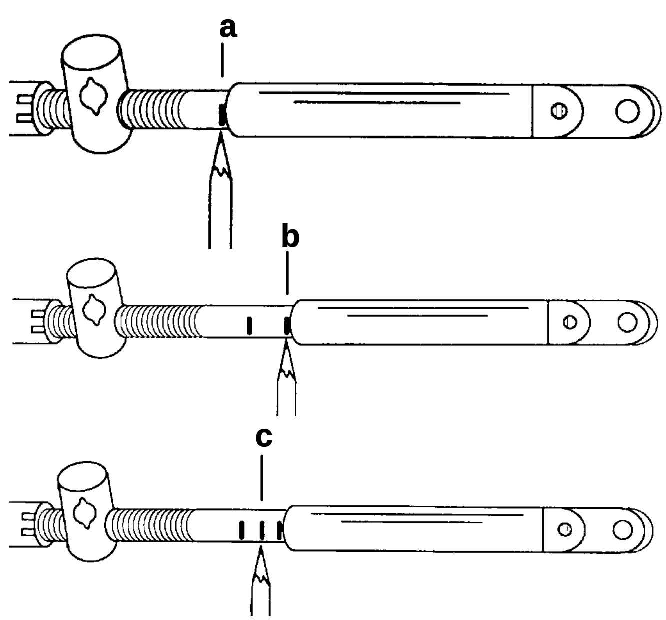
1. Install the shift cable to the remote control. Refer to installation instructions included with the remote control.
2. Before installing the shift cable to the engine, locate the center point of the slack or lost motion that exists in the remote control and shift cable as follows.

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

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

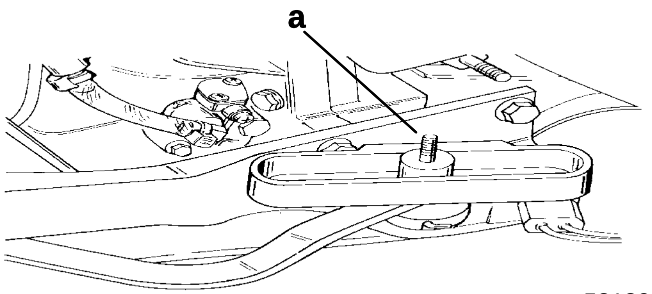
   b. Move the remote control handle into reverse and advance the handle to the full speed position. Slowly return the handle back to the neutral detent position. Place a mark on the shift cable against the cable end guide at location (b).

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

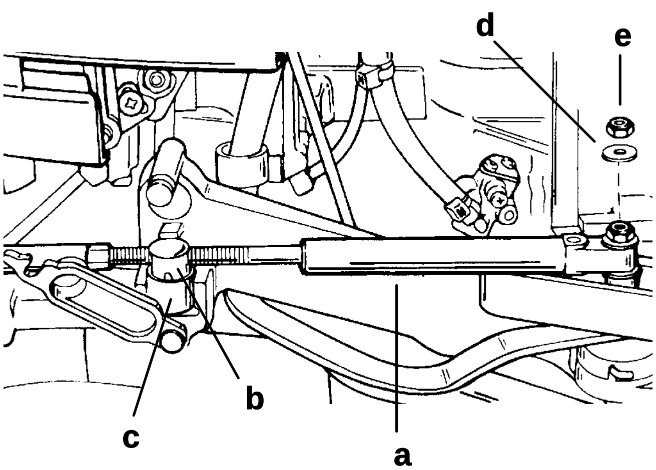


IMPORTANT: The procedure in Step 3 following, must be used for proper adjustment of the shift cable.

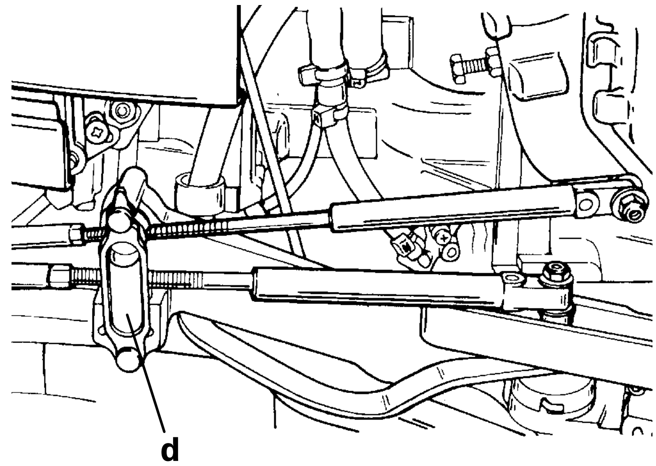
3. Manually shift the engine (move shift actuator "a") into neutral detent position.
4. Slide shift actuator (a) forward until resistance is felt, then slide shift actuator toward rear until resistance is felt. Center the shift actuator between resistance points.



5. Align cable end guide (a) with the center mark as instructed in Step 4. Place shift cable on shift actuator stud and adjust cable barrel (b) so that barrel slips freely into the plastic barrel retainer (c)
6. Secure shift cable to shift actuator stud with plastic washer (d) and locknut (e). Tighten locknut against shift cable than back-off the locknut 1/4 turn.



7. Lock cable barrels in place with cable retainer.
8. 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 in it. Readjust cable barrel if necessary.

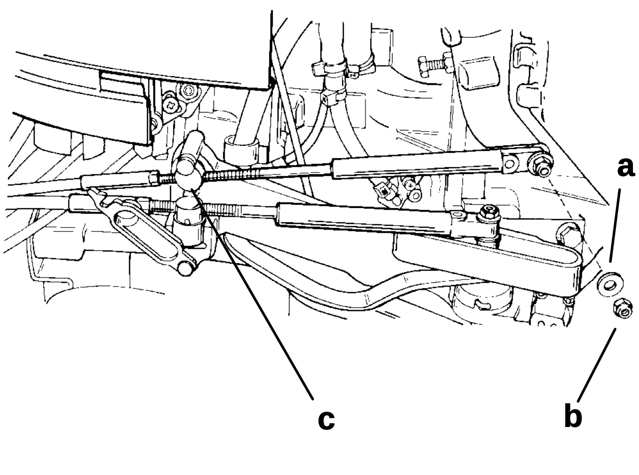


d - Cable Retainer

Throttle Cable Adjustment and Installation to the Outboard

Attach Shift cable to engine prior to attaching throttle cable.

1. Position remote control handle in neutral detent.
2. Position engine throttle lever against idle stop.
3. Install throttle cable to throttle lever with plastic washer (a) and locknut (b). Tighten locknut against throttle cable than back-off the locknut 1/4 turn.
4. Hold throttle lever against idle stop. Adjust cable barrel (c) to slip into its plastic retainer with a very light preload of the throttle lever against the idle stop.



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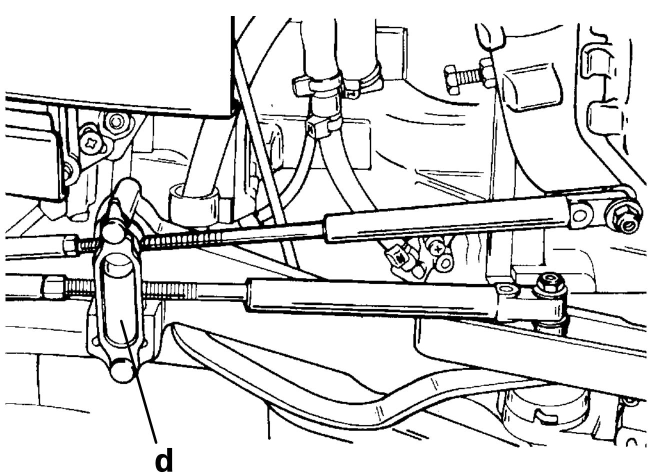
5. Lock cable barrels in place with cable retainer.
6. Check preload on throttle cable by placing a thin piece of paper between idle stop screw and idle stop. Preload is correct when paper can be removed without tearing, but has some drag in it. Readjust cable barrel if necessary.



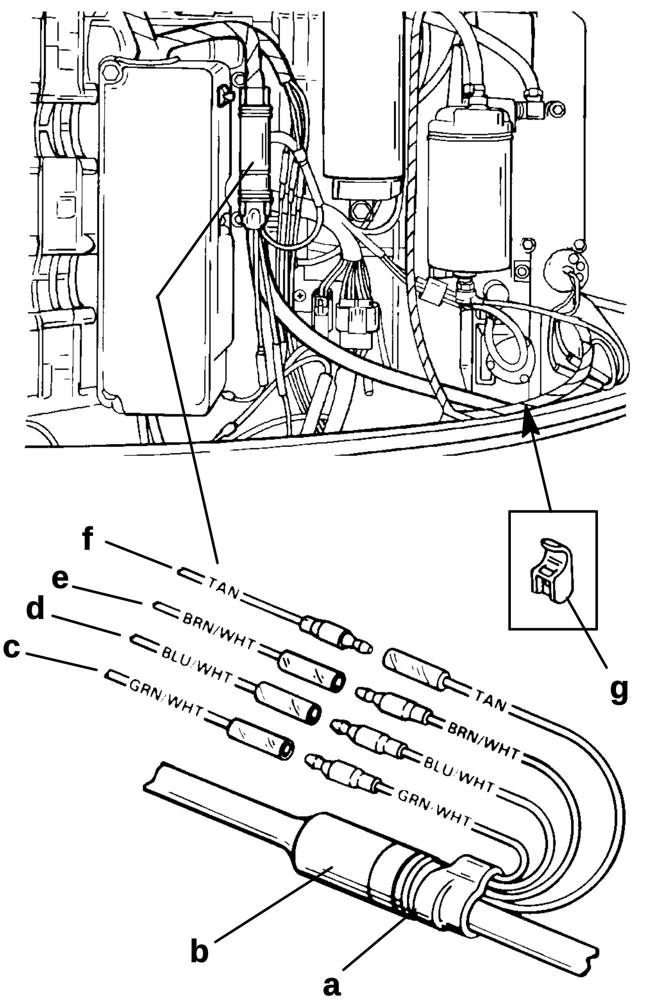
d - Cable Retainer

Remote Wiring Connections

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

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

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



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

Battery Connections

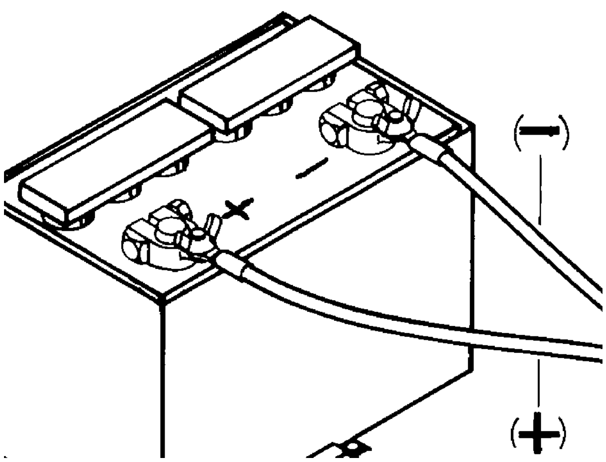
⚠ CAUTION

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

⚠ CAUTION

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

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

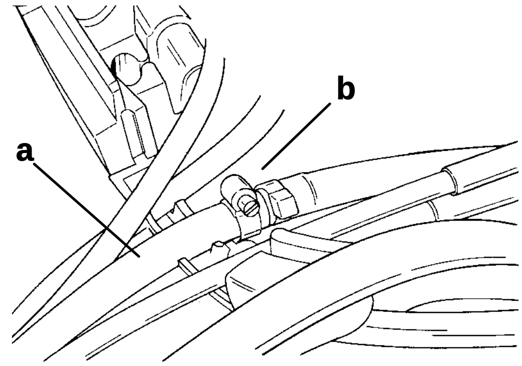


Fuel Connections

Connecting Fuel Hose to Engine

EFI MODELS

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



Portable Fuel Tank

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

Permanent Fuel Tank

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

Fuel Line

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

Set Up Instructions for Oil Injection System

⚠ CAUTION

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

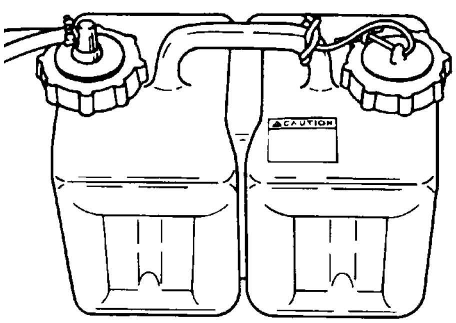
⚠ CAUTION

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

⚠ CAUTION

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

Installing Remote Oil Tank



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

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

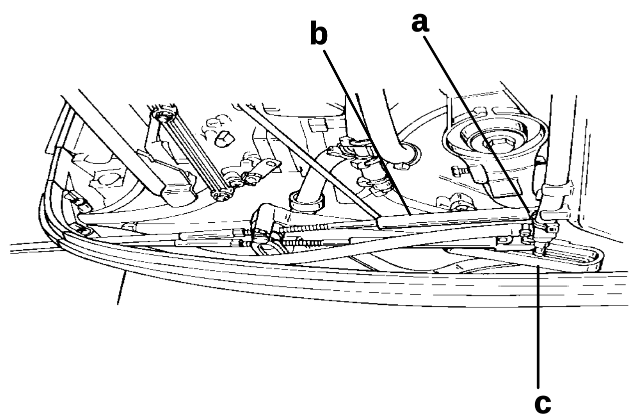
3. Oil hoses when routed thru engine well, must be able to extend to the hose fittings on engine.
4. Oil hoses must be arranged so they cannot become pinched, kinked, sharply bent or stretched during operation of the outboard.

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

Installing Oil Hoses To Engine

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

The third fitting (c) is a vent and does not get connected.



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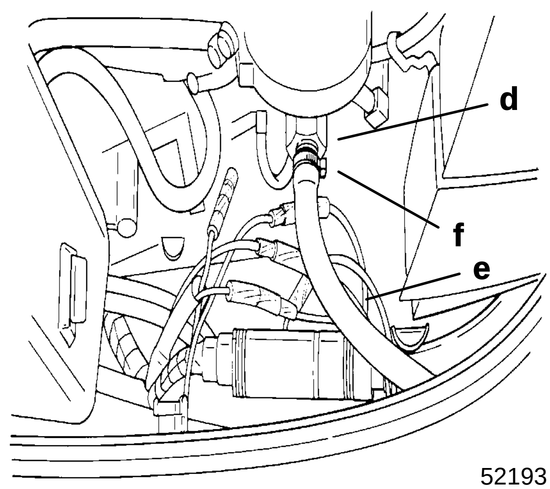
3. Remove (and discard) the shipping cap from pulse fitting (d).
4. Route the second oil hose (e) behind retainer (f) and connect to pulse fitting as shown. Secure with sta-strap.



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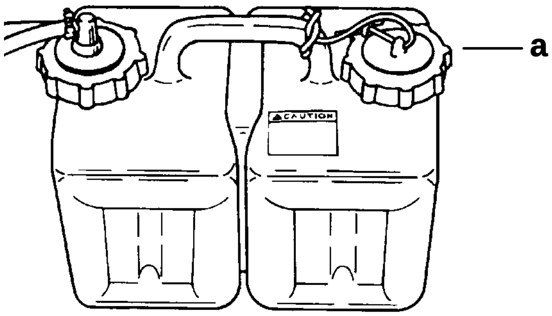
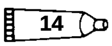
5. Refer to page 1D-6 for proper routing of oil hose routing thru clamp in the bottom cowl.

Filling the Oil Injection System

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





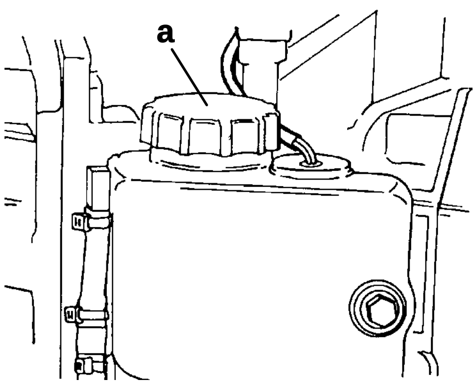
2 Cycle Outboard Oil (92-826666A24)

a - Fill Cap

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

⚠ CAUTION

Be certain that the fill caps on the oil reservoir tank and the remote oil tank are installed tightly. An air leak, at the remote oil tank fill cap will prevent oil flow to the engine. An oil leak at the reservoir fill cap will cause oil spillage.

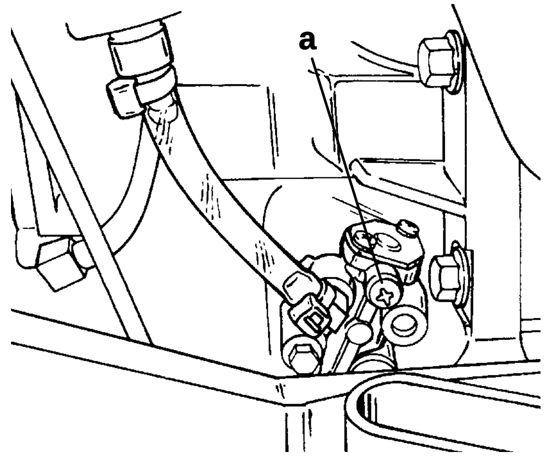


a - Reservoir Tank

Bleeding Air from Oil Injection Pump and Oil Injection Outlet Hose

BLEEDING AIR FROM OIL INJECTION PUMP

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

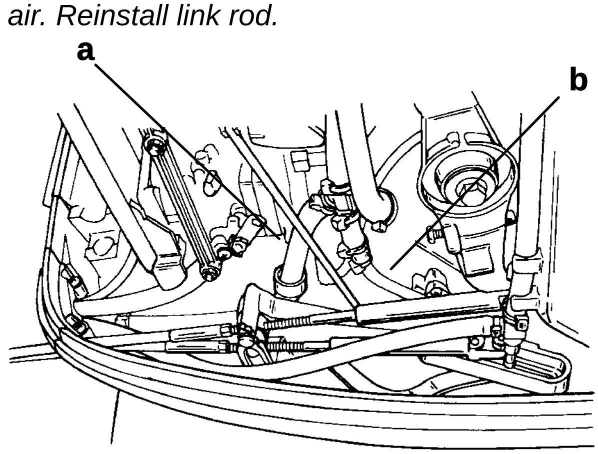


a - Bleed Screw

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.

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.



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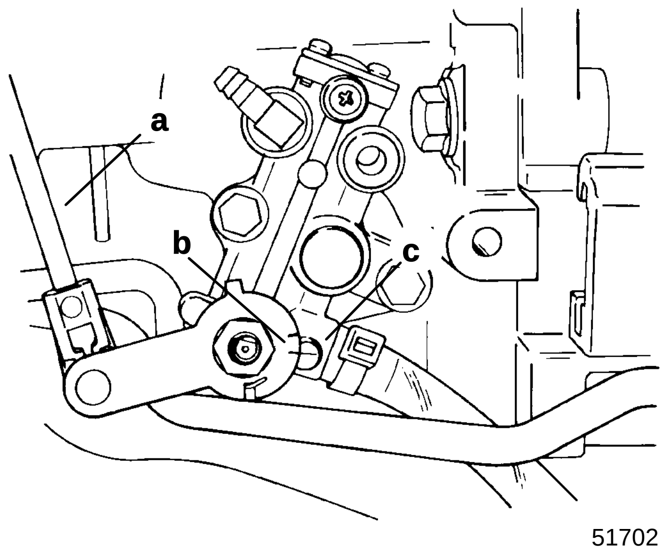
a - Fuel Line
b - Oil Line

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

Trim Tab Adjustment

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

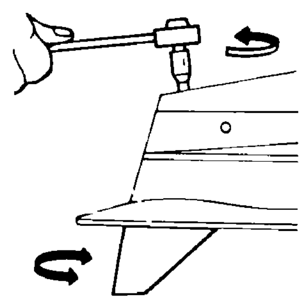
MODELS WITHOUT POWER STEERING

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

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

MODELS WITH POWER STEERING

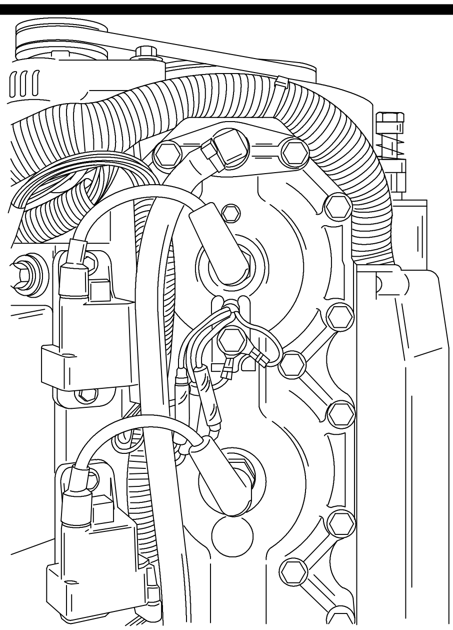
Trim tab adjustment is not required. The trailing edge of the trim tab should be set straight back.



ELECTRICAL

2

A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IGNITION SYSTEM

Table of Contents

Ignition Specifications

Ignition System	
Type	Capacitor Discharge
Spark Plug Type 1994 – 1996 S/N 0D280813 - 0G437999 3 Litre Work/225 Carb 1997 S/N 0G438000 and UP 3 Litre Work/225 Carb 1994/95/96/97 225 EFI/250EFI	NGK BPZ8H-N-10 Champion QL77CC Champion QL77CC
Spark Plug Gap NGK BPZ8H-N-10 Champion QL77CC	0.040 in. (1.0mm) 0.035 in. (0.889mm)
Voltage @ Spark Plugs	45000 Volts

Stator Ohms Test

Test Leads to	**Resistance Ohms**
Connect meter leads between the 2 leads coming out of each bobbin.	**1994 Models** 1100 ± 10%
Connect meter leads between lead coming out of each bobbin and engine ground.	**1995 and Newer Models** 1100 ± 10%

Crank Position Sensor

Test Leads to	**Resistance Ohms**
Connect meter leads between the 2 sensor leads	1100 ± 200

Throttle Position Sensor

At Idle		**W.O.T.**	
Carb Models	EFI Models	Carb Models	EFI Models
.950 ? 0.050 VDC		3.8 ? .10	3.80 ? .25

Engine Temperature Sensor

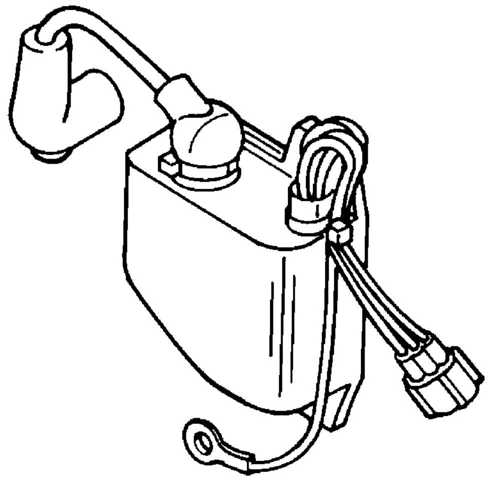
Between Black and EACH Tan/Blk wire.	No Continuity

Insert digital or analog ohmmeter test leads into both TAN/BLACK sensor leads. With engine at temperature (C° or F°) indicated, ohm readings should be as indicated ± 10%.

Block Temperature C°	**F°**	**Resistance (Ohms)**
–15	5	7465
–10	14	5636
–5	23	4288
0	32	3287
5	41	2551
10	50	1996
15	59	1574
20	68	1250
25	77	1000
30	86	805
35	95	652
40	104	532
45	113	436
50	122	360
55	131	298
60	140	248
65	149	208
70	158	175
75	167	148
80	176	126
85	185	107
90	194	92
95	203	79
100	212	68
105	221	59
110	230	51
115	239	44
120	248	38
125	257	34

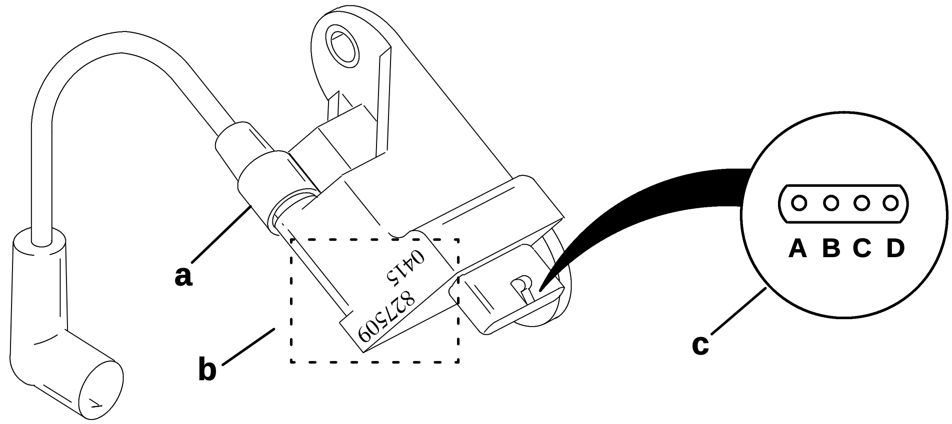
CAPACITOR DISCHARGE MODULE (PN 822779) OHMS TEST

Spark Gap Test – With battery @ a minimum of 9 volts, CDM should produce a spark to jump a 3/8 in. gap @ a cranking speed of 350 RPM



TESTED PART	MULTIMETER WIRES	CONNECTED TO	SCALE	READING
IGNITION MODULE	RED BLACK	GROUND WHITE	R X 1	40 ± 10 OHMS
	RED BLACK	GRN\WHT GROUND	R X 1	CONTINUITY
	RED BLACK	GROUND GRN\WHT	R X 1K	NO CONTINUITY
	RED BLACK	GRN\WHT BLK/YEL	R X 1K	NO CONTINUITY
	RED BLACK	BLK/YEL GRN\WHT	R X 1	CONTINUITY
	RED BLACK	COIL TOWER GROUND	R X 10	1000 ± 300 OHMS

CAPACITOR DISCHARGE MODULE (PN 827509) OHMS TEST



a - Spark Plug Wires Are Screwed into CDM.
b - Part Number: 827509
Date Code:0415 (Julian Date and Year: 5=1995)
c - Pins are Labeled: A:Black - Ground
B:Black/Yellow - Stop Circuit
C:White - Trigger
D:Green - Stator

A resistance check, although not necessary for any troubleshooting procedure, can be made of 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			
Connect Positive (+) Meter Lead To:	**Connect Negative (–) Meter Lead To:**	**Ohms Scale**	**Results:**
Ground Pin (A)/ or Black test harness lead	White (C)/ or White test harness lead	R x 100	1250 ? 100 Ohms
Green (D)/ or Green test harness lead	Ground Pin (A)/ or Black test harness lead	R x 100 Diode Reading*	Continuity
Ground Pin (A) or Black test harness lead	Green (D)/ or Green test harness lead	R x 100 Diode Reading*	No Continuity
Green (D)/ or Green test harness lead	Black/Yellow (B)/ or Black/ Yellow test harness lead	R x 100 Diode Reading*	No Continuity
Black/Yellow (B)/ or Black/ Yellow test harness lead	Green (D)/ or Green test harness lead	R x 100 Diode Reading*	Continuity
Spark Plug Terminal (At Spark Plug Boot)	Ground Pin (A) or Black test harness lead	R x 100	1000 ? 300 Ohms
Ground Pin (A)/ or Black test harness lead	Black/Yellow (B)/ or Black/ Yellow test harness lead	R x 100	No Continuity
Black/Yellow (B)/ or Black/ Yellow test harness lead	Ground Pin (A)/ or Black test harness lead	R x 100	Continuity

*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 and ECM DVA Tests

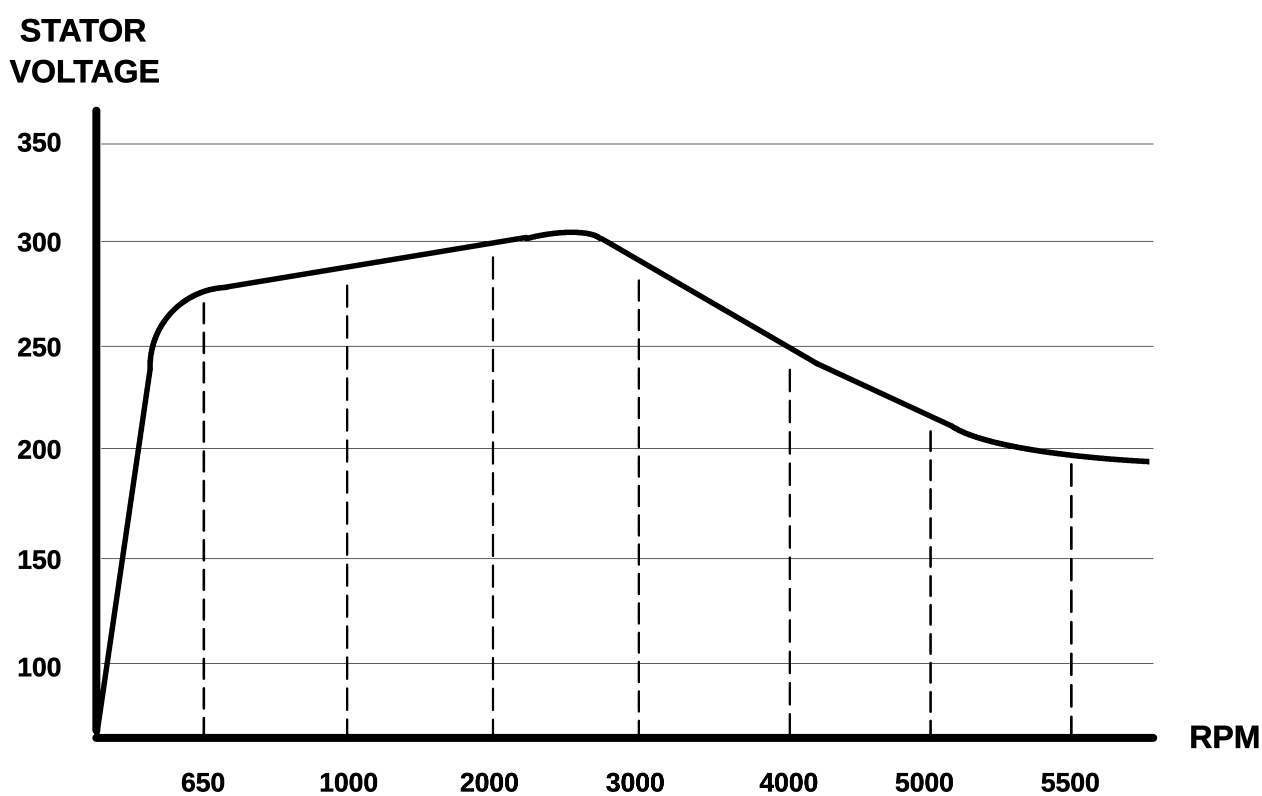
Stator and ECM DVA tests can be made using Quicksilver Multimeter/DVA Tester 91-99750 and TPS/CDM Harness Assembly 84-825207A1 for 1994/1995 models or CDM Harness Assembly 84-825207A2 for1996/1997 models. Connect the harness in series at a CDM connector. Attach the appropriate DVA test leads to the harness as listed below:

TEST	DVA POSITION	DVA LEAD	TPI/CDM LEAD	VOLTAGE @ CRANKING	VOLTAGE @ 650–3000 RPM	VOLTAGE @ 4000–5500 RPM
Stator	400 DVA	RED	1994/1995 RED	100 – 225	250 – 300	230 – 200
		BLACK - To GRD	1996/1997 GREEN			
ECU Trigger	40 DVA	RED	WHITE	2 – 10		
		BLACK - To GRD				

IMPORTANT: Use the Quicksilver Multimeter/DVA Tester 91-99750 to obtain comparable voltages as listed when testing the 3.0 Liter ignition system.

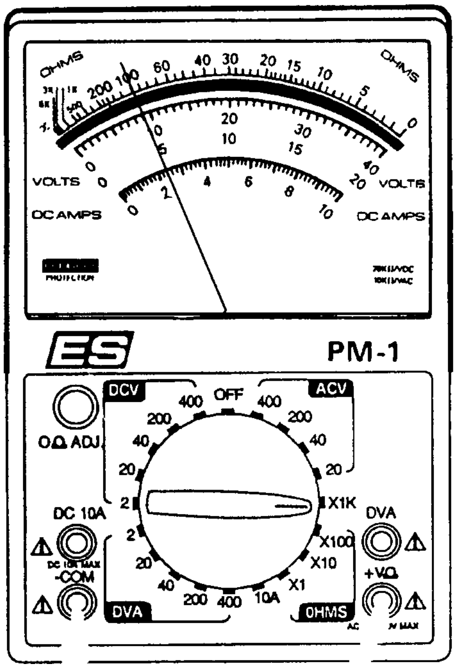
IMPORTANT: The TPS/CDM Harness BLACK lead is not a ground when the TPS/CDM Harness is connected in series with a CDM connector. The BLACK lead is the engine stop lead and should not be connected to the DVA BLACK lead as a ground.

NOTE: *The 3.0 Liter CDM is charged by a single stator coil whose efficiency is greatest (highest voltage) at low and mid-range RPM.*



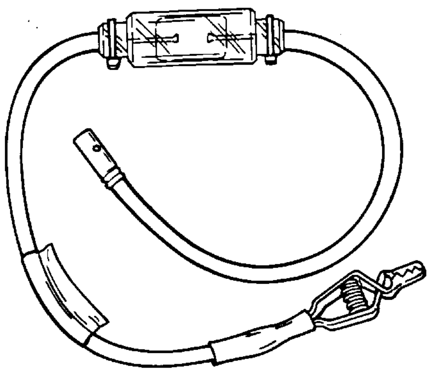
Special Tools

Multi-Meter DVA Tester 91-99750

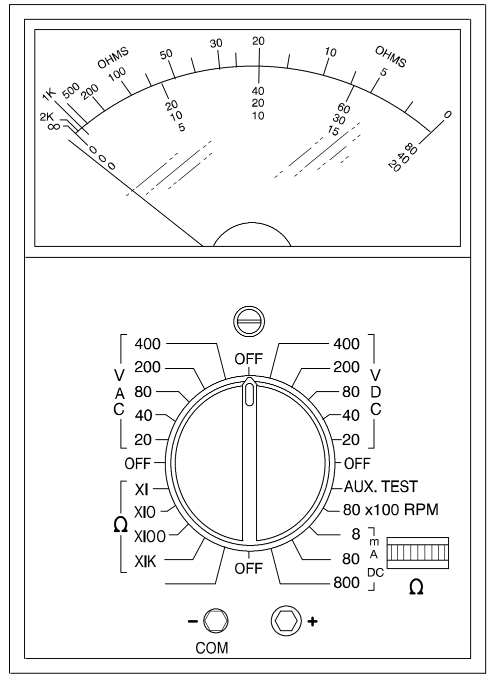


NOTE: *There are 3 different Multi-Meter DVA Testers using the part number 91-99750 or 91-99750A1 having a DVA built in. Any one of these testers will work with the 3.0 Liter V-6 ignition system.*

Spark Gap Tester 91-63998A1



Volt/Ohm Multi-Meter 91-62562



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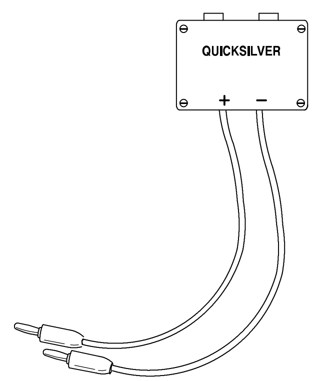
NOTE: *Volt/Ohm Multi-Meter 91-62562 can be used to test ignition system voltages if used in conjunction with DVA ADAPTOR 91-89045.*

DVA Adapter 91-89045



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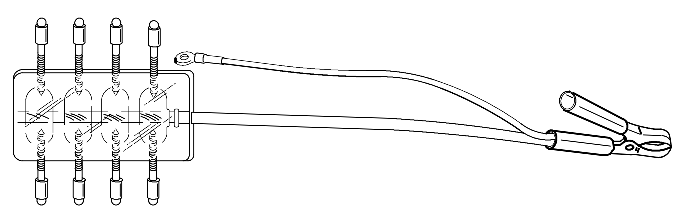
NOTE: *There are 2 versions of the DVA adapter – 1 with studs and 1 with leads. Both are designed to be used with Volt/Ohm Multi-Meter 91-62562 or any volt/ohm meter that has a 400 vdc or higher scale.*

Spark Gap Board 91-850439



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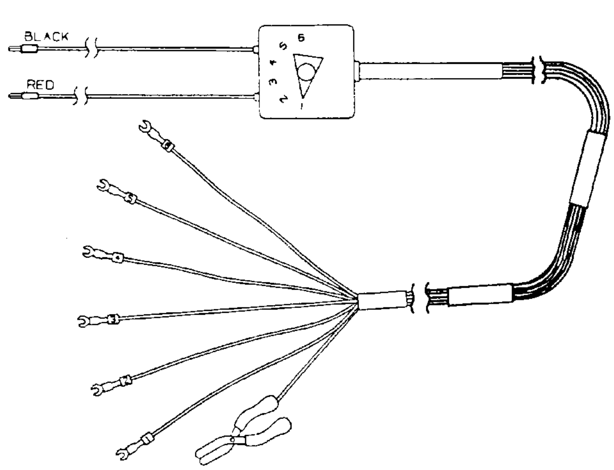
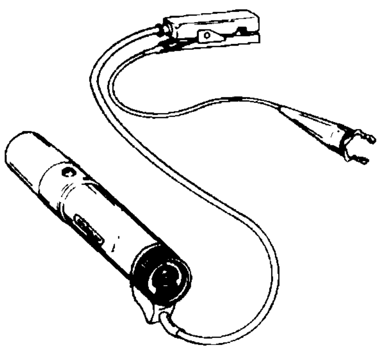
Test Harness 91-14443A1

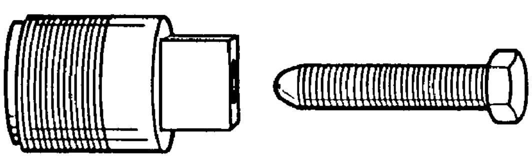


Timing Light 91-99379

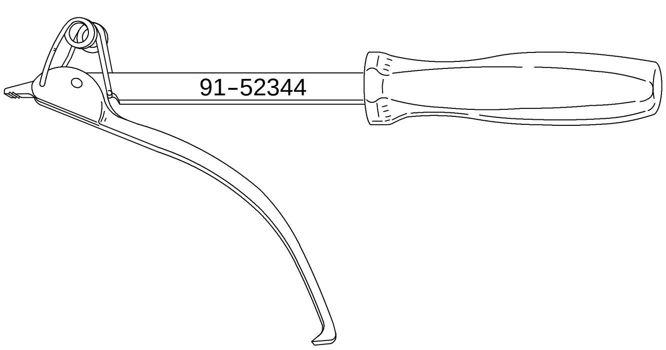


Crank Shaft Protector Cap 91-24161

Flywheel Puller 91-73687A2



Flywheel Holder 91-52344



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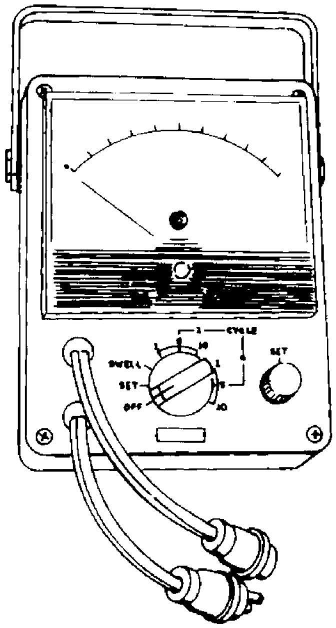
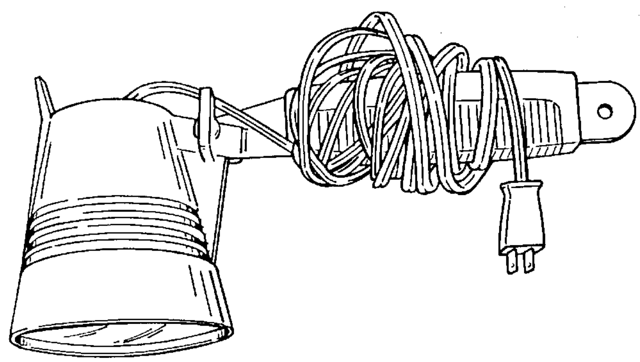
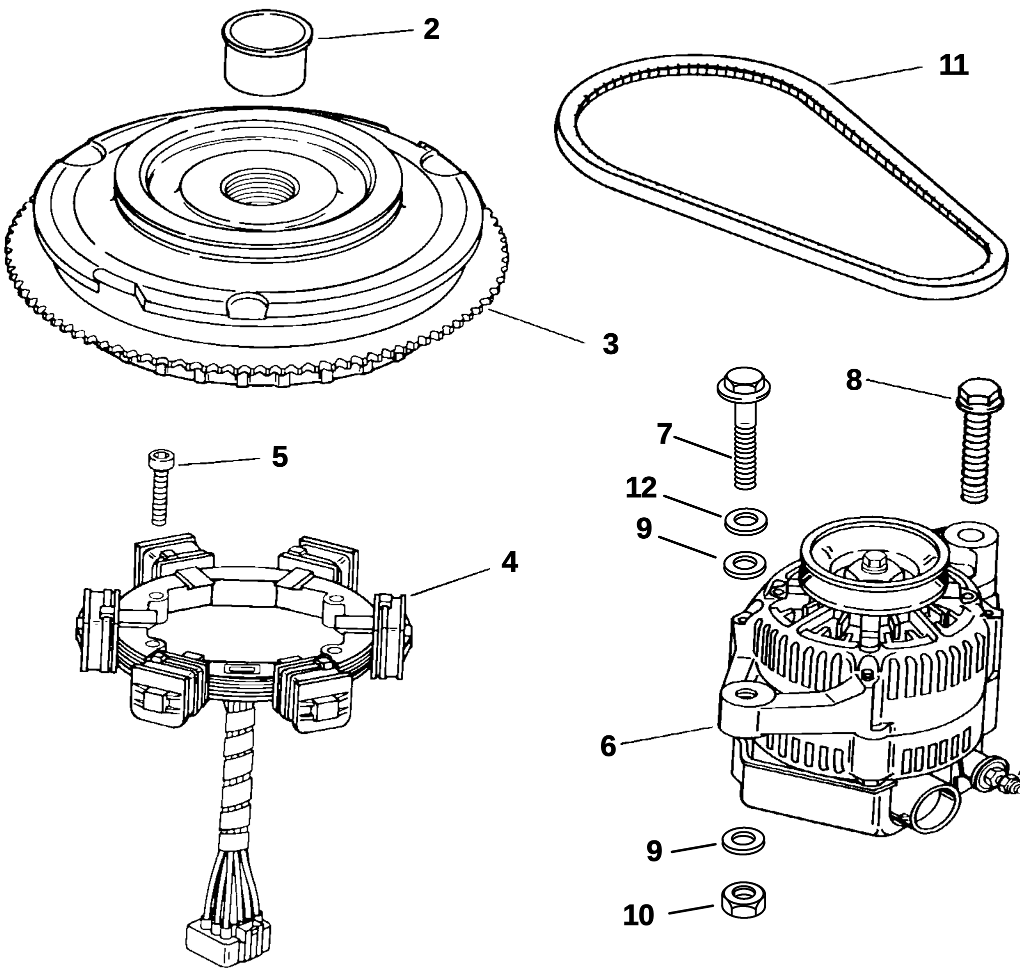
Service Tachometer 91-59339



Heat Lamp 91-63209

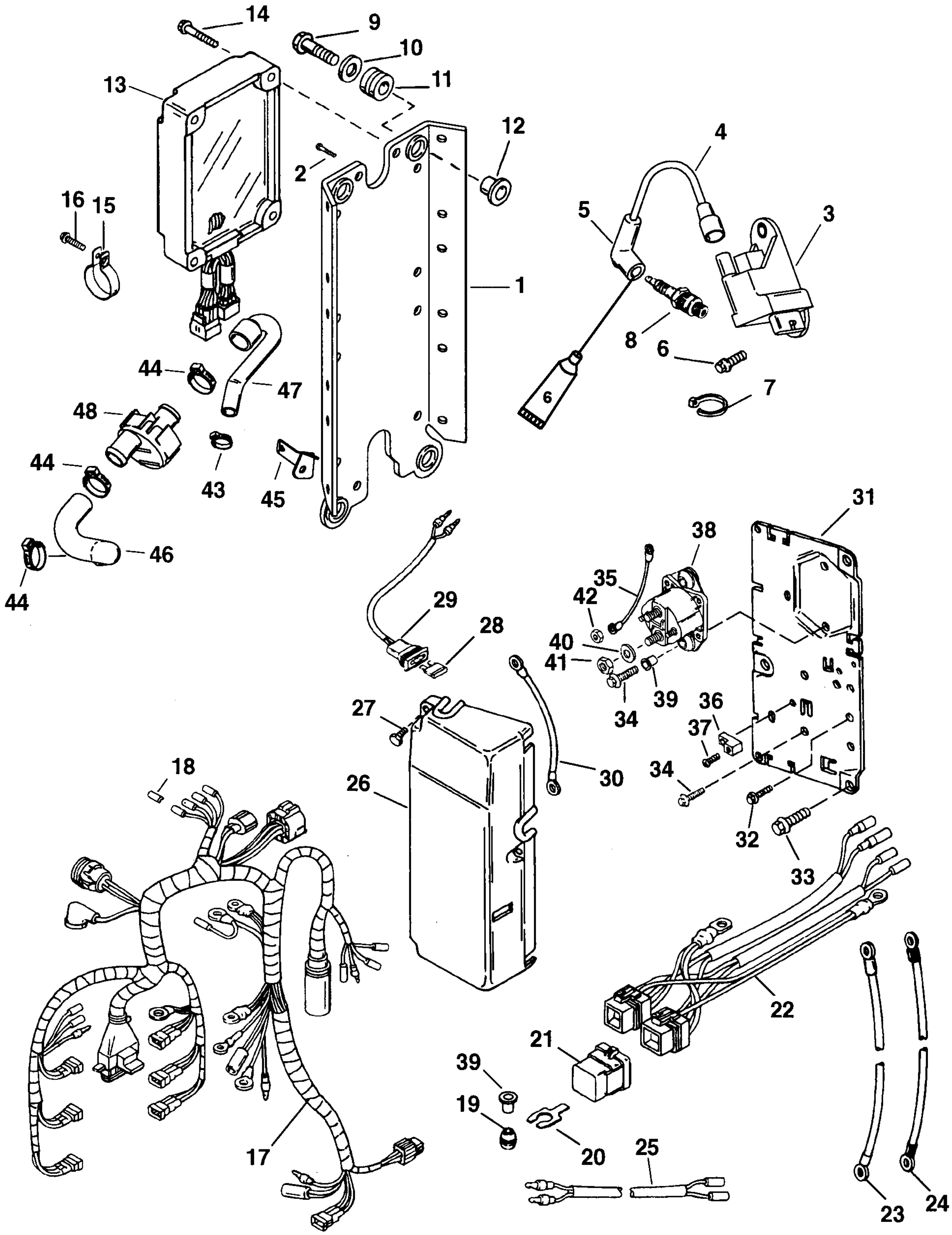


Flywheel/Stator



REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	NUT	36		4.1
2	1	PLUG			
3	1	FLYWHEEL			
4	1	STATOR **(S/N-0G129221 & BELOW)**			
4	1	STATOR **(S/N-0G129222 & UP)(SEAPRO/MARATHON)**			
5	4	SCREW (M6 x 1 x 30)	100		11.3
6	1	ALTERNATOR			
7	1	SCREW (M10 x 55) **DESIGN II**		60	81.0
8	1	SCREW (M10 x 40)	240	20	27.0
9	2	WASHER			
10	1	NUT			
6	1	ALTERNATOR **DESIGN I**			
7/8	2	SCREW (M10 x 40)		40	54.0
11	1	V-BELT			
12	1	WASHER			

Electrical Components (All Models–S/N-0G303046 & UP)



6 Dielectric Grease (92-823506--1)

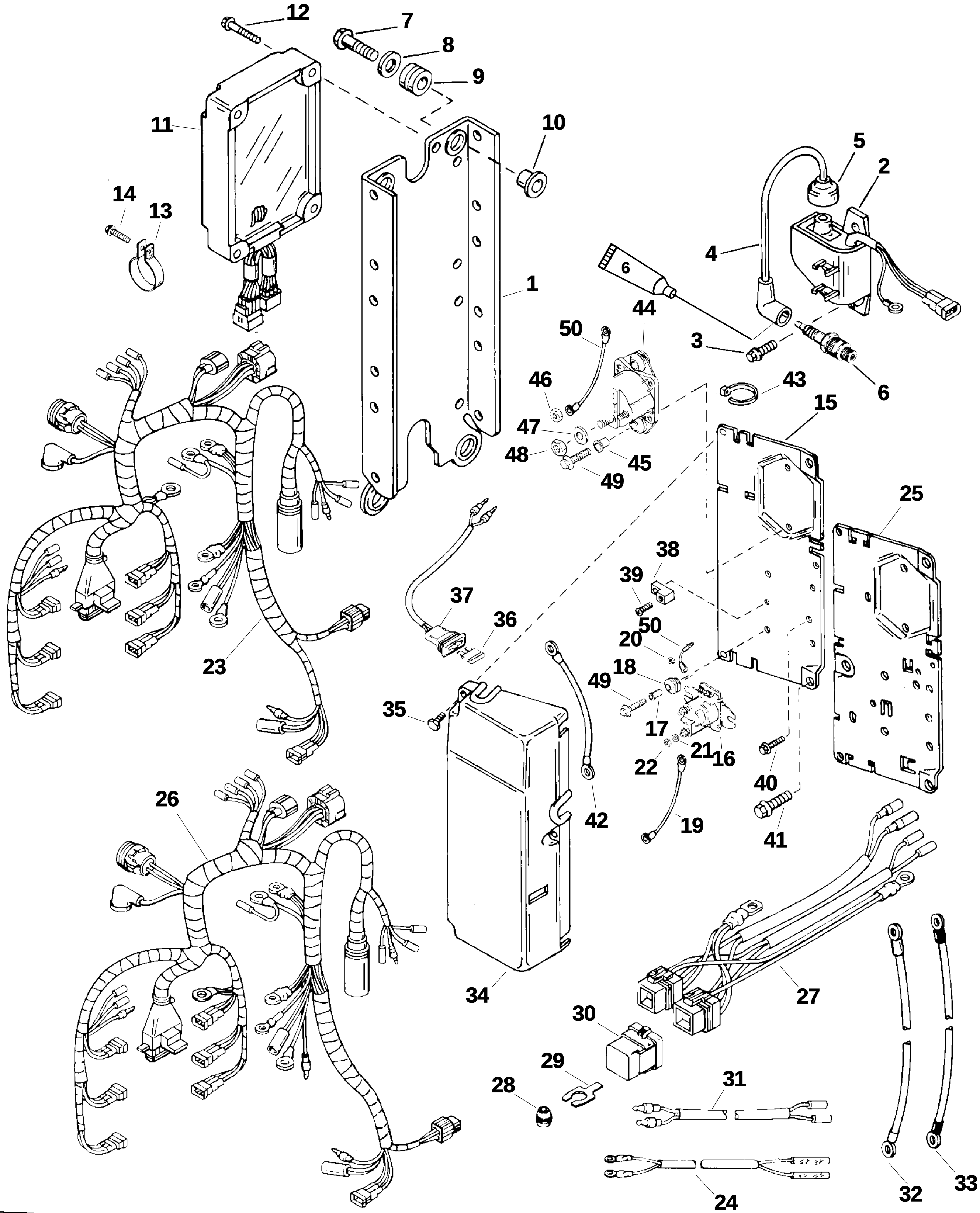
Liquid Neoprene (92-25711--2)

Note: Coat all ring terminal wiring connections with Liquid Neoprene.

Electrical Components (All Models–S/N-0G303046 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	ELECTRICAL MOUNTING PLATE			
2	2	SCREW (M6 x 14)			
3	6	CDM ASSEMBLY			
4	1	HI–TENSION CABLE **(SET OF 6)**			
	6	HI–TENSION CABLE **(SINGLE CABLE)**			
5	6	BOOT			
6	12	SCREW (M6 x 14)	80		9.0
7	AR	STA–STRAP			
8	6	SPARK PLUG **(NGK #BPZ8H-N-10)**	240	20	27.0
	6	SPARK PLUG **(CHAMPION #QL77CC)**	240	20	27.0
9	4	SCREW (M8 x 35)	235	19.0	26.0
10	4	WASHER			
11	4	GROMMET			
12	4	BUSHING			
13	1	ECU ASSEMBLY **S/N-0G303046 THRU 0G437999**			
	1	ECU ASSEMBLY **(SEAPRO/MARATHON)**			
	1	ECU ASSEMBLY **S/N-0G438000 & UP**			
	1	ECU ASSEMBLY **(SEAPRO/MARATHON)**			
14	4	SCREW (M6 x 40)	80		9.0
15	1	CLAMP			
16	1	SCREW			
17	1	HARNESS-Ignition			
18	AR	PLUG **(SEAPRO/MARATHON)**			
19	2	GROMMET			
20	2	BRACKET			
21	2	RELAY			
22	1	HARNESS-Trim			
23	1	BATTERY CABLE **(POSITIVE)**			
24	1	BATTERY CABLE **(NEGATIVE)**			
25	1	HARNESS (26 IN.)			
26	1	COVER			
27	3	SCREW (M5 x 0.8)	Drive Tight		
28	1	FUSE			
29	1	FUSE SOCKET			
30	1	CABLE (BLACK)			
31	1	SOLENOID MOUNTING PLATE			
32	1	SCREW (M6 x 10)	100	8.0	11.3
33	3	SCREW (M8 x 25)	200	17.0	23.0
34	4	SCREW (M6 x 25)	100	8.0	11.3
35	1	CABLE (BLACK)			
36	1	TERMINAL BLOCK			
37	1	SCREW (10-16 x 1/2)	Drive Tight		
	1	SCREW (10-16 x 3/8 IN.)	Drive Tight		
38	1	STARTER SOLENOID			
39	AR	BUSHING			
40	2	LOCKWASHER			
41	2	NUT (5/16-18)	45		5.1
42	2	NUT (10-32)	20		2.3
43	1	CLAMP			
44	3	CLAMP			
45	1	BRACKET			
46	1	HOSE **(INLET)**			
47	1	HOSE **(OUTLET)**			
48	1	PULSE FLUSH			

Electrical Components (S/N-0G129222–0G303045) (Non Seapro/Marathon)



6 Dielectric Grease (92-823506--1)

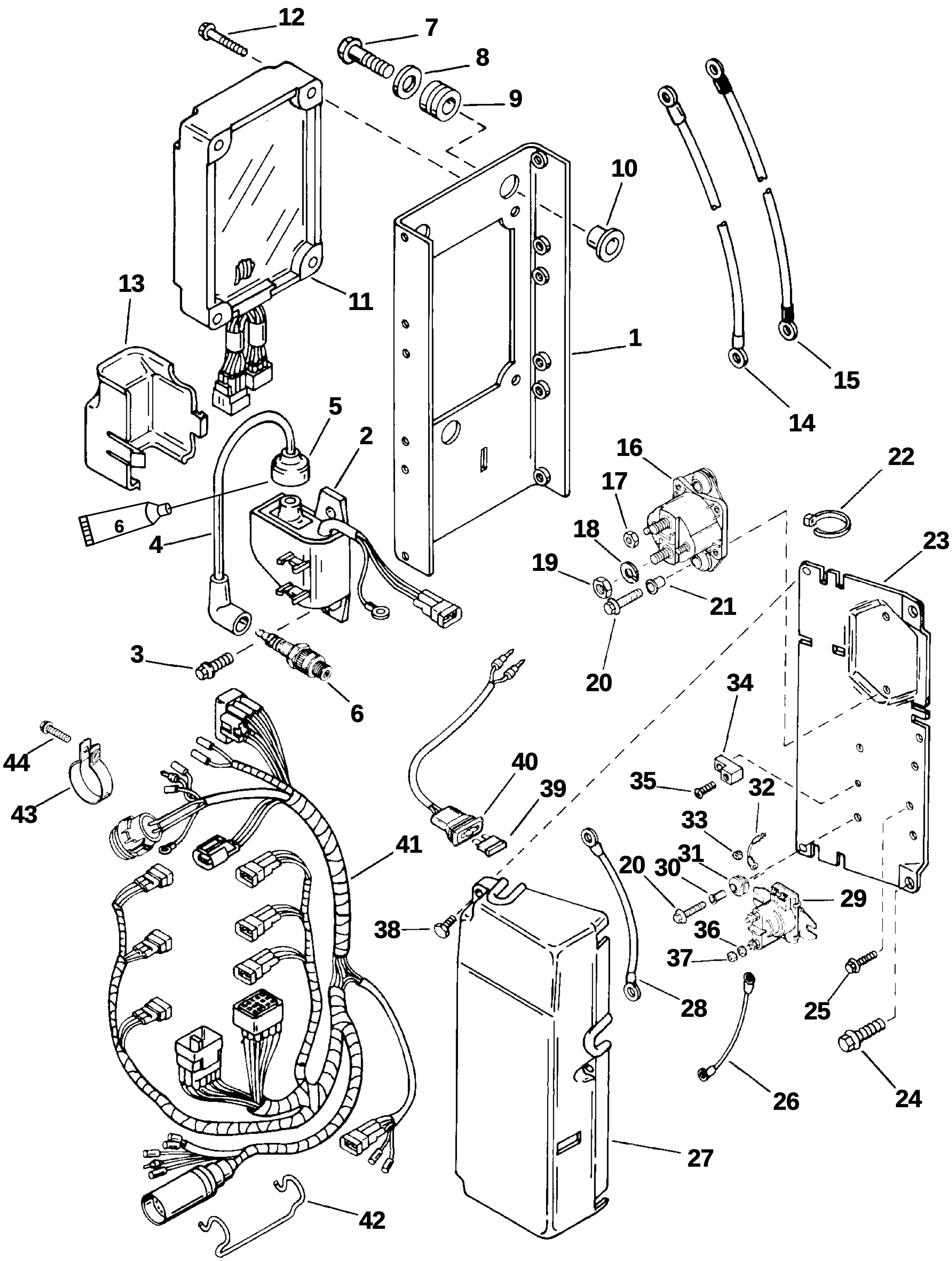
Liquid Neoprene (92-25711--2)

Note: Coat all ring terminal wiring connections with liquid neoprene.

Electrical Components (S/N-0G129222–0G303045) (Non Seapro/Marathon)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	ELECTRICAL MOUNTING PLATE			
2	6	CDM ASSEMBLY			
3	13	SCREW (M6 x 14)	80		9.0
4	1	HI-TENSION CABLE			
5	6	BOOT			
6	6	SPARK PLUG (BPZ8H-N-10)	240	20	27.0
7	4	SCREW (M8 x 35)	235	19.0	26.0
8	4	WASHER			
9	4	GROMMET			
10	4	BUSHING			
11	1	E.C.U. ASSEMBLY			
12	4	SCREW (M6 x 40)	80		9.0
13	1	CLAMP			
14	1	SCREW			
15	1	SOLENOID MOUNTING PLATE			
16	2	TRIM SOLENOID			
17	4	BUSHING			
18	4	GROMMET **DESIGN I**			
19	2	CABLE (RED) **W/ TRIM SOLENOIDS**			
20	4	NUT (#8-32)			
21	2	LOCKWASHER			
22	2	NUT (1/4-20)			
23	1	HARNESS – Ignition			
24	1	HARNESS – Trim			
25	1	SOLENOID MOUNTING PLATE			
26	1	HARNESS – Ignition			
27	1	HARNESS – Trim **DESIGN II**			
28	2	GROMMET			
29	2	BRACKET			
30	2	RELAY			
31	1	HARNESS – Shift Interrupt (26 IN.)			
32	1	BATTERY CABLE **(POSTITIVE)**			
33	1	BATTERY CABLE **(NEGATIVE)**			
34	1	COVER–plate			
35	3	SCREW (M5 x 0.8)	Drive Tight		
36	1	FUSE			
37	1	FUSE SOCKET			
38	1	TERMINAL BLOCK			
39	1	SCREW (#10-16 x 1/2 IN.)			
	1	SCREW (#10-16 x 3/8 IN.)			
40	1	SCREW (M6 x 10)	100	8.0	11.3
41	3	SCREW (M8 x 25)	200	17.0	23.0
42	1	CABLE (BLACK)			
43	AR	STA-STRAP			
44	1	STARTER SOLENOID			
45	AR	BUSHING			
46	2	NUT (10-32)	20		2.3
47	2	LOCKWASHER			
48	2	NUT (5/16-18)	45		5.1
49	AR	SCREW (M6 x 25)	100	8.0	11.3
50	AR	CABLE (BLACK)			

Electrical Components (S/N-0G129221 & Below)
(Non Seapro/Marathon)



6 Dielectric Grease (92-823506--1)

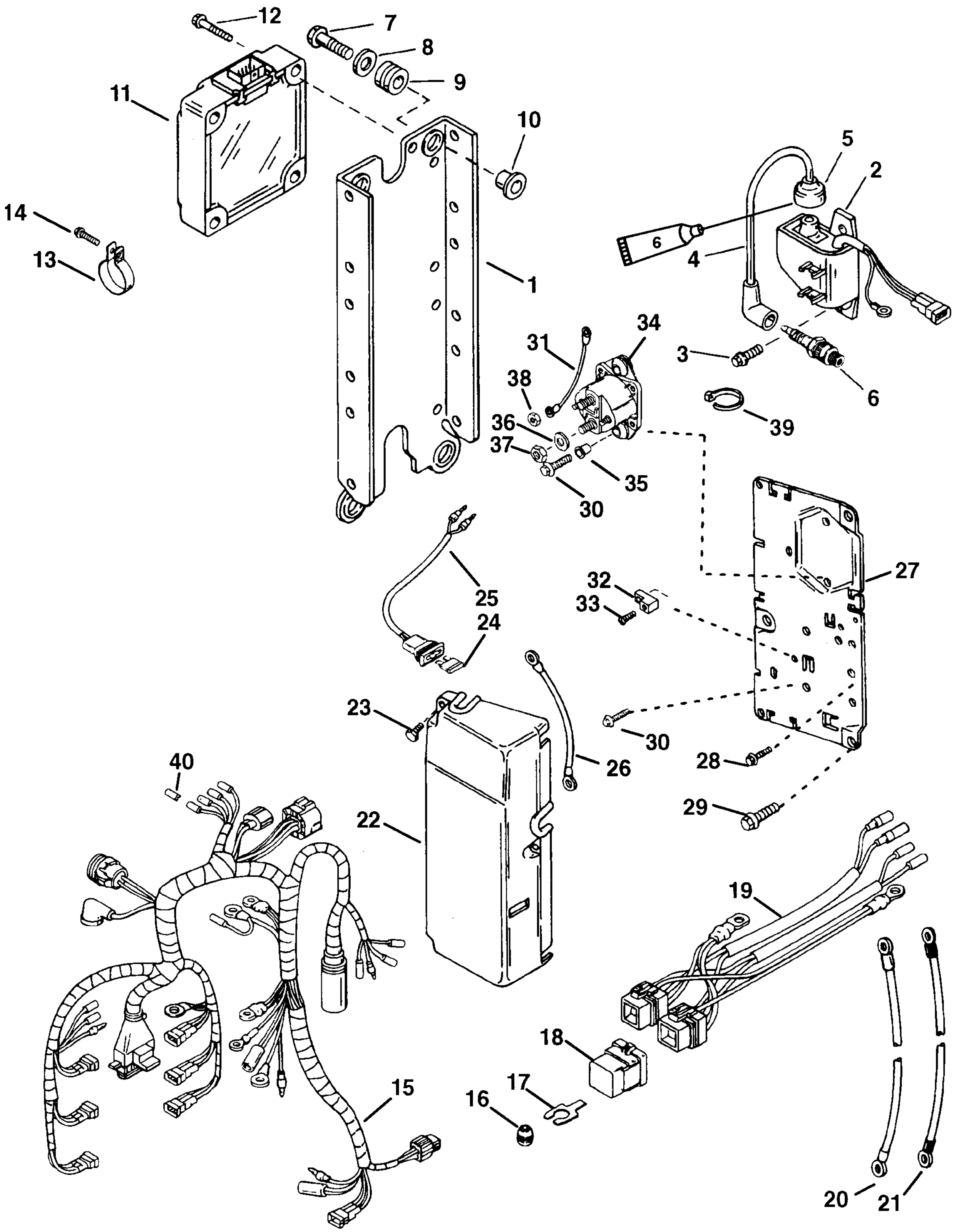
Liquid Neoprene (92-25711--2)

Note: Coat all ring terminal wiring connections with liquid neoprene.

Electrical Components (S/N-0G129221 & Below) (Non Seapro/Marathon)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	ELECTRICAL MOUNTING PLATE			
2	6	CDM ASSEMBLY			
3	13	SCREW (M6 x 14)	80		9.0
4	1	HI-TENSION CABLE			
5	6	BOOT			
6	6	SPARK PLUG (BPZ8H-N-10)	240	20	27.0
7	3	SCREW (M8 x 35)	235	19.0	26.0
8	3	WASHER			
9	3	GROMMET			
10	3	BUSHING			
11	1	E.C.U. ASSEMBLY			
12	4	SCREW (M6 x 40)	80		9.0
13	1	COVER			
14	1	BATTERY CABLE **(POSTITIVE)**			
15	1	BATTERY CABLE **(NEGATIVE)**			
16	1	STARTER SOLENOID			
17	2	NUT (10-32)	20		2.3
18	2	LOCKWASHER			
19	2	NUT (5/16-18)	45		5.1
20	6	SCREW (M6 x 25)	50		5.6
21	2	BUSHING			
22	AR	STA-STRAP			
23	1	SOLENOID MOUNTING PLATE			
24	3	SCREW (M8 x 25)	200	17.0	23.0
25	1	SCREW (M6 x 10)	100	8.0	11.3
26	2	CABLE (RED)			
27	1	COVER–plate			
28	1	CABLE (BLACK)			
29	2	TRIM SOLENOID			
30	4	BUSHING			
31	4	GROMMET			
32	3	CABLE (BLACK)			
33	4	NUT (#8-32)			
34	1	TERMINAL BLOCK			
35	2	SCREW (#10-16 x 1/2 IN.)	Drive Tight		
36	2	LOCKWASHER			
37	2	NUT (1/4-20)			
38	3	SCREW (M5 x 0.8)	Drive Tight		
39	1	FUSE			
40	1	FUSE SOCKET			
41	1	ENGINE HARNESS **(See Service Bulletin 94-8)**			
42	1	RETAINER			
43	1	CLAMP			
44	1	SCREW			

Electrical Components (Seapro/Marathon) S/N-0G303045 & Below



6 Dielectric Grease (92-823506--1)

Liquid Neoprene (92-25711--2)

Note: Coat all ring terminal wiring connections with liquid neoprene.

Electrical Components (Seapro/Marathon) S/N-0G303045 & Below

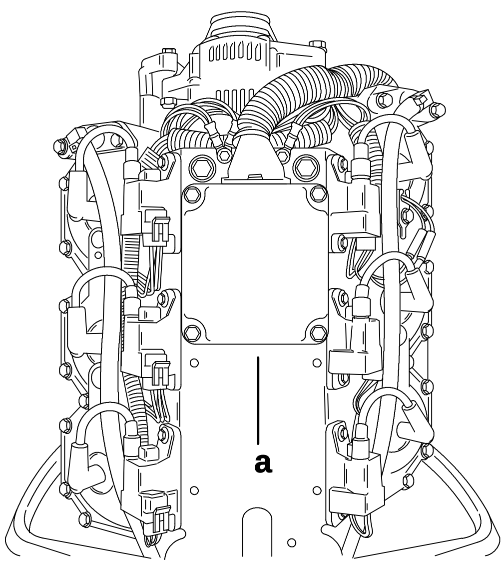
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	ELECTRICAL MOUNTING PLATE			
2	6	CDM ASSEMBLY			
3	13	SCREW (M6 x 14)	80		9.0
4	1	HI–TENSION CABLE			
5	6	BOOT			
6	6	SPARK PLUG (BPZ8H-N-10)	240	20	27.0
7	4	SCREW (M8 x 35)	235	19.0	26.0
8	4	WASHER			
9	4	GROMMET			
10	4	BUSHING			
11	1	ECU ASSEMBLY			
12	4	SCREW (M6 x 40)	80		9.0
13	1	CLAMP			
14	1	SCREW			
15	1	HARNESS-Ignition			
16	2	GROMMET			
17	2	BRACKET			
18	2	RELAY			
19	1	HARNESS-Trim			
20	1	BATTERY CABLE **(POSITIVE)**			
21	1	BATTERY CABLE **(NEGATIVE)**			
22	1	COVER			
23	3	SCREW (M5 x 0.8)	Drive Tight		
24	1	FUSE			
25	1	FUSE SOCKET			
26	1	CABLE (BLACK)			
27	1	SOLENOID MOUNTING PLATE			
28	1	SCREW (M6 x 10)	100	8.0	11.3
29	3	SCREW (M8 x 25)	200	17.0	23.0
30	4	SCREW (M6 x 25)	100	8.0	11.3
31	1	CABLE (BLACK)			
32	1	TERMINAL BLOCK			
33	1	SCREW (10-16 x 1/2)	Drive Tight		
	1	SCREW (10-16 x 3/8)	Drive Tight		
34	1	STARTER SOLENOID			
35	AR	BUSHING			
36	2	LOCKWASHER			
37	2	NUT (5/16-18)	45		5.1
38	2	NUT (10-32)	20		2.3
39	AR	STA–STRAP			
40	AR	PLUG			

Theory of Operation

Ignition current is generated by the stator under the flywheel. The stator consists of six bobbins - one for each cylinder. The positive current wave charges the capacitor in the capacitor discharge module (CDM). The electronic control module (ECM) activates the switching device (SCR) in the CDM which allows the capacitor to discharge, causing the spark to occur. Ignition timing is regulated by the ECM which receives status input from a variety of sensors. These sensors include: crank position, throttle position sensor (TPS), engine temperature. There are six CDMs - one for each cylinder. The CDM consists of a capacitor, switching device, primary winding, secondary winding, and spark plug lead.

Ignition Component Description

ELECTRONIC CONTROL MODULE (ECM)



a - Electronic Control Unit

Under normal conditions, ECM controls and provides:

Spark timing by monitoring engine RPM, throttle shutter opening and coolant temperature.

Cold engine starting by advancing spark timing and opening fuel enrichment valve.

Over-speed protection in the event engine RPM exceeds 6000 for carb models and 6100 for EFI models. This is accomplished in two stages. Initially timing is gradually retarded to reduce RPM to 5900 for carb models and 6000 for EFI models. If RPM continues to increase above 6400 for carb models and 6500 for EFI models – i.e.– propeller breaks water surface – timing will rapidly retard to 2°ATDC to prevent any further RPM increase. When an over-speed condition occurs, the low-oil and overheat lamps will illuminate alternately and the warning horn will be activated.

Warning control of LOW-OIL, WATER SEPARATOR and OVER-HEAT conditions. Warning is provided through activation of a horn and indicator lamps. A LOW-OIL condition exists when switch in engine-mounted oil tank is shorted to ground (CLOSED). A WATER SEPARATOR condition exists when excessive water accumulates in the bottom of the separator to short out the sensor. In either case, 30 seconds after switch is closed, the warning lamp will illuminate and the warning horn will be activated. The horn will beep 4 times in 1 second intervals followed by a 2 minute off-period. It will then repeat its beep sequence. Continuous lamp illumination and horn beep sequence will occur until the key switch is turned off. If there is no LOW-OIL condition then the WATER SEPARATOR must be checked. An OVER-HEAT condition occurs when the coolant temperature rises above 200°F (93.3°C). The warning lamp will illuminate and the over-heat horn will sound continuously. The ECM will retard the ignition timing until a maximum RPM of approximately 3000 is obtained. The ECM will maintain this RPM until engine temperature drops to 190°F (87.8°C).

Idle stabilizer function by advancing the ignition timing the number of degrees indicated, following, at the respective RPM.

RPM	DEGREES
450	3°
Below 450	6°

Throttle position and engine temperature sensor failure warning to boat operator. Sensor failure is indicated by alternately illuminating the low-oil and overheat lamps as well as activating the warning horn. This warning will occur 15 seconds after a sensor failure has been detected by the ECM. The warning will continue until the key switch is turned off or sensor problem is corrected.

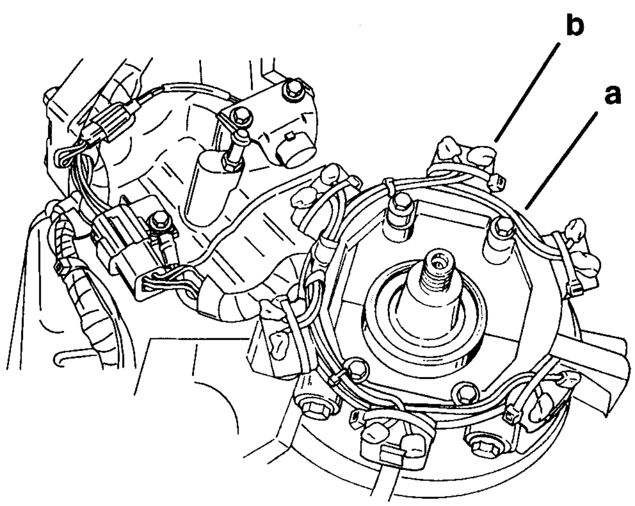
Controls Power-Up Sequence – 1/2 second after ignition key is turned to “ON”, and power is applied to ECM, warning lamps will illuminate for 1/2 second and horn will beep for 1/2 second.

1996/1997/1998 Model Additional ECM Features

- Prom identification with Digital Diagnostic Terminal. Refer to Quicksilver Technician Reference Manual shipped with new diagnostic cartridge.
- Air temperature and/or MAP sensor failure will sound an intermittant warning horn and alternately flash the low oil and overheat lights on the dash.
- Fuel ECM wire harness plug disconnect will sound an intermittent warning horn and alternately flash the low oil and overheat lights on the dash. Engine will not run.

NOTE: *An ignition ECM failure will not activate the warning horn as the warning signal originates from the ignition ECM.*

STATOR



a - Stator
b - Bobbins

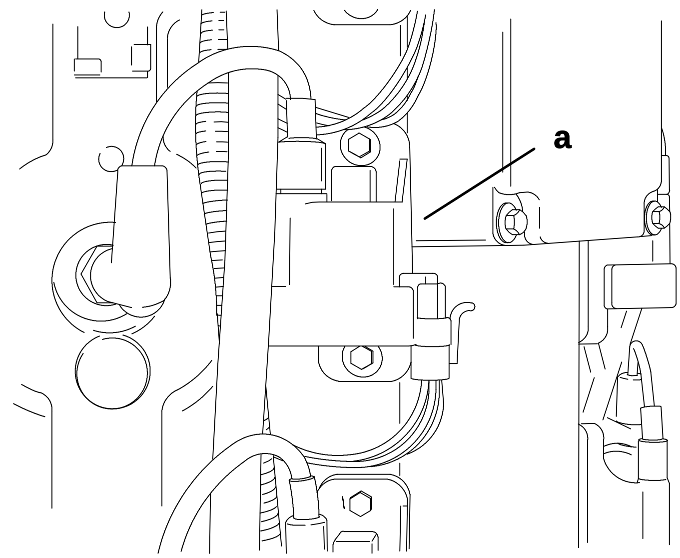
Stator has 6 charging bobbins – 1 bobbin for each ignition module.

Each stator bobbin charges the ignition capacitor in each module.

1994 Model 225 – Stator has 2 functions – charges ignition capacitor in each module and in the event of ECM failure, stator controls spark timing @ 9° ± 1° ATDC by triggering ignition modules. One lead of each bobbin provides voltage for CDM while other lead provides trigger voltage.

1995/1996/1997/1998 Model 3 Litre Work/225 Carb/225 EFI/250 EFI – Stator charges ignition capacitor in each module only. 1995/1996/1997/1998 models do not have "LIMP HOME" capability.

IGNITION MODULES (CDM)



a - Capacitor Discharge Module

Each module contains a capacitor, switching device and ignition coil which can produce approximately 45000 volts (open circuit) at the spark plugs.

1994 MODEL 225 – Module is triggered by the ECM under normal conditions and, in the event of ECM failure, by the stator.

1995/1996/1997/1998 MODEL 3.0 Litre WORK/225/225 EFI/250 EFI – Module is triggered by ECM only. Ground wire for each CDM is incorporated in the wire harness. Capacitor is internally protected from being overcharged by the stator.

FLYWHEEL

Contains two magnets which charge stator bobbins.

Flywheel has 22 teeth on outside rim which, by passing through crank position sensor's magnetic field, informs the ECM of engine RPM and crankshaft angle.

CRANK POSITION SENSOR

Contains a permanent magnet and is positioned 0.040 ±0.020 (1.02mm ±0.51mm) from the flywheel teeth.

The timed passing of the flywheel teeth through the sensor's magnetic field enables the ECM to determine engine RPM and crankshaft angle.

THROTTLE POSITION SENSOR

Measures the amount of throttle opening and sends corresponding voltage signal to ECM.

ENGINE TEMPERATURE SENSOR

Monitors powerhead temperature.

ECM uses this signal to activate fuel enrichment valve on carburetor models and increase fuel injector pulse on EFI models for cold starts and to retard timing in the event of an over-heat condition.

Engine Temperature Sensor Graph –

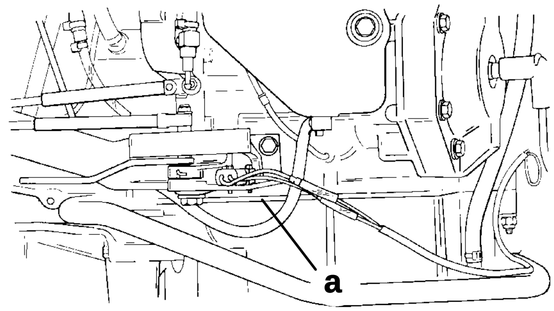
NOTE: *Engine timing is advanced as a function of engine coolant temperature, which, in conjunction with fuel enrichment, aids in cold starting.*

BLOCK TEMPERATURE

Block Temperature C°	F°	Timing Advanced by:
5	41	10°
10	50	10°
15	59	10°
20	68	10°
25	77	8°
30	86	6°
40	104	4°
50	122	2°
60 And Above	146	0°

NOTE: *The amount of sensor timing advance listed above is in addition to the normal engine timing at a given RPM. Engine timing will not advance as a function of block temperature if crank shaft RPM is above 3000.*

SHIFT INTERRUPT SWITCH



a - Shift Interrupt Switch

A shift interrupt switch is mounted below the shift cable on the PORT side of the engine.

1994 MODEL 225 – This switch momentarily grounds out the capacitor voltage within the ignition modules on cylinders 2,4,6 when shifting from FORWARD or REVERSE into NEUTRAL. The dropping of 3 cylinders reduces the torque load on the sliding clutch allowing the gear case to be shifted into NEUTRAL. A diode within the interrupt switch wiring prevents all 6 cylinders from being shut down when shifting into NEUTRAL.

If high effort is required to shift outboard into NEUTRAL, or outboard quits running when shifting into NEUTRAL, or there is weak spark or no spark on cylinders 2,4,6; test diode as follows:

a. Disconnect BLK\YEL female connector from switch.
b. Insert one ohm meter test lead into female connector and second test lead into PIN 1 of engine harness connector.
c. Observe meter reading.
d. Reverse test leads and observe meter.

Ohm meter should indicate CONTINUITY in one direction and NO CONTINUITY in the other direction. If correct results are not obtained, order SHIFT INTERRUPT DIODE REPLACEMENT KIT (17461A5) as described in **SERVICE BULLETIN 94-8**.

1995/1996/1997/1998 MODEL 3.0 Litre WORK/225 Carb/225 EFI/250 EFI – When shift interrupt switch is activated, the ECM retards ignition timing to 20° ATDC. If switch is activated for longer than 2 seconds, the ECM detects switch failure and returns ignition timing to normal.

Ignition Diagnostic Procedures

⚠ CAUTION

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

- **INSURE 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".**

TROUBLESHOOTING TIP: With engine running, use inductive timing light to check spark advance of each cylinder as throttle is opened and closed. If timing advances and retards smoothly on each cylinder, ignition system is MOST LIKELY functioning properly. To mark off flywheel to check for individual cylinder timing advance, temporarily tape a degree wheel on top of the flywheel with 0° on the degree wheel aligning with the TDC mark on the flywheel; this would be #1 cyl. timing mark. 60° in a clockwise direction would be #2 cyl. – use a magic marker to mark the flywheel; 120° = #3 cyl.; 180° = #4 cyl.; 240° = #5 cyl. and 300° = #6 cyl.
If a degree wheel is not available, install a dial indicator in each cylinder, consecutively. Bring each respective piston up to top dead center. Mark the flywheel in-line with the timing pointer.

IMPORTANT: If outboard appears to have an ignition system failure, it is recommended that before beginning in-depth troubleshooting:

1. All grounds should be checked for proper continuity.

2. Disconnect, inspect and reconnect ignition harness connectors to verify proper continuity.

IMPORTANT: The following corrections are listed in sequence of probable occurrence. Refer to "TESTING IGNITION COMPONENTS" to determine individual component failure. Verify harness integrity BEFORE replacing components.

Ignition Troubleshooting

IMPORTANT: The following corrections are listed in sequence of probable occurrence. Refer to "TESTING IGNITION COMPONENTS" to determine individual component failure. Verify harness integrity BEFORE replacing components.

PROBLEM	CORRECTION
1. No spark or weak spark on all 6 cylinders. *NOTE: Disconnect all CDMs' and then reconnect 1 CDM at a time to determine if CDM produces spark. If a CDM is good, disconnect that CDM and then try another CDM until all CDMs' have been tested.*	No Spark – Stop lead (BLK/YEL) shorted to ground. – Stator harness disconnected. – Defective Crank Position Sensor – 1 or More Defective CDM – No DC Voltage to ECM – Flywheel Key Sheared Weak Spark – High resistance on stop lead (BLK/YEL) resulting in voltage being bled off to ground.
2. No spark or weak spark on 1 cylinder	– Ignition module (CDM) defective. – 1 stator bobbin defective.
3. Timing fluctuates – Note: It is normal for timing to fluctuate 2° @ idle. – If engine over-heats [above 200°F(93.3°C)], Engine Temperature Sensor will retard timing to limit RPM to 3000. – If engine RPM exceeds 6000, over-rev circuit in ECM will retard timing to reduce RPM. – If engine RPM drops below 475, idle stabilizer in ECM will advance timing 3° to 6°.	– Loose/poor ground connection. – Crank Position Sensor not properly set up or defective. – Defective Throttle Position Sensor. – Defective Engine Temperature Sensor. – Defective ECM.
4. Timing will not advance – Note: If timing will not advance on only 1 cylinder, check wiring between Ignition Module and ECM. If wiring is OK, replace Ignition Module.	– Defective Crank Position Sensor. – Defective Throttle Position Sensor. – Defective ECM.
5. Engine misfires at high RPM.	– Defective Ignition Module. – Defective Crank Position Sensor. – Alternator RED output lead is loose. – Defective ECM.
6. Engine hard to start when cold.	– Defective Enrichment Solenoid. – Defective Engine Temperature Sensor. – Defective Crank Position Sensor. – Defective ECM.
7. Engine misfires @ low RPM but runs smooth @ high RPM	– Defective harness (loose connec tions) between ECM and Ignition Modules. – Defective Ignition Modules.

8. Engine starts hard when hot.	– Defective Enrichment Solenoid. – Defective Crank Position Sensor. – Defective Engine Temperature Sen sor.
9. Engine will not run over 3000 RPM and is not overheating	– Defective Engine Temperature Sensor. – Defective Throttle Position Sensor. – Defective ECM.
10. Engine will not run.	– Defective Crank Position Sensor. – Wrong Spark Plugs Installed. Install Champion QL77CC. – Tach Signal (GREY Lead) is shorted to ground. Inspect Tach Wiring – Fuel ECM disconnected.

ECM Sensor Specifications using Digital Diagnostic Terminal 91-823686A2		
DISPLAY	**TERMINAL RANGE**	**NORMAL OPERATING RANGE**
Engine RPM	0 – 9000	650 – 5800 NOTE: Above 6100 RPM engine RPM limiter is activated. Dash mounted OIL and TEMP lights will flash, horn will beep and timing will be retarded to limit RPM.
Coolant Temp Deg F	0 – 199	Ambient Air Temp – 160°F NOTE: Water temperature that engine is operating in will affect engine coolant temp. Engine is equipped with 142°F thermostats. When coolant temperature exceeds 200°F, over-heat warning system is activated. Dash mounted TEMP light will illuminate and horn will sound continuously. Timing will be retarded to reduce RPM to a maximum of 3000.
Throttle Pos Volts	0.95 – 4.0	0.95 @ Idle for all Models 3.80 @ W.O.T. for Carb Models 4.00 @ W.O.T. for EFI Models

Spark Angle	20 ATDC – 30 BTDC	4 – 9 ATDC @ Idle for all Models 1994 225 Carb – 22 BTDC @ 5500 w/ECM 821717 1994 225 Carb – 25-27 BTDC @ 5500 w/ECM 284866-1 1995 WORK/225 Carb – 20 BTDC @ 5000 and 23 BTDC @ 5500 1996/7/8 WORK/225 Carb – 19 BTDC @ 5000 and 26 BTDC @ 5500 1995 225 EFI – 20 BTDC @ 5000 and 23 BTDC @ 5800 1996/7/8 225 EFI – 24 BTDC @ 5000 and 24 BTDC @ 5800 1996/7/8 250 EFI – 24 BTDC @ 5000 and 28 BTDC @ 5800 NOTE: When engine is shifted out of gear, timing may retard to 20 ATDC to reduce torque load on gears to ease shifting effort.

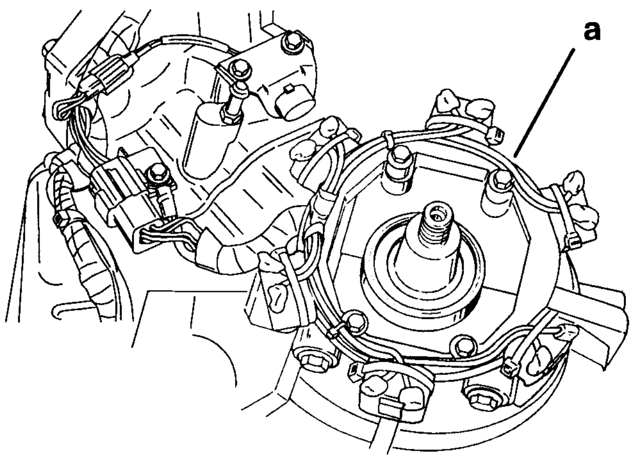
DISPLAY	TERMINAL RANGE	NORMAL OPERATING RANGE
Knock Volts	0 – 10	Knock Voltage Circuitry is not incorporated in 1994/1995/1996/1997 Models.
Battery Volts	0 – 15	11 – 15
Atmosph PSI	0 – 16	11 – 16 PSI NOTE: Atmosphere PSI will vary with the altitude above sea level that engine is operated at. The higher the altitude, the lower the PSI.
MAP PSI	0 – 16	9 – 16 PSI NOTE: Manifold Absolute Pressure (MAP) will vary with the altitude above sea level that engine is operated at. The higher the altitude, the lower the PSI.
Air Temp Deg F	0 – 199	Ambient Air Temperature
Inject Msec	0 – 16	3.5 – 8.0 Fuel Injector Pulse Width will vary due to the following: Air Temperature Coolant Temperature Barometric Pressure (Altitude) RPM Throttle Position Sensor Setting Battery Voltage An Average Pulse Width Readout for either a 225 EFI or 250 EFI would be as follows: Idle – 4 1000 RPM – 4.5 2000 RPM – 5 3000 RPM – 5.5 4000 RPM – 6 5000 RPM – 6.5
Fuel Pump % On	0 – 100	100 The fuel pump runs continuously; 100% duty cycle, when the engine RPM is above 2500.

TESTING IGNITION COMPONENTS

Normally, if timing advances and retards with corresponding changes in throttle, most likely the ECM is functioning correctly. In order to determine if all aspects of the ECM are functioning correctly, a CAPACITOR DISCHARGE MODULE (CDM) must be attached to the ECM. Refer to page 21 for a DVA test of the trigger circuit of the ECM.

STATOR

When performing an OHM check of the stator, disconnect the stator wires.



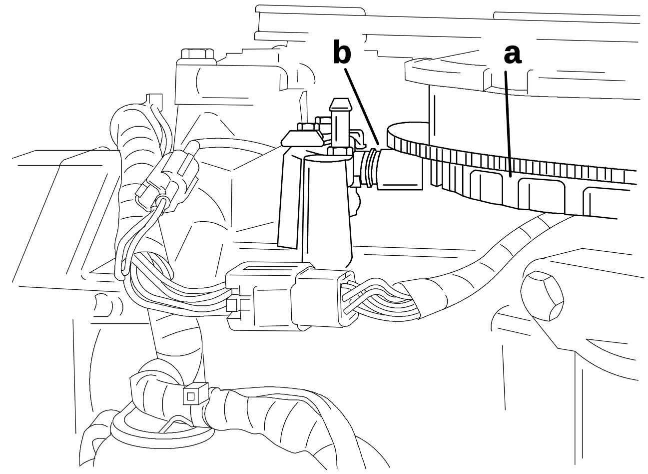
53459

a - Stator

Stator Ohms Test	
Connect meter leads between the two leads coming out of each bobbin.	**1994 Models** 1100 **?** 10%
Connect meter leads between lead coming out of each bobbin and engine ground	**1995 and Newer Models** 1100 **?** 10%

CRANK POSITION SENSOR

NOTE: *If boat tachometer is reading properly, then Crank Position Sensor is functioning normally.*

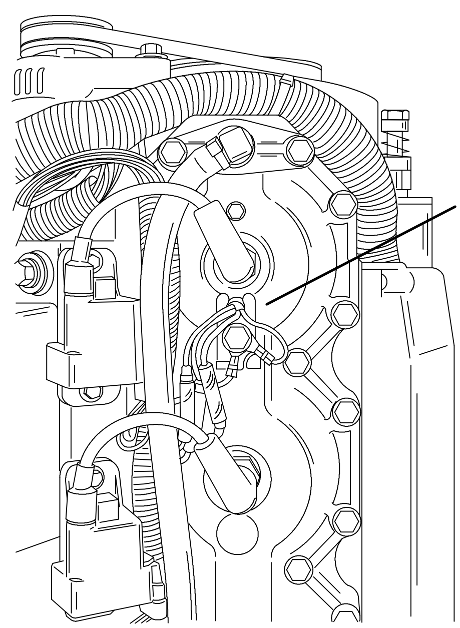


53455

a - Flywheel Teeth
b - Crank Position Sensor

Crank Position Sensor Ohms Test	
Connect meter leads between the two sensor leads	1100 **?** 200

ENGINE TEMPERATURE SENSOR



54387

a - Engine Temperature Sensor

Insert digital or analog ohmmeter test leads into both TAN/BLACK sensor leads. With engine at temperature (C° or F°) indicated, ohm readings should be as indicated ±10%.

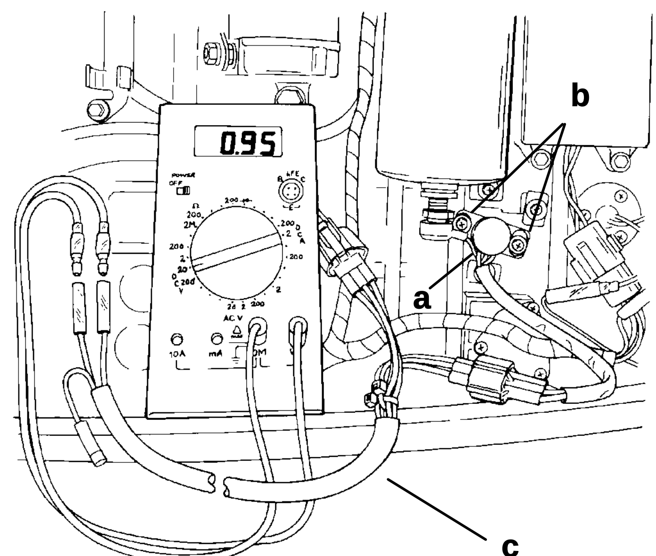
Block Temperature C°	Block Temperature F°	Resistance (Ohms)
–15	5	7465
–10	14	5636
-5	23	4288
0	32	3287
5	41	2551
10	50	1996
15	59	1574
20	68	1250
25	77	1000
30	86	805
35	95	652
40	104	532
45	113	436
50	122	360
55	131	298
60	140	248
65	149	208
70	158	175
75	167	148
80	176	126
85	185	107
90	194	92
95	203	79
100	212	68
105	221	59
110	230	51
115	239	44
120	248	38
125	257	34

Engine Temperature Sensor and Ground	
Between Black and EACH Tan/Blk wire.	No Continuity

THROTTLE POSITION SENSOR (TPS)

A digital or an analog volt meter can be used to test or adjust the TPS. However, only very expensive analog meters have the capability to measure the small voltage readings. With outboard NOT running, connect voltmeter using sensor test lead assembly (84-825207A1) between sensor connector and ignition harness connector. With ignition key turned to the “ON” position, voltage reading at idle should be 0.950 ±0.050 VDC. Voltage progression from idle to wide-open-throttle should be smooth. If voltage reading of 3.80 ±0.10 VDC (for carb models) or 3.80 ± 0.25 (for EFI models) cannot be obtained, replace sensor. Refer to page 2C-4 for carb model TPS test harness setup or 2C-10 for EFI model TPS test harness setup.

TPS Voltage Readings			
At Idle		W.O.T.	
Carb Models	EFI Models	Carb Models	EFI Models
.950 ? 0.050 VDC		3.8 ? .10	3.80 ? .25



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a - TPS
b - Set Screws
c - TPS/CDM TEST HARNESS (84-825207A1)

IGNITION MODULE (CDM – PN 822779)

Possible CDM failure modes and test procedures:

1. Secondary Coil Winding Failure –
   a. Internal short in secondary coil winding.
   b. Failure will only affect that CDM.
2. Detected by:
   a. DVA voltage within specification.
   b. Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.
   c. Ohm test – not valid.

Improved coil winding procedure beginning with date code 2703 – 270 day of 1993. Any previous CDM is suspect.

3. Stop Circuit Failure –
   a. Common cause is moisture and/or resultant carbon track to ground.
   b. CDM case may be separating from the potting.
4. Detected by:
   a. Low DVA voltage.
   b. Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.
   c. Ohm test – BLACK/YELLOW and BLACK – good CDM will have continuity in one direction only. CDM MUST BE DISCONNECTED FROM THE ELECTRICAL HARNESS.
   d. Weak spark on other cylinder(s) – bad CDM will affect other cylinders.
      (1.) 1994 225 – Bad CDM on 2, 4, 6 will affect only 2, 4, 6 individual or multiple cylinders. Defective CDM on 1, 3, 5 will affect individual or multiple cylinders. Disconnecting bad CDM will allow good CDMs to operate.
      (2.) 1995 All Models– Defective CDM will affect any cylinder.
5. SCR Failure –

Premature SCR switch closing. Lower than specified voltage closes switch and produces a spark. A CDM with this type failure does not affect the operation of other good CDMs.

   a. SCR failures of this type have been found in CDMs with printed numbers 822779A5.
   b. CDMs with printed numbers 822779A8 have an improved SCR.
   c. As the SCR degrades, any voltage pulse above the reduced break-over (trigger) point will produced a spark. Continued operation may cause the SCR to short to ground.

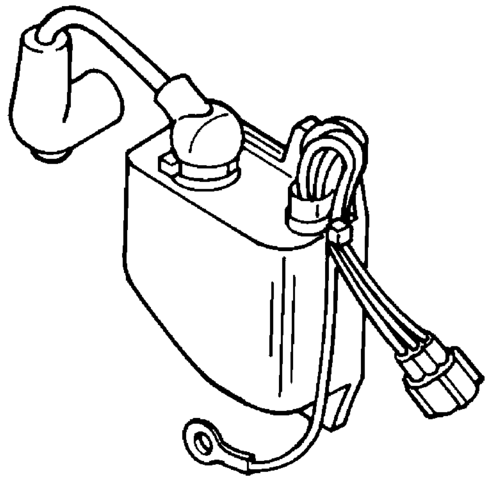
6. Detected Failure –

Shorts to ground – Failed SCR will only affect that CDM.

7. Detected by:
   a. Low DVA voltage.
   b. Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.
   c. Ohm test – not valid.

CAPACITOR DISCHARGE MODULE (PN 822779) OHMS TEST

Spark Gap Test – With battery @ a minimum of 9 volts, CDM should produce a spark to jump a 3/8 in. gap @ a cranking speed of 350 RPM



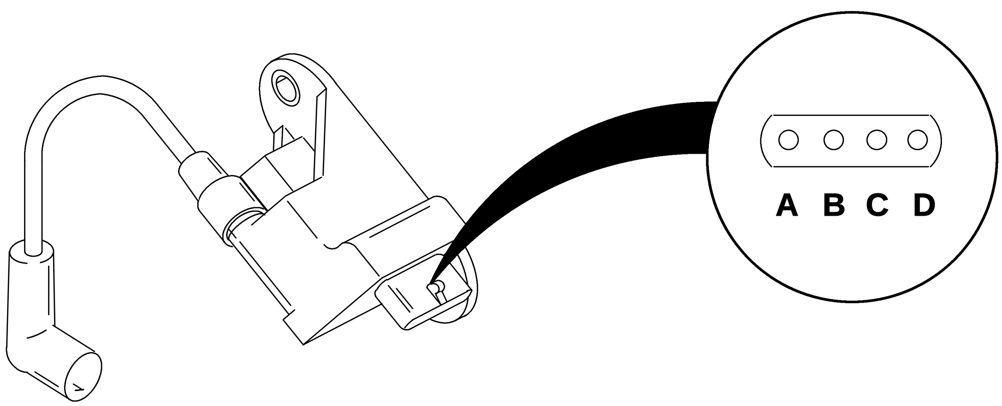
TESTED PART	MULTIMETER WIRES	CONNECTED TO	SCALE	READING
IGNITION MODULE	RED BLACK	GROUND WHITE	R X 1	40 ± 10 OHMS
	RED BLACK	GRN\WHT GROUND	R X 1	CONTINUITY
	RED BLACK	GROUND GRN\WHT	R X 1K	NO CONTINUITY
	RED BLACK	GRN\WHT BLK/YEL	R X 1K	NO CONTINUITY
	RED BLACK	BLK/YEL GRN\WHT	R X 1	CONTINUITY
	RED BLACK	COIL TOWER GROUND	R X 10	1000 ± 300 OHMS

CDM (P/N 827509) Trouble Shooting Flowchart

Chart 1

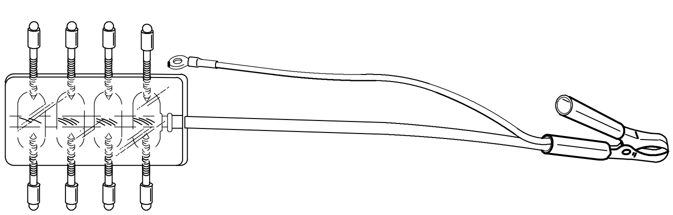
Step	Action	Value	Yes	No	Tools
1	Verify High Tension Leads, Spark Plug and Spark Boots are in good condition. Inspect wires for chafing. **Visual Inspection**	–	Step 2	Replace Failed Component Step 2	High Tension lead pin P/N 84-813706A56
2	Verify 4 Pin Connector Integrity **Visual Inspection**	–	Step 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	DVA/Multimeter P/N 91-99750 Test Harness P/N 84-825207A2
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

Spark Gap Tester P/N 91-850439



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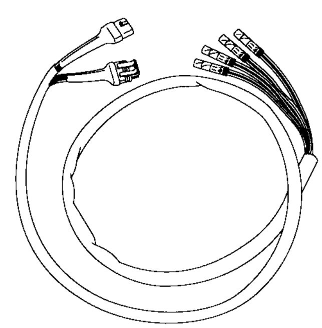
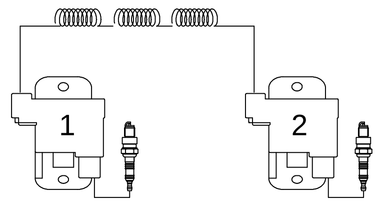
CDM Test Harness 84-825207A2

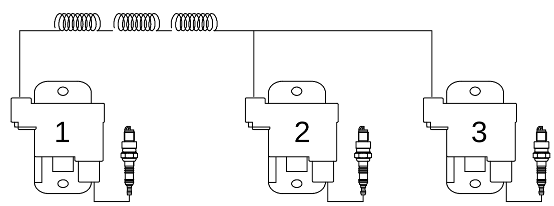


CDM Stop Diode Trouble Shooting

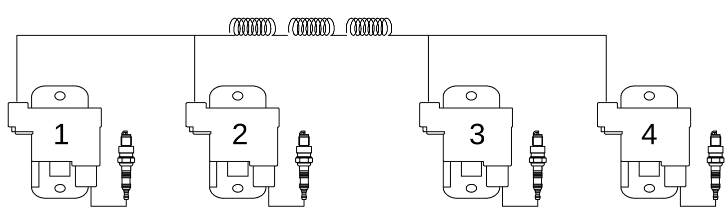
2 Cyl.:
CDM #1 gets its charging ground path through CDM #2
CDM #2 gets its charging ground path through CDM #1
A shorted Stop Diode in either CDM would prevent the opposite one from sparking.



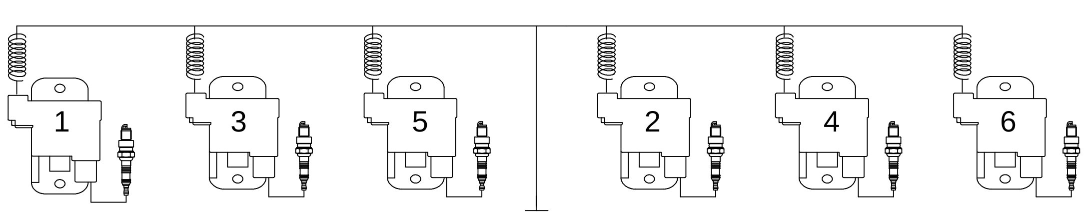
3 Cyl.:
CDM #1 gets its charging ground path through CDM #2 or #3
CDM #2 and #3 get their charging ground path through CDM #1
A shorted Stop Diode in CDM #1 would prevent CDMs #2 and #3 from sparking.
A shorted Stop Diode in CDM #2 or #3 would prevent CDM #1 from sparking.



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 CDM #1 and #2 from sparking.



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 BLK/YEL harness wire and ground. **This Test Checks:** Lanyard Switch Key Switch Rev Limiter (external) Chafed BLK/YEL wire CDM Stop Circuit	NO continuity	Step 2	Repair or Replace Component Run Engine Verify Repair Step 6	DVA/Multimeter P/N 91-99750
2	Check Stator Resistance between GRN/WHT and WHT/GRN Open circuit voltage at cranking should be no less than 100 Volts on the DVA	660-710 Ohms 2, 3 & 4 Cyl. Models 990 - 1210 Ohms 6 Cyl.	Step 3	Replace Stator Run Engine Verify Repair Step 6	DVA/Multimeter P/N 91-99750
3	Check Trigger/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 5	2, 3, & 4 Cyl Replace Trigger Run Engine Verify Repair Step 6 6 Cyl. - Step 4	DVA/Multimeter P/N 91-99750 TPI/CDM Test Harness 84-825207A2
4	V-6 Models Resistance Check Crank Position Sensor	900 - 1300 Ohms	Step 5	Replace Crank Position Sensor Run Engine Verify Repair Step 6	DVA/Multimeter P/N 91-99750
5	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 6	Verify All Preceding Steps	Spark Gap Tester P/N 91-850439
6	If mis-firing is in a repeatable range: Perform DVA readings on stator and trigger at all running speeds.*	Stator: 200 Volts and above Trigger: 2 Volts and above	Run Engine Verify Repair END	Refer to *Note Below	DVA/Multimeter P/N 91-99750 TPI/CDM Test Harness 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

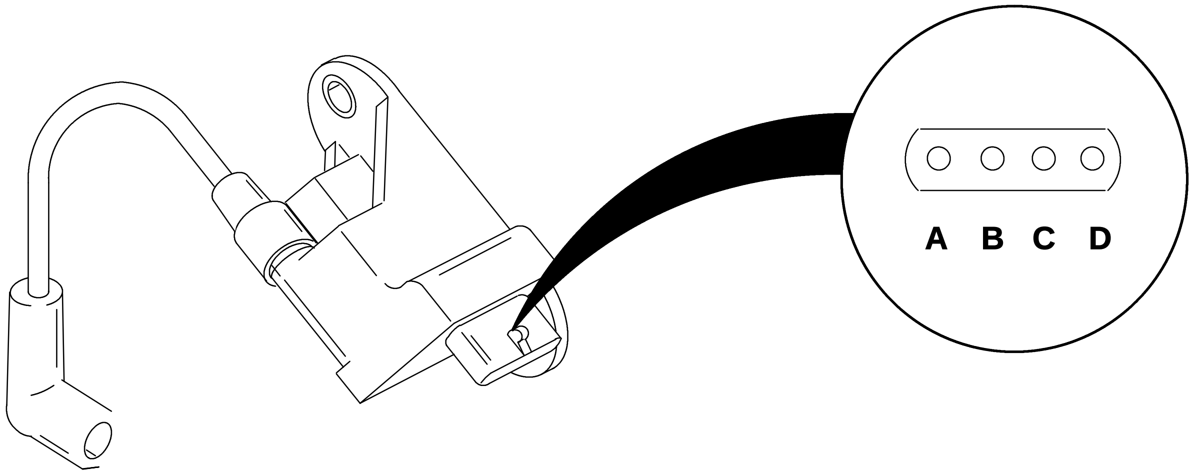
Chart #3 (At least one CDM has spark)

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	DVA/Multimeter P/N 91-99750
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 6	Step 3	Spark Gap Tester P/N 91-850439
3	Check Trigger Output: Cranking with CDM disconnected. Cranking with CDM connected.	1 Volt and above - CDM disconnected. 0.2 - 5 Volts - CDM connected.	Step 5	2, 3, & 4 Cyl - Replace Trigger Run Engine Verify Repair Step 6 6 Cyl–Step 4	DVA/Multimeter P/N 91-99750 TPI/CDM Test Harness 84-825207A2
4	V6 Models Resistance Check Crank Position Sensor	900 - 1300 Ohms	Step 5	Replace Crank Position Sensor Run Engine Verify Repair Step 6	DVA/Multimeter P/N 91-99750
5	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 6	Replace any non-firing CDMs Step 6	Spark Gap Tester P/N 91-850439
6	If mis-firing is in a repeatable range: Perform DVA readings on stator and trigger at all running speeds.*	Stator: 200 Volts and above Trigger: 2 Volts and above	Run Engine Verify Repair END	Refer to *Note Below.	DVA/Multimeter P/N 91-99750 TPI/CDM Test Harness 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.

CAPACITOR DISCHARGE MODULE

IMPORTANT: Spark plug wires are screwed into CDM.



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

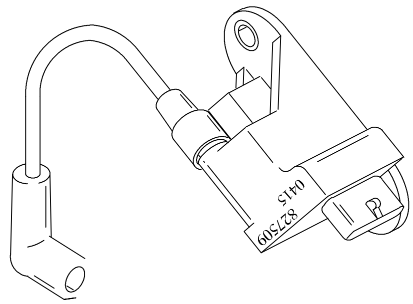
A resistance check is required and can be performed on the CDM as follows:

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.*

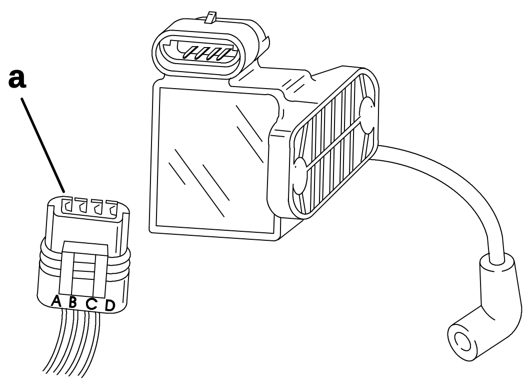
CAPACITOR DISCHARGE MODULE				
Circuit Test	**Connect Negative (-) Meter Lead To:**	**Connect Positive (+) Meter Lead To:**	**Ohms Scale**	**Results:**
Stop Diode Forward Bias	Green (D)/ or Green test harness lead	Black/Yellow (B)/ or Black/Yellow test harness lead	R x 100 Diode Reading*	Continuity
Stop 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.

CAPACITOR DISCHARGE MODULE (PN 827509)



***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.*



a - Ground Wire

Possible CDM failure modes and test procedures:

1. Secondary Coil Winding Failure –

   a. Internal short in secondary coil winding.

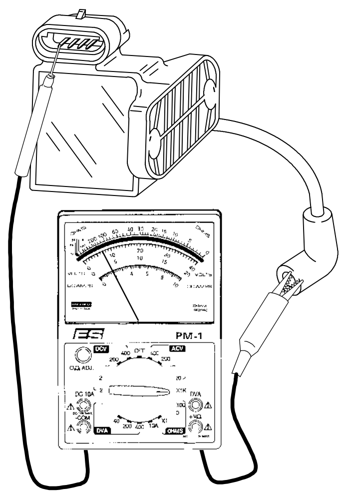
   b. Failure will only affect that CDM.

- Detected by:

  (1.) DVA voltage within specification.

  (2.) Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.

  (3.) Ohm test – 900-1200 ohms



2. Stop Circuit Failure –

   a. Common cause is moisture and/or resultant carbon track to ground.

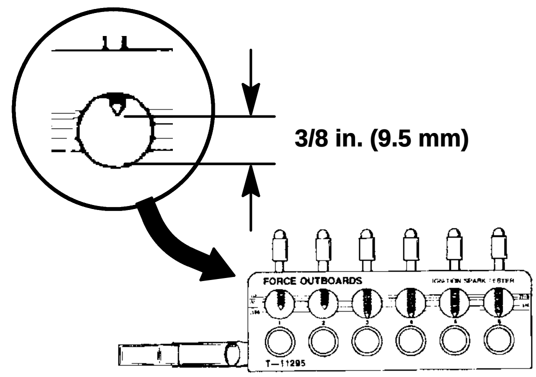
   b. CDM case may be separating from the potting.

   c. Potting Cracked.

- Detected by:

  (1.) Low DVA voltage.

  (2.) Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.



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  (3.) Ohm test – BLACK/YELLOW and BLACK – good CDM will have continuity in one direction only. CDM MUST BE DISCONNECTED FROM THE ELECTRICAL HARNESS.

  (4.) Weak spark on other cylinder(s) – bad CDM will affect other cylinders.

  (5.) Defective CDM will affect any cylinder.

3. SCR Failure –

Premature SCR switch closing. Lower than specified voltage closes switch and produces a spark. A CDM with this type failure does not affect the operation of other good CDMs.

   a. As the SCR degrades, any voltage pulse above the reduced break-over (trigger) point will produced a spark. Continued operation may cause the SCR to short to ground. A failed SCR will only affect that CDM.

- Detected by:

  (1.) Low DVA voltage.

  (2.) Weak spark – unable to jump 3/8 in. (9.5mm) spark gap at cranking.

  (3.) Ohm test – not valid.

  (4.) Advanced ignition timing on that cylinder.

Stator and ECM DVA Tests

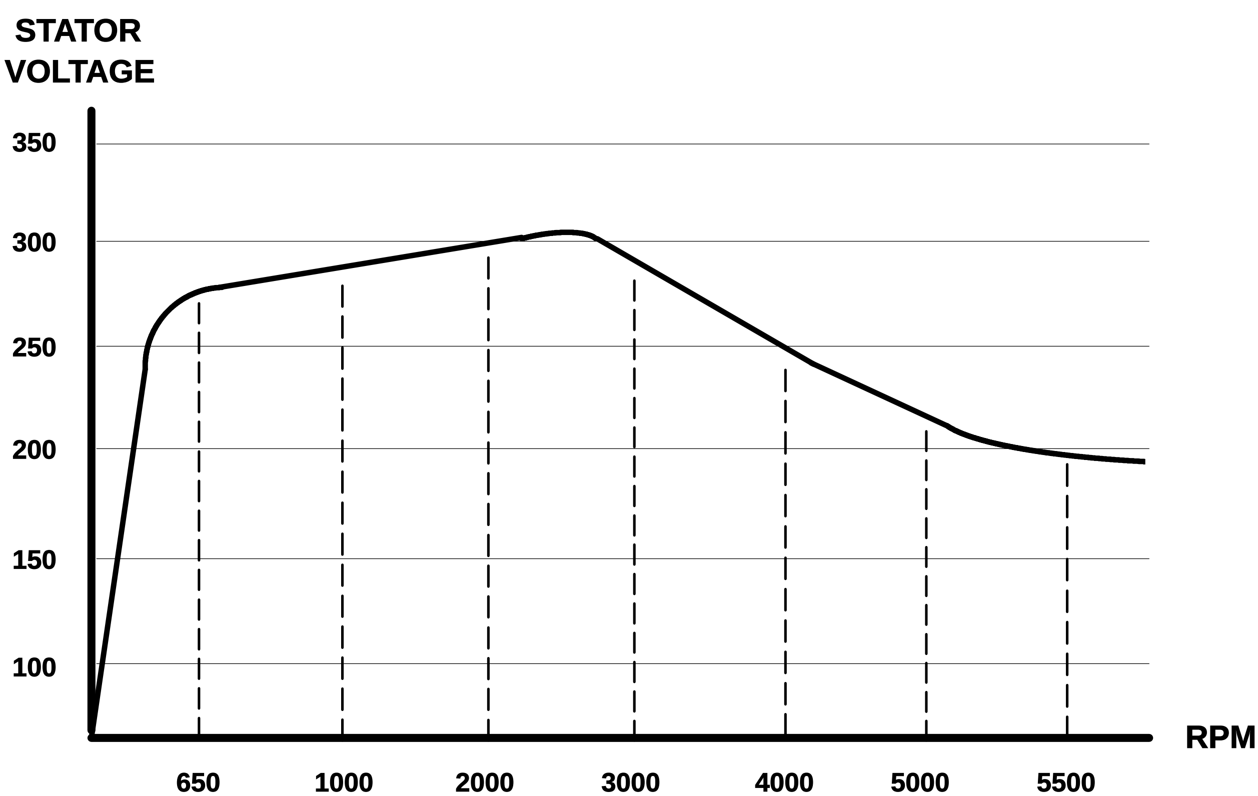
Stator and ECM DVA tests can be made using Quicksilver Multimeter/DVA Tester 91-99750 and TPS/CDM Harness Assembly 84-825207A1 for 1994/1995 models or CDM Harness Assembly 84-825207A2 for1996/1997 models. Connect the harness in series at a CDM connector. Attach the appropriate DVA test leads to the harness as listed below:

TEST	DVA POSITION	DVA LEAD	TPI/CDM LEAD	VOLTAGE @ CRANKING	VOLTAGE @ 650-3000 RPM	VOLTAGE @ 4000-5500 RPM
Stator	400 DVA	RED	1994/1995 RED	100 - 225	250 - 300	230 - 200
		BLACK - To GRD	96/97/98 GREEN			
ECU Trigger	40 DVA	RED	WHITE	2 - 10		
		BLACK - To GRD				

IMPORTANT: Use the Quicksilver Multimeter/DVA Tester 91-99750 to obtain comparable voltages as listed when testing the 3.0 Liter ignition system.

IMPORTANT: The TPS/CDM Harness BLACK lead is not a ground when the TPS/CDM Harness is connected in series with a CDM connector. The BLACK lead is the engine stop lead and should not be connected to the DVA BLACK lead as a ground.

NOTE: *The 3.0 Liter CDM is charged by a single stator coil whose efficiency is greatest (highest voltage) at low and mid-range RPM.*



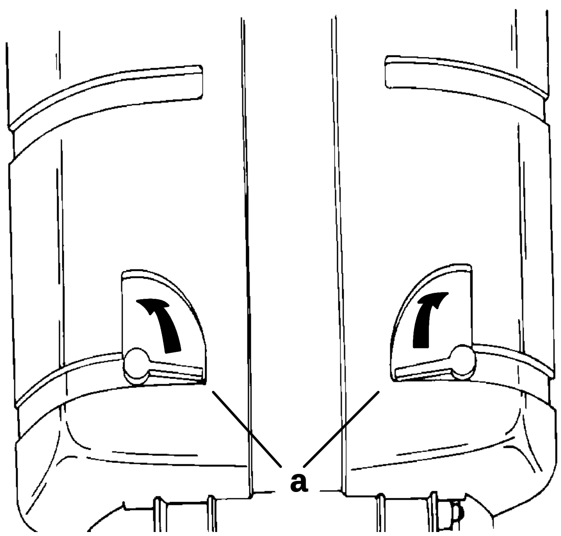
Ignition Components Removal and Installation

FLYWHEEL REMOVAL AND INSTALLATION

Removal

IMPORTANT: Ignition key switch should be in the "OFF" position to prevent accidental starting while removing flywheel.

1. Remove top cowling.
2. Remove flywheel cover and attenuator. Remove flywheel cover by sliding back and lifting cover in a simultaneous motion. Remove attenuator by releasing two latches at bottom of attenuator.



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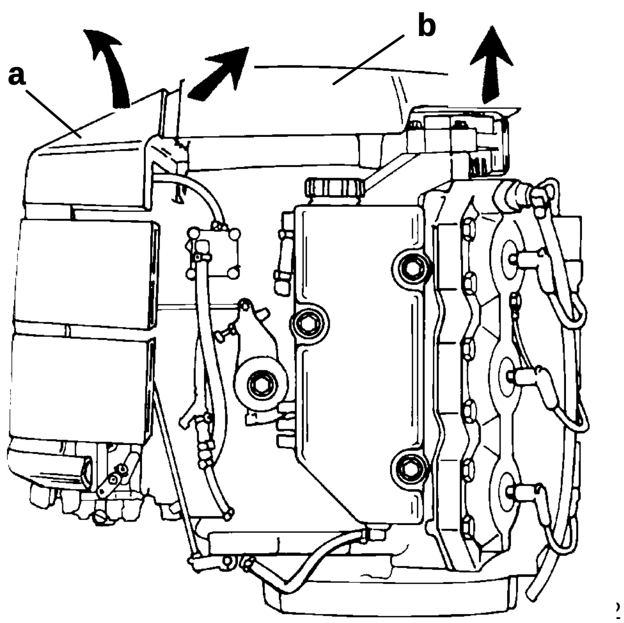
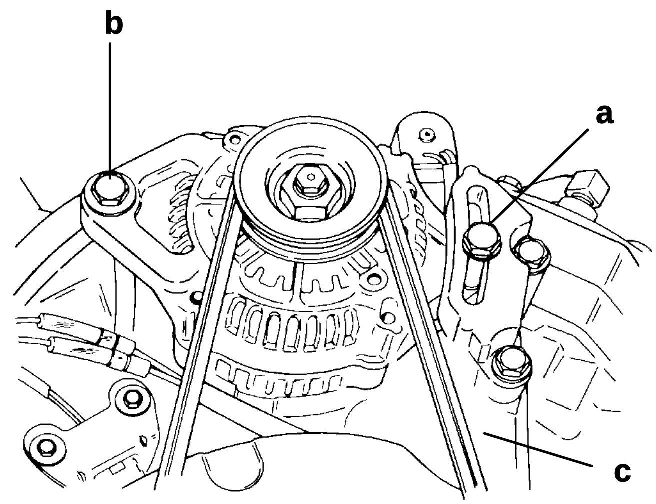
a - Latches



a - Attenuator
b - Flywheel Cover

3. Loosen alternator tension bolt and pivot bolt.
4. Remove alternator belt.



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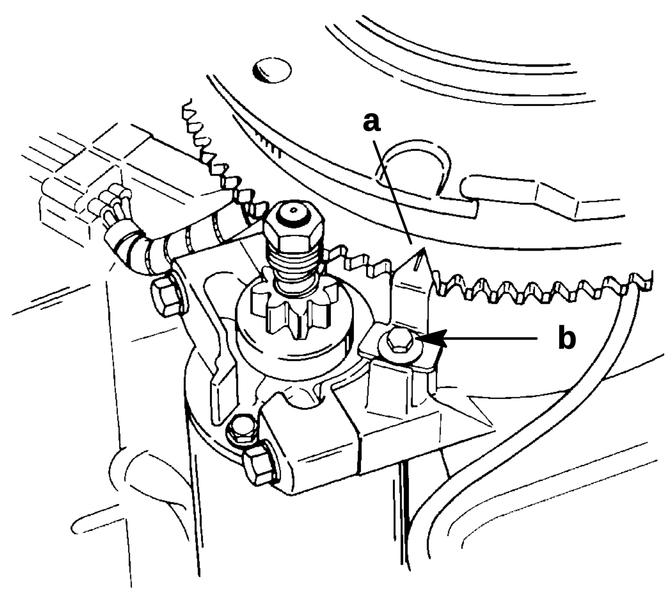
a - Tension Bolt
b - Pivot Bolt
c - Belt

5. Remove timing pointer.



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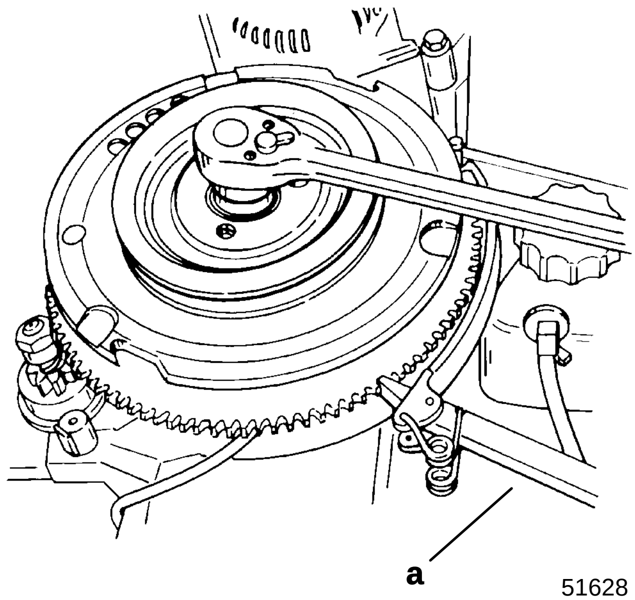
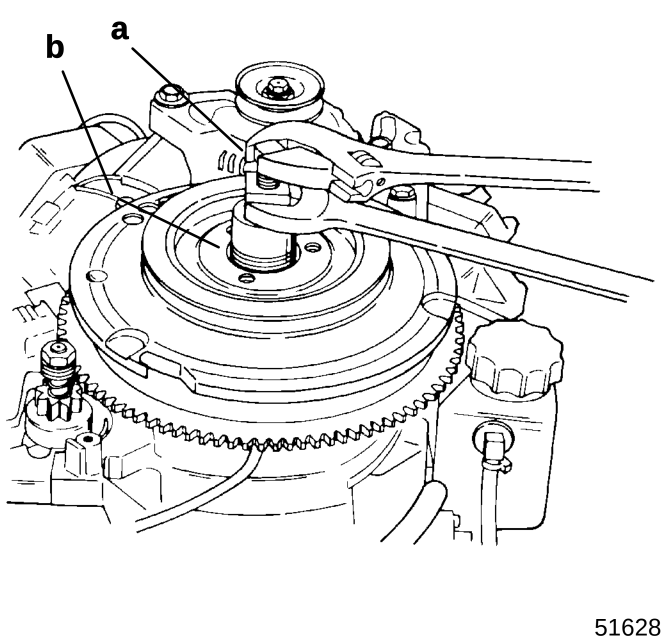
a - Timing Pointer
b - Bolt

6. Remove flywheel nut.



a - Flywheel Holding Tool (91-52344)

7. Remove flywheel.



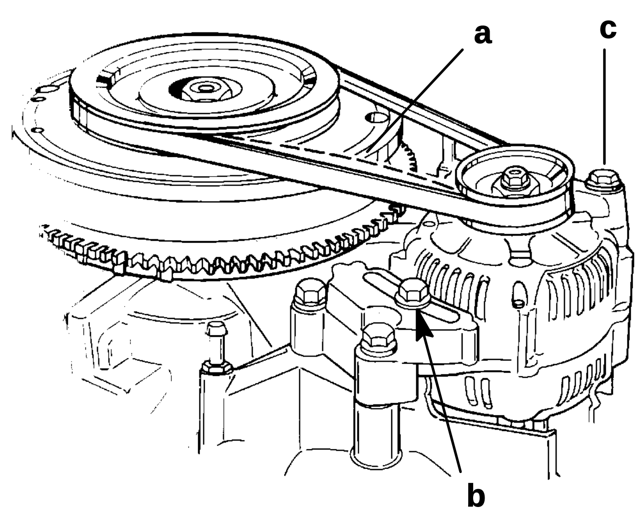
a - Puller (91-73687A1)
b - Protector Cap (91-24161) (HIDDEN)

Installation

IMPORTANT: Inspect flywheel magnets for clinging debris. Failure to remove debris from magnets will result in damage to stator and magnets when outboard is initially started.

1. Reinstall flywheel with nut and washer.
2. Torque flywheel nut to 125 lb. ft. (169.5 N·m)
3. Reinstall alternator belt.
4. Pull alternator away from flywheel until belt deflects 1/2 in. (12.7mm) with a 22 lb. ft. (98.0 N·m) side load.
5. Tighten tension adjustment bolt [Torque to 35 lb. ft. (47.5 N·m)] and pivot bolt [Torque to 35 lb. ft. (47.5 N·m)].

NOTE: *A belt tensioning tool (obtain locally) may also be used to adjust belt tension. Adjust belt tension to 80 lb. (356.0 N·m).*



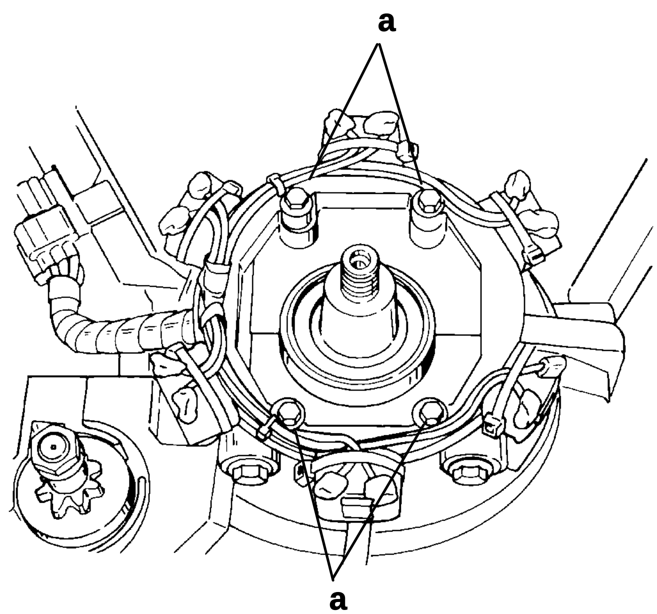
a - Deflection [1/2 in. (12.7mm) under 22 lb. ft. (98.0 N·m) side load]
b - Tension Bolt [Torque to 35 lb. ft. (47.5 N·m)]
c - Pivot Bolt [Torque to 35 lb. ft. (47.5 N·m)]

6. Reinstall timing pointer. Refer to "TIMING/SYNCHRONIZING/ADJUSTING" for proper pointer alignment. Torque pointer attaching bolt to 105 lb. in. (12.0 N·m).
7. Reinstall flywheel cover and attenuator.
8. Reinstall top cowling.

STATOR

Removal

1. Refer to "Flywheel Removal" to remove flywheel.
2. Remove 4 allen screws securing stator.



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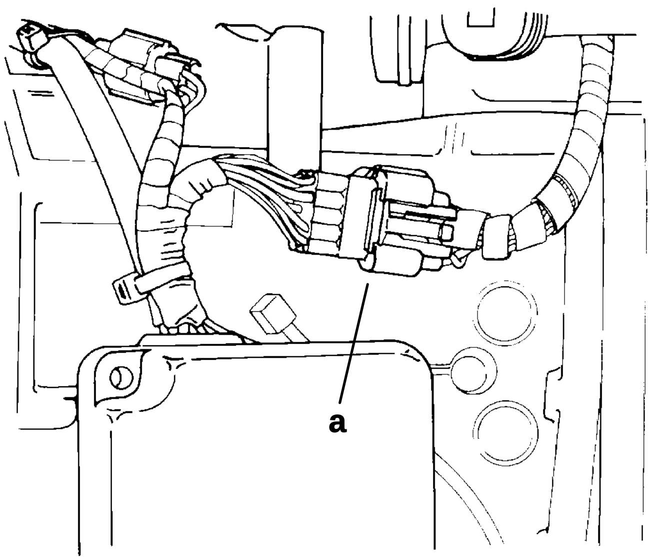
a - Bolts

3. Disconnect stator harness.



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a - Harness

4. Remove stator.

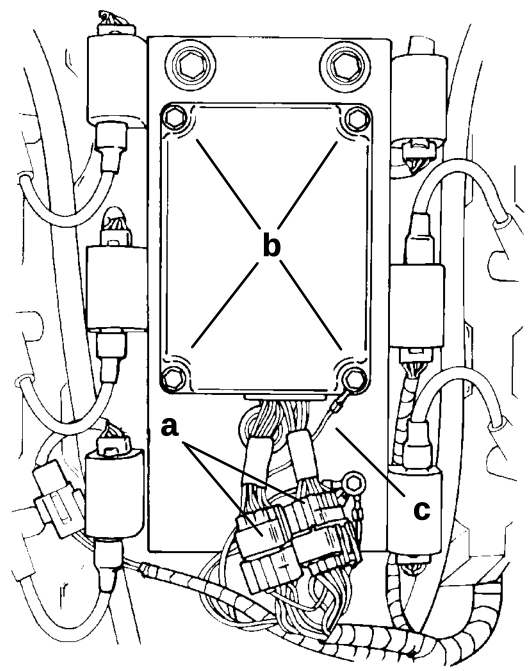
Installation

1. Position stator on powerhead. Torque attaching screws to 105 lb. in. (11.9 N·m).
2. Reconnect stator harness.
3. Refer to "FLYWHEEL INSTALLATION" to complete reassembly.

ELECTRONIC CONTROL MODULE (ECM)

Removal (1994 Models)

1. Remove top cowling.
2. Disconnect ECM harness connector(s).
3. Remove 4 bolts securing ECM.



1994 MODEL 225

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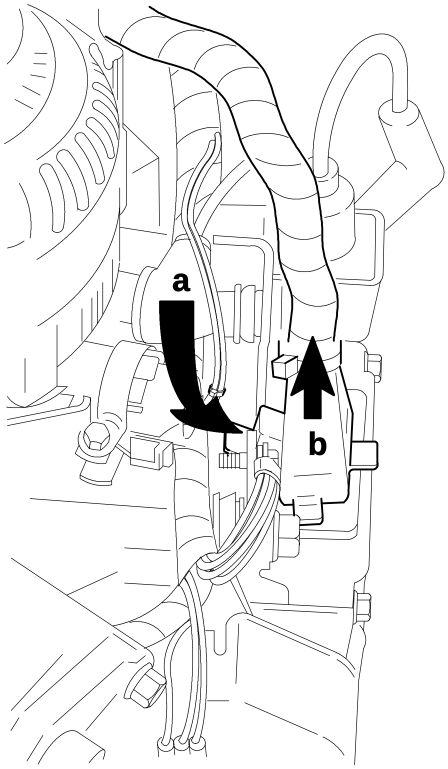
a - Harness Connectors
b - Bolts
c - Ground Lead

NOTE: *On 1995 Model ECM harness connectors, squeeze in on the rubber boot tab (to disconnect retaining clip) while pulling harness away from ECM.*



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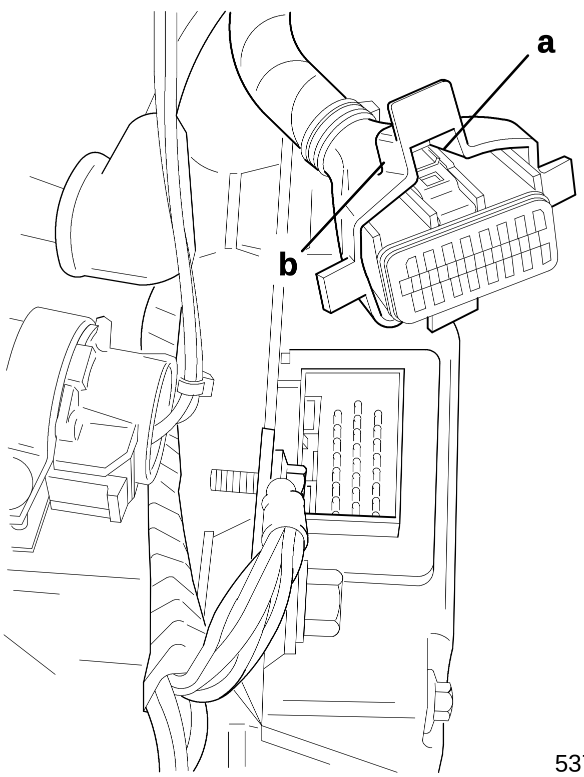
a - Bottom Tab (Squeeze in)
b - Harness Connector



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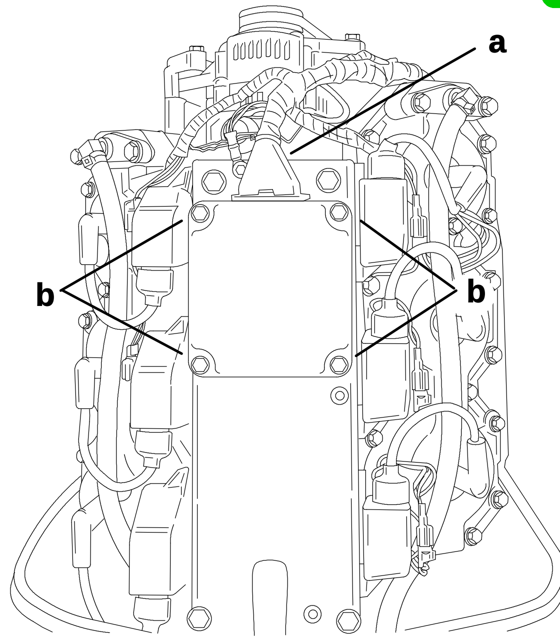
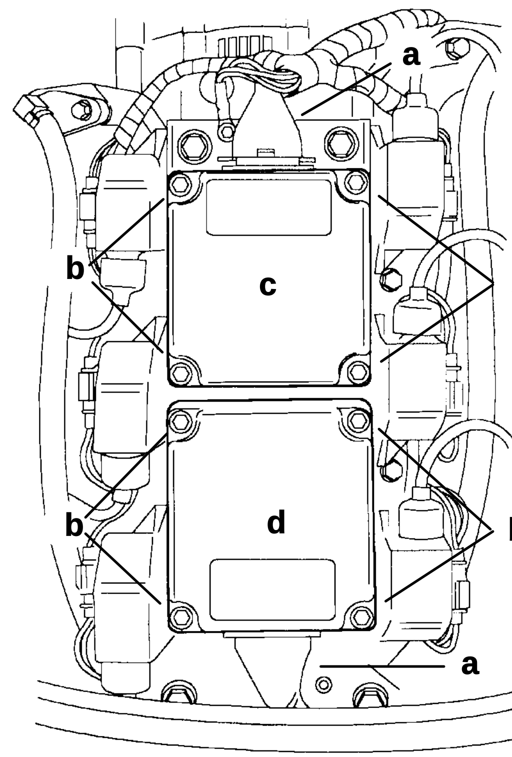
a - Retainer Clip
b - Rubber Boot Tab



1995 MODEL 3.0 Litre WORK/225 53459

a - Harness Connector
b - Bolts



53638

1995/6 225 EFI/250 EFI

a - Harness Connectors
b - Bolts
c - Ignition ECM
d - Fuel ECM

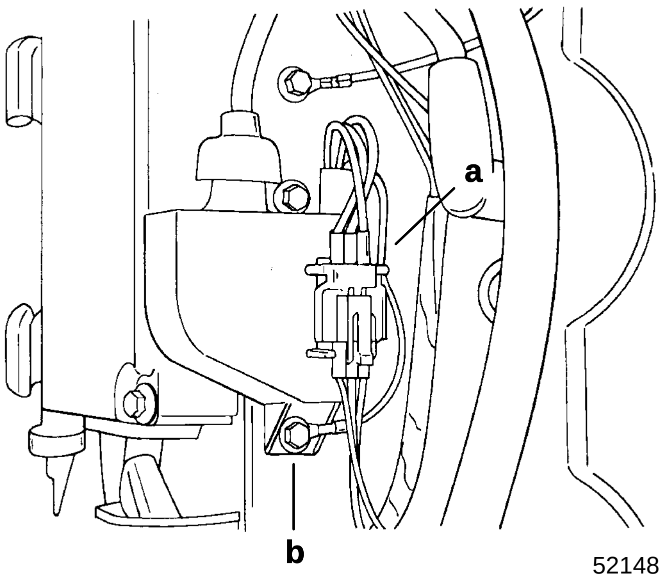
Installation

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

IGNITION MODULE

Removal

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



52148

a - Harness
b - Attaching Bolt

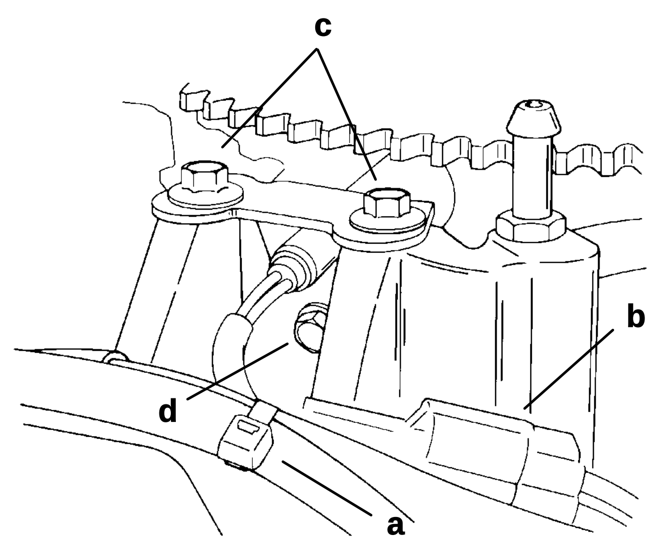
Installation

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

CRANK POSITION SENSOR

Removal

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



51627

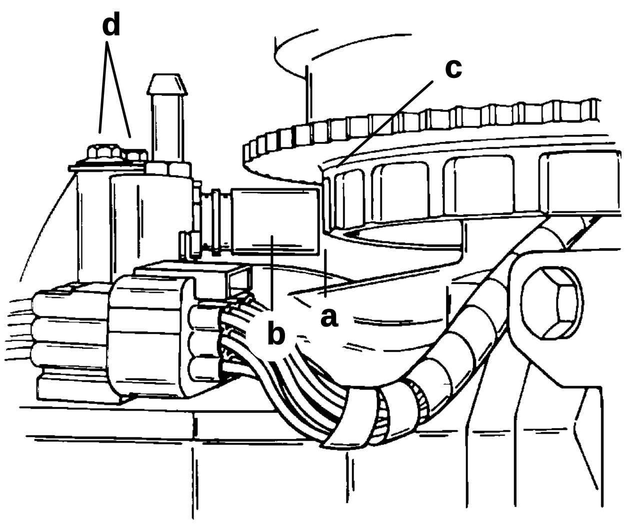
a - Sta-strap
b - Harness
c - Bracket Bolts
d - Sensor Bolt

Installation

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

NOTE: *Position bracket/sensor assembly to allow a .040 .in ± .020 in. (1.02mm ± 0.51mm) air gap between sensor and flywheel teeth.*

3. Torque bracket bolts to 100 lb. in. (11.5 N·m).



51533

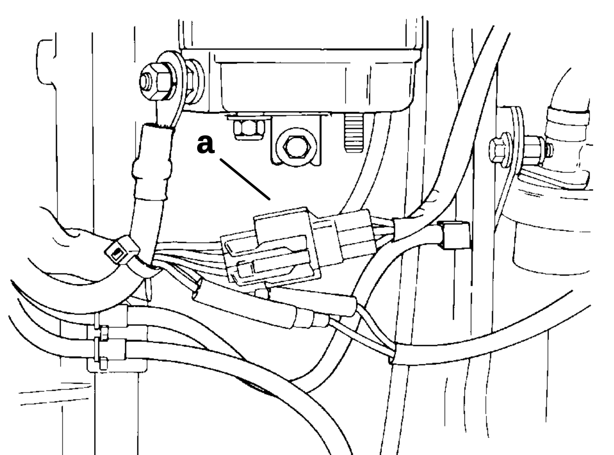
a - Air Gap [.040 in. ± .020 in. (1.02mm ± 0.51mm)]
b - Crank Position Sensor
c - Flywheel Tooth
d - Bracket Bolts [Torque to 100 lb. in. (11.5 N·m)]

4. Reconnect sensor harness.
5. Secure harness with sta-strap.
6. Reinstall top cowling.

THROTTLE POSITION SENSOR

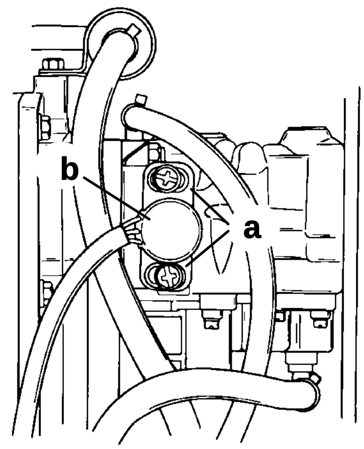
Removal

1. Remove top cowling.
2. Disconnect sensor harness.



a - Sensor Harness Connector

3. Remove 2 screws securing sensor to bracket.

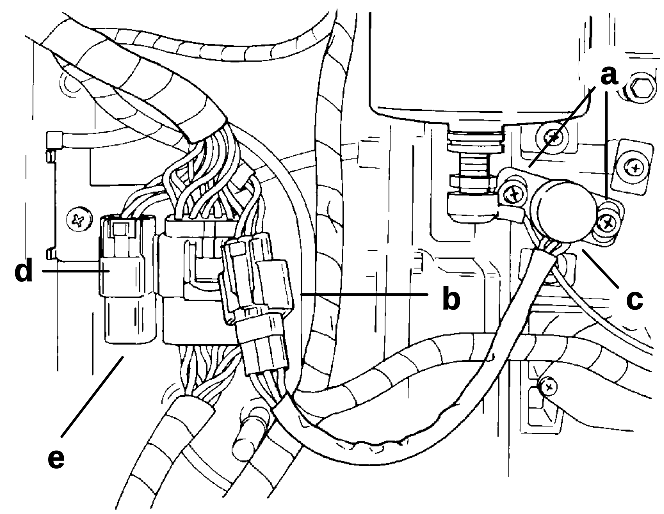


51535

MODEL 3 LITRE WORK/225 CARB

a - Screws
b - Sensor

NOTE: *1995 CARBURETOR and EFI outboards have an on-board test harness connector for plugging in the DIGITAL DIAGNOSTIC TERMINAL (91-823686A-2) to monitor various engine functions while outboard is running. Remove connector plug and connect DDT harness to test connector.*



MODEL 225 EFI/250 EFI

53329

a - Screws
b - Harness
c - Sensor
d - Test Harness Connector for Digital Diagnostic Tester
e - Plug

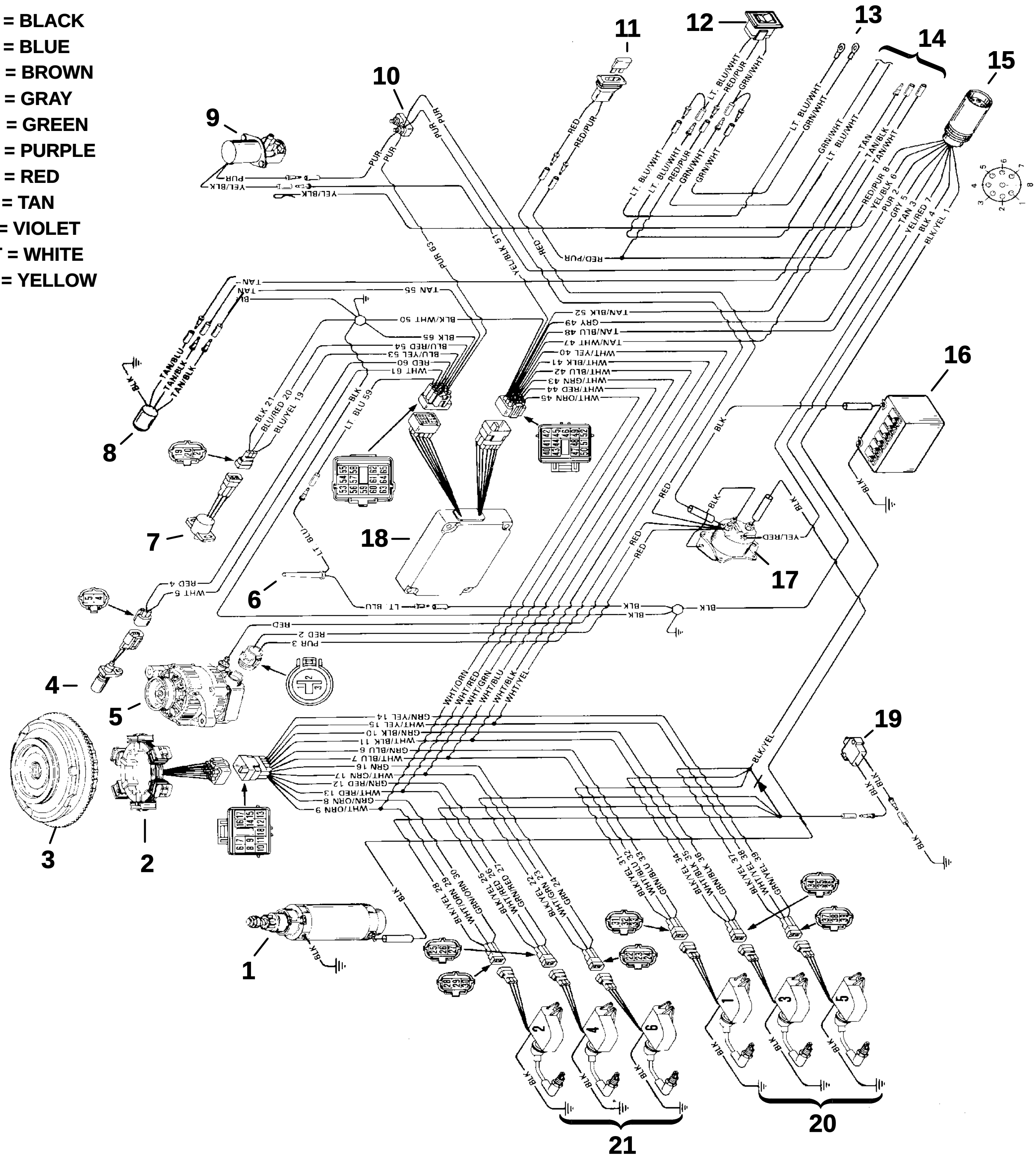
Installation

1. Secure sensor to bracket with 2 screws. Torque screws to 20 lb. in. (2.3 N·m).
2. Reconnect harness.
3. Refer to SECTION 2C "TIMING/SYNCHRONIZING/ADJUSTING" for proper sensor set-up.
4. Reinstall top cowling.

Notes:

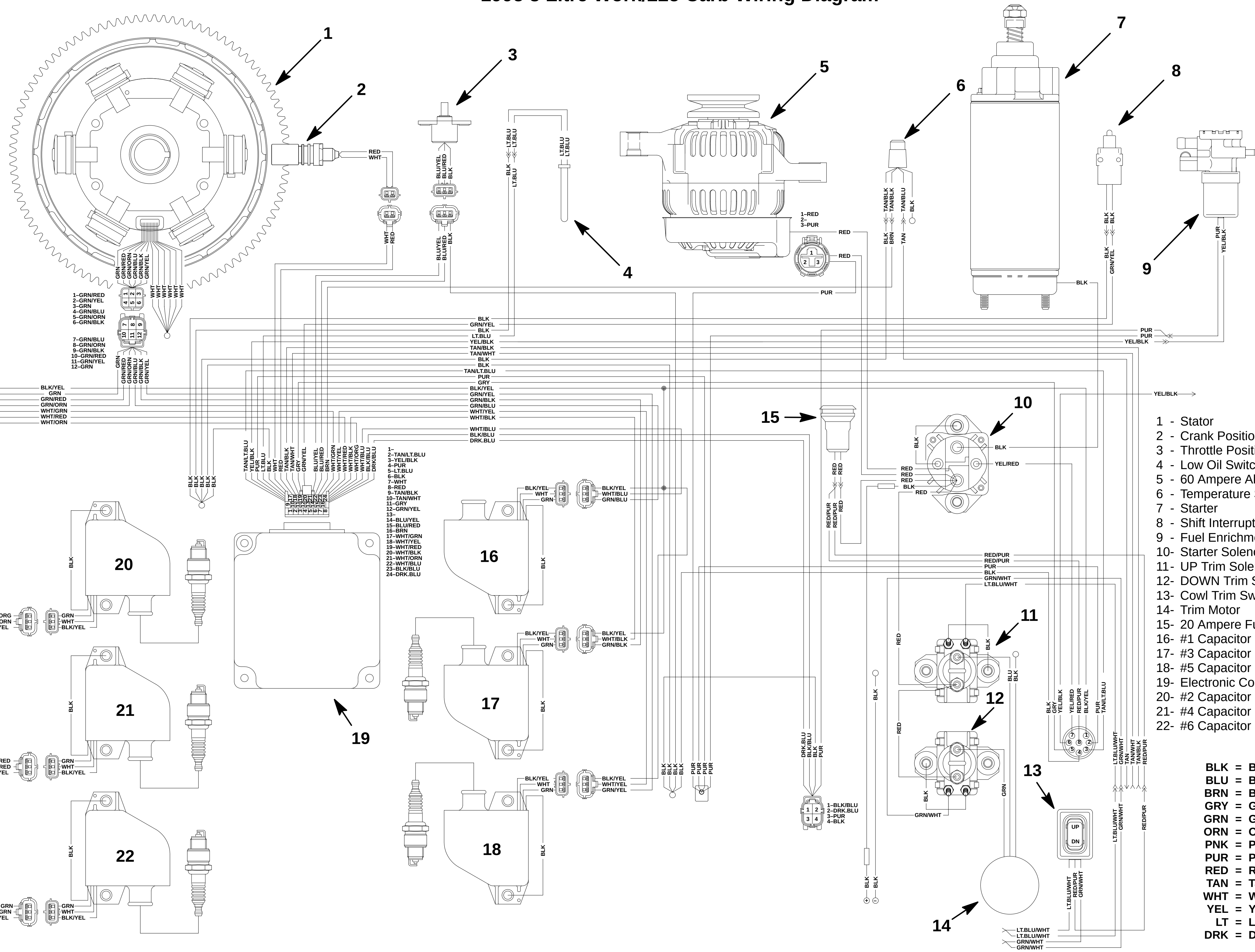
1994 225 IGNITION DIAGRAM

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



1 - Starter
2 - Ignition Stator
3 - Flywheel
4 - Crank Position Sensor
5 - 60 Ampere Alternator
6 - Low Oil Sensor
7 - Throttle Position Sensor
8 - Overheat Sensor
9 - Fuel Enrichment Valve
10- Terminal Block
11 -20 Ampere Fuse
12- Cowl Trim Switch
13- To Trim Solenoids
14- To Remote Control Harness
15- Engine Harness Plug
16- 12 Volt Battery
17- Starter Solenoid
18- Electronic Control Module (ECM)
19- Shift Interrupt Switch
20- Starboard Ignition Modules - 1,3,5
21- Port Ignition Modules - 2,4,6
22- Ignition Stator

1995 3 Litre Work/225 Carb Wiring Diagram

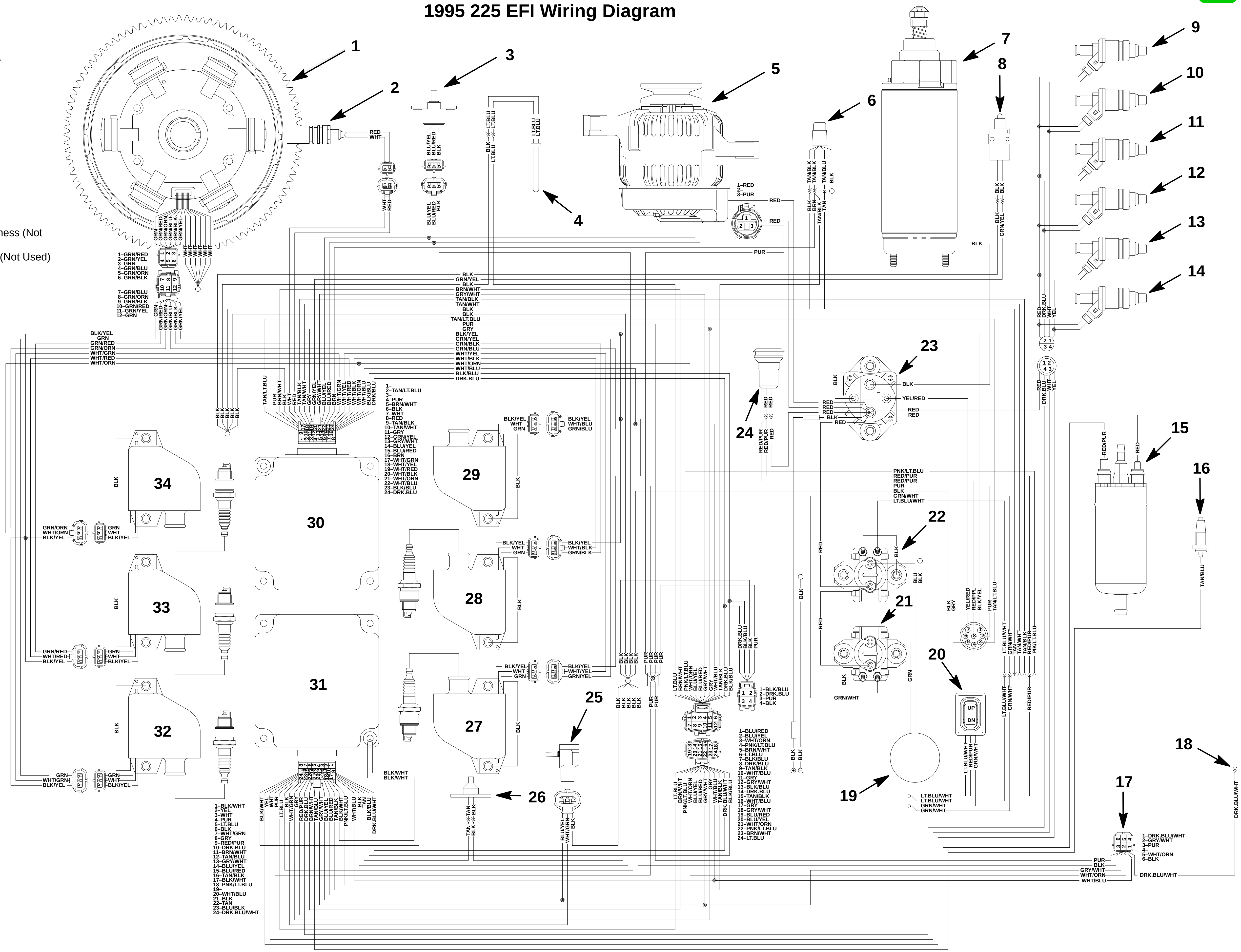


1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch (225 Carb Only)
5 - 60 Ampere Alternator
6 - Temperature Sensor
7 - Starter
8 - Shift Interrupt Switch
9 - Fuel Enrichment Valve
10- Starter Solenoid
11- UP Trim Solenoid
12- DOWN Trim Solenoid
13- Cowl Trim Switch
14- Trim Motor
15- 20 Ampere Fuse
16- #1 Capacitor Discharge Module
17- #3 Capacitor Discharge Module
18- #5 Capacitor Discharge Module
19- Electronic Control Module
20- #2 Capacitor Discharge Module
21- #4 Capacitor Discharge Module
22- #6 Capacitor Discharge Module

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

1995 225 EFI Wiring Diagram

1. Stator
2. Crank Position Sensor
3. Throttle Position Sensor
4. Low Oil Switch
5. 60 Ampere Alternator
6. Temperature Sensor
7. Starter
8. Shift Interrupt Switch
9. #1 Fuel Injector
10. #2 Fuel Injector
11. #3 Fuel Injector
12. #4 Fuel Injector
13. #5 Fuel Injector
14. #6 Fuel Injector
15. Fuel Pump
16. Water Sensor
17. Detonation Module Harness (Not Used)
18. Knock Sensor Harness (Not Used)
19. Trim Motor
20. Cowl Trim Switch
21. DOWN Trim Solenoid
22. UP T rim Solenoid
23. Starter Solenoid
24. 20 Ampere Fuse
25. MAP Sensor
26. Air Temperature Sensor
27. #5 CDM
28. #3 CDM
29. #1 CDM
30. Ignition ECM
31. EFI (Fuel) ECM
32. #6 CDM
33. #4 CDM
34. #2 CDM



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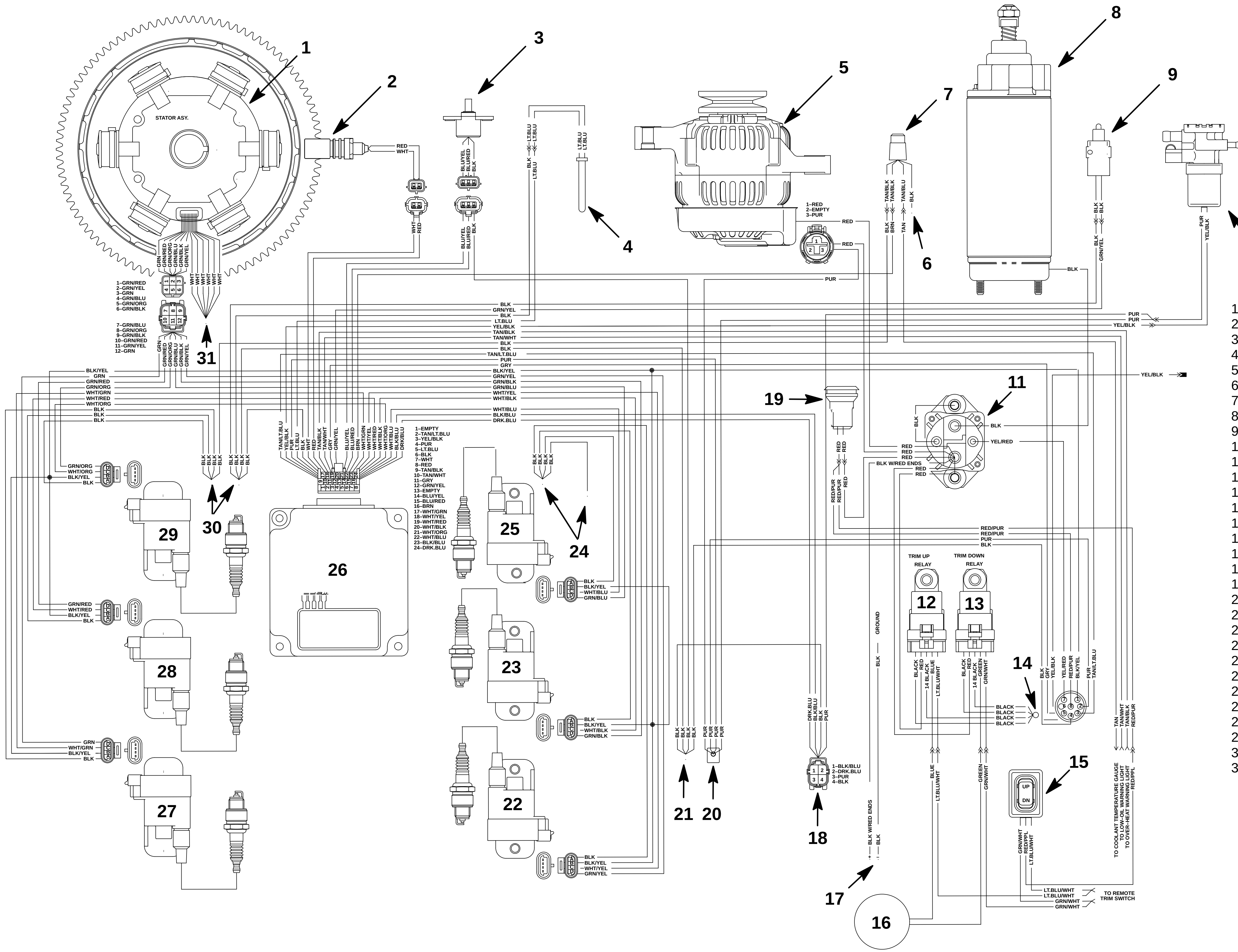
1996/1997/1998 3 Litre Work/225 Carburetor Wiring Diagram



1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch (225 Carb Only)
5 - 60 Ampere Alternator
6 - Ground
7 - Temperature Sensor
8 - Starter
9 - Shift Interrupt Switch
10- Fuel Enrichment Valve
11- Starter Solenoid
12- UP Trim Solenoid
13- DOWN Trim Solenoid
14- Ground
15- Cowl Trim Switch
16- Trim Motor
17- To 12 Volt Battery
18- Diagnostic Harness
19- 20 Ampere Fuse
20- Terminal Block
21- Ground
22- #5 CDM
23- #3 CDM
24- Grounds
25- #1 CDM
26- Ignition ECU
27- #6 CDM
28- #4 CDM
29- #2 CDM
30- Grounds
31- Ground

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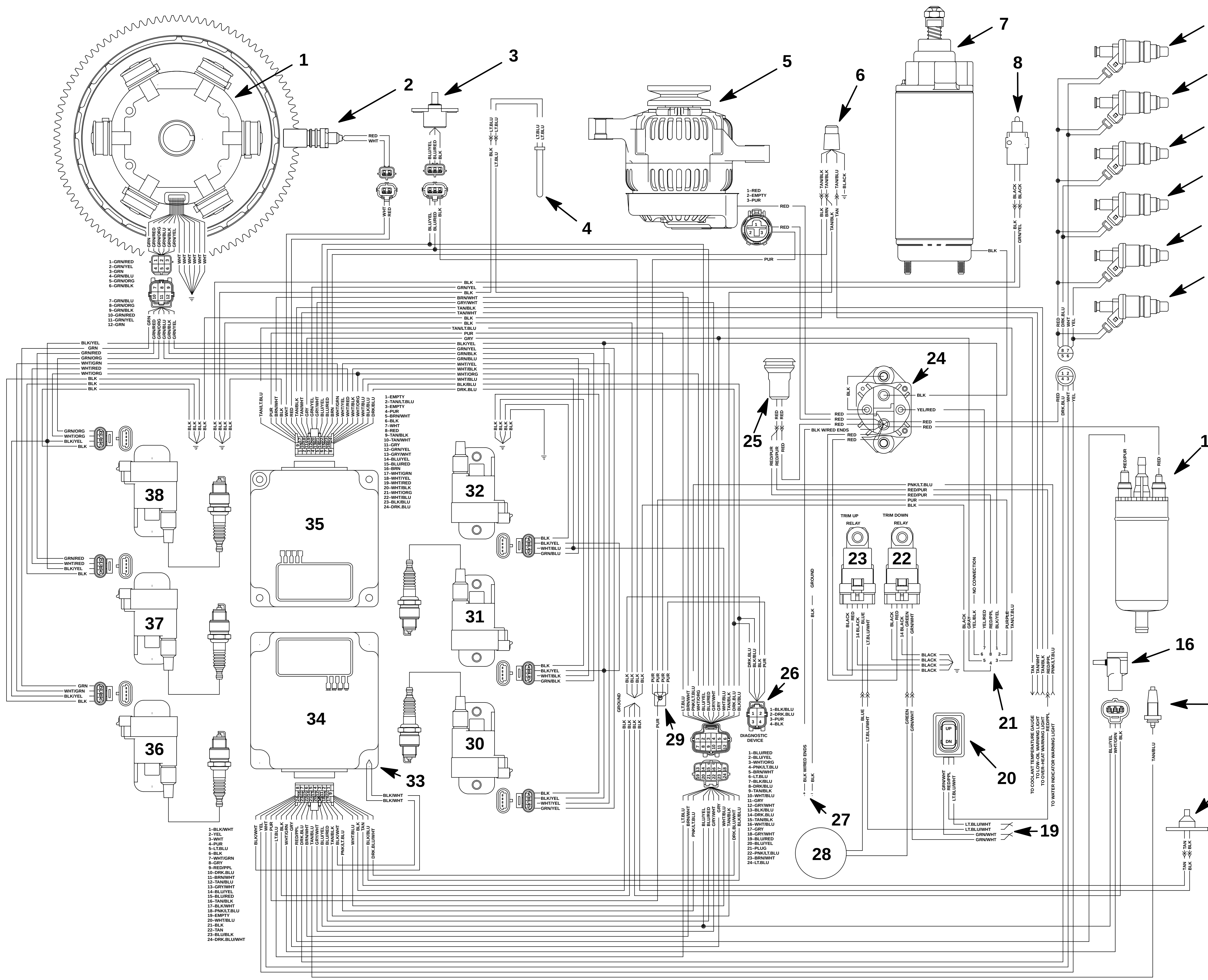
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark

1996/1997/1998 225 EFI/250 EFI Wiring Diagram

Stator
Crank Position Sensor
Throttle Position Sensor
Low Oil Switch
60 Ampere Alternator
Temperature Sensor
Starter
Shift Interrupt Switch
#1 Fuel Injector
#2 Fuel Injector
#3 Fuel Injector
#4 Fuel Injector
#5 Fuel Injector
#6 Fuel Injector
Fuel Pump
Map Sensor
Water Sensor
Air Temperature Sensor
To Remote Trim Switch
Cowl Trim Switch
Remote Control Harness
DOWN Trim Solenoid
UP Trim Solenoid
Starter Solenoid
20 Ampere Fuse
Diagnostic Harness
To 12 Volt Battery
Trim Motor
Terminal Block
#5 CDM
#3 CDM
#1 CDM
Ground
EFI (Fuel) ECM
Ignition ECM
#6 CDM
#4 CDM
#2 CDM



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GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
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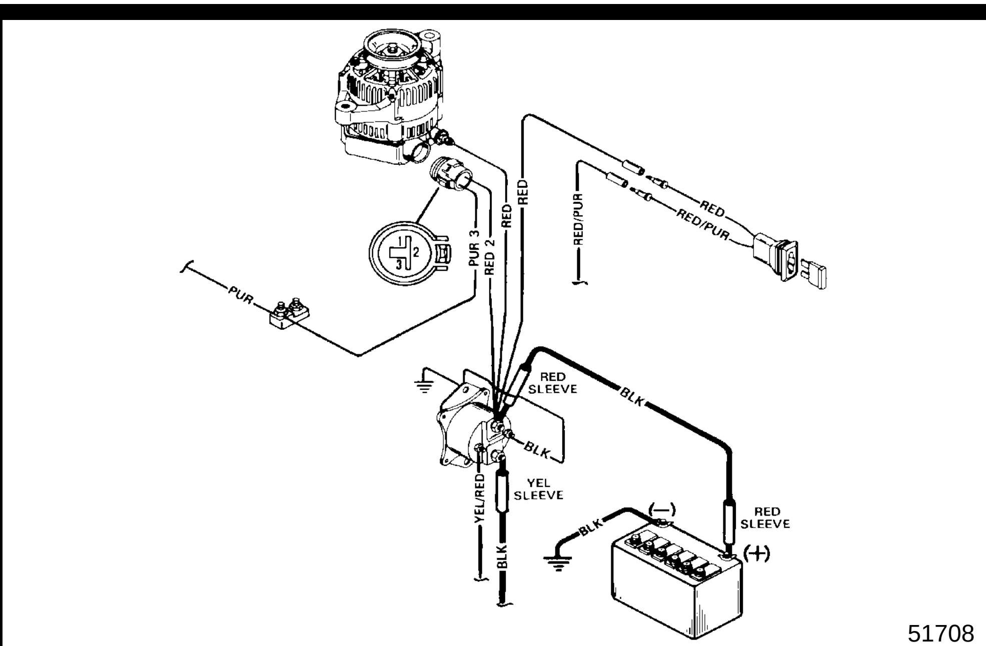
YEL = Yellow
LT = Light
DRK = Dark

ELECTRICAL

2

B



BATTERY CHARGING AND STARTING SYSTEMS

Table of Contents

Specifications

Starter Draw (No Load)	25 Amperes
Starter Draw (Under Load)	165 Amperes
Starter Brush Minimum-Length	0.25 in. (65.4mm)
Battery Rating	630 Marine Cranking Amperes (MCA) 490 Cold Cranking Amperes (CCA)
Alternator Output @ 750 RPM @ 2000 RPM	 30 Amperes 60 Amperes
Alternator Brush Length Standard Exposed Minimum Exposed	 0.413 in. (10.5mm) 0.059 in. (1.5mm)
Voltage Regulator Draw Ignition Key in the OFF Position Ignition Key in the ON Position	 0.15 Milliamperes 30.0 Milliamperes

NOTE: *Due to the fact that the voltage regulator draws 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.*

Alternator Torque Specifications

Fastener	Torque
End Frame Bolts and Nuts	39.5 lb. in. (4.5 N·m)
Pulley Nut	50 lb. ft. (68.0 N·m)
Regulator Screws	17 lb. in. (1.9 N·m)
Rectifier Screws	17 lb. in. (1.9 N·m)
End Cover Screws	23 lb. in. (2.6 N·m)
Terminal Insulator Nut	36 lb. in. (4.1 N·m)
Tension Adjustment Bolt	40 lb. ft. (54.0 N·m)
Pivot Bolt	40 lb. ft. (54.0 N·m)
Belt Deflection	1/2 in. (12.7mm) under a 22 lb. ft. (30 0 N·m) side load

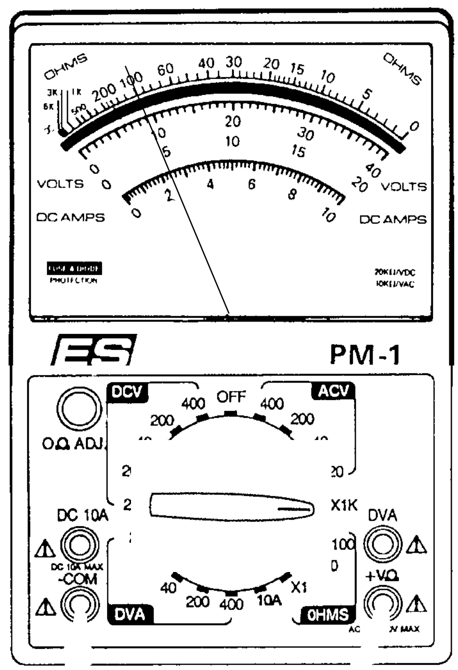
Replacement Parts

⚠ 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.

Special Tools

Multi-Meter DVA Tester 91-99750



Hydrometer (obtain locally)

Ammeter (obtain locally)

Belt Tension Tool (obtain locally)

Battery

Precautions

WARNING

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

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

The following precautions should be observed to prevent an explosion.

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

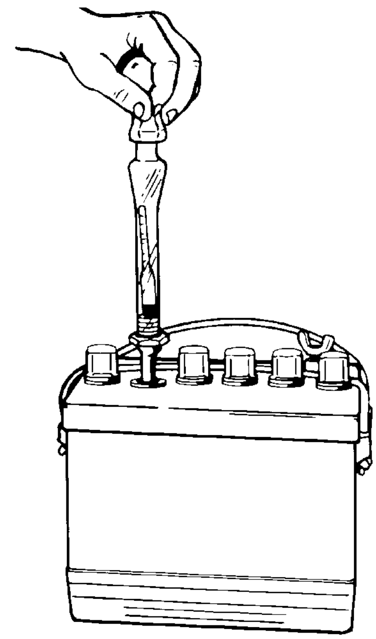
Specific Gravity Readings

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

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

When using a hydrometer, observe the following points:

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



22532

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

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

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

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

Specific Gravity Cell Comparison Test

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

Electrolyte Level

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

⚠ CAUTION

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

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

Charging a Discharged Battery

The following basic rules apply to any battery charging situation:

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

Winter Storage of Batteries

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

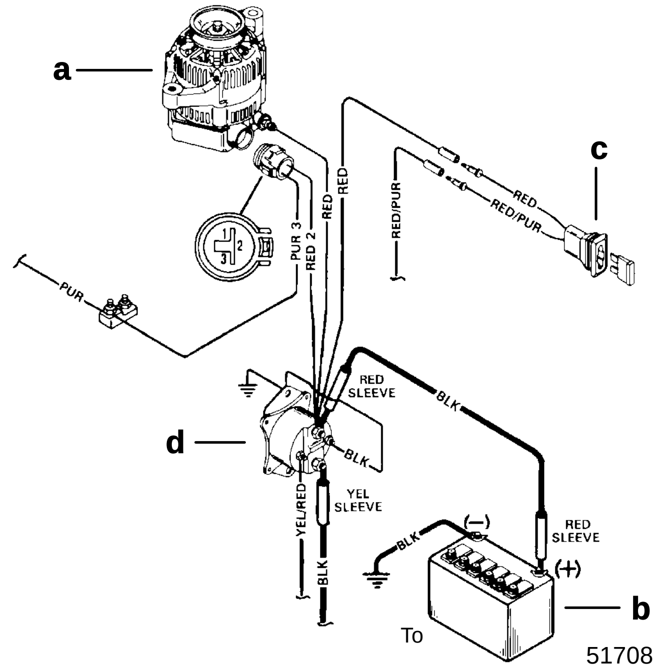
1. Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface by running water over top of battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure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

⚠ WARNING

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

System Components

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



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

Precautions

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

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed.
3. Never disconnect the alternator output lead, regulator harness or battery cables when the alternator is being driven by the engine.
4. Always remove NEGATIVE (–) battery cable from battery before working on alternator system.
5. When installing battery, be sure to connect the NEGATIVE (–) (GROUNDED) battery cable to NEGATIVE (–) battery terminal and the POSITIVE (+) battery cable to POSITIVE (+) battery terminal.
6. When using a charger or booster battery, connect it in parallel with existing battery (POSITIVE to POSITIVE; NEGATIVE to NEGATIVE).

Alternator Description

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

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

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

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

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

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

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

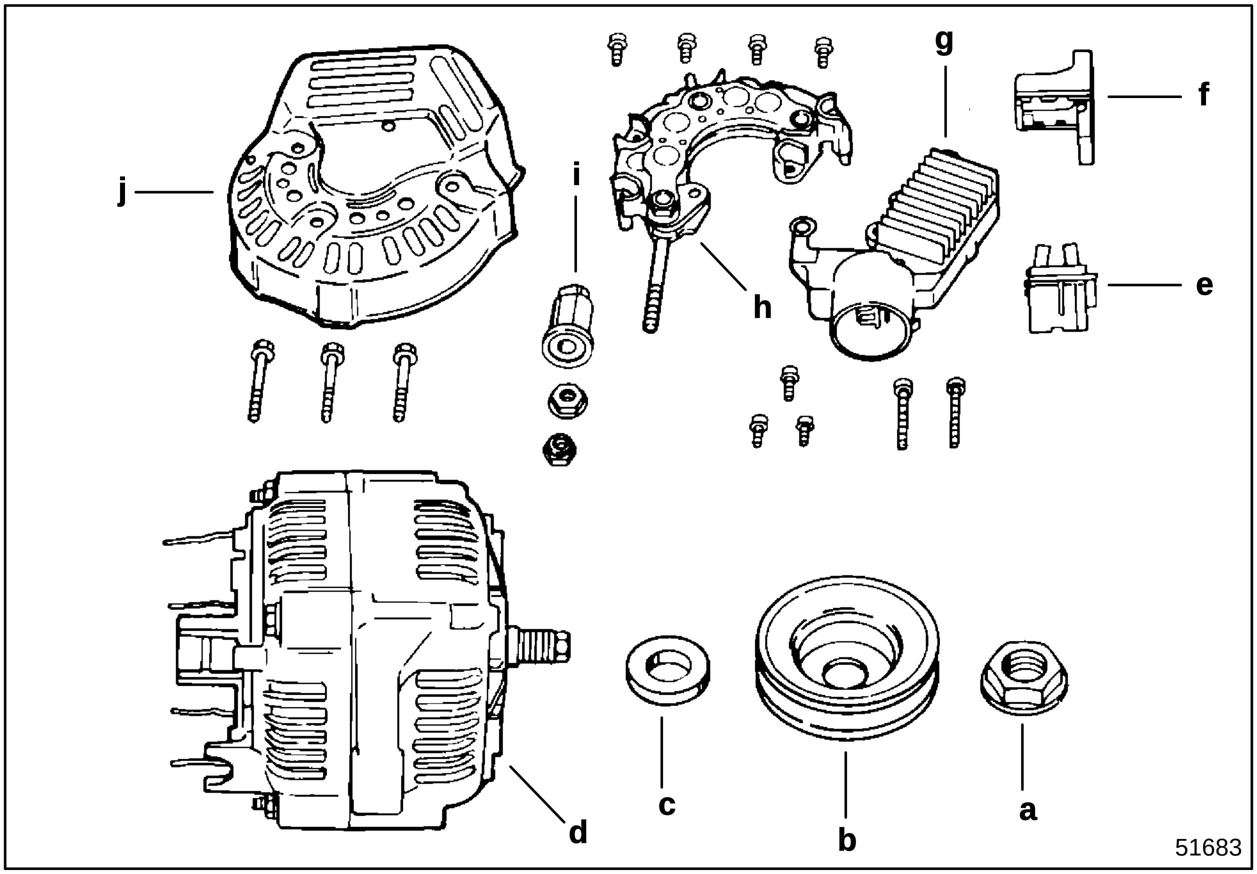
Diagnosis of Alternator System on Engine

1. If problem is an undercharged battery, verify condition has not been caused by excessive accessory current draw or by accessories which have accidentally left on.
2. Check physical condition and state of charge of battery. Battery must be at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.

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

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

Alternator Assembly



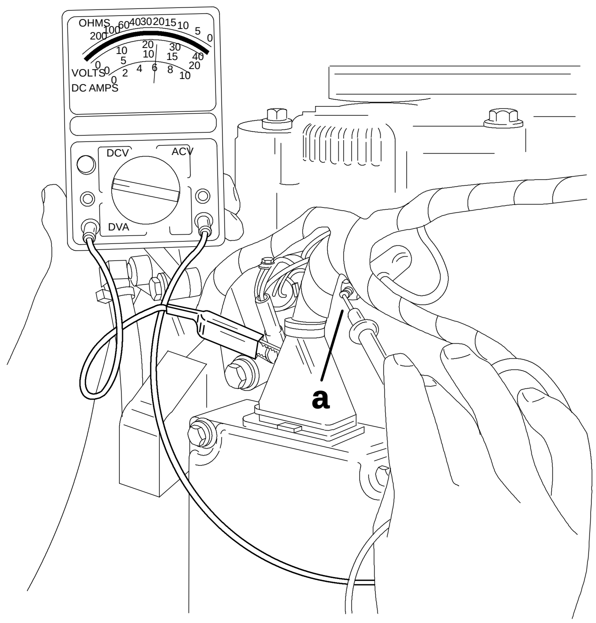
a - Pulley Nut
b - Pulley
c - Spacer
d - Frame and Rotor Assembly
e - Brush Holder
f - Brush Cover
g - Regulator
h - Rectifier (Diode Assembly)
i - Insulator
j - End Cover

Alternator System Circuitry Test

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

OUTPUT CIRCUIT

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



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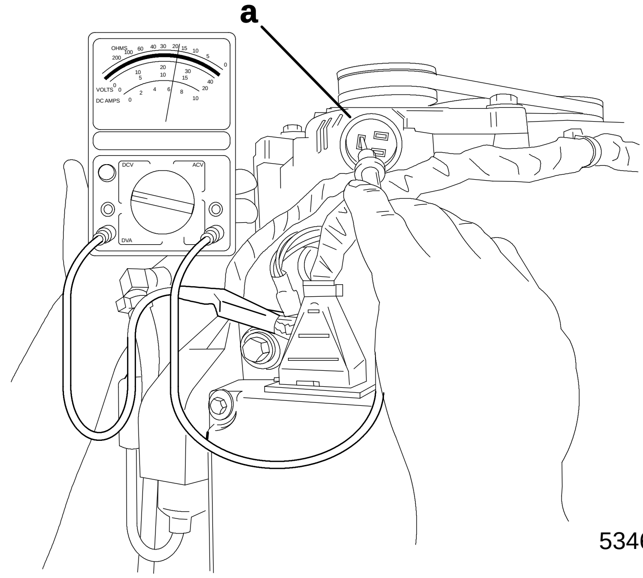
a - Output Terminal

SENSING CIRCUIT

1. Unplug RED and PURPLE lead connector from alternator.
2. Connect POSITIVE (+) voltmeter lead to RED lead and NEGATIVE (–) voltmeter lead to ground.
3. Voltmeter should indicate battery voltage. If correct voltage is not present, check sensing circuit (RED lead) for loose or dirty connections or damaged wiring.

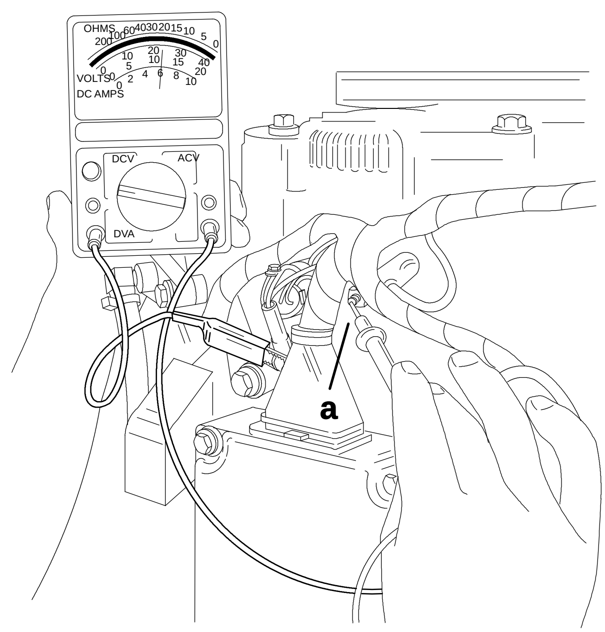


53460

a - Sense Lead (RED)

VOLTAGE OUTPUT

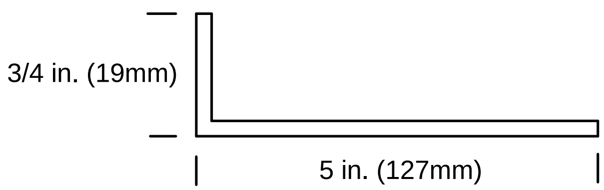
1. Using a 0-20 volt DC voltmeter, connect POSITIVE (+) lead of voltmeter to TERMINAL B of alternator and NEGATIVE (–) lead of voltmeter to engine ground.



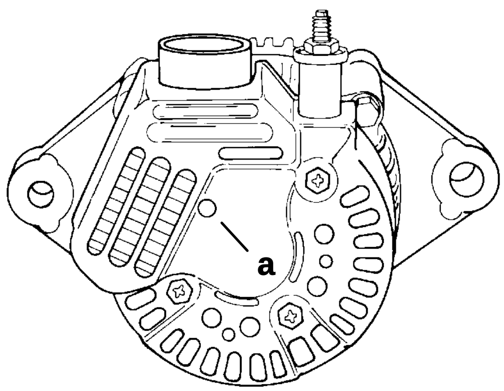
53465

a - Terminal B

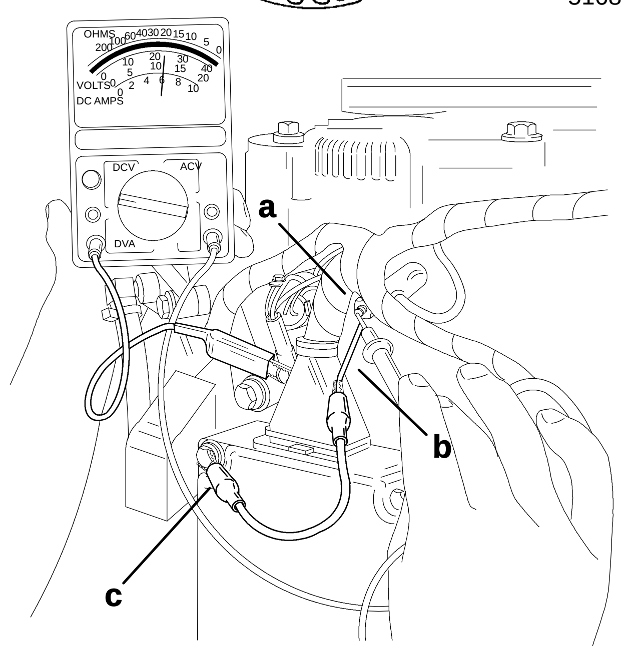
2. Start engine and allow to warm up. Increase engine RPM from idle to 2000. Normal voltage output should be 13.5 – 15.1 volts. If voltage reading is greater than normal, replace voltage regulator.
3. If voltage reading is less than normal, fabricate a tool from a piece of stiff wire to the following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



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



51683



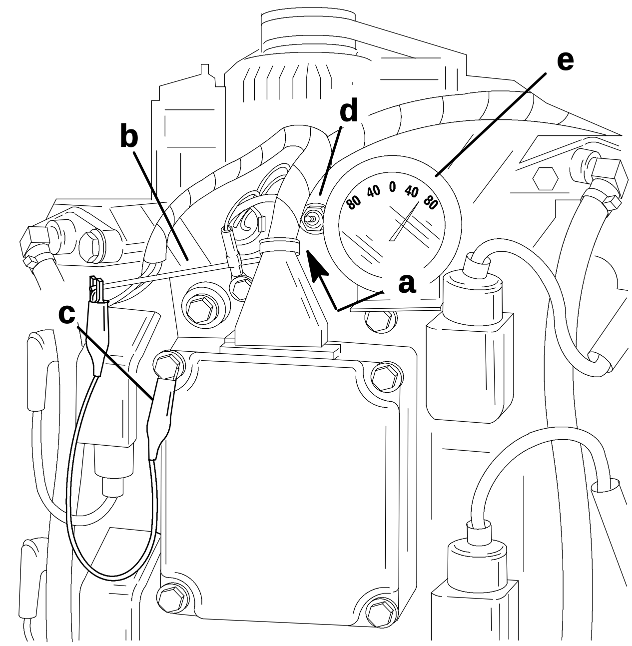
53561

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

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

CURRENT OUTPUT

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



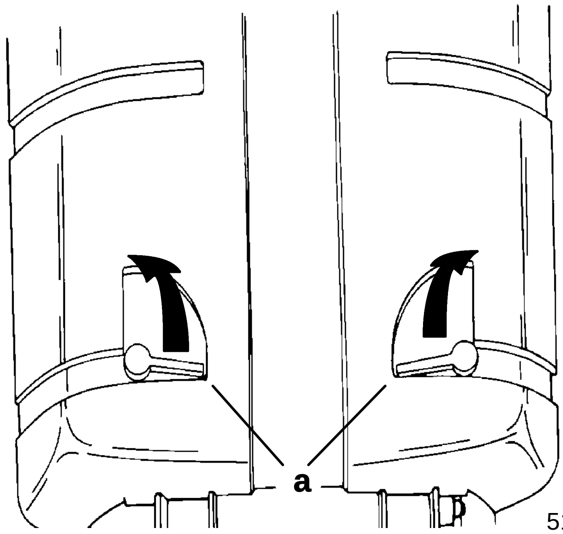
53457

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

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

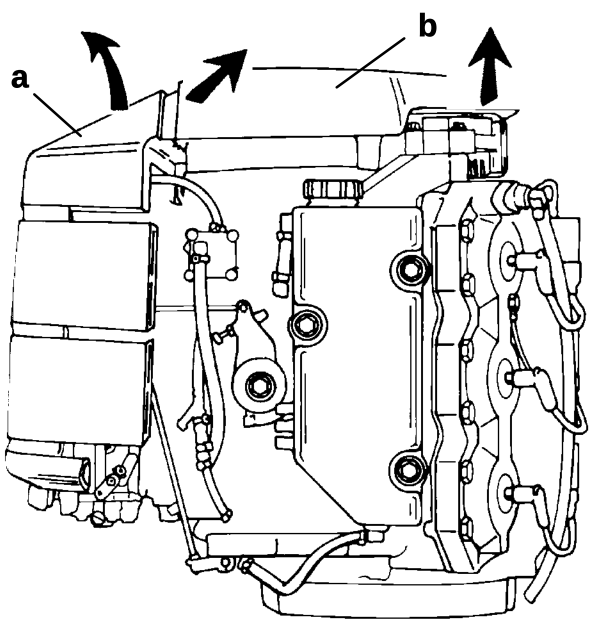
REMOVAL

1. Remove top cowling.
2. Remove flywheel cover by sliding back and lifting cover in a simultaneous motion. Remove carburetor air attenuator by releasing two latches at bottom of attenuator.



51696

a - Latches

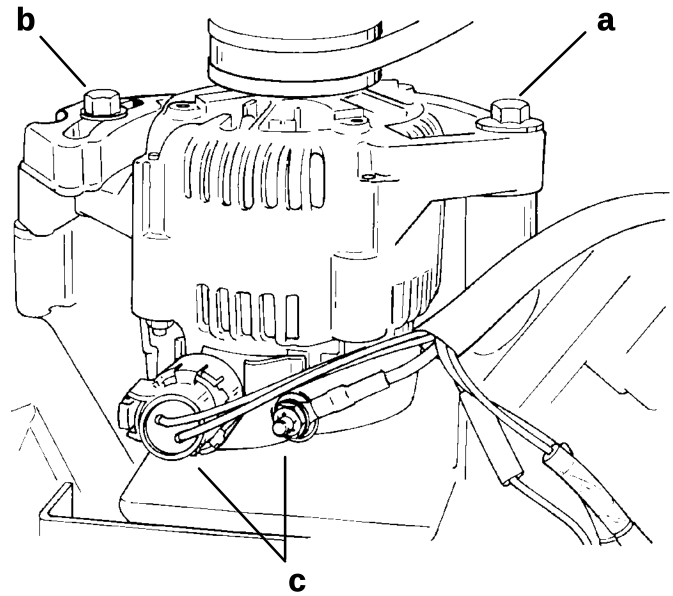


51532

a - Attenuator
b - Flywheel Cover

NOTE: *To reinstall attenuator and flywheel cover, install and latch attenuator first, then install flywheel cover.*

3. Disconnect battery cables from battery.
4. Disconnect wiring harness from alternator.
5. Remove pivot bolt and tension bolt.

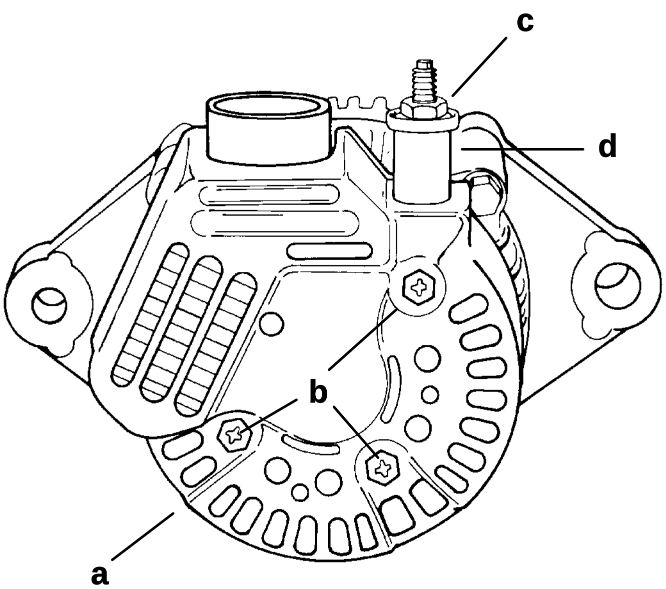


51684

a - Pivot Bolt
b - Tension Bolt
c - Harness

DISASSEMBLY AND TEST

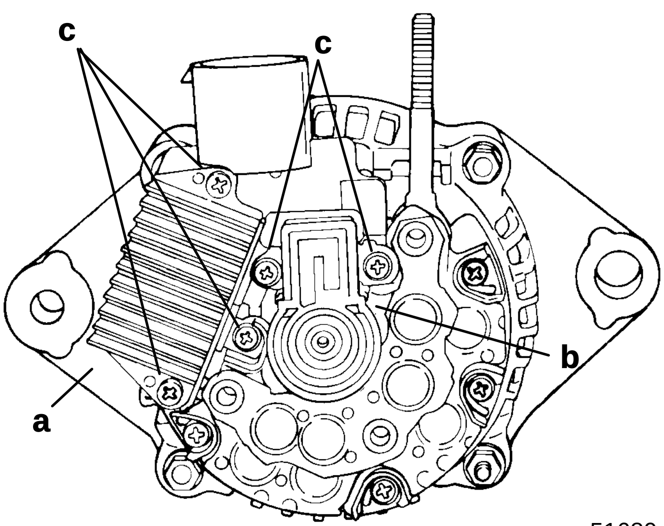
1. Remove 3 screws and nut securing end cover and remove insulator and cover.



51683

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

2. Remove 5 screws securing regulator and brush assembly.



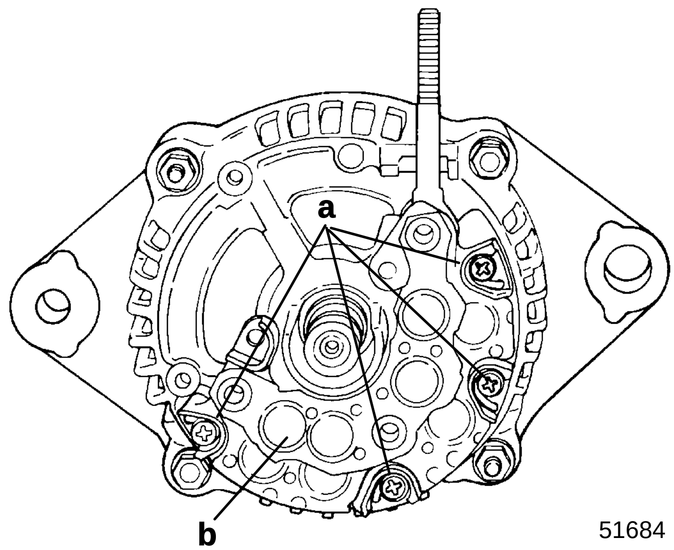
51680

a - Regulator
b - Brush Assembly
c - Screws

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

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

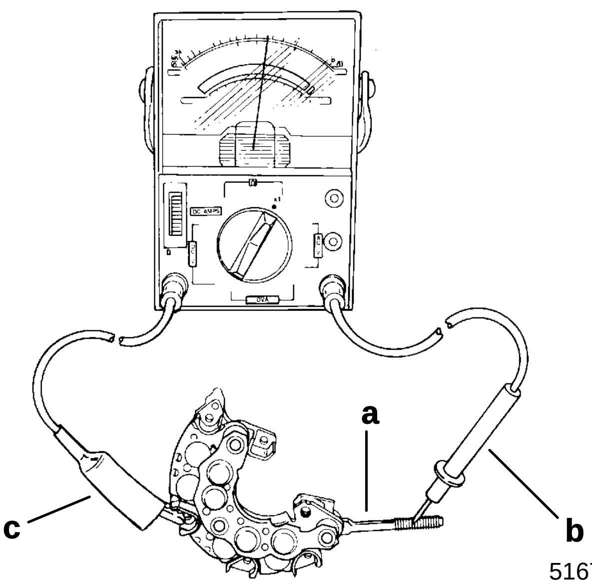
3. Remove 4 screws securing rectifier (diode assembly) to alternator.



51684

a - Screws
b - Rectifier (Diode Assembly)

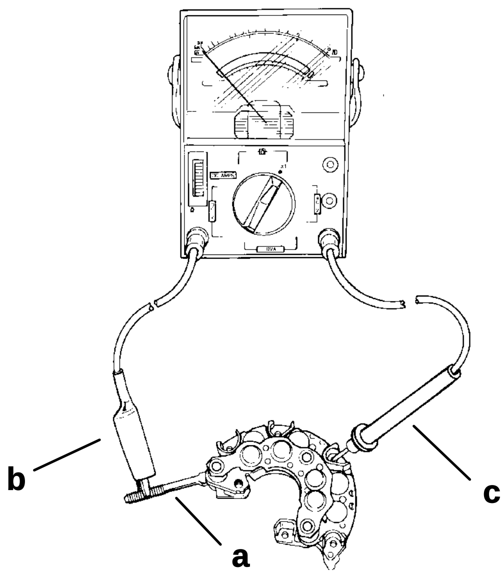
NOTE: *To test rectifier assembly, touch POSITIVE (+) lead from ohmmeter to POSITIVE stud and NEGATIVE (–) lead from ohmmeter to each diode terminal. The ohmmeter should indicate continuity.*



51679

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

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



51679

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

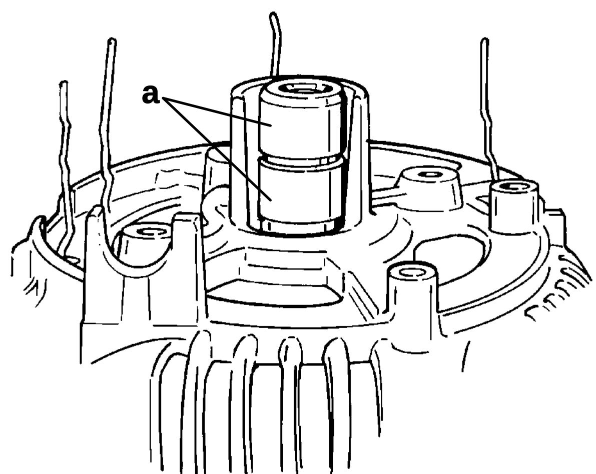
IMPORTANT: Depending on the polarity of the ohmmeter, reversed readings may be obtained – I.E. – CONTINUITY is observed when the NEGATIVE lead touches the POSITIVE stud and NO CONTINUITY is observed when the POSITIVE lead touches the POSITIVE stud.

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

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

ROTOR TEST

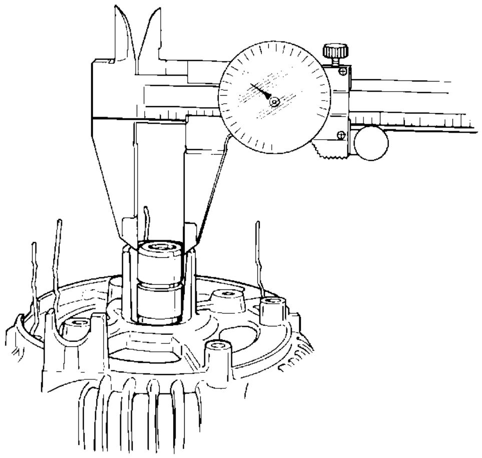
1. Inspect slip ring surface for roughness, abnormal wear and/or burning. If such conditions exist, rotor is not considered serviceable and alternator should be replaced.



51684

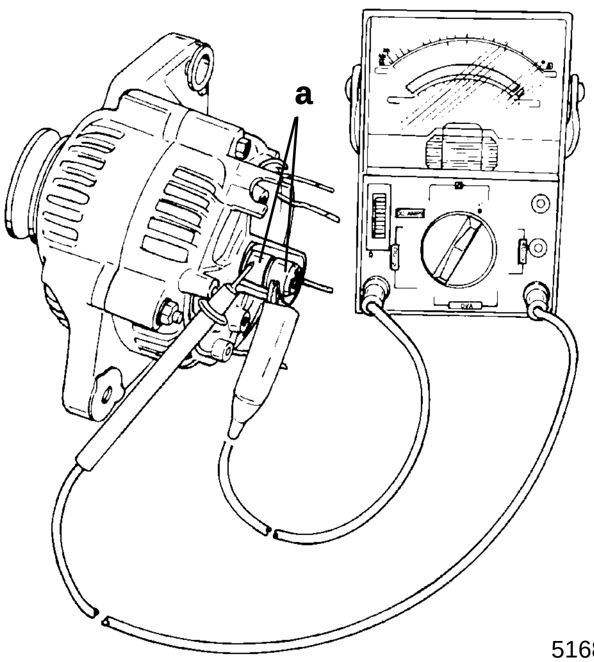
a - Slip Rings

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



51680

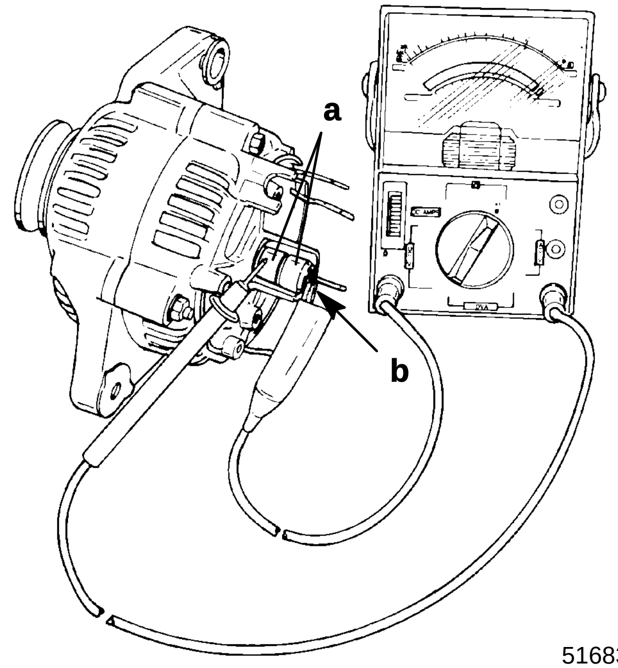
3. Inspect rotor for an open circuit. Using an ohmmeter, check for continuity between slip rings. Resistance should not exceed 3 ohms. If no continuity exists, rotor is defective.



51682

a - Slip Rings

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

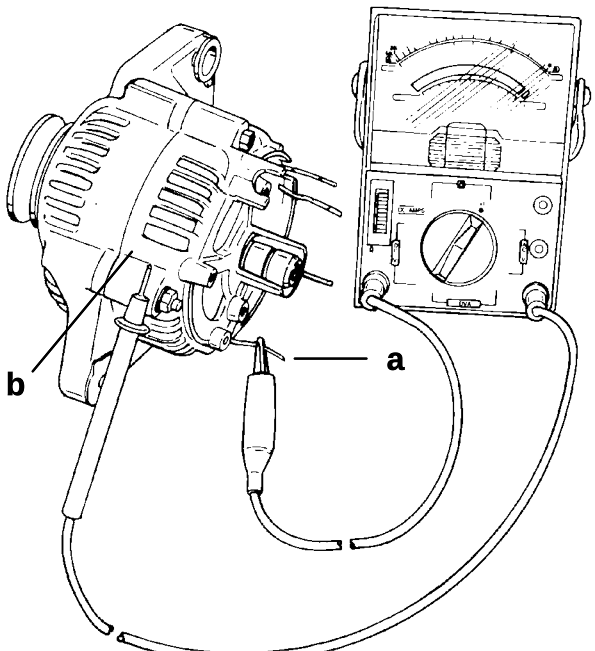


51683

a - Slip Rings
b - Rotor Shaft

STATOR TEST

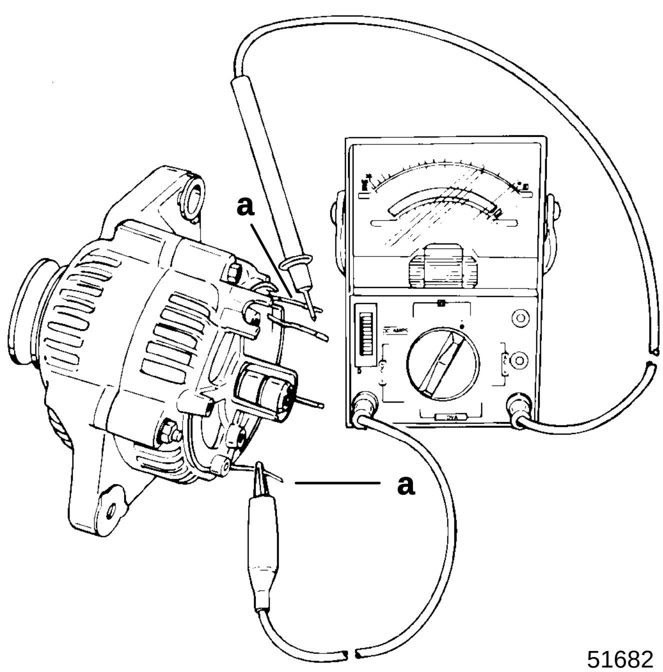
1. With rectifier removed, use an ohmmeter to check for a short circuit between each stator lead and the stator frame. If CONTINUITY exists, stator is defective.



51682

a - Stator Leads
b - Frame

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

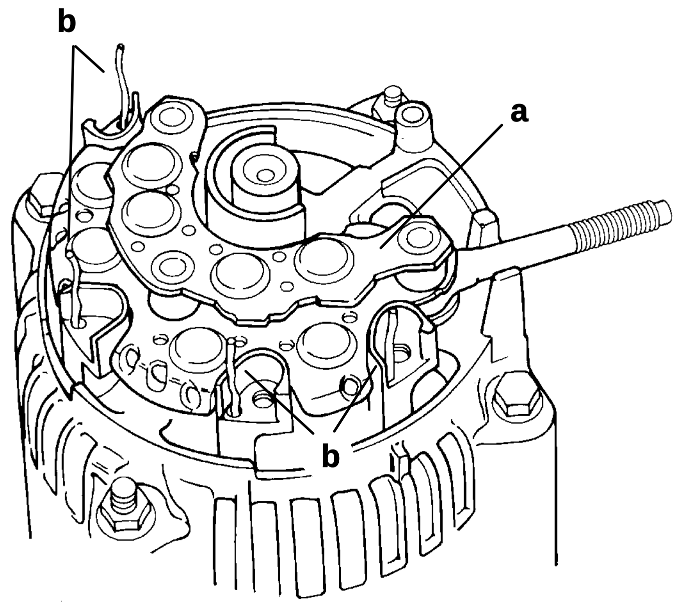


51682

a - Stator Leads

REASSEMBLY

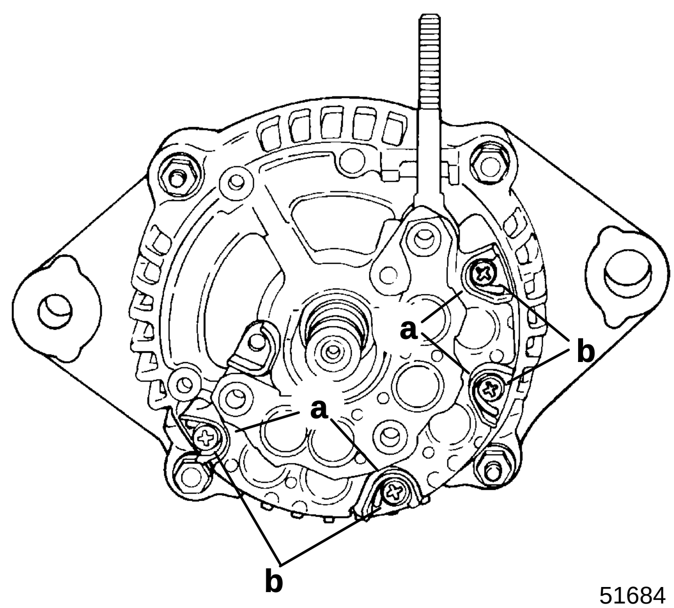
1. Position rectifier assembly over stator leads.



51683

a - Rectifier Assembly
b - Stator Leads

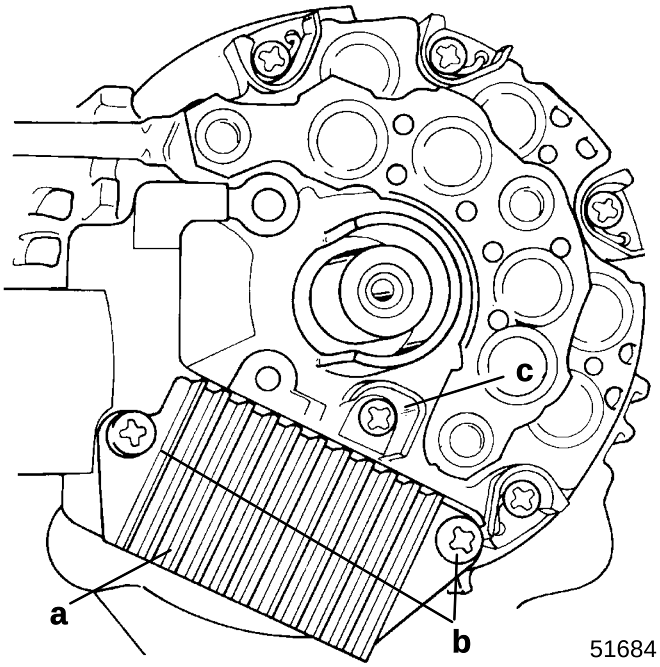
2. Form stator leads in a clockwise loop and secure leads to rectifier with 4 screws. Torque screws to 17 lb. in. (1.9 N·m).



51684

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

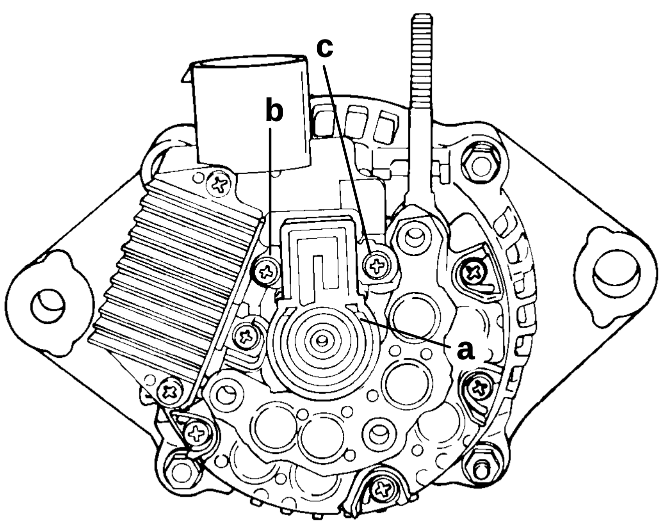
3. Secure regulator to alternator with 2 screws [1 in. (25.4mm) long]; 1 screw [0.25 in. (6.4mm) long] and lockwashers. DO NOT tighten screws at this time.



51684

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

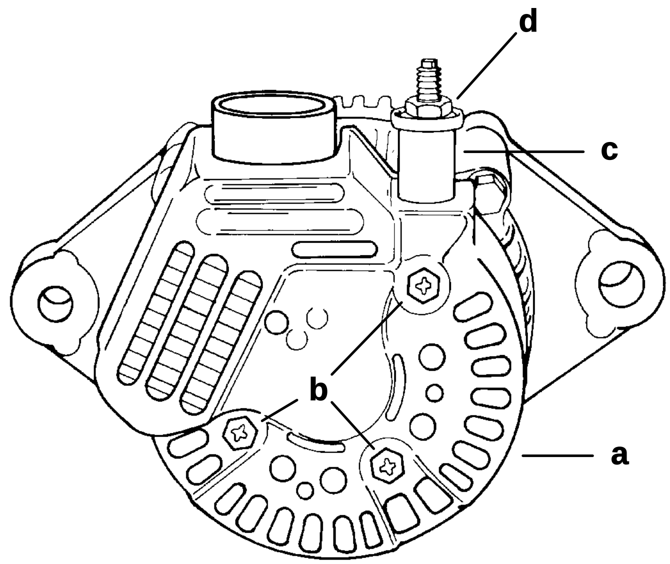
4. Secure brush assembly with 2 screws – [0.25 in. (6.4mm) long] and [0.312 in. (8.0mm) long].



51680

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

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

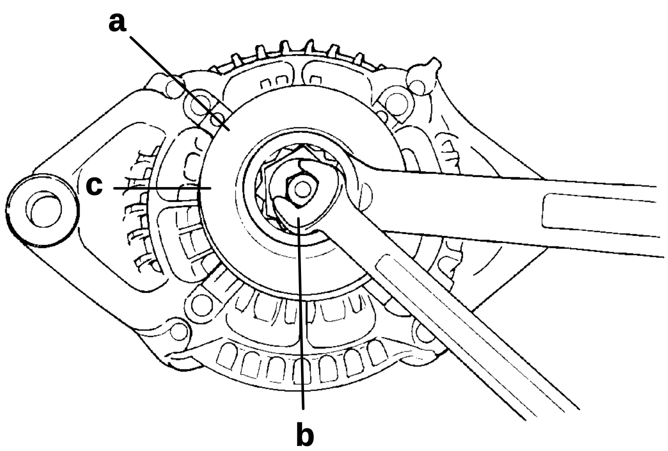


51683

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

PULLEY

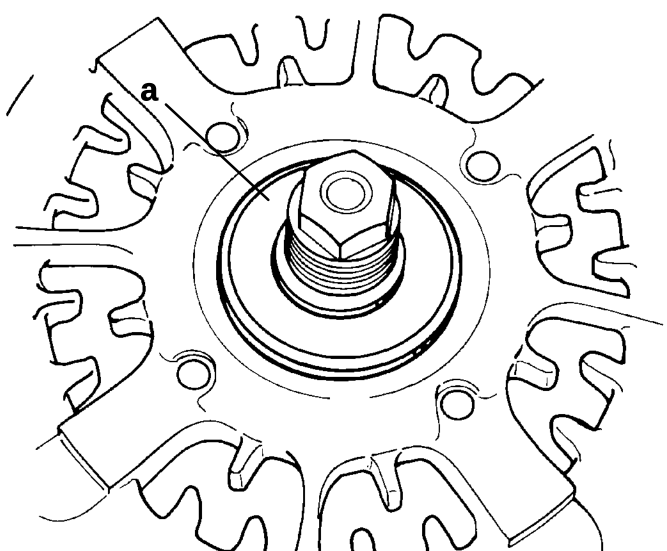
1. While holding rotor shaft, remove pulley nut.



51679

a - Pulley
b - Rotor Shaft
c - Nut

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



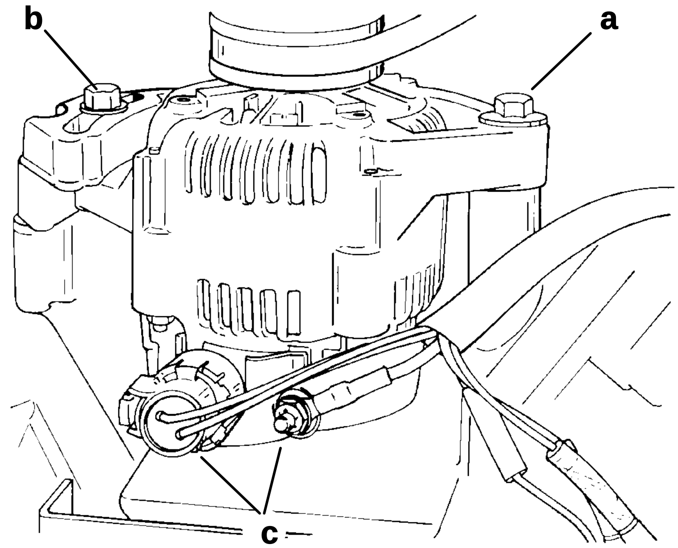
51683

a - Spacer

3. Torque pulley nut to 50 lb. ft. (68.0 N·m).

Installation

1. Secure alternator to engine block with pivot bolt and tension bolt. DO NOT tighten bolts at this time.
2. Install alternator belt in V-groove of flywheel and alternator pulley.
3. Reconnect electrical harness to alternator.



51684

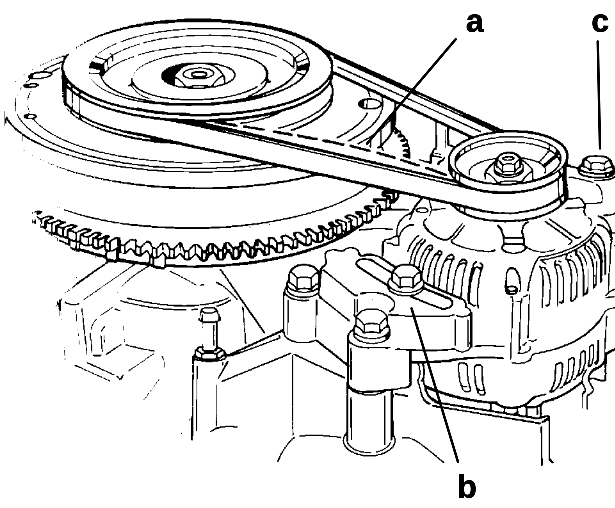
a - Pivot Bolt
b - Tension Bolt
c - Harness

4. Move alternator away from flywheel to increase tension. Tighten tension adjustment bolt [Torque to 40 lb. ft. (54.0 N·m)] and pivot bolt [Torque to 40 lb. ft. (54.0 N·m)].

Alternator Belt Tension Adjustment

1. Belt tension is correct if belt deflects 1/2 in. (12.7mm) from center under a 22 lb. ft. (30.0 N·m) side load.
2. If belt tension is not correct, loosen pivot bolt and tension adjustment bolt. Move alternator away from flywheel to increase tension.
3. Tighten tension adjustment bolt [Torque to 40 lb. ft. (54.0 N·m)] and pivot bolt [Torque to 40 lb. ft. (54.0 N·m)].

NOTE: *A belt tensioning tool (obtain locally) may also be used to adjust belt tension. Adjust belt tension to 80 lb. (356.0 N).*



a - Deflection [1/2 in. (12.7mm) under 22 lb. ft. (30.0 N·m) side load]
b - Tension Bolt [Torque to 40 lb. ft. (54.0 N·m)]
c - Pivot Pivot Bolt [Torque to 40 lb. ft. (54.0 N·m)]

Starter System

STARTER MOTOR AMPERES DRAW

STARTER MOTOR PART NO.	NO LOAD AMP. DRAW	NORMAL AMP. DRAW
50-818445-1	25 AMPS	165 AMPS

STARTER SYSTEM COMPONENTS

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

DESCRIPTION

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

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

⚠ CAUTION

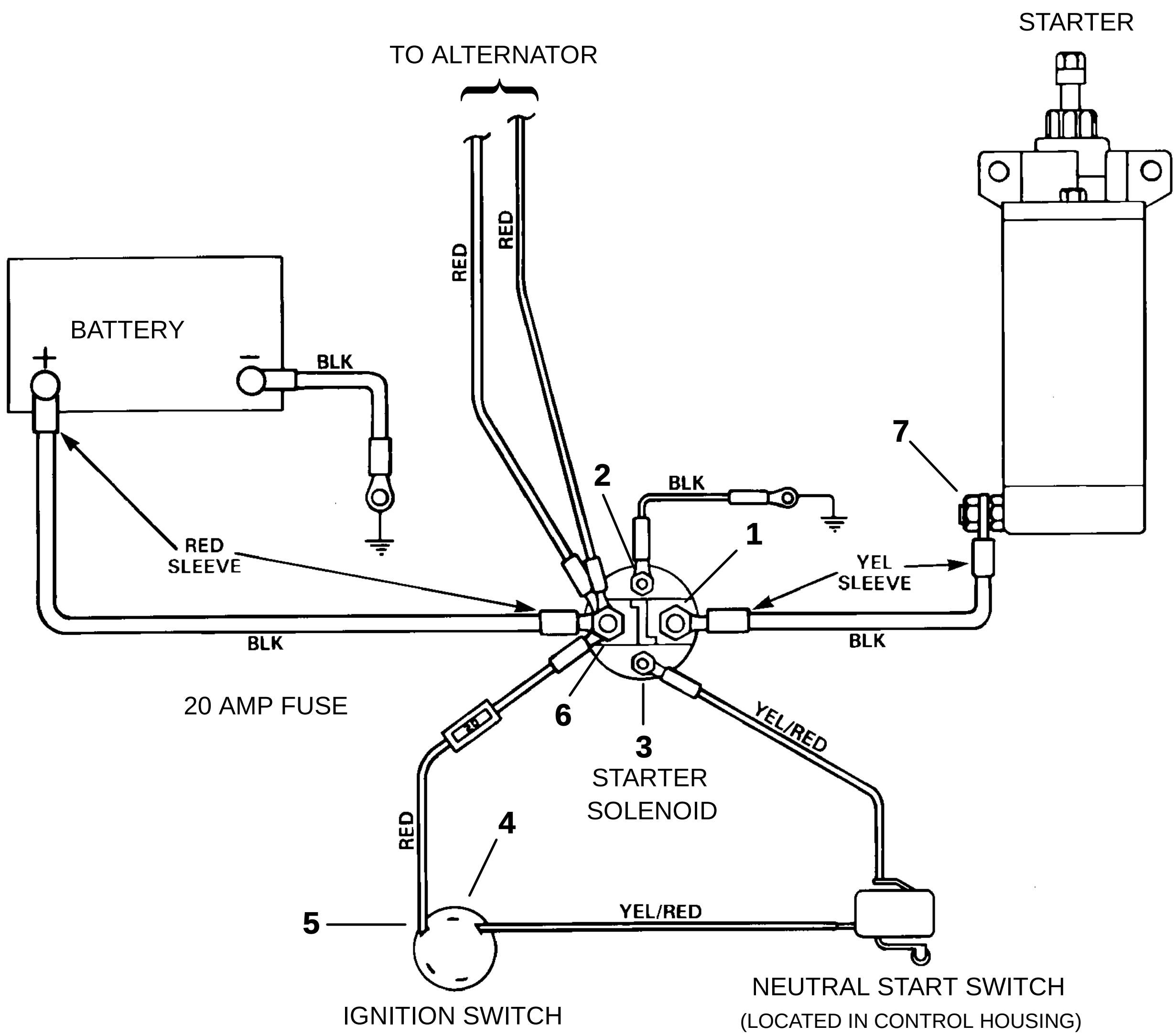
The starter motor may be damaged if operated continuously. DO NOT operate continuously for more than 30 seconds. Allow a 2 minute cooling period between starting attempts.

TROUBLESHOOTING THE STARTER CIRCUIT

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

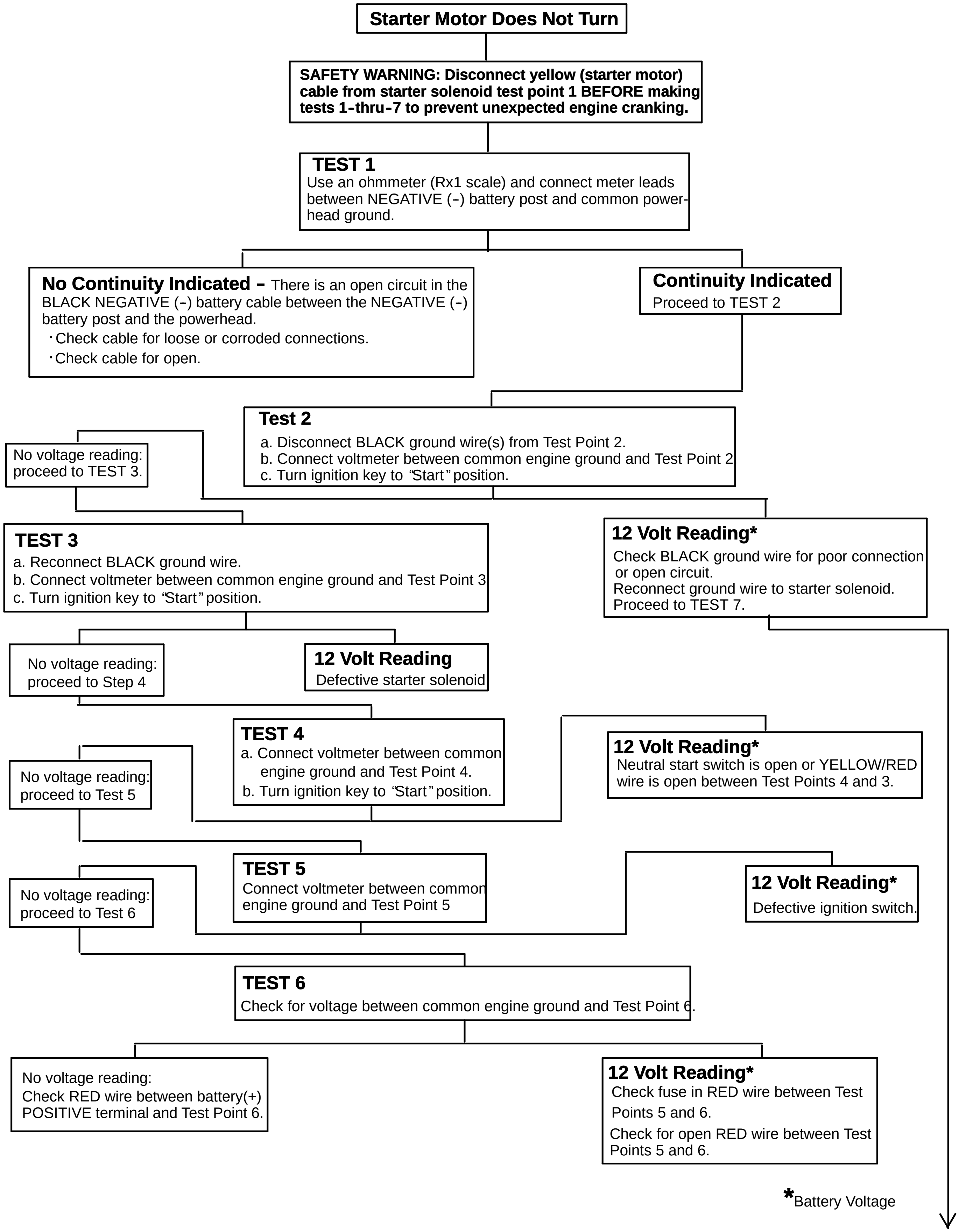
1. Confirm that battery is fully charged.
2. Check that control lever is in "NEUTRAL" position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check 20 amp fuse.

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



Starter Circuit

Starter Circuit Troubleshooting Flow Chart



TEST 7
a. Connect voltmeter between common engine and Test Point1.
b. Turn ignition key to "Start" position.

No voltage reading:
Defective starter solenoid

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

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

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

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

*Battery Voltage

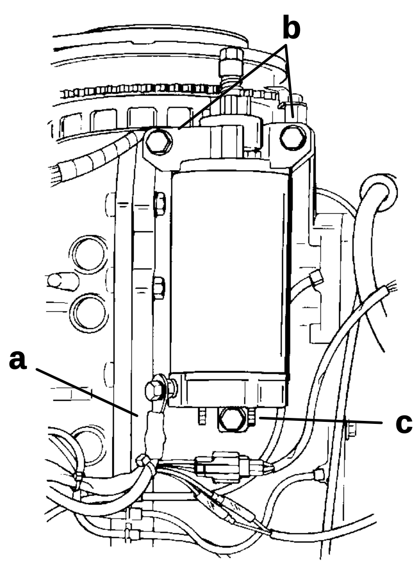
Starter Removal and Installation

REMOVAL

⚠ CAUTION

Disconnect battery leads from battery before removing starter.

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

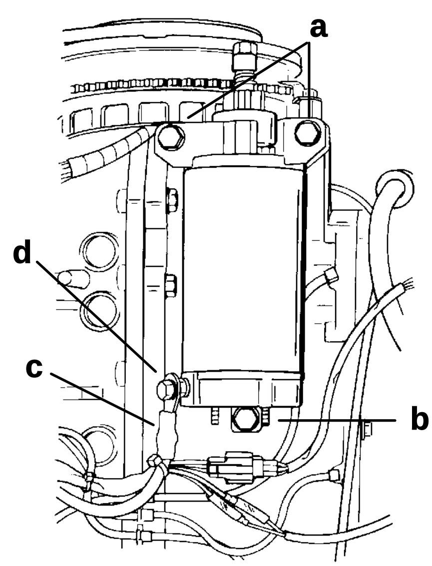


52135

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

INSTALLATION

1. Secure starter to engine with 3 bolts. Use Left top bolt to attach BLACK NEGATIVE (–) battery cable.
   Torque top attaching bolts to 23 lb. ft. (31.0 N·m).
   Torque bottom attaching bolt to 21 lb. ft. (29.0 N·m).
2. Secure BLACK cable (with YELLOW sleeve) to POSITIVE (+) terminal on starter. Torque nut to 60 lb. in. (6.8 N·m).

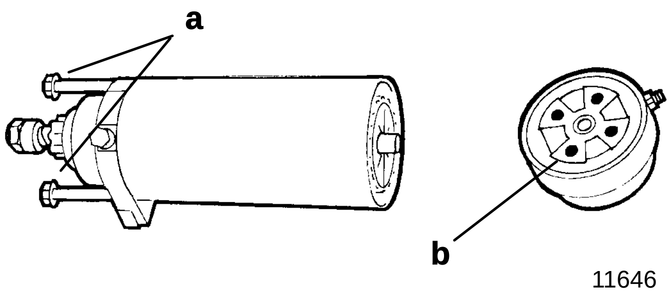


52135

a - Top Bolts [Torque to 23 lb. ft. (31.0 N·m)]
b - Bottom Bolt [Torque to 21 lb. ft. (29.0 N·m)]
c - BLACK Cable (with YELLOW sleeve)
d - Nut [Torque to 60 lb. in. (6.8 N·m)]

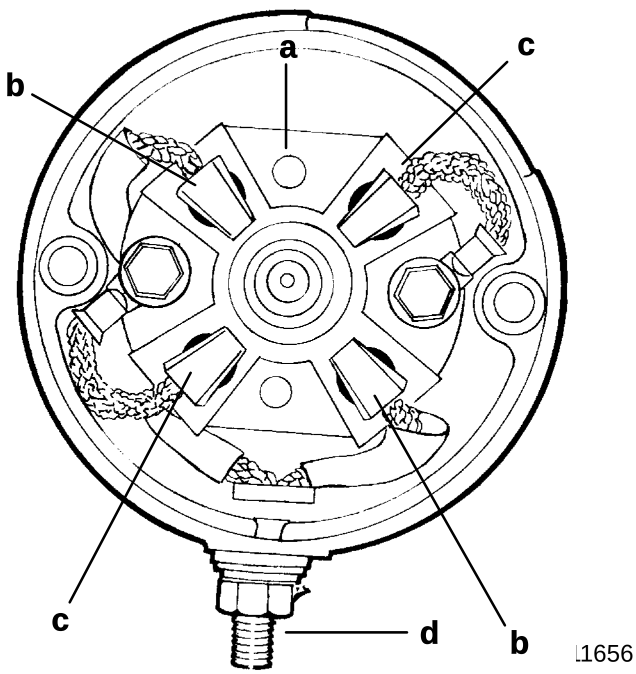
DISASSEMBLY

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



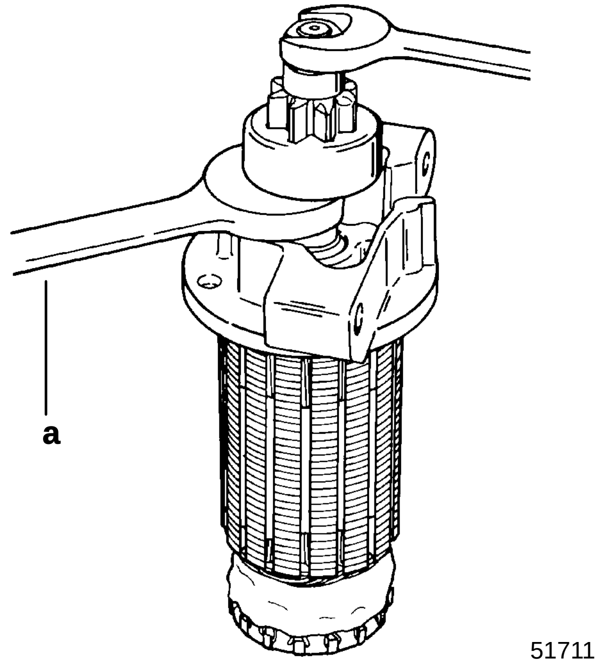
a - Through Bolts
b - Commutator End Cap

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

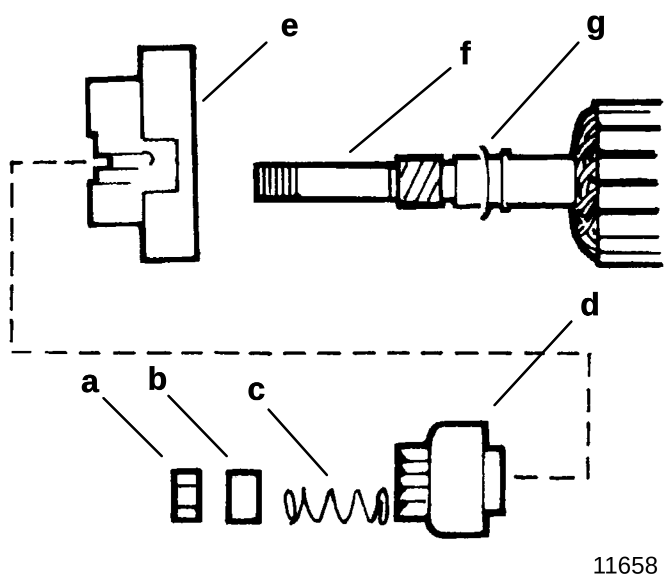


a - Brush Holder
b - Positive Brushes
c - Negative Brushes
d - Positive Terminal

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



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



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.

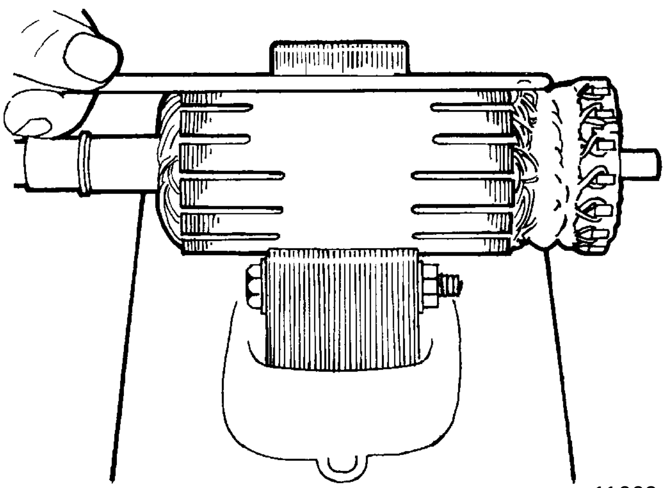
   a. Resurface the commutator and undercut the insulation between the commutator bars 1/32 in. (0.8mm) to the full width of the insulation and so that the undercut is flat.
   b. Clean the commutator slots after undercutting.
   c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then 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

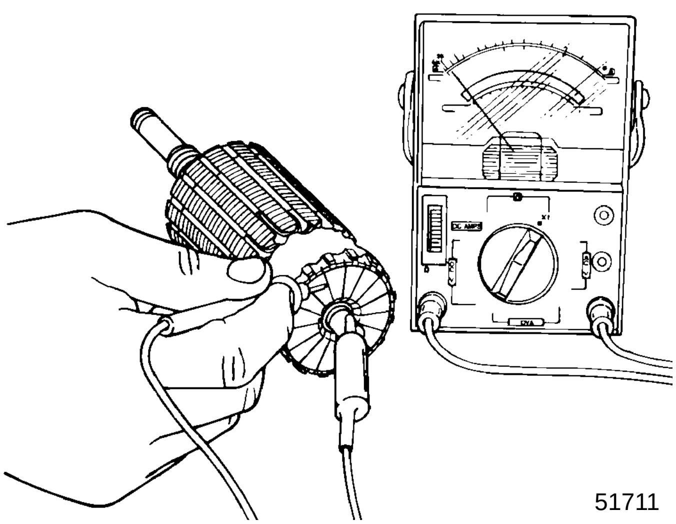
Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



11669

Armature Test for Ground

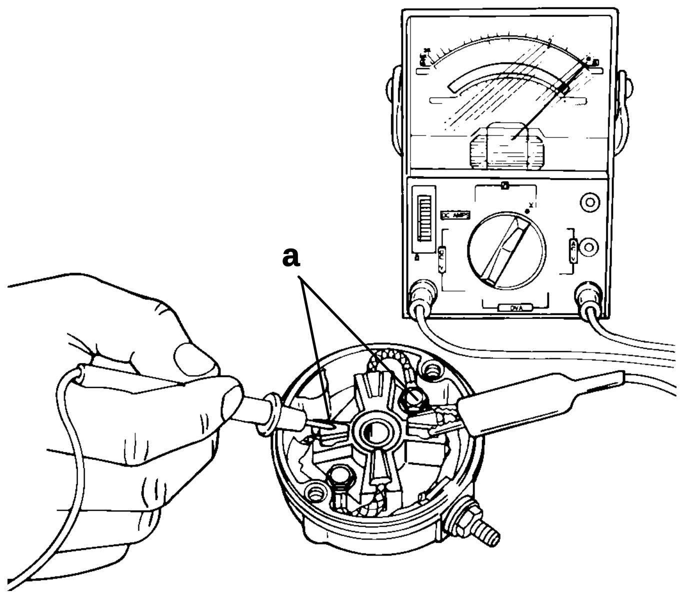
1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.
2. If meter indicates continuity, armature is grounded and must be replaced.



51711

Checking Positive Brushes and Terminal

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

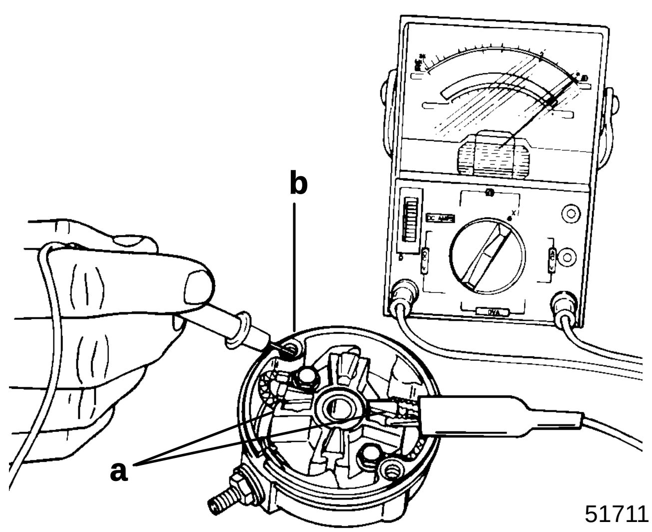


51711

a - POSITIVE (+) Brushes

Testing Negative Brushes for Ground

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



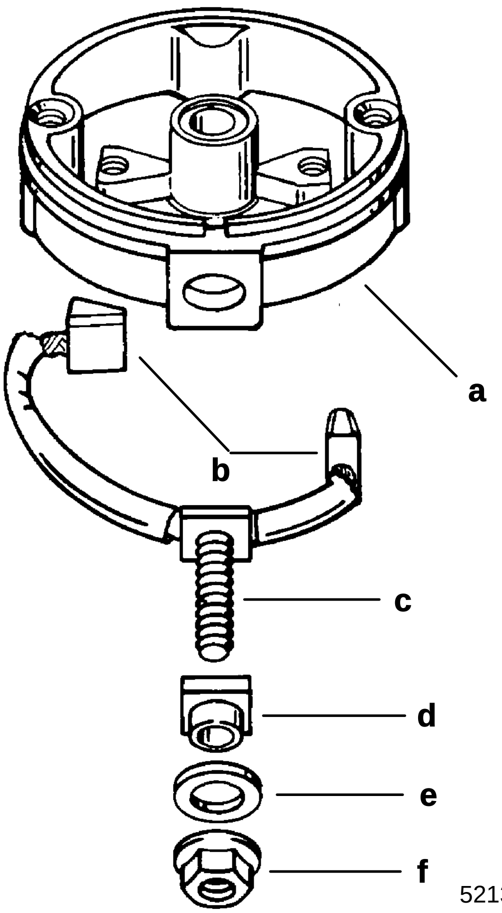
51711

a - NEGATIVE (–) Brushes
b - End Cap

STARTER REASSEMBLY

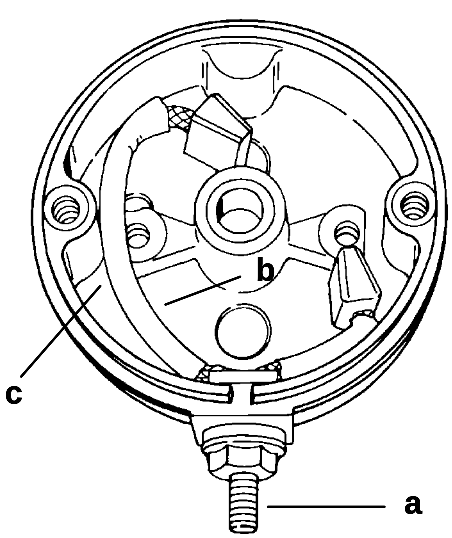
1. If brushes were removed, replace as follows:

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



52131

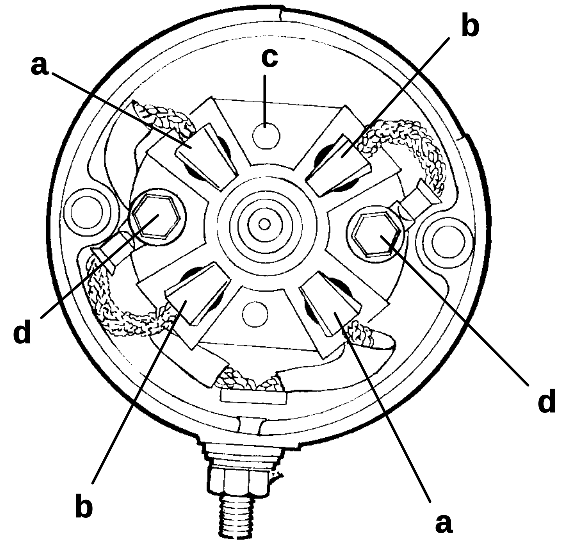
a - End Cap
b - POSITIVE Brushes
c - POSITIVE Terminal
d - Insulating Block
e - Insulating Washer
f - Hex Nut



51713

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

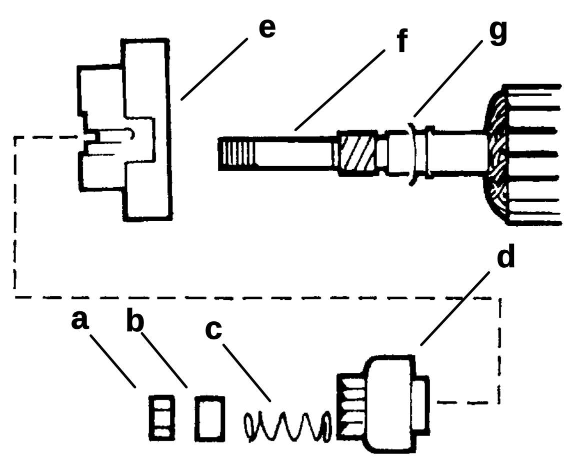
   b. Install NEGATIVE brushes (along with brush holder).



11656

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

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



11658

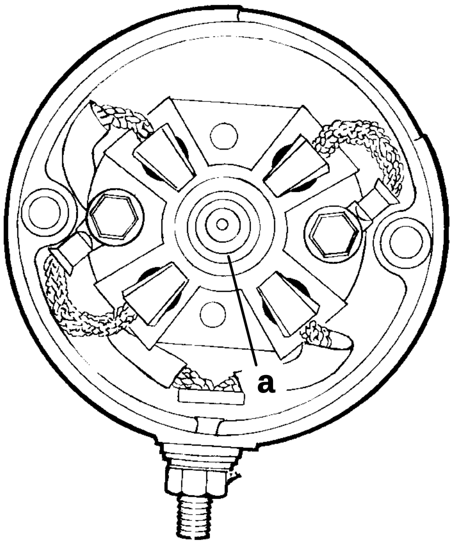
a - Locknut
b - Spacer
c - Spring
d - Drive Assembly
e - Drive End Cap
f - Armature Shaft
g - Washer

3. Lubricate helix threads on armature shaft with a drop of SAE 10W oil.

4. Lubricate bushing in drive end plate with a drop of SAE 10W oil.

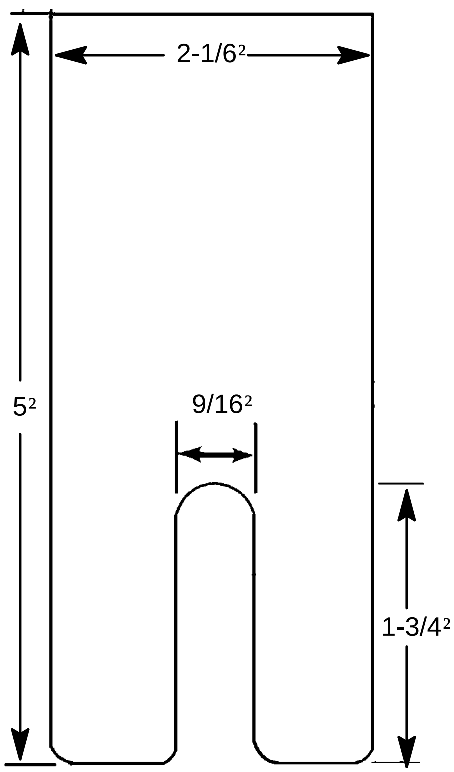
5. Position armature into starter frame.

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

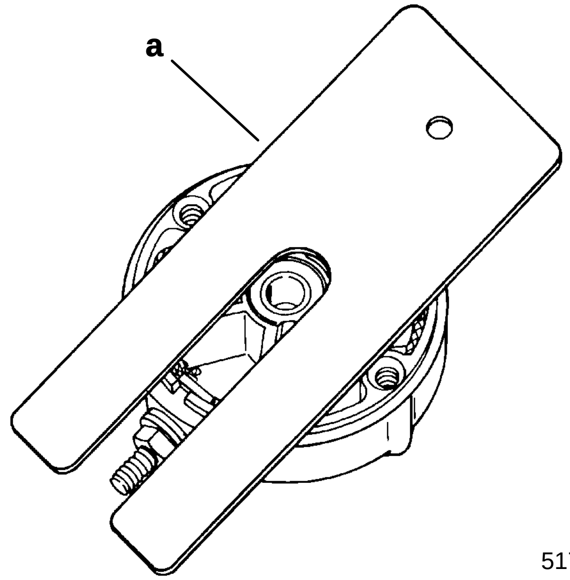


a - Bushing (DO NOT Over Lubricate)

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



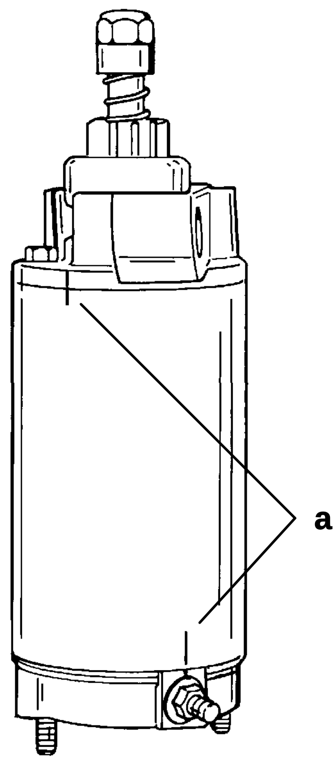
8. Place springs and brushes into brush holder and hold in place with brush retainer tool.



51713

a - Brush Retainer Tool

9. Install commutator end cap onto starter frame. Align marks on frame with alignment marks on end caps. Remove brush retainer tool. Install through bolts and torque to 70 lb. in. (7.9 N·m).

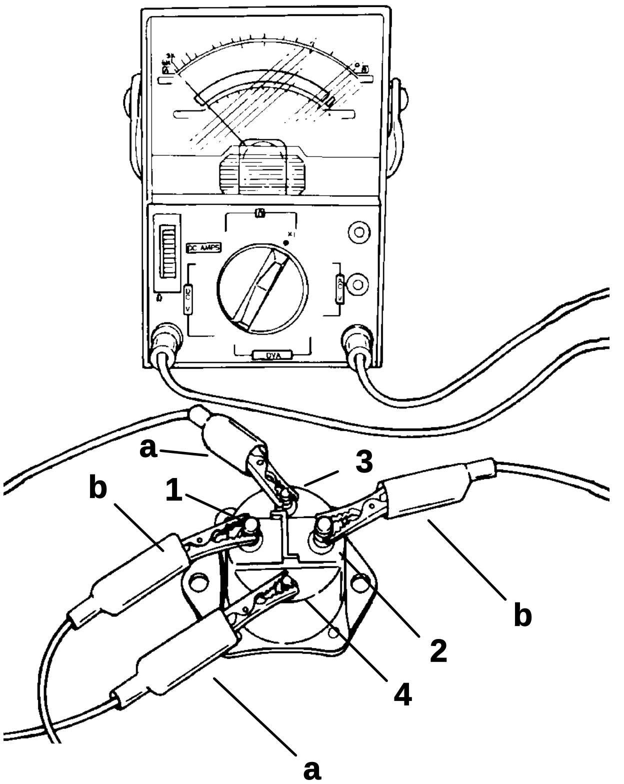


52130

a - Alignment Marks

STARTER SOLENOID TEST

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

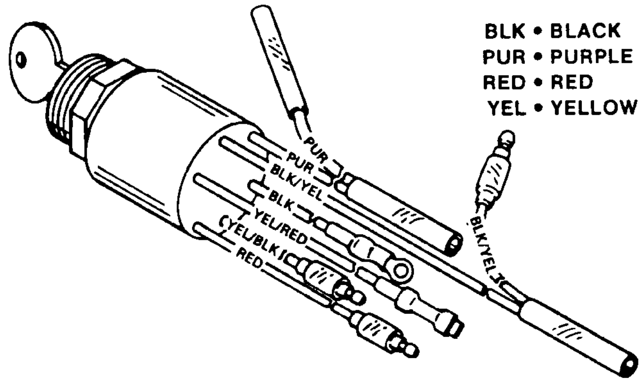


a - 12-VOLT Supply
b - VOA Leads

Commander 2000 Key Switch Test

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

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

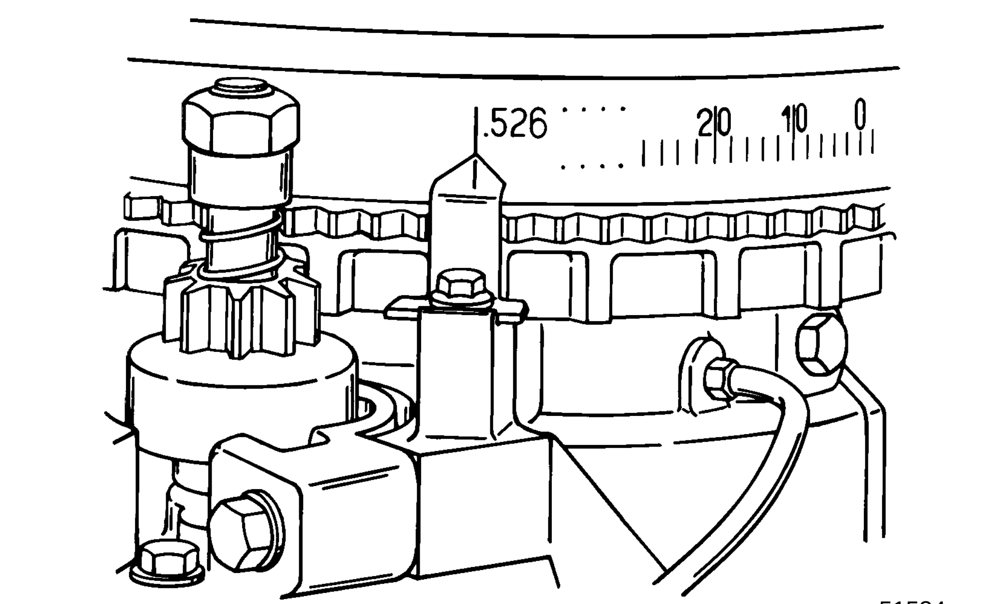


23894

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

ELECTRICAL

2
C



51534

TIMING, SYNCHRONIZING AND ADJUSTING

Table of Contents

Timing/Synchronizing/ Adjusting

Specifications

CARBURETOR MODELS

MODEL 3 LITRE WORK/225 CARBURETOR	
FULL THROTTLE RPM RANGE	5000 - 5500
IDLE RPM (IN FORWARD GEAR)	600 - 700
MAXIMUM TIMING: @ WIDE OPEN THROTTLE 1994 MODEL 225 1995 MODEL 3 LITRE WORK/225 1996/97 MODEL 3 LITRE WORK/225	 22° BTDC @ 5500 RPM (ECU - 821717) 25° - 27° BTDC @ 5500 RPM (ECU - 824866-1) 20° BTDC @ 5000 RPM 23° BTDC @ 5500 RPM 19° BTDC @ 5000 RPM 26° BTDC @ 5500 RPM
IDLE TIMING	4° - 9° ATDC
SPARK PLUG 1994/95/96 SPARK PLUG GAP	NGK - BPZ8H-N-10 0.040 in. (1.0mm)
SPARK PLUG 1997/98 SPARK PLUG GAP	CHAMPION QL77CC 0.035 in. (0.89mm)
FIRING ORDER	1-2-3-4-5-6
THROTTLE POSITION SENSOR @ IDLE @ W.O.T.	 0.950 ± 0.050 VOLTS 3.80 ± 0.10 VOLTS

Specifications

ELECTRONIC FUEL INJECTION MODELS

1995 MODEL 225 EFI	
FULL THROTTLE RPM RANGE	5000 - 5800
IDLE RPM (IN FORWARD GEAR)	600 - 700
MAXIMUM TIMING: @ WIDE OPEN THROTTLE MODEL 225 EFI – MODEL 250 EFI –	 20° BTDC @ 5000 RPM 23° BTDC @ 5800 RPM 24° BTDC @ 5000 RPM 28° BTDC @ 5800 RPM
IDLE TIMING	4° - 9° ATDC
SPARK PLUG SPARK PLUG GAP	CHAMPION QL77CC 0.035 in. (0.889mm)
FIRING ORDER	1-2-3-4-5-6
THROTTLE POSITION SENSOR @ IDLE @ W.O.T.	 0.950 ± 0.050 VOLTS 3.80 ± 0.25 VOLTS

1996/1997/1998 MODEL 225 EFI/250 EFI	
FULL THROTTLE RPM RANGE	5000 - 5800
IDLE RPM (IN FORWARD GEAR)	600 - 700
MAXIMUM TIMING: @ WIDE OPEN THROTTLE MODEL 225 EFI – MODEL 250 EFI –	 24° BTDC @ 5000 RPM 24° BTDC @ 5800 RPM 24° BTDC @ 5000 RPM 28° BTDC @ 5800 RPM
IDLE TIMING	4° - 9° ATDC
SPARK PLUG SPARK PLUG GAP	CHAMPION QL77CC 0.035 in. (0.89mm)
FIRING ORDER	1-2-3-4-5-6
THROTTLE POSITION SENSOR @ IDLE @ W.O.T.	 0.950 ± 0.050 VOLTS 3.80 ± 0.25 VOLTS

⚠ WARNING

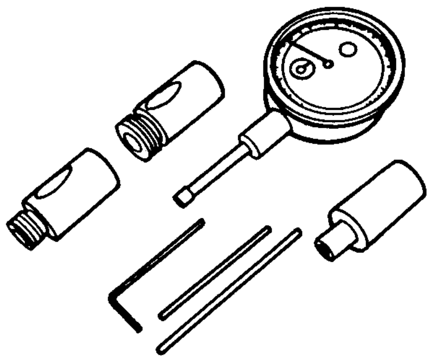
Engine could start when turning flywheel to check timing pointer adjustment. Remove all spark plugs from engine to prevent engine from starting.0

⚠ WARNING

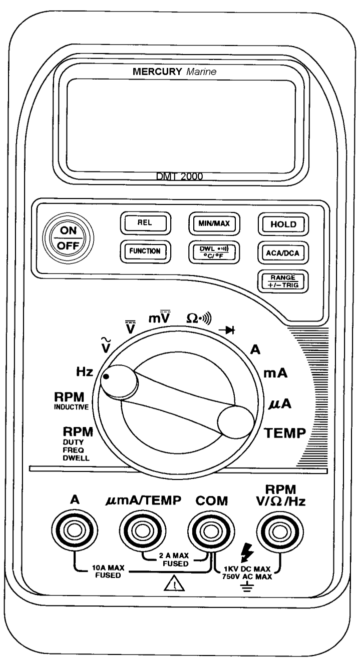
Engine could start when turning flywheel to check timing pointer adjustment. Remove all spark plugs from engine to prevent engine from starting.

Special Tools

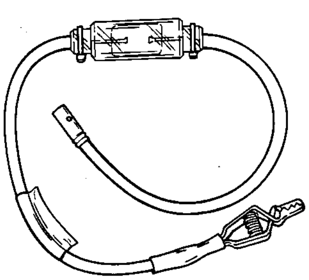
Dial Indicator Gauge Kit 91-58222A1



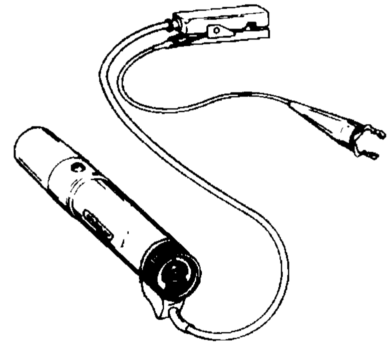
Service Tachometer 91-59339



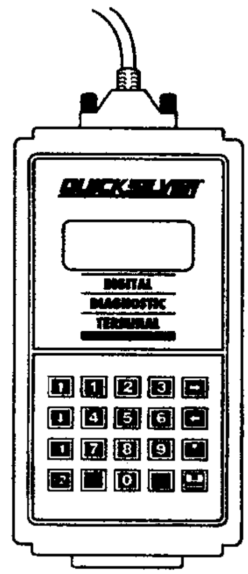
Spark Gap Tool 91-63998A1



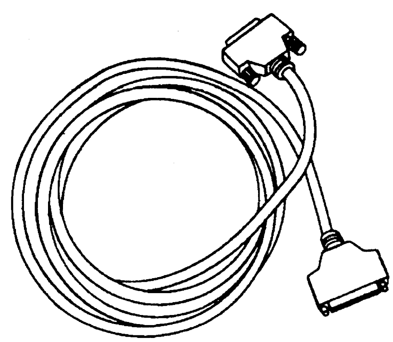
Timing Light 91-99379



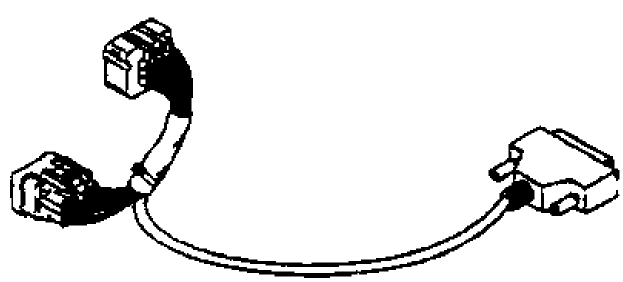
Digital Diagnostic Terminal 91-823686A2



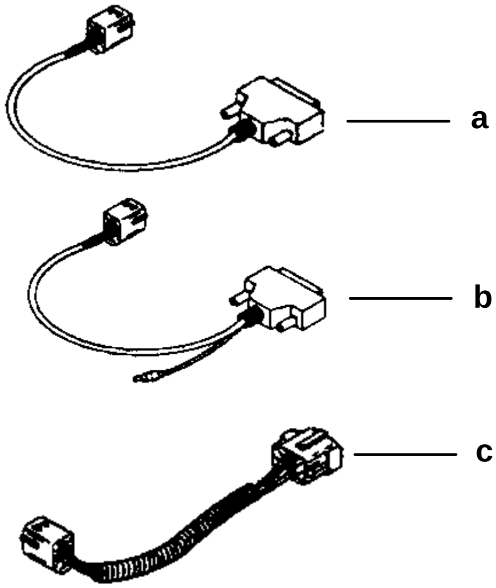
Cable [10 ft. (3.05m)] 84-825003A1*



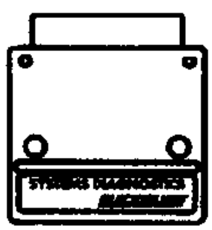
1994 ECM Harness 84-822560A1



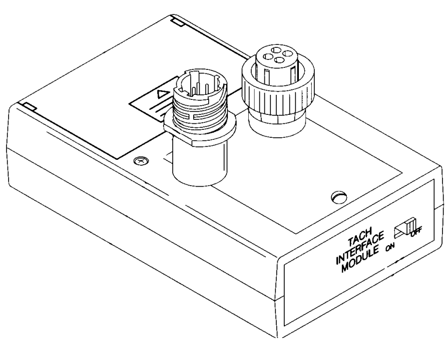
1995/96/96/98 ECM Harness (a) 84-822560A3;or (b) 84-822560A7 with (c) 84-822560A6+



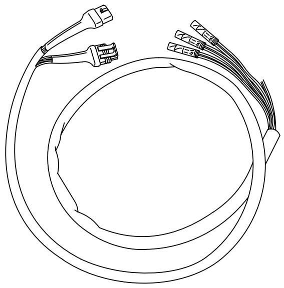
Cartridge 91-822608-2 or -4



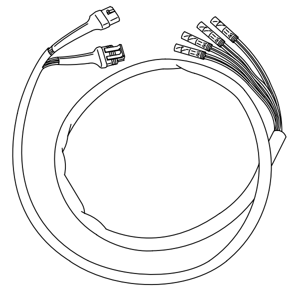
Tachometer Adaptor 91-825824A2



TPS/CDM Test Harness (3 Pin Connector) (w/CDM PN 822779) 84-825207A1



TPS/CDM Test Harness (4 Pin Connector) (w/CDM PN 827509) 84-825207A2



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

+ 84-822560A6 must be used in conjunction with 84-822560A7 to enable the Digital Diagnostic Tester to provide accurate readouts.

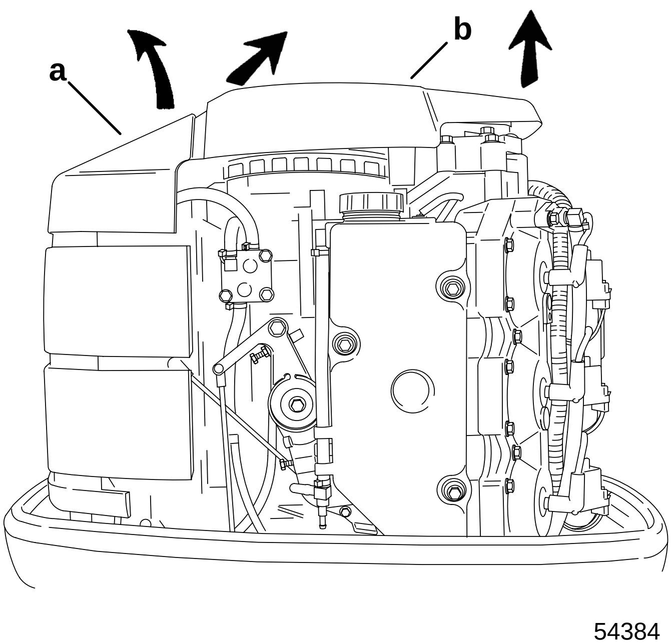
Adjustments

Carburetor Models

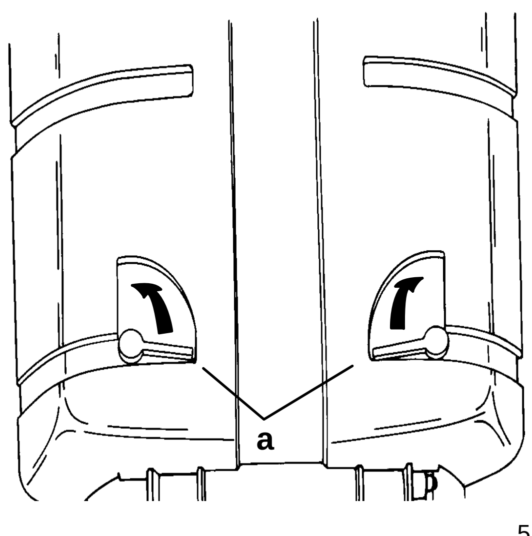
⚠ WARNING

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

1. Remove flywheel cover by sliding back and lifting cover in a simultaneous motion. Remove carburetor air attenuator by releasing two latches at bottom of attenuator.



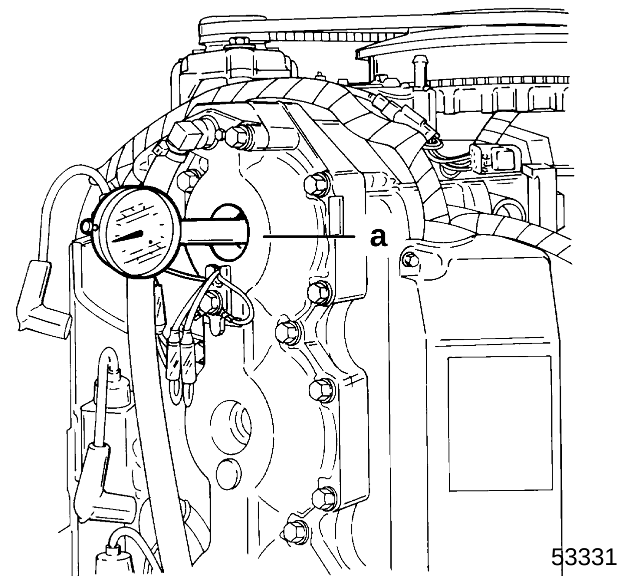
a - Attenuator
b - Flywheel Cover



a - Latches

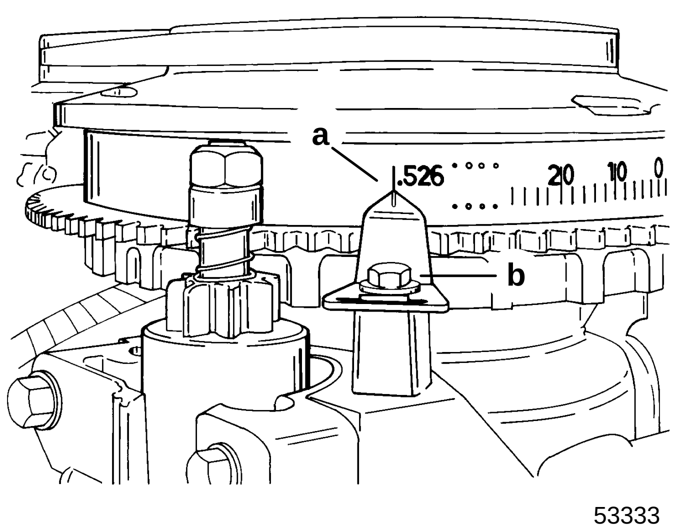
NOTE: *To reinstall attenuator and flywheel cover, install and latch attenuator first, then install flywheel cover.*

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



a - Dial Indicator Installed in No. 1 Cylinder

3. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at “0” (zero) and tighten indicator set screw.
4. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4-turn beyond 0.526 in., then turn flywheel clockwise so that dial indicator reads 0.526 in. (11.7mm) exactly.
5. Reposition timing pointer (if necessary) so that timing pointer is aligned with 0.526 in. mark on flywheel. Torque pointer attaching screw to 105 lb. in. (11.8 N·m).

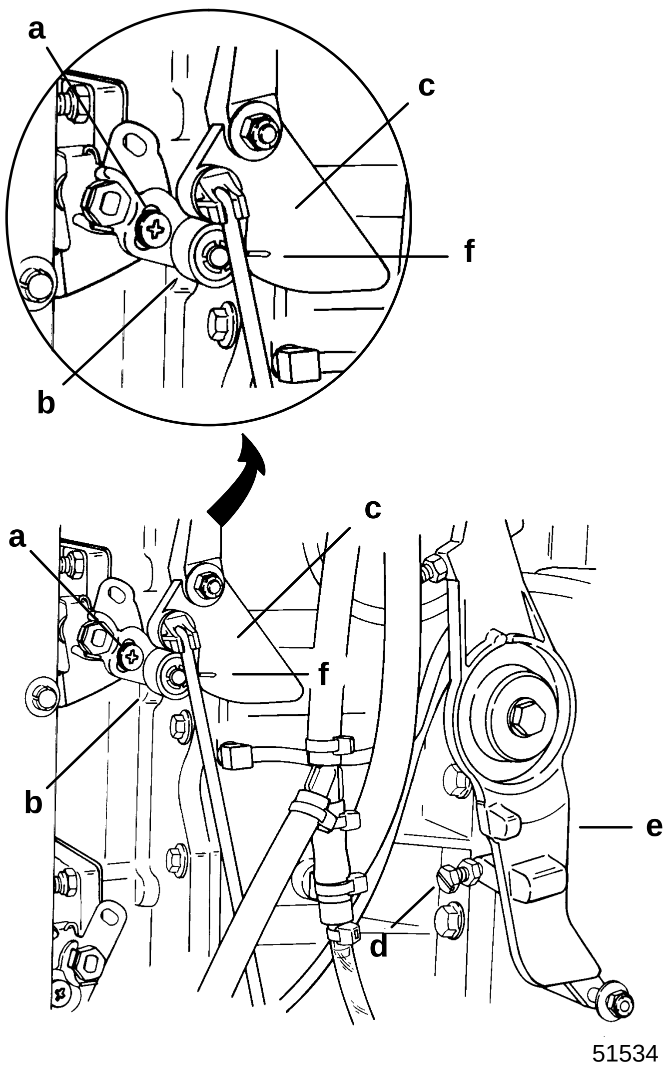


a - Timing Pointer
b - Attaching Screw [Torque to 105 lb. in. (11.8 N·m)]

6. Remove dial indicator from cylinder.

Throttle Cam Adjustment (Carburetor Models 1994/1995)

1. Loosen cam follower screw allowing cam follower to move freely.
2. Allow roller to rest on throttle cam. Adjust idle stop screw on throttle arm to align mark on throttle cam with center of roller. Tighten jam nut.

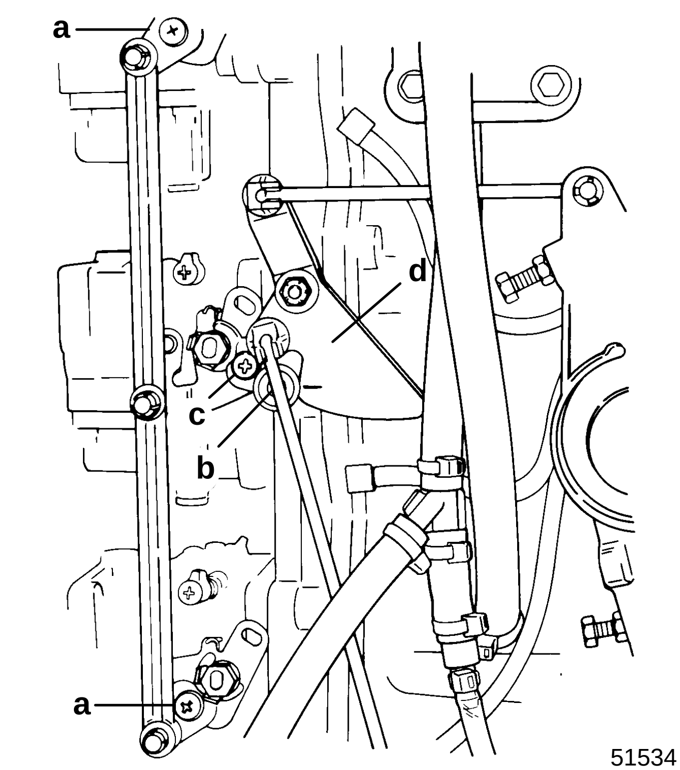


a - Cam Follower Screw
b - Roller
c - Throttle Cam
d - Idle Stop Screw
e - Throttle Arm
f - Mark (Throttle Cam)

3. Proceed to “Carburetor Synchronization” (following) before tightening cam follower screw.

Carburetor Synchronization (Carburetor Models 1994/1995)

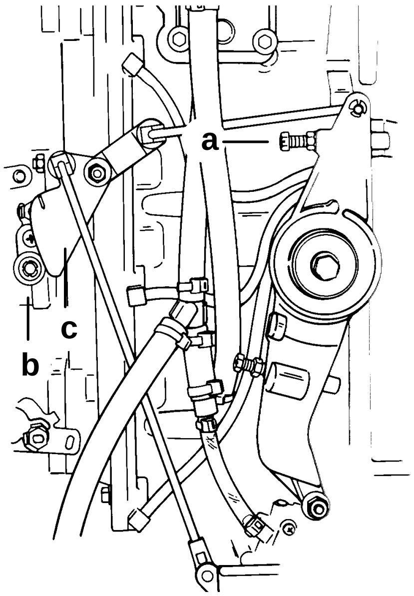
1. Loosen two carburetor synchronization screws to allow shutter plates to close completely.
2. Position throttle lever so that idle stop screw is against idle stop and move roller arm until roller lightly touches throttle cam. Without moving roller from this position, retighten carburetor synchronization screws and cam follower screw.



a - Synchronizing Screw   b - Roller
c - Cam Follower Screw   d - Throttle Cam

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 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 roller and throttle cam at W.O.T. Retighten jam nut on adjustment screw.



a - Full Throttle Stop Screw
b - Roller
c - Throttle Cam

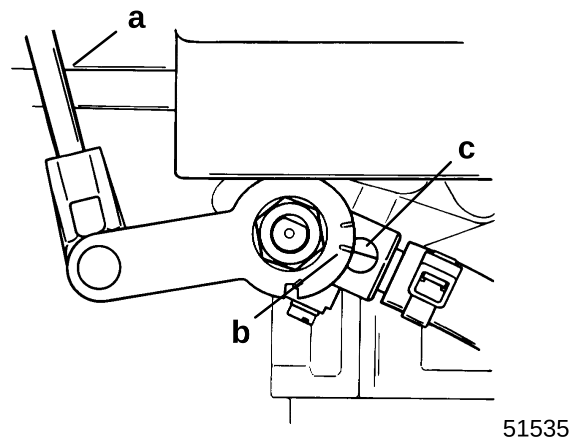
5. Reinstall air box and flywheel cover.

Carburetor/Oil Pump Synchronization 1994/1995 Models

NOTE: *3 Liter WORK model IS NOT equipped with an oil injection pump and requires premix oil and fuel for lubrication. The 225 model is equipped with an oil injection pump. However, the 1994/1995 225 carburetor models DO NOT have an adjustable oil link rod.*

Carburetor/Oil Pump Synchronization 1996/1997/1998 Model 225 Carb

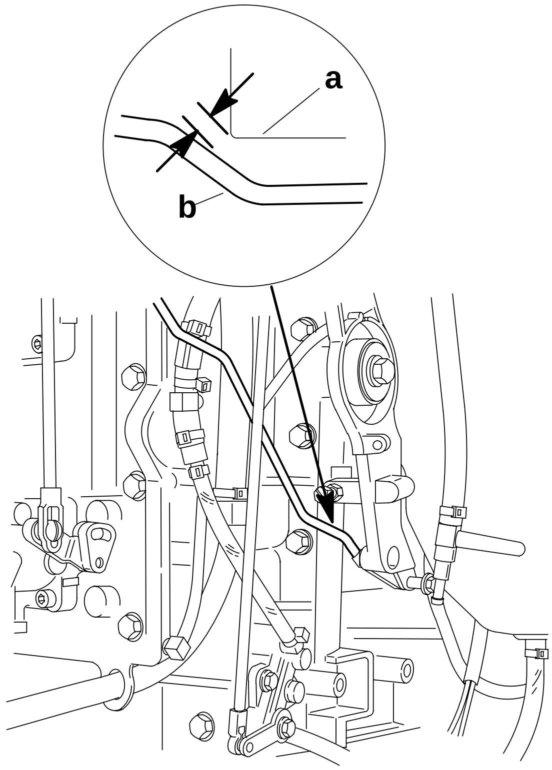
1. Remove the shift rail assembly and inspect the oil pump index marks. When throttle linkage is at idle position, the lower alignment mark on oil injection arm should be in-line with mark on casting as shown. If necessary, adjust link rod.



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

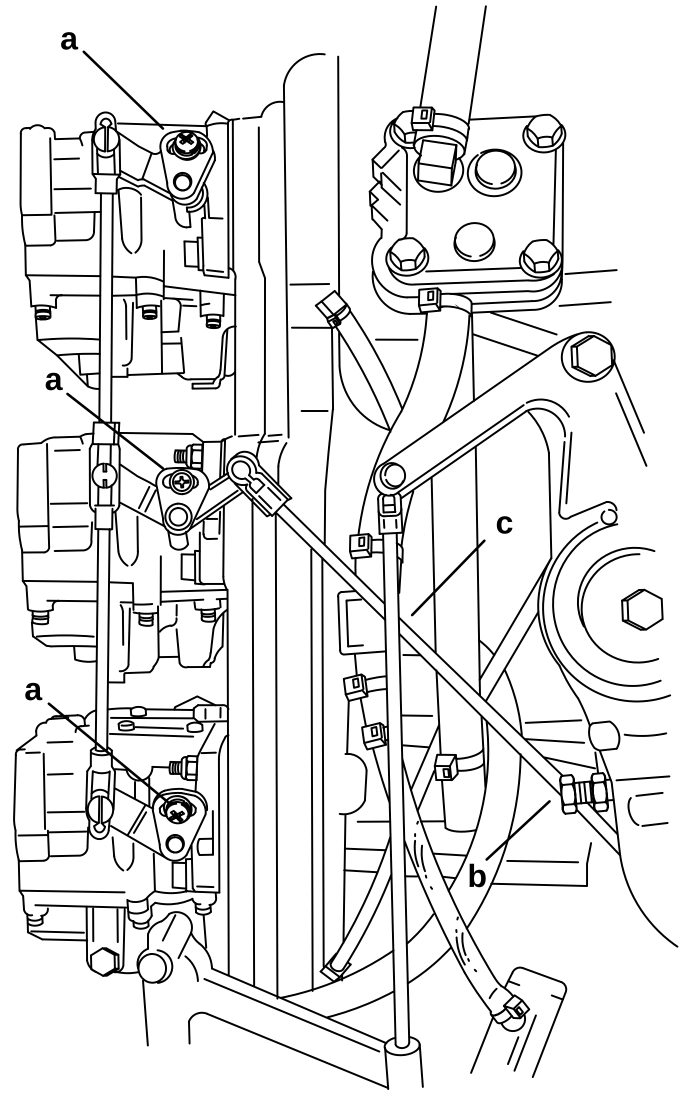
Carburetor Synchronization 1996/1997/1998 Model 225 Carburetor

1. Adjust idle stop screw until the bend in the carburetor link is 1/4 in. (6.3mm) from the crankcase casting. The threaded idle stop boss on the back side of the throttle arm should be close to the middle of the idle stop screw.



a - Crankcase
b - Carburetor Link Rod

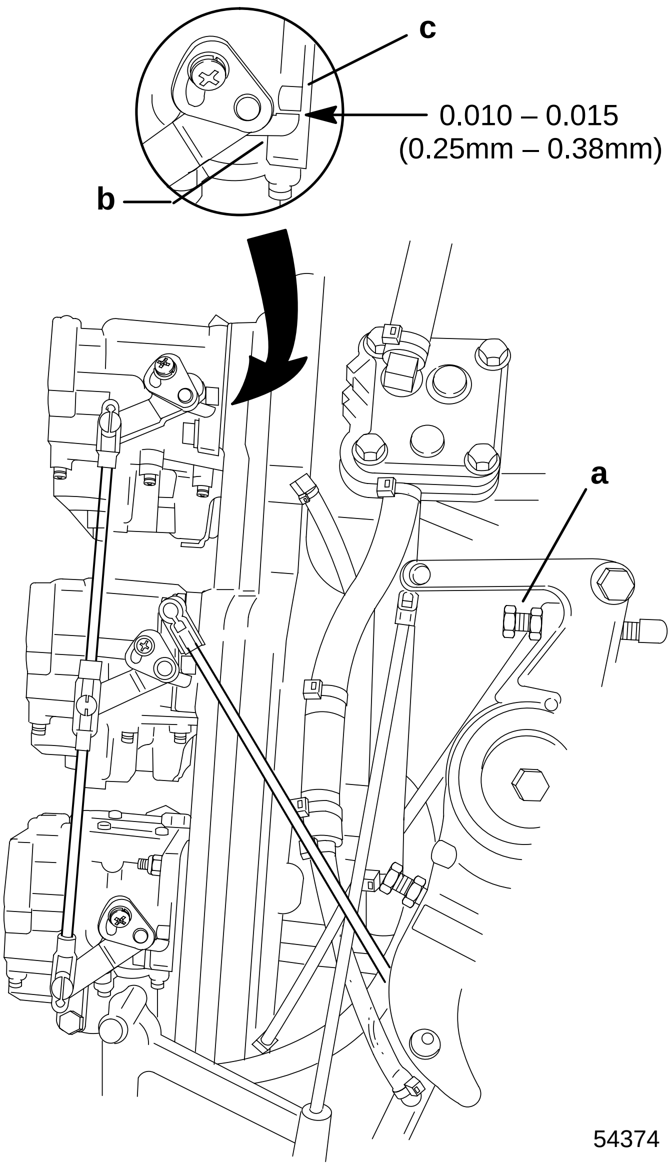
2. Loosen 3 carburetor synchronization screws to allow shutter plates to close completely.
3. Position throttle lever so that idle stop screw is against idle stop. Without moving throttle linkage, retighten center carburetor synchronization screw first and then upper and lower carburetor synchronization screws.



a - Synchronizing Screw
b - Idle Stop Screw
c - Carburetor Link Rod [Approx. 8.3 in. (21.1cm) between Pivot Centers]

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

5. Move throttle lever to wide-open-throttle (W.O.T.) position and adjust full throttle stop screw 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 and stop at W.O.T. Retighten jam nut on adjustment screw.



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

6. Reinstall air box and flywheel cover.

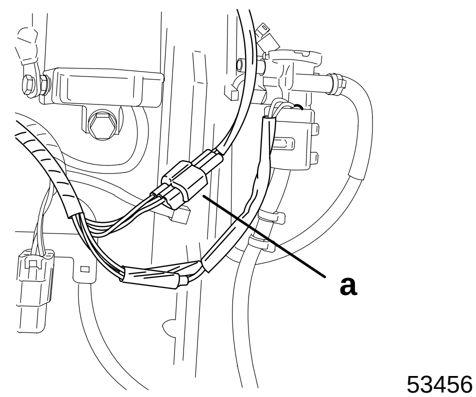
Timing Adjustments

Throttle Position Sensor (TPS) Adjustment for Idle Timing

IMPORTANT: TPS can be adjusted using a digital meter. Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

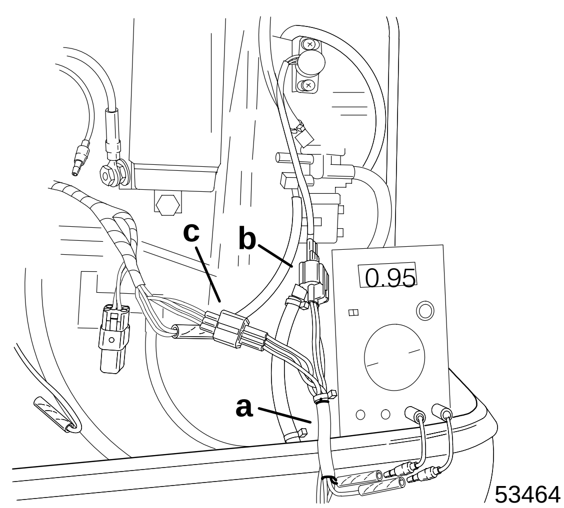
TPS ADJUSTMENT USING DIGITAL VOLTMETER

1. Disconnect TPS from ignition harness.



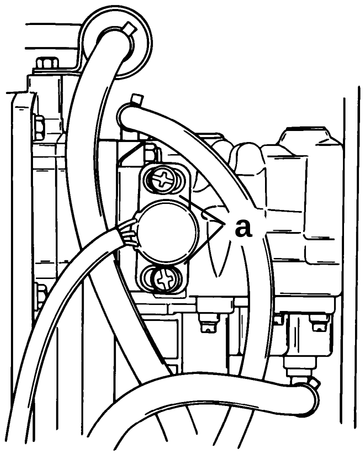
a - TPS Plug

2. Connect digital voltmeter using TPS Test Lead Assembly 84-825207A1 between TPS connector and ignition harness connector.
   1994/1995 Models – Connect BLACK VOA lead to BLACK test harness connector. Connect RED VOA lead to WHITE test harness connector.
   1996/1997/1998 Models – Connect BLACK VOA lead to WHITE test harness connector. Connect RED VOA lead to RED test harness connector. Set voltmeter to 20 VDC.



a - TPI Test Lead Assembly
b - TPI Connector
c - Ignition Harness Connector

3. Turn key switch to the "ON" position.
4. Loosen screws securing TPS to bracket.



51535

a - Screws

5. Rotate TPS to attain voltage reading of 0.950 +/– .050.
6. Tighten TPS screws (holding correct tolerance).
7. Disconnect remote control cable from throttle lever.
8. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly.
9. Check TPS at W.O.T. Maximum voltage reading at full throttle is approximately 3.80 ± 0.10 volts.

IMPORTANT: If voltage reading of TPS is not correct @ W.O.T., verify W.O.T. stop is adjusted correctly before replacing TPS.

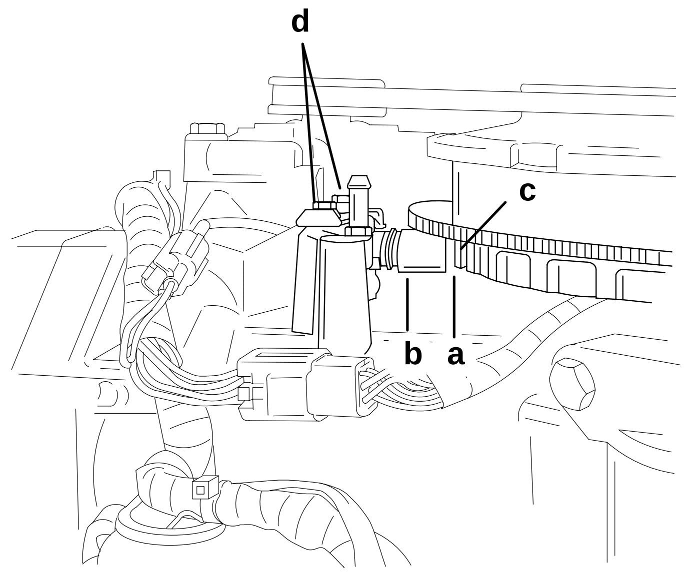
10. Remove test lead and reconnect TPS harness to ignition harness.

Crank Position Sensor Adjustment

1. Remove flywheel cover.
2. Using a feeler gauge, measure the air gap between the crank position sensor and a tooth on the flywheel. It should be 0.040 in. ± 0.020 in. [1.02mm ± 51mm)]. If not, loosen bracket screws, set gap to specification, and retighten screws to 105 lb. in. (11.8 N·m).

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

3. Reinstall flywheel cover.



53455

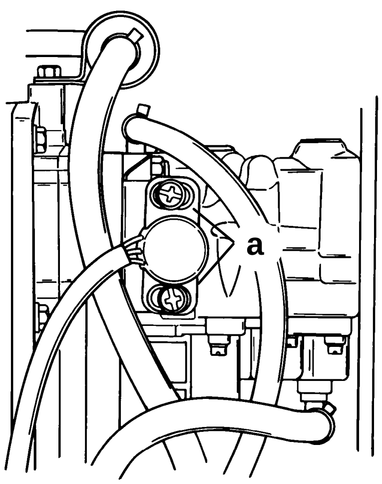
a - Air Gap [0.040 in. ± 0.020 in. (1.02mm ± 0.51mm)]
b - Crank Position Sensor
c - Flywheel Tooth
d - Bracket Screws [Torque to 105 lb. in. (11.8 N·m)]

Maximum Timing Adjustment

The maximum spark timing is controlled by the ignition ECM (Electronic Control Model) and is non-adjustable. As long as the ECM and sensors (Crank Position Sensor and Throttle Position Sensor) are functioning properly, the maximum timing will be correct.

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 (600-700), verify carburetor synchronization is correct and/or readjust idle mixture screws. If necessary, Throttle Position Sensor lock screws may be loosened and TPS readjusted to attain recommended engine speed. A 0.05 volt change in TPS setting results in a 1 degree change in timing. Retighten TPS screws.



a - TPI Screws

⚠ CAUTION

The unit must be set up to have an "IN GEAR" idle speed no greater than 700 RPM. Higher "IN GEAR" idle speeds will result in increased shift loads that could ultimately prevent shifting of the gear case assembly.

3. With end of 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.

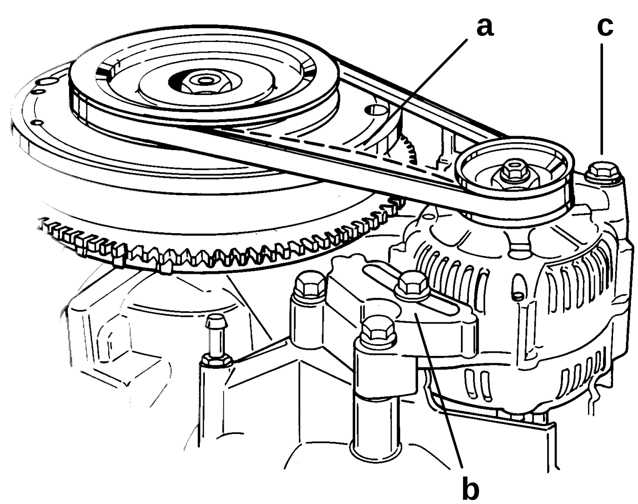
IMPORTANT: Excessive preload on throttle cable will cause difficulty when shifting from forward to neutral. (Readjust throttle cable barrel if necessary.)

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

Alternator Belt Tension Adjustment

1. Belt tension is correct if belt deflects 1/2 in. (12.7mm) from center under a 22 lb. (30.0 N) side load.
2. If belt tension is not correct, loosen pivot bolt and tension adjustment bolt. Move alternator away from flywheel to increase tension.
3. Tighten tension adjustment bolt [Torque to 40 lb. ft. (54.0 N·m)] and pivot bolt [Torque to 40 lb. ft. (54.0 N·m)].

NOTE: *A belt tensioning tool (obtain locally) may also be used to adjust belt tension. Adjust belt tension to 80 lb. (356.0 N).*



a - Deflection [1/2 in. (12.7mm) under 22 lb. ft. (30.0 N·m) side load]
b - Tension Bolt [Torque to 40 lb.ft. (54.0 N·m)]
c - Pivot Bolt [Torque to 40 lb. ft. (54.0 N·m)]

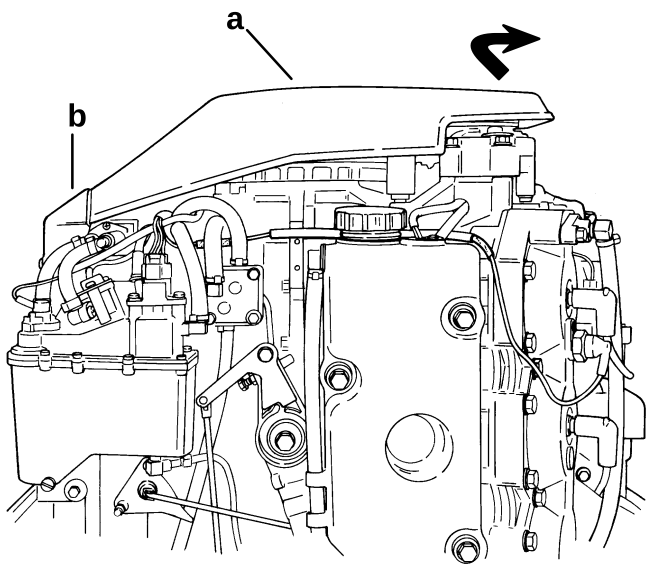
Adjustments

Electronic Fuel Injection Models

⚠ WARNING

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

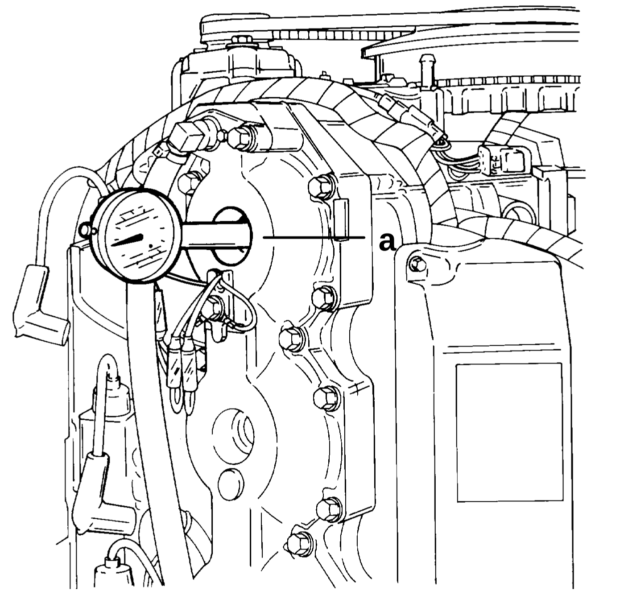
1. Remove flywheel/alternator cover by lifting rear of cover and sliding cover aft and off of attenuator.



53634

a - Flywheel/Alternator Cover
b - Attenuator

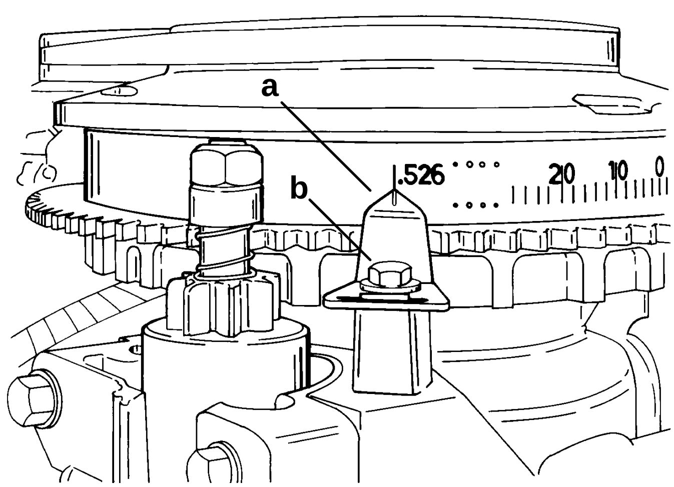
2. Remove all spark plugs and install Dial Indicator (91-58222A1) into No. 1 cylinder (top cylinder, starboard bank).



53331

a - Dial Indicator Installed in No. 1 Cylinder

3. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at “0” (zero) and tighten indicator set screw.
4. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4-turn beyond 0.526 in., then turn flywheel clockwise so that dial indicator reads 0.526 in. (11.7mm) exactly.
5. Reposition timing pointer (if necessary) so that timing pointer is aligned with 0.526 in. mark on flywheel. Torque pointer attaching screw to 105 lb. in. (11.8 N·m).



53333

a - Timing Pointer
b - Attaching Screw [Torque to 105 lb. in. (11.8 N·m)]

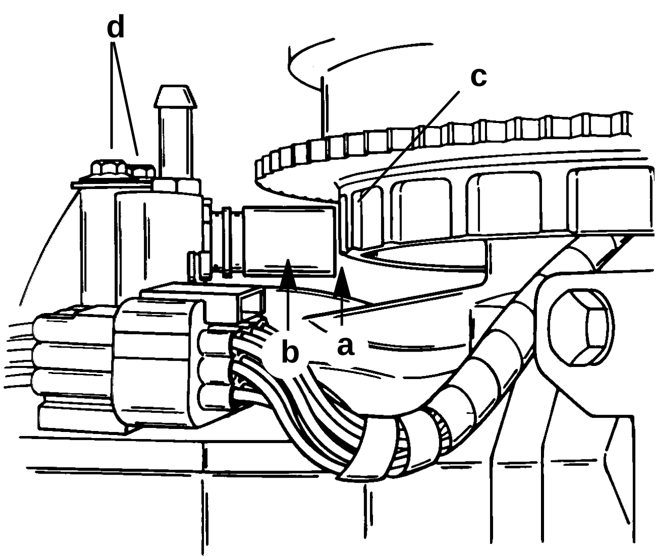
6. Remove dial indicator from cylinder.

Crank Position Sensor Adjustment

1. Remove flywheel cover.
2. Using a feeler gauge, measure the air gap between the crank position sensor and a tooth on the flywheel. It should be 0.040 in. ± 0.020 in. [1.02mm ± 0.51mm)]. If not, loosen bracket screws, set gap to specification, and retighten screws to 105 lb. in. (11.8 N·m).

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

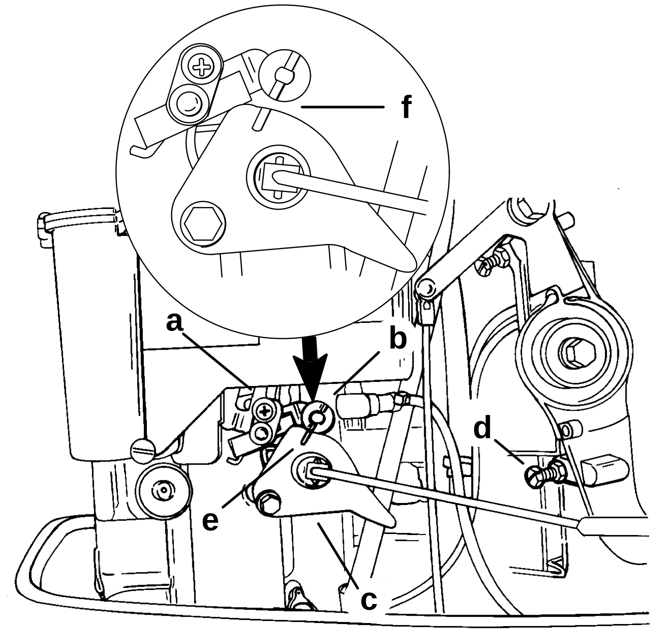
3. Reinstall flywheel cover.



a - Air Gap [0.040 in. ± 0.020 in.(1.02mm ± 0.51mm)]
b - Crank Position Sensor
c - Flywheel Tooth
d - Bracket Screws [Torque to 105 lb. in.(11.8 N·m)]

Throttle Cam Adjustment

1. Loosen cam follower screw allowing cam follower to move freely.
2. Allow roller to rest on throttle cam. Adjust idle stop screw on throttle arm to align mark on throttle cam with center of roller.
3. Tighten roller arm screw to provide clearance of 0.005 in. ± 0.005 in. (0.13mm ± 0.13mm) between roller and cam.

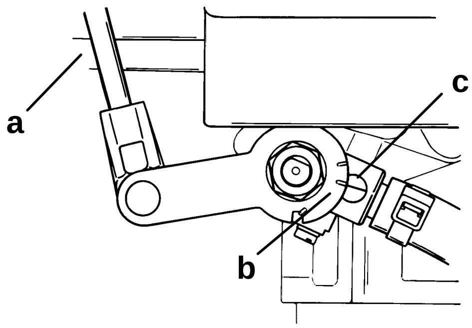


a - Cam Follower Screw
b - Roller
c - Throttle Cam
d - Idle Stop Screw
e - Mark
f - 0.005 in. ± 0.005 in. (0.13mm ± 0.13mm)

Carburetor/Oil Pump Synchronization

NOTE: *On 1996/1997 models, the shift rail assembly must be removed in order to check the alignment of casting marks.*

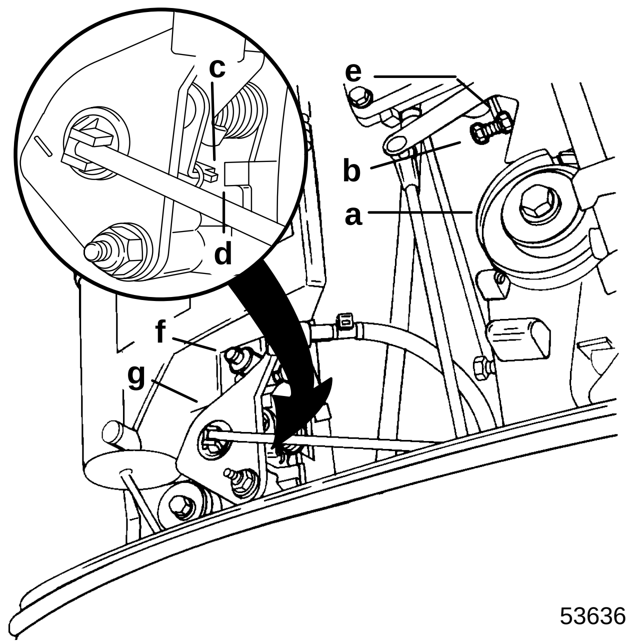
1. When carburetor linkage is at idle position, alignment mark on oil injection arm should be in-line with mark on casting as shown. If necessary, adjust link rod.



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

Maximum Throttle

1. Hold throttle arm against full throttle stop screw.
2. Adjust full throttle stop screw to allow full throttle valve opening while maintaining a 0.010 in. (0.25mm) clearance between arm of throttle shaft and stop on attenuator box.
3. Tighten jam nut.
4. Check for free play (roller lifts from cam) between roller and cam at full throttle to prevent linkage from binding. Readjust full throttle stop screw, if necessary.



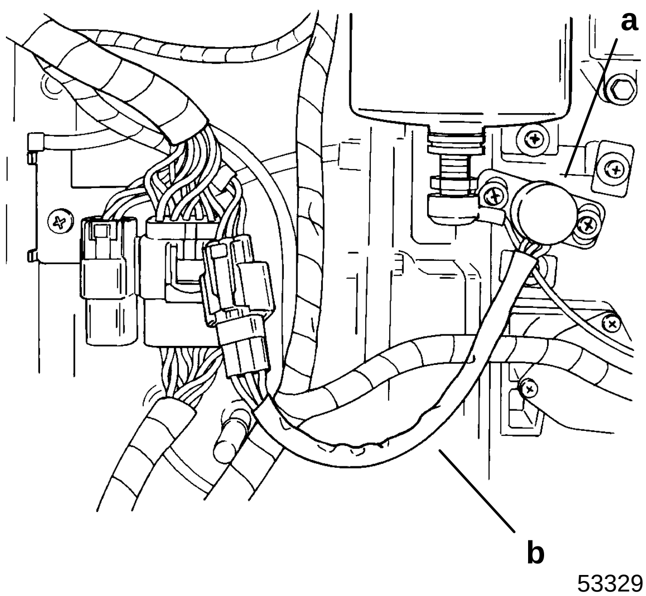
a - Throttle Arm
b - Full Throttle Stop Screw
c - Throttle Shaft Arm
d - Stop
e - Locknut
f - Roller
g - Cam

Throttle Position Sensor (TPS) Adjustment

IMPORTANT: TPS can be adjusted using a digital meter. Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

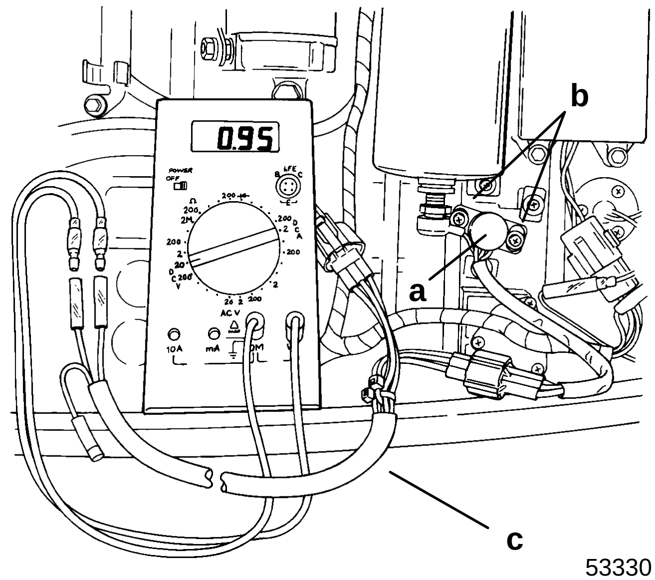
TPS ADJUSTMENT USING A DIGITAL VOLTMETER

1. Disconnect TPS from ignition harness.



a - TPS
b - TPS Harness

2. Connect digital voltmeter using TPS/CDM TEST LEAD ASSEMBLY (84-825207A1) between TPS connector and EFI harness connector.
3. Connect RED voltmeter lead to RED lead of harness assembly and BLACK voltmeter lead to WHITE lead of harness assembly for a TPS measurement. Set voltmeter to 20VDC.
4. Turn ignition key to “ON” position.
5. With throttle shaft at the close position, voltmeter should read 0.95 ± 0.05 volts. Loosen TPS set screws and adjust as necessary.



a - TPS
b - Set Screws
c - TPS/CDM TEST HARNESS (84-825207A1)

6. Slowly move throttle lever to WIDE OPEN THROTTLE position and then back to IDLE while monitoring voltage reading. Voltage reading should increase (throttle opens) and decrease (throttle closes) smoothly.
7. At WIDE OPEN THROTTLE, maximum voltage reading should be approximately 3.80 ± 0.25 volts using a digital voltmeter.
8. Torque TPS screws to 20 lb. in. (2.3 N·m).

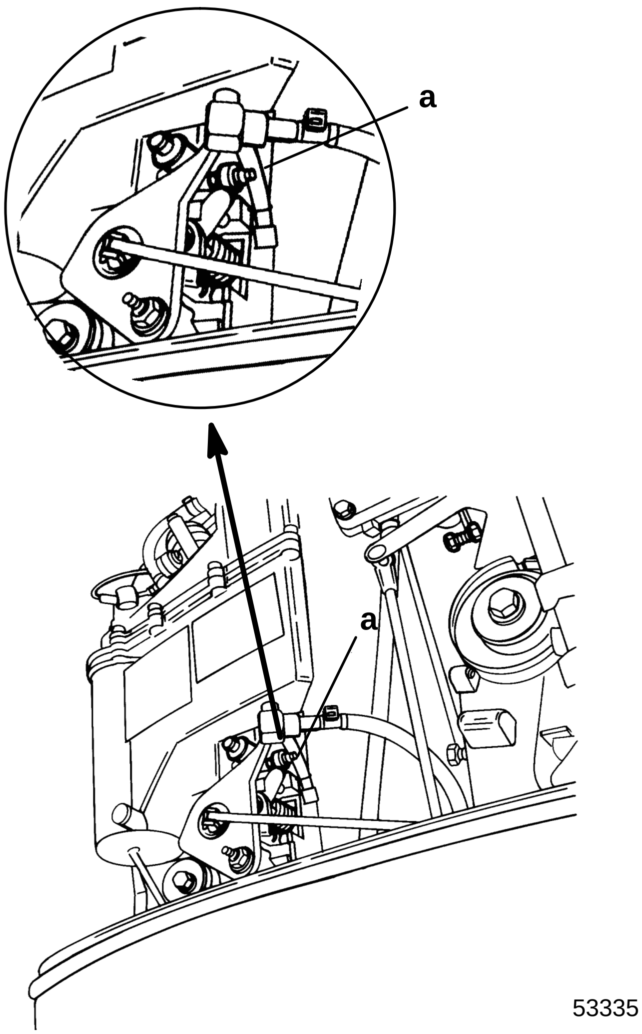
NOTE: *If using the DIGITAL DIAGNOSTIC TERMINAL to monitor TPS voltage, the maximum voltage reading at WIDE OPEN THROTTLE will be 4.00 ± 0.25 volts. The idle TPS voltage will be the same – 0.95 ± 0.050 volts – whether the DIGITAL DIAGNOSTIC TERMINAL or digital voltmeter is used.*

9. Remove test harness and reconnect TPS harness to EFI harness.
10. Reinstall spark plugs. Torque spark plugs to 20 lb. ft. (27.0 N·m).

Idle Speed

Engine idle speed should be 600 – 700 RPM in gear.

1. If idle speed is not correct, adjust idle air flow screw at lower throttle shaft on PORT side of induction manifold.
2. Secure idle air flow screw with jam nut.
3. After adjusting idle speed, recheck TPS voltage and reset (if necessary) to 0.95 ± 0.05 VDC. Torque TPS screws to 20 lb. in. (2.3 N·m).

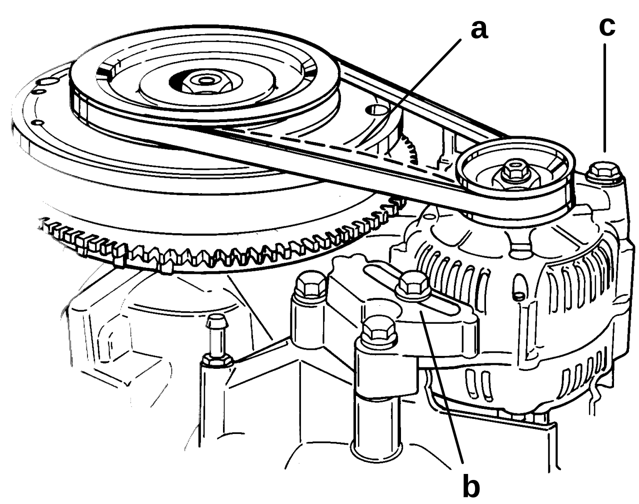


a - Idle Air Screw

Alternator Belt Tension Adjustment

1. Belt tension is correct if belt deflects 1/2 in. (12.7mm) from center under a 22 lb. (30.0 N) side load.
2. If belt tension is not correct, loosen pivot bolt and tension adjustment bolt. Move alternator away from flywheel to increase tension.
3. Tighten tension adjustment bolt [Torque to 40 lb. ft. (54.0 N·m)] and pivot bolt [Torque to 40 lb. ft. (54.0 N·m)].

***NOTE:** A belt tensioning tool (obtain locally) may also be used to adjust belt tension. Adjust belt tension to 80 lb. (356.0 N·m).*

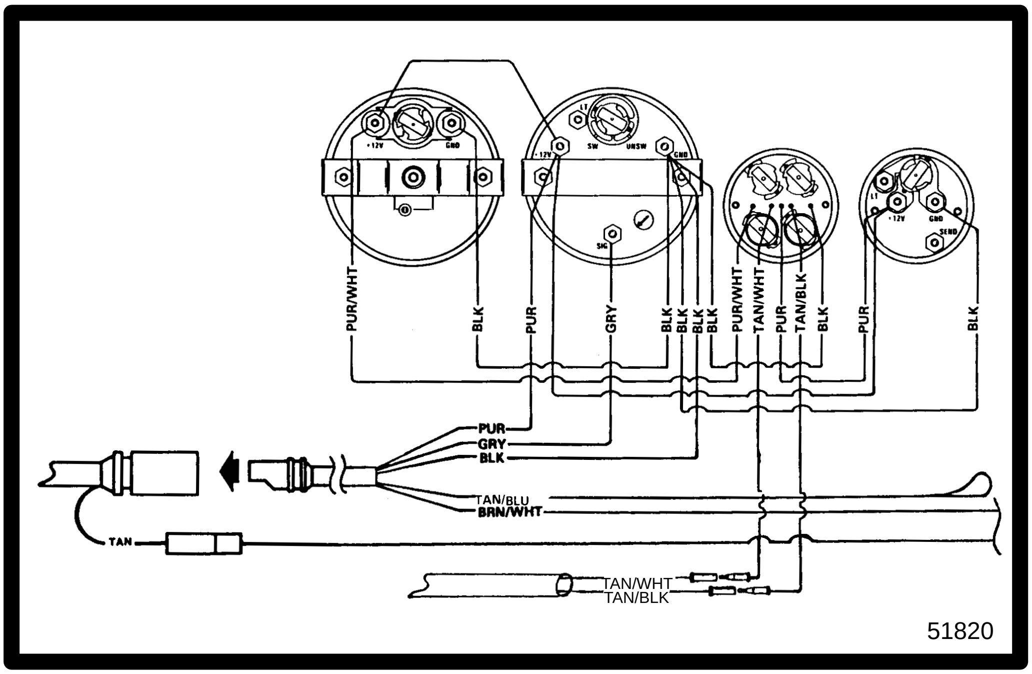


a - Deflection [1/2 in. (12.7mm) under 22 lb. ft. (30.0 N·m) side load]
b - Tension Bolt [Torque to 40 lb.ft. (54.0 N·m)]
c - Pivot Bolt [Torque to 40 lb. ft. (54.0 N·m)]

ELECTRICAL

2

D



WIRING

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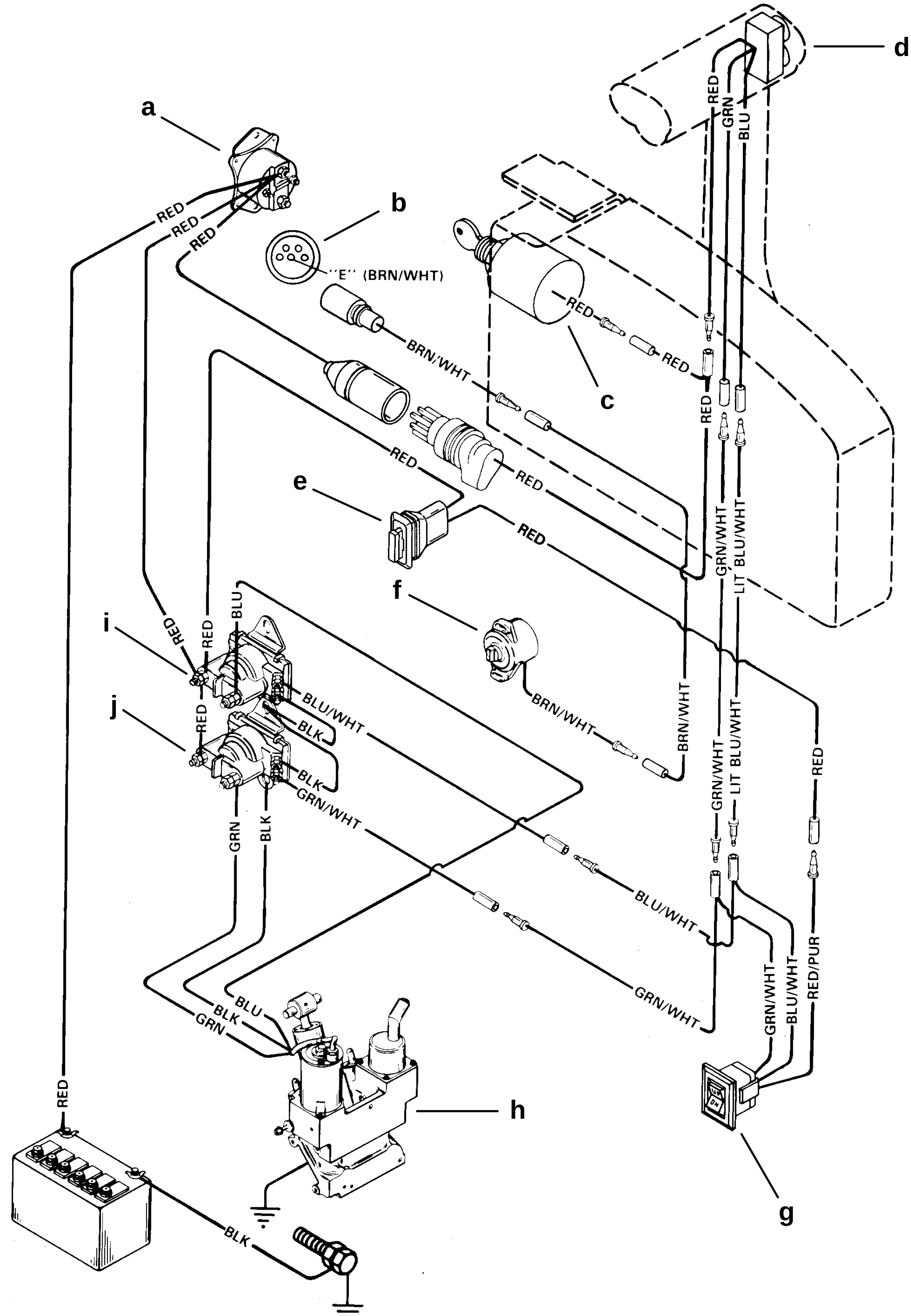
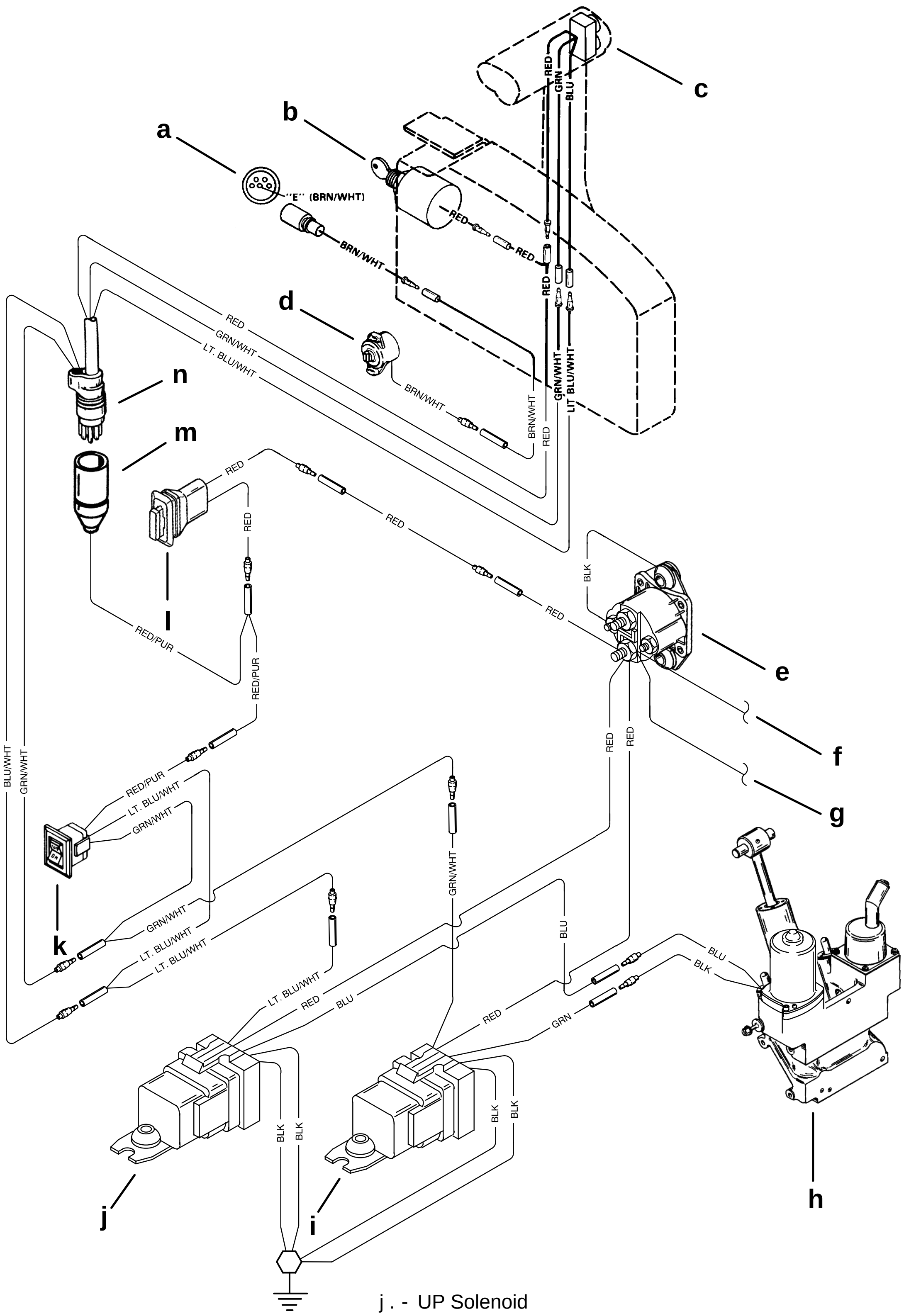
Power Trim Wiring Diagram 1994 Models



52203

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

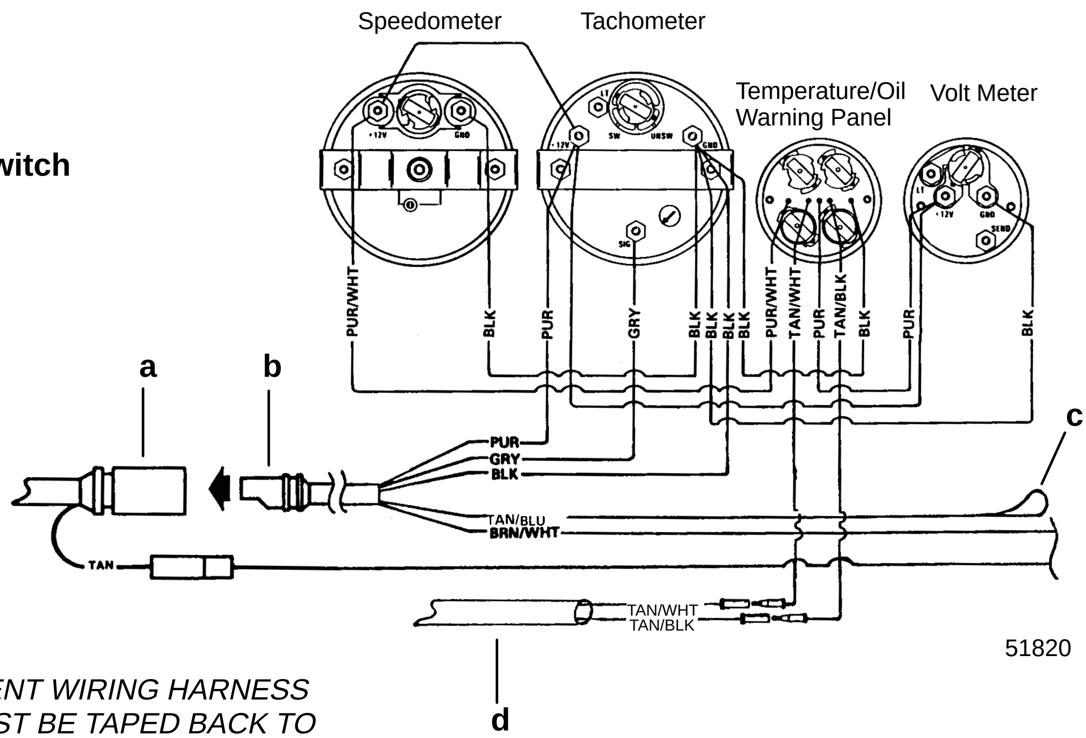
Power Trim Wiring Diagram
1995/1996/1997/1998 Models



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

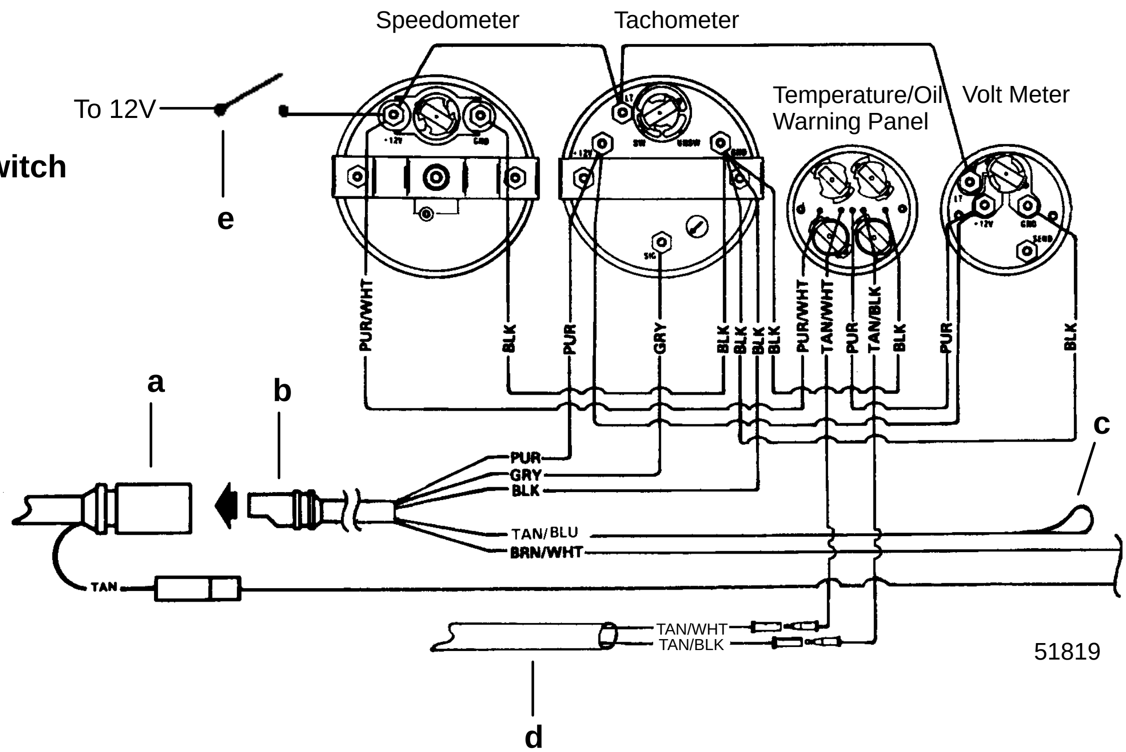
Instrument Wiring Connections

Figure 1
Without Light Switch



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

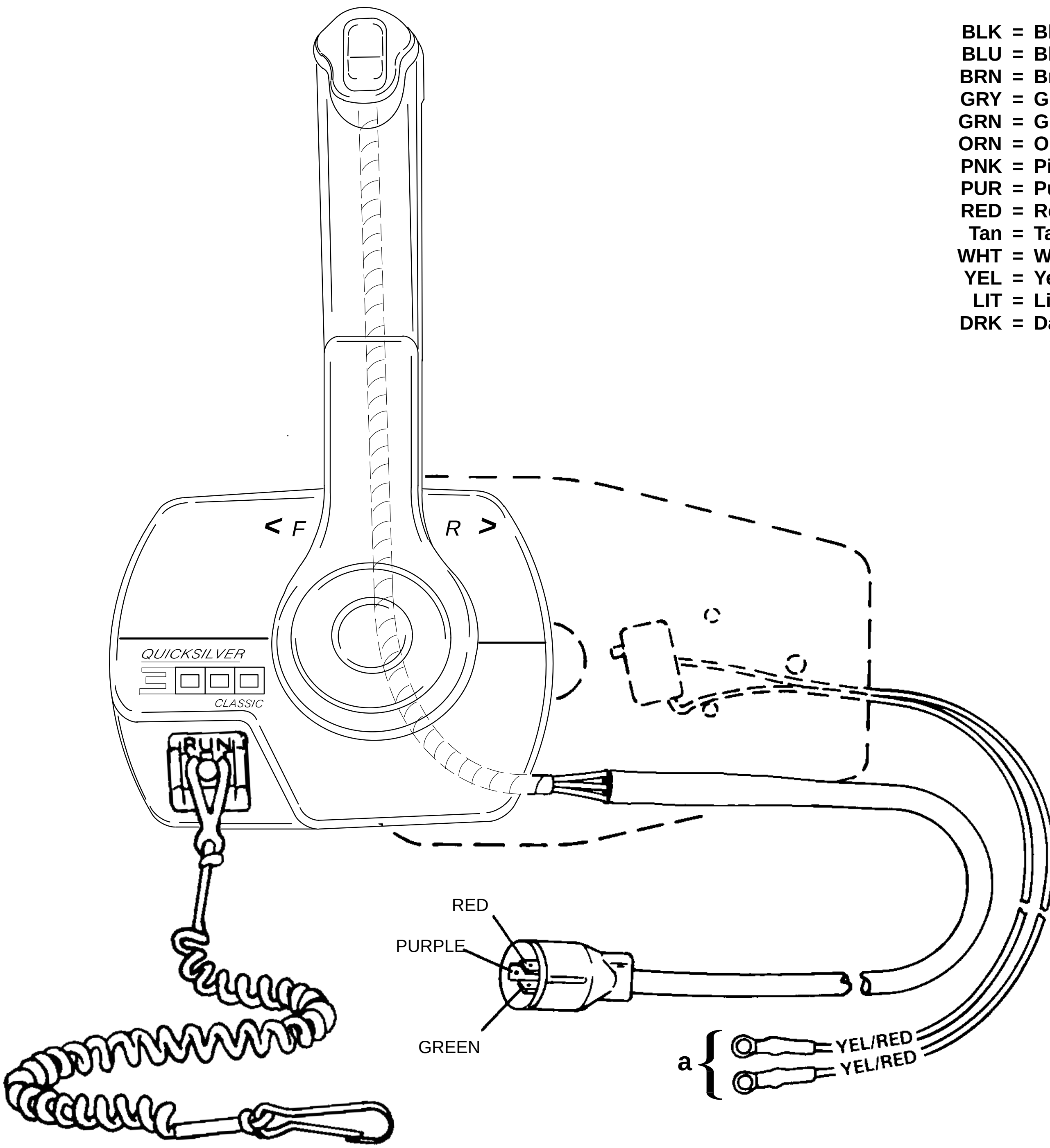
Figure 2
With Light Switch



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

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

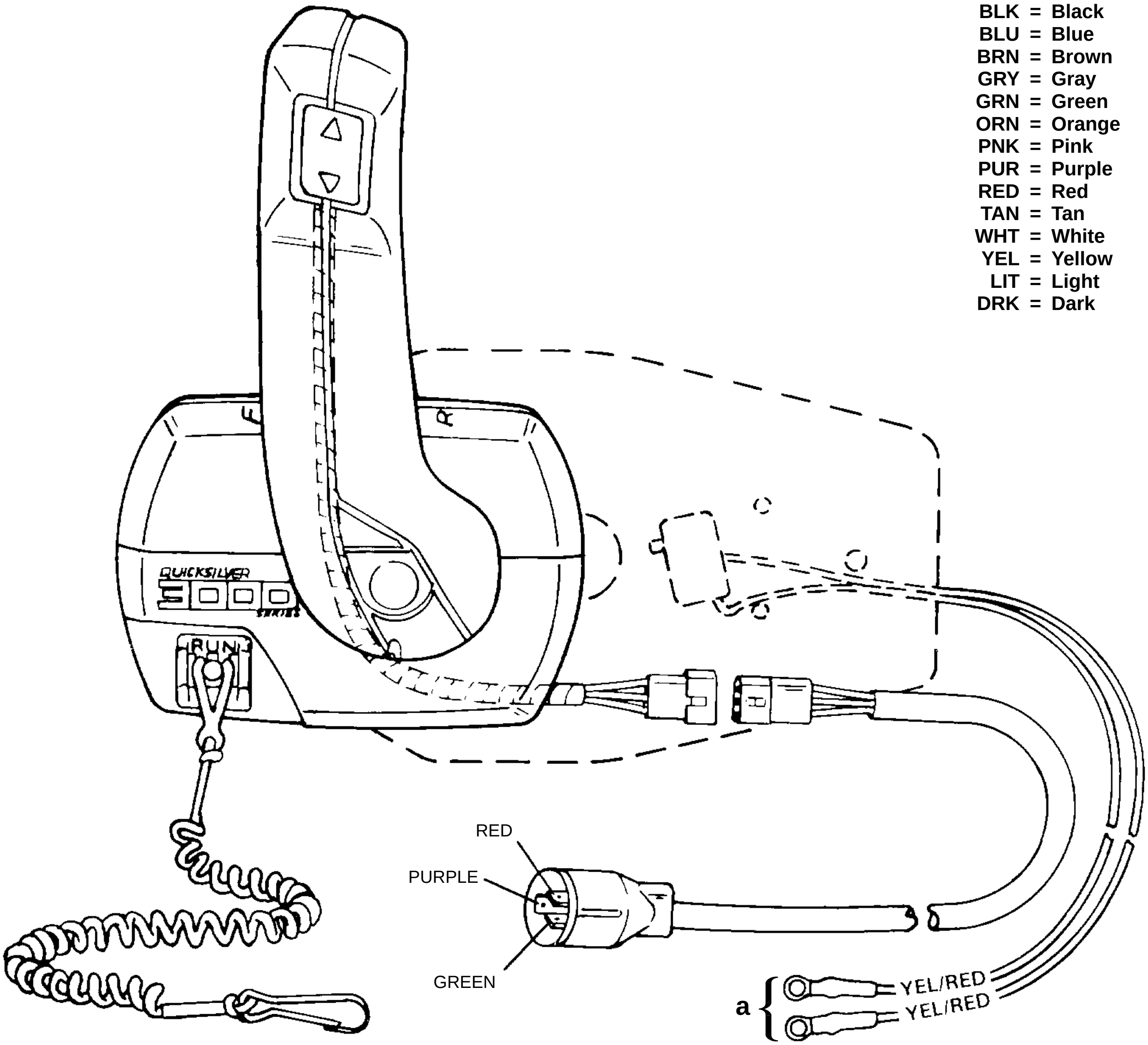
Commander 3000 Classic Panel Remote Control



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

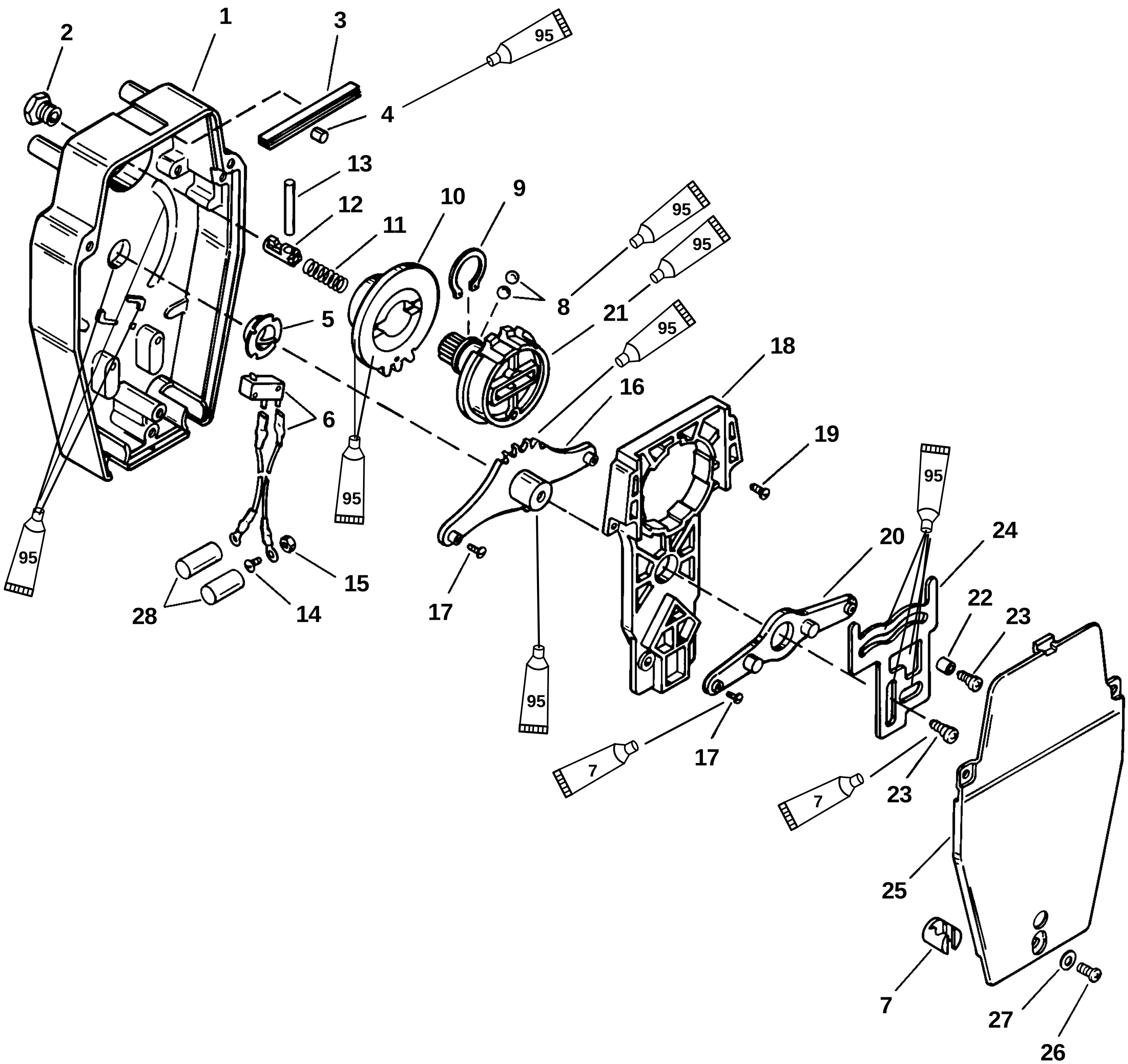
a - Neutral Interlock Switch

Commander 3000 Panel Remote Control



a - Neutral Interlock Switch

Commander 3000/3000 Classic Components

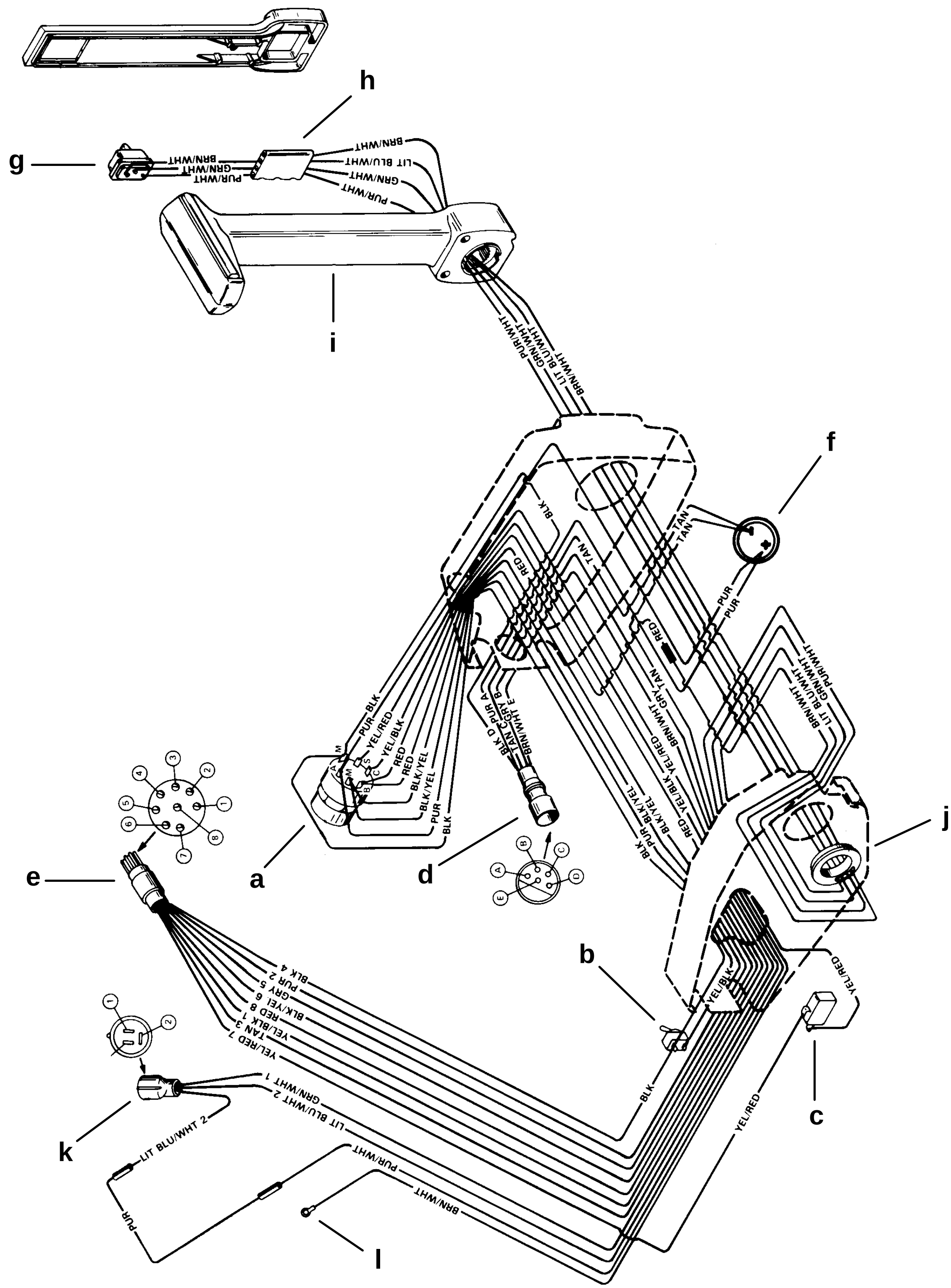


7 Loctite 271 (92-809820)

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

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

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

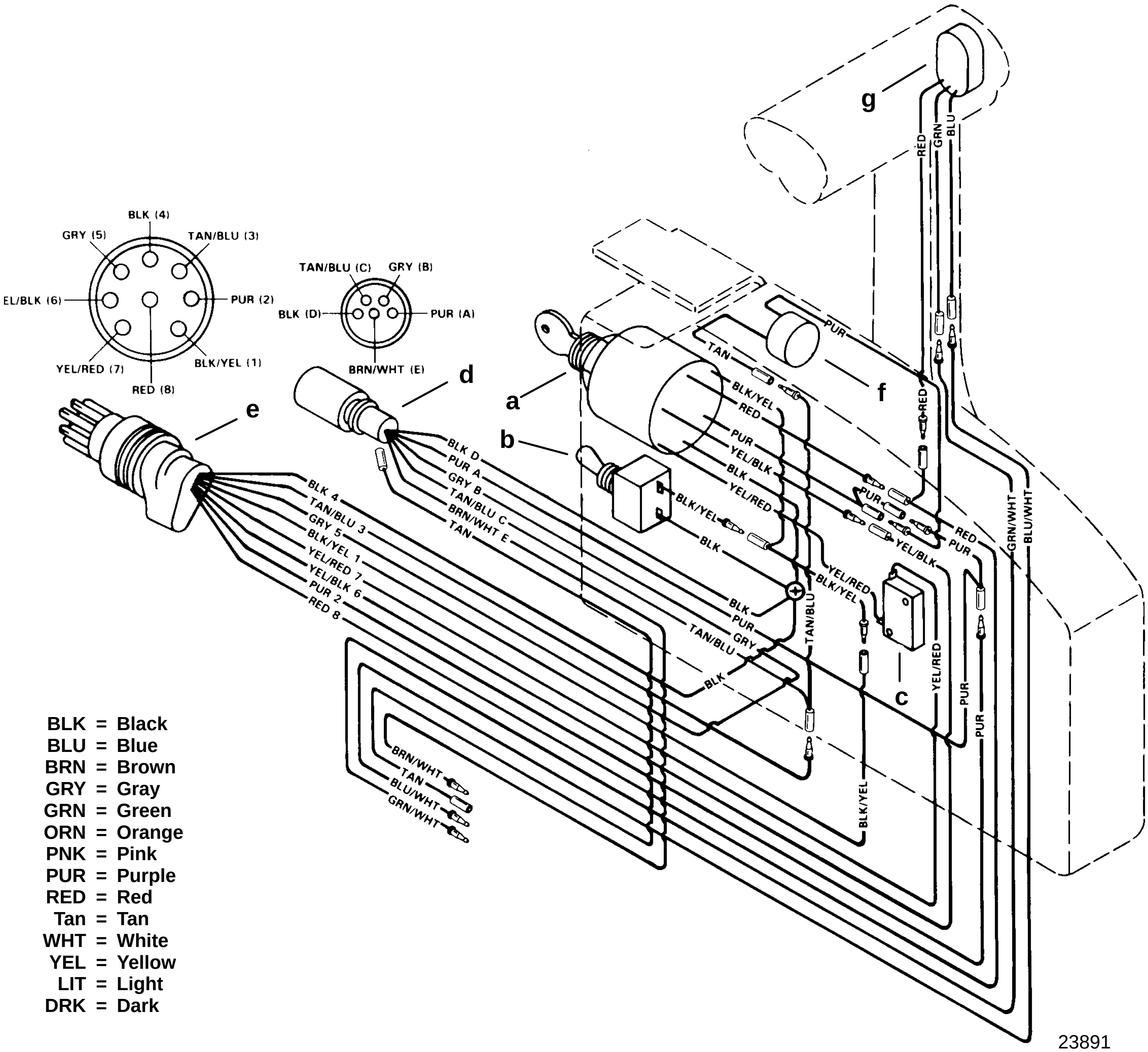


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
Tan = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

24072

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

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

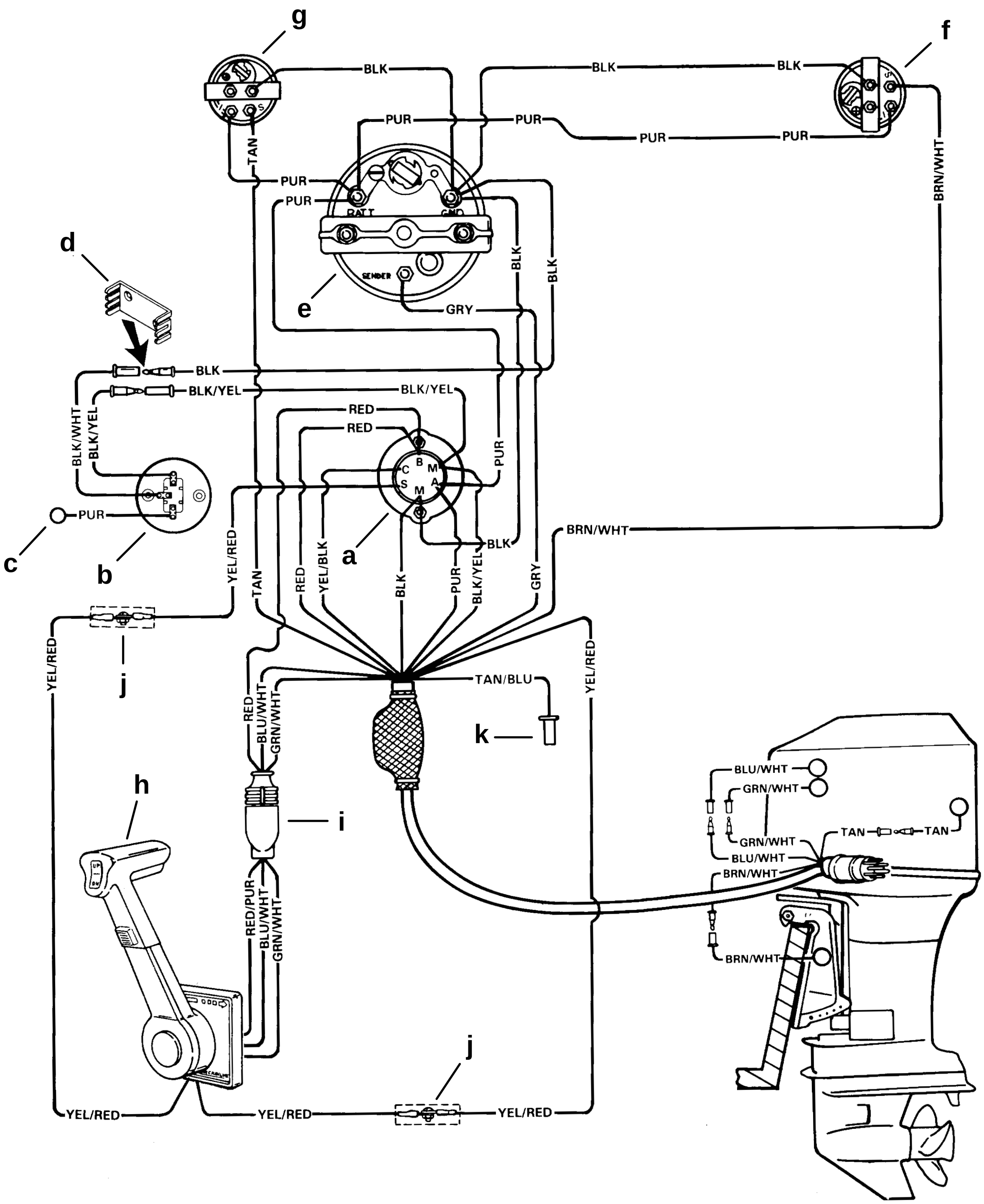


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
Tan = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

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

Instrument/Lanyard Stop Switch Wiring Diagram

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

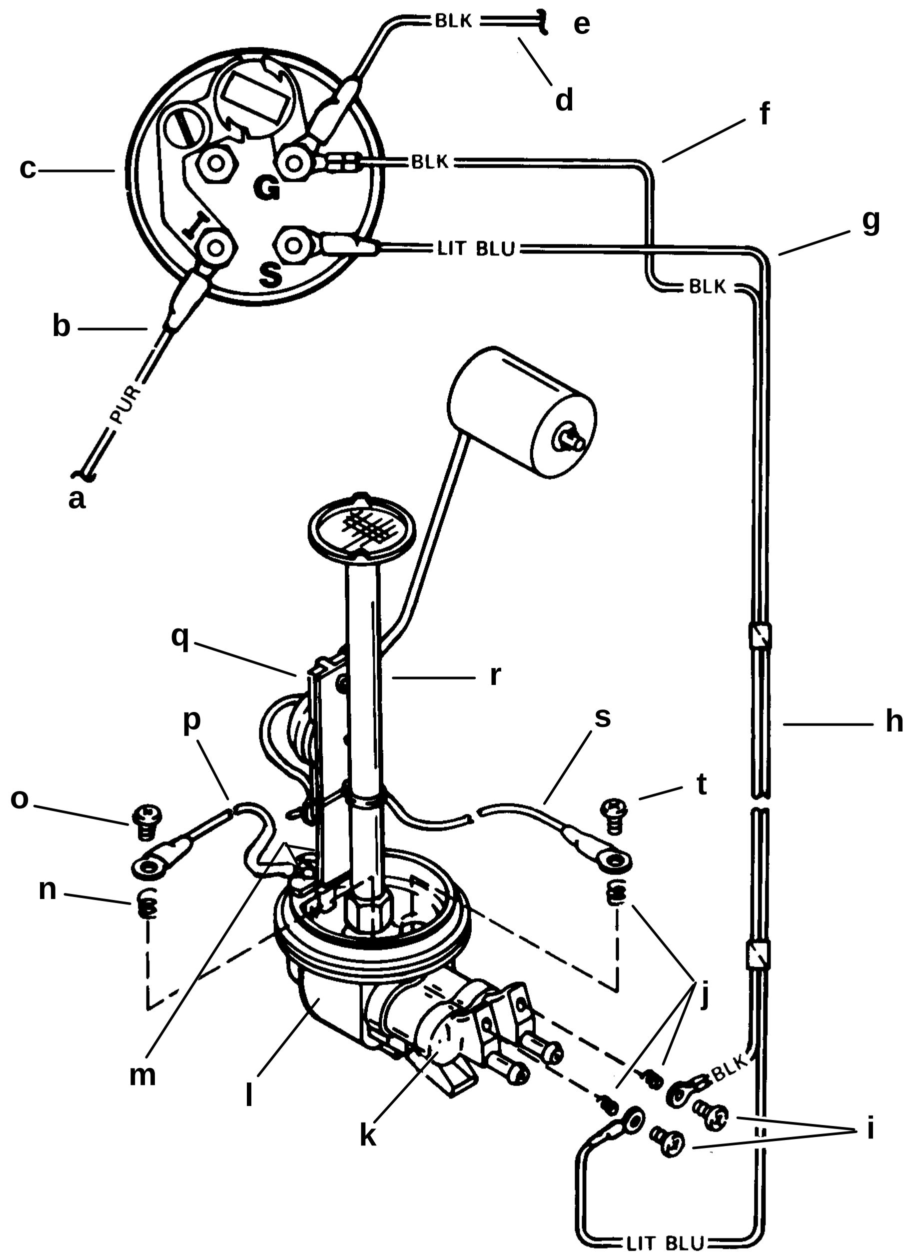


52204

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

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

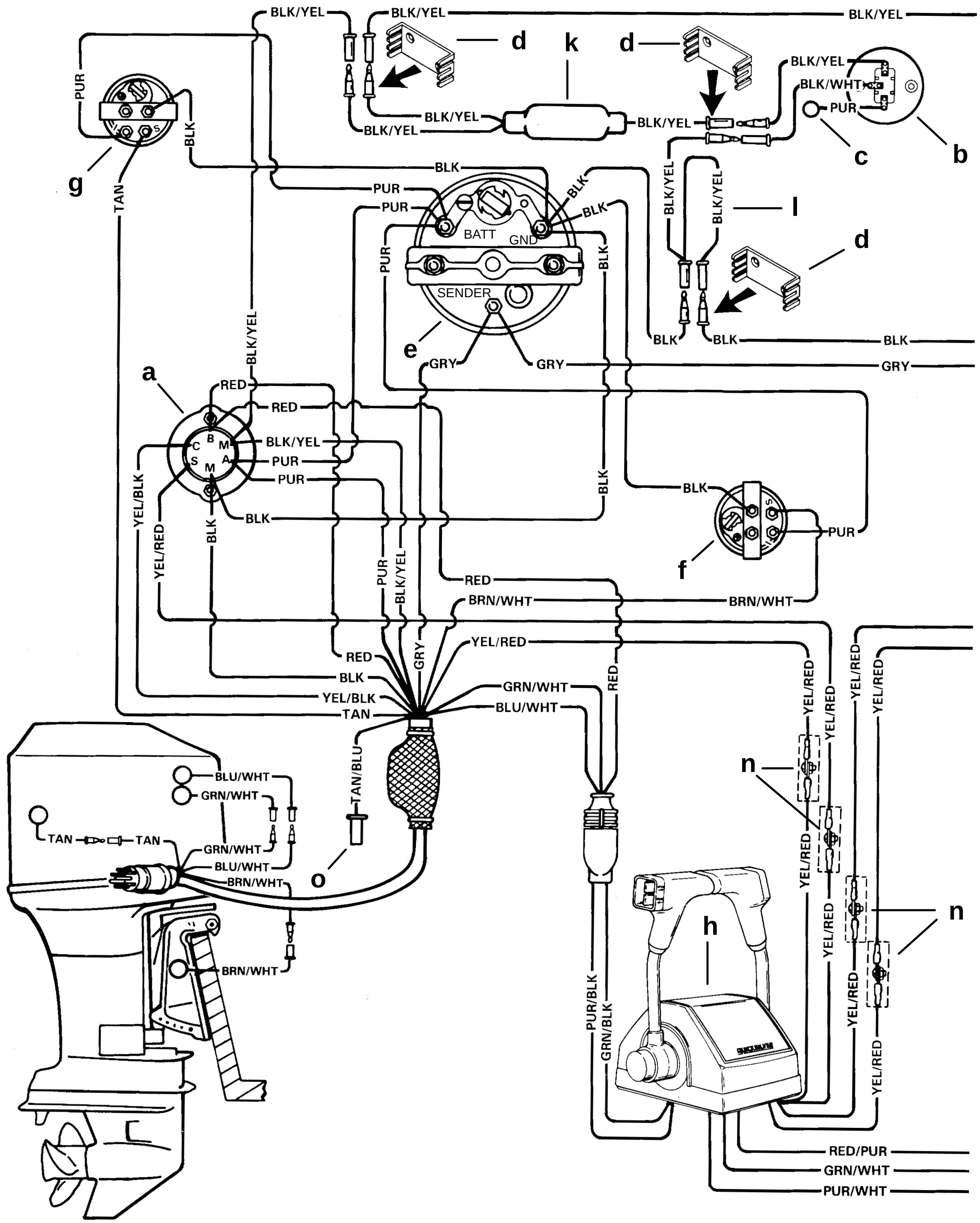
Oil Level Gauge Wiring Diagram



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

Instrument/Lanyard Stop Switch Wiring Diagram (Dual Outboard)

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

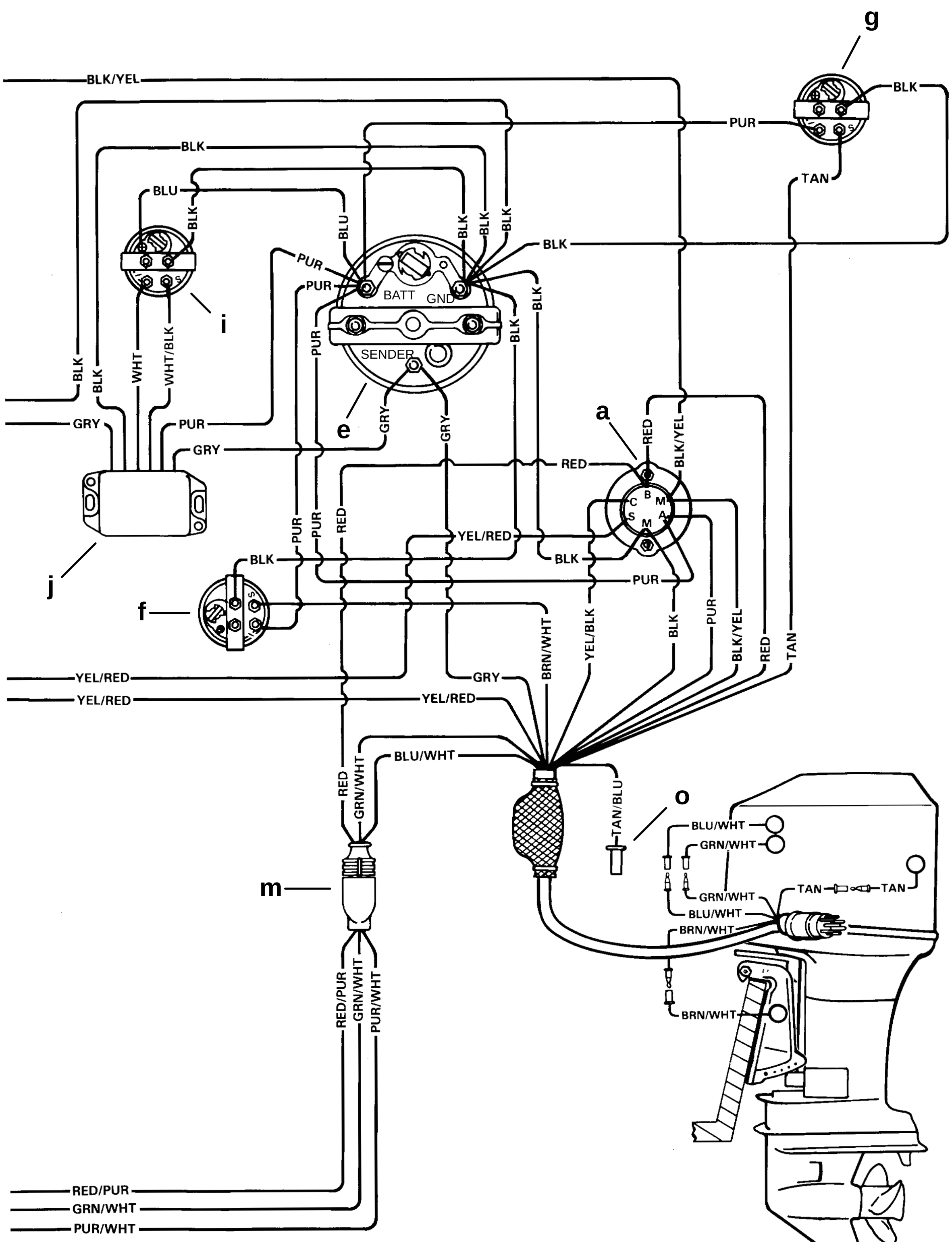


PORT INSTALLATION

52205

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

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



STARBOARD INSTALLATION

52206

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

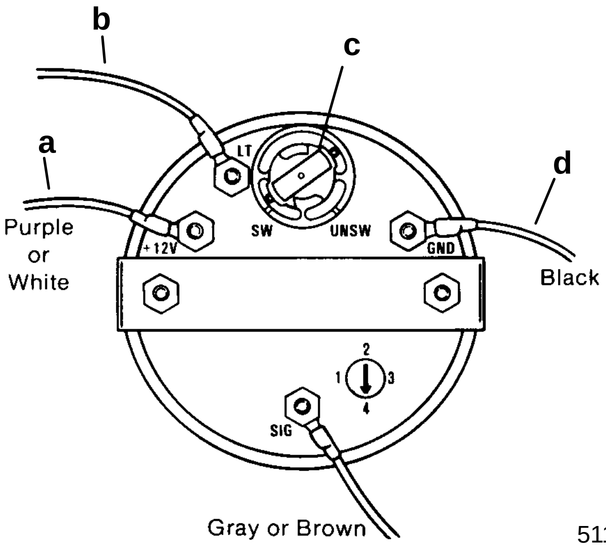
QSI Gauge Wiring Diagrams

Tachometer Wiring Diagram

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

WIRING DIAGRAM A

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

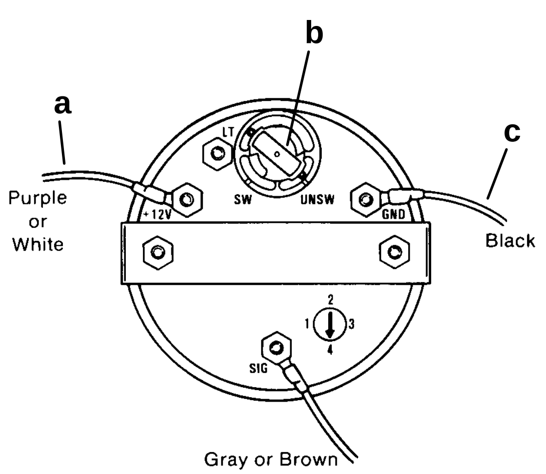


51106

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

WIRING DIAGRAM B

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



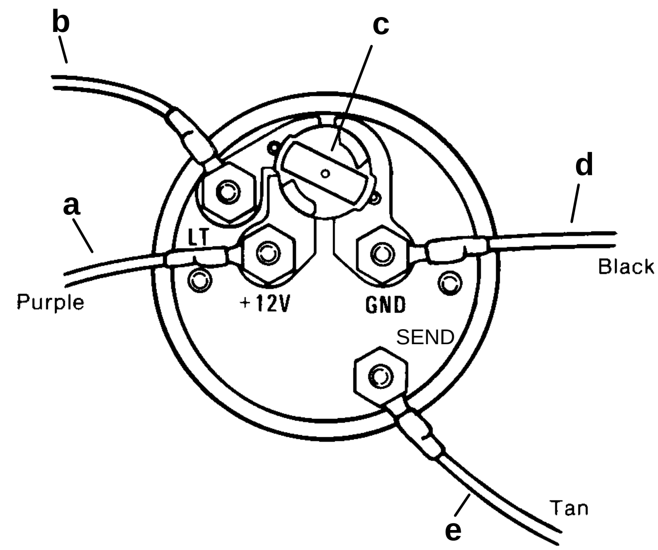
51106

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

Water Temperature Gauge

WIRING DIAGRAM A

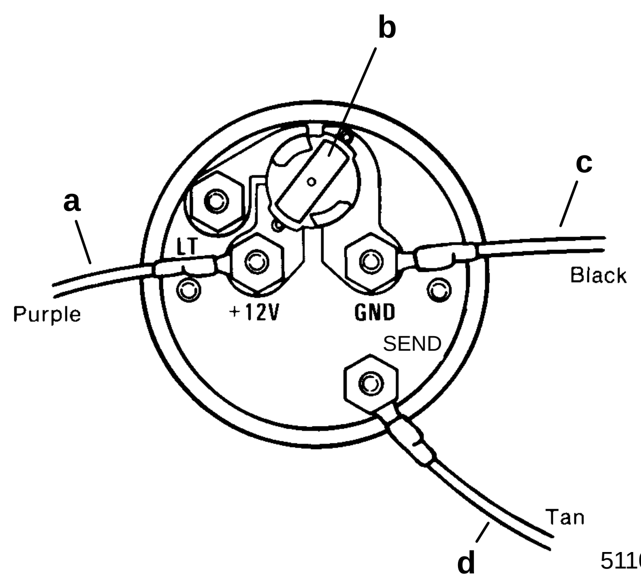
Use this wiring diagram when using a separate light switch for instrument lighting.



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

WIRING DIAGRAM B

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

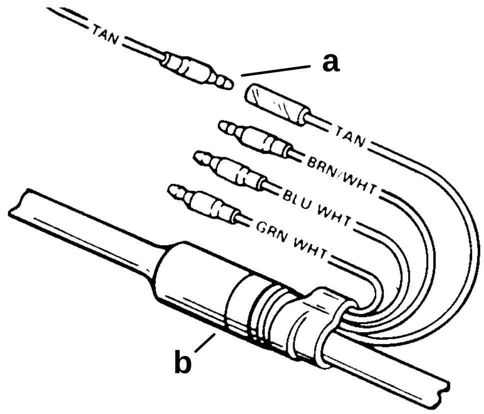


51105

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

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.

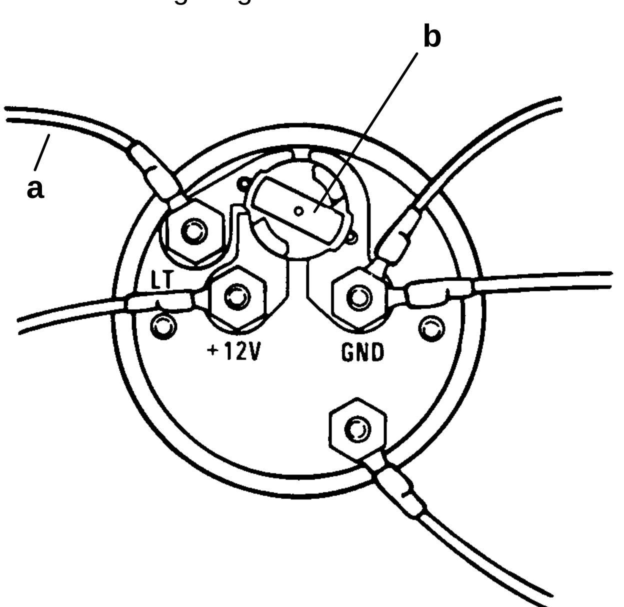


a - Lead from Temperature Sender
b - Engine/Remote Control Harness

Oil Level Gauge Wiring

LIGHT BULB POSITION A

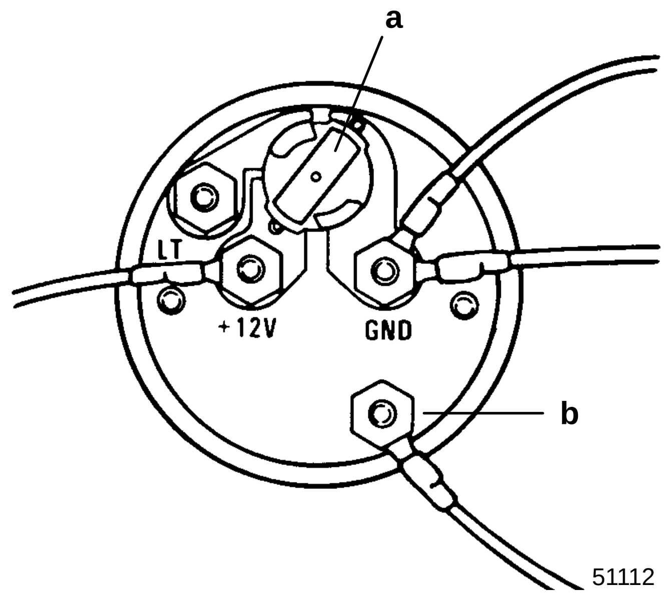
Use this position when using a separate light switch for instrument lighting.



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

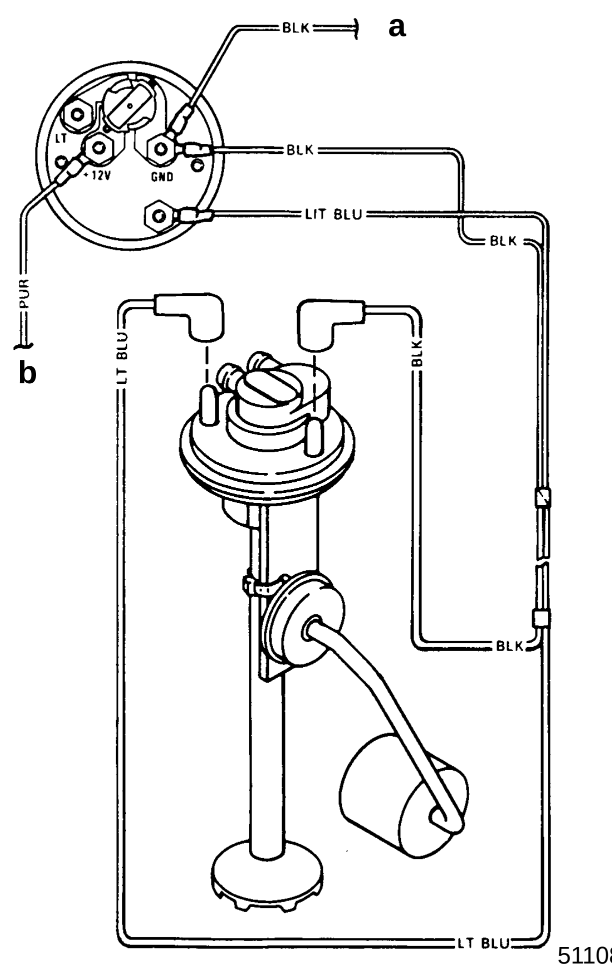
LIGHT BULB POSITION B

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

SENDER WIRING

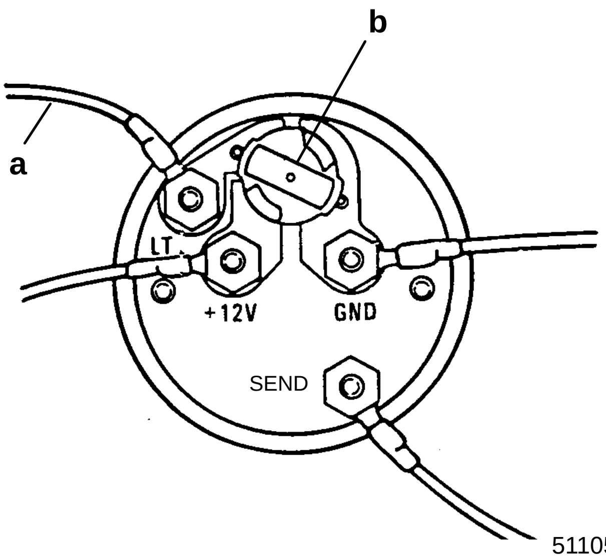


a - Connect to +12 Volt
b - Connect to NEGATIVE (–) Ground

Engine Synchronizer Wiring Diagram

LIGHT BULB POSITION A

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

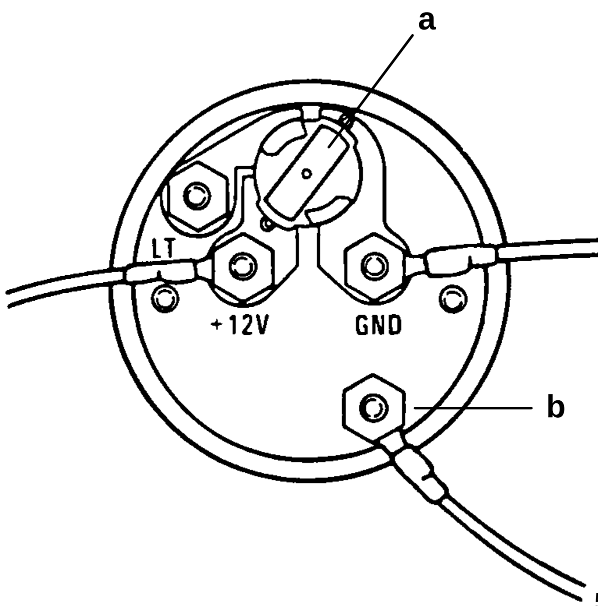


51105

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

LIGHT BULB POSITION B

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

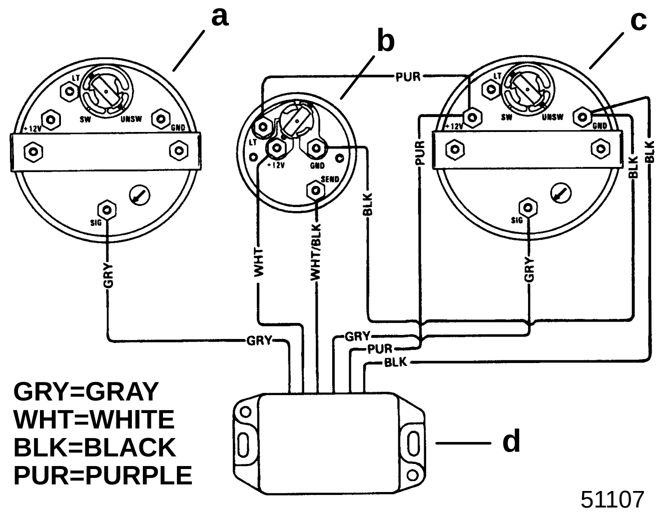


51106

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

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

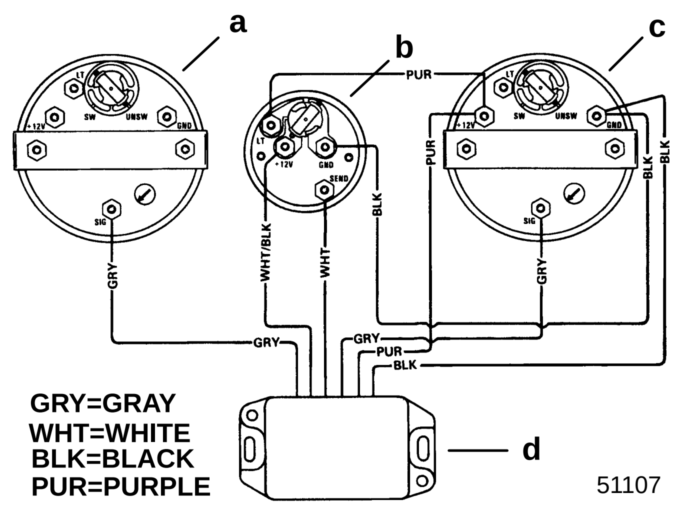
Wiring Diagram – Gauge needle to point toward slow running engine



51107

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

Wiring Diagram – Gauge needle to point toward fast running engine



51107

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

Maintenance

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

2 Function Gauge (Carburetor Models)

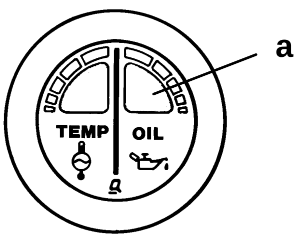
Operation of Warning Panel

When the ignition key is initially turned on, the warning horn will sound (beep) for a moment as a test to tell you the system is working. Failure of this test sound (beep) indicates a problem with the outboard or warning panel.

LOW OIL LEVEL

The low oil level warning is activated when the remaining oil in the engine mounted oil reservoir tank drops below 50 fl. oz. (1.5 liters).

The Low Oil Indicator Light will come on and the warning horn will begin a series of four beeps. If you continue to operate the outboard, the light will stay on and the horn will beep every two minutes.The engine has to be shut off to reset the warning system.

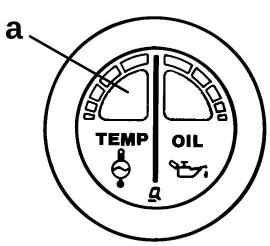


a - Low Oil Level Indicator Light

ENGINE OVERHEAT

The engine overheat warning is activated when the engine temperature is too hot.

The Engine Overheat Indicator Light will come on and the warning horn sounds continuously. The warning system will automatically limit the engine speed to 3000 RPM.

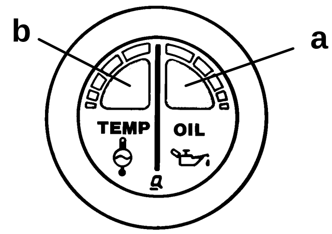


a - Engine Overheat Indicator Light

ENGINE OVER-SPEED

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

Anytime the engine over-speed system is activated, the warning horn begins beeping and the Engine Overheat and Low Oil Indicator Lights will turn on and alternately flash. In addition, the system will automatically reduce the engine speed to within the allowable limit by retarding the ignition timing.

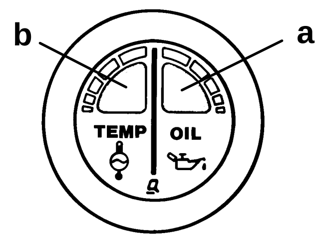


a - Low Oil Level Indicator Light
b - Engine Overheat Indicator Light

ELECTRICAL SENSOR NOT FUNCTIONING

The warning system is activated if the electrical throttle sensor or engine temperature sensor is not functioning, or is out of its operating range.

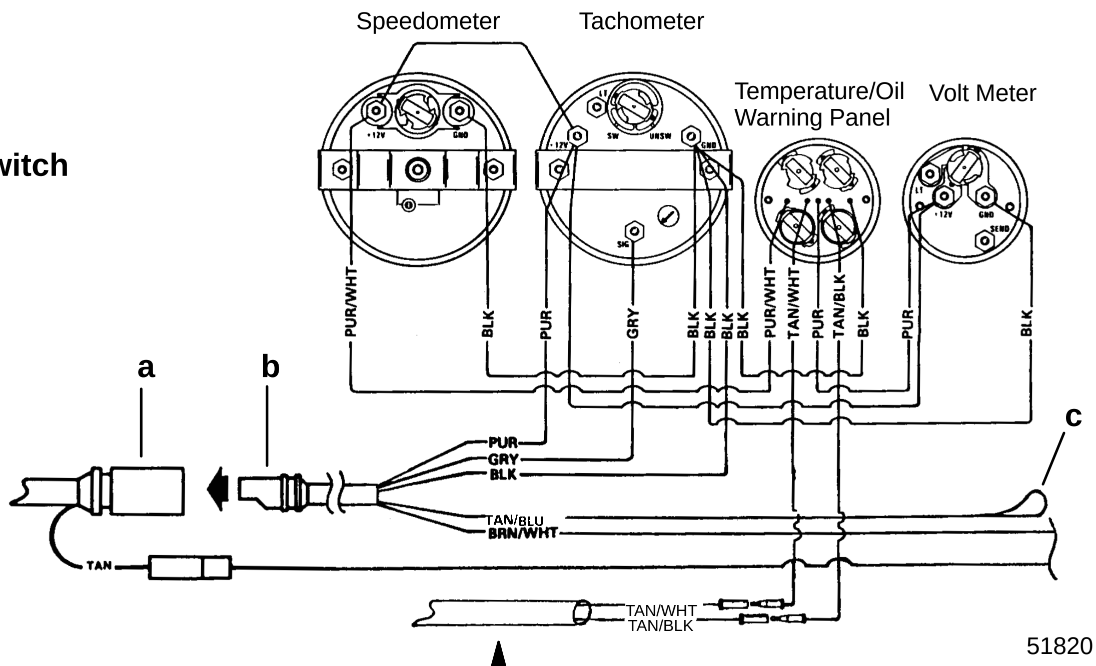
The warning horn begins beeping and the Engine Overheat and Low Oil Indicator Lights will turn on and alternately flash.



a - Low Oil Level Indicator Light
b - Engine Overheat Indicator Light

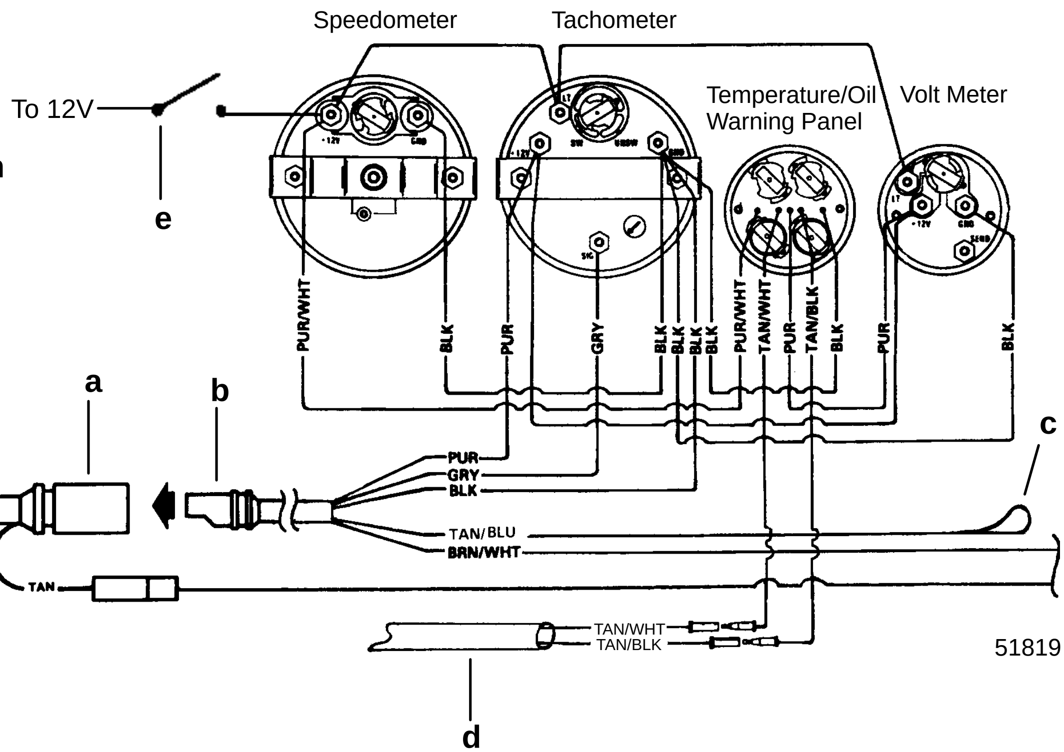
Instrument Wiring Connections (2 Function Gauge)

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

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.)

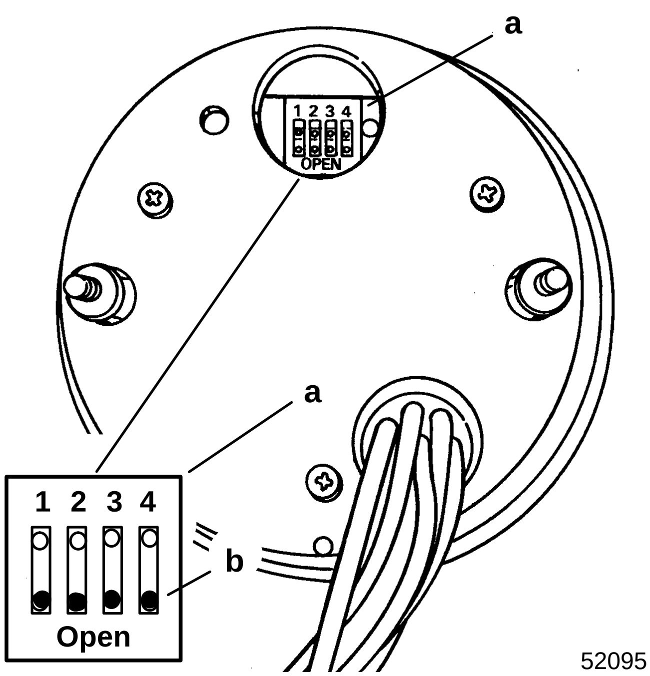
Multi-Function Gauge

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.

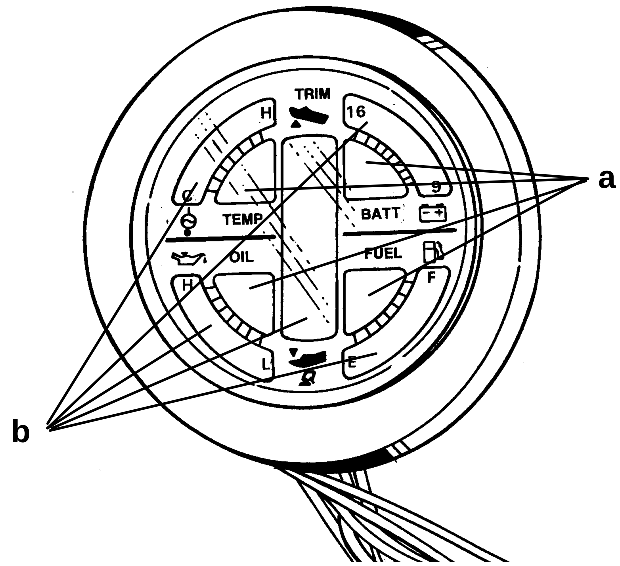
1. With the ignition switch in the "Off" position, set the multi-function gauge "Dip Switch" in (test) position as shown. (Black dot indicates switch position).



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

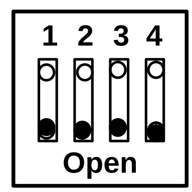
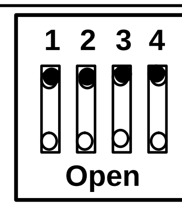
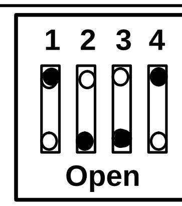
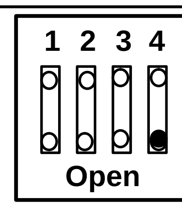
2. Turn ignition switch to the "Run" position. The multi-function gauge now is in the display test mode. The gauge Temp, Batt, Oil, and Fuel red warning lights should be alternately flashing "On" and "Off"; the Black L.C.D. bar graphs should be cycling. (This indicates that all gauge functions are operational.)

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.

225 EFI/250 EFI Warning Panel (3 Function Gauge)

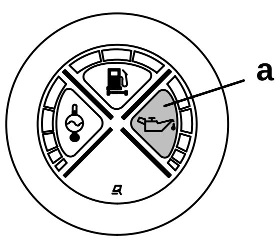
Operation of Warning Panel

When the ignition key is initially turned on, the warning horn will sound (beep) for a moment as a test to tell you the system is working. Failure of this test sound (beep) indicates a problem with the outboard or warning panel.

LOW OIL LEVEL

The low oil level warning is activated when the remaining oil in the engine mounted oil reservoir tank drops below 50 fl. oz. (1.5 liters).

The Low Oil Indicator Light will come on and the warning horn will begin a series of four beeps. If you continue to operate the outboard, the light will stay on and the horn will beep every two minutes.The engine has to be shut off to reset the warning system.

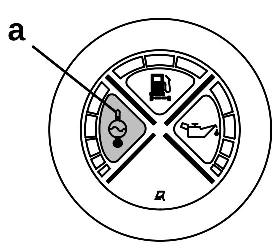


a - Low Oil Level Indicator Light

ENGINE OVERHEAT

The engine overheat warning is activated when the engine temperature is too hot.

The Engine Overheat Indicator Light will come on and the warning horn sounds continuously. The warning system will automatically limit the engine speed to 3000 RPM.

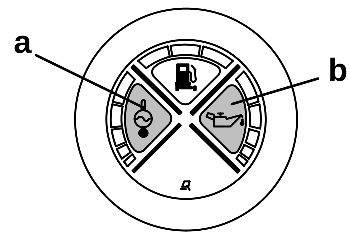


a - Engine Overheat Indicator Light

ENGINE OVER-SPEED

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

Anytime the engine over-speed system is activated, the warning horn begins beeping and the Engine Overheat and Low Oil Indicator Lights will turn on and alternately flash. In addition, the system will automatically reduce the engine speed to within the allowable limit by retarding the ignition timing.

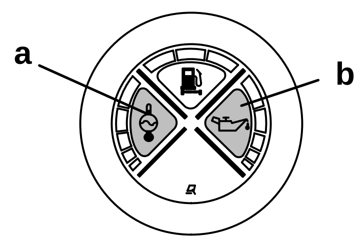


a - Low Oil Level Indicator Light
b - Engine Overheat Indicator Light

ELECTRICAL SENSOR NOT FUNCTIONING

The warning system is activated if the electrical throttle sensor or engine temperature sensor is not functioning, or is out of its operating range.

The warning horn begins beeping and the Engine Overheat and Low Oil Indicator Lights will turn on and alternately flash.

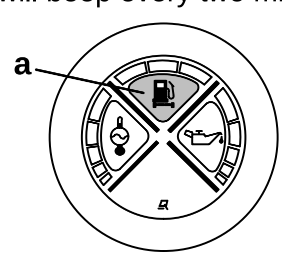


a - Low Oil Level Indicator Light
b - Engine Overheat Indicator Light

WATER SEPARATING FUEL FILTER IS FULL OF WATER

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

The Water Detection Light will come on and the warning horn will begin a series of four beeps. If you continue to operate the outboard, the light will stay on and the horn will beep every two minutes.



a - Water Detection Light

Maintenance

Maintenance inspection is the owner's responsibility and must be performed at intervals as specified.

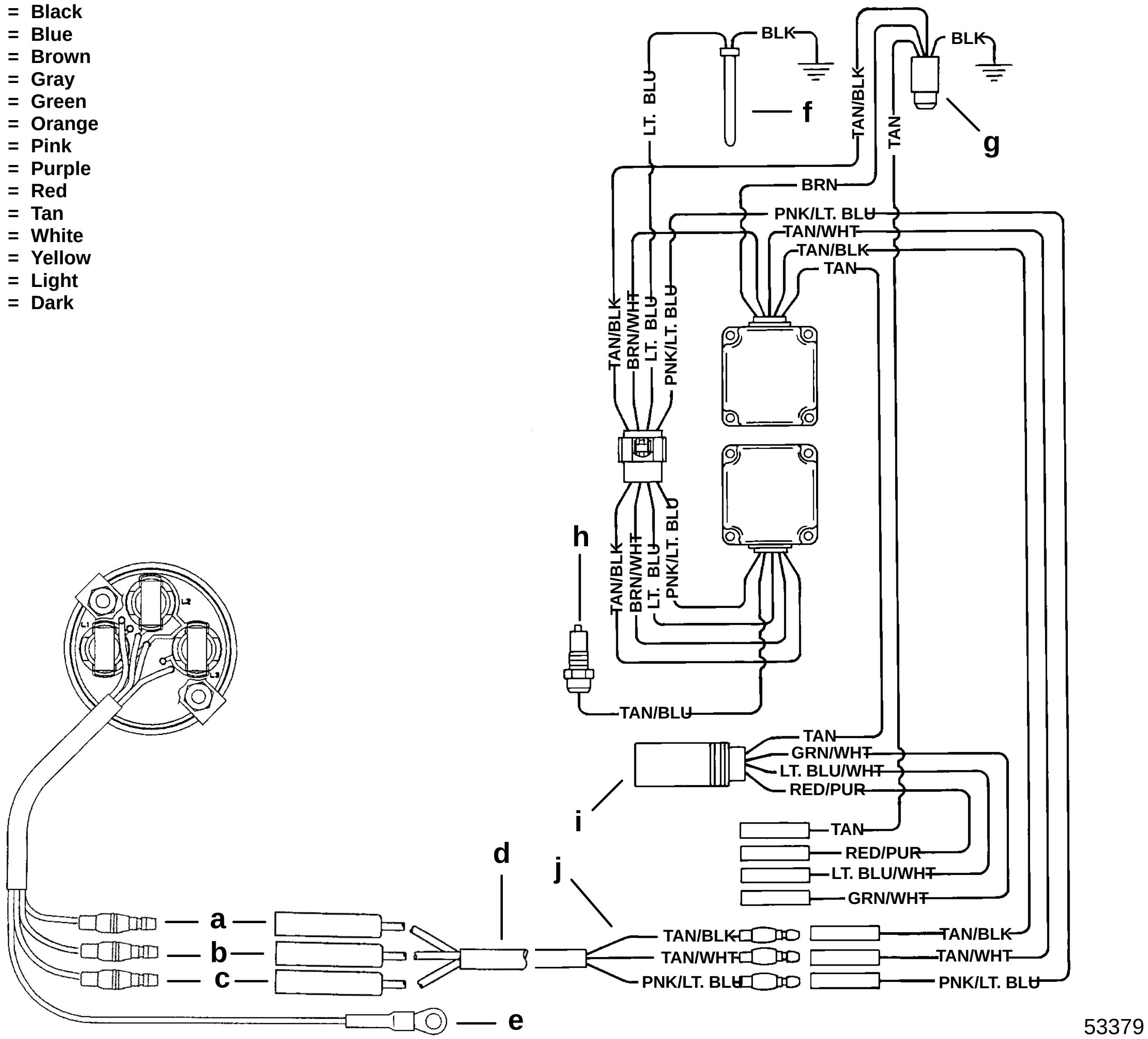
Normal Service - Every 50 hours of operation or 60 days (whichever comes first)

***Severe Service* - Every 25 hours of operation or 30 days (whichever comes first)**

*Salt water area operation is considered "Severe Service".

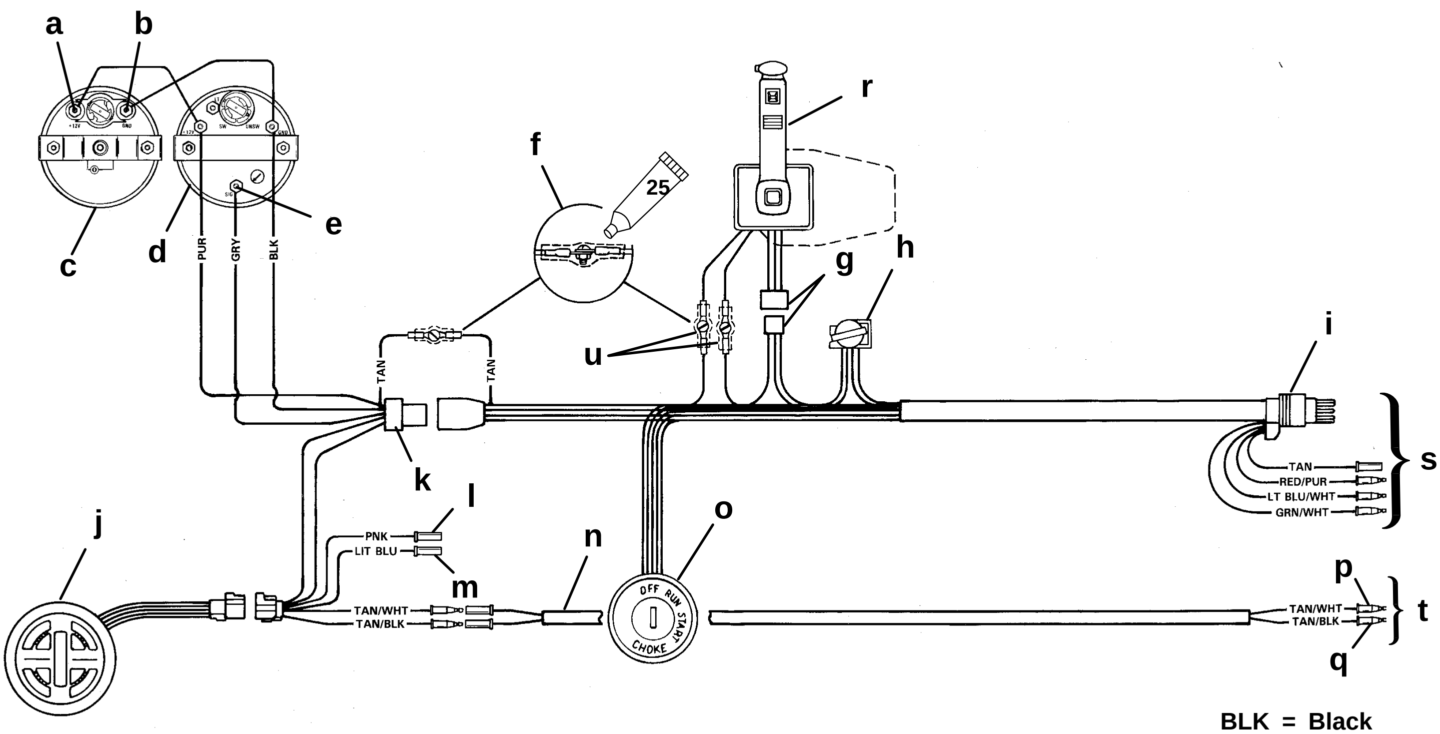
1. Check gauge for adequate tightness in dashboard and retighten retaining nuts if necessary.
2. Check electrical connections. Tighten and reseal with Quicksilver Liquid Neoprene (92-25711-2).
3. Clean gauge by washing with fresh water to remove sand and salt deposits. Wipe off with a soft cloth moistened 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 trichlorethylene, turpentine, etc.

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 - Connect TAN/BLACK to TAN/BLACK
b - Connect TAN/WHITE to TAN/WHITE
c - Connect PINK/LT. BLUE to PINK/LT. BLUE
d - Harness Extension
e - Connect PURPLE to 12 Volt Source or Adjacent Gauge
f - Low Oil Sensor
g - Engine Temperature Sensor
h - Water in Fuel Sensor
i - Engine Harness Plug In
j - Harness Extension Plugging Into Engine Harness

Panel Mount Remote Control Wiring Installation



BLK = Black
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GRY = Gray
GRN = Green
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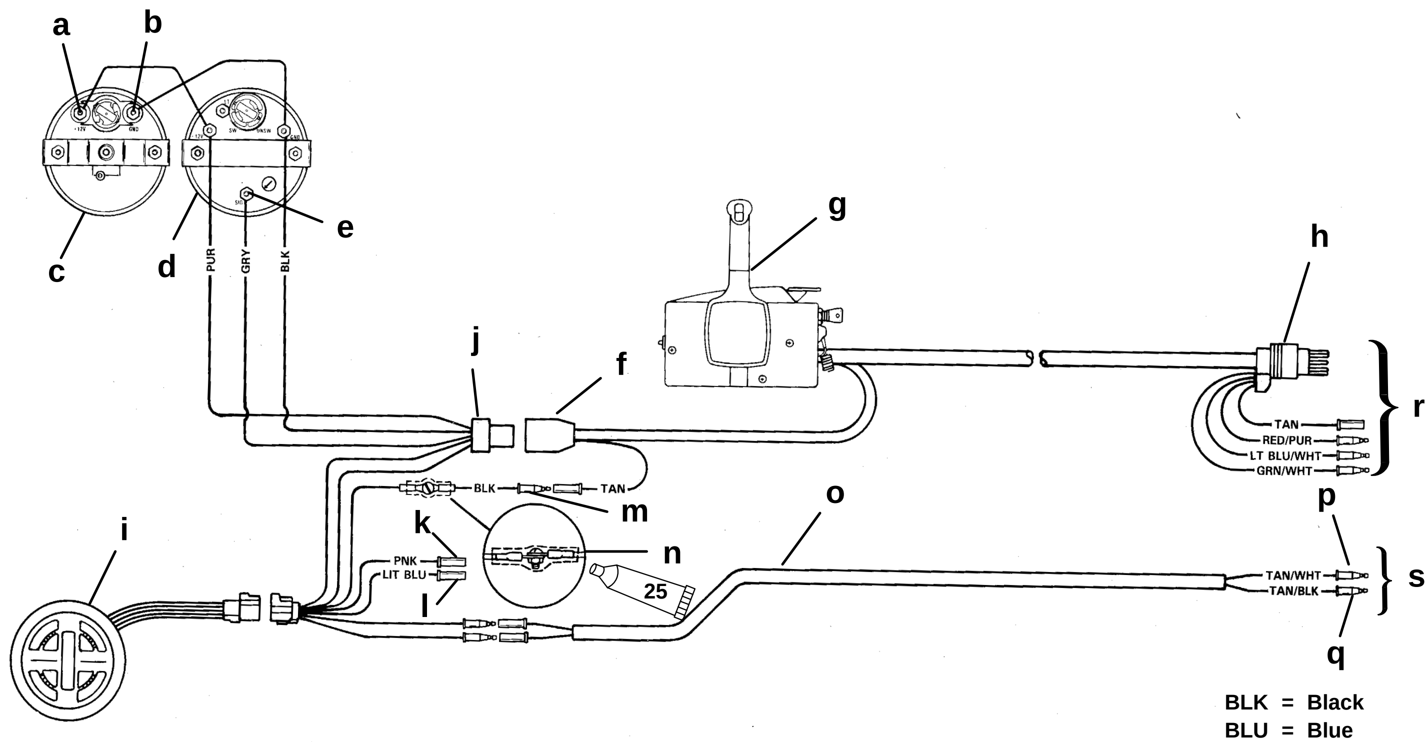
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

25 Liquid Neoprene (92-25711--2)

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

Side Mount Remote Control Wiring Installation



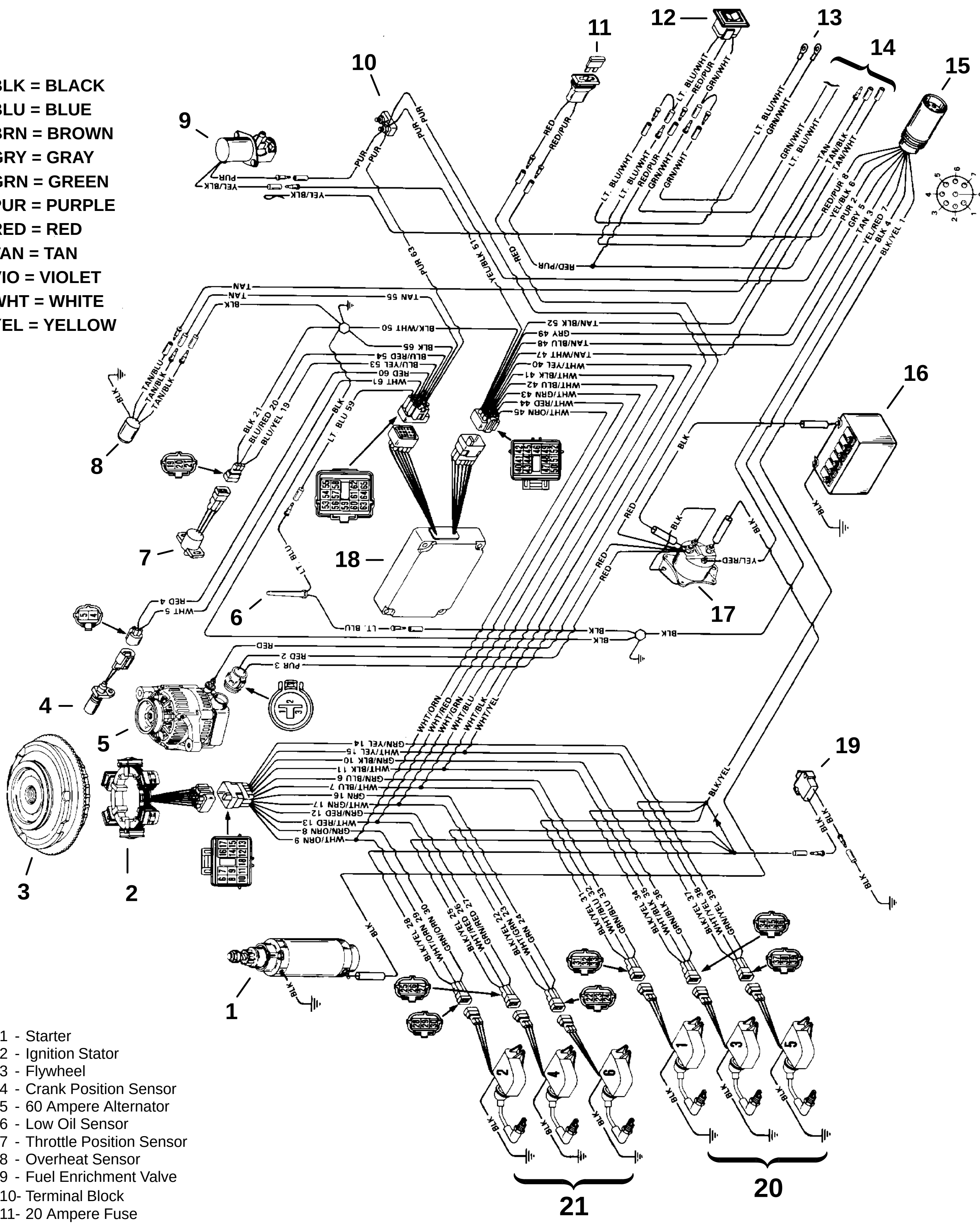
BLK	=	Black
BLU	=	Blue
BRN	=	Brown
GRY	=	Gray
GRN	=	Green
ORN	=	Orange
PNK	=	Pink
PUR	=	Purple
RED	=	Red
TAN	=	Tan
WHT	=	White
YEL	=	Yellow
LIT	=	Light
DRK	=	Dark

25 Liquid Neoprene (92-25711--2)

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

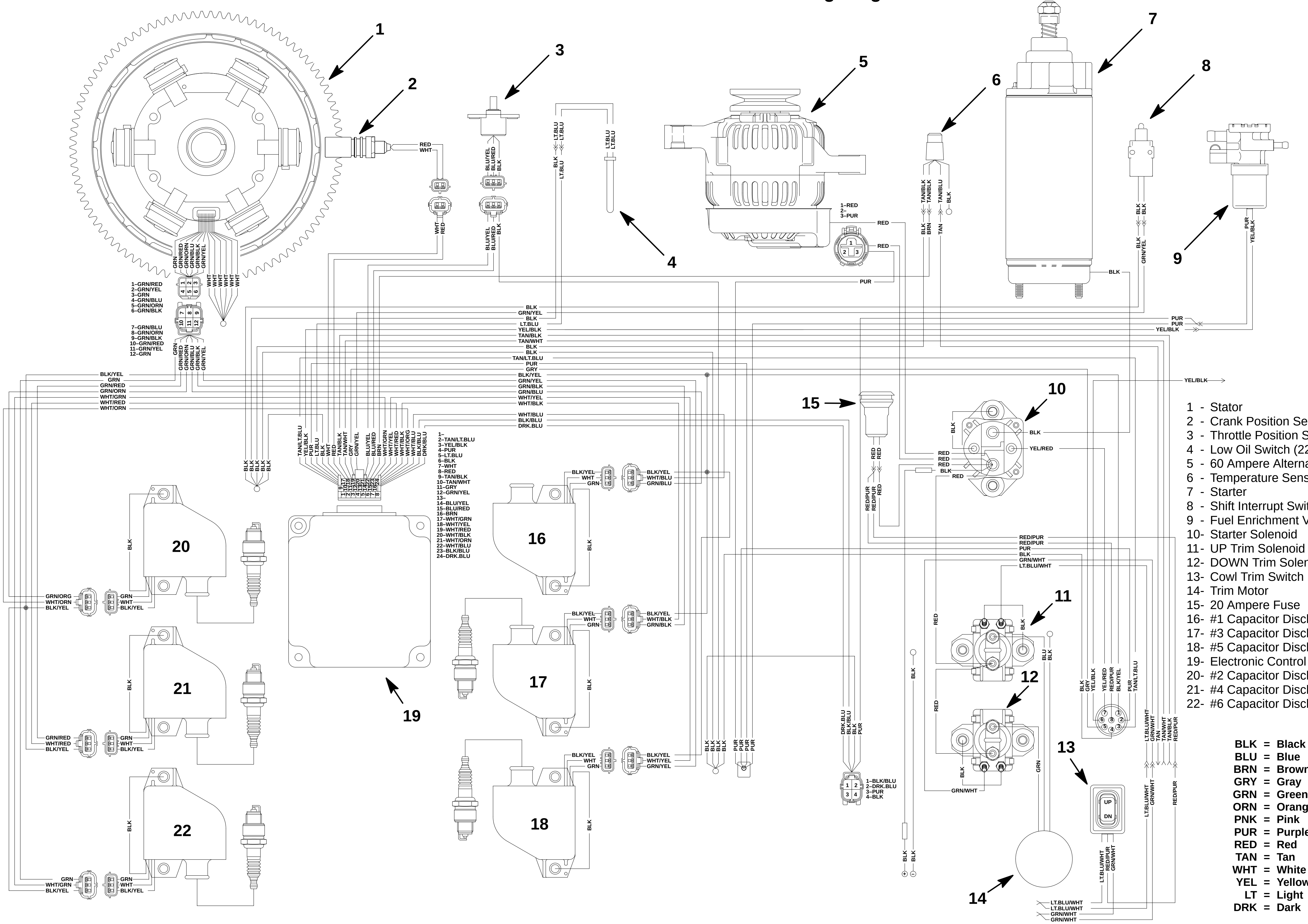
1994 225 Wiring Diagram

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



1 - Starter
2 - Ignition Stator
3 - Flywheel
4 - Crank Position Sensor
5 - 60 Ampere Alternator
6 - Low Oil Sensor
7 - Throttle Position Sensor
8 - Overheat Sensor
9 - Fuel Enrichment Valve
10- Terminal Block
11- 20 Ampere Fuse
12- Cowl Trim Switch
13- To Trim Solenoids
14- To Remote Control Harness
15- Engine Harness Plug
16- 12 Volt Battery
17- Starter Solenoid
18- Electronic Control Module (ECM)
19- Shift Interrupt Switch
20- Starboard Ignition Modules - 1,3,5
21- Port Ignition Modules - 2,4,6
22- Ignition Stator

1995 3 Litre Work/225 Carb Wiring Diagram

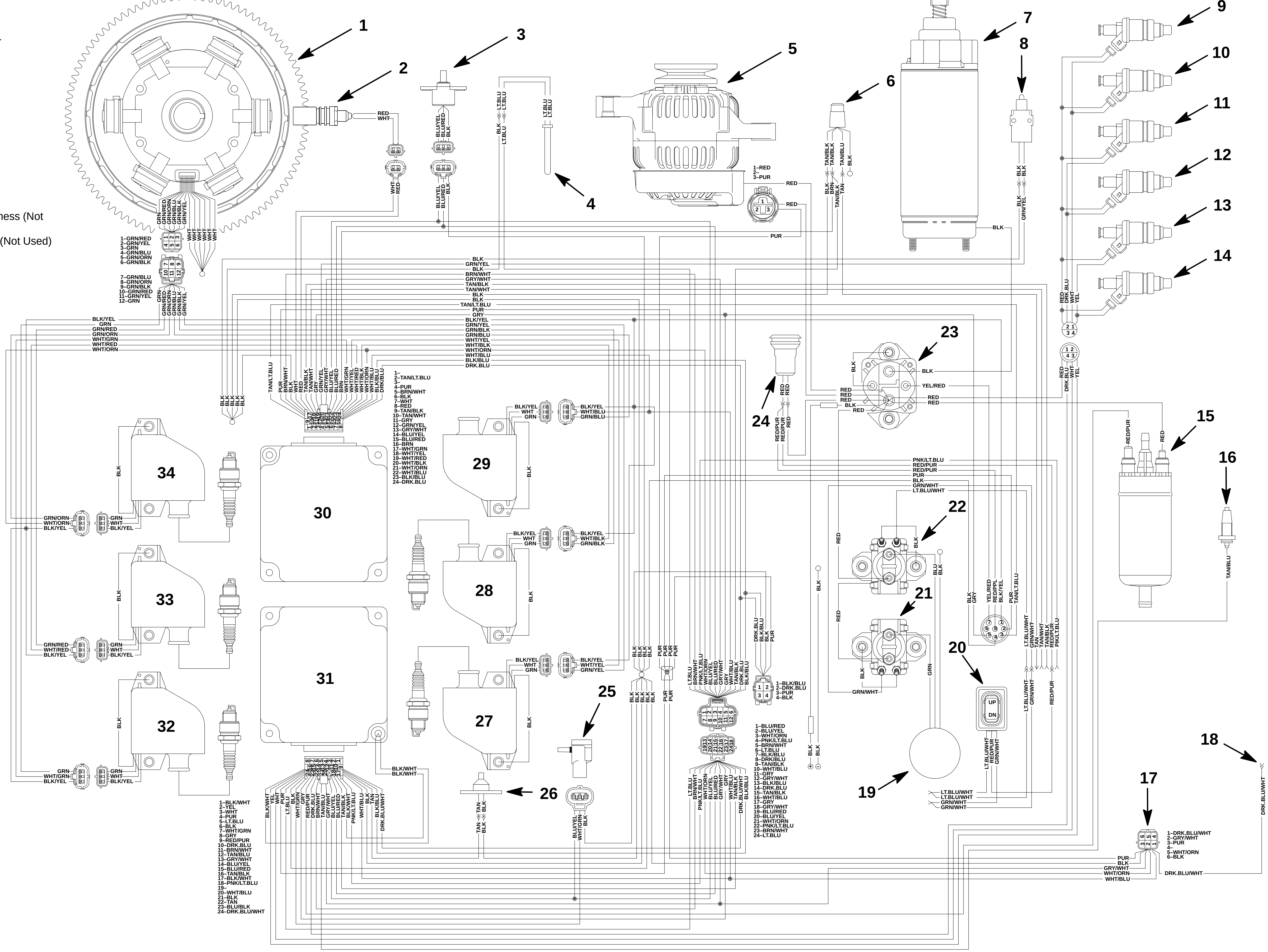


1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch (225 Carb Only)
5 - 60 Ampere Alternator
6 - Temperature Sensor
7 - Starter
8 - Shift Interrupt Switch
9 - Fuel Enrichment Valve
10- Starter Solenoid
11- UP Trim Solenoid
12- DOWN Trim Solenoid
13- Cowl Trim Switch
14- Trim Motor
15- 20 Ampere Fuse
16- #1 Capacitor Discharge Module
17- #3 Capacitor Discharge Module
18- #5 Capacitor Discharge Module
19- Electronic Control Module
20- #2 Capacitor Discharge Module
21- #4 Capacitor Discharge Module
22- #6 Capacitor Discharge Module

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

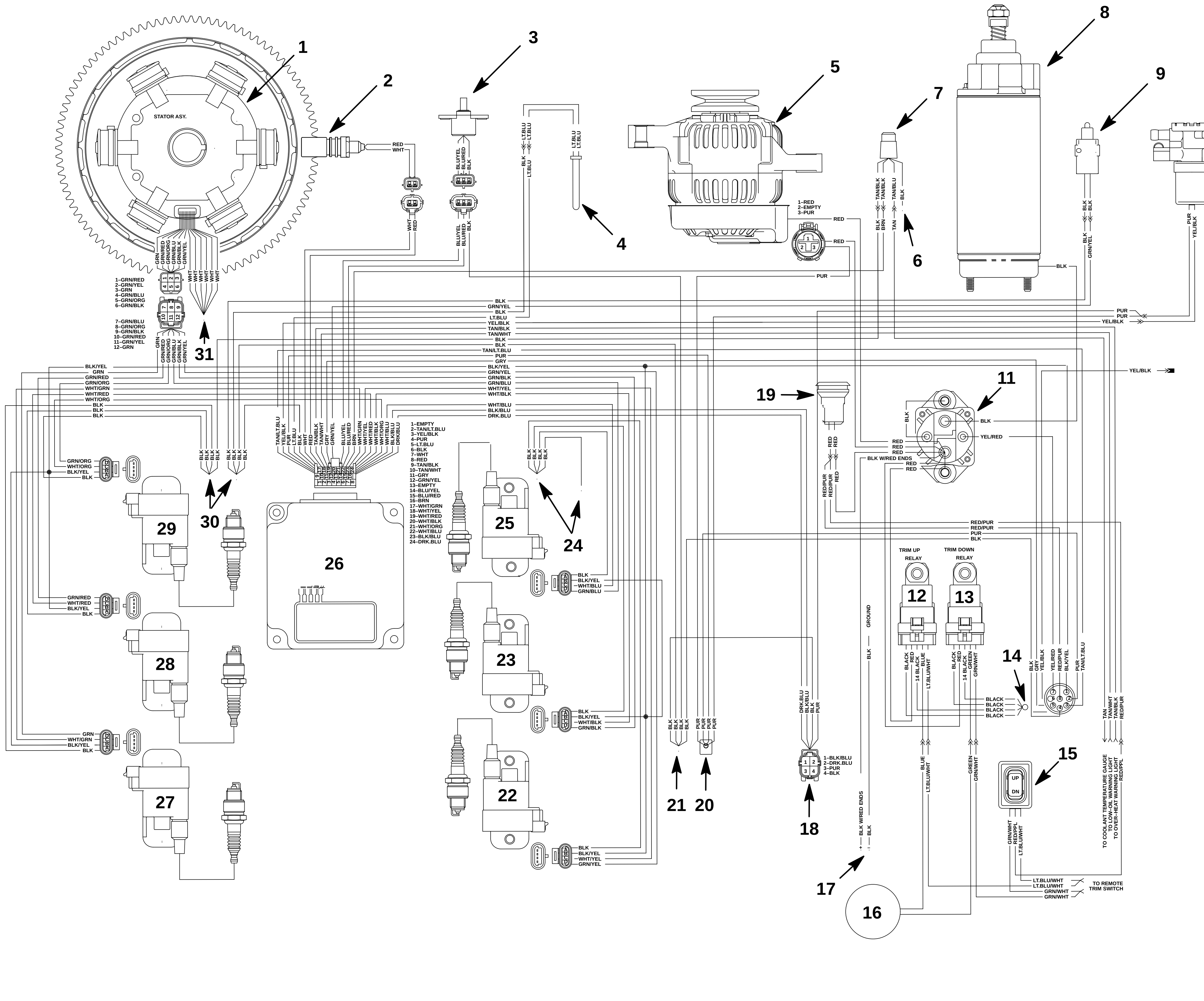
1995 225 EFI Wiring Diagram

Stator
Crank Position Sensor
Throttle Position Sensor
Low Oil Switch
60 Ampere Alternator
Temperature Sensor
Starter
Shift Interrupt Switch
#1 Fuel Injector
#2 Fuel Injector
#3 Fuel Injector
#4 Fuel Injector
#5 Fuel Injector
#6 Fuel Injector
Fuel Pump
Water Sensor
Detonation Module Harness (Not Used)
Knock Sensor Harness (Not Used)
Trim Motor
Cowl Trim Switch
DOWN Trim Solenoid
UP T rim Solenoid
Starter Solenoid
20 Ampere Fuse
MAP Sensor
Air Temperature Sensor
#5 CDM
#3 CDM
#1 CDM
Ignition ECM
EFI (Fuel) ECM
#6 CDM
#4 CDM
#2 CDM



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

1996/1997/1998 3 Litre Work/225 Carburetor Wiring Diagram



1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch (225 Carb Only)
5 - 60 Ampere Alternator
6 - Ground
7 - Temperature Sensor
8 - Starter
9 - Shift Interrupt Switch
10- Fuel Enrichment Valve
11- Starter Solenoid
12- UP Trim Solenoid
13- DOWN Trim Solenoid
14- Ground
15- Cowl Trim Switch
16- Trim Motor
17- To 12 Volt Battery
18- Diagnostic Harness
19- 20 Ampere Fuse
20- Terminal Block
21- Ground
22- #5 CDM
23- #3 CDM
24- Grounds
25- #1 CDM
26- Ignition ECU
27- #6 CDM
28- #4 CDM
29- #2 CDM
30- Grounds
31- Ground

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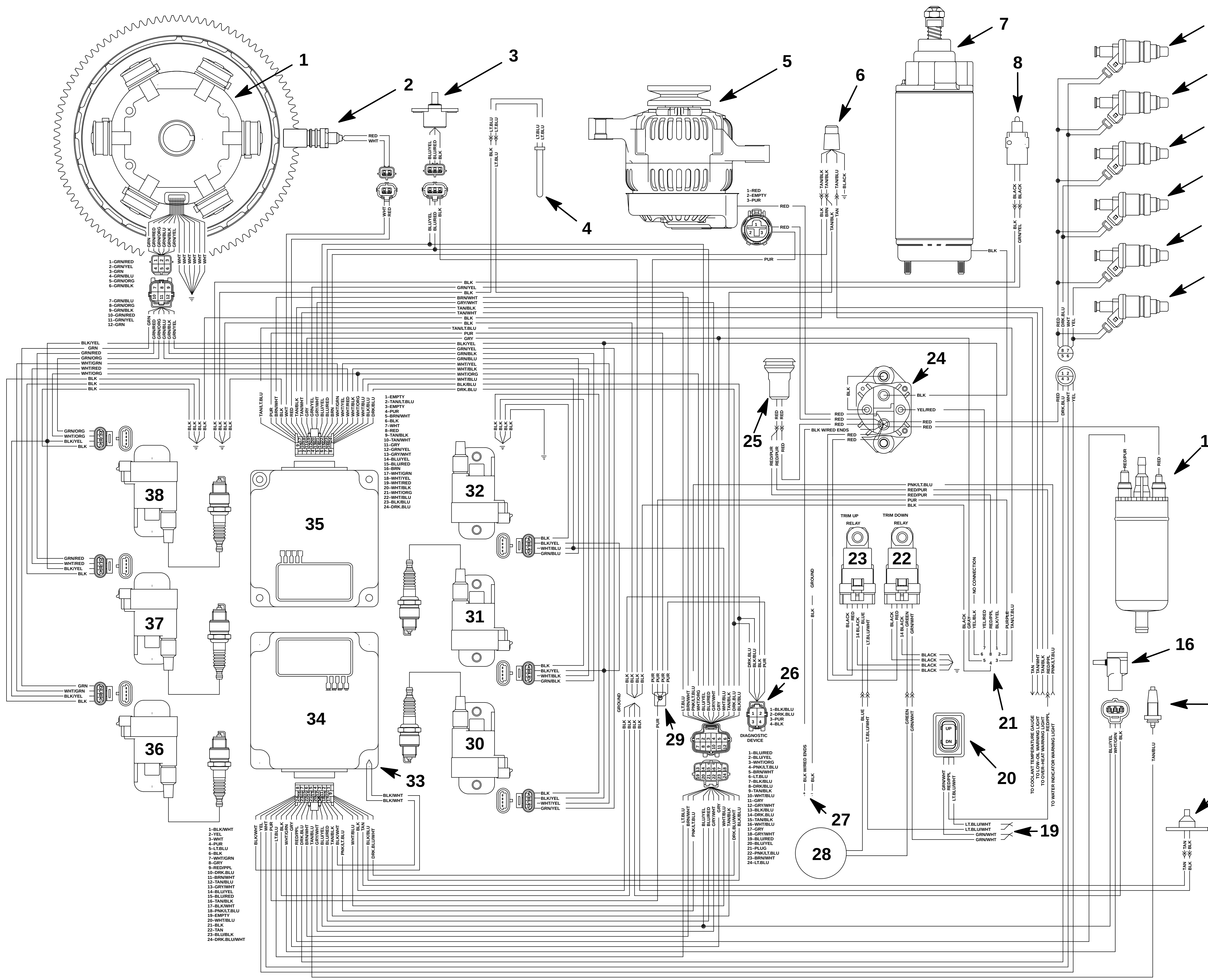
LT = Light
DRK = Dark

1996/1997/1998 225 EFI/250 EFI Wiring Diagram

Stator
Crank Position Sensor
Throttle Position Sensor
Low Oil Switch
60 Ampere Alternator
Temperature Sensor
Starter
Shift Interrupt Switch
#1 Fuel Injector
#2 Fuel Injector
#3 Fuel Injector
#4 Fuel Injector
#5 Fuel Injector
#6 Fuel Injector
Fuel Pump
Map Sensor
Water Sensor
Air Temperature Sensor
To Remote Trim Switch
Cowl Trim Switch
Remote Control Harness
DOWN Trim Solenoid
UP Trim Solenoid
Starter Solenoid
20 Ampere Fuse
Diagnostic Harness
To 12 Volt Battery
Trim Motor
Terminal Block
#5 CDM
#3 CDM
#1 CDM
Ground
EFI (Fuel) ECM
Ignition ECM
#6 CDM
#4 CDM
#2 CDM

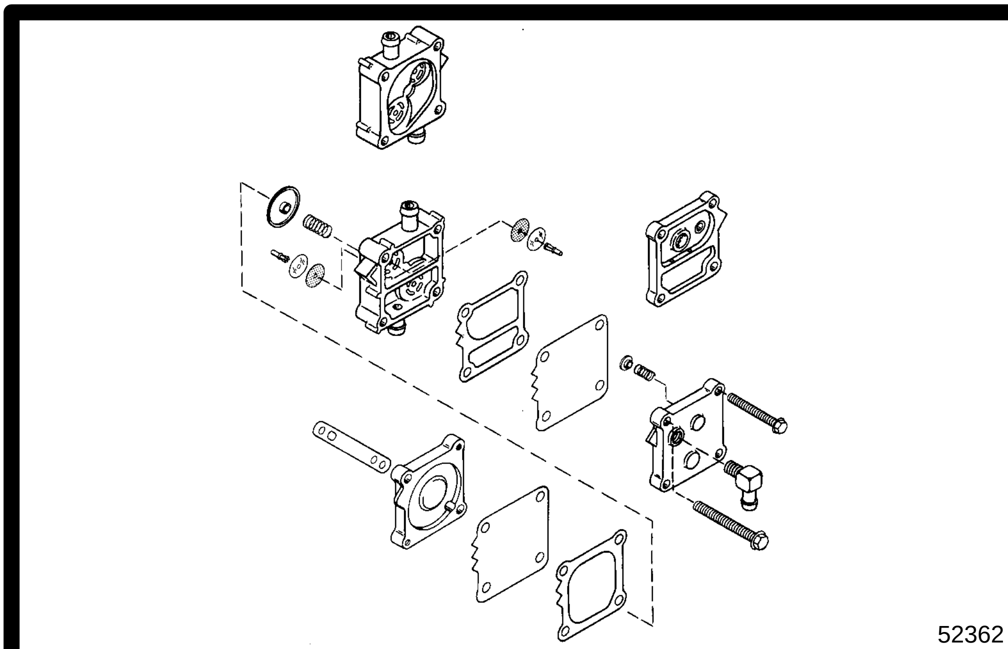


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark

FUEL SYSTEMS

3

A



FUEL PUMP

Table of Contents

Specifications

Fuel Pump Pressure @ W.O.T.

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

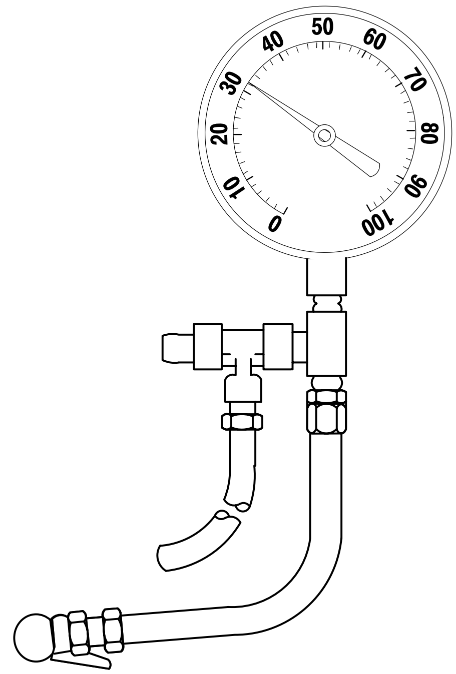
Fuel Pump Pressure @ Idle

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

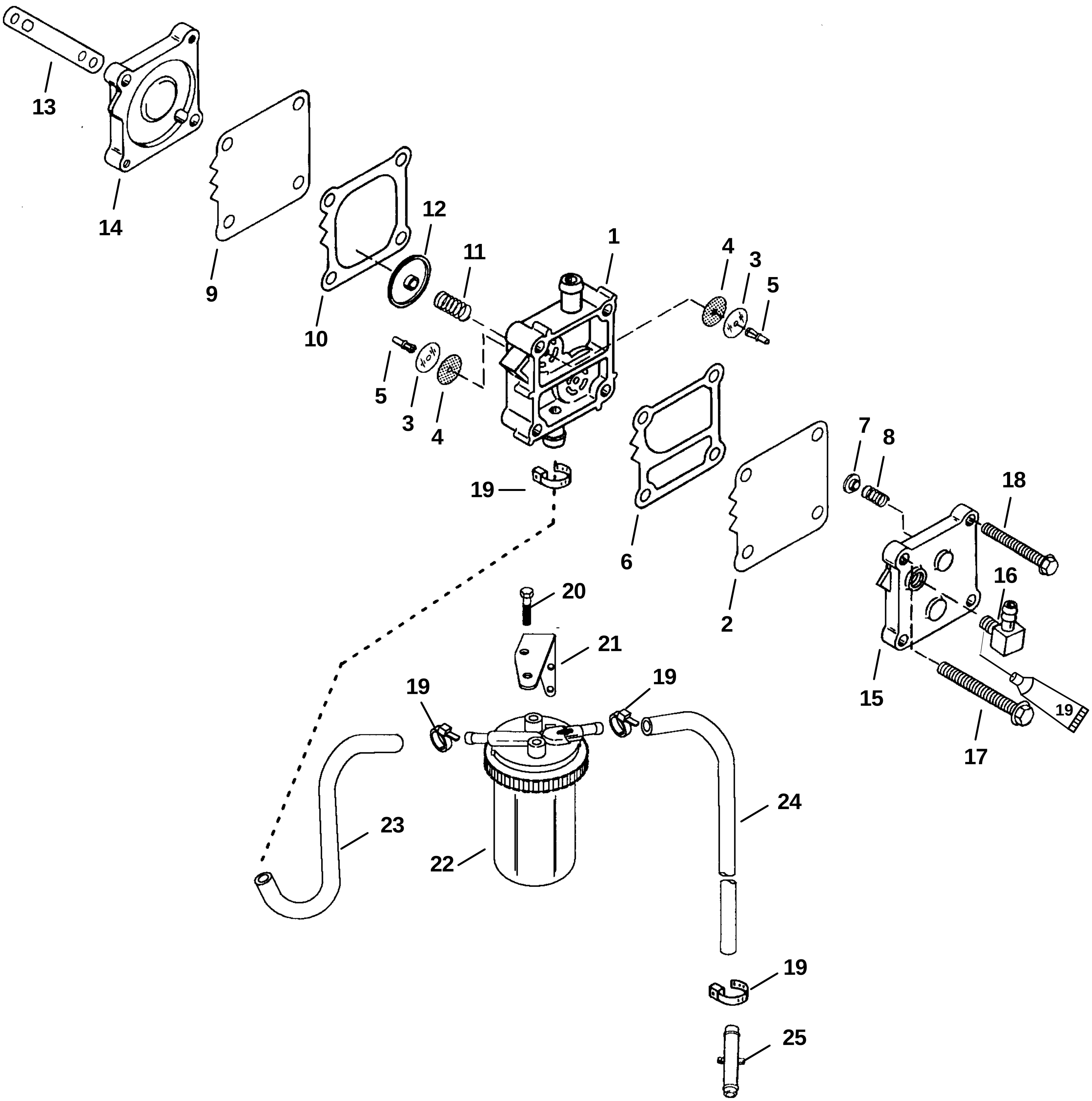
NOTE: Electric fuel pump pressure, if used in conjunction with engine mechanical fuel pump, must be limited to no more than 4 psi. (27.4kPa)

Special Tools

Fuel Pressure Gauge 91-16850



Fuel Pump



19 Perfect Seal (92-34227-1)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE– rubber			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	GASKET – boost			
7	1	CAP			
8	1	SPRING			
9	2	DIAPHRAGM			
10	1	GASKET – pulse			
11	1	SPRING			
12	1	CAP			
13	1	GASKET – base			
14	1	BASE – fuel pump			
15	1	PLATE – fuel pump			
16	1	ELBOW (90°)			
17	2	SCREW – fuel pump to crankcase	60		6.8
18	2	SCREW – fuel pump (M5 x .8 x 40)	60		6.8
19	AR	STA–STRAP			
20	4	SCREW (M6 x 12)			
21	1	BRACKET			
22	1	FUEL FILTER **SEAPRO/MARATHON**			
23	1	HOSE (INLET)			
24	1	HOSE (OUTLET)			
25	1	CONNECTOR			

Fuel Pump

General Information

FUEL PUMP DESCRIPTION/OPERATION

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

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

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

FUEL PUMP SPECIFICATIONS

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

Fuel Pump Pressure at Wide Open Throttle:

Maximum: 10 PSI
Normal: 6 - 8 PSI
Minimum: 4 PSI (With Water Separating Fuel Filter)

Fuel Pump Pressure at Idle:

Normal : 2 - 3 PSI
Minimum: 1 PSI

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

CHECKING FOR RESTRICTED FUEL FLOW CAUSED BY ANTI-SIPHON VALVES

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

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

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

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

Testing Fuel Pump

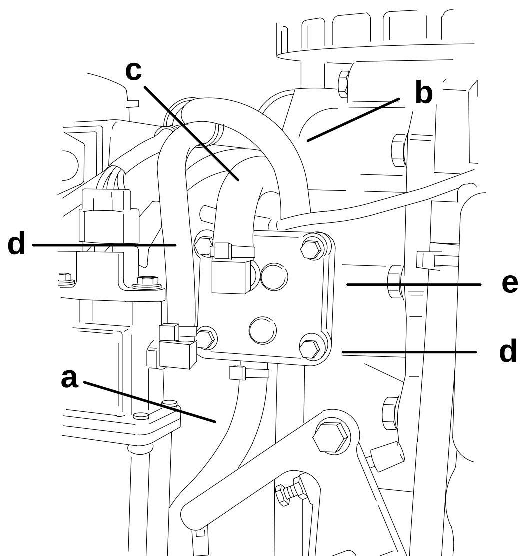
Install clear fuel hose(s) between fuel pump and carburetor(s). Run engine, and inspect fuel passing thru hose(s) for air bubbles. If air bubbles are found, see "Air Bubbles in Fuel Line," below. If air bubbles are NOT found, see "Lack of Fuel Pump Pressure," below.

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

Fuel Pump Removal/Disassembly

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

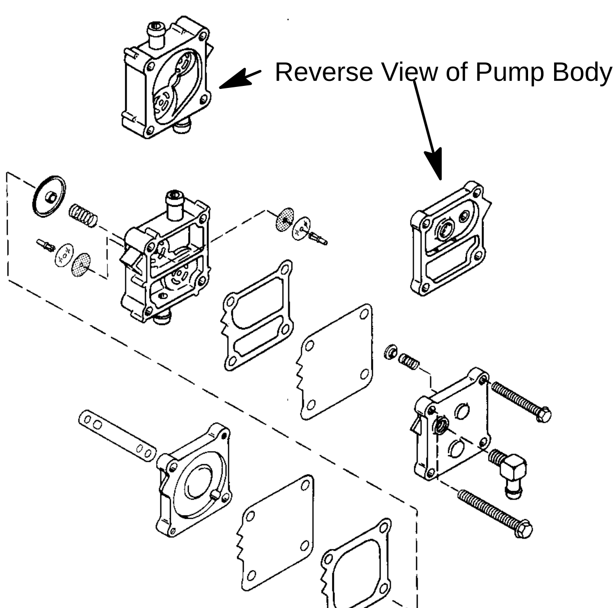
1. Disconnect fuel hoses from fuel pump.
2. Disconnect pulse hose.
3. Remove two mounting screws.
4. Remove fuel pump from engine.



53643

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

5. Disassemble fuel pump.



52362

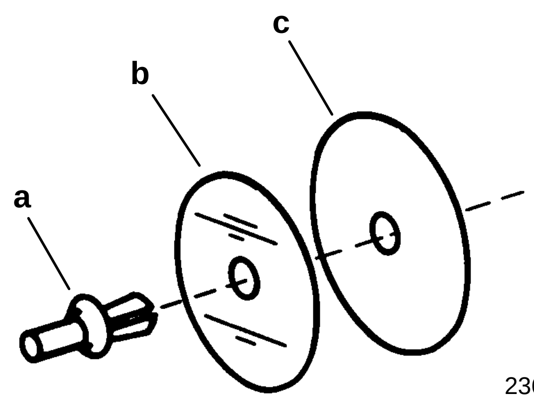
Cleaning/Inspection

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

Reassembly/Installation

ASSEMBLY

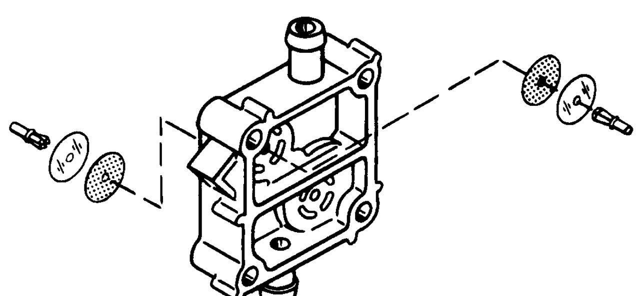
1. Insert retainer thru plastic disc and rubber check valve.



23601

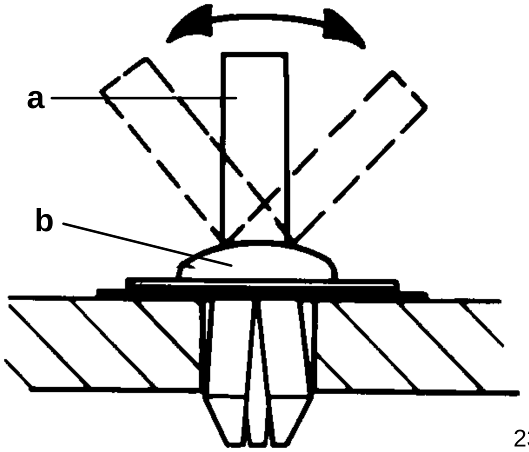
a - Retainer
b - Plastic Disc
c - Rubber Check Valve

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



50161

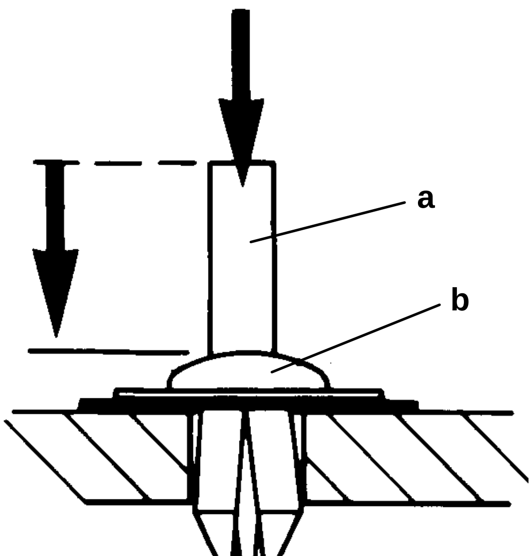
3. With retainer installed in pump body, break retainer rod from retainer by bending sideways.



23601

a - Rod
b - Retainer Cap

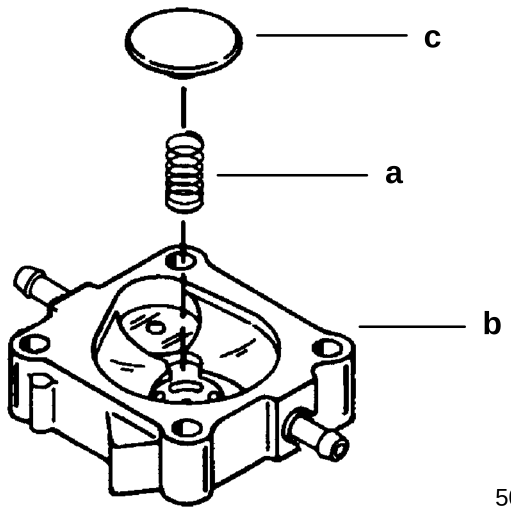
4. Reinstall rod into retainer cap and, use a small hammer or hammer and punch to tap rod down into retainer until flush with top of retainer.



23601

a - Rod
b - Retainer Cap

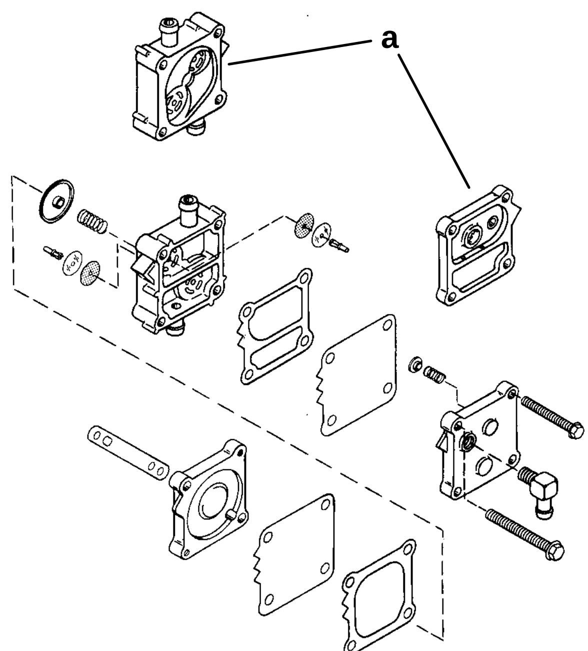
5. Place boost spring into pump body and place cap onto boost spring.



50161

a - Boost Spring
b - Pump Body
c - Cap

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



52362

a - Reverse View of Pump Body

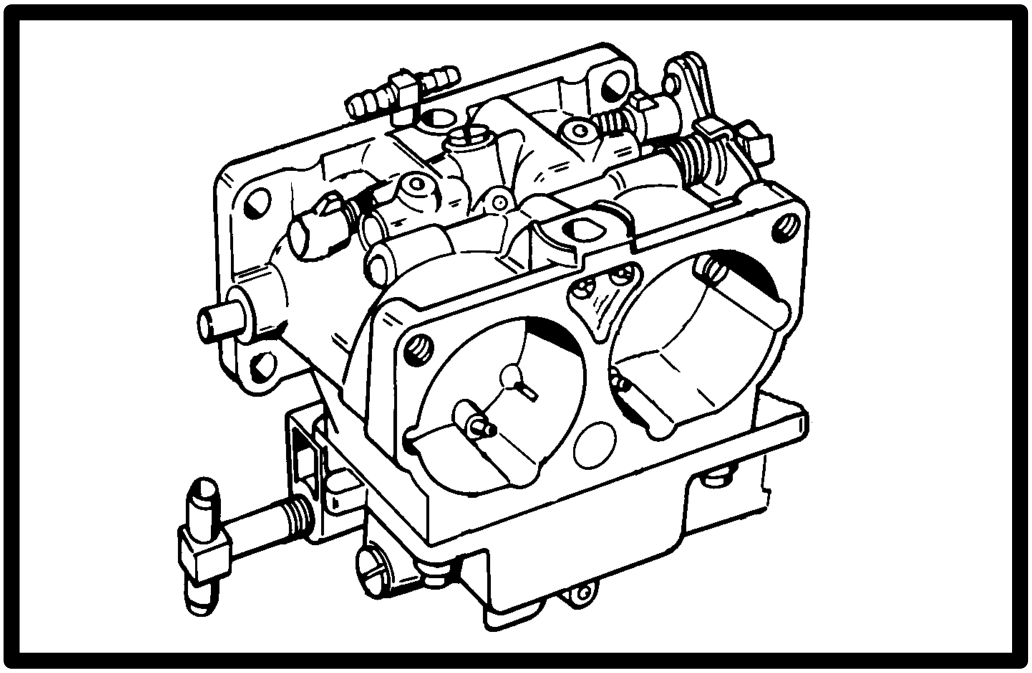
INSTALLATION

1. Install pump onto engine. Torque to 60 lb. in. (6.8 N·m).
2. Install hoses onto proper fittings and secure with sta-straps.
3. Run engine and check for leaks.

FUEL SYSTEMS

3

B



CARBURETORS

Table of Contents

Specifications

C A R B U R E T O R	**Model 3 Litre Work**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 6	
	– Cylinder #1	
	– Main Jet	.078
	– Idle Jet	.042
	– Vent Jet	.080
	– Cylinder #2	
	– Main Jet	.078
	– Idle Jet	.042
	– Vent Jet	.080
	– Cylinder #3	
	– Main Jet	.080
	– Idle Jet	.056
	– Vent Jet	.080
	– Cylinder #4	
	– Main Jet	.078
	– Idle Jet	.018
	– Vent Jet	.080
	– Cylinder #5	
	– Main Jet	.088
	– Idle Jet	.056
	– Vent Jet	.080
	– Cylinder #6	
	– Main Jet	.078
	– Idle Jet	.018
	– Vent Jet	.080

C A R B U R E T O R	**Model 3 Litre Work** **Idle RPM** **Wide Open Throttle (WOT) RPM** **Idle Mixture Screw Adjustment** **Float Adjustment**	 650 ± 50 5000 – 5500 1-1/2±1/4 Float is Level with top of Bowl w/Bowl Inverted
	WMV 11 **– Cylinder #1** **– Main Jet** **– Idle Jet** **– Vent Jet**	 .082 .040 .080
	– Cylinder #2 **– Main Jet** **– Idle Jet** **– Vent Jet**	 .082 .046 .080
	– Cylinder #3 **– Main Jet** **– Idle Jet** **– Vent Jet**	 .082 .058 .080
	– Cylinder #4 **– Main Jet** **– Idle Jet** **– Vent Jet**	 .086 .048 .080
	– Cylinder #5 **– Main Jet** **– Idle Jet** **– Vent Jet**	 .082 .054 .080
	– Cylinder #6 **– Main Jet** **– Idle Jet** **– Vent Jet**	 .082 .048 .080

CARBURETOR	**Model 225**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 7	
	– Cylinder #1	
	– Main Jet	.086
	– Idle Jet	.038
	– Vent Jet	.080
	– Cylinder #2	
	– Main Jet	.086
	– Idle Jet	.038
	– Vent Jet	.080
	– Cylinder #3	
	– Main Jet	.088
	– Idle Jet	.070
	– Vent Jet	.080
	– Cylinder #4	
	– Main Jet	.088
	– Idle Jet	.020
	– Vent Jet	.080
	– Cylinder #5	
	– Main Jet	.088
	– Idle Jet	.070
	– Vent Jet	.080
	– Cylinder #6	
	– Main Jet	.088
	– Idle Jet	.032
	– Vent Jet	.080

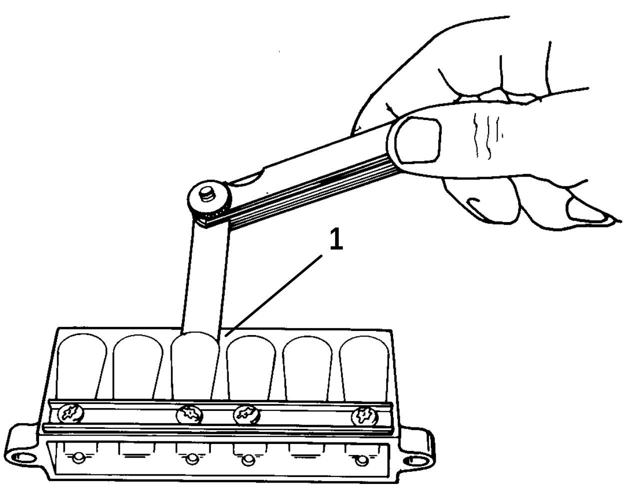
CARBURETOR	**Model 225**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 13	
	– Cylinder #1	
	– Main Jet	.084
	– Idle Jet	.046
	– Vent Jet	.082
	– Cylinder #2	
	– Main Jet	.082
	– Idle Jet	.060
	– Vent Jet	.082
	– Cylinder #3	
	– Main Jet	.084
	– Idle Jet	.054
	– Vent Jet	.086
	– Cylinder #4	
	– Main Jet	.086
	– Idle Jet	.052
	– Vent Jet	.086
	– Cylinder #5	
	– Main Jet	.084
	– Idle Jet	.058
	– Vent Jet	.082
	– Cylinder #6	
	– Main Jet	.082
	– Idle Jet	.052
	– Vent Jet	.082

CARBURETOR	**Model 225**	
	Idle RPM	650 ± 50
	Wide Open Throttle (WOT) RPM	5000 – 5500
	Idle Mixture Screw Adjustment	1-1/2±1/4
	Float Adjustment	Float is Level with top of Bowl w/Bowl Inverted
	WMV 13	
	– Cylinder #1	
	– Main Jet	.084
	– Idle Jet	.046
	– Vent Jet	.082
	– Cylinder #2	
	– Main Jet	.082
	– Idle Jet	.060
	– Vent Jet	.082
	– Cylinder #3	
	– Main Jet	.084
	– Idle Jet	.054
	– Vent Jet	.086
	– Cylinder #4	
	– Main Jet	.086
	– Idle Jet	.052
	– Vent Jet	.086
	– Cylinder #5	
	– Main Jet	.084
	– Idle Jet	.058
	– Vent Jet	.082
	– Cylinder #6	
	– Main Jet	.082
	– Idle Jet	.052
	– Vent Jet	.082

REED VALVE SPECIFICATIONS

REED VALVE OPENING

1 – Max. 0.020 in. (0.59 mm.)



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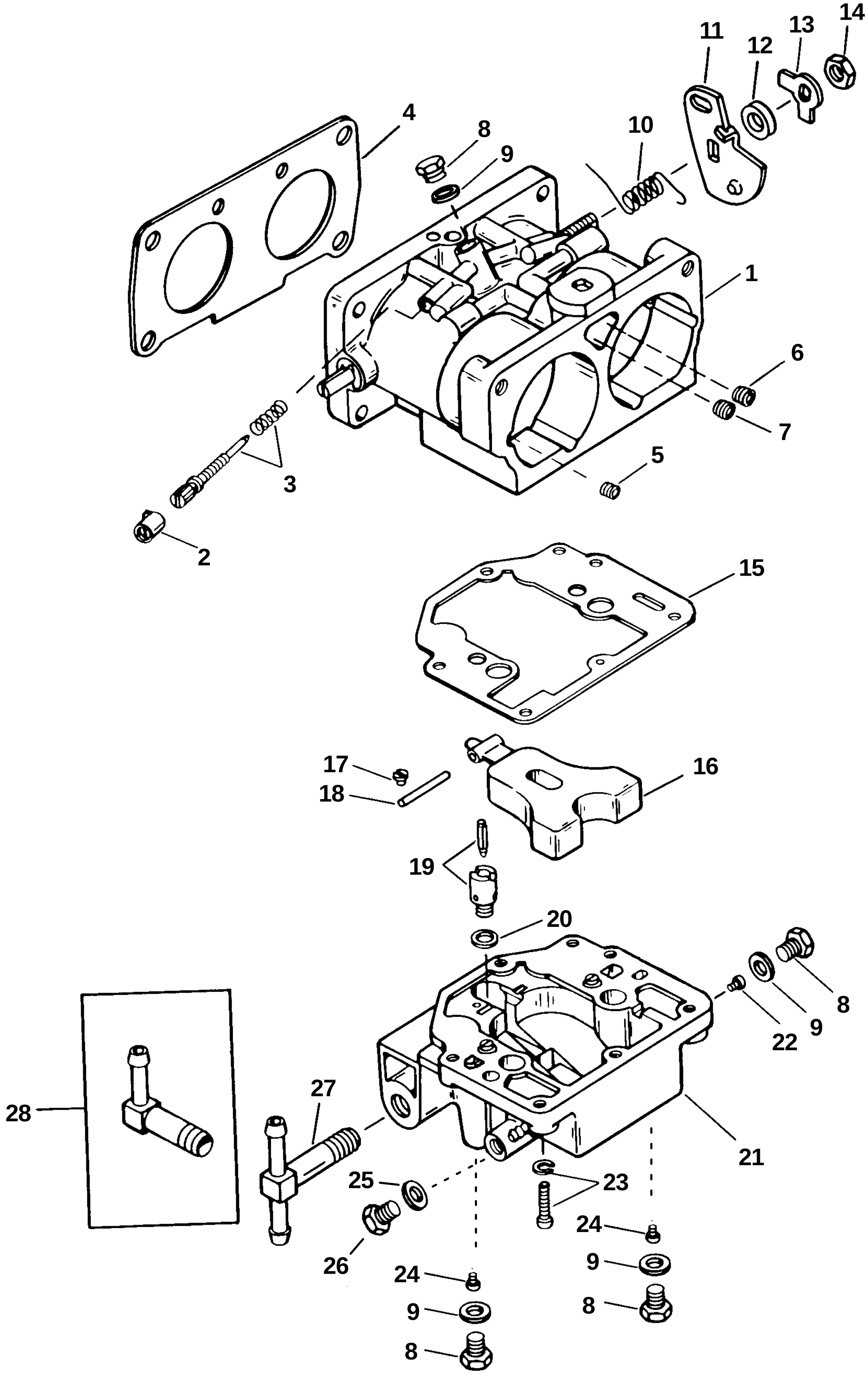
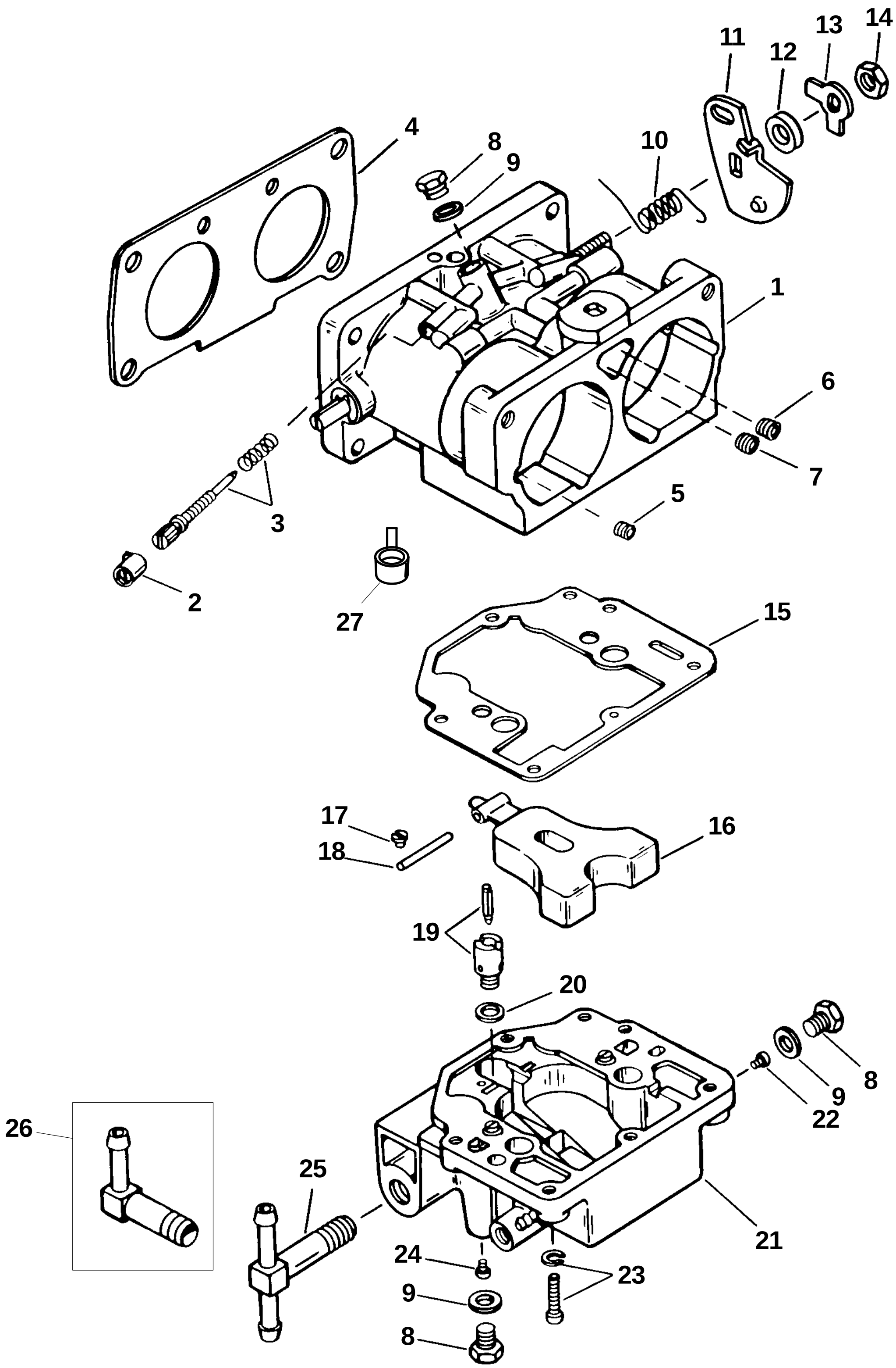
Carburetor (SEAPRO/MARATHON) (S/N–0G303045 & BELOW)



Carburetor (SEAPRO/MARATHON) (S/N–0G303045 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	2	JET– progression air (.030)**(TOP)**	10		1.1
5	4	JET– progression air(.040) **(CENTER/BOTTOM)**	10		1.1
6	3	JET– bowl vent (.072)	15		1.7
7	1	JET– idle air bleed (.052)**(TOP)**	15		1.7
7	2	JET– idle air bleed (.054) **(CENTER/BOTTOM)**	15		1.7
8	12	PLUG	33		3.7
9	12	GASKET– plug			
10	3	SPRING– valve return			
11	2	THROTTLE LEVER **(TOP/BOTTOM)**			
11	2	THROTTLE LEVER **(CENTER)**			
12	3	SPACER			
13	3	WASHER			
14	3	NUT	50		5.6
15	3	GASKET– fuel bowl			
16	3	FLOAT			
17	3	SCREW– float pin	10		1.1
18	3	FLOAT SHAFT			
19	3	VALVE SEAT KIT	33		3.7
20	3	GASKET– valve seat			
21	1	FUEL BOWL **(TOP)**			
21	2	FUEL BOWL **(CENTER/BOTTOM)**			
22	3	JET– main fuel (.070)	14		1.6
23	18	SCREW– fuel bowl	26		3.0
24	6	JET– progression fuel	14		1.6
25	3	SEAL– bowl drain plug			
26	3	PLUG– bowl drain	33		3.7
27	2	TEE FITTING **(TOP/CENTER)**	45		5.1
28	1	ELBOW **(BOTTOM)**	45		5.1

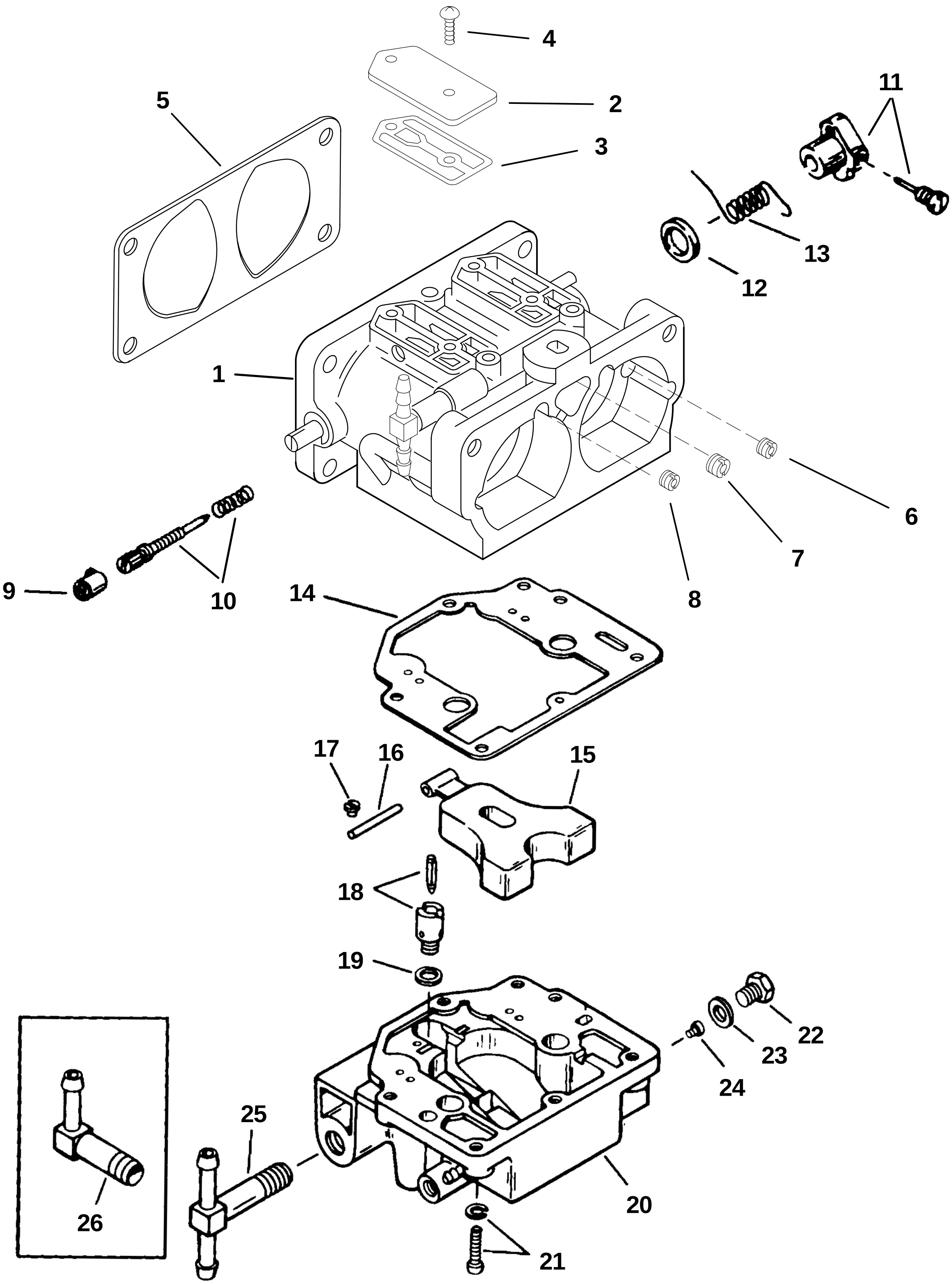
CARBURETOR (Model 225) (S/N–0G303045 & BELOW)



Carburetor (Model 225) (S/N–0G303045 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	TOP CARBURETOR			
1	1	CENTER CARBURETOR **WMH-19**			
1	1	BOTTOM CARBURETOR			
1	1	TOP CARBURETOR			
1	1	CENTER CARBURETOR **WMH-46**			
1	1	BOTTOM CARBURETOR			
1	1	TOP CARBURETOR			
1	1	CENTER CARBURETOR **WMH-47**			
1	1	BOTTOM CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	6	JET–progression air (.060)**(WMH–19/46)**	10		1.1
5	6	JET–progression air (.050)**(WMH–47)**	10		1.1
6	3	JET–bowl vent (.070)	14		1.6
7	3	JET–idle air bleed (.048)	14		1.6
8	15	PLUG	33		3.7
9	15	GASKET–plug			
10	3	SPRING–throttle return			
11	2	THROTTLE LEVER **(Top/Bottom)**			
11	1	THROTTLE LEVER **(Center - WMH-19)**			
11	1	THROTTLE LEVER **(Center - WMH-46/47)**			
12	3	SPACER			
13	3	WASHER			
14	3	NUT	50		5.6
15	3	GASKET–fuel bowl			
16	3	FLOAT			
17	3	SCREW–float pin	10		1.1
18	3	FLOAT SHAFT			
19	3	VALVE SEAT KIT	33		3.7
20	3	GASKET–valve seat			
21	1	FUEL BOWL (Top)			
21	2	FUEL BOWL (Center/Bottom)			
22	3	JET–main fuel (.078 - PORT)	14		1.6
22	AR	JET–main fuel (.074 - STBD.)	14		1.6
22	1	JET–main fuel (.076 - STBD.- Bottom) **WMH-19**	14		1.6
23	18	SCREW–fuel bowl	26		3.0
24	6	JET–progression fuel	14		1.6
22	2	JET–main fuel (.074 - PORT/STBD. - Top)	14		1.6
22	2	JET–main fuel (.074 - STBD. - Center/Bottom)	14		1.6
22	2	JET–main fuel (.076 - PORT. - Center/Bottom)	14		1.6
23	18	SCREW–fuel bowl	26		3.0
24	4	JET–progression fuel (Top/Center) **WMH-46**	14		1.6
24	2	JET–progression fuel (Bottom)	14		1.6
22	3	JET–main fuel (.074 - STBD.)	14		1.6
22	1	JET–main fuel (.074 - PORT- Top) **WMH-47**	14		1.6
22	2	JET–main fuel (.076 - PORT. - Center/Bottom)	14		1.6
23	18	SCREW–fuel bowl	26		3.0
24	6	JET–progression fuel	14		1.6
25	2	TEE FITTING (Top/Center)	45		5.1
26	1	ELBOW (Bottom)	45		5.1
27	1	FILLER BLOCK			

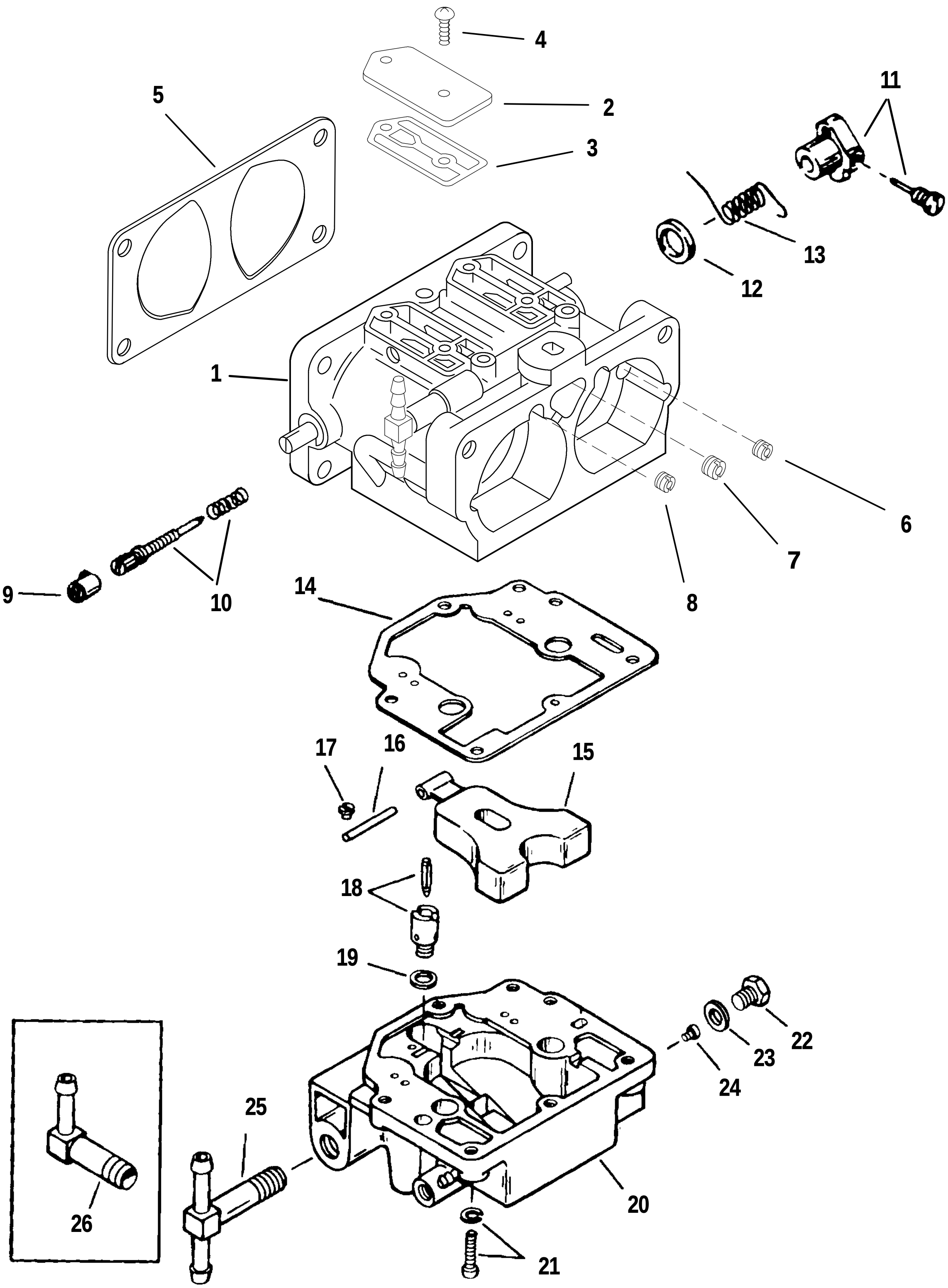
Carburetor (All Models) (S/N–0G303046 & UP)



Carburetor (All Models) (S/N–0G303046 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	TOP CARBURETOR **SEAPRO/MARATHON**			
	1	CENTER CARBURETOR **WMV-6**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **WMV–7**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR **SEAPRO/MARATHON**			
	1	CENTER CARBURETOR **WMV-11**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **WMV–13**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR **SEAPRO/MARATHON**			
	1	CENTER CARBURETOR **WMV-11A**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **WMV–13A**			
	1	BOTTOM CARBURETOR			
2	6	COVER			
3	6	GASKET			
4	12	SCREW	18		2.0
5	3	GASKET			
6	1	JET–idle air vent (.042-Top) **RIGHT BORE**	14		1.6
	2	JET–idle air vent (.056-Center/Bottom) **WMV-6**	14		1.6
	1	JET–idle air vent (.038-Top) **RIGHT BORE**	14		1.6
	2	JET–idle air vent (.070-Center/Bottom) **WMV-7**	14		1.6
	1	JET–idle air vent (.040-Top)	14		1.6
	1	JET–idle air vent (.058-Center) **RIGHT BORE-WMV11**	14		1.6
	1	JET–idle air vent (.054-Bottom)	14		1.6
	1	JET–idle air vent (.046-Top)	14		1.6
	1	JET–idle air vent (.054-Center) **RIGHT BORE-WMV-13**	14		1.6
	1	JET–idle air vent (.058-Bottom)	14		1.6
7	3	JET–bowl vent (.080)**(WMV-6/7/11/11A)**	14		1.6
	2	JET–bowl vent (.082-Top/Bottom)**(WMV-13)**	14		1.6
	1	JET–bowl vent (.086-Center)**(WMV-13)**	14		1.6

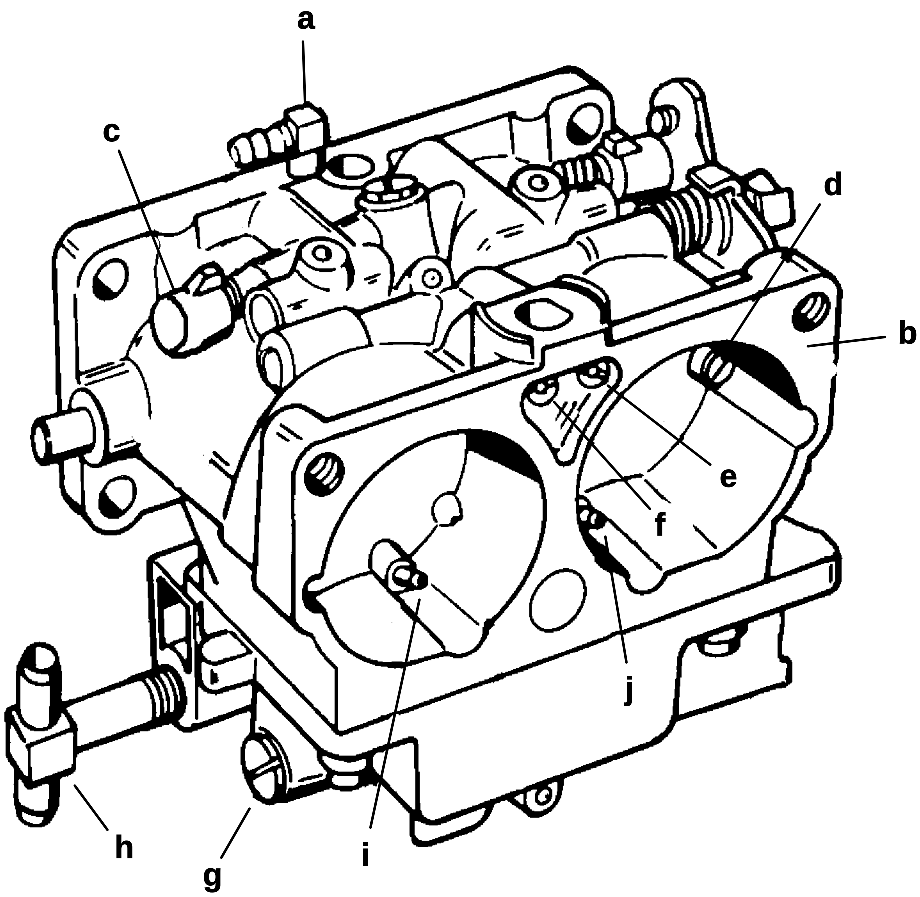
Carburetor (All Models) (S/N–0G303046 & UP)



Carburetor (All Models) (S/N–0G303046 & UP)

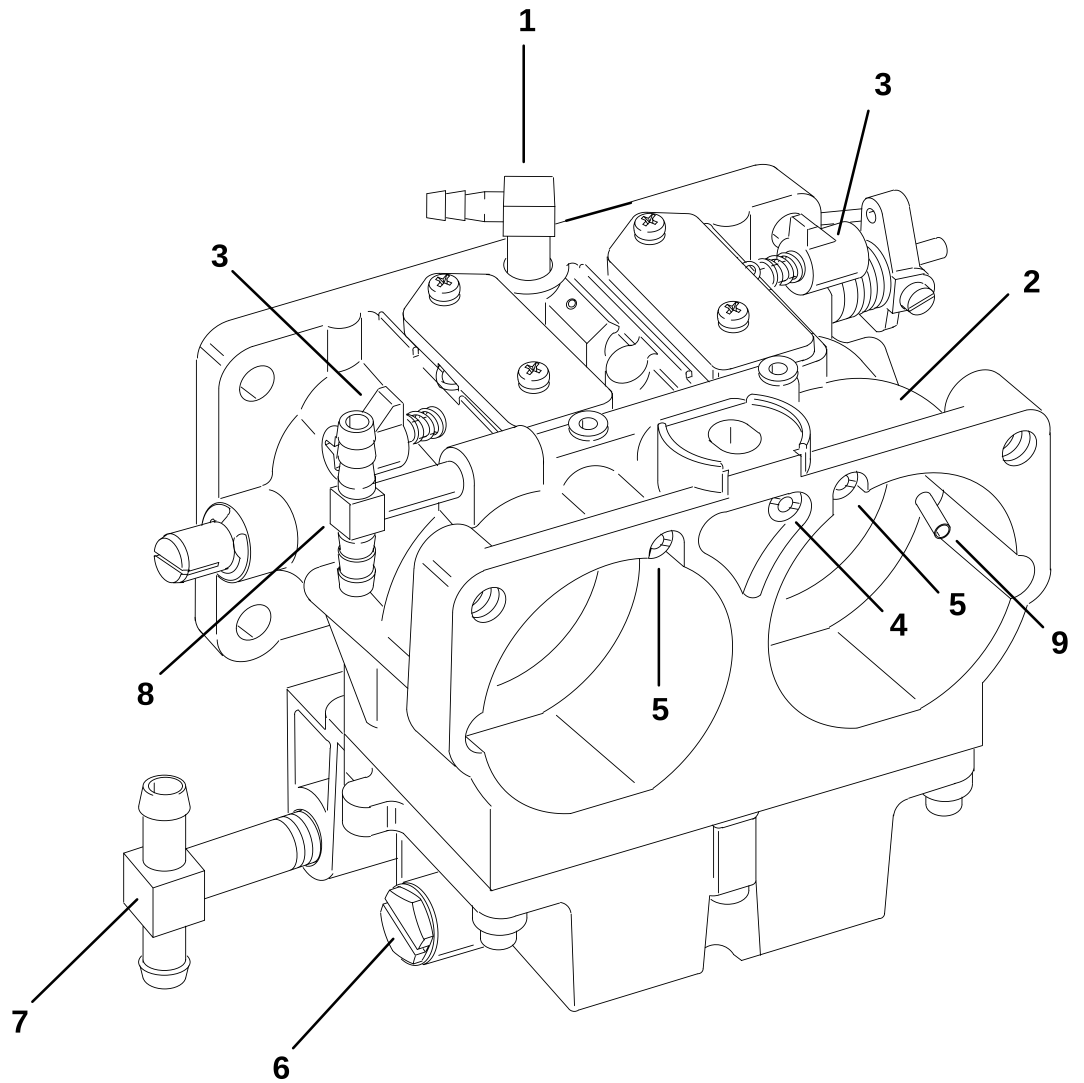
REF. NO.	QTY.	DESCRIPTION		TORQUE lb. in.	lb. ft.	N·m
8	1	JET–idle air vent (.042-Top)	**LEFT BORE**	14		1.6
	2	JET–idle air vent (.018-Center/Bottom)	**WMV-6**	14		1.6
	1	JET–idle air vent (.038-Top)	**LEFT BORE**	14		1.6
	1	JET–idle air vent (.020-Center)	**WMV-7**	14		1.6
	1	JET–idle air vent (.032-Bottom)		14		1.6
	1	JET–idle air vent (.046-Top)	**LEFT BORE-WMV11**	14		1.6
	2	JET–idle air vent (.048-Center/Bottom)		14		1.6
	1	JET–idle air vent (.060-Top)	**LEFT BORE-WMV13**	14		1.6
	2	JET–idle air vent (.052-Center/Bottom)		14		1.6
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		1.1
18	3	VALVE SEAT KIT				
	3	VALVE SEAT KIT **(WMV-11/13A)**				
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		3.7
23	6	GASKET				
24	4	JET–main fuel (.078)	**SEAPRO/MARATHON**	14		1.6
	2	JET–main fuel (.080)	**WMV–6**	14		1.6
	4	JET–main fuel (.088)		14		1.6
	2	JET–main fuel (.086)	**WMV–7**	14		1.6
	2	JET–main fuel (.082)**(PORT-TOP/BOTTOM)**		14		1.6
	1	JET–main fuel (.086)**(PORT-CENTER)**	**WMV-11**	14		1.6
	3	JET–main fuel (.082)**(STBD.)**		14		1.6
	2	JET–main fuel (.082)**(PORT-TOP/BOTTOM)**		14		1.6
	1	JET–main fuel (.086)**(PORT-CENTER)**	**WMV-13**	14		1.6
	3	JET–main fuel (.084)**(STBD.)**		14		1.6
25	2	TEE FITTING (TOP/CENTER)		45		5.1
26	1	ELBOW (BOTTOM)		45		5.1

Carburetor - (S/N-0G303045 and BELOW)



a - Enrichment Hose Fitting
b - Carburetor Number
c - Fuel Mixture Adjustment Screw
d - Off Idle "Progression" Air Jet (2)
e - Back Draft Vent Jet (one, if equipped)
f - Idle Air Jet (one)
g - High Speed Fuel Jet Access Plug (2)
h - Fuel Line Fitting
i - Main Nozzle Well Vent (2)
j - Main Discharge Tube Air Inlet (2)

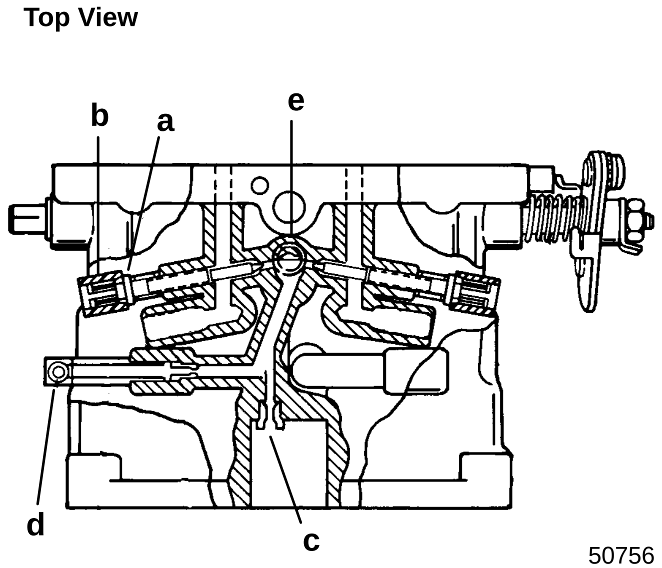
Carburetor - (S/N–0G303046 and ABOVE)



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 - Thermal Air Valve Hose Fitting
9 - Main Nozzle Well Vent (2)

WMH Carburetor Fuel Circuits

Idle Circuit Description



a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Idle Air Bleed Jet
d - Thermal Air Valve Air Inlet
e - Idle Tube

The idle circuit is independent of progression and main circuits. The idle circuit consists of externally adjustable fuel mixture screws, idle air bleed jet, and factory set air trim screws located beneath welch plugs.

IDLE CIRCUIT ADJUSTMENTS

a. Fuel mixture screws (2 per carb.) - When adjusting fuel mixture screws all screws must be turned the same amount and the same direction for engine to operate efficiently at idle speeds. DO NOT remove mixture screw caps to further richen or lean fuel flow.

Clockwise direction - leans mixture

Counterclockwise direction - richens mixture

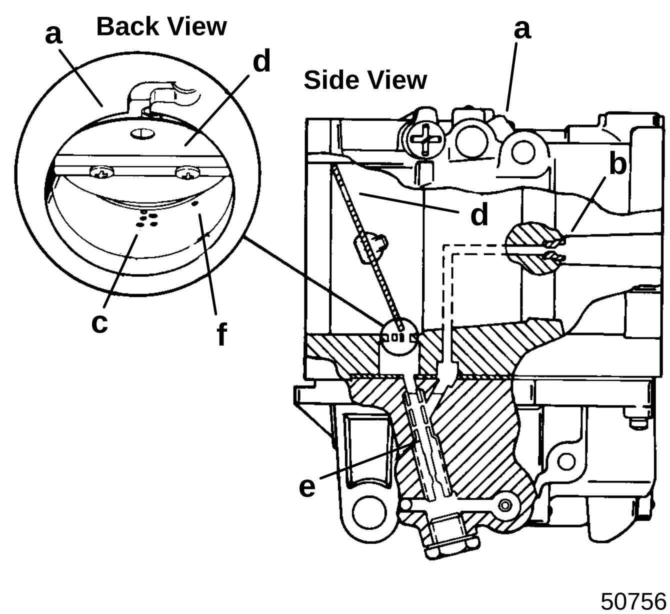
NOTE: *If caps are removed from mixture screws and screws are removed for carburetor cleaning refer to "IMPORTANT" preceding.*

b. Idle Air Bleed Jets (1 per carb.) - The idle air bleed jet meters air and is located next to the back drag vent jet. If a jet with a smaller orifice is installed the fuel/air ratio becomes richer. If a jet with a larger orifice is installed, fuel/air ratio becomes leaner.

c. Air Trim Screws (2 per carb.) - Located beneath welch plugs and are preset at factory. DO NOT remove welch plugs and adjust trim screws.

NOTE: *If welch plugs and trim screws are removed for carburetor cleaning, refer to "IMPORTANT" preceding.*

Off-Idle Circuit Description



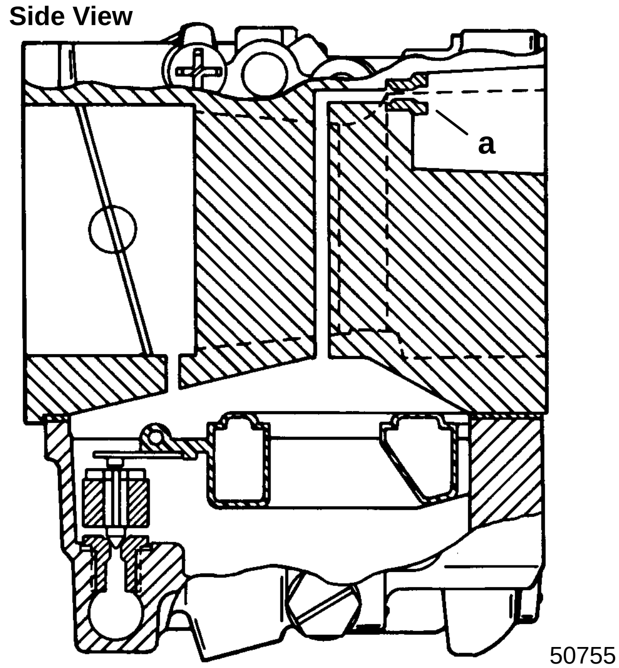
a - Carburetor Body
b - Off-Idle Air Jet
c - Off-Idle Discharge Holes
d - Throttle Shutter
e - Off-Idle Tube
f - Back Draft Circuit Port (Port Bore Only)

The off-idle fuel flow circuit is controlled by an off-idle air jet located in each carburetor bore. Each venturi has one off-idle tube and one off-idle air jet. The circuit functions at off-idle speeds until full throttle operation occurs.

OFF-IDLE CIRCUIT ADJUSTMENTS

Off-Idle Air Jet (2 per carb.) - If a jet with a smaller orifice is installed, the off-idle fuel/air ratio becomes richer. If a jet with a larger orifice is installed, the off-idle ratio becomes leaner.

Back Draft Circuit Description



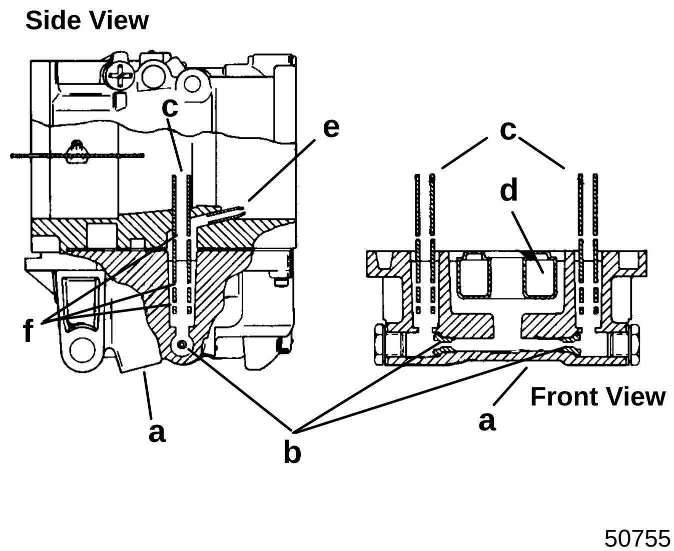
a - Back Draft Jet (Bowl Vent)

The back draft circuit contains a vent jet, located next to the idle air jet, which supplies less than atmospheric pressure to the fuel bowl at mid-range which results in improved fuel economy.

BACK DRAFT CIRCUIT ADJUSTMENTS

Back Draft Jet (1 per carb.) - If a jet with a smaller orifice is installed, the mid-range fuel/air ratio will be leaner. If a jet with a larger orifice is installed, the ratio will become richer.

High Speed Fuel Circuit Description



a - Fuel Bowl
b - Main Fuel Jet
c - Main Discharge Tube
d - Float
e - Main Discharge Tube Air Inlet
f - Cross Hole Vents

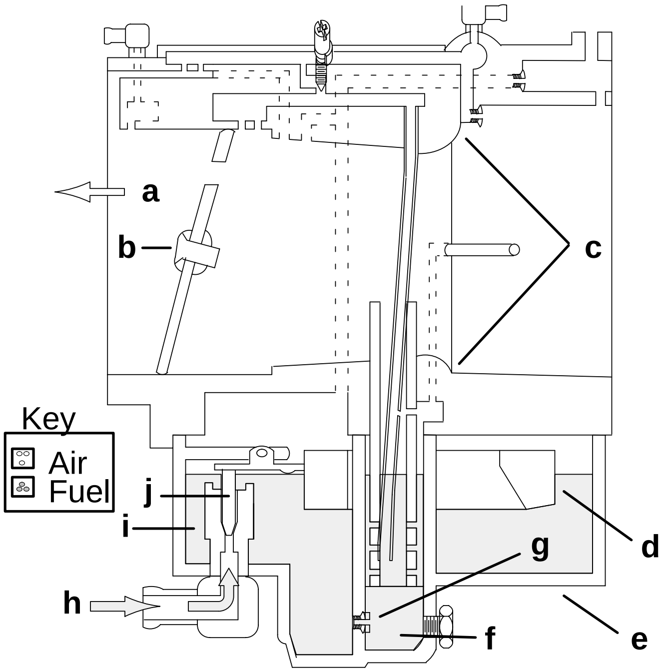
The high speed fuel flow is controlled by the main (high speed) jets and are located in the fuel bowl. A fuel/air mixture is drawn from the fuel bowl thru the main discharge tubes during full throttle operation.

HIGH SPEED FUEL CIRCUIT ADJUSTMENTS

Main (High Speed) Jet (2 per carb.) - If a jet with a smaller orifice is installed, the fuel/air ratio becomes leaner. If a jet with a larger orifice is installed, the ratio becomes richer.

WMV Carburetor Fuel Circuits

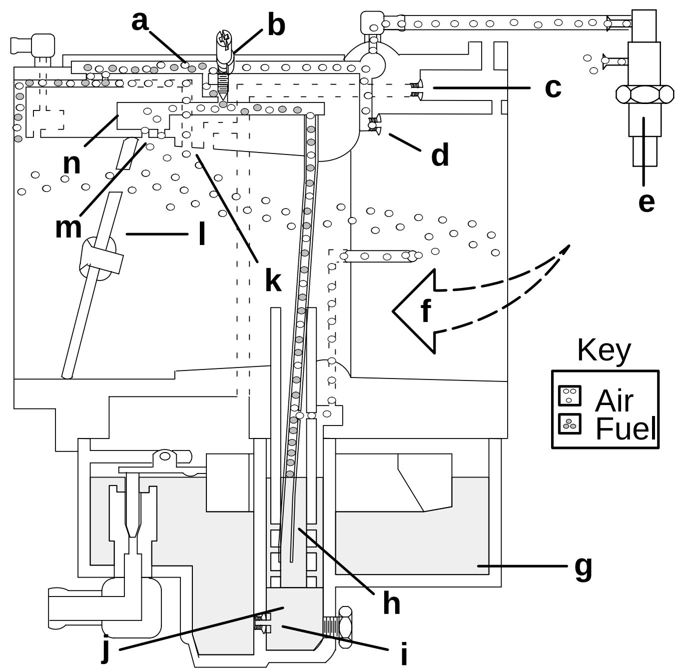
Float Bowl Circuit



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:

(1.) Through the main fuel jet into the main fuel well,

(2.) Up the idle tube,

(3.) Through the off-idle passages,

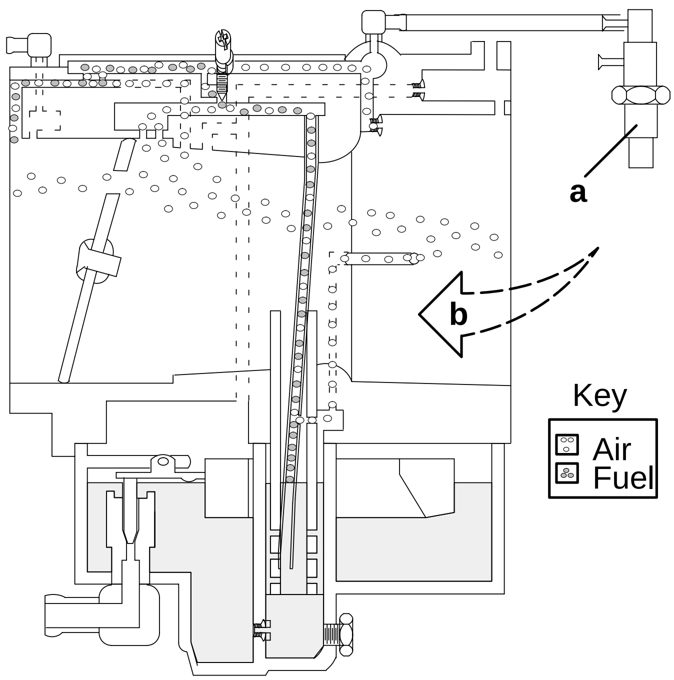
(4.) Past the idle mixture screw,

(5.) Into the idle passage

(6.) And into the carburetor throat.

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

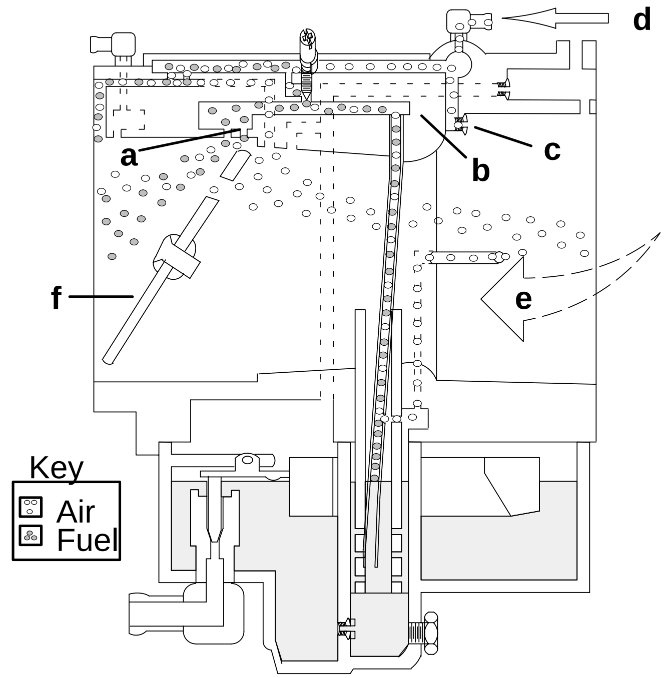
Cold Start Circuit



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

A cold engine will require a richer mixture. When the engine is cold, the thermal air valve (located on the cylinder head) is closed. Air is prevented from entering the idle circuit. Without this additional air, the idle mixture is richened. A failure in the thermal air valve (closed) will cause the idle circuit to be rich. To test the thermal air valve, plug the inlet fitting (located on the valve). With the fitting closed, the air flow is stopped, and the engine should run rich at idle speeds.

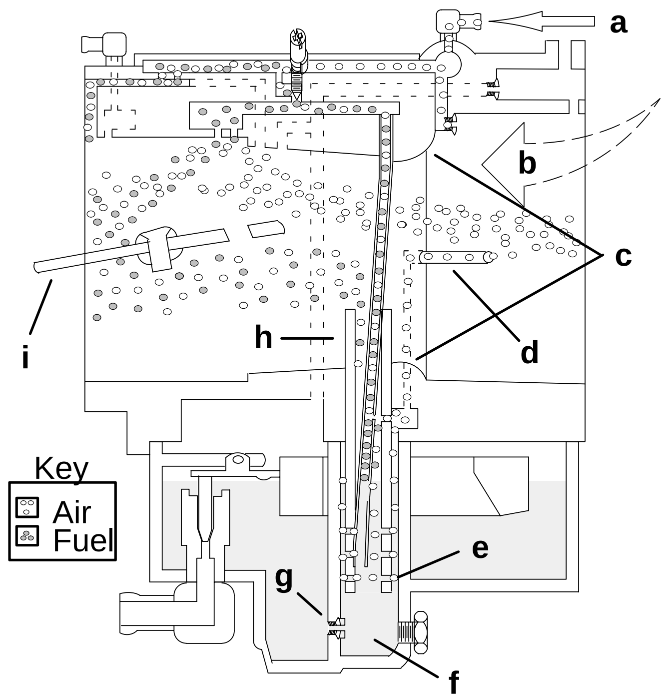
Off-Idle Circuit



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

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

Main Circuit



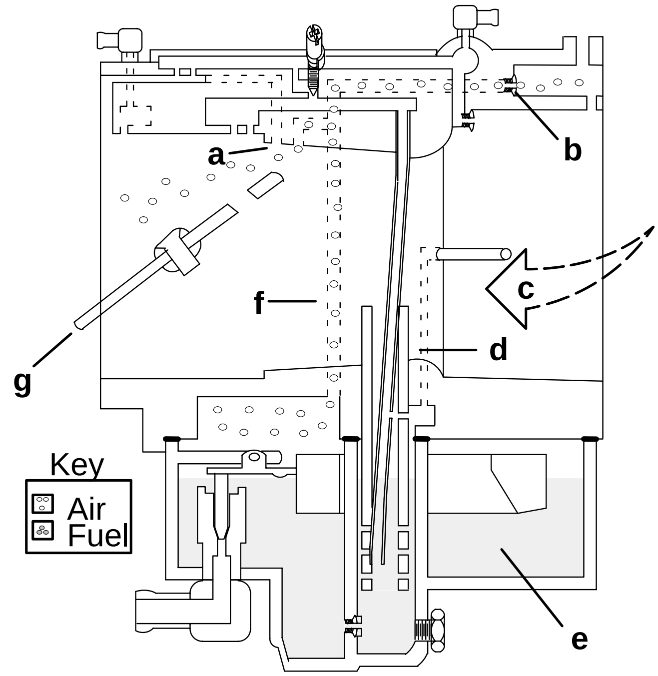
a - From Open Thermal Air Valve
b - Air Flow
c - Venturi
d - Main Discharge Air Inlet Tube
e - Cross Holes
f - Main Fuel Well
g - Main Fuel Jet
h - Main Discharge Nozzle
i - Throttle Plate

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

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

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

Back Draft Circuit



NOTE: *Fuel Flow Not Shown For Clarity*

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

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

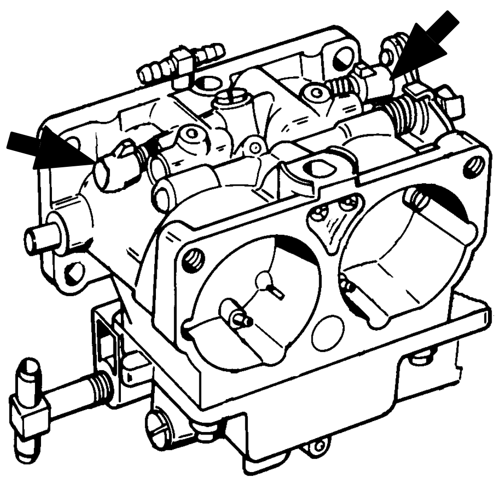
Adjustments

SYNCHRONIZING CARBURETORS

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

IDLE MIXTURE SCREW (ALL MODELS)

For best running quality, the adjustable idle mixture screws are set at the factory with the limit tabs pointing straight up. 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 counterclockwise 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. Refer to page 3B-34.

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.*

RE-JETTING CARBURETORS FOR HIGH ALTITUDE OPERATION

The carburetor jets installed at the factory are for engine operation at sea level through an elevation of 1524m (5000 ft.) above sea level. If the engine is to be operated at an altitude higher than 1524m (5000 ft.) above sea level, it will be necessary to re-jet (remove the carburetor jets and install jets with a different orifice size) the carburetors. Each time the engine is to be operated at a different elevation from the previous time, refer to the “Carburetor Jet Charts”, following and re-jet the carburetors for elevation engine will be operated at.

Fuel System - Troubleshooting

General Information

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

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

Problem: Engine Turns Over But Will Not Start Or Starts Hard When Cold.

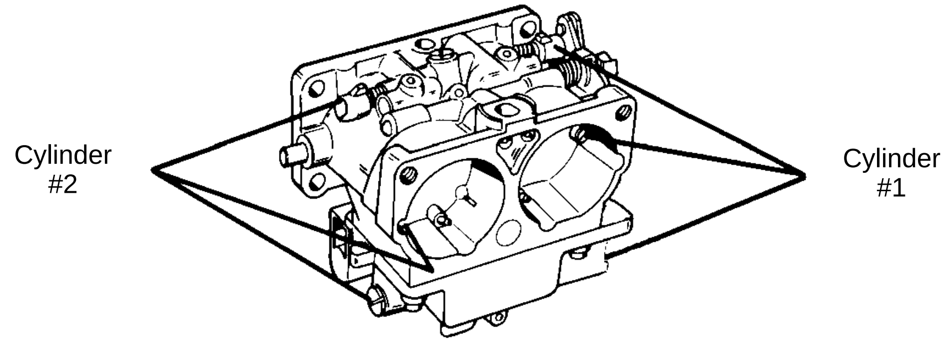
Possible Cause	Corrective Action
Improper starting procedure used.	Check proper starting procedure, as outlined in "Operation and Maintenance Manual."
Fuel tank empty or too low. Improperly mixed fuel. Contaminants (water, dirt, etc.) in fuel	Check fuel in fuel tank and replace or add whichever is necessary.
Fuel tank air vent closed or restricted.	Check air vent on fuel tank. Air vent must be open all-the-way and free from any contaminants.
A pinched, cut or restricted fuel line. Also loose fuel line connection.	Check all fuel lines and replace as needed. Check and tighten all fuel line connections.
Dirty or restricted fuel filter.	Check and replace or clean all fuel filters.
Low fuel pump pressure.	Refer to Section 3B.
An anti-siphon valve.	Refer to "Checking for Restricted Fuel Flow" in this section.
Choke solenoid, or enrichment valve not operating.	Check choke solenoid or valve, and electrical wiring to solenoid or valve. Replace if necessary.
A needle and seat (in carburetor) that is either stuck open or closed. Open=Flooding - Closed=Starving	Refer to "Carburetor Disassembly" in this section.
Improper carburetor jets, restricted jet or idle mixture screw out of adjustment.	Refer to "Carburetor Adjustments" in this section.
Improper carburetor float level.	Refer to "Carburetor Adjustments" in this section.
Engine Temperature Sensor Crank Position Sensor Electronic Control Unit (ECU)	Refer to Section 2A "Electrical and Ignition" for troubleshooting procedures.

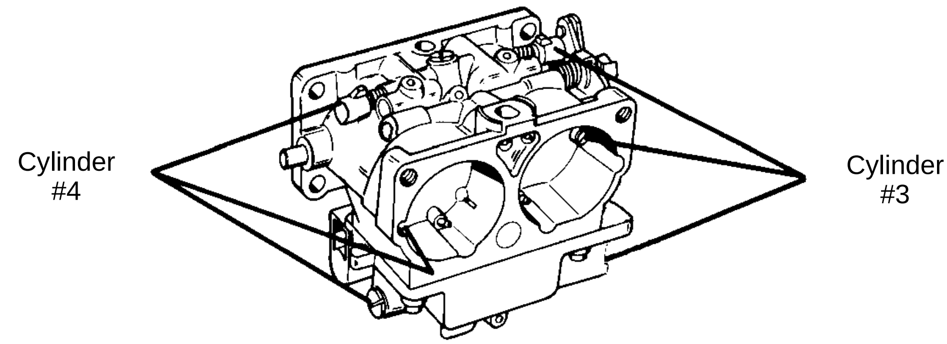
Problem: Engine Idles Rough and Stalls.
Problem: Engine Hesitates Upon Acceleration.
Problem: Engine Runs Uneven or Surges.

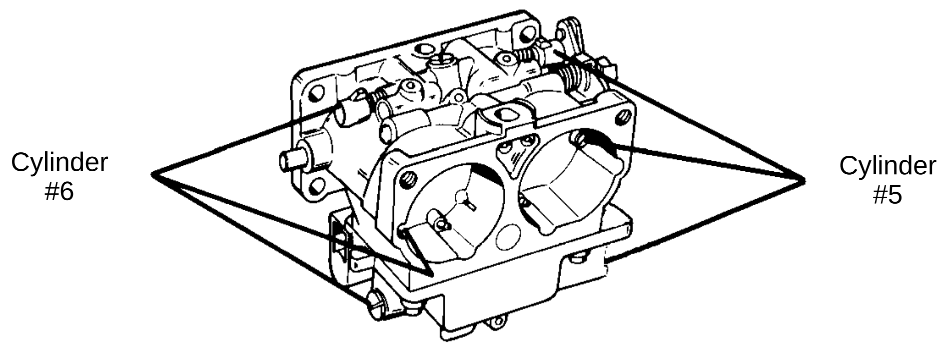
Possible Cause	Corrective Action
Improperly mixed fuel. Contaminants (water, dirt, etc.) in fuel.	Check fuel in fuel tank and replace if necessary.
Fuel tank air vent closed or restricted.	Check air vent on fuel tank. Air vent must be open all-the-way and free from restrictions.
A pinched, cut or restricted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

Possible Cause	Corrective Action
Low fuel pump pressure.	Refer to Section 3B.
An anti-siphon valve.	Refer to Section 3B.
A needle and seat (in carburetor) that is either stuck open or closed. (A needle and seat, that is stuck open, will cause a flooding condition. A needle and seat, that is stuck closed, will prevent fuel from entering carburetor.	Refer to ‘‘Carburetor Adjustments” in this section.
Improper carburetor jets, restricted jet or idle mixture screw out of adjustment.	Refer to ‘‘Carburetor Adjustments” in this section.
Improper carburetor float level.	Refer to ‘‘Carburetor Adjustments” in this section.
Carburetor loose on reed block housing.	Tighten carburetor nuts securely.
Reed block housing loose, or gaskets are defective.	Using a pressure oil can, spray 2-cycle oil around reed block housing/crankcase housing matching surfaces and carburetor base. If engine RPM changes, tighten or replace reed block housing gaskets or carburetor base gaskets, as needed.
Improperly routed or restricted bleed hose(s).	Refer to bleed line routing in Section 4.
Engine Temperature Sensor Crank Position Sensor Electronic Control Module (ECM)	Refer to Section 2A “Electrical and Ignition” for troubleshooting procedures.

JET LOCATION FOR EACH CYLINDER (WMH CARBURETORS)







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.*

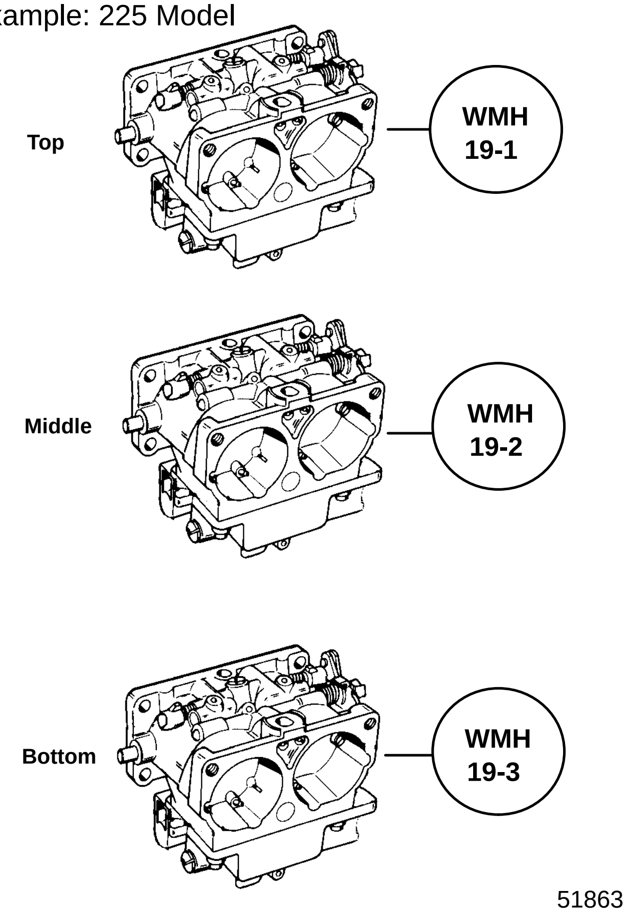
NOTE: *The idle jet and back draft jet affect both cylinders.*

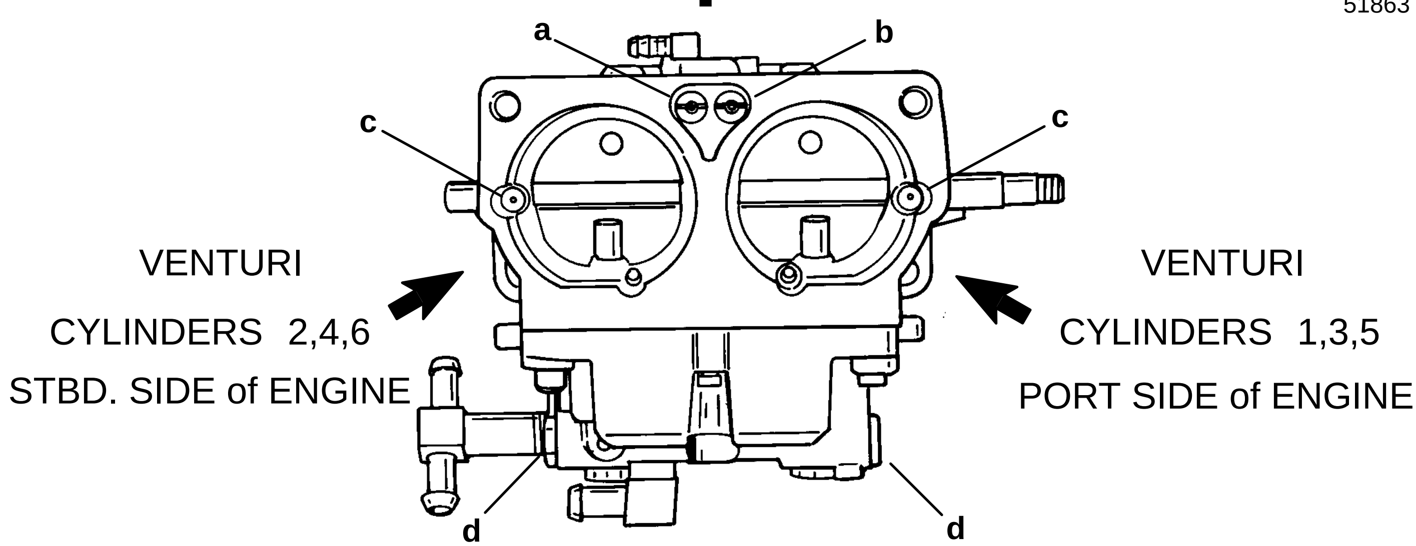
Carburetor Placement

Model 3 LITRE SEAPRO MARATHON	Top WMH	Middle WMH	Bottom WMH
1995	45-1	45-2	45-3

Model 225	Top WMH	Middle WMH	Bottom WMH
1994	19-1A	19-2A	19-3A
1994 1/2	46-1	46-2	46-3
1995	47-1	47-2	47-3

Example: 225 Model





Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**	**Main Jet d**	**Off-Idle "Progression" Air Jet c**	**Idle Air Bleed Jet a**	**Back Draft Vent Jet b**
1995 3 LITRE SEAPRO MARATHON	WMH 45-1	PORT Bore .070 STBD Bore .070	.030	.052	.072
	WMH 45-2	PORT Bore .070 STBD Bore .070	.040	.054	.072
	WMH 45-3	PORT Bore .070 STBD Bore .070	.040	.054	.072

Standard Jets WMH-19/46/47

Important: Refer to Service Bulletin 93-20 for WMH-19 Main Jet Change Information.

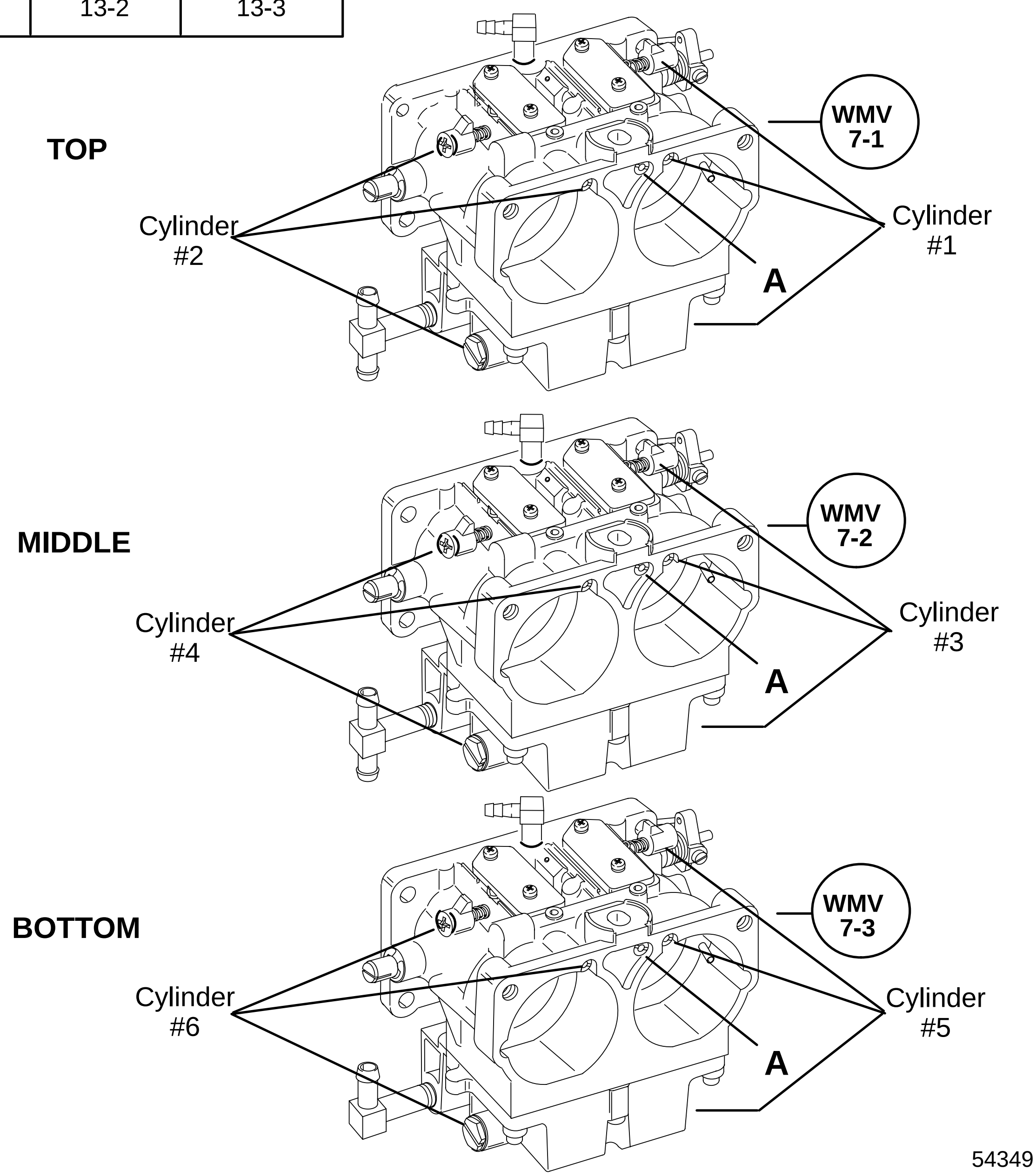
Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**	**Main Jet d**	**Off-Idle "Progression" Air Jet c**	**Idle Air Bleed Jet a**	**Back Draft Vent Jet b**
1994 225	WMH 19-1 changed to WMH 19-1A	Cylinder #1 .078 changed to .074 Cylinder #2 .078 changed to .074	.060	.048	.070
	WMH 19-2 changed to WMH 19-2A	Cylinder #3 .078 changed to .076 Cylinder #4 .074	.060	.048	.070
	WMH 19-3 changed to WMH 19-3A	Cylinder #5 .080 changed to .076 Cylinder #6 .076 changed to .074	.060	.048	.070

Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**	**Main Jet d**	**Off-Idle "Progression" Air Jet c**	**Idle Air Bleed Jet a**	**Back Draft Vent Jet b**
1994 1/2 225	WMH 46-1	Cylinder #1 .074 Cylinder #2 .074	.060	.048	.070
	WMH 46-2	Cylinder #3 .076 Cylinder #4 .074	.060	.048	.070
	WMH 46-3	Cylinder #5 .076 Cylinder #6 .074	.060	.048	.070

Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**	**Main Jet d**	**Off-Idle "Progression" Air Jet c**	**Idle Air Bleed Jet a**	**Back Draft Vent Jet b**
1995 225	WMH 47-1	PORT Bore .074 STBD Bore .074	.050	.046	.070
	WMH 47-2	PORT Bore .074 STBD Bore .076	.050	.048	.070
	WMH 47-3	PORT Bore .074 STBD Bore .076	.050	.048	.070

Carburetor Placement and Jet Location for Each Cylinder (WMV Carburetors)

Model	Top WMV	Middle WMV	Bottom WMV
1996 3 Litre Work	6-1	6-2	6-3
1996 225	7-1	7-2	7-3
1997 3 Litre Work	11-1	11-2	11-3
1997 225	13-1	13-2	13-3



A - Backdraft Jet Affects Both Cylinders

Carburetor Placement (WMV)

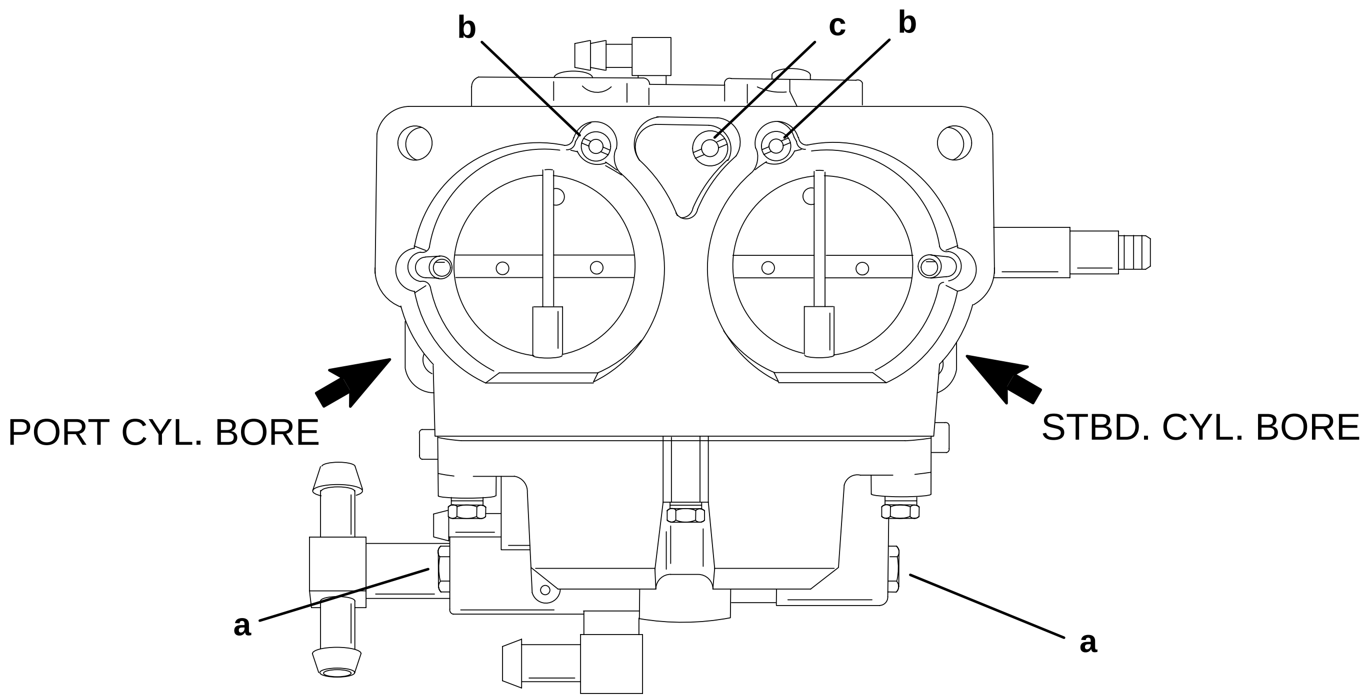
1996 Model 3 Litre WORK Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
3 Litre Work	WMV 6-1	PORT Bore	.078	.042	.080
		STBD Bore	.078	.042	
	WMV 6-2	PORT Bore	.078	.018	.080
		STBD Bore	.080	.056	
	WMV 6-3	PORT Bore	.078	.018	.080
		STBD Bore	.080	.056	

1996 Model 225 Carburetor Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
225	WMV 7-1	PORT Bore	.086	.038	.080
		STBD Bore	.086	.038	
	WMV 7-2	PORT Bore	.088	.020	.080
		STBD Bore	.088	.070	
	WMV 7-3	PORT Bore	.088	.032	.080
		STBD Bore	.088	.070	

1996-1/2/1997 Model 3 Litre WORK Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
3 Litre Work	WMV 11-1	PORT Bore	.082	.046	.080
		STBD Bore	.082	.040	
	WMV 11-2	PORT Bore	.086	.048	.080
		STBD Bore	.082	.058	
	WMV 11-3	PORT Bore	.082	.048	.080
		STBD Bore	.082	.054	

1996-1/2/1997 Model 225 Carburetor Standard Jet Chart Note: Jets listed are for engine operation from 0-5000 feet (0-1524m) of elevation.					
Outboard Model	**Carburetor Identification Number**		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
225	WMV 13-1	PORT Bore	.082	.060	.082
		STBD Bore	.084	.046	
	WMV 13-2	PORT Bore	.086	.052	.086
		STBD Bore	.084	.054	
	WMV 13-3	PORT Bore	.082	.052	.082
		STBD Bore	.084	.058	

WMV Carburetor Jet Placement



High Altitude Jet Chart - WMH and WMV Carburetors

Factory installed main fuel jets are normally adequate for proper performance up to approximately 5000 feet (1524m) above sea level. Between 2000 feet (615.4m) 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 (307.7m) in the following chart.

Feet Meter	1000 304.8	2000 609.6	3000 914.4	4000 1219.2	5000 1524	6000 1828.8	7000 2133.6	8000 2438.4	9000 2743.2	10000 3048	11000 3352.8	12000 3657.6
Jet Size												
0.030	0.030	0.030	0.030	0.028	0.028	0.028	0.028	0.028	0.028	0.026	0.026	0.026
0.032	0.032	0.032	0.032	0.030	0.030	0.030	0.030	0.030	0.028	0.028	0.028	0.028
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

Jet 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*

Enrichment System

The Electronic Control Module (ECM) electrically controls the enrichment valve to provide a rich fuel charge for starting a cold engine.

The ECM monitors engine coolant temperature (thru the temperature sensor) and ignition timing (thru the crank position sensor).

The ECM electronically opens the enrichment valve for varying lengths of time – the colder the engine, the longer the valve remains open. The ECM also advances ignition timing – the colder the engine, the more the ignition timing is advanced to improve cold starting characteristics.

Fuel is gravity fed to the enrichment valve from the top carburetor float bowl. When the valve is opened, fuel is drawn to outlet ports on each carburetor flange by crankcase suction. During cold start, throttle shutters should be closed – maximizing crankcase suction – to draw ample fuel from the enrichment valve.

Fuel Enrichment operates as a function of time and block temperature.

a. When block is cold and keyswitch is turned to "ON" position (engine not running), enrichment valve will provide fuel for 2 – 3 seconds.

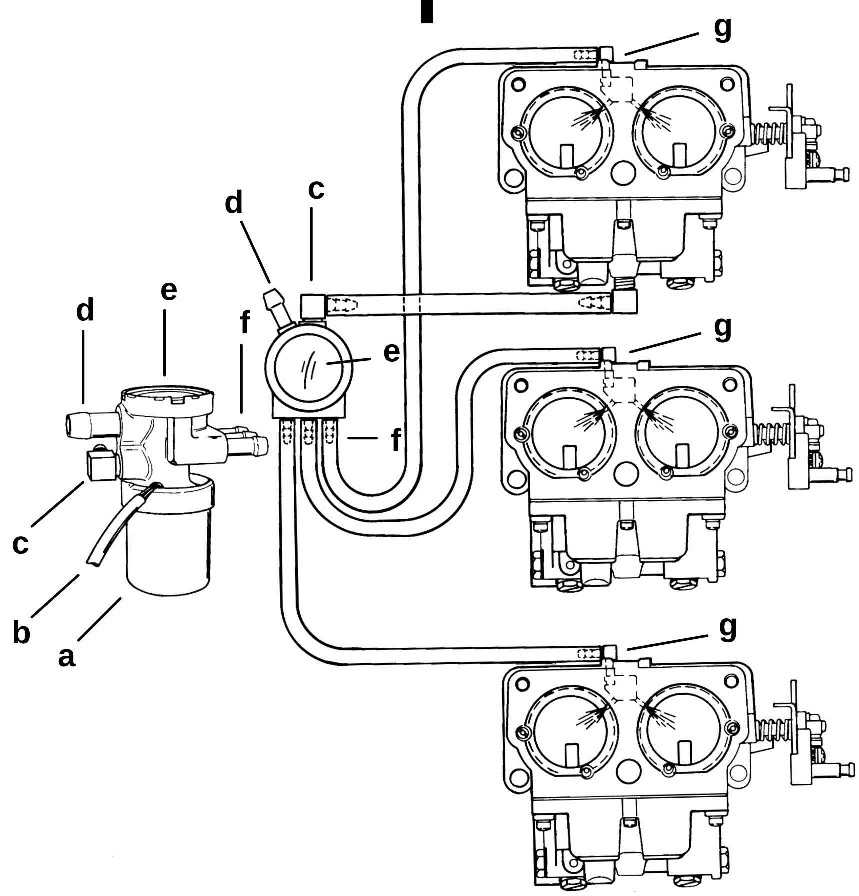
b. Enrichment valve will continue to provide fuel while engine is cranking until block temperature reaches approximately 122° F (50° C), at which point it will no longer provide fuel.

c. When block is hot (normal operating temperature – 140° to 155° F) enrichment valve will provide fuel for approximately 1/2 second when key is turned to "ON" position. The valve will not provide fuel during cranking at temperatures above 122° F (50° C).

MANUAL OPERATION OF ENRICHMENT VALVE

IMPORTANT: Manual use of enrichment valve if engine is warm could result in engine flooding.

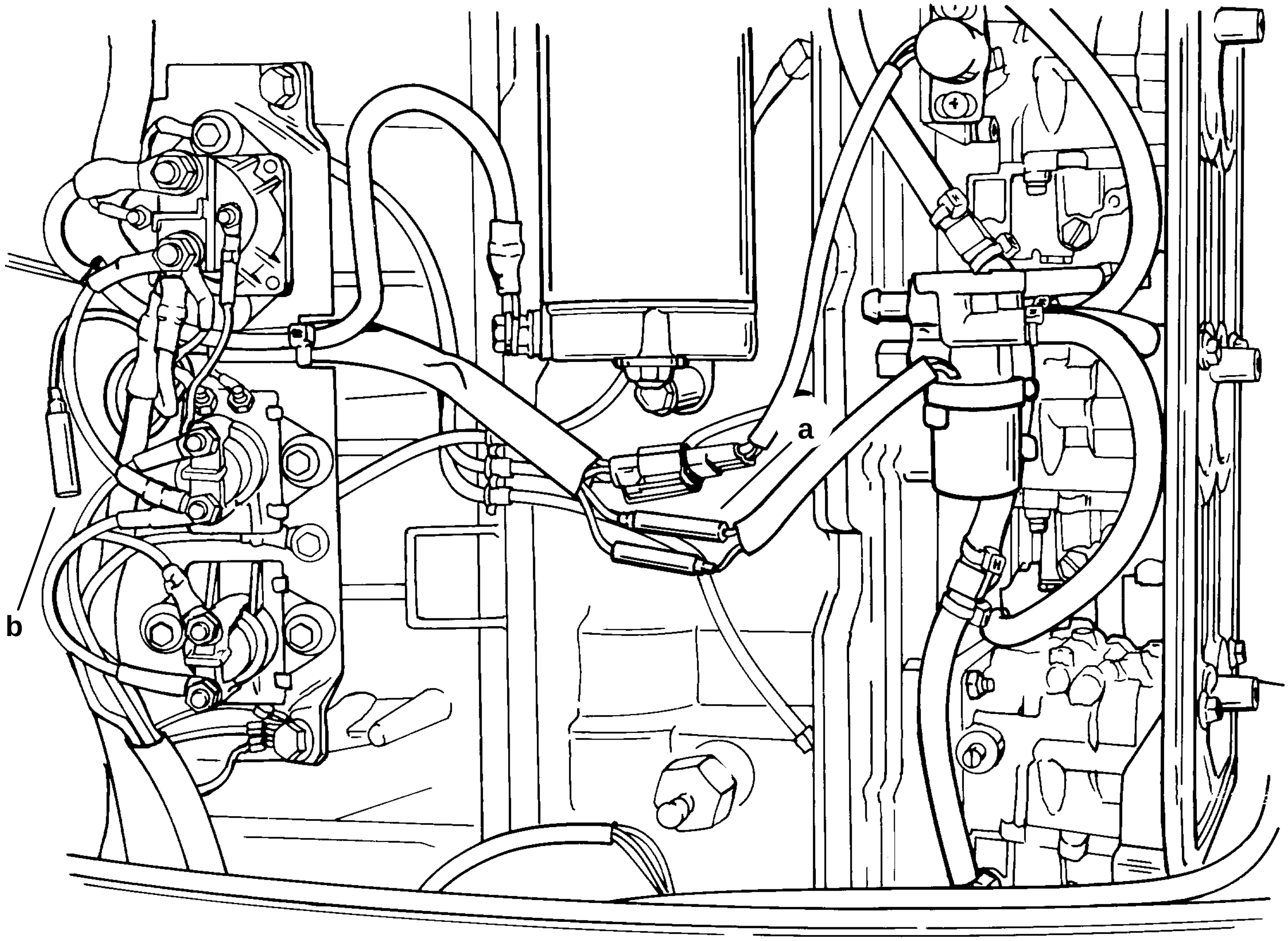
Should enrichment circuit of ECM fail, press button in on enrichment valve and hold approximately 5 seconds. Release button. Start outboard.



a - Enrichment Valve
b - Enrichment Valve Harness (to ECM)
c - Inlet Fuel
d - Vent
e - Manual Button
f - Outlet Ports
g - Inlet Fuel Ports

Enrichment Valve Test

1. Remove top cowl.
2. Remove ignition plate cover.
3. Disconnect YELLOW/BLACK bullet connector (a) to enrichment valve.
4. Remove plug from YELLOW/BLACK male connector (b) on ignition plate and connect male connector to female connector lead of enrichment valve.



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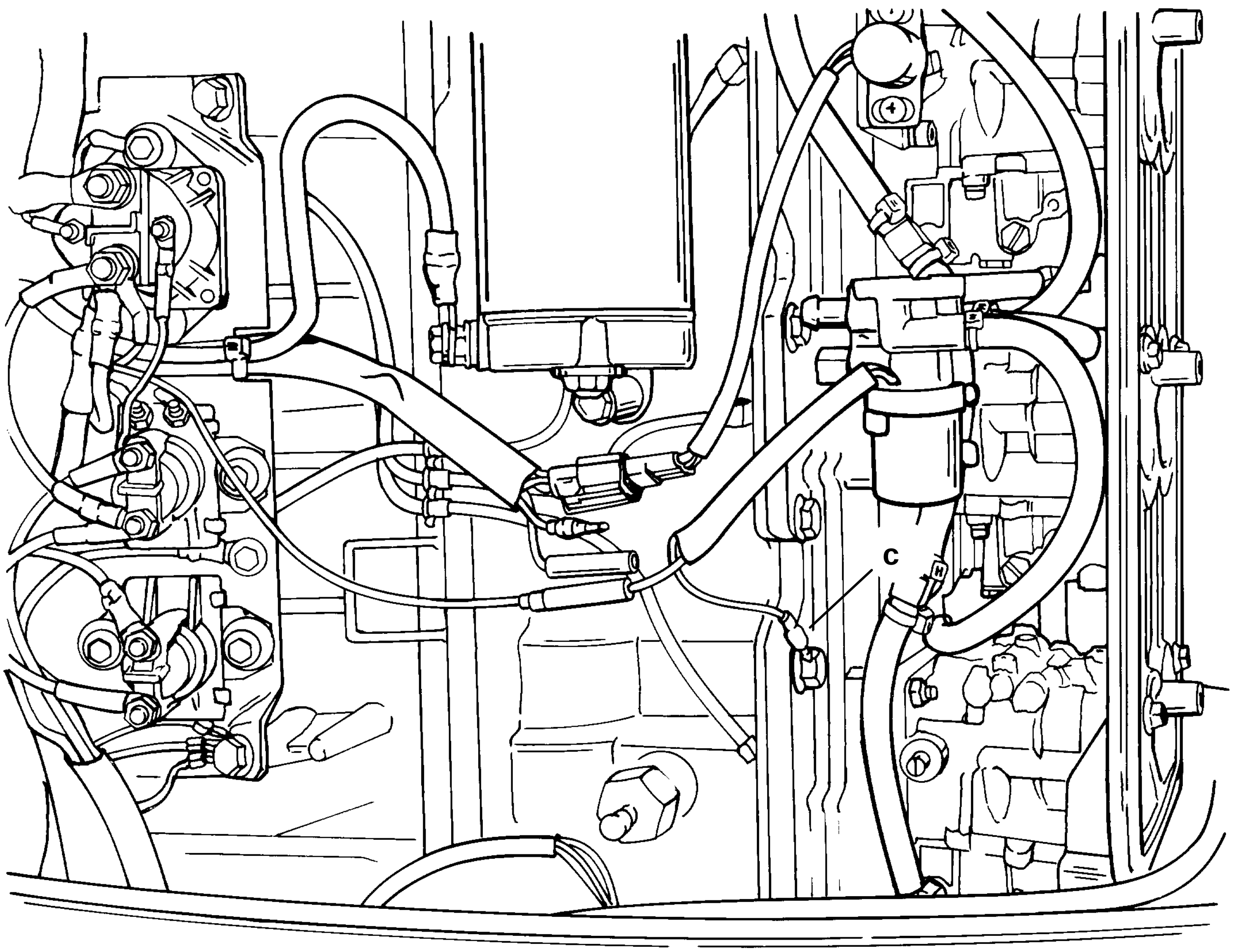
DVA Test of Fuel Enrichment Valve

Tested Part	DVA Leads	Connected To	Scale	Reading
Fuel Enrichment Solenoid Valve	RED BLACK	YELLOW/BLACK Engine Ground	200 DVA	When engine is initially started, DVA meter will deflect to 25 – 50 VDC. This will last only a short period and will then indicate 10 – 15 VDC. If above results are not obtained, valve is defective.

5. Disconnect PURPLE bullet connector lead of enrichment valve and touch MALE end (c) to GROUND.
6. Remove one outlet hose from enrichment valve and place container under valve.
7. Squeeze primer bulb until firm.
8. Turn ignition key to “ON” position and push IN on key.
9. While holding key IN, enrichment valve should click and fuel drain from exposed port.
10. If valve does not click, replace valve.



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ENRICHMENT VALVE REPLACEMENT

1. Disconnect YELLOW/BLACK and PURPLE bullet connectors.
2. Place container under valve and remove 3 outlet hoses and 1 inlet hose.
3. Remove valve from clamp
4. Dispose of caught fuel in proper container.
5. Reconnect hoses to new valve. Secure hoses with sta-straps.
6. Place valve into clamp.
7. Reconnect YELLOW/BLACK and PURPLE bullet connectors.

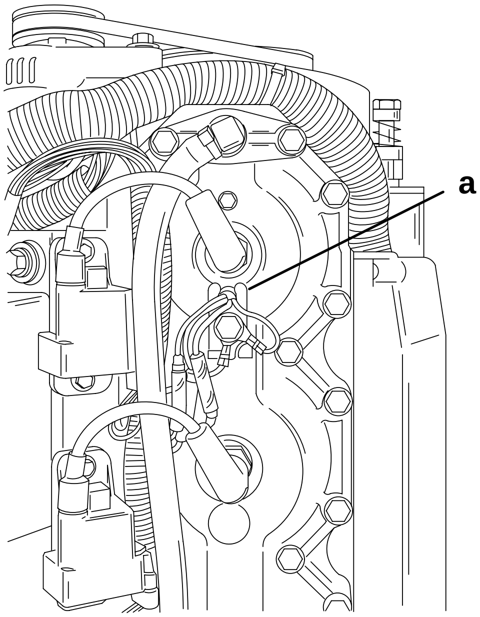
ENRICHMENT VALVE “CLICKS” BUT FUEL DOES NOT DRAIN FROM PORT

Inspect drain hose and top carburetor float bowl for blockage. Refer to SECTION 3A for carburetor disassembly.

ENRICHMENT VALVE “CLICKS” AND FUEL DRAINS FROM PORT

1. Inspect wiring between valve and ECM, between ECM and TEMPERATURE SENSOR, and between ECM and CRANK POSITION SENSOR for breaks or loose connections. Refer to SECTION 2D for engine wiring diagram.
2. If wiring is functional, refer to TEMPERATURE SENSOR OHM CHART, following, for proper functioning of sensor.

ENGINE TEMPERATURE SENSOR



a - Engine Temperature Sensor

Insert digital or analog ohmmeter test leads into both TAN/BLACK sensor leads. With engine at temperature (C° or F°) indicated, ohm readings should be as indicated ± 10%.

Block Temperature C°	F°	Resistance (Ohms)
–15	5	7465
–10	14	5636
–5	23	4288
0	32	3287
5	41	2551
10	50	1996
15	59	1574
20	68	1250
25	77	1000
30	86	805
35	95	652
40	104	532
45	113	436
50	122	360
55	131	298
60	140	248
65	149	208
70	158	175
75	167	148
80	176	126

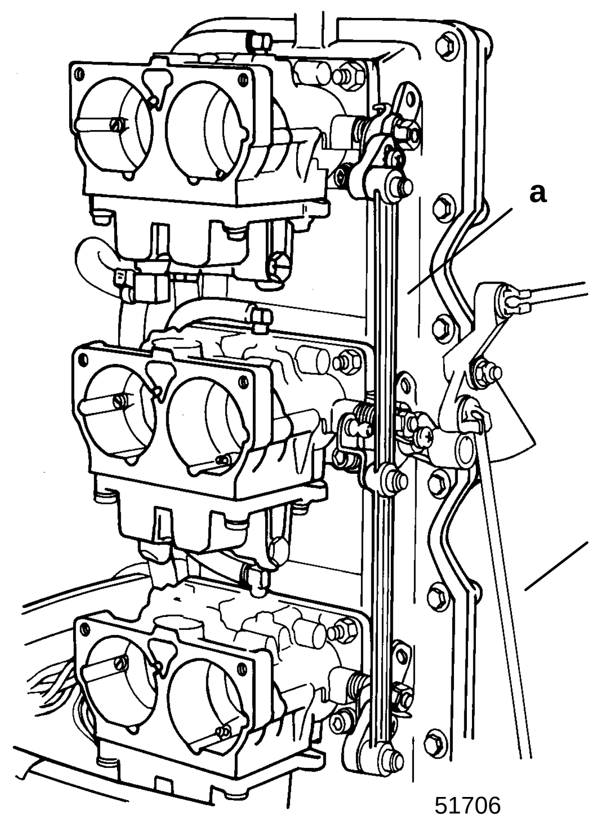
Removing Carburetor(s) from Engine

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.

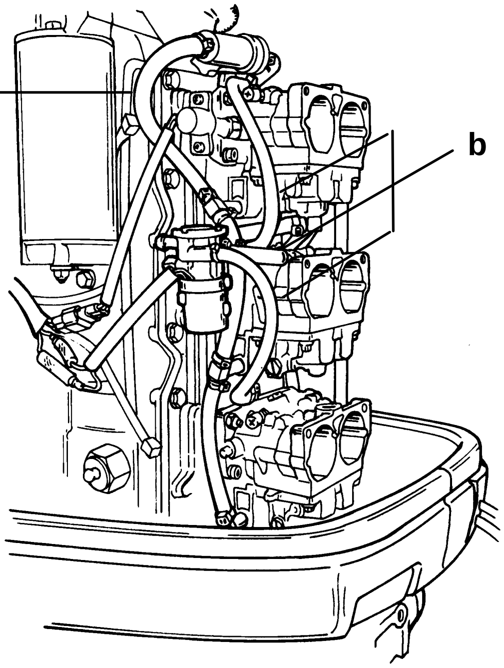
NOTE: *As each carburetor is removed from intake manifold, their respective fuel enrichment hose should be disconnected.*

2. Remove air box cover 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.



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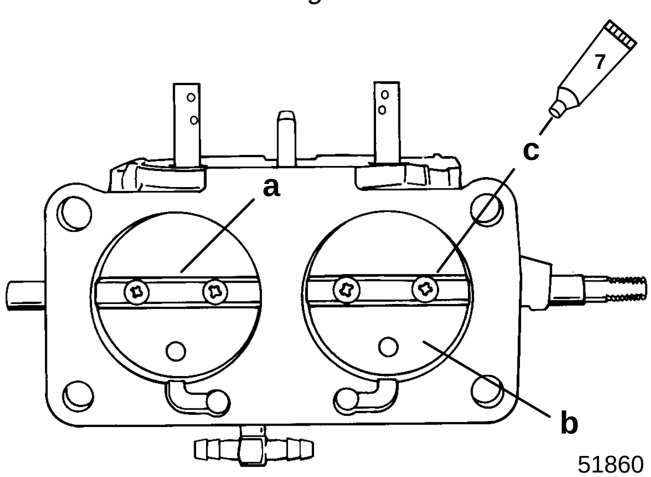
a - Fuel Hose
b - Enrichment Valve Hoses

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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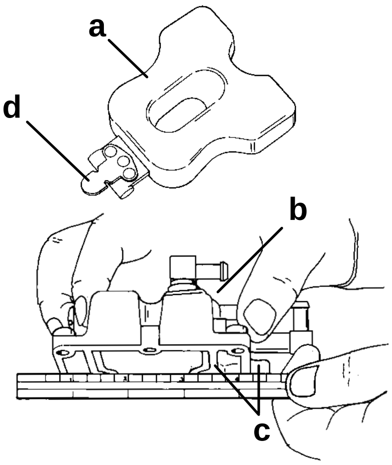
7 Loctite 271 (92-809820)

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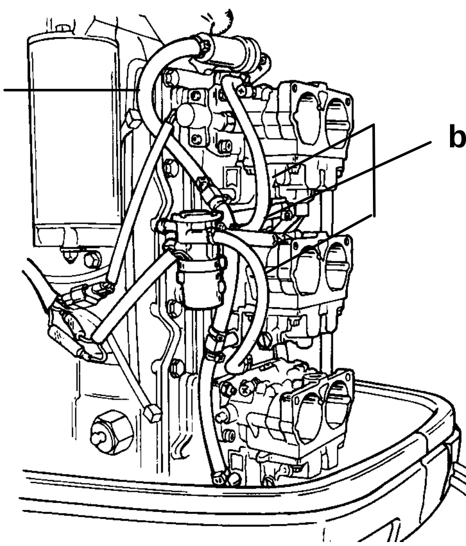
a - Float (Adjust by bending tab)
b - Fuel Bowl (Upside-Down)
c - Float Level Even with Bowl Edge
d - Float Tab

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.



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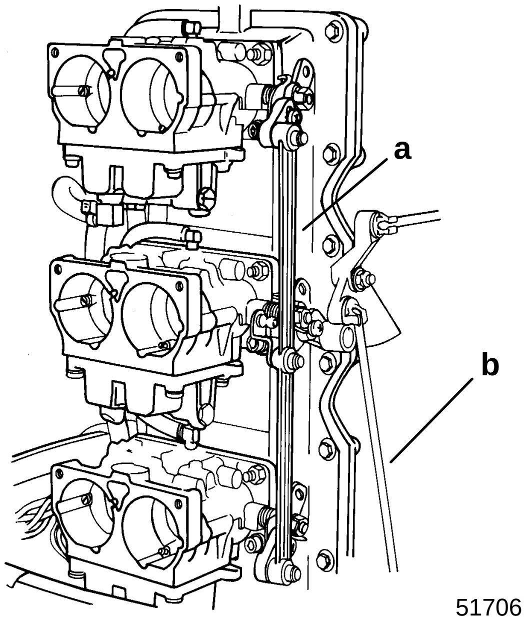
a - Fuel Hose
b - Enrichment Valve Hose

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



a - Throttle Linkage
b - Oil Pump Link Rod

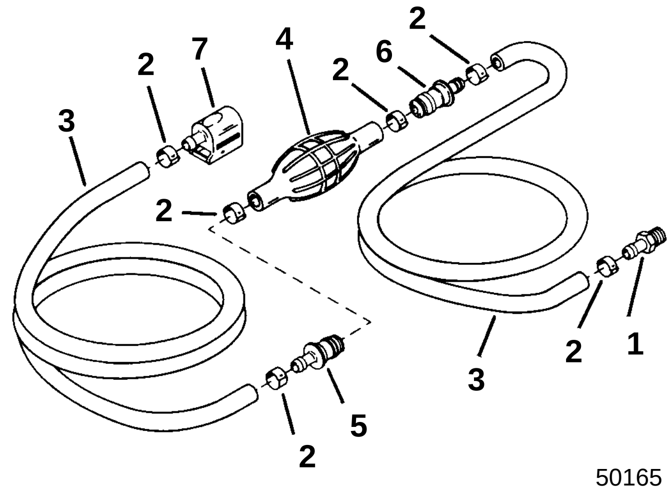
5. Re-synchronize carburetors following carburetor installation. Refer to “Timing/Synchronizing/Adjusting” Section 2.

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

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

6. Reinstall outboard cowling.

Fuel Line and Primer Bulb Assembly



1 - Fitting (Fuel Line)
2 - Clamp
3 - Fuel Line
4 - Primer Bulb
5 - Check Valve (Black)
6 - Check Valve (White)
7 - Fuel Line Connector (Engine End)

MAINTENANCE

Periodically check fuel line and primer bulb for cracks, breaks, restrictions or chafing. Check all fuel line connections for tightness. All fuel line connections must be clamped securely.

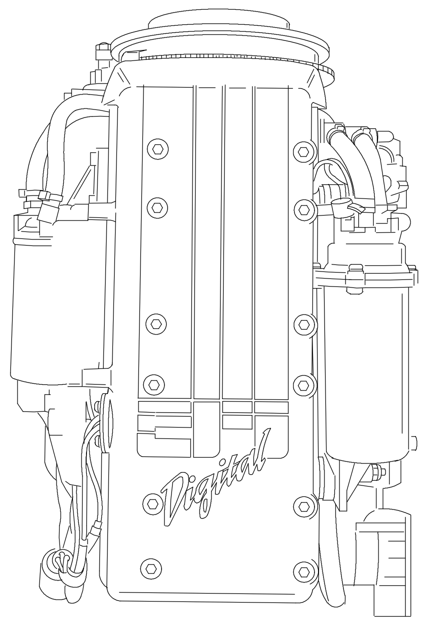
Primer bulb assembly has 2 check valves: Fuel inlet (toward tank) and a fuel outlet (toward engine).

The fuel inlet valve allows fuel to fill primer bulb but closes to prevent fuel from returning to tank when bulb is squeezed. The fuel outlet valve opens when primer bulb is squeezed to allow fuel flow to carburetor, but closes as bulb is released to prevent fuel from returning to primer bulb.

FUEL SYSTEMS

3

C



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FUEL INJECTION

Table of Contents

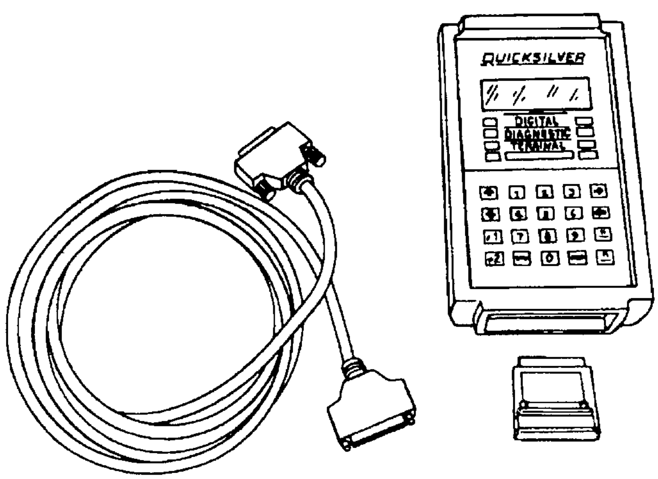
Specifications

Electronic Fuel Injection	
Idle RPM – All Models	650 ± 50
Wide Open Throttle RPM – Model 225 EFI – Model 250 EFI	 5000 – 5800 5000 – 5800
Float Adjustment (Vapor Separator) – Float Level	 Preset @ Factory
Fuel Injectors –All Models (Quantity) – Fuel ECU Receives Signal from: – #2 Primary Ignition Circuit – #4 Primary Ignition Circuit – #6 Primary Ignition Circuit	 6 #1 and #2 Injectors (WHITE Lead) #3 and #4 Injectors (DARK BLUE Lead) #5 and #6 Injectors (YELLOW Lead)
Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)
ECM (either Fuel or Ignition) Amperage Draw with Ignition Switch in the ON or RUN Position	20 to 90 Milliamperes* (measured @ PURPLE lead @ respective ECM harness connector with inductive test meter)

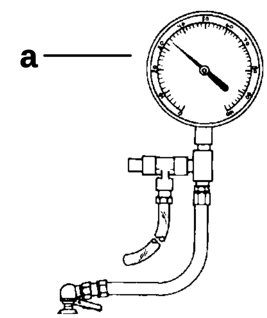
***NOTE:** The use of an in-series type test meter may result in different readings from those of an inductive test meter. Test results listed are approximate.*

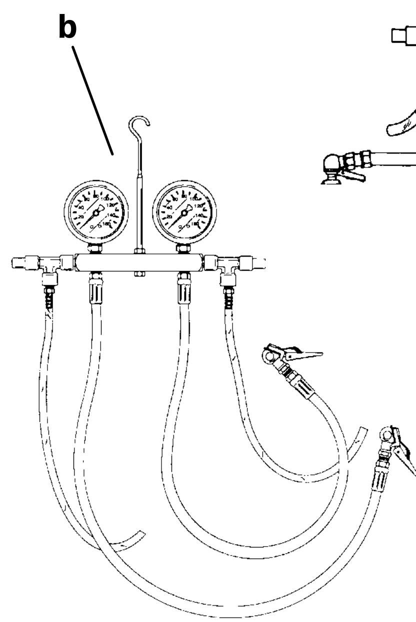
Special Tools

Digital Diagnostic Terminal (DDT)

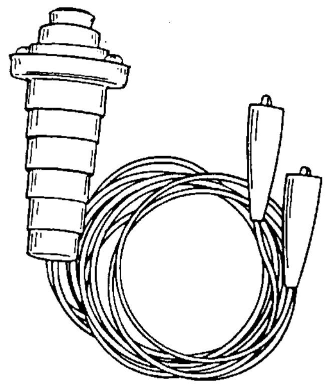


Fuel Pressure Gauge 91-16850 (a) or Fuel Pressure Gauge 91-852087A1 (b).

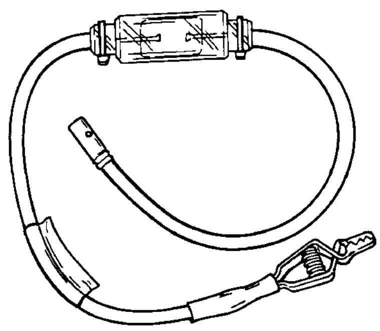




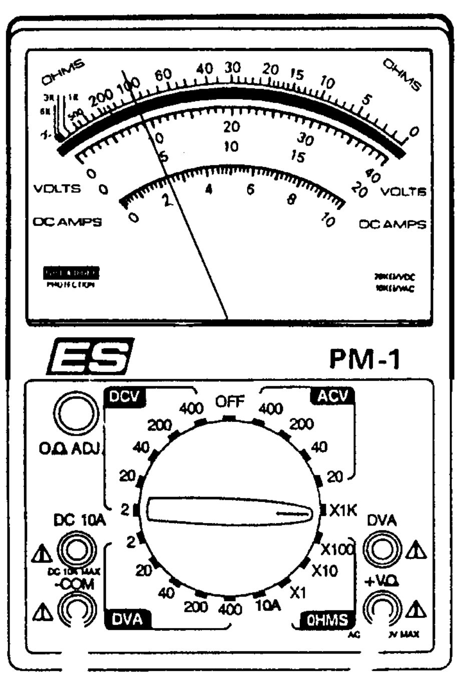
Remote Starter Switch 91-52024A1



Spark Gap Tester 91-63998A1



Multi-Meter DVA Tester 91-99750



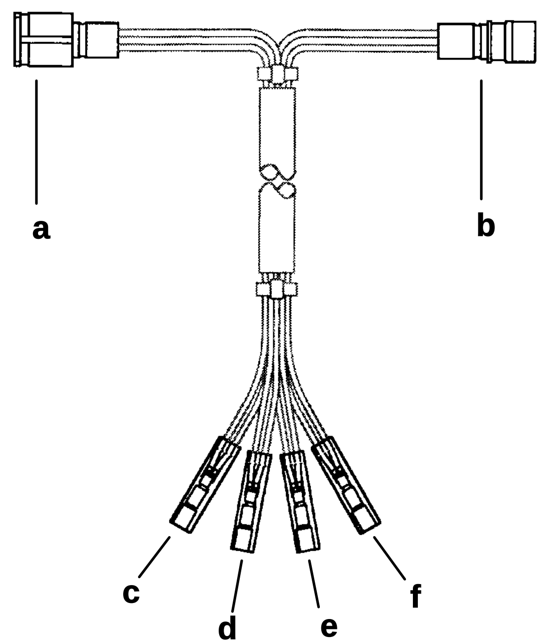
***NOTE:** There are 3 different Multi-Meter DVA Testers using the part number 91-99750 or 91-99750A1 having a DVA built in. Any one of these testers will work with the small V-6 EFI system.*

Injector Test Harness 91-833169A1

– For Mercury/Mainer 150 thru 250 HP with Electronic Fuel Injection

– For Hi-Performance 150 thru 300 HP PRO MAX/ SUPER MAGNUM models only

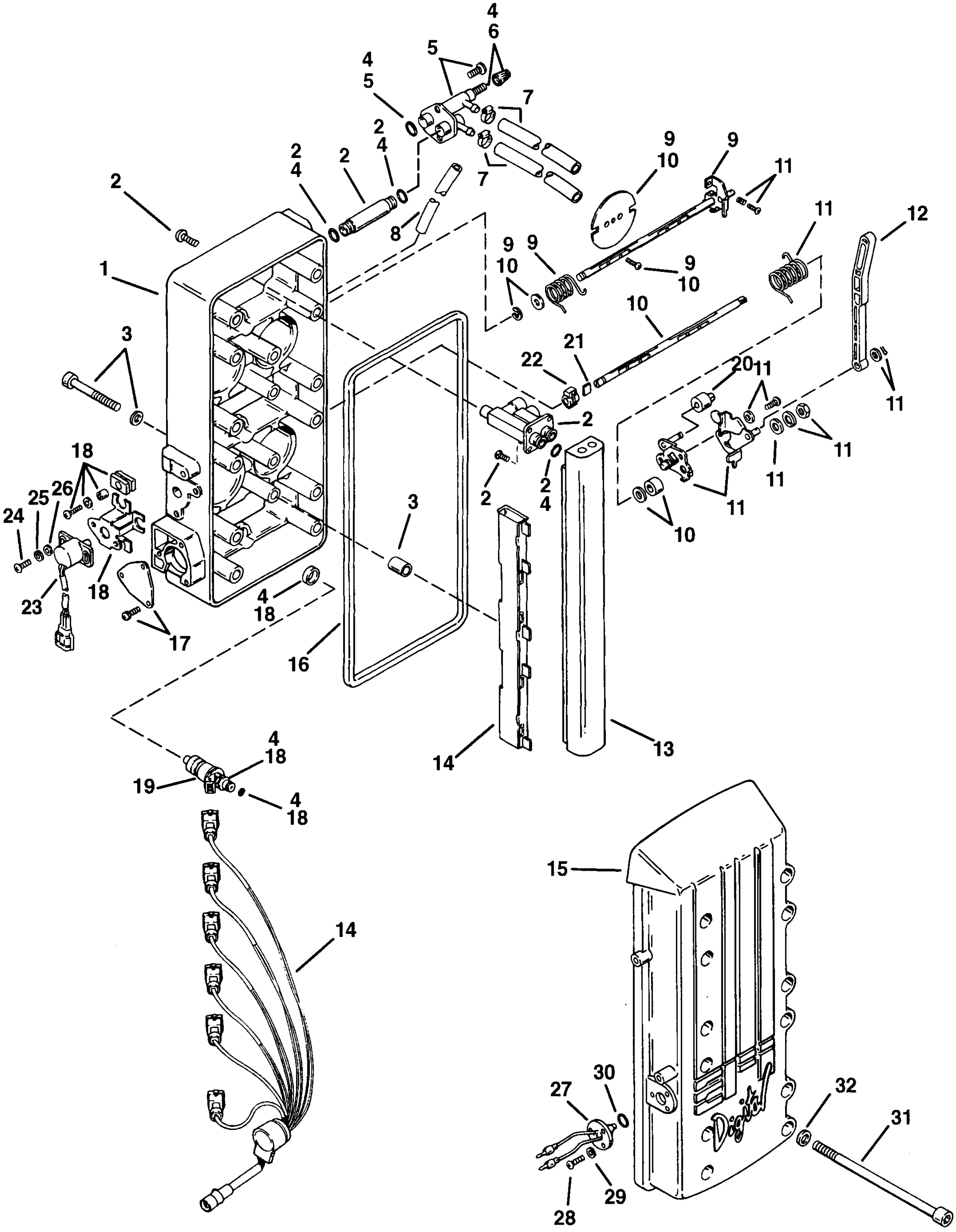
Can be used to verify that the ECM is supplying operating voltage to the injectors. Harness is connected between the injector harness and the engine harness. Harness is used in conjunction with DVA meter 91-99750A1. Harness will also serve as a convenient way to connect the injector harness to perform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



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

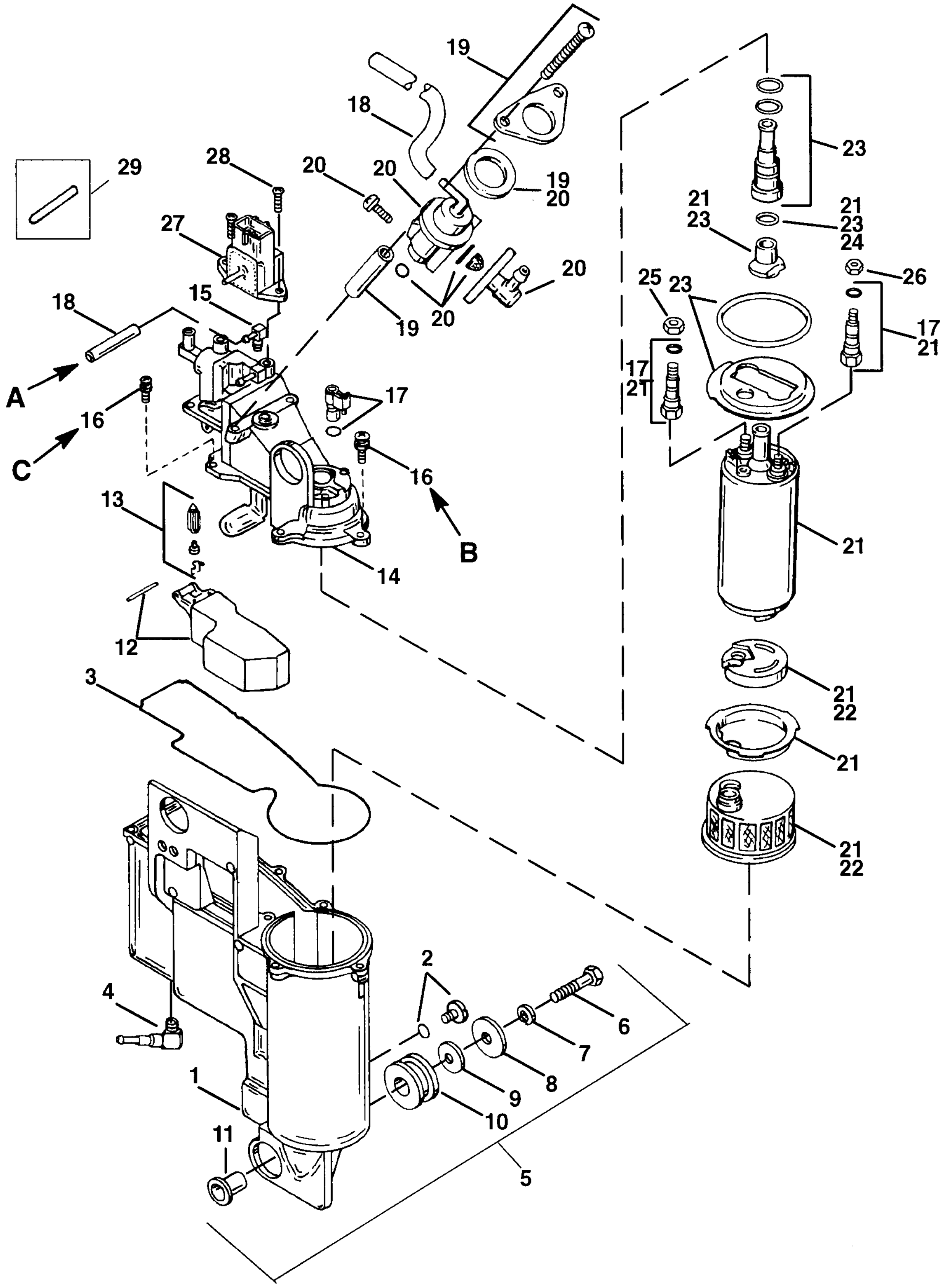
Notes:

Fuel Management System



REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	FUEL MANAGEMENT **(250 - 4 SHUTTER)**			
–	1	FUEL MANAGEMENT **(225 - 2 SHUTTER)**			
1	1	THROTTLE BODY **(4 SHUTTER)**			
1	1	THROTTLE BODY **(2 SHUTTER)**			
2	1	FUEL RAIL JOINT KIT	18		2.0
3	1	SCREW KIT-Fuel Rail	45		5.1
4	1	O-RING KIT			
5	1	FMA JOINT KIT	45		5.1
6	1	SCHRADER VALVE KIT			
7	1	TUBING KIT			
8	1	TUBING KIT			
9	1	THROTTLE SHAFT KIT **(TOP-4 SHUTTER)**			
10	1	THROTTLE SHAFT KIT **(BOTTOM)**			
11	1	LINK LEVER KIT			
12	1	LINK			
13	1	FUEL RAIL			
14	1	HARNESS KIT			
15	1	COVER			
16	1	SEAL			
17	1	RETAINING KIT			
18	5	BRACKET KIT-TPS			
19	6	INJECTOR KIT			
20	1	ROLLER			
21	1	KEY			
22	1	COUPLING			
23	1	SENSOR-Throttle Position			
24	2	SCREW (M4 x 10)	20		2.3
25	2	LOCKWASHER			
26	2	WASHER			
27	1	TEMPERATURE SENSOR			
28	3	SCREW (M4 x 10)	Drive Tight		
29	3	LOCKWASHER			
30	1	O RING			
31	12	SCREW		19	26.0
32	12	WASHER			

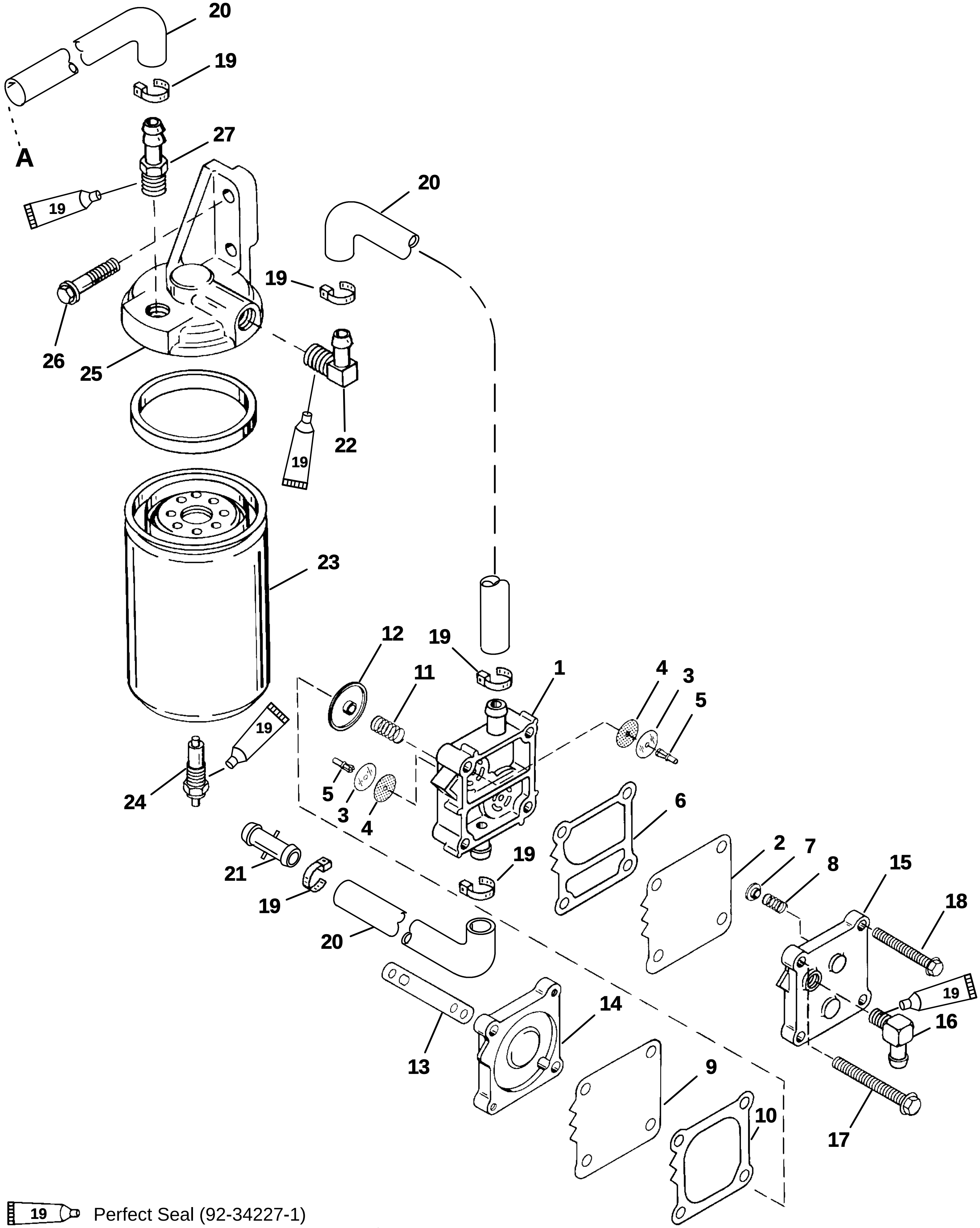
Fuel Management System



A – To Fuel Filter
B – Large Screws (5mm) [Torque to 30 lb. in. (3.4 N·m)]
C – Small Screws (4mm) [Torque to 20 lb. in. (2.3 N·m)]

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	FUEL MANAGEMENT **(250 - 4 SHUTTER)**			
–	1	FUEL MANAGEMENT **(225 - 2 SHUTTER)**			
1	1	VAPOR SEPARATOR BODY KIT			
2	1	DRAIN SCREW KIT			
3	1	O RING			
4	1	CHECK VALVE			
5	1	MOUNTING SCREW KIT			
6	3	BOLT	45		5.1
7	3	LOCKWASHER			
8	3	WASHER			
9	3	WASHER			
10	3	GROMMET			
11	3	COLLAR			
12	1	FLOAT KIT			
13	1	FLOAT VALVE KIT			
14	1	COVER			
15	1	ELBOW KIT			
16	1	SCREW KIT			
17	1	ELECTRICAL CONNECTION KIT			
18	1	TUBING KIT			
19	1	ATTACHING KIT-Pressure Regulator	30		3.4
20	1	PRESSURE REGULATOR KIT	45		5.1
21	1	FUEL PUMP KIT			
22	1	FUEL STRAINER KIT			
23	1	FUEL PUMP FITTING KIT			
24	1	O RING KIT			
25	1	NUT (M4 x .7)	6		0.7
26	1	NUT (M5 x .8)	8		0.9
27	1	MAP SENSOR			
28	2	SCREW (M6 x 12)	Drive Tight		
29	1	CAP **(BLACK) (S/N 0G438000 & UP)**			

Fuel Pump

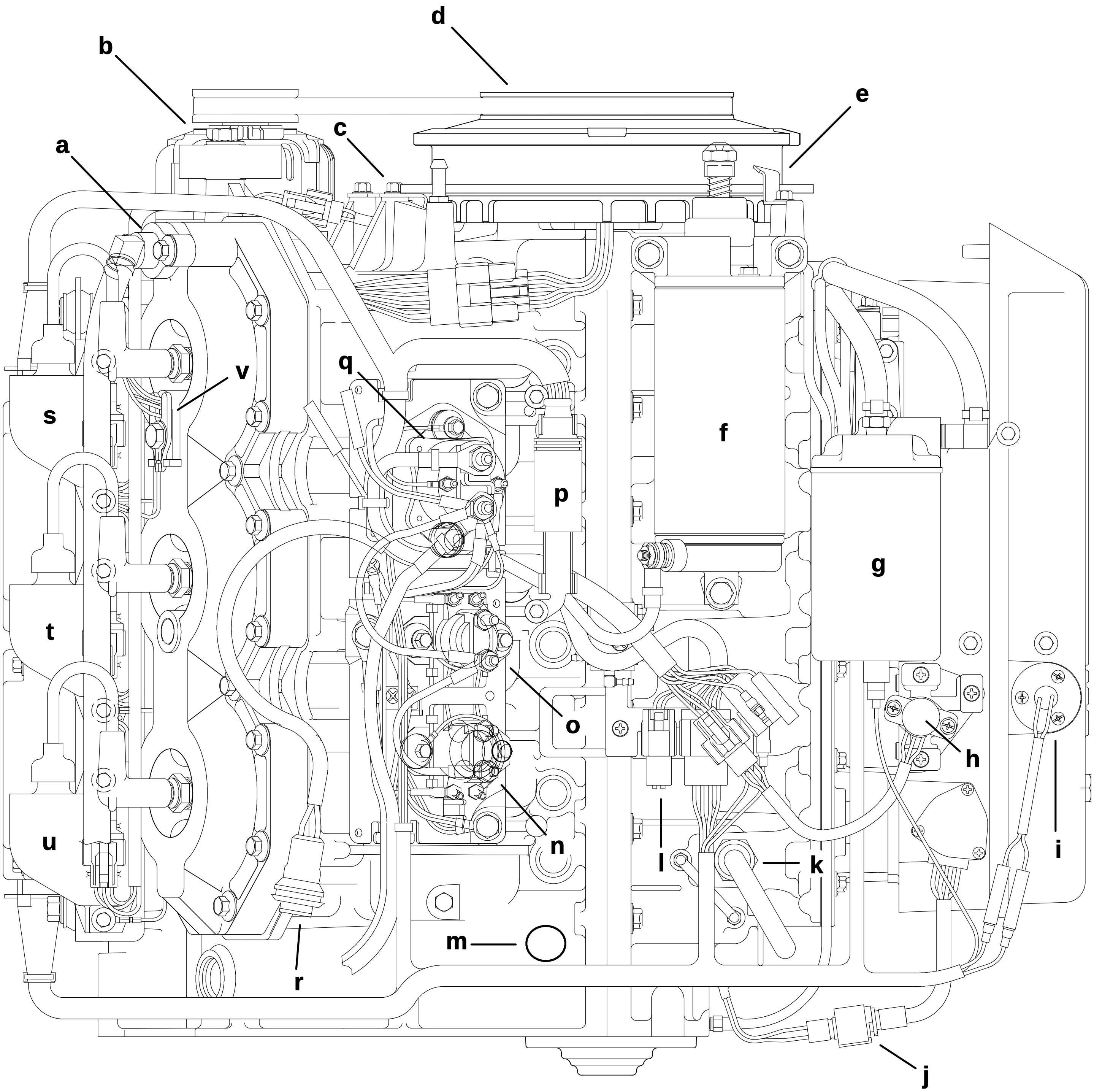


19 Perfect Seal (92-34227-1)

A = TO VAPOR SEPARATOR

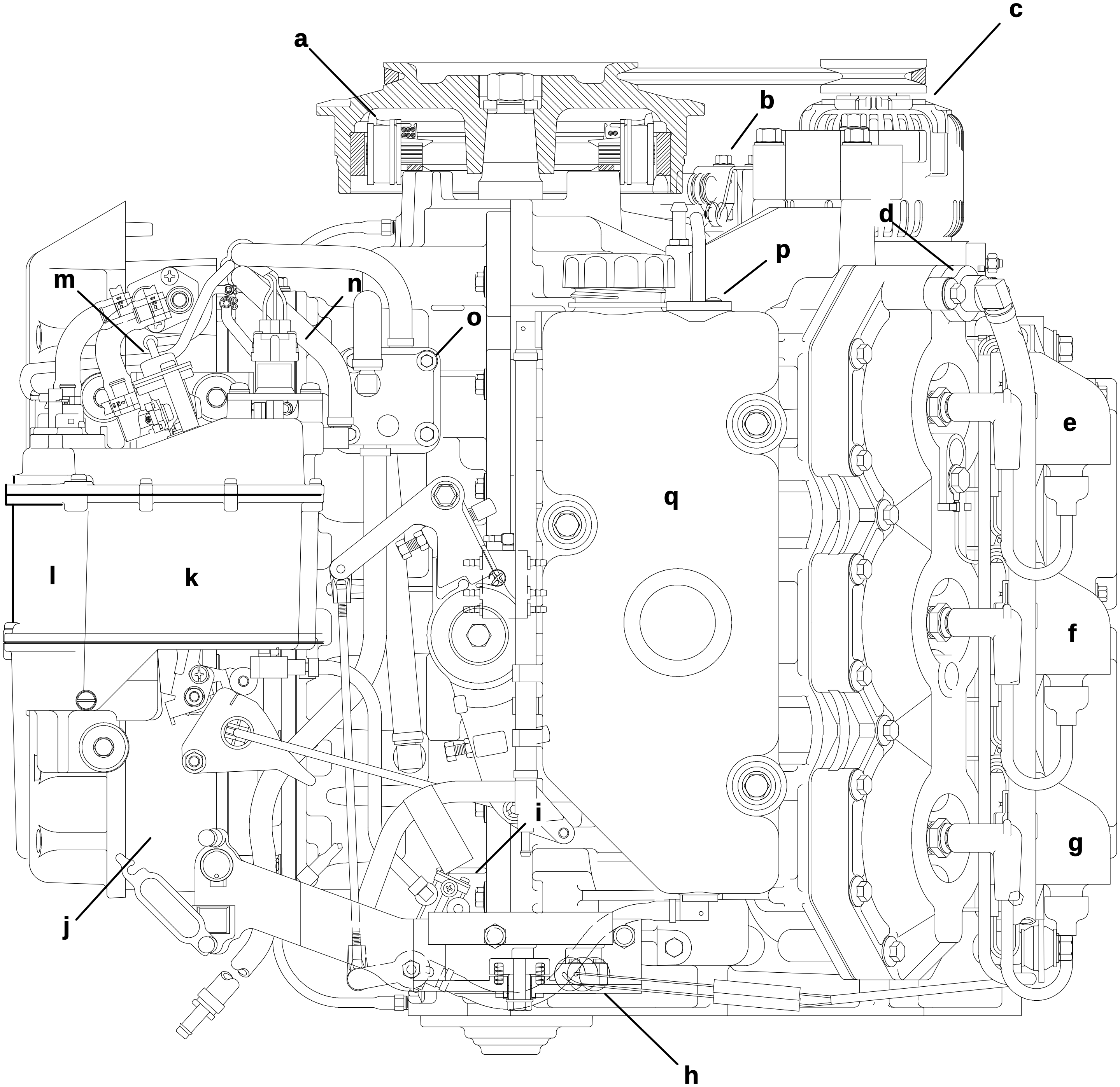
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE–rubber			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	GASKET–boost			
7	1	CAP			
8	1	SPRING			
9	2	DIAPHRAGM			
10	1	GASKET–pulse			
11	1	SPRING			
12	1	CAP			
13	1	GASKET–base			
14	1	BASE–fuel pump			
15	1	PLATE–fuel pump			
16	1	ELBOW (90°)			
17	2	SCREW–fuel pump to crankcase (M6 x 1)	60		6.8
18	2	SCREW–fuel pump (M5 x 0.8 x 40)	60		6.8
19	AR	STA-STRAP			
20	3	TUBING (17")			
21	1	CONNECTOR			
22	1	FITTING-Base (Included with Ref. #25)			
23	1	FUEL FILTER **S/N–0G303045 & BELOW**			
24	1	PROBE			
23	1	FUEL FILTER **S/N–0G303046 & UP**			
24	1	PROBE			
25	1	BASE-Fuel Filter			
26	2	SCREW (M6 x 30)	100		11.3
27	1	CONNECTOR (STRAIGHT)			

Powerhead View (Starboard)



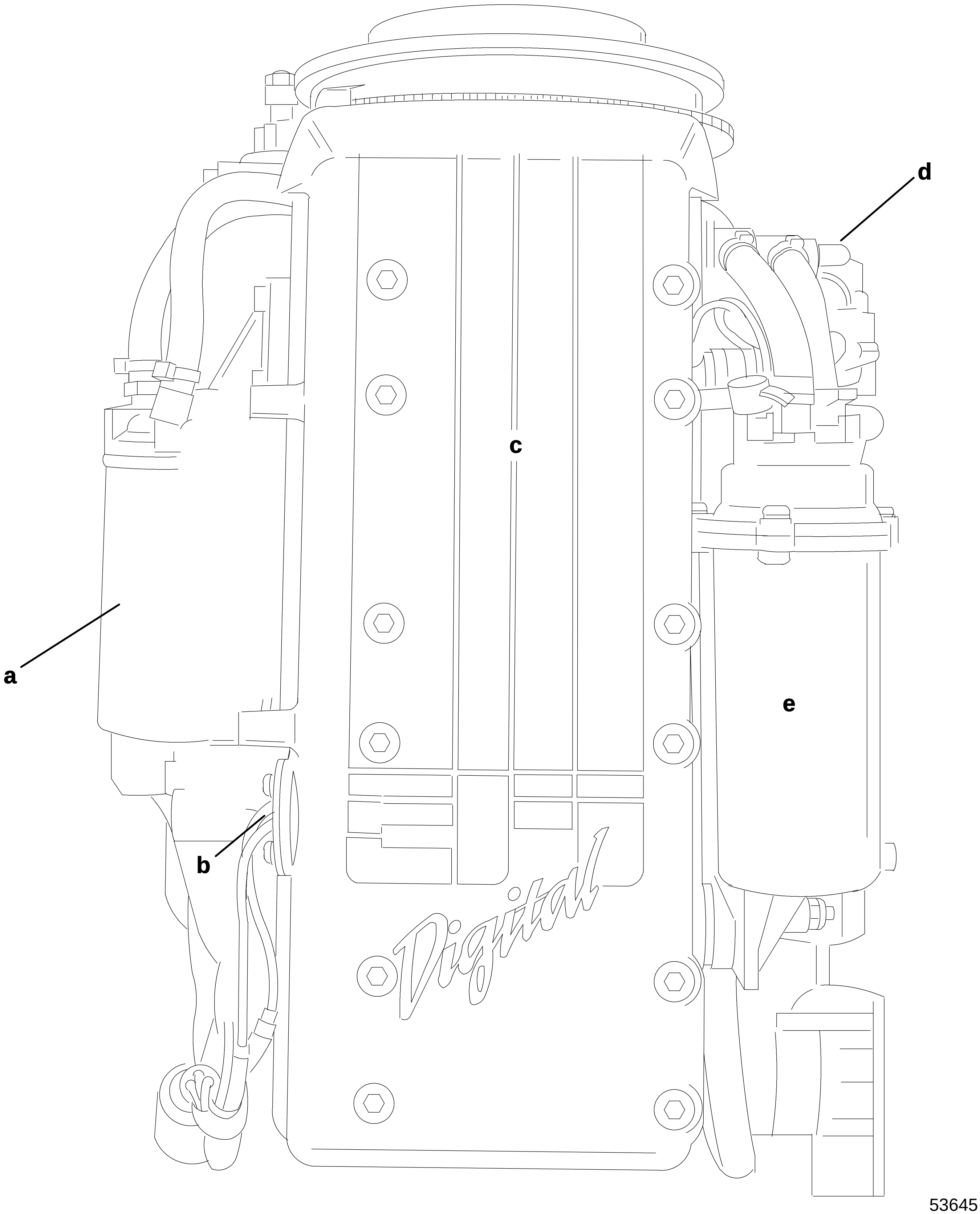
a - Thermostat (143°F)
b - 60 Ampere Alternator
c - Crank Position Sensor
d - Flywheel
e - Timing Pointer
f - Starter Motor
g - Water Separator
h - Throttle Position Sensor
i . - Air Temperature Sensor
j . - Injector Harness
k - Oil Tank Pressure Port
l - DDT Test Connector
m - Serial # Plug
n - DOWN Trim Solenoid
o - UP Trim Solenoid
p - Engine Harness Plug
q - Starter Solenoid
r - 20 Ampere Fuse
s - #1 Capacitor Discharge Module
t - #3 Capacitor Discharge Module
u - #5 Capacitor Discharge Module
v - Temperature Sensor

Powerhead View (Port)



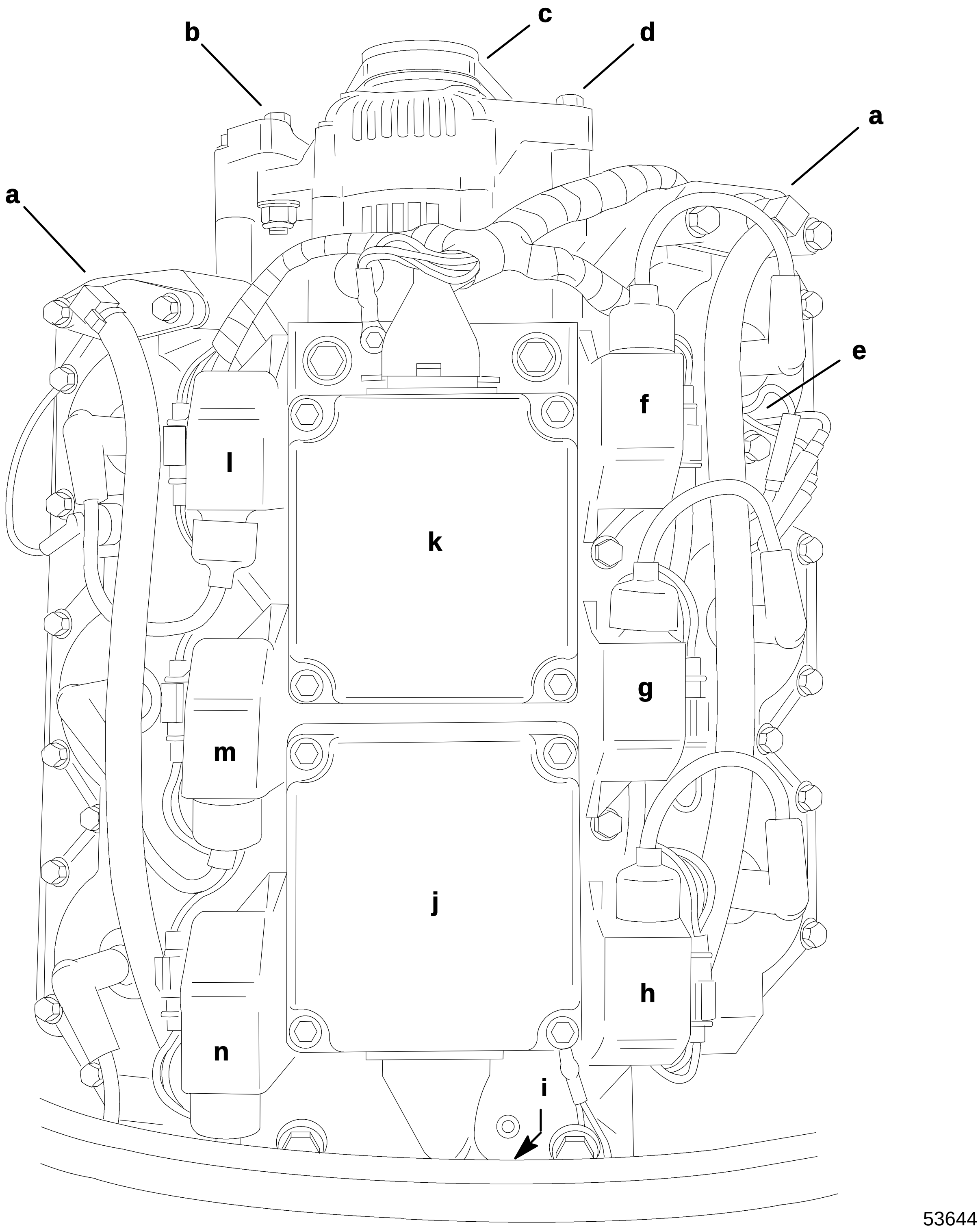
a - Stator
b - Crank Position Sensor
c - 60 Ampere Alternator
d - Thermostat (143 °F)
e - #2 Capacitor Discharge Module
f - #4 Capacitor Discharge Module
g - #6 Capacitor Discharge Module
h - Shift Interrupt Switch
i - Oil Injection Pump
j - Fuel Injection Manifold
k - Vapor Separator
l - Electric Fuel Pump
m - Fuel Rail Pressure Regulator
n - MAP Sensor
o - Fuel Pump
p - Low Oil Switch
q - Oil Tank [1.9 qt. (1.8 Liter)]

Powerhead View (Front)



a - Fuel Water Separator
b - Air Temperature Sensor
c - Fuel Injection Air Intake Cover
d - Fuel Rail Pressure Port
e - Electric Fuel Pump

Powerhead View (Rear)

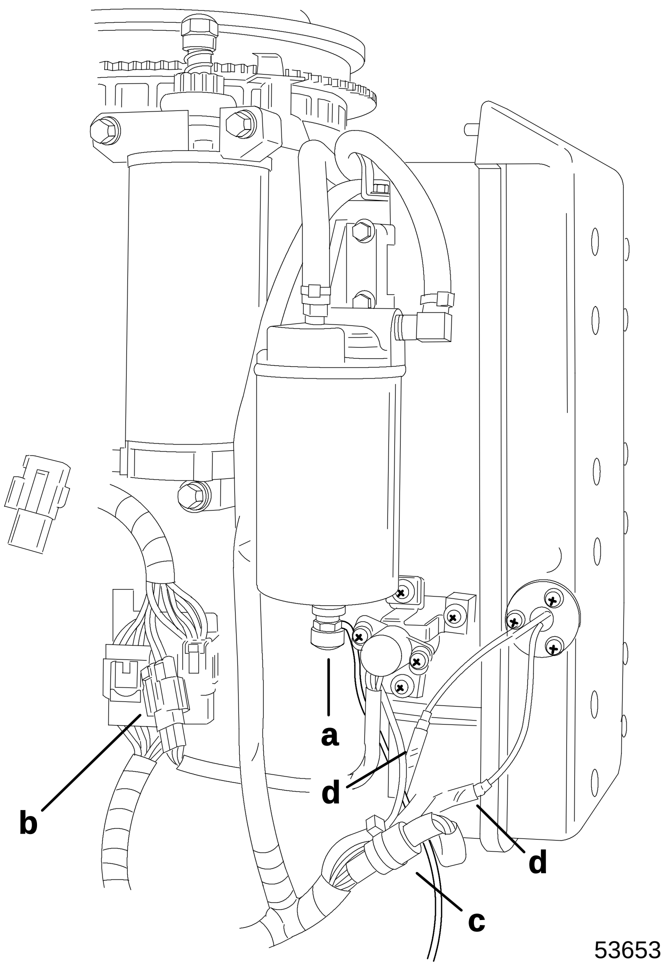


a - Thermostat (143 °F)
b - Alternator Belt Tension Bolt
c - 60 Ampere Alternator
d - Alternator Pivot Bolt
e - Temperature Sensor
f - #1 Capacitor Discharge Module
g - #3 Capacitor Discharge Module
h - #5 Capacitor Discharge Module
i - Water Pressure Gauge Plug
j - EFI ECM
k - Ignition ECM
l - #2 Capacitor Discharge Module
m - #4 Capacitor Discharge Module
n - #6 Capacitor Discharge Module

Removal of Electronic Fuel Injection as an Assembly

If no problem exists with the fuel injection system and the powerhead must be disassembled, the EFI assembly may be removed without being disassembled as follows:

1. Disconnect Water Separator Fuel Filter warning lead.
2. Disconnect Detonation Module harness.
3. Disconnect Throttle Position Sensor harness.
4. Disconnect injector harness.
5. Disconnect Air Temperature Sensor bullet connectors.



53653

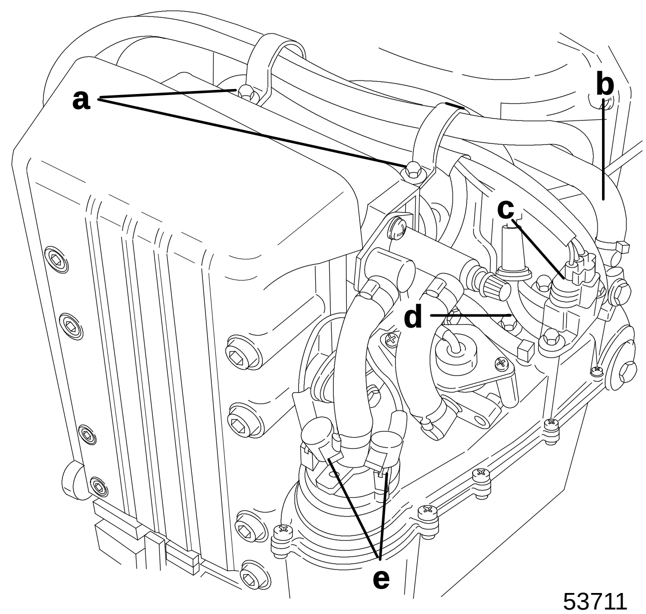
a - Water Separator Warning Lead
b - TPS Harness
c - Injector Harness
d - Air Temperature Sensor Bullet Connectors

6. Remove 2 hose clamp bolts.
7. Disconnect fuel pump outlet hose.
8. Disconnect MAP sensor harness.
9. Disconnect bleed hose.

⚠ CAUTION

Battery leads must be disconnected before removing electric fuel pump leads.

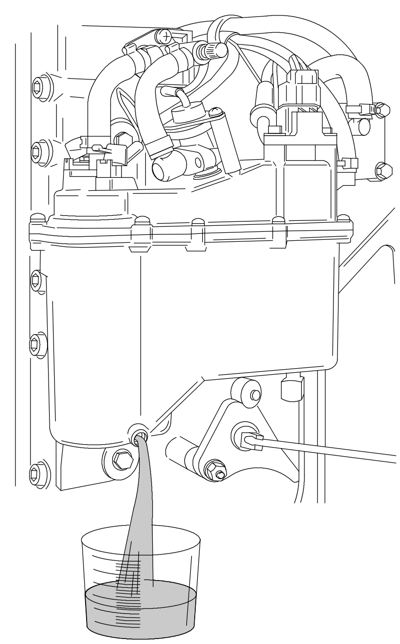
10. Disconnect electric fuel pump leads.



53711

a - Clamp Bolts
b - Fuel Pump Outlet Hose
c - MAP Sensor Harness
d - Bleed Hose
e - Electric Fuel Pump Leads

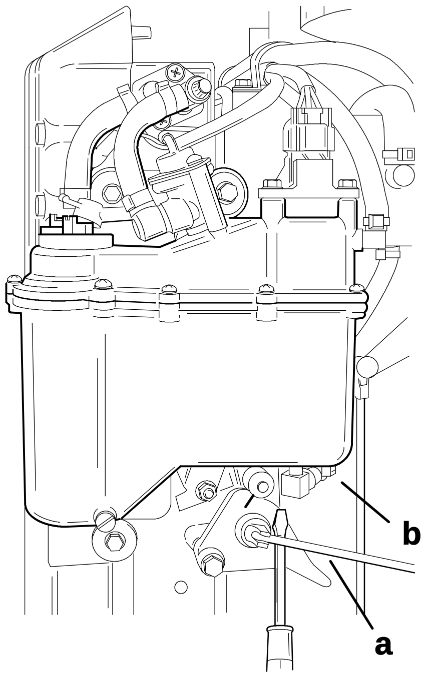
11. Place a suitable container underneath vapor separator drain plug and remove plug.



53652

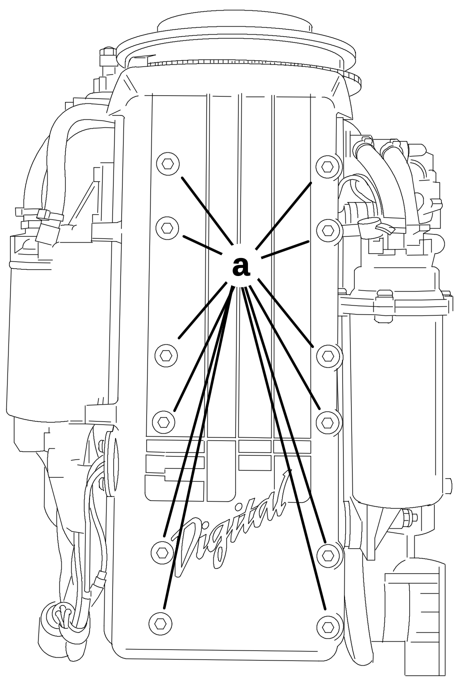
12. Remove throttle link arm with screwdriver.

13. Disconnect oil injection hose.



a - Throttle Link Arm
b - Oil Injection Hose

14. Remove 12 allen screws securing EFI assembly to powerhead and remove assembly.



a - Allen Screws

Safety Precautions

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

⚠ WARNING

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 to the powerhead by fuel injectors. These injectors are provided with a constant supply of fuel [34 – 36 psi (234 to 248 kPa)] from the fuel rail. The injectors are opened and closed electrically 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.

Troubleshooting

Marine engines are, by the nature of their environment, engineered to be trouble-free, durable power plants. The experienced mechanic, when investigating a possible marine engine problem, will isolate boat related support systems from the marine engine. This can be accomplished through the use of a remote fuel tank filled with fresh fuel and utilizing a known good fuel line/primer bulb assembly. If the engine runs properly after being connected to the remote fuel tank, the mechanic's troubleshooting time will be spent in the boat checking for pinched/damaged fuel lines, stuck anti-siphon valves, plugged filters or draining fuel tanks of poor quality fuel.

If the engine does not run properly on the remote fuel tank, the mechanic can sometimes further isolate the the problem by squeezing the fuel line primer bulb. If the engine runs properly, the problem lies in fuel delivery – defective or weak mechanical fuel pump, electric fuel pump, plugged filters or leaking fuel lines.

Poor running characteristics of a particular outboard can usually be identified as the result of a problem in one of three areas: Mechanical, Electrical, or Fuel Management.

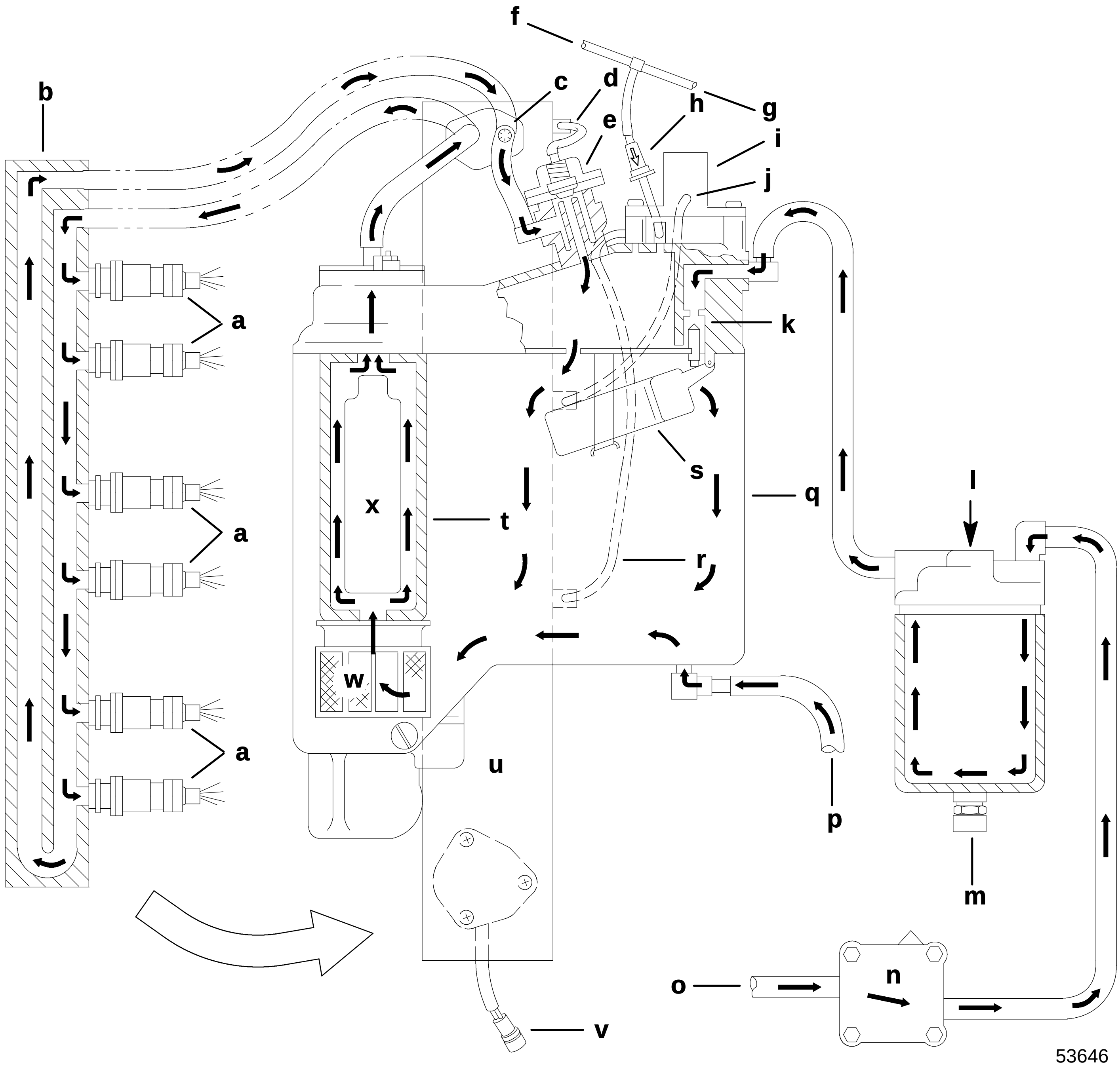
Before disassembling and replacing EFI components, the experienced mechanic will isolate the problem(s) to one (or more) of the 3 aforementioned areas.

Mechanical – A compression check should be performed with the powerhead warm (if possible), all spark plugs removed, the throttle shutters held wide open and a fully charged battery employed for cranking duties. Normal compression psi should be 100 to 110 psi (689 to 758 kPa) for 225/250 horsepower engines and 80 to 90 psi (551 to 620 kPa) for 3 Litre Work engines. Inspect powerhead for leaking seals, gaskets or broken/disconnected throttle spark linkages.

Due to the precise fuel delivery characteristics of electronic fuel injection and its dependency on many sensors to determine the correct fuel/air ratio during all conditions, IT IS IMPERATIVE THAT SET-UP PROCEDURES BE FOLLOWED EXACTLY AS STATED IN FACTORY SERVICE LITERATURE.

Electrical – The ignition system can be quickly checked through the use of a good inductive timing light. With all spark plugs installed (and torqued), water being supplied to the water pump (in case engine starts), crank the outboard while sequentially attaching the timing light pickup to each spark plug lead. The timing light should flash brightly and steadily. If timing light does not flash on 1 or more cylinders, test the individual cylinder ignition components with a Direct Voltage Adaptor (DVA) or with a volt/ohm meter. Refer to SECTION 2A for ignition test specifications.

Fuel Flow Diagram



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

Fuel Flow Component Description

Pulse Fuel Pump

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

Water Separating Filter

The water separating filter protects the fuel injectors from water and debris. The filter contains a sensor probe which monitors water level in the filter. If water is above the sensor probe, the water detection light-will come on and the warning horn will begin a series of 4 beeps. If the outboard continues to run, the light will stay on and the horn will beep every 2 minutes.

Vapor Separator

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

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

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

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

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

Bleed System

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

On EFI engines, excess crankcase fuel is directed through a filter (to eliminate contaminates) and emptied into the vapor separator. It mixes with fresh incoming fuel and is pumped to the fuel rail and fed through the injectors.

Final Filter

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

Electric Fuel Pump

The electric fuel pump runs continuously while providing fuel in excess of engine demands. The excess fuel is circulated through the fuel rail to the fuel pressure regulator and back to the vapor separator.

Fuel Injectors

The fuel injectors are located inside the induction manifold on the fuel rail. The injector valve body consists of a solenoid actuated needle and seat assembly. The injector receives signals from the EFI Electronic Control Module. These signals determine how long the needle is lifted from the seat (pulse width) allowing a measured fuel flow. The pulse width will widen (richer) or narrow (leaner) depending on various signals received from sensors connected to the EFI FUEL ECM and the IGNITION ECM.

Induction Manifold

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains either 4 throttle shutters on 2 throttle shafts for the 250 hp model or 2 throttle shutters on 1 throttle shaft for the 225 hp model. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor. A fuel rail pressure port is located on the fuel pressure regulator.

Fuel Pressure Regulator

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

EFI Electrical Components

EFI Electronic Control Module

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

Sensor Interaction with the ECM

The ECM relies on sensor feedback to provide proper fuel rates and timing advance for optimum engine performance under all conditions.

Should a sensor fail, the ECM will try to compensate for lack of sensor information by providing predetermined fuel rates and timing advance for average conditions.

Therefore, a change in engine performance may not be readily noticeable. However, a sensor failure will result in the ECM activating a warning horn to alert the operator.

Air Temperature Sensor

The air temperature sensor transmits manifold air temperature, through full RPM range, to the EFI ECM. As air temperature increases "sensor" resistance decreases causing the ECM to decrease fuel flow (leaner mixture).

***NOTE:** *A warning horn will sound if the sensor fails or is disconnected on 1996 models, only.*

The air temperature sensor circuit can be tested using a volt/ohm meter. Test procedures are on page 9-31.

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is mounted on the vapor separator. This sensor monitors changes in manifold absolute pressure and is connected to the intake manifold by a vacuum hose. The MAP sensor functions through the full RPM range and is continually signaling induction manifold pressure readings to the EFI ECM. The EFI ECM 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.

***NOTE:** *A warning horn will sound if sensor fails or is disconnected on 1996 models, only. The engine may, however, run rough at idle if the sensor is inoperative on all models.*

Engine Head Temperature Sensor

This sensor provides the EFI ECM with signals related to engine temperature to determine level of fuel enrichment during engine warm-up. The EFI ECM receives information at all engine temperatures but stops fuel enrichment at an engine temperature of 110°F (43°C).

An overheat condition will occur if engine temperature exceeds 200°F (93°C). A constant warning horn will sound as long as the overheat condition exists. If the overheat condition should occur at wide-open-throttle, the engine RPM will be reduced to 3000. The engine will return to normal operating condition when the temperature drops below 200°F (93°C).

The temperature sensor can be tested using a digital volt/ohm meter. Test procedures are on page 2A-7.

***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).

OTHER COMPONENTS ASSOCIATED WITH THE ECM.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

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 EFI ECM contains a fuel pump driver circuit that provides power to the electric fuel pump. The amount of time the fuel pump operates varies with the RPM of the engine. Above approximately 3000 RPM, the fuel pump is operating continuously (or at 100% of its duty cycle).

Water Sensing System

The system consists of a water separating fuel filter (starboard side powerhead) and a sensing probe (bottom of filter).

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.

***NOTE:** The water detection light will stay on and the warning horn will "BEEP" 4 times and remain off for 2 minutes. This cycle will continue until the water is removed. This warning is the same as for the "Low Oil" warning.*

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 30 seconds.

EFI Fuel Management
(Low Pressure Fuel Route)

- Perform all preliminary checks
- Install fuel pressure gauge (P/N 91-16850) 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 (see page 9-22).

Fuel pressure above 36 psi (234 kPa)

Follow High Pressure Fuel Route Flow Chart.

Results

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

Perform Vapor Separator Float Test (see page 9-23).

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 (see page 9-23).

Results

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

Perform Pulse Fuel Pump Delivery Test (see page 9-24).

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 3. Locate all fragments of failed pump before reassembly.

Results

No fuel flow to pulse fuel pump.

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

EFI Fuel Management (High Pressure Fuel Route)

- Perform low pressure checks (page 9-19) before performing checks on high pressure route.
- Install fuel pressure gauge (P/N 91-16850) on to manifold pressure port.
- Place ignition switch in "OFF" position 30 seconds before testing.
- Place ignition switch in "ON" position and note pressure within 30 seconds (34 to 36 psi; 234 to 248 kPa).

Fuel pressure above 36 psi (248 kPa)

Clogged or faulty fuel pressure regulator remove and replace.

No or low fuel pressure

Perform Fuel Pump Inlet Filter Check (see page 9-25).

Results

Inlet filter OK.

Perform Fuel Pressure Regulator Test (see page 9-26).

Results

Steady stream of fuel (pressure still below 34 psi).

Replace fuel regulator.

Results

Low or no fuel flow.

Perform Electric Fuel Pump Test (see page 9-27).

Results

Voltage from ECM driver circuit OK.

Replace fuel pump.

Results

Low or inconsistent voltage from ECM driver circuit.

Replace ECM.

Results

Inlet filter clogged.

Clean or replace inlet filter.

Pump does not run

Perform Electric Fuel Pump Test (see page 9-27).

EFI System Test Procedures

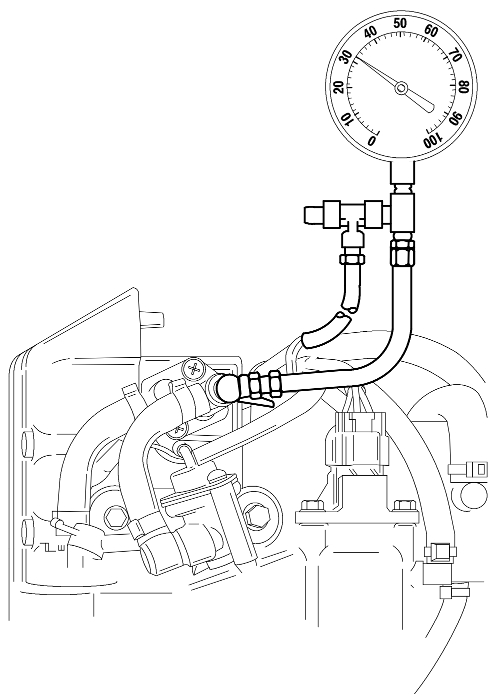
Fuel Gauge Connection/Pressure Test

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 (91-16850) to induction manifold pressure port.



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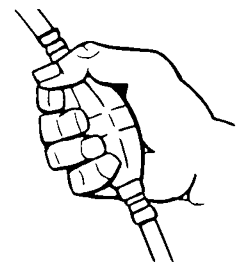
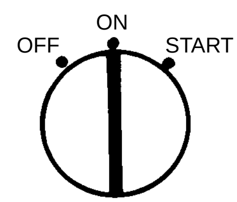
2. Prime engine using fuel primer bulb.



3. Turn ignition key switch to "On" position.



4. Operate electric fuel pump for approximately 10 seconds.

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

5. Take reading on fuel pressure gauge.

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

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

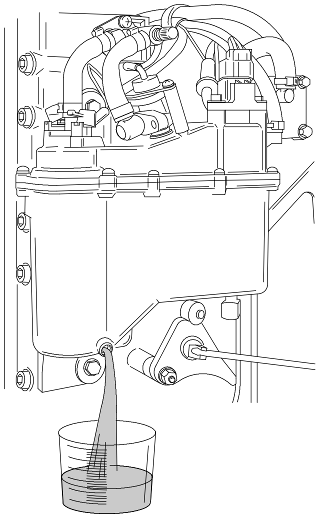
If fuel pressure is above 36 psi (248 kPa) go to fuel pressure regulator test.

Vapor Separator Fuel Delivery Test

***NOTE:** Full capacity of vapor separator is approximately 380 ml.

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.



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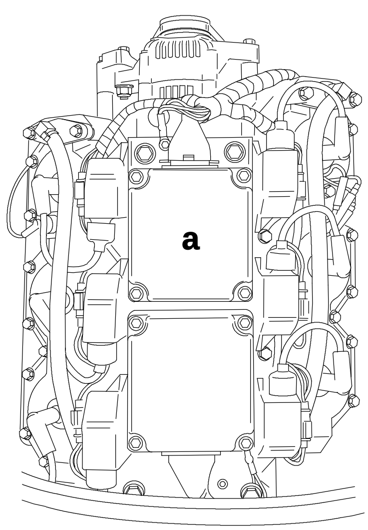
Results: If fuel flow is present, fuel is being delivered to electric fuel pump. Go to high pressure flow chart.

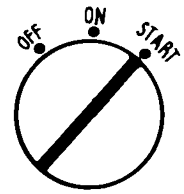
2. Disconnect Ignition ECM to prevent engine from starting.



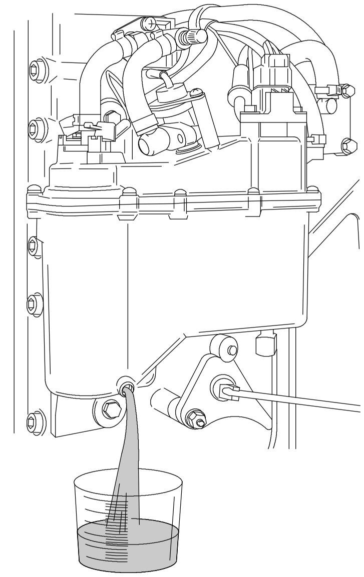
53638

a - Ignition ECM

3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from drain hole.



53652

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

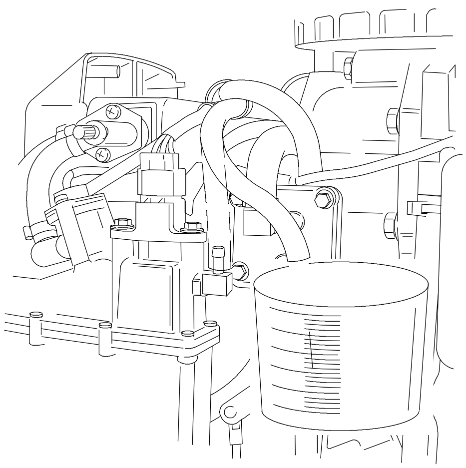
Vapor Separator Float Test

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.*

Procedure: If float is suspected of sticking in the up position:

1. Remove fuel inlet hose from vapor separator and put end of hose in clean container.



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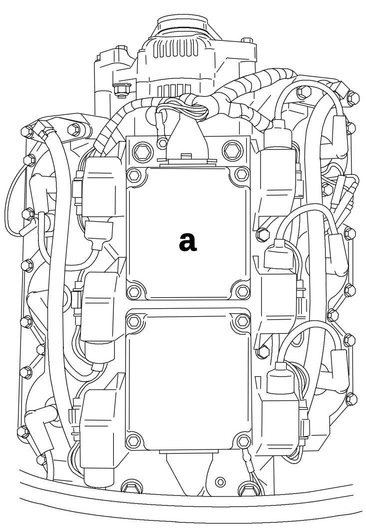
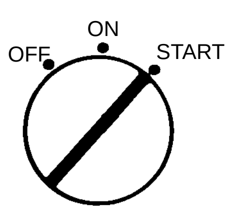
2. Disconnect Ignition ECM to prevent from engine starting.



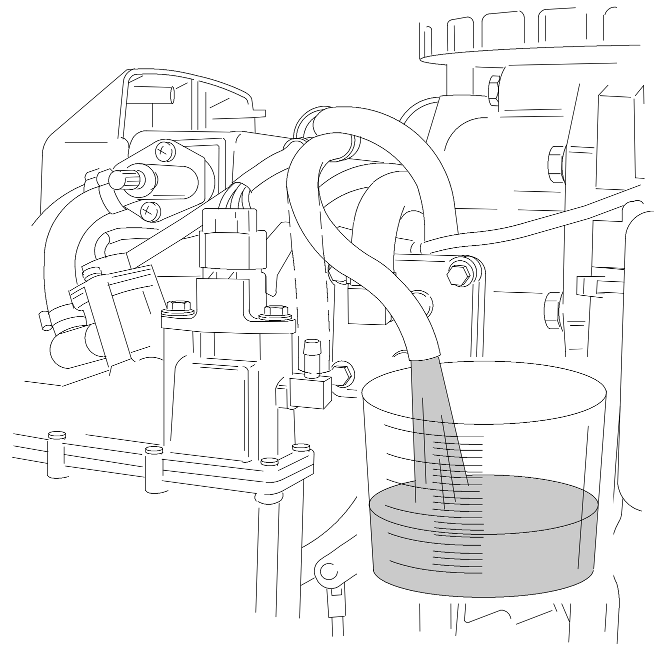
53638

a - Ignition ECM

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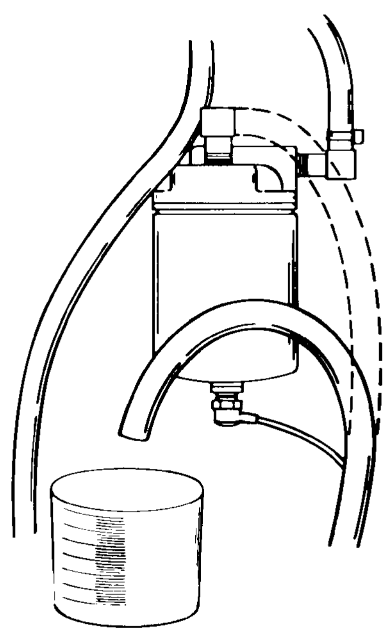
Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

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.



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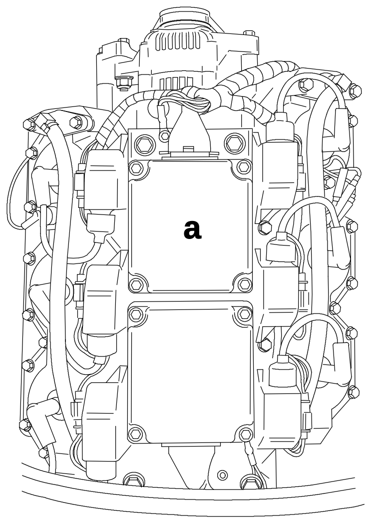
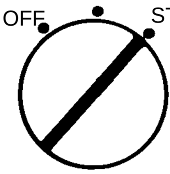
2. Disconnect Ignition ECM to prevent engine from starting.



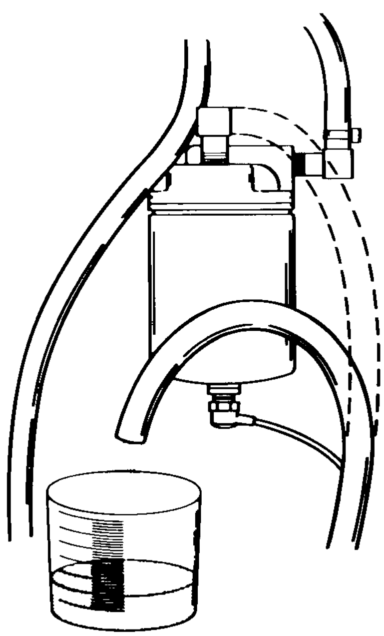
53638

a - Ignition ECM

3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



50346

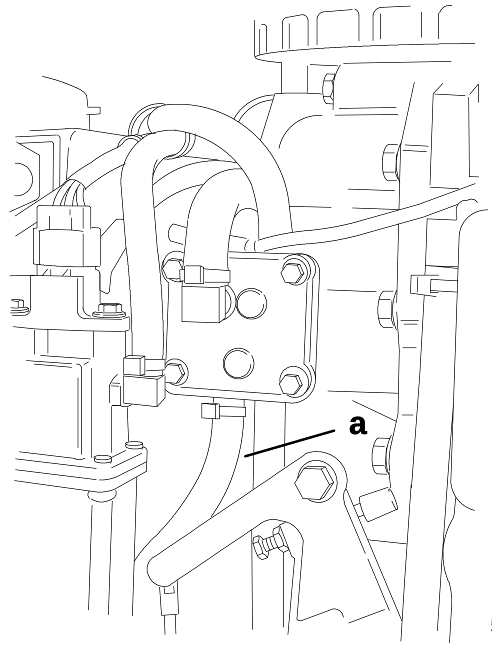
Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

Low or no fuel flow from water separating inlet hose. Perform pulse fuel pump delivery test.

Pulse Fuel Pump Delivery Test

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

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



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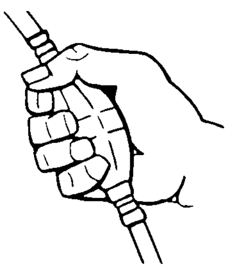
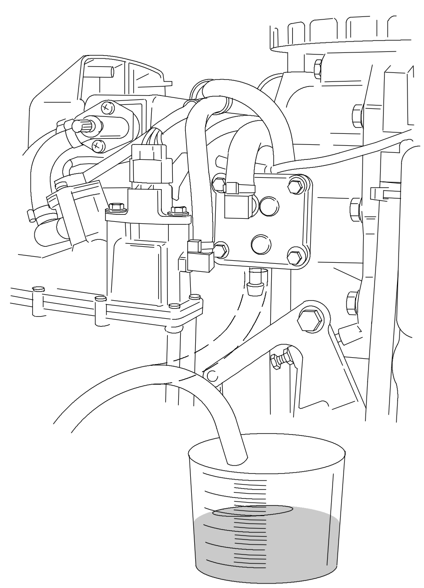
a - Inlet Hose

2. Squeeze primer bulb several times.



3. Look for fuel flow from hose.



53655

Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump (SECTION 3).

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

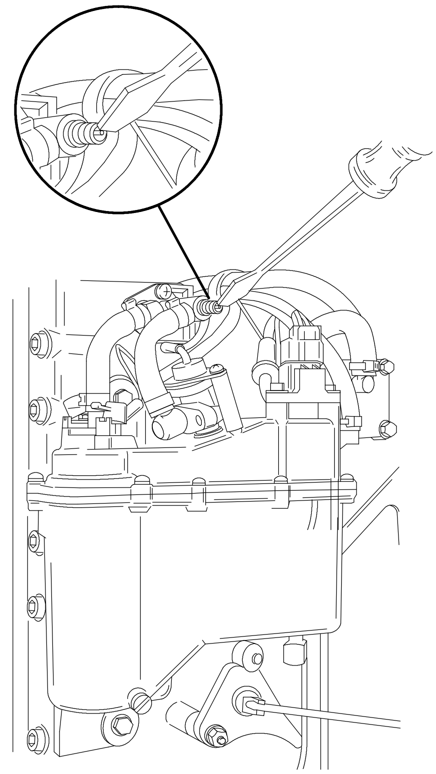
No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

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

Inlet Filter Check and De-pressurizing EFI System Procedures

Purpose: Checking the Inlet 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.



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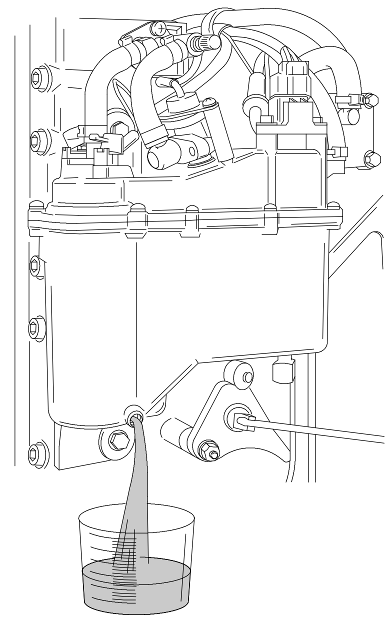
2. Remove drain plug from vapor separator and allow fuel to drain into suitable container.



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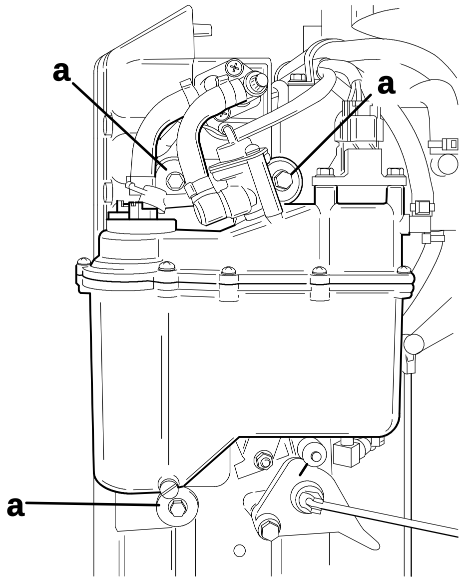
3. Remove 3 bolts securing vapor separator assembly to manifold.



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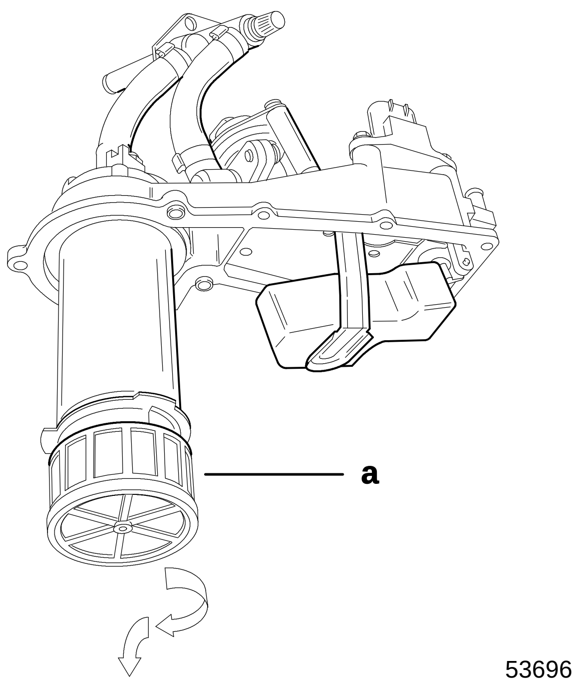
a - Attaching Bolts

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.



53696

a - Inlet Filter

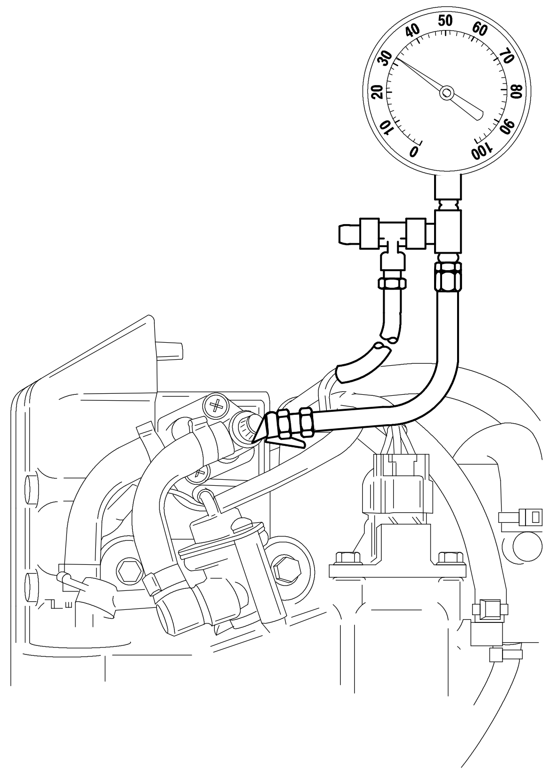
7. Inspect filter for debris or damage.

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 36 psi (248 kPa), perform fuel pressure regulator test.

Pressure Regulator Test

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

1. Connect pressure gauge (91-16850) to fuel pressure test port.



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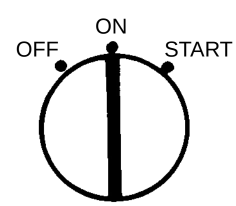
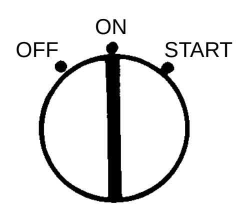
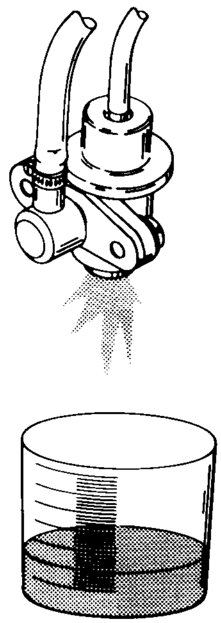
2. Turn ignition key switch to "ON" position and check fuel pressure reading on gauge. If pressure reading is below 34 psi (234 kPa) go to step 3 following.



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.

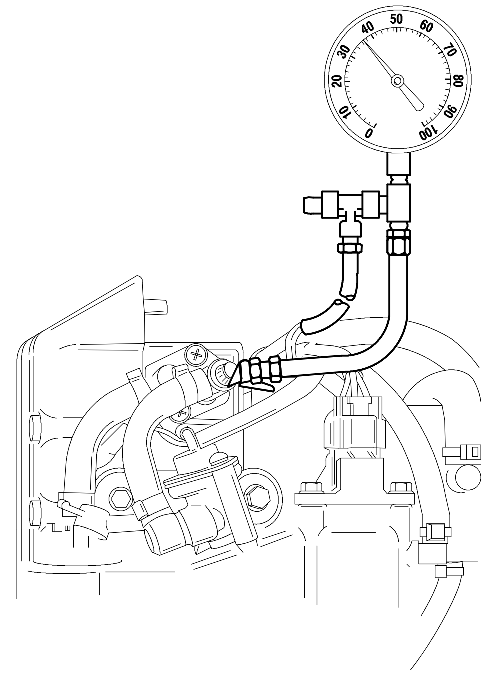
If low or no fuel exits regulator into container and pressure is below 34 psi (234 kPa) perform electric fuel pump pressure test.

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

Electric Fuel Pump Test

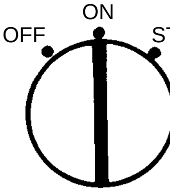
Purpose: This test will determine if electric fuel pump is capable of producing adequate fuel pressure needed for normal engine operation, 34 to 36 psi (234 to 248 kPa).

1. Connect pressure gauge (91-16850) to pressure port.

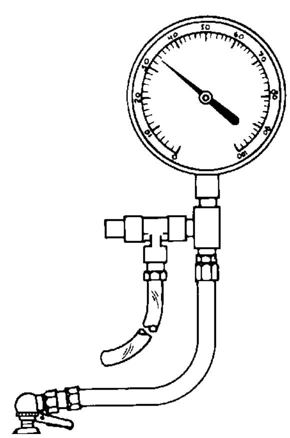


53709

2. Put ignition key switch in “ON” position.



3. Take a fuel pressure reading, within 30 seconds.

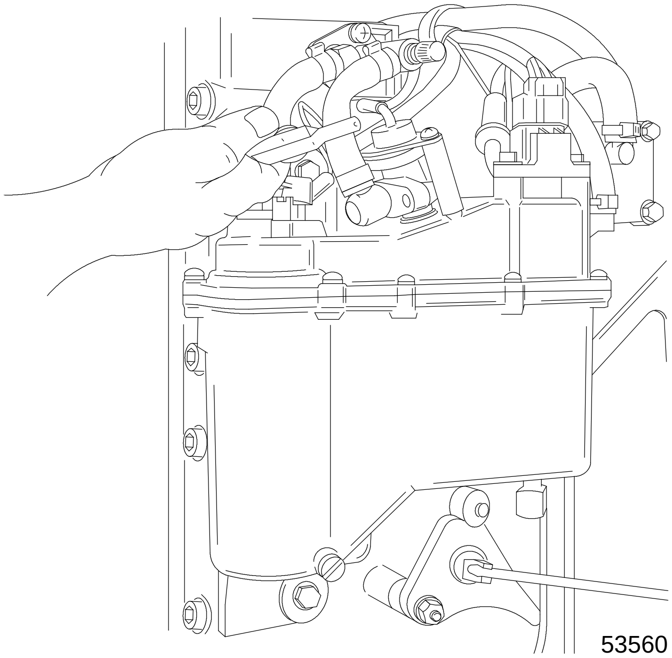


51796

⚠ CAUTION

Do not close-off fuel hose completely in step 4, or damage could result to hose or pump.

4. Partially close off fuel hose to pressure regulator.



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5. Check pressure gauge for increase in pressure.

Results: Fuel pressure increases as hose is partially closed off. Electric fuel pump OK, perform Fuel Rail Leak Check.

Fuel pressure does not increase when hose is partially closed off. This may indicate defective electric fuel pump. Before replacing, perform procedure following.

⚠ CAUTION

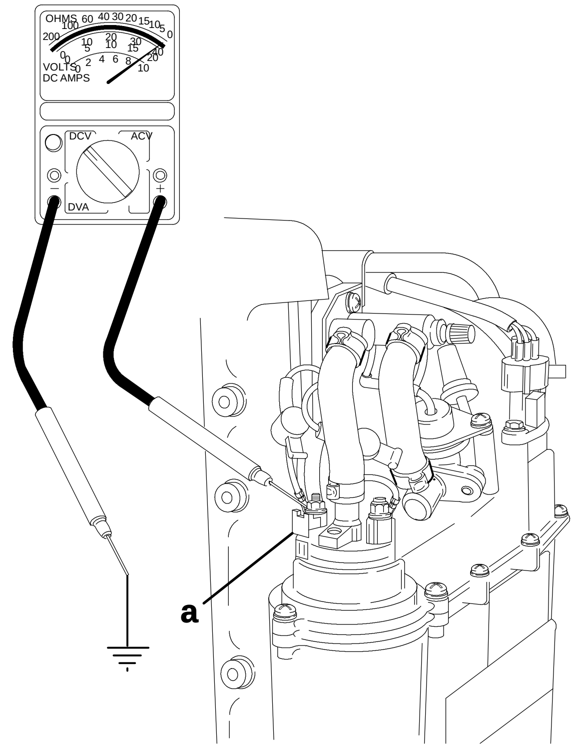
When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM can result.

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

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

***NOTE:** Refer to voltage test chart for voltage readings.*

Positive Test Terminal

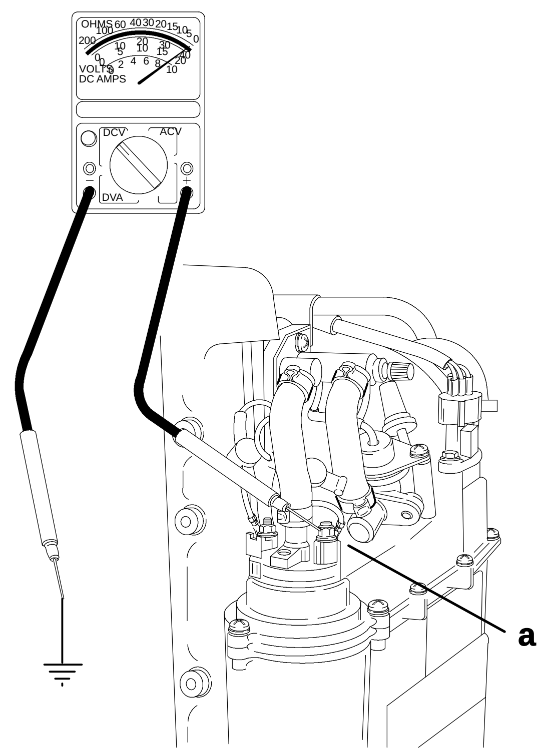


53647

a - POSITIVE (+) Terminal

7. 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



53648

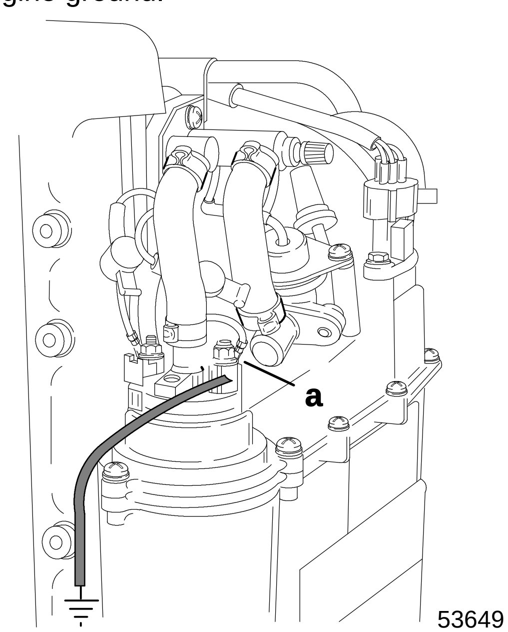
a - NEGATIVE Terminal

8. Perform voltage tests below.

VOLTAGE TEST CHART			
Engine Mode	**Black Meter Lead To Engine Ground, Red Meter Lead To:**	**Approx. Voltage Reading**	**If Approx. Voltage Is Not Obtained, This Indicates:**
All models	(+) terminal of fuel pump.	12-13.5 Volts	If reading is below 12 volts, the battery is bad or discharged, or a bad con- nection(s) on bat- tery harness. If reading is higher than 13.5 volts, the battery is over- charged.
Ignition key in "off" posi- tion.	(-) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above).	If reading is lower than in check 1, the ECM or wire in harness is defective.
Ignition key in "on" posi- tion and engine NOT running.	(-) terminal of fuel pump.	1 volt or less (voltage should then raise to 12-13.5 volts after approx. 15 seconds).	Defective ECM or fuel pump*
Engine being cranked.	(-) terminal of fuel pump.	1 volt or less.	Defective ECM or fuel pump*
Engine running below approx. 3000 RPM.	(-) terminal of fuel pump.	The voltage will vary as engine RPM changes.	Defective ECM or fuel pump*
Engine running above approx. 3000 RPM.	(-) terminal of fuel pump.	1 volt or less.	Defective ECM or fuel pump*

*Check for proper electrical operation of electric fuel pump

9. Disconnect RED/PURPLE wire to NEGATIVE terminal on electric fuel pump. Connect a ground jumper wire from NEGATIVE pump terminal to a good engine ground.



a - NEGATIVE Terminal

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

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

Pump operates. Check RED/PURPLE (-) lead and harness for good continuity.

NOTE: *RED/PURPLE lead is connected to pin 9 of EFI ECM harness.*

Fuel Injector Electrical Harness Test

1. Disconnect injector harness (4 pin connector).
2. Remove spark plug leads from spark plugs to prevent engine from starting.

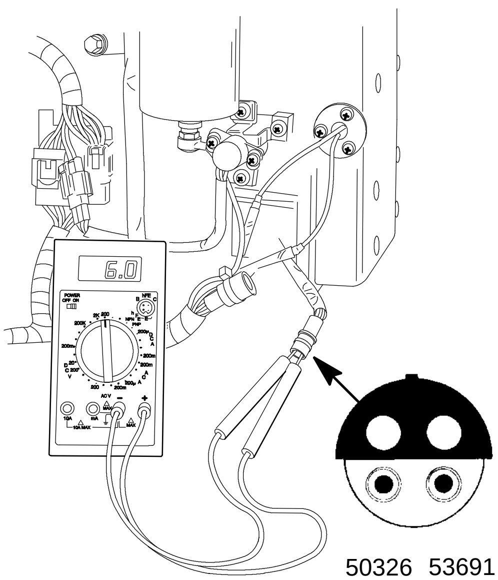
IMPORTANT: Use digital ohmmeter when testing injector harness.

3. Connect digital ohmmeter (dial set at R200 OHM 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 = Injectors, Cylinders 1 and 2

   Dark Blue = 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 6.0 ±1.0, both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are 12.0 ± 1.0, one injector does not have a complete circuit. Perform induction manifold disassembly and inspection.

Injector Operation Test

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

The DIGITAL DIAGNOSTIC TERMINAL (DDT) (91-823686A2) is required for this test. Refer to the instruction manual provided with the DDT for proper test set-up and this service manual (90-822900R3) for specifications.

Fuel Rail Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel rail 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. Remove spark plug leads from spark plugs 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.

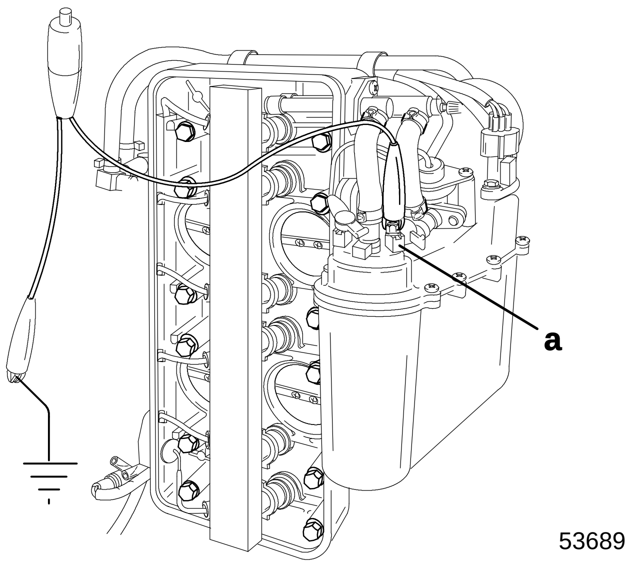
⚠ WARNING

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.

1. Remove spark plug leads from spark plugs to prevent engine from starting.
2. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

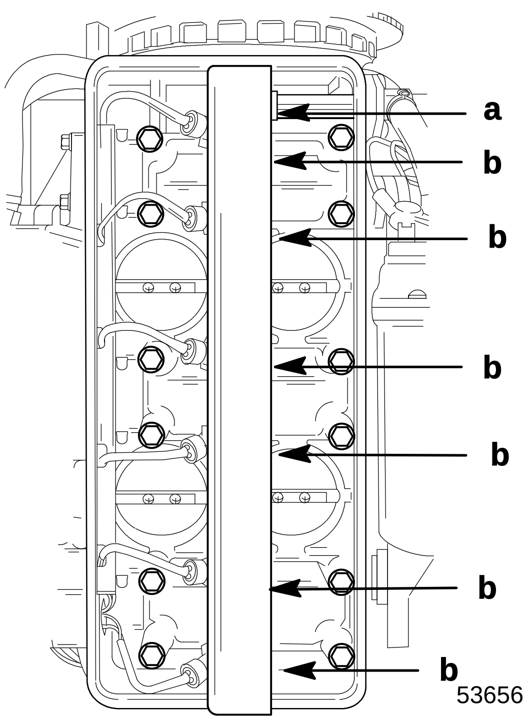
⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



a - NEGATIVE Terminal

3. Look for leak points on fuel rail while depressing remote starter switch.



a - Check for leaks at fuel tube o-rings
b - Check for leaks at injector o-rings on fuel rail

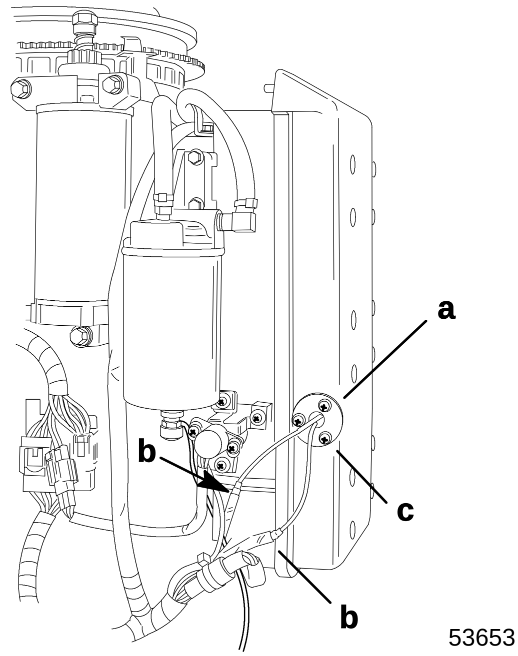
Results: If no leaks are present, reinstall cover and gasket. Torque screws to 19 lb. ft. (26.0 N·m).

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.

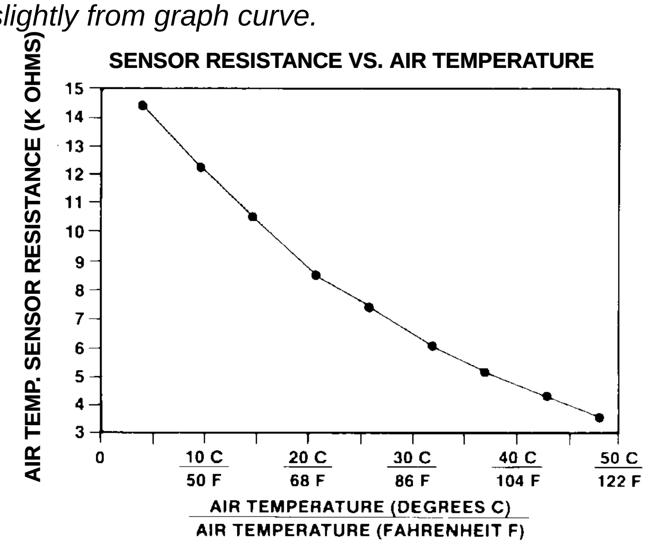
1. Disconnect and remove Air Temperature Sensor from induction manifold.



a - Air Temperature Sensor
b - Bullet Connectors
c - Screws (3)

2. Connect digital meter set at 20K scale 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.*



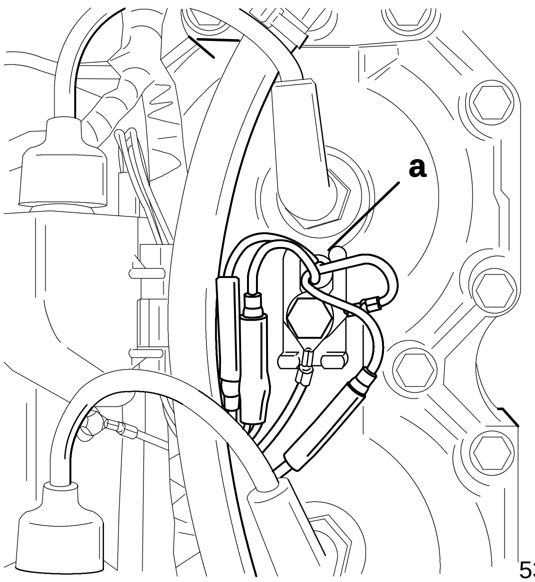
Results: Resistance does not change inversely with temperature change. Replace defective Air Temperature Sensor.
(Continued next page)

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.



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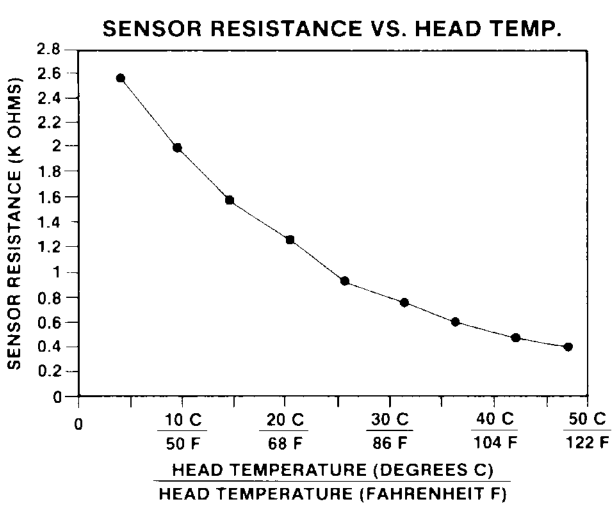
a - Temperature Sensor

2. Connect Digital Meter set at 2K Scale to 2 TAN/BLACK 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.

NOTE: *1 TAN/BLACK temperature sensor lead is normally shorted to ground in the engine harness. The ECM recognizes this and uses the other TAN/BLACK sensor lead for information.*
There should be NO CONTINUITY between each TAN/BLACK lead and the sensor case (Ground). If resistance (continuity) is noted, sensor is shorted internally and should be replaced.
Normal continuity reading between both TAN/BLACK leads out of sensor is 1000Ω ±100Ω at room temperature.

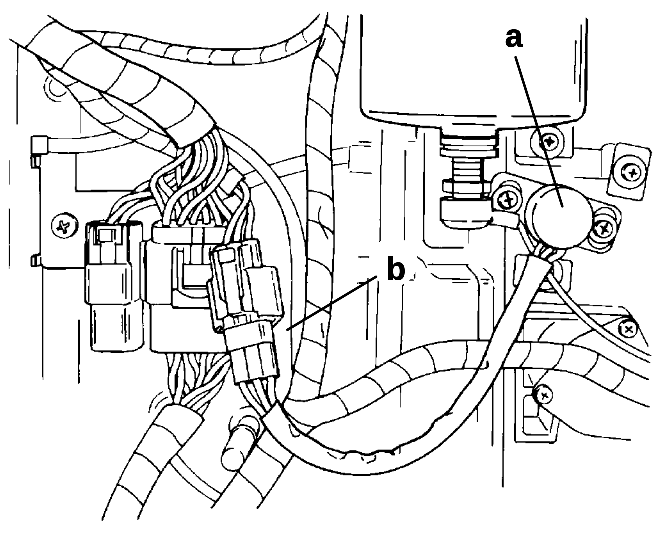
Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator.

IMPORTANT: TPS can be adjusted using a digital meter. Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

TPS ADJUSTMENT USING A DIGITAL VOLTMETER

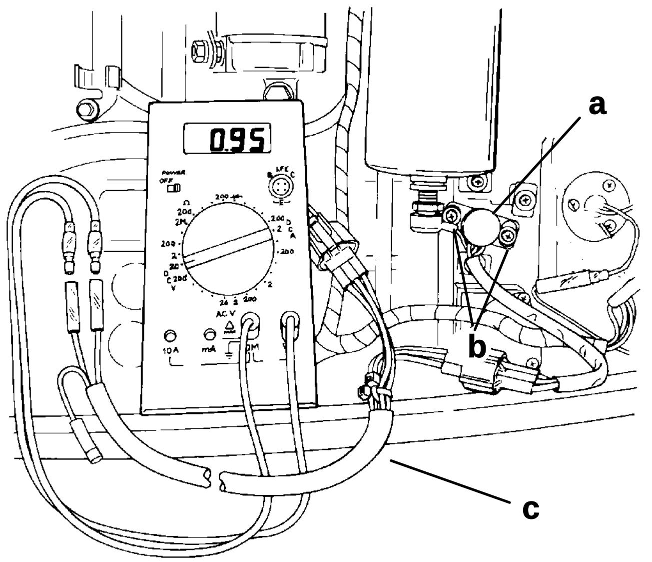
1. Disconnect TPS from ignition harness.



a - TPI
b - TPI Harness

2. Connect digital voltmeter using TPS/CDM TEST LEAD ASSEMBLY (84-825207A1) between TPS connector and EFI harness connector.

3. Connect RED voltmeter lead to RED lead of harness assembly and BLACK voltmeter lead to WHITE lead of harness assembly for a TPS measurement. Set voltmeter to 20 VDC.
4. Turn ignition key to "ON" position.
5. With throttle shaft at the close position, voltmeter should read 0.95 ± 0.05 volts. Loosen TPS set screws and adjust as necessary.



a - TPS
b - Set Screws
c - TPS/CDM TEST HARNESS

6. Slowly move throttle lever to WIDE OPEN THROTTLE position and then back to IDLE while monitoring voltage reading. Voltage reading should increase (throttle opens) and decrease (throttle closes) smoothly.
7. At WIDE OPEN THROTTLE, **using a digital voltmeter**, maximum voltage reading should be approximately 3.80 ± 0.25 volts.

***NOTE:** If using the **DIGITAL DIAGNOSTIC TERMINAL** to monitor TPS voltage, the maximum voltage reading at WIDE OPEN THROTTLE should be 4.00 ± 0.20 volts. The idle TPS voltage will be the same – 0.95 ± 0.05 volts – whether the DIGITAL DIAGNOSTIC TERMINAL or digital voltmeter is used.*

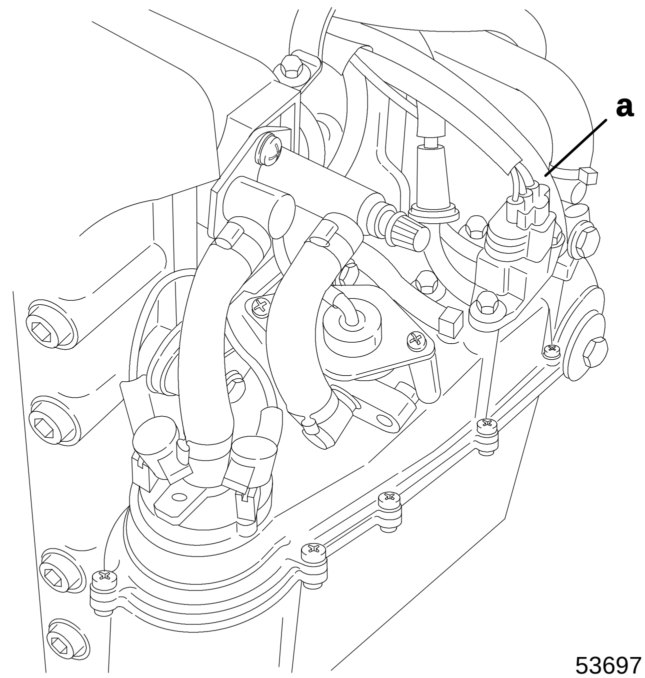
8. Torque TPS screws to 20 lb. in. (2.3 N·m).
9. Remove test harness and reconnect TPS harness to EFI harness.

MAP Sensor Test

MAP Sensor failure will be indicated by audible warning horn activation.

***NOTE:** If using the Digital Diagnostic Terminal (91-823686A2), a PASS or FAIL indicator will be displayed as to the serviceability of the MAP sensor.*

***NOTE:** If MAP sensor is functioning properly, disconnecting sensor harness connector while engine is running may result in deterioration of engine's running characteristics.*



53697

a - Harness Connector

Problem Diagnosis

CONDITION	POSSIBLE SOURCE	ACTION
Engine Down on Power or RPM	Defective CDM (s) Defective Stator Coil(s) Low Compression Broken Reed(s) Fuel Delivery Problem Fuel Rail Leak	See Section 2A "Electrical and Ignition" for Ohm/Voltage tests. See Section 2A "Electrical and Ignition" for Ohm tests. See Section 4 "Power Head". Inspect Visually Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart. Perform Fuel Rail Leak Check.
Poor Acceleration - Idles OK, Top Speed OK	Improper EFI Setup Water Covering Idle Relief Exhaust Ports TPS Failure MAP Sensor Failure R.F.I. Problem*	See Section 2C "Timing/Synchronizing/Adjusting" for proper EFI set up procedures. Boats with extended transoms or low engine mount can cause engine to load up on acceleration. Engine will not accelerate. See Section 2C "Timing/Synchronizing/Adjusting" for proper EFI set up procedures. Engine runs rough. Maximum RPM Approx. 2000. Perform EFI Electrical System and ECM Check. Install Champion QL77CC Spark Plugs
Engine Surges Between 4000 & 5000 RPM	Final Filter Clogging TPS - Improper Adjustment Injector Fuel Delivery Problem	Perform Inlet Filter Check. See Section 2C "Timing/Synchronizing/Adjusting" for TPS Adjustment Perform Injector Operation Test with DDT.

*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).

CONDITION	POSSIBLE SOURCE	ACTION
Engine Idles Rough and loses RPM @ W.O.T.	Spark Plugs	Check Condition of Spark Plugs and Replace if Worn.
	Ignition Problem	Refer to Section 2A for Trouble-shooting Ignition.
		NOTE: If idle speed is to low, engine will idle rough. Increase idle speed to recommended specification – 650 ± 50 RPM
Engine Will Not Start – No Spark at Spark Plugs	Stop Wire (BLACK/YELLOW) Shorted	Replace Harness.
	Open Circuit in Crank Position Sensor Harness	Replace Harness.
	No Power (12VDC) on PURPLE Wire to Ignition ECM	Check Battery Connections or Replace Harness.
	Improperly Positioned or Defective Crank Position Sensor	Refer to Section 2A for Setup and Testing.
	Shorted CDM	Refer to Section 2A for Testing CDM.
	Incorrect Spark Plugs Installed	Install Champion QL77CC for EFI Models Install NGK - BP8H-N-10 or NGK - BPZ8H-N-10 for Carb Models
	Failed Ignition ECM	Replace ECM.
Engine Idles OK but Stumbles at Off Idle Speeds	Improper EFI Set Up	See Section 2C "Timing,Synchronizing, Adjusting" for set up procedures.
	Failed or Disconnected EFI Sensors	Perform EFI Sensor Tests
	Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	Fuel Leak Rail Leak	Perform Fuel Rail Leak Check.
		Install Champion QL77CC Spark Plugs.
	R.F.I. Problem	See Section 2A "Electrical and Ignition" for tests
	Defective Stator Coil(s)	

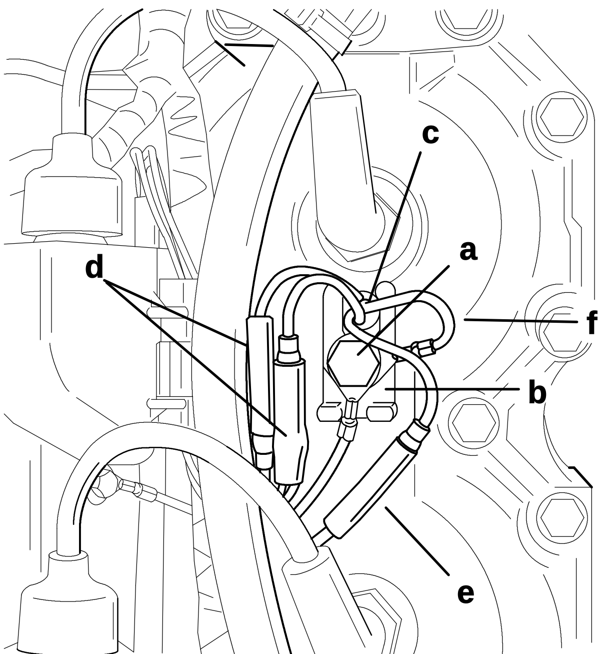
CONDITION	POSSIBLE SOURCE	ACTION
Engine Idles Rough (May Lean Sneeze) - Acceleration OK, Full Throttle OK	Improper EFI Set Up Failed MAP Sensor Coolant Sensor Failure Broken Reed	See Section 2C "Timing,Synchronizing, Adjusting" for set up procedures. Perform MAP Sensor Test (See EFI Electrical System and ECM Check. Perform "Engine Head Temperature Sensor Test". Visual Inspection
Engine Runs but Slowly Drops RPM then Dies	Restrictions in Fuel System (Between Tank and engine) Clogged Inlet Filter Pulse Fuel Pump Failure Electric Fuel Pump Failure	Install remote gas tank with fresh high quality fuel. Perform Inlet 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 (Less than 8.0 Volts) EFI Harness Connections Ignition System Failure Pulse Fuel Pump Failure Electric Fuel Pump Failure Incorrect Spark Plugs Installed ECM Failure	Check battery connections, undercharged battery or worn out battery Check EFI harness connectors for loose/corroded connections. See Section 2A "Electrical and Ignition" for test procedures. Follow Low Pressure Fuel Route Flow Chart. Follow High Pressure Fuel Route Flow Chart Install Champion QL77CC Spark Plugs. Replace ECM

EFI Component Removal and Installation

Engine Head Temperature Sensor Removal

1. Remove bolt and retaining plate.
2. Disconnect bullet connectors.

***NOTE:** 1 TAN/BLACK temperature sensor lead is normally shorted to ground in the engine harness. The ECU recognizes this and uses the other TAN/BLACK sensor lead for information.*
There should be NO CONTINUITY between each TAN/BLACK lead and the sensor case (Ground). If resistance (continuity) is noted, sensor is shorted internally and should be replaced.
Normal continuity reading between both TAN/BLACK leads out of sensor is 1000Ω ±100Ω. at room temperature.



53685

a - Bolt
b - Retaining Plate
c - Temperature Sensor
d - TAN/BLACK Leads (See note above)
e - TAN/BLUE Lead (for Temperature Gauge)
f - BLACK Lead (Ground)

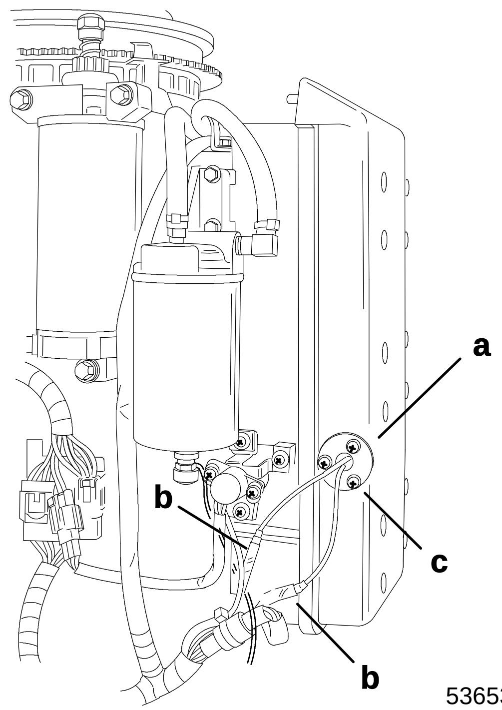
Engine Head Temperature Sensor Installation

IMPORTANT: Temperature sensor must make clean contact with cylinder head for circuit to function properly.

1. Connect bullet connectors.
2. Install sensor and secure with retaining plate and bolt.
3. Torque bolt to 17 lb. ft. (23.0 N·m).

Air Temperature Sensor Removal

1. Disconnect TAN lead bullet connectors.
2. Remove 3 screws securing sensor to manifold cover.
3. Remove sensor and inspect O-ring for cuts or abraisions. Replace O-ring as required.



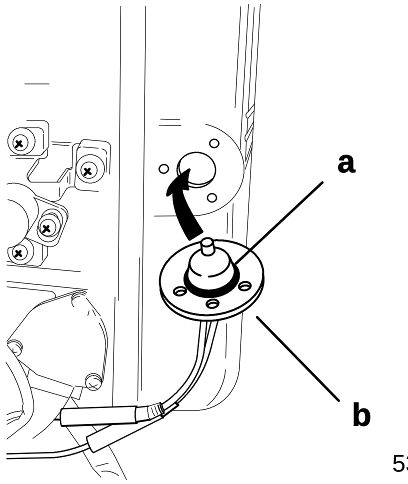
53653

a - Air Temperature Sensor
b - TAN Leads
c - Screws

Air Temperature Sensor Installation

1. Reinstall O-ring and install sensor into cover.
2. Secure sensor with 3 screws. Drive screws tight.

3. Reconnect TAN bullet connector leads.



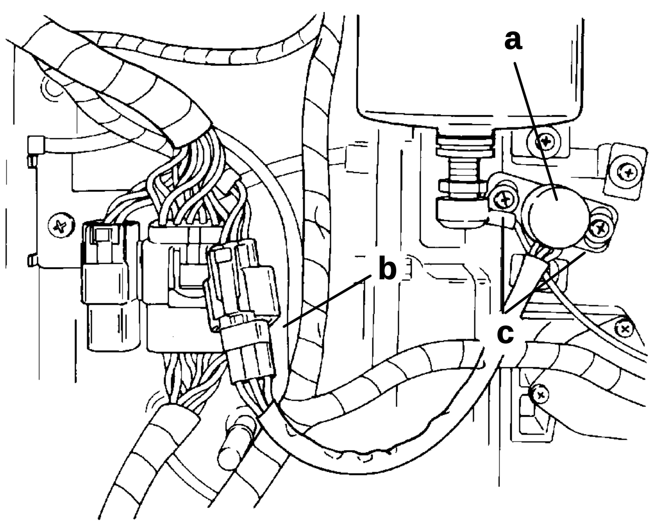
53688

a - O-ring
b - Air Temperature Sensor

Throttle Position Sensor (TPS) Removal

IMPORTANT: TPS will need to be set after installation.

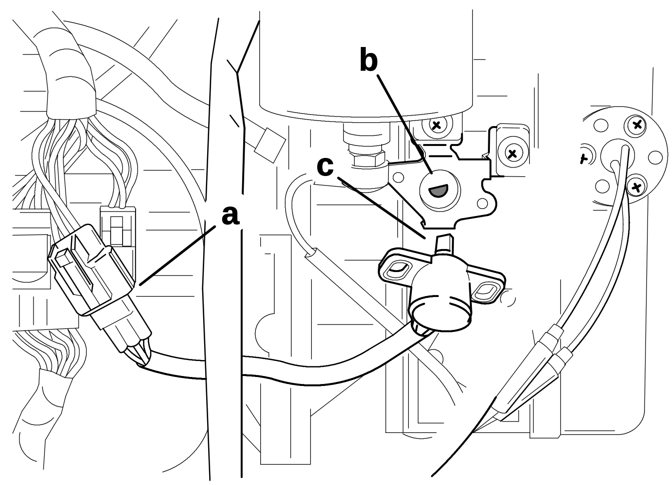
1. Disconnect TPS harness.
2. Remove 2 screws securing TPS and remove TPS.



a - Throttle Position Indicator
b - TPI Harness
c - Screws

Throttle Position Sensor (TPS) Installation

1. Reconnect TPS harness.
2. With throttle closed (at idle) flat on TPS coupler should be UP and slightly aft.
3. Align flat of TPS shaft with coupler flat and reinstall TPS.
4. Secure TPS with 2 screws, lock washers and flat washers.
5. Refer to Section 2C "Timing/Synchronizing/Adjusting" for proper TPS adjustment procedure.



53694

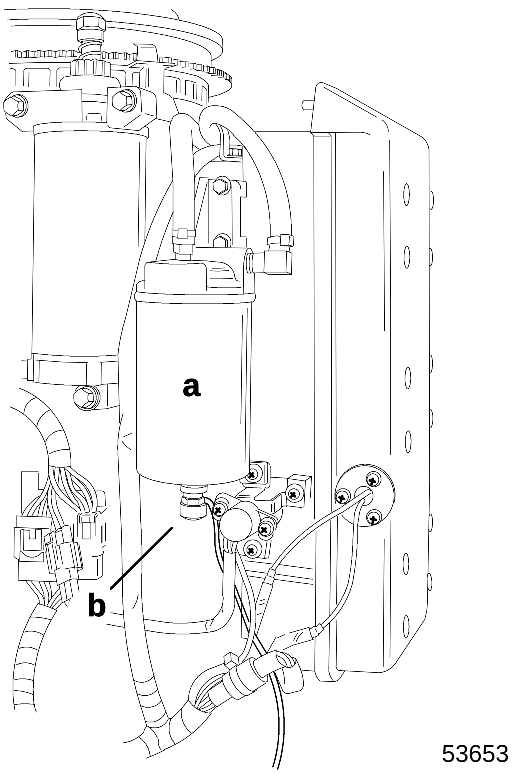
a - TPS Harness
b - Coupler Flat
c - TPS Flat

6. After final adjustment of TPS is completed, torque screws to 20 lb. in. (2.3 N·m). Recheck TPI setting after screws are torqued.

Water Separating Filter Assembly Removal

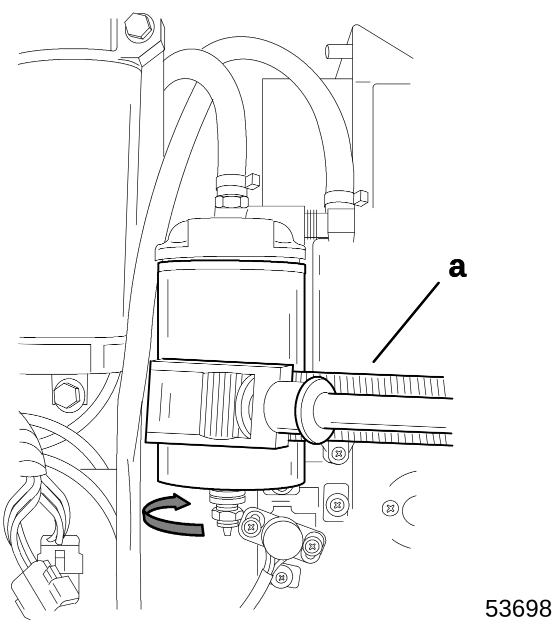
***NOTE:** To inspect or replace water separator, it is not necessary to remove inlet and outlet fuel lines or to unbolt bracket from manifold.*

1. Remove water sensor lead from bottom of separator.



a - Water Separator
b - Water Sensor Lead

2. With wipe towels available, use Strap Wrench (91-24937A1) to remove water separator.

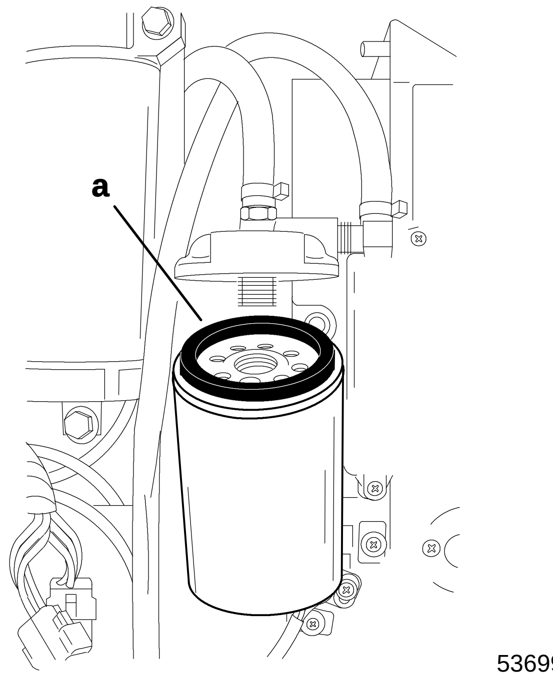


a - Strap Wrench (91-24937A1)

Water Separating Filter Assembly Installation

IMPORTANT: Apply a light coat of outboard oil to the sealing rectangular ring on the water separator before installation.

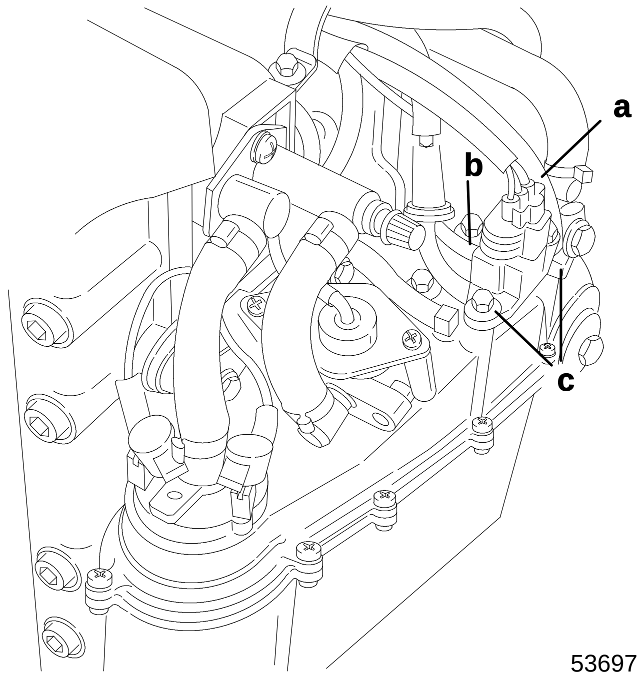
1. After applying oil to sealing ring of water separator, install separator onto bracket.
2. HAND TIGHTEN SEPARATOR. DO NOT use strap wrench or other tool to tighten separator.
3. Reconnect water sensor lead to bottom of separator.



a - Sealing Ring (apply oil)

MAP Sensor Removal

1. Disconnect MAP sensor harness.
2. Disconnect MAP sensor hose.
3. Remove 2 bolts securing sensor.



a - Harness
b - Hose
c - Bolts

MAP Sensor Installation

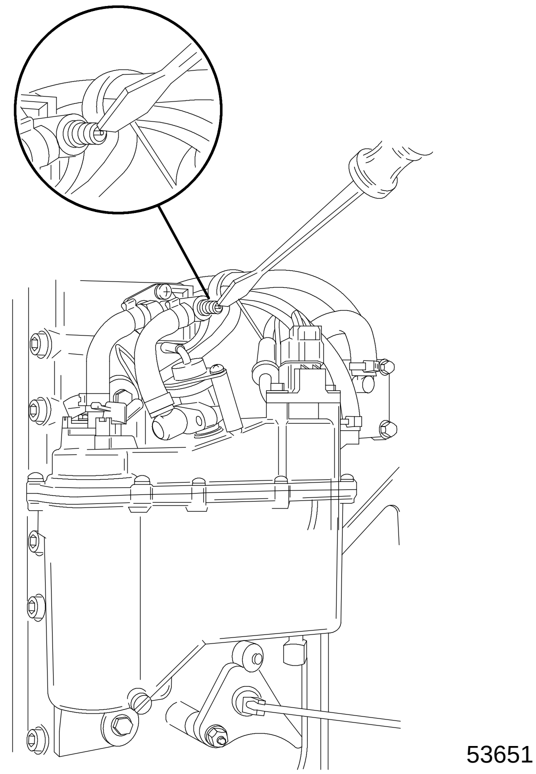
1. Secure MAP sensor to vapor separator with 2 bolts. Drive bolts tight.
2. Connect MAP sensor hose.

***NOTE:** Verify MAP sensor connector gasket is in place before reconnecting sensor harness.*

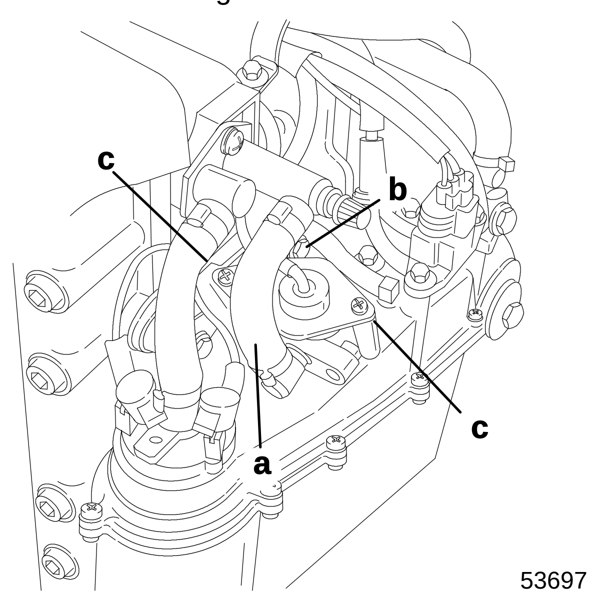
3. Connect MAP sensor harness.

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.



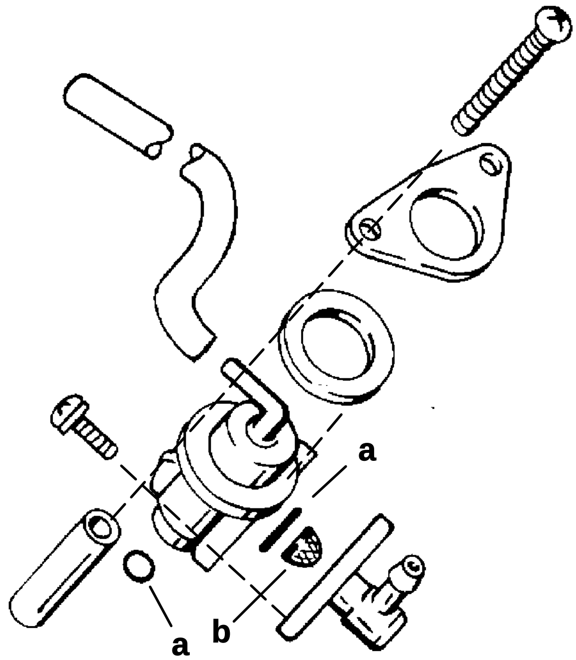
3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.



a - Return Fuel Line
b - Regulator Hose
c - Screws

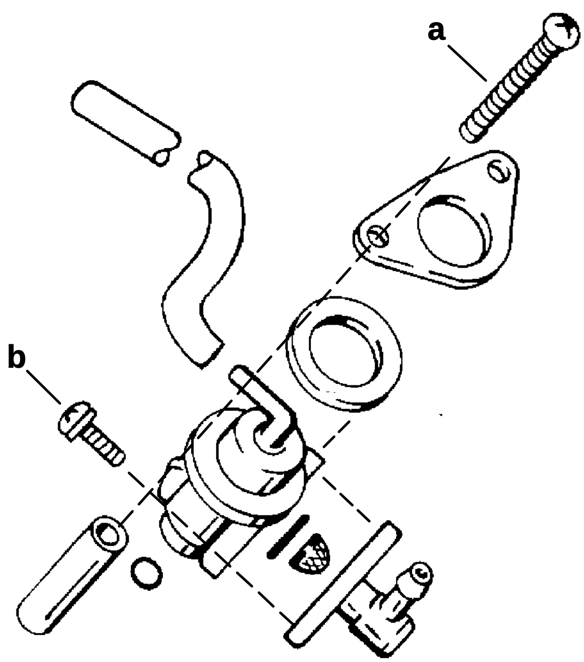
Fuel Pressure Regulator Disassembly

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

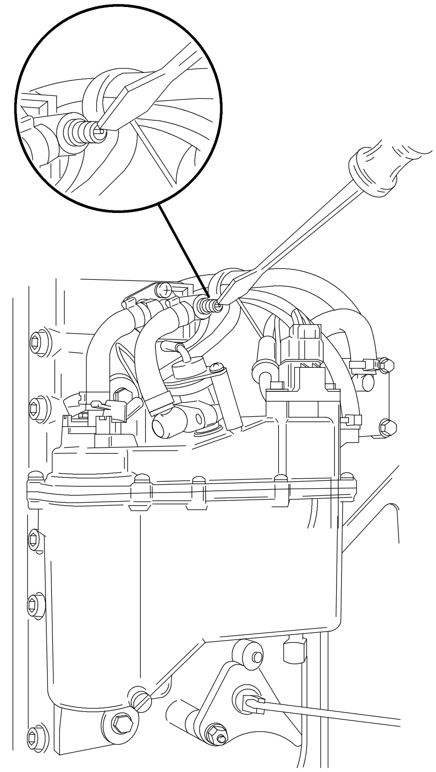
Fuel Pressure Regulator Reassembly



a - Screw (2) [Torque to 30 lb. in. (3.4 N·m)]
b - Screw (2) [Torque to 45 lb. in. (5.1 N·m)]

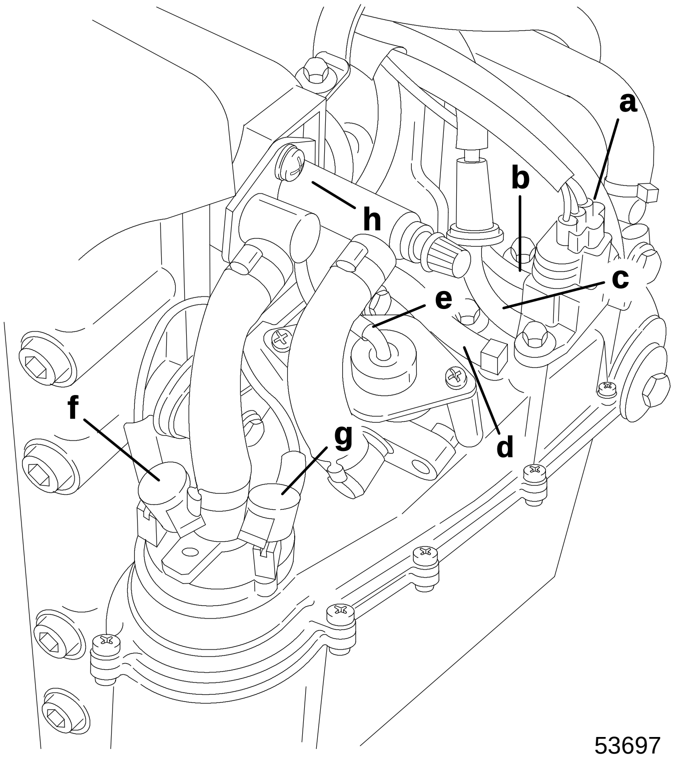
Vapor Separator Removal

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



53651

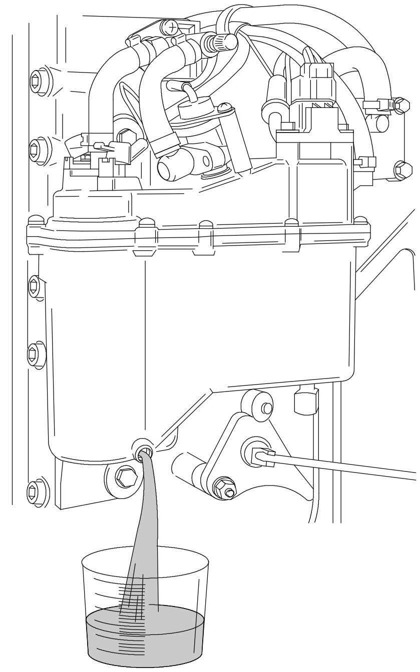
3. Disconnect MAP sensor harness.
4. Disconnect MAP sensor manifold hose.
5. Disconnect separator bleed and vacuum hoses.
6. Disconnect pressure regulator manifold hose.
7. Disconnect POSITIVE (+) and NEGATIVE (–) leads from electric fuel pump.
8. Remove 2 screws securing inlet/outlet fuel lines to manifold.



53697

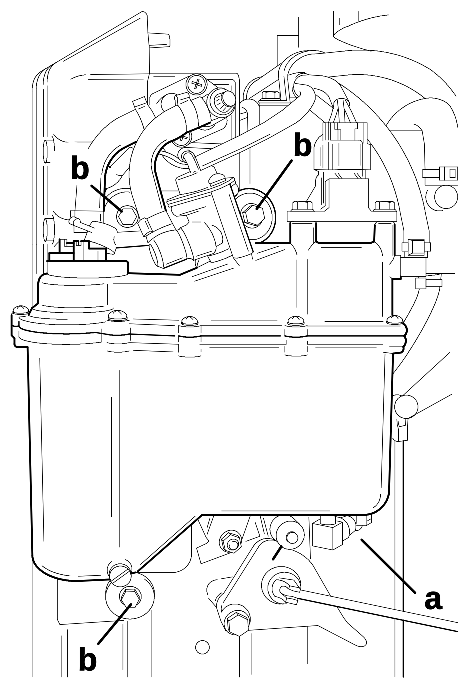
a - MAP Sensor Harness
b - MAP Sensor Manifold Hose
c - Separator Bleed Hose
d - Separator Vacuum Hose
e - Pressure Regulator Manifold Hose
f - POSITIVE (+) Lead
g - NEGATIVE (–) Lead
h - 2 Screws (1 hidden)

9. Remove drain screw from separator and drain fuel into suitable container.



53652

10. Disconnect and plug oil inlet hose to vapor separator.
11. Remove 3 bolts securing separator to manifold assembly.

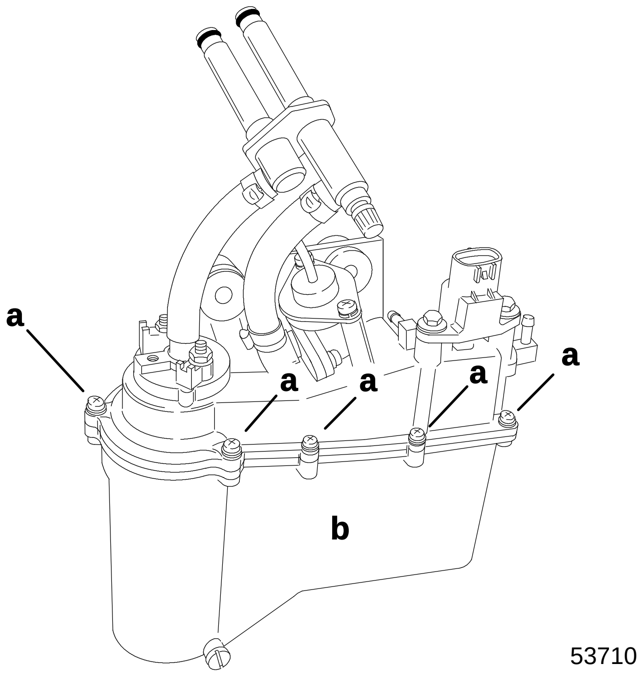


53657

a - Oil Inlet Hose
b - Bolts

Vapor Separator Disassembly

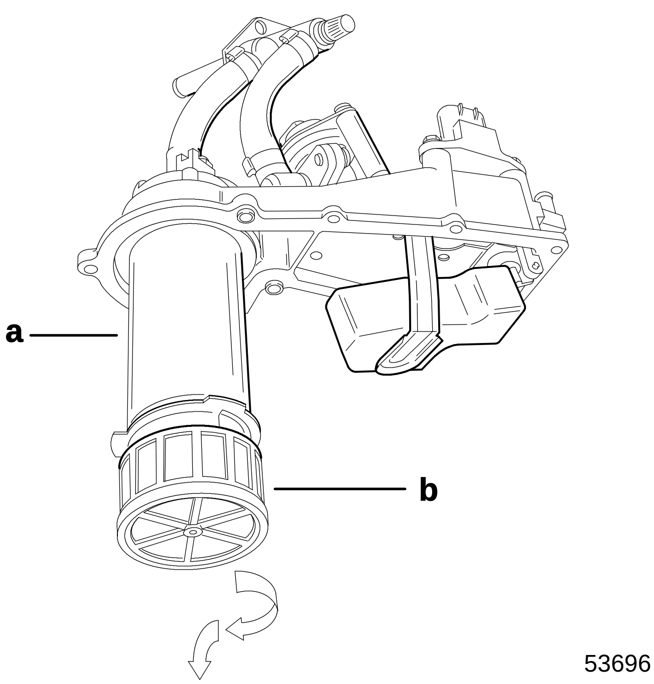
1. Remove 9 screws securing cover to vapor separator and remove separator tank.



a - Screws (4 screws are hidden on back side)
b - Separator Tank

FINAL FILTER REMOVAL

1. Rotate final filter counterclockwise and pull down.

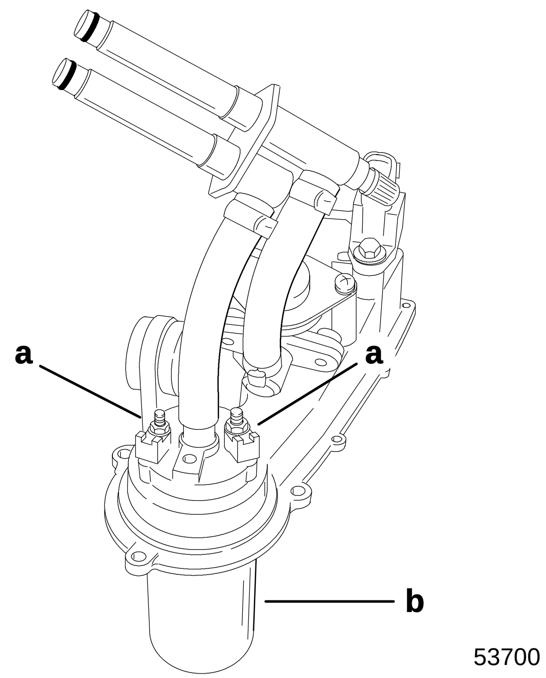


a - Final Filter
b - Electric Fuel Pump

ELECTRIC FUEL PUMP REMOVAL

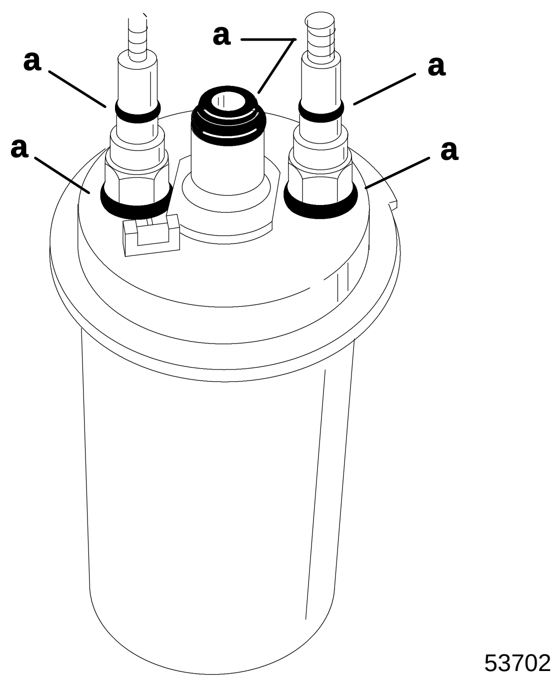
***NOTE:** There are no individually replaceable parts within the electric pump. If brushes or armature fails, entire pump must be replaced.*

1. Remove 2 nuts on POSITIVE and NEGATIVE terminals. Remove pump from separator cover.



a - Nuts
b - Pump

2. Inspect pump o-rings for cuts or abraisions. Replace O-rings as required.

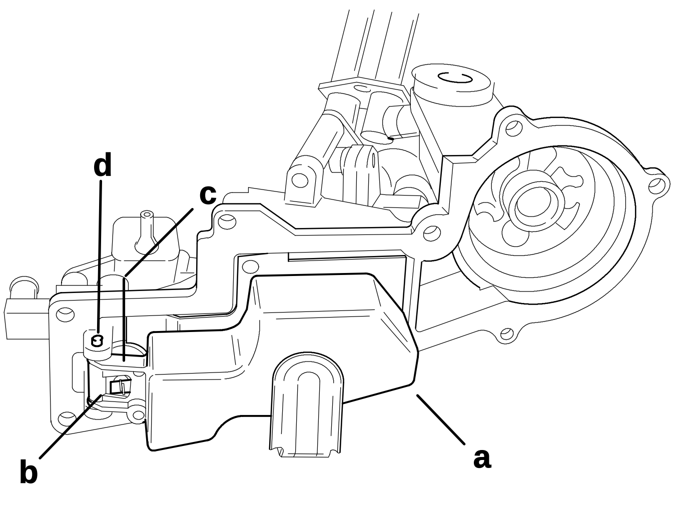


a - O-rings

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.



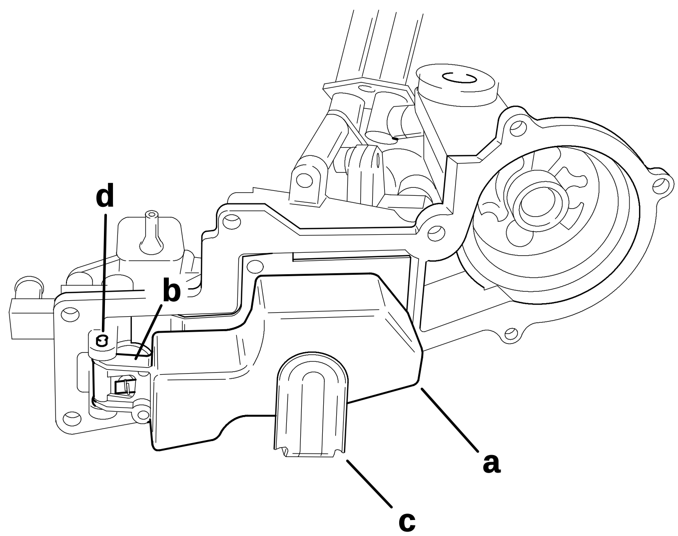
a - Float
b - Float Arm
c - Float Needle (Hidden)
d - Pivot Pin

*Seat and separator cover must be replaced as an assembly.

Vapor Separator Reassembly

VAPOR SEPARATOR FLOAT INSTALLATION

1. Attach float needle to float arm.
2. Guide float/needle assembly under float drop limit bracket and place needle into seat.
3. Slide pivot pin through float arms.
4. Verify float's freedom of movement through pivot range.



a - Float
b - Needle
c - Float Drop Limit Bracket
d - Pivot Pin

ELECTRIC FUEL PUMP INSTALLATION

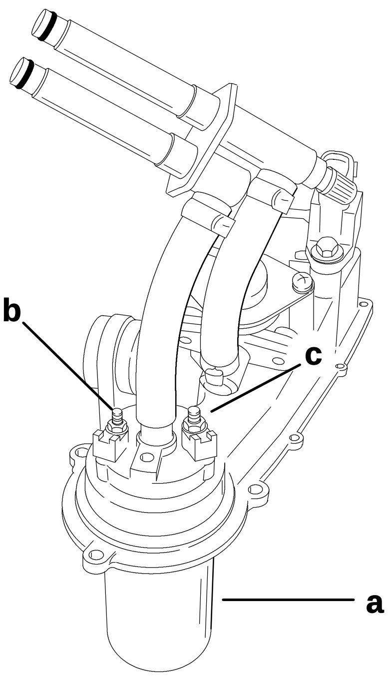
1. Slide fuel pump into separator cover.

***NOTE:** Fuel pump electrical studs are different diameters. Pump will install properly into cover only one way.*

⚠ CAUTION

DO NOT over torque fuel pump POSITIVE and NEGATIVE attaching nuts as damage to fuel pump will result.

2. Secure pump to cover with 2 nuts. Torque POSITIVE nut to 6 lb. in. (0.7 N·m). Torque NEGATIVE nut to 8 lb. in. (0.9 N·m).



53700

a - Electric Pump
b - POSITIVE (+) Stud (Small Diameter)
c - NEGATIVE (–) Stud (Large Diameter)

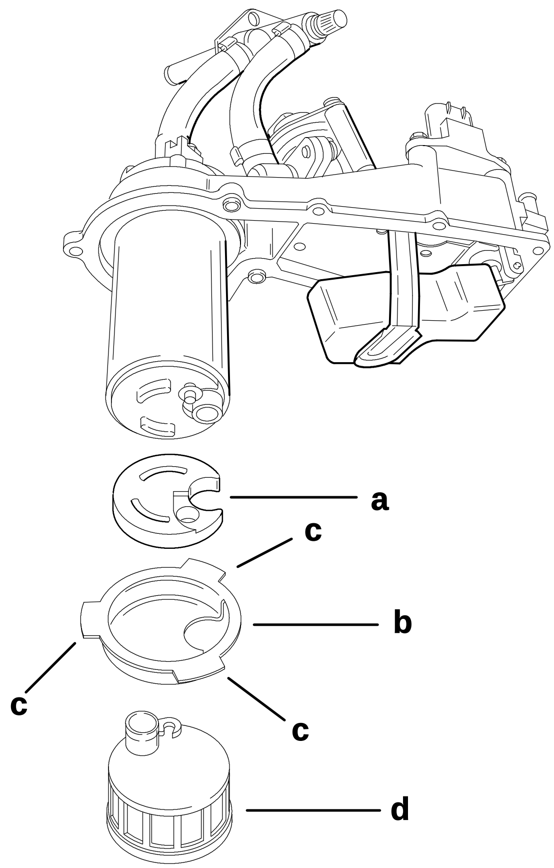
3. Install rubber pad on bottom of pump.

***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).*

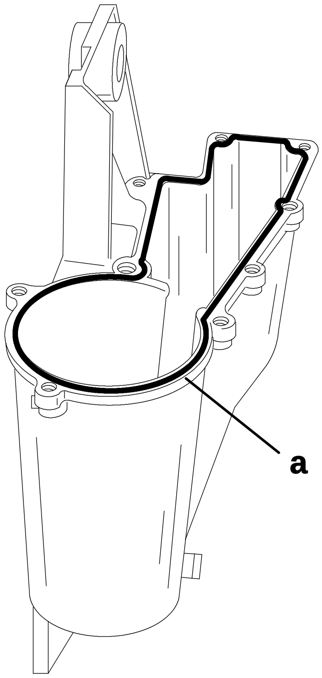
5. Install final filter into pump bottom. Rotate filter clockwise to lock filter onto pump.



a - Rubber Pad
b - Support Ring
c - Tabs (face up)
d - Final Filter

INSTALLING SEPARATOR COVER ASSEMBLY ONTO SEPARATOR TANK

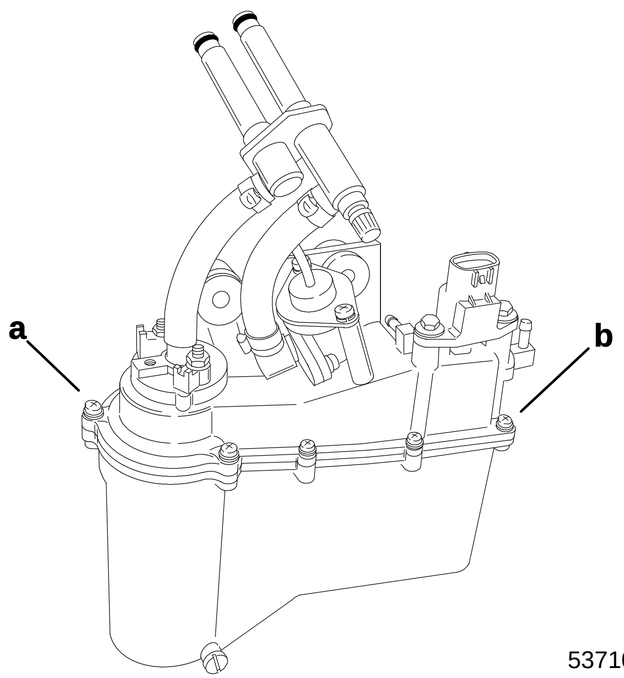
1. Inspect separator tank sealing O-ring for cuts or abraisions. Replace O-ring as required.



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. (3.4 N·m). Torque 4mm screws to 20 lb. in. (2.3 N·m).

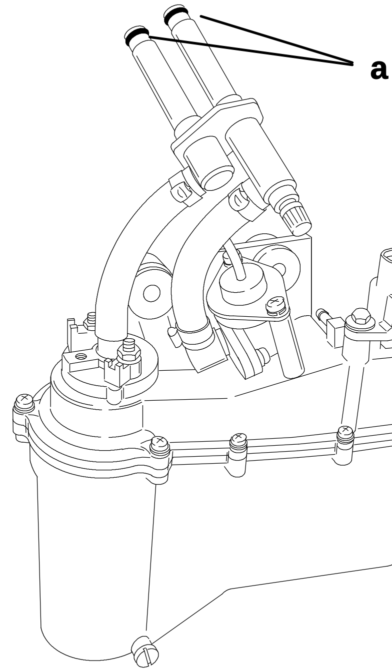


53710

a - Large Screws (4) (5mm) Torque to 30 lb. in. (3.4 N·m)
b - Small Screws (5) (4mm) Torque to 20 lb. in. (2.3 N·m)

Installing Vapor Separator Assembly to Induction Manifold

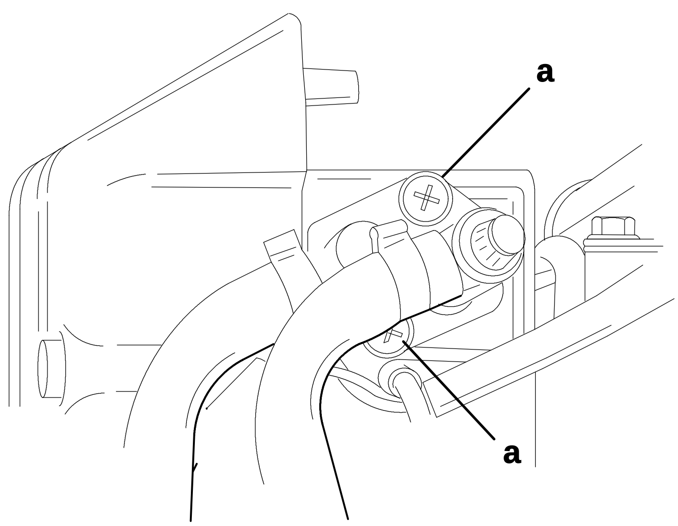
1. Inspect O-rings on end of separator fuel tubes for cuts or abraisions. Replace O-rings as required.



53710

a - O-rings

2. Guide fuel tubes into manifold. Secure tube assembly with 2 screws. Torque screws to 45 lb. in. (5.1 N·m).

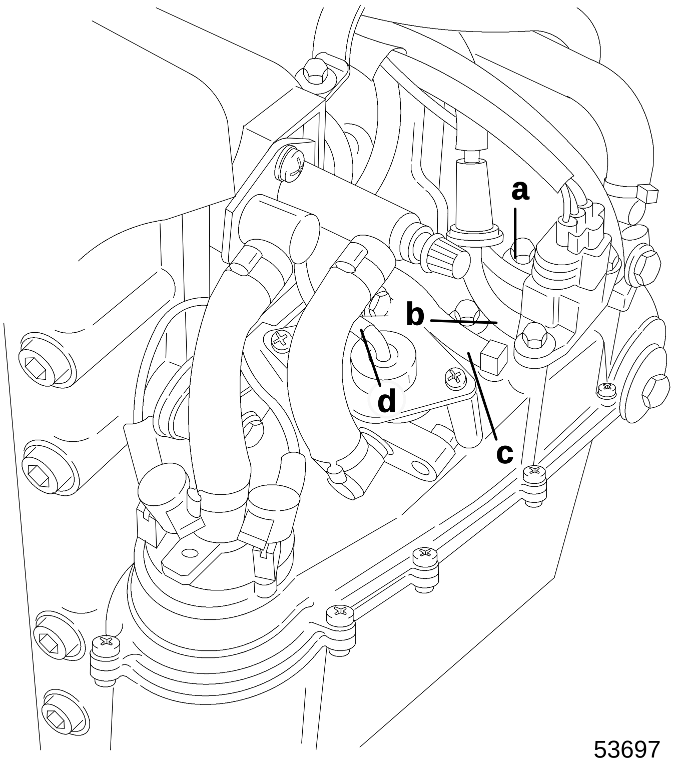


53657

a - Screws [Torque to 45 lb. in. (5.0 N·m)]

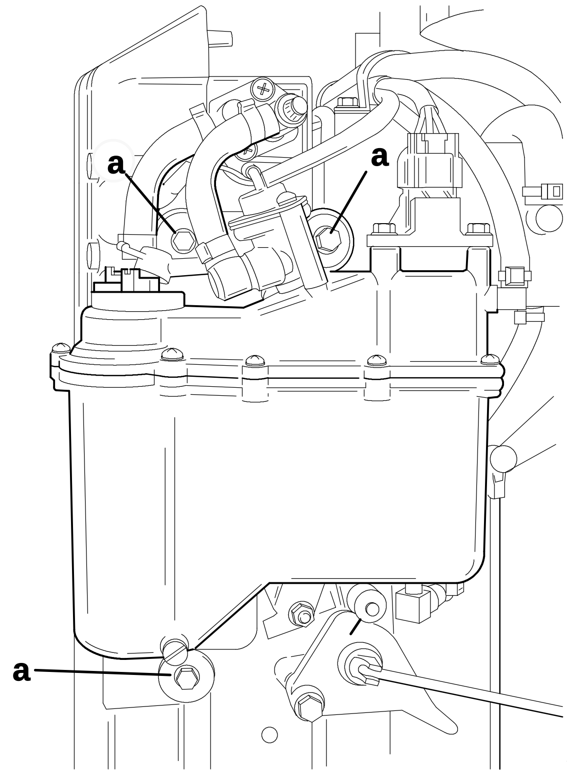
NOTE: *Refer to fuel flow diagram for proper placement of hoses when reinstalling separator to manifold.*

3. Reconnect MAP sensor hose to middle fitting on manifold.
4. Reconnect engine bleed hose (with filter) to fitting under MAP sensor.
5. Reconnect vapor separator hose (next to MAP sensor) to bottom fitting on manifold.
6. Reconnect pressure regulator hose to top fitting on manifold.



a - MAP Sensor Hose
b - Engine Bleed Hose
c - Vapor Separator Hose
d - Pressure Regulator Hose

7. Secure separator assembly to manifold with 3 bolts and washers. Torque bolts to 45 lb. in. (5.1 N·m).



a - Bolts and Washers [Torque to 45 lb. in. (5.0 N·m)]

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.

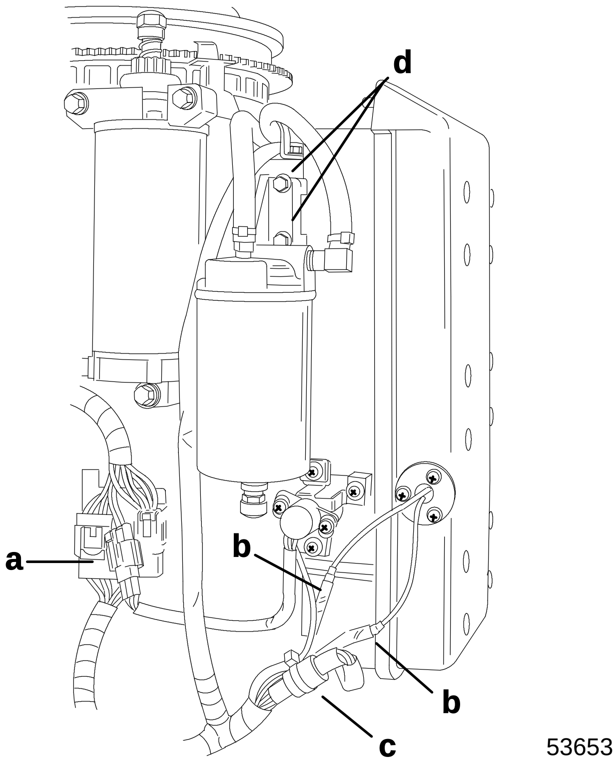
Inspection

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 ECU box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECU 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 Removal

IMPORTANT: Disconnect battery cables from battery before removing and disassembling induction manifold.

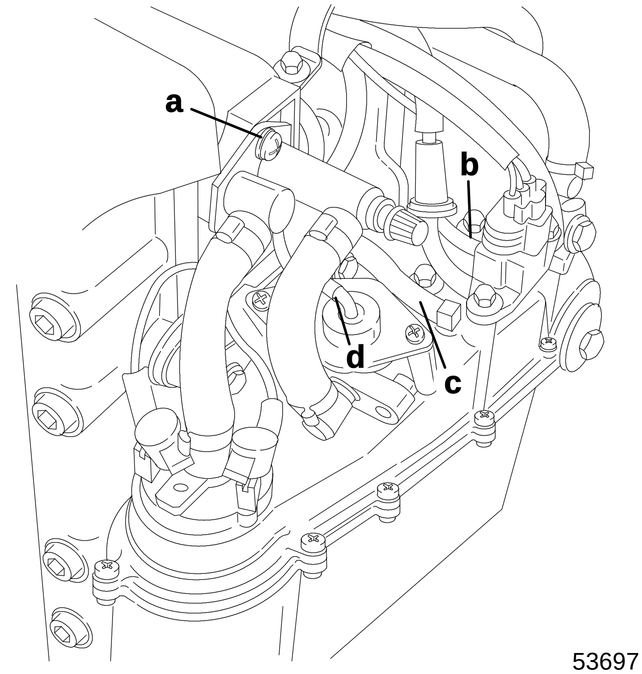
1. Disconnect TPI harness.
2. Disconnect Air Temperature Sensor bullet connectors.
3. Disconnect injector wiring harness.
4. Remove 2 bolts securing water separator filter and lay filter off to one side.



53653

a - TPI Harness
b - Air Temperature Sensor Bullet Connectors
c - Injector Wiring Harness
d - Water Separator Filter Attaching Bolts

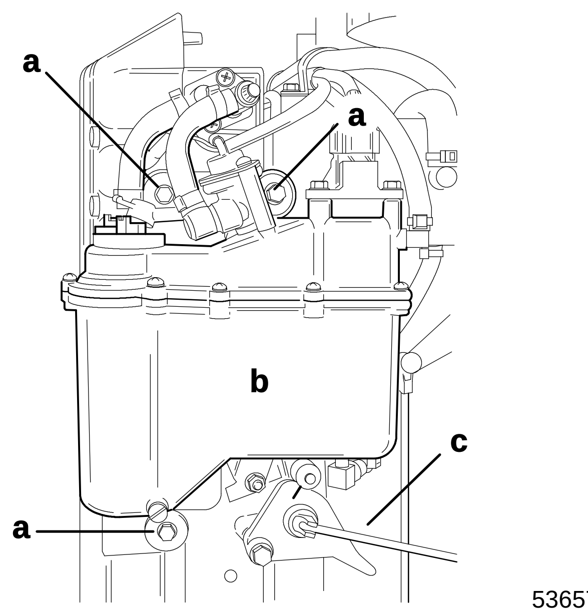
5. Remove 2 screws securing fuel inlet/outlet pipes to manifold.
6. Remove MAP sensor hose.
7. Remove Vapor Separator hose.
8. Remove Fuel Pressure Regulator hose.



53697

a - Fuel Inlet/Outlet Pipe Screws
b - Map Sensor Hose
c - Vapor Separator Hose
d - Fuel Pressure Regulator Hose

9. Pry throttle link arm from throttle cam with screw driver.
10. Remove 3 bolts securing vapor separator assembly to manifold and lay separator off to one side.

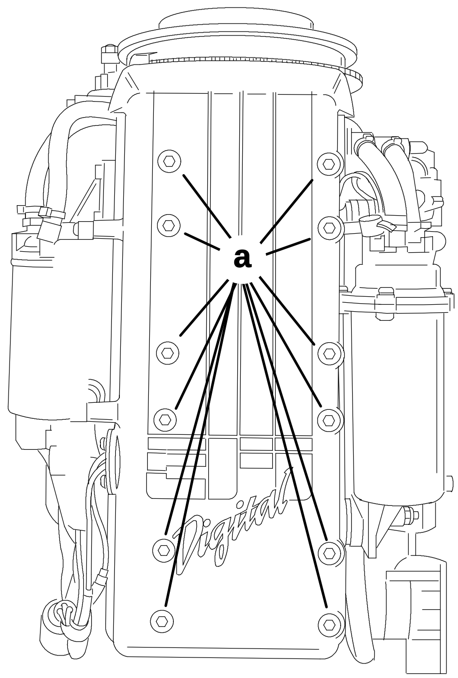


53657

a - Bolts
b - Vapor Separator
c - Throttle Link Arm

***NOTE:** Screws that attach cover to induction manifold also secure induction manifold to cylinder block. Support induction manifold as last screws are removed.*

11. Remove 12 screws securing intake cover and induction manifold to cylinder block. Remove induction manifold assembly from cylinder block.

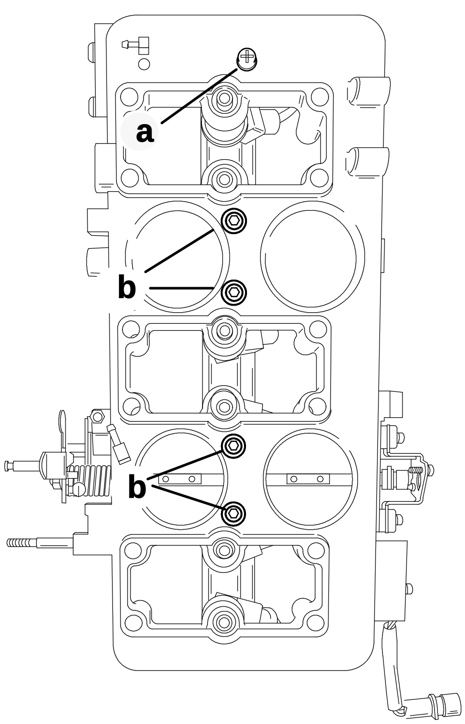


53645

a - Screws

FUEL RAIL REMOVAL

1. Remove 5 screws securing fuel rail to induction manifold and remove fuel rail.



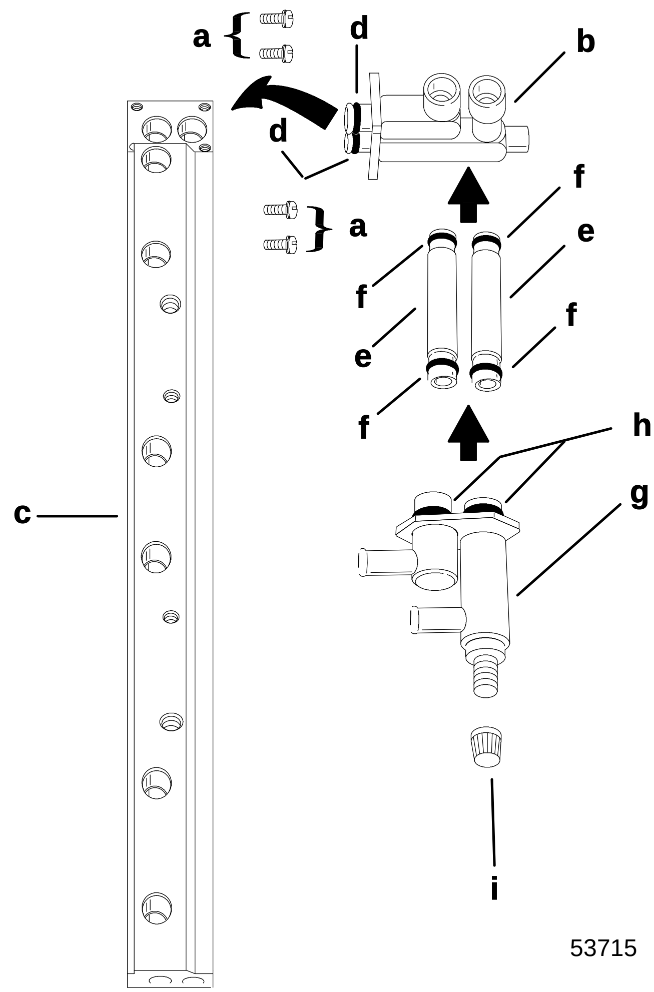
53707

a - Philips Screw
b - Allen Screw

2. Fuel injectors are held into fuel rail by O-ring tension. Pull out on injector to remove from fuel rail.

FUEL RAIL DISASSEMBLY

1. Remove 4 screws securing inlet/outlet elbow to fuel rail and remove elbow.
2. Inspect O-rings on elbow for cuts and abraisions. Replace as required.
3. Remove transfer tubes from external fuel pressure regulator joint.
4. Inspect O-rings on transfer tubes for cuts and abraisions. Replace as required.
5. Inspect O-rings on regulator joint for cuts and abraisions. Replace as required.

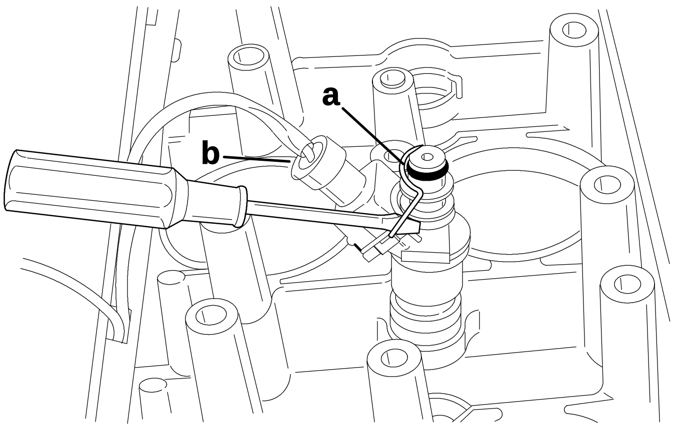


53715

a - Screws
b - Inlet/Outlet Elbow
c - Fuel Rail
d - O-rings
e - Transfer Tubes
f - O-rings
g - Regulator Joint
h - O-rings
i - Dust Cap

FUEL INJECTOR DISASSEMBLY AND REASSEMBLY

1. Pry out on spring clip with small flat tipped screwdriver to unlock electrical connector from injector.



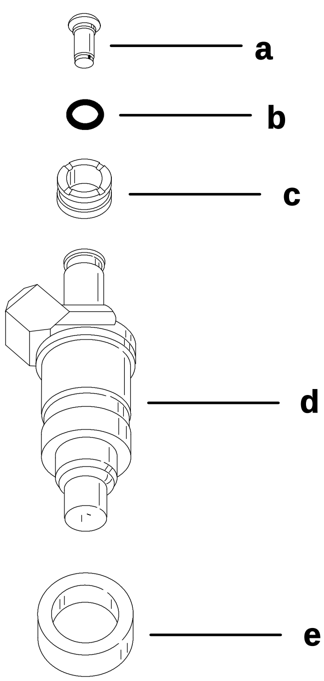
53716

a - Spring Clip
b - Connector

2. Place injector on clean work surface and remove filter, O-ring and seals.

3. Inspect O-ring and seals for cuts or abraisions. Replace as required.

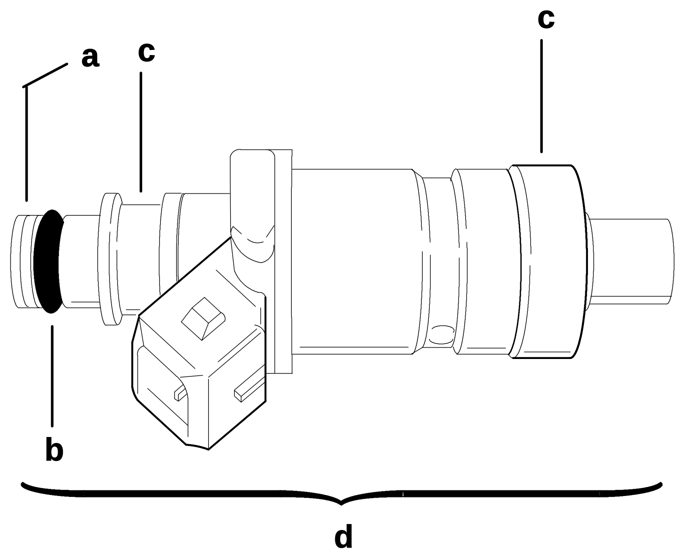
4. Inspect filter for debris. Flush with solvent. DO NOT reinstall injector without filter as injector will require replacement if debris enters injector assembly.



53712

a - Filter
b - O-ring
c - Seals
d - Injector

5. Reassemble injector.



53704

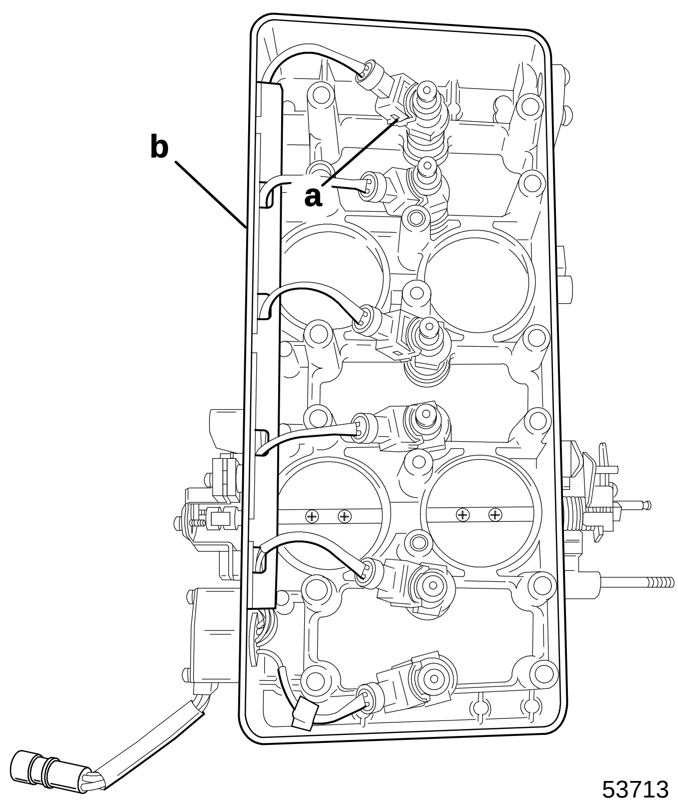
a - Filter
b - O-ring
c - Seals
d - Injector

INJECTOR HARNESS REMOVAL

1. Note position of wiring for reassembly.

2. Remove locking spring clip from each injector harness connector and disconnect each injector.

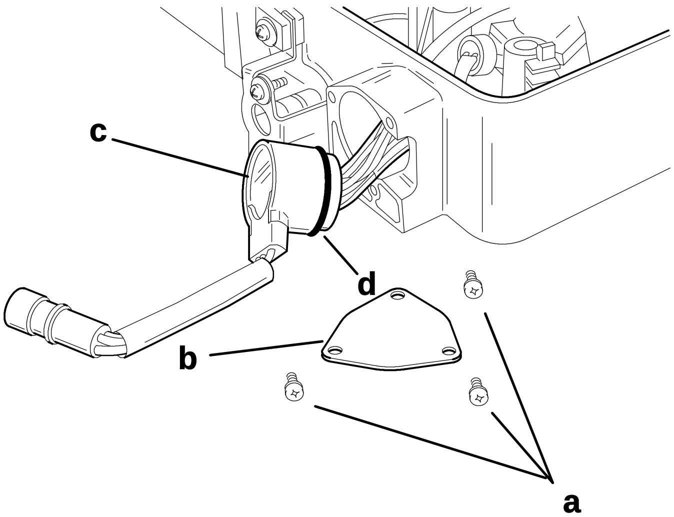
3. Remove protective casing from harness.



53713

a - Spring Clip
b - Protective Casing

4. Remove 3 screws and injector harness plate.
5. Remove harness plug from manifold.
6. Inspect harness plug o-ring for cuts or abraisions. Replace as required.

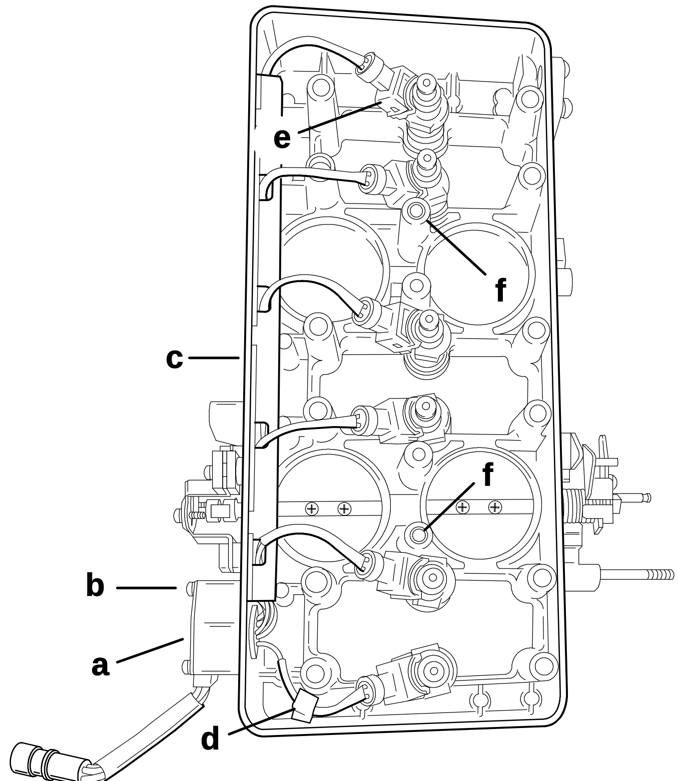


53708

a - Screws
b - Plate
c - Harness Plug
d - O-ring

INJECTOR HARNESS INSTALLATION

1. Seat O-ring on harness plug and install plug into manifold receptacle.
2. Secure plug in manifold with plate and 3 screws. Drive screws tight.
3. Install harness case onto harness and route injector connectors to each injector.
4. Secure connector to each injector with spring clip.
5. Reinstall fuel rail alignment sleeves (if removed).

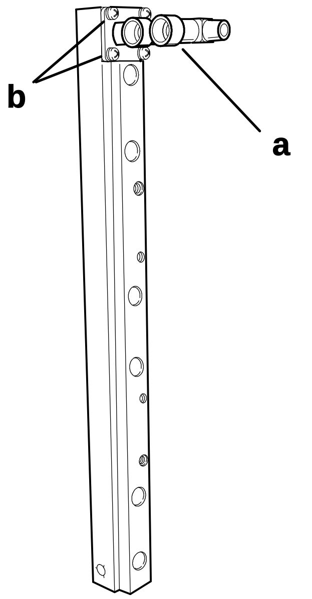


53713

a - Plate
b - Screws (3) (Drive Tight)
c - Harness Case
d - Harness Guide
e - Spring Clip
f - Alignment Sleeves

FUEL RAIL REASSEMBLY AND INSTALLATION

1. Install inlet/outlet elbow to fuel rail. Torque screws to18 lb. in. (2.0 N·m).

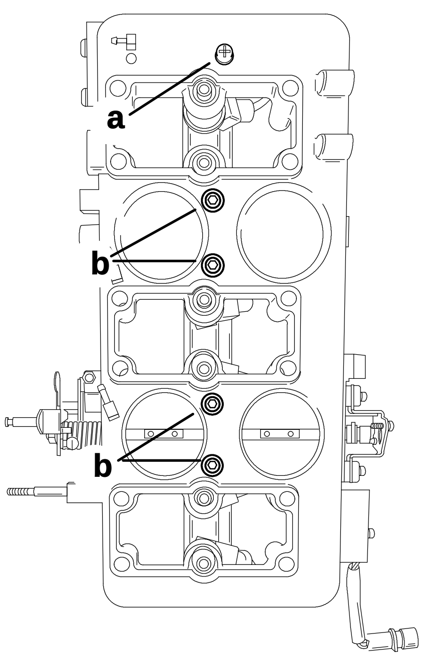


53707

a - Inlet/Outlet Elbow
b - Screws [Torque to 18 lb. in. (2.0 N·m)]

2. Align fuel rail over injectors and carefully press rail downward. Adjust individual injectors as required to facilitate the seating of the injectors into the fuel rail.

3. When fuel rail is seated fully onto injectors and alignment sleeves, carefully turn induction manifold over and secure fuel rail with 1 philips screw and washer and 4 allen screws and washers. Torque screws to 45 lb. in. (5.1 N·m).

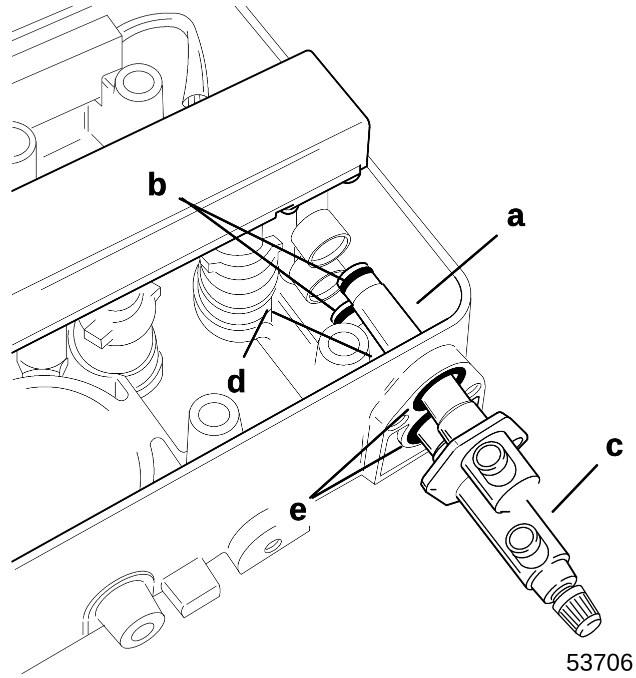


53707

a - Philips Screw and Washer
b - Allen Screws and Washer

4. Install inlet/outlet tubes with O-rings into fuel pressure regulator elbow.

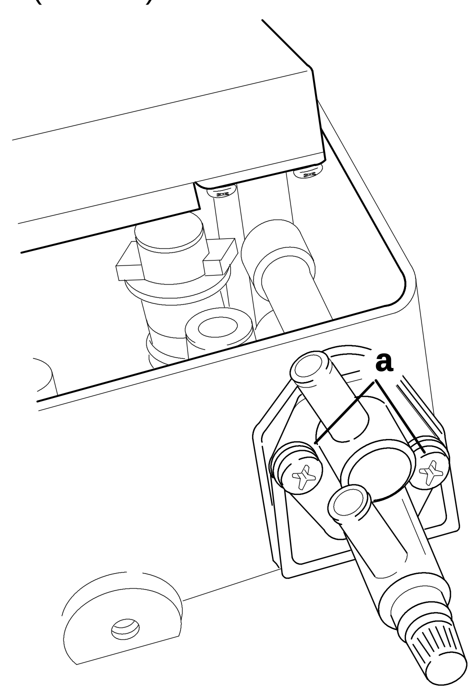
5. Install O-rings on fuel ports on manifold. Slide inlet/outlet tube and regulator assembly through ports and into inlet/outlet elbow on fuel rail.



53706

a - Inlet/Outlet Tubes
b - O-rings
c - Pressure Regulator Elbow
d - O-rings (hidden)
e - O-rings (Fuel Ports)

6. Secure pressure regulator assembly to manifold with 2 screws and washers. Torque screws to 45 lb. in. (5.1 N·m).

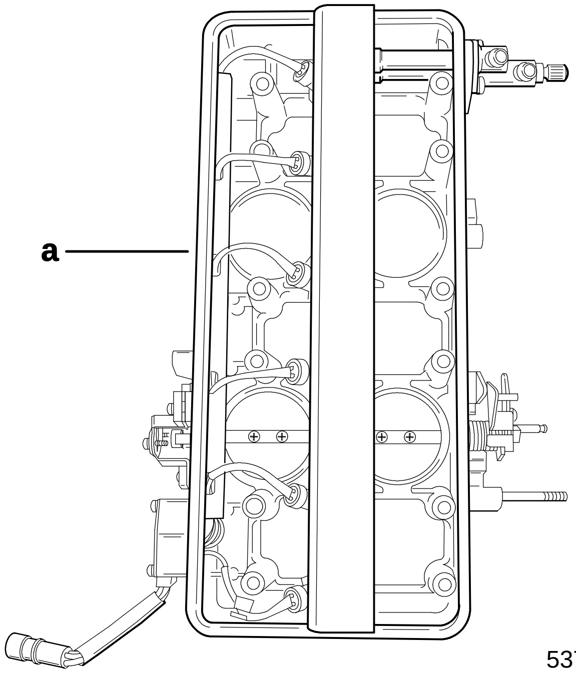


53705

a - Screws and Washers

Induction Manifold Installation

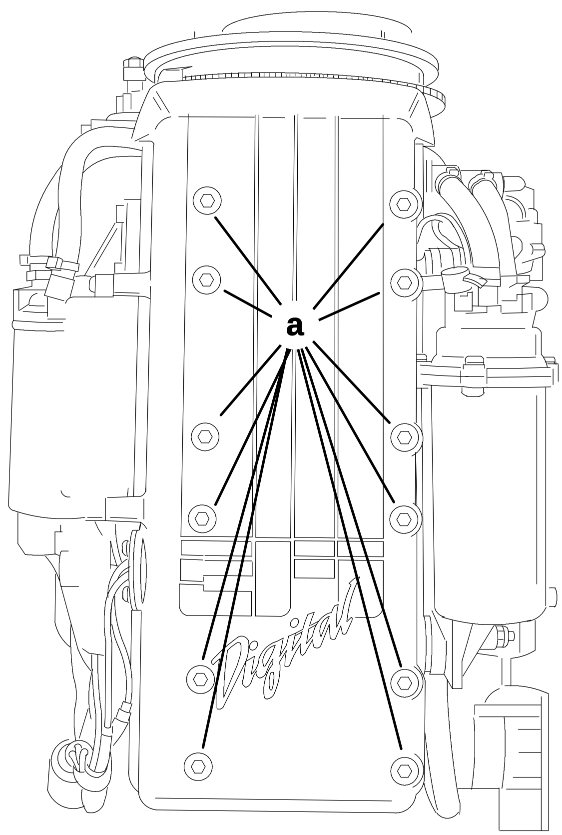
1. Inspect induction manifold cover seal for cuts or abraisions. Replace as required.



53714

a - Seal

2. Place cover onto manifold assembly and install cover/manifold assembly onto cylinder block. Secure assembly with 12 allen screws. Torque screws to 19 lb. ft. (26.0 N·m).



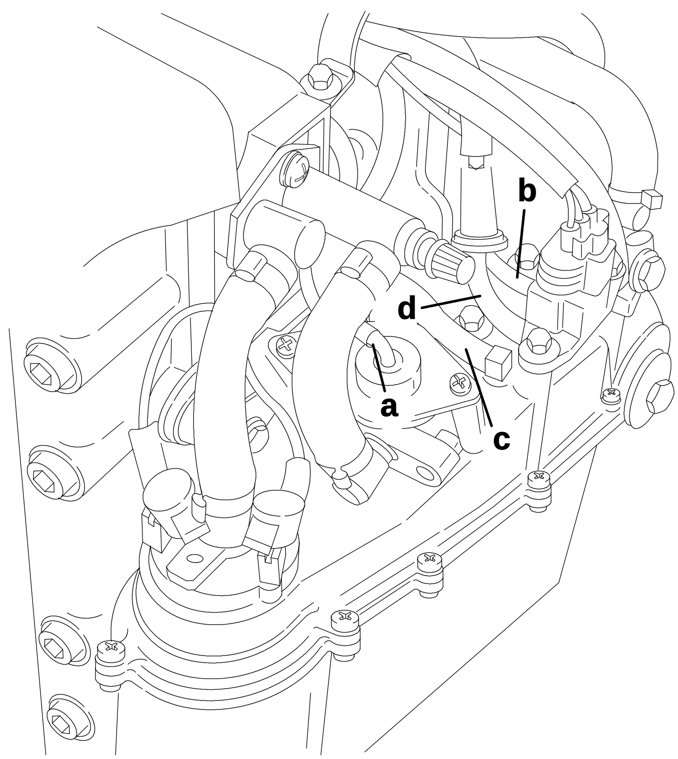
53645

a - Screws [Torque to 19 lb. ft. (26.0 N·m)]

3. Connect fuel pressure regulator hose to top manifold fitting.
4. Connect MAP sensor hose to middle manifold fitting.
5. Connect vapor separator hose to bottom manifold fitting.
6. Connect engine bleed hose (with white filter) to fitting under MAP sensor.

***NOTE:** Refer to FUEL FLOW DIAGRAM for visual aid of hose placement*

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 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.



53697

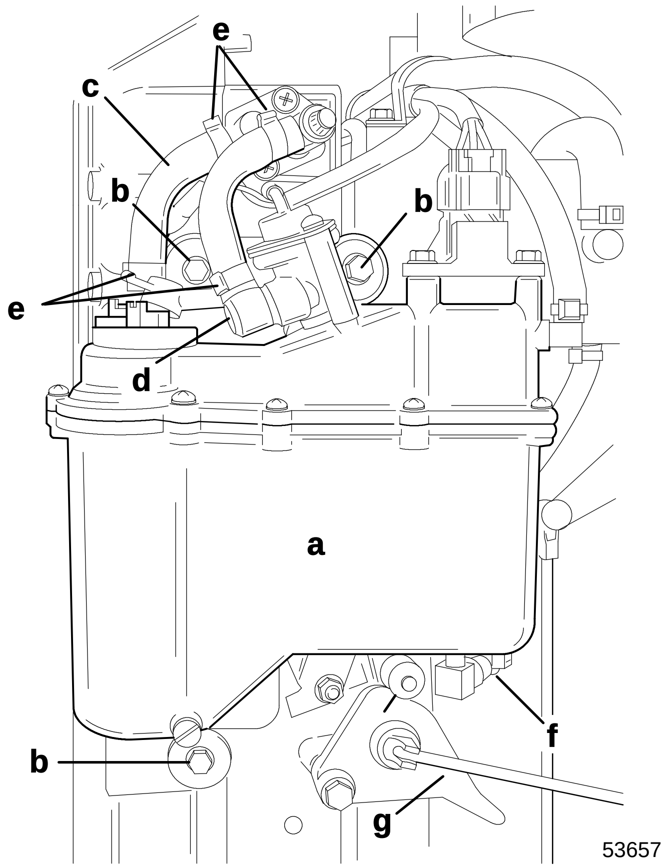
a - Pressure Regulator Hose
b - MAP Sensor Hose
c - Vapor Separator Hose
d - Engine Bleed Hose

7. Secure vapor separator to induction manifold with 3 bolts and washers. Torque bolts to 45 lb. in. (5.1 N·m).

8. Secure fuel outlet hose and return hose to manifold with hose clamps, if removed, or install tubing kit (32-827694) if hoses are to be replaced.

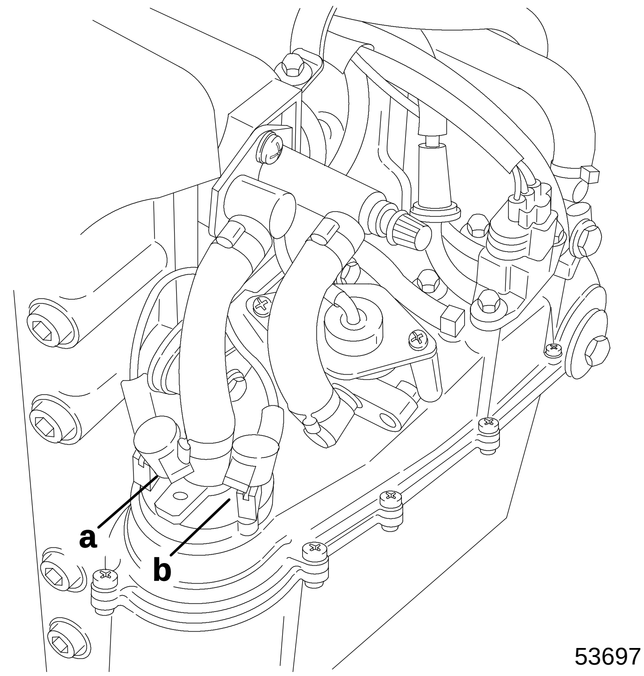
9. Reconnect oil inlet hose to vapor separator. Secure hose with sta-strap.

10. Install throttle link rod to throttle cam.



a - Vapor Separator
b - Bolts and Washers [Torque to 45 lb. in. (5.1 N·m)]
c - Fuel Outlet Hose
d - Fuel Return Hose
e - Steel Clamps
f - Oil Inlet Hose
g - Throttle Link Rod

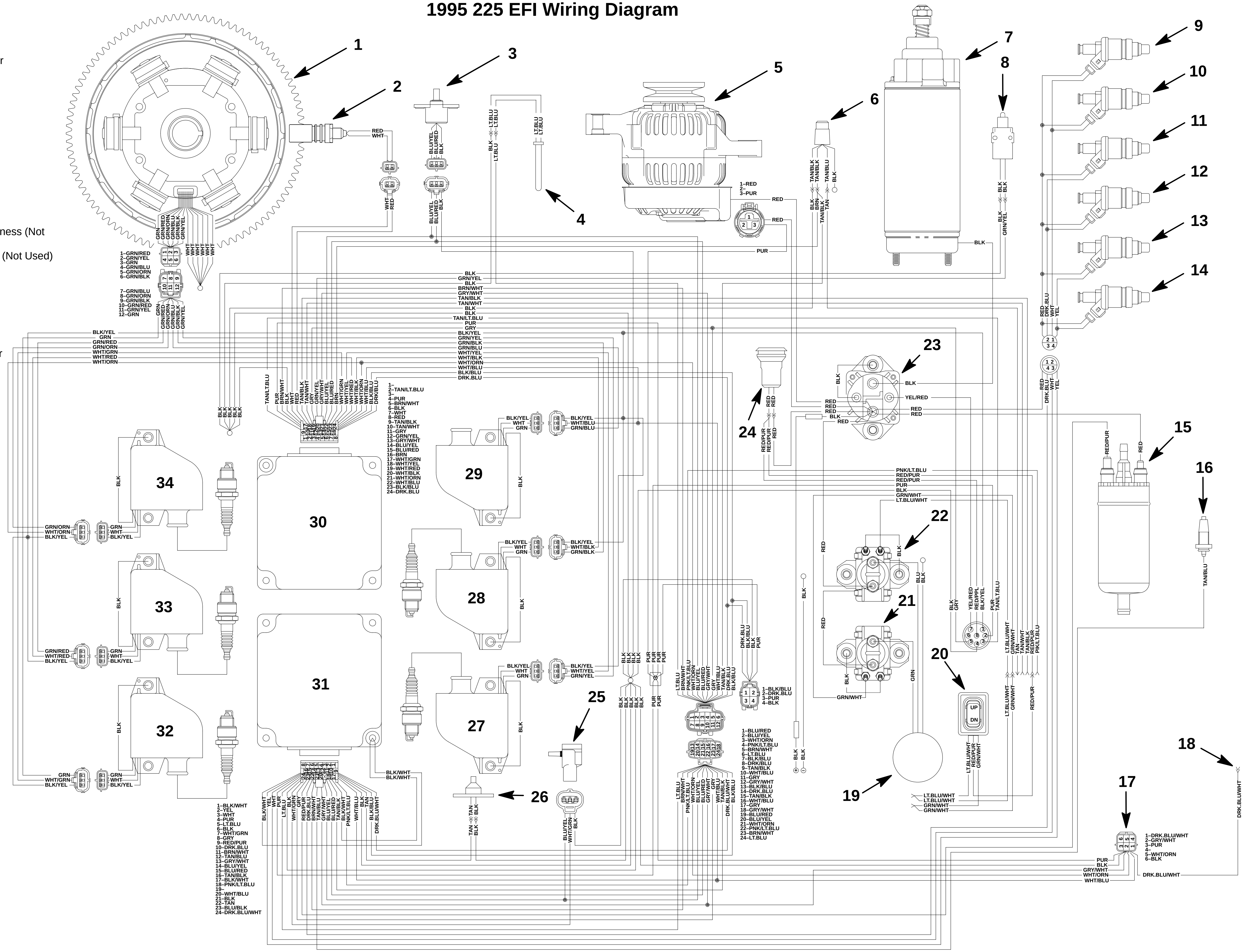
11. Connect RED (POSITIVE) lead to PORT terminal of electric fuel pump and RED/PURPLE (NEGATIVE) lead to STARBOARD terminal of electric fuel pump.



a - RED (POSITIVE) Lead
b - RED/PURPLE (NEGATIVE) Lead

1995 225 EFI Wiring Diagram

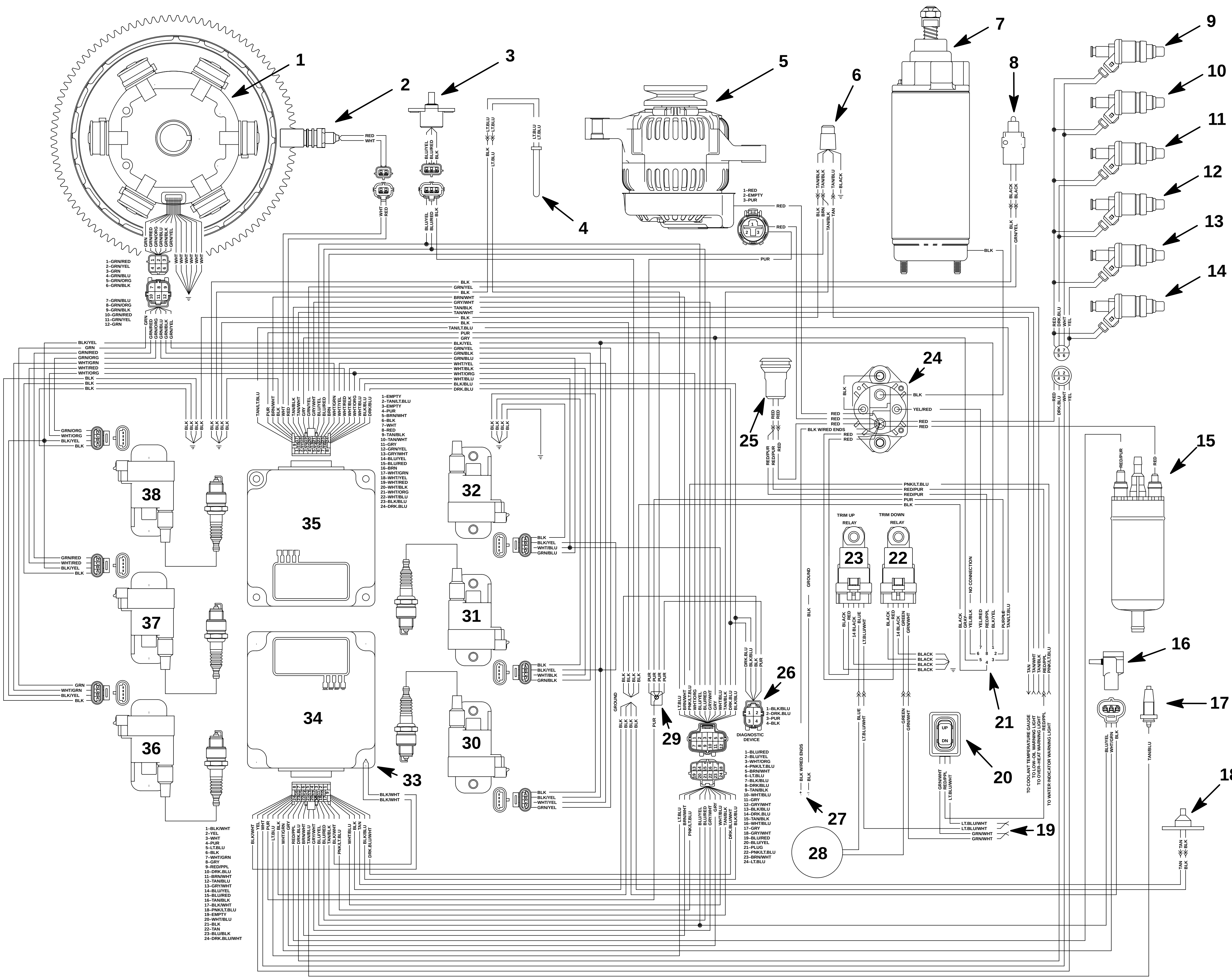
1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch
5 - 60 Ampere Alternator
6 - Temperature Sensor
7 - Starter
8 - Shift Interrupt Switch
9 - #1 Fuel Injector
10- #2 Fuel Injector
11- #3 Fuel Injector
12- #4 Fuel Injector
13- #5 Fuel Injector
14- #6 Fuel Injector
15- Fuel Pump
16- Water Sensor
17- Detonation Module Harness (Not Used)
18- Knock Sensor Harness (Not Used)
19- Trim Motor
20- Cowl Trim Switch
21- DOWN Trim Solenoid
22- UP T rim Solenoid
23- Starter Solenoid
24- 20 Ampere Fuse
25- MAP Sensor
26- Air Temperature Sensor
27- #5 CDM
28- #3 CDM
29- #1 CDM
30- Ignition ECM
31- EFI (Fuel) ECM
32- #6 CDM
33- #4 CDM
34- #2 CDM



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

1996/1997/1998 225 EFI/250 EFI Wiring Diagram

Stator
Crank Position Sensor
Throttle Position Sensor
Low Oil Switch
60 Ampere Alternator
Temperature Sensor
Starter
Shift Interrupt Switch
#1 Fuel Injector
#2 Fuel Injector
#3 Fuel Injector
#4 Fuel Injector
#5 Fuel Injector
#6 Fuel Injector
Fuel Pump
Map Sensor
Water Sensor
Air Temperature Sensor
To Remote Trim Switch
Cowl Trim Switch
Remote Control Harness
DOWN Trim Solenoid
UP Trim Solenoid
Starter Solenoid
20 Ampere Fuse
Diagnostic Harness
To 12 Volt Battery
Trim Motor
Terminal Block
#5 CDM
#3 CDM
#1 CDM
Ground
EFI (Fuel) ECM
Ignition ECM
#6 CDM
#4 CDM
#2 CDM



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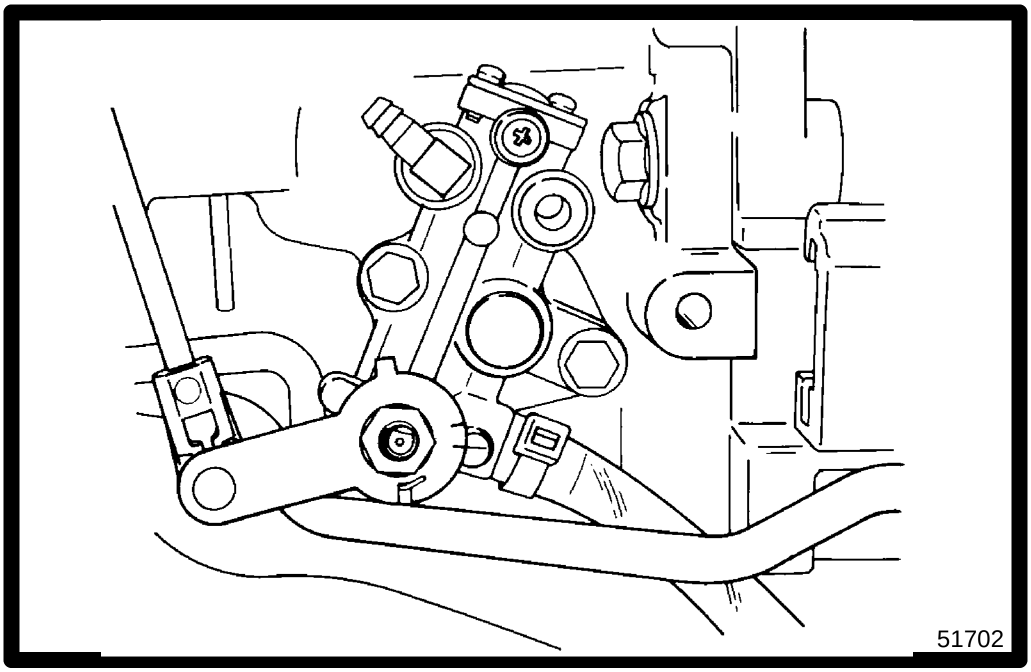
LT = Light
DRK = Dark

FUEL SYSTEM

3

D



OIL INJECTION

Table of Contents

3 Liter Oil Injection System

CAUTION

DO NOT allow dirt or other contamination to enter 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 psig. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psig maximum.

Operation of the Oil Injection System

The oil injection system delivers oil mixture on engine demand, from 100 to 1 at idle to 50 to 1 at wide open throttle.

The remote oil tank can be removed from the boat for easy refilling. The remote tank holds enough oil for over 150 gallons of fuel at wide open throttle.

The remote oil tank supplies the oil reservoir mounted on the engine. The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

The oil injection pump feeds oil into the fuel just before the fuel pump. 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

- Verify 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 a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, open cowl and check that no oil is leaking out of engine oil reservoir fill cap.

Oil Injection Components (See Page 3 for Location)

① REMOTE OIL TANK

Holds 3 gallons of oil.

The tank is pressurized by air from crankcase pressure thus forcing oil up the outlet hose to the oil reservoir on engine.

② OIL PICK UP TUBE

A filter screen is located in end of tube to prevent dirt or other particles from entering the system.

③ OIL RESERVOIR

The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

④ OIL INJECTION PUMP

Injection pump is driven off the crankshaft. See illustration on page 3.

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.

⑤ 4 PSI CHECK VALVE

If oil flow to reservoir is obstructed and injection pump continues to pump oil, the 4 PSI valve will open to allow air to enter reservoir to prevent a vacuum.

⑥ 2 PSI CHECK VALVE

This valve prevents gasoline from being forced into the oil lines.

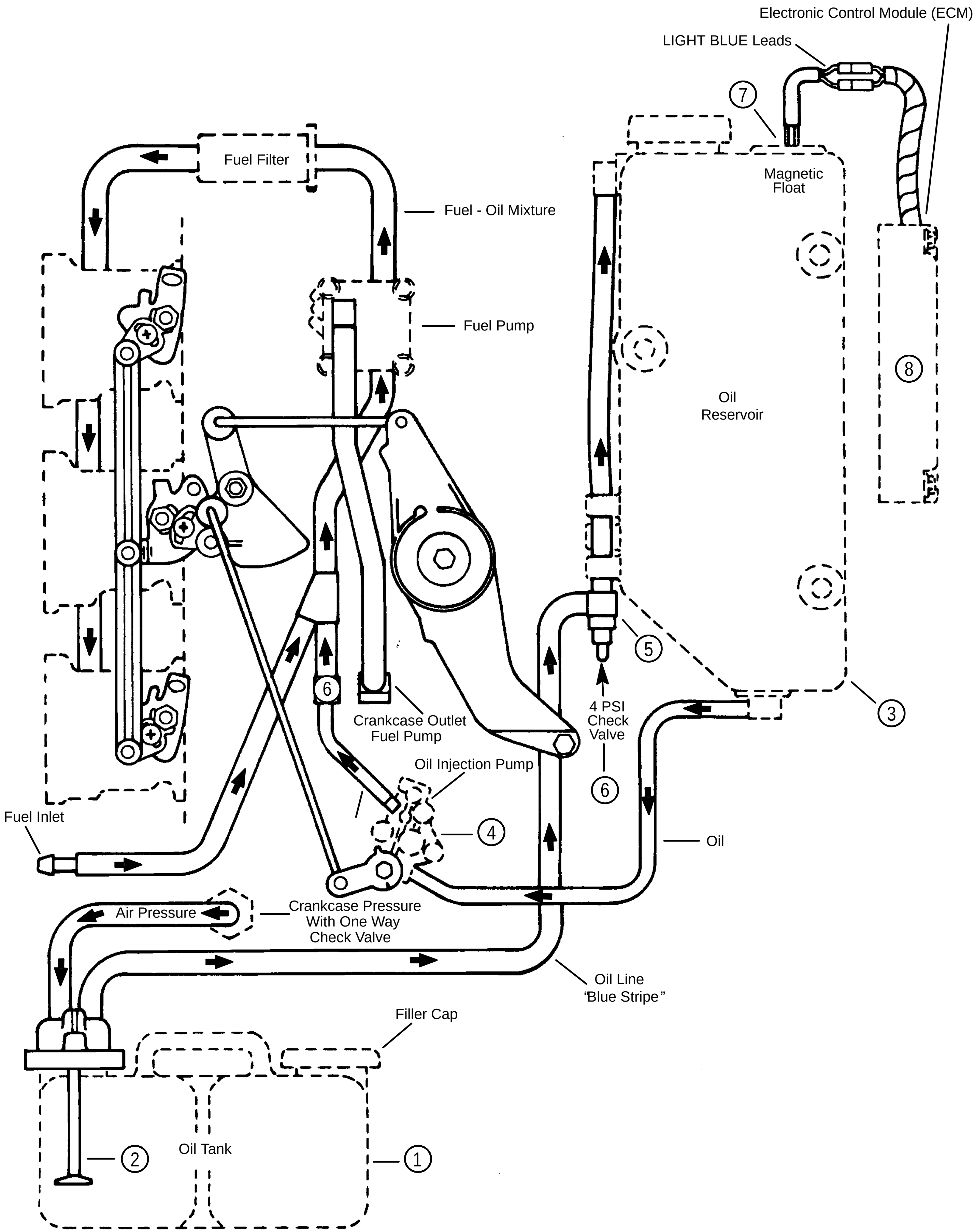
⑦ LOW OIL (FLOAT) SENSOR

If oil level drops in oil reservoir, the sensor will signal the warning module to sound the warning horn.

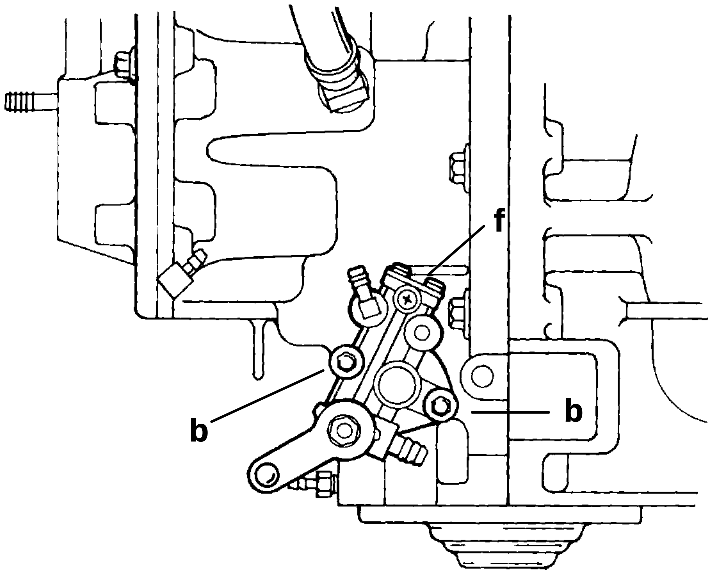
⑧ ELECTRONIC CONTROL MODULE

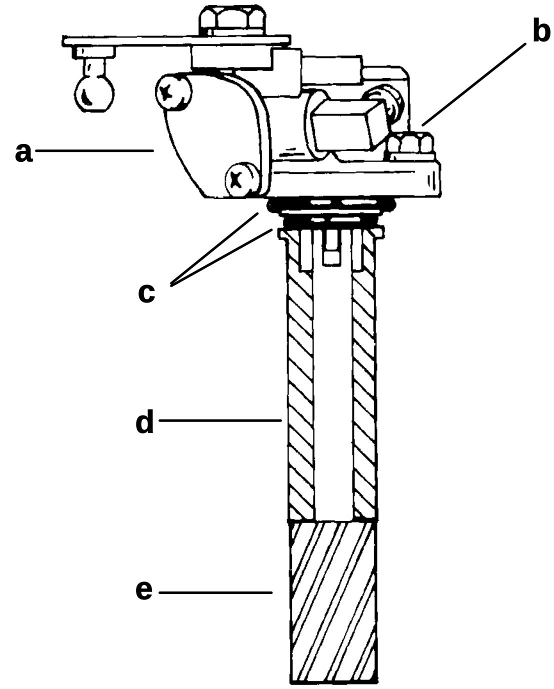
The Electronic Control Module (ECM) continuously monitors the oil reservoir oil level. The ECM activates the warning horn when signaled by the low oil sensor.

Oil Injection Flow System

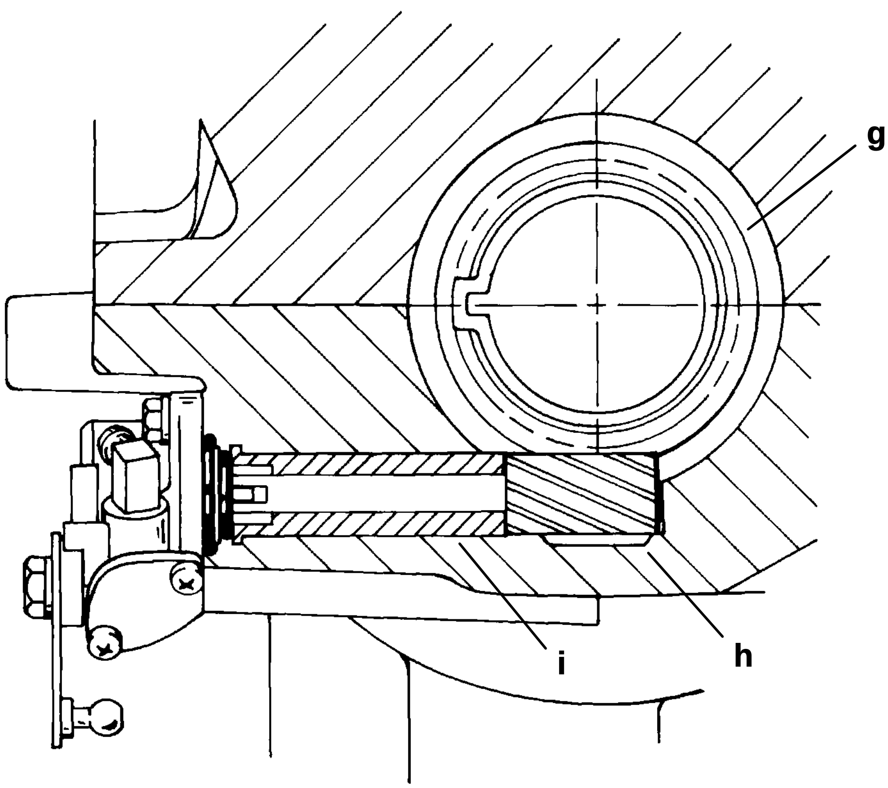


Pump Drive Assembly





Pump Drive System



a - Oil Pump
b - Retaining Bolts (2)
c - O-rings
d - Bushing
e - Driven Gear
f - Oil Pump (Installed)
g - Drive Gear
h - Driven Gear
i - Gear 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.

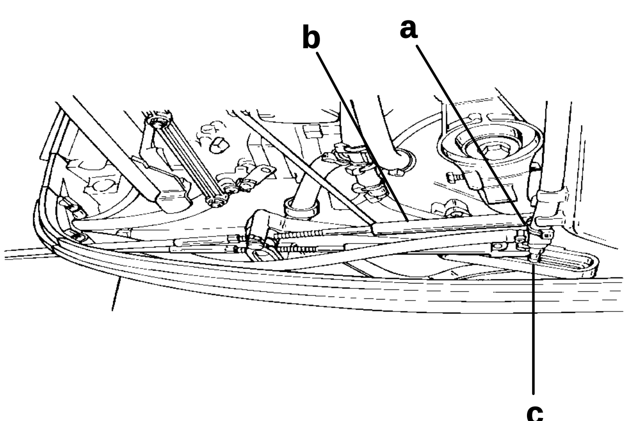
⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 4 psig. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psig maximum.

INSTALLING REMOTE OIL TANK HOSES TO ENGINE

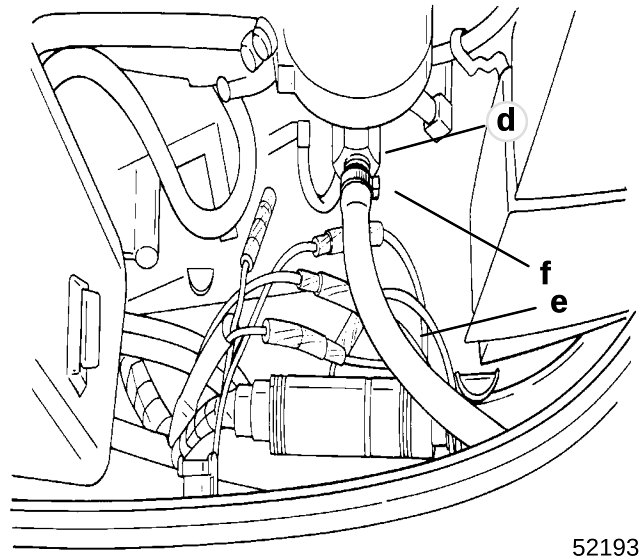
1. Remove (and discard) the shipping cap from hose fitting (a).
2. Connect oil hose "b" (with blue stripe) to fitting as shown. Secure with sta-strap.

NOTE: *The third fitting (c) is a vent and does not get connected.*



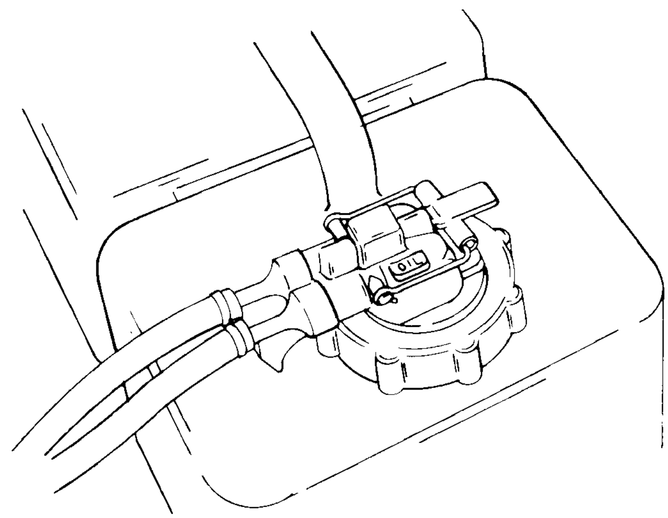
52189

3. Remove (and discard) the shipping cap from pulse fitting (d).
4. Route the second oil hose (e) behind retainer (f) and connect to pulse fitting as shown. Secure with sta-strap.



52193

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



22750

Quicksilver 2-Cycle Outboard Oil is recommended for this oil injection system. In emergency, when Quicksilver oil is not available, substitute a high quality 2 cycle oil that is intended for outboard use and meets BIA rating TC-W III, shown on oil container. BIA rating TC-W is the Boating Industry Association's designation for approved, 2-cycle water-cooled outboard oils.

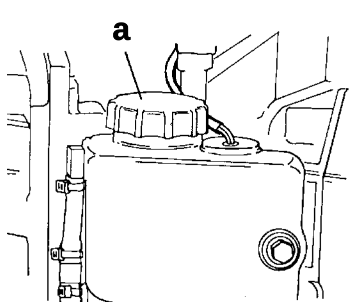
FILLING THE OIL INJECTION SYSTEM WITH OIL

Use Quicksilver 2-Cycle Outboard Oil which is NMMA/BIA Certified TC-W III. If Quicksilver 2-Cycle Outboard Oil is not available, substitute a major 2-cycle outboard manufacturers oil that is NMMA/BIA Certified TC-W III.

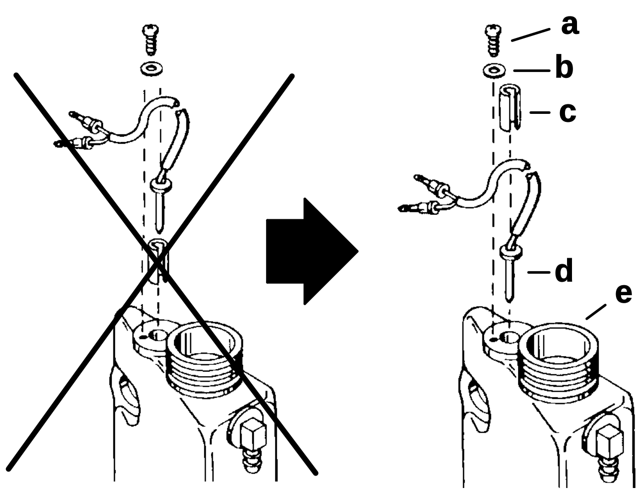
1. Fill the remote oil tank to the fill mark. Retighten the fill cap.
2. Fill the engine reservoir tank (a) with oil. Retighten the fill cap.
3. Loosen (1/2 turn) the engine reservoir tank fill cap. Run the engine until air from inside the remote oil hoses has been purged out of the reservoir and oil starts to flow out of the reservoir tank. Retighten the fill cap.

⚠ CAUTION

Be certain that the fill caps on the oil reservoir tank and the remote oil tank are installed tightly. An air leak, at the remote oil tank fill cap will prevent oil flow to the engine. An oil leak at the reservoir fill cap (a) will cause oil spillage.



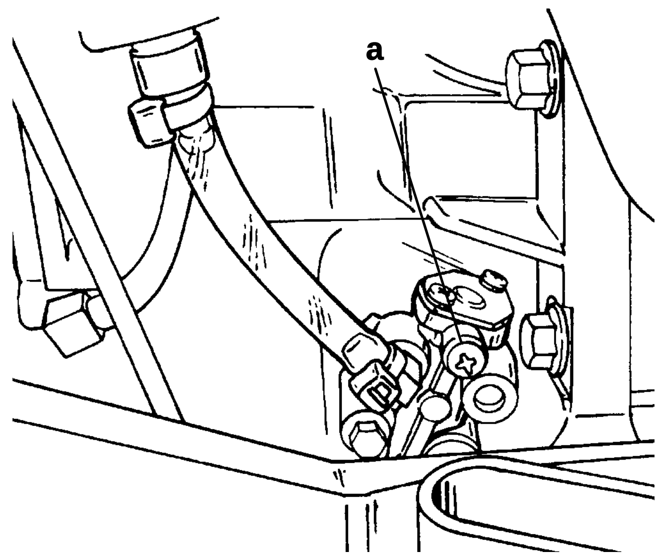
REPLACEMENT OF LOW OIL SWITCH



a - Screw (Tighten Securely)
b - Washer
c - Spacer
d - Low Oil Switch
e - Oil Tank

BLEEDING AIR FROM OIL INJECTION PUMP

With engine not running, place a shop towel below the oil injection pump. Loosen bleed screw (a) 3 turns and allow oil to flow from bleed hole. This procedure allows the pump to fill with oil.

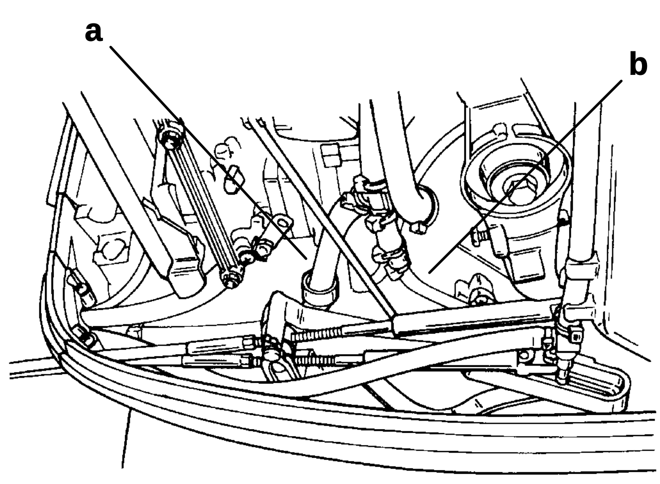


52190

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. Retighten bleed screw when bubbles are purged.

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.*

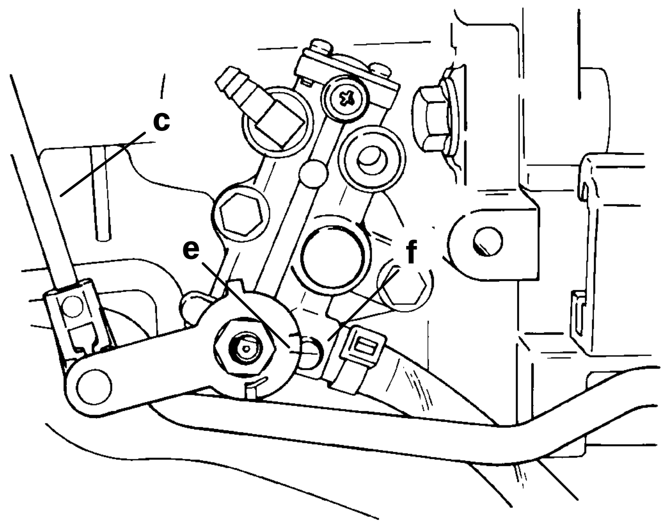


52189

a - Fuel Line
b - Oil Line

CONNECTING OIL INJECTION PUMP LINK ARM

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



c - Link Rod
e - Alignment Mark
f - Casting Mark

OPERATION OF THE OIL INJECTION SYSTEM

IMPORTANT: The outboard is equipped with a warning system - horn and sensors - to alert the operator of an overheat or low oil situation. This system self-tests each time the ignition key is turned to the "ON" position. The horn will "beep" 4 times and pause. During an actual failure, the system will continue to beep and pause cyclically until the problem is corrected. THE OPERATOR MUST DETERMINE WHETHER A LOW OIL OR AN OVERHEAT CONDITION HAS OCCURRED.

1. Verify fill cap gaskets or O-rings are in place and caps are tight on engine reservoir tank and remote oil tank.
2. Verify a remote gasoline and oil mixture of 50:1 is used during the initial break-in of the engine or after extended storage.
3. Be certain the warning horn is operational.

Each time the key switch is turned from the "off" to "on" position (engine not running); the warning horn will sound momentarily. This tells you the 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.

CHECK OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent "beep", "beep", "beep" during operation, this indicates a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, open cowl and check that no oil is leaking out of engine oil reservoir fill cap.

REQUIRED SIDE MOUNT REMOTE CONTROL OR IGNITION KEY ASSEMBLY TO BE USED WITH ENGINES WITH OIL INJECTION

Boats Equipped with a Side Mount Remote Control

A Quicksilver Commander Series Side Mount Remote Control equipped with a warning horn, must be used with this outboard. This warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

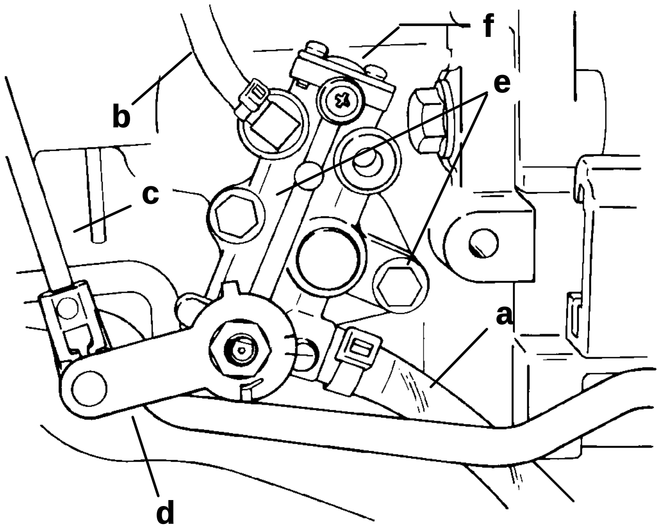
Boats Equipped with Panel or Console Mount Remote Controls

A Quicksilver Ignition Key/Choke Assembly equipped with a warning horn, must be used with this outboard. This warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

Oil Injection Pump

Oil Pump Removal

1. Disconnect and plug inlet hose to oil pump.
2. Disconnect outlet hose on oil pump.
3. Disconnect link arm from oil pump injection arm.
4. Remove two bolts securing oil pump to powerhead and remove pump.



51702

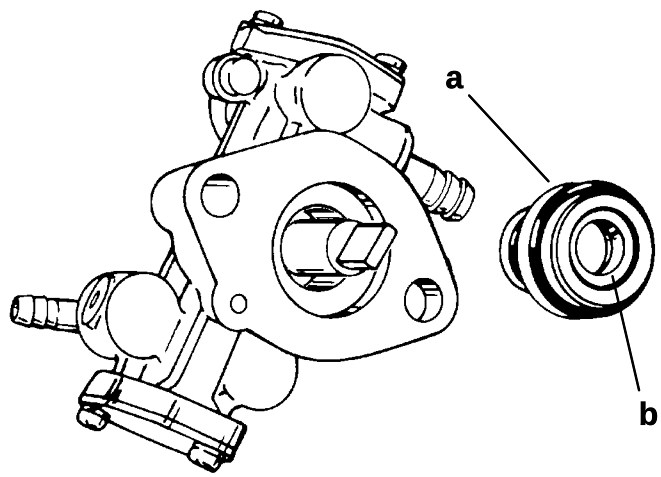
a - Inlet Hose
b - Outlet Hose
c - Link Arm
d - Injection Arm
e - Bolts
f - Oil Pump

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.*

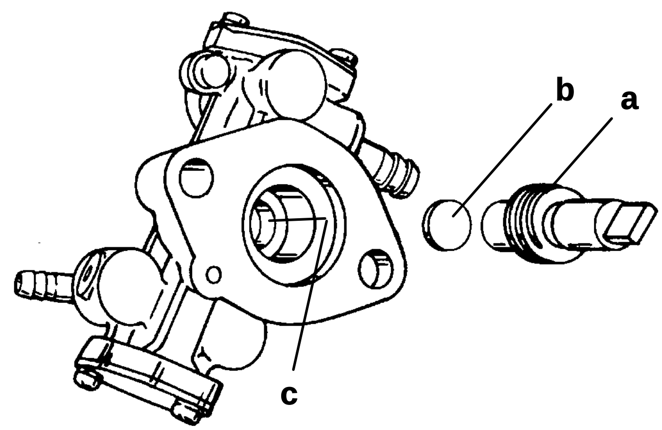


52356

a - Bushing
b - Seal

Worm Bushing Installation

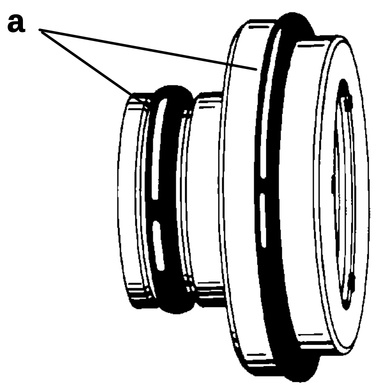
IMPORTANT: If worm shaft is removed from oil pump with worm bushing, verify thrust washer is positioned in center of worm shaft pocket before reinstalling worm shaft.



52316

a - Worm Shaft
b - Thrust Washer
c - Pocket

2. Inspect bushing O-rings for cuts and abrasions. Replace O-rings if necessary.



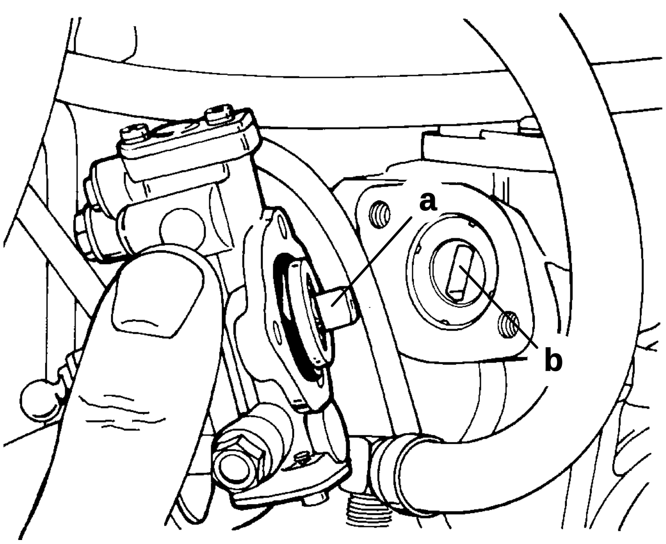
51782

a - O-rings

3. Reinstall bushing/seal assembly.

Oil Injection Pump Installation

1. Align oil pump worm shaft with coupler in powerhead.



51782

a - Worm Shaft
b - Coupler

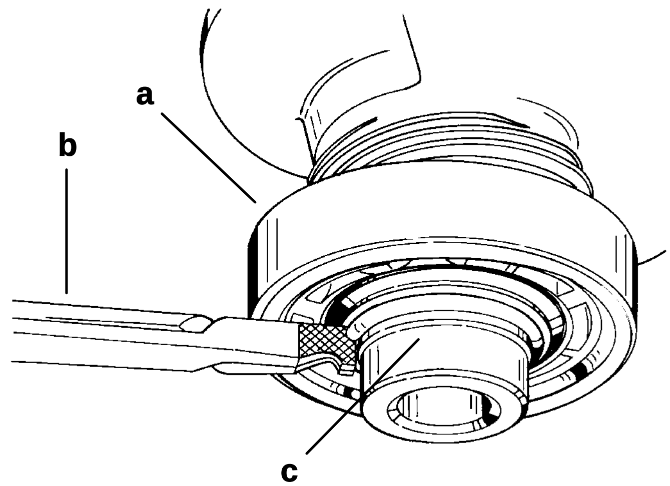
2. Secure oil pump to powerhead. Torque bolts to 55 lb. in. (6.2 N·m).
3. Connect inlet and outlet hoses to oil pump. Secure hoses with clamps.
4. Connect link arm to oil pump arm.
5. Prior to starting outboard, refer to "**BLEEDING AIR FROM OIL INJECTION PUMP**" and "**ADJUSTING OIL INJECTION PUMP**" Section 7.

Installing Drive Gear (for Oil Injection Pump) Onto Crankshaft

IMPORTANT: The removal of the oil pump drive gear from the crankshaft requires that the lower crankshaft ball bearing be removed first. The removal process of this bearing will normally damage the bearing thus requiring its replacement. DO NOT remove the oil pump drive gear unless it is damaged.

REMOVAL OF DRIVE GEAR

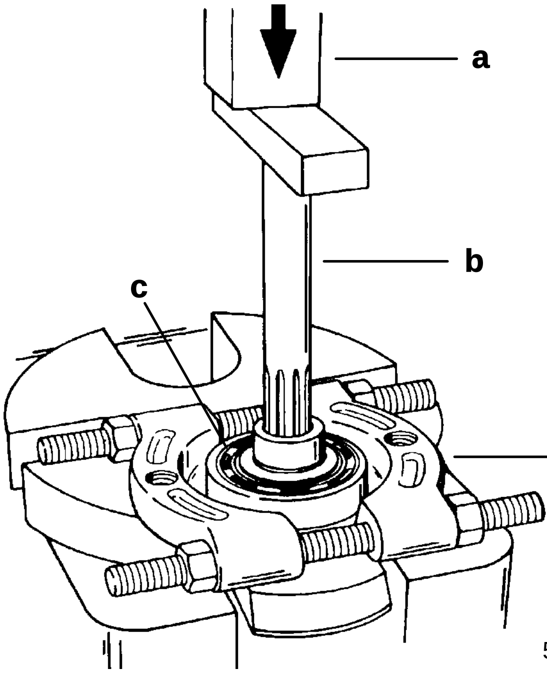
1. Remove lower ball bearing from crankshaft as follows:
   a. Remove retaining ring using a pair of snap ring pliers.



52319

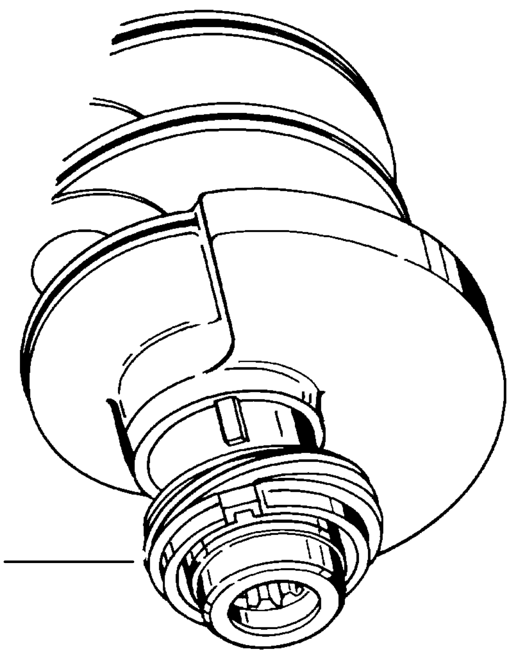
a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring

b. Press crankshaft out of lower ball bearing as shown.



a - Press
b - Powerhead Stand (91-30591A1)
c - Crankshaft Ball Bearing
d - Universal Puller Plate (91-37241)

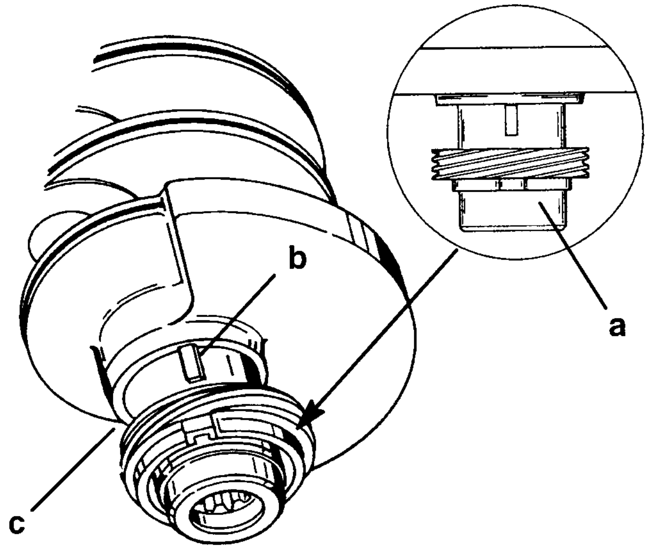
2. Slide oil pump drive gear off of crankshaft.



a - Oil Pump Drive Gear

INSTALLATION OF NEW DRIVE GEAR

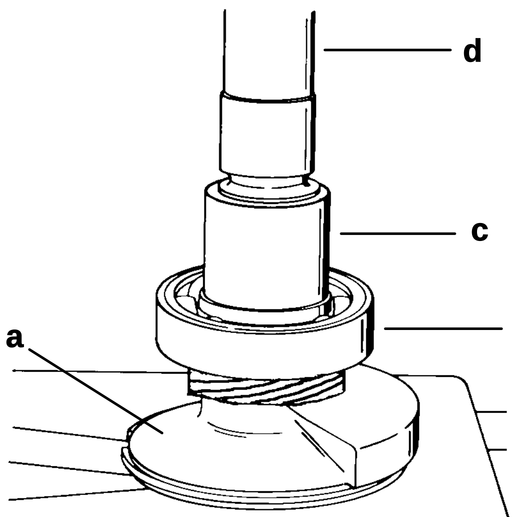
1. Slide oil pump drive gear (flange facing down) onto crankshaft. Align slot in gear with keyway on crankshaft. Seat gear against counter weight shoulder.



a - Flange (Faces Down Towards Ball Bearing)
b - Keyway
c - Shoulder

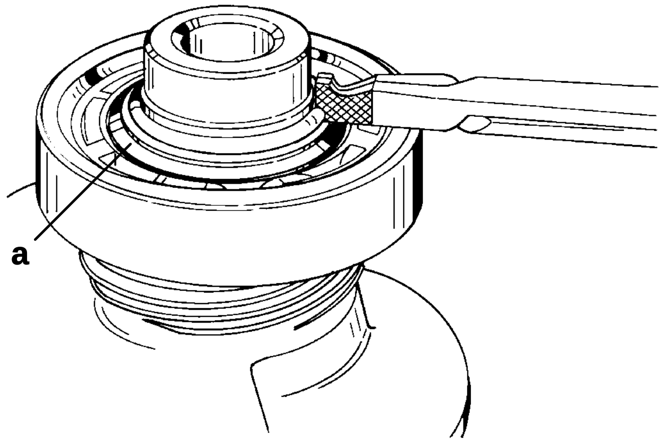
IMPORTANT: If lower drive shaft ball bearing has been removed, it is recommended that a new bearing be installed as the removal process will damage the bearing.

2. If removed, press new lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against shoulder.



a - Crankshaft
b - Crankshaft Ball Bearing
c - Suitable Mandrel
d - Press

3. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



52319

a - Retaining Ring

Oil Injection System Trouble Shooting Chart

TROUBLE SHOOTING THE OIL INJECTION SYSTEM

If a problem occurs with the oil injection system and the warning horn sounds in a pulsating manner, stop engine and check if problem is caused by (1) low oil level or (2) a faulty warning sensor.

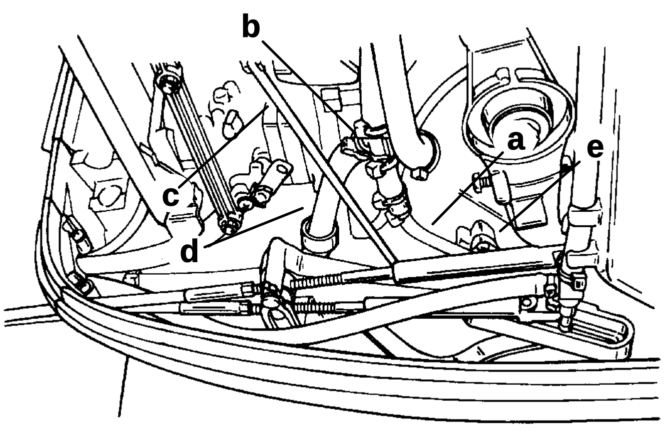
1. Open the cowling on engine and check oil level in engine reservoir tank. If oil is not to the top of tank, the problem is low oil. There is a safety reserve of oil left in the reservoir after the low oil warning is sounded that allows you enough oil for 30 to 40 minutes of full throttle operation. Refer to troubleshooting chart to correct the problem.

Problem: Oil Level in Engine Oil Reservoir Tank is Low But Not Low in Remote Oil Tank.	
Possible Cause	**Corrective Action**
Fill cap is leaking air on the remote tank.	Make sure O-rings or gaskets are in place and caps are tight.
Quick disconnect on remote oil tank is not fully connected.	Re-connect
Remote oil hose (blue stripe) is blocked.	Check length of hose for a kink.
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for a kink or leakage.
Remote pulse hose check valve is faulty (this valve is located at the engine end of the hose).	Replace check valve.
A restricted oil outlet filter in the remote tank.	Remove filter and clean.
Air leak in upper portion of oil pickup tube.	Replace tube.
Problem: Warning Horn Does Not Sound When Ignition Key is Turned to “ON” Position.	
Possible Cause	**Corrective Action**
Horn malfunction or open (TAN) wire between horn and engine.	Use a jumper wire to ground TAN lead (at engine terminal block) to engine ground. Warning horn should sound. If not, check TAN wire between horn and engine for open circuit and check horn.
Electronic Control Module (ECM)	Check if all ECM leads are connected to harness leads. If so, ECM may be faulty.
Using incorrect side mount remote control or ignition/choke assembly.	Refer to Section 7.
Open circuit on PURPLE wire going to (+) terminal of horn.	Check for battery voltage at (+) terminal of horn when ignition key is turned on.

Problem: Warning Horn Stays on When Ignition Key is Turned to "ON" Position.	
Possible Cause	**Corrective Action**
Engine overheat sensor	If horn sounds a continuous signal, the engine overheat sensor may be faulty. Disconnect overheat sensor and turn ignition key to "ON" position. If horn still sounds a continuous signal, the ECM is faulty. Replace ECM and re-test. If signal does not sound, then engine overheat sensor is faulty. Replace and re-test.
Electronic Control Module (ECM)	Check connections – replace ECM.
Problem: Warning Horn sounds when Engine is Running and Oil Level in Engine Reservoir is Full.	
Possible Cause	**Corrective Action**
Defective low oil sensor	Disconnect both low oil sensor leads from terminal connectors. connect an ohmmeter between leads. There should be NO continuity through sensor. If continuity exists, sensor is faulty.

Oil Pump Volume (Flow) Test

NOTE: *The following specifications are determined with the outboard running off a remote fuel supply with pre-mix fuel. The oil pump output hose (clear) must be disconnected from the input fuel line TEE fitting and directed into a graduated container. The input fuel line TEE fitting from which the oil line was removed MUST BE CAPPED OFF to prevent fuel leakage while the engine is running.*



52189

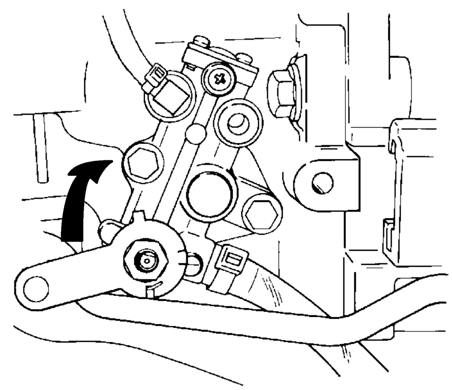
a - Oil Pump Output Hose (Clear)
b - Tee Fitting
c - Link Arm
d - Input Fuel Line
e - Oil Pump

Flow specifications are as follows:

225/250 Model:

@ 1500 RPM with oil pump link arm ATTACHED = 6.8cc ± 10% in 3 MINUTES.

@ 1500 RPM with oil pump link arm DISCONNECTED and PUMP ARM ROTATED FULL CLOCKWISE AND HELD AGAINST PUMP CASTING = 31.5cc ± 10% in 3 MINUTES.



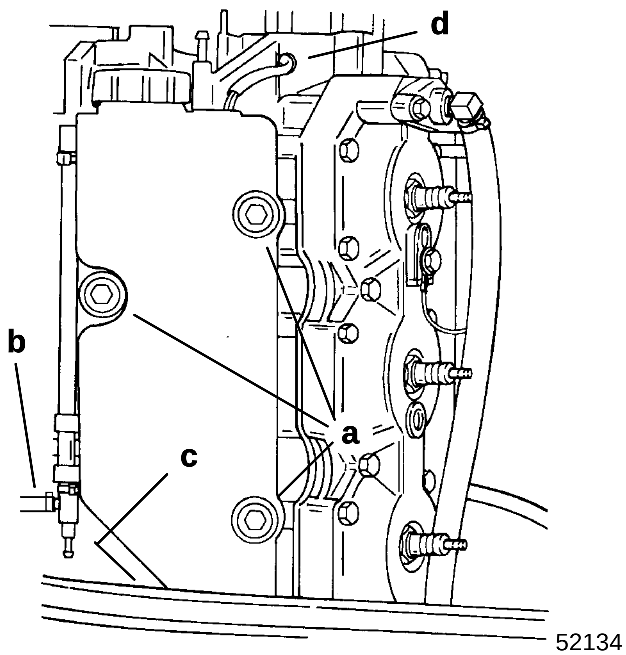
51702

Engine Mounted Oil Reservoir

REMOVAL

NOTE: *If oil reservoir contains oil, the clear oil hose going to the oil pump should be plugged upon removal to prevent oil spillage.*

1. Disconnect input oil hose to oil reservoir.
2. Disconnect LIGHT BLUE leads from their respective connections.
3. Disconnect clear input hose to oil pump and plug off hose.
4. Remove three bolts securing oil reservoir to powerhead and remove reservoir.

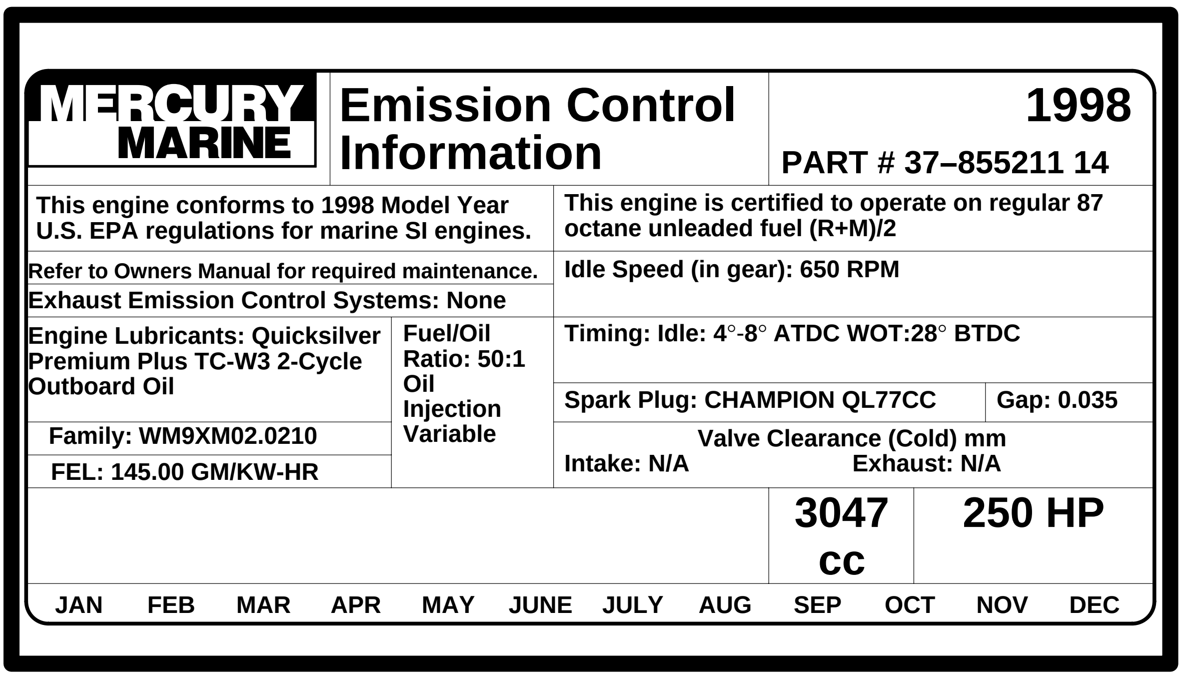


a - Bolts
b - Input Oil Hose
c - Oil Pump Output Hose (Clear)
d - LIGHT BLUE Leads

INSTALLATION

1. Secure oil reservoir to powerhead with 3 bolts. Torque bolts to 14 lb. ft. (19.0 N·m).
2. Reconnect input oil hose to oil reservoir and secure with sta-strap.
3. Reconnect LIGHT BLUE leads to their respective bullet connectors.
4. Connect clear output hose from oil reservoir to oil pump. Secure hose with sta-straps.

FUEL SYSTEMS



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 U.S.

What Are Emissions?

Emissions are what comes out of the exhaust system in the exhaust gas when the engine is running. They are formed as a result of the process of combustion or incomplete combustion. To understand exhaust gas emissions, remember that both air and fuel are made of several elements. Air contains oxygen and nitrogen among other elements; gasolene contains mainly hydrogen and carbon. These four elements combine chemically during combustion. If combustion were complete, the mixture of air and gasoline would result in these emissions: water, carbon dioxide and nitrogen, which are not harmful to the environment. But combustion is not usually complete. Also, potentially harmful gases can be formed during and after combustion.

All marine engines must reduce the emission of certain pollutants, or potentially harmful gases, in the exhaust to conform with levels legislated by the EPA. Emissions standards become more stringent each year. Standards are set primarily with regard to three emissions: hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx).

Hydrocarbons – HC

Gasoline is a hydrocarbon fuel. The two elements of hydrogen and carbon are burned during combustion in combination with oxygen. But they are not totally consumed. Some pass through the combustion chamber and exit the exhaust system as unburned gases known as hydrocarbons.

Carbon Monoxide – CO

Carbon is one of the elements that make up the fuel burned in the engine along with oxygen during the combustion process. If the carbon in the gasoline could combine with enough oxygen (one carbon atom with two oxygen atoms), it would come out of the engine in the form of carbon dioxide (CO_2). CO_2 is a harmless gas. But carbon often combines with insufficient oxygen (one carbon atom with one oxygen atom). This forms carbon monoxide, CO. Carbon monoxide is the product of incomplete combustion and is a dangerous, potentially lethal gas.

Oxides of Nitrogen - NOx

NOx is a slightly different byproduct of combustion. Nitrogen is one of the elements that makes up the air going into the engine. Under extremely high temperatures it combines with oxygen to form oxides of nitrogen (NOx). This happens in the engine's combustion chambers when temperatures are too high. NOx itself is not harmful, but when exposed to sunlight it combines with unburned hydrocarbons to create the visible air pollutant known as smog. Smog is a serious problem in California as well as many other heavily populated areas of the United States.

Controlling Emissions

There are two principle methods of reducing emissions from a two-stroke-cycle marine engine. The first method is to control the air/fuel ratio that goes into the combustion chamber. The second is to control the time when this air/fuel mixture enters the combustion chamber. Timing is important, to prevent any unburned mixture from escaping out of the exhaust port.

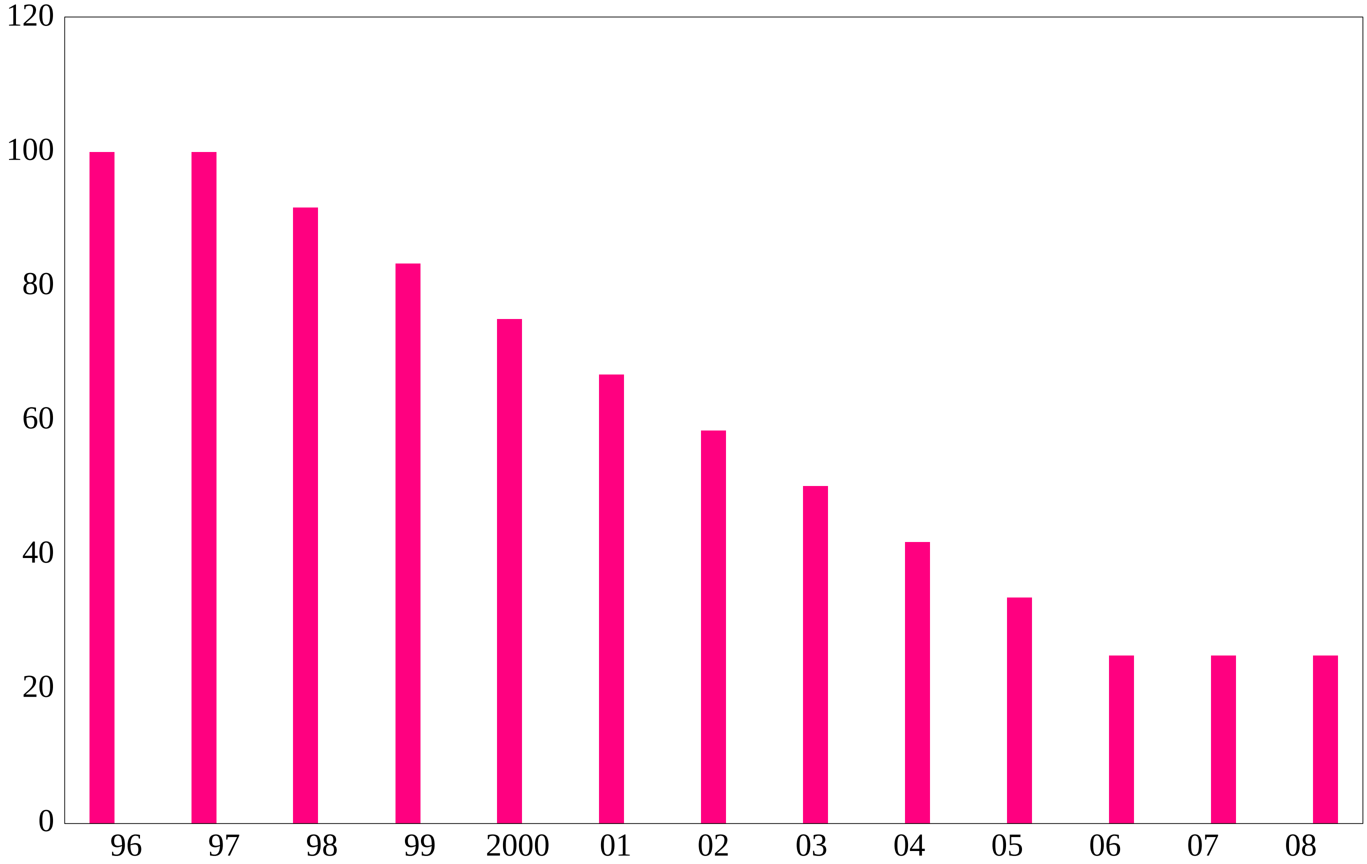
Stoichiometric (14.7:1) Air/Fuel Ratio

In the search to control pollutants and reduce exhaust emissions, engineers have discovered that they can be reduced effectively if a gasoline engine operates at an air/fuel ratio of 14.7:1. the technical term for this ideal ratio is stoichiometric. An air/fuel ratio of 14.7:1 provides the best control of all three elements in the exhaust under almost all conditions. The HC and CO content of the exhaust gas is influenced significantly by the air/fuel ratio. At an air/fuel ratio leaner than 14.7:1, HC and CO levels are low, but with a ratio richer than 14.7:1 they rise rapidly. It would seem that controlling HC and CO by themselves might not be such a difficult task; the air/fuel ratio only needs to be kept leaner than 14.7:1. However, there is also NOx to consider.

As the air/fuel ratio becomes leaner, combustion temperatures increase. Higher combustion temperatures raise the NOx content of the exhaust. But, enrichening the air/fuel ratio to decrease combustion temperatures and reduce NOx also increases HC and CO, as well as lowering fuel economy. So the solution to controlling NOx - as well as HC and CO - is to keep the air/fuel ratio as close to 14.7:1 as possible.

OUTBOARD HYDROCARBON EMISSIONS REDUCTIONS

8 1/3% ↓ PER YEAR OVER 9 MODEL YEARS



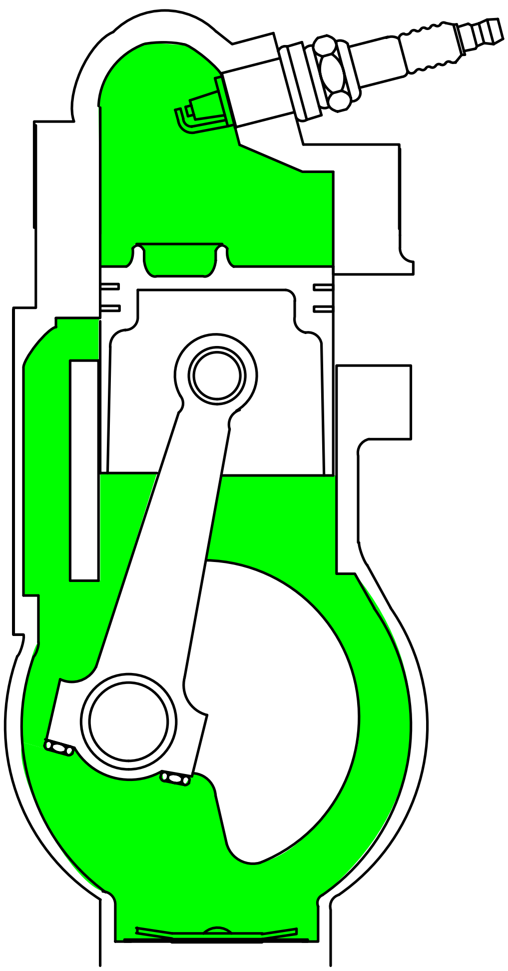
STRATIFIED VS HOMOGENIZED CHARGE

DFI engines use a stratified charge inside the combustion chamber to aid in reducing emissions. All other models use a homogenized charge. The difference between the two is:

Homogenized Charge

A homogenized charge has the fuel/air particles mixed evenly throughout the cylinder. This mixing occurs inside the carburetor venturi, reed blocks and crankcase. Additional mixing occurs as the fuel is forced through the transfer system into the cylinder.

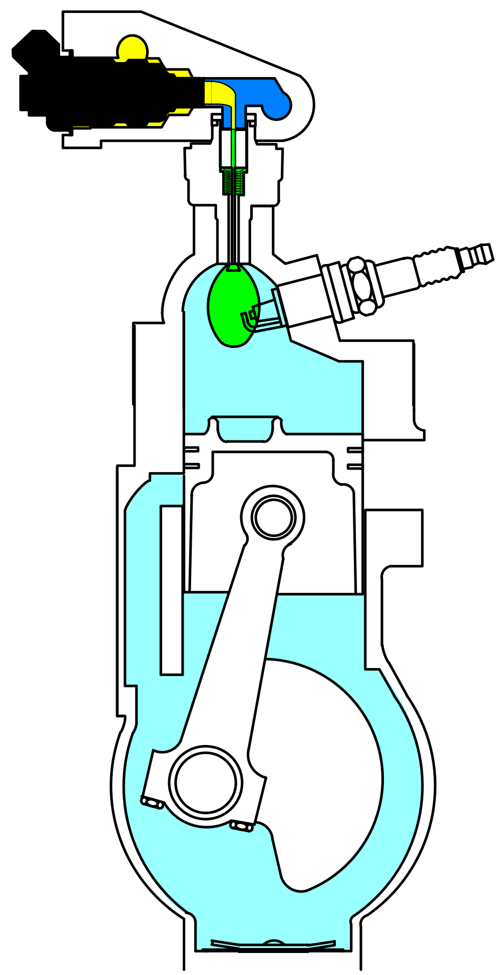
The homogenized charge is easy to ignite as the air/fuel ratio is approximately 14.7:1.



Stratified Charge

A stratified charge engine only pulls air through the transfer system. The fuel required for combustion is forced into the cylinder through an injector placed in the top of the cylinder (head). The injector sprays a fuel/air mixture in the form of a bubble into the cylinder. Surrounding this bubble is air supplied by the transfer system. As the bubble is ignited and burns, the surrounding air provides almost complete combustion before the exhaust port opens.

A stratified charge is hard to ignite, the fuel/air bubble is not evenly mixed at 14.7:1 and not easily ignited.



Emissions Information

Manufacturer's Responsibility:

Beginning with 1998 model year engines, manufacturers of all marine propulsion engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States Environmental Protection Agency (EPA). A certification decal/emissions control information label, showing emission levels and engine specifications directly related to emissions, **must** be placed on each engine at the time of manufacture.

Dealer Responsibility:

When performing service on all 1998 and later outboards that carry a certification, attention must be given to any adjustments that are made that affect emission levels.

Adjustments must be kept within published factory specifications.

Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.

Dealers are **not** to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturers prescribed changes, such as that for altitude adjustments.

Owner Responsibility:

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is **not** to modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Exceptions:

- Carburetor jets may be changed for high altitude use in accordance with factory recommendations.
- Single engine exceptions may be allowed with permission from the EPA for racing and testing.

EPA Emission Regulations:

All new 1998 and later outboards manufactured by Mercury Marine are certified to the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new outboard motors. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA laws on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

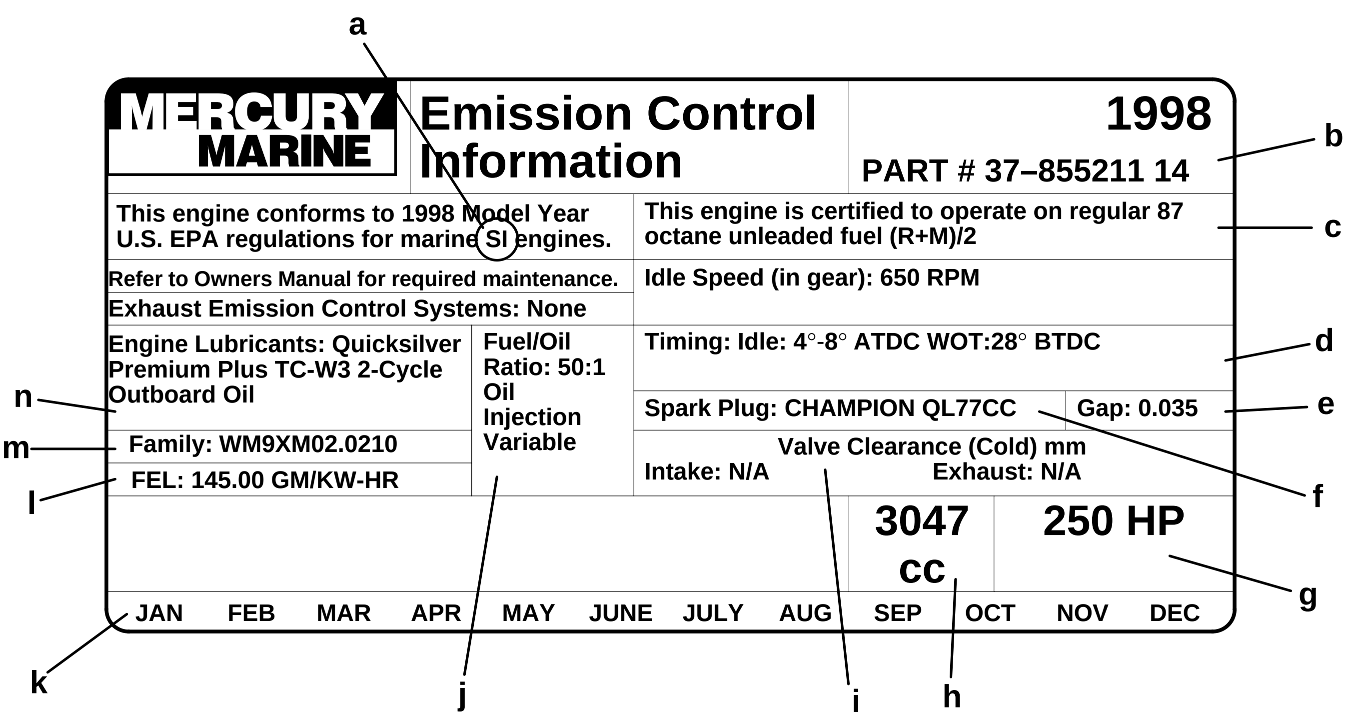
VIA U.S. POSTAL SERVICE:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

VIA EXPRESS or COURIER MAIL:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
501 3rd St. NW
Washington, DC 20001

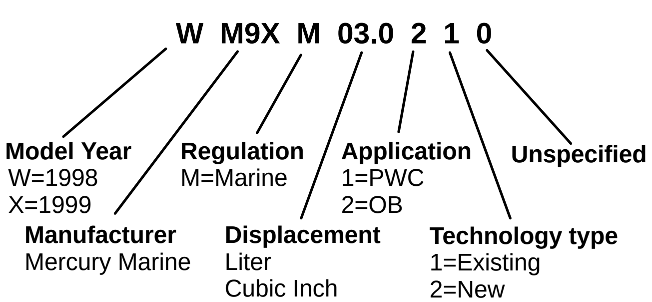
EPA INTERNET WEB SITE:
http:/www.epa.gov/omswww

CERTIFICATION LABEL:

The certification label must be placed on each engine at the time of manufacture and must be replaced in the same location if damaged or removed. Shown below is a typical certification label and is not representative of any one model. Label shown below is not to scale; (shown at twice the normal size).



a - Spark Ignition (SI)
b - Model year of engine and production decal part number
c - Type and octane of fuel used to establish emission levels
d - Timing specifications when adjustable
e - Spark plug gap in thousandths of an inch
f - Recommended spark plug for best engine performance
g - Engine Horsepower rating
h - Cubic Centimeter
i - Valve Clearance (Four Stroke engines only)
j - Recommended oil/fuel ratio for best engine performance and minimal emissions
k - Month of production (Boxing month will punched)
l - FEL: Represents (Mercury Marine) statement of the maximum emissions output for the engine family
m - Family example:



n - Engine lubricants recommended by the manufacturer

Decal Location for 1998 Models:

Model	Production Part No.	Service Part No.	Location on Engine
Merc/Mar 3.0 L V6 EFI/ Carb (225 – 250 H.P.)	37-855211 14	37-855577 14	Vapor Separator (EFI) Air Cover (Carb)

POWERHEAD

4

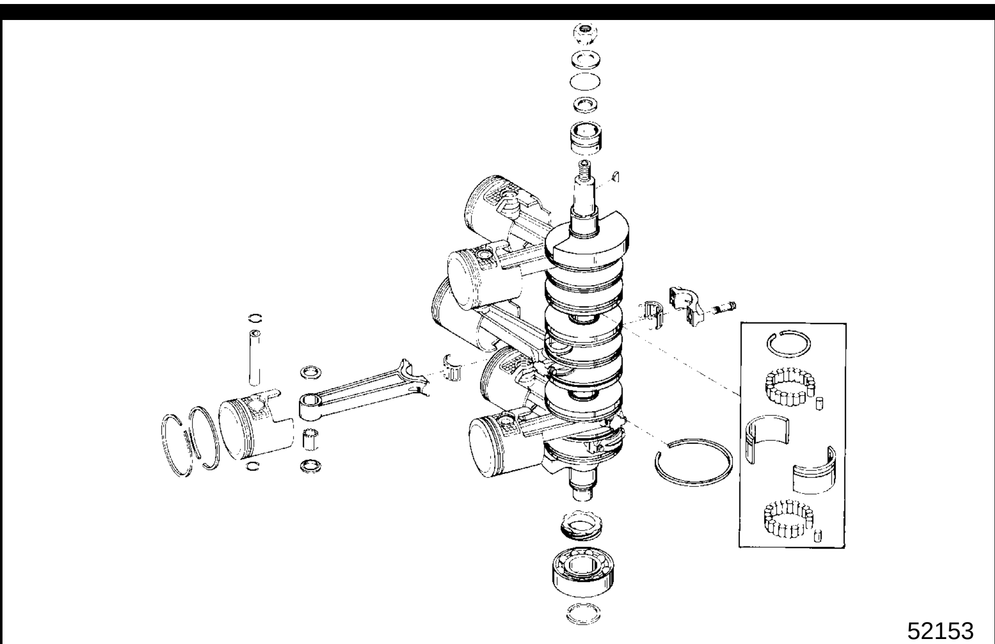


Table of Contents

Powerhead Specifications

Block

Type . . . . 60°V, 2 Cycle
Displacement . . . . 185.9 cu. in. (3047cc)

Reed Valve Opening

Opening (Max.) . . . . 0.020 in. (0.50mm)

Stroke

Length . . . . 3.00 in. (76.2mm)

Cylinder Bore

Dia. Standard . . . . 3.625 in. (92.1mm)
0.015 Oversize . . . . 3.640 in. (92.5mm)
0.030 Oversize . . . . 3.655 in. (92.8mm)

Taper/Out of Round Max. 0.003 in. (0.076mm)

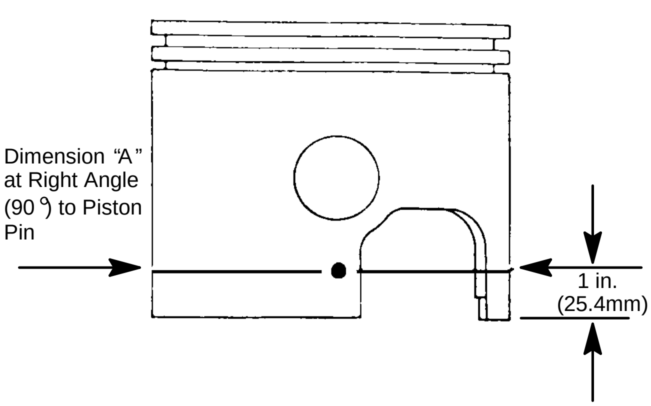
Piston

Dia. Standard . . . . 3.6210 in. ±.0005 in. (91.97mm ±.013mm)
0.015 Oversize . . . . 3.636 in. ±.0005 in. (92.35mm ±.013mm)
0.030 Oversize . . . . 3.666 in. ±.0005 in.) (93.1mm ±.013mm)

Compression

All Models – Using a fully charged battery, throttle shutters wide open and cylinder block warm – 90 – 110 psi (616.3 – 753.3 kPa) Variance between cylinders should not exceed 15 psi (102.7 kPa)

IMPORTANT: Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be 3.6210 in. ±.0005 for a STANDARD size piston.

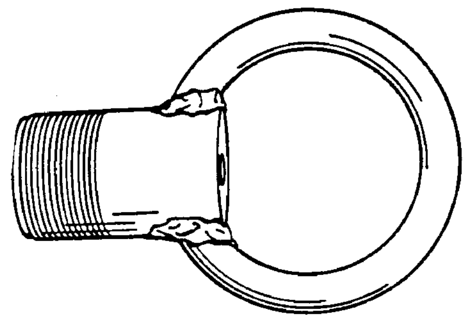


Piston Ring

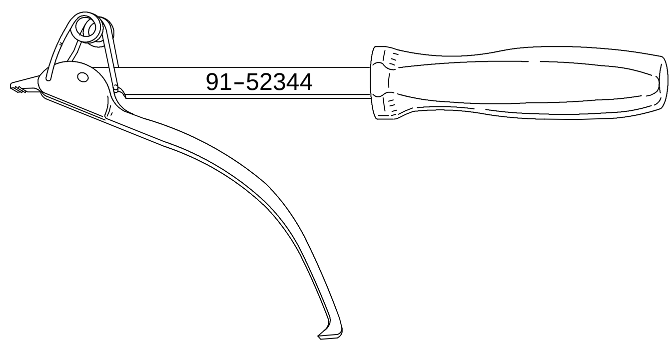
End Gap . . . . 0.010 in. to 0.018 in. (0.25mm to 0.46mm)

Special Tools

Lifting Eye 91-90455



Flywheel Holder 91-52344



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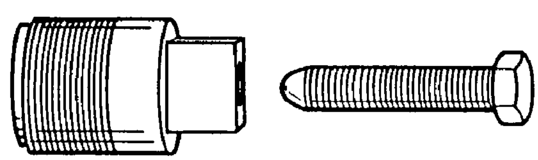
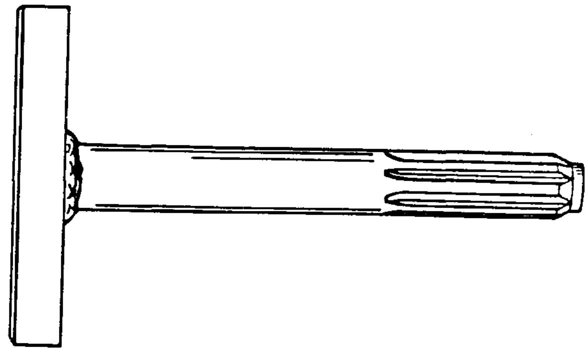
Protector Cap 91-24161

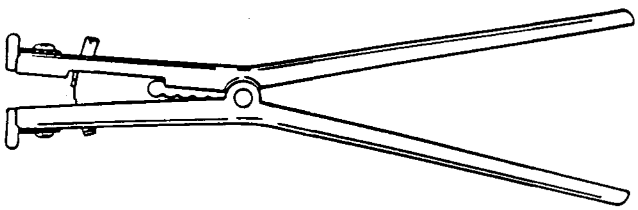
Flywheel Puller 91-73687A1



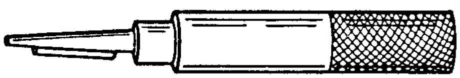
Powerhead Stand 91-30591A1



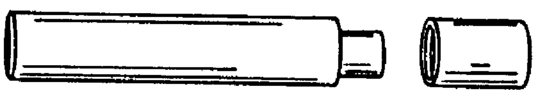
Piston Ring Expander 91-24697



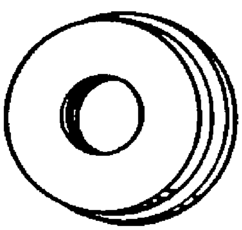
Lockring Removal Tool 91-52952A1



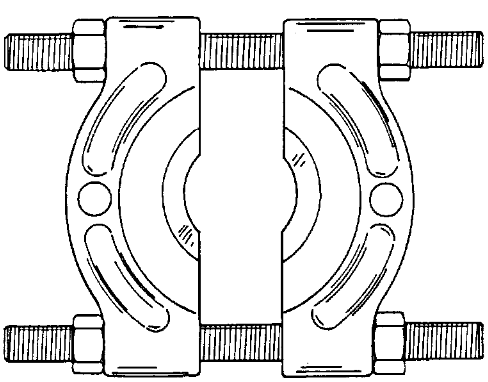
Piston Pin Tool 91-92973A1



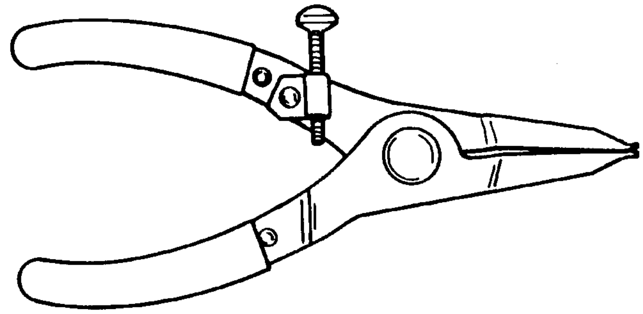
Driver Head 91-55919



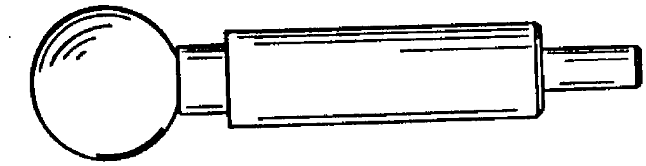
Universal Puller Plate 91-37241



Snap Ring Pliers 91-24283

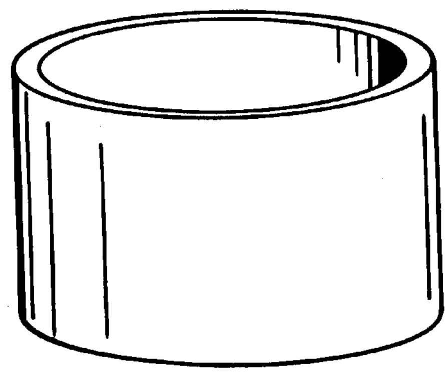


Lockring Installation Tool 91-91-93004A2

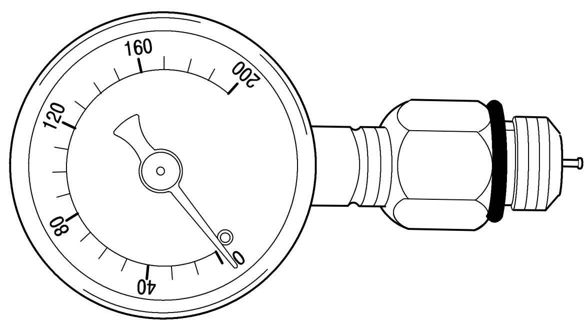


****Note:** If 3.4 Liter Piston Lock Ring Installer (91-93004A1) is available, then only Guide (91-93005-1) is required to install 3 Litre piston lock rings.*

Piston Ring Compressor 91-823237

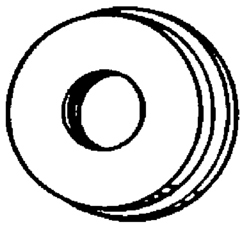


Compression Tester 91-29287

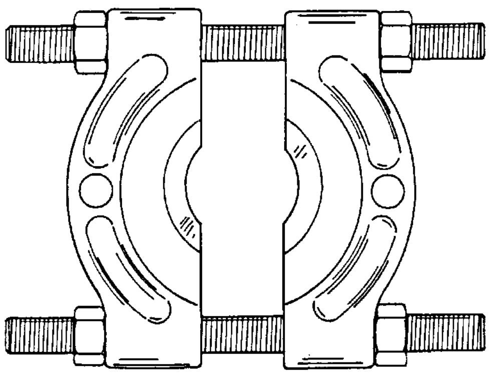


54965

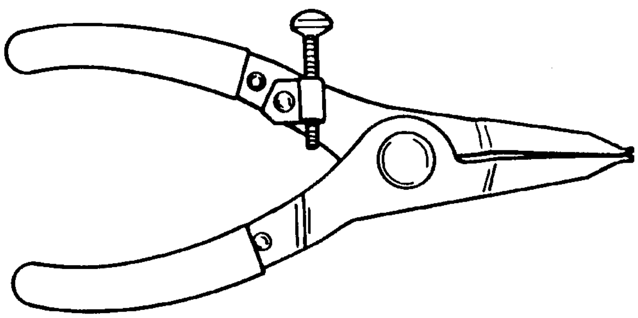
Driver Head 91-55919



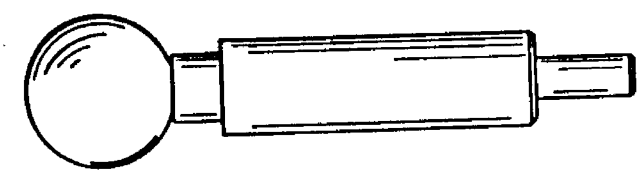
Universal Puller Plate 91-37241



Snap Ring Pliers 91-24283



Lockring Installation Tool 91-91-77109A1

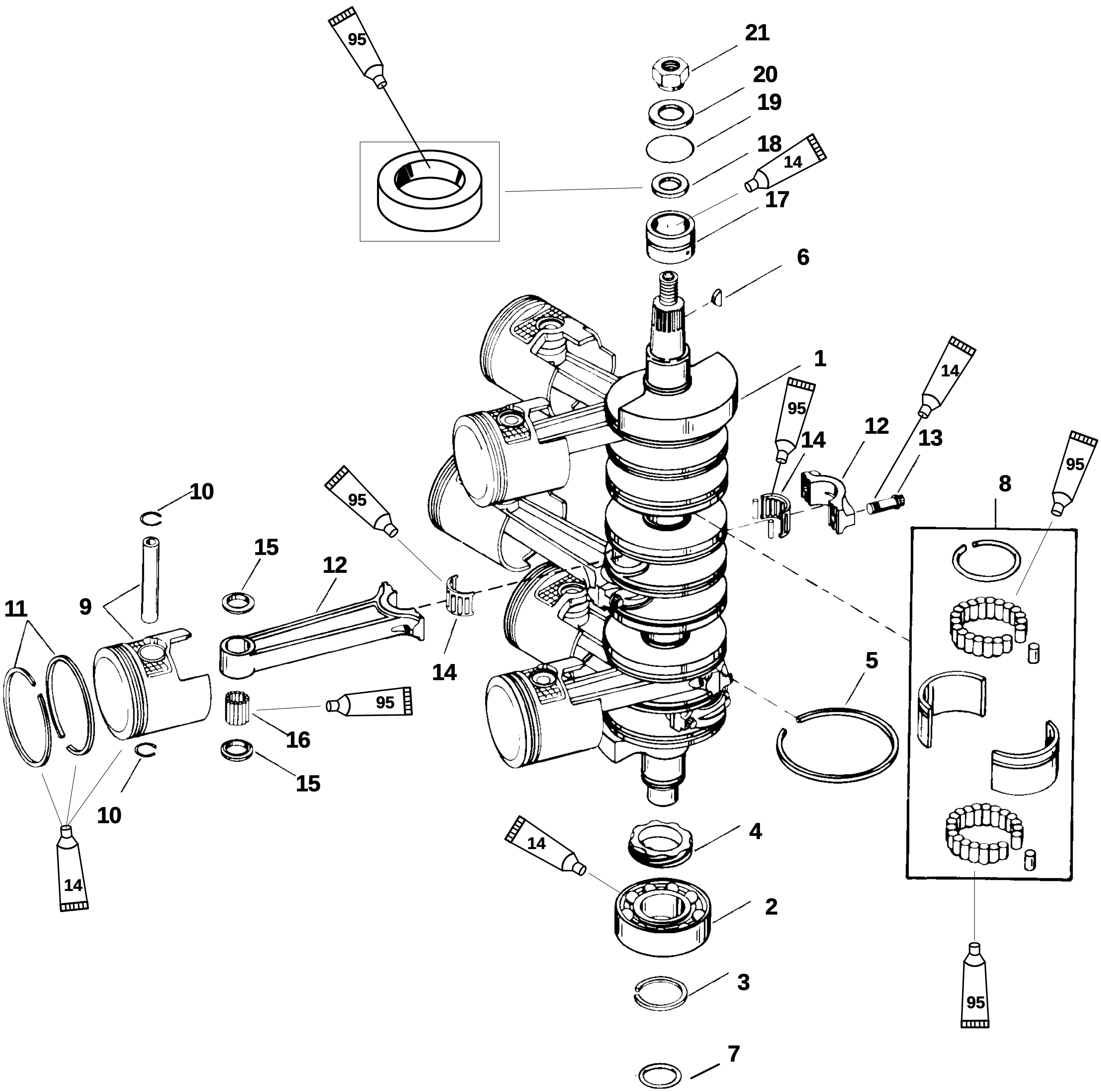


Powerhead Repair Stand

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

Crankshaft - Pistons - and Connecting Rods



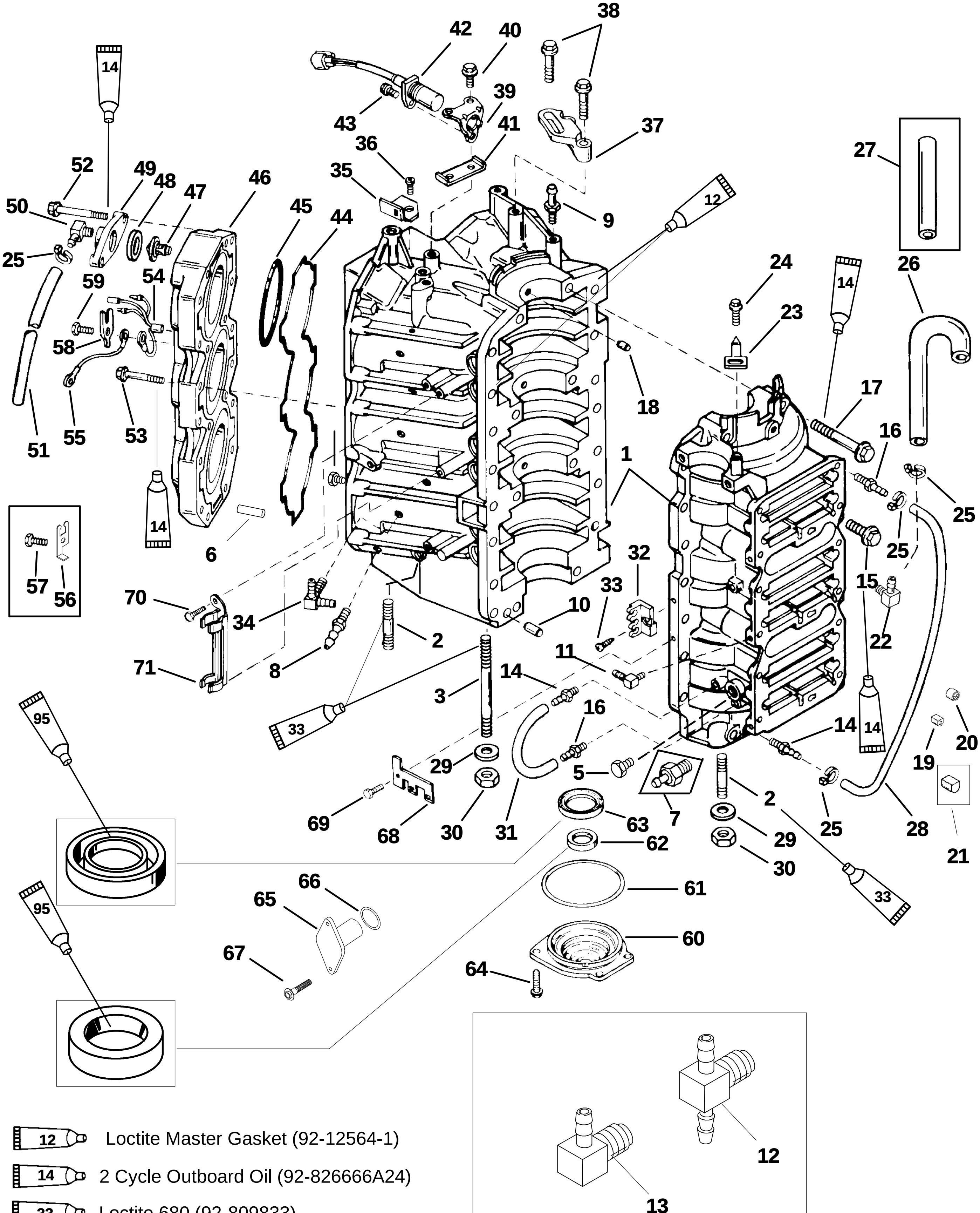
14 2 Cycle Outboard Oil (92-826666A24)

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

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	CRANKSHAFT **(8 TOOTH SPLINES)**			
1	1	CRANKSHAFT **(13 TOOTH SPLINES)**			
1	1	CRANKSHAFT			
2	1	BALL BEARING (LOWER)			
3	1	RETAINING RING			
4	1	DRIVER GEAR			
5	7	SEAL RING			
6	2	WOODRUFF KEY			
7	1	O RING			
8	2	BEARING RACE			
9	3	PISTON **(STBD-STANDARD)**			
9	3	PISTON **(PORT-STANDARD)**			
9	AR	PISTON **(STBD-.015 O/S)**			
9	AR	PISTON **(PORT-.015 O/S)**			
9	AR	PISTON **(STBD-.030 O/S)**			
9	AR	PISTON **(PORT-.030 O/S)**			
10	12	LOCK RING			
11	1	PISTON RING **(STANDARD)**			
11	AR	PISTON RING **(.015 O/S)**			
11	AR	PISTON RING **(.030 O/S)**			
12	6	CONNECTING ROD ASSEMBLY			
13	12	SCREW (1-1/4") **Important: It is recommended that connecting rod bolts be discarded after removal and new bolts be installed.**	Apply Light Oil to Threads and Bolt Face: 1st Torque - 15 lb. in. (1.7 N·m) 2nd Torque - 30 lb. ft. (41.0 N·m) Turn Bolt an Additional 90° after 2nd Torque is Attained.		
14	6	BEARING CAGE			
15	12	THRUST WASHER			
16	204	ROLLER BEARING			
17	1	MAIN BEARING (UPPER)			
18	1	OIL SEAL			
19	1	O RING			
20	1	WASHER			
21	1	NUT (M16 x 1.5)		125	170.0

S/N-0G129221 & BELOW (8 TOOTH SPLINES)
S/N-0G129222 THRU 0G303045 (13 TOOTH SPLINES)
NOTE: WHEN ORDERING REPLACEMENT POWERHEAD FOR ENGINES WITH S/N-0G178947 & BELOW, REFER TO SERVICE BULLETIN #94-11 AND ORDER EXHAUST PLATE KIT 818450A1, IF NECESSARY.

Cylinder Block and End Cap



12 — Loctite Master Gasket (92-12564-1)

14 — 2 Cycle Outboard Oil (92-826666A24)

33 — Loctite 680 (92-809833)

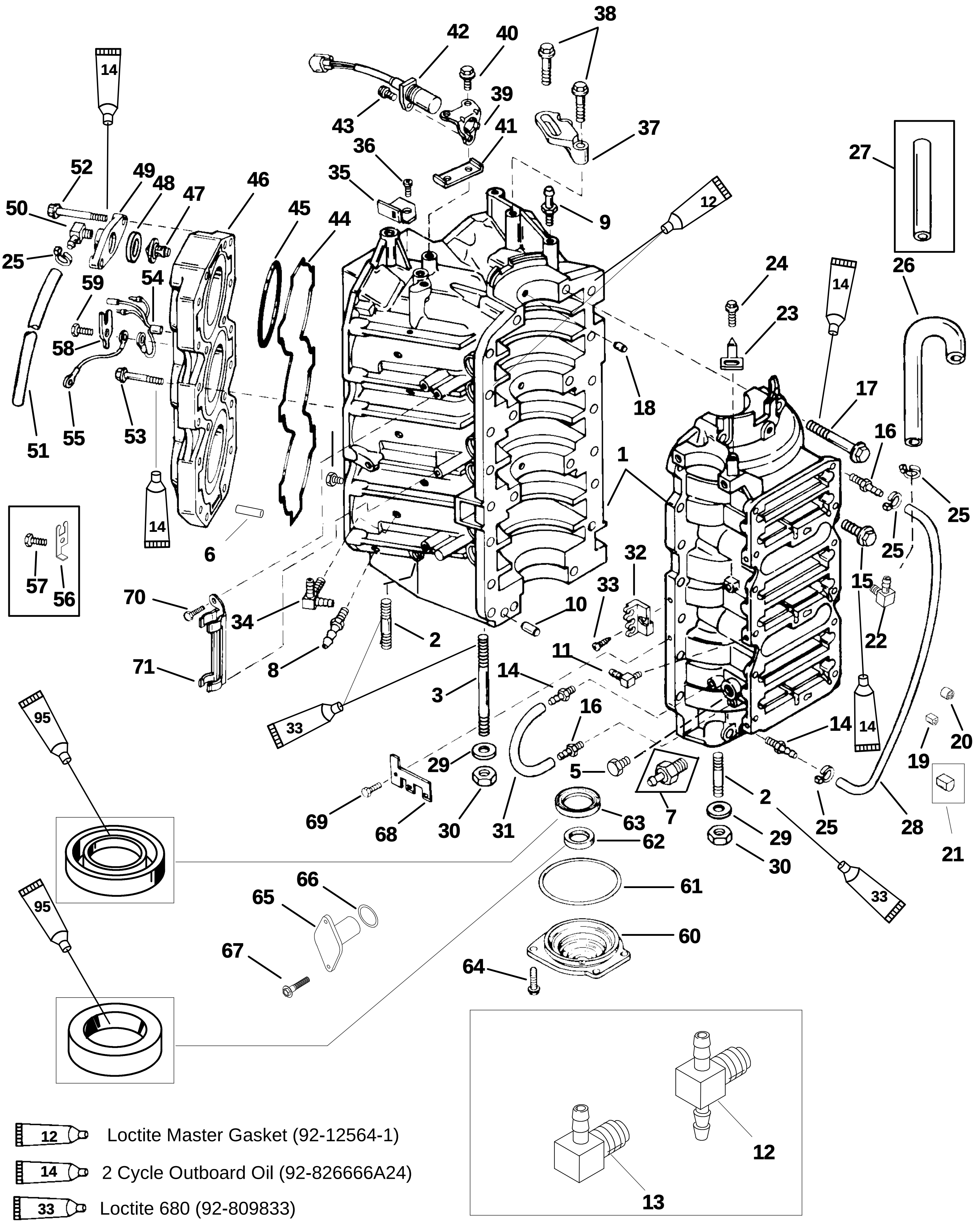
95 — 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	CYLINDER BLOCK **(S/N–0G129221 & BELOW)**			
	1	CYLINDER BLOCK **(S/N-0G129222 thru 0G437999)**			
	1	CYLINDER BLOCK **(S/N-0G438000 & UP)**			
2	4	STUD (M10 x 1.5 x 64)			
3	6	STUD (M10 x 1.5 x 155)			
4	1	PIPE PLUG (1/8 IN.)			
5	1	PIPE PLUG (1/4 IN.-18)**(SEAPRO/MARATHON)**			
6	4	WATER DEFLECTOR **(S/N-0G438000 & UP)**			
7	1	CHECK VALVE			
8	6	FITTING			
9	2	PIN			
10	1	DOWEL PIN			
11	6	FITTING **(S/N-0G437999 & BELOW)**			
	12	FITTING **(S/N-0G438000 thru 0G485988)**			
12	6	CHECK VALVE T-FITTING **S/N-0G485989 & UP**			
13	6	CHECK VALVE			
14	2	CHECK VALVE			
15	14	SCREW (M8 x 35)		21	29.0
16	2	CHECK VALVE			
17	8	SCREW (M10 x 1.5)		Note	
18	3	CENTER MAIN PIN			
19	1	CARRIER ASSEMBLY **(Includes 6 Carriers)**			
20	6	CHECK VALVE			
21	6	STOP PLUG **(S/N-0G438000 & UP)**			
22	1	ELBOW (W/Ref.#24)(**S/N–0G129222 &UP)**			
	1	ELBOW (45 degrees)**(S/N–0G129221 & BELOW)**			
23	1	TIMING POINTER			
24	1	SCREW (M6 x 1)	100		11.3
25	AR	STA-STRAP			
26	1	TUBING-MOLDED**(S/N–0G129222 & UP)**			
27	1	TUBING (9-1/4 IN.)**(S/N–0G129221 & BELOW)**			
28	1	TUBING (22-1/2 IN.)			
29	10	WASHER			
30	10	NUT		50	68.0
31	1	TUBING (4 IN.)**(S/N-0G437999 & BELOW)**			
	1	TUBING (3-3/4 IN.)**(S/N-0G438000 & UP)**			
32	2	RETAINER– check valve			

☞ = S/N–0G129222 & UP (13 TOOTH SPLINES)
☜ = S/N–0G129221 & BELOW (8 TOOTH SPLINES)
☜☞ = S/N–0G129222 THRU 0G437999 (13 TOOTH SPLINES)
✳ = NOTE: WHEN ORDERING REPLACEMENT POWERHEAD FOR ENGINES WITH S/N–0G178947 & BELOW, REFER TO SERVICE BULLETIN #94-11, AND ORDER EXHAUST PLATE KIT 818450A1 IF NECESSARY.

Note: Torque bolt to 30 lb. ft. (41.0 N·m) and rotate 90 degrees

Cylinder Block and End Cap



12 Loctite Master Gasket (92-12564-1)

14 2 Cycle Outboard Oil (92-826666A24)

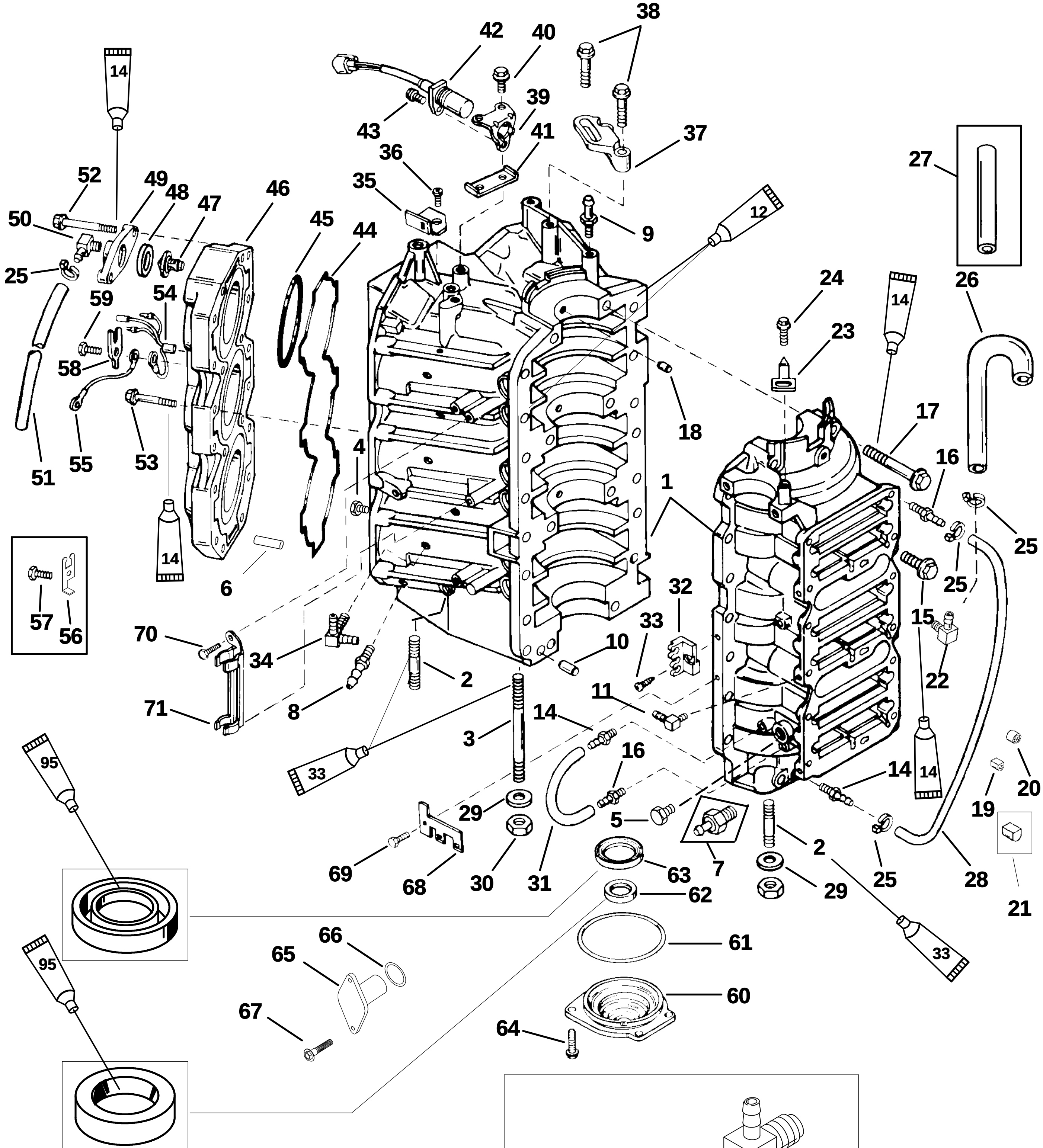
33 Loctite 680 (92-809833)

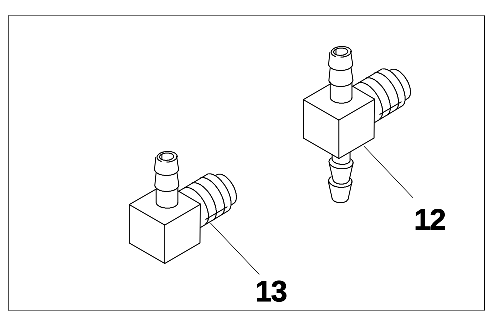
95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
33	2	SCREW (#10-16 x 1/2 IN.)	Drive Tight		
34	6	FITTING			
35	1	BRACKET **(S/N–0G129222 & UP)(SEAPRO/MARATHON)**			
	1	BRACKET **(S/N–0G129221 & BELOW)**			
36	1	SCREW (M6 x 1)	100		11.3
37	1	BRACKET– alternator			
38	2	SCREW (M8 x 50)		23	31.0
39	1	BRACKET			
40	2	SCREW (M6 x 1)	100		11.3
41	1	GUIDE BRACKET			
42	1	SENSOR			
43	1	SCREW (M5 x 10)	50		5.6
44	2	SEAL– cylinder head			
45	6	O RING			
46	2	CYLINDER HEAD **(SEAPRO/MARATHON)**			
	2	CYLINDER HEAD **(S/N–0G303045 & BELOW)**			
	2	CYLINDER HEAD **(S/N–0G303046 & UP)**			
47	2	THERMOSTAT (143 degrees)**(S/#-0G438000 & UP)**			
	2	THERMOSTAT (143 degrees)**(S/#-0G437999 & BELOW)**			
48	2	GASKET– thermostat			
49	2	COVER– thermostat			
50	2	ELBOW **(45 Degrees)** **USE WITH 45 DEGREE ELBOW**			
51	2	TUBING (19 IN.)(20-1/2 IN.)			
47	2	COVER– thermostat			
48	2	ELBOW **(90 Degrees)** **USE WITH 90 DEGREE ELBOW**			
49	2	TUBING (20 IN.)(21-1/2 IN.)			
52	4	SCREW (M8 x 90)	30 lb. ft. (41.0 N·m) and Rotate 90 deg.		
53	36	SCREW (M8 x 50)	20 lb. ft. (27.0 N·m) and Rotate 90 deg.		

☞ = S/N–0G129222 & UP (13 TOOTH SPLINES)
☜ = S/N–0G129221 & BELOW (8 TOOTH SPLINES)
⁎ = NOTE: WHEN ORDERING REPLACEMENT POWERHEAD FOR ENGINES WITH S/N–0G178947 & BELOW, REFER TO SERVICE BULLETIN #94-11, AND ORDER EXHAUST PLATE KIT 818450A1 IF NECESSARY.

Cylinder Block and End Cap





12 Loctite Master Gasket (92-12564-1)

14 2 Cycle Outboard Oil (92-826666A24)

33 Loctite 680 (92-809833)

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

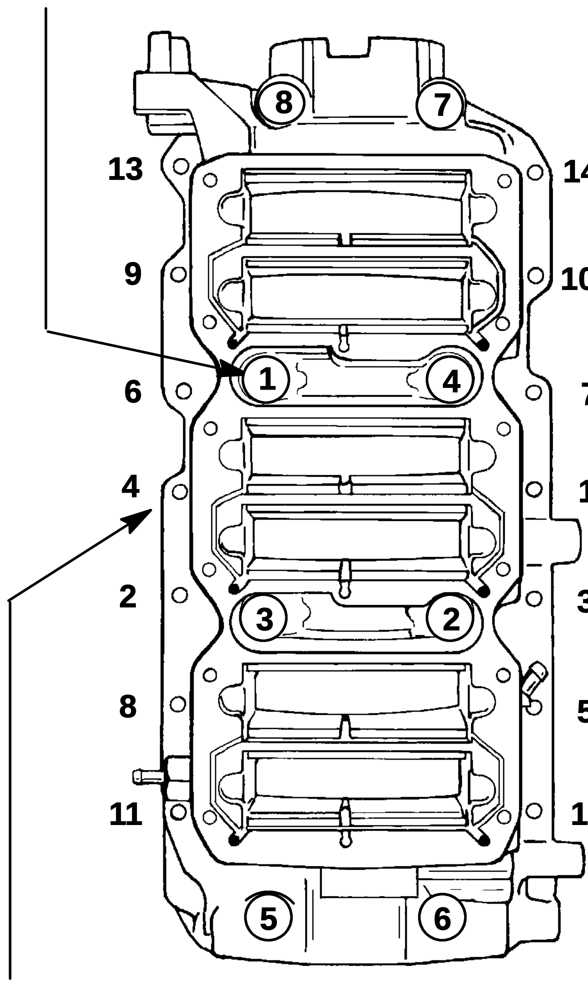
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
54	1	TEMPERATURE SENSOR **S/N-0G217420 & UP &**			
55	1	CABLE (Use where applicable) **SEAPRO/MARATHON**			
52	1	TEMPERATURE SENSOR **S/N-0G217419 & BELOW**			
53	1	CABLE			
56	1	SENSOR RETAINER **DESIGN I**			
57	1	SCREW (.375-16 x 1/2)			
58	1	SENSOR RETAINER **DESIGN II**			
59	1	SCREW (M8 x 12)	200	17.0	23.0
60	1	LOWER END CAP			
61	1	O RING **(S/N-0G303045 & BELOW)**			
62	2	OIL SEAL **See Service Bulletin 95-4**			
63	1	OIL SEAL			
58	1	LOWER END CAP			
59	1	O RING **S/N-0G303046 & UP**			
61	2	OIL SEAL			
64	4	SCREW (M6 x 1)	85		9.6
65	1	PLUG			
66	1	O RING **SEAPRO/MARATHON**			
67	2	SCREW (M5 x 20)			
68	1	BRACKET			
69	1	SCREW			
70	2	SCREW (M6 x 1)	100		11.3
71	1	CLAMP			

☞ **= S/N-0G129222 & UP (13 TOOTH SPLINES)**
☜ **= S/N-0G129221 & BELOW (8 TOOTH SPLINES)**
∗ **= NOTE: WHEN ORDERING REPLACEMENT POWERHEAD FOR ENGINES WITH S/N-0G178947 & BELOW, REFER TO SERVICE BULLETIN #94-11, AND ORDER EXHAUST PLATE KIT 818450A1 IF NECESSARY.**

Powerhead Torque Sequence and Torque Specifications

CRANKCASE COVER BOLTS
(AND TORQUE SEQUENCE)

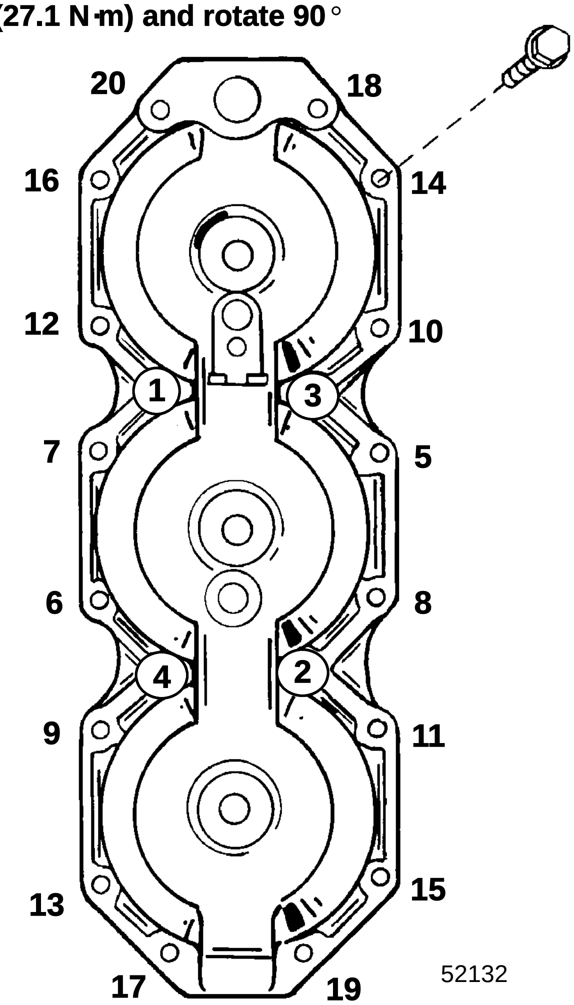
Add light oil to threads and bolt face:
8 Bolts (M10 x 1.5 x 80)
30 lb. ft. (40.5 N·m) and rotate 90°



14 Bolts (M8 x 1.25 x 35)
21.0 lb. ft. (28.5 N·m)

CYLINDER HEAD BOLTS
(AND TORQUE SEQUENCE)

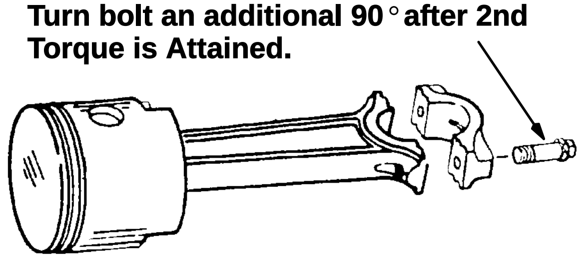
IMPORTANT
Add light oil to threads and bolt face:
Bolts 18 and 20 - Torque to 30 lb. ft. (40.5 N·m) and rotate 90°
All other bolts - Torque to 20 lb. ft. (27.1 N·m) and rotate 90°



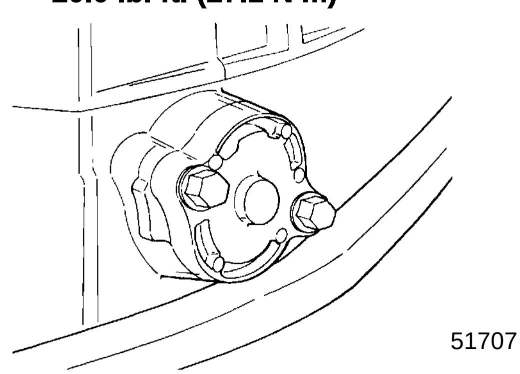
PISTON ROD BOLTS

IMPORTANT: IT IS RECOMMENDED THAT ROD BOLTS BE DISCARDED AFTER REMOVAL AND REPLACED WITH NEW BOLTS.

Apply light oil to threads and bolt face:
1st Torque - 15 lb. in. (1.7 N·m.)
2nd Torque - 30 lb. ft. (40.5 N·m.)
Turn bolt an additional 90° after 2nd Torque is Attained.



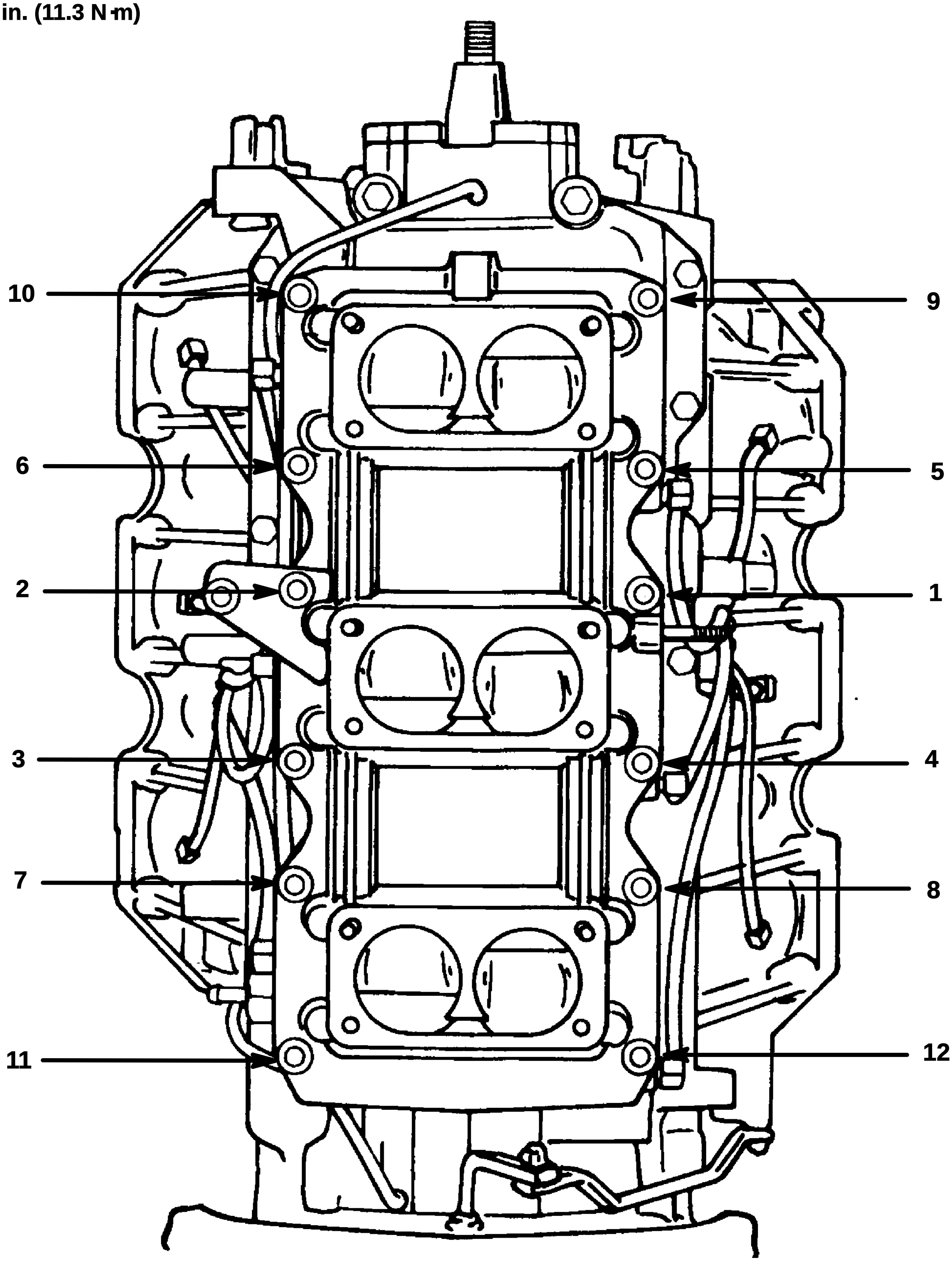
RELIEF VALVE COVER BOLTS
20.0 lb. ft. (27.1 N·m)



Powerhead Torque Sequence

Intake Manifold

100 lb. in. (11.3 N·m)



Notes:

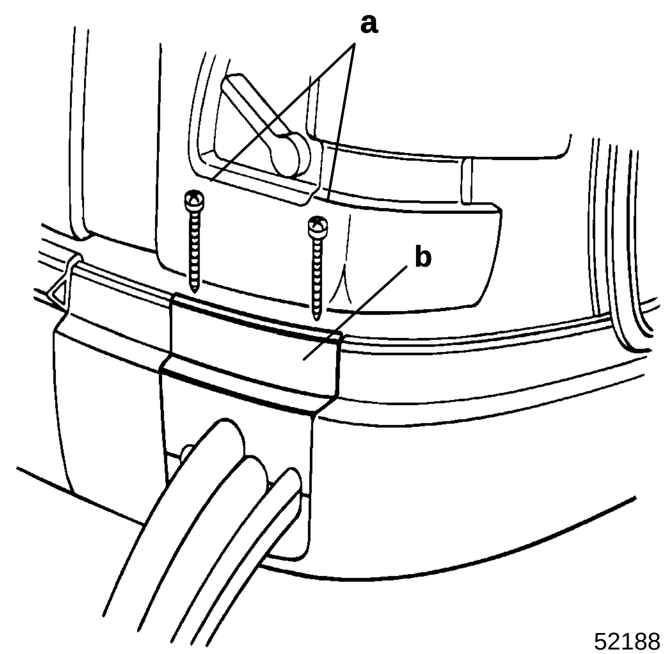
General Information

Powerhead "Disassembly" and "Reassembly" instructions are printed in a sequence that should be followed to assure best results when removing or replacing powerhead components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. (Refer to "Table of Contents," preceding.)

If major powerhead repairs are to be performed, remove powerhead from drive shaft housing. Removal of powerhead is not required for 1) inspection of cylinder walls and 2) minor repairs on components such as ignition system, carburetors, reed blocks, cylinder heads and checking operation of thermostats.

Powerhead Removal from Driveshaft Housing

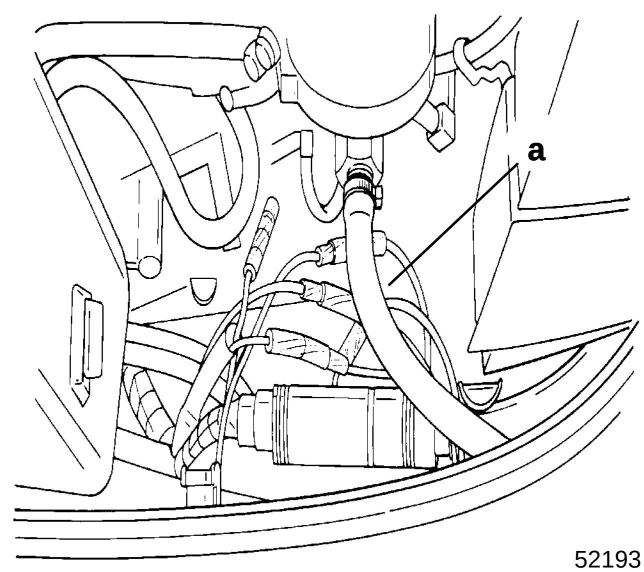
1. Disconnect battery cables from battery terminals.
2. Disconnect fuel tank hose from outboard.
3. Remove top cowling.
4. Remove two screws which secure remote control harness retainer and remove retainer.



52188

a - Screws
b - Retainer

5. Disconnect remote oil tank hose from pulse fitting.



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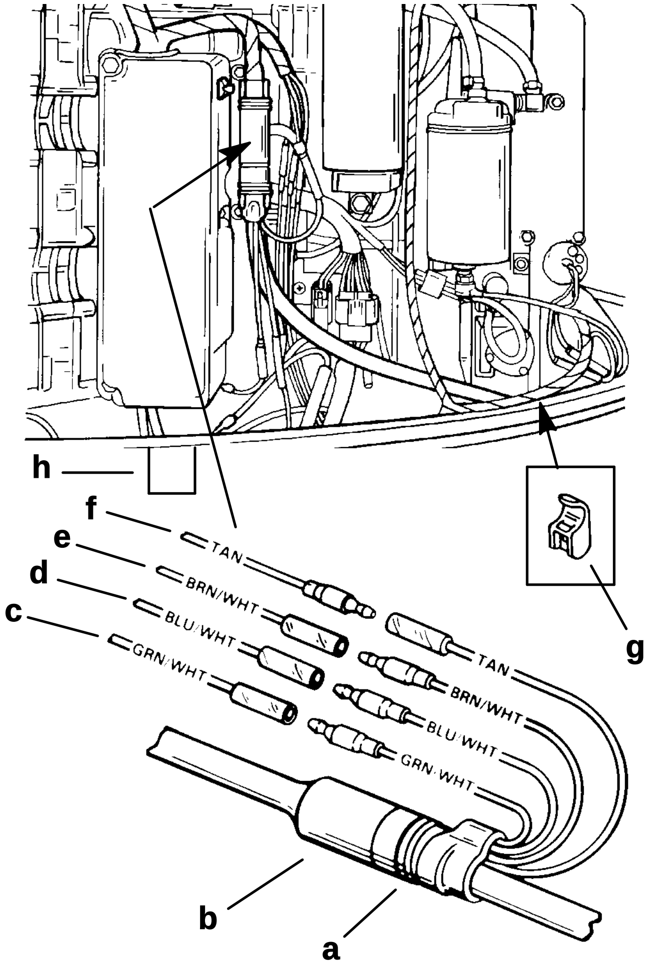
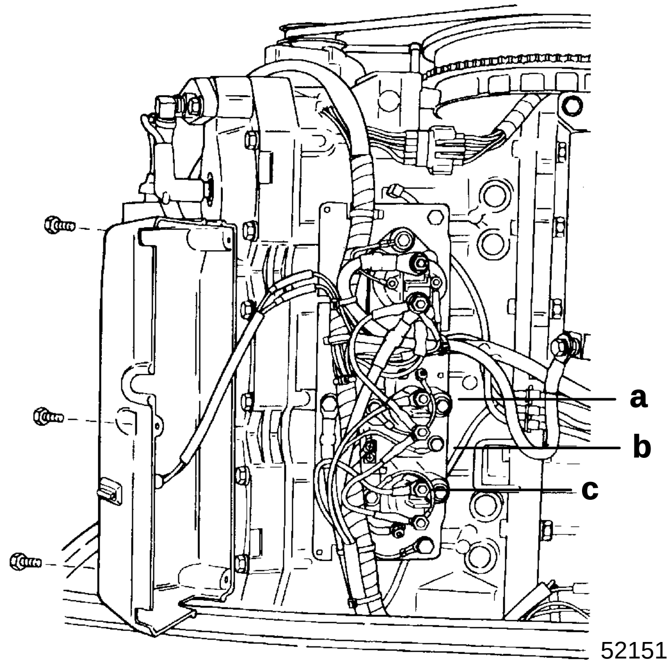
a - Oil Hose

6. Disconnect remote control harness from powerhead harness connector and wires as shown.
7. Disconnect cowl mounted tilt switch harness.



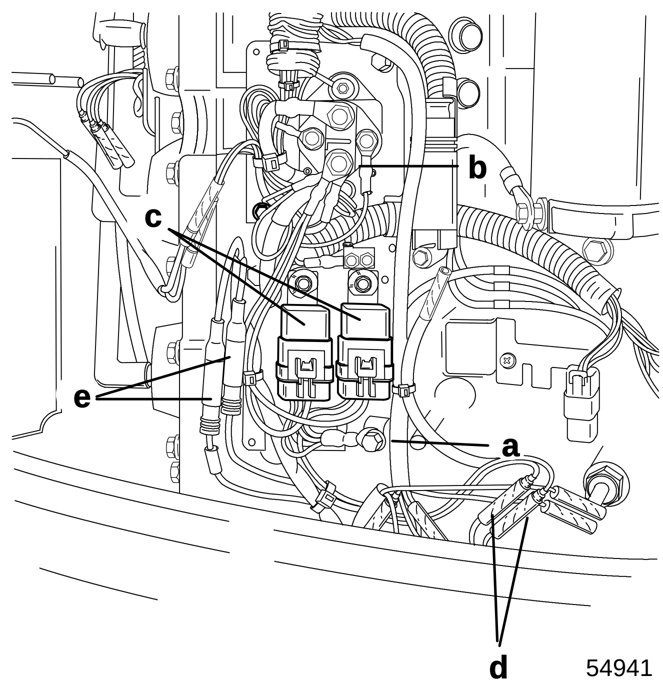
a - Remote Wiring Harness
b - Engine Wiring Harness Connector
c - Lead From Trim Solenoid (Down Solenoid)
d - Lead From Trim Solenoid (Up Solenoid)
e - Lead From Trim Sender
f - Lead From Temperature Sender
g - Harness Holder (Located in Cowl)
h - Tilt Switch

8. **MODELS WITH TRIM SOLENOIDS -** Remove BLUE, GREEN and BLACK trim harness leads from trim solenoids.

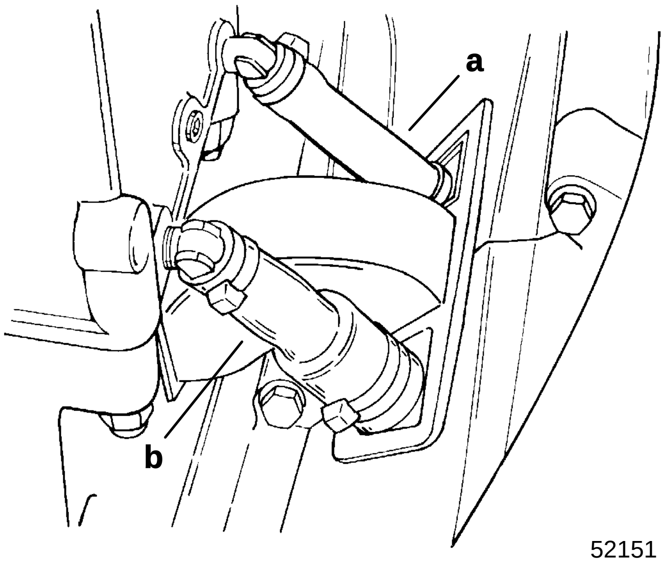


a - BLUE Trim Lead
b - BLACK Trim Lead
c - GREEN Trim Lead

MODELS WITH TRIM RELAYS - Remove relay ground harness from lower electrical plate mounting bolt (a).
Remove relay positive leads (b) (RED) from BATTERY SIDE of starter solenoid.
Disconnect trim relay harness from each relay (c).
Disconnect BLUE/WHITE and GREEN/WHITE trim leads from lower cowl trim switch harness (d).
Disconnect BLUE (sleeve) and GREEN power trim leads from trim motor harness (e).



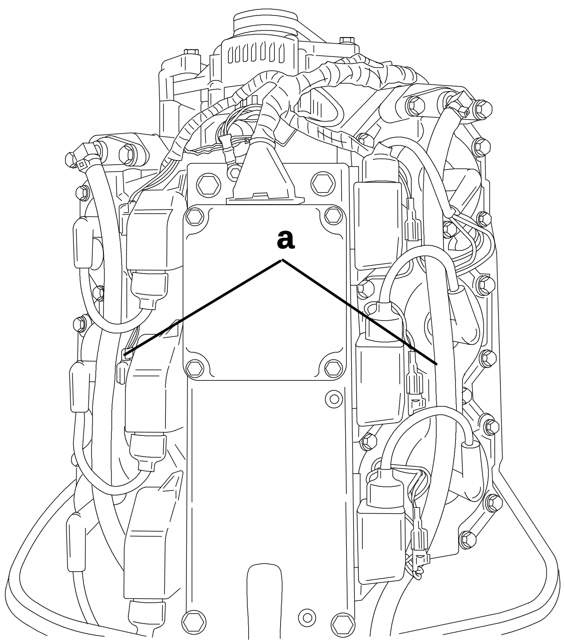
9. Remove sta-straps securing tell-tale hose and flush hose to powerhead.



52151

a - Tell-Tale Hose
b - Flush Hose

10. Disconnect bypass hoses between thermostats and exhaust adaptor plate.



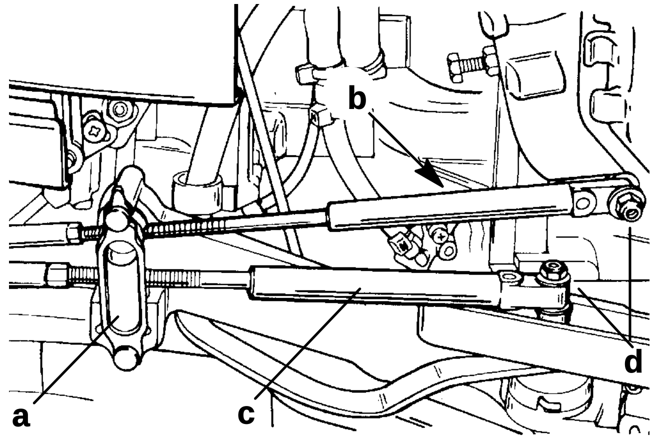
53459

a - Bypass Hose

11. Shift outboard into NEUTRAL position.

12. Unlatch throttle and shift cable retainer.

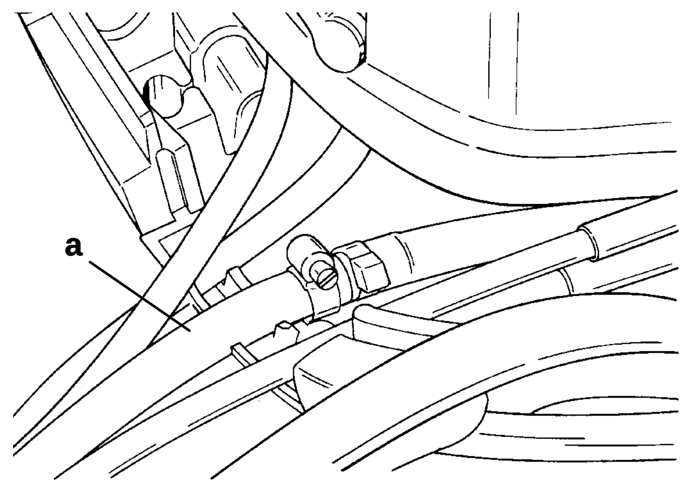
13. Remove locknut and flat washer securing throttle shift cables and remove cables.



52195

a - Cable Retainer
b - Throttle Cable
c - Shift Cable
d - Locknut and Flat Washer

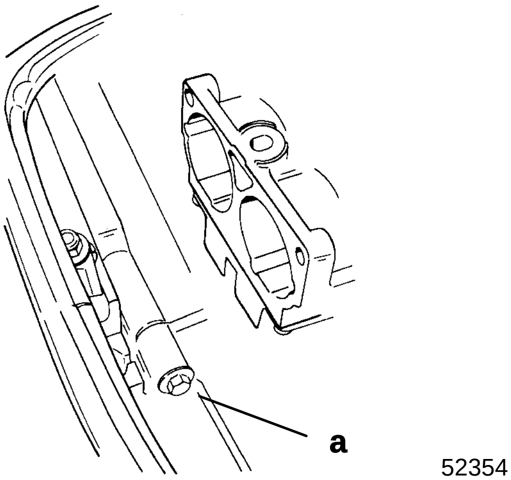
14. Disconnect inlet fuel line.



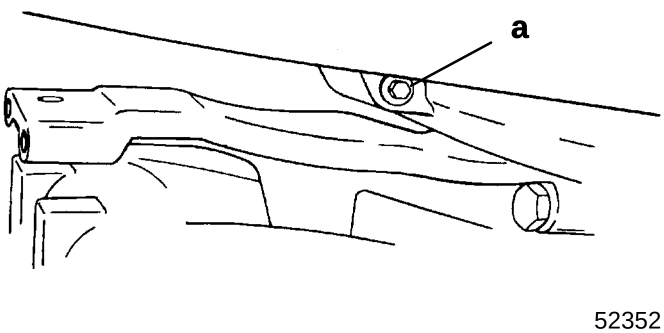
52191

a - Inlet Fuel Line

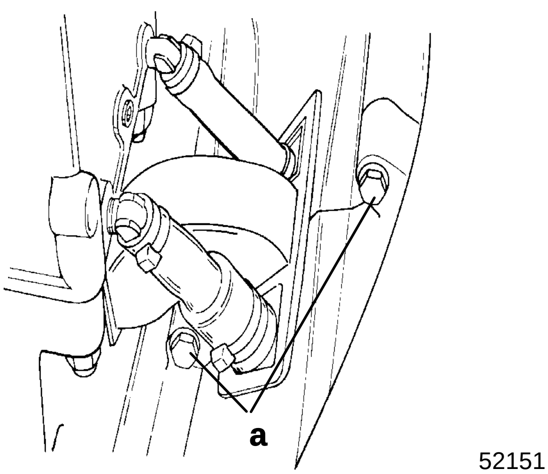
15. Remove 4 bolts securing bottom cowl halves and remove bottom cowling.



a - Bolt

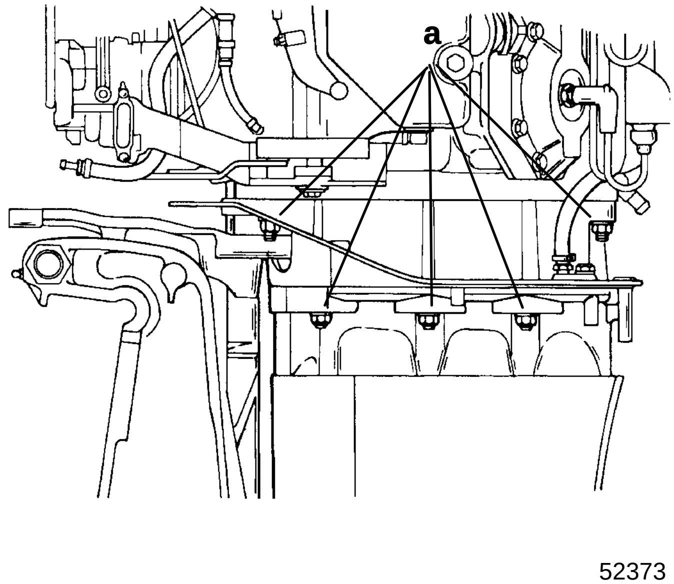


a - Bolt



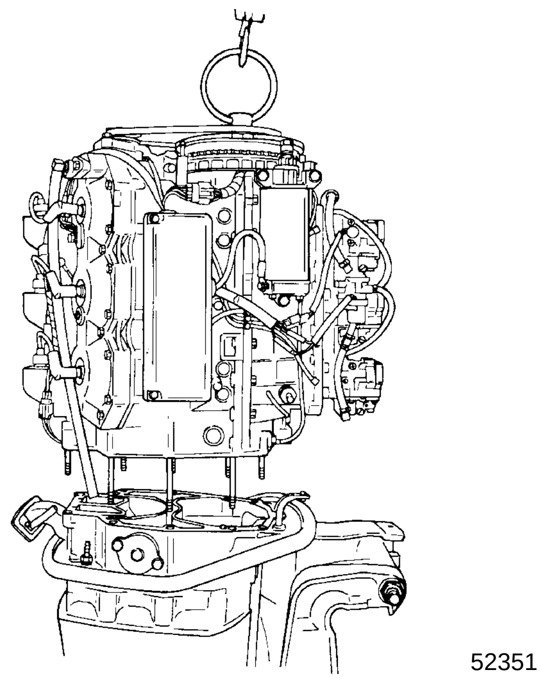
a - Bolt

16. Remove 10 nuts and washers (5 each side) from powerhead base.



a - Nuts and Washers (5 each side)

17. Remove plastic cap from center of flywheel and install Lifting Eye (91-90455) into flywheel at least 5 full turns. Using a hoist, lift powerhead assembly from drive shaft housing.



REMOVING ENGINE COMPONENTS

Remove the following engine components:

Section 2
Starter Motor
Alternator
Stator
Ignition Modules
Electronic Control Unit
Solenoids
Crank Position Sensor
Throttle Position Sensor
Temperature Sensor

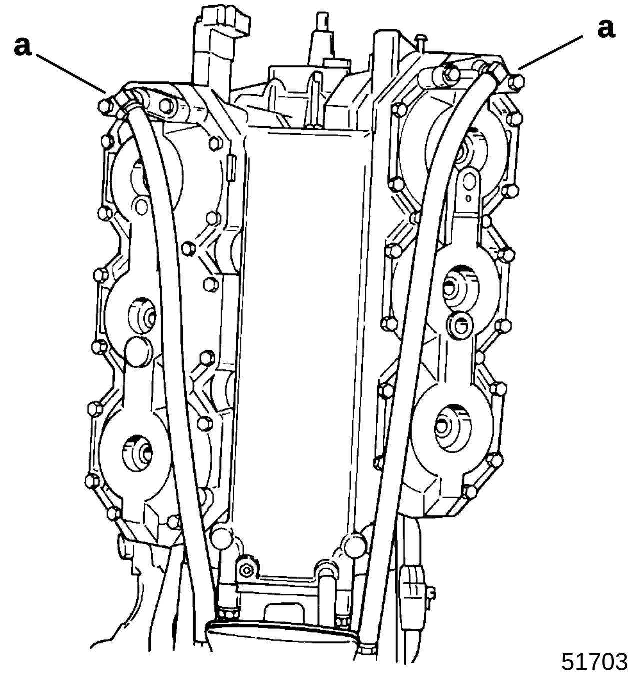
Section 3
Air Silencer
Carburetors and Linkage
Fuel Pump
Fuel Enrichment

Section 8
On-Board Oil Tank
Oil Pump

Section 9
EFI Removal

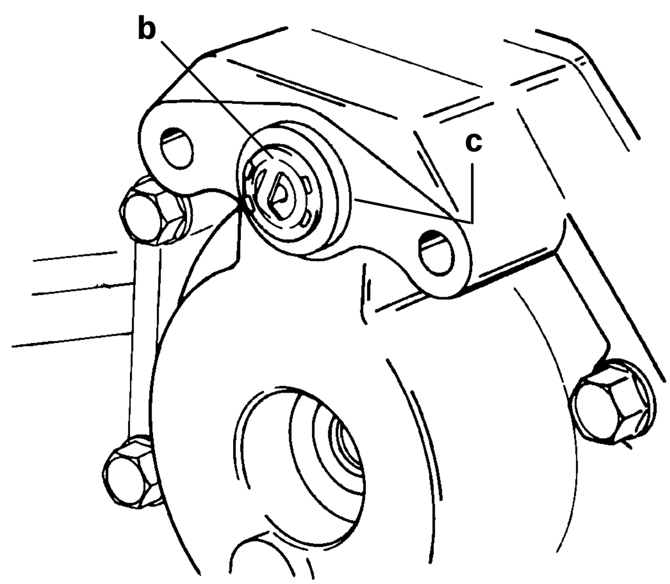
Powerhead Disassembly

1. Place powerhead in repair stand or on a bench.
2. Remove thermostat covers, thermostats and gaskets.



51703

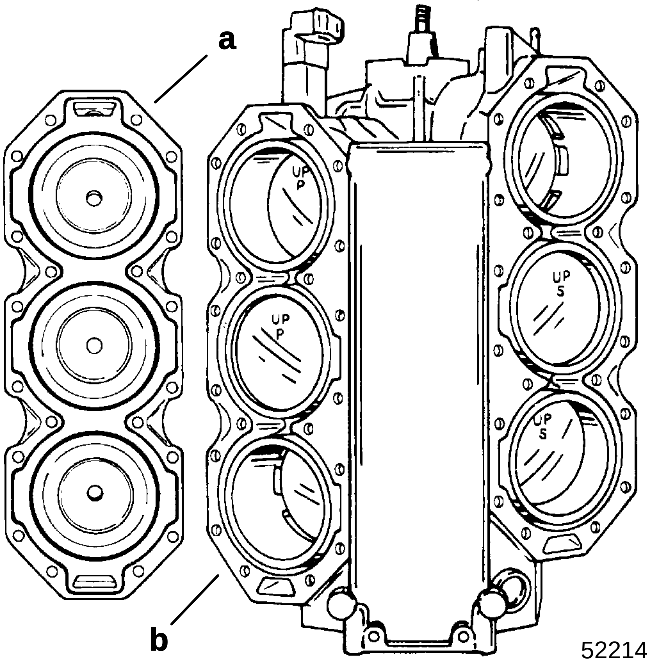
a - Thermostat Cover



51712

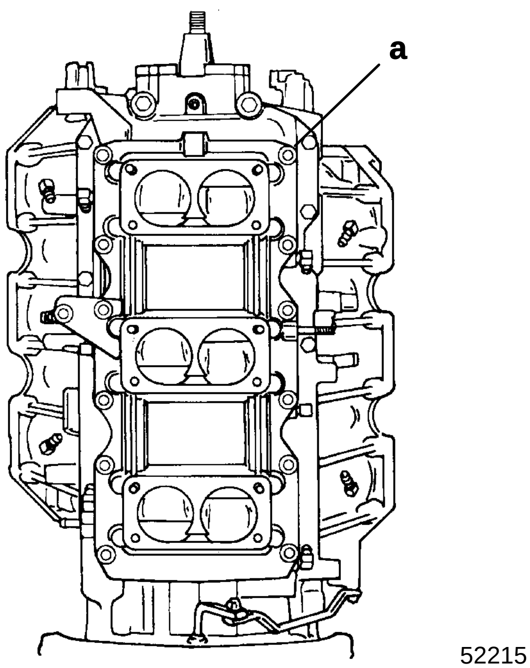
b - Thermostat
c - Gasket

3. Remove cylinder heads from engine block.



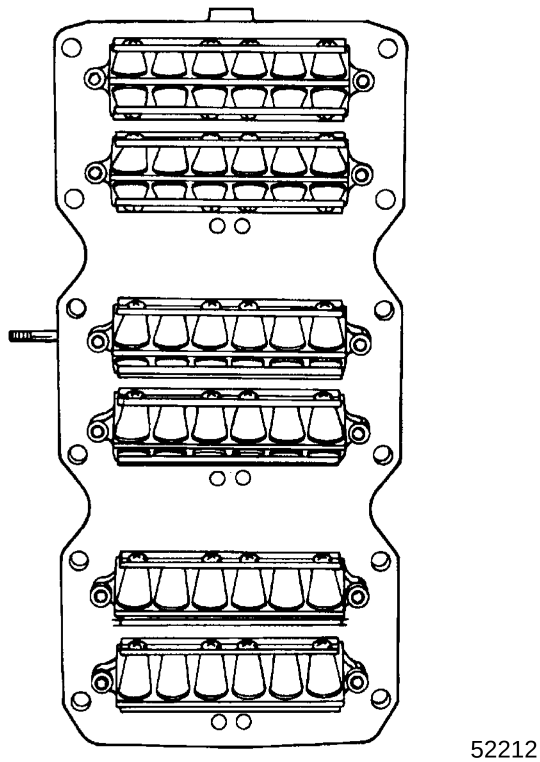
a - Cylinder Head
b - Engine Block

4. Remove reed block housing from cylinder block.



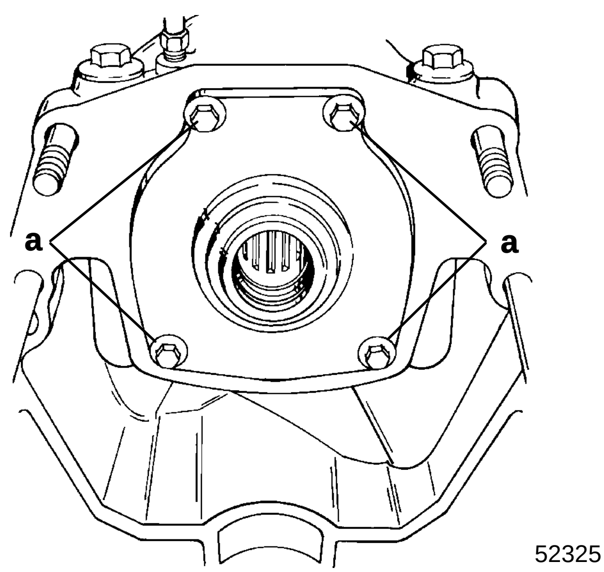
a - Reed Block Housing

5. Inspect reeds as outlined in "Cleaning and Inspection".



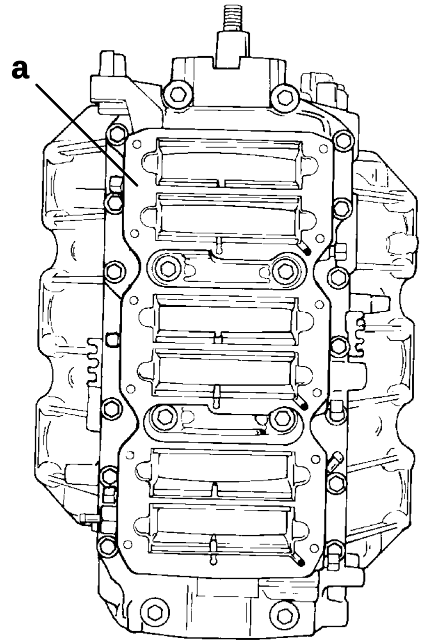
6. Remove bolts from end cap.

LOWER END CAP



a - Crankcase Attaching End Cap Bolts

7. Remove bolts which secure crankcase cover to cylinder block.

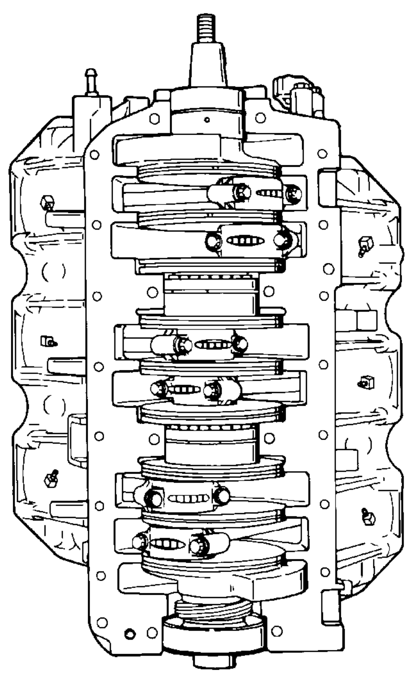


52330

a - Crankcase Cover

8. Remove crankcase end cap.

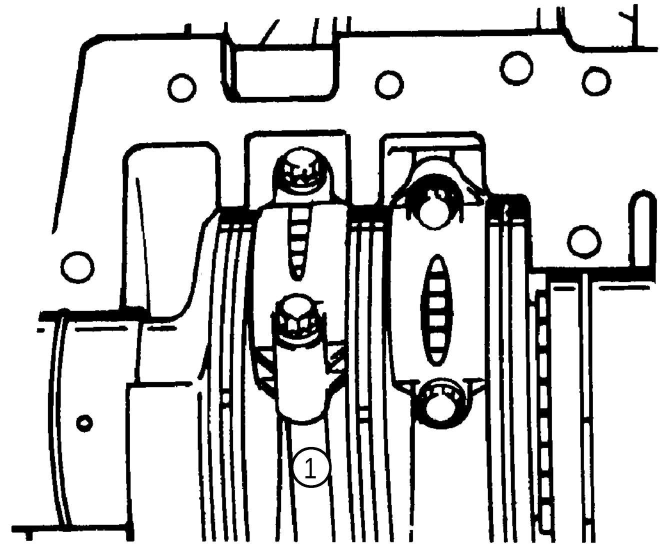
CRANKCASE COVER REMOVED



52216

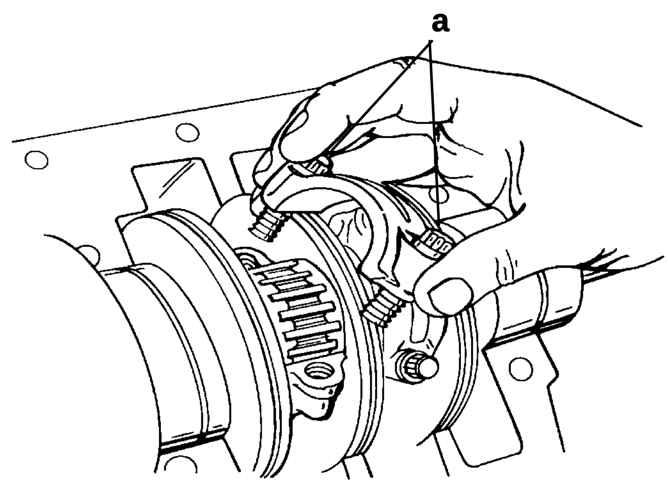
9. Use Powerhead Stand (91-812549) for rotating crankshaft to desired position for removal of connecting rods.

10. Using an awl or electric pencil, scribe the cylinder identification number on each connecting rod as shown. Reassemble connecting rods in same cylinder.



52347

11. Use a 3/8 in. 12 point socket to remove connecting rod bolts, then remove rod cap, roller bearings and bearing cage from connecting rod.



52316

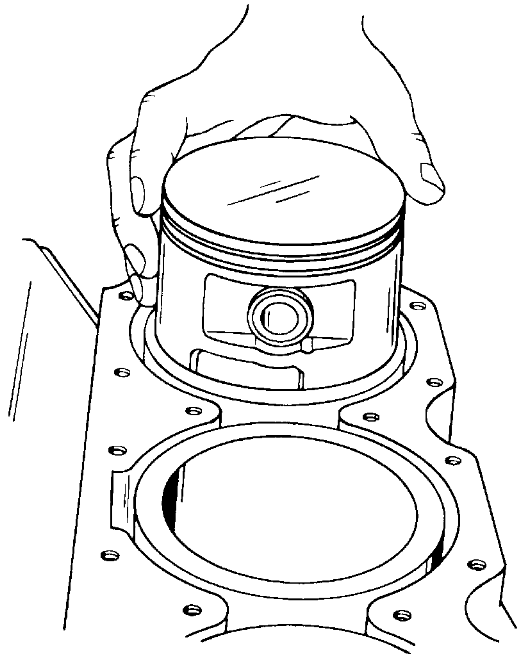
a - Connecting Rod Bolts

12. Push piston out of cylinder block.

13. After removal, reassemble each piston and connecting rod assembly.

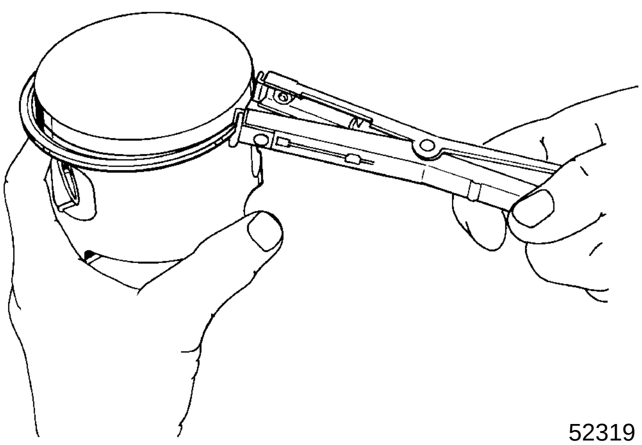
⚠ CAUTION

Each connecting rod and end cap are a matched machined set and must never be mismatched.



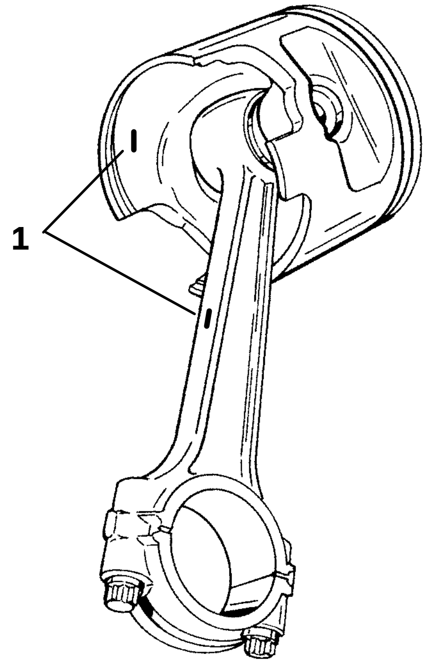
52348

14. Inspect pistons as outlined in "Cleaning and Inspection," following.
15. Use Piston Ring Expander (91-24697) to remove piston rings. Always install new piston rings.



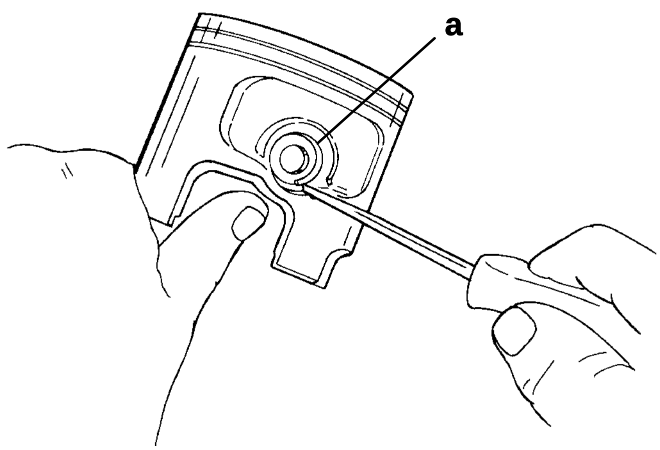
52319

16. Using an awl, scribe identification number of connecting rod on inside of piston (1). Reassemble piston on same connecting rod.



52326

17. Using tool (91-52952A1), remove piston pin lockrings from both ends of piston pin. Never re-use piston pin lockrings.

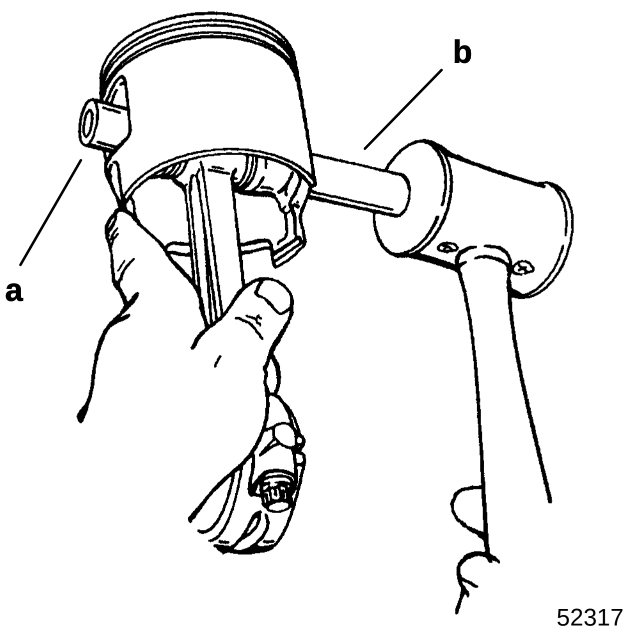


52316

a - Lockring

IMPORTANT: Warming the piston dome using a torch lamp will ease removal and installation of piston pin.

18. Support piston and tap out piston pin using service tool (91-92973A1) as shown.

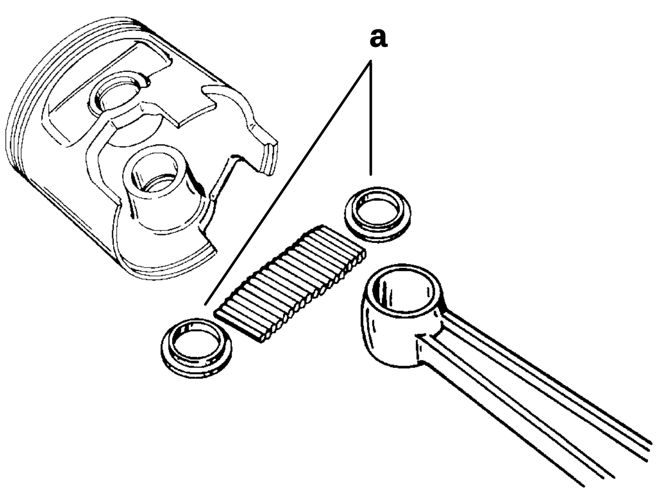


52317

a - Piston Pin
b - Piston Pin Tool (91-76159A1)

19. Remove piston pin needle bearings (34 per piston) and locating washers (2 per piston) as shown.

IMPORTANT: We recommend that you use new needle bearings at reassembly for lasting repair. However, if needle bearings must be re-used, keep each set of bearings identified for reassembly on same connecting rod.

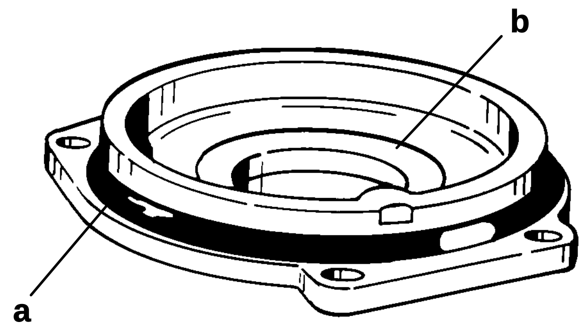


52321

a - Needle Bearing Locating Washers

20. Remove and discard O-ring seal from end cap.

21. Remove oil seals from end cap by driving seals out with a punch and hammer.

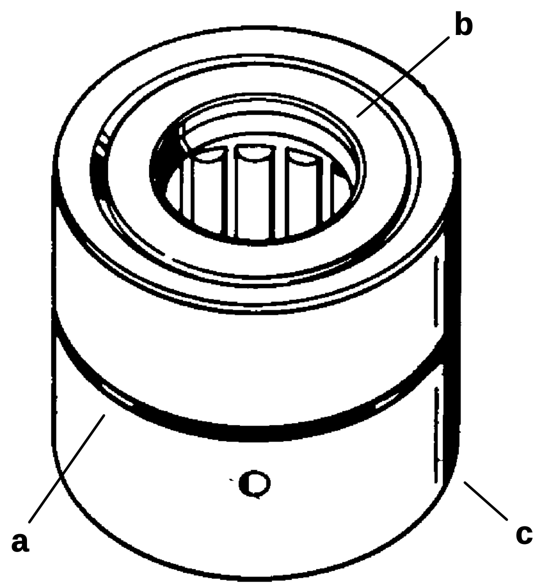


51849

a - O-ring
b - Seals (2)

22. Inspect roller bearing in upper bearing carrier as outlined in "Cleaning and Inspection".

NOTE: *If roller bearing is damaged, replace bearing carrier assembly.*



51473

a - O-Ring
b - Seal
c - Carrier

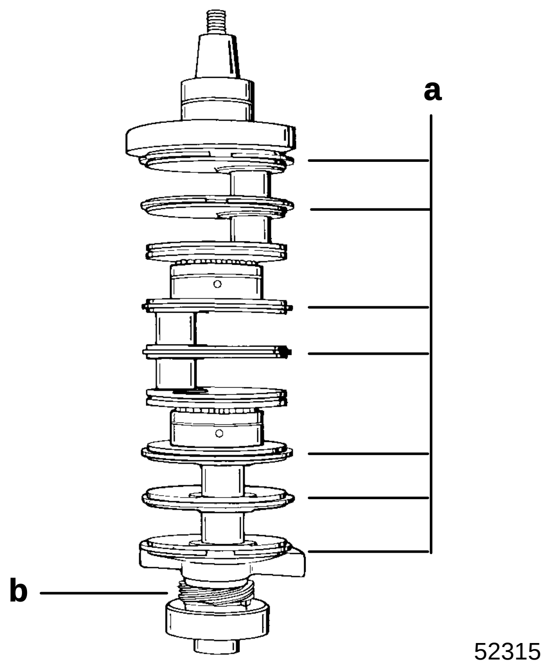
23. Remove crankshaft and place in powerhead stand as shown.

IMPORTANT: DO NOT remove crankshaft sealing rings from crankshaft, unless replacement of a sealing ring(s) is necessary. Usually, crankshaft sealing rings do not require replacement, unless broken.

⚠ CAUTION

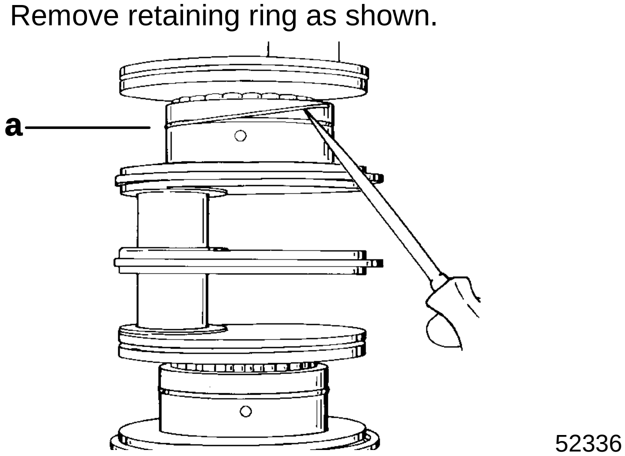
Safety glasses should be worn when removing or installing crankshaft sealing rings.

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 8" for proper oil drive gear installation procedures.



a - Sealing Rings (7)
b - Oil Pump Drive Gear

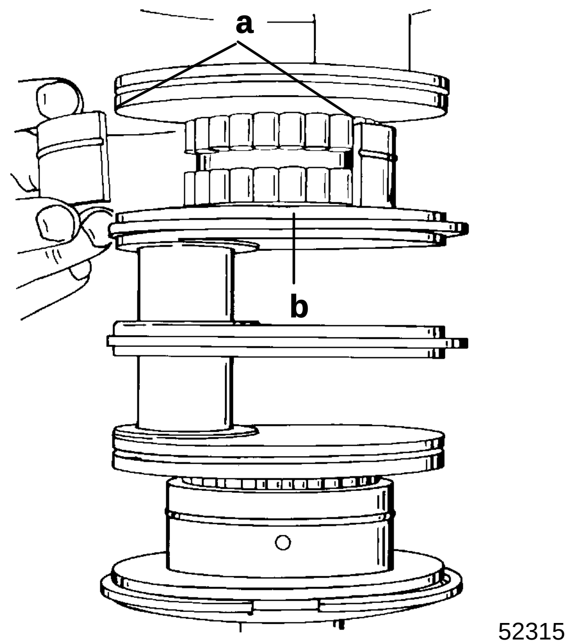
24. Remove retaining ring as shown.



a - Retaining Ring

25. Remove bearing race halves and roller bearings from crankshaft.

IMPORTANT: Keep same bearing races and roller bearings together.



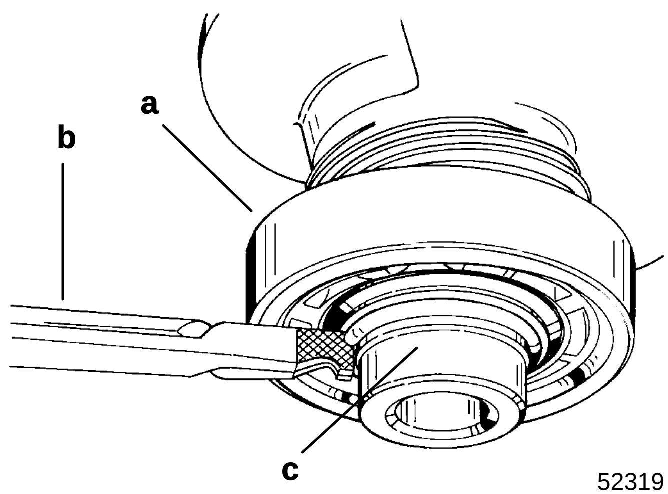
a - Bearing Race Halves
b - Roller Bearings

Inspect crankshaft ball bearing as outlined in "Cleaning and Inspection," following.

IMPORTANT: DO NOT remove crankshaft ball bearing, unless replacement is required.

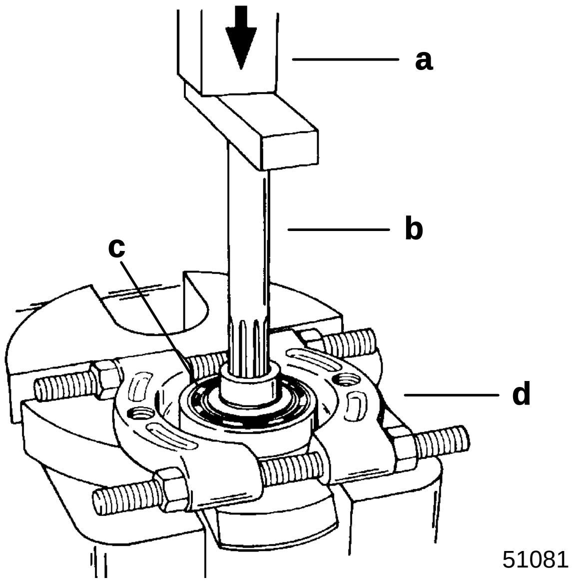
26. Remove lower ball bearing from crankshaft as follows:

    a. Remove retaining ring using a pair of snap ring pliers.



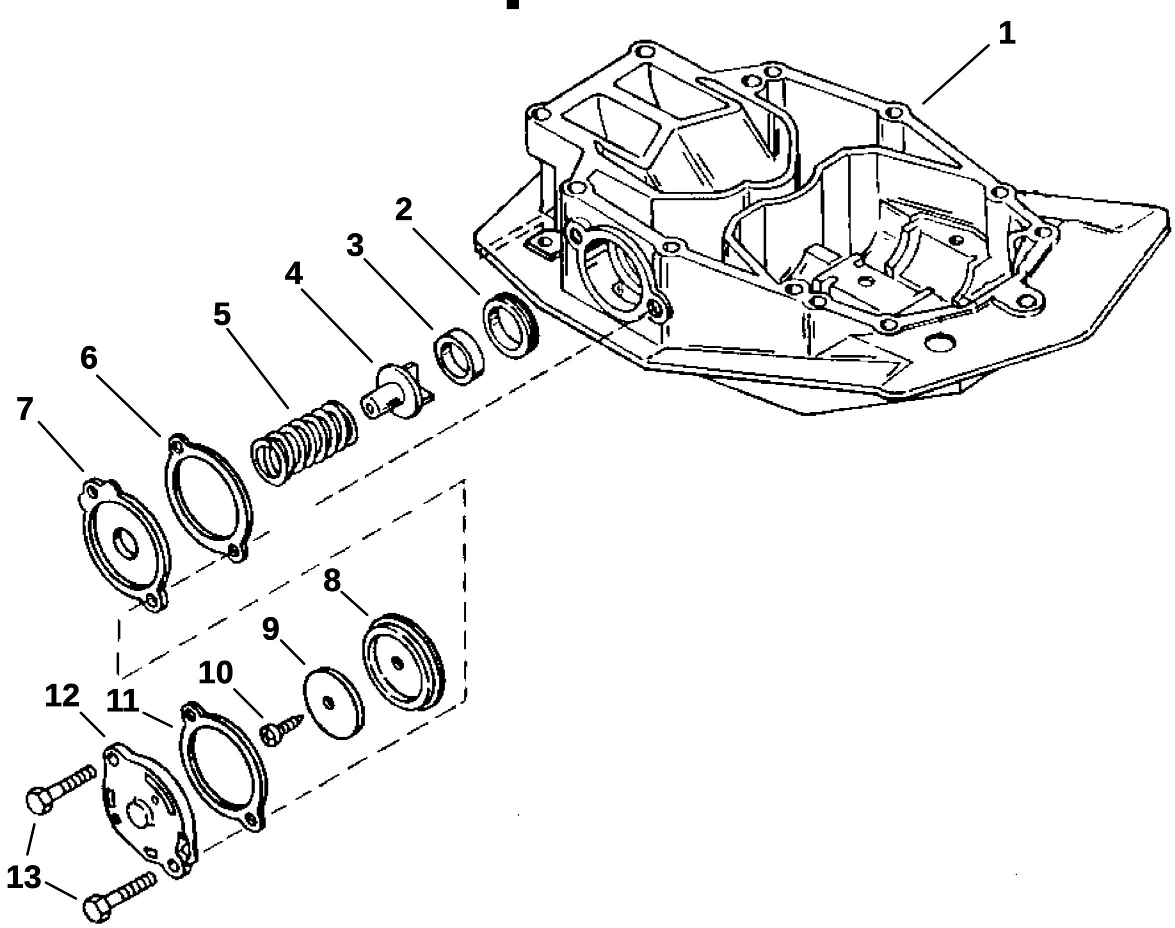
a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring

b. Press crankshaft out of lower ball bearing as shown.



a - Press
b - Powerhead Stand (91-812549)
c - Crankshaft Ball Bearing
d - Universal Puller Plate (91-37241)

27. Remove and inspect water pressure relief valve components for debris or damage. Replace components as required.

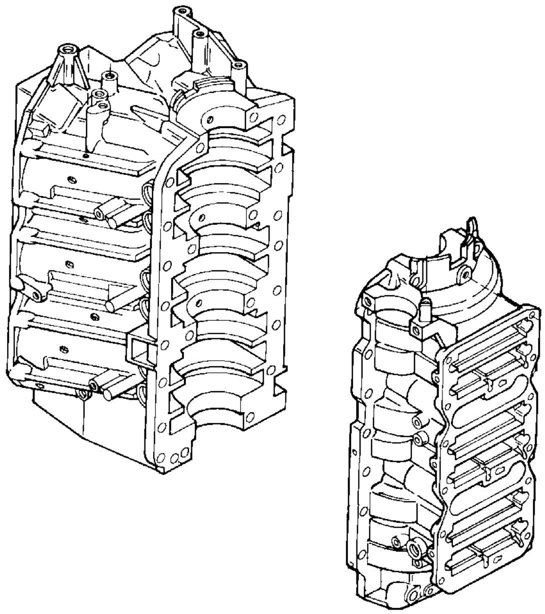


1 - Exhaust Plate
2 - Carrier
3 - Grommet
4 - Poppet/Relief Valve
5 - Spring
6 - Gasket
7 - Inner Plate
8 - Diaphragm
9 - Washer
10- Screw
11- Gasket
12- Outer Cover
13- Bolts [Torque bolts to 20 lb. ft. (27.1 N·m)]

Cleaning and Inspection

Cylinder Block and Crankcase Cover

IMPORTANT: Crankcase cover and cylinder block are a matched, line-bored assembly and never should be mismatched by using a different crankcase cover or cylinder block.



⚠ CAUTION

It crankcase cover or cylinder block is to be submerged in a very strong cleaning solution, it will be necessary to remove the crankcase cover/cylinder block bleed system from crankcase cover/cylinder block to prevent damage to hoses and check valves.

1. Thoroughly clean cylinder block and crankcase cover. Be sure that all sealant and old gaskets are removed from matching surfaces. Be sure that carbon deposits are removed from exhaust ports.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Check gasket surfaces for nicks, deep grooves, cracks and distortion that could cause compression leakages.
4. Check all water and oil passages in cylinder block and crankcase cover to be sure that they are not obstructed and that plugs are in place and tight.

Special Service Information

Grooves in Cylinder Block Caused By Crankshaft Sealing Rings

Grooves in cylinder block caused by crankshaft sealing rings are not a problem, except if installing a new crankshaft and the new sealing rings on crankshaft do not line up with existing grooves in cylinder block. If installing a new crankshaft, refer to crankshaft installation, Powerhead Reassembly section to determine if powerhead can be used.

Cylinder Bores

1. Inspect cylinder bores for scoring, scuffing or a transfer of aluminum from piston to cylinder wall. Scoring or scuffing, if NOT TOO SEVERE, can normally be removed by honing. If a transfer of aluminum has occurred, an acidic solution such as "TIDY BOWL CLEANER" should be applied to the areas of the cylinder bore where transfer of aluminum has occurred. After the acidic solution has removed the transferred aluminum, thoroughly flush the cylinder bore(s) to remove any remaining acid. Cylinder walls may now be honed to remove any glaze and to aid in the seating of new piston rings.

HONING PROCEDURE

a. When cylinders are to be honed, follow the hone manufacturer's recommendations for use of the hone and cleaning and lubrication during honing.

b. For best results, a continuous flow of honing oil should be pumped into the work area. If pumping oil is not practical, use an oil can. Apply oil generously and frequently on both stones and work area.

⚠ CAUTION

When honing cylinder block, remove hone frequently and check condition of cylinder walls. DO NOT hone any more than absolutely necessary, as hone can remove cylinder wall material rapidly.

c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.

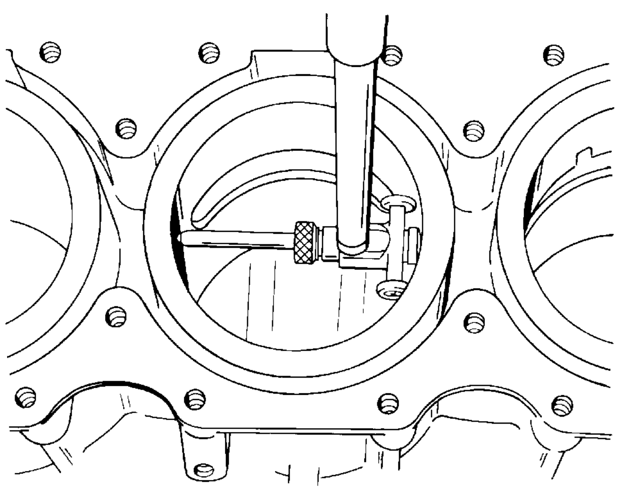
d. Localize stroking in the smallest diameter until drill speed is constant throughout length of bore. Expand stones, as necessary, to compensate for stock removal and stone wear.

Stroke at a rate of 30 complete cycles per minute to produce best cross-hatch pattern. Use honing oil generously.

e. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. A good cleaning is essential. If any of the abrasive material is allowed to remain in the cylinder bore, it will cause rapid wear of new piston rings and cylinder bore in addition to bearings. After cleaning, bores should be swabbed several times with engine oil and a clean cloth, then wiped with a clean, dry cloth. Cylinders **should not** be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

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

3. Measure cylinder bore diameter (with a snap gauge micrometer) of each cylinder, as shown below. Check for tapered, out-of-round (egg-shaped) and oversize bore.



52324

3 Litre Work/225 Carb/225 EFI/250 EFI Models

Model	Cylinder Block Finish Hone
3 Litre Work/225 Carb 225 EFI/250 EFI	3.6265 (92.1131mm)
0.015 in. Oversize	3.6415 (92.4941mm)
0.030 in. Oversize	3.6565 (92.8751mm)

4. If a cylinder bore is tapered, out-of-round or worn more than 0.003 in. (0.08mm) 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. (0.38mm) oversize or 0.030 in. (0.76mm) oversize and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to re-bore all cylinders in a block just because one cylinder requires re-boring.*

5. After honing and thoroughly cleaning cylinder bores, apply light oil to cylinder walls to prevent rusting.

Pistons and Piston Rings

IMPORTANT: If engine was submerged while engine was running, piston pin and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. (Piston pins are not sold separately because of matched fit into piston.) If piston pin is bent, connecting rod must be checked for straightness (refer to "Connecting Rods," following, for checking straightness).

1. Inspect pistons for scoring and excessive piston skirt wear.
2. Check tightness of piston ring locating pins. Locating pins must be tight.
3. Thoroughly clean pistons. Carefully remove carbon deposits from pistons, with a soft wire brush or carbon remove solution. Do not burr or round off machined edges.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves **being careful not to scratch sides of grooves**. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

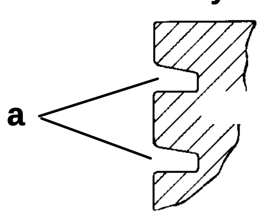
Keystone (tapered) ring grooves

⚠ CAUTION

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

1. Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable the inside edge of the ring to reach the inner diameter of the groove. Carefully scrape carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the side surfaces of the grooves.

Piston with two half keystone (half tapered) rings



a - Ring Grooves

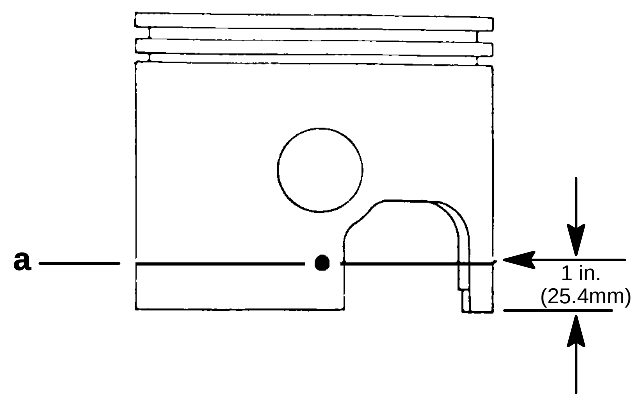
MEASURING PISTON ROUNDNESS

Piston has a barrel profile shape and is not a true diameter.

1. Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be as indicated in chart following.

Piston	Dimension "A"
Standard Piston	3.6210 in. ± .0005 in.
.015 in. Oversize Piston	3.636 in. ± .0005 in.
.030 in. Oversize Piston	4.383 in. ± .0005 in.

2. Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be 3.6210 in. ± 0.0005 in. for a STANDARD size piston.



a - Dimension "A" at Right Angle (90°) to Piston Pin

Cylinder Heads

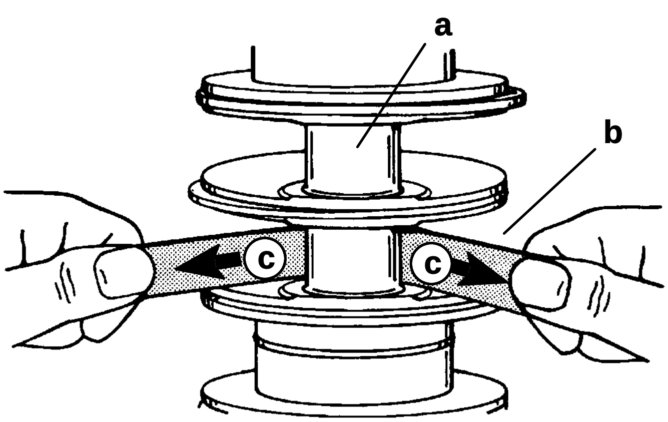
1. Inspect internal surface of cylinder heads for possible damage (as a result of piston or foreign material striking cylinder heads).

IMPORTANT: Cylinder head warpage should not exceed 0.005 in. (0.13mm) over the ENTIRE length of the cylinder head. If measured warpage, as determined on a surface block, exceeds 0.005 in. (0.13mm) or a discontinuity of up to 0.001 in. (0.03mm) exists in a 1.0 in. (25.4mm) length of the cylinder head's surface, then the cylinder head must be replaced.

2. Replace cylinder head(s) as necessary.

Crankshaft

1. Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary).
2. Check crankshaft for straightness. Maximum runout – 0.002 in. (0.0508mm) Check runout at center main bearing surfaces with ends of crankshaft supported in v-blocks. (Replace as necessary).
3. Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. (Replace as necessary).
4. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheat- ing. (Refer to "Connecting Rods").
5. If necessary, clean crankshaft surfaces with crocus cloth.



52323

a - Crankshaft Journals
b - Crocus Cloth
c - Work Cloth "Back-and-Forth"

⚠ WARNING

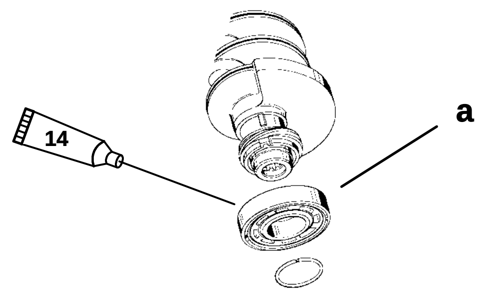
DO NOT spin-dry crankshaft ball bearing with compressed air.

6. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearing. Recheck surfaces of crankshaft. Replace crankshaft, if surfaces cannot be properly "cleaned up." If crankshaft will be re-used, lubricate surfaces of crankshaft with light oil to prevent rust. DO NOT lubricate crankshaft ball bearing at this time.

Crankshaft (and End Cap) Bearings

IMPORTANT: When overhauling powerhead assembly, it is recommended that all crankshaft bearings – upper/lower, center main, connecting rod and wrist pin bearings – be replaced to ensure optimum powerhead performance and longevity.

1. After cleaning crankshaft, grasp outer race of crankshaft ball bearing (installed on lower end of crankshaft) and attempt to work race back-and-forth. There should not be excessive play.
2. Lubricate ball bearing with light oil. Rotate outer bearing race. Bearing should have smooth action and no rust stains. If ball bearing sounds or feels "rough" or has "catches," remove and discard bearing. (Refer to "Powerhead Removal and Disassembly - Crankshaft Removal and Disassembly").



52326

14 2 Cycle Outboard Oil (92-826666A24)

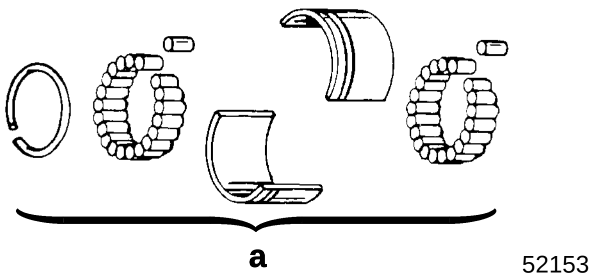
a - Lower Ball Bearing

3. Thoroughly clean (with solvent) and dry crankshaft center main roller bearings. Lubricate bearings with 2-Cycle Outboard Oil.

CAUTION

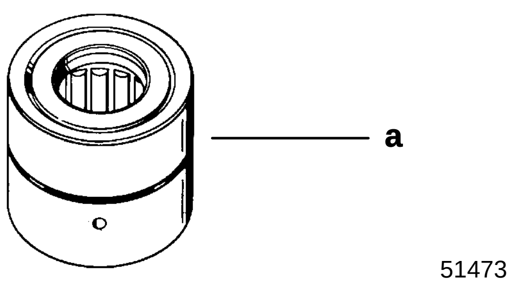
DO NOT intermix halves of upper and lower crankshaft center main roller bearings. Replace bearings in pairs only.

4. Thoroughly inspect center main roller bearings. Replace bearings if they are rusted, fractured, worn, galled or badly discolored.



a - Center Main Roller Bearing

5. Clean (with solvent) and dry crankshaft roller bearing that is installed in upper end cap. Lubricate bearing with light oil.
6. Thoroughly inspect upper crank shaft roller bearing. If roller bearing is rusted, fractured, worn, galled or badly discolored, replace roller bearing.

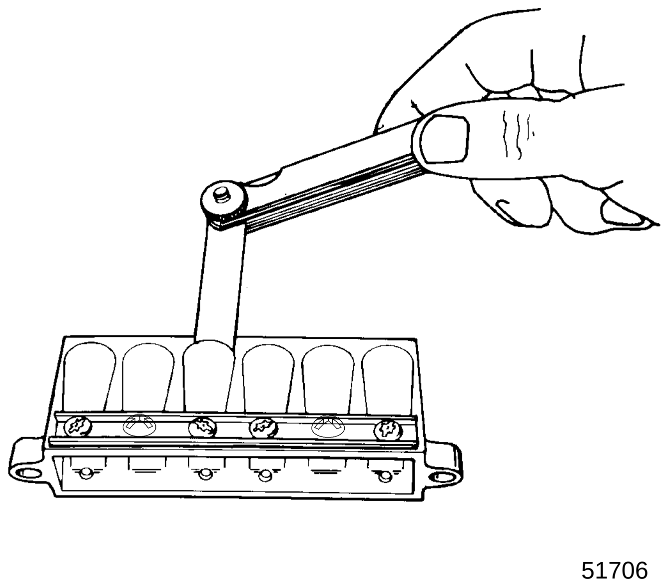


a - Upper Roller Bearing

Reed Block Assembly

IMPORTANT: DO NOT remove reeds from reed blocks, unless replacement is necessary. DO NOT turn used reeds over for re-use. Replace reeds in sets only.

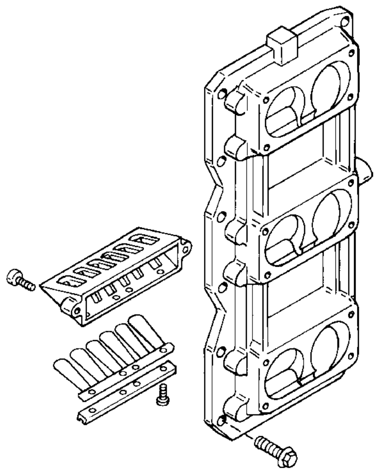
1. Thoroughly clean gasket surfaces of reed blocks and reed block housing. Check for grooves, cracks and distortion that could cause leakage. Replace parts as necessary.
2. Check for wear (indentations) on face of each reed block. Replace block(s), if reeds have made indentations.
3. Check for chipped and broken reeds.



Allowable reed opening is 0.020 in. (0.51mm) or less. Replace reeds if either reed is standing open more than 0.020 in. (0.51mm).

Reed Block

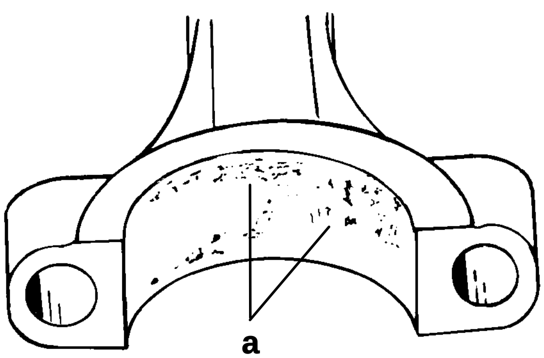
Inspect passages in reed block to be sure that they are not obstructed.



52156

Connecting Rods

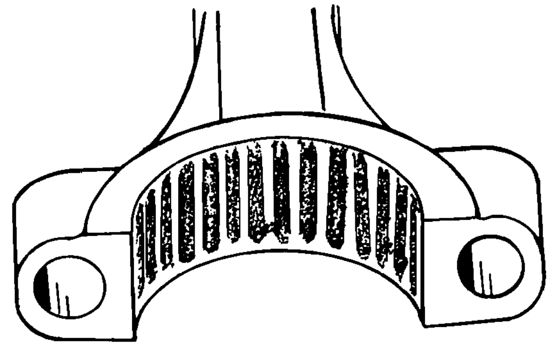
1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.05mm) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be discarded.
2. **Overheating:** Overheating is visible as a bluish bearing surface color that is caused by inadequate lubrication or excessive RPM.
3. **Rust:** Rust formation on bearing surfaces causes uneven pitting of surface(s).



51853

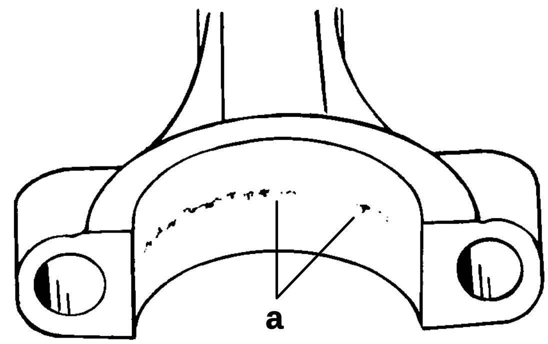
a - Pitting

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



51853

5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the "I" beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.

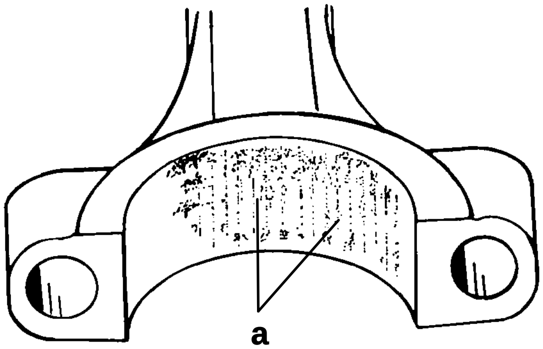


51853

a - Spalling

6. **Chatter Marks:** Chatter marks are the result of a combination of low speed - low load - cold water temperature operation, aggravated by inadequate lubrication and/or improper fuel. Under these conditions, the crankshaft journal is hammered by the connecting rod. As ignition occurs in the cylinder, the piston pushes the connecting rod with tremendous force, and this force is transferred to the connecting rod journal. Since there is little or no load on the crankshaft, it bounces away from the connecting rod. The crankshaft then remains immobile for a split second until the piston travel causes the connecting rod to catch up to the waiting crankshaft journal, then hammers it. The repetition of this action causes a rough bearing surface(s) which resembles a tiny

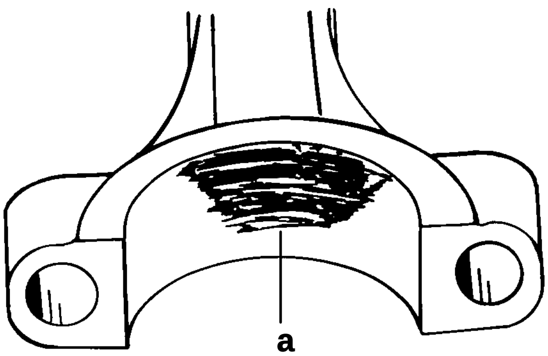
washboard. In some instances, the connecting rod crank pin bore becomes highly polished. During operation, the engine will emit a "whirr" and/or "chirp" sound when it is accelerated rapidly from idle speed to approximately 1500 RPM, then quickly returned to idle. If the preceding conditions are found, replace both the crankshaft and connecting rod(s).



51853

a - Chatter Marks Between Arrows

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



51853

a - Uneven Wear Between Arrows

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

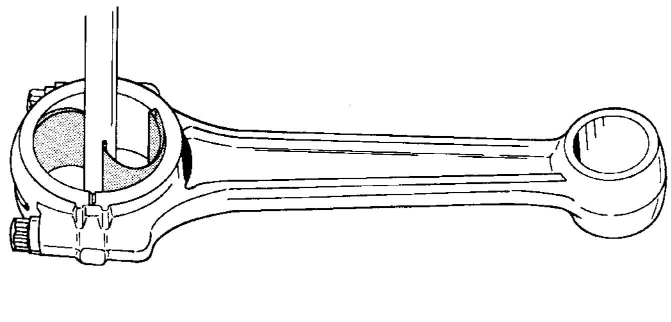
   a. Be sure that "etched" marks on connecting rod (crankshaft end) are perfectly aligned with "etched" marks on connecting rod cap. Tighten connecting rod cap attaching bolts securely.

⚠ CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

   b. **Clean CRANKSHAFT END of connecting rod by using CROCUS CLOTH** placed in a slotted 3/8 in. (9.5mm) diameter shaft, as shown. Chuck shaft in a drill press and operation press at high speed while keeping connecting rod at a 90° angle to slotted shaft.

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



52323

   c. **Clean PISTON PIN END of connecting rod**, using same method as in Step "b", preceding, but using 320 grit carborundum cloth instead of crocus cloth.

   d. Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod(s) that cannot be properly "cleaned up." Lubricate bearing surfaces of connecting rods (which will be re-used) with light oil to prevent rust.

Thermostats

1. Inspect thermostat covers and cylinder head covers (thermostat opening) for cracks and corrosion 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.

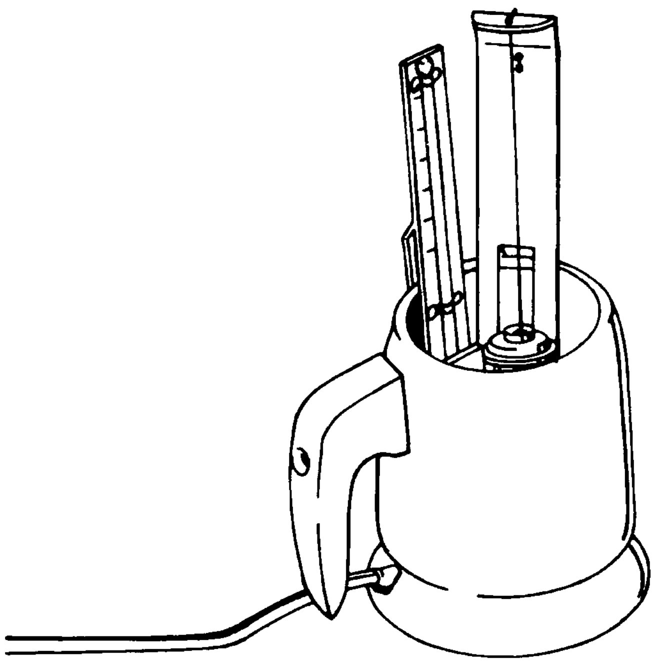
e. Observe temperature at which thermostat begins to open. (Thermostat will drop off thread, that was installed in Step "a", when it starts to open.) Thermostat must begin to open when temperature reaches 140°-145°F (60°-63°C).

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 130°F (56°C)] before testing the other thermostat.*



51087

IMPORTANT: DO NOT operate engine without thermostats installed.

Powerhead Reassembly and Installation

General

Before proceeding with powerhead reassembly, be sure that all parts to be re-used have been carefully cleaned and thoroughly inspected, as outlined in "Cleaning and Inspection," preceding. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly good powerhead within the first few minutes of operation. All new powerhead gaskets MUST BE installed during reassembly.

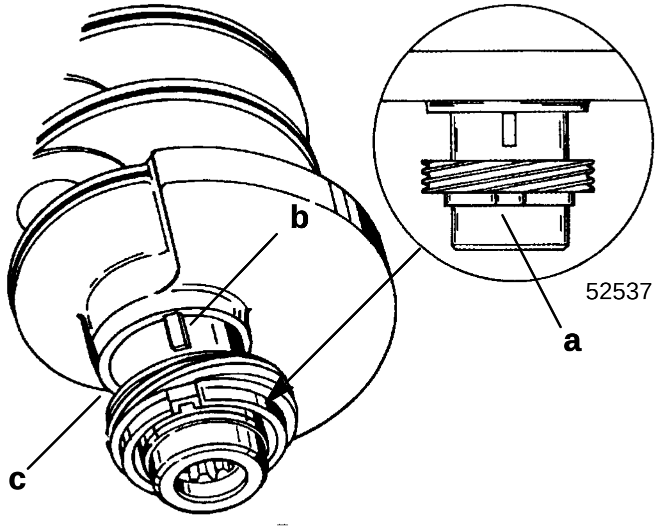
During reassembly, lubricate parts with Quicksilver 2-Cycle Outboard Lubricant whenever "light oil" is specified. Quicksilver part numbers of lubricants, sealers and locking compounds and tools are listed in "Powerhead General Information," preceding.

A torque wrench is **essential** for correct reassembly of powerhead. DO NOT attempt to reassemble powerhead without using a torque wrench. Attaching bolts for covers, housings and cylinder heads MUST BE torqued by tightening bolts in 3 progressive steps (following specified torque sequence) until specified torque is reached (see "Example," following).

EXAMPLE: If cylinder head attaching bolts require a torque of 20 lb. ft. (27.0 N·m), a) tighten all bolts to **5 lb. ft. (7.0 N·m)**, following specified torque sequence, b) tighten all bolts to **10 lb. ft. (13.6 N·m)**, following torque sequence, then finally c) tighten all bolts to **20 lb. ft. (27.0 N·m)**, following torque sequence.

IMPORTANT: If oil pump drive gear has been removed from crankshaft, GEAR MUST BE REINSTALLED WITH GEAR FLANGE FACING DOWN TOWARDS BALL BEARING.

1. Slide oil pump drive gear (flange facing down) onto crankshaft. Align slot in gear with keyway on crankshaft. Seat gear against counter weight shoulder.

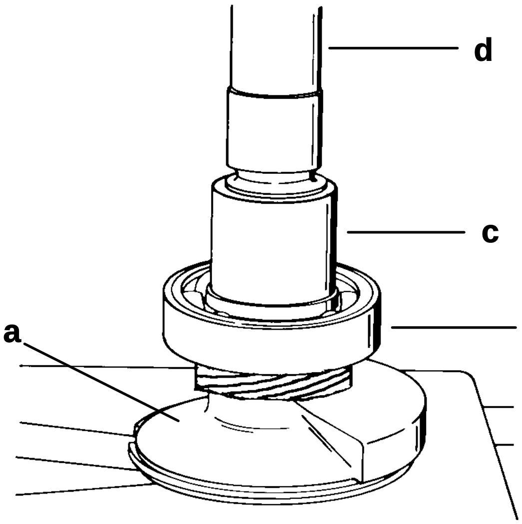


52326

a - Flange (Faces Down Towards Ball Bearing)
b - Keyway
c - Shoulder

IMPORTANT: If lower drive shaft ball bearing has been removed, it is recommended that a new bearing be installed as the removal process will damage the bearing.

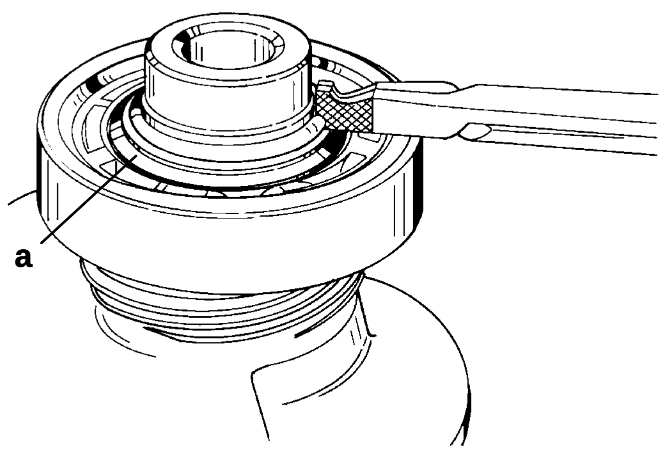
1. If removed, press new lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against shoulder.



51852

a - Crankshaft
b - Crankshaft Ball Bearing
c - Suitable Mandrel
d - Press

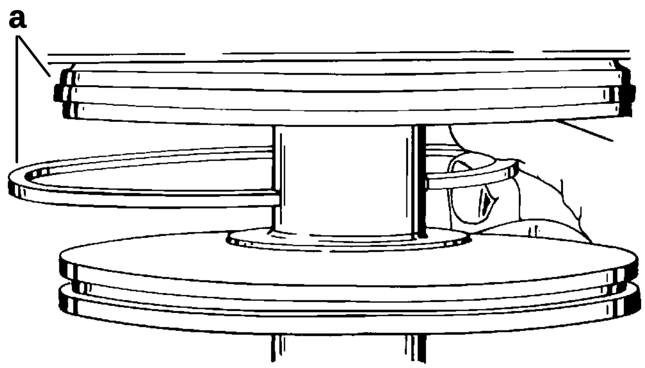
2. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



52319

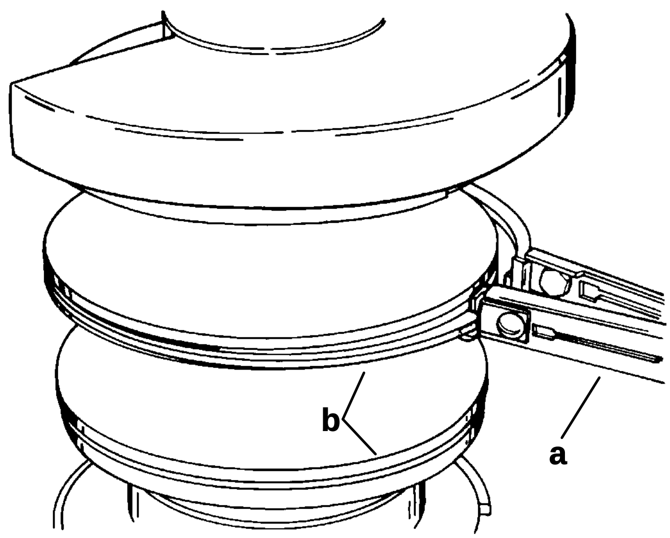
a - Retaining Ring

3. If removed, spread new crankshaft sealing rings just enough to slide over crankshaft journal.



a - Crankshaft Sealing Rings

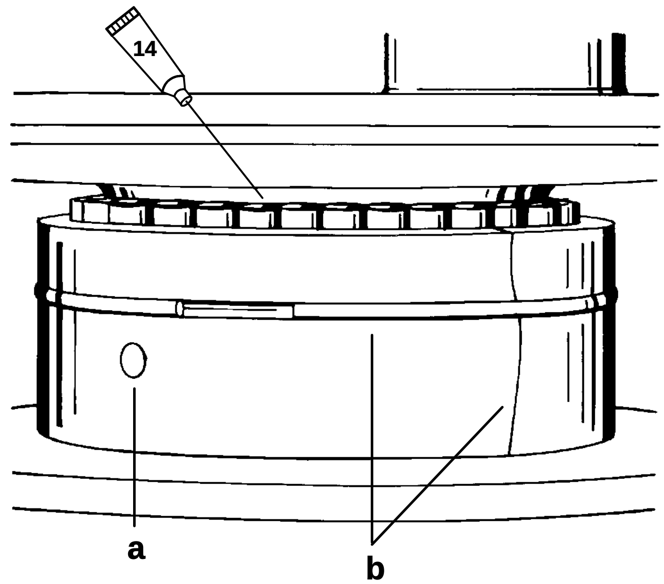
4. Use Piston Ring Expander (91-24697) and install crankshaft sealing rings into groove.



52320

a - Piston Ring Expander (91-24697)
b - Crankshaft Sealing Rings (7 Each)

5. Lubricate center main crankshaft roller bearings and races with light oil.



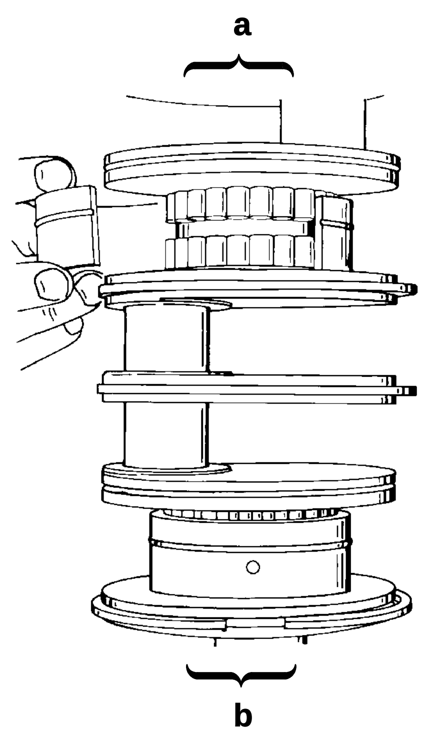
52318

14 2 Cycle Outboard Oil (92-826666A24)

a - Install so Hole is Toward Drive Shaft End of Crankshaft
b - Verify Retaining Ring Bridges the Separating Lines of the Bearing Race

6. Place center main crankshaft roller bearings on upper and lower main bearing journals as shown.

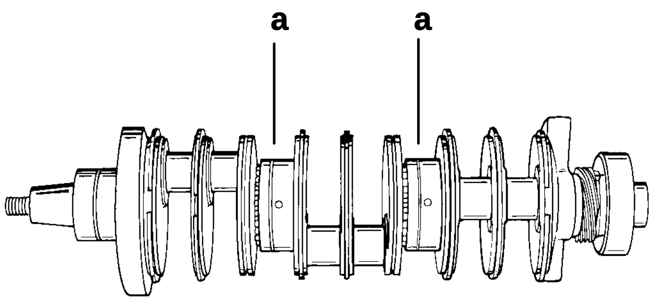
7. Install center main bearing races as shown.



52315

a - Flywheel End
b - Drive Shaft End

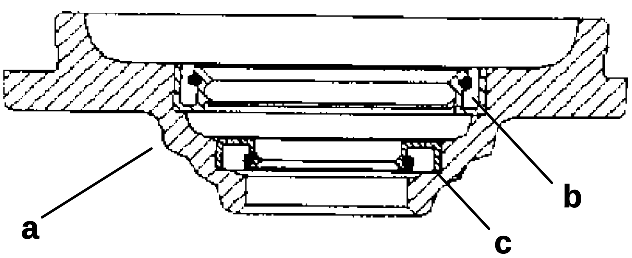
8. Secure center main bearing races together with retaining rings. Make sure retaining ring bridges the separating lines of the bearing race.



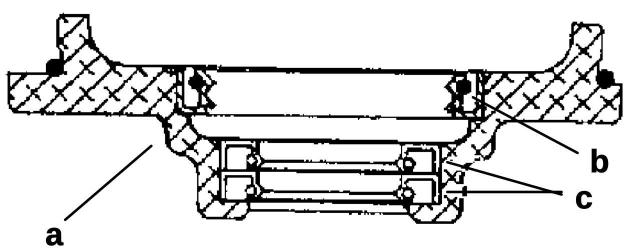
52315

a - Center main Bearing Races

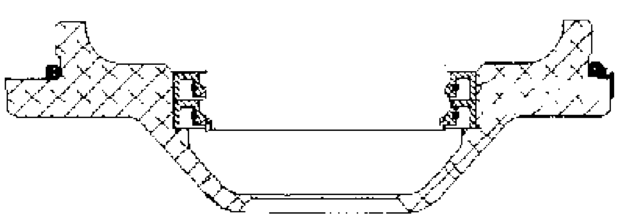
NOTE: *Four styles of end caps have been used on 3 liter powerheads – 1171-9787A1; 1171-9787A3; 1171-9787A4 and 1171-9787A5. If not previously installed, it is recommended that end cap 1171-9787A5 be installed.*



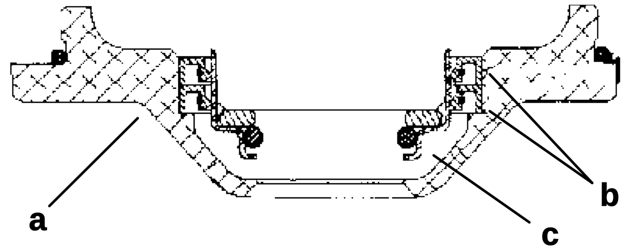
a - 1171-9787A1
b - 1 Crankshaft Seal (Faces UP)
c - 1 Drive Shaft Seal (Faces DOWN)



a - 1171-9787A3
b - 1 Crankshaft Seal (Faces UP)
c - 2 Drive Shaft Seals (Both Face DOWN)



a - 1171-9787A4
b - 2 Crankshaft Seals (Both Face DOWN)



a - 1171-9787A5
b - 2 Crankshaft Seals (Both Face DOWN)
c - 1 Drive Shaft O-Ring w/Sleeve that slides over Crankshaft

9. Install oil seals into typical lower end cap as follows:

   a. Apply a thin bead of Loctite Type 271 (92-32609-1) to outer diameter of lower end cap oil seals.

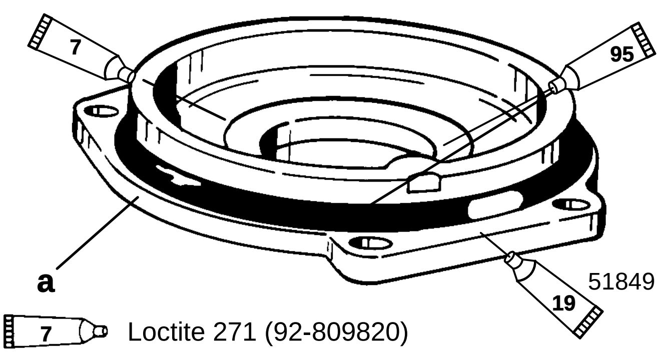
   b. Using driver head (91-55919) or suitable mandrel, press one oil seal (lip facing DOWN) into lower end cap until firmly seated. Remove any excess Loctite.

   c. Press second oil seal (lip facing UP or DOWN, as required by specific end cap) until firmly seated on first oil seal. Remove any excess Loctite.

   d. Lubricate oil seal lips with 2-4-C w/Teflon (92-825407A12).

   e. Apply a light coat of Perfect Seal (92-34227-1) to end cap flange.

   f. Lubricate O-ring seal with 2-4-C w/Teflon (92-825407A12) and install over lower end cap.

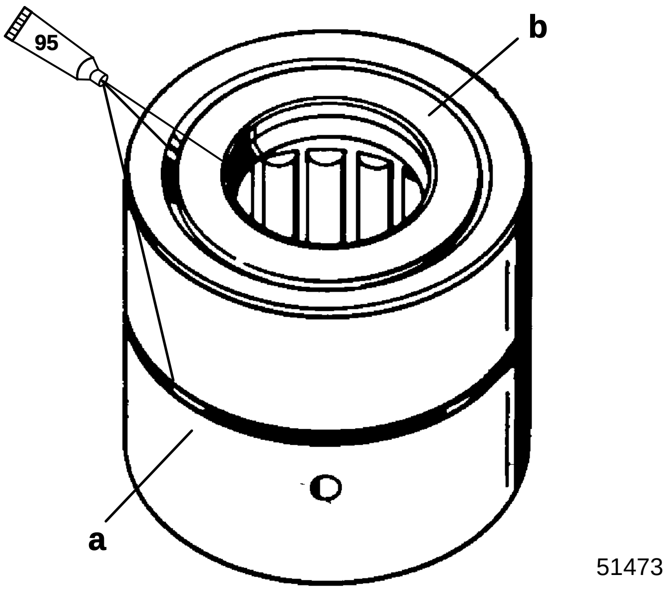


51849

7 Loctite 271 (92-809820)
19 Perfect Seal (92-34227-1)
95 2-4-C With Teflon (92-825407A12)

a - O-ring

10. Install oil seal into upper bearing carrier assembly as follows:
    a. Apply a light film of 2-4-C w/Teflon (92-825407A12) to outer diameter of oil seal; this will ease seal installation into carrier.
    b. Lubricate oil seal lip with 2-4-C w/Teflon.
    c. Use a suitable mandrel, press oil seal into carrier (lip facing DOWN) until bottomed out on shoulder of carrier.
    d. Lubricate O-ring with 2-4-C w/Teflon and install on carrier.



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

a - O-ring
b - Seal

Crankshaft Installation

SPECIAL INFORMATION

Installing A New Crankshaft Assembly Into Cylinder Block

Check the crankshaft sealing ring mating surfaces in the cylinder block and crankcase cover for wear grooves that were caused by the crankshaft sealing rings from the previous crankshaft. If wear grooves are present, the sealing rings on the new crankshaft will have to fit into the grooves without binding the crankshaft.

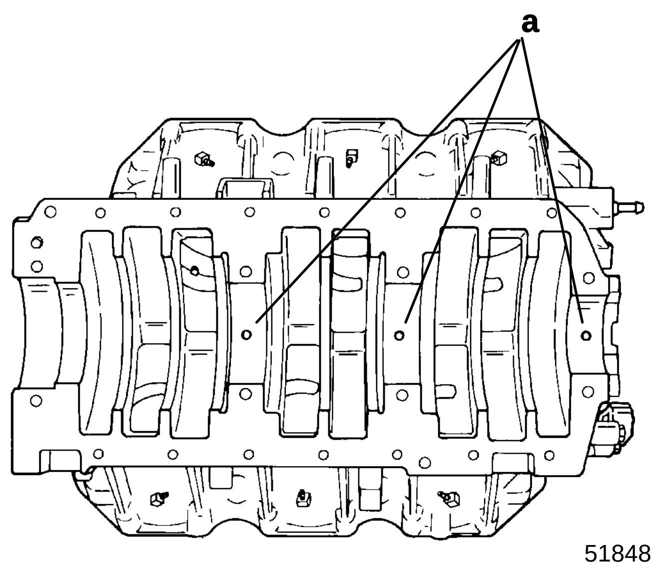
Before installing crankshaft, remove any burrs that may exist on groove edges.

Lubricate sealing rings with light oil and install new crankshaft as instructed.

Install upper and lower end caps and then inspect fit between sealing rings and grooves. Temporarily install crankcase cover and rotate crankshaft several times to check if sealing rings are binding against crankshaft. (You will feel a drag on the crankshaft.) If sealing rings are binding, recheck grooves for burrs. If this does not correct the problem, it is recommended that the cylinder block be replaced.

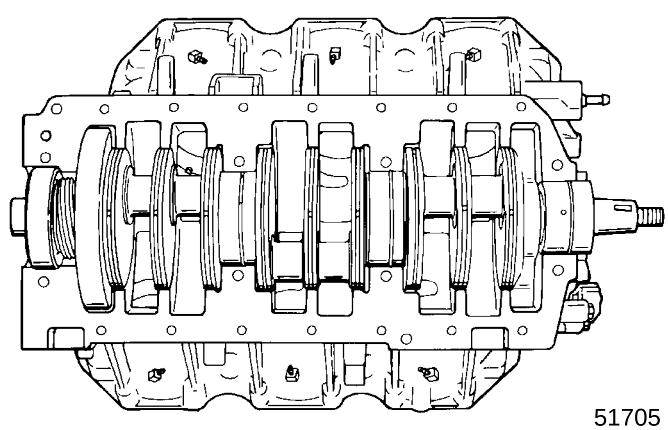
Install crankshaft as follows:

1. Lubricate crankshaft sealing rings with light oil.
2. Check cylinder block to be sure that dowel pins are in place.

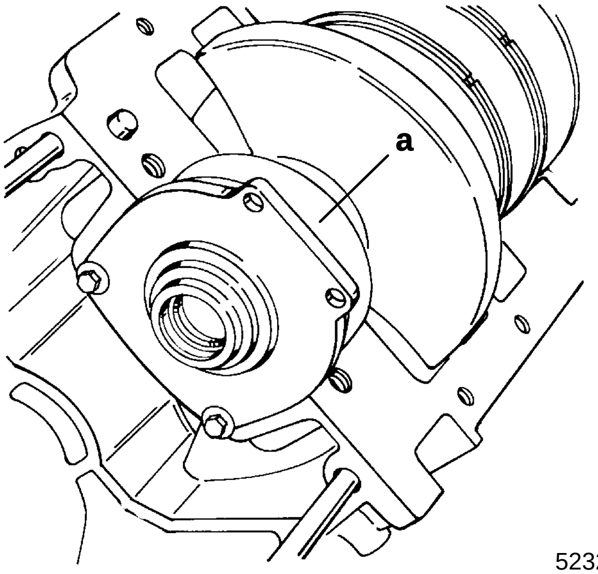


a - Dowel Pins

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.



6. Lubricate lower crankshaft end (oil seal area) with light oil, then install lower end cap. Secure end cap to cylinder block with attaching bolts. DO NOT tighten end cap bolts at this time.



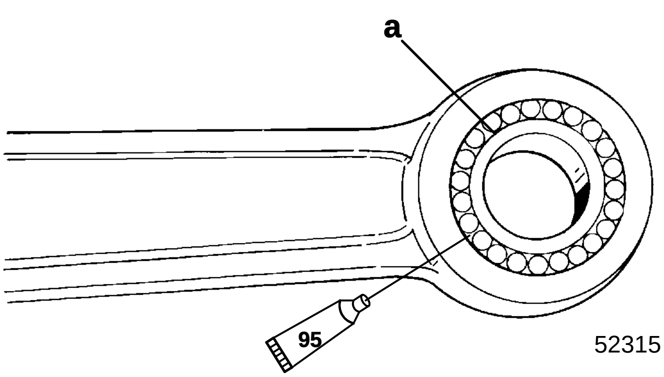
a- Lower End Cap

Piston and Connecting Rod Reassembly

1. Place needle bearings on a clean piece of paper and lubricate with 2-4-C w/Teflon (92-825407A12).

NOTE: *There are 34 needle bearings per piston.*

2. Place sleeve which is part of piston pin tool (91-92973A1) into connecting rod and install needle bearings around sleeve as shown.



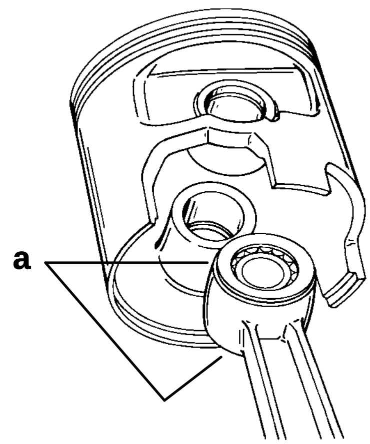
95 2-4-C With Teflon (92-825407A12)

a - Sleeve (Part of Tool Assy. 91-92973A1)

3. Place locating washers on connecting rod.

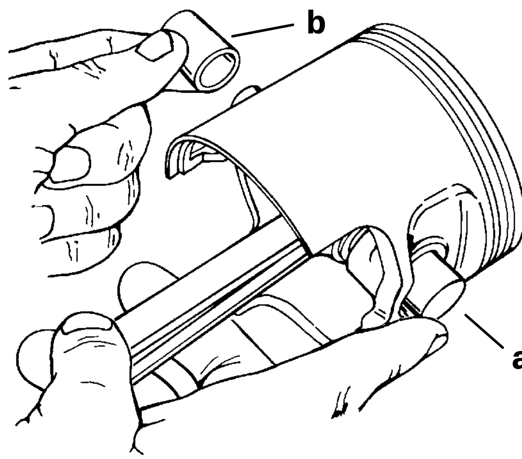
IMPORTANT: Position connecting rod part number facing towards flywheel.

Position piston over end of rod. Verify locating washers remain in place.



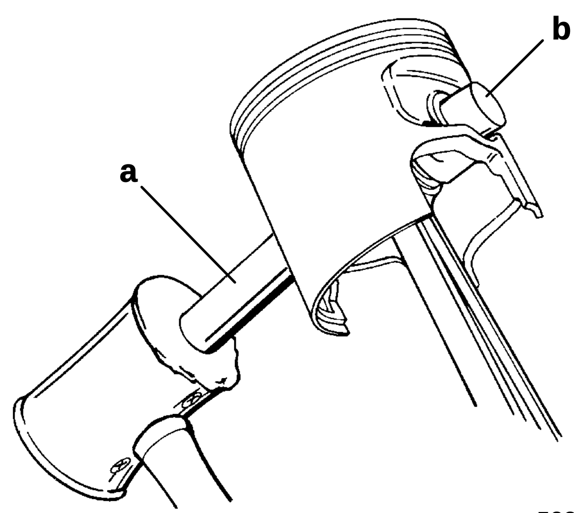
a - Locating Washers

4. Insert piston pin tool (91-92973A1) and push sleeve out of piston. Keep piston pin tool in piston.



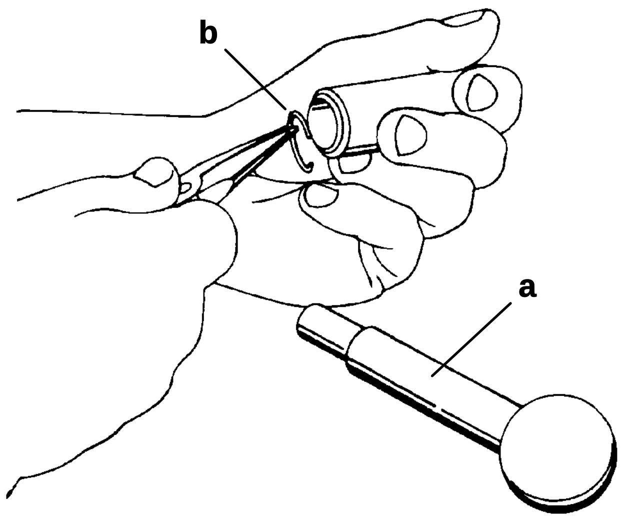
a - Piston Pin Tool (91-92973A1)
b - Sleeve

5. Use a mallet and tap piston pin into piston and push piston pin tool out.



a - Piston Pin
b - Piston Pin Tool

6. Install new piston pin lockrings (one each end of piston pin) with Lockring Installation Tool (91-93004A2).
7. Make sure lockrings are properly seated in piston grooves.



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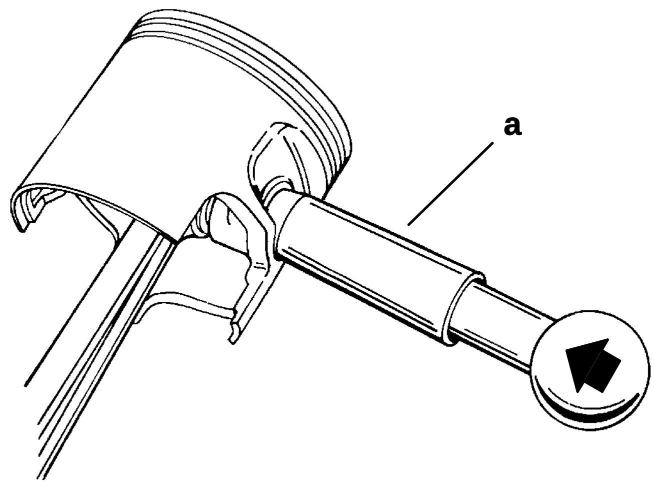
a - Lockring Installation Tool (91-93004A2)
b - Lockring



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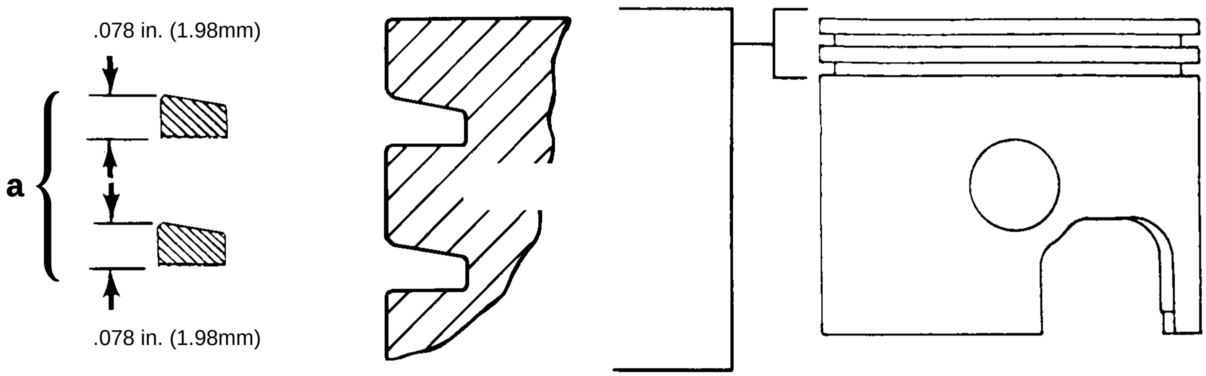
a - Lockring Installation Tool

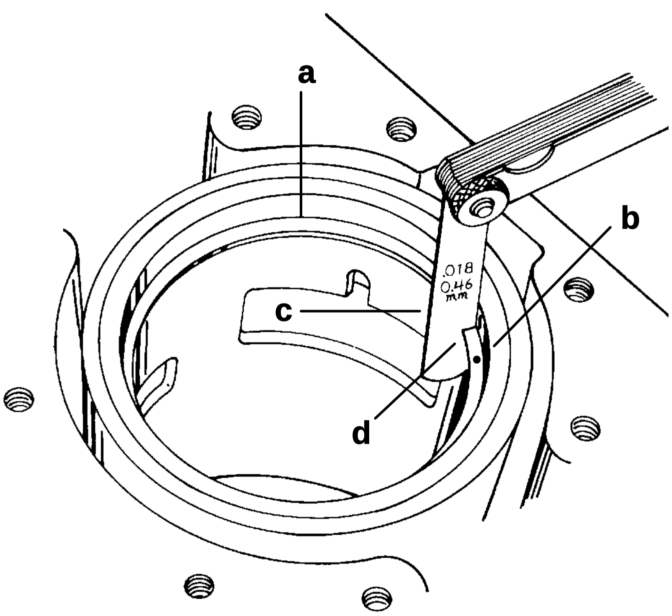
Piston and Piston Ring Combination



a - Half Keystone (tapered) Piston Ring

Piston Installation

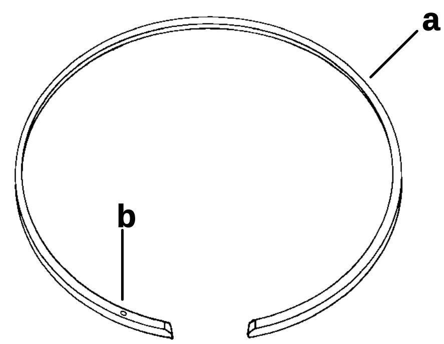
1. Before installing new piston rings, check gap between ring ends by placing each ring in its respective cylinder, then pushing ring about 1/2 in. (12.7mm) into cylinder using piston to assure proper position.
2. Check end gap of each new piston ring with a feeler gauge. End gap must be within 0.010 in. to 0.018 in. (0.25mm to 0.46mm). If end gap is greater, check other piston rings in cylinder bore, until rings (within tolerance) are found.



52327

a - Piston Ring
b - Dots (Faces Up)
c - Feeler Gauge
d - Ring End Gap

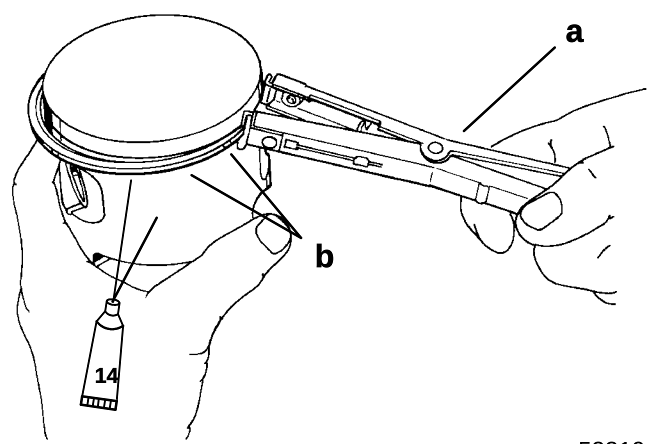
IMPORTANT: Piston ring side with dot or letter must be facing up.



52317

a - Piston Ring
b - Dot

3. Use Piston Ring Expander (91-24697) and install piston rings (dot side up) on each piston. Spread rings just enough to slip over piston.
4. Check piston rings to be sure that they fit freely in ring groove.
5. Lubricate piston, rings and cylinder wall with 2-Cycle Outboard Oil.



52319

14 2 Cycle Outboard Oil (92-826666A24)

a - Piston Ring Expander
b - Dot Side "UP" on Piston Ring

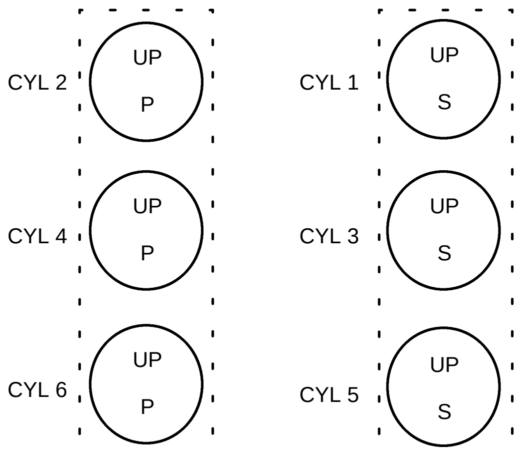
6. Rotate each piston ring so end of ring is aligned with locating pin as shown.
7. Install Piston Ring Compressor.
8. Remove screws and connecting rod cap from piston rod assembly being installed.

IMPORTANT: Piston must be correctly installed and positioned as shown.

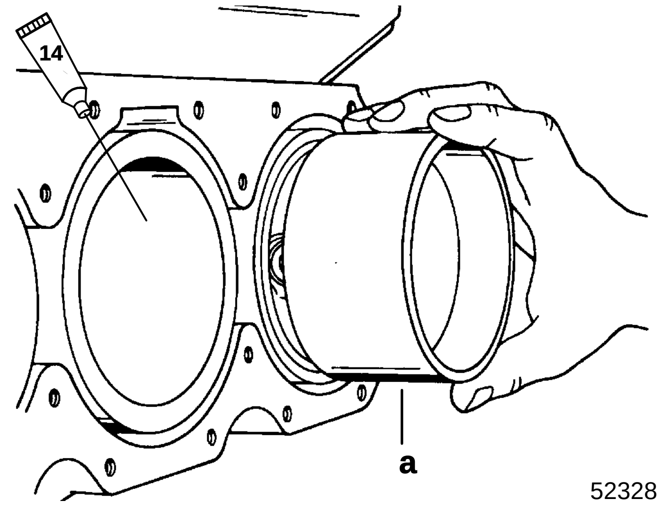
Pistons marked with the word "UP" and with the letter "P" or "S" on top of piston.

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.



14 2 Cycle Outboard Oil (92-826666A24)

a - Piston Ring Compressor (91-823237)

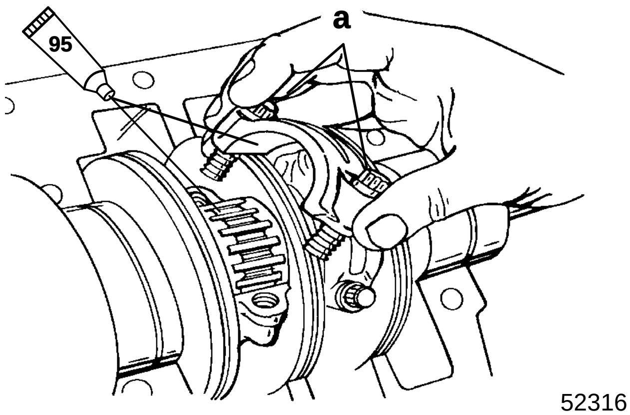
10. Apply 2-4-C w/Teflon to bearing surface of connecting rod and install bearing assembly, as shown.
11. Place connecting rod cap on connecting rod. Apply light oil to threads and face of connecting rod bolts. Thread connecting rod bolts finger-tight while checking for correct alignment of the rod cap as shown.

IMPORTANT: Connecting rod and connecting rod caps are matched halves. Do not torque screws before completing the following procedure.

- Run a pencil lightly over ground area.
- If pencil stops at fracture point, loosen bolts, retighten, and check again.

NOTE: *If you still feel the fracture point, discard the rod.*

12. Tighten connecting rod bolts (using a 5/16 in. - 12 point socket) First torque to 15 lb. in. (1.7 N·m) then 30 lb. ft. (41.0 N·m). Turn each bolt an additional 90° after 2nd torque is attained. Recheck alignment between rod cap and rod as shown.



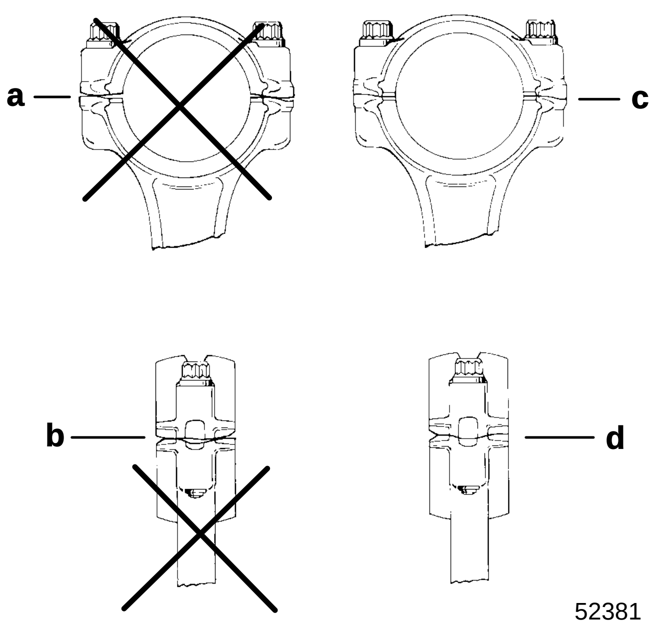
95 2-4-C With Teflon (92-825407A12)

a - Connecting Rod Screws

13. Rotate crankshaft several times (using powerhead stand) to assure free operation (no binds and catching).

Connecting Rod Cap Alignment

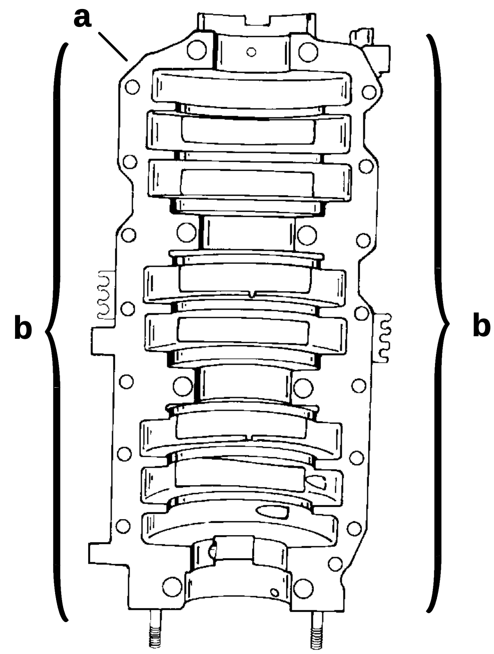
Check each connecting rod cap for correct alignment. If not aligned, a ridge can be seen or felt at the separating line as shown below. Correct any misalignment.



a - Side View Incorrect – Cap on Backwards
b - End View Incorrect – Cap on Backwards
c - Side View Correct
d - End View Correct

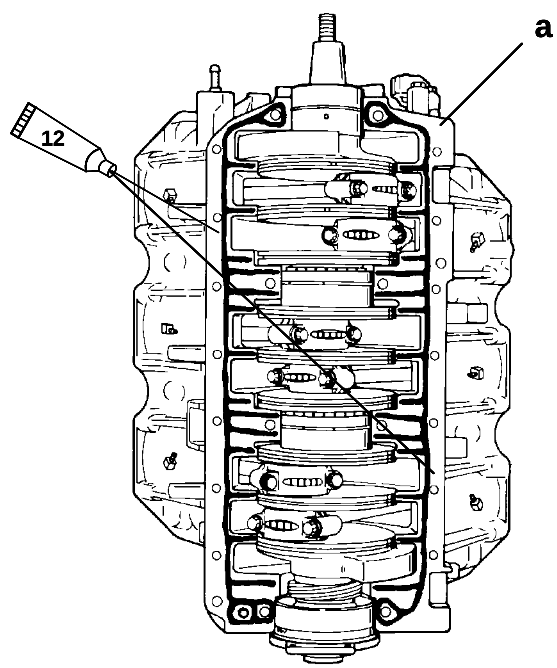
Crankcase Cover Installation

1. Thoroughly remove all oil from mating surfaces of crankcase cover and cylinder block with Loctite Primer 203 included in Master Gasket Kit (92-12564-1).



a - Crankcase Cover
b - Remove All Oil

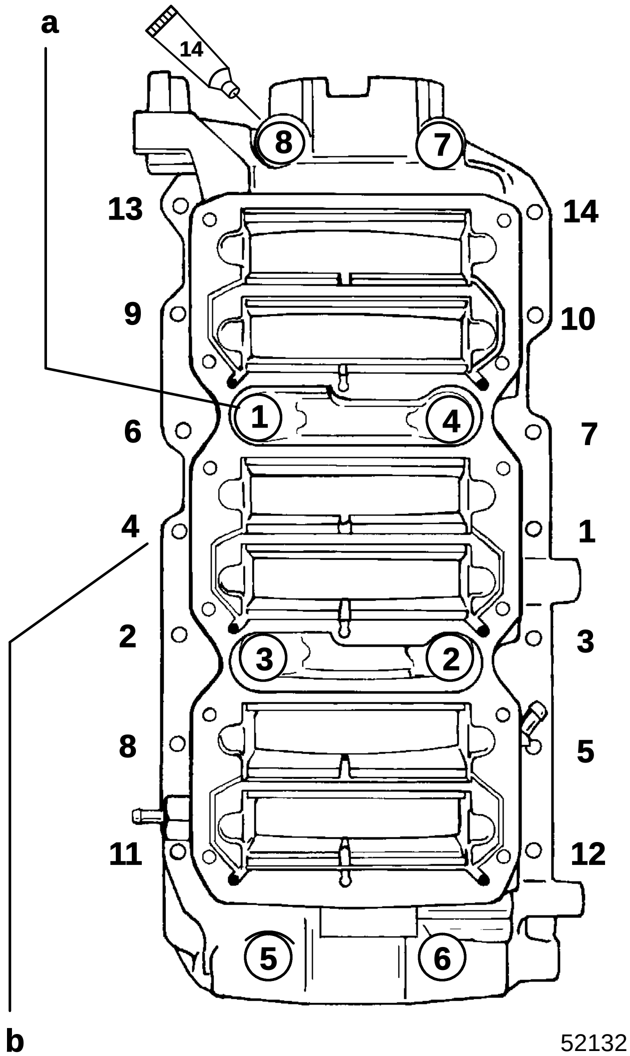
2. Apply a thin, even coat of Loctite Master Gasket on mating surface of cylinder block.



12 Loctite Master Gasket (92-12564-2)

a - Loctite Master Gasket (92-12564-1)

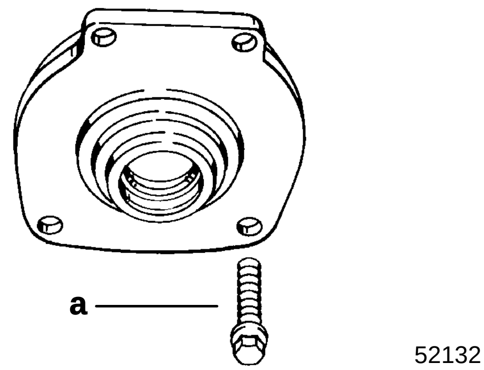
3. Place crankcase cover in position on cylinder block. Turn the 8 center main bolts in a LITTLE at a time, (following torque sequence) compressing crankshaft seal rings until crankshaft cover has been drawn down to cylinder block. Tighten eight bolts (a) evenly in three progressive steps (following torque sequence).
4. Install remaining crankcase cover flange bolts (following torque sequence).



14 2 Cycle Outboard Oil (92-826666A24)

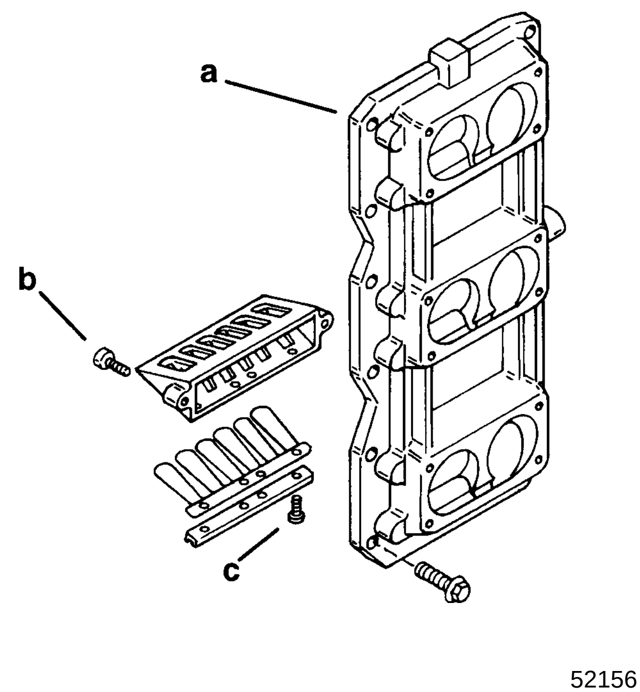
a - Add a Small Amount of Light Oil to Threads and Bolt Face;
8 Bolts (M10 x 1.5 x 80);
30 lb. ft. (40.5 N·m) and Rotate 90°
b - 14 Bolts (M8 x 1.25 x 35)
28 lb. ft. (37.9 N·m)

5. Tighten end cap bolts to specified torque.



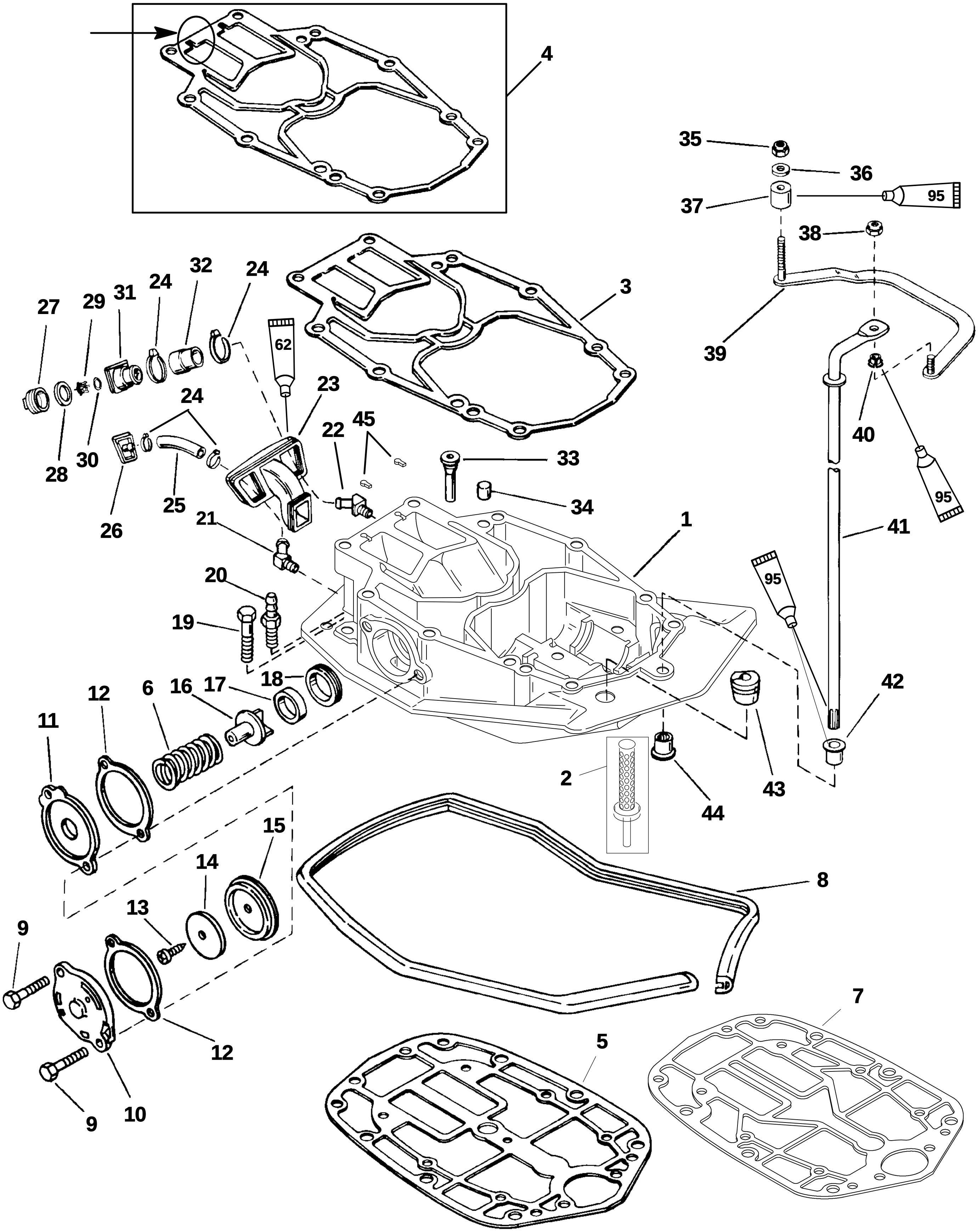
a - Torque Bolts to 85 lb. in. (9.6 N·m)

Assembly of Reed Blocks to Intake Manifold



a - Intake Manifold Bolts [Torque to 100 lb. in. (11.3 N·m)]
b - Reed Block Mounting Bolts [Torque to 90 lb. in. (10.2 N·m)]
c - Reed Attaching Screws [Torque to 25 lb. in. (2.8 N·m)]

Exhaust Plate w/Water Pressure Relief Valve Components



62 3M Permabond #3MO8155 (Obtain Locally)

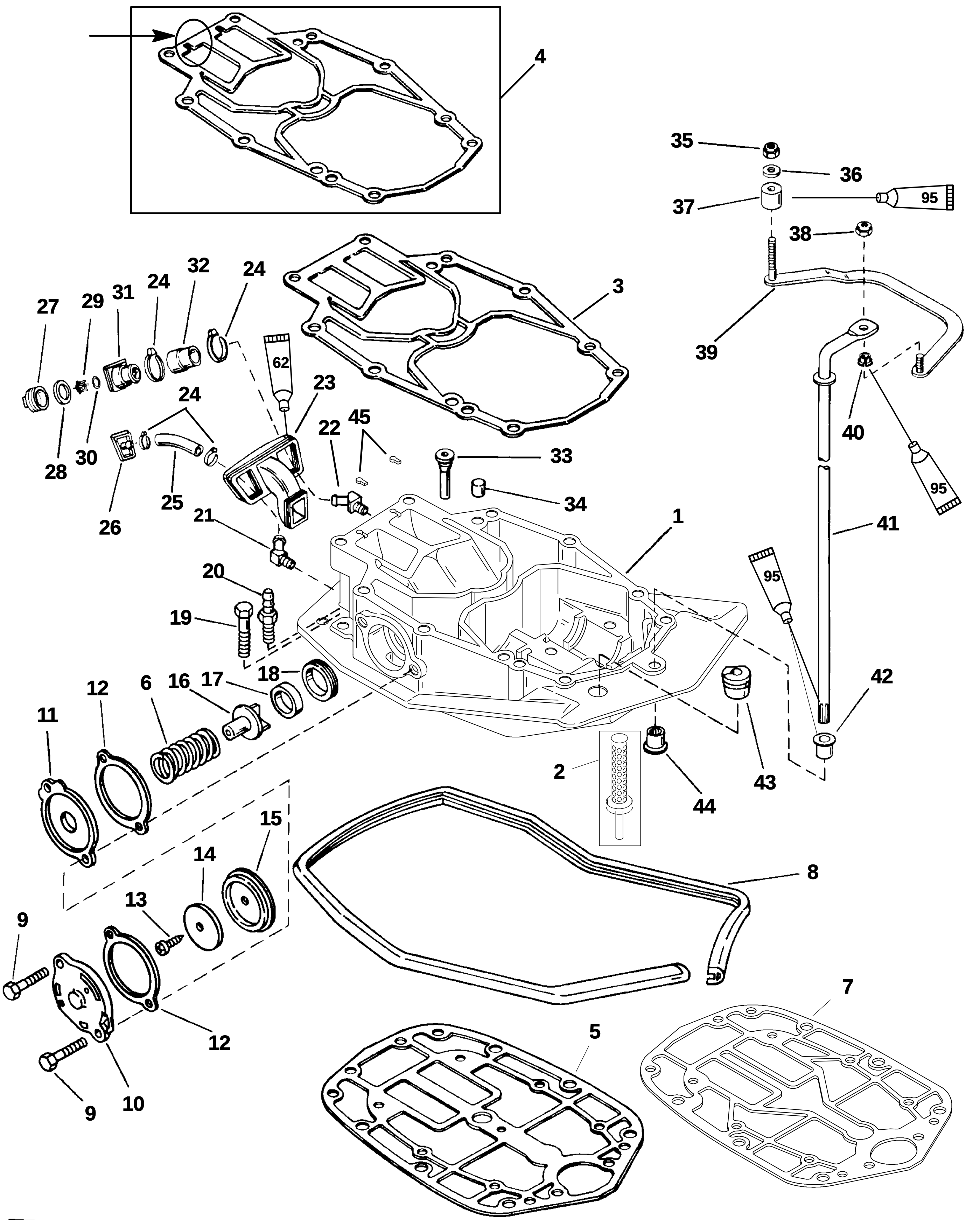
95 2-4-C With Teflon (92-825407A12)

Exhaust Plate w/Water Pressure Relief Valve Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	EXHAUST PLATE **(W/O REF #2)**			
	1	EXHAUST PLATE **(WITH REF #2)**			
2	2	STRAINER **S/N-0G437999 & BELOW**			
3	1	GASKET			
4	1	GASKET **(Refer to Service Bulletin #94-11)**			
5	1	GASKET (LOWER)			
6	1	SPRING			
	1	SPRING			
1	1	EXHAUST PLATE **S/N-0G438000 & UP**			
3	1	GASKET			
7	1	GASKET (LOWER)			
8	1	SEAL			
9	2	SCREW (M8 x 35)	240	20	27.1
10	1	COVER			
11	1	RELIEF VALVE PLATE ASSEMBLY			
12	2	GASKET			
13	1	SCREW	Drive Tight		
14	1	WASHER			
15	1	DIAPHRAGM			
16	1	POPPET			
17	1	GROMMET			
18	1	CARRIER			
19	4	SCREW (M8 x 35)	300	25	33.9
20	2	CONNECTOR			
21	1	ELBOW (45 degrees)			
22	1	ELBOW (45 degrees)			

☞ = S/N-0G129222 & UP (13 TOOTH SPLINES)
☜ = S/N-0G129221 & BELOW (8 TOOTH SPLINES)
✻ = NOTE: WHEN ORDERING REPLACEMENT POWERHEAD FOR ENGINES WITH S/N-0G178947 & BELOW, REFER TO SERVICE BULLETIN #94-11, AND ORDER EXHAUST PLATE KIT 818450A1 IF NECESSARY.

Exhaust Plate w/Water Pressure Relief Valve Components



62 3M Permabond #3MO8155 (Obtain Locally)

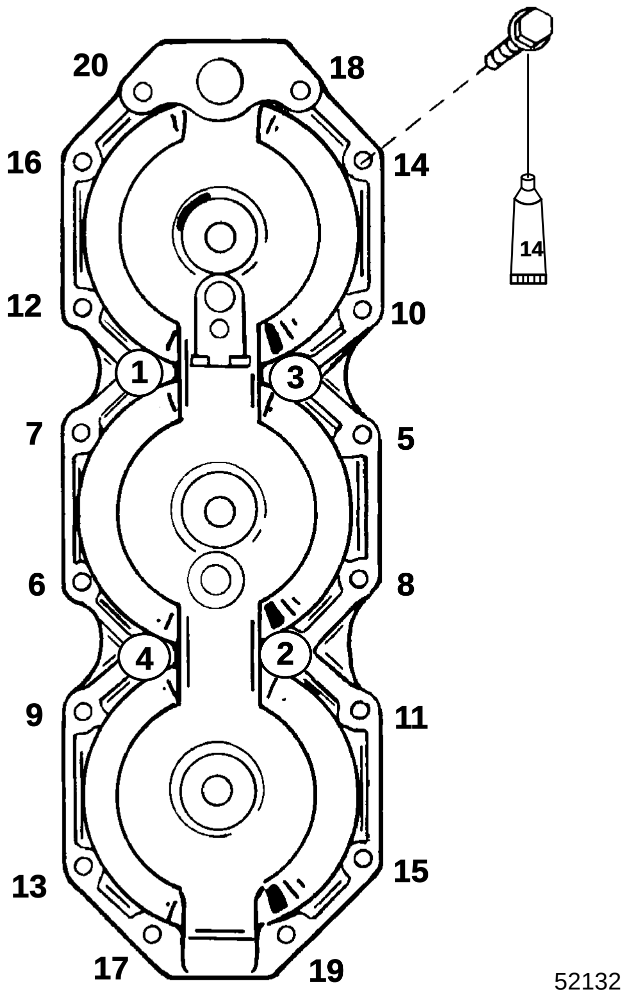
95 2-4-C With Teflon (92-825407A12)

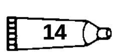
Exhaust Plate w/Water Pressure Relief Valve Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
23	1	IDLE EXHAUST BOOT			
24	AR	STA STRAP			
25	1	HOSE– telltale (2-1/2 IN.)			
26	1	FITTING– telltale			
27	1	PLUG			
28	1	WASHER			
29	1	CHECK VALVE			
30	1	O RING			
31	1	FITTING			
32	1	HOSE			
33	2	DRAIN CHECK VALVE			
34	4	DOWEL PIN			
35	1	NUT			
36	1	WASHER			
37	1	ROLLER			
38	1	NUT			
39	1	SHIFT LINK			
40	1	BUSHING			
41	1	UPPER SHIFT SHAFT **(LONG)**			
	1	UPPER SHIFT SHAFT **(X-LONG)**			
	1	UPPER SHIFT SHAFT **(XX-LONG)**			
42	1	BUSHING			
43	1	GROMMET			
44	1	COUPLING			
45	2	PLUG **(S/N-0G178947 & BELOW)**			

Cylinder Head Installation

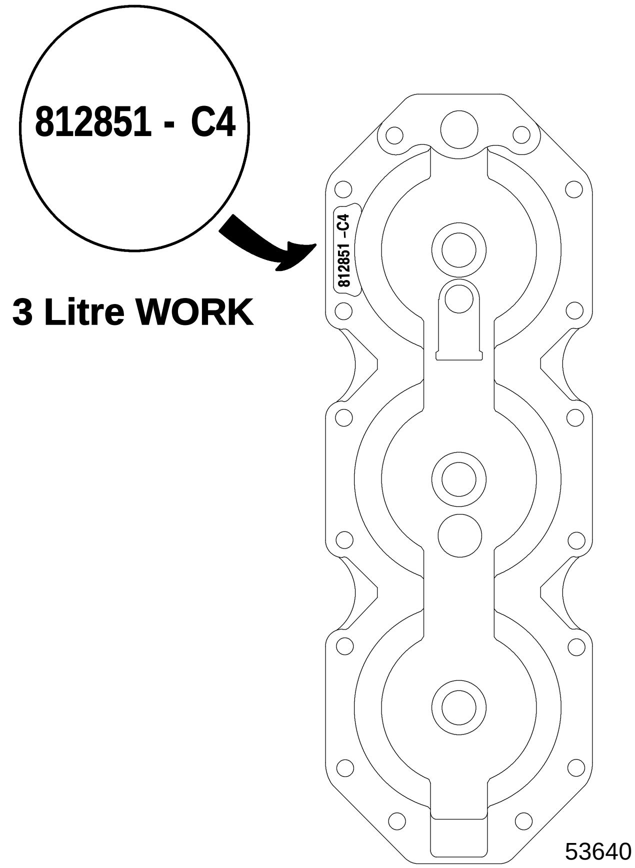
1. Install each cylinder head to engine block with thermostat pocket "UP". Apply light oil to cylinder head bolt threads and bolt face. Torque bolts 18 and 20 to 30 lb. ft. (40.5 N·m) and rotate 90°. Torque all other bolts to 20 lb. ft. (27.1 N·m) and rotate 90°.

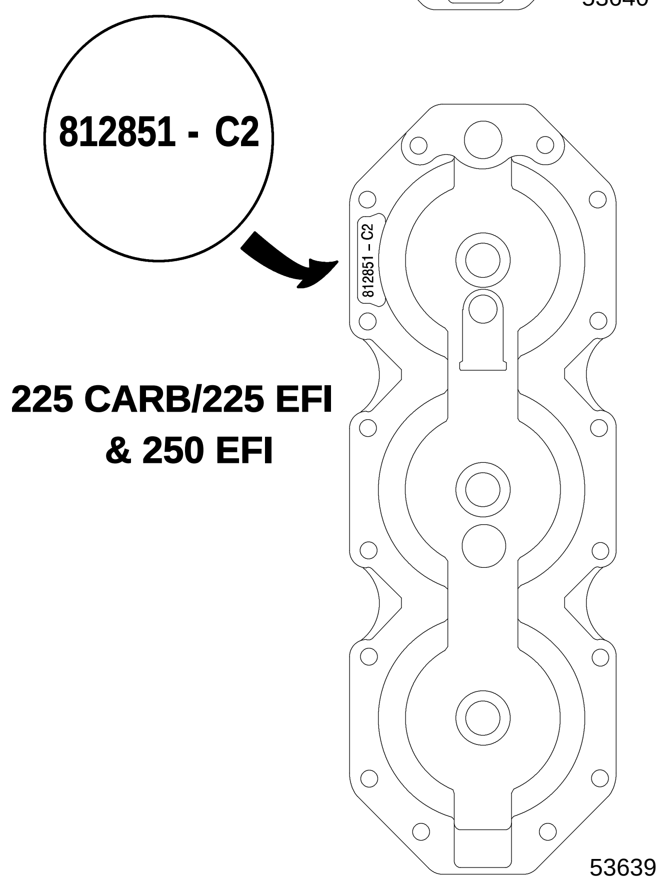




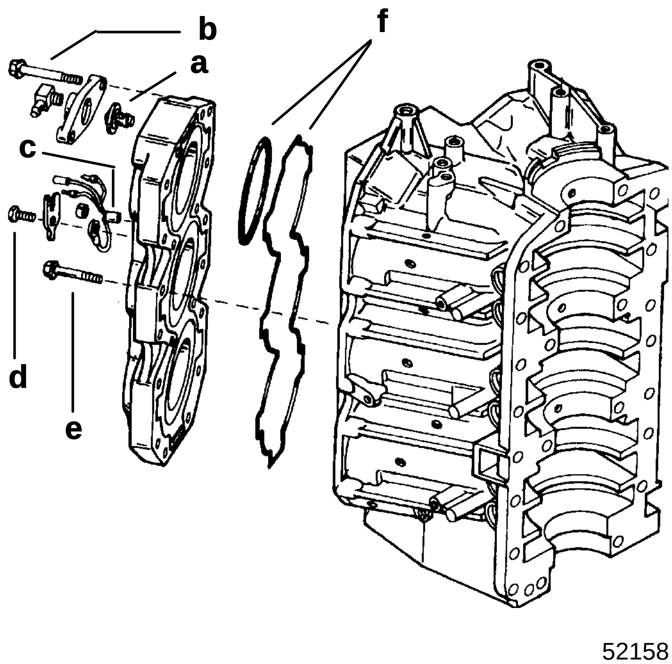
2 Cycle Outboard Oil (92-826666A24)

NOTE: *The 3 Litre Work has low compression cylinder heads which can be identified from other 225 CARB/ 225 EFI/ 250 EFI cylinder heads by the casting #.*





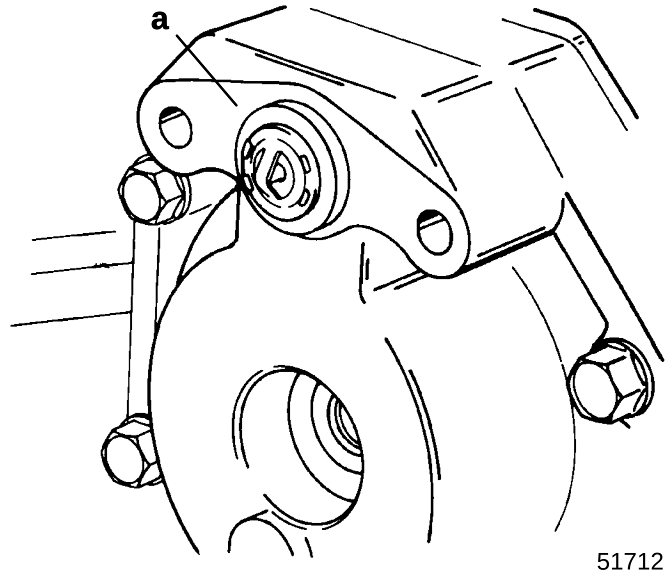
2. Install thermostat assembly into each cylinder head.
3. Install overheat temperature sensor into STARBOARD cylinder head below #1 spark plug.



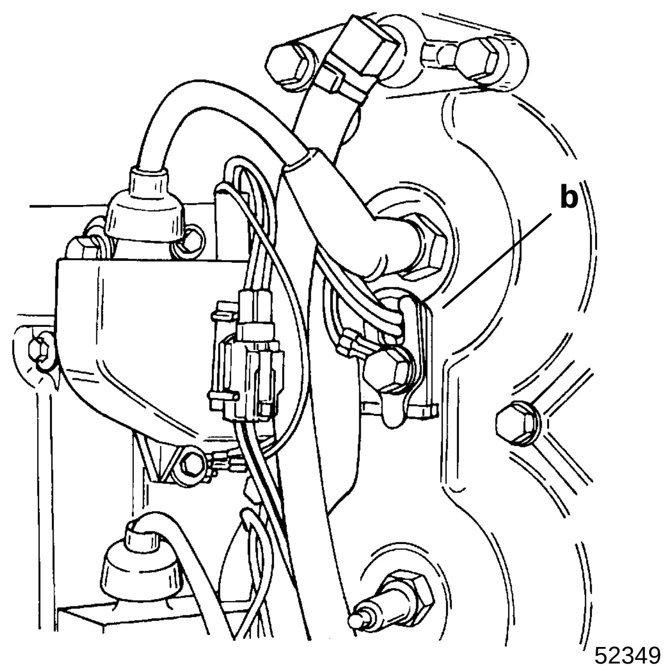
a - Thermostat (143°F - 61.7°C)
b - Bolt - Torque to 30 lb. ft. (40.5 N·m) and rotate 90°
c - Temperature Sensor
d - Bolt - Torque to 200 lb. in. (22.6 N·m)
e - Bolt - Torque to 20 lb. ft. (27.1 N·m) and rotate 90°
f - O-ring

***NOTE:** During normal engine operating temperature, the sender electrical circuit is open and will close if temperature reaches 200°F ± 8°F (93.3°C ± 13.3°C) thus activating the overheat alarm*.

4. Thermostat and temperature sensor installed.



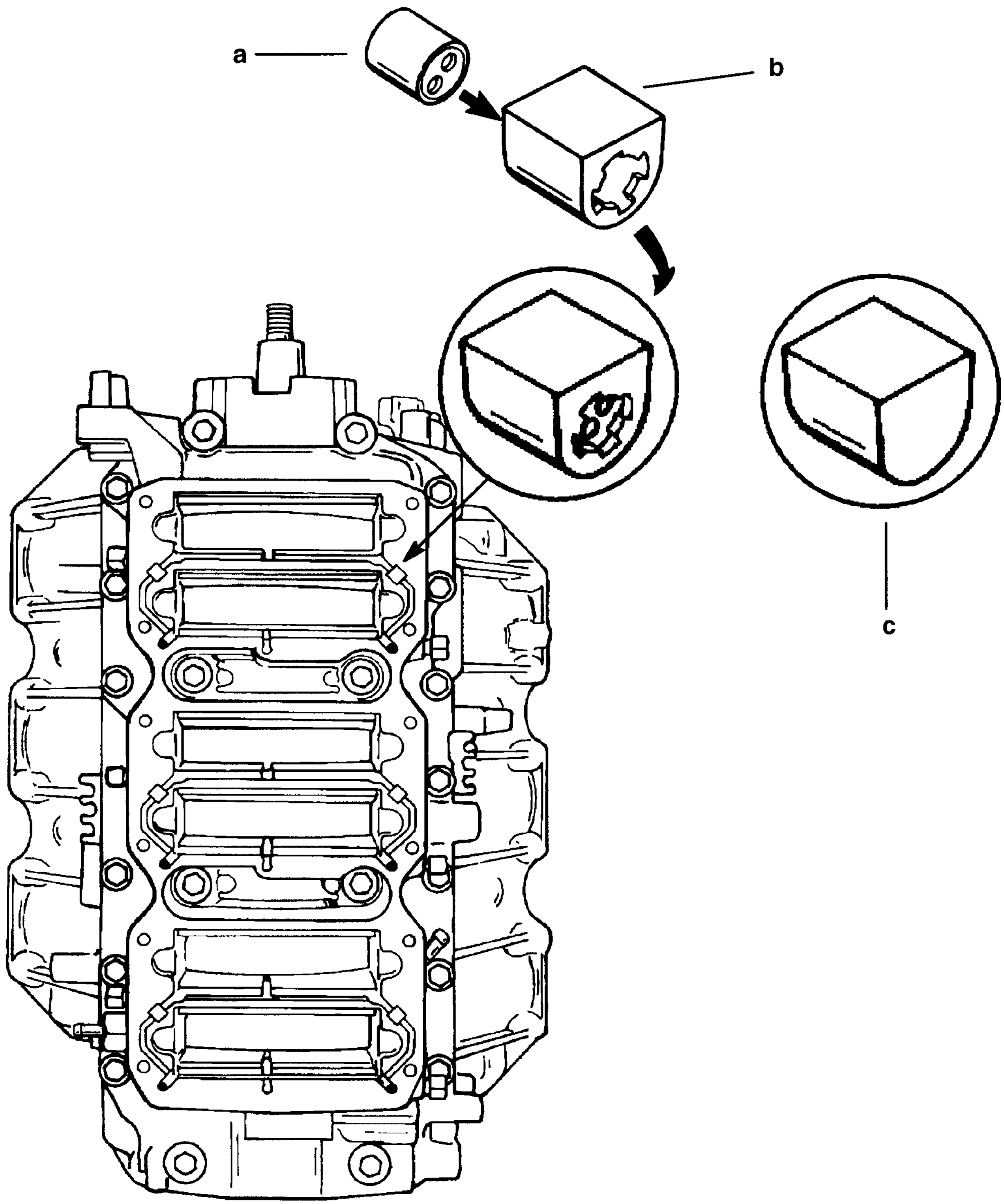
a - Thermostat [143°F (61.7°C)]



b - Overheat Temperature Sensor

3 Liter Work/225 Carb/225 EFI/250 EFI Bleed Routing 1994/1995/1996 Models (1997 Models DO NOT have Front Mounted Bleed Check Valves)

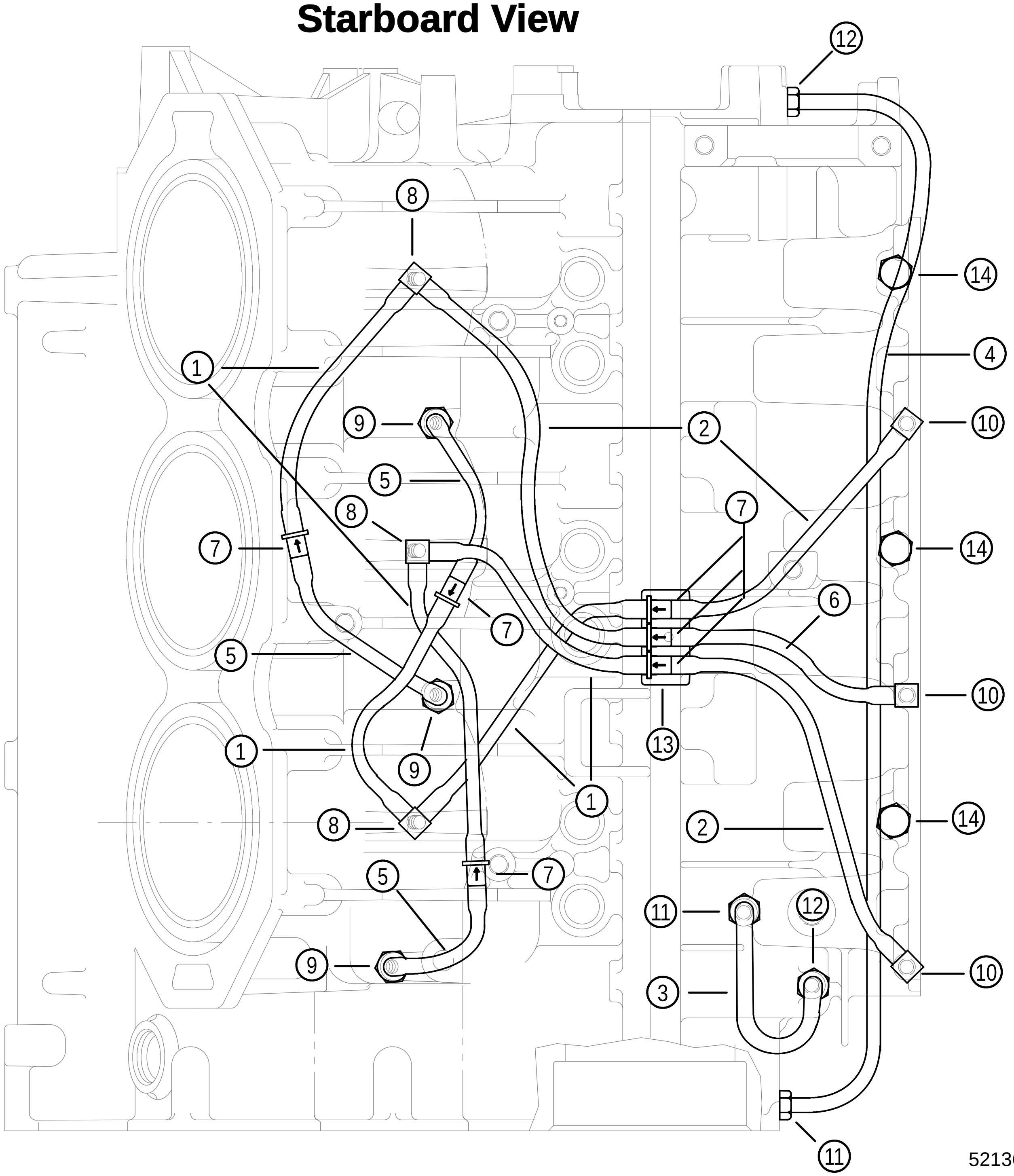
Front View



a - Check Valve (6 Each) (1994/1995/1996 Models)
b - Carrier (6 Each)
c - Carrier (No Check Valve – 1997 Models)

3 Liter Work/225 Carburetor Bleed Routing for 1995/1996 Models (SN 0G129222 to 0G437999)

Starboard View

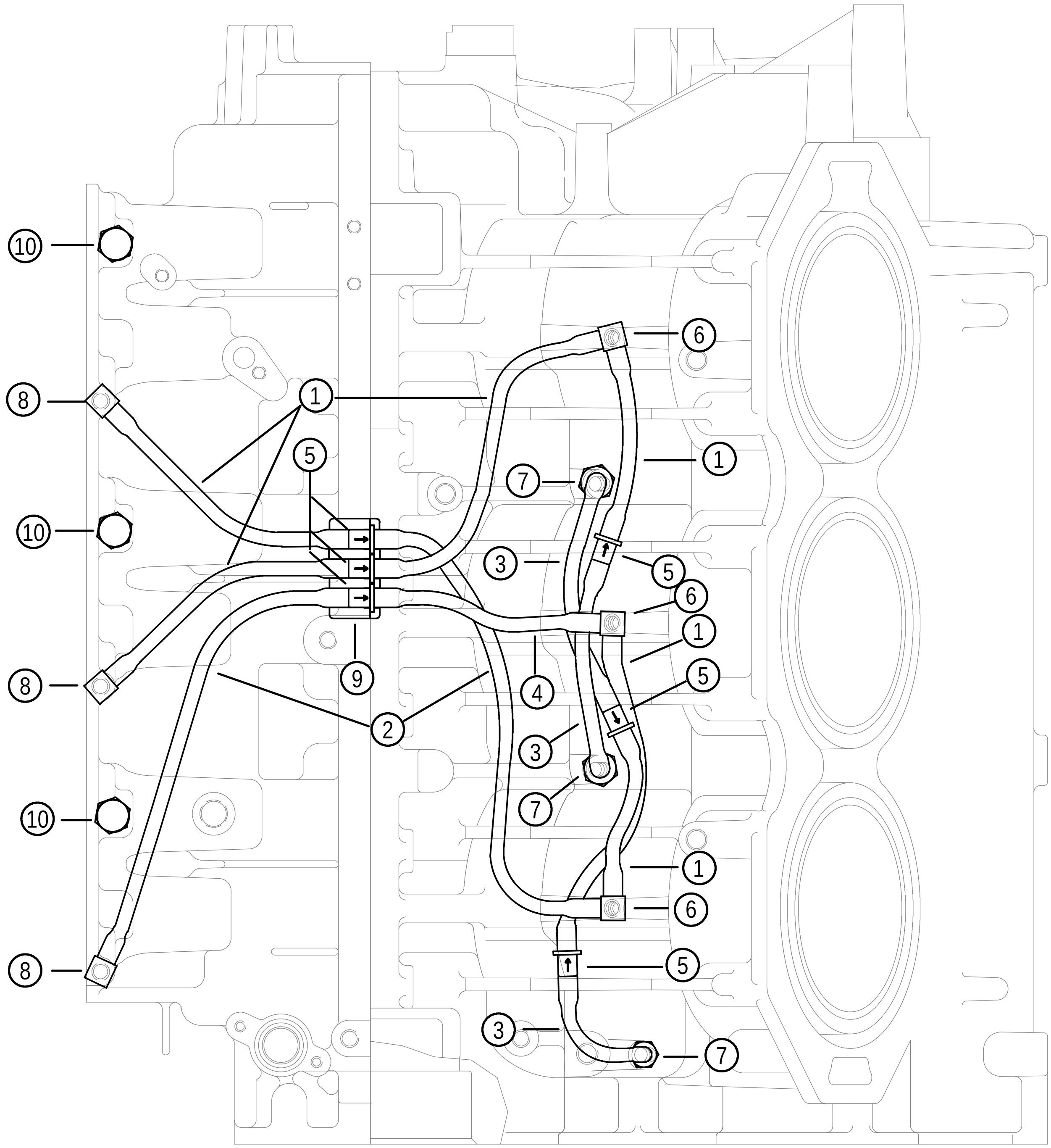


52136

1 - 6 in. (15.2cm) (5 ea.)
2 - 8.5 in. (21.6cm) (3 ea.)
3 - 4 in.(10.2cm)
4 - 22.5 in. (57.2cm)
5 - 3 in. (7.6cm)
6 - 4.5 in. (11.4cm)
7 - Check Valve (21-14912--2) (12 ea.)
8 - Fitting (22–824356-1) (3 ea.)
9 - Fitting (Straight) (22-824502-1)
10- Fitting (90°) (22-76843) (3 ea.)
11- Check Valve (21-42658-5) (2 ea.)
12- Check Valve (21-815923-4) (2 ea.)
13- Retainer (821556) (2 ea.)
14- Pipe Plug (1/16) (22-827201) (3 ea.)

3 Liter Work/225 Carburetor Bleed Routing for 1995/1996 Models (SN 0G129222 to 0G437999)

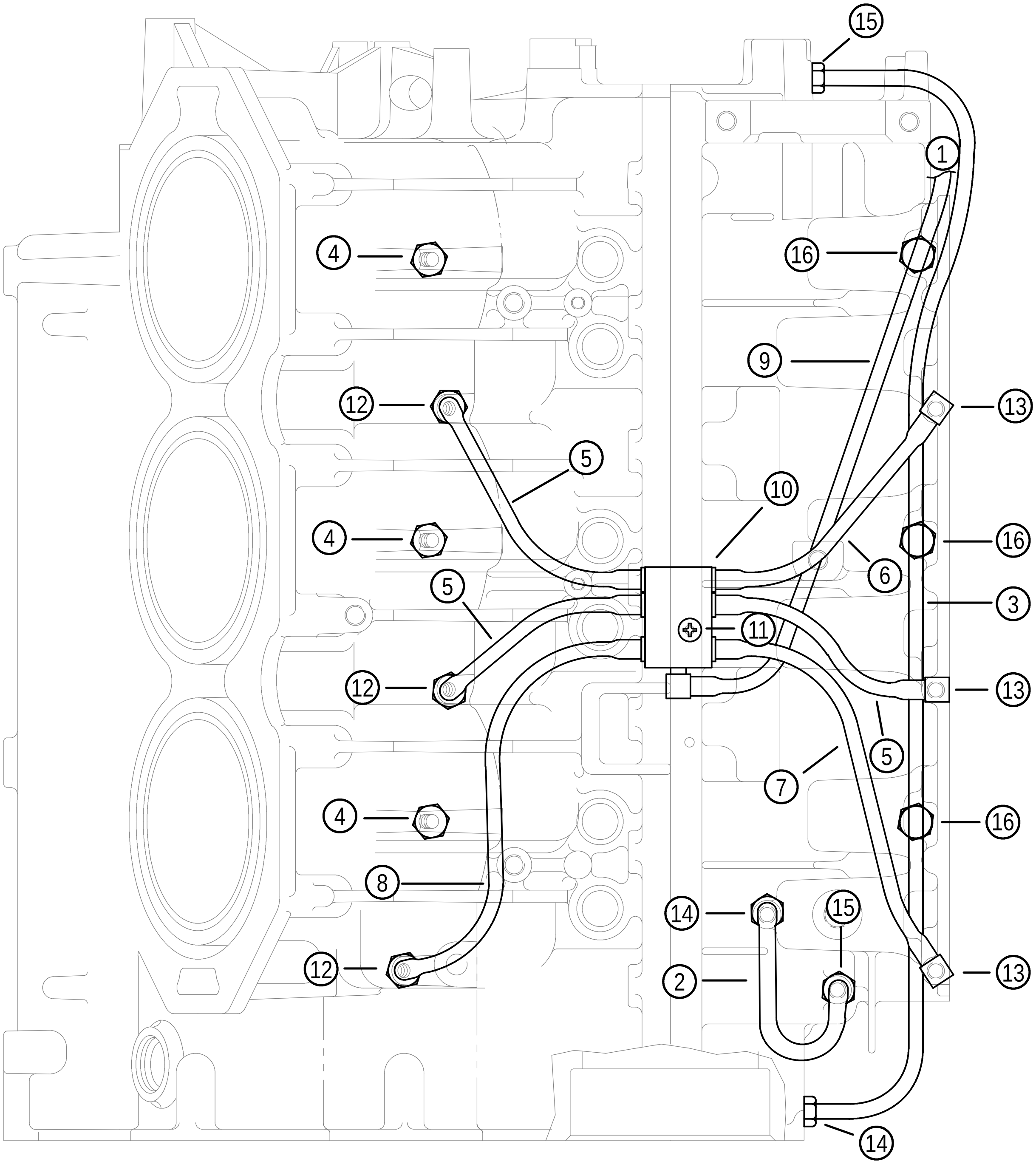
Port View



1 - 6 in. (15.2cm) (6 ea.)
2 - 8.5 in. (21.6cm) (2 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 4.5 in. (11.4cm)
5 - Check Valve (21-14912--2) (6 ea.)
6 - Fitting (22-76843) (3 ea.)
7 - Fitting (Straight) (22-824502-1) (3 ea.)
8 - Fitting (90°) (22-76843)
9 - Retainer (821556)
10- Pipe Plug (1/16) (22-827201) (3 ea.)

225 EFI/250 EFI Bleed Routing for 1995/1996 Models (SN 0G129222 to 0G437999)

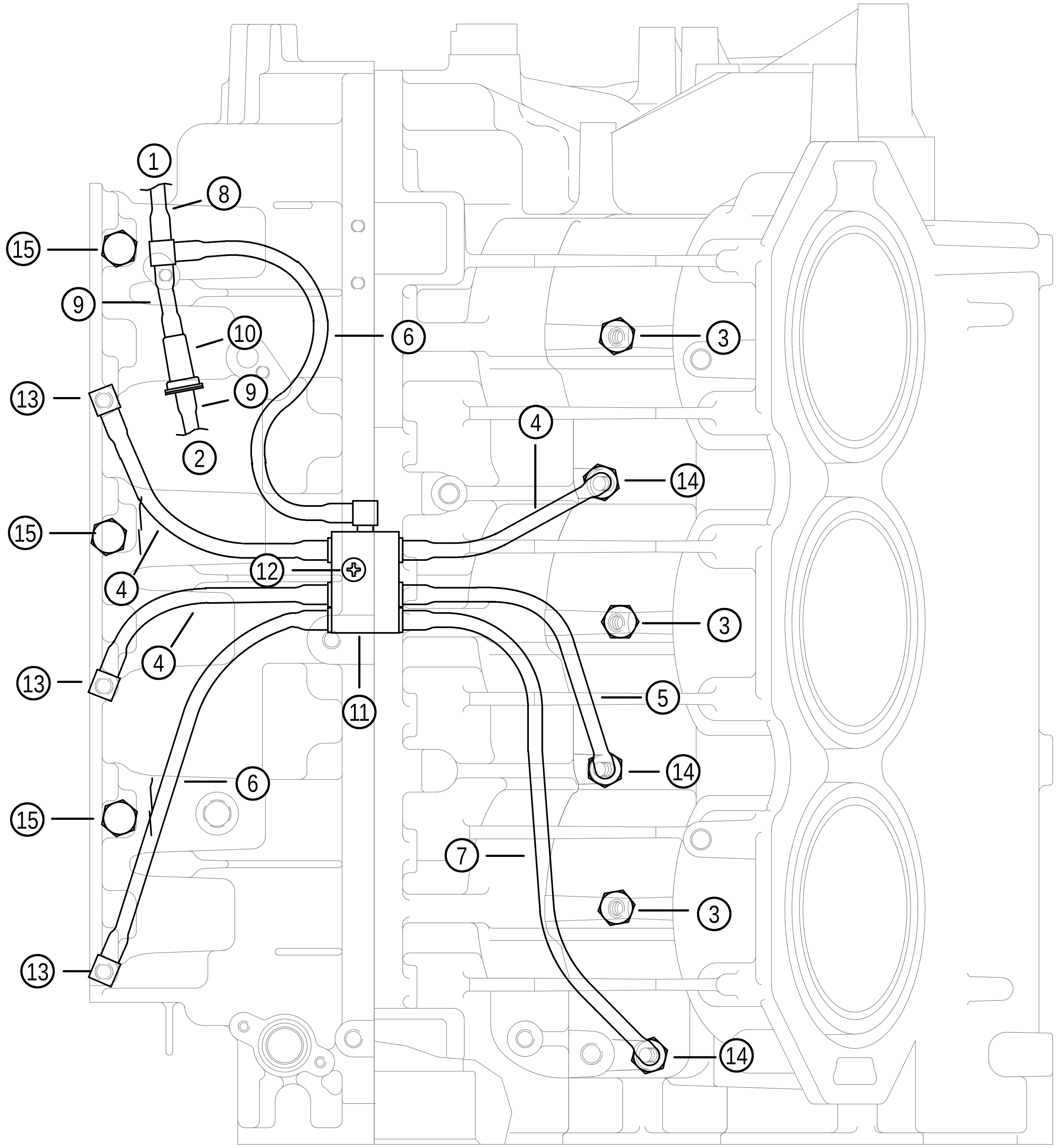
Starboard View



1 - Continuation of bleed line from PORT side
2 - 4 in. (10.2cm)
3 - 22.5 in. (57.2cm)
4 - Pipe Plug (1/16) (3 ea.)
5 - 5.25 in. (13.3cm) (3 ea.)
6 - 7 in. (17.8cm)
7 - 8-1/2 in. (21.6cm)
8 - 9 in. (22.9cm)
9 - 17 in. (43.2cm)
10- Manifold (827210A1)
11- Screw (10-16x3/4) (10-92051) (2 ea.)
12- Pipe Plug (1/16) (22-827201)
13- Fitting (90°) (22-76843)
14- Check Valve (21-42658-5) (2ea.)
15- Check Valve (21-815923--4) (2ea.)
16- Pipe Plug (1/16) (22-827201) (3 ea.)

225 EFI/250 EFI Bleed Routing for 1995/1996 Models (SN 0G129222 to 0G437999)

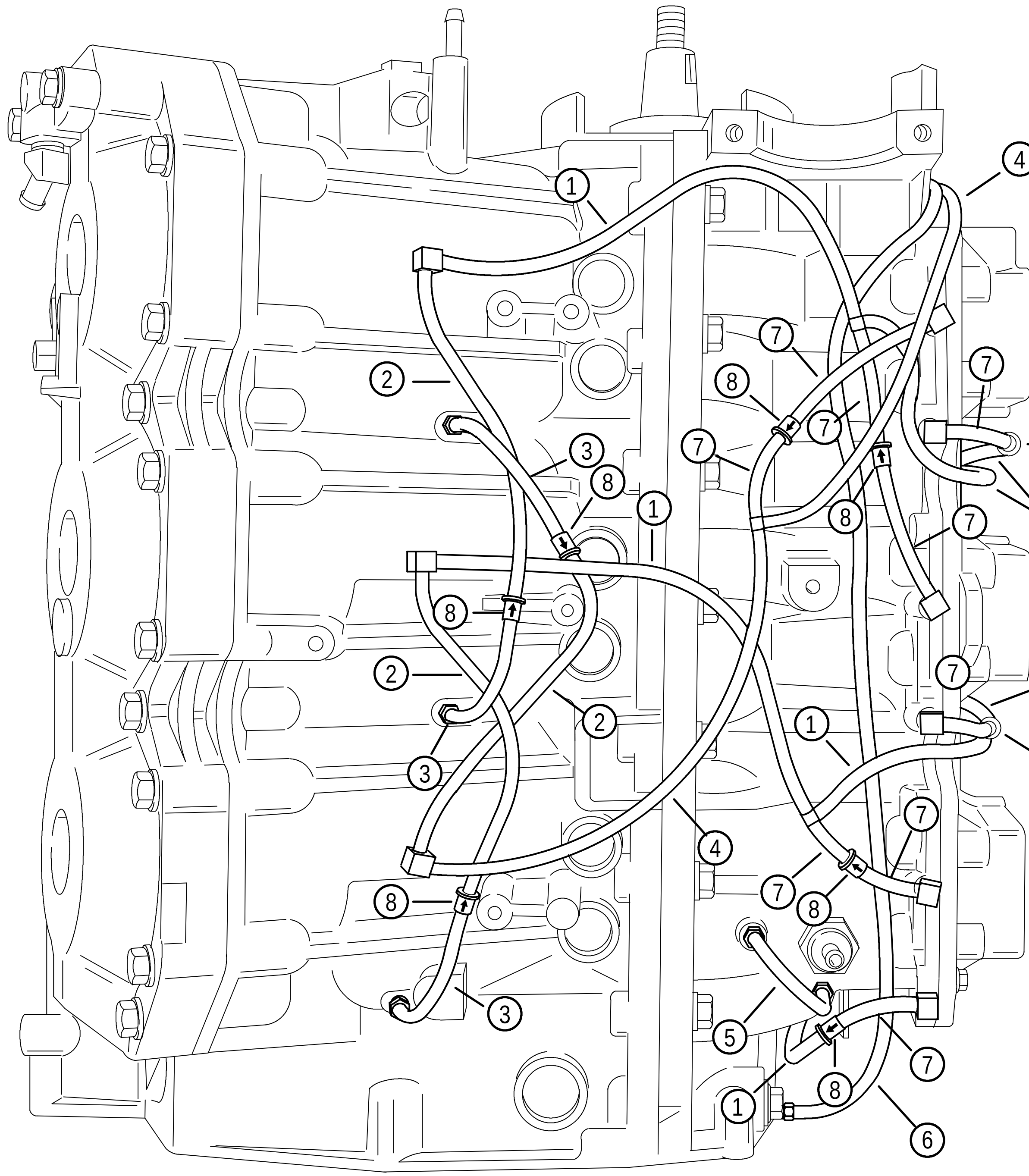
Port View



1 - Continuation of Bleed Line from STARBOARD side.
2 - To Vapor Separator
3 - Pipe Plug (1/16) (3 ea.)
4 - 5.25 in. (13.4cm) (3 ea.)
5 - 7 in. (17.8cm)
6 - 9 in. (22.8cm) (2 ea.)
7 - 11 in. (27.9cm)
8 - 17 in. (43.2cm)
9 - 1.75 in. (4.5cm) (2 ea.)
10- Filter (35-18206)
11- Manifold (827210A1)
12- Screw (10-16x3/4) (10-92051)
13- Fitting (90°) (22-76843) (3 ea.)
14- Fitting (Straight) (22-824502-1) (3 ea.)
15- Pipe Plug (1/16) (22-827201) (3 ea.)

1997 3 Liter Work and 225 Carburetor Models (SN 0G438000 to 0G485988)

Starboard View

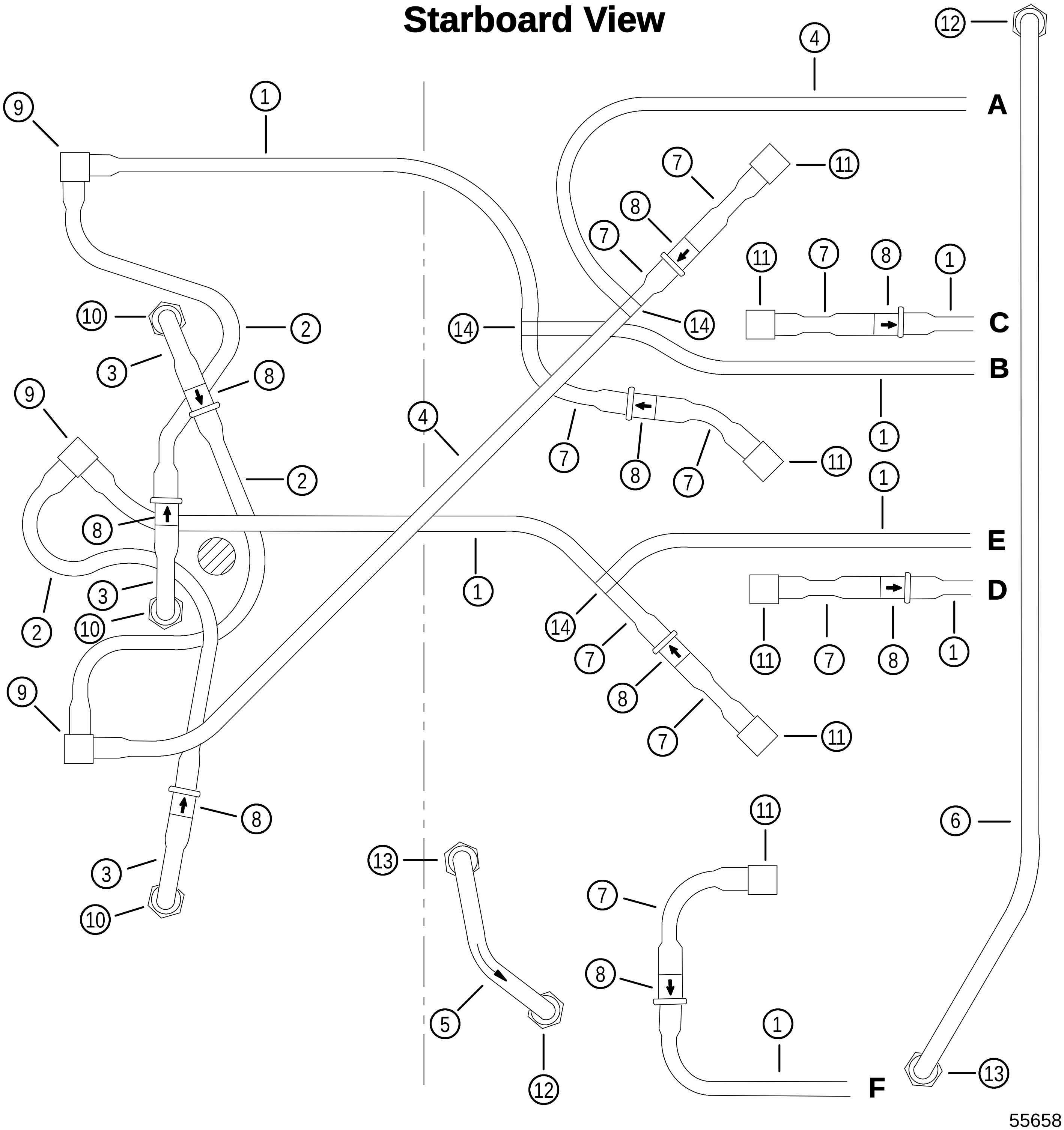


55657

1 - 9.5 in. (24.1cm) (7 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 11.75 in. (29.8cm) (2 ea.)
5 - 3.75 in. (9.5cm) (1 ea.)
6 - 22.5 in. (57.1cm (1 ea.)
7 - 1.5 in. (3.8cm) (9 ea.)
8 - Check Valves (21-14912--2) (9 ea.)

1997 3 Liter Work and 225 Carburetor Bleed Hose Flow Diagram (SN 0G438000 to 0G485988)

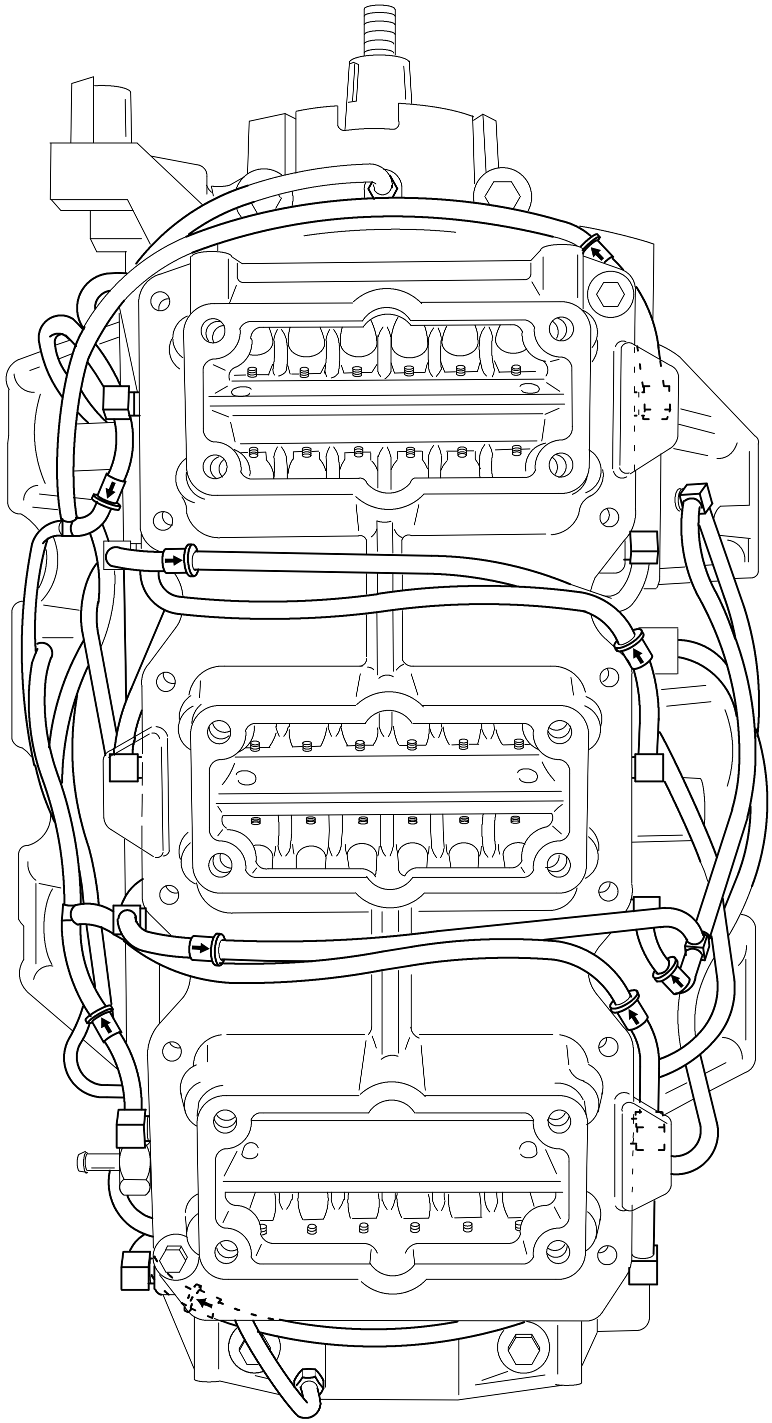
Starboard View



1 - 9.5 in. (24.1cm) (7 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 11.75 in. (29.8cm) (2 ea.)
5 - 3.75 in. (9.5cm) (1 ea.)
6 - 22.5 in. (57.1cm (1 ea.)
7 - 1.5 in. (3.8cm) (9 ea.)
8 - Check Valves (21-14912--2) (9 ea.)
9 - Fitting (22-824356-1) (3 ea.)
10- Fitting (Straight) (22-824502-1) (3 ea.)
11- Fitting (90°) (22-76843) (6 ea.)
12- Check Valve (21-815923-4) (2 ea.)
13- Check Valve (21-42658-5) (2 ea.)
14- T-Fitting (22-59169) (3 ea.)

1997 3 Liter Work and 225 Carburetor Models (SN 0G438000 to 0G485988)

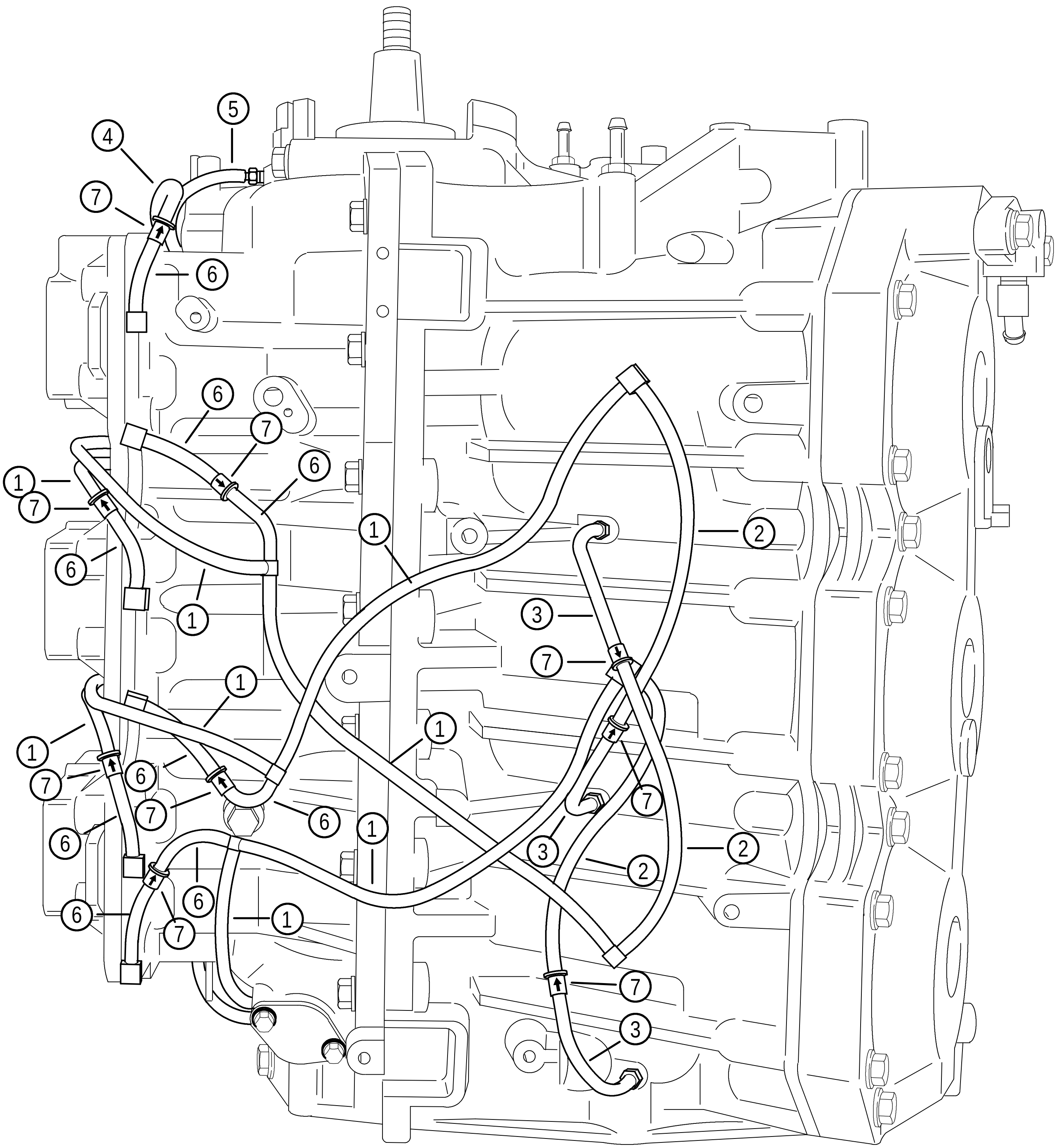
Front View



55659

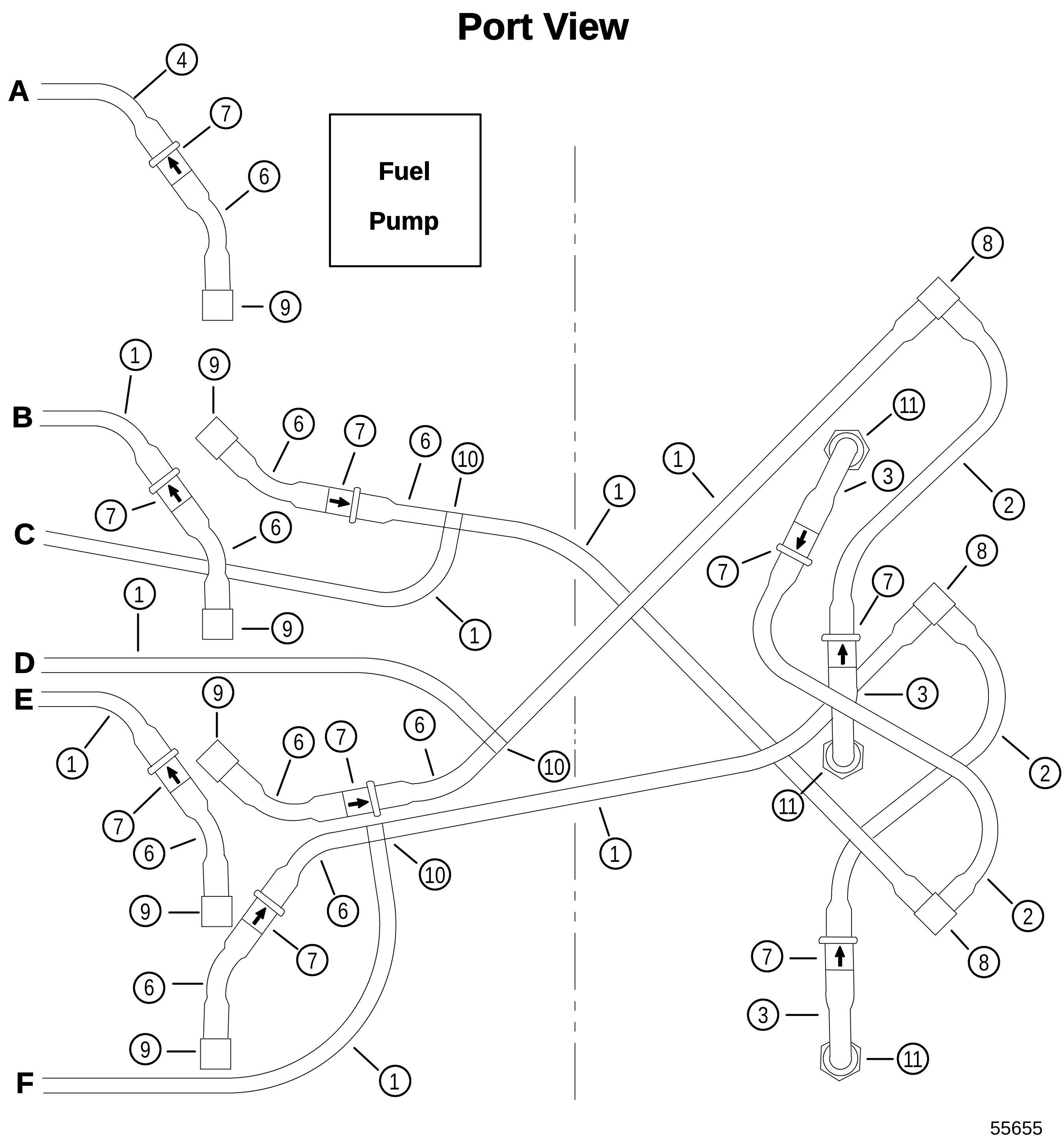
1997 3 Liter Work and 225 Carburetor Models (SN 0G438000 to 0G485988)

Port View



1 - 9.5 in. (24.1cm) (8 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 1.5 in. (3.8cm) (9 ea.)
7 - Check Valves (21-14912--2) (9 ea.)

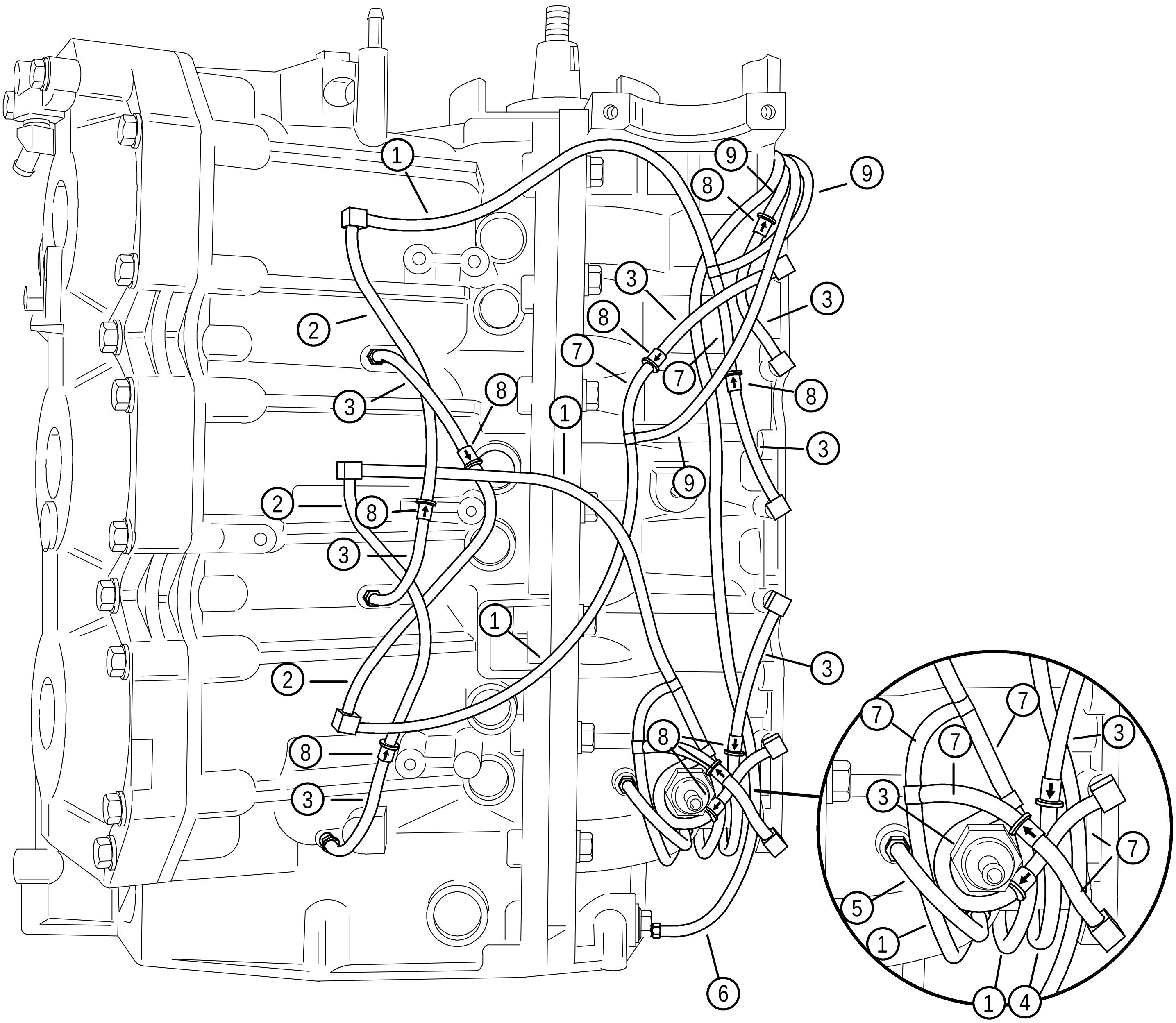
1997 3 Liter Work and 225 Carburetor Bleed Hose Flow Diagram (SN 0G438000 to 0G485988)



1 - 9.5 in. (24.1cm) (8 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 1.5 in. (3.8cm) (9 ea.)
7 - Check Valves (21-14912--2) (9 ea.)
8 - Fitting (22-824356-1) (3 ea.)
9 - Fitting (90°) (22-76843) (6 ea.)
10- T-Fitting (22-59169) (2 ea.)
11- Fitting (Straight) (22-824502-1) (3 ea.)

1997 225/250 EFI Models (SN 0G438000 to 0G485988) (225 EFI w/FUEL ECM 830046-4 and 250 EFI w/FUEL ECM 830046-5)

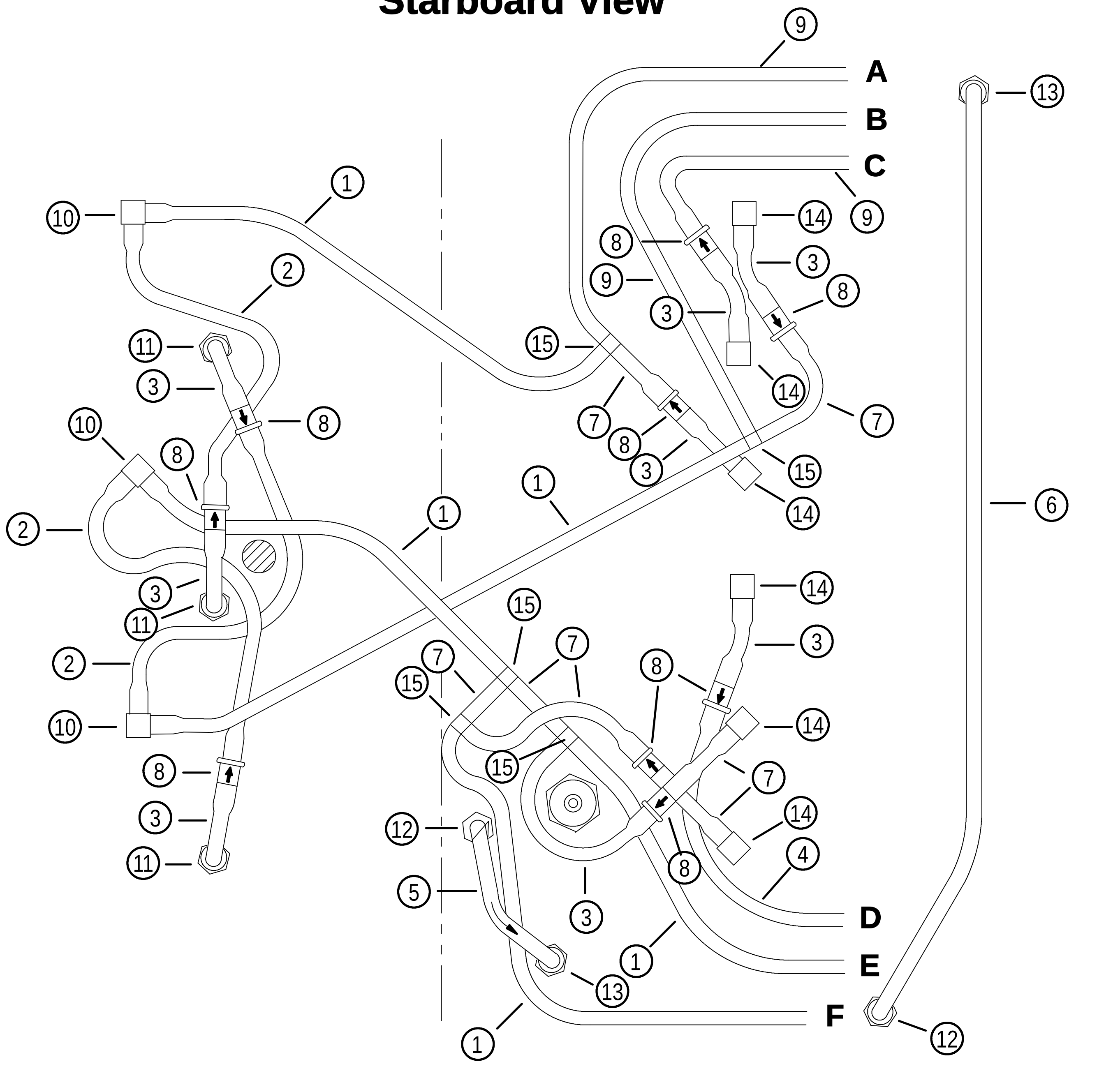
Starboard View



1 - 9.5 in. (24.1cm) (6 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (8 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 3.75 in. (9.5cm) (1 ea.)
6 - 22.5 in. (57.1cm (1 ea.)
7 - 1.5 in. (3.8cm) (6 ea.)
8 - Check Valves (21-14912--2) (9 ea.)
9 - 14 in. (35.6cm) (3 ea.)

1997 225/250 EFI Bleed Hose Flow Diagram (SN 0G438000 to 0G485988) (225 EFI w/FUEL ECM 830046-4 and 250 EFI w/FUEL ECM 830046-5)

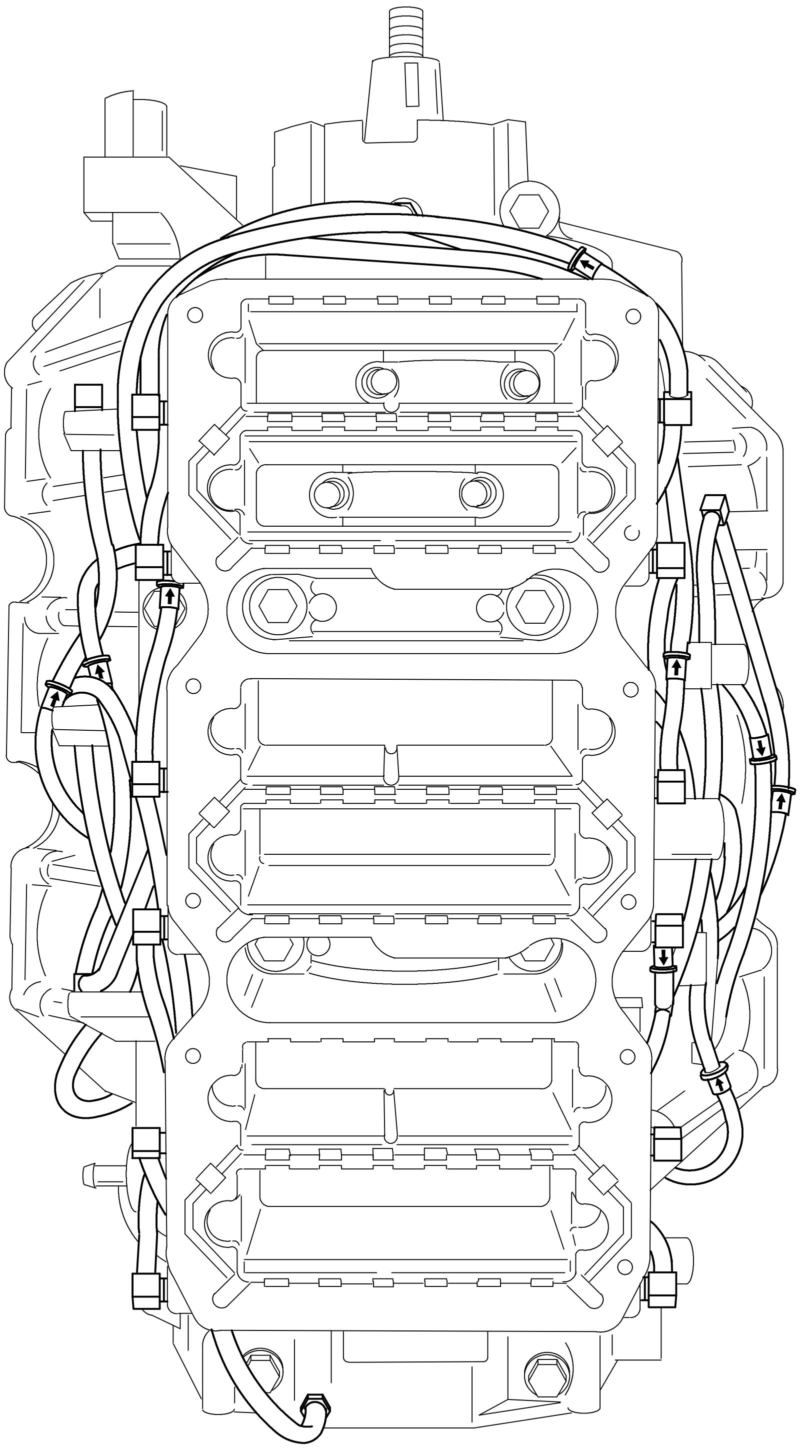
Starboard View



1 - 9.5 in. (24.1cm) (6 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (8 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 3.75 in. (9.5cm) (1 ea.)
6 - 22.5 in. (57.1cm (1 ea.)
7 - 1.5 in. (3.8cm) (6 ea.)
8 - Check Valves (21-14912--2) (9 ea.)
9 - 14 in. (35.6cm) (3 ea.)
10- Fitting (22-824356-1) (3 ea.)
11- Fitting (Straight) (22-824502-1) (3 ea.)
12- Check Valve (21-42658-5) (2 ea.)
13- Check Valve (21-815923-4) (2 ea.)
14- Fitting (90°) (22-76843) (6 ea.)
15- T-Fitting (22-59169) (5 ea.)

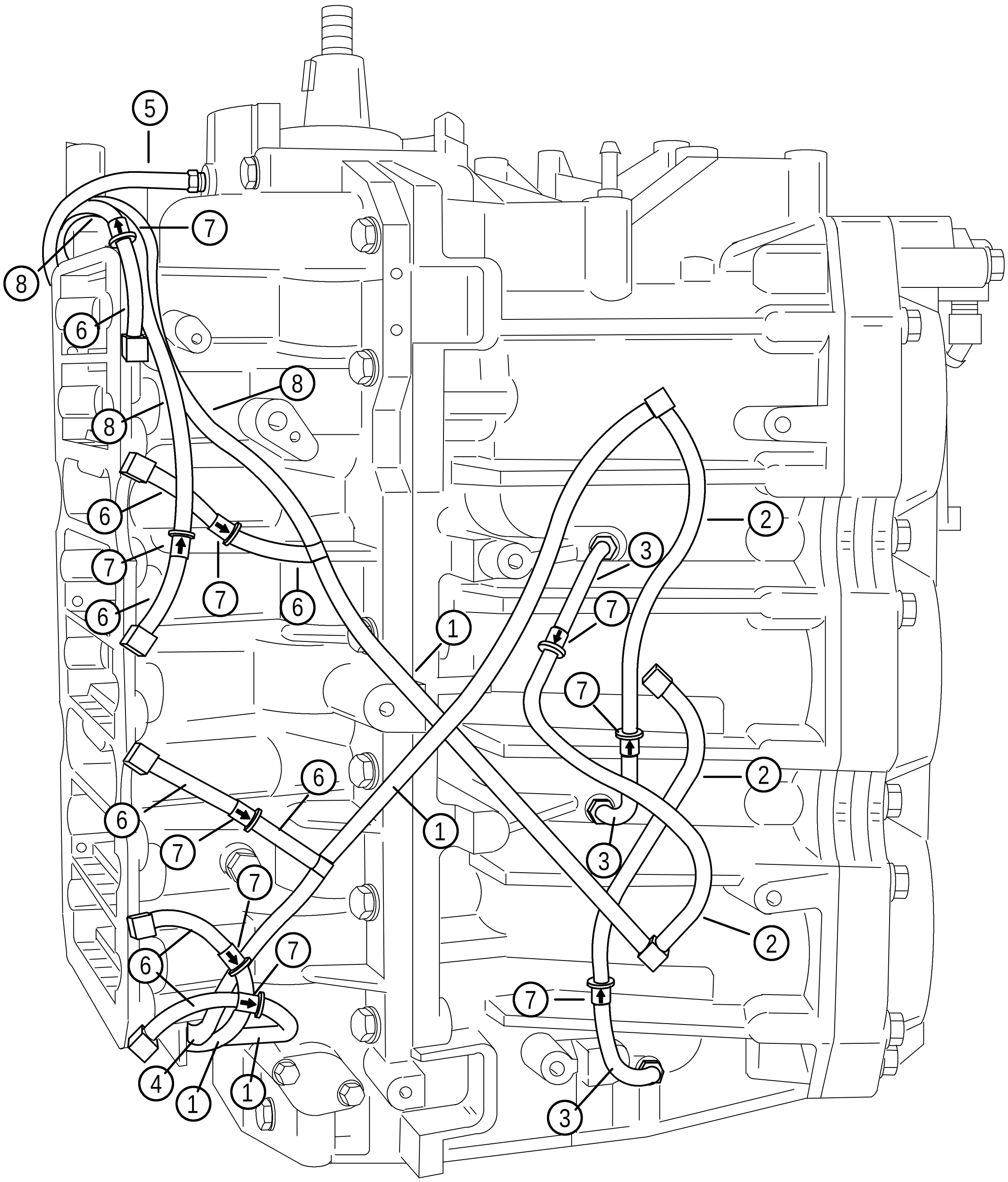
1997 and Newer 225/250 EFI Models (225 EFI w/FUEL ECM 830046-4 and 250 EFI w/FUEL ECM 830046-5)

Front View



1997 225/250 EFI Models (SN 0G438000 to 0G485988) (225 EFI w/FUEL ECM 830046-4 and 250 EFI w/FUEL ECM 830046-5)

Port View

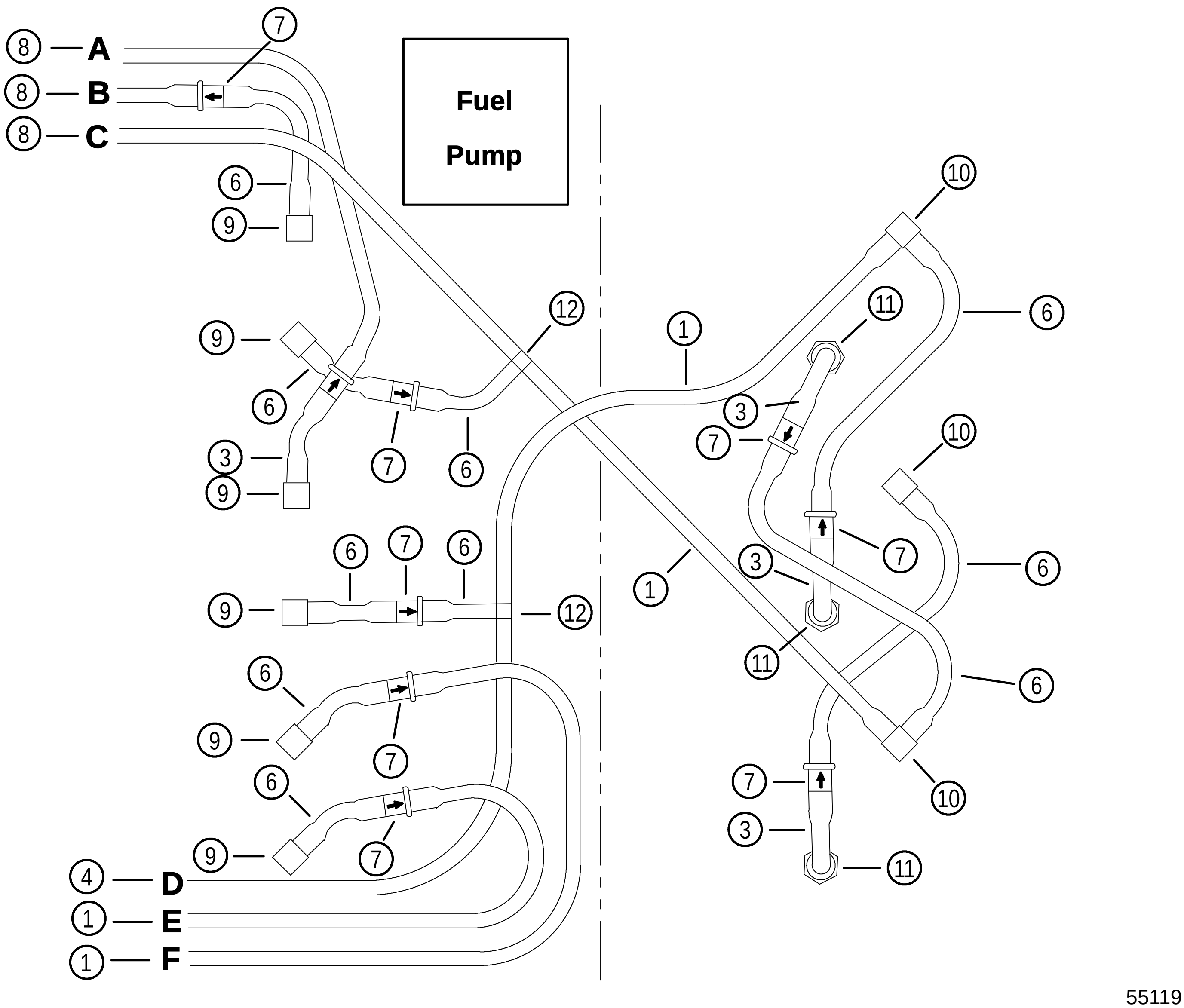


55118

1 - 9.5 in. (24.1cm) (3 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (4 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 1.5 in. (3.8cm) (7 ea.)
7 - Check Valves (21-14912--2) (9 ea.)
8 - 14 in. (35.6cm) (3 ea.)

1997 225/250 EFI Bleed Hose Flow Diagram (SN 0G438000 to 0G485988) (225 EFI w/FUEL ECM 830046-4 and 250 EFI w/FUEL ECM 830046-5)

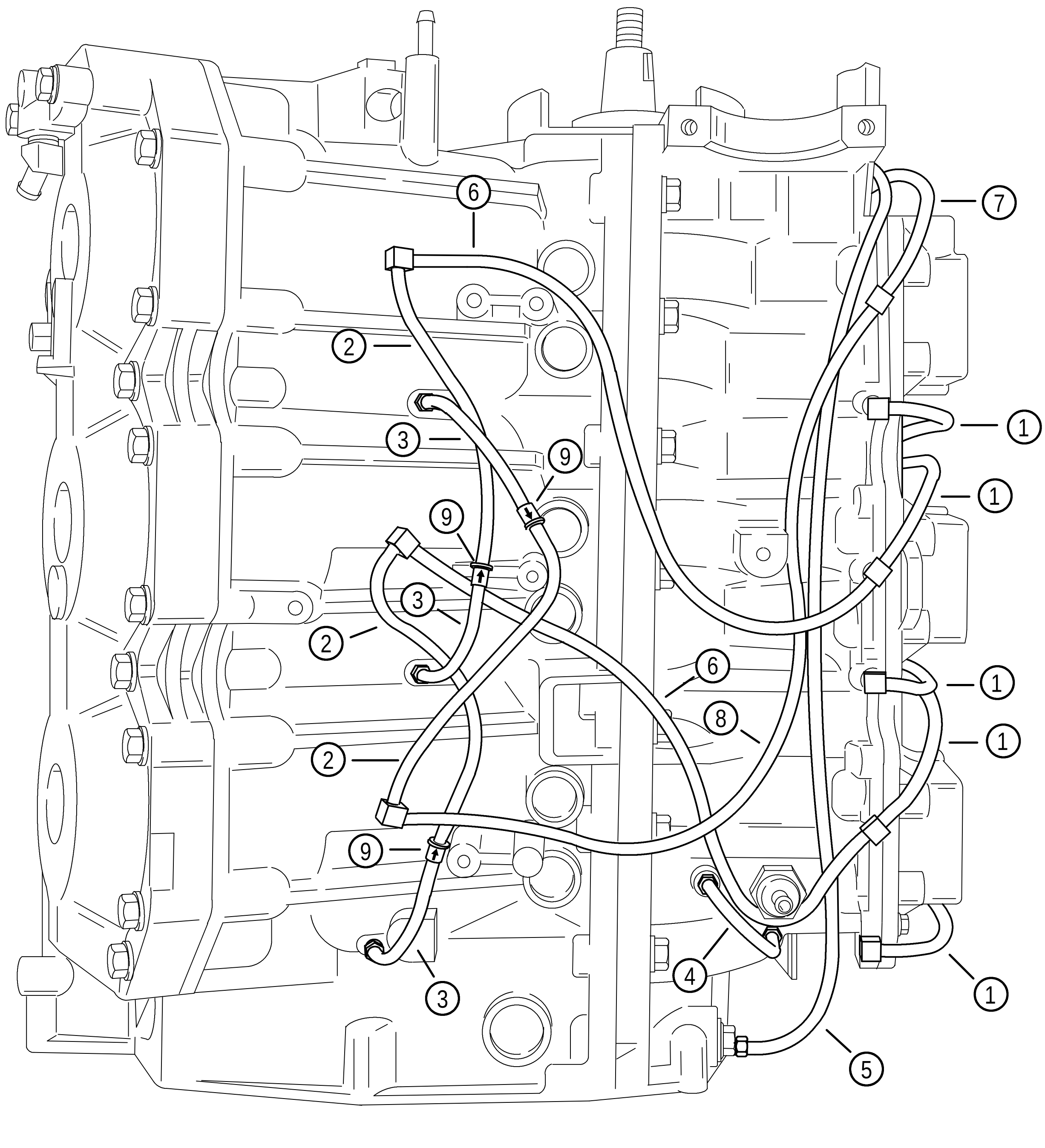
Port View



1 - 9.5 in. (24.1cm) (3 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (4 ea.)
4 - 11.75 in. (29.8cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 1.5 in. (3.8cm) (7 ea.)
7 - Check Valves (21-14912--2) (9 ea.)
8 - 14 in. (35.6cm) (3 ea.)
9 - Fitting (90°) (22-76843) (6 ea.)
10- Fitting (22-824356-1) (3 ea.)
11- Fitting (Straight) (22-824502-1) (3 ea.)
12- T-Fitting (22-59169) (2 ea.)

1997 and Newer 3 Liter Work and 225 Carburetor Models (SN 0485989 and ABOVE)

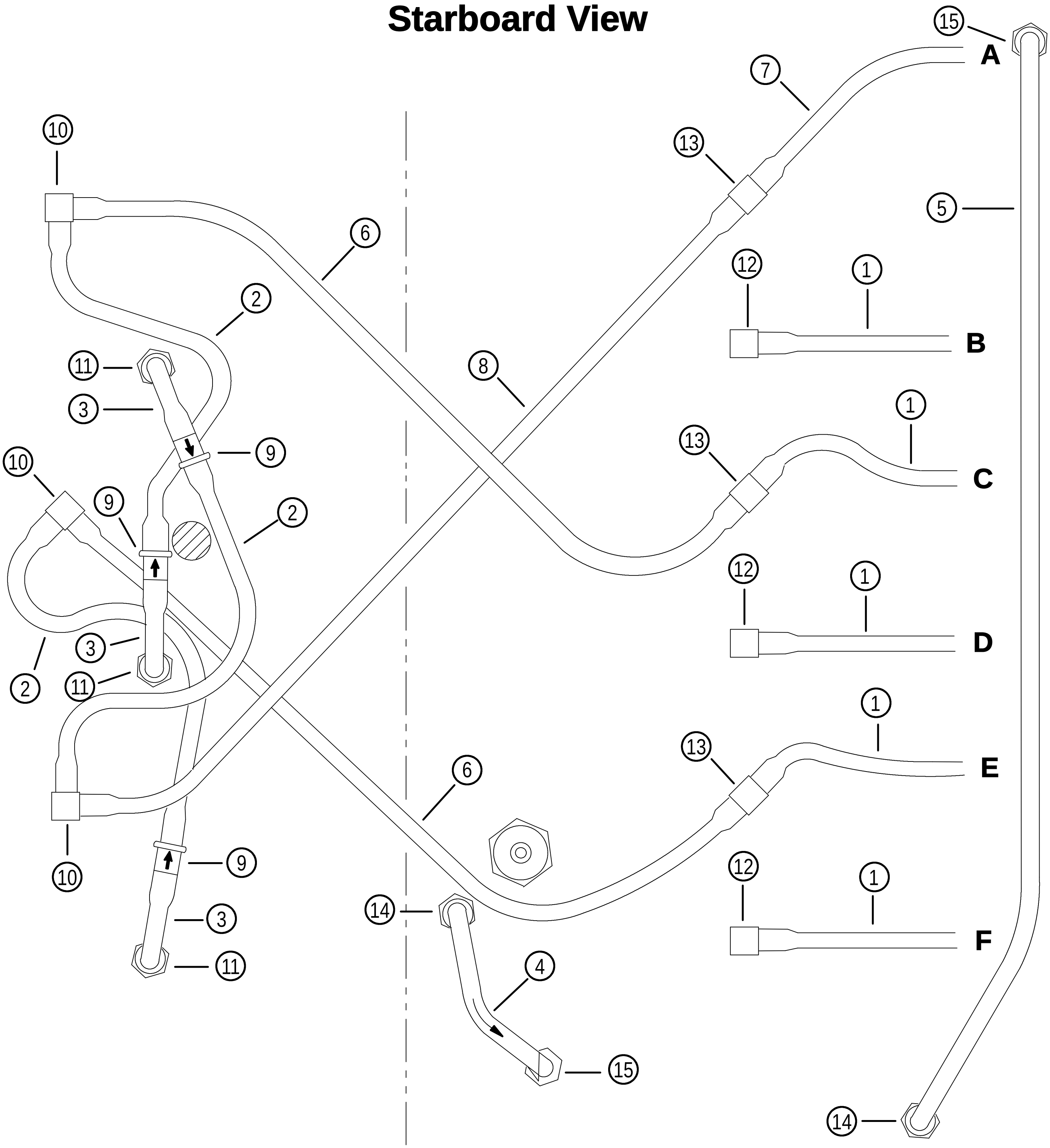
Starboard View



1 - 9.5 in. (24.1cm) (5 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 3.75 in. (9.5cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 13.25 in. (33.6cm) (2 ea.)
7 - 10.25 in. (26.0cm) (1 ea.)
8 - 16 in. (40.6cm) (1 ea.)
9 - Check Valves (21-14912--2) (3 ea.)

1997 and Newer 3 Liter Work and 225 Carburetor Bleed Hose Flow Diagram (SN 0G485989 and ABOVE)

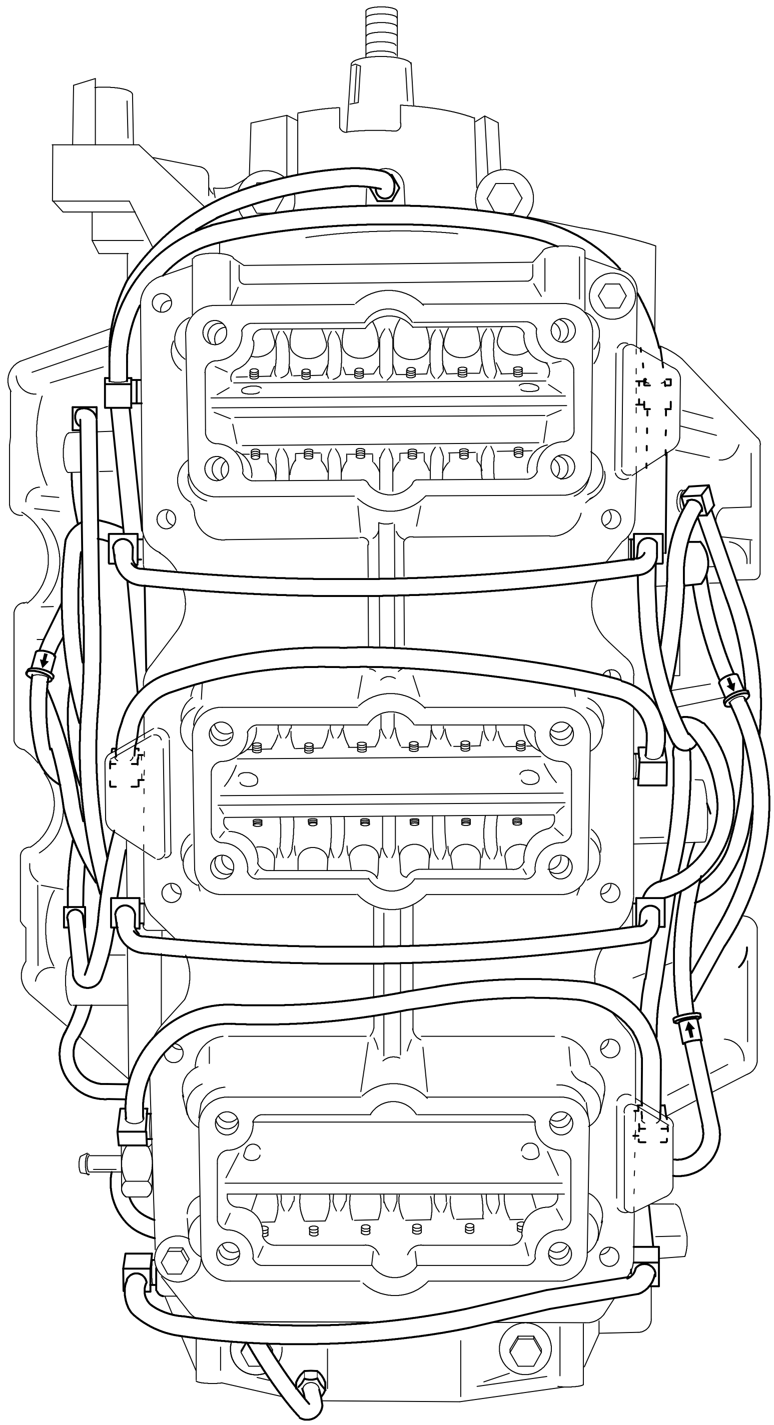
Starboard View



1 - 9.5 in. (24.1cm) (5 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 3.75 in. (9.5cm) (1 ea.)
5 - 22.5 in. (57.1cm (1 ea.)
6 - 13.25 in. (33.6cm) (2 ea.)
7 - 10.25 in. (26.0cm) (1 ea.)
8 - 16 in. (40.6cm) (1 ea.)
9 - Check Valves (21-14912--2) (3 ea.)
10- Fitting (22-824356-1) (3 ea.)
11- Fitting (Straight) (22-824502-1) (3 ea.)
12- Check Valve (90°) (21-828218-2) (3 ea.)
13- Check Valve (T-Fitting) (21-834804-1) (3 ea.)
14- Check Valve (Straight) (21-42658-1) (2 ea.)
15- Check Valve (Straight) (21-815923-1) (2 ea.)

1997 and Newer 3 Liter Work and 225 Carburetor Models (SN 0G485989 and ABOVE)

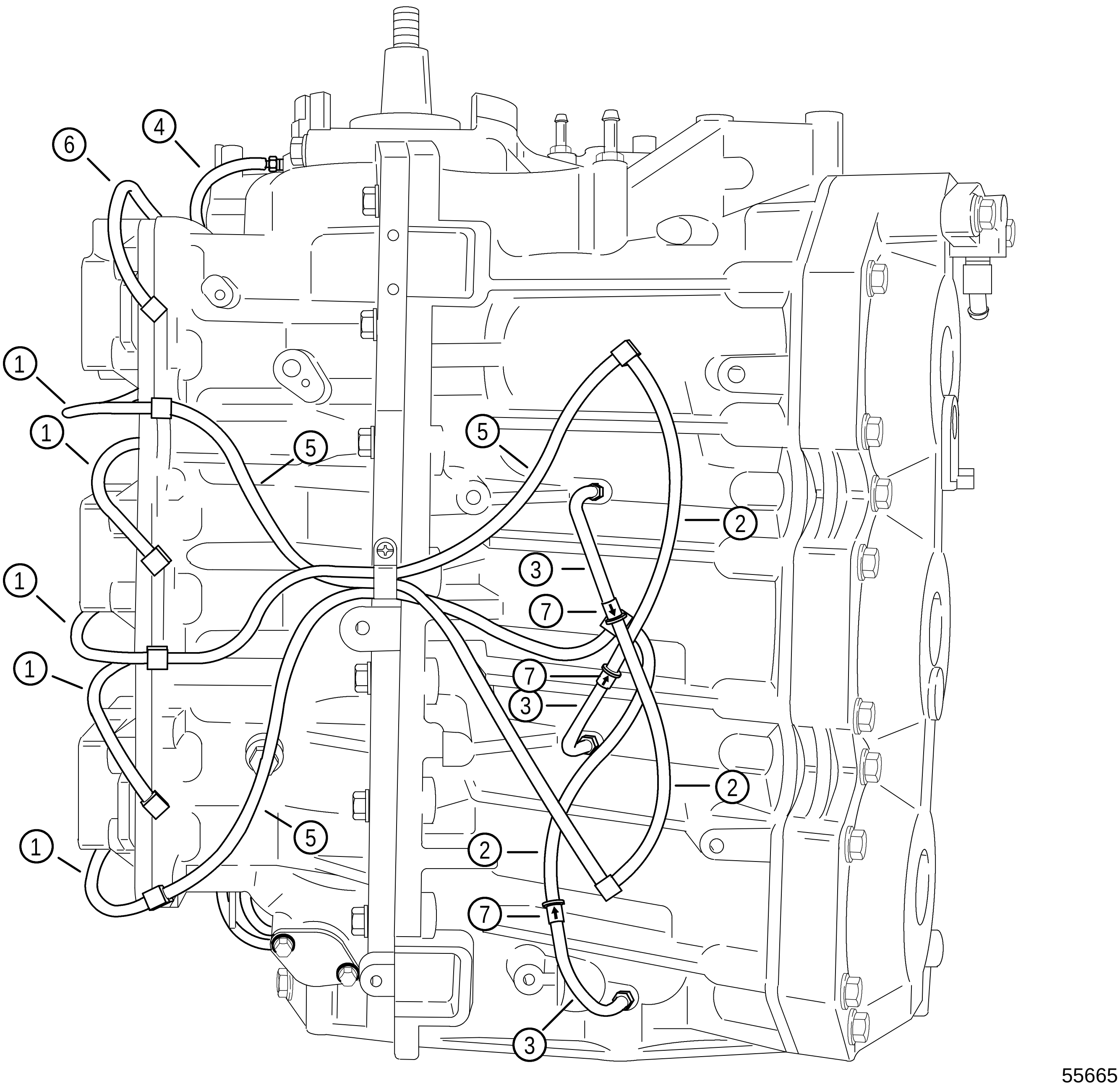
Front View



55669

1997 and Newer 3 Liter Work and 225 Carburetor Models (SN 0G485989 and ABOVE)

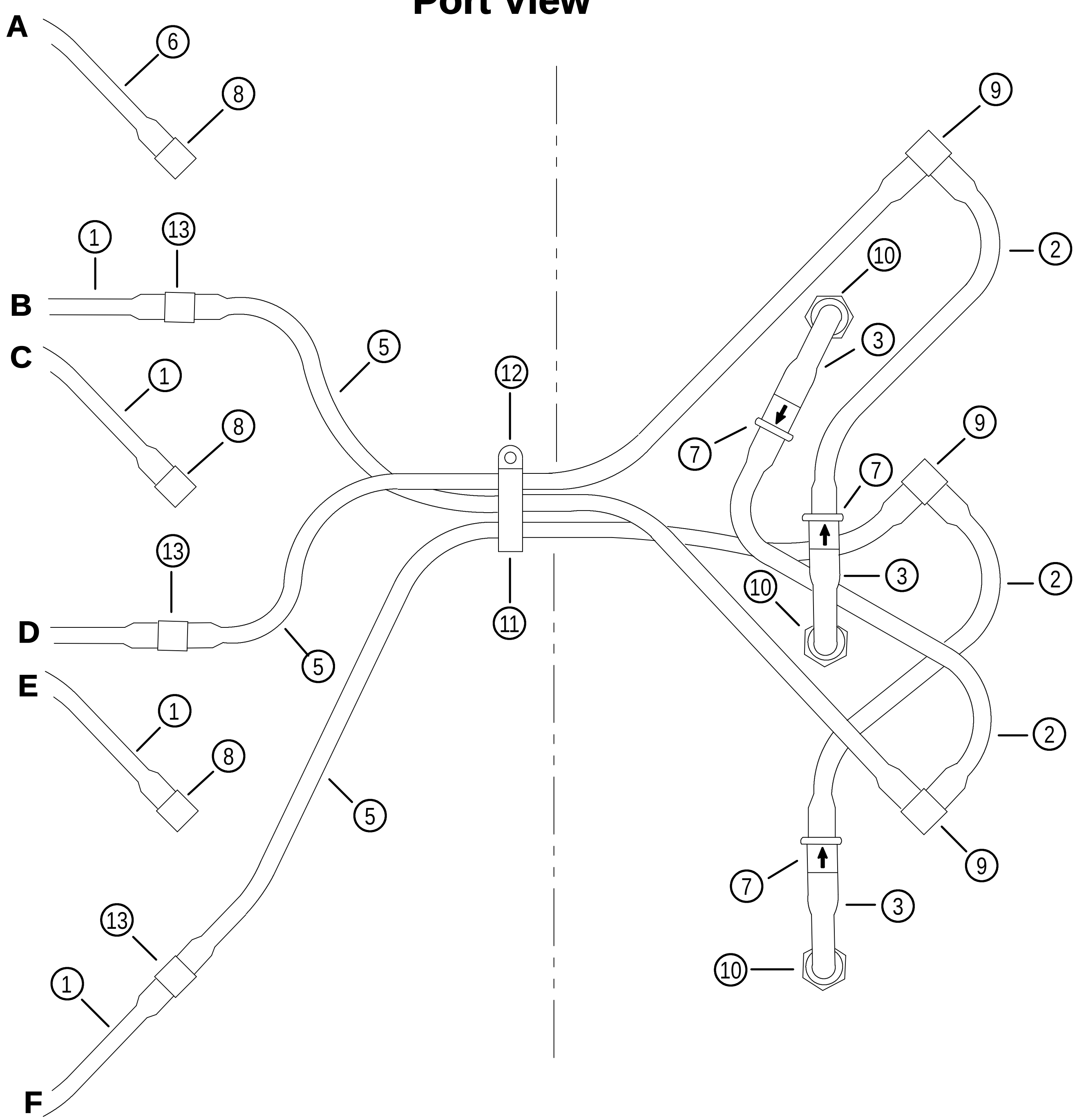
Port View



1 - 9.5 in. (24.1cm) (5 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (3 ea.)
6 - 10.25 in. (26.0cm) (1 ea.)
7 - Check Valves (21-14912--2) (3 ea.)

1997 and Newer 3 Liter Work and 225 Carburetor Bleed Hose Flow Diagram (SN 0G485989 and ABOVE)

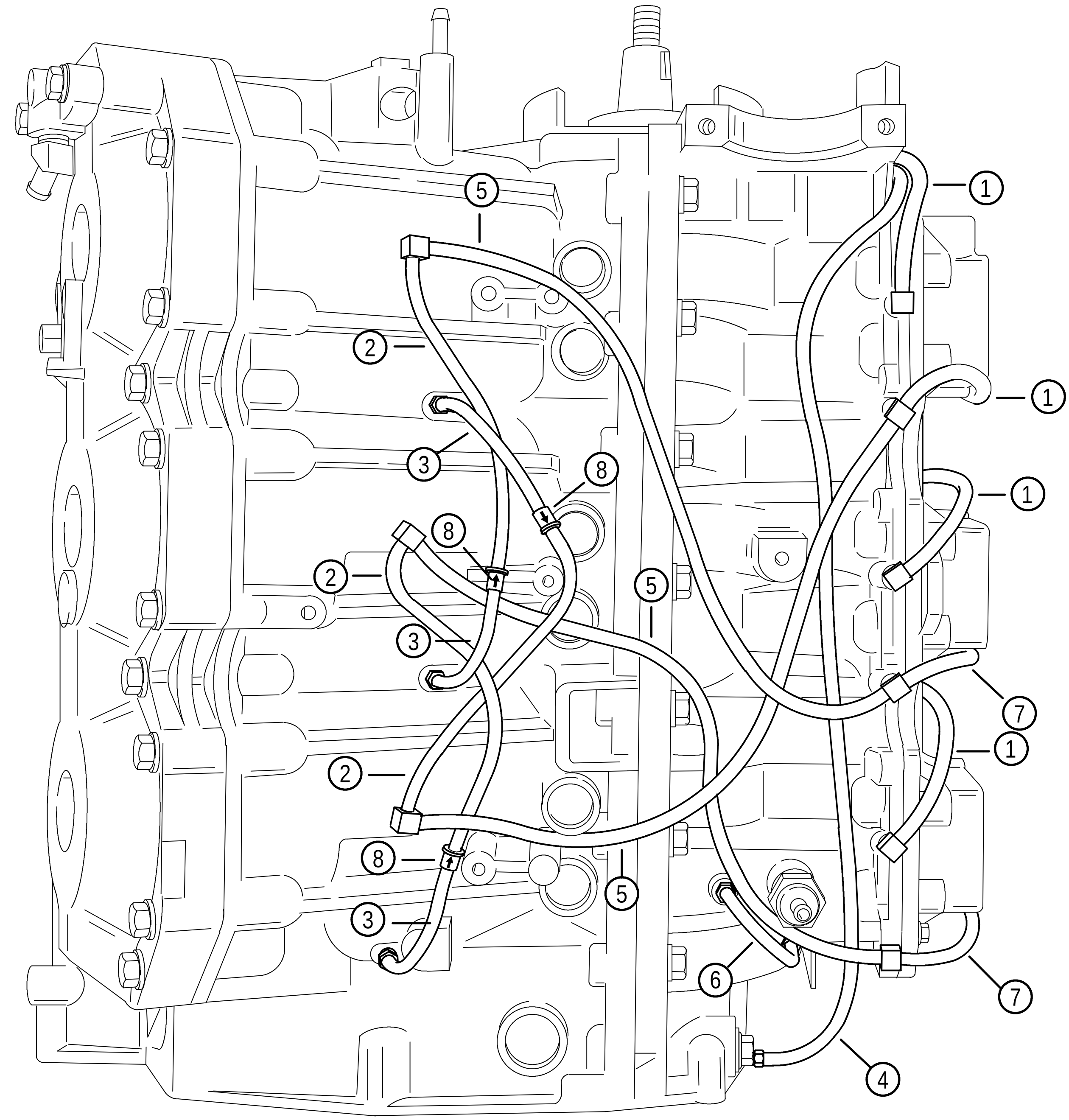
Port View



1 - 9.5 in. (24.1cm) (5 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (3 ea.)
6 - 10.25 in. (26.0cm) (1 ea.)
7 - Check Valves (21-14912--2) (3 ea.)
8 - Check Valve (90°) (21-828218-2) (3 ea.)
9 - Fitting (22-824356-1) (2 ea.)
10- Fitting (Straight) (22-824502-1) (3 ea.)
11- Clamp (54-22875)
12- Screw (10-48408)
13- Check Valve (T-Fitting) (21-834804-1) (3 ea.)

1997 and Newer 225/250 EFI Models (SN 0G485989 and ABOVE) (225 EFI w/FUEL ECM 830046-7 and 250 EFI w/FUEL ECM 830046-8)

Starboard View

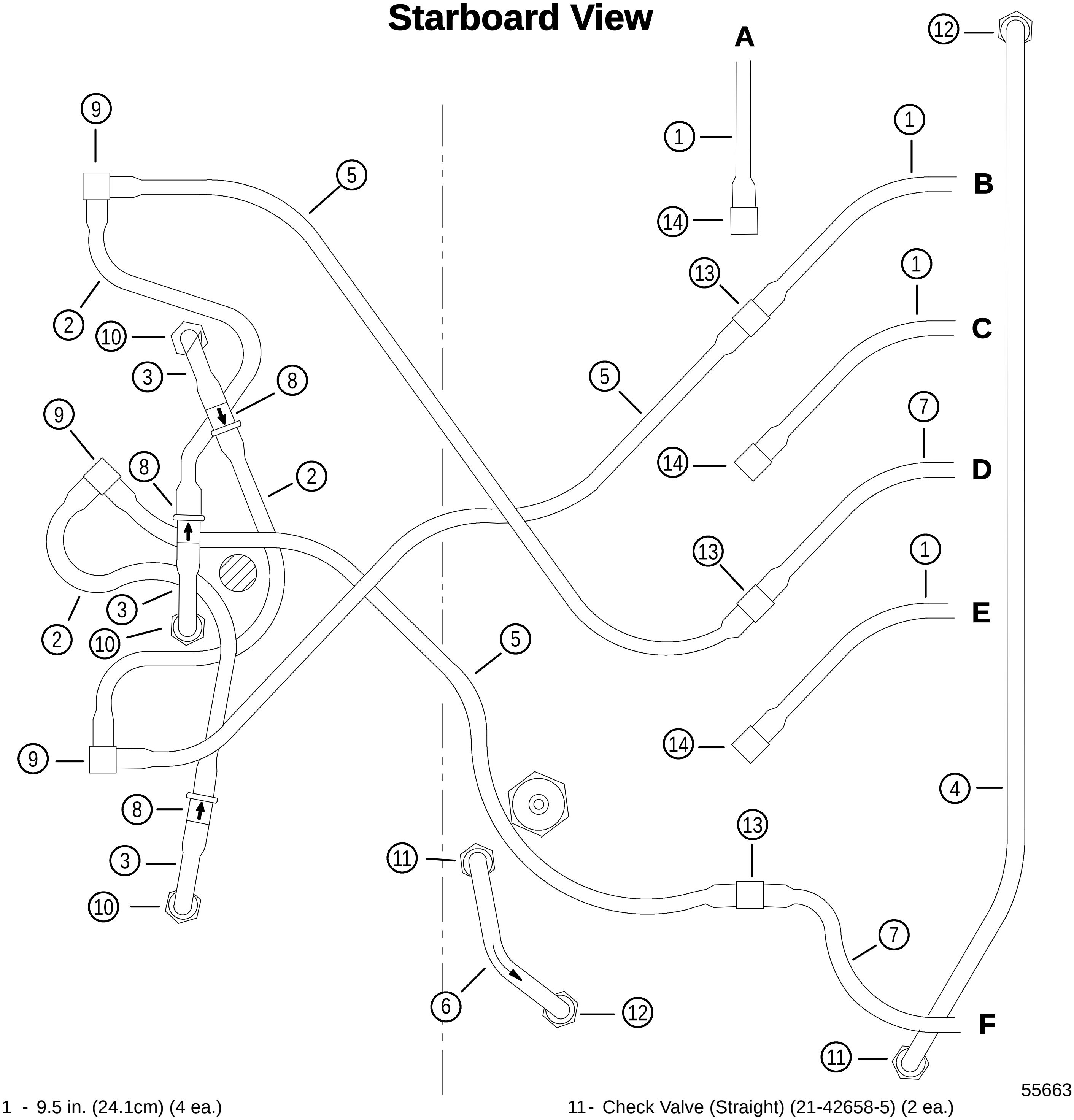


55662

1 - 9.5 in. (24.1cm) (4 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (3 ea.)
6 - 3.75 in. (9.5cm) (1 ea.)
7 - 9.25 in. (23.5cm) (2 ea.)
8 - Check Valves (21-14912--2) (3 ea.)

1997 225/250 EFI Bleed Hose Flow Diagram (SN 0G485989 and ABOVE) (225 EFI w/FUEL ECM 830046-7 and 250 EFI w/FUEL ECM 830046-8)

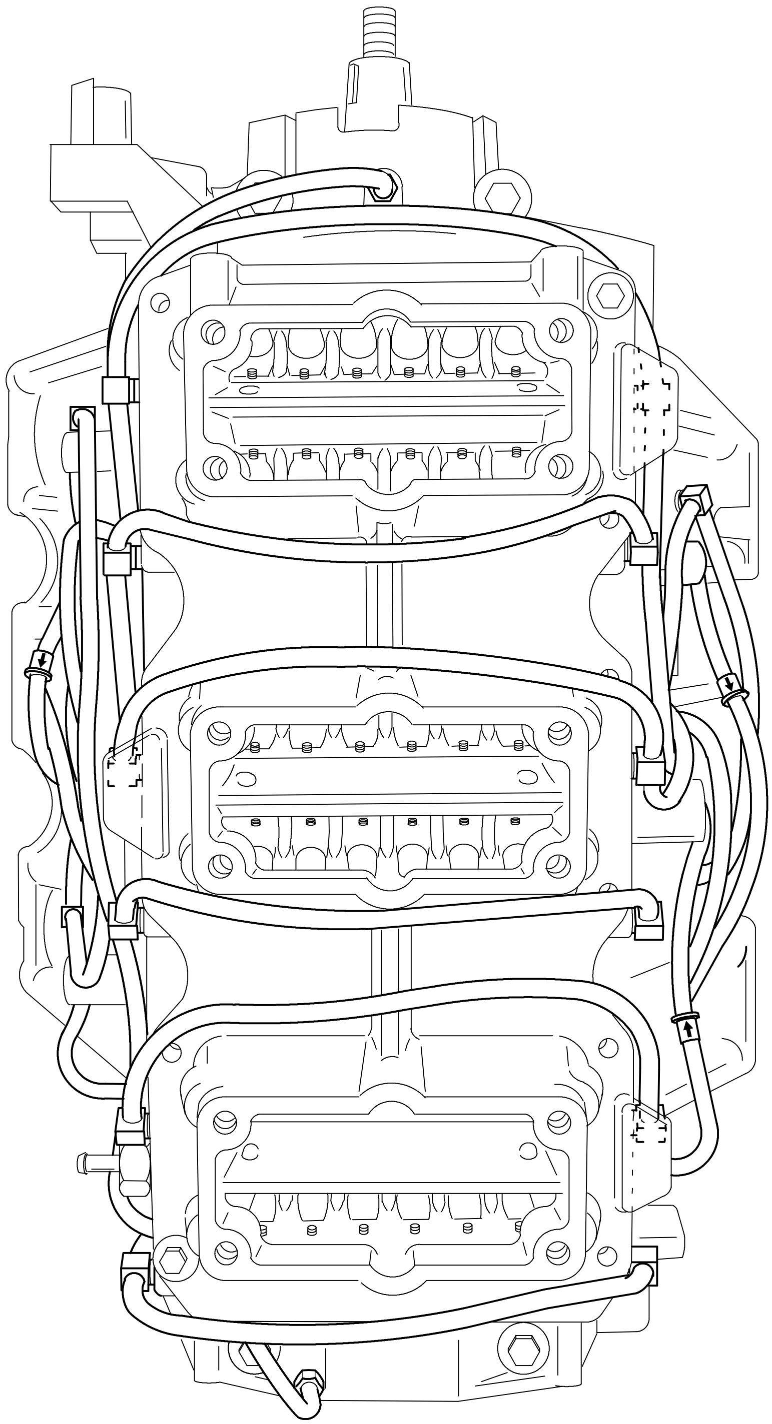
Starboard View



1 - 9.5 in. (24.1cm) (4 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (3 ea.)
6 - 3.75 in. (9.5cm) (1 ea.)
7 - 9.25 in. (23.5cm) (2 ea.)
8 - Check Valves (21-14912--2) (3 ea.)
9 - Fitting (22-824356-1) (3 ea.)
10- Fitting (Straight) (22-824502-1) 3 ea.)
11- Check Valve (Straight) (21-42658-5) (2 ea.)
12- Check Valve (Straight) (21-815923-4) (2 ea.)
13- Check Valve (T-Fitting) (21-834804-1) (3 ea.)
14- Check Valve (90°) (21-828218-2) (3 ea.)

1997 and Newer 225/250 EFI Models (SN 0G485989 and ABOVE) (225 EFI w/FUEL ECM 830046-7 and 250 EFI w/FUEL ECM 830046-8)

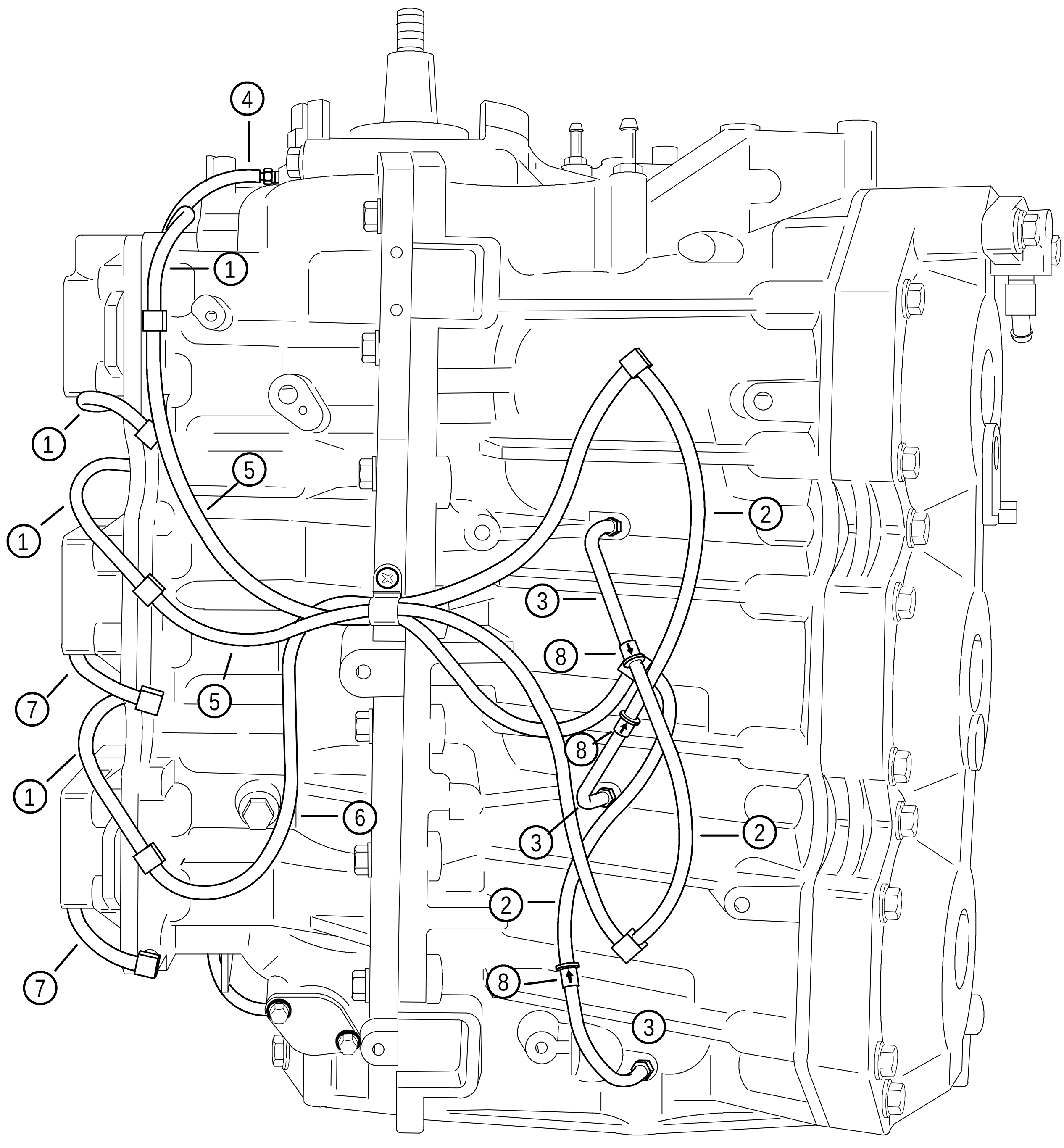
Front View



55664

1997 and Newer 225/250 EFI Models (SN 0G485989 and ABOVE) (225 EFI w/FUEL ECM 830046-7 and 250 EFI w/FUEL ECM 830046-8)

Port View

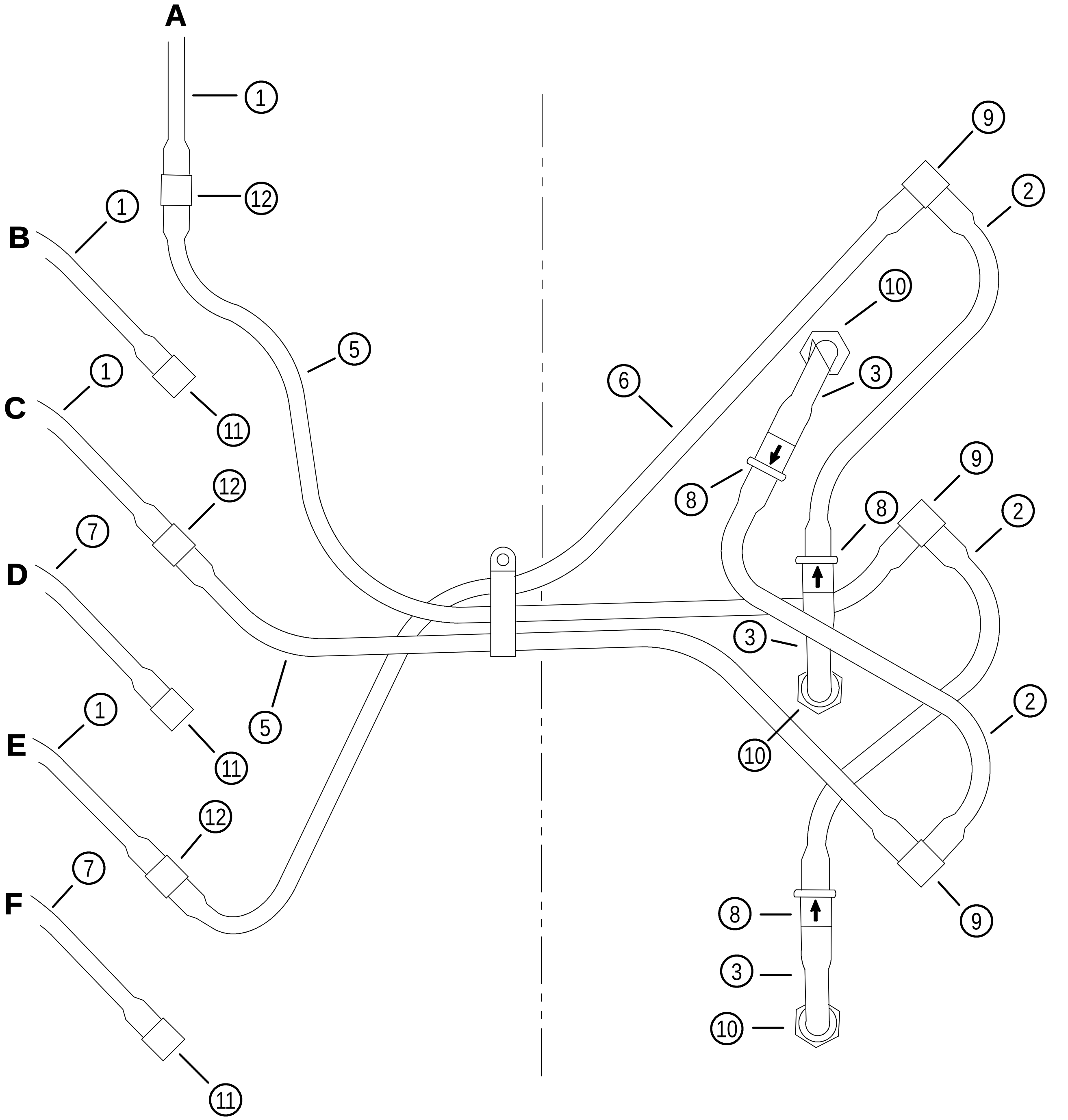


55660

1 - 9.5 in. (24.1cm) (4 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (2 ea.)
6 - 16 in. (40.6cm) (1 ea.)
7 - 9.25 in. (23.5cm) (2 ea.)
8 - Check Valves (21-14912--2) (3 ea.)

1997 and Newer 225/250 EFI Models Bleed Hose Flow Diagram (SN 0G485989 and ABOVE) (225 EFI w/FUEL ECM 830046-7 and 250 EFI w/FUEL ECM 830046-8)

Port View



1 - 9.5 in. (24.1cm) (4 ea.)
2 - 6 in. (15.2cm) (3 ea.)
3 - 3 in. (7.6cm) (3 ea.)
4 - 22.5 in. (57.1cm (1 ea.)
5 - 13.25 in. (33.6cm) (2 ea.)
6 - 16 in. (40.6cm) (1 ea.)
7 - 9.25 in. (23.5cm) (2 ea.)
8 - Check Valves (21-14912--2) (3 ea.)
9 - Fitting (22-824356-1) (3 ea.)
10- Fitting (Straight) (824502-1) (3 ea.)
11- Check Valve (90°) (21-828218-2) (3 ea.)
12- Check Valve (T-Fitting) (21-834804-1) (3 ea.)
13- Clamp (54-22875)
14- Screw (10-48408)

Reinstalling Engine Components

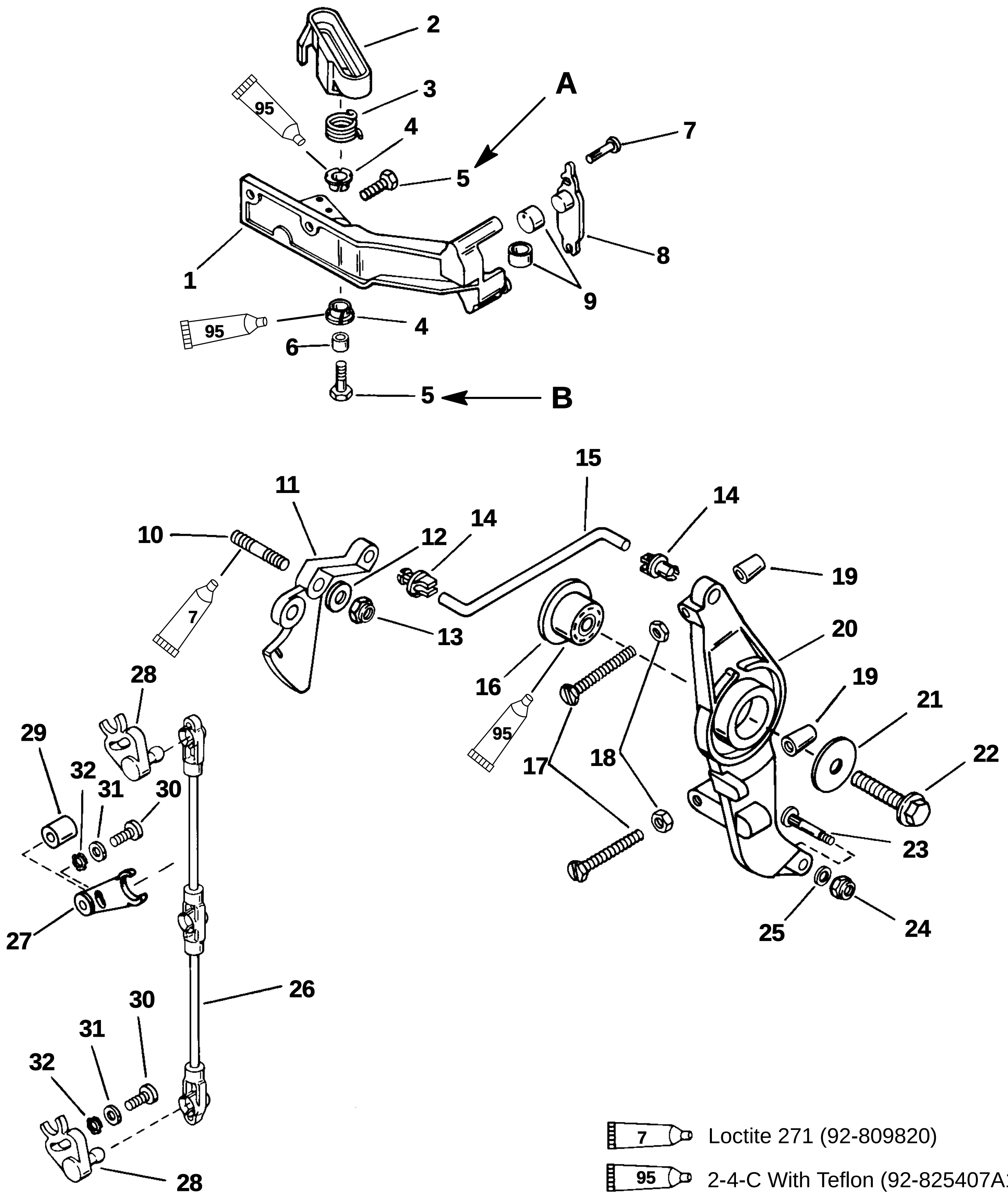
Reinstall the following components:

Section 2
Starter Motor
Alternator
Stator
Ignition Modules
Electronic Control Unit
Solenoids
Crank Position Sensor
Throttle Position Sensor
Temperature Sensor

Section 3
Air Silencer
Carburetors and Linkage
Fuel Pump
Fuel Enrichment

Oil Injection
On-Board Oil Tank
Oil Pump

Anchor Bracket/Throttle Linkage
SEAPRO/MARATHON (S/N-0G303045 & BELOW)



7 Loctite 271 (92-809820)

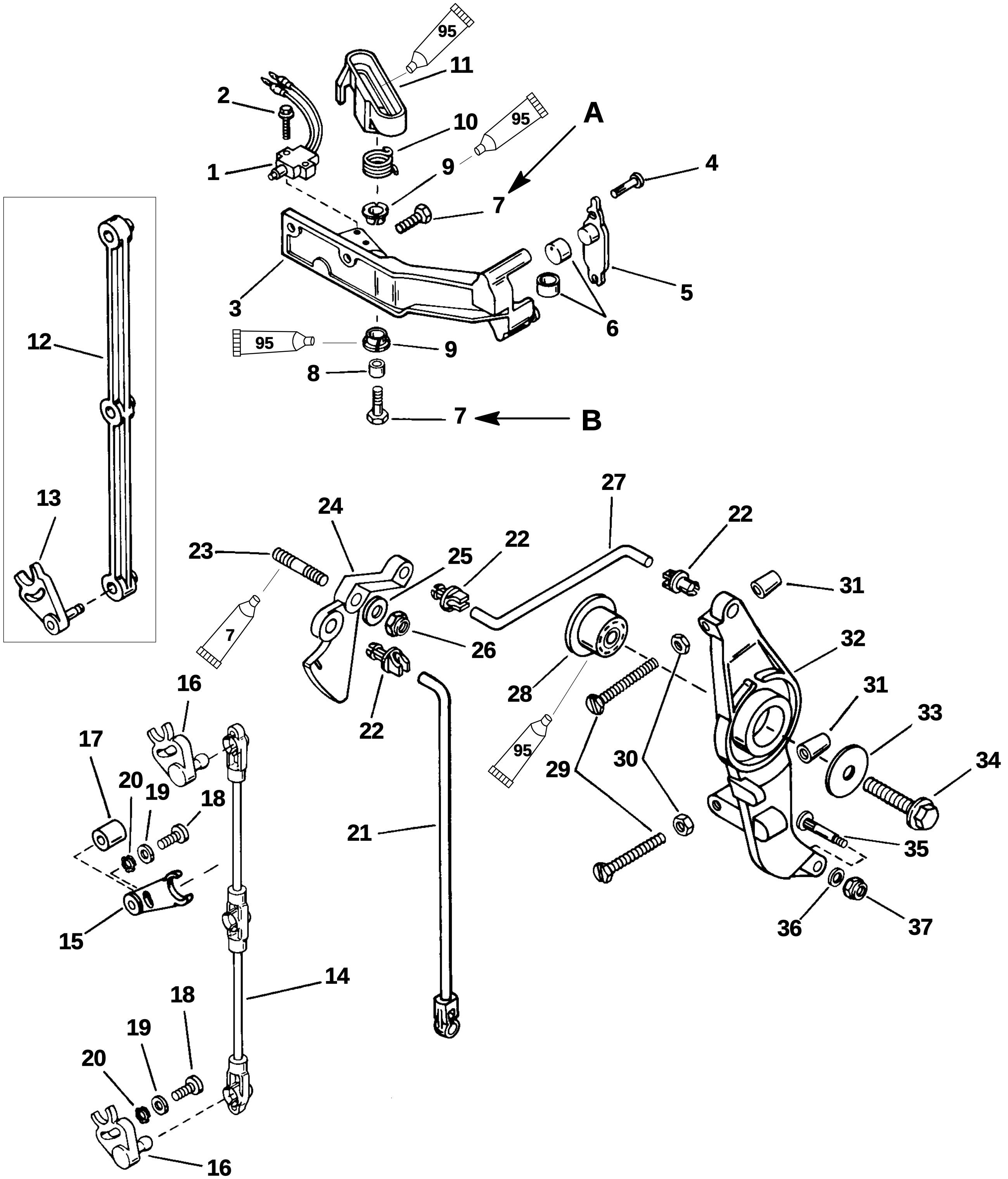
95 2-4-C With Teflon (92-825407A12)

A – 25 lb. ft. (33.9 N·m)
B – 20 lb. ft. (27.1 N·m)

Anchor Bracket/Throttle Linkage
SEAPRO/MARATHON (S/N-0G303045 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	ANCHOR BRACKET			
2	1	ROLLER GUIDE			
3	1	SPRING			
4	2	BUSHING			
5	3	SCREW (M8 x 25)			
6	1	BUSHING			
7	2	DRIVE SCREW			
8	1	LATCH			
9	2	CUP			
10	1	STUD			
11	1	THROTTLE CAM			
12	1	WASHER			
13	1	NUT			
14	2	SWIVEL BUSHING			
15	1	THROTTLE LINK			
16	1	BUSHING			
17	2	SCREW (M6 x 1 x 55)			
18	2	NUT			
19	2	CAP			
20	1	THROTTLE LEVER			
21	1	WASHER			
22	1	SCREW (M8 x 35)	240	20	27.1
23	1	PIN INSERT			
24	1	NUT			
25	1	WASHER			
26	1	THROTTLE LINK KIT			
27	1	LINK (Stub Shaft)			
28	2	LINK (Ball Shaft)			
29	1	ROLLER			
30	3	SCREW (10-32 x 1/2")			
31	3	WASHER			
32	3	LOCKWASHER			

Anchor Bracket/Throttle Linkage 225 Carb (S/N-0G303045 & BELOW)



7 Loctite 271 (92-809820)

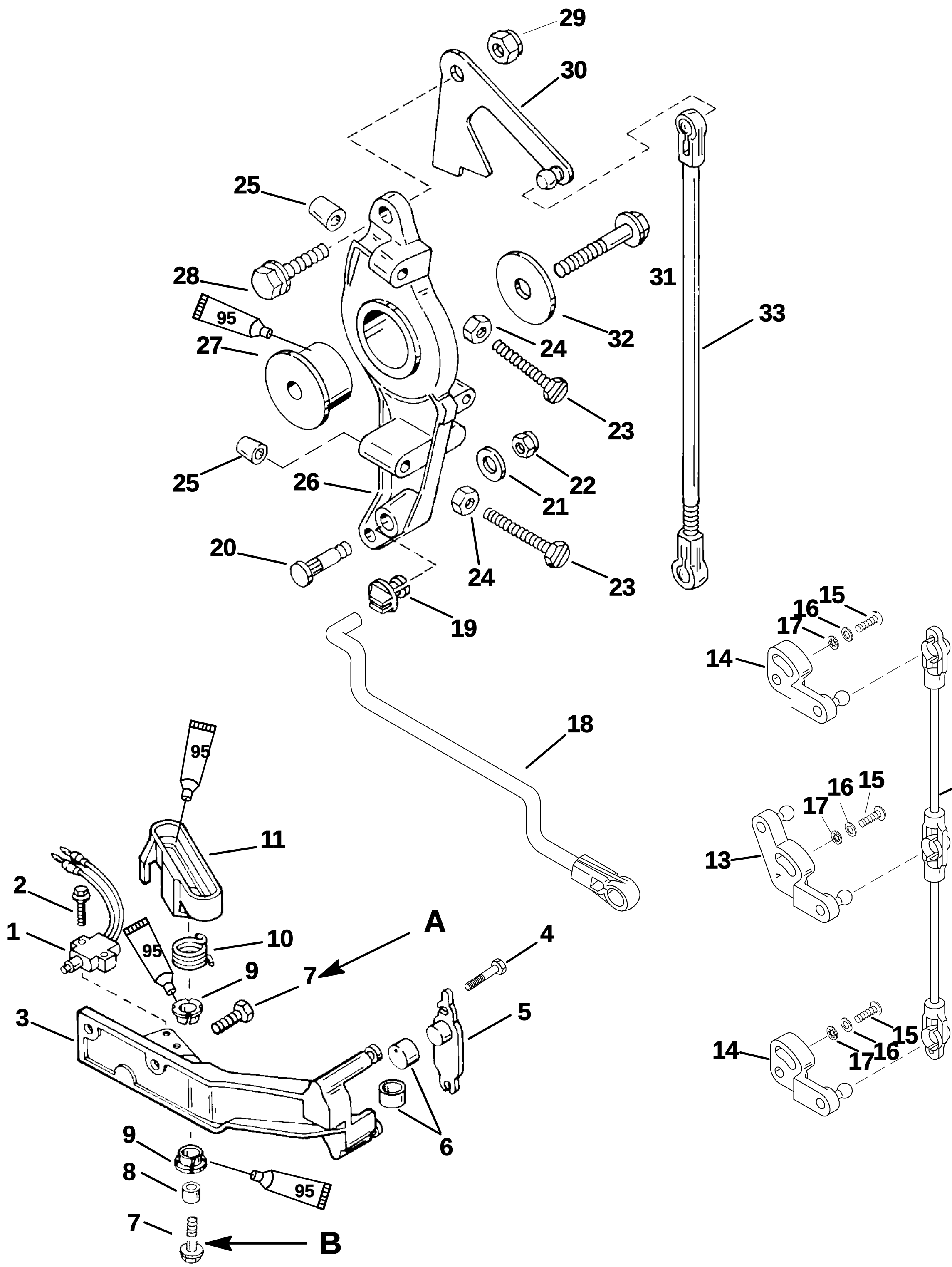
95 2-4-C With Teflon (92-825407A12)

A – 25 lb. ft. (33.9 N·m)
B – 20 lb. ft. (27.1 N·m)

Anchor Bracket/Throttle Linkage
225 Carb (S/N-0G303045 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWITCH			
2	2	SCREW (M3.5 x 20)	10		1.1
3	1	ANCHOR BRACKET			
4	2	DRIVE SCREW			
5	1	LATCH			
6	2	CUP			
7	3	SCREW (M8 x 25)			
8	1	BUSHING			
9	2	BUSHING			
10	1	SPRING			
11	1	ROLLER GUIDE			
12	1	THROTTLE LINK **Use With WMH-19**			
13	3	LINK (Stub Shaft) **Series Carburetors**			
14	1	THROTTLE LINK KIT **Use With WMH-46/47**			
15	1	LINK (Stub Shaft) **Series Carburetors**			
16	2	LINK (Ball Shaft)			
17	1	ROLLER			
18	3	SCREW (10-32 x 1/2^{2})			
19	3	WASHER			
20	3	LOCKWASHER			
21	1	LINK			
22	3	SWIVEL BUSHING			
23	1	STUD			
24	1	THROTTLE CAM			
25	1	WASHER			
26	1	NUT			
27	1	THROTTLE LINK			
28	1	BUSHING			
29	2	SCREW (M6 x 1 x 55)			
30	2	NUT			
31	2	CAP			
32	1	THROTTLE LEVER			
33	1	WASHER			
34	1	SCREW (M8 x 35)	240	20	27.1
35	1	PIN INSERT			
36	1	WASHER			
37	1	NUT			

Anchor Bracket/Throttle Linkage (Carb Models) (S/N-0G303046 & Up)



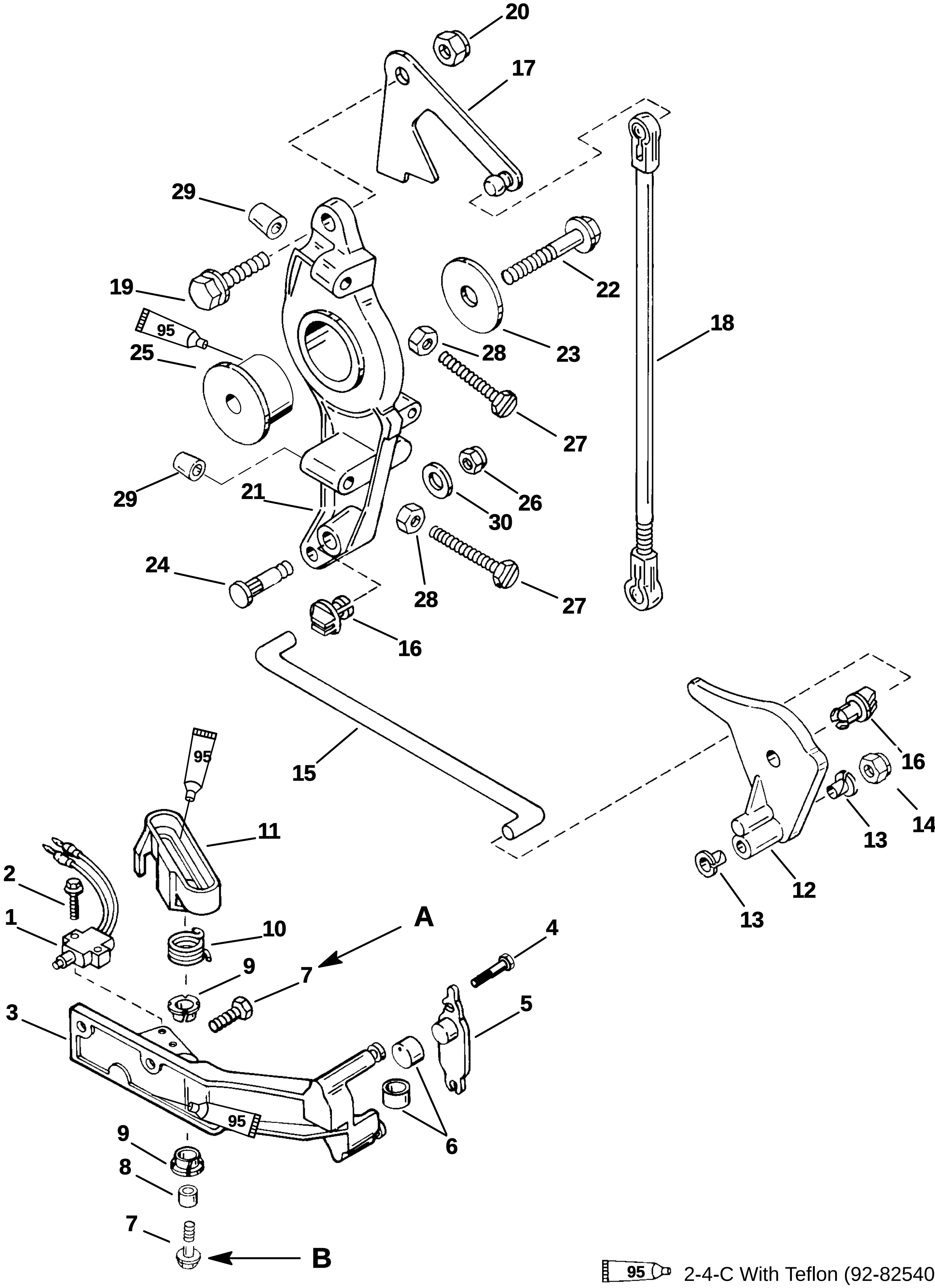
95 2-4-C With Teflon (92-825407A12)

A – 25 lb. ft. (33.9 N·m)
B – 20 lb. ft. (27.1 N·m)

Anchor Bracket/Throttle Linkage (Carb Models) (S/N-0G303046 & Up)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWITCH **NON SEAPRO/MARATHON**			
2	2	SCREW (M3.5 x 20)	10		1.1
3	1	ANCHOR BRACKET			
4	2	DRIVE SCREW			
5	1	LATCH			
6	2	CUP			
7	3	SCREW (M8 x 25)			
8	1	BUSHING			
9	2	BUSHING			
10	1	SPRING			
11	1	ROLLER GUIDE			
12	1	THROTTLE LINK KIT			
13	1	THROTTLE LEVER			
14	2	THROTTLE LEVER			
15	3	SCREW (10-32 x 3/4")			
16	3	WASHER			
17	3	LOCKWASHER			
18	1	THROTTLE LINK			
19	1	SWIVEL BUSHING			
20	1	PIN INSERT			
21	1	WASHER			
22	1	NUT			
23	2	SCREW (M6 x 1 x 55)			
24	2	NUT			
25	2	CAP			
26	1	THROTTLE LEVER			
27	1	BUSHING			
28	1	SCREW (M8 x 25)	200	16.5	22.4
29	1	NUT			
30	1	BRACKET-Oil Link			
31	1	SCREW (M8 x 35)	240	20	27.1
32	1	WASHER			
33	1	LINK			

Anchor Bracket/Throttle Linkage (EFI Models)



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

A – 25 lb. ft. (33.9 N·m)
B – 20 lb. ft. (27.1 N·m)

Anchor Bracket/Throttle Linkage (EFI Models)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	SWITCH			
2	2	SCREW (M3.5 x 20)	10		1.1
3	1	ANCHOR BRACKET			
4	2	DRIVE SCREW			
5	1	LATCH			
6	2	CUP			
7	3	SCREW (M8 x 25)			
8	1	BUSHING			
9	2	BUSHING			
10	1	SPRING			
11	1	ROLLER GUIDE			
12	1	THROTTLE CAM			
13	2	BUSHING			
14	1	NUT			
15	1	THROTTLE LINK			
16	2	SWIVEL BUSHING			
17	1	BRACKET-Oil Link			
18	1	LINK			
19	1	SCREW (M8 x 25)	200	17.0	23.0
20	1	NUT			
21	1	THROTTLE LEVER			
22	1	SCREW (M8 x 35)	240	20	27.1
23	1	WASHER			
24	1	PIN INSERT			
25	1	BUSHING			
26	1	NUT			
27	2	SCREW (M6 x 1 x 55)			
28	2	NUT			
29	2	CAP			
30	1	WASHER			

Powerhead Installation on Driveshaft Housing

1. Install Lifting Eye (91-90455) into flywheel.

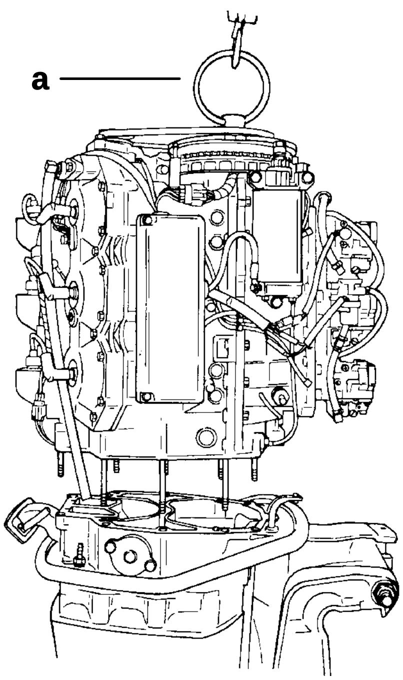
⚠ WARNING

BE SURE that Lifting Eye is threaded into flywheel as far as possible BEFORE lifting powerhead.

2. Using a hoist, lift powerhead high enough to allow removal of powerhead from repair stand. Remove powerhead from repair stand, being careful not to damage drive shaft housing gasket surface of powerhead.
3. Place a new gasket around powerhead studs and into position on base of powerhead.

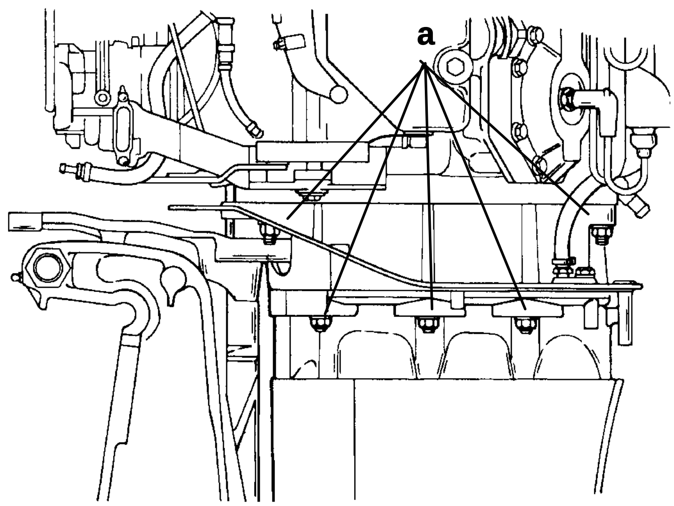
IMPORTANT: DO NOT apply lubricant to top of drive- shaft as this will prevent driveshaft from fully engaging into crankshaft.

4. Apply a small amount of 2-4-C w/Teflon (92-825407A12) onto driveshaft splines.
5. Use hoist to lower powerhead onto driveshaft housing. It may be necessary to turn flywheel (aligning crankshaft splines with drive shaft splines) so that powerhead will be fully installed.



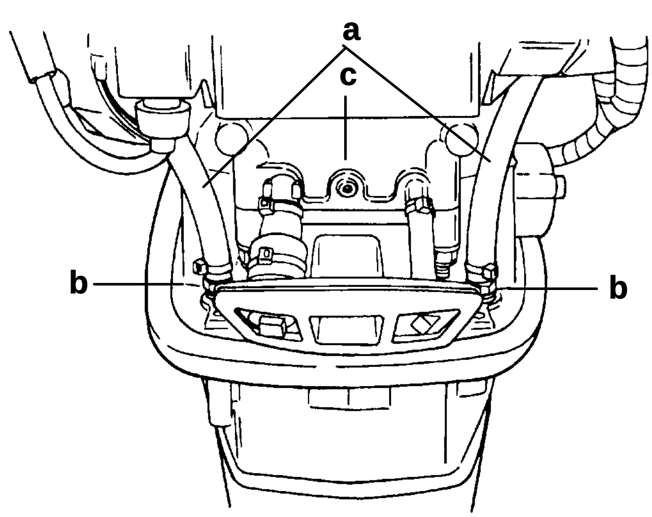
a - Lifting Eye (91-90455)

6. Install 10 flat washers and 10 locknuts which secure powerhead to exhaust extension plate/driveshaft housing. Torque locknuts in 3 progressive steps until secured.
7. Disconnect hoist from Lifting Eye and remove Lifting Eye from flywheel.
8. Reinstall plastic cap into center of flywheel cover.



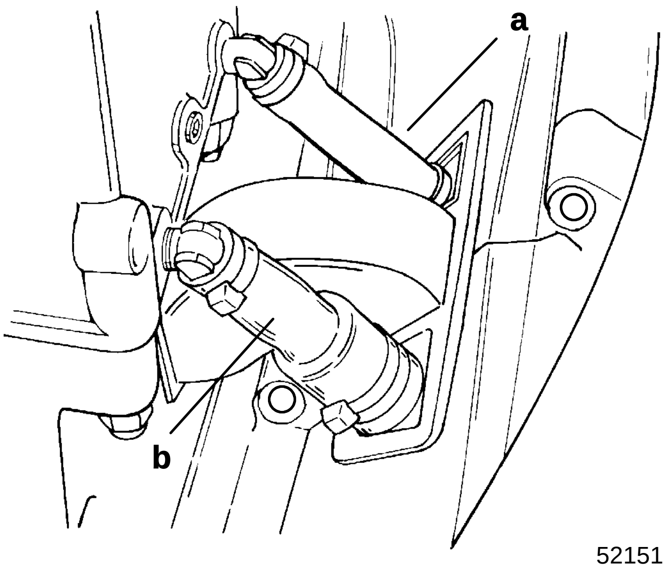
a - Locknuts and Flat Washers [Torque to 50 lb. ft. (68.0 N·m)]

9. Connect bypass water hoses to fittings on exhaust adaptor plate.



a - Water Hose
b - Fitting
c - Water Pressure Gauge Fitting

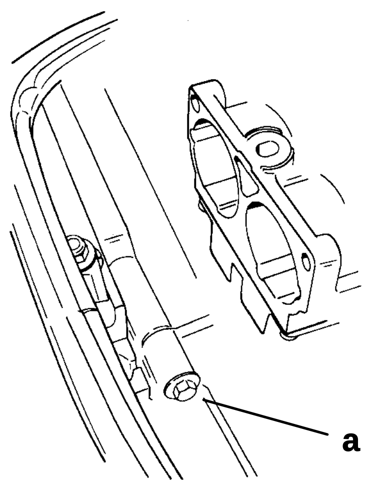
10. Connect tell-tale hose and flush hose to engine block.



52151

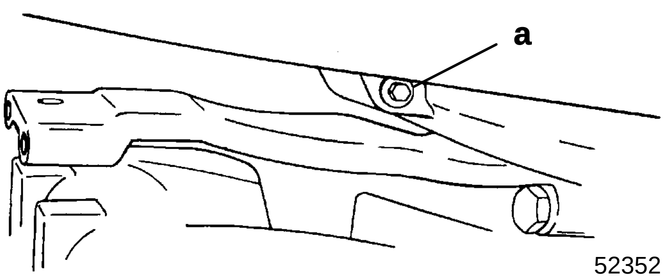
a - Tell-Tale Hose
b - Flush Hose

11. Install four bolts which secure bottom cowl halves together.



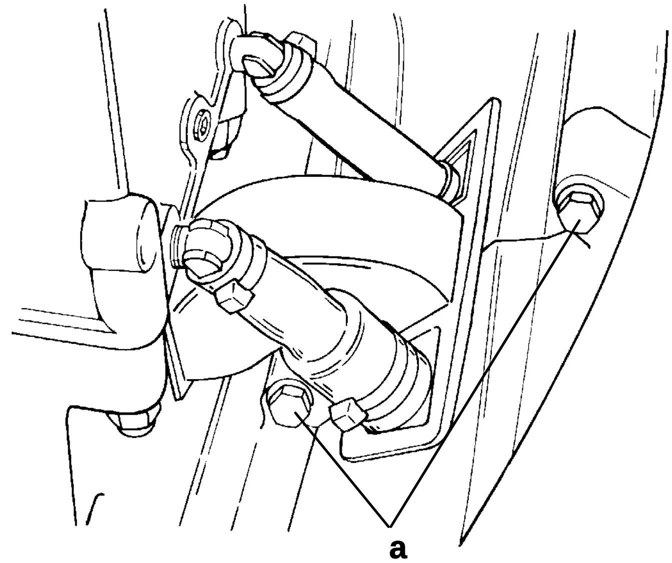
52354

a - Bolts [Torque to 65 lb. in. (7.3 N·m)]



52352

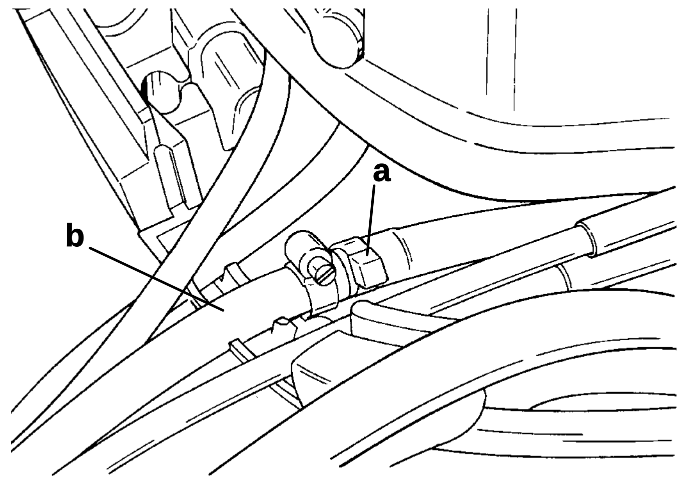
a - Bolts [Torque to 65 lb. in. (7.3 N·m)]



52151

a - Bolts [Torque to 65 lb. in. (7.3 N·m)]

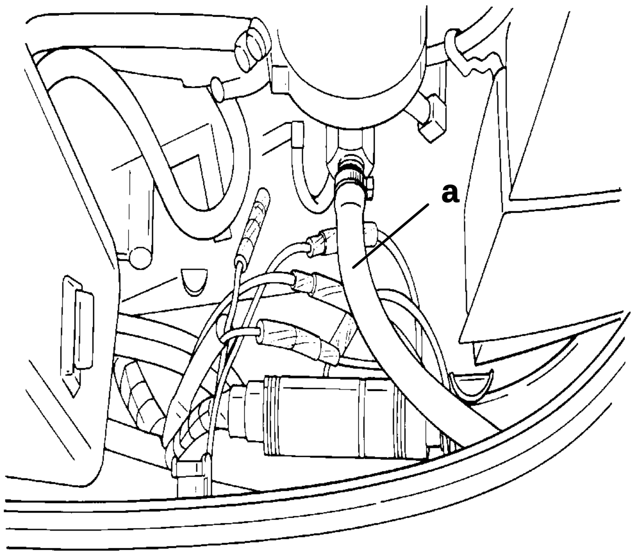
12. Re-connect input fuel line.



52191

a - Sta-Strap
b - Fuel Line

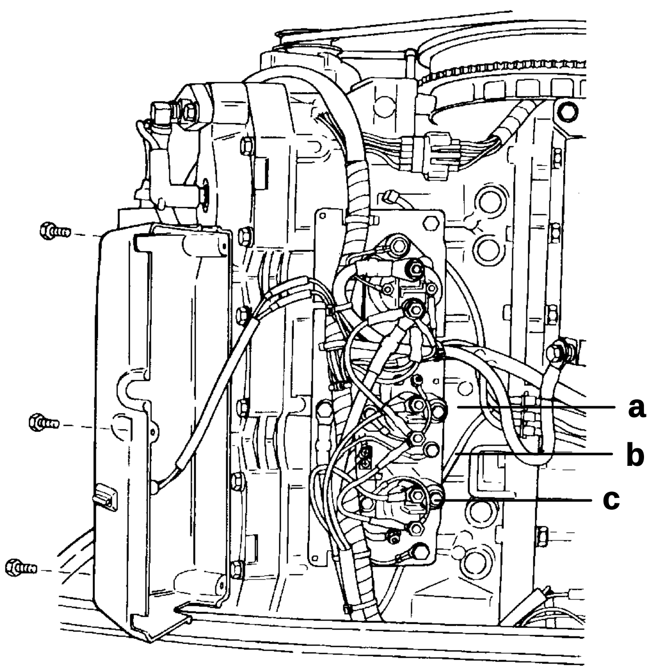
13. Connect remote oil tank pressure hose to to crankcase fitting.



52193

a - Remote Oil Tank Pressure Hose

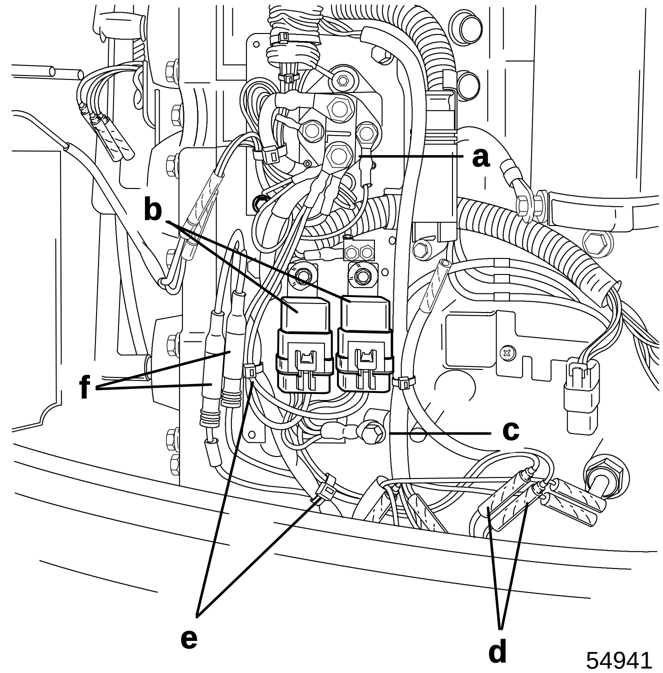
14. **MODELS WITH TRIM SOLENOIDS –** Connect BLUE, GREEN and BLACK trim harness leads to trim solenoids. Install trim harness to J-clip on exhaust cover.



52151

a - Blue Trim Lead
b - Black Trim Lead
c - Green Trim Lead

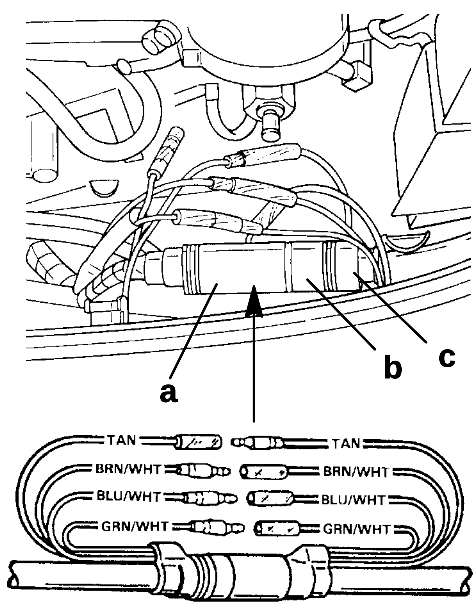
MODELS WITH TRIM RELAYS – Attach relay ground harness to lower electrical plate mounting bolt. Torque bolt to 16.5 lb. ft. (22.4 N·m).
Attach relay positive leads (RED) to BATTERY SIDE of starter solenoid with nut. Torque nut to 45 lb. in. (5.1 N·m).



54941

a - Nut – Attach RED Relay Leads – Torque Nut to 45 lb. in. (5.1 N·m)
b - Relays – Secure with Retained Bolts and Nuts
c - Bolt – Attach BLACK (ground) Relay leads – Torque Bolt to 16.5 lb. ft. (22.4 N·m).
d - Connect BLUE/WHITE and GREEN/WHITE Trim Leads to Lower Cowl Trim Switch Harness.
e - Sta-Straps
f - Connect BLUE (sleeve) and GREEN Power Trim Leads.

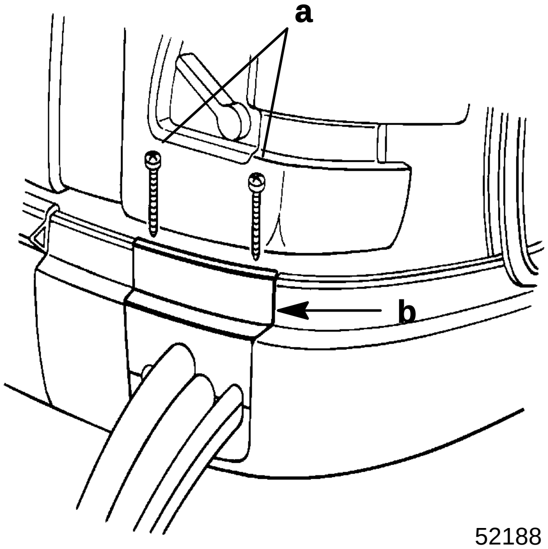
15. Re-connect remote control harness to powerhead harness connector and wires as shown.



52186

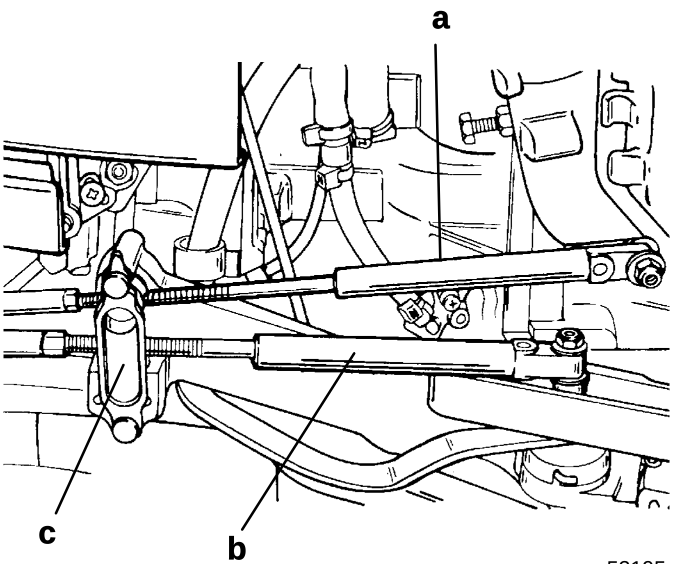
a - Engine Harness Connector
b - Remote Wiring Harness
c - “J” Clamp

16. Install two screws which secure remote control harness retainer.



a - Screws
b - Retainer

17. Slide outboard shift lever into neutral position.
18. Install throttle cable.
19. Install shift cable assembly as shown Refer to "Cable Adjustment" Section 7A.



a - Throttle Cable
b - Shift Cable
c - Cable Retainer

Refer to Section 2 of this Service Manual "Timing/Synchronizing/Adjusting" for engine set-up procedures.

Break-In Procedure

MODELS WITH OIL INJECTION

Use a 50:1 (2%) gasoline/oil mixture in the first tank of fuel. Follow the table below for mixing ratios. Use of this fuel mixture combined with oil from the oil injection system will supply adequate lubrication during engine break-in.

After the break-in fuel mixture is used up, it is no longer necessary to add oil with the gasoline.

NOTE: *At the end of the break-in period, visually check to see if the oil level in the oil injection tank has dropped. Oil usage indicates the oil injection system is functioning correctly.*

GASOLINE/OIL MIXING RATIO CHART

GAS/OIL RATIO	1 GALLON GAS (3.8 LITERS)	3 GALLONS GAS (11.5 LITERS)	6 GALLONS GAS (23 LITERS)
50:1 (2%)	3 FL. OZ. (89 ML) OIL	8 FL. OZ. (237 ML) OIL	16 FL. OZ. (473 ML) OIL

MODELS WITHOUT OIL INJECTION

Use a 25:1 (4%) gasoline/oil mixture in the first tank of fuel.

After the break-in fuel mixture is used up, use a 50:1 (2%) gasoline/oil mixture. Follow the table below for mixing ratios.

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)
25:1 (4%)	5 FL. OZ. (148 ML) OIL	16 FL. OZ. (473 ML) OIL	32 FL. OZ. (946 ML) OIL
50:1 (2%)	3 FL. OZ. (89 ML) OIL	8 FL. OZ. (237 ML) OIL	16 FL. OZ. (473 ML) OIL

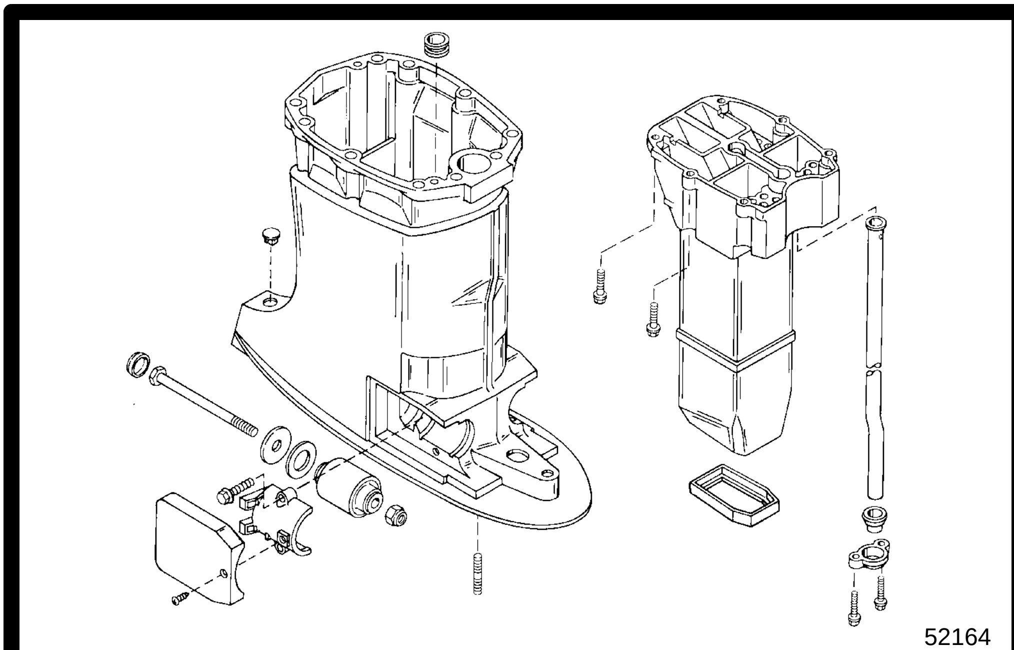
ENGINE BREAK-IN PROCEDURE (ALL MODELS)

Vary the throttle setting during the first hour of operation. Avoid remaining at a constant speed for more than two minutes and avoid sustained wide open throttle.

MID-SECTION

5

A



CLAMP BRACKET/SWIVEL BRACKET/ DRIVE SHAFT HOUSING

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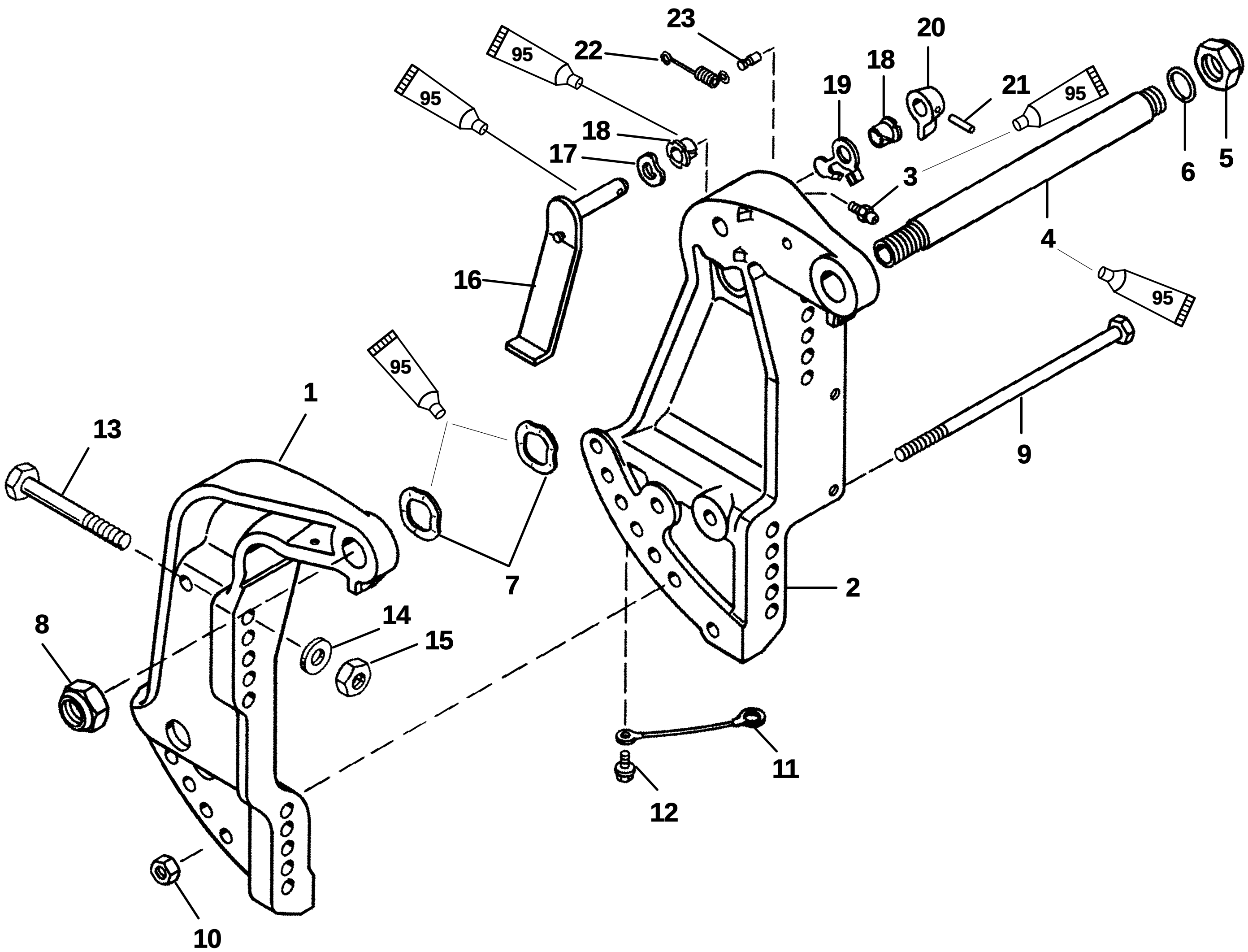
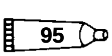
Notes:

Transom Brackets (S/N-0G589999 & BELOW)



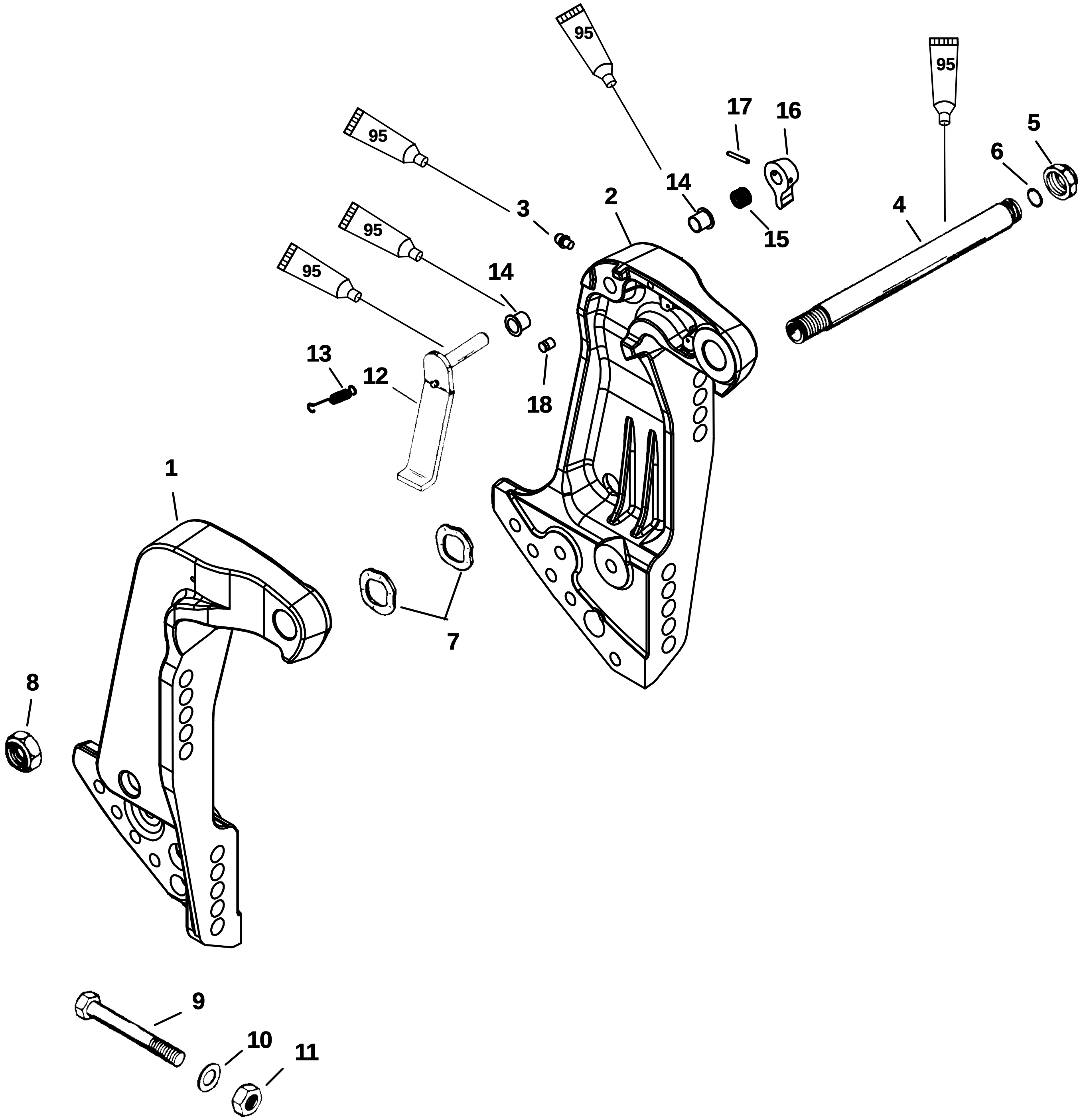


2-4-C With Teflon (92-825407A12)

Transom Brackets (S/N-0G589999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	TRANSOM BRACKET **(STBD)**			
2	1	TRANSOM BRACKET **(PORT)**			
3	1	GREASE FITTING **(PORT)**	85		9.6
4	1	TILT TUBE			
5	1	NUT (1^2-14)		45	61
6	1	O RING			
7	2	WAVE WASHER			
8	1	NUT (7/8-14)		45	61
9	1	BOLT ASSEMBLY			
10	1	NUT (.375-24)	90		10.2
11	1	GROUND WIRE			
12	1	SCREW (1/4-20 x .375)	70		7.9
13	4	BOLT			
14	4	WASHER			
15	4	NUT			
16	1	TILT LOCK LEVER ASSEMBLY			
17	1	WAVE WASHER			
18	2	BUSHING			
19	1	STOP			
20	1	KNOB			
21	1	GROOVE PIN			
22	1	SPRING			
23	1	GROOVE PIN			

Transom Brackets (S/N-0G590000 & UP)

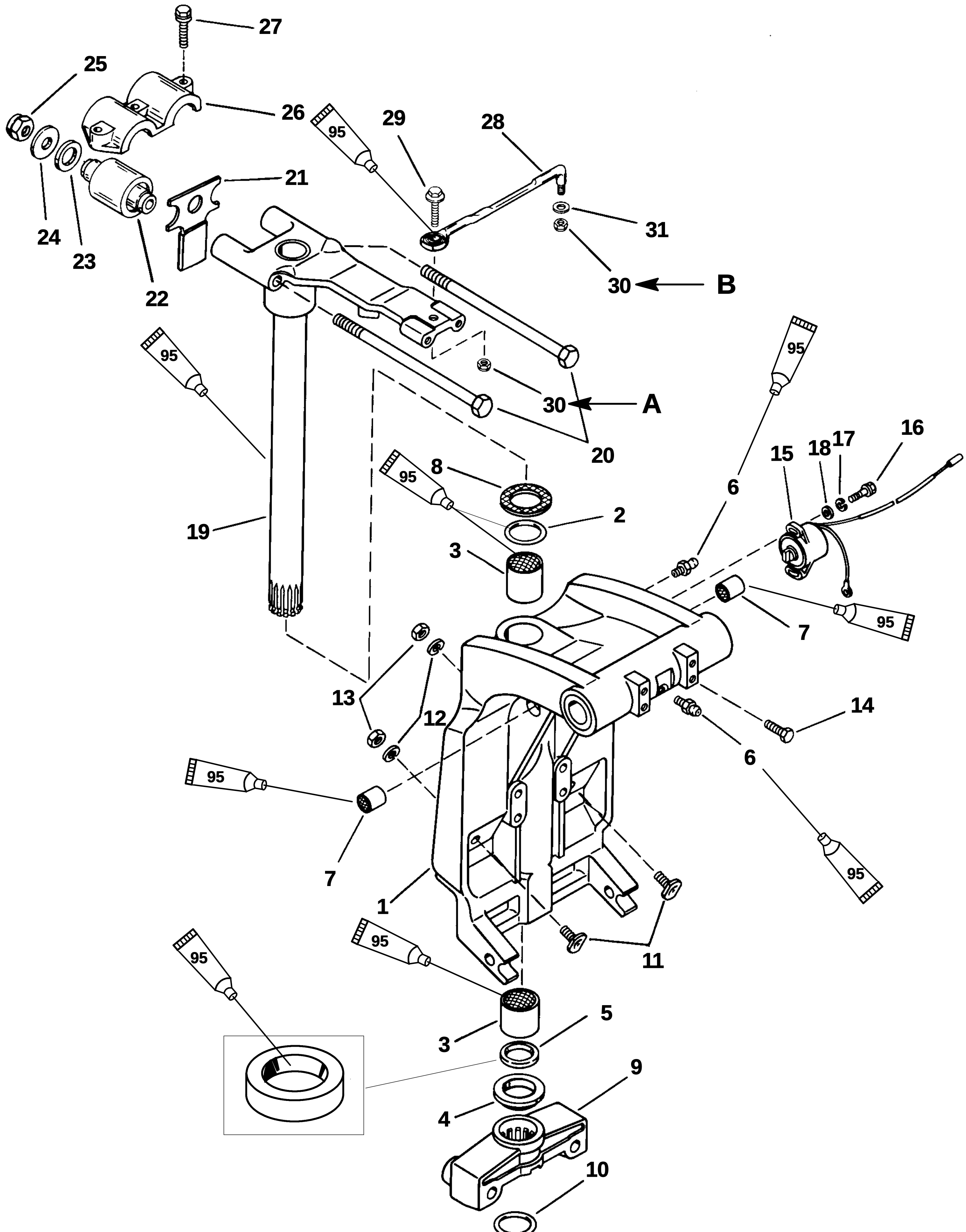


95 2-4-C With Teflon (92-825407A12)

Transom Brackets (S/N-0G590000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	TRANSOM BRACKET			
2	1	TRANSOM BRACKET			
3	1	GREASE FITTING **(PORT)**	85	7.0	9.6
4	1	TILT TUBE			
5	1	NUT (1 IN.-14)		45	61.0
6	1	O-RING			
7	2	WAVE WASHER			
8	1	NUT (7/8-14)		45	61.0
9	4	BOLT			
10	4	WASHER			
11	4	NUT			
12	1	TILT LOCK LEVER ASSEMBLY			
13	1	SPRING			
14	2	BUSHING			
15	1	SPRING			
16	1	KNOB			
17	1	GROOVE PIN			
18	1	PIN			

Swivel Bracket and Steering Arm



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

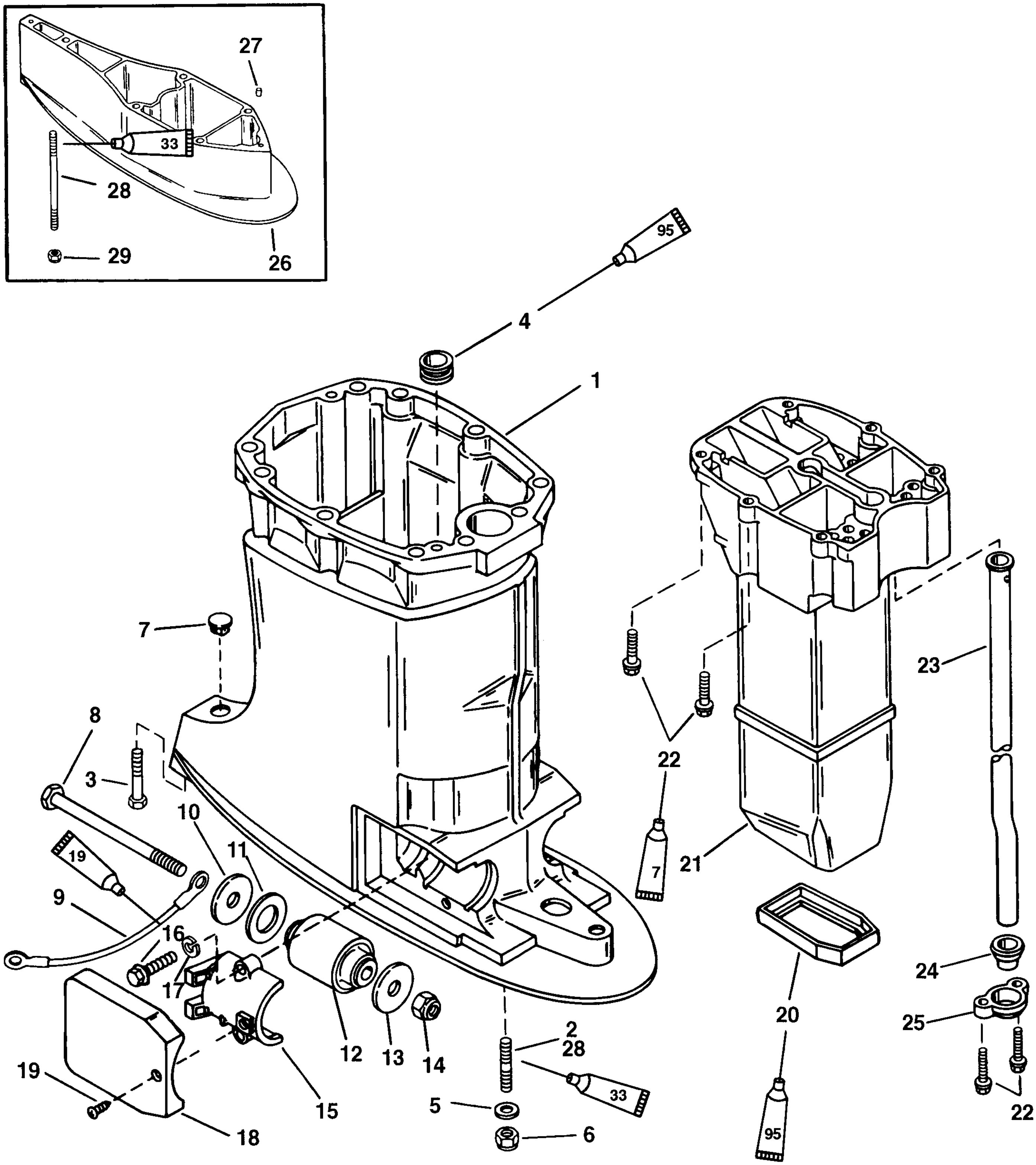
Swivel Bracket and Steering Arm

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	SWIVEL BRACKET			
2	1	O RING			
3	2	BUSHING			
4	1	SPACER			
5	1	OIL SEAL (LOWER)			
6	2	GREASE FITTING	85		9.6
7	2	BUSHING			
8	1	THRUST WASHER			
9	1	BOTTOM YOKE **(LONG - CARBON STEEL)**			
9	1	BOTTOM YOKE **(XL/XXL-STAINLESS STEEL)**			
10	1	RETAINING RING			
11	2	STRIKER PLATE			
12	2	LOCKWASHER			
13	2	NUT		25	33.9
14	2	SCREW (1/4-28)	100		11.3
15	1	TRIM SENDER			
16	2	SCREW (10-24 x 3/4²)	15		1.7
17	2	LOCKWASHER			
18	2	WASHER			
19	1	SWIVEL PIN/STEERING ARM **(LONG - CARBON STEEL)**			
19	1	SWIVEL PIN/STEERING ARM **(XL/XXL-STAINLESS STEEL)**			
20	2	SCREW (M12 x 1.75 x 190)		55	74.6
21	1	BUMPER			
22	2	UPPER MOUNT			
23	2	WASHER			
24	2	WASHER			
25	2	NUT		50	67.8
26	1	CLAMP			
27	3	SCREW (M8 x 35)		20	27.1
28	1	STEERING LINK ASSEMBLY			
29	1	SCREW		20	27.1
30	2	NUT (.375-24)			
31	2	WASHER			

A - Torque nut to 20 lb. ft. (27.1 N·m)

B - Torque nut until it seats [DO NOT Exceed 120 lb. in. (13.6 N·m) of Torque], Then Back Off 1/4 Turn.

Drive Shaft Housing and Exhaust Tube (S/N-0G437999 & BELOW)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

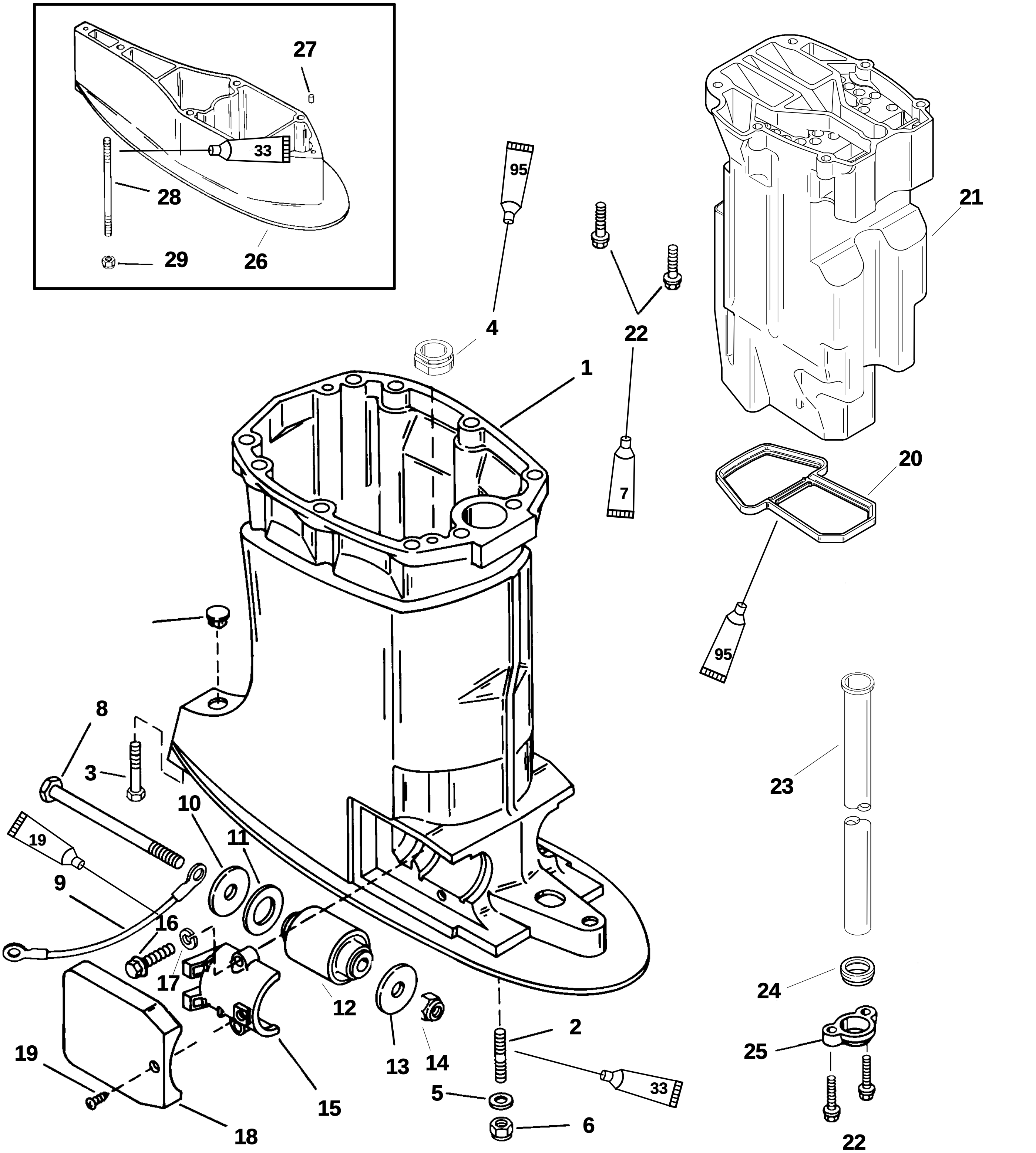
33 Loctite 680 (92-809833)

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

Drive Shaft Housing and Exhaust Tube (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	DRIVE SHAFT HSG. **(LONG)**			
	1	DRIVE SHAFT HOUSING **(X/XX-LONG)**			
2	4	STUD (M12 x 1.75 x 50) **(L/X-LONG)**			
3	1	SCREW (M10 x 1.5 x 30) **(L/X-LONG)**		45	61.0
4	1	GROMMET			
5	4	WASHER			
6	4	NUT (M12 x 1.75)		55	74.6
7	1	PLUG			
8	2	SCREW (M14 x 2 x 178)			
9	1	GROUND WIRE			
10	2	WASHER			
11	2	WASHER			
12	2	MOUNT			
13	1	WASHER			
14	2	NUT		90	122
15	2	CLAMP			
16	4	SCREW (M8 x 35)		20	27.1
17	1	LOCKWASHER			
18	2	COVER			
19	2	SCREW (5/8 IN.)	Drive Tight		
20	1	SEAL			
21	1	EXHAUST TUBE			
22	8	SCREW (M8 x 35)		16.5	22.4
23	1	WATER TUBE **(LONG)**			
	1	WATER TUBE **(X-LONG)**			
	1	WATER TUBE **(XX-LONG)**			
24	1	SEAL			
25	1	CLAMP			
26	1	SPACER			
27	2	DOWEL PIN **XX-LONG**			
28	4	STUD (M12 x 1.75 x 183)			
	1	STUD (M10 x 1.5 x 173)			
29	1	NUT (M10 x 1.5)		55	74.6

Drive Shaft Housing and Exhaust Tube (S/N-0G438000 & UP)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

33 Loctite 680 (92-809833)

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

Drive Shaft Housing and Exhaust Tube (S/N-0G438000 & UP)

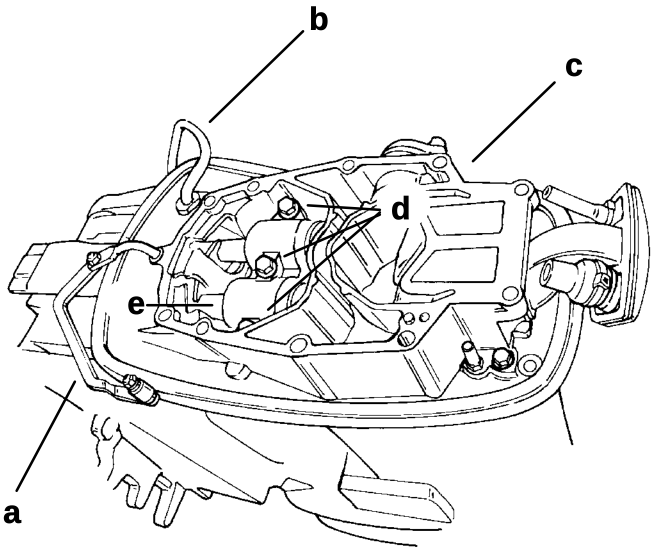
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	DRIVE SHAFT HOUSING **(LONG)**			
	1	DRIVE SHAFT HOUSING **(X/XX-LONG)**			
2	4	STUD (M12 x 1.75 x 50)			
3	1	SCREW (M10 x 1.5 x 30)		45	61.0
4	1	GROMMET			
5	4	WASHER			
6	4	NUT (M12 x 1.75)		55	74.6
7	1	PLUG			
8	2	SCREW (M14 x 2 x 178)			
9	1	GROUND WIRE			
10	2	WASHER			
11	2	WASHER			
12	2	MOUNT			
13	1	WASHER			
14	2	NUT		90	122
15	2	CLAMP			
16	4	SCREW (M8 x 35)		20	27.1
17	1	LOCKWASHER			
18	2	COVER			
19	2	SCREW (5/8 IN.)	Drive Tight		
20	1	SEAL			
21	1	EXHAUST TUBE			
22	6	SCREW (M8 x 35)		16.5	22.4
23	1	WATER TUBE **(LONG)**			
	1	WATER TUBE **(X-LONG)**			
	1	WATER TUBE **(XX-LONG)**			
24	1	SEAL			
25	1	CLAMP			
26	1	SPACER			
27	2	DOWEL PIN **XX-LONG**			
28	4	STUD (M12 x 1.75 x 183)			
	1	STUD (M10 x 1.5 x 173)			
29	1	NUT (M10 x 1.5)		55	74.6

Drive Shaft Housing and Dyna-Float Suspension

Refer to "Powerhead Removal" Section to Remove Powerhead. Refer to "Lower Unit Removal" in This Section to Remove Lower Unit.

Removal and Disassembly

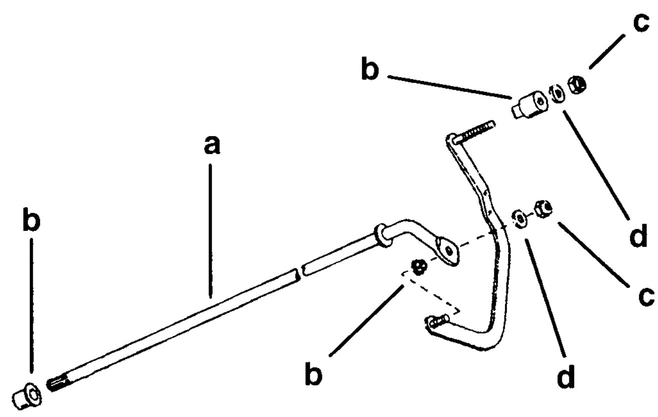
1. Remove shift shaft from drive shaft housing by pulling straight up on shaft.
2. Remove power trim wiring harness from exhaust adaptor plate.
3. Remove 3 bolts which secure upper mount cover to adaptor plate. Remove cover.



52310

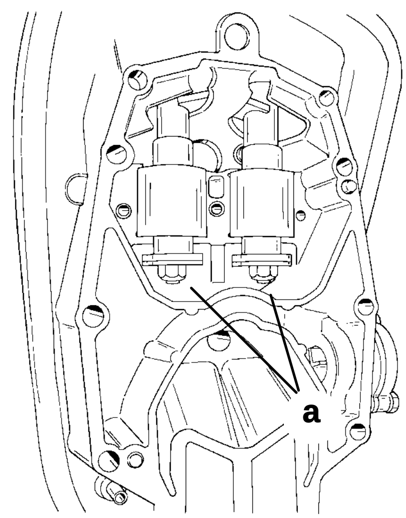
a - Shift Shaft
b - Wiring Harness
c - Adaptor Plate
d - Bolts
e - Upper Mount Cover

SHIFT LINKAGE ASSEMBLY



a - Shift Shaft
b - Bushing (3)
c - Lock Nut (2)
d - Washer (2)

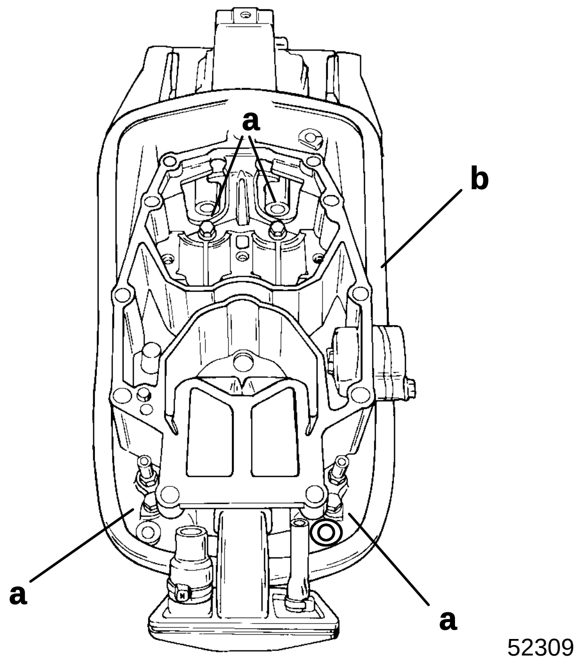
4. Remove upper mount nuts and flat washers.
5. Pull mount bolts thru mounts and remove mounts.



52312

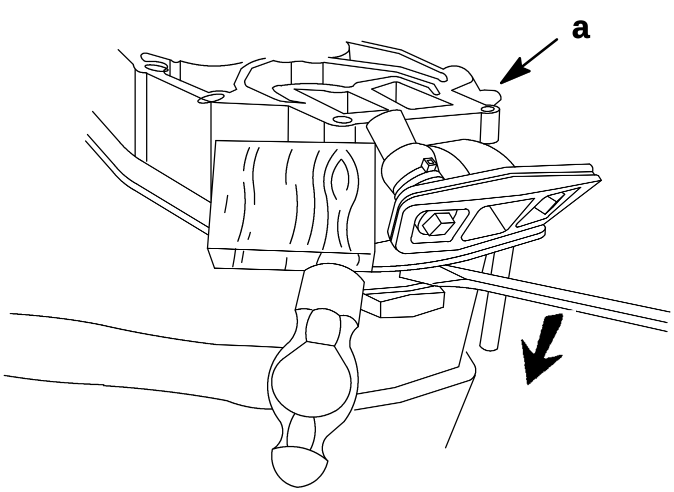
a - Upper Mount Nuts

6. Remove 4 bolts securing exhaust adaptor plate to drive shaft housing.



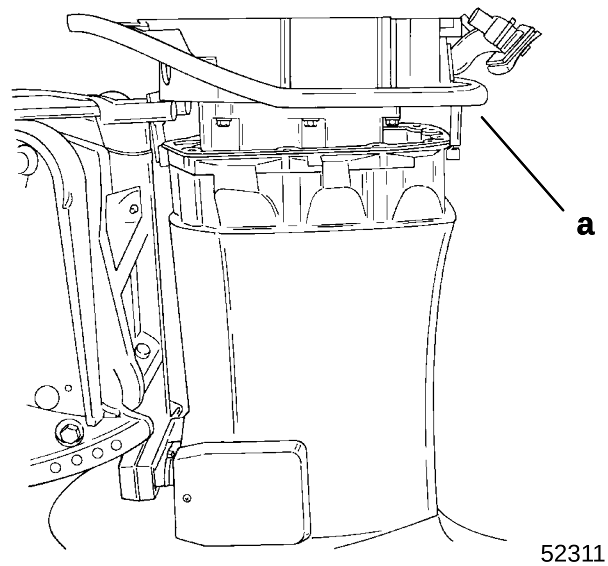
a - Bolts
b - Adaptor Plate

7. While applying upward pressure on rear of adaptor plate, use a mallet and a piece of hardwood gainst the adaptor plate to loosen gasket adhesion.



a - Adaptor Plate

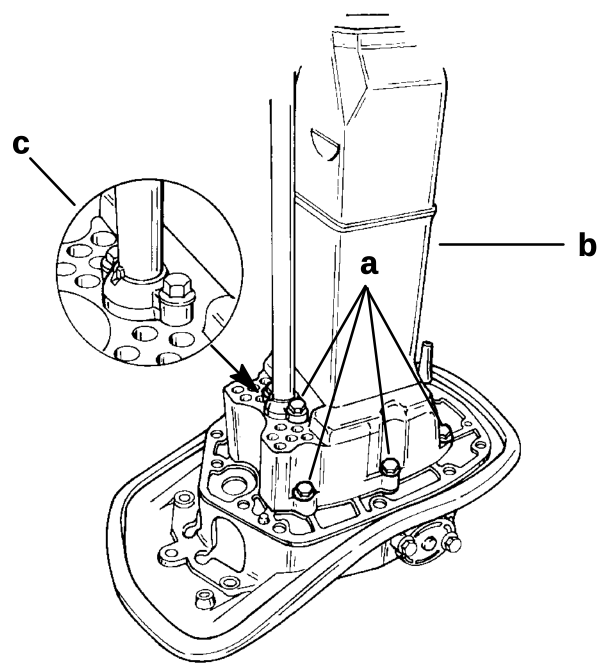
8. Lift adaptor plate off housing.



a - Adaptor Plate

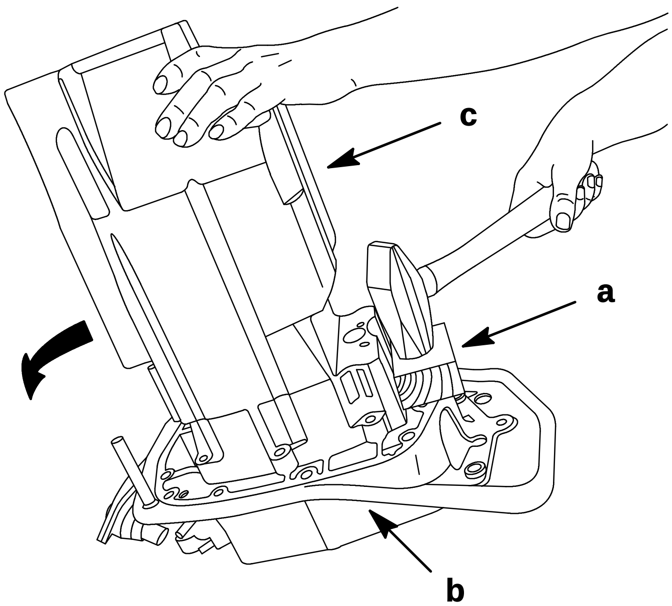
9. Remove 2 bolts securing water tube to adaptor plate and remove tube.

10. Remove 6 bolts securing exhaust tube to adaptor plate..



a - Bolts
b - Exhaust Tube
c - Water Tube

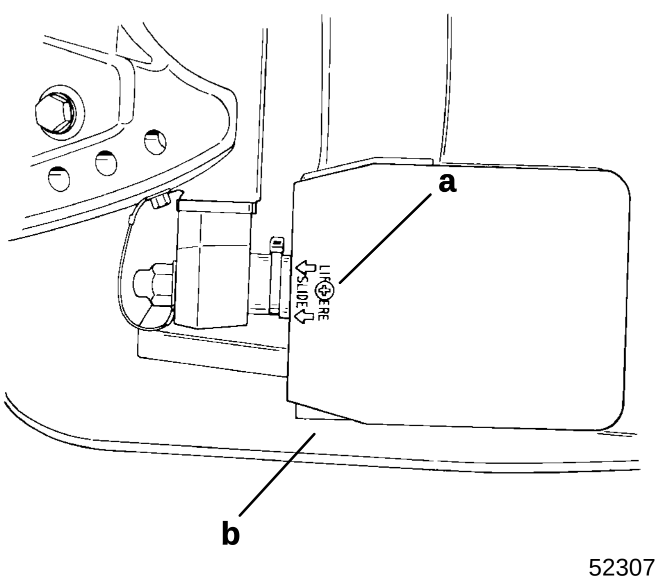
11. While tilting adaptor plate/exhaust tube assembly, use a piece of hardwood and a mallet to loosen gasket adhesion. Remove exhaust tube.



a - Hardwood
b - Adaptor Plate
c - Exhaust Tube

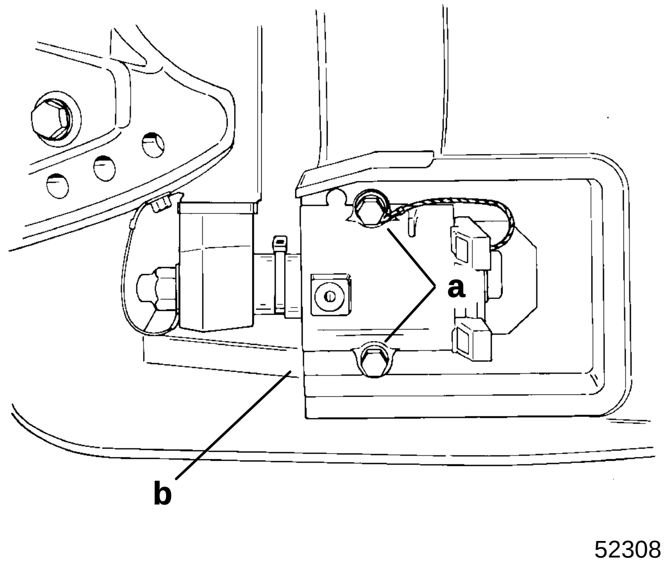
12. Remove all gasket and gasket material from drive shaft housing and related components.

13. Remove screw which secures each lower mount cover to drive shaft housing. Remove covers.



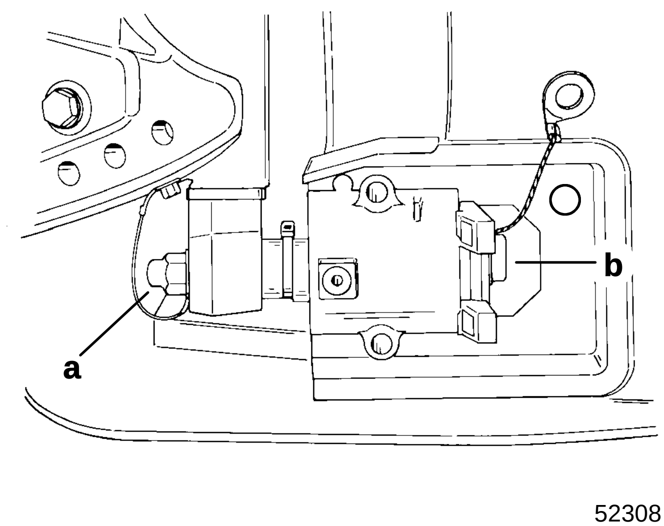
a - Screw
b - Cover

14. Remove bolts securing lower mount retainers to drive shaft housing. Remove retainers.



a - Bolts
b - Lower Mount Retainer (One Each Side)

15. Remove lower mount nuts and rubber caps.



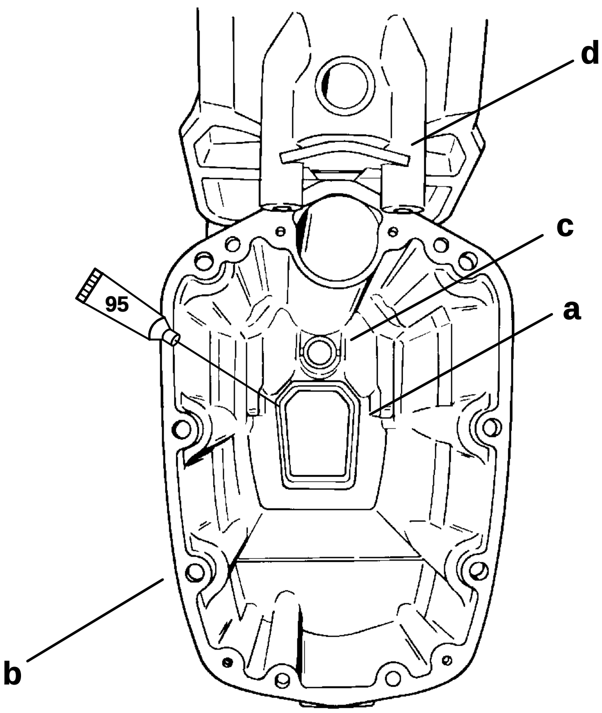
a - Lower Mount Nuts
b - Rubber Caps

16. Remove drive shaft housing from swivel bracket by pulling alternately from top to bottom on housing.

17. Remove upper and lower mounts by lifting them out of drive shaft housing.

Reassembly and Installation

1. Apply a thin coat of 2-4-C Marine Lubricant onto inside portion of exhaust tube seal and water tube grommet.
2. Install exhaust tube seal into drive shaft housing with tapered side of seal facing up.
3. Position drive shaft housing to plate gasket on top of housing.
4. Position leather bumper on steering arm.

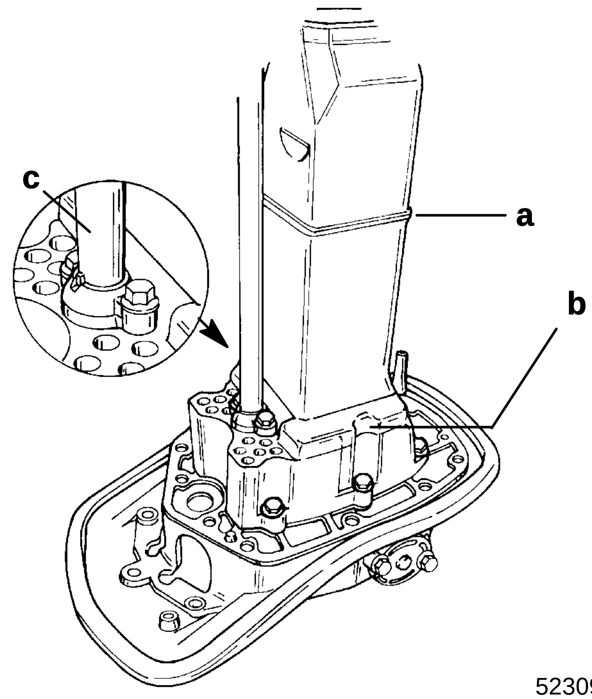


52307

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

a - Exhaust Tube Seal
b - Drive Shaft Housing
c - Water Tube Grommet
d - Leather Bumper

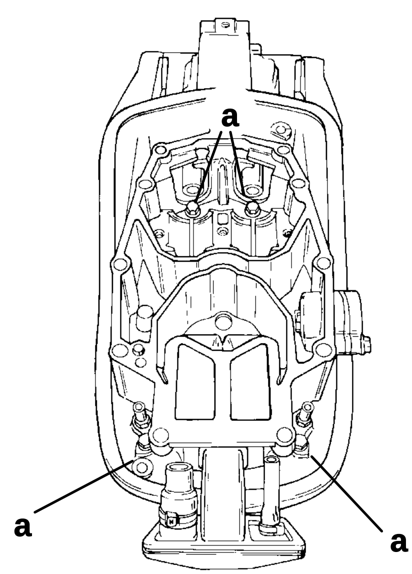
5. Position exhaust tube and gasket on adaptor plate. Secure both to plate with 6 bolts. Torque bolts to 21 lb. ft. (28.5 N·m).
6. Aligning water tube tab with slot, secure tube to adaptor plate with 2 bolts. Torque bolts to 80 lb. in. (9.0 N·m).



52309

a - Exhaust Tube
b - Gasket
c - Tab

7. Position adaptor plate on top of housing.
8. Secure adaptor plate to drive shaft with 4 bolts. Torque bolts to 25 lb. ft. (33.9 N·m).

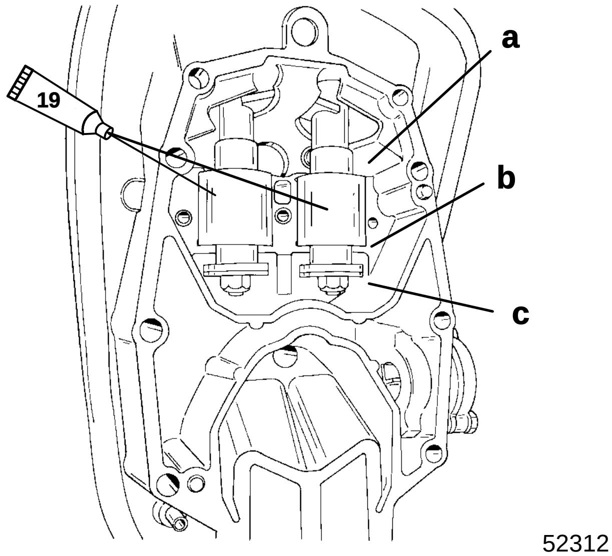


52309

a - Bolts [Torque to 25 lb. ft. (33.9 N·m)]

9. Apply a thin coat of Perfect Seal onto metal portion of upper dyna-float mounts.
10. Position mounts on drive shaft housing plate.

11. Install a rubber washer onto each upper mount, followed by a metal washer.
12. Push bolts thru mounts.



52312

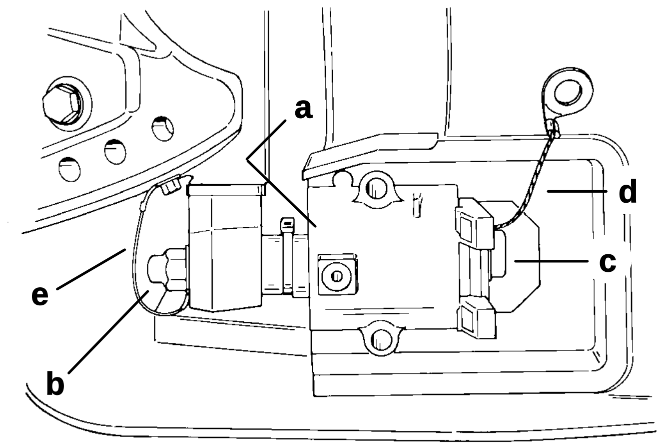
19 Perfect Seal (92-34227-1)

a - Dyna-Float Mounts
b - Rubber Washers
c - Metal Washer

13. Install a ground strap onto port lower mount bolt.

NOTE: *Apply Perfect Seal along length of lower mount bolts.*

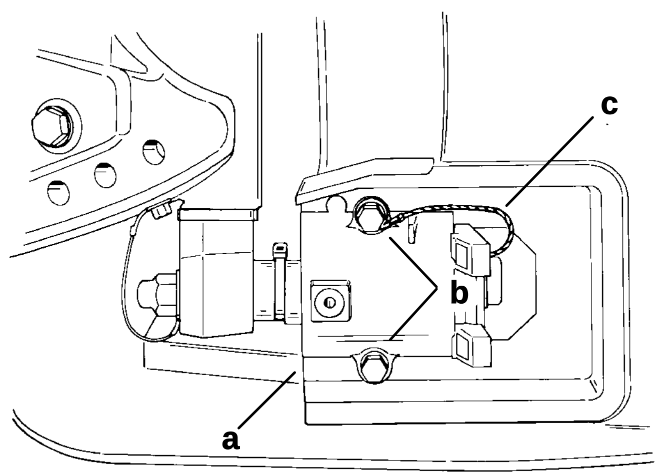
14. Insert a mounting bolt thru the short end of each lower mount.
15. Position a mount on each lower side of drive shaft housing.
16. Install a flat washer over each lower mounting bolt.
17. Start upper mounting bolts in upper mounts and align lower mounting bolts with holes in swivel pin yoke. Slide drive shaft housing up against yoke and bumper.
18. Secure upper mounts to steering arm with flat washers and self-locking nuts. Torque nuts to 50 lb. ft. (68.0 N·m).
19. Install ground strap between port lower mount bolt and swivel bracket.
20. Secure lower mounts to swivel pin yoke with self-locking nuts. Torque nuts to 90 lb. ft. (122.0 N·m). Place a rubber cap over each lower mounting bolt head.



52308

a - Lower Mount
b - Nut [Torque to 90 lb. ft. (122.0 N·m)]
c - Rubber Cap
d - Ground Strap (only one side)
e – Ground Strap (to swivel bracket)

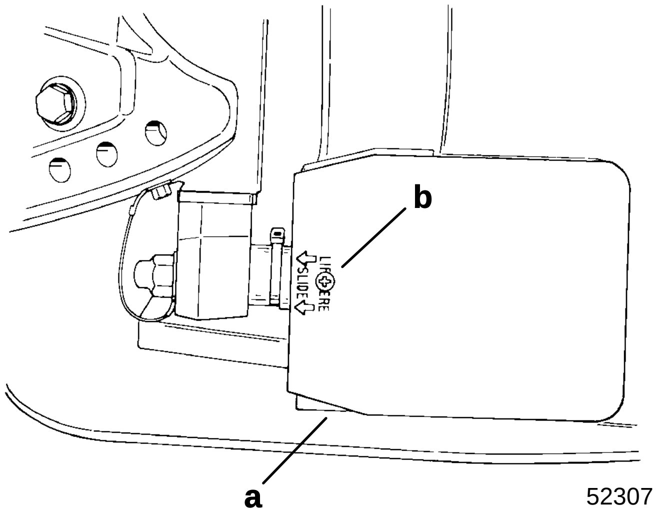
21. Install lower mount retainers and secure each retainer with 2 bolts. (Secure ground strap with the nearest retainer bolt and flat washer.) Torque bolts to 20 lb. ft. (27.1 N·m).



52308

a - Lower Mount Retainer
b - Bolts [Torque to 20 lb. ft. (27.1 N·m)]
c - Ground Strap

22. Install lower mount covers and secure each cover with a screw.

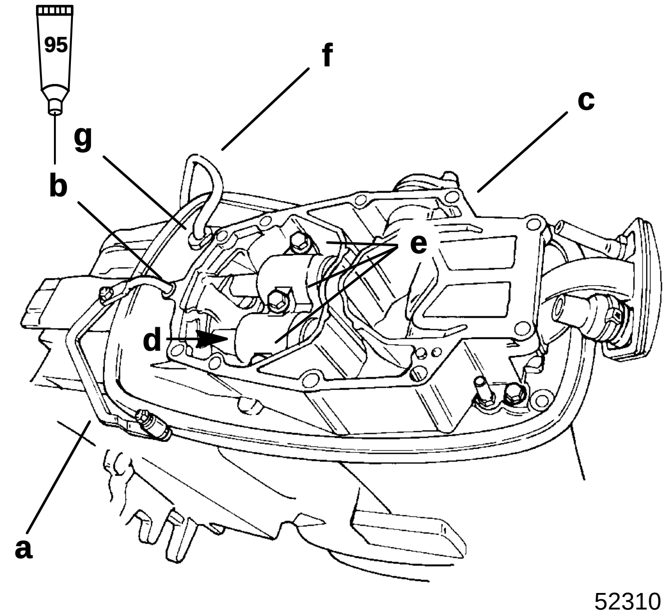


a - Cover
b - Screw (1 for Each Cover)

23. Install upper mount cover on adaptor plate. Secure cover with 3 bolts. Torque bolts to 20 lb. ft. (27.1 N·m).

24. Route power trim harness thru grommet in adaptor plate.

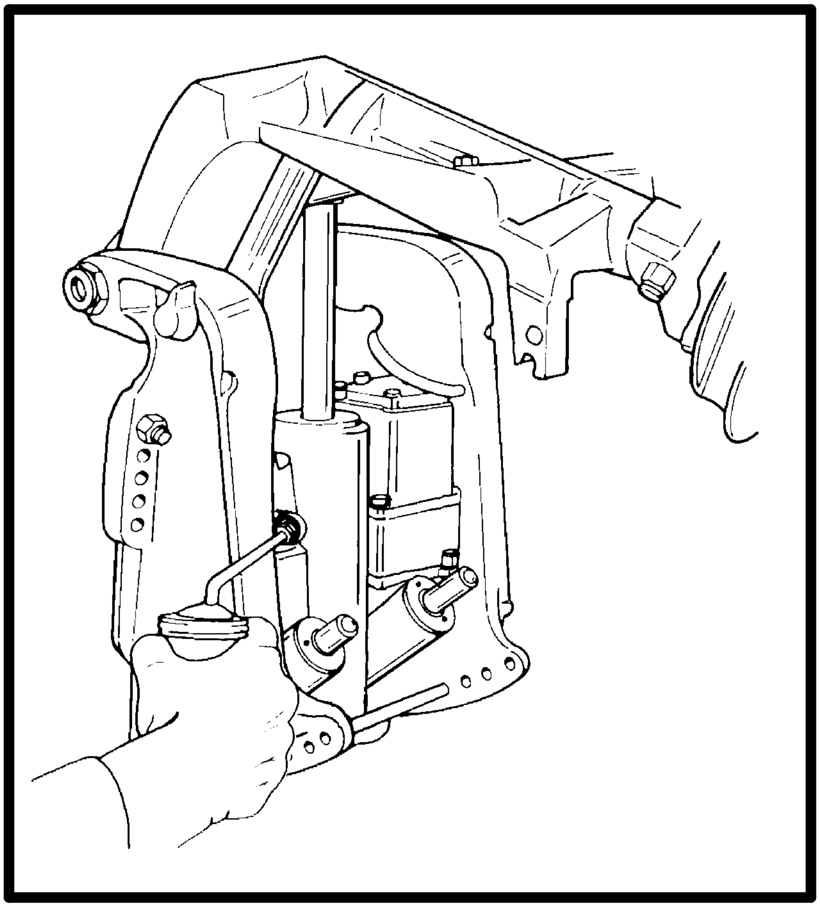
25. Reinstall shift shaft with bushing into adaptor plate. Apply 2-4-C w/Teflon to bushing.



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

a - Shift Shaft Linkage
b - Bushing
c - Exhaust Adaptor Plate
d - Upper Mount Cover
e - Bolts [Torque to 20 lb. ft. (27.1 N·m)]
f - Power Trim Harness
g - Grommet

MID-SECTION



POWER TRIM
SQUARE MOTOR AND
ROUND MOTOR DESIGN

5

B

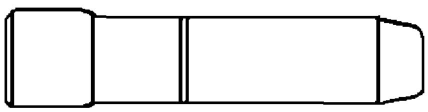
Table of Contents

Power Trim Specifications

Test	Reading
Trim "UP"	1300 PSI (91kg/cm^2) Maximum Pressure
Trim "DOWN"	500 PSI (35kg/cm^2) Minimum Pressure

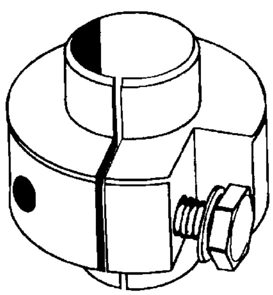
Special Tools

Alignment Tool 91-11230



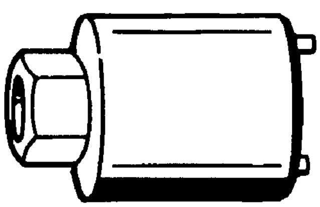
17238

Trim Rod Removal Tool 91-44486A1



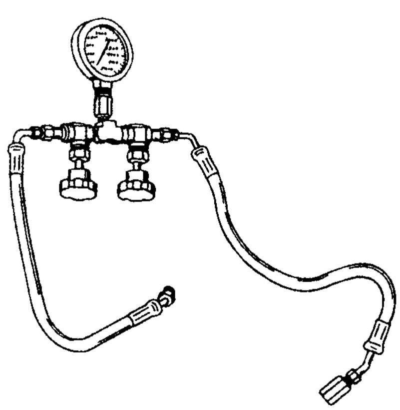
51337

Trim Rod Guide Removal Tool 91-44487A1



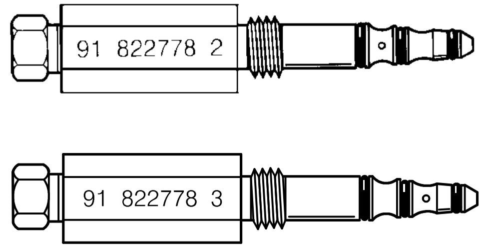
51337

Power Trim Test Gauge Kit 91-52915A6



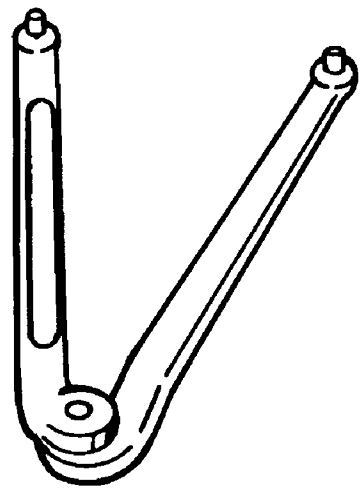
73835

Adaptor Fitting 91-822778A2 and 91-822778A3



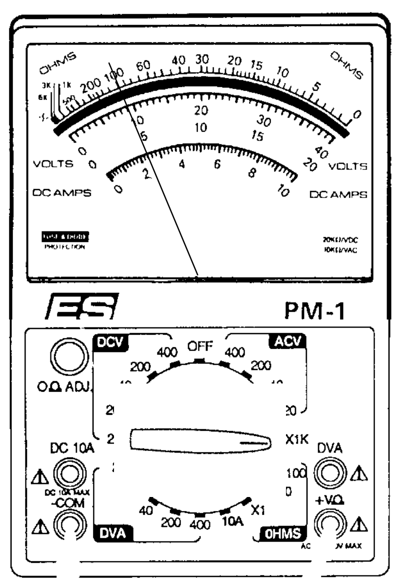
54458

Spanner Wrench 91-74951

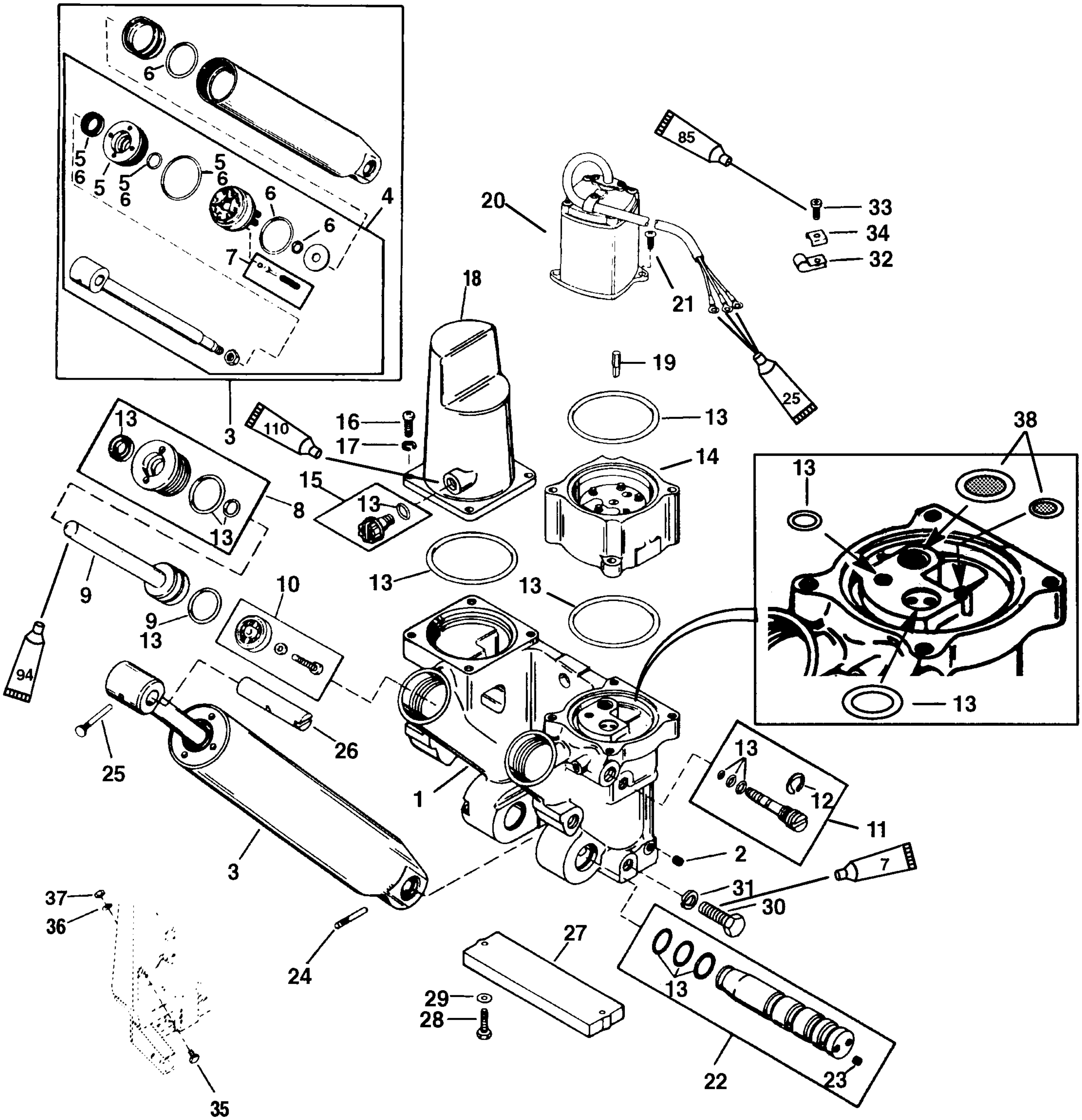


51337

Multi-Meter DVA Tester 91-99750A1



Power Trim Components (Square Motor)

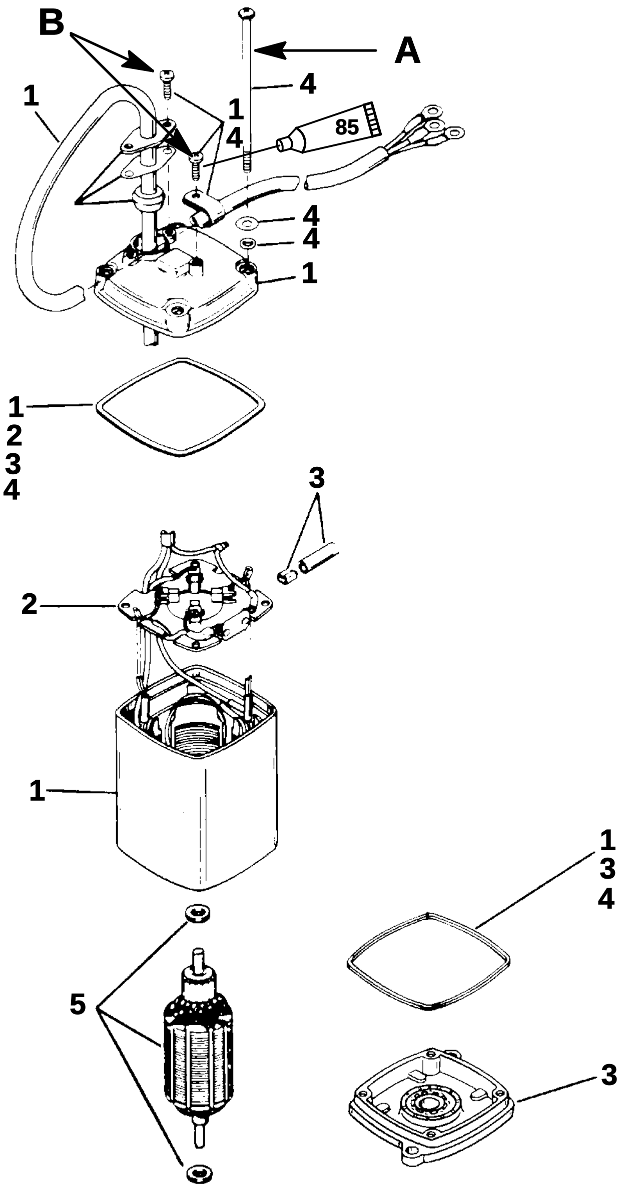


7	Loctite 271 (92-809820)
	Liquid Neoprene (92-25711--2)
85	RTV Silicone Sealer (92-91601-1)
94	Anti-Corrosion Grease (92-78376A6)
	Power Trim and Steering Fluid (92-90100A12)

Power Trim Components (Square Motor)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	POWER TRIM ASSEMBLY–Complete			
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY **(PORT)**			
	1	PISTON/ROD ASSEMBLY **(STBD.)**			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT			
20	1	TRIM MOTOR			
21	2	SCREW **(LONG)**	80		9.0
	2	SCREW **(SHORT)**	80		9.0
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	60	5	6.8
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		40	54.2
31	6	WASHER			
32	2	CLIP			
33	2	SCREW (10-16 x .44)			
34	2	C WASHER			
35	2	STRIKER PLATE			
36	2	LOCKWASHER			
37	2	NUT	80	6.5	9.0
38	2	FILTER SCREENS			

NOTE: Lubricate all o-rings with Power Trim and Steering Fluid.



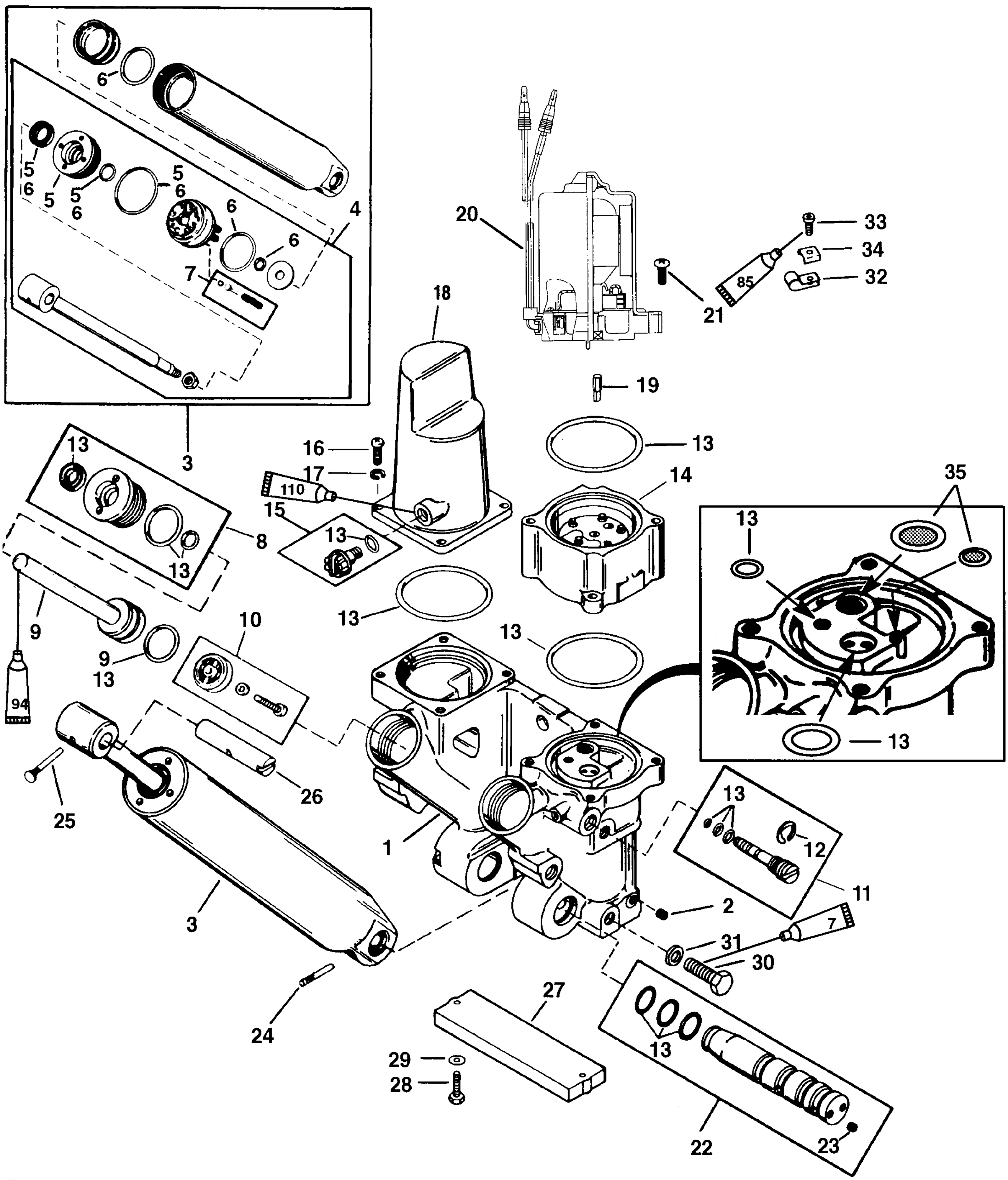
85 RTV Silicone Sealer (92-91601-1)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
-	1	POWER TRIM MOTOR			
1	1	FRAME AND FIELD KIT			
2	1	BRUSH CARD KIT **S/N-0G217419**			
3	1	END FRAME KIT **& BELOW**			
4	1	SEAL KIT			
5	1	ARMATURE KIT			

A – Torque to 60 lb. in. (6.8 N·m).
B – Drive tight.

Notes:

Power Trim Components (Round Motor)



7 Loctite 271 (92-809820)

85 RTV Silicone Sealer (92-91601-1)

94 Anti-Corrosion Grease (92-78376A6)

Power Trim and Steering Fluid (92-90100A12)

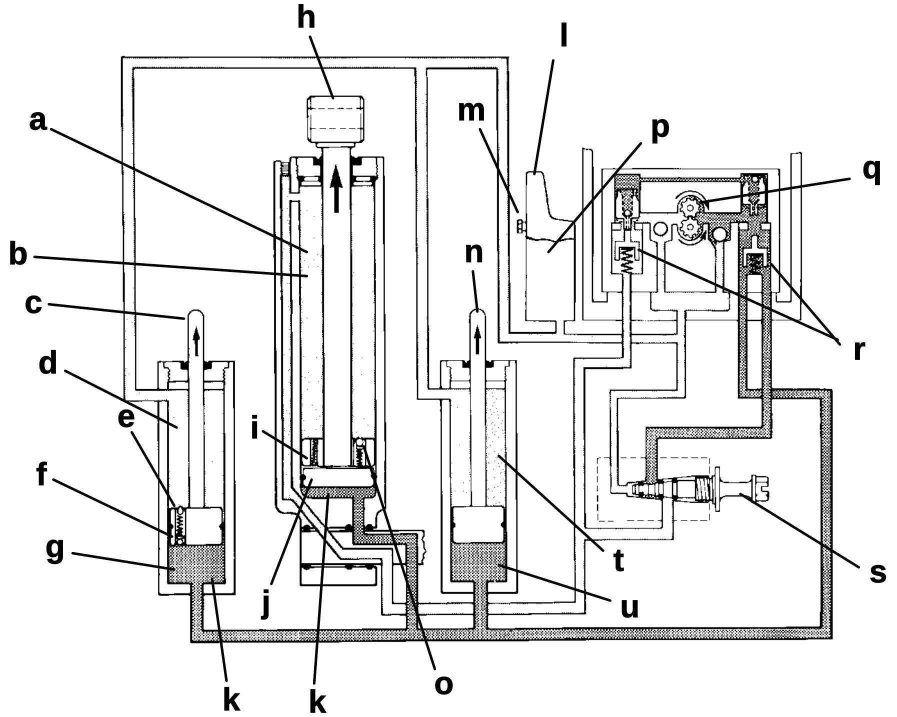
Power Trim Components (Round Motor)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY **(PORT)**			
9	1	PISTON/ROD ASSEMBLY **(STBD.)**			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT **S/N-0G217420 & UP**			
20	1	TRIM MOTOR			
19	1	DRIVE SHAFT **S/N-0G217419 & BELOW**			
20	1	TRIM MOTOR			
21	2	SCREW **(LONG)(S/N-0G217420 & UP)**	80		9.0
21	2	SCREW **(LONG)(S/N-0G217419 & BELOW)**	80		9.0
21	2	SCREW **(SHORT)**	80		9.0
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	70		7.9
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		40	54.2
31	6	WASHER			
32	2	CLIP**(S/N-0G217419 & BELOW)**			
32	2	CLIP**(S/N-0G217420 & UP)**			
33	2	SCREW (10-16 x .44)		Drive Tight	
34	2	C WASHER			
35	2	FILTER SCREEN			

NOTE: Lubricate all o-rings with Power Trim and Steering Fluid.

3 Ram Power Trim (External Mounted - Aft Fill) Hydraulic System

Trim Up

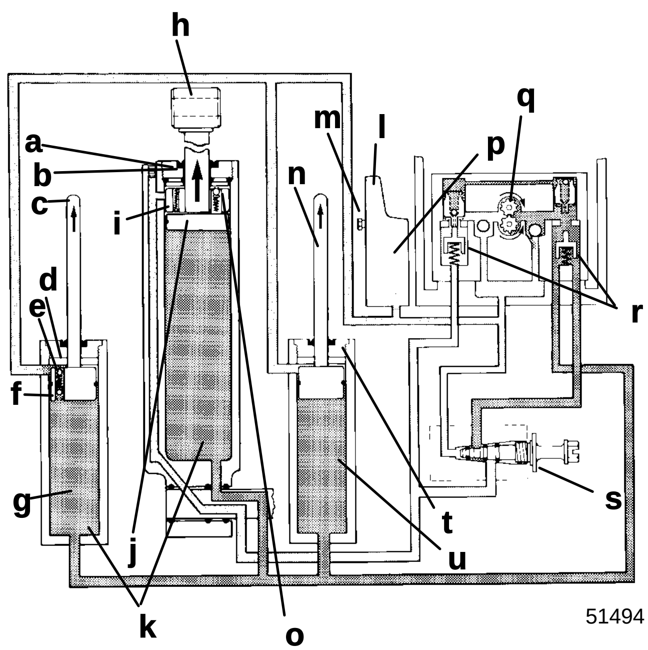


51492

a - Down Pressure 500 psi (3424.0kPa)
b - Down Cavity
c - Trim Ram
d - Down Cavity
e - Mechanical Check Valve
f - Tilt Relief 850-1150 psi (5820.8 – 7875.2kPa)
g - Up Pressure 1300 psi (8902.4kPa)
h - Tilt and Shock Ram
i - Siphon Valve
j - Memory Piston
k - Up Cavity
l - Reservoir
m - Fill Cap
n - Trim ram
o - Impact Relief Valve 1 Opens at 600 psi (4108.8kPa), the Remaining at 3200 psi (21913.6kPa)
p - Reservoir Pressure 6 psi (41.1kPa)
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

3 Ram Power Trim (External Mounted - Aft Fill) Hydraulic System

Hydraulic Tilt



51494

a - Down Pressure 500 psi (3424.0kPa)
b - Down Cavity
c - Trim Ram
d - Down Cavity
e - Mechanical Check Valve
f - Tilt Relief 850-1150 psi (5820.8 – 7875.2kPa)
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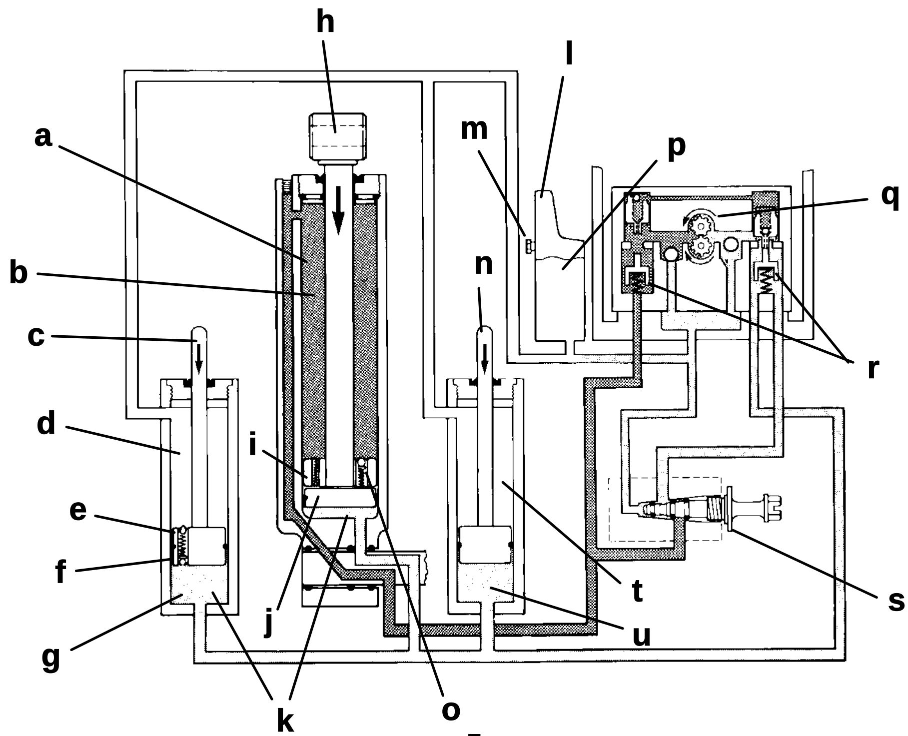
l - Reservoir
m - Fill Cap
n - Trim ram
o - Impact Relief Valve 1 Opens at 600 psi (4108.8kPa), the Remaining at 3200 psi (21913.6kPa)
p - Reservoir Pressure 6 psi (41.1kPa)
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

UP CIRCUIT

When the up button is activated the electric motor will rotate the oil pump gears. As the oil pump gears begin to rotate, oil is drawn through the up circuit pick up and into the pump, supplying pressure for the up circuit. Oil is blocked from returning into the reservoir by the closed check ball inside the down circuit pick up. Oil, under pressure moves the (up) shuttle valve up, oil also flows through the (up) shuttle valve center pin. Oil flows past the check ball and through a connecting passage into a chamber above the down shuttle valve. The down shuttle valve and check ball are forced against the spring loaded down circuit pilot check valve, opening the pilot check valve and allowing oil to return into the pump from the down side cavity of the tilt cylinder, which supplies oil to operate the "up circuit". Oil under pressure opens the up circuit pilot check valve, allowing oil to exit through the up pressure port, and into the manifold casting. The oil then continues on through the up passage into the up cavities below the trim and tilt ram pistons, pushing the rams up and out. Oil returns into the reservoir, from the trim rams, through passages cast inside of the manifold. Oil returning from above the tilt cylinder piston exits the down cavity through an interconnecting passage cast located along side of the cylinder. Oil returns through the lower pivot pin and past the open pilot valve, into the pump, suppling some of the oil required for the up circuit. Due to the surface area of their pistons, the small outer trim rams move first. As the trim rams reach the limit of their travel, the mechanical check valve, on the top of the port trim ram piston, contacts the trim ram cover. The "pin" contact with the cover mechanically opens the shut off valve, allowing oil, to flow through the piston. The oil flowing through the port trim ram lowers the pressure available for the tilt ram (850-1150 psi). However, due to the smaller diameter of the tilt cylinder, the engine will move at a faster rate. The tilt cylinder will continue to raise the outboard engine, until reaching its maximum limit. At full travel, the only passage for the oil from the pump is through the port trim ram, at a very slow rate. To supply oil into the pump at this time, a small amount of oil is drawn up through the oil pick up. If the up button is not released, the electric motor will heat up and the thermal overload switch, inside the electric motor will open, stopping the motor. To prevent the high oil "up" pressure from continuing to move the engine, after the trim button is released, the "system" pressure must be bleed off. A small bleed passage past the down circuit oil pick up will allow the up pressure to bleed out of the pump.

3 Ram Power Trim Hydraulic System

Trim Down



51493

a - Down Pressure 500 psi (3424.0kPa)
b - Down Cavity
c - Trim Ram
d - Down Cavity
e - Mechanical Check Valve
f - Tilt Relief 850-1150 psi (5820.8 – 7875.2kPa)
g - Up Pressure 1300 psi (8902.4kPa)
h - Tilt and Shock Ram
i - Siphon Valve
j - Memory Piston
k - Up Cavity
l - Reservoir
m - Fill Cap
n - Trim ram
o - Impact Relief Valve 1 Opens at 600 psi (4108.8kPa), the Remaining at 3200 psi (21913.6kPa)
p - Reservoir Pressure 6 psi (41.1kPa)
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Reservoir and Feed Oil

Return Oil

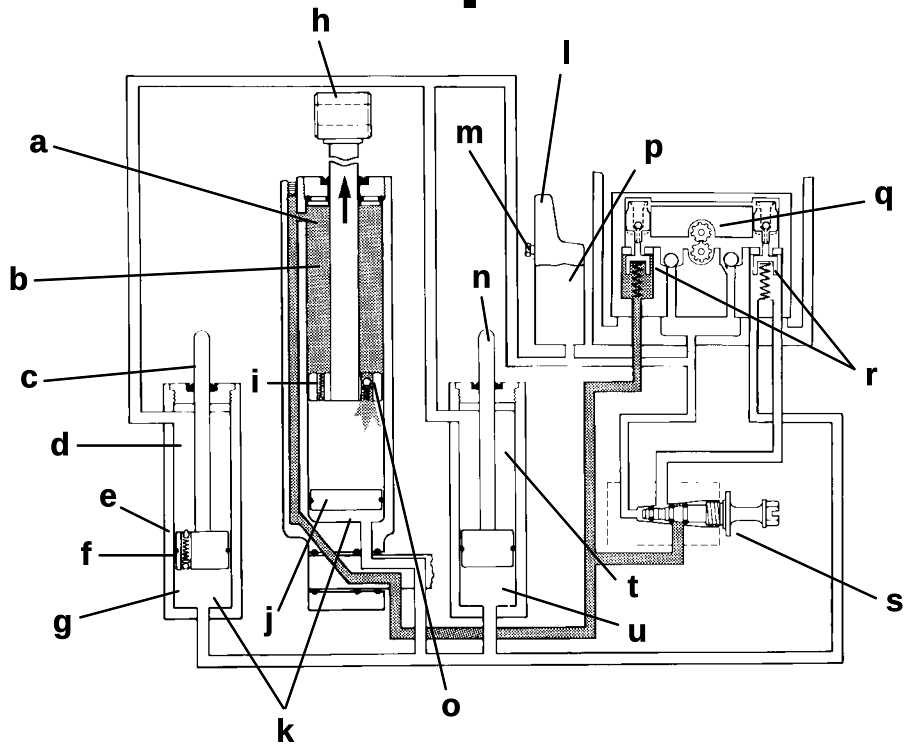
Oil Under Pressure

Down Circuit

When you depress the down button, the power trim pump is activated in the opposite direction. As the oil pump gears begin to rotate, oil is drawn through the down circuit pickup and into the pump, suppling pressure for the down circuit. Oil is blocked from returning into the reservoir by the closed check ball inside the up circuit pickup. Oil under pressure then moves the down shuttle valve up. Oil also flows around the down shuttle valve center "pin", around the check ball and into a connecting passage to the chamber above the "up" shuttle valve. The check ball inside the "up" shuttle valve closes. The "up" shuttle valve then moves down and opens the up circuit pilot check valve. The oil pump draws returning oil from the up circuit trim and tilt cylinders cavities to supply oil to the trim pump for the down circuit.At this same time, oil under pressure opens the down circuit pilot valve allowing oil to exit through the down pressure port. The oil then continues through the down pressure passage, through the pivot pin, and into the interconnecting passage of the cylinder leading to the cavity above the tilt ram piston, and pushes the piston rod in and down. As the outboard engine contacts the extended ends of the trim rams, the weight of the motor, propeller thrust and pump down pressure will force the trim rams to retract.

3 Ram Power Trim Hydraulic System

Bounce and Shock Absorber



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j - Memory Piston
k - Up Cavity
l - Reservoir
m - Fill Cap
n - Trim ram
o - Impact Relief Valve 1 Opens at 600 psi (4108.8kPa), the Remaining at 3200 psi (21913.6kPa)
p - Reservoir Pressure 6 psi (41.1kPa)
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Oil Under Pressure

Bounce System

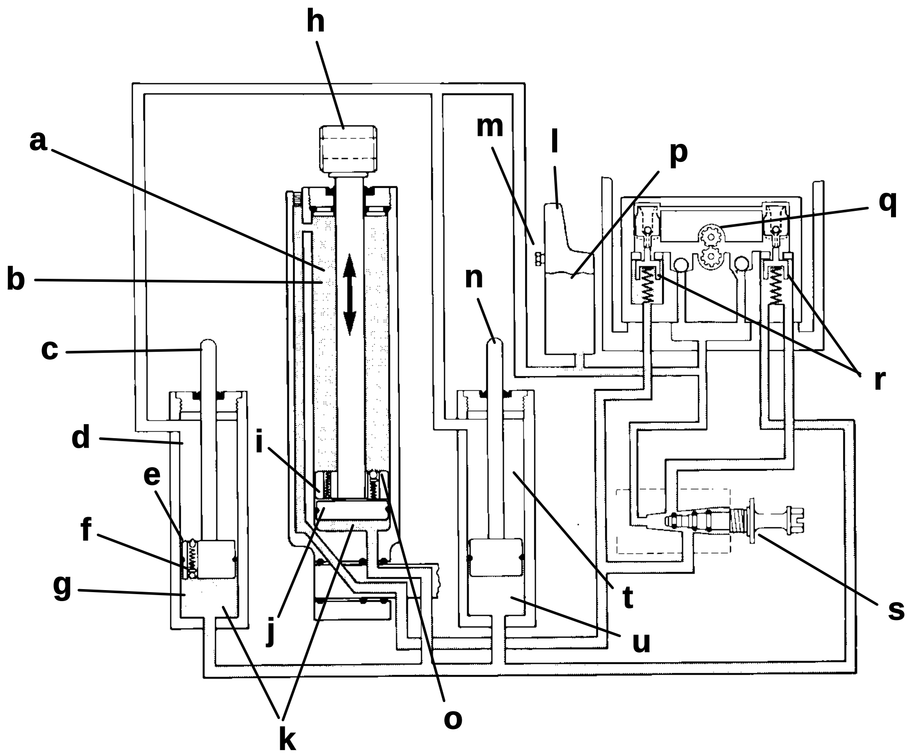
Should the outboard motor strike a submerged object with light steady pressure, while in forward motion, the oil in the trim system is locked in a static position by the up and down circuit pilot check valves and the manual tilt valve. Due to no oil movement in the up side of the trim cylinder, the tilt rod and piston move outward and will create a vacuum between the tilt ram shock piston and the floating piston, until the outboard engine returns to its normal running position.

Shock System

When a submerged object is hit with great force, oil will build up sufficient pressure in the tilt cylinder down side cavity to open the piston impact relief valve. Oil in the "up" side cavity is locked in by the up circuit pilot check valve and manual tilt valve. Therefore, the piston impact relief valve allows the oil from the down side cavity of the trim cylinder to pass through the piston impact relief valve, into the vacuum area between the tilt ram piston and the floating piston. The siphon valve allows the oil to return through the piston, back to the down side cavity as the outboard returns to its normal running position. Propeller thrust and the weight of the outboard provides the return motion for the engine.

3 Ram Power Trim Hydraulic System

Manual Tilt



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p - Reservoir Pressure 6 psi (41.1kPa)
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Return Oil

Manual Tilt System

If the outboard motor is to be raised manually, turn the manual release (tilt) valve counterclockwise to the full out position. When in the full (out) position, oil in the trim cylinder can flow freely from the up side to the down side or from the down side to the up side. The oil return line into the reservoir is also open, allowing free oil flow to either side of the tilt cylinder to accommodate the differential oil capacities between the tilt cylinder up side and down side cavities.

When trimming the outboard in either the up or down position, with the manual tilt valve open or leaking, little or no movement will occur. Oil pressure from the pump will move to both, the up cavity and through the manual tilt valve into the down cavity, each cavity would have equal pressure resulting in little or no movement.

Reverse Operation

To prevent the outboard from coming up or trailing out, when shifted into reverse and/or throttling back rapidly, oil in the trim system must be locked in a static position. This is accomplished with the up and down pilot check valves. Thus, not allowing oil in the system to move in either direction.

Power Trim - General Information

Description

The Power Trim System consists of an electric motor, pressurized fluid reservoir, pump, tilt cylinder, and two trim rams.

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

Trimming Characteristics

NOTE: *Because hull designs react differently in varying water conditions, varying the trim position will often improve the ride and boat handling. When trimming from a mid-trim position (with outboard trim tab in a straight fore and aft position), expect the following:*

TRIMMING OUTBOARD "UP" (OUT):

⚠ WARNING

Excessive trim "Out" may reduce the stability of some high speed hulls. To correct instability, reduce the power gradually and trim the outboard "In" slightly before resuming high speed operation. A rapid reduction in power will result in a sudden change of steering torque and may cause additional boat instability.

Will lift boat bow, increasing top speed.

Transfers steering torque harder to port (left) on installations above 23 in. transom height.

Increases gearcase clearance over submerged objects.

Excess trim can cause "porpoising" and/or ventilation.

⚠ WARNING

Excessive outboard trim angle will result in insufficient water supply causing water pump and/or powerhead overheating damage. Insure water level is above water intake holes whenever outboard is running.

The "Up" circuit actuates the "up" solenoid (under outboard cowl) and closes the motor circuit. The electric motor drives the pump, forcing fluid thru passageways into the "up" side of the trim cylinders.

The trim cylinders position the outboard at the desired trim angle in the 20 degree maximum trim range. The system will not allow the outboard to be trimmed above the 20 degree trim range as long as the engine RPM is above approximately 2000 RPM.

The outboard can be trimmed above the 20 degree maximum trim angle (for shallow water operation, etc.), by keeping the engine RPM below 2000. If the RPM increases over 2000, propeller thrust (if propeller is deep enough) will result in the trim system to return the outboard to the 20 degree maximum trim position.

TRIMMING OUTBOARD "DOWN" (IN):

⚠ WARNING

Excessive speed at minimum trim "In" may result in undesirable and/or unsafe steering conditions. Test for handling characteristics after any adjustment is made to the trim angle (and tilt pin location).

Aids planing, particularly with heavy loads.

Improves ride in choppy water conditions.

Excess trim "In" can cause "bow steer" (boat veers to left or right).

Transfers steering torque to starboard (right).

Improves acceleration to planing speed.

The "Down" circuit actuates the "down" solenoid (under engine cowl) and closes the motor circuit. The electric motor drives the pump in the opposite direction as the "up" circuit, forcing fluid thru passageways into the "down" side of the tilt ram. The tilt ram moves the engine down to the desired position.

Trailering Outboard

The "Up" circuit first moves the trim cylinders; when the trim cylinders extend fully, the tilt ram extends to tilt the outboard to the full "Up" position for trailering.

Before the boat is trailered, the operator should check for clearance between the outboard skeg and pavement to prevent damage to skeg from striking pavement.

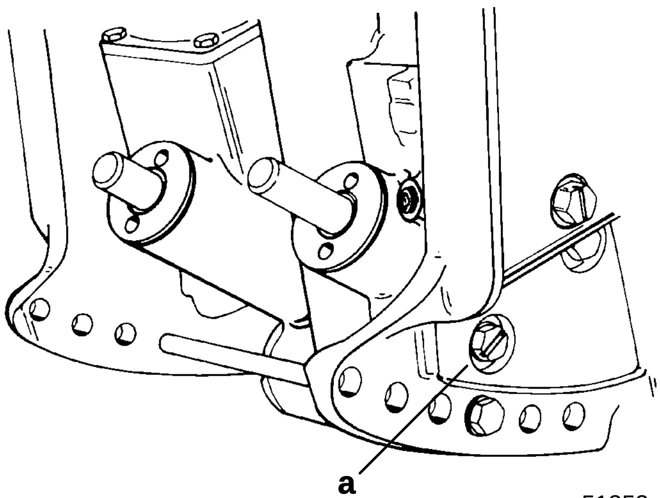
If the outboard must be tilted for clearance between skeg and pavement, a device such as a "Transom Saver" should be installed to prevent stress to boat transom from outboard weight while the boat/outboard are being trailered.

Tilting Outboard Manually

⚠ WARNING

Before opening the manual release valve knob, insure all persons are clear of outboard as outboard will drop to full "Down" when valve is opened.

The outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns counterclockwise. Close manual release valve to hold outboard at the desired tilt position.



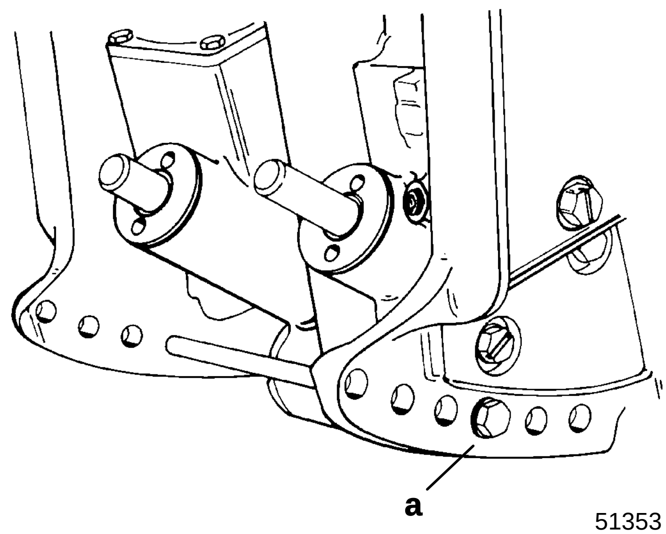
a - Manual Release Valve

Trim "In" Angle Adjustment

⚠ WARNING

Boat operation with outboard trimmed to the full "In" trim angle [not using the trim angle adjustment bolt (a)] at planing speed may result in undesirable and/or unsafe steering conditions. A water test for handling/steering conditions is required after any trim angle adjustments.

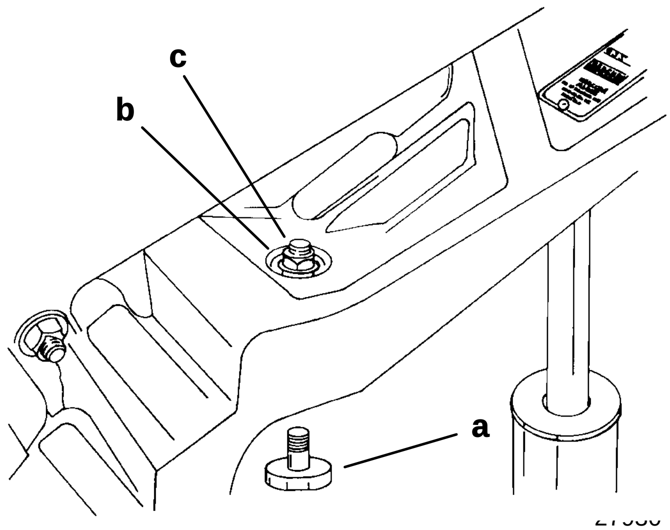
IMPORTANT: Some boat/motor combinations not using the trim angle adjustment pin (a) and trimmed to the full "In" trim angle position may not exhibit any undesirable and/or unsafe handling and/or steering characteristics at planing speed. If so, not using the trim angle adjustment bolt (a) may be advantageous to acceleration and planing. A water test is required to determine if these characteristics apply to a particular boat/motor combination.



a - Trim Angle Adjustment Bolt

Striker Plate Replacement

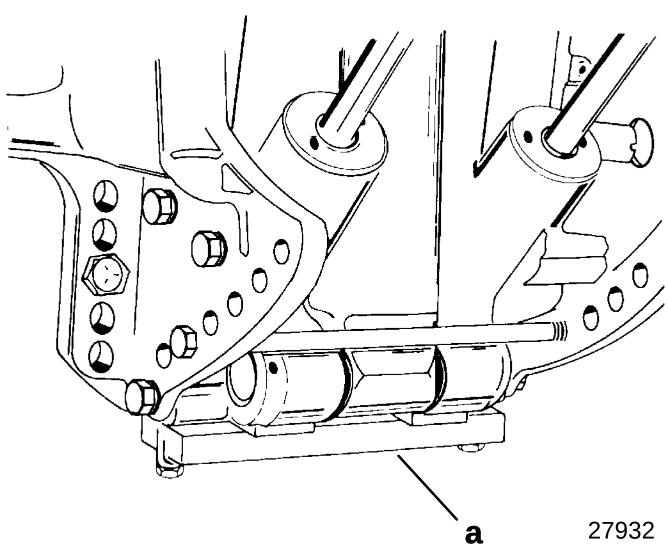
Visually inspect striker plates (a) and replace if worn excessively.



a - Striker Plate (2)
b - Lockwasher
c - Locknut. Torque to 80 lb. in. (9.0 N·m)

Anode Plate

Anode plate (a) is a self-sacrificing alloy plate that is consumed gradually by corrosion while providing protection to the midsection and power trim from galvanic corrosion. Replace anode plate when it is 50% consumed.



a - Anode Plate

IMPORTANT: Do not paint or place protective coating on anode plate, or corrosion protection function will be lost.

Trim Indicator Gauge

A Quicksilver Trim Indicator Gauge accessory kit is available for the power trim sender (if not previously installed).

Check, Fill and Purge - Power Trim System

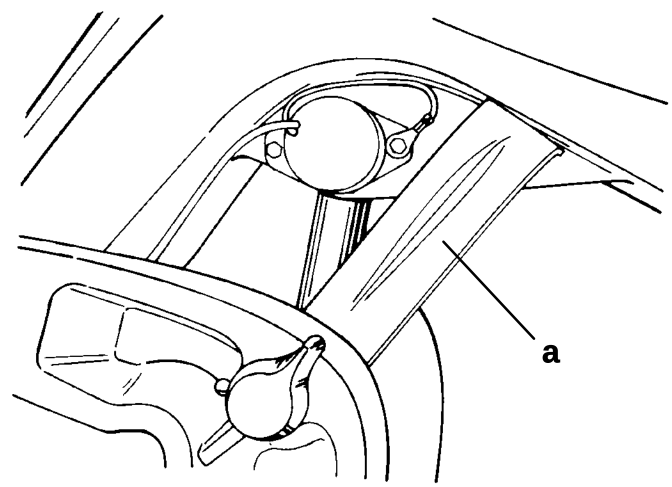
TO CHECK:

⚠ 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.

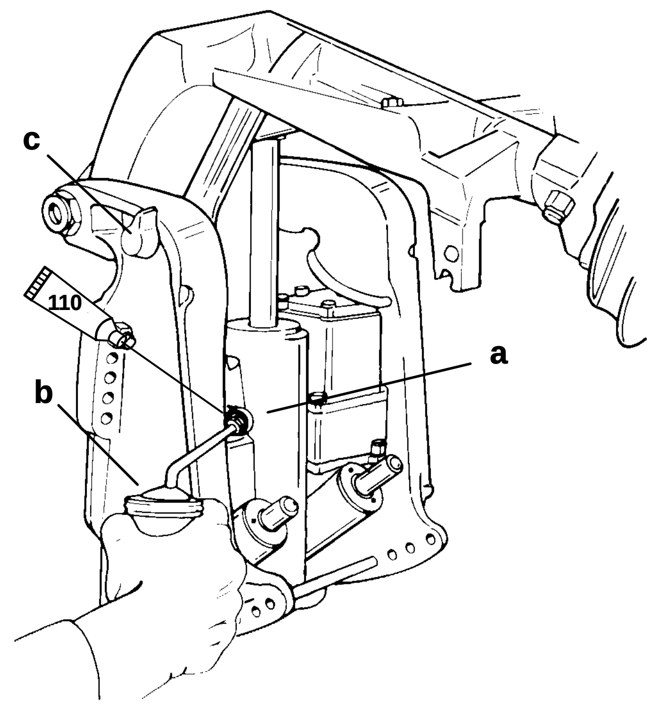
NOTE: *Automatic Transmission Fluid (ATF) Type F, FA, Dexron II or Dexron III may be used.*



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.



Power Trim & Steering Fluid (92-90100A12)

a - Fill Plug and O-ring (remove to fill system, tighten securely)
b - Oil Can (fill system with Quicksilver Power Trim and Steering Fluid)
c - Tilt Lock Lever (engage to support engine in "Up" position)

TO PURGE:

IMPORTANT: Fill plug and O-ring must be tightened securely before purging system.

IMPORTANT: Run Trim System in short "jogs" until pump is primed and trim system moves. If trim motor is run without priming pump, driveshaft failure could result.

Cycle outboard through entire trim/tilt range 4 times. Check fluid level after purging system.

Push down on outboard when trim rams are slightly extended. If rams retract more than 1/8 in. (3.2 mm), air is present in system. Cycle system again and check fluid level.

Hydraulic System Troubleshooting

IMPORTANT: Operate Power Trim System after each check to see if problem is corrected. If problem has not been corrected, proceed to next check.

1. Check that Manual Release Valve knob is tightened to full right (clockwise) position.
2. Check trim pump fluid level and fill if necessary. (Refer to "**Check, Fill and Purge - Power Trim System**") preceding.
3. Check for external leaks in the system. Replace defective parts if leak is found.
4. Check for air in the system and purge if necessary. (Refer to "**Check, Fill and Purge - Power Trim System"**) preceding.

NOTE: *When troubleshooting the hydraulic system, cleanliness, and inspection of sealing surfaces, seals, O-rings, and moving parts is important. The internal pressures required for proper operation of the Power Trim System require these parts to be in excellent condition. Replace any parts that may be suspect of failure.*

Troubleshooting (Square Motor)

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

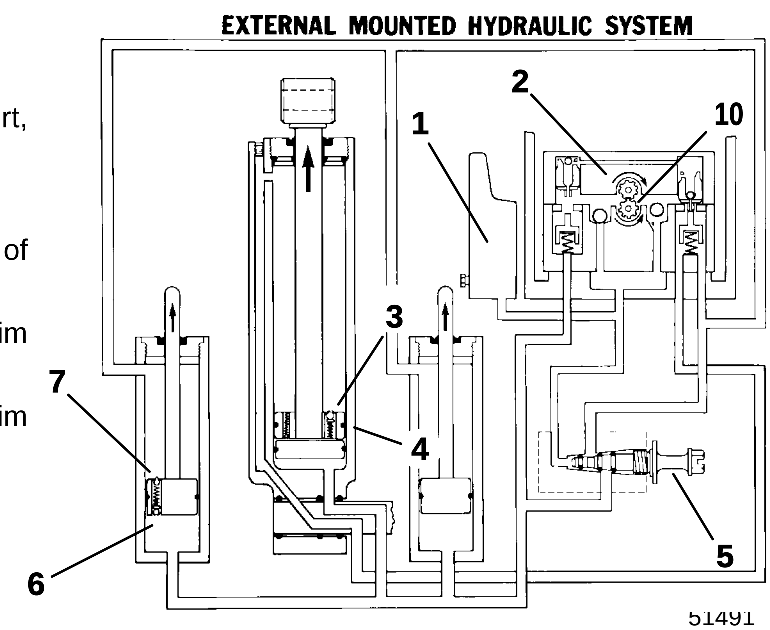
HYDRAULIC SYSTEM TROUBLESHOOTING

IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5, 10
B. Does not trim full down. Up trim OK.	2, 3, 4
C. Does not trim full up. Down trim OK.	1, 6
D. Partial or "Jerky" down/up.	1
E. "Thump" noise when shifting.	2, 3, 6, 7
F. Does not trim under load.	8, 9
G. Does not hold trim position under load.	2, 5, 6
H. Trail out when backing off from high speed.	3, 4
I. Leaks down and does not hold trim.	2, 5, 7
J. Trim motor working hard and trims slow up and down.	8, 9
K. Trims up very slow.	1, 2, 8, 9
L. Starts to trim up from full down position when "IN" trim button is depressed.	3, 4
M. Trim position will not hold in reverse.	3, 4

PROBLEM

1. Low oil Level.
2. Pump Assembly faulty.
3. Tilt ram piston ball not seated (displaced, dirt, nickel seat).
4. Tilt ram piston O-ring leaking or cut.
5. Manual release valve leaking (check condition of O-rings) (Valve not fully closed.)
6. Lower check valve not seating in port side trim ram.
7. Upper check valve not seating in port side trim ram.
8. Check condition of battery.
9. Replace motor assembly.
10. Broken motor/pump driveshaft.



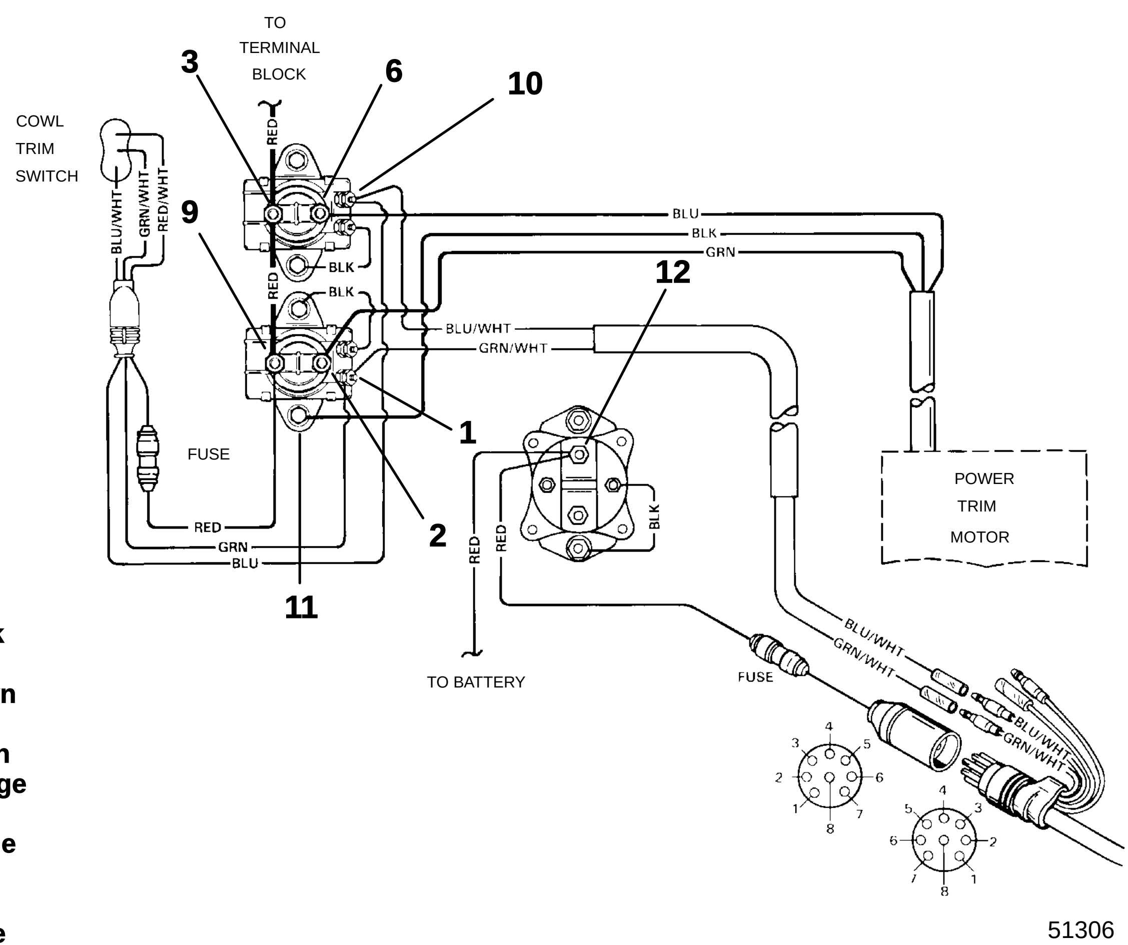
CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor does not run when trim button is depressed.	1, 2, 4, 5, 6
B. Trim system trims opposite of buttons.	3
C. Cowl mounted trim buttons do not activate trim system.	2, 4, 5, 6

PROBLEM

1. Battery low or discharged.
2. Open circuit in trim wiring.
3. Wiring reversed in remote control.
4. Wire harness corroded through.
5. Internal motor problem (brushes, shorted armature).
6. Blown fuse(s).

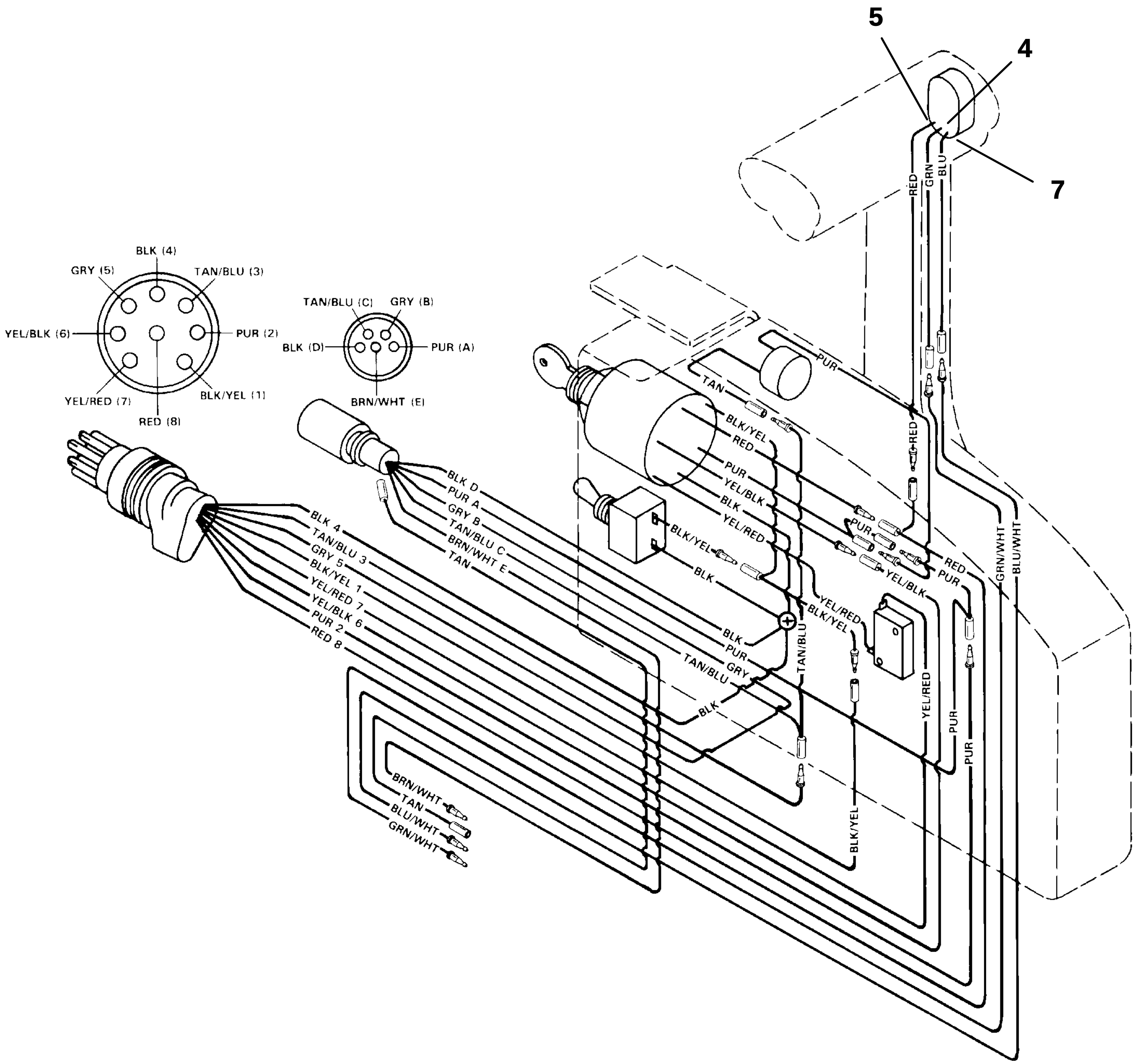
***NOTE:** Refer to following pages to troubleshoot Power Trim Electrical System.*

POWER TRIM SYSTEM WITH SOLENOIDS AND 3 WIRE TRIM MOTOR



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

Side Mount Remote Control Wiring Diagram (Test Points for Electrical Troubleshooting)



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Electrical System Troubleshooting

GENERAL CHECKS

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

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

Refer to the preceding four wiring diagrams for connection points when troubleshooting the electrical systems (Connection points are specified by number.)

Troubleshooting the "Down" Circuit (When "Up" Circuit is OK)

Connect Voltmeter RED lead to Point 1 and BLACK lead to ground.
Depress the "Down" trim button.

Battery Voltage Indicated:
Connect Voltmeter RED lead to Point 9.

Battery Voltage Indicated:
· Connect Voltmeter RED lead to Point 2.
· Depress "Down" trim button.

Battery voltage indicated:
· Test UP relay – refer to relay test procedure

Relay Good:
· Check "Down" solenoid terminals for loose or corroded connections.
· Check BLACK ground wire (on "Down" solenoid) for corrosion or open.
· Test "Down" solenoid. Refer to "Motor and Electrical Tests", see Index.

No Voltage Indicated:
Solenoid is defective.

No Voltage Indicated:
There is an open circuit between Point 9 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 (When “Down” Circuit Is OK)

Connect Voltmeter RED lead to Point 10 and BLACK lead to ground.
Depress the “Up” trim button.

Battery Voltage Indicated:
Connect Voltmeter RED lead to Point 3.

Battery Voltage Indicated:
- Connect Voltmeter RED lead to Point 6.
- Depress “Up” trim button.

Battery voltage indicated:
- Test DOWN relay – refer to relay test procedure

Relay Good:
- Check “Up” solenoid terminals for loose or corroded connections.
- Check BLACK ground wire (on “Up” solenoid) for corrosion or open.
- Test “Up” solenoid. Refer to “Motor and Electrical Tests/Repair”, following.

No Voltage Indicated:
Solenoid is defective.

No Voltage Indicated:
- Check for loose or corroded connection at Point 9 or Point 3.
- Check RED lead between Point 9 and Point 3 for open.

No Voltage Indicated:
Connect voltmeter RED lead to Point 7 and BLACK lead to ground. Depress “UP” button. If battery voltage is indicated, wire is open between Points 10 and 7.

No Voltage Indicated:
Connect voltmeter RED lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the "Down" and "Up" Circuits (All Circuits Inoperative)

Check in-line fuses (under cowl) to see if fuses are blown.

Blown Fuse:
- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:
Connect Voltmeter RED lead to Point 3 and BLACK lead to ground. Battery voltage should be indicated.

No Voltage Indicated:
- Check battery leads and RED leads (between engine starter motor solenoid and Point 3) for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:
- Connect Voltmeter RED lead to Point 10.
- Depress "Up" trim button and check for battery voltage.

No Voltage Indicated:
Connect RED Voltmeter lead to Point 5, and BLACK lead to ground.

Battery Voltage Indicated:
- Check BLACK ground wires at solenoids for poor connection or poor ground.
- Check BLACK motor lead for poor ground at Point 11. If wire is grounded, the pump motor is faulty. Refer to "Motor and Electrical Tests/ Repair", following.

No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
- DO NOT start engine.
- Turn ignition switch to "Run" position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires [GREEN-WHITE, BLUE-WHITE and PURPLE-WHITE (OR PURPLE)] between trim buttons and trim pump.
- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

No Voltage Indicated:
RED wire is open between Point 12 and red terminal on back of the ignition switch.
- Check for loose or corroded connections.
- Check for open in wire.

Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and RED lead terminal on the back of the ignition switch.

Troubleshooting (Round Motor)

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

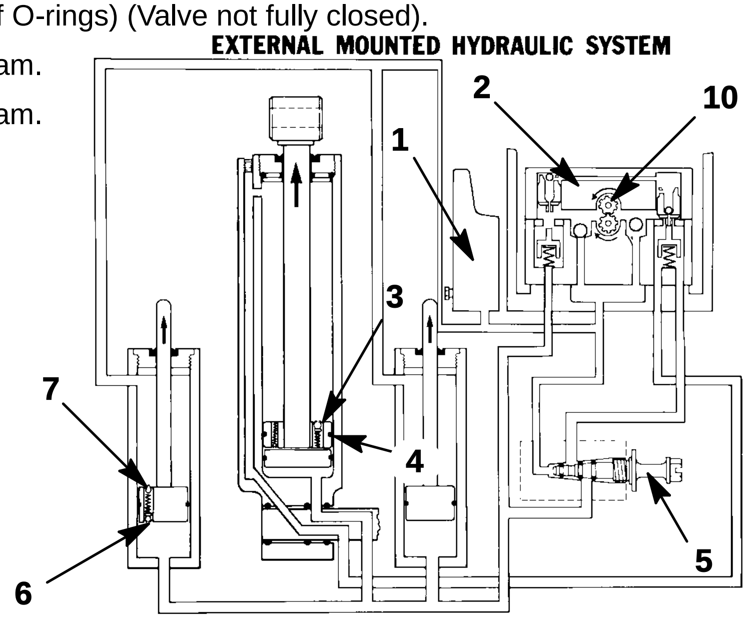
HYDRAULIC SYSTEM TROUBLESHOOTING

IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5, 10
B. Does not trim full down. Up trim OK.	2, 3, 4
C. Does not trim full up. Down trim OK.	1, 6
D. Partial or “Jerky” down/up.	1, 3
E. “Thump” noise when shifting.	2, 3, 6, 7
F. Does not trim under load.	5,8, 9,10
G. Does not hold trim position under load.	2, 5, 6
H. Trail out when backing off from high speed.	3, 4
I. Leaks down and does not hold trim.	2, 5, 7
J. Trim motor working hard and trims slow up and down.	8, 9
K. Trims up very slow.	1, 2, 8, 9
L. Starts to trim up from full down position when “IN” trim button is depressed.	3, 4
M. Trim position will not hold in reverse.	3, 4

PROBLEM

1. Low oil level.
2. Pump assembly faulty.
3. Tilt ram piston ball not seated (displaced, dirt, nickel seat).
4. Tilt ram piston O-ring leaking or cut.
5. Manual release valve leaking (check condition of O-rings) (Valve not fully closed).
6. Lower check valve not seating in port side trim ram.
7. Upper check valve not seating in port side trim ram.
8. Check condition of battery.
9. Replace motor assembly.
10. Broken motor/pump drive shaft.



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ELECTRICAL SYSTEM TROUBLESHOOTING (ROUND MOTOR)

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

PROBLEM

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

POWER TRIM RELAY TEST PROCEDURE

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

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

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

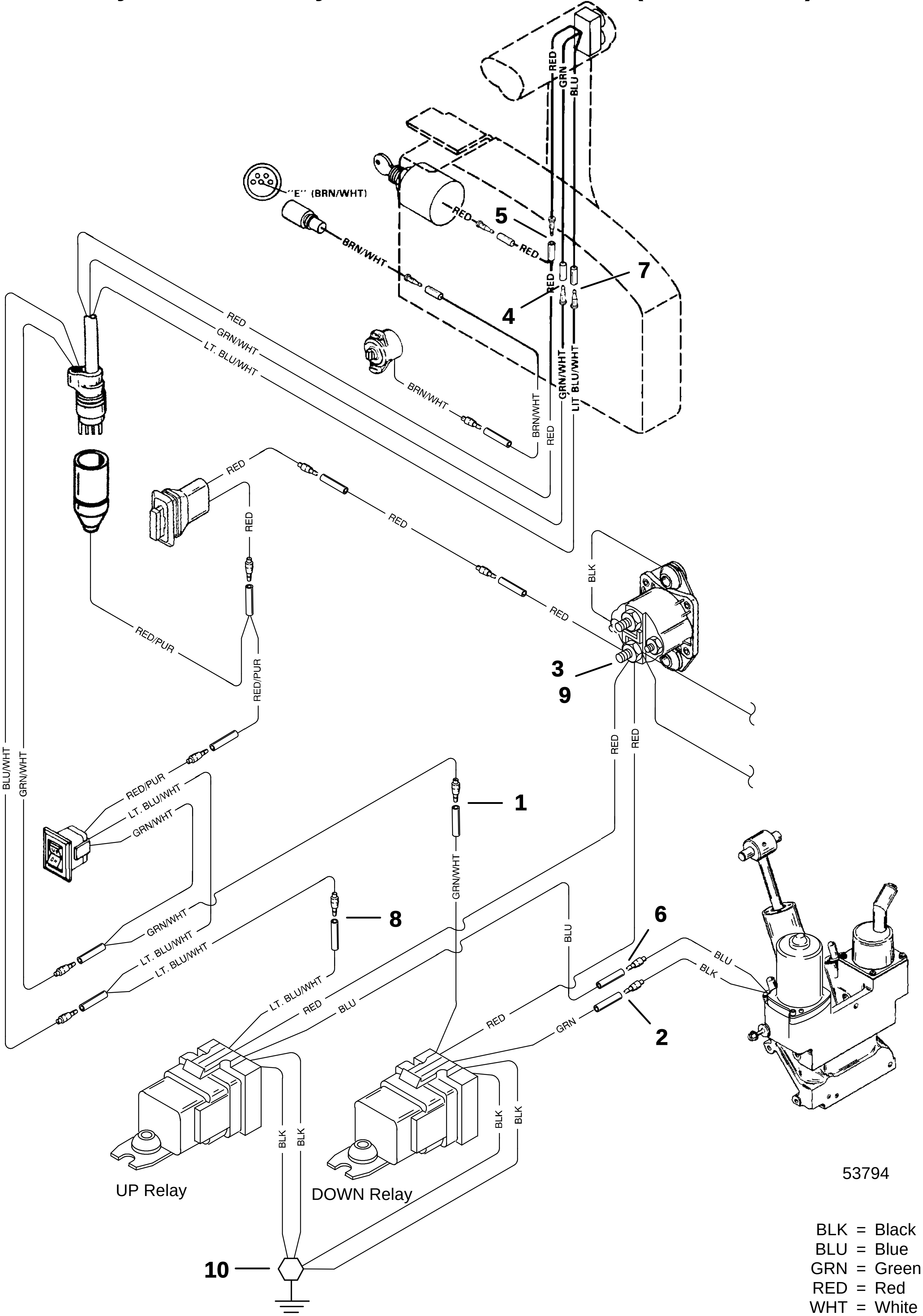
1. Disconnect the heavy gauge pump wires from the trim control relay.
2. Check for continuity between the heavy leads from the trim relays to ground.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x__________)
GREEN and Ground	0	Full Continuity (Rx1)
BLUE and Ground	0	Full Continuity (Rx1)

Replace the relay that does not have continuity.

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

Power Trim System with Relays and 2 Wire Trim Motor (Round Motor)



BLK = Black
BLU = Blue
GRN = Green
RED = Red
WHT = White

Electrical System Troubleshooting (Round Motor)

GENERAL CHECKS

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

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

Refer to the preceding four wiring diagrams for connection points when troubleshooting the electrical systems (Connection points are specified by number.)

Troubleshooting the “Down Circuit”

Connect Voltmeter red lead to Point 1 and black lead to ground.

Depress the “Down” trim button.

Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.

No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 4 and 1.

Battery Voltage Indicated:

- Connect Voltmeter red lead to Point 2.
- Depress “Down” trim button.

No Voltage Indicated:

There is an open circuit between Point 3 and positive (+) battery terminal.

- Check for loose or corroded connections.
- Check wires for open.

Battery Voltage Indicated:

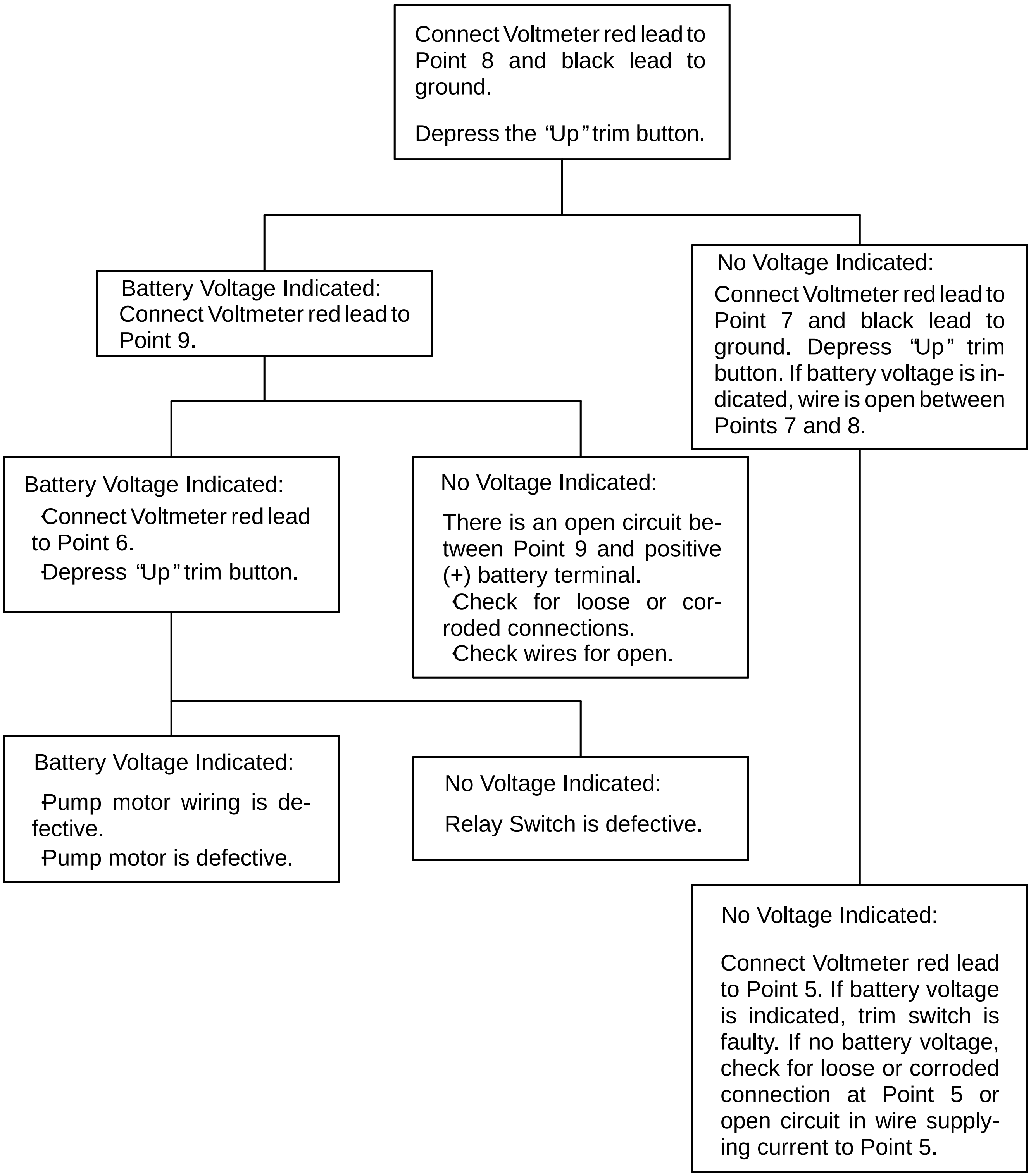
- Pump motor wiring is defective.
- Pump motor is defective.

No Voltage Indicated:
Relay Switch is defective.

No Voltage Indicated:

Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Up” Circuit



Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)

Check in-line fuse (under cowl) to see if fuse is blown.

Blown Fuse:

- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:

Connect Voltmeter red lead to Point 3 and black lead to ground. Battery voltage should be indicated.

No Voltage Indicated:

- Check battery leads for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:

- Connect Voltmeter red lead to Point 8 and black lead to ground.
- Depress “Up” trim button and check for battery voltage.

No Voltage Indicated:

Connect red Voltmeter lead to Point 5, and black lead to ground.

Battery Voltage Indicated:

- Check black ground wires for poor connection or poor ground, Point 10.
- Pump motor is faulty. Refer to “Motor and Electrical Tests/Repair”, following.

No Voltage Indicated:

Check that voltage is being supplied to control by performing the following checks:

- DO NOT start engine.
- Turn ignition switch to “Run” position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:

Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.

- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

No Voltage Indicated:

Red wire is open between Point 3 and red terminal on back of the ignition switch.

- Check for loose or corroded connections.
- Check for open in wire.

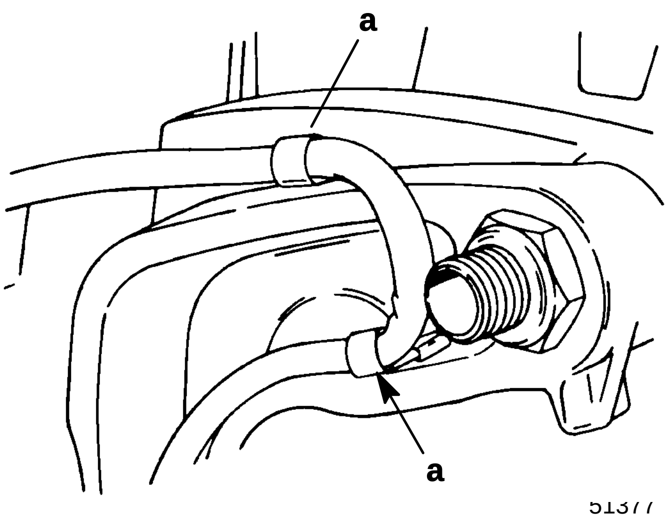
Battery Voltage Indicated:

There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim Assembly Removal and Installation (All Models)

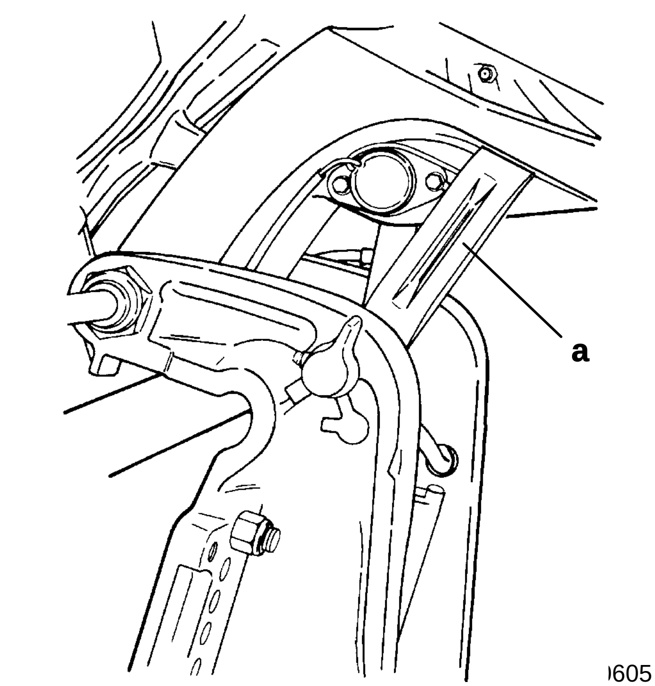
Removal

1. Remove clamps on transom bracket to free power trim wiring.



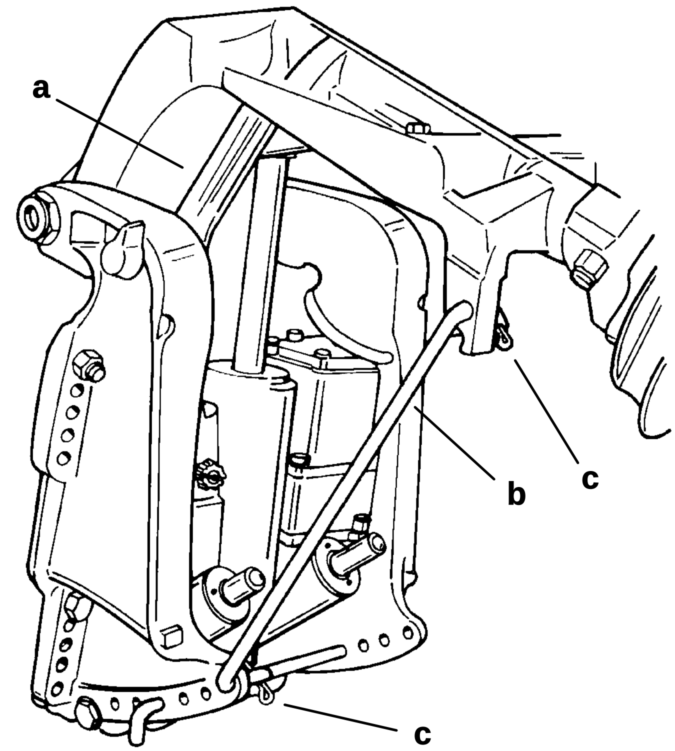
a - Clamps

2. Raise outboard to full "Up" position and engage tilt lock lever.



a - Tilt Lock Lever

> ⚠ **WARNING**
>
> **Failure to support outboard as shown could result in personal injury and/or damage to outboard or boat.**

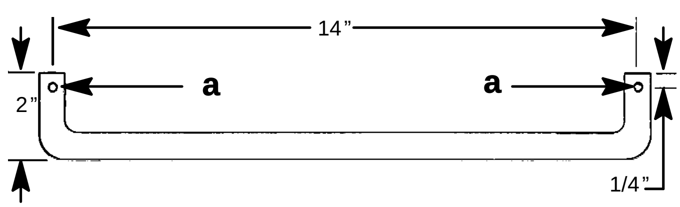


a - Tilt Lock Lever
b - Support Tool
c - Retaining Clips

IMPORTANT: Support outboard as shown above to prevent engine from tipping when power trim retaining pin is removed.

SUPPORT TOOL

3/8 in. diameter metal rod (a used shift shaft works well)



a - Drill holes for retaining clips

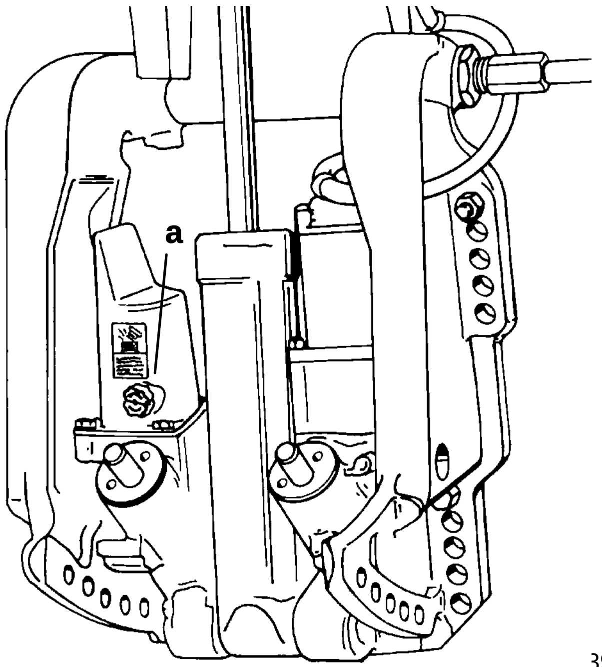
METRIC CONVERSION

14 in. = 35.56 cm.	2 in. = 50.8 mm
3/8 in. = 9.5 mm.	1/4 in. = 6.35 mm.

⚠ CAUTION

Disconnect battery cables at battery before removing power trim wires from solenoids.

3. Disconnect power trim wires at solenoids (BLUE, GREEN, and BLACK) or if relay style, disconnect (BLUE and GREEN) bullet connector harness.
4. Open filler cap and release any remaining pressure in the system.



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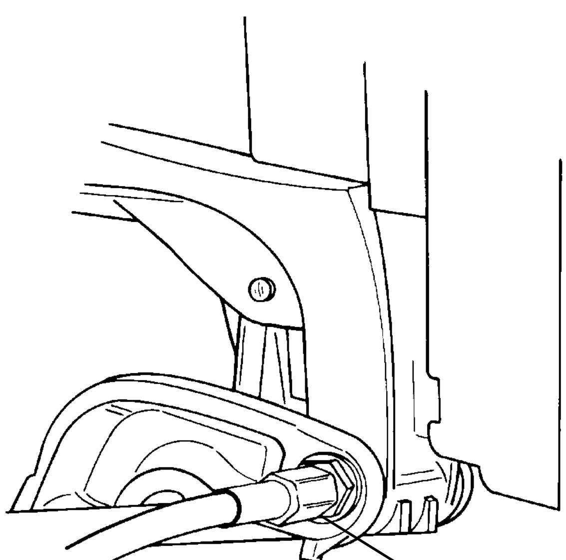
a - Filler Cap

IMPORTANT: Outboards equipped with thru-the-tilt-tube steering - remove steering link arm from end of steering cable and cable retaining nut from tilt tube.



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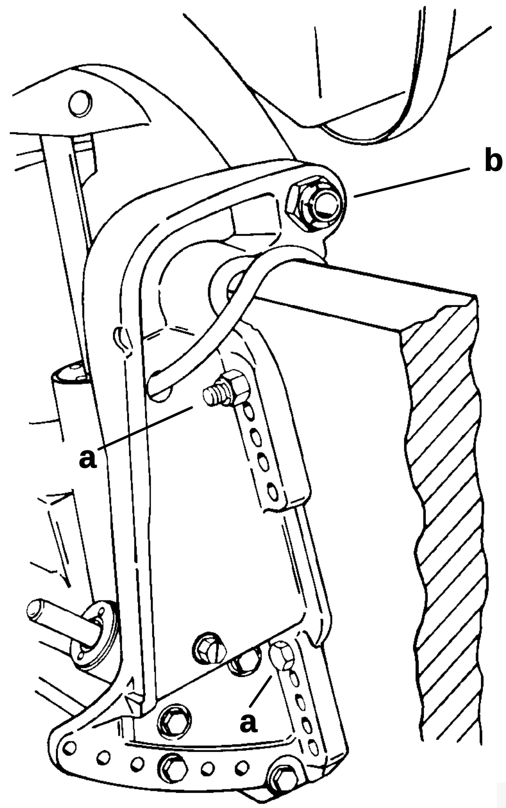
a - Retaining Nut

5. Remove outboard transom mounting bolts, and loosen tilt tube nut until nut is flush with end of tilt tube thread.



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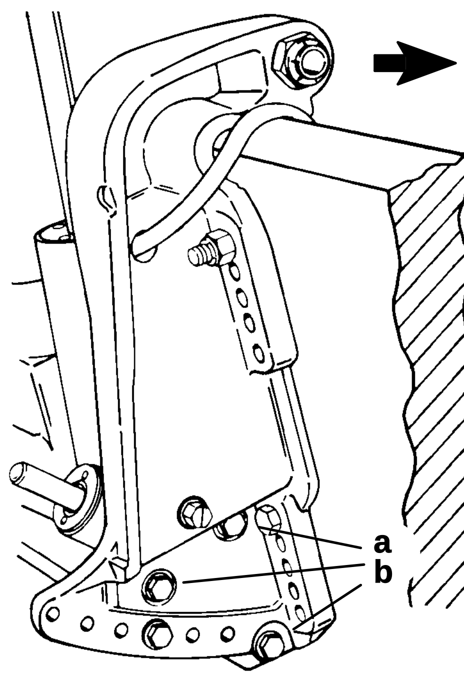
a - Transom Mount Bolts (2)
b - Tilt Tube Nut (flush with end of thread)

6. Remove 3 screws and washers and move starboard transom bracket.

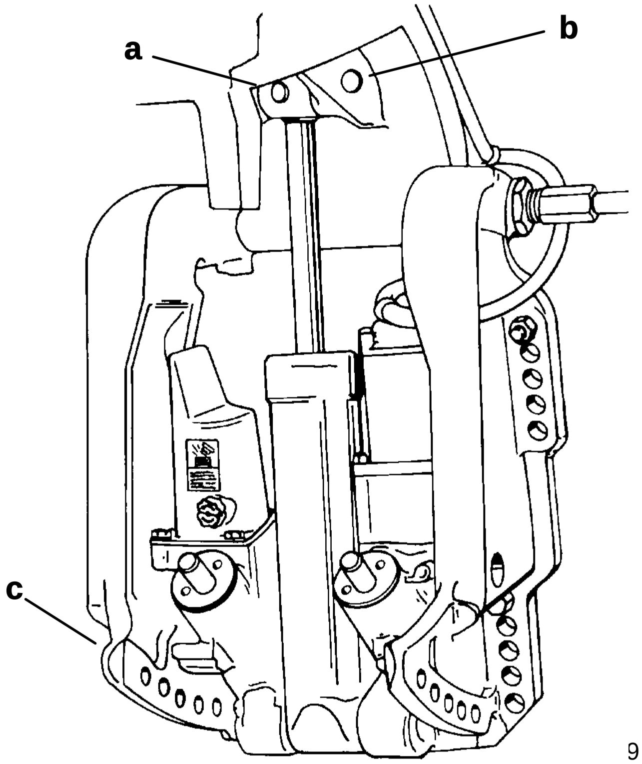


51375

a - Screws (3)
b - Washers (3)

IMPORTANT: Cross pin (a) should not be reused. Replace with new cross pin.

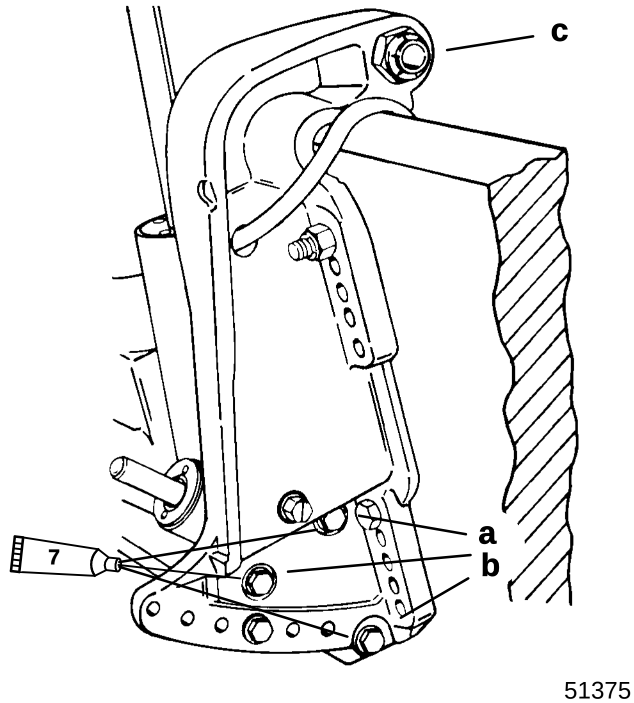
7. Drive out cross pin, push out upper swivel pin, and remove 3 screws and washers retaining trim system. Remove system from outboard.



a - Cross Pin
b - Upper swivel pin
c - Port transom bracket screws and washers (3). Remove to release trim system from outboard.

Installation

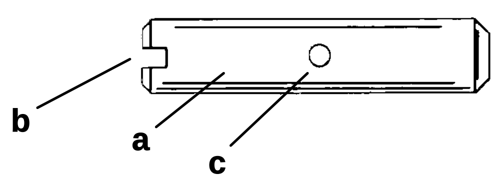
1. Paint any exposed metal surfaces to prevent corrosion.
2. Apply Loctite 271 to screws. Install trim system, starboard transom bracket, and tilt tube nut.



7 Loctite 271 (92-809820)

a - Screw (6) Torque to 40 lb. ft. (54.0 N·m)
b - Lockwasher (6) Install one per screw
c - Tilt Tube Nut

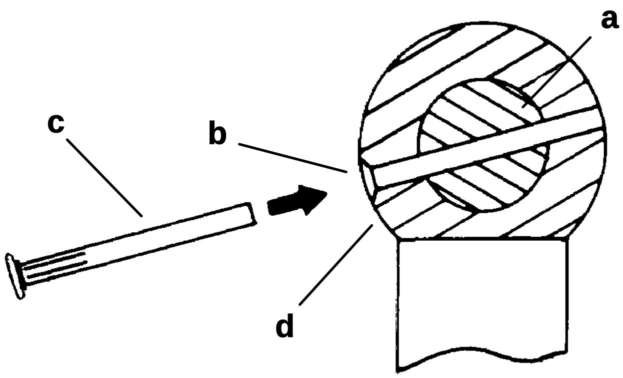
3. Use a 12 volt power source to extend tilt ram up to align upper swivel shaft hole and end of ram. Connect trim motor wires [BLUE wire to POSITIVE (+), BLACK wire to NEGATIVE (–)]. If ram extends too far, retract ram by connecting GREEN wire to POSITIVE (+).
4. Install Upper Swivel Pin with slotted end to left (port) side of engine.



a - Upper Swivel Pin
b - Slotted end
c - Cross hole (in line with slotted end)

IMPORTANT: Cross pin should not be reused. Install a new pin.

5. Position slot on end of swivel shaft in line with hole in tilt ram end. Insert a punch into tilt ram hole to align cross hole in upper swivel shaft. Tap new cross pin in until flush.



a - Upper Swivel Shaft (Slot is in line with cross hole)
b - Chamfered end of hole (Faces away from transom)
c - Retaining pin
d - Tilt ram end

6. Connect trim motor wires to solenoids. Refer to Wiring Diagrams in this manual. Route trim wires as specified in this manual.

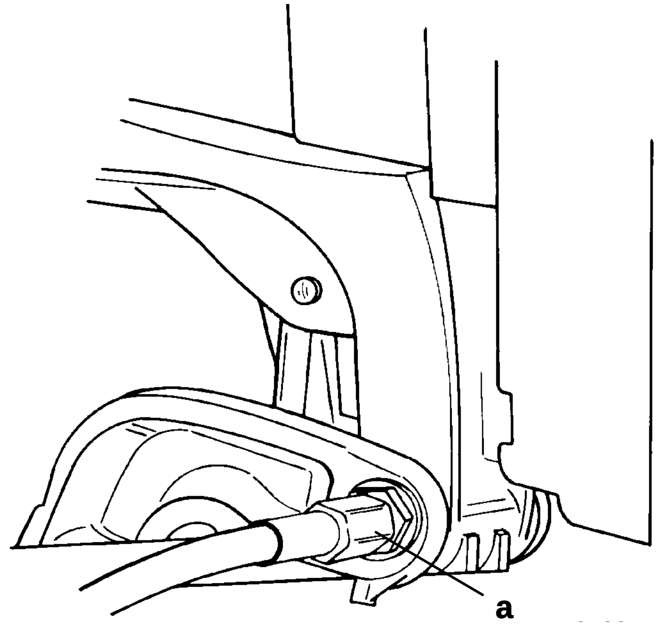
7. Apply marine sealer to shanks of mount bolts and install transom mount bolts.

IMPORTANT: Do not use an impact driver to tighten transom mount bolts.

Apply marine sealer to threads of mount bolts. Secure with flat washers and locknuts. Be sure installation is watertight.

8. Tighten tilt tube nut securely.

IMPORTANT: Outboards equipped with thru-the-tilt-tube steering: Tighten steering cable retaining nut securely to tilt tube.



a - Steering Cable Retaining Nut

9. Apply Quicksilver Liquid Neoprene (91-25511--2) on all electrical connections.

WARNING

Electrical wires passing through cowl openings must be protected from chafing or being cut. Follow the recommended procedures outlined in Section 1 of this Manual. Failure to protect wires as described could result in electrical system failure and/or injury to occupants of boat.

Testing Power Trim System With Test Gauge Kit (91-52915A6)

IMPORTANT: This test will not locate problems in the trim system. The test will show if the system is correct after a repair. If minimum pressures are not obtainable, the trim system requires additional repair.

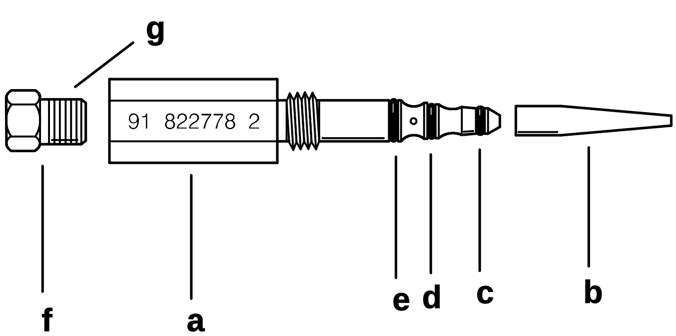
"UP" Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full "Up" position and engage tilt lock lever.
2. Slowly remove "Fill" plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

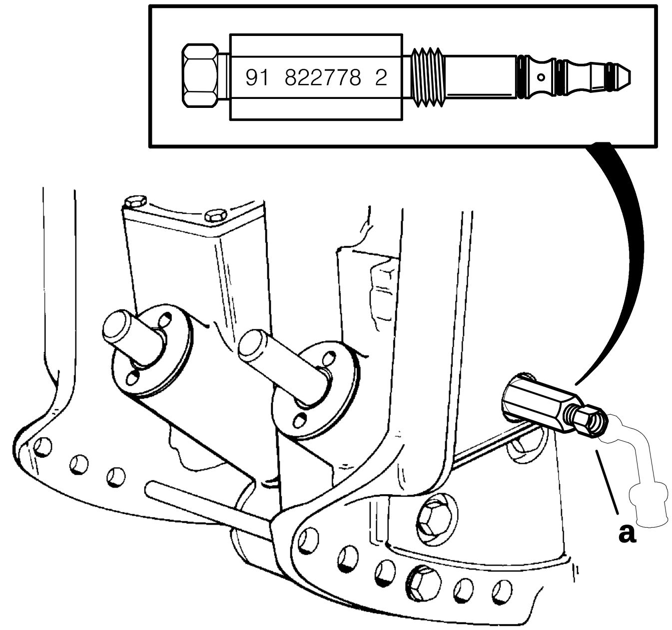
NOTE: *Assemble test adaptor by using O-ring installation tool to position small O-ring onto adaptor 1st, then install medium O-ring and lastly large O-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.*



54457

a - Test Adaptor (91-822778A2)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

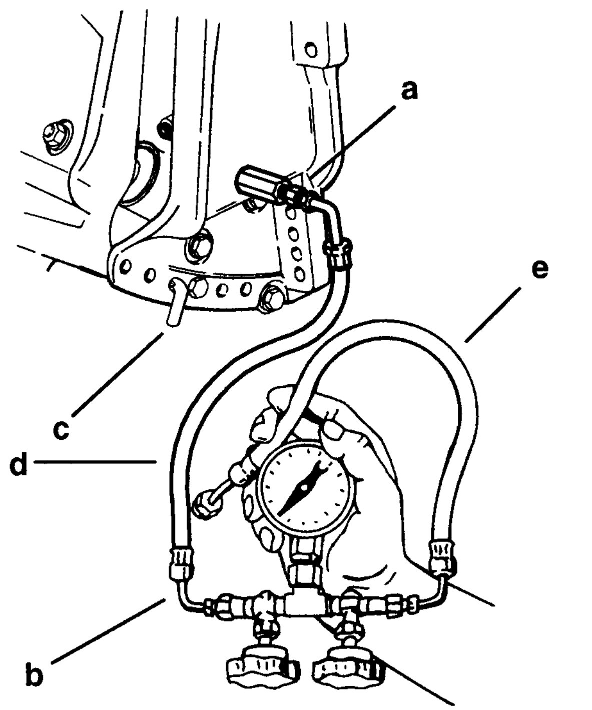
4. Install test adaptor 91-822778A2 into manual release valve hole.



54458

a - Test Adaptor (91-822778A2)

5. Thread hose from Test Gauge Kit (91-52915A6) into brass fitting on adaptor.



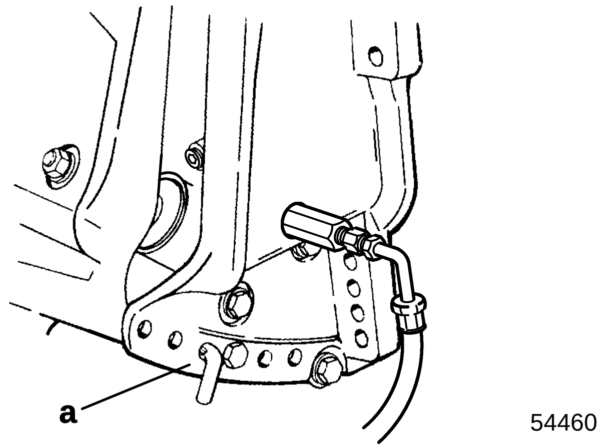
54459

a - Brass Fitting
b - Test Gauge Assembly
c - Tilt Pin (Position in Hole Shown)
d - Hose
e - Hose (Not Used)

6. Reinstall fill plug.
7. Disengage tilt lock lever.

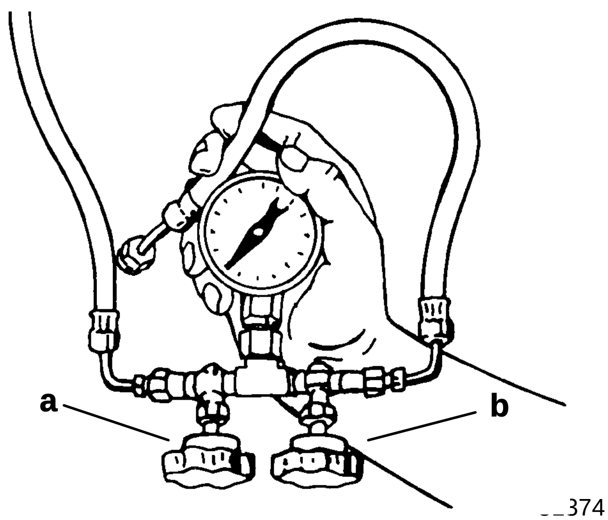
> **⚠ CAUTION**
>
> **Failure to install spare tilt pin (or hardened bolts and nuts) in hole shown could result in transom bracket failure and possible injury.**

8. Move outboard "IN" until hole in swivel bracket "ear" aligns with the 3rd tilt hole in transom bracket. Lock engine in trim range by installing a 3/8 in. (9.5 mm) diameter tilt pin or two 3/8 in. (9.5 mm) hardened bolts and nuts thru the transom brackets and swivel bracket in the hole shown.



a - Tilt Pin Hole (Install Spare Tilt Pin or Hardened Bolts and Nuts)

9. Open valve (a) and close valve (b).



10. Run trim "UP". The minimum pressure should be 1300 psi (8902.4kPa).
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 (8902.4kPa), troubleshoot system per instructions on page 5B-16.*

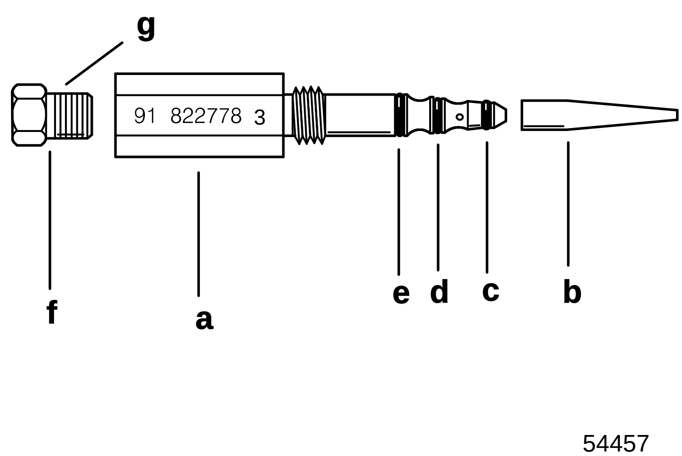
"DOWN" Pressure Check

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.

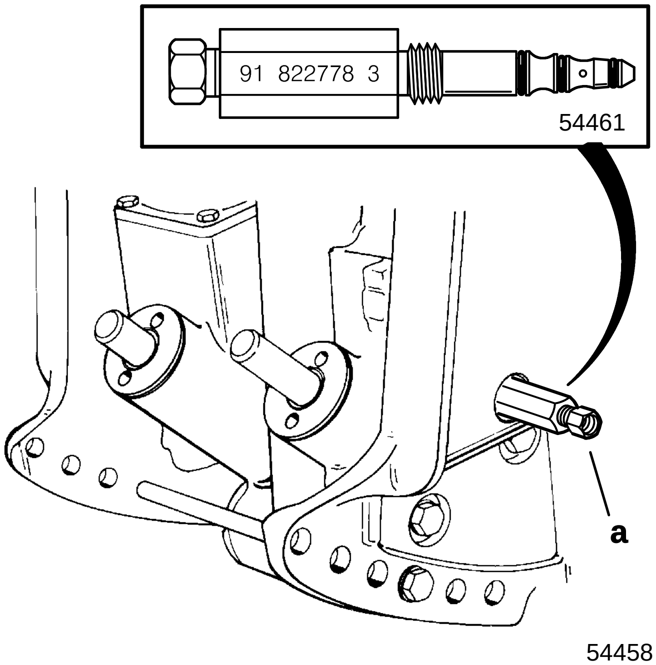
NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

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.*



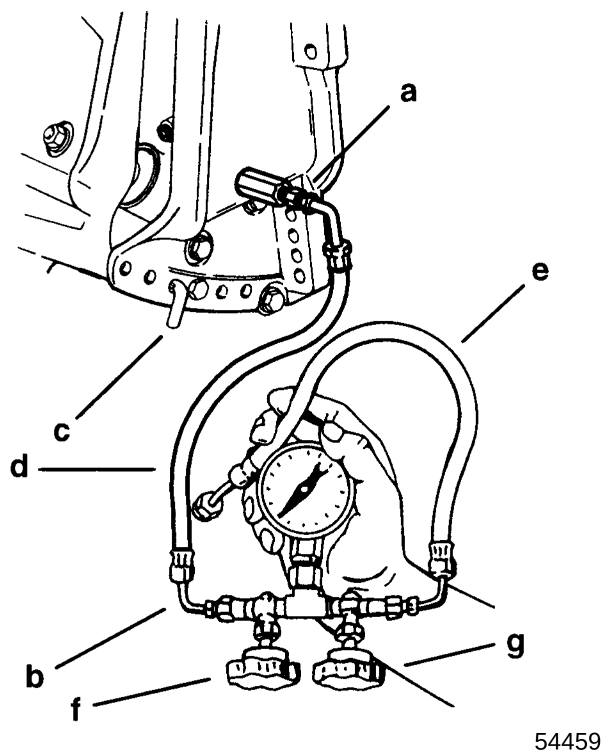
a - Test Adaptor (91-822778A3)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

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. (4324.0kPa).
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 troubleshoot system per instructions on Page 5B-16.*

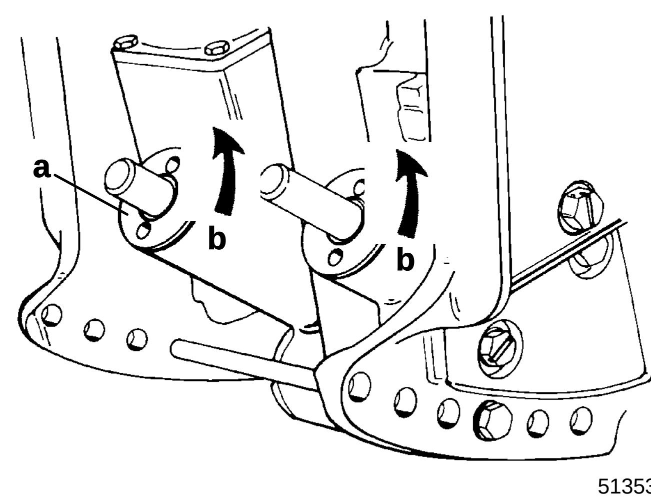
Hydraulic Repair

TRIM ROD REMOVAL AND REPAIR

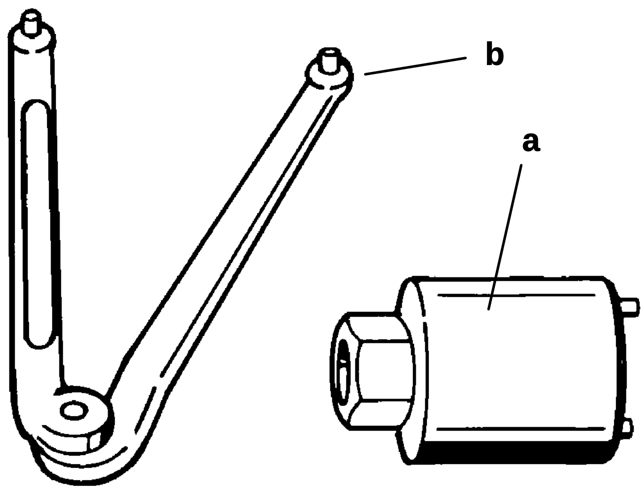
Note: Power Trim does not have to be removed from outboard to remove trim rods.

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.*



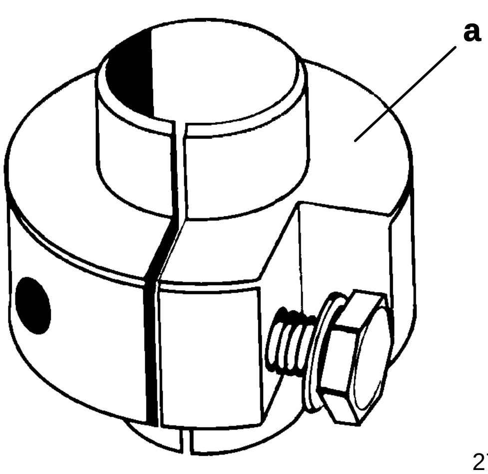
a - Trim Rod Cylinder Cap
b - Turn counterclockwise to remove



51337

a - Removal Tool (91-44487A1)
b - Spanner Wrench (91-74951)

5. Install trim rod removal tool and pull trim rod from cylinder.



27933

a - Trim Rod Removal Tool (91-44486A1)

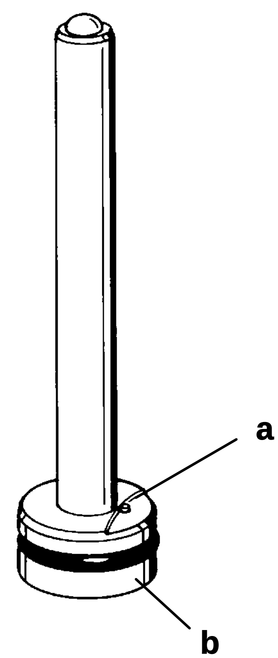
CLEANING AND INSPECTION - TRIM RODS AND CAPS

⚠ CAUTION

Do not remove check valve (a). Check valve is preset to operate at a specific pressure. Removal and installation of check valve could result in improper operating pressure and possible system damage.

NOTE: *Check valve is in port side trim rod only.*

1. Inspect check valve and check valve screen for debris; if debris cannot be removed, replace trim rod assembly. Clean trim rod with parts cleaner and dry with compressed air.

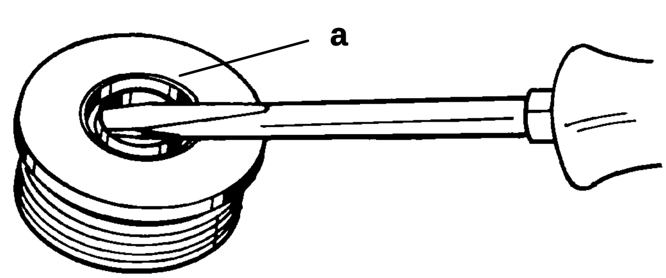


51352

a - Check valve
b - Check valve screen

Trim Rod End Cap Seal

1. Inspect trim cap end seal and replace if damaged or if seal does not keep trim rod clean.



a - Seal (Remove as shown)

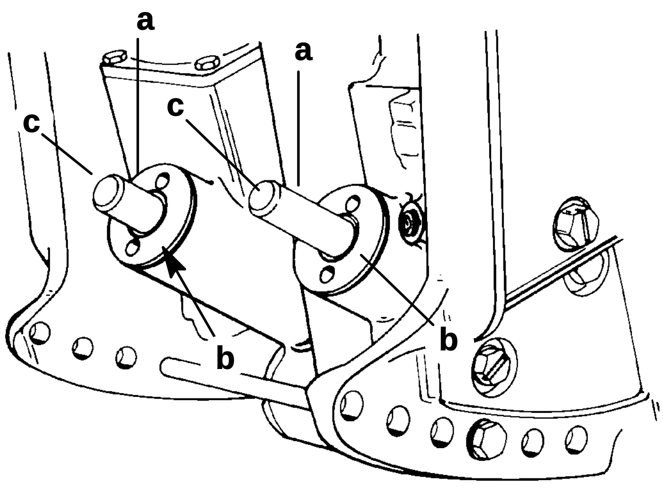
2. Install new seal with seal lip up.

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.



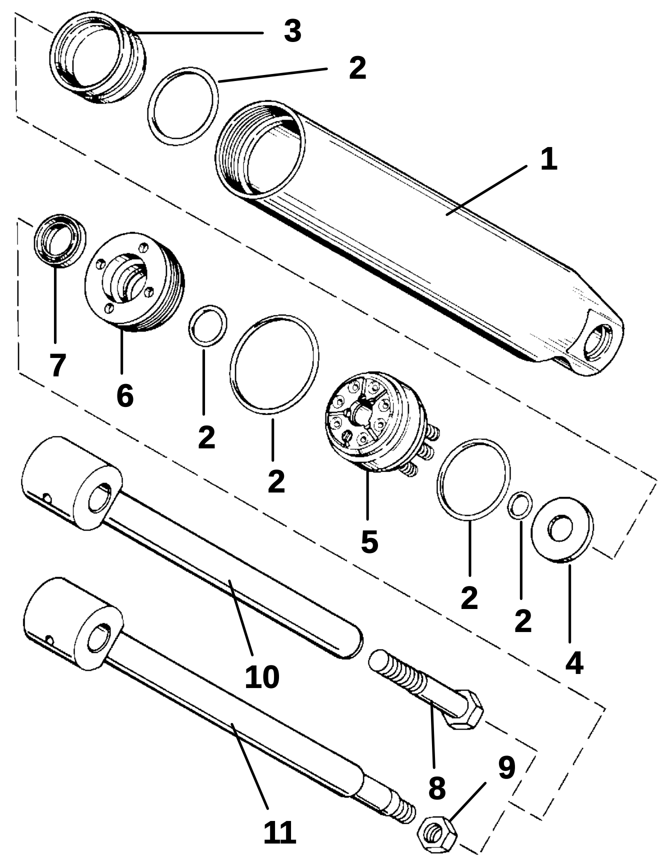
a - Trim rods
b - Cylinder end caps
c - Rod end rollers (lubricate with Quicksilver Anti-Corrosion Grease or Special Lubricant 101)

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)

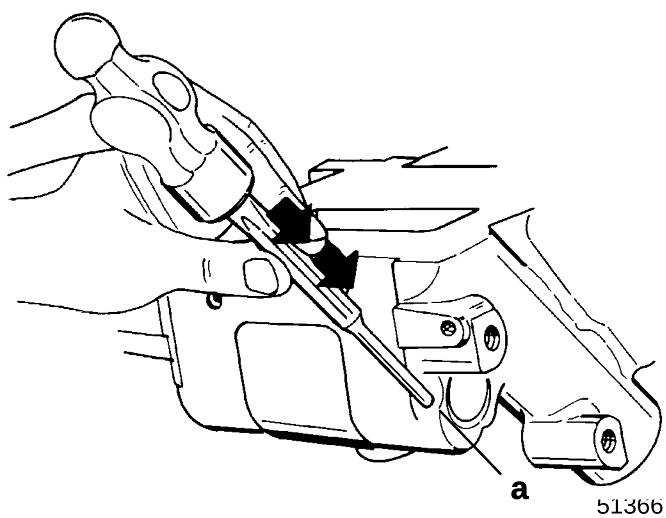
**Memory piston (3) for tilt rods (j and k) are different and must be used with correct tilt rod/cylinder assembly. Memory piston for Design 1 tilt rod is flat, Design 2 is dished to clear nut and thread.

TILT RAM REMOVAL - POWER TRIM SYSTEM REMOVED FROM OUTBOARD

⚠ CAUTION

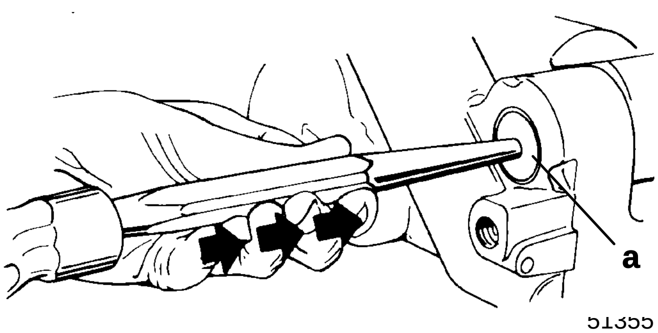
Insure trim system is depressurized prior to tilt ram removal.

1. Remove cross pin.



a - Cross Pin (Remove as shown)

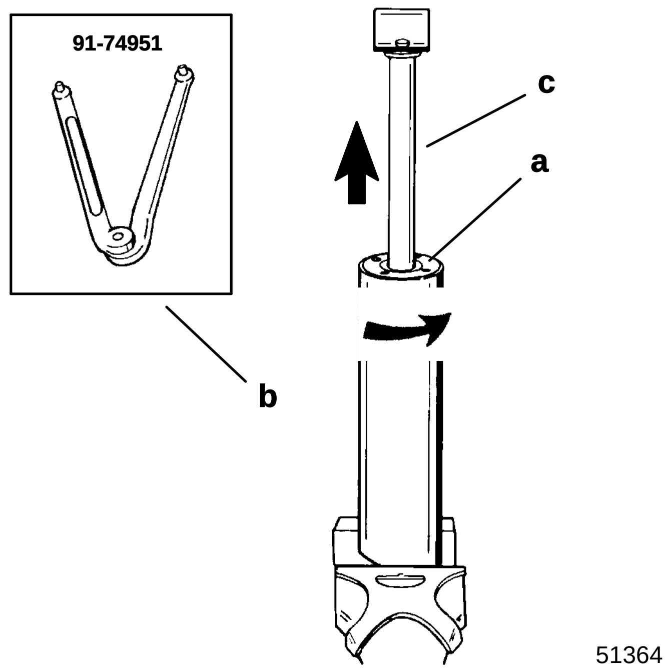
2. Remove lower swivel pin.



a - Lower Swivel Pin (Remove as shown)

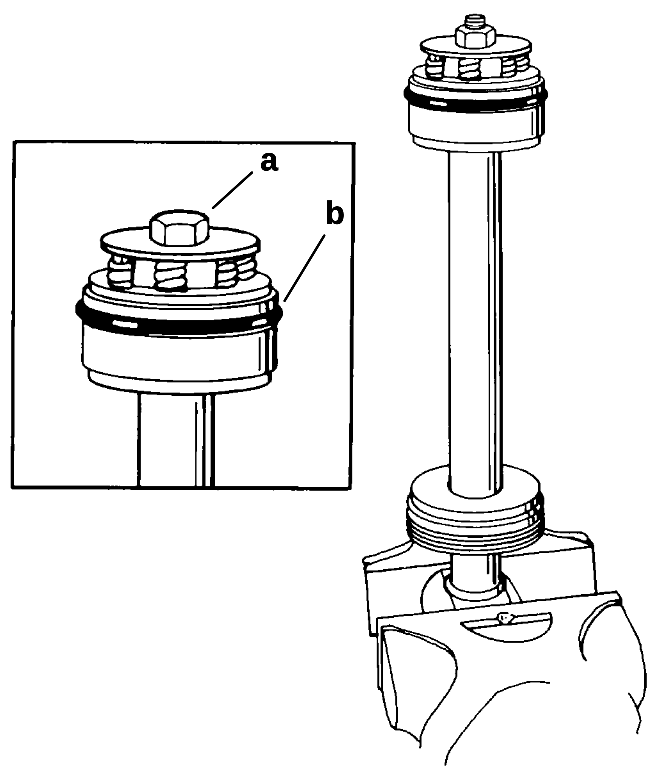
Disassembly

1. Secure tilt ram in a soft jawed vise. Remove tilt rod and cap.



a - Cap (Turn counterclockwise to remove)
b - Spanner wrench (91-74951)
c - Tilt Rod - Pull to remove

2. Clamp tilt rod in a soft jawed vise. Remove bolt or nut as applicable to disassemble rod assembly. Remove O-ring.

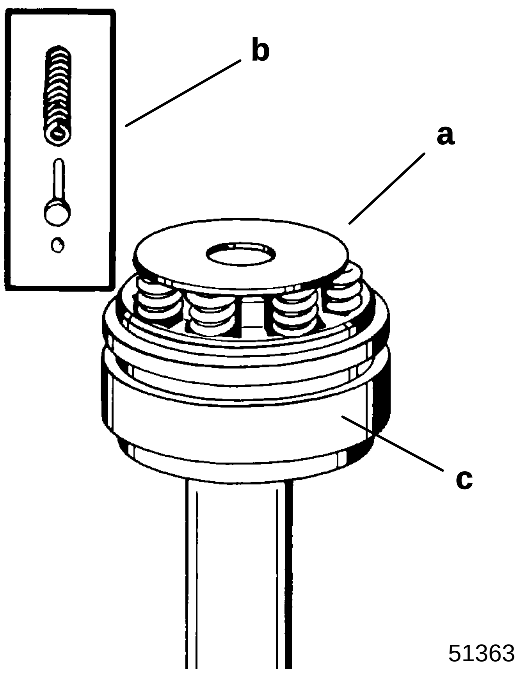


a - Bolt (Design 1) or Stud/Nut (Design 2)
b - O-Ring

IMPORTANT: Note Design 1 and 2 on page 5B-36. Design 1 tilt rod assembly replaces either tilt rod assembly. Either design will fit as a (replace) cylinder assembly complete.
Design 2 will NOT fit a cylinder originally using a Design 1 tilt rod assembly.
Memory Pistons for Design 1 and 2 differ also and must be used only on the cylinder the piston was removed from.

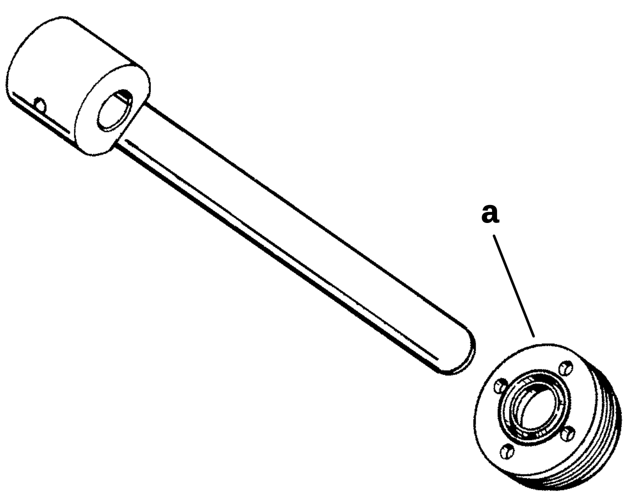
3. Remove washer, check valve assemblies, and piston.

NOTE: *Check valve held in by roll pin can be cleaned but not removed.*



a - Washer
b - Check valve assembly (7)
c - Piston

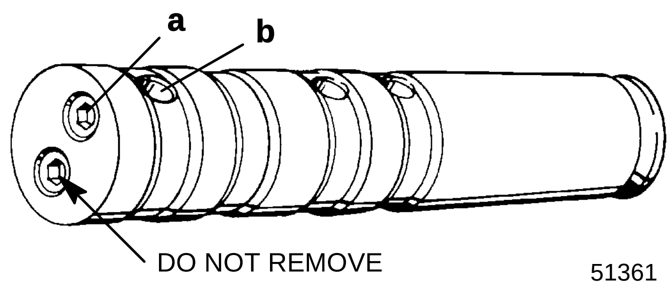
4. Remove end cap from tilt rod.



a - End cap

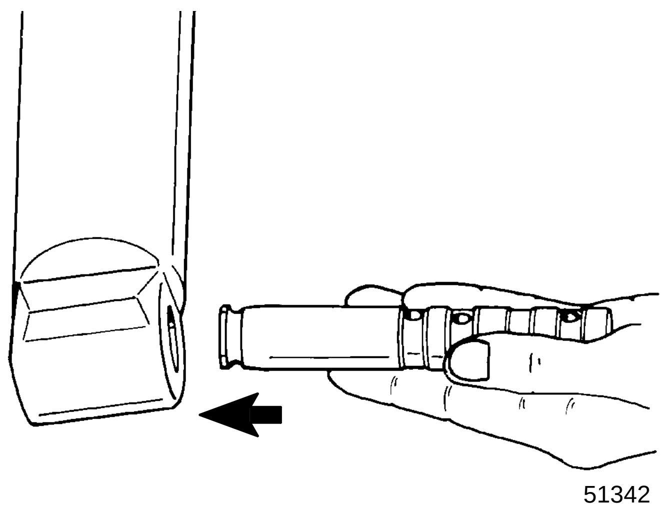
5. Remove allen plug.

IMPORTANT: Remove plug from same side as holes in shaft.

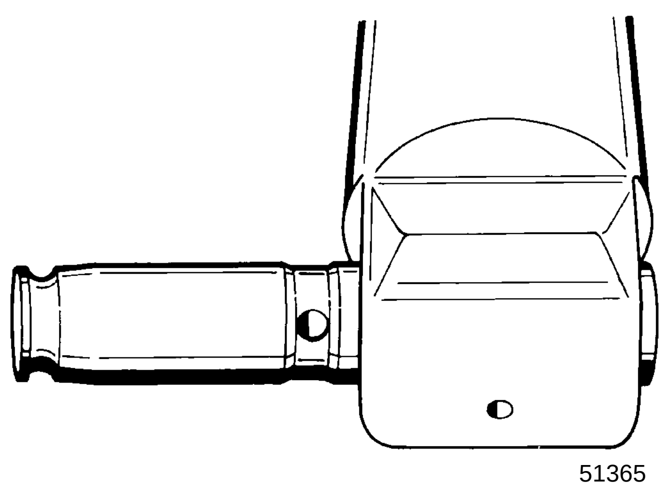


a - Allen plug
b - Hole in shaft

6. Lubricate shaft with Quicksilver Power Trim and Steering Fluid. Insert shaft into cylinder.



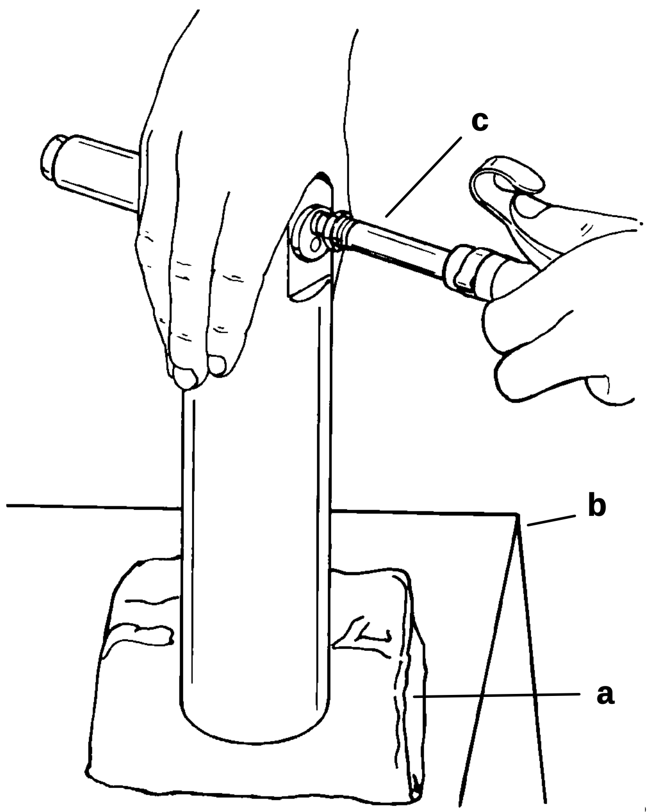
7. Tap shaft into cylinder until shaft is positioned as shown.



⚠ WARNING

Memory Piston Cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

8. Place cylinder as shown. Hold down on cylinder and inject air into shaft opening.



a - Shop Cloth
b - Solid surface
c - Air nozzle

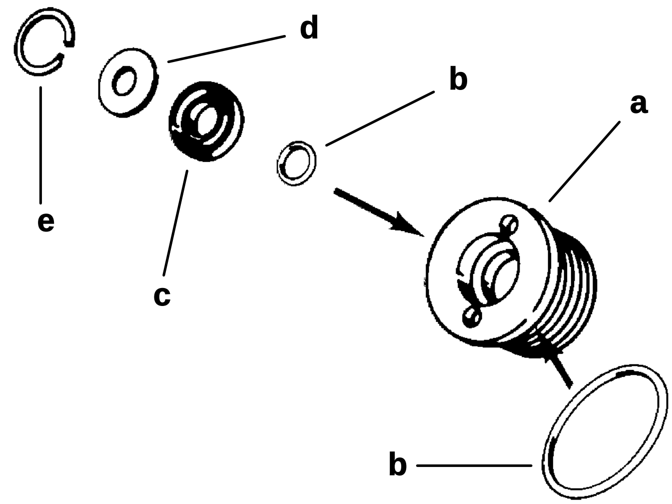
9. Remove shaft after Memory Piston Cup has been expelled. Replace allen plug removed in Step 5 and tighten securely.

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.



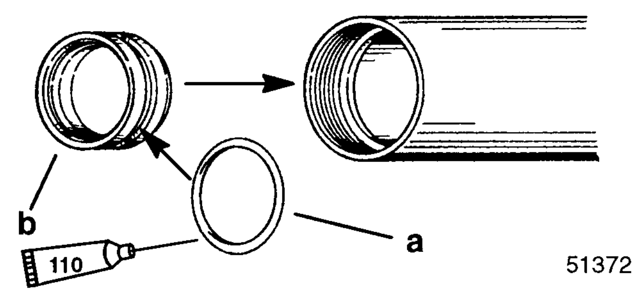
a - Cap
b - O-ring (2)
c - Scraper seal
d - Washer
e - Retaining ring

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.*

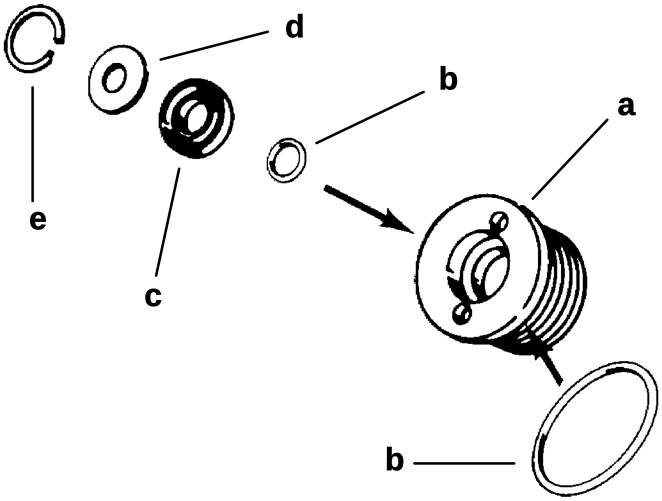
1. Apply Quicksilver Power Trim and Steering Fluid on O-rings prior to reassembly.
2. Install O-ring on Memory Piston Cup and install in cylinder.



Power Trim & Steering Fluid (92-90100A12)

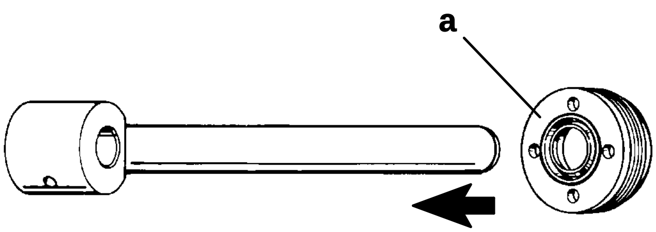
a - O-ring
b - Memory piston cup (Design 1 shown)

3. Assemble end cap.



a - End Cap
b - O-ring (2)
c - Scraper seal
d - Washer
e - Retaining ring

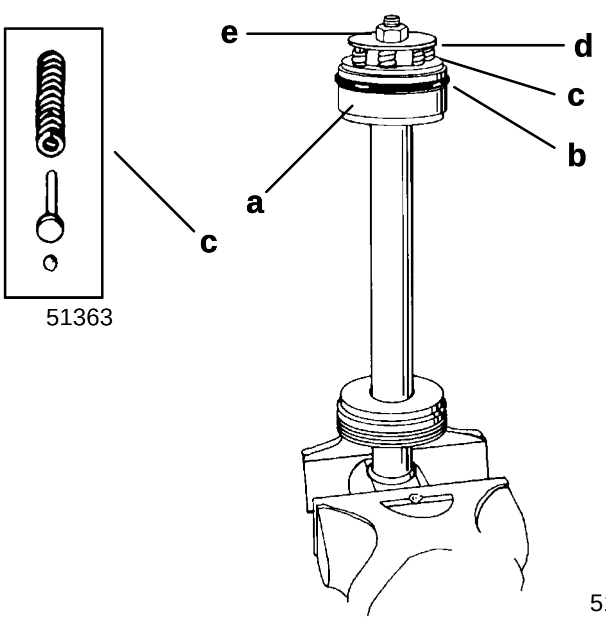
4. Install end cap.



51376

a - End Cap

5. Install components on rod.

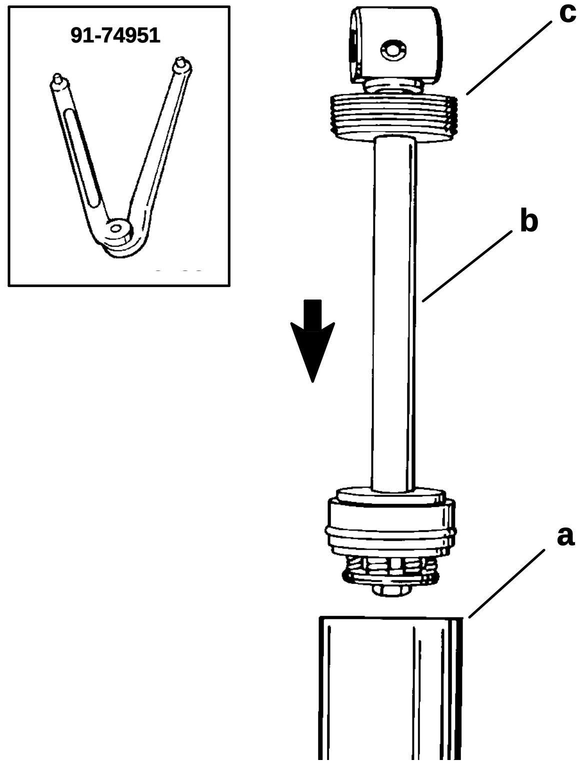


51363

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.

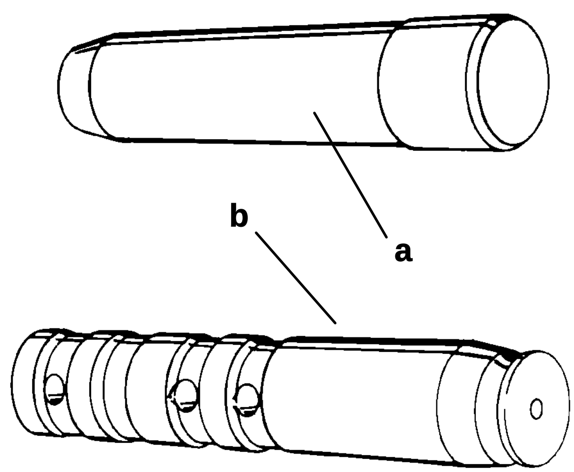


51341

a - Cylinder
b - Tilt rod assembly
c - End cap (Tighten securely.) Use spanner wrench.

TILT RAM ASSEMBLY INSTALLATION

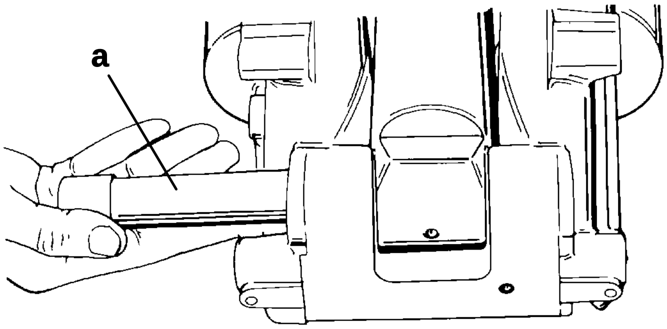
1. Lubricate alignment tool (91-11230) and shaft. Use Quicksilver Power Trim and Steering Fluid.



51369

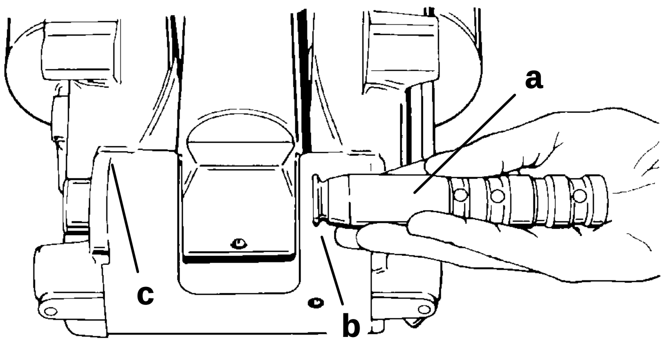
a - Alignment Tool (91-11230)
b - Shaft

2. Align tilt ram and housing using alignment tool.



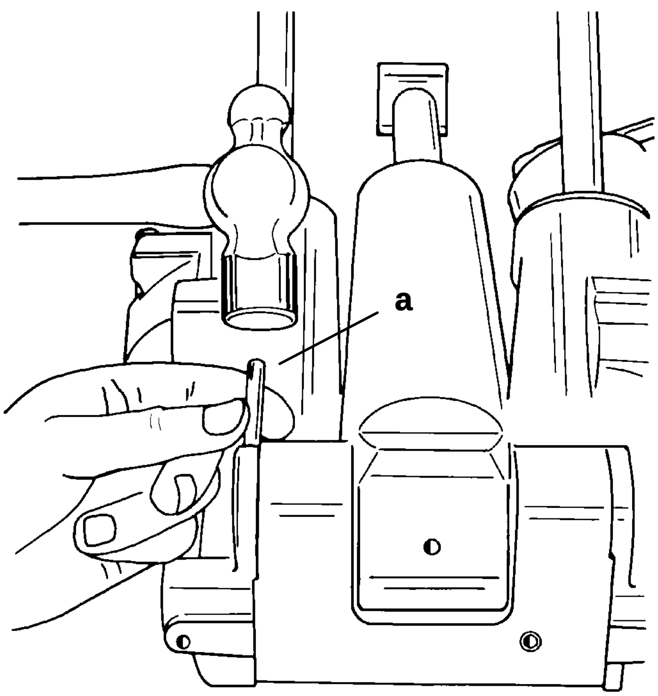
a - Alignment Tool (91-11230)

3. Install shaft.



a - Shaft
b - Groove
c - Hole [groove (b) will align with this hole]

4. Drive pin in until flush.



a - Pin (Drive Against Knurled End)

5. Install Power Trim Assembly on outboard. Refer to "Installation" instructions on page 5B-30.

MOTOR AND PUMP REPLACEMENT (SQUARE MOTOR)

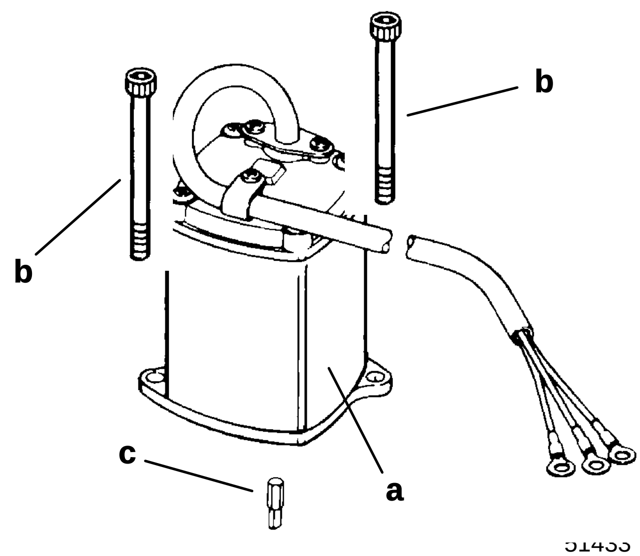
IMPORTANT: The pump is not rebuildable. If pump is defective, replace as an assembly.

NOTE: *Power Trim System does not have to be removed from outboard to replace pump or motor.*

1. Tilt outboard to full "UP" position. Depressurize power trim system, and loosen starboard transom bracket as outlined in **"Removal and Installation"** on page 5B-28.

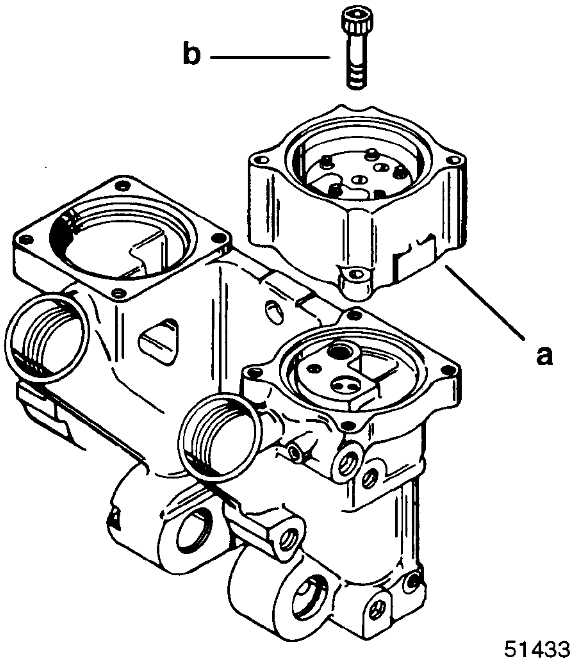
2. Remove 2 screws to remove motor from system.

NOTE: *Driveshaft is a loose part and may fall out of motor when motor is removed.*



a - Motor
b - Screw (2)
c - Driveshaft

3. Remove two screws to remove pump.



a - Pump
b - Screw (2)

Motor and Electrical Tests/ Repair (Square Motor)

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

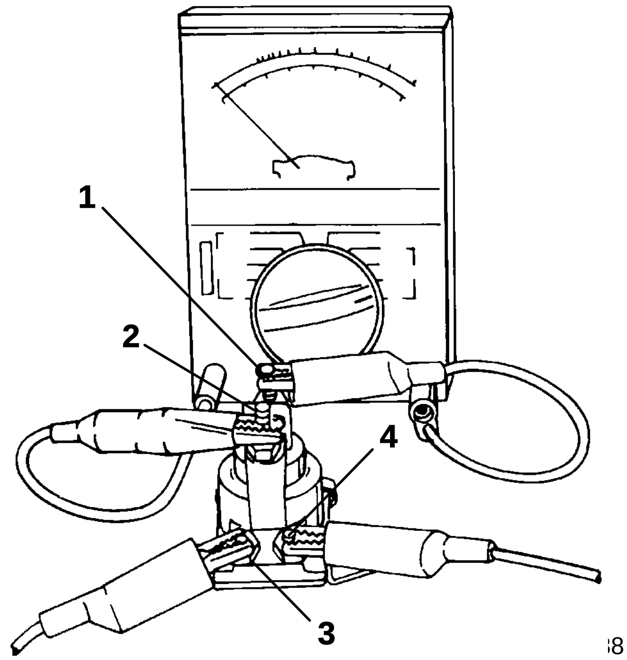
1. Connect a 12 volt power supply to motor wires [positive (+) to blue wire and negative (-) to black wire]. Motor should run. Disconnect blue wire and connect green wire to positive (+) terminal of power supply. Motor should run.
2. If motor does not run, disassemble and check components.

Solenoid Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

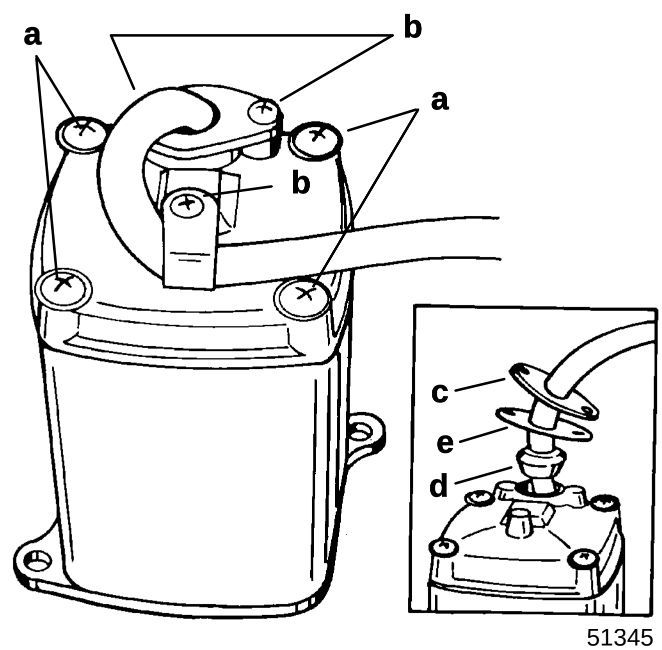
1. Disconnect all wires from solenoid terminals.
2. Set an Ohmmeter to Rx1 scale and connect meter leads to solenoid terminals 1 and 2.
3. Connect a 12 volt power supply to terminals 3 and 4. Solenoid should click and meter should read zero (0) ohms (full continuity).



4. If meter does not read zero (0) ohms, replace solenoid.

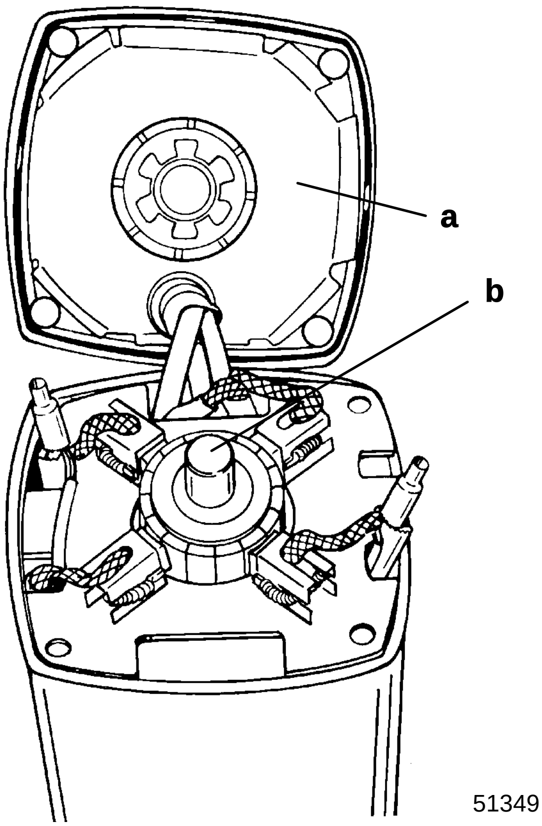
Motor Disassembly

1. Remove screws and clamp.



a - Screw (4)
b - Screw (3)
c - Clamp
d - Grommet
e - Gasket

2. Lift motor from end cap. Use care not to drop armature.



a - End Cap
b - Armature

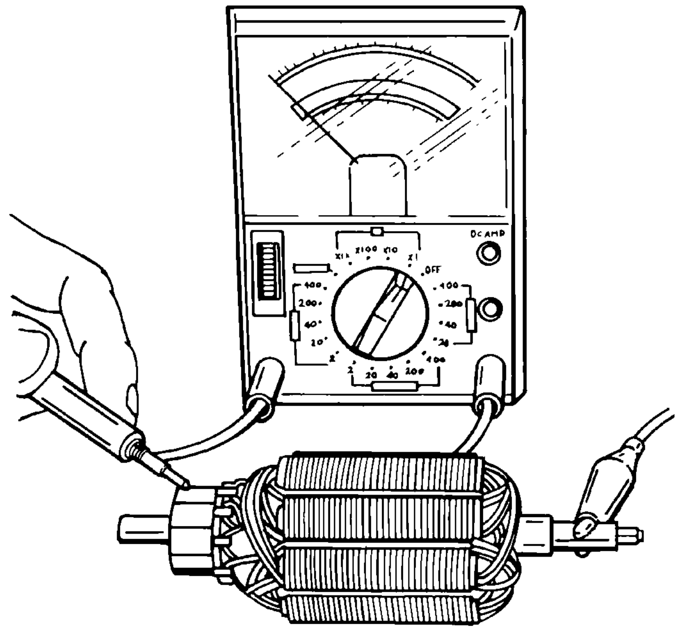
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

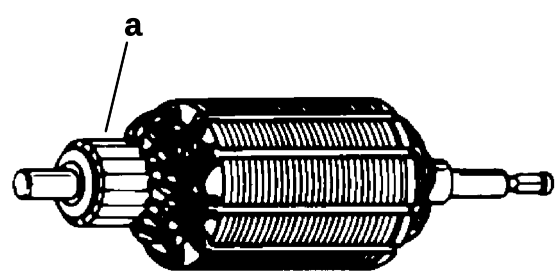
TEST FOR GROUND

1. Use an Ohmmeter (Rx1 scale). Connect one lead on armature shaft and other lead on commutator. If continuity is indicated, armature is grounded. Replace armature.



CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with "OO" sandpaper.



a - Commutator

FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x__________)
Green and Blue Motor Wires	0	Full Continuity (Rx1)
Green and Black Motor Wires	0	Full Continuity (Rx1)
Blue and Black Motor Wires	0	Full Continuity (Rx1)
Black Motor Wire, and Frame (Motor Housing	No Continuity	Full Continuity (Rx1)
Green Motor Wire, and Frame	No Continuity	Full Continuity (Rx1)
Blue Motor Wire, and Frame	No Continuity	Full Continuity (Rx1)

*If specified readings are not obtained, check for:

- defective armature
- dirty or worn brushes
- dirty or worn commutator

If defective components are found, repair or replace component(s) and retest.

Motor Repair

REMOVAL

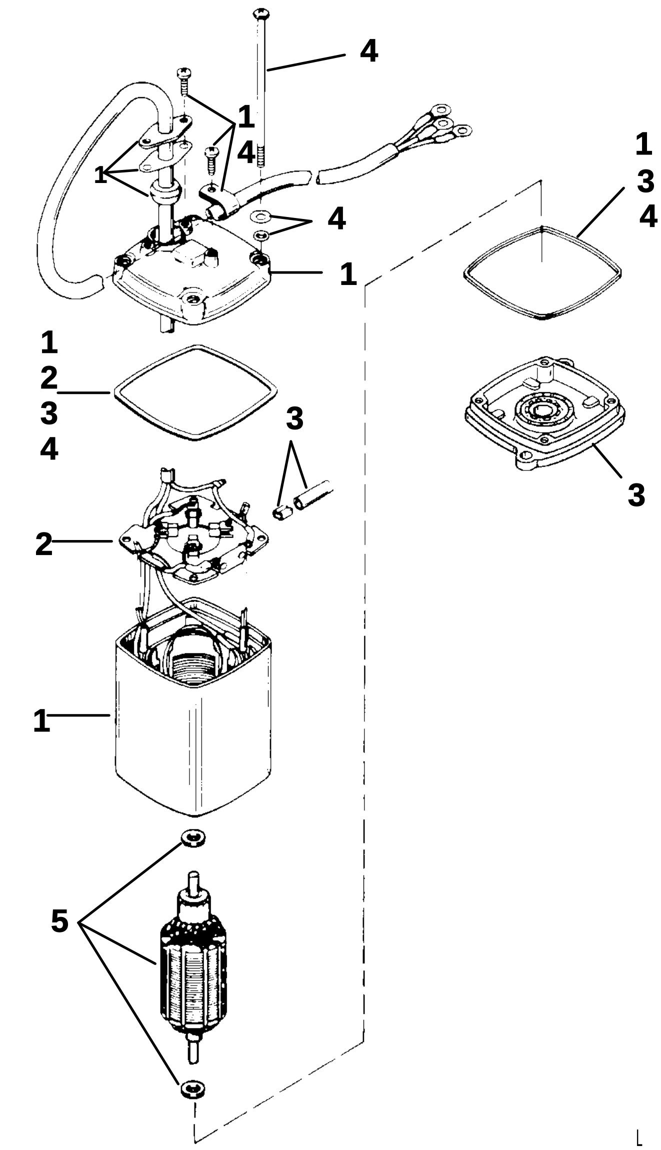
NOTE: *Power Trim System does not have to be removed from outboard to repair/replace motor.*

DISASSEMBLY

Refer to **"Motor and Pump Replacement"** on page 5B-41 to disassemble motor from pump.

CLEANING AND INSPECTION

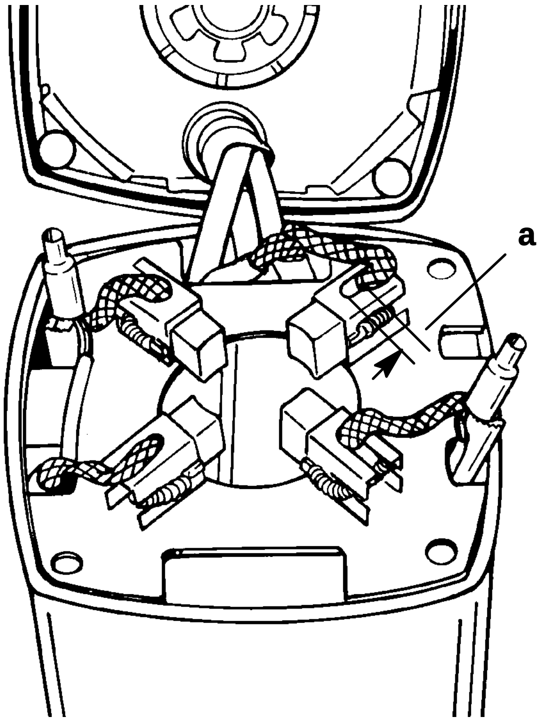
Inspect O-rings and replace if necessary. Clean, inspect, and test motor components. Refer to **"Brush Replacement"**, **"Armature Test"**, and **"Field Tests"** for inspection and test procedures.



Power Trim Motor
1. Frame and Field Kit
2. Brush Card Kit
3. End Frame Kit
4. Seal Kit
5. Armature Kit

BRUSH REPLACEMENT

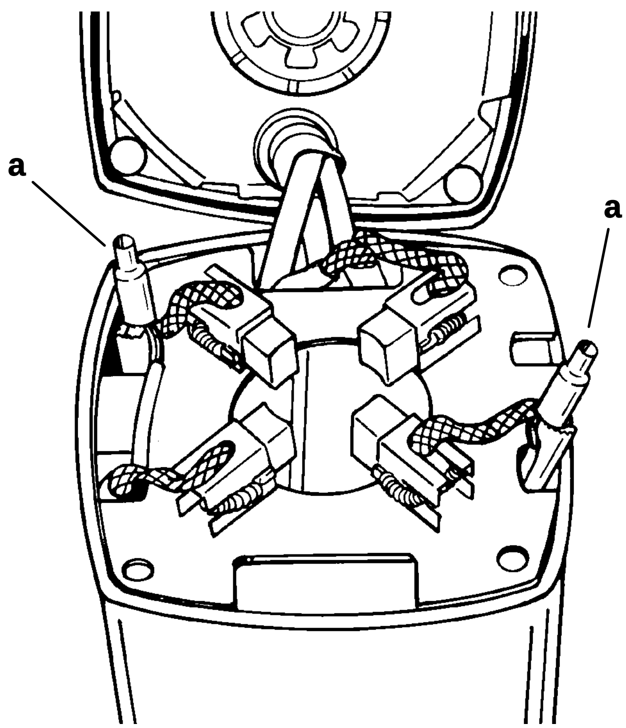
1. Brush replacement is required if brushes are pitted, chipped, or if distance (a) between the brush pigtail and end of brush holder slot is 1/16 in. or less. Check distance with armature installed.



51350

a - 1/16 in.

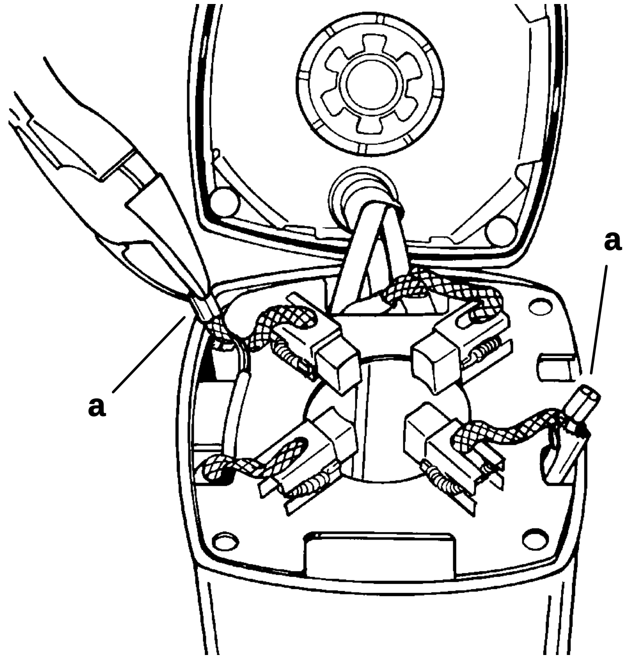
2. To replace brush card, remove insulators.



51350

a - Insulators

3. Remove metal connectors.



51351

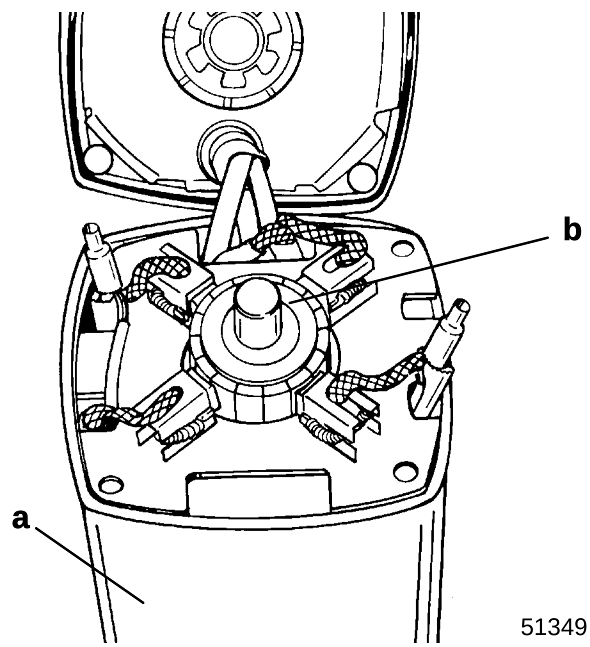
a - Metal Connectors

4. Install new brush card.
5. Crimp new metal connectors onto wires.
6. Insulate connections with heat shrink tubing.

Reassembly

IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

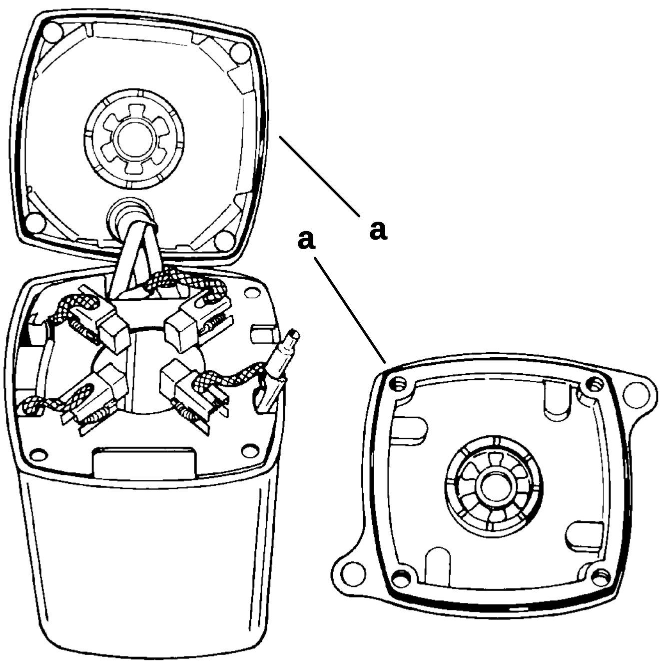
1. Install armature in motor housing.



51349

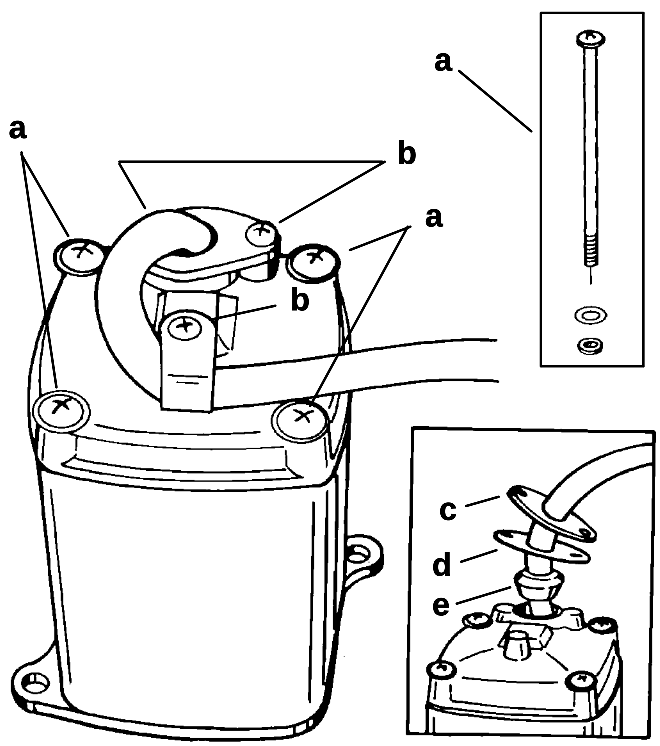
a - Motor Housing
b - Armature (Spread brushes to insert commutator.)

2. Install O-rings in end caps.



a - O-rings

3. Install screws and clamp. Tighten screws securely.



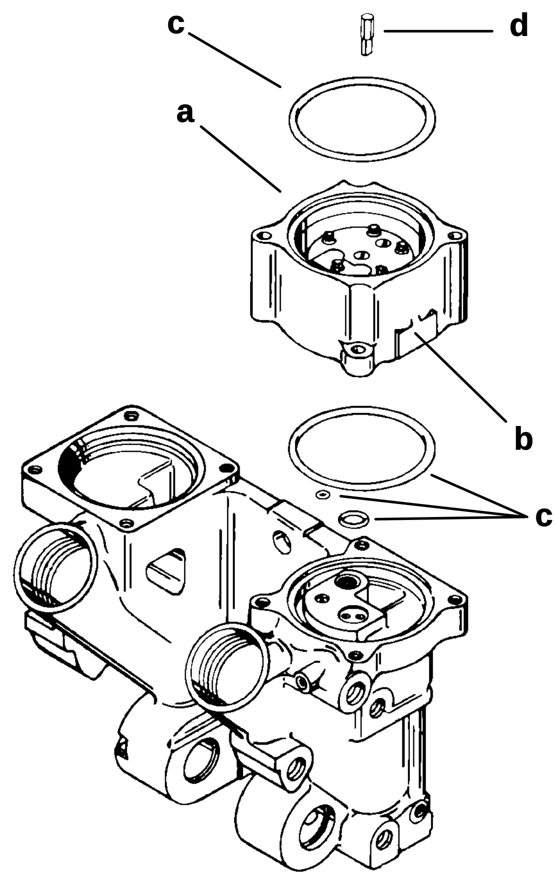
a - Screw (4) Contains flat washer and O-ring. Torque screws to 60 lb. in. (6.8 N·m).
b - Screw (3)
c - Clamp
d - Gasket
e - Grommet

Reassembly - Motor and Pump

NOTE: *Driveshaft is a loose part and may fall out of position.*

1. Install pump onto power trim manifold. Insure O-rings are in proper locations. Secure with two (2) screws. Torque screws to 80 lb. in. (9.0 N·m).

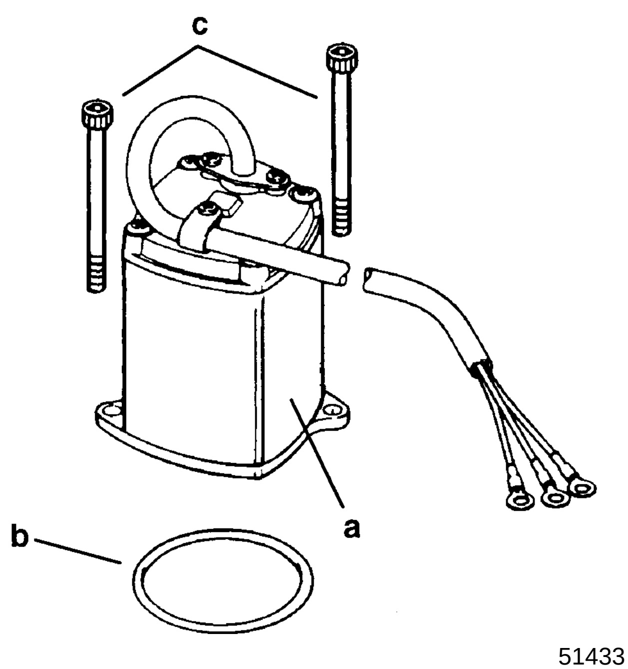
IMPORTANT: Install pump with location flat facing towards starboard transom bracket.



a - Pump (Flat towards starboard transom bracket)
b - Flat - faces starboard transom bracket)
c - O-rings (4)
d - Driveshaft (Install in **center** hole in pump)

2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.
3. Install motor, secure with two (2) screws. Torque screws to 80 lb. in. (9.0 N·m). Route wiring; refer to Wiring Diagrams in this service manual.

__NOTE:__ Insure motor and driveshaft are aligned.



a - Motor
b - O-ring
c - Screw (2) – Torque to 80 lb. in. (9.0 N·m)

4. Complete reassembly of Power Trim System as outlined in **"Installation"** on page 5B-30.

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-14.

IMPORTANT: Run Trim System in short "jogs" until pump motor primes and trim system moves. If trim motor is run without priming pump, drive-shaft failure could result.

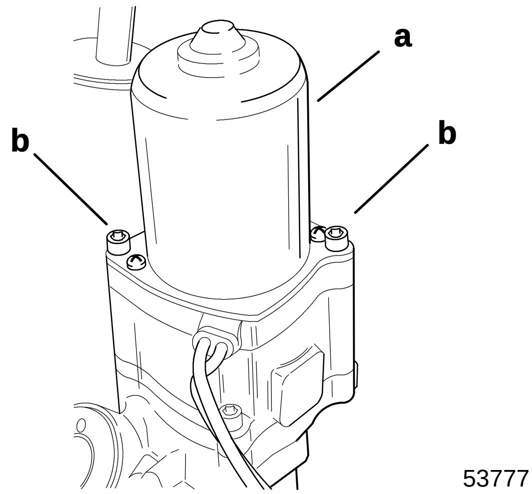
MOTOR AND PUMP REPLACEMENT

IMPORTANT: The pump is not rebuildable. If pump is defective, replace as an assembly.

__NOTE:__ Power Trim System does not have to be removed from outboard to replace pump or motor.

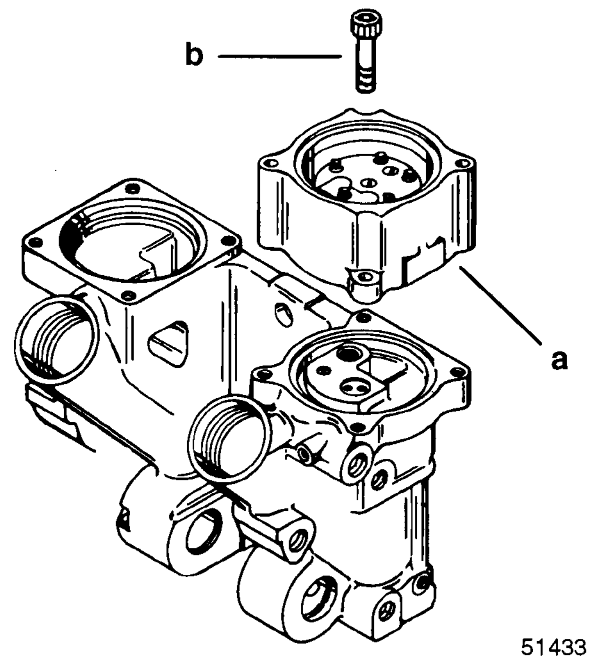
1. Tilt outboard to full "UP" position. Depressurize power trim system, and loosen starboard transom bracket as outlined in **"Removal and Installation"** on page 5B-28.
2. Remove 2 allen screws to remove motor from system.

__NOTE:__ Drive shaft is a loose part and may fall out of motor when motor is removed.



a - Motor
b - Screw (2)

3. Remove two screws to remove pump.



a - Pump
b - Screw (2)

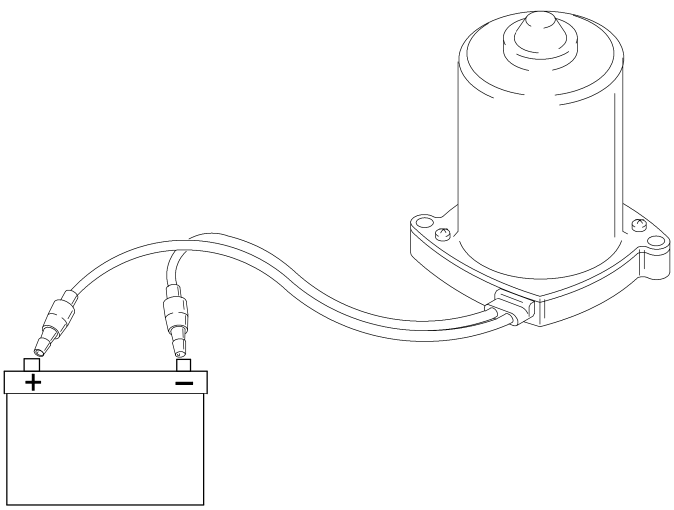
Motor and Electrical Tests/ Repair (Round Motor)

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

1. Connect a 12 volt power supply to motor wires; one motor lead to POSITIVE (+) battery terminal and the other motor lead to the NEGATIVE (–) battery terminal. Motor should run. Reverse motor leads between battery terminals. Motor should run.

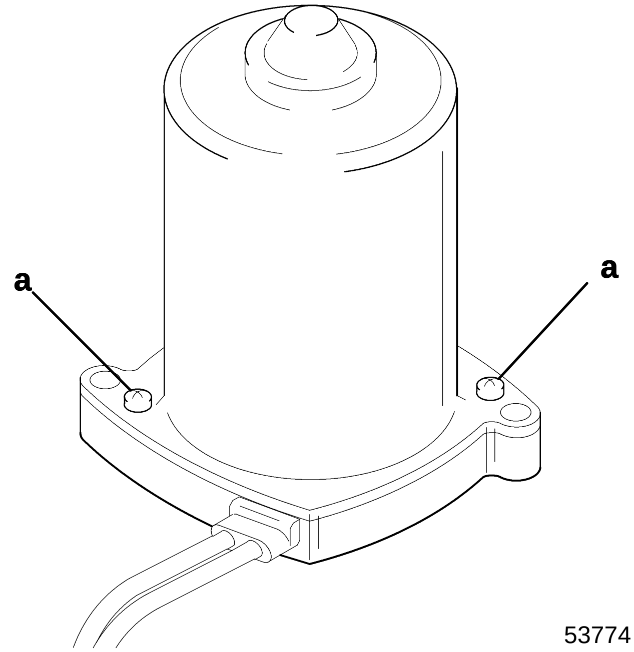


53774

2. If motor does not run, disassemble and check components.

Motor Disassembly

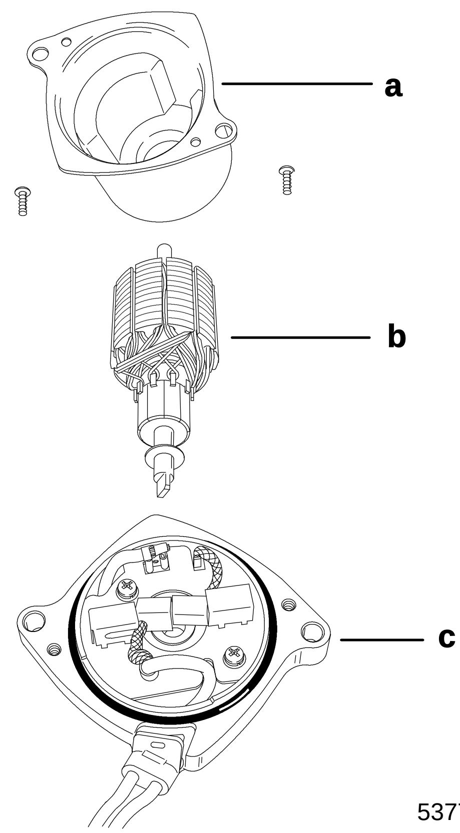
1. Remove 2 screws.



53774

a - Screw (2)

2. Remove frame and armature from end cap. Use care not to drop armature.



53779

a - Frame
b - Armature
c - End Cap

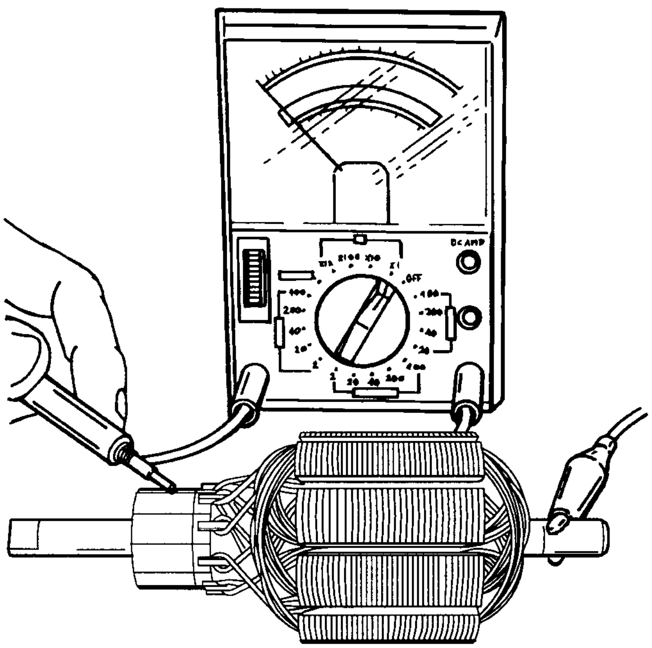
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

TEST FOR GROUND

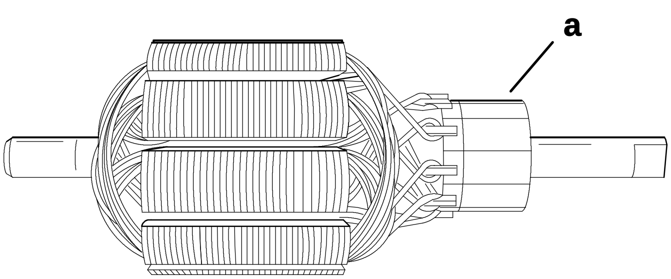
1. Use an Ohmmeter (Rx1 scale). Connect one lead on armature shaft and other lead on commutator. If continuity is indicated, armature is grounded. Replace armature.



53786

CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with "OO" sandpaper.



53775

a - Commutator

FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x__________)
BLUE and BLACK Motor Wires	0	(Rx1)
BLACK Motor Wire, and Frame (Motor Housing)	No Continuity	(Rx1)
BLUE Motor Wire and Frame	No Continuity	(Rx1)

*If specified readings are not obtained, check for:

- defective armature
- dirty or worn brushes
- dirty or worn commutator

If defective components are found, repair or replace component(s) and retest.

Motor Repair

REMOVAL

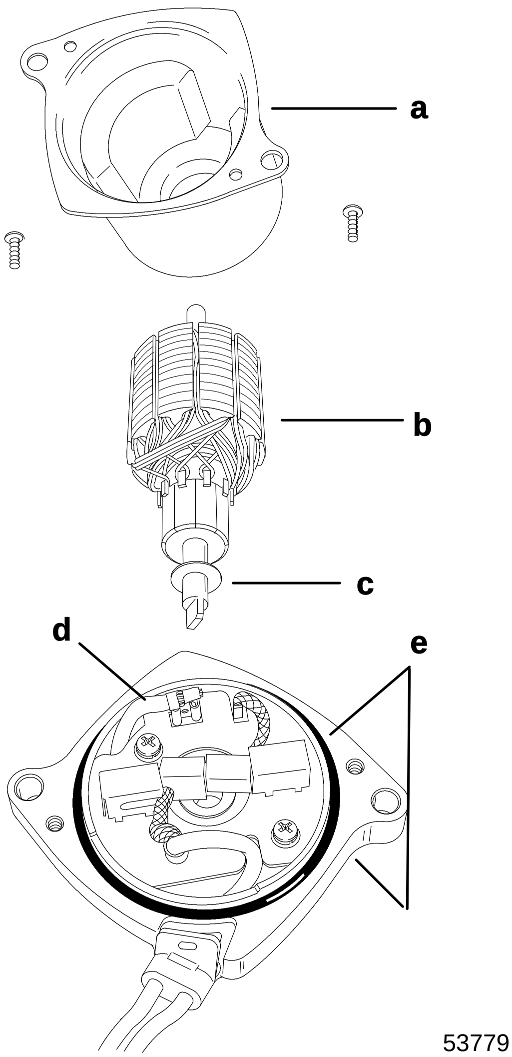
NOTE: *Power Trim System does not have to be removed from outboard to repair/replace motor.*

DISASSEMBLY

Refer to **"Motor Disassembly"** on page 5B-42 to disassemble motor from pump.

CLEANING AND INSPECTION

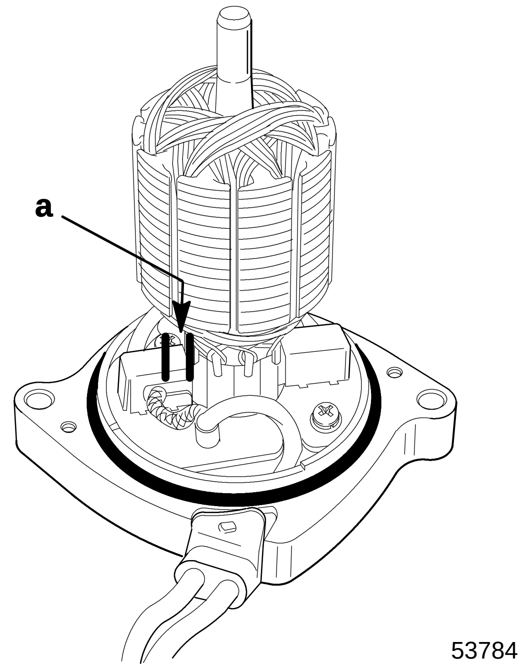
Inspect O-rings and replace if necessary. Carefully inspect power cord for cuts or tears which will allow water to enter motor. Replace cord if cut or torn. Clean, inspect, and test motor components. Refer to **"Brush Replacement"**, **"Armature Test"**, and **"Field Tests"** for inspection and test procedures.



a - Frame
b - Armature
c - Shim
d - Brush Card Assembly
e - O-rings

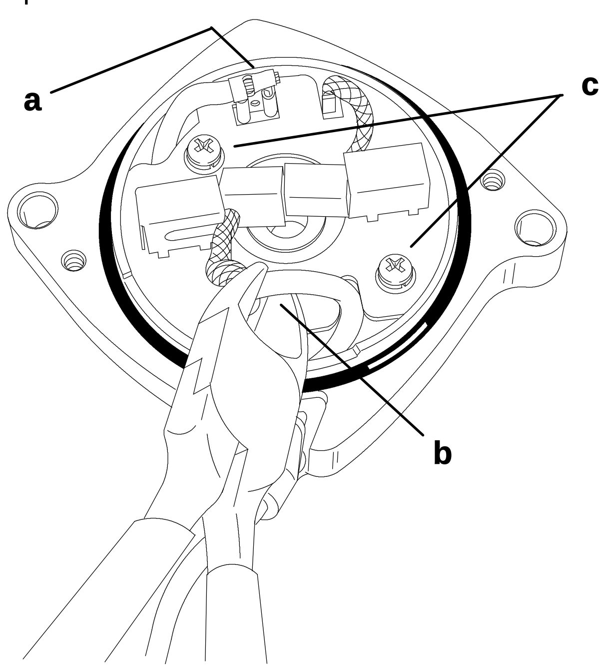
BRUSH REPLACEMENT

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. (1.6mm) or less. Check distance with armature installed.



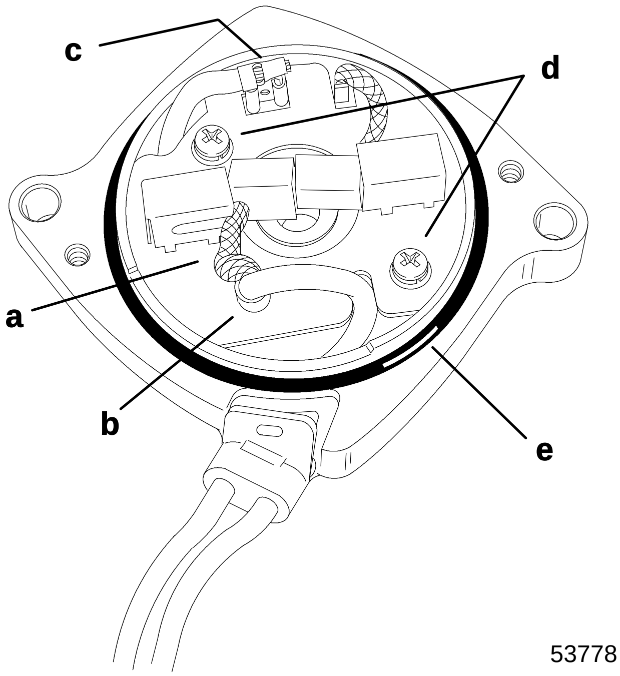
a - 1/16 in. (1.6mm)

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

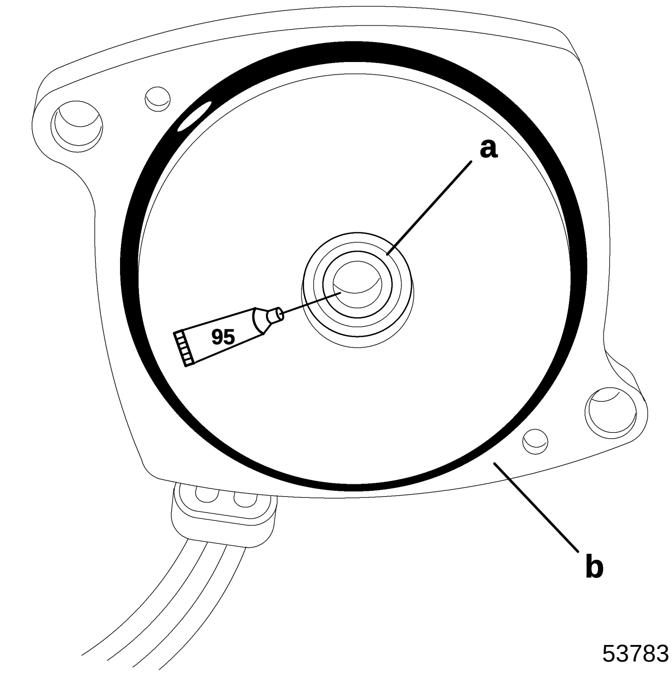
5. Install new brush card (BRUSH and SEAL KIT 828714A1).
6. Crimp metal connector onto motor lead and new brush lead.
7. Connect spade connector motor lead to brush card connector.
8. Secure brush card to end cap with 2 screws and lockwashers.
9. Inspect O-ring for cuts and abraisions. Replace O-ring 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

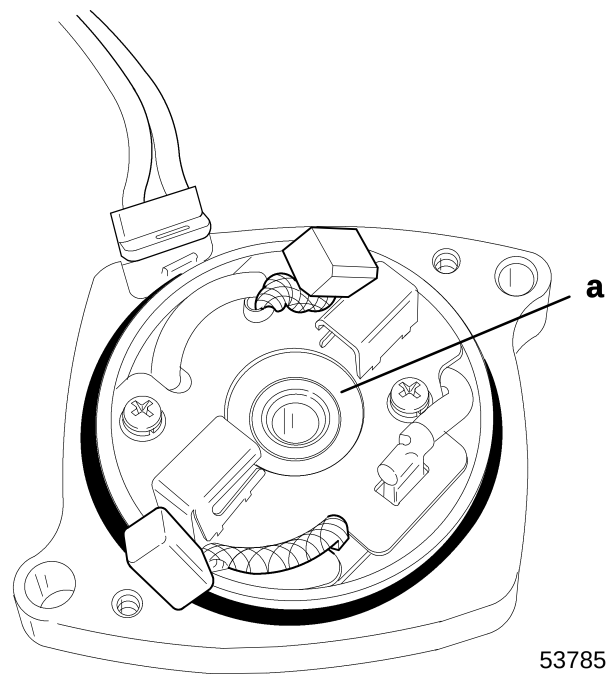
1. Inspect seal and O-ring for cuts and abraisions. If replacement is required, install BRUSH and SEAL KIT 828714A1.



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

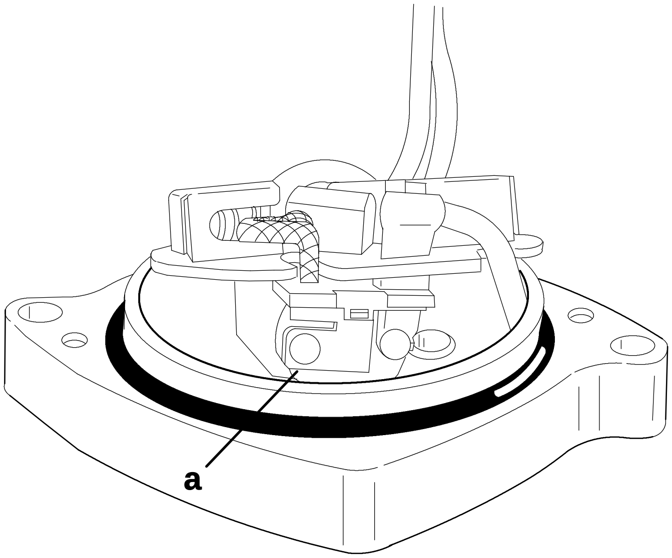
a - Seal (Apply 2-4-C w/Teflon to seal lips)
b - O-ring

2. Inspect bushing for wear. If bushing appears to be excessively worn – grooves, scratches, etc. – install END FRAME ASSEMBLY (COMPLETE) 828715A1.



a - Bushing

3. If trim motor is overheated, a thermoswitch located under brush card will open. Normally, this switch will reset itself within 1 minute.



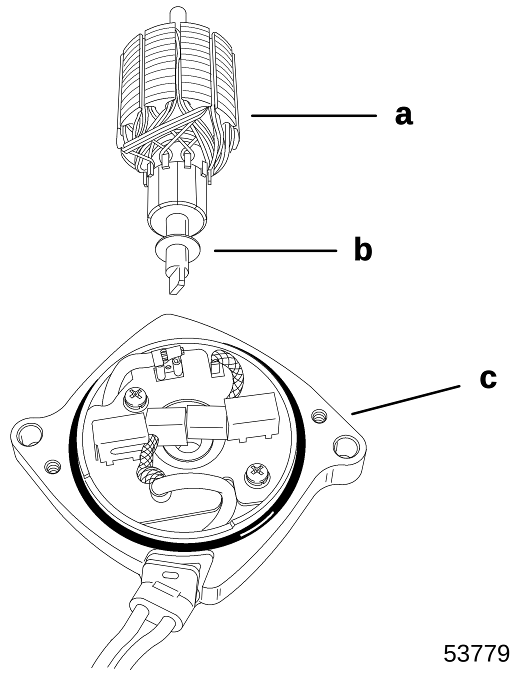
53781

a - Thermoswitch

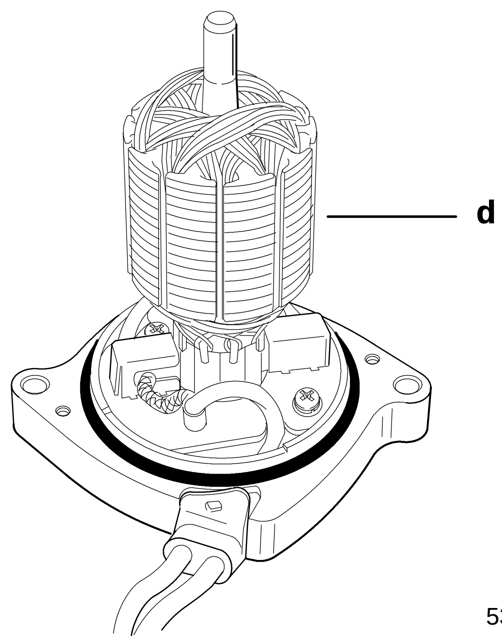
Reassembly

IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

1. Install armature into end cap/brush card assembly.



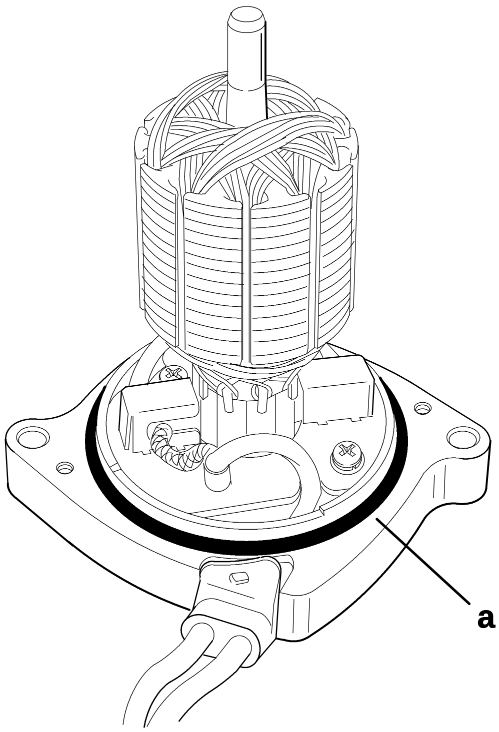
53779



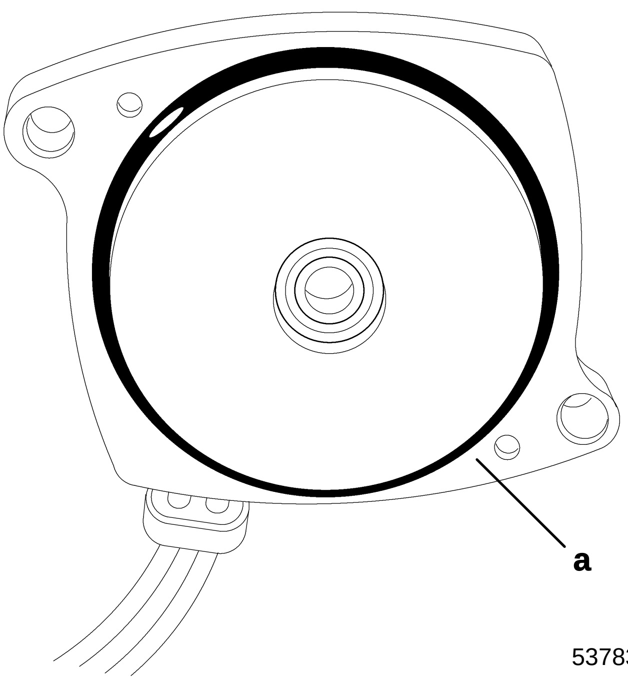
53784

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

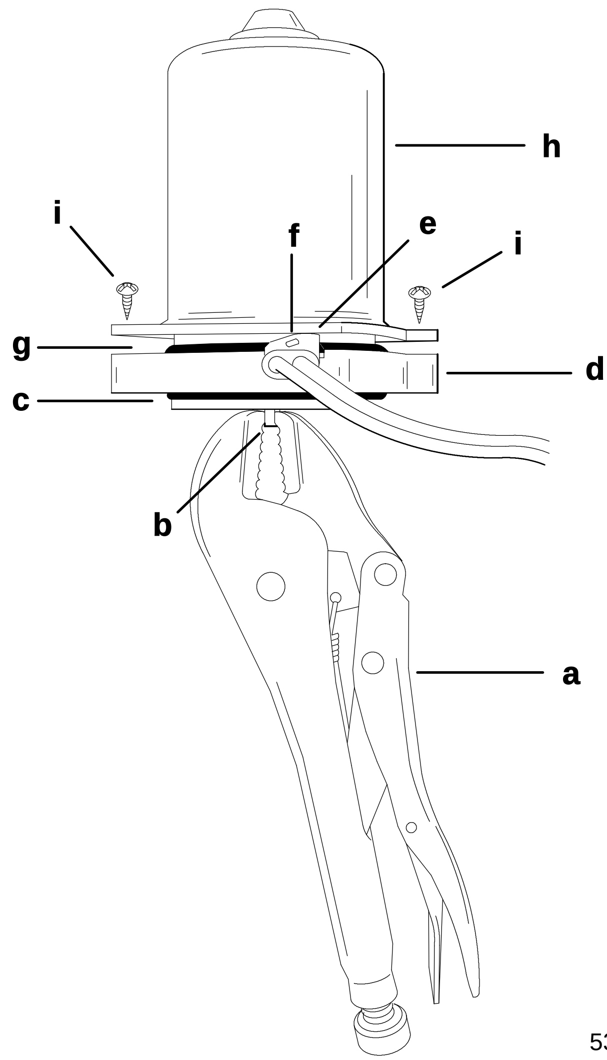


53783

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

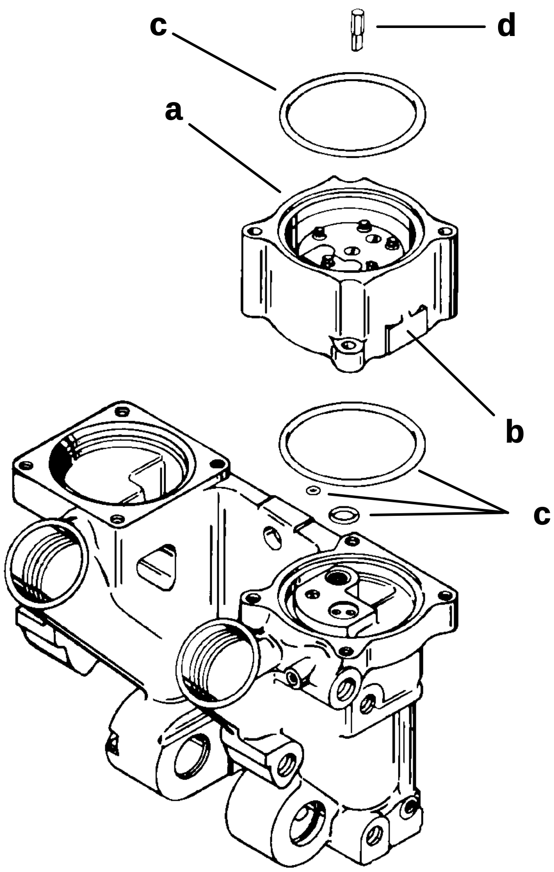
a - Vise Grip® Pliers
b - Armature Shaft
c - O-ring
d - End Cap
e - Harness Retainer
f - Retainer Hole
g - O-ring
h - Frame Assembly
i - Screws

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. (9.0 N·m).

IMPORTANT: Install pump with location flat facing towards starboard transom bracket.

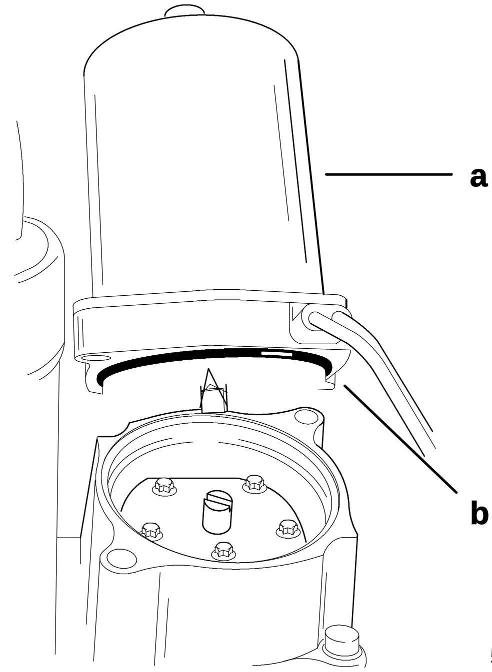


51433

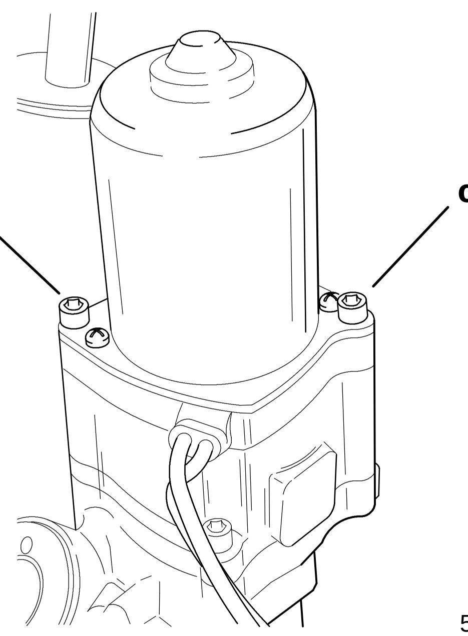
a - Pump (Flat towards starboard transom bracket)
b - Flat - faces starboard transom bracket)
c - O-rings (4)
d - Drive Shaft (Install in **center** hole in pump)

2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.
3. Install motor, secure with two (2) screws. Route wiring; refer to Wiring Diagrams in this service manual.

NOTE: *Verify motor and drive shaft are aligned.*



53782



53777

a - Motor
b - O-ring
c - Screw (2) Tighten securely.

4. Complete reassembly of Power Trim System as outlined in **"Installation"** on page 5B-28.

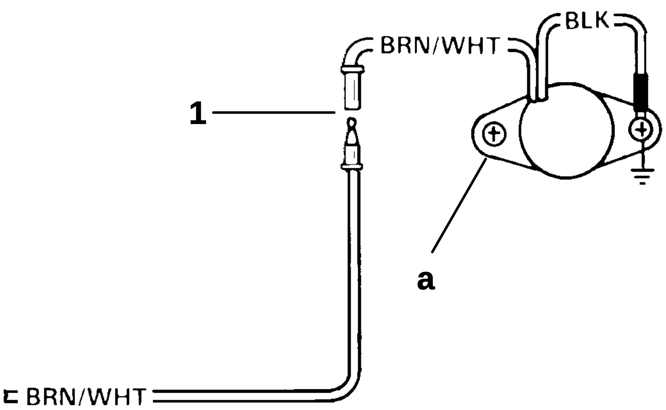
Priming Power Trim System

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-14.

IMPORTANT: Run Trim System in short “jogs” until pump motor primes and trim system moves. If trim motor is run without priming pump, drive shaft failure could result.

Trim Sender (Optional Accessory) Test

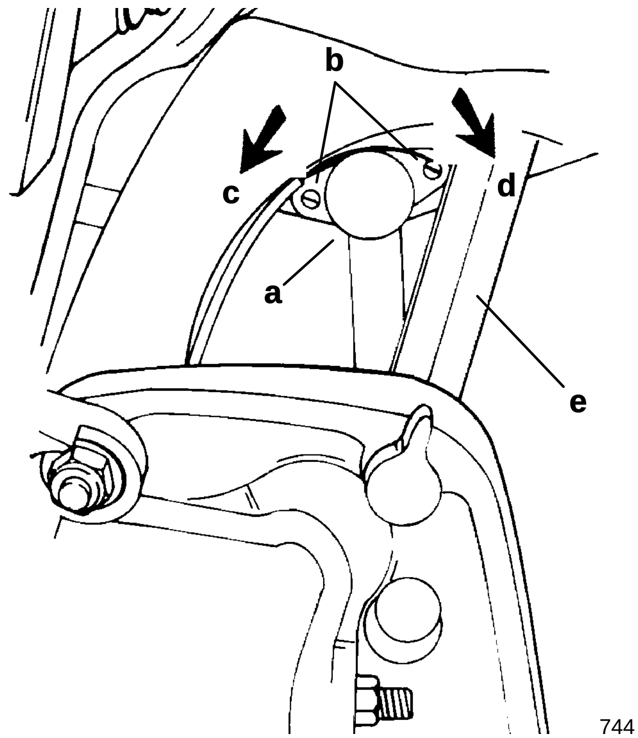
1. Check trim sender black lead for proper ground.
2. Trim outboard to full “DOWN” position.
3. Place ignition switch to “ON” position.
4. Disconnect BRN/WHT trim sender wire from trim sender harness.
5. Connect Ohmmeter (Rx1 scale) leads between outboard ground and Point 1 (trim sender end).
6. Depress “UP” button. Ohmmeter needle should move as the outboard is trimmed up. If needle does not move, trim sender is defective.



a - Trim sender

Trim Indicator Gauge Needle Adjustment

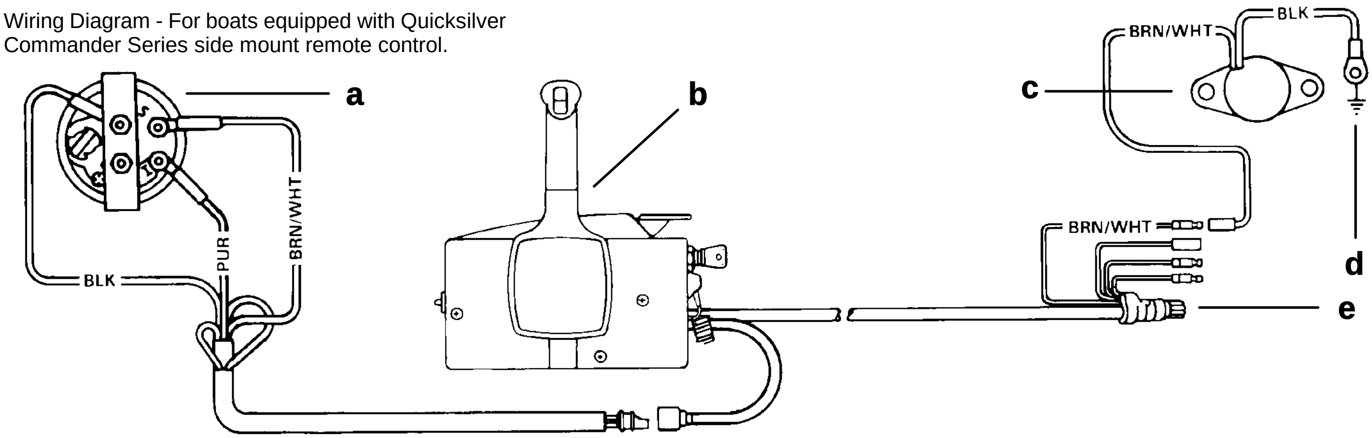
1. Turn ignition key to “RUN” position.
2. Tilt outboard to full “IN” position. Needle of trim indicator gauge should be in full “IN” position.
3. If not, tilt outboard to full “OUT” position to gain access to trim sender and engage tilt lock lever.
4. Loosen trim sender screws and reposition trim sender.
5. Tighten trim sender screws.



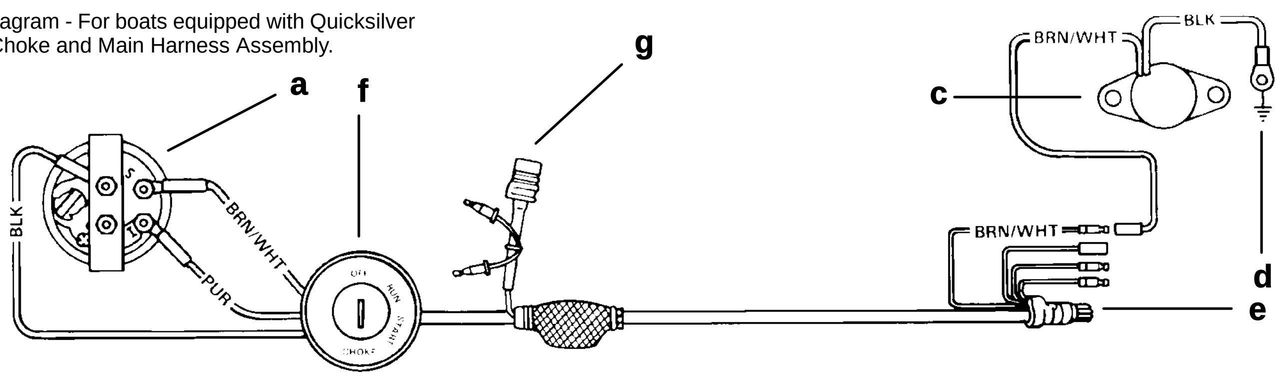
a - Trim Sender
b - Screws, loosen to rotate sender
c - Turn sender **counterclockwise** to raise needle reading
d - Turn sender **clockwise** to lower needle reading
e - Tilt lock lever

Trim Indicator Wiring Diagrams

Wiring Diagram - For boats equipped with Quicksilver Commander Series side mount remote control.



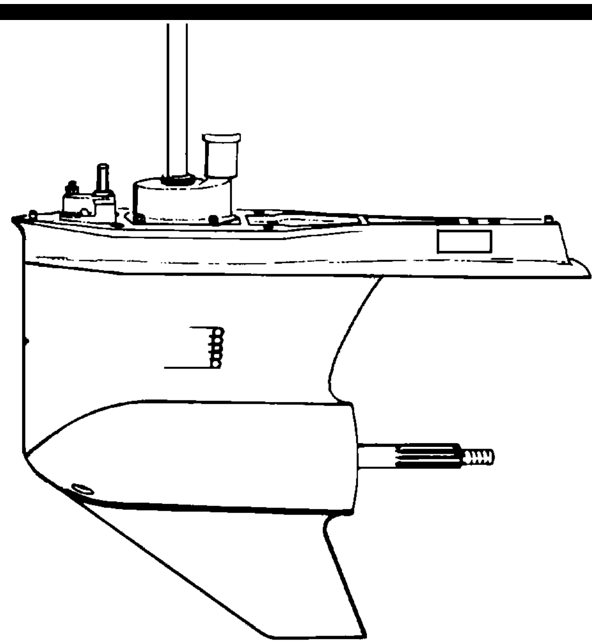
Wiring Diagram - For boats equipped with Quicksilver Ignition/Choke and Main Harness Assembly.



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



6
A

GEAR HOUSING
RIGHT HAND OPERATION
(STANDARD ROTATION)
(RATCHETING AND NON-RATCHETING)

Table of Contents

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s). It is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

Disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Table of Contents" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon on all O-rings. To prevent wear, apply 2-4-C w/Teflon on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver Perfect Seal or 2-4-C w/Teflon to external surfaces of bearing carrier and retainer nut threads prior to installation. DO NOT allow Perfect Seal to enter bearings or O-ring area.

NOTE: *Before filling gear case, apply 10-15 psi (68.5 – 102.7kPa) of air pressure at the VENT hole. Pressure should not drop for 15 seconds while alternately applying a 2-3 pound force to the top of the shift shaft in the fore and aft direction.*

Gear Housing Specifications (Standard Rotation)

Forward/Reverse Gear Backlash and Pinion Depth (Ratcheting and Non-Ratcheting)

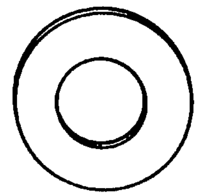
Pinion Depth	
All Models	0.025 in. (0.64mm) with Tool 91-12349A2 Using Disc #2 and Flat #4
Forward Gear Backlash	
1.64:1and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-53549
Reverse Gear Backlash	
1.64:1and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.030 in. to 0.050 in. (0.76mm to 1.27mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)
Forward Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-78473
Reverse Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.030 in. to 0.050 in. (0.76mm to 1.27mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)

Gear Ratio	Teeth in Pinion Gear	Teeth in Forward and Reverse Gear
1.62:1	13	21
1.64:1	17	28
1.75:1	12	21
1.87:1	15	28

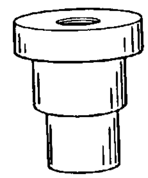
Water Pressure	
Idle	1-1/2 – 4-1/2 psi (10.3 – 30.8kPa)
Poppet Valve Opening	6 – 7 psi (41.1 – 47.9kPa)
W.O.T.	8-10 psi 54.9 – 68.5kPa)
Test Propeller for Static Test	
12 Dia. x 15 Pitch	48-78116A40

Special Tools (Ratcheting and Non-Ratcheting)

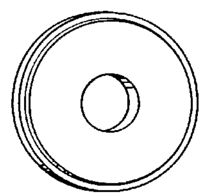
Bellville Washer 12-54048



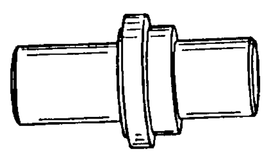
Needle Bearing Driver 91-15755



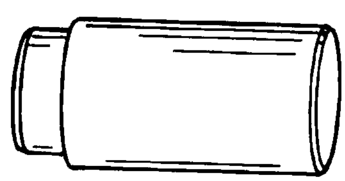
Bearing Driver Cup 91-31106



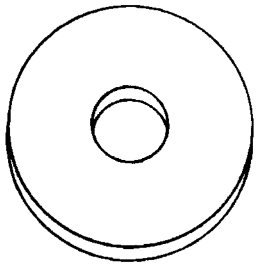
Oil Seal Driver 91-31108



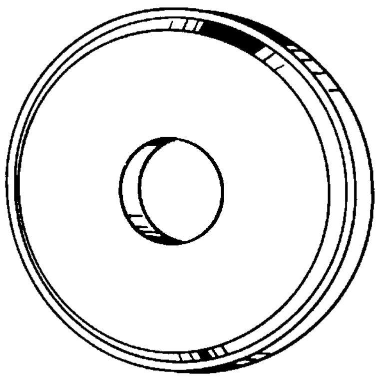
Needle Bearing Driver 91-33491



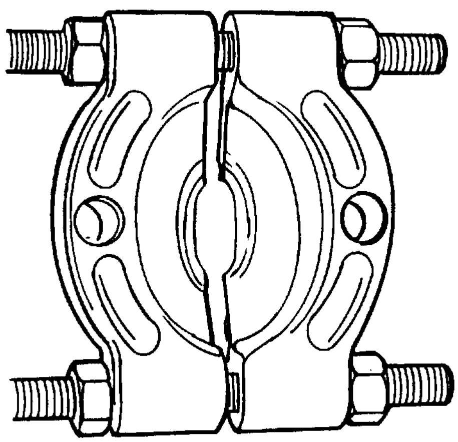
Pilot Washer 91-36571



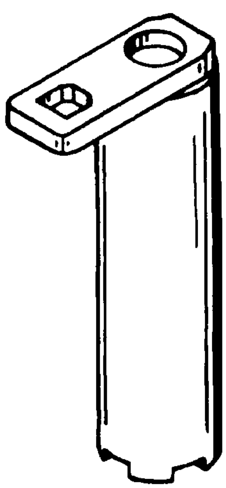
Driver Cup 91-36577



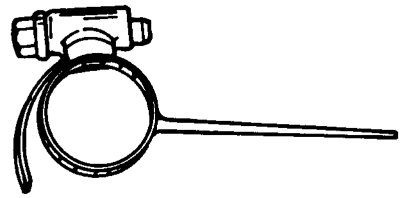
Universal Puller Plate 91-37241



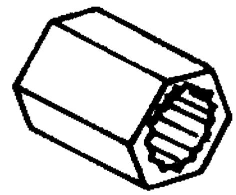
Bearing Retainer Tool 91-43506



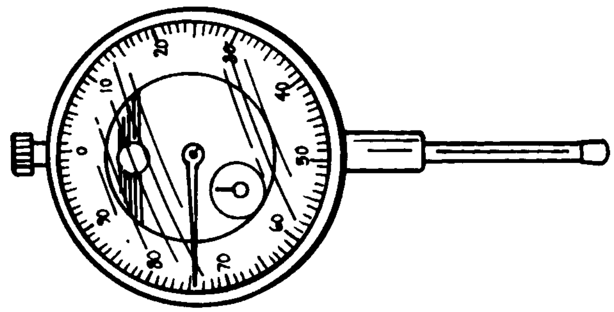
Backlash Indicator Rod 91-53459



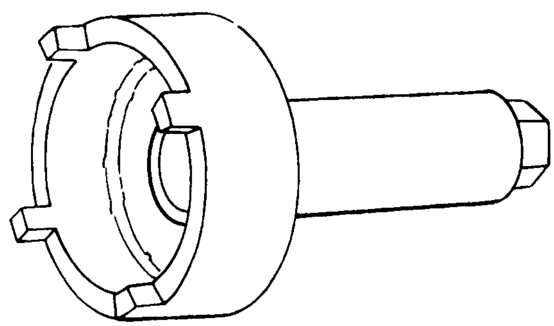
Drive Shaft Nut Wrench 91-56775



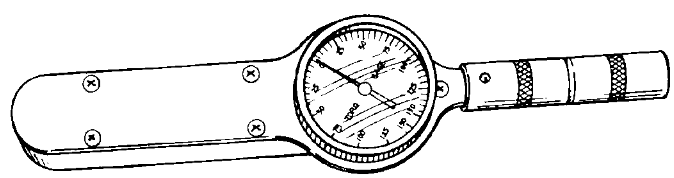
Dial Indicator 91-58222A1



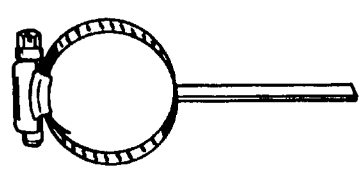
Bearing Carrier Retainer Wrench 91-61069



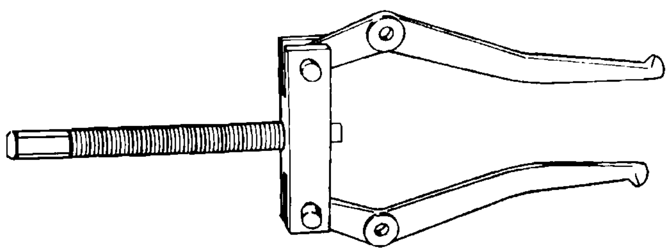
Torque Wrench (lb. in.) 91-66274



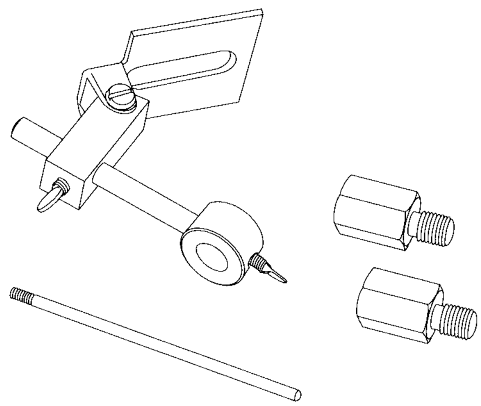
Backlash Indicator Rod 91-78473



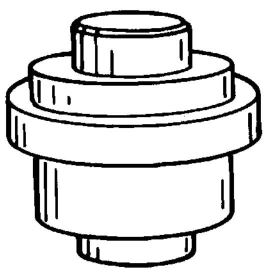
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



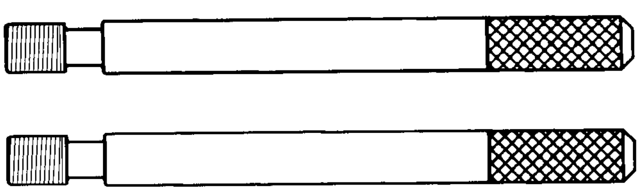
Dial Indicator Holding Tool 91-83155



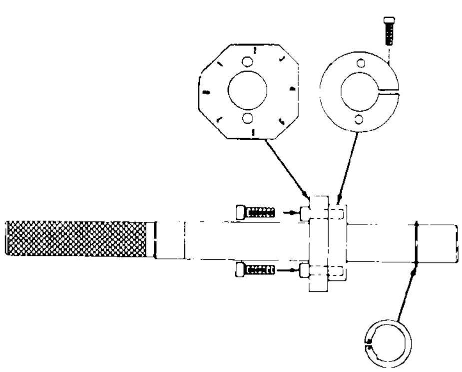
Oil Seal Driver 91-817569



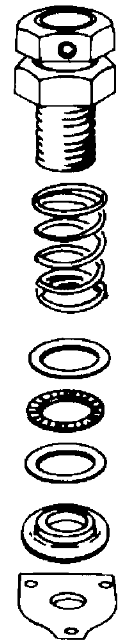
Water Pump Alignment Pins 91-82157A1



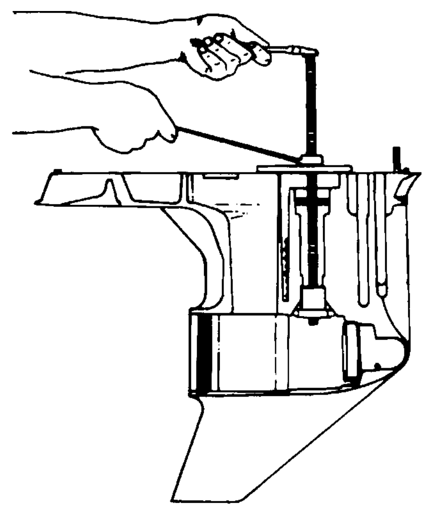
Pinion Gear Shimming Tool 91-12349A2



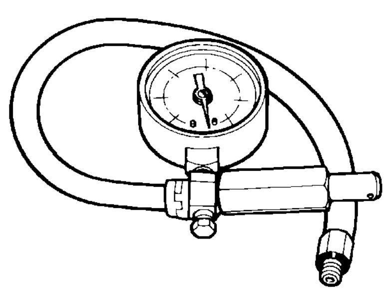
Bearing Preload Tool 91-14311A2



Bearing Removal and Installation Tool 91-31229A7 – Includes Driver Head 91-36569: Driver Head Rod 91-37323; Nut 11-24156; Pilot Washer 91-36571; Pilot Plate 91-29610; Puller/Driver Head 91-38628; Mandrel 91-30366; Plate 91-29310; Driver Head 91-32325; Puller Shaft 91-31229; Washer 91-34961.

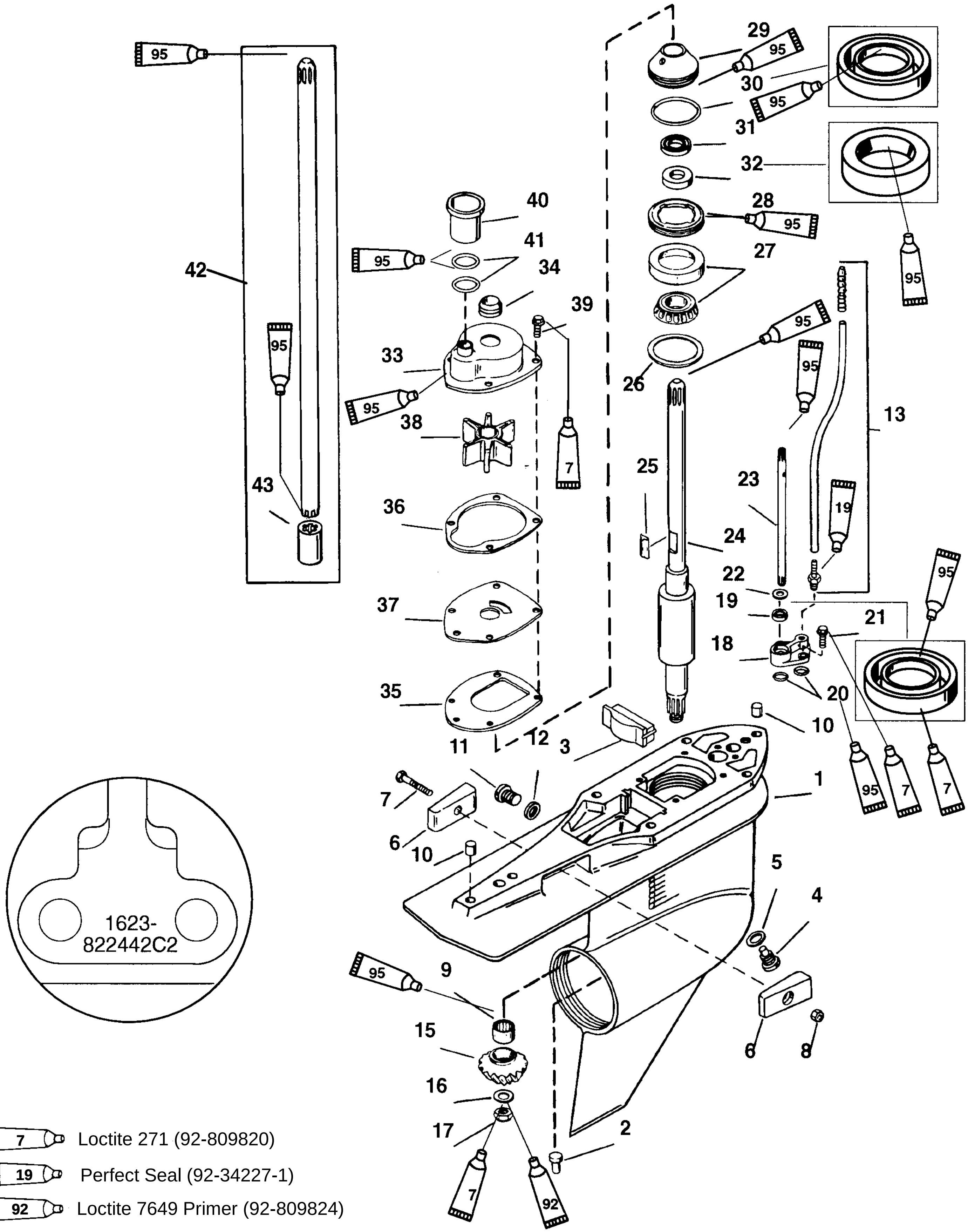


Leakage Tester FT8950



Notes:

Gear Housing (Drive Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

92 Loctite 7649 Primer (92-809824)

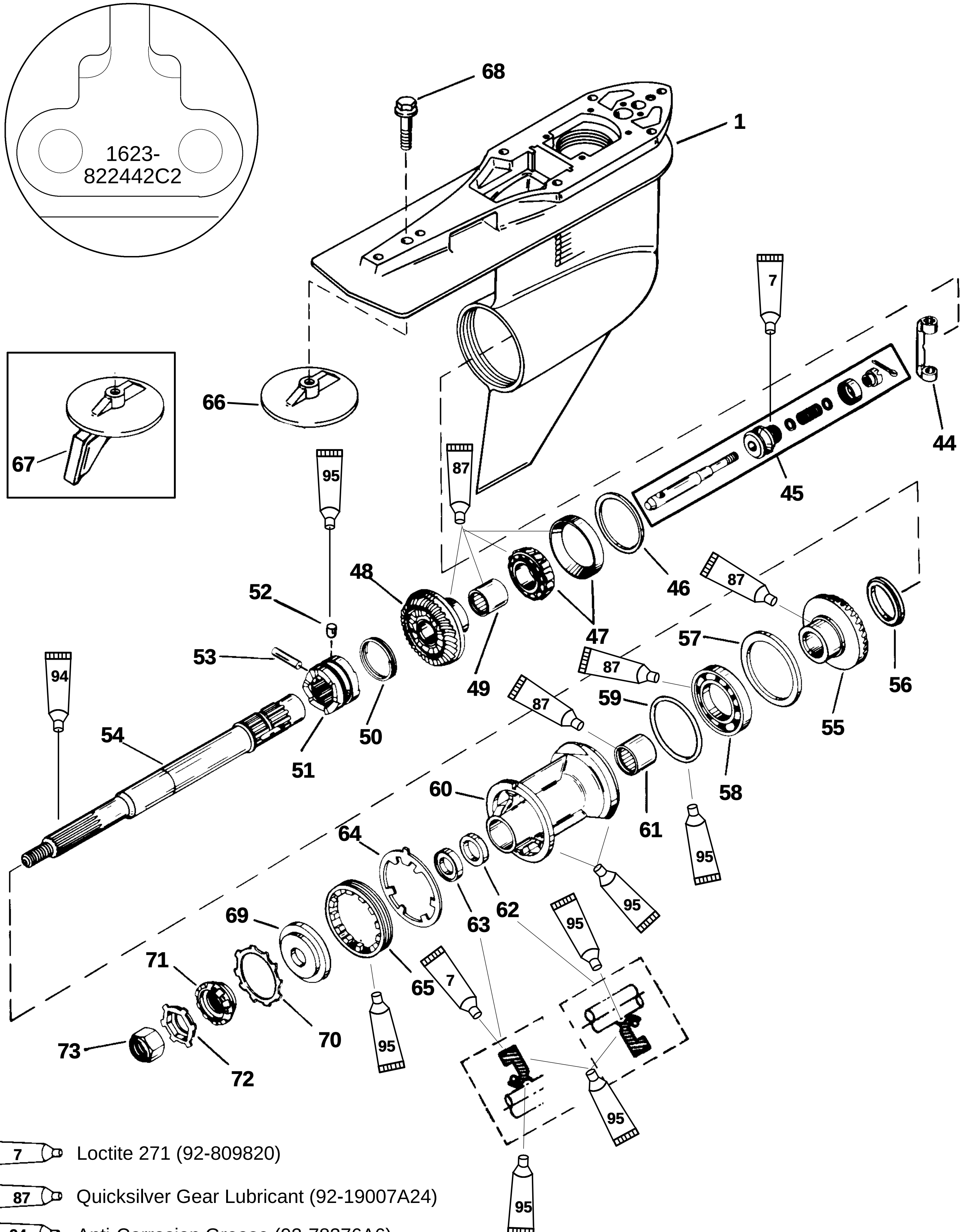
95 2-4-C With Teflon (92-825407A12)

Gear Housing (Drive Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW			
8	1	NUT	60		6.8
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR **(LONG/X-LONG)**			
14	1	CONNECTOR **(XX-LONG)**			
15	1	PINION GEAR (Part of 43-826181A2 – 1.75:1 or 43-828072A2 – 1.62:1)			
16	1	WASHER			
17	1	NUT		75	101
18	1	BUSHING ASSEMBLY			
19	1	OIL SEAL			
20	2	O RING			
21	2	SCREW	60		6.8
22	1	RUBBER WASHER			
23	1	SHIFT SHAFT (LOWER)			
24	1	DRIVE SHAFT (LOWER)			
25	1	KEY			
26	AR	SHIM			
27	1	TAPERED ROLLER BEARING			
28	1	RETAINER		100	135
29	1	CARRIER ASSEMBLY			
30	1	O RING			
31	1	OIL SEAL			
32	1	OIL SEAL			
33	1	WATER PUMP ASSEMBLY			
34	1	SEAL			
35	1	GASKET			
36	1	GASKET			
37	1	FACE PLATE			
38	1	IMPELLER			
39	4	SCREW	60		6.8
40	1	COUPLING ASSEMBLY			
41	2	O RING			
42	1	DRIVESHAFT KIT **(LONG-20 IN.)** **SEE NOTE**			
	1	DRIVESHAFT KIT **(X-LONG-25 IN.)** **13 SPLINES**			
	1	DRIVESHAFT KIT **(XX-LONG-30 IN.)**			
	1	DRIVESHAFT KIT **(LONG-20 IN.)** **SEE NOTE**			
	1	DRIVESHAFT KIT **(X-LONG-25 IN.)** **8 SPLINES**			
	1	DRIVESHAFT KIT **(XX-LONG-30 IN.)**			
43	1	COUPLING			

NOTE: *Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 24 & 42.*

Gear Housing (Prop Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-19007A24)

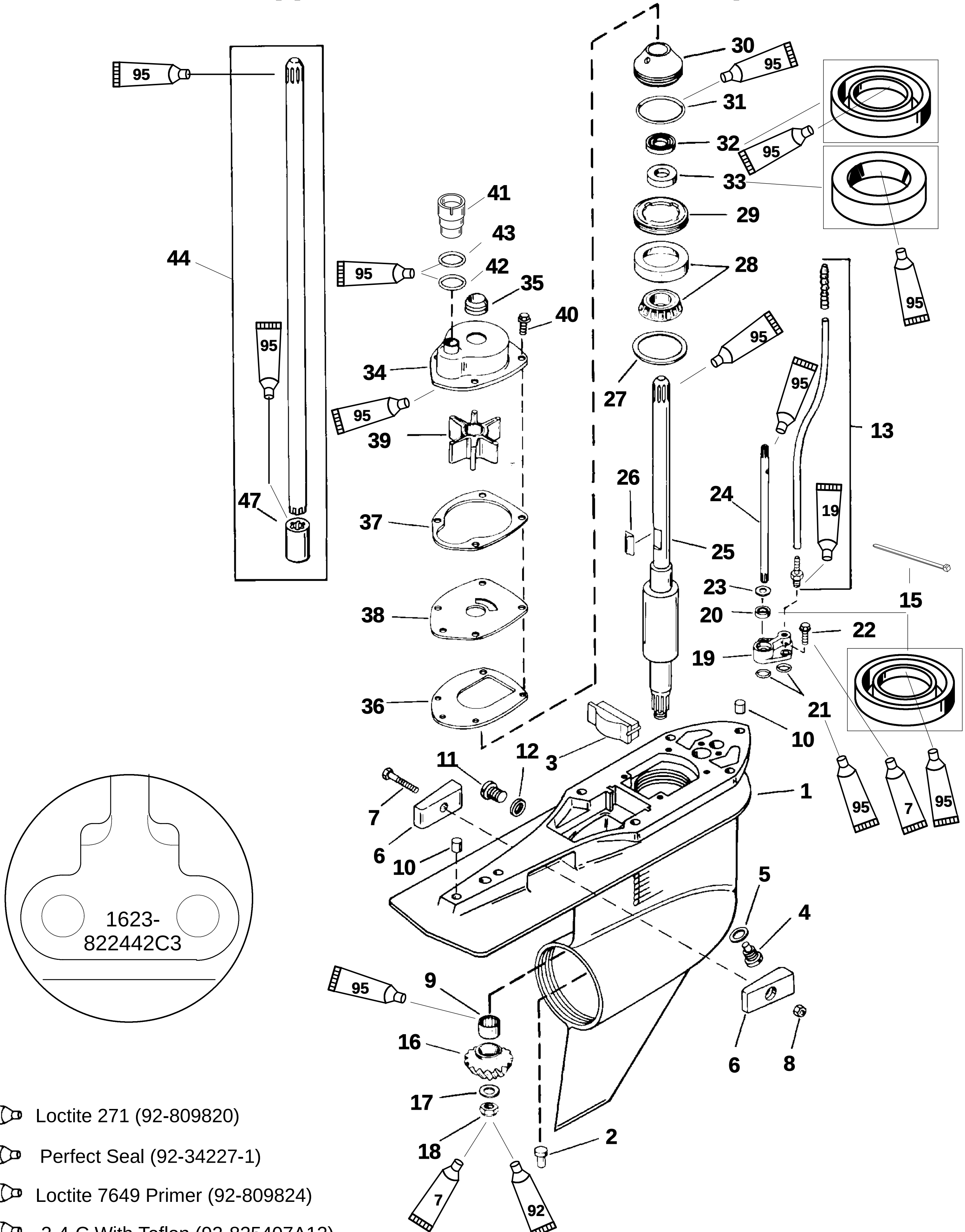
94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
44	1	SHIFT CRANK			
45	1	SHIFT SPOOL KIT			
46	AR	SHIM			
47	1	TAPERED ROLLER BEARING **(USE WITH 1623-822442C2 CASTING)**			
	1	TAPERED ROLLER BEARING **(USE WITH 1623-822442C3 CASTING)**			
48	1	FORWARD GEAR SET (Includes Pinion Gear)**(1.75:1 GEAR RATIO)**			
	1	FORWARD GEAR **(NOTE: THIS COMPLETE GEAR SET IS A 1.62:1 GEAR RATIO REPLACING A 1.64:1 GEAR RATIO)**			
49	1	ROLLER BEARING			
50	1	SPRING			
51	1	SLIDING CLUTCH			
52	1	DETENT PIN			
53	1	CROSS PIN			
54	1	PROPELLER SHAFT			
55	1	REVERSE GEAR **(1.75:1 GEAR RATIO)**			
	1	REVERSE GEAR **(1.64:1 GEAR RATIO)**			
	1	REVERSE GEAR **(1.62:1 GEAR RATIO)(PART OF 43-828072A2)**			
56	1	THRUST SPACER			
57	1	THRUST RING			
58	1	BALL BEARING			
59	1	O RING			
60	1	BEARING CARRIER			
61	1	ROLLER BEARING			
62	1	OIL SEAL (INSIDE)			
63	1	OIL SEAL (OUTSIDE)			
64	1	TAB WASHER			
65	1	RETAINER		210	285
66	1	ANODIC PLATE			
67	1	TRIM TAB **(BLACK ALUMINUM)**			
	1	TRIM TAB **(ANODIC)** **THESE REPLACEMENT**			
68	1	SCREW **PARTS ARE NOT**		40	54.0
69	1	THRUST HUB **INCLUDED WITH**			
70	1	LOCKWASHER **COMPLETE GEAR**			
71	1	WASHER **HOUSING REPLACEMENT**			
72	1	TAB WASHER			
73	1	PROPELLER NUT		55	75.0

Gear Housing (Drive Shaft)(Standard Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

92 Loctite 7649 Primer (92-809824)

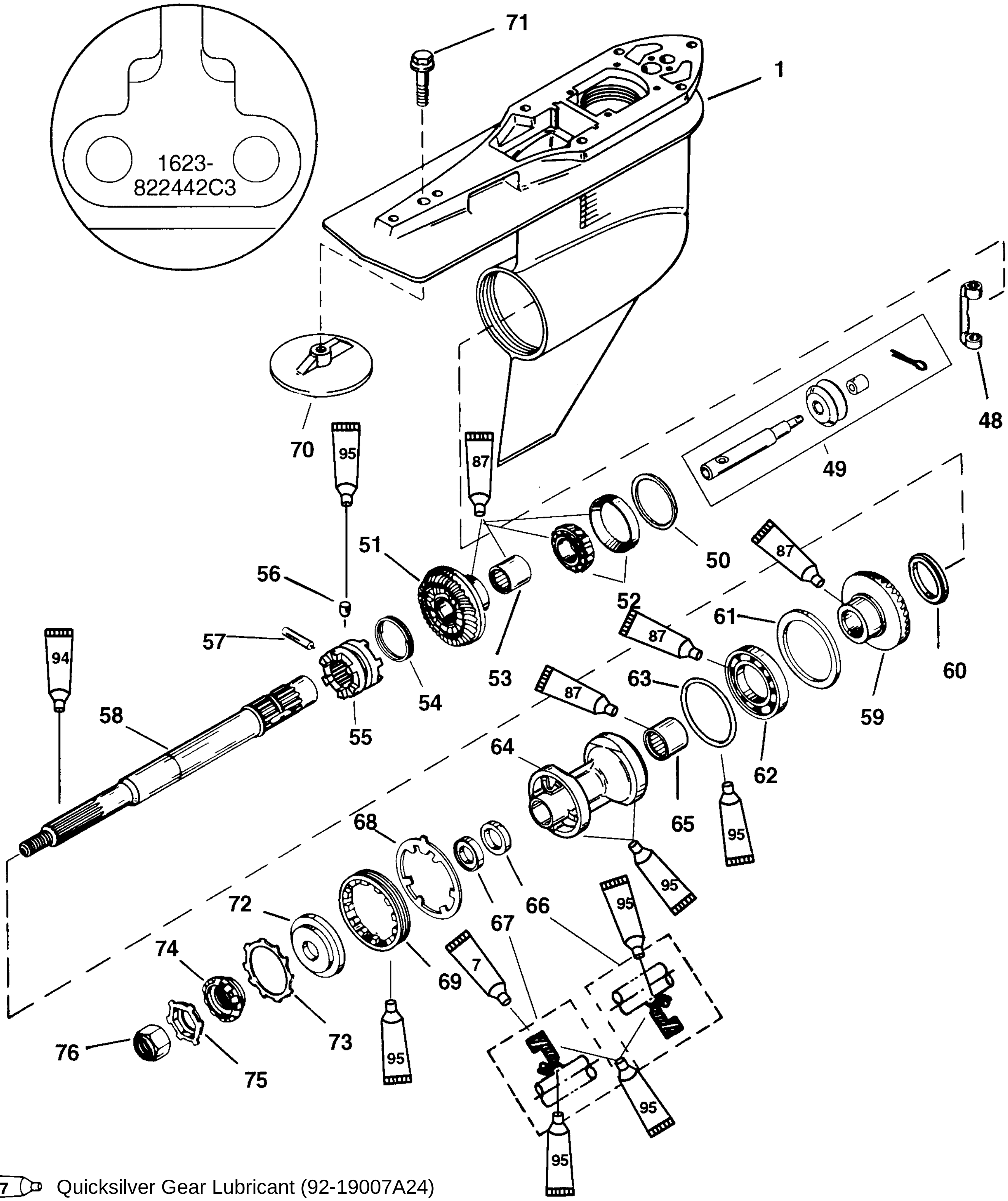
95 2-4-C With Teflon (92-825407A12)

Gear Housing (Drive Shaft)(Standard Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW ASSEMBLY	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR **(L/XL)**			
14	1	CONNECTOR **(XXL)**			
15	1	CABLE TIE			
16	1	PINION GEAR (Part of 43-828168A2)			
17	1	WASHER			
18	1	NUT		75	101
19	1	BUSHING ASSEMBLY			
20	1	OIL SEAL			
21	2	O RING			
22	2	SCREW	60		6.8
23	1	RUBBER WASHER			
24	1	SHIFT SHAFT (LOWER)			
25	1	DRIVE SHAFT (LOWER)			
26	1	KEY			
27	AR	SHIM			
28	1	TAPERED ROLLER BEARING			
29	1	RETAINER		100	135
30	1	CARRIER ASSEMBLY			
31	1	O RING			
32	1	OIL SEAL			
33	1	OIL SEAL			
34	1	WATER PUMP ASSEMBLY			
35	1	SEAL			
36	1	GASKET			
37	1	GASKET			
38	1	FACE PLATE			
39	1	IMPELLER			
40	4	SCREW	60		6.8
41	1	COUPLING ASSEMBLY			
42	1	O RING			
43	1	O RING			
44	1	DRIVESHAFT KIT **(LONG-20 IN.)**			
45	1	DRIVESHAFT KIT **(X-LONG-25 IN.)** **SEE NOTE**			
46	1	DRIVESHAFT KIT **(XX-LONG-30 IN.)**			
47	1	COUPLING			

NOTE: *Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 25 & 44/45/46.*

Gear Housing (Prop Shaft)(Standard Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)



87 Quicksilver Gear Lubricant (92-19007A24)

94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft)(Standard Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
48	1	SHIFT CRANK			
49	1	SHIFT SPOOL KIT			
50	AR	SHIM			
51	1	FORWARD GEAR SET (Includes Pinion Gear)			
52	1	TAPERED ROLLER BEARING			
53	1	ROLLER BEARING			
54	1	SPRING			
55	1	SLIDING CLUTCH			
56	1	DETENT PIN			
57	1	CROSS PIN			
58	1	PROPELLER SHAFT			
59	1	REVERSE GEAR			
60	1	THRUST SPACER			
61	1	THRUST RING			
62	1	BALL BEARING			
63	1	O RING			
64	1	BEARING CARRIER			
65	1	ROLLER BEARING			
66	1	OIL SEAL (INSIDE)			
67	1	OIL SEAL (OUTSIDE)			
68	1	TAB WASHER			
69	1	RETAINER		210	285
70	1	ANODIC PLATE **THESE**			
71	1	SCREW **PARTS ARE NOT**		40	54.0
72	1	THRUST HUB **INCLUDED WITH**			
73	1	LOCKWASHER **COMPLETE GEAR**			
74	1	WASHER **HOUSING REPLACEMENT**			
75	1	TAB WASHER			
76	1	PROPELLER NUT		55	75.0

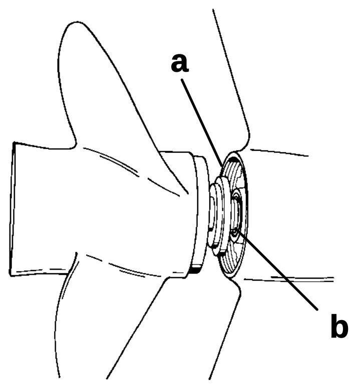
Removal, Disassembly, Cleaning and Inspection – Standard Rotation (Ratcheting and Non-Ratcheting)

REMOVAL

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from drive shaft housing.

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



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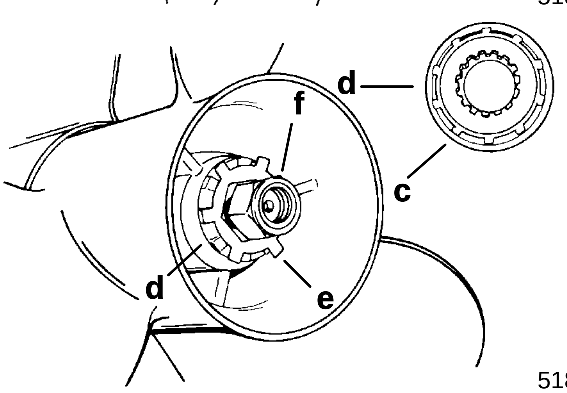
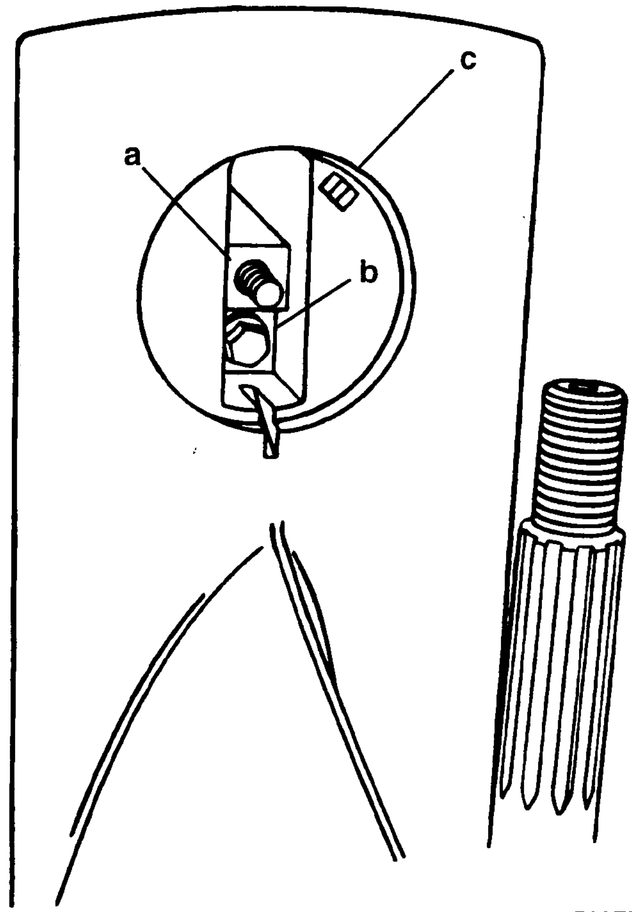


51871

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

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of drive shaft housing. While holding trim tab securely, unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

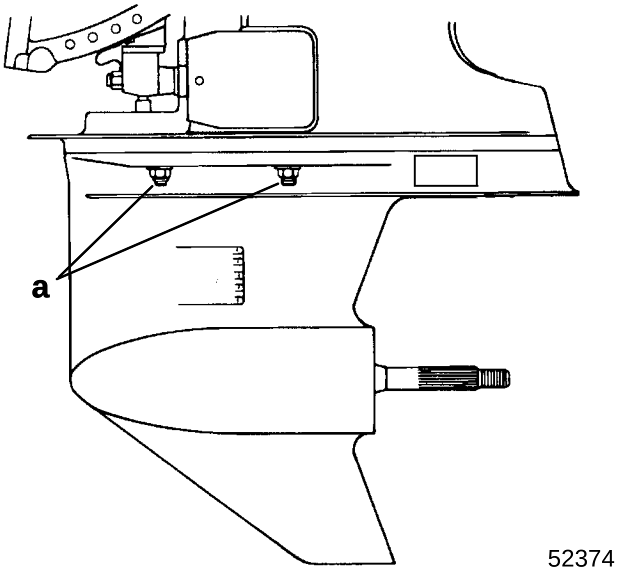


52375

a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Ribs – Align Carefully with Trim Tab while Securing Tab

7. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or drive shaft housing could be damaged.)
8. Pull gear housing away from drive shaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)

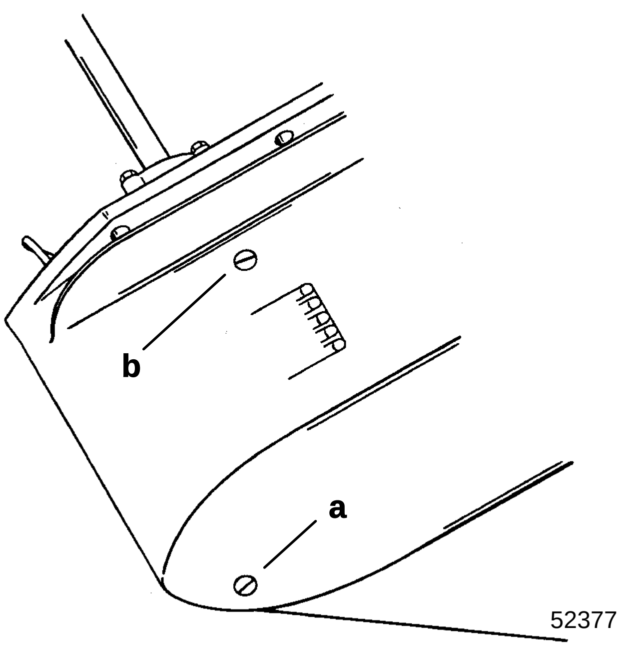
9. Pull gear housing from drive shaft housing.



a - Side Mounting Locknut (2 Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the drive shaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing. Do not loose sealing washers on Fill and Vent screws.



a - "Fill" Screw
b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

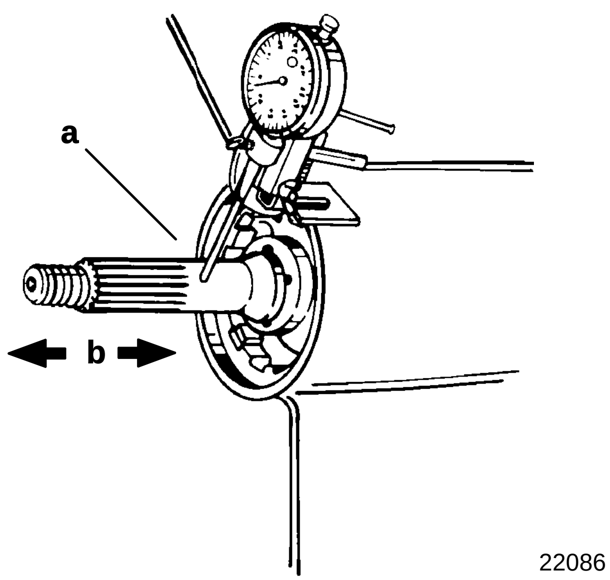
NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*

Pre-Disassembly Inspection

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
   a. Position the dial indicator on the propeller shaft.
   b. Push the propeller shaft to one side and zero the dial indicator.
   c. Move the propeller shaft to the opposite side while observing the dial indicator. Without rotating the propeller shaft, reposition the dial indicator and check the up and down deflection. A shaft deflection of more than 0.003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
   a. Rotate the propeller shaft while observing the dial indicator. If the deflection is more than 0.010 in. (0.25mm), a bent propeller shaft is indicated.
3. Measure propeller shaft end play. If it is in excess of 0.045 in. (1.14mm), disassemble gear case and check condition of the reverse shoulder of the propeller shaft, reverse gear and thrust washer. Replace components as required.



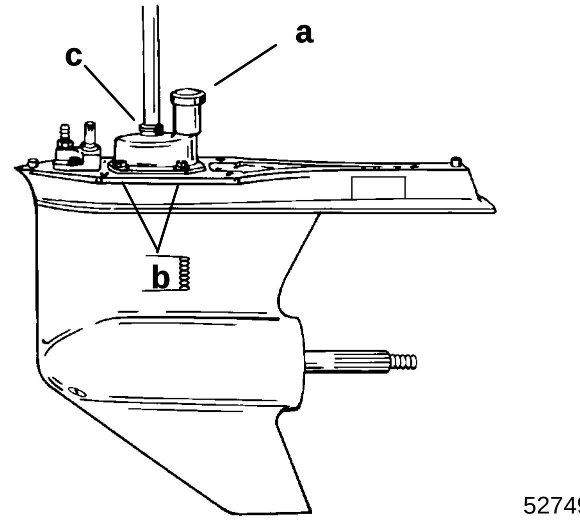
a - Prop Shaft Runout
b - Prop Shaft End play

Gear Housing and Component Disassembly

Water Pump Assembly

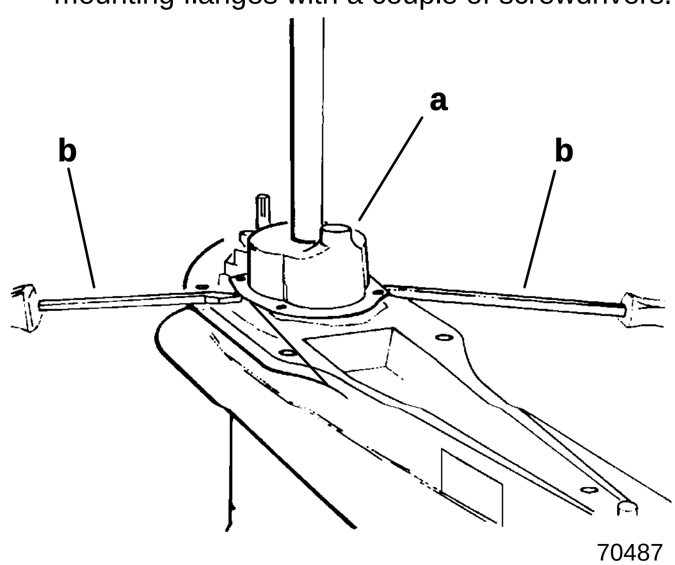
REMOVAL

1. Remove the water seal, water tube coupling assembly, and the water pump screws.



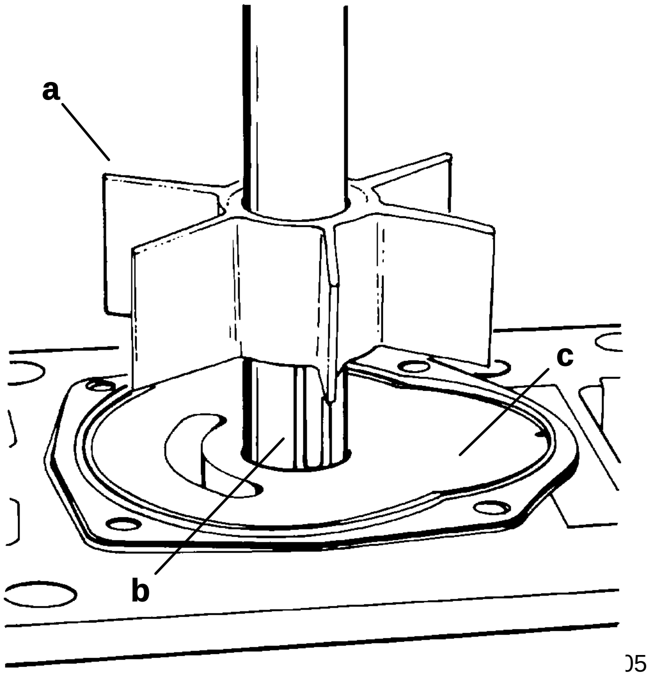
a - Water Tube Assembly
b - Water Pump Screws (4)
c - Seal

2. Carefully slide the water pump straight up off of the drive shaft. It may be necessary to encourage the water pump up by gently prying up on its mounting flanges with a couple of screwdrivers.



a - Water Pump Body
b - Screw Drivers

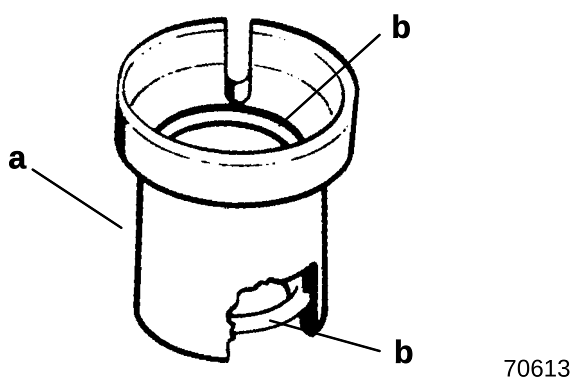
3. Remove the impeller, impeller key, the face plate and gaskets, (discard the gaskets).



a - Impeller
b - Impeller Key
c - Water Pump Face Plate and Gaskets (One on each side of the face plate)

WATER PUMP ASSEMBLY - Component Inspection

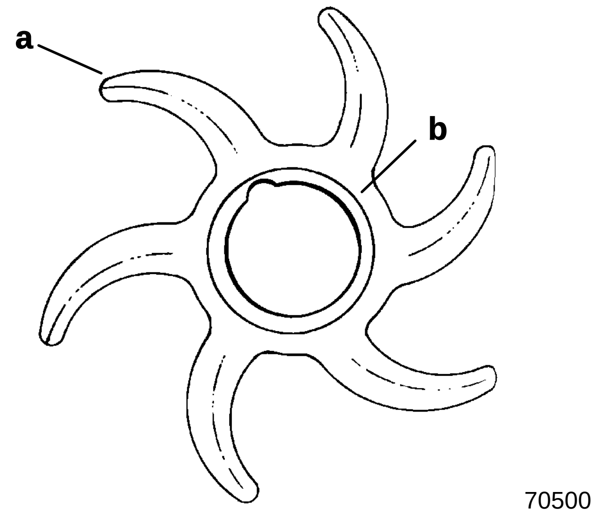
1. Inspect the water tube coupling assembly for wear or damage. If necessary replace the worn or damaged components especially the two O-rings on the inside, one at the top and one at the bottom.



a - Water Tube adapter
b - O-rings (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.

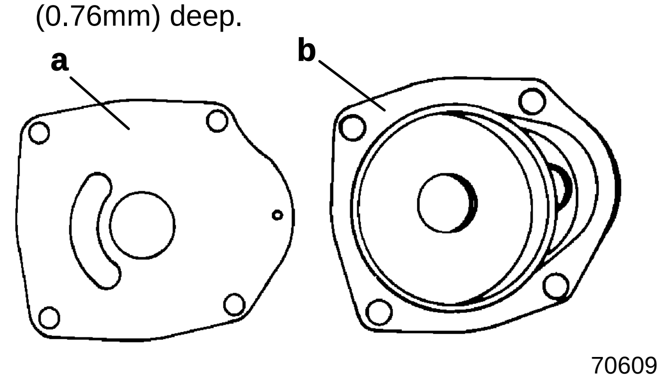


a - Impeller
b - Hub

4. Inspect the impeller blades to see if they are cracked, burnt, hard or deformed. Replace the impeller if the blades are in this condition.

IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate. The depth of the groove will not affect water pump output.

5. Replace cover if thickness of steel at the discharge slot is 0.060 in. (1.5mm) or less or if grooves (other than impeller sealing bead groove) in cover roof are more than 0.030 in. (0.76mm) deep.



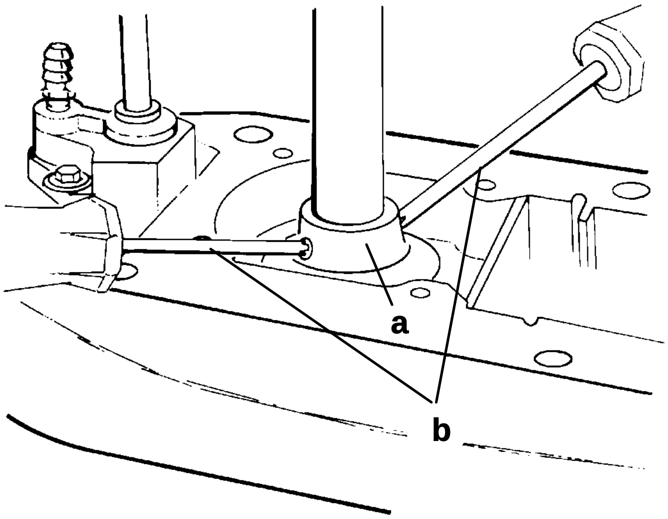
a - Water Pump Face Plate
b - Water Pump Cover

6. Inspect the water pump face plate and the water pump interior for roughness and/or grooves. Replace the appropriate components if any are found.

Oil Seal Carrier Assembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screwdrivers.



70489

a - Oil Seal Carrier
b - Screwdrivers

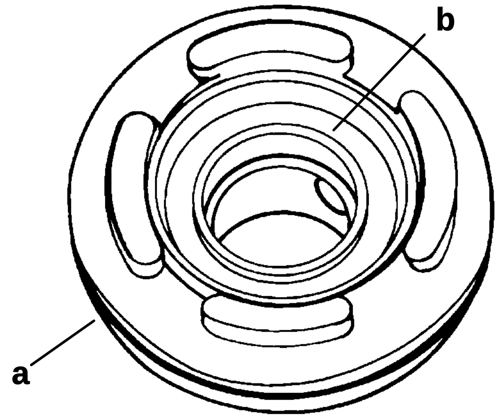
OIL SEAL CARRIER ASSEMBLY - Inspection

1. Inspect the oil seal carrier, O-ring, and seals for wear and/or damage. If necessary replace defective parts as outlined following.

OIL SEAL CARRIER ASSEMBLY - Component Disassembly

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

1. Remove the O-ring.



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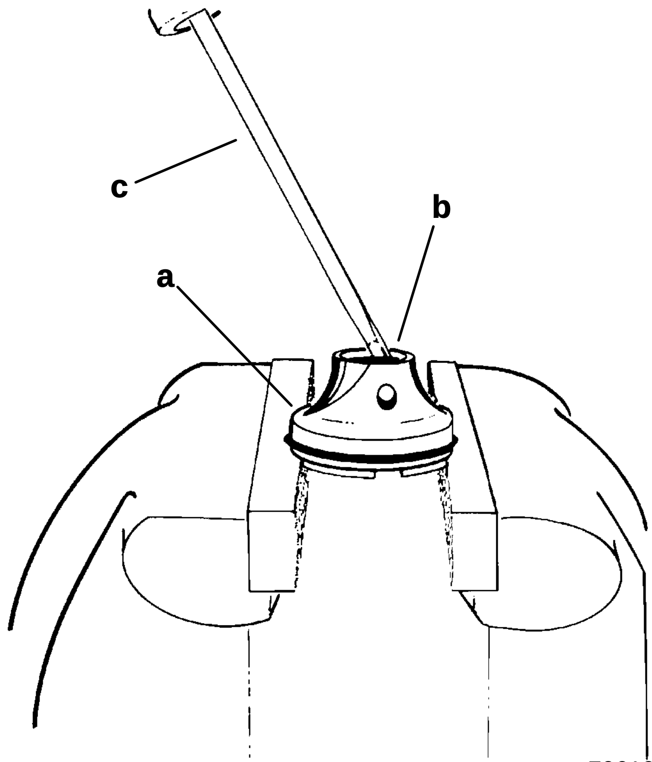
a - O-ring
b - Oil Seals (2)

2. Remove the oil seals.

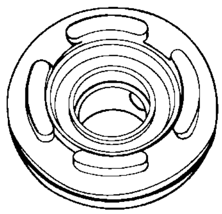


70610

a - Oil Seal Carrier
b - Oil Seals
c - Screwdriver

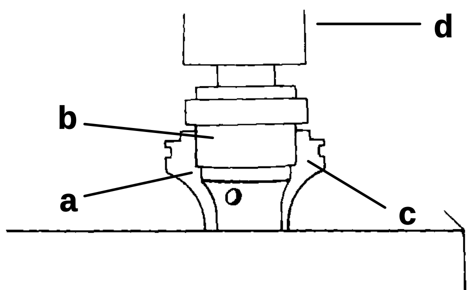
OIL SEAL CARRIER ASSEMBLY - Component Reassembly (1994/1995 MODELS)

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*



70501

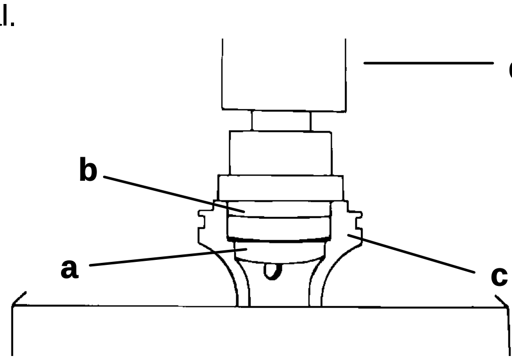
1. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.
2. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70611

a - Oil Seal
b - Oil Seal Driver (91-817569) use long end
c - Oil Seal Carrier
d - Press

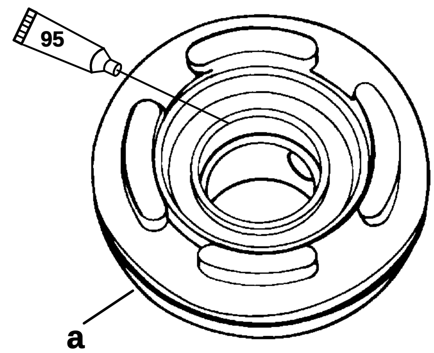
3. Assemble the large oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
4. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70612

a - Oil Seal
b - Oil Seal Driver (91-817569) use short end
c - Oil Seal Carrier
d - Press

5. Fill the area between the seal lips with 2-4-C w/Teflon. Apply 2-4-C w/Teflon to the O-ring.
6. Install the O-ring onto the oil seal carrier.



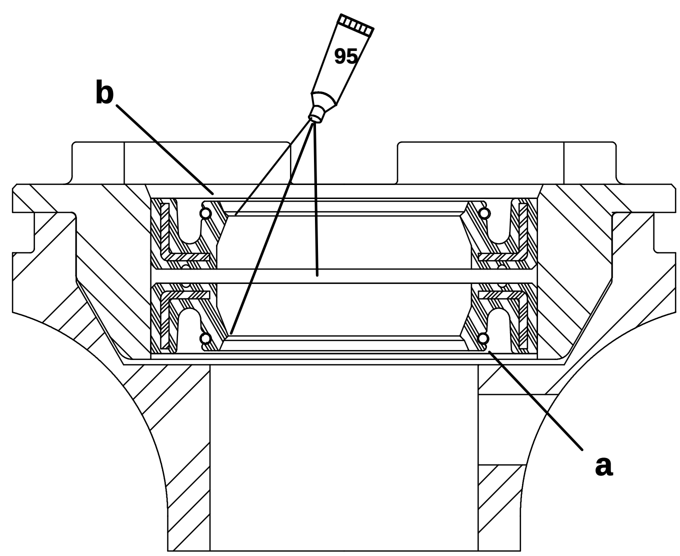
70501

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

a - O-ring

OIL SEAL CARRIER ASSEMBLY - Component Reassembly (96/97/98 MODELS)

The oil seals in 1996/1997 carrier assemblies are the same diameter. The bottom (first) seal lip faces down; the top (second) seal lip faces up. Apply 2-4-C Marine Lubricant to seal lips and between seals. Press seal into carrier with suitable mandrel. Second seal should be pressed in flush with carrier surface.



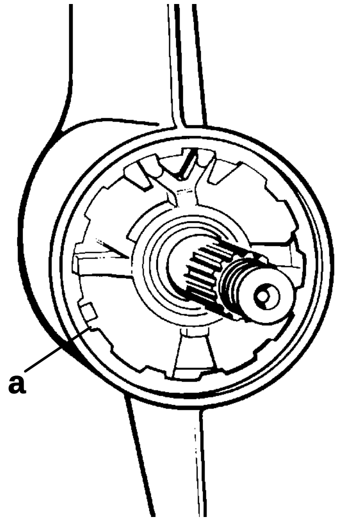
95 2-4-C With Teflon (92-825407A12)

a - Bottom Seal (Lip Faces Down)
b - Top Seal (Lip Faces Up)

Bearing Carrier Assembly

REMOVAL

1. Straighten the tab on the tab washer.



70490

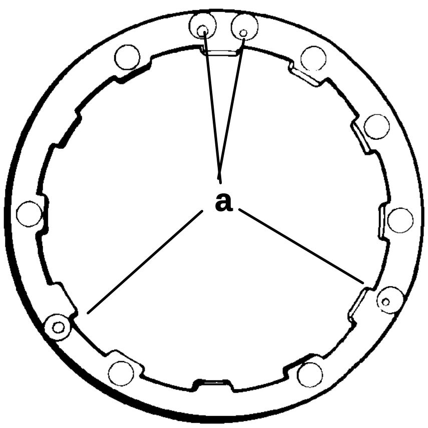
a - Tab on Tab Washer

2. Remove the bearing carrier retainer following step a or b as follows:

⚠ CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

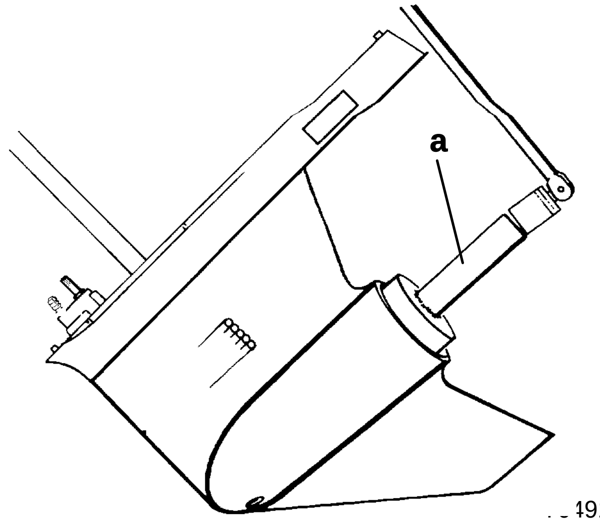
   a. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.



23356

a - Drilled Holes

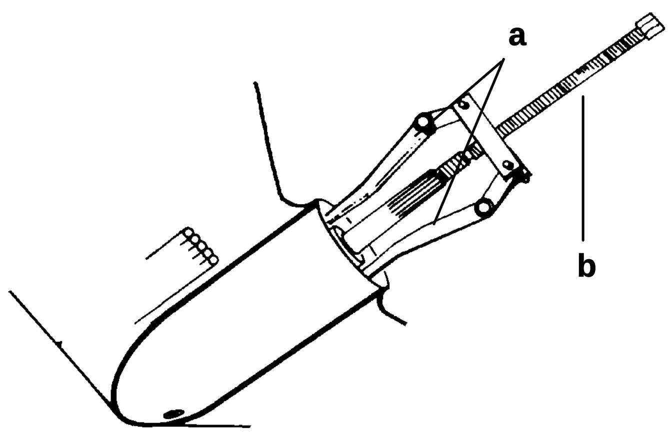
   b. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench (91-61069).



a - Bearing Carrier Retainer Wrench

3. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier. POSITION PULLER JAWS CLOSE TO BOSSES IN CARRIER.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



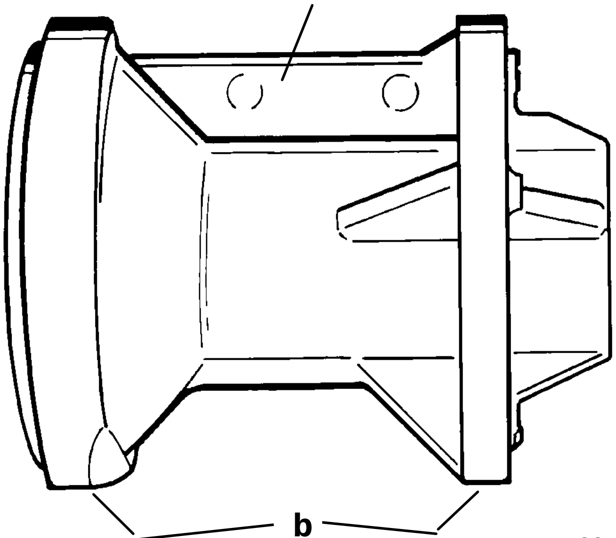
a - Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)

BEARING CARRIER ASSEMBLY - Inspection

1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.

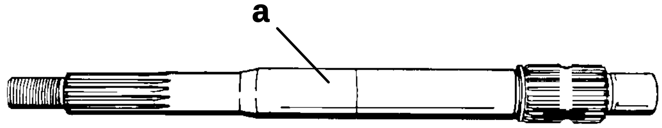
NOTE: *If any of the following items are found to be defective complete the appropriate instruction(s) in "Bearing Carrier Assembly", Component Disassembly and Inspection' section found on page 6A-22.*

2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident replace the carrier.



a - Bearing Carrier
b - Mating Surfaces

3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.

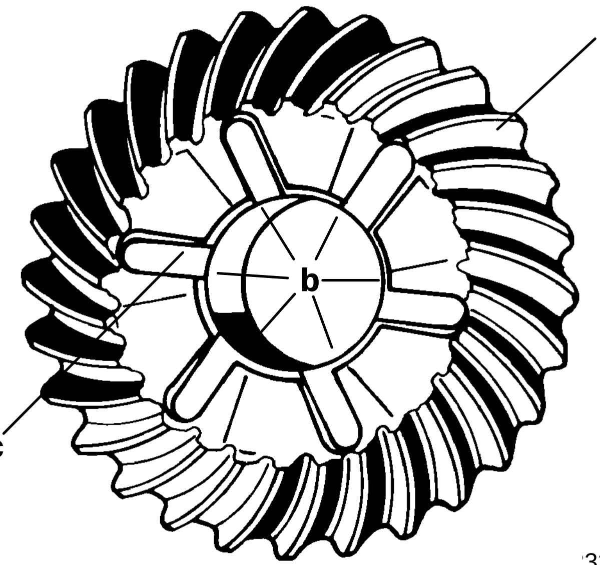


a - Propeller Shaft Bearing Contact Area

4. Inspect the reverse gear for pitted, chipped, broken teeth, hairline fractures, and excessive or uneven wear. Replace the gear if any defects are found.

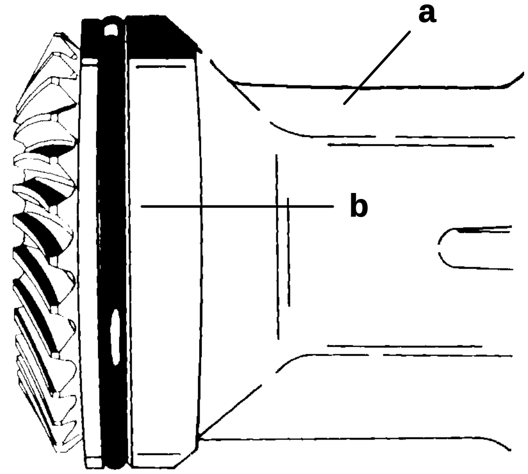
NOTE: *If outboard jumps out of gear, inspect not only clutch dog teeth on reverse gear but also thrust washer surface on reverse gear for excessive wear. Replace gear if wear is evident.*

5. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the gear if any are found.



a - Reverse Gear Teeth
b - Thrust Washer Surface
c - Clutch Jaws

6. Inspect the reverse gear bearing for excessive movement or roughness by rotating gear. Replace the bearing if either of these conditions exists.
7. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace carrier if any are found.
8. Remove the O-ring from the bearing carrier assembly.



a - Bearing Carrier
b - O-ring

   a. Inspect the O-ring for damage and or deterioration. Replace it if necessary.

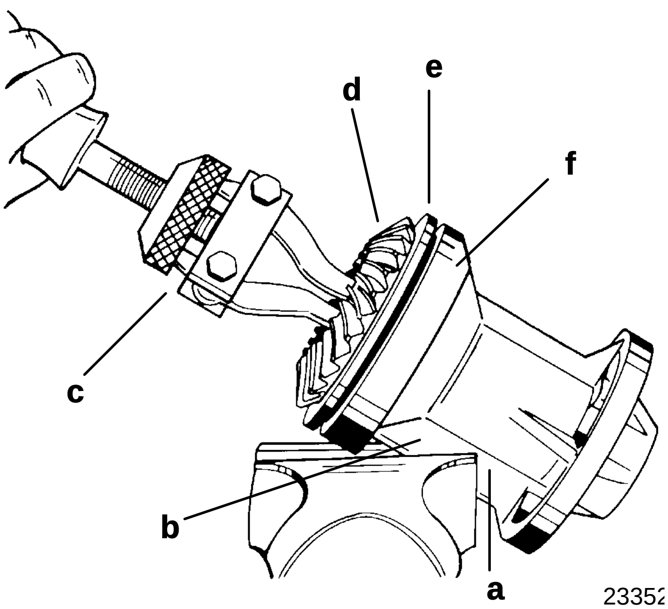
BEARING CARRIER ASSEMBLY - Component Disassembly and Inspection

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

⚠ CAUTION

Clamp onto the reinforcing rib of the bearing carrier ONLY, or damage to the carrier may result.

1. Place the bearing carrier in a vise, clamping on the reinforcing rib.
2. Remove the reverse gear, thrust ring, and bearing as an assembly, using a slide hammer puller.

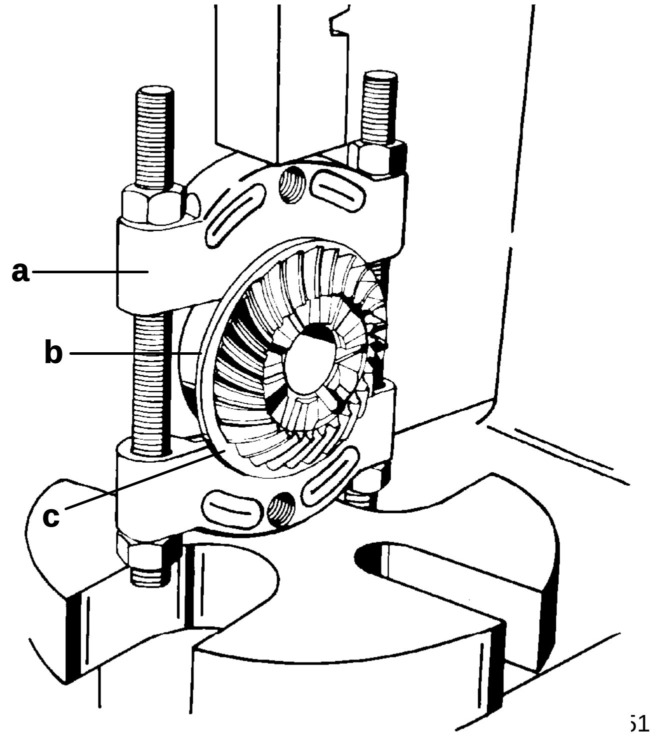


a - Bearing Carrier Reinforcing Rib
b - Bearing Carrier
c - Slide Hammer Puller (91-34569A1)
d - Reverse Gear
e - Thrust Hub
f - Bearing (not seen) - Located in the Carrier

3. Clean all components thoroughly with a suitable solvent and inspect them for damage and/or excessive wear. Replace any parts that are found to be defective.

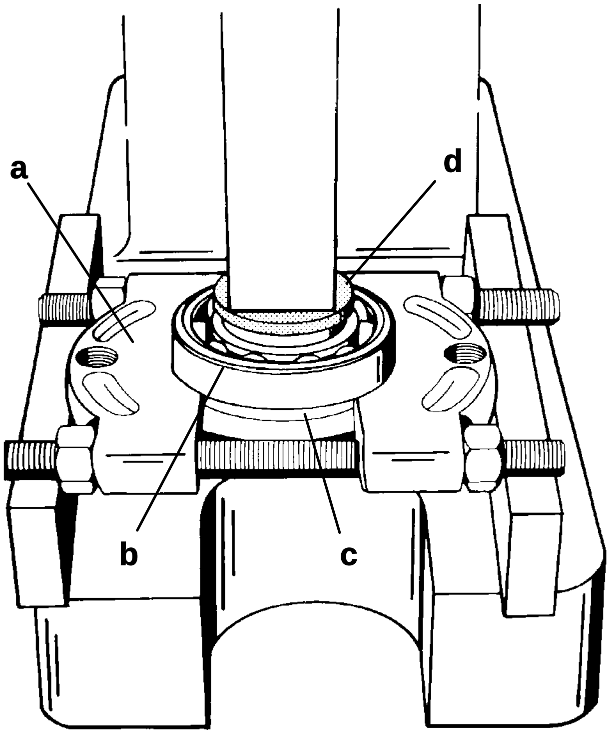
IMPORTANT: The bearing MUST BE replaced if removed from gear.

4. Place the universal puller plate between the thrust washer and bearing as shown and press on the plate until it bottoms.



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

5. Using a suitable mandrel and the universal puller plate to support the bearing, press the bearing from the reverse gear as shown.



23351

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

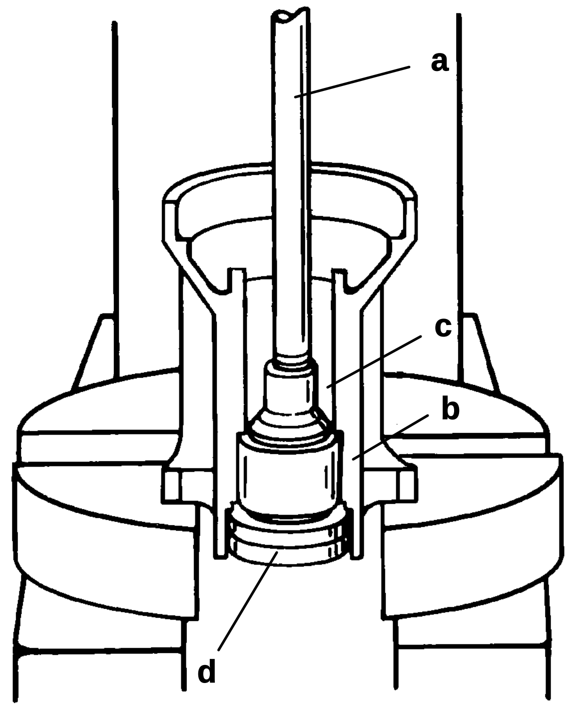
a. **<u>Discard the bearing.</u>**

b. Inspect the gear, and thrust washer for excessive wear, cracks, or damage. Replace the appropriate components if any of these conditions are found.

NOTE: *Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.*

6. Perform the following step a. or b. as necessary.

a. **If Replacing the Needle Bearing <u>and</u> Seals:** Remove the needle bearing and seals with the tools as shown.

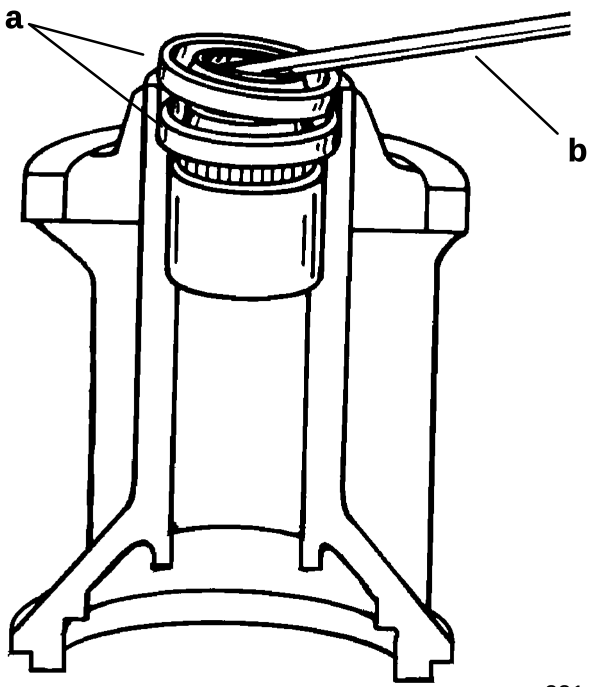


140

a - Bearing Driver Rod (91-37323)
b - Needle Bearing
c - Driver Head (91-36569)
d - Oil Seals

(1.) **<u>Discard the needle bearing and both seals.</u>**

b. **If Replacing the Seal Only:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier.



23140

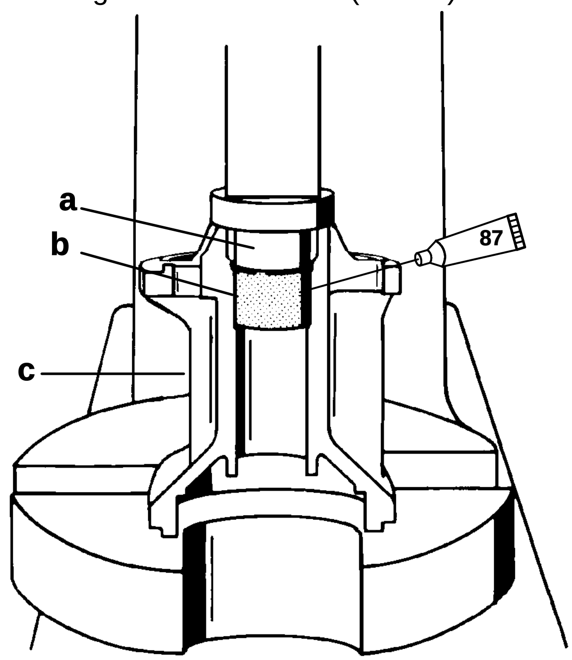
a - Oil Seals
b - Pry Bar

(1.) **Discard both of the seals.**

BEARING CARRIER ASSEMBLY Component reassembly

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lubricate the bore that the needle bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).
3. Assemble the needle bearing (with the numbered end of the bearing towards the driver shoulder), onto the driver.
4. Press the needle bearing into the bearing carrier until the driver bottoms out on the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.



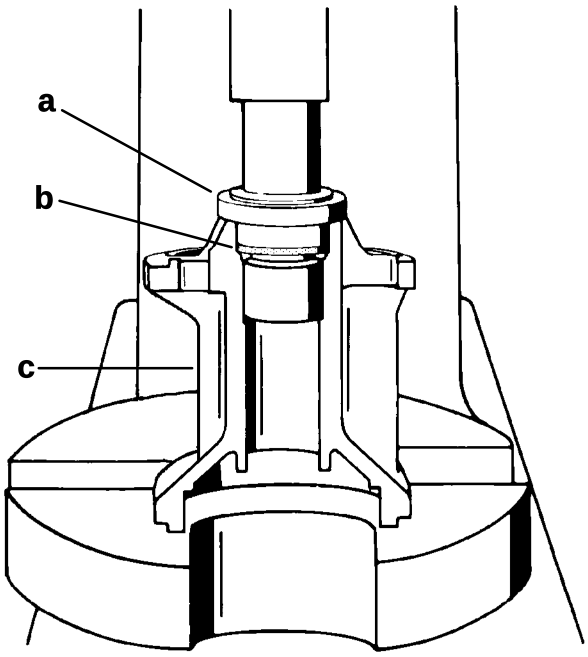
50315

87 Quicksilver Gear Lubricant (92-19007A24)

a - Needle Bearing Driver (P/N 91-15755)
b - Needle Bearing
c - Bearing Carrier

5. **Thoroughly clean** the bore in which the first seal is to be pressed.
6. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.

7. Press on the oil seal driver until the driver bottoms onto the aft face of the bearing carrier.

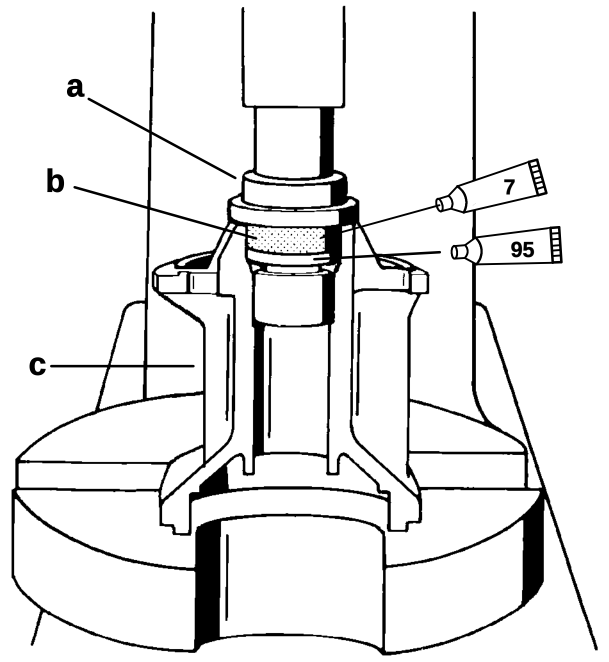


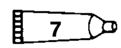
a - Oil Seal Driver (91-31108)
b - Oil Seal
c - Bearing Carrier

8. Apply a thin film of Loctite 271 (92-809820) to the outer diameter of the second seal.

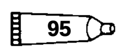
9. Assemble the second seal (with the lips of the seal facing the driver shoulder) onto the short end of the driver.

10. Press the oil seal with the driver until the driver bottoms out on the bearing carrier.





Loctite 271 (92-809820)



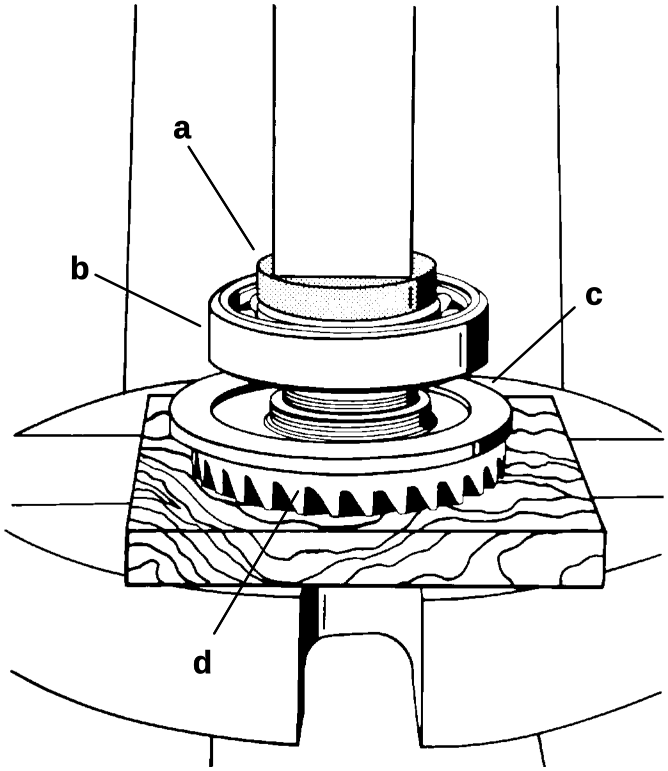
2-4-C With Teflon (92-825407A12)

a - Driver (short end)
b - Oil Seal (lips toward driver shoulder)
c - Bearing Carrier

11. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.

12. Lubricate the seal lips and fill the area between the seals with 2-4-C w/Teflon (92-825407A12).

13. Install the thrust washer and **a new ball bearing** onto the reverse gear. Press on the inner race of the ball bearing using the pilot washer until the bearing bottoms out on the gear.

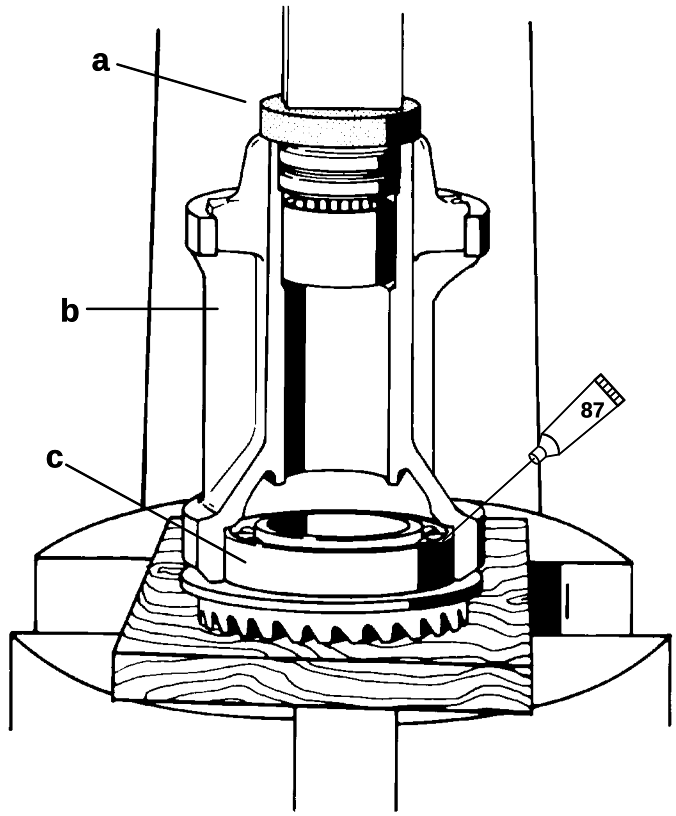


23346

a - Pilot Washer (P/N 91-36571)
b - Ball Bearing
c - Thrust Hub
d - Reverse Gear

14. Lubricate the bore that the bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).

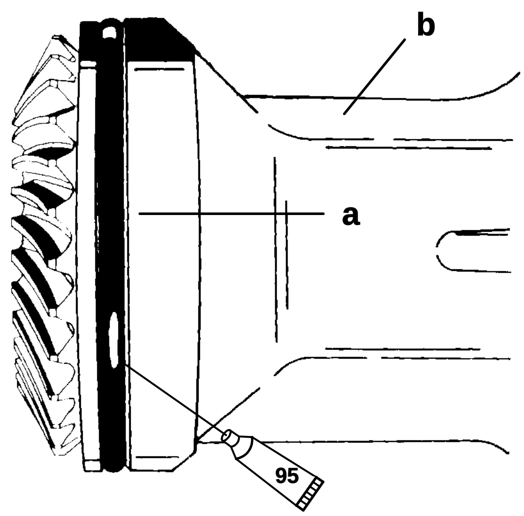
15. Press the bearing carrier onto the reverse gear and bearing until the bearing bottoms out in bearing carrier, using the pilot washer to press against the carrier.



87 Quicksilver Gear Lubricant (92-19007A24)

a - Pilot Washer (91-36571)
b - Bearing Carrier
c - Reverse Gear and Bearing Assembly

16. Lubricate the O-ring with 2-4-C w/Teflon and install the O-ring onto the bearing carrier.



23354

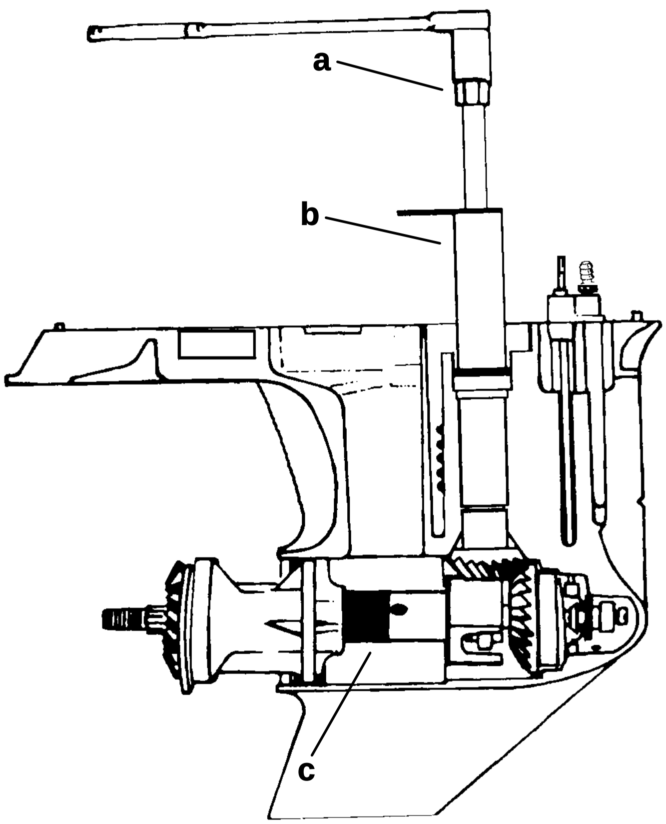
95 2-4-C With Teflon (92-825407A12)

a - O-ring
b - Bearing Carrier

Drive Shaft Assembly

REMOVAL

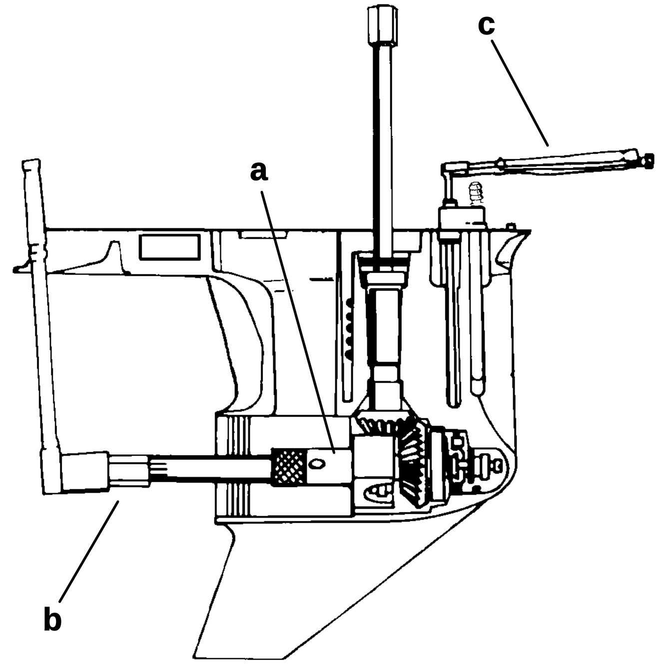
1. Remove the drive shaft pinion nut as follows:
   a. Place the drive shaft nut wrench onto the drive shaft. Do not loosen the retainer at this time.
   b. Insert the pinion nut adapter with the MR slot facing the pinion gear into the gear housing. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
   c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
   d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew), the pinion nut by rotating the drive shaft counterclockwise.



a - Drive Shaft Nut Wrench (91-56775)
b - Drive Shaft Bearing Retainer Wrench (91-43506)
c - Pinion Nut adapter (MR Slot) (91-61067A2)

   e. **If the drive shaft is broken,** place propeller shaft nut wrench onto the propeller shaft splines, hold shift shaft in forward gear and **loosen**, (but do not fully unscrew), the pinion nut by rotating prop shaft counterclockwise to turn gears, thus loosening the pinion nut.

NOTE: *The propeller shaft nut wrench is included with the pinion nut adapter kit.*

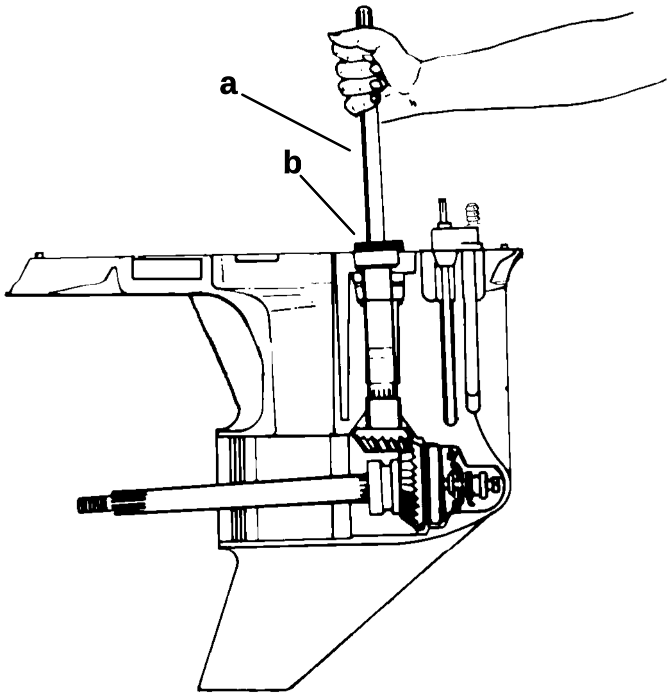


a - Pinion Nut adapter (91-61067A2)
b - Propeller Shaft Nut Wrench (91-61077)
c - Shift Shaft (Turn Clockwise) (Protect shaft splines w/soft material)

   f. Completely unscrew the drive shaft bearing retainer.
   g. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.
   h. Remove all tools.

IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to loose the (18) rollers.

2. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



a - Drive Shaft
b - Drive Shaft Retainer, Bearing Cup, Bearing, and Shims

3. Move the prop shaft downward and to the PORT side of the gear case.
4. Retrieve the pinion gear, the washer and the nut from the inside of the gear housing.

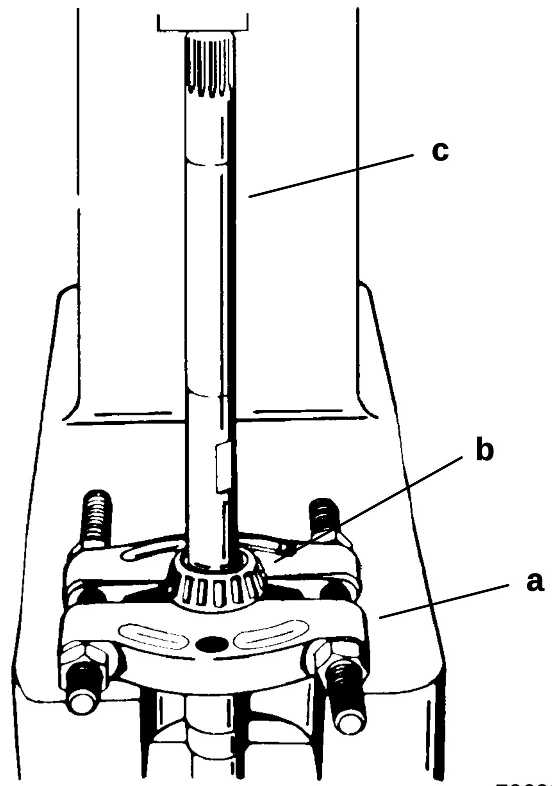
DRIVE SHAFT ASSEMBLY - Inspection

1. Clean all parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the pinion gear and the forward gear as a set** if any defects are found.

DRIVE SHAFT ASSEMBLY - Component Disassembly

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.

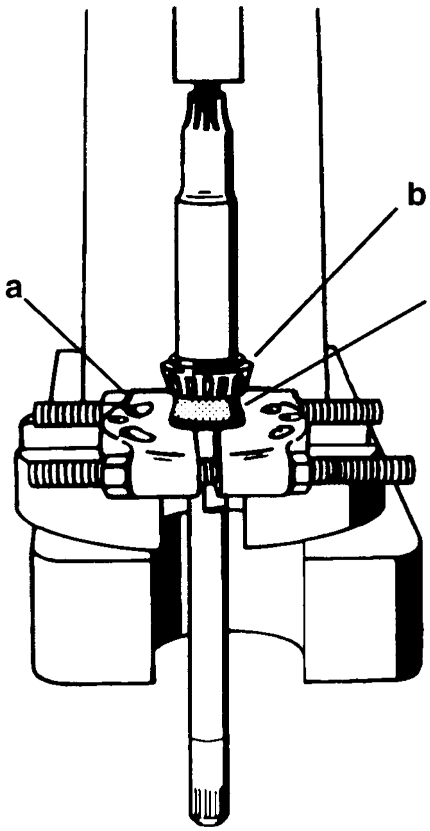


a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

DRIVE SHAFT ASSEMBLY - Component Reassembly

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Assemble a new tapered roller bearing to the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel, (an old tapered roller bearing inner race).

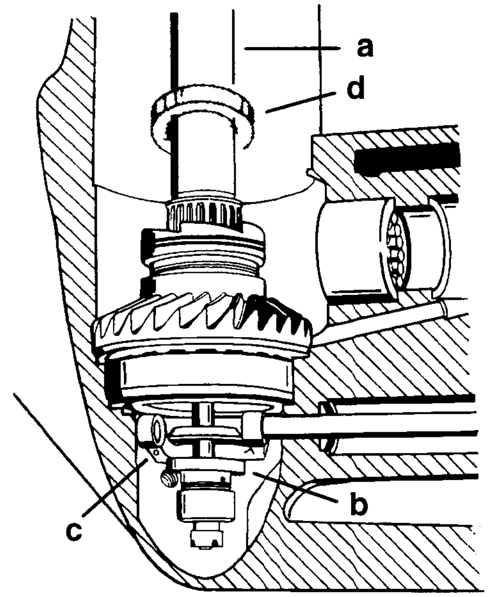


a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Suitable Mandrel (Inner Race of Old Bearing)

Propeller Shaft Assembly and Forward Gear Bearing Cup

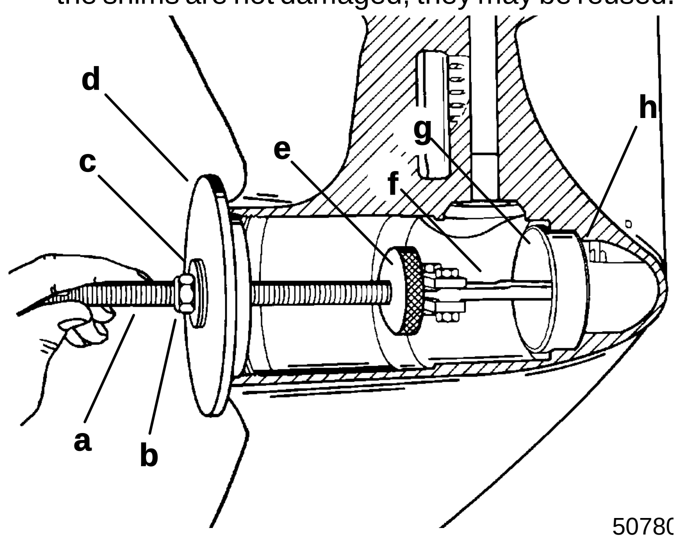
REMOVAL

1. Tilt the propeller shaft to the port side of the gear housing and remove the shaft by pulling it straight up and out.



a - Propeller Shaft Assembly
b - Shift Spool
c - Shift Crank
d - Thrust Washer (Reverse Gear)

2. Remove the forward gear bearing cup and shims. Measure and make note of the shim thickness. If the shims are not damaged, they may be reused.

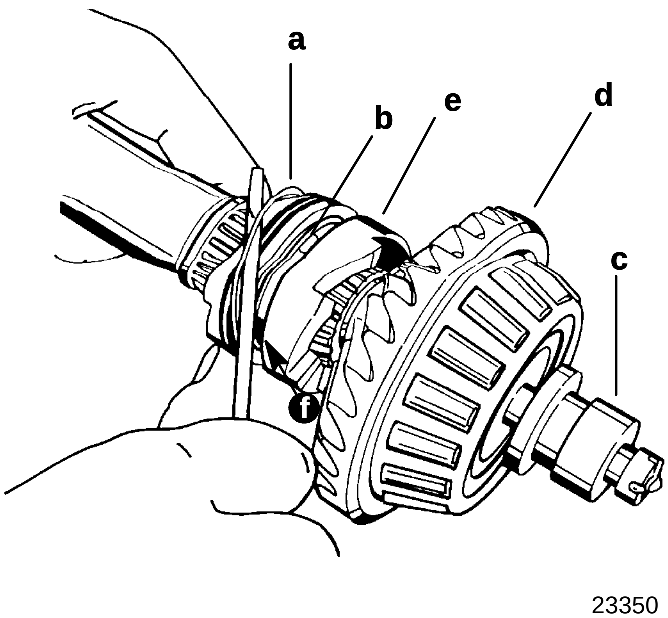


a - Puller Shaft (91-31229)
b - Nut (11-24156)
c - Washer (91-34961)
d - Guide Plate (91-816243)
e - Puller Head (from Slide Hammer Puller Kit 91-34569A1)
f - Jaws (from Slide Hammer Puller Kit)
g - Bearing Cup
h - Shims

PROPELLER SHAFT ASSEMBLY - Component Disassembly

NOTE: *When accomplishing the next step, all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged and to avoid personal injury.*

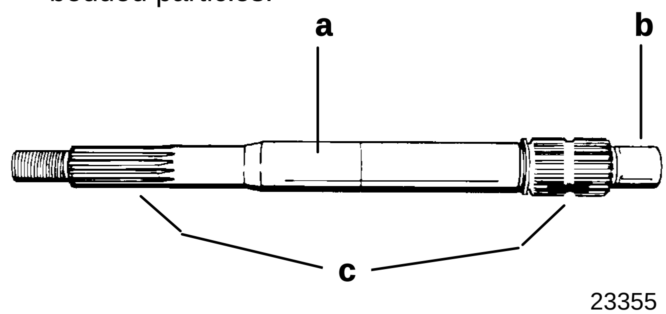
1. Remove the spring around the clutch being careful not to over-stretch it during removal. If the spring does not coil back to its normal position once it has been removed, it must be replaced.
2. Remove detent pin.
3. Remove the cross pin that goes through the clutch.
4. Remove the remainder of the components (Ratcheting type assembly shown).



a - Spring
b - Cross Pin
c - Shift Spool Assembly
d - Forward Gear Assembly
e - Sliding Clutch
f - Detent Pin

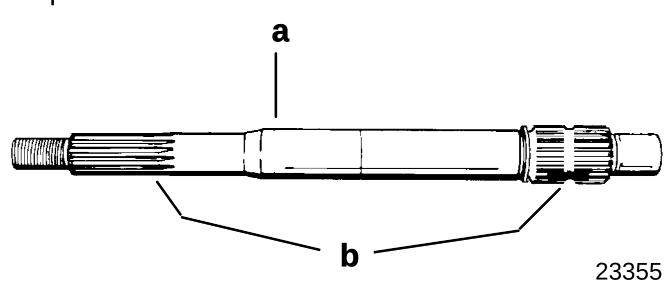
PROPELLER SHAFT ASSEMBLY - Component Inspection

1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are.
3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the forward gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.



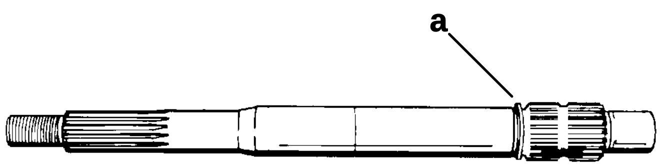
a - Bearing Carrier Needle Bearing Contact Area
b - Forward Gear Needle Bearing Contact Area
c - Splines

4. Inspect the propeller shaft splines at both ends for a broken, worn, or twisted condition. Replace the propeller shaft if any of these conditions exists.
5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, replace the propeller shaft and oil seals.



a - Bearing Carrier Seal Contact Area
b - Splines

6. Inspect reverse gear thrust washer surface for wear or taper. If surface is worn or tapered, propeller shaft must be replaced.



a - Thrust Washer Surface

7. Inspect the propeller shaft for a bent condition.

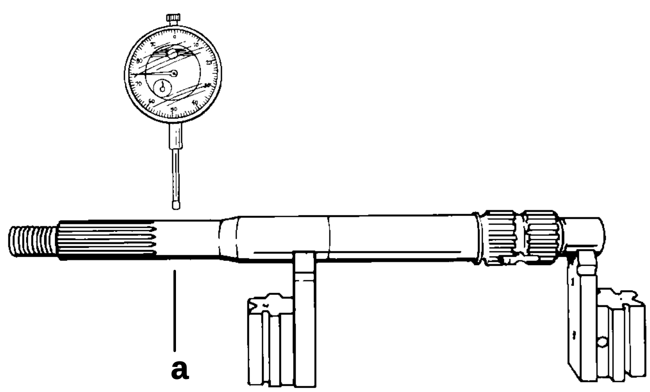
   a. **V-Blocks and Dial Indicator**

      (1.) Position the propeller shaft bearing surfaces on V-blocks.

      (2.) Adjust the height of V-blocks to level the propeller shaft.

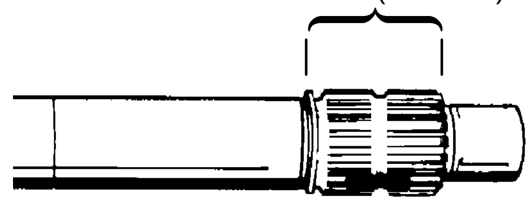
      (3.) Position the dial indicator tip just forward of the propeller shaft splines.

8. Rotate the propeller shaft and observe the dial indicator movement, If the indicator in the dial moves more than 0.010 in. (0.25mm), replace the propeller shaft.

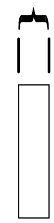


a - Check Movement with Dial Indicator (P/N 91-58222A1) Here.

9. Measure propeller shaft FORWARD to REVERSE shoulder length. If measurement is under 2.040 in. (51.82mm), replace propeller shaft.



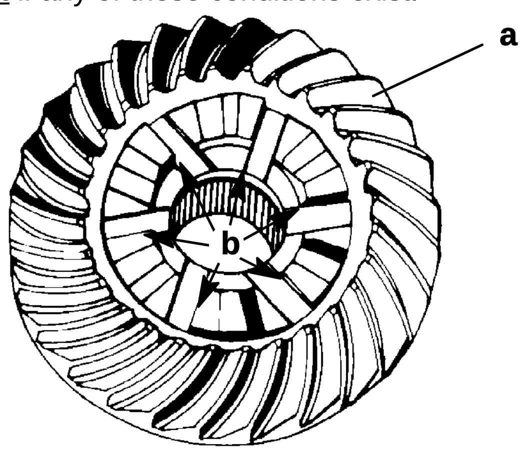
10. Inspect REVERSE thrust washer for wear or taper. Measure thickness of washer. If thickness is LESS than 0.240 in. (6.1mm), replace washer.



Forward Gear Assembly

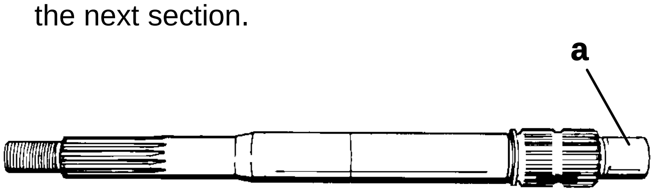
COMPONENT INSPECTION

1. Clean the forward gear assembly and the forward gear bearing cup with a suitable solvent and dry with compressed air. Be careful not to spin the bearings.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the forward gear and the pinion gear as a set** if any defects are found.
3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace both the forward and pinion gear as a set** if any of these conditions exist.



a - Forward Gear Teeth
b - Clutch Jaws

4. Inspect the needle bearings on the inside of the forward gear and the bearing surface on the propeller shaft. If either the needle bearing or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the forward gear as outlined in the next section.



a - Forward Gear Needle Bearing Contact Area

5. Inspect the tapered roller bearings on the forward gear and the bearing surface on the forward gear bearing cup. If either the roller bearings or the bearing surface of the forward gear bearing cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the forward gear bearing cup and remove and replace the tapered roller bearings as outlined in the next section.

FORWARD GEAR ASSEMBLY - Component Disassembly

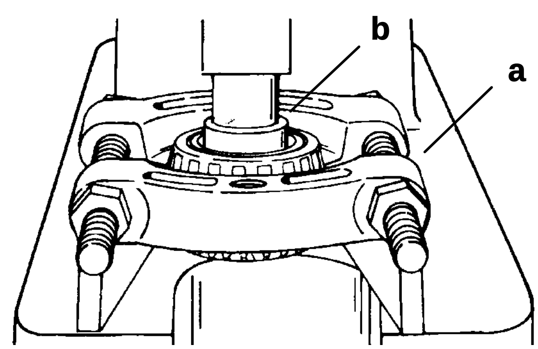
NOTE: *Forward gear can only be removed from gear housing after drive shaft and pinion gear have been removed.*

1. Reach into gear housing and lift out forward gear.

IMPORTANT: DO NOT remove tapered bearing or needle bearings from forward gear unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required, separate gear from bearing as follows:
   a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.
   b. Place assembly on press and press gear out of bearing with suitable mandrel.

NOTE: *Tapered bearing and race MUST BE replaced as a set.*



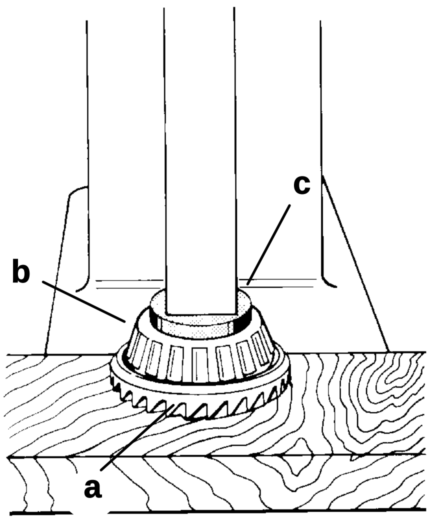
a - Universal Puller Plate (91-37241)
b - Mandrel

3. If inspection determines that replacement of propeller shaft needle bearings is required, remove bearing as follows:
   a. Clamp forward gear in a soft jaw vise securely.
   b. From toothed-side of gear, drive propeller shaft needle bearings out of gear with a punch and hammer.

FORWARD GEAR ASSEMBLY - Component Reassembly

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

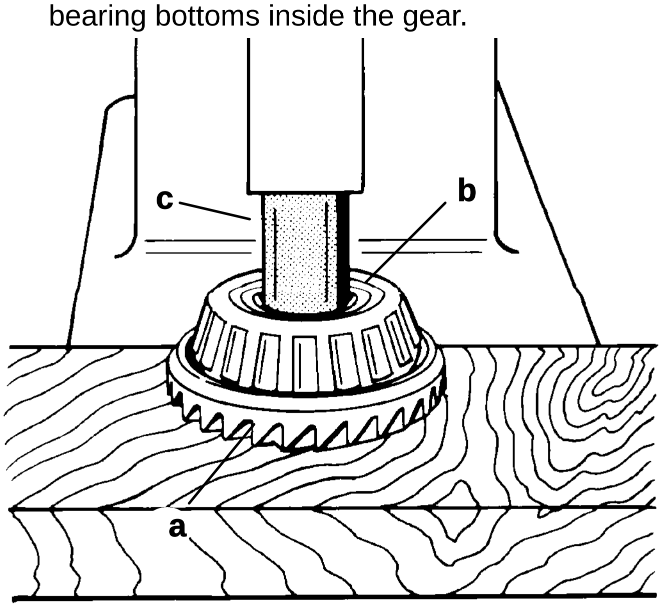
1. Using a suitable mandrel, press the tapered roller bearing onto the forward gear by pressing on the inner bearing race, until the bearing bottoms out on the gear mounting shoulder.



23353

a - Forward Gear
b - Tapered Roller Bearing
c - Suitable Mandrel (or Inner Race from old Bearing)

2. Using the needle bearing driver, press the needle bearing, with the the lettered side facing away from the gear teeth, into the forward gear until the bearing bottoms inside the gear.



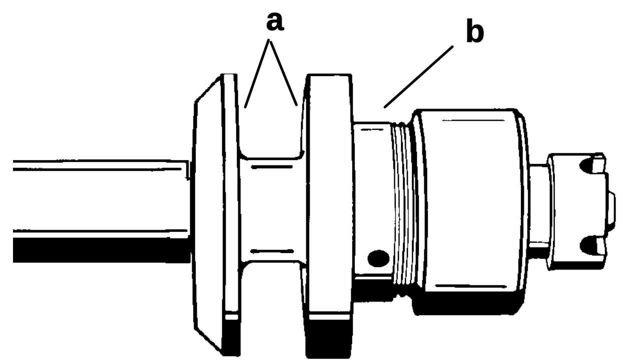
23350

a - Forward Gear
b - Needle Bearing (not seen)
c - Needle Bearing Driver (91-33491)

Shift Spool Assembly

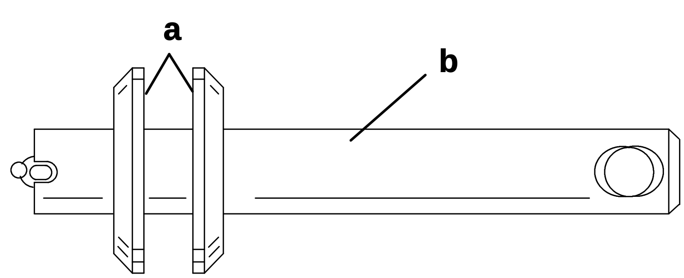
INSPECTION

1. Clean the assembly with a suitable solvent and dry the parts using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn excessively, it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

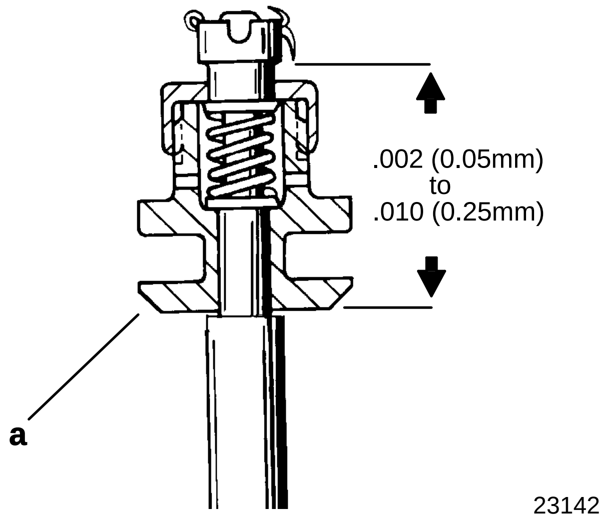
a - Contact Area
b - Ratcheting Shift Spool



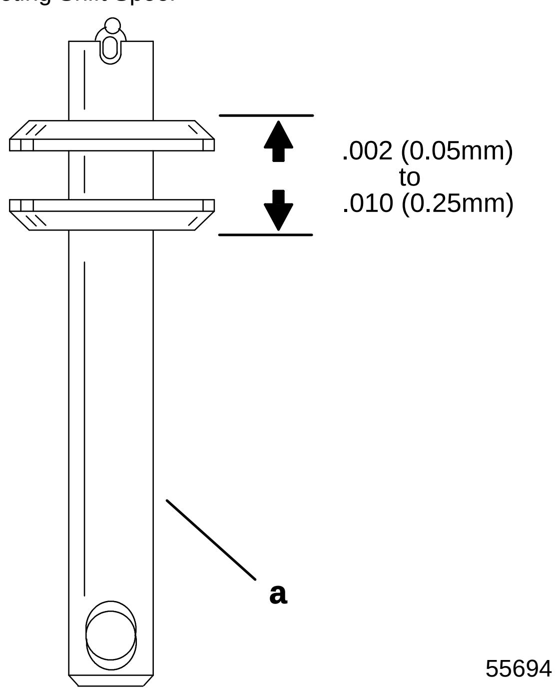
55694

a - Contact Area
b - Non-Ratcheting Shift Spool

4. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift shaft against a firm surface to align the internal parts).
5. Inspect to insure that both ratcheting and non-ratcheting spools have 0.002-0.010 in. (0.05-0.25 mm) end play. This end play may be achieved by turning the castle nut (clockwise) down on either spool until it is snug and then backing off the nut (counterclockwise) to the first cotter pin slot.



a - Ratcheting Shift Spool



a - Non-Ratcheting Shift Spool

NOTE: *Non-Ratcheting shift spools do not contain a spring under the castle nut.*

NOTE: *If the spool meets the above two criteria skip the disassembly and reassembly section following.*

NOTE: *If the spool does not meet the above criteria proceed with the disassembly and reassembly section following.*

SHIFT SPOOL ASSEMBLY - Component Disassembly

NOTE: *Disassembly of the shift spool is for cleaning and inspection of the internal parts due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.*

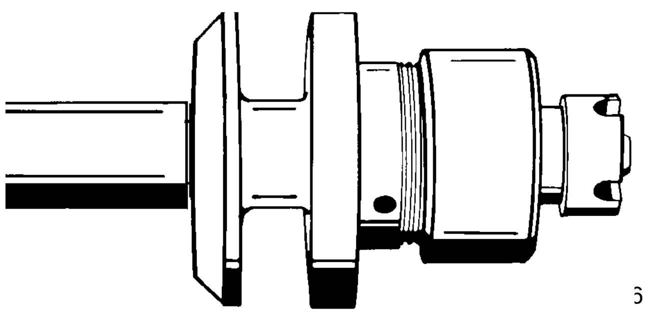
1. Disassemble the shift spool assembly as follows:
   a. Remove and discard the cotter pin.
   b. Remove the castle nut and spool.
   c. Clamp the spool in a vice being careful not to damage the spool.
   d. Remove the retainer by unscrewing it with a pair of pliers.
   e. Remove the two washers and the spring.

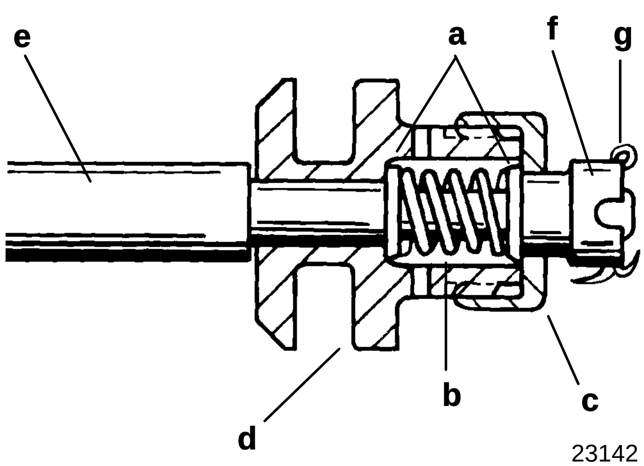
SHIFT SPOOL ASSEMBLY - Component Inspection

1. Clean all components with a suitable solvent and dry them thoroughly with compressed air.
2. Inspect each component for wear or damage. If any components are worn excessively, damaged, or broken it will be necessary to replace the complete shift spool assembly. Small nicks or burrs may be smoothed and the parts reused.

SHIFT SPOOL ASSEMBLY (RATCHETING) - Component Reassembly

1. Assemble the shift spool and shift spool shaft as follows:
   a. Place the shift spool onto the shift spool shaft.
   b. Assemble the first washer, then the spring, then the second washer into the shift spool.
   c. Apply Loctite 271 (92-809820) to the first 3 threads of the spool. Thread the retainer onto the spool and tighten the retainer securely with a pair of pliers.
   d. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
   e. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
   f. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.





23142

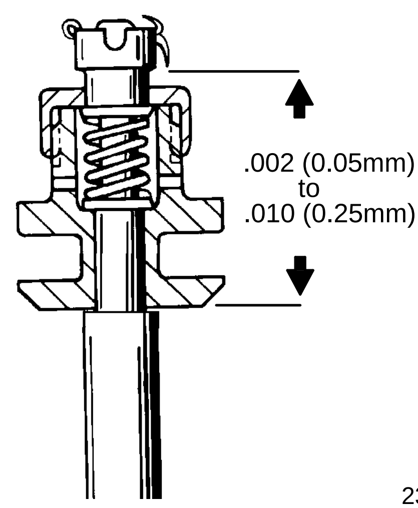
a - Washers (2)
b - Spring
c - Retainer
d - Spool
e - Shift Shaft
f - Castle Nut
g - Cotter Pin

SHIFT SPOOL ASSEMBLY (RATCHETING) - Adjustment

NOTE: *If the shift spool assembly has been disassembled and reassembled (as in the previous two sections) skip the following instructions, (1 through 4).*

NOTE: *If the shift spool assembly has not been disassembled and reassembled, do all of the following steps.*

1. Remove and discard the cotter pin.
2. Screw the castle nut down until it touches the washer and a slight resistance is felt.
3. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is aligned at the hole in the shaft, back off the castle nut until the next available slot in the nut is aligned with the hole in the shaft.
4. Insert a new cotter pin and bend ends in opposite directions.
5. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
6. Inspect to insure that the spool has 0.002 - 0.010 in. (0.05 - 0.25mm) end play, if it doesn t, adjust the castle nut once again as outlined previously.

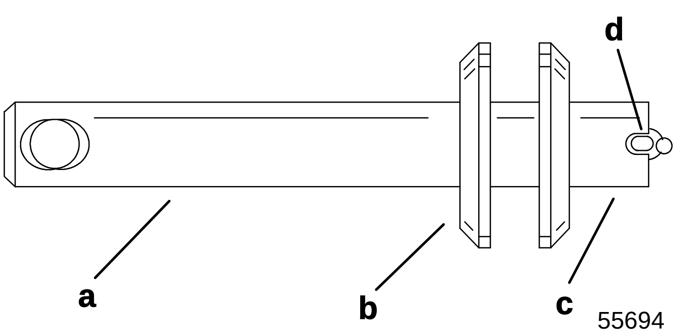


23142

7. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.

SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - Component Reassembly and Adjustment

1. Assemble the shift spool and shift spool shaft as follows:
   a. Place the shift spool onto the shift spool shaft.
   b. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
   c. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
   d. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.
   e. Inspect to insure that the spool has 0.002 - 0.010 in. (0.05 - 0.25mm) end play, if it doesn t, adjust the castle nut once again as outlined previously.



a - Shift Shaft
b - Spool
c - Castle Nut
d - Cotter Pin

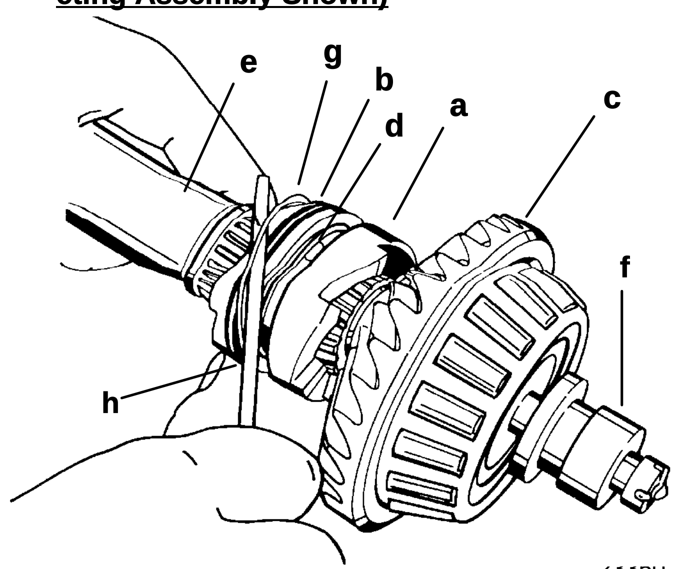
   f. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.

Propeller Shaft Assembly

COMPONENT REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Install the sliding clutch on the propeller shaft. Align cross pin holes in the clutch with the slot in the propeller shaft. The grooved end of the clutch should be facing the propeller end of the shaft.
2. Assemble the forward gear assembly to the propeller shaft.
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch.
4. Assemble the cross pin through the sliding clutch, through the propeller shaft and through the shift spool shaft hole.
5. Install detent pin in 3rd hole in clutch.
6. Assemble the cross pin retaining spring over the propeller end of the propeller shaft and wind it around the clutch over the cross pin hole. Be careful not to distort the spring while assembling it. **Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch a new spring must be installed. (Ratcheting Assembly Shown)**



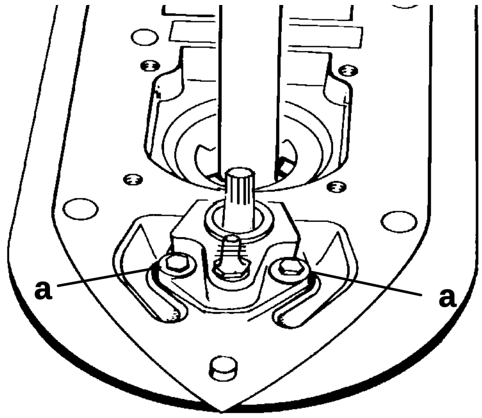
a - Sliding Clutch
b - Grooves in Clutch
c - Forward Gear Assembly
d - Cross Pin
e - Propeller Shaft
f - Spool and Actuating Shaft Assembly
g - Cross Pin Retaining Spring
h - Detent Pin

Shift Shaft Assembly

REMOVAL

NOTE: *It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.*

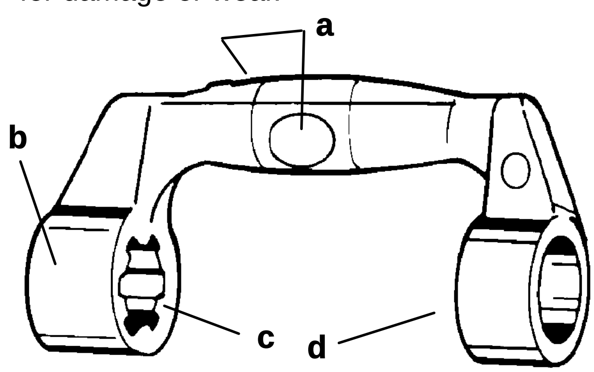
1. Remove the shift shaft bushing screws, and remove the shift shaft and bushing by pulling both straight out of gear housing.



70494

a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or wear.

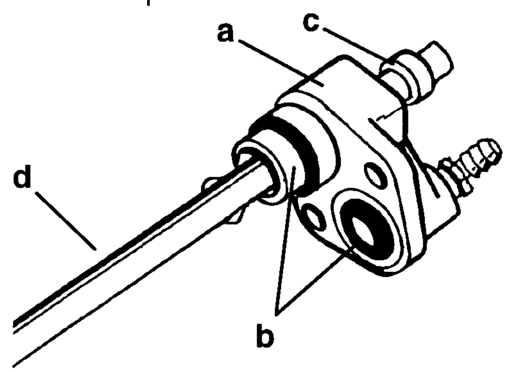


23350

a - Contact Area
b - Shift Crank
c - Splines
d - Diameter for Locating Pin

SHIFT SHAFT ASSEMBLY - Component Disassembly and Inspection

1. Slide the bushing assembly off the shift shaft. Remove the coupler from the shaft.

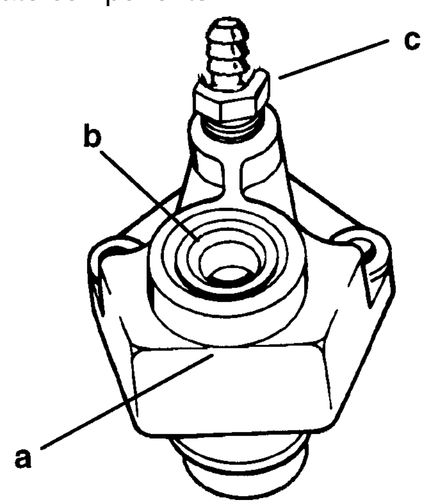


70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Coupler
d - Shift Shaft

2. Clean all components with a suitable solvent and dry thoroughly with compressed air.
   a. Inspect the shift shaft bushing for cracking, damage, or excessive wear.
   b. Inspect the oil seal inside the bushing, the sleeve, and the O-rings on the outside of the bushing for damage or excessive wear.
   c. Inspect the speedometer connector for damage or blockage.

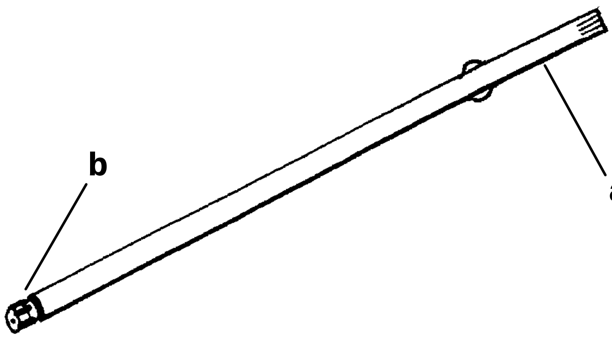
   If any of these conditions exist, replace the appropriate components.



70617

a - Shift Shaft Bushing
b - Oil Seal (Oil Seal is Replaceable)
c - Speedometer Tube Connector

3. Inspect the shift shaft splines and oil seal surface for corrosion and/or excessive wear. Replace the shift shaft if either if these conditions are found.

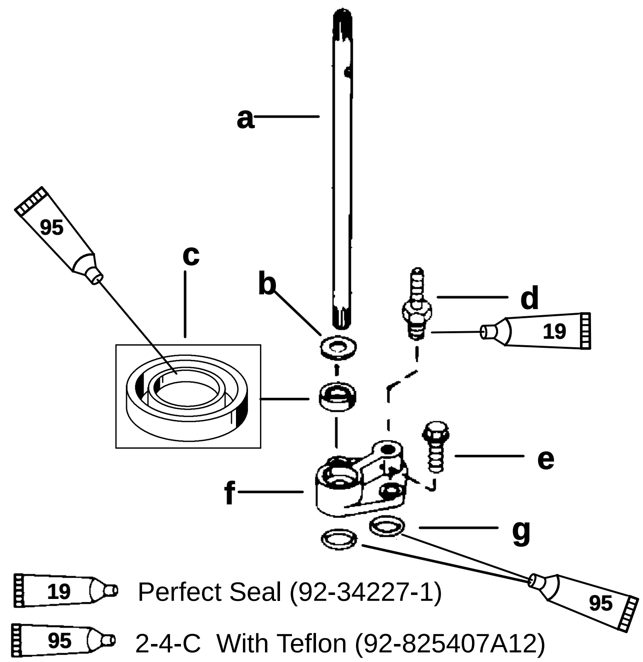


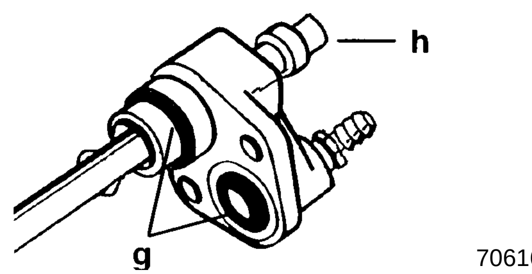
a - Oil Seal Surface
b - Spline

SHIFT SHAFT ASSEMBLY - Component Reassembly

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with 2-4-C w/Teflon (92-825407A12).
2. If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal (91-34277-1). Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb. in. (0.51 N·m).
3. Assemble all components as shown below.





a - Shift Shaft
b - Rubber Washer
c - Seal (Lip Faces Up)
d - Speedometer Connector
e - Bolt (2 ea.) [Torque to 60 lb. in. (6.8 N·m)]
f - Bushing
g - O-Rings (2 ea.)
h - Coupler

NOTE: *For reinstalling the shift shaft when none of the other components of the gear housing were disassembled see the "Shift Shaft Assembly", "Installation".*

Pinion Bearing

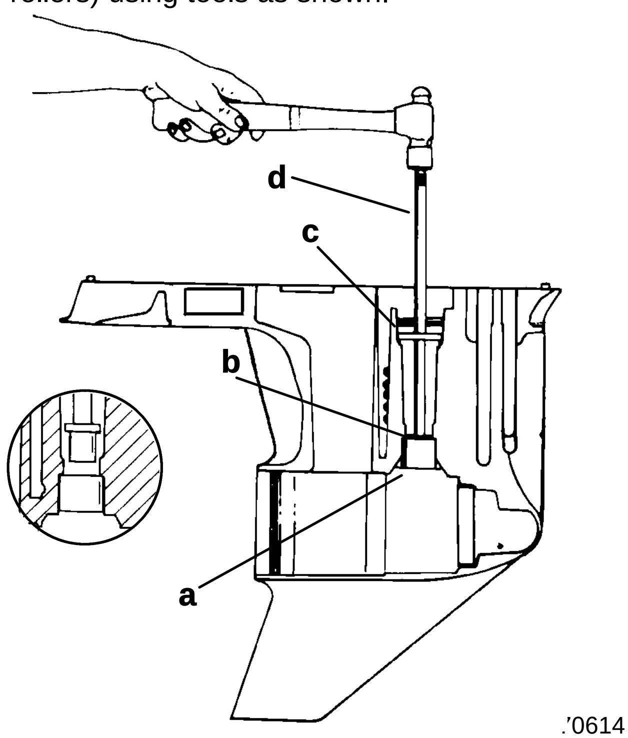
REMOVAL

NOTE: *Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location gives an indication of the condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved scored, worn unevenly, discolored from overheating, or has embedded particles.*

IMPORTANT: All the needle bearings (18) MUST BE in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. Remove and discard the pinion bearing (race and rollers) using tools as shown.



a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

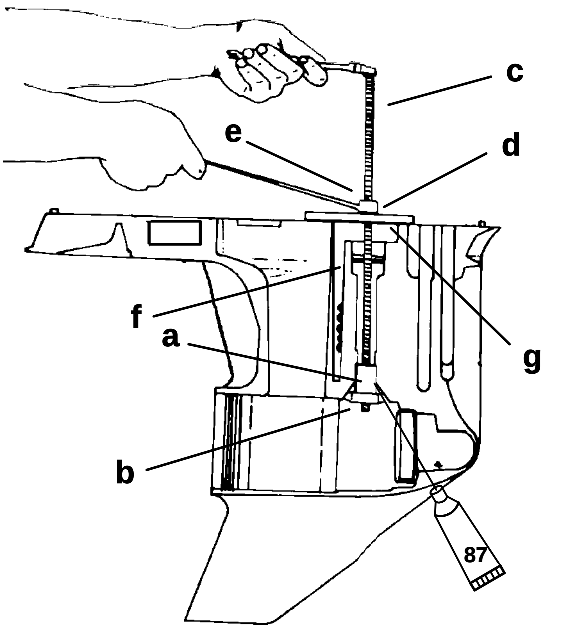
1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing thoroughly using compressed air. Insure that all sealants, locking agents and debris are removed.
2. Verify the 2 oil circulation holes in the drive shaft bore and the shift shaft hole are clear and free of debris.
3. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
4. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Damage or corrosion to the threads requires replacement of the gear housing.
5. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose will require replacement of the gear housing.
6. Inspect for blockage in water inlet holes and the speedometer hole, clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
7. Make sure that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

Pinion Bearing

INSTALLATION

IMPORTANT: Install only a NEW pinion bearing. Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver Gear Lube (92-19007A24).
2. Position the new pinion bearing (with the cardboard shipping sleeve in place) onto the driver head, with the lettered and numbered side of the bearing oriented upward.
3. Insert the driver with the bearing assembly, into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



70615

87 Quicksilver Gear Lubricant (92-19007A24)

a - Drive Shaft Pinion Bearing (With Cardboard Shipping Sleeve)
b - Driver Head (91-38628)
c - Puller Shaft (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Puller Plate (91-29310)

4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Forward Gear Bearing Cup

INSTALLATION

Forward Gear Backlash - .017 in. to .028 in. (0.43mm to 0.71mm)

NOTE: *If the forward gear, forward gear bearing and cup, or gear housing were not replaced, install the same quantity of shims that were taken out when cup was removed. If the forward gear, forward gear bearing/cup, or gear housing were replaced, install 0.020 in. (0.51mm) of shims.*

NOTE: *If backlash has already been checked and it has determined that it needs to be adjusted, (see Checking Forward Gear Backlash), adding or subtracting 0.001 in. (0.03mm) shims will **change** the gear backlash by the same amount.*

Example 1 (if backlash is too high)

If Forward Backlash Checks:	.040 in.	(1.02mm)
(Subtract):	.018 in.	(0.46mm)
Add This Quantity of Shims:	.022 in.	(0.56mm)
Provides Backlash of 0.018		(0.46mm)

Example 2 (if backlash is too low)

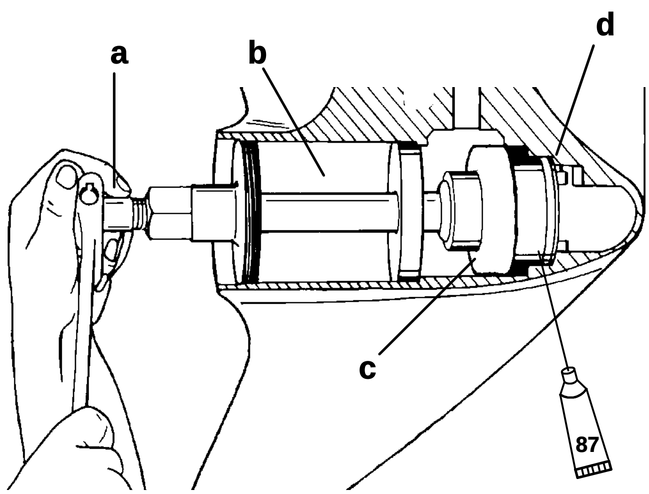
Backlash Checks:	.010 in.	(0.25mm)
Subtract this Quantity of Shims:	.008 in.	(0.30mm)
Provides Backlash of 0.018		(0.46mm)

1. Lubricate the bore into which the forward gear bearing cup is to be installed with Quicksilver Gear Lube (92-19007A24).
2. Place the shim(s) into forward bore of gear housing.

3. Press the bearing cup into the gear housing using the installation tool as follows:

NOTE: *Ratcheting type gear cases use bearing cup driver 91-36577. Non-ratcheting gear cases use bearing cup driver 91-31106.*

IMPORTANT: Verify that the bearing cup is position as straight as possible to avoid cocking it in the bore while pressing it in.



50791

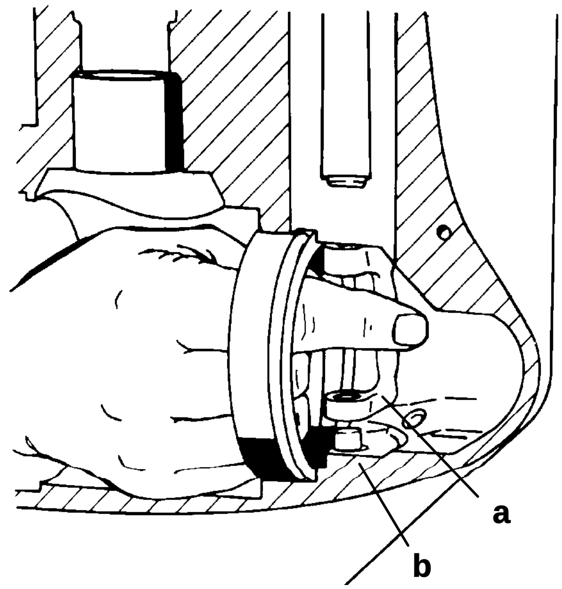
87 Quicksilver Gear Lubricant (92-19007A24)

a - Hex-Head Screw
b - Bearing Cup Installation Tool (91-18605A1)
c - Driver Cup (91-36577) for ratcheting type gear cases.
Driver Cup (91-31106) for non-ratcheting type gear cases.
d - Shims

Shift Shaft Assembly

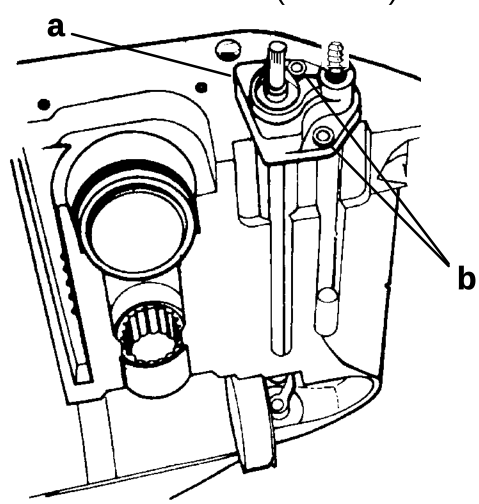
INSTALLATION

1. Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces towards the left (port) side of the gear housing.



a - Shift Crank
b - Locating Pin

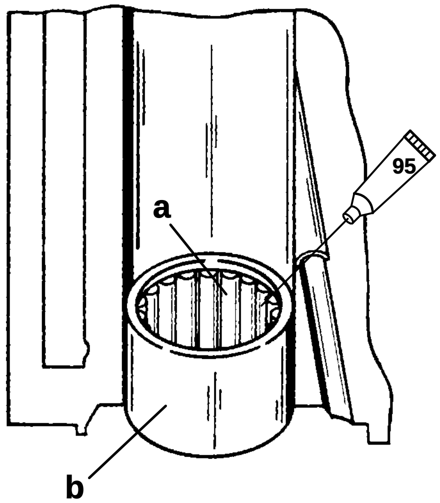
2. Install the shift shaft assembly into the gear housing as shown. Engage the splined end of the shift shaft with the shift crank. Verify O-rings are positioned properly and lubricated with 2-4-C w/Teflon. Secure shift shaft bushing with 2 screws. Torque screws to 60 lb. in. (6.8 N.m).



70620

a - Shift Shaft Assembly
b - Screws [Torque to 60 lb. in. (6.8 N·m)]

NOTE: *If the pinion bearing needle bearings have fallen out, install 18 needles into needle bearing outer race. Use 2-4-C w/Teflon (92-825407A12), to help hold needles in place.*



23142

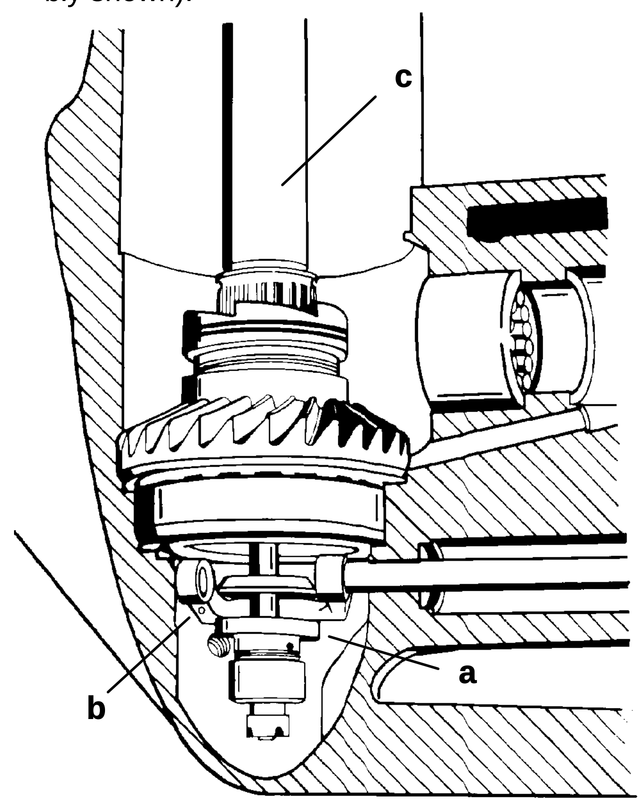
95 2-4-C With Teflon (92-825407A12)

a - Rollers (18)
b - Roller Bearing Outer Race

Propeller Shaft Assembly

INSTALLATION

1. To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing and rotate the shift shaft from reverse to neutral while installing shaft (ratcheting assembly shown).

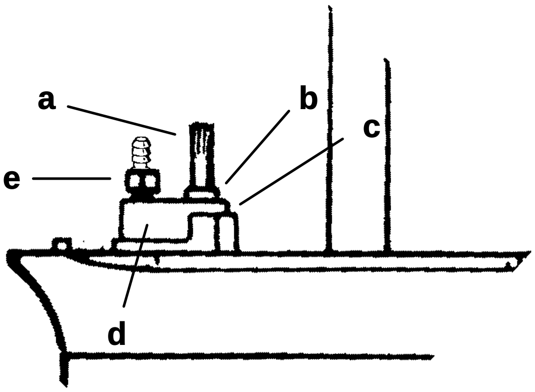


23343

a - Shift Actuating Spool
b - Shift Crank
c - Propeller Shaft Assembly

2. Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise, and should move aft when the shift shaft is turned counterclockwise.

3. Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



2

a - Shift Shaft
b - Rubber Sleeve
c - Oil Seal
d - Shift Shaft Bushing
e - Speedometer Connector

NOTE: *Secure the speedometer tube to the speedometer connector with a sta-strap.*

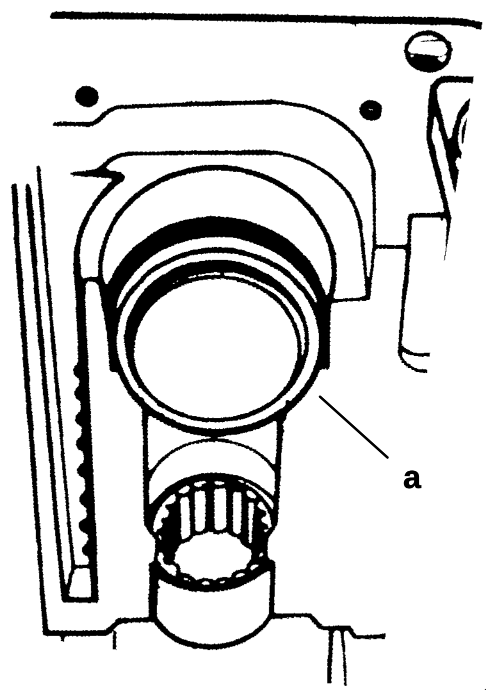
Drive Shaft and Pinion Gear

INSTALLATION

NOTE: *If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup, or gear housing were replaced, start off by installing a 0.038 in. (0.96 mm) shim(s).*

NOTE: *If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the same shims or same amount of shims.*

1. Place the shim(s) into the drive shaft housing bore.



70620

a - Shim(s)

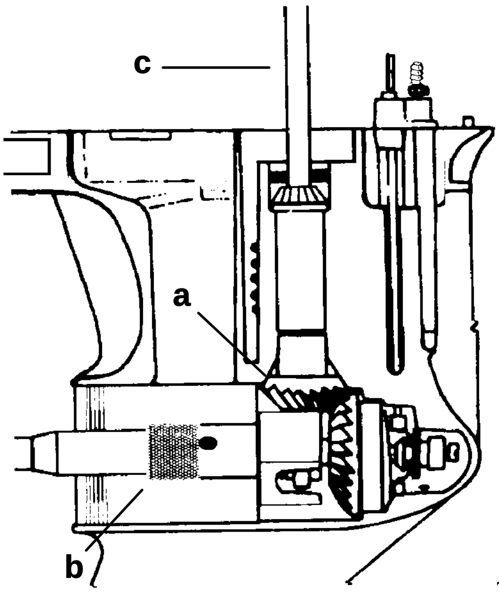
NOTE: *For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.*

NOTE: *If the backlash may have to be changed, it is recommended that Loctite 271 NOT be applied to the pinion nut UNTIL the backlash setting is finalized. DO NOT reuse the old pinion nut. Install a NEW pinion nut after backlash is finalized.*

2. Apply Loctite 271 (92-809820) to the threads of the pinion gear nut and place the pinion gear nut into the MR slot of the pinion nut adapter.

NOTE: *Install the pinion gear nut with the flat side of the nut away from the pinion gear.*

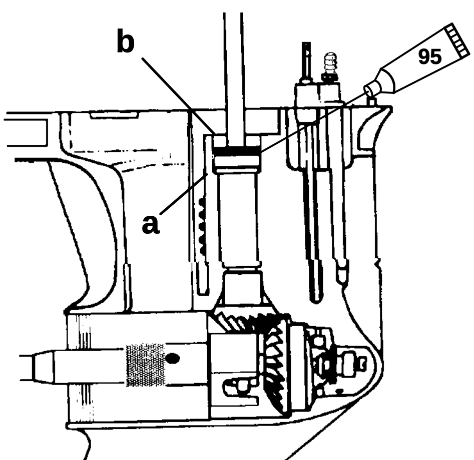
3. Place the pinion gear and washer into the gear housing.
4. Insert the pinion nut adapter (with the nut) into the gear housing.
5. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



. 0891

a - Pinion Gear (with the washer glued to it)
b - Pinion Nut Adaptor (91-61067A2)
c - Drive Shaft

7. Install the drive shaft tapered roller bearing cup. Apply 2-4-C w/Teflon to the retainer threads and install the retainer.

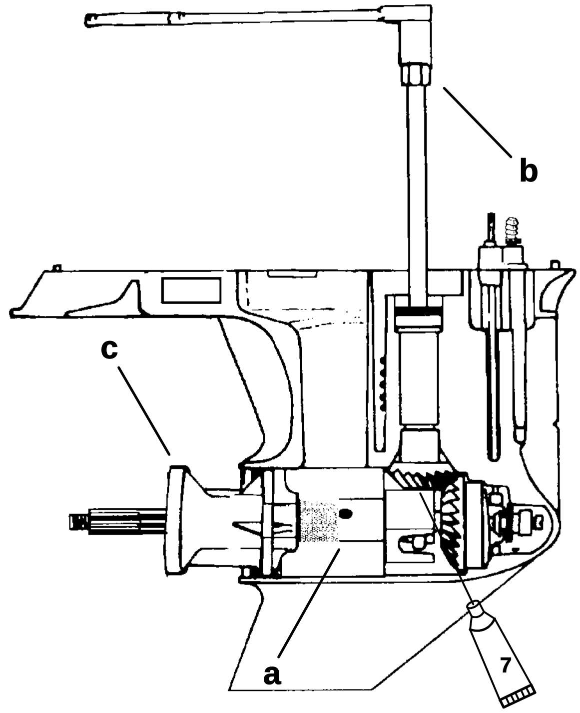


70890

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

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

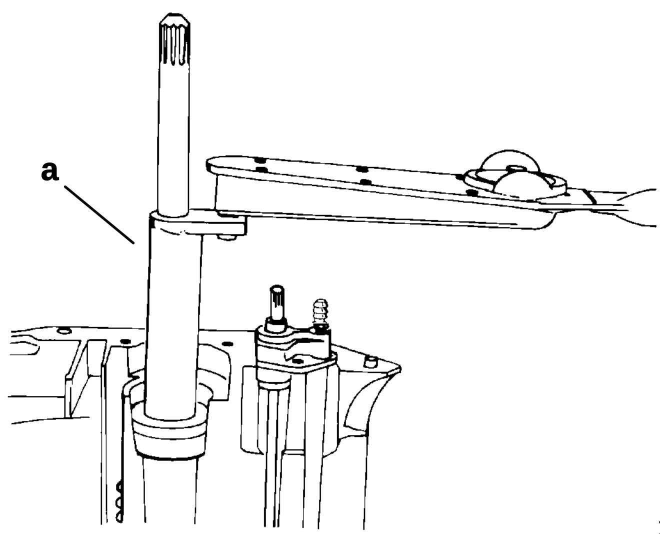
8. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.
9. Torque the pinion nut to 75 lb. ft. (101.7 N·m) by turning the drive shaft using the drive shaft nut wrench and torque wrench.



7 Loctite 271 (92-809820) 70892

a - Pinion Nut Adapter (91-61067A2)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (installed backwards)

10. Torque the retainer to 100 lb. ft. (136.0 N·m).



1

a - Drive Shaft Bearing Retainer Wrench (91-43506)

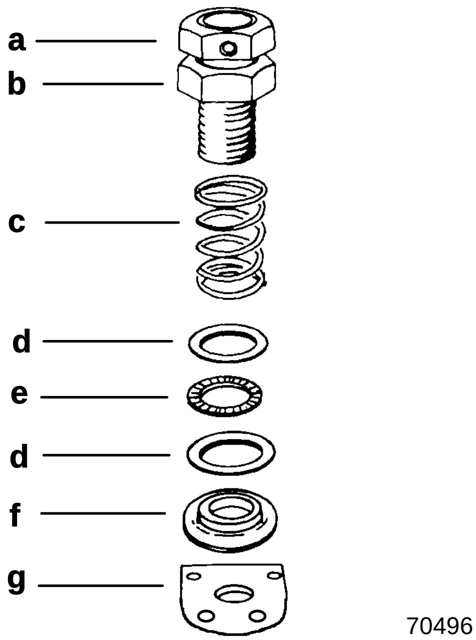
11. Remove the bearing carrier, pinion nut adapter and drive shaft nut wrench.

Gear Location/Backlashes Checking and Adjustment

Drive Shaft - Bearing Preload Tool

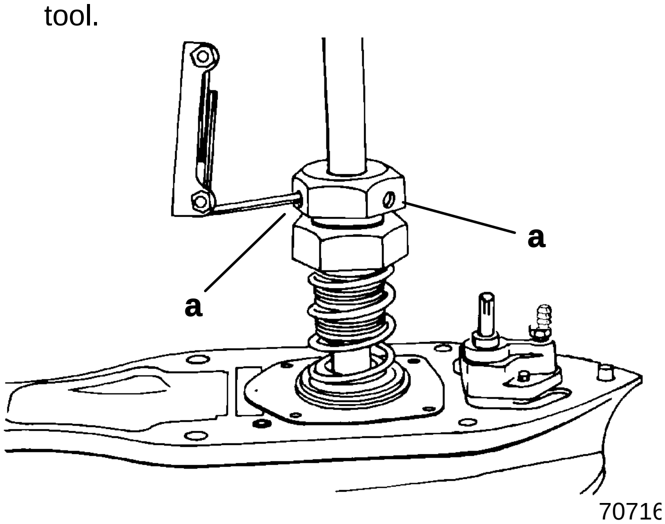
INSTALLATION

1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



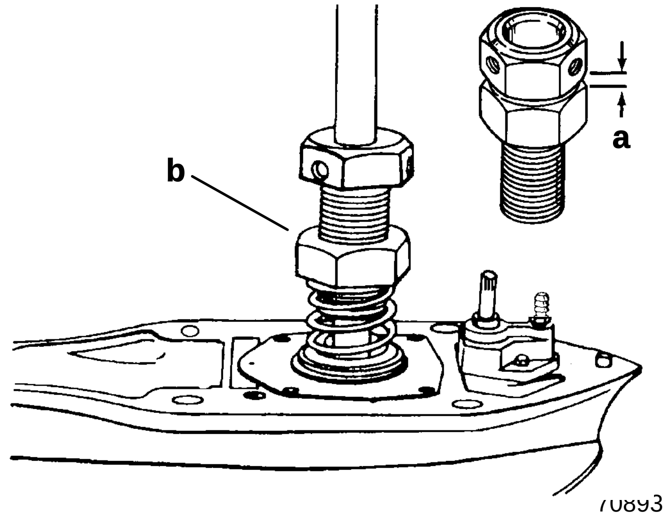
a - Top Nut with Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer (2 Required) (12-18448)
e - Thrust Bearing
f - Thrust Washer
g - Water Pump Face Plate (from your gear housing)

2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



a - Allen Screws

3. Measure distance (a) and increase that distance by 1 in. (25.4mm) by turning bottom nut away from top nut.



a - Distance 1 in. (25.4mm)
b - Bottom nut [screwed down approximately 1 in. (25.4mm)]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Pinion Gear Location

CHECKING AND ADJUSTING

Pinion Depth – .025 in. (0.64mm)

NOTE: *If the bearing preload tool has not already been set up, refer to "Drive Shaft - Bearing Preload Tool", Installation' section first.*

NOTE: *The prop shaft and forward gear can be installed when checking pinion height IF Pinion Height Tool 91-56048 is used.*

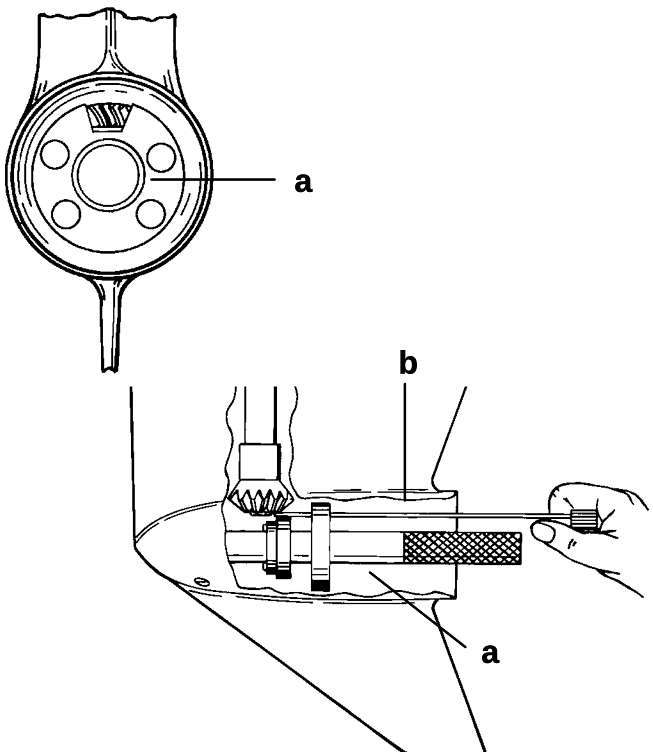
1. Place the pinion gear shimming tool into the gear housing.

NOTE: *Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).*

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.
3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height. Make note of this average measurement.

The average pinion gear height should be 0.025 in. (0.64mm).

6. If the average pinion gear height is not correct, remove the bearing preload tool, the drive shaft retainer and the drive shaft tapered roller bearing cup. (The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing and shaking it.) Add or subtract shims beneath the cup to obtain the proper average pinion gear height. Reinstall the cup and retainer. Retorque retainer to 100 lb. ft. (135.6 N·m). Reinstall the bearing preload tool and rotate the drive shaft at least 3 full turns in a clockwise direction. Recheck the pinion gear height as in step 5 above. Repeat this process until the average pinion gear height is within specification.



24643

a - Pinion Gear Shimming Tool (91-12349A2) Using Disc #2 and Flat #4
b - 0.025 in. (0.64mm) Feeler Gauge

NOTE: *Install a NEW pinion nut with Loctite 271 AFTER all clearances are correct.*

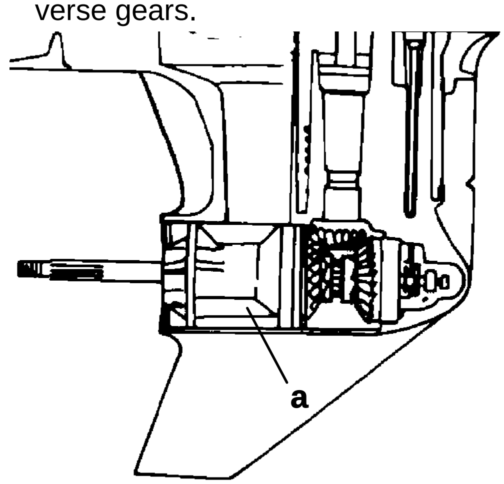
7. When the correct pinion gear height is achieved, remove pinion nut and apply Loctite 271 to nut threads IF FORWARD GEAR and PROP SHAFT ARE INSTALLED. Reinstall pinion nut and torque to 75 lb. ft. (101.7 N·m).

Bearing Carrier Assembly

INSTALLATION - (FOR CHECKING BACKLASHES)

NOTE: *If backlashes have already been checked and they are to specification proceed with "Bearing Carrier Assembly", Final Installation' section found on page 6A-50.*

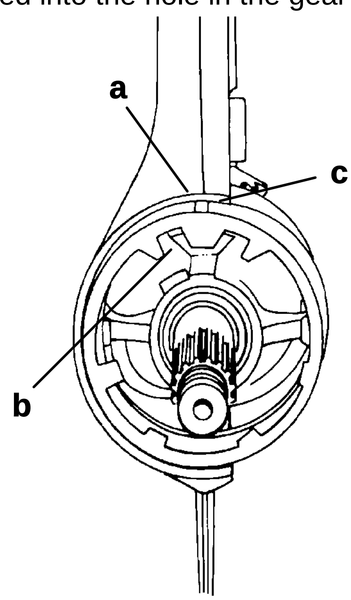
1. Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.



70712

a - Bearing Carrier Assembly

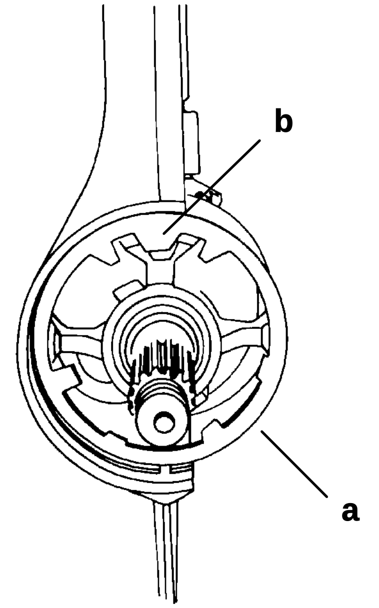
2. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Housing Tab Washer Alignment Hole (not seen)
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

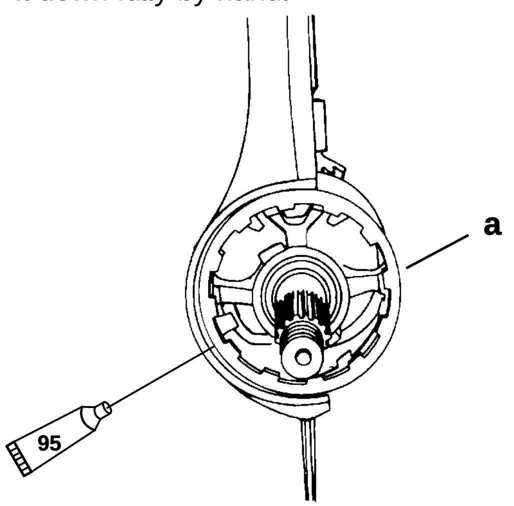
3. Verify that the "V" shaped tab aligns with the "V" notch in bearing carrier.



70714

a - Tab Washer
b - "V" Tab

4. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



70715

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

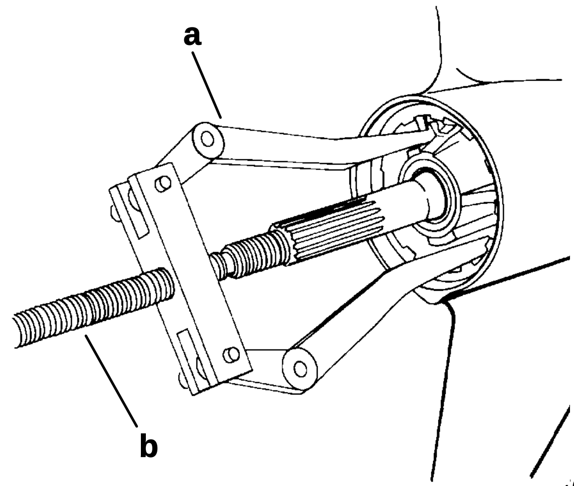
a - Bearing Carrier Retainer

Forward Gear Backlash

CHECKING

1. Apply forward pressure to propeller shaft as follows:

   a. Attach puller jaws and puller bolt onto bearing carrier bosses and propeller shaft.



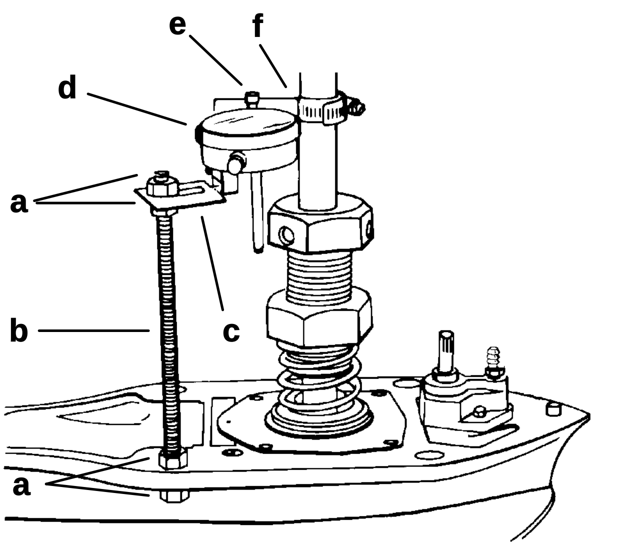
70719

a - Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)

   b. Torque the puller bolt to 45 lb. in. (5.1 N·m). Rotate drive shaft three full turns clockwise and retorque the bolt to 45 lb. in. (5.1 N·m).

NOTE: *If the bearing preload tool has not already been set up, see "Drive Shaft - Bearing Preload Tool", "Installation" section found on page 6A-45 first.*

2. Install a dial indicator and align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.



70717

a - Nuts (4) (Obtain Locally)
b - Threaded Rod [3/8 in. (9.5mm) obtain locally]
c - Dial Indicator Holding Tool (91-83155)
d - Dial Indicator (91-58222A1)
e - Indicator Pointer
f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
Backlash Indicator Rod (91-78473) (for 1.87:1 ratio)

3. Take the backlash readings by lightly turning the drive shaft back and forth, (no movement should be noticed at the propeller shaft).
   a. Observe the dial indicator and record the reading.
   b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat step 2 above and take and record another reading. Repeat step 3 until a total of 4 backlash readings have been taken.
4. Add the four readings together and divide the sum by four. This is your average backlash, which should be 0.017 in. - 0.028 in. (0.431mm - 0.711mm) (for 1.64:1; 1.75:1 and 1.87 ratios).
5. If backlash is LESS than the specified minimum, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When re-installing pinion nut, apply Loctite 271 to threads of nut.
6. If backlash is MORE than the specified MAXIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 to threads of nut.

NOTE: *By adding or subtracting 0.001 in. (0.03mm) shim, the backlash will change approximately 0.001 in. (0.03mm).*

Reverse Gear Backlash

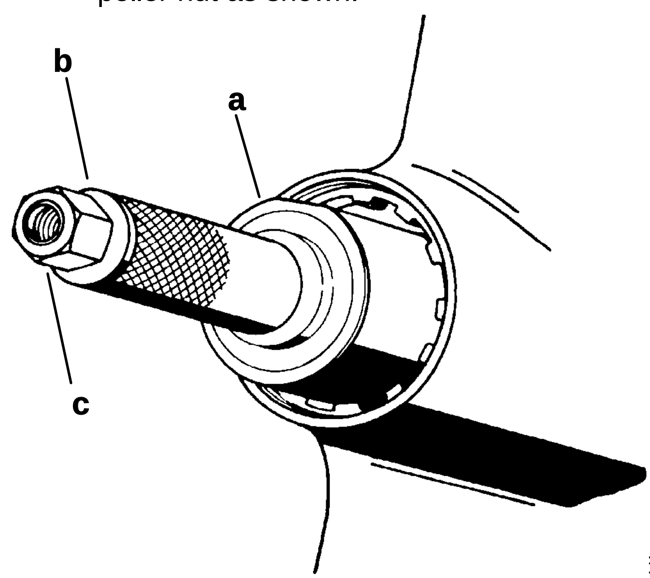
CHECKING

Reverse Gear Backlash – 0.030 in. to 0.050 in. (0.76mm to 1.27mm)

Although reverse gear backlash is not adjustable, it may be checked as follows:

NOTE: *Torque cover nut to 210 lb. ft. (284.7 N·m).*

1. Apply backward pressure on the propeller shaft as follows:
   a. Install the pinion nut adaptor, washer and propeller nut as shown.

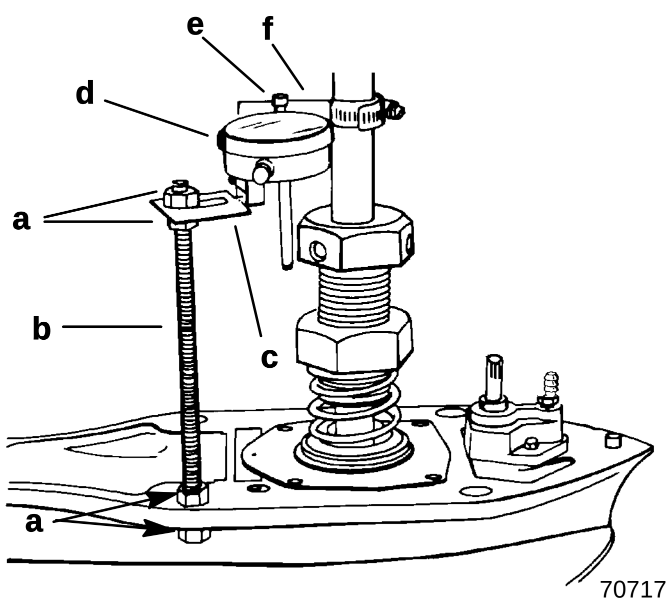


55

a - Pinion Nut Adaptor (91-61067A2)
b - Washer (12-54048)
c - Prop Nut

b. Torque the propeller nut to 45 lb. in. (5.1 N·m). Rotate the drive shaft 3 full turns in a clockwise direction and retorque the propeller nut to 45 lb. in. (5.1 N·m).

2. Install a dial indicator and align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.



a - Nuts (4) (obtain locally)
b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
c - Dial Indicator Holding Tool (91-83155)
d - Dial Indicator (91-58222A1)
e - Indicator Pointer
f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
g - Backlash Indicator Rod (91-78473) (for 1.87:1 ratio)

3. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gears, (no movement should be noticed at the propeller shaft).

   a. Observe the dial indicator and record the reading.

   b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.

   c. Repeat step 2 above and take and record another reading. Repeat step 3 until a total of 4 backlash readings have been taken.

4. Add the four readings together and divide the sum by four. This is your average backlash and it should be 0.030 in. - 0.050 in. (0.76mm - 1.27mm) (for 1.64:1; 1.75:1 and 1.87:1 ratios).

If backlash is not as indicated, gear case is not properly assembled or parts are excessively worn and must be replaced before returning gear case to service.

5. Loosen the backlash indicator tool and remove the propeller nut, washer and pinion nut adaptor. Remove the dial indicator and all its mounting components. **Do not remove the bearing preload tool. The following instructions give specific instructions for its removal.**

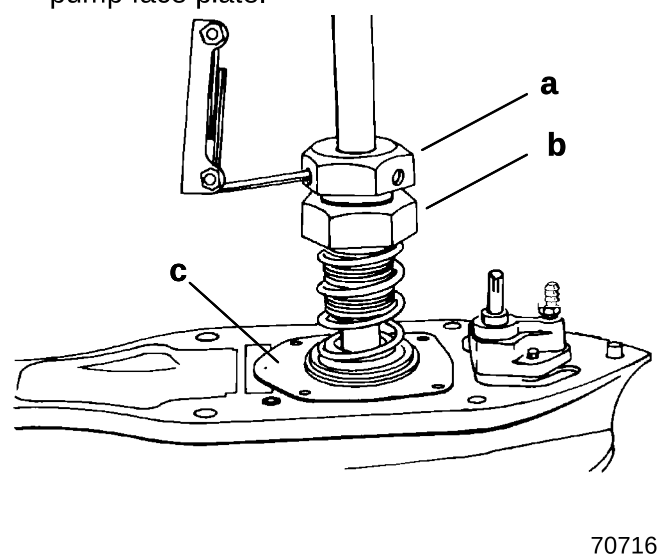
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut.

1. Remove the dial indicator and its supporting tooling.
2. Screw the bottom nut of the bearing preload tool until it is as close as possible to top nut.
3. Loosen the allen screws in the top nut.
4. Remove all components including the water pump face plate.

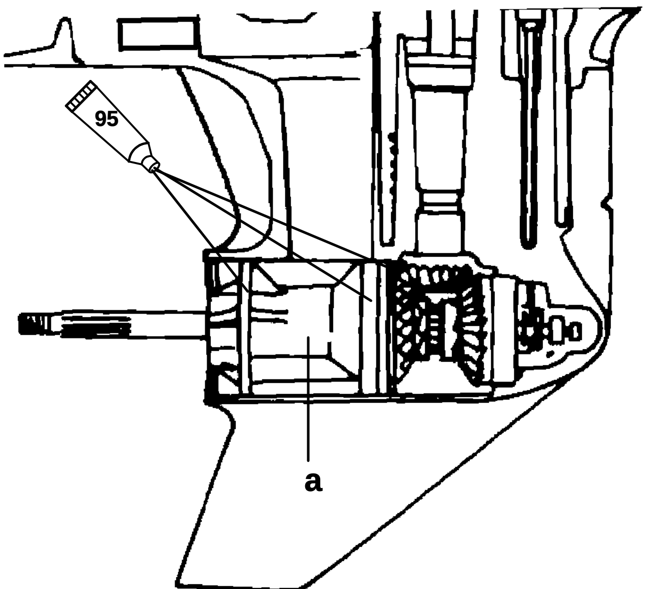


a - Top Nut (with allen screws)
b - Bottom Nut
c - Water Pump Face Plate

Bearing Carrier Assembly

Final Installation

1. Remove the Bearing Carrier and lubricate the following as specified:
   a. Lubricate the carrier O-ring with 2-4-C w/Teflon (92-825407A12).
   b. Lubricate both the forward ad aft outer diameters of the bearing carrier and gear case area where carrier will seat with 2-4-C w/Teflon.
   c. Fill the space between the carrier oil seals with 2-4-C w/Teflon.
2. Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.

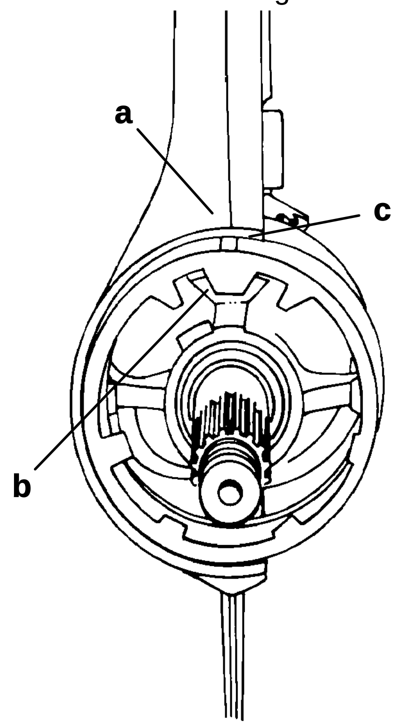


70712

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

a - Bearing Carrier Assembly

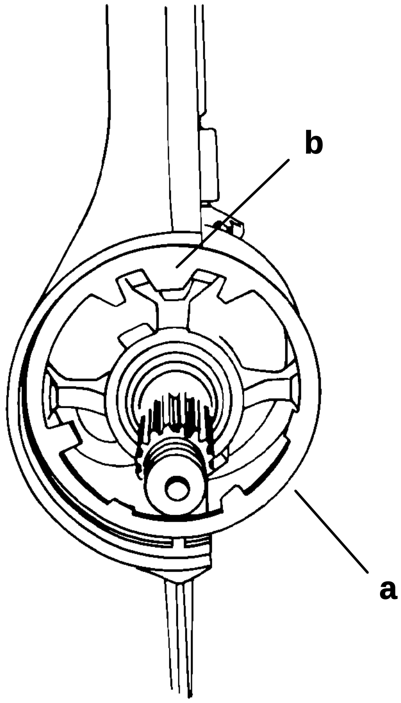
3. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Case Alignment Hole
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

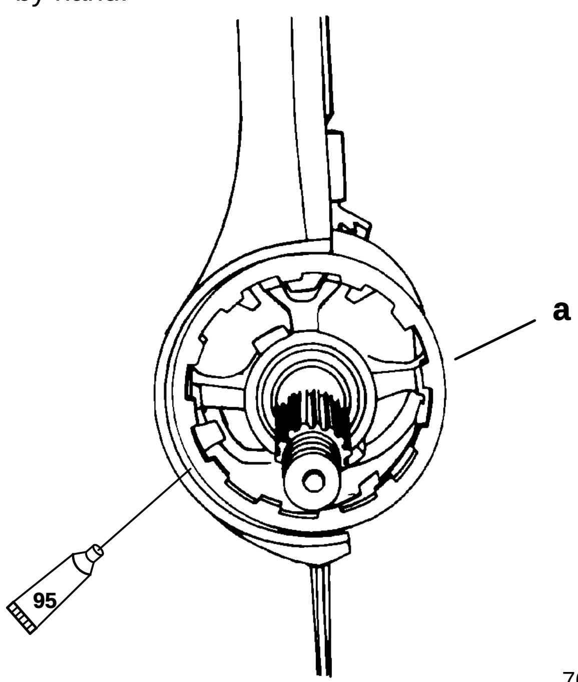
4. Verify the "V"shaped tab aligns with the "V"notch in bearing carrier.



70714

a - Tab Washer
b - "V" Tab

5. Fill the bearing carrier retainer nut threads and corresponding gear housing threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



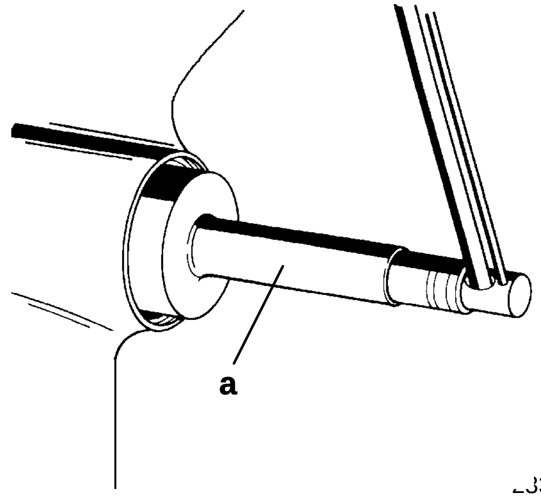
70715

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

a - Bearing Carrier Retainer

IMPORTANT: Before torquing bearing carrier retainer, gear case must be bolted to drive shaft housing or securely fastened in a gear case holding fixture to avoid possible damage to gear housing.

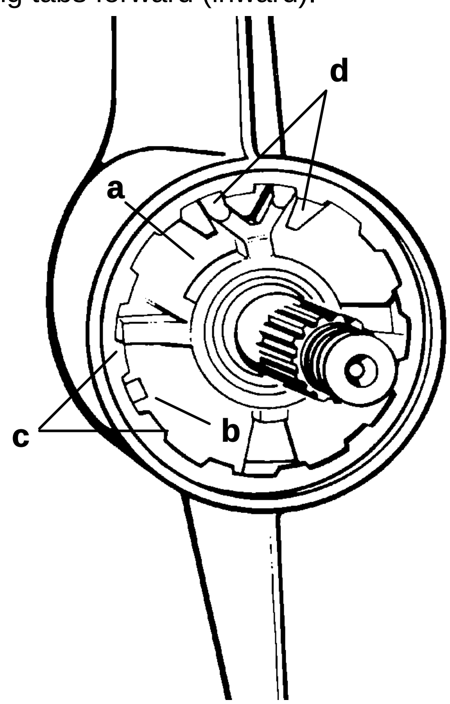
6. Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m). If one tab does not align up in space between two of the notches, continue to tighten retainer until alignment is achieved. DO NOT loosen retainer to achieve alignment.



3355

a - Bearing Carrier Retainer Wrench (91-61069)

7. Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



70490

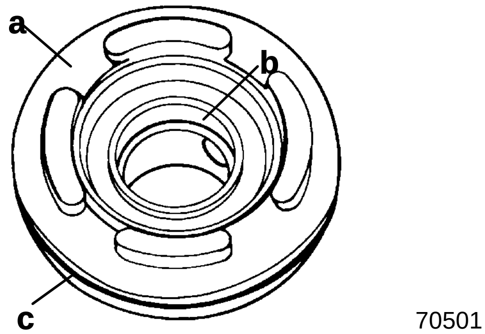
a - Bearing Carrier
b - Tab
c - Retainer Notches
d - Alignment Tabs (Bend Inward)

Oil Seal Carrier Assembly

Installation

NOTE: *Apply hand pressure only to install the oil seal carrier into position. Do not hammer it into position.*

1. Lubricate the oil seal carrier oil seal lips, space between seals and O-ring with 2-4-C w/Teflon and install the oil seal carrier over the drive shaft and into the gear case.



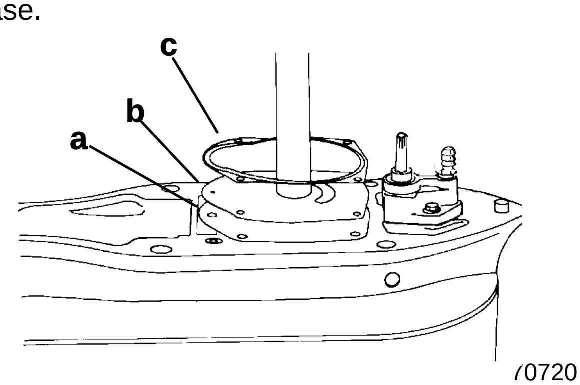
a - Oil Seal Carrier
b - Oil Seal Lips
c - O-ring

Water Pump Assembly

Installation

NOTE: *The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.*

1. Install the small hole gasket then the face plate followed by the large hole gasket onto the gear case.

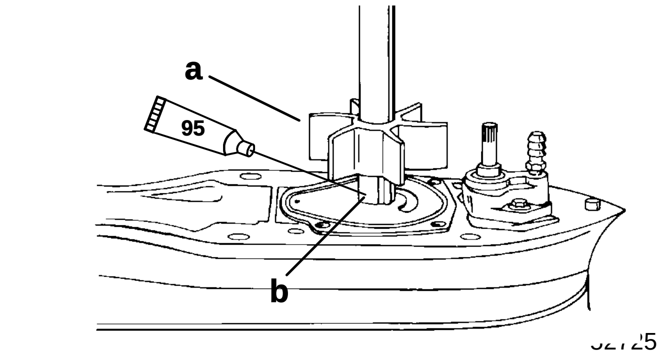


a - Small Hole gasket
b - Face Plate
c - Large Hole Gasket

2. Place a small amount of 2-4-C w/Teflon on the flat surface of the impeller key and install the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. DO NOT install the impeller with its blades oriented in a reversed direction from original rotation, or premature impeller failure <u>will</u> occur.

3. Assemble the water pump impeller onto the drive shaft and down over the key.

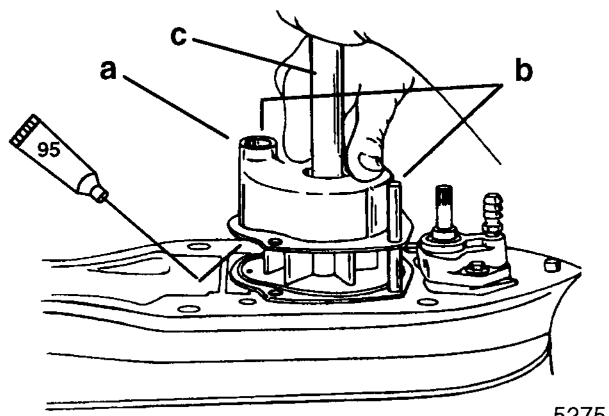


95 2-4-C With Teflon (92-825407A12)

a - Water Pump Impeller
b - Water Pump Impeller Key

4. Install the 2 water pump locating pins through the gaskets and face plate.

5. Apply a light coat of 2-4-C w/Teflon to the inside of the pump cover. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



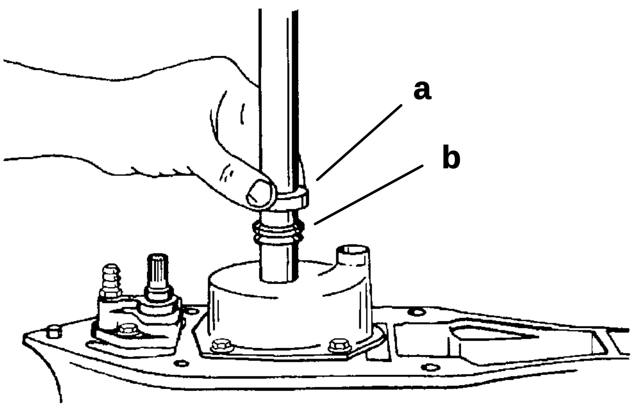
95 2-4-C With Teflon (92-825407A12)

a - Water Pump Body
b - Water Pump Alignment Pins (91-821571A1)
c - Drive Shaft (turn clockwise while installing water pump body)

6. Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Install the remaining 2 fasteners. Run all fasteners down and torque to 60 lb. in. (6.8 N·m).
7. Lightly lubricate the O-rings in the water tube coupling with 2-4-C w/Teflon (92-825407A12).
8. Install the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

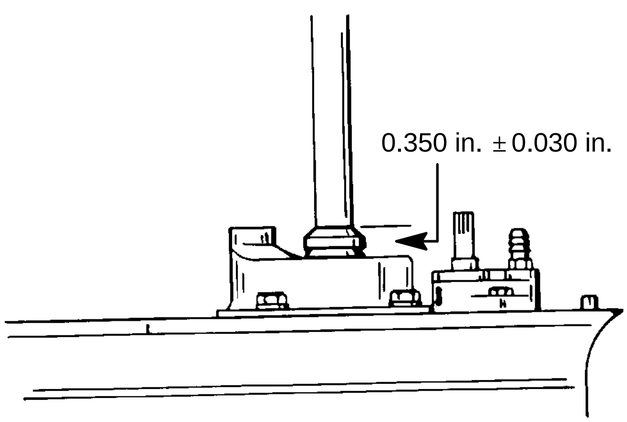
IMPORTANT: If seal installed above pump housing is not at the proper height, air will be drawn into the pump resulting in overheating of the engine.

9. Using tool (a) provided in seal kit (26-816575A2) or water pump kit (817275A3), press seal (b) down over drive shaft (DO NOT GREASE DRIVE SHAFT) until tool seats against pump housing.



52724

If tool is not available, lightly press seal against housing until a height of 0.350 in. ± 0.030 in. (8.9mm ± 0.76mm) is obtained.



52726

***NOTE:** Secure speedometer tube to speedometer connector with a sta-strap.*

Gear Lubricant Filling Instructions

1. Inspect "Fill" and "Vent" sealing washers for cuts or abrasions. Replace O-rings if necessary.
2. Clean any metal debris from magnet on "Fill" plug.

IMPORTANT: Never add lubricant to gear housing without first removing "Vent" screw, or gear housing cannot be filled because of trapped air. Fill gear housing ONLY when housing is in a vertical position.

3. Slowly fill housing thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

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

5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Drive Shaft Housing

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing into drive shaft housing.

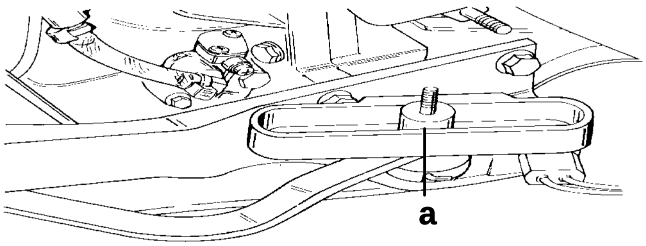
1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of 2-4-C w/Teflon onto drive shaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow drive shaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of drive shaft) will load the drive shaft/crankshaft and damage either or both the powerhead and gear housing. Top of drive shaft is to be wiped free of lubricant.

3. Apply a light coat of 2-4-C w/Teflon onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)

4. Insert a NEW trim tab bolt (with patch) into hole in rear of gear housing to drive shaft housing machined surface.
5. Shift gear housing into NEUTRAL and place guide block anchor pin into NEUTRAL position.



a - Guide Block Anchor Pin

6. Position gear housing so that the drive shaft is protruding into drive shaft housing.
7. Feed speedometer tube through opening in drive shaft housing.

NOTE: *If, while performing Step 8, the drive shaft splines will not align with crankshaft splines, have helper rotate flywheel slightly to align drive shaft splines with crankshaft.*

8. Move gear housing up toward drive shaft housing while aligning shift shaft splines and water tube.
9. Place flat washers onto studs (located on either side of drive shaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

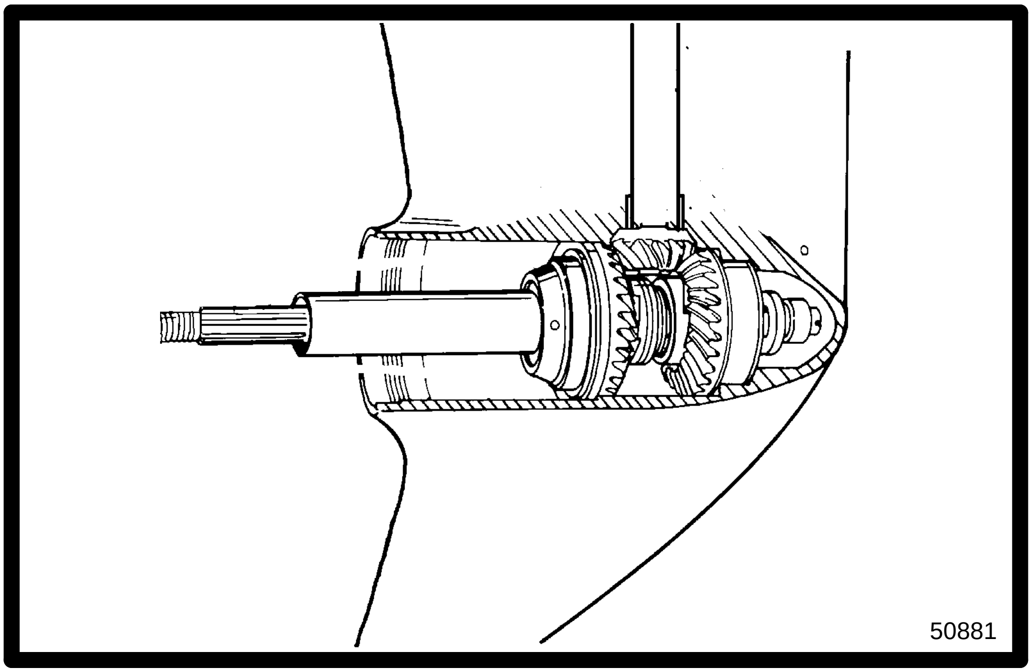
IMPORTANT: Do not force gear case up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to 55 lb. ft. (74.6 N·m).
13. After 2 nuts (located on either side of drive shaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install remaining washers and nuts onto drive shaft studs. Torque to 55 lb. ft. (74.6 N·m).
15. Torque bolt (started in Step 10) to 45 lb. ft. (61.0 N·m).
16. Position trim tab in gear housing aligning grooves of trim tab with ribs in trim tab pocket. Adjust to position in which it had previously been installed, and while holding trim tab, torque bolt to 40 lb. ft. (54.2 N·m)
17. Install plastic cap into trim tab bolt opening at rear edge of drive shaft housing.

LOWER UNIT



GEAR HOUSING
LEFT HAND OPERATION
(COUNTER ROTATION)
(RATCHETING AND NON-RATCHETING)

6

B

Table of Contents

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s). It is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

Disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Table of Contents" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon (92-825407A12) on all O-rings. To prevent wear, apply 2-4-C w/Teflon on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver Perfect Seal or 2-4-C w/Teflon to external surfaces of bearing carrier and retainer nut threads prior to installation. DO NOT allow Perfect Seal to enter bearings or O-ring area.

NOTE: *Before filling gear case, apply 10-15 psi (68.5 – 102.7kPa) of air pressure at the VENT hole. Pressure should not drop for 15 seconds while alternately applying a 2-3 pound force to the top of the shift shaft in the fore and aft direction.*

Gear Housing Specifications (Counter Rotation)

Backlash and Pinion Depth (Ratcheting and Non-Ratcheting)

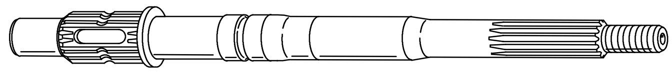
Pinion Depth	
All Models	0.025 in. (0.64mm) with Tool 91-12349A2 Using Disc 2 and Flat 4
Forward Gear Backlash	
1.64:1and 1.75:1 Gear Ratios **1.62:1 Gear Ratio Service Replacement**	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-53549
Reverse Gear Backlash	
1.64:1and 1.75:1 Gear Ratios **1.62:1 Gear Ratio Service Replacement**	0.040 in. to 0.060 in. (1.01mm to 1.52mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)
Forward Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-78473
Reverse Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.040 in. to 0.060 in. (1.01mm to 1.52mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)

Gear Ratio	Teeth in Pinion Gear	Teeth in Forward and Reverse Gear
1.62:1	13	21
1.64:1	17	28
1.75:1	12	21
1.87:1	15	28

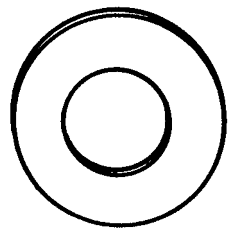
Water Pressure	
Idle	1-1/2 – 4-1/2 psi (10.3 – 30.8kPa)
Poppet Valve Opening	6 – 7 psi (41.1 – 47.9kPa)
W.O.T.	8-10 psi 54.9 – 68.5kPa)
Test Propeller for Static Test	
12 Dia. x 15 Pitch	48-78116A40

Special Tools

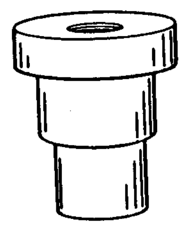
Propeller Shaft 44-93003 and Load Washer 12-37429



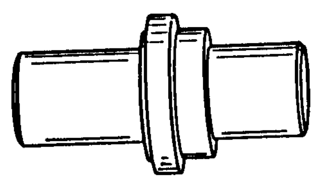
Bellville Washer 12-54048



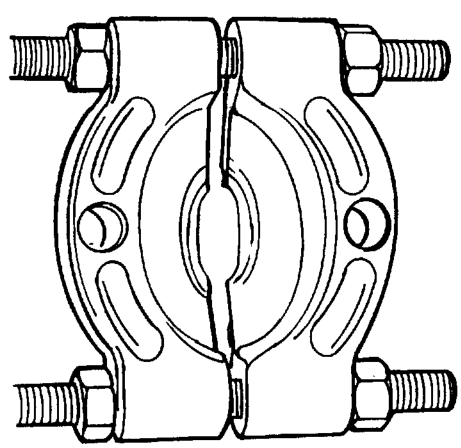
Needle Bearing Driver 91-15755



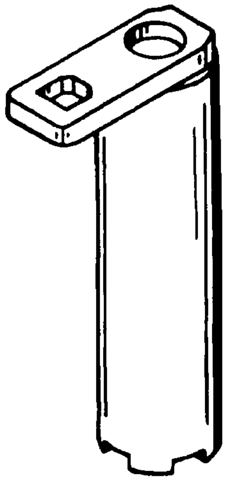
Oil Seal Driver 91-31108



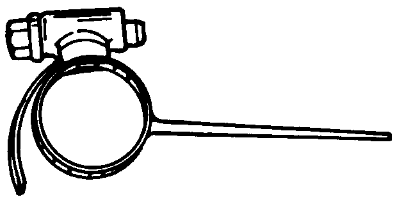
Universal Puller Plate 91-37241



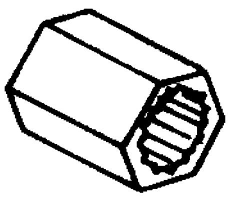
Bearing Retainer Tool 91-43506



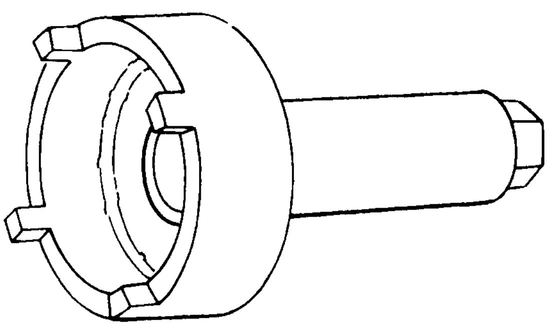
Backlash Indicator Rod 91-53459



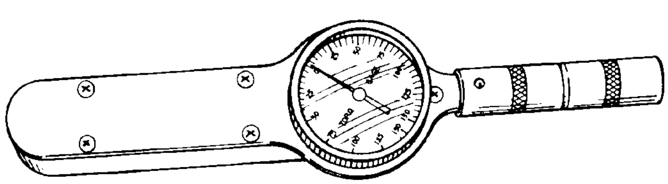
Drive Shaft Nut Wrench 91-56775



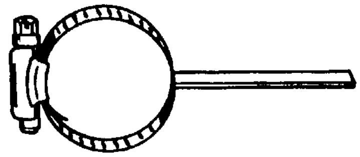
Bearing Carrier Retainer Wrench 91-61069



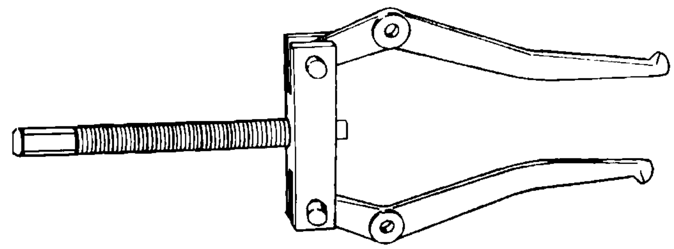
Torque Wrench (lb. in.) 91-66274



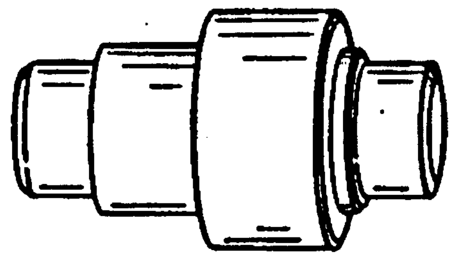
Backlash Indicator Rod 91-78473



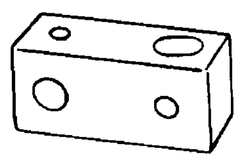
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



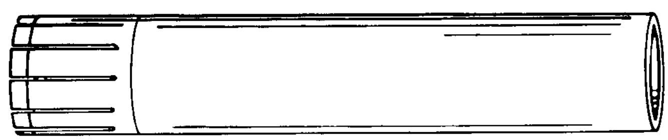
Forward Gear Bearing Tool 91-86943



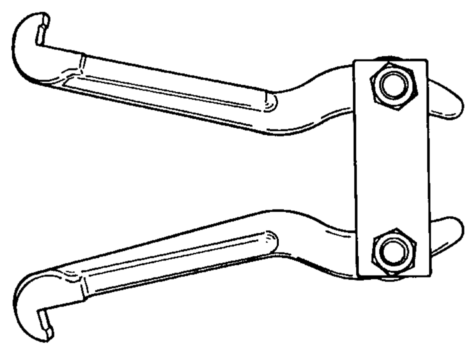
Dial Indicator Holding Tool 91-89897



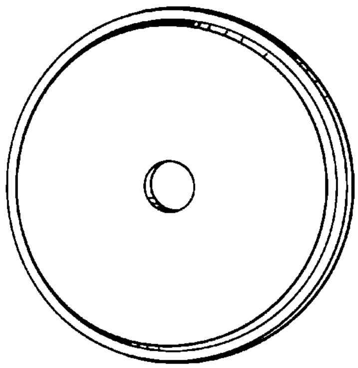
Forward Gear Installation Tool 91-815850



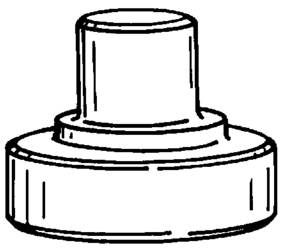
Puller Jaws 91-816242



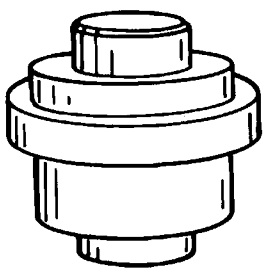
Guide Plate 91-816243



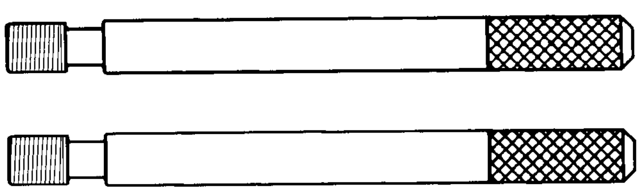
Bearing Driver 91-816244



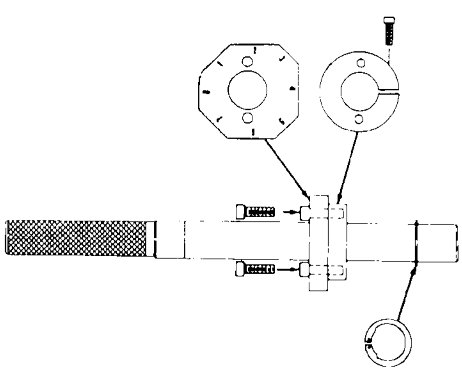
Oil Seal Driver 91-817569



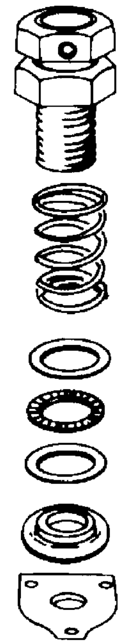
Water Pump Alignment Pins 91-82157A1



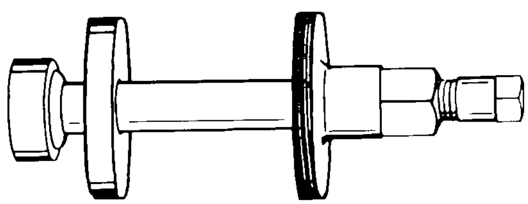
Pinion Gear Shimming Tool 91-12349A2



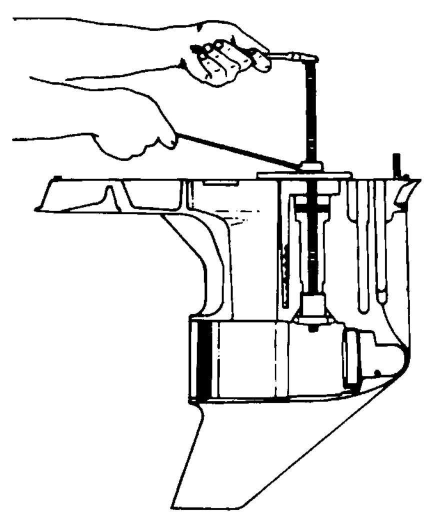
Bearing Preload Tool 91-14311A2



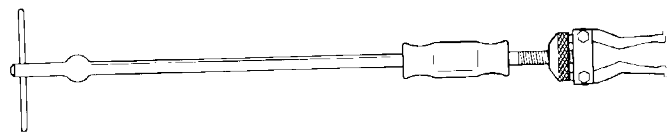
Bearing Adaptor Installation Tool 91-18605A2



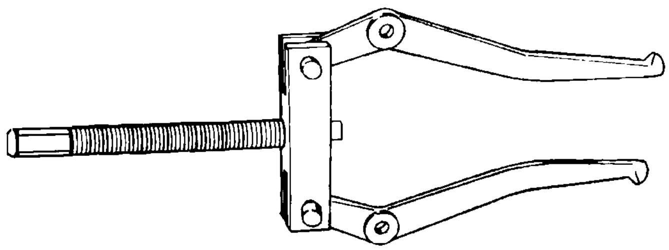
Bearing Removal and Installation Tool 91-31229A7 – Includes Driver Head 91-36569: Driver Head Rod 91-37323; Nut 11-24156; Pilot Washer 91-36571; Pilot Plate 91-29610; Puller/Driver Head 91-38628; Mandrel 91-30366; Plate 91-29310; Driver Head 91-32325; Puller Shaft 91-31229; Washer 91-34961.



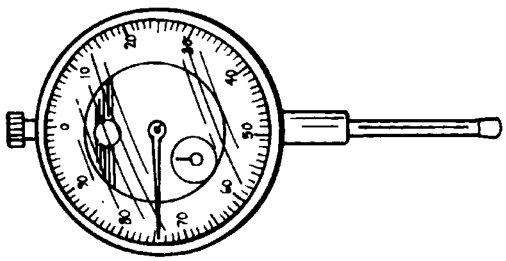
Slide Hammer Puller 91-34569A1



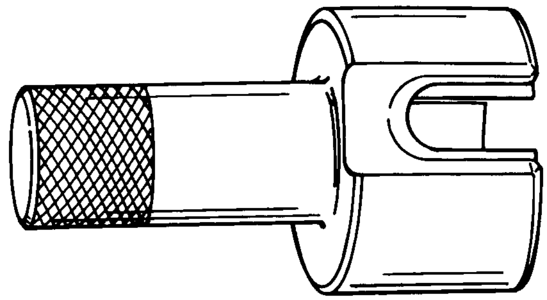
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



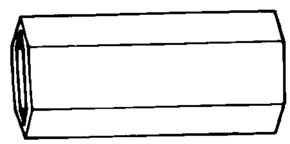
Dial Indicator 91-58222A1



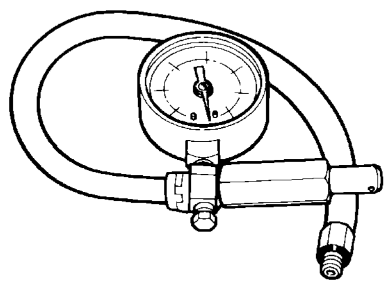
Pinion Nut Adaptor 91-61067A3



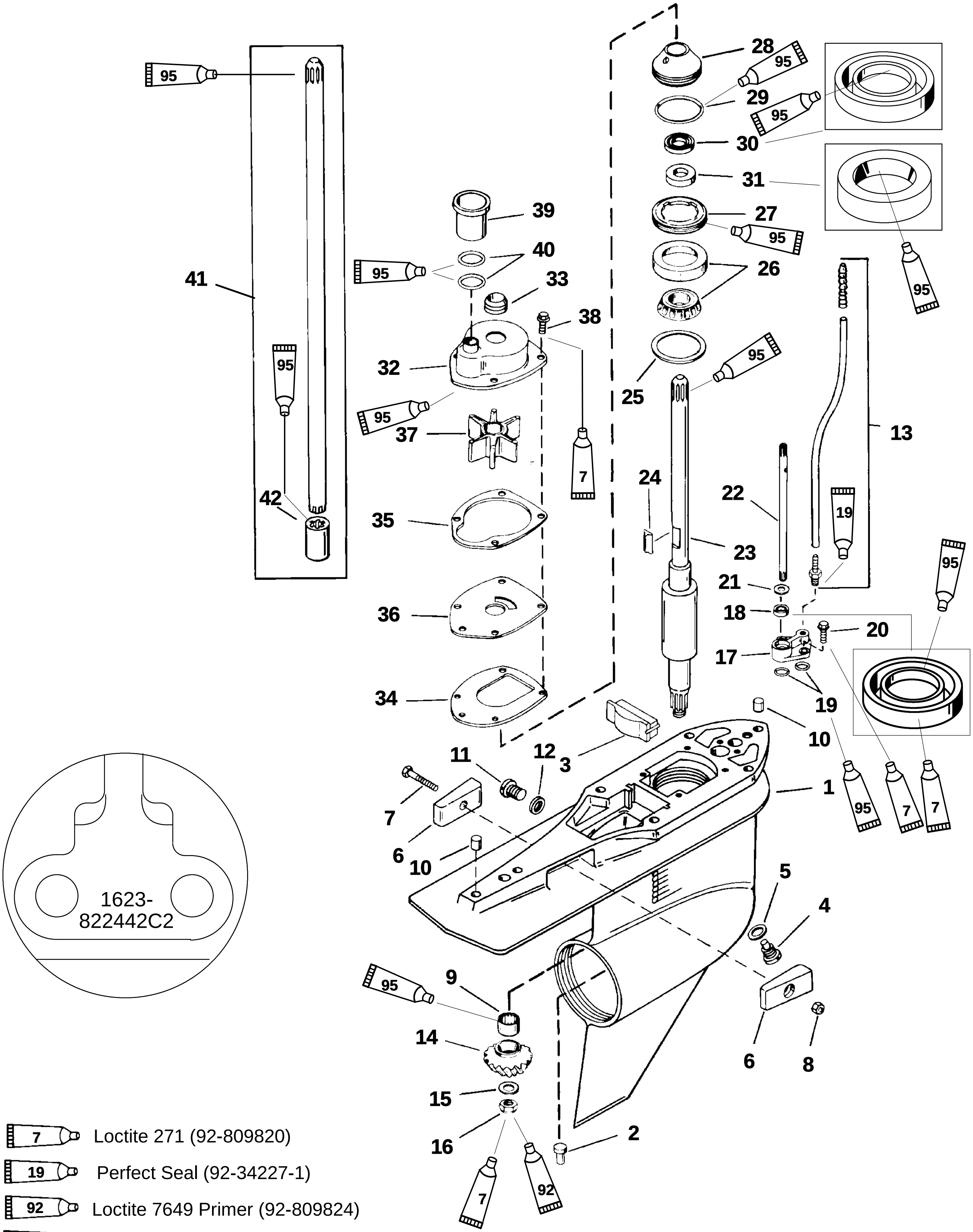
Drive Shaft Adaptor 91-61077



Leakage Tester FT8950



Gear Housing (Drive Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



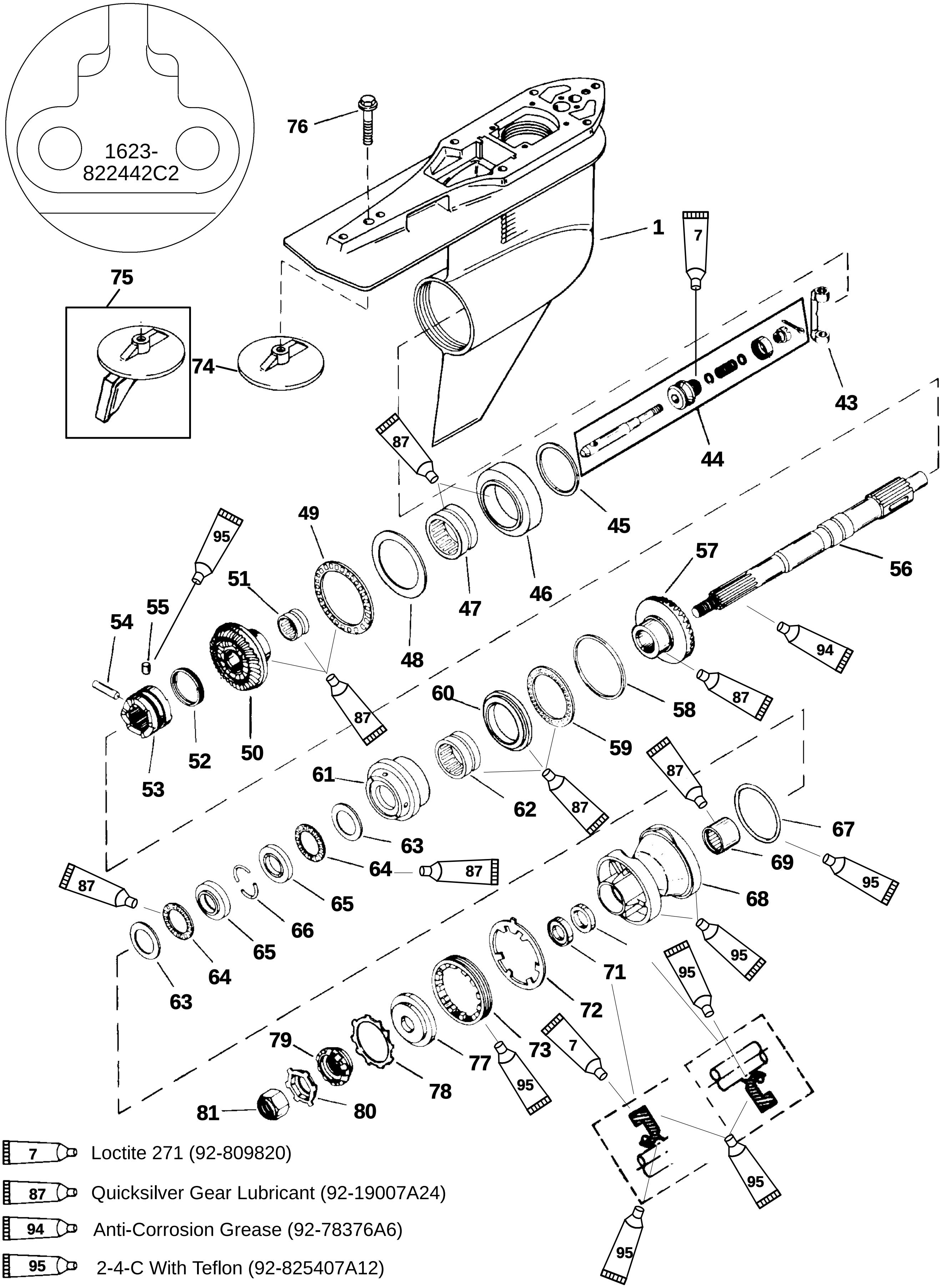
7	Loctite 271 (92-809820)
19	Perfect Seal (92-34227-1)
92	Loctite 7649 Primer (92-809824)
95	2-4-C With Teflon (92-825407A12)

Gear Housing (Drive Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR **(X-LONG)**			
	1	CONNECTOR **(XX-LONG)**			
14	1	PINION GEAR (Part of 43-826287A1 or 43-812975A5 or 43-828289A3)			
15	1	WASHER			
16	1	NUT		75	101
17	1	BUSHING ASSEMBLY			
18	1	OIL SEAL			
19	2	O RING			
20	2	SCREW	60		6.8
21	1	RUBBER WASHER			
22	1	SHIFT SHAFT (LOWER)			
23	1	DRIVE SHAFT (LOWER)			
24	1	KEY			
25	AR	SHIM			
26	1	TAPERED ROLLER BEARING			
27	1	RETAINER		100	135
28	1	CARRIER ASSEMBLY			
29	1	O RING			
30	1	OIL SEAL			
31	1	OIL SEAL			
32	1	WATER PUMP ASSEMBLY			
33	1	SEAL			
34	1	GASKET			
35	1	GASKET			
36	1	FACE PLATE			
37	1	IMPELLER			
38	4	SCREW	60		6.8
39	1	COUPLING ASSEMBLY			
40	2	O RING			
41	1	DRIVESHAFT KIT **(LONG-20 IN.)** **SEE NOTE 13 SPLINES**			
	1	DRIVESHAFT KIT **(X-LONG-25 IN.)**			
	1	DRIVESHAFT KIT **(X-LONG-30 IN.)**			
	1	DRIVESHAFT KIT **(LONG-20 IN.)** **SEE NOTE 8 SPLINES**			
	1	DRIVESHAFT KIT **(X-LONG-25 IN.)**			
	1	DRIVESHAFT KIT **(XX-LONG-30 IN.)**			
42	1	COUPLING			

NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 23 & 41.

Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-19007A24)

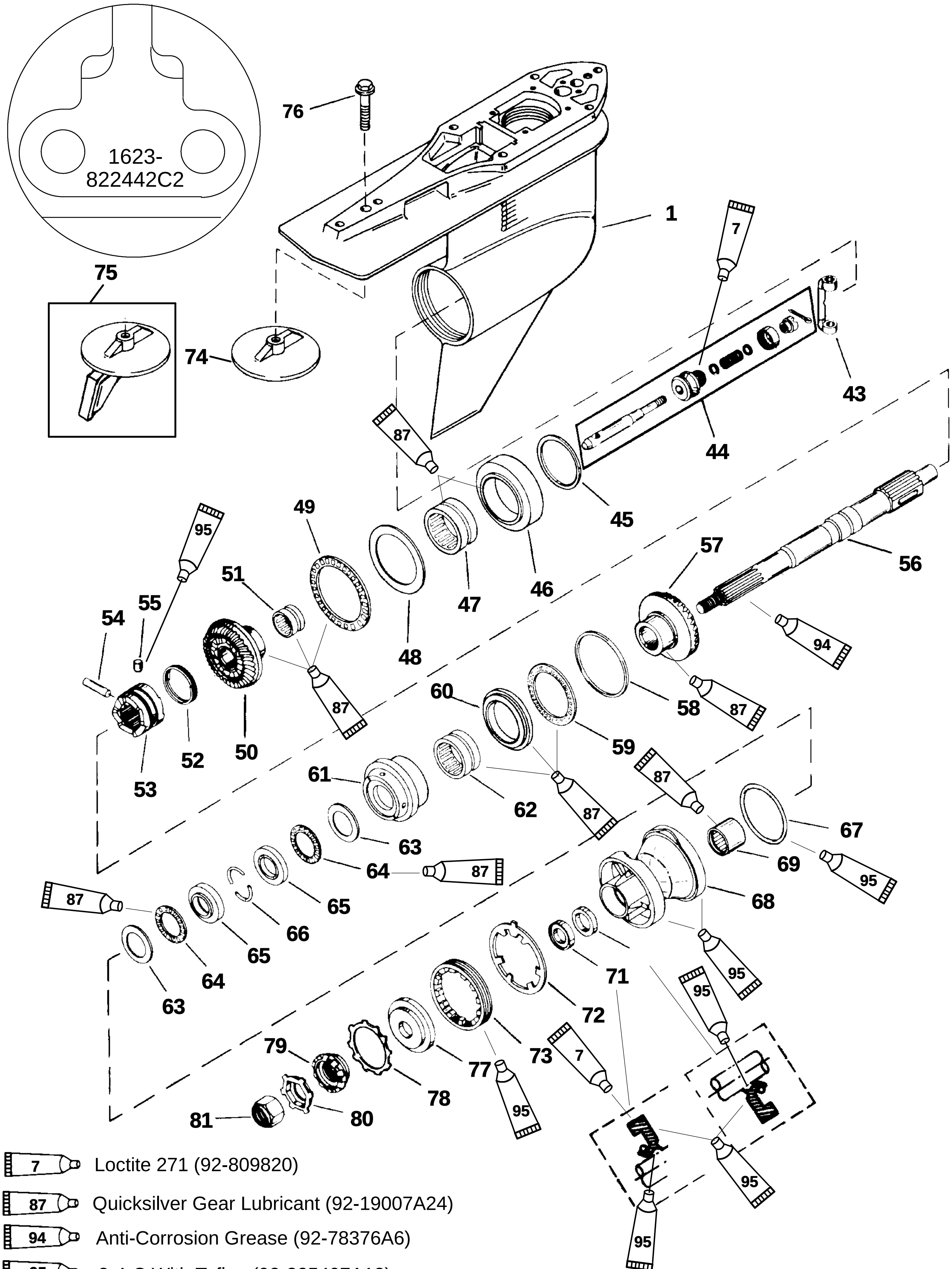
94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
43	1	SHIFT CRANK			
44	1	SHIFT SPOOL KIT			
45	AR	SHIM			
46	1	BEARING ADAPTOR ASSEMBLY **(1623-822442C2 CASTING)**			
47	1	ROLLER BEARING			
48	1	THRUST WASHER			
49	1	THRUST BEARING			
50	1	REVERSE GEAR **(1.75:1 GEAR RATIO)**			
	1	REVERSE GEAR **(1.64:1 GEAR RATIO)**			
	1	REVERSE GEAR **(1.62:1 GEAR RATIO)**			
51	1	ROLLER BEARING			
52	1	SPRING			
53	1	SLIDING CLUTCH			
54	1	CROSS PIN			
55	1	DETENT PIN			
56	1	PROPELLER SHAFT			
57	1	FORWARD GEAR (Includes Pinion)**(1.75:1 GEAR RATIO)**			
	1	FORWARD GEAR (Includes Pinion)**(NOTE: THIS COMPLETE GEAR SET IS A 1.62:1 GEAR RATIO REPLACING A 1.64:1 GEAR RATIO)**			
58	AR	SPACER SHIM .206 IN.			
	AR	SPACER SHIM .208 IN.			
	AR	SPACER SHIM .210 IN.			
	AR	SPACER SHIM .212 IN.			
	AR	SPACER SHIM .214 IN.			
	AR	SPACER SHIM .216 IN.			
	AR	SPACER SHIM .218 IN.			
	AR	SPACER SHIM .220 IN.			
	AR	SPACER SHIM .222 IN.			
	AR	SPACER SHIM .224 IN.			
	AR	SPACER SHIM .226 IN.			
	AR	SPACER SHIM .228 IN.			
	AR	SPACER SHIM .230 IN.			

Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-19007A24)

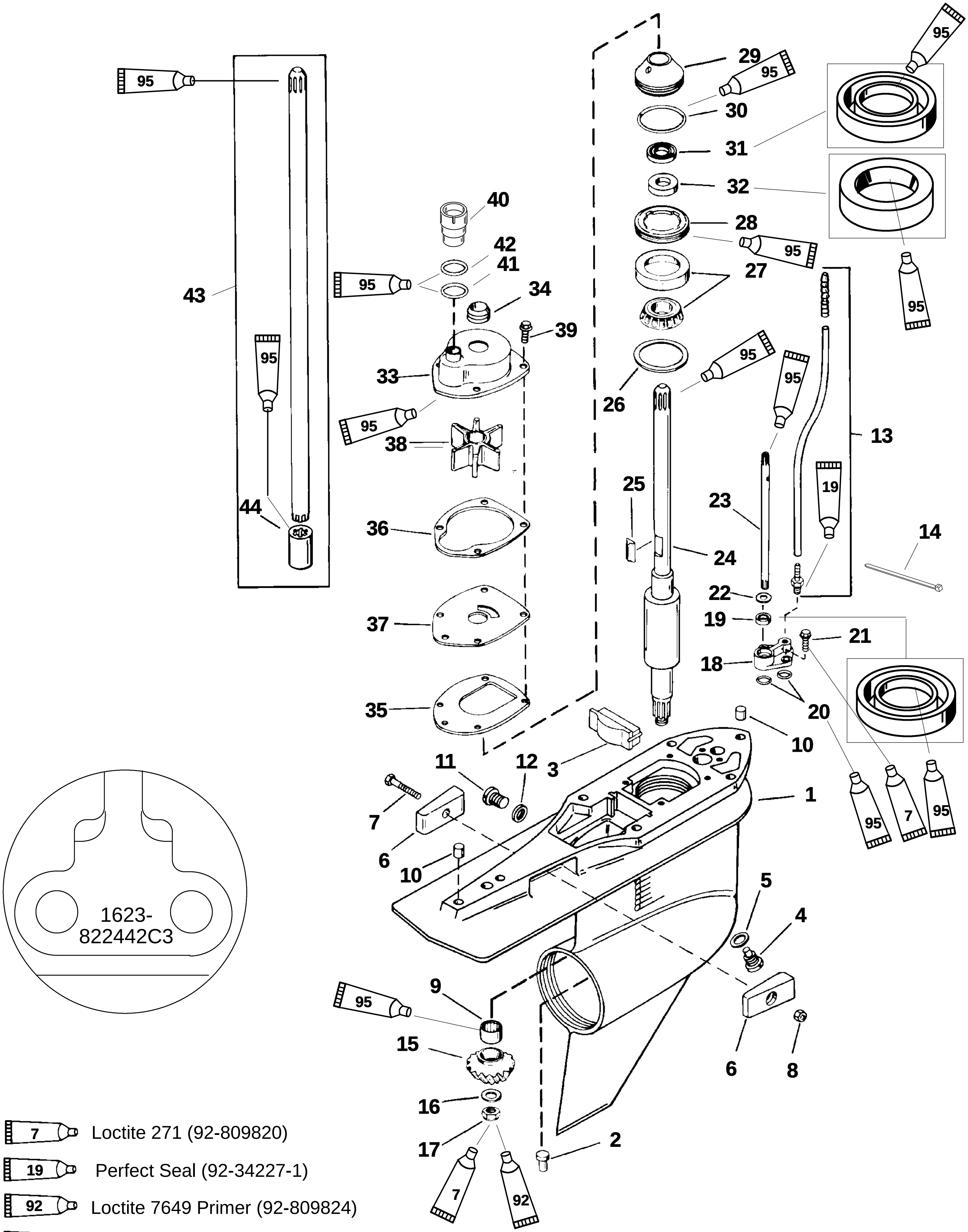
94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
59	1	ROLLER BEARING			
60	1	THRUST RING			
61	1	BEARING ADAPTOR ASSEMBLY			
62	1	ROLLER BEARING			
63	2	THRUST WASHER			
64	2	THRUST BEARING			
65	2	THRUST RACE			
66	2	KEEPER			
67	1	O RING			
68	1	BEARING CARRIER ASSEMBLY			
69	1	ROLLER BEARING			
70	1	OIL SEAL (INSIDE)			
71	1	OIL SEAL (OUTSIDE)			
72	1	TAB WASHER			
73	1	RETAINER	210		285
74	1	ANODIC PLATE			
75	1	TRIM TAB **(ANODIC)**			
	1	TRIM TAB **(BLACK ALUMINUM)**			
76	1	SCREW **THESE REPLACEMENT**		40	54.2
77	1	THRUST HUB **PARTS ARE NOT**			
78	1	LOCKWASHER **INCLUDED WITH**			
79	1	WASHER **COMPLETE GEAR**			
80	1	TAB WASHER **REPLACEMENT**			
81	1	PROPELLER NUT		55	74.6

Gear Housing (Drive Shaft)(Counter Rotation)(Non-Ratcheting)(S/N-0G438000 & UP)(CASTING #1623-822442C3)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

92 Loctite 7649 Primer (92-809824)

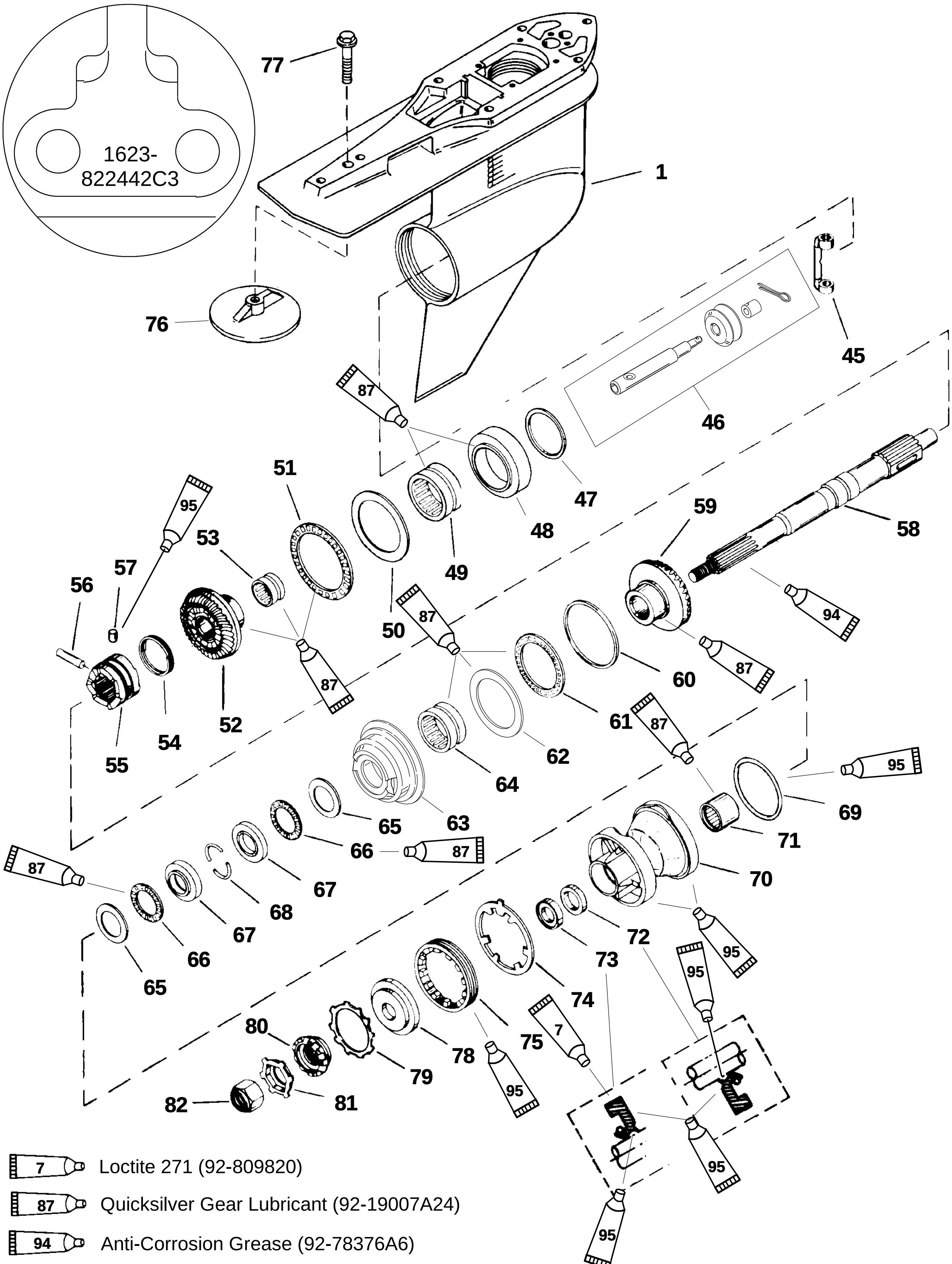
95 2-4-C With Teflon (92-825407A12)

Gear Housing (Drive Shaft)(Counter Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW ASSEMBLY	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR **(XL)**			
	1	CONNECTOR **(XXL)**			
14	1	CABLE TIE			
15	1	PINION GEAR (Part of 43-828695A1)			
16	1	WASHER			
17	1	NUT		75	101
18	1	BUSHING ASSEMBLY			
19	1	OIL SEAL			
20	2	O RING			
21	2	SCREW	60		6.8
22	1	RUBBER WASHER			
23	1	SHIFT SHAFT (LOWER)			
24	1	DRIVE SHAFT (LOWER)			
25	1	KEY			
26	AR	SHIM			
27	1	TAPERED ROLLER BEARING			
28	1	RETAINER		100	135
29	1	CARRIER ASSEMBLY			
30	1	O RING			
31	1	OIL SEAL			
32	1	OIL SEAL			
33	1	WATER PUMP ASSEMBLY			
34	1	SEAL			
35	1	GASKET			
36	1	GASKET			
37	1	FACE PLATE			
38	1	IMPELLER			
39	4	SCREW	60		6.8
40	1	COUPLING ASSEMBLY			
41	1	O RING			
42	1	O RING			
43	1	DRIVESHAFT KIT **(XL)** **SEE NOTE**			
	1	DRIVESHAFT KIT **(XXL)**			
44	1	COUPLING			

NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 24 & 43.

Gear Housing (Prop Shaft)(Counter Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-19007A24)

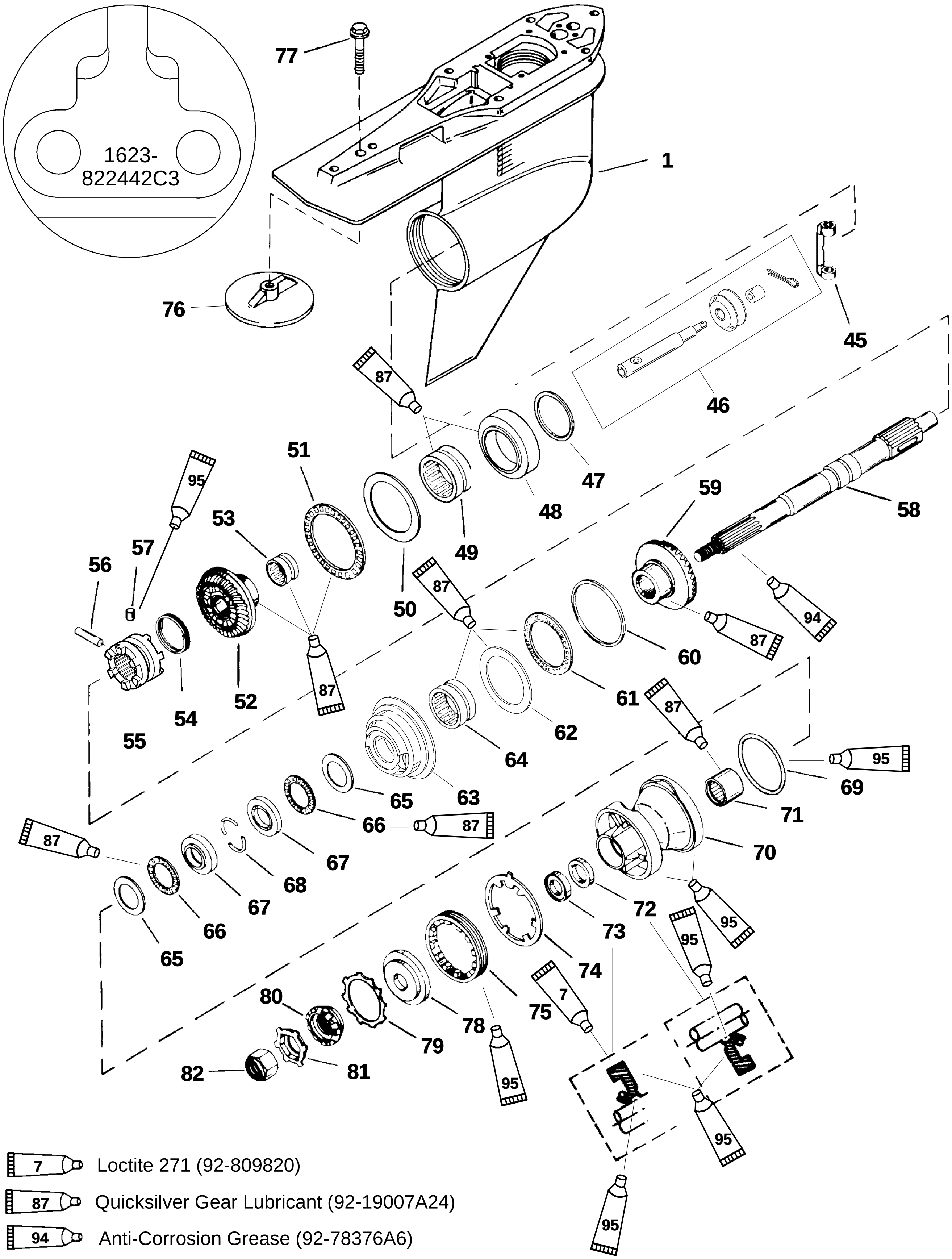
94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft)(Counter Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
45	1	SHIFT CRANK			
46	1	SHIFT SPOOL KIT			
47	AR	SHIM			
48	1	BEARING ADAPTOR ASSEMBLY			
49	1	ROLLER BEARING			
50	1	THRUST WASHER			
51	1	THRUST BEARING			
52	1	REVERSE GEAR			
53	1	ROLLER BEARING			
54	1	SPRING			
55	1	SLIDING CLUTCH			
56	1	CROSS PIN			
57	1	DETENT PIN			
58	1	PROPELLER SHAFT			
59	1	FORWARD GEAR (Includes Pinion)			
60	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)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-19007A24)

94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft)(Counter Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(BASIC-BLACK)**			
	1	GEAR HOUSING **(BASIC-GRAY)**			
	1	GEAR HOUSING **(BASIC-WHITE)**			
61	1	ROLLER BEARING			
62	1	THRUST RING			
63	1	BEARING ADAPTOR ASSEMBLY			
64	1	ROLLER BEARING			
65	2	THRUST WASHER			
66	2	THRUST BEARING			
67	2	THRUST RACE			
68	2	KEEPER			
69	1	O RING			
70	1	BEARING CARRIER ASSEMBLY			
71	1	ROLLER BEARING			
72	1	OIL SEAL (INSIDE)			
73	1	OIL SEAL (OUTSIDE)			
74	1	TAB WASHER			
75	1	RETAINER		210	285
76	1	ANODIC PLATE			
77	1	SCREW **THESE REPLACEMENT**		40	54.2
78	1	THRUST HUB **PARTS ARE NOT**			
79	1	LOCKWASHER **INCLUDED WITH**			
80	1	WASHER **COMPLETE GEAR**			
81	1	TAB WASHER **REPLACEMENT**			
82	1	PROPELLER NUT		55	74.6

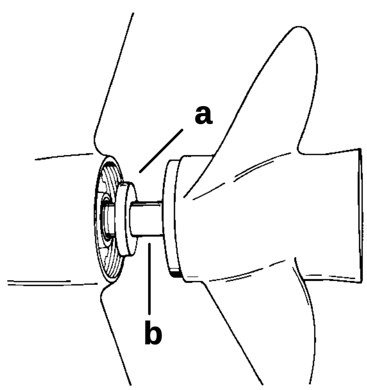
Removal, Disassembly, Cleaning and Inspection – Counter Rotation (Ratcheting and Non-Ratcheting)

REMOVAL

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from drive shaft housing.

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



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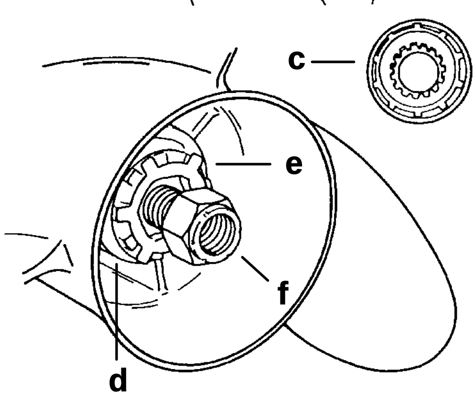
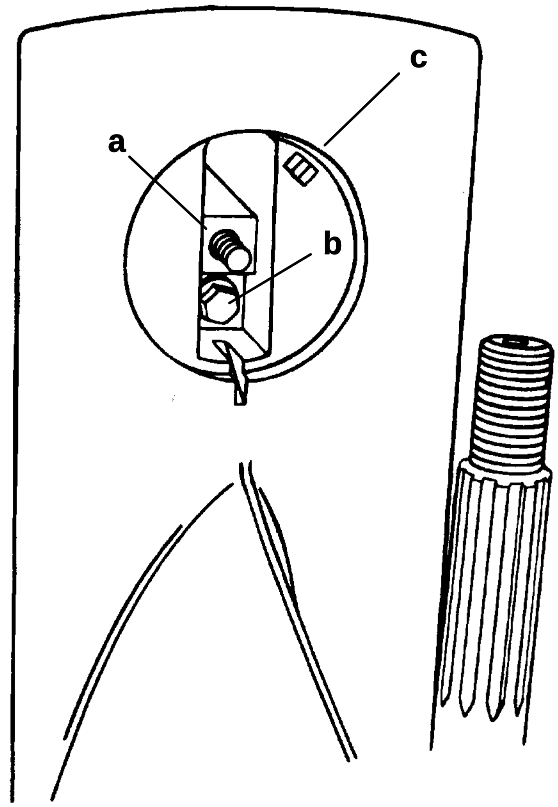


51916

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

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of drive shaft housing, then unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

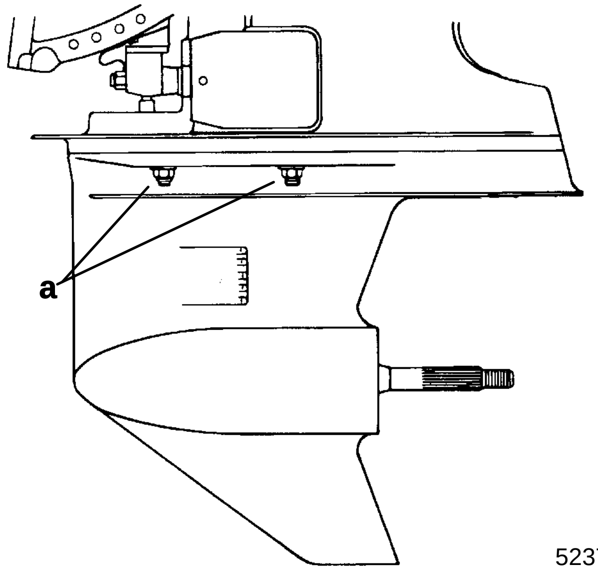


52375

a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Ribs – Align Carefully with Trim Tab while Securing Tab

7. Disconnect speedometer tube, if connected.
8. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or drive shaft housing could be damaged.)
9. Pull gear housing away from drive shaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)

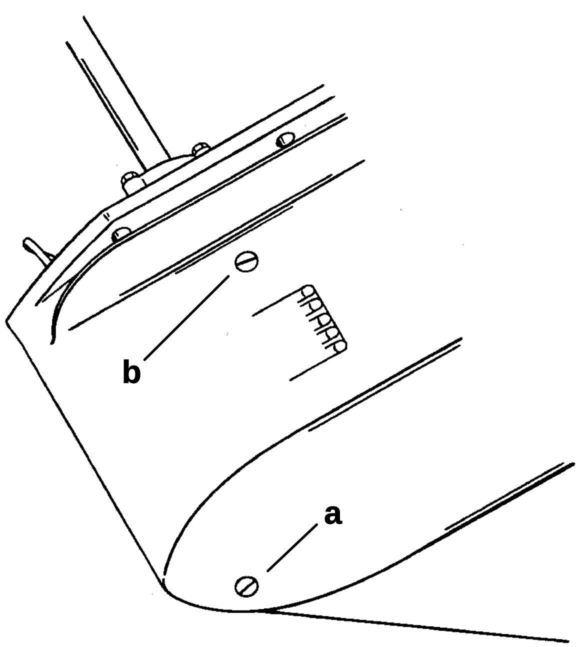
10. Pull gear housing from drive shaft housing.



a - Side Mounting Locknut (One Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the drive shaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing. Do not loose sealing washers on FILL and VENT screws.



a - "Fill" Screw
b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

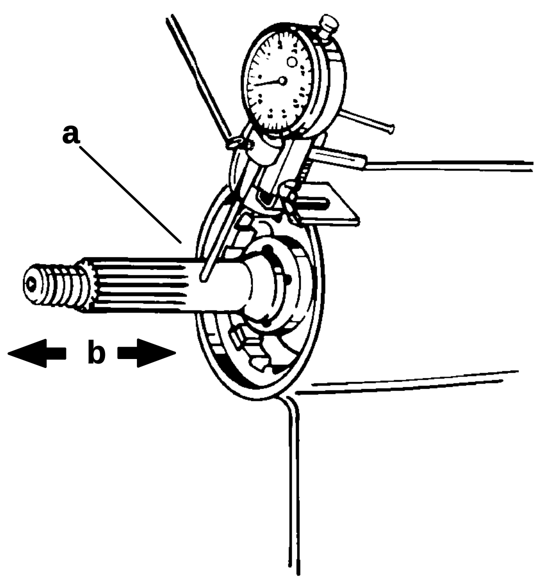
NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*

Pre-Disassembly Inspection

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
   a. Position the dial indicator on the propeller shaft.
   b. Push the propeller shaft to one side and zero the dial indicator.
   c. Move the propeller shaft to the opposite side while observing the dial indicator. Without rotating the propeller shaft, reposition the dial indicator and check the up and down deflection. A shaft deflection of more than 0.003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
   a. Rotate the propeller shaft while observing the dial indicator. If the deflection is more than 0.009 in. (0.23 mm), a bent propeller shaft is indicated.
3. Measure propeller shaft endplay. If it is in excess of 0.093 in. (2.36mm), disassemble gear case and check condition of the reverse shoulder of the propeller shaft, reverse gear and thrust washer. Replace components as required.



22086

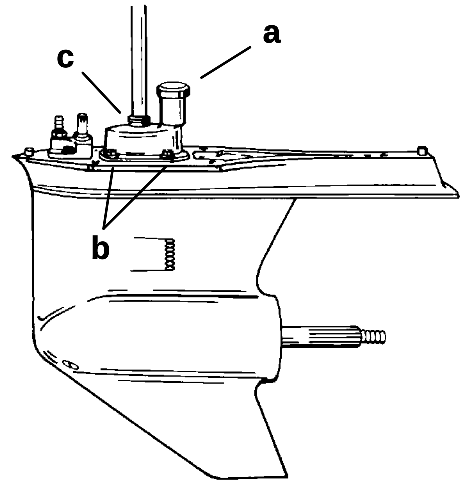
a - Prop Shaft Runout
b - Prop Shaft Endplay

Gear Housing and Component Disassembly

Water Pump Assembly

REMOVAL

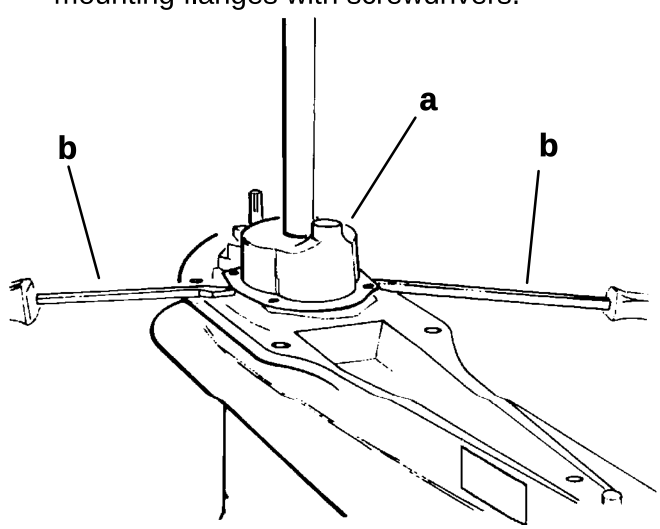
1. Remove the water seal, water tube coupling assembly, and the water pump screws.



52749

a - Water Tube Assembly
b - Water Pump Screws (4)
c - Seal

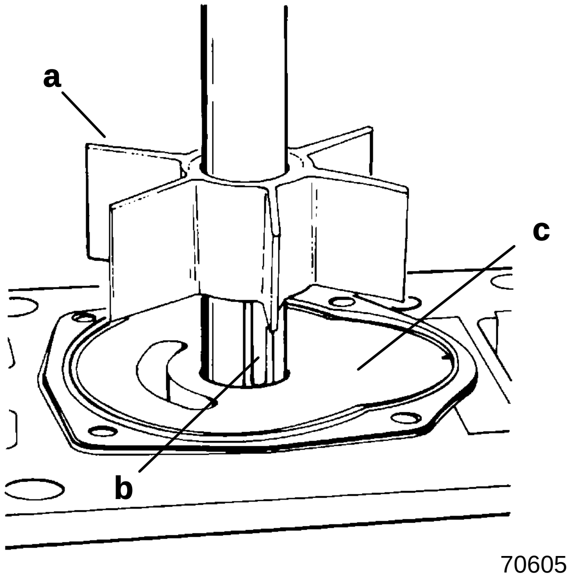
2. Carefully slide the water pump straight up off of the drive shaft. It may be necessary to encourage the water pump up by gently prying up on its mounting flanges with screwdrivers.



70487

a - Water Pump Body
b - Screw Drivers

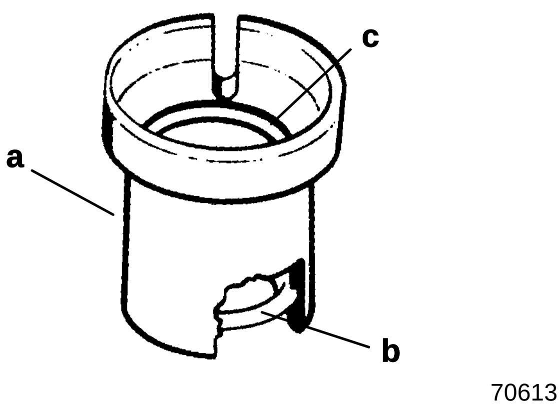
3. Remove the impeller, impeller key, the face plate and gaskets, (discard the gaskets).



a - Impeller
b - Impeller Key
c - Water Pump Face Plate and Gaskets (One on each side of the face plate)

WATER PUMP ASSEMBLY - COMPONENT INSPECTION

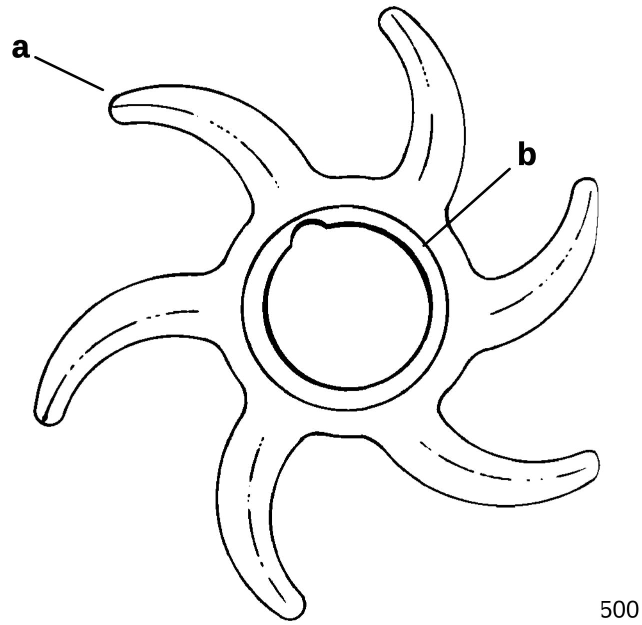
1. Inspect the water tube coupling assembly for wear or damage. If necessary, replace the worn or damaged components especially the two O-rings on the inside, one at the top and one at the bottom.



a - Water Tube adapter
b - O-rings (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.

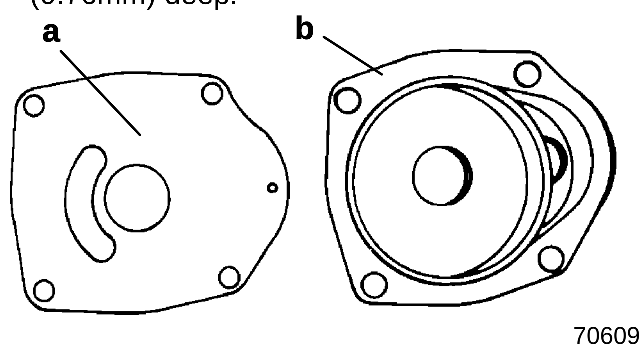


a - Impeller
b - Hub

4. Inspect the impeller blades to see if they are cracked, burnt, hard or deformed. Replace the impeller if the blades are in this condition.

IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate. The depth of the groove will not affect water pump output.

5. Replace cover if thickness of steel at the discharge slot is 0.060 in. (1.5mm) or less or if grooves (other than impeller sealing bead groove) in cover roof are more than 0.030 in. (0.76mm) deep.

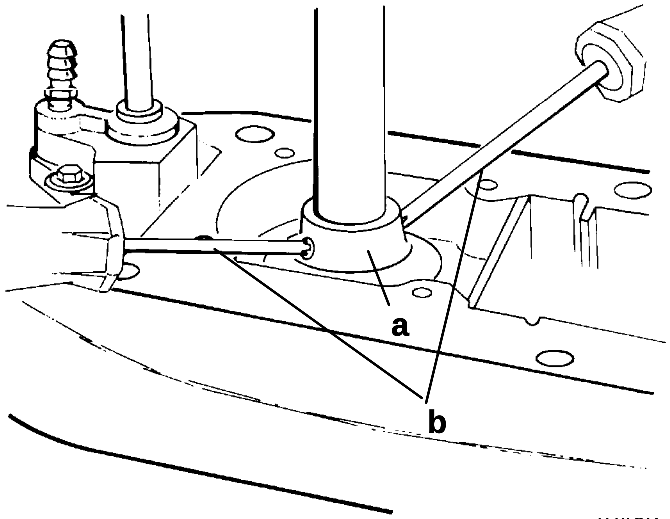


a - Water Pump Face Plate
b - Water Pump Cover

Oil Seal Carrier Assembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screw drivers.



70489

a - Oil Seal Carrier
b - Screwdrivers

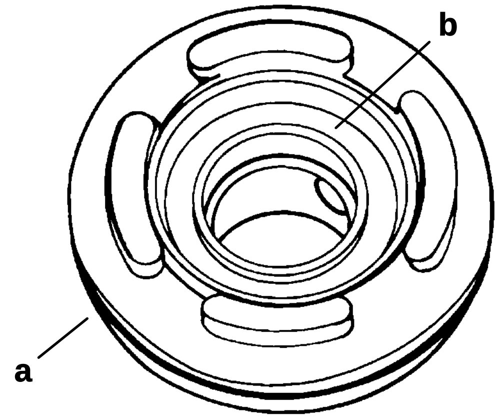
OIL SEAL CARRIER ASSEMBLY - INSPECTION

1. Inspect the oil seal carrier, O-ring, and seals for wear and/or damage. If necessary, replace defective parts as outlined following.

OIL SEAL CARRIER ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

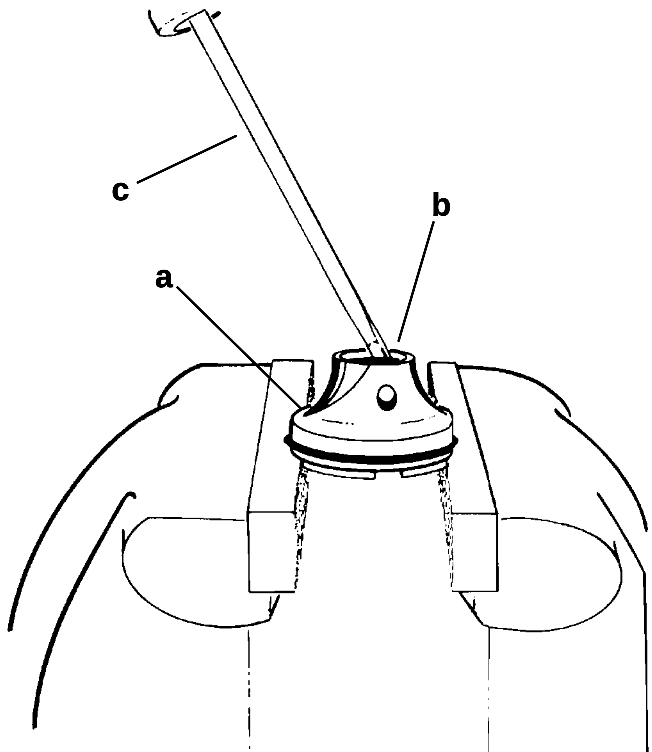
1. Remove the O-ring.



70501

a - O-ring
b - Oil Seals (2)

2. Remove the oil seals.

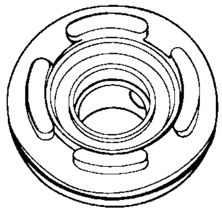


70610

a - Oil Seal Carrier
b - Oil Seals
c - Screwdriver

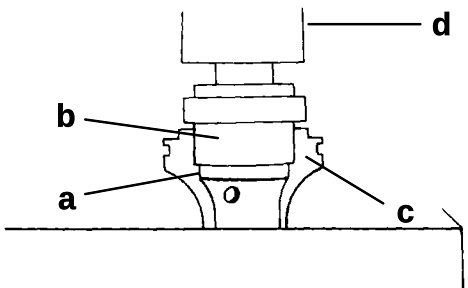
OIL SEAL CARRIER ASSEMBLY - COMPONENT REASSEMBLY (1994/1995 MODELS)

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*



70501

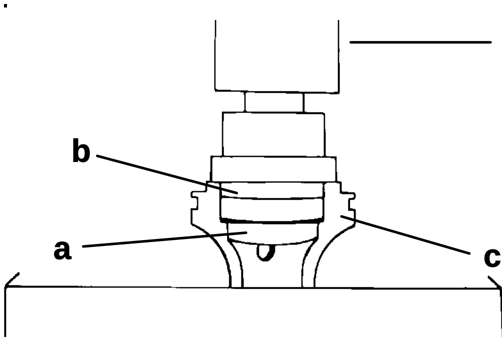
1. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.
2. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70611

a - Oil Seal
b - Oil Seal Driver (91-817569) use long end
c - Oil Seal Carrier
d - Press

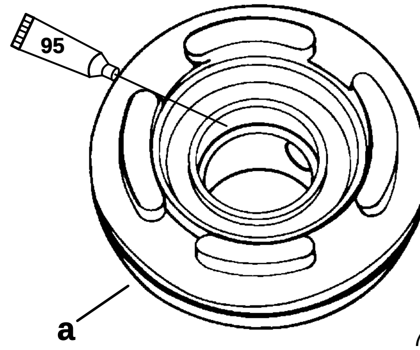
3. Assemble the large oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
4. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70612

a - Oil Seal
b - Oil Seal Driver (91-817569) use short end
c - Oil Seal Carrier
d - Press

5. Fill the area between the seal lips with 2-4-C w/Teflon. Apply 2-4-C w/Teflon to the O-ring.
6. Install the O-ring onto the oil seal carrier.



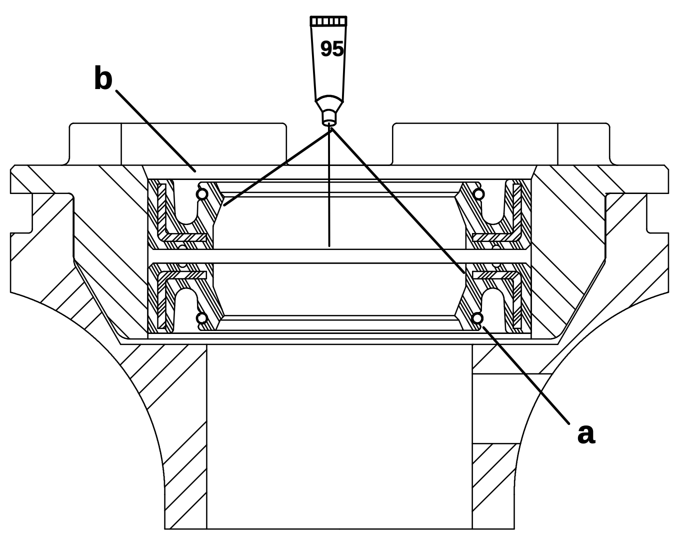
70501

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

a - O-ring

OIL SEAL CARRIER ASSEMBLY - COMPONENT REASSEMBLY (1996/1997 MODELS)

The oil seals in 1996/1997 carrier assemblies are the same diameter. The bottom (first) seal lip faces down; the top (second) seal lip faces up. Apply 2-4-C w/Teflon Marine Lubricant to seal lips and between seals. Press seal into carrier with suitable mandrel. Second seal should be pressed in flush with carrier surface.



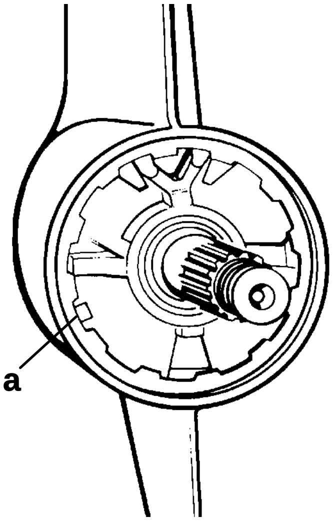
95 2-4-C With Teflon (92-825407A12)

a - Bottom Seal (Lip Faces Down)
b - Top Seal (Lip Faces Up)

Bearing Carrier Assembly

REMOVAL

1. Straighten the tab on the tab washer.



70490

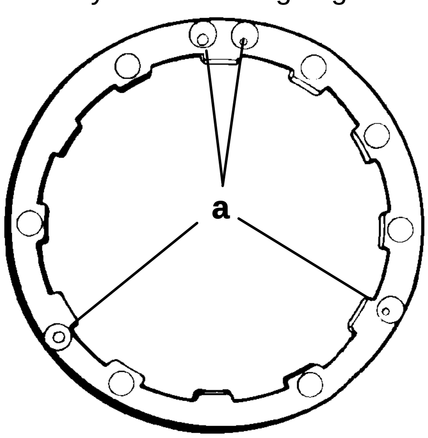
a - Tab on Tab Washer

2. Remove the bearing carrier retainer following step a or b as follows:

⚠ CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

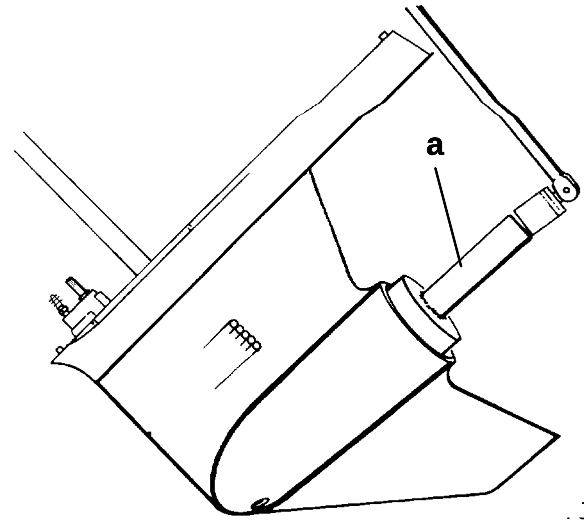
   a. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.



23356

a - Drilled Holes

   b. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench (91-61069).

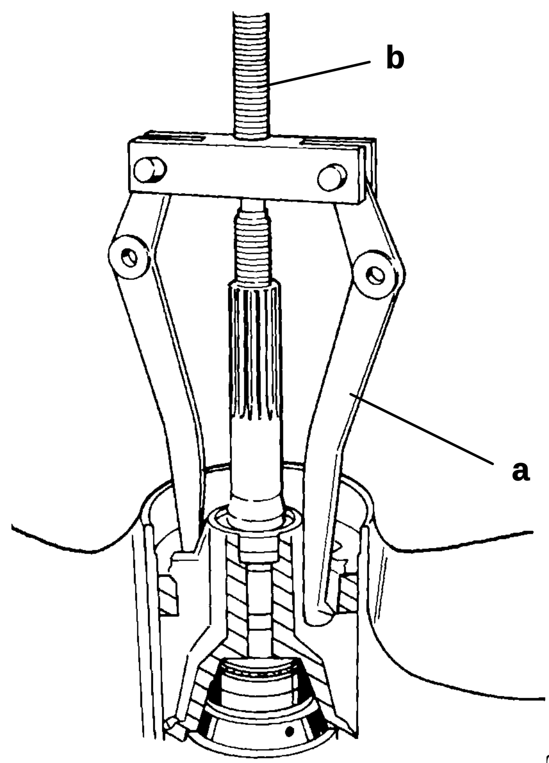


0491

a - Bearing Carrier Retainer Wrench

3. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier. POSITION PULLER JAWS CLOSE TO BOSSES IN CARRIER.

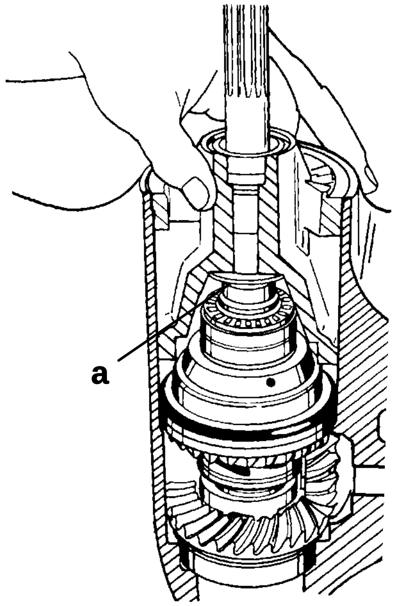
NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



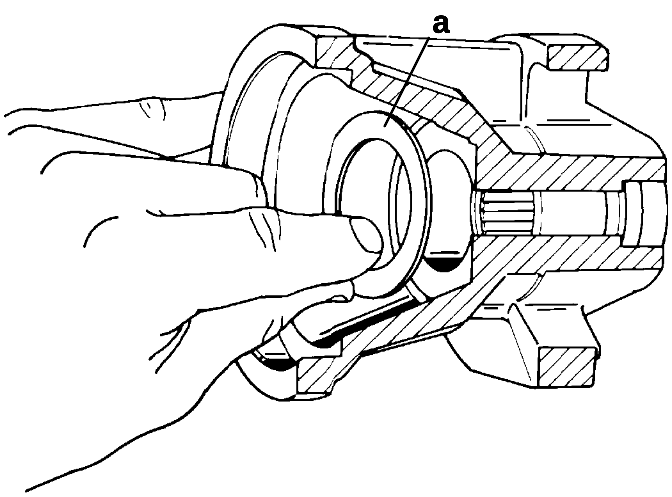
0786

a - Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)

4. Lift the bearing carrier out of the gear housing. Locate and retain the thrust washer that may be stuck to the inside surface of the bearing carrier.



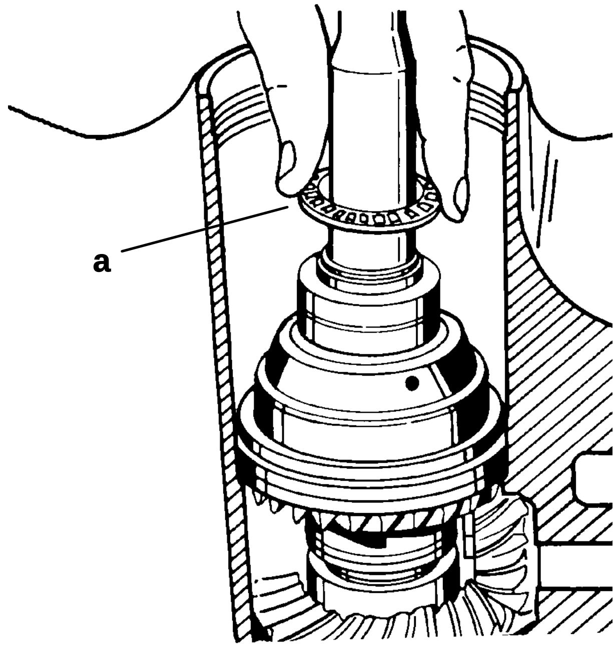
50826



50779

a - Thrust Washer

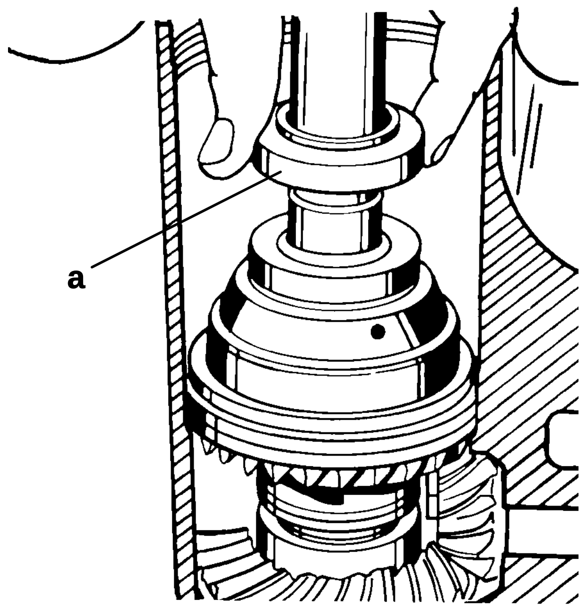
5. Remove the aft thrust bearing.



50786

a - Thrust Bearing

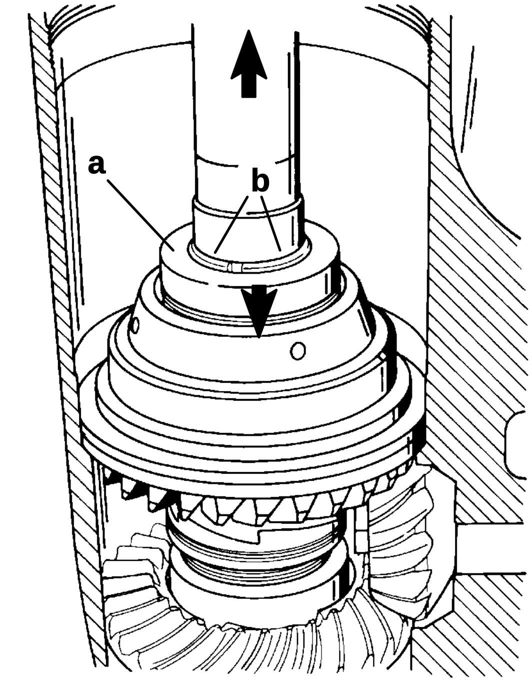
6. Remove the aft thrust collar.



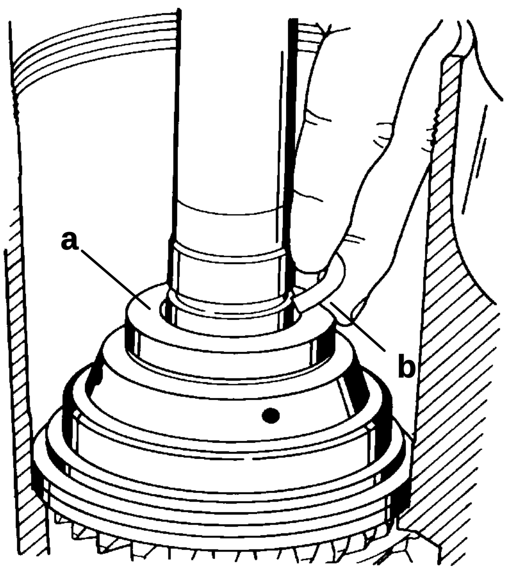
50787

a - Thrust Collar

7. Lift up on the propeller shaft and push down on the forward thrust collar to remove the two keepers.



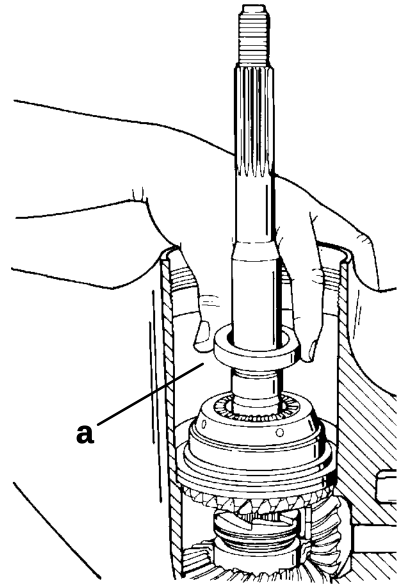
50778



50826

a - Thrust Collar
b - Keepers (2)

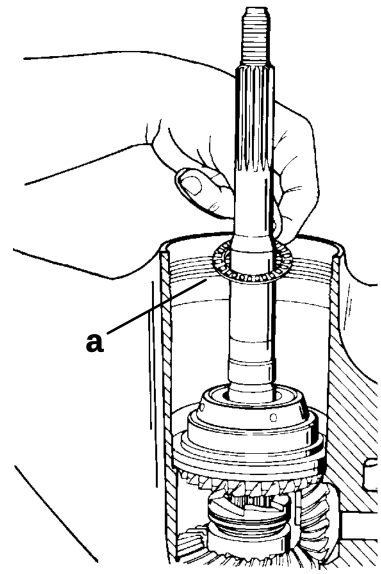
8. Remove the forward thrust collar.



50784

a - Thrust Collar

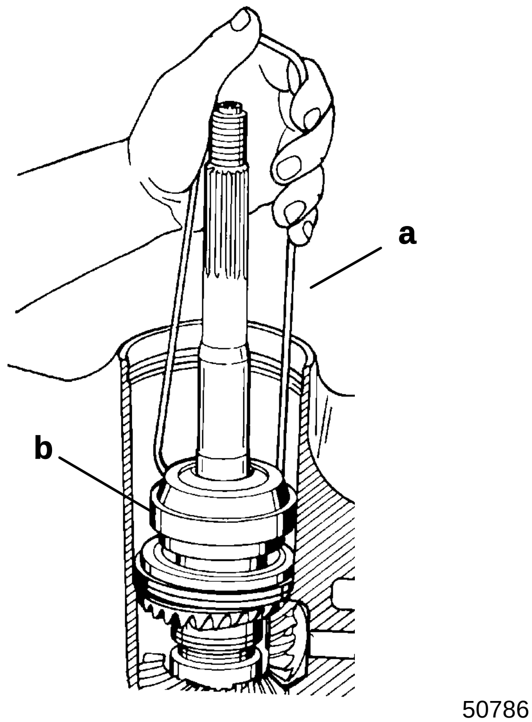
9. Remove the forward thrust bearing.



50783

a - Thrust Bearing

10. Form a tool using a 1/8 in. (3 mm) wire as shown in the following figure and remove the forward gear bearing adaptor.

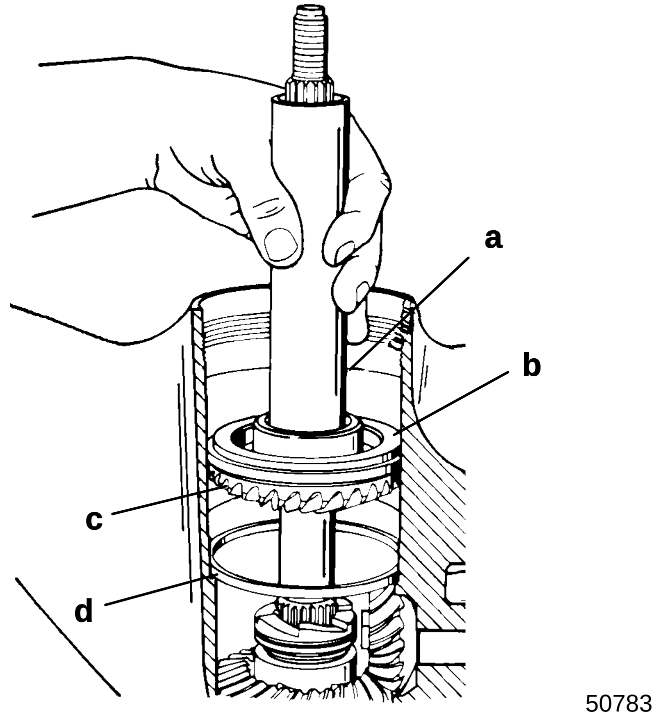


a - Wire Tool
b - Forward Gear Bearing Adaptor

11. Shift gear case into forward gear.

NOTE: *The thrust race has a tight fit in the gear housing bore. Use the Forward Gear Installation Tool (91-815850) to remove the thrust race and the forward gear together. If this attempt fails, form a small hook on the end of a stiff piece of wire and while applying heat to the outside of gear case, pull the thrust race up and out of the gear housing.*

12. Remove the O-ring from inside the gear housing.
13. Remove the forward gear, thrust race, and the thrust bearing (between the gear and the race).
14. Remove the forward gear shim.



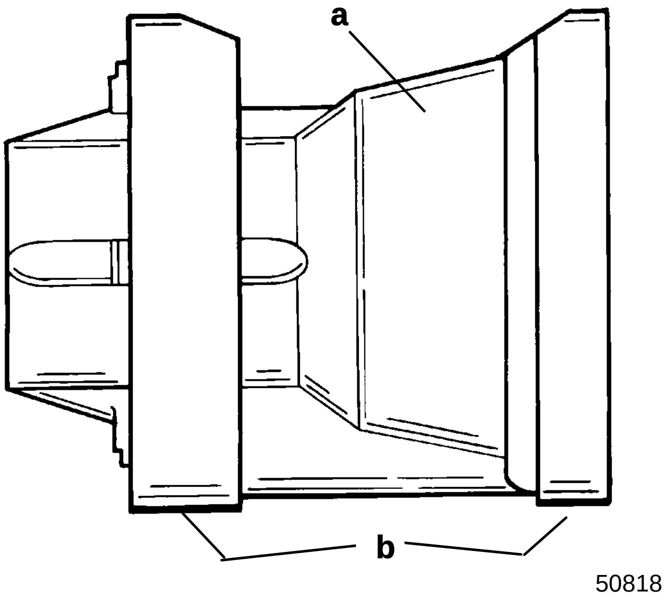
a - Forward Gear Installation Tool (91-815850)
b - Thrust Race
c - Forward Gear
d - Shim

BEARING CARRIER ASSEMBLY - INSPECTION

1. Clean the assembly and all components with a suitable solvent and dry the parts thoroughly using compressed air.

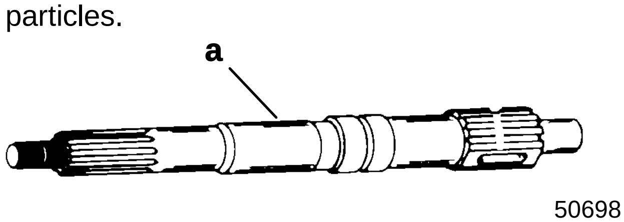
NOTE: *If any of the following items are found to be defective complete the appropriate instruction(s) in "Bearing Carrier Assembly", Component Disassembly and Inspection' section.*

2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident replace the carrier.



a - Bearing Carrier
b - Mating Surfaces

3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.

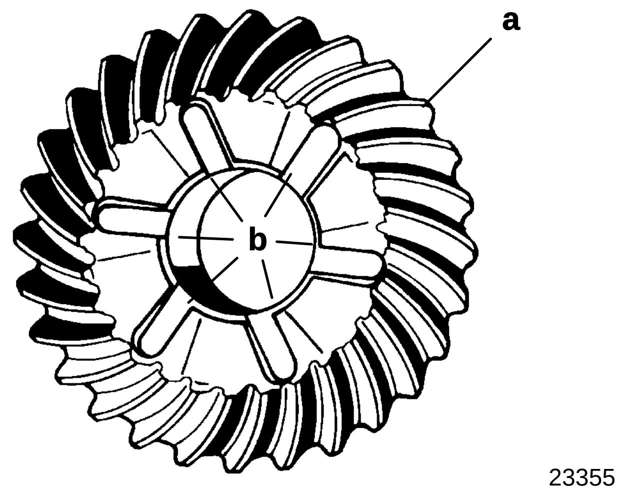


a - Propeller Shaft Bearing Contact Area

4. Inspect the forward gear for pitted, chipped, broken teeth, hairline fractures, and excessive or uneven wear. Replace the forward gear and the pinion gear if any defects are found.

5. Inspect the outer hub of the forward gear for excessive wear or damage. Replace the forward and the pinion gear if either of these conditions exist.

6. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the forward and the pinion gear if any are found.



a - Reverse Gear Teeth
b - Clutch Jaws

7. Inspect the thrust bearings, collars and forward gear bearing adaptor for excessive wear in the areas where the thrust bearings come into contact with them. Replace the appropriate components if they are found to be defective.

8. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace it if any are found.

9. Inspect the large O-ring for damage and/or deterioration. Replace it if either condition is found.

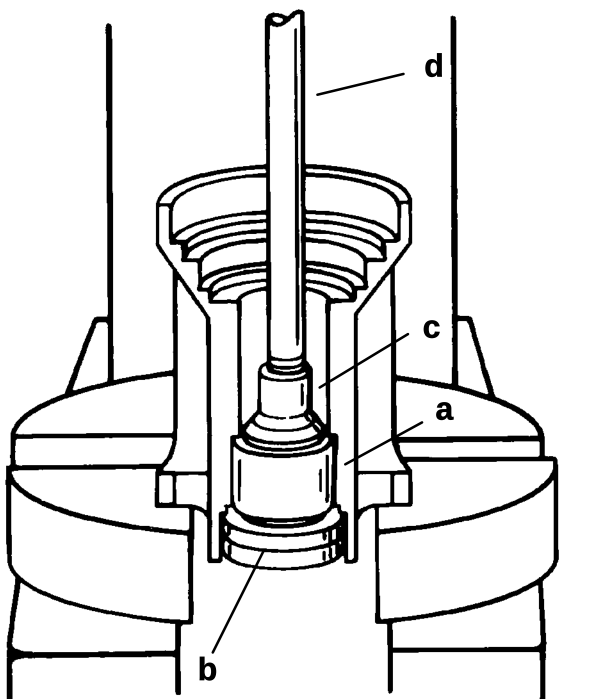
BEARING CARRIER ASSEMBLY - COMPONENT DISASSEMBLY AND INSPECTION

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective.*

NOTE: *Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.*

1. Perform the following step a. or b. as necessary.

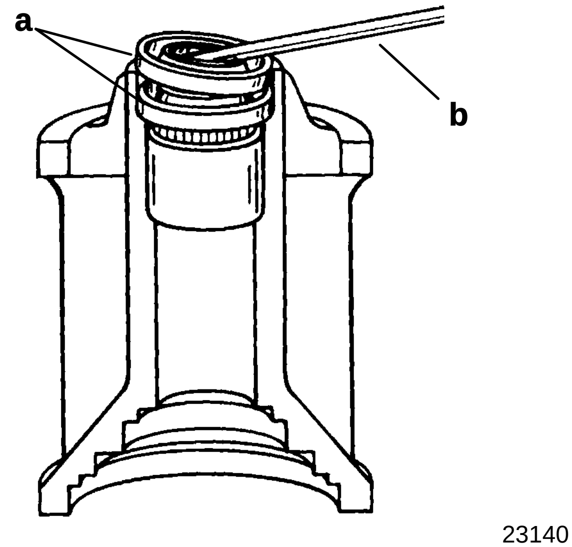
   a. **If Replacing the Needle Bearing <u>and</u> Seals:** Remove the needle bearing and seals with the tools as shown.



a - Needle Bearing
b - Oil Seals
c - Driver Head (91-36569)
d - Bearing Driver Rod (91-37323)

(1.) <u>**Discard the needle bearing and both seals.**</u>

   b. **If Replacing the Seal <u>Only</u>:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier.



a - Oil Seals
b - Pry Bar

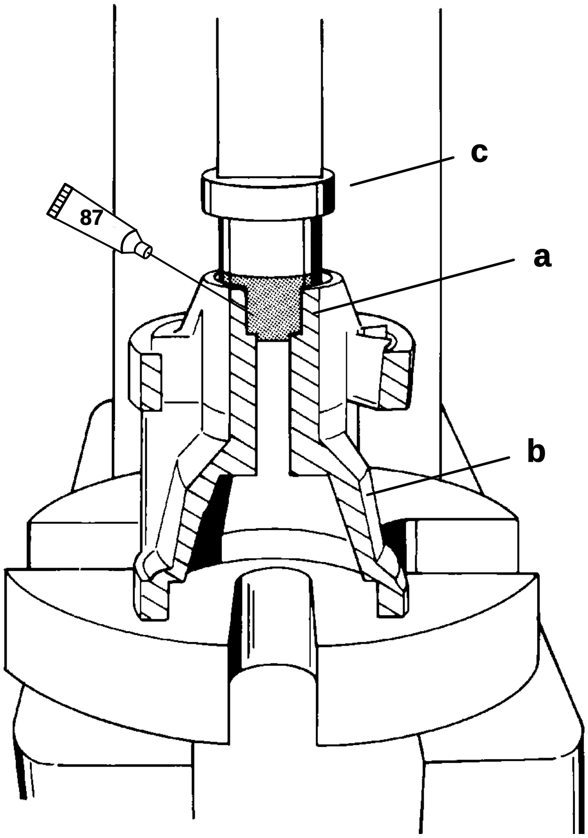
(1.) <u>**Discard both of the seals.**</u>

BEARING CARRIER ASSEMBLY - COMPONENT REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lubricate the bore that the needle bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).
3. Assemble the needle bearing (with the numbered end of the bearing towards the driver shoulder), onto the driver.

4. Press the needle bearing into the bearing carrier until the driver bottoms out on the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.



50788

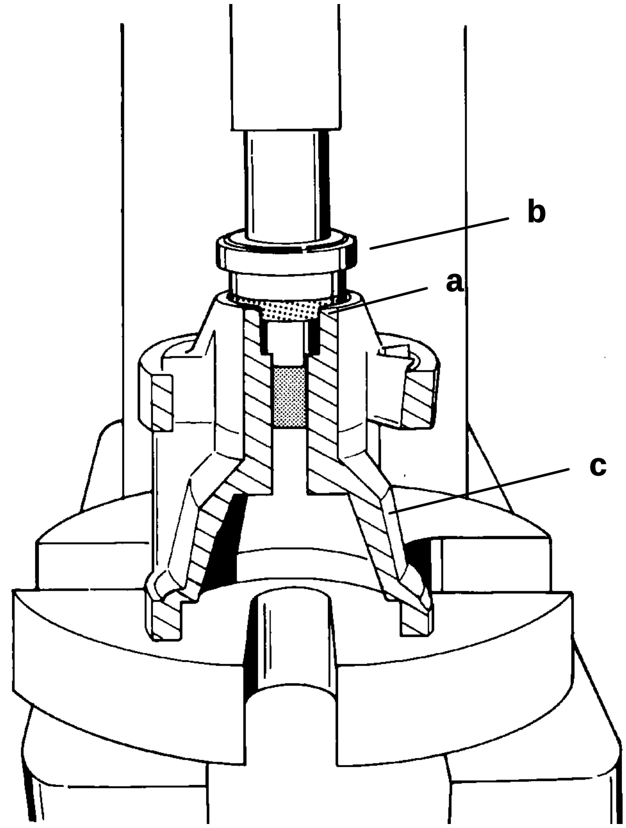
87 Quicksilver Gear Lubricant (92-19007A24)

a - Needle Bearing
b - Bearing Carrier
c - Needle Bearing Driver (91-15755)

5. **<u>Thoroughly clean</u>** the bore to which the first seal is to be pressed.

6. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.

7. Press on the oil seal driver until the driver bottoms onto the aft face of the bearing carrier.



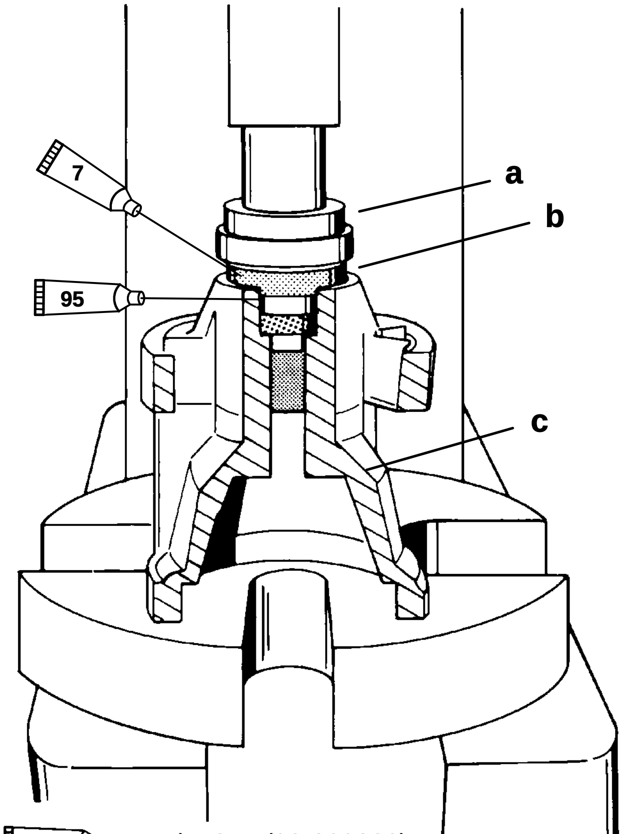
50788

a - Oil Seal
b - Oil Seal Driver (91-31108) (long end)
c - Bearing Carrier

8. Apply a thin film of Loctite 271 (92-809820) to the outer diameter of the second seal.

9. Assemble the second seal (with the lips seal facing the driver shoulder) onto the short end of the driver.

10. Press the oil seal with the driver until the driver bottoms out on the bearing carrier.



7 Loctite 271 (92-809820)

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

50788

a - Driver (short end)
b - Oil Seal (lips toward driver shoulder)
c - Bearing Carrier

11. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.

12. Lubricate the seal lips and fill the area between the seals with 2-4-C w/Teflon (92-825407A12).

Forward Gear Bearing Adaptor Assembly

INSPECTION

1. Thoroughly clean the forward gear bearing adaptor with a suitable solvent and dry it using compressed air.

NOTE: *The condition of the bearing surfaces on the forward gear in the areas that the bearings of the bearing adaptor and the thrust bearing rides, is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.*

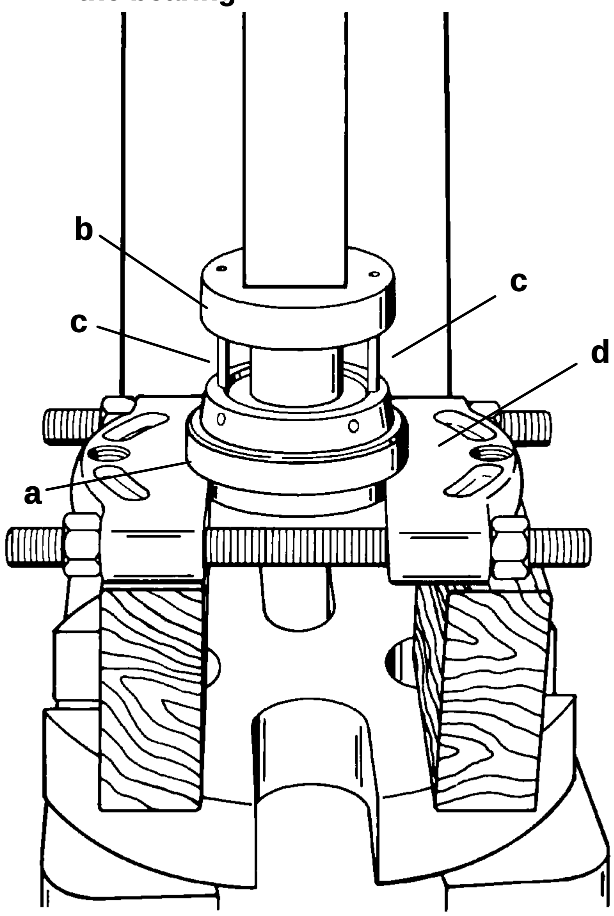
2. Assemble the forward gear to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor if either of these conditions exist.

3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.

FORWARD GEAR BEARING ADAPTOR ASSEMBLY - COMPONENT DISASSEMBLY AND REASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.*

1. Disassemble the adaptor as follows:
   a. Remove the bearing from the adaptor using the bearing removal tool. Align the pins of the tool with the holes of the adaptor and apply pressure to the center of the tool so that the pressure is equal on both of the pins. **Discard the bearing.**



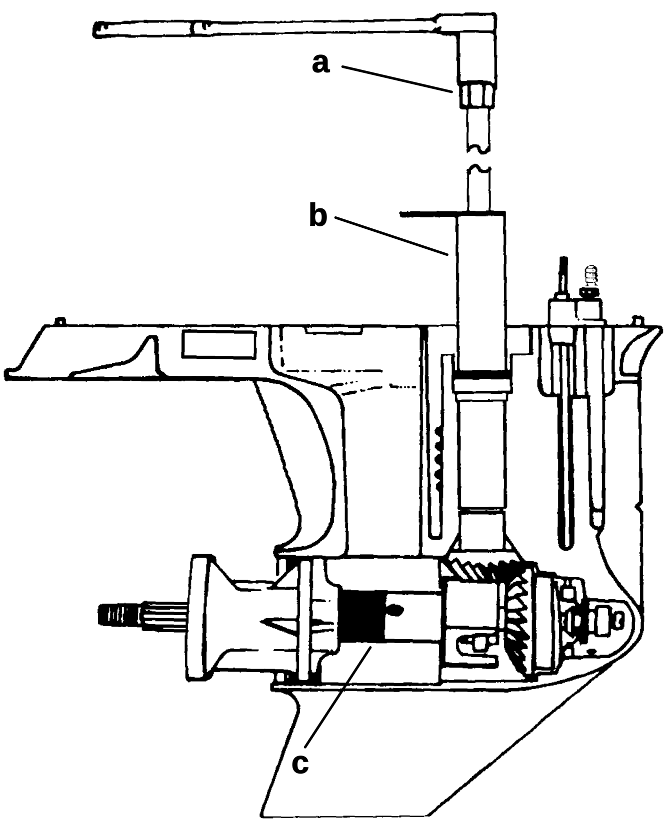
a - Forward Gear Bearing Adaptor
b - Bearing Removal Tool (91-816245)
c - Pins
d - Universal Puller Plate

2. Assemble the adaptor as follows:
   a. Lubricate the bore that the needle bearing is pressed into with 2-4-C w/Teflon (92-825407A12).
   b. Assemble the needle bearing to the adaptor with the numbered end of the bearing facing the driver shoulder.
   c. Press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing bottoms in the adaptor.

Drive Shaft Assembly

REMOVAL

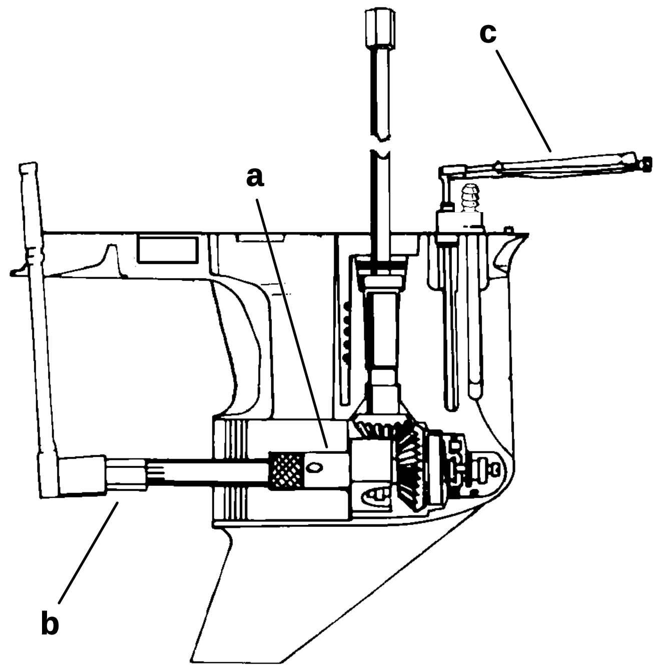
1. Remove the drive shaft pinion nut as follows:
   a. Place the drive shaft bearing retainer wrench onto the drive shaft. Do not loosen the retainer at this time.
   b. Insert the pinion nut adapter, with the MR slot facing the pinion gear, into the gear housing. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
   c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
   d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew), the pinion nut by rotating the drive shaft counterclockwise.



a - Drive Shaft Nut Wrench (91-56775)
b - Drive Shaft Bearing Retainer Wrench (91-43506)
c - Pinion Nut adapter (91-61067A3) (MR Slot)

   e. **If the drive shaft is broken,** place propeller shaft nut wrench onto the propeller shaft splines, hold shift shaft in forward gear and **loosen**, (but do not fully unscrew), the pinion nut by rotating prop shaft counterclockwise to turn gears, thus loosening the pinion nut.

NOTE: *The propeller shaft nut wrench is included with the pinion nut adapter kit.*

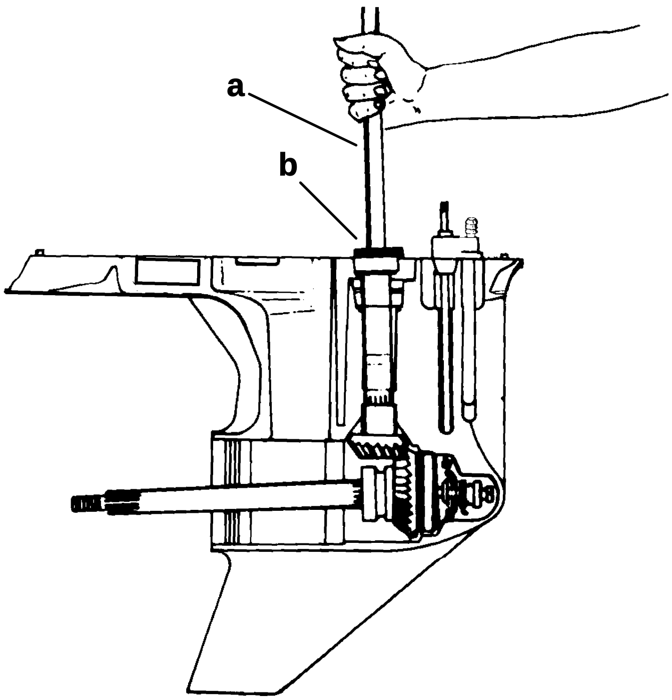


a - Pinion Nut adapter (91-61067A3)
b - Propeller Shaft Nut Wrench (91-61077)
c - Shift Shaft (Turn Clockwise)(Protect Splines w/Soft Material)

2. Completely unscrew the drive shaft bearing retainer.
3. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.
4. Remove the bearing carrier and all tools.

IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to lose the (18) rollers.

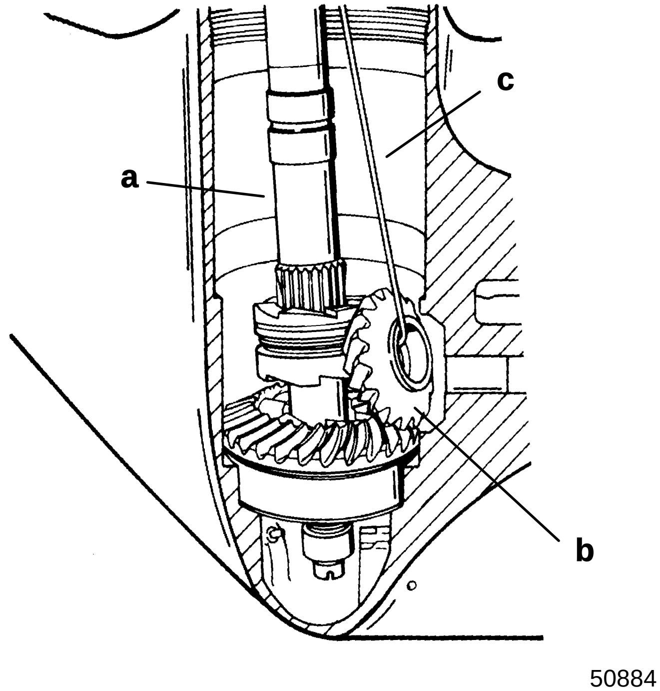
5. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



a - Drive Shaft
b - Drive Shaft Retainer, Bearing Cup, Bearing, and Shims

6. With propeller shaft facing straight up, rotate shift lever into forward. Pull propeller shaft up and over towards port side of gear case.

7. Form a small hook on a stiff piece of wire and attempt to hook onto the top side of the gear and pull it out. It may be necessary to slightly move the propeller shaft from side-to-side to dislodge the pinion gear.



a - Propeller Shaft
b - Pinion Gear
c - Wire Tool

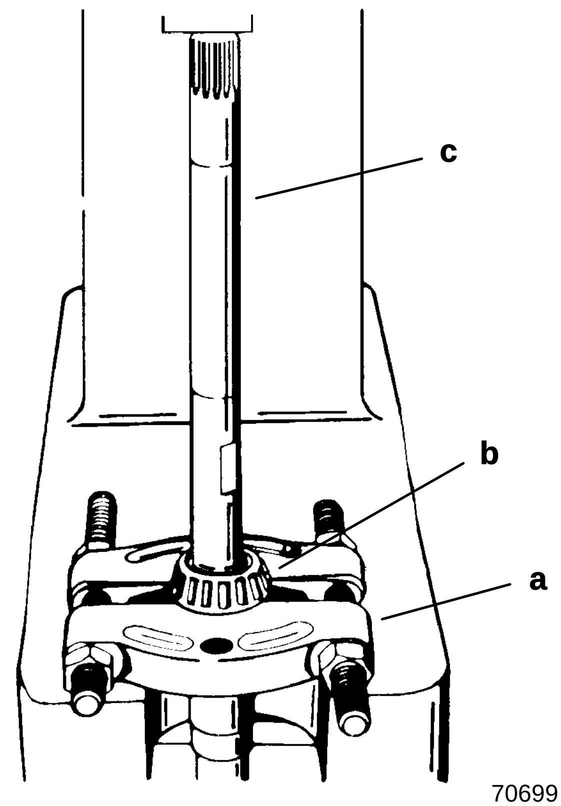
DRIVE SHAFT ASSEMBLY - INSPECTION

1. Clean all parts with a suitable solvent and dry the parts using compressed air. DO NOT spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored form overheating, or has embedded particles.
4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the pinion gear and the forward gear** if any defects are found.

DRIVE SHAFT ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.

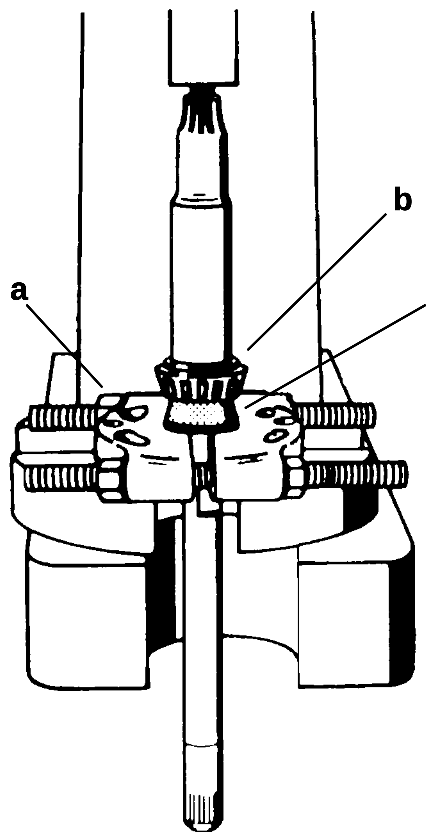


a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

DRIVE SHAFT ASSEMBLY - COMPONENT REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Assemble a new tapered roller bearing to the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel, (an old tapered roller bearing inner race).



70700

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Suitable Mandrel (Inner Race of Old Bearing)

Propeller Shaft Assembly

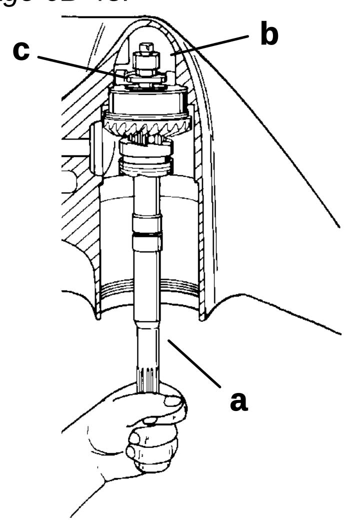
REMOVAL

⚠ CAUTION

Hold onto the propeller shaft assembly in the following step to avoid personal injury and/or dropping components when turning the gear housing over.

1. While holding onto the propeller shaft, turn the gear housing over so that the bore opening is facing down.
2. While moving the propeller shaft to the left (port) side of the gear housing, to allow the shift spool to disengage from the shift crank, lower the propeller shaft out of the gear housing.

NOTE: *The rollers of the reverse gear bearing adaptor may become dislodged while removing the propeller shaft assembly. If this occurs, inspect the bearing cage to see if it has been damaged. If it has not been damaged simply snap the rollers back into position. If it has been damaged it will be necessary to remove and replace the bearing as outlined in the "Reverse Gear Bearing Adaptor Assembly", 'Component Disassembly and Reassembly' section found on page 6B-45.*



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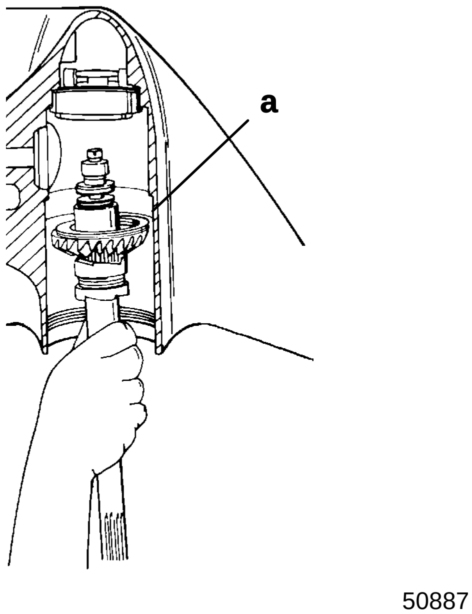
a - Propeller Shaft Assembly
b - Shift Spool
c - Shift Crank

3. Locate and retain the thrust race and thrust bearing which could be on top of the reverse gear (if not, they may be stuck to the reverse gear bearing adaptor).

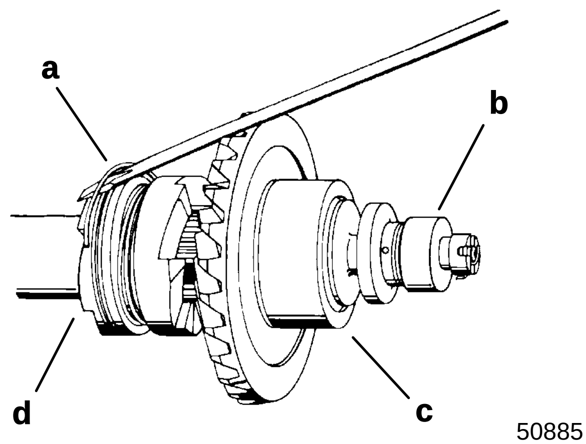


a - Thrust Bearing and Race

PROPELLER SHAFT ASSEMBLY - COMPONENT DISASSEMBLY

IMPORTANT: When accomplishing the next step, all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged, and to avoid personal injury.

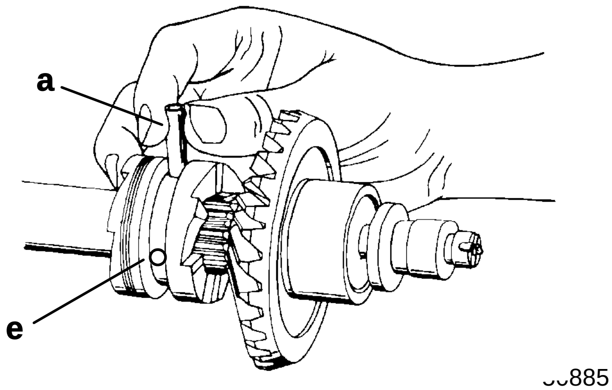
1. Remove the spring around the clutch being careful not to overstretch it during removal. If the spring does not coil back to its normal position once it has been removed, it must be replaced (ratcheting assembly shown).

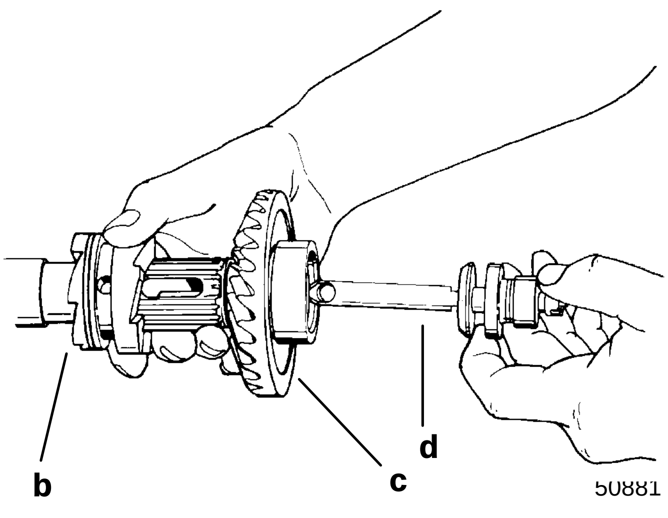


a - Spring
b - Shift Spool Assembly
c - Reverse Gear Assembly
d - Sliding Clutch

2. Remove detent pin.

3. Remove the cross pin that goes through the clutch dog. Remove the reverse gear and slide the clutch off of the propeller shaft.

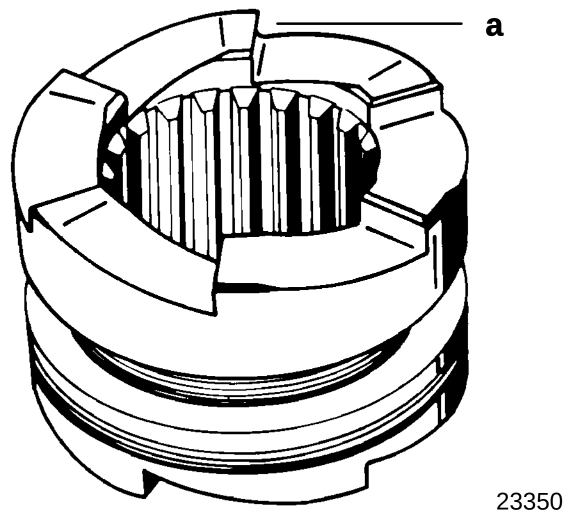




a - Cross Pin
b - Clutch
c - Reverse Gear Assembly
d - Spool
e - Detent Pin

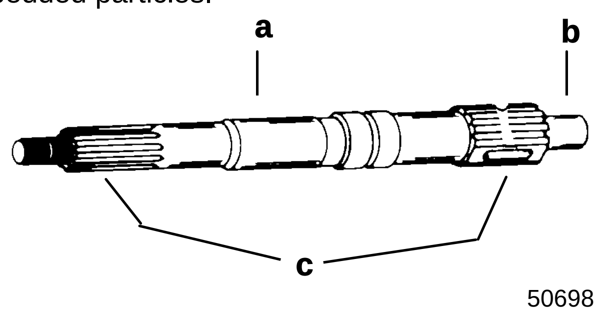
PROPELLER SHAFT ASSEMBLY - COMPONENT INSPECTION

1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are (ratcheting assembly shown).



a - Jaws

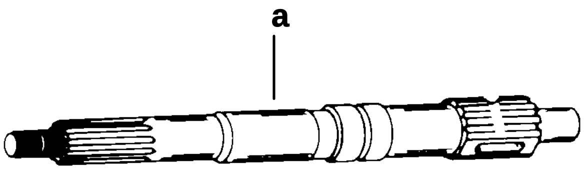
3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the forward gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.



a - Bearing Carrier Needle Bearing Contact Area
b - Reverse Gear Needle Bearing Contact Area
c - Splines

4. Inspect the propeller shaft splines at both ends for a broken, worn, or twisted condition. Replace the propeller shaft if any of these conditions exists.

5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, replace propeller shaft and seals.



50698

a - Bearing Carrier Seal Contact Area

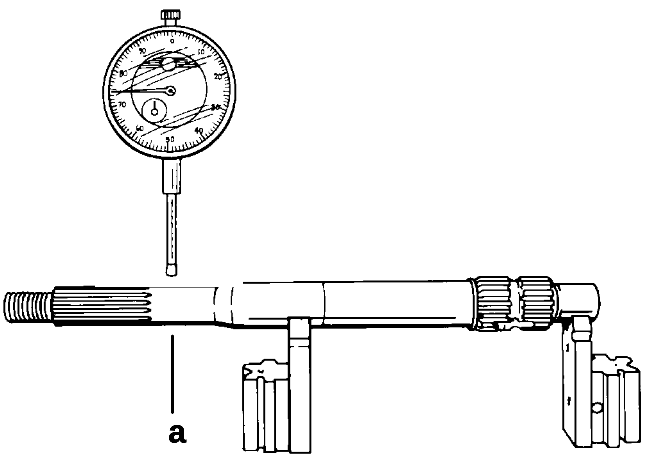
6. Inspect the propeller shaft for a bent condition.

   a. **V-Blocks and Dial Indicator**

      (1.) Position the propeller shaft bearing surfaces on V-blocks.

      (2.) Adjust the height of V-blocks to level the propeller shaft.

      (3.) Position the dial indicator tip just forward of the propeller shaft splines.



52727

a - Check Movement with Dial Indicator (91-58222A1) Here

7. Rotate the propeller shaft and observe the dial indicator movement. If the indicator in the dial moves more than 0.009 in. (0.23mm), replace the propeller shaft.

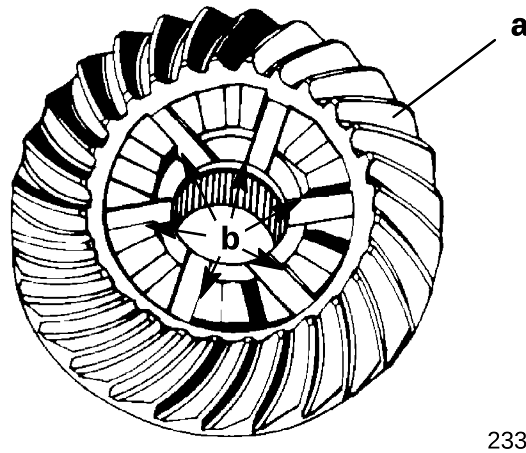
Reverse Gear Assembly

COMPONENT INSPECTION

1. Clean the reverse gear assembly with a suitable solvent and dry thoroughly with compressed air. Be careful not to spin the bearings.

2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the reverse gear** if any defects are found.

3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace the reverse gear** if any of these conditions exist.

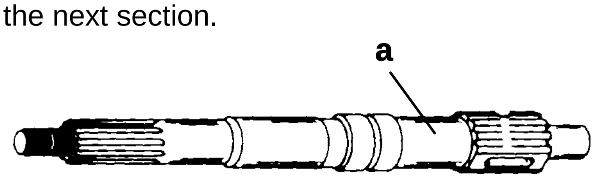


23351

a - Reverse Gear Teeth
b - Clutch Jaws

NOTE: *The needle bearing in the reverse gear should not be removed unless damage has been found. Inspect to ensure that all of the needles are present and in position. The needles may have become dislodged while removing the gear from the propeller shaft (and/or while removing the propeller shaft assembly from the gear housing). They may be snapped back into place as long as no damage has occurred to the bearing cage.*

4. Inspect the needle bearings on the inside of the reverse gear and the bearing surface on the propeller shaft. If either the needle bearings, or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the reverse gear as outlined in the next section.



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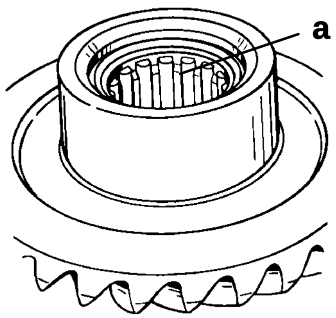
a - Forward Gear Needle Bearing Contact Area

REVERSE GEAR ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the gear has been found to be defective and the reverse gear is to be reused. Bearings that have become dislodged may be snapped back into position. If this is the only problem that exists it is not necessary to replace the needle bearing.*

1. Press the reverse gear needle bearing out using suitable mandrel.

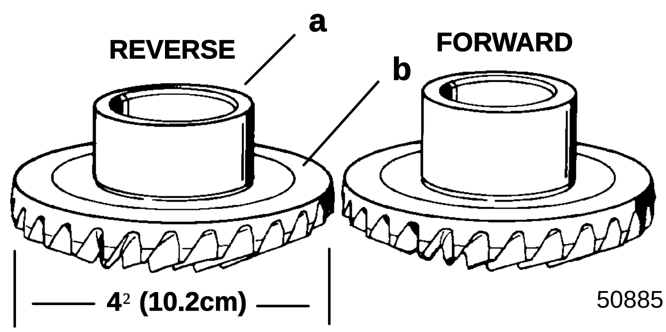


a - Reverse Gear Needle Bearing

REVERSE GEAR ASSEMBLY - COMPONENT REASSEMBLY

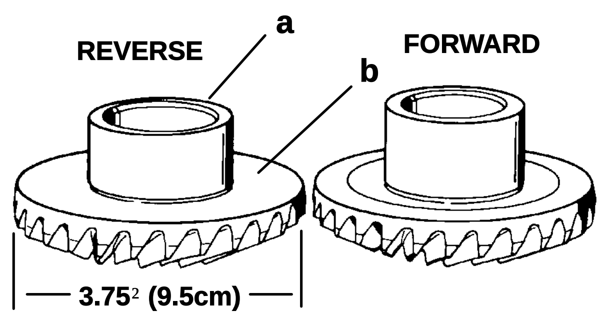
NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



1994/1995/1996 Models

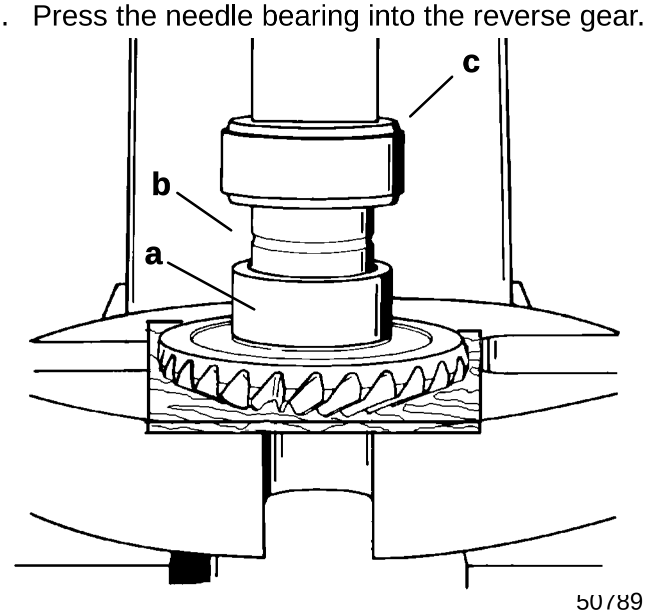
a - Shorter Hub
b - Groove



1997/1998 Models 50885

a - Reverse Gear is Smaller in Diameter for 97/98 Models
b - No Groove in Reverse Gear for 97/98 Models

1. Press the needle bearing into the reverse gear.

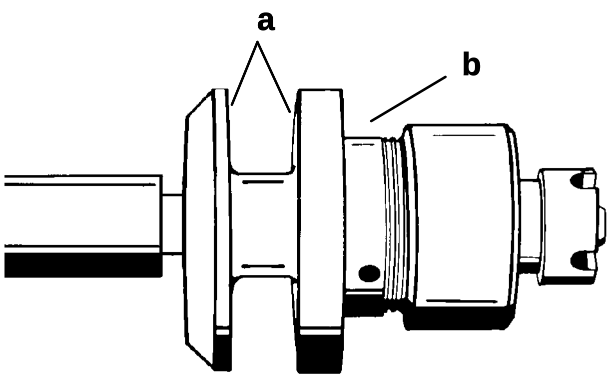


a - Reverse Gear
b - Needle Bearing
c - Bearing Driver (91-816244)(Ratcheting gear cases)
Bearing Driver (91-86943) (Non-Ratcheting gear cases)

Shift Spool Assembly

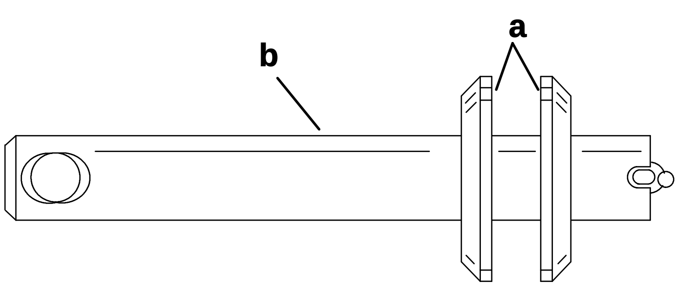
INSPECTION

1. Clean the assembly with a suitable solvent and dry the parts using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

a - Contact Area
b - Ratcheting Shift Spool



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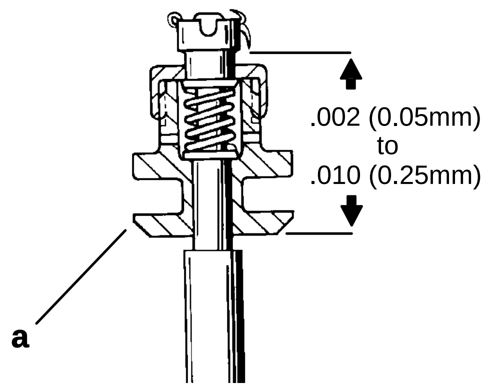
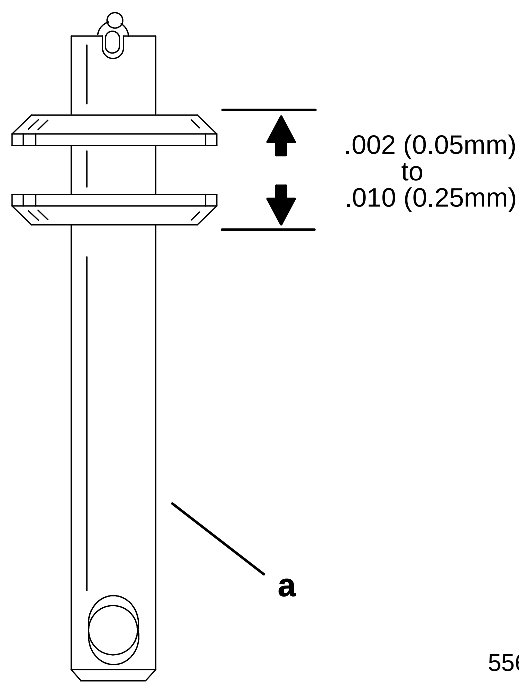
a - Contact Area
b - Non-Ratcheting Shift Spool

4. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
5. Inspect to insure that the spool has no more than 0.002-0.010 (0.05-0.25 mm) end play.



23142

a - Ratcheting Spool



55694

a - Non-Ratcheting Spool

SHIFT SPOOL ASSEMBLY (RATCHETING) - COMPONENT DISASSEMBLY

NOTE: *Disassembly of the shift spool is for cleaning and inspection of the internal parts of the assembly due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.*

1. Disassemble the shift spool assembly as follows:
   a. Remove and discard the cotter pin.
   b. Remove the castle nut and the spool.
   c. Clamp the spool in a vice being careful not damage the spool.
   d. Remove the retainer by unscrewing it with a pair of pliers.
   e. Remove the two washers and the spring.

SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - COMPONENT DISASSEMBLY

NOTE: *Disassembly of the shift spool is for cleaning and inspection of the internal parts of the assembly due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.*

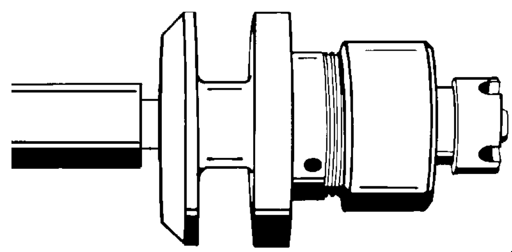
1. Disassemble the shift spool assembly as follows:
   a. Remove and discard the cotter pin.
   b. Remove the castle nut and the spool.

SHIFT SPOOL ASSEMBLY - COMPONENT INSPECTION

1. Clean all components with a suitable solvent and dry them with compressed air.
2. Inspect each component for wear or damage. If any components are worn beyond repair, damaged, or broken it will be necessary to replace the complete shift spool assembly. Small nicks or burrs may be smoothed and the parts reused.

SHIFT SPOOL ASSEMBLY (RATCHETING) - COMPONENT REASSEMBLY

1. Assemble the shift spool and shift spool shaft as follows:
   a. Place the shift spool onto the shift spool shaft.
   b. Assemble the first washer, then the spring, then the second washer into the shift spool.
   c. Apply Loctite 271 (92-809820) to the first three threads of the spool. Thread the retainer onto the spool and tighten the retainer securely with a pair of pliers.
   d. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
   e. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
   f. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.



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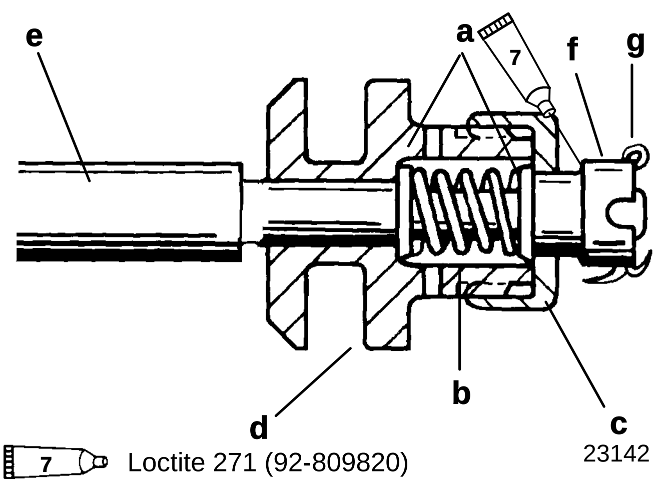


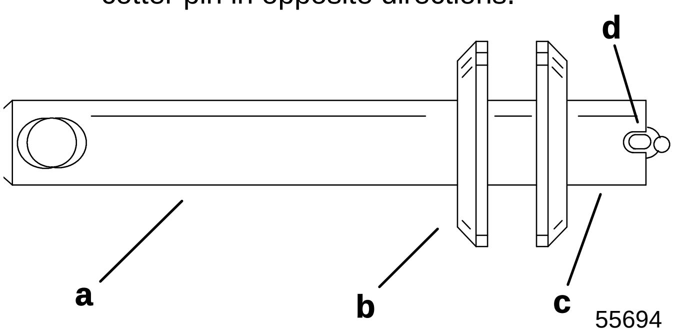
Loctite 271 (92-809820)

23142

a - Washers (2)
b - Spring
c - Retainer
d - Spool
e - Shift Shaft
f - Castle Nut
g - Cotter Pin

SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - COMPONENT REASSEMBLY

1. Assemble the shift spool and shift spool shaft as follows:
   a. Place the shift spool onto the shift spool shaft.
   b. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
   c. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
   d. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.



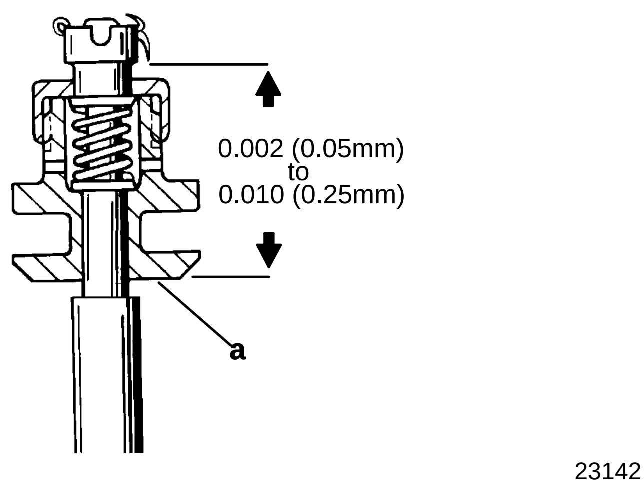
a - Shift Spool Shaft
b - Shift Spool
c - Castle Nut
d - Cotter Pin

SHIFT SPOOL ASSEMBLY - ADJUSTMENT

NOTE: *If the shift spool assembly has been disassembled and reassembled (as in the previous two sections) skip the following instructions, (1 through 4).*

NOTE: *If the shift spool assembly has not been disassembled and reassembled, do all of the following steps.*

1. Remove and discard the cotter pin.
2. Screw the castle nut down until it touches the washer and a slight resistance is felt.
3. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is not aligned at the hole in the shaft, back off the castle nut until the next available slot in the nut is aligned with the hole in the shaft.
4. Insert a new cotter pin and bend ends in opposite directions.
5. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
6. Inspect to insure that the spool has no more than 0.002-0.010 (0.05-0.25 mm) end play, if it does adjust the castle nut once again as outlined previously.



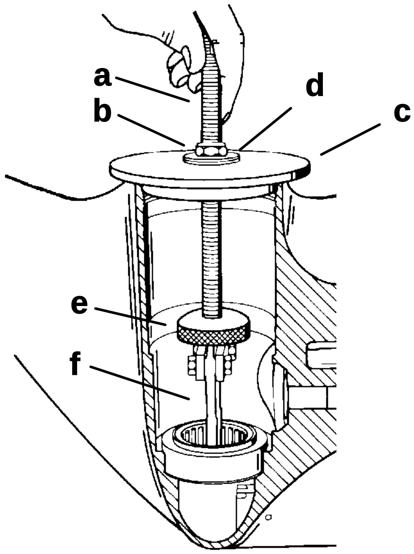
a - Ratcheting Type Spool

7. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.

Reverse Gear Bearing Adaptor Assembly

REMOVAL

1. Remove the reverse gear bearing adaptor using the tools as shown in the next figure. Remove, measure and make note of the shim thickness. If the shims are not damaged, they may be reused.



50780

a - Bolt (91-31229)
b - Nut (11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (from Slide Hammer Puller Kit 90-34569A1)
f - Jaws (91-816242)

REVERSE GEAR BEARING ADAPTOR ASSEMBLY - INSPECTION

1. Thoroughly clean the reverse gear bearing adaptor with a suitable solvent and dry it using compressed air.

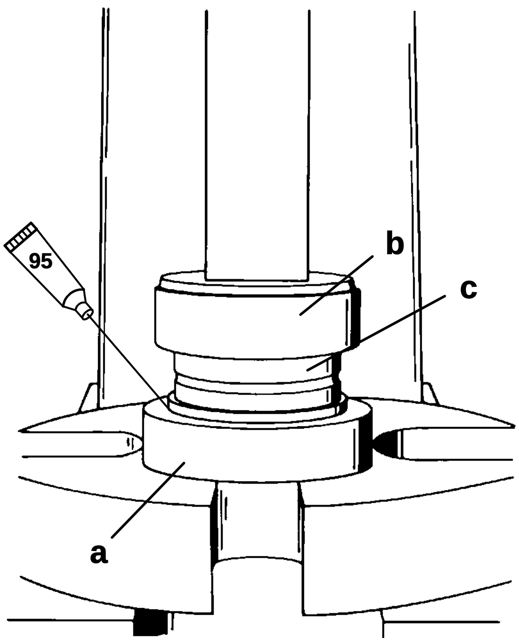
NOTE: *The condition of the bearing surfaces on the reverse gear in the areas that the bearings of the bearing adaptor and the thrust bearing rides, is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.*

2. Assemble the reverse gear, the thrust bearing, and the thrust race, to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor and/or the thrust bearing if either of these conditions exist.
3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.

REVERSE GEAR BEARING ADAPTOR ASSEMBLY - COMPONENT DISASSEMBLY AND REASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.*

1. Disassemble the adaptor as follows:
   a. Remove the bearing from the adaptor using a suitable mandrel.
   b. **Discard the bearing.**
2. Assemble the adaptor as follows:
   a. Lubricate the bore that the needle bearing is to be pressed into with 2-4-C w/Teflon (92-825407A12).
   b. Position the needle bearing on the adaptor with the numbered end of the bearing facing the driver shoulder.
   c. Press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing is flush with the face of the adaptor.



50790

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

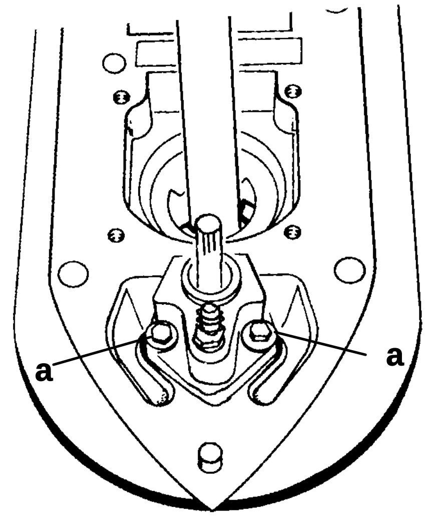
a - Reverse Gear Bearing Adaptor
b - Suitable Mandrel
c - Bearing

Shift Shaft Assembly

REMOVAL

NOTE: *It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.*

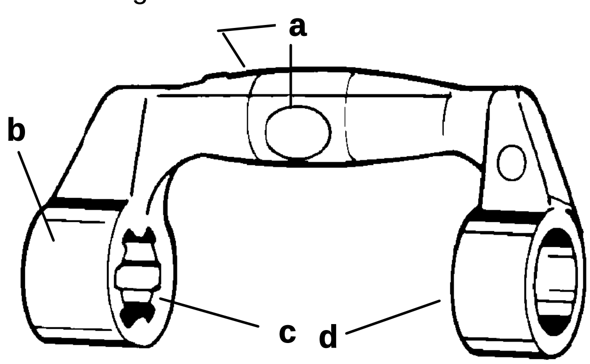
1. Remove the shift shaft bushing screws, and remove the shift shaft and bushing by pulling them straight out of gear housing.



70494

a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or excessive wear.

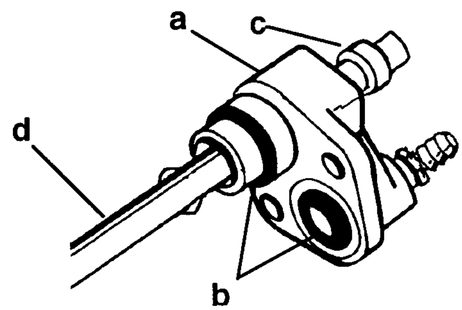


23350

a - Contact Area
b - Shift Crank
c - Splines
d - Diameter for Locating Pin

SHIFT SHAFT ASSEMBLY - COMPONENT DISASSEMBLY AND INSPECTION

1. Slide the bushing assembly off of the straight end of the shaft shaft. Remove the coupler from the shaft.

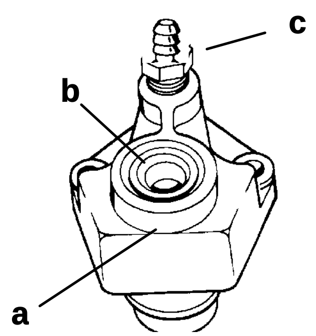


70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Coupler
d - Shift Shaft

2. Clean all components with a suitable solvent and dry thoroughly with compressed air.
   a. Inspect the shift shaft bushing for cracking, damage, or excessive wear.
   b. Inspect the seal inside the bushing, the sleeve, and the O-rings on the outside of the bushing for damage or excessive wear.
   c. Inspect the speedometer connector for damage or blockage.

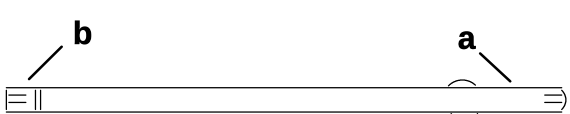
If any of these conditions exist, replace the appropriate components. The oil seal is a replaceable component.



70617

a - Shift Shaft Bushing
b - Seal (Lips Face Up)
c - Speedometer Tube Connector

3. Inspect the shift shaft splines and seal surface for corrosion and/or excessive wear. Replace the shift shaft if either if these conditions are found.

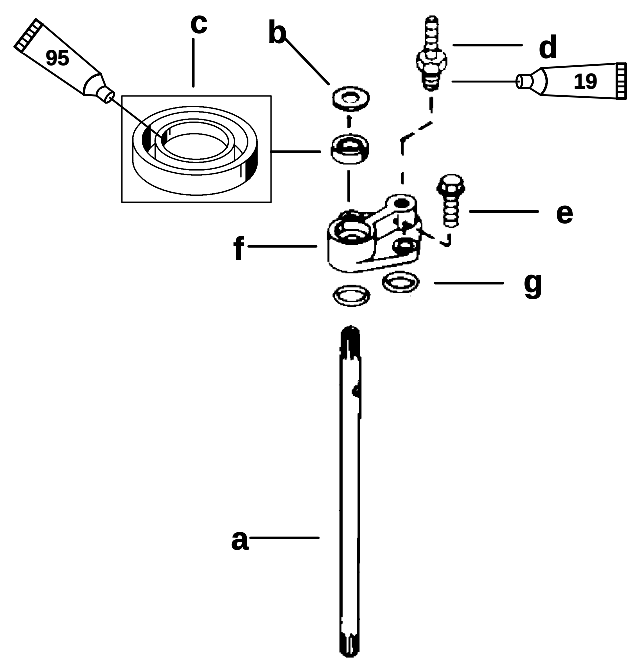


a - Seal Surface
b - Spline

SHIFT SHAFT ASSEMBLY - COMPONENT REASSEMBLY

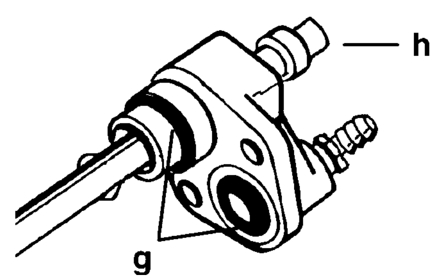
NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with Quicksilver 2-4-C w/Teflon (92-825407A12).
2. If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal (91-34277-1). Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb. in. (0.5 N·m).
3. Assemble all components as shown below.



19 Perfect Seal (92-34227-1)

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



70616

a - Shift Shaft
b - Rubber Washer
c - Seal (Lip Faces Up)
d - Speedometer Connector
e - Bolt (2 ea.) [Torque to 60 lb. in. (6.8 N·m)]
f - Bushing
g - O-Rings (2 ea.)
h - Coupler

Pinion Bearing

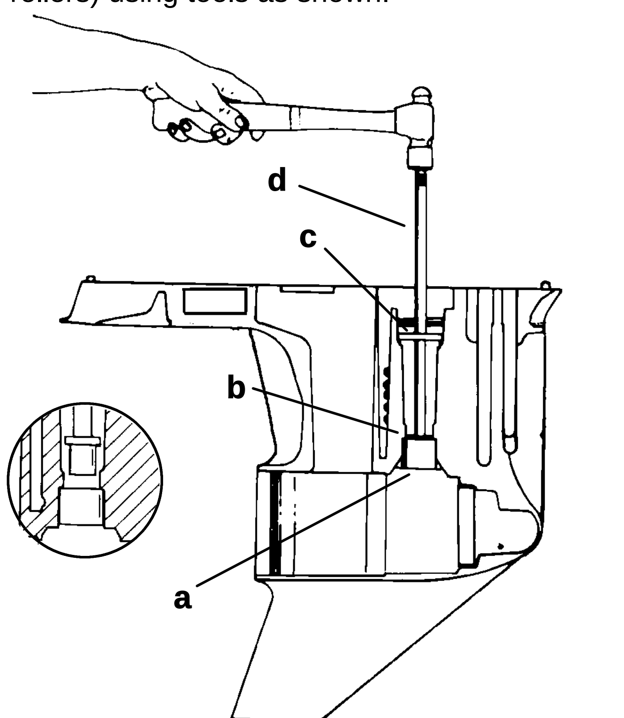
REMOVAL

NOTE: *Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location give an indication of the condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.*

IMPORTANT: All the needle bearings (18) MUST BE in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. Remove and discard the pinion bearing (race and rollers) using tools as shown.



a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

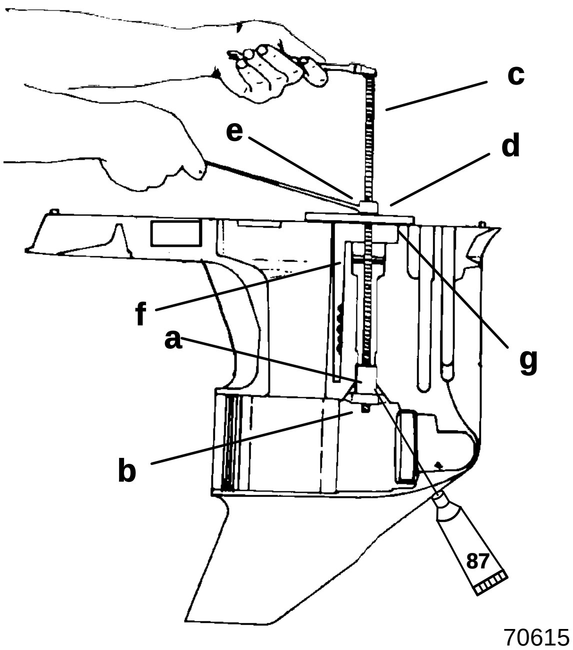
1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing using compressed air. Insure that all sealants, locking agents and debris are removed.
2. Verify the 2 oil circulation holes in the drive shaft bore and shift shaft hole are clear and free of debris.
3. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
4. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Excessive damage to the the threads requires replacement of the gear housing.
5. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose will require replacement of the gear housing.
6. Inspect for blockage in water inlet holes and the speedometer hole, clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
7. Verify that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

Pinion Bearing

INSTALLATION

IMPORTANT: Install only a NEW pinion bearing (race and rollers). Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver Gear Lubricant (92-13783A24).
2. Position the new pinion bearing (with the cardboard shipping sleeve in place) onto the driver head, with the lettered and numbered side of the bearing oriented upward.
3. Insert the driver with the bearing assembly, into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



87 Quicksilver Gear Lubricant (92-19007A24)

a - Drive Shaft Pinion Bearing (w/cardboard sleeve)
b - Driver Head (91-38628)
c - Puller Shaft (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Puller Plate (91-29310)

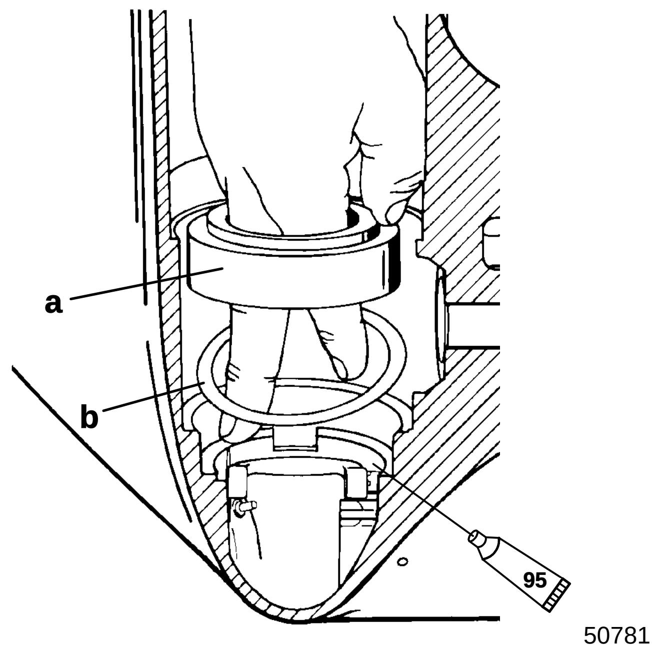
4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Reverse Gear Bearing Adaptor Assembly

INSTALLATION

NOTE: *If the reverse gear, reverse gear adaptor, large thrust bearing, or bearing race in the gear housing were not replaced, install the same shim(s) (or the same thickness of shim(s) that were taken out when adaptor was removed. If the reverse gear, reverse gear adaptor, large thrust bearing, bearing race, or gear housing were replaced, install 0.008 in. (0.51 mm) of shims.*

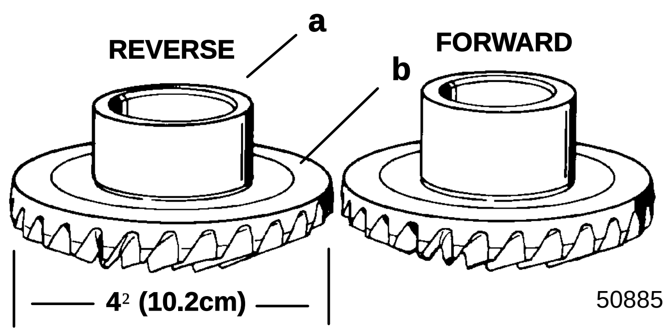
1. Lubricate the bore into which the reverse gear bearing adaptor is to be installed with 2-4-C w/Teflon (92-825407A12).
2. Place the shim(s) into reverse bore of gear housing.
3. Position the bearing adaptor in the gear housing.



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

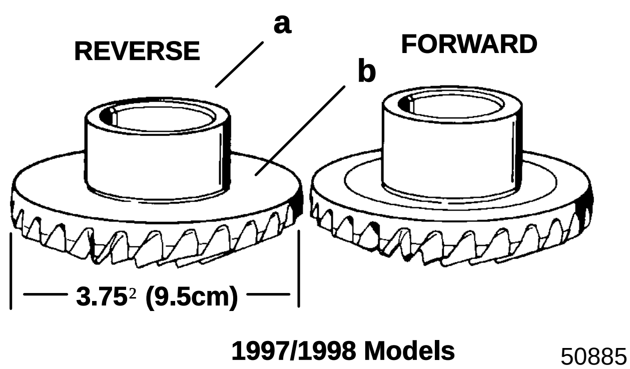
a - Bearing Adaptor
b - Shims

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



1994/1995/1996 Models

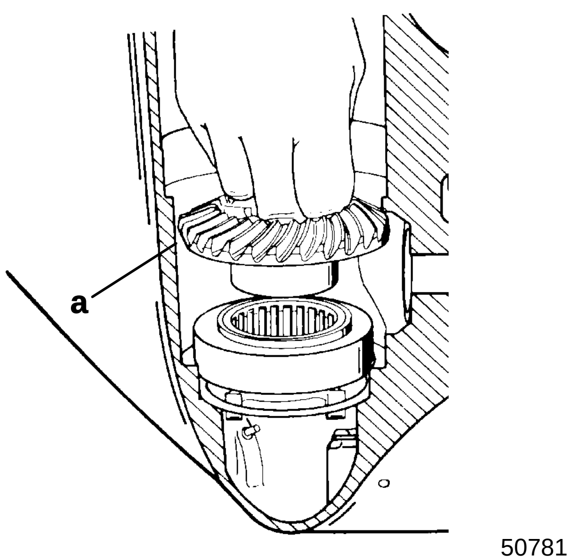
a - Shorter Hub
b - Groove



1997/1998 Models

a - Reverse Gear is Smaller in Diameter for 97/98 Models
b - No Groove in Reverse Gear for 97/98 Models

4. Position the reverse gear (without the thrust race or thrust bearing) into the gear housing and into the adaptor.



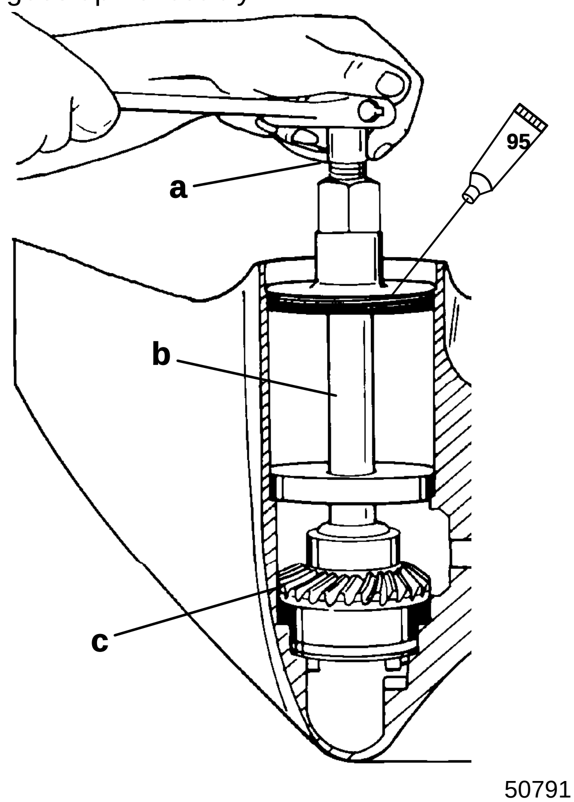
a - Reverse Gear

5. Press the bearing adaptor into the gear housing using the installation tool as follows:

IMPORTANT: Be sure that the bearing adaptor is positioned as straight as possible to avoid cocking it in the bore while pressing it in.

   a. Lubricate the threads of the installation tool with 2-4-C w/Teflon (92-825407A12).

   b. Turn the hex-head screw of the installation tool until the bearing adaptor bottoms out on the gear housing shoulder. DO NOT continue to turn the tool once the screw resistance goes up noticeably.



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

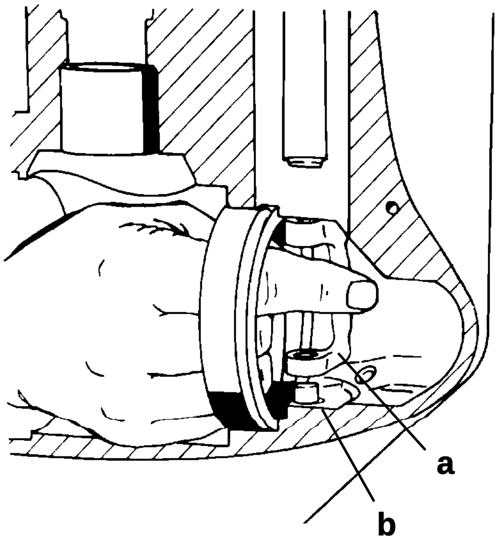
a - Hex-Head Screw
b - Bearing Adaptor Installation Tool (91-18605A1)
c - Reverse Gear

   c. Remove the installation tool **and the reverse gear.**

Shift Shaft Assembly

INSTALLATION

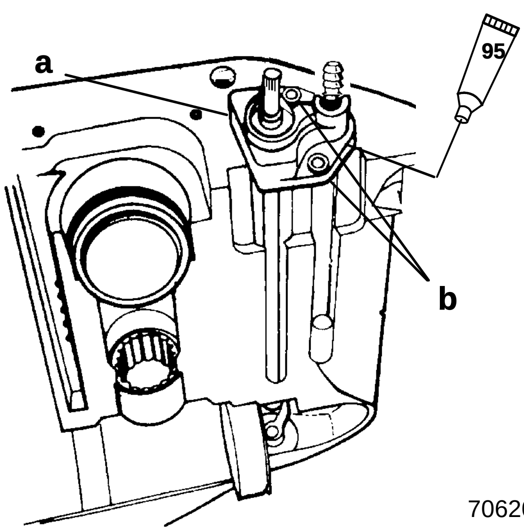
1. Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces towards the left (port) side of the gear housing.



50314

a - Shift Crank
b - Locating Pin

2. Install the shift shaft assembly into the gear housing. Engage the splined end of the shift shaft with the shift crank. Verify O-rings are positioned properly and lubricated with 2-4-C w/Teflon. Secure shift shaft bushing with 2 screws. Torque screws to 60 lb. in. (6.8 N·m).

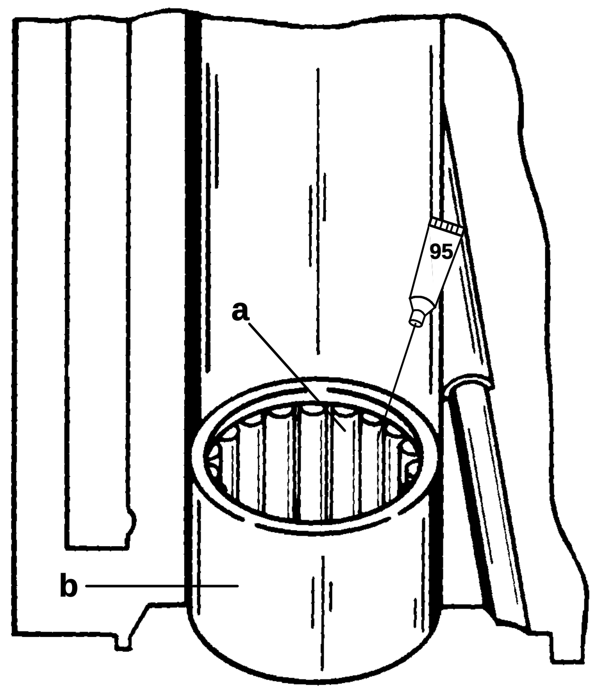


70620

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

a - Shift Shaft Assembly
b - Screws [Torque to 60 lb. in. (6.8 N·m)]

NOTE: *If the pinion bearing needle bearings have fallen out, install 18 needles into needle bearing outer race. Use 2-4-C w/Teflon, to help hold needles in place.*



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

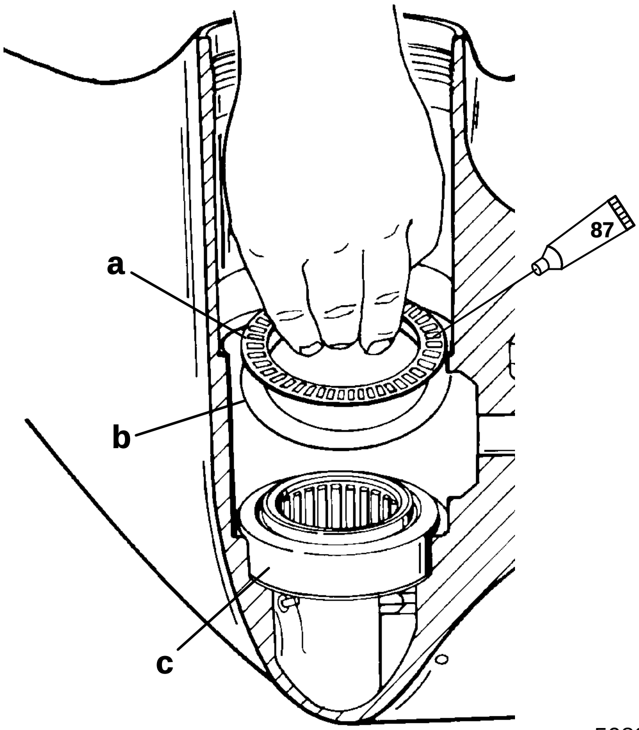
a - Rollers (18)
b - Roller Bearing Outer Race

Gear Location/Backlashes Checking and Adjustment

Reverse Gear

INSTALLATION (FOR CHECKING BACKLASH ONLY)

1. Lubricate the large reverse gear thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and position first the thrust race, then the bearing into the gear housing and onto the reverse gear bearing adaptor.

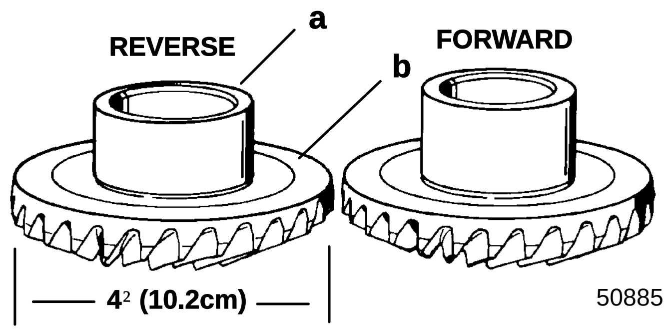


50882

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Thrust Race
c - Reverse Gear Bearing Adaptor

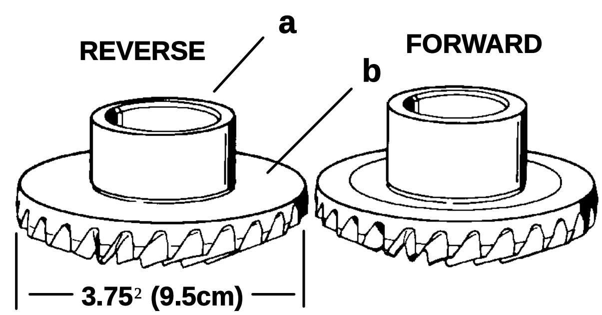
IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



50885

1994/1995/1996 Models

a - Shorter Hub
b - Groove

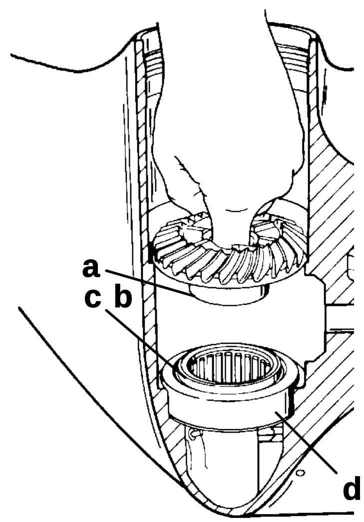


1997/1998 Models

50885

a - Reverse Gear is Smaller in Diameter for 97/98 Models
b - No Groove in Reverse Gear for 97/98 Models

2. Install the reverse gear into the gear housing and into the reverse gear bearing adaptor.



50884

a - Reverse Gear
b - Thrust Bearing
c - Thrust Race (under Bearing)
d - Reverse Gear Bearing Adaptor

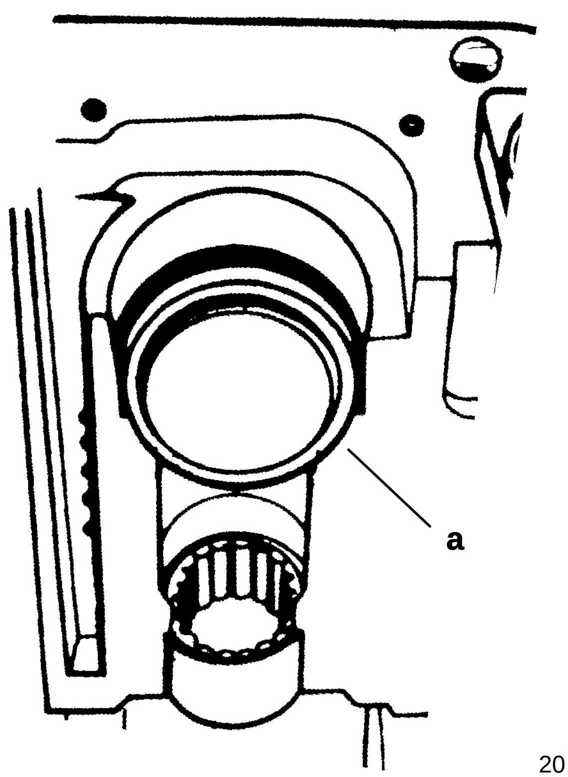
Drive Shaft and Pinion Gear

INSTALLATION (FOR CHECKING GEAR LOCATION AND BACKLASHES ONLY)

NOTE: *If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup, or gear housing were replaced, start off by installing a 0.038 in. (0.96 mm) shim(s).*

NOTE: *If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the original shims (or an amount of shims equal to the original shims).*

1. Place the shim(s) into the drive shaft housing bore at the location shown.



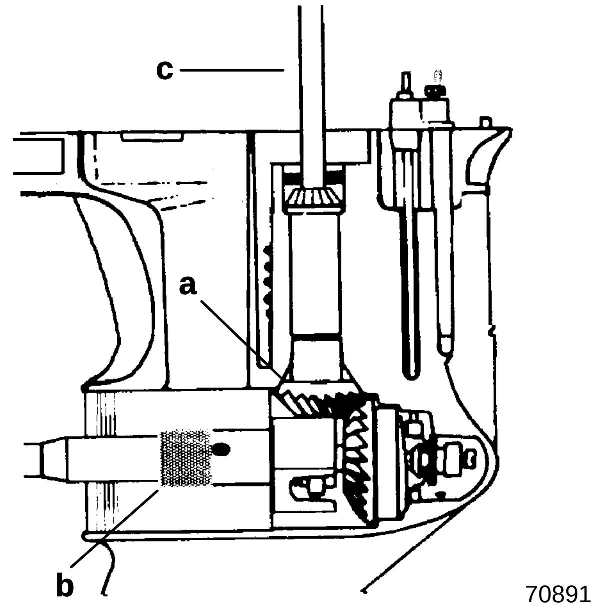
a - Shim(s)

NOTE: *For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.*

2. Apply Loctite 271 (92-809820) to the threads of the pinion nut and position the pinion gear nut in the MR slot of the pinion nut adapter.

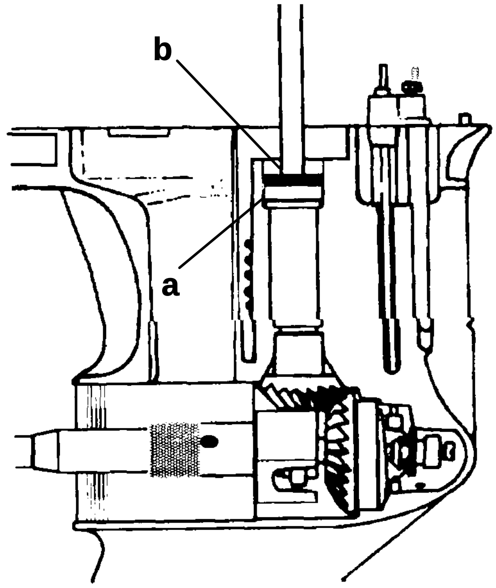
NOTE: *Install the pinion gear nut with the flat side of the nut away from the pinion gear.*

3. Place the pinion gear (with the washer glued to it) into the gear housing.
4. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.
5. Temporarily install the propeller shaft (without the sliding clutch installed) into reverse gear.
6. Insert the pinion nut adaptor (with the nut) into the gear housing. It may be necessary to raise the drive shaft slightly to clear the tool.
7. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



a - Pinion Gear (with the washer glued to it)
b - Pinion Nut Adaptor (91-61067A3)
c - Drive Shaft

8. Install the drive shaft tapered roller bearing cup followed by the retainer.

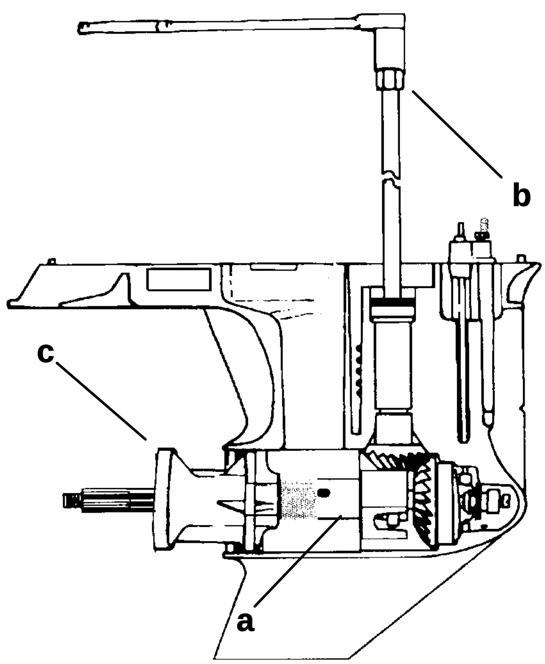


70890

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

9. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.

10. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket to 75 lb. ft. (101.7 N·m).

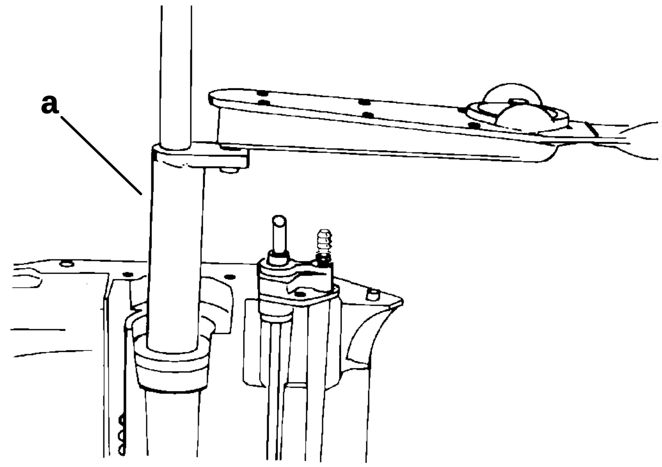


70892

a - Pinion Nut Adaptor (91-61067A2)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (installed backwards)

11. Remove bearing carrier, pinion nut adaptor and drive shaft nut wrench.

12. Torque retainer to 100 lb. ft. (135.6 N·m).



70711

a - Drive Shaft Bearing Retainer Wrench (91-43506)

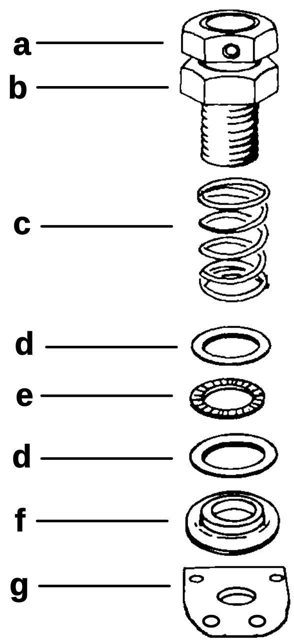
13. Remove retainer wrench.

Drive Shaft - Bearing Preload Tool

INSTALLATION

NOTE: *Ensure that the top nut and the bottom nut of the bearing preload tool are screwed as close together as possible prior to proceeding with the following step.*

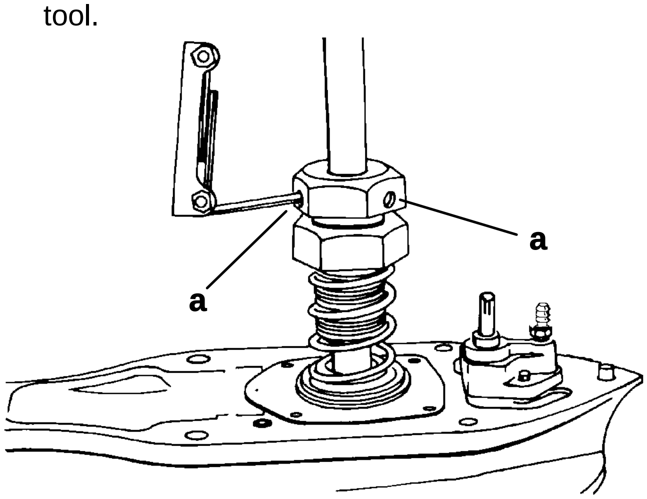
1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



70496

a - Top Nut with Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer (2 Required) (12-18448)
e - Thrust Bearing
f - Thrust Washer
g - Water Pump Face Plate (from your gear housing)

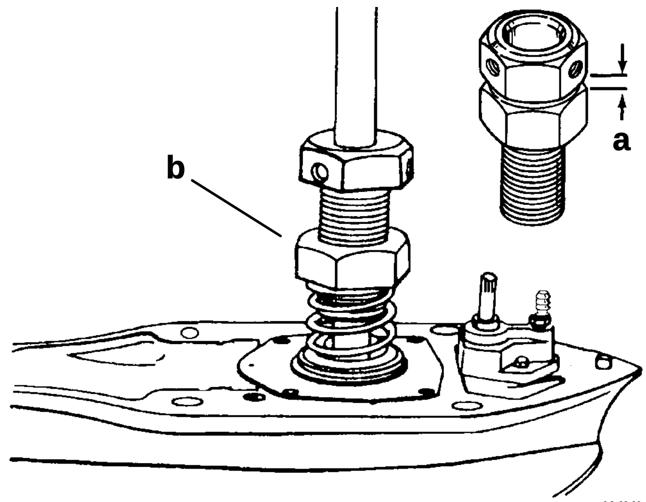
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



70716

a - Allen Screws

3. Measure distance (a) and increase that distance by 1 in. (25.4mm) by turning bottom nut away from top nut.



70893

a - Measure distance and increase by 1 in. (25.4mm)
b - Bottom Nut [screwed down by approximately 1 in. (25.4mm)]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Pinion Gear Location

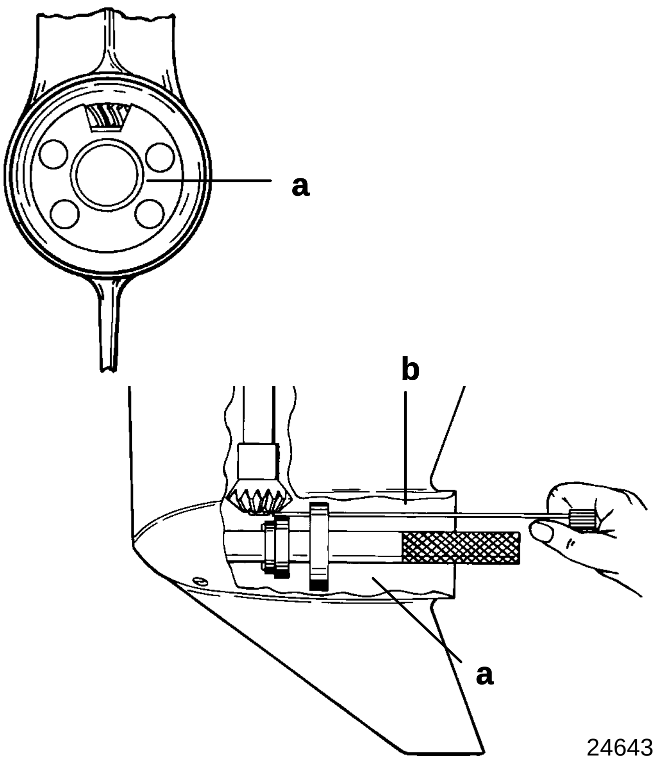
CHECKING

Pinion Gear Location Specification: .025 in. (0.64 mm)

1. Place the pinion gear shimming tool into the gear housing.

NOTE: *Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).*

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.



a - Pinion Gear Shimming Tool 91-12349A2 Using Disc #2 and Flat #4
b - 0.025 in. (0.64mm) Feeler Gauge

3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height.
6. **A.** If the (average) pinion gear location does not meet the specification of 0.025 in. (0.64 mm) continue with the instructions on the following section.

B. If the (average) pinion gear location meets specification, skip the following section and go on to the "Reverse Gear Backlash", "Checking" section.

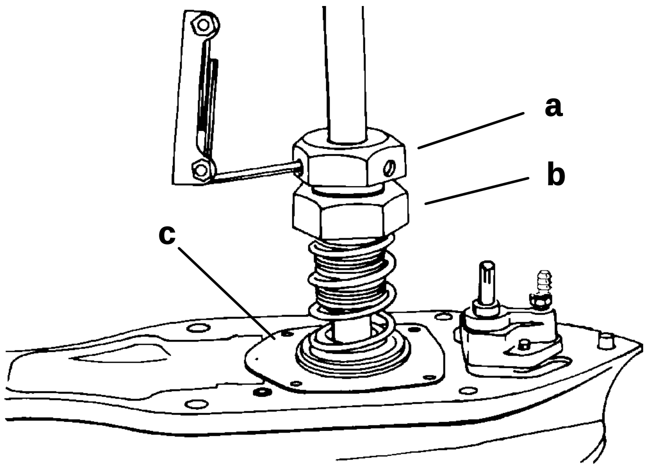
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut.

1. Screw the bottom nut of the bearing preload tool until it is as close as possible to top nut.
2. Loosen the allen screws in the top nut.
3. Remove all components including the water pump face plate.



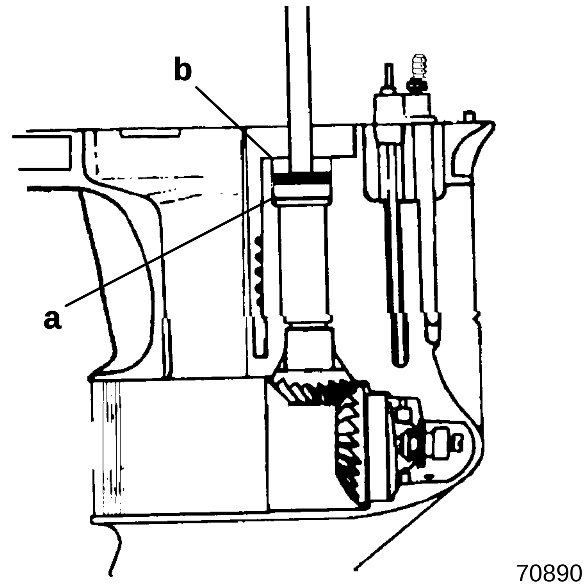
a - Top Nut (with allen screws)
b - Bottom Nut
c - Water Pump Face Plate

Pinion Gear Location

ADJUSTING

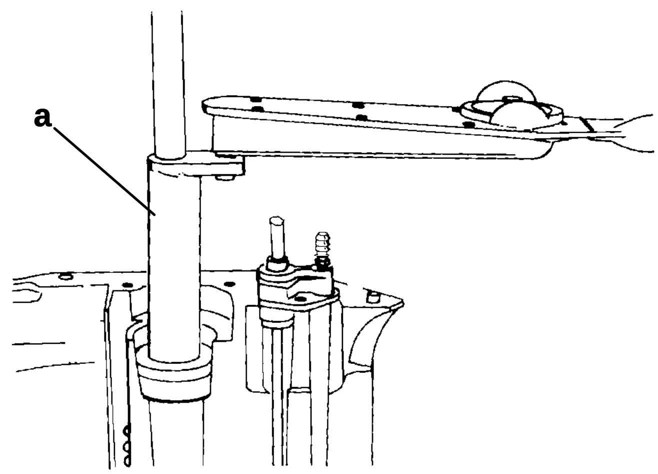
NOTE: *Adding 0.001 in. (0.03mm) shims will increase the gear location by 0.001 in. (0.03mm). Subtracting 0.001 in. (0.03mm) will decrease the gear location by 0.001 in. (0.03mm).*

1. Remove the drive shaft retainer and the drive shaft tapered roller bearing cup. (The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing over and shaking it.) Add or subtract shims beneath the cup to obtain the proper average pinion gear height.
2. Install the drive shaft tapered roller bearing cup, then the retainer.



a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

3. Torque the retainer to 100 lb. ft. (135.6 N·m).



a - Drive Shaft Bearing Retainer Wrench (91-43506)

4. Reinstall the drive shaft bearing preload tool as outlined in the "Drive Shaft - Bearing Preload Tool", "Installation" section.
5. Recheck the pinion gear height as outlined in the "Pinion Gear Location", "Checking" section.

Reverse Gear Backlash

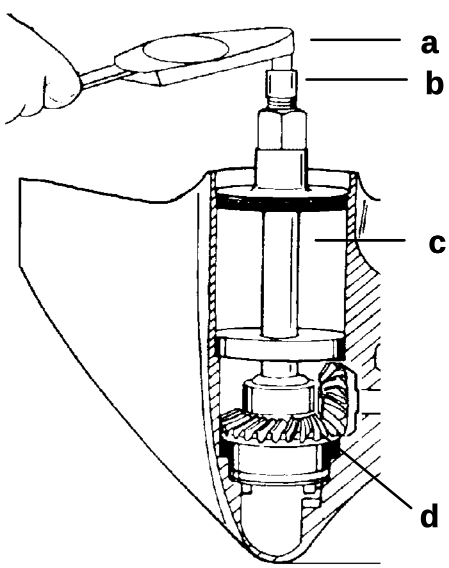
CHECKING

Reverse Gear Backlash Specification:
0.040-0.060 in. (1.01mm-1.5 mm).

NOTE: *If the bearing preload tool has not already been set up see "Drive Shaft - Bearing Preload Tool", 'Installation' section first.*

NOTE: *The reverse gear bearing adaptor installation tool is used to apply a light preload to the reverse gear in the following steps.*

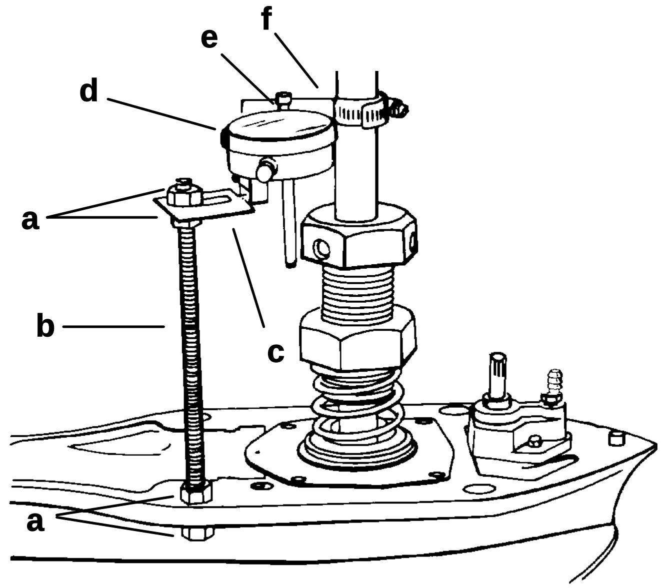
1. Install the reverse gear bearing adaptor installation tool into the gear housing to hold the reverse gear against the thrust bearing as follows:
   a. Assemble the reverse gear bearing adaptor installation tool into the gear housing and tighten it by hand until a slight resistance is felt.
   b. Torque the adaptor's driver bolt to 45 lb. in. (5.1 N·m).



70973

a - Torque Wrench (91-66274)
b - Driver Bolt
c - Bearing Adaptor Installation Tool (91-18605A1)
d - Reverse Gear

2. Install a dial indicator as shown in the following figure.



70717

a - Nuts (4) (obtain locally)
b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)
e - Indicator Pointer
f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
g - Backlash Indicator Rod (91-78473) (for 1.87:1)

3. Align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to the "0" mark on the dial indicator scale.
4. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gears.
   a. Observe the dial indicator and record the reading.
   b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat step 3 an 4 above until a total of 4 backlash readings have been taken.
5. Add the four readings together and divide the sum by four. This is your average backlash and it should be 0.040 in. - 0.060 in. (1.0mm - 1.5mm) (for 1.64:1, 1.75:1 and 1.87:1 ratios).

NOTE: *If backlash needs to be adjusted, (see Checking Reverse Gear Backlash), adding 0.001 in. (0.03 mm) shims will* ***reduce*** *the gear backlash by approximately 0.001 in. (0.03mm). Subtracting 0.001 in. (0.03mm) shims will* ***increase*** *backlash by approximately the same amount.*

Example 1 (if backlash is too high)

Backlash checks:	.070 in.	(1.79 mm)
(subtract) middle of specification:	.050 in.	(1.27 mm)
You get:	.020 in.	(0.50 mm)
add this quantity of shims		

Example 2 (if backlash is too low)

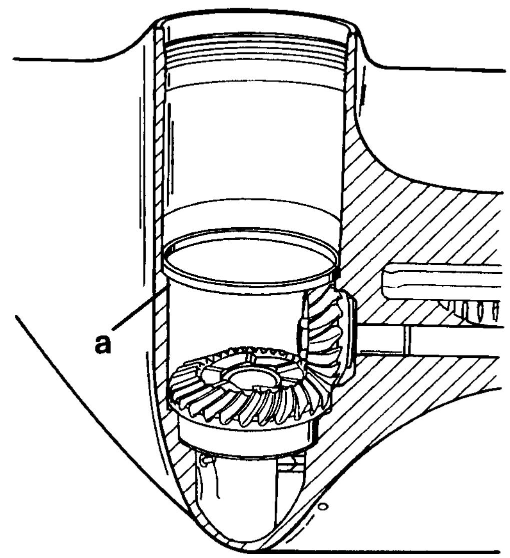
middle of specification:	.050 in.	(1.27 mm)
Backlash checks:	.020 in.	(0.50 mm)
(subtract) You get:	.030 in.	(0.76 mm)
subtract this quantity of shims		

Forward Gear/Bearing Carrier Assembly

CHECKING FORWARD GEAR BACKLASH - (RATCHETING)

NOTE: *If backlashes have already been checked and they are to specification, proceed with "Bearing Carrier Assembly", Final Installation' section.*

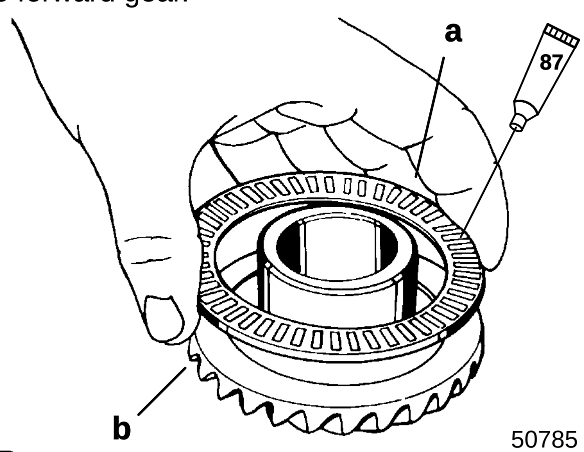
1. Install the appropriate spacer shim into the gear housing.



55428

a - Shim

2. Temporarily install the propeller shaft (without sliding clutch installed) into the reverse gear. Position the shift crank so propeller shaft will rest on the crank.
3. Lubricate the thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and place it onto the forward gear.

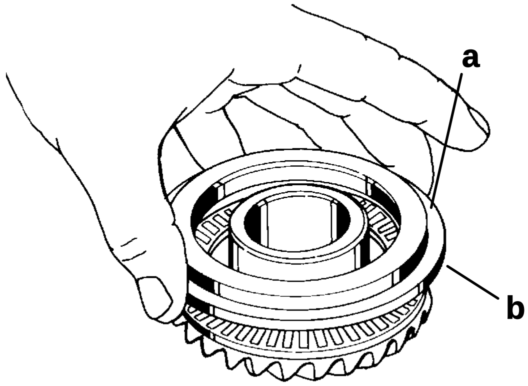


50785

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Forward Gear

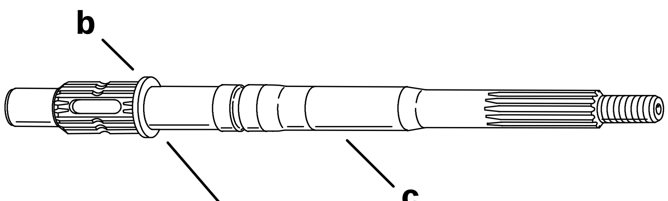
4. Place the thrust race on top of the thrust bearing with the **wide flat side against** the thrust bearing.



50785

a - Thrust Race
b - Wide Flat Side

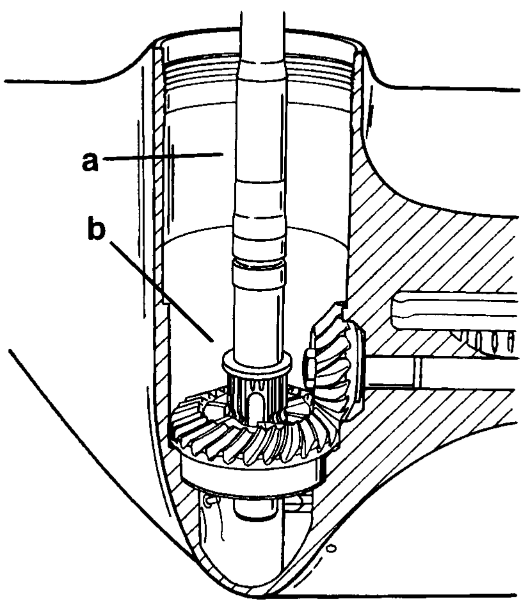
5. Install a load washer (12-37429) over a 44-93003 propeller shaft so that it seats against the REAR shoulder of the clutch spline teeth.



55088

a - Load Washer (12-37429)
b - Shoulder
c - Propeller Shaft (44-93003)

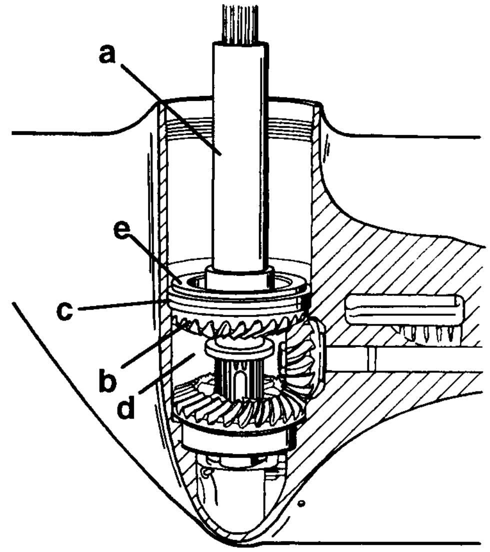
6. Install propeller shaft with load washer into gear housing.



55623

a - Propeller Shaft (44-93003)
b - Load Washer (12-37249)

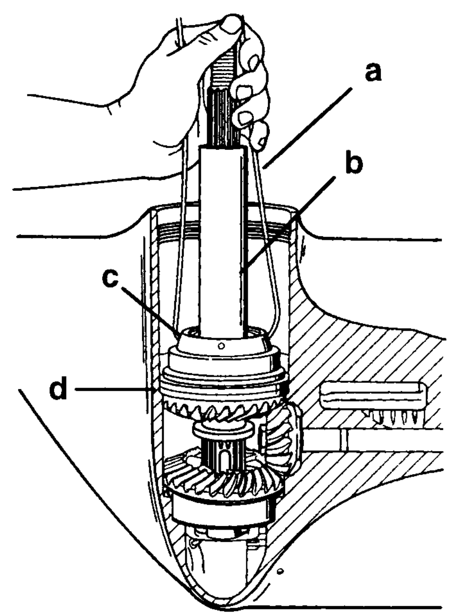
7. Assemble the forward gear installation tool to the forward gear, then place it down over the propeller shaft. Ensure that the thrust race seats evenly onto the shim. Tap the thrust race down lightly with a soft tool, do not damage the thrust race surface.



55624

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear
c - Spacer Shim
d - Load Washer (12-37429)
e - Thrust Race

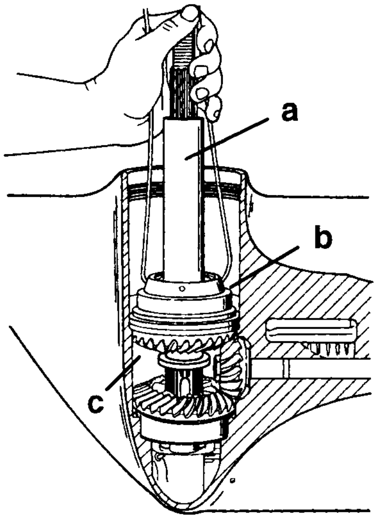
8. Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.



55430

a - Hook Tool
b - Forward Gear Installation Tool (91-815850)
c - Forward Gear Bearing Adaptor
d - Thrust Race

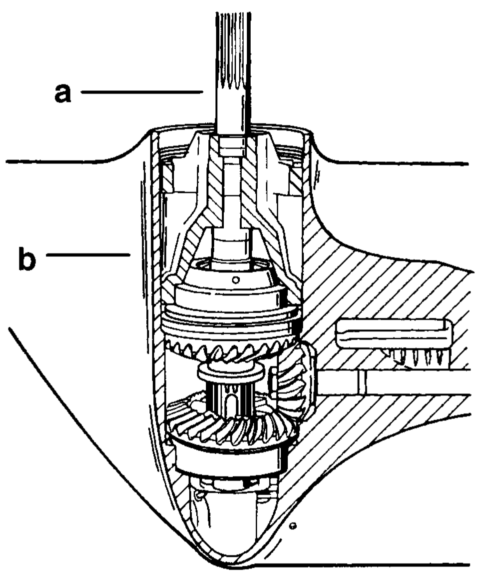
9. Remove the hook tool and while holding down on the forward gear remove the forward gear installation tool.



55430

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear Bearing Adaptor
c - Forward Gear

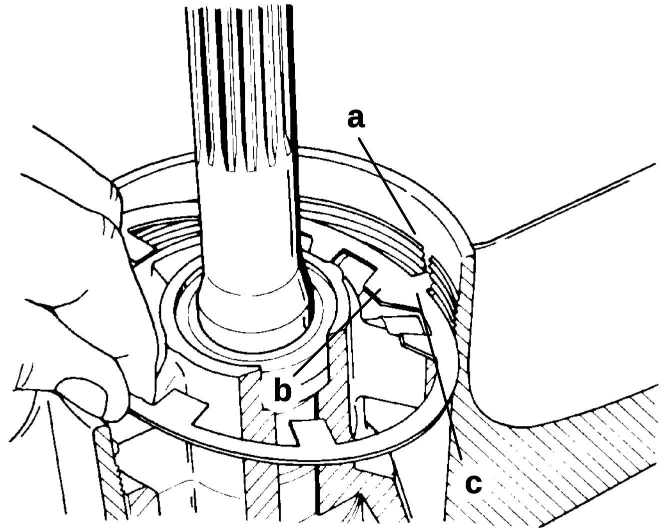
10. Install the bearing carrier over the propeller shaft pushing bearing carrier down until it is fully seated.



55429

a - Propeller Shaft
b - Bearing Carrier

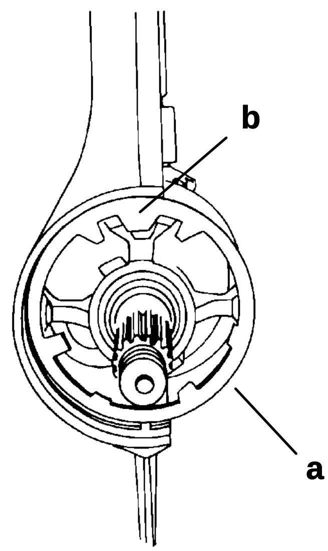
11. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing. Install the tab washer with the external tab inserted into the hole in the gear housing.



50779

a - Gear Housing Tab Washer Alignment Hole (not seen)
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

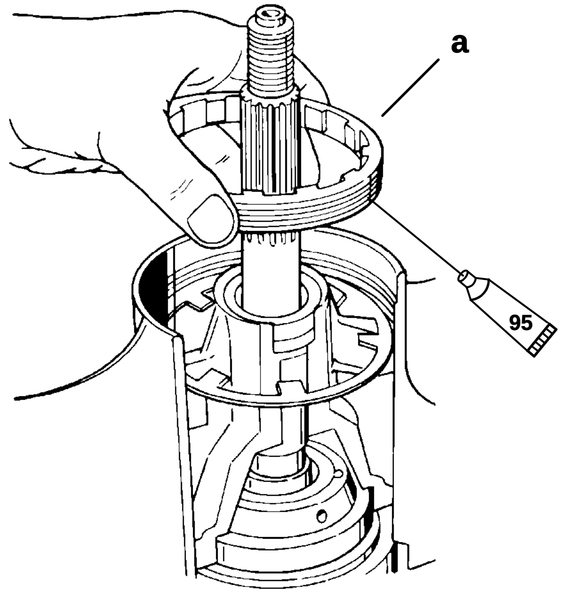
12. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.



70714

a - Tab Washer
b - "V" Tab

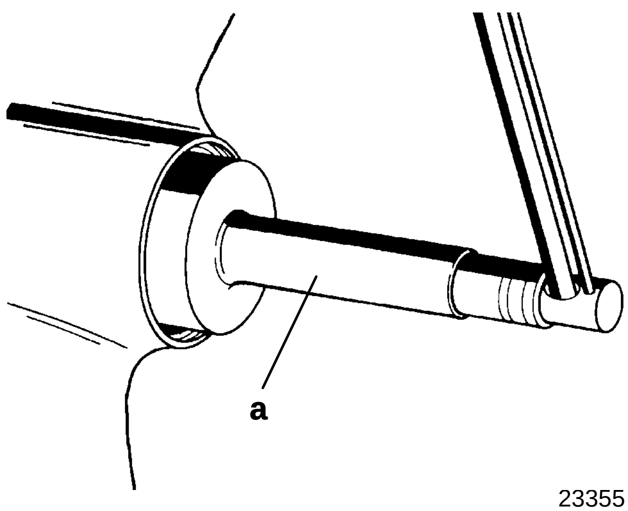
13. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



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

a - Bearing Carrier Retainer

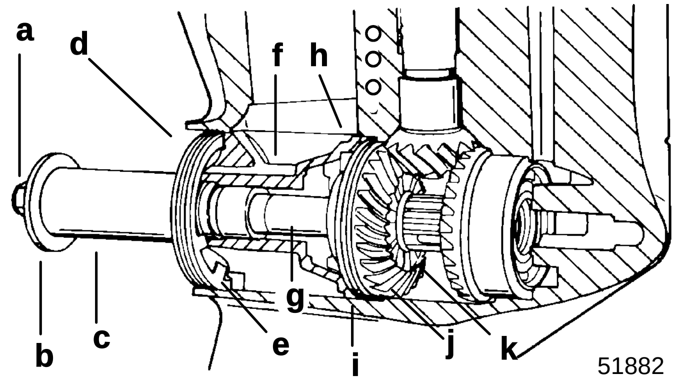
14. Torque the bearing carrier retainer to 210 lb. ft. (285.0 N·m) to seat forward gear assembly in gear case.



a - Bearing Carrier Retainer Wrench (91-61069)

NOTE: *Drill a 3/8^2 (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5^2 x 2^2 (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.*

15. Install a 5^2 x 2^2 (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.

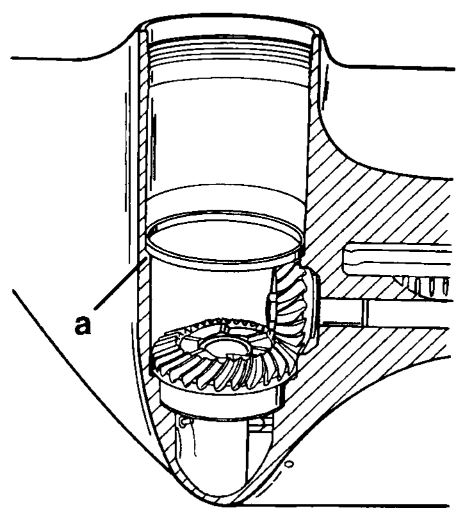


a - Prop Nut
b - Flat Washer
c - PVC Pipe [5^2 x 2^2 (127mm x 50.8mm)]
d - Retainer
e - Tab Washer
f - Bearing Carrier
g - Prop Shaft
h - Bearing Adaptor
i - Shim
j - Forward Gear
k - Load Washer

16. Tighten nut to 45 lb. in. (5.1 N·m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

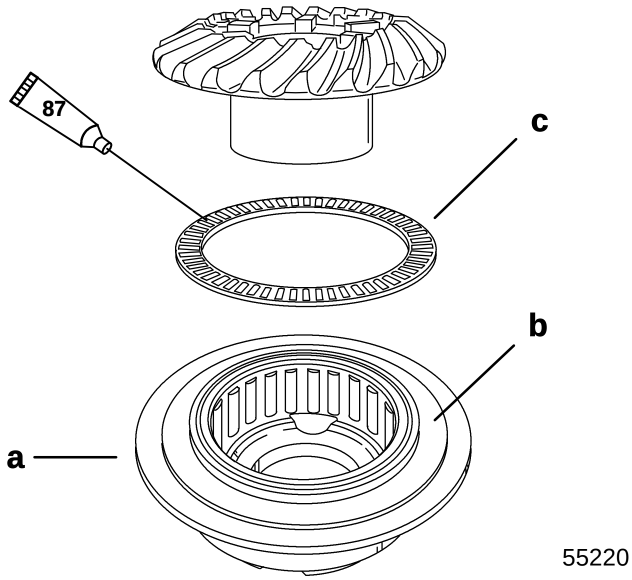
CHECKING FORWARD GEAR BACKLASH - NON-RATCHETING

1. Install the appropriate spacer shim into the gear housing.



a - Shim

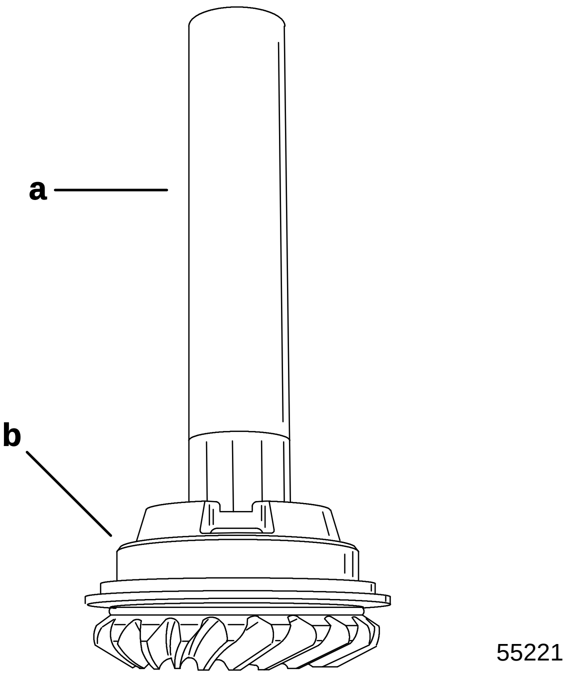
2. Apply Quicksilver Gear Lubricant to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.



87 Quicksilver Gear Lubricant (92-19007A24)

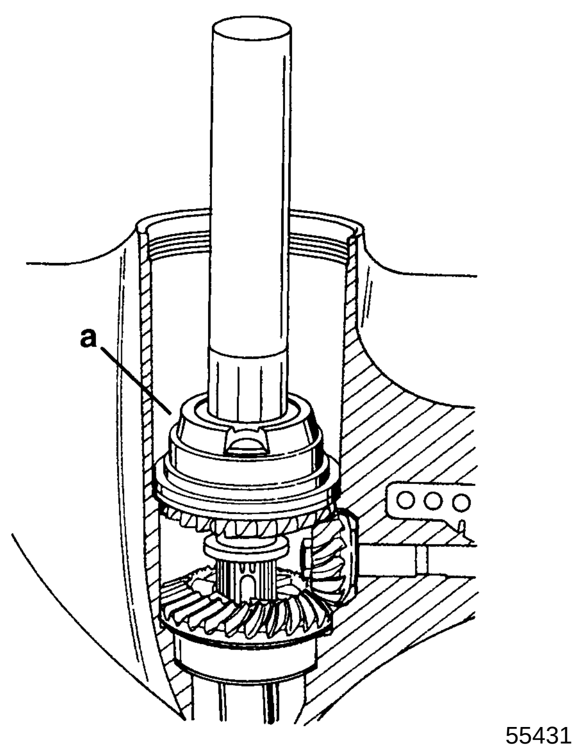
a - Bearing Adaptor
b - Thrust Washer
c - Thrust Bearing

3. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.



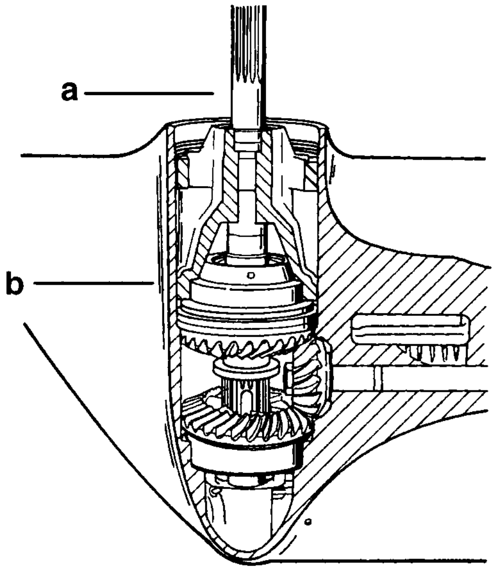
a - Forward Gear Installation Tool (91-815850)
b - Forward Gear/Bearing Adaptor Assembly

4. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.



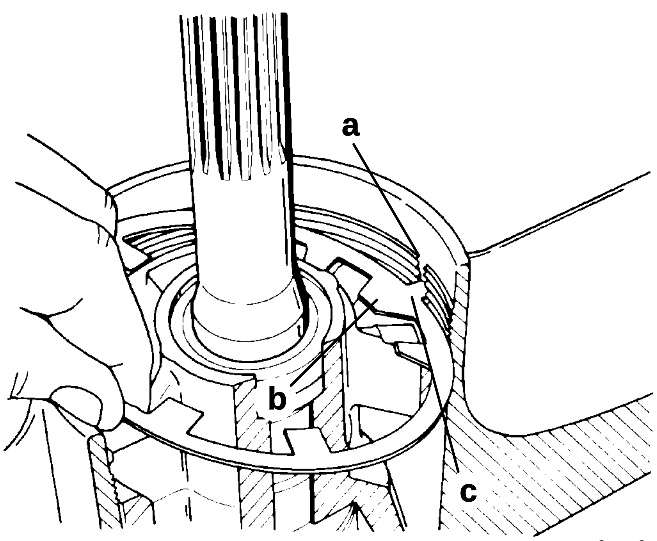
a - Forward Gear Bearing Adaptor

5. Install the bearing carrier over the propeller shaft pushing bearing carrier down until it is fully seated.



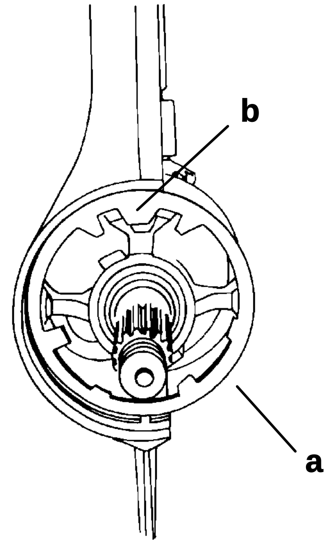
a - Propeller Shaft
b - Bearing Carrier

6. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing. Install the tab washer with the external tab inserted into the hole in the gear housing.



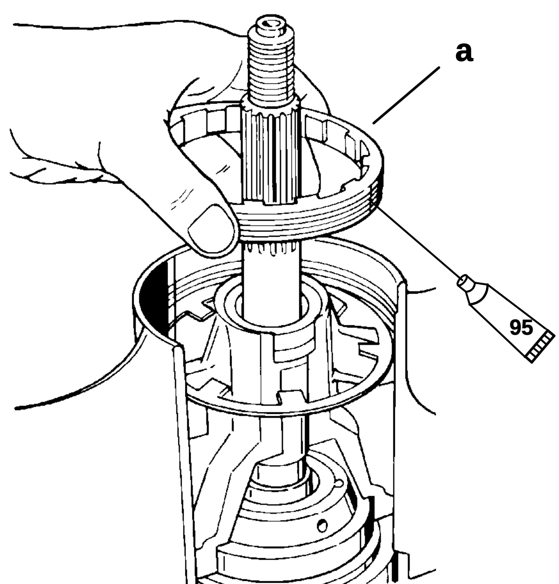
a - Gear Housing Tab Washer Alignment Hole (not seen)
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

7. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.



a - Tab Washer
b - "V" Tab

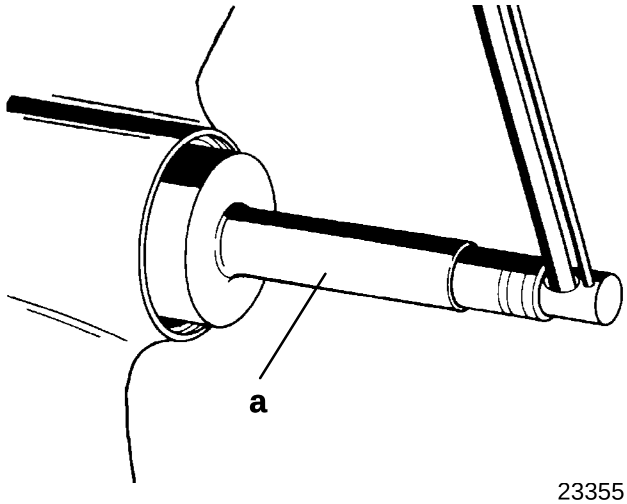
8. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



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

a - Bearing Carrier Retainer

9. Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m) to seat forward gear assembly in gear case.

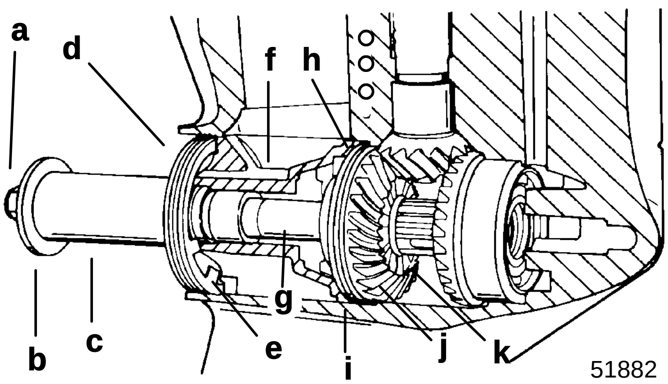


23355

a - Bearing Carrier Retainer Wrench (91-61069)

NOTE: *Drill a 3/8" (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.*

10. Install a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.



51882

a - Prop Nut
b - Flat Washer
c - PVC Pipe [5" x 2" (127mm x 50.8mm)]
d - Retainer
e - Tab Washer
f - Bearing Carrier
g - Prop Shaft
h - Bearing Adaptor
i - Shim
j - Forward Gear
k - Load Washer

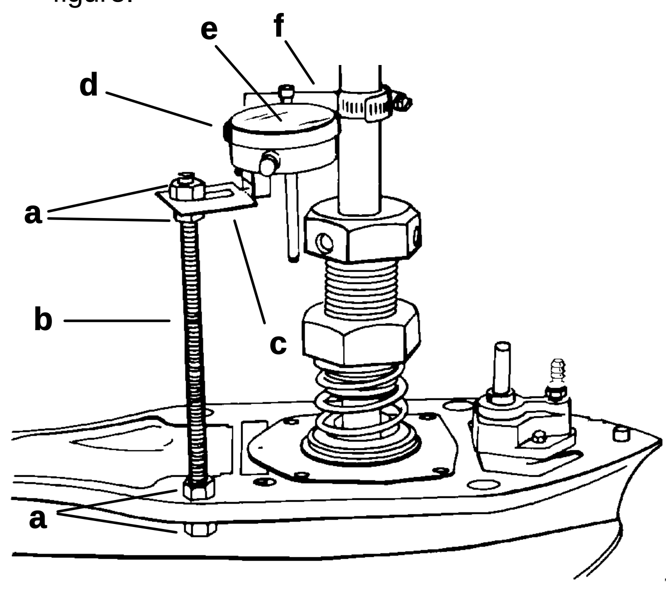
11. Tighten nut to 45 lb. in. (5.1 N·m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

Forward Gear Backlash

CHECKING

NOTE: *If the bearing preload tool has not already been set up, see "Drive Shaft - Bearing Preload Tool", "Installation" section first.*

1. Install a dial indicator as shown in the following figure.



a - Nuts (4) (obtain locally)
b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)
e - Indicator Pointer
f - Backlash Indicator Rod (91-53459) (for 1.64:1 and 1.75:1 ratios) Backlash Indicator Rod (91-78473 (for 1.87:1 ratio)

2. Align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.
3. Take the backlash readings by lightly turning the drive shaft back and forth.
   a. Observe the dial indicator and record the reading.
   b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat step 4 above and take and record another reading. Repeat step 4 until a total of 4 backlash readings have been taken.
4. Add the four readings together and divide the sum by 4. This is your average backlash, which should be 0.017 in. - 0.028 in. (0.431mm - 0.711mm) (for 1.64:1; 1.75:1 and 1.87:1 ratios).

5. If backlash is MORE than the specified MAXIMUM, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 to threads of nut.
6. If backlash is LESS than the specified MINIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 to threads of nut.

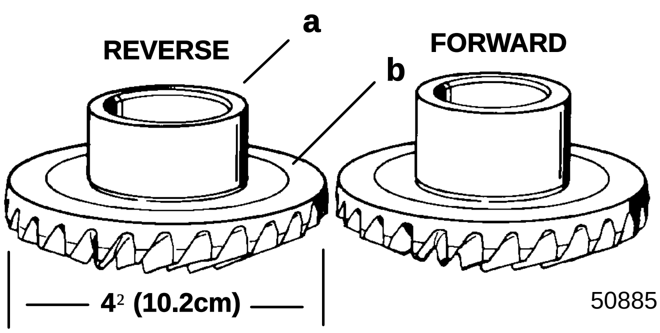
NOTE: *By adding or subtracting 0.001 in. (0.03mm) shim, the backlash will change approximately 0.001 in. (0.03mm).*

7. Remove the propeller nut, washer, and the pinion nut adaptor.
   a. **If the Backlash is to Specification,** skip the next step (8b), and go on to step 9 following.
   b. **If the Backlash is not to Specification,** complete the following instructions to install a different size spacer shim under the forward gear thrust race.
      (1.) Remove the bearing carrier retainer, tab washer, and the bearing carrier.
      (2.) Using the hook tool, remove the forward gear bearing adaptor.
      (3.) Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.
      (4.) Remove the spacer shim.
      (5.) Complete the instruction found in section "Forward Gear/Bearing Carrier Assembly", "Installation - (For Checking Forward Gear Backlash)" section found on page 6B-58.
      (6.) Recheck backlash as outlined in the "Forward Gear Backlash", "Checking" section.
8. Remove the following items as outlined following:
   a. Remove the bearing carrier retainer, tab washer, and the bearing carrier.
   b. Using the hook tool remove the forward gear bearing adaptor.
   c. Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.
   d. Remove the propeller shaft.
   e. Remove the spacer shim.
   f. "Drive Shaft - Bearing Preload Tool", "Removal" section.
   g. "Drive Shaft Assembly", "Removal" section.
   h. Remove the reverse gear.
9. Reinstall the following items as outlined in the following sections:
   a. "Drive Shaft and Pinion Gear", "Installation (For Checking Gear Location and Backlashes Only)" section.
   b. "Drive Shaft - Bearing Preload Tool", "Installation" section.

Propeller Shaft Assembly

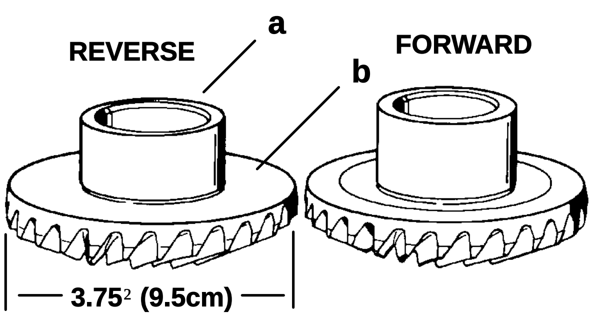
Component Reassembly

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



1994/1995/1996 Models

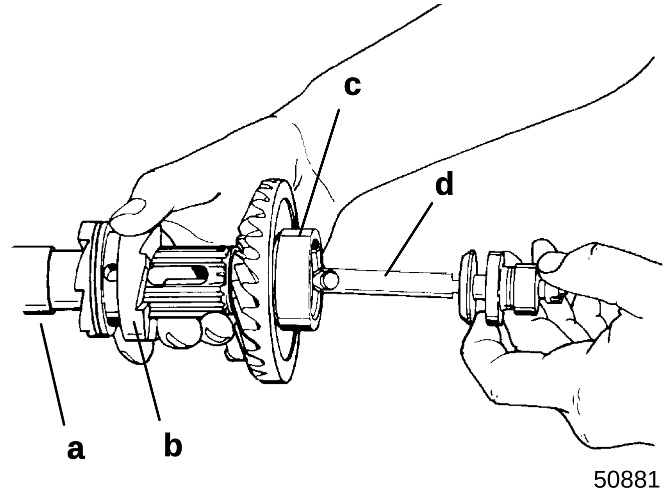
a - Shorter Hub
b - Groove



1997/1998 Models

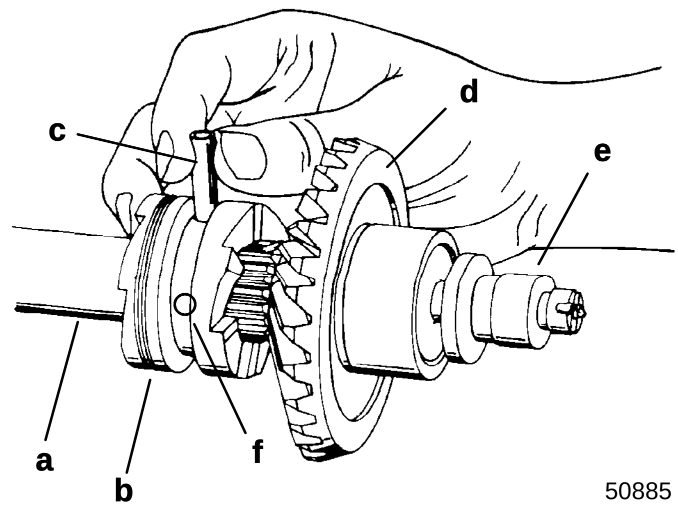
a - Reverse Gear is Smaller in Diameter for 97/98 Models
b - No Groove in Reverse Gear for 97/98 Models

1. Assemble the sliding clutch on the propeller shaft, being sure to align cross pin holes in the clutch with the slot in the propeller shaft. Make sure that the sliding clutch is placed on the propeller shaft with the grooved end of the clutch facing the propeller end of the shaft.
2. Assemble the reverse gear onto the propeller shaft.
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch slot.



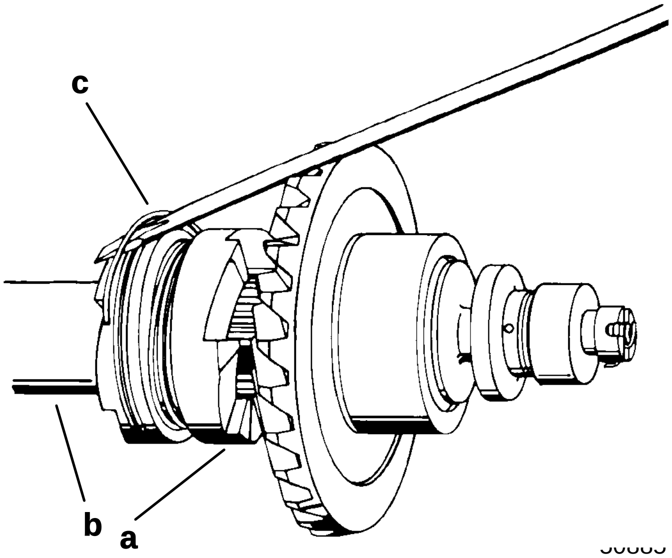
a - Propeller Shaft
b - Sliding Clutch
c - Reverse Gear
d - Shift Spool Assembly

4. Assemble the cross pin through the sliding clutch, through the propeller shaft and through the shift spool shaft hole.
5. Install detent pin in third hole in clutch.



a - Propeller Shaft
b - Sliding Clutch
c - Cross Pin
d - Reverse Gear
e - Shift Spool Assembly
f - Detent Pin

6. Assemble the cross pin retaining spring over the propeller shaft and wind it around the clutch over the cross pin hole. Be careful not to distort the spring while assembling it. **Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch a new spring must be installed.**

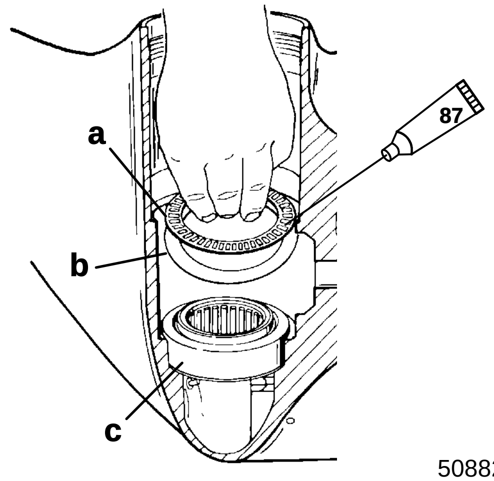


a - Sliding Clutch
b - Propeller Shaft
c - Cross Pin Retaining Spring

Propeller Shaft Assembly

Installation

1. Lubricate the large thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and position first the thrust race then the bearing into the gear housing onto the reverse gear bearing adaptor.

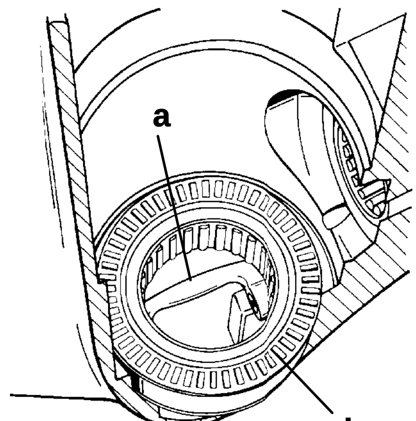


50882

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Thrust Race
c - Reverse Gear Bearing Adaptor

2. Rotate the shift crank toward the aft end of the gear housing until it touches against the bearing adaptor and hold it in this position.

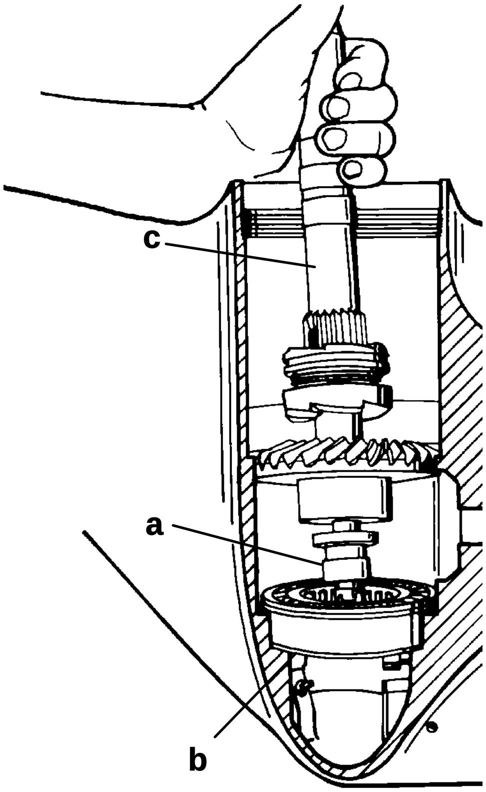


50885

a - Shift Crank
b - Bearing Adaptor

IMPORTANT: Be careful when inserting the propeller shaft assembly into the gear housing as the needle bearings in the reverse gear bearing adaptor can become dislodged . If it is suspected that a needle has become dislodged, remove the propeller shaft assembly and inspect the needle bearing cages for damage. If the cages have not been damaged and a needle bearing is mispositioned, it can be snapped back into place.

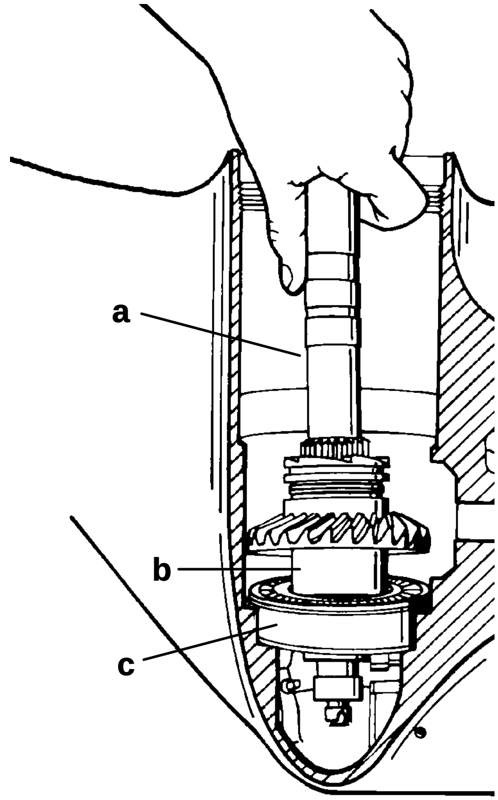
3. To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing and begin to lower it into the gear housing.



50888

a - Shift Actuating Spool
b - Shift Crank
c - Propeller Shaft Assembly

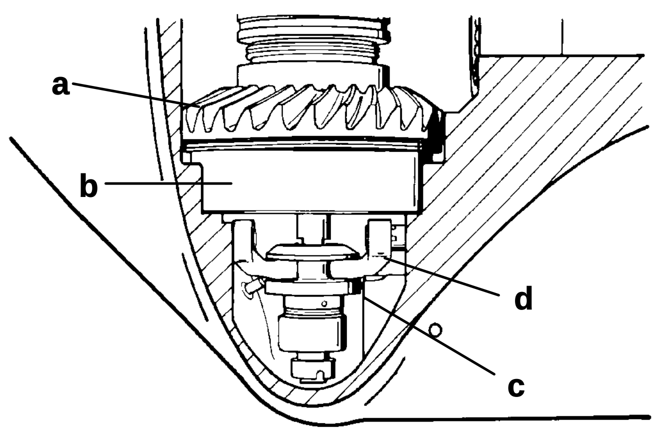
4. With the propeller shaft assembly tilted to the port side of the gear housing, continue to lower the assembly until the reverse gear hub comes into contact with the reverse gear bearing adaptor and the propeller shaft is fully inserted into the reverse gear.



50888

a - Propeller Shaft
b - Reverse Gear Hub
c - Bearing Adaptor

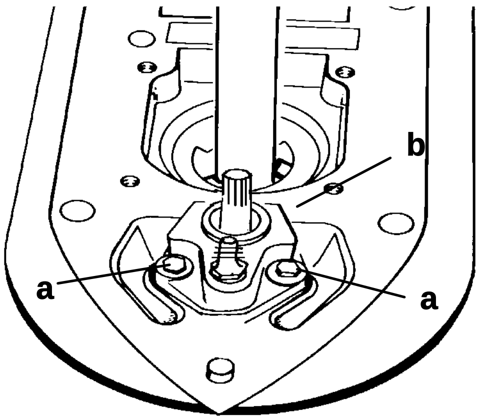
5. Slowly move the propeller shaft to the center of the housing and lower the reverse gear into the bearing adaptor. The shift spool should engage with the shift crank as the propeller shaft centers itself.



50885

a - Reverse Gear
b - Bearing Adaptor
c - Shift Spool
d - Shift Crank

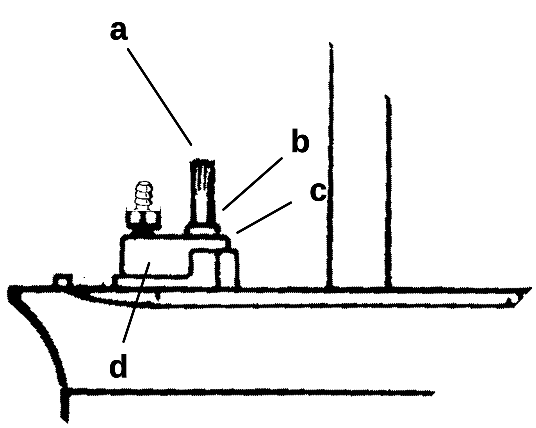
6. Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise, and should move aft when the shift shaft is turned counterclockwise.
7. Make sure that the O-rings are present and positioned correctly. Install the screws that secure the shift shaft bushing and torque them to 60 lb. in. (6.8 N·m).



70494

a - Screws (2)
b - Shift Shaft Bushing

8. Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



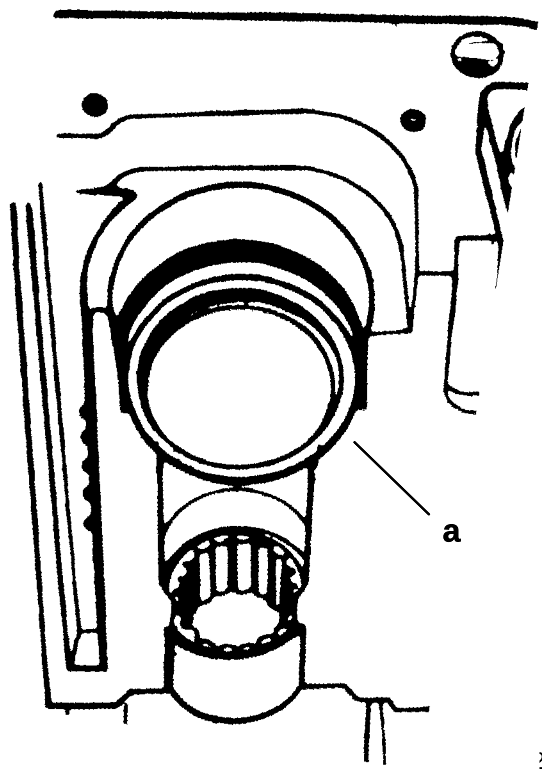
2

a - Shift Shaft
b - Rubber Sleeve
c - Oil Seal
d - Shift Shaft Bushing

Drive Shaft and Pinion Gear

Final Installation (Ratcheting and Non-Ratcheting)

1. Place the shim(s) into the drive shaft housing bore at the location shown.



20

a - Shim(s)

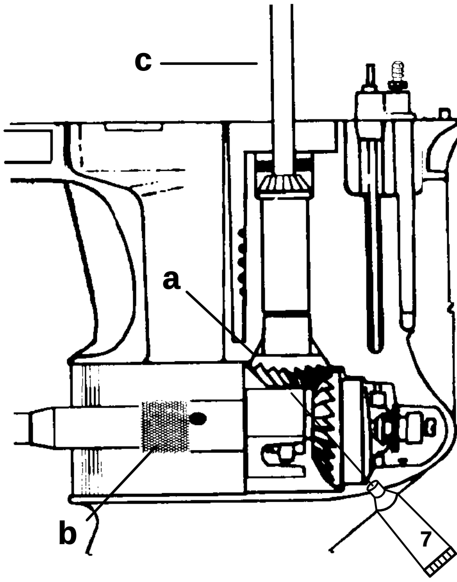
NOTE: *For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.*

2. Apply Loctite Type 271 (92-809820) to the threads of the **NEW** pinion gear **NUT** and assemble the pinion gear nut into the MR slot of the pinion nut adaptor.

NOTE: *Install the pinion gear nut with the flat side of the nut away from the pinion gear.*

3. Place the pinion gear (with the washer glued to it) into the gear housing.
4. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.

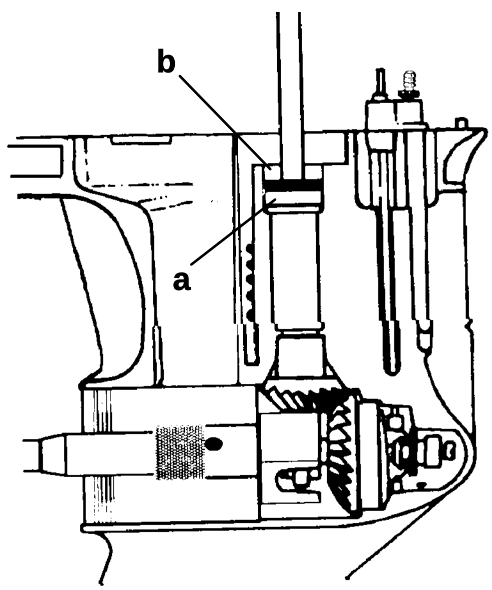
5. Insert the pinion nut adaptor (with the nut assembled to it) into the gear housing. It may be necessary to raise the drive shaft slightly to clear the tool.
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



7 Loctite 271 (92-809820)

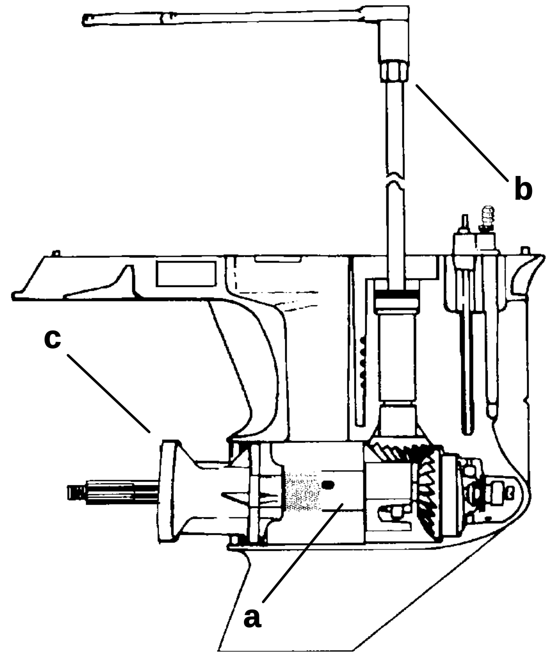
a - Pinion Gear (with the washer glued to it)
b - Pinion Nut Adaptor (91-61067A3)
c - Drive Shaft

7. Install the drive shaft tapered roller bearing cup then the retainer.



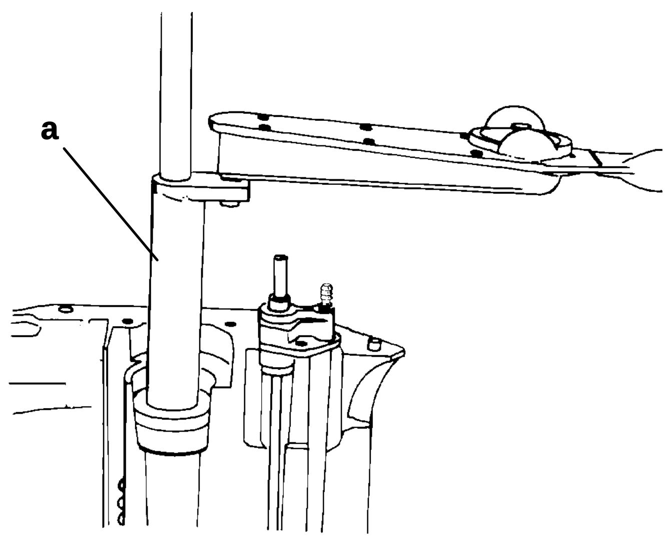
a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

8. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.
9. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket to 75 lb. ft. (101.7 N·m).



a - Pinion Nut Adaptor (91-61067A2)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (installed backwards)

10. Remove the bearing carrier, pinion nut adaptor and drive shaft nut wrench.
11. Torque the retainer to 100 lb. ft. (135.6 N·m).



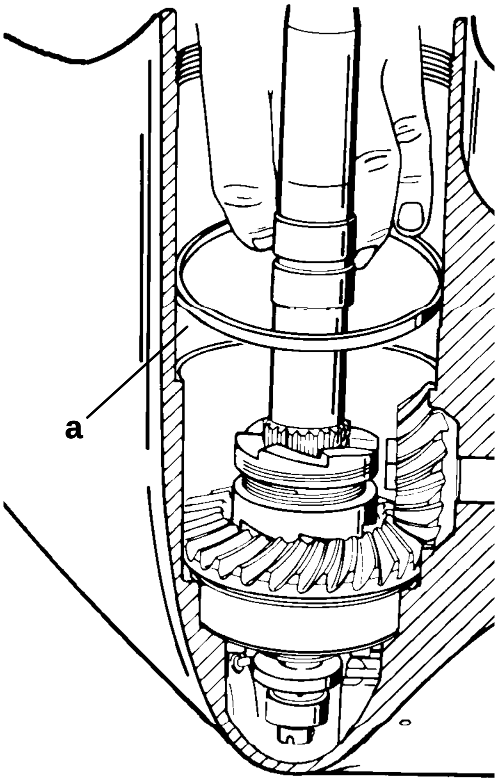
a - Drive Shaft Bearing Retainer Wrench (91-43506)

12. Remove the retainer wrench.

Bearing Carrier Assembly

Final Installation (Ratcheting)

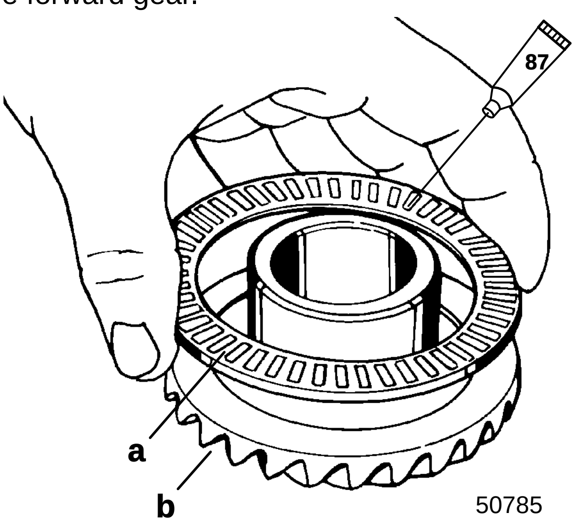
1. Install the appropriate spacer shim into the gear housing.



50782

a - Shim

2. Lubricate the thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and place it onto the forward gear.

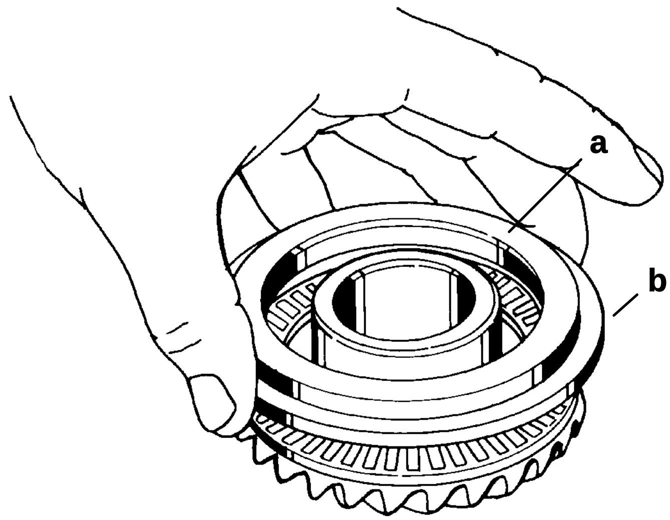


50785

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Forward Gear

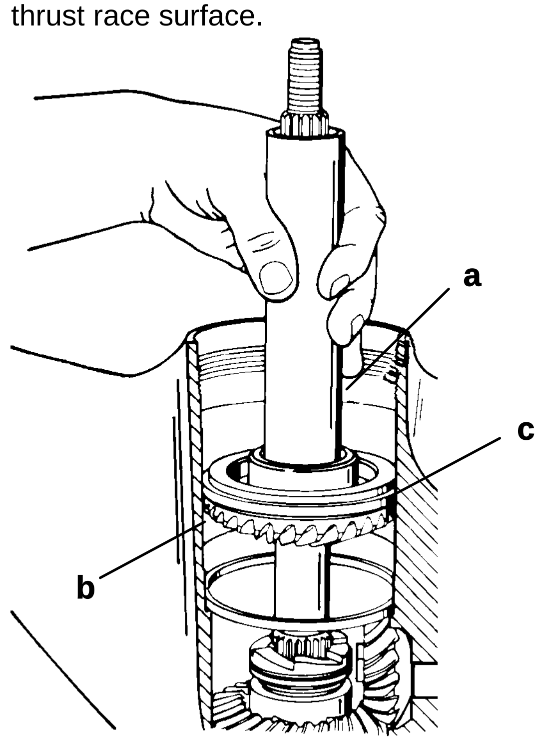
3. Place the thrust hub on top of the thrust bearing with the **wide flat side against** the thrust bearing.



50785

a - Thrust Hub
b - Wide Flat Side

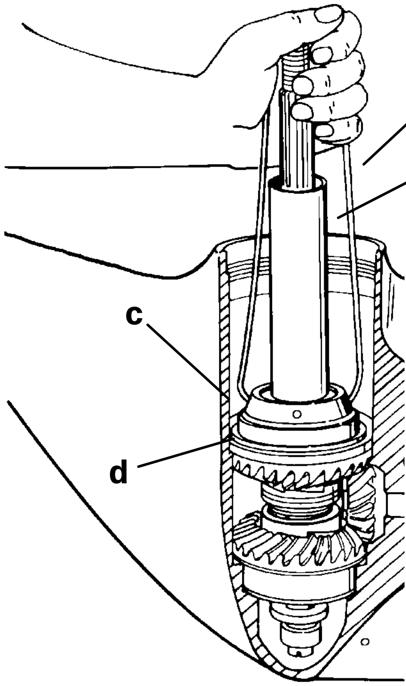
4. Use the Forward Gear Installation Tool (91-815850) to install the forward gear down over the propeller shaft. Ensure that the thrust hub seats evenly onto the shim. Tap the race down lightly using a soft punch. Do not damage the thrust race surface.



50783

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear
c - Spacer Shim

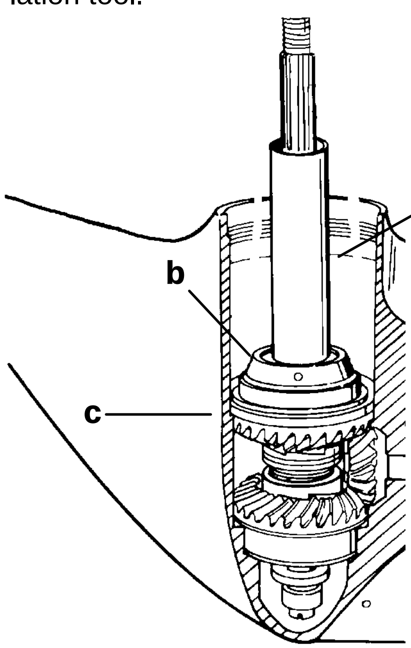
5. Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.



50881

a - Hook Tool
b - Forward Gear Installation Tool (91-815850)
c - Forward Gear Bearing Adaptor
d - Thrust Race

6. Remove the hook tool and while holding down on the forward gear, remove the forward gear installation tool.

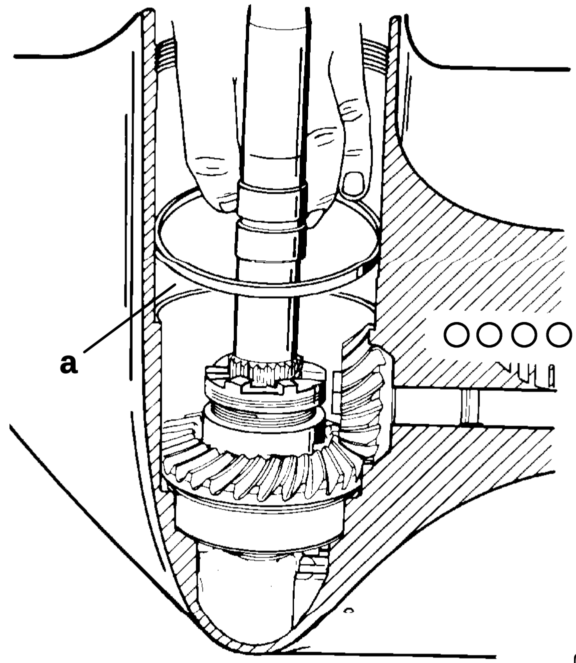


50881

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear Bearing Adaptor
c - Forward Gear

Final Installation (Non-Ratcheting)

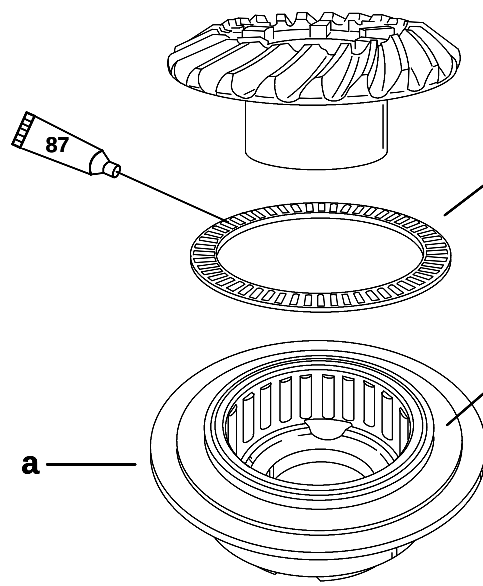
1. Install appropriate spacer shim into the gear housing.



0782

a - Shim

2. Apply Quicksilver Gear Lubricant to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.

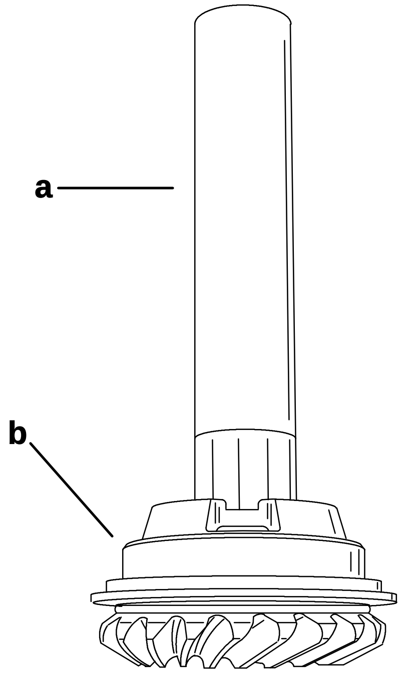


55220

87 Quicksilver Gear Lubricant (92-19007A24)

a - Bearing Adaptor
b - Thrust Washer
c - Thrust Bearing

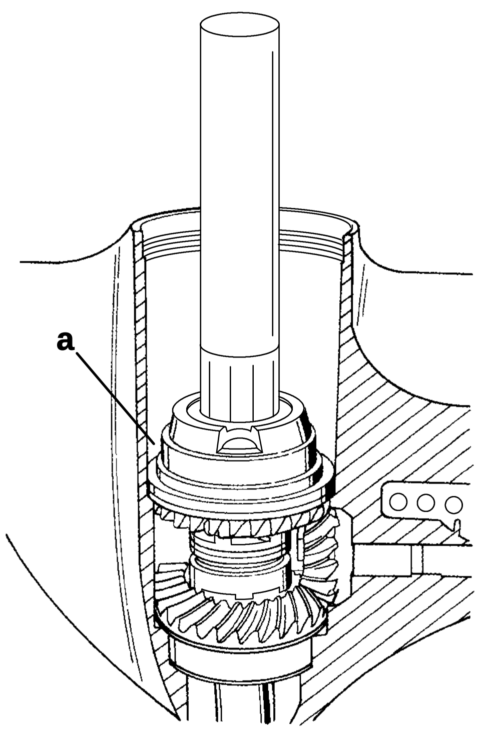
3. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.



55221

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear/Bearing Adaptor Assembly

4. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.

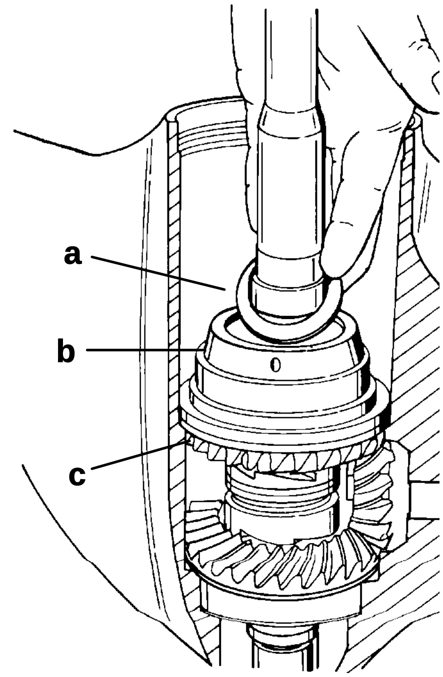


55202

a - Forward Gear Bearing Adaptor

Final Installation (Ratcheting and Non-Ratcheting)

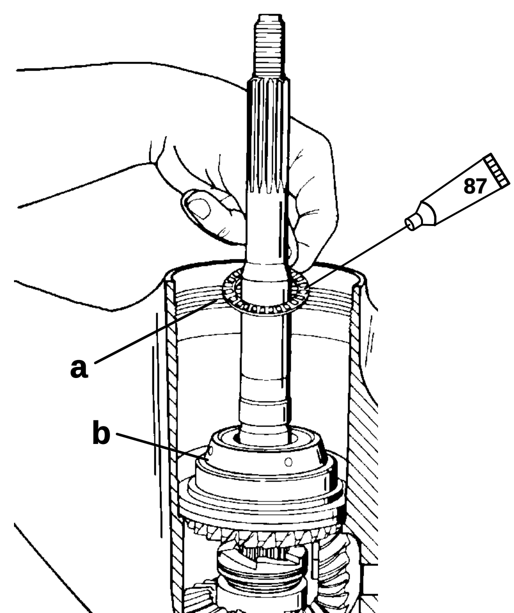
1. Ensure that the top of the bearing adaptor is clean and install the small thrust race on top of the bearing adaptor.



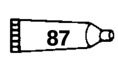
50880

a - Thrust Race
b - Forward Gear Bearing Adaptor
c - Forward Gear

2. Lubricate the small thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and install it on top of the thrust race.



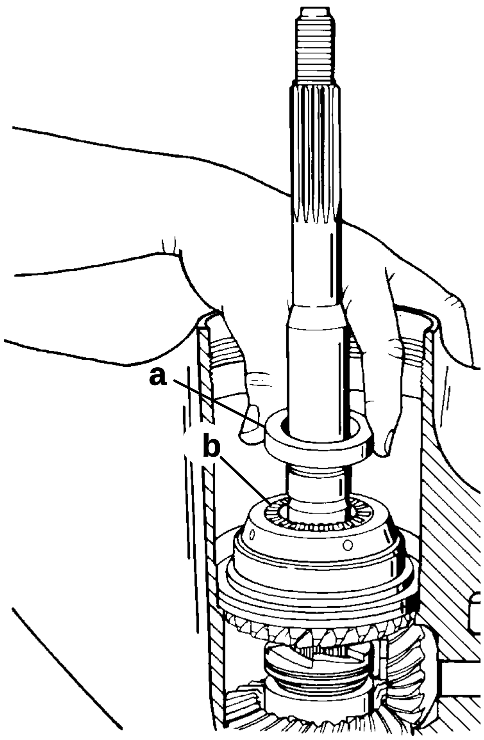
50783



Quicksilver Gear Lubricant (92-19007A24)

a - Small Thrust Bearing
b - Forward Gear Bearing Adaptor

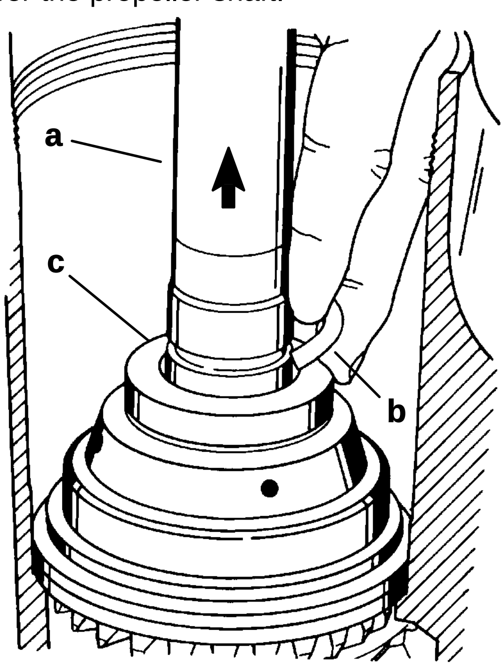
3. Assemble the thrust collar with its STEPPED SIDE DOWN toward the small thrust bearing.



50784

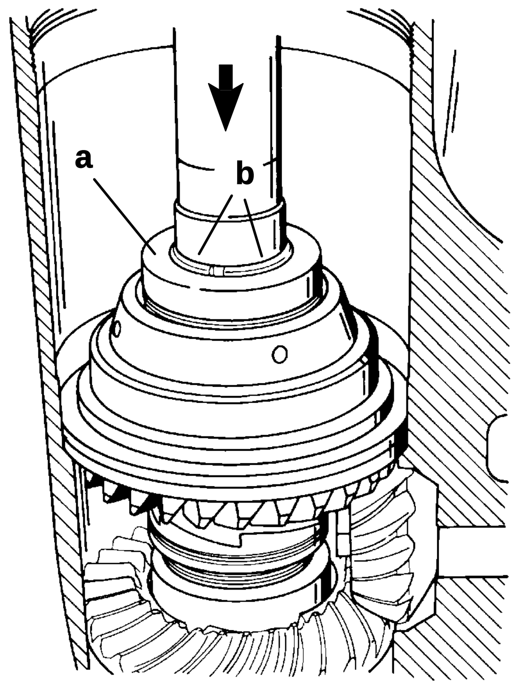
a - Thrust Collar
b - Small Thrust Bearing

4. Pull up slightly on the propeller shaft to gain access to the groove on the shaft for the keepers. Assemble the two keepers into the groove and lower the propeller shaft.



0826

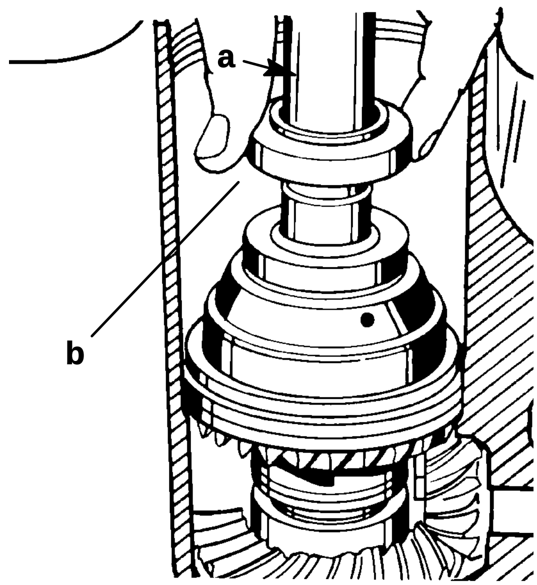
a - Propeller Shaft (slightly lifted)
b - Keepers (2)
c - Thrust Collar



50778

a - Thrust Collar
b - Keepers

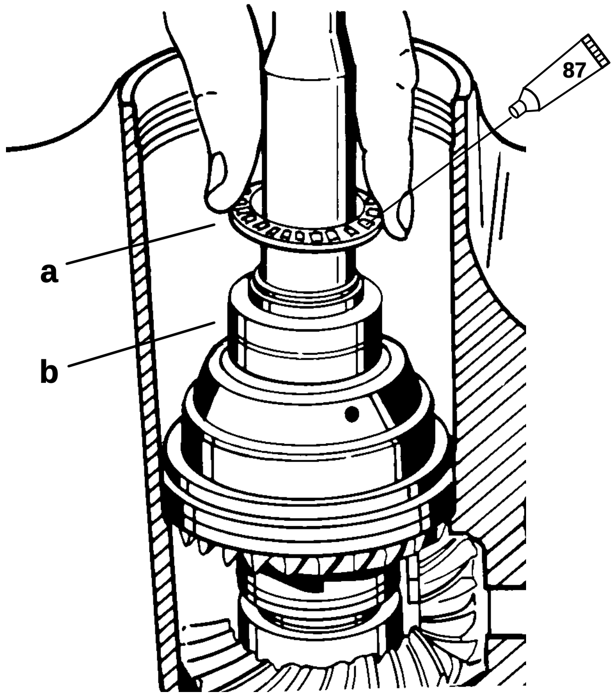
5. Install the second thrust collar with its STEPPED SIDE UP.



50787

a - Propeller Shaft
b - Thrust Collar

6. Lubricate the second thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and install it to the top of the thrust collar.

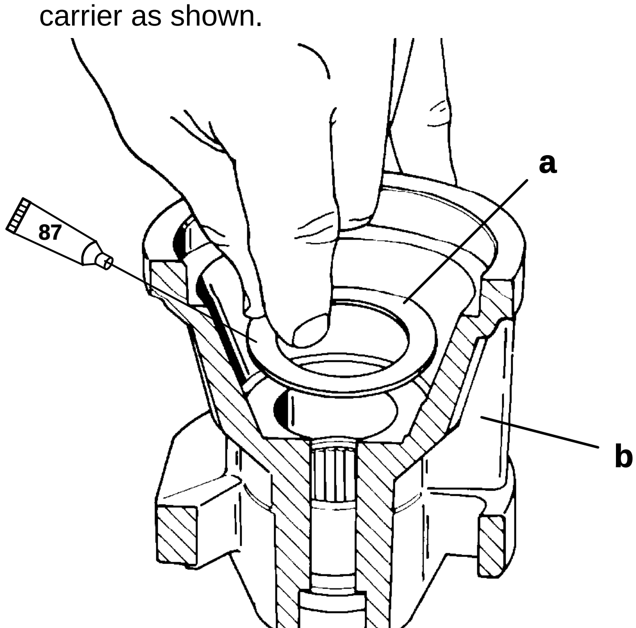


50786

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Thrust Collar

7. Lubricate the second small thrust bearing race with Quicksilver Gear Lubricant (92-13783A24). Assemble it to the surface inside of the bearing carrier as shown.

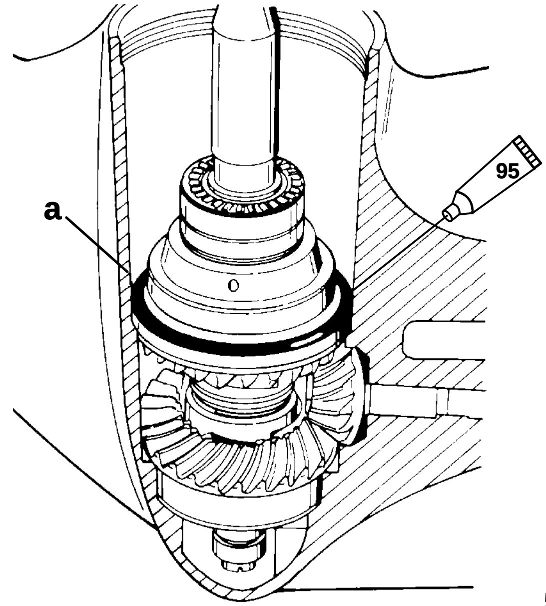


50779

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Race
b - Bearing Carrier

8. Lubricate the large O-ring with 2-4-C w/Teflon (92-825407A12) and assemble into the gear housing as shown following.



50886

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

a - O-ring

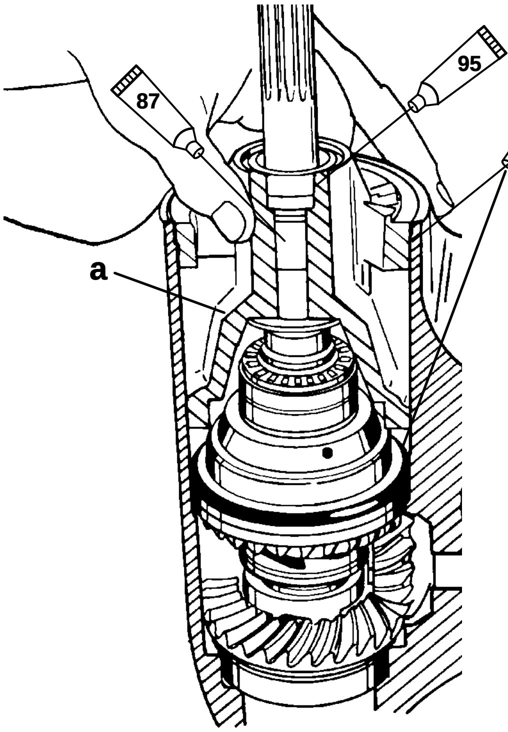
9. Prepare the bearing carrier for installation as follows:

   a. Lubricate the outer diameter of the bearing carrier with 2-4-C w/Teflon (92-825407A12).

   b. Fill the space between the carrier oil seals with 2-4-C w/Teflon.

   c. Lubricate the needle bearing with Quicksilver Gear Lubricant (92-13783A24).

10. Install the bearing carrier assembly into the gear housing.



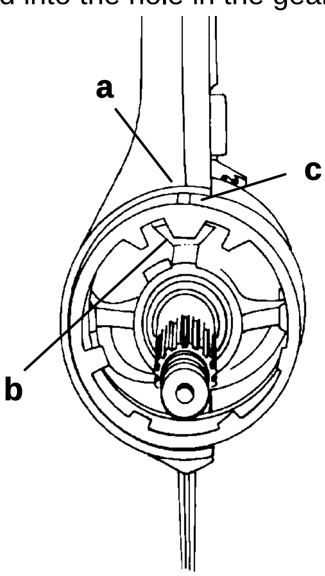
50826

87 Quicksilver Gear Lubricant (92-19007A24)

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

a - Bearing Carrier Assembly

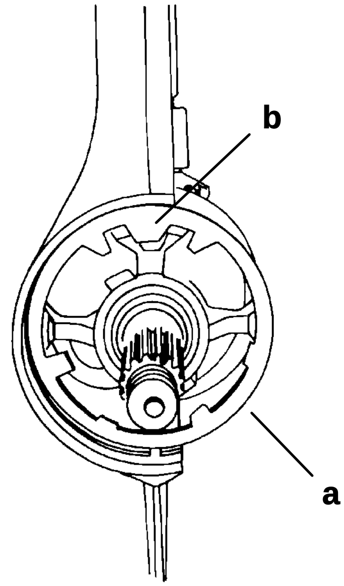
11. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Case Alignment Hole
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

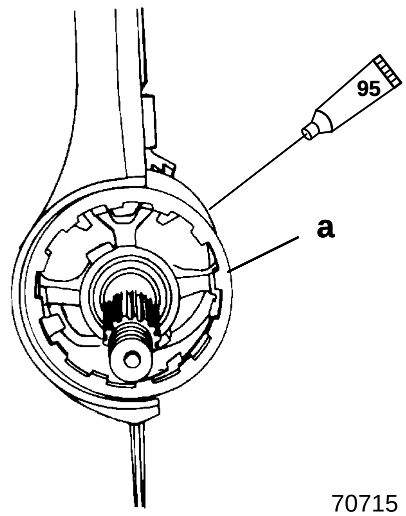
12. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.



70714

a - Tab Washer
b - "V" Tab

13. Fill the bearing carrier retainer nut threads and corresponding gear housing threads (360°) with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



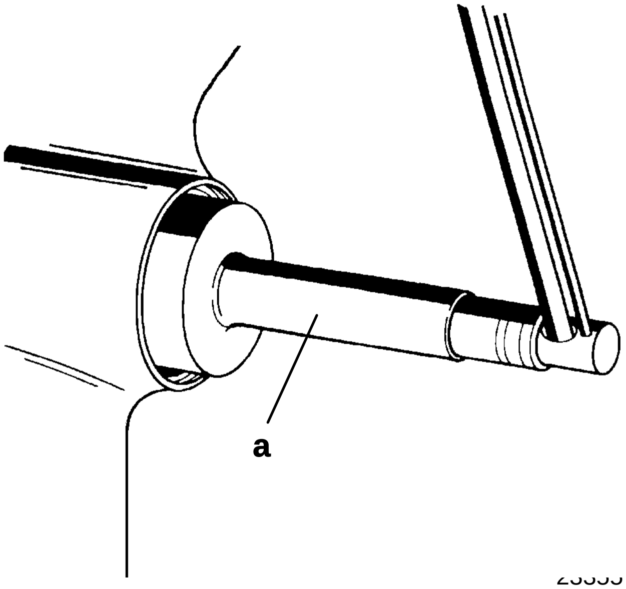
70715

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

a - Bearing Carrier Retainer

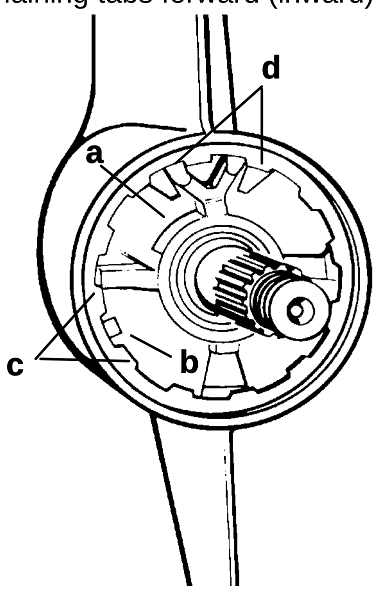
IMPORTANT: Before torquing bearing carrier retainer, gear case must be bolted to drive shaft housing or securely fastened in a gear case holding fixture to avoid possible damage to gear housing

14. Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m). If one tab does not align up in space between two of the notches, continue to tighten retainer until alignment is achieved. DO NOT loosen retainer to achieve alignment.



a - Bearing Carrier Retainer Wrench (91-61069)

15. Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



70490

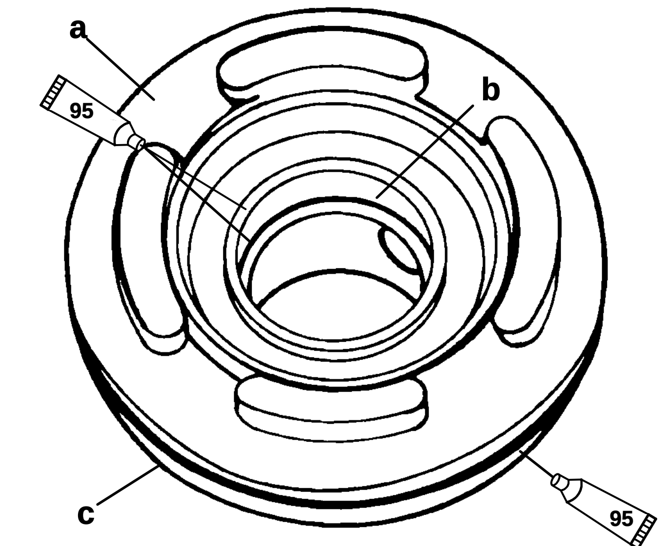
a - Bearing Carrier
b - Tab
c - Retainer Notches
d - Alignment Tabs (Bend Inward)

Oil Seal Carrier Assembly

Installation

NOTE: *Apply hand pressure only to install the oil seal carrier into position. Do not hammer it into position.*

1. Lubricate the oil seal carrier oil seal lips, between oil seals and O-ring with 2-4-C w/Teflon (92-825407A12) and install the oil seal carrier over the drive shaft and into the gear case.



95 2-4-C With Teflon (92-825407A12) 70501

a - Oil Seal Carrier
b - Oil Seal Lips
c - O-ring

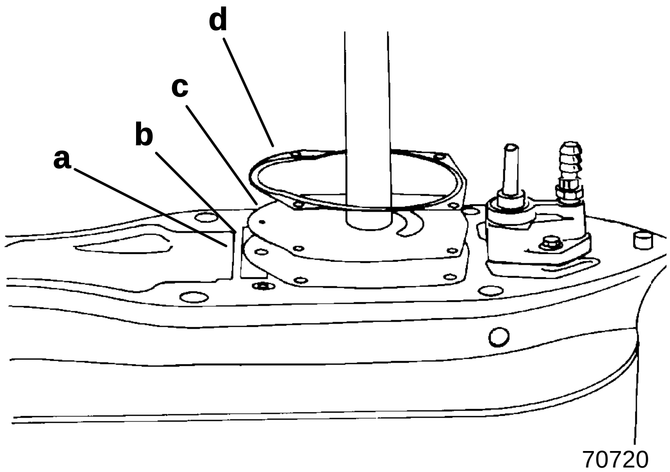
Water Pump Assembly

Installation

NOTE: *The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.*

1. Reinstall filler block in housing, if removed.

2. Install the small hole gasket then the face plate followed by the large hole gasket onto the gear case.

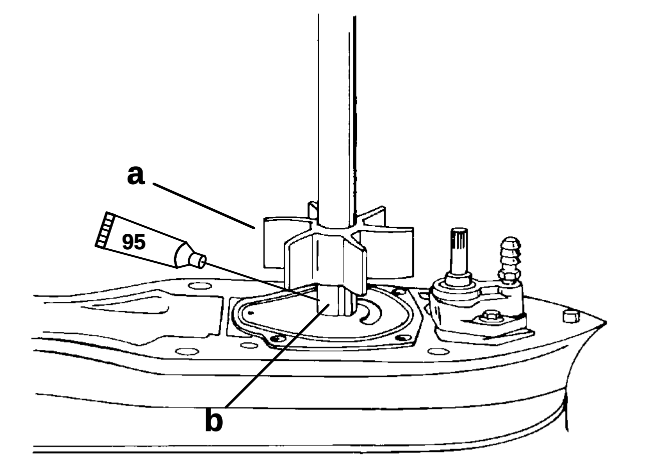


a - Filler Block
b - Small Hole Gasket
c - Face Plate
d - Large Hole Gasket

3. Place a small amount of 2-4-C w/Teflon (92-825407A12) on the flat surface of the impeller key and install the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. DO NOT install the impeller with its blades oriented in a reversed direction from original rotation, or premature impeller failure <u>will</u> occur.

4. Assemble the water pump impeller onto the drive shaft and down over the key.

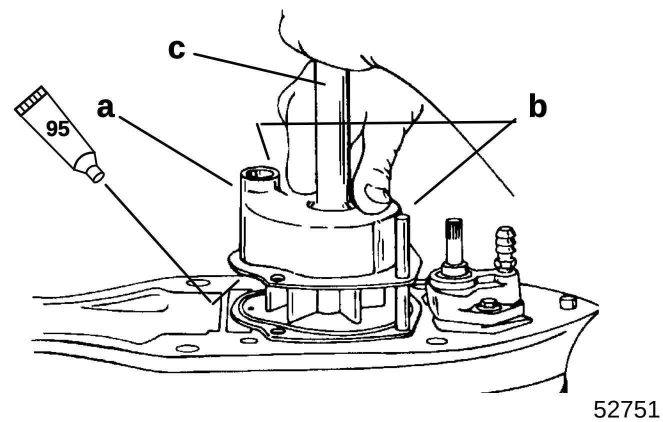


95 2-4-C With Teflon (92-825407A12)

a - Water Pump Impeller
b - Water Pump Impeller Key

5. Install the 2 water pump locating pins through the gaskets and face plate.

6. Apply a light coat of 2-4-C w/Teflon (92-825407A12) to the inside of the pump cover. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



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

a - Water Pump Body
b - Water Pump Alignment Pins (91-821571A1)
c - Drive Shaft (turn clockwise while installing water pump body)

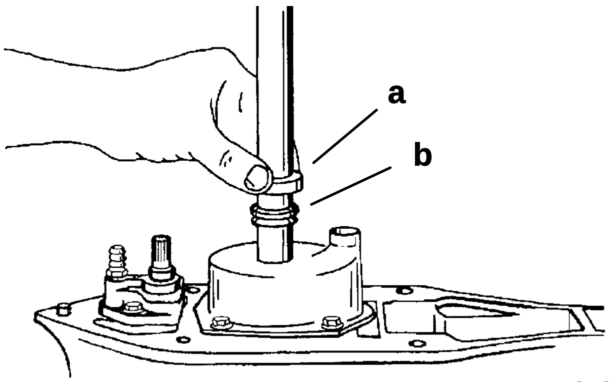
7. Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Install the remaining 2 fasteners. Run all fasteners down and torque to 60 lb. in. (6.8 N·m).

8. Lightly lubricate the O-rings in the water tube coupling with 2-4-C w/Teflon (92-825407A12).

9. Install the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

IMPORTANT: If seal installed above pump housing is not at the proper height, air will be drawn into the pump resulting in overheating of the engine.

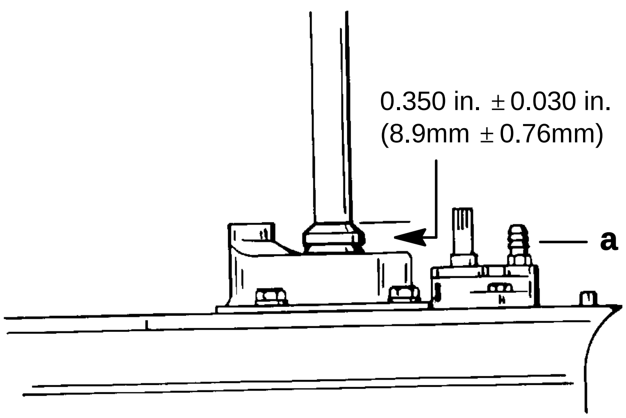
10. Using tool provided in seal kit (26-816575A2) or water pump kit (817275A3), press seal down over drive shaft (DO NOT GREASE DRIVE SHAFT) until tool seats against pump housing.



52724

a - Tool
b - Seal

11. If tool is not available, lightly press seal against housing until a height of 0.350 in. ± 0.030 in. (8.9mm ± 0.76mm) is obtained.



52726

a - Speedometer Connector

NOTE: *Secure speedometer tube to speedometer connector with sta-strap.*

Gear Lubricant Filling Instructions

1. Inspect "Fill" and "Vent" sealing washers for cuts or abrasions. Replace washers if necessary.
2. Clean any metal debris from magnet on "Fill" plug.

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

3. Slowly fill housing thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

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

5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Drive Shaft Housing

⚠ WARNING

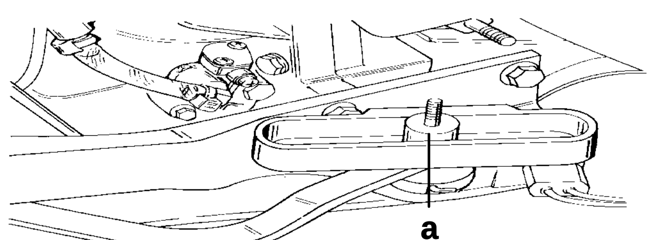
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing into drive shaft housing.

1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of 2-4-C w/Teflon onto drive shaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow drive shaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of drive shaft) will load the drive shaft/crankshaft and damage either or both the powerhead and gear housing. Top of drive shaft is to be wiped free of lubricant.

3. Apply a light coat of 2-4-C w/Teflon onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Insert a NEW trim tab bolt (with patch) into hole in rear of gear housing to drive shaft housing machined surface.
5. Shift gear housing into NEUTRAL and place guide block anchor pin into NEUTRAL position.



52189

a - Guide Block Anchor Pin

6. Position gear housing so that the drive shaft is protruding into drive shaft housing.
7. Feed speedometer tube through opening in drive shaft housing.

NOTE: *If, while performing Step 8, the drive shaft splines will not align with crankshaft splines, lower the gear case enough to reach in and turn the drive shaft by hand slightly to align drive shaft splines with crankshaft.*

8. Move gear housing up toward drive shaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of drive shaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gear case up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to 55 lb. ft. (74.6 N·m).
13. After 2 nuts (located on either side of drive shaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into FORWARD gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install remaining washers and nuts onto drive shaft studs. Torque to 55 lb. ft. (74.6 N·m).
15. Torque bolt (started in Step 10) to 45 lb. ft. (61.0 N·m).
16. Position trim tab in gear housing aligning grooves of trim tab with ribs in trim tab pocket. Adjust to position in which it had previously been installed, and while holding trim tab, torque bolt to 40 lb. ft. (54.2 N·m).
17. Install plastic cap into trim tab bolt opening at rear edge of drive shaft housing.

ATTACHMENTS/CONTROL LINKAGE

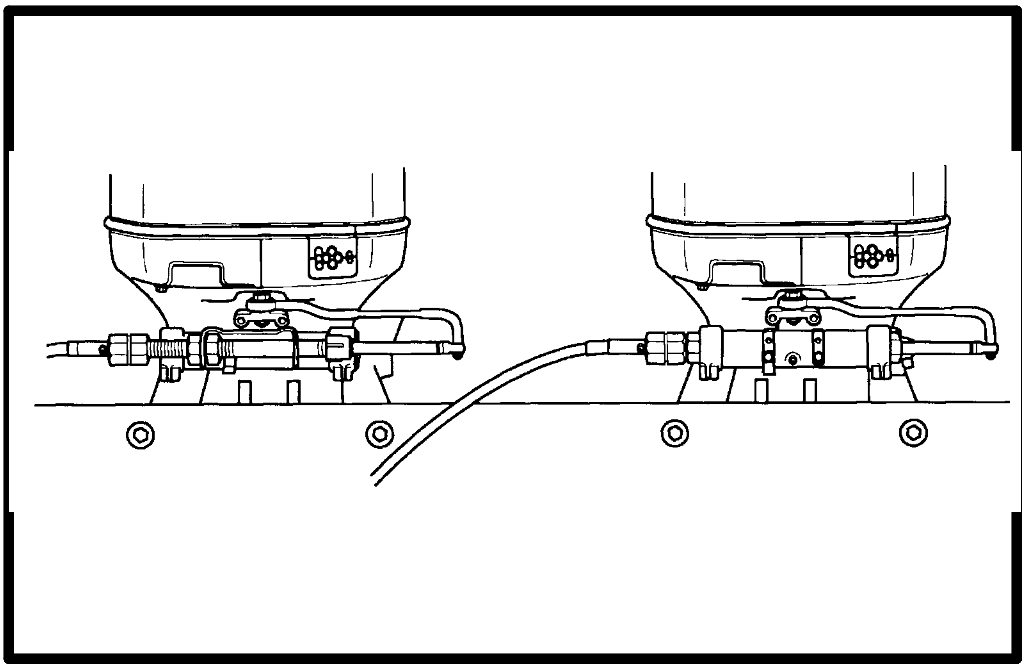


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Table of Contents

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.

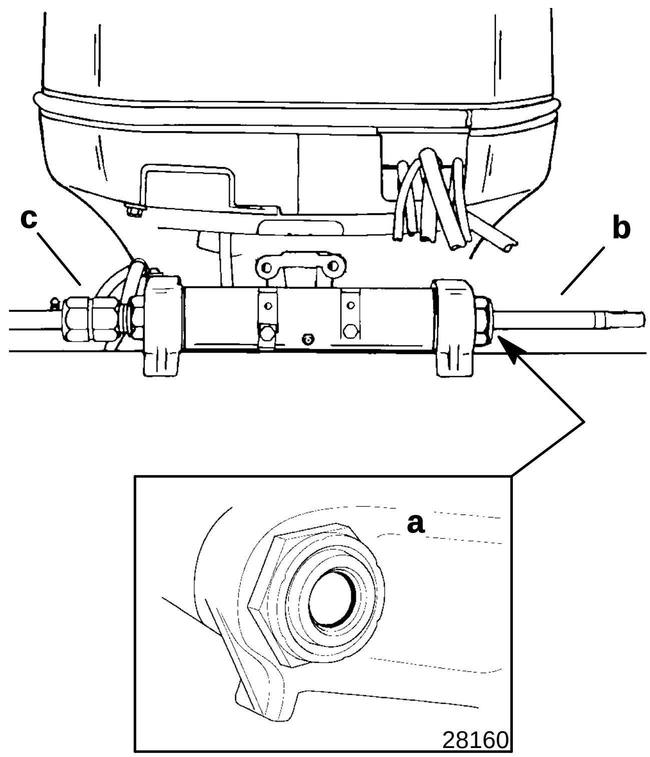
IMPORTANT: Steering cable and remote control cables must be the correct length, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

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).



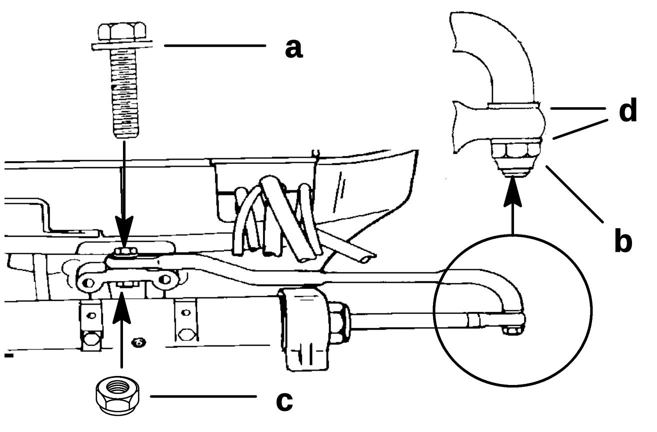
STEERING LINK ROD INSTALLATION

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. (27.1 N·m), then torque locknut (c) to 20 lb. ft. (27.1 N·m).
   High Performance Outboards - An access hole is provided through the bottom cowl to ease installation of the link rod connecting bolt. Remove the **BACK** plug for installation and reinstall after installation.



⚠ WARNING

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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

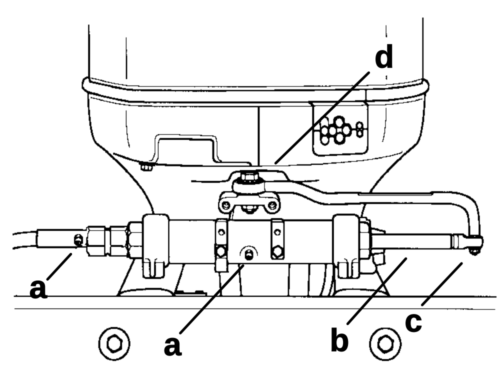
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: *Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

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

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable end (b) with 2-4-C w/Teflon.
4. Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod with SAE 30 Weight Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon. Ride Guide Steering Cable / Attaching Kit Installation (92876A3).



Ride Guide Steering Cable/ Attaching Kit Installation (92876A3)

Dual Cable - Single Outboard

WARNING

Quicksilver Super Ride-Guide Steering (dual cables) MUST BE USED with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

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

IMPORTANT: Steering cables and remote control cables MUST BE THE CORRECT LENGTH, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

CAUTION

With this kit installed, the upper (outboard) mounting bolts MUST BE installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between steering cable nut and ends of mounting bolts when outboard is tilted up.

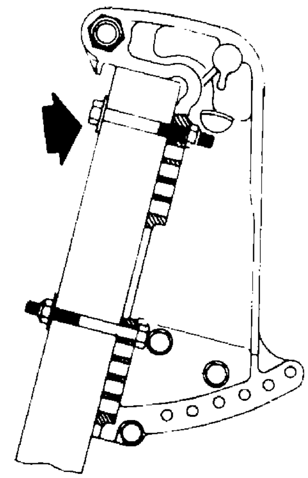
CAUTION

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

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

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

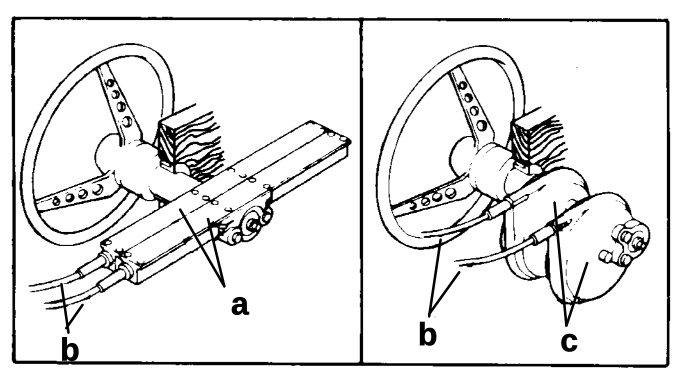
Install upper bolts so that hex head end of bolts is on the inside of boat transom.



Super Ride-Guide Steering Kit Installation

IMPORTANT: Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push-and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.
2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together down starboard side of boat and will push-and-pull together.

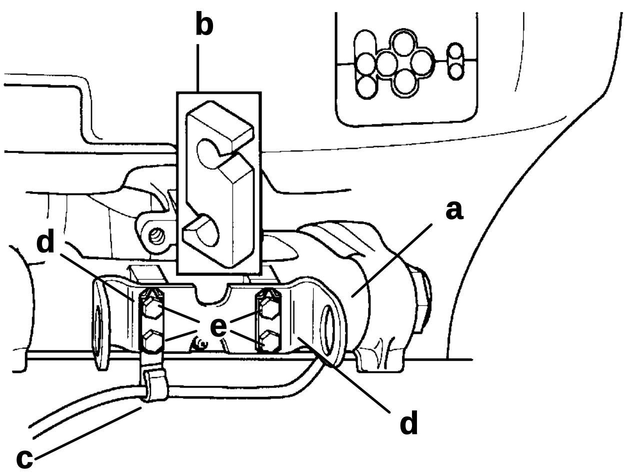


a - Gear Rack
b - Steering Cables
c - Rotary Steering Heads

Steering Cable Mounting Tube Installation

IMPORTANT: Spacers (b) must be installed between outboard swivel bracket and mounting bracket for steering cable mounting tube to provide proper spacing between steering cables.

Secure mounting bracket for steering cable mounting tube on to swivel bracket of outboard.



28163

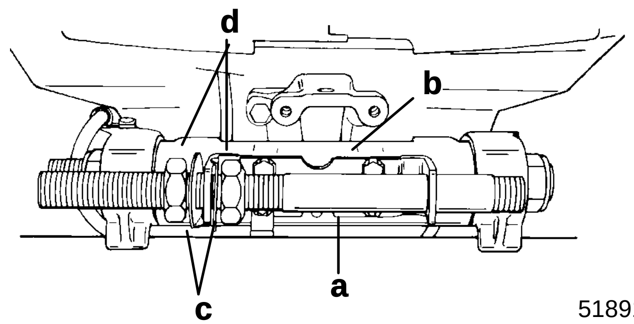
a - Mounting Bracket for Steering Cable Mounting Tube
b - Spacer (2)
c - Locking Retainer (2)
d - Bolts (4) - 7/8 in. (22mm) Long - Torque to 100 lb. in. (11.3 N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket to prevent bolts from turning out.

Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



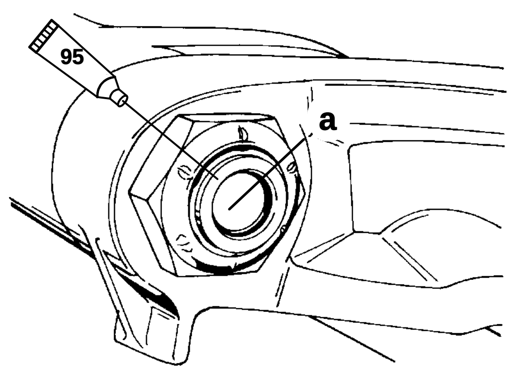
51891

a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

Installing Steering Cables

IMPORTANT: Lubricate inside of outboard tilt tube, inside of steering cable mounting tube and rubber O-ring seal (located in outboard tilt tube) with Quicksilver 2-4-C w/Teflon before installing steering cables.

Lubricate inside of outboard tilt tube and inside of steering cable mounting tube with Quicksilver 2-4-C w/Teflon. Verify rubber O-ring seal (a) (located in outboard tilt tube) is lubricated.

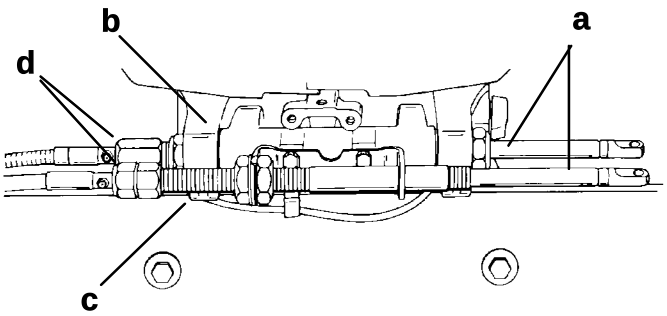


51890

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

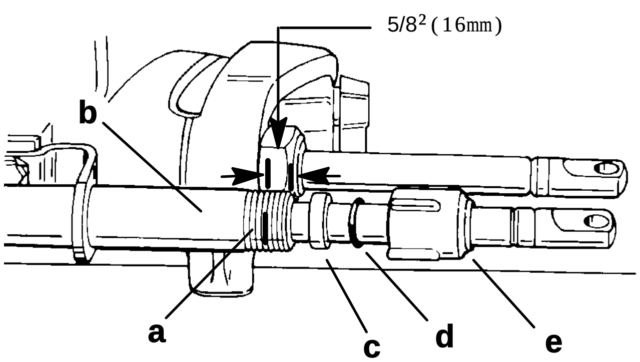
Insert steering cable ends (a) thru outboard tilt tube (b) and cable mounting tube (c). Thread steering cable attaching nuts (d) on to tubes hand tight.

NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*



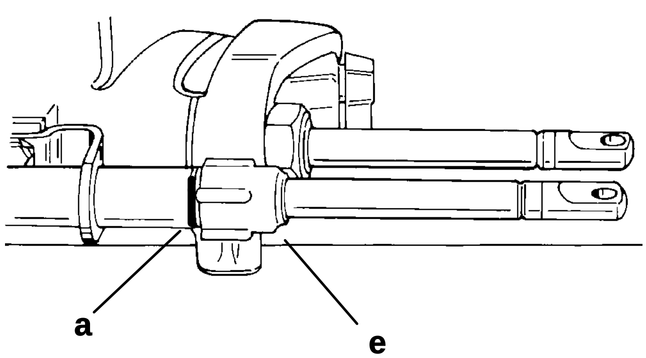
51891

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).



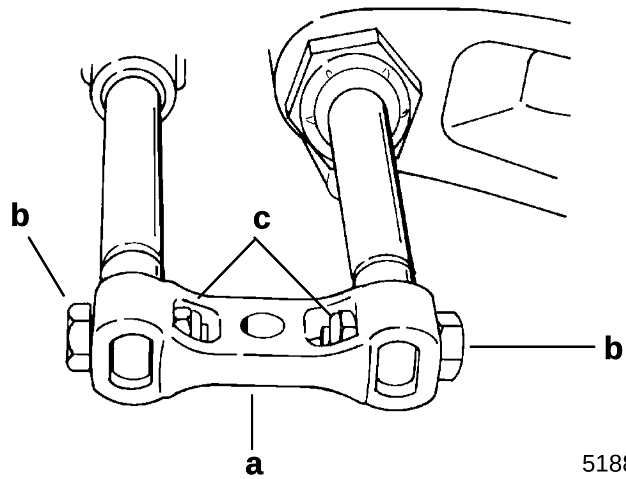
51890

Coupler Installation

⚠ WARNING

Locknuts must be used with bolts to secure steering cables to coupler. Failure to adhere to this requirement could result in steering system failure.

Slide coupler (a) onto steering cable ends and secure each steering cable to coupler with bolt (b) and locknut (c) as shown. Tighten to a torque of 20 lb. ft. (27.1 N·m).



51888

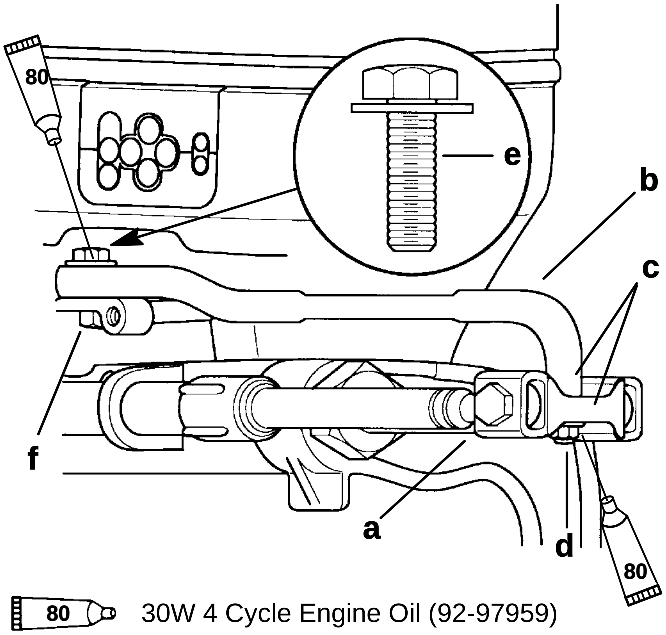
Installing Link Rod

⚠ WARNING

Steering link rod MUST BE secured between outboard steering arm and steering coupler, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate hole in steering coupler, with Quicksilver 2-4-C w/Teflon. Assemble steering link rod to steering coupler, using 2 flat washers (one each side of coupler) and nylon insert locknut. Tighten locknut until it seats [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joint in steering link rod with SAE 30W Motor Oil. Secure link rod to outboard steering arm, using special washer head bolt (10-14000) provided and nylon insert locknut as shown. Torque special bolt to 20 lb. ft. (27.1 N·m), then torque locknut to 20 lb. ft. (27.1 N·m).



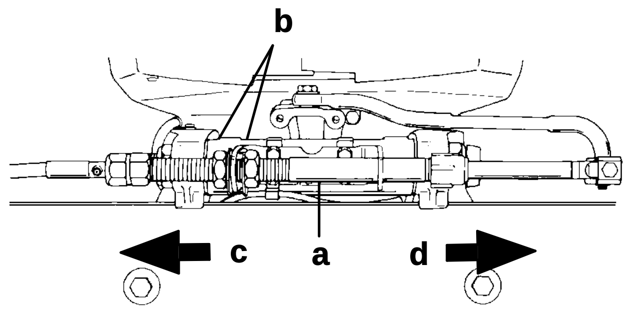
28172

a - Steering Coupler
b - Steering Link Rod
c - Flat Washer (2)
d - Nylon Insert Locknut - Torque until it seats [DO NOT exceed 120 lb. in. (14.0 N·m) of torque], then back nut off 1/4 turn
e - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.1 N·m)
f - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)

STEERING SYSTEM TENSION ADJUSTMENT

IMPORTANT: After this dual steering cable attachment kit is installed, there must be proper tension in forward mounted steering cable tor this attachment kit to operate properly. Not enough tension will cause slack (or play) in steering system. Too much tension will cause steering cables to bind. Perform the following steps to adjust for correct tension.

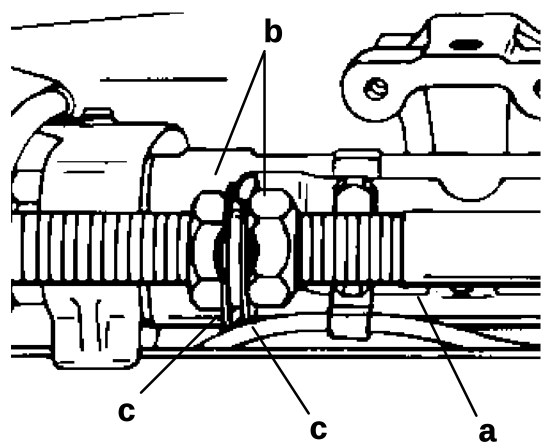
Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steer ing System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

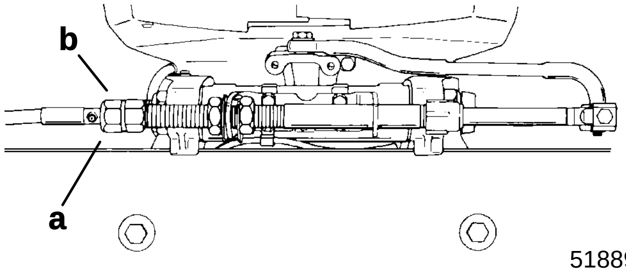
After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.4 N·m) and bend a tab lock washer against flat on each adjustment nut.



51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts; Torque to 35 lb. ft. (47.4 N·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).

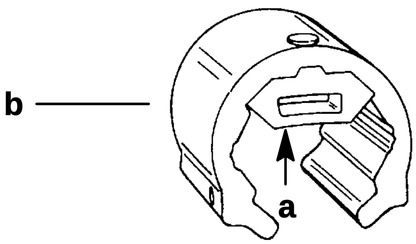


51889

a - Cable Attaching Nut
b - "V" Groove

NOTE: *Cable attaching nuts with a "V" groove around the outer circumference of the nut are self locking and do not require locking sleeves.*

Install rubber bumpers (a) on inside of each locking sleeve (b).



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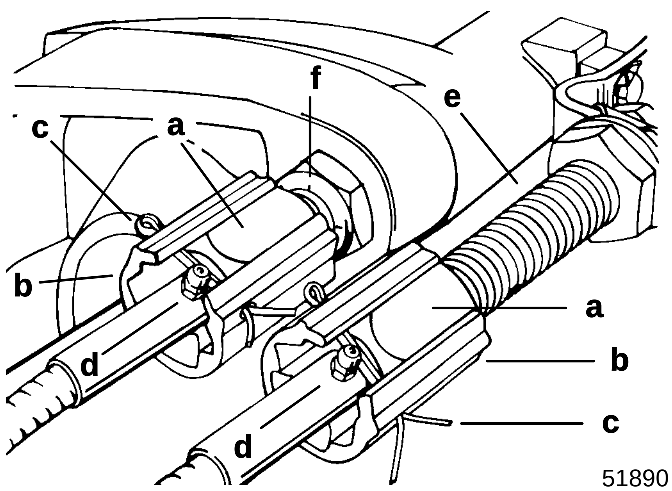
Install locking sleeves over steering cable attaching nuts and secure with cotter pins. Spread ends of cotter pins. Be sure to install cotter pin so that it is located in between attaching nut and grease fitting.



51890

a - Steering Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
b - Locking Sleeve (If Equipped)
c - Cotter Pin
d - Grease Fitting
e - Steering Cable Mounting Tube
f - Outboard Tilt Tube

⚠ WARNING

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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)
***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Severe Service."

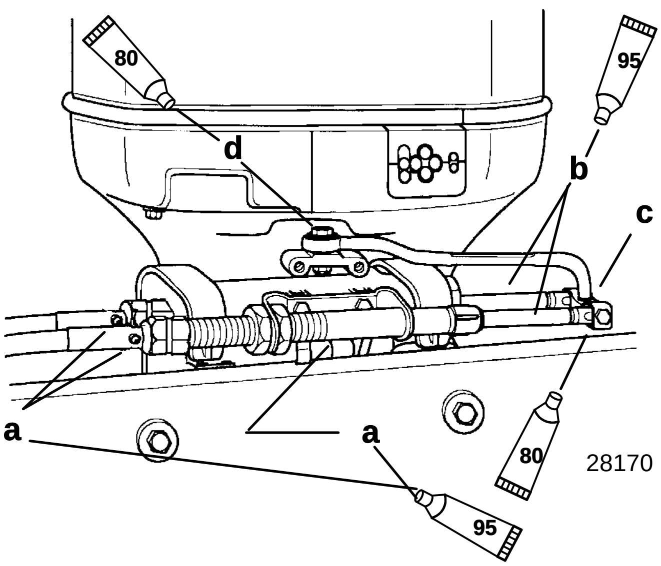
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: *Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

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

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A2).
4. Lubricate ball joint (d) of link rod/steering coupler and pivot point (c) of steering link rod with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



80 30W 4 Cycle Engine Oil (92-97959)

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

Ride Guide Steering Cable/ Attaching Kit Installation (92876A6)

Dual Cable - Dual Outboard

⚠ WARNING

Quicksilver Super Ride-Guide Steering (dual cables) MUST BE USED with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

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

IMPORTANT: Steering cable and remote control cables MUST BE THE CORRECT LENGTH, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables.

Installation Requirements

IMPORTANT: The distance from each outboard's centerline to the side of transom opening MUST BE a minimum of 16 in. (40.6cm).

This kit contains all necessary parts to connect both outboards to Ride-Guide Steering Cables for 23-1/2 in. thru 27-1/2 in. (59.7cm thru 69.9cm) outboard centerline spacing. If outboard centerline distance is other then specified, refer to end of this instruction manual for optional extension couplers.

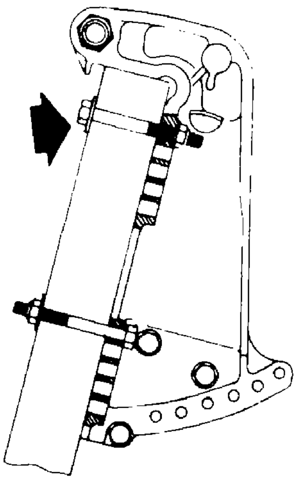
DETERMINE ROUTING OF STEERING CABLES

Use "1" or "2", following, to route steering cables:

1. **Parallel cable routing:** Cables routed together down starboard side of boat Refer to **"Parallel Routed Steering Cables and Attaching Kit Installation,"** immediately following.
2. **Opposite side cable routing:** One cable routed down starboard side of boat and one cable routed down port side of boat. Refer to **"Opposite Side Routed Steering Cables and Attaching Kit Installation,"** located on page 20 of this instruction manual.

⚠ CAUTION

With this kit installed, the upper (outboard) mounting bolts MUST BE installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between outer steering cable locking sleeve and ends of mounting bolts when outboard is tilted up.



Install upper bolts so that hex head end of bolts is on the inside of boat transom.

Parallel Routed Steering Cables and Attaching Kit Installation

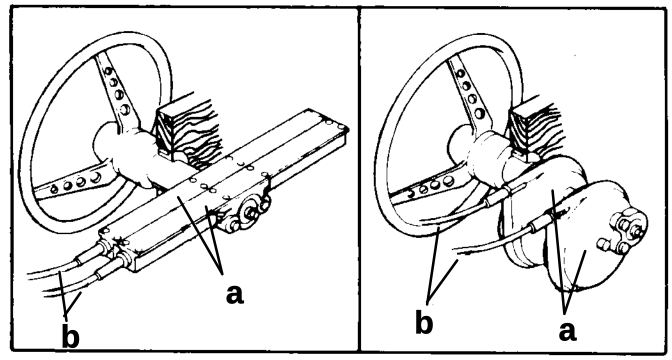
(Both Steering Cables Routed Together Down Starboard Side of Boat)

SUPER RIDE-GUIDE STEERING KIT INSTALLATION

IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push- and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.
2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together and will push-and-pull together.

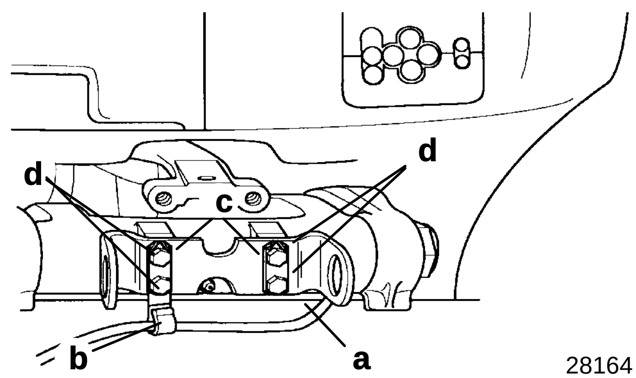


a - Straight Rack (Left); Rotary Steering (Right)
b - Steering Cables (Install so that Both Cables Will Push and Pull Together)

STEERING CABLE INSTALLATION STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube MUST BE secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



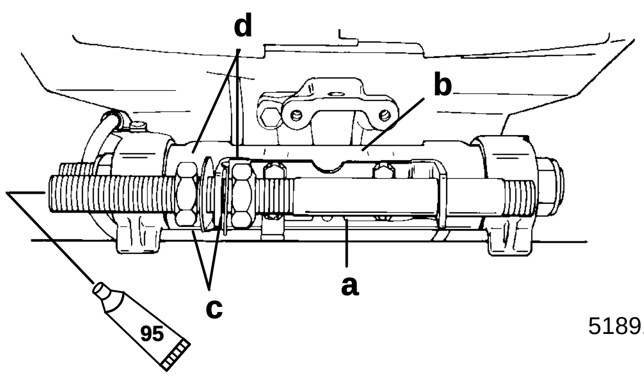
a - Mounting Bracket for Steering Cable Mounting Tube
b - "J" Clip - Supplied with Outboard
c - Locking Retainers (2)
d - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.3 N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket, to prevent bolts from turning out.

Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Be sure longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



51891

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

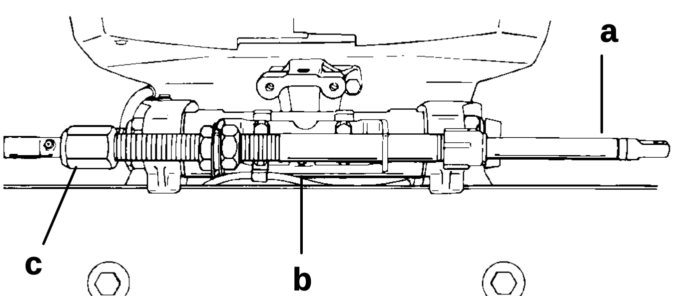
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering cable mounting tube with 2-4-C w/Teflon before installing steering cable.

Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

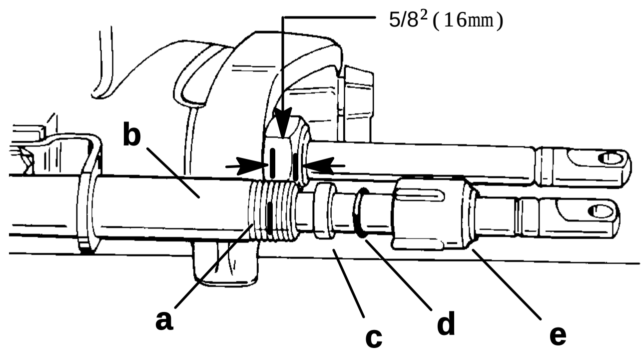
Insert steering cable end (a) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



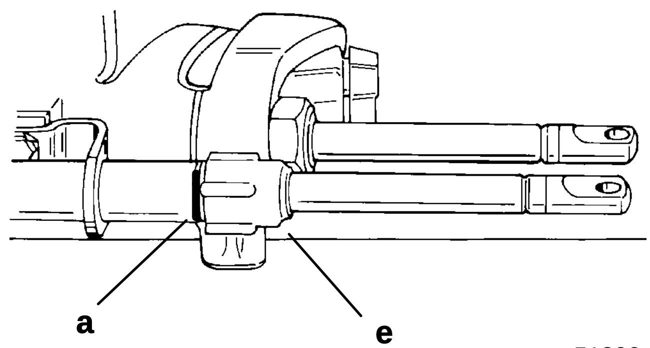
51887

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).



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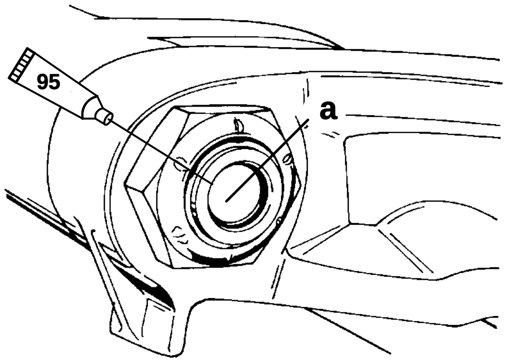
STEERING CABLE INSTALLATION - PORT OUTBOARD

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.

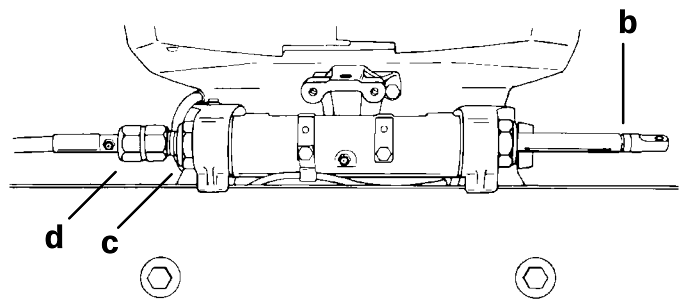


51890

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

Insert steering cable end (b) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*



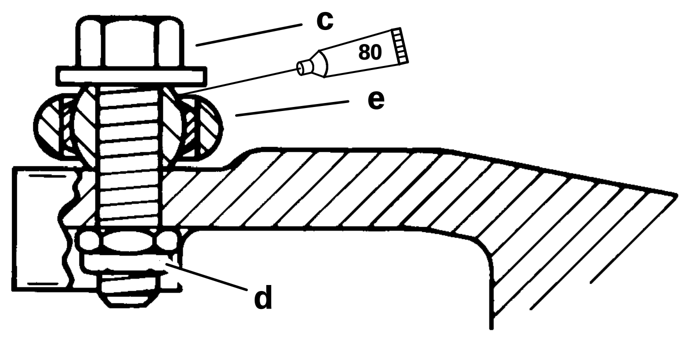
51887

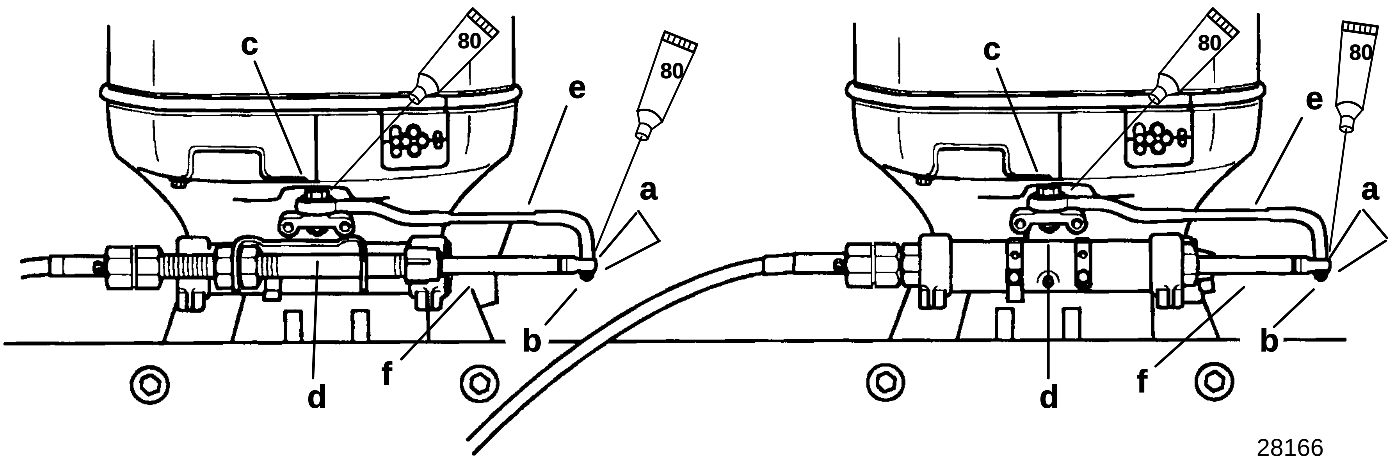
STEERING LINK ROD INSTALLATION

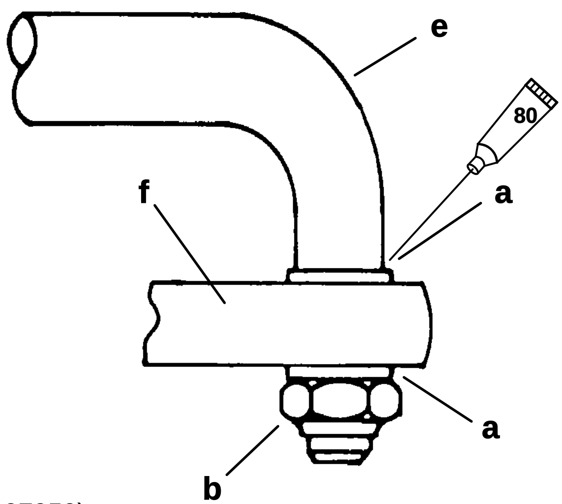
⚠ WARNING

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.







80 30W 4 Cycle Engine Oil (92-97959)

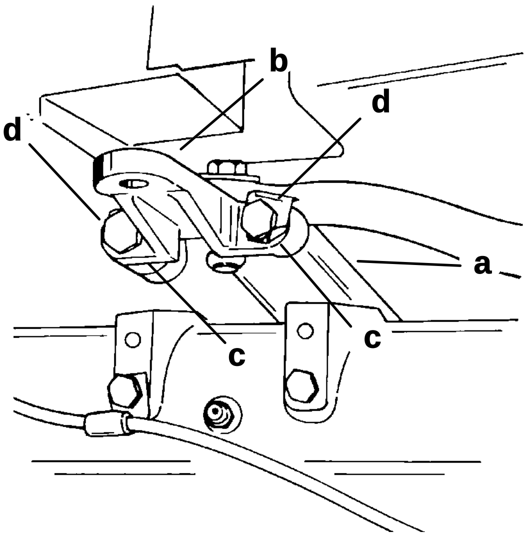
a - Flat Washer (2 Each Link Rod)
b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.6 N·m) of Torque], Then Back Off 1/4 Turn
c - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.1 N·m)
d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
e - Steering Link Rod
f - Steering Cable End

Lubricate holes in ends of steering cables with SAE 30W Motor Oil. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 Ib. in. (13.6 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 Ib. ft. (27.1 N·m) then torque locknuts to 20 Ib. ft. (27.1 N·m).

STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

a - Steering Arm (Port Outboard Shown)
b - Extension Bracket
c - Locking Retainer (2 Each Bracket)
d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.6 N·m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm to prevent bolts from turning out.

STEERING COUPLER ASSEMBLY AND INSTALLATION

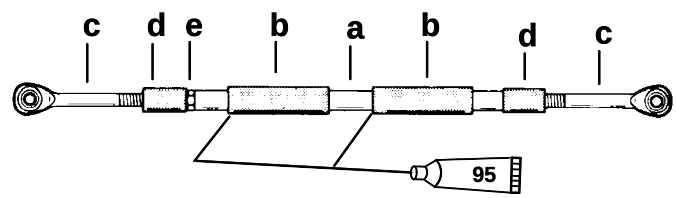
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes MUST BE of equal length and threads MUST NOT extend out from coupler more than 2-3/4 in. (69.9mm).



50061

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

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut

⚠ WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (88.9mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (69.9mm). Failure to adhere to this requirement could result in steering system failure.

Lubricate ball joint in steering eyes, with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown.

IMPORTANT: With assembled steering coupler in- stalled and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. It adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

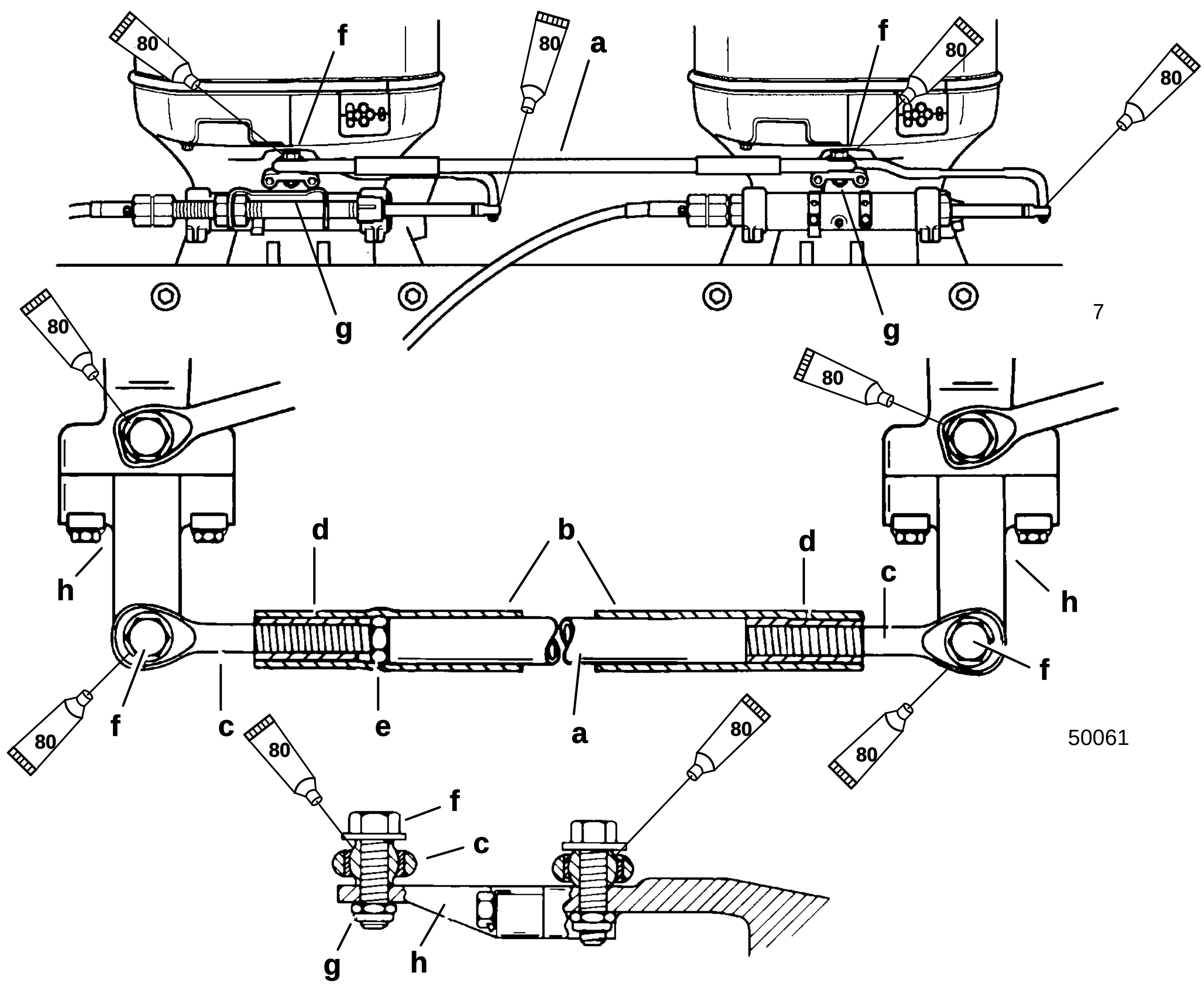
Torque special washer head bolts to 20 lb. ft. (27.1 N·m), then torque locknuts to 20 lb. ft. (27.1 N·m).

⚠ WARNING

Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque “jam” nut to 20 lb. ft. (27.1 N·m).

Tighten “jam” nut against coupler. Torque “jam” nut to 20 lb. ft. (27.1 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.



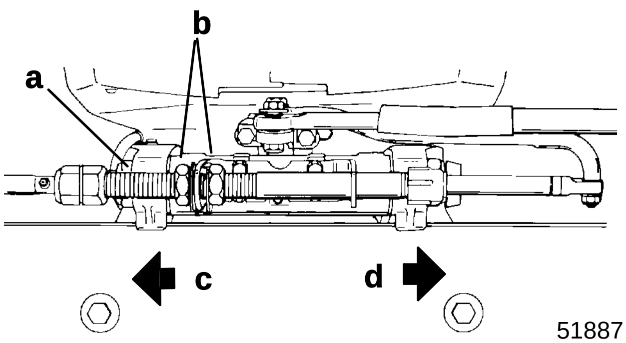
80 30W 4 Cycle Engine Oil (92-97959)

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.1 N·m)
f - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
h - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

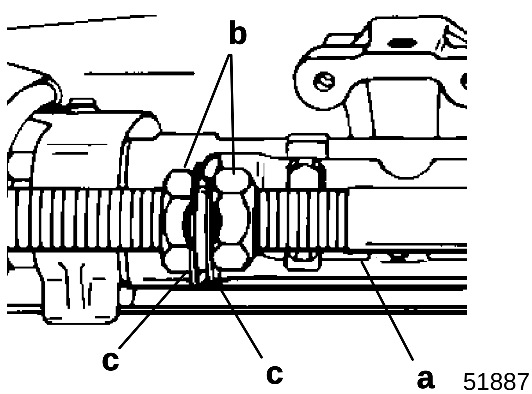
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play). If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



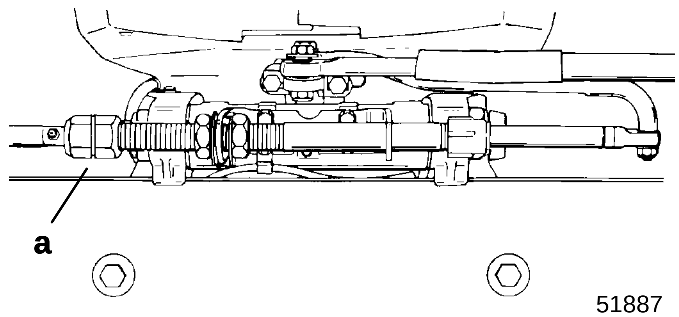
a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steering System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.



a - Steering Cable Mounting Tube
b - Adjustment Nuts Torque to 35 lb. ft. (47.5 N·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).



a - Cable Attaching Nut

⚠ WARNING

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

Adjust trim tabs of both outboards, as outlined in **"Trim Tab Adjustment"**, following.

Opposite Side Routed Steering Cables and Attaching Kit Installation

(One Cable Routed down Starboard Side of Boat and One Cable Routed down Port Side of Boat)

SUPER RIDE-GUIDE STEERING KIT INSTALLATION

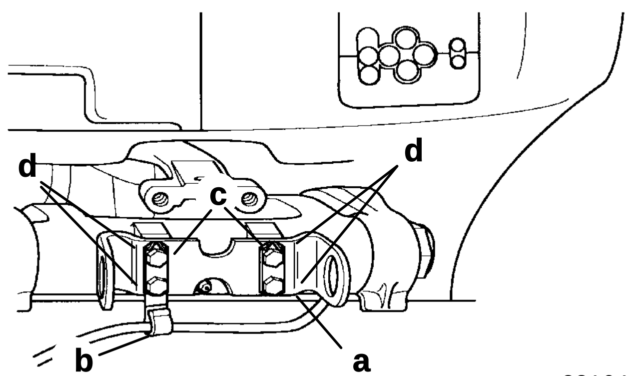
IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.

STEERING CABLE INSTALLATION - STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube MUST BE secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



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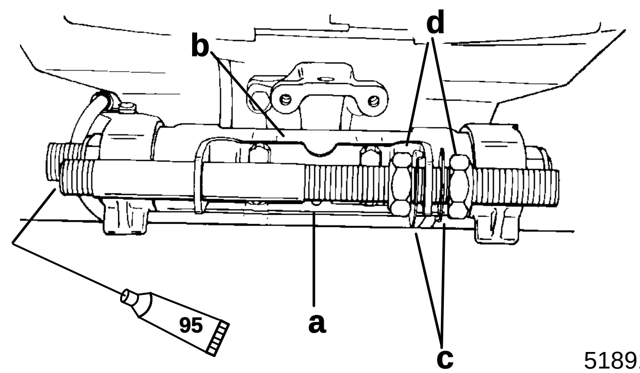
a - Mounting Bracket for Steering Cable Mounting Tube
b - "J" Clip - Supplied with Outboard
c - Locking Retainers (2)
d - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.3 N·m), Then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube, to prevent bolts from turning out.

Install Steering Cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward center of boat transom.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



51891

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

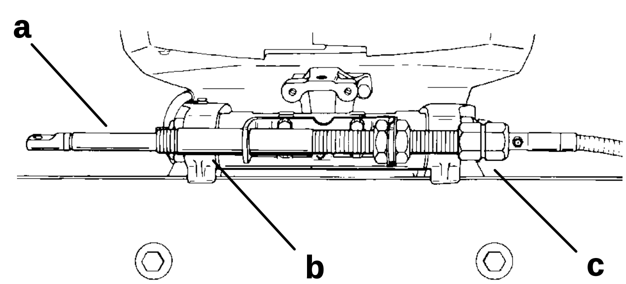
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Center of Boat Transom)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering mounting tube with 2-4-C w/Teflon (92-825407A12) before installing steering cable.

Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

Insert steering cable end (a) (steering cable routed down port side of boat) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



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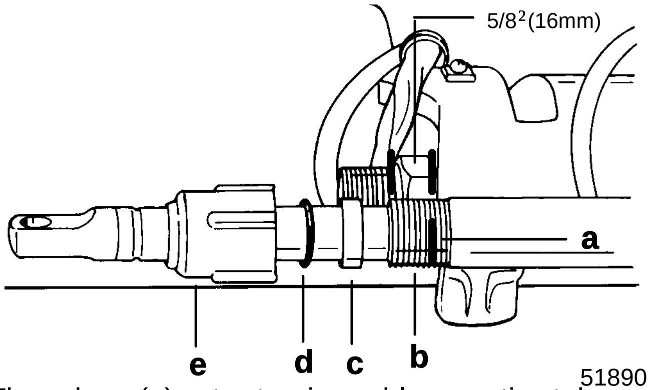
Place a mark (a) on steering cable mounting tube (b) 5/8 in (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



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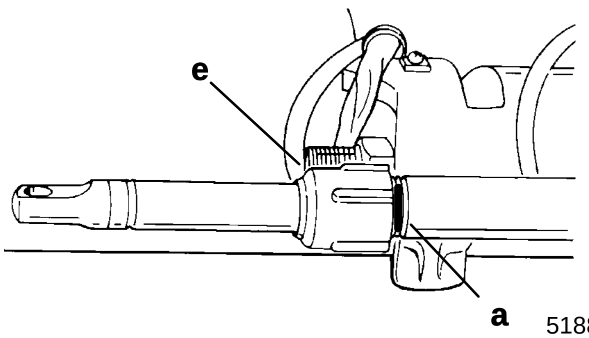
Thread cap (e) onto steering cable mounting tube, up to mark (a).



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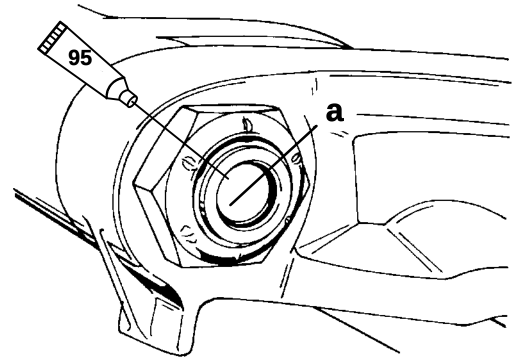
STEERING CABLE INSTALLATION - PORT OUTBOARD

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.

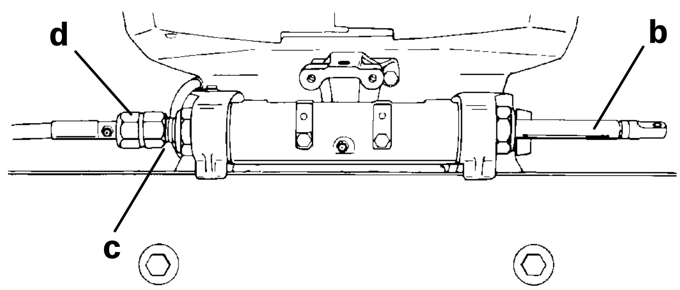


51890

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

Insert steering cable end (b) (steering cable routed down starboard side of boat) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



51887

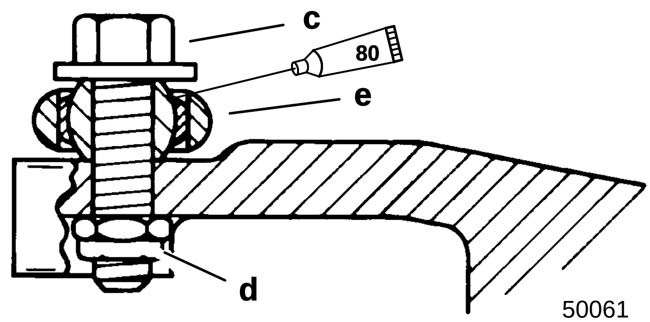
STEERING LINK ROD INSTALLATION

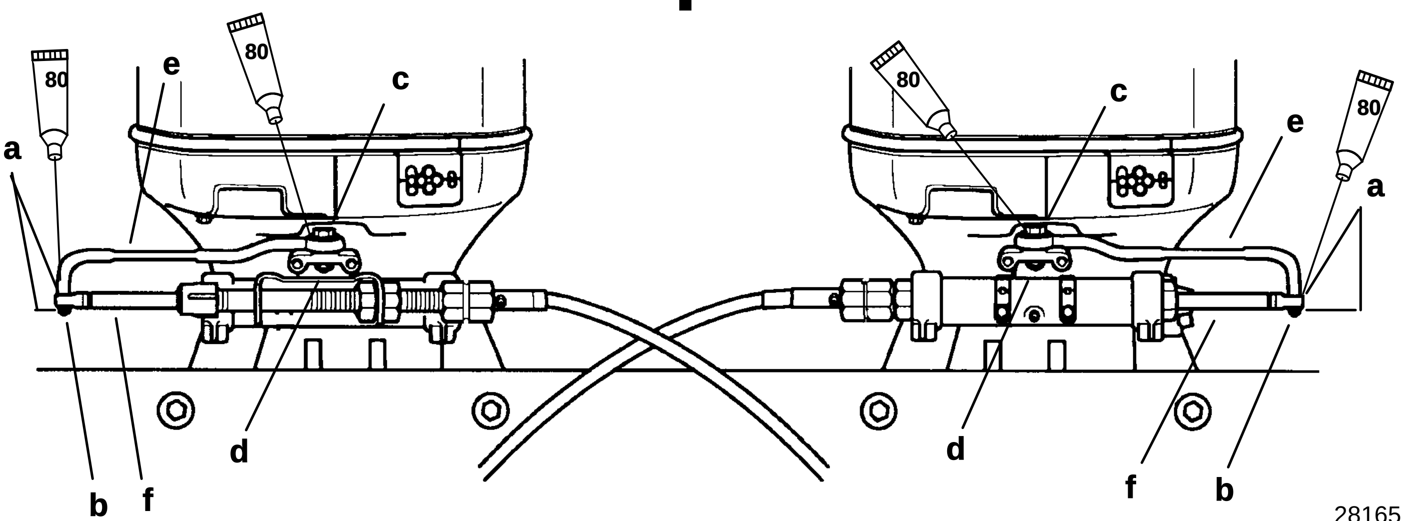
⚠ WARNING

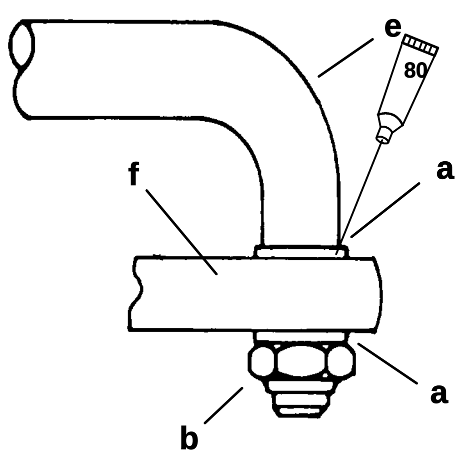
Steering link rods MUST BE secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate holes in ends of steering cables with SAE 30W Motor Oil. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 lb. ft. (27.1 N·m) then torque locknuts to 20 lb. ft. (27.1 N·m).



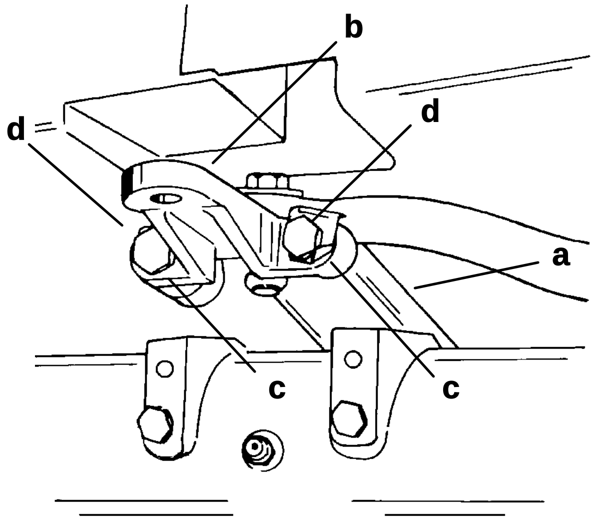




a - Flat Washer (2 Each Link Rod)
b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.6 N·m) of Torque], Then Back Off 1/4 Turn
c - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
e - Steering Link Rod
f - Steering Cable End

STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

a - Steering Arm (Port Outboard Shown)
b - Extension Bracket
c - Locking Retainer (2 Each Bracket)
d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.6 N·m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm, to prevent bolts from turning out.

STEERING COUPLER ASSEMBLY AND INSTALLATION

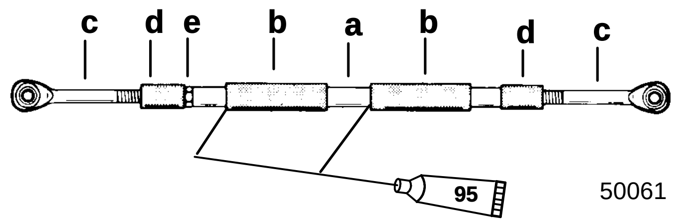
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes MUST BE of equal length and threads MUST NOT extend out from coupler more than 2-3/4 in. (69.9mm).



50061

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

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut

WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (88.9mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (69.9mm). Failure to adhere to this requirement could result in steering system failure.

Lubricate ball joint in steering eyes with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts, as shown.

IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. If adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

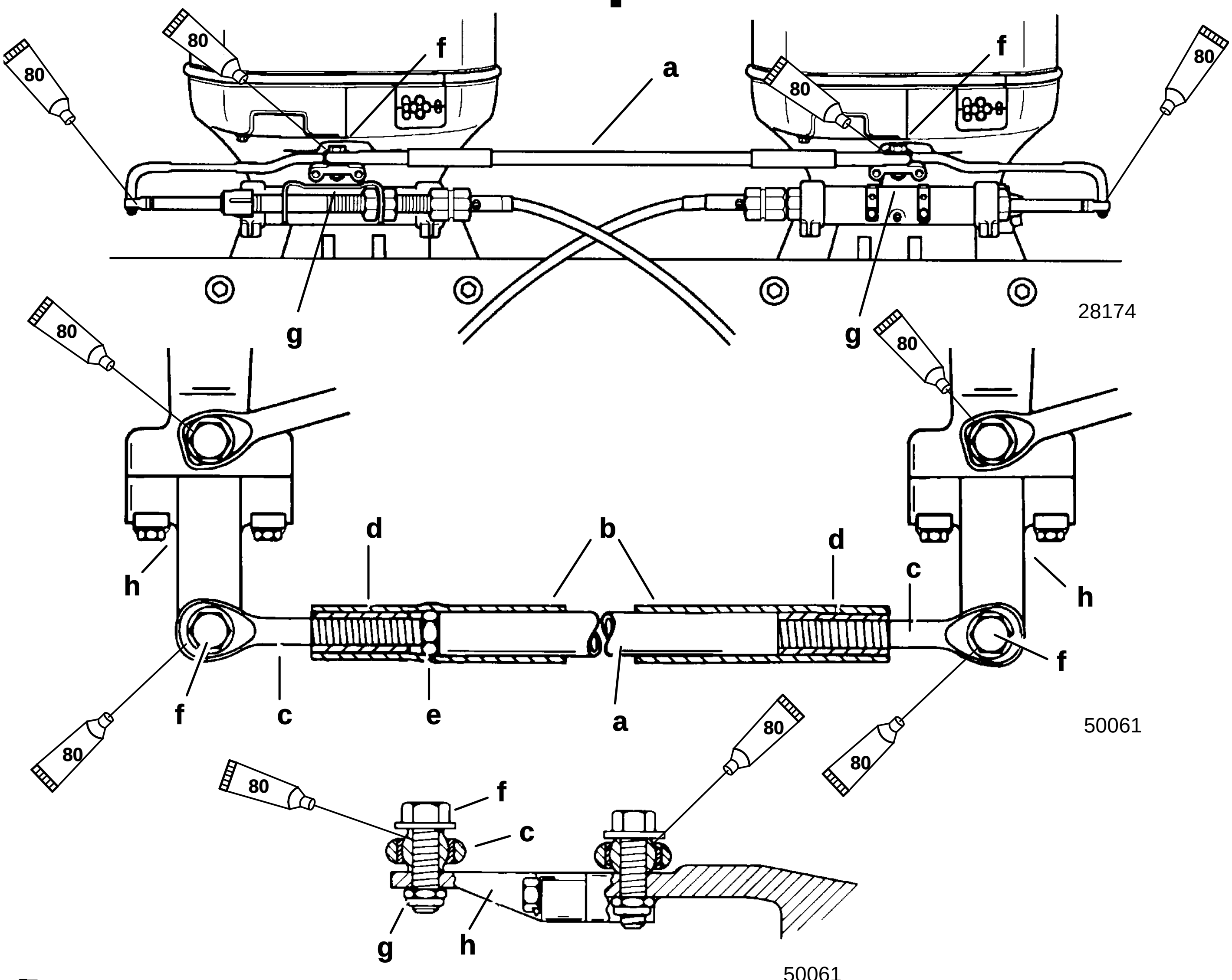
Torque special washer head bolts to 20 lb. ft. (27.1 N·m), then torque locknuts to 20 lb. ft. (27.1 N·m).

⚠ WARNING

Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.



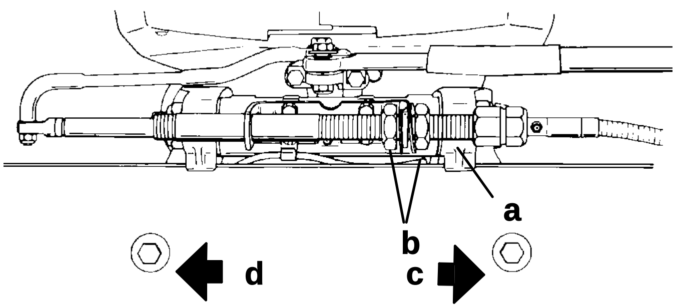
80 30W 4 Cycle Engine Oil (92-97959)

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.1 N·m)
f - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
h - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

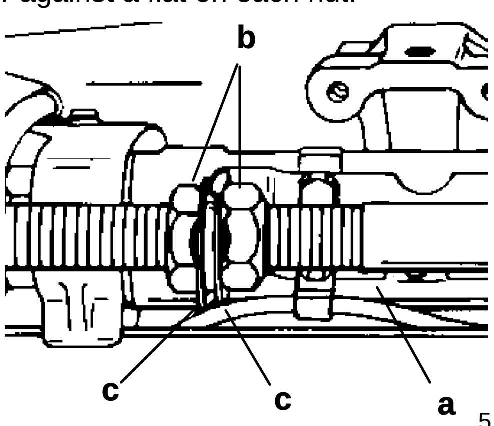
Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system.) Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steering System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.



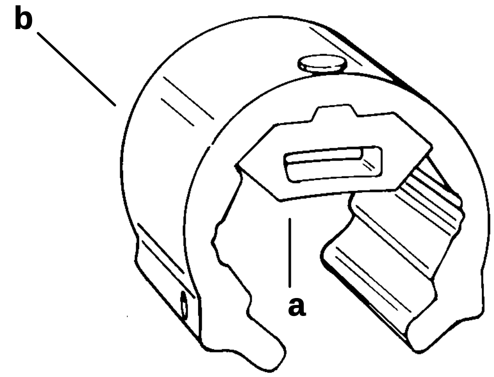
51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts; Torque to 35 lb. ft. (47.5 N·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).

NOTE: *Cable attaching nuts with a "V" groove around outer circumference are self locking and do not require locking sleeves.*

Install rubber bumpers (a) on inside of each locking sleeve (b).



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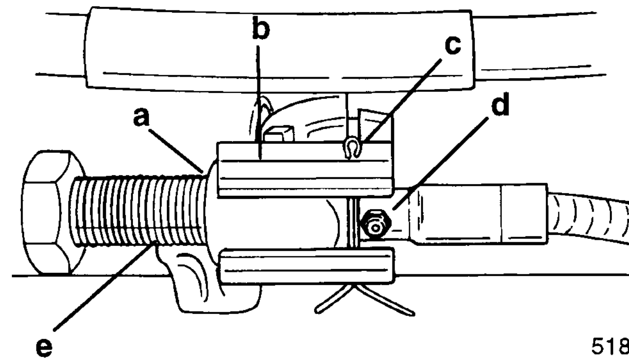
Install locking sleeves over steering cable attaching nuts and secure with cotter pins. Spread ends of cotter pins. Be sure to install cotter pin so that it is located in between attaching nut and grease fitting.



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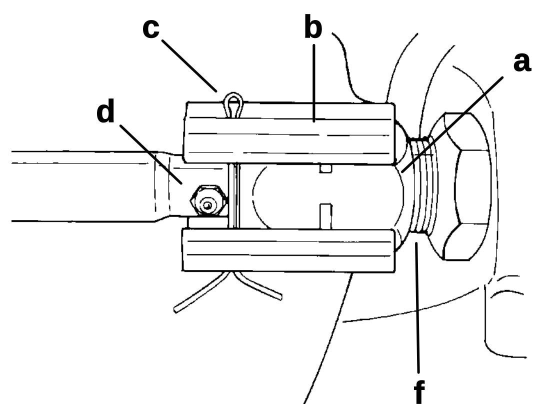


51888

a - Steering Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
b - Locking Sleeve (If Equipped)
c - Cotter Pin
d - Grease Fitting
e - Steering Cable Mounting Tube (Starboard Outboard)
f - Outboard Tilt Tube (Port Outboard)

⚠ WARNING

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

Adjust trim tabs of both outboards, as outlined in **"Trim Tab Adjustment,"** following.

Trim Tab Adjustment

DUAL OUTBOARD - COUNTER ROTATION INSTALLATION

1. Shift outboard into neutral and make sure ignition key is at "OFF" position.
2. Remove plastic cap from rear of drive shaft housing and loosen bolt and trim tab.
3. Position trim tabs of both outboards straight to rear of outboard, so that tabs are aligned with gear housing center line.
4. Tighten both trim tab bolts securely and replace plastic caps. No further adjustment will be required.

DUAL OUTBOARD - NON COUNTER ROTATION INSTALLATION

1. Check trim tab position as follows:

IMPORTANT: Initial trim tab setting for both outboards should be straight to rear of outboard, so that tabs are aligned with gear housing center line. Refer to "If necessary, adjust trim tab as follows," following.

   a. Operate boat at normal cruise throttle setting and adjust trim to optimum setting.

   b. If boat pulls to the right (starboard), trailing edge of trim tab must be moved to the right (when viewing outboard from behind). If boat pulls to the left (port), trailing edge of trim tab must be moved to the left.

2. If necessary, adjust trim tab as follows:

   a. Shift outboard into NEUTRAL and make sure ignition key is at "OFF" position.

   b. Remove plastic cap from rear of drive shaft housing and loosen bolt and trim tab.

IMPORTANT: Trim tabs MUST BE set in the same position on both outboards.

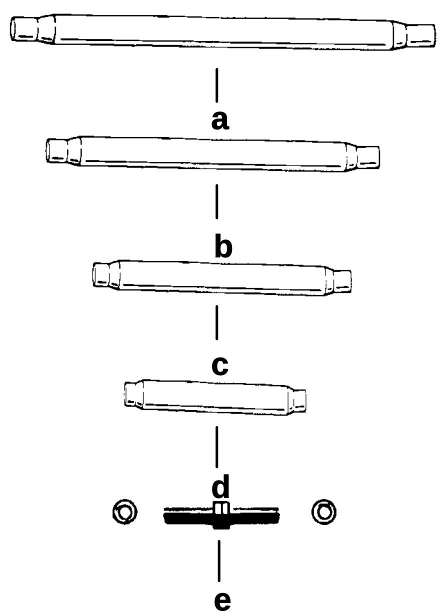
   c. If boat pulls to the right, adjust trailing edges of both trim tabs to the right. If boat pulls to the left, adjust trailing edges of both trim tabs to the left.

   d. Tighten both trim tab bolts securely and replace plastic caps.

   e. Operate boat per **"Check trim tab position as follows,"** preceding, to check trim tab setting. Readjust trim tabs, if necessary.

Ride Guide Steering Attachment Extension Couplers

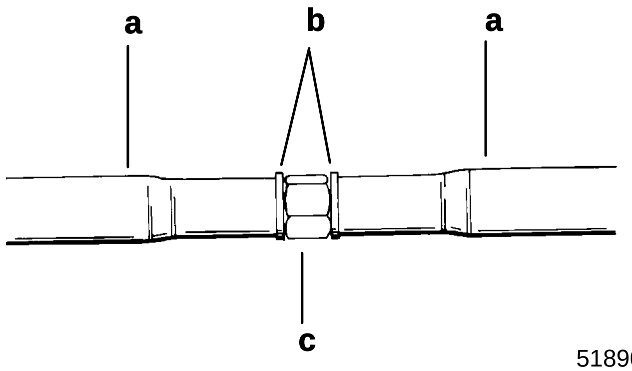
Outboard Center Line Distance	Required Coupler(s) Between Steering Eyes
22-1/2 in. thru 24-1/2 in. (57.2cm thru 62.2cm)	12 in. (30.5cm) Coupler
23-1/2 in. thru 27-1/2 in. (59.7cm thru 69.9cm)	15 in. (38.1cm) Coupler (Supplied with this kit)
26-1/2 in. thru 30-1/2 in. (67.3cm thru 75.5cm)	18 in. (45.7cm) Coupler
30 in. thru 34 in. (76.3cm thru 86.4cm)	9 in. (22.9cm) Coupler and 12 in (30.5cm) Coupler (Connected together with coupler link rod)
33 in. thru 37 in.	12 in. (30.5cm) Coupler and 12 in. (30.5cm) Coupler (Connected together with coupler link rod)



a - 18 in. (45.7cm) Coupler (97932-3)
b - 15 in. (38.1cm) Coupler (97932-2)
c - 12 in. (30.5cm) Coupler (97932-1)
d - 9 in. (22.9cm) Coupler (97932-4)
e - Coupler Link Rod (98181A1)

⚠ WARNING

When 2 couplers are connected together with coupler link rod, a lock washer must be used on each side of coupler link rod, and link rod must be torqued to 20 lb. ft. (27.1 N·m) into end of each coupler.



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a - Couplers Connected Together
b - Lock washers
c - Coupler Link Rod [Torque to 20 lb. ft. (27.1 N·m) into End of Each Coupler]

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

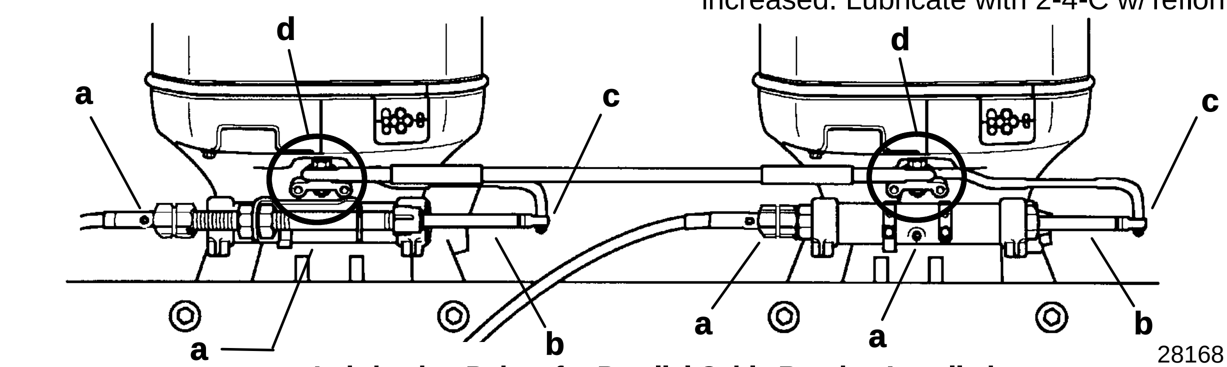
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

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

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable ends (b) with 2-4-C w/Teflon.
4. Lubricate pivot points (c) of steering link rods and ball joints (d) of link rods/steering coupler with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



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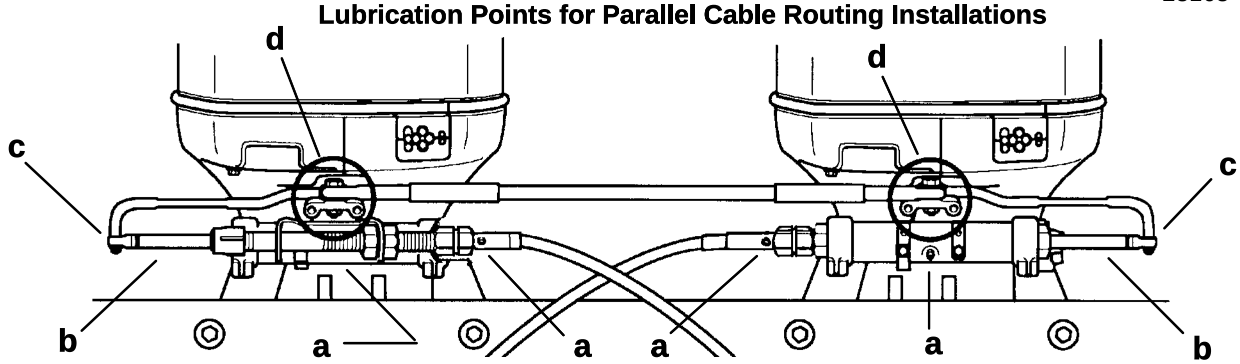
Lubrication Points for Parallel Cable Routing Installations



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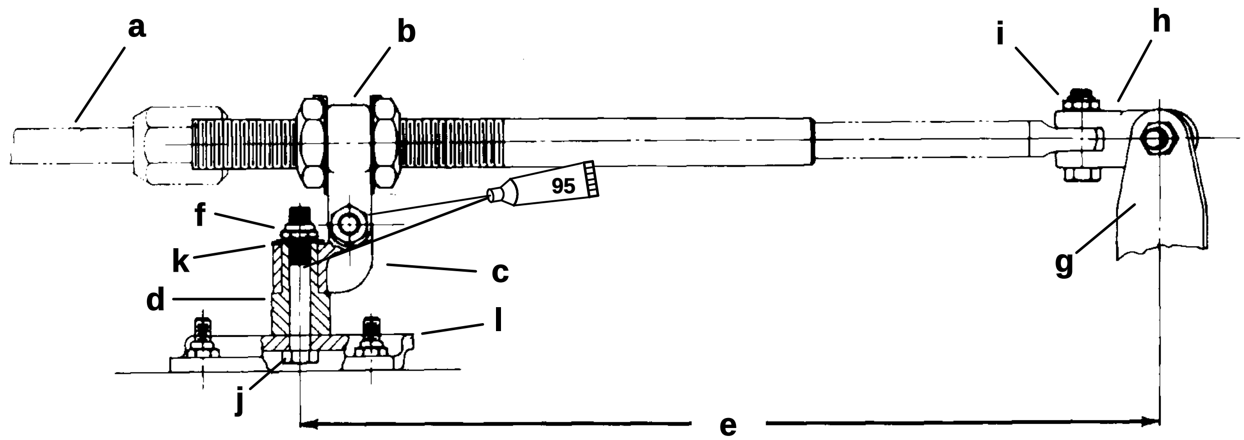
Lubrication Points for Opposite Side Cable Routing Installations

Transom Mounted Ride Guide Attaching Kit Installation (73770A1)

Attaching Kit Installation

1. Lubricate both holes in pivot block (Figure 1) with Quicksilver 2-4-C w/Teflon.
2. Place pivot block on pivot spacer and secure to transom bracket with 3/8 in. x 2-1/2 in. (9.5mm x 63.5mm) bolt, flat washer and locknut, as shown in Figure 1. Torque locknut to 20 lb. ft. (27.1 N·m).



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

Figure 1

- a - Ride-Guide Cable
- b - Ride-Guide Yoke
- c - Pivot Block
- d - Pivot Spacer
- e - 15 in. (381mm) (Centerline of Attaching Kit Pivot to Centerline of Outboard)
- f - Pivot Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)]
- g - Outboard Steering Arm
- h - "Clevis Kit"
- i - Ride-Guide Cable Attaching Locknut [Torque to 10 lb. ft. (13.6 N·m)]
- j - Bolt [3/8 in. x 2-1/2 in. (9.5mm x 63.5mm)]
- k - Flat Washer
- l - Transom Bracket

3. Place Ride-Guide yoke on pivot block and secure with 7/16 in. x 1-3/4 in. (11.1mm x 44.5mm) bolt and locknut, as shown in Figures 1 and 2. Torque locknut to 10 lb. ft. (13.6 N·m), **then back off 1/4-turn.**

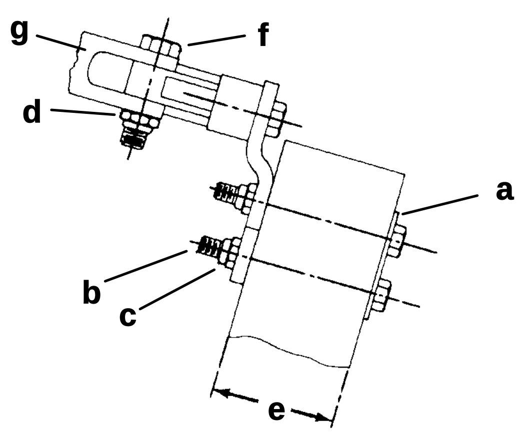


Figure 2

- a - Transom Backing Plate
- b - Bolt [5/16 in. x 3-1/4 in. (7.9mm x 82.5mm)]
- c - Locknut [Torque to 10 lb. ft. (13.6 N·m)]
- d - Ride-Guide Yoke Attaching Locknut {Torque to 10 lb. ft. (13.6 N·m) **Then Back Off 1/4-Turn**
- e - 2-3/8 in. (60.3mm) Maximum Transom Thickness
- f - Bolt [7/16 in. x 1-3/4 in. (11.1mm x 44.5mm)]
- g - Ride-Guide Yoke

4. Install one cable tube jam nut onto steering cable tube. Place tab washer over Ride-Guide yoke, then insert cable tube thru tab washer and yoke. Install second cable tube jam nut onto cable tube but do not tighten at this time. (Figure 3)
5. Position transom attaching kit on transom as
   a. Determine centerline of outboard, then measure 15 in. (38.1cm) over from this centerline and draw a vertical line on transom. (Figure 1)
   b. Position attaching kit on transom so that **transom bracket is centered on the 15 in. (38.1mm) (**Figure 1) at a height where the **center of Ride-Guide yoke is even with, or not more than 1/2 in. (12.7mm)** above top edge of transom. (Figure 3)

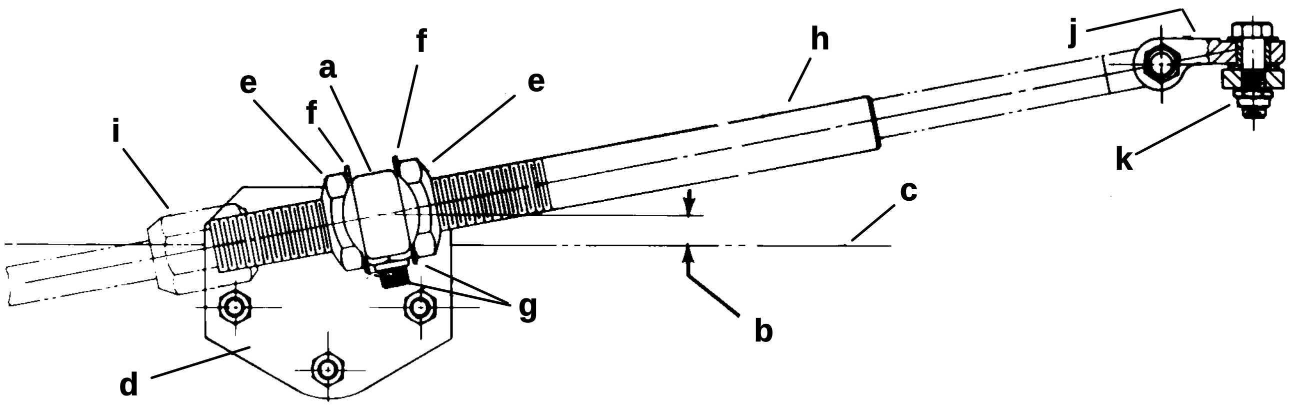


Figure 3

a - Ride-Guide Yoke
b - 0 in. to 1/2 in. (0mm to 12.8mm) (Center of Ride-Guide Yoke to Top of Transom
c - Top of Transom
d - Transom Bracket
e - Cable Tube Jam Nuts [Torque to 35 lb. ft. (47.5 N·m)]
f - Tab Washer
g - After Jam Nuts Are Torqued to Specification, Bend Locking Tabs against Nuts
h - Cable Guide Tube
i - Ride-Guide Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
j - "Clevis Kit"
k - Clevis Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)]

NOTE: *When drilling thru transom, be sure that holes are drilled perpendicular to transom.*

6. With attaching kit positioned as outlined preceding, use 3 holes in transom bracket as a guide and drill three 11/32 in. (8.7mm) holes thru transom.
7. Use a marine-type sealer on three 5/16 in. x 3-1/4in. (7.9mm x 82.6mm) bolts. Secure attaching kit to transom, using transom backing plate, 3 bolts (with sealer) and 3 locknuts, installed as shown in Figure 2. Torque lock nuts to 10 Ib. ft. (13.5 N·m).

STEERING CABLE INSTALLATION

1. Lubricate steering cable end with Quicksilver 2-4-C w/Teflon (92-825407A12).
2. Install steering cable thru steering cable tube and secure to cable tube with cable attaching nut. (Figure 3) Do not tighten cable attaching nut at this time.
3. Attach Ride-Guide cable to outboard steering arm, using the proper "Clevis Kit." Installation instructions for clevis are with "Clevis Kit."
4. Adjust 2 large jam nuts on cable tube of attaching kit, so that **steering wheel** is in normal straight-driving position with outboard in straight-running position. Torque each jam nut to 35 Ib. ft. (47.5 N·m), then bend a side of tab washer against flat of each jam nut. (Figure 3)
5. Torque Ride-Guide cable attaching nut (which secures cable to guide tube) to 35 Ib. ft. (47.5 N·m). (Figure 3) Install locking sleeve over cable attaching nut and secure with cotter pin. Spread ends of cotter pin.

⚠ WARNING

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

Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

⚠ CAUTION

Core of steering cable must be fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

1. Lubricate outboard end of Ride-Guide steering cable (thru grease fitting next to cable attaching nut) with Quicksilver 2-4-C w/Teflon.

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

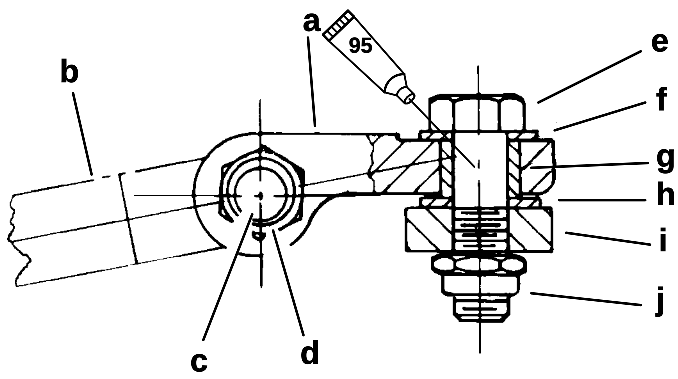
2. Lubricate all steering system pivot points (and exposed portion of steering cable core) with Quicksilver 2-4-C w/Teflon. Lubricate at intervals specified preceding.
3. Carefully check steering system components for wear (at intervals specified, preceding). Replace worn parts.
4. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications. (Figures 1, 2 and 3)

Clevis Attaching Kit Installation (A-70599A2)

***NOTE:** This kit is used to attach Ride-Guide cable to outboard steering arm ONLY when **"Transom Mounted Ride-Guide Attaching Kit"** is being used. If Ride-Guide cable is installed thru outboard tilt tube, then "Steering Link Rod" must be used.*

Installation Instructions

1. Install clevis to steering cable as shown.
2. Lubricate 3/8 in. x 1-3/8 in. (9.5mm x 34.9mm) bolt (area without threads) with 2-4-C w/Teflon, then secure clevis to steering cable with this bolt and a locknut. Torque locknut (item "d") to 10 lb. ft. (13.6 N·m).



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

a - Clevis
b - Steering Cable
c - Bolt [3/8 in. x 1-3/8 in. (9.5mm x 34.9mm)
d - Clevis to Steering Cable Locknut [Torque to 10 lb. ft. (13.6 N·m)]
e - Bolt [3/8 in. x 1-1/4 in. (9.5mm x 31.8mm)] [Torque to 20 lb. ft. (27.1 N·m)]
f - Thin Washer [1/16 in. (1.6mm) Thick]
g - Spacer
h - Thick Washer [1/8 in. (3.2mm) Thick]
i - Engine Steering Arm
j - Clevis to Engine Locknut [Torque to 20 lb. ft. (27.1 N·m)]

3. Lubricate spacer (supplied with this kit) with 2-4-C w/Teflon.
4. Attach clevis to top of outboard steering arm with a 3/8 in. x 1-1/4 in. (9.5mm x 31.8mm) bolt, thin washer, spacer, thick washer (thick washer must be installed between clevis and steering arm) and locknut, as shown. Torque bolt (item "e") to 20 lb. ft. (27.1 N·m), then torque locknut (item "j") to 20 lb. ft. (27.1 N·m).

Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

1. Carefully check steering system components (at intervals specified, preceding) for wear. Replace worn parts.
2. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications.
3. Lubricate clevis pivot points with a drop of light oil. Lubricate at intervals specified, preceding.