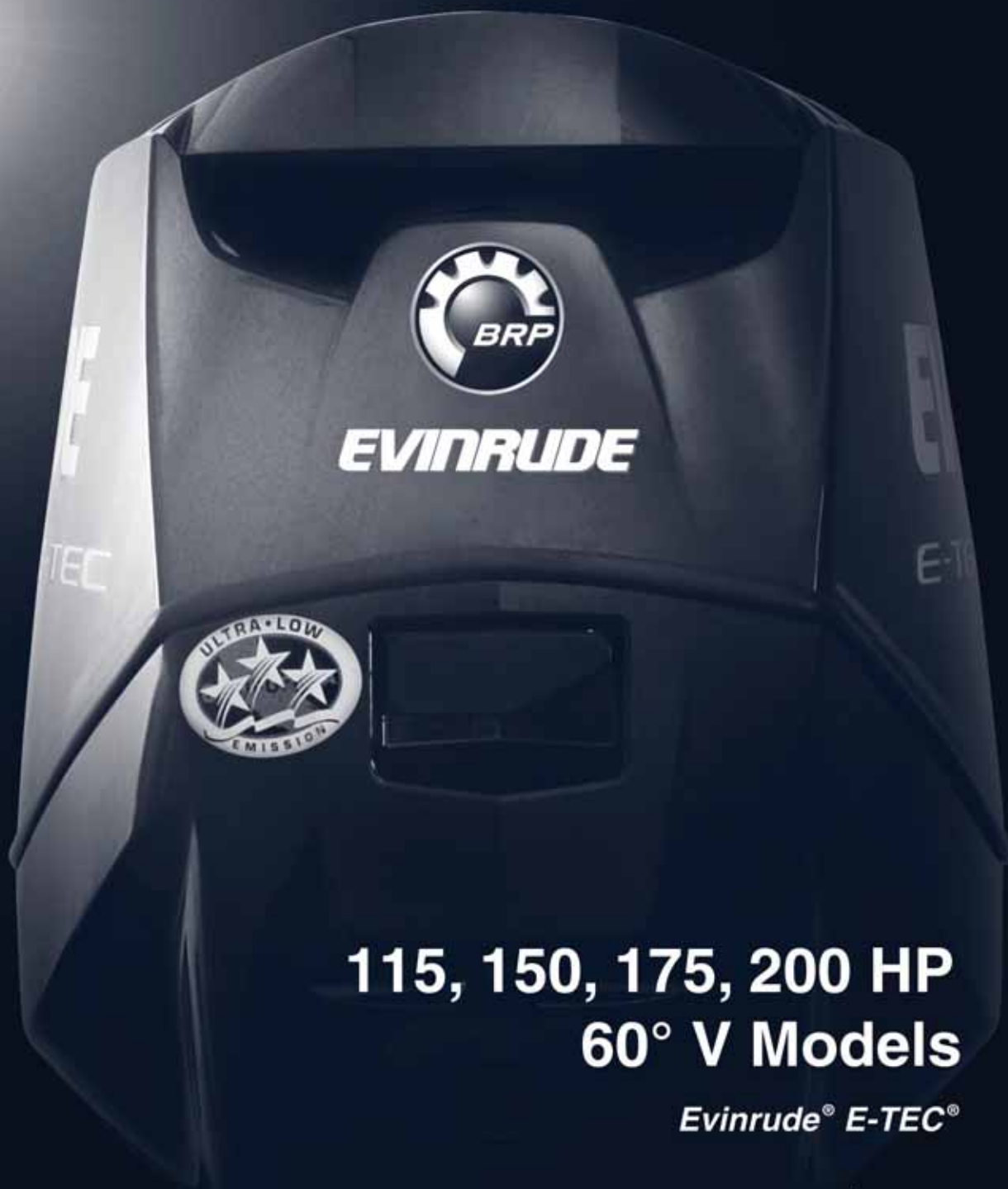


# 2007 Service Manual



**115, 150, 175, 200 HP**  
**60° V Models**

*Evinrude® E-TEC®*

**EVINRUDE**



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TYPICAL PAGE – B

Section Title

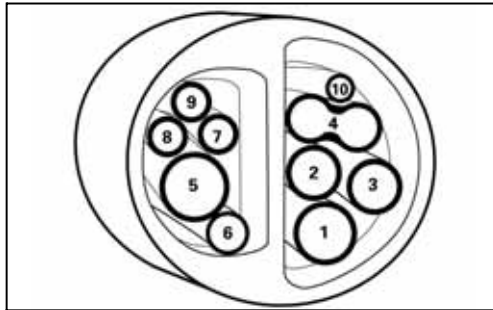
**INSTALLATION AND PREDELIVERY  
OUTBOARD RIGGING PROCEDURE**

Subsection Title

**Cable, Hose, and Wire Routing**

Route all hoses, control cables, and wiring through a protective sleeve or conduit into the boat and through the grommet.

Refer to the following diagram to ensure proper positioning of rigging components in grommet.



000084

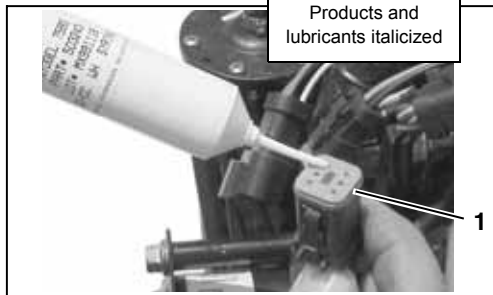
1. Fuel supply hose
2. Oil return hose
3. Oil supply hose
4. Battery cables
5. Main wire harness (MWS)
6. Throttle cable
7. Shift cable
8. Oil tank sending unit harness
9. Water pressure hose
10. Accessory charge wire

Model specific illustrations designated with image captions

Connect outboard main wire harness to boat main wire harness.

Before installing electrical connectors, check that the seal is in place. Clean off any dirt from connectors. Apply a light coat of *Electrical Grease™* to the seal. Push connectors together until latched.

Products and lubricants italicized



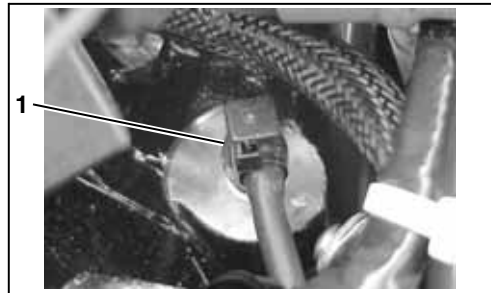
1. Seal

DP0824

If a water pressure gauge is to be used, install the water pressure hose fitting in the cylinder block. Use *Pipe Sealant with Teflon* (P/N 910048) on the threads of the hose fitting. Refer to installation instructions supplied with gauge.

Route the water pressure hose through cover grommet with oil tank sending unit harness. Route hose along battery cables toward the back of the powerhead. Use tie straps to fasten in place.

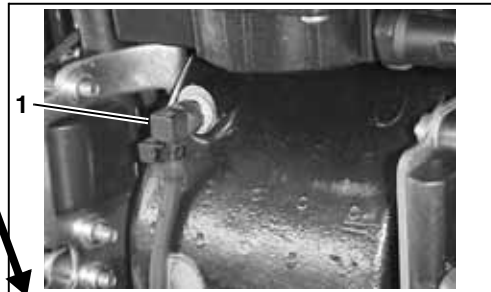
**2**



V4 Models

DP0827

1. Water pressure fitting location: top, starboard side of cylinder/crankcase assembly, below throttle position sensor.



V6 Models

DP0828

1. Water pressure fitting location: rear of cylinder/crankcase assembly

If temperature gauge is to be used, route sending unit wire through grommet with hose for water pressure gauge. Follow the path of battery cables. Provide adequate length to reach cylinder head. Refer to installation instructions supplied with gauge.

## SERVICE SPECIFICATIONS AND SPECIAL TOOLS TECHNICAL DATA

	HP	115	150, 175, 200
<b>ELECTRICAL</b>	Minimum Battery Requirements	675 CCA (845 MCA); or 750 CCA (940 MCA) below 32°F (0°C) (Use a 107 amp-hr battery for extreme applications.)	
	Alternator	Dual Voltage 50 Amp with Voltage Regulator and Battery Isolation	
	Tachometer Setting	6 pulse (12 pole)	
	Charging Isolator	Integral, Terminal on Engine Harness	
	Engine Fuses	P/N 967545 – 10 A	
<b>COOLING</b>	Thermostat	143°F (62°C)	
	Maximum Temperature	230°F (110°C) Below 3000 RPM and 194°F (90°C) Above 3000 RPM	
	Water pressure	21 psi minimum @ 3000 RPM	
<b>IGNITION</b>	Type	Capacitor Discharge	
	Firing Order	1-2-3-4	1-2-3-4-5-6
	Ignition Features	EMM Controlled	
	RPM Limit	6250	
	Crankshaft Position Sensor Air Gap	Fixed	
	Spark Plug	Refer to Emission Control Information Label Champion† QC10PEPB @ 0.028 ± .003 in. (0.76 mm) Refer to Emission Control Information Label	
<b>GEARCASE</b>	Gear Ratio	<b>V4 “S” Type Gearcase:</b> 13:26 (.500) (2:1) <b>V4 “O” Type Gearcase:</b> 12:27 (.444) (2.25:1) <b>V6 “M” Type Gearcase:</b> 13:24 (.542) (1.85:1) <b>V6 “O” Type Gearcase:</b> 14:26 (.538) (1.86:1) <b>V6 “L” Type Gearcase:</b> 14:26 (.538) (1.86:1) Refer to <b>GEARCASE TYPES</b> on p. 305	
	Lubricant	HPF XR Gearcase Lubricant	
	Capacity	<b>“S” Type Gearcase:</b> 31.6 fl. oz. (935 ml) <b>V4 “M” Type Gearcase:</b> 43.0 fl. oz. (1270 ml) <b>V6 “M” Type Gearcase:</b> 44.0 fl. oz. (1300 ml) <b>“M” Type – Counter Rotation:</b> 41 fl. oz. (1220 ml) <b>“O” Type Gearcase:</b> 33.1 fl. oz. (980 ml) <b>“L” Type Gearcase:</b> 33.1 fl. oz. (980 ml) Refer to <b>GEARCASE TYPES</b> on p. 305	
	Shift Rod Height	<b>20 in. (L) Models:</b> 20.945 (532 mm) ± one-half turn <b>25 in. (X) Models:</b> 25.945 (659 mm) ± one-half turn	
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD	
<b>POWER TRIM/TILT</b>	Lubrication	<b>115 (Single Piston style):</b> Evinrude/Johnson Biodegradable TNT Fluid <b>115-200 (Three Piston style):</b> Evinrude/Johnson Power Trim/Tilt & Power Steering Fluid or GM Dextron† II Automatic Transmission Fluid	
	Fluid Capacity	21 fl. oz. (622ml)	
	Trim Range	0° to 21°	
	Tilt Range	22° to 75°	

1

**SERVICE SPECIFICATIONS AND SPECIAL TOOLS**  
**SHOP AIDS**

**1**



HI-VIS™ Gearcase Lube P/N 775605



Triple-Guard® Grease P/N 508298



Extreme Pressure Grease™  
P/N 508303



Moly Lube P/N 175356



Needle Bearing Grease, P/N 378642



Starter Bendix Lube P/N 337016



Storage Fogging Oil  
P/N 777186



Power Trim/Tilt and Power Steering Fluid  
P/N 775612



Biodegradable TNT Fluid  
P/N 763439



Lubriplate† 777 P/N 317619



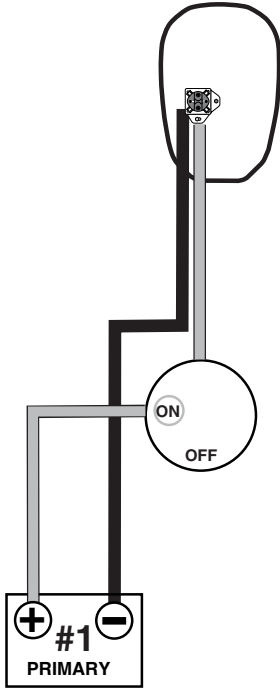
Black Neoprene Dip P/N 909570



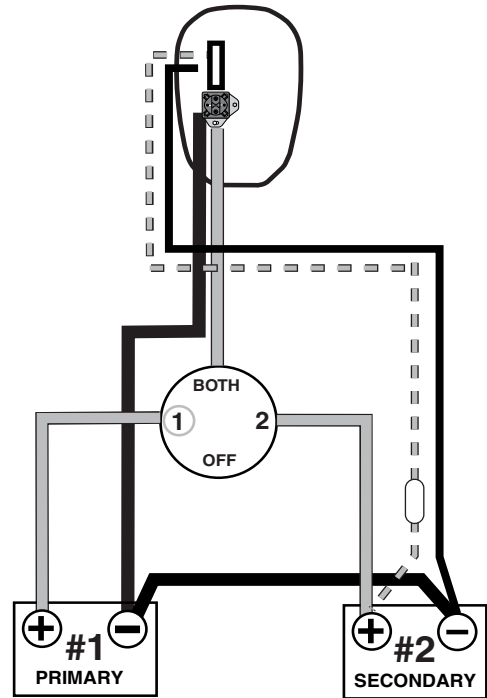
Electrical Grease P/N 503243

## Battery and Switch Wiring Diagrams

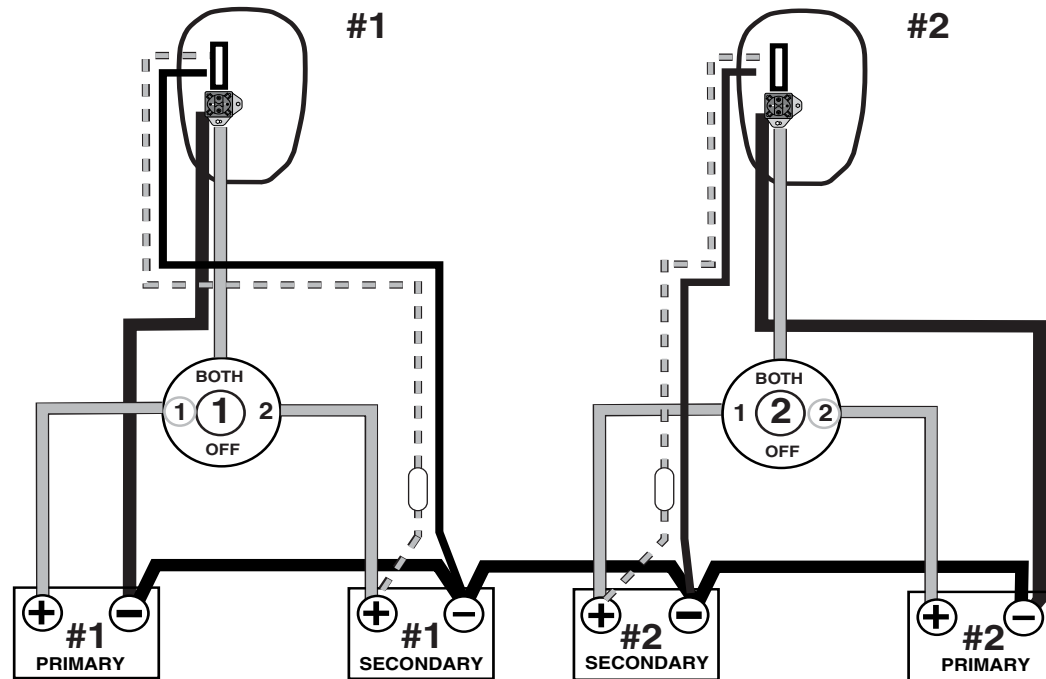
One outboard: Battery disconnect



One outboard: One primary starting battery; one secondary battery



Two outboards: Two starting batteries for each outboard



- Positive (+) Battery cables
- Negative (-) Battery cables
- Accessory charge wires, P/N 5006253
- 50 amp Fuse

000134N

### Clamp Installation

A constant stress should be applied to close the ear clamps. This method ensures a positive stress on the hose and does not result in excessive compression or expansion of the band material.

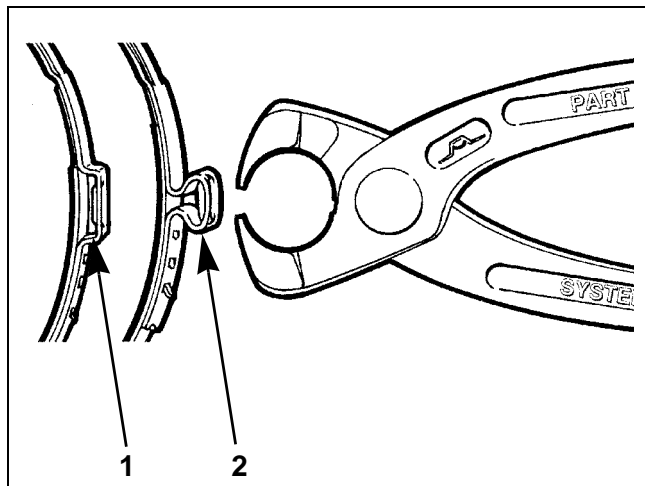
**IMPORTANT:** Use only *Oetiker* recommended tools to close *Oetiker* stepless clamps.

*Oetiker* pincers are available in the *Evinrude/Johnson Genuine Parts and Accessories Catalog* (P/N 787145).



DP0886

- Position correct size clamp over hose.
- Install hose on fitting.
- Close clamp ear fully with *Oetiker* pincers (pliers).

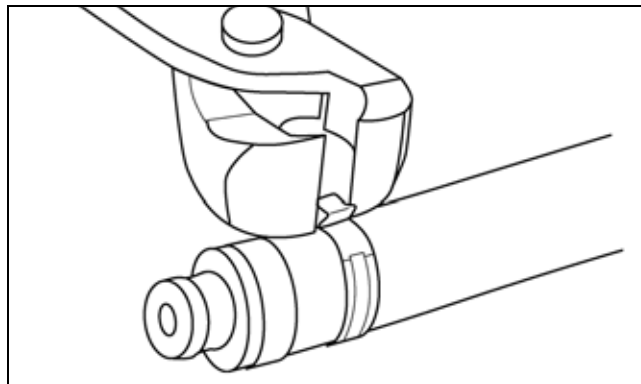


1. Open clamp
2. Closed clamp

000092

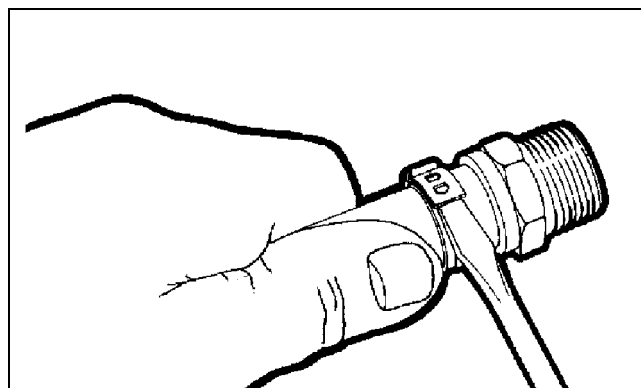
### Clamp Removal

**Method 1:** Position *Oetiker* pincers across clamp ear and cut clamp.



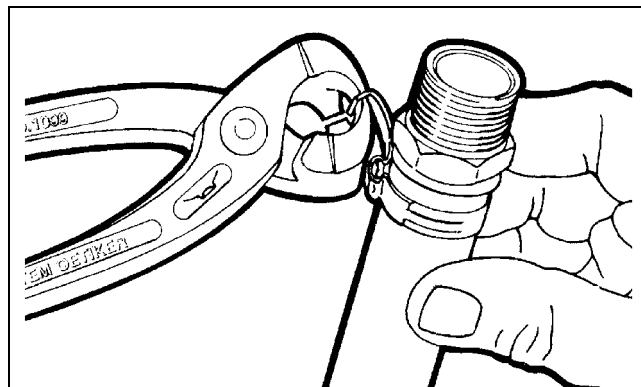
000108

**Method 2:** Lift end of stepless clamp with screwdriver.



000090

**Method 3:** Use *Oetiker* pincers (pliers) to grip clamp. Pull clamp off of connection and discard.



000091

# OUTBOARD RIGGING



## CAUTION



To prevent accidental starting while servicing, disconnect the battery cables at the battery. Twist and remove all spark plug leads.

## Cable, Hose, and Wire Routing

Remove two screws and bracket that fasten the grommet to lower motor cover.



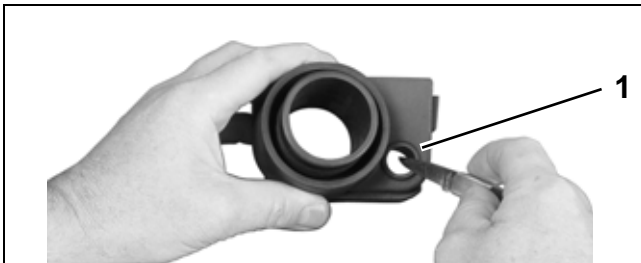
1. Grommet retaining bracket

003964

Route all hoses, control cables, and wiring through a protective sleeve or conduit into the boat and through the grommet.

The fuel hose may be routed through the protective sleeve or through an alternate hole in the lower motor cover grommet.

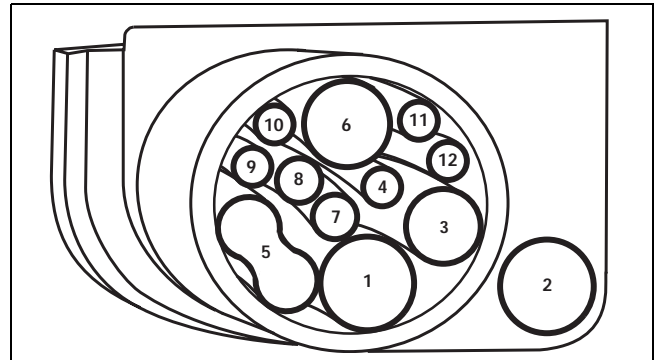
To route the fuel hose outside the sleeve, trim the material covering the alternate fuel hose slot in the grommet.



1. Alternate fuel hose location

003970

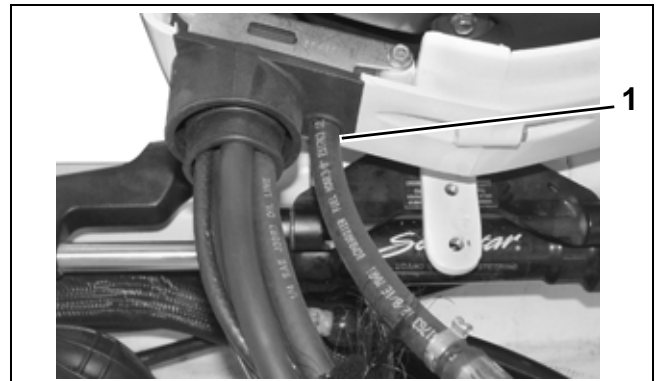
Refer to the following diagram to ensure proper positioning of rigging components in grommet.



1. Fuel supply hose
2. Fuel supply hose--alternate location
3. Oil supply hose
4. Oil tank sending unit harness
5. Battery cables
6. Main wire harness (MWS)
7. Shift cable
8. Throttle cable
9. Accessory charge wires
10. CANbus harness
11. Water pressure hose
12. Speedometer hose

000095c

2



1. Alternate fuel hose location

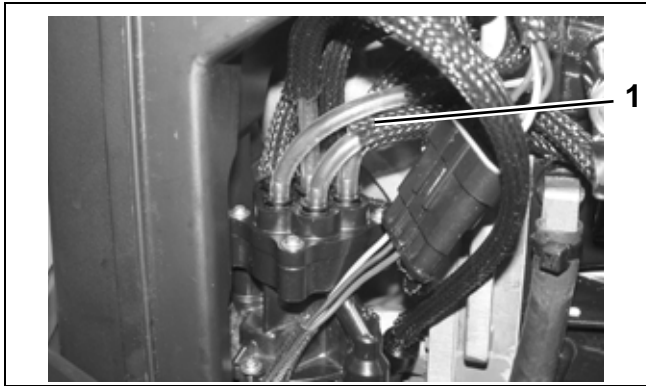
004946

The main wiring harness, battery cables, oil tank sending unit harness, and any CANbus cables should be routed along the same path to the star-

## INSTALLATION AND PREDELIVERY FUEL AND OIL PRIMING

2

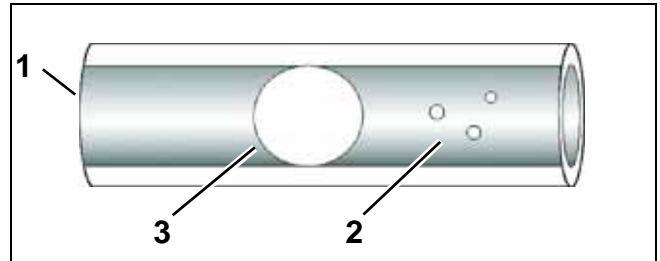
Observe oil flow through the oil distribution hoses.



1. Oil distribution hoses (7)

004965

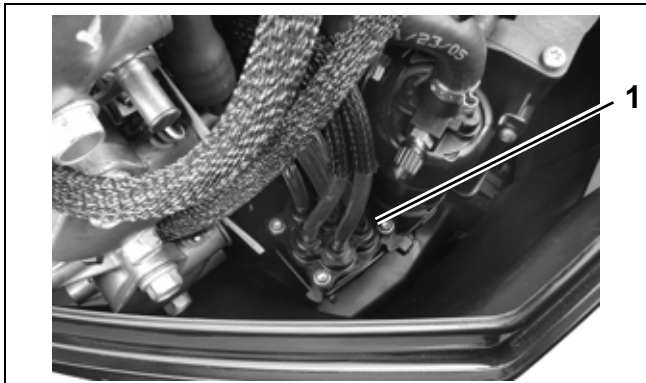
Small bubbles are acceptable. Large bubbles must be eliminated through a continued priming process.



1. Oil distribution hose
2. Small bubbles
3. Large bubbles

004398

Make sure that oil flows through the rear oil distribution manifold to the cylinder block fittings.



1. Rear oil distribution manifold

005271

**IMPORTANT:** All clear “blue” oil distribution hoses on the powerhead should fill with oil as the air is purged from the lines.

Repair any fuel or oil leaks.

The oiling system can also be primed using the Self-Winterizing feature if diagnostic software is not available. Refer to **STORAGE** on p. 91.

# MAINTENANCE

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# SPARK PLUGS

Spark plugs should be removed and examined periodically. Replace worn, fouled or damaged spark plugs.

Use only recommended spark plugs with the correct gap setting.

<b>Spark Plug, <i>Champion</i></b>
QC10PEPB @ 0.028 ± 0.003 in. (0.71 mm)

- Remove spark plugs and inspect condition.
- Set spark plug gap on new, replacement spark plugs.
- Mark spark plugs for ground electrode orientation.
- Apply *Electrical Grease* to the ribbed portion of the spark plug ceramic and to the opening of the spark plug cover to prevent corrosion.
- Install spark plugs using “indexing” procedure.

## Indexing

Spark plug indexing positions the ground electrode of the spark plug opposite the fuel injector nozzle.

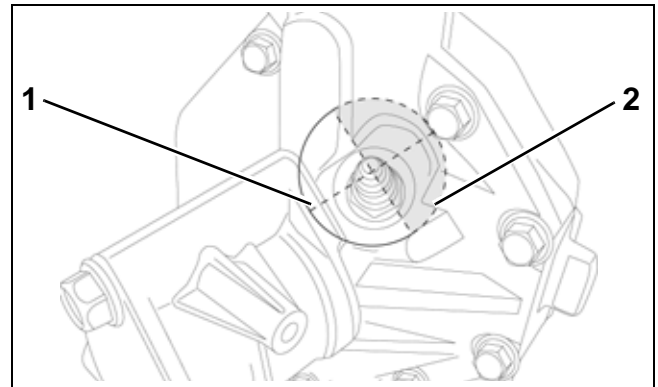
Put an ink mark on the ceramic of the spark plug that is in line with the OPEN side of the ground electrode. This mark will be used to orient the spark plug with the OPEN side of the ground electrode facing the fuel injector.



1. Ink mark  
2. Open side  
000758

Apply *Triple-Guard* grease to the gasket surface of the spark plugs. Install all spark plugs and tighten them to a torque of 15 ft. lbs. (20 N·m).

If the mark is in unshaded area do not tighten anymore.



**Spark Plug Indexing Diagram**  
1. Unshaded area  
2. Shaded area  
004294

If the mark is in the shaded area, reset torque wrench to 30 ft. lbs. (41 N·m) and continue to turn until the mark is in the unshaded area.

If the mark does not reach the unshaded area before the torque of 30 ft. lbs. (41 N·m) is reached, the spark plug cannot be indexed for that cylinder. Try another spark plug and repeat the steps above.

If EITHER cylinder head temperature exceeds 248°F (120°C), the *EMM*

Activates SHUTDOWN
Stores a service code 31
Flashes <i>EMM</i> NO OIL / OVERHEAT (LED 4)
Flashes <i>SystemCheck</i> TEMP/HOT light

The outboard will not restart, after a temperature related SHUTDOWN, until the engine temperature is BELOW 120°C (returns to normal. Refer to **SHUTDOWN MODE** on p. 103.

If sensor values are below -15°F (-26.1°C) or above 331°F (166.5°C), the *EMM*:

Stores a service code 41
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

If sensor values are below -4°F (-20°C), the *EMM*:

Stores a service code 42 (engine temperature below expected range)
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

If engine does not reach operating temperature on PORT cylinder head (122°F / 50°C below 2300 RPM) in 10 minutes, the *EMM*:

Stores a service code 58 (engine not reaching operating temperature)
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

If engine does not reach operating temperature on STARBOARD cylinder head (122°F / 50°C below 2300 RPM) in 10 minutes, the *EMM*:

Stores a service code 59 (engine not reaching operating temperature)
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

### Oil Pressure Sensor

The oil pressure sensor monitors oil pressure in the oil distribution manifold.

If the sensor fails to indicate pressure in the oil distribution manifold, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores a service code 38
Initiates <i>EMM</i> NO OIL / OVERHEAT (LED 4)
Initiates the <i>SystemCheck</i> NO OIL light

If outboard has been run for more than 5 hours with the existence of NO OIL faults (codes 34 & 38), the *EMM*

Activates SHUTDOWN
Stores a service code 33
Flashes <i>EMM</i> NO OIL / OVERHEAT (LED 4)
Flashes <i>SystemCheck</i> NO OIL light

**IMPORTANT:** The outboard will restart for **one minute intervals** until problem is resolved and code is cleared. To clear code use the diagnostic software program.

If the sensor circuit fails to indicate within a specific range or fails, the *EMM*:

Stores a service code 71
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

If the sensor circuit indicates below expected range (<.5 V), the *EMM*:

Stores a service code 72
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

If the sensor circuit indicates above expected range (> 4.5 V), the *EMM*:

Stores a service code 73
Initiates <i>EMM</i> SENSOR FAULT (LED 3)

## Oil Control

### Oil Injection Ratio (Used with XD100 oil only)

Evinrude E-TEC outboards can be programmed to run a reduced oiling rate. This feature should only be used with Evinrude/Johnson XD100 oil.



1. Oil control setting

005140



### CAUTION



Running an Evinrude E-TEC outboard on other grades of oil while set to the XD100 oil ratio will result in increased engine wear and shortened outboard life.

## Powerhead Break-In

Use the diagnostic software to initiate break-in oiling. Break-in is a predetermined oiling program that runs for two hours of outboard operation, above 2000 RPM.



1. Break-in oil setting

005140

**IMPORTANT:** Initiate *Break-in* programming for rebuilt powerheads.

## Timing Verification

Use the *Ignition Timing* screen of the diagnostic software to check and adjust EMM timing. EMM timing must be synchronized to crankshaft position.

Refer to **TIMING ADJUSTMENTS** on p. 157.



005148

Perform timing verification after any of the following procedures:

- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- EMM replacement
- EMM software replacement

**IMPORTANT:** Make sure the timing pointer is set and the outboard reaches operating temperature before timing verification is performed.

## Symptoms

### Outboard will not crank, starter does not operate:

- Check condition of battery and cables (main battery switch and cables). Make sure battery cables are not reversed.
- Confirm that B+ is present at “A” terminal (purple wire) of starter solenoid with key switch in the ON position.
- Proceed to **START CIRCUIT** on p. 122. Repair starter or start circuit as needed.

### Outboard cranks, will not start:

- Use LED indicators of *EMM* for initial diagnostic information.
- Perform a spark test using the *Evinrude* Diagnostics Software program. Refer to **IGNITION OUTPUT** on p. 127.

### Results:

Steady spark on all cylinders and proper ignition voltage:

- Check operation of all fuel injectors. Refer to **FUEL COMPONENT TESTS** on p. 184.
- Check fuel quality and that fuel is present at injectors.
- Refer to **FUEL COMPONENT TESTS** on p. 184 for fuel system pressure tests.

No spark on one or more cylinders:

- Note cylinder with no ignition output. Refer to **IGNITION OUTPUT** on p. 127.
- Monitor cranking RPM using the diagnostic program (approximately 175 RPM, minimum 75 RPM).
- Check CPS operation (verify RPM reading.)
- Perform ignition circuit resistance test(s). Refer to **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 141.

### Outboard runs:

- Use *Evinrude* Diagnostics Software program to perform *Dynamic Tests*. See **Dynamic Tests** on p. 133.
- Use the engine *Monitor* screen of the *Evinrude* Diagnostics Software program to observe circuit voltages. Refer to **Engine Monitoring Information** on p. 121.
- Use the diagnostic software *Logging* function to record engine data as a runability problem is occurring.

Time (min)	RPM	Fuel	Ignition	Spark	Battery	Ignition	Charge/Current	Battery
5000	875	0.1	0.46	54.92	13.30	195.23	6.8	14.61
7000	955	0.1	0.46	55.12	13.30	195.23	6.8	14.61
9000	902	0	0.46	55.27	13.30	195.58	6.95	14.61
4000	494	0	0.46	54.8	13.30	195.58	6.95	14.61
7000	908	0.1	0.46	56.21	13.07	195.23	6.95	14.61
7000	472	0	0.46	55.9	13.03	195.23	6.8	14.61
8000	506	0	0.46	54.8	13.30	195.58	6.64	14.61
9000	502	0	0.46	55.02	13.05	195.58	6.64	14.61
9000	450	0	0.46	55.23	13.30	195.96	6.8	14.61
9000	468	0	0.46	56.21	13.30	195.58	6.95	14.61
10000	912	0	0.46	56.7	13.02	195.23	6.95	14.61
10000	458	0	0.46	55.23	13.05	194.92	6.95	14.61

Logging Screen

005154

- Use an inductive timing light to monitor the injector circuits and ignition primary circuits. Refer to **Testing with Timing Light** on p. 120, **IGNITION OUTPUT** on p. 127, **FUEL DELIVERY** on p. 131 and **FUEL COMPONENT TESTS** on p. 184.
- Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.

**Results:**

- Spark control on all cylinders and outboard runs, Refer to **Running Ignition Tests** on p. 129 and **Dynamic Tests** on p. 120.
- NO spark control on one or more cylinders, note cylinders. Refer to **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 141.

**Running Ignition Tests**

The purpose of this test is to isolate ignition system malfunction. This test should be used in conjunction with other ignition system tests to identify component failures. This test provides limited information. Use the findings of this test to eliminate ignition system components. A thorough understanding of the outboard's ignition system is required.

**Monitor Voltage Outputs**

Use the *Evinrude* Diagnostics Software program to monitor system voltage (55 V) and ignition voltage (200 V).

- Voltage readings at a specific speed (RPM) should be steady.



Engine Monitor Screen, System and Ignition Voltage 005141

**Results:**

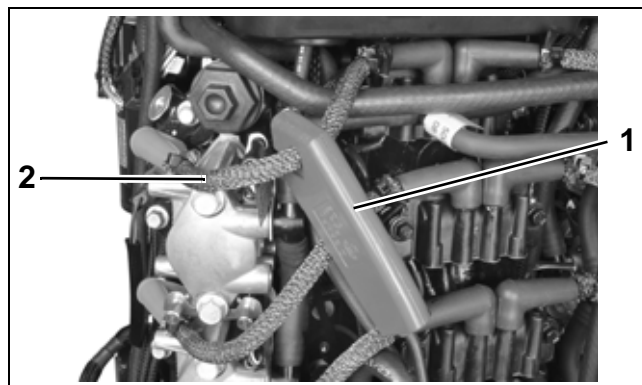
Low voltages: refer to **System Voltage** on p. 128 and **Ignition Voltage** on p. 127.

**Monitor Ignition Output with Timing Light**

Use a timing light to monitor the spark signal through each of the high tension spark plug wires.

Start outboard and observe the timing light's strobe. Look for a consistent flash and only one flash per revolution. The strobe of the timing light should be consistent or the same for each cylinder's ignition output.

**IMPORTANT:** Test on primary circuit if strobe from secondary circuit appears faulty.



1. Timing light pick-up  
2. Secondary, high tension wire 005319

**5**

**Results:**

Steady voltage and strobe:

- Inspect or replace spark plugs, check fuel system performance, and / or eliminate the possibility of internal engine damage.

Voltages are steady, engine misfires:

- Check CPS air gap and resistance, check ignition voltage while problem is occurring. See **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 141.

Voltages fluctuate, engine misfires:

- Inspect condition of battery and connections, test capacitor, and check all ground connections. See **System Voltage** on p. 128, **Ignition Voltage** on p. 127, **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 141.

**IMPORTANT:** If a running problem occurs at about 1200 RPM, the outboard may be in *S.A.F.E.* Refer to **Conditions that initiate S.A.F.E.** on p. 103.

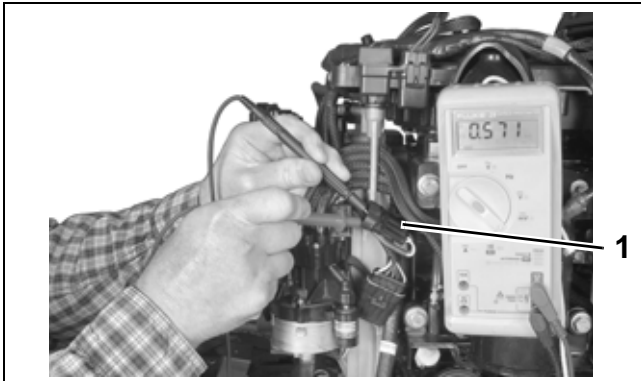
# SENSOR RESISTANCE TESTS

All sensor circuits are dependent on wiring and connections, *EMM* supplied current (5 V), and sensor resistance. The supplied current flows through the wiring circuit and sensor before returning to the appropriate circuit in the *EMM*.

**IMPORTANT:** Use the *Evinrude* Diagnostics Software program to monitor sensor circuit voltages or values.

## Crankshaft Position Sensor (CPS) Test

Disconnect the battery cables at the battery. Use an ohmmeter to measure sensor resistance between the yellow and white wires.



1. CPS Connector

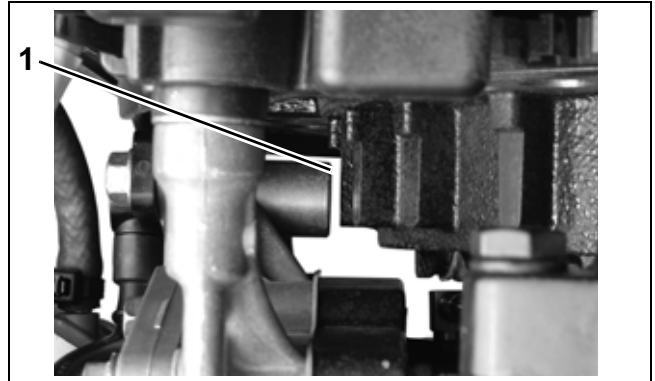
005431

Sensor Resistance
-------------------

560 Ω ± 10% @ 77°F (25°C)
---------------------------

The CPS is mounted to throttle body housing and requires no adjustment. Air gap or clearance to flywheel is fixed at approximately 0.073 in.

(1.85 mm). The acceptable clearance is 0.036 to 0.110 in. (1 to 2.8 mm).



1. CPS gap

005321

## Throttle Position Sensor (TPS) Test

TPS voltage can be monitored using the diagnostic program. Use the engine *Monitor* screen to observe voltage while outboard is running. Voltage should change evenly as sensor lever is moved.

Use an ohmmeter to measure sensor resistance.

Disconnect the battery cables at the battery. Remove the electrical connector from the TPS.

### STEP 1

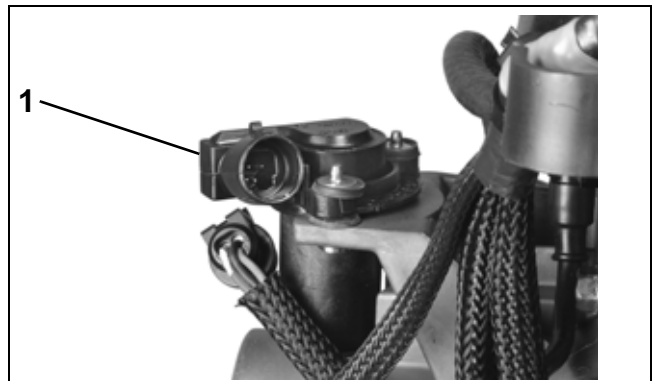
Connect red meter lead to terminal "A" and black meter lead to terminal "B."

Sensor Resistance (between "A" and "B")
---

> 3000 Ω @ 77°F (25°C)
------------------------

Sensor Resistance (between "A" and "C")
---

> 4000 Ω @ 77°F (25°C)
------------------------



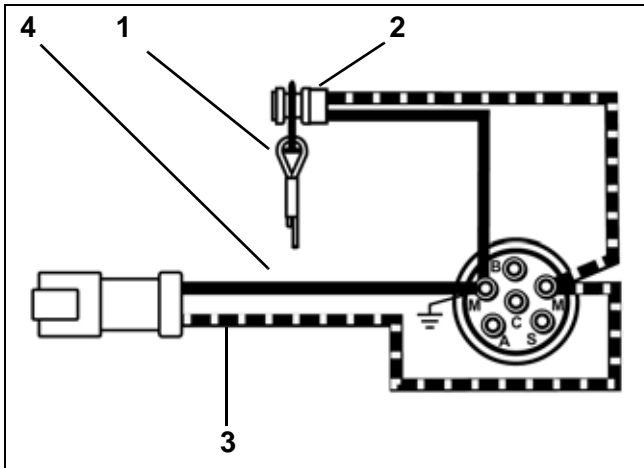
1. TPS

005430

## Emergency Stop Switch Test

This switch can be incorporated into the key switch or installed as a separate switch. Either style effectively connects the “M” terminals of the key switch.

The emergency stop switch function grounds the stop circuit wire (black/yellow) when the lanyard clip is removed. One “M” terminal is the ground wire (black) and one “M” terminal is the stop circuit wire (black/yellow).

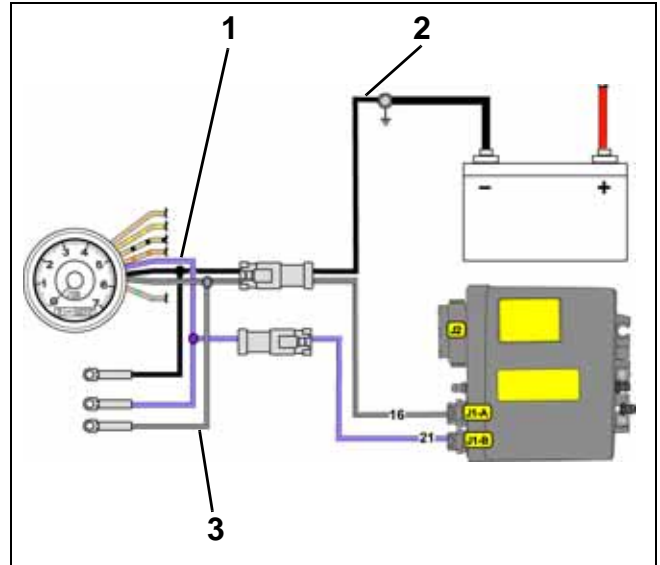


1. Lanyard and clip assembly 000444
2. Emergency stop switch, separate from key switch
3. Stop circuit wire (black/yellow)
4. Ground wire (black)

Install the clip on the emergency stop switch or key switch. Start the outboard. Pull the clip from the switch. The outboard must stop running.

## TACHOMETER CIRCUIT TESTS

Check voltage at the battery. Use this reading as a reference for battery voltage.



1. Purple lead
2. Black lead
3. Gray lead

004287

6

### STEP 1

Connect the red meter lead to the tachometer purple wire and the black meter lead to the tachometer black wire (key ON, outboard NOT running).

- If meter shows battery voltage, go to **STEP 2**.
- If meter shows less than battery voltage, check the purple, red/purple, and black wiring circuits, fuse, key switch, and battery connections.

### STEP 2

Disconnect gray and black wires at tachometer. Set *Fluke* 29 Series II meter, or equivalent, to Hz scale. Connect meter between gray wire and black wire. With outboard running at 1000 RPM, meter should indicate 90 to 105 Hz.

- If meter reads 90 to 105 Hz, replace tachometer.
- If meter reads low or no signal, confirm output on gray wire at pin 16 of *EMM* J1-A connector.
  - Reading OK – Check condition of tachometer circuit (gray wire). Repair as needed.
  - Reading not OK – Check connection at *EMM*; replace faulty *EMM*.

## Timing Verification

Use the *Evinrude* Diagnostics Software program to synchronize the mechanical timing of the outboard with the electronic timing control function of the *EMM*.



Timing Adjustment Screen

005148

Perform timing verification after any of the following procedures:

- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- *EMM* replacement
- *EMM* software replacement (reprogramming)

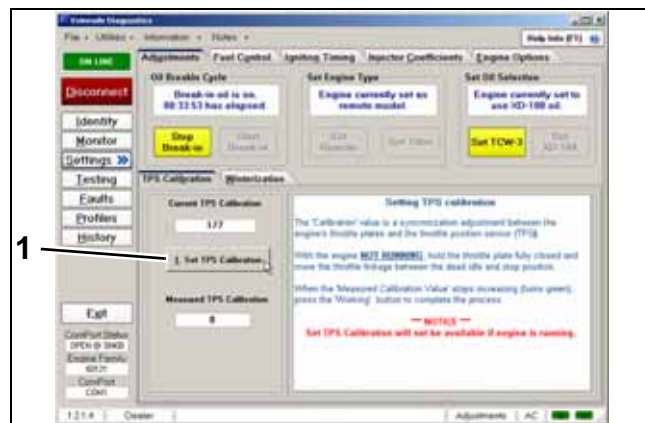
**IMPORTANT:** Make sure the timing pointer is set and the outboard reaches operating temperature before timing verification is performed.

## TPS CALIBRATION

Use the *Evinrude* Diagnostics Software program to tell the *EMM* what the throttle position sensor voltage level is when the throttle plates begin to open.

Remove the air silencer.

On the *Settings* screen of the diagnostic software, click the “Set TPS Calibration” button.



1. TPS Calibration button

006311

While holding the throttle plates closed, advance the throttle linkage until it stops. The “Measured TPS Calibration” field on the screen will increase.

Click the “Working” button in the software to calibrate the TPS.

Install the air silencer.

Perform TPS Calibration after replacing or adjusting any throttle body or throttle linkage parts.

## AMP Connectors

**IMPORTANT:** Always use the appropriate meter test probes and adapters when testing components fitted with these terminals. Electrical grease is NOT used on AMP connectors.

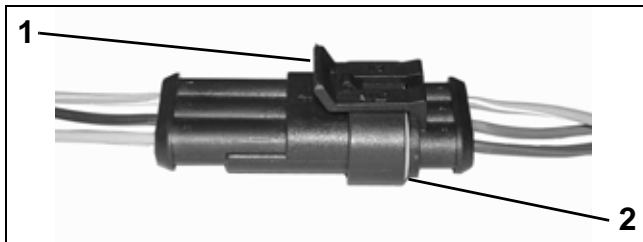
### SUPERSEAL<sup>†</sup> 1.5

#### Disconnect

Lift latch. Pull connectors apart.

#### Connect

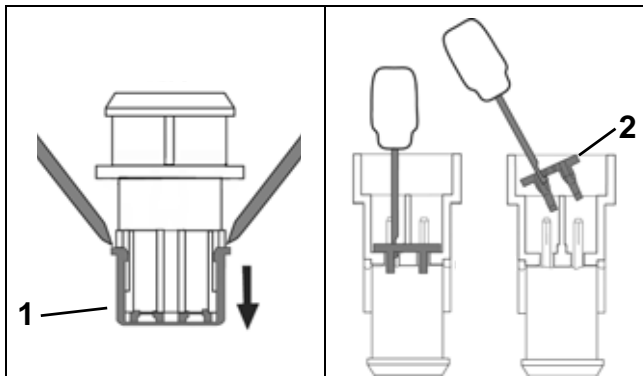
Confirm the seal is in place. Push connectors together until latched.



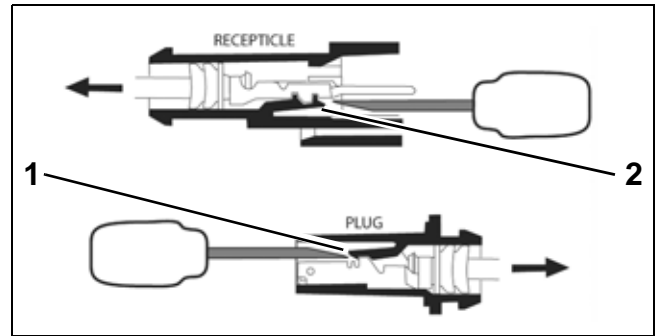
1. Latch  
2. Seal  
002448

#### Terminal Removal

Use Secondary Lock Tool, P/N 777078, to release anti-backout device of connector housing. Next, use Primary Lock Tool, P/N 777077, to release locking tab of connector housing. Release locking tab and pull on wire to remove from connector housing.



1. Anti backout device, plug  
2. Anti backout device, receptacle  
002449  
002450



1. Locking tab, plug  
2. Locking tab, receptacle  
002447

#### Terminal Installation

Align terminal with connector housing. Push connector and seal into housing until seated.



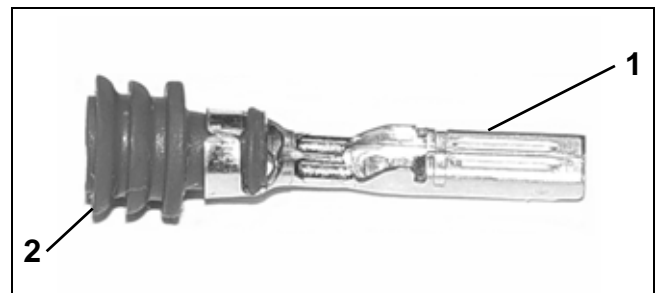
1. Terminal and seal  
002451

Align anti-backout device with connector housing and terminals. Use Secondary Lock Installer, P/N 777079, to seat device in connector.

#### Crimping Terminals

Crimping *Superseal 1.5* terminals requires the *PRO-CRIMPER II*<sup>†</sup> with a specific crimping die set.

The *PRO-CRIMPER II* hand tool assembly, P/N 58583-1, comes with die assembly P/N 58583-2.



1. Terminal  
2. Seal  
002452

### Pressure Regulator

The fuel pressure regulator helps maintain consistent fuel pressure in the fuel system.

Fuel returning from the injectors enters the fuel chamber of the vapor separator through a pressure regulator. The pressure regulator maintains approximately 20 to 30 psi (138 to 207 kPa) of fuel pressure in the high pressure side of the fuel system.

### Fuel Circulation Pump

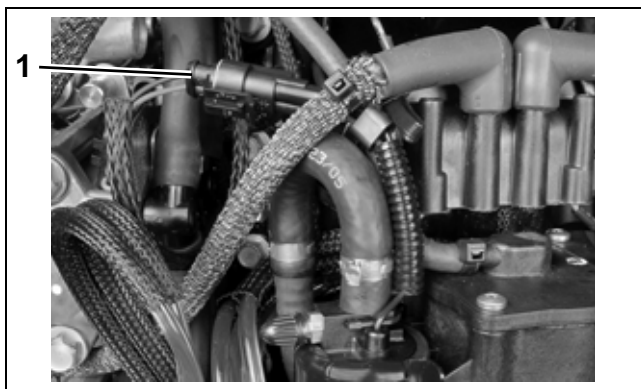
The fuel circulation pump is an electric high pressure fuel pump. The pump is controlled by the *EMM*.

### Fuel Supply

The pump is mounted to the vapor separator and draws fuel from the fuel chamber. The fuel injectors receive pressurized fuel from a fuel supply manifold connected directly to the circulation pump.

### Electrical Circuit

Activation of the circulation pump is controlled by the *EMM* and operates on the 12 V circuit. The circulation pump is activated momentarily when the *EMM* powers up.



1. Fuel pump electrical connector

005327

### Fuel Manifolds

The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

### Fuel Supply Manifold

The fuel supply manifold supplies pressurized fuel to the inlet port of each fuel injector.

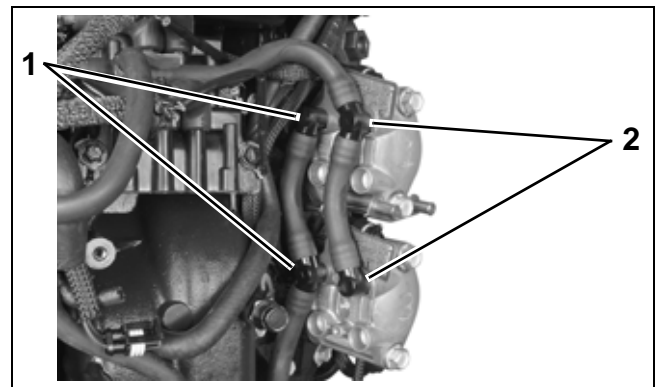
### Fuel Return Manifold

The fuel return manifold provides a route for fuel passing through the fuel injectors to flow back to the fuel chamber of the vapor separator.



1. Fuel supply manifold  
2. Fuel return manifold

005328



1. Inlet ports  
2. Return ports

005332

# FUEL COMPONENT SERVICING



## WARNING



Gasoline is extremely flammable and highly explosive under certain conditions. Use caution when working on any part of the fuel system.

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure.

Always disconnect the battery cables at the battery before servicing the fuel system unless instructed to do otherwise.

Always work in a well ventilated area and wipe off any fuel spillage.

DO NOT smoke and make certain no open flames or ignition sources exist.

After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

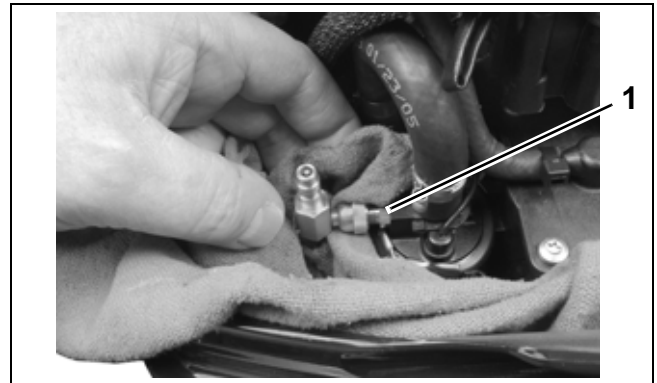
## Relieving Fuel System Pressure

**IMPORTANT:** Minimize fuel system pressure prior to disassembly. Temporarily restrict the fuel supply hose from fuel tank with hose pincer. Remove propeller and disconnect circulation fuel pump electrical connector. If outboard runs, start and run at IDLE for 5 seconds and STOP outboard. If outboard does NOT run, crank for 10 seconds.

Disconnect the battery cables at the battery.

Wrap a shop towel completely around the pressure test valve while connecting fitting from Fuel Pressure Gauge, P/N 5007100, to top test fitting

of high pressure fuel pump/vapor separator assembly.



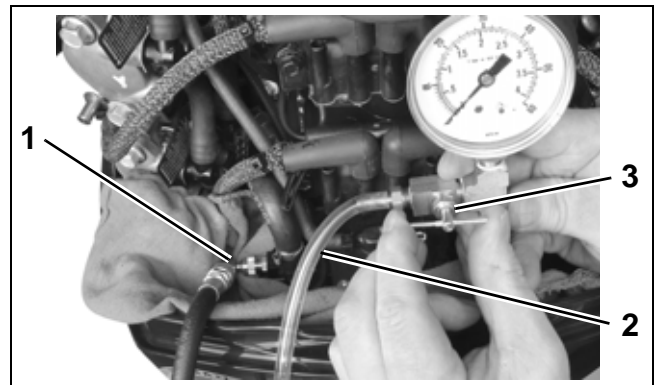
1. High pressure test fitting

005334

Insert venting hose of gauge into a suitable container.

Slowly open gauge's venting valve.

Clean up any spilled fuel with shop towels.



1. Test fitting  
2. Venting hose  
3. Venting valve

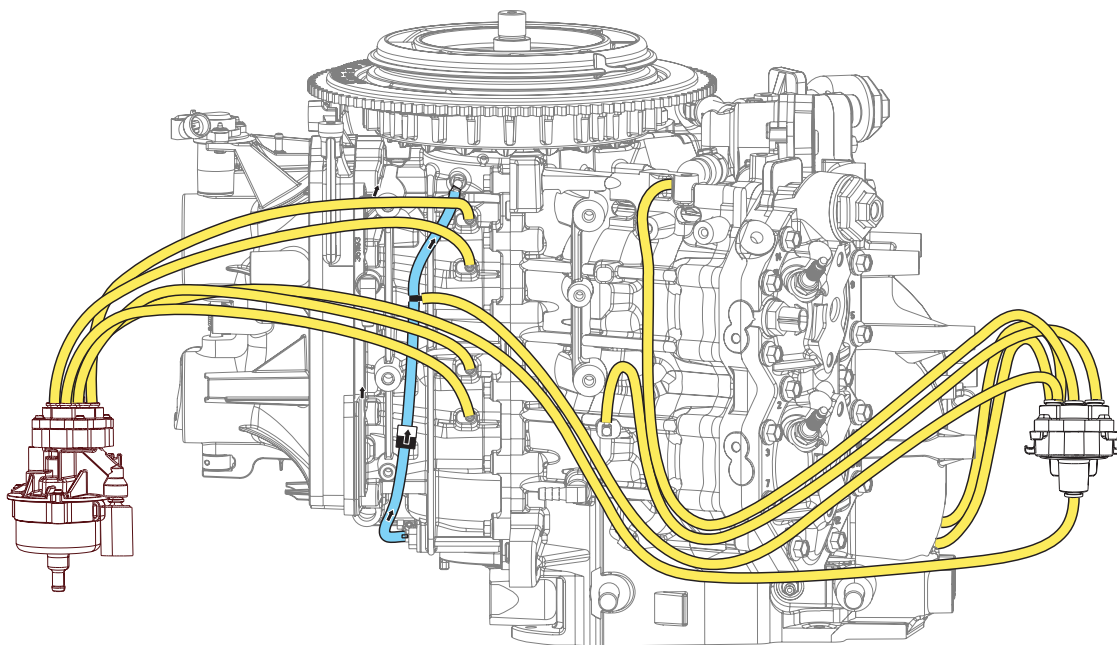
005335

# OILING SYSTEM

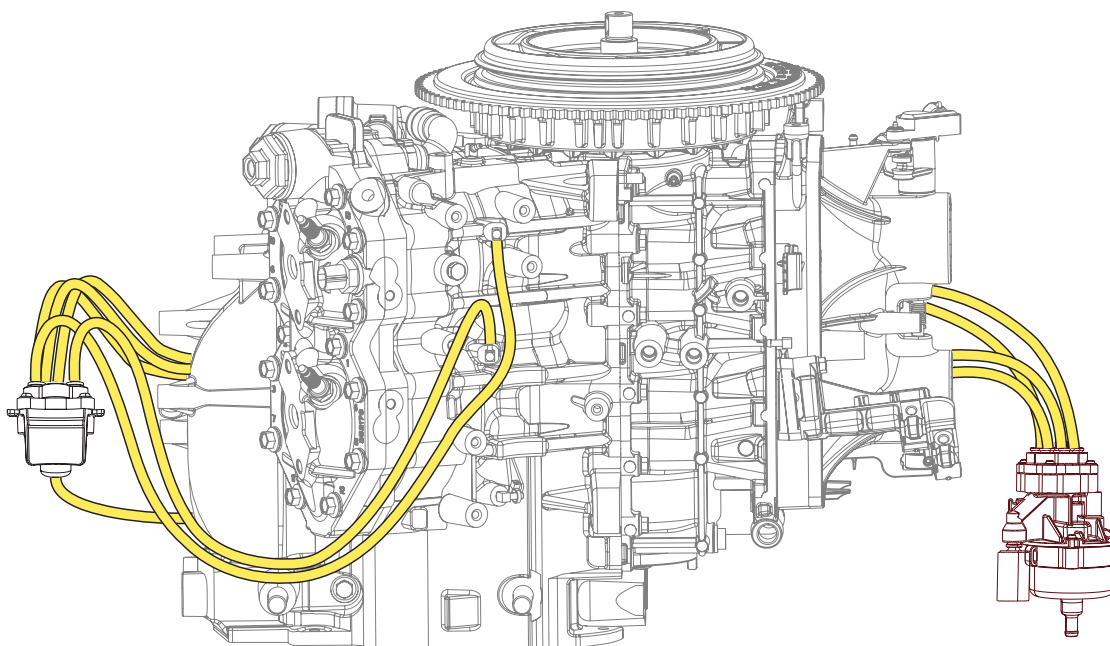
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Port Side View



Starboard Side View



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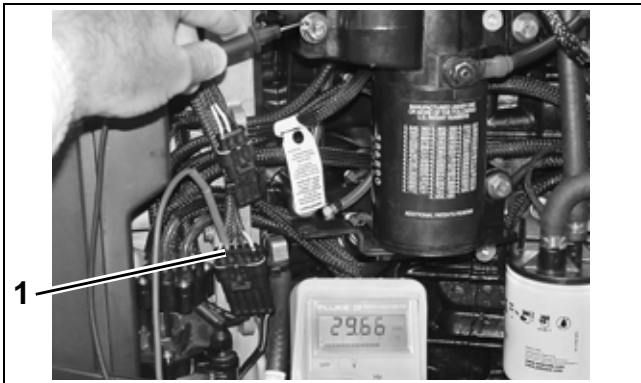
- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: [www.heydownloads.com](http://www.heydownloads.com) by clicking the link below



- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

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pin 2 (blue wire) of oil injection pump connector. Key switch must be ON.



1. Oil injection pump connector (pin 2) 005442

**Results:**

- Approximately 30 V is acceptable, leave adapter connected, proceed to **STEP 4**.
- No voltage, refer to **Oil Injection Pump Circuit Resistance Test** on p. 219.

**STEP 4**

Activate oil injector using the *Evinrude* Diagnostics Software program. Monitor the voltage on oil injector pump circuit at pin 2 of oil injection pump connector.



1. Oil injector test button 005146

**Oil Injection Pump Circuit Resistance Test**

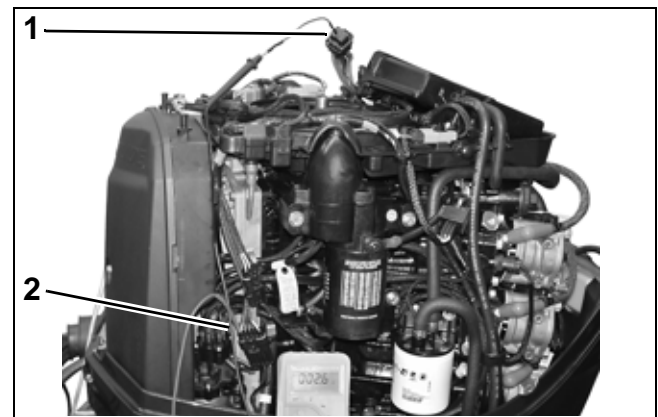
The oil injection pump circuit includes the engine wire harness, the injection pump winding and connector, and the oil injection control circuit of the *EMM*.

Disconnect the battery cables at the battery.

Use Electrical Test Probe Kit, P/N 342677, to make a connection to pin 23 of the *EMM* J1-B connector.

Calibrate ohmmeter to the LOW OHMS scale and measure the resistance between pin 23 of the *EMM* J1-B connector and pin 1 of oil injection pump connector.

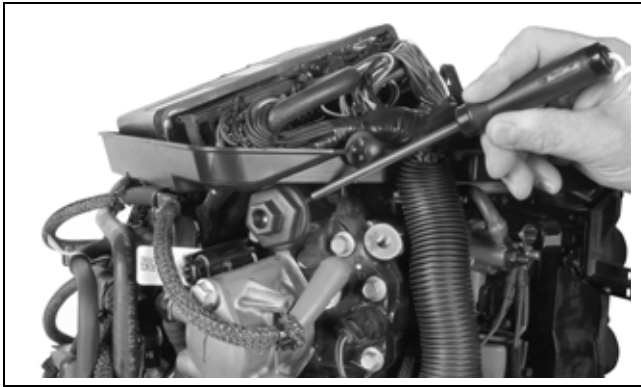
Oil Injection Pump Circuit Resistance
2 to 3 Ω



1. EMM J1-B connector (pin 23) 005443  
2. Oil injection pump connector (pin 1)

**Results:**

- An infinite reading ( $\infty$ ) indicates an open circuit. Isolate the faulty wiring, connection, or injection pump winding. Repair faulty wiring or replace faulty component and retest.
- For a higher than expected reading, test resistance of the injection pump. If injection pump resistance reading is approximately 2-3 Ω, injection pump winding is good. Isolate faulty component. Repair faulty wiring or replace faulty component and retest.



005390

Typical pyrometer temperature displays at IDLE speed should be  $150^{\circ}\text{F} \pm 20^{\circ}\text{F}$  ( $66^{\circ}\text{C} \pm 11^{\circ}\text{C}$ ).

**IMPORTANT:** If you get low or inaccurate readings during these tests, coat the probe location of the digital pyrometer with a liberal amount of *Thermal Joint Compound*, P/N 322170.

If engine temperature tests within range, but the *SystemCheck* gauge indicates a "WATER TEMP" warning, refer to **WATER TEMP/ HOT Circuit Test** on p. 146.

### **Idle Operating Temperature Troubleshooting (Below Range)**

If engine temperature is below operating range, check pressure relief valve and thermostat operation. Remember, cold running outboards prevent spark plugs from achieving proper operating temperatures and may decrease spark plug life.

### **Pressure Relief Valve**

The pressure relief valve should be closed at IDLE speed. Water should not flow past the plunger and seal.

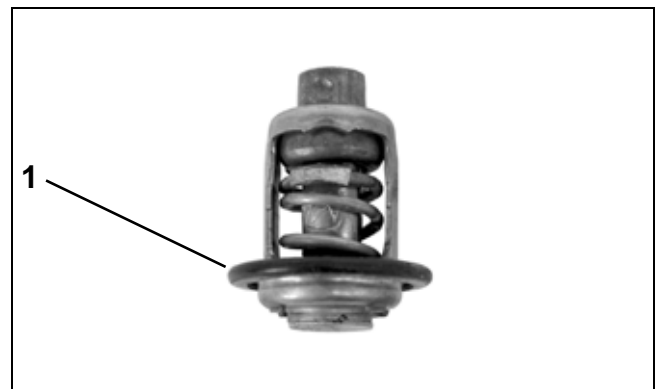
Check for damage or debris that could prevent the valve from closing completely. Replace pressure relief valve if necessary.

Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 233.

### **Thermostats**

If IDLE temperature is still below operating range, inspect thermostats and thermostat seals.

Check position of thermostat seal and how thermostat seals against cylinder head. Seal must be properly fitted to flange of thermostat.



1. *Thermostat seal*

005392

Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at  $143^{\circ}\text{F}$  ( $62^{\circ}\text{C}$ ).

Refer to **THERMOSTAT SERVICING** on p. 233.

# REMOVAL



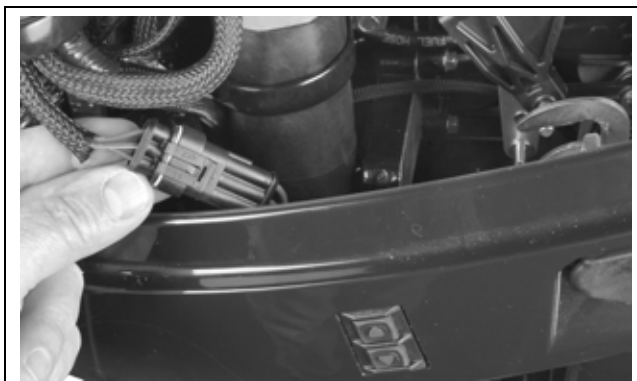
## WARNING



Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 189.

To prevent accidental starting while servicing, disconnect the battery cables at the battery.

Disconnect the power trim/tilt switch connector.



005246

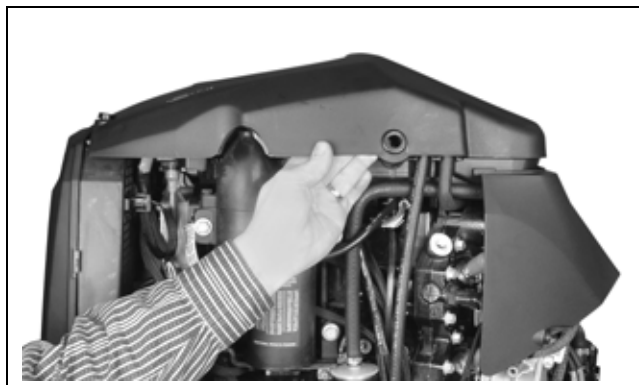
Remove lower engine cover screws and port and starboard covers.



1. Lower cover screws

005242

Remove flywheel cover and rear shroud.



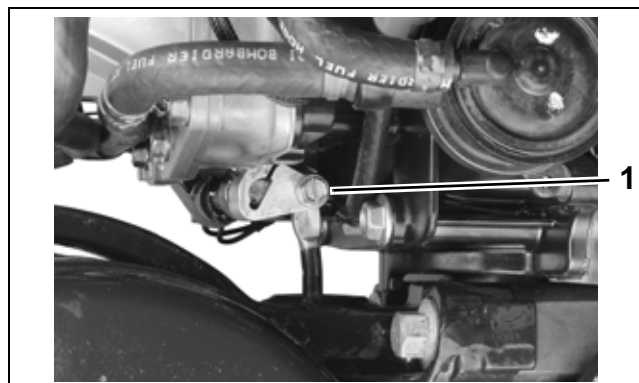
005248

Remove air temperature sensor from air silencer. Remove the air silencer.



005272

Remove screw and washer from shift rod lever to release the lower shift rod.

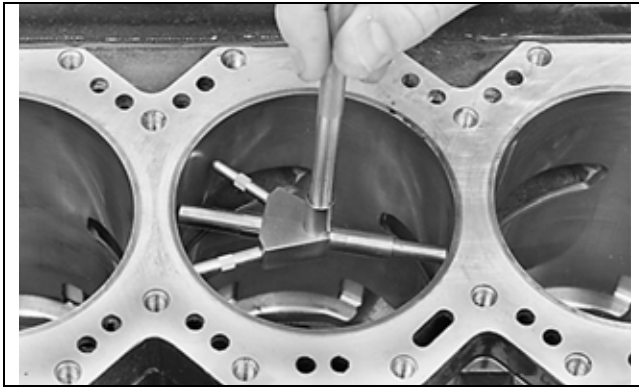


1. Shift rod screw

005253

## Cylinder Bore

Use Cylinder Bore Gauge, P/N 771310, to inspect each cylinder bore for an out-of-round, oversize, or tapered condition. Be sure the gauge is perfectly square in the bore when measuring.



Measure as shown

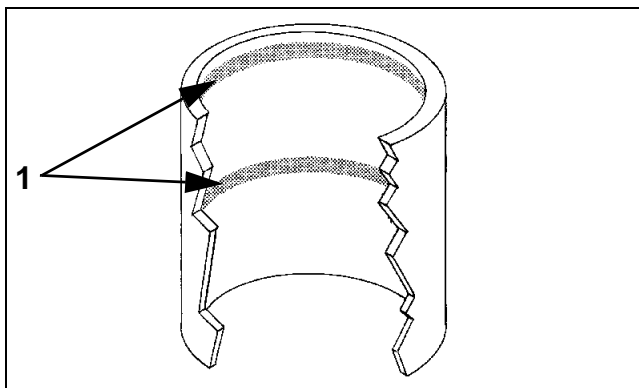
46528

Measure each cylinder in at least two areas. Each area should be measured twice. The difference between the two measurements in each area is the cylinder out-of-round dimension.

- The cylinder must not be out-of-round by more than 0.004 in. (0.10 mm).

The dimensional difference between the two areas is cylinder taper.

- The cylinder taper must not exceed 0.002 in. (0.05 mm).



1. Cylinder taper

DR3482

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to **TECHNICAL DATA** on p. 18.

- The cylinder must not be oversized by more than 0.004 in. (0.10 mm).

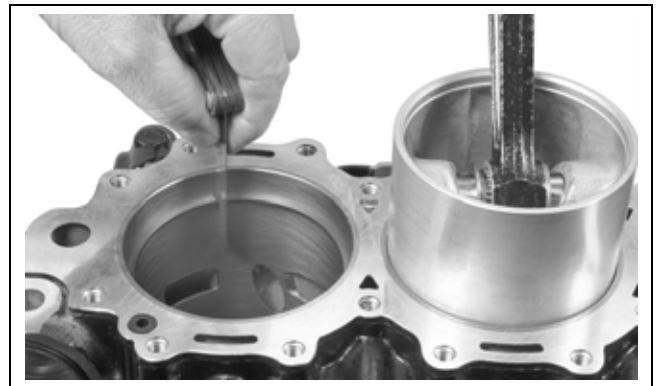
**IMPORTANT:** If any cylinder is outside these tolerances, it must be bored oversize. It is permissible to have one or more oversize pistons in an engine.

## Pistons

Visually inspect pistons for signs of abnormal wear, scuffing, cracks, or burning.

## Piston Rings

For new ring sets, place each ring separately in its respective bore. Use a piston to square the ring in the cylinder. Use a feeler gauge to measure the ring end gap.



002143

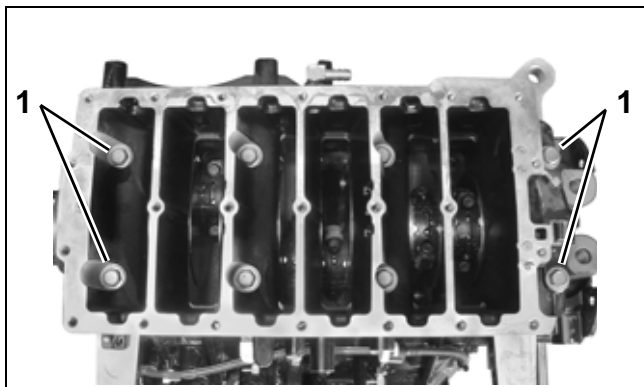
### Ring End Gap Specification

Standard or Oversize rings	0.011 to 0.023 in. (0.28 to 0.58 mm)
-------------------------------	---

**IMPORTANT:** Ring end gap increases approximately 0.003 in. (0.08 mm) for each 0.001 in. (0.025 mm) increase in cylinder bore diameter. **DO NOT** exceed cylinder oversize dimension.

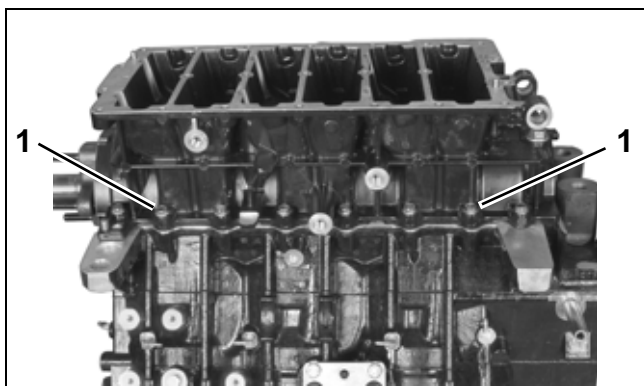
Use a machinist's straightedge to check for proper ring clearance. Position piston rings on piston. Push rings into groove and hold straightedge against the side of the piston. Rings must be even

Torque main bearing screws in stages to 31 to 35 ft. lbs. (42 to 47.5 N·m). Begin with the center screws and work outward in a spiral pattern.



1. Main bearing screws (6 on V4; 8 on V6) 005313

Apply *Triple-Guard* grease to crankcase flange screws. Install screws and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Flange screws (12 on V4; 16 on V6) 005306

Test that the crankshaft spins freely without binding.

**IMPORTANT:** After powerhead has been assembled, allow at least two hours for *Gel-Seal II* to cure before running outboard.

## General

Connect all crankcase recirculating hoses. Refer to **Recirculation Hose Routings and Check Valve Diagrams – V4** on p. 213, **Recirculation Hose Routings and Check Valve Diagrams – V6** on p. 211, or **POWERHEAD VIEWS** on p. 266.

Install pressure valve assembly. Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 233.

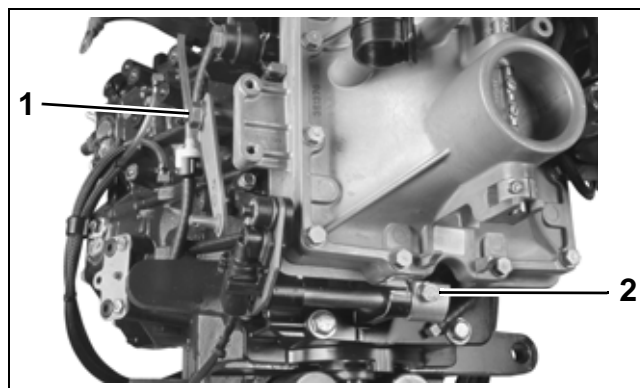
Install the throttle body and reed plate assemblies. Refer to **INTAKE MANIFOLD** on p. 196.

Lubricate shift linkage bosses at the base of the crankcase with *Triple-Guard* grease. Insert bushings into bosses.

Apply *Triple-Guard* grease to the shaft of the shift lever assembly. Guide shaft through bushings in crankcase.

Install shift rod lever and tighten retaining screw 60 to 84 in. lbs. (7 to 9.5 N·m).

Apply *Triple-Guard* grease to shoulder of shift arm screw and *Nut Lock* to threads. Install arm, screw, and washer and torque screw to 120 to 144 in. lbs. (14 to 16 N·m).



1. Shift arm screw  
2. Shift lever screw

005294

**V4 Port**



**10**

005224

**V6 Rear**



**10**

005251

## Cleaning and Inspection



### WARNING



Wear safety glasses to avoid personal injury, and set compressed air to less than 25 psi (172 kPa).

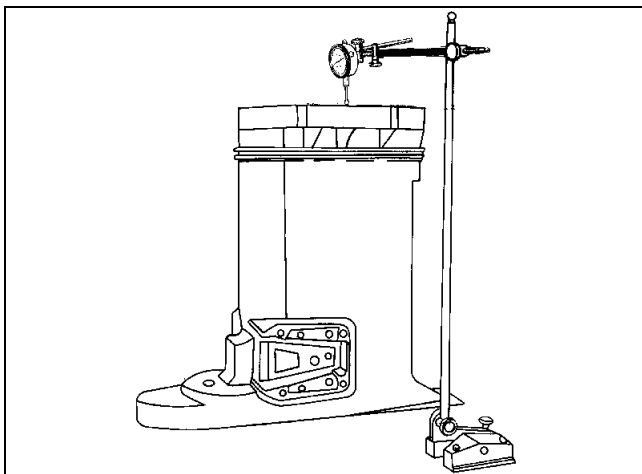
Clean all parts with parts cleaning solvent and dry with compressed air. All nut and screw threads coated with thread locking material must be thoroughly cleaned before assembly. When using a thread locking product, be sure to prime the threads with *Locquic Primer*.

Examine the upper and lower thrust mounts, and replace if deteriorated or damaged.

Before checking the exhaust housing for distortion, thoroughly clean the top and bottom mating surfaces and remove all sealer and corrosion.

Check the exhaust housing for distortion. Place the housing on a surface plate. Using a dial indicator, check flatness by measuring the run-out on the top edge of housing. The maximum allowable run-out is 0.009 in. (0.228 mm). If you do not have access to a dial indicator and surface plate, seek the services of a machine shop. DO NOT attempt to straighten a distorted housing. Replace it.

**IMPORTANT:** A distorted exhaust housing will cause the upper driveshaft splines to wear excessively and will damage the crankshaft splines.



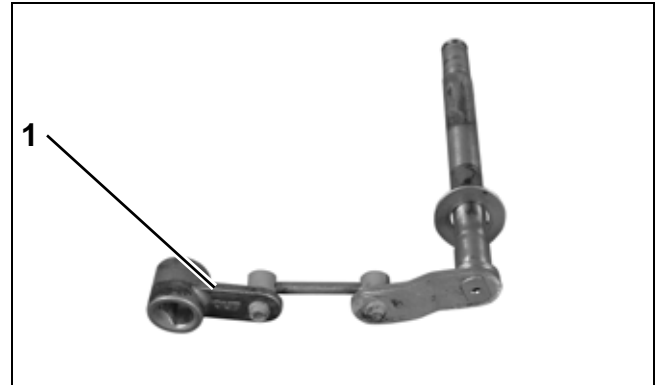
DR2223

Inspect the water tube for obstructions or kinks, which may restrict water flow.

## Assembly

### V4 MODELS

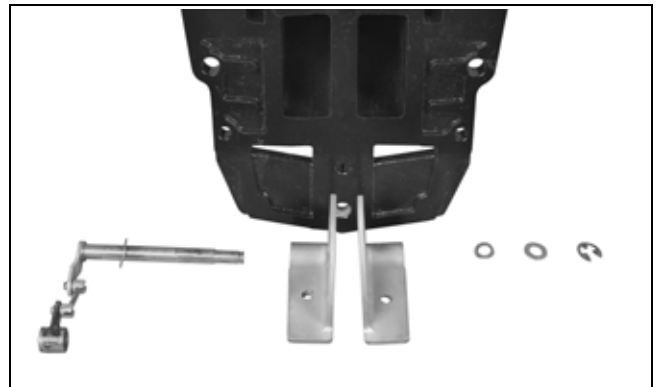
Assemble linkage to exhaust valve shaft as shown. Be sure the word "OUT" on the lever is facing away from the shaft.



1. "OUT" mark

005213

Place rear of inner exhaust housing on bench. Arrange exhaust valves and linkage as shown.



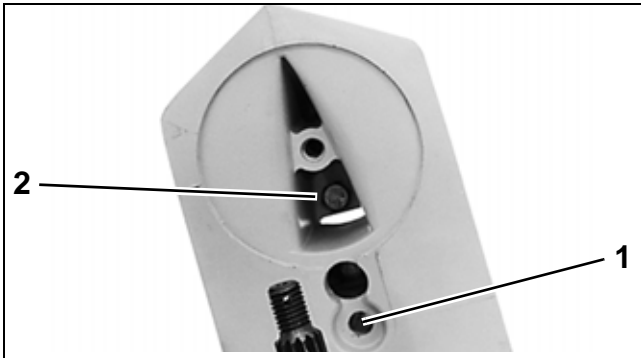
005214

# GEARCASE

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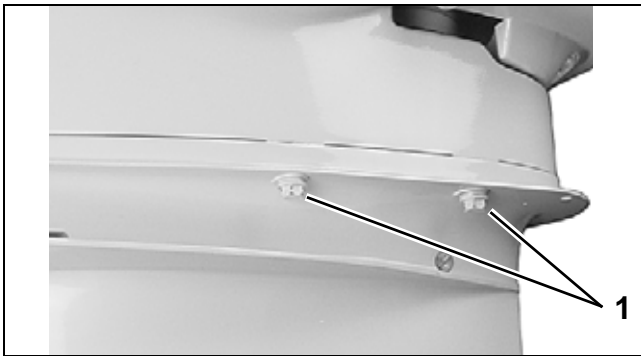
Remove the forward screw with the washer, and remove middle screw.



1. Forward screw
2. Middle screw

COA3139

Remove the four gearcase retaining screws.



1. Gearcase retaining screws

001990

Remove the gearcase assembly from the exhaust housing, being careful not to bend the shift rod or damage the water tube. The lower inner exhaust housing may come out with the gearcase.

## Installation



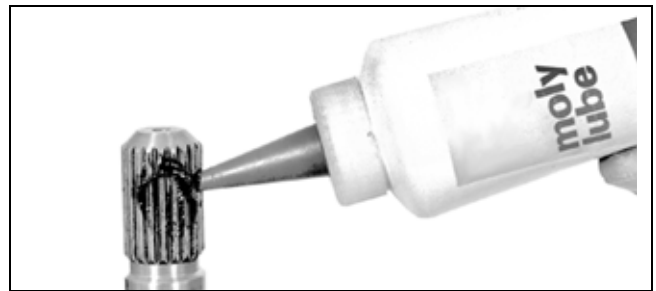
### WARNING



During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboard's weight with a suitable hoist or the tilt support bracket during service.

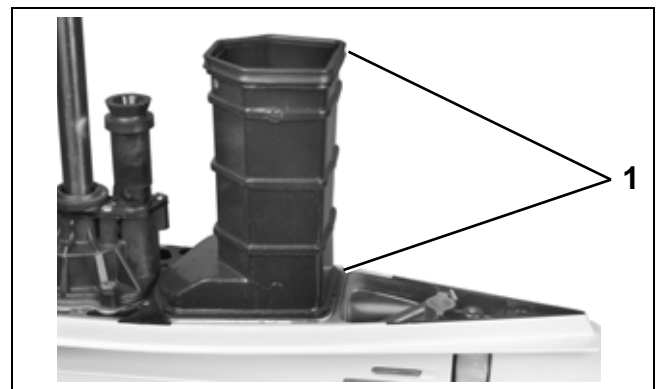
**IMPORTANT:** Before installation of gearcase on motor, shift rod adjustment **MUST** be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 314.

Coat the driveshaft splines with *Moly Lube*. DO NOT coat top surface of the driveshaft because lubricant may prevent seating of the driveshaft in the crankshaft.



30385

Apply *Adhesive 847* to the lower exhaust housing seals' inner surfaces. Position two new seals on the housing. Apply *Triple-Guard* grease to the seals' outer surfaces and position the housing on the gearcase.



TYPICAL

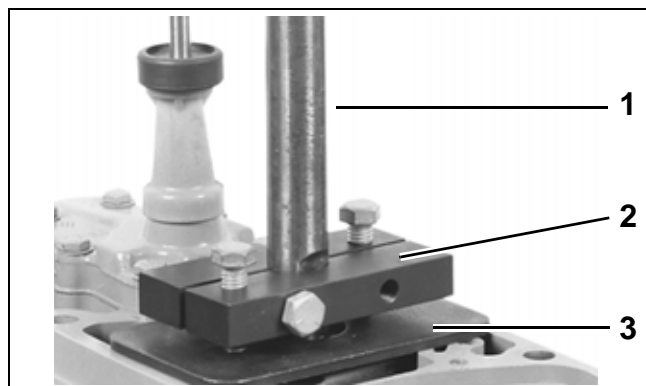
1. Lower exhaust seals

001985

**(Special) Driveshaft Removal Procedures**

**“O,” “L,” AND “M” TYPE GEARCASES**

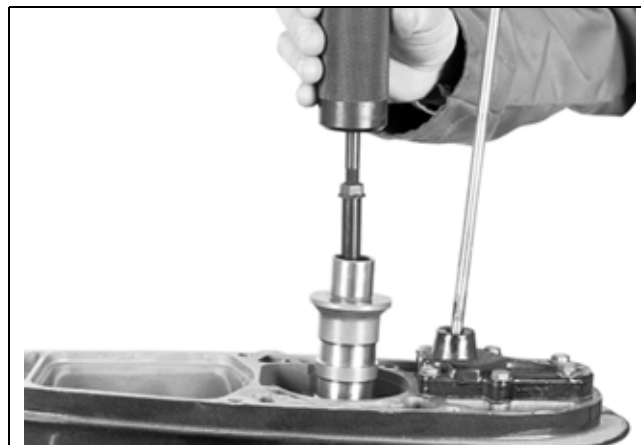
The driveshaft to pinion taper is a locking taper. If necessary, use Driveshaft Puller, P/N 390706, and Backing Plate, P/N 325867, to break the lock. Install the tools as shown by clamping them around the driveshaft. Alternately tighten the two vertical screws against the backing plate inserted between the puller and the gearcase until the driveshaft pops loose from the pinion.



- 1. Drive shaft
- 2. Puller
- 3. Backing plate

41177

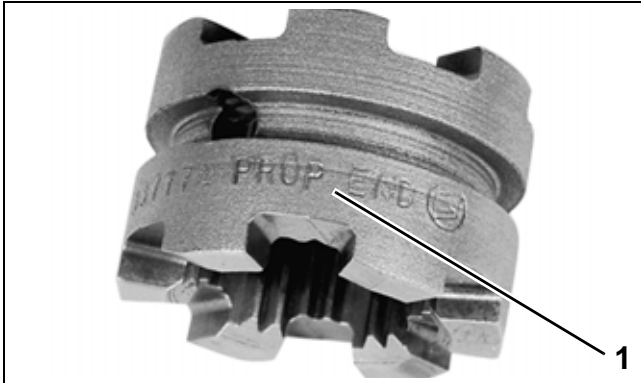
If upper driveshaft becomes separated from lower driveshaft, use Lower Driveshaft Puller, P/N 342681, to remove. Install puller into lower driveshaft and turn 90° to position hook under pin in driveshaft. Thread Slide Hammer, P/N 391008, into puller and remove driveshaft.



46905

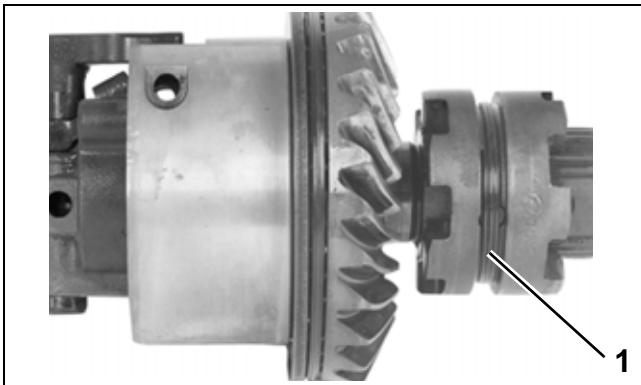
Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog on the shaft with "PROP END" facing rear of the shaft.

**IMPORTANT:** The clutch dog is not symmetrical. If installed backward, it will not fully engage and will immediately damage itself and the gears.



1. "PROP END" COB7581

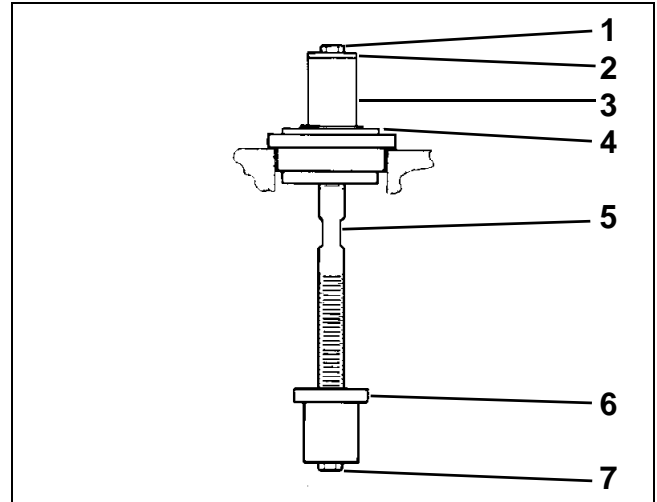
Slide the propeller shaft onto the shift shaft, align the hole in the shaft with the hole in the clutch dog, install the pin and then, a **new** clutch dog retaining spring. Position three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring COB3101

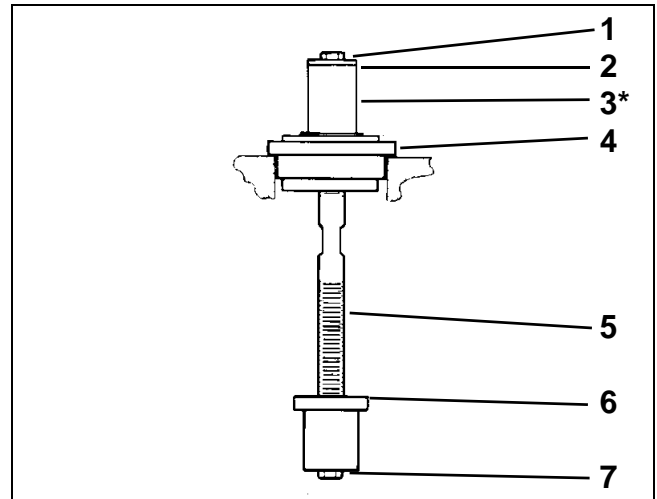
### Pinion Gear Bearing

Assemble the following components of Pinion Bearing Remover and Installer, P/N 391257, as shown:



**"S" Type Gearcases** 824182

1. 1/4-20 X 1/2 in. Hex head screw
2. 1 in. O.D. Flat washer
3. Spacer, P/N 341437
4. Plate, P/N 391260
5. Rod, P/N 326582
6. Installer/Remover, P/N 326574
7. 1/4-20 X 1 1/4 in. Hex head screw

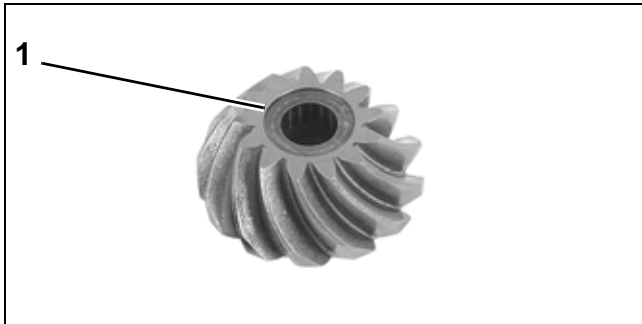


**"O," "L," and "M" Type Gearcases** 824182

1. 1/4-20 X 1/2 in. Hex head screw
2. 1 in. O.D. Flat washer
3. Spacer; P/N 350932 "M" and "XP", P/N 326584 "L"
4. Plate and Bearing P/N 391260
5. Rod P/N 326582
6. Installer/Remover, P/N 350958
7. 1/4-20 X 1 1/4 in. Hex head screw

**IMPORTANT:** Spacers are different sizes and cannot be interchanged.

Washer must be snapped into recess of pinion gear.



1. Washer

DSC02293

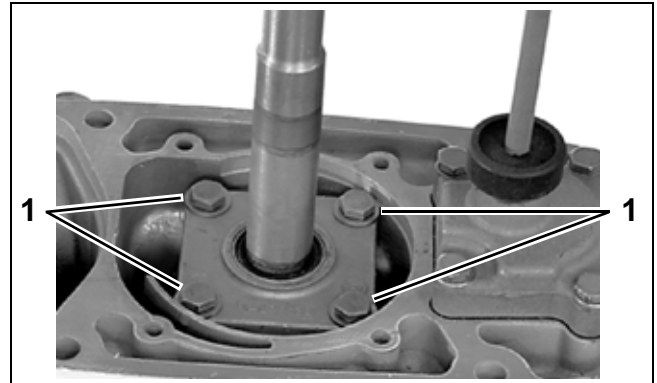
**IMPORTANT:** The inside taper of the pinion gear and the driveshaft taper **MUST** be completely free of grease. Clean the tapers with *Cleaning Solvent*. Use a shop towel free of grease and lint.

Lightly coat the threads of a **new** pinion nut with outboard lubricant and install on the driveshaft using Pinion Nut Starting Tool, P/N 342216. Turn the driveshaft by hand to engage the nut. Hand tighten pinion nut and remove the pinion nut starting tool. Proceed to next step and then torque procedure.



42230

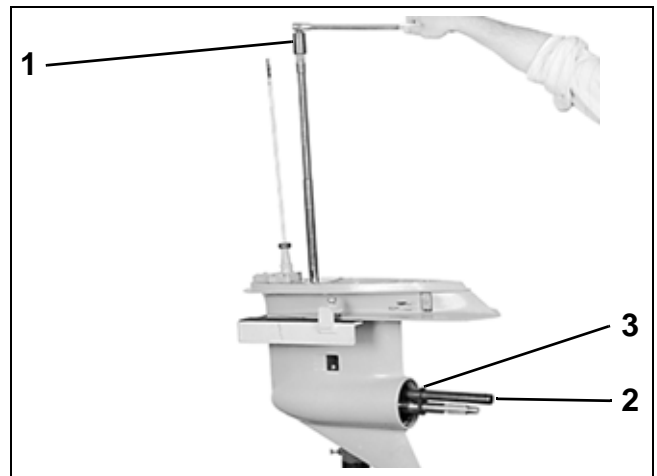
Install washers on the driveshaft bearing housing screws. Apply *Gasket Sealing Compound* to the threads of the screws. Install screws and torque to 120 to 144 in. lbs. (13.6 to 16.3 N·m).



1. Driveshaft bearing housing screws

COA3153

Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Holder, P/N 334455, and Wrench Retainer, P/N 341438, to torque the pinion nut to 100 to 110 ft. lbs. (136 to 149 N·m).



1. Holding socket  
2. Pinion holder  
3. Retainer

42229

For seal and bearing service, refer to **Propeller Shaft Bearing Housing Seals and Bearings** on p. 350.

**Assembly**

Apply *Needle Bearing* grease to the thrust bearing. Position bearing around shoulder on the propeller shaft.

Apply *Needle Bearing* grease to the thrust washer. Place washer in recess of bearing housing.



1. Thrust bearing  
2. Thrust washer

14214

Coat bearing surfaces of propeller shaft with gearcase lubricant. Slide the propeller housing onto the propeller shaft.



14159

**IMPORTANT:** Use caution when assembling the propeller shaft in the bearing housing. Thrust bearing must remain around shoulder on the propeller shaft.

Install gear housing retaining ring as shown.

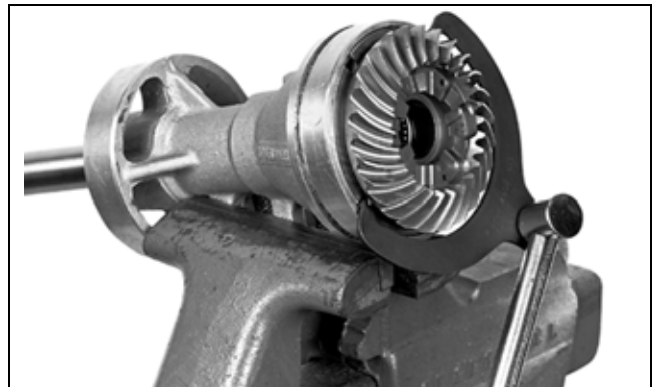


1. Retaining ring

Apply gearcase lubricant to the threads of the forward gear.

**IMPORTANT:** To prevent damage to threads, install forward gear by hand until fully seated against propeller shaft bearing housing.

Use Spanner Wrench, P/N 432400, to tighten the gear assembly to a torque of 100 ft. lbs. (136 N·m).



13529

Inspect the anode. Replace if necessary. Torque screws to 108 to 132 in. lbs. (12.2 to 14.9 N·m).

## MODES OF OPERATION (Three Piston System)

The three piston trim/tilt hydraulic assembly achieves trim and tilt movement through the following modes of operation.

### Trim-OUT / Tilt-UP Mode

When the UP switch is pressed, the trim/tilt motor rotates clockwise (as viewed from pump end) and turns the pump gears.

Fluid pressure passes through the **UP shuttle valve** to the **DOWN shuttle valve**, mechanically opening the **DOWN check valve**.

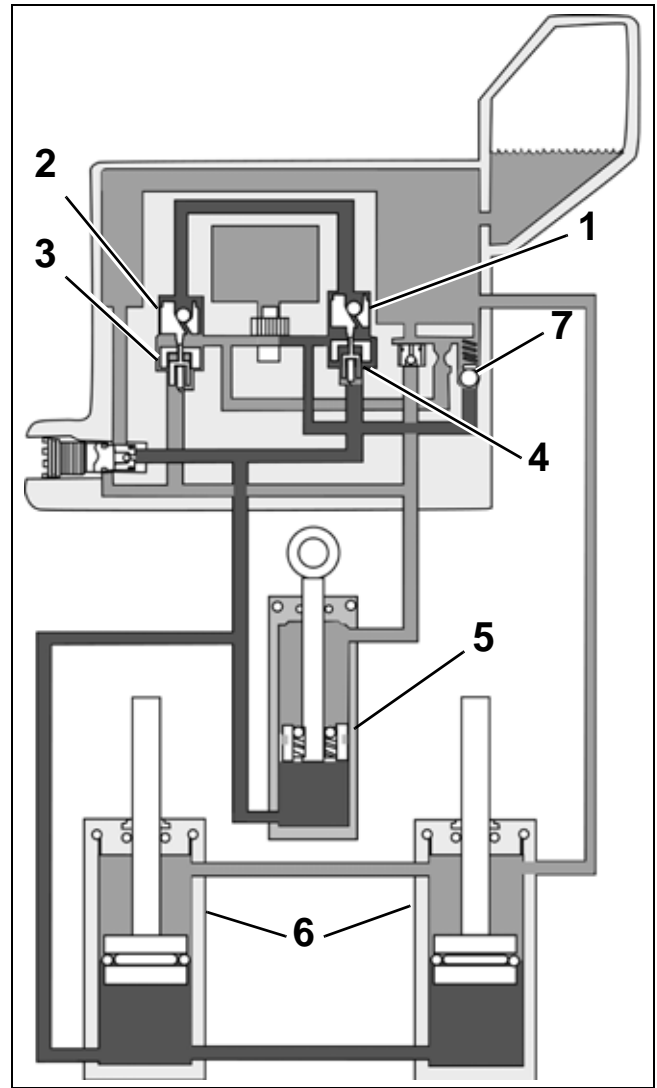
Fluid pressure pushes the **UP check valve** off its seat, and fluid passes through the valve to the bottom of all cylinders, pushing the pistons UP.

Fluid is pushed from the top of the **tilt cylinder** by the piston and returns to the pump through the open **DOWN check valve**.

In the trim range, fluid is pushed from the top of the **trim cylinders** by the pistons and returns to the reservoir.

Only fluid from the top of the tilt cylinder is returned to the pump. Because the cylinder rod displaces some fluid, that volume is less than the volume of the bottom of the tilt cylinder. So, additional fluid is drawn into the pump from the reservoir.

When all the cylinders are completely extended, the pressure increases until the **UP relief valve** opens at the tilt-up stall pressure (approximately 1500 psi (10342 kPa)).



1. Up shuttle valve
2. Down shuttle valve
3. Down check valve
4. Up check valve
5. Tilt cylinder
6. Trim cylinders
7. Up relief valve



DRC3462

Remove the manual release valve. Install pressure gauge and adapter “B” to check problems in the DOWN circuit. Cycle the unit down and up several times to purge air. With all rods fully extended, **run the unit down momentarily to reduce pressure.** Check fluid level again, and add fluid if necessary. Remember that all rods must be completely extended to check fluid level.

Starting with the tilt cylinder fully extended, run the unit DOWN.

- The gauge should show 0 to 200 psi (0 to 1379 kPa) as the tilt cylinder is retracting.
- The gauge should show approximately 800 psi (5516 kPa) as the unit stalls.
- Release the switch and watch for a pressure drop. The stall pressure reading must not drop more than 200 psi (1379 kPa) after motor stops.

If results vary from the above limits, there is a problem in the DOWN circuit. Refer to **MODES OF OPERATION (Three Piston System)** on p. 359 for circuit description.

	<b>CAUTION</b>	
<p><b>After tests are complete, run the unit up, then down momentarily. Cycle the unit down and up several times to purge air. With all rods fully extended, run the unit down momentarily to reduce pressure.</b></p>		

Check fluid level again and add fluid, if necessary.

## Single Piston System

Use the following guidelines to check a single piston trim/tilt unit that is not working correctly.

### Cylinder Leakdown:

- Manual release valve seals
- External leaks

### No reverse lock:

- External leaks

### No operation, motor runs:

- Manual release valve open
- Fluid level low
- Pump coupler
- Hydraulic pump

### No tilt down:

- Manual release valve
- Fluid level

### Slow performance:

- Manual release valve
- Fluid level low
- Mechanical binding
- Electric motor
- Hydraulic pump

### Unit locked in tilt up:

- Mechanical binding
- Hydraulic pump

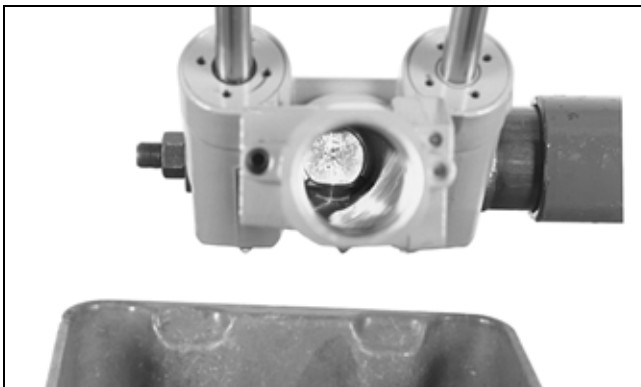
## TRIM AND TILT SERVICING – THREE PISTON SYSTEM

Slowly pull the piston out with a rag wrapped around the rod and the top of the cylinder. Drain the remaining fluid from the cylinder.



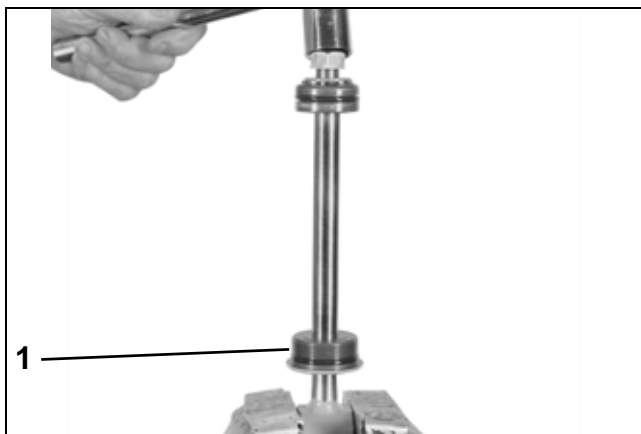
41765

Inspect the bore of the tilt cylinder for excessive scoring. If the bore of the tilt cylinder is scored or damaged, the hydraulic assembly must be replaced.



41767

Clamp the rod eye tightly in a soft jaw vise. Remove the nut from the piston end of the rod.



1. End cap

41781

Remove the washer. Slide the tilt piston off the rod. Be careful not to lose the springs, plungers, or small check valves in the piston assembly.



41784

Remove and discard the small inner O-ring and large outer O-ring.



1. Small inner O-ring  
2. Large outer O-ring

41819

### Tilt Piston Identification



#### WARNING



Different tilt pistons are used on hydraulic units for various outboard models. All plungers and check balls are identical. The tilt piston assemblies contain valving specific to certain models. To provide impact protection, it is important the correct piston assembly be installed.

## TRIM AND TILT SERVICING—SINGLE PISTON SYSTEM

Remove drive coupler from either the motor or the pump assembly.



004281

### Assembly

**IMPORTANT:** Use only *Evinrude/Johnson* Biodegradable TNT Fluid to fill the hydraulic system.

Install drive coupler in pump assembly.

Install a new motor O-ring.



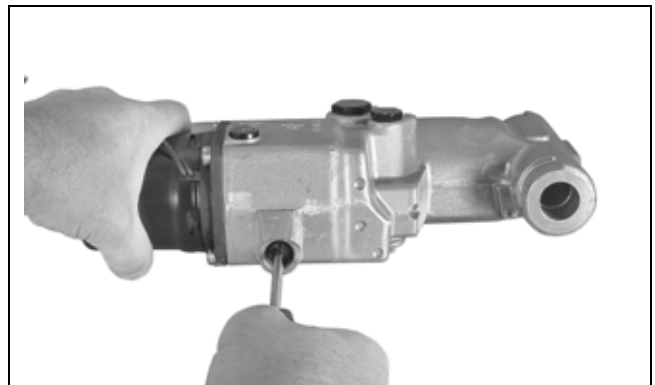
004280

Position the motor on the manifold and install four **new** screws and lock washers. Tighten the screws 35 to 50 in. lbs. (4 to 6 N·m).



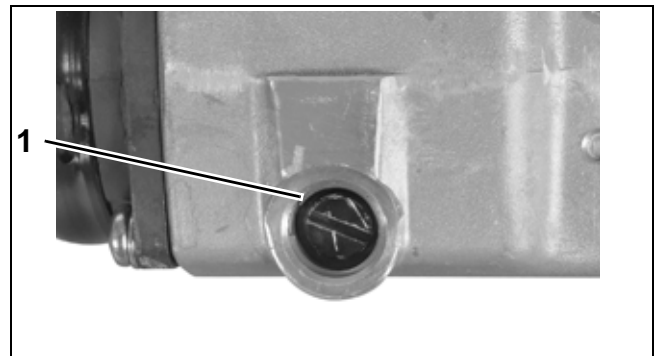
004282

Oil O-rings and install them on the manual release valve. Oil and install the manual release valve. Tighten the valve to a torque of 45 to 55 in. lbs. (5 to 6 N·m).



004285

Install **new** retaining ring in groove.



1. Retaining ring

004283

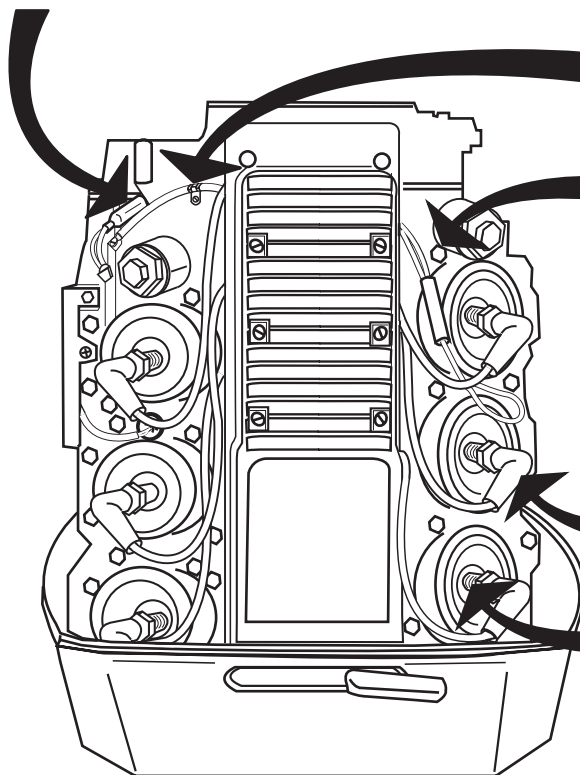
If electrical parts are replaced or even removed from the outboard, check the following:

### Wire and high voltage lead routing

- As shown in service manual
- Away from moving parts which could cut wires or wire insulation
- Away from engine cover latches which can catch and cut insulation from high voltage spark plug leads

### Sleeves, boots, shields

- In position (to avoid shock hazard)
- Not torn or cracked



### Metal Clamps – Tie Straps

- Position as shown in manual

### Screws, Nuts, Washers

- Tighten firmly—these keep clamps in position and ends of wires from sparking
- Where lock washers are called for, use them

### Spark Plug Boots

- Not torn or cracked
- Fully pushed onto spark plug

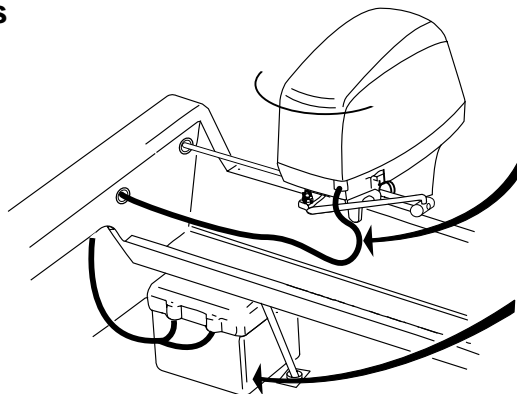
### Spark Plugs

- Avoid rough handling that could crack ceramic part of plug. (Sparks may jump across outside of plug.)

In transom area:

### All Connections

- Clean
  - Tight
- (Prevents sparks)



### Electric Cable

- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

### Batteries

- Secure in approved battery box or battery tray
- Battery terminals insulated
- No strain on cables

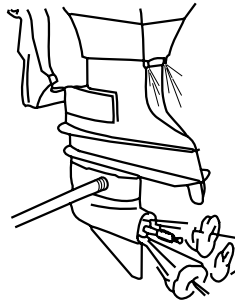
## Running outboard too fast (Overspeeding)

- “Too fast” means running faster than outboard normally runs on boat.

Running too fast can happen when:

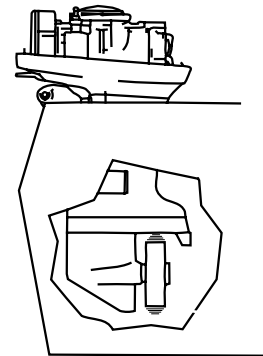
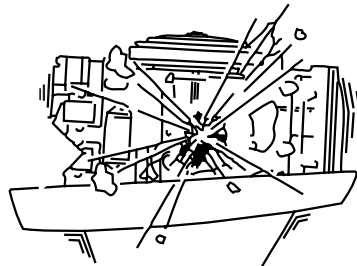
### 1) Using a flushing device...

Turn on water before starting outboard. Keep engine speed below 2000 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.



### 2) Running with the wrong test wheel...

This may happen if outboard runs too fast.



Use the right test wheel.

## Running outboards: Exhaust fumes



**DANGER**



**DO NOT run the engine indoors or without adequate ventilation or permit exhaust fumes to accumulate in confined areas. Engine exhaust contains carbon monoxide which, if inhaled, can cause serious brain damage or death.**

- Whenever running the engine, assure there is proper ventilation to avoid the accumulation of carbon monoxide (CO), which is odorless, colorless, and tasteless, and can lead to unconsciousness, brain damage, or death if inhaled in sufficient concentrations. CO accumulation can occur while docked, anchored, or underway, and in many confined areas such as the boat cabin, cockpit, swim platform, and heads. It can be worsened or caused by weather, mooring and operating conditions, and other boats. Avoid exhaust fumes from the engine or other boats, provide proper ventilation, shut off the engine when not needed, and be aware of the risk of backdrafting and conditions that create CO accumulation. In high concentrations, CO can be fatal within minutes. Lower concentrations are just as lethal over long periods of time.

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## OUTBOARD STARTS, LOW MAXIMUM RPM

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
System Check light	Outboard is in <i>S.A.F.E.</i>	Access <i>EMM</i> service codes and check <i>System-Check</i> warning
Setup or rigging change	Incorrect propeller	Refer to specifications, check recommended WOT RPM; water test and install correct pitch propeller
	Incorrect outboard mounting height	Refer to installation guidelines
Performance of outboard at lower speeds appears normal	Throttle plate opening	Check throttle plate and WOT opening
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Contaminated or poor quality fuel	Check or replace fuel supply
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low alternator output (55 V)	Check voltage on 55 V circuits, refer to <b>SYSTEM ANALYSIS</b> on p. 113 and <b>ELECTRICAL AND IGNITION</b> on p. 135
	Weak or erratic ignition operation	Check ignition, refer to <b>SYSTEM ANALYSIS</b> on p. 113 and <b>ELECTRICAL AND IGNITION</b> on p. 135
	Fuel injector electrical circuit or control function	Check voltage at injectors, refer to <b>SYSTEM ANALYSIS</b> on p. 113
	Restricted or leaking fuel injectors	Check injectors, refer to <b>FUEL SYSTEM</b> on p. 173
	Low fuel pressure	Check circulation pump operation, refer to <b>FUEL SYSTEM</b> on p. 173
	<i>EMM</i> programming, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Restricted engine exhaust	Check and repair as needed

## EXCESSIVE SMOKING

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
May coincide with increased oil consumption (normal if occurs after winterization)	Contaminated or poor fuel	Check or replace fuel supply
	Excessive fuel or oil consumption	Check fuel system for fuel supply air leaks or leaking fuel injectors
	Outboard in break-in mode	Use diagnostic program to confirm
	Outboard mounted too low	Check installation height of outboard
	Vapor separator vent	Check vapor separator assembly for proper venting/float valve operation
	Faulty/leaking fuel injector(s)	Check injectors, refer to <b>FUEL SYSTEM</b> on p. 173
	Damaged fuel lift pump	Check for internal leaks

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