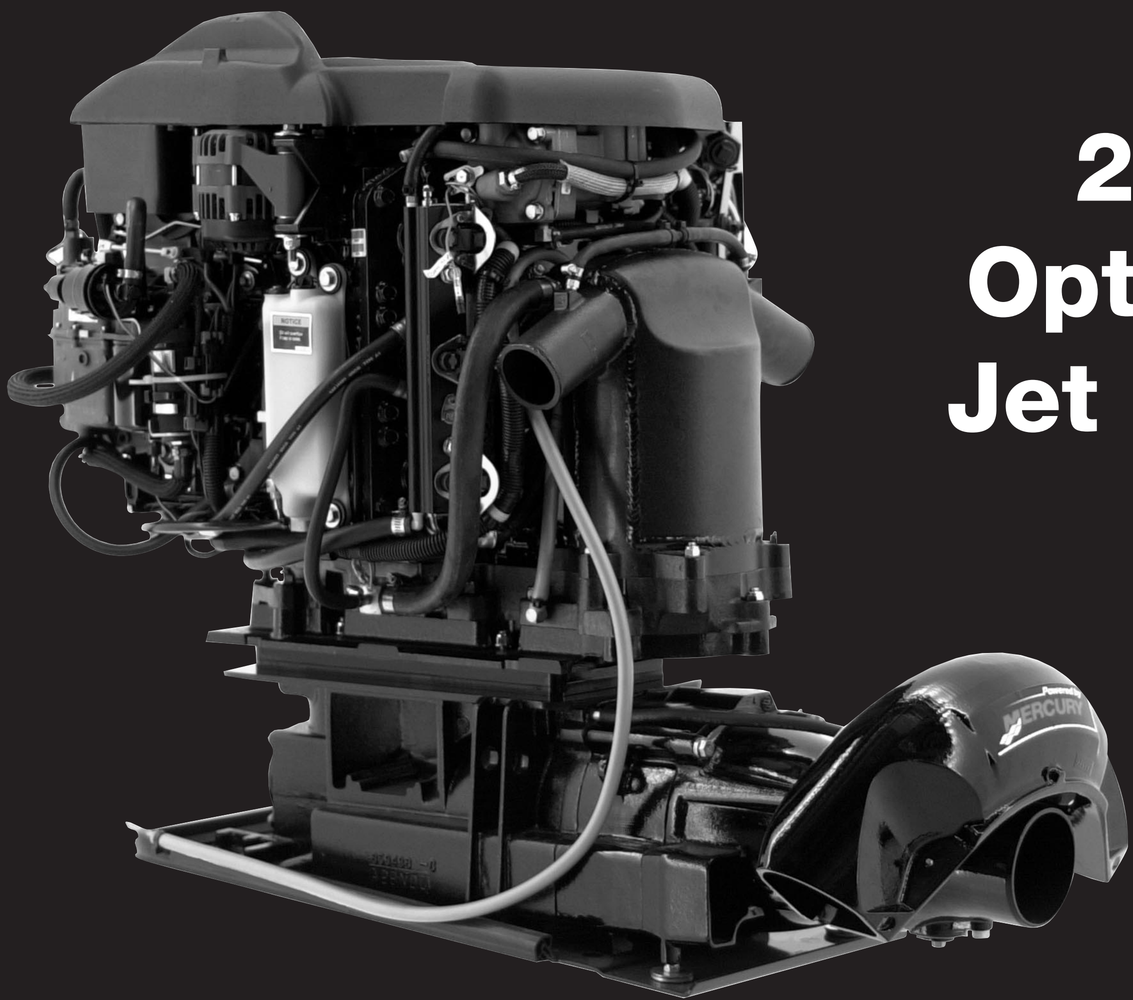
MERCURY

Service Manual



200 OptiMax Jet Drive

Starting Model Year 2001
Starting Serial Number 0E384500 for Powerhead
Starting Serial Number 0E379931 for Pump Unit

MERCURY
200 OptiMax Jet Drive
Starting Model Year 2001
Starting Powerhead S/N 0E384500

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 Mercury Jet Unit

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

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

Personnel should not work on or under a powerhead which is suspended. Powerheads should be attached to work stands, or lowered to ground as soon as possible.

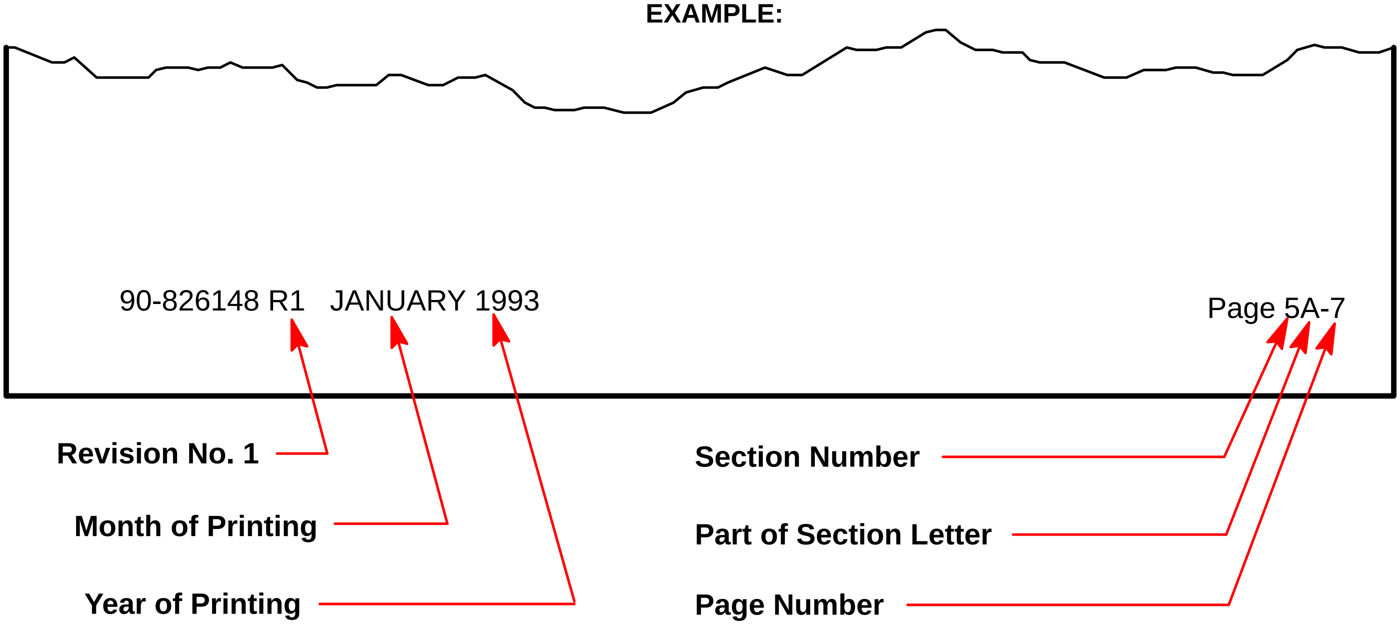
We reserve the right to make changes to this manual without prior notification.

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

Page Numbering

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

EXAMPLE:



Service Manual Outline

Section 1 - Important Information
- A - Specifications
- B - Maintenance
- C - General Information
- D - Jet Installation

Section 2 - Electrical
- A - Ignition
- B - Charging & Starting System
- C - Timing, Synchronizing & Adjusting
- D - Wiring Diagrams

Section 3 - Fuel System
- A - Fuel Pump
- B - Direct Fuel Injection
- C - Oil Injection
- D - Emissions

Section 4 - Powerhead
- A - Powerhead
- B - Cooling

Section 5 - Pump Unit

Section 6 - Color Diagrams

Important Information	1
Electrical	2
Fuel System	3
Powerhead	4
Pump Unit	5
Color Diagrams	6

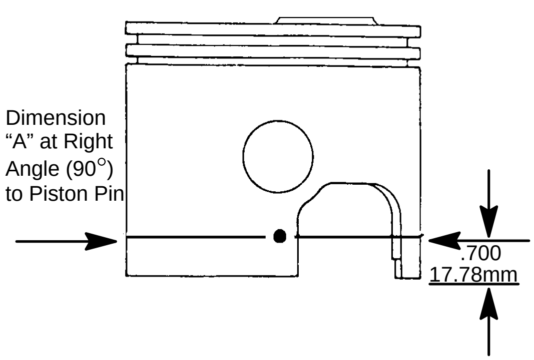
IMPORTANT INFORMATION

Section 1A - Specifications

Table of Contents

Master Specifications 1A-2
Torque Chart 1A-6
Standard Hardware 1A-7
Metric Hardware 1A-7

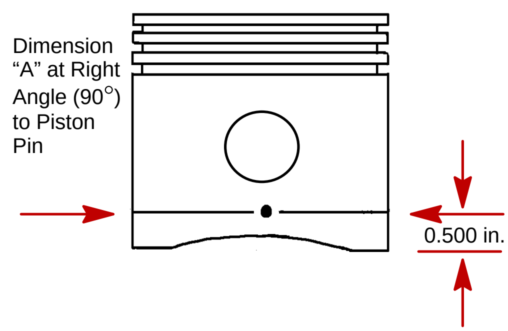
Master Specifications

Model 200 Optimax Jet Drive		
HORSEPOWER (KW)	**Model 200 Full Throttle RPM Idle RPM (In Gear) RPM Limiter All Models**	200 (149.1) 5150 - 5650 900 - 1000 Refer to System Information in the Digital Diagnostic Terminal (DDT) for latest information
JET DRIVE WEIGHT	**Powerhead Pump Unit**	257 (116.6 kg) 110 (49 kg)
CYLINDER BLOCK	**Type Displacement**	V-6 Cylinder, Two Cycle, Direct Injected 153 cu. in. (2508 cc) 60° Vee
STROKE	**Length (All Models)**	2.65 in. (67.3 mm)
CYLINDER BORE	**Diameter (Std) Diameter 0.015 in. Oversize Taper/Out of Round/Wear Maximum Bore Type**	3.501 in. (88.925 mm) 3.516 in. (89.306 mm) 0.003 in. (0.076 mm) Cast Iron
CRANKSHAFT	**Maximum Runout**	0.006 in. (0.152 mm)
PISTON	**Piston Type Diameter Standard Diameter 0.015 in. Oversize**	Aluminum 3.4925 in. ± .0005 in. (88.7095 mm ± 0.0127 mm) 3.5075 in. ± 0.0005 in. (89.0905 mm ± 0.0127 mm)
PISTON DIAMETER		3.4925 in. ± .0005 in. (88.7095 mm ± .0127 mm) **Using a micrometer, measure dimension “A” at location shown. Dimension “A” should be 3.4925 in. ± .0005 for a STANDARD size piston (new) Dimension “A” will be 0.001 – 0.0015 less if coating is worn off piston (used)**
REEDS	**Reed Stand 0pen (Max.)**	0.020 in. (0.50 mm)

Model 200 Optimax Jet Drive		
DIRECT INJECTION	**Injectors** **– Quantity** **– Injectors are Crank Angle Driven by ECM** **– #2 Cylinder** **– #4 Cylinder** **– #6 Cylinder** **– #1 Cylinder** **– #3 Cylinder** **– #5 Cylinder** **Fuel Line Pressure @ Injectors** **Air Pressure** **High Pressure Electric Fuel Pump Amperage Draw** **Low Pressure Electric Fuel Pump Amperage Draw** **Low Pressure Electric Fuel Pump Output** **Fuel Lift Electric Fuel Pump Output** **Fuel Lift Electric Fuel Pump Amperage Draw** **Fuel Injector Ohm Resistance** **Direct Injector Ohm Resistance** **Fuel/Air Differential**	 6 RED/WHT + RED/BLU Leads YEL/WHT + RED/BLU Leads PPL/WHT + RED/BLU Leads BRN/WHT + RED/BLU Leads ORG/WHT + RED/BLU Leads BLU/WHT + RED/BLU Leads 89 ± 2 psi (613.5 ± 13.8 kPa) 79 ± 2 psi (544.0 ± 13.8 kPa) 5 – 9 Amperes 1 – 2 Amperes 6 – 9 psi (41.37 – 62.04 kPa) 1 – 10 psi (6.89 – 68.94 kPa) 1 – 2 Amperes 1.8 ± 0.1 Ω 1.3 ± 0.3 Ω 10 psi (68.5 kPa)
FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Recommended Oil** **Gasoline/Oil Ratio** **– @ Idle** **– @ WOT**	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver TC-W3 Premium Plus 2 Cycle Outboard Oil 300 – 400:1 40:1

Model 200 Optimax Jet Drive		
STARTING SYSTEM	**Electric Start – All Models** **Starter Draw (Under Load)** **Starter Draw (No Load)** **Minimum Brush Length** **Battery Rating**	 170 Amperes 60 Amperes 0.25 in. (65.4 mm) 1000 (Minimum) Marine Cranking Amps 750 (Minimum) Cold Cranking Amps 105 (Minimum) Ampere Hours
IGNITION SYSTEM	**Type** **Spark Plug Type** **Spark Plug Gap** **Maximum Timing** **Idle Timing** **Throttle Position Sensor** **@ Idle** **@ WOT** **Crank Position Sensor** **Air Gap** **Firing Order**	Digital Inductive NGK PZFR5F-11 0.040 in. (1.0 mm) Not Adjustable; Controlled by ECM Not Adjustable; Controlled by ECM 0.19 – 1.0 VDC 3.45 – 4.63 VDC 0.025 in. – 0.040 in. (0.635 mm – 1.01 mm) 1-2-3-4-5-6
CHARGING SYSTEM	**Alternator Output (Regulated)** **Brush Length** **Voltage Output** **Regulator Current Draw**	32 - 38 Amperes @ 2000 RPM @ Battery* 52 - 60 Amperes @ 2000 RPM @ Alternator Std Exposed Length: 0.413 in. (10.5 mm) Min. Exposed Length: 0.059 in. (1.5 mm) 13.5 to 15.1 Volts 0.15 mA (Ign. Switch Off) 30.0 mA (Ign. Switch On)

*Amperage listed is when battery is in a discharged state. If battery is fully charged, amperage readings will be less.

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

Torque Chart

PUMP UNIT

Special Items	Torque
Inlet Screen Screw (6 mm)	75 lb. in. (8.5 N·m)
Ride Plate Screw	75 lb. in. (8.5 N·m)
Reverse Gate Stop Screw	120 lb. in. (13.6 N·m)
Impeller Shaft Cover Screw	15 lb. ft. (20.3 N m)
Steering Lever Screw	15 lb. ft. (20.3 N m)
Pinion Shaft Housing Screw	15 lb. ft. (20.3 N m)
Inlet Screen Screw (8 mm)	16.5 lb. ft. (22.4 N m)
Drive Housing Cover Nuts	35 lb. ft. (47.5 N·m)
Nozzle to Stator Bolts	35 lb. ft. (47.5 N·m)
Stator Bolts	35 lb. ft. (47.5 N·m)
Rudder Pivot Bolt	50 lb. ft. (68 N·m)
Reverse Gate Pivot Bolt	80 lb. ft. (108.5 N·m)
Impeller Gear Nut	90 lb. ft. (122 N·m)
Impeller Nut	150 lb. ft. (203.4 N·m)

POWERHEAD

Special Items	Torque
Reed Block Screws	90 lb. in. (10.2 N m)
Vapor Separator	140 lb. in. (15.8 N m)
Air Handler Assembly	14.5 lb. ft. (19.7 N m)
Crank Case Cover Bolts .312-18x1-1/4 (6 ea)	15 lb. ft. (20.3 N m)
Crank Case Cover Bolts 3/8-16x3-1/4 (8 ea)	37 lb. ft. (50.2 N m)
Expansion Chamber Nuts	20 lb. ft. (27.1 N·m)
Connecting Rod Screws	*20 lb. ft. (27.1 N·m) Then Turn Additional 90°
Spark Plug	20 lb. ft. (27.1 N m)
Cylinder Head	*30 lb.ft. (40.6 N·m) Then Turn Additional 90°
Port Fuel Rail Nut	35 lb. ft. (47.5 N m)
Starboard Fuel Rail Nut	20 lb. ft. (27.1 N m)
Starboard Fuel Rail Spacer	35 lb. ft. (47.5 N m)
Strainer Fitting	40 lb. ft. (54 N m)
Adaptor Plate to Powerhead	35 lb. ft. (47.5 N·m)
Powerhead to Drive Housing Nuts	35 lb. ft. (47.5 N·m)
Flywheel Nut	125 lb. ft. (169.5 N·m)

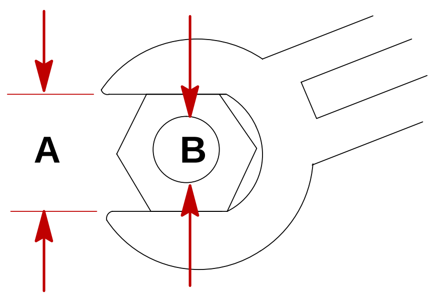
***NOTE:** *Screws should not be reused after removal*

Standard Hardware

Screw or Nut Size	Torque
6 - 32	9 lb. in. (1.0 N·m)
8 - 32	20 lb. in. (2.3 N·m)
10 - 24	30 lb. in. (3.4 N·m)
10 - 32	35 lb. in. (3.9 N·m)
12 - 24	45 lb. in. (5.0 N·m)
1/4 - 20	70 lb. in. (7.8 N·m)
5/16 - 18	160 lb. in. (18.1 N·m)
3/8 - 16	270 lb. in. (30.4 N·m)

Metric Hardware

A	B	Torque Specification		
		lb. in.	lb. ft.	N·m
8 mm	M5	36	3	4
10 mm	M6	70	6	8
12 mm	M8	156	13	18
14 mm	M10	312	26	36
17 mm	M12	372	31	42



IMPORTANT INFORMATION

Section 1B - Maintenance

Table of Contents

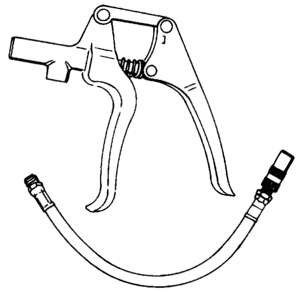
Specifications 1B-1
Special Tools 1B-2
Quicksilver Lubricant/Sealant 1B-2
Maintenance 1B-3
Before Each Use 1B-3
After Each Use 1B-3
Every 10 Hours of Use or Once a Month 1B-3
Every 50 Hours of Use or Once a Month 1B-3
Every 100 Hours of Use or Once a Season 1B-3
Fuel System 1B-4
Fuel Line Inspection 1B-4
Water Separating Fuel Filter 1B-4
Spark Plug Inspection 1B-5
Battery Inspection 1B-5
Fuse Replacement 1B-6
Compressor Air intake Filter 1B-6
Removal 1B-6
Flushing Cooling System 1B-7
Corrosion Protection 1B-7
Out-of-Season Storage 1B-8
Fuel System 1B-8
Protecting Jet Pump Components 1B-9
Battery Storage 1B-9

Specifications

FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Recommended Oil**	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver Optimax/DFI 2-Cycle Outboard Oil or Quicksilver TC-W3 Premium Plus 2 Cycle Outboard Oil
IGNITION SYSTEM	**Spark Plug Type** **Spark Plug Gap**	NGK PZFR5F-11 0.040 in. (1.0 mm)
STARTING SYSTEM	**Battery Rating**	1000 (Minimum) Marine Cranking Amps 750 (Minimum) Cold Cranking Amps 105 (Minimum) Ampere Hours
DRIVE HOUSING	**Lubricant Capacity**	24 fl. oz. (710 ml)
STATOR ASSEMBLY	**Lubricant Capacity**	19 fl. oz. (562 ml)

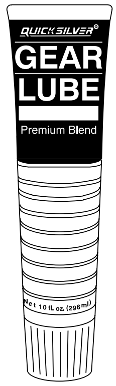
Special Tools

1. Grease Gun 91-37299A1

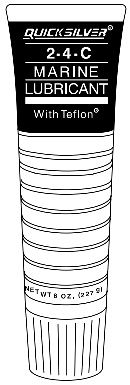


Quicksilver Lubricant/Sealant

1. Gear Lubricant - Premium Blend 92-850737A1



2. 2-4-C Marine Lubricant with Teflon 92-825736A1



Maintenance

Before Each Use

1. Check that lanyard stop switch stops the engine.
2. Visually inspect the fuel system for deterioration or leaks.
3. Check the engine compartment and use your nose to detect any fuel fumes.
4. Check throttle, shift and steering system for binding or loose components.

After Each Use

1. Wash off all salt deposits with fresh water if operating in salt water.
2. Flush out the engine cooling system if operating in salt or polluted waters or sandy locations.

Every 10 Hours of Use or Once a Month

1. Check bilge siphon system.
2. Inspect cable bellows: worn, rubbing, or leaking.
3. Inspect battery and connections.
4. Check tightness of bolts, nuts and other fasteners.

Every 50 Hours of Use or Once a Month

1. Check level and condition of drive housing and stator lubricant.
2. Check corrosion control anodes.
3. Check tightness of bolts, nuts and other fasteners.

Every 100 Hours of Use or Once a Season

1. Lubricate all lubrication points. Lubricate more frequently when used in salt water.
2. Replace spark plugs at first 100 hours or first year. After that, inspect spark plugs every 100 hours or once yearly. Replace spark plugs as needed.
3. Drain and replace drive housing lubricant.
4. Drain and replace stator housing lubricant.
5. Remove impeller and lubricate impeller shaft with Quicksilver or Mercury Precision 2-4-C w/Teflon to prevent impeller from seizing to the shaft.
6. Remove engine deposits with Quicksilver or Mercury Precision Power Tune Engine Cleaner.
7. Replace engine fuel line filter.

Fuel System

⚠ WARNING

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

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

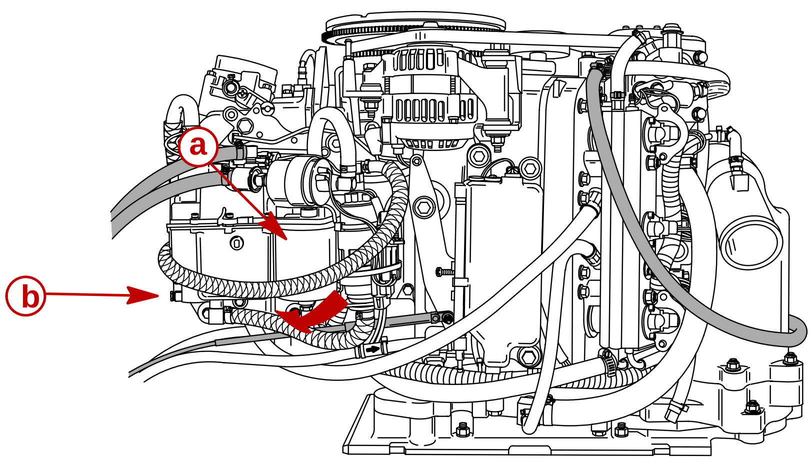
Fuel Line Inspection

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

Water Separating Fuel Filter

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

1. This filter (a) 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.



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a - Fuel/Water Separating Filter
b - Vapor Separator Tank Drain Plug

Remove and replace filter as follows:

a. Turn ignition key switch to OFF position.

b. Disconnect wire at bottom of filter.

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

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

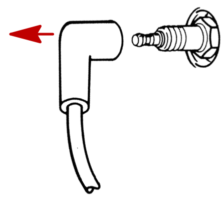
IMPORTANT: With the key switch in the RUN position, the fuel lift pump will fill the filter with fuel. Visually inspect for fuel leakage from the filter. If leakage is observed, turn key switch to the OFF position. Remove filter and inspect sealing ring/surface for damage or debris.

Spark Plug Inspection

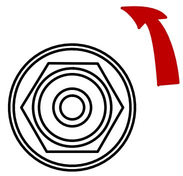
Inspect spark plugs at the recommended intervals.

NOTE: *On some applications it may be necessary to remove powerhead from boat to access expansion chamber and spark plugs.*

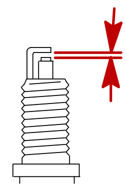
1. Remove expansion chamber.
2. Remove the spark plug leads by twisting the rubber boots slightly and pull off. Inspect spark plug boots and replace if cracked.



3. 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.



4. Set the spark plug gap. See Specification Chart in General Information Section.



5. Before reinstalling spark plugs, clean away dirt on the spark plug seats. Install plugs finger tight, and tighten 1/4 turn or torque to 20 lb. ft. (27 Nm).
6. Reinstall expansion chamber. Torque nuts to 20 lb. ft. (27 Nm).

Battery Inspection

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

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

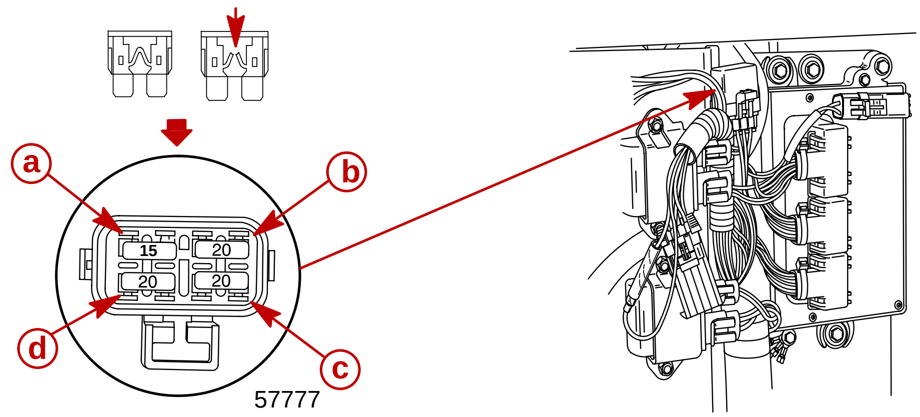
1. Turn off the engine before servicing the battery.
2. Add water as necessary to keep the battery full.
3. Make sure the battery is secure against movement.
4. Battery cable terminals should be clean, tight, and correctly installed. Positive to positive and negative to negative.
5. Make sure the battery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

Fuse Replacement

IMPORTANT: Always carry spare SFE 15 and 20 AMP fuses.

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

1. Open the fuse holder and look at the silver colored band inside the fuse. If band is broken, replace the fuse. Replace fuse with a new fuse with the same rating.
2. The fuses and circuits are identified as follows:
   a. Smart Craft Data Bus Circuit – SFE 15 AMP Fuse.
   b. Accessories – SFE 20 AMP Fuse.
   c. Ignition Coil Circuit – SFE 20 AMP Fuse.
   d. Electric Fuel Pump/ECM Driver Power/Oil Pump Circuit – SFE 20 AMP Fuse.



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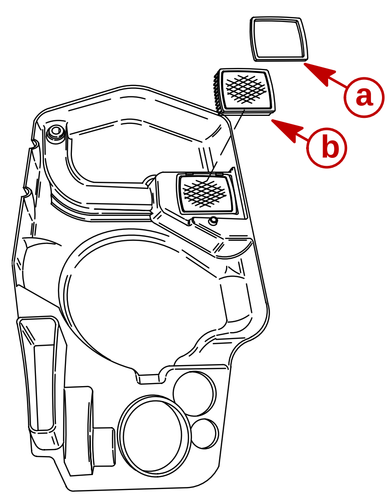
Compressor Air intake Filter

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

Removal

1. Remove flywheel cover from the engine. Snap out the retainer (a) and remove filter (b).



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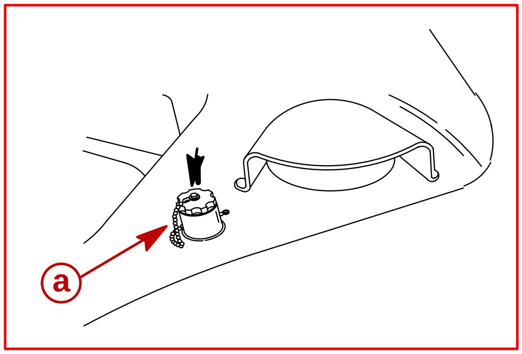
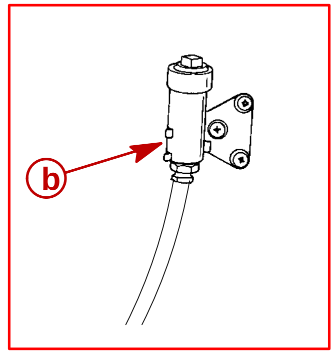
Flushing Cooling System

Flushing the cooling system is essential after each use in salt water, after the boat has run aground, or when the overheat warning horn sounds (possible debris in jet powerhead).

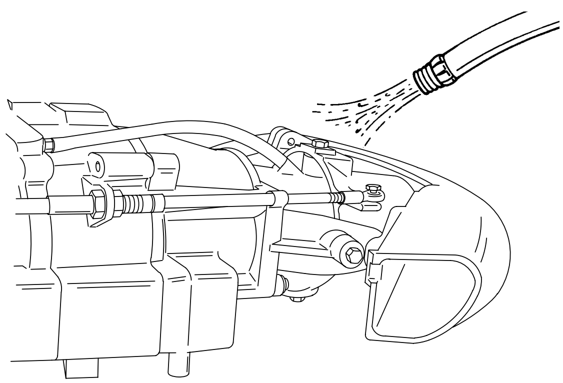
1. Locate the flush adapter in the boat. Some boats may have the adaptor mounted in the hull (a) or mounted in the engine compartment (b). Remove flush adaptor plug and attach water hose.





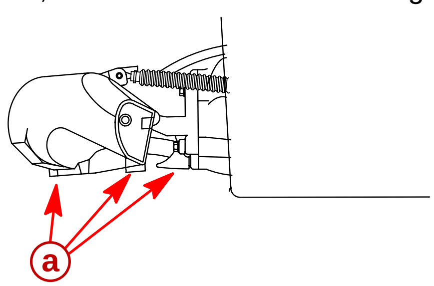
a - Flush Adapter Plug Mounted on Hull
b - Flush Adapter Plug Mounted in Engine Compartment

2. The engine may be run using the Flushing Attachment: DO NOT run the engine above idle speeds.
3. Turn water on and flush engine block for at least 10 minutes.
4. Remove water hose and install flush adaptor plug.
5. Flush outer surfaces of pump with water stream.



Corrosion Protection

The jet drive has three corrosion control anodes (a). One of the anodes is installed on the bottom of the nozzle, one installed on the reverse gate and one is installed under the rudder.



Out-of-Season Storage

⚠ WARNING

As a safety precaution, when boat is in storage, remove positive (+) battery cable. This will eliminate possibility of accidental starting of engine and resultant overheating and damage to engine from lack of water.

In preparing for out-of-season storage, two precautions must be considered: 1) The engine must be protected from physical damage caused by freezing trapped water and 2) the engine must be protected from rust, corrosion and dirt.

If the length of storage time between each use varies from 1 week to 2 months, it is recommended to add Mercury Precision Fuel Stabilizer to the fuel tank regularly each time gasoline is added following the recommended amount as described on the Fuel Stabilizer container.

The following storage procedures should be followed to prepare the Jet Drive for out-of-season storage or prolonged storage (two months or longer).

⚠ CAUTION

Never start or run the Jet Drive without water circulating through the cooling system to prevent damage to the unit.

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.

The most effective method for storage preparation is to add the recommended amount of Mercury Precision Fuel Stabilizer and Mercury Precision Quickleen products as described on their containers to the fuel tank before the last operation of the boat. Adding Fuel Stabilizer will help prevent the formation of varnish and gum in the gasoline. The Mercury Precision Quickleen product will help clean and lubricate the fuel injectors.

To properly prepare the engine for prolong storage:

a. Drain the fuel from the Vapor Separator Tank (VST) into a suitable container by removing the drain plug. After the fuel has been drained, reinstall the drain plug.

b. Remove the water separator fuel filter and empty the fuel into a suitable container. Discard both the fuel and the filter properly.

c. Premix the following in a container:

   (1.) 0.68 oz (20 cc) or 2 tablespoons of Mercury Precision Premium Plus Outboard oil or Quicksilver Optimax/DFI 2-Cycle Outboard Oil.

   (2.) 0.27 oz (8 cc) or 2 teaspoons of Mercury Precision Quickleen lubricant.

   (3.) 0.27 oz (8 cc) or 2 teaspoons of Mercury Precision Fuel Stabilizer.

d. Pour this mixture in the new water separator fuel filter.

e. Reinstall the filter.

f. Prime the fuel system as outlined in the STARTING PROCEDURES.

g. Using a flushing attachment, start the engine and allow the engine to run at idle speeds for 10 minutes.

h. Turn the engine off. Turn the water off if using a flushing attachment. Allow the water to drain out of the unit completely.

i. Complete the other recommended items for storage.

Protecting Jet Pump Components

IMPORTANT: Check and refill housing with Quicksilver Premium Gear Lube before storage to protect against possible water leakage into housing which is caused by loose lubricant vent or fill plug. Inspect gaskets under lubricant vent and fill plugs replacing any damaged gaskets before reinstalling plugs.

1. Drain and refill drive housing unit and stator assembly with Quicksilver Premium Gear Lube as explained in "**Jet Pump**" section (see **Table of Contents**).
2. Lubricate all lubrication points.

Battery Storage

1. Remove battery as soon as possible and remove all grease, sulfate and dirt from top surface.
2. Cover plates with distilled water, but not over 3/16 in. (5 mm) above perforated baffles.
3. Cover terminal bolts well with grease.
4. Store battery in a cool, dry place in a dry carton or box.
5. Remove battery from storage every 60 days. Check water level and place on charge for 5 to 6 hours at 6 amperes. DO NOT fast charge.

⚠ CAUTION
A discharged battery can be damaged by freezing.

IMPORTANT INFORMATION

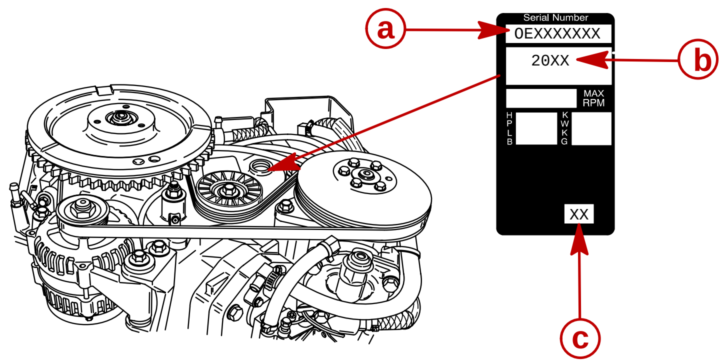
Section 1C - General Information

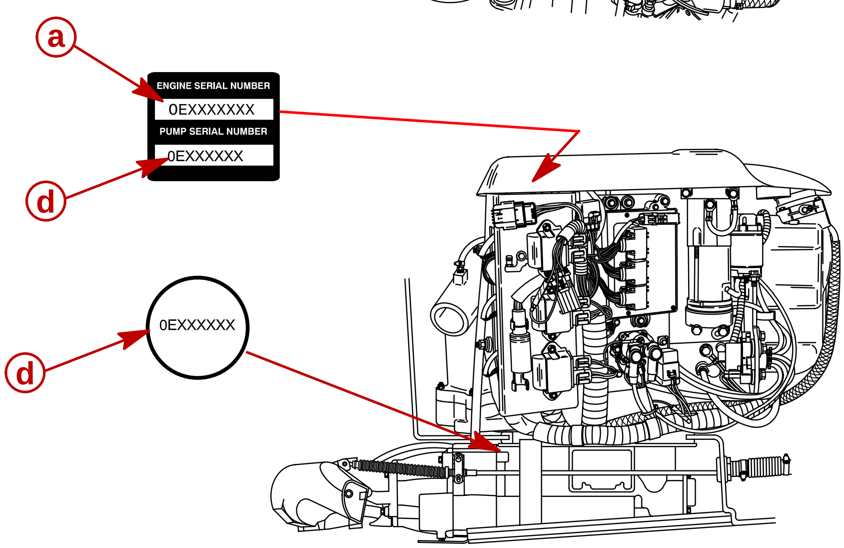
Table of Contents

Serial Number Location	1C-1
Conditions Affecting Performance	1C-2
Weather	1C-2
Boat	1C-2
Engine	1C-3
Engine Compression	1C-4
Water Pressure Check	1C-5
Following Complete Submersion	1C-5
Salt Water Submersion	1C-5
Submerged While Running	1C-5
Fresh Water Submersion	1C-5
Model 200 HP Front View	1C-7
Model 200 HP Starboard View	1C-8
Model 200 HP Port View	1C-9
Model 200 HP Aft View	1C-10
Model 200 HP Top View	1C-11
Mercury Jet Pump Starboard View	1C-12
Mercury Jet Pump Port View	1C-12

Serial Number Location

A serial number decal is located on the side of the flywheel cover and on top of the cylinder block.

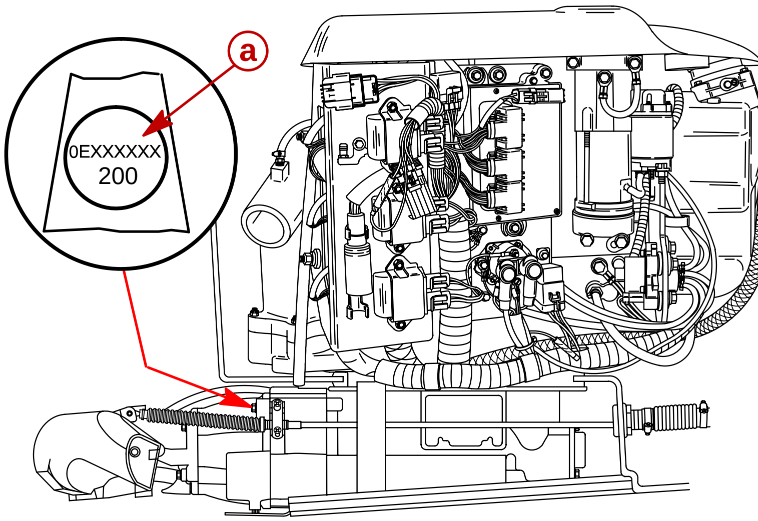




a - Engine Serial Number
b - Model Year
c - Year Manufactured
d - Pump Serial Number

IMPORTANT: The Pump Unit Serial Number sticker must be taken out of the envelope affixed to the pump unit and applied to decal on electrical plate.

The engine serial number and pump serial number are different and unique. The engine serial number is located aft of the flywheel cover. The pump unit serial number is stamped in a plug located above the shift cable hole on the starboard side of the pump housing.



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a - Pump Unit Serial Number

Conditions Affecting Performance

Weather

It is a known fact that weather conditions exert a profound effect on power output of internal combustion engines. Therefore, 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 the engine power. This, in turn, is reflected in decreased boat speeds--as much as 2 or 3 miles-per-hour (3 or 5 km per hour) in some cases. Nothing will regain this speed for the boater, but the coming of cool, dry weather.

In pointing out the practical consequences of weather effects, an engine running on a hot, humid, summer day may encounter a loss of 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, in turn, this density is dependent upon the temperature of the air, its barometric pressure and water vapor (or humidity) content.

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 increases skin friction and cause speed loss. Clean surfaces when necessary.

   d. **Jet Unit:** 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.

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 sharp turns or from an irregularity in the impeller blade itself. These vapor bubbles flow back and collapse when striking the surface of the impeller blade resulting in the erosion of the impeller 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 (in reverse) into the impeller blades. These air bubbles strike the impeller blade surface and cause erosion of the blade surface. If allowed to continue, eventual blade failure (breakage) will occur.

Engine

DETONATION

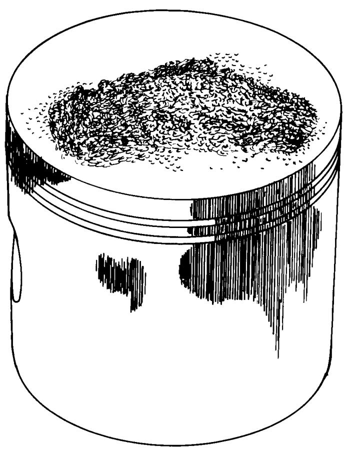
Detonation in a 2-cycle engine resembles the “pinging” heard in an automobile engine. It can be described as a “rattling” or “plinking” sound.

Detonation generally is thought of as spontaneous ignition, but it is best described as a noisy explosion in an unburned portion of the fuel/air charge after the spark plug has fired. Detonation creates severe, untimely shock waves in the engine and these shock waves often find or create a weakness: the dome of a piston, piston rings or piston ring lands, piston pin and roller bearings.

While there are many causes for detonation in a 2-cycle engine emphasis is placed on those causes which are most common in marine 2-cycle application. A few which are not commonly understood are:

1. Over-advanced ignition timing.
2. Use of low octane gasoline.
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 provided that (1) the engine is correctly set up and (2) diligent maintenance is applied to combat the preceding detonation causes listed.



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Damaged Piston Resulting from Detonation

Engine Compression

1. Remove spark plugs.
2. Install compression gauge in spark plug hole.
3. Hold throttle plates at W.O.T.
4. Crank engine through at least four compression strokes to obtain highest possible reading.
5. Check and record compression of each cylinder. Variation of more than 15 psi (103.5 kPa) between cylinders indicates that lower compression cylinder is in some way defective such as worn or sticking piston rings and/or scored piston and cylinder.
6. Compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. It is essential, therefore, that improper compression be corrected before proceeding with an engine tune-up.
7. Cylinder scoring: if powerhead shows any indication of overheating, such as discolored or scorched paint, visually inspect cylinders for scoring or other damage as outlined in Section 4: **Powerhead**.

Water Pressure Check

Water pressure may be checked by using a Digital Diagnostic Terminal (91-823686A2), or if the boat is so equipped, with a Mercury Monitor or Smartcraft Gauges.

RPM	Water Pressure PSI (kPa)
1,000 - 1,100 (in Neutral)	0.2 - 0.6 (1.4 - 4.0)
5500 (Boat on Plane)	10 - 15 (69 - 103)
5750 (Boat on Plane)	13 - 17 (90 - 117)

Following Complete Submersion

Submerged engine treatment is divided into three distinct problem areas. The most critical is submersion in salt water; the second is submersion while running; the third is submerged in fresh water.

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 rotate 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.

Fresh Water Submersion

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

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

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

b. Remove air outlet hose for the air compressor and drain water from compressor and hose. Reinstall hose.

c. Remove the air hose from bottom of port side fuel rail and drain water. Reinstall hose.

7. Drain water from engine as follows:

   a. Remove throttle plate assembly (4 bolts) and sponge water/debris out of air plenum.

   b. Remove spark plugs from engine.

   c. Rotate flywheel manually to blow out any water from the cylinders.

   d. Add approximately one ounce (30ml) of engine oil into each spark plug hole. Rotate the flywheel manually several times to distribute the oil in the cylinders. Reinstall spark plugs.

8. Drain water from the oil injection system as follows:

   a. Remove remote oil hose (black without blue stripe) from pulse fitting on starboard side of engine.

   b. Drain any water from hose and reconnect.

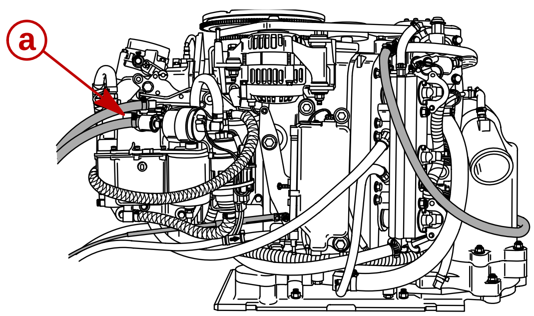
   c. If water was present in hose, check for water in the remote oil tank. Drain tank if water is present.

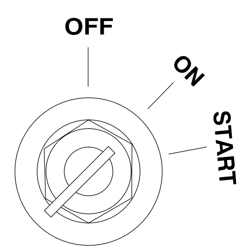
9. Disassemble the engine starter motor and dry components.

10. Prime the oil injection pump as follows:

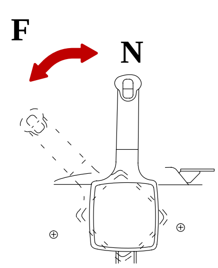
   a. Fill the engine fuel system with fuel. Connect fuel hose to fuel lift pump (a).

   b. Turn the ignition key switch to the “ON” position.





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

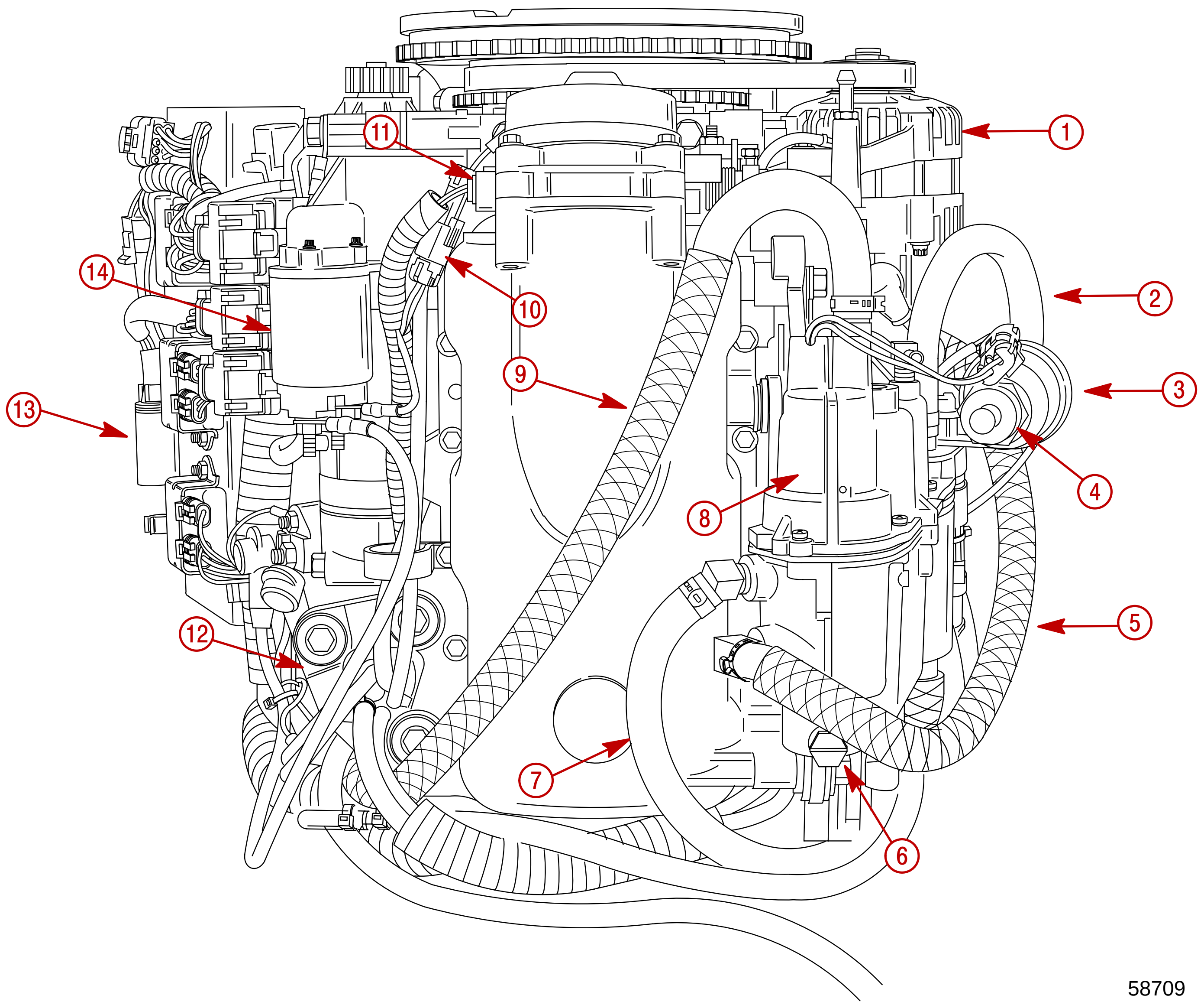


***NOTE:** Audible click from the oil pump will tell you the pump is priming. It may take a few minutes for the pump to complete the priming process.*

11. Attempt to start engine, using a fresh fuel source. If engine starts, it should be run for at least one hour to eliminate any water in engine.

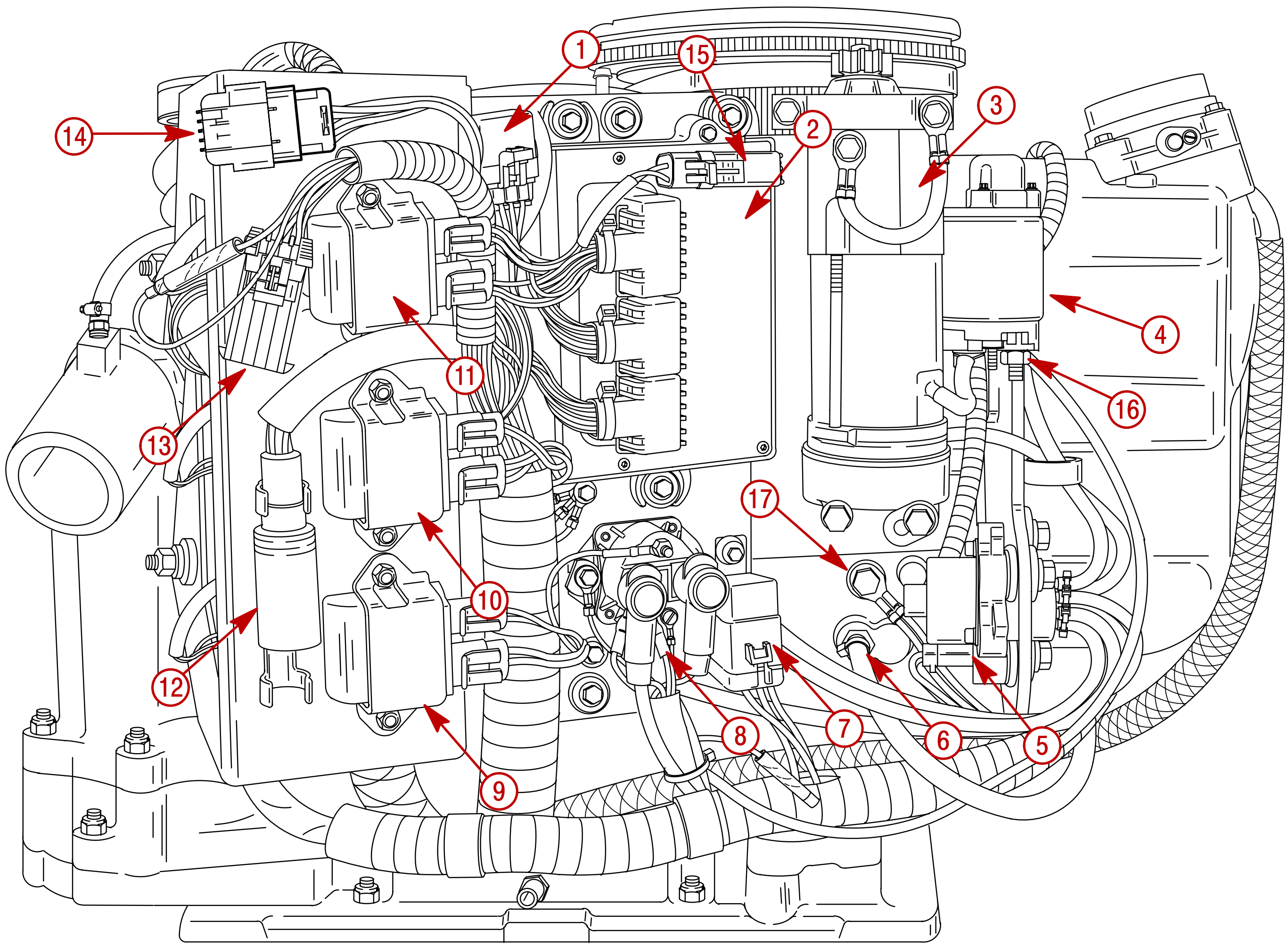
12. If engine fails to start, determine cause (fuel, electrical or mechanical).

Model 200 HP Front View



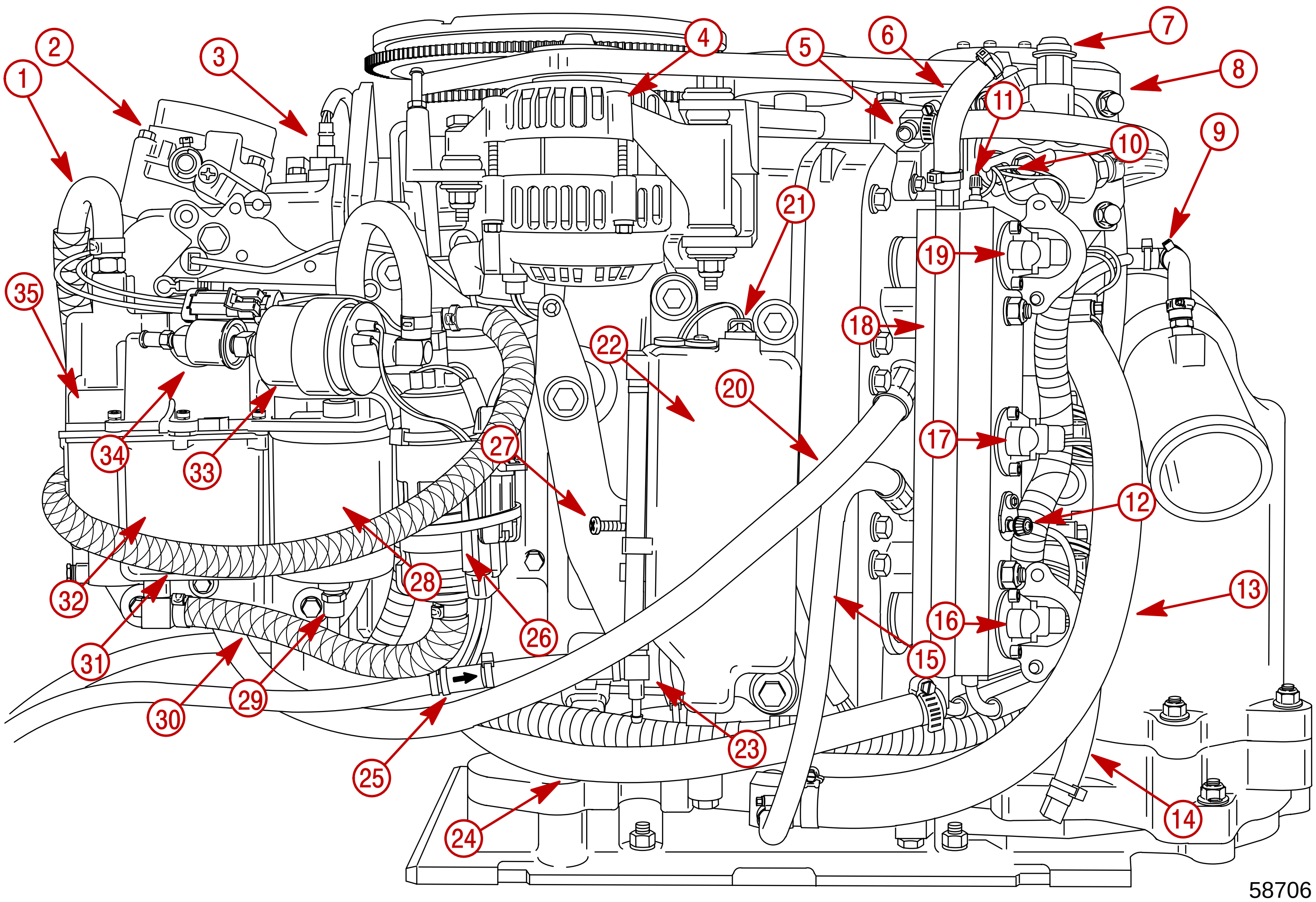
1 - 60 Ampere Alternator
2 - Fuel Inlet to Fuel/Water Separator
3 - Fuel Lift Pump
4 - Fuel Filter
5 - Low Pressure Fuel Pump Outlet Hose
6 - Vapor Separator Drain Plug
7 - Excess Fuel Return to Vapor Separator
8 - High Pressure Electric Fuel Pump (Inside Vapor Separator)
9 - Fuel Out (90 psi) to Fuel Rails
10 - Air Temperature Sensor Connector
11 - MAP Sensor Connector
12 - Oil Pump
13 - Engine Harness Connector
14 - Starter Solenoid

Model 200 HP Starboard View



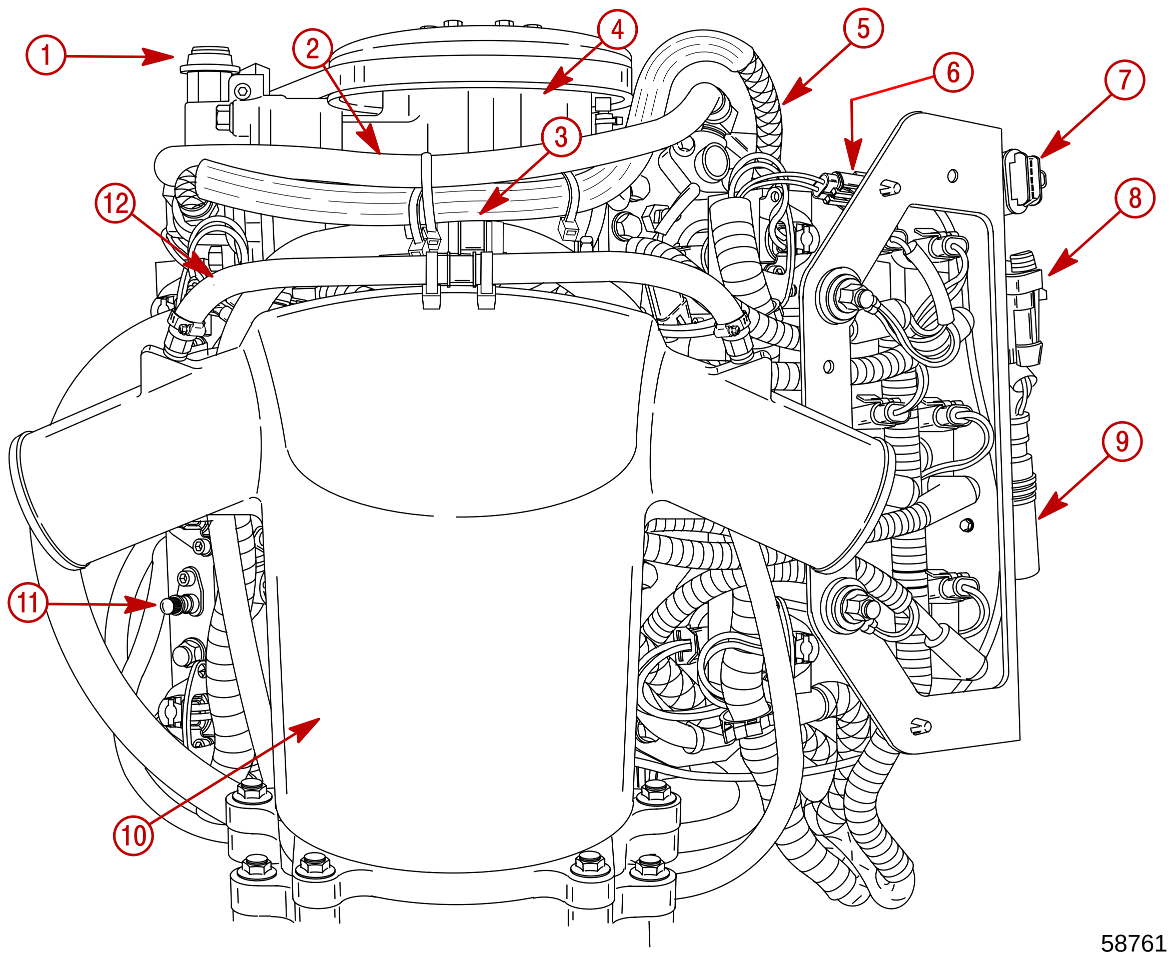
1 - Fuses (4)
2 - Electronic Control Module
3 - Starter Motor
4 - Starter Solenoid
5 - Oil Pump
6 - Remote Oil Tank Pressure Hose
7 - Main Power Relay
8 - Slave Solenoid
9 - Cyl. #5 and #6 Coil Driver
10 - Cyl. #3 and #4 Coil Driver
11 - Cyl. #1 and #2 Coil Driver
12 - Engine Harness Connector
13 - OIL/Fuel/Paddle Wheel Sensor Connector
14 - SmartCraft Gauge Data Buss
15 - DDT Connector
16 - Positive (+) Battery Connector
17 - Negative (–) Battery Connector

Model 200 HP Port View



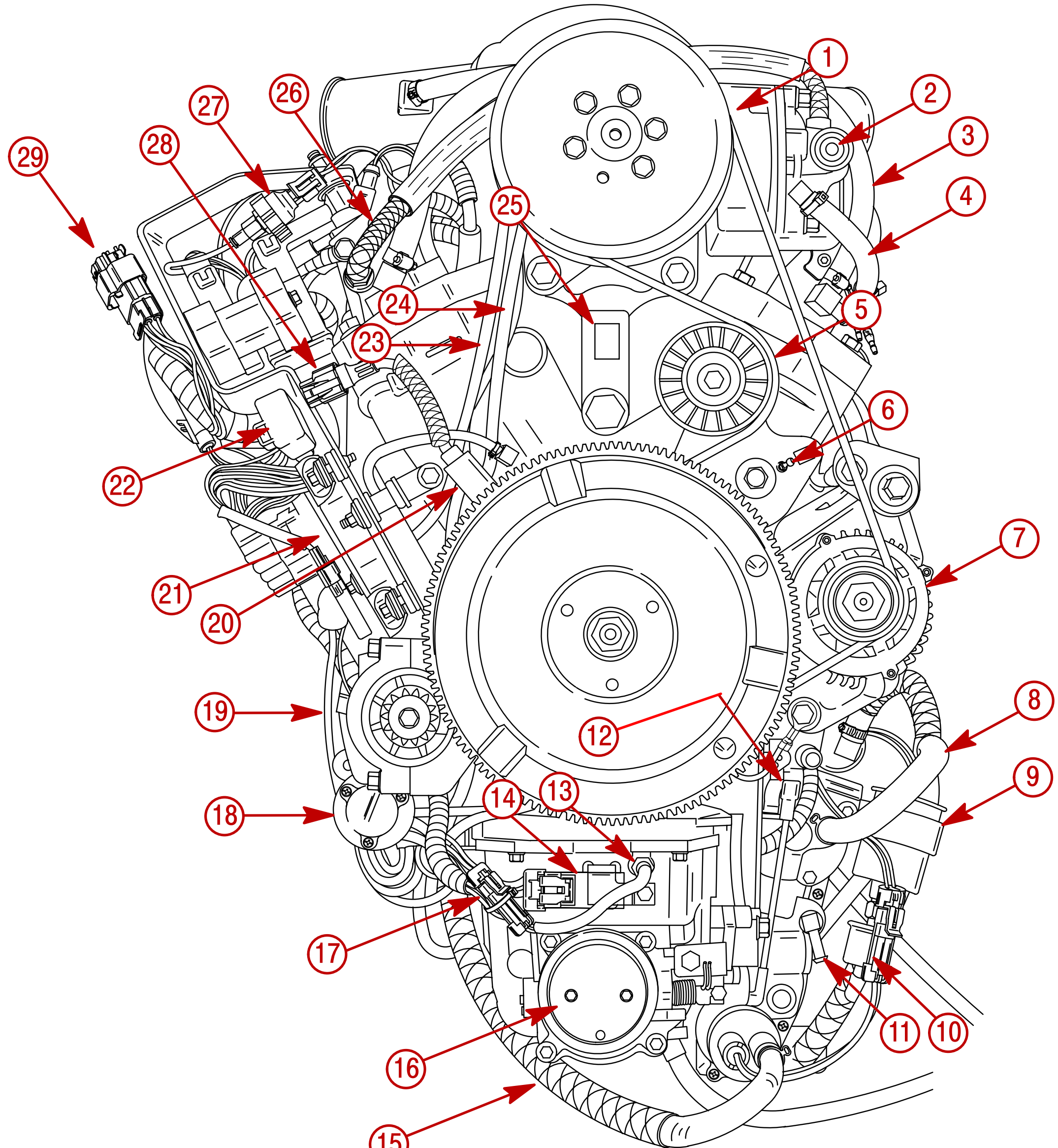
1 - Fuel Out (90 psi)
2 - Throttle Plate Assembly
3 - Air Temperature Sensor
4 - 60 Ampere Alternator
5 - Water Bypass Fitting
6 - Air Compressor Coolant Hose
7 - Air Inlet to Air Compressor
8 - Air Compressor
9 - Exhaust Pipe Coolant Hose
10 - Air Compressor Temperature Sensor
11 - Fuel Pressure Test Port
12 - Air Pressure Test Port
13 - Expansion Chamber Coolant Hose
14 - Bilge Siphon Hose
15 - Excess Air to Adaptor Plate
16 - #6 Fuel Injector
17 - #4 Fuel Injector
18 - Port Fuel Rail
19 - #2 Fuel Injector
20 - Excess Fuel Return to Vapor Separator
21 - Low Oil Switch
22 - Oil Reservoir
23 - 2 psi Check Valve
24 - Water Inlet to Fuel Rail
25 - Inlet Oil Hose Filter
26 - Low Pressure Electric Fuel Pump
27 - Idle Stop Screw
28 - Fuel/Water Separator
29 - Fuel/Water Sensor
30 - Low Pressure Fuel Pump Inlet Hose
31 - Low Pressure Fuel Pump Outlet Hose
32 - Vapor Separator
33 - Fuel Lift Electric Fuel Pump
34 - Fuel Filter
35 - High Pressure Electric Fuel Pump (Inside Vapor Separator)

Model 200 HP Aft View



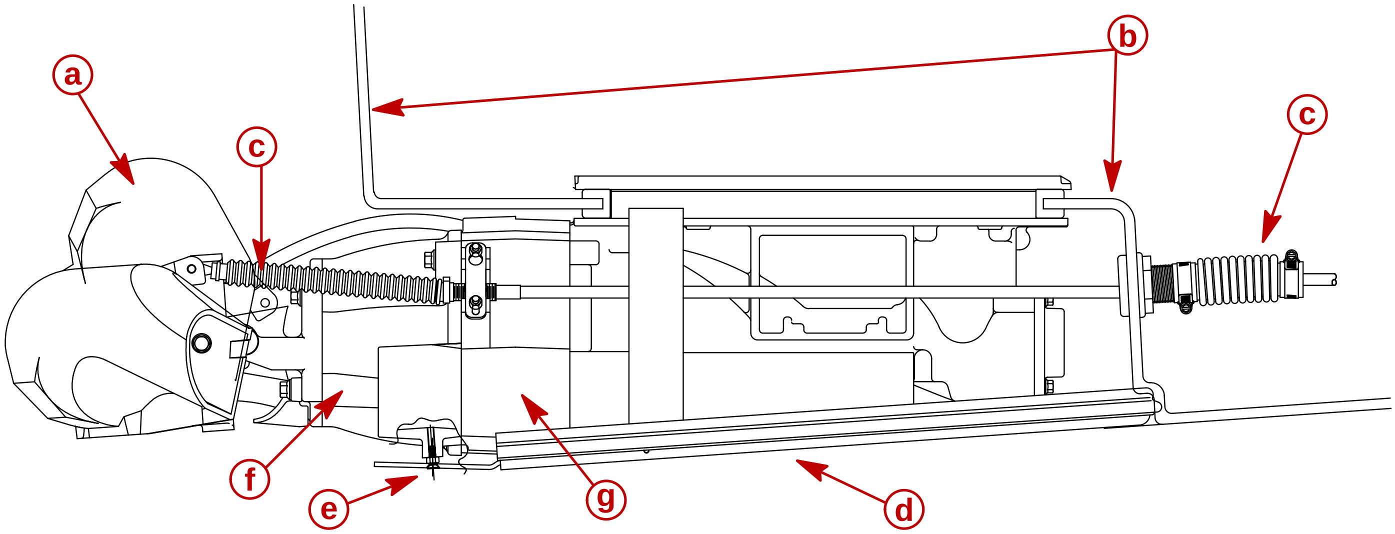
1 - Air Inlet to Air Compressor
2 - Water Bypass Hose
3 - Siphon Break
4 - Air Compressor
5 - Air Hose (80 psi) to Fuel Rail
6 - Water Pressure Sensor
7 - SmartCraft Gauge Data Buss
8 - OIL/Fuel/Paddle Wheel Sensor Connector
9 - Engine Harness Connector
10 - Expansion Chamber
11 - Air Pressure Test Port
12 - Exhaust Pipe Coolant Hose

Model 200 HP Top View



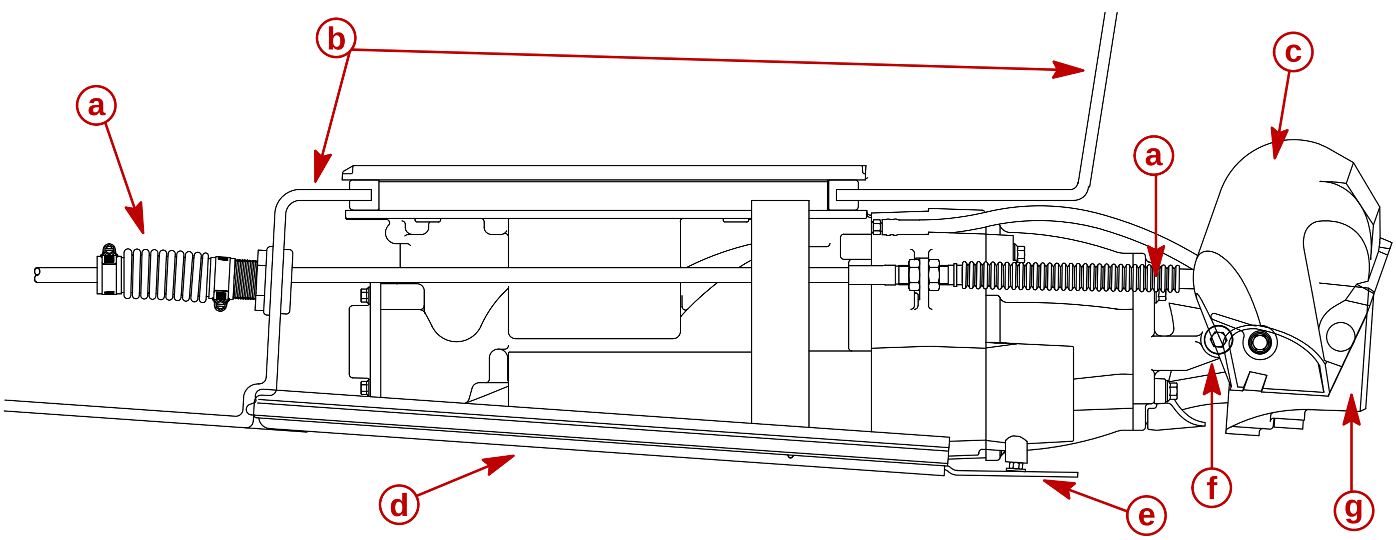
1 - Air Compressor
2 - Air Inlet to Air Compressor
3 - Water Bypass Hose
4 - Air Compressor Coolant Hose
5 - Belt Tensioner
6 - Tensioner Grease Fitting
7 - 60 Ampere Alternator
8 - Fuel Inlet to Fuel/Water Separator
9 - Fuel Lift Pump
10 - Fuel Filter
11 - VST Vent Hose Fitting
12 - Throttle Position Sensor
13 - Air Temperature Sensor
14 - MAP Sensor
15 - Fuel (90 psi) to Fuel Rails
16 - Throttle Plate Assembly
17 - Air Temp Sensor Connector
18 - Starter Solenoid
19 - Starter Motor
20 - Crank Position Sensor
21 - Electronic Control Module
22 - Fuses
23 - Oil Return Hose from Air Compressor
24 - Oil Hose to Air Compressor from Oil Pump
25 - Engine Serial Number
26 - Air Hose (80 psi) to Fuel Rail
27 - Water Pressure Sensor
28 - Crank Position Sensor Connector
29 - SmartCraft Sensor Connector

Mercury Jet Pump Starboard View



a - Reverse Gate
b - Hull
c - Shift Cable Assembly
d - Water Intake
e - Trim Plate Assembly
f - Stator
g - Wear Ring

Mercury Jet Pump Port View



a - Steering Cable Assembly
b - Hull
c - Reverse Gate
d - Water Intake
e - Trim Plate Assembly
f - Forward Stop
g - Rudder

IMPORTANT INFORMATION

Section 1D - Mercury Jet Installation

Table of Contents

General Information 1D-2
- Notice to Installer 1D-2
- Installation Products 1D-3
- Torque Specifications 1D-3

Installation Requirements 1D-3
- Battery/Battery Cables 1D-3
- Boat Construction 1D-4
- Engine Compartment Ventilation 1D-4
- Exhaust System 1D-5
- Fuel Delivery System 1D-5
- Instrumentation 1D-6
- Wiring Diagrams 1D-7
- Remote Control and Cables 1D-8
- Steering Helm and Cable 1D-9

Mercury Jet Drive Hull Dimensions 1D-10

Installing Jet Pump 1D-12
- Hull Cutout 1D-12
- Steering Cable Adjustment 1D-16
- Shift Cable Adjustment 1D-19

Bilge Siphon Feature 1D-22
- Installing Bilge Siphon 1D-22

Water By-Pass System 1D-23
- Installation of Flushing Kit 1D-25
- Operation Instructions 1D-26
- Suggested Flushing Intervals 1D-27

Installing Powerhead 1D-28
- Battery Connection 1D-30

Throttle Cable 1D-31
- Installation 1D-31

Oil Injection Set-Up 1D-33
- Filling 1D-33
- Priming the Oil Injection Pump 1D-34
- Purging Air From the Engine Oil Tank . . . 1D-34

Trim Plate Adjustment 1D-35

Muffler Installation 1D-36

Pre-delivery Inspection 1D-37

General Information

Notice to Installer

Throughout this publication, “Warnings” and “Cautions” (accompanied by the International Hazard Symbol) are used to alert the installer 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.

⚠ 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.

IMPORTANT: Indicates information or instructions that are necessary for proper installation and/or operation.

This installation manual has been written and published by the service department of Mercury Marine to aid installers when installing the products described herein.

It is assumed that these personnel are familiar with the installation procedures of these products, or like or similar products manufactured and marketed by Mercury Marine. Also, that they have been trained in the recommended installation 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 marine trade of all conceivable procedures by which an installation 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 an installation procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product’s safety will be endangered by the installation procedure selected.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at time of publication. As required, revisions to this manual will be sent to all OEM boat companies.

Installation Products

Loctite 242	92-809821
Loctite 271	92-809820
Liquid Neoprene	92-25711--2
Dielectric Grease	92-823506--1
Perfect Seal	92-34227--1
Special Lube 101	92-13872A1

Torque Specifications

NOTE: *Tighten all fasteners, not listed, securely.*

10 mm Fasteners (Powerhead to Pump)	35 lb. ft. (47 N·m)
Reverse Stop Screw	120 lb. in. (14 N·m)
Forward Stop Screw	120 lb. in. (14 N·m)
Ride Plate-to-Pump Screws	75 lb. in. (8.5 N·m)
Pump Cover to Pump Housing Nuts	35 lb. ft. (47 N·m)

Installation Requirements

IMPORTANT: The M^2 Jet Drive is considered an INBOARD engine. The boat it is installed in must meet industry standards (ABYC, NMMA, etc.), federal standards and Coast Guard regulations for INBOARD engine installations

Battery/Battery Cables

IMPORTANT: Boating industry standards (ABYC, NMMA, etc.), federal standards and Coast Guard regulations must be adhered to when installing battery. Be sure battery cable installation meets the pull test requirements and that positive battery terminal is properly insulated in accordance with regulations.

IMPORTANT: Engine electrical system is negative (–) ground. It is recommended (required in some states) that battery be installed in an enclosed case. Refer to regulations for your area.

1. Select a battery that meets all of the following specifications:
   a. 12-volt marine type.
   b. 1000 Marine Cranking Amps (MCA) or
      750 Cold Cranking Amps (CCA) minimum.
   c. Reserve capacity rating of at least 105 minutes.
2. Select proper size positive (+) and negative (–) battery cables using chart. Battery should be located as close to engine as possible.

IMPORTANT: Terminals must be soldered to cable ends to ensure good electrical contact. Use electrical grade (resin flux) solder only. Do not use acid flux solder, as it may cause corrosion and a subsequent failure.

Cable Length	Cable Gauge
Up to 3-1/2 ft. (1.1 m)	4 (25mm^2)
3-1/2 - 6 ft. (1.1-1.8 m)	2 (35mm^2)
6 - 7-1/2 ft. (1.8-2.3 m)	1 (50mm^2)
7-1/2 - 9-1/2 ft. (2.3-2.9 m)	0 (50mm^2)
9-1/2 - 12 ft. (2.9-3.7 m)	00 (70mm^2)
12 - 15 ft. (3.7-4.6 m)	000 (95mm^2)
15 - 19 ft. (4.6 - 5.8 m)	0000 (120mm^2)

Boat Construction

IMPORTANT: All applicable U.S. Coast Guard regulations for INBOARD engines must be complied with, when constructing engine compartment.

Care must be exercised in the design and construction of the engine compartment. Seams must be located so that any rain water or splash, which may leak through the seams, is directed away from the engine and its air intake. Also, the passenger compartment drainage system should not be routed directly to the engine compartment. **Water that runs on or is splashed in the carburetor cover may enter the engine and cause serious damage to internal engine parts.**

IMPORTANT: Mercury Marine will not honor any warranty claim for engine damage as a result of water entry.

Engine Compartment Ventilation

Engine compartment must be designed to provide a sufficient volume of air for engine breathing and also must vent off any fumes in engine compartment in accordance with industry standards (ABYC, NMMA, etc.), federal standards and U.S. Coast Guard regulations for inboard engines. Pressure differential (outside engine compartment versus inside engine compartment) should not exceed 2 in. (51mm) of water (measured with a manometer) at maximum air flow rate.

Engine Compartment Specifications		
Model	Engine Air Requirements at Wide Open Throttle	Physical Engine Volume*
200 Optimax	508 ft.^{3}/min. (0.240 m^3/sec.)	1.41 ft.^{3} (40.4 L)

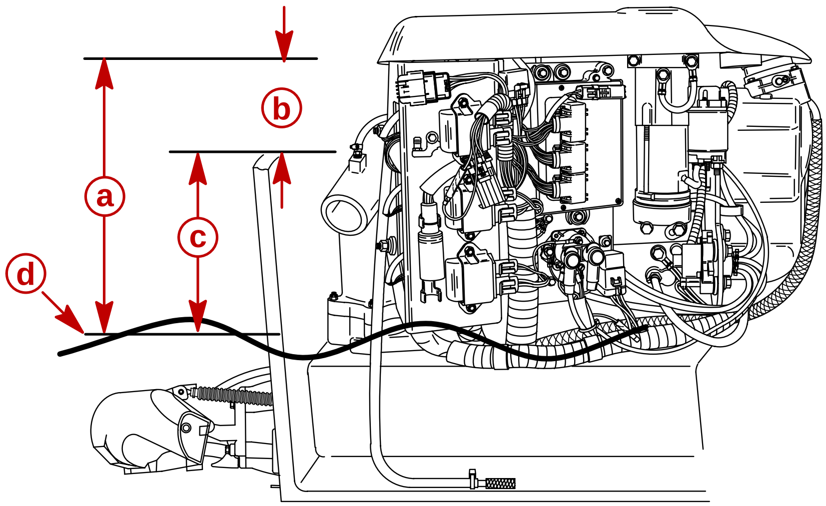
* Physical engine volume is used in flotation calculations and is representative of the amount of flotation the engine provides.

For serviceability, it is recommended that an additional 6 inches minimum (152 mm) (per side) of clearance be allowed between powerhead and engine compartment walls.

Exhaust System

IMPORTANT: It is the responsibility of the boat manufacturer, or installing dealer, to properly locate the engine. Improper installation may allow water to enter the expansion chamber and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by Mercury Marine Limited Warranty, unless this damage is the result of defective part(s).

The engine must be properly located to ensure that water will not enter the engine through the exhaust system. Determine the correct engine height by taking measurements (a) and (b), with boat at rest in the water and maximum load aboard. Subtract (b) from (a) to find (c). If (c) is less than specified in chart, boat construction must be altered to properly lower waterline relative to exhaust chamber.



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a - From Waterline to Top of Transom
b - From Highest Point on Expansion Chamber to Top of Transom
c - (a) minus (b) = (c)
d - Waterline at Rest (at Maximum Load)

Model	c = (a) minus (b)
Jet Drive	(c) must be 8 in. (203 mm) or more.

Fuel Delivery System

⚠ WARNING

Boating standards (NMMA, ABYC, etc.), federal standards and U. S. Coast Guard regulations for INBOARD engines must be adhered to when installing fuel delivery system. Failure to comply could result in severe personal injury or death.

⚠ CAUTION

Remove plastic plug from fuel inlet fitting. Attach fuel line to fuel fitting with U.S. Coast Guard approved hose clamp. Inspect for fuel leaks.

1. Fuel pickup should be at least 1 in. (25 mm) from the bottom of the fuel tank to prevent picking up impurities.
2. Fuel lines used must be U.S. Coast Guard approved (USCG type A1), <u>fittings and lines must not be smaller than 5/16 in. (8 mm) I.D.</u>

3. On installations requiring long lines or numerous fittings, larger size lines should be used.
4. Fuel line should be installed free of stress and firmly secured to prevent vibration and/or chafing.
5. Sharp bends in fuel line should be avoided.
6. A flexible fuel line must be used to connect fuel line to engine fuel pump to absorb deflection when engine is running.
7. A primer bulb is not necessary with this application. If a primer bulb is used, it must be U.S. Coast Guard approved for inboard engine installations.
8. Vapor separator must be vented to fuel tank. Vent hose must comply with U.S. Coast Guard/ABYC regulations.

Instrumentation

⚠ CAUTION

If a fused accessory panel is to be used, it is recommended that a separate circuit (properly fused) be used from the battery to the fuse panel with sufficient wire size to handle the intended current load.

NOTE: *The charging system on this engine is capable of producing 60 amperes maximum at the alternator and 38 amperes maximum charge @ 2000 RPM at the battery. The electrical load of the boat should not exceed this capacity.*

We recommend the use of Quicksilver Instrumentation and Wiring Harness(es). Refer to “Quicksilver Accessories Guide” for selection.

If other than Quicksilver electrical accessories are to be used, it is good practice to use waterproof ignition components (ignition switch, lanyard stop switch, etc.). A typical jet boat of this nature will see water splashed on these components. Therefore, precautions must be taken to avoid ignition failure due to shorting out of ignition components.

⚠ WARNING

Sudden stopping of engine (shorting ignition components) while boat is underway will cause loss of steering control due to loss of thrust. This loss of steering control may cause property damage, personal injury or death.

A warning horn must be incorporated in the wiring harness (see wiring diagram) to alert the user of an overheat, low oil condition or oil pump failure.

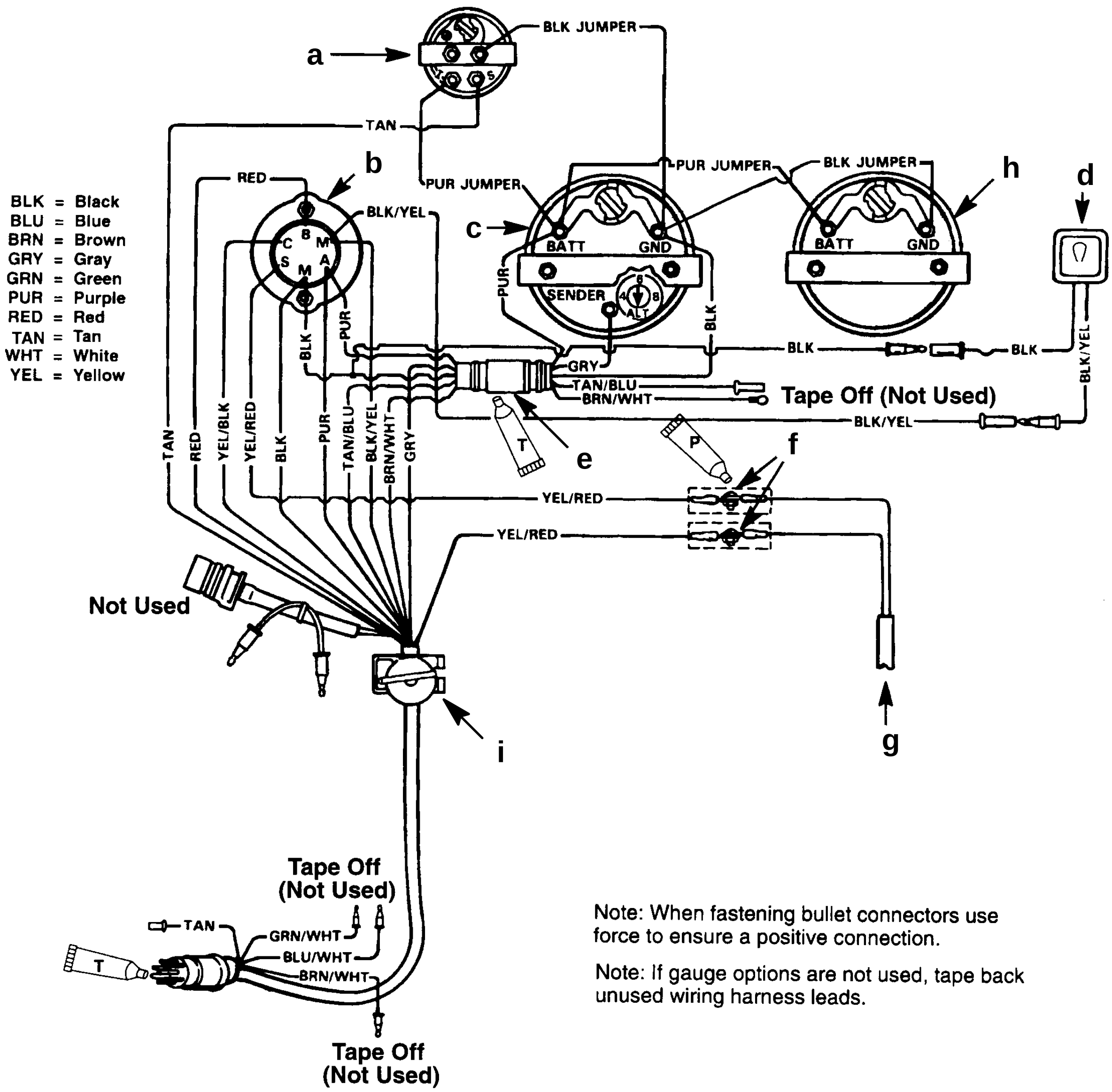
IMPORTANT: If a warning horn system is not installed by the boat manufacturer, Mercury Marine will not honor any warranty claims for engine damage as a result of overheating or lack of engine oil.

Route instrumentation wiring harness back to engine, making sure that harness does not rub or get pinched. If an extension harness is required, be sure to secure connection properly. Fasten harness(es) to boat at least every 18 in. (460 mm), using appropriate fasteners.

Wiring Diagrams

QUICKSILVER INSTRUMENTATION, TYPICAL INSTALLATION SHOWN

NOTE: *Refer to gauge manufacturer's instructions for specific connections.*



a - Temperature Gauge
b - Key Switch
c - Tachometer Gauge
d - Emergency Stop Switch
e - Tachometer Harness (P/N 84-86396A8) (Not Included With Key/Choke Harness Kit)
f - Connect Wires Together With Screw and Hex Nut (2 Places) Apply Quicksilver Liquid Neoprene to Connections and Slide Rubber Sleeve Over Each Connection.
g - To Neutral Start Safety Switch In Remote Control Box
h - Speedometer Gauge
i - Overheat/low oil horn

P Liquid Neoprene (92-25711--2)

T Dielectric Grease (92-823506--1)

Remote Control and Cables

The remote control must provide the following required features:

- Start-in-gear protection
- Neutral rpm limit at 2,000 rpm
  Note: This applies to dual lever remote controls as well as single lever remote controls.
- High strength mechanism to accommodate loads transmitted to the remote control
- Shift cable travel of 3 inches ± 1/8 inch (76 mm ± 3 mm)
- Ability to use 40 series shift cable

The remote control must meet the above criteria as well as the design criteria outlined in the ABYC manual pertaining to Mini-Jet Boats (Standard P-23).

SHIFT CABLE

The shift cable to be used MUST MEET the following criteria:

- 40-Series Cable
- 40 Series bulkhead fitting at output end
- Allow for a minimum of 3 inches (76 mm) of travel.
- A means of attaching and locking the cable to the shift cable bracket (provided).
- Cable end at pump must allow for a 1/4 inch clevis pin and cotter pin (all provided) to connect cable to the reverse gate.
- Protected against water intrusion and/or corrosion as the cable end (at the pump) is submersed in water with the boat at rest.

The shift cable end (at the pump) is submersed in water. It should be sealed against water intrusion, protected against corrosion and be able to withstand the shift loads imparted on it by the reverse gate.

Follow shift cable adjustment procedure for proper adjustment.

THROTTLE CABLE

The throttle cable must have one end compatible with the control box. The other end must have Mercury style connectors.

Follow throttle cable adjustment procedures for proper adjustment.

Steering Helm and Cable

STEERING HELM

The steering helm must limit steering cable travel to 3.50 ± .10 inches (88.9 ± 2.5 mm).

⚠ WARNING

Failure to limit steering cable travel at the helm could pre-load the cable resulting in premature failure of a steering component causing loss of steering. This loss of steering could cause property damage, personal injury or death.

STEERING CABLE

The steering cable to be used MUST MEET the following criteria:

- 60 Series Steering Cable
- 60 Series bulkhead fitting at output end
- Allow for a minimum of 3.75 inches (95.3 mm) of travel.
- Cable end at pump must allow for a 5/16 in. threaded adaptor shouldered thru-bolt and lock nut to connect the cable to the steering arm.
- A means of attaching and locking the cable to the steering cable bracket (provided).
- Protected against water intrusion and/or corrosion as the cable end (at the pump) is submersed in water with the boat at rest.
- The steering cable should be able to withstand the steering loads imparted on it by the rudder.

A locking tab is provided by Mercury to be used with the steering cable having threads and locknuts located 11.31 inches (287 mm) from cable end at pump with cable at center of travel.

Follow steering cable adjustment procedure for proper adjustment.

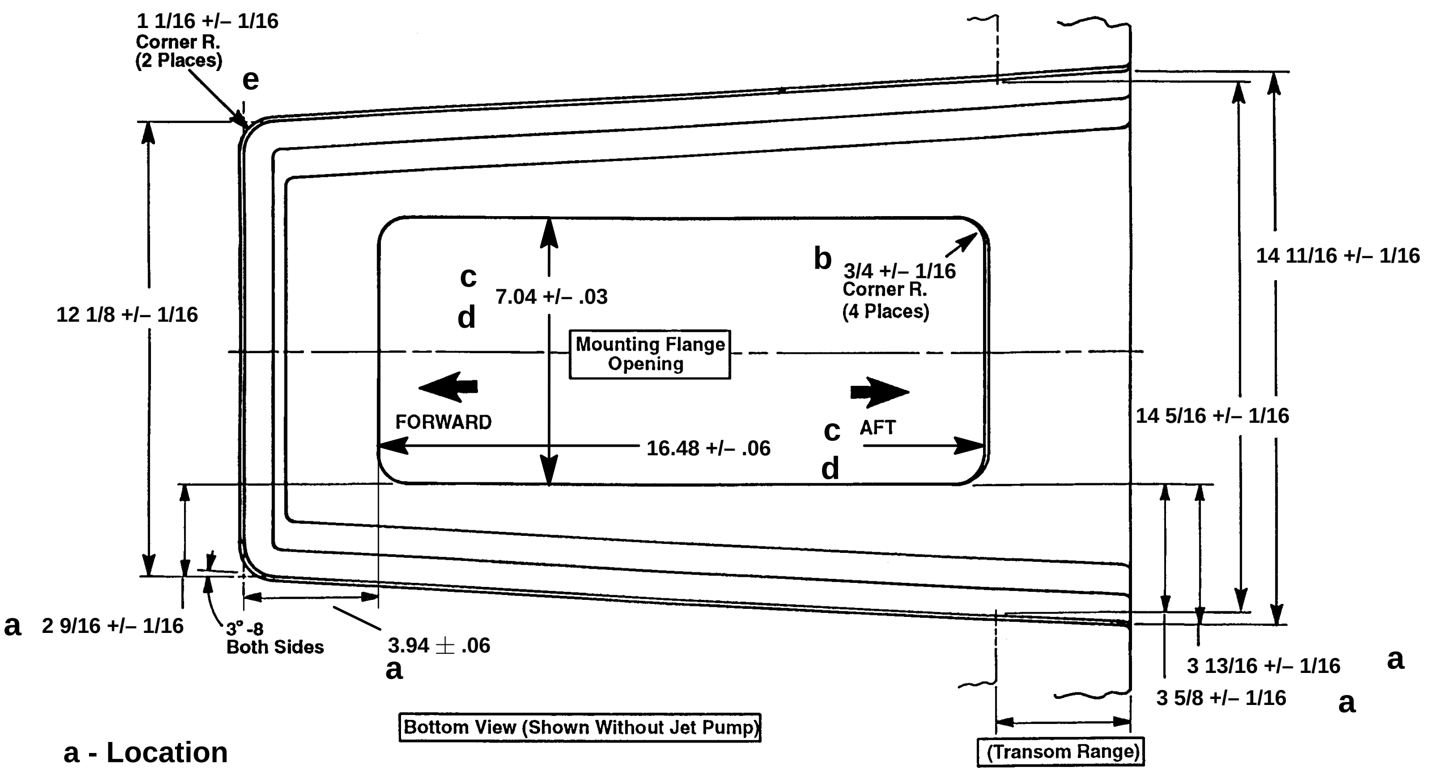
Mercury Jet Drive Hull Dimensions

HULL OPENING

The pump to powerhead opening in the hull is the most important factor to consider in a Jet Drive installation. There are three areas of concern:

1. Location (a) of the pump to powerhead hull opening relative to the boat bottom for proper ride plate seal fit.
2. Dimensional control of the opening - corner radii (b), straightness (c) and size (d) for proper grommet installation, and corner radii (e) for ride plate seal fit.
3. Flatness and thickness of the area around the hull opening for proper grommet sealing (see drawing on next page).
4. The hull opening must have a 0.125 inch radius on both the top and bottom corners all around the opening.

Tunnel Dimensions (in inches)



a - Location
b and e – Corner Radii
c and d - Size and Straightness

METHOD FOR CONTROLLING LOCATION AND SIZE

Mercury Marine recommends that the tunnel opening be done as a part of the manufacture of the tunnel. This will ensure consistency of location as well as size.

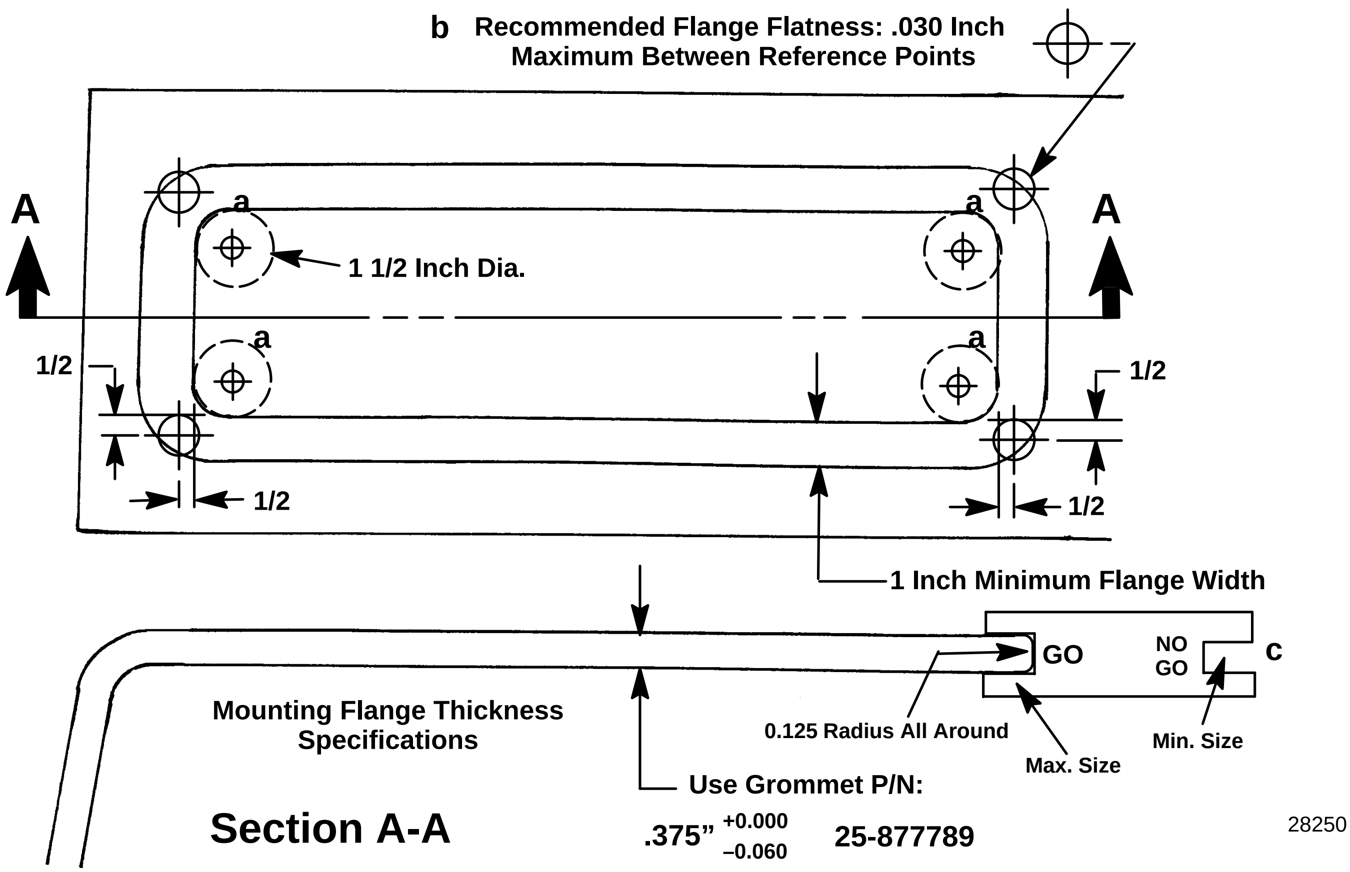
CHECKING MOUNTING FLANGE THICKNESS AND FLATNESS

Use a flat plate that will contact the flange at the reference points (b) and a .030 in. feeler gauge to check flatness.

Additional sanding and / or resin / filler may be required to maintain the flatness specification.

A simple slotted go / no go gauge (c) will check the flange thickness.

Preferred Method: Mold in shape, then route to 0.125” radius.



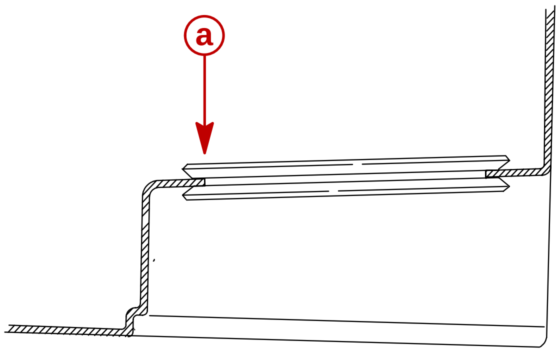
a - Location Pins in Hull Mold
b - Flange Flatness Specification
c - Go – No Go Gauge for Thickness

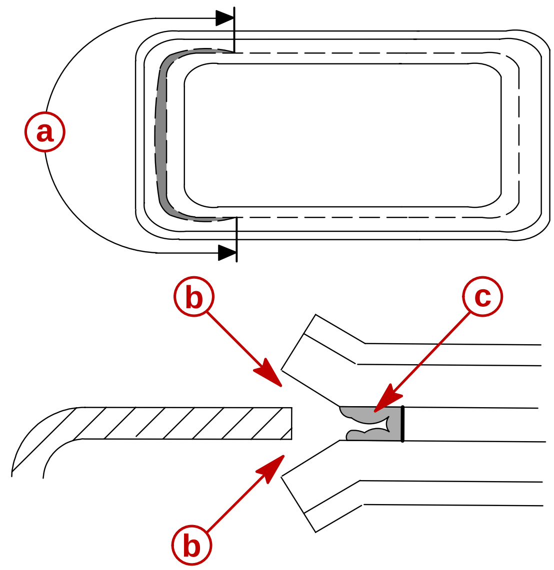
Installing Jet Pump

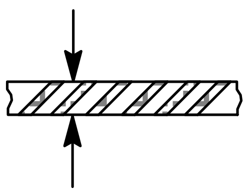
Hull Cutout

> **⚠ CAUTION**
>
> **The hull cutout dimensions are critical for proper sealing between Jet Pump and boat. Measure cutout thickness and overall dimensions before attempting a Jet Pump installation.**

1. Install tunnel grommet in cut-out of boat by gluing front portion of grommet to tunnel with Loctite 454 or equivalent. Avoid gluing flexible sealing lips to tunnel.







CUTOUT THICKNESS

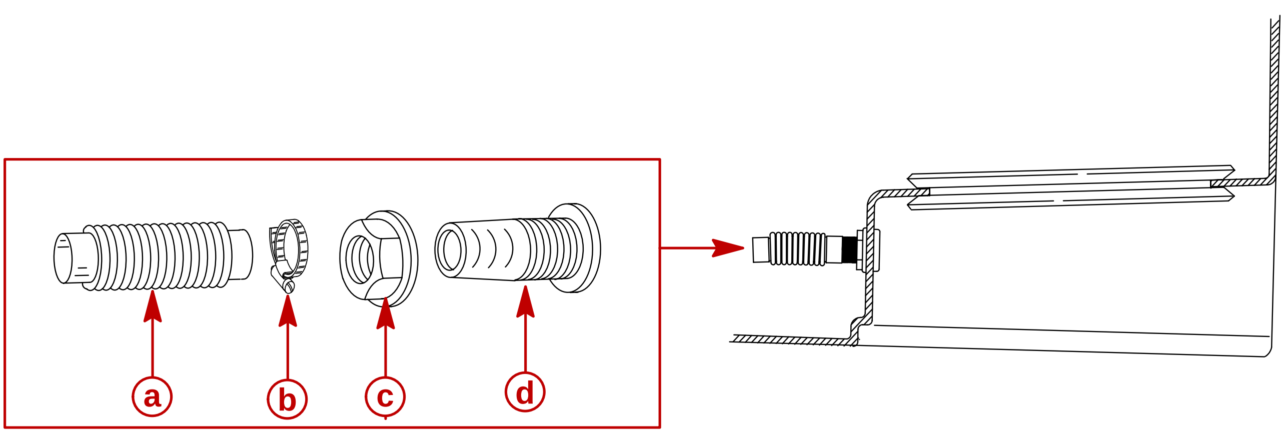
.375” $^{+0.050}_{-0.030}$

Use Grommet P/N:

25-877789

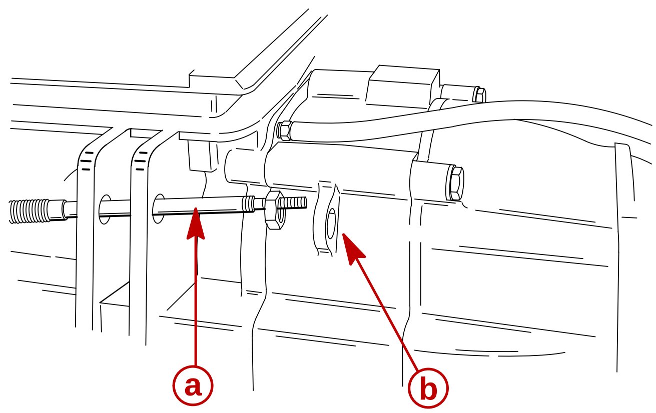
a - Glue Front Portion of Grommet
b - Avoid Gluing Flexible Sealing Lips to Tunnel
c - Loctite 454

2. Install steering and shift through hull bellows assemblies. Tighten securely.



a - Bellows
b - Clamp
c - Nut
d - Through Hull Fitting

3. Route steering cable through the through hull fitting and bellows. Route cable through the port side hole in flange of pump housing. Install nut on cable before routing cable through wear ring.



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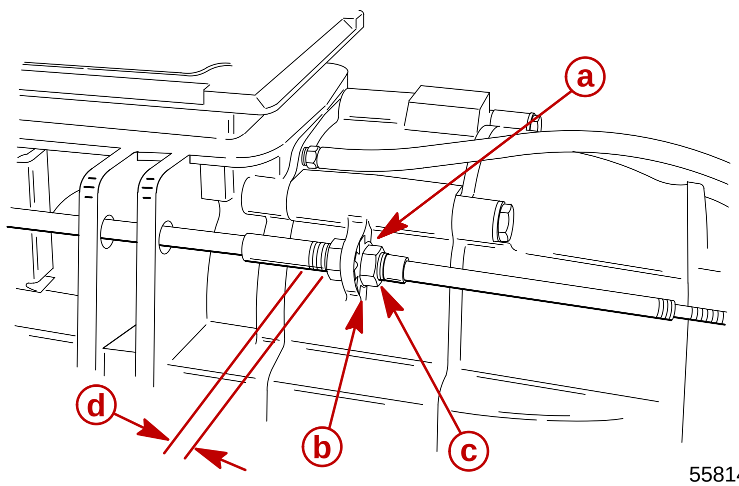
a - Shift Cable
b - Wear Ring

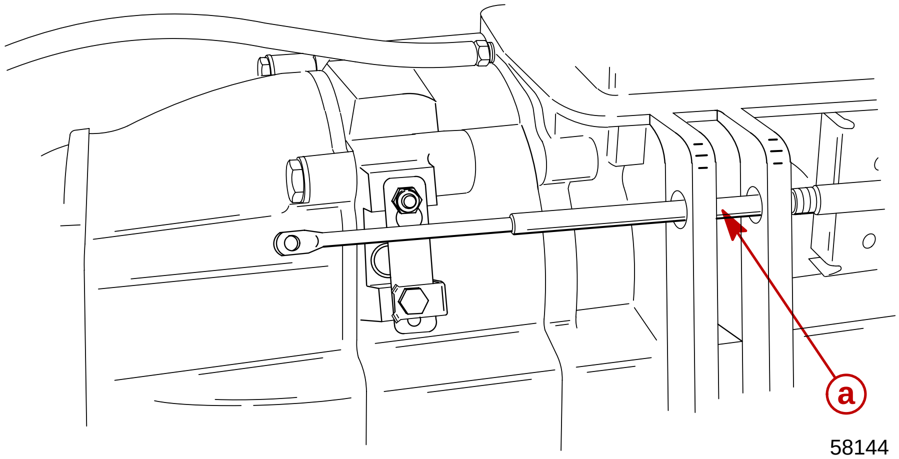
4. Install tab washer and nut on cable after guiding through wear ring. Locate tab washer in tab hole. Coarse cable adjustment is made using these nuts. Do not tighten until after final steering adjustment is made.



558143

a - Tab Hole
b - Nut
c - Tab Washer
d - 0.25 in. (6.4mm)

5. Route shift cable through the through hull fitting and bellows. Route cable through the starboard side hole in flange of pump housing.

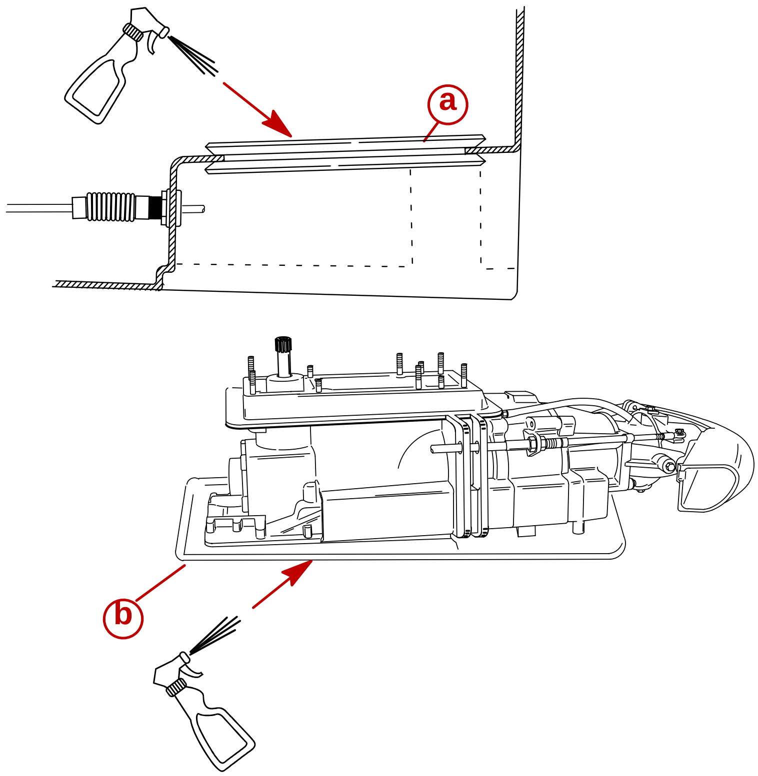


a - Shift Cable

IMPORTANT: Ensure that the shift lever in the control box is set for three (3) inches of travel.

NOTE: *It is easier to adjust the shift and steering cables before installing pump unit in boat.*

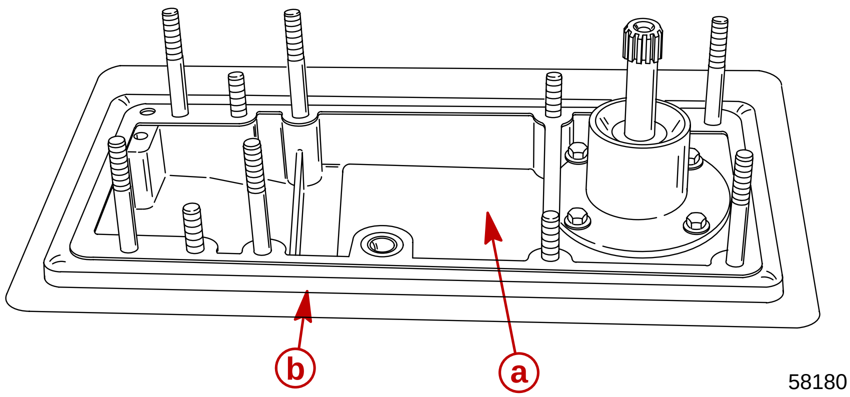
6. Spray soapy water on inside surface of tunnel grommet and ride plate seal.



a - Tunnel Grommet
b - Ride Plate Seal

NOTE: *When installing pump in tunnel, be sure cables are below tunnel grommet flange on pump to prevent pinching of cables between pump and boat.*

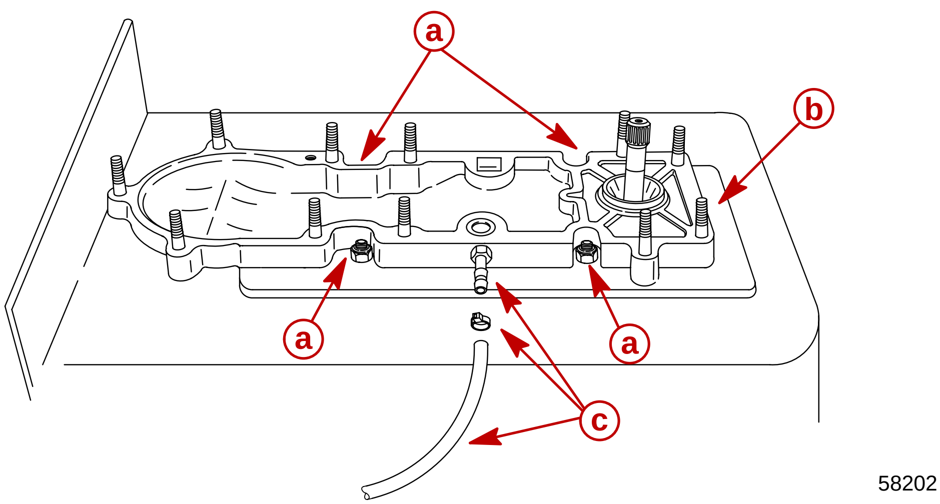
7. Install jet pump (a) by pushing unit through opening in tunnel grommet (b). Ride plate seal should fit snug in boat tunnel without any gaps along perimeter.



a - Jet Pump
b - Tunnel Grommet

NOTE: *Before torquing fasteners, check ride plate seal for proper fit in tunnel.*

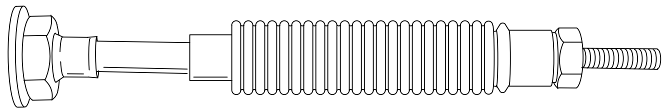
8. Install gasket, o-ring, and cover on jet pump. Align holes in cover with studs in housing and secure with four (4) M10 x 1.5 nuts. Check ride plate seal for proper fit in tunnel and torque housing cover nuts to 35 lb. ft. (47 N·m).
9. Check steering and shift cables for freedom of movement. Correct installation if cables are pinched.
10. Attach flush hose to fitting and secure with hose clamp. Failure to secure hose will allow water to fill boat.



a - M10x1.5 Nuts (4)
b - Cover and Gasket
c - Attach Flush Hose to Fitting with Hose Clamp

Steering Cable Adjustment

1. Slide bellows assembly over cable and thread on cable completely. Do not tighten.
2. Route cable through hull fitting after routing through bellows



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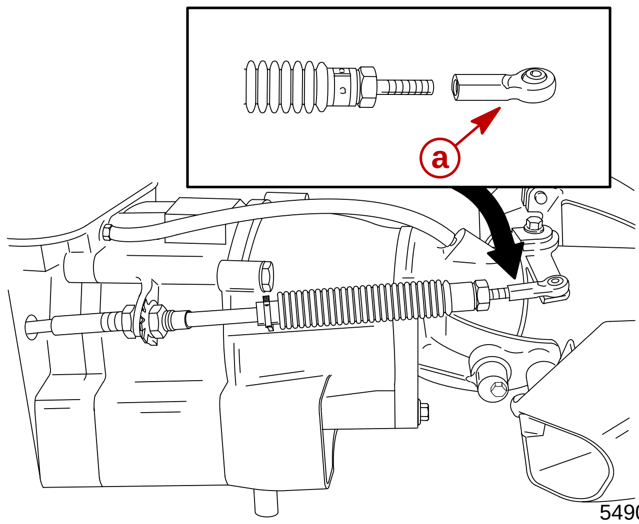
3. Thread cable end adaptor (a) on steering cable 14 turns (to allow for adjustment).

WARNING

Cable end adaptor must be installed a minimum of nine (9) turns. Failure to install cable end adaptor on steering cable a minimum of nine (9) turns could result in loss of steering control of boat, personal injury, or death.

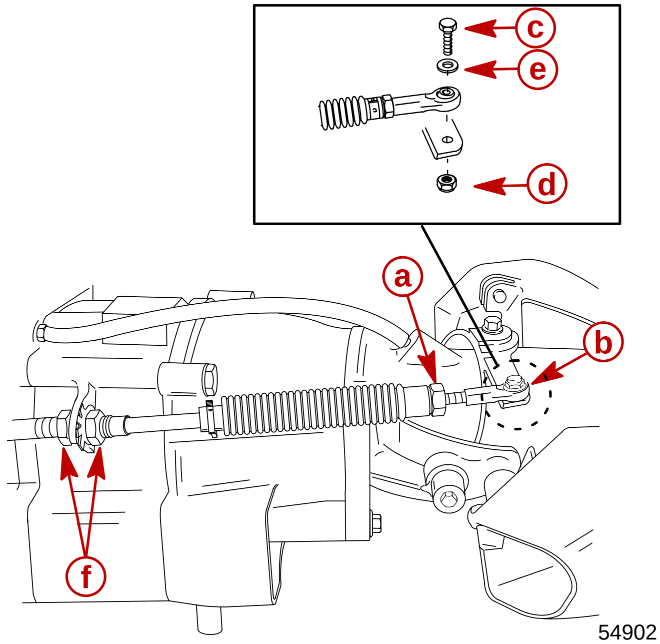


54902

a - Cable End Adaptor

4. Center rudder assembly on nozzle.
5. Center steering wheel by turning wheel lock to lock and positioning wheel midway between locks.

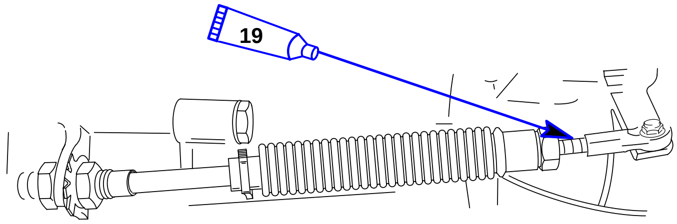
6. Adjust cable end adaptor until thru-hole in adaptor lines up with threaded hole in steering arm (b). This is the steering cable fine adjustment. Cable end adaptor **MUST** be installed on steering cable a minimum of nine (9) turns.
7. Attach steering cable to steering arm with bolt, washer and locknut. Torque nut to 70 lb. in. (7.9 N·m).



a - Bellows Nut
b - Steering Arm
c - Bolt
d - Lock Nut
e - Flat Washer
f - Cable Nuts

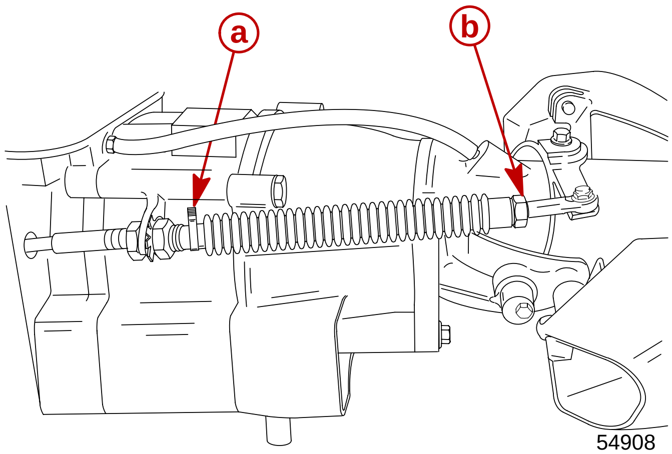
8. Tighten cable nuts (f).
9. Check steering adjustment to ensure that the helm limits cable travel for maximum left and right turns. Correct if required.
10. Secure cable nut with tab washer by bending a tab over flat of hex nut.

11. Apply perfect seal (92-34227-1) to end threads and cable conduit end.



19 Perfect Seal (92-34227-1)

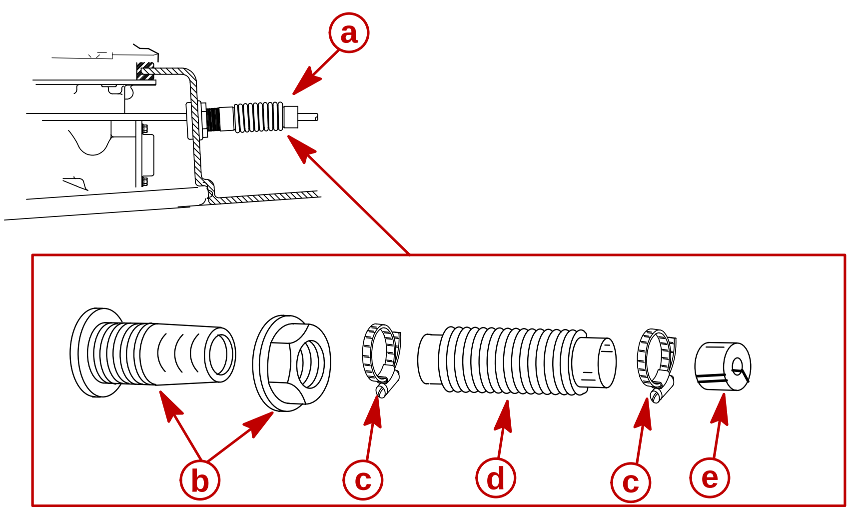
12. Turn bellows nut out and tighten against cable end adaptor.



a - Bellows Clamp
b - Bellows Nut Tight Against Jam Nut

13. Turn rudder to port to compress bellows as much as possible. Pull bellows over cable conduit and secure with bellows clamp.

14. Secure bellows to fitting with clamp. Slide slit adaptor (e) over cable and push into bellows. Secure with clamp (c).

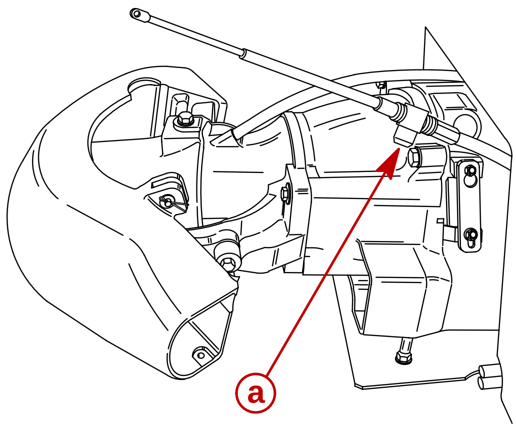


a - Steering Cable, Thru-Hull Fitting, and Bellows Assembly
b - Thru-Hull Fitting and Nut
c - Clamp
d - Bellows
e - Slit Adaptor

Shift Cable Adjustment

IMPORTANT: The shift cable MUST BE properly adjusted. The shift cable is adjusted so that the reverse gate is not pre-loaded against either the forward or reverse stop. Pre-load in either position may cause failure of the stop and/or premature wear of the shift cable or control box components. It may also cause stiffness of the throttle control.

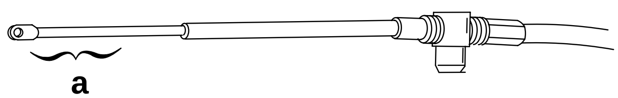
1. Thread the cable barrel onto the shift cable.



a - Cable Barrel

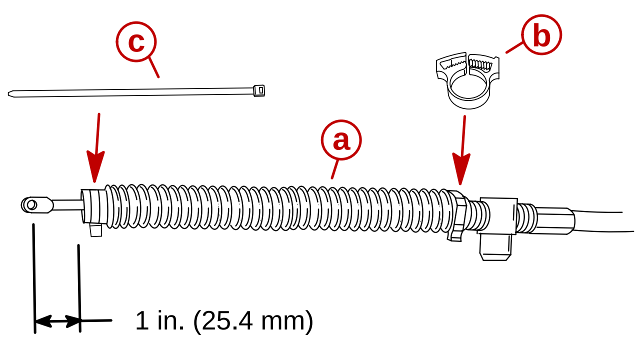
2. Use a de-greaser and clean off all oil film from the area on the shift cable shown.

NOTE: *Removing the oil film from the shift cable is necessary to prevent the bellows from sliding on the cable.*



a - Remove Oil Film From This Area

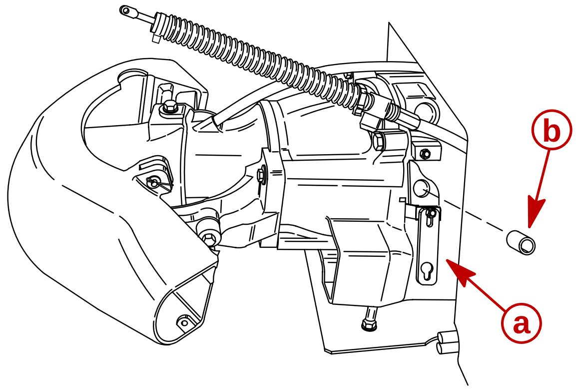
3. Slide the bellows over the shift cable end. Position and install the bellows onto the cable conduit as shown. Fasten ends with clamp and sta-strap.



a - Bellows
b - Clamp
c - Sta-Strap

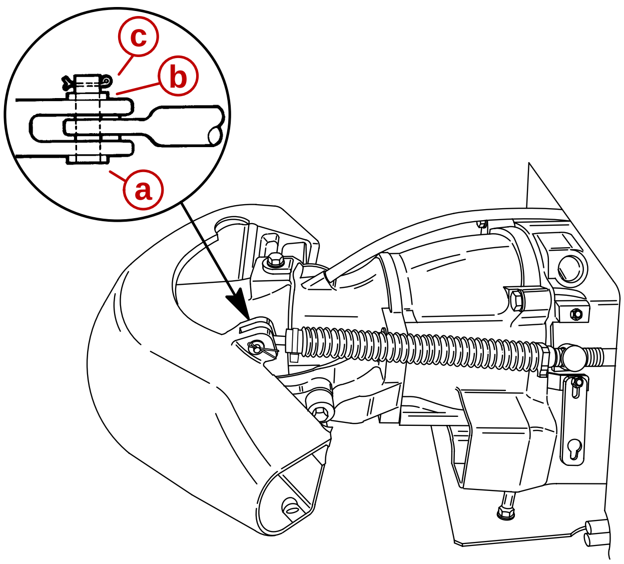
4. Loosen the lock nuts and unfasten the top end of the shift cable retainer.

NOTE: *Locknuts do not have to be removed to open retainer.*



a - Shift Cable Retainer
b - Plastic Barrel Holder

5. Install shift cable end in slot of the reverse gate and secure with clevis pin, flat washer, and cotter pin. Bend over ends of cotter pin.



a - Clevis Pin
b - Flat Washer
c - Cotter Pin

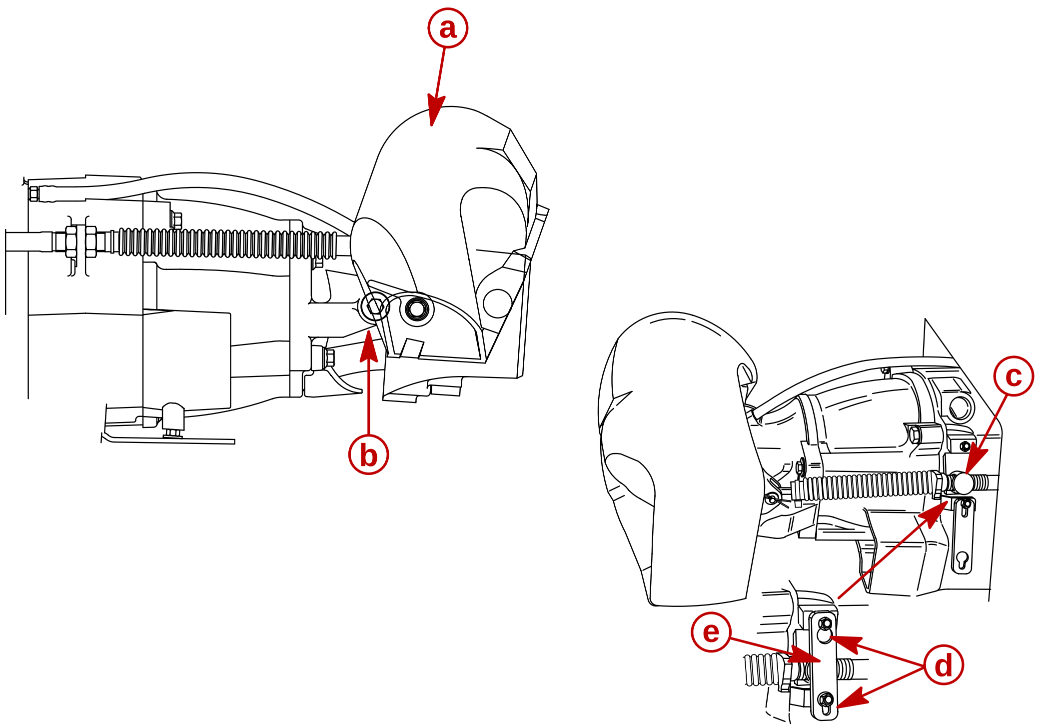
⚠ WARNING

The shift cable must be adjusted correctly so that the reverse gate does not interfere with water flow coming out of the rudder. If the reverse gate hangs down into the water flow, a vibration may be felt in the control box. If this occurs, reduce throttle immediately and readjust the cable. Improper adjustment may result in pump damage including loss of the reverse gate. Failure to properly adjust the shift cable could result in loss of neutral and reverse, property damage, personal injury or death.

6. Adjust shift cable as follows:
   a. Position the control box into forward position.
   b. Position the reverse gate against the forward stop. With the reverse gate at this position, adjust the cable barrel to fit into the barrel holder with slight tension of the reverse gate against the stop.
   c. After adjusting the shift cable, secure the cable barrel in place with the shift cable retainer. Fasten the retainer by tightening both locknuts.

IMPORTANT: The shift cable retainer must be fastened with self locking nylon insert locknuts. These locknuts must never be replaced with common nuts (non locking) as they could vibrate off, freeing the shift cable to disengage.

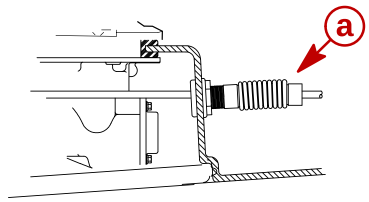
WARNING
Disengagement of the shift cable can result in the boat suddenly shifting into reverse. This unexpected action could cause occupants to be thrown forward in the boat or to be ejected overboard. Serious injury or death could result.



a - Reverse Gate
b - Forward Stop
c - Cable Barrel
d - Locknuts
e - Shift Cable Retainer

7. Adjust the reverse stop (located on starboard side of the nozzle) so that the stop just touches the reverse gate with the control handle in reverse position. Torque reverse stop screw to 120 lb in. (14 N·m)
8. Check shift cable/reverse gate adjustment as follows:
   a. Shift the control box a few times from the forward position to reverse position.
   b. Return the control handle back to forward. Pull back on the reverse gate gently to take slack out of the cable. Check for the 3/8 to 1/2 in. clearance space between the reverse gate and rudder. If necessary, readjust the cable barrel.

9. Seal the thru-hull fitting to prevent any water leaks.



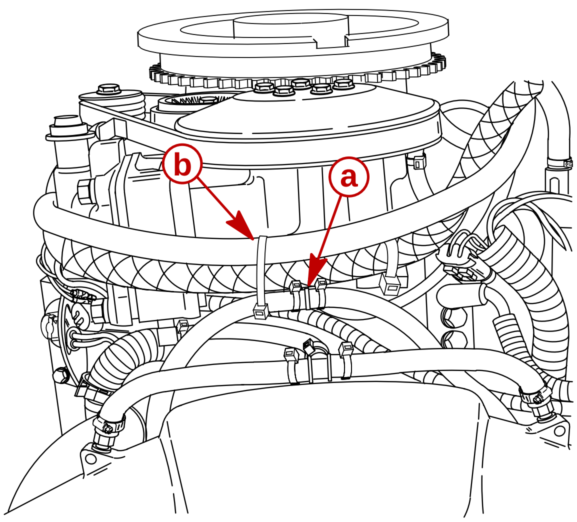
a - Steering Cable Thru-Hull Fitting

Bilge Siphon Feature

The Sport Jet incorporates an automatic bilge siphoning feature. The bilge siphon is working whenever the engine is running above idle speeds. Maximum performance of the bilge siphon is realized above 3,000 rpm. A hose is attached to the jet pump nozzle. The hose is routed to the engine compartment and placed in the bilge. Water exiting the nozzle creates a suction or vacuum in the hose creating the bilge siphon, drawing water out of the boat.

Installing Bilge Siphon

Uncoil siphon hose from exhaust manifold. Place siphon hose in bilge.



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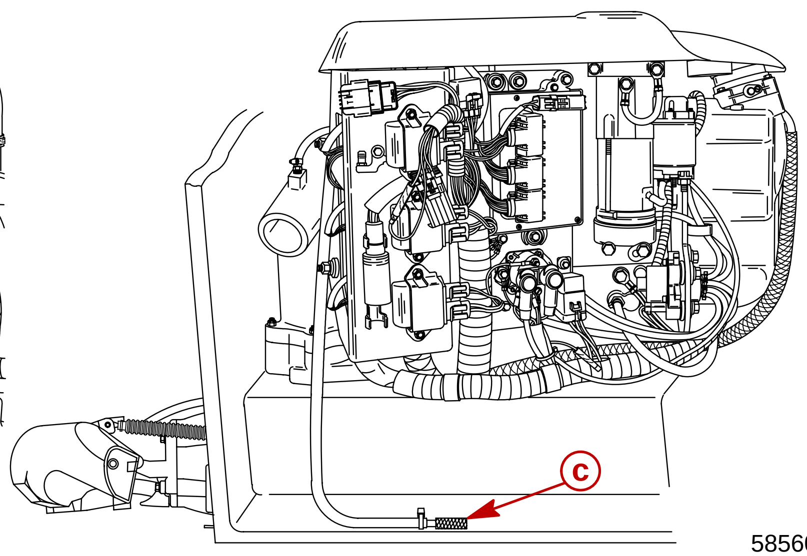

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a - Siphon Break
b - Sta-Strap – Do Not Remove
c - Pick Up Screen

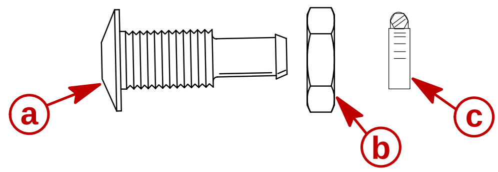
The siphon break must be located above the water line at the highest point (sta-strap). The siphon break has a 0.020 in. hole which must be kept open.

⚠ WARNING
Failure to locate siphon break above the water line and keep hole open could result in water entering the bilge through the siphon system causing property damage, personal injury or death.

Water By-Pass System

The water by-pass system is designed to improve powerhead cooling at idle speed.

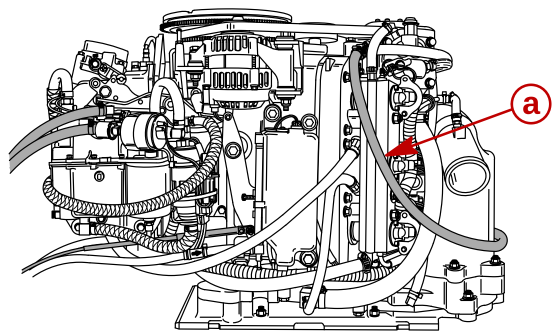
1. Locate the water by-pass components (provided).



a - Thru-Hull Fitting
b - Brass Nut
c - Hose Clamp

IMPORTANT: The thru-hull fitting must be correctly positioned in the boat transom as instructed in Step 3.

2. Cut the sta-strap and uncoil the water by-pass hose.



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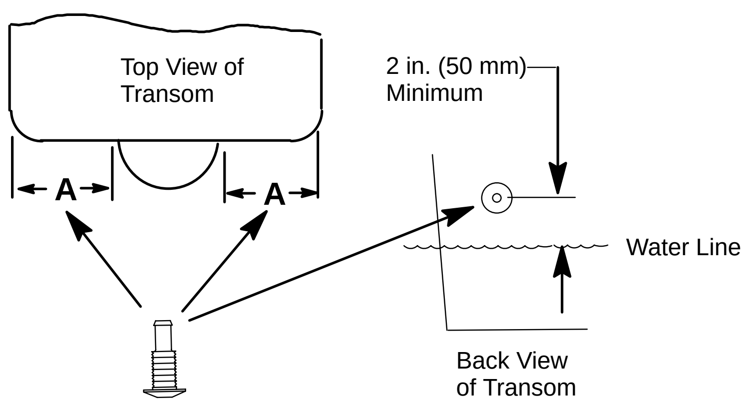
a - Water By-Pass Hose

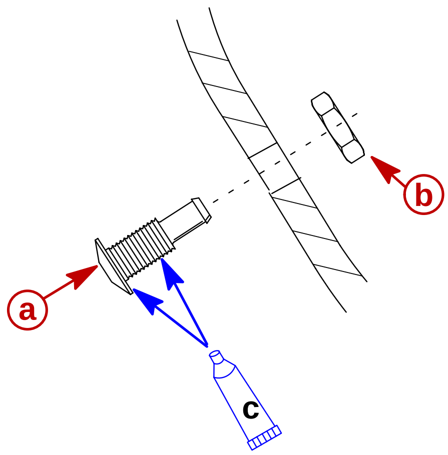
3. Select the mounting location for the thru-hull fitting as follows:



- The thru-hull fitting must be mounted in either side of the transom within the zones marked A.
- The thru-hull fitting must be located a <u>Minimum of 2 in. (50 mm)</u> above the water line when boat is at its maximum load.
- The water by-pass hose must slope down towards the thru-hull fitting at a minimum rate of 1 in. (25 mm) drop per 12 inches (300 mm) of hose.
- The thru-hull fitting should be positioned so the water spray will be pointed downward.

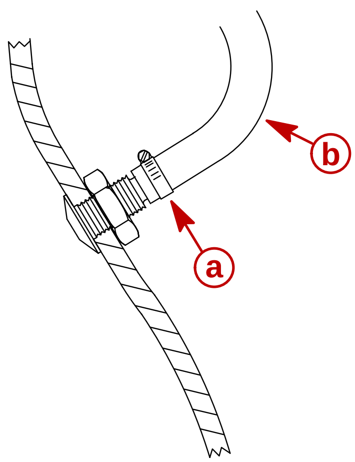
4. After the location has been selected for the thru-hull fitting, drill a 9/16 in. (14.3 mm) dia. hole.

5. Apply Marine Sealer to entire length of threads and under the head of the thru-hull fitting. Fasten the fitting into the transom with the brass nut (provided).



a - Thru-Hull Fitting
b - Brass Nut
c - Marine Sealer

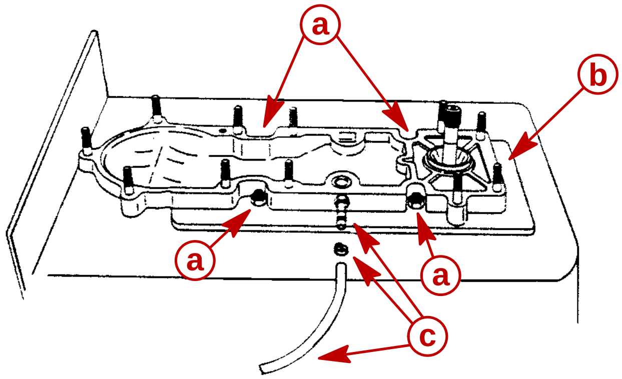
6. Connect the water by-pass hose to the thru-hull fitting with the hose clamp (provided). Make sure the hose slopes at a minimum rate of 1 in. (25 mm) drop per 12 inches (300 mm) of hose.



a - Hose Clamp
b - Water By-Pass Hose

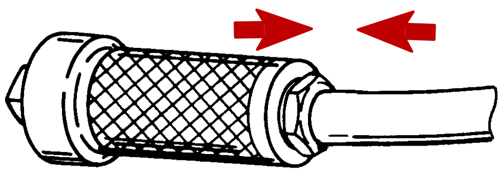
Installation of Flushing Kit

1. Attach flush hose to fitting and secure with hose clamp. Failure to secure hose will allow water to fill boat.



a - M10x1.5 Nuts (4)
b - Cover and Gasket
c - Attach Flush Hose to Fitting with Hose Clamp

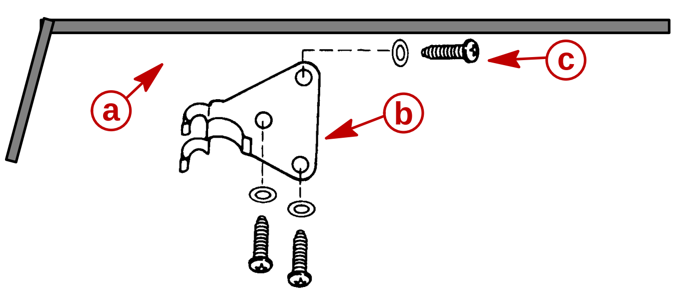
2. Attach one end of hose to flush adapter. Secure with clamp as shown.



⚠ CAUTION
BEFORE mounting flush adapter bracket, route adapter and hose to selected mounting location. Hose routing MUST NOT INTERFERE with throttle and/or control linkage.

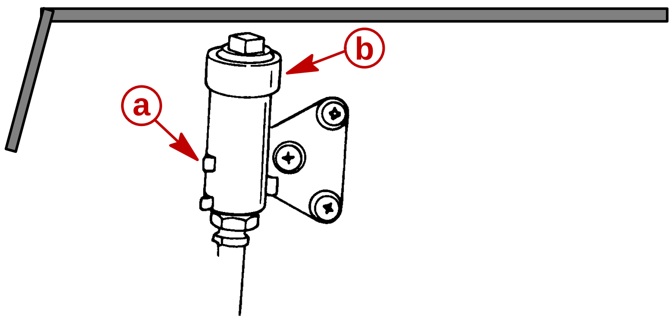
NOTE: *Mount flush adapter bracket in area of motor compartment that has mounting surface thicker than depth of mounting bracket screws.*

3. Locate area (easily accessible) within motor compartment to mount flush adapter bracket. Secure bracket to mounting surface with three screws supplied.



a - Mounting Surface
b - Bracket
c - Screw (3)

4. Snap flush adapter into bracket as shown.

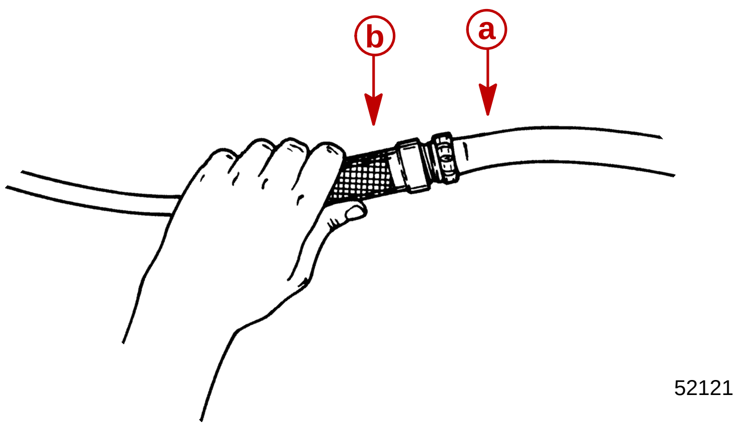


a - Bracket
b - Flush Adapter

Operation Instructions

⚠ WARNING
DO NOT run engine on flushing kit above idle speeds. Damage to engine from over-heating, due to lack of water supply may occur.

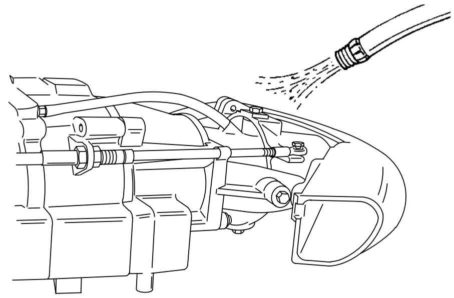
1. With **"engine off"**, remove flush adapter plug and attach water hose.



a - Flush Adapter
b - Water Hose

2. Turn water hose "on" and flush engine block for a minimum of ten minutes.
3. Remove water hose from flush adapter and install adapter plug. Tighten plug securely. Place flush adapter into adapter bracket.

4. Flush outer surfaces of water outlet nozzle.



Suggested Flushing Intervals

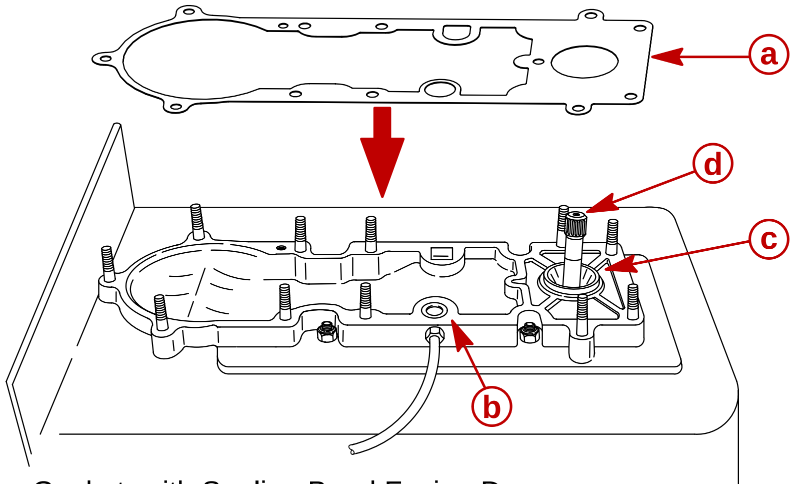
- After running jet in salt water environment
- Where boat was run aground
- Overheat warning horn sounds (May be caused from accumulation of particles/debris in jet powerhead)

⚠ CAUTION

If any of the above conditions are not corrected with normal flushing of engine, it is recommended that the jet be taken to your authorized dealer for service.

Installing Powerhead

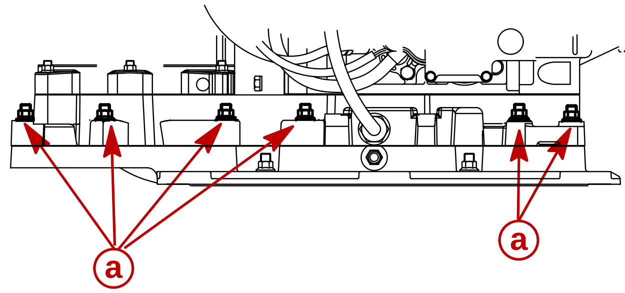
1. Install gasket on drive housing cover. Ensure sealing bead is facing down towards drive housing cover.
2. Install two (2) O-rings.
3. Check that slinger is on drive shaft.
4. Lubricate drive shaft splines with Special Lube 101 (92-13872A-1).

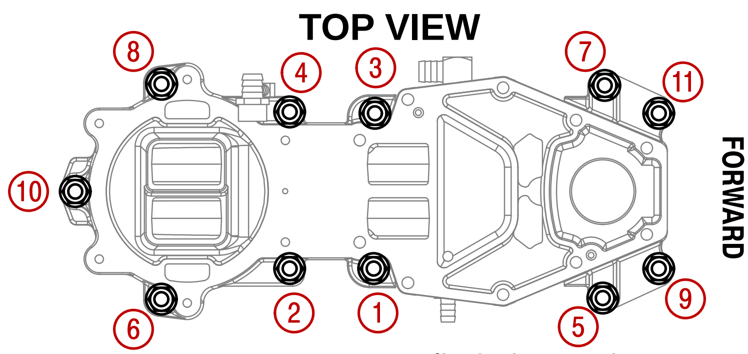


a - Gasket, with Sealing Bead Facing Down
b - Drive Housing Cover O-Ring
c - Drive Shaft O-Ring
d - Lubricate drive shaft splines with Special Lube 101 (92-13872A-1)

5. Lower powerhead on drive housing cover. Align drive shaft splines with crankshaft splines, and powerhead mounting studs with adapter plate holes.

6. Secure powerhead to drive housing cover with eleven (11) M10 x1.5 (a). Torque fasteners to 20 lb. ft. (27 N·m) following the torque sequence given. Repeat torque sequence, torquing fasteners to 35 lb. ft. (47 N·m).

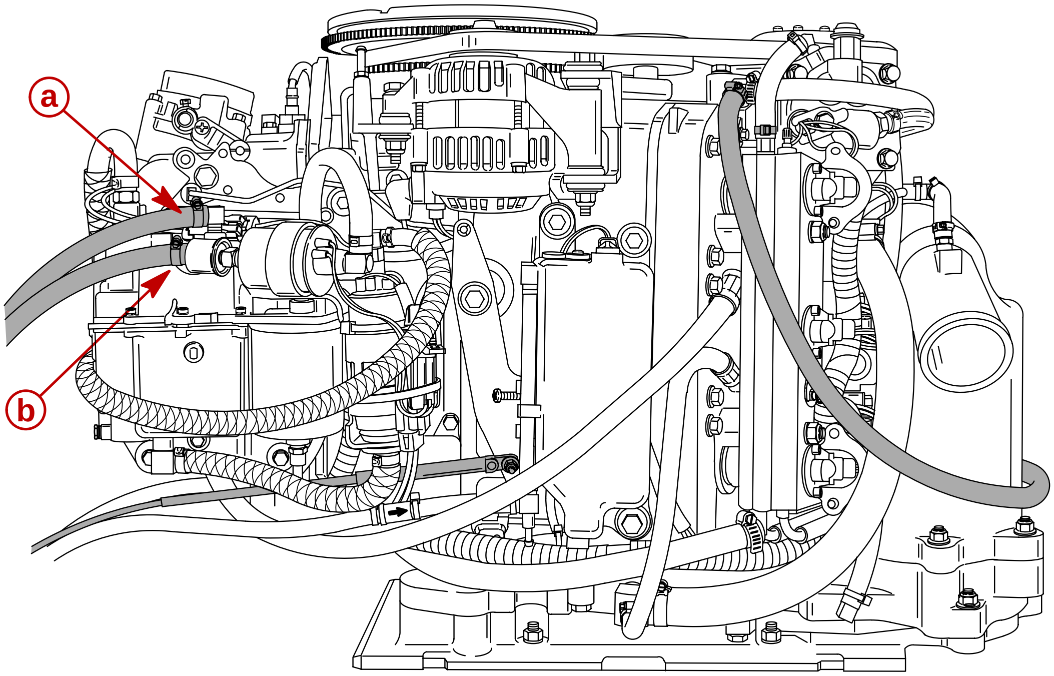




a - M10 x 1.5 Nuts, Torque to 35 lb. ft. (47 N·m)

7. Connect fuel line to fuel inlet fitting, secure with U.S. Coast Guard approved hose clamp (183.532).

8. Vapor separator tank (VST) must be vented to fuel tank. Vent hose must comply with U.S. Coast Guard/ABYC regulations.



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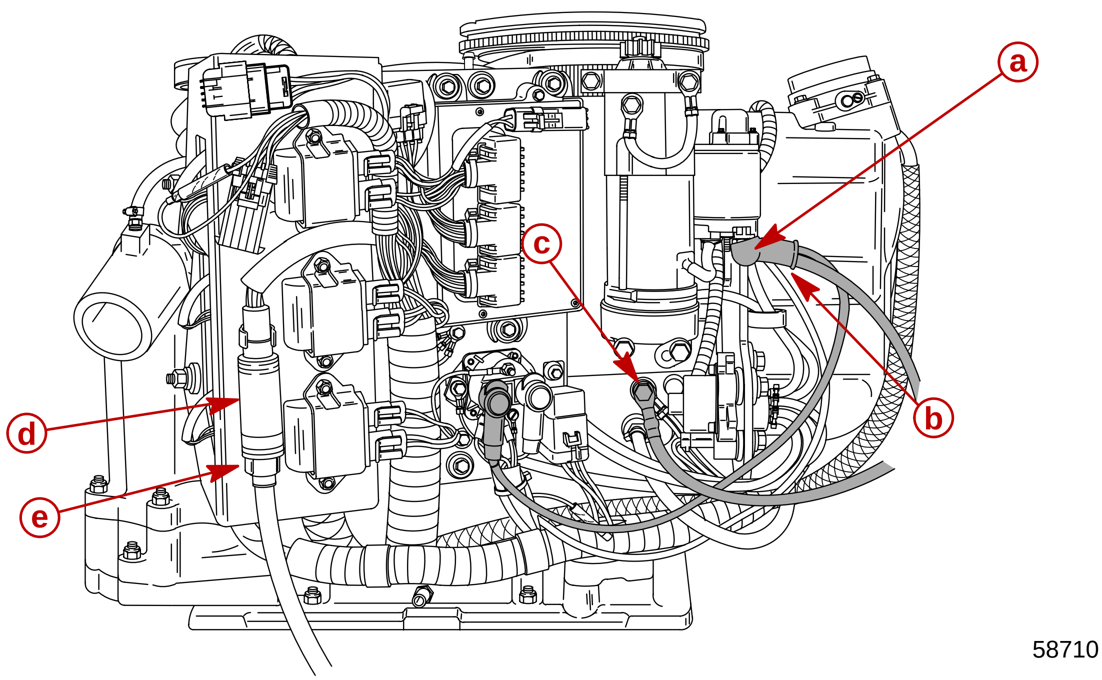
a - VST Vent Hose Fitting
b - Fuel Inlet Fitting

Battery Connection

NOTE: *Engine electrical system is negative (–) ground.*

1. Connect positive (+) battery cable (usually red) to starter solenoid using protective boot (provided).
2. Connect negative (–) battery cable (usually black) to engine ground at forward starter motor bolt (c).
3. Connect battery cables to battery. Make sure that all battery terminal connections are tight; then, spray terminals with a battery connection sealant to help retard corrosion.
4. Attach remote control harness plug to engine harness plug. Reinstall harness plug in clip.

WARNING
U.S. Coast Guard regulation #33 CFR 183.445 requires that the "positive" battery cable connection at the starter solenoid terminal be protected by either a boot ("b" shown following), or protective shield.

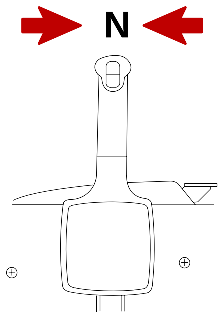


a - Positive Battery Cable Attaching Location
b - Boot Protector for Positive Battery Cable
c - Negative Battery Cable Attaching Location (Engine Ground)
d - Engine Harness Plug
e - Clip

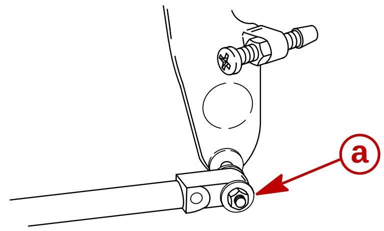
Throttle Cable

Installation

1. Position remote control into neutral.

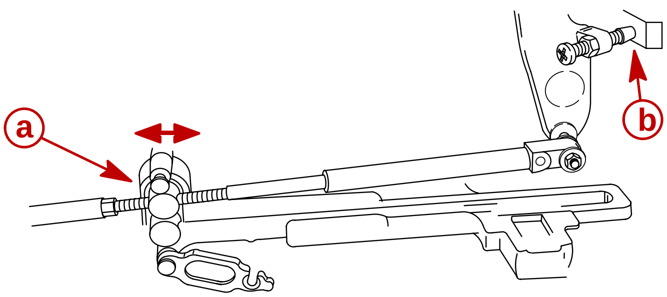


2. Attach throttle cable to the throttle lever. Secure with washer and locknut.



a - Washer and Locknut – Tighten locknut and back off 1/4 turn

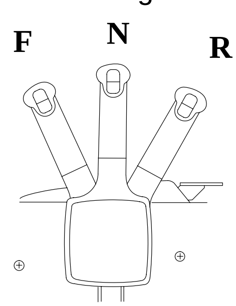
3. Adjust the cable barrel so that the installed throttle cable will hold the idle stop screw against the stop.



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

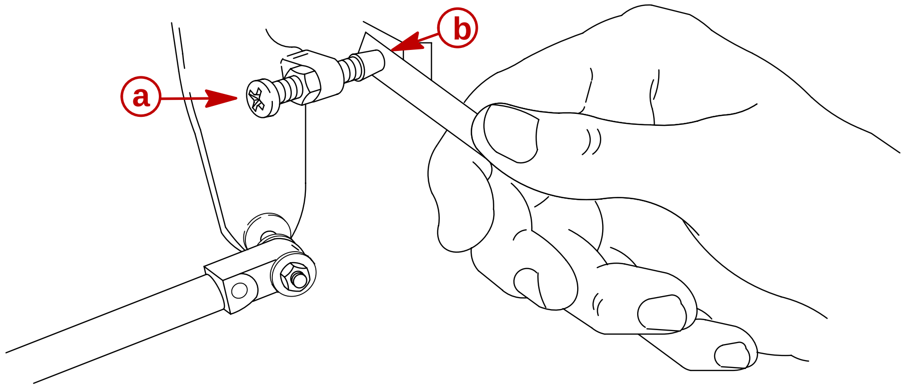
4. Check throttle cable adjustment as follows:

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



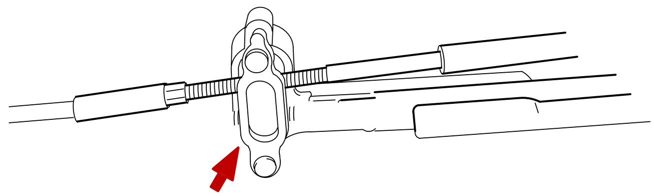
   b. Return remote control to neutral. Place a thin piece of paper between idle adjustment screw and idle stop. Adjustment is correct when the paper can be removed without tearing, but has some drag on it. Readjust cable barrel if necessary.

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



a - Idle Stop Screw
b - Idle Stop

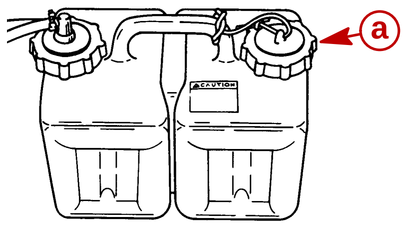
5. Lock the barrel holder in place with the cable latch.



Oil Injection Set-Up

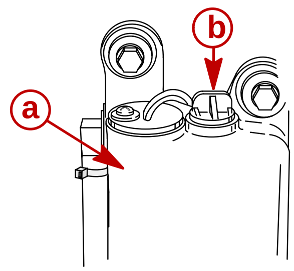
Filling

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



a - Fill Cap

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



a - Engine Oil Tank
b - Fill Cap

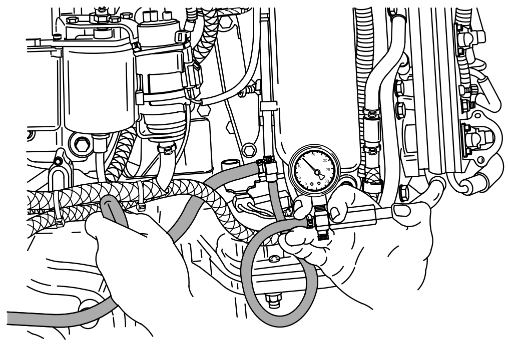
Priming the Oil Injection Pump

(DDT) DIGITAL DIAGNOSTIC TERMINAL – OIL PUMP PRIME

This method fills the oil pump, oil supply hose feeding pump, and oil hoses going to the crankcase and air compressor.

Refer to procedure in the Technician Reference Manual provided with the Digital Diagnostic Software Cartridge Part. No. 91-880118 for Model Year 2001.

NOTE: *If a new powerhead is being installed or oil hoses/oil pump has been removed, it is recommended all air be purged from oil pump/oil lines using gearcase leakage tester (FT-8950). Connect the leakage tester to the inlet t-fitting on the onboard oil reservoir. While clamping off the inlet hose, manually pressurize the reservoir to 10 psi. Using the Digital Diagnostic Terminal 91-823686A2, activate the oil pump prime sequence. Maintain the 10 psi pressure throughout the auto prime sequence. When the auto prime is completed, remove the leakage tester and refill the onboard oil reservoir.*



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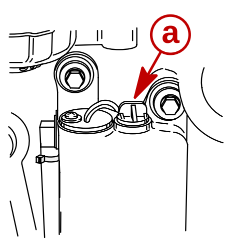
Priming the oil pump (filling pump and hoses using pressure) is required on new or rebuilt power heads and any time maintenance is performed on the oiling system that allows air into the oil system.

Purging Air From the Engine Oil Tank

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

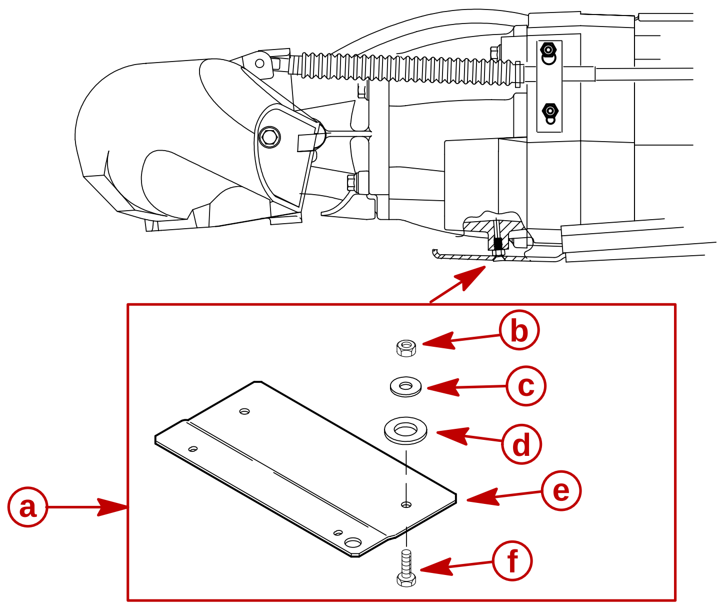


a - Fill Cap

Trim Plate Adjustment

The Jet Drive unit trim plate is factory set for general applications. Should a particular boat experience porpoising problems, the trim plate can be adjusted as follows:

1. Loosen both jam nuts on trim plate (one starboard and one port).



- **a** - Jam Nut w/Washer (Two: One On Each Side)
- **b** - Jam Nut
- **c** - Small Diameter Washer
- **d** - Large Diameter Washer
- **e** - Plate
- **f** - Screw

2. Turn both screws the exact same number of turns. Tighten both jam nuts against trim plate. The distance from top of nut to bottom of boss should be equal on both sides.

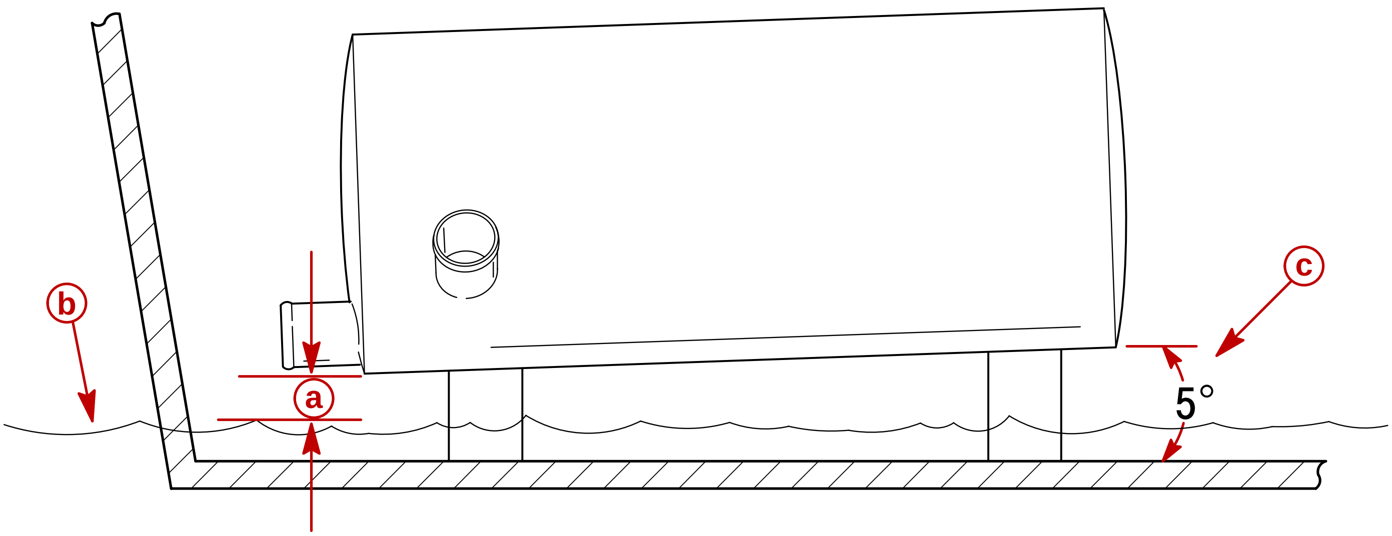
⚠ WARNING

Adjusting the trim plate may affect boat handling (steering). Overly sensitive steering or reduced turning ability could result from trim plate adjustments. Boat handling characteristics also vary with the load distribution in the boat. Use caution after adjusting: check for acceptable handling characteristics under all loading conditions. Failure to adequately test the boat could result in inadequate steering control resulting in property damage, personal injury or death.

Muffler Installation

IMPORTANT: When installing muffler assemblies, a 2.0 inch minimum distance between bottom of muffler and water line must be kept. This minimum distance must be calculated with boat under its maximum load.

1. Install muffler assemblies with a 2.0 inch minimum distance between bottom of muffler and water line. This distance must be calculated with boat under its maximum load. Tilt muffler assemblies back towards outlet to ensure self draining.



a - 2.0 inch Minimum
b - Water Line
c - 5 Degree Tilt for Self Draining

Pre-delivery Inspection

Not Applicable	Check/ Adjust	CHECK BEFORE RUNNING
❑	❑	Water hose connection/torqued
❑	❑	Cover plate & adaptor plate fasteners torqued
❑	❑	Battery charged & secure
❑	❑	All electrical connections tight
❑	❑	All fuel connections tight
❑	❑	Throttle, shift, & steering adjusted correctly and fasteners torqued
❑	❑	Shift cable adjusted to keep reverse gate above rudder in forward w/ slack pulled out of cable and against the stop.
❑	❑	Carb throttle shutters open & close completely
❑	❑	Pump housing oil level full (See Owner’s Manual)
❑	❑	Oil injection reservoir full and bled
❑	❑	Warning system(s) operational

ON THE WATER CHECK

❑	❑	Starter neutral safety switch operational
❑	❑	Lanyard stop switch operational
❑	❑	All gauges read properly
❑	❑	No fuel or oil leaks
❑	❑	No water leaks
❑	❑	No exhaust leaks
❑	❑	Ignition timing set to specs
❑	❑	Idle:____________RPM
❑	❑	Idle mixture adjusted
❑	❑	Forward-Neutral-Reverse operational
❑	❑	Steering operational throughout entire range
❑	❑	Acceleration test
❑	❑	WOT:___________RPM
❑	❑	Boat handling

POST WATER CHECK

❑	❑	Re-torque adapter plate fasteners
❑	❑	No fuel, oil, water or exhaust leaks
❑	❑	Re-check shift cable adjustment. Readjust as necessary

2
A

ELECTRICAL

Section 2A – Ignition

Table of Contents

Specifications 2A-1
Special Tools 2A-2
Electrical Components 2A-4
Theory of Operation 2A-7
Ignition Component Description 2A-8
- Fuses 2A-8
- Electronic Control Module (ECM) 2A-9
- Flywheel 2A-9
- Ignition Coils 2A-10
- Coil Driver 2A-11
- Crank Position Sensor 2A-12
- Throttle Position Sensor (TPS) 2A-12
- Throttle Position Sensor Troubleshooting 2A-13
- Charging System Alternator 2A-14
- Temperature Sensor 2A-15
- Manifold Absolute Pressure (MAP) Sensor . . 2A-18
- Air Temperature Sensor 2A-18
- Direct Injectors 2A-19
- Fuel Injectors 2A-19
- Disconnecting Harness Connectors from Ignition Coils and/or Injectors 2A-20
- Troubleshooting 2A-20

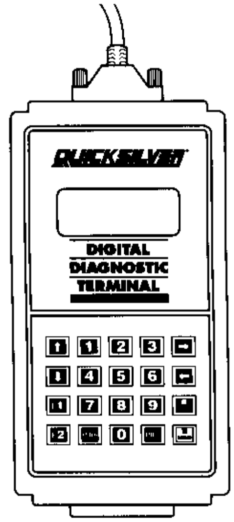
Troubleshooting Without Digital Diagnostic Terminal 2A-20
Troubleshooting With the Digital Diagnostic Terminal 2A-21
Notes 2A-22
DDT Functions 1.0 (P/N 880118) 2A-23
DFI Troubleshooting Guide 2A-25
Ignition Components Removal and Installation . . 2A-28
- Flywheel Cover Removal and Installation 2A-28
- Electronic Control Module (ECM) 2A-29
- Ignition Module (Coil) 2A-30
- Crank Position Sensor 2A-31
- Throttle Position Sensor (TPS) 2A-32

Specifications

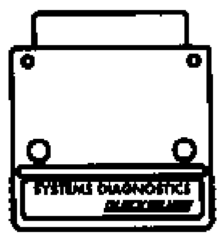
IGNITION SYSTEM	**Type** **Spark Plug Type** **Spark Plug Gap** **Maximum Timing** **Idle Timing** **Throttle Position Sensor** **@ Idle** **@ WOT**	Digital Inductive NGK PZFR5F-11 0.040 in. (1.0 mm) Not Adjustable; Controlled by ECM Not Adjustable; Controlled by ECM 0.19 – 1.0 VDC 3.45 – 4.63 VDC

Special Tools

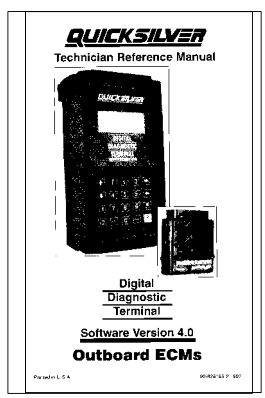
1. Digital Diagnostic Terminal (DDT) 91-823686A2



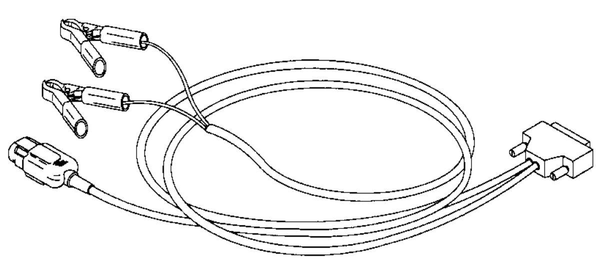
2. Software Cartridge 91-88018-1



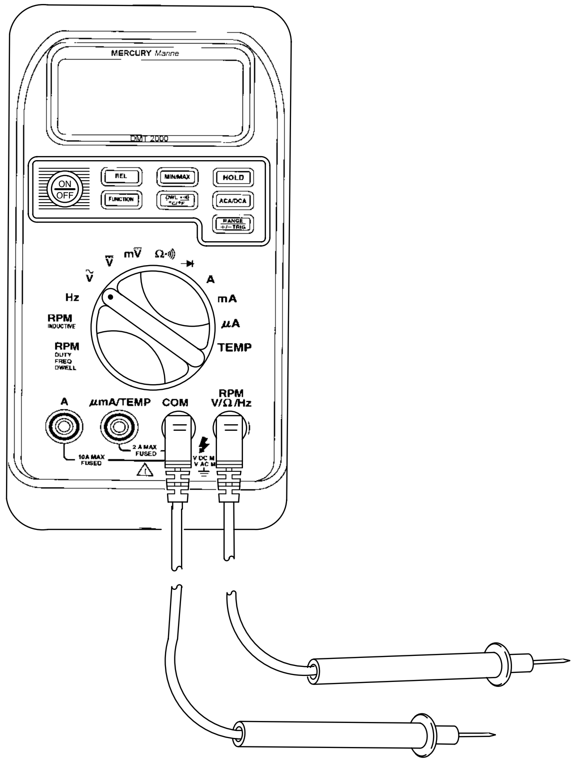
3. DDT Reference Manual 90-881204-1



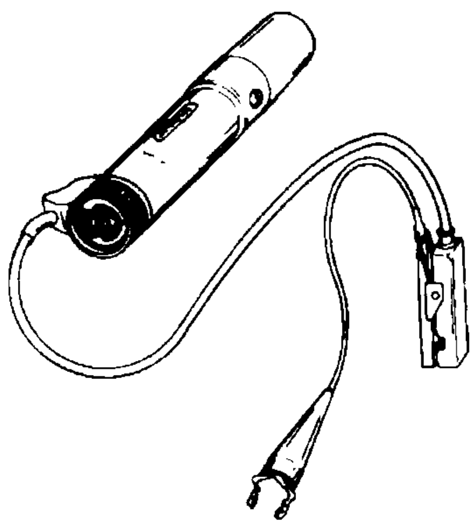
4. Adaptor Harness 84-822560A5



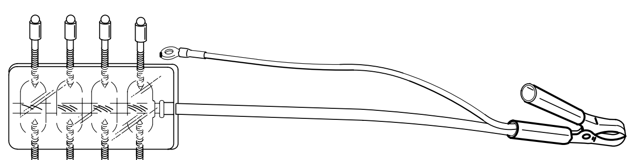
5. DMT 2000 Digital Tachometer Multimeter 91-854009A1



6. Inductive Timing Light 91-99379



7. Spark Gap Tester 91-850439T



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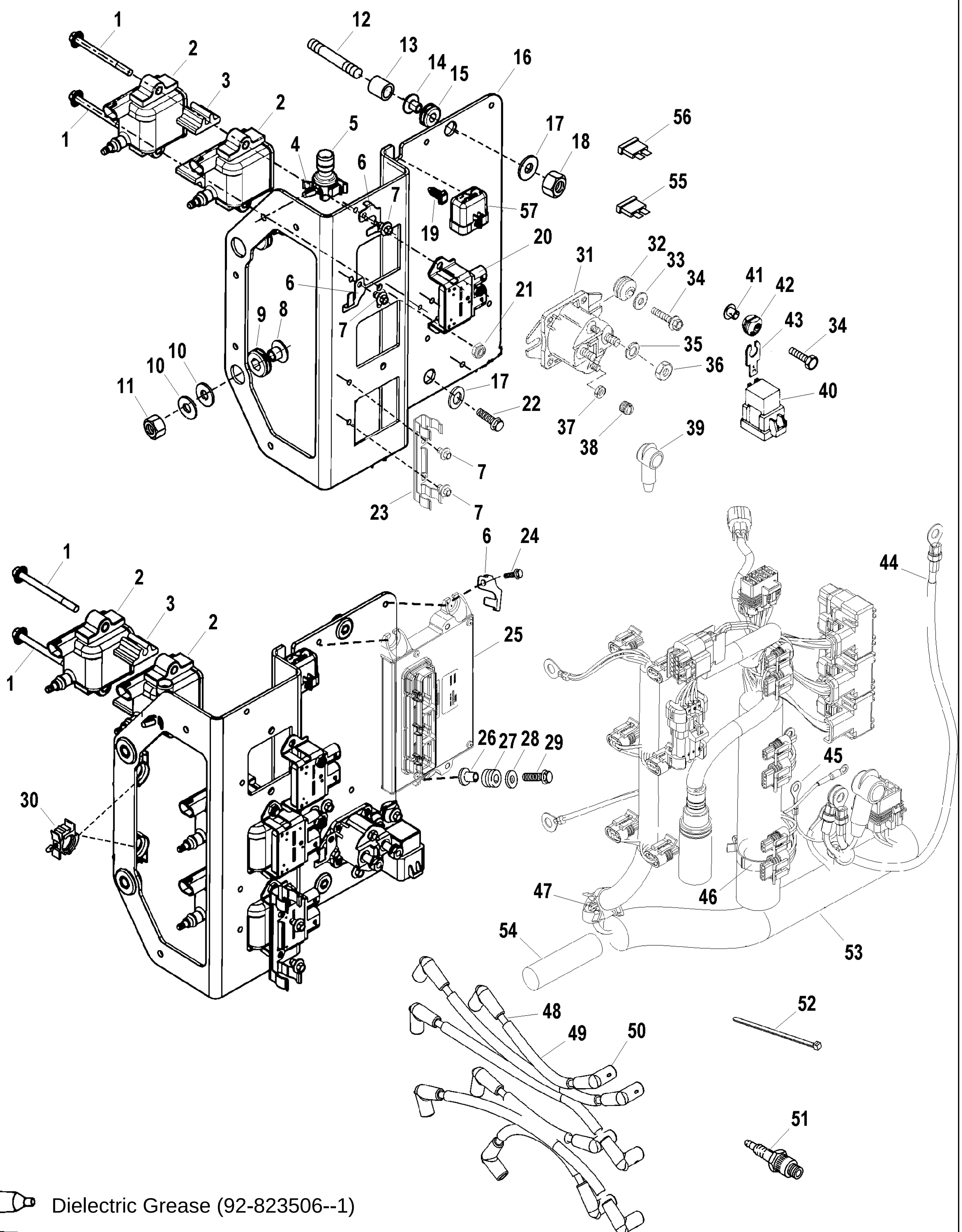
Electrical Components



6 Dielectric Grease (92-823506--1)

25 Liquid Neoprene (92-25711--2)

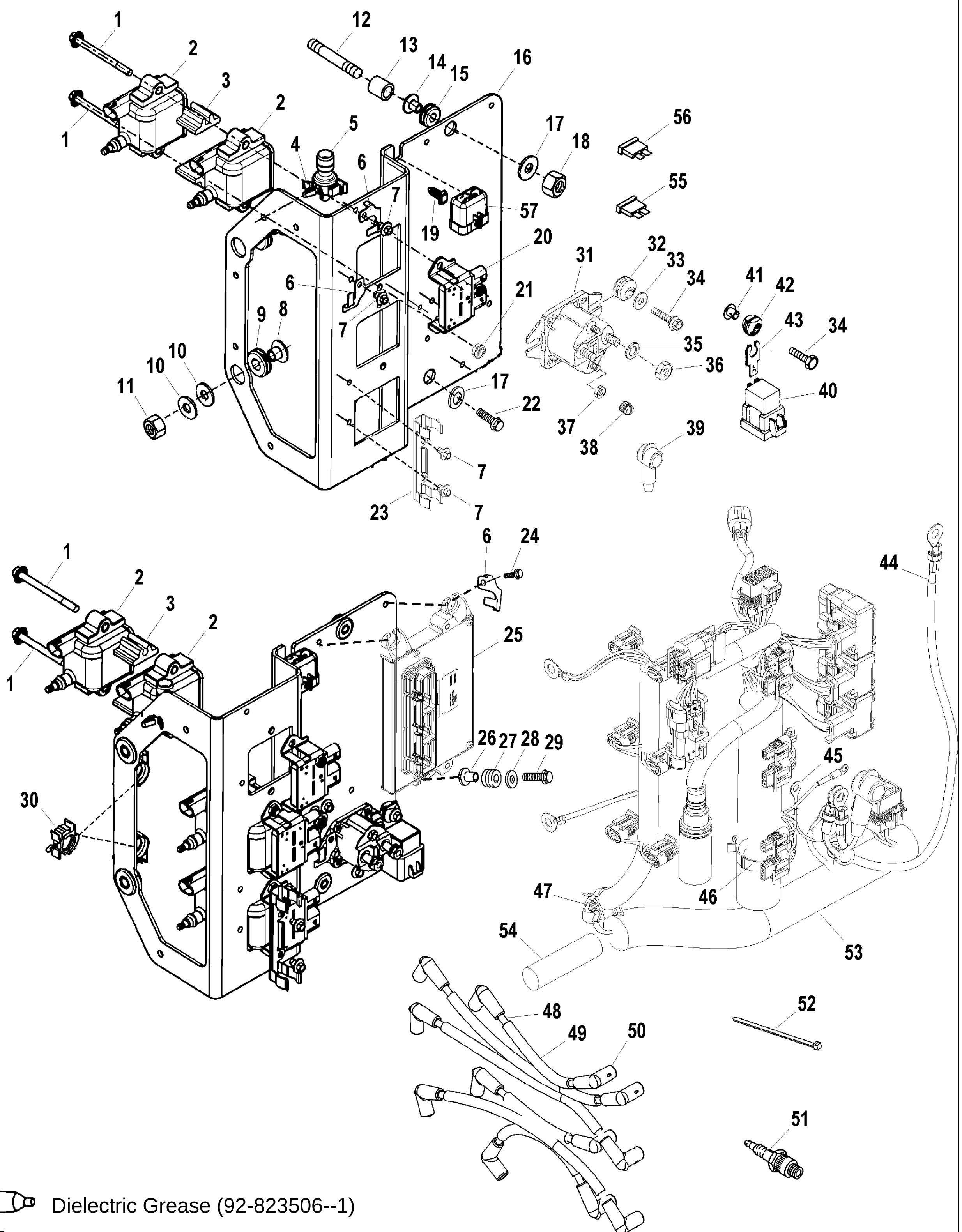
NOTE: COAT ALL EYELET WIRING TERMINALS WITH #25 GACO N700

NOTE: COAT ALL MULTI-PIN ELECTRICAL CONNECTIONS WITH #6 DC-4

Electrical Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	6	SCREW (0.250-20 x 3.25)			
2	6	COIL KIT-Ignition			
3	6	SPACER			
4	1	CLIP-Water Pressure Sensor			
5	1	SENSOR-Water Pressure			
6	3	CLIP-Plug Mounting			
7	7	SCREW (M6 x 10)	60		7
8	2	GROMMET			
9	2	BUSHING			
10	4	WASHER			
11	2	NUT (M8)		20	27
12	1	STUD (M6 x 50)			
13	1	BUSHING			
14	2	BUSHING			
15	2	GROMMET			
16	1	PLATE-Electrical Mounting			
17	2	WASHER			
18	1	NUT (M6)	100		11
19	1	CLIP-Connector			
20	3	DRIVER-Dual Coil			
21	6	NUT (0.250-20)	100		11
22	1	SCREW (M6 x 25)	100		11
23	1	CLAMP			
24	1	SCREW (M4 x 14)	1.7		0.2
25	1	ECM			
26	3	BUSHING			
27	3	GROMMET			
28	3	WASHER			
29	3	SCREW (M6 x 25)	35		4
30	2	CLIP			
31	1	SOLENOID ASSEMBLY			
32	2	GROMMET			
33	1	WASHER			
34	3	SCREW (M6 x 25)	60		7
35	2	LOCKWASHER (0.312)			
36	2	NUT (0.312-18)	60		7
37	2	NUT (#10-32)	40		5
38	1	CAP NUT (#10-32)			
39	1	INSULATOR BOOT **(RED)**			
40	1	RELAY ASSEMBLY			
41	1	BUSHING			
42	1	GROMMET			
43	1	BRACKET			
44	1	CABLE ASSEMBLY **(RED)**			
45	1	CABLE ASSEMBLY			
46	1	CLIP-Conduit			
47	1	CLIP-Conduit			
48	1	CABLE SET-High Tension **(6 Cables)**			
49	AR	CONDUIT **(0.359 x 3.00 feet) (Cut as Required)**			
50	12	BOOT KIT (High Tension Cables)			
51	6	SPARK PLUG **(NGK - PZFR5F-11)**			
52	AR	CABLE TIE (8.00 Inch)			
53	1	HARNESS ASSEMBLY			

Electrical Components



6 Dielectric Grease (92-823506--1)

25 Liquid Neoprene (92-25711--2)

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

NOTE: COAT ALL MULTI-PIN ELECTRICAL CONNECTIONS WITH #6 DC-4

Electrical Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
	AR	CONDUIT **(0.350 x 3.00 Feet) (Cut as Required)**			
54	AR	CONDUIT **(0.500 x 3.00 Feet) (Cut as Required)**			
55	AR	CONDUIT **(0.630 x 3.00 Feet) (Cut as Required)**			
56	AR	CONDUIT **(0.100 x 3.00 Feet) (Cut as Required)**			
55	1	FUSE-Mini **(Blue - 15 AMP)**			
56	4	FUSE-Mini **(Yellow - 20 AMP)**			
57	1	COVER-Fuses			

Theory of Operation

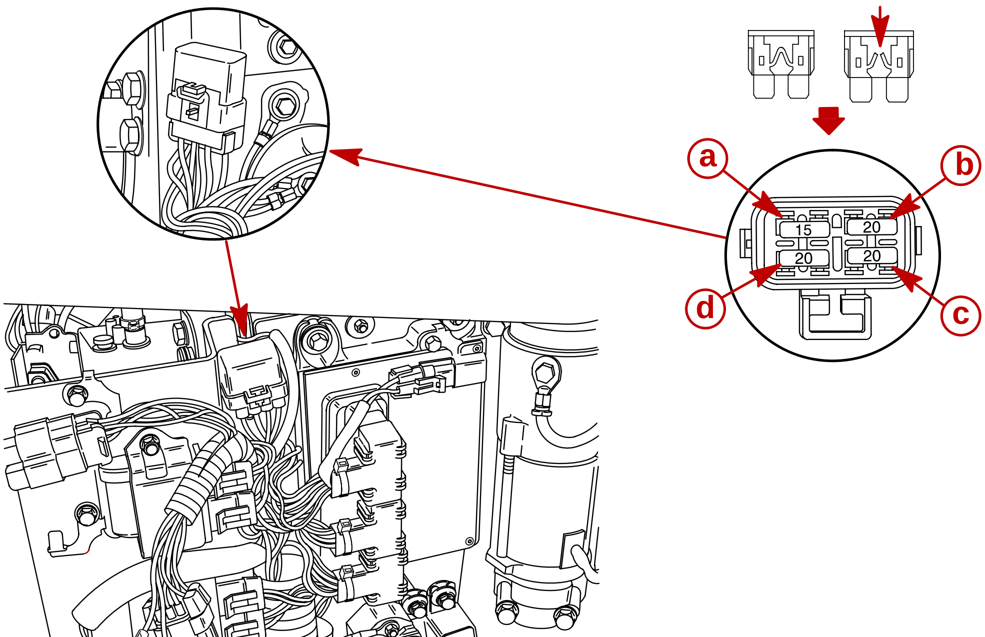
When the ignition key is turned to the RUN position, battery voltage is applied to the main relay through the PURPLE wire. When the Electronic Control Module (ECM) receives a signal from the Crank Position Sensor, the main relay ground circuit is completed through the ECM. The main relay is then closed and D.C. current from the battery or charging system is transferred through the main relay 20 ampere fuse to the positive terminal of all 6 ignition coil primary windings. The negative terminal of the coil primary is connected to engine ground through the Dual Coil Driver which is triggered by the ECM. At this time, when this circuit is closed, a magnetic field is allowed to be built up in the ignition coil. The Crank Position Sensor senses the location of the 54 teeth on the flywheel and supplies a trigger signal to the ECM. ECM provides a signal to the dual coil driver prior to cylinder firing. The Crank Position Signal the ECM receives also determines when the trigger signal is removed from the Coil Driver thus turning off the driver and opening the ground circuit of the coil primary. The magnetic field in the ignition coil primary will then collapse cutting across the coil secondary winding creating a high voltage charge (50,000 volts) that is sent to the spark plug.

Ignition Component Description

Fuses

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

1. Open the fuse holder and look at the silver colored band inside the fuse. If band is broken, replace the fuse. Replace fuse with a new fuse with the same rating.
2. The fuses and circuits are identified as follows:
   a. Smart Craft Data Bus Circuit – SFE 15 AMP Fuse.
   b. Accessories – SFE 20 AMP Fuse.
   c. Ignition Coil Circuit – SFE 20 AMP Fuse.
   d. Electric Fuel Pump/Injectors/Oil Pump Circuit – SFE 20 AMP Fuse.



58459

58558

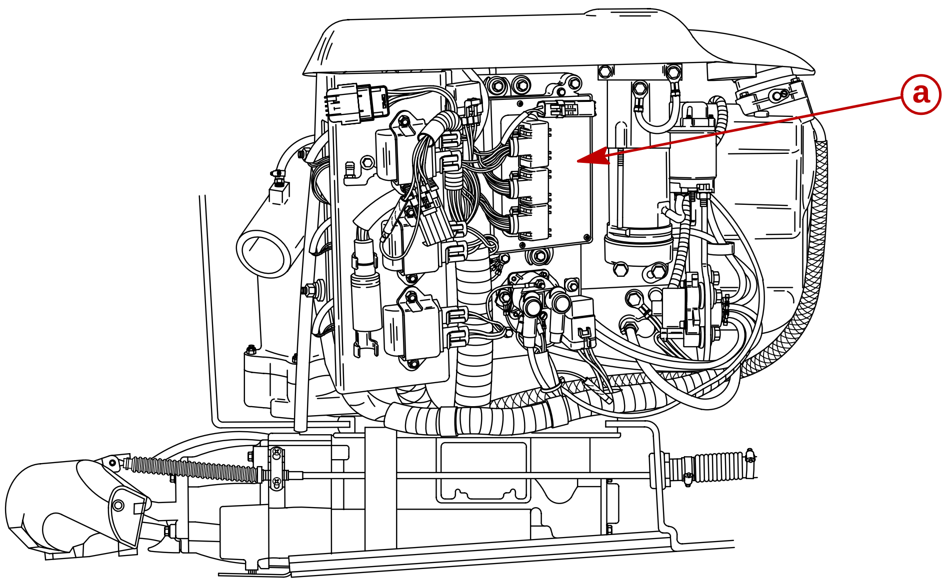
Electronic Control Module (ECM)

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

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

The ECM performs the following functions:

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

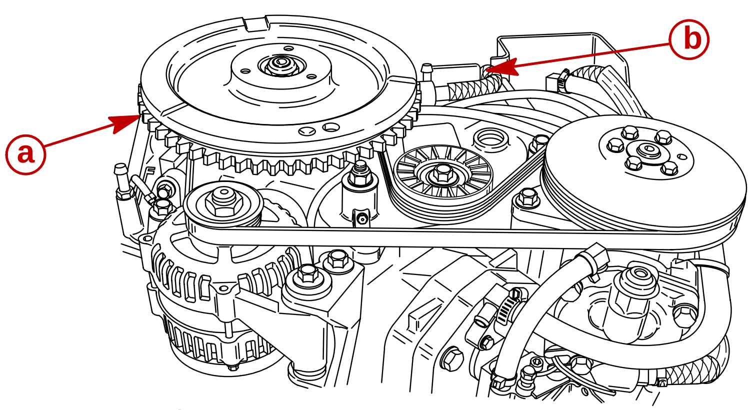


58561

a - Electronic Control Module (ECM)

Flywheel

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

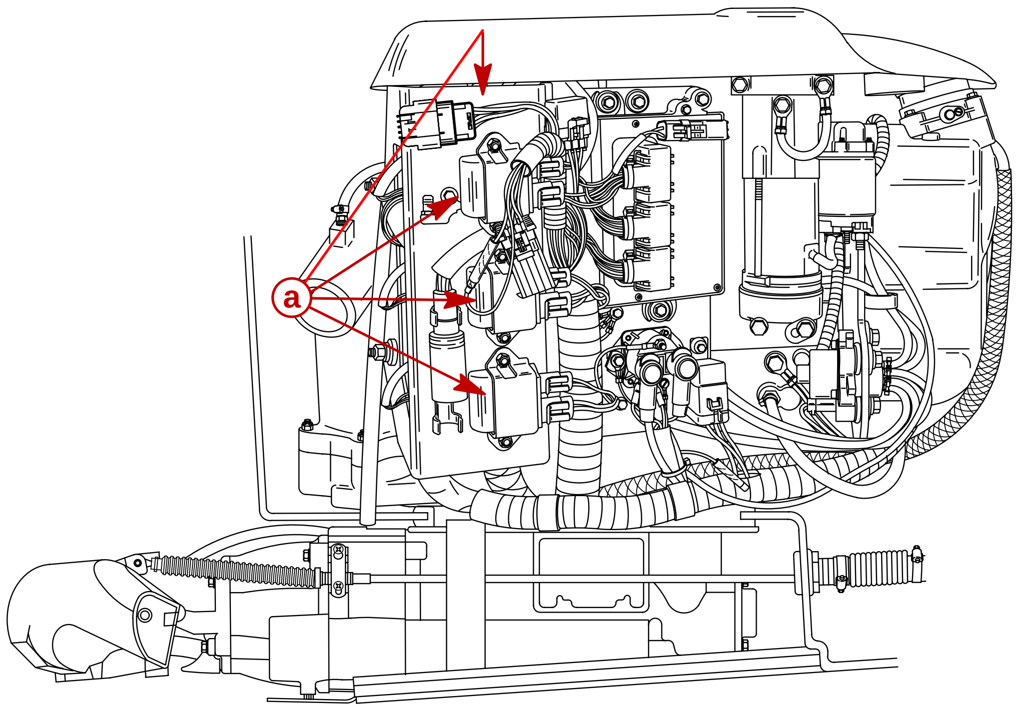


58557

a - Flywheel
b - Crank Position Sensor

Ignition Coils

Inductive type ignition coils are used on the DFI engines. 12 volt DC is supplied to the coils at all times from the boat battery. For a predetermined length of time (dwell), the primary circuit of the coil is completed by closing the electrical circuit within the coil driver. When the coil driver circuit opens, the primary field of the coil collapses inducing high voltage in the secondary windings which produces up to 50000 volts at the spark plugs.



58561

a - Ignition Coils – 3 coils are mounted behind 3 visible coils

Ignition Coil Ohm Test

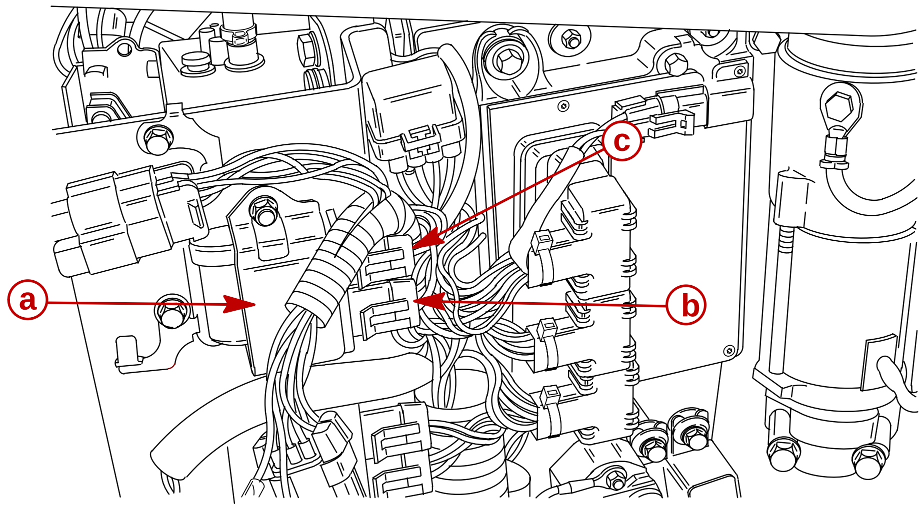
Connect meter leads between primary terminal (GRN/Striped) and (RED/YELLOW) terminal pin.	0.38 - 0.78 Ω
Connect meter leads between spark plug wire/high voltage tower and ground terminal pin.	8.1 - 8.9 k Ω

Coil Driver

The ECM sends a 5 VDC pulse to the coil driver mounted on each ignition coil. Which coil driver receives this pulse is determined by the ECM receiving a signal from the crank position sensor.

When the coil driver receives its ECM pulse (signal), it closes its circuit which allows the primary side of the ignition coil to build up energy which it initially receives from the boat battery.

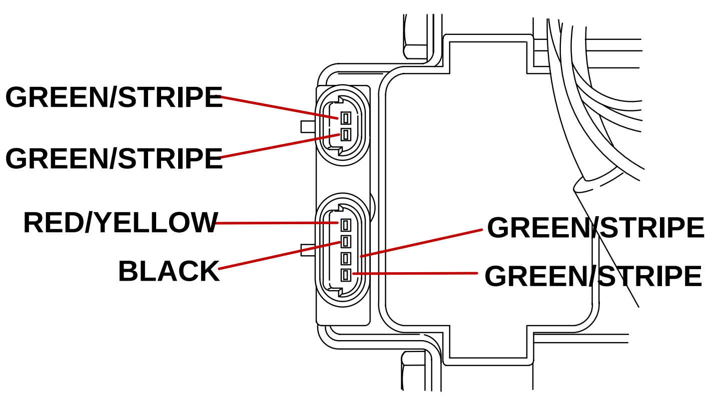
When the ECM pulse (signal) to the coil driver drops below 1.3 volts, the coil driver opens its circuit which causes the primary field of the ignition coil to collapse. This field collapse induces a voltage buildup in the secondary winding of the ignition coil resulting in a potential voltage of up to 50000 volts at the spark plug.



58558

a - Coil Driver
b - 4 Pin Connector
c - 2 Pin Connector

Coil Driver Ohm Test

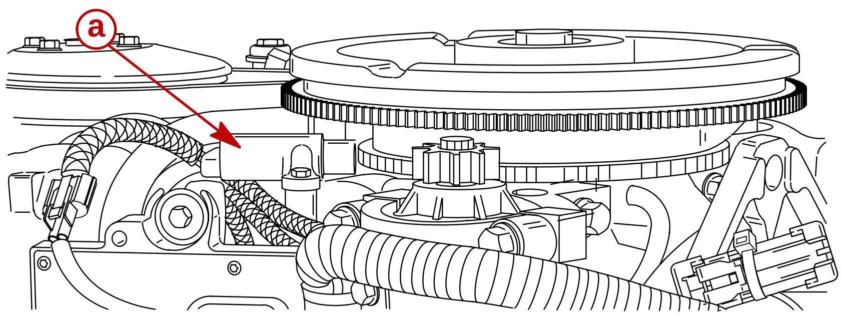


58418

4 Pin Connector – Connect meter leads between RED/YEL and BLACK male pins.	85 k Ω ± 10%
4 Pin Connector – Connect meter leads between BLACK male pin and each GREEN STRIPED male pin.	10 k Ω ± 10%
Connect meter leads between BLACK male pin on 4 pin connector and each GREEN STRIPED male pin on the 2 pin connector.	OPEN – No Continuity

Crank Position Sensor

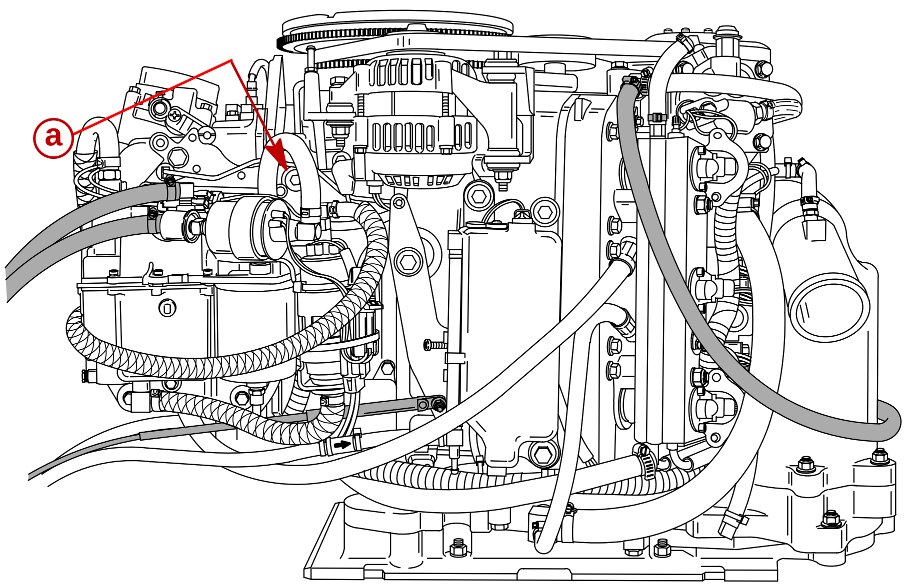
Senses 54 teeth located on flywheel under ring gear.
Supplies the ECM with crank position information and engine speed. If sensor should fail, the engine will stop running.



a - Crank Position Sensor

Throttle Position Sensor (TPS)

The TPS transmits throttle angle information to the ECM which varies the injector pulse width accordingly. Should the sensor fail, the warning horn will sound. RPM will be reduced by the ECM. TPS settings are not adjustable. TPS settings can be monitored with the Digital Diagnostic Terminal through the ECM. Voltage change should be smooth from idle to wide open throttle. If voltage change is erratic, TPS is defective.



a - Throttle Position Sensor (TPS)

Throttle Position Sensor Specifications	
Idle	0.19 – 1.0 VDC
Wide Open Throttle	3.45 – 4.63 VDC

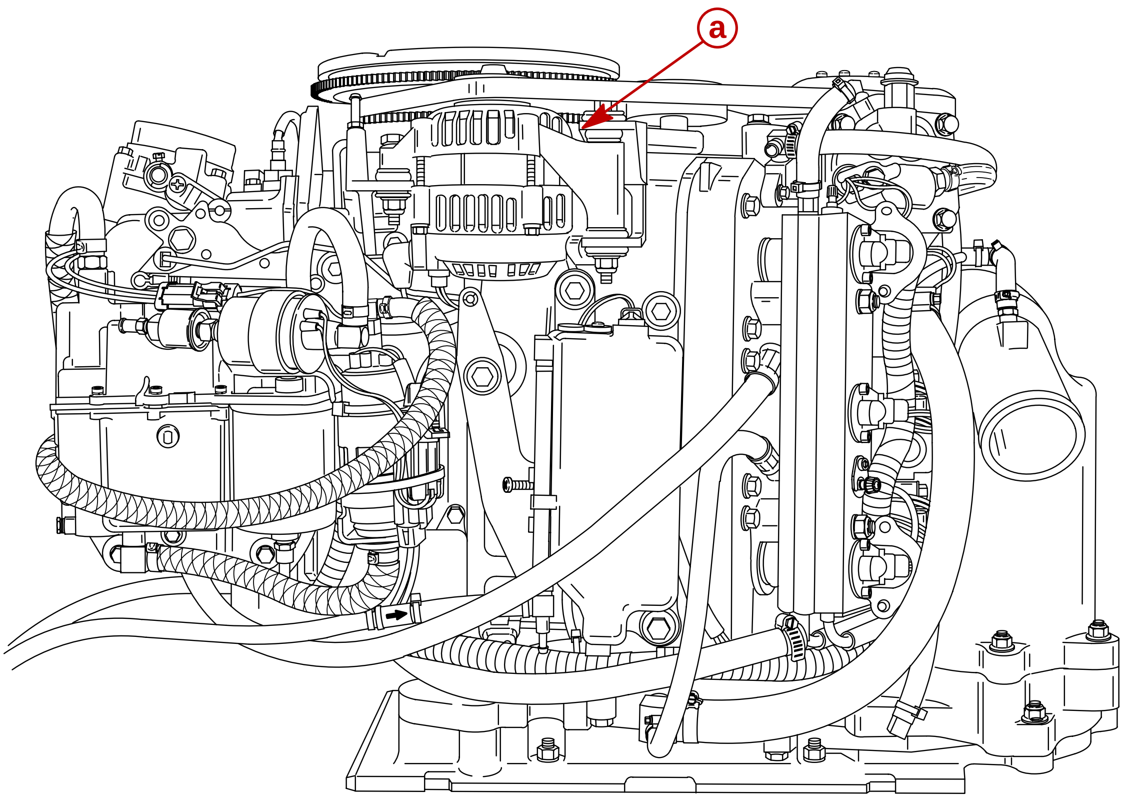
Throttle Position Sensor (TPS) Troubleshooting

If the throttle position sensor is out of the intended operating range when the engine is started, the Electronic Control Module (ECM) will sense that the Throttle Position Sensor (TPS) has failed. The warning horn will sound, check engine light will illuminate, DDT will indicate failed TPS and the engine will go into RPM reduction. When the engine is started, the throttle arm on the engine must be against the throttle stop screw. Do not move throttle or fast idle control lever forward.

- Check throttle cable adjustment. The throttle stop screw on the throttle arm must be against the throttle stop on the cylinder block when the engine is started. Pre-load the throttle cable barrel 1 or 2 turns if necessary.
- Verify driver is not pushing on throttle (if foot throttle is used) or advancing the throttle only on the control box.
- Check throttle cam to roller adjustment. If the roller is not down in the pocket/valley area on the cam, there is a tendency for the roller to ride up or down on the cam which causes the TPS link arm to push/pull on the TPS lever resulting changing values.

Charging System Alternator

Battery charging system is contained within the belt driven alternator, including the regulator. At cranking speeds, electrical power for the engine is provided by the boat battery – minimum recommended size is 750 CCA, 1,000 MCA, cold cranking amperes or 105 (Minimum) Ampere Hours. Above 550 RPM, all electrical power is provided by the alternator. Should engine rpm drop below 550 RPM, the alternator is not capable of providing sufficient output and the battery becomes the primary source of electrical power.
Alternator output (when hot) to the battery @ 2000 RPM is approximately 33 - 38 amperes.



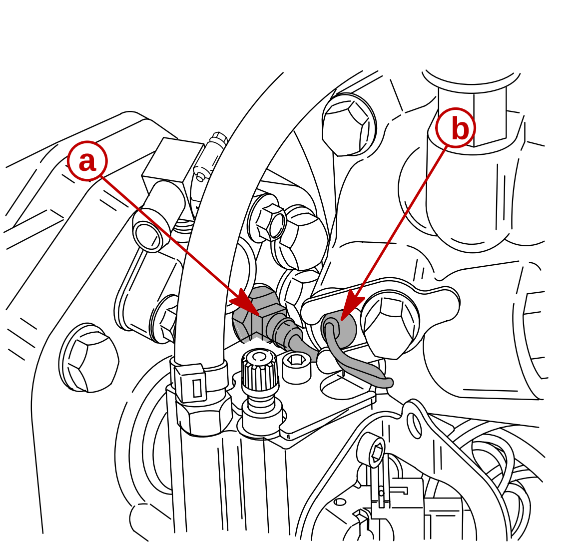
58706

a - Alternator

Temperature Sensor

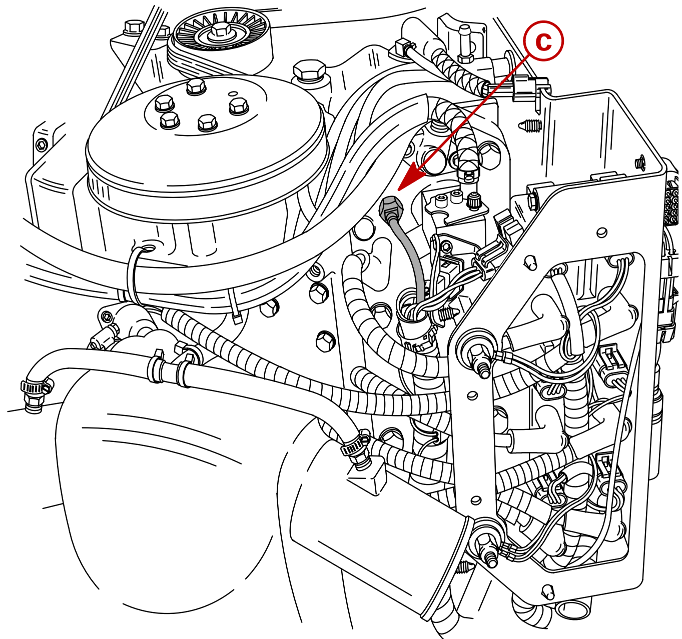
Three (3) temperature sensors are used to provide temperature information to the ECM. One sensor is mounted in each cylinder head and one sensor is mounted in the air compressor cylinder head.

The ECM uses this information to increase injector pulse width for cold starts and to retard timing in the event of an over-heat condition.



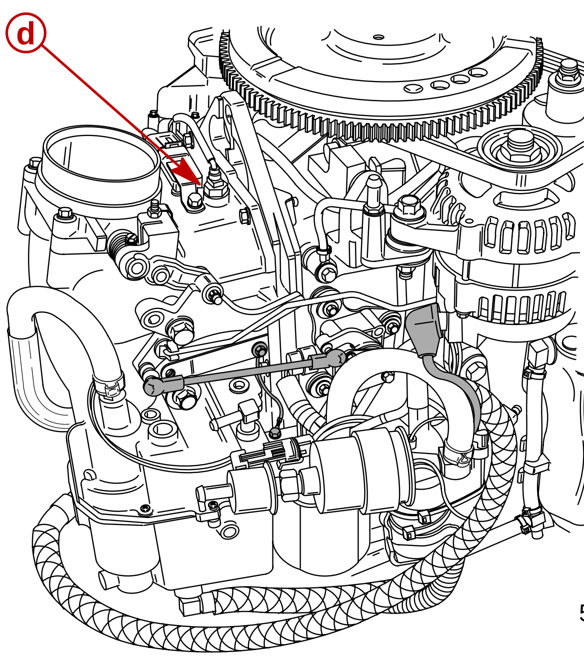
58715

PORT



STARBOARD

58734



58765

a - Cylinder Temperature Sensor (PORT)
b - Air Compressor Temperature Sensor
c - Cylinder Temperature Sensor (STARBOARD)
d - Air Temperature Sensor

AIR COMPRESSOR TEMPERATURE SENSOR TEST

Between BLACK/ORANGE and each GREEN or TAN/GREEN wire.	No Continuity
Between each lead and ground	No Continuity

Temperature Sensor Specifications		
Fahrenheit	**Centigrade**	**OHMS (± 10%)**
–22	–30	18230
–13	–25	13420
–4	–20	9966
5	–15	7465
14	–10	5636
23	–5	4288
32	0	3287
41	5	2551
50	10	1996
59	15	1574
68	20	1250
77	25	1000
86	30	805
95	35	653
104	40	532
113	45	437
122	50	360
131	55	299
140	60	249
149	65	209
158	70	176
167	75	148
176	80	126
185	85	107

PORT AND STARBOARD CYLINDER TEMPERATURE SENSORS
AIR TEMPERATURE SENSOR

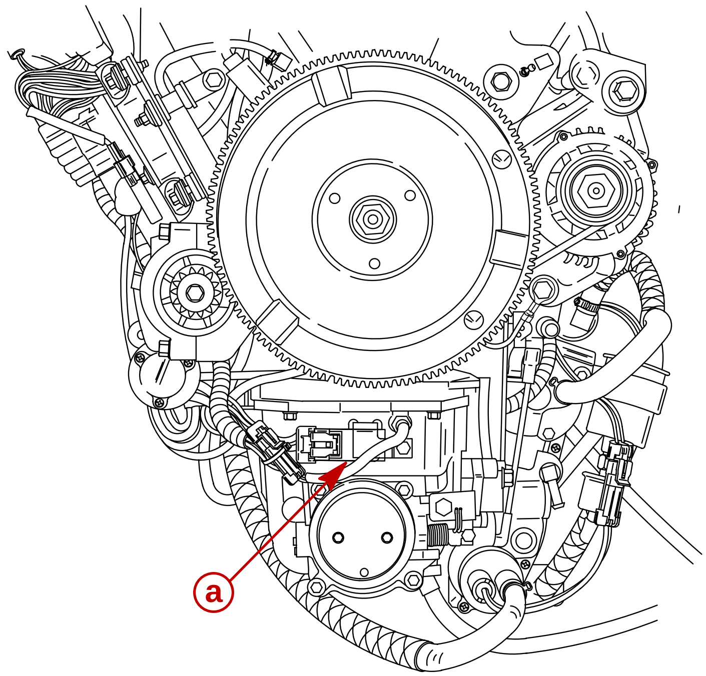
An ohms test of the temperature sensors would be as follows:

Disconnect temperature sensor harness and check continuity with digital or analog ohm-meter test leads between both connector pins. With engine at temperature (F°) indicated, ohm readings should be as indicated ±10%. There should be no continuity between each connector pin and ground.

Temperature Sensor Specifications		
Fahrenheit	**Centigrade**	**OHMS**
257	125	340
248	120	390
239	115	450
230	110	517
221	105	592
212	100	680
203	95	787
194	90	915
185	85	1070
176	80	1255
167	75	1480
158	70	1752
149	65	2083
140	60	2488
131	55	2986
122	50	3603
113	45	4370
104	40	5327
95	35	6530
86	30	8056
77	25	10000
68	20	12493
59	15	15714
50	10	19903
41	5	25396
32	0	32654
14	–10	55319
5	–15	72940

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is mounted on top of the air plenum. The ECM regulates fuel flow, in part, based on manifold absolute pressure.

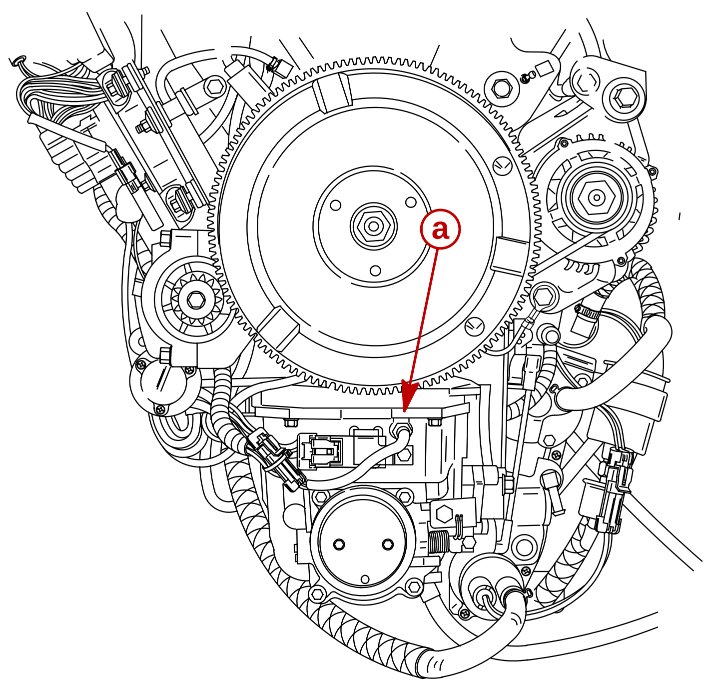


58705

a - MAP Sensor

Air Temperature Sensor

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

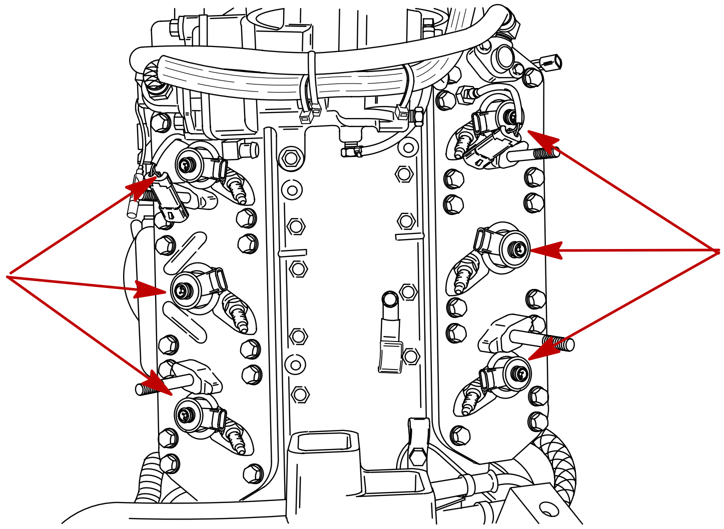


58705

a - Air Temperature Sensor

Direct Injectors

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

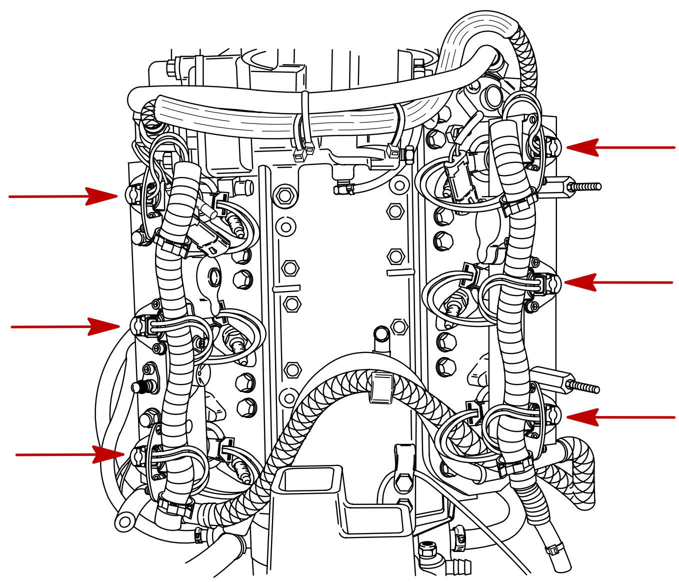


58714

Direct Injector Ohm Test (Injector Lead Disconnected)	
Connect meter leads between each injector terminal pin.	1 - 1.6 Ω
Connect meter leads between injector housing and each terminal pin.	No Continuity

Fuel Injectors

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

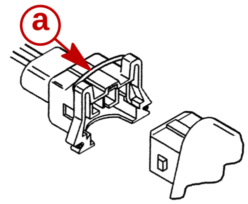


58717

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

NOTE: *Injector ohms test verifies electrical integrity; not mechanical integrity of injectors.*

Disconnecting Harness Connectors from Ignition Coils and/or Injectors



a - Wire Clip (push center down to remove)

Troubleshooting

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

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

Troubleshooting Without Digital Diagnostic Terminal

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

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

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

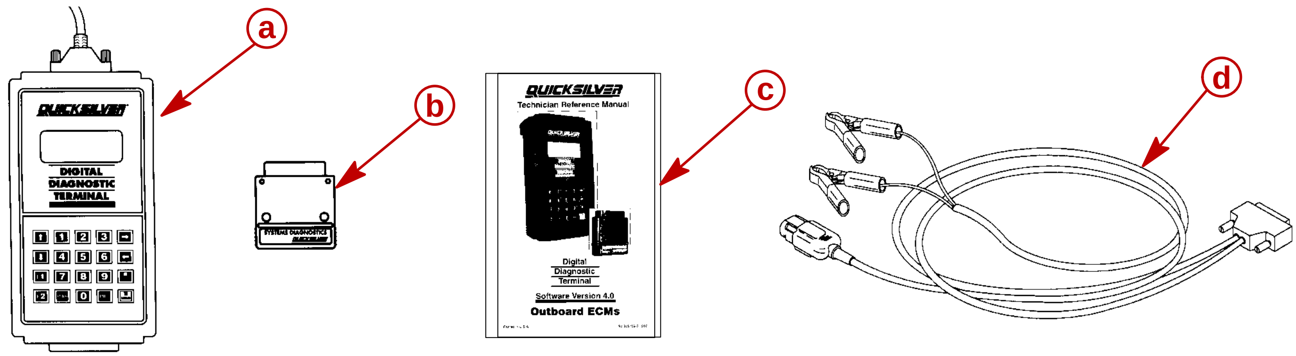
NOTE: *ECMs are capable of performing a cylinder misfire test to isolate problem cylinders. Once a suspect cylinder is located, an output load test on the ignition coil, fuel injector and direct injector may be initiated through use of the DDT.*

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

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

- If all cylinders exhibit similar symptoms, the problem is with a sensor or harness input to the ECM.
- If problem is speed related or intermittent, it is probably connector or contact related. Inspect connectors for corrosion, loose wires or loose pins. Secure connector seating; use dielectric compound 92-823506-1.
- Inspect the harness for obvious damage: pinched wires, chaffing.
- Secure grounds and all connections involving ring terminals (coat with Liquid Neoprene 92-25711--3).
- Check fuel pump connections and fuel pump pressure.
- Check air compressor pressure.

Troubleshooting with the Digital Diagnostic Terminal



a - Digital Diagnostic Terminal (91-823686A2)
b - Software Cartridge (91-880118–1)
c - DDT Reference Manual (90-881204–1)
d - Adapter Harness (84-822560A5)

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

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

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

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

Notes:

DDT Functions – Optimax Models
Software Version 1.0 (P/N 880118)

SmartCraft Monitor
1 – Mercury Marine
2 – Tool Setup

THIS ENGINE IS A
xx MY xxx x.xL xxx
PRESS 1 to CONTINUE

Select Function:
1 - AUTO SELF TEST
2 - MANUAL TEST

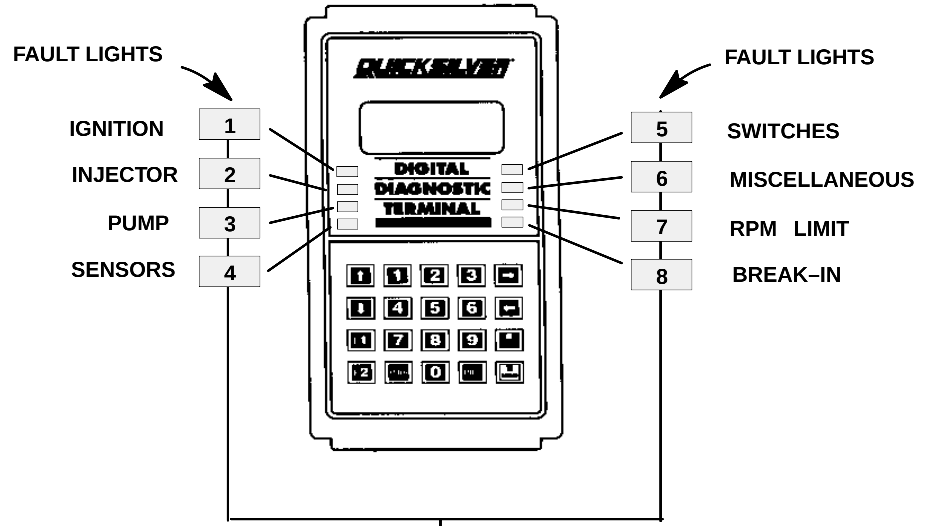
Select Auto Test:
1 – STATIC TEST

Select Function:
1 - DATA MONITOR
2 - FAULT STATUS
3 - SYSTEM INFO
4 - HISTORY
5 - SPECIAL FUNCTIONS

ENGINE RPM
TPI 1 VOLTS
BATTERY VOLTS
PWR 1 VOLTS
COOL TMP STB °F
COOL TMP PRT °F
MAP PSI
AIR TMP °F
BLOCK PSI
OIL INJ CNT
TPI %
AIR COM TMP °F
OIl LEVEL
FUEL LEVEL
AVAILABLE PWR %
SHIFT
TRIM
PITOT
PADDLE WHEEL
LAKE/SEA TMP °F

01MY DI 2.5L J200
ECM #
CODE
IGN PRI .38-.78 ohm
SEC 8.1-8.9 Kohm
DINJ 1.0-1.6 ohm
FINJ 1.7-1.9 ohm
TYPICAL TPI RANGE
TPI 1 0.19-1.0v IDLE
3.45-4.63v WOT
TGAP 0.025-.04in
PWR RLY 81-99 ohm
RPM LIMIT 6200
PROP RPM 5150-5650
AIR COMPRESSOR
1Kohm @ 77F/25C
AIRTEMP/COOLANT
10 Kohm @ 77F/25C
BATV 12.6-15.0
MAP 7-15 psi
FUEL AIR +10 psi
AIR 77-82 psi
OIL PUMP COIL
1.8-2.0 ohms
1 FUSE-FUEL PUMP
2 FUSE-BUS +12V
3 FUSE-ACCESSORY
4 FUSE-IGNITION
OVERTEMP/BLOCK
PRESSURE LIMITS ARE
CONTROLLED BY
ENGINE GUARDIAN
SEE SERVICE MANUAL
FOR GUARDIAN INFO

Any fault will turn on fault light. Refer to
Fault Status to identify fault



Fault Status List

ACT INPUT HI or LO	Air compessor temperature sensor input is high or low
AT INPUT HI or LO	Air temperatrure (engine) sensor input is high or low
BATT VOLT HI or LOW	Battery voltage is high or low
BLOCK PRESS LOW	Block pressure is low
BPSI INPUT HI or LO	Block Pressure Sensor input is high or low
BREAK-IN	Engine Break-In In Progess
COMP OVERHEAT	Compressor overheat
CTP INPUT HI or LO	Coolant temp port sensor input is high or low
CTS INPUT HI or LO	Coolant temp starboard sensor input is high or low
DINJ 1 thru 6 SHORT or OPEN	Direct injector (1 thru 6) is short or open circuit
EST 1 thru 6 SHORT or OPEN	Electronic spark trigger signal (1 thru 6) is short or open circuit
FINJ 1 thru 6 SHORT or OPEN	Fuel injector (1 thru 6) is short or open circuit
FUEL LVL IN HI or LO	Fuel level sensor input is high or low
GUARDIAN	Guardian system activated
H2O IN FUEL	Water in fuel
MAP INPUT HI or LO	MAP sensor input high or low
MPRLY BACKFEED	Main Power Relay is Receiving a Current Back feed
MPRLY OUTPUT	Main Power Relay Output
OIL LVL IN HI or LO	Oil level sensor input is high or low
OIL PUMP	Oil pump electrical failure
OIL RESERVE STR	Oil reserve strategy is active
OVERSPEED	Overspeed is activated
PITOT INPUT HI or LO	Pilot Pressure Sensor input is high or low
PORT OVERHEAT	Port cylinder head overheat
SEA TMP IN HI or LO	Sea or lake temperature sensor input is high or low
STAR OVERHEAT	Starboard cylinder head overheat
TPI1 INPUT HI or LO	TPI #1 sensor input is high or low
TPI1 NO ADAPT	ECM is unable to adapt to the current position of the TPI
TPI1 RANGE HI or LO	TPI #1 is above or below the allowable range
TRIM INPUT HI or LO	Trim sensor input is high or low
WARNING HORN	Warning horn fault

Select Function:
1 - FAULT HISTORY
2 - RUN HISTORY
3 - CLEAR FAULT HIST
4 - CLEAR RUN HIST

Select Fault Hist:
1 – FREEZE FRAME
2 – FAULT SECONDS

FREEZE FRAME BUFFERS
0-BREAK-IN
BARO PSI
BATT VOLTS
BLOCK PSI
BOAT SPEED
AIR TMP °F
COOL TMP °F
DEMAND %
ENGINE RPM
ENGINE STATE
FPC TOTAL
FREQ COUNTER
FUEL LEVEL %
SHIFT
LAKE/SEA TMP °F
LOAD%
MPRLY REQ
MAP PSI
OIL LEVEL %
PORT TAB POS
AVAILABLE PWR %
RUN TIME
STAR TAB POS
TPI %
TRIM POSITION
COOL TMP STB °F
COOL TMP PRT °F

FAULT SECONDS
BATT VOLT HIGH
BATT VOLT LOW
BLOCK PRESS LOW
COMP OVERHEAT
ETC MOTOR OPEN
ETC MOTOR SHORT
FUEL P INPUT HI
FUEL P INPUT LO
GUARDIAN
KNOCK SENS1
KNOCK SENS2
OIL PSI STR
OIL REMOTE STR
OIL RESERVE STR
MAP INPUT HI
MAP INPUT LO
MAP IDLE CHECK
OIL PUMP
OVERSPEED
PORT OVERHEAT
STAR OVERHEAT
WARNING HORN
H2O IN FUEL

RUN TIME HR.
RPM 0 – 749
RPM 750 – 1499
RPM 1500 – 2999
RPM 3000 – 3999
RPM 4000 – 4499
RPM 4500 – 4999
RPM 5000– 5499
RPM 5500 – 6249
RPM 6250 +
BREAK-IN LEFT
RPM LIMIT Sec
GRD LIMIT Sec
ACT TEMP Sec
BLOCK PSI Sec
CTS TMP Sec
CTP TEMP Sec
LOW OIL Sec
OIL PMP Sec

Select Function:
1 - OIL PUMP PRIME
2 - CYLINDER MISFIRE
3 - OUTPUT LOAD TEST
4 - RESET BREAK-IN OIL
5 - CHANGE FUEL OFFSET
6 - ENGINE LOCATION

Select Load Test:
1 - IGNITION
2 - FUEL INJECTOR
3 - DIRECT INJECTOR
4 - OIL PUMP
5 - FUEL PUMP
6 - HORN
7 - Reserve
8 - TACHOMETER
9 - MAIN POWER RELAY

DFI Troubleshooting Guide		
Symptom	**Cause**	**Action**
1. Engine cranks but won't start	**1.0** Lanyard stop switch in wrong position.	Reset lanyard stop switch.
	1.1 Weak battery or bad starter motor, battery voltage drops below 8 volts while cranking (ECM cuts out below 8 volts) (Fuel pump requires 9 volts).	Replace/charge battery. Inspect condition of starter motor. Check condition of battery terminals and cables.
	1.2 Low air pressure in rail (less than 70 psi at cranking)	Inspect air system for leaks. Inspect air filter for plugging (air pressure measured on port rail). Inspect air compressor reed valves if necessary.
	1.3 No fuel	Check that primer bulb is firm. Key-on engine to verify that fuel pump runs for 2 seconds and then turn off. Measure fuel pressure (valve on starboard rail). Fuel pressure should be 10 ± 1 psi greater than the air pressure.
	1.4 Low fuel pressure	Check fuel pressure from low pressure electric fuel pump (6–10 psi). Check for fuel leaks. If fuel pressure leaks down faster than air pressure, seals on fuel pump may be leaking. Check air system pressure, see **1.2**.
	1.5 Flywheel misaligned during installation	Remove flywheel and inspect.
	1.6 Blown fuse	Replace fuse. Inspect engine harness and electrical components.
	1.7 Main Power Relay not functioning	Listen for relay to "click" when the key switch is turned on.
	1.8 Spark Plugs	Remove fuel pump fuse. Unplug all direct injector connectors. Remove spark plugs from each cylinder. Connect spark plug leads to Spark Gap Tester 91-850439T. Crank engine or use DDT output load test for each ignition coil and observe spark. If no spark is present, replace appropriate ignition coil. If spark is present, replace spark plugs.

DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
1. Engine cranks but will not start (continued)	**1.9** ECM not functioning	Injection System: Listen for injector "ticking" when cranking or connect spare injector to each respective harness. Ticking should start after 2 cranking revolutions. Ignition System: – Check for proper operation by using Inductive Timing Light 91-99379. – Check battery voltage (RED/YEL Lead) @ ignition coils. – Check for blown fuse (C15). – Check battery voltage to fuse from main power relay (PURPLE Lead). – Check for shorted stop wire (BLK/YEL). – Check crank position sensor setting [0.025 in. – 0.040 in. (0.64 mm – 1.02 mm)] from flywheel or for defective crank position sensor. – Defective ECM. Power Supply: Clean and inspect remote control male and female harness connectors.
	1.9A Crank Position Sensor not functioning	– Sensor faulty. – Bad connection – Air gap incorrect
2. Engine cranks, starts and stalls	**2.0** Low air pressure in rail	See **1.2**
	2.1 Low fuel pressure in rail	See **1.2** and **1.3**
	2.2 Abnormally high friction in engine	Check for scuffed piston or other sources of high friction.
	2.3 Air in fuel system/lines	See **1.3** Crank and start engine several times to purge.
	2.4 TPS malfunction	Check motion of throttle arm. Stop nuts should contact block at idle and WOT. Check TPS set-up. Must connect DDT with adapter harness (84-822560A5) to ECM.
	2.5 Remote control to engine harness connection is poor	Clean and inspect male and female connectors.

DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
3. Engine idle is rough	**3.1** Low air pressure in rail (less than 79 ± 2 psi while running)	See **1.2**
	3.2 Fouled spark plug	Replace spark plug: –If carbon bridges electrode gap or if it is completely black. –If it is not firing and is wet with fuel. *Note: If spark plug is grey or completely black with aluminum specs, this indicates a scuffed piston.*
	3.3 Failed direct injector	Refer to ohm test.
	3.4 Failed fuel injector	Refer to ohm test.
	3.5 Bad coil/weak spark	Refer to ohm test.
	3.6 Bad dual coil driver	Replace dual coil driver.
	3.7 Flywheel misaligned during installation	Remove flywheel and inspect.
4. Engine idles fast (rpm >1100) or surges	**4.1** Broken fuel pressure regulator or tracker diaphragm	Measure fuel pressure. Remove and inspect diaphragms (a special tool is required for assembly).
	4.2 Fuel leak	Check for fuel entering induction manifold or air compressor inlet. Vapor Separator flooding over.
	4.3 Tracker Valve spring missing	Inspect tracker valve for proper assembly.
	4.4 Improper set-up	Check throttle cable & cam roller adjustment.
	4.5 TPS malfunction	See **2.4**
5. Engine runs rough below 3000 rpm	**5.1** Fouled spark plug	See **3.2**
	5.2 Low air pressure in rail	See **1.2**
	5.3 Throttle misadjusted	Check throttle cam setup on induction manifold. Inspect linkage and roller. If throttle plate stop screws have been tampered with, contact Mercury Marine Service Department for correct adjustment procedures.
	5.4 Bad coil/weak spark	See **3.5**
	5.5 Bad dual coil driver	Replace dual coil driver
	5.6 TPS malfunction	See **2.4**
6. Engine runs rough above 3000 rpm	**6.1** Fouled spark plug	See **3.2**
	6.2 Speed Reduction	See **7**
	6.3 Low air pressure in rails	See **1.2**
	6.4 TPS malfunction	See **2.4**

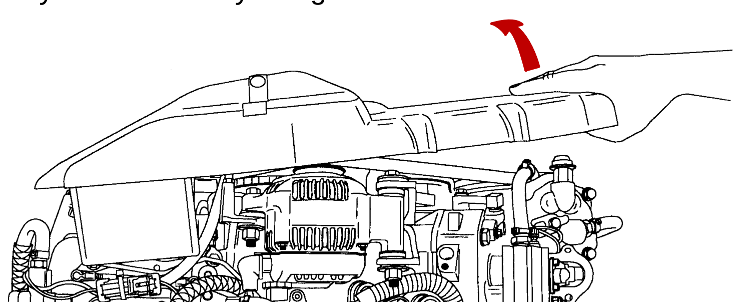
DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
7. Speed Reduction (RPM reduced)	**7.1** Low battery voltage ECM requires 8 volts minimum Fuel Pump requires 9 volts	Check battery and/or alternator. Check electrical connections.
	7.2 Overheat condition (engine and/or air compressor)	Check water pump impeller/cooling system.
	7.3 Oil pump electrical failure	Check electrical connection.
	7.4 TPS failure If TPS and MAP Sensor fails, rpm is reduced to idle	Check electrical connections.
8. Engine RPM reduced to idle only	**8.1** TPS and MAP Sensor failed	See **2.4**
	8.2 Battery voltage below 9.5 volts	Use DDT to monitor system
9. Loss of spark on 1 cylinder	**9.1** Loose wire or pin in connectors between ECM and coil primary.	Check connectors.
	9.2 Faulty ignition coil.	Replace coil.
	9.3 Faulty dual coil driver	Replace dual coil driver
	9.4 Faulty spark plug.	Replace spark plug.
	9.5 Faulty spark plug wire	Replace spark plug wire.

Ignition Components Removal and Installation

Flywheel Cover Removal and Installation

REMOVAL

Remove flywheel cover by lifting off.



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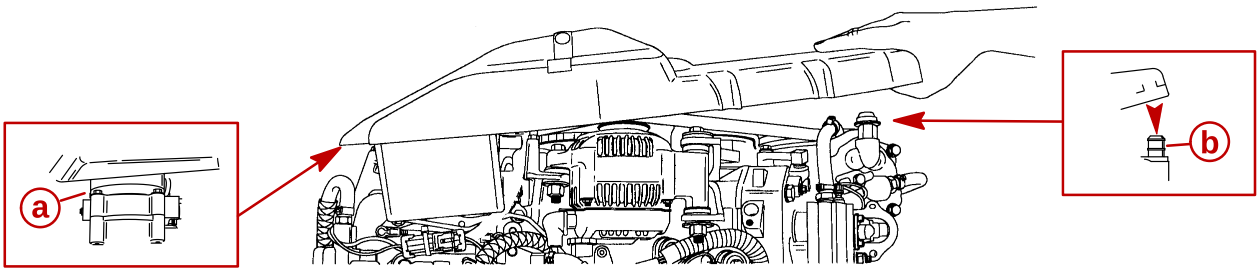
INSTALLATION

Install flywheel cover as follows:

a. Place cover onto the front flange (a).

b. Push rear of the cover down onto the rear pin and air intake tube (b) for the air compressor.



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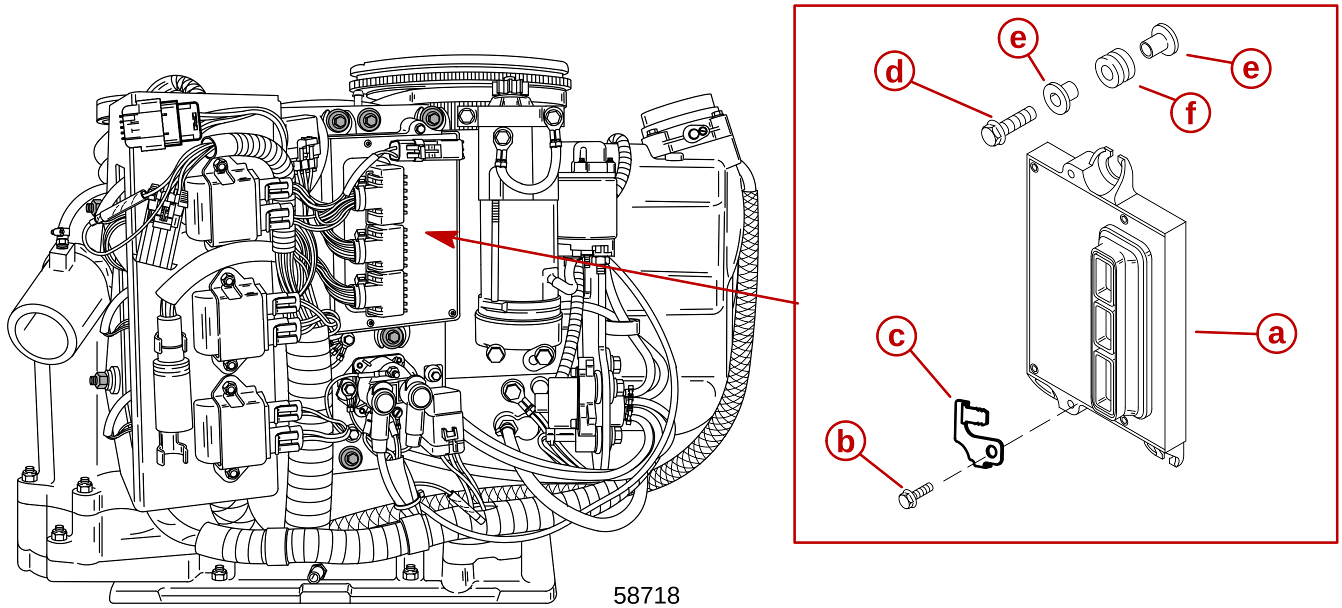
Electronic Control Module (ECM)

REMOVAL

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



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a - Electronic Control Module
b - Screw [Torque to 100 lb in. (11.5 Nm)]
c - Bracket
d - Screw [Torque to 70 lb in. (8.0 Nm)]
e - Bushing
f - Grommet

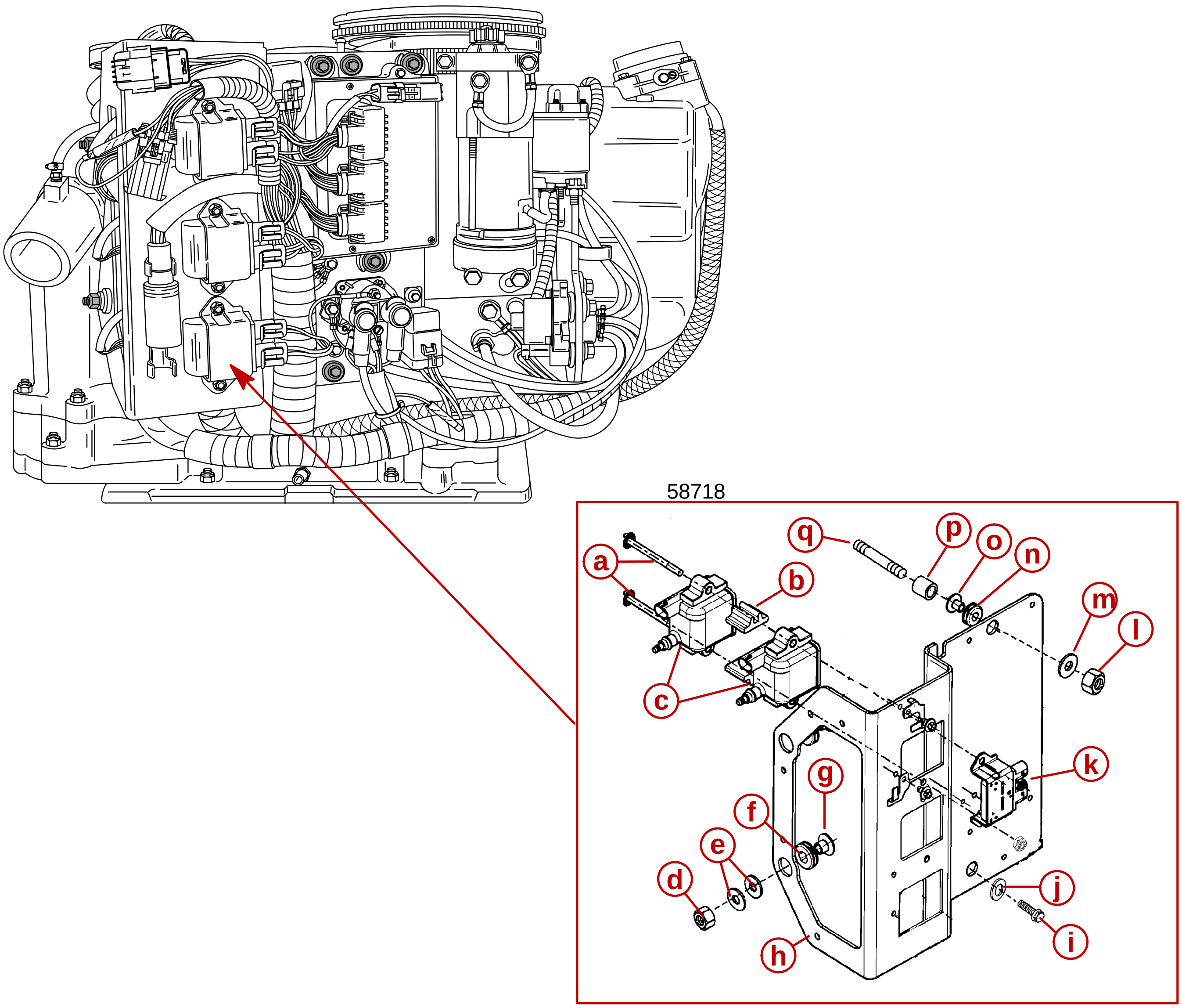
INSTALLATION

1. Secure ECM to powerhead with 3 bolts.
2. Reconnect harness connectors.

Ignition Module (Coil)

REMOVAL

1. Disconnect spark plug leads from coil towers.
2. Disconnect water pressure sensor harness.
3. Disconnect crank position sensor harness.
4. Remove 3 nuts and 1 screw securing electrical component.



a - Bolts (6) –Torque to 100 lb-in (11.3 Nm).
b - Spacer – Place on Bolts between Coils
c - Ignition Coils (6)
d - Nut (2) – Torque to 20 lb. ft. (27 Nm)
e - Washers (4)
f - Grommet (2)
g - Bushing (2)
h - Bracket
i - Screw – Torque to 100 lb. in. (11 Nm)
j - Washer
k - Dual Coil Driver (3)
l - Nut – Torque to 100 lb. in. (11 Nm)
m - Washer
n - Grommet
o - Bushing
p - Spacer
q - Stud

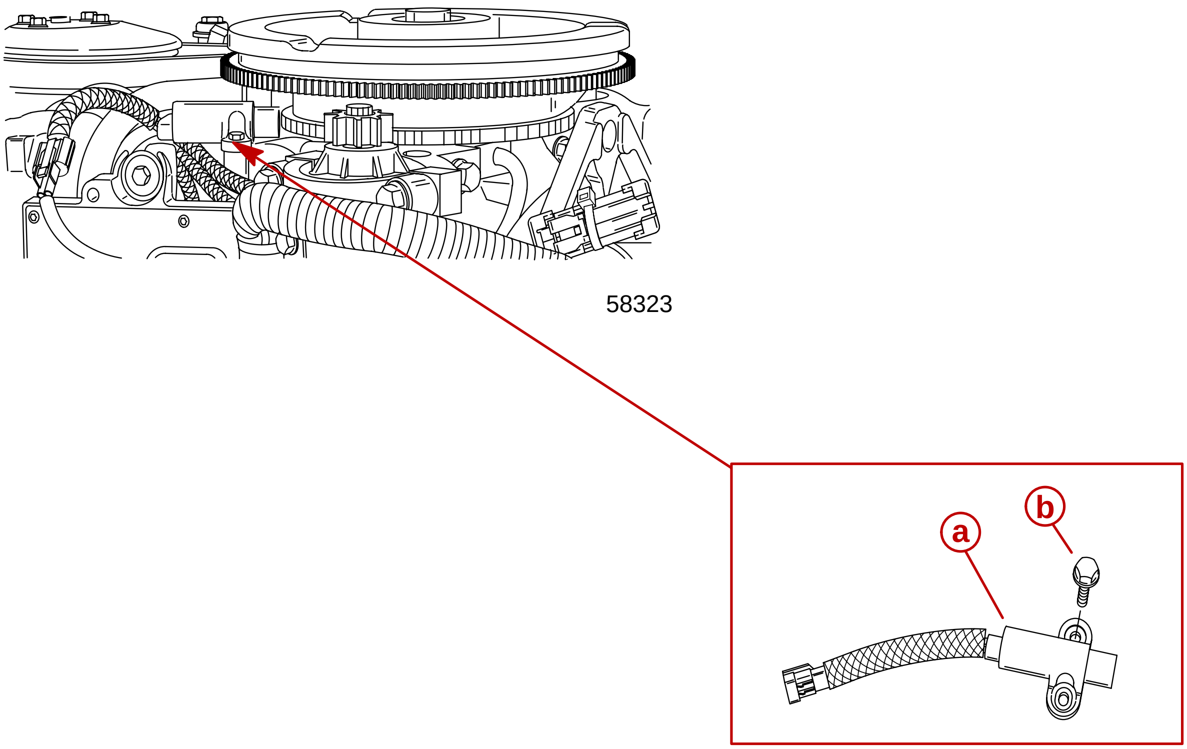
INSTALLATION

1. Fasten coils to electrical mounting plate as shown.
2. Reinstall electrical mounting plate.
3. Reconnect spark plug lead and coil harness.

Crank Position Sensor

REMOVAL

1. Disconnect harness.
2. Remove screws securing sensor to engine.



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a - Crank Position Sensor
b - Screws – Torque to 45 lb. in (5.0 Nm)

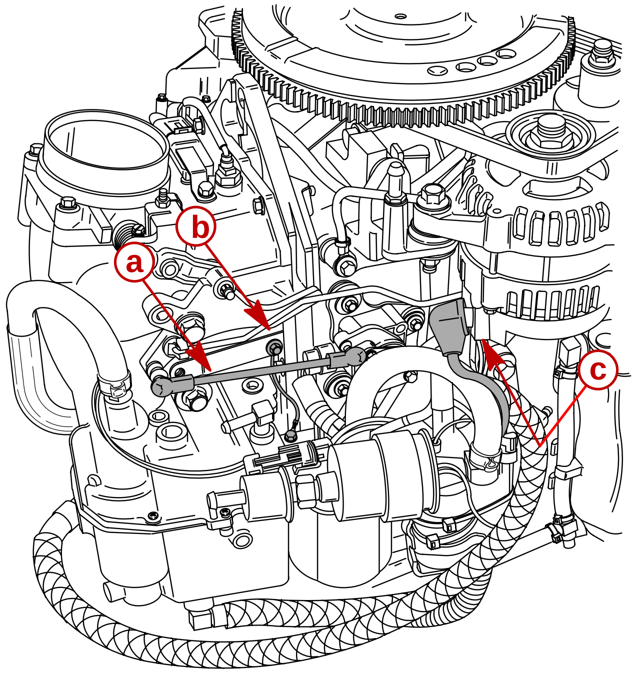
INSTALLATION

1. Fasten sensor to engine with screws. Torque screws to 45 lb. in. (5.0 Nm)
2. Reconnect sensor harness.

Throttle Position Sensor (TPS)

REMOVAL

1. Disconnect TPS link arm.
2. Remove ground lead bolt from vapor separator.
3. Disconnect sensing circuit connector from bottom of alternator.



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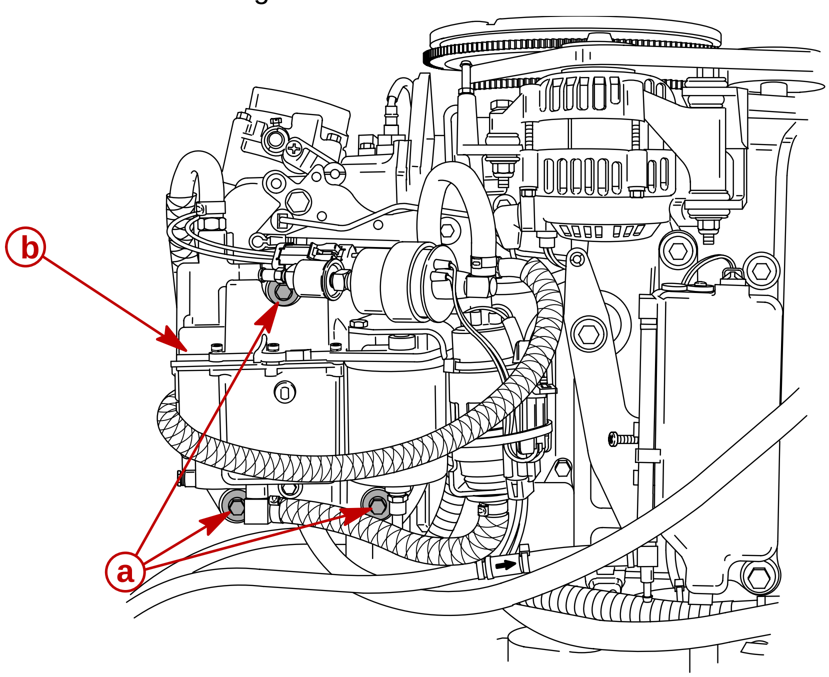
a - TPS Link Arm
b - Ground Lead Bolt
c - Sensing Circuit Connector

4. Remove 3 screws securing vapor separator and move separator to gain access to TPS retaining screws.



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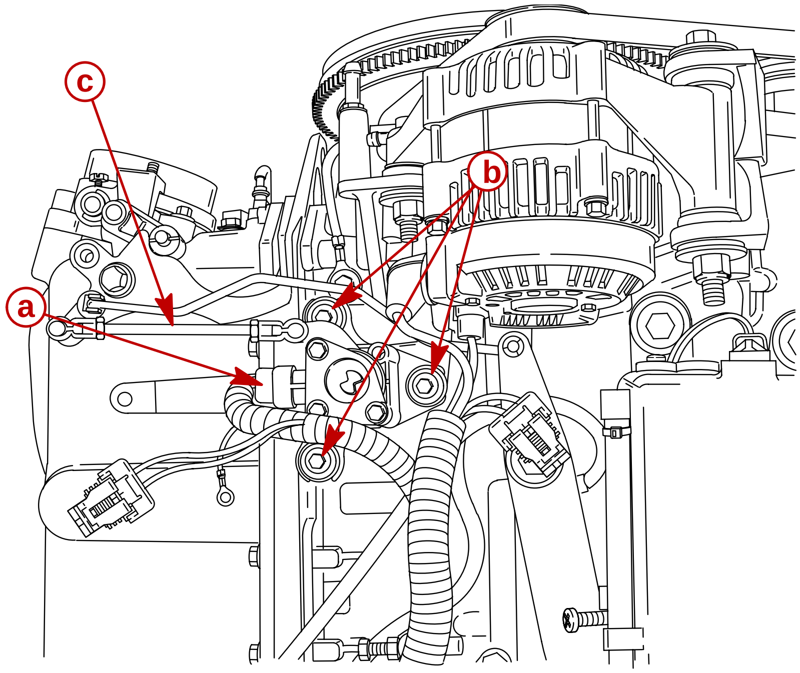
a - Screws
b - Vapor Separator

5. Disconnect TPS connector.
6. Remove 3 screws securing TPS and remove TPS.



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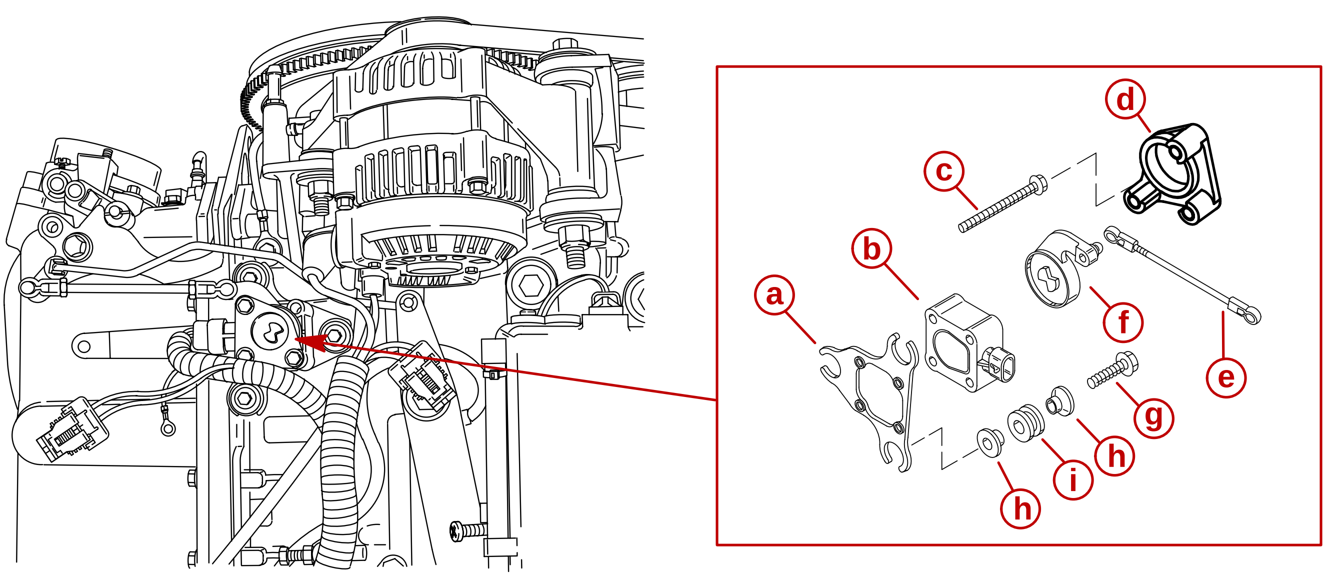
a - TPS Connector
b - Screws
c - TPS Link Arm – Disconnect

INSTALLATION

1. Fasten sensor and bracket to engine as shown.
2. Reconnect wiring harness.



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a - Bracket
b - Sensor
c - Screw (3) – Torque to 20 lb. in (2.5 Nm).
d - TPS Cover
e - Throttle Link
f - TPS Lever
g - Screw [Torque to 70 lb. in. (8.0 Nm)]
h - Bushing (2)
i - Grommet

ELECTRICAL

Section 2B – Charging & Starting System

Table of Contents

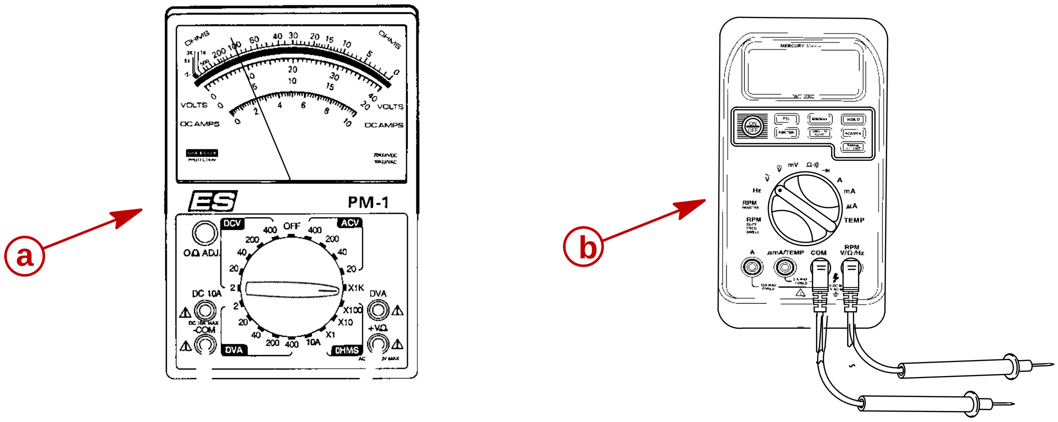
Specifications 2B-1
Special Tools 2B-2
Battery Cable Size 2B-3
Replacement Parts 2B-3
Recommended Battery 2B-3
Battery 2B-4
Precautions 2B-4
Charging a Discharged Battery 2B-4
Winter Storage of Batteries 2B-5
Flywheel Removal and Installation 2B-6
Removal 2B-6
Installation 2B-7
Flywheel/Alternator 2B-8
System Components 2B-10
Precautions 2B-10
Alternator Description 2B-11
Diagnosis of Alternator System on Engine . . 2B-11
Alternator System Circuitry Test 2B-12
Output Circuit 2B-12
Sensing Circuit 2B-13
Voltage Output 2B-14
Current Output 2B-15
Current Output Troubleshooting 2B-16
Repair 2B-16
Removal 2B-16
Installation 2B-17
Alternator Belt Tension Adjustment 2B-18
Starter System 2B-18
Starter Motor Amperes Draw 2B-18
Starter System Components 2B-18
Description 2B-18
Starter Motor (Solenoid Driven Bendix) 2B-20
Troubleshooting the Solenoid Driven Bendix Starter Circuit 2B-22
Starter Circuit Troubleshooting Flow Chart . . 2B-23
Starter Removal and Installation 2B-25
Removal 2B-25
Installation 2B-26
Disassembly 2B-27
Cleaning and Inspection 2B-30
Reassembly 2B-31
Starter Cleaning, Inspection and Testing . . . 2B-34
Cleaning and Inspection 2B-34
Testing Solenoid Driven Bendix Starters . 2B-35
Slave Solenoid Test 2B-37
Commander 2000 Key Switch Test 2B-38

Specifications

CHARGING SYSTEM	**Alternator Output (Regulated)** **Brush Length** **Voltage Output** **Regulator Current Draw**	32 - 38 Amperes @ 2000 RPM @ Battery 52 - 60 Amperes @ 2000 RPM @ Alternator Std Exposed Length: 0.413 in. (10.5 mm) Min. Exposed Length: 0.059 in. (1.5 mm) 13.5 to 15.1 Volts 0.15 mA (Ign. Switch Off) 30.0 mA (Ign. Switch On)
STARTING SYSTEM	**Starter Draw (Under Load)** **Starter Draw (No Load)** **Minimum Brush Length** **Battery Rating**	170 Amperes 60 Amperes 0.25 in. (65.4 mm) 1000 (Minimum) Marine Cranking Amps (MCA) 750 (Minimum) Cold Cranking Amps (CCA) 105 (Minimum) Amp Hour

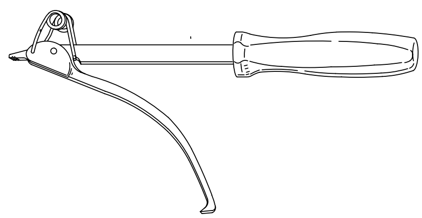
Special Tools

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



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

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



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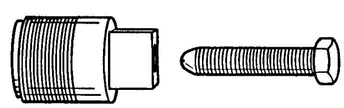
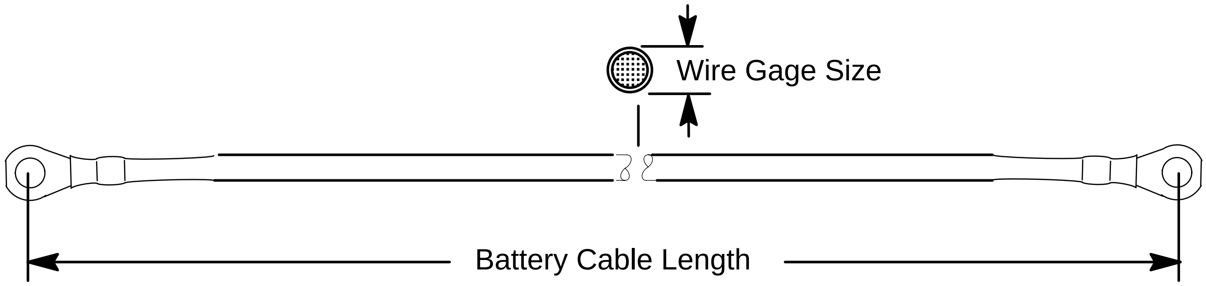
4. Protector Cap 91-24161

5. Flywheel Puller 91-73687A1



Battery Cable Size

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



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

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

Replacement Parts

⚠ WARNING

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

Recommended Battery

A 12 volt marine battery with a minimum Cold Cranking amperage rating of 750 amperes or 1000 (minimum) Marine Cranking amperes should be used.

Battery

Precautions

CAUTION

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

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

The following precautions should be observed to prevent an explosion.

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

Charging a Discharged Battery

WARNING

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

The following basic rule applies to any battery charging situation:

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

4. To check battery voltage while cranking engine with electric starting motor, place RED (+) lead of tester on POSITIVE (+) battery terminal and BLACK (–) lead of tester on NEGATIVE (–) battery terminal. If the voltage drops below 9-1/2 volts while cranking, the battery is weak and should be recharged or replaced.

Winter Storage of Batteries

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

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

Flywheel Removal and Installation

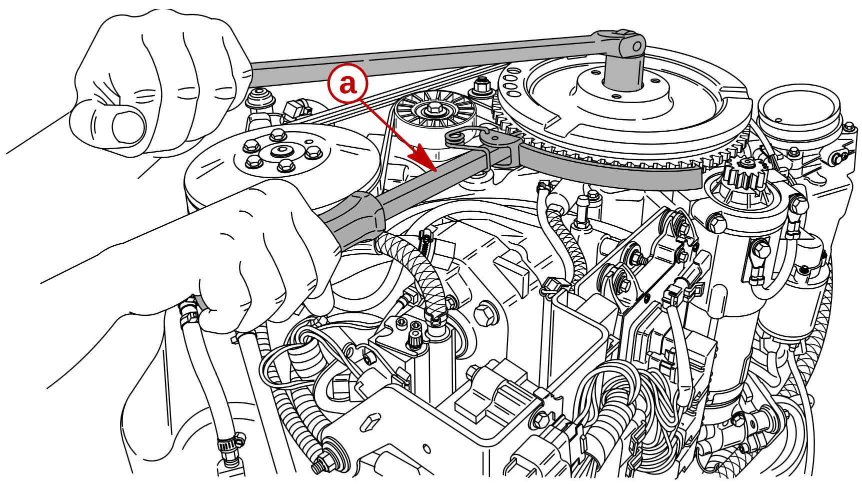
Removal

1. Remove flywheel cover from engine.

⚠ WARNING

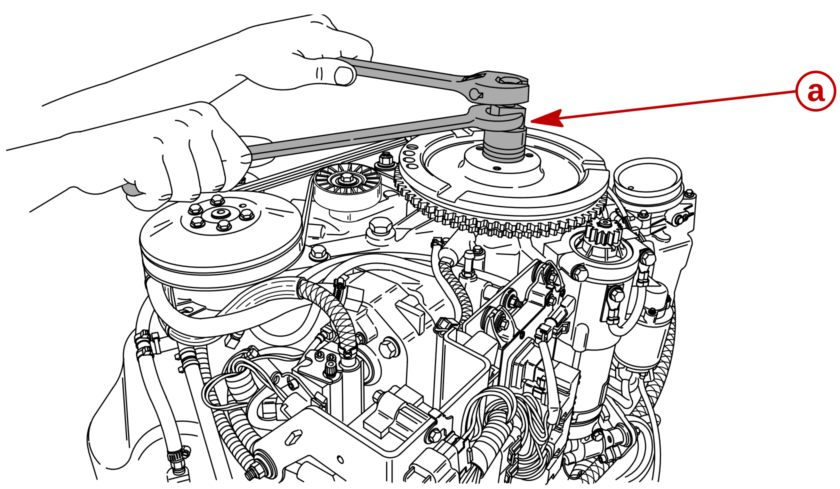
Engine could possibly start when turning flywheel during removal and installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

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



a - Flywheel Holder (91-25344)

4. Install a crankshaft Protector Cap (91-24161) on end of crankshaft, then install Flywheel Puller (91-73687A2) into flywheel.
5. Hold flywheel tool with wrench while tightening bolt down on protector cap. Tighten bolt until flywheel comes free.



a - Flywheel Puller (91-73687A2)

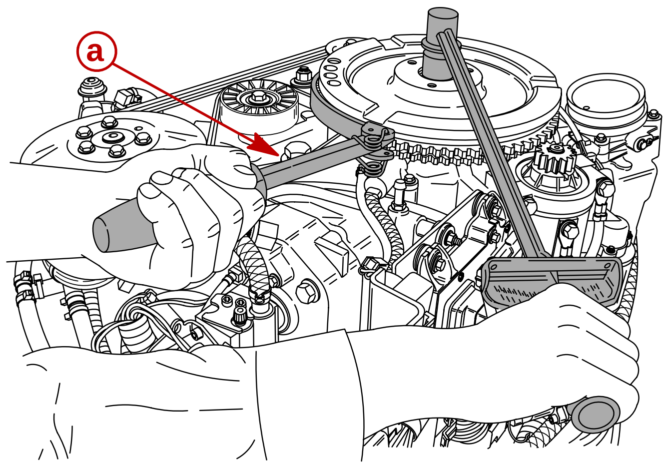
NOTE: *Neither heat or hammer should be used on flywheel to aid in removal as damage to flywheel or electrical components under flywheel may result.*

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

Installation

IMPORTANT: Clean flywheel/crankshaft taper with solvent and assemble dry.

1. Install flywheel.
2. Install flywheel washer and nut.
3. Hold flywheel with Flywheel Holder (91-52344). Torque nut to 125 lb-ft (169.5 Nm).



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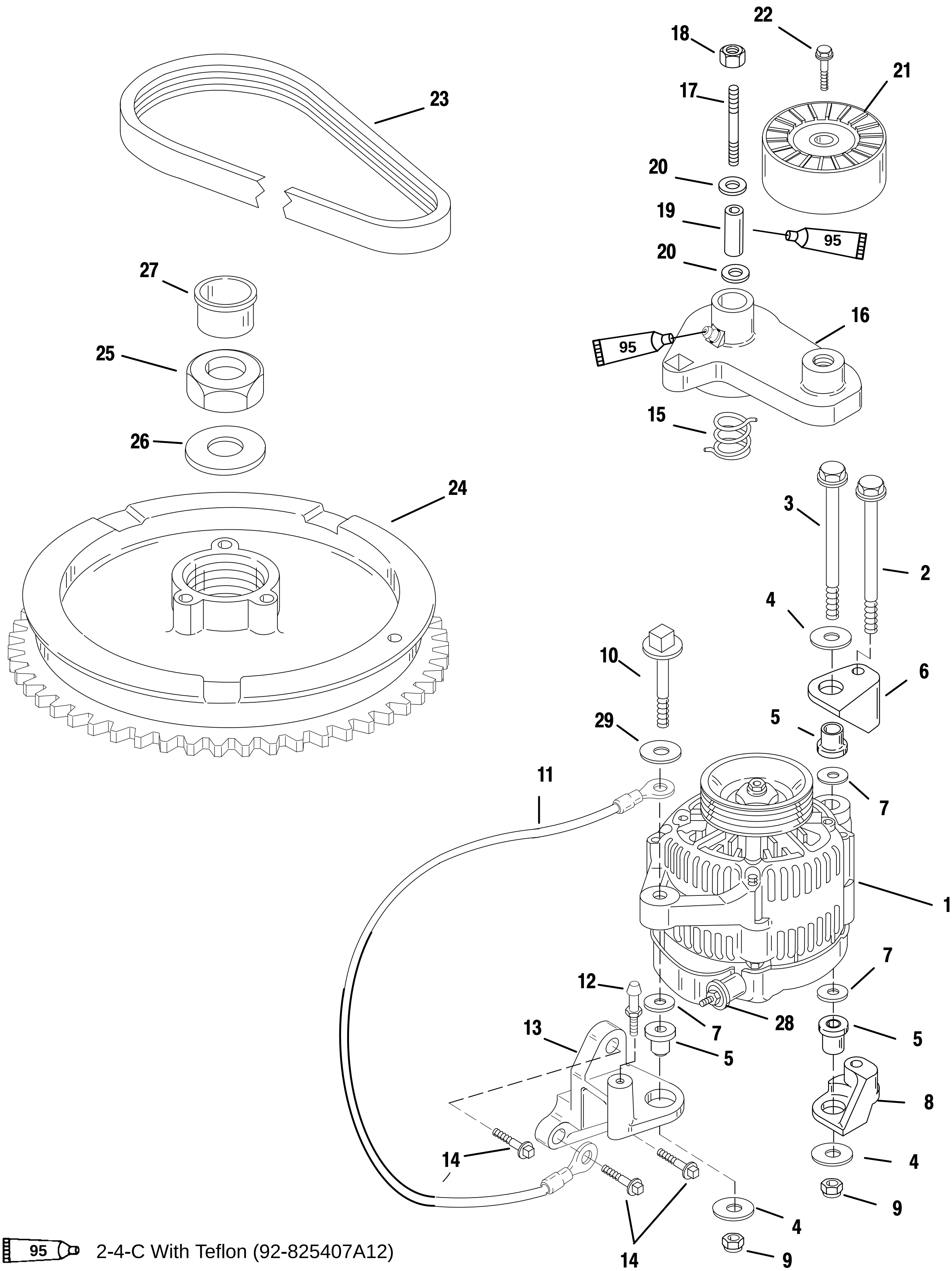
a - Flywheel Holder (91-52344)

Flywheel/Alternator



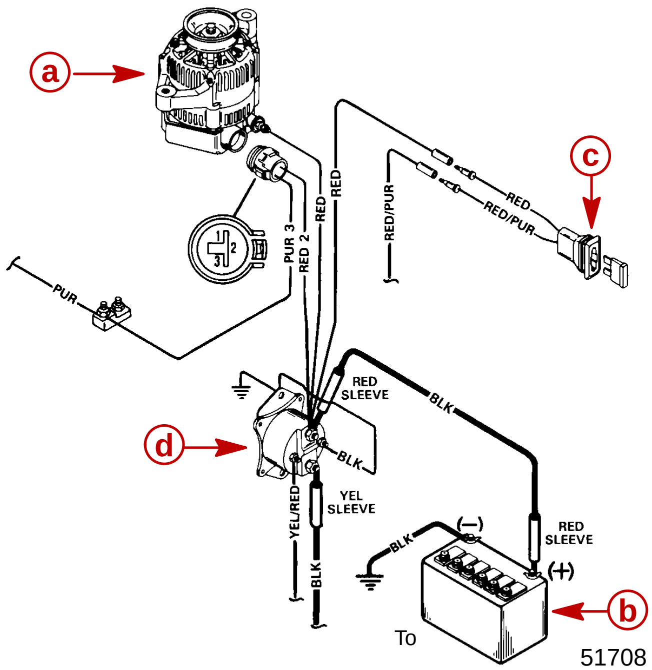
95 2-4-C With Teflon (92-825407A12)

Flywheel/Alternator

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	Nm
1	1	ALTERNATOR			
2	1	SCREW (M10 x 100)		40	54
3	1	SCREW (M10 x120)		40	54
4	3	WASHER			
5	3	MOUNT			
6	1	BRACKET			
7	3	WASHER			
8	1	BRACKET			
9	2	NUT		25	34
10	1	SCREW (M10 x 55)		25	34
11	1	CABLE			
12	1	PIN			
13	1	BRACKET			
14	3	SCREW (5/16-18 x 1 IN.)		15.5	21
15	1	SPRING			
16	1	BELT TENSIONER ARM ASSY			
17	1	STUD (M10 x 85)			
18	1	NUT		15	20
19	1	BUSHING			
20	2	WASHER			
21	1	PULLEY			
22	1	SCREW (M10 x 35)		25	34
23	1	BELT			
24	1	FLYWHEEL			
25	1	NUT (M16X1.5)		125	170
26	1	WASHER			
27	1	PLUG			
28	1	NUT	110		12
29	1	WASHER			

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 been 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.

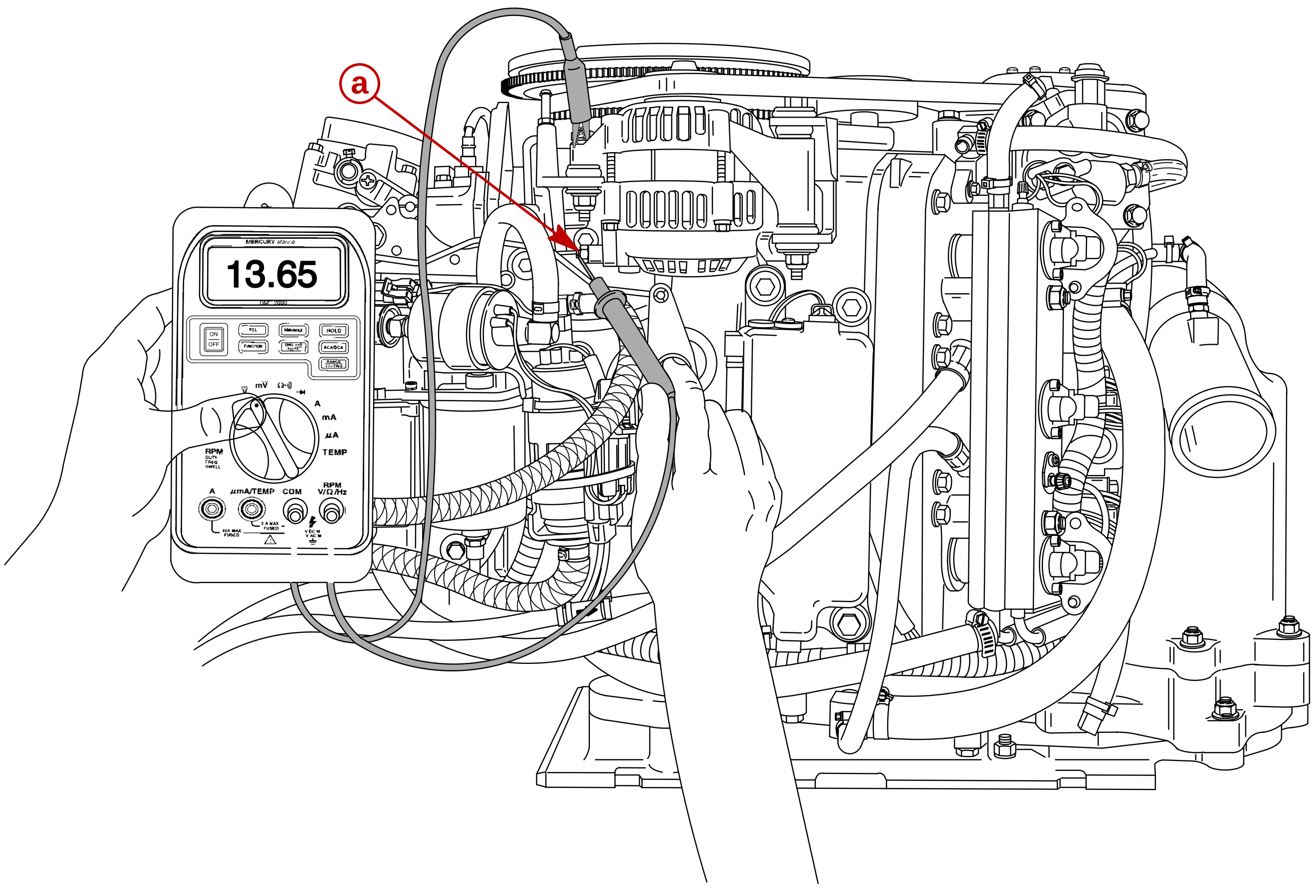
4. Check alternator drive belt for cracks and fraying. Replace if necessary. Check belt tension. Adjust if necessary, as outlined under “**Drive Belt Replacement and Adjustment.**”

Alternator System Circuitry Test

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

Output Circuit

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

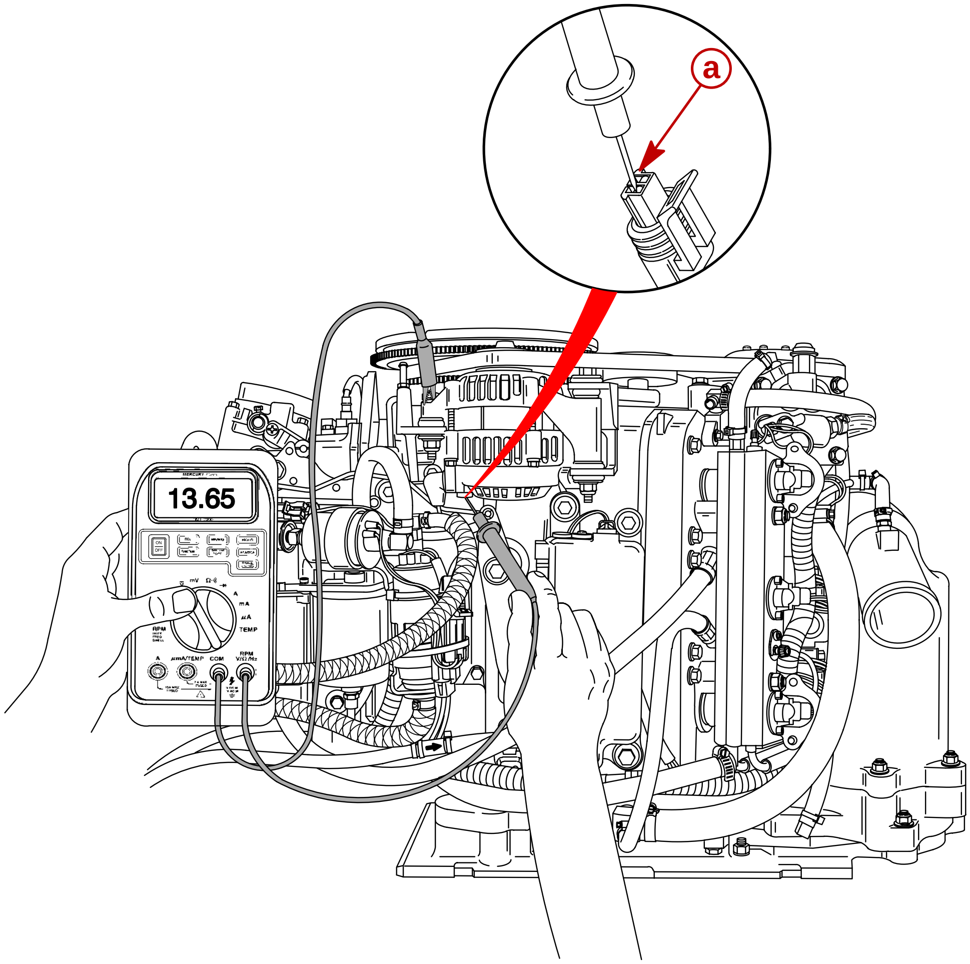


58727

a - Terminal B

Sensing Circuit

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



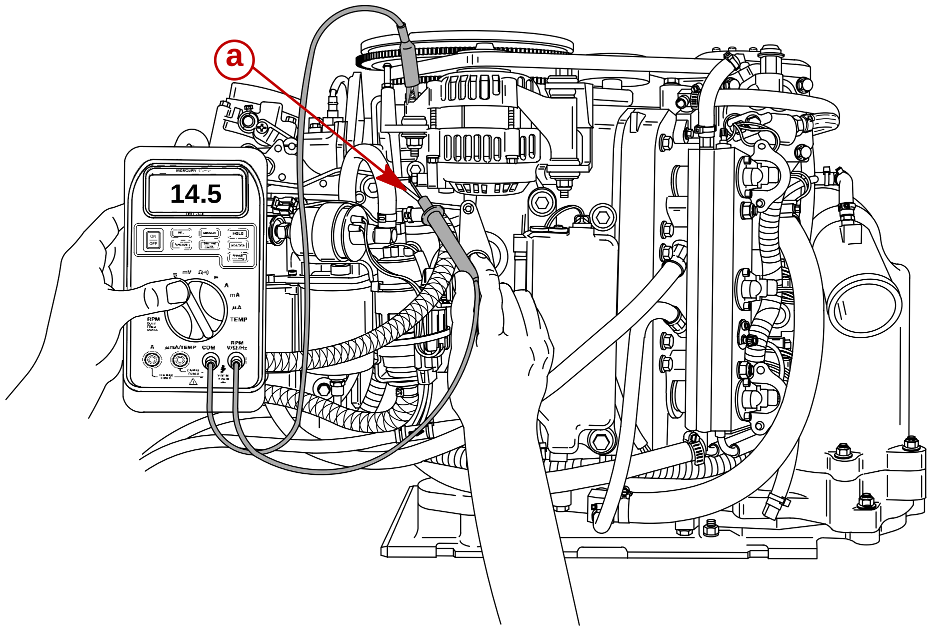
58726

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.
2. Start engine and allow to warm up. Increase engine RPM from idle to 2000. At ambient temperature normal voltage output should be 14.2 – 15. volts.

NOTE: *If alternator is under-charging check connections. If alternator is over-charging replace alternator.*



58727

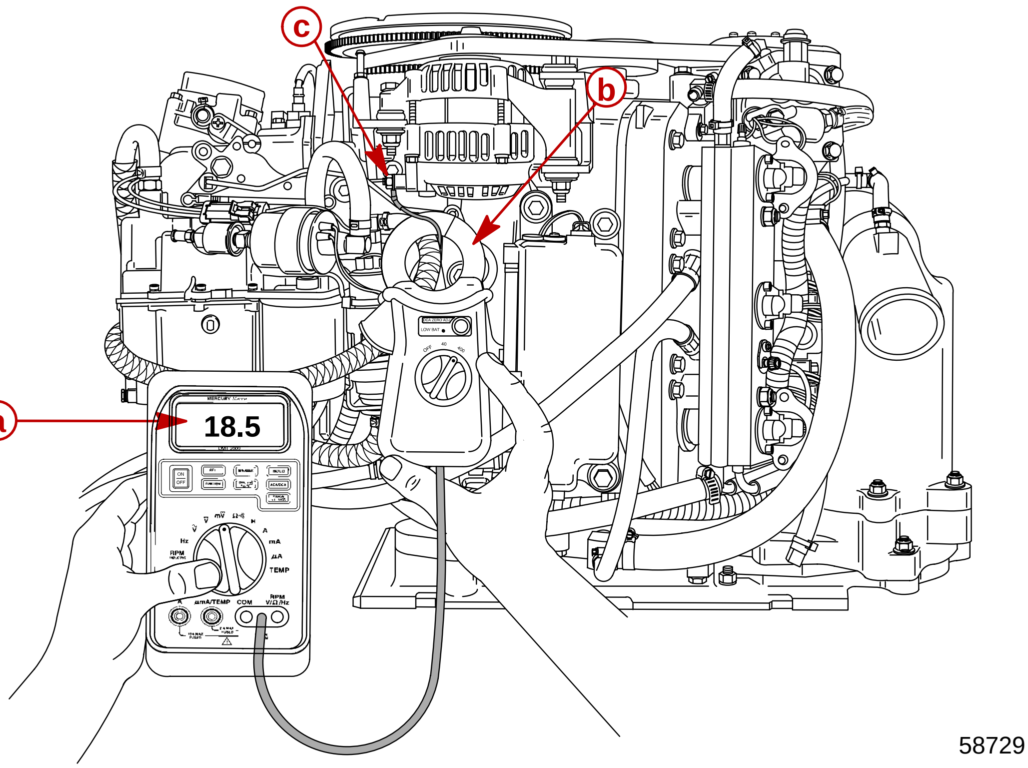
a - Terminal B

Current Output

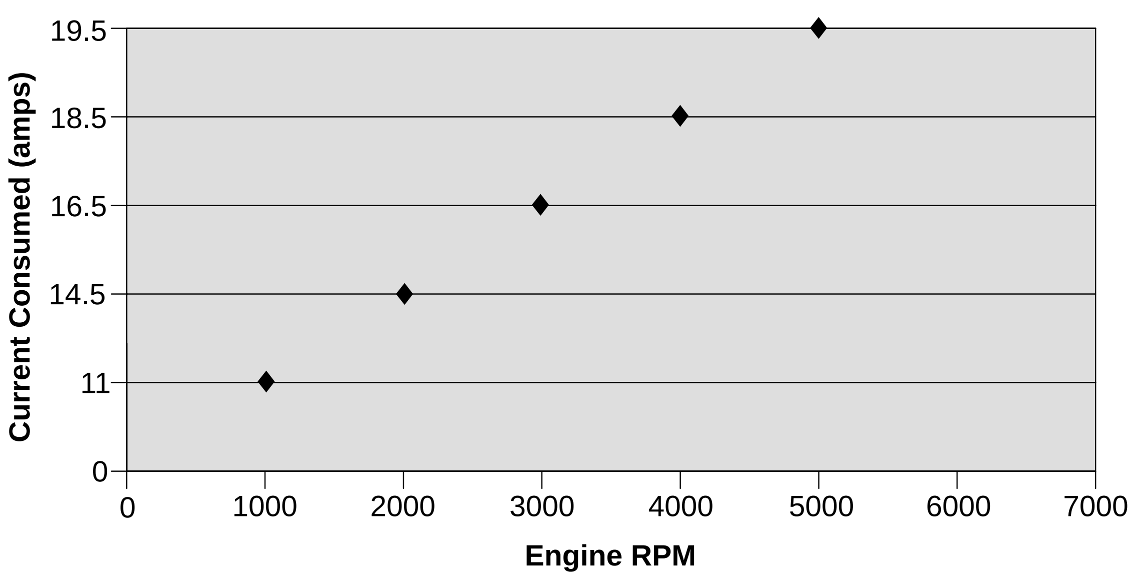
NOTE: *Before conducting current output test, assure that all boat electrical accessories are turned* ***OFF****.*

1. With engine shut off, install ammeter with clamp-on current probe (capable of reading 60+ amperes) onto alternator charging conductor (10 AWG Red Wire).
2. Start engine and allow to warm up.
3. Battery voltage should be between 14.2 and 15.0 VDC for all engine RPM's.

Alternator output current should correspond with graph below. **Example:** If engine is revolving at 2000 RPM current meter should be approximately 14.5 ± 3 Amps.



a - Ammeter (DMT 2000 Digital Tachometer Multimeter 91-854009A1)
b - Clamp-On Current Probe (91-802650)
c - Alternator Charging Conductor (10 AWG Red Wire)



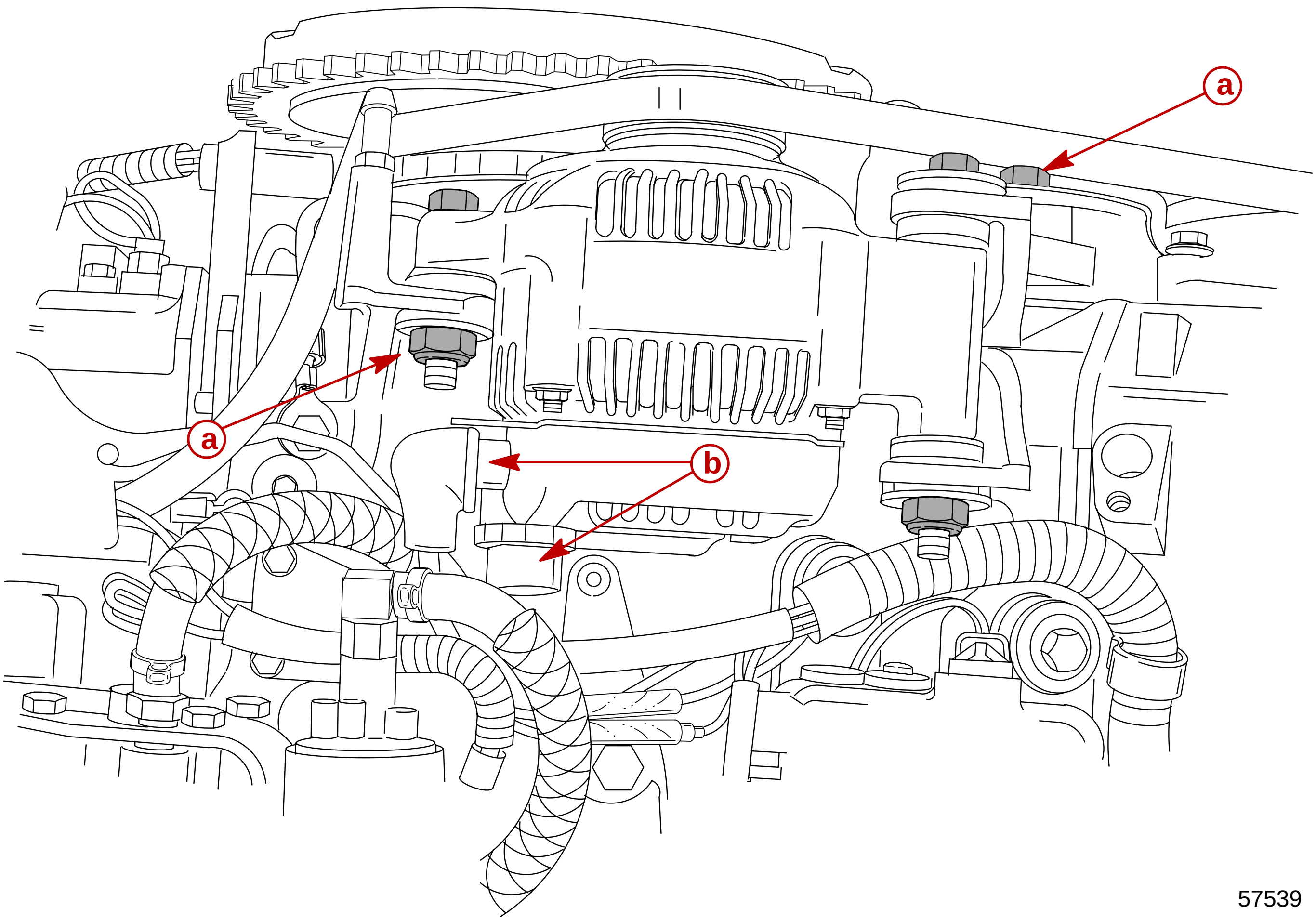
Current Output Troubleshooting

Current Output is Low	Battery Cables are loose or corroded Defective Battery (Open Circuit) Defective Alternator
Current Output is High	Accessories turned on Defective Battery (Internal Short) Defective Alternator

Repair

Removal

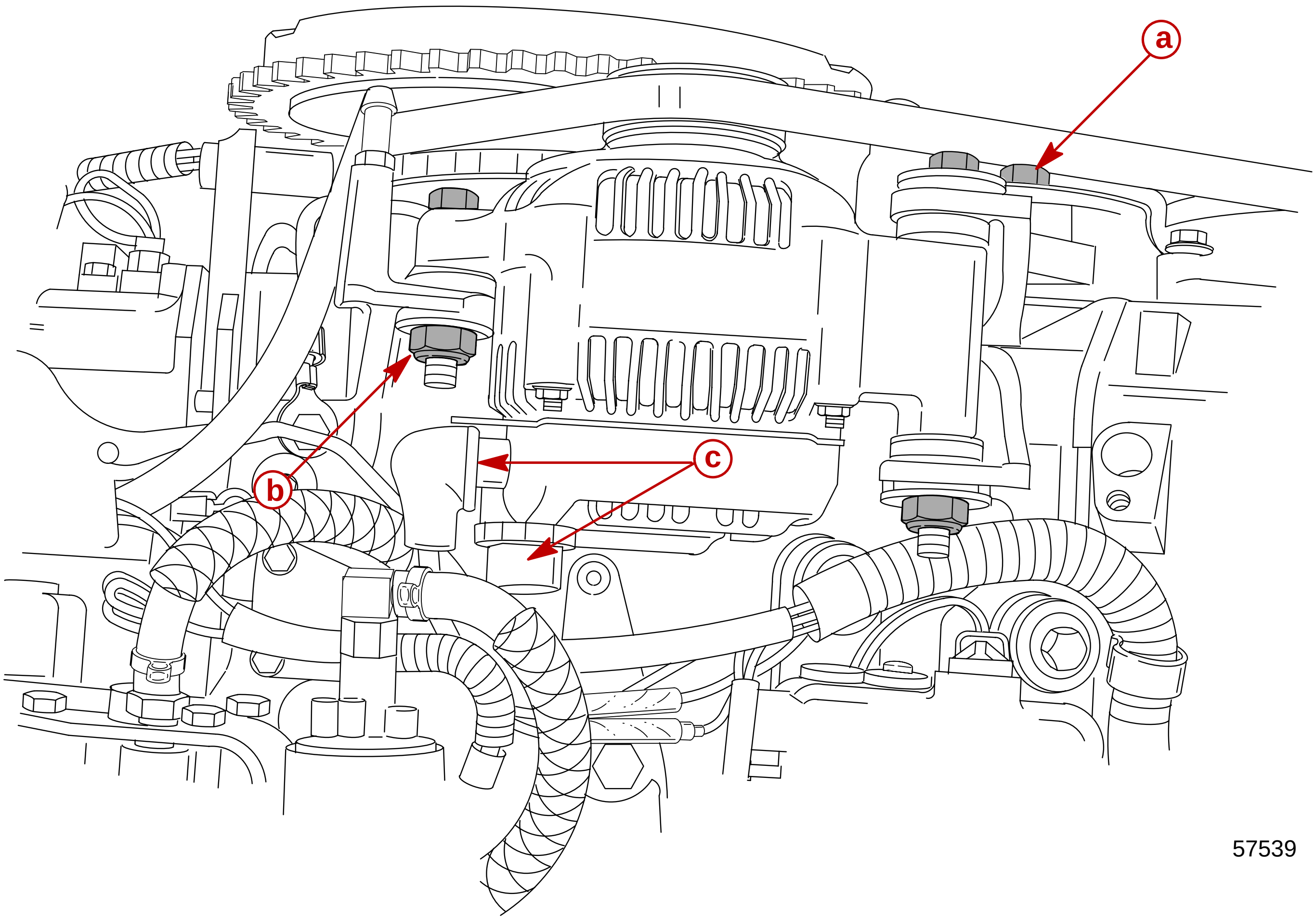
1. Remove top cowling.
2. Disconnect battery cables from battery.
3. Disconnect wiring harness from alternator.
4. Remove pivot bolt and tension bolt.



a - Attaching Bolt   **b** - Harnesses

Installation

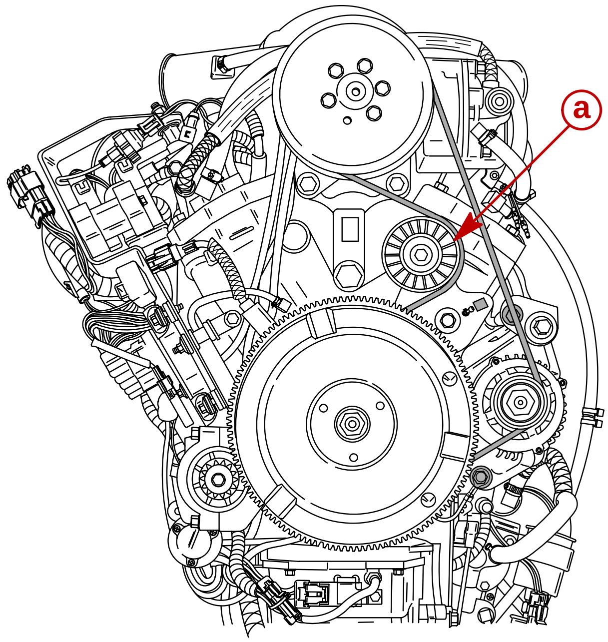
1. Secure alternator to engine block with attaching bolts. Torque top bolt to 40 lb-ft (54 Nm). Torque bottom bolt to 25 lb-ft (34 Nm).
2. Install alternator belt in V-groove of flywheel and alternator pulley.
3. Reconnect electrical harness to alternator.



a - Top Bolt [Torque to 40 lb-ft (54 Nm)]
b - Bottom Nut [Torque to 25 lb-ft. (34 Nm)
c - Harnesses

Alternator Belt Tension Adjustment

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



a - Belt Tensioner Assembly

Starter System

Starter Motor Amperes Draw

STARTER MOTOR PART NO.	NO LOAD AMP. DRAW	NORMAL AMP. DRAW
50-833153-1	30 AMPS	165 AMPS
50-853329-1	60 AMPS	170 AMPS

Starter System Components

Battery

Neutral Start Switch

Starter Motor

Ignition Switch

Slave Solenoid

Description

The battery supplies electricity to activate the starter motor. When the ignition is turned to the “START” position, the slave solenoid is energized which in turn activates the starter solenoid, thus completing the starter circuit between the battery and starter.

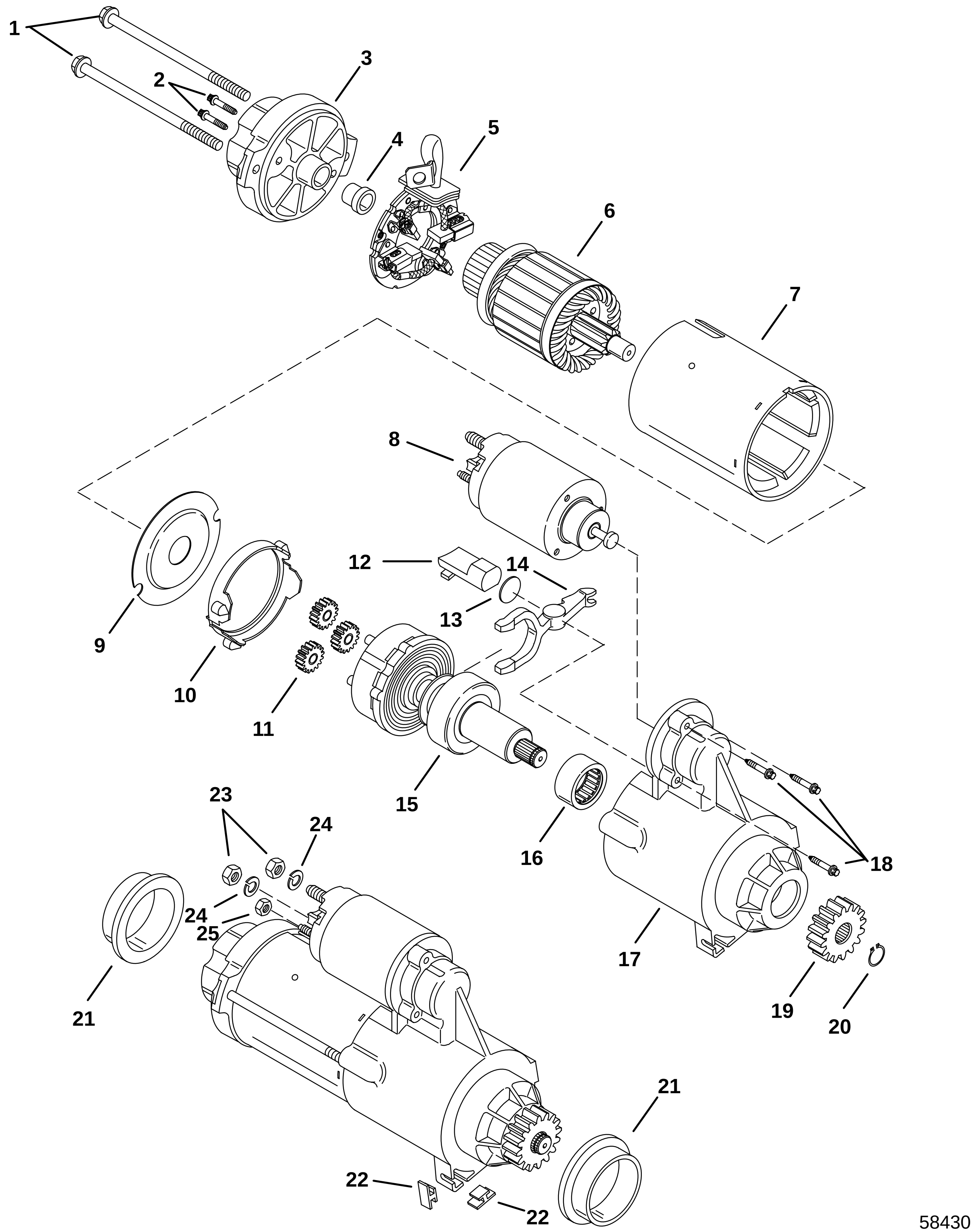
The neutral start switch opens the starter circuit when the shift control lever is not in neutral thus preventing accidental starting when the engine is in gear.

⚠ 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.

Notes:

Starter Motor (Solenoid Driven Bendix)



Starter Motor (Solenoid Driven Bendix)

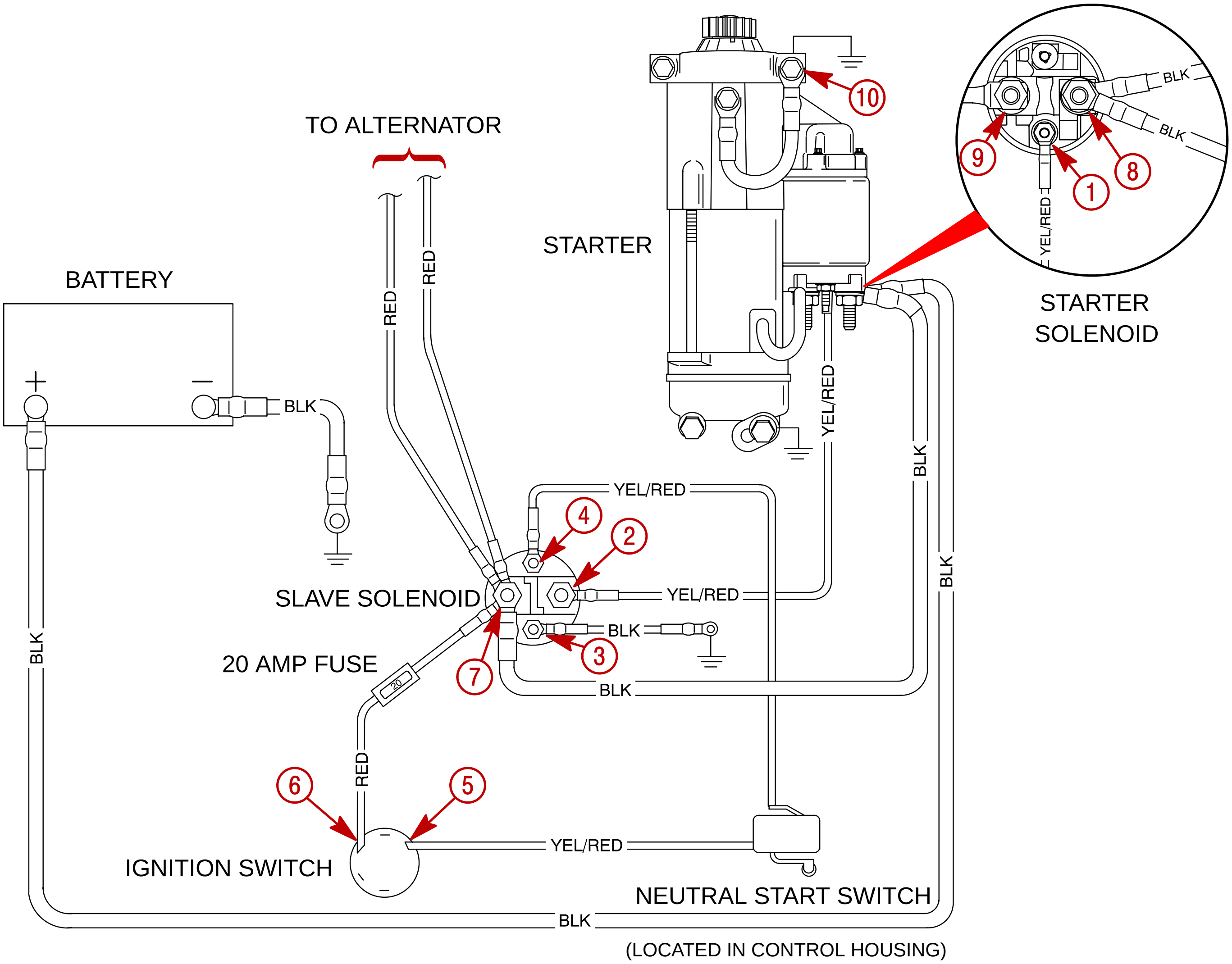
REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	2	THRU BOLT	110		12.5
2	2	SCREWS	30		3.4
3	1	END CAP			
4	1	BUSHING			
5	1	BRUSH PLATE ASSEMBLY			
6	1	ARMATURE			
7	1	FIELD FRAME			
8	1	SOLENOID			
9	1	SHIELD			
10	1	CUSHION			
11	3	PLANETARY GEARS			
12	1	PLUG			
13	1	DISC			
14	1	SHIFT FORK			
15	1	GEAR/CLUTCH ASSEMBLY			
16	1	BEARING			
17	1	HOUSING			
18	3	SCREW	40		4.5
19	1	DRIVE GEAR			
20	1	SNAP RING			
21	2	MOUNTING COLLAR			
22	2	STOP			
23	2	NUT	55		6.0
24	2	WASHER			
25	1	NUT	20		2.3

Troubleshooting the Solenoid Driven Bendix 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.



Solenoid Driven Bendix Starter Circuit

Starter Circuit Troubleshooting Flow Chart (Solenoid Driven Bendix)

Starter Motor Does Not Turn

TEST 1
With ignition key in START position, check for battery voltage at TEST POINT 1.

Voltage indicated and solenoid clicks

Voltage indicated at Test Point 9 is 9.5 volts or greater.

Defective starter motor

Voltage indicated at Test Point 9 is less than 9.5 volts.

Defective starter solenoid

No voltage indicated

Go to TEST 2

Voltage indicated and solenoid does not click

Check for starter motor ground at Test Point 10

Good ground

Defective starter solenoid

Bad ground – clean cable ends or replace ground cable

SAFETY WARNING: Disconnect BLACK with RED sleeve (starter motor) cable from slave solenoid test point 7 BEFORE making tests 1–thru–7 to prevent unexpected engine cranking.

TEST 2
Use an ohmmeter (Rx1 scale) and connect meter leads between NEGATIVE (–) battery post and common powerhead ground.

No Continuity Indicated – There is an open circuit in the BLACK NEGATIVE (–) battery cable between the NEGATIVE (–) battery post and the powerhead.

- Check cable for loose or corroded connections.
- Check cable for open.

Continuity Indicated
Proceed to TEST 3

Test 3
a. Disconnect BLACK ground wire(s) from Test Point 3.
b. Connect voltmeter between common engine ground and Test Point 3.
c. Turn ignition key to "Start" position.

No voltage reading: proceed to TEST 4.

TEST 4
a. Reconnect BLACK ground wire.
b. Connect voltmeter between common engine ground and Test Point 4.
c. Turn ignition key to "Start" position.

12 Volt Reading*
Check BLACK ground wire for poor connection or open circuit.
Reconnect ground wire to starter solenoid.
Proceed to TEST 8.

No voltage reading: proceed to TEST 5

12 Volt Reading
Defective starter solenoid

TEST 5
a. Connect voltmeter between common engine ground and Test Point 5.
b. Turn ignition key to “Start” position.

No voltage reading: proceed to TEST 6

12 Volt Reading*
Neutral start switch is open or YELLOW/RED wire is open between Test Points 5 and 4.

TEST 6
Connect voltmeter between common engine ground and Test Point 6

No voltage reading: proceed to TEST 7

12 Volt Reading*
Defective ignition switch.

TEST 7
Check for voltage between common engine ground and Test Point 7.

No voltage reading: Check BLACK cable with RED sleeve between battery(+) POSITIVE terminal and Test Point 8 and Test Point 7.

12 Volt Reading*
Check fuse in RED wire between Test Points 6 and 7.
Check for open RED wire between Test Points 6 and 7.

TEST 8
a. Connect voltmeter between common engine ground and Test Point 2.
b. Turn ignition key to “Start” position.

No voltage reading: Defective slave solenoid

12 Volt Reading*
Should hear solenoid click: proceed to TEST 9

TEST 9
a. Reconnect BLACK cable (with RED sleeve) to slave solenoid Test Point 7.
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 RED sleeve) for poor connection or open circuit.

*Battery Voltage

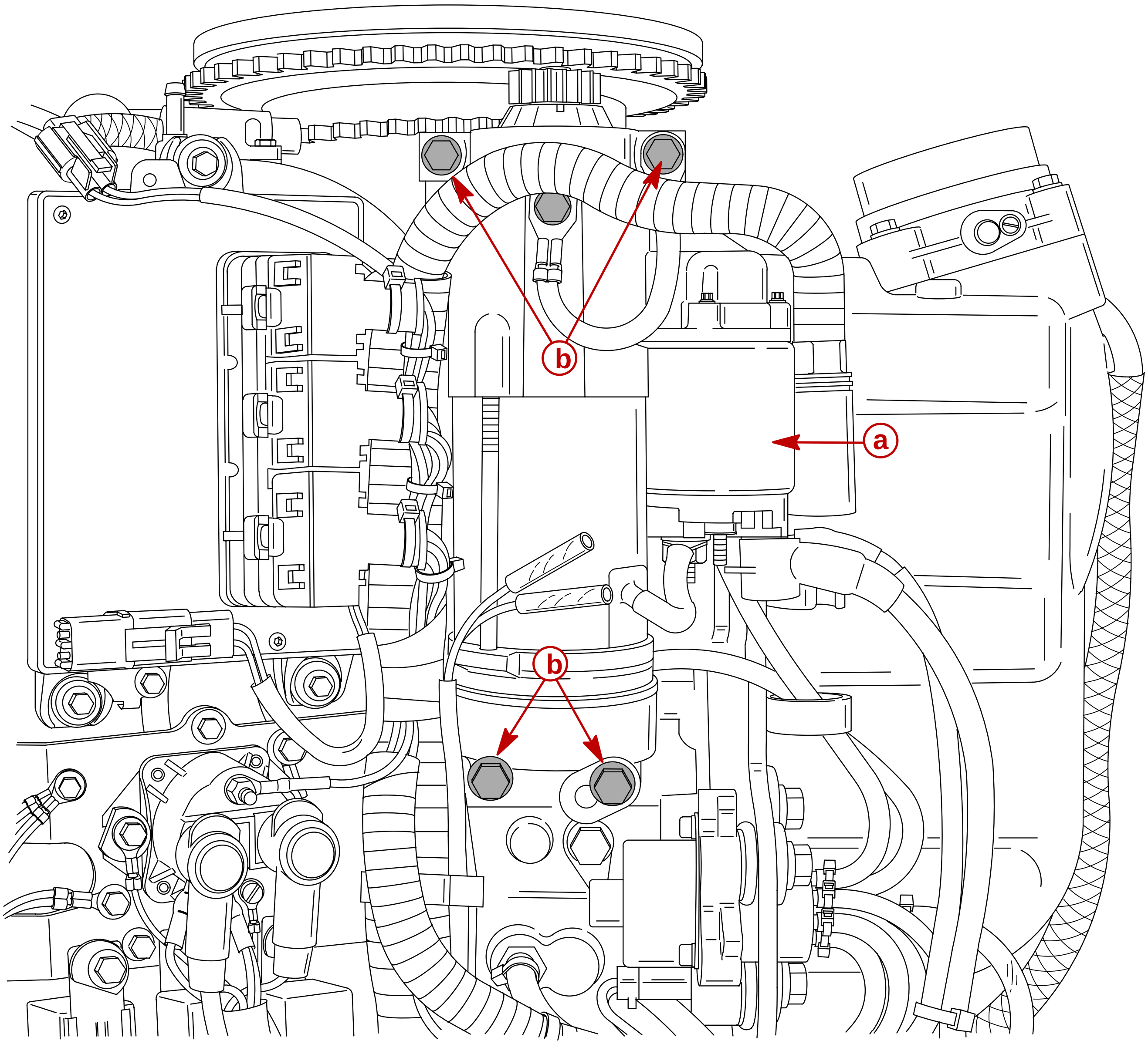
Starter Removal and Installation

Removal

⚠ CAUTION

Disconnect battery leads from battery before removing starter.

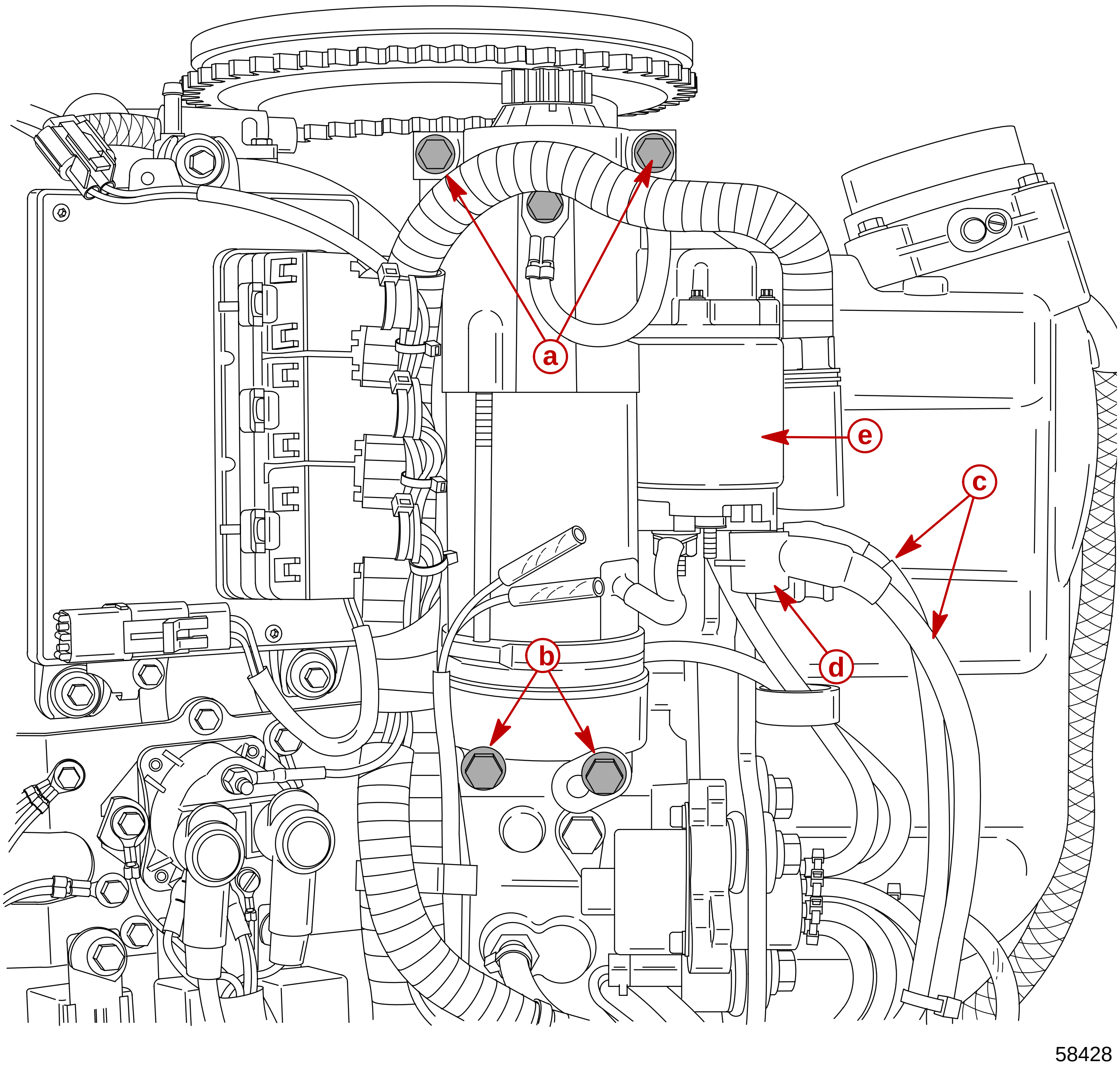
1. Disconnect battery cables from battery.
2. Disconnect wires from starter solenoid terminals.
3. Remove starter trunion mounting bolts and remove starter from engine.



a - Starter Solenoid
b - Mounting Bolts

Installation

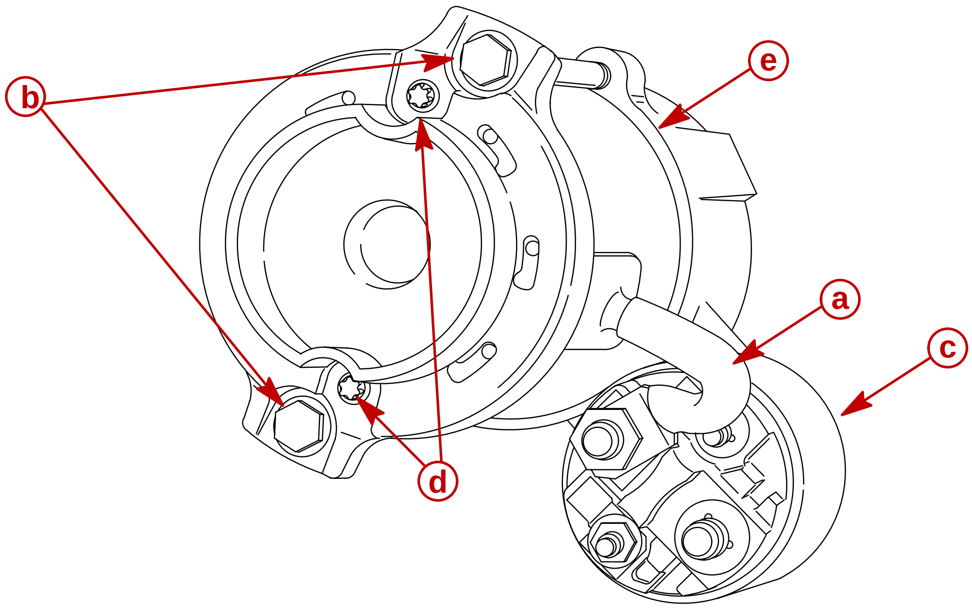
1. Secure starter to engine with 4 bolts. Use right top bolt to attach BLACK NEGATIVE. Torque top attaching bolts to 18 lb-ft (24 Nm). Torque bottom attaching bolts to 18 lb-ft. (24 Nm).
2. Secure BLACK cables (with RED sleeves) to POSITIVE (+) terminal on starter solenoid. Torque nut to 55 lb-in (6 Nm).



a - Top Bolts [Torque to 18 lb-ft (24 Nm)]
b - Bottom Bolts [Torque to 18 lb-ft (24 Nm)]
c - BLACK Cables (with RED sleeves)
d - Nut (under RED boot) [Torque to 55 lb-in (6 Nm)]
e - Starter Solenoid

Disassembly (Solenoid Driven Bendix Starter)

1. Remove brush lead from solenoid and through bolts from end frame.

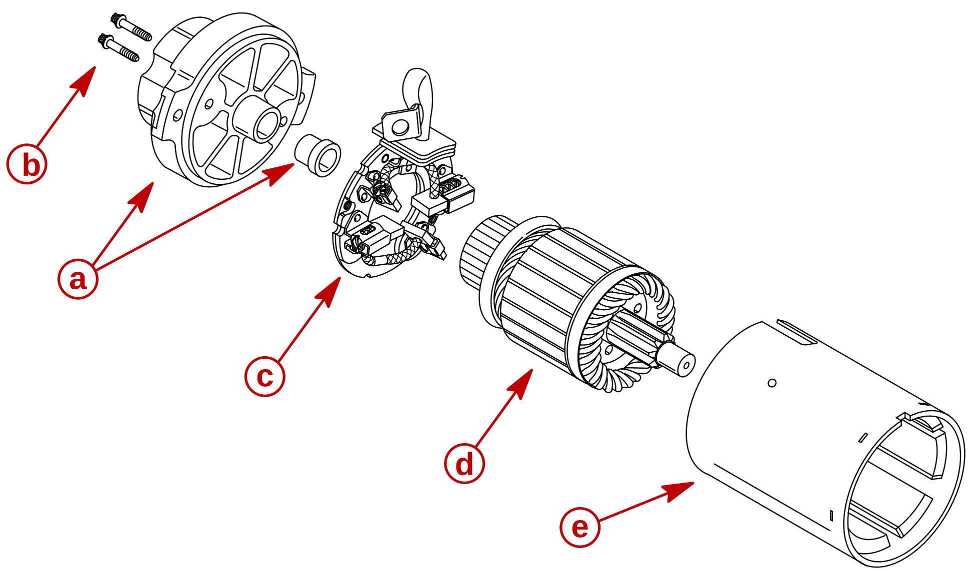


58434

- **a** - Brush Lead
- **b** - Through Bolts
- **c** - Starter Solenoid
- **d** - Brush Plate Screws
- **e** - End Frame

2. Remove armature and field frame from drive housing.

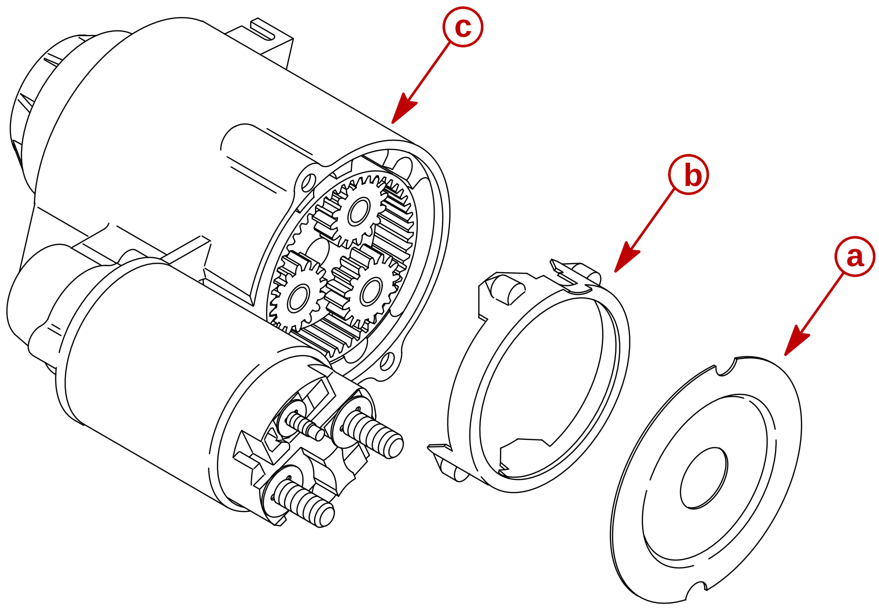
NOTE: *Permanent magnets inside field frame will be holding armature in place.*



58430

- **a** - End Frame and Bearing
- **b** - Screws (2) [Internal Torx – Snap On E6 Socket]
- **c** - Brush Holder
- **d** - Armature
- **e** - Field Frame

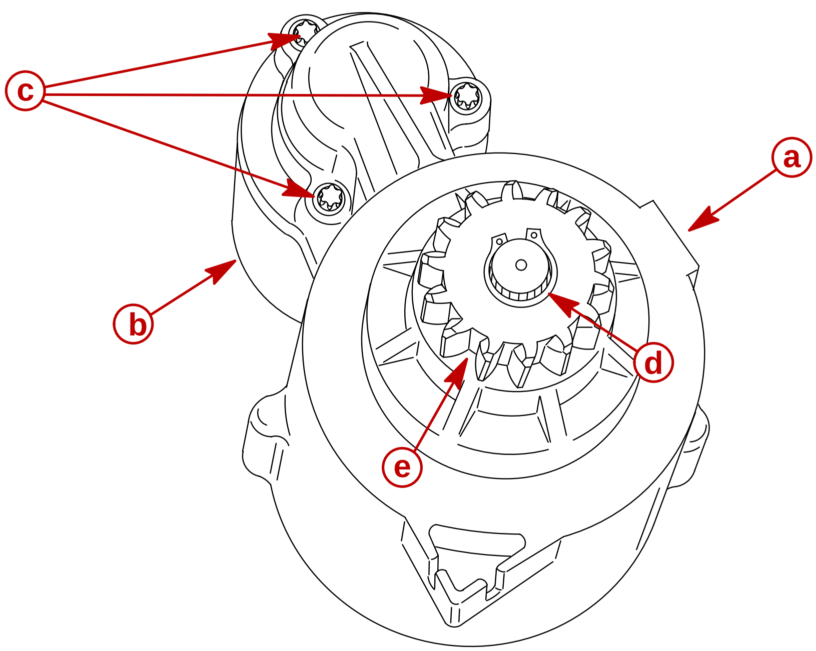
3. Remove shield and cushion from drive housing.



a - Shield
b - Cushion
c - Drive Housing

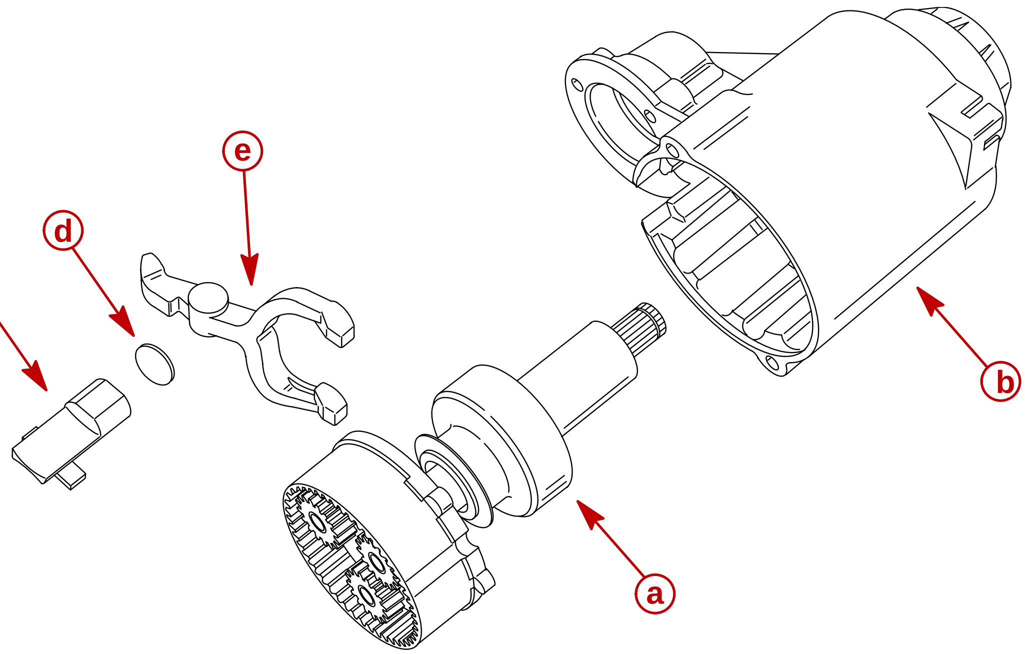
4. Remove 3 screws retaining starter solenoid. Remove solenoid from drive housing.

5. Remove snap ring and gear from starter shaft.



a - Drive Housing
b - Starter Solenoid
c - Screws (3) [Internal Torx– Snap On E6 Socket]
d - Snap Ring
e - Pinion Gear

6. Remove planetary gear and clutch assembly from drive housing.
7. Remove solenoid arm, metal disc and plug from drive housing.

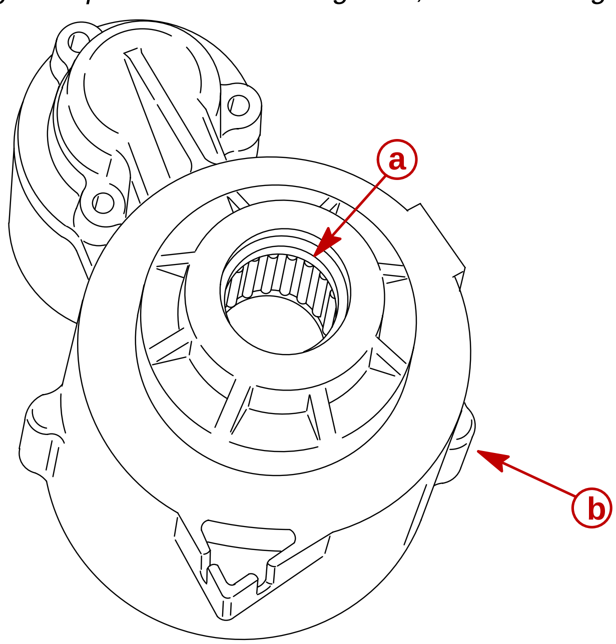


58437

a - Planetary Gear and Clutch Assembly
b - Drive Housing
c - Plug
d - Metal Disc
e - Solenoid Arm

8. Inspect drive housing needle bearing for roughness. If bearing is worn or damaged, bearing can be removed by using an appropriate mandrel to drive/press bearing from drive housing.

NOTE: *If bearing has spun in drive housing bore, drive housing must be replaced.*



58439

a - Needle Bearing
b - Drive Housing

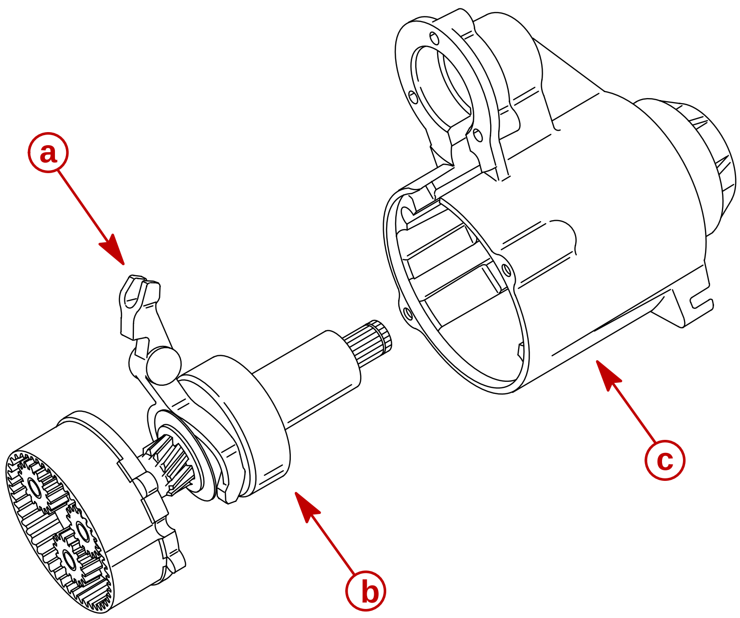
Cleaning and Inspection

IMPORTANT: Do not use grease dissolving solvents to clean electrical components, planetary gears or drive clutch. Solvent will damage insulation and wash the lubricant out of the clutch drive and gears. Use clean rags and compressed air to clean components.

1. Test over-running clutch action of drive. Pinion should turn freely in over-running direction and must not slip in cranking direction.
2. Inspect pinion teeth for wear.
3. Inspect spring for tension and drive collar for wear.
4. Check that bearings roll freely. If any roughness is felt, replace bearing.
5. Inspect planetary gear assembly. Gears must mesh easily and roll freely with no binding.

Reassembly (Solenoid Driven Bendix Starter)

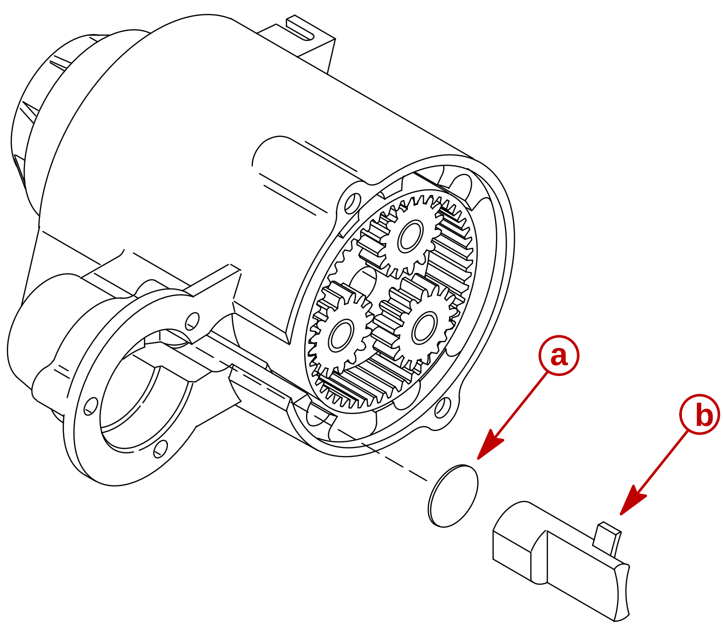
1. Install solenoid arm with planetary gear and clutch assembly into drive housing.



58438

a - Solenoid Arm
b - Planetary Gear and Clutch Assembly
c - Drive Housing

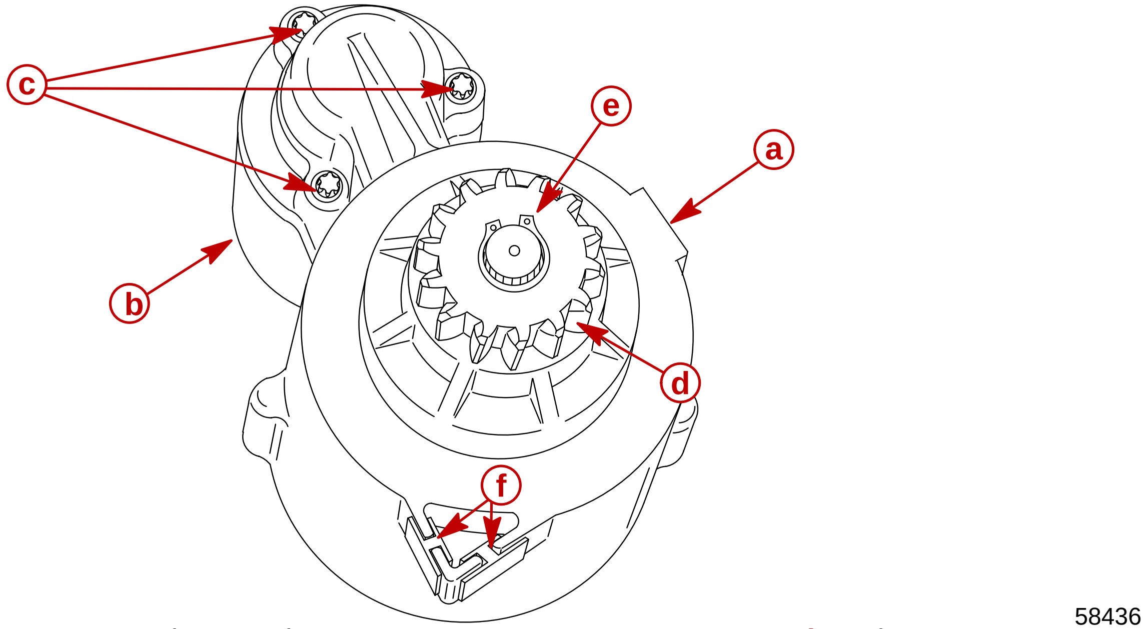
2. Install metal disc and plug into drive housing.



58433

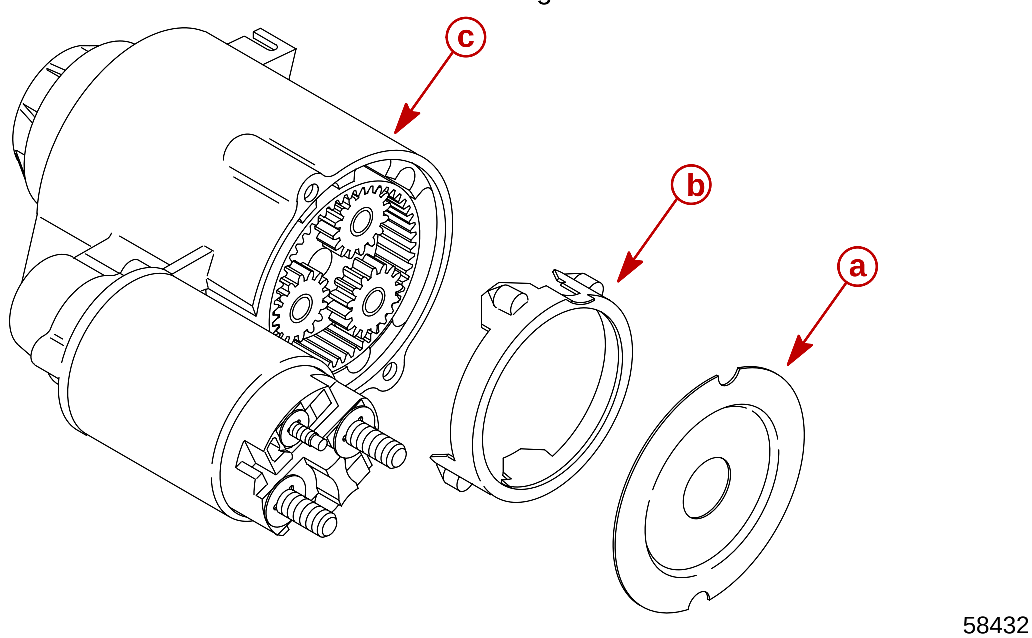
a - Metal Disc
b - Plug

3. Attach solenoid arm to starter solenoid. Install starter solenoid in drive housing and secure with 3 screws. Torque screws to 40 lb-in (4.5 N.m).
4. Install drive gear and secure with snap ring.
5. Reinstall rubber bumpers on housing.



a - Drive Housing
b - Starter Solenoid
c - Screw (3) [Torque to 40 lb-in (4.5 N.m)
d - Drive Gear
e - Snap Ring
f - Bumpers

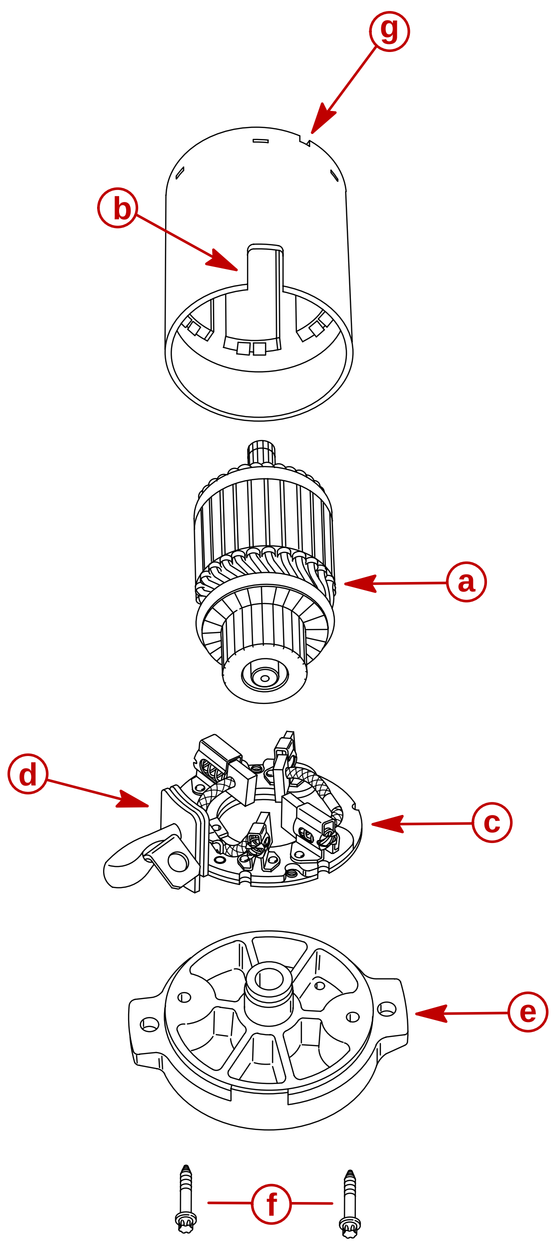
6. Install cushion and shield in drive housing.



a - Shield
b - Cushion
c - Drive Housing

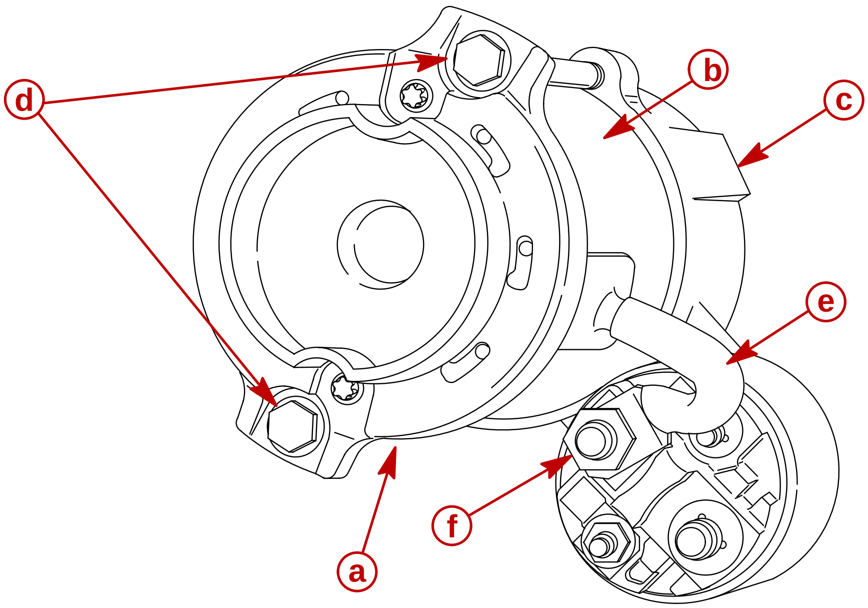
7. Install field frame over armature.
8. While holding brushes back, slide brush plate onto armature while aligning brush lead grommet with slot in field frame.
9. Secure end plate to brush assembly with 2 screws. Torque screws to 30 lb-in (3.4 Nm).

NOTE: *Prior to installing field frame assembly into drive housing, align slot in field frame with plug in drive housing.*



a - Armature
b - Field Frame Grommet Slot
c - Brush Plate
d - Brush Lead Grommet
e - End Plate
f - Screws [Torque to 30 lb-in (3.4 Nm)]
g - Field Frame Plug Slot

10. Install field frame and end frame in drive housing.
11. Install through bolts and brush lead. Torque through bolts to 110 lb-in (12.5 Nm). Torque brush nut to 55 lb-in (6 Nm).



a - End Frame
b - Field Frame
c - Drive Housing
d - Through Bolts [Torque to 110 lb-in (12.5 Nm)]
e - Brush Lead
f - Brush Nut [Torque to 55 lb-in (6 Nm)]

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. (6.4 mm) 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.

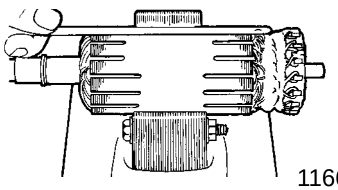
10. Clean out the copper or brush dust from slots between the commutator bars.

11. Check the armature for ground. See the following procedure ("Testing").

Testing Solenoid Driven Bendix Starters

Armature Test for Shorts

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



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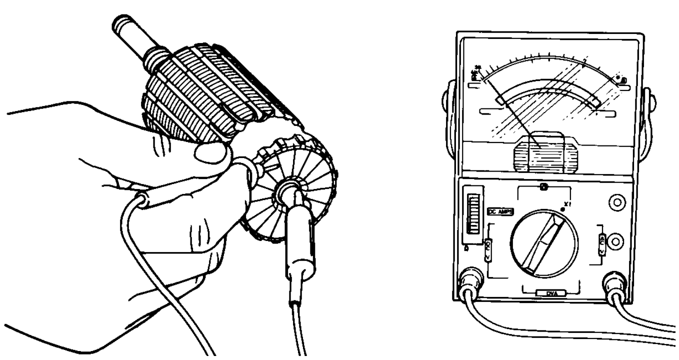
Armature Test for Ground

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

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



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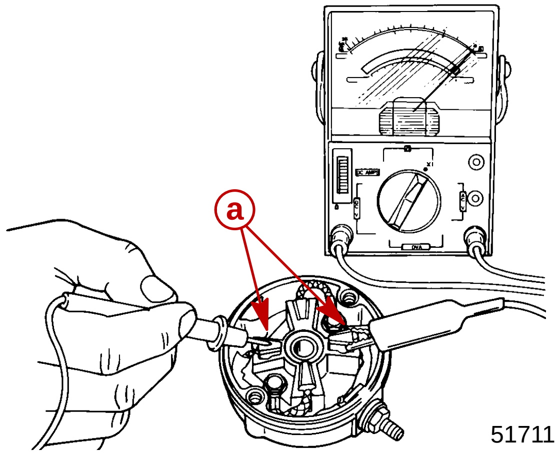
Checking Positive Brushes and Terminal

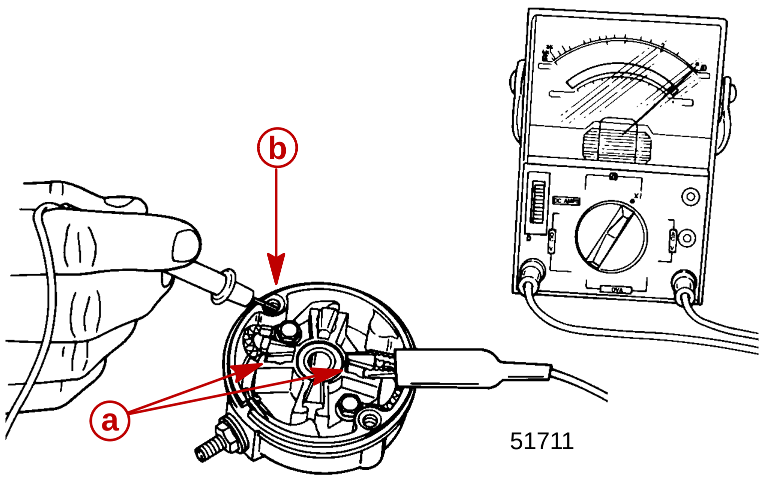
Set ohmmeter to (R x 1 scale). Connect meter leads between POSITIVE brushes. Meter must indicate full continuity or zero resistance. If resistance is indicated, inspect lead to brush and lead to POSITIVE terminal solder connection. If connection cannot be repaired, brushes must be replaced.



a - POSITIVE (+) Brushes

Testing Negative Brushes for Ground

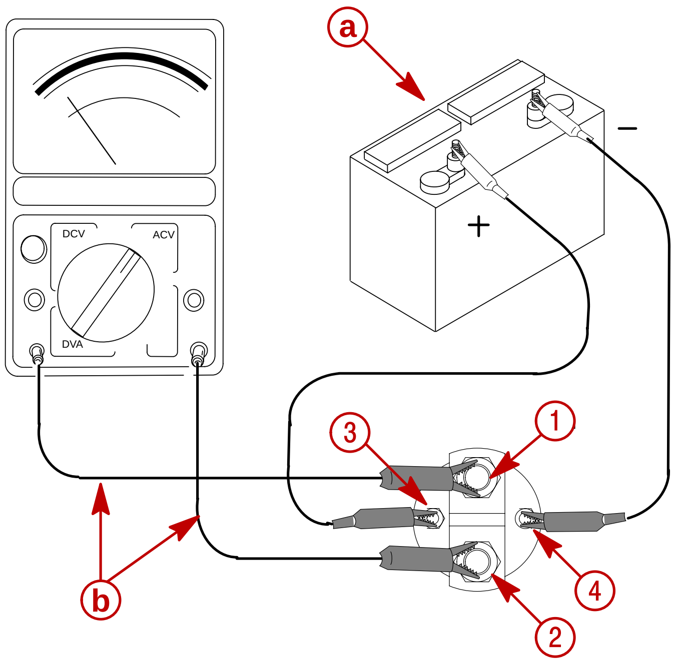
Set ohmmeter to (R x1 scale). Place one lead of the ohmmeter on the NEGATIVE brush and the other lead on the end cap (bare metal). If the meter indicates NO continuity, replace the NEGATIVE brush. Repeat this procedure on the other NEGATIVE brush.



a - NEGATIVE (–) Brushes
b - End Cap

Slave Solenoid Test

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

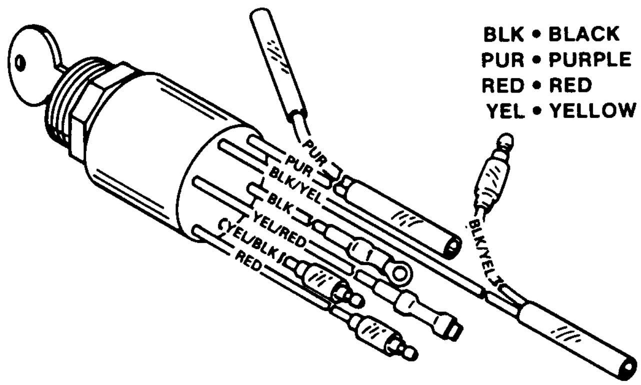


a - 12-VOLT Supply
b - VOA Leads

Commander 2000 Key Switch Test

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

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



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

ELECTRICAL

Section 2C – Timing, Synchronizing & Adjusting

Table of Contents

Specifications 2C-1
Special Tools 2C-2
Crank Position Sensor 2C-4
Throttle Cam Adjustment 2C-5
Maximum Throttle 2C-6
Throttle Plate Screw 2C-7
Throttle Position Sensor (TPS) Adjustment 2C-7
Idle Speed 2C-7

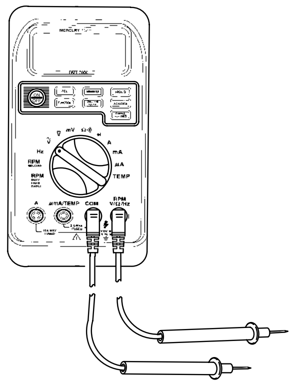
2C

Specifications

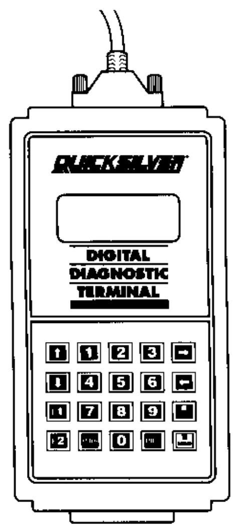
IGNITION SYSTEM	**Type**	Digital Inductive
	Spark Plug Type	NGK PZFR5F-11
	Spark Plug Gap	0.040 in. (1.0 mm)
	Maximum Timing	Not Adjustable; Controlled by ECM
	Idle Timing	Not Adjustable; Controlled by ECM
	Throttle Position Sensor	
	@ Idle	0.19 – 1.0 VDC
	@ WOT	3.45 – 4.63 VDC
	Crank Position Sensor	Not Adjustable
	Firing Order	1-2-3-4-5-6

Special Tools

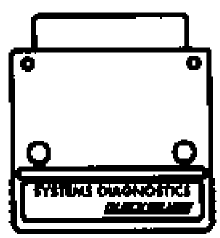
1. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009A1



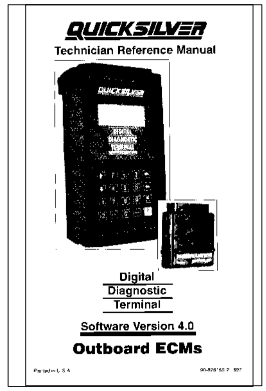
2. Digital Diagnostic Tool (DDT) 91-823686A2



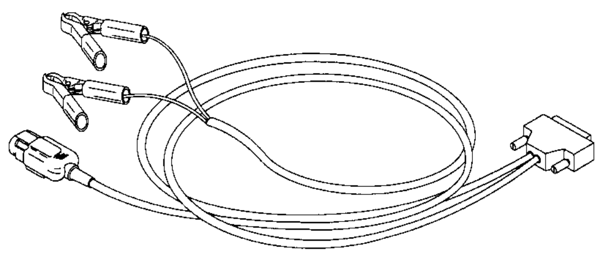
3. Software Cartridge 91-880118



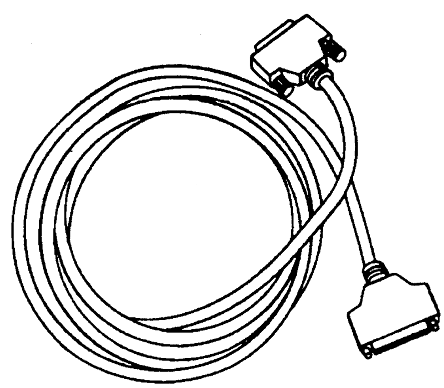
4. DDT Reference Manual 90-825159-4 (2000 Model Year)
   DDT Reference Manual 90-881204 (2001 Model Year)



5. ECM Harness 84-822560A5



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

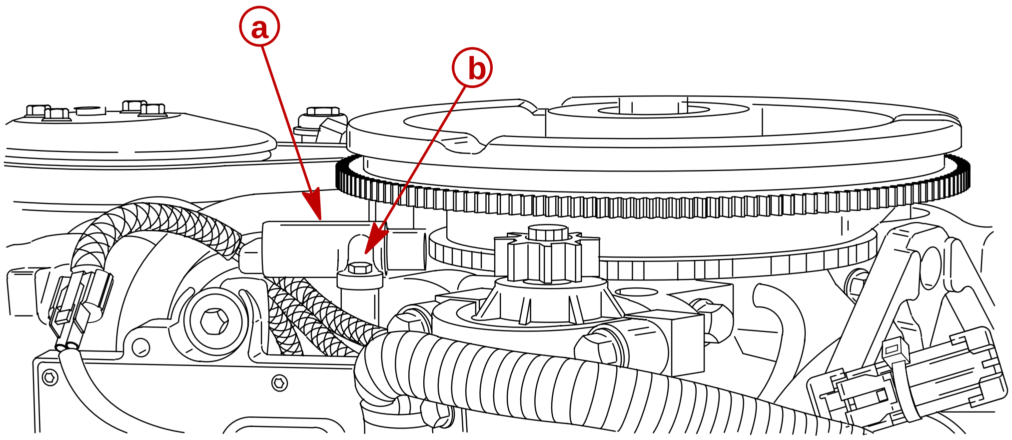


Crank Position Sensor

1. Remove flywheel cover.

IMPORTANT: Crank Position Sensor air gap (between flywheel tooth and sensor) is not adjustable. Visually inspect sensor for damage from foreign debris. Replace sensor as required.

2. Reinstall flywheel cover.



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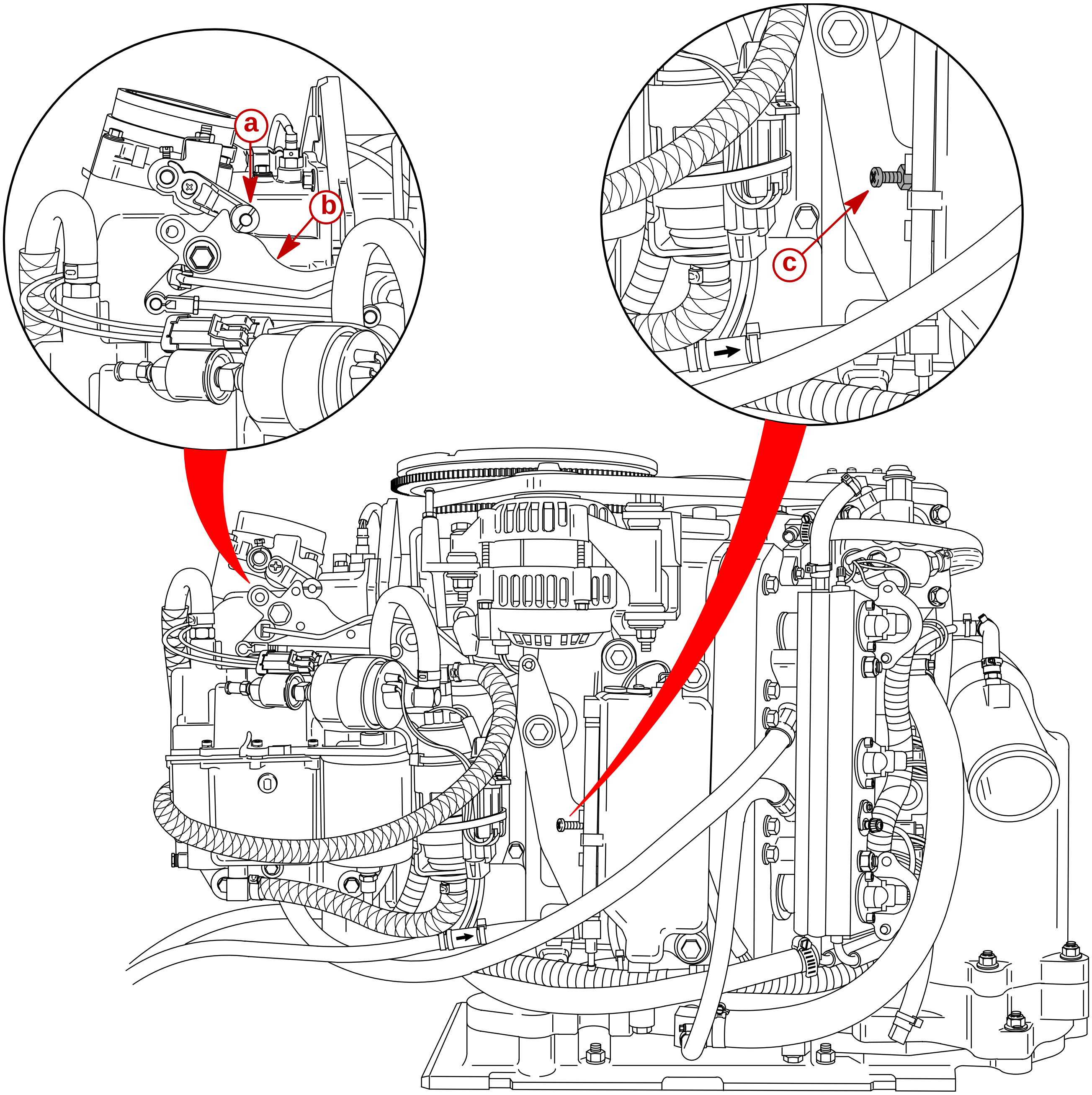
a - Crank Position Sensor
b - Bracket Screw – Torque to 45 lb. in. (5.0 Nm)

Throttle Cam Adjustment

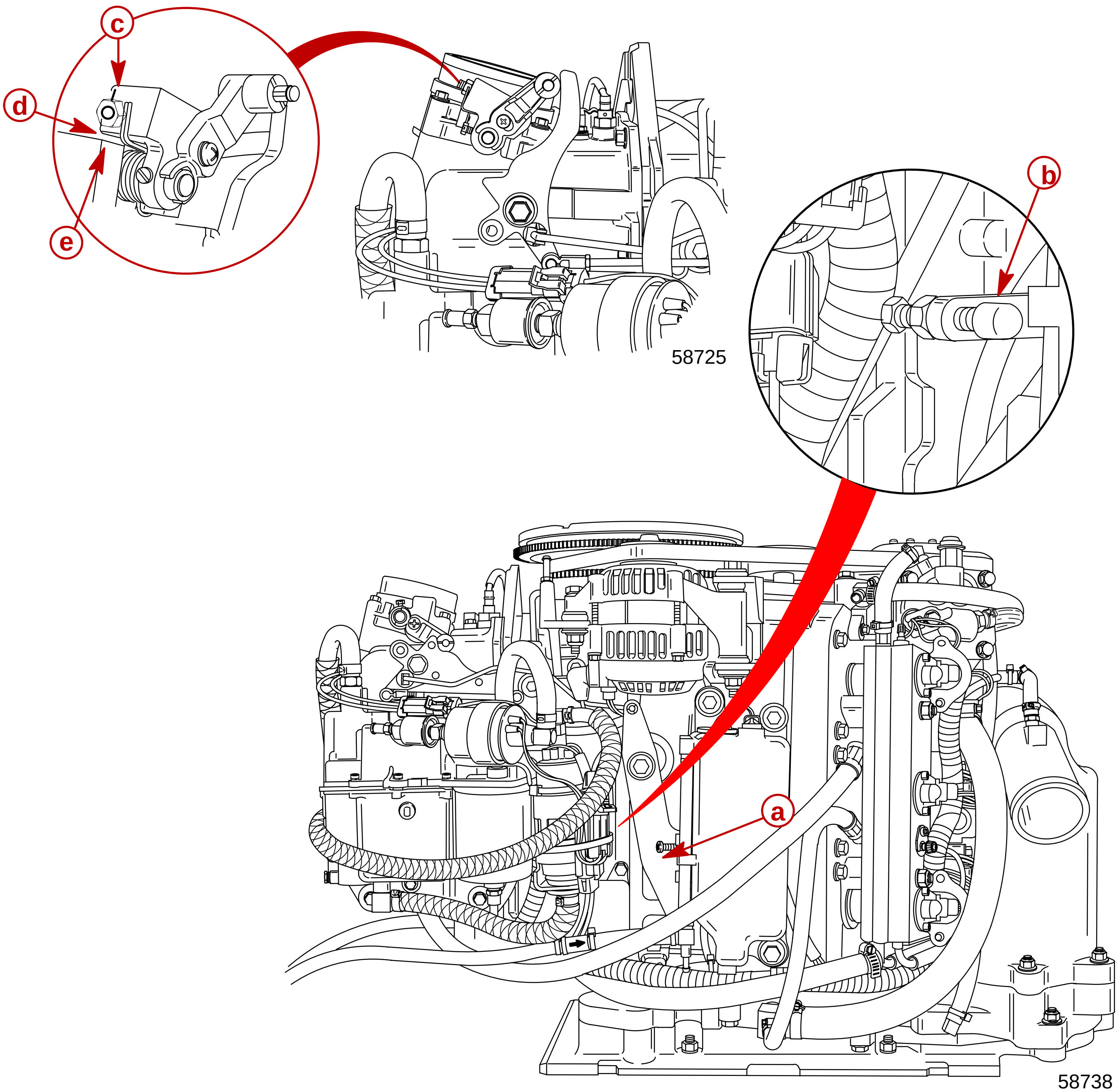
1. Adjust idle stop screw on throttle arm to align cam roller in the pocket of the throttle cam.
2. Tighten idle stop screw to provide clearance of 0.005 in. ± 0.005 in. (0.127 mm ± 0.127 mm) between roller and cam.



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

Maximum Throttle

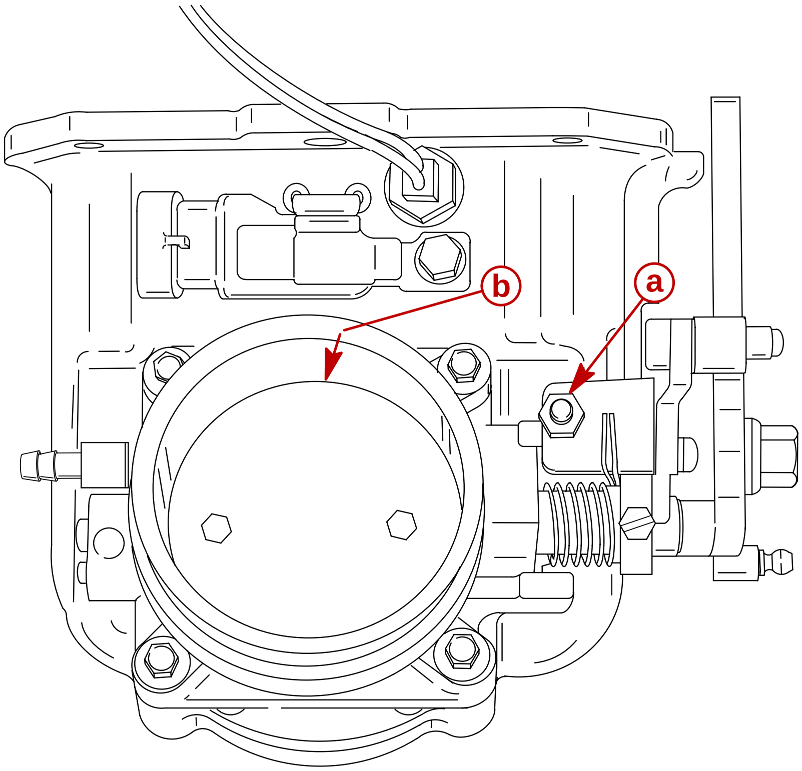
1. Hold throttle arm against full throttle stop.
2. Adjust full throttle stop screw (located behind electric fuel pump) to allow full throttle valve opening while maintaining a 0.020 in. (0.508 mm) clearance between arm of throttle shaft and stop on attenuator box.
3. Tighten jam nut on full throttle stop screw.
4. Check for free play (roller lifts from cam) between roller and cam at full throttle to prevent linkage from binding. Readjust full throttle stop screw, if necessary.



a - Throttle Arm
b - Full Throttle Stop Screw (behind electric fuel pump)
c - Throttle Shaft Arm
d - 0.020 in. (0.508 mm) Clearance
e - Stop on Attenuator Box

Throttle Plate Screw

IMPORTANT: DO NOT adjust throttle plate stop screw from factory setting. However, should the throttle plate require adjustment, use the throttle plate stop screw to set the throttle plate clearance @ 0.031 in. (0.7937 mm) using a #68 drill.



a - Throttle Plate Stop Screw
b - Throttle Plate Clearance

Throttle Position Sensor (TPS) Adjustment

The Throttle Position Sensor is not adjustable. TPS settings can be monitored with the Digital Diagnostic Terminal through the ECM. If TPS settings are not within specifications, refer to Section 2A.

Idle Speed

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

ELECTRICAL

Section 2D - Wiring Diagrams

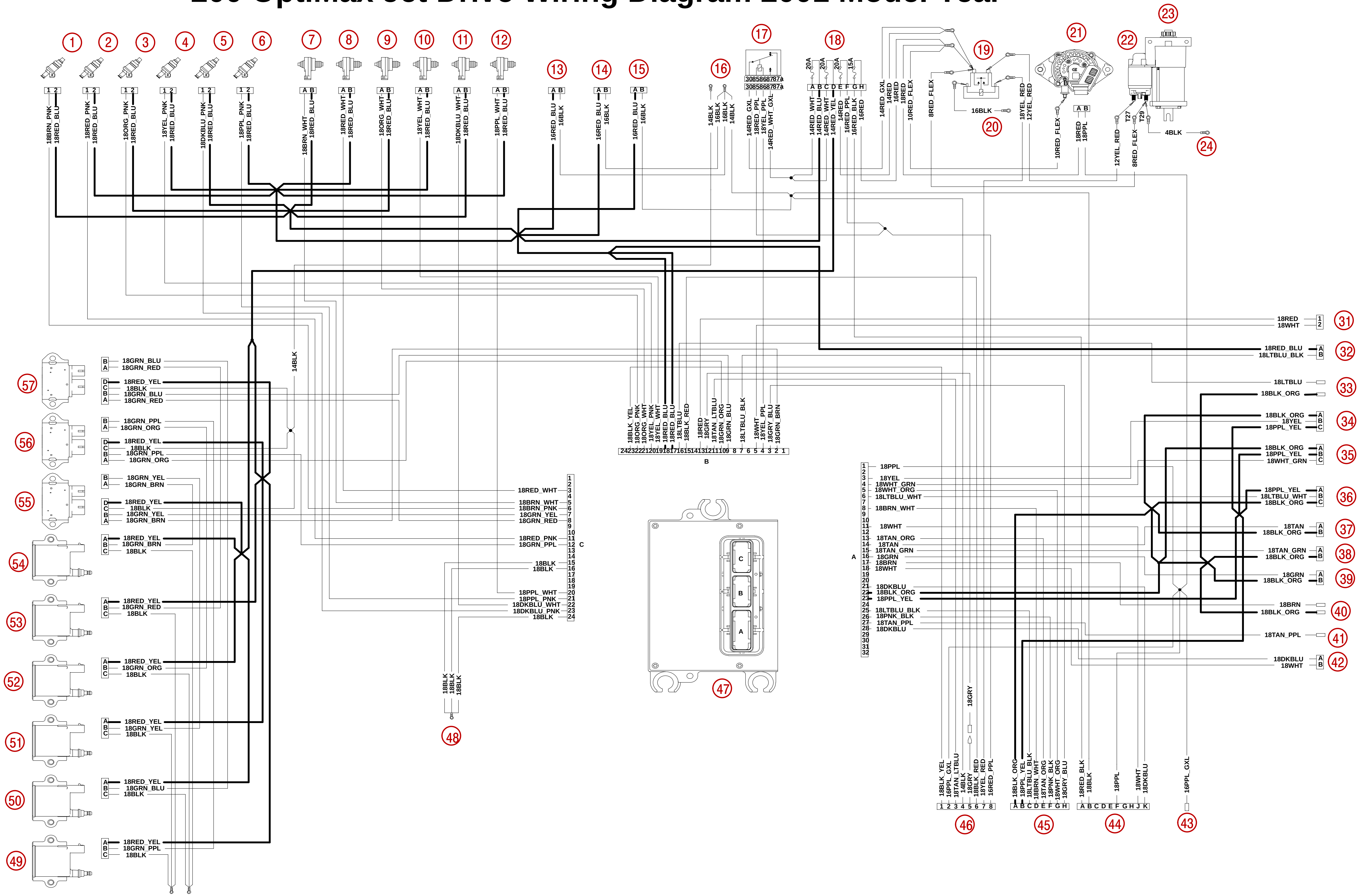
Table of Contents

200 HP OptiMax Jet Drive Wiring Diagram
2001 Model Year 2D-3

Notes:

200 OptiMax Jet Drive Wiring Diagram 2001 Model Year

1 - #1 Fuel Injector
2 - #2 Fuel Injector
3 - #3 Fuel Injector
4 - #4 Fuel Injector
5 - #5 Fuel Injector
6 - #6 Fuel Injector
7 - #1 Direct Injector
8 - #2 Direct Injector
9 - #3 Direct Injector
10 - #4 Direct Injector
11 - #5 Direct Injector
12 - #6 Direct Injector
13 - #1 Fuel Pump
14 - #2 Fuel Pump
15 - Lift Pump
16 - To Ground
17 - Main Power Relay
18 - Fuses (4)
19 - Slave Solenoid
20 - To Ground
21 - 60 Amp Alternator
22 - Starter Solenoid
23 - Starter
24 - To 12 Volt Battery (+ Cable)
25 - Trim UP Relay
26 - Trim DOWN Relay
27 - To Ground
28 - Trim Pump
29 - Cowl Trim Switch
30 - Remote Trim Switch
31 - Crank Sensor
32 - Oil Pump
33 - Low Oil Switch
34 - MAP Sensor
35 - Block Pressure Sensor
36 - Throttle Position Indicator
37 - Air Temperature Sensor
38 - Starboard Head Temp Sensor
39 - Port Head Temp Sensor
40 - Compressor Temp Sensor
41 - Water-in-Fuel Sensor
42 - Diagnostic Connector
43 - Accessory Power
44 - Data Bus (Control Area Network)
45 - Boat Harness (Digital Sensor)
46 - Remote Control
47 - Electronic Control Unit
48 - To Ground
49 - Ignition Coil #5
50 - Ignition Coil #6
51 - Ignition Coil #4
52 - Ignition Coil #3
53 - Ignition Coil #2
54 - Ignition Coil #1
55 - Coil Driver #1 and #4
56 - Coil Driver #3 and #6
57 - Coil Driver #2 and #5



FUEL SYSTEM

Section 3A – Electric Fuel Pump

Table of Contents

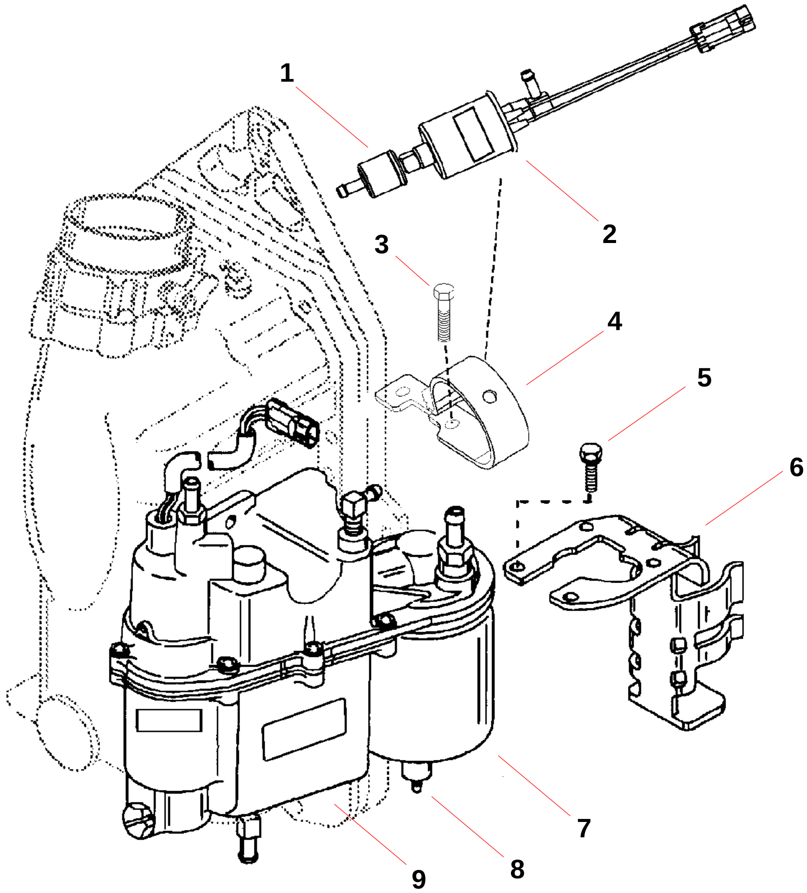
Specifications	3A-1
Fuel Pump Assembly	3A-2
Special Tools	3A-3
Fuel Lift Pump Description/Operation	3A-3
Checking for Restricted Fuel Flow Caused by Anti-siphon Valves	3A-4
Checking Fuel Pump Lift (Vacuum)	3A-5
Vacuum Test Troubleshooting	3A-5
Testing Fuel Pump	3A-6
Fuel Lift Pump Removal/Disassembly	3A-7
Cleaning/Inspection	3A-8
Reassembly/Installation	3A-9

3
A

Specifications

FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Recommended Oil** **Gasoline/Oil Ratio** **– @ Idle** **– @ WOT**	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver TC-W3 Premium Plus 2 Cycle Outboard Oil 300 – 400:1 40:1
FUEL LIFT PUMP	**Fuel Pressure** **Amperage Draw**	Normal – 1-2 psi (6.8 – 13.7 kPa) Maximum – 10 psi (68.5 kPa) 1 – 2 Amperes

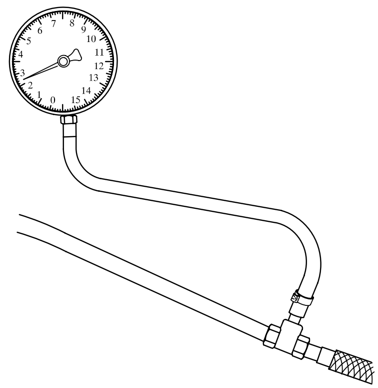
Fuel Pump Assembly



REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL FILTER			
2	1	FUEL LIFT PUMP			
3	2	BOLT	145		16
4	2	BRACKET			
5	1	BOLT	145		16
6	1	BRACKET			
7	1	FUEL/WATER SEPARATOR			
8	2	WATER SENSOR			
9	1	VAPOR SEPARATOR			

Special Tools

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



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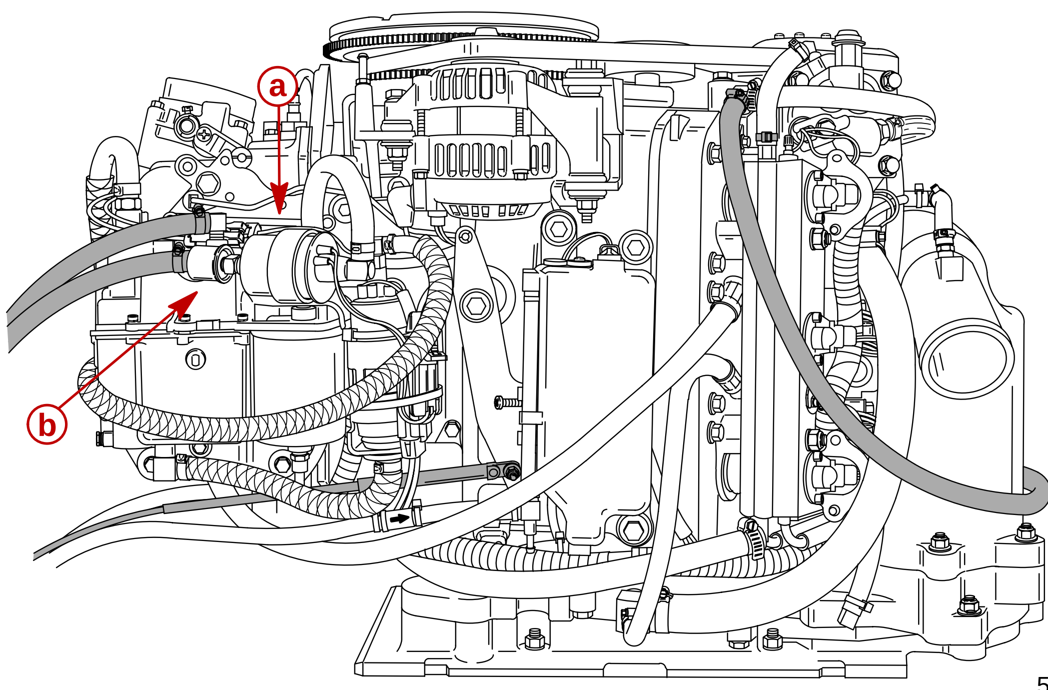
Fuel Lift Pump Description/Operation

The fuel lift pump is an electric fuel pump used to supply fuel to the engine vapor separator.



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a - Fuel Lift Pump
b - Fuel Filter

Electrical power is supplied to the fuel lift pump from the starter solenoid positive terminal (starter side).

Checking for Restricted Fuel Flow Caused by Anti-siphon Valves

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

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

Since any type of anti-siphon device must be located between the engine 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 engine with a separate fuel supply which is known to be good, such as a remote fuel tank.

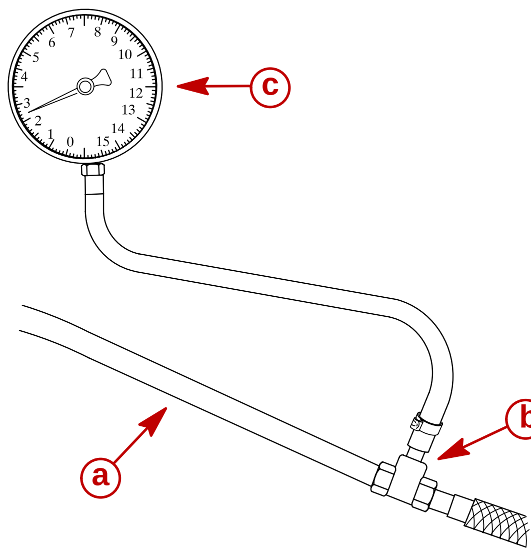
If, after using a separate fuel supply, it is found that the anti-siphon valve is the cause of the problem, there are 2 solutions to the problem; either 1) replace the anti-siphon valve with one that has lighter spring tension or 2) replace it with a solenoid-operated fuel shut off valve.

Checking Fuel Pump Lift (Vacuum)

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

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

Before proceeding with the system vacuum test, confirm that the pulse fuel pump is capable of supplying the required vacuum. To do this, start the engine, pinch off/restrict the fuel supply hose between the vacuum gauge and fuel tank. The vacuum gauge should rise to or exceed the maximum normal reading of 2.5 inches vacuum (mercury). If it fails to reach this minimum number, the pump needs servicing or there is a lack of crankcase pressure to operate the pump.



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

Vacuum Test Troubleshooting

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

Normal Reading	Below 2.5 in. of vacuum (mercury)

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

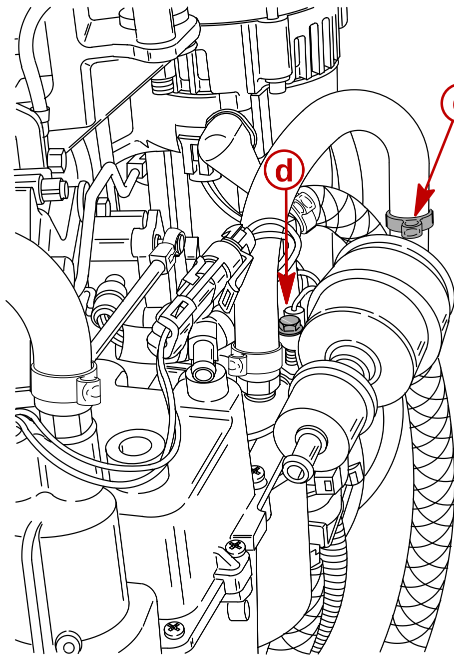
Testing Fuel Pump

Install clear fuel hose(s) between fuel pump and VST. Run engine, and inspect fuel passing thru hose(s) for air bubbles.

Problem: Air Bubbles in Fuel Line	
Low fuel in tank.	Fill tank with fuel.
Loose fuel line connection.	Check and tighten all connectors.
Fuel pump fitting loose.	Tighten fitting.
A hole or cut in fuel line.	Check condition of all fuel lines and replace
Fuel Pump anchor screw(s) loose.	Tighten all screws evenly and securely.
Fuel Pump filter cover anchor screw loose.	Tighten screws securely.
Fuel pump filter gasket worn out.	Replace gasket.
Fuel pump gasket(s) worn out.	Rebuild fuel pump.
Fuel vaporizing	Fuel with high reed vapor pressure (winter grade fuel) may vaporize (form bubbles) when used in hot/warm weather. Use fuel with a lower reed vapor pressure (summer grade fuel)
Problem: Lack of Fuel Pump Pressure	
An anti-siphon valve.	See "Checking for Restricted Fuel Flow" preceding.
Air in fuel line.	See "Air Bubbles in Fuel Line", above.
A dirty or clogged fuel filter.	Clean or replace fuel filter.
The fuel pickup in fuel tank is clogged or dirty.	Clean or replace pickup.
Worn out fuel pump diaphragm.	Rebuild fuel pump.
Worn out check valve(s) in fuel pump.	Rebuild fuel pump.
A leaky check valve gasket.	Rebuild fuel pump.
Pulse hole(s) plugged.	Remove fuel pump and clean out holes.
Hole in pulse hose.	Replace pulse hose.
Loose pulse hose.	Tighten connection(s).
Fuel hose internal diameter too small.	Use 5/16 I.D. fuel hose.
Excessive fuel lift required.	Fuel lift exceeds 2.5 in. of vacuum (mercury)

Fuel Lift Pump Removal/Disassembly

1. Disconnect fuel pump harness connector.
2. Disconnect fuel hose from fuel filter.
3. Use sharp side cutter or end cutter to peel back end of clamp securing vapor separator hose. Remove hose from fuel pump.
4. Loosen bolt securing pump retaining clamp and remove pump.



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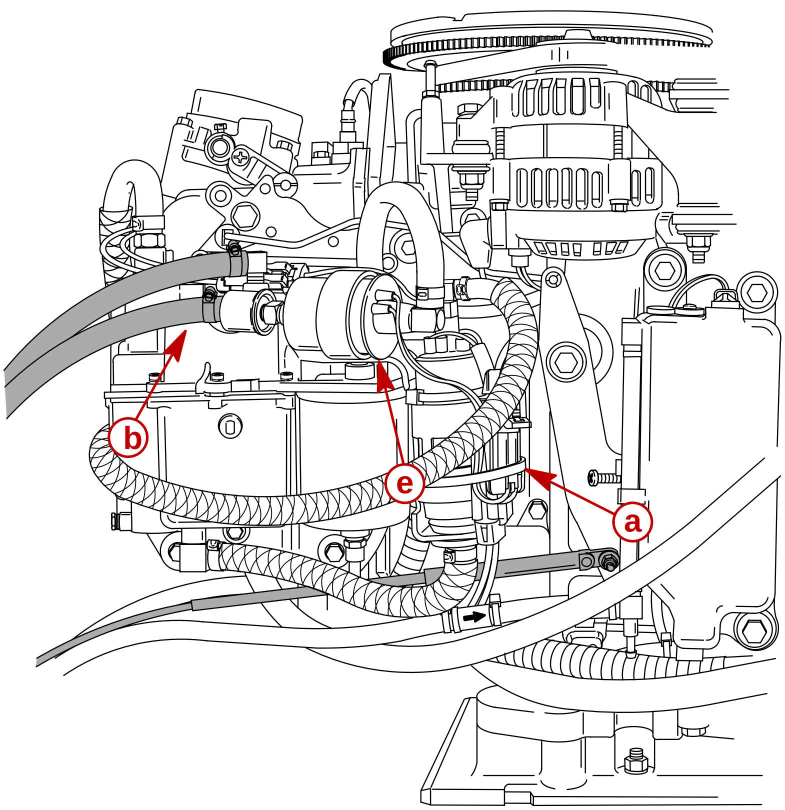

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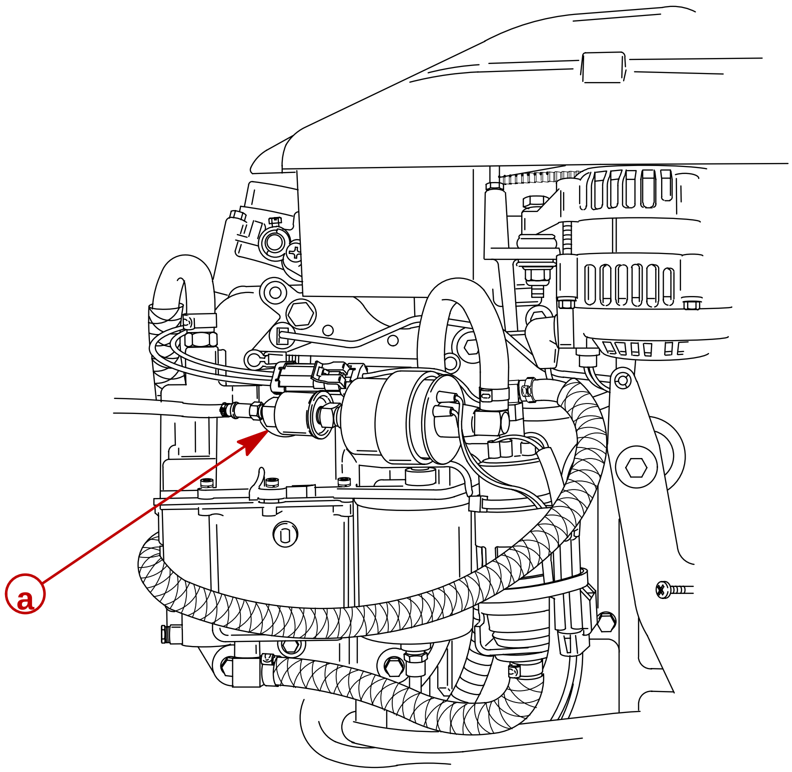
a - Harness Connector
b - Fuel Hose
c - Clamp
d - Bolt
e - Fuel Pump

Cleaning/Inspection

There are no serviceable parts within the electric fuel pump. However, there is a replaceable fuel filter on the pump which should be replaced every 100 hours or once a season. Use a strap wrench to remove filter.

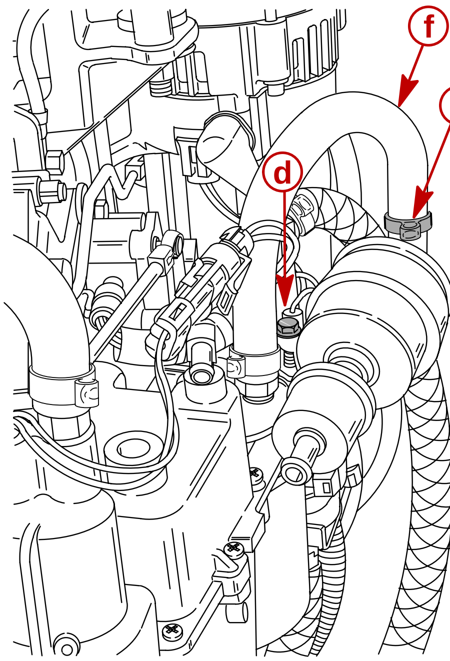


a - Fuel Filter

Reassembly/Installation

ASSEMBLY

1. Install fuel pump inside retaining clamp. Secure clamp with screw. Torque screw to 145 lb. in. (16.0 Nm)
2. Reconnect harness connector.
3. Reconnect fuel tank hose to filter. Use stainless hose clamp to secure fuel hose.
4. Reconnect vapor separator fuel hose to fuel pump. Secure hose with clamp #183. Use Clamp Tool 91-803146T to secure clamp.
5. Run engine and check for leaks.



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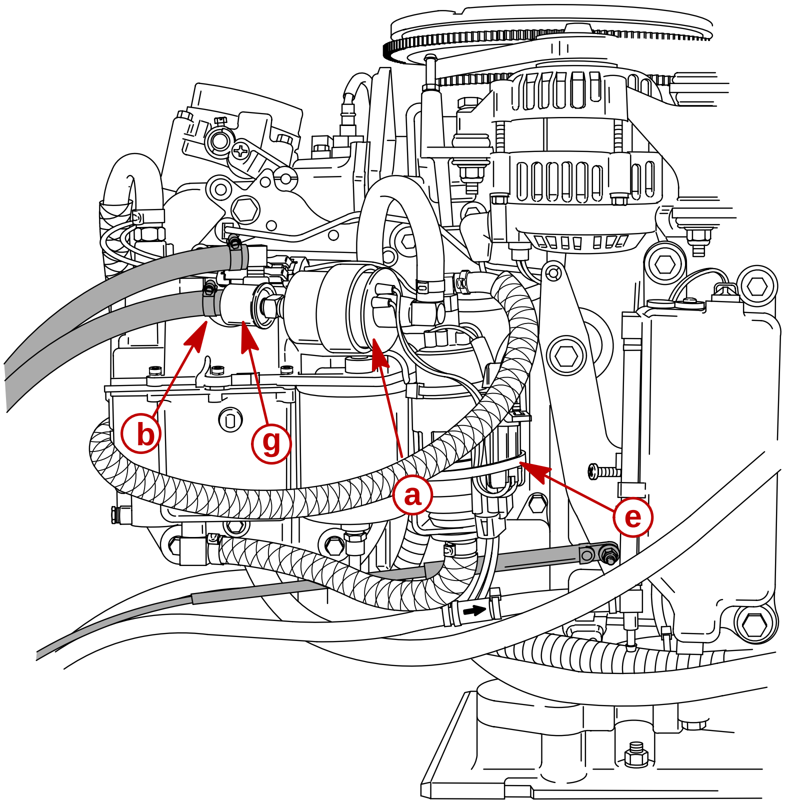

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a - Fuel Pump
b - Stainless Hose Clamp
c - Hose Clamp #183
d - Screw Torque to 145 lb. in. (16.0 Nm)
e - Harness Connector
f - Fuel Hose
g - Filter

FUEL SYSTEM

Section 3B – Direct Fuel Injection

Table of Contents

Specifications . . . 3B-2
Special Tools . . . 3B-3
Air Handler . . . 3B-6
Air Handler Components . . . 3B-8
Vapor Separator Components . . . 3B-10
Air Hoses . . . 3B-12
Water Hoses . . . 3B-14
Fuel Hoses . . . 3B-16
Fuel Rails . . . 3B-18
Air Compressor Components . . . 3B-20
DFI Operation . . . 3B-22
- Air Induction Through Crankcase . . . 3B-22
- Air Compressor System . . . 3B-22
- Fuel . . . 3B-22
- Oil . . . 3B-23
- Electrical . . . 3B-23
- Operation . . . 3B-23

Testing Electric Fuel Pump Pressure Output 3B-24
- Low Pressure Electric Fuel Pump . . . 3B-24
- High Pressure Electric Fuel Pump . . . 3B-25

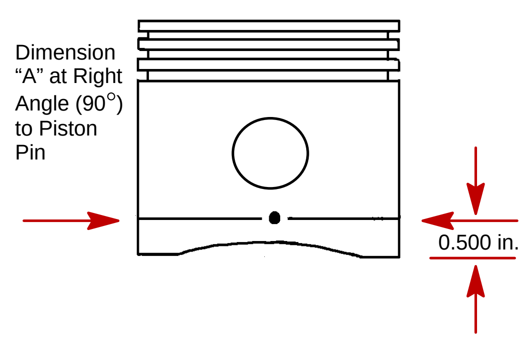
Fuel Management Assembly Removal . . . 3B-26
- Reed Block Disassembly/Assembly . . . 3B-29
- Air Temperature Sensor Removal . . . 3B-29
- Air Temperature Sensor Installation . . . 3B-30
- Throttle Plate Assembly Removal . . . 3B-30
- Throttle Plate Assembly Installation . . . 3B-30
- Vapor Separator Disassembly . . . 3B-30
- Vapor Separator Reassembly . . . 3B-32
- Air Plenum Installation . . . 3B-33
- Low Pressure Electric Fuel Pump Installation . . . 3B-33
- Vapor Separator Installation . . . 3B-36
- Fuel Rail Removal . . . 3B-38
- Fuel Pressure Regulator . . . 3B-43
- Air Pressure Regulator . . . 3B-46
- Tracker Valve . . . 3B-48
- Fuel Rail Cleaning . . . 3B-50
- Direct Injector Removal . . . 3B-51
- Direct Injector Leak Test . . . 3B-53
- Fuel Rail and Direct Injector Installation . 3B-54

Air Compressor . . . 3B-55
- Compressor Removal . . . 3B-56
- Air Compressor Disassembly/Reassembly . . . 3B-58
- Air Compressor Flow Diagram . . . 3B-59
- Air Compressor Pressure Test . . . 3B-60

3
B

Specifications

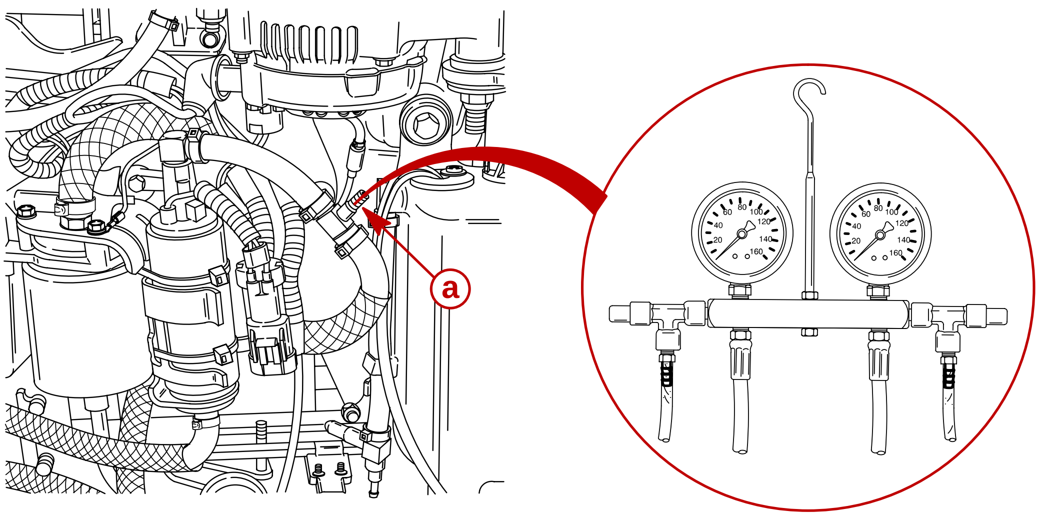
DIRECT INJECTION	**Injectors**	
	– Quantity	6
	– Injectors are Crank Angle Driven by ECM	
	– #2 Cylinder	RED/WHT + RED/BLU Leads
	– #4 Cylinder	YEL/WHT + RED/BLU Leads
	– #6 Cylinder	PPL/WHT + RED/BLU Leads
	– #1 Cylinder	BRN/WHT + RED/BLU Leads
	– #3 Cylinder	ORG/WHT + RED/BLU Leads
	– #5 Cylinder	BLU/WHT + RED/BLU Leads
	Fuel Line Pressure @ Injectors	89 ± 2 psi (613.5 ± 13.8 kPa)
	Air Pressure	79 ± 2 psi (544.0 ± 13.8 kPa)
	High Pressure Electric Fuel Pump Amperage Draw	5 – 9 Amperes
	Low Pressure Electric Fuel Pump Amperage Draw	1 – 2 Amperes
	Low Pressure Electric Fuel Pump Output	6 – 9 psi (41.37 – 62.04 kPa)
	Fuel Injector Ohm Resistance	1.8 ± 0.1 Ω
	Direct Injector Ohm Resistance	1.3 ± 0.3 Ω
	Fuel/Air Differential	10 psi (68.5 kPa)
AIR COMPRESSOR	**Type**	Reciprocating Piston (1 to 1 ratio with engine RPM)
	Compressor Output	@ Idle – 80 psi @ W.O.T. – 110 psi
	Cylinder Block Displacement	7.07 cu. in. (116 cc)
	Cylinder Bore	
	Diameter (Standard)	2.5591 in. (65.0 mm)
	Taper/Out-of-Round/ Wear Maximum	0.001 in. (0.025 mm)
	Bore Type	Cast Iron
	Stroke Length	1.374 in. (34.9 mm)
	Piston Type	Aluminum
	Piston Diameter	2.5578 ± .0004 in. (64.97 ± 0.010 mm)



AIR COMPRESSOR	**Piston Ring End Gap**	
	Top Ring	0.0059 – 0.0098 in. (0.15 – 0.25 mm)
	Middle Ring	0.0059 – 0.0098 in. (0.15 – 0.25 mm)
	Bottom Ring	0.0039 – 0.014 in. (0.10 – 0.35 mm)
	Reeds	
	Stand Open	0.010 in. (0.25 mm)

Special Tools

1. Duel Fuel/Air Pressure Gauge 160 psi – 91-852087A1/A2/A3

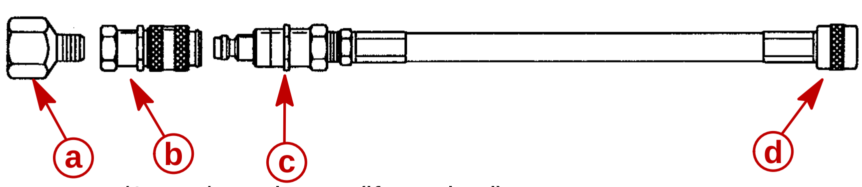


57416

a - Schrader Valve (22-849606)

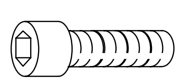
2. Adaptors to convert pressure gauge 91-852087A1/A2 to an A3

NOTE: *2 Adaptors 91-803804A2 are required to convert a pressure gauge set.*

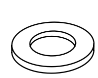


a - 1/2 to 1/4” Adapter (if required)
b - Female Quick Disconnect
c - Male Quick Disconnect
d - Screw on Schrader

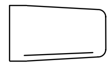
3. Screw (5mm x 25mm) (2 each) – 10-40073-25



4. Flat Washer (2 each) – 12-30164.



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



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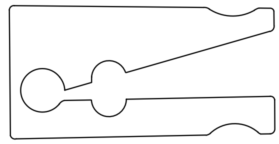
6. Seal/Teflon Ring Sizing Tool – 91-851980–1



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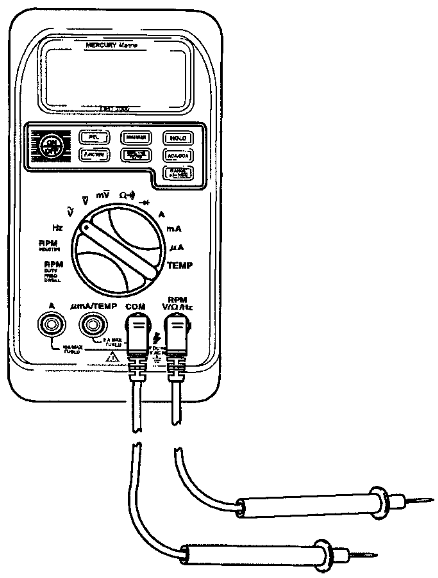
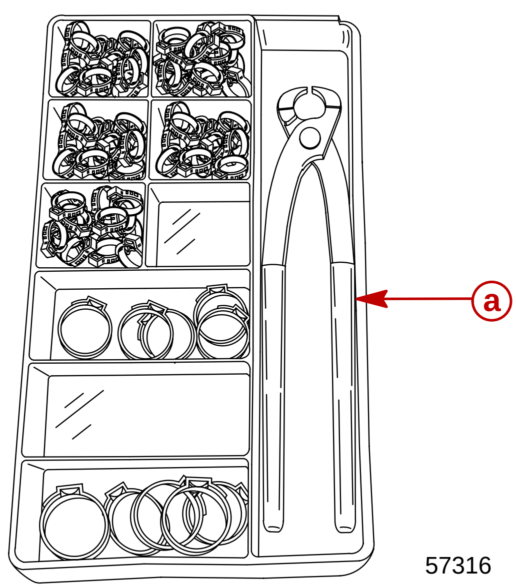
7. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009T1



8. Clamp Tool Kit 91-803146A2



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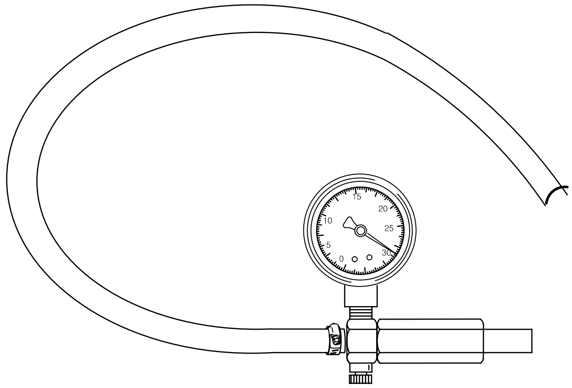
a - Clamp Tool 91-803146T

9. Gearcase Leakage Tester (FT-8950)



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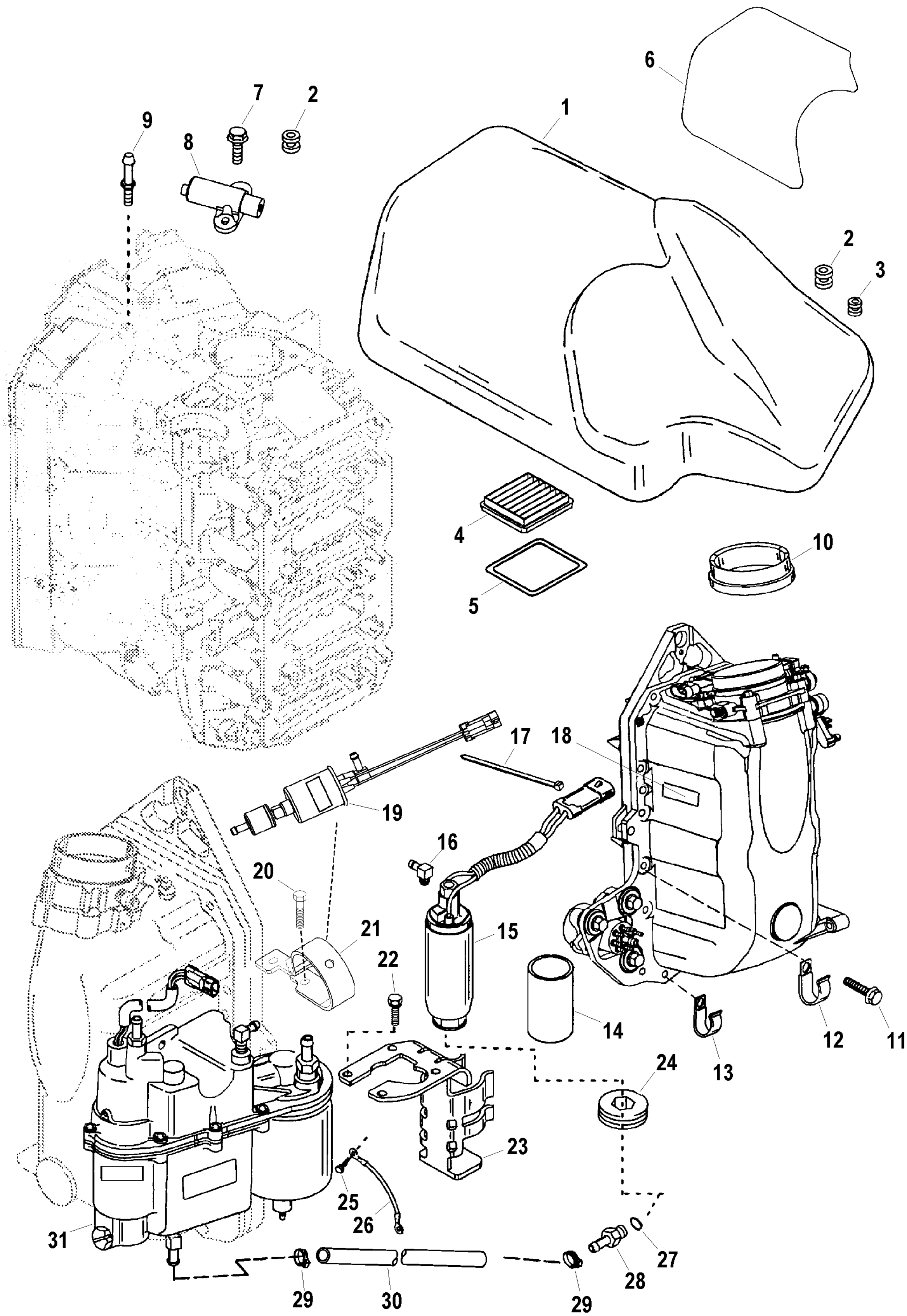
Air Handler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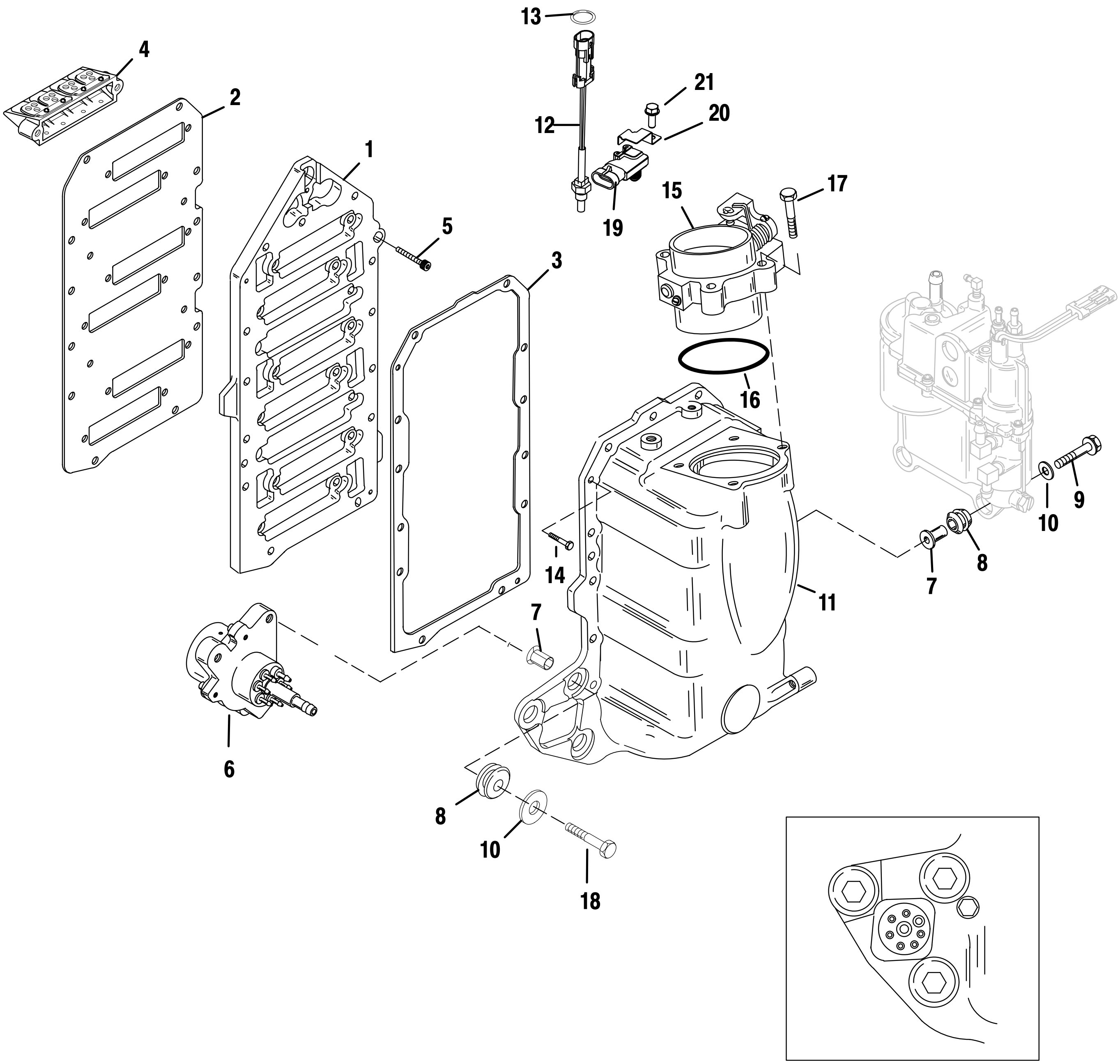
Air Handler

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	COVER ASSEMBLY			
2	2	GROMMET (0.310 x 0.620)			
3		GROMMET (0.270 x 0.570)			
4	1	AIR FILTER			
5	1	COVER			
6	1	DECAL (Mercury Optimax 200 M2 Jet Drive)			
7	2	SCREW (M5 x 16)	145		16.5
8	1	SENSOR-Crank Position			
9	1	PIN (Special)			
10	1	GROMMET-Throttle Body			
11	12	SCREW (0.250-20 x 1.500)		16	21
12	1	CLAMP			
13	2	J CLIP			
14	1	SLEEVE			
15	1	PUMP ASSEMBLY-Fuel			
16	1	ELBOW			
17	1	CABLE TIE (14.00 Inch)			
18	1	DECAL -EPA Label Info			
19	1	PUMP ASSEMBLY-Fuel			
20	1	SCREW (M6 x 35)	145		16.5
21	1	BRACKET			
22	3	SCREW (M6 x 16)	145		16.5
23	1	BRACKET KIT			
24	1	GROMMET	175	15	20
25	1	SCREW (M6 x 10)	35		4
26	1	CABLE ASSEMBLY			
27	1	O RING			
28	1	FITTING			
29	4	CLAMP			
30	1	HOSE-Molded (Fuel Pump to Vapor Separator)			
31	1	VAPOR SEPARATOR ASSEMBLY			

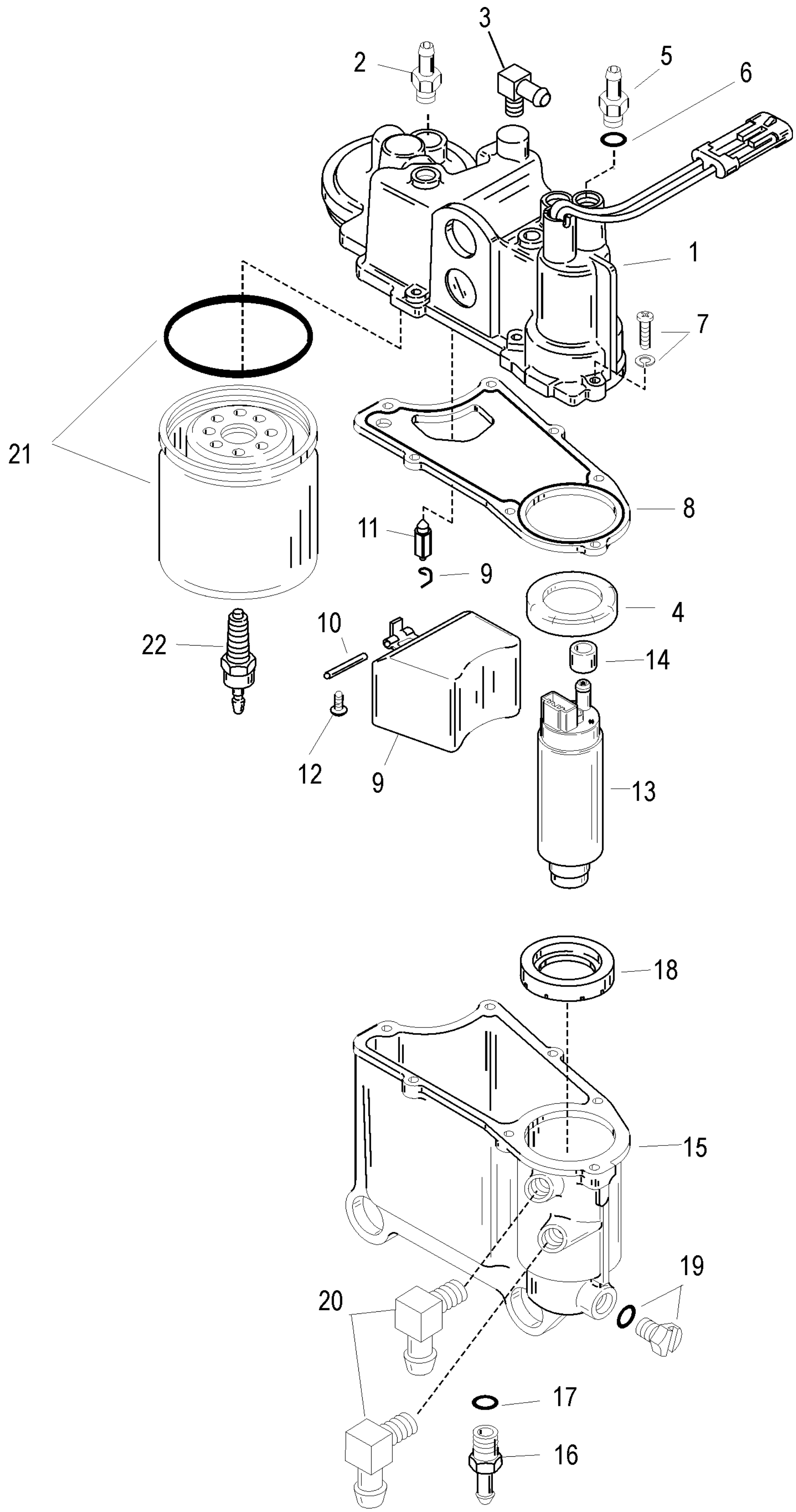
Air Handler Components



Air Handler Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
–	1	AIR HANDLER			
1	1	ADAPTOR PLATE KIT			
2	1	GASKET			
3	1	GASKET			
4	6	REED BLOCK			
5	12	SCREW (1/4-20 x .88)	90		10
6	1	OIL PUMP			
7	6	BUSHING			
8	6	GROMMET			
9	3	SCREW (M8 x 35)	140		16
10	6	WASHER			
11	1	AIR PLENUM KIT			
12	1	TEMPERATURE SENSOR			
13	3	O RING			
14	2	SCREW (M4 x 16)	Drive Tight		
15	1	THROTTLE BODY KIT			
16	1	O RING			
17	4	SCREW	100		11.5
18	3	SCREW	140		16
19	1	MAP SENSOR			
20	1	BRACKET			
21	1	SCREW (M6 x 16)	60		7

Vapor Separator Components

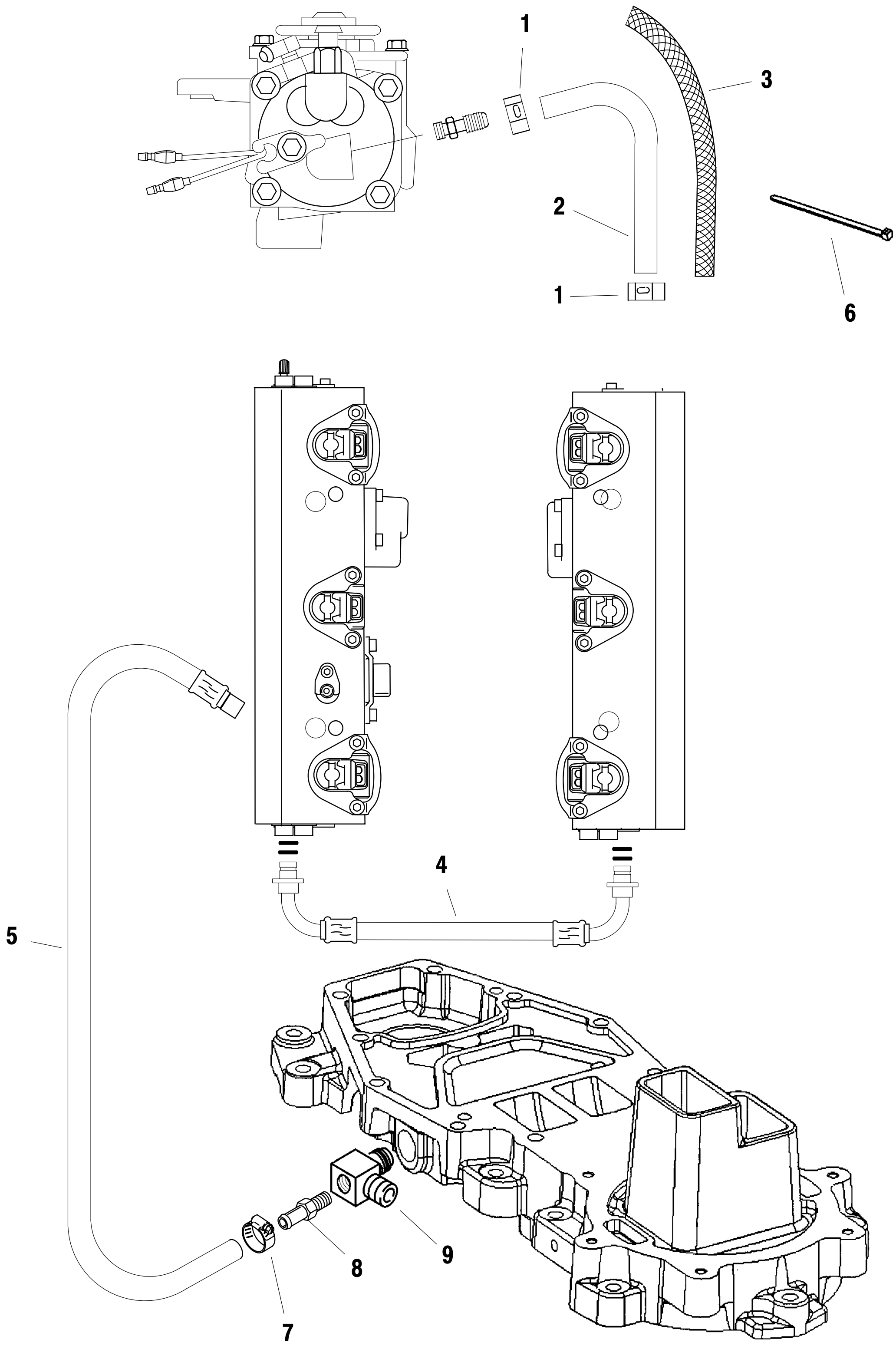


Vapor Separator Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	lb-ft	Nm.
–	1	VAPOR SEPARATOR ASSY			
1	1	COVER KIT			
2	1	FITTING - Straight	130		14.5
3	1	ELBOW	120		13.5
4	1	SEAL			
5	1	FITTING KIT-Pump Outlet	150		17
6	1	O RING			
7	7	SCREW	30		3.5
8	1	GASKET			
9	1	FLOAT KIT			
10	1	FLOAT PIN			
11	1	NEEDLE VALVE			
12	1	SCREW	10		1.0
13	1	FUEL PUMP KIT			
14	1	SLEEVE			
15	1	BOWL KIT			
16	1	FITTING KIT			
17	1	O RING			
18	1	SEAL			
19	1	PLUG KIT			
20	2	ELBOW			
21	1	FUEL FILTER ASSEMBLY	See Note		
22	1	PROBE-Water Sensing	120		13.5

NOTE: *Tighten filter until finger tight, then tighten additional 1/2 to 3/4 turn.*

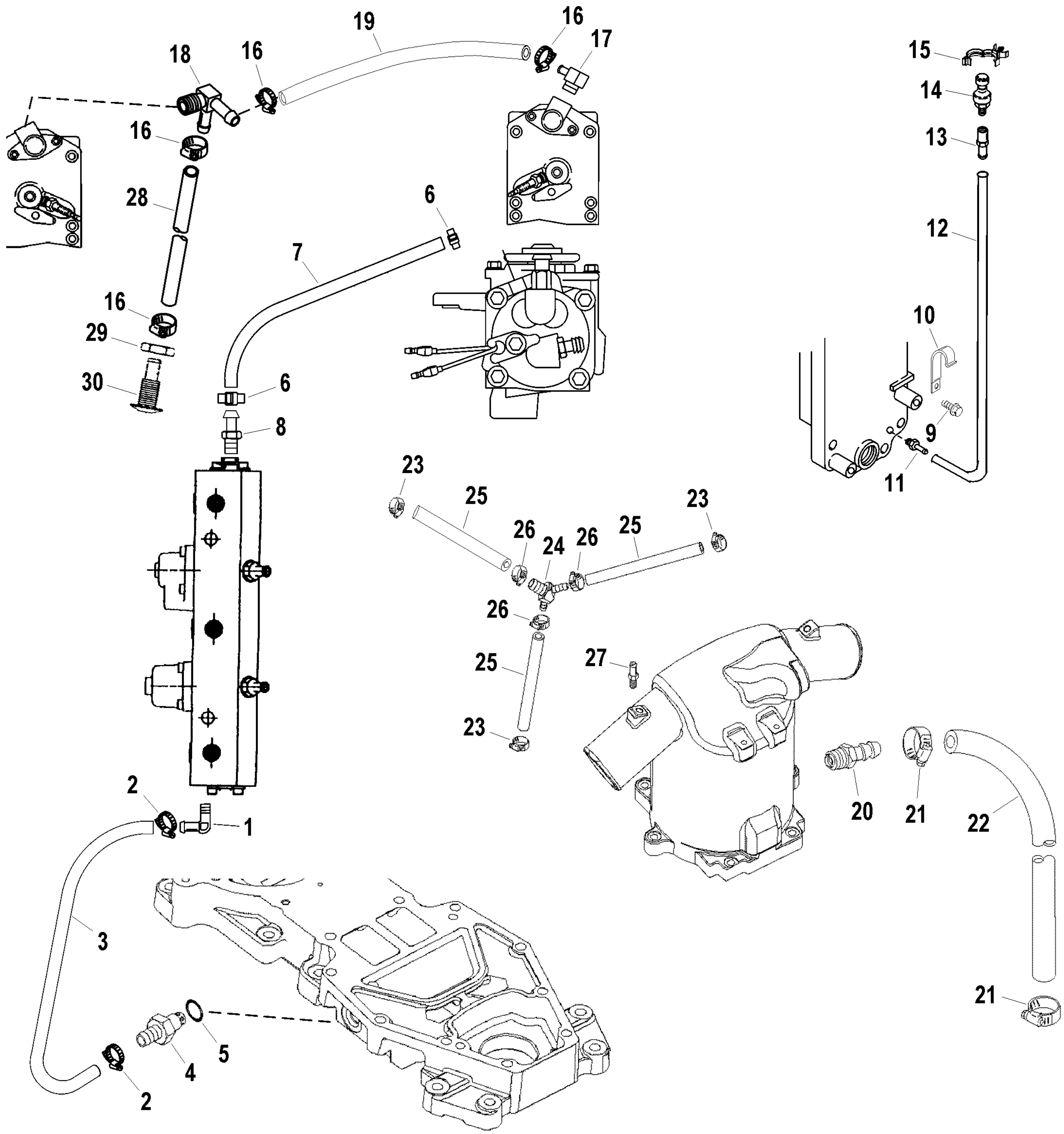
Air Hoses



Air Hoses

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
1	2	CLAMP			
2	1	HOSE (AIR SUPPLY)			
3	1	SLEEVE			
4	1	HOSE (AIR BALANCE)			
5	1	HOSE (AIR BYPASS)			
6	2	STA-STRAP			
7	1	CLAMP	17		1.9
8	1	CONNECTOR			
9	1	FITTING (90° -3/4 Inch)			

Water Hoses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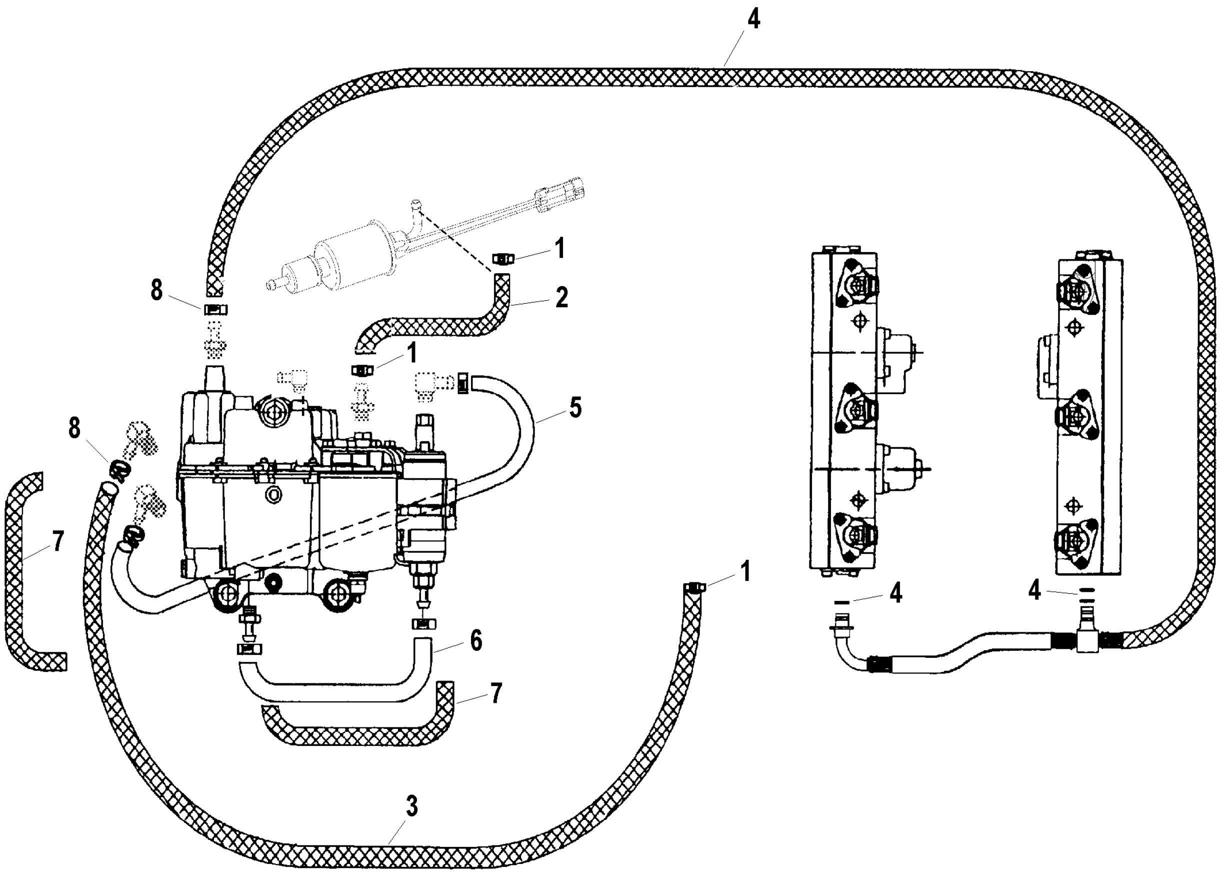
Water Hoses

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
1	1	ELBOW			
2	2	CLAMP	23		2.5
3	1	HOSE ASSEMBLY (32.00 Inches)			
4	1	FITTING-Strainer		40	54
5	1	O RING			
6	2	STA-STRAP (8.00 Inch)			
7	1	HOSE-Air Bypass (4.500 Inches)			
8	1	FITTING-Straight			
9	1	SCREW (0.312-18 x 0.500)		13	17.5
10	1	J-CLIP			
11	1	FITTING			
12	1	TUBING (26.00 Inches)			
13	1	FITTING			
14	1	WATER PRESSURE SENSOR			
15	1	CLIP			
16	2	CLAMP	23		2.5
17	1	FITTING			
18	1	FITTING			
19	1	HOSE (21.00 Inches)			
20	1	CONNECTOR (0.750-14)			
21	2	CLAMP	23		2.5
22	1	HOSE (19.00 Inches)			
23	3	CLAMP	13		1.5
24	1	FITTING			
25	3	TUBING (5.250 Inches)			
26	3	STA-STRAP (8.00 Inch)			
27	2	FITTING			
28	1	HOSE (To Thru Hull Fitting)			
29	1	NUT (0.562-18)			
30	1	FITTING-Cool Water Vent			

Fuel Hoses

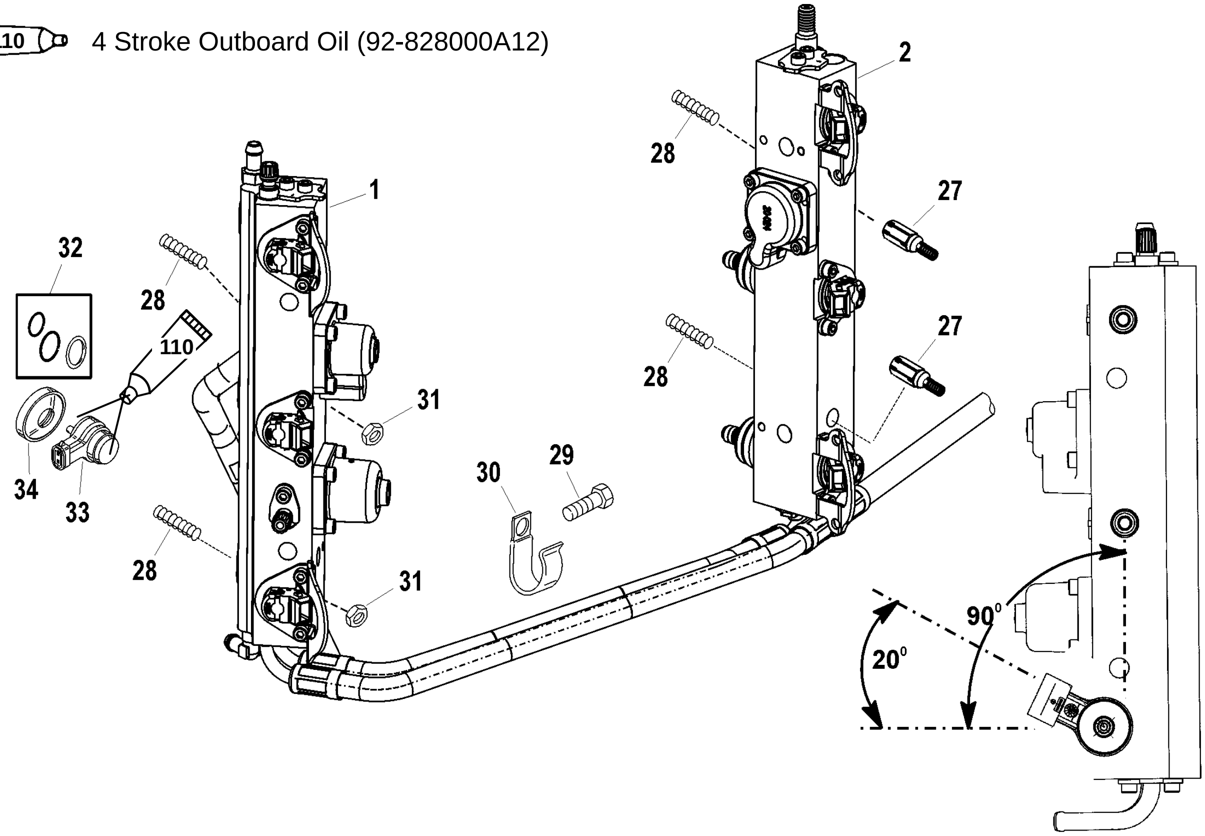


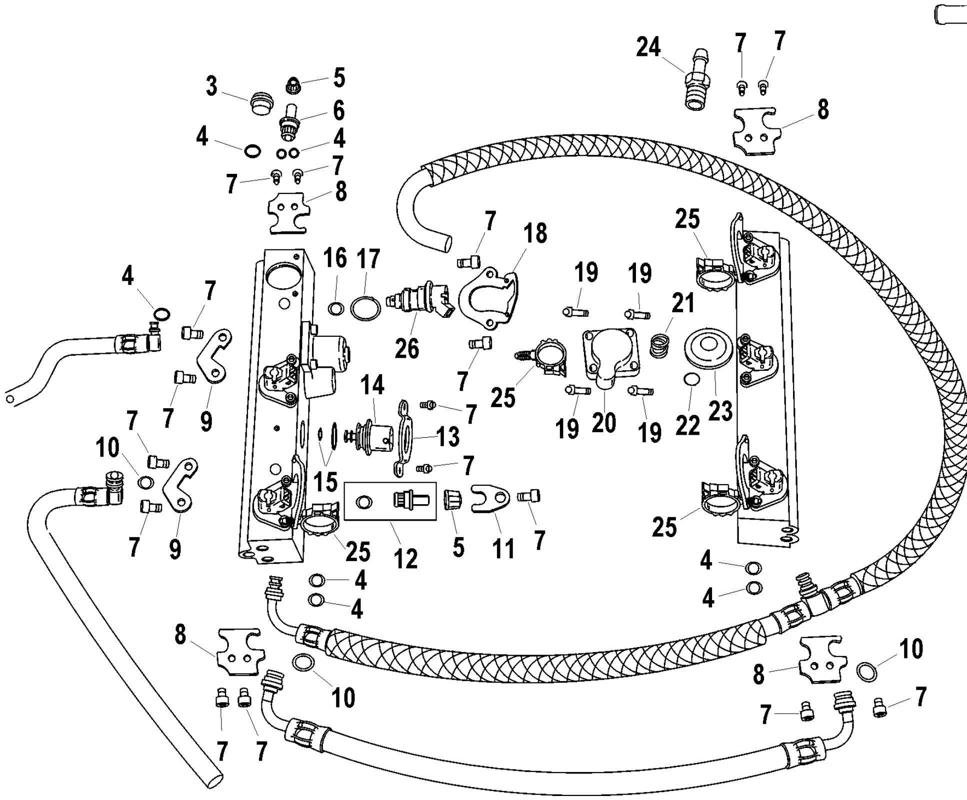
Fuel Hoses

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in.	TORQUE lb-ft.	TORQUE Nm
1	5	CLAMP			
2		HOSE (8.50 Inches)			
3	1	HOSE ASSEMBLY-Fuel Return			
4	1	HOSE ASSEMBLY			
5	1	HOSE (8.50 Inches)			
6	1	HOSE (7.50 Inches)			
7	1	SLEEVE (27.00 Inches)			
8	1	CLAMP			

Fuel Rails

110 4 Stroke Outboard Oil (92-828000A12)

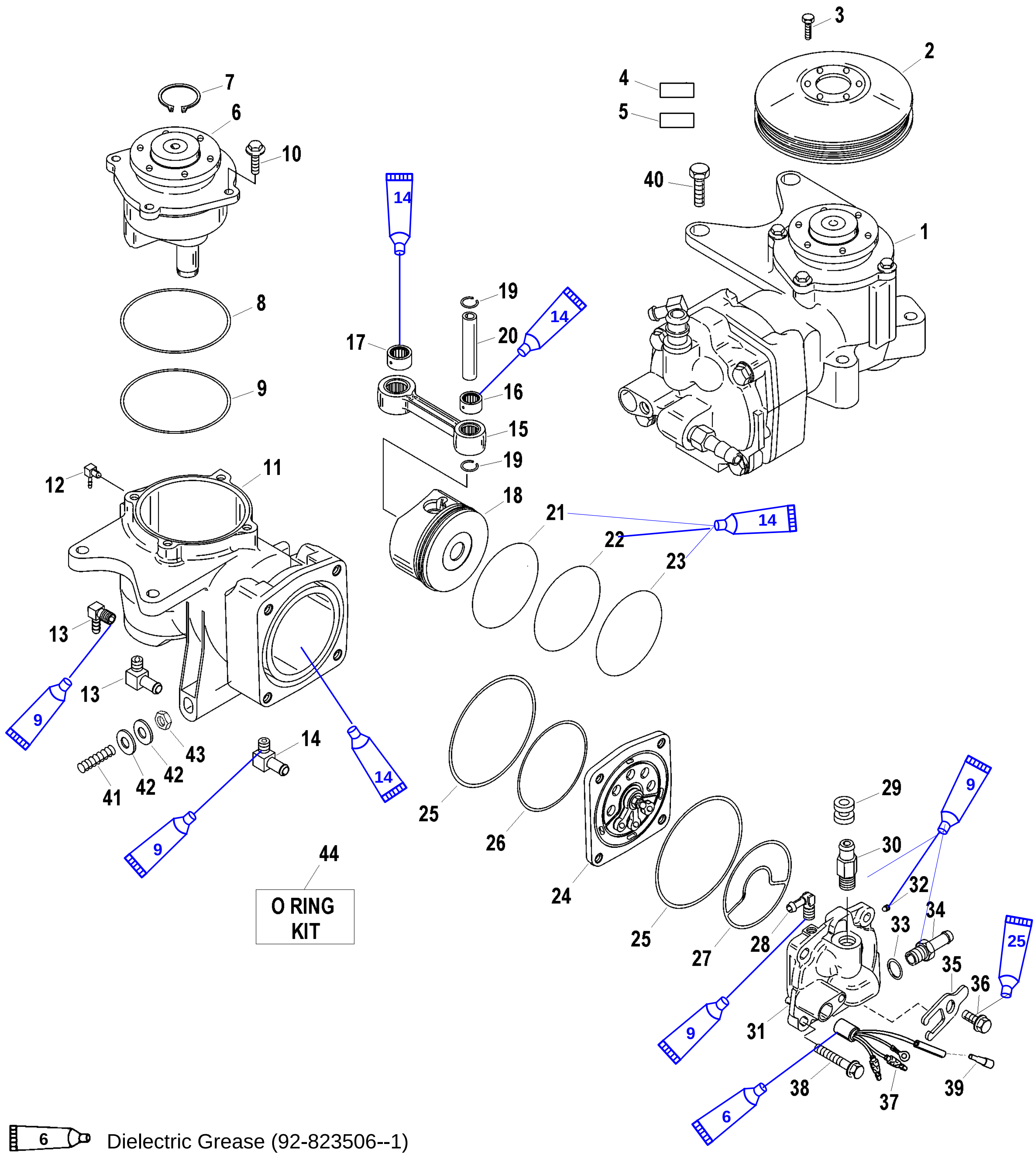




Fuel Rails

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	RAIL AND HOSE ASSEMBLY (Port)			
2	1	RAIL AND HOSE ASSEMBLY (Starboard)			
3	1	PLUG (AIR)			
4	1	O-RING KIT			
5	2	CAP-Air Injector			
6	2	VALVE ASSEMBLY-Fuel			
7	27	SCREW (M5 x 8)	70		8
8	4	CLAMP			
9	2	CLAMP			
10	1	O-RING KIT			
11	2	CLAMP			
12	1	VALVE ASSEMBLY-Air			
13	1	CLAMP	70		8
14	1	AIR REGULATOR (Port)			
15	1	O-RING			
16	1	O-RING			
17	1	O-RING			
18	4	CLAMP			
19	8	SCREW (M5 x 16)	70		8
20	1	COVER			
21	15	SPRING			
22	1	O-RING			
23	1	DIAPHRAGM ASSEMBLY			
24	1	FITTING			
25	4	CLIP			
26	6	FUEL INJECTOR			
27	2	SPACER		34	46
28	4	STUD (M10 x 91)			
29	1	SCREW (0.312-18 x 0.500)		13	17.5
30	1	J CLIP			
31	2	NUT (M10)		34	46
32	1	SEAL KIT			
33	6	AIR INJECTOR KIT			
34	6	WASHER ASSEMBLY			

Air Compressor Components



6 Dielectric Grease (92-823506--1)

9 Loctite PST Pipe Sealant (92-809822)

14 2 Cycle Outboard Oil (92-826666A24)

25 Liquid Neoprene (92-25711--2)

Air Compressor Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	AIR COMPRESSOR			
2	1	PULLEY			
3	5	SCREW (M6 x 12)	100		11.5
4	1	DECAL			
5	1	DECAL			
6	1	END CAP ASSEMBLY			
7	1	RING-Retaining			
8	1	O-RING (2.862 x 0.103)			
9	1	O-RING (2.739 x 0.070)			
10	4	SCREW (6 x 20)	100		11.5
11	1	BODY-Compressor			
12	1	FITTING			
13	2	VALVE-Check			
14	1	ELBOW (90°)			
15	1	CONNECTING ROD ASSEMBLY			
16	1	BEARING			
17	2	BEARING			
18	1	PISTON ASSEMBLY			
19	2	RING-Lock			
20	1	PIN-Wrist			
21	1	RING-Oil			
22	1	RING-Oil Scraper			
23	1	RING-Top			
24	1	REED PLATE ASSEMBLY			
25	2	O-RING (3.489 x 0.070)			
26	1	O-RING (2.739 x 0.070)			
27	1	SEAL			
28	1	FITTING			
29	1	GROMMET			
30	1	FITTING-Straight	25		2.7
31	1	HEAD ASSEMBLY-Compressor			
32	1	PLUG-Pipe (0.125-27)			
33	1	O-RING			
34	1	FITTING	25		2.7
35	1	RETAINER			
36	1	SCREW (M8 x 12)		20	27
37	1	SENSOR-Temperature			
38	4	SCREW (M8 x 35)		20	27
39	1	PLUG			
40	2	SCREW (M10 x 25)		41	55.5
41	1	STUD (0.312-24 x 4.190)			
42	2	WASHER			
43	1	NUT (0.312-24)		25	34
44	1	O-RING KIT			

DFI Operation

Air Induction Through Crankcase

Combustion air enters the bilge through air intakes of the boat. The air intakes on the boat deck have hoses that route the air to bottom of bilge. This limits the exposure of salt air to the components inside the bilge.

Once inside the bilge, the air enters the plenum through the throttle shutter which is located in the plenum assembly. The air then continues through the reed valves and into the crankcase. The throttle shutter is actuated by the throttle shaft. Mounted on a separate shaft is a throttle position sensor (TPS). This sensor tells the engine control unit (ECM) the position of the throttle.

If the TPS should fail, the warning horn will sound. Engine speed will be reduced by and the ECM will reference the MAP sensor for fuel calibration.

Air Compressor System

Air from inside the bilge is drawn into the compressor through the flywheel cover. This cover acts like a muffler to quiet compressor noise and contains a filter to prevent the ingestion of debris into the compressor. The compressor is driven by a belt from a pulley mounted on the flywheel and is automatically self adjusted using a single idler pulley. This air compressor is a single cylinder unit containing a connecting rod, piston, rings, bearings, reed valves, and a crankshaft. The compressor is water cooled to lower the temperature of the air charge and is lubricated by oil from the engine oil pump assembly. As the compressor piston moves downward inside the cylinder, air is pulled through the filter, reed valves and into the cylinder. After the compressor piston changes direction, the intake reeds close and the exhaust reeds open allowing compressed air into the hose leading to the air/fuel rails.

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

Fuel

Fuel for the engine is stored in a typical fuel tank. A fuel lift pump draws fuel through the fuel line to a fuel pump assembly that pushes the fuel thru a water separating fuel filter. This filter removes any contaminates and water before the fuel reaches the vapor separator. Fuel vapors are vented through a hose to the fuel tank. The electric fuel pump is different than the fuel pump that is utilized on the standard EFI engine (non DFI), and is capable of developing fuel pressures in excess of 90 psi. Fuel inside the rail must remain pressurized at exactly 10 psi over the air rail pressure or the ECM (map) calibrations will be incorrect. Fuel from the vapor separator is supplied to the bottom of the starboard fuel rail. A fuel line connects the bottom of the first rail to the opposite fuel rail. Fuel is stored inside the rail until an injector opens. A fuel pressure regulator controls pressure in the fuel rails, and allows excess fuel to return into the vapor separator. The fuel regulator not only regulates fuel pressure but also regulates it at approximately 10 p.s.i. higher than whatever the air rail pressure is. The fuel regulator diaphragm is held closed with a spring that requires 10 p.s.i. to force the diaphragm off the diaphragm seat. The back side of the diaphragm is exposed to air rail pressure. As the air rail pressure increases, the fuel pressure needed to open the regulator will equally increase. Example: If there is 50 p.s.i. of air pressure on the air rail side of the diaphragm, 60 p.s.i. of fuel pressure will be required to open the regulator. The port fuel rail is water cooled.

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

Oil

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

The ECM will change the discharge rate of the oil pump, depending upon engine demand. The ECM will also pulse the pump on initial start up to fill the oil passages eliminating the need to bleed the oil system. The ECM provides additional oil for break in, as determined by its internal clock. The oil ratio varies with engine rpm and load.

Electrical

The electrical system consists of the ECM, crank position sensor (flywheel speed & crankshaft position), throttle position sensor (TPS), MAP sensor, engine temperature sensor(s), ignition coils and injectors (fuel & direct). The engine requires a battery to start (i.e. the ignition and injection will not occur if the battery is dead). The system will run off of the alternator.

Operation

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

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

Idle Notes: Idle quality is controlled by fuel volume and fuel timing. The throttle shutter will be open at idle speed.

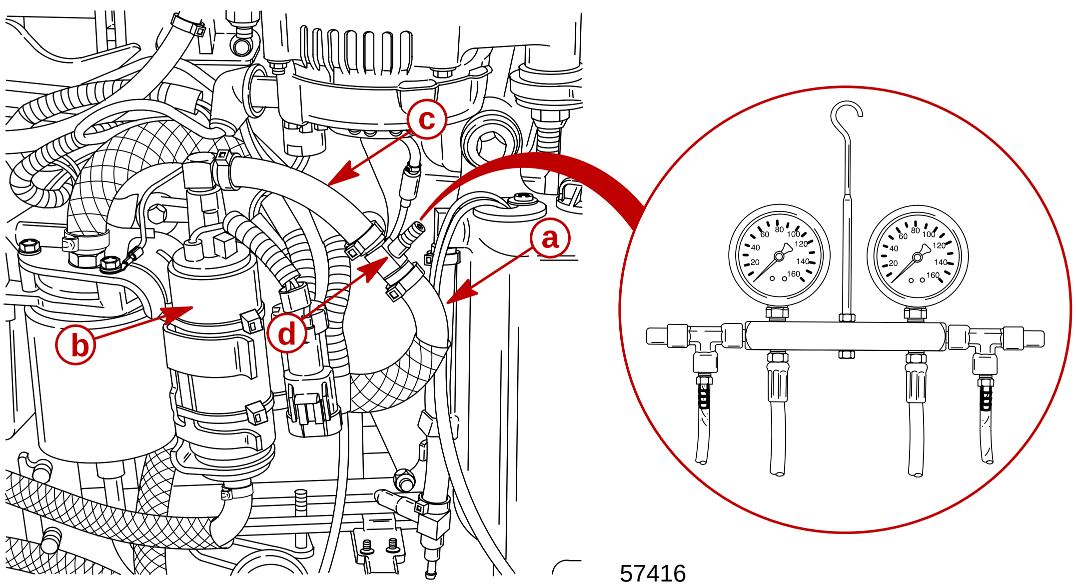
The TPS signals the ECM to change the fuel and spark without movement of the throttle shutters. The throttle cam is manufactured to allow the TPS sensor shaft to move before opening the throttle shutter.

Testing Electric Fuel Pump Pressure Output

Low Pressure Electric Fuel Pump

IMPORTANT: After completing fuel pressure tests, reconnect and secure fuel outlet hose to fuel pump with full circle stainless clamps in Clamp Tool Kit 91-803146A1.

1. Remove outlet fuel hose from low pressure pump. Install a short piece of hose (obtain locally) onto pump outlet fitting. Install Schrader Valve t-fitting (22-849606) between outlet fuel hose (removed from pump) and new fuel hose (installed on pump). Secure hose connections with sta-straps. Due to the low pressure output of this pump, it is recommended that the air gauge of the Dual Fuel/Air Pressure Gauge (91-852087A1/A2/A3) be connected to the Schrader Valve. Gauge should indicate 6–9 psi (41.37 – 62.04 kPa).



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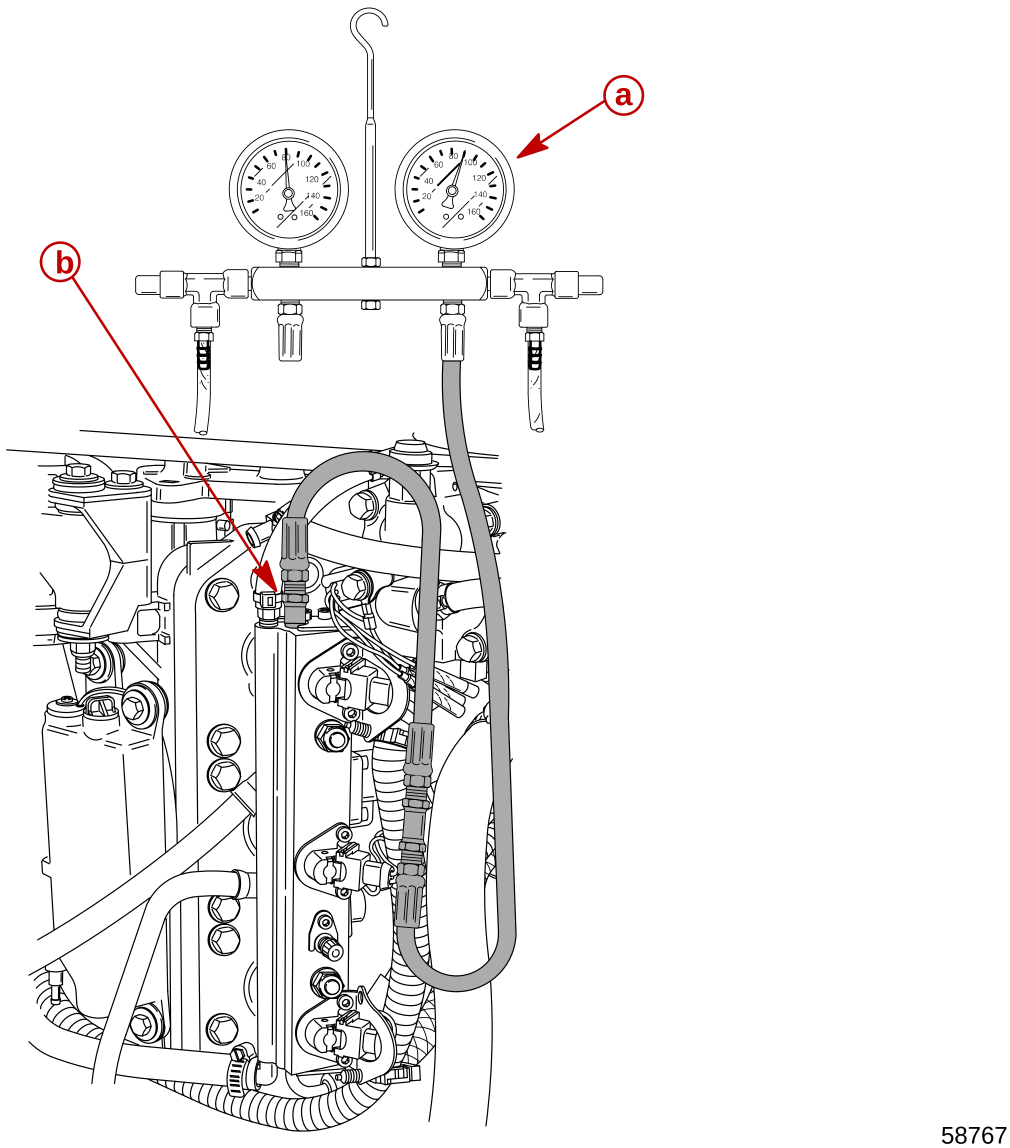
a - Outlet Fuel Hose
b - Low Pressure Electric Fuel Pump
c - Fuel Hose (obtain locally)
d - Schrader Valve (22-849606)

High Pressure Electric Fuel Pump

1. Install Pressure Gauge Assembly 91-852087A1/A2/A3 to port fuel rail pressure test valve.

NOTE: *If low air or low fuel pressure is indicated, swap hoses between air and fuel test ports. If low reading moves, gauge accuracy should be checked.*

NOTE: *After 15 seconds of cranking engine with starter motor, fuel pressure gauge should indicate 89 ± 2 psi (613.5 ± 13.8 kPa).*



a - Fuel Pressure Gauge (Should Indicate 89 ± 2 psi (613.5 ± 13.8 kPa)
b - Fuel Pressure Test Valve

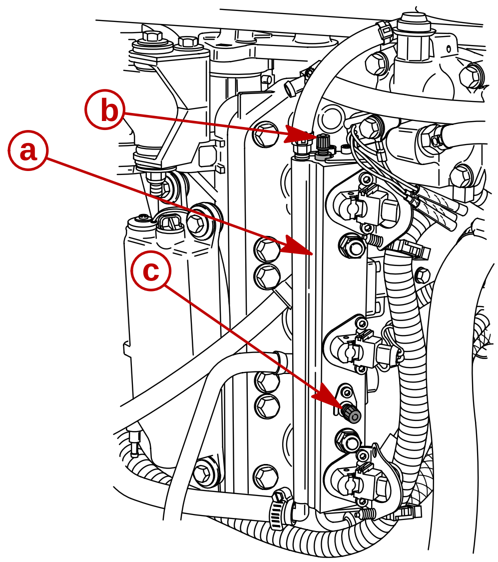
Fuel Management Assembly Removal

CAUTION

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

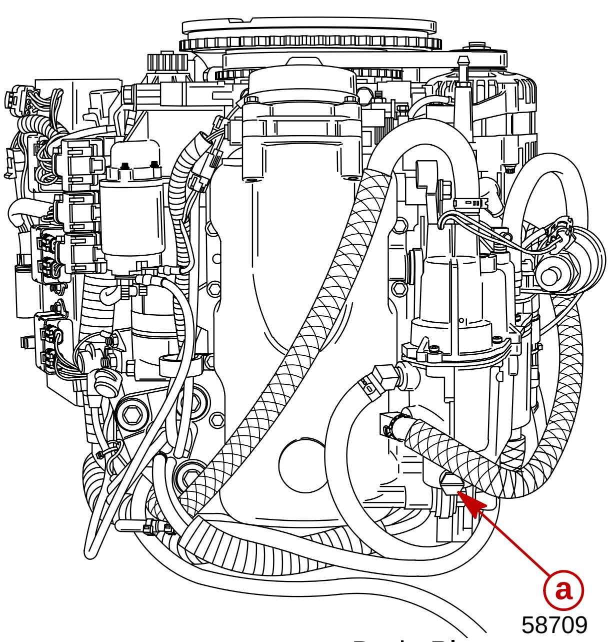
NOTE: *Use Fuel/Air Pressure Gauge 91-16850--1 or 91-852087A1/A2/A3 to de-pressurize air hose first and then fuel hose.*

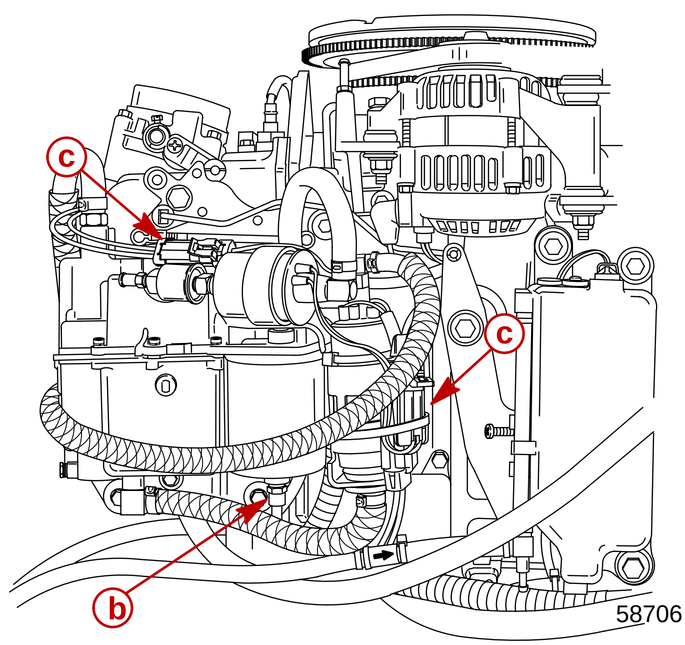
1. De-pressurize fuel system.



a - Port Fuel Rail
b - Fuel Pressure Port
c - Air Pressure Port

2. Place suitable container underneath vapor separator drain plug and remove plug.
3. Disconnect water separator sensor lead.
4. Disconnect electric fuel pump harness connectors.



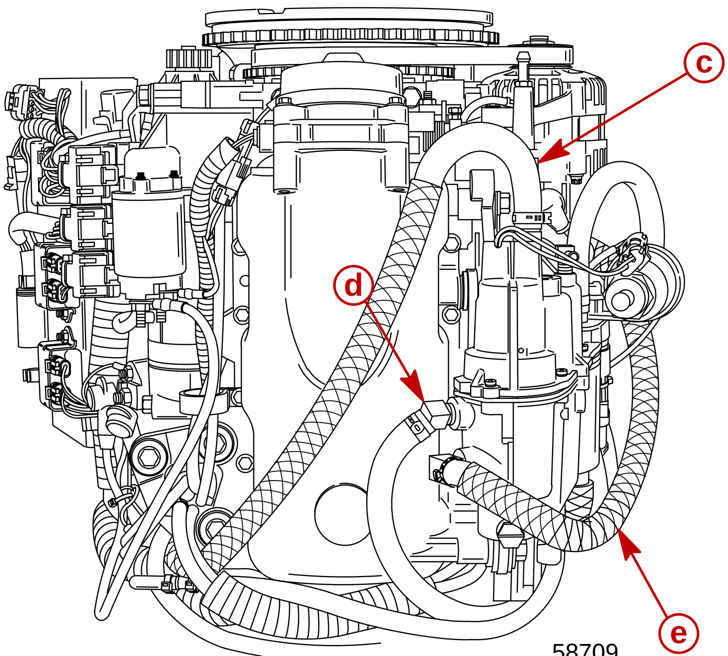


a - Drain Plug
b - Sensor Lead

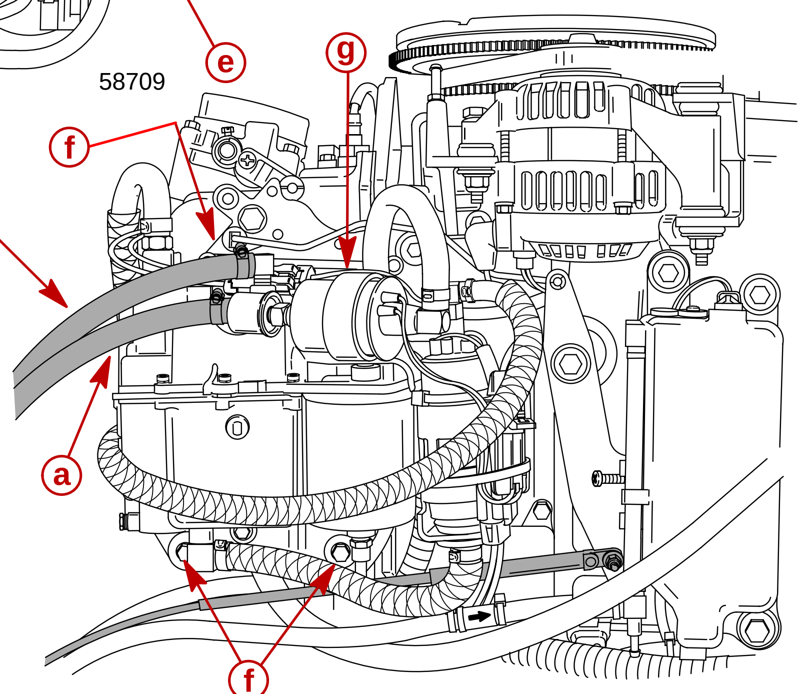
c - Harness Connectors

NOTE: *Upper fuel hose is excess fuel return from fuel rails; lower fuel hose is fuel inlet from electric circulating pump beside fuel/water separator.*

5. Remove the fuel inlet hose from the fuel lift pump.
6. Remove vapor separator vent hose.
7. Remove the fuel outlet hose and fuel return hose from fuel rails.
8. Remove vapor separator ground lead.
9. Remove 3 mounting bolts and remove separator.



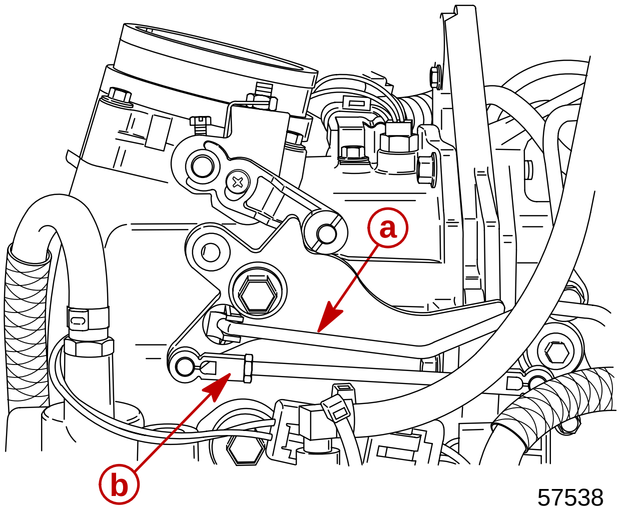
58709



58740

a - Fuel Inlet Hose to Fuel Lift Pump
b - Vapor Separator Vent Hose
c - Fuel Outlet Hose
d - Fuel Return Hose
e - Fuel Inlet Hose
f - Mounting Bolts (3)
g - Ground Lead

10. Disconnect throttle cam link rod and the Throttle Position Sensor link rod.
11. Disconnect MAP Sensor from air management assembly.



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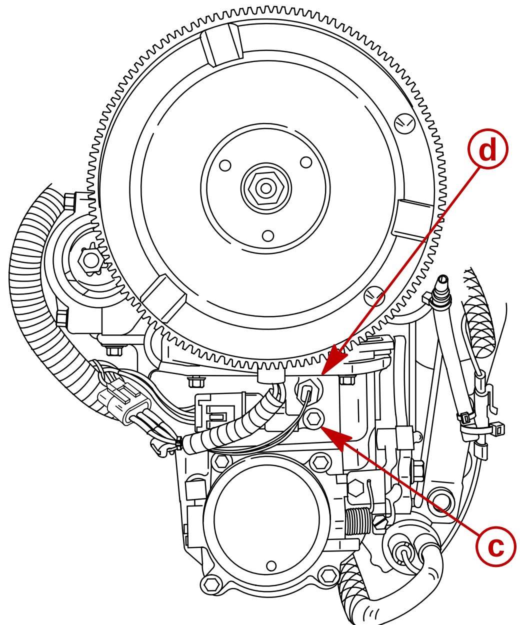
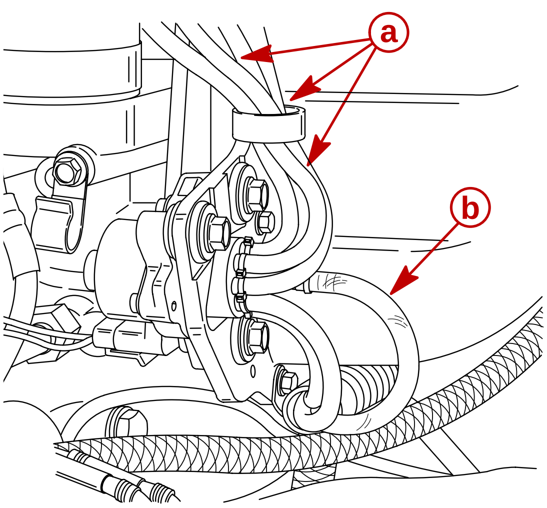


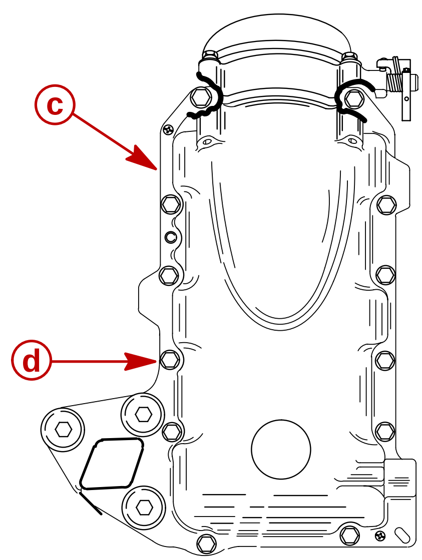
57489

a - Throttle Link Rod
b - Throttle Position Sensor Link Rod
c - MAP Sensor
d - Temperature Sensor

12. Disconnect oil hoses from oil pump.
13. Remove and plug oil inlet hose to oil pump.
14. Remove 12 bolts securing air management assembly to crankcase and remove assembly.



57686

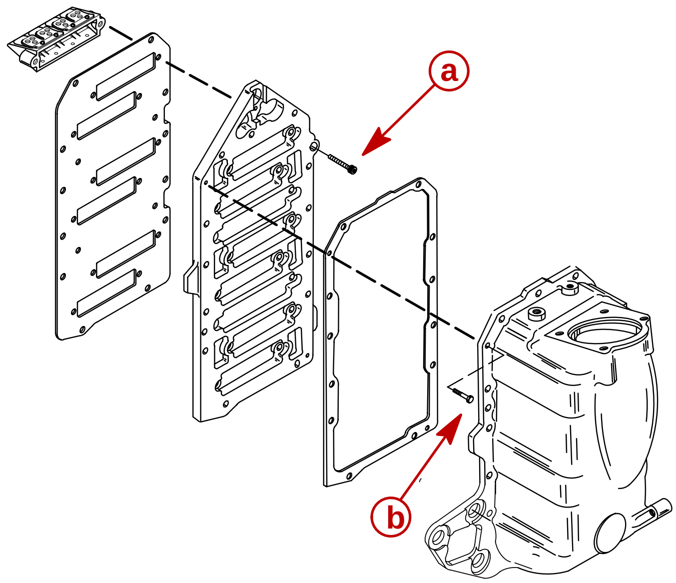


56144

a - Oil Outlet Hoses
b - Oil Inlet Hose
c - Air Management
d - Bolts (12 each)

Reed Block Disassembly/Assembly

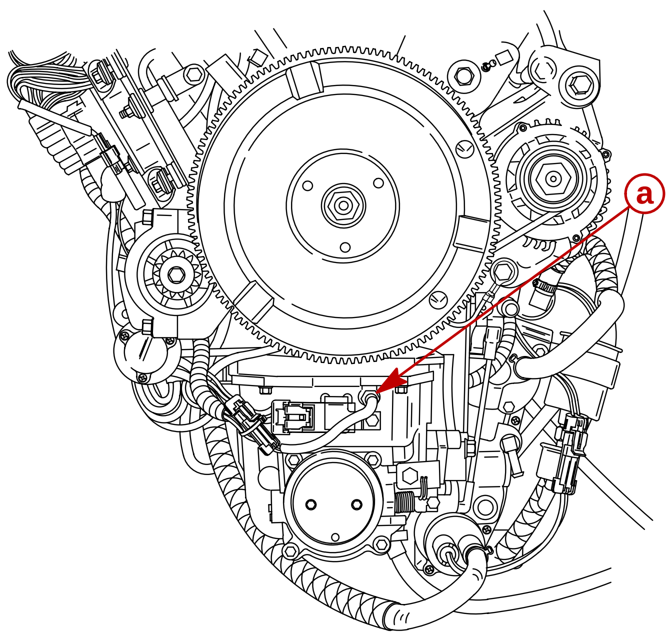
1. Remove 2 screws securing air plenum to reed plate assembly. Drive screws tight on reassembly.
2. Remove 12 screws securing reed blocks to reed plate assembly. Torque screws to 90 lb. in. (10 Nm) on reassembly.



a - Screws (2 each) (M4x16)
b - Screws (12 each) (1/4x20x0.88)

Air Temperature Sensor Removal

Disconnect sensor harness and unscrew sensor.



58705

a - Air Temperature Sensor

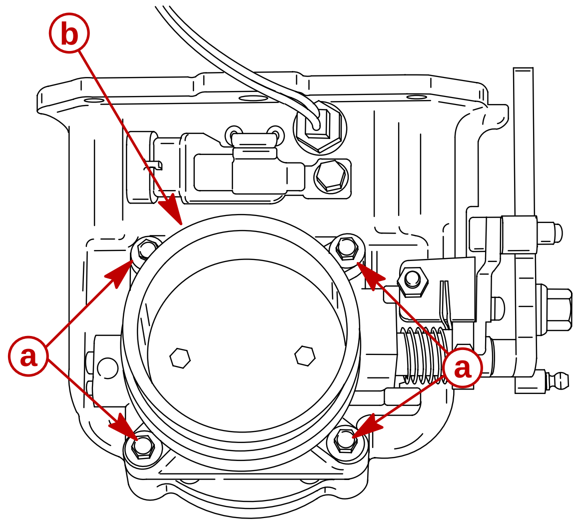
Air Temperature Sensor Installation

Screw sensor into air plenum. Reconnect sensor harness.

Throttle Plate Assembly Removal

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

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



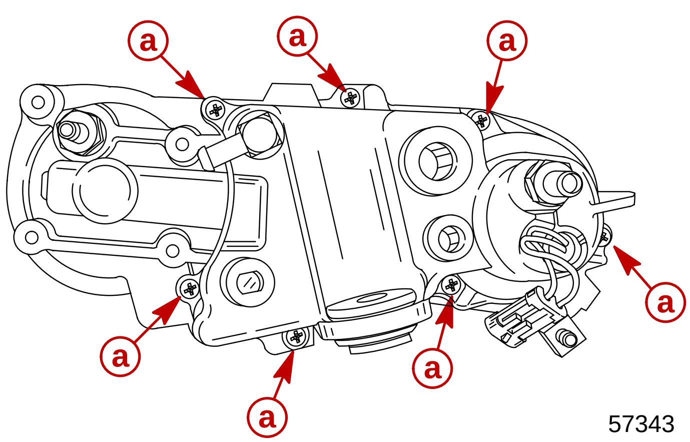
a - Bolts
b - Throttle Plate Assembly

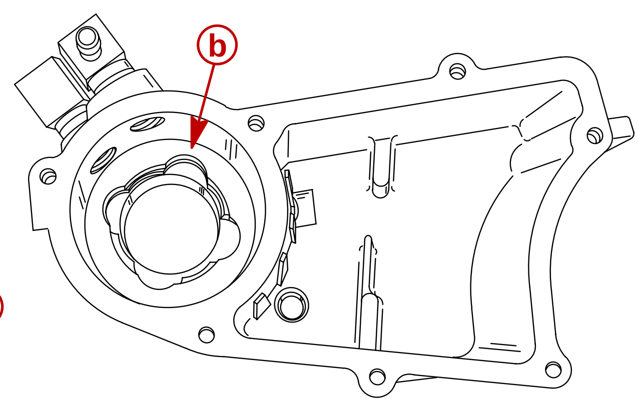
Throttle Plate Assembly Installation

Secure throttle plate assembly to air plenum with 4 bolts. Torque bolts to 100 lb. in. (11.5 Nm).

Vapor Separator Disassembly

1. Remove 7 screws securing separator cover and remove cover.
2. Inspect seal in fuel pump chamber of separator tank for cuts and abraisions. Replace seal if necessary. If seal is serviceable, apply 2-4-C w/Teflon Marine Lubricant (92-825407A12) to seal lips.





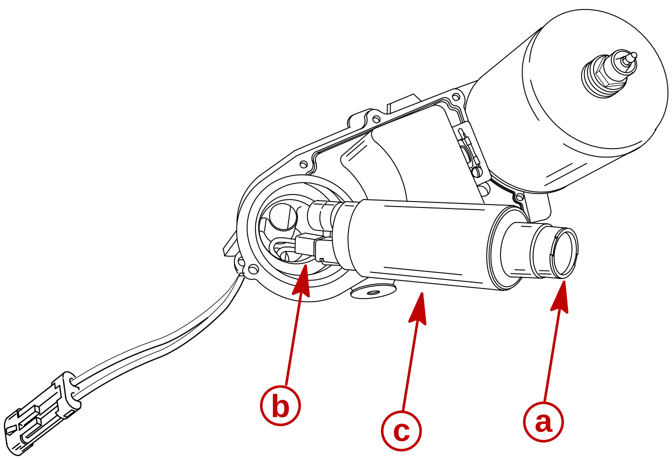
a - Screws (7 each)
b - Seal

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

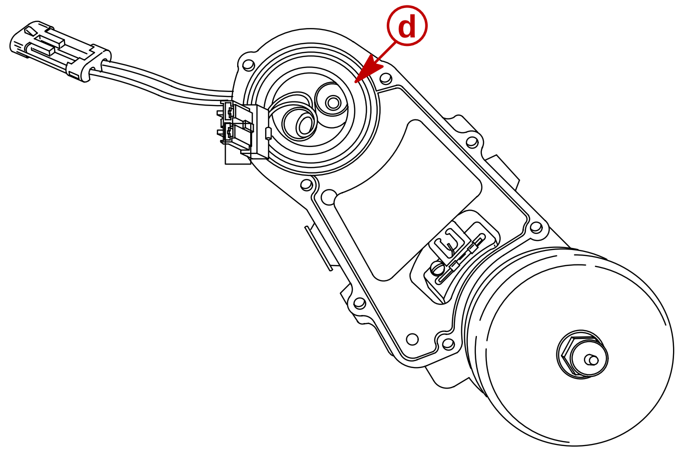
IMPORTANT: DO NOT twist pump during removal as wire harness may be damaged.

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

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



56057

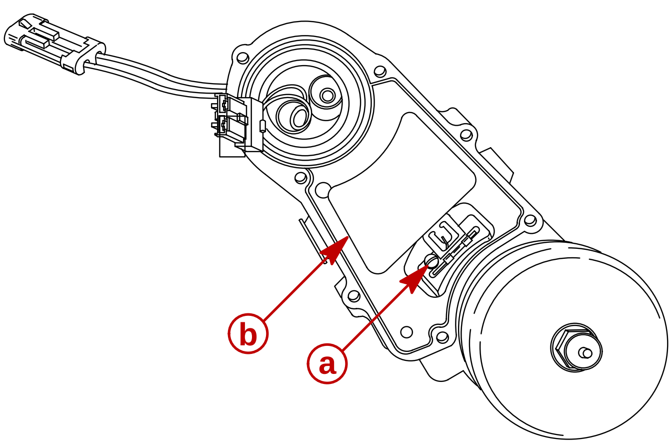


56058

- **a** - Filter Screen
- **b** - Harness Connector
- **c** - Pump
- **d** - Seal (Seal shoulder faces OUT)

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

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



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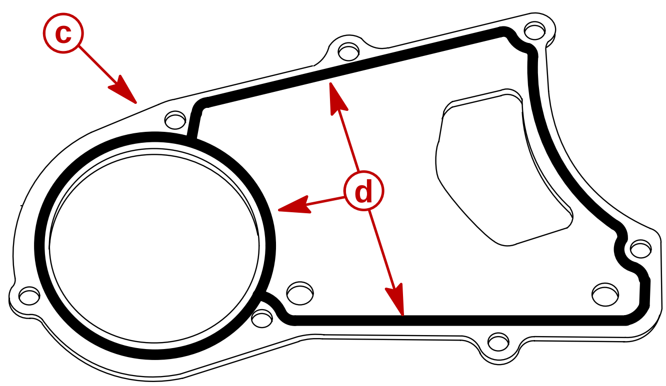
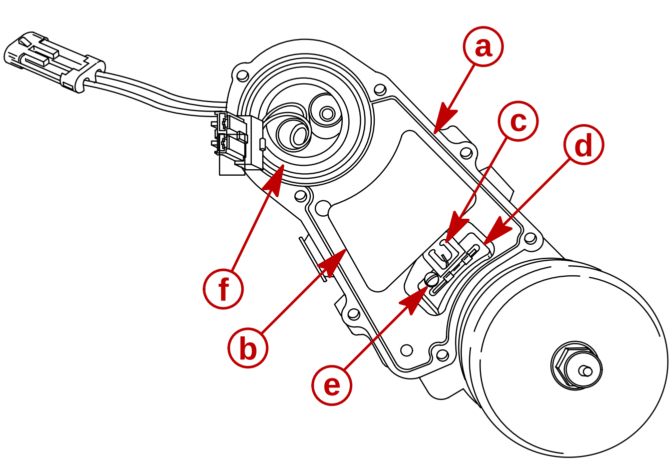


56059

- **a** - Screw
- **b** - Float
- **c** - Plate
- **d** - Seal

Vapor Separator Reassembly

1. Reinstall phenolic sealing plate onto vapor separator cover.
2. Secure float, needle and pivot pin assembly to separator cover with screw. Torque screw to 10 lb. in. (1.0 Nm)
3. Apply 2-4-C w/Teflon to lips of seal in separator cover.
4. Connect electrical harness to fuel pump. Inspect fuel pump filter screen for debris. Remove screen and clean as required.
5. Seat fuel pump and harness into separator cover being careful not to pinch harness.



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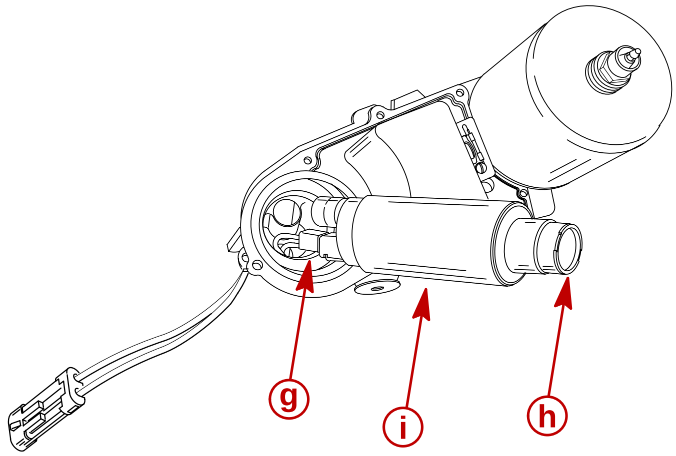
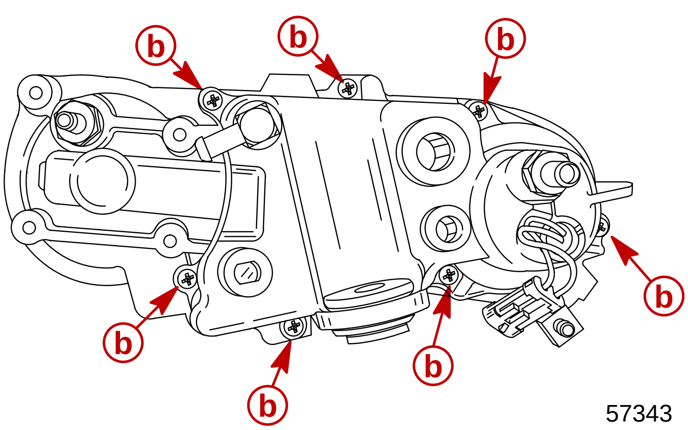


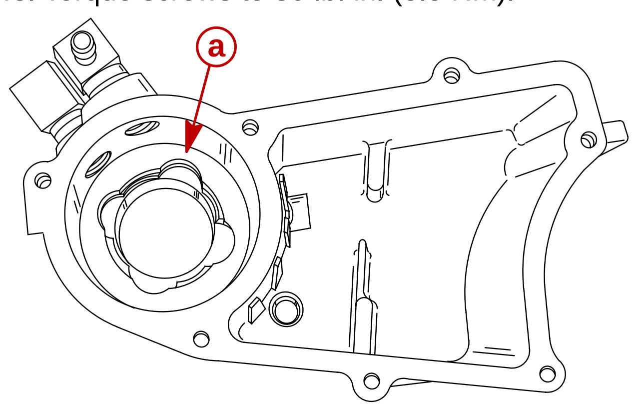
56057

a - Sealing Plate
b - Float
c - Needle
d - Pivot Pin
e - Screw [Torque to 10 lb. in. (1.0 N·m)
f - Seal (Seal shoulder faces OUT)
g - Harness
h - Filter
i - Fuel Pump

6. Apply 2-4-C w/Teflon to lips of seal in separator tank.
7. Install separator cover with pump onto separator tank.
8. Secure cover to tank with 7 screws. Torque screws to 30 lb. in. (3.5 Nm).



57343

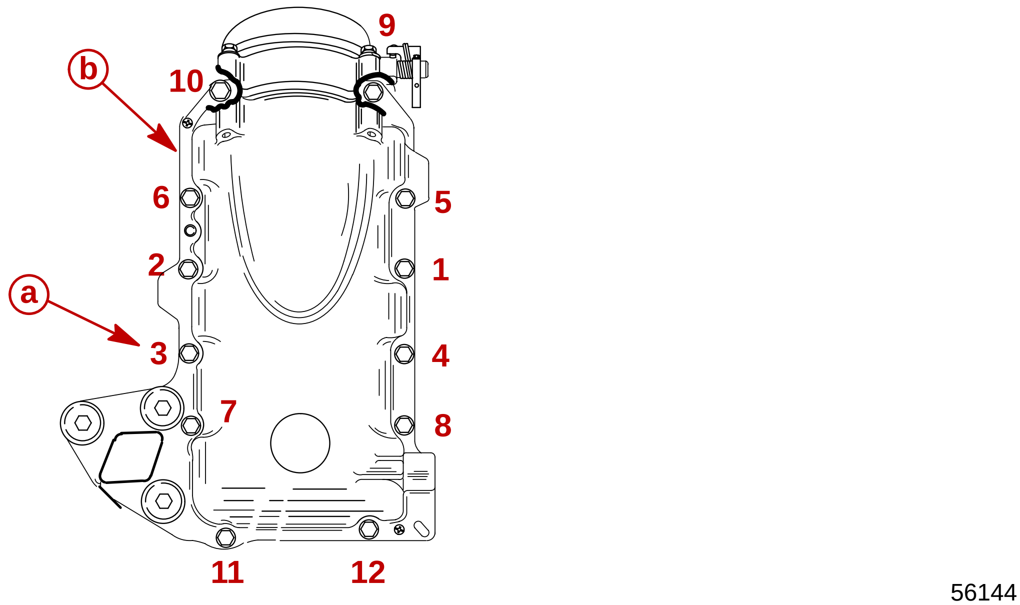


57342

a - Seal
b - Screws [Torque to 30 lb. in. (3.5 Nm)]

Air Plenum Installation

Secure plenum to crankcase with 12 bolts. Torque bolts to 175 lb. in. (20 Nm). in sequence shown

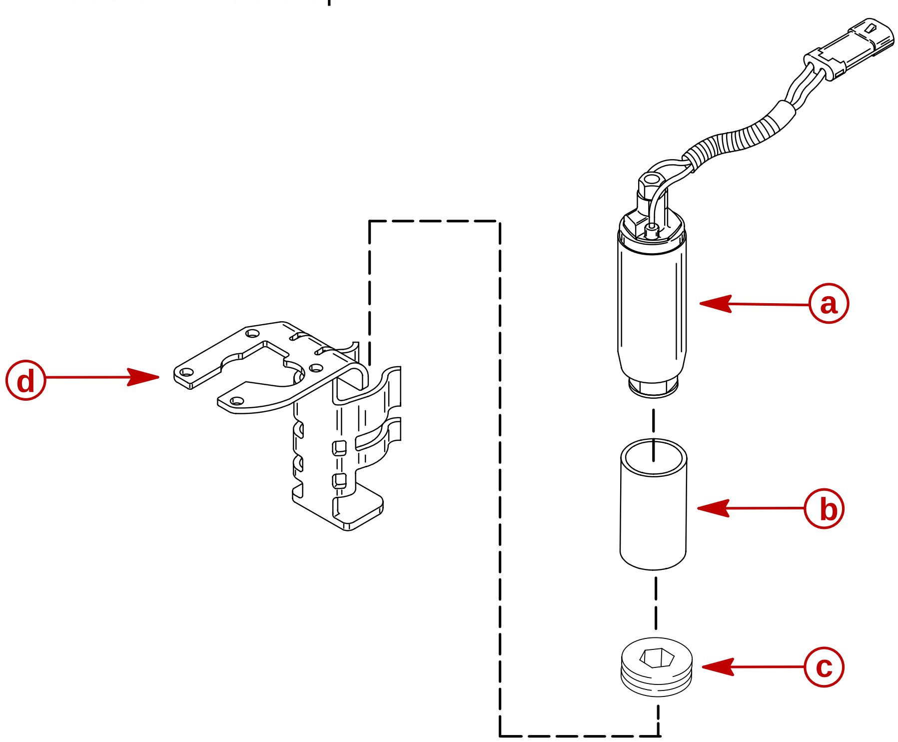


a - Air Plenum
b - Bolts [Torque to 175 lb. in. (20 Nm)]

Low Pressure Electric Fuel Pump Installation

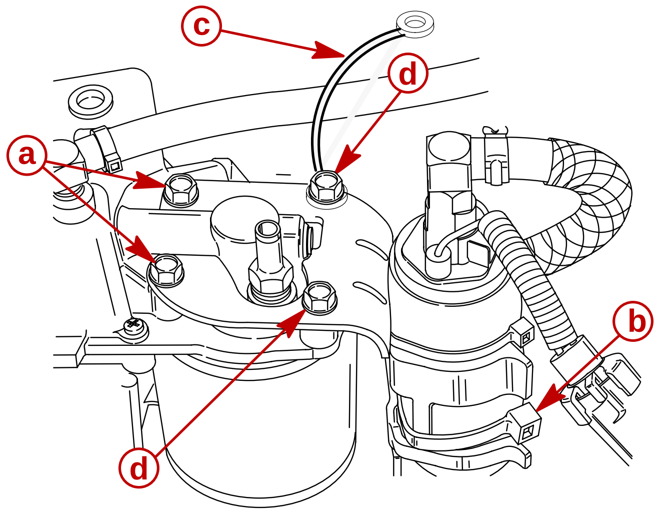
NOTE: *If pump does not have a sleeve or grommet, refer to Service Bulletin 98–8.*

1. Seat electric fuel pump w/sleeve against grommet in pump bracket. Secure pump to bracket with sta-strap.



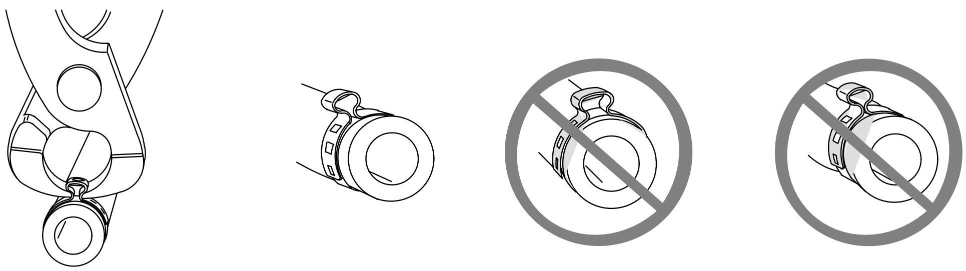
a - Low Pressure Electric Fuel Pump
b - Sleeve
c - Grommet
d - Bracket

2. Secure bracket assembly to vapor separator with 3 screws. Torque screws to 145 lb. in. (16 Nm). Screw (d) is used to secure electric fuel lift pump with clamp to bracket.

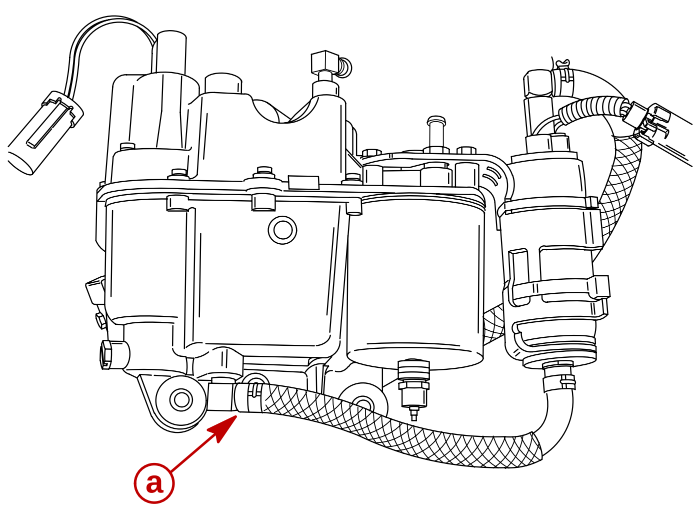


a - Screws – Torque to 145 lb. in. (16 Nm)
b - Sta-strap securing pump to bracket
c - Ground lead – attach to air plenum
d - Screw – Secures fuel lift pump – Torque to 145 lb. in. (16 Nm)

IMPORTANT: Only use tool 91-803146T (or Snap-On equivalent YA3080) to crimp full circle clamps. Using a different tool could result in a crimp that is too loose, or too tight. Do not use screw type metal hose clamp as it may damage hose.



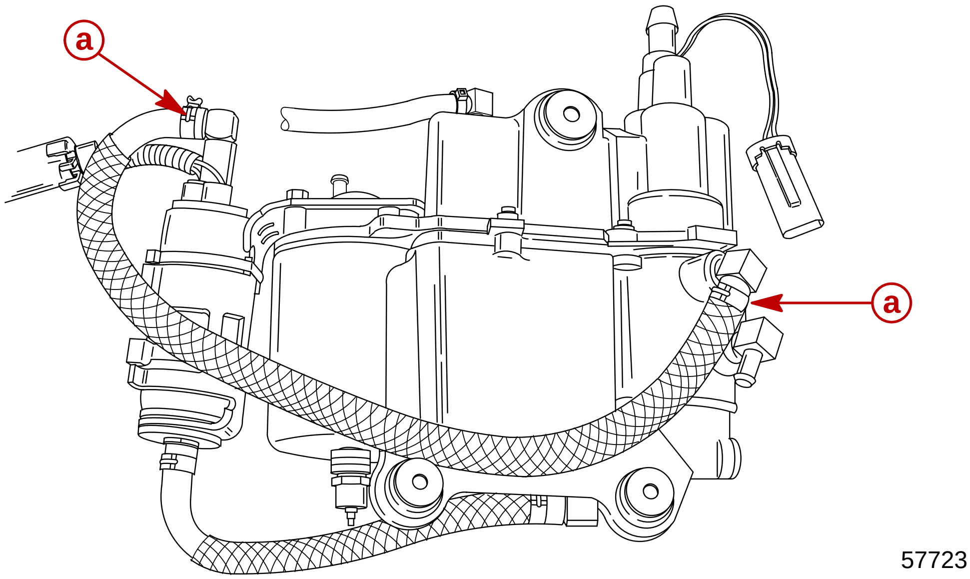
3. Connect fuel hose from bottom of low pressure fuel pump to 90° elbow in bottom of vapor separator. Secure hose with 18.3 mm full circle clamp (54-880141) using crimping tool 91-803146T.



27291

a - Secure Fuel Hose with 18.3 mm Full Circle Clamp (54-880141)

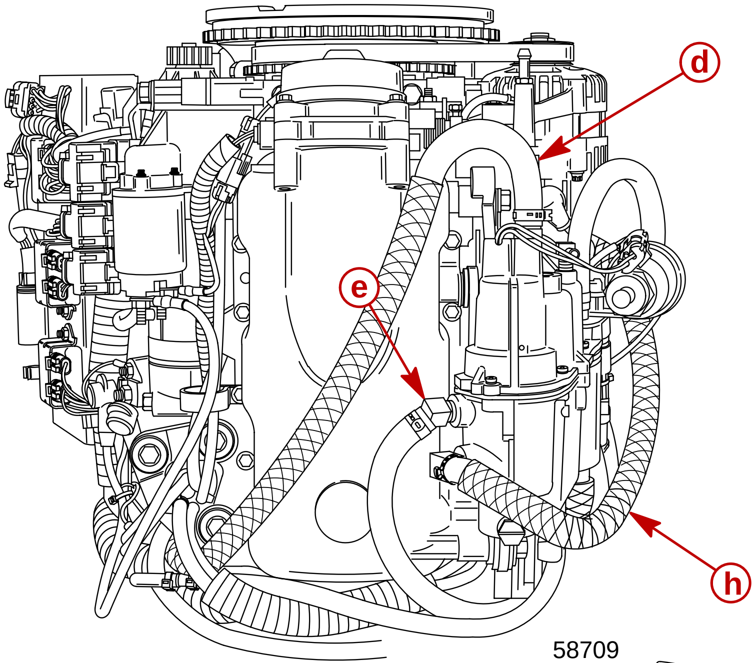
4. Connect fuel hose from top of low pressure fuel pump to 90° elbow on back side of vapor separator. Secure hose with 18.3 mm full circle clamp (54-880141) using crimping tool 91-803146T. (Back view of vapor separator shown below)

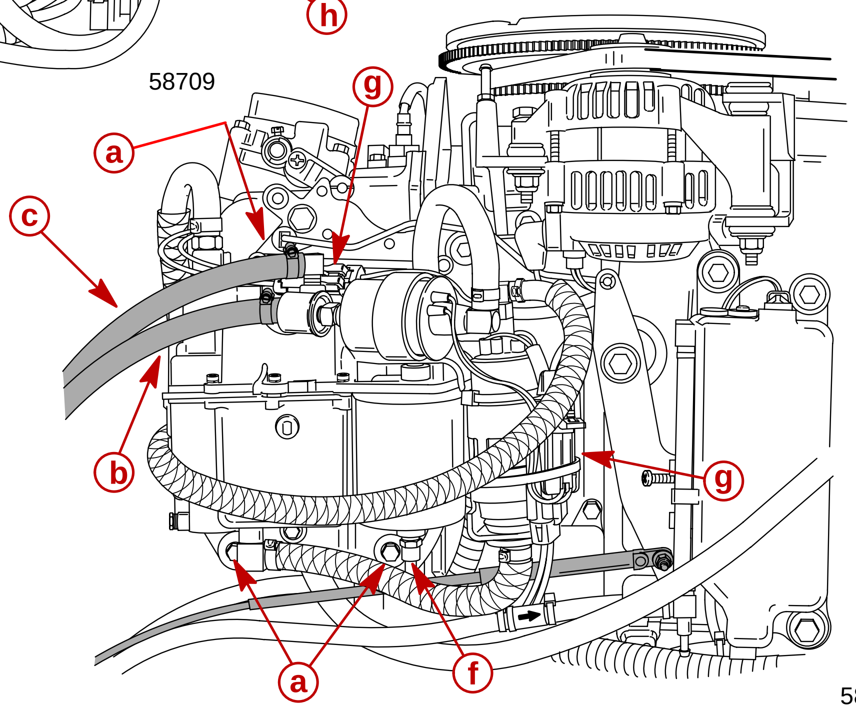


a - Secure Fuel Hose with 18.3 mm Full Circle Clamp (54-880141)

Vapor Separator Installation

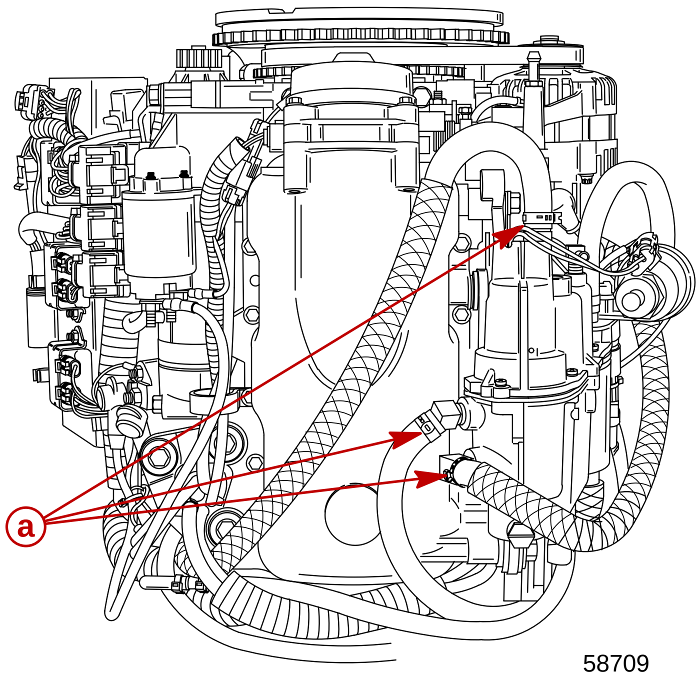
1. Secure vapor separator to air plenum with 3 bolts. Torque bolts to 140 lb. in. (16.0 Nm).
2. Connect fuel inlet hose to fuel lift pump.
3. Connect vent hose to vapor separator.
4. Connect fuel outlet hose and fuel return hose to vapor separator.
5. Connect water separator sensor lead to water separator.
6. Connect electric fuel pump harnesses.





a - Mounting Bolts [Torque to 140 lb. in. (16.0 Nm)
b - Fuel Inlet Hose
c - Vent Hose
d - Fuel Outlet Hose
e - Fuel Return Hose
f - Water Separator Sensor Lead
g - Electrical Harnesses
h - Fuel Outlet from Low Pressure Pump

7. If fuel hoses were removed, secure hoses with proper full circle clamp using tool 91-803146T (or Snap-On equivalent YA3080) to crimp clamps. Use stainless screw clamp on vapor separator vent hose and inlet fuel hose to fuel lift pump.



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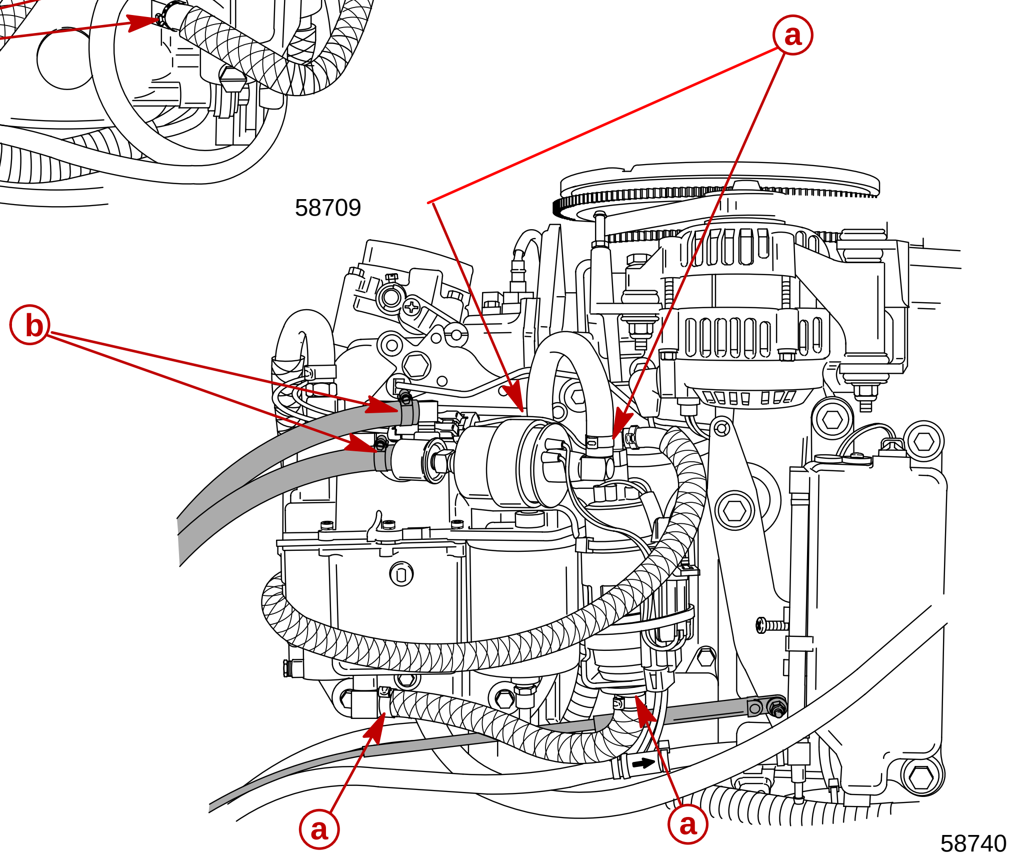


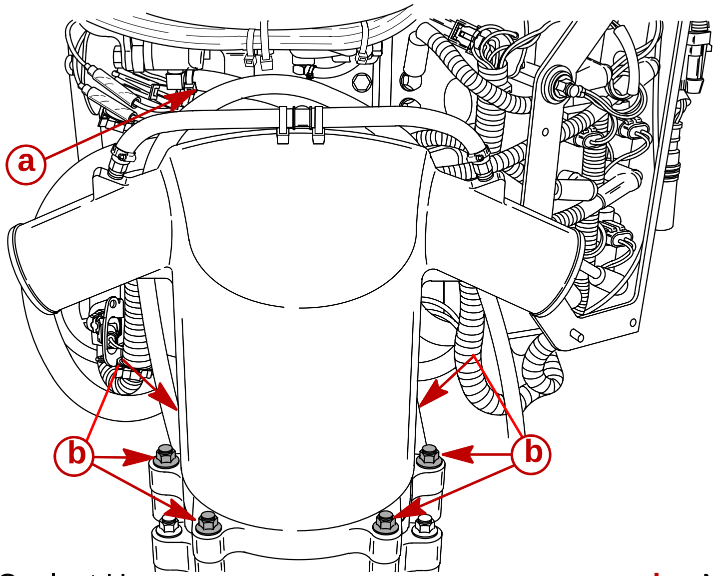
58740

a - Full Circle Clamp
b - Stainless Screw Clamp

Fuel Rail Removal

NOTE: *To provide improved access to the fuel rails, it is recommended that the expansion chamber be removed as follows:*

1. Remove coolant hose between air compressor and expansion chamber.
2. Remove 6 nuts securing expansion chamber and lay chamber off to one side.

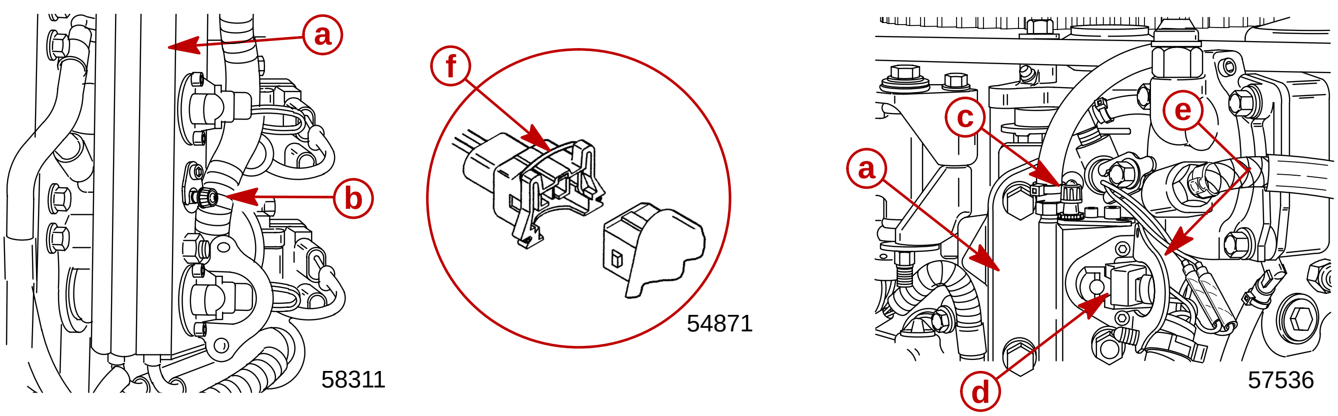


a - Coolant Hose
b - Nuts (6)

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

NOTE: *Use Fuel/Air Pressure Gauge 91-16850--1 or 91-852087A1/A2 to de-pressurize air hose first and then fuel hose.*

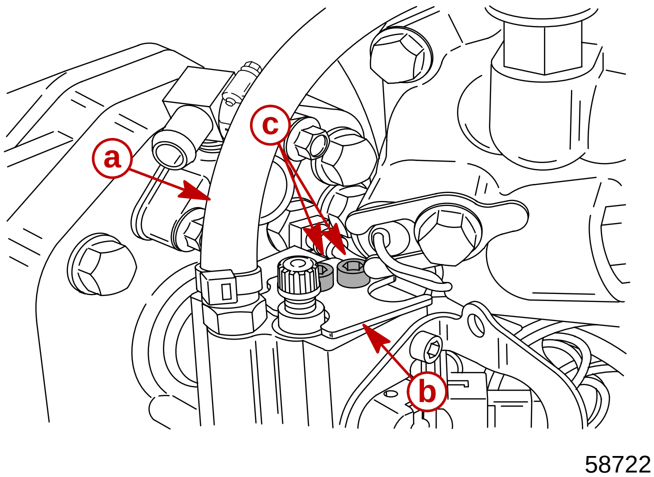
1. De-pressurize fuel system.
2. Remove fuel injector harness from each injector by compressing spring clip with flat tip screw driver while pulling on connector.



a - Port Fuel Rail
b - Air Pressure Port
c - Fuel Pressure Port
d - Fuel Injector
e - Harness Connector (hidden)
f - Spring Clip

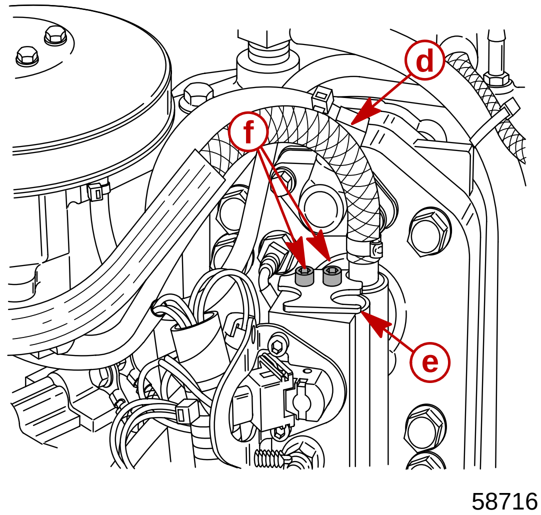
NOTE: *Always remove fuel/air hose and fitting together by removing fitting retainer rather than cutting clamps.*

3. Remove fuel, water and air hoses from fuel rail.



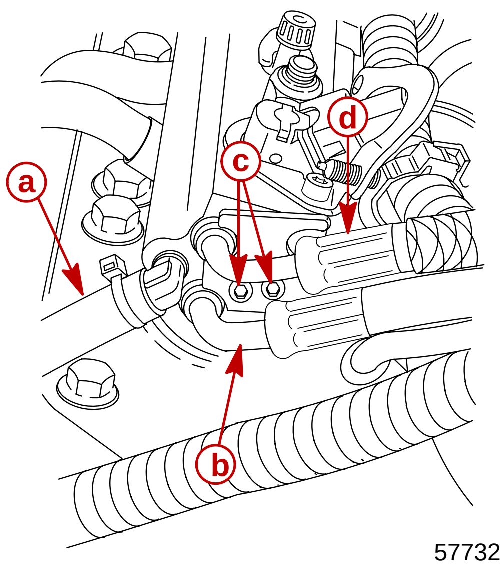
Port Top Fuel Rail Connections

a - Water Inlet Hose to Compressor
b - Retainer
c - Allen Screws (remove)



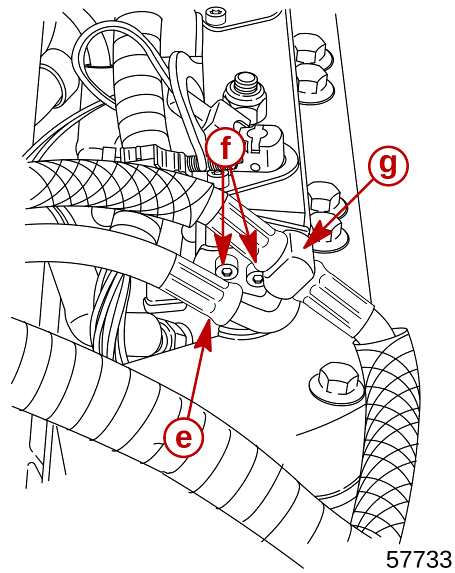
Starboard Top Fuel Rail Connections

d - Air Hose
e - Retainer
f - Allen Screws (remove)



Port Bottom Fuel Rail Connections

a - Water Inlet Hose to Fuel Rail
b - Air Hose
c - Allen Screws (remove)
d - Fuel Hose



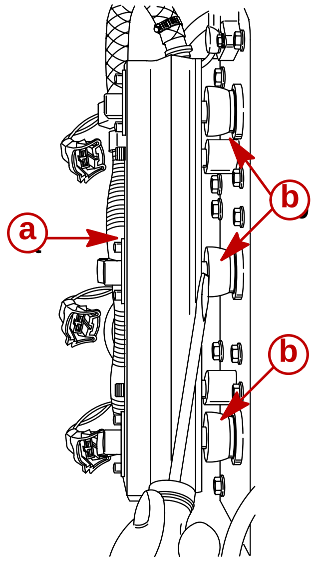
Starboard Bottom Fuel Rail Connections

e - Air Hose
f - Allen Screws
g - Fuel Hose

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

4. Remove 2 nuts securing fuel rail.

5. As fuel rail is removed, use a flat tip screw driver to hold direct injectors in cylinder head.

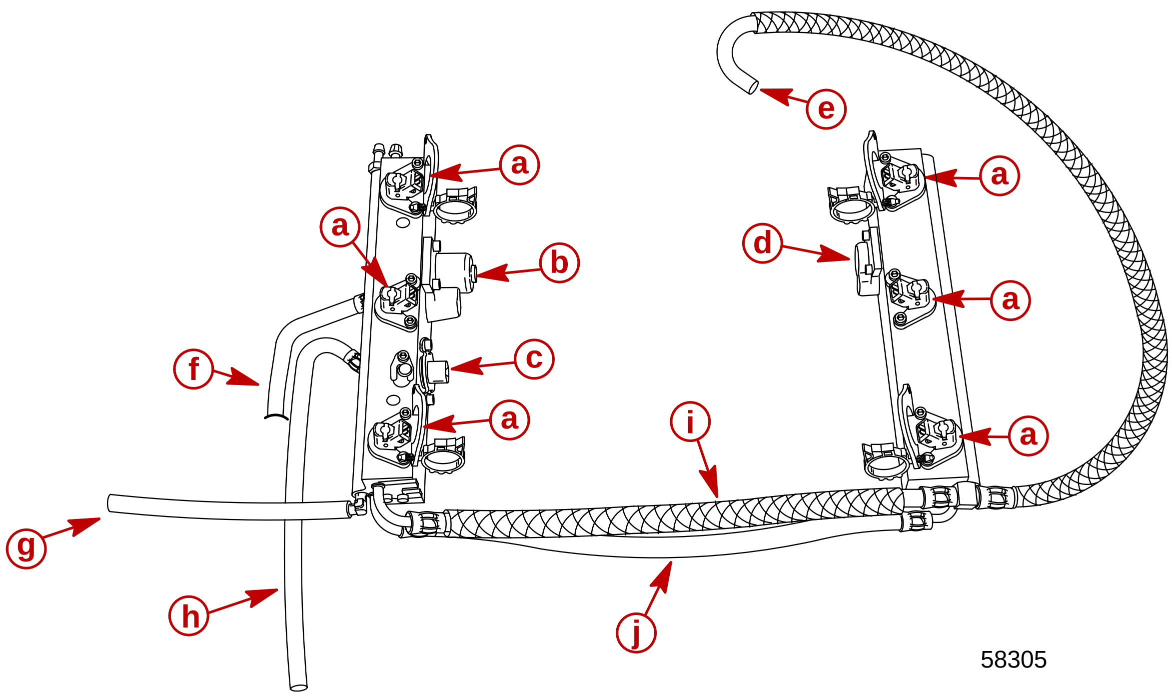


a - Fuel Rail
b - Direct Injectors

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

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

NOTE: *Each fuel/air inlet or outlet hose adaptor has 2 o-ring seals. These o-rings should be inspected for cuts or abraisions and replaced as required when fuel rail is disassembled for cleaning.*



a - Fuel Injector
b - Fuel Regulator
c - Air Regulator
d - Tracker Valve
e - Fuel Inlet
f - Excess Fuel Return to VST
g - Water Inlet for Cooling Fuel Rail
h - Excess Air to Adaptor Plate
i - 90 psi (616 kPa) Fuel
j - 80 psi (547.8 kPa) Air

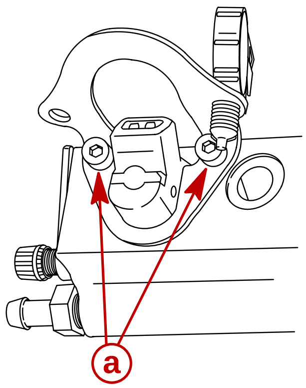
FUEL INJECTOR REMOVAL

NOTE: *A leaking fuel injector will create fuel in the air side of the air/fuel rail. Using the dual pressure gauges, discharge the air side and watch for fuel vapors. If vapors exist, pull the rail back for visibility and re-pressurize the system without rotating the engine (key "on"). Inspect each injector for signs of fuel droplets.*
Multiple static tests will induce fuel into the air side as a natural occurrence. The engine will run up (flair) on initial restart.

1. Remove 2 screws securing injector.

NOTE: *Use a cotter pin extractor tool in pry holes to remove injectors.*

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



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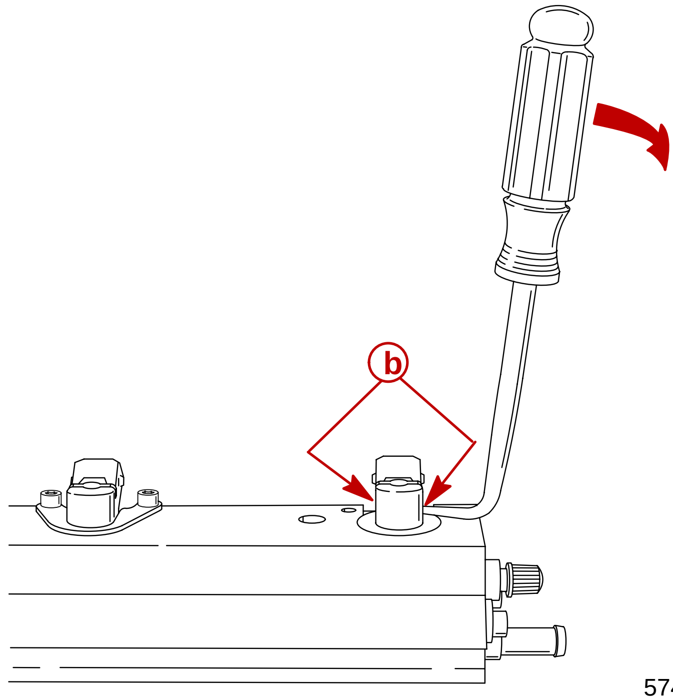
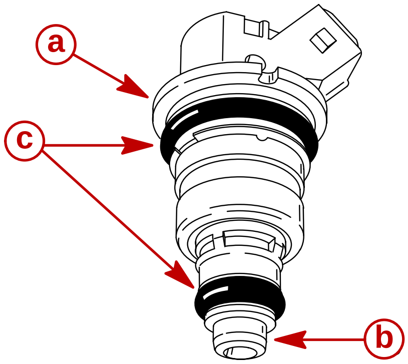


57418

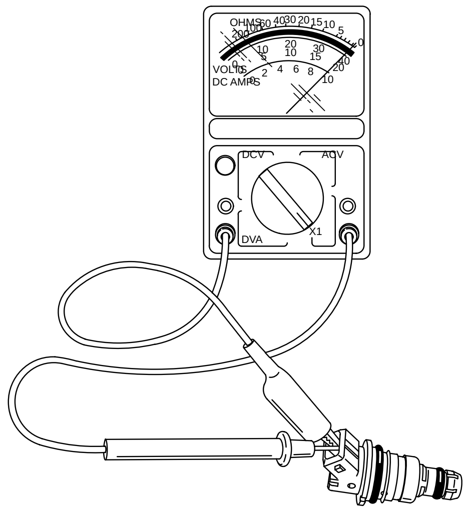
a - Screws
b - Pry Holes

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

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



56124



56002

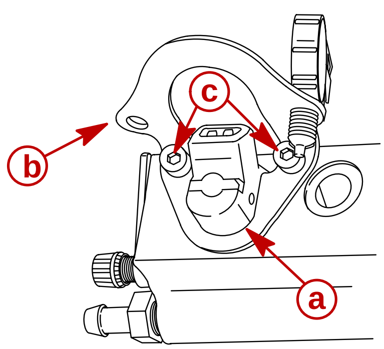
a - Fuel Injector
b - Fuel Nozzle
c - O-Rings

FUEL INJECTOR INSTALLATION

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

1. Insert fuel injector into fuel rail with connector pins facing (inwards) towards center of engine.

NOTE: *Turn injector back-and-forth slightly to seat injector o-rings in fuel rail while securing injector with retainer and 2 screws. Torque screws to 70 lb. in. (8.0 Nm).*

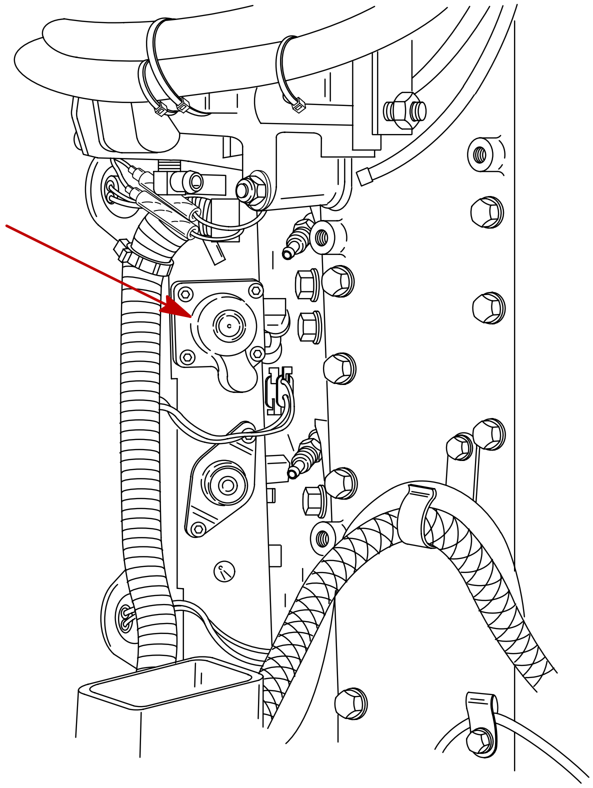


57712

a - Injector
b - Retainer
c - Screws [Torque to 70 lb. in. (8.0 Nm)]

Fuel Pressure Regulator

The fuel regulator is located on the port fuel rail.



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

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

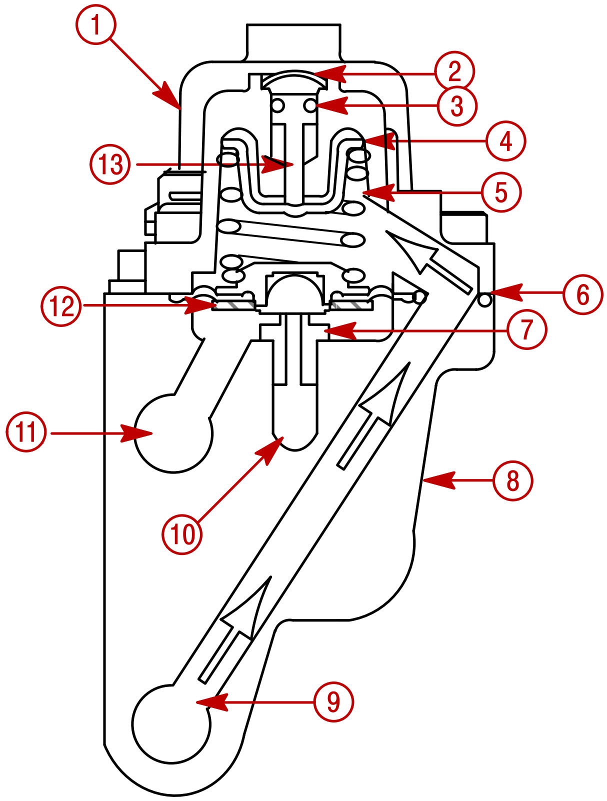
The fuel regulator is mounted on the port fuel rail, near the top. This regulator relies on both air and spring pressure to control the fuel pressure. Inside the regulator assembly is a 10 lb. spring, this spring holds the diaphragm against the diaphragm seat. The contact between the diaphragm and diaphragm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

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

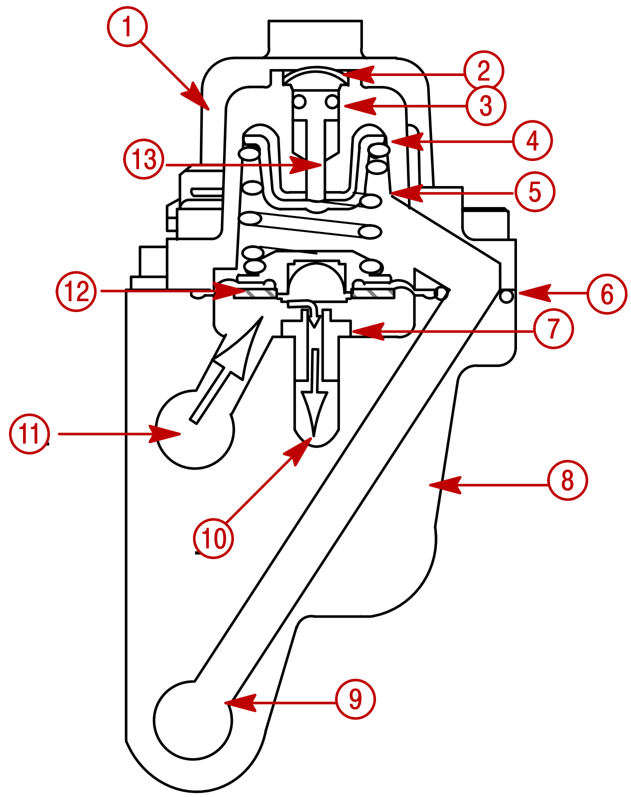
When the engine is running, air pressure from the air compressor (80 psi) is routed through the air passages, to the spring side of the fuel pressure regulator diaphragm.

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

Regulator Closed



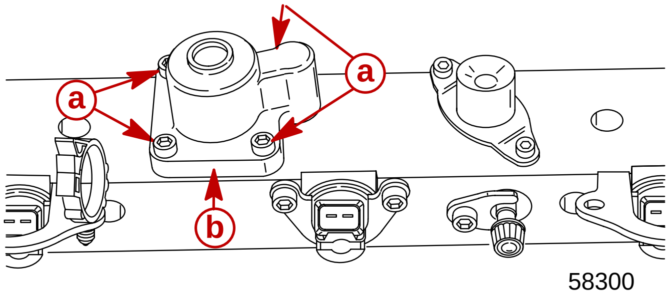
Regulator Open

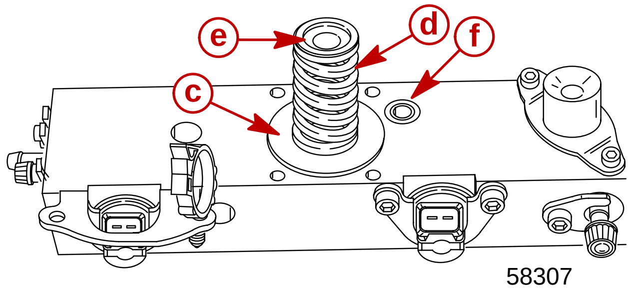


1 - Top Cover
2 - Expansion Plug
3 - O-ring
4 - Spring Retainer
5 - Spring
6 - O-ring
7 - Diaphragm Seat
8 - Air Rail
9 - Air Passage (from Air Compressor)
10 - Fuel Return Passage (to Vapor Separator)
11 - Fuel Inlet Passage (from Electric Fuel Pump)
12 - Diaphragm Assembly
13 - Calibration Screw (Do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

FUEL REGULATOR REMOVAL

1. Remove 4 screws securing regulator and remove regulator.
2. Inspect regulator diaphragm for cuts or tears.
3. Inspect regulator housing o-ring for cuts and abraisions. If parts are damaged, port rail assembly must be replaced.





a - Screws
b - Fuel Regulator

c - Diaphragm
d - Spring
e - Cup
f - O-Ring

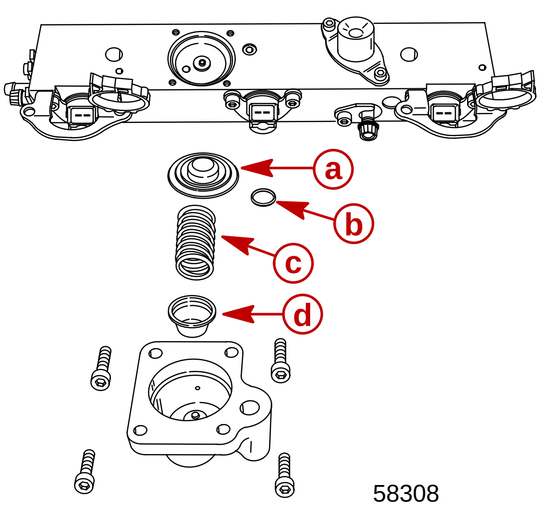
FUEL REGULATOR INSTALLATION

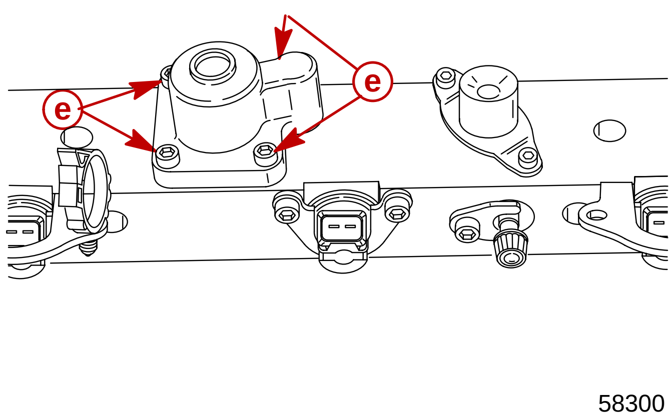
NOTE: *Apply a light coat of 2-4-C w/Teflon to diaphragm surface and o-ring to aid in the retention of diaphragm and o-ring on fuel rail during reassembly.*

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

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

4. Place cover over spring/cup/diaphragm assembly and secure with 4 screws. Torque screws to 70 lb. in. (8.0 Nm).



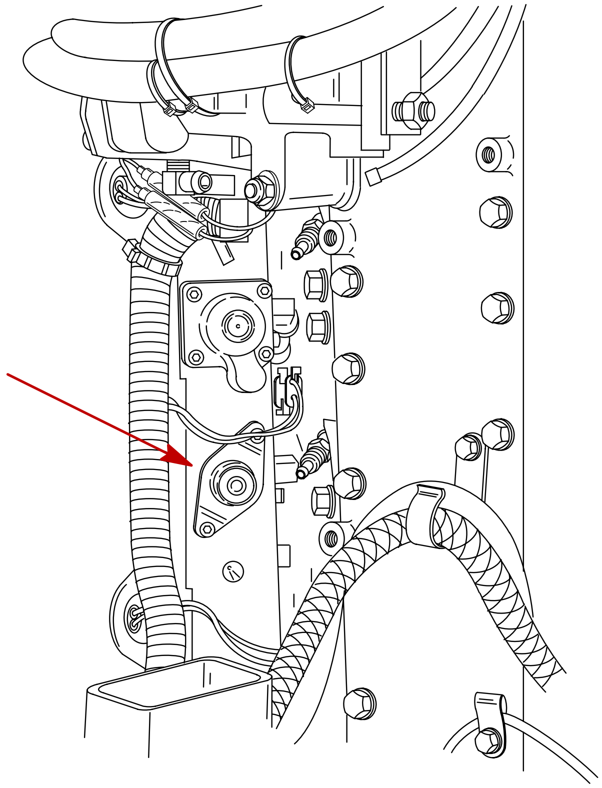


a - Diaphragm
b - O-Ring
c - Spring

d - Cup
e - Screws [Torque to 70 lb. in. (8.0 Nm)]

Air Pressure Regulator

The air pressure regulator is located on the port fuel rail.



58712

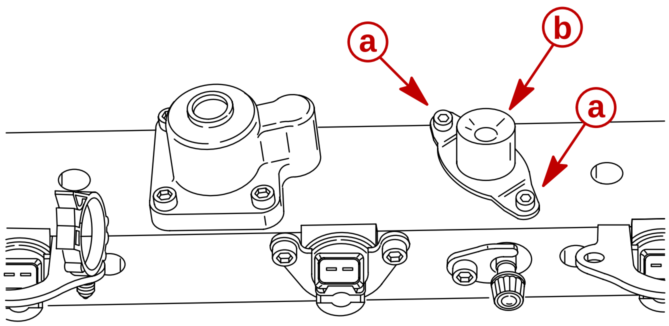
The air pressure regulator is designed to limit the air pressure inside the rails to approximately 80 psi.

The air regulator uses a spring (pressure) to control the air pressure. This spring (80 psi) holds the diaphragm against the diaphragm seat. The contact area blocks (closes) the air inlet passage from the excess air, return passage. As the air pressure rises (below the diaphragm), it must reach a pressure equal to or greater than the spring pressure holding the diaphragm closed. Once this pressure is achieved, the spring compresses, allowing the diaphragm to move. The diaphragm moves away from the diaphragm seat, allowing air to exit through the diaphragm seat, into the excess air passage leading to the exhaust adaptor plate.

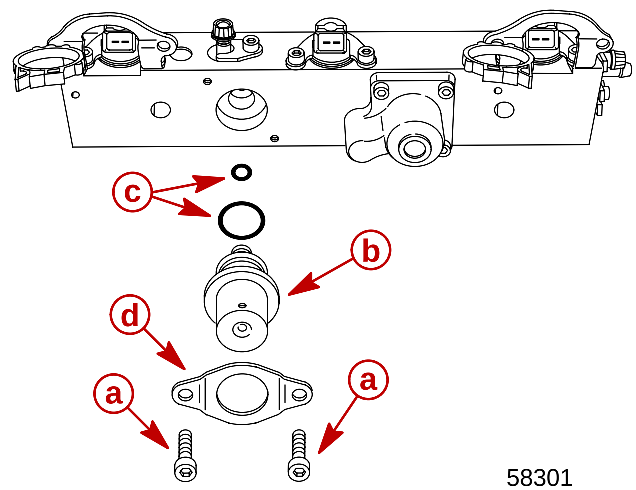
AIR REGULATOR REMOVAL

1. Remove 2 screws securing regulator and remove regulator.
2. Inspect regulator o-rings for cuts and abrasions. Replace as required.

NOTE: *Air regulator is not serviceable. If regulator doesn't maintain approximately 80 psi replace it.*



58300



58301

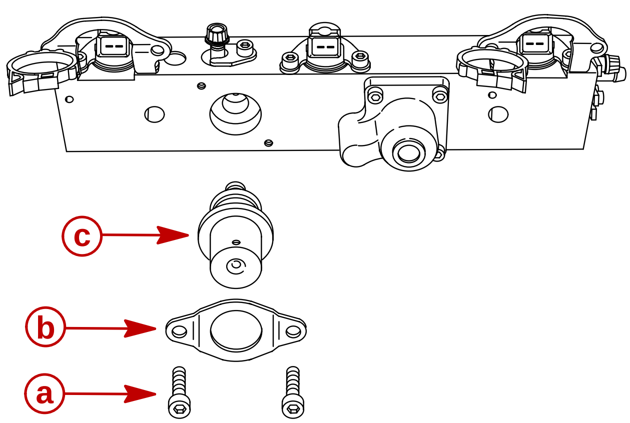
a - Screws
b - Air Regulator
c - O-Rings
d - Retainer

AIR REGULATOR INSTALLATION

1. Position air regulator, retainer and screws onto fuel rail as shown below.

NOTE: *Apply anti-seize grease (obtain locally) or 2-4-C w/Teflon to regulator attaching screw threads. Torque screws to 70 lb. in. (8.0 Nm).*

NOTE: *Apply a light coat of outboard oil to regulator o-rings to ease installation.*

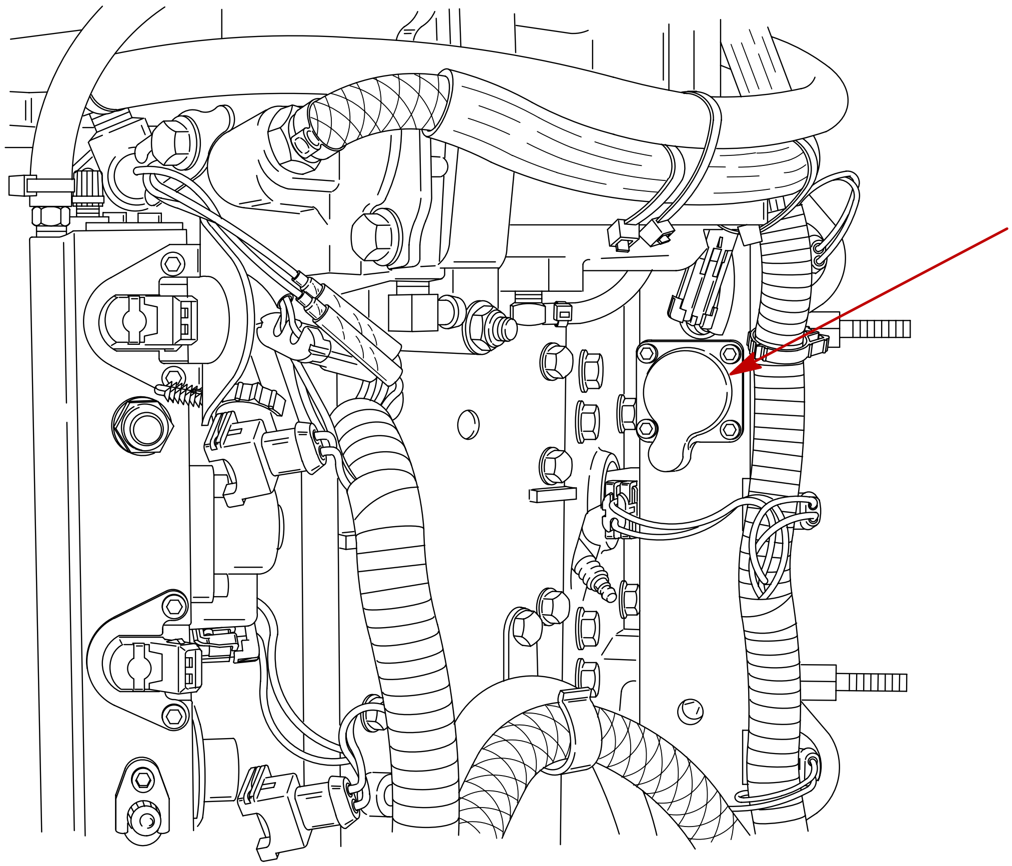


58301

a - Screws
b - Retainer
c - Air Regulator

Tracker Valve

The tracker valve is located on the starboard fuel/air rail assembly.



58713

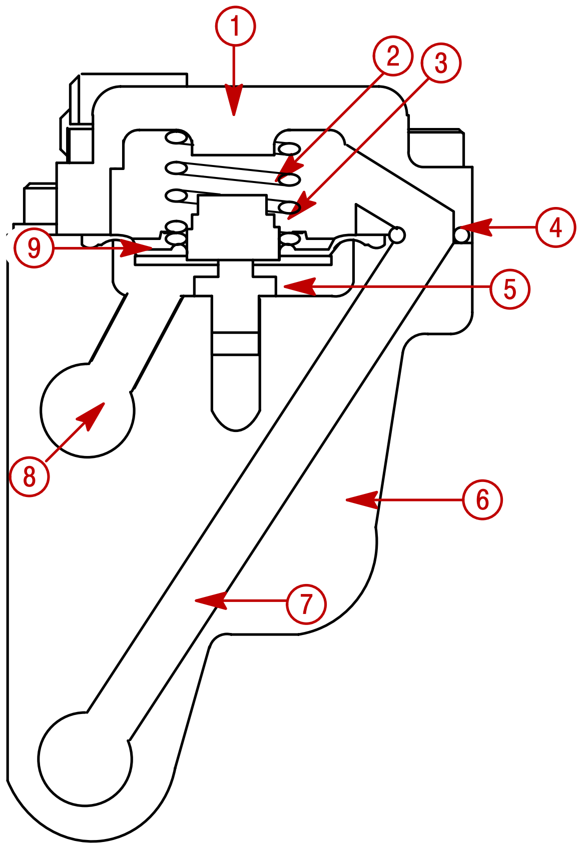
The DFI system must maintain a constant 10 psi pressure difference between the fuel pressure and air pressure in the rails, at all times. The tracker is designed to maintain the 10 psi differential when the air or fuel pressure suddenly raises (i.e. pulses generated by the compressor's piston or by the fuel injectors opening and closing). The tracker contains a spring on the air side of the diaphragm. This spring positions the diaphragm against the diaphragm's seat (when the engine is not running).

After the engine starts, and the fuel and air pressure reach normal operating range, the fuel pressure will compress the spring and the diaphragm will move slightly away from the seat (to a neutral position). At this point the pressure on both sides of the tracker diaphragm is equal (10 psi spring pressure + 80 psi air pressure = 90 psi fuel pressure).

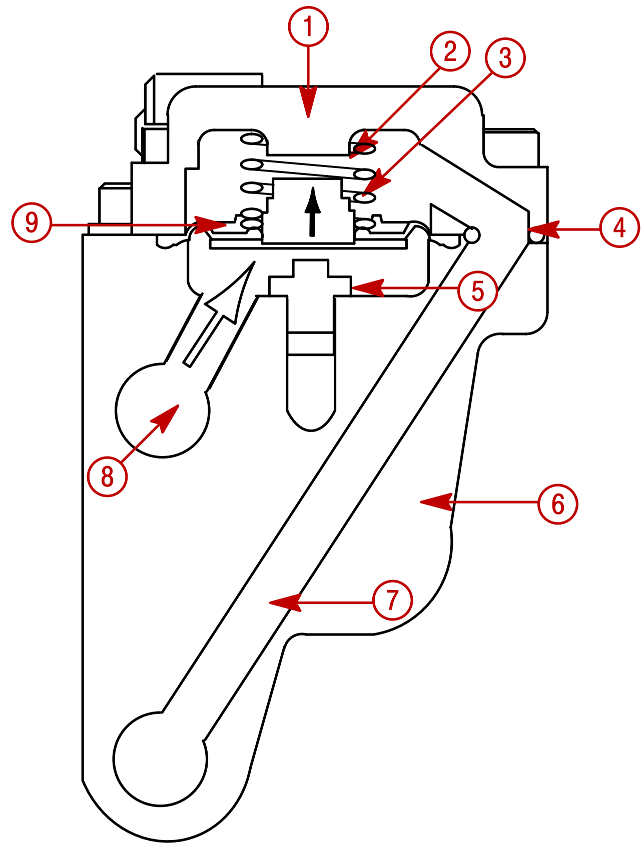
Any air or fuel pressure "spikes" on one side of the diaphragm will transfer this pressure rise to the other system (air or fuel) on the other side of the diaphragm. Both systems will have a momentary increase in pressure so that the 10 psi difference between air and fuel system pressures can be maintained.

NOTE: *To prevent excessive wear in the seat, the tracker is calibrated to allow the diaphragm to be slightly away from the seat during normal operation.*

Engine Off (No Pressure)



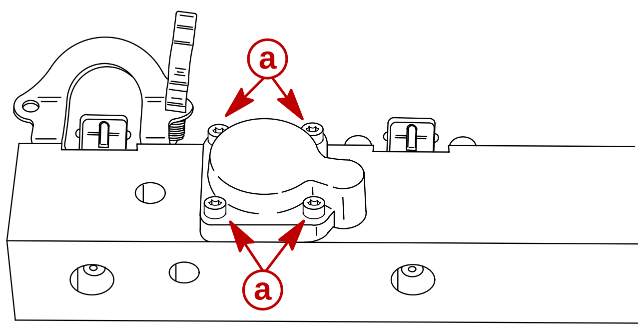
Engine at Operating Pressures



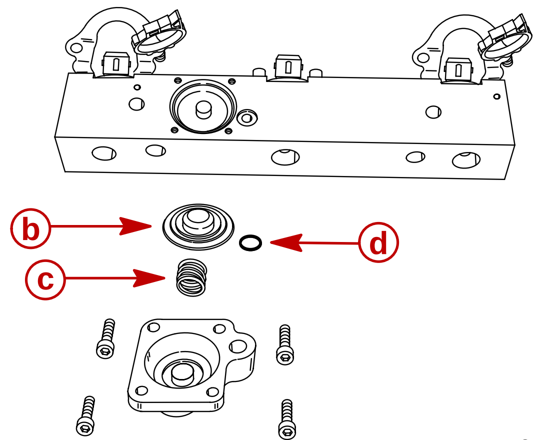
1 - Top Cover
2 - Spring Retainer (not shown)
3 - Spring
4 - O-ring
5 - Diaphragm (at rest) Seat
6 - Air Rail
7 - Air Passage (from Air Compressor)
8 - Fuel Inlet Passage (from Electric Fuel Pump)
9 - Diaphragm Assembly

TRACKER VALVE REMOVAL

1. Remove 4 screws securing tracker valve and remove tracker assembly.
2. Inspect tracker diaphragm for cuts and tears.
3. Inspect tracker cover o-ring for cuts and abraisions. Replace components as required.



57710



57716

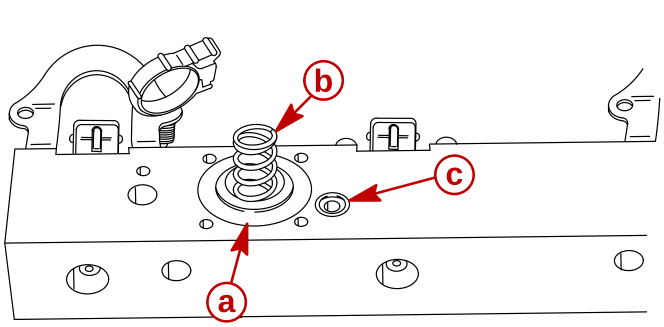
a - Screws
b - Diaphragm
c - Spring
d - O-Ring

TRACKER VALVE INSTALLATION

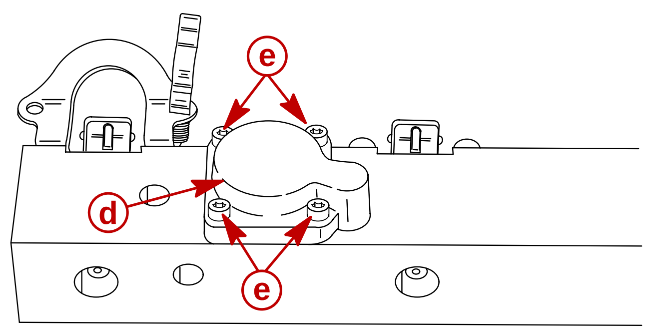
NOTE: *Apply a light coat of 2-4-C w/Teflon to tracker diaphragm and cover o-ring to aid in their retention on fuel rail while reinstalling tracker valve to fuel rail.*

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

1. Position diaphragm, spring and o-ring onto fuel rail.
2. Place cover over diaphragm/spring/o-ring assembly and secure with 4 screws. Torque screws to 70 lb. in. (8.0 Nm).



57711



57710

a - Diaphragm
b - Spring
c - O-Ring
d - Cover
e - Screws [Torque to 70 lb. in. (8.0 Nm)]

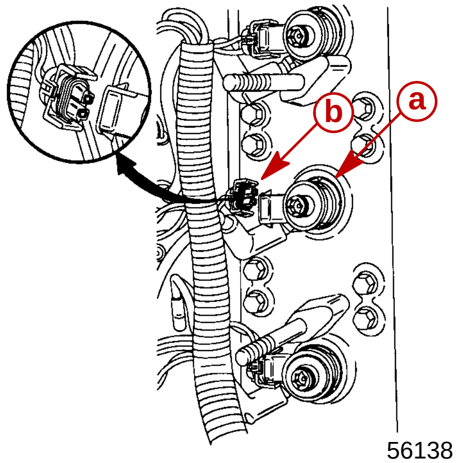
Fuel Rail Cleaning

After all fuel injectors, air regulator, tracker valve, fuel regulator, inlet hoses and outlet hoses have been removed, the fuel rails may be flushed out with a suitable parts cleaning solvent. Use compressed air to remove any remaining solvent.

Direct Injector Removal

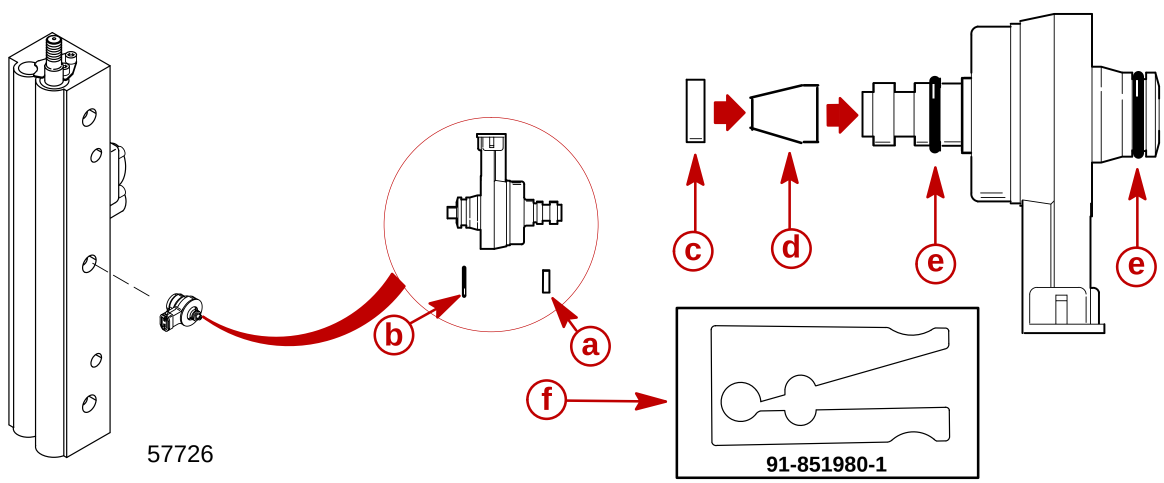
NOTE: *If direct injector should fail due to a broken pintle, inspect the end of the fuel injector adjacent to the broken direct injector. If the fuel injector tip has black build up on it, replace it. Inspect for and clean out any dirt or debris in the air passage of the fuel rail adjacent to the broken direct injector.*

1. Remove harness connectors from direct injectors.
2. Remove direct injector from cylinder head



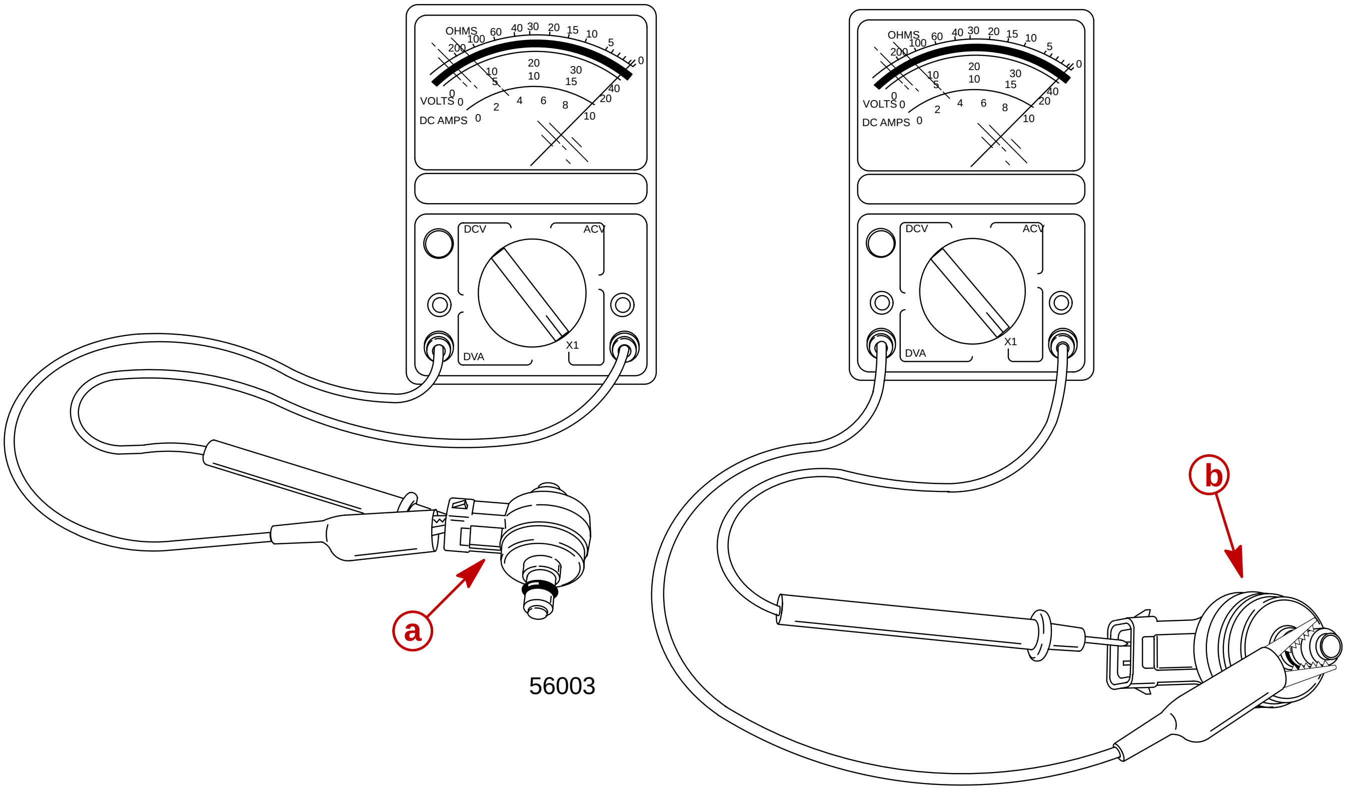
a - Direct Injector (3 each cylinder head)
b - Harness Connector

3. Inspect injector teflon sealing ring (white) for signs of combustion blowby (teflon ring will be streaked brownish black). If blowby is present, replace teflon sealing ring. If blowby is not present, sealing ring may be reused.
4. Inspect o-rings for cuts or abraisions. Replace components as required.
5. If teflon seal requires replacement, use teflon ring installation tool 91-851980 to slide new seal onto injector. Following installation of teflon ring, the teflon ring sizing tool (91-851980–1) can be used to compress the teflon seal to aid in the installation of the injector into the cylinder head.



a - Teflon Sealing Ring
b - O-Ring
c - Teflon Seal
d - Seal Installation Tool (91-851980)
e - O-Ring
f - Teflon Ring Sizing Tool (91-851980-1)

6. An ohm test of the direct injector may be made by connecting test leads to injector terminals. Ohm reading should be 1.3 ± 0.3 ohm.
7. An ohm test to determine if direct injector windings are shorted to ground can be made by connecting one ohm lead to either injector pin while touching the other ohm lead to the injector metal case. There should be no continuity. If there is continuity, the internal windings are shorted and the injector must be replaced.

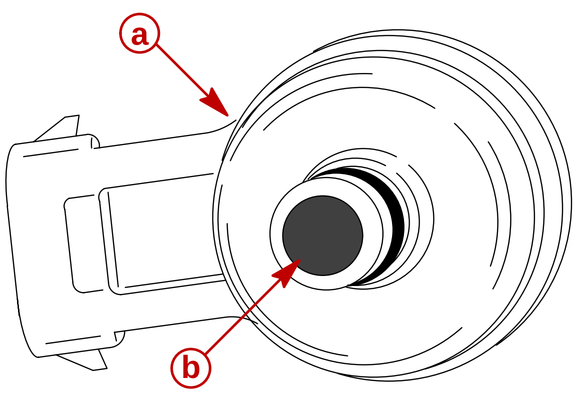


56003

58456

a - Direct Injector Ohm Test (1.3 ± 0.3 ohm)
b - Direct Injector Short to Ground Ohm Test (no continuity)

8. Carbon buildup on tip of direct injector may be removed by use of a brass wire hand brush.

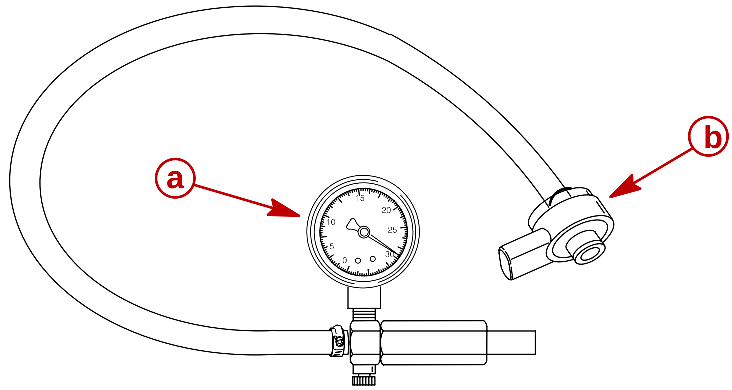


56017

a - Direct Injector
b - Tip

Direct Injector Leak Test

1. Attach Gearcase Leakage Tool (FT-8950) to discharge side of injector.

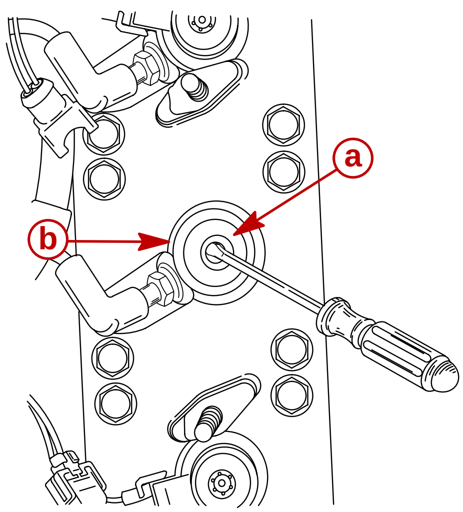


57714

a - Gearcase Leakage Tool (FT-8950)
b - Direct Injector

2. Pump up leakage tool to indicate 25 – 30 psi (172.4 – 206.8 kPa)
3. Direct injector should not leak down more than 1/2 psi (3.5 kPa) in 1 minute.
4. If injector does not meet the above specifications, replace injector.

NOTE: *If cylinder head is going to be replaced, remove cup washers from each direct injector port by prying out with a flat tip screwdriver. Reinstall washers with retainers into new cylinder head. Washers provide tension between direct injectors, cylinder head and fuel rails.*



57731

a - Cup Washer
b - Retainer

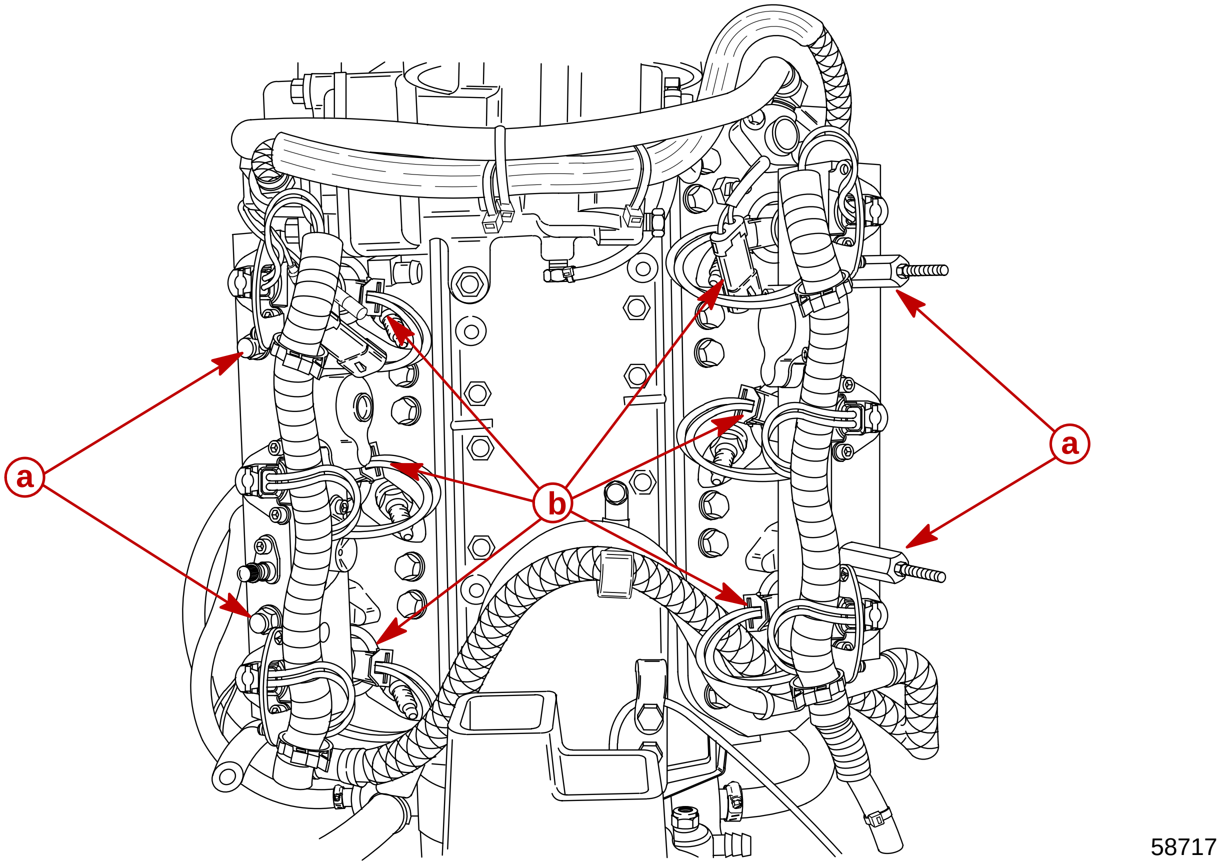
Fuel Rail and Direct Injector Installation

***NOTE:** Refer to Powerhead Section 4A for complete installation instructions.*

1. Use Teflon Ring Sizing Tool (91-851980-1) to compress new teflon sealing rings prior to installation of injector into cylinder head.
2. Carefully slide fuel rail over mounting studs and onto direct injectors.

IMPORTANT: If fuel or air hoses have been replaced, they MUST be secured with proper full circle clamps using tool 91-803146T (or Snap-On equivalent YA3080) to crimp clamps**.**

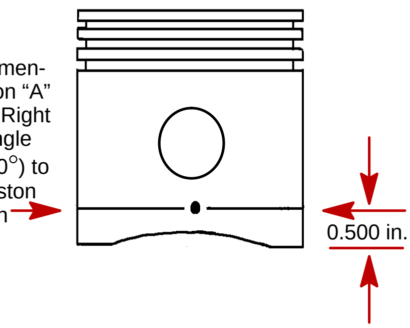
3. Secure each fuel rail. Torque nuts to 35 lb. ft. (47 Nm).
4. Reinstall fuel injector harness connectors.



a - Nuts [Torque to 35 lb.ft. (47 Nm)]
b - Fuel Injector Harness Connectors (6) (3 each fuel rail)

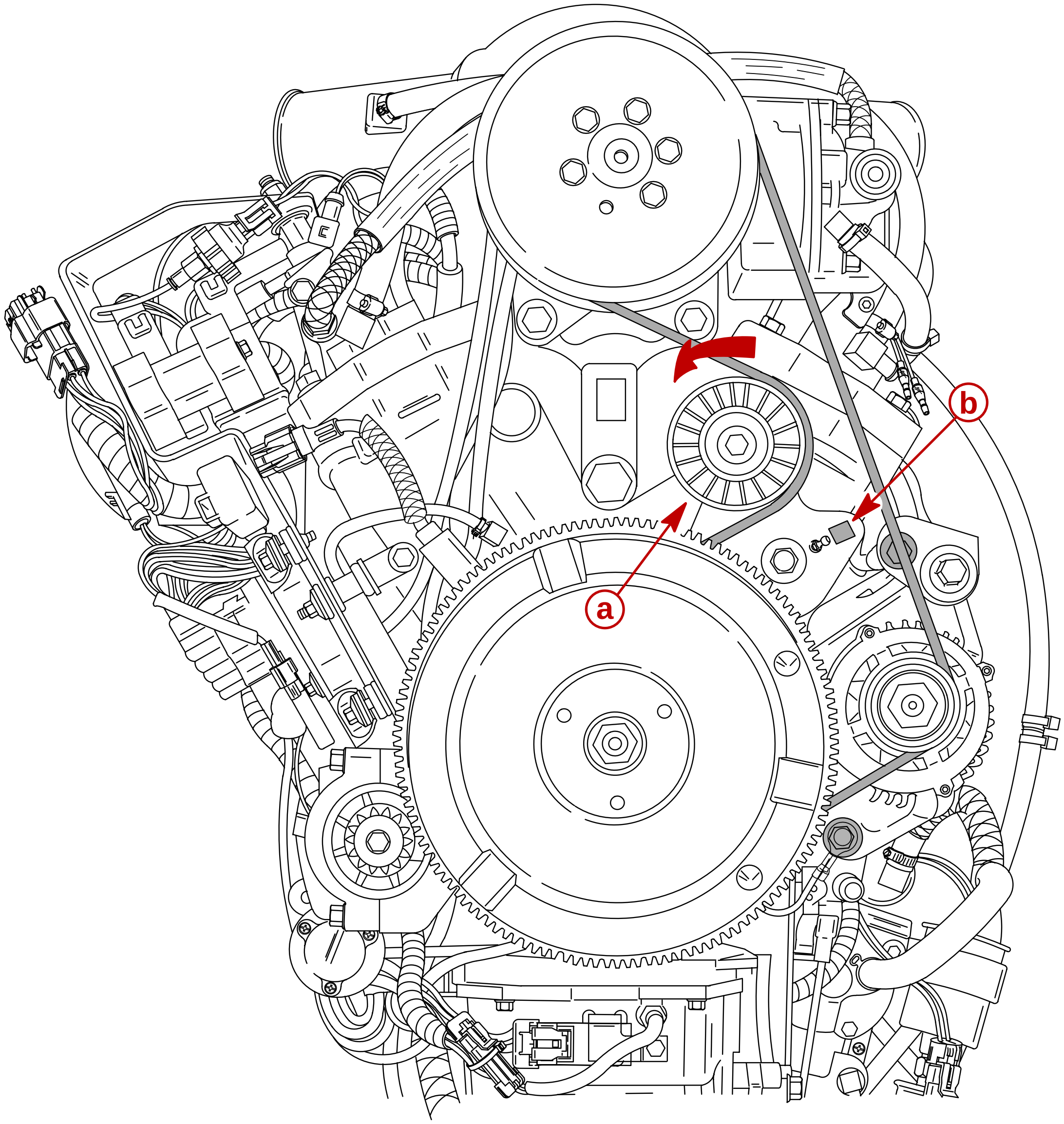
Air Compressor

The air compressor is a single cylinder water cooled compressor, and is lubricated by the outboard oil pump.

Air Compressor Specifications		
Air Compressor	Type Compressor Output	Reciprocating Piston (1 to 1 ratio with engine RPM) @ Idle – 80 psi @ W.O.T. – 110 psi
Cylinder Block	Displacement	7.07 cu. in. (116 cc)
Cylinder Bore	Diameter (Standard) Taper/Out-of-Round/Wear Maximum Bore Type	2.5591 in. (65.0 mm) 0.001 in. (0.025 mm) Cast Iron
Stroke	Length	1.374 in. (34.9 mm)
Piston	Piston Type	Aluminum
Piston Diameter	Dimension “A” at Right Angle (90°) to Piston Pin 	2.5578 ± .0004 in. (64.97 ± 0.010 mm)
Piston Ring	End Gap Top Ring Middle Ring Bottom Ring	 0.0059 – 0.0098 in. (0.15 – 0.25 mm) 0.0059 – 0.0098 in. (0.15 – 0.25 mm) 0.0039 – 0.014 in. (0.10 – 0.35 mm)
Reeds	Reed Stand Open	0.010 in. (0.25 mm)

Compressor Removal

1. Disconnect battery cables from battery terminals.
2. Remove flywheel cover.
3. Use 3/8 inch (9.5 mm) drive on belt tensioner arm to relieve belt tension. Remove belt.



58749

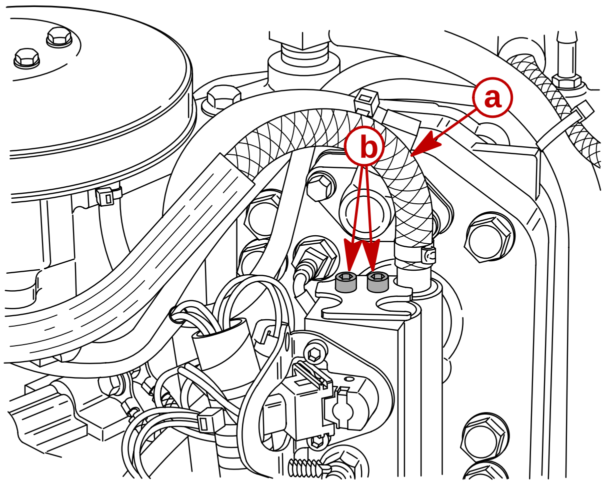
a - Belt Tensioner
b - 3/8 in. (9.5 mm) drive

⚠ CAUTION

If engine has been recently run, air pressure outlet hose fittings may be extremely hot. Allow components to cool off before beginning disassembly.

NOTE: *Remove 2 screws securing retainer plate to remove air pressure outlet hose. Inspect o-rings on air pressure hose fitting for cuts or abraisions. Replace o-rings as required.*

4. Remove air pressure outlet hose.
5. Disconnect compressor water inlet hose and remove 2 screws.



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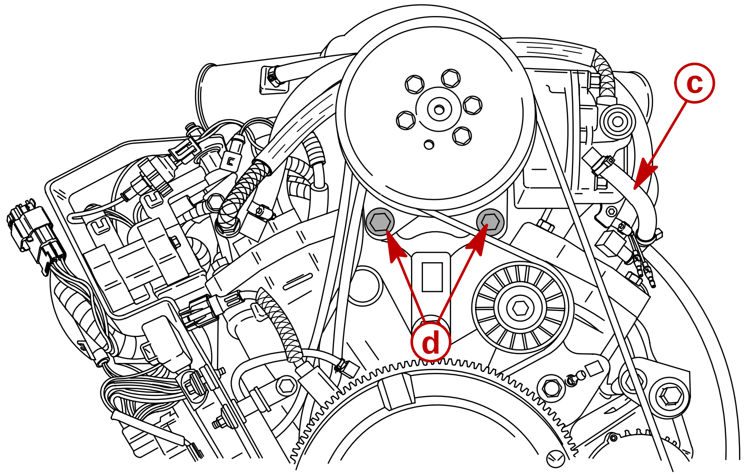
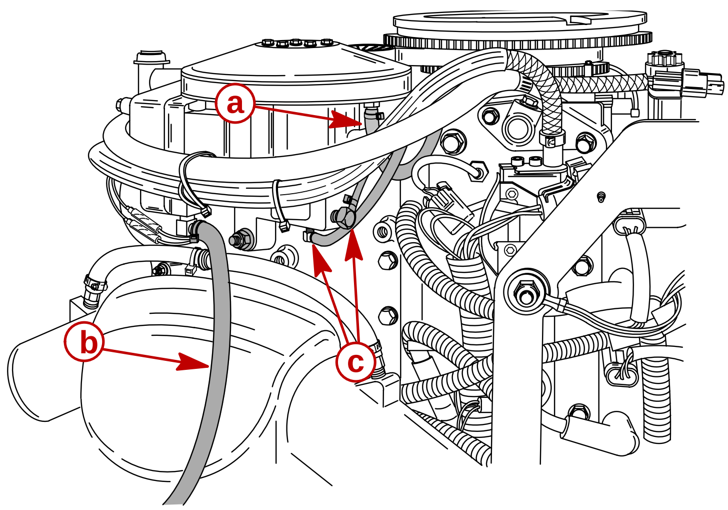


58750

a - Air Pressure Outlet Hose
b - Retainer Screws

c - Compressor Water Inlet Hose
d - Compressor Screws

6. Disconnect air compressor oil inlet hose.
7. Disconnect air compressor water outlet hose to expansion chamber outlets.
8. Disconnect excess oil return hoses (2).



58739

a - Air Compressor Oil Inlet Hose
b - Air Compressor Water Outlet Hose to Expansion Chamber Outlets
c - Excess Oil Return Hoses (2)

9. Remove 2 bolts and 1 nut securing air compressor to engine and remove compressor.

Air Compressor Disassembly/Reassembly

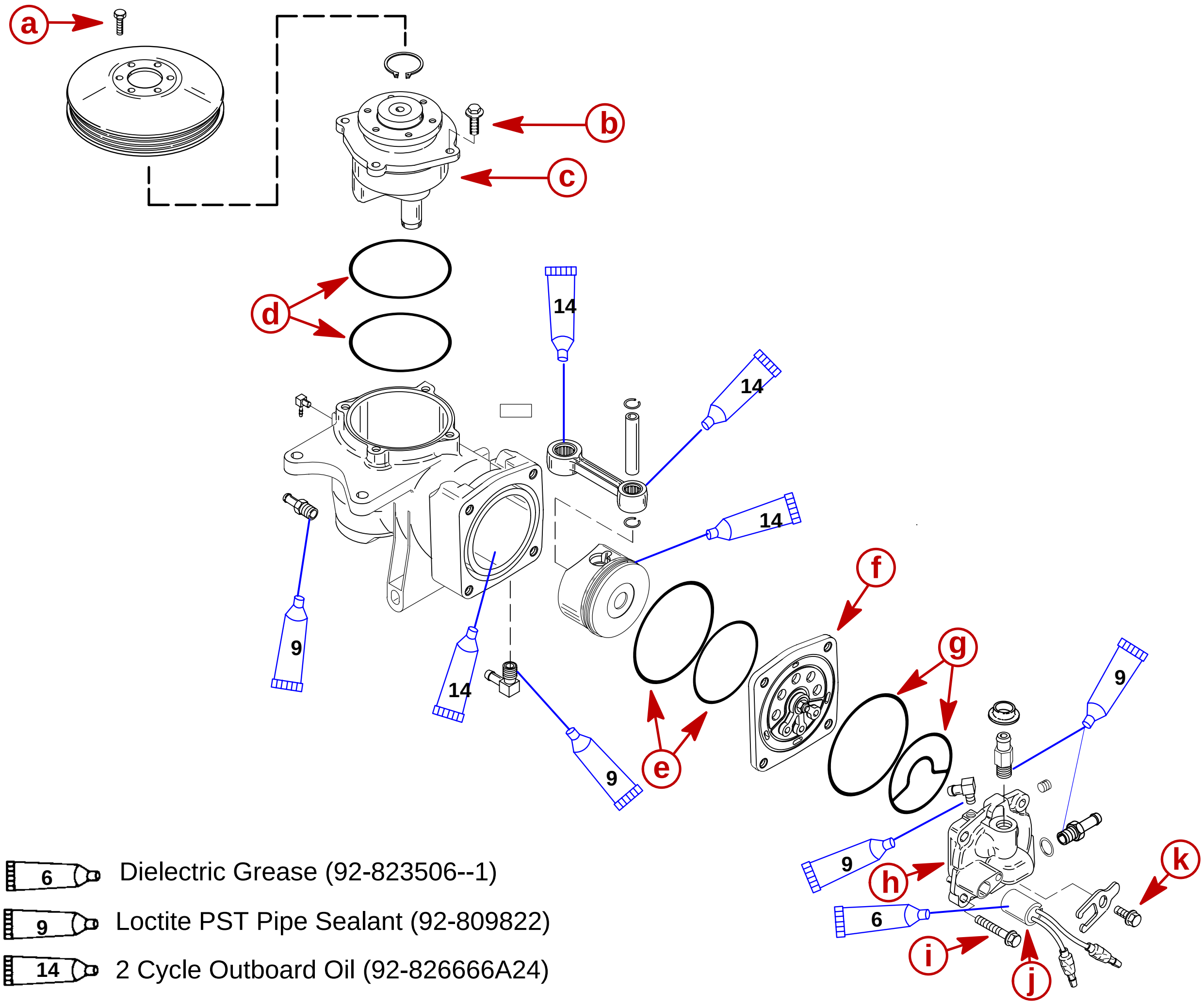
NOTE: *If cylinder bore is scored, air compressor must be replaced as an assembly. Items to inspect or replace after a compressor failure are:*

Air/fuel rail inlet fitting (for debris restricting air flow)

Oil return (from compressor) check valve (for debris)

To inspect for debris inside plenum, remove throttle plate from top of plenum, wipe inside of plenum with white paper towel.

NOTE: *The piston and rings are not sold separately. They must be replaced as an assembly. The connecting rod and bearings are not sold separately. They must be replaced as assembly.*

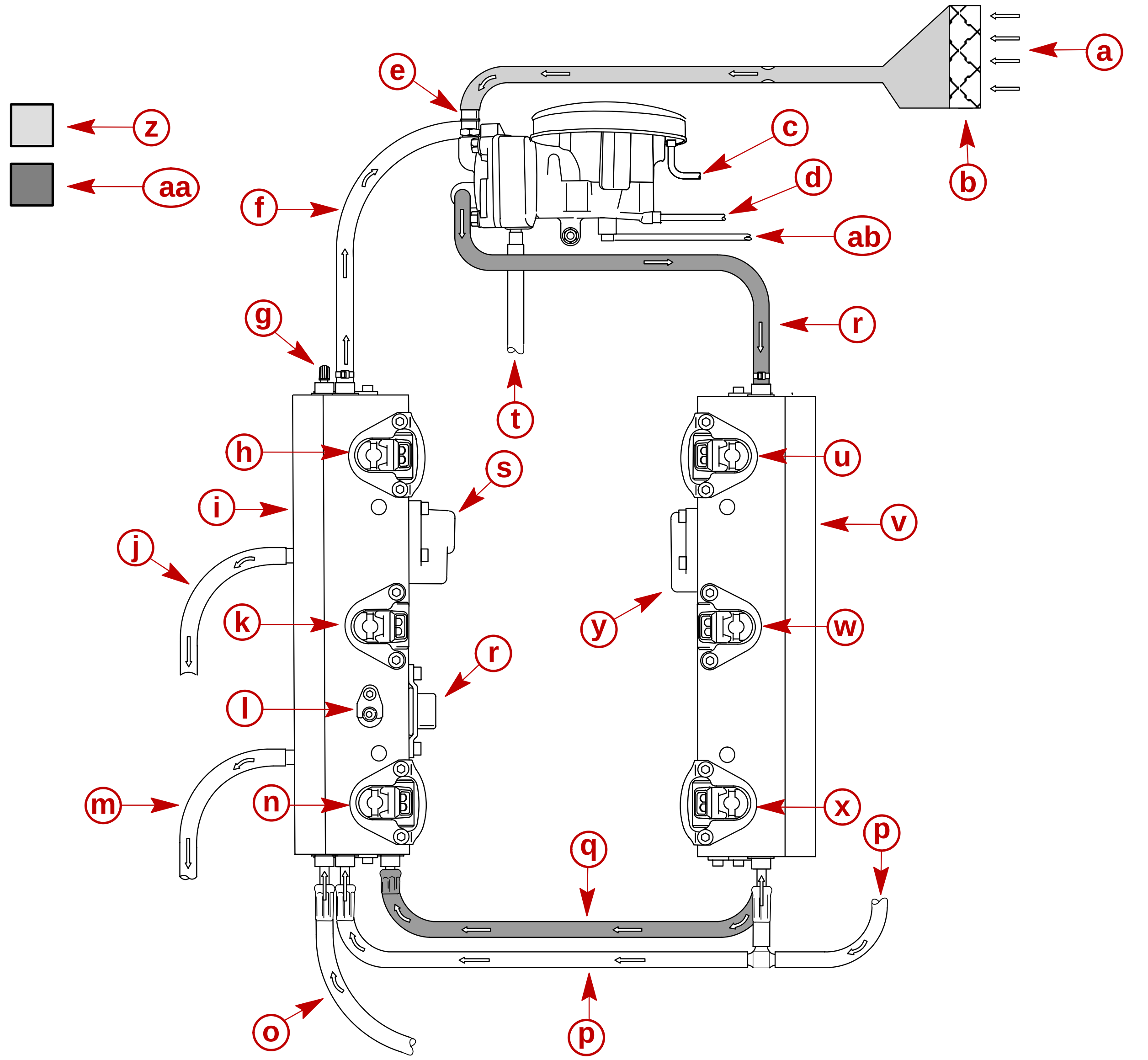


NOTE: *End cap bearing and seal are not sold separately. End cap must be replaced as an assembly.*

NOTE: *Piston Installation – use a metal hose clamp for piston ring compressor. Stagger piston ring openings.*

a - Bolt [Torque to 100 lb. in. (11.5 Nm)]
b - Bolt (4 each) [Torque to 100 lb. in. (11.5 Nm)]
c - End Cap Assembly (Inspect bearing for roughness)
d - O-Rings (Inspect for cuts or abraisions)
e - O-Rings (Inspect for cuts or abraisions)
f - Reed Plate (Inspect for broken or chipped reeds/stops) Maximum Reed Stand-Open – 0.010 in. (0.254 mm)
g - O-Rings (Inspect for cuts or abraisions)
h - Cylinder Head
i - Bolt [Torque to 20 lb. ft. (27 Nm)]
j - Temperature Sensor
k - Bolt [Torque to 20 lb. ft. (27 Nm)]

Air Compressor Flow Diagram

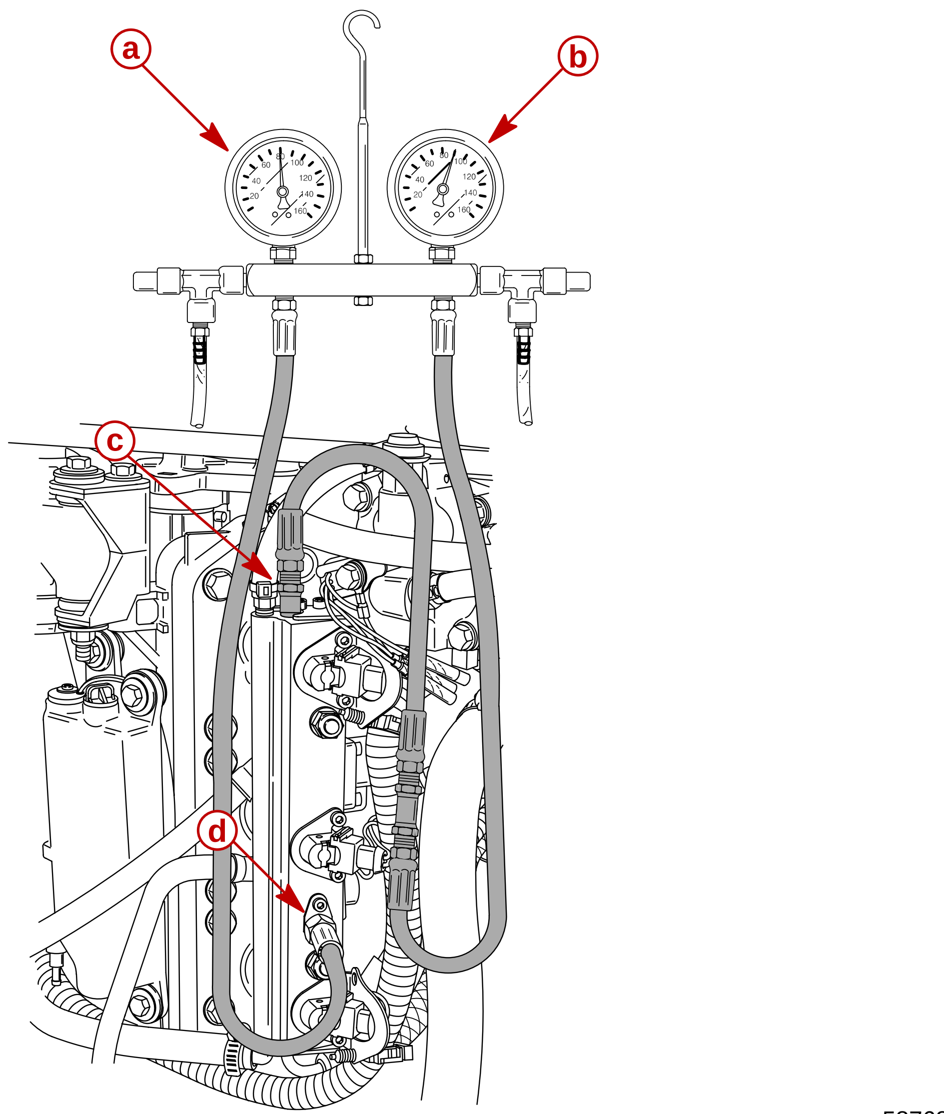


a - Air Inlet
b - Air Filter
c - Compressor Oil Inlet
d - Oil to Upper Main Bearing
e - Compressor Air Inlet
f - Compressor Water Inlet
g - Fuel System Pressure Test Valve
h - #2 Fuel Injector
i - Port Fuel Rail
j - Excess Fuel Return to VST
k - #4 Fuel Injector
l - Air Pressure Test Valve
m - Excess Air Return to Exhaust Adaptor Plate
n - #6 Fuel Injector
o - Water Inlet to Fuel Rail
p - High Pressure Fuel [89 ± 2 psi (613.5 ± 13.8 kPa)]
q - Air [79 ± 2 psi (544.0 ± 13.8 kPa)]
r - Air Regulator [79 ± 2 psi (544.0 ± 13.8 kPa)]
s - Fuel Regulator [89 ± 2 psi (613.5 ± 13.8 kPa)]
t - Water Outlet to Expansion Chamber Outlets
u - #1 Fuel Injector
v - Starboard Fuel Rail
w - #3 Fuel Injector
x - #5 Fuel Injector
y - Tracker Valve
z - Low Pressure (Air)
aa - High Pressure (Air)
ab - Oil to Lower Crankshaft Bearing

Air Compressor Pressure Test

Install Pressure Gauge Assembly 91-852087A1/A2 to fuel rail pressure test valves. The fuel pressure and air pressure test valves are located on the starboard rail.

NOTE: *After 15 seconds of cranking engine with starter motor, air pressure gauge should indicate 79 ± 2 psi (544.0 ± 13.8 kPa) and fuel pressure gauge should indicate 89 ± 2 psi (613.5 ± 13.8 kPa).*



a - Air Pressure Gauge (Should Indicate 79 ± 2 psi (544.0 ± 13.8 kPa)
b - Fuel Pressure Gauge (Should Indicate 89 ± 2 psi (613.5 ± 13.8 kPa)
c - Fuel Pressure Test Valve
d - Air Pressure Test Valve

FUEL PRESSURE AND AIR PRESSURE TROUBLESHOOTING CHART

PROBLEM	CORRECTIVE ACTION
Fuel Pressure and Air Pressure are Both Low	1. Inspect air compressor air intake (air filter in flywheel cover) for blockage. 2. Remove air compressor cylinder head and inspect for scuffing of cylinder wall. Inspect for broken reeds and/or reed stops. 3. Tracker Valve – Remove and inspect diaphragm for cuts or tears and seat damage on diaphragm and rail. 4. Air Regulator – Remove and inspect diaphragm for cuts or tears on diaphragm and rail.
Fuel Pressure Low or Fuel Pressure Drops while Running (Air Pressure Remains Normal)	1. Each time key is turned to the RUN position, both electric pumps should operate for 2 seconds. If it they do not run, check 20 ampere fuse and wire connections. 2. If pumps run but have no fuel output, check vapor separator (remove drain plug) for fuel. 3. If no fuel present in vapor separator, check fuel/ water separator for debris. Check crankcase mounted fuel pump for output. 4. Check high pressure pump amperage draw. Normal draw is 6 – 9 amperes; if draw is below 2 amperes, check fuel pump filter (base of pump) for debris. If filter is clean, replace pump. If amperage is above 9 amperes, pump is defective – replace pump. Check low pressure output – 8–12 psi. Check low pressure electric fuel pump amperage draw. Normal draw is 1 – 2 amperes; if draw is below 1 ampere, check for blockage between pump inlet fitting and vapor separator tank. If ampere draw is above 2 amperes, replace pump. 5. Fuel Regulator – Remove and inspect diaphragm for cuts or tears.
Fuel Pressure High and Air Pressure is Normal	1. Stuck check valve in fuel return hose. 2. Debris blocking fuel regulator hole. 3. Faulty pressure gauge
Fuel and Air Pressure Higher than Normal	1. Debris blocking air regulator passage. 2. Air dump hose (rail to driveshaft housing) blocked/plugged.

FUEL SYSTEM

Section 3C – Oil Injection

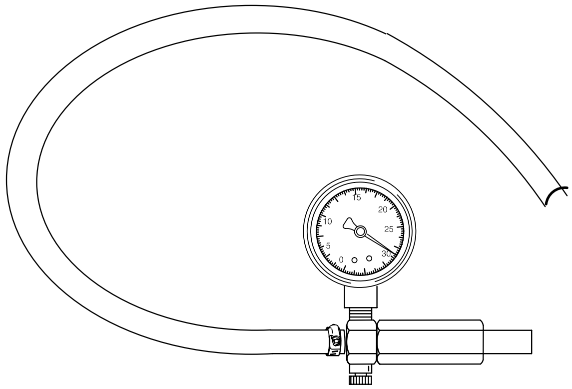
Table of Contents

Special Tools 3C-2
Oil System Operation 3C-2
Oil Pump Output 3C-2
Oil System – Oil Hose Installation 3C-3
Oil Pump Removal and Installation 3C-4
Engine Oil Reservoir Removal and Installation 3C-5
Priming the Oil Pump 3C-6
Priming Procedure – Method 1 . . . . 3C-7
Remote Oil Hose Connections 3C-8
Filling the Oil Tanks 3C-9
Purging Air From the Engine Oil Reservoir and Remote Oil Hose 3C-9
Oil Warning Systems 3C-10
Oil System Troubleshooting 3C-12
Low Oil Warning System is Activated 3C-12

3
C

Special Tools

1. Gearcase Leakage Tester (FT-8950)



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Oil System Operation

Oil in this engine is not mixed with the fuel before entering the combustion chamber. Oil is stored inside the remote oil tank in the boat. Crankcase pressure forces oil from the remote oil tank into the engine oil reservoir. The engine oil reservoir feeds oil to the oil pump. The oil pump is ECM driven and controls oil distribution to the crankcase and air compressor. The oil pump has seven oil discharge ports. Six of the oil discharge ports inject oil into the crankcase through hoses, one hose for each cylinder. The last oil discharge port discharges oil into the air compressor for lubrication. Unused oil from the air compressor returns to the top main bearing.

The ECM is programmed to automatically increase the oil supply to the engine during the initial engine break-in period. The oil ratio is doubled during the first 120 minutes of operation whenever engine speed exceeds 2500 RPM and is under load; below 2500 RPM the oil pump provides oil at the normal ratio. After the engine break-in period, the oil ratio will return to normal – 300 - 400:1 at idle to 40:1 at WOT.

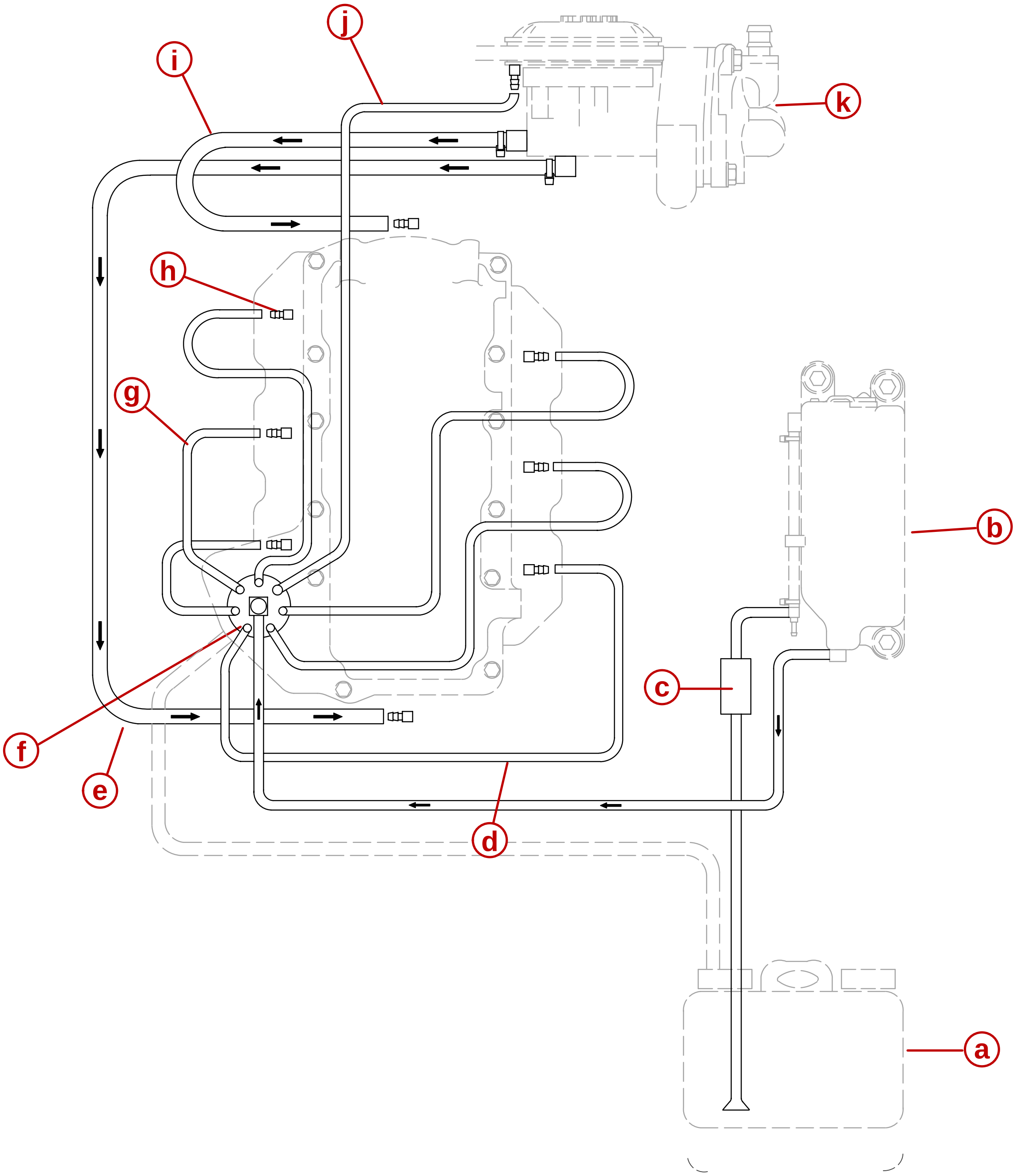
Oil Pump Output

Using the DDT to activate auto prime, the oil pump should discharge 110 ml (cc) ± 8 ml (cc) during the auto prime time period.

To check the oil pump output:

- Verify the onboard oil reservoir is full.
- Release any pressure (loosen cap) from the remote oil tank in the boat.
- With engine not running, use the DDT to activate the auto prime.
- Using a ml or cc graduated container, record the amount of oil needed to refill the onboard oil reservoir.
- Retighten cap on the remote oil tank in the boat.

Oil System – Oil Hose Installation

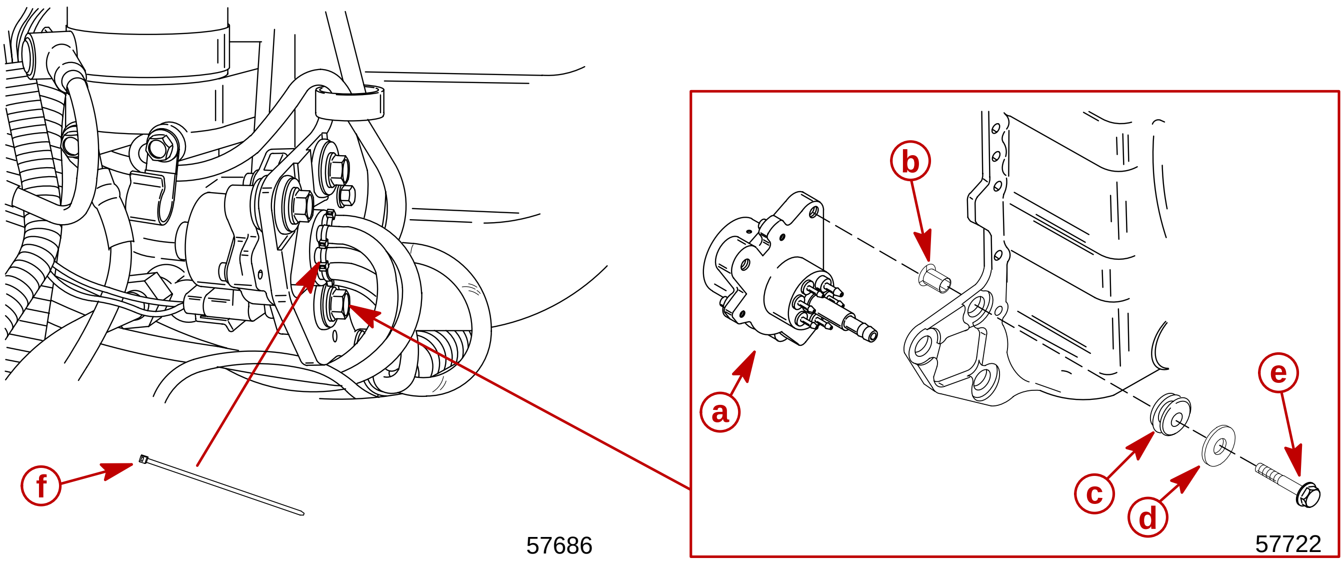


- **a** - Remote Oil Tank
- **b** - Engine Oil Reservoir
- **c** - Filter
- **d** - Oil Supply Hose to the Oil Pump
- **e** - Oil Supply Hose to Lower Crankshaft Bearing
- **f** - Oil Pump
- **g** - Oil Supply Hoses to the Cylinders (6)
- **h** - Fitting and Check Valve (8)
- **i** - Oil Supply Hose to Upper Crankshaft Bearing
- **j** - Oil Supply Hose to the Air Compressor
- **k** - Air Compressor

Oil Pump Removal and Installation

REMOVAL

1. Disconnect the wiring harness from the pump.
2. Disconnect the oil hoses.
3. Remove three bolts and remove pump.



a - Oil Pump
b - Bushing (3)
c - Rubber Grommet (3) – Insert into Hole
d - Washer (3)
e - Bolt (3) – Torque to 12 lb. ft. (16 Nm)
f - Sta-Straps – Fasten All Hose Ends

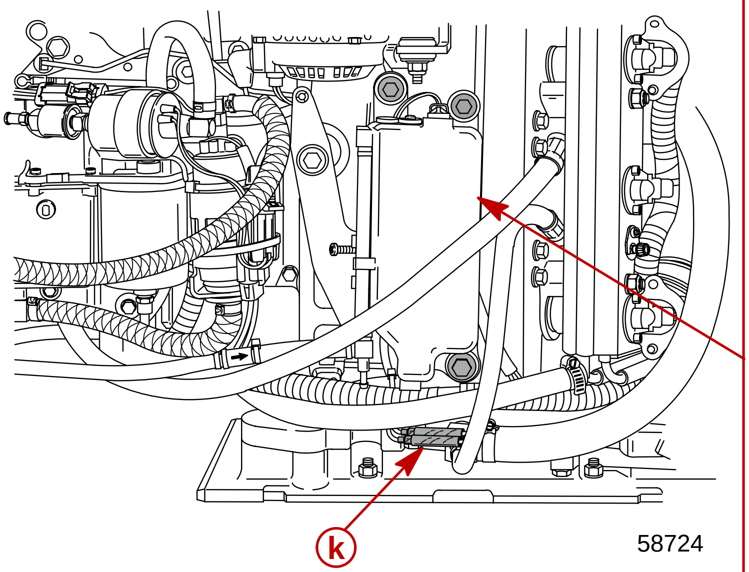
INSTALLATION

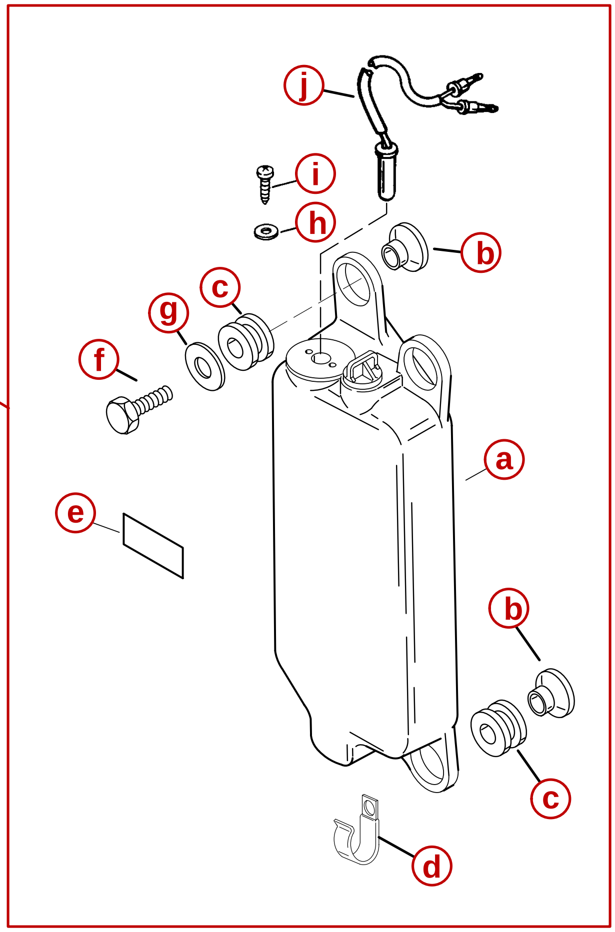
1. Install pump as shown.
2. Reconnect the oil hoses. Refer to Oil Injection Hose Installation for correct location. Fasten hoses to pump fittings with sta-straps.
3. Connect the wiring harness.
4. Refill the oil system. Refer to Priming the Oil Pump.

Engine Oil Reservoir Removal and Installation

REMOVAL

1. Disconnect the oil hoses. Plug the hoses to prevent spillage.
2. Disconnect the BLUE with BLACK STRIPE wire leads.
3. Remove three bolts securing oil tank to powerhead and remove tank.





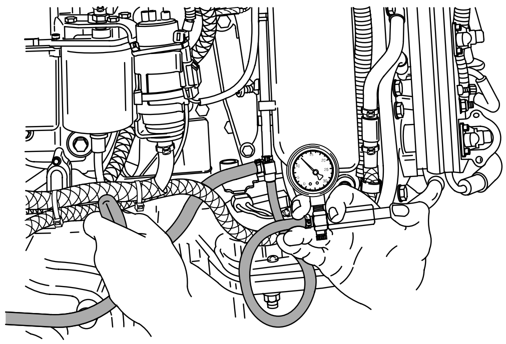
- **a** - Oil Reservoir
- **b** - Bushing (3)
- **c** - Rubber Grommet (3) – Insert into Holes
- **d** - J-Clip
- **e** - Decal
- **f** - Bolt (3) – Torque to 170 lb. in. (19 Nm)
- **g** - Washer (3)
- **h** - Washer
- **i** - Screw (Drive Tight)
- **j** - Low Oil Switch (Normally Closed Circuit)
- **k** - BLUE/BLACK Leads

INSTALLATION

1. Install oil reservoir as shown.
2. Fasten the oil hoses with sta-straps.
3. Connect the BLUE with BLACK STRIPE wire leads.
4. Refill the oil system. Refer to Priming the Oil Pump.

Priming the Oil Pump

***NOTE:** If a new powerhead is being installed or oil hoses/oil pump has been removed, it is recommended all air be purged from oil pump/oil lines using gearcase leakage tester (FT-8950). Connect the leakage tester to the inlet t-fitting on the onboard oil reservoir. While clamping off the inlet hose, manually pressurize the reservoir to 10 psi. Using the Digital Diagnostic Terminal 91-823686A2, activate the oil pump prime sequence. Maintain the 10 psi pressure throughout the auto prime sequence. When the auto prime is completed, remove the leakage tester and refill the onboard oil reservoir.*



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Priming the oil pump (filling pump and hoses using pressure) is required on new or rebuilt power heads and any time maintenance is performed on the oiling system that allows air into the oil system.

There are three methods for priming the oil pump:

METHOD 1 – SHIFT SWITCH ACTIVATION PRIME

This method does three things:

a. Fills the oil pump, oil supply hose feeding pump and oil hoses going to the crankcase and air compressor.

b. Activates break-in oil ratio.

c. Initiates a new 120 minute engine break-in cycle.

Refer to priming procedure following.

METHOD 2 – (DDT) DIGITAL DIAGNOSTIC TERMINAL – RESET BREAK-IN

This method is the same as Method 1, except the run history and fault history are erased from the ECM.

Refer to procedure in the Technician Reference Manual provided with the Digital Diagnostic Software Cartridge Part. No. 91-822608-6 for Model Year 2000. Use cartridge 91-880118 for Model Year 2001.

METHOD 3 – (DDT) DIGITAL DIAGNOSTIC TERMINAL – OIL PUMP PRIME

This method fills the oil pump, oil supply hose feeding pump, and oil hoses going to the crankcase and air compressor.

Refer to procedure in the Technician Reference Manual provided with the Digital Diagnostic Software Cartridge Part. No. 91-822608-6 for Model Year 2000 and cartridge 91-880118 for Model Year 2001.

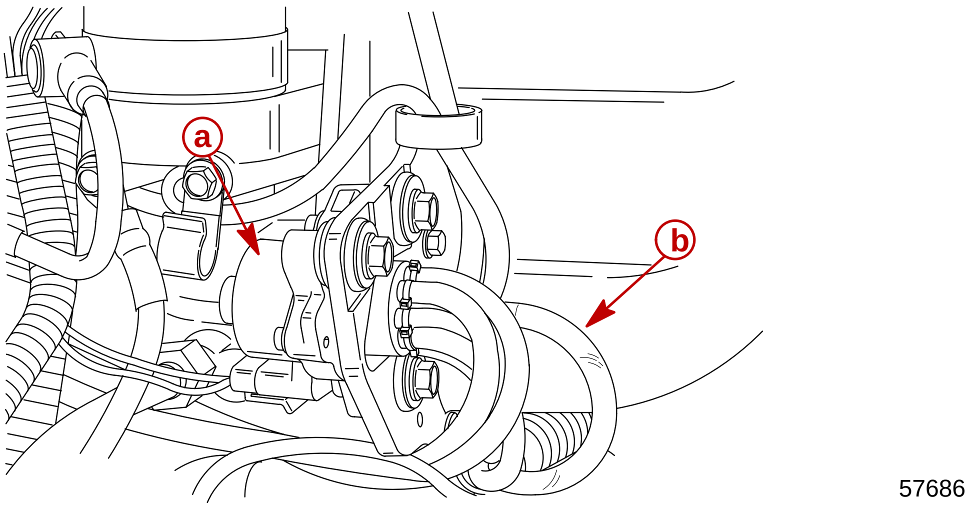
Conditions Requiring Priming the Oil Pump	
Condition	Priming Procedure
New engine	Use Method 1 or 2
Rebuilt Powerhead	Use Method 1 or 2

Conditions Requiring Priming the Oil Pump (Continued)	
New Powerhead	Use Method 1 or 2
Oil system ran out of oil	Use Method 3
Oil drained from oil supply hose feeding pump	Use Method 3
Oil pump removed	Use Method 3
Oil injection hoses drained	Use Method 3

Priming Procedure – Method 1

METHOD 1 – SHIFT SWITCH ACTIVATION PRIME PROCEDURE

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



a - Oil Injection Pump
b - Oil Supply Hose

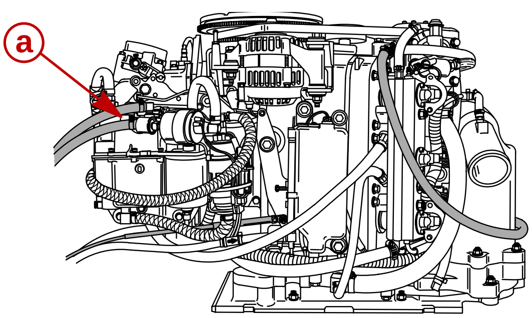
⚠ CAUTION

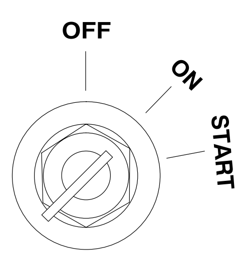
To prevent damage to the fuel pumps, fill the engine fuel system with fuel. Otherwise the fuel pumps will run without fuel during the priming process.

Prime the oil injection pump as follows:

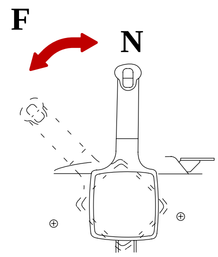
d. Fill the engine fuel system with fuel. Connect fuel hose to fuel lift pump (a).

e. Turn the ignition key switch to the “ON” position.





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

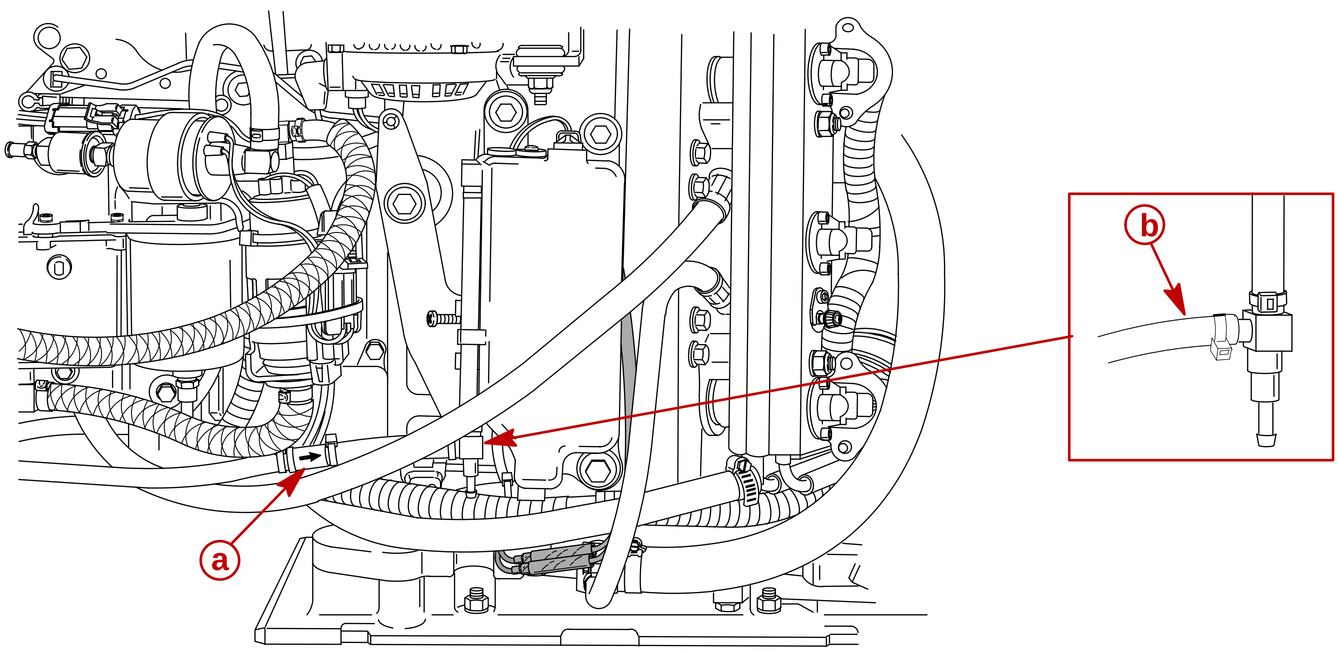


NOTE: *Audible click from the oil pump will tell you the pump is priming. It may take a few minutes for the pump to complete the priming process.*

Remote Oil Hose Connections

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

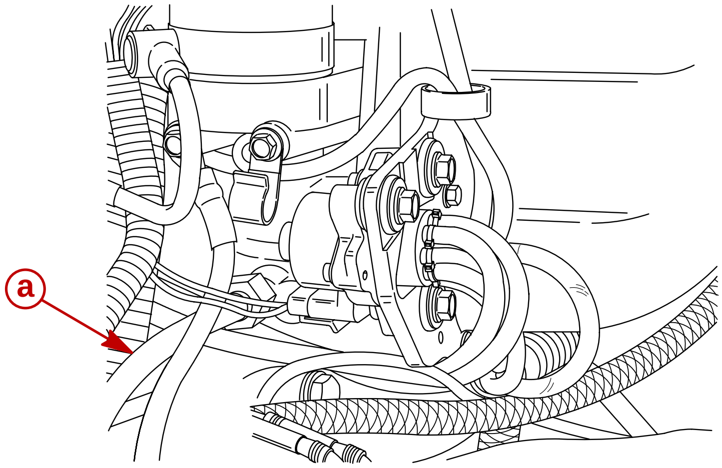
NOTE: *Oil hose with BLUE stripe contains a directional filter which is designed to trap any debris in the oil before the oil reaches the engine oil reservoir. The filter is marked with an arrow denoting direction of flow of oil and should be installed accordingly. Should engine oil reservoir oil level drop while remote oil tank oil level is normal, oil flow through inline filter has been reduced by debris and filter must be replaced.*



a - Oil Filter
b - Oil Hose with Blue Stripe

CONNECTING OIL HOSE WITHOUT BLUE STRIPE

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



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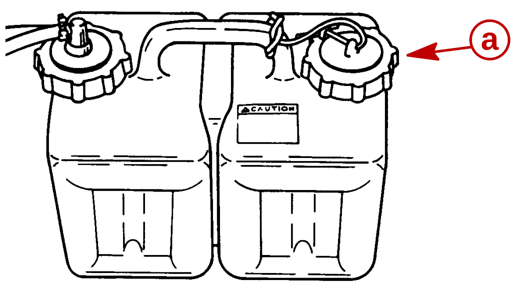
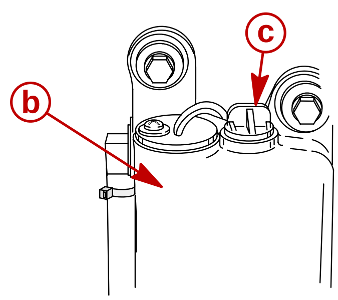
a - Oil Hose Without Blue Stripe

Filling the Oil Tanks

1. Fill remote oil tank with the recommended oil listed in the Operation and Maintenance Manual. Tighten fill cap.
2. Remove cap and fill engine oil tank with oil. Reinstall the fill cap.
3. Remove air from remote oil hose. Refer to Purging Air from the Engine Oil Reservoir and Remote Oil Hose.



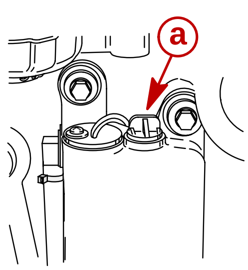


a - Fill Cap
b - Engine Oil Reservoir
c - Fill Cap

Purging Air From the Engine Oil Reservoir and Remote Oil Hose

NOTE: *Before starting engine, make sure the oil pump has been primed.*

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



a - Fill Cap

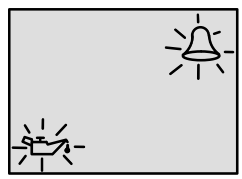
Oil Warning Systems

The 200 Jet Drive incorporates an Engine Guardian System within the ECM to monitor critical engine functions through sensors on the engine. The operator can be notified of impending abnormal engine conditions audibly through a warning horn (4 intermittent beeps) and/or visually by a System Monitor or Smartcraft gauges.

LOW OIL LEVEL

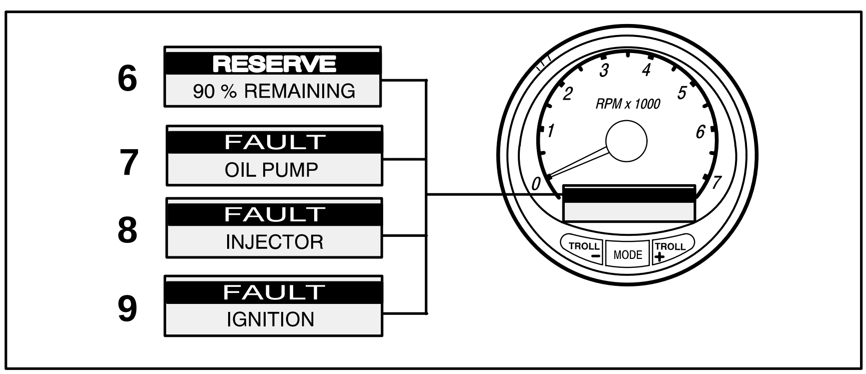
System Monitor

Alarm – Low Oil Reserve: The bell and oil icons are displayed and the warning horn begins sounding a series of four beeps every two minutes to inform the driver that the oil level is critically low in the engine mounted oil reservoir tank. When the oil level gets close to empty, the horn begins sounding continuously and the Engine Guardian System will start limiting engine power. The engine mounted oil reservoir tank along with the remote oil tank will have to be refilled.



Smartcraft Gauge

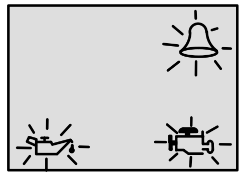
6 Alarm – Low Oil Reserve: This message is displayed and the warning horn begins sounding a series of four beeps every two minutes to inform the driver that the oil level is critically low in the engine mounted oil reservoir tank. When the oil level gets close to empty, the horn begins sounding continuously and the Engine Guardian System will start limiting engine power. The display shows percent of reserve oil that's remaining. The engine mounted oil reservoir tank along with the remote oil tank will have to be refilled.



OIL PUMP NOT FUNCTIONING ELECTRICALLY

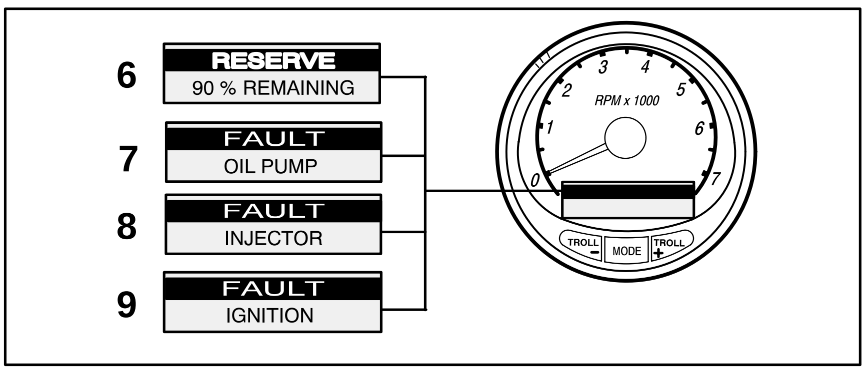
System Monitor

Alarm – Oil Pump Fault: The Bell, Engine and oil icons are displayed and the warning horn begins sounding continuously to inform the driver that the oil pump has stopped functioning electrically. No lubricating oil is being supplied to the engine. Stop the engine as soon as possible. The Engine Guardian system will start limiting the engine power.



Smartcraft Gauge

7 Alarm – Oil Pump Fault: This message is displayed and the warning horn begins sounding continuously to inform the driver that the oil pump has stopped functioning electrically. No lubricating oil is being supplied to the engine. Stop the engine as soon as possible. The Engine Guardian system will start limiting the engine power.



Oil System Troubleshooting

Low Oil Warning System is Activated

Problem
Low oil level in engine oil reservoir but not low in remote oil tank
Note: Oil level in engine oil reservoir should be up to the fill cap

Air was never purged from engine oil tank — Purge air from engine oil tank. Refer to procedure

Fill cap is leaking air on remote tank — Caps on remote tank must be sealed and installed tight

Remote oil hoses blocked or punctured — Check hoses for a kink or leakage

Restricted oil outlet filter in remote oil tank — Remove filter and clean

Restricted oil inlet filter in oil hose before engine oil reservoir — Replace oil filter

Air leak in upper portion on the oil pickup tube — Replace tube

Faulty pressure check valve. Located in engine at end of (black without blue stripe) remote oil hose — Replace check valve

Problem
Low oil level in engine oil reservoir and also remote oil tank

Refill both oil tanks. Purge air from engine oil tank. Refer to procedure

Problem
Oil level is not low in either tank

Disconnect BLUE/BLACK wires going to the low oil float switch in the engine oil reservoir. Check switch for continuity

No Continuity
Remove engine oil reservoir cap and use wire to pull float to top of travel

No Continuity
Oil Float switch is faulty. Replace switch

Continuity
Float in oil tank is faulty. Replace oil tank

Continuity
Check for open wire between oil float switch and ECU

Problem
Oil leaks out of exhaust or #6 cylinder

Pulse hose and oil supply hose are reversed

Boat oil tank is mounted higher than pulse hose fitting on engine and oil tank is over-filled

FUEL SYSTEM

Section 3D – Emissions

Table of Contents

Exhaust Emissions Standards 3D-1
What Are Emissions? 3D-1
Hydrocarbons – HC 3D-1
Carbon Monoxide – CO 3D-1
Oxides of Nitrogen - NOx 3D-2
Controlling Emissions 3D-2
Stoichiometric (14.7:1) Air/Fuel Ratio 3D-2
Outboard Hydrocarbon Emissions Reductions . . . 3D-2
Stratified vs Homogenized Charge 3D-3
Homogenized Charge 3D-3
Stratified Charge 3D-4
Emissions Information 3D-4
Manufacturer’s Responsibility: 3D-4
Dealer Responsibility: 3D-5
Owner Responsibility: 3D-5
EPA Emission Regulations: 3D-5
Manufacturer’s Certification Label 3D-6
Service Replacement Certification Label 3D-7
Removal 3D-7
Date Code Identification 3D-7
Installation 3D-7
Decal Location: 3D-7

Exhaust Emissions Standards

Through the Environmental Protection Agency (EPA), the federal government has established exhaust emissions standards for all new marine engines sold in the United States.

What Are Emissions?

Emissions are what comes out of the exhaust system in the exhaust gas when the engine is running. They are formed as a result of the process of combustion or incomplete combustion. To understand exhaust gas emissions, remember that both air and fuel are made of several elements. Air contains oxygen and nitrogen among other elements; gasoline contains mainly hydrogen and carbon. These four elements combine chemically during combustion. If combustion were complete, the mixture of air and gasoline would result in these emissions: water, carbon dioxide and nitrogen, which are not harmful to the environment. However, combustion is not usually complete. Also, potentially harmful gases can be formed during and after combustion.

All marine engines must reduce the emission of certain pollutants, or potentially harmful gases, in the exhaust to conform with levels legislated by the EPA. Emissions standards become more stringent each year. Standards are set primarily with regard to three emissions: hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx).

Hydrocarbons – HC

Gasoline is a hydrocarbon fuel. The two elements of hydrogen and carbon are burned during combustion in combination with oxygen. But they are not totally consumed. Some pass through the combustion chamber and exit the exhaust system as unburned gases known as hydrocarbons.

Carbon Monoxide – CO

Carbon is one of the elements that make up the fuel burned in the engine along with oxygen during the combustion process. If the carbon in the gasoline could combine with enough oxygen (one carbon atom with two oxygen atoms), it would come out of the engine in the form of carbon dioxide (CO_2). CO_2 is a harmless gas. However, carbon often combines with insufficient oxygen (one carbon atom with one oxygen atom). This forms carbon monoxide, CO. Carbon monoxide is the product of incomplete combustion and is a dangerous, potentially lethal gas.

Oxides of Nitrogen - NOx

NOx is a slightly different byproduct of combustion. Nitrogen is one of the elements that makes up the air going into the engine. Under extremely high temperatures it combines with oxygen to form oxides of nitrogen (NOx). This happens in the engine's combustion chambers when temperatures are too high. NOx itself is not harmful, but when exposed to sunlight it combines with unburned hydrocarbons to create the visible air pollutant known as smog. Smog is a serious problem in California as well as many other heavily populated areas of the United States.

Controlling Emissions

There are two principle methods of reducing emissions from a two-stroke-cycle marine engine. The first method is to control the air/fuel ratio that goes into the combustion chamber. The second is to control the time when this air/fuel mixture enters the combustion chamber. Timing is important, to prevent any unburned mixture from escaping out of the exhaust port.

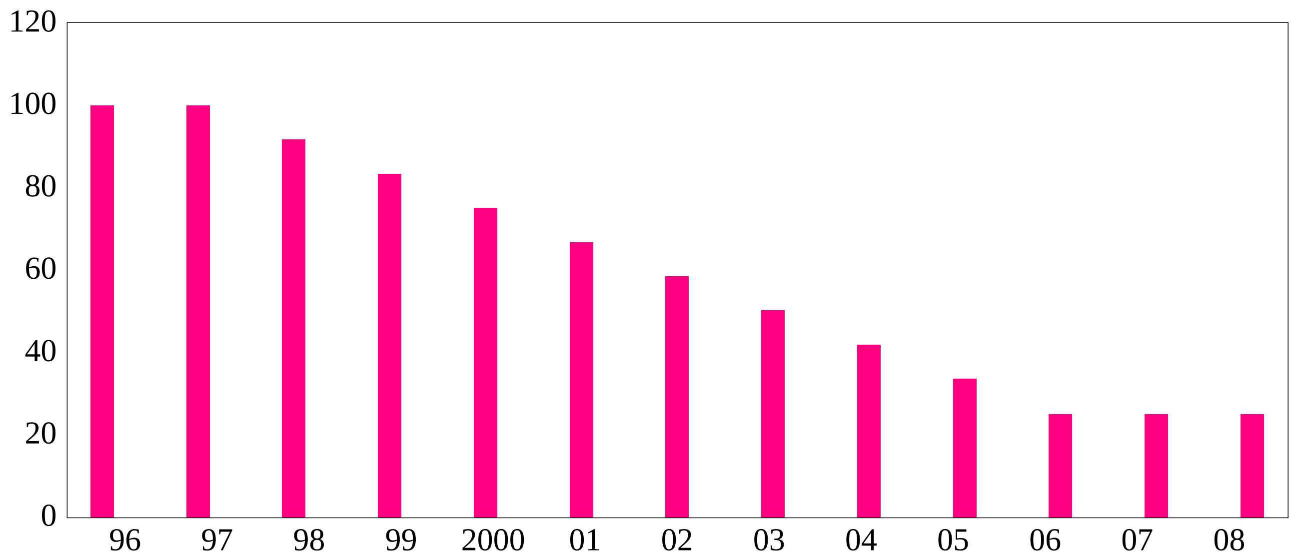
Stoichiometric (14.7:1) Air/Fuel Ratio

In the search to control pollutants and reduce exhaust emissions, engineers have discovered that they can be reduced effectively if a gasoline engine operates at an air/fuel ratio of 14.7:1. The technical term for this ideal ratio is stoichiometric. An air/fuel ratio of 14.7:1 provides the best control of all three elements in the exhaust under almost all conditions. The HC and CO content of the exhaust gas is influenced significantly by the air/fuel ratio. At an air/fuel ratio leaner than 14.7:1, HC and CO levels are low, but with a ratio richer than 14.7:1 they rise rapidly. It would seem that controlling HC and CO by themselves might not be such a difficult task; the air/fuel ratio only needs to be kept leaner than 14.7:1. However, there is also NOx to consider.

As the air/fuel ratio becomes leaner, combustion temperatures increase. Higher combustion temperatures raise the NOx content of the exhaust. However, enrichening the air/fuel ratio to decrease combustion temperatures or reduce NOx also increases HC and CO, as well as lowering fuel economy. So the solution to controlling NOx - as well as HC and CO - is to keep the air/fuel ratio as close to 14.7:1 as possible.

Outboard Hydrocarbon Emissions Reductions

8 1/3% ↓ per Year Over 9 Model Years



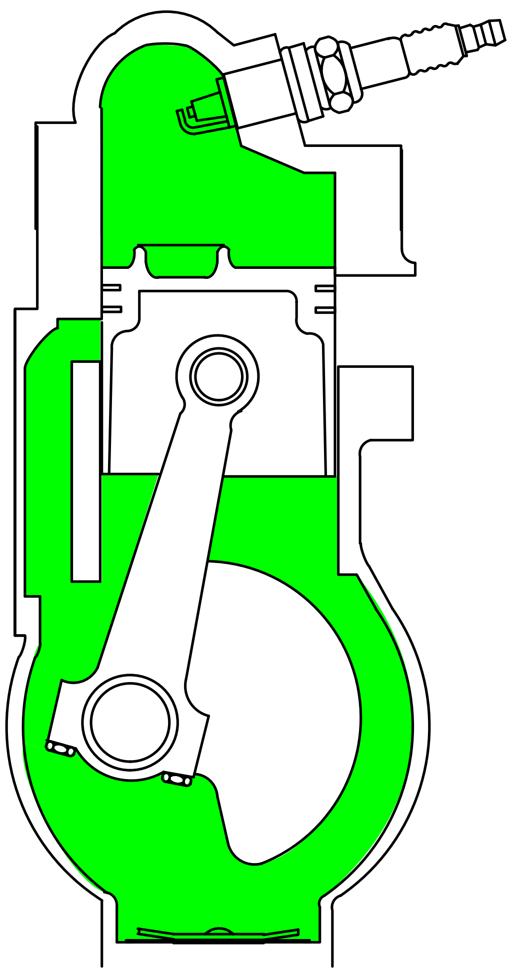
Stratified vs Homogenized Charge

At certain operating conditions, DFI engines use a stratified charge inside the combustion chamber to aid in reducing emissions. All other models exclusively use a homogenized charge. The difference between the two is:

Homogenized Charge

A homogenized charge has the fuel/air particles mixed evenly throughout the cylinder. This mixing occurs inside the carburetor venturi, reed blocks, crankcase and/or combustion chamber. Additional mixing occurs as the fuel is forced through the transfer system into the cylinder.

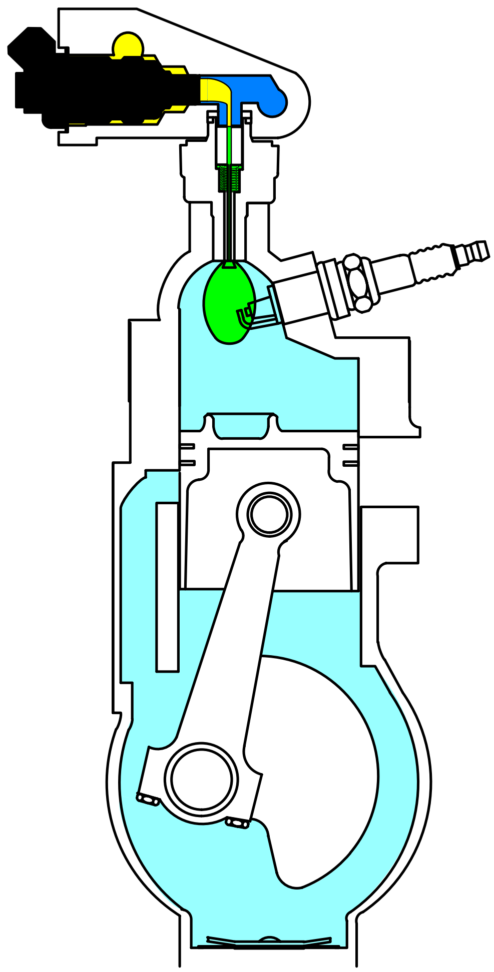
The homogenized charge has an air/fuel ratio of approximately 14.7:1 and is uniform throughout the cylinder.



Stratified Charge

A stratified charge engine only pulls air through the transfer system. The fuel required for combustion is forced into the cylinder through an injector placed in the top of the cylinder (head). The injector sprays a fuel/air mixture in the form of a fuel cloud into the cylinder. Surrounding this cloud is air supplied by the transfer system. As the cloud is ignited and burns, the surrounding air provides almost complete combustion before the exhaust port opens.

A stratified charge engine concentrates a rich mixture in the vicinity of the spark plug (air/fuel ratio is less than 14.7:1). Elsewhere, the mixture is very lean or is comprised of air only.



Emissions Information

Manufacturer’s Responsibility:

Beginning with 1998 model year engines, manufacturers of all marine propulsion engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States Environmental Protection Agency (EPA). A certification decal/emissions control information label, showing emission levels and engine specifications directly related to emissions, **must** be placed on each engine at the time of manufacture.

Dealer Responsibility:

When performing service on all 1998 and later jet drives that carry a certification, attention must be given to any adjustments that are made that affect emission levels.

Adjustments must be kept within published factory specifications.

Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.

Dealers are **not** to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturers prescribed changes, such as that for altitude adjustments. Also included would be factory authorized:

- Installation of performance style gear housings by Mercury Marine.
- Service replacement parts modified, changed or superceded by Mercury Marine.

Owner Responsibility:

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is **not** to modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Single engine exceptions may be allowed with permission from the EPA for racing and testing.

EPA Emission Regulations:

All new 1998 and later jet drives 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:

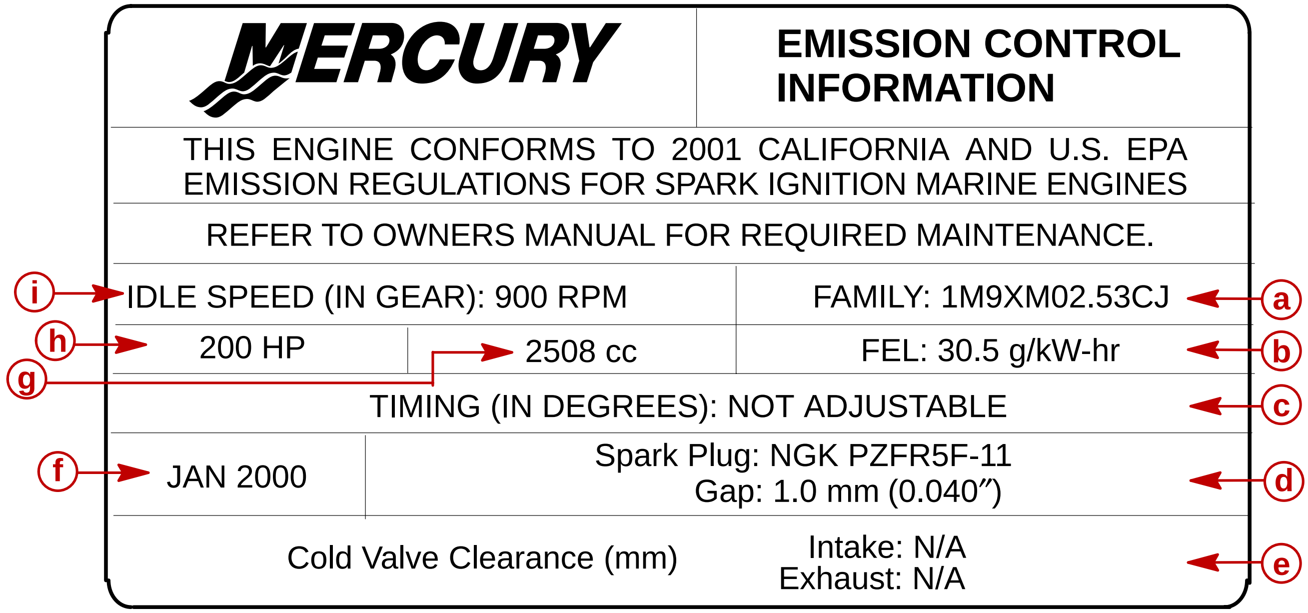
VIA U.S. POSTAL SERVICE:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

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

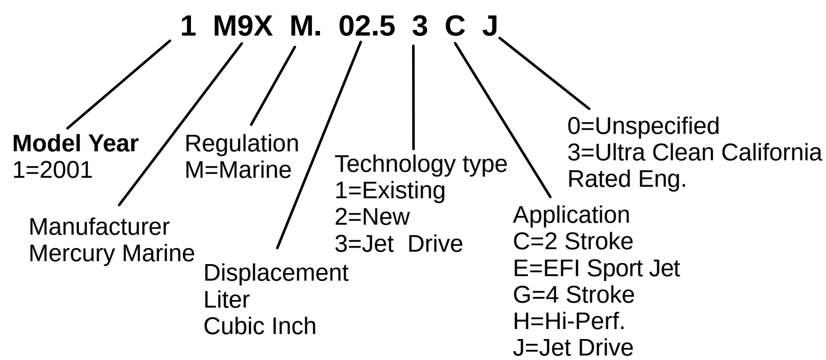
EPA INTERNET WEB SITE:
http:/www.epa.gov/omswww

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 - Family Example
b - FEL: Represents (Mercury Marine) statement of the maximum emissions output for the engine family
c - Timing specifications when adjustable
d - Recommended spark plug for best engine performance
e - Valve Clearance (Four Stroke engines only)
f - Date of Manufacture
g - Cubic Centimeter
h - Engine Horsepower rating
i - Idle Speed (In Gear)



Decal Location:

Model	Service Part No.	Location on Engine
2001 JET DRIVE 2.5 L V6 DFI (200 H.P.)	37-883190AO1	Vapor Separator

Service Replacement Certification Label

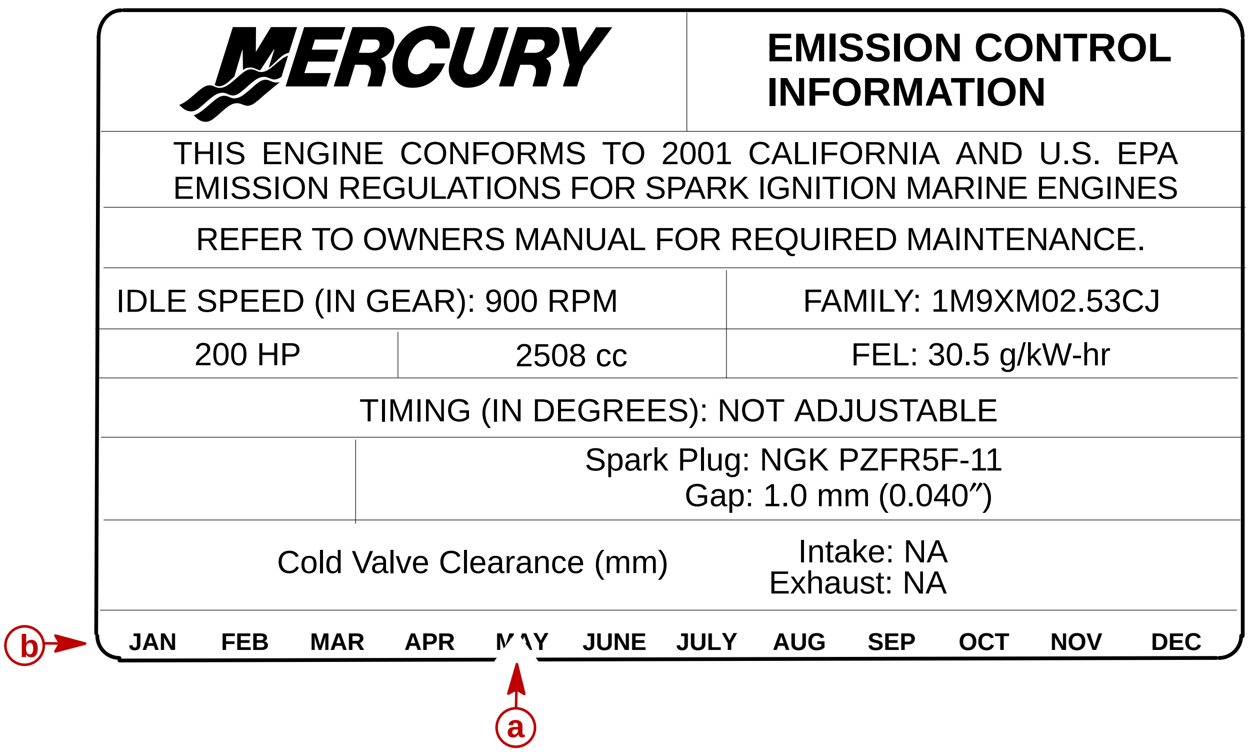
IMPORTANT: By federal law, it is required that all 1998 and newer Mercury Marine jet drives have a visible and legible emission certification label. If this label is missing or damaged, contact Mercury Marine Service for replacement if appropriate.

Removal

Remove all remaining pieces of the damaged or illegible label. Do not install new label over the old label. Use a suitable solvent to remove any traces of the old label adhesive from the display location.

Date Code Identification

Cut and remove a “V” notch through the month of engine manufacture before installing the new label. The month of manufacture can be found on the old label. If the label is missing or the date code illegible, contact Mercury Marine Technical Service for assistance.



a - “V” Notch
b - Month of Manufacture

Installation

Install the label on a clean surface in the original factory location.

Decal Location:

Model	Service Part No.	Location on Engine
2001 JET DRIVE 2.5 L V6 DFI (200 H.P.)	37-883190AO1	Vapor Separator

POWERHEAD

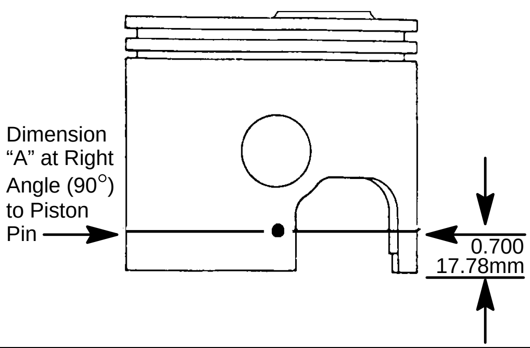
Section 4A

Table of Contents

Powerhead Specifications 4A-2
Special Tools 4A-3
Powerhead Repair Stand 4A-4
Cylinder Block Assembly 4A-6
Cylinder Block and End Caps 4A-8
Cylinder Head Assembly 4A-10
Crankshaft, Pistons and Connecting Rods . . 4A-12
Expansion Chamber and Adaptor Plates . . . 4A-14
Torque Sequence 4A-16
General Information 4A-18
Powerhead Removal from Pump Unit 4A-18
Removing Engine Components 4A-21
Removing Engine Components Individually 4A-21
Removing Engine Components as an Assembly 4A-22
Starboard Side Oil Hose Routing 4A-33
Port Side Oil Hose Routing 4A-34
Water By-Pass Hose Routing 4A-35
Powerhead Disassembly 4A-36
Cleaning and Inspection 4A-44
Cylinder Block and Crankcase Cover . . . 4A-44
Special Service Information 4A-44
Cylinder Bores 4A-45
Pistons and Piston Rings 4A-46
Cylinder Heads and Exhaust Divider Plate 4A-48
Crankshaft 4A-48
Crankshaft (and End Cap) Bearings 4A-49
End Bearing Bleed System 4A-50
Connecting Rods 4A-50
Powerhead Reassembly and Installation . . . 4A-52
General 4A-52
Crankshaft Installation 4A-55
Piston and Connecting Rod Reassembly 4A-57
Piston and Piston Ring Combinations . . . 4A-58
Piston Installation 4A-59
Crankcase Cover Installation 4A-61
Reed Block Assembly 4A-62
Assembly of Reed Blocks to Reed Block Adaptor Plate 4A-63
Assembly of Exhaust Divider Plate to Block 4A-63
Cylinder Head Installation 4A-64
Reinstalling Engine Components 4A-65
Throttle Lever/Throttle Cam Assembly 4A-66
Throttle Lever and Shift Shaft 4A-67
Powerhead Installation on Pump Unit 4A-68
Break-In Procedure 4A-71

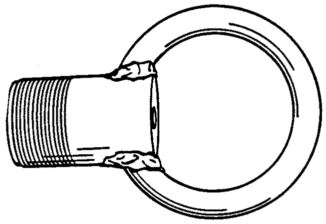
4
A

Powerhead Specifications

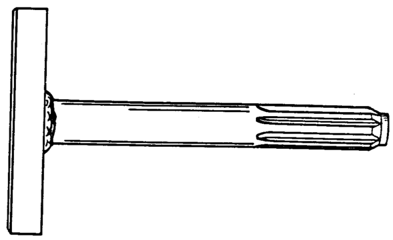
CYLINDER BLOCK	**Type** **Displacement** **Thermostat**	V–6 Cylinder, Two Cycle, Direct Injected 153 cu. in. (2508 cc) 60° Vee 142° F (61° C)
STROKE	**Length (All Models)**	2.65 in. (67.3 mm)
CYLINDER BORE	**Diameter (Std)** **Diameter 0.015 in. Oversize** **Taper/Out of Round/Wear Maximum** **Bore Type**	3.501 in. (88.925 mm) 3.516 in. (89.306 mm) 0.003 in. (0.076 mm) Cast Iron
CRANKSHAFT	**Maximum Runout**	0.006 in. (0.152 mm)
PISTON	**Piston Type** **Diameter Standard** **Diameter 0.015 in. Oversize**	Aluminum 3.4925 in. ± .0005 in. (88.7095 mm ± 0.0127 mm) 3.5075 in. ± 0.0005 in. (89.0905 mm ± 0.0127 mm)
PISTON DIAMETER		3.4925 in. ± .0005 in. (88.7095 mm ± .0127 mm) **Using a micrometer, measure dimension “A” at location shown. Dimension “A” should be 3.4925 in. ± .0005 for a STANDARD size piston (new) Dimension “A” will be 0.001 – 0.0015 less if coating is worn off piston (used)**
REEDS	**Reed Stand 0pen (Max.)**	0.020 in. (0.50 mm)

Special Tools

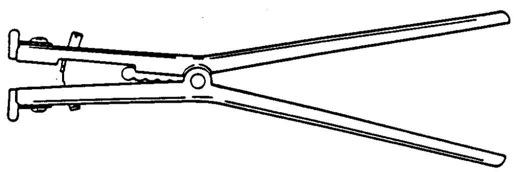
1. Lifting Eye 91-90455T



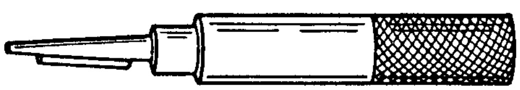
2. Powerhead Stand 91-30591T1



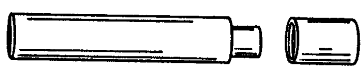
3. Piston Ring Expander 91-24697



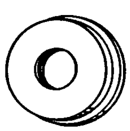
4. Lockring Removal Tool 91-52952T1



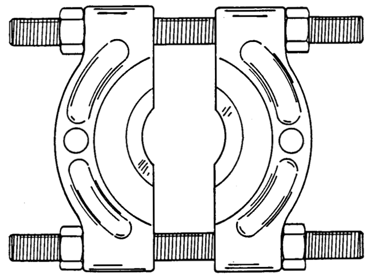
5. Piston Pin Tool 91-74607A1



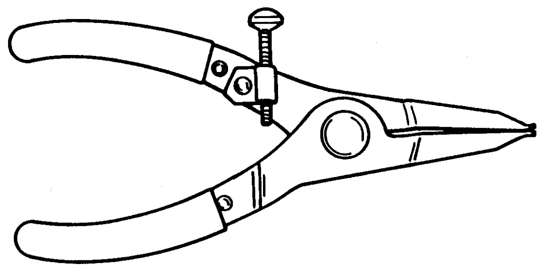
6. Driver Head 91-55919



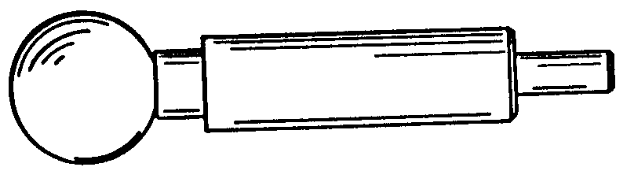
7. Universal Puller Plate 91-37241



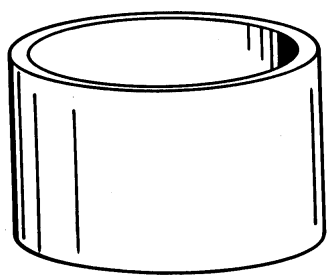
8. Snap Ring Pliers 91-24283



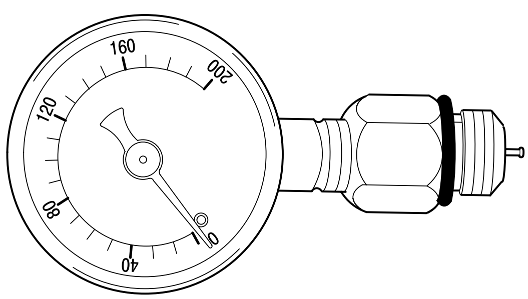
9. Lockring Installation Tool 91-77109A3



10. Piston Ring Compressor for 2.5 Litre (153 cu. in.) 91-818773T



11. Compression Tester 91-29287



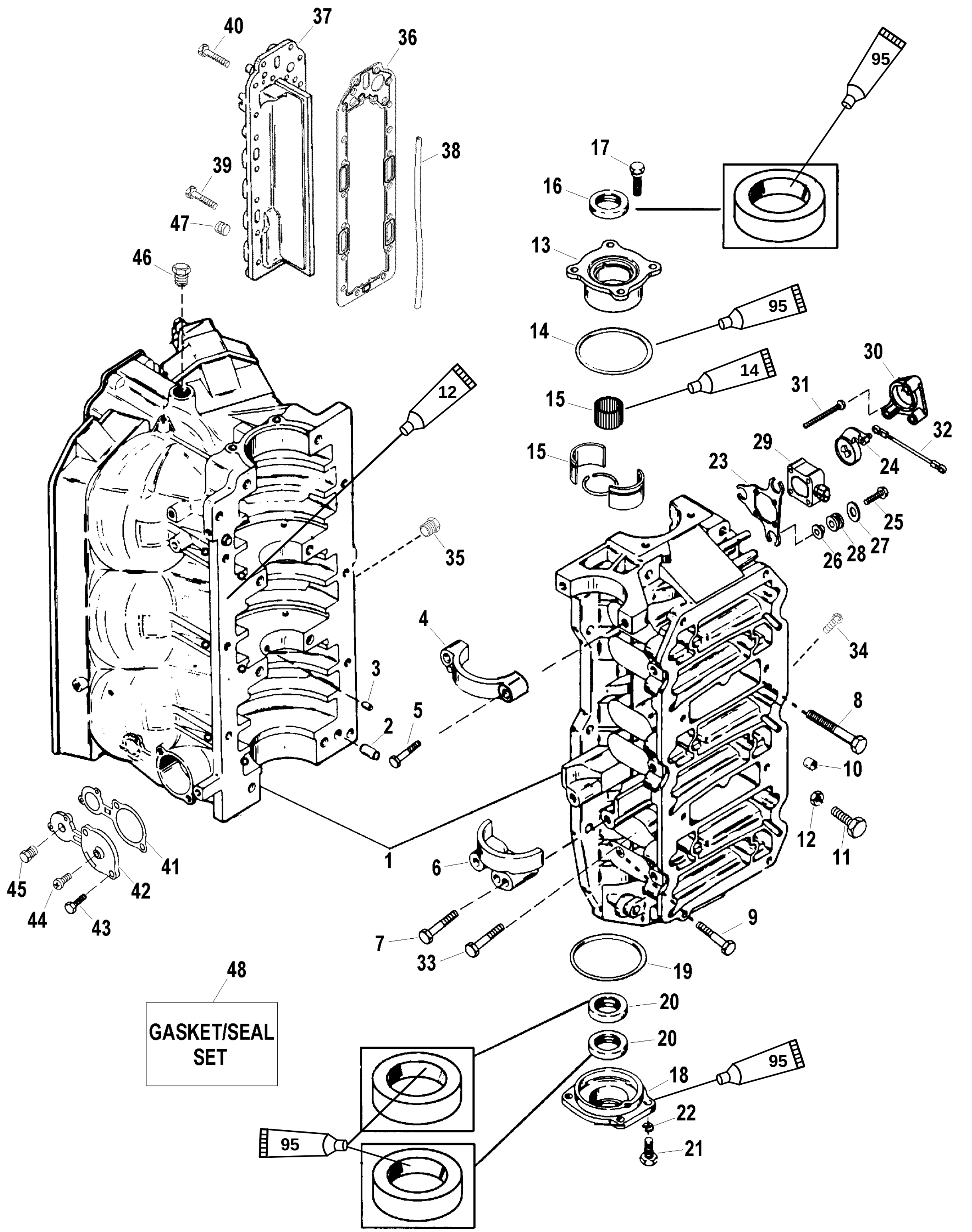
Powerhead Repair Stand

A powerhead repair stand may be purchased from:

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787
Telephone: (305) 656-2089

Notes:

Cylinder Block Assembly



12 Loctite Master Gasket (92-12564-2)

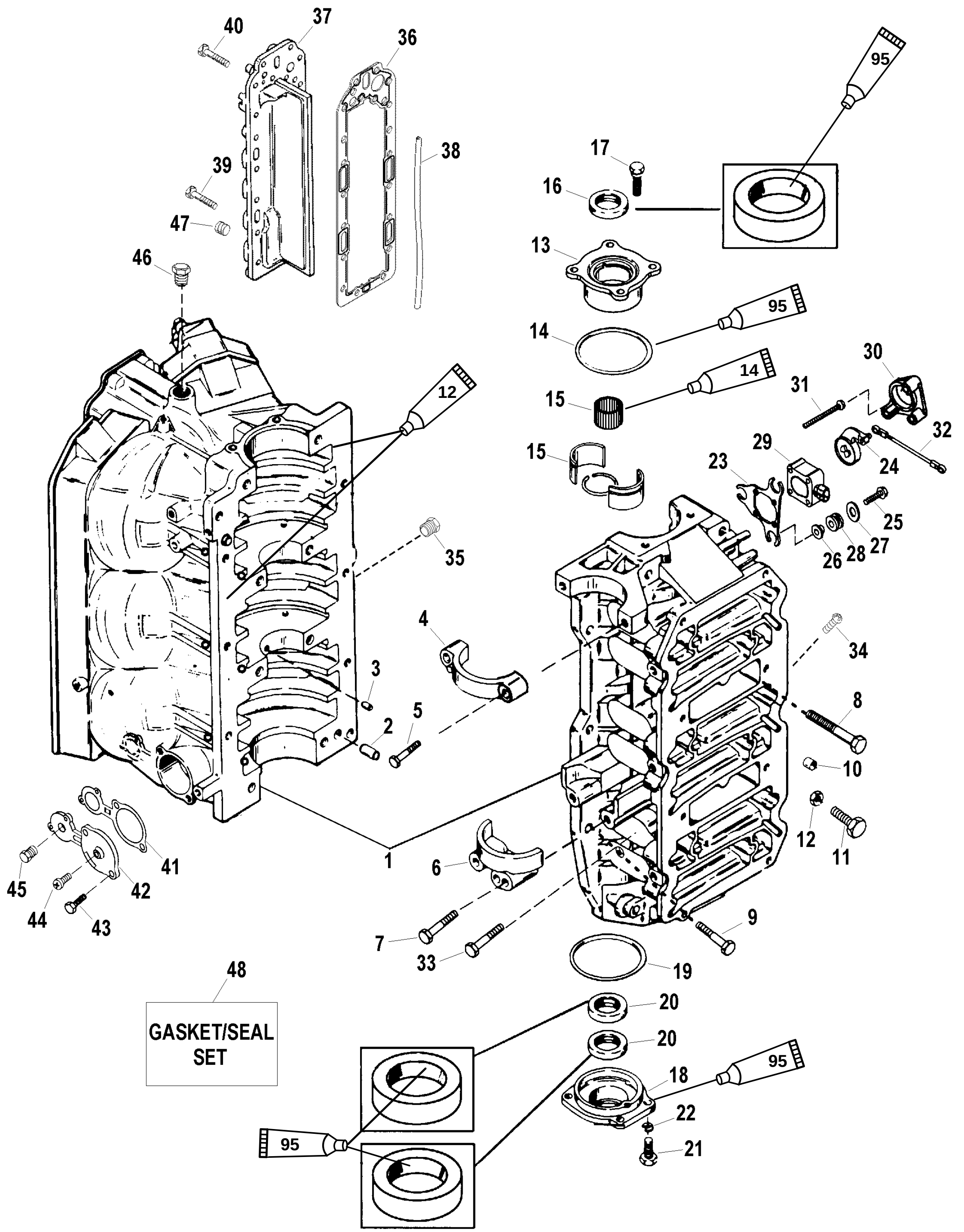
14 2 Cycle Outboard Oil (92-826666A24)

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

Cylinder Block and End Caps

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	lb-ft	Nm
1	1	CYLINDER BLOCK ASSEMBLY			
2	2	DOWEL PIN (0.375 x 0.620) locating			
3	2	DOWEL PIN (Center Main)			
4	1	COVER-Top Starter Mounting			
5	2	SCREW (0.312-18 x 1.50)			
6	1	COVER (Bottom Starter Mounting))			
7	2	SCREW (0.312-18 x 2.00)		17.5	24
8	8	SCREW (0.312-16 x 3.250)		37	50
9	6	SCREW (0.312-18 x 1.250)		15	20
10	1	CAP (Nylon)			
11	1	ADJUSTING SCREW (0.250-20 x 1.750)			
12	1	JAM NUT (0.250-20)			
13	1	END CAP ASSEMBLY-Upper			
14	1	O-RING			
15	1	BEARING KIT (Top Main)			
16	1	SEAL-Oil			
17	4	SCREW with LOCKWASHER (0.312-18 x1.00)		17	23
18	1	END CAP ASSEMBLY-Lower			
19	1	O-RING (3-1/4 IN. I.D.)			
20	2	OIL SEAL			
21	4	SCREW (0.250-20 x 0.750)	80		9
22	4	LOCKWASHER (0.250)			
23	1	BRACKET			
24	1	TPS LEVER			
25	3	SCREW-(M6 x 25) Bracket to Crankcase	70		8
26	3	BUSHING			
27	3	WASHER			
28	3	GROMMET			
29	1	THROTTLE POSITION SENSOR			
30	1	TPS COVER			
31	3	SCREW -TPS to bracket (#10-32 x 2.00)	15		1.7
32	1	THROTTLE LINK			
33	1	SCREW (M8 x 14)		13	18
34	1	SCREW (#12-14 x 0.375)	85		9.5
35	1	PLUG (0.125-27)			
36	1	GASKET			
37	1	PLATE KIT-Exhaust Divider			
38	1	SEAL-Exhaust Divider			
39	17	SCREW with WASHER (0.312-18 x 1.50)		13	18
40	2	SCREW (0.312-18 x 1.00)		13	18
41	1	GASKET			
42	1	COVER-Relief Valve			
43	4	SCREW (0.312-18 x 0.880)		13	18
44	1	SCREW (#6-32 x 0.250)	9		1

Cylinder Block Assembly



12 Loctite Master Gasket (92-12564-2)

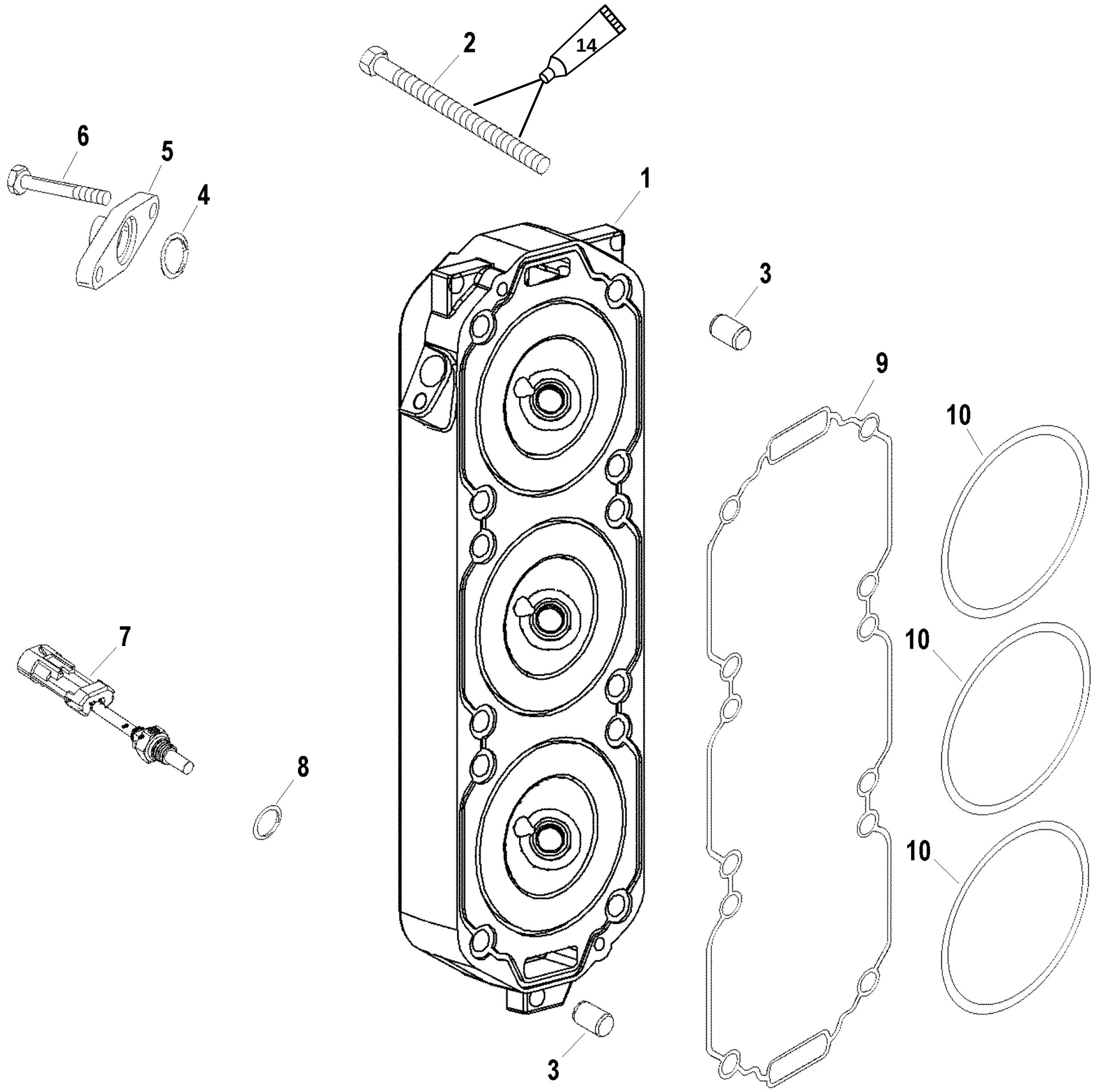
14 2 Cycle Outboard Oil (92-826666A24)

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

Cylinder Block and End Caps

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
45	1	PLUG-Pipe (0.250 x 18)			
46	1	PLUG-Pipe (0.500 x 14)			
47	1	PLUG-Pipe (0.750 x 14)			
48	1	GASKET/SEAL SET			

Cylinder Head Assembly

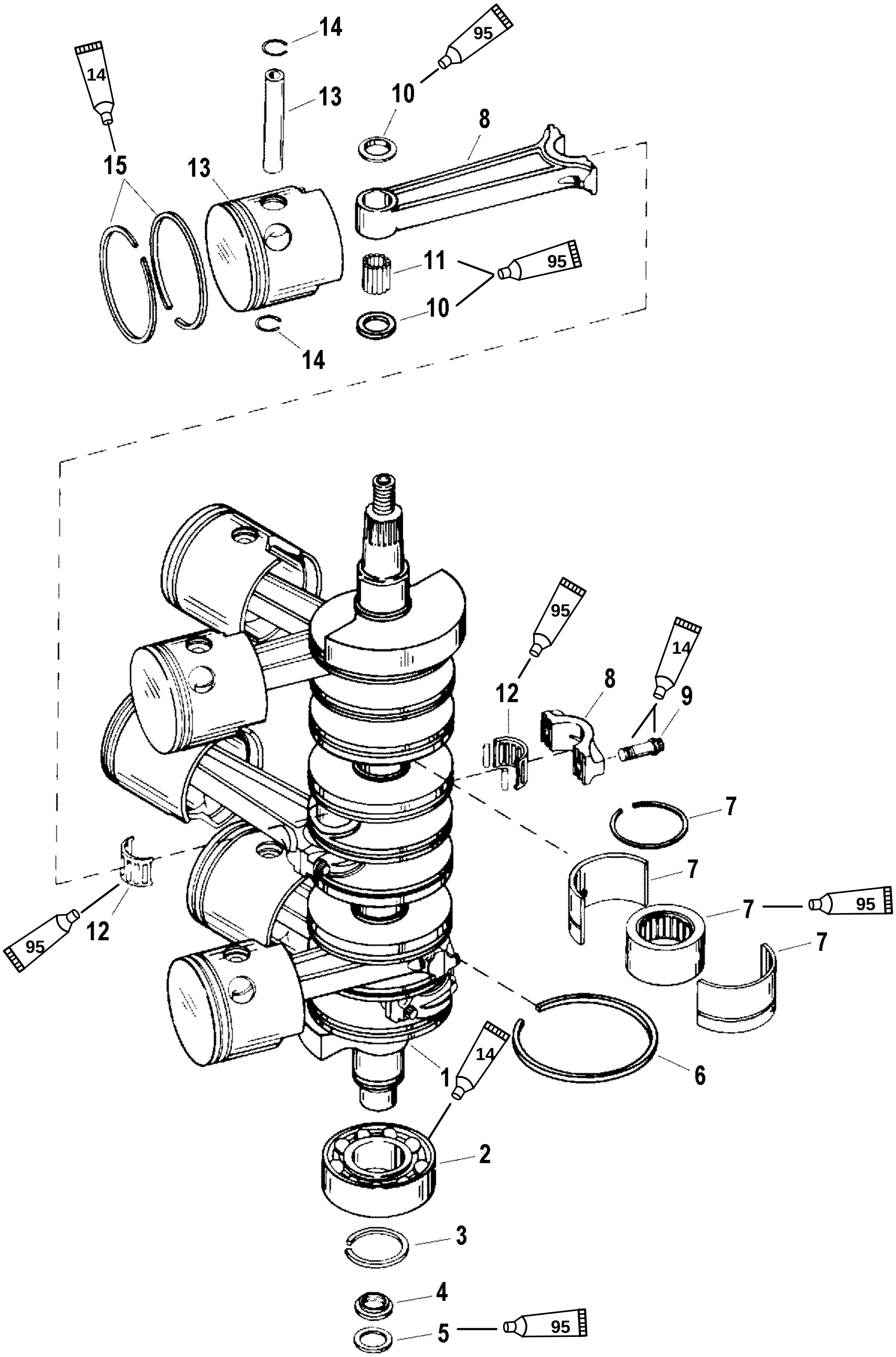


14 2 Cycle Outboard Oil (92-826666A24)

Cylinder Head Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	CYLINDER HEAD **(PORT)**			
	1	CYLINDER HEAD **(STARBOARD)**			
2	24	BOLT (0.375-16 x 2.750)	30 lb-ft (41 Nm), then tighten additional 90 degrees		
3	4	DOWEL PIN (0.250 x 0.625)			
4	2	O-RING			
5	2	COVER-Thermostat			
6	4	SCREW (M6 x 25)	120		13.5
7	2	SENSOR-Temperature (Port and Starboard)	14		1.6
8	2	O-RING			
9	2	SEAL–Cylinder Head			
10	6	SEAL–Cylinder Bore			

Crankshaft, Pistons and Connecting Rods



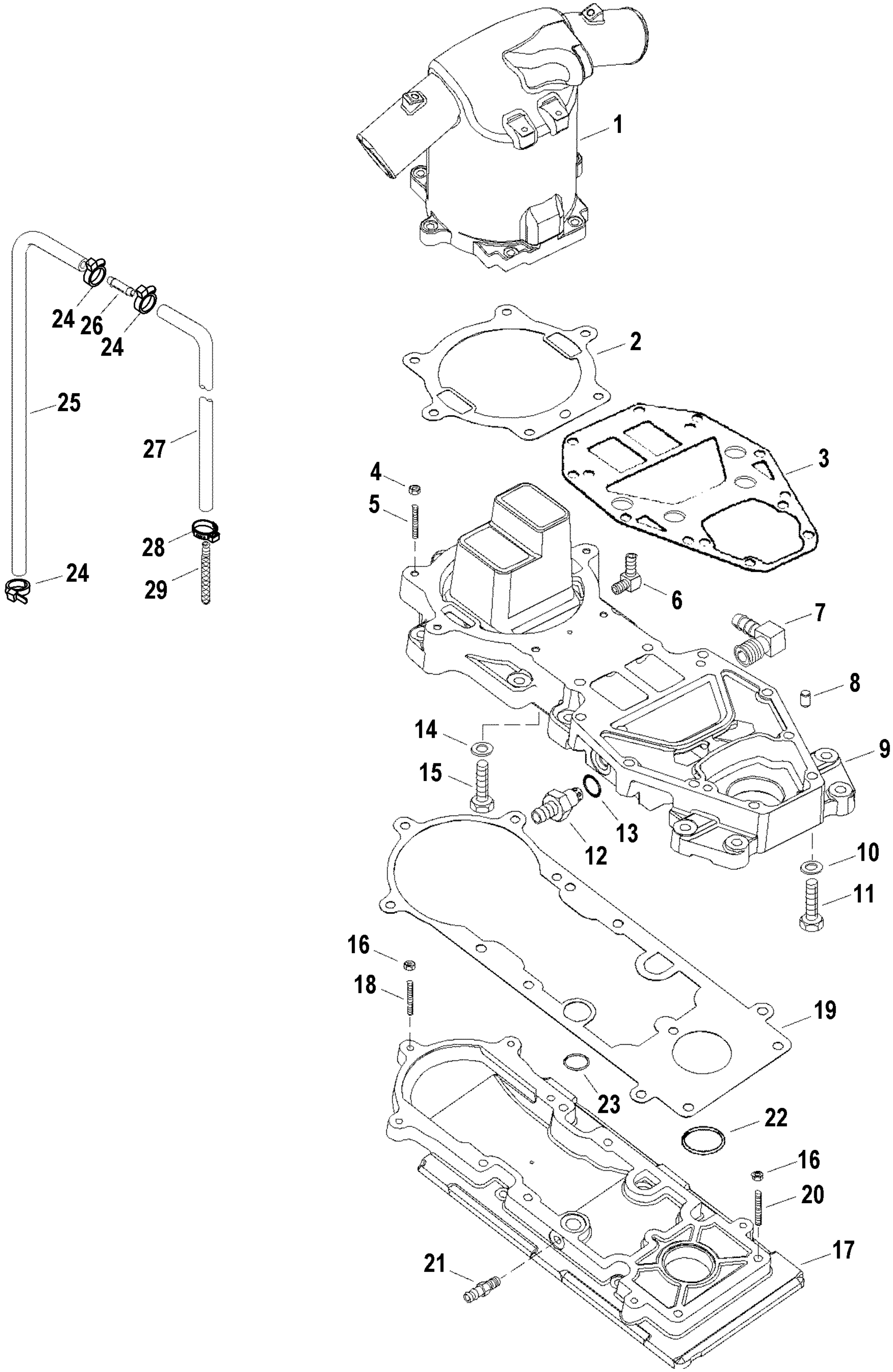
14 2 Cycle Outboard Oil (92-826666A24)

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

Crankshaft, Pistons and Connecting Rods

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	CRANKSHAFT ASSEMBLY			
2	1	BALL BEARING (LOWER)			
3	1	RETAINING RING			
4	1	CARRIER ASSEMBLY			
5	1	PACKING-Carrier			
6	7	RING–Sealing			
7	2	BEARING KIT-Crankshaft (Center Main)			
8	2	CONNECTING ROD KIT			
9	12	SCREW (0.312-24 x 0.875)	1st Torque: 15 lb-in 2nd Torque: 20 lb-ft Turn screw addition-al 90 degrees after 2nd torque. ▼		
10	12	WASHER-Thrust			
11	204	NEEDLE BEARING–piston end			
12	6	BEARING KIT-Needle Bearings			
13	3	PISTON **(STARBOARD)**			
	3	PISTON **(PORT**)			
14	12	LOCK RING			
15	12	RING SET-Piston (Upper and Lower - 12 Rings)			

Expansion Chamber and Adaptor Plates

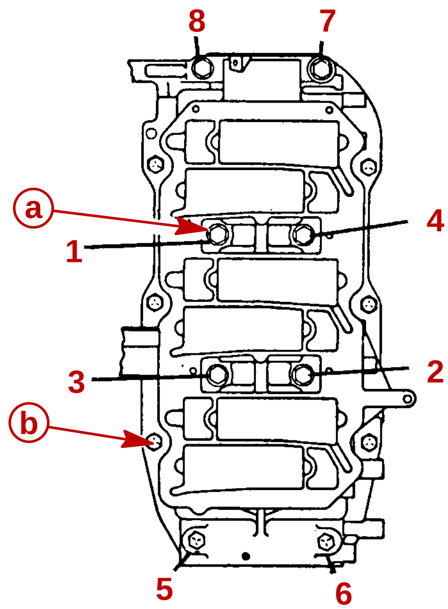


Expansion Chamber and Adaptor Plates

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CHAMBER-Expansion			
2	1	GASKET-Expansion Chamber			
3	2	GASKET (Block to Exhaust Expansion Chamber)			
4	6	NUT (M8)		20	27
5	6	STUD (M8 x 48)			
6	1	ELBOW (0.125-27)			
7	1	ELBOW (90°)			
8	2	PIN-Dowel-(0.375 x 0.620)			
9	1	ADAPTOR-Engine			
10	8	WASHER			
11	8	SCREW (.375-16 x 2.250)		35	47
12	1	FITTING-Strainer			
13	1	O-RING			
14	2	WASHER			
15	2	SCREW (.375-16 x 3.750)		35	47
16	11	NUT (M10)		35	47
17	1	COVER ASSEMBLY-Top Of Drive Housing			
18	5	STUD (M10 x 53)		30	40
19	1	GASKET-Engine Adaptor			
20	6	STUD (M10 x 101)		30	40
21	1	CONNECTOR			
22	1	O-RING			
23	1	O-RING			
24	3	CABLE TIE (8.00 Inch)			
25	1	HOSE-Siphon **(9.00 Feet Bulk) (Cut 42.00 Inches)**			
26	1	SIPHON BREAK			
27	1	HOSE-Siphon **(9.00 Feet Bulk) (Cut 18.00 Inches)**			
28	1	CLAMP			
29	1	FILTER-Siphon Hose			

Torque Sequence

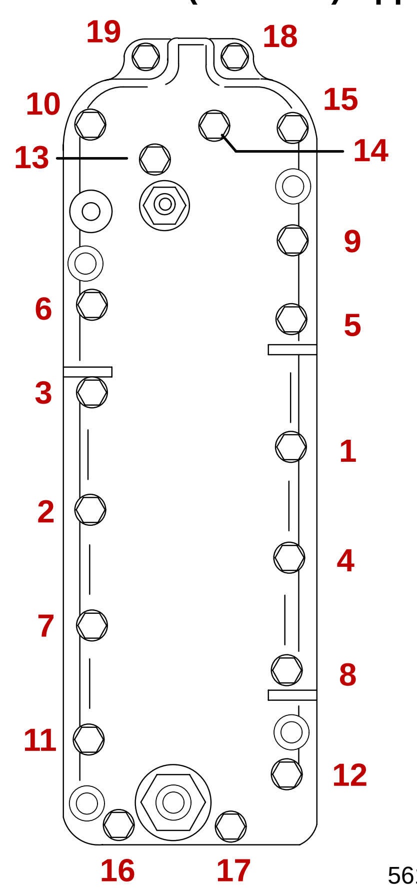
CRANKCASE COVER BOLTS (AND TORQUE SEQUENCE)



a - Add light oil to threads and bolt face: 8 Bolts (3/8 in. - 16 in.) 38 lb. ft. (51.5 N·m)

b - Bolts (5/16 in. - 18) 180 lb. in. (20 N·m)

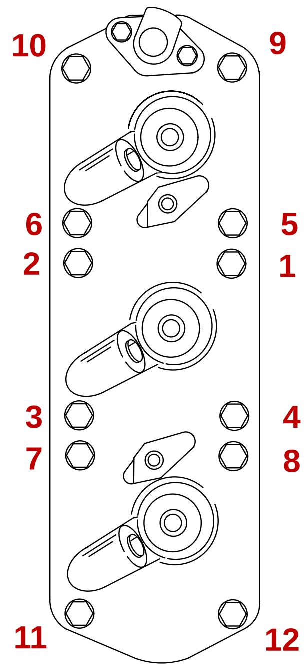
EXHAUST DIVIDER PLATE BOLTS 16.5 lb. ft. (22.5 N·m) Apply Loctite 271 to threads



56167

CYLINDER HEAD BOLTS

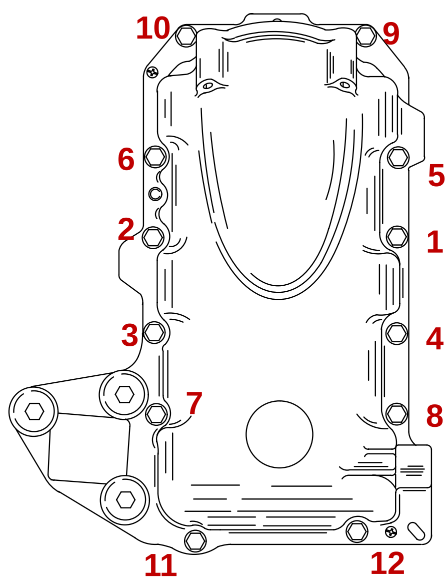
Add light oil to threads and bolt face: 30 lb. ft. (41 N·m) then turn an additional 90°.



56168

AIR PLENUM/REED BLOCK ASSEMBLY PLATE BOLTS

14.5 lb. ft. (19.5 N·m)



56160

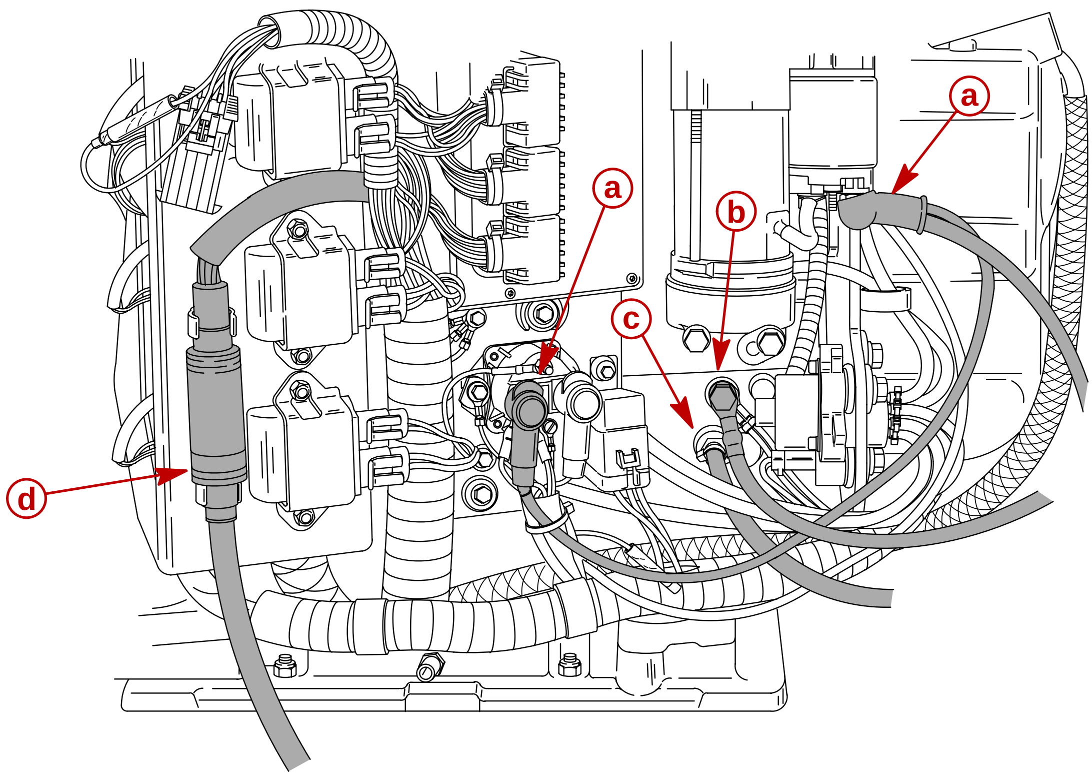
General Information

Powerhead “Disassembly” and “Reassembly” instructions are printed in a sequence that should be followed to assure best results when removing or replacing powerhead components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. (Refer to “Table of Contents,” preceding.) Usually, complete disassembly of powerhead will be required.

If major powerhead repairs are to be performed, remove powerhead from the pump unit.

Powerhead Removal from Pump Unit

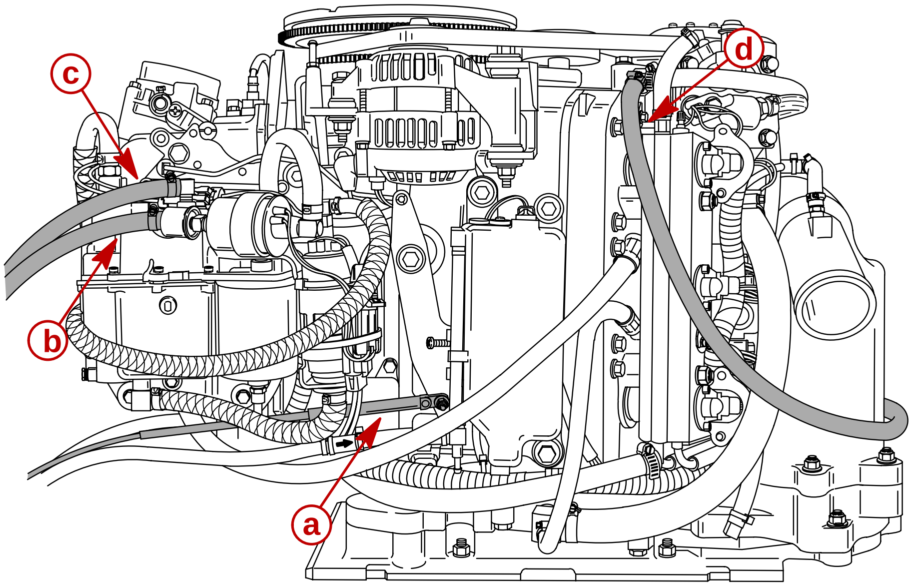
1. Disconnect battery cables from battery terminals. Remove positive battery cable from starter solenoid. Remove negative battery cable from lower front starter mounting bolt.
2. Disconnect remote oil tank hose.
3. Disconnect remote control harness from powerhead harness connector.



58733

a - Positive Battery Cable
b - Negative Battery Cable
c - Remote Oil Tank Hose
d - Remote Control Harness

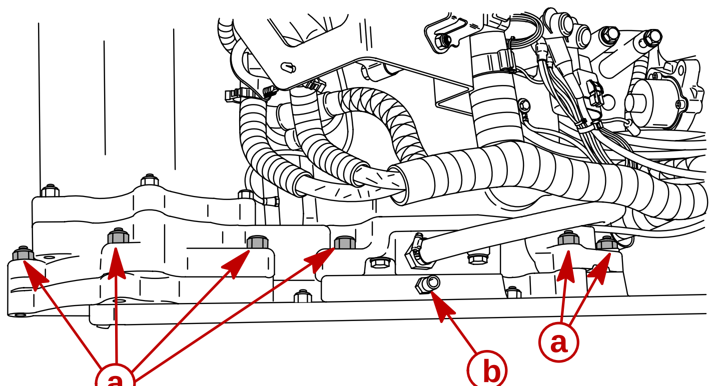
4. Remove throttle cable.
5. Remove fuel inlet line.
6. Disconnect water by-pass hose.
7. Disconnect vapor separator vent hose between vapor separator and boat hull.



58740

a - Throttle Cable
b - Fuel Inlet
c - Vent Hose
d - Water By-Pass

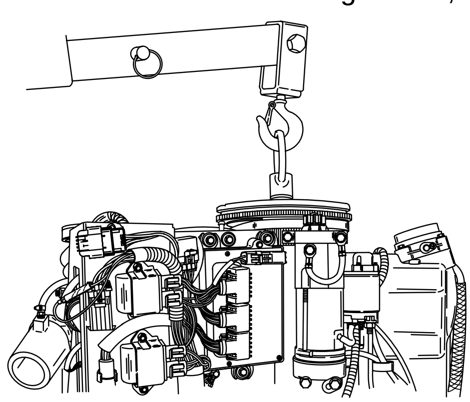
8. Remove 11 nuts (5 nuts on opposite side) securing powerhead to housing cover.



58742

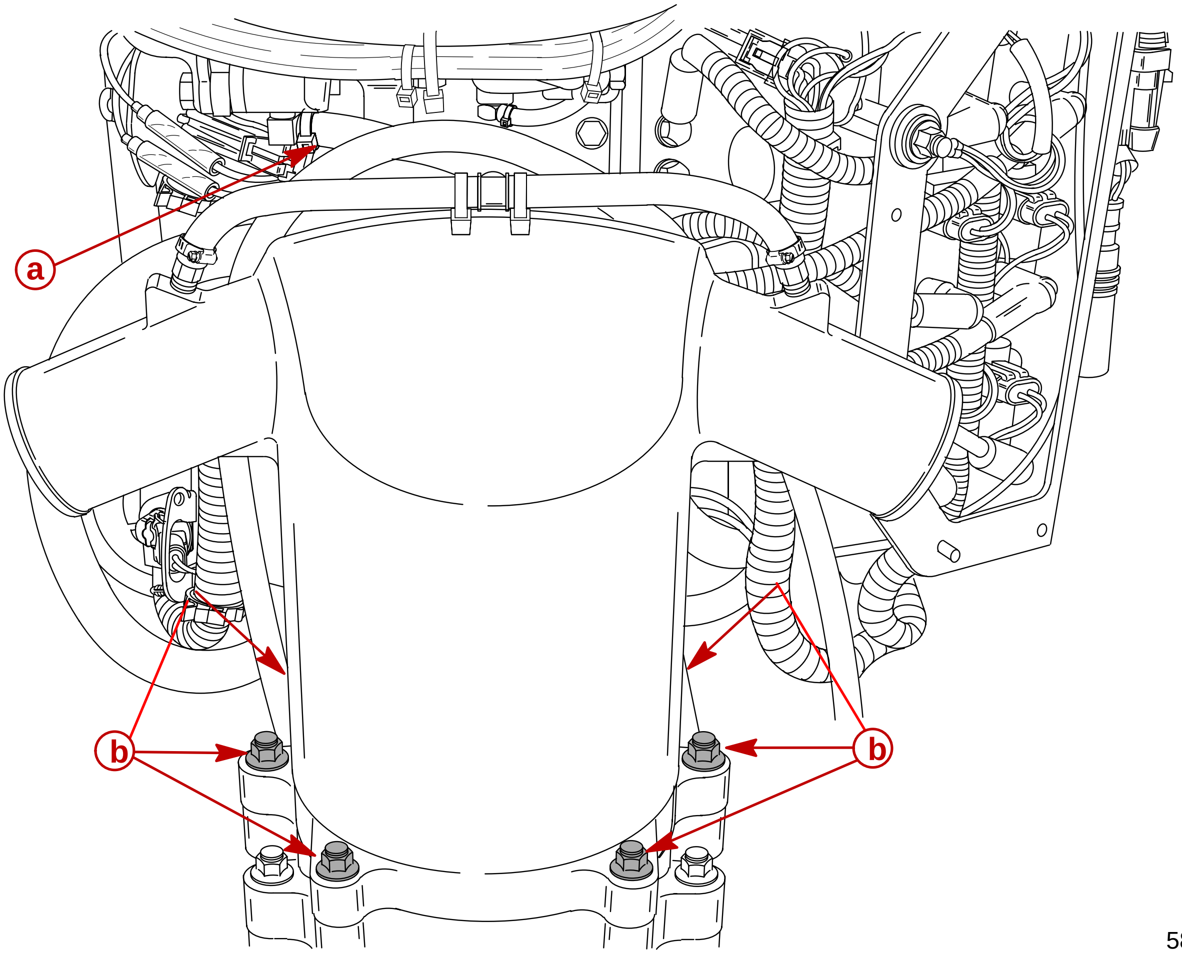
a - M10 x 1.5 Nuts
b - Flush Hose Attachment

9. Remove plastic cap from center of flywheel and install LIFTING EYE (91-90455) into flywheel at least five full turns. Using a hoist, lift powerhead assembly from pump unit.



58757

10. Remove exhaust outlet coolant hose from air compressor.
11. Remove 6 nuts securing expansion chamber and remove expansion chamber.



a - Coolant Hose
b - Nuts (6)

Removing Engine Components

NOTE: *Engine components can be removed individually or in some cases as an assembly.*

Removing Engine Components Individually

Section 2 Starter Motor
Starter Motor
*Electronic Control Module
*Ignition Coil
*Starter Solenoid
Alternator
Flywheel

Section 3
Direct Fuel Injection
Fuel Pump
On-Board Oil Tank
Oil Pump

***All ignition and electrical components should remain attached to electrical plate. Plate with components can be removed as an assembly.**

Removing Engine Components as an Assembly

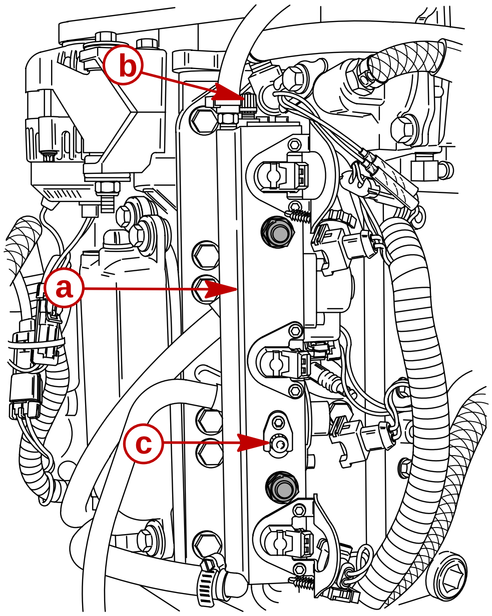
VAPOR SEPARATOR TANK (VST) REMOVAL

⚠ CAUTION

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

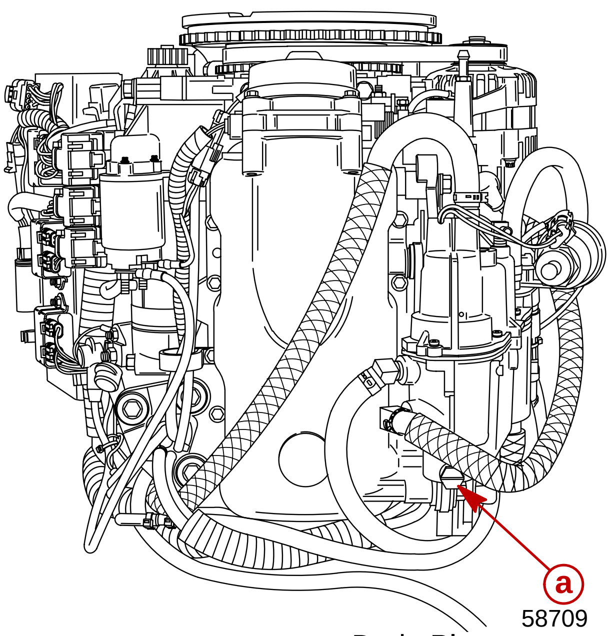
NOTE: *Use Fuel/Air Pressure Gauge 91-16850--1 or 91-852087A1/A2/A3 to de-pressurize air hose first and then fuel hose.*

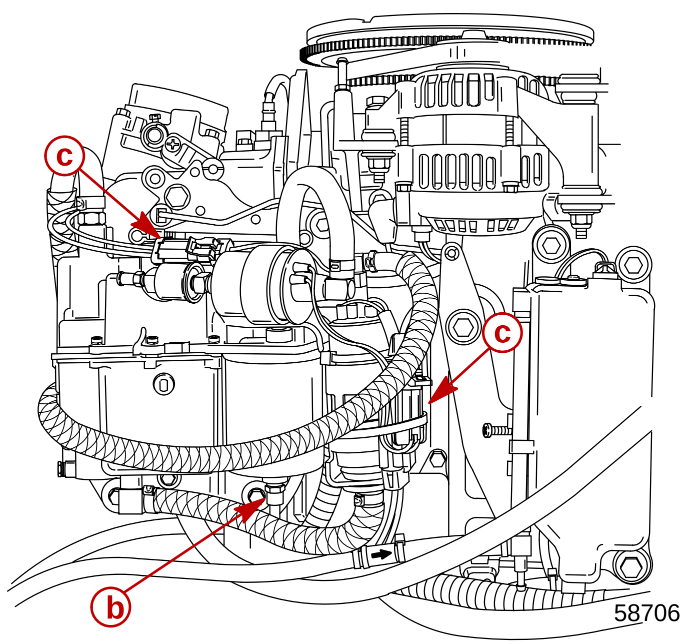
1. De-pressurize fuel system.



a - Port Fuel Rail
b - Fuel Pressure Port
c - Air Pressure Port

2. Place suitable container underneath vapor separator drain plug and remove plug.
3. Disconnect water separator sensor lead.
4. Disconnect electric fuel pump harness connectors.

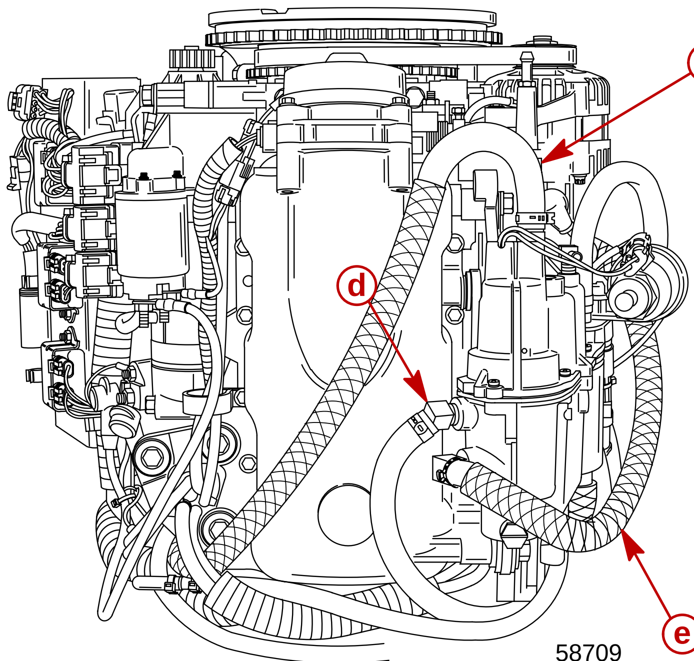


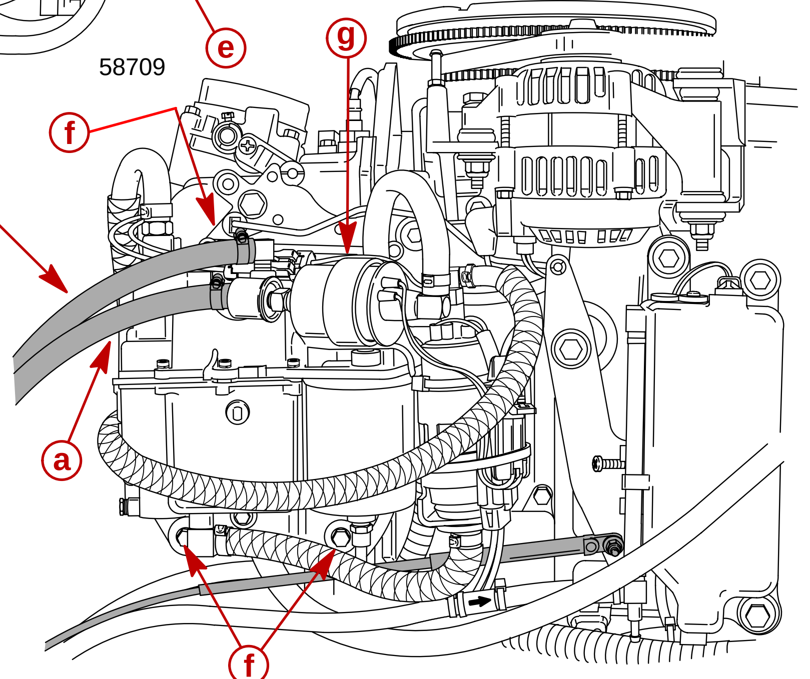


a - Drain Plug
b - Sensor Lead
c - Harness Connectors

NOTE: *Upper fuel hose is excess fuel return from fuel rails; lower fuel hose is fuel inlet from electric circulating pump beside fuel/water separator.*

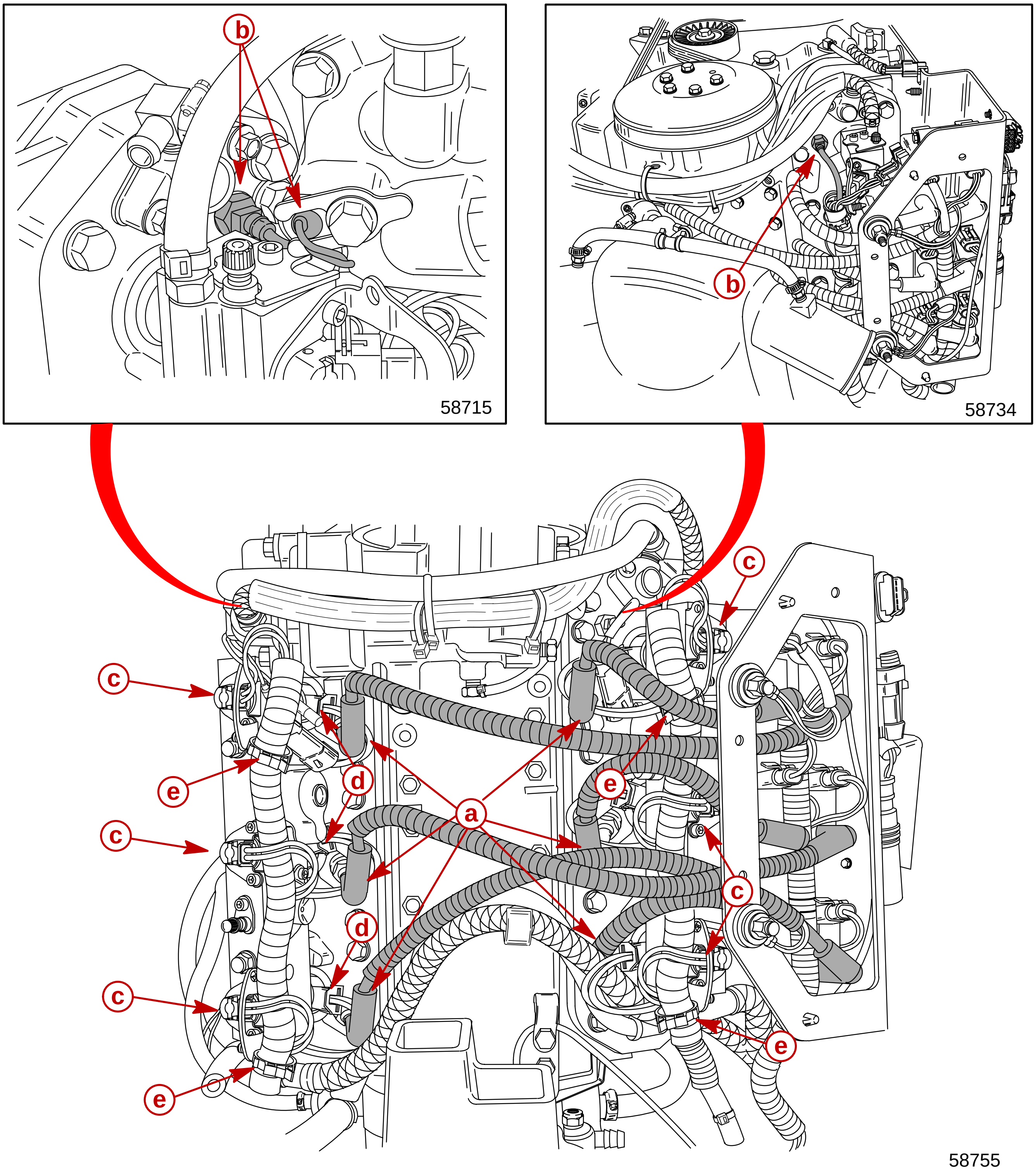
5. Remove the fuel inlet hose from the fuel lift pump.
6. Remove vapor separator vent hose.
7. Remove the fuel outlet hose and fuel return hose from fuel rails.
8. Remove vapor separator ground lead.
9. Remove 3 mounting bolts and remove separator.



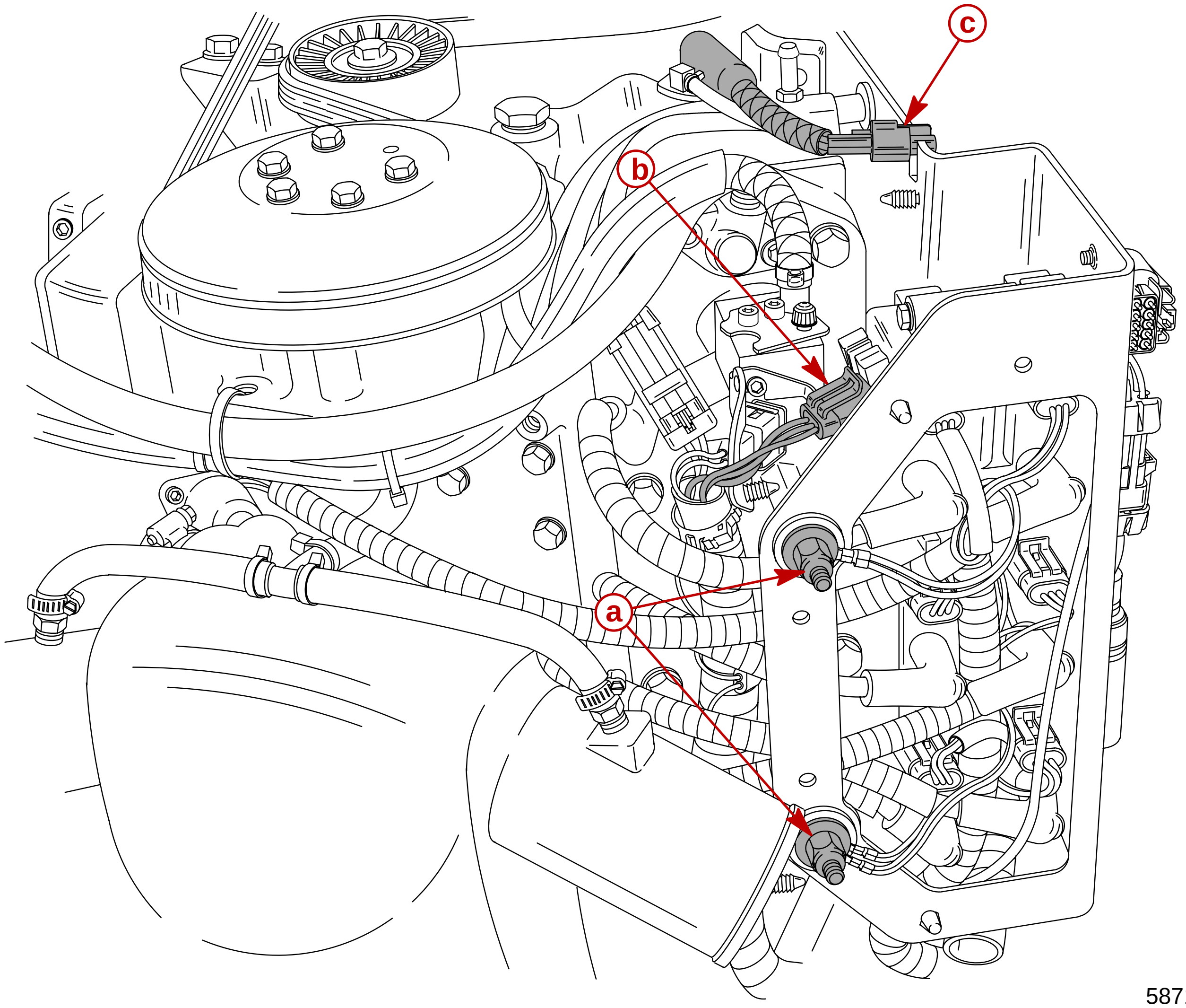


a - Fuel Inlet Hose to Fuel Lift Pump
b - Vapor Separator Vent Hose
c - Fuel Outlet Hose
d - Fuel Return Hose
e - Fuel Inlet Hose
f - Mounting Bolts (3)
g - Ground Lead

ELECTRICAL PLATE AND HARNESS REMOVAL

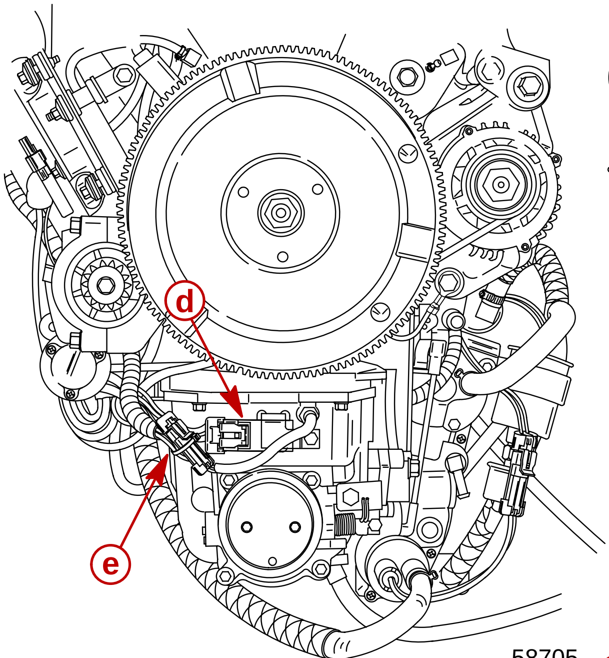


a - Remove Spark Plug Boots (6) from Spark Plugs
b - Disconnect Temperature Sensor Connectors
c - Disconnect Fuel Injector Connectors
d - Disconnect Direct Injector Connectors – Injectors are hidden from view on Starboard Fuel Rail
e - Disconnect Wiring Harness Retainers



58711

a - Remove 2 Nuts Securing Aft Portion of Electrical Plate
b - Disconnect Water Pressure Sensor Harness and Sensor Retainer
c - Disconnect Crank Position Sensor Connector



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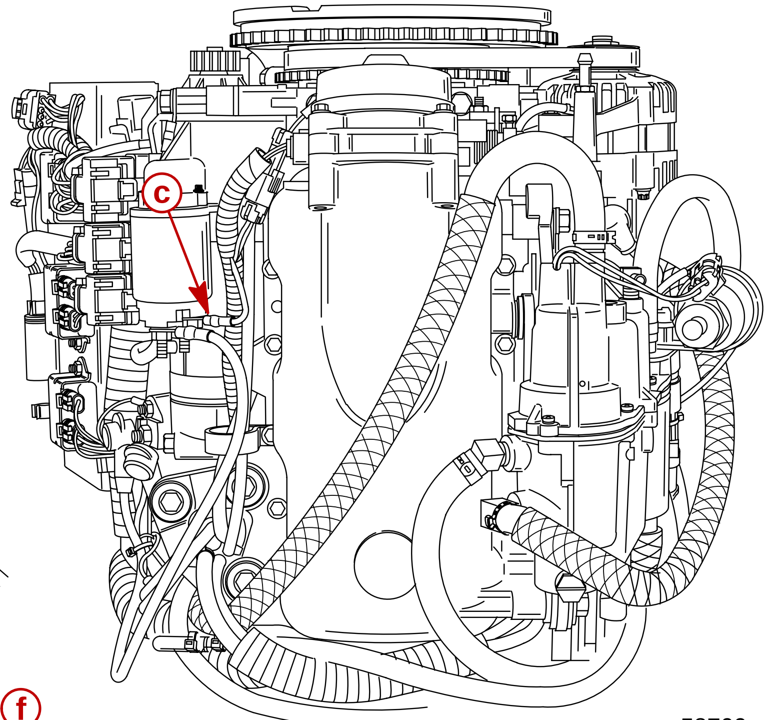
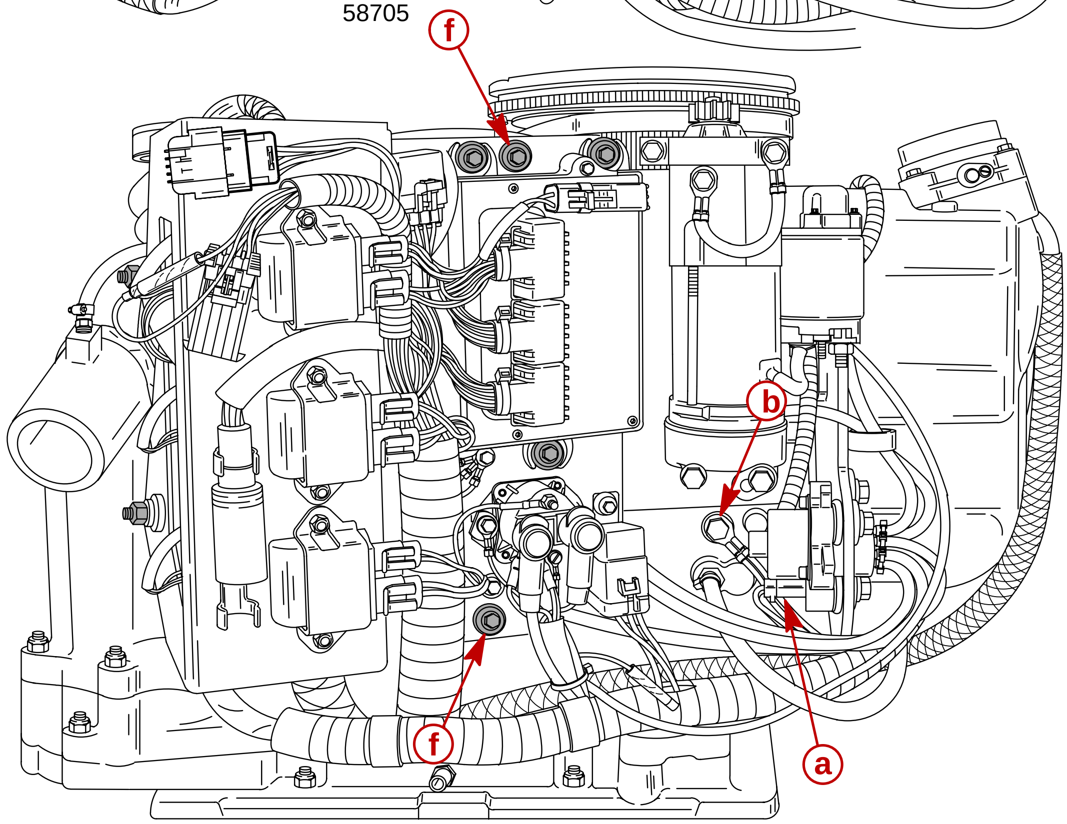
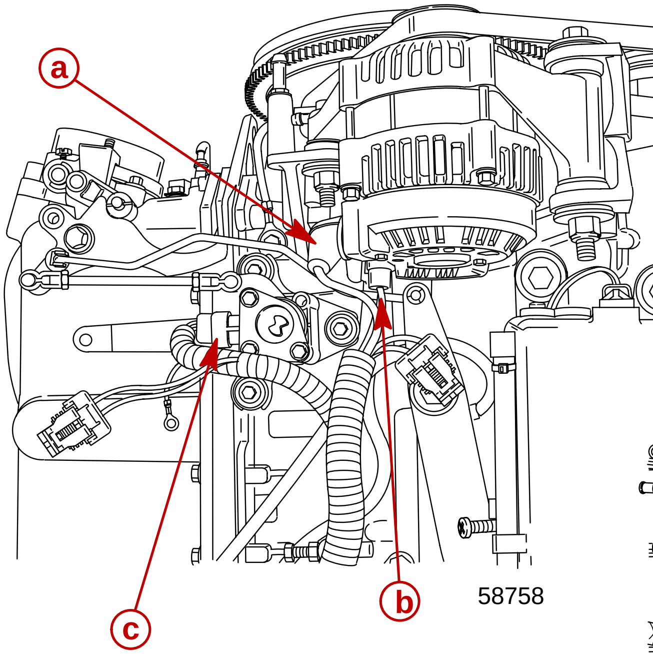


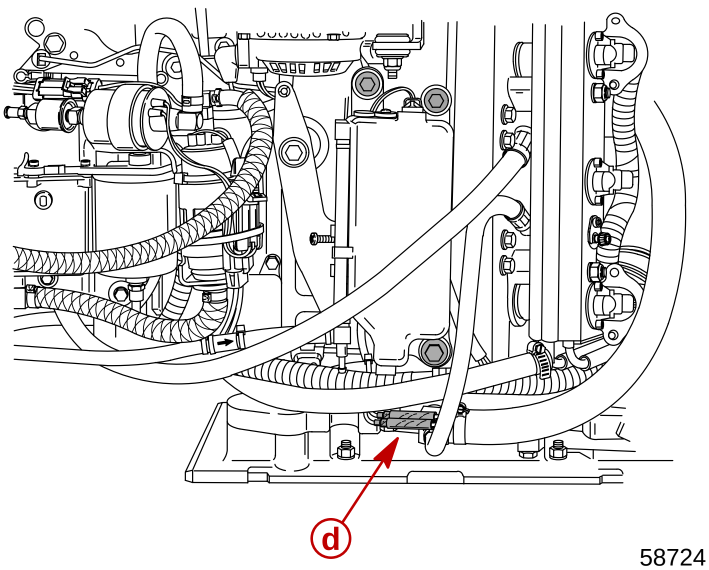
58709



58718

a - Disconnect Oil Pump Connector
b - Disconnect Harness Ground Lead below Starter Motor
c - Disconnect RED and RED/YELLOW leads from Starter Solenoid
d - Disconnect MAP Sensor Connector
e - Disconnect Air Temperature Sensor Connector
f - Remove Nut and Screw Securing Electrical Plate



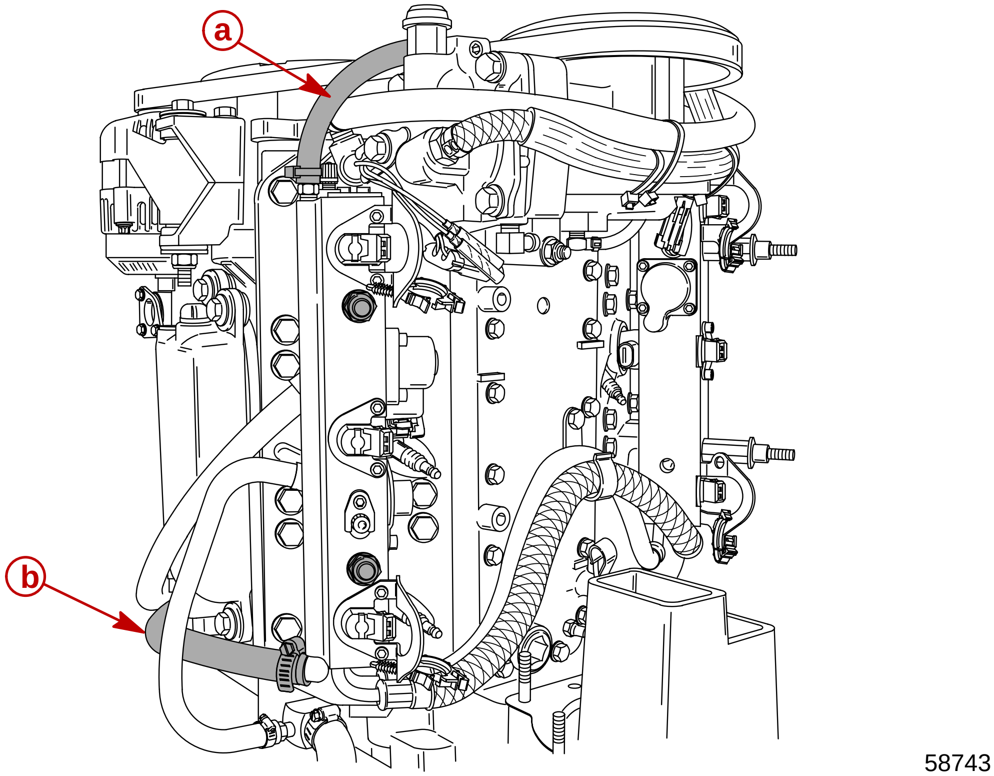


a - Remove Output lead from Alternator
b - Remove Sense lead from Alternator
c - Disconnect TPS Harness Connection
d - Disconnect Low Oil Sensor Bullet Connectors

10. Remove electrical harness assembly from engine.

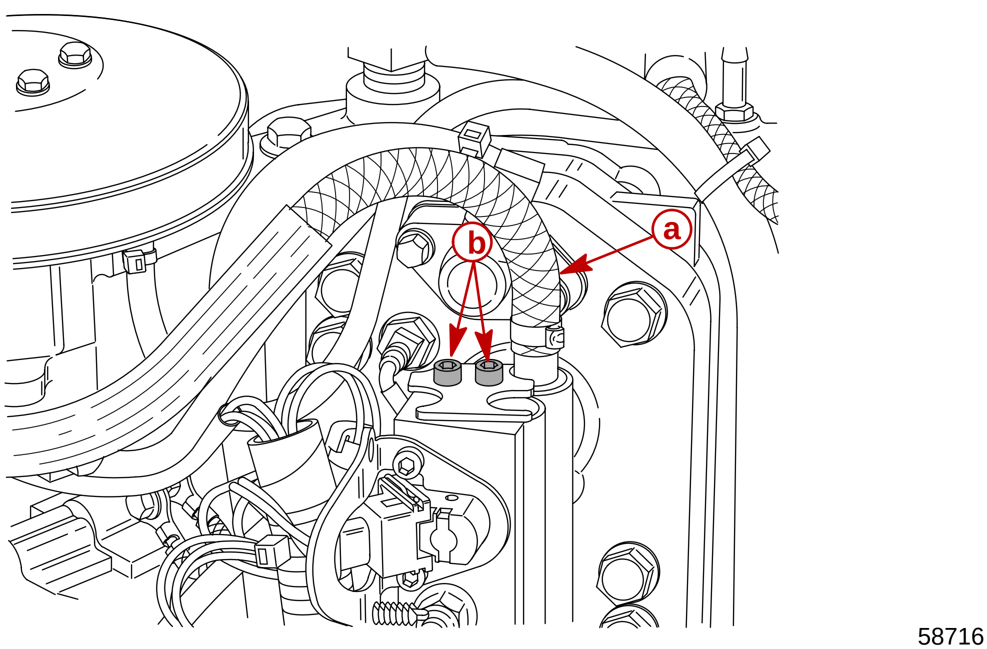
FUEL RAIL REMOVAL

1. Remove coolant hose between PORT fuel rail and air compressor.
2. Remove incoming coolant hose from PORT fuel rail.



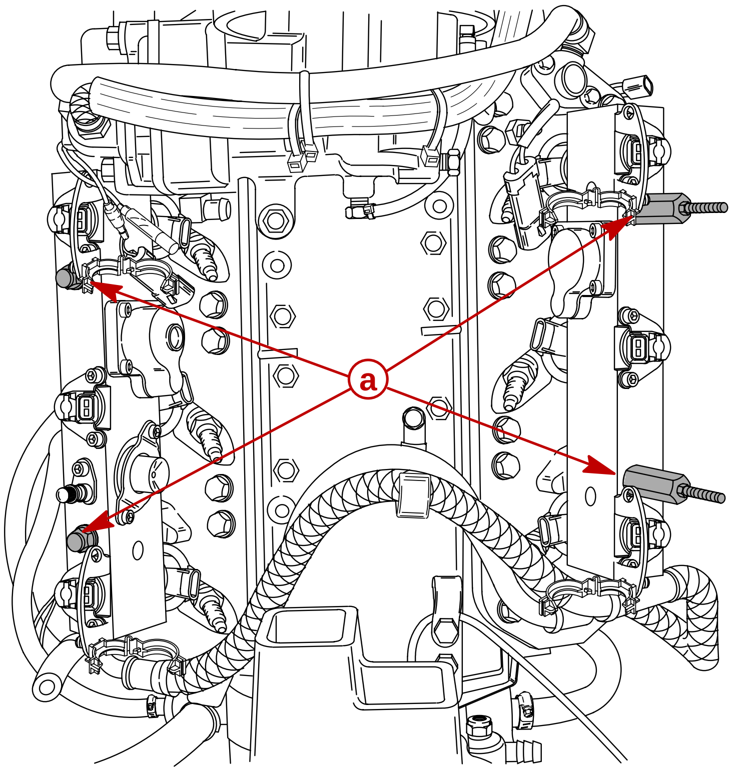
a - Coolant Hose (Air Compressor)
b - Incoming Coolant Hose

3. Remove 2 screws securing compressor air hose and remove hose from STARBOARD fuel rail.



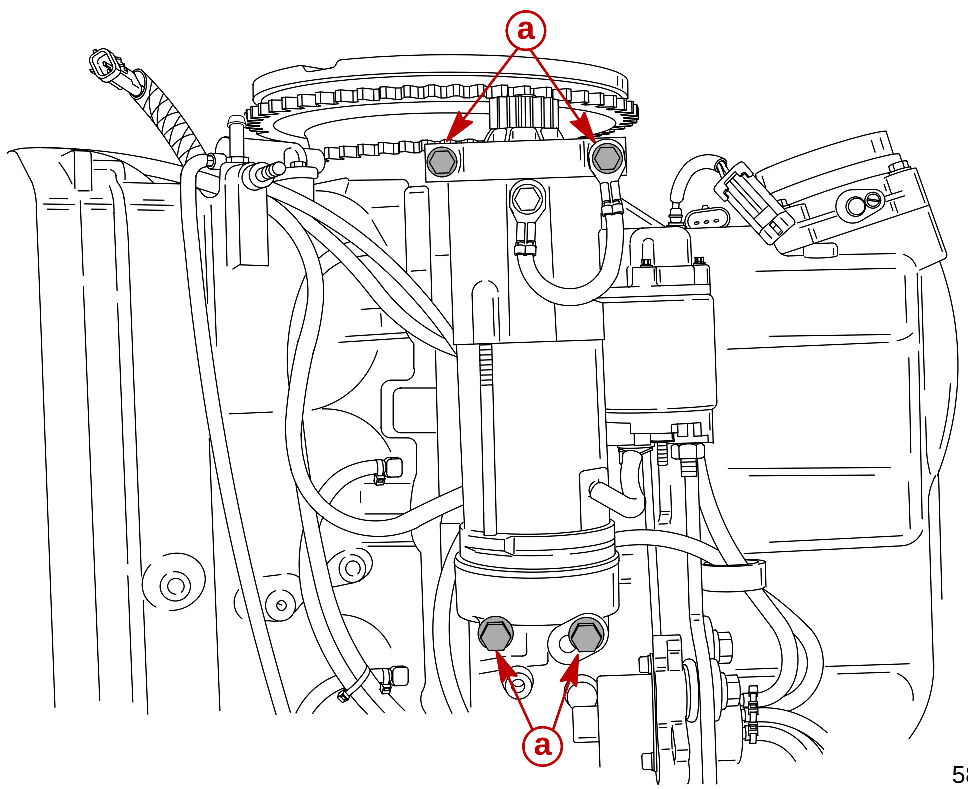
a - Air Hose
b - Screws

4. Remove 2 nuts securing each fuel rail and remove both fuel rails as an assembly.



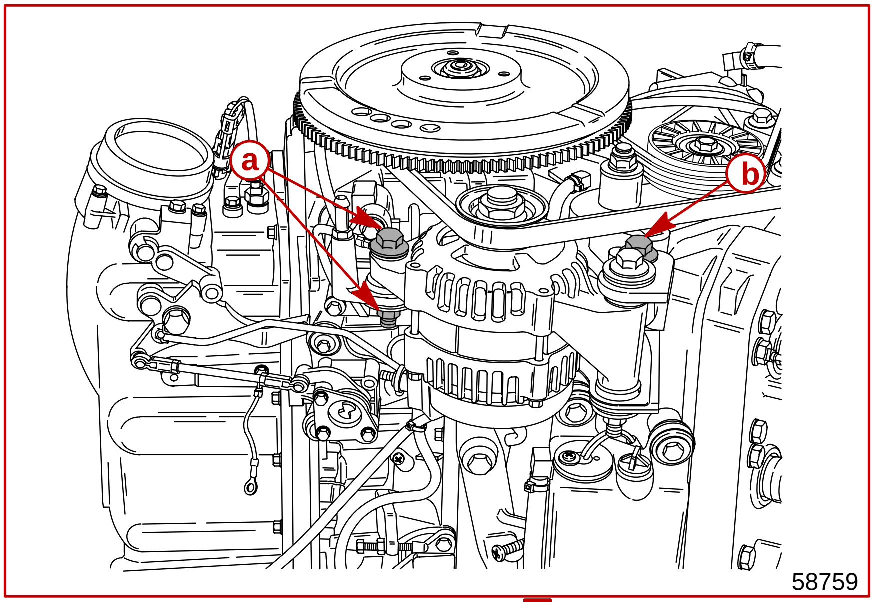
a - Nuts

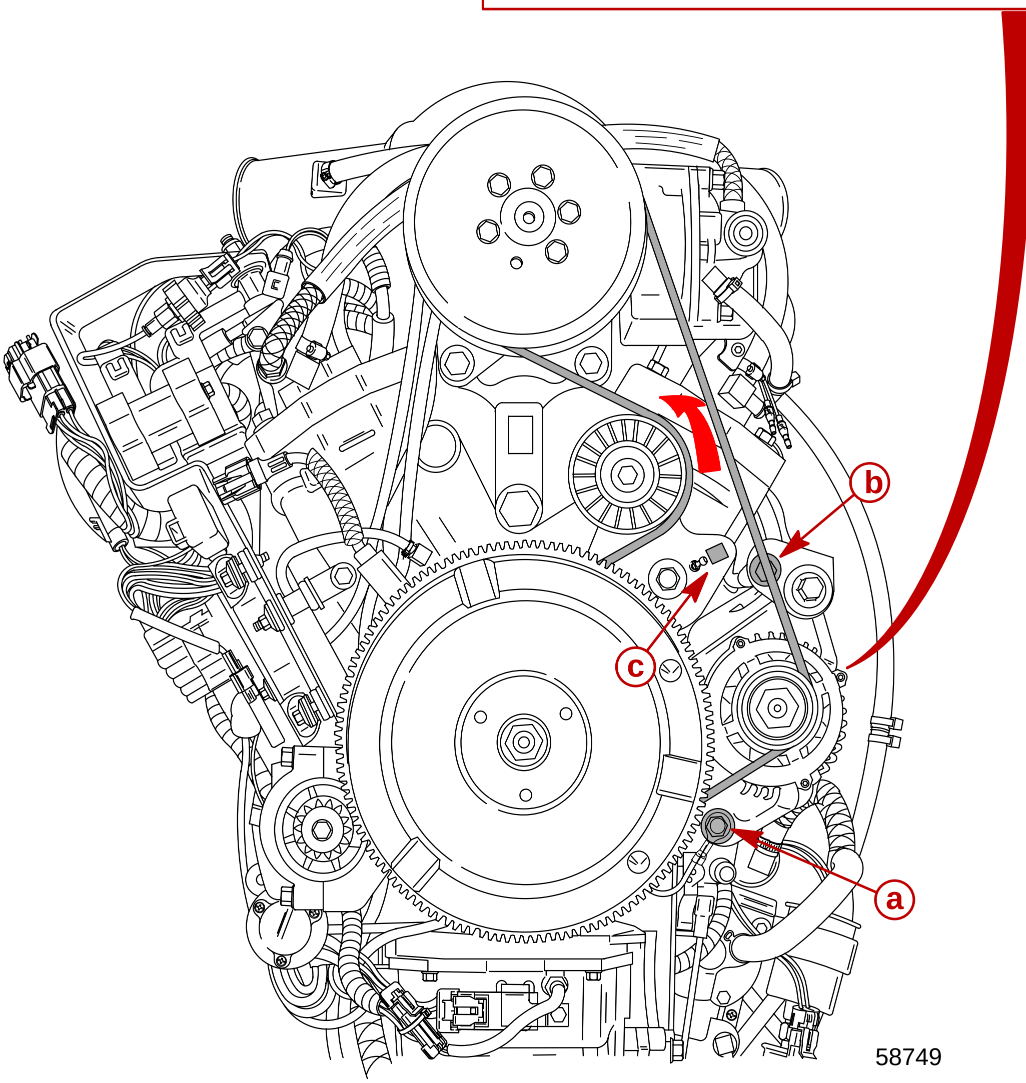
STARTER MOTOR REMOVAL



a - Remove 4 Bolts Securing Starter Motor

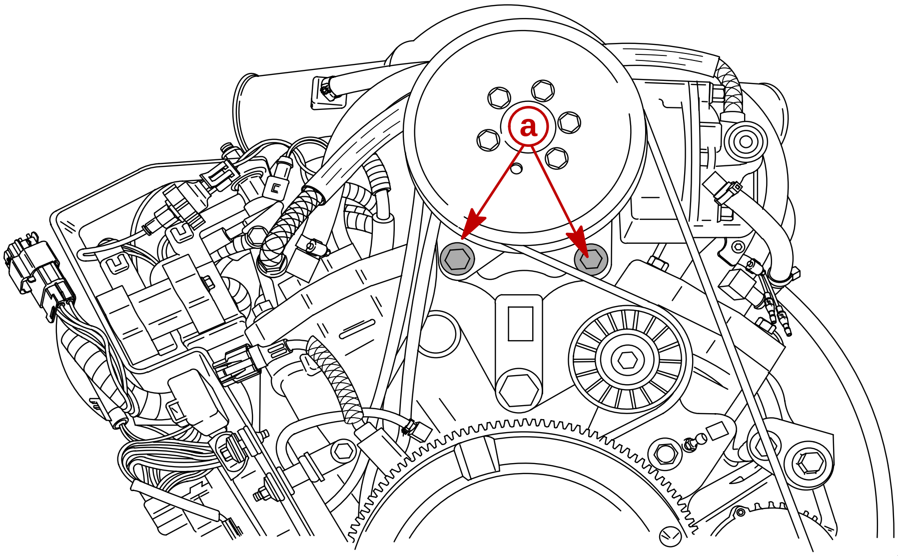
ALTERNATOR REMOVAL





a - Remove Bolt and Nut
b - Remove Bolt
c - Rotate Belt Tensioner

AIR COMPRESSOR REMOVAL



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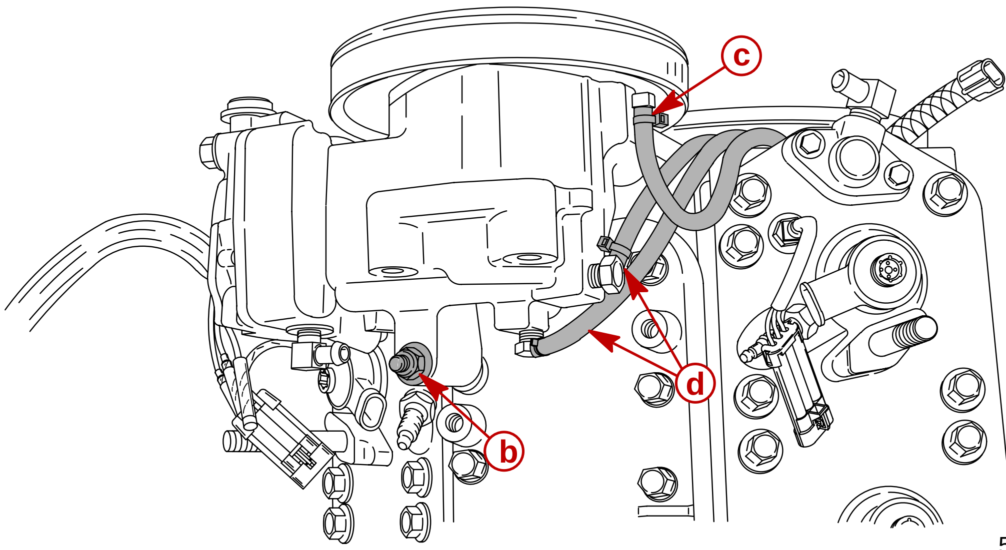
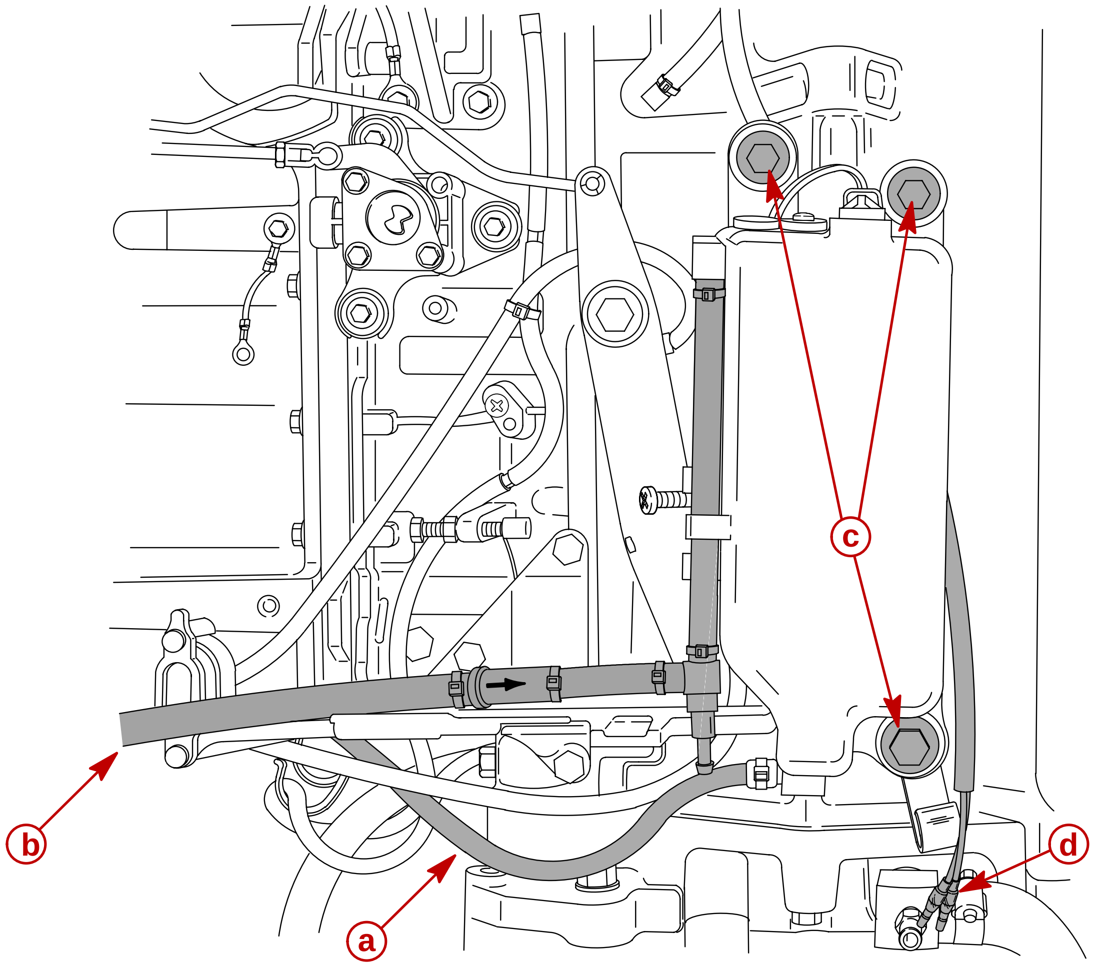


58752

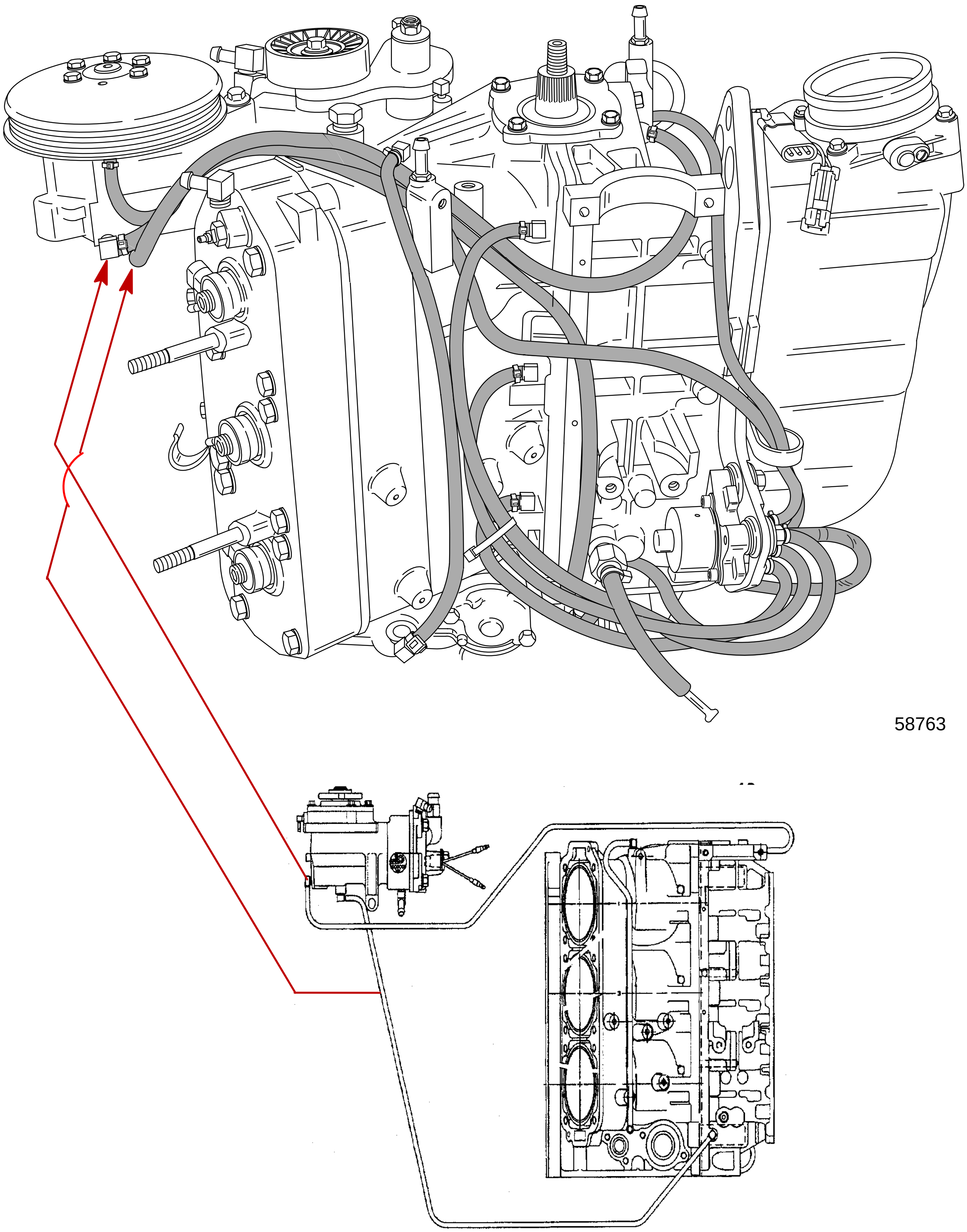
a - Remove 2 Bolts (top)
b - Remove Nut
c - Remove Oil Input Hose
d - Remove Oil Return Hoses

OIL RESERVOIR REMOVAL

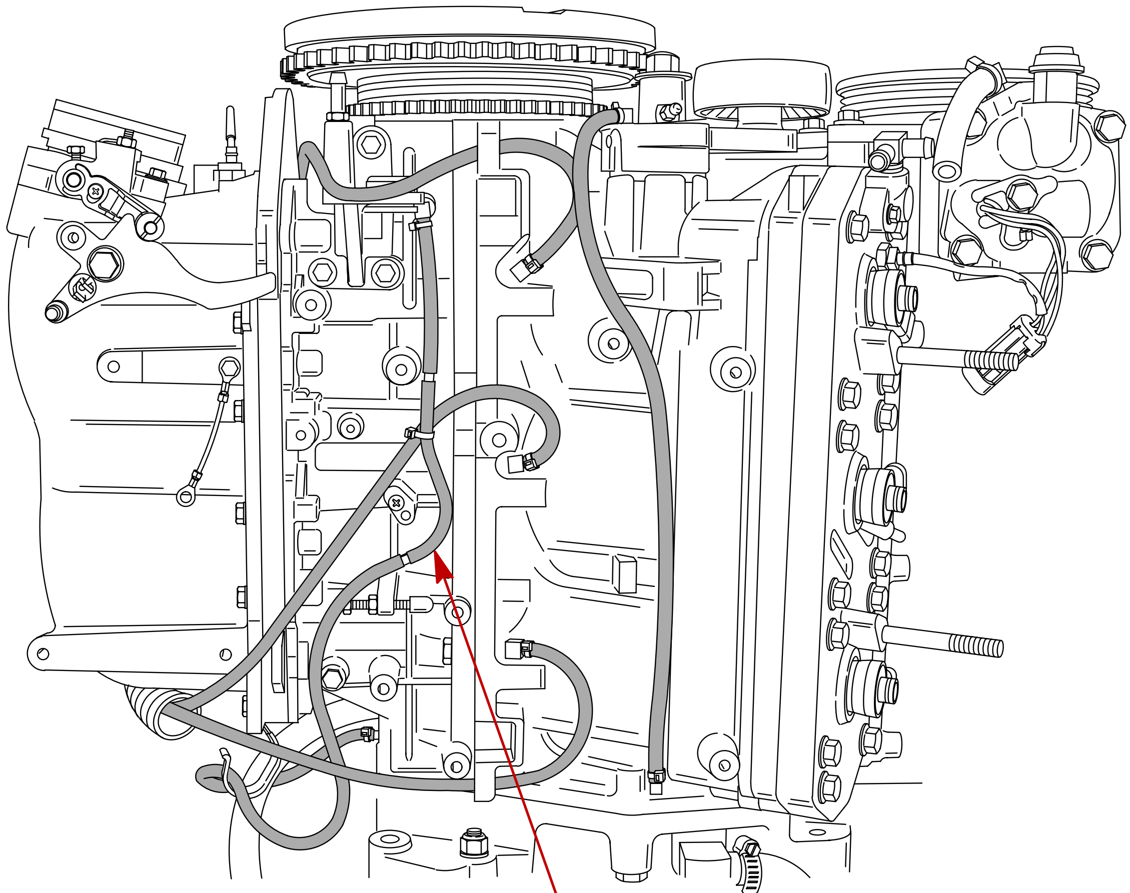


a - Plug Off Oil Hose to Oil Pump
b - Plug Off Incoming Oil Hose
c - Remove 3 Bolts Securing Reservoir
d - Disconnect Low Oil Sensor Bullet Connectors

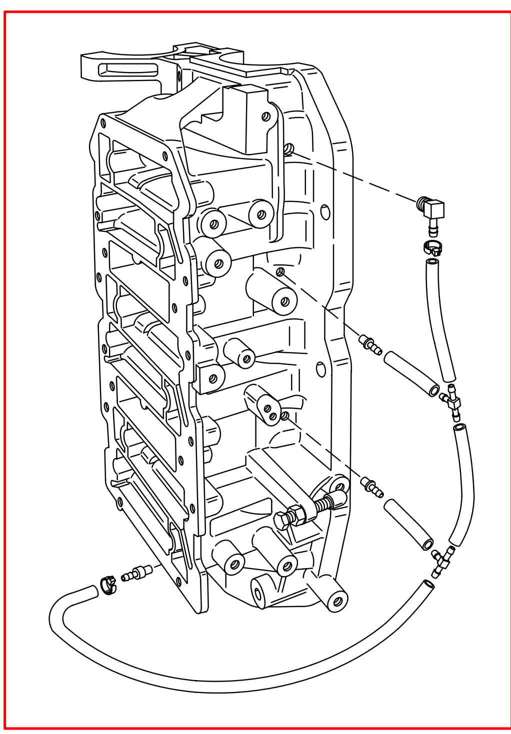
Starboard Side Oil Hose Routing



Port Side Oil Hose Routing

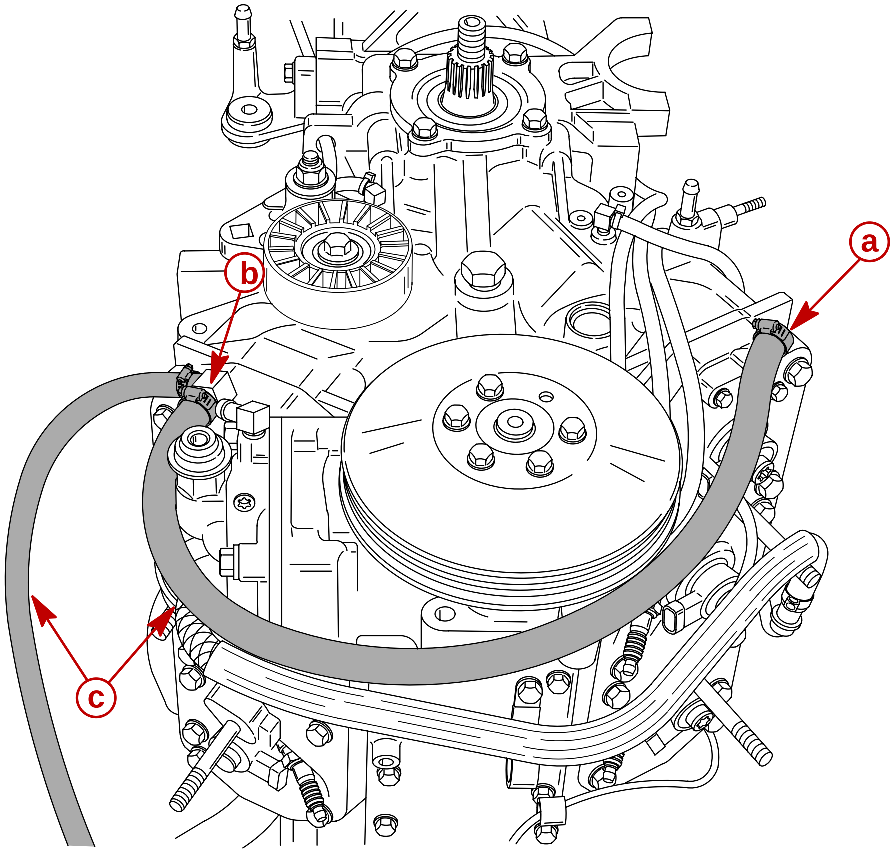


58766



58618

Water By-Pass Hose Routing

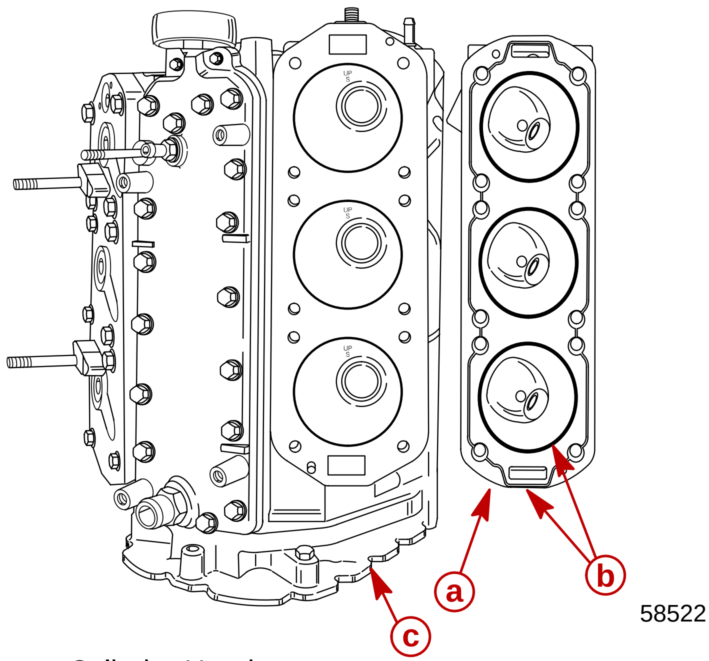


58762

a - Starboard Housing
b - Port Housing
c - Water by-Pass Hose to Thru Hull Fitting

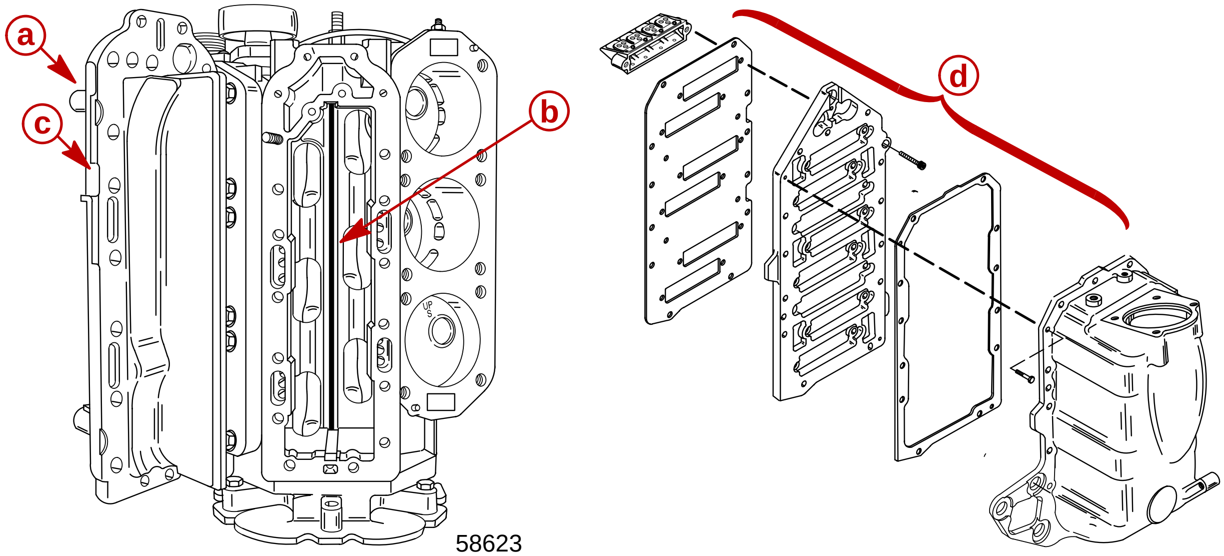
Powerhead Disassembly

1. Place powerhead in repair stand or on a bench.
2. Remove cylinder heads from engine block.



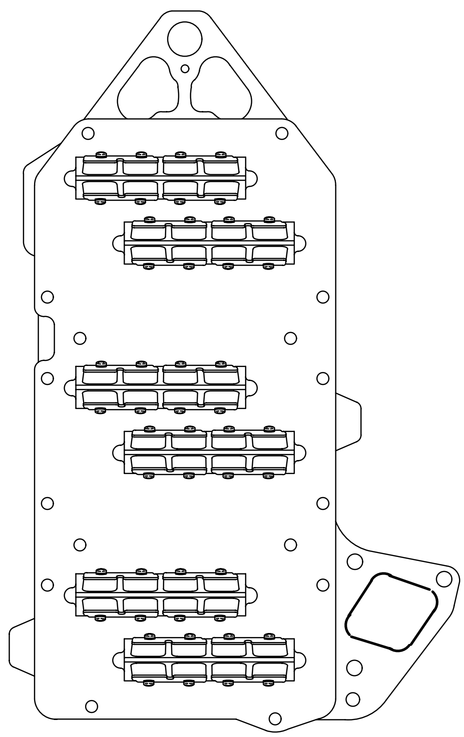
a - Cylinder Head
b - O-Rings
c - Engine Block

3. Remove exhaust manifold cover and seal.
4. Referring to Section 3B, remove air plenum/reed block/adaptor plate assembly from cylinder block.



a - Exhaust Manifold Cover
b - Seal
c - Gasket
d - Air Plenum/Reed Block/Adaptor Plate Assembly

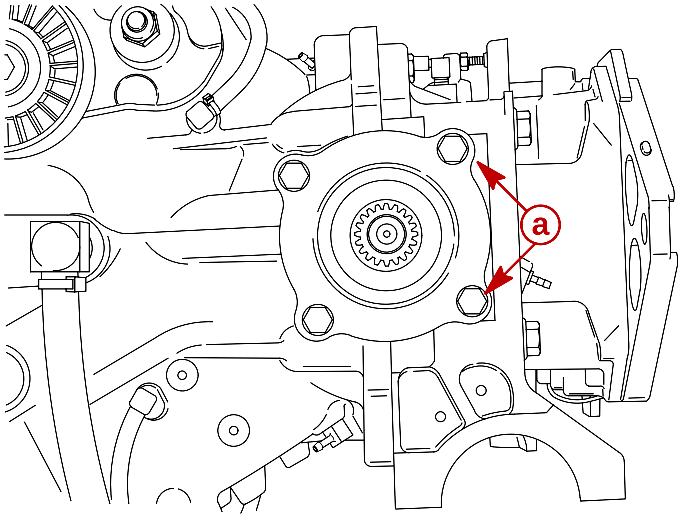
5. Inspect reeds as outlined in “Cleaning and Inspection”.



56169

6. Remove bolts from end caps.

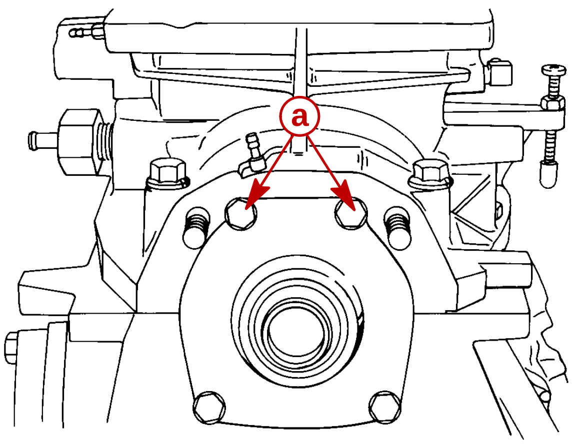
UPPER END CAP



58350

a - Crankcase Attaching End Cap Bolts

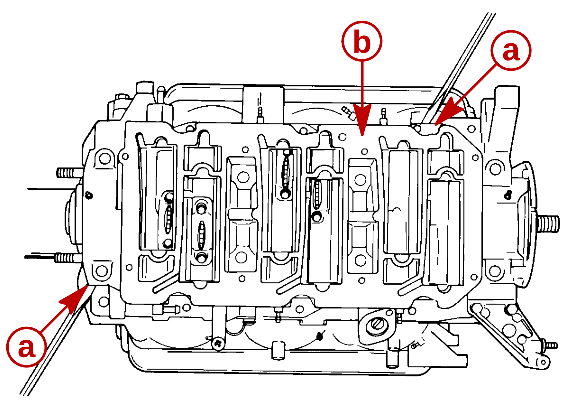
LOWER END CAP



51849

a - Crankcase Attaching End Cap Bolts

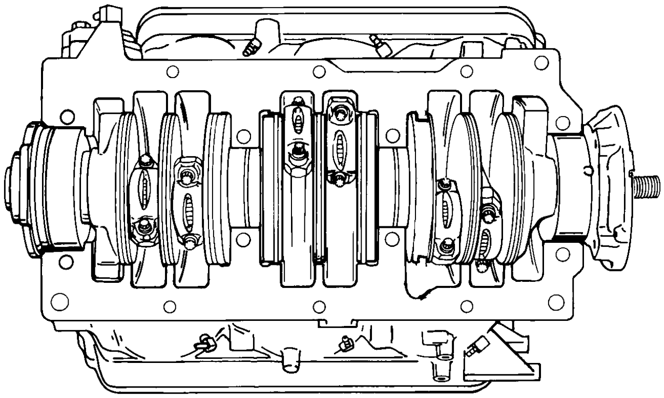
7. Remove bolts which secure crankcase cover to cylinder block.
8. Pry crankcase cover off cylinder block using pry bars in locations shown.



51845

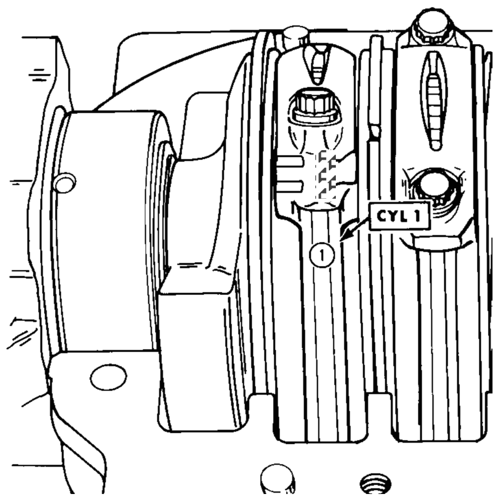
a - Pry Points
b - Crankcase Cover

CRANKCASE COVER REMOVED



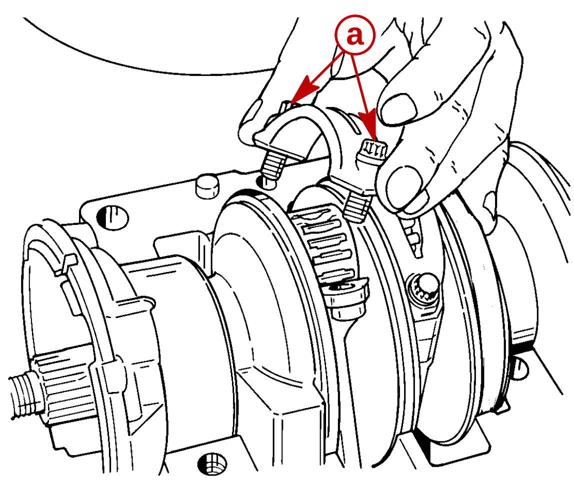
51848

1. Use Powerhead Stand (91-30591A1) for rotating crankshaft to desired position for removal of connecting rods.
2. Using an awl or electric pencil, scribe the cylinder identification number on each connecting rod as shown. Reassemble connecting rods in same cylinder.



51849

3. Use a 5/16 in. 12 point socket to remove connecting rod bolts, then remove rod cap, roller bearings and bearing cage from connecting rod.



51850

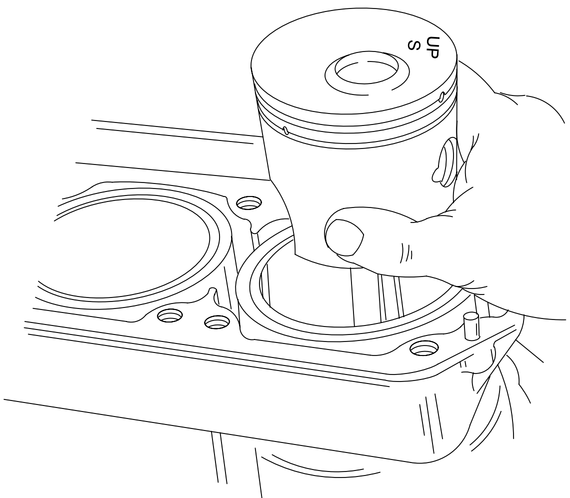
a - Connecting Rod Bolts

4. Push piston out of cylinder block.
5. After removal, reassemble each piston and connecting rod assembly.

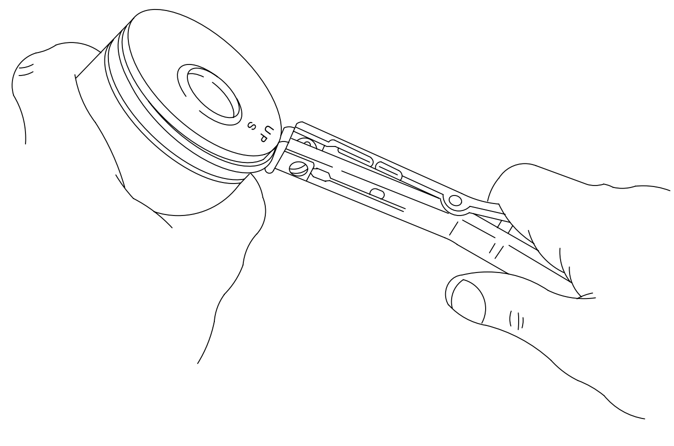
CAUTION

Each connecting rod and end cap are a matched machined set and must never be mismatched.

6. Inspect pistons as outlined in “Cleaning and Inspection,” following.
7. Use Piston Ring Expander (91-24697) to remove piston rings. Always install new piston rings.

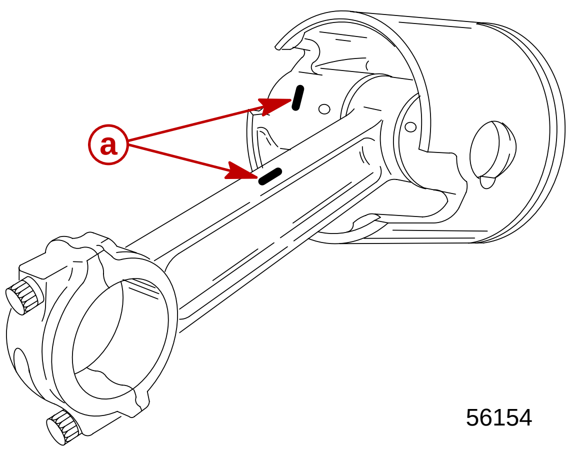


56153

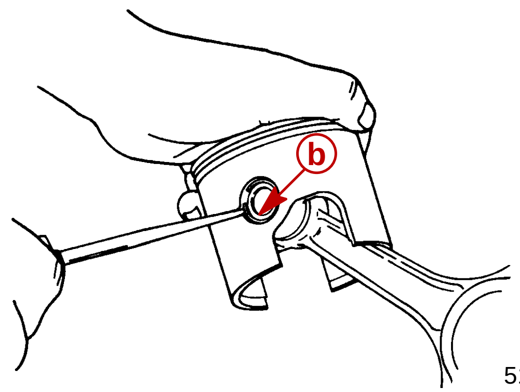


56155

8. Using an awl, scribe identification number of connecting rod on inside of piston. Reassemble piston on same connecting rod.
9. Using tool (91-52952A1), remove piston pin lockrings from both ends of piston pin. Never re-use piston pin lockrings.



56154



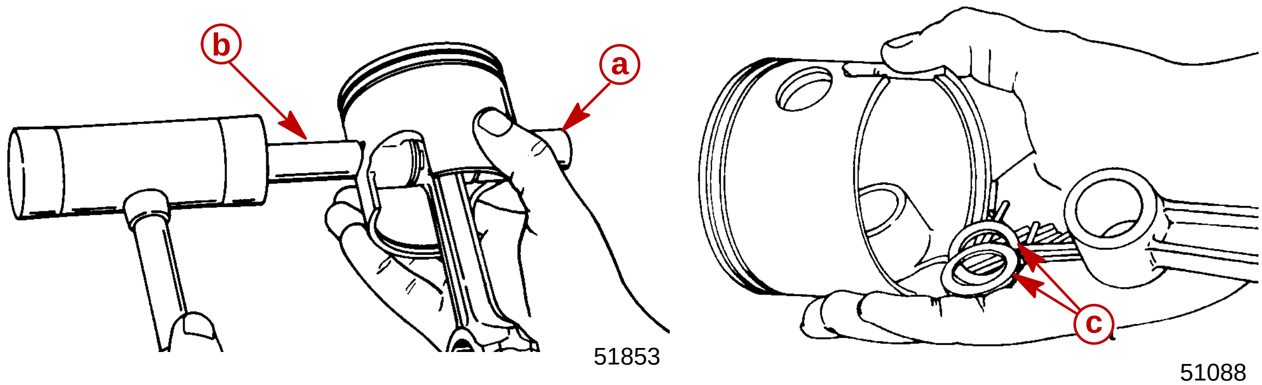
51083

a - Scribe Identification Number
b - Lockring

IMPORTANT: Warming the piston dome using a torch lamp will ease removal and installation of piston pin.

10. Support piston and tap out piston pin using service tool (91-92973A1) as shown.
11. Remove piston pin needle bearings (35 per piston) and locating washers (2 per piston) as shown.

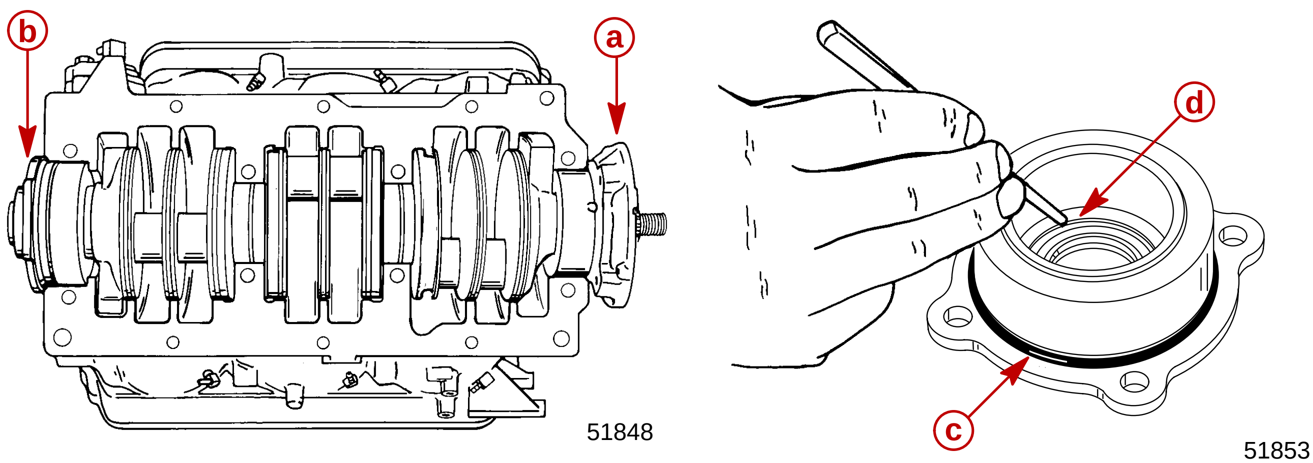
IMPORTANT: We recommend that you use new needle bearings at reassembly for lasting repair. However, if needle bearings must be re-used, keep each set of bearings identified for reassembly on same connecting rod.



a - Piston Pin
b - Piston Pin Tool
c - Needle Bearing Locating Washers

12. Remove upper end cap and lower end cap from crankshaft.
13. Remove and discard O-ring seals from each end cap.
14. Remove oil seal(s) from end of each end cap by driving seal out with a punch and hammer.
15. Inspect roller bearing in upper end cap as outlined in "Cleaning and Inspection".

NOTE: *If roller bearing is damaged, replace upper end cap and roller bearings as an assembly.*



a - Upper End Cap
b - Lower End Cap

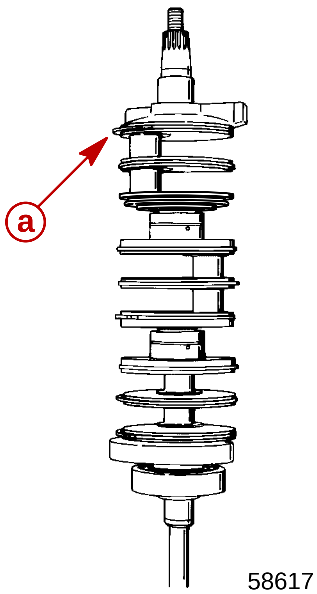
c - O-Ring
d - Seal

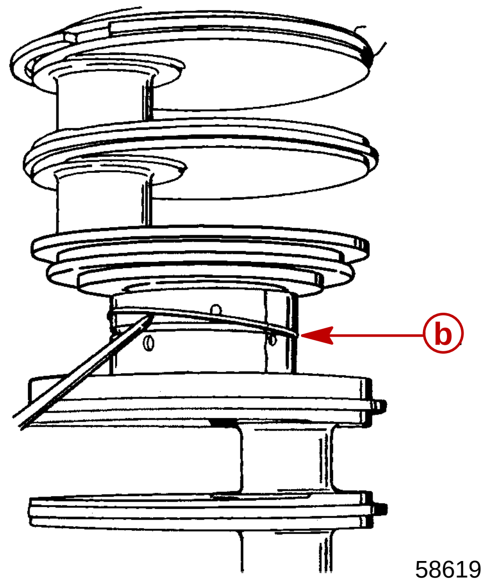
16. Remove crankshaft and place in powerhead stand as shown.

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.

17. Remove retaining ring as shown.

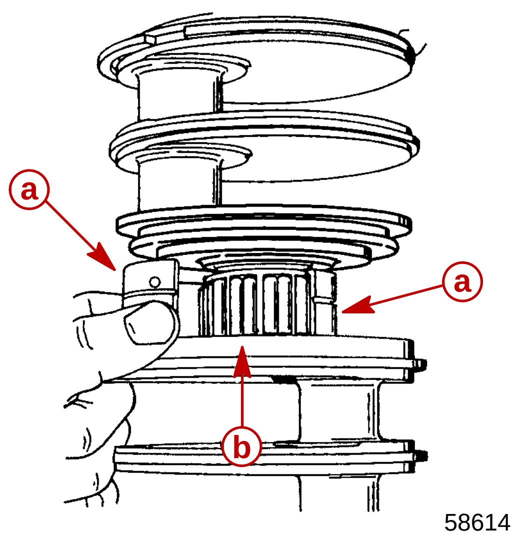




a - Sealing Rings
b - Retaining Ring

18. Remove bearing race halves and roller bearings from crankshaft.

IMPORTANT: Keep same bearing races and roller bearings together.



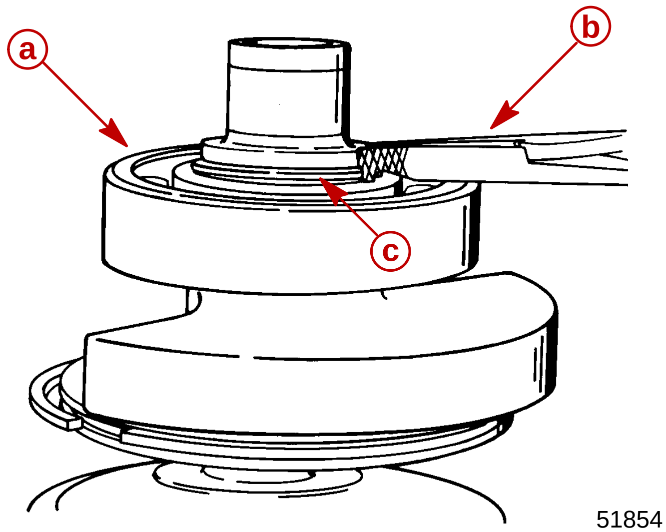
a - Bearing Race Halves
b - Roller Bearings

Inspect crankshaft ball bearing as outlined in “Cleaning and Inspection,” following.

IMPORTANT: DO NOT remove crankshaft ball bearing, unless replacement is required.

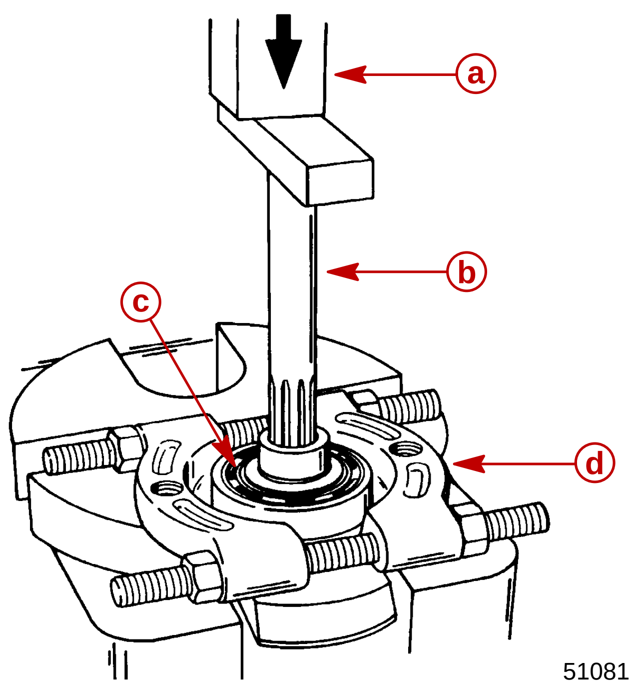
19. Remove lower ball bearing from crankshaft as follows:

   a. Remove retaining ring using a pair of snap ring pliers.



a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring

b. Press crankshaft out of lower ball bearing as shown.

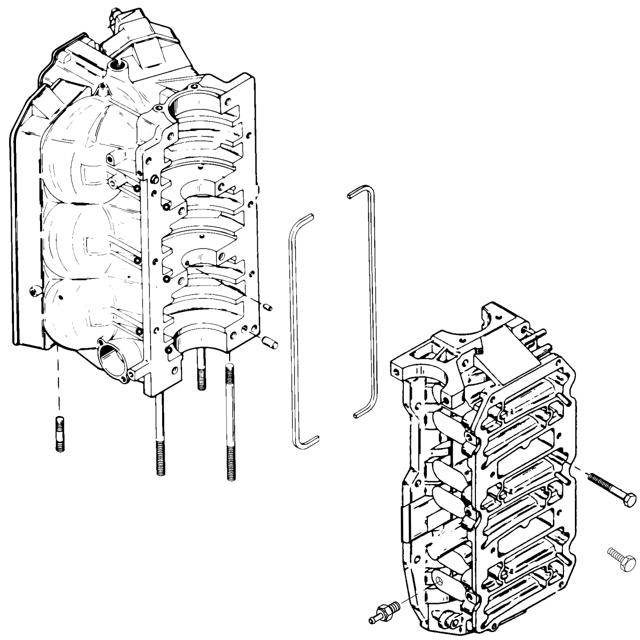


a - Press
b - Powerhead Stand (91-30591A1)
c - Crankshaft Ball Bearing
d - Universal Puller Plate (91-37241)

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

If crankcase cover or cylinder block is to be submerged in a very strong cleaning solution, it will be necessary to remove the oil system to prevent damage to hoses and check valves.

1. Thoroughly clean cylinder block and crankcase cover. Be sure that all sealant and old gaskets are removed from matching surfaces. Be sure that carbon deposits are removed from exhaust ports.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Check gasket surfaces for nicks, deep grooves, cracks and distortion that could cause compression leakages.
4. Check all water and oil passages in cylinder block and crankcase cover to be sure that they are not obstructed and that plugs are in place and tight.

Special Service Information

Grooves in Cylinder Block Caused By Crankshaft Sealing Rings

Grooves in cylinder block caused by crankshaft sealing rings are not a problem, except if installing a new crankshaft and the new sealing rings on crankshaft do not line up with existing grooves in cylinder block. If installing a new crankshaft, refer to crankshaft installation, Powerhead Reassembly section to determine if powerhead can be used.

Cylinder Bores

1. Inspect cylinder bores for scoring, scuffing or a transfer of aluminum from piston to cylinder wall. Scoring or scuffing, if NOT TOO SEVERE, can normally be removed by honing. If a transfer of aluminum has occurred, an acidic solution such as “TIDY BOWL CLEANER” should be applied to the areas of the cylinder bore where transfer of aluminum has occurred. After the acidic solution has removed the transferred aluminum, thoroughly flush the cylinder bore(s) to remove any remaining acid. Cylinder walls may now be honed to remove any glaze and to aid in the seating of new piston rings.

HONING PROCEDURE

a. When cylinders are to be honed, follow the hone manufacturer’s recommendations for use of the hone and cleaning and lubrication during honing.

b. For best results, a continuous flow of honing oil should be pumped into the work area. If pumping oil is not practical, use an oil can. Apply oil generously and frequently on both stones and work area.

CAUTION

When honing cylinder block, remove hone frequently and check condition of cylinder walls. DO NOT hone any more than absolutely necessary, as hone can remove cylinder wall material rapidly.

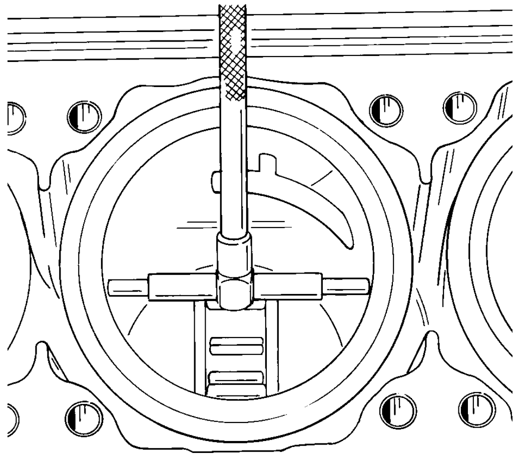
c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.

d. Localize stroking in the smallest diameter until drill speed is constant throughout length of bore. Expand stones, as necessary, to compensate for stock removal and stone wear. Stroke at a rate of 30 complete cycles per minute to produce best cross-hatch pattern. Use honing oil generously.

e. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. A good cleaning is essential. If any of the abrasive material is allowed to remain in the cylinder bore, it will cause rapid wear of new piston rings and cylinder bore in addition to bearings. After cleaning, bores should be swabbed several times with engine oil and a clean cloth, then wiped with a clean, dry cloth. Cylinders **should not** be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

2. Hone all cylinder walls **just enough** to de-glaze walls.

3. Measure cylinder bore diameter (with a snap gauge micrometer) of each cylinder, as shown below. Check for tapered, out-of-round (egg-shaped) and oversize bore.



51846

Models	Cylinder Block Finish Hone
Standard Piston Bore	3.501 in. (88.93mm)
.015 in. (0.381mm) Oversize Piston Bore	3.516 in. (89.31mm)

4. If a cylinder bore is tapered, out-of-round or worn more than 0.003 in. (0.076mm) from standard “Cylinder Block Finish Hone” diameter (refer to chart, preceding), it will be necessary to re-bore that cylinder(s) to 0.015 in. (0.381mm) oversize or re-sleeve and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to re-bore all cylinders in a block just because one cylinder requires re-boring.*

5. After honing and thoroughly cleaning cylinder bores, apply light oil to cylinder walls to prevent rusting.

Pistons and Piston Rings

IMPORTANT: If engine was submerged while engine was running, piston pin and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. (Piston pins are not sold separately because of matched fit into piston.) If piston pin is bent, connecting rod must be checked for straightness (refer to “Connecting Rods,” following, for checking straightness).

1. Inspect pistons for scoring and excessive piston skirt wear.
2. Check tightness of piston ring locating pins. Locating pins must be tight.
3. Thoroughly clean pistons. Carefully remove carbon deposits from pistons, with a soft wire brush or carbon remove solution. Do not burr or round off machined edges.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves **being careful not to scratch sides of grooves**. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

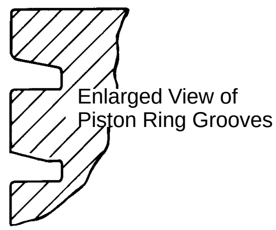
Keystone (tapered) ring grooves

⚠ CAUTION

Care must be taken not to scratch the side surfaces of the ring groove. Scratching the side surface of the ring groove will damage the ring groove.

1. Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable the inside edge of the ring to reach the inner diameter of the groove. Carefully scrape carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the side surfaces of the grooves.

Piston with two half keystone (half tapered) rings



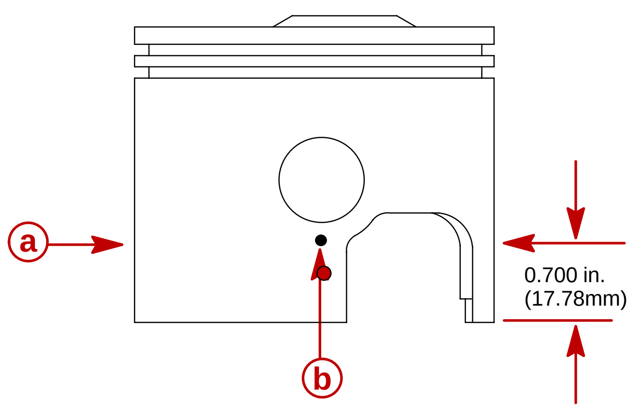
MEASURING PISTON ROUNDNESS

Piston has a barrel profile shape and is not a true diameter.

1. Using a micrometer, measure dimension “A” at location shown. Dimension “A” should be as indicated in chart following.

Piston	Dimension “A”
Standard Piston	3.4925 in. ± 0.0005 in.
0.015 in. Oversize Piston	3.5075 in. ± 0.0005 in.

2. Using a micrometer, measure dimension “B” at location shown. Dimension “B” should be within 0.008 in. of dimension “A.”



a - Dimension “A” at RIGHT Angle (90°) to Piston Pin
b - Dimension “B” (in line with Piston Pin)

Cylinder Heads and Exhaust Divider Plate

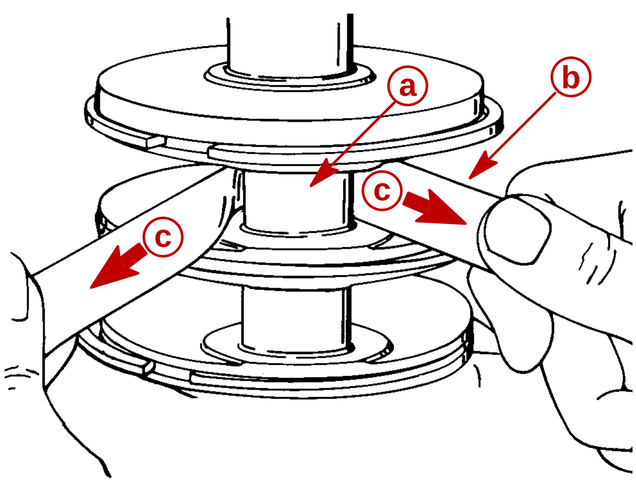
1. Inspect internal surface of cylinder heads for possible damage (as a result of piston or foreign material striking cylinder heads).

IMPORTANT: Cylinder head warpage should not exceed 0.004 in. (0.1 mm) over the ENTIRE length of the cylinder head. If measured warpage, as determined on a surface block, exceeds 0.004 in. (0.1 mm) or a discontinuity of up to 0.004 in. (0.1 mm) exists in a narrow portion of the cylinder head's surface length, then the cylinder head should be replaced. It is recommended that the cylinder head not be resurfaced as the o-ring groove depth in the head will be reduced resulting in possible cylinder leakage.

2. Replace cylinder head(s) as necessary.
3. Thoroughly clean gasket surfaces of exhaust divider plate.
4. Inspect exhaust divider plate for deep grooves, cracks or distortion that could cause leakage. Replace parts as necessary.

Crankshaft

1. Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary.)
2. Check crankshaft for straightness. Maximum runout is 0.006 in. (0.152 mm). (Replace as necessary.)
3. Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. (Replace as necessary.)
4. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating. (Refer to "Connecting Rods".)
5. If necessary, clean crankshaft surfaces with crocus cloth .



51847

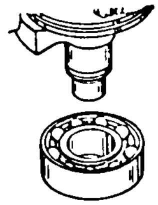
a - Crankshaft Journals
b - Crocus Cloth
c - Work Cloth "Back-and-Forth"

⚠ WARNING
DO NOT spin-dry crankshaft ball bearing with compressed air.

6. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearing. Recheck surfaces of crankshaft. Replace crankshaft, if surfaces cannot be properly "cleaned up." If crankshaft will be re-used, lubricate surfaces of crankshaft with light oil to prevent rust. DO NOT lubricate crankshaft ball bearing at this time.

Crankshaft (and End Cap) Bearings

1. After cleaning crankshaft, grasp outer race of crankshaft ball bearing (installed on lower end of crankshaft) and attempt to work race back-and-forth. There should not be excessive play.
2. Lubricate ball bearing with light oil. Rotate outer bearing race. Bearing should have smooth action and no rust stains. If ball bearing sounds or feels “rough” or has “catches,” remove and discard bearing. (Refer to “Powerhead Removal and Disassembly - Crankshaft Removal and Disassembly”).



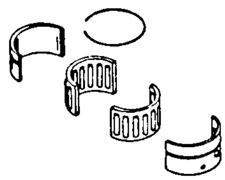
Lower Ball Bearing

3. Thoroughly clean (with solvent) and dry crankshaft center main roller bearings. Lubricate bearings with 2-Cycle Outboard Oil.

CAUTION

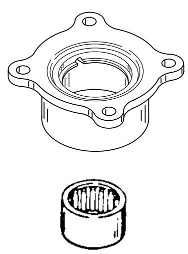
DO NOT intermix halves of upper and lower crankshaft center main roller bearings. Replace bearings in pairs only.

4. Thoroughly inspect center main roller bearings. Replace bearings if they are rusted, fractured, worn, galled or badly discolored.



Center Main Roller Bearing

5. Clean (with solvent) and dry crankshaft roller bearing that is installed in upper end cap. Lubricate bearing with light oil.
6. Thoroughly inspect upper end cap roller bearing. If roller bearing is rusted, fractured, worn, galled, badly discolored or loose inside of end cap replace end cap and roller bearing as an assembly.



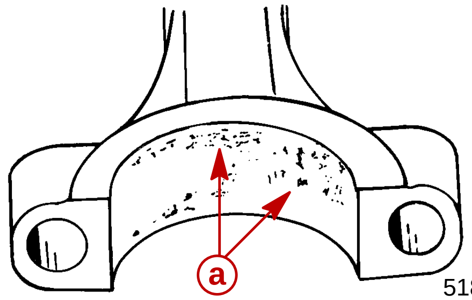
Upper Roller Bearing

End Bearing Bleed System

1. Check rubber bleed hoses. Replace any hose that is cracked, cut or deteriorating.
2. Check operation of lower end cap check valve. If valve is working properly, air can be drawn thru check valve “one way” only. If air can pass thru a check valve both ways, valve is not working properly and must be replaced.

Connecting Rods

1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.051 mm) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be discarded.
2. **Overheating:** Overheating is visible as a bluish bearing surface color that is caused by inadequate lubrication or excessive RPM.
3. **Rust:** Rust formation on bearing surfaces causes uneven pitting of surface(s).



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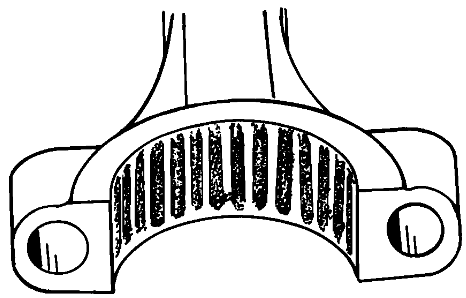
a - Pitting

4. **Water Marks:** When bearing surfaces are subjected to water contamination, a bearing surface “etching” occurs. This etching resembles the size of the bearing.



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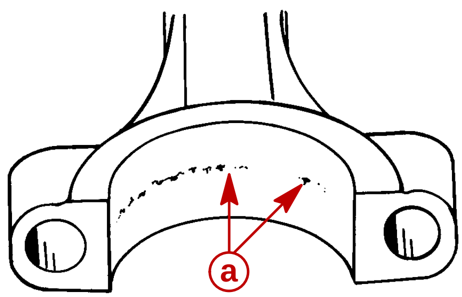
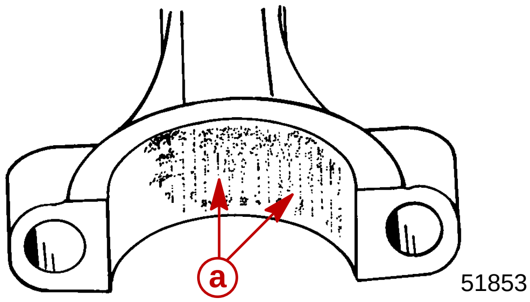
5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the “I” beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.



51853

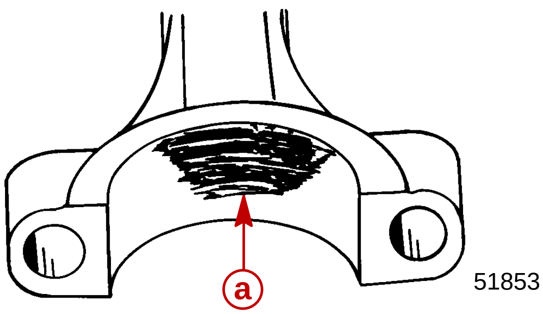
a - Spalling

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).



a - Chatter Marks Between Arrows

7. **Uneven Wear:** Uneven wear could be caused by a bent connecting rod.



a - Uneven Wear Between Arrows

8. If necessary, clean connecting rod bearing surfaces, as follows:

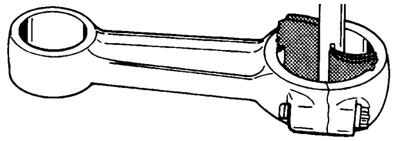
   a. Be sure that “etched” marks on connecting rod (crankshaft end) are perfectly aligned with “etched” marks on connecting rod cap. Tighten connecting rod cap attaching bolts securely.

CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

   b. **Clean CRANKSHAFT END of connecting rod by using CROCUS CLOTH** placed in a slotted 3/8 in. (9.5 mm) diameter shaft, as shown. Chuck shaft in a drill press and operation press at high speed while keeping connecting rod at a 90° angle to slotted shaft.

IMPORTANT: Clean connecting rod just enough to clean up bearing surfaces. DO NOT continue to clean after marks are removed from bearing surfaces.



51083

c. **Clean PISTON PIN END of connecting rod**, using same method as in Step "b", preceding, but using 320 grit carborundum cloth instead of crocus cloth.

d. Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod(s) that cannot be properly "cleaned up." Lubricate bearing surfaces of connecting rods (which will be re-used) with light oil to prevent rust.

Powerhead Reassembly and Installation

General

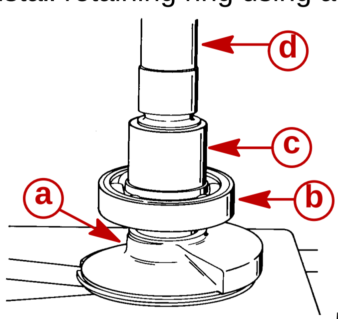
Before proceeding with powerhead reassembly, be sure that all parts to be re-used have been carefully cleaned and thoroughly inspected, as outlined in "Cleaning and Inspection," preceding. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly good powerhead within the first few minutes of operation. All new powerhead gaskets MUST BE installed during reassembly.

During reassembly, lubricate parts with Quicksilver 2-Cycle Outboard Lubricant whenever "light oil" is specified. Quicksilver part numbers of lubricants, sealers and locking compounds and tools are listed in "Powerhead General Information," preceding.

A torque wrench is **essential** for correct reassembly of powerhead. DO NOT attempt to reassemble powerhead without using a torque wrench. Attaching bolts for covers, housings and cylinder heads MUST BE torqued by tightening bolts in 3 progressive steps (following specified torque sequence) until specified torque is reached (see "Example," following).

EXAMPLE: If cylinder head attaching bolts require a torque of 30 lb. ft. (41 N·m), a) tighten all bolts to **10 lb. ft. (13.5 N·m)**, following specified torque sequence, b) tighten all bolts to **20 lb. ft. (27 N·m)**, following torque sequence, then finally c) tighten all bolts to **30 lb. ft. (41 N·m)**, following torque sequence.

1. If removed, press lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against counterweight.
2. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



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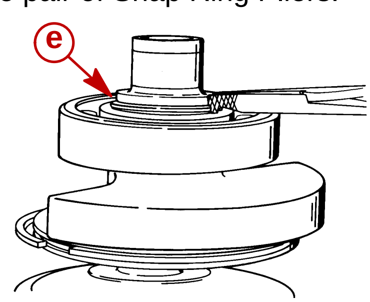
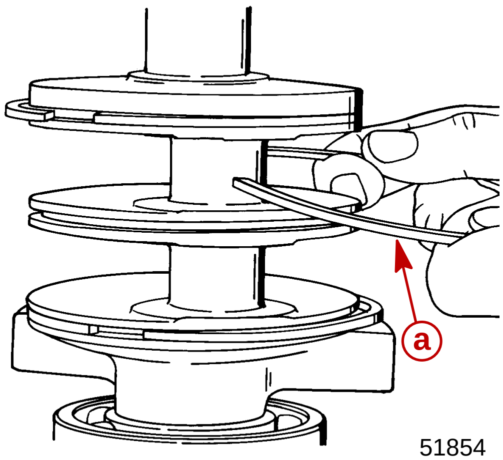
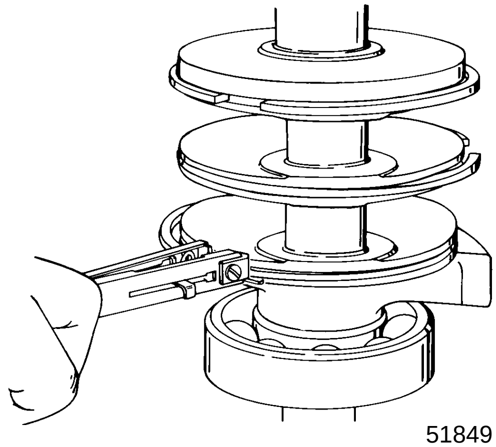


51854

a - Crankshaft
b - Ball Bearing
c - Suitable Mandrel
d - Press
e - Retaining Ring

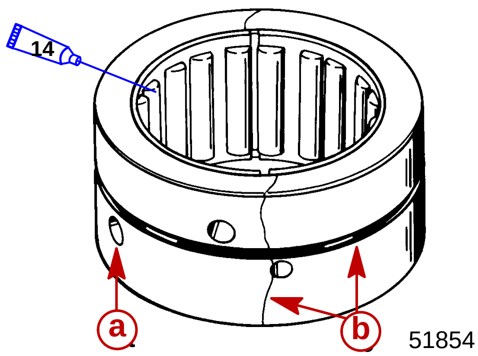
3. If removed, spread new crankshaft sealing rings just enough to slide over crankshaft journal.
4. Use Piston Ring Expander (91-24697) and install crankshaft sealing rings into groove.





a - Crankshaft Sealing Rings

5. Lubricate center main crankshaft roller bearings and races with light oil.

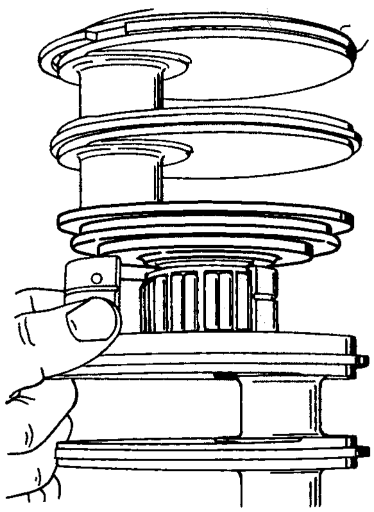


14 2 Cycle Outboard Oil (92-826666A24)

a - Install so LARGER of the 3 holes is toward DRIVE SHAFT end of crankshaft
b - Verify retaining ring bridges the separating lines of the bearing race

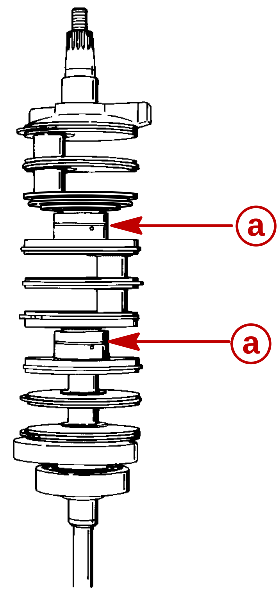
6. Place center main crankshaft roller bearings on upper and lower main bearing journals as shown.
7. Install center main bearing races as shown.
8. Secure center main bearing races together with retaining rings. Make sure retaining ring bridges the separating lines of the bearing race.

FLYWHEEL END



DRIVE SHAFT END

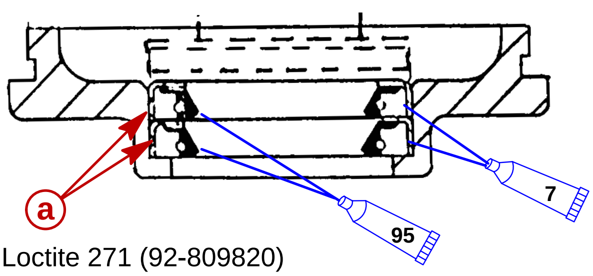
58614

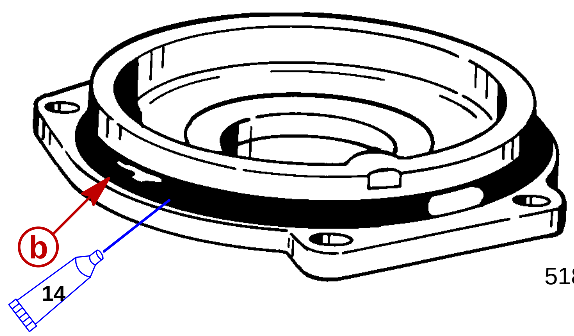


58617

a - Center Main Bearing Races

9. Install oil seals into lower end cap as follows:
   a. Apply a thin bead of Loctite 271 to outer diameter on 2 lower end cap oil seals (a).
   b. Using driver head (91-55919) press one oil seal (lip facing down) into lower end cap until firmly seated. Remove any excess Loctite.
   c. Press second oil seal (lip facing down) until firmly seated on first oil seal. Remove any excess Loctite.
   d. Lubricate oil seal lips with Quicksilver 2-4-C w/Teflon (92-825407A12).
   e. Lubricate O-ring seal surface on end cap with 2 cycle oil. Install o-ring over lower end cap.





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7 Loctite 271 (92-809820)

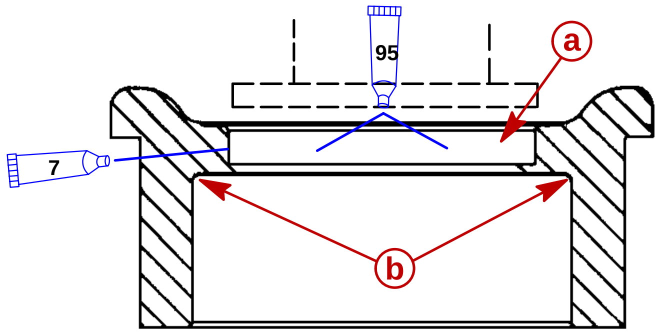
14 2 Cycle Outboard Oil (92-826666A24)

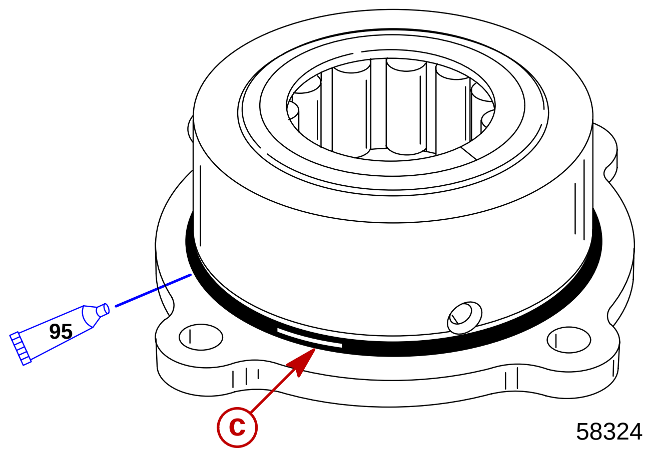
95 2-4-C With Teflon (92-825407A12)

a - Oil Seal

b - O-ring

10. Install oil seal into upper end cap as follows:
   a. Apply a thin bead of Loctite 271 to outer diameter of upper end cap oil seal.
   b. Use a suitable mandrel, press oil seal into upper end cap (lip facing down) until bottomed out on lip of end cap. Remove any excess Loctite.
   c. Lubricate oil seal lip with Quicksilver 2-4-C w/Teflon (92-825407A12).
   d. Lubricate O-ring seal surface on end cap with Quicksilver 2-4-C w/Teflon (92-825407A12). Install O-ring on end cap.





7 Loctite 271 (92-809820)
95 2-4-C With Teflon (92-825407A12)

a - Oil Seal
b - Lip of End Cap
c - O-ring

Crankshaft Installation

SPECIAL INFORMATION

Installing A New Crankshaft Assembly Into Cylinder Block

Check the crankshaft sealing ring mating surfaces in the cylinder block and crankcase cover for wear grooves that were caused by the crankshaft sealing rings from the previous crankshaft. If wear grooves are present, the sealing rings on the new crankshaft will have to fit into the grooves without binding the crankshaft.

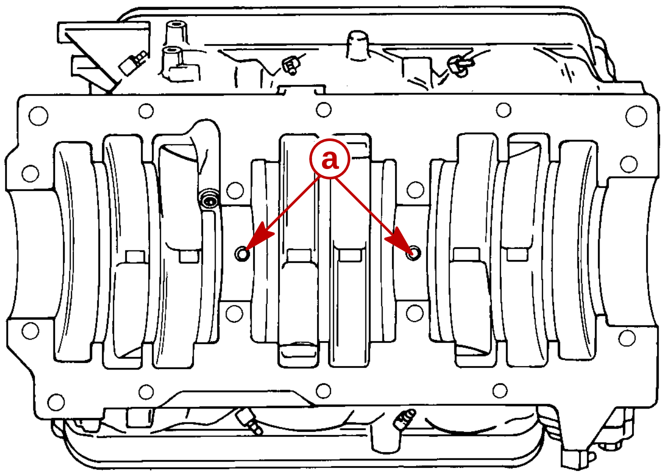
Before installing crankshaft, remove any burrs that may exist on groove edges.

Lubricate sealing rings with light oil and install new crankshaft as instructed.

Install upper and lower end caps and then inspect fit between sealing rings and grooves. Temporarily install crankcase cover and rotate crankshaft several times to check if sealing rings are binding against crankshaft. (You will feel a drag on the crankshaft.) If sealing rings are binding, recheck grooves for burrs. If this does not correct the problem, it is recommended that the cylinder block be replaced.

Install crankshaft as follows:

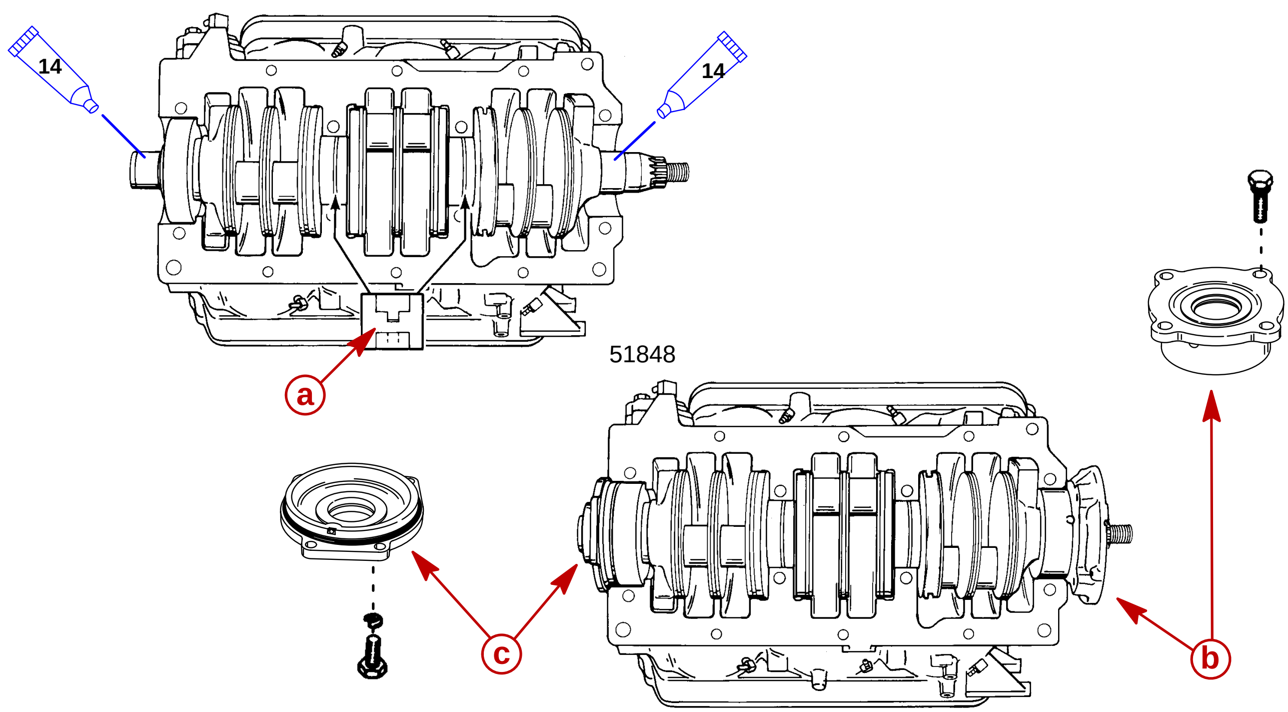
1. Lubricate crankshaft sealing rings with light oil.
2. Check cylinder block to be sure that dowel pins are in place.



51848

a - Dowel Pins

3. Position all crankshaft seal ring gaps straight up.
4. Align hole in each center main bearing race with dowel pin.
5. Gently push crankshaft down into position making sure that the dowel pins are lined up with the holes in center main bearings and crankshaft seal rings are in place.
6. Lubricate crankshaft ends (oil seal areas) with light oil, then install upper and lower end caps (“a” and “b”). Secure end caps to cylinder block with attaching bolts. DO NOT tighten end cap bolts at this time.



51848

14 2 Cycle Outboard Oil (92-826666A24)

a - Dowel Pin
b - Upper End Cap
c - Lower End Cap

Piston and Connecting Rod Reassembly

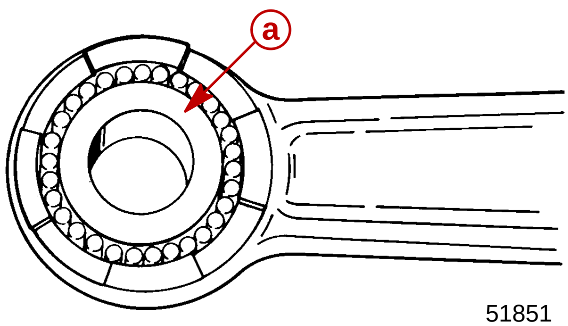
1. Place needle bearings on a clean piece of paper and lubricate with Quicksilver 2-4-C w/Teflon Marine Lubricant.

***NOTE:** There are 35 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.
3. Place locating washers on connecting rod.

IMPORTANT: Position connecting rod part number facing towards flywheel.

Carefully position piston over end of rod. Make sure locating washers remain in place.



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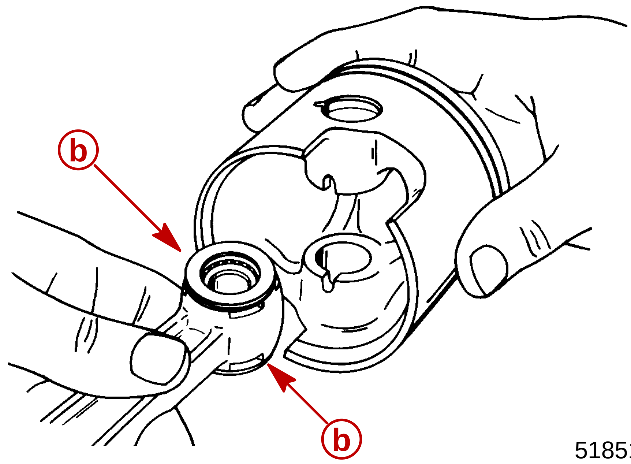
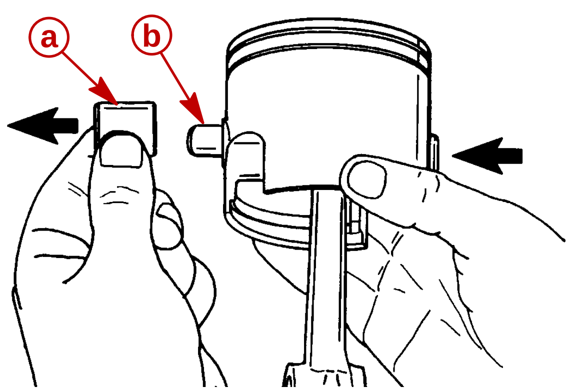


51851

a - Sleeve
b - Locating Washers

4. Insert piston pin tool (91-92973A1) and push sleeve out of piston. Keep piston pin tool in piston.
5. Use a mallet and tap piston pin into piston and push piston pin tool out.



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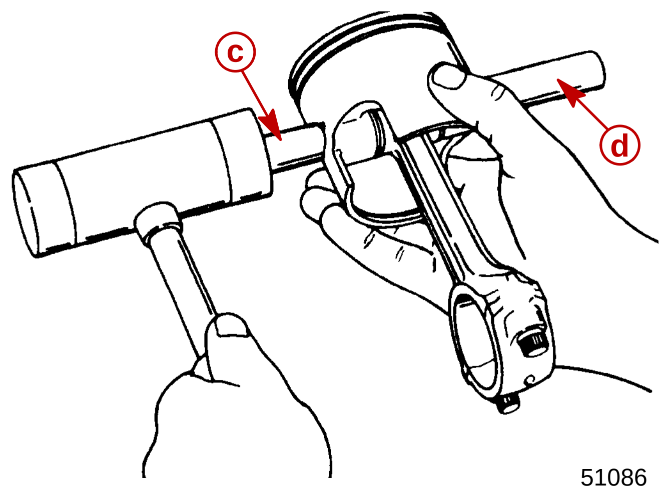


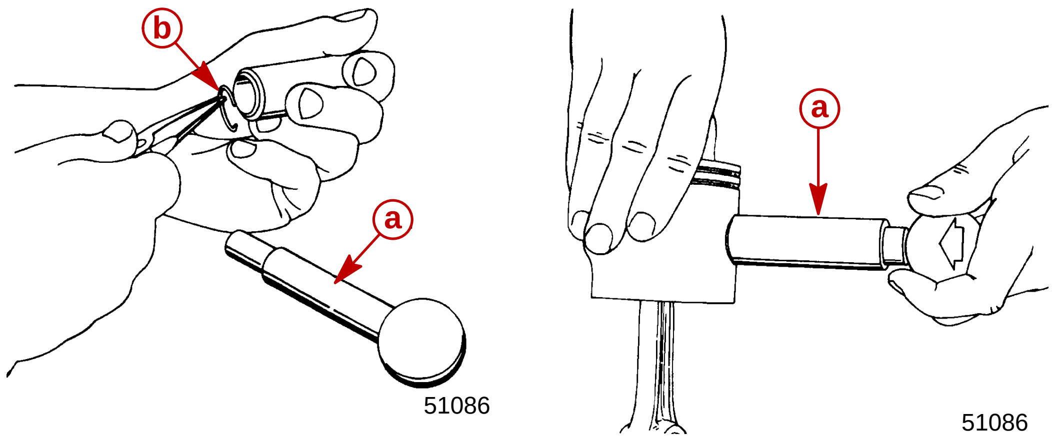
51086

a - Piston Pin Tool
b - Sleeve

c - Piston Pin
d - 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.



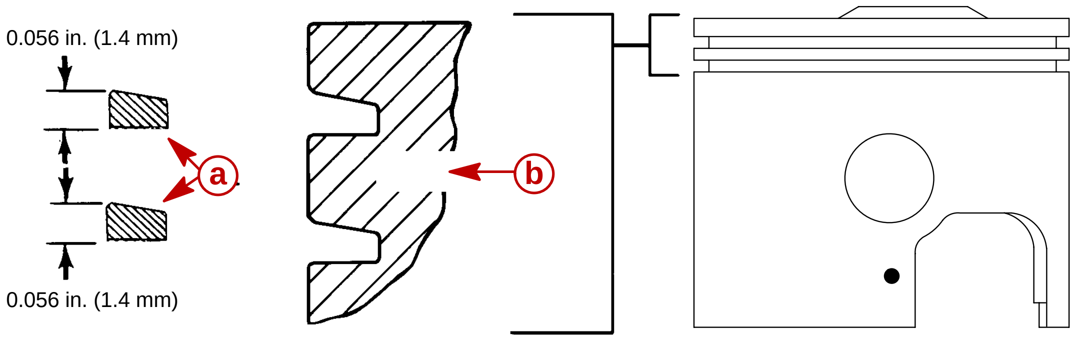
a - Lockring Installation Tool

b - Lockring

Piston and Piston Ring Combinations

All models have two half keystone (half tapered) rings.

Pistons with two half keystone (half tapered) rings



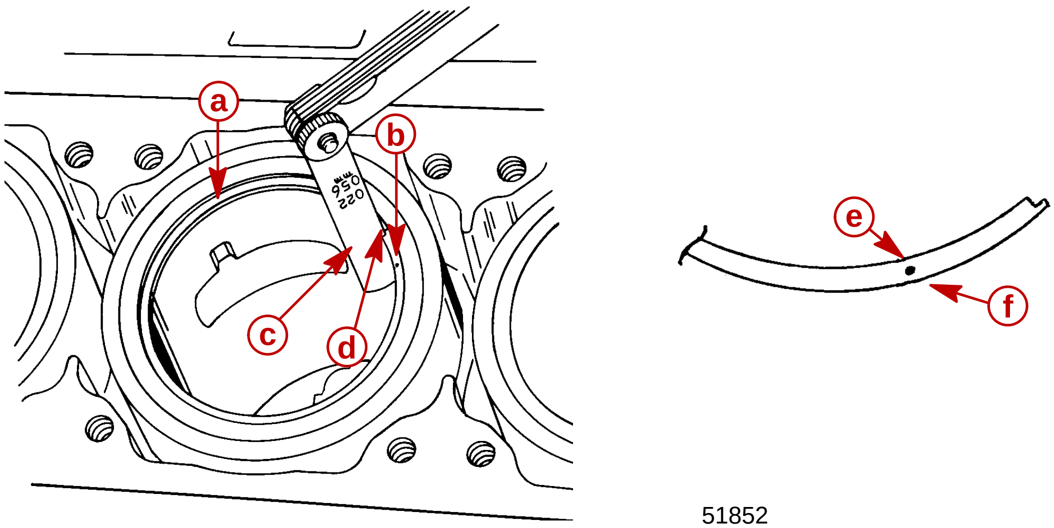
a - Half Keystone (half tapered) Piston Ring

b - Enlarged View of Piston Ring Grooves

Piston Installation

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. (12.7 mm) 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. (0.25 mm to 0.45 mm). If end gap is greater, check other piston rings in cylinder bore, until rings (within tolerance) are found.

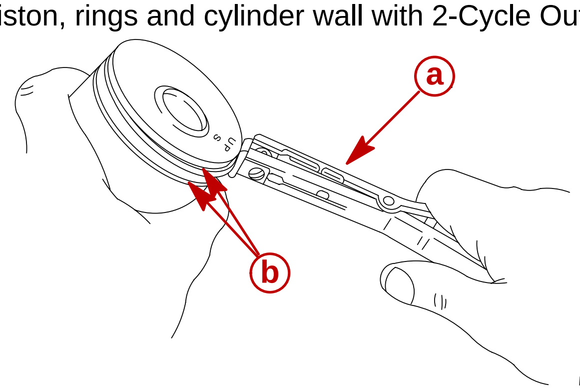
IMPORTANT: Piston ring side with dot or letter must be facing up.



51852

a - Piston Ring
b - Dots (Faces Up)
c - Feeler Gauge
d - Ring End Gap
e - Dot or Letter
f - Piston Ring

3. Use Piston Ring Expander (91-24697) and install piston rings (dot side up) on each piston. Spread rings just enough to slip over piston.
4. Check piston rings to be sure that they fit freely in ring groove.
5. Lubricate piston, rings and cylinder wall with 2-Cycle Outboard Oil.



56155

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.

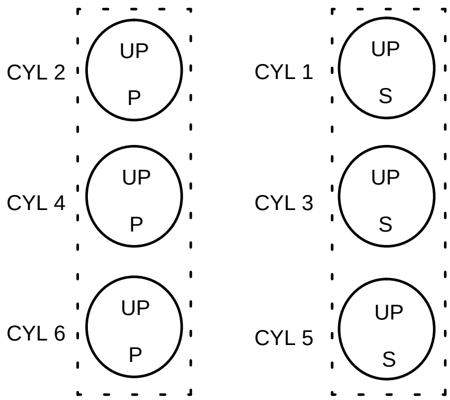
IMPORTANT: Piston must be correctly installed and positioned as shown.

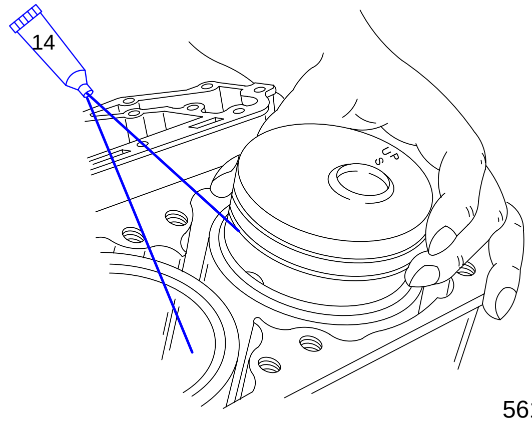
Pistons marked with the word “UP” and with the letter “P” or “S” on top of piston.

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.





56156

14 2 Cycle Outboard Oil (92-826666A24)

10. Apply Quicksilver 2-4-C w/Teflon to bearing surface of connecting rod and install bearing assembly as shown.

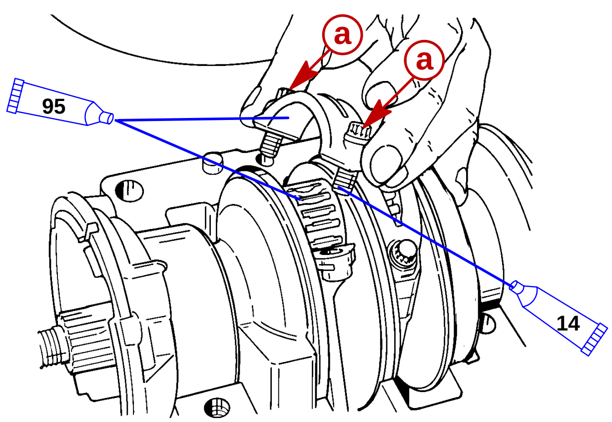
11. Place connecting rod cap on connecting rod. Apply light oil to threads and face of connecting rod bolts. Thread connecting rod bolts finger-tight while checking for correct alignment of the rod cap as shown.

IMPORTANT: Connecting rod and connecting rod caps are matched halves. Do not torque screws before completing the following procedure.

- Run a pencil lightly over ground area.
- If pencil stops at fracture point, loosen bolts, retighten, and check again.

NOTE: *If you still feel the fracture point, discard the rod.*

12. Tighten connecting rod bolts (using a 5/16 in. - 12 point socket). First torque to 15 lb. in. (1.7 N·m) then 20 lb. ft. (27 N·m). Turn each bolt an additional 90° after 2nd torque is attained. Recheck alignment between rod cap and rod as shown.



51850

14 2 Cycle Outboard Oil (92-826666A24)

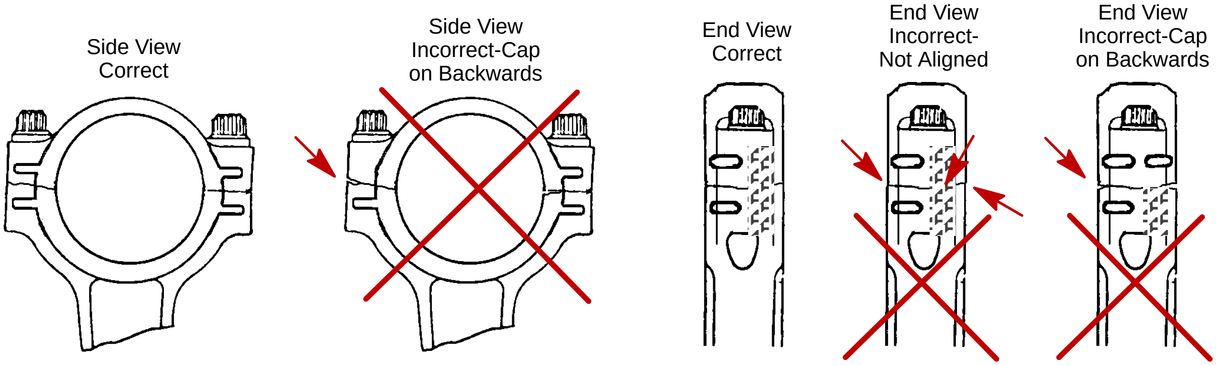
95 2-4-C With Teflon (92-850736A1)

a - Connecting Rod Screws

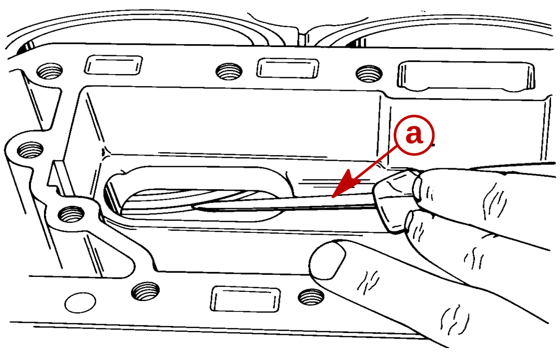
13. Rotate crankshaft several times (using powerhead stand) to assure free operation (no binds and catching).

Connecting Rod Cap Alignment

Check each connecting rod cap for correct alignment. If not aligned, a ridge can be seen or felt at the separating line as shown below. Correct any misalignment.



14. Verify that no piston rings were broken during installation by pressing in on each piston ring thru exhaust port using a screwdriver. If no spring tension exists (ring fails to return to position), it's likely ring is broken and must be replaced.

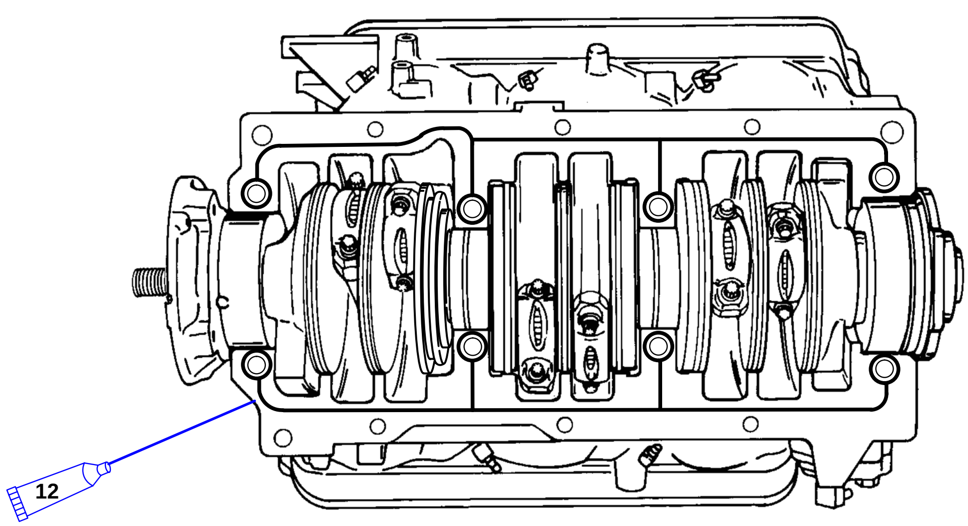


51852

a - Screwdriver

Crankcase Cover Installation

1. Remove all oil from mating surfaces of crankcase cover and cylinder block with Loctite 7649 Primer (92-809824).
2. Apply a thin, even coat of Loctite Master Gasket #203 on mating surfaces of crankcase cover or cylinder block.

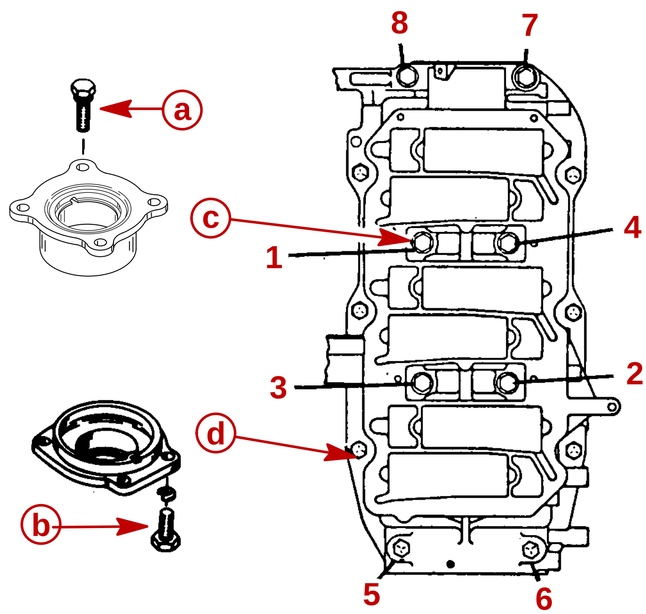


58620

12 Loctite Master Gasket (92-12564-2)

a - Loctite Master Gasket (92-12564-2)

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.
5. Tighten end cap bolts to specified torque.

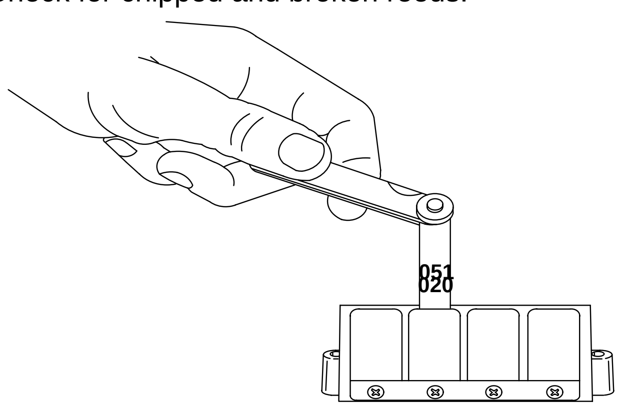


a - Upper End Cap Bolts – Torque to 17 lb. ft. (23 N·m)
b - Lower End Cap Bolts – Torque to 80 lb. in. (9 N·m)
c - Add Light Oil to Threads and Bolt Face – 8 Bolts (3/8 in.-18) Torque to 38 lb. ft. (51.5 N·m)
d - Bolts (5/16 in.-18) Torque to 180 lb. in. (20 N·m)

Reed Block Assembly

IMPORTANT: DO NOT remove reeds from reed blocks, unless replacement is necessary. DO NOT turn used reeds over for re-use. Replace reeds in sets only.

1. Thoroughly clean gasket surfaces of reed blocks and reed block housing. Check for deep grooves, cracks and distortion that could cause leakage. Replace parts as necessary.
2. Inspect reed block neoprene surface for wear, cuts or abraisions. Replace reed block(s) as required.
3. Check for chipped and broken reeds.



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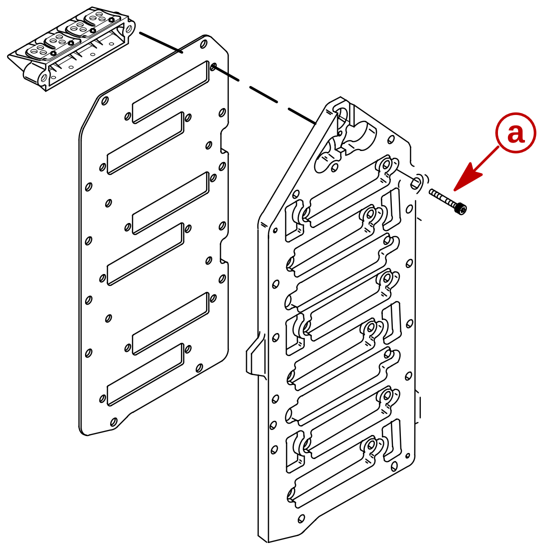
Allowable reed opening is 0.020 in. (0.51 mm) or less. Replace reeds if either reed is standing open more than 0.020 in. (0.51 mm).

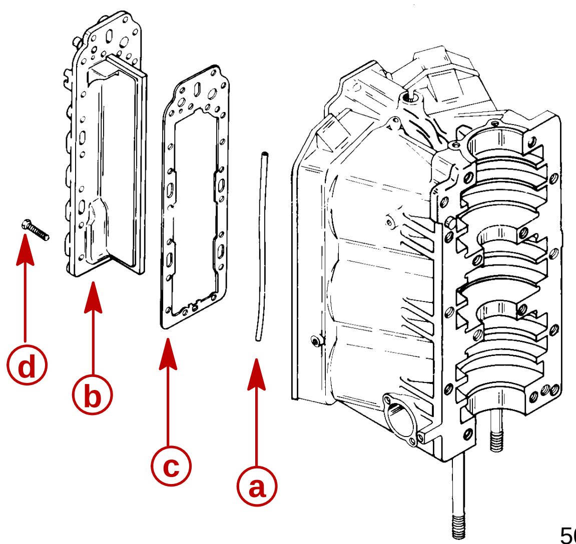
Assembly of Reed Blocks to Reed Block Adaptor Plate



a - Torque to 90 lb. in. (10 N·m)

Assembly of Exhaust Divider Plate to Block

1. Place exhaust divider seal into slot in block and install divider plate with gasket.
2. Clean bolt threads with Loctite 7649 Primer (92-809824).
3. Apply Loctite 271 to bolt threads and torque bolts to 16.5 lb. ft. (22 Nm).
4. Torque exhaust divider plate bolts in following sequence.



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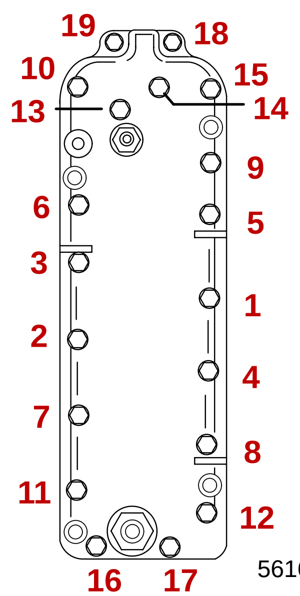
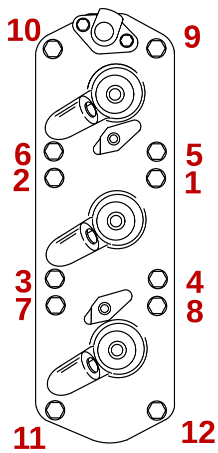


56167

a - Divider Seal
b - Exhaust Divider Plate
c - Gasket
d - Attaching Bolt

Cylinder Head Installation

1. Install each cylinder head to engine block with thermostat pocket “UP”. Apply light oil to new cylinder head bolt threads and torque bolts to 30 lb. ft. (41 N·m), then turn an additional 90°. Install thermostat assembly into each cylinder head.
2. Install temperature sensors in STARBOARD and PORT cylinder heads.



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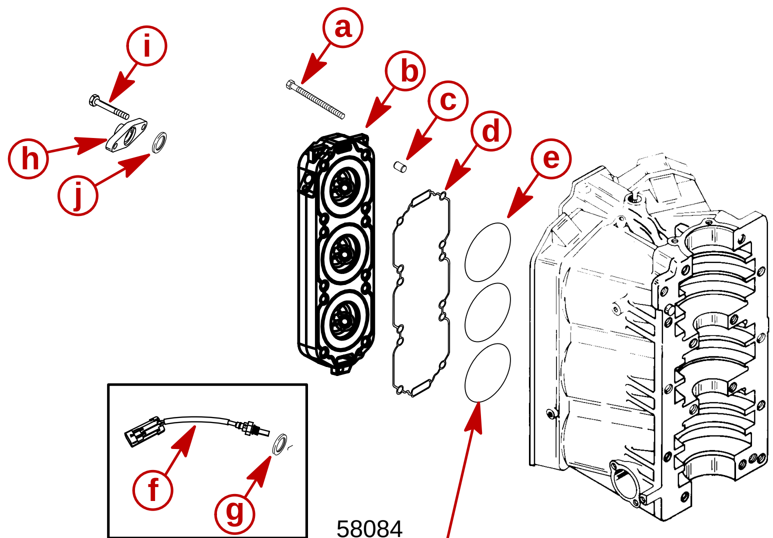

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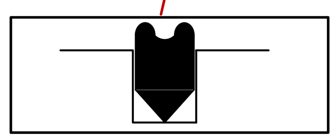

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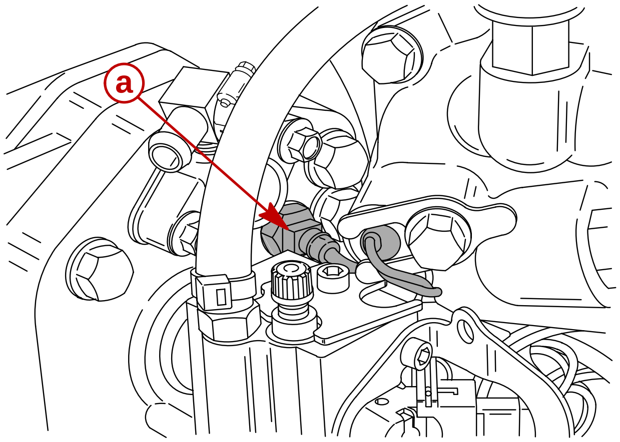
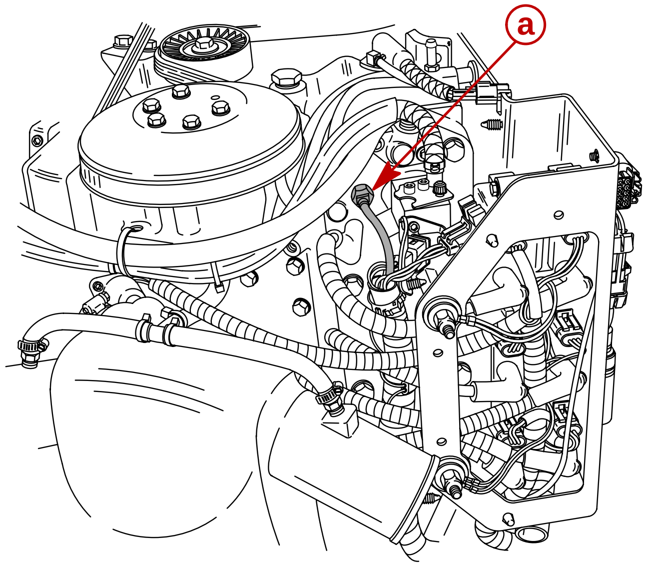
***NOTE:** Cylinder head o-rings are directional in their installation. The grooved side faces the cylinder block. The pointed side faces into the cylinder head. Failure to install the o-rings correctly may result in cylinder head leakage. O-rings should not be damaged or twisted. Replace as required.*

- **a** - Bolt [Torque to 30 lb. ft. (41 N·m) and then turn 90°]
- **b** - Cylinder Head
- **c** - Dowel Pin
- **d** - Seal
- **e** - O-ring
- **f** - Temperature Sensor
- **g** - O-ring
- **h** - Cover
- **i** - Bolt [Torque to 10 lb. ft. (13.0 N·m)]
- **j** - O-ring

***NOTE:** The temperature sender provides continuous temperature information to the ECU while the engine is running. Should temperature reach pre-programmed levels, the ECU will activate a warning horn and warning light.*

3. Temperature sensor installed.





PORT **STARBOARD**

a - Overheat Temperature Sensor

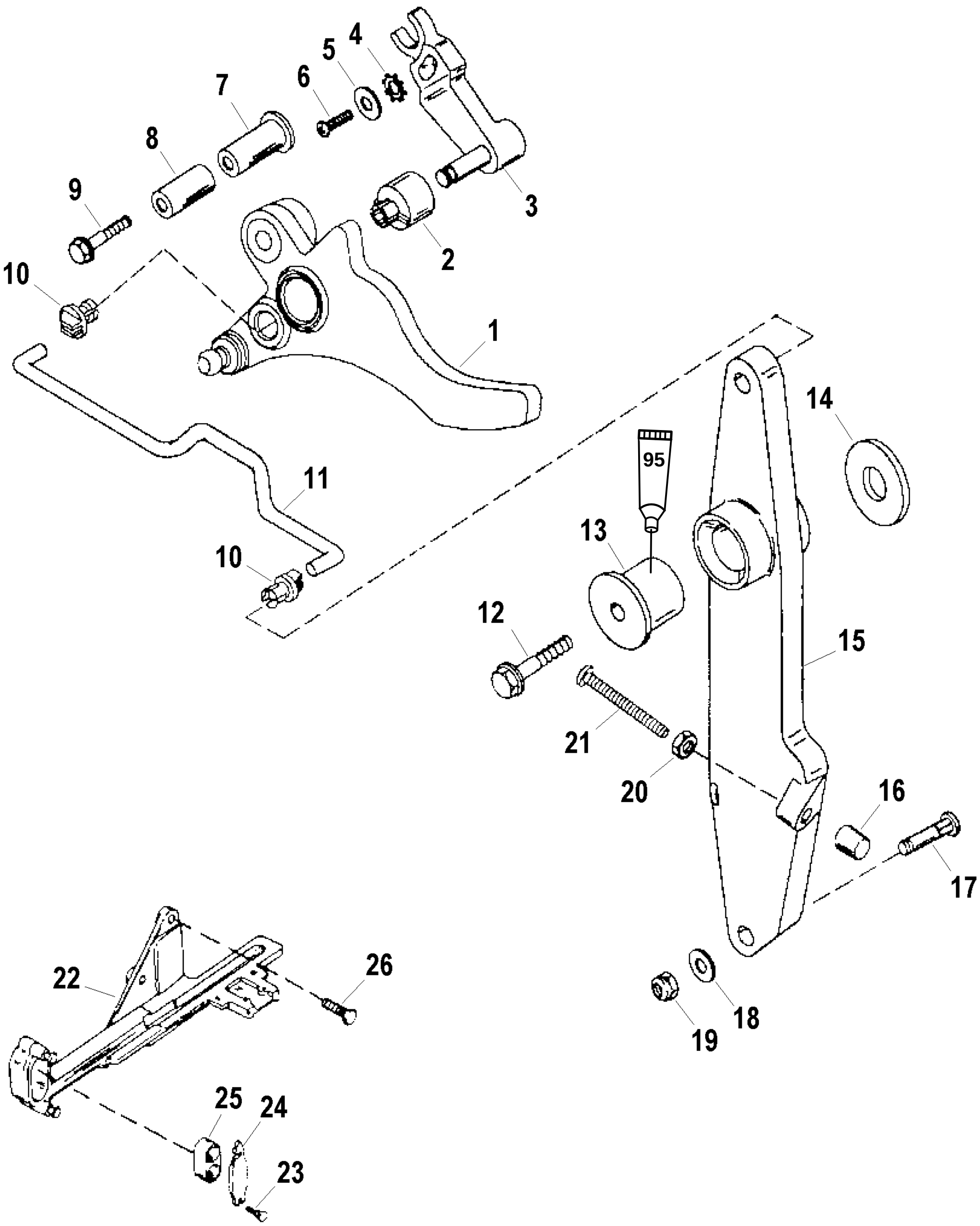
Reinstalling Engine Components

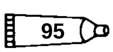
NOTE: *Components can be reinstalled individually or as an assembly. If reinstalling components individually, refer to the following sections. If reinstalling components as an assembly, refer to* ***Removing Engine Components as an Assembly****, page 4A-20 through 4A-29, and reinstall in reverse sequence.*

Section 2
Starter Motor
Electronic Control Module
Ignition Coil
Starter Solenoid
Alternator
Flywheel
Throttle Position Sensor

Section 3
Direct Fuel Injection
Fuel Pump
On-Board Oil Tank
Oil Pump
Fuel Lift Pump

Throttle Lever/Throttle Cam Assembly





2-4-C With Teflon (92-850736A1)

Throttle Lever and Shift Shaft

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	Nm
1	1	CAM-Throttle			
2	1	ROLLER			
3	1	ROLLER-Throttle			
4	1	LOCKWASHER (#10)			
5	1	WASHER			
6	1	SCREW (M5 x 16)	Drive Tight		
7	1	BUSHING			
8	1	BEARING			
9	1	SCREW (M8 x 40)	145		16
10	2	BUSHING-Swivel			
11	1	ROD-Throttle Control			
12	1	SCREW (0.375-16 x 1.750)		20	27
13	1	BUSHING			
14	1	SPACER			
15	1	LEVER-Throttle			
16	1	CAP (Nylon)	Drive Tight		
17	1	INSERT			
18	1	WASHER	Drive Tight		
19	1	NUT (M6)	50		6
20	1	NUT (0.250-20)			
21	1	SCREW (0.250-20 x 2.125)			
22	1	BRACKET-Anchor			
23	2	SCREW-Drive			
24	1	Latch-Control Lever			
25	1	CUP-Barrel Retainer			
26	1	SCREW (0.312-18 x 0.880)		13	18

Powerhead Installation on Pump Unit

1. Install Lifting Eye (91-90455) into flywheel.

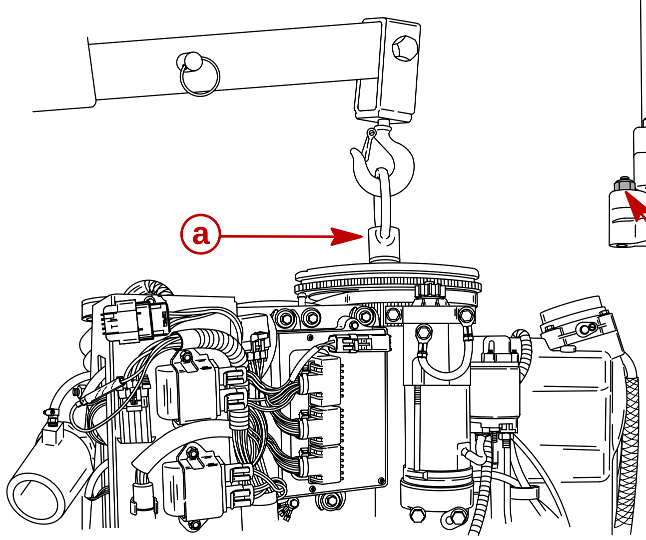
⚠ WARNING

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 gasket surface of adaptor plate.

IMPORTANT: DO NOT apply lubricant to top of driveshaft as this will prevent driveshaft from fully engaging into crankshaft.

3. Apply a small amount of Special Lubricant 101 (92-13872A1) onto driveshaft splines.
4. Use hoist to lower powerhead onto pump unit. It may be necessary to turn flywheel (aligning crankshaft splines with driveshaft splines) so that powerhead will be fully installed.
5. Install 11 locknuts which secure powerhead to exhaust extension plate/driveshaft housing. Torque locknuts in 3 progressive steps until secured.
6. Disconnect hoist from Lifting Eye and remove Lifting Eye from flywheel.
7. Reinstall plastic cap into center of flywheel cover.



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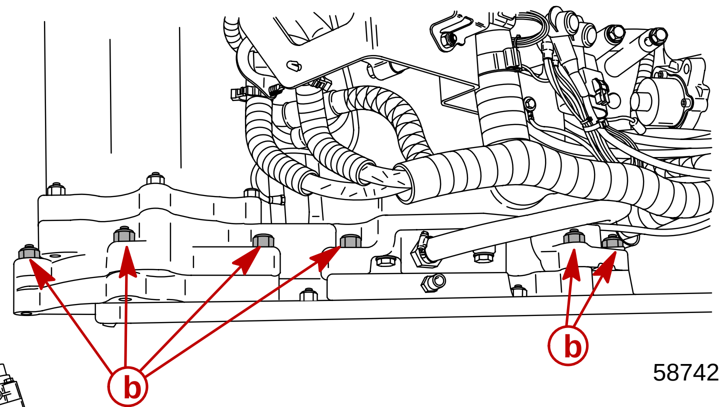


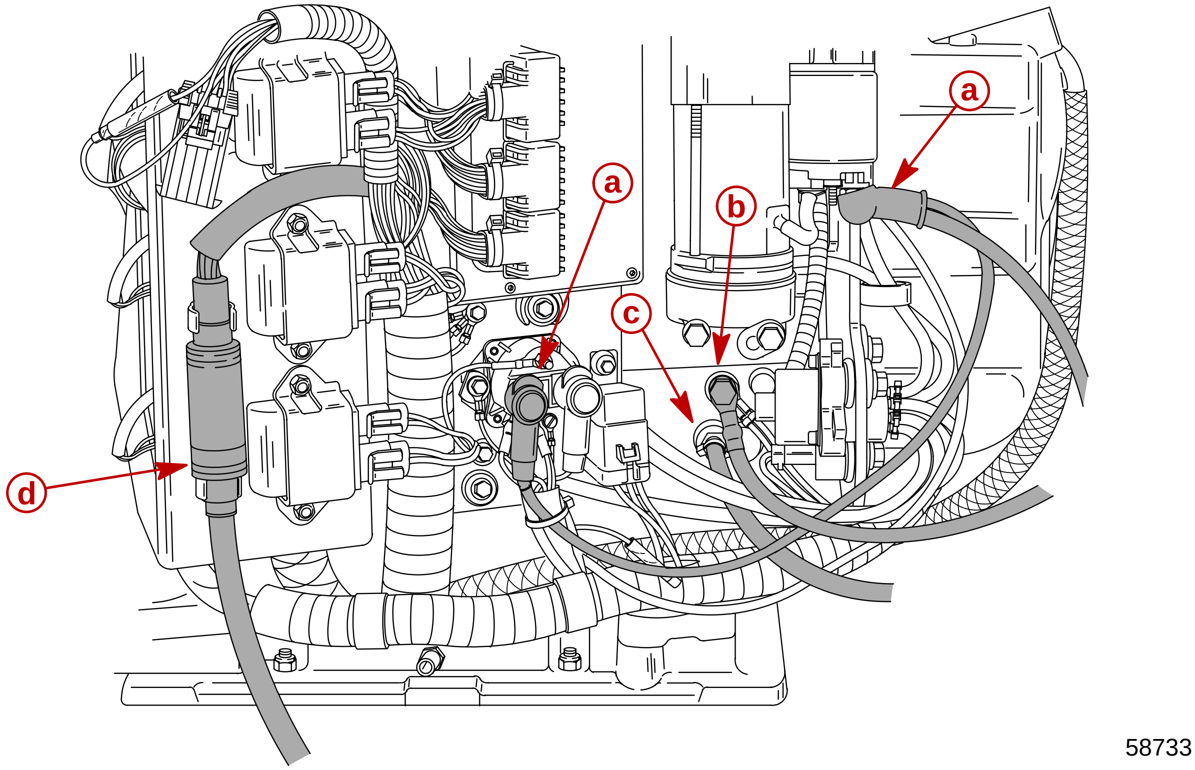
58742

a - Lifting Eye (91-90455)
b - Powerhead Attaching Locknuts – Torque Nuts to 35 lb. ft. (47 N·m)

Refer to Section 1D, Sport Jet Installation to complete powerhead installation and cable adjustment.

Follow Timing, Synchronizing and Adjusting as outlined in Section 2C.

8. Connect positive battery cable to starter solenoid.
9. Connect negative battery cable to lower front starter mounting bolt.
10. Connect remote oil tank pressure hose.
11. Connect remote control harness to powerhead harness connector.

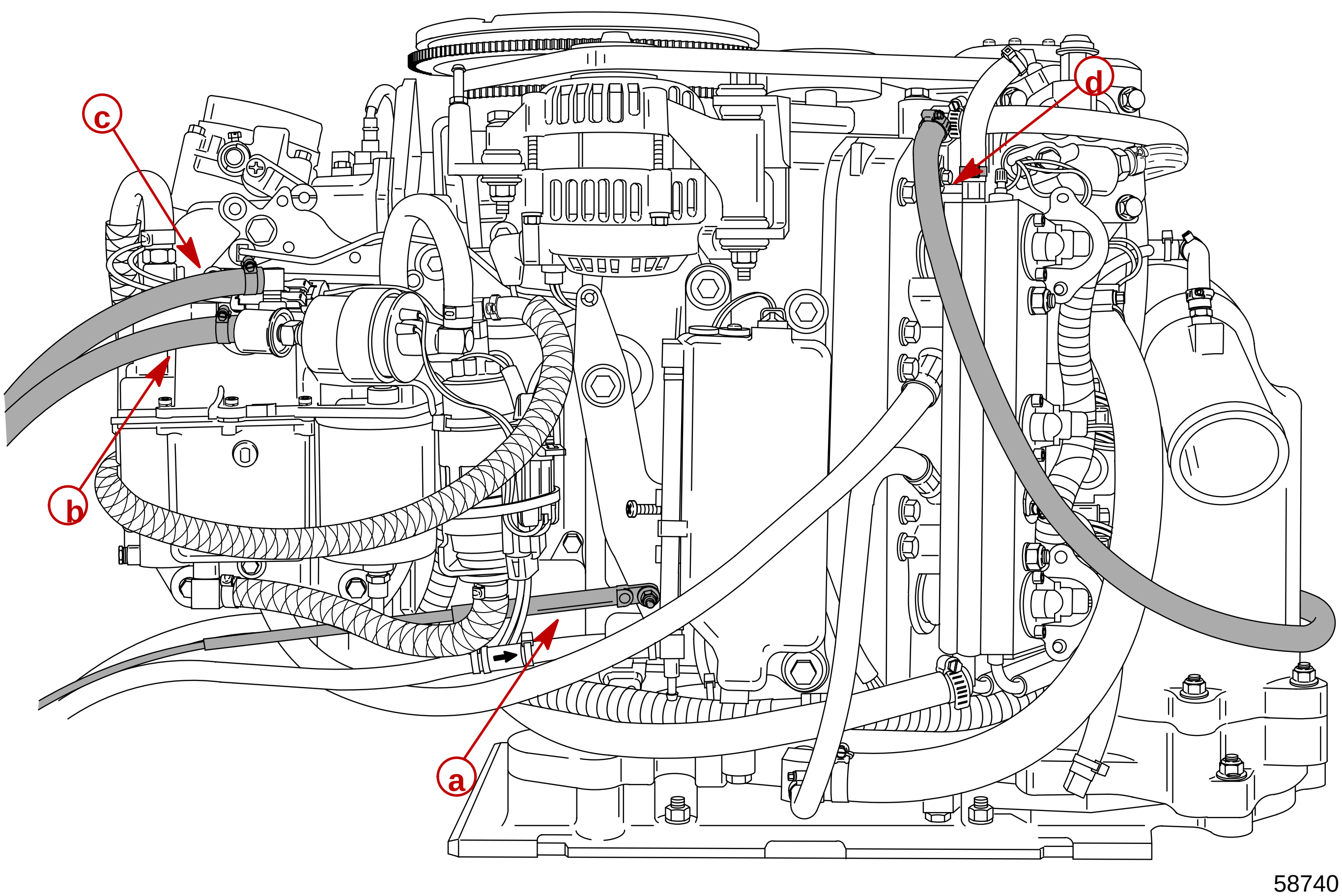


a - Positive Battery Cable
b - Negative Battery Cable
c - Remote Oil Tank Hose
d - Remote Control Harness

12. Install throttle cable. Secure with washer and locknut. Tighten locknut and then back off 1/4 turn.
13. Install fuel inlet line. Secure hose with stainless hose clamp.
14. Install vapor separator vent hose. Secure hose with stainless hose clamp.

IMPORTANT: High Pressure Pump Connector MUST BE routed on the outside of VST vent fitting.

15. Install water by-pass hose. Secure hose with stainless hose clamp.



a - Throttle Cable
b - Fuel Inlet
c - Vent Hose
d - Water By-Pass

Refer to Section 2 of this Service Manual “Timing/ Synchronizing/Adjusting” for engine set-up procedures.

Break-In Procedure

⚠ CAUTION

Severe damage to the engine can result by not complying with the Engine Break-in Procedure.

FUEL REQUIREMENTS

Do not use pre-mixed gas and oil in this engine. Use straight gasoline during engine break-in and after engine break-in. The ECM is programmed to signal the oil pump to provide additional oil (50:1 ratio) during the first 120 minutes of operation. The ECM will monitor this period through its own internal clock. At the end of this period, the ECM will signal the oil pump to go to a standard ratio of 300 – 400:1 @ idle and 40:1 @ W.O.T.

INITIATING ENGINE BREAK-IN SEQUENCE

Refer to Section 3C for proper procedures.

ENGINE BREAK-IN PROCEDURE (ALL MODELS)

First Hour

- Allow engine to warm up for 30 – 60 seconds.
- Avoid continuous operation at idle speed for more than 10 minutes.
- Run engine for the majority of the time between 3000 and 4500 rpm; approximately 3/4 throttle.
- Vary engine speed; change engine speed approximately every 2 minutes.
- Short bursts of full throttle for periods up to 10 seconds are acceptable.

Next 3 Hours

- Change engine speed every 10 minutes.

POWERHEAD

Section 4B - Cooling

Table of Contents

Specifications 4B-2
Water Pressure 4B-2
Temperature Sensor 4B-2
Special Tools 4B-3
Temperature Sensor 4B-4
Model 200 Water Flow Description 4B-5
Model 200 Water Flow Diagram 4B-7
Water Pressure Check 4B-9
Problem Diagnosis 4B-9

4
B

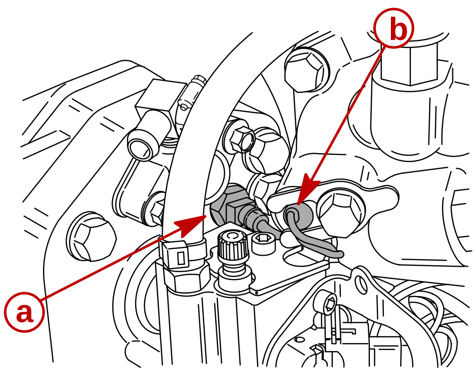
Specifications

Water Pressure

900 – 1000	0.2 – 0.6 PSI (1.4 – 4.0 kPa)
5500 (Boat on Plane)	10 – 15 PSI (69 – 103 kPa)

Temperature Sensor

Temperature Sensor(s)	
Between Black and each TAN/BLK wire.	No Continuity
Between each lead and ground	No Continuity



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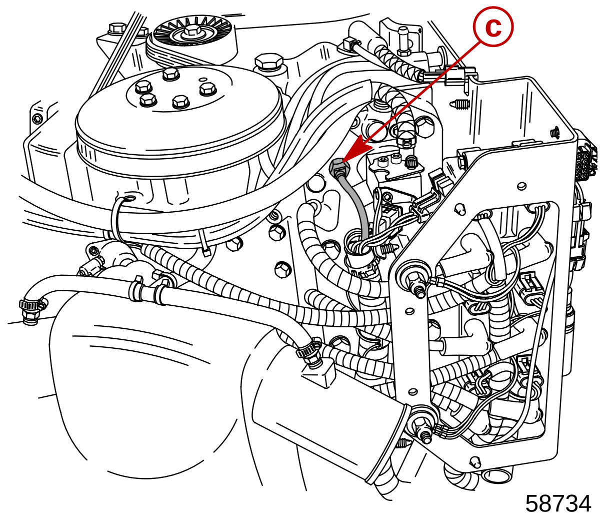


58734

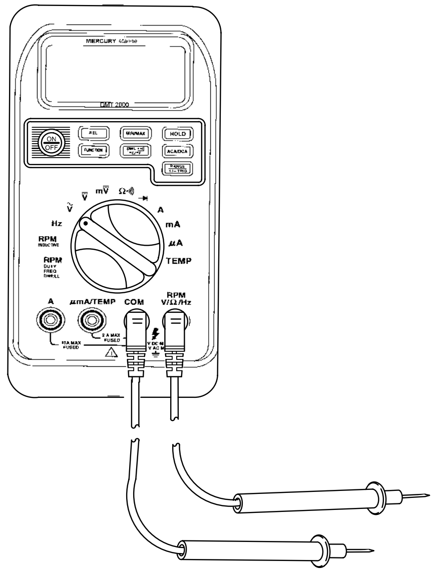
a - Port Cylinder Head Temperature Sensor – Horn Activation and Speed Reduction

b - Air Compressor Temperature Sensor – Horn Activation only

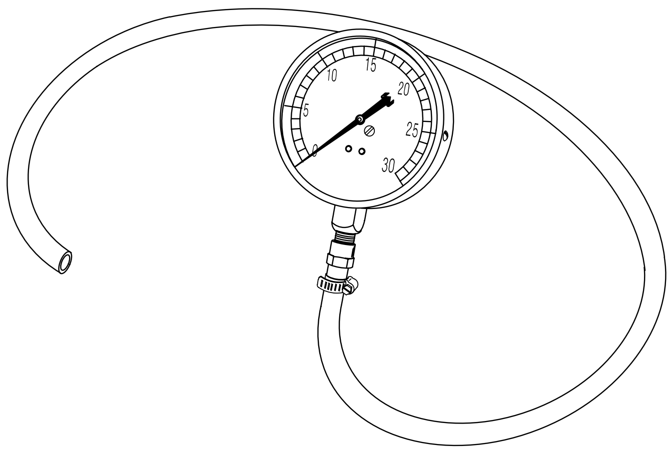
c - Starboard Cylinder Head Temperature Sensor – Horn Activation and Speed Reduction

Special Tools

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



2. Water Pressure Gauge 91-79250A2



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Temperature Sensor

Three temperature sensors are used to provide temperature information to the ECM. One sensor is mounted in each cylinder head and one sensor is mounted in the air compressor cylinder head.

The ECM uses this information to increase injector pulse width for cold starts and to retard timing in the event of an over-heat condition.

An ohms test of the temperature sensor would be as follows:

Disconnect temperature sensor harness and check continuity with digital or analog ohmmeter test leads between both connector pins. With engine at temperature (F°) indicated, ohm readings should be as indicated ± 10%. There should be no continuity between each connector pin and ground.

MODEL 200		
Fahrenheit	**Centigrade**	**Ohms**
257	125	340
248	120	390
239	115	450
230	110	517
221	105	592
212	100	680
203	95	787
194	90	915
185	85	1070
176	80	1255
167	75	1480
158	70	1752
149	65	2083
140	60	2488
131	55	2986
122	50	3603
113	45	4370
104	40	5327
95	35	6530
86	30	8056
77	25	10000
68	20	12493
59	15	15714
50	10	19903
41	5	25396
32	0	32654
14	–10	55319
5	–15	72940

Model 200 Water Flow

Description

Water is pumped up through the adaptor plate (9) and into the powerhead by the jet pump impeller which is constantly turning whenever the engine is running. Water flows through the center of the block, around the cylinder sleeves and through the cylinder heads (1).

Water exits from the bottom of the block and into the adaptor plate (9) flowing past the exhaust runners and into the expansion chamber. The water fills the expansion chamber and exits out the top of the chamber via a hose and back into the adaptor plate where it drains into the pump.

Water is also pumped from the starboard side of the adaptor plate to the fuel cooler (13) and then to the air compressor (12). The water exits the air compressor via a hose to a t-fitting over the expansion chamber. The water is then sprayed into each exhaust pipe for cooling purposes.

To allow complete passage filling and to prevent steam pockets, all cooling passages are interconnected. Small passages are incorporated to allow the cooling system to drain.

Notes:

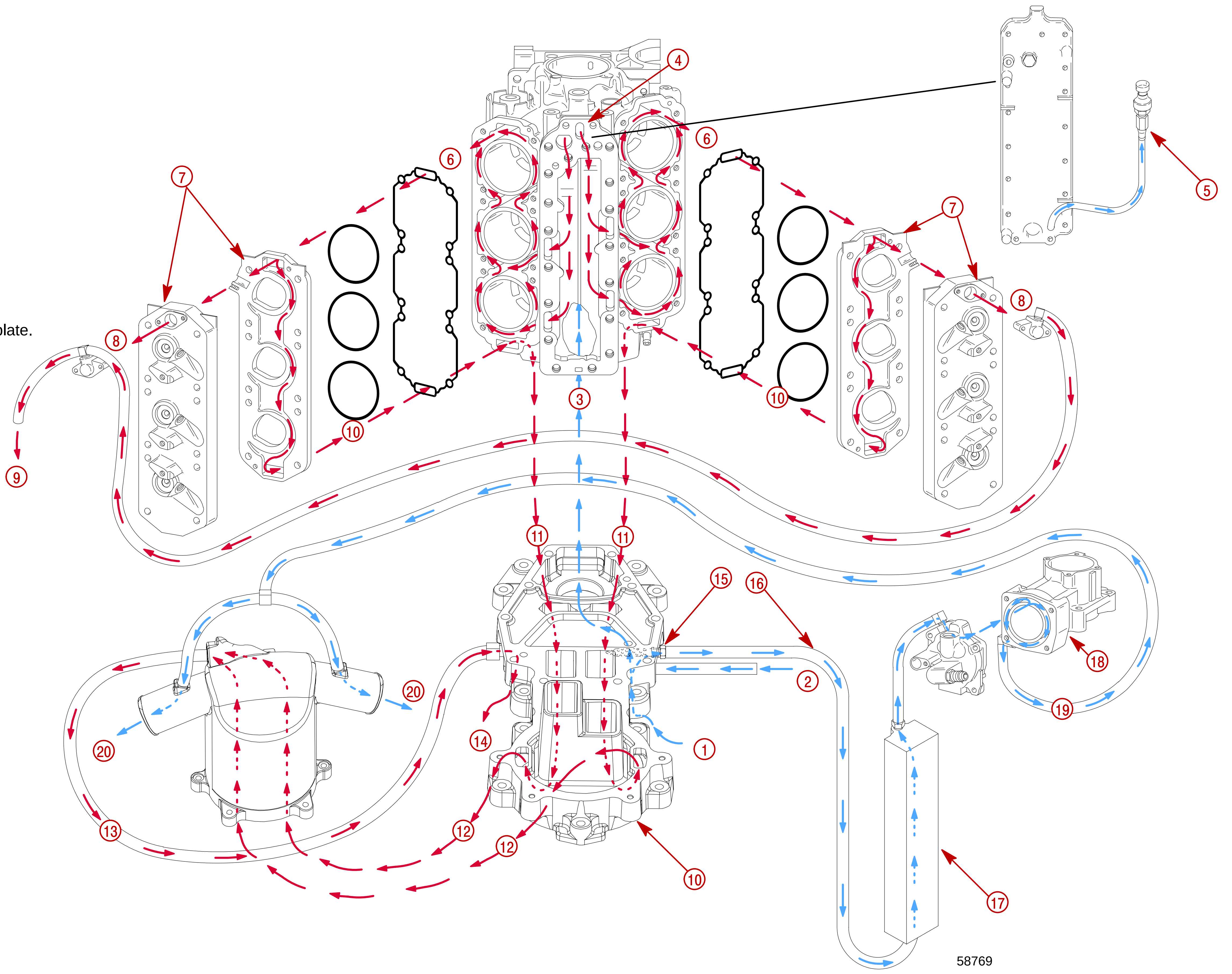
200 OptiMax Jet Drive Water Flow

Powerhead and Exhaust Cooling Circuit

1. Inlet cooling water from jet pump.
2. Water inlet from flushing connection.
3. Water flows from adapter to powerhead.
4. Water fills center of powerhead, flows over exhaust runners, then to cylinder jackets.
5. Water Pressure Sensor
6. Cooling water fills cylinder jackets, then flows to cylinder head.
7. Majority of water flows down cylinder head. Cylinder head cover has been removed from head for illustration. It is normally part of head casting.
8. Small amount of water flows out top of head to water bypass.
9. Water Bypass – discharged outside of boat.
10. Water flows from bottom of cylinder head through passage in cylinder block to adapter plate.
11. Water flows from block through adapter plate, cooling exhaust passages in adapter.
12. Water flows from adapter to expansion chamber water jacket.
13. Cooling water from expansion chamber is emptied back into adaptor plate.
14. Cooling water from adaptor plate is exhausted through the jet tunnel.

Compressor and Fuel Cooling Circuit

15. Fitting with Strainer
16. Incoming cooling water is directed to fuel rail.
17. Water flows through fuel rail (port) to air compressor.
18. Air compressor
19. Water flows from air compressor to expansion chamber exhaust pipes.
20. Cooling water for exhaust tubes is discharged with exhaust.



Water Pressure Check

Water pressure may be checked by using a Digital Diagnostic Terminal (91-823686A2), or if the boat is so equipped, with a Mercury Monitor or Smartcraft Gauges.

RPM	Water Pressure PSI (kPa)
900 - 1000	0.2 - 0.6 (1.4 - 4.0)
5500 (Boat on Plane)	10 - 15 (69 - 103)

Problem Diagnosis

Condition	Recommended Range	Possible Cause
Pressure below specification @ idle	0.2 - 0.6 psi (1.4 - 4.0 kPa)	•Severe internal leak •Inlet restriction
Pressure above 5 psi (34.2kPa) @ idle	0.2 - 0.6 psi (1.4 - 4.0 kPa)	•Plugged tell-tale
Pressure is below minimum specification @ W.O.T. 5500 (Boat on Plane)	10 psi (103 kPa)	•Inlet restriction •Severe internal leak
Pressure higher than normal @ W.O.T., but engine still indicates overheat condition 5500 (Boat on Plane)	Maximum pressure 15 psi (69 - 103 kPa)	•Outlet water passages restricted. •Steam pocket has formed at top of powerhead due to lack of cooling water •Kinked hose (expansion chamber to adaptor plate)
Pressure below specification @ idle or WOT		•Pinched/kinked/leaky hose from exhaust cover to water pressure sensor •Plugged fitting on exhaust cover •Faulty water pressure sensor •Wire harness connection @ water pressure sensor •Weeds or rope on impeller shaft
Exhaust hose burned (expansion chamber to muffler)		•Kink in hose (strainer to starboard fuel rail) •Plugged strainer (adaptor plate) •Kink in hose (compressor to expansion chamber)

JET PUMP

Section 5 - Jet Pump

Table of Contents

General Information 5A-1
Principles of Operation 5A-1
Special Tools 5A-2
Drive Housing Components 5A-4
Pinion & Impeller Shaft 5A-6
Nozzle/Rudder Components 5A-8
Servicing Stator, Impeller and Wear Ring 5A-10
Disassembly 5A-10
Inspecting Components 5A-12
Installing Impeller 5A-14
Removing Jet Drive From Boat 5A-15
Drive Housing Disassembly and Reassembly 5A-16
Pinion Shaft Removal 5A-16
Impeller Shaft Removal 5A-19
Shimming Procedures 5A-23

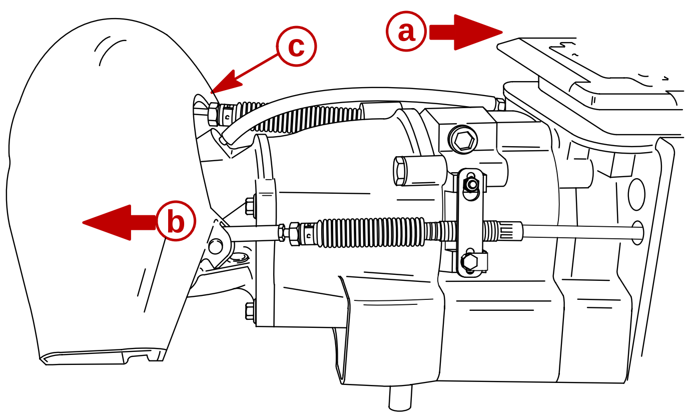
General Information

5

NOTE: *Due to running changes, some illustrations may not be exactly the same as your drive unit. Service procedures remain the same unless otherwise noted.*

Principles of Operation

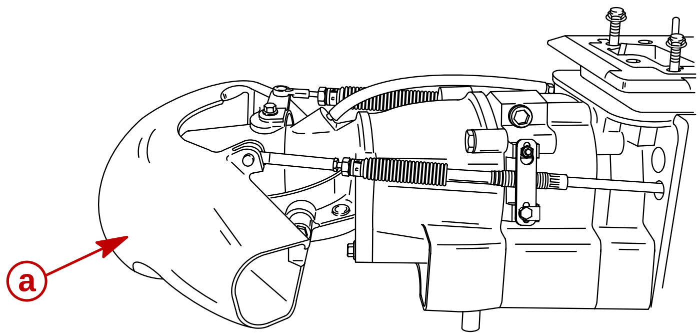
The jet pump operates by drawing water into a housing forward of the impeller. The water is pressurized within the specially designed housing and then directed to the rear to provide thrust and motion.



a - Forward Motion
b - Water Thrust
c - Reverse Gate (Shown In the Forward Position)

The jet pump is equipped with a steerable nozzle (rudder) at the aft end of the pump housing that directs the thrust of water. The jet of water can be directed right or left when the operator turns the steering wheel in the respective direction. When the operator turns the steering wheel to the right, for example, the nozzle turns to the right and the jet force from the nozzle pushes the stern of the boat to the left causing the bow of the boat to turn right.

Forward, reverse drive and the neutral position are achieved by the position of a reverse gate located just aft of the nozzle. Forward drive has the reverse gate clearing the nozzle to allow all the thrust to be directed straight back. Reverse drive has the reverse gate covering the entire opening enough to divert the thrust forward. Neutral position has the reverse gate covering 75 percent of the nozzle to direct the water stream forward and downward, as well as backward. The shift position is controlled at the control box in the boat.



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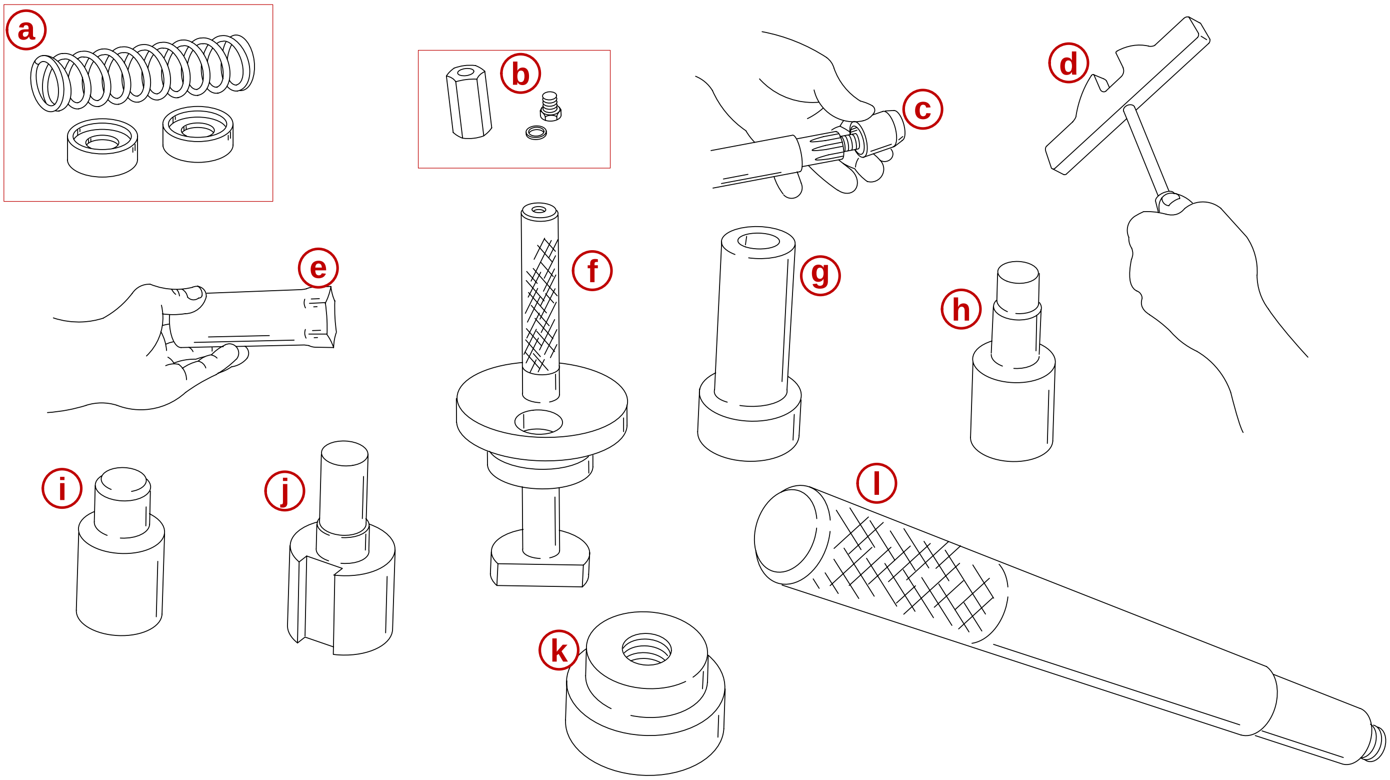
a - Reverse Gate (Shown In the Reverse Position)

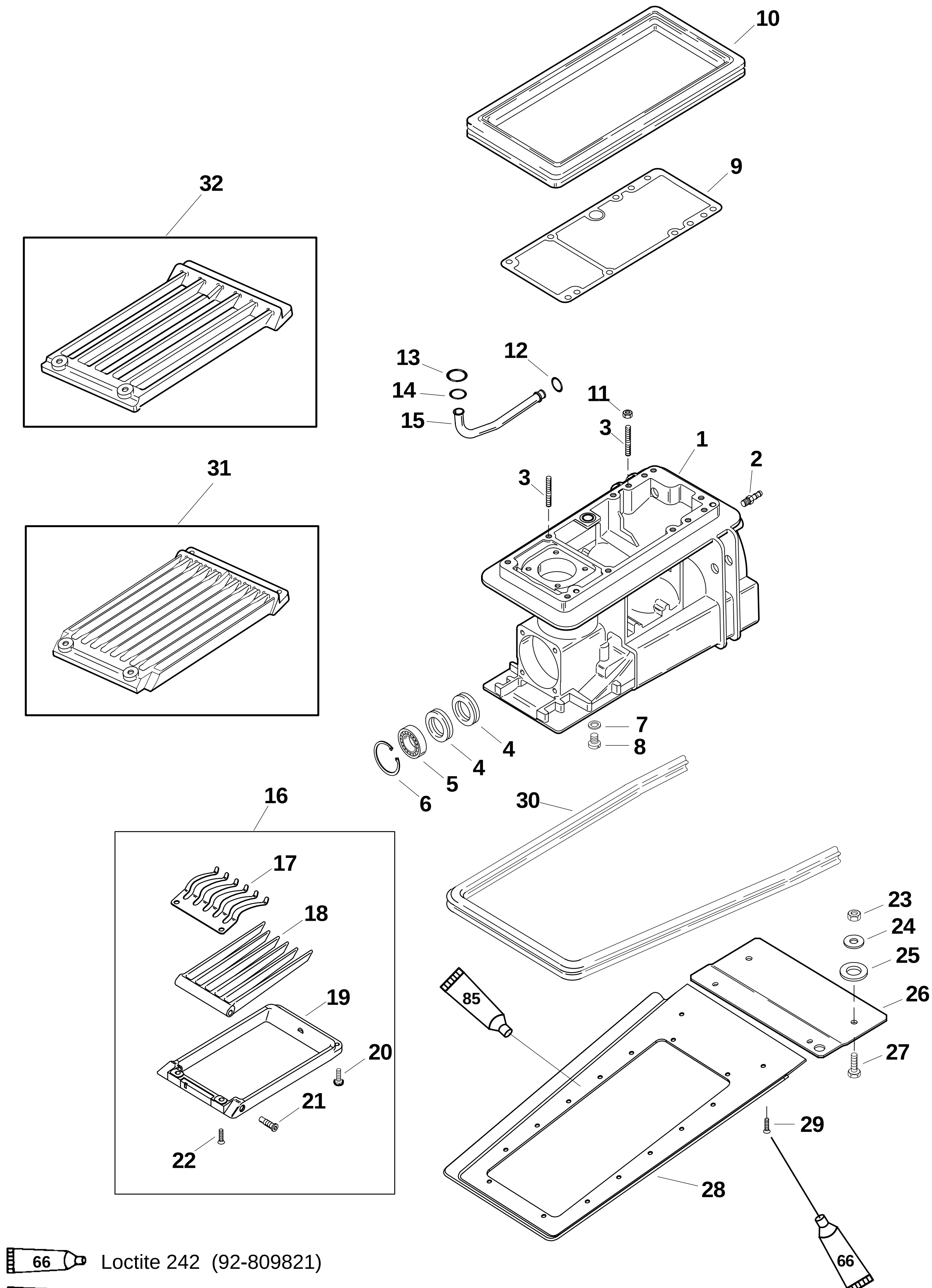
Special Tools

Jet Pump Tool Kit 91-809957A1		
	Description	**Part Number**
a	Pre-Load Kit Impeller Shaft	91-824871A2
b	Thread Extender Kit used w/ Backlash Kit	91-824869A1
c	Seal Protector Impeller Shaft	91-850233
d	Impeller Shaft Wrench	91-832093A1
e	Impeller Nut Socket	91-850297
f	Pinion Gear Location Tool	91-831897
g	Bearing Installer press ball bearing and seals into pinion shaft housing	91-832016
h	Bushing Installer stator bushings & seal	91-850831
i	Seal Installer impeller shaft seals in drive housing	91-832019
j	Bearing Installer impeller shaft ball bearing in drive housing	91-832017
k	Bearing Cup Installer pinion shaft housing and drive housing front cover	91-832018
l	Handle Driver	91-824892



Backlash Indicator Flag use MCII line	91-53459
Dial Indicator Kit	91-58222A1
Dial Indicator Adapter Kit	91-83155
Slide Hammer	91-34569A1
Bearing Puller Kit	91-83165M
Retaining Ring Pliers	91-25081
Lubricants/Adhesives	**Part Number**
Loctite, #271	92-809820
Loctite, #242	92-809821
Perfect Seal	92-34227--1
2-4-C Lubricant w/ Teflon	92-850736A1
Special Lube 101	92-13872A1
Premium Gear Lube	92-850737A1

Drive Housing Components



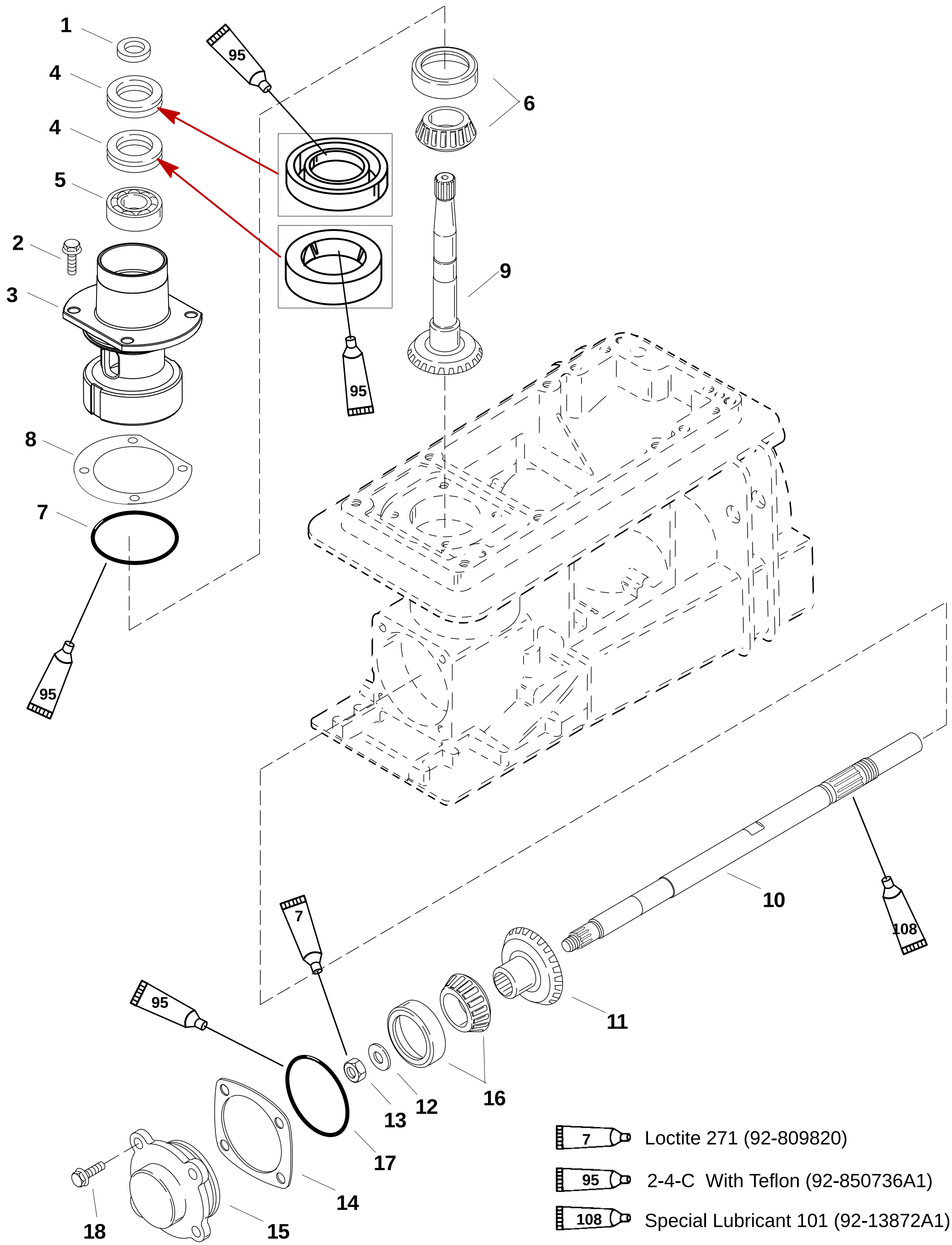
66 Loctite 242 (92-809821)

85 RTV 587 Silicone Sealer (92-809825)

Driving Housing Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	HOUSING KIT-Drive (Painted) **(COMPLETE) (NO IMPELLER)**			
	1	HOUSING ASSY-Drive (Painted) **(BASIC)**			
2	1	FITTING-Syphon Drain Hose (.125-27)			
3	4	STUD (M10 x 55)			
4	2	SEAL-Oil			
5	1	BEARING-Ball			
6	1	RING-Snap			
7	2	SCREW KIT			
8	2	WASHER-Sealing			
9	1	GASKET-Drive Housing To Top Cover			
10	1	GROMMET-Pump Mount			
11	4	NUT (M10)		35	47.5
12	1	O RING			
13	1	O RING (.139 x .796)			
14	1	O RING (.210 x .412)			
15	1	TUBE-Water			
16	1	INLET GRATE KIT (Painted)			
17	1	SPRING-Inlet Grate			
18	1	TINES-Inlet Grate			
19	1	FRAME-Inlet Grate			
20	2	SCREW With Nylon Patch (M6 x 20)	75		8.5
21	2	SCREW-Pivot (Special)	75		8.5
22	2	SCREW (M8 x 25)	200		22.6
23	2	NUT (M8)	156		18
24	2	WASHER (1.50 OD x .390 ID x .12)			
25	2	WASHER (1.50 OD x .900 ID x .125)			
26	1	PLATE-Trim			
27	2	SCREW (M8 x 35)			
28	1	RIDE PLATE KIT (Painted)			
29	16	SCREW With Nylon Patch (M6 x 20)	75		8.5
30	1	SEAL KIT-Ride Plate			
31	1	INLET GRATE			
32	1	ROCK GRATE			

Pinion & Impeller Shaft



7 Loctite 271 (92-809820)

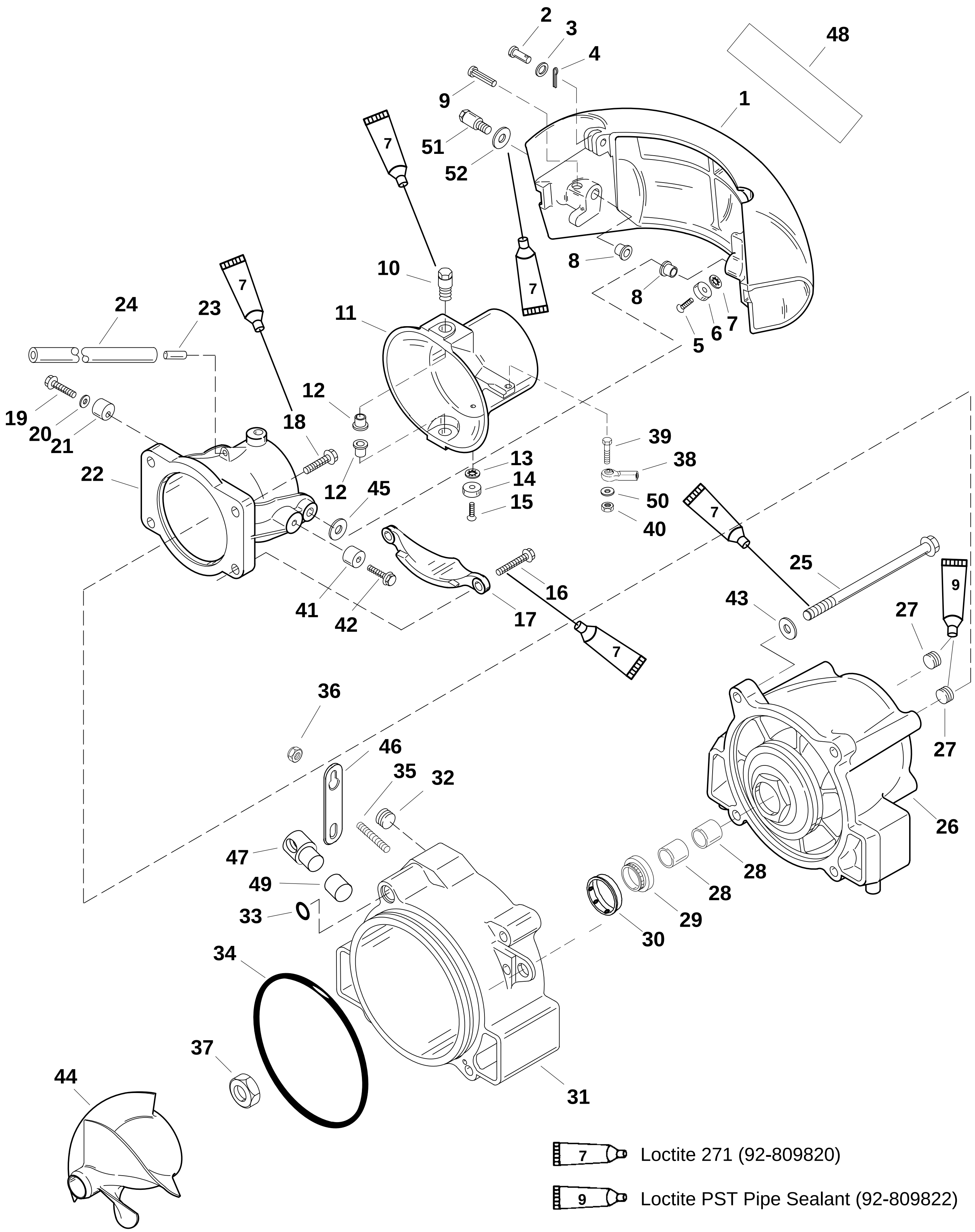
95 2-4-C With Teflon (92-850736A1)

108 Special Lubricant 101 (92-13872A1)

Pinion and Impeller Shaft

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	RING-Rubber			
2	4	SCREW (M8 x 25)	180		20.5
3	1	HOUSING ASSEMBLY-Pinion Shaft (Painted)			
4	2	SEAL-Pinion Shaft Housing			
5	1	BEARING-Ball			
6	1	BEARING SET (Cone And Cup)			
7	1	O RING			
8	AR	SHIM **(.002)**			
	AR	SHIM **(.004)**			
	AR	SHIM **(.005)**			
	AR	SHIM **(.0075)**			
	AR	SHIM **(.010)**			
9	1	GEAR/SHAFT ASSEMBLY-Pinion			
10	1	SHAFT-Impeller			
11	1	GEAR-Impeller Shaft			
12	1	WASHER			
13	1	NUT (M14)		90	122
14	AR	SHIM **(.002)**			
	AR	SHIM **(.004)**			
	AR	SHIM **(.005)**			
	AR	SHIM **(.0075)**			
	AR	SHIM **(.010)**			
15	1	COVER ASSEMBLY-Impeller Shaft (Painted)			
16	1	BEARING SET (Cone And Cup)			
17	1	O RING			
18	4	SCREW (M8 x 25)	180		20.5

Nozzle/Rudder Components



7 Loctite 271 (92-809820)

9 Loctite PST Pipe Sealant (92-809822)

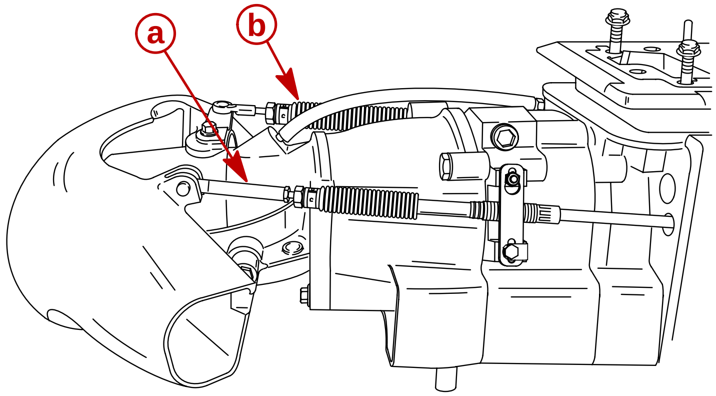
Nozzle/Rudder Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	REVERSE GATE KIT (Painted)			
2	1	PIN-Clevis (.250 x 1.13)			
3	1	WASHER			
4	1	PIN-Cotter			
5	1	SCREW (M6 x 20)	70		8
6	1	ANODE			
7	1	LOCKWASHER (.250 Internal)			
8	2	BUSHING-Pivot			
9	2	PIN-Trilobe			
10	2	BOLT (Special)-Pivot		50	68
11	1	RUDDER KIT (Painted)			
12	2	BUSHING-Pivot			
13	1	LOCKWASHER (.250 Internal)			
14	1	ANODE			
15	1	SCREW (M6 x 20)	70		8
16	2	SCREW (M10 x 45)		35	47
17	1	ANODE (With Bushings In Casting)			
18	2	SCREW (M10 x 35)		35	47
19	1	SCREW (M8 x 30)	120		13.5
20	1	WASHER			
21	1	STOP-Reverse Gate			
22	1	NOZZLE ASSEMBLY-With Pivot Bushings (Painted)			
23	1	FITTING-Nozzle			
24	1	HOSE-Syphon (12.250 Inches)			
25	4	SCREW (M10 x 150)		35	47
26	1	STATOR ASSEMBLY (Painted)			
27	2	PLUG-Pipe (.250-18)			
28	2	BUSHING-Stator Rear			
29	1	SEAL			
30	1	PROTECTOR-Seal			
31	1	RING KIT-Wear (Painted)			
32	1	PLUG-Pipe (.750-14)			
33	1	O RING			
34	1	O RING			
35	2	STUD (M6 x 36)			
36	2	NUT (M6)			
37	1	NUT-Impeller Shaft (1.250-12)		150	203
38	1	END KIT-Swivel			
39	1	BOLT AND NUT KIT			
40	1	NUT (.250-20)			
41	1	STOP-Non Adjustable			
42	1	SCREW (M8 x 25)			
43	4	WASHER			
44	1	IMPELLER-SS-4 Blade			
45	2	WASHER (Special)			
46	1	LATCH-Retainer Shift Cable			
47	1	RETAINER-Shift Cable			
48	1	DECAL-Reverse Gate (Powered By Mercury)			
49	1	CUP-Barrel-Shift Cable Retainer			
50	1	WASHER			
51	2	PIVOT		80	108
52	2	WASHER			

Servicing Stator, Impeller and Wear Ring

Disassembly

1. Disconnect spark plug leads from spark plugs.
2. Disconnect shift and steering cables at reverse gate and rudder.



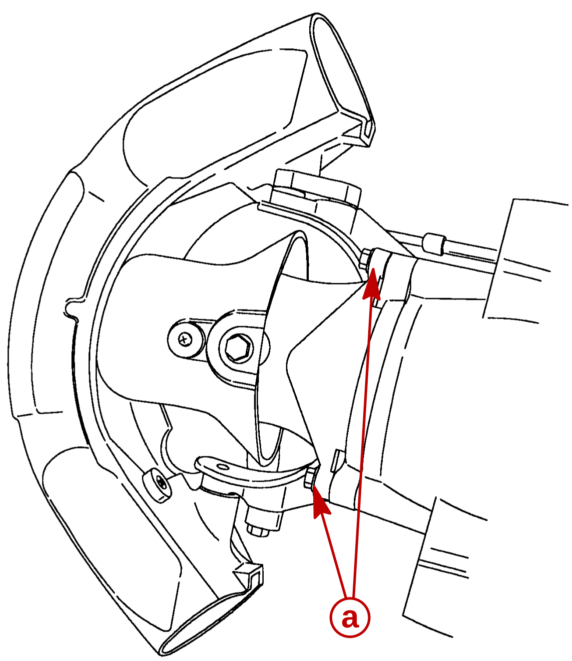
58193

a - Shift Cable
b - Steering Cable

IMPORTANT: This procedure lists the disassembly of external pump components. If servicing a specific component, follow the procedure in that section.

REMOVING REVERSE GATE, RUDDER AND NOZZLE AS AN ASSEMBLY

1. Remove four screws securing nozzle to stator. Remove reverse gate/rudder/nozzle assembly.

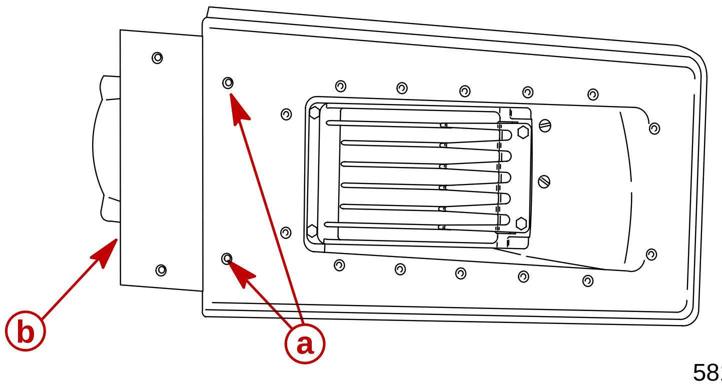


54579

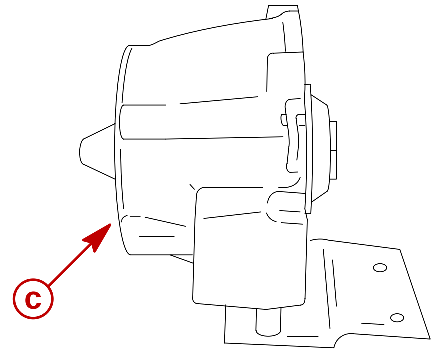
a - Screws (4)

STATOR REMOVAL

1. Remove two screws securing trim plate to ride plate and wear ring.
2. Remove four screws securing stator assembly to drive housing. Remove stator assembly.



58195



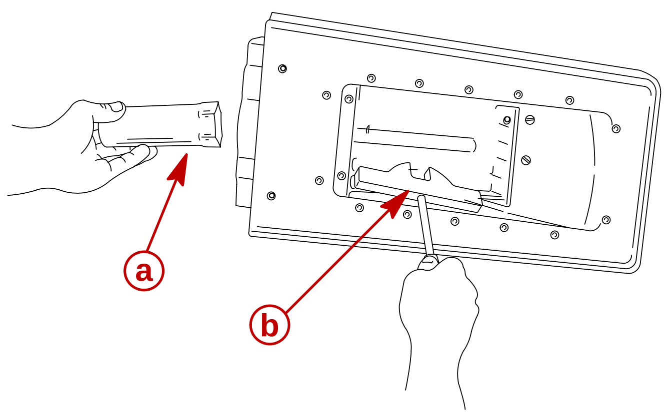
28253

a - Screws (2) to Trim Plate & Wear Ring
b - Trim Plate
c - Stator

3. Drain stator by tilting stator forward and allowing the oil to drain over the impeller shaft seals. Complete oil draining by removing stator fill plug and pour the remaining oil out the fill plug hole.

IMPELLER REMOVAL

1. If removed, install wear ring to support impeller and shaft during impeller removal.
2. Remove inlet screen on bottom of drive housing to allow access to machined flats on impeller shaft. Use Special Tool 91-832093A1 to hold impeller shaft for removing propeller nut.
3. While holding impeller shaft, remove impeller nut using Special Tool 91-850297. Impeller nut is a standard right hand thread. Remove impeller.



28252

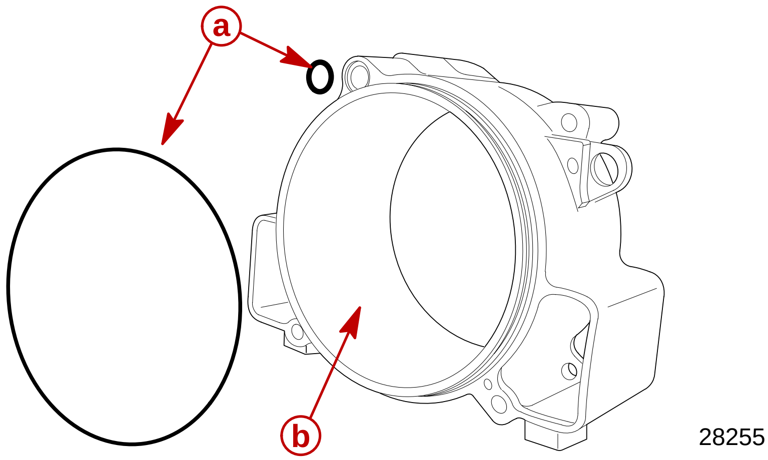
a - Special Tool 91-850297
b - Special Tool 91-832093A1

4. Remove wear ring.

Inspecting Components

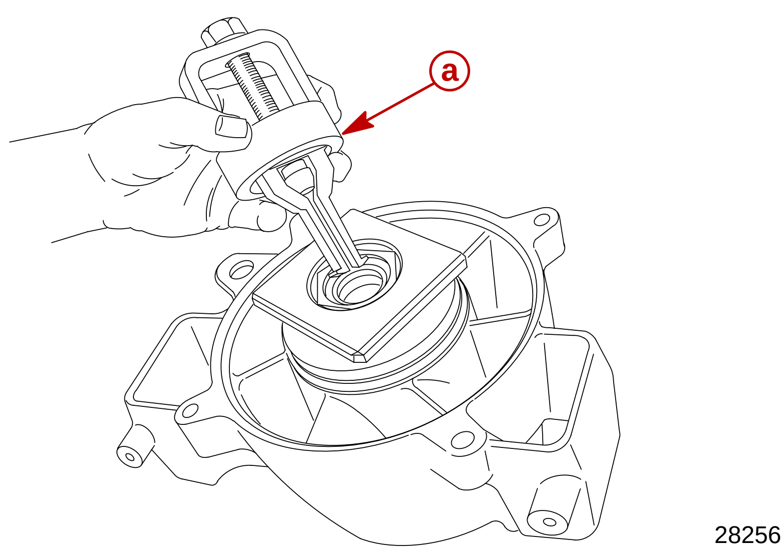
WEAR RING

1. Inspect wear ring for excessive scoring and/or grooves. Replace wear ring if deep grooves are present or if severe scoring has taken place.
2. Ensure O-ring is in counterbore before installing wear ring to drive housing.



a - O-rings
b - Inspect Surface for Grooves/Scoring

3. Inspect seal in stator for wear/damage.
4. Inspect bellows on cables for wear.
5. Inspect anodes, replace as necessary.
6. Inspect pivot pins and bushings, replace as necessary. Torque on reverse gate pivot pins is 80 lb. ft. (108 N·m). Rudder pivot pins is 50 lb. ft. (68 N·m). Use Loctite 271 on threads.
7. Inspect impeller for cracks and damaged blades.
8. Inspect stator vanes for cracks and/or damage.
9. If replacement is required, remove stator seal using Puller 91-83165M.



a - Puller 91-83165M

10. Install new seal using Special Tool 91-850831. Smaller diameter seal lip faces out.

IMPELLER

1. Place impeller in wear ring bore and push to one side.
2. Measure clearance between impeller blades and wear ring with a feeler gauge. If clearance is over 0.100 in. (2.54 mm), replace impeller and wear ring.

NOTE: *Impeller wear usually accounts for 75% of the wear. Reducing the clearance can improve both top speed and acceleration performance.*

COMPONENT SPECIFICATIONS

Wear Ring Bore Diameter	7.273 - 7.283 in. (184.73 - 184.98 mm)
Impeller Outside Diameter	7.225 - 7.235 in. (183.52 - 183.77 mm)
Clearance between Impeller and Wear Ring	0.038 - 0.058 in. (0.96 - 1.47 mm)

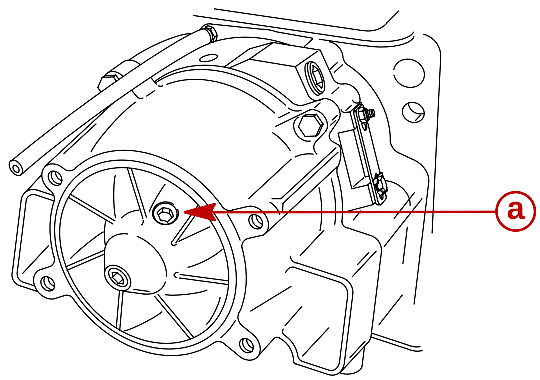
3. Inspect leading edges of the impeller for nicks and damage. Leading edges should be sharpened to 0.020 in. (0.51 mm) on the outer 1/2 of the leading edge for optimum performance. Dull leading edges can increase cavitation during initial acceleration.

Installing Impeller

1. Lubricate splines of impeller shaft with Special Lube 101 (92-13872A1).
2. Install impeller and nut on impeller shaft. Torque impeller nut to 150 lb. ft. (203 N·m).
3. Install inlet screen. Apply Loctite 242 to threads of screws and bolts. Torque the two 6 mm screws to 75 lb. in. (8.5 N·m). Torque the two 8 mm bolts to 200 lb. in. (22.5 N·m).
4. Install wear ring and stator. Apply Perfect Seal to threads of four bolts. Torque to 35 lb. ft. (47 N·m).

NOTE: *The stator oil should be checked periodically for contamination and fluid level. To check stator oil, shift the reverse gate to the forward position. Using an allen socket and extension, remove the stator fill plug. Use a small screw driver to dip into the oil to check it for contamination, discoloration and level. If oil is low, add oil. If oil is contaminated or discolored, shaft, seals and bushings must be inspected and/or replaced before refilling stator with new oil. After refilling stator with oil, apply Loctite PST Pipe Sealant (92-809822) to fill plug threads and reinstall plug.*

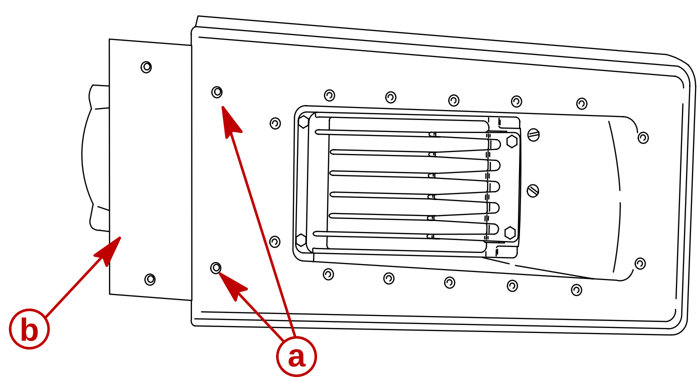
5. Remove stator fill plug and fill stator with Premium Gear Lube (92-850737A1) until oil flows out fill hole (capacity is 19 fl. oz. (550 cc)). Install fill plug.



58196

a - Fill Plug

6. Apply Loctite 242 to screws (2) securing trim plate to the ride plate. Torque screws to 75 lb. in. (8.5 N·m).



58195

a - Screws (2) to Trim Plate & Wear Ring
b - Trim Plate

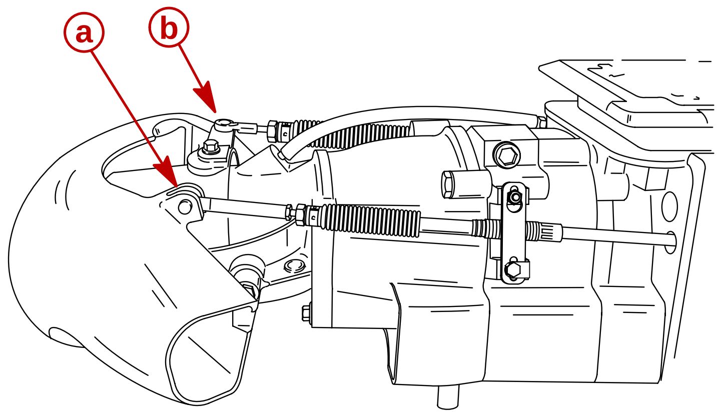
7. Install nozzle assembly and anode. Apply Loctite 271 to threads of screws. Torque all four (4) screws to 35 lb. ft. (47 N·m).
8. Attach shift and steering cables.

REFER TO SECTION 1D: SPORT JET INSTALLATION FOR SHIFT AND STEERING INSTALLATION AND ADJUSTMENT.

Removing Jet Drive From Boat

REMOVE POWERHEAD AS OUTLINED IN SECTION 4.

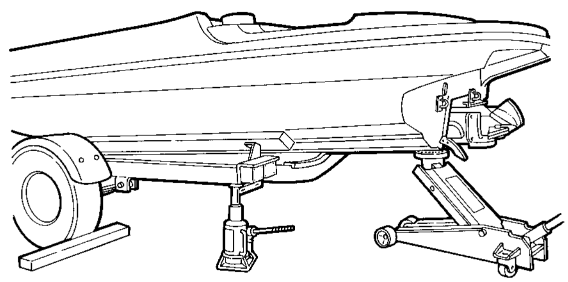
1. Disconnect shift and steering cables from reverse gate and rudder. Remove cable adaptors and bellows assemblies. Loosen shift and steering cables at wear ring.



58193

a - Shift Cable
b - Steering Cable

2. Loosen shift and steering cable thru hull fittings.
3. Support pump.

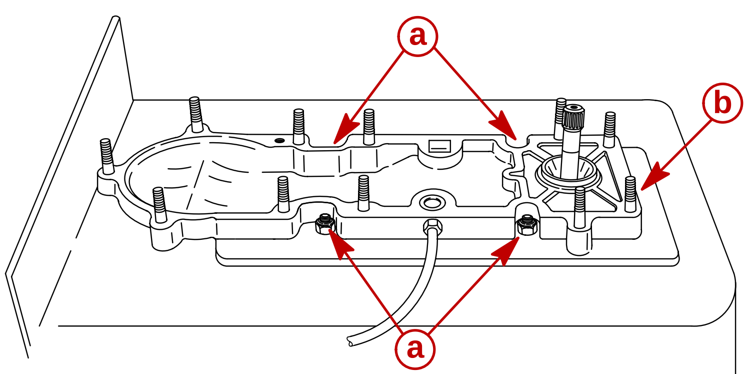


28257

WARNING

The pump unit must be supported to prevent it from dropping through the opening when the remaining fasteners are removed.

4. Remove remaining four nuts from drive housing cover. Remove drive housing cover and gasket.



58197

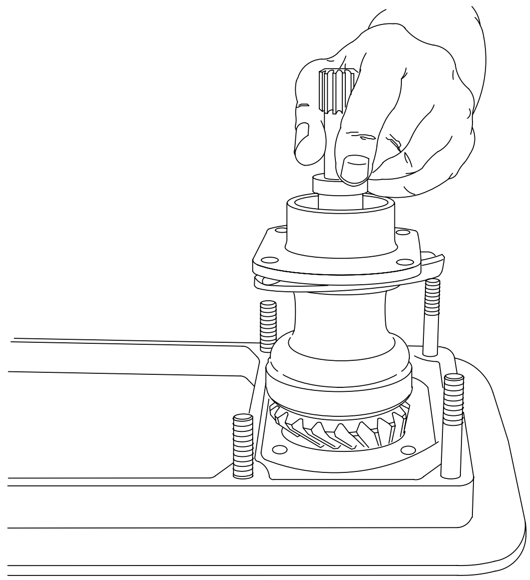
a - Nuts (4) **b** - Gasket

5. Lower drive housing while sliding cables out. Place on bench or suitable work stand for disassembly/repair.

Drive Housing Disassembly and Reassembly

Pinion Shaft Removal

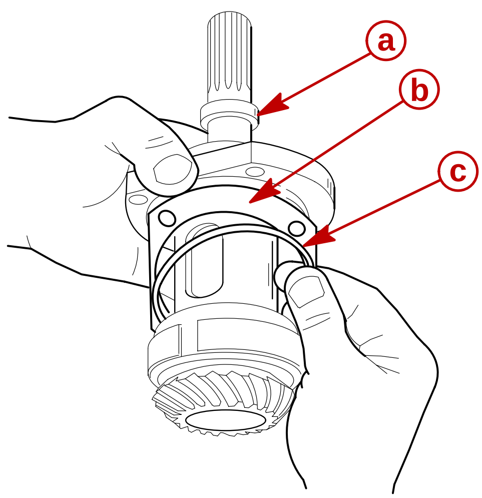
1. Remove four screws securing pinion shaft housing to drive housing. Remove pinion shaft assembly.



28257

NOTE: *Take care not to damage or misplace colored shims.*

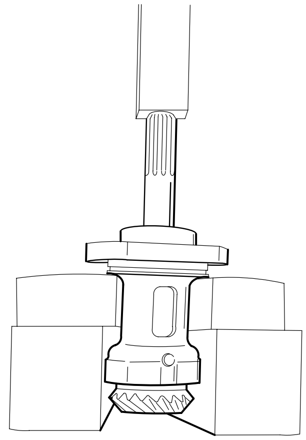
2. Remove rubber ring, O-ring and shims.



53797

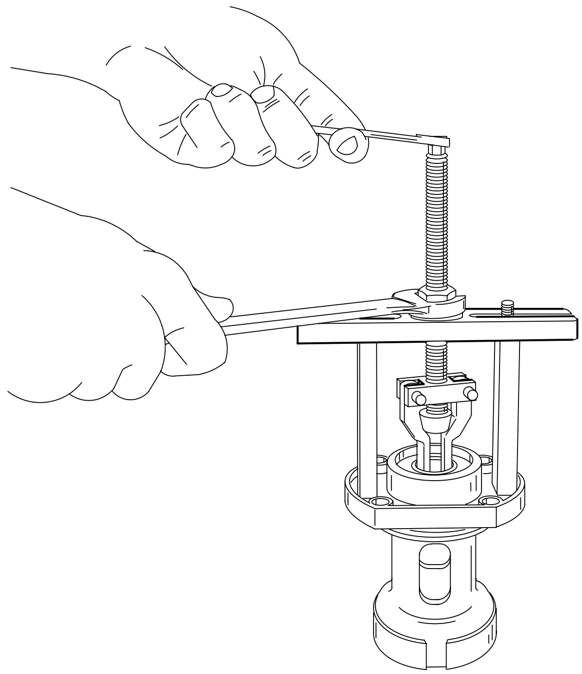
a - Rubber Ring
b - Shims
c - O-ring

3. Press pinion shaft out of pinion shaft housing.



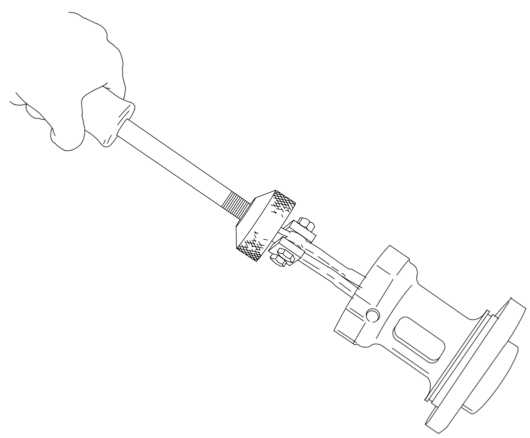
53796

4. Remove pinion shaft ball bearing and two seals using Puller 91-83165M.



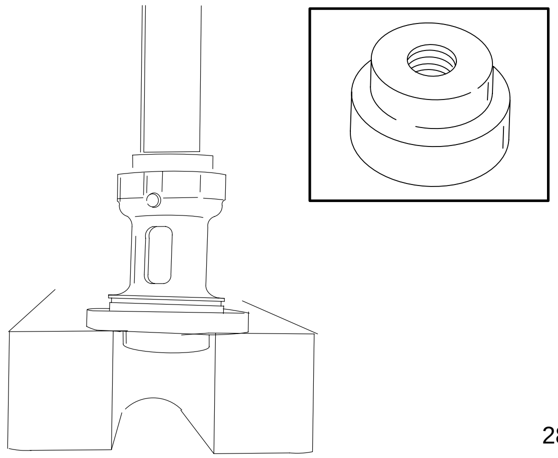
28264

5. Remove pinion shaft outer race from pinion shaft housing using slide hammer 91-34569A1.



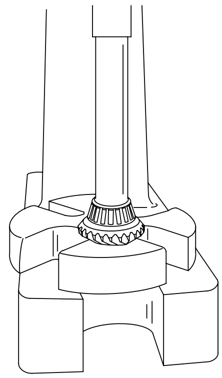
28265

6. Press new outer race into pinion shaft housing using mandrel 91-832018.



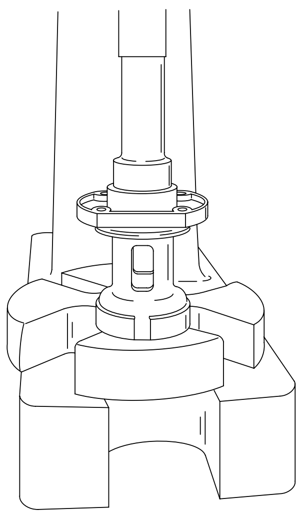
28264

7. Remove tapered roller bearing from pinion shaft using universal puller plate 91-37241.
8. Press new tapered roller bearing onto pinion shaft using Special Tool 91-827983.



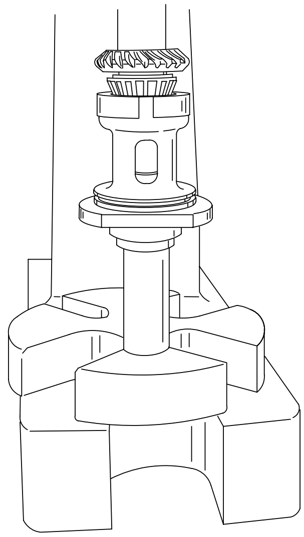
28265

9. Press new ball bearing into pinion shaft housing using Special Tool 91-832016.



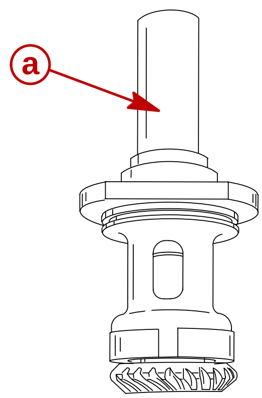
28266

10. Press pinion shaft into pinion housing.



28267

11. Press new seals into pinion shaft housing, one at a time, using Special Tool 91-820552. Inner seal faces in, outer seal faces out.

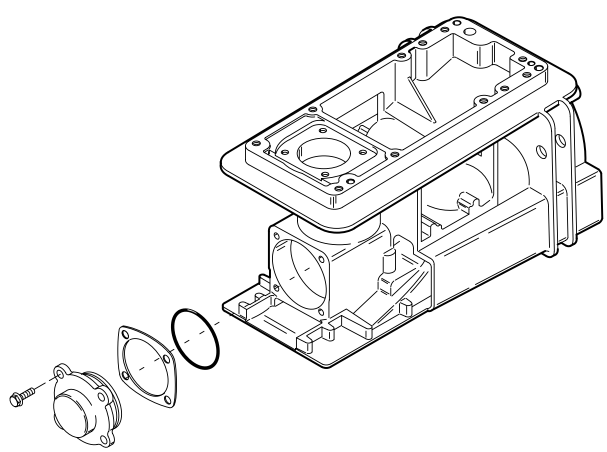


28268

a - Special Tool 91-820552

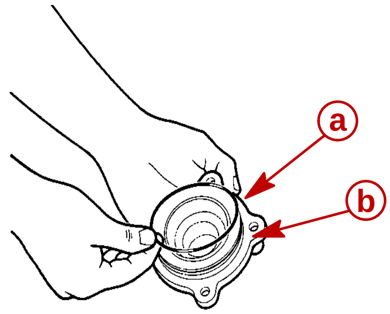
Impeller Shaft Removal

1. Remove stator, wear ring and impeller as described in “Servicing Impeller”.
2. Remove stator fill screw; drain oil into a suitable container.
3. Remove ride plate.
4. Remove four screws securing impeller shaft cover to drive housing. Remove cover.



28257

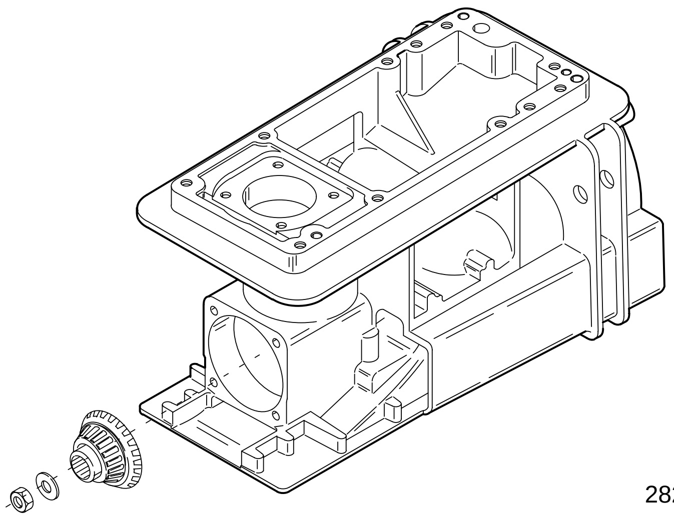
NOTE: *Take care not to damage or misplace colored shims.*



28258

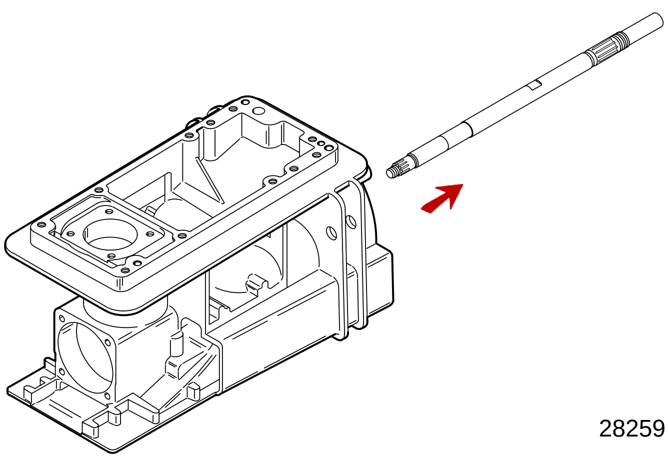
a **-** O-ring
b **-** Shims

5. Remove nut and washer from end of impeller shaft. Remove impeller shaft gear.



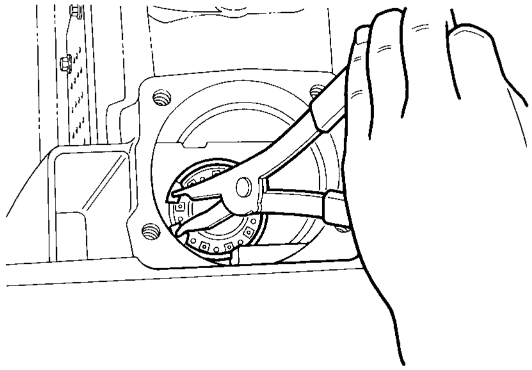
28259

6. Pull impeller shaft from drive housing.



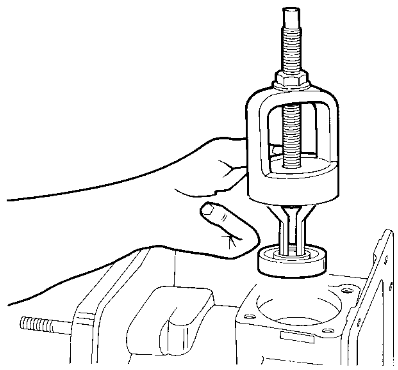
28259

7. Remove bearing retaining ring from drive housing.



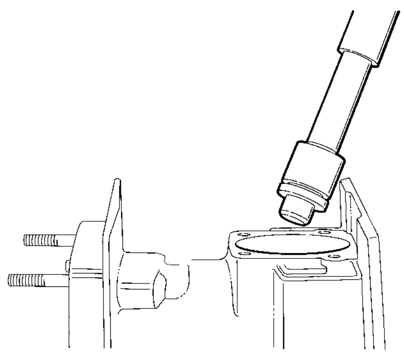
28262

8. Remove bearing using Puller 91-83165M.



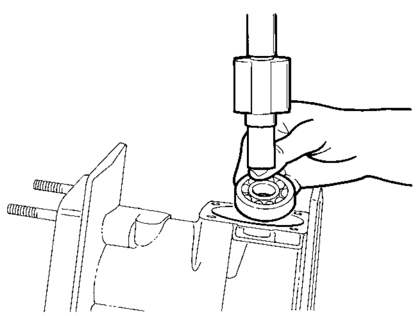
28263

9. Remove impeller shaft seals using Slide Hammer 91-34569A1.
10. Install new seals using Special Tool 91-832019.



28260

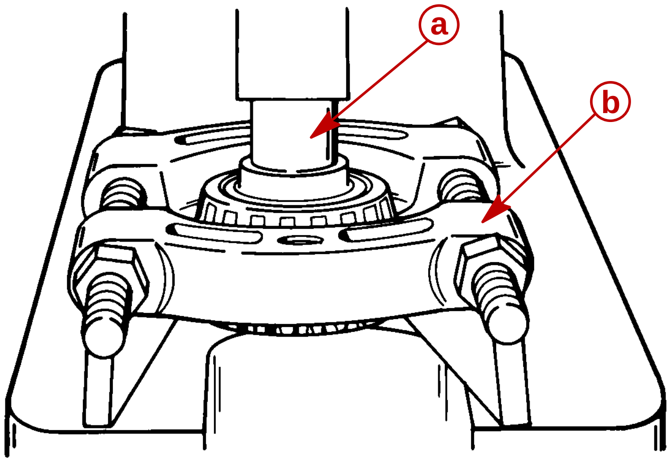
11. Install new bearing using Special Tool 91-832017.



28261

12. Install retaining ring in drive housing after bearing is installed.

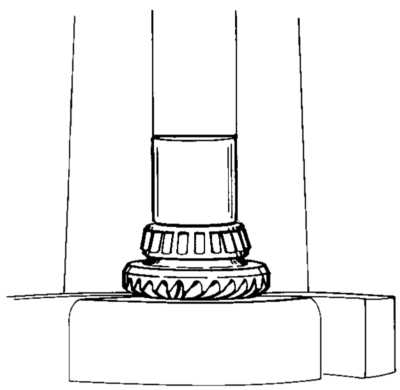
13. If replacing impeller shaft gear bearing, remove using universal plate.



28269

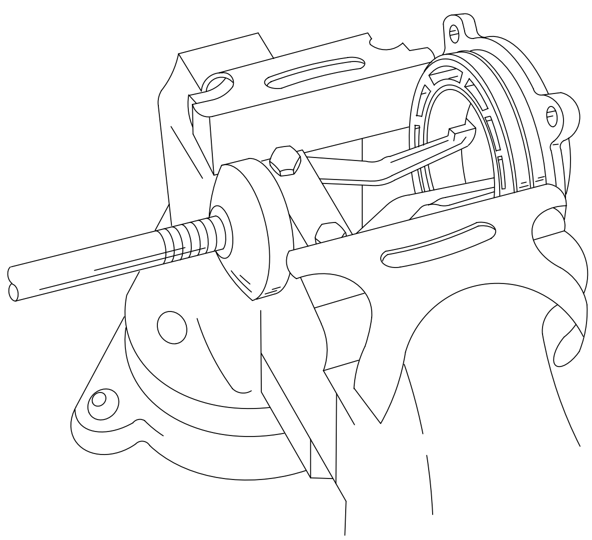
a - Suitable Mandrel
b - Universal Plate

14. Press new bearing on gear using an appropriate size mandrel.



28270

15. If replacing bearing, remove outer race from front cover using slide hammer. Press new outer race in cover using suitable mandrel.



54985

Shimming Procedures

NOTE: *Pinion gear shimming and backlash procedures must be preformed when any of the following components have been replaced:*

a. Jet Drive Housing

b. Pinion Gear

c. Pinion Gear Bearing Assembly

d. Pinion Shaft Housing

e. Impeller Gear

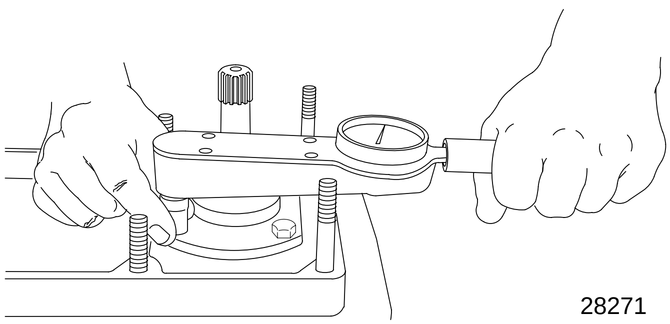
f. Impeller Gear Bearing Assembly

g. Impeller Shaft Front Cover

1. Install original shims on pinion shaft housing. Install O-ring on pinion shaft housing.

NOTE: *If original shims are not available, start with 0.030 in. (0.76 mm) shims (three brown colored shims).*

2. Install pinion shaft assembly into drive housing bore. Torque screws to 180 lb. in. (20.3 N·m).



28271

3. Rotate pinion shaft ten revolutions to properly seat roller bearings.
4. Insert Pinion Location Tool (Special Tool 91-824890) in drive housing.

NOTE: *Carefully inspect location tool to make sure it is seated in drive housing bearing.*

5. Insert feeler gauge through hole in pinion location tool between gauging surface of tool and flats on bottom of pinion gear teeth.

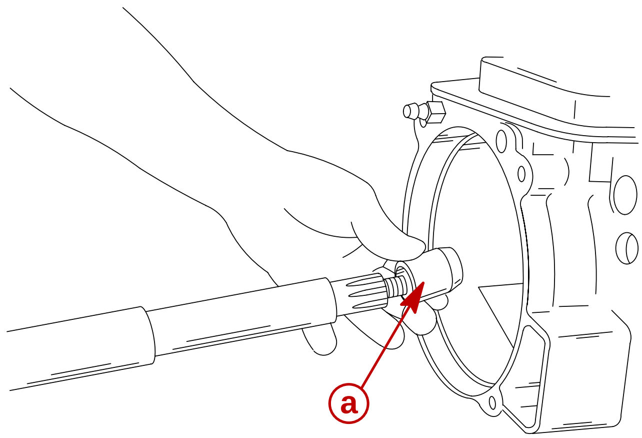
IMPORTANT: The correct clearance is 0.025 inch (0.64 mm).

6. Use 0.025 inch (.064 mm) feeler gauge as a starting thickness. Adjust thickness of feeler gauge until a slight drag is felt as gauge is drawn out between gauging surface of tool and pinion gear.

NOTE: *Once the thickness is determined, the difference between feeler gauge thickness and .025 inch (0.64mm) required clearance must be either added or subtracted from the total thickness of shims between pinion shaft housing and drive housing.*

- Remove the screws securing the pinion shaft housing assembly to the drive housing. Lift assembly out of the drive housing.
- Adjust shim thickness as required.

7. Install seal protector, Special Tool 91-850233, on impeller shaft. Install impeller shaft in drive housing, then remove seal protector.



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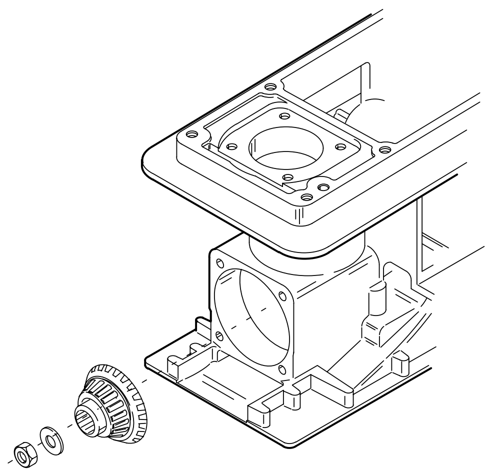
a - Seal Protector, Special Tool 91-850233

8. Install gear/bearing assembly and washer on impeller shaft. Apply Loctite 271 to threads of impeller shaft. Hold impeller shaft with Special Tool 91-832093A1. Install nut and torque to 90 lb. ft. (122 N·m).



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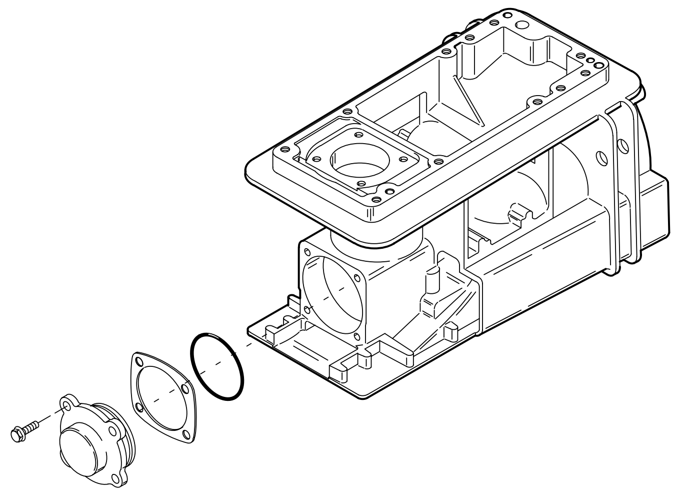
9. Install original shims on impeller shaft cover. Install O-ring on impeller shaft cover.

NOTE: *If original shims are not available, start with 0.030 in. (0.76 mm) shims (three brown colored shims).*

- Lubricate O-ring and bore with Quicksilver lubricant 2-4-C.
- Lubricate cone bearing with gearcase lubricant.

10. Install impeller shaft cover. Torque screws to 180 lb. in. (20.5 N·m).



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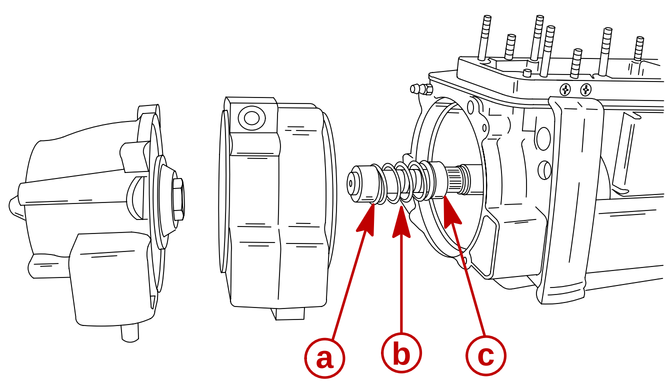
11. Install impeller shaft pre-load tool (91-824871A2).



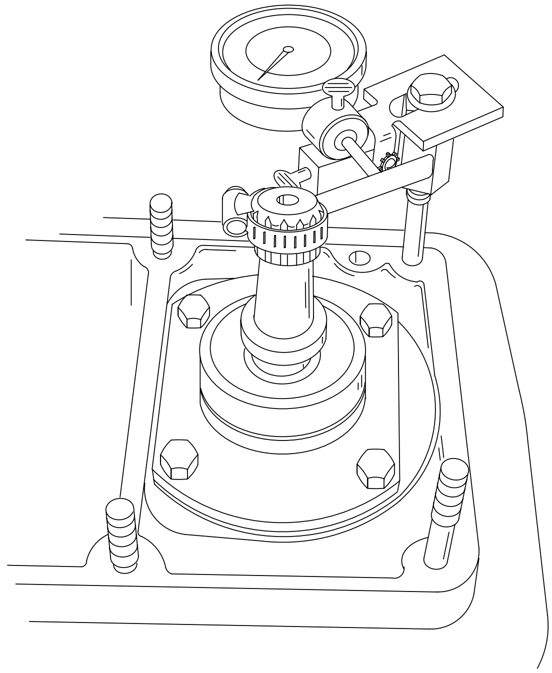
54983

a - Spring Seat, Rear
b - Spring
c - Spring Seat, Forward

12. Install wear ring and stator on impeller shaft. Secure assembly with two bolts (opposite corners). Torque bolts to 35 lb. ft. (47 N·m).

- Rotate impeller shaft ten revolutions to properly seat roller bearings.

13. Install Backlash Indicator Rod (Special Tool No. 91-53459) on pinion shaft.



14. Install Dial Indicator Kit, Adapter Kit and Thread Extender Kit.

- Position rod from dial indicator on the center mark “II” of the backlash indicator rod.

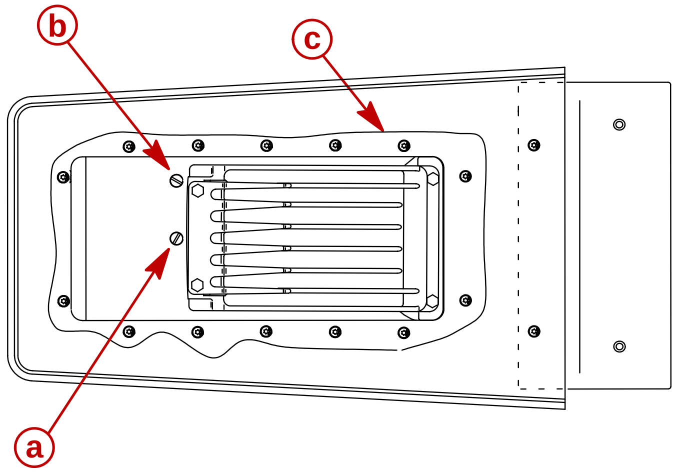
15. Rotate pinion shaft back and forth lightly to contact gear teeth in each direction.

NOTE: *Average total amount of reading of indicator backlash specification is 0.007 inch (0.18 mm) to 0.009 inch (0.23 mm).*

- If reading is less than minimum, add shims between impeller cover and drive housing.
- If reading is more than maximum remove shims between impeller cover and drive housing.
- Ratio of backlash reading to shims is 1:1.

16. Install impeller, wear ring and stator as outlined in “Installing Impeller” in this section.
17. Apply RTV Sealant (92-809825) on rideplate. Install rideplate. Apply Loctite 242 to threads of screws. Torque to 75 lb. in. (8.5 N·m).
18. Install nozzle/reverse gate assembly and anode. Apply Loctite #271 to threads of screws. Torque all four (4) screws to 35 lb. ft. (47 N·m).

19. Remove fill and vent screws from bottom of drive housing. Fill drive housing with Premium Gear Lube. Capacity is 27 oz. (825 cc).



58199

a - Fill/Drain Screw
b - Vent Screw
c - RTV Sealant 92-809825

NOTE: *To obtain correct oil level pump housing must be level and upright.*

Refer to Section 1D: Sport Jet Installation to complete installation of Drive Housing, Shift and Steering Cable Installation and Adjustment.

COLOR DIAGRAMS

Section 6

Table of Contents

200 OptiMax Jet Drive
Engine Wiring 6-3

200 OptiMax Jet Drive
Typical Key Switch Wiring 6-5

200 OptiMax Jet Drive
Typical Remote Control and Dash Wiring
for Non-SmartCraft 6-7

200 OptiMax Jet Drive
Typical Remote Control and Dash Wiring
for SmartCraft 6-9

200 OptiMax Jet Drive
Fuel and Air Flow 6-11

200 OptiMax Jet Drive
Water Flow 6-13

6

Notes:

200 OPTIMAX
JET DRIVE
ENGINE WIRING

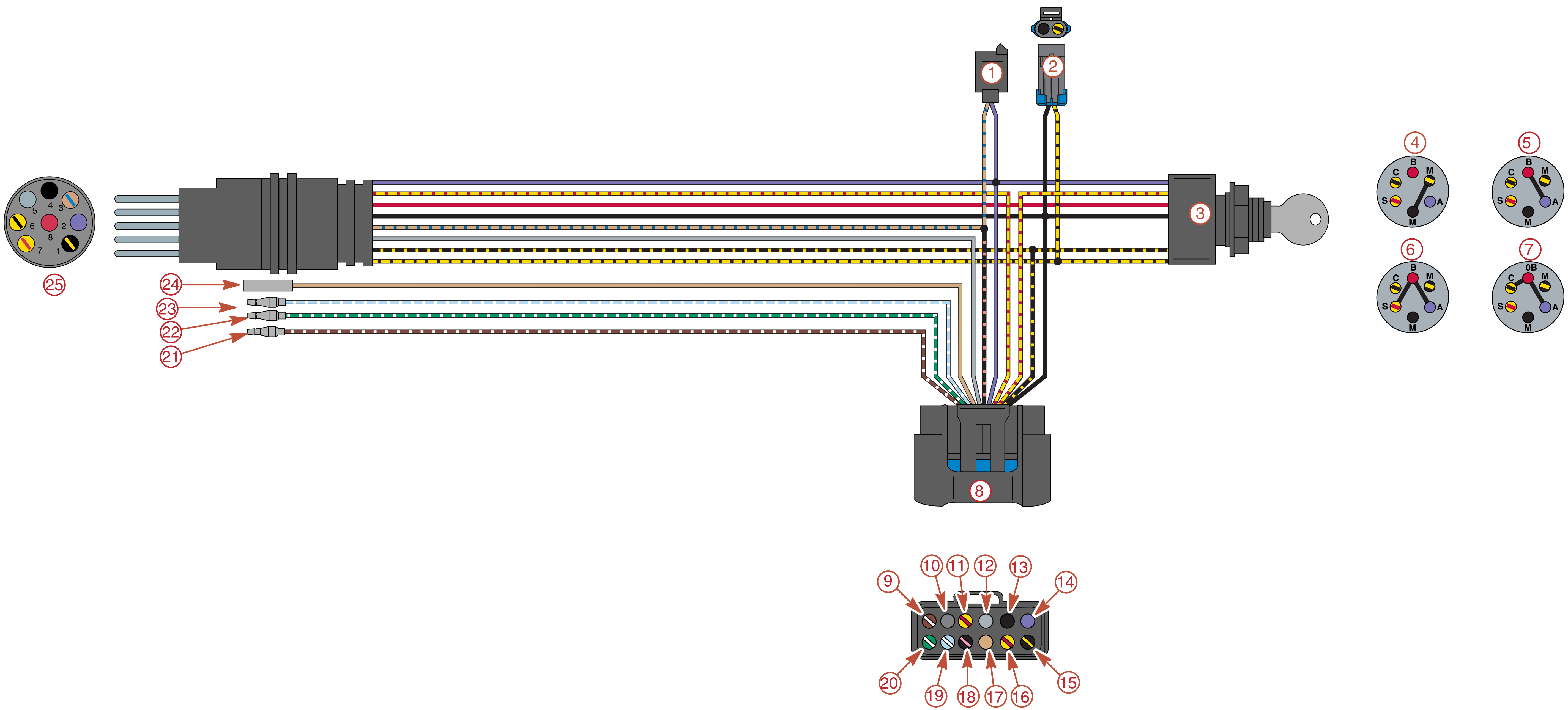
200 OPTIMAX JET DRIVE ENGINE WIRING

1. ECM
2. Ignition Coils
3. Coil Drivers
4. Fuel Injectors
5. Direct Injectors
6. Oil Pump
7. MAP Sensor
8. Block Pressure Sensor
9. Water Sensor
10. Starboard Head Temperature Switch
11. Port Head Temperature Switch
12. Throttle Position Sensor (TPS)
13. Crank Position Sensor
14. SmartCraft Data Bus Circuit 15 Ampere Fuse
15. Accessories 20 Ampere Fuse
16. Ignition Coil 20 Ampere Fuse
17. ECM Driver/Oil Pump/Electric Fuel Pump Circuit 20 Ampere Fuse
18. Low Oil Switch
19. Compressor Temperature Switch
20. Slave Solenoid
21. Starter Solenoid
22. Starter Motor
23. 60 Ampere Alternator
24. Air Temperature Sensor
25. Main Power Relay
26. To 12 Volt Battery
27. Accessory Power
28. Fuel Pump #1 (Inside Vapor Separator)
29. Fuel Pump #2 (Outside Vapor Separator)
30. Fuel Lift Pump
31. Engine Harness
32. Data Buss (10 Pin) Control Area Network (CAN)
33. DDT Test Port
34. SmartCraft Data Link Connection

200 OPTIMAX JET DRIVE
TYPICAL KEY SWITCH WIRING

200 OPTIMAX JET DRIVE
TYPICAL KEY SWITCH WIRING

1.Warning Horn
2.Connector for Low-Speed Control.
3.Key Switch
4.Key Switch Connections for OFF Position
5.Key Switch Connections for ON Position
6.Key Switch Connections for START Position
7.Key Switch Connections for CHOKE or PRIME Position
8.Harness Connection to Boat Dash
9.Not Used
10.Blank
11.To Neutral-Only Start Switch.
12.Provides Tachometer Signal to Tachometer.
13.Provides Ground for Dash Gauges and Lanyard Stop Switch.
14.Supplies Switched 12 Volt + to Dash Gauges.
15.Connects to Lanyard Stop Switch.
16.To Neutral–Only Start switch.
17.Not used.
18.Not used.
19.Connects to Oil Level Gauge
20.Not used
21.Not Used
22.Not used
23.Connects to Oil Level Sender in Tank
24.Not Used
25.Key Switch Harness Connection to Engine Harness



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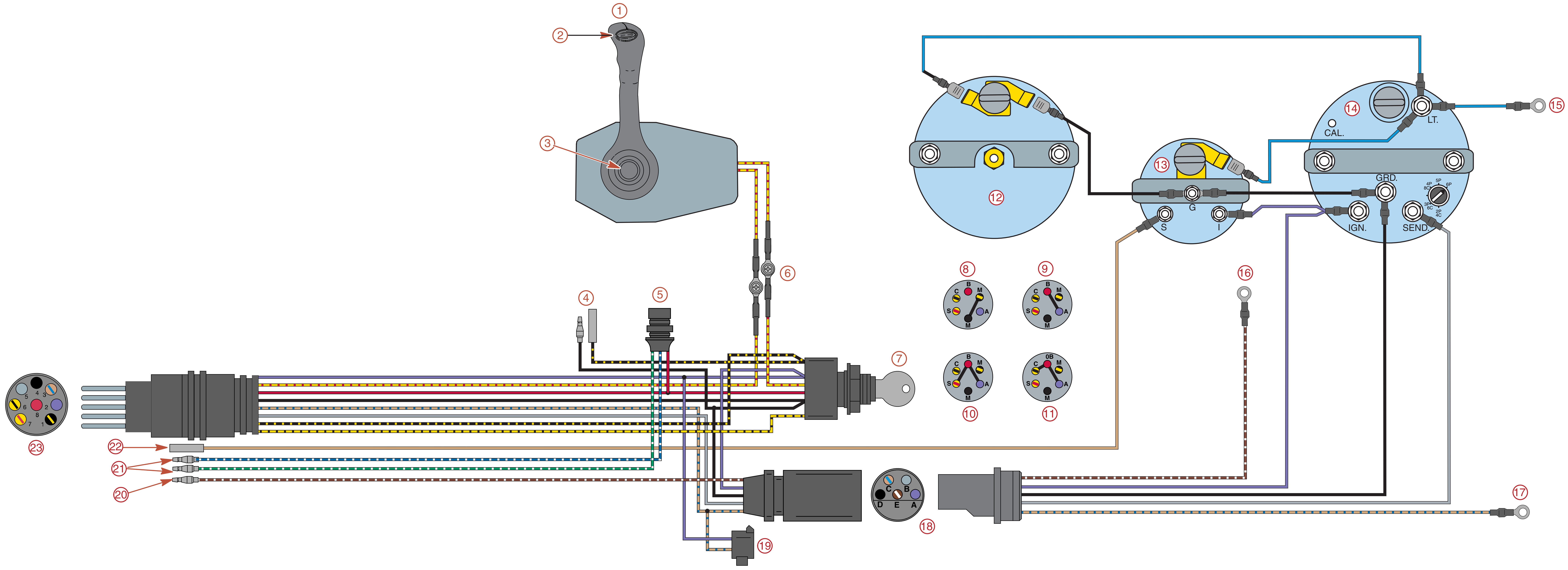
200 OPTIMAX JET DRIVE
TYPICAL REMOTE CONTROL AND DASH WIRING
NON-SMARTCRAFT

200 OPTIMAX JET DRIVE
TYPICAL REMOTE CONTROL AND DASH WIRING
NON-SMARTCRAFT

1. Remote Control meeting ABYC Mini Jet Boat Standard P23
2. Neutral Lock Button
3. Throttle Only Button
4. To Lanyard Stop Switch. Lanyard stop switch leads must be soldered and covered with shrink tube for a water proof connection.
   If alternate method of connection is made (use of electrical butt connector) verify connection is secure and seal for moisture proof connection.
5. Not Used
6. To Neutral Start Switch. Connect wires together with screw and hex nut (2 places); apply Quicksilver Liquid Neoprene to connections and slide heat shrink tubing over each connection.
7. Key Switch
8. Key Switch Connections for OFF Position
9. Key Switch Connections for ON Position
10. Key Switch Connections for START Position
11. Key Switch Connections for CHOKE or PRIME Position
12. Speedometer
13. Temperature Gauge
14. Tachometer
15. Light Switch Connection
16. Not Used
17. To Warning Light (if equipped)
18. Tachometer Harness Connection
19. Warning Horn
20. Not Used
21. Not Used
22. To Temperature Sensor (if equipped)
23. Remote Control Harness Connection



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200 OPTIMAX JET DRIVE
TYPICAL REMOTE CONTROL AND DASH WIRING
WITH SMARTCRAFT

200 OPTIMAX JET DRIVE
TYPICAL REMOTE CONTROL AND DASH WIRING WITH SMARTCRAFT

1. 8-Pin Digital Sensor Harness Extension, Connect to 8-Pin SmartCraft Harness on Engine
2. Digital Speedometer Sensor
3. Not used
4. 6-Pin Digital Sensor Harness
5. Not Used
6. Not Used
7. Not Used
8. Remote Control Harness Connects to Engine Harness
9. 10-Pin Control Area Network (CAN) Harness, Connect to Data Buss 10-Pin CAN Harness on Engine
10. Resistors within CAN Harness (120Ω 1/4W 5%)
11. Connections for Auxiliary Warning Horn for Depth Sensor
12. 10-Pin Control Area Network (CAN) Connection to System Monitor
13. System Monitor
14. System Link Series Connections
15. 3-1/4 in. System Link Gauges (Tachometer and Speedometer)
16. 2-1/4 in. Dia. System Link Gauges (Fuel, Temperature, Trim, etc.)
17. Series Connection for Additional System Link Gauges
18. Remote Control meeting ABYC Mini Jetboat Standard P23
19. Neutral Lock Button
20. Throttle Only Button
21. Connections for Lanyard Stop Switch
22. Connections for Power Trim Switch
23. Connections for Neutral Start Safety Switch
24. Ignition Key Switch
25. Key switch connections for OFF position
26. Key switch connections for ON position
27. Key switch connections for START position
28. Key switch connections for CHOKE or PRIME position
29. Analog Temperature Gauge Connection
30. Analog Tachometer Harness (Not Used on CAN Installation)
31. Warning Horn
32. Paddle Wheel/Lake/Sea Water Temperature Sender
33. 4-Pin Digital Sensor Harness Connection to Paddle Wheel
34. Digital Connections to Oil Sender
35. Digital Connections for Fuel Sender


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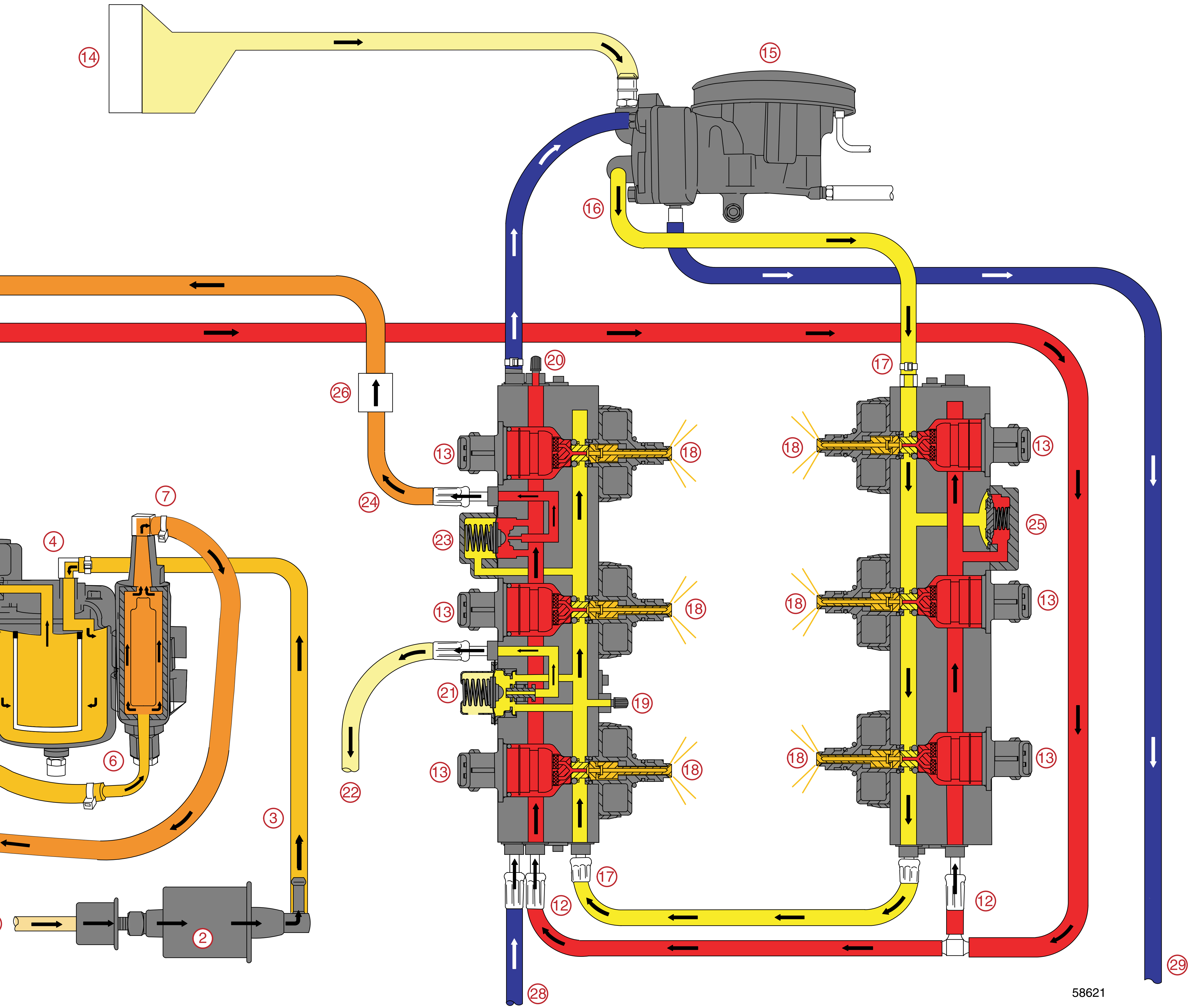
200 OPTIMAX JET DRIVE
FUEL & AIR FLOW DIAGRAM

200 OPTIMAX JET DRIVE
FUEL & AIR FLOW DIAGRAM

1. Fuel Inlet from Boat Fuel Tank
2. Engine Fuel Lift Pump
3. Fuel Line to Water Separating Fuel Filter – 2-8 psi (14-55 kPa)
4. Water Separating Fuel Filter in Vapor Separator Tank (VST) Assembly
5. Fuel Outlet from VST
6. Fuel Inlet to Low Pressure Electric Fuel Pump
7. Fuel Outlet from Low Pressure Electric Fuel Pump – 7-9 psi (48-62 kPa)
8. Fuel Inlet to High Pressure Electric Fuel Pump.
9. Relief Passage – Unused Fuel Returning to VST
10. Air Vent to Boat Fuel Tank
11. Fuel Outlet from High Pressure Electric Fuel Pump – 90 psi (620 kPa)
12. High Pressure Fuel Inlet to Air/Fuel Rails – 90 psi (620 kPa)
13. Fuel Injector is opened by the ECM, 90 psi (620 kPa) fuel is discharged into a machined cavity inside the air chamber of the air/fuel rail. This mixes the fuel with the air charge.
14. Air Inlet to Air Compressor
15. Air Compressor
16. High Pressure Air Outlet – 80 psi (551 kPa)
17. High Pressure Air Inlet to Air/Fuel Rails – 80 psi (551 kPa)
18. Direct Injector discharges the air/fuel mixture into the combustion chamber
19. Schrader Valve for Testing Air Pressure
20. Schrader Valve for Testing Fuel Pressure
21. Air Pressure Regulator will limit the amount of pressure developed inside the air passages to approximately 10 psi (69 kPa) below the pressure of the fuel inside the fuel passages (i.e. 80 psi [551 kPa] air vs 90 psi [620 kPa] fuel)
22. Bleed Off from Air Pressure Regulator, Routed to the Exhaust Adaptor and Exits thru the Propeller
23. Fuel Pressure Regulator not only regulates fuel pressure but also regulates it at approximately 10 p.s.i. (69 kPa) higher than whatever the air rail pressure is. The fuel regulator diaphragm is held closed with a spring that requires 10 p.s.i. (69 kPa) to force the diaphragm off the diaphragm seat. The back side of the diaphragm is exposed to air rail pressure. As the air rail pressure increases, the fuel pressure needed to open the regulator will equally increase.
24. Bleed Off from Fuel Pressure Regulator, Routed Back to VST
25. Tracker Valve has a rubber diaphragm which expands and retracts to equalize the pulses developed by the pumps (both air and fuel).
26. Check Valve – 40 psi (276 kPa)
27. Fuel return inlet from Fuel Regulator
28. Water Inlet to Cool Port Air/Fuel Rail and Air Compressor
29. Cooling Water from Compressor Routed to Expansion Chamber Exhaust Outlets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200 OPTIMAX JET DRIVE WATER FLOW

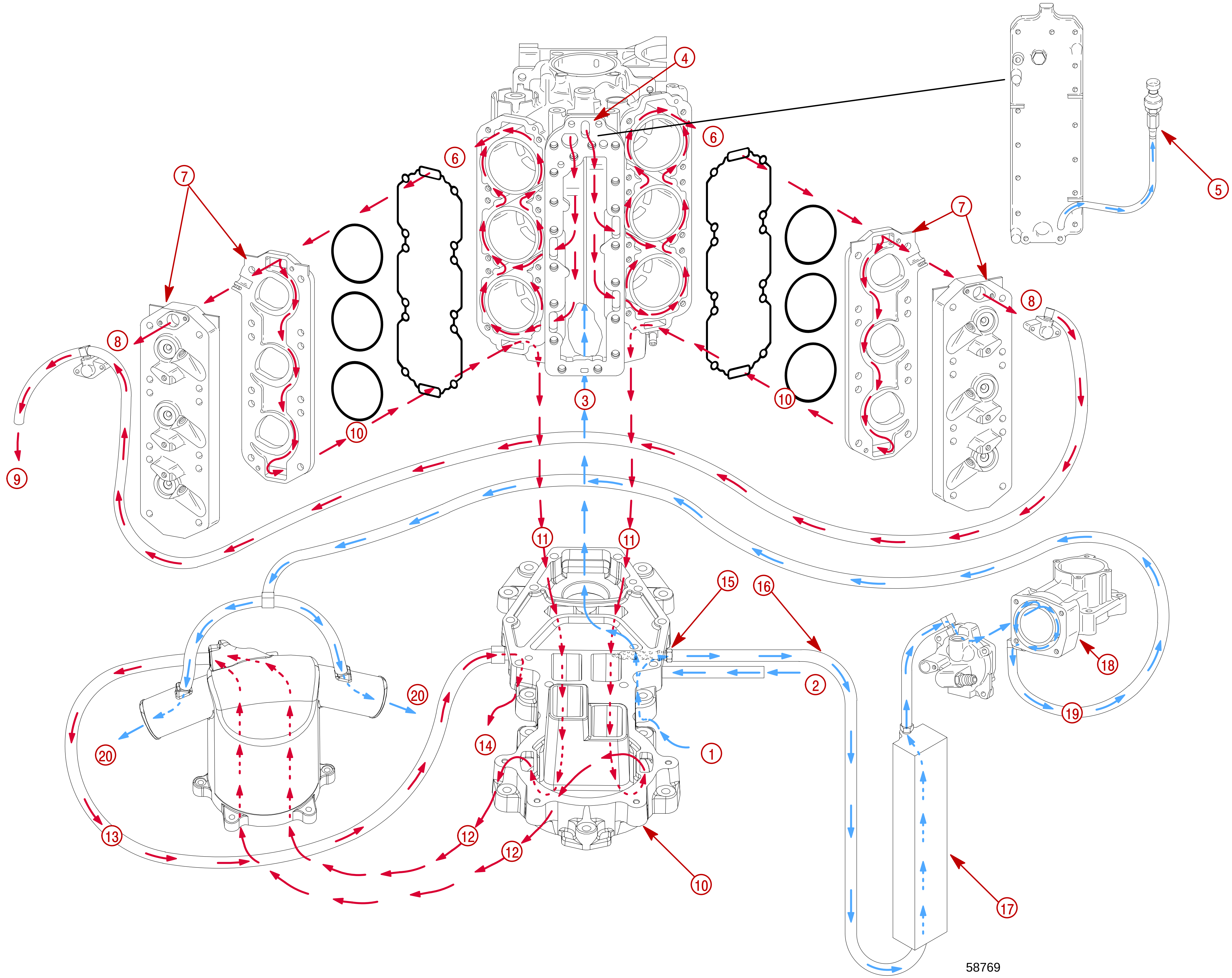
200 OPTIMAX JET DRIVE WATER FLOW

Powerhead and Exhaust Cooling Circuit

1. Inlet Cooling Water from Jet Pump.
2. Water Inlet from Flushing Connection.
3. Water Flows from Adapter Plate to Powerhead.
4. Water Fills Center of Powerhead, Flows Over Exhaust Runners, then to Cylinder Jackets
5. Water Pressure Sensor
6. Cooling Water Fills Cylinder Jackets, then flows to Cylinder Heads.
7. Majority of water flows down Cylinder Heads. Cylinder Head Cover has been removed from Head for illustration, it is normally part of Head Casting.
8. Small amount of water flows out top of Cylinder Head to Water By-Pass.
9. Water By-pass – Discharged outside of Boat.
10. Water flows from bottom of Cylinder Head through passage in Cylinder Block to Adapter Plate.
11. Water flows from Cylinder Block through Adapter Plate, Cooling Exhaust Passages.
12. Water flows from Adapter Plate to Expansion Chamber Water Jacket.
13. Cooling Water from Expansion Chamber is emptied back into Adaptor Plate.
14. Cooling Water from Adaptor Plate is exhausted through the Jet Tunnel.

Compressor and Fuel Cooling Circuit

15. Fitting with Strainer
16. Incoming Cooling Water is directed to Fuel Rail.
17. Cooling Water flows through Fuel Rail (port) to Air Compressor.
18. Air Compressor
19. Cooling Water flows from Air Compressor to Expansion Chamber Exhaust Pipes.
20. Cooling Water for Exhaust Tubes is discharged with Exhaust.



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