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- Evinrude®
- Johnson®
- Evinrude® E-TEC®
- FasTrak™
- S.A.F.E.™
- SystemCheck™
- I-Command™
- Evinrude® / Johnson® XD30™ Outboard Oil
- Evinrude® / Johnson® XD50™ Outboard Oil
- Evinrude® / Johnson® XD100™ Outboard Oil
- Twist Grip™
- Nut Lock™
- Screw Lock™
- Ultra Lock™
- Gel-Seat II™
- Moly Lube™
- Triple-Guard® Grease
- DPL™ Lubricant
- 2+4® Fuel Conditioner
- Carbon Guard™
- HPF XR™ Gearcase Lubricant
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## INTRODUCTION

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SAFETY INFORMATION

Before working on any part of the outboard, read the SAFETY section at the end of this manual.

This manual is written for qualified, factory-trained technicians who are already familiar with the use of Evinrude®/Johnson® Special Tools. This manual is not a substitute for work experience. It is an organized guide for reference, repair, and maintenance of the outboard(s).

This manual uses the following signal words identifying important safety messages.

⚠️ DANGER ⚠️
Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠️ WARNING ⚠️
Indicates a potentially hazardous situation which, if not avoided, CAN result in severe injury or death.

⚠️ CAUTION ⚠️
Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate personal injury or property damage. It also may be used to alert against unsafe practices.

**IMPORTANT:** Identifies information that will help prevent damage to machinery and appears next to information that controls correct assembly and operation of the product.

These safety notices mean:

**ATTENTION!**
**BECOME ALERT!**
**YOUR SAFETY IS INVOLVED!**

Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so to protect yourself, as well as the people around you.

It is understood that this manual may be translated into other languages. In the event of any discrepancy, the English version shall prevail.

To reduce the risk of personal injury, safety warnings are provided at appropriate times throughout the manual.

DO NOT make any repairs until you have read the instructions and checked the pictures relating to the repairs.

Be careful, and never rush or guess a service procedure. Human error is caused by many factors: carelessness, fatigue, overload, preoccupation, unfamiliarity with the product, and drugs and alcohol use, to name a few. Damage to a boat and outboard can be fixed in a short period of time, but injury or death has a lasting effect.

When replacement parts are required, use Evinrude/Johnson Genuine Parts or parts with equivalent characteristics, including type, strength and material. Using substandard parts could result in injury or product malfunction.

Torque wrench tightening specifications must be strictly followed. Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to turning must be felt when reusing a locking fastener. If replacement is specified or required because the locking fastener has become weak, use only authorized Evinrude/Johnson Genuine Parts.

If you use procedures or service tools that are not recommended in this manual, YOU ALONE must decide if your actions might injure people or damage the outboard.
**DANGER**

Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off. Remove propeller before servicing and when running the outboard on a flushing device.

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.

---

**WARNING**

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

The motor cover and flywheel cover are machinery guards. Use caution when conducting tests on running outboards. DO NOT wear jewelry or loose clothing. Keep hair, hands, and clothing away from rotating parts.

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.

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

The electrical system presents a serious shock hazard. DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.

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.

Do not smoke, or allow open flames or sparks, or use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.

Keep all electrical connections clean, tight, and insulated to prevent shorting or arcing and causing an explosion.

Always work in a well ventilated area.

Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to tightening must be felt when reusing a locking fastener. If replacement is indicated, use only authorized replacement or equivalent.
### Units of Measurement

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Amperes</td>
</tr>
<tr>
<td>amp-hr</td>
<td>Ampere hour</td>
</tr>
<tr>
<td>fl. oz.</td>
<td>fluid ounce</td>
</tr>
<tr>
<td>ft. lbs.</td>
<td>foot pounds</td>
</tr>
<tr>
<td>HP</td>
<td>horsepower</td>
</tr>
<tr>
<td>in.</td>
<td>inch</td>
</tr>
<tr>
<td>in. Hg</td>
<td>inches of mercury</td>
</tr>
<tr>
<td>in. lbs.</td>
<td>inch pounds</td>
</tr>
<tr>
<td>kPa</td>
<td>kilopascals</td>
</tr>
<tr>
<td>ml</td>
<td>milliliter</td>
</tr>
<tr>
<td>mm</td>
<td>millimeter</td>
</tr>
<tr>
<td>N-m</td>
<td>Newton meter</td>
</tr>
<tr>
<td>P/N</td>
<td>part number</td>
</tr>
<tr>
<td>psi</td>
<td>pounds per square inch</td>
</tr>
<tr>
<td>RPM</td>
<td>revolutions per minute</td>
</tr>
<tr>
<td>°C</td>
<td>degrees Celsius</td>
</tr>
<tr>
<td>°F</td>
<td>degrees Fahrenheit</td>
</tr>
<tr>
<td>ms</td>
<td>milliseconds</td>
</tr>
<tr>
<td>µs</td>
<td>microseconds</td>
</tr>
<tr>
<td>Ω</td>
<td>Ohms</td>
</tr>
<tr>
<td>V</td>
<td>Volts</td>
</tr>
<tr>
<td>VAC</td>
<td>Volts Alternating Current</td>
</tr>
<tr>
<td>VDC</td>
<td>Volts Direct Current</td>
</tr>
</tbody>
</table>

### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABYC</td>
<td>American Boat &amp; Yacht Council</td>
</tr>
<tr>
<td>ATDC</td>
<td>after top dead center</td>
</tr>
<tr>
<td>AT</td>
<td>air temperature sensor</td>
</tr>
<tr>
<td>BPS</td>
<td>barometric pressure sensor</td>
</tr>
<tr>
<td>BTDC</td>
<td>before top dead center</td>
</tr>
<tr>
<td>CCA</td>
<td>cold cranking amps</td>
</tr>
<tr>
<td>CPS</td>
<td>crankshaft position sensor</td>
</tr>
<tr>
<td>EMM</td>
<td>Engine Management Module</td>
</tr>
<tr>
<td>ICOMIA</td>
<td>International Council of Marine Industry Associations</td>
</tr>
<tr>
<td>MCA</td>
<td>marine cranking amps</td>
</tr>
<tr>
<td>MWS</td>
<td>modular wiring system</td>
</tr>
<tr>
<td>NMEA</td>
<td>National Marine Electronics Assoc.</td>
</tr>
<tr>
<td>NTC</td>
<td>negative temperature coefficient</td>
</tr>
<tr>
<td>PTC</td>
<td>positive temperature coefficient</td>
</tr>
<tr>
<td>ROM</td>
<td>read only memory</td>
</tr>
<tr>
<td>S.A.F.E.™</td>
<td>speed adjusting failsafe electronics</td>
</tr>
<tr>
<td>SAC</td>
<td>start assist circuit</td>
</tr>
<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
</tr>
<tr>
<td>SYNC</td>
<td>synchronization</td>
</tr>
<tr>
<td>TDC</td>
<td>top dead center</td>
</tr>
<tr>
<td>TPS</td>
<td>throttle position sensor</td>
</tr>
<tr>
<td>WOT</td>
<td>wide open throttle</td>
</tr>
<tr>
<td>WTS</td>
<td>water temperature sensor</td>
</tr>
</tbody>
</table>
ENGINE EMISSIONS INFORMATION

Maintenance, replacement, or repair of the emission control devices and systems may be performed by any marine SI (spark ignition) engine repair establishment or individual.

Manufacturer’s Responsibility

Beginning with 1999 model year outboards, manufacturers of marine outboards must determine the exhaust emission levels for each outboard horsepower family and certify these outboards with the United States of America Environmental Protection Agency (EPA). An emissions control information label, showing emission levels and outboard specifications, must be placed on each outboard at the time of manufacture.

Dealer’s Responsibility

When performing service on all 1999 and more recent Evinrude/Johnson outboards that carry an emissions control information label, 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 outboard in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturer’s prescribed changes, such as altitude adjustments, for example.

Owner’s Responsibility

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

The owner/operator is not to, and should not allow anyone to, modify the outboard in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Tampering with the fuel system to change horsepower or modify emission levels beyond factory settings or specifications will void the product warranty.

EPA Emission Regulations

All new 1999 and more recent Evinrude/Johnson outboards are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new watercraft marine spark ignition outboards. 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 practical, 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 requirements 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:
www.epa.gov
INTRODUCTION
MODEL DESIGNATION

MODEL DESIGNATION

PREFIX

STYLE:
J = Johnson
E = Evinrude

HORSEPOWER

LENGTH:
= 15” Std.
L = 20” Long
Y = 22.5” Special
X = 25” X-long
Z = 30” XX-long

MODEL RUN
or SUFFIX

DESIGN FEATURES:
AP = Advanced Propulsion
B = Blue Paint
C = Counter Rotation
D = Evinrude E-TEC™
E = Electric Start w/Remote Steering
F = Direct-Injection
G = Graphite Paint
H = High Output
J = Jet Drive
M = Military
P = Power Trim and Tilt
R = Rope Start w/Tiller Steering
S = Saltwater Edition
T = Tiller Steering
TE = Tiller Electric
V = White Paint
W = Commercial Model

MODEL YR:
I = 1
N = 2
T = 3
R = 4
O = 5
D = 6
U = 7
C = 8
E = 9
S = 0
Ex: SC = 2008
MODELS COVERED IN THIS MANUAL

This manual covers service information on all 52.7 cubic inch, 2-Cylinder Evinrude E-TEC® models.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Shaft</th>
<th>Color</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>E40DRLSCB</td>
<td>20”</td>
<td>BL</td>
<td>Tiller/Rope</td>
</tr>
<tr>
<td>E40DTLSCS</td>
<td>20”</td>
<td>BL</td>
<td>Tiller/Electric</td>
</tr>
<tr>
<td>E40DPLSCB</td>
<td>20”</td>
<td>BL</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E40DSLSCS</td>
<td>20”</td>
<td>WH</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E50DTLSCS</td>
<td>20”</td>
<td>BL</td>
<td>Tiller/Electric</td>
</tr>
<tr>
<td>E50DPLSCB</td>
<td>20”</td>
<td>BL</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E50DSLSCS</td>
<td>20”</td>
<td>WH</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E60DTLSCS</td>
<td>20”</td>
<td>BL</td>
<td>Tiller/Electric</td>
</tr>
<tr>
<td>E60DPLSCB</td>
<td>20”</td>
<td>BL</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E60DSLSCS</td>
<td>20”</td>
<td>WH</td>
<td>Remote/Electric</td>
</tr>
<tr>
<td>E65WDLRSCS</td>
<td>20”</td>
<td>BL</td>
<td>Tiller/Rope</td>
</tr>
<tr>
<td>E65WDRYSCS</td>
<td>22.5”</td>
<td>BL</td>
<td>Tiller/Rope</td>
</tr>
</tbody>
</table>

Identifying Model and Serial Numbers

Outboard model and serial numbers are located on the swivel bracket and on the powerhead.

1. Model and serial number

1. Serial number

002224

002225
## 40 – 65 HP E-TEC Models

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>Full Throttle Operating Range RPM</th>
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<tr>
<td></td>
<td>40 HP – 5000 to 6000 RPM</td>
</tr>
<tr>
<td></td>
<td>50 HP – 5500 to 6000 RPM</td>
</tr>
<tr>
<td></td>
<td>60 HP – 5500 to 6000 RPM</td>
</tr>
<tr>
<td></td>
<td>650 HP – 5500 to 6000 RPM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power</th>
<th>40 HP (30 kw) @ 5500 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 HP (37 kw) @ 5750 RPM</td>
</tr>
<tr>
<td></td>
<td>60 HP (45 kw) @ 5750 RPM</td>
</tr>
<tr>
<td></td>
<td>65 HP (45 kw) @ 5750 RPM</td>
</tr>
</tbody>
</table>

| Idle RPM in Gear | 800 ± 50 EMM Controlled |
| Idle RPM in Neutral | 750 ± 50 EMM Controlled |

| Test Propeller | P/N 382861 |

<table>
<thead>
<tr>
<th>WEIGHT (may vary depending on model)</th>
<th>(RL) Models: 232 lbs. (105 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(PL) Models: 240 lbs. (109 kg)</td>
</tr>
</tbody>
</table>

| Lubrication | Evinrude/Johnson XD100, XD50, XD30; or NMMA TC-W3 certified |

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>In-line, 2 Cylinder, Two-Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>52.7 cu. in. (864 cc)</td>
</tr>
<tr>
<td>Bore</td>
<td>3.601 in (91.47 mm)</td>
</tr>
<tr>
<td>Stroke</td>
<td>2.588 in. (65.74 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Bore</th>
<th>3.6005 to 3.6015 in. (91.45 to 91.48 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To bore oversize, add piston oversize dimension to standard bore</td>
</tr>
<tr>
<td>Top Crankshaft Journal</td>
<td>2.1870 to 2.1875 in. (55.55 to 55.56 mm)</td>
</tr>
<tr>
<td>Center Crankshaft Journal</td>
<td>2.1870 to 2.1875 in. (55.55 to 55.56 mm)</td>
</tr>
<tr>
<td>Bottom Crankshaft Journal</td>
<td>1.5747 to 1.5752 in. (40.0 to 40.01 mm)</td>
</tr>
<tr>
<td>Rod Crankpin</td>
<td>1.3757 to 1.3762 in. (34.94 to 34.96 mm)</td>
</tr>
<tr>
<td>Piston Ring End Gap, Both</td>
<td>0.011 to 0.023 in. (0.28 to 0.58 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FUEL</th>
<th>Fuel/Oil Control</th>
<th>EMM Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Starting Enrichment</td>
<td>EMM Controlled</td>
</tr>
<tr>
<td>Minimum (High) Fuel Pressure</td>
<td>24 to 28 psi (165 to 193 kPa)</td>
<td></td>
</tr>
<tr>
<td>Minimum Fuel Lift Pump Pressure</td>
<td>3 psi (21 kPa)</td>
<td></td>
</tr>
<tr>
<td>Maximum Fuel Inlet Vacuum</td>
<td>4 in. Hg.</td>
<td></td>
</tr>
<tr>
<td>Minimum Octane</td>
<td>87 AKI (R+M)/2 or 90 RON</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additives</th>
<th>2+4® Fuel Conditioner, Fuel System Cleaner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use of other additives may result in engine damage.</td>
</tr>
</tbody>
</table>

See Fuel Requirements on p. 53 for additional information.
### 40 – 65 HP E-TEC Models

<table>
<thead>
<tr>
<th>Electrical</th>
<th>640 CCA (800 MCA) or 800 CCA (1000 MCA) below 32° F (0° C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternator</td>
<td>25-Amp fully regulated</td>
</tr>
<tr>
<td>Tachometer Setting</td>
<td>6 pulse (12 pole)</td>
</tr>
<tr>
<td>Engine Fuse</td>
<td>P/N 967545 – 10 A</td>
</tr>
<tr>
<td>Thermostat</td>
<td>143°F (62°C)</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>212°F (100°C)</td>
</tr>
<tr>
<td>Water pressure</td>
<td>11 psi minimum @ 5000 RPM</td>
</tr>
<tr>
<td>Type</td>
<td>Capacitor Discharge</td>
</tr>
<tr>
<td>Firing Order</td>
<td>1-2</td>
</tr>
<tr>
<td>Ignition Timing</td>
<td>EMM Controlled</td>
</tr>
<tr>
<td>RPM Limit in Gear</td>
<td>6250</td>
</tr>
<tr>
<td>RPM Limit in Neutral</td>
<td>1800</td>
</tr>
<tr>
<td>Crankshaft Position Sensor Air Gap</td>
<td>Fixed</td>
</tr>
<tr>
<td>Spark Plug</td>
<td>Refer to Emission Control Information Label</td>
</tr>
<tr>
<td>Gear Ratio</td>
<td>12:32 (.375)</td>
</tr>
<tr>
<td>Lubricant</td>
<td>HPF XR Gearcase Lube</td>
</tr>
<tr>
<td>Capacity</td>
<td>22 fl. oz. (650 ml)</td>
</tr>
<tr>
<td>Shift Rod Height</td>
<td>20 in. (L) Models: 21.38 (543 mm) ± one-half turn</td>
</tr>
<tr>
<td>Shift Cable Stroke</td>
<td>1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Evinrude/Johnson Biodegradable TNT Fluid</td>
</tr>
<tr>
<td>Fluid Capacity</td>
<td>15.2 fl. oz. (450 ml)</td>
</tr>
<tr>
<td>Trim Range</td>
<td>0° to 15°</td>
</tr>
<tr>
<td>Tilt Range</td>
<td>16° to 65°</td>
</tr>
</tbody>
</table>
**INTRODUCTION**

**STANDARD TORQUE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Size</th>
<th>In. Lbs.</th>
<th>Ft. Lbs.</th>
<th>N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 6</td>
<td>7–10</td>
<td>0.58–0.83</td>
<td>0.8–1.1</td>
</tr>
<tr>
<td>No. 8</td>
<td>15–22</td>
<td>1.25–1.83</td>
<td>1.7–2.5</td>
</tr>
<tr>
<td>No. 10</td>
<td>24–36</td>
<td>2–3</td>
<td>2.7–4.0</td>
</tr>
<tr>
<td>No. 12</td>
<td>36–48</td>
<td>3–4</td>
<td>4.0–5.4</td>
</tr>
<tr>
<td>1/4 in.</td>
<td>60–84</td>
<td>5–7</td>
<td>7–9.5</td>
</tr>
<tr>
<td>5/16 in.</td>
<td>120–144</td>
<td>10–12</td>
<td>13.5–16.5</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>216–240</td>
<td>18–20</td>
<td>24.5–27</td>
</tr>
<tr>
<td>7/16 in.</td>
<td>336–384</td>
<td>28–32</td>
<td>38–43.5</td>
</tr>
</tbody>
</table>

**IMPORTANT:** These values apply only when a specific torque for a specific fastener is not listed in the appropriate section. When tightening two or more screws on the same part, DO NOT tighten screws completely, one at a time.

**WARNING**

Torque wrench tightening specifications must be strictly adhered to. Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to turning must be felt when reusing a locking fastener.

If replacement is specified or required because the locking fastener has become weak, use only authorized Evinrude/Johnson Genuine Parts.

---

**PRODUCT REFERENCE AND ILLUSTRATIONS**

BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of such change. Specifications used are based on the latest product information available at the time of publication.

The continuing accuracy of this manual cannot be guaranteed.

All photographs and illustrations used in this manual may not depict actual models or equipment, but are intended as representative views for reference only.

Certain features or systems discussed in this manual might not be found on all models in all marketing areas.

All service technicians must be familiar with nautical orientation. This manual often identifies parts and procedures using these terms.

---

**Nautical Orientation**

006411
SPECIAL TOOLS

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SPECIAL TOOLS
DIAGNOSTIC TOOLS

DIAGNOSTIC TOOLS

- Diagnostic Software P/N 764642 764642
- Bootstrap tool P/N 586551 002276
- Interface cable P/N 437955 45583

UNIVERSAL TOOLS

- Universal Puller Set P/N 378103 32885
- Lifting eye P/N 321537 23701
- Lifting ring assembly P/N 396748 000669

- Flywheel holder P/N 771311 42938
- Slide hammer P/N 391008 CO1577
- Slide hammer P/N 432128 15345

- Slide hammer adapter P/N 340624 39435
- Slide hammer adapter P/N 390898 15356
- Puller Bridge – 432127 23146
Small puller jaws P/N 432131 23150
Large puller jaws P/N 432129 23146
Bearing puller jaws P/N 432130 23149

Tilt tube nut wrench P/N 342680 46879
Tilt tube service kit P/N 434523 33249
Syringe P/N 346936 50243

Temperature gun P/N 772018 45240
Fresh water flusher P/N 500542 50110
Twist-Grip™ Remover P/N 390767 COA6017

Remover, ball socket
P/N 342226 002584
Installer, ball socket
P/N 342225 002583
Oetiker† pincers, P/N 787145 001081
SPECIAL TOOLS
ELECTRICAL / IGNITION TOOLS

ELECTRICAL / IGNITION TOOLS

- Digital multimeter
  DRC7265
  Ohms resolution 0.01
  Purchase through local supplier

- Peak reading voltmeter
  P/N 507972
  P/N 507972

- Test probe kit P/N 342677
  45241

- Stator Test Adapter P/N 5005799
  002273

- Crimping pliers P/N 322696
  30387

- AMP° connector tools
  Primary Lock Tool P/N 777077
  Secondary Lock Tool P/N 777078
  Release Tool P/N 351413
  Lock Installer P/N 777079

- Test probe kit P/N 507972
  49799

- Tachometer/timing light P/N 507980
  49789

- Connector tool P/N 342667
  42004
FUEL /OIL SYSTEM TOOLS

Fuel pressure gauge (60 PSI)
P/N 5007100
90° fitting, P/N 353322

Fuel pressure gauge (15 PSI)
P/N 5006397
90° fitting, P/N 353322

Injector test fitting kit
P/N 5005844

POWERHEAD TOOLS

Cylinder bore gauge P/N 771310

Rod cap alignment fixture
P/N 396749

Crankshaft bearing and sleeve installer P/N 338647

Piston stop tool P/N 342679
Replacement tip P/N 5006098

Torquing socket P/N 331638

Wrist pin bearing installer P/N 336660
GEARCASE TOOLS

- **Wrist pin pressing tool**
  - P/N 326356

- **Wrist pin retaining ring driver**
  - P/N 318599
  - Wrist pin cone P/N 318600

- **Ring compressor – standard**
  - P/N 336314

- **Universal Driveshaft Shimming Tool**
  - P/N 5005925
  - Lower Driveshaft Shimming Bolt (S2 gearcase) P/N 352878

- **Gearcase filler**
  - P/N 501882

- **Gearcase pressure tester**
  - P/N 507977 (Stevens P/N S-34)
  - Gearcase vacuum tester
    - P/N 507982 (Stevens P/N V-34)

- **Universal Pinion Bearing Remover and installer kit**
  - P/N 5005927

- **Retaining ring pliers**
  - P/N 331045

- **Replacement tip set**
  - P/N 395967

- **Universal shift rod height gauge**
  - P/N 389997
Holding Socket P/N 334995 16302
Driveshaft seal protector P/N 312403 23692
Prop shaft housing seal installer P/N 326551 32973

Backing plate P/N 325867 23621
Nut starting tool P/N 320675 40372
Seal Installer P/N 342665 42233

Puller P/N 387206 47254
Bearing Installer P/N 326562 32962
Guide rods P/N 383175 000828
SPECIAL TOOLS
TRIM AND TILT TOOLS

TRIM AND TILT TOOLS

Tilt cylinder end cap remover
P/N 352932, for single-piston
tilt systems

Spanner wrench P/N 912084
005340 32213

MANUAL STARTER TOOLS

Starter rope threading tool
P/N 378774
23682

Starter spring winder/installer
P/N 392093
CO3583
SHOP AIDS

- Cleaning Solvent P/N 771087
- D.P.L. Spray P/N 777183
- Oil - XD30™ P/N 777219
- “6 in 1” Multi-Purpose Lubricant P/N 777192
- Oil - XD50™ P/N 777225
- HPF XR™ Gear Lube P/N 778755
- Oil - XD100™ P/N 777118
- Anti-Corrosion Spray P/N 777193
- HPF PRO Gearcase Lube P/N 778755
- Engine Tuner P/N 777185
- Silicone spray P/N 775630
- Moly Lube P/N 175356
SPECIAL TOOLS
SHOP AIDS

Storage Fogging Oil
P/N 777186

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

Electrical Grease P/N 503243

Lubriplate† 777 P/N 317619

Black Neoprene Dip P/N 909570

2 + 4™ Fuel conditioner P/N 775613

Triple-Guard® Grease P/N 508298

Starter Bendix Lube P/N 337016

Gel-Seal and Gasket Remover P/N 771050

Needle Bearing Grease, P/N 378642

Biodegradeable TNT Fluid
P/N 763439

Permatex® No. 2, P/N 910032
RTV Silicone Sealant P/N 263753
Fuel System Cleaner P/N 777184
Gel-Seal II P/N 327361
Carbon Guard™ P/N 775629

Gasket Sealing Compound P/N 317201
Pipe Sealant with Teflon P/N 910048
Locquic Primer P/N 772032
Adhesive 847 P/N 776964

Thermal Joint Compound P/N 322170
Instant Bonding Adhesive P/N 509955

1. Screw Lock P/N 500417
   (Loctite Purple 222 equivalent)
2. Nut Lock P/N 500421
   (Loctite Blue 242 Equivalent)
3. Ultra Lock P/N 500423
   (Loctite Red 271 Equivalent)
<table>
<thead>
<tr>
<th>Technician’s Notes</th>
<th>Related Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Bulletins</strong></td>
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</tbody>
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# INSTALLATION AND PREDELIVERY

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Remote control and wiring harness options are described in the *Evinrude/Johnson Genuine Parts and Accessories Catalog.*

The remote control used must have start-in-gear prevention. This feature can prevent injuries resulting from unexpected boat movement when the outboard starts.

Remote control and wiring harness combination must have the following features:
- Start-in-gear prevention
- Emergency stop / key switch
- Shift stroke must measure 1.125 to 1.330 in. (28.6 to 33.8 mm) between NEUTRAL and FORWARD
- Throttle stroke must PUSH for open
- Connections for engine monitor warning system.

**Engine Monitoring System**

**IMPORTANT:** Outboards with remote controls must be equipped with an *I-Command* system, a *SystemCheck* gauge, or an equivalent engine monitor. Operating the outboard without an engine monitor will void the warranty for failures related to monitored functions.

Refer to **ENGINE MONITORING SYSTEM** on p. 93.
Control Installation
Plan the installation of remote controls carefully, following all instructions provided with the remote control.

Make sure the following items are checked:
• Correct length, type and quality of control cables and wiring harnesses
• Proper routing of cables and harnesses
• Slack in front of the outboard for remote control cables
• Positioning and securing of cables and harnesses along their lengths to prevent movement or damage.

Typical transom-mounted outboard installations require a 12 in. (30 cm) cable loop at the front of the outboard when the cables are routed from the side of the splash well.

Battery Installation
Each outboard requires its own starting battery. Select a battery that meets or exceeds the minimum requirements.

Minimum 12 Volt Battery Recommendations

<table>
<thead>
<tr>
<th>Outboard Model</th>
<th>Battery Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–90 HP</td>
<td>640 CCA (800 MCA), or 800 CCA (1000 MCA) below 32° F (0° C) 107 amp-hr in extreme applications</td>
</tr>
</tbody>
</table>

Location and Preparation
Proper installation will prevent battery movement while underway.
• Secure all batteries in protected locations.
• Place battery as close to the outboard as possible.
• Battery location must provide access for periodic maintenance.
• Use battery mounting trays or battery boxes on all battery installations.
• Connections and terminals must be covered with an insulator.
• Battery connections must be clean and free from corrosion.
• Read and understand the safety information supplied with the battery before installation.

WARNING
Keep the battery connections clean, tight, and insulated to prevent their shorting or arcing and causing an explosion. If the battery mounting system does not cover the connections, install protective covers. Check often to see that connections stay clean and tight.
Connections

**IMPORTANT:** Connect the battery positive (+) cable to the battery positive (+) post FIRST. Connect the battery negative (–) cable to the battery negative (–) post LAST.

Install a starwasher on the threaded battery post. Stack cables from the outboard, then cables from accessories. Finish this connection with a hex nut.

**IMPORTANT:** Do not use wing nuts to fasten ANY battery cables. Wing nuts can loosen and cause electrical system damage not covered under warranty.

Tighten all connections securely. Apply Triple-Guard grease to prevent corrosion.

<table>
<thead>
<tr>
<th>Battery Cable Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evinrude</strong> outboards are shipped with stranded copper battery cables for typical installations in which the starting battery is positioned close to the transom.</td>
</tr>
</tbody>
</table>

Specialized outboard installations with extended length battery cables require an increased wire size. Refer to the following table.

<table>
<thead>
<tr>
<th>Length</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10 Ft.</td>
<td>4 Gauge</td>
</tr>
<tr>
<td>(.3 to 3 m)</td>
<td></td>
</tr>
<tr>
<td>11 to 15 Ft.</td>
<td>2 Gauge</td>
</tr>
<tr>
<td>(3.4 to 4.6 m)</td>
<td></td>
</tr>
<tr>
<td>16 to 20 Ft.</td>
<td>1 Gauge</td>
</tr>
<tr>
<td>(4.9 to 6.1 m)</td>
<td></td>
</tr>
</tbody>
</table>

**IMPORTANT:** Inadequate battery cables can affect the performance of an outboard’s high amperage start circuit and the cranking speed of the outboard. DO NOT use aluminum wire cables. Use ONLY AWG stranded copper wire cables.

**Battery Switches and Multiple Batteries**

A multiple battery setup, including marine battery selector switches, can provide flexibility in single and dual outboard installations.

Refer to **Battery and Switch Wiring Diagrams** on p. 30 for battery connection options.

The battery selection function can be used for emergency starting if a primary battery becomes discharged.

The OFF position of the battery selector switch can be used to minimize battery discharge during periods of non-use.
Typical battery functions

IMPORTANT: Never connect an external battery isolator to the stator of an Evinrude E-TEC.

Primary
• Used as starting battery under normal operating conditions.
• Red (+) cable connected to battery selector switch.
• Primary battery is charged by connection to main red (+) outboard battery cable.

Dual outboard installations can utilize the opposing outboard’s primary battery as a secondary battery for emergency starting only.

Secondary
• Used as back-up starting battery under abnormal operating conditions.
• Red (+) cable connected to battery selector switch.
• Secondary battery is charged independently from primary battery.

Accessory
• Not used as starting battery.
• Isolated from outboard start function.
• No red (+) cable connected to battery selector switch.

Battery Switch Requirements
Battery switches must meet the following requirements.
• The switch must be approved for marine use.
• The switch should be a “make before break” design to protect the charging system from a no-load condition.
• Switch amperage rating should be adequate for the outboard it will be used on.
• Use one battery switch for each outboard installed.
• Use the appropriate sized wire and terminals for all connections.
• Use AWG stranded copper wire.

Battery Switch Location
• Always locate battery switch as close to the batteries as possible.
• Locate switch so that it cannot be accidently bumped or switched.
• Refer to the battery switch manufacturer’s installation instructions for specific information related to the installation of switch.
• Fasten all battery switches to solid surfaces.
• Route wiring as directly as possible.
• Support the battery switch as needed to prevent abrasion.
• Use appropriate wiring and connectors.
• Seal all connections and terminals with liquid neoprene or electrical sealer to prevent corrosion.

IMPORTANT: Insulate all battery positive (+) terminals to prevent shorting.

Battery Switch Operation
• Select the primary battery for normal operation.
• Secondary batteries should only be selected for emergency starting.
• ALL or BOTH switch position is for emergency starting only.

Provide operator with the documentation supplied by the battery switch manufacturer. Make sure that the operator is informed of proper battery switch operation.

IMPORTANT: The negative (–) terminals of a multiple 12-volt battery installation must be connected together.
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
Two outboards: One primary starting battery for each outboard

Positive (+) Battery cables
Negative (–) Battery cables
Fuel System Requirements

Overview
Boat fuel systems must meet minimum specifications to insure the proper delivery of fuel to the outboard.

The guidelines established by the ABYC and U.S. Coast Guard should always be followed.

• Permanent fuel tanks must be properly vented outside of the hull.
• Remote fuel tank gas fills must be grounded.
• Permanent fuel tank pickups should have the correct anti-siphon valve installed to prevent fuel flow if a leak occurs in the fuel distribution system. Refer to ABYC Standard H-24.

Fuel Hose
All fuel hoses must be designated as fuel hose and approved for marine use.

• Use only fuel lines (or copper tubing) that meet the outboard minimum I.D. requirement.
• “USCG Type A1” fuel hose must be used between permanent fuel tanks and motor well fittings on inaccessible routings.
• Use “USCG Type B1” for fuel hose routings in motor well areas.
• Permanently installed fuel hoses should be as short and horizontal as possible.
• Use corrosion-resistant metal clamps on permanently installed fuel hoses.
• Multi-outboard applications require separate fuel tank pickups and hoses. (A fuel selector switch may be used for “kicker” motors as long as it has enough flow capacity for the larger outboard.)

Fuel System Primer
Outboards require a priming system capable of refilling the fuel system after periods of non-use.

Primer bulbs that meet the outboard's minimum inside diameter fuel line requirements are used on most outboards.

Install the primer bulb in the fuel supply hose as follows:

• The primer bulb should be installed in an accessible location.
• The arrow on the primer bulb must point in the direction of fuel flow.
• The fuel primer bulb must be positioned in the fuel supply hose so the primer bulb can be held with the arrow pointing “up” during priming.

An alternative to a primer bulb is a U.S. Coast Guard approved marine primer pump. Electric primer pumps offer the convenience of outboard priming from a dash-mounted momentary switch.
Fuel Filters

Boat-mounted fuel filters and water-separating fuel filter assemblies must meet the required fuel flow and filter specification. The filter must be mounted to a rigid surface above the “full” level of the fuel tank and accessible for servicing.

Fuel Filter Assembly, P/N 174176, meets all requirements for a water-separating fuel filter.

**IMPORTANT:** Avoid using “in-line” fuel filters. The filter area and flow characteristics may not be adequate for high horsepower outboards.

**Portable Fuel Tanks**

Do not use portable fuel tanks for outboards larger than 115 HP. Inadequate fuel flow to high horsepower outboards can result in serious powerhead damage.

### Outboard Fuel System Recommendations

<table>
<thead>
<tr>
<th>Component</th>
<th>25 HP – 130 HP Models</th>
<th>135 HP – 250 HP Models</th>
</tr>
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<tbody>
<tr>
<td>Fuel tank pickup tube</td>
<td>5/16 in. (7.9 mm) min. I.D.</td>
<td>3/8 in. (9.5 mm) min. I.D.</td>
</tr>
<tr>
<td>Fuel fittings</td>
<td>1/4 in. (6.4 mm) min. I.D.</td>
<td>9/32 in. (7.1 mm) min. I.D.</td>
</tr>
<tr>
<td>Fuel supply hoses</td>
<td>5/16 in. (7.9 mm) min. I.D.</td>
<td>3/8 in. (9.5 mm) min. I.D.</td>
</tr>
<tr>
<td>Fuel tank pickup screen</td>
<td>100 mesh, 304 grade stainless steel wire, 0.0045 in. wire diameter, 1 in. (25 mm) long</td>
<td></td>
</tr>
<tr>
<td>Antisiphon valve</td>
<td>2.5 in. (63.5 mm) Hg maximum pressure drop at 20 gph (76 l/hr) flow</td>
<td></td>
</tr>
<tr>
<td>Remote fuel filter</td>
<td>0.4 in. Hg maximum pressure drop at 20 gph (76 l/hr) flow, 150 in.$^2$ (1290 cm$^2$) of filter area</td>
<td></td>
</tr>
<tr>
<td>Maximum fuel pump lift height</td>
<td>Fuel pump should not be located more than 30 in. (76.2 cm) above bottom of fuel tank</td>
<td></td>
</tr>
</tbody>
</table>
Cable and Hose Installation

Before installation, identify all required wiring, cables, and hoses:
• Throttle and shift cables
• Instrument harnesses
• Battery cables and switches
• Oil tank sender harness
• Fuel supply hose
• Primer bulb or primer pump
• Oil supply hose

Determine whether any additional wiring or hoses will be needed for accessory gauges or batteries:
• Speedometer pick-up hose
• Mechanical water pressure gauge hose
• Accessory battery charging kit
• CANbus adapter harnesses
• CANbus water pressure sensor kit
• CANbus oil level sensor kit

Cable and Wire Harness Routing

![Diagram showing cable and wire harness routing]

**WARNING**

Improper installation and routing of outboard controls could wear, bind, and damage components, causing loss of control.

Remote control cables, wiring, and hoses must follow a similar path into the lower motor covers. Select the best routing for the specific application.

All cables, wiring, and hoses must be long enough to provide adequate slack. Check clearances at all possible combinations of trim angles and steering positions.

Typical outboard installation:
1. Oil tank
2. Anti-siphon valve
3. Water separating fuel filter
4. Starting battery
5. Accessory battery
6. Flexweave protective sleeve
7. Access cover
8. Primer bulb
9. Battery switch

Typical Small Splash Well
![Diagram of typical small splash well]

Typical Large Splash Well
![Diagram of typical large splash well]
Protective Sleeve/Conduit
Make sure all cables, wiring, and hoses have been identified and fitted to the appropriate lengths. Refer to OUTBOARD RIGGING on p. 48.

Next, bundle the components that route to the outboard with appropriate shielding, such as an expandable “flexweave” sleeve or a flexible conduit.

Battery Cables
Evinrude outboards are equipped with premium quality battery cables that should be long enough for most installations.

When routing battery cables, be sure to:
• Route cables through the protective sleeve.
• Use the most direct path to route the battery cables to the battery or battery switch.

Fuel Hose
The fuel hose may be routed outside of the protective sleeve or conduit. Electric primers or manual primers may not require this consideration.

Route fuel hoses with enough slack to allow the primer bulb arrow to point “up” during use.

Install the primer bulb with the arrow pointing in the direction of fuel flow to the outboard.

Connect the fuel supply hose from the fuel tank to the fuel supply line at the outboard.

IMPORTANT: Do not permanently fasten this connection until the boat’s fuel system has been primed.
Oetiker Clamp Servicing

Use Oetiker clamps for making hose connections. These clamps provide corrosion resistance, minimize the potential for abrasion of rigging components, and provide solid, permanent connections.

The selection and installation of an Oetiker clamp is essential in the proper sealing of hose connections. The clamp identification numbers appear in millimeters on the side of the clamp, near the top of the ear. Refer to Oetiker Stainless Steel Stepless Clamps chart for actual dimensions.

⚠️ WARNING ⚠️

DO NOT re-use Oetiker clamps. Fuel leakage could contribute to a fire or explosion.

The nominal size of the clamp should be chosen so that, when it is assembled on the connecting part, the outside diameter of the hose lies approximately in the middle of the clamping range of the clamp.

### Oetiker Stainless Steel Stepless Clamps

<table>
<thead>
<tr>
<th>CLAMP NO.</th>
<th>NOMINAL O.D.</th>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement</td>
<td>Clamp I.D.</td>
<td>Inches</td>
<td>MM</td>
</tr>
<tr>
<td>346930</td>
<td>95</td>
<td>3/8</td>
<td>9.5</td>
</tr>
<tr>
<td>348838</td>
<td>105</td>
<td>13/32</td>
<td>10.5</td>
</tr>
<tr>
<td>349516</td>
<td>113</td>
<td>7/16</td>
<td>11.3</td>
</tr>
<tr>
<td>347107</td>
<td>133</td>
<td>1/2</td>
<td>13.3</td>
</tr>
<tr>
<td>347108</td>
<td>138</td>
<td>17/32</td>
<td>13.8</td>
</tr>
<tr>
<td>346931</td>
<td>140</td>
<td>34/64</td>
<td>14</td>
</tr>
<tr>
<td>346785</td>
<td>145</td>
<td>9/16</td>
<td>14.5</td>
</tr>
<tr>
<td>346786</td>
<td>157</td>
<td>5/8</td>
<td>15.7</td>
</tr>
<tr>
<td>348839</td>
<td>170</td>
<td>11/16</td>
<td>17</td>
</tr>
<tr>
<td>346150</td>
<td>185</td>
<td>23/32</td>
<td>18.5</td>
</tr>
<tr>
<td>346151</td>
<td>210</td>
<td>13/16</td>
<td>21</td>
</tr>
<tr>
<td>346152</td>
<td>256</td>
<td>1</td>
<td>25.6</td>
</tr>
<tr>
<td>346153</td>
<td>301</td>
<td>13/16</td>
<td>30.1</td>
</tr>
<tr>
<td>349759</td>
<td>316</td>
<td>1 1/4</td>
<td>31.6</td>
</tr>
<tr>
<td>349729</td>
<td>410</td>
<td>1 5/8</td>
<td>41</td>
</tr>
</tbody>
</table>
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).

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

Clamp Removal

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

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

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

IMPORTANT: Control cable function must be identified before rigging outboard.

Identify each control cable:
- Put the control handle into NEUTRAL position. The throttle cable casing guide will retract completely and the shift cable casing guide will go to the midpoint of its travel.

Extend the control cables and lubricate them with Triple-Guard grease.

OUTBOARD INSTALLATION

HULL PREPARATION

MAXIMUM CAPACITY

WARNING

Do not overpower the boat by installing an outboard that exceeds the horsepower indicated on the boat’s capacity plate. Overpowering could result in loss of control.

Before installing outboard:
- Refer to the boat manufacturer’s certification label for maximum horsepower rating.
- Refer to ABYC Standards to determine the maximum horsepower capacity for boats without certification labeling.

MOUNTING SURFACE

Inspect transom surface prior to drilling mounting holes.
- The transom should meet ABYC Standards.
- The transom must be flat.
- The transom angle should be approximately 14 degrees.
- Check transom strength and height.

The stern brackets must contact the flat surface of the transom. Modify trim that prevents the stern brackets from resting against the transom surface. Do not modify stern brackets.
Transom Clearances
Make sure the transom and splash well area provide adequate clearances:
• The top edge of the transom should be wide enough to allow full steering travel. The ABYC standard for most single outboard installations is 33 in. (84 cm).
• Check cable and hose routing clearances.
• Make sure there is clearance for mounting bolts and washers. Check the inside area of the transom for obstructions before drilling holes.

Water Flow
Inspect the hull area directly in front of the mounting location.
• Boat-mounted equipment should not create turbulence in the water flow directly in front of the outboard’s gearcase. Turbulence or disruptions in the water flow directly in front of the gearcase will affect engine cooling and propeller performance.
• Avoid locating outboard centerlines within 3 in. (76 mm) of bottom strakes on dual-outboard installations.

Transom Brackets and Jack Plates
When mounting an outboard on boats equipped with transom brackets or jack plates, refer to the manufacturer's recommendations.
• Confirm maximum weight and horsepower capacities.
• Jack plate assemblies must provide a one-piece mounting surface to support the outboard.

Mounting Hardware

![Diagram](DR5704)

The required outboard mounting bolts, backing plates, washers, and nuts are used to attach the outboard to the frame of the shipping pallet.

Refer to the outboard's parts catalog for alternate length mounting bolts or replacement parts.
• Use only *Evinrude/Johnson Genuine Parts* or parts of equivalent type, strength, and material.
• Use the mounting hardware provided with outboard whenever possible.
INSTALLATION AND PREDELIVERY
OUTBOARD INSTALLATION

Transom Measuring and Drilling

Hull Centerline

Use the chines of the boat as reference points to locate the centerline of the boat transom.

Use a straightedge to draw a line connecting the port and starboard chines.

Use a framing square to accurately place a vertical line on the transom. The centerline of the hull should be in line with the keel, and perpendicular to the midpoint of the line connecting the chines.

Dual-Outboard Centerlines

The following table lists standard ABYC centerline spacing between outboards in dual installations:

<table>
<thead>
<tr>
<th>Outboard Type</th>
<th>Centerline Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 and 3 cylinder</td>
<td>22 in. (559 mm)</td>
</tr>
<tr>
<td>V4 and V6</td>
<td>26 in. (660 mm)</td>
</tr>
</tbody>
</table>

Some applications may require changes in this dimension to avoid strakes, to adjust for transom height, or for performance reasons. Best performance can be determined only through testing. Refer to boat manufacturer for recommendations.

If the standard spacing does not allow full steering travel in a particular installation, it may be necessary to increase the spacing.

IMPORTANT: Some steering systems may require additional spacing. Refer to steering system manufacturer for recommendations.

The top edge of the transom should be more than twice the width of the dual-outboard centerline spacing dimension. Bracket installations may not require this consideration.

Measure the transom for dual-outboard spacing after the centerline of the hull is established.

Divide the spacing dimension by two. Use the resulting number to space the outboard centerlines from the hull centerline.

EXAMPLE: A 26 in. (660 mm) dual-outboard spacing would result in two outboard centerlines, each 13 in. (330 mm) from the hull centerline.

Transom Height

Make sure the transom height matches the length of the outboard to be installed.
- A 19 to 21 in. (48.3 to 53.3 cm) transom height uses a 20 in. (50.8 cm) shaft outboard.
- The shaft length of the outboard being installed should come close to matching the transom height of the boat.

Determine transom height by measuring from the top edge of the transom, along the centerline.
For dual-outboard installations, transom height should be measured at the outboard centerlines.

Use a straightedge as a reference to extend the bottom of the boat.

Position the straightedge along centerline. The distance from the top edge of the straightedge to the top edge of the transom is the actual transom height.

The indicators are affected by the squareness of the top edge of the transom. If either side of the fixture must be raised more than ¼ in. (6 mm) above the transom’s top surface to make both indicators align, the transom must be modified.

**IMPORTANT:** DO NOT assume that the top edge of the transom is straight. Position the drill fixture based on measurements aligning it to the bottom of the hull.

**IMPORTANT:** Maintain at least 1.75 in. (45 mm) of transom surface above the top mounting bolts.

Before drilling any mounting holes:
- Make sure the hole locations provide enough clearance for mounting bolts and washers.
- Check the inside area of the transom for obstructions.
- Check transom height(s) at centerlines.

Drill four ½ in. (13 mm) mounting holes in the appropriate locations.

**IMPORTANT:** Be sure to drill the required holes perpendicular to transom surface.

**MANUAL TILT MODELS**
Center the outboard on the transom (or mounting bracket) and tighten clamp screws by hand.

Use each stern bracket’s mounting holes as a guide to drill holes through the transom.
- 40–65 HP models require four 11/32 in. (8.7 mm) holes.
Drilling and Hardware Diagrams

**POWER TRIM MODELS**

**IMPORTANT:** This is not a template.

<table>
<thead>
<tr>
<th>Number</th>
<th>Item Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Center of Transom</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Top of Transom</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1/2&quot; Bolt Hole Locations</td>
<td>2</td>
<td>318573 3 1/2 in. (89 mm)</td>
</tr>
<tr>
<td>4</td>
<td>Outside of Transom</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bolt *</td>
<td>4</td>
<td>Choose from the following bolt sizes:</td>
</tr>
<tr>
<td>6</td>
<td>318272 Plate</td>
<td>2</td>
<td>327053 3 in. (76 mm)</td>
</tr>
<tr>
<td>7</td>
<td>318273 Retainer</td>
<td>2</td>
<td>318573 3 1/2 in. (89 mm)</td>
</tr>
<tr>
<td>8</td>
<td>319886 Screw</td>
<td>4</td>
<td>313327 4 in. (102 mm)</td>
</tr>
<tr>
<td>9</td>
<td>307238 Washer</td>
<td>2</td>
<td>336676 4 1/2 in. (114 mm)</td>
</tr>
<tr>
<td>10</td>
<td>320248 Washer</td>
<td>4</td>
<td>321577 5 in. (127 mm)</td>
</tr>
<tr>
<td>11</td>
<td>313623 Nut</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>318572 Cap</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
**Manual Tilt Models**

**IMPORTANT:** This is not a template.

1. Center of Transom
2. Top of Transom
3. 11/32” Bolt Hole Locations
INSTALLATION AND PREDELIVERY
OUTBOARD INSTALLATION

Lifting the Outboard

Lifting Fixtures

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard. DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.</td>
</tr>
</tbody>
</table>

Remove shipping carton.

The mounting hardware used to attach the outboard to the pallet is reused to fasten outboard to boat transom.

Use correct Lifting Fixture to lift outboard:

<table>
<thead>
<tr>
<th>Model</th>
<th>Lifting Fixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–90 HP</td>
<td>P/N 396748 with 1 1/8 in. screws</td>
</tr>
</tbody>
</table>

With recoil starter removed, Place lifting tool on flywheel and seat the three screws completely. Refer to RECOIL STARTER REMOVAL on p. 311.

IMPORTANT: Use only the 1 1/8 in. (short) screws, P/N 398067, included with the tool to avoid damage to electronic components under the flywheel.

Fasten appropriate chain hook to eye of tool. Carefully hoist outboard with chain and unbolt outboard mounting brackets from frame.

Steering Systems

Mechanical Cables

All Evinrude outboards equipped with tilt tubes are designed to be compatible with mechanical steering systems that meet ABYC Standard P-17. Single-cable mechanical steering systems can be used on single or dual-outboard installations if an ABYC-approved steering link is used.

Dual-cable mechanical steering helps provide firm steering control at high speeds.

Extend the steering cable and lubricate the inner core before installation.

IMPORTANT: Install steering cable through tilt tube before mounting outboard on transom. Tighten nut securely.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT use cable over pulley steering on 40 HP and larger outboards.</td>
</tr>
</tbody>
</table>

ABYC-approved Mechanical Steering Cable 5873
Manual Hydraulic Steering

Manual hydraulic steering systems use hydraulic fluid to transfer motion and load from the helm to the outboard.

Use only a hydraulic steering system designed for the specific application. Refer to the steering system manufacturer’s specifications for recommended applications.

**IMPORTANT:** Some hydraulic steering systems require additional centerline spacing in dual-outboard installations. Refer to steering system manufacturer’s recommendations and to Dual-Outboard Centerlines on p. 40.

Drag Links

Use the correct drag link to allow full steering travel:

<table>
<thead>
<tr>
<th>Model</th>
<th>Drag Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–60 HP</td>
<td>P/N 173699</td>
</tr>
</tbody>
</table>

Install cable wiper nut on tilt tube and connect drag link to the correct location on the steering arm. For single motor, single cable applications, the drag link should be installed in the rear hole.
Outboard Mounting

**IMPORTANT:** Some rigging components, such as steering cables, must be fitted to the outboard before the outboard is mounted to the transom. Determine what equipment will be installed before mounting.

**Mounting Height**

Boat performance depends on outboard mounting height.

Generally, the anti-ventilation plate of the gear-case should align with the bottom of the hull. Conventional V-hulls often perform well with the anti-ventilation plate approximately 1 in. (25 mm) above the bottom of the hull.

Boats that exceed 50 MPH may benefit from higher outboard heights. Consult the boat manufacturer for specific outboard mounting height information for a particular hull.

Test outboard and boat performance at different heights until the best performance is achieved.

**IMPORTANT:** Be sure that outboard water pressure is not adversely affected by the mounting height of the outboard.

**Mounting Bolt Installation**

**IMPORTANT:** Use a marine sealant rated for above or below waterline use. RTV silicone is not approved for below waterline use. Polyurethane sealants are not easily removed and may damage outboard or boat mounting surfaces.

Apply marine sealer under hex heads of bolts, on the mounting plates, and to the bolt shanks.

**Power Trim Models**

Assemble transom mounting plates on mounting bolts.

Install the mounting bolts through the transom from the inside of the boat.

Position the square aluminum transom mounting plates (when applicable) so the retainer holes are horizontal.

Position hex head of bolt with flats toward holes in the mounting plates. Install retainer over hex head of the bolt and secure it with screws provided.

Install all washers and nuts. Tighten to a torque of 40 ft. lbs. (54 N·m).

**WARNING**

If either side of the transom deforms or cracks when the bolts are tightened to their recommended torque, the transom construction may not be adequate or may be deteriorated. Structural failure of the transom could result in loss of boat control and injury to the occupants.
**Manual Tilt Models**

Manual tilt models require Transom Mounting Kit, P/N 394219. The kit includes a transom mounting plate and hardware for fastening outboard to transom.

The kit also includes clamp pads, P/N 315774, which must be used to secure mounting bolts in slots at the bottom of the outboard stern brackets.

Install the mounting bolts through the stern brackets and transom. Install round backing plates and locknuts onto bolts and tighten securely.
Cable, Hose, and Wire Routing

Refer to Control Cable Identification on p. 38.

Remove cable retainer from anchor block. Apply Triple-Guard grease to both anchor block pockets. Place the grommet into position in the lower engine cover.

CAUTION

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

Move the remote control handle to NEUTRAL and make sure throttle is in the IDLE position.

Apply soapy water to the inside surfaces of grommet and install cables and fuel line as shown:

When grommet is in place and all cables have been installed, tighten a tie strap around the outside of the grommet to form a watertight seal around the cables.

Control Cable Adjustments

IMPORTANT: DO NOT attach cables to throttle and shift levers until all cables, wires, and hoses have been routed and grommet has been placed into the lower engine cover.

Pull firmly on shift cable casing to remove slack. With outboard in NEUTRAL, place the cable trunnion into the lower anchor pocket. Adjust the trunnion nut so the casing fits onto the shift lever pin.

If there are not enough threads on the shift cable for the adjustment, or if the gearcase does not shift fully into FORWARD or REVERSE, refer to SHIFT ROD ADJUSTMENT on p. 280.
With remote control lever in NEUTRAL, pull firmly on firmly on throttle cable casing to remove slack.

With engine throttle cam against stop, place the cable trunnion into the upper anchor pocket and adjust the trunnion nut so the casing fits onto the throttle lever pin.

**IMPORTANT:** Move control handle to FORWARD and pull back slowly to NEUTRAL. Make sure the engine throttle lever is against the stop. If not, remove slack by adjusting cable trunnion.

**Cable Retainer Clip Installation**

When installing retainer clips on control arm linkage pins, clips should be locked and must not be bent or deformed.

For proper installation, review the following steps:
- Place washer on pin.
- Position retainer clip with straight section on the bottom and angled section on the top.

**IMPORTANT:** After installation, make sure there is enough clearance for all cables to avoid binding or chafing through all engine steering and tilting angles.

- Use long nose pliers to insert straight section of clip into linkage pin hole.
- Push the clip towards the hole while lifting on the curved end with the pliers.
- Be sure retainer clip fully engages the pin.
- Lock the retainer by moving the angled section behind the straight section.

Make sure remote control provides accurate throttle and shift operation. Then, install cable retainer and torque screw 60 to 84 in. lbs. (7 to 9 N·m).
Electrical Harness Connections

Place the wiring harness through notch in lower motor cover and route to the recess in the flywheel cover. Secure the cable with a tie strap as shown:

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.

Arrange connectors in flywheel cover.

Install electrical cover and secure with screws.

**IMPORTANT:** BE SURE all harnesses and wires are not pinched, cannot contact flywheel, and do not interfere with moving throttle or shift linkages.

Water Pressure Gauge

If a mechanical water pressure gauge is 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.
CANbus Connections

If the outboard will be used with I-Command, or other NMEA 2000 compliant CANbus instruments, the following connections will supply information to the network.

Remove lower motor covers. Remove air silencer.

Route CANbus network harness around the front of the throttle body, following the path of the TPS wiring, and behind the battery cable. Loosely install tie straps as shown.

**IMPORTANT:** To prevent wire chafing, harness must be routed below the flywheel cover.

Adjust harness routing as needed and secure tie straps.

Use a CANbus Ignition Harness, in place of the standard MWS harness, to connect the outboard to the key switch and trim/tilt control. Seal unused SystemCheck connector with 6-Pin Connector Seal, P/N 586076.

If installing a Deutsch-style network, connect the purple wire from the CANbus Ignition Harness to the CANbus network harness. This connection supplies power to the network when the key switch is on. Quick Connect-style network does NOT use this connection.
Route CANbus ignition harness through wire channel in flywheel cover. Install electrical cover. Make sure both harnesses are in front of the tab and tighten the tie strap.

Use *Evinrude Diagnostics* software to activate CANbus control functions in the *EMM*. From the *Settings* screen, select *Engine Options*.

Install air silencer and check that CANbus network harness is not pinched behind air silencer. Make sure both harnesses are in front of tab and CANbus ignition harness is in wire channel.
FUEL AND OIL PRIMING

Fuel Requirements

⚠️ WARNING ⚠️
Gasoline is extremely flammable and highly explosive under certain conditions. Improper handling of fuel could result in property damage, serious injury or death.

Always turn off the outboard before fueling.

Never permit anyone other than an adult to refill the fuel tank.

Do not fill the fuel tank all the way to the top or fuel may overflow when it expands due to heating by the sun.

Remove portable fuel tanks from the boat before fueling.

Always wipe off any fuel spillage.

Do not smoke, allow open flames or sparks, or use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.

When using alcohol-extended fuels, be aware of the following:

- The boat’s fuel system may have different requirements regarding the use of alcohol fuels. Refer to the boat’s owner guide.
- Alcohol attracts and holds moisture that can cause corrosion of metallic parts in the fuel system.
- Alcohol blended fuel can cause engine performance problems.
- All parts of the fuel system should be inspected frequently and replaced if signs of deterioration or fuel leakage are found. Inspect at least annually.

IMPORTANT: Always use fresh gasoline. Gasoline will oxidize, resulting in loss of octane and volatile compounds, as well as the production of gum and varnish deposits which can damage the outboard.

Additives

IMPORTANT: The only fuel additives approved for use in Evinrude outboards are 2+4® fuel conditioner and Evinrude/Johnson Fuel System Cleaner. Use of other fuel additives can result in poor performance or engine damage.

Evinrude/Johnson 2+4 Fuel Conditioner will help prevent gum and varnish deposits from forming in fuel system components and will remove moisture from the fuel system. It can be used continuously and should be used during any period when the outboard is not being operated on a regular basis. Its use will reduce spark plug fouling, fuel system icing, and fuel system component deterioration.

Evinrude/Johnson Fuel System Cleaner will help keep fuel injectors in good operating condition.

Minimum Octane

Evinrude/Johnson outboards are certified to operate on unleaded automotive gasoline with an octane rating equal to or higher than:

- 87 (R+M)/2 AKI, or
- 90 RON

Use unleaded gasoline that contains methyl tertiary butyl ether (MTBE) ONLY if the MTBE content does not exceed 15% by volume.

Use alcohol-extended fuels ONLY if the alcohol content does not exceed:

- 10% ethanol by volume
- 5% methanol with 5% cosolvents by volume

IMPORTANT: Always use fresh gasoline. Gasoline will oxidize, resulting in loss of octane and volatile compounds, as well as the production of gum and varnish deposits which can damage the outboard.

Additives

IMPORTANT: The only fuel additives approved for use in Evinrude outboards are 2+4® fuel conditioner and Evinrude/Johnson Fuel System Cleaner. Use of other fuel additives can result in poor performance or engine damage.

Evinrude/Johnson 2+4 Fuel Conditioner will help prevent gum and varnish deposits from forming in fuel system components and will remove moisture from the fuel system. It can be used continuously and should be used during any period when the outboard is not being operated on a regular basis. Its use will reduce spark plug fouling, fuel system icing, and fuel system component deterioration.

Evinrude/Johnson Fuel System Cleaner will help keep fuel injectors in good operating condition.
INSTALLATION AND PREDELIVERY
FUEL AND OIL PRIMING

Fuel System Priming

Vent Line Clamp
In compliance with Code of Federal Regulations, 49 CFR §173.220, all outboards using a fuel vapor separator must be shipped with a vent line clamp installed. This clamp must be removed before priming the fuel system or starting the outboard for the first time.

IMPORTANT: Failure to remove the clamp may cause fuel starvation and poor running qualities.

Priming the Fuel System

Insert the fuel supply hose from the fuel tank into a suitable container. Squeeze the fuel primer bulb or activate the boat-mounted electric fuel primer until fuel flows from the fuel hose.

Once fuel flow is observed, connect fuel supply hose from fuel tank to hose fitting on outboard. Secure hose with Oetiker clamp.

Use the primer to fill the outboard’s fuel system.

Observe all fuel lines, both in the boat and on the outboard. Repair any fuel leaks.

WARNING

Failure to check for fuel leaks could allow a leak to go undetected, resulting in fire or explosion and may cause personal injury or property damage.

The high-pressure fuel circuits and injectors will prime as the outboard is cranked with the starter.

Oil Requirements

Evinrude/Johnson XD100, XD50, or XD30 outboard oils are recommended for use in Evinrude E-TEC outboards. If these oils are not available, you must use a TC-W3 certified oil.

Evinrude/Johnson XD100 outboard oil is highly recommended for all conditions and applications.

Engine Lubricant Below 32°F (0°C)
If the outboard will be operated in temperatures below freezing (32°F, 0°C), use Evinrude/Johnson XD100.

IMPORTANT: For new outboards, test low oil warning before filling oil tank.

Turn key switch to ON. The engine monitor warning display should show “LOW OIL.”

Add enough oil to raise level to at least one-quarter capacity.

The “LOW OIL” warning should not display.

IMPORTANT: Failure to follow these recommendations could void the outboard warranty if a lubrication-related failure occurs.

Refer to ENGINE MONITORING SYSTEM on p. 93.

WARNING

Fuel vapors are highly flammable. Perform the following procedure in a well ventilated area. Extinguish all smoking materials and make certain no ignition sources are present.

WARNING

Failure to check for fuel leaks could allow a leak to go undetected, resulting in fire or explosion and may cause personal injury or property damage.
Oil Injection Rate

The Engine Management Module (EMM) controls the oil injection rate based on engine RPM. This rate can be adjusted for the type of oil being used, and also for powerhead break-in. Use Evinrude Diagnostics software to access these features.

The Set Oil Type option controls the injection rate for the oil being and typical operating conditions.

The TC-W3 oil type setting is the standard setting for all outboards. Set TC-W3 for:

- Operation with all TC-W3 outboard oils including XD30, XD50, or XD100.
- Applications requiring maximum lubrication.
- Extreme applications (racing or harsh conditions)

The XD100 setting provides an option to run the outboard at a reduced oil injection rate. This setting REQUIRES the use of Evinrude XD100 outboard lubricant and is not recommended for all applications.

Use the XD100 setting for:

- Conventional use (runabouts, cruisers)
- Moderate applications

Powerhead oil programming labels are provided to identify EMM oil programming. Install the correct label to alert user to specific oil requirements.

An XD100 Outboard Oil Decal, P/N 352369, is available to label boats equipped with outboards that have been programmed for the reduced oil injection ratio.

**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.
**INSTALLATION AND PREDELIVERY**

**FUEL AND OIL PRIMING**

**Break-In Oiling**

**IMPORTANT:** DO NOT add oil in the fuel tank on Evinrude E-TEC models.

The Engine Management Module (EMM) automatically supplies extra oil to the engine during the first two hours of operation above 2000 RPM.

Follow these steps for outboard set-up:

- Use *Evinrude Diagnostics* software to make sure the break-in program has been started. Refer to *Oil Control Settings* on p. 98.
- The oil tank should be filled and the oil level marked for reference.

**IMPORTANT:** The operator must monitor the oil tank level to confirm oil consumption. This may require several hours of operation above idle.

**Oil Supply Priming**

**WARNING**

Always use caution while working around machinery with moving parts. The following set-up procedures require running tests that are performed with the outboard's motor cover removed.

Use *Evinrude Diagnostics* software to make sure the EMM is programmed for the type of oil being used.

Start the outboard and use the oil priming function in the software for a minimum of 90 seconds to make sure the system is completely primed.

**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 diagnostics software is not available. Refer to *STORAGE* on p. 77.
BEFORE START-UP

Gearcase Lubricant

With outboard vertical, check the gearcase lubricant level:
- Remove the lubricant level plug. Lubricant must be even with the bottom of the threaded hole.
- A clean tie strap can be used as a “dip stick” if the lubricant level is not obvious.
- Add HPF XR gearcase lubricant as needed.

Oil Level

Make sure oil tank contains an adequate supply of the correct lubricant for the outboard and that the LOW OIL warning has been tested. Refer to Oil Requirements on p. 54.

When starting the outboard for the first time, refer to Oil Supply Priming on p. 56.

Trim and Tilt Fluid

Make sure trim and tilt reservoir is full before running outboard:
- Tilt the motor up and engage the tilt support.
- Remove filler cap and check fluid level.

- Single Ram System—Add Evinrude/Johnson Biodegradable TNT Fluid, as needed, to bring level to the bottom of the fill plug threads.

Install the fill plug and tighten to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

![Gearcase lubricant level](image)

**WARNING**

Correct fluid level must be maintained to ensure operation of the impact protection built into the unit.
INSTALLATION AND PREDELIVERY
RUNNING CHECKS

RUNNING CHECKS

⚠️ WARNING ⚠️
DO NOT run outboard without a water supply to the outboard’s cooling system. Cooling system and/or powerhead damage could occur.

⚠️ 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.

⚠️ DANGER ⚠️
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off.

Emergency Stop / Key Switch
Check emergency stop function. With outboard running at IDLE, pull safety lanyard from emergency stop switch. Outboard must stop immediately.

Remote Control Operation
Make sure that control can be easily moved into all gear and throttle settings. Do not shift remote control when outboard is not running.

Start-In-Gear Prevention

⚠️ WARNING ⚠️
Make certain that the outboard will not start when in gear. The start-in-gear prevention feature is required by the United States Coast Guard to help prevent personal injuries.

Start outboard and shift to FORWARD.
Turn outboard OFF while control is in FORWARD.
Try to restart the outboard. Outboard should not start.
Shift back to NEUTRAL and restart outboard.
Shift to REVERSE. Turn outboard OFF while control is in REVERSE.
Try to restart the outboard. Outboard should not start.

Tachometer Pulse Setting
Confirm accuracy of tachometer reading.
- Adjust dial on back of tachometer to required setting (the outboard should not be running).

<table>
<thead>
<tr>
<th>Outboard Model</th>
<th>Tachometer Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–250 HP</td>
<td>6 Pulse or 12 Pole</td>
</tr>
</tbody>
</table>

Engine Monitoring System
Attach emergency stop lanyard.

Turn key switch to ON. Warning horn should sound for 1/2 second.

All SystemCheck warning lights should turn on at the same time, then turn off one at a time.

Fuel System
Perform running checks of the fuel system by following these steps:
- Squeeze fuel primer bulb until hard or activate electric primer. Observe all fuel hoses and connections. Repair any leaks.
- Start outboard. Inspect all hoses and connections. Repair any leaks or misrouted hoses immediately.

WARNING
DO NOT run outboard without a water supply to the outboard’s cooling system. Cooling system and/or powerhead damage could occur.

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.

Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off.

Make certain that the outboard will not start when in gear. The start-in-gear prevention feature is required by the United States Coast Guard to help prevent personal injuries.

Start outboard and shift to FORWARD.
Turn outboard OFF while control is in FORWARD.
Try to restart the outboard. Outboard should not start.
Shift back to NEUTRAL and restart outboard.
Shift to REVERSE. Turn outboard OFF while control is in REVERSE.
Try to restart the outboard. Outboard should not start.

Confirm accuracy of tachometer reading.
- Adjust dial on back of tachometer to required setting (the outboard should not be running).
**Water Pump Overboard Indicator**

A steady stream of water should flow from the overboard indicator.

**Idle Speed**

Make sure the outboard idles within the specified idle RPM range. If the outboard is run on a flushing device, the idle speed and quality may not be representative of actual in water use.

**Break-In**

When the outboard is delivered, refer the customer to the break-in information in the Operator’s Guide.

The Engine Management Module (EMM) automatically supplies extra oil to the engine during the first two hours of operation, above 2000 RPM.

Use Evinrude Diagnostics software to confirm that the break-in program has been started. Refer to Oil Control Settings on p. 98.

**Operating Temperature**

An outboard run at idle speed should achieve a temperature based on the engine’s thermostatic control. In general, the powerhead temperature should reach at least 104°F (40°C) after five minutes of idling. Check that the powerhead reaches idle temperature. Refer to SERVICE SPECIFICATIONS on p. 10.
PROPELLERS

Propeller Selection

**CAUTION**

Selection of the wrong propeller could reduce engine service life, affect boat performance, or cause serious damage to the powerhead.

Water testing with various propeller designs and sizes is the best method of propeller selection.

The correct propeller, under normal load conditions, will allow the engine to run near the midpoint of the RPM operating range at full throttle. Refer to SERVICE SPECIFICATIONS on p. 10.

**IMPORTANT:** If the propeller blades have too much pitch, the engine will operate below its normal range at full throttle. Power will be lost, and powerhead damage could occur. If the propeller blades have too little pitch, the engine will operate above its normal range and damage from overspeeding could occur.

When selecting a propeller, consider the following:

- Use an accurate tachometer to determine the engine’s full-throttle RPM.
- The outboard should be trimmed for top speed.
- Select a propeller that suits the customer’s application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load.
- Occasionally, one propeller will not cover a wide range of boat applications — water skiing to high speed performance boating. In such cases, it might be necessary to have a propeller for each situation.
- Refer to the Evinrude/Johnson Genuine Parts and Accessories Catalog for propeller styles and sizes.

---

**Diagram:**

1. Percentage of horsepower
2. Engine RPM
3. Horsepower curve
4. Full throttle operating range
5. Midpoint of full throttle operating range
6. Engine is overloaded at full throttle
7. Engine is overspeeding at full throttle

**Legend:**

- DR1261

---

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**Propeller Hardware Installation**

**WARNING**

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and twist and remove all spark plug leads so the engine cannot be started accidentally.

Apply *Triple-Guard* grease to the entire propeller shaft before installing the propeller.

Install thrust bushing onto propeller shaft with shoulder of thrust bushing facing aft. Taper of bushing must match taper of propeller shaft.

Install propeller on propeller shaft by aligning splines and pushing until seated on the thrust bushing.

**IMPORTANT:** Depending on propeller style, different thrust bushings, spacers, and cotter pin keepers are used. See the *Evinrude/Johnson Genuine Parts* book for a complete listing and descriptions.

Install the spacer, engaging the propeller shaft splines.

Wedge a block of wood between propeller blade and the anti-ventilation plate.

Install the propeller nut and tighten to a torque of:
- 120 to 144 in. lbs. (13.6 to 16.3 N·m)

If cotter pin holes in the propeller nut and propeller shaft are not aligned, tighten the nut until they are in line. Do not loosen.

Insert a new cotter pin through the propeller nut and shaft. Bend its ends over the nut to secure the assembly.

**IMPORTANT:** After fastening propeller nut, make sure outboard is in NEUTRAL and carefully spin propeller. Propeller must turn freely and should not spin off center. If propeller appears to wobble, check for possible bent propeller shaft.

---

1. Thrust bushing
2. Spacer
3. Cotter pin
4. Propeller Nut
INSTALLATION AND PREDELIVERY
FINAL ADJUSTMENTS

FINAL ADJUSTMENTS

Trim Sending Unit Adjustment

The sending unit eccentric cam must be adjusted so that the gauge needle is aligned with the lowest gauge mark with the outboard trimmed all the way DOWN.

Check if the gauge needle is above or below the lowest gauge mark. Tilt engine UP and engage trailering lock.

When the outboard is trimmed all the way DOWN, the sending unit lever touches the eccentric cam just forward of the top of the cam at the contact point.

Loosen cam screw and rotate eccentric cam to adjust full down gauge position:
• If the needle was above the lowest mark, move the thick part of the cam TOWARD the contact point. Tighten the screw, and recheck the gauge reading.
• If the needle was below the lowest mark, move the thick part of the cam AWAY from the contact point. Tighten the screw, and recheck the gauge reading.

Tighten eccentric cam retaining screw and check needle position at full trim DOWN.
Trim Tab Adjustment

A propeller will generate steering torque when the propeller shaft is not running parallel to the water’s surface. The trim tab is adjustable to compensate for this steering torque.

**IMPORTANT:** A single trim tab adjustment will relieve steering effort under only one set of speed, outboard angle and load conditions. No single adjustment can relieve steering effort under all conditions.

If the boat pulls to the left or right when its load is evenly distributed, adjust the trim tab as follows:

- With the engine OFF, loosen the trim tab screw.
  - If the boat pulled to the right, move rear of the trim tab slightly to the right. If the boat pulled to the left, move rear of the trim tab slightly to the left.
- Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m).

Test the boat and, if needed, repeat the procedure until steering effort is as equal as possible.

**Outboards with High Transom Heights**
The trim tab may be above the surface of the water when the outboard is trimmed out. Steering effort might increase. Lower the trim setting to submerge the trim tab and to reduce steering effort.

**Dual Standard Rotation Outboards**
Move both trim tabs equally and in the same direction.

**Dual Outboards, One Counter and One Standard Rotation**
Set both trim tabs to the center position.

**WARNING**
Improper trim tab adjustment can cause difficult steering and loss of control.
Dual-Outboard Alignment

Dual outboards must be connected with a tie bar and adjusted to align the outboards for correct water flow to the gearcases and propellers.

Incorrect outboard alignment could cause one or more of the following:
- Propeller ventilation
- Reduction of top speed
- Improper boat tracking
- Engine overheat and powerhead damage

Follow the instructions provided by the tie-bar manufacturer for tie bar installation and adjustment.

Measure Alignment

The “toe-in” (gearcase leading edges closer together than propeller shaft centers) or “toe-out” (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:
- Position outboards straight with the anti-ventilation plates parallel with the bottom of the boat.
- Measure between propeller shaft centers.

Alignment Adjustment

Various boat/motor combinations respond differently to dual-outboard alignments. Each application must be thoroughly tested until the ideal combination of performance, steering, and cooling is found.

A common practice is to set-up the outboards parallel, or with a small amount of “toe-out,” and adjust inward until best results are achieved.
- A typical set-up with 2-stroke outboards mounted directly on the transom often runs best with a slight amount of “toe-in.”
- Outboards mounted behind the transom on motor brackets usually require “parallel” alignment or “toe-out.”

Adjust the outboard alignments by adjusting tie bar. Follow the tie bar manufacturer’s adjustment procedures.

Check steering operation. Make sure that the steering system operates properly at various trim angles.

Confirm Alignment

To confirm proper alignment, perform the following steps:
- Water test the boat.
- Monitor the water pressure for both outboards.
- Run the boat at various trim angles.
- Perform steering maneuvers and vary the throttle settings.
- Monitor boat and outboard performance.

A sudden loss of water pressure or excessive propeller ventilation on one or both outboards may indicate a misalignment of the gearcases. Reset the outboard alignment and retest.
# MAINTENANCE

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**MAINTENANCE**

**INSPECTION AND MAINTENANCE SCHEDULE**

Routine inspection and maintenance is necessary to prolong outboard life. The following chart provides guidelines for inspection and maintenance to be performed by an authorized Dealer.

**IMPORTANT:** Outboards used in rental, commercial, or other high hour applications require more frequent inspections and maintenance. Adjust schedule for operating and environmental conditions.

<table>
<thead>
<tr>
<th>Description</th>
<th>Engine Care Product</th>
<th>Routine Inspection</th>
<th>Every 300 hours or every three years (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Monitor self-test and warning horn, check</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency stop circuit and lanyard, check operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls, steering and tilting; check operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine mounting hardware, re-tighten (40 ft. lbs.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasteners, tighten any loosened components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water intake screens, check condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling system; check water pump indicator / water pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticorrosion anodes, check condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gearcase, check condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propeller, check condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel and oil systems, inspect and repair leaks (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check battery connections and condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access EMM information, resolve any service codes</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Electrical and ignition wires, inspect for wear or chafing</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fuel filter, replace</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Oil filters, replace</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Gearcase lubricant, replace</td>
<td>A</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Spark plugs, inspect or replace (2)</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Thermostats, inspect and check operation (2)</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Grease fittings, lubricate (3)</td>
<td>C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Power trim/tilt and fluid level, inspect</td>
<td>B</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Propeller shaft splines, inspect and lubricate (3)</td>
<td>C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Starter pinion shaft, inspect and lubricate (3)</td>
<td>D</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Control cables, inspect and adjust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering cable, inspect and lubricate</td>
<td>C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Water pump, inspect / replace (more often if water pressure loss or overheating occurs)</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

(1) Average recreational use. Commercial use, heavy use, or use in salt or polluted water requires more frequent inspection and maintenance.
(2) Emission-related component
(3) Annually in salt water applications

A  **HPF XR Gearcase Lubricant**  
   **HPF Pro** in high performance or commercial applications
B  Biodegradable TNT Fluid (Single ram hydraulic systems)
C  **Triple-Guard Grease**
D  Starter Bendix Lube Only, P/N 337016
ANTI-CORROSION PROTECTION

Sacrificial Anodes

Galvanic corrosion occurs in fresh or salt water. Salt, brackish, and polluted water can accelerate corrosion. “Sacrificial” anodes are intended to protect the underwater metal components of the outboard from galvanic corrosion.

Outboards are equipped with three sacrificial anodes.

Visually inspect anodes and metal components below water level. Erosion of anodes is normal and indicates the anodes are functioning properly.

**IMPORTANT:** Anodes that are not eroding may not be properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

For best anode performance:
- Replace all anodes that have eroded or disintegrated to two-thirds of their original size.
- Do not paint or apply protective coatings to anodes or anode fasteners.
- Avoid using metal-based antifouling paint on the boat or outboard.

**Testing Procedure – Continuity**

Connect ohmmeter leads between engine ground and anode surface.

The meter should show little or no resistance. If resistance is high, check the following:
- Remove the anode and clean the area where the anode is installed.
- Clean the mounting screws.
- Install the anode and test again.

**Metallic Component Protection**

Protect metal components on outboards from corrosion. Use the following products to minimize corrosion.
- **Anti-Corrosion Spray** provides a heavy, waxy coating to protect components.
- **“6 in 1” Multi-Purpose Lubricant** provides a thin film of anti-corrosion protection.

**Exterior Finishes**

Maintain the outboard’s exterior finish to prevent corrosion and reduce oxidation.
- Use automotive wax to protect the outboard’s exterior finish from oxidation.
- Clean regularly using clean water and mild detergent soap.
- Touch-up damage to painted surfaces promptly.
MAINTENANCE
COOLING SYSTEM

COOLING SYSTEM

Check the condition of cooling system components regularly:
• water intake screens;
• water pump;
• all internal water passages;
• thermostats;
• all external water hoses and fittings;
• vapor separator cooling passages and fittings;
• EMM cooling passages and fittings;
• overboard water pressure indicator.

Flush the outboard with fresh water following each use in brackish, salt, or polluted water to minimize the accumulation of scale and silt deposits in cooling system passages.

The outboard can be flushed on the trailer or at dockside; running or not running.

IMPORTANT: The outboard must be located in a well ventilated area with appropriate ground drainage during the flushing procedures.

Keep water inlet pressure between 20 to 40 psi (140 to 275 kPa).

Flush the outboard with fresh water following each use in brackish, salt, or polluted water to minimize the accumulation of scale and silt deposits in cooling system passages.

The outboard can be flushed on the trailer or at dockside; running or not running.

IMPORTANT: The outboard must be located in a well ventilated area with appropriate ground drainage during the flushing procedures.

Keep water inlet pressure between 20 to 40 psi (140 to 275 kPa).

Flushing — Outboard Running

To prevent injury from contact with rotating propeller, remove the propeller before flushing.

Refer to Propeller Hardware Installation on p. 61.

Place outboard in VERTICAL (DOWN) position in a well ventilated area.

Thread garden hose into flushing port.

Shift the outboard to NEUTRAL with the propeller removed.

Turn water supply on.

START outboard. Run it at IDLE only.

Shut OFF the outboard. Turn off water supply and remove garden hose.

Leave the outboard in VERTICAL (DOWN) position long enough for the powerhead to drain completely.

Reinstall propeller.

Flush outboard for at least five minutes.

Turn water supply ON.

Flush outboard for at least five minutes.

Turn off water supply and remove garden hose.

Position outboard in VERTICAL position (DOWN) long enough to allow the powerhead to drain completely.
Water Intake Screens
Inspect condition of water intake screens. Clean or replace as needed.

Confirm function of overboard water pressure indicator.

Additional Maintenance
- Check Engine Monitor function.
- Check operation or visually inspect thermostats and pressure relief valve. Clean or replace as needed.
- Check that all water passages, hoses, and fittings for both the EMM and the vapor separator flow water freely.
- Replace water pump.

LUBRICATION
Steering System

WARNING
Failure to regrease as recommended could result in steering system corrosion. Corrosion can affect steering effort, making operator control difficult.

Grease the stainless steel output end of the steering cable with Triple-Guard grease.

Use an appropriate cleaning solvent to remove corrosion and dirt from output end of cable prior to coating it with grease. Make sure wiper nut is installed and not damaged.
Swivel Bracket and Trailering Bracket
Lubricate the swivel bracket with *Triple-Guard* grease.

Apply grease until the grease begins to flow from the upper or lower swivel bracket areas.

Coat the pivot points of the trailering bracket with *Triple-Guard* grease.

---

Throttle and Shift Linkage
Disconnect the battery cables at the battery.

Remove clips and washers from throttle and shift lever pins. Carefully, remove casing guides from pins.

**IMPORTANT:** DO NOT disturb cable trunnion adjustments.

Shift remote control into FULL THROTTLE/REVERSE position to fully extend the plastic casing guides.

Apply *Triple-Guard* grease to:
- Cable attachment pins of both the throttle and shift levers
- Brass inner casings of both the throttle and shift cables.

Shift the remote control to the NEUTRAL/IDLE position.

Install control cables.

Check proper throttle and shift function.
Propeller Shaft
Debris from the water can become lodged around propeller shaft. Frequent inspection can minimize potential gearcase damage.

⚠️ **WARNING** ⚠️
When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and disconnect the battery cables at the battery.

Remove propeller. Refer to Propeller Hardware Installation on p. 61.

Inspect bushing and blade surfaces. Replace damaged or worn propellers.

Clean propeller shaft. Inspect propeller shaft seals. Replace damaged or worn seals.

Apply Triple-Guard grease to entire length of propeller shaft prior to installing propeller.

Reinstall propeller hardware and propeller.

Gearcase Lubricant

Draining

⚠️ **WARNING** ⚠️
Gearcase lubricant may be under pressure and/or hot. If plug is removed from a recently operated outboard, take precautions to avoid injury.

**IMPORTANT:** Always check the fill level of the gearcase lubricant at the upper plug before removing the lower, drain/fill plug. A tie strap can be used to check lubricant level.

Remove the lubricant level plug, then the lubricant drain/fill plug, and drain the lube from the gearcase into a container.

**Inspection**
Inspect the lube and the magnets on the plugs for metal chips. The presence of metal fuzz can indicate normal wear of the gears, bearings, or shafts within the gearcase. Metal chips can indicate extensive internal damage.
Inspect the lubricant for water contamination. Water can make the lubricant milky in appearance. However, normal aeration can also cause the same appearance.

To check for water contamination, put lubricant into a glass container. Allow the oil to settle for a minimum of one hour to determine if there is an abnormal amount of water in the oil. Some gearcase lubricants are designed to mix with a small amount of water from normal water vapor condensation within the gearcase.

Refer to **GEARCASE LEAK TEST** on p. 275.

Overheated lubricant will have a black color and burned odor.

Internal gearcase inspection is recommended when lubricant is contaminated or shows signs of failure.

**Filling**

Refer to the **INSPECTION AND MAINTENANCE SCHEDULE** on p. 66 for service frequency and recommended lubricants.

Secure the gearcase in a vertical position.

Remove the lubricant level plug and the lubricant drain/fill plug.

Slowly fill the gearcase with gearcase lube through the drain/fill hole until it appears at the oil level hole. Filling the gearcase too quickly can cause air pockets and the gearcase may not fill completely. Clean plug seal area and install the lubricant level plug and **new** seal, then the lubricant drain/fill plug and **new** seal. Tighten them to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

**IMPORTANT:** The recommended gear lubricants are formulated for marine applications. Do not use automotive gear lubricants, engine oils, or any other oil or grease.
Trim and Tilt

Check reservoir fluid level at least every three years or 300 operating hours. System capacity is approximately 15.2 fl. oz. (450 ml).

- Tilt the outboard and engage the tilt support.

- Remove the fill plug.
- **Single Ram System**—Add *Evinrude/Johnson* Biodegradable TNT Fluid, as needed, to bring level to the bottom of the fill plug threads.

![Image of tilt support bracket]

1. Tilt support bracket

- Install the fill plug and tighten to a torque of 45 to 55 in. lbs. (5 to 6 N·m).
- Disengage tilt support.
- Cycle the unit at least five complete cycles to purge all air from the system. When cycling the unit, hold the trim switch ON an additional 5 to 10 seconds after the unit reaches the end of its travel before activating the switch in the opposite direction.

![33700]

**WARNING**

Correct fluid level must be maintained to ensure operation of the impact protection built into the unit.
BATTERY AND BATTERY CONNECTIONS

Check battery connections frequently. Periodically remove battery to clean and service connections.

• Confirm that battery meets the minimum engine requirements.
• Connections must be clean and tight.
• Observe all wiring connections prior to disassembly.

Disconnect battery negative (–) cable first and the battery positive (+) cable last.

Clean all terminals, battery posts, and connectors with a solution of baking soda and water. Use a wire brush or battery terminal tool to remove corrosion buildup. Rinse and clean all surfaces.

Reinstall battery and tighten all connections securely. Refer to Battery Installation on p. 27.

IMPORTANT: DO NOT secure battery cables with wing nuts.

Coat all connections with Triple-Guard grease and insulate to prevent shorts or spark arcing.

FUEL AND OIL SYSTEMS

Routine replacement of filters reduces the possibility of foreign material restricting the incoming fuel or oil supplies.

Replacement filter elements are available through Evinrude/Johnson Genuine Parts.

Fuel Filter

Evinrude E-TEC 40–90 HP outboards are equipped with an in-line fuel filter. Refer to Fuel Component Servicing on p. 166.

Oil Filters and Oil Reservoir

Perform visual inspections to identify oiling system leaks. Make certain the oil tank is filled and oil supply is not contaminated.
Air Silencer
The air silencer on Evinrude outboards maximizes air flow while minimizing noise.

Routine cleaning of the air silencer is recommended to remove any accumulation of debris.

Hoses and Connections
Check condition of all hoses and connections in both the fuel and oil systems:
• Visually inspect all components.
• Observe all clamps, hoses, and connections while outboard is running.
• Replace all damaged components.
• Repair all leaks.

WARNING
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.
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.

<table>
<thead>
<tr>
<th>Spark Plug, Champion</th>
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<tr>
<td>QC10WEP @ 0.028 ± 0.003 in. (0.71 mm)</td>
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- 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.

Removal

Remove ignition coil above spark plug to gain access. When reinstalling coils, tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

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 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.

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

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

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.
**STORAGE**

**IMPORTANT:** DO NOT start outboard without a water supply to the outboard’s cooling system. Cooling system and/or powerhead damage could occur.

**Fuel System Treatment**
Stabilize the boat’s fuel supply with *Evinrude/Johnson 2+4 Fuel Conditioner* following the instructions on the container.

**Internal Engine Treatment**
Remove the propeller, attach garden hose to flushing port and turn on water.

*Evinrude E-TEC* models are designed to be self-winterizing using either of the following methods:

**IMPORTANT:** Engine MUST be in NEUTRAL throughout these procedures.

**Throttle Control Method**
- Advance throttle control to 1/2 throttle (50%) position and then start the outboard. All four - SystemCheck lights will turn on and the outboard will run at idle speed.
- After approximately 15 seconds, the SystemCheck lights will go off. Move throttle to IDLE position. SystemCheck lights will light again.
- Wait another 15 seconds. SystemCheck lights will go off. At this point, advance throttle to FULL (in neutral). SystemCheck lights will flash, indicating that outboard is in winterize mode.
- Outboard will automatically go to fast idle and fog itself. Allow outboard to run until it shuts itself off (about one minute).

**IMPORTANT:** If SystemCheck lights do not flash, or outboard runs above fast idle, immediately turn off outboard and start the procedure again.

**Software Control Method**
Winterization can also be run using *Evinrude Diagnostics* software. With the outboard running, start the process at the Settings/Adjustments screen and follow the instructions.

1. **Winterization start button**

After the outboard shuts itself off, turn key switch OFF, then detach garden hose.

**IMPORTANT:** When finished, leave the outboard in vertical position long enough to completely drain the powerhead.
Additional Recommendations

- Top off oil reservoir.
- Inspect the fuel filter. If there is debris in the fuel filter, it must be replaced.
- Replace gearcase lubricant.
- Remove and inspect propeller.
- Clean and grease propeller shaft.
- Blow water from gearcase speedometer pickup system (gearcase speedometer models only).
- Lubricate all grease fittings and linkages.
- Inspect outboard, steering system, and controls. Replace all damaged and worn components. Refer to manufacturer’s and lubrication recommendations.
- Touch up painted surfaces as needed. Coat outer painted surfaces with automotive wax.
- Remove battery(s) from boat. Store in a cool, dry location. Periodically charge battery(s) while stored. Refer to manufacturer’s maintenance recommendations when servicing batteries.
- Store outboard in upright (vertical) position.
- Check for fuel leakage.

**WARNING**

Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

PRE-SEASON SERVICE

If the outboard was removed from the boat for storage, make sure it is reinstalled with factory specified hardware. Refer to the INSTALLATION AND PREDELIVERY section for proper set-up.

Outboard Mounting Bolts

- Check and re-tighten outboard mounting bolts to a torque of 40 ft. lbs. (54 N·m).

Gearcase Lubricant

- Check the lubricant level.
- Inspect gearcase for leaks. If leak is apparent, pressure and vacuum test gearcase.
- Repair gearcase as needed.

Battery(s)

- Replace batteries that cannot be charged.

Power Trim and Tilt

- Remove filler cap and check fluid level.
- Inspect the power trim and tilt unit for leaks. Repair as needed.

Operational Checks

- Steering system
- Remote controls
- SystemCheck gauge
- All other accessories and instrumentation

Check Oil Injection Tank

- Inspect the oil tank for leaks.

Check Fuel System

- Inspect entire fuel system for leaks before starting outboard.
- Repair all leaks.

Water Pump

- Make sure a steady stream of water flows from overboard indicator.

**WARNING**

Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.
SUBMERGED ENGINES

Once an outboard has been submerged in fresh or salt water, it must be serviced within three (3) hours of recovery. Immediate service can minimize the corrosive affect that air has on the polished surfaces of the crankshaft, connecting rods, and internal powerhead bearings.

IMPORTANT: If outboard cannot be started or serviced immediately, it should be resubmerged in fresh water to avoid exposure to the atmosphere.

Engine Dropped Overboard (Not Running)

Disconnect the battery cables at the battery.

Rinse powerhead with clean water.

Remove spark plug leads and spark plugs.

Place outboard in horizontal position (cylinder heads down). Slowly rotate flywheel in a clockwise rotation to work all water out of powerhead.

IMPORTANT: If sand or silt may have entered the outboard, DO NOT attempt to start it. Disassemble and clean.

Disassemble all electrical connectors. Clean connectors and terminals, and treat with water displacing electrical spray. Apply Electrical Grease to terminals prior to reassembly. Coat all exposed solenoid terminals and engine grounds with Black Neoprene Dip.

Clean and inspect all electrical components. Replace damaged or corroded components prior to returning the outboard to service. Electric starters should be disassembled, cleaned, flushed with clean water, and treated with water displacing electrical spray prior to reassembly.

Disconnect fuel supply hose from outboard. Drain and clean all fuel hoses, filters, and fuel tanks.

Disconnect oil supply hose and oil return hose from outboard. Drain and clean all oil hoses, filters, and oil tank assemblies.

Refill fuel tank with fresh fuel and oil tank with recommended oil.

Prime oil system and fuel system. Refer to FUEL AND OIL PRIMING on p. 53. Make sure all oil injection hoses are clean and filled with oil.

Make sure high pressure fuel system does not contain water. Flush as needed.

Inject a small amount of outboard lubricant into spark plug holes and install new spark plugs. Refer to Spark Plug Indexing on p. 76.

Reinstall all removed or disconnected parts.

Use Evinrude Diagnostics software to:
- Initiate Break-in
- Check fuel pump operation
- Check injector operation (fuel and oil)
- Check timing (once outboard is running at full operating temperature)

Run outboard below 1500 RPM for one-half hour.

Engine Dropped Overboard (Running)

Follow the same procedures as Engine Dropped Overboard (Not Running). However, if there is any binding when the flywheel is rotated, it may indicate a bent connecting rod and no attempt should be made to start the outboard. Powerhead must be disassembled and serviced immediately.

Engine Dropped Overboard (In Salt Water)

Follow the same procedures used for Engine Dropped Overboard (Not Running) and Engine Dropped Overboard (Running). Disassemble and clean outboards that have been submerged in salt water for prolonged periods of time. Clean or replace electrical components as necessary.

Prolonged Submersion (Fresh or Salt Water)

Outboards that have been dropped overboard and not recovered immediately, must be serviced within three hours of recovery. Follow the same procedures used for Engine Dropped Overboard (Not Running) and Engine Dropped Overboard (Running).
## Notes

### Technician's Notes

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### Related Documents

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UPPER COVER SERVICE

Latch Hook Installation
Insert threaded bracket into pocket.

Apply *Ultra-Lock* to screw threads. Place hook into position with opening toward the front. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

LOWER COVER SERVICE

Lower Cover Removal
Remove lower engine cover screws.

Loosen port side cover slightly, and disconnect trim/tilt switch connector. Then, remove port and starboard covers.
Lower Cover Installation

Installation of lower motor covers will be easier if the following steps are performed in order:

- Install air silencer on throttle body.
- Place starboard cover on outboard and route fuel hose and battery cable through grommet notch.
- Insert trim cable grommet into port side cover.
- Connect trim/tilt switch connector.
- Place port side cover into position on outboard.

Start the screw above the exhaust relief grommet first. Tighten just enough to hold the grommet in place.

Install remaining cover screws and tighten all screws to 24 to 36 in. lbs. (3 to 4 N·m).
Latch Handle Installation
Apply a light coat of *Triple-Guard* grease to latch handle shaft. Insert handle into lower cover.

Apply *Ultra-Lock* to screw threads. Place spring washer and hook into position and tighten screw to a torque of 180 in. lbs. (20 N·m).

Trim Switch Installation
Place switch into position through cover.

Install nut on switch. Tighten nut to a torque of 10 to 16 in. lbs. (1 to 2 N·m).

Install electrical connector. Refer to *CONNECTOR SERVICING* on p. 148.
ENGINE MANAGEMENT MODULE (EMM)

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ENGINE MANAGEMENT MODULE (EMM)
DESCRIPTION

The Engine Management Module (EMM) is a water-cooled engine controller. It controls many outboard systems including alternator output for the 12 V and 55 V circuits. Operating voltage is supplied to the EMM by the stator.

This section discusses the functions of the EMM and its various internal and external sensors. It also describes using Evinrude Diagnostics software to retrieve and adjust service information stored in the EMM.

EMM Functions

The EMM controls the following processes and functions:
- Alternator output; 55 V and 12 V
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil injector pump activation
- Electric fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Service code creation and storage
- Warning system activation
- ROM verification, self-test
- Choke-less cold starting
- Output of diagnostic data
- Tachometer signal
- RPM profile and engine hours
- Oiling ratios
- Exhaust water valve activation

EMM Connections

IMPORTANT: EMM connections and wiring must be clean and tight. Improper electrical connections can damage the EMM. DO NOT run the outboard with loose or disconnected wiring.

Make sure EMM connections are clean and tight.
- Engine wire harness to EMM connectors; J1-A, J1-B, J2
- Stator to EMM connections; one 6-pin AMP and J2 connector.

LED Indicators

The EMM has four LED indicators located next to the electrical connectors that provide useful information about the status of the system.

IMPORTANT: LED 1 is toward the top of the outboard (Closest to EMM J1-B connector).

When the ignition key is turned ON, LEDs 3 and 4 should light, indicating that sensor circuits and the stop circuit are working.

As the outboard is being started, all four LEDs should light and then go off in sequence. If any of the LEDs does NOT light during starting, refer to EMM LED INDICATORS on p. 107.

When the outboard is running, all LEDs should be off. If any LED is illuminated while the outboard is running, refer to EMM LED INDICATORS on p. 107.
1. Engine Management Module (EMM)
2. Battery (12 volt)
3. Stator
4. Crankshaft Position Sensor (CPS)
5. Throttle Position Sensor (TPS)
6. Neutral Switch
7. Air Temperature Sensor (AT)
8. Oil Pressure Switch (component of 11)
9. Engine Temperature Sensor
10. Fuel Pump (high pressure)
11. Oil Injection Pump and Manifold
12. Ignition Coil
13. Fuel Injector
14. Tachometer/SystemCheck Gauge
15. Diagnostic Connector
16. LED Indicators
17. Exhaust Water Valve
INTERNAL SENSORS

Sensor inputs and internal EMM controllers are used to control outboard operation. Use Evinrude Diagnostics software to troubleshoot the sensors. Refer to the EMM Service Code Chart at the back of this manual for a complete list of all engine fault codes.

Internal sensors are NOT serviceable. Reprogramming or replacement may be required to resolve internal EMM issues.

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

If the EMM temperature exceeds 176°F (80°C) or the circuit fails, the EMM:

- Activates S.A.F.E.
- Stores service code 25
- EMM LED 4: ON (Running)
- Engine Monitor TEMP display: ON

If the EMM temperature exceeds 212°F (100°C) or the circuit fails, the EMM:

- Activates S.A.F.E.
- Stores service code 29
- EMM LED 4: FLASHING
- Engine Monitor TEMP display: FLASHING

IMPORTANT: The outboard will not restart until the engine cools below 212°F (100°C) and the EMM temperature returns to normal. Refer to SHUTDOWN MODE on p. 94.

If the EMM temperature is less than -22°F (-30°C) or the circuit fails, the EMM:

- Stores service code 24
- EMM LED 3: OFF (Cranking)
- EMM LED 3: ON (Running)

If the EMM temperature is less than -71°F (-57.4°C) or greater than 313°F (156°C), a sensor circuit fault is detected and the EMM:

- Stores service code 23
- EMM LED 3: OFF (Cranking)
- EMM LED 3: ON (Running)

55 V Circuit Sensor

Monitors the EMM's 55 V alternator circuit.

If system voltage exceeds 57 volts, the EMM:

- Activates S.A.F.E.
- Stores service code 18
- EMM LED 1: ON (Running)
- Engine Monitor CHECK ENGINE display: ON

If system voltage is below 45 volts with outboard running 500 to 1000 RPM or is below 52 volts with outboard running above 1000 RPM, the EMM:

- Activates S.A.F.E.
- Stores service code 17
- EMM LED 1: ON (Running)
- Engine Monitor CHECK ENGINE display: ON

12 V Circuit Sensor

Monitors the EMM's 12 V alternator circuit.

If battery voltage exceeds 15.5 volts, the EMM:

- Stores service code 27
- EMM LED 1: ON (Running)
- Engine Monitor LOW BATTERY display: ON

If battery voltage is below 12 volts with outboard running 500 to 2000 RPM OR is below 12.5 volts with outboard running above 2000 RPM, the EMM:

- Stores service code 26
- EMM LED 1: ON (Running)
- Engine Monitor LOW BATTERY display: ON
Barometric Pressure Sensor
Supplies the EMM with barometric pressure reading to compensate for changes in altitude and air density.

If the BP sensor reads below 13.3 KPa or above 119.0 KPa, or the sensor or circuit fails, the EMM:
- Stores service code 44

If the BP sensor reads below 70 KPa, the EMM:
- Stores a service code 45

If the BP sensor reads above 105 KPa, the EMM:
- Stores service code 46

EXTERNAL SENSORS
Sensor inputs and internal EMM controllers are used to control outboard operation. Use Evinrude Diagnostics software to troubleshoot the sensors. Refer to the EMM Service Code Chart at the back of this manual for a complete list of all engine fault codes.

The EMM provides a 5 V DC signal for sensor circuits. It monitors all sensor voltage inputs and compares them to predetermined acceptable ranges. Inputs that fall outside of the acceptable range create service codes.

Air Temperature Sensor
Monitors the air temperature at the throttle body. The air temperature sensor is a negative temperature coefficient (NTC) thermistor. As temperature increases, the resistance of the sensor decreases resulting in a lower voltage reading at the EMM. Temperature decreases result in a resistance increase and a higher voltage reading at the EMM.

If the AT sensor voltage is out of the expected range, or the sensor or circuit fails, the EMM:
- Stores service code 47
- EMM LED 3: OFF (Cranking)
- EMM LED 3: ON (Running)
- Engine Monitor CHECK ENGINE display: ON
Engine Temperature Sensor

Monitors cylinder head temperature. The sensor is a negative temperature coefficient thermistor (NTC).

If cylinder head temperature exceeds 212°F (100°C), the **EMM**:

- Activates S.A.F.E.
- Stores service code 43
- **EMM** LED 4: ON (Running)
- Engine Monitor TEMP display: ON

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

- Activates SHUTDOWN
- Stores service code 31
- **EMM** LED 4: FLASHING
- Engine Monitor TEMP display: FLASHING

The outboard will not restart after a temperature related SHUTDOWN until the engine temperature returns to normal. Refer to **SHUTDOWN MODE** on p. 94.

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

- Stores service code 41
- **EMM** LED 3: OFF (Cranking)
- **EMM** LED 3: ON (Running)

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

- Stores service code 42
- **EMM** LED 3: OFF (Cranking)
- **EMM** LED 3: ON (Running)

If engine does not reach operating temperature on cylinder head (104°F / 40°C below 2300 RPM) in 10 minutes, the **EMM**:

- Stores service code 58
- **EMM** LED 3: OFF (Cranking)
- **EMM** LED 3: ON (Running)

Low Oil Switch

The low oil switch monitors the oil level in the oil tank.

If the oil level falls below one-quarter capacity, the **EMM** signals:

- Engine Monitor LOW OIL display: ON

When the oil level falls below one-quarter, the **EMM** begins counting oil pump pulse cycles. When it reaches 4800 pulses, the **EMM**:

- Activates S.A.F.E.
- Stores service code 117
- **EMM** LED 4: ON (Running)
- Engine Monitor NO OIL display: ON

To recover from S.A.F.E. mode, the oil pump must cycle for a minimum of three pulses with the oil level above one-quarter.

If outboard has been run for more than 3 hours with NO OIL faults (codes 34 & 117), the **EMM**:

- Activates SHUTDOWN
- Stores service code 33
- **EMM** LED 4: FLASHING
- Engine Monitor NO OIL display: FLASHING

Throttle Position Sensor

The throttle position sensor is connected to the throttle plate shaft. The sensor receives a voltage signal from the **EMM**. As the throttle lever is rotated, the **EMM** receives a return voltage signal through a second wire. This signal increases as the TPS lever is advanced. A third wire provides a ground circuit back to the **EMM**.

Refer to **TPS Calibration** on p. 143.

If the TPS circuit reads above 0.78 volts when the key is turned to ON, or the recoil starter is pulled, the **EMM**:

- Creates service code 11

If the outboard starts, the code is stored.
If code 11 is present as both a Hard Fault and a Stored Fault, refer to Control Cable Adjustments on p. 48.

For tiller models, refer to Throttle Cable Adjustment on p. 259.

If the TPS or TPS circuit fails (below 0.14 volts or above 4.92 volts), the EMM:

- Stores service code 12
- Limits engine RPM to IDLE
- **EMM LED 3**: OFF (Cranking)
- **EMM LED 3**: ON (Running)
- Engine Monitor CHECK ENGINE display: ON

**IMPORTANT:** When a TPS circuit fault has been detected, the outboard will not accelerate above idle speed. To reset, stop the outboard and correct the fault.

If the TPS circuit reads below 0.2 volts, the EMM:

- Stores service code 13
- **EMM LED 3**: OFF (Cranking)
- **EMM LED 3**: ON (Running)
- Engine Monitor CHECK ENGINE display: ON

If the TPS circuit reads above 4.85 volts, the EMM:

- Stores service code 14
- **EMM LED 3**: OFF (Cranking)
- **EMM LED 3**: ON (Running)
- Engine Monitor CHECK ENGINE display: ON

### Crankshaft Position Sensor

The CPS is a magnetic device. It is mounted on the throttle body, next to the flywheel.

Ribs spaced on the flywheel mark crankshaft position. As the ribs pass the magnetic field of the CPS, an AC voltage signal is generated. The EMM uses this signal to identify crankshaft position and speed, generate a tachometer signal, and control fuel and ignition timing.

If the sensor is damaged or the signal is intermittent (10 instances), the EMM:

- Stores service code 16
- **EMM LED 3**: OFF (Cranking)
- **EMM LED 3**: ON (Running)

Approximate air gap between CPS and flywheel ribs is 0.073 (1.85 mm).

Use the Monitor screen of Evinrude Diagnostics software to check CPS operation. The software should show an RPM reading while the outboard is cranking. If the CPS or its circuit fails, no RPM reading will appear and the outboard cannot run.

### Neutral Switch

The powerhead mounted neutral switch controls a ground signal from the EMM to indicate shift linkage position. This allows the EMM to control idle speed variations for NEUTRAL or IN GEAR. Tiller models use the switch for start in gear protection. Fuel and ignition functions are turned off if the neutral switch is not closed.

If the starter is cranked while the outboard is in gear, or if the switch fails, the EMM:

- Stores service code 19
- **EMM LED 3**: OFF (Cranking)
- Engine Monitor CHECK ENGINE display: ON

The Monitor screen of the diagnostics software displays switch position, NEUTRAL or IN GEAR. Make sure switch is operating properly.
INTERNAL EMM FUNCTIONS

ROM Verification
The EMM performs a self-test of programming every time it is turned ON. Service code 15 indicates a programming (software) issue. Reprogram the EMM with the correct software program to correct the problem.

Idle Controller
The idle controller reacts to engine operating conditions. Fuel and ignition timings are altered to maintain a specific RPM when engine is cold or warm. The controller is inactive when TPS is advanced from idle position.

RPM Limiter
This feature of EMM programming prevents engine damage due to excessive RPM. At 6250 RPM, fuel and ignition to the cylinders is shut off. Normal operation resumes when engine RPM returns to the specified range.

Neutral RPM Limiter
This feature prevents engine damage due to excessive RPM if accelerated in NEUTRAL. Neutral engine speed is limited to 1800 RPM.

Exhaust Water Valve Activation (60 HP)
During acceleration, the EMM opens a valve that injects water into the exhaust housing. This water changes the tuning of the exhaust, allowing the engine to develop more midrange horsepower as the boat comes on plane.

Two conditions must be met to activate the valve:
• Throttle opening above 80%
• RPM between 2500 to 4600.

The valve may not activate if the engine is accelerated slowly.

Engine Monitor and Warning Systems
Refer to ENGINE MONITORING SYSTEM on p. 93.
Refer to S.A.F.E. WARNING SYSTEM on p. 94.
Refer to SHUTDOWN MODE on p. 94.

Fault Code Creation and Storage
Refer to the EMM Service Code Chart at the back of this manual for a complete list of all engine fault codes.
ENGINE MONITORING SYSTEM

The engine monitoring system warns the operator of conditions that could damage the outboard. The system includes sensors on the engine and oil tank, a warning horn, a dash-mounted gauge, and related wiring.

The EMM sends information about monitored functions to:
• An I-Command, or other NMEA 2000 compliant CANbus network
• The SystemCheck Modular Wiring System (MWS)
• EMM LED indicators

IMPORTANT: Outboards with remote controls must be equipped with an I-Command system, a SystemCheck gauge, or an equivalent engine monitor. Operating the outboard without an engine monitor will void the warranty for failures related to monitored functions.

The EMM activates the warning horn and gauge displays as follows:
• LOW OIL means that oil in the tank is at reserve level (about 1/4 full).
• NO OIL indicates the oil tank is empty.
• WATER TEMPERATURE or HOT indicates an engine or EMM overheat condition.
• CHECK ENGINE or FAULT is used to indicate other fault conditions identified by the EMM.

Refer to the EMM Service Code Chart at the back of this manual for a complete list of all fault codes.

System Self-Test

During engine start-up, pause with the key switch in the ON position. The horn self-tests by sounding a half-second beep. SystemCheck gauges self-test by turning the indicator lights on simultaneously, then off in sequence.

Service Mode

SystemCheck goes into a service mode if the key is left ON after self-test (engine NOT running). All light circuits and sensors are active, but the horn is not. Grounding the appropriate light circuit wire will turn the light on, but the horn will not sound. Refer to SystemCheck CIRCUIT TESTS on p. 136.

Engine Running

All warning circuits are active when the engine is running. The horn circuit is active when engine speed exceeds 500 RPM.

Engine monitor warnings activate the horn for 10 seconds and the appropriate gauge light for a minimum of 30 seconds. If the failure is momentary (for example, oil moving in the tank), the light will remain ON for the full 30 seconds before going out. If the fault continues, the light remains ON until the key is turned OFF or the failure is corrected. The warning will reoccur at the next start-up if the problem is not corrected.
S.A.F.E. WARNING SYSTEM

The S.A.F.E. (Speed Adjusting Failsafe Electronics) warning system alerts the operator and protects against engine damage from the following abnormal conditions:

- Code 17: Alternator 55 V below expected range
- Code 18: Alternator 55 V above expected range
- Code 25: EMM temperature above expected range
- Code 34: Oil injector open circuit
- Code 43: Cylinder head temperature above expected range
- Code 117: NO OIL detected

### Activation

When one of these conditions occurs, the EMM interrupts fuel injector and ignition operation, reducing engine speed to 1200 RPM. The warning horn sounds and an Engine Monitor message displays. When S.A.F.E. is active, the engine will run normally below 1200 RPM. Above 1200 RPM, the engine will shake excessively.

### Recovery

The engine will operate in S.A.F.E. as long as the fault condition exists. To recover normal operation, two conditions must be met:
- Sensor or switch readings must be back within limits
- The EMM must be reset—stop and restart

### SHUTDOWN MODE

Outboard "shutdown" will occur if specific faults are detected by the EMM:

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<th>Description</th>
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<td>Excessive EMM temperature</td>
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<tr>
<td>31</td>
<td>Excessive engine temperature</td>
</tr>
<tr>
<td>33</td>
<td>Excessive NO OIL condition</td>
</tr>
<tr>
<td>57</td>
<td>High RPM with low TPS setting</td>
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</table>

Code 57 occurs when the EMM detects abnormally high RPM relative to the TPS position. This condition could be caused by uncontrolled fuel entering the combustion cycle. Before removing the code and STARTING the outboard, find and repair the cause.

- Perform Fuel System Pressure Test on p. 161. Check for external fuel leakage that could allow fuel and/or vapor to enter the engine through the air intake.
- Check for internal fuel leakage from a leaking injector or vapor separator vent hose.

### WARNING

If the engine shuts OFF and the "CHECK ENGINE" light or EMM SENSOR FAULT LED is flashing, the engine cannot be restarted. A hazardous fuel condition may exist which could result in a fire or explosion.

### Recovery

To recover from shutdown mode, the EMM must NOT detect the related fault at start-up. The outboard will not restart until the cause of the stored service code is resolved (code 29 and 31) and the code is cleared using diagnostics software (code 33 and 57). Then, the EMM must be turned OFF and ON again.

**IMPORTANT:** Shutdown related to code 57 or 33 requires the removal of the stored service code. Use Evinrude Diagnostics software to clear a code 57 or 33.
DIAGNOSTIC SOFTWARE FUNCTIONS

The EMM stores valuable information about the outboard and its running history. This information can be used for troubleshooting, for checking parts information, and for making adjustments to the system.

Use Evinrude Diagnostics software, P/N 764642, and a laptop computer to access program information.

IMPORTANT: For software help, refer to the “Help” menu in the software.

Communication

Locate the diagnostic connector on the engine. Remove the cover and install the Diagnostic Interface Cable, P/N 437955.

Connect the 9-pin connector of the interface cable directly to the computer’s serial port.

The EMM must turn ON before it will communicate with the computer. Power is normally supplied to the EMM when the key switch is turned ON. Switched B+ (12 V) enters the EMM at pin 28 (purple) of the EMM J1-B connector.

The EMM is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.

IMPORTANT: Diagnostic communications on non-running rope start models requires temporary installation of a key switch at the engine harness connection and a 12 V battery and battery cables at the solenoid.

Static Information

Static information is viewed when the outboard is NOT running. This includes manufacturing information.

The outboard model and serial numbers displayed on the Identity screen must match the identification label on the outboard swivel bracket.

The serial number and cylinder location displayed on the Injector Coefficients screen must match the actual cylinder placement for each injector.
Dynamic Information

Dynamic information is viewed while the outboard is running. Changes in data, such as voltages or temperatures, are shown as they happen.

Stored Service Codes (Faults)

Service codes are stored if an abnormal condition occurs while the outboard is running.

The Stored Faults screen of the diagnostics software shows the code number, the number of times the event occurred, and operating hours of first and last occurrences.

Hard Faults

A hard fault is a service code that currently exists. Hard faults become stored faults only if the outboard is running.

Persistent Faults

The Persistent Faults screen keeps a history of all previously stored codes, including code number, the number of times the event occurred, and operating hours of the last occurrence.

Persistent faults cannot be erased.

Static Tests

Static Tests allow diagnostic testing of system components while the outboard is NOT running.
**Ignition Test**
Use the diagnostics software to test each ignition circuit. Refer to Static Ignition Test on p. 111.

**Fuel Test**
Use the diagnostics software to test each fuel injector circuit. Refer to Fuel Injector Static Test on p. 114.

**Oil Injector**
Use the diagnostics software to test the oil injection pump circuit. Refer to OILING SYSTEM TESTS on p. 183.

**Fuel Pump**
Use the diagnostics software to test the fuel pump circuit. Refer to Fuel Pump Static Test on p. 114.

**Water Injector**
This test activates the exhaust water valve solenoid (60 HP). Refer to Exhaust Water Valve Static Test on p. 116.

**Overheat**
This test is used to check the “ENG TEMP” or “HOT” circuit of the Engine Monitoring system.

**Oil Fault**
This test is used to check the “NO OIL” circuit of the Engine Monitoring system.

**Check Engine**
This test is used to check the “CHECK ENGINE” circuit of the Engine Monitoring system.

**Tachometer**
This test is used to check operation of the tachometer circuit.

**Dynamic Tests**
Dynamic tests are performed with the outboard running.

**Ignition Test**
This test momentarily disables the ignition and fuel injection circuits to one cylinder. By dropping one cylinder, RPM and running quality changes can be observed. Refer to DYNAMIC TESTS on p. 106.

**Fuel Test**
This test momentarily disables one fuel injector circuit. By dropping one cylinder, RPM and running quality changes can be observed. Refer to DYNAMIC TESTS on p. 106.

**Prime Oil**
This test is used to cycle the oil injection pump for priming the oiling system. Perform this test with outboard running to activate oil injection pump.
Oil Control Settings

Set Oil Type
The TC-W3 oil type setting is the standard setting for all outboards. Set TC-W3 for:
• Operation with all TC-W3 outboard oils including XD30, XD50, or XD100.
• Applications requiring maximum lubrication.
• Extreme applications (racing or harsh conditions)

The XD100 setting provides an option to run the outboard at a reduced oil injection rate. This setting REQUIRES the use of Evinrude XD100 outboard lubricant and is not recommended for all applications.

Use the XD100 setting for:
• Conventional use (runabouts, cruisers)
• Moderate applications

Powerhead Break-In
Use the diagnostics software to start break-in oiling after a powerhead rebuild. The break-in oiling program runs for two hours of outboard operation, above 2000 RPM.

Tiller/Remote Programming
This feature controls the start in gear protection function of the neutral switch. Tiller operated models, including remote models with an installed tiller conversion kit, MUST be set to TILLER.

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.
Ignition Timing

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

Refer to TIMING ADJUSTMENTS on p. 142.

Check timing 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 making adjustments.

TPS Calibration

TPS Calibration synchronizes throttle plate opening with throttle position sensor voltage.

Refer to TPS Calibration on p. 143.

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

Idle Speed Control

Use the Idle Adjust function to increase or decrease IN GEAR IDLE speed. This adjustment offsets the basic EMM programming and will not set an absolute fixed speed. After the offset is changed, the EMM continues to control engine operation normally. Engine idle speed is not fixed.
Fuel Injector Servicing

All E-TEC fuel injectors use software programming to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the EMM. DO NOT install an injector without updating the compensation software.

To install a service injector, click the “Replace” button on the Injector Coefficients screen and select the file for the replacement injector. Refer to Fuel Injector Service on p. 169.

Reports

Engine reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

Click the print button in a window of the diagnostics software to print engine data, or to export the information to a computer file.
Software Replacement

Engine Management Software programs are loaded into the EMM at the factory. Periodically, a new program may be available to enhance the operation of an outboard. Select Engine Software Update from the Utilities menu and refer to the instructions provided with the program.

**IMPORTANT:** Software replacement requires a “Bootstrap” Tool, P/N 586551.

**EMM Transfer**

EMM Transfer is used to save engine history data when the EMM must be replaced. Select EMM Data Transfer from the Utilities menu. Select the Collect EMM data to FILE option and follow the instructions provided with the program.

**IMPORTANT:** Whenever the EMM is replaced, EMM timing must be synchronized to crankshaft position. Refer to Timing Adjustments on p. 142.
EMM SERVICING

IMPORTANT: If a new EMM is being installed, refer to EMM Transfer on p. 101.

Disconnect cooling hoses from EMM.

Disconnect J1-A, J1-B, and J2 connectors.

Remove three EMM retaining screws and washers. Remove EMM.

Remove EMM from behind oil tank bosses.

Installation

Installation is the reverse of removal. Pay close attention when performing the following tasks.

Make sure isolator mounts are placed in slots in of EMM case. Slide EMM into position.

Apply Nut Lock to threads of EMM retaining screws. Tighten to a torque of 30 to 42 in. lbs. (4 to 5 N·m).

Install harness connectors and cooling hoses. Secure hoses with tie straps.
# SYSTEM ANALYSIS

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DIAGNOSTIC PROCEDURES

Visual Inspections
Inspect wiring and electrical connections. Disassemble and clean all corroded connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits.
- Refer to ELECTRICAL HARNESS CONNECTIONS on p. 121.
- Refer to WIRING DIAGRAM at the back of this manual.
- Refer to CONNECTOR SERVICING on p. 148.

Make sure all ground connections are clean and tight. Refer to GROUND CIRCUITS on p. 123.

Operational Inspections
Run the outboard to confirm actual symptoms before performing any unnecessary procedures. Inspection should include the following:
- Make sure the outboard can be cranked easily, with no mechanical binding.
- Check the EMM LED Indicators for system status information. Refer to EMM LED INDICATORS on p. 107.
- Check the Evinrude Diagnostics software Hard Faults and Stored Faults screens for current service codes. Correct any problems and clear the codes before further troubleshooting. Refer to Stored Service Codes (Faults) on p. 96.

Check the diagnostics software Profiles, History, and Persistent Faults screens for evidence of abnormal operation.

1. Main engine harness ground
2. Ground stud (battery)
Troubleshooting

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 switched B+ is present at “A” terminal (yellow/red wire) of starter solenoid with key switch in the START position.
• Check ground at “B” terminal harness connection.
• Refer to ELECTRIC START TESTS on p. 131. Repair starter or start circuit as needed.

Outboard cranks, will not start:
• Check emergency stop switch and lanyard
• Check powerhead mounted neutral switch
• Check the EMM LED Indicators for system status information. Refer to EMM LED INDICATORS on p. 107.
• Use the Evinrude Diagnostics software Stored Faults screen to check for current service codes. If there are multiple stored sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
• Perform a Static Ignition test using Evinrude Diagnostics software and an inductive timing light. Refer to Static Ignition Test on p. 111.
• If ignition test indicates steady spark, refer to FUEL DELIVERY TESTS on p. 114.

Outboard runs, low on power, misfires:
• Check the EMM LED Indicators for system status information. Refer to EMM LED INDICATORS on p. 107.
• Use the Evinrude Diagnostics software Monitor screen to check system (55 V) and TPS voltages. System voltage should be steady, and TPS voltage should be between 0.2 and 4.85 V.
• Use the diagnostics software Dynamic Tests to isolate a faulty cylinder. See DYNAMIC TESTS on p. 106.
• Use an inductive timing light to check ignition and fuel injector circuits. Refer to Running Ignition Tests on p. 112 and Running Fuel System Tests on p. 115.
• Use the diagnostics software Fuel Control Adjustment test to help identify a cylinder that may be too rich or too lean. Refer to Fuel Control Adjustment on p. 106.
• Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.
• Check fuel quality and that fuel is present at injectors.
• Use the diagnostics software Logging function to record engine data as a problem is occurring.

IMPORTANT: Use a digital multimeter to check voltage on external circuits only when necessary. All EMM output currents are DC current.
DYNAMIC TESTS

Cylinder Drop Tests

Use the Evinrude Diagnostics software Dynamic Tests to momentarily disable one cylinder while the outboard is running.
- The Dynamic Ignition test disables the ignition and fuel injection circuits to a cylinder.
- The Dynamic Fuel test momentarily disables one fuel injector circuit.

By dropping one cylinder, RPM and running quality changes can be compared for each cylinder.

IMPORTANT: Test the outboard at the RPM where the problem is occurring. Use the test procedures to identify inconsistencies in voltages and cylinder performance. Once a circuit has been identified as malfunctioning, inspect all related wiring and connections. Check all voltage inputs and grounds; and perform resistance tests for all circuits before replacing any suspect components.

Dynamic Tests can be used with:
- A timing light to determine how other cylinders are affected by one cylinder being “dropped”; or
- A voltmeter to check voltage changes on electrical circuits.

Fuel Control Adjustment

Use this test to help identify a cylinder that may be too rich or too lean. This feature should not be used by itself to identify a faulty injector.

Evinrude Diagnostics software allows temporary adjustments to the fuel flow characteristics of the injectors. Factory fuel flow settings are restored when power to the EMM is returned to OFF.

Test the outboard at the RPM where the problem is occurring.

If the outboard run quality improves with a fuel control adjustment, eliminate other possibilities before replacing an injector:
- Refer to Fuel System Pressure Test on p. 161.
- Refer to Running Fuel System Tests on p. 115.

IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the EMM compensates to maintain a constant IDLE speed.

Inductive Amp Meter Test

Use an inductive amp meter to monitor battery charging and current flow. Identifying erratic amperage in a circuit can be used to isolate a problem component.
**EMM LED INDICATORS**

The EMM LED indicators provide a quick reference to the status of several outboard systems. Checking the LEDs FIRST when diagnosing an engine problem can save time.

**IMPORTANT:** LED 1 is toward the top of the outboard (closest to EMM J1-B connector).

---

**Key ON**

**IMPORTANT:** Diagnostic communications on non-running rope start models requires that power is supplied to the EMM. Refer to Communication on p. 95.

When the EMM is ON (engine not running), the following LEDs should light:

**LED 3** – Sensor Circuits working. FLASHING LIGHT indicates Code 57 – engine will not start.

**LED 4** – Stop Circuit not grounded—okay to start. FLASHING LIGHT indicates severe overheat or no oil – engine in SHUTDOWN mode.

---

**Starting**

Starting mode occurs from the time the flywheel begins to turn until the outboard is running for 2 seconds. During starting, all four LEDs should light and then go off in sequence.

**LED 1** – CHARGING OKAY – Stator signal 30 V or higher.

**LED 2** – CRANK POSITION OKAY – input from CPS, EMM powered ON. For NO LIGHT, check for:
- Code 16 – CPS, intermittent loss of sync

**LED 3** – SENSORS OKAY (5 V). For NO LIGHT, check for:
- Code 12 – TPS circuit fault
- Code 13 – TPS below expected range
- Code 14 – TPS above expected range
- Code 19 – In Gear (tiller models)
- Code 23 – EMM temp. sensor circuit fault
- Code 24 – EMM temp. below expected range
- Code 41 – temp. sensor circuit fault
- Code 42 – temp. below expected range
- Code 47 – AT sensor circuit fault
- Code 48 – AT sensor below expected range
- Code 49 – AT sensor above expected range
- Code 58 – Operating temperature not reached

For FLASHING LIGHT, check for Code 57.

**LED 4** – LANYARD/STOP OKAY. For NO LIGHT, check for:
- Grounded stop circuit.

For FLASHING LIGHT, check for:
- Code 29 – EMM temp. OVER range (flashing)
- Code 31 – Engine temp. OVER range (flashing)
- Code 33 – Engine shutdown, excessive no oil condition
SYSTEM ANALYSIS
EMM LED INDICATORS

Running
When the outboard is running, all of the LEDs should be off. If a light is on, check for:

LED 1 – CHARGING FAULT:
- Code 17 – system voltage (55 V) below range
- Code 18 – system voltage (55 V) above range
- Code 26 – low battery (12 V) voltage
- Code 27 – high battery (12 V) voltage

LED 2 – INJECTOR/IGNITION FAULT:
- Code 51 – cylinder no. 1 injector circuit open
- Code 52 – cylinder no. 2 injector circuit open
- Code 61 – cylinder no. 1 injector circuit short
- Code 62 – cylinder no. 2 injector circuit short
- Code 81 – no. 1 ignition primary circuit open
- Code 82 – no. 2 ignition primary circuit open
- Code 91 – fuel pump circuit open
- Code 94 – fuel pump circuit short

LED 3 – Sensor circuits (5 V), “SENSOR FAULT.”
For LIGHT ON, check for possible fault codes:
- Code 12 – TPS circuit fault
- Code 13 – TPS below expected range
- Code 14 – TPS above expected range
- Code 16 – CPS, intermittent loss of sync
- Code 23 – EMM temp. sensor circuit fault
- Code 24 – EMM temp. below expected range
- Code 41 – temp. sensor circuit fault
- Code 42 – temp. below expected range
- Code 47 – AT sensor circuit fault
- Code 48 – AT sensor below expected range
- Code 49 – AT sensor above expected range
- Code 57 – high RPM with low TPS setting
- Code 58 – operating temp. not reached

LED 4 – Engine overheat, EMM temperature or sensor, oil injection pump or sensor, “NO OIL / OVERHEAT.” For LIGHT ON, check for possible fault codes:
- Code 25 – EMM temp. above expected range
- Code 29 – EMM temp. OVER range (flashing)
- Code 31 – engine temp. OVER range (flashing)
- Code 33 – excessive NO OIL faults
- Code 34 – oil injection pump circuit open
- Code 43 – temp. above expected range
- Code 117 – Critical NO OIL detected
IGNITION OUTPUT TESTS

DANGER
The electrical system presents a serious shock hazard. Allow outboard to sit for two minutes after running before handling capacitor or 55 V electrical components. Failure to handle capacitor properly can result in uncontrolled electrical discharge and possible electrical shock to humans. DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.

Use the Evinrude Diagnostics software Stored Faults screen to check for current service codes before troubleshooting. Correct any problems and clear the codes FIRST.

Ignition System Requirements
Following is a complete list of circuits required for ignition output:

Stop Circuit
- Black/yellow wire NOT grounded (emergency stop switch lanyard in place).

Neutral Switch
- Powerhead mounted neutral switch provides a switched ground circuit to EMM. The circuit enables specialized control functions such as neutral start protection and RPM limiting in NEUTRAL.

Stator Output Voltage
- Provides A/C voltage to EMM J2 connector: Outboard cranking, typical range is 20-40 VAC (AC output voltage is related to cranking RPM); Outboard running, approximately 55 VAC.

EMM
- Controls ignition grounds, injector grounds, and engine timing.

Crankshaft Position Sensor
- Provides EMM with input.
- Outboard cranking speed exceeds 300 RPM and a steady CPS signal is generated.

Alternator Output/System Voltage
- System voltage from EMM (white/red) provides 55 VDC to the high pressure fuel pump, the oil injection pump, the fuel injectors, and the ignition coils.

Capacitor
- Connected to 55 V circuit (white/red) to stabilize current on 55 V circuit
- Negative terminal of capacitor must be grounded.

Ignition Coil
- Primary circuits are powered by system (55 V) voltage
- EMM provides control signal to ignition coil
- Output from ignition coil secondary winding and high tension spark plug wire.

Wiring Inspection
Visually inspect all wiring, connections, and grounds.

Use an ohmmeter to test resistance on all ground circuits and connections. Ohmmeter readings should be approximately 0.0 Ω.

Check that all engine wire harness grounds have continuity to the cylinder/crankcase.

Clean or repair all ground circuits, wiring, and connections as needed.
Crankshaft Position Sensor (CPS) Test

When the CPS is working properly, *EMM* LED 2 turns on while the outboard is being started.

Use the *Evinrude Diagnostics* software CPS Sync and engine RPM displays to confirm a valid CPS signal while the outboard is cranking or running. An RPM display higher than zero indicates a CPS signal to the *EMM*.

If the *Monitor* screen says “Check CPS Sync,” refer to Crankshaft Position Sensor (CPS) Test on p. 124.

System Voltage Test

The ignition system is powered by the 55 V system.

Use the *Evinrude Diagnostics* software *Monitor* screen to check system voltage.

**Results:**
- **KEY ON (not running)** - approximately 1 V less than battery voltage, system voltage is GOOD.
- **KEY ON (not running)** - no voltage, check 12 V power to *EMM*. Repair connection or wiring.
- **RUNNING** - 55 V ± 2, system voltage is GOOD.
- **RUNNING** - less than 55 V ± 2, check stator output to *EMM*. Repair connection or wiring. Possible faulty stator or *EMM*. Refer to STA-TOR TESTS on p. 126.

**IMPORTANT:** The *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. Power is normally supplied to the *EMM* when the key switch is turned ON. The *EMM* is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.
Static Ignition Test
Perform the static ignition test using Evinrude Diagnostics software and an inductive timing light.

**IMPORTANT:** DO NOT use a spark checker tool with E-TEC models. Radio Frequency Interference (RFI) generated by the arcing current can cause erratic EMM operation.

The outboard must NOT be running and the emergency stop switch lanyard must be installed.

**IMPORTANT:** Diagnostic communications on non-running rope start models requires that power is supplied to the EMM. Refer to Communication on p. 95.

Connect timing light pickup to the secondary circuit (spark plug lead) of the cylinder being tested. Activate test and observe timing light strobe for consistent flash.

**RESULTS:**
No spark on one or more cylinders:
- Inspect or replace spark plugs
- Refer to Ignition Control Circuit Tests on p. 113
- Refer to Ignition Coil Tests on p. 113

Steady spark on all cylinders:
- Refer to Running Ignition Tests on p. 112 and DYNAMIC TESTS on p. 106.
Running Ignition Tests

Use Evinrude Diagnostics Software to monitor system voltage (55 V).
• Voltage readings at a specific speed (RPM) should be steady.
• Refer to System Voltage Test on p. 110.

Use an inductive timing light to monitor the spark signal through each of the secondary circuit (spark plug lead) wires.

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

Results:
Steady voltage and strobe, engine misfires:
• Inspect or replace spark plugs
• Refer to FUEL DELIVERY TESTS on p. 114
• Inspect for internal engine damage.

Steady voltage, erratic strobe, engine misfires:
• Inspect or replace spark plugs
• Check CPS air gap and resistance.
• Refer to Ignition Control Circuit Tests on p. 113
• Refer to Ignition Coil Tests on p. 113.

Voltages fluctuate, engine misfires:
• Inspect battery and connections
• Test capacitor and all ground connections.
• Refer to System Voltage Test on p. 110
• Refer to Ignition Control Circuit Tests on p. 113
• Refer to Ignition Coil Tests on p. 113.

IMPORTANT: If a running problem occurs at about 1200 RPM, the outboard may be in S.A.F.E. Refer to S.A.F.E. WARNING SYSTEM on p. 94.
Ignition Control Circuit Tests
Use a digital multimeter to test the following:
• System voltage supply to ignition coil.
• Ignition control signal from EMM.
• Engine harness resistance.

Disconnect ignition coil connector.

Supply voltage test:
Connect the red meter lead to pin 3 (white/red) of the engine harness connector and the black lead to ground. With KEY ON, voltage should be approximately 1 V less than battery voltage.

Control signal test:
Set meter to the Hz scale to check ignition control signal.

Connect the red meter lead to pin 2 (orange) of the engine harness connector and the black lead to ground. Activate diagnostics software Static Ignition test and observe meter for consistent reading (approximately 2 Hz).

If control signal is present, connect black meter lead to pin 1 and repeat test to confirm harness ground.

Harness resistance test:
If control signal is NOT present, calibrate multimeter to low ohms scale.

With key switch OFF, remove the EMM J1-B connector and test the continuity of each ignition control circuit (orange). Check resistance between J1-B connector and ignition coil connector. Refer to engine wiring diagram.

If circuits test good, replace EMM.

Ignition Coil Tests
There are no simple ignition coil tests available. Before replacing an ignition coil, be sure:
• 55 V is supplied to the white/red wire of the ignition coil connector
• A control signal is present on the orange wire of the ignition coil connector. Refer to Ignition Control Circuit Tests on p. 113.
• The black wire of the ignition coil connector provides continuity to ground.
• The secondary spark plug lead provides continuity.

If all of the above tests are good, and a cylinder does not have spark, replace the ignition coil with a known good coil.

Capacitor Test
IMPORTANT: Make sure the capacitor is discharged before testing. Make a momentary connection between the two terminals to ground any stored energy.

Use an ohmmeter set on the high ohms scale to test the capacitor. Connect the meter leads to the capacitor terminals:
• If the capacitor is working correctly, it will store energy from the meter. The resistance reading will increase until it goes to (nearly) infinity.
• If the capacitor is shorted, the reading will immediately show full continuity.
• If there is an open circuit in the capacitor, the meter will show no continuity.

If the resistance reading starts as a negative number, or the reading goes down in value, the capacitor already retains some stored energy. Ground the capacitor and test again.
FUEL DELIVERY TESTS

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. 166.

Check the Evinrude Diagnostics software Stored Faults screen for current service codes before troubleshooting. Correct any problems and clear the codes FIRST.

Inspect all fuel hoses, filters, and connections. Check quality of fuel supply.

Fuel Pump Static Test

Use the Evinrude Diagnostics software Fuel Pump test to activate the electric fuel pump. If the pump runs, the EMM and fuel pump circuit are not at fault.

If the pump does not run:

- Check voltage at pin 1 of fuel pump connector. Voltage should be slightly less than 12 V with KEY ON, or when fuel pump test is activated. Voltage should be 55 V when the outboard is cranking or running.

- The EMM controls the fuel pump ground (brown wire). Use an ohmmeter to check continuity between pin 2 of fuel pump connector and ground. Use the fuel pump static test to activate the control function of the EMM. Resistance should drop as EMM connects the control circuit to ground.

- Refer to Circulation Pump Resistance Test on p. 163.

If the pump runs:

- Refer to Fuel System Pressure Test on p. 161.
- Refer to Running Fuel System Tests on p. 115.

Fuel Injector Static Test

Use the Evinrude Diagnostics software Fuel Injector Static Test to activate each fuel injector. Listen for an audible “click” from each injector when it is actuated. If the injector activates, the EMM and injector circuits are not at fault.

IMPORTANT: This test is operating the injectors with 12 V battery power on the system voltage (55 V) circuit. Battery must be fully charged and connections must be clean and tight. Injector activation should be carefully confirmed.
Results:
No injectors actuate:
• Use the Monitor screen of the diagnostics software to make sure voltage is present on the system voltage circuit.
• Refer to Running Fuel System Tests on p. 115.

Some injectors actuate; some do not:
• Test the resistance of individual injector circuits between the injector connector and injector control wire at the EMM.
• See Fuel Injector Resistance Test on p. 163.

All injectors actuate:
• Refer to Running Fuel System Tests on p. 115.

Running Fuel System Tests
Run or crank the outboard.

Use the Evinrude Diagnostics software Monitor screen to check system voltage. If voltage is low, or drops as RPM increases, refer to Stator Voltage Output Test on p. 126.

Use an inductive timing light to monitor the injector control wire (connector pin 2) for each injector. Make sure the pickup is attached to only one wire. Flashes on the timing light indicate current in the circuit is being switched by the EMM. The Dynamic Tests screen allows the control signal to be turned off to a particular injector.

IMPORTANT: Some timing lights may not flash consistently at cranking speeds. Always check the orientation of the timing light pickup and the operation of the timing light.

Results:
No light activation on any injector wires (outboard cranks and starter turns flywheel):
• Check stator input to EMM, CPS operation, and all grounds and wiring connections.
• Eliminate all other possibilities to isolate a faulty EMM.

Irregular or no light activation on some injector wires:
• Test the resistance of individual injector circuits between the injector connector and injector control wire at the EMM.
• Check battery cable connections.
• Make sure all grounds are clean and tight.
• See Fuel Injector Resistance Test on p. 163.

Steady light activation on all injector wires and consistent voltage readings, EMM injector control function is good:
• Use the diagnostics software Dynamic Fuel Test to isolate a faulty cylinder. See DYNAMIC TESTS on p. 106.
• Refer to Fuel Injector Pressure Test on p. 162.
• Refer to Fuel System Pressure Test on p. 161.
EXHAUST WATER VALVE

During rapid acceleration, the *EMM* opens a valve that injects water into the exhaust. This water changes exhaust tuning, boosting midrange horsepower as the boat comes on plane.

If the valve is plugged or not working, the operator may not notice a problem during slow acceleration. During rapid acceleration, the outboard will be low on power around 3200 rpm, depending on boat and load.

If the valve is stuck open, the outboard may be low on top speed power (above 4600 RPM).

**Exhaust Water Valve Static Test**

Use *Evinrude Diagnostics* software to test the water valve solenoid electrical circuit. The water valve is a 55 volt coil. The static test, which operates on 12 VDC, will not activate the water valve.

Monitor the voltage at pin 2 (blue/red wire) of the water valve connector. Voltage should drop while the static test is active.

**Exhaust Water Valve Dynamic Test**

Use the diagnostics program to perform a dynamic test of the water valve while the outboard is running.

Disconnect the water valve outlet hose.

Start the outboard. No water should flow from the hose. If water appears, check for debris in valve assembly.

With the outboard idling, activate the dynamic water valve test and check for water flow. A steady stream of water should flow from the hose while the test is running.

Water should flow at a rate of 18 to 25 ounces / minute (550 to 750cc / minute).

**Results:**

- No water flow—check for debris in valve assembly and water supply line. Refer to EXHAUST WATER VALVE TEST on p. 136.
- Water appears—make sure fitting into exhaust housing is clear.
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**SERVICE CHART**

- **5 to 8 in lbs.** (0.6 to 0.9 N·m)
- **100 to 115 ft. lbs.** (136 to 156 N·m)
- **120 to 140 in lbs.** (13.5 to 16 N·m)
- **84 to 106 in lbs.** (9.5 to 12 N·m)
- **168 to 192 in lbs.** (19 to 21 N·m)
- **24 to 36 in lbs.** (2.7 to 4 N·m)

**IMPORTANT:** DO NOT lubricate TPS to throttle shaft surface

**A** - Triple-Guard Grease

**B** - Gasket Sealing Compound

**C** - Adhesive 847

**D** - Moly Lube

**E** - Red Ultra Lock

**F** - Blue Nut Lock

**N** - Starter Bendix Lube

**T** - Liquid Neoprene
ELECTRICAL AND IGNITION
SERVICE CHART

A  Triple-Guard Grease
B  Gasket Sealing Compound
C  Adhesive 847
D  Moly Lube
E  Red Ultra Lock
F  Blue Nut Lock
J  Thermal Grease
T  Liquid Neoprene
X  Refer to Spark Plug Indexing on p. 76
DASH CONNECTIONS, INSTRUMENT HARNESS

3-pin connector – Connect to trim switch located in the handle of the remote control or to trim switch mounted on the boat dash.

6-pin connector – Connect to a pre-wired remote control or to a dash-mounted key switch.

Black, purple, white/tan wires – Connect to the trim gauge.

8-pin connector – Connect to a 2 in. SystemCheck gauge or to a 3 1/2 in. SystemCheck tachometer.

2-pin connector – Must connect to the warning horn in all installations.

Black, purple, gray wires – Connect to a conventional tachometer when a SystemCheck tachometer is not used.
ELECTRICAL HARNESS CONNECTIONS

Inspect wiring and electrical connections. Disassemble and clean all corroded connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits. Refer to wiring diagrams and reference charts for specific wiring details.

Refer to CONNECTOR SERVICING on p. 148.

Engine Harness to Stator Connector

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description of Circuit</th>
<th>Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stator winding (yellow)</td>
<td>Yellow/White</td>
</tr>
<tr>
<td>2</td>
<td>Stator winding (yellow)</td>
<td>Yellow</td>
</tr>
<tr>
<td>3</td>
<td>Stator winding (orange)</td>
<td>Orange/White</td>
</tr>
<tr>
<td>4</td>
<td>Stator winding (orange)</td>
<td>Orange</td>
</tr>
<tr>
<td>5</td>
<td>Stator winding (brown)</td>
<td>Brown/White</td>
</tr>
<tr>
<td>6</td>
<td>Stator winding (brown)</td>
<td>Brown</td>
</tr>
<tr>
<td>7</td>
<td>Crankshaft position sensor (CPS)</td>
<td>Yellow</td>
</tr>
<tr>
<td>8</td>
<td>Ground, CPS (digital)</td>
<td>White</td>
</tr>
<tr>
<td>9</td>
<td>Stop circuit</td>
<td>Blk/Yellow</td>
</tr>
<tr>
<td>10</td>
<td>Throttle position sensor (TPS) 5 V</td>
<td>Red</td>
</tr>
<tr>
<td>11</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>CANbus, NET-L</td>
<td>Blue</td>
</tr>
<tr>
<td>14</td>
<td>CANbus, NET-H</td>
<td>White</td>
</tr>
<tr>
<td>15</td>
<td>12 V to EMM (fused)</td>
<td>Red/Purple</td>
</tr>
<tr>
<td>16</td>
<td>Tachometer</td>
<td>Gray</td>
</tr>
<tr>
<td>17</td>
<td>CHECK ENGINE signal, SystemCheck</td>
<td>Tan/Orange</td>
</tr>
<tr>
<td>18</td>
<td>TPS</td>
<td>Green</td>
</tr>
<tr>
<td>19</td>
<td>Engine temperature sensor</td>
<td>Pink/Black</td>
</tr>
<tr>
<td>20</td>
<td>Air temperature sensor</td>
<td>Pink/Blue</td>
</tr>
<tr>
<td>21</td>
<td>CANbus, NET-S</td>
<td>Red</td>
</tr>
<tr>
<td>22</td>
<td>CANbus, NET-C</td>
<td>Black</td>
</tr>
<tr>
<td>23</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>LOW OIL signal, SystemCheck</td>
<td>Tan/Black</td>
</tr>
<tr>
<td>25</td>
<td>WATER TEMP signal, SystemCheck</td>
<td>Tan</td>
</tr>
<tr>
<td>26</td>
<td>TPS ground (analog)</td>
<td>Black</td>
</tr>
<tr>
<td>27</td>
<td>Engine temp. sensor ground (analog)</td>
<td>Black</td>
</tr>
<tr>
<td>28</td>
<td>Switched B+ to EMM</td>
<td>Purple</td>
</tr>
<tr>
<td>29</td>
<td>LOW OIL switch</td>
<td>Tan/Black</td>
</tr>
<tr>
<td>30</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Neutral switch (shift linkage)</td>
<td>Yellow/Red</td>
</tr>
<tr>
<td>33</td>
<td>vacanat</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>vacanat</td>
<td></td>
</tr>
</tbody>
</table>
### EMM J1-B Connector

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description of Circuit</th>
<th>Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Injector, cylinder 2</td>
<td>Green</td>
</tr>
<tr>
<td>2</td>
<td>Exhaust water valve</td>
<td>Blue/Red</td>
</tr>
<tr>
<td>3</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NO OIL signal, SystemCheck</td>
<td>Tan/Yellow</td>
</tr>
<tr>
<td>7</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Injector, cylinder 1</td>
<td>Blue</td>
</tr>
<tr>
<td>9</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Injector ground</td>
<td>Black</td>
</tr>
<tr>
<td>15</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Ignition, cylinder 2</td>
<td>Orange/Green</td>
</tr>
<tr>
<td>20</td>
<td>Injector ground</td>
<td>Black</td>
</tr>
<tr>
<td>21</td>
<td>Injector ground</td>
<td>Black</td>
</tr>
<tr>
<td>22</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Oil solenoid</td>
<td>Blue</td>
</tr>
<tr>
<td>24</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Ignition, cylinder 1</td>
<td>Orange/Blue</td>
</tr>
</tbody>
</table>

### EMM J2 Connector

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description of Circuit</th>
<th>Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stator winding, 1S</td>
<td>Yellow</td>
</tr>
<tr>
<td>2</td>
<td>Stator winding, 2S</td>
<td>Brown</td>
</tr>
<tr>
<td>3</td>
<td>Stator winding, 3S</td>
<td>Orange</td>
</tr>
<tr>
<td>4</td>
<td>Fuel pump control</td>
<td>Brown</td>
</tr>
<tr>
<td>5</td>
<td>System Ground</td>
<td>Black</td>
</tr>
<tr>
<td>6</td>
<td>+12 V out</td>
<td>Red</td>
</tr>
<tr>
<td>7</td>
<td>System Ground</td>
<td>Black</td>
</tr>
<tr>
<td>8</td>
<td>System Ground</td>
<td>Black</td>
</tr>
<tr>
<td>9</td>
<td>Stator winding, 1F</td>
<td>Yellow/White</td>
</tr>
<tr>
<td>10</td>
<td>Stator winding, 2F</td>
<td>Brown/White</td>
</tr>
<tr>
<td>11</td>
<td>Stator winding, 3F</td>
<td>Orange/White</td>
</tr>
<tr>
<td>12</td>
<td>Fuel pump (flyback)</td>
<td>White/Red</td>
</tr>
<tr>
<td>13</td>
<td>+55 V, out</td>
<td>White/Red</td>
</tr>
<tr>
<td>14</td>
<td>+12 V out</td>
<td>Red</td>
</tr>
<tr>
<td>15</td>
<td>vacant</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>vacant</td>
<td></td>
</tr>
</tbody>
</table>
GROUND CIRCUITS

All ground circuits are essential to reliable outboard performance. Make sure all ground connections are clean and tight. Refer to wiring diagrams for specific wiring details.

**EMM Ground Tests**

Disconnect the battery cables at the battery.

Use an ohmmeter to check continuity of ground circuits. Calibrate the ohmmeter on the high ohms scale. Resistance readings for all ground circuits should be 0 Ω.

- System/power supply grounds: Check continuity between terminal pins 5, 7, and 8 of EMM J2 connector and the main harness ground.
- Injector circuit grounds: Check continuity between terminal pins 14, 20, and 21 of the EMM J1-B connector and the main harness ground.
- Sensor circuit grounds: Check continuity between terminal pins 26 and 27 of the EMM J1-A connector and the appropriate sensor ground connections. Refer to wiring diagrams.

**Additional Ground Tests**

Check connections and continuity at the following locations:

- Starter solenoid terminal B and main harness ground.
- Trim and Tilt module ground at main harness ground.
- CPS connector pin 3 and main harness ground.

**FUSE**

The engine harness 12 V (B+) circuit is protected by one automotive style 10 amp minifuse.

The fuse is located on the port side of the powerhead, in the flywheel cover.

**IMPORTANT:** Repeat failures of fuse could be the result of faulty connections or accessories. The 12 V accessory circuit (purple wire from terminal “A” of key switch) is often used to power accessories.
SENSOR 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 EMM.

IMPORTANT: Use Evinrude Diagnostics software to monitor sensor circuit voltages or values.

Crankshaft Position Sensor (CPS) Test

Use the Evinrude Diagnostics software CPS Sync and engine RPM displays to confirm a valid CPS signal while the outboard is cranking or running. An RPM display higher than zero indicates a CPS signal to the EMM.

Remove the electrical connector from the crankshaft position sensor.

Use a digital multimeter to measure sensor resistance between the yellow and white wires. The complete circuit can be tested by measuring between pins 6 and 7 of the EMM J1-A connector.

<table>
<thead>
<tr>
<th>Sensor Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>560 Ω ± 10% @ 77°F (25°C)</td>
</tr>
</tbody>
</table>

Sensor Resistance between “A” and “B”

> 3000 Ω @ 77°F (25°C)

Sensor Resistance between “A” and “C”

> 4000 Ω @ 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).

Throttle Position Sensor (TPS) Test

Use Evinrude Diagnostics software to monitor TPS voltage while the outboard is running. Voltage should change evenly as sensor lever is moved.

Remove the electrical connector from the throttle position sensor.

Use a digital multimeter to measure sensor resistance.

1. CPS Connector 002286

1. CPS gap 006527

1. TPS 002289
Connect red meter lead to terminal “A” and black meter lead to terminal “C.” Rotate the sensor lever through its range of travel. Resistance reading must change evenly as the sensor lever is moved.

Connect red meter lead on terminal “B” and black meter lead to terminal “C.” Rotate the sensor lever. Resistance reading must change evenly as the sensor lever is moved.

**Engine Temperature Sensor Test**
Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter to measure sensor resistance.

<table>
<thead>
<tr>
<th>Sensor Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000 to 11000 Ω @ 77°F (25°C)</td>
</tr>
</tbody>
</table>

**Air Temperature Sensor (AT) Test**
Remove the electrical connector from the air temperature sensor.

Use a digital multimeter to measure sensor resistance.

<table>
<thead>
<tr>
<th>Sensor Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000 to 11000 Ω @ 77°F (25°C)</td>
</tr>
</tbody>
</table>

1. Engine temperature sensor

1. AT sensor
ELECTRICAL AND IGNITION
STATOR TESTS

STATOR TESTS

The stator consists of 3 windings (4 poles each) on a 5 inch diameter core and generates an output voltage of 55 VAC (1100 watts maximum). This voltage is converted by the EMM to provide 12 VDC for battery charging (3 to 5 A at 500 RPM and 25 A from 3000 RPM to WOT) and 55 VDC for fuel injector, and fuel and oil pump operation.

Stator Resistance Tests

Use a digital multimeter to check resistance of stator windings.

Disconnect EMM J2 connector from EMM.

To check for a grounded winding, connect one meter lead to ground and alternately connect the other meter lead to each stator wire. Meter should read no continuity. If meter reads continuity, replace stator.

Stator Voltage Output Test

Use a digital multimeter to check stator output voltage. Set meter to read 110 VAC output.

**WARNING**

To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Disconnect CPS.

Connect meter leads to terminals of adaptor tool.

With a fully charged battery, crank outboard (300 RPM minimum) and observe meter reading:

- 30 VAC at 300 RPM
- 40 VAC at 400 RPM
- 55 VAC above 500 RPM

**IMPORTANT:** Rope start models can be tested using a Peak Reading Voltmeter, set to the 50 VAC scale. Remove spark plugs and rotate fly-wheel with the starter rope, using a lone, steady pull. Voltage should be approximately 30 VAC.

### Stator Winding Resistance Specification

<table>
<thead>
<tr>
<th>Color Combination</th>
<th>Resistance Range</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow &amp; Yellow / white</td>
<td>0.670 ± 0.020 Ω</td>
<td>73°F (23°C)</td>
</tr>
<tr>
<td>Brown &amp; Brown / white</td>
<td>0.670 ± 0.020 Ω</td>
<td>73°F (23°C)</td>
</tr>
<tr>
<td>Orange &amp; Orange / white</td>
<td>0.670 ± 0.020 Ω</td>
<td>73°F (23°C)</td>
</tr>
</tbody>
</table>

**IMPORTANT:** A reading of less than 2 ohms is acceptable. Make sure meter is calibrated to read 1 ohm or less.
CHARGING SYSTEM TESTS

12 V Charging Circuit

To test the operation of the regulator in the EMM, you must be able to run the outboard continuously at approximately 5000 RPM, such as in a test tank or on a marine dynamometer.

The test consists of monitoring the system’s response to a partially discharged battery. Use a variable load tester to discharge the battery.

IMPORTANT: The regulator requires battery voltage on the red wire to operate. Before proceeding, make sure there is battery voltage on the connector red wire when key is ON.

Disconnect the battery cables at the battery.

Use an inductive amp meter or connect a 0 to 50 A ammeter in series between the red wire of engine wire harness (alternator output from EMM) and the positive (B+) battery cable terminal of starter solenoid.

Fluke† model 334 or 336, Snap-On† model MT110 or EETA501, and various other amp meters should be available through local tool suppliers.

Reconnect the battery cables.

Following the manufacturer’s directions, connect the variable load tester (carbon pile) across the battery terminals. Stevens model LB-85 and Snap-On model MT540D are examples of testers available.

WARNING

Excessive battery discharge rates might overheat battery causing electrolyte gassing. This might create an explosive atmosphere. Always work in a well ventilated area.

Variable Load Test Diagram

1. Red wire (alternator output from EMM)
2. Starter solenoid
3. Battery cable terminal (B+)
4. Variable load tester
5. Ammeter

Battery Charging Graph

1. Current (A) @ 11 V
2. Engine Speed (RPM)
ELECTRICAL AND IGNITION
CHARGING SYSTEM TESTS

Start and run the outboard at approximately 5000 RPM. Use the variable load tester to draw the battery down at a rate equivalent to the stator’s full output.
• The ammeter should indicate nearly full output, Approximately 25 A @ 5000 RPM.

Decrease the battery load toward 0 A.
• Ammeter should show a reduced output. As the current draw decreases, the battery voltage should stabilize at approximately 14.5 V.
• If results vary, check stator BEFORE replacing the EMM. Refer to STATOR TESTS on p. 126.

55 V Alternator Circuit
Check battery ground cable for continuity.

With the key switch ON, check battery voltage at battery (12 V), then check voltage on white/red wires at J2 connector of EMM. Use Electrical Test Probe Kit, P/N 342677 and a multimeter set to read 55 VDC. Voltage at EMM connector should be 0.5 to 1 V less than battery.

With outboard running at 1000 RPM, voltage on white/red wires should increase to 55 V.

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

If there is any other reading, refer to STATOR TESTS on p. 126. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or EMM.
1. Marine battery
2. RED wire (POS)
3. BLACK wire (NEG)
4. Starter solenoid
5. Fuse (10 amp)
6. RED/PURPLE wire
7. 6-pin connectors
8. Ignition switch
9. PURPLE wire (switched B+)  
10. 26-pin J1-B EMM connector
11. 34-pin J1-A EMM connector
12. Engine Management Module (EMM)
13. YELLOW/RED wire, start
14. BLACK wire, start signal ground
15. Neutral Safety Switch (remote control)
16. RED starter motor cable
17. Electric starter motor
**Start Circuit Operation**

The starter must engage and turn the flywheel. The outboard must crank a minimum of 300 RPM to start.

Starter performance depends on the following:
- Proper battery and cable capacity.
- Clean, tight cable connections.
- Solenoid activation through the key switch and neutral safety switch.

Refer to **Battery Installation** on p. 27 for battery, terminal, and cable requirements.

**Solenoid Wiring**

The positive (B+) battery cable connects to a large terminal of the starter solenoid. This terminal also provides the 12 V power supply to the engine harness (red wire) and the 10 A fuse. The red/purple wire from the fuse holder (10 A) provides 12 V to terminal “B” of key switch.

The negative (B–) battery cable connects to the main ground stud on the starter housing.

**Engine Wire Harness**

Contains the following circuits:
- Red/purple output wire from fuse provides 12 V to instrument harness.
- Purple wire provides switched 12 V to **EMM**.
- Yellow/red wire provides switched 12 V to solenoid (terminal “A”).
- Black wire provides ground (NEG) to starter solenoid (terminal “B”).

**Instrument Wire Harness**

Contains the following circuits:
- Red/purple wire provides 12 V to key switch terminal “B”.
- Purple wire provides switched 12 V to engine wire harness.
- Yellow/red wire from terminal “S” of key switch provides switched 12 V to solenoid (terminal “A”) (key switch in START position).

**Key Switch, ON position**

12 V is applied to the accessory circuit. Key switch ON:
- Switches 12 V to terminal “A” of key switch and to the purple wires of the wire harnesses.
- Provides 12 V input to terminal 28 of **EMM** J1-B connector. **EMM** turns ON.

*Diagram:

1. Key switch, ON position – Continuity between terminals “B” and “A”
2. Terminal “B”, 12 V (Red/purple)
3. Terminal “A”, 12 V (Purple)
Key Switch, START Position

Key switch START:
• Switches 12 V to terminal “S” of key switch and to the neutral safety switch (in remote control).
• A closed neutral safety switch provides 12 V to the engine wire harness yellow/red wire and solenoid (terminal “A”).

ELECTRIC START TESTS

Starter Solenoid Test

Disconnect the B+ (POS) battery cable at the battery.

IMPORTANT: Disconnect all wiring from solenoid terminals before proceeding with this test.

Use a digital multimeter to measure resistance.

Put one meter lead on the starter positive (+) cable terminal and the other lead on the battery positive (+) cable terminal:
• Meter must not show continuity (high reading).
• If meter shows continuity (low reading), replace the solenoid.

Apply B+ to terminal “A” of solenoid and ground (NEG) to terminal “B” of solenoid. Measure resistance between the starter positive (+) cable terminal and the positive battery (+) cable terminal.
• The solenoid must close with an audible click.
• Meter must show continuity (low reading).
• If meter shows no continuity (high reading), replace the solenoid.
ELECTRICAL AND IGNITION
ELECTRIC START TESTS

After re-installing the solenoid, coat all wires and terminals with Black Neoprene Dip.

No Load Current Draw Test
Securely fasten starter in a vise or suitable fixture before proceeding with this check.

Use a battery rated at 500 CCA (60 amp-hr) or higher that is in good condition and fully charged.

Use an inductive ammeter or connect a 0 to 100 amp ammeter in series with a heavy jumper between the battery positive (+) terminal and the starter positive (+) terminal.

Fluke model 334 or 336, Snap-On model MT110 or EETA501, and various other ammeters should be available through local tool suppliers.

Attach or hold a vibration tachometer, such as a Frahm† Reed tachometer, to the starter.

Complete the circuit with a heavy jumper between the battery negative (−) terminal and the starter frame.

Monitor the starter RPM and current draw.
• At 10,500 RPM the ammeter should show a maximum of 30 A.
REMOTE CONTROL SWITCH TESTS

Key Switch Test
Refer to Wiring Diagrams at back of manual.

Use an ohmmeter or a continuity light to test key switch operation. Replace switch if results are incorrect with any of the following tests.

**IMPORTANT:** Disconnect battery and key switch wiring before proceeding with the following tests.

Stop/Ground Terminals (M) – Connect meter between the two “M” terminals. Meter must indicate NO continuity at START or ON.

Turn key switch OFF. Meter must indicate continuity.

Accessory Terminal (A) – Make sure the key switch is OFF. Connect the ohmmeter or continuity light between terminals “B” (battery) and “A” (accessory) of key switch. Meter must indicate NO continuity.

Turn switch ON. Meter must indicate continuity.

Turn key switch to START. Meter must continue to indicate continuity.

**IMPORTANT:** The choke function or terminal “C” of the key switch is NOT used.

Neutral Start Circuit Test
Use an ohmmeter or continuity light to test the continuity of the circuit while positioning the remote control in NEUTRAL, FORWARD, and REVERSE.

**IMPORTANT:** Turn propeller shaft or disconnect shift cable to allow proper remote control shift action while outboard is not running. Disconnect the instrument harness connector from the key switch harness connector.

Make sure the remote control handle is in NEUTRAL. Connect meter between terminal 5 (red/purple wire) and terminal 2 (yellow/red wire). Turn the key switch to START. Meter must indicate continuity.

Move the remote control handle to FORWARD and turn the key switch to START. Meter must NOT indicate continuity.

Move the remote control handle to REVERSE and turn the key switch to START. Meter must NOT indicate continuity.

**IMPORTANT:** Reconnect shift cable and instrument harness connector to key switch harness connector.

![Wiring Diagram](image)
Neutral Start Switch Test

Use an ohmmeter or a continuity light to test neutral start switch operation.

**IMPORTANT:** All wiring must be disconnected from the switch before proceeding with this test.

Disassemble the remote control and remove the neutral start switch.

Connect one meter lead to each terminal of the switch.
- Meter must indicate continuity when the plunger is depressed
- Meter must indicate no continuity when the plunger is released.

Replace switch if results are incorrect.

---

Emergency Stop Switch Test

This switch can be part of the key switch or installed as a separate switch. Either style 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).

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.
The tilt and trim switch provides B+ input to green/white or blue/white wire of the TNT module.

**Operation**

The relay activates when B+ input from the switch is supplied to terminal 86 of the internal relays.

Terminal 87a connects to ground (B–).

Terminal 87 connects to B+.

Terminal 30 connects TNT motor.

Terminals 87a and 30 are connected when relay is not activated. This supplies ground (B–) connection to TNT motor.

Terminals 87 and 30 are considered “normally open.” B+ is applied to terminal 30 when relay is activated. This supplies ground B+ connection to TNT motor.

Refer to **Tilt and Trim Module Diagram**.

---

**Test Procedure**

Make sure red and black wires are connected to 12 V battery power supply.

Set voltmeter to 12 VDC scale. Connect test leads to terminals “A” and “B” of TNT motor connector.

Use a wire jumper to alternately connect B+ to terminals “1” and “2” of tilt and trim switch connector.

The meter must indicate battery voltage (12 V) with B+ connected to either terminal.

---

**Tilt and Trim Module Diagram**

1. **Green/white wire**
2. **Blue/white wire**
3. **B+, red wire**
4. **B–, black wire**
5. **TNT motor connector**
6. **TNT switch connector**
EXHAUST WATER VALVE TEST

Disconnect electrical connector from water valve solenoid. Use an ohmmeter to measure solenoid resistance.

1. Water valve electrical connector

SystemCheck CIRCUIT TESTS

Make sure the SystemCheck engine monitor can warn the operator during a “NO OIL,” “WATER TEMP” or “HOT,” “CHECK ENGINE,” or “LOW OIL” condition. Check the condition of the warning system and associated wiring and connections. Test the engine monitor regularly and anytime you suspect an alert situation has been missed.

The instrument harness must be connected to the outboard before performing the following tests. Refer to the Engine Wiring diagram and the MWS Instrument Wiring diagram in the back of this manual.

IMPORTANT: Use jumper wires made with the appropriate terminals to test the warning circuits.

Gauge Self-Test Check

Turn the key switch to ON with the outboard NOT running. The gauge warning lights for NO OIL, WATER TEMP, CHECK ENGINE, and LOW OIL must all light at once, then turn off in sequence, and the warning horn must sound for one-half second.

If the gauge lights do not turn on, turn the key switch OFF. Disconnect the gauge 8-pin connector from the back of the gauge and turn the key switch ON. Test for battery voltage between...
instrument harness terminal 1 (purple wire) and terminal 2 (black wire).

- If battery voltage is present, replace the gauge.
- If there is no battery voltage, check that 12 V is present at terminal “B” of the key switch. Check condition of the instrument harness, key switch, and connections.

If the lights worked, but the warning horn did not sound for one-half second, turn the key switch OFF. Disconnect the warning horn 2-pin connector. Substitute a known good warning horn. Turn the key switch ON.
- If the substitute horn beeps, the original horn is defective and must be replaced.
- If the substitute horn does not beep, check for battery voltage between instrument harness 2-pin connector, terminal 2 (purple wire) and ground with the key switch ON. Also, check the tan/blue wire for continuity between pin 8 of the 8-pin connector and pin 1 of the 2-pin connector.
- If battery voltage is present at the purple wire and the tan/blue wire has continuity between the two connectors, replace SystemCheck gauge.

CHECK ENGINE Circuit Test
Separate the 6-pin SystemCheck connector of MWS instrument harness from engine harness. Black wire (pin 3) must be grounded.

Using a jumper wire, connect tan/orange wire (pin 2) to a clean engine ground.

Turn the key switch ON. After the normal self-test sequence, the CHECK ENGINE light should stay on.
- If the CHECK ENGINE light is not on, test circuit for continuity. Check continuity of the MWS instrument harness (tan/orange wire).
- Check continuity of the engine wire harness between terminal 2 (tan/orange wire) of the SystemCheck connector and pin 17 of the EMM J1-A connector.

Turn the key switch OFF and reconnect all disconnected circuits.
WATER TEMP/ HOT Circuit Test

The tan wire of engine harness and the MWS harness receives a signal from the EMM. The EMM receives information from the temperature sensor on the cylinder head.

Using a jumper wire, connect tan wire (pin 6) of the engine harness connector to a clean engine ground.

Turn the key switch ON. After the normal self-test sequence, the gauge WATER TEMP / HOT indicator should stay on.

- If LED is not on, test circuit for continuity. Test for continuity of both the engine harness (tan wire) and the MWS instrument harness (tan wire).

Turn the key switch OFF and reconnect all disconnected circuits.

IMPORTANT: To test the temperature sensor itself, refer to Engine Temperature Sensor Test on p. 125.

LOW OIL Circuit Test

Turn the key switch ON. Using a jumper wire, connect tan/black wire (pin 4) of the engine harness connector to a clean engine ground. The LOW OIL light should turn on after 40 seconds.

If the LOW OIL light does not turn on after connecting the terminal to ground, test circuit for continuity.

Turn the key switch OFF and reconnect all disconnected circuits.

NO OIL Circuit

Separate the 6-pin SystemCheck connector of MWS instrument harness from engine harness. Black wire (pin 3) must be grounded.

Using a jumper wire, connect tan/yellow wire (pin 5) to a clean engine ground.

Turn the key switch ON. After the normal self-test sequence, the NO OIL light should stay on.

- If the NO OIL light is not on, test circuit for continuity. Test for continuity of the MWS instrument harness (tan/yellow wire).
- Test for continuity of the engine wire harness between terminal 5 (tan/yellow wire) of the SystemCheck connector and pin 24 of the EMM J1-A connector.

Turn the key switch OFF and reconnect all disconnected circuits.
TACHOMETER CIRCUIT TESTS

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

![Diagram of tachometer circuit](image)

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

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 next step.
- If meter shows less than battery voltage, check the purple, red/purple, and black wiring circuits; fuse, key switch, and battery connections.

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.

FLYWHEEL AND STATOR SERVICING

IMPORTANT: Weak flywheel magnets can cause low alternator output and affect outboard performance. Weak flywheel magnets can also cause low readings on ignition test equipment, such as a peak-reading voltmeter, which might cause unnecessary parts replacement.

An accurate test of alternator output can help determine the flywheel’s condition. Refer to CHARGING SYSTEM TESTS on p. 127.

Flywheel Removal

**WARNING**

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

Remove the recoil starter assembly (rope start models). Refer to RECOIL STARTER REMOVAL on p. 311.

Remove the electrical cover from flywheel cover.
**ELECTRICAL AND IGNITION**

**FLYWHEEL AND STATOR SERVICING**

Disconnect wiring harness and remove wiring from cover.

1. MWS harness

Remove fuse holder from flywheel cover.

1. Fuse holder

Lift flywheel cover to remove.

Use Flywheel Holder, P/N 771311, or equivalent, and a 1 5/16 in. socket to remove flywheel nut. Discard flywheel nut.

Apply *Moly Lube* grease to the threads of the puller pressing screw, P/N 307637, and the center hole of the crankshaft.

Assemble the following components from Universal Puller Set, P/N 378103:
- Body, P/N 307636
- Screw, P/N 307637
- Handle, P/N 307638
- Three screws P/N 309492
- Three washers, P/N 307640

Put the puller on flywheel with body flat side up. Attach the puller body with the three shoulder screws and washers. Hold puller body with handle, and tighten pressing screw until flywheel releases. Turn the center screw and lift the flywheel off of the crankshaft.
Stator Service

Disconnect stator harness connector.

Remove three allen head screws to remove stator.

To install stator, position stator on cylinder block. Apply Nut Lock to screw threads. Install screws and tighten in crossing pattern to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).

Flywheel Installation

Install the outer edge of flywheel key parallel with centerline of crankshaft.

Thoroughly clean the crankshaft and flywheel tapers with Cleaning Solvent™ and let dry.

Align the flywheel keyway and install flywheel. Coat the threads of a new flywheel nut with Triple-Guard grease. Install the washer and nut and tighten to a torque of 100 to 115 ft. lbs. (136 to 156 N·m).

Replace flywheel cover and recoil starter (rope start models).

IMPORTANT: Check ignition timing after flywheel removal or replacement. Refer to TIMING ADJUSTMENTS on p. 142.
TIMING ADJUSTMENTS

Timing Pointer

The timing pointer must be adjusted to indicate top dead center (TDC) of the number 1 piston. This reference to the position of the number 1 piston is used to synchronize the electronic timing controlled by the EMM with the mechanical position of the number 1 piston.

Use Evinrude Diagnostics software to verify and adjust timing. Refer to the software’s help system for outboard timing verification procedures.

---

**WARNING**

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

---

Remove spark plugs. Rotate the flywheel clockwise to 30° ATDC.

Install Piston Stop Tool, P/N 342679, into the spark plug hole of the number 1 cylinder.

Rotate flywheel counterclockwise until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly against the tool. Mark the flywheel directly across from the pointer. Label this mark “A.”

Rotate the flywheel clockwise until the piston contacts the tool. Mark the flywheel directly across from the pointer. Label this mark “B.” Rotate flywheel counterclockwise slightly to release tool then remove it from spark plug hole.

Use a flexible measuring device to find the exact center between marks “A” and “B.” Measure along the edge of the flywheel. Mark and label the center point “C.” If mark “C” and the cast-in TDC boss on flywheel are in alignment, the timing pointer is in the correct location.

If the pointer alignment is NOT correct, rotate the flywheel clockwise to align the mark “C” with the pointer. Hold the flywheel in this position. Loosen the pointer retaining screw and adjust the pointer location to align with the cast-in TDC boss on the flywheel. Tighten retaining screw.
Repeat the entire adjustment process to make sure pointer is aligned correctly.

Install spark plugs. Refer to Spark Plug Indexing on p. 76.

**Timing Verification**

Use *Evinrude Diagnostics* software to synchronize the mechanical timing of the outboard with the electronic timing of the *EMM*.

Check ignition timing 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 making any timing adjustments.

### TPS Calibration

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

Remove the air silencer.

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

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.

Set TPS Calibration after replacing or adjusting any throttle body or throttle linkage parts.
ELECTRIC STARTER SERVICING

Starter Removal

IMPORTANT: Do not clean the starter drive while the starter motor and drive are installed on the powerhead. The cleaning agent could drain into the starter motor, washing dirt from the drive into the starter bearings and commutator.

Disconnect the battery cables at the battery.

Remove lower motor covers and air silencer. Refer to Lower Cover Removal on p. 82.

Remove the starter positive (+) cable from post on starter. Remove the battery negative cable (−) from the double-ended stud.

Remove two starter mounting screws and double-ended stud. Remove the starter.

Starter Disassembly

Remove the retaining ring, spacers, spring and starter pinion from pinion shaft.

Mark the end cap and brush holder cap orientation. Remove the two thru-bolts.

Remove the end cap and thrust washer.
Remove brush holder cap from armature and frame assembly. Do not lose the brush springs.

Slowly, remove the armature from frame.

**Starter Cleaning and Inspection**

Inspect the brushes for wear and damage. Replace brushes if damaged or worn. Replace weak brush springs.

Clean the commutator with 300-grade emery cloth. If commutator surface is unevenly worn or pitted, turn it on a lathe. Remove any trace of oil or metal dust from commutator.

Check the armature on a growler for shorted turns using a test light or meter. Inspect armature insulation for indications of overheating or damaged windings. Clean off any carbon deposits or foreign matter which could contribute to failure of windings.

Check permanent magnets and make sure they strongly attract any steel or iron object held inside frame. Weak magnetism could cause excessive RPM on No Load Current Draw Test on p. 132.

After disassembling the drive, clean each part with Cleaning Solvent and inspect for wear and distortion.
If the pinion does not properly engage the flywheel, the pinion and screw shaft assembly could be worn, distorted, or dirty. Locate the cause of binding and correct it before completing the assembly.

Inspect and replace end cap thrust washer if distorted or worn excessively.

**Starter Assembly**

**IMPORTANT:** If removed, apply *Locquic Primer* and *Screw Lock™* to the brush card screws before installing.

Place armature in frame.

Apply *Moly Lube* to the armature bushing.

Route the brush leads and install the springs and brushes.

**IMPORTANT:** Incorrect orientation of the brushes could damage the starter or cause reverse rotation.

Compress the brushes and springs with a modified putty knife.

Align and place brush holder cap firmly on armature and slide putty knife out, making sure the brushes are retained properly.

Install thrust washer. Align and place end cap onto armature shaft.
Apply Locquic Primer and Screw Lock to the threaded portion, and install the two thru-bolts. Tighten bolts to a torque of 100 to 110 in. lbs. (11 to 12.5 N·m).

Lubricate the splines (helix) of starter pinion shaft with Starter Bendix Lube. DO NOT use liquid or aerosol spray lubricants.

Install pinion, spacer and spring.

Install spacer and retaining clip. Spacer must be raised to cover clip completely.

To test the assembly and operation of the starter, refer to No Load Current Draw Test on p. 132.
Starter Installation
Apply Triple-Guard grease to the threads of the two starter screws, the double-ended stud, and also to the washers.

Position the starter and install the screws and washers. Tighten screws to a torque of 168 to 192 in. lbs. (19 to 21 N·m).

Attach starter positive (+) cable to post with lock washer and nut; tighten securely.

Install the battery negative cable (−) to the double-ended stud.

Coat connections with Black Neoprene Dip.

CONNECTOR SERVICING

DEUTSCH Connectors

IMPORTANT: Electrical Grease is recommended. Incorrect grease application can cause electrical or warning system problems.

To disconnect the connector, press the latch and pull the connectors apart.

To connect the connector, confirm that the seal is in place. Clean off any old grease and dirt from connectors. Apply a light coat of Electrical Grease to seal. Push connectors together until latched.

Terminal Removal
Use hook-end of Connector Service Tool, P/N 342667, to pull out wedge from receptacle, or use other end of tool to pry out wedge from plug. Use needle-nose pliers to remove wedge from 3-pin receptacle.
Release terminal latch and gently pull on wire.

1. Terminal latch (plug)
2. Terminal latch (receptacle)

**Terminal Installation**
Push terminal through seal until it locks into place. Fill connector with *Electrical Grease* to 1/32 in. (0.8 mm) below ledge or end of plug.

1. Ledge of plug
2. End of plug

Push wedge in until latched. Wedge in 2-pin receptacle is not symmetrical; position latch shoulders next to terminals.

**Crimping Terminals**

1. End of wire strands
2. Insulation crimp area
3. End of insulation
4. Wire crimp area

**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† 1.5**

**Disconnect**
Lift latch. Pull connectors apart.

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

**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
ELECTRICAL AND IGNITION
CONNECTOR SERVICING

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

Crimping Terminals
Crimping Superseal 1.5 terminals requires the PRO-CRIMPER II † 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.

Super Seal†
The J1-A and J1-B connectors of the EMM are AMP Super Seal connectors.

Disconnect
Depress BOTH latches and pull connector from plug.

Connect
Push connector into plug until latches engage.

Terminal Removal
Open lock mechanism and remove terminal from connector housing.

Terminal Installation
Push terminal through seal until it is seated in connector housing. Close lock mechanism.
**POWER TIMER† SERIES**
The J2 connector of the EMM is a *AMP Power Timer Series* connector.

**Disconnect**
Use a screw driver to open latch. Pull connector from plug.

**Connect**
Push connector until seated in plug. Close latch completely.

---

**Terminal Removal**
Use Terminal Release Tool, P/N 351413, to release BOTH locking mechanisms of connector. Pull terminal from housing.

**Terminal Installation**
Align terminal with connector housing and push terminal with seal into connector housing until seated.

---

**Packard† Connectors**

**IMPORTANT:** Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

**Disconnect**
Lift latch(s). Remove connector.

**Connect**
Confirm the seal is in place. Push connector onto housing until latched.
Terminal Removal
A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place. The terminal is removed by pushing wire and terminal through connector housing.

Insert a thin wire, such as a paper clip, into the connector above the terminal to release tab.

Terminal Installation
Install wire gasket on wires and feed wires through the correct terminal position of the connector housing. Terminal is crimped onto wire and then pulled back into connector housing until locking tab engages and terminal is seated.

Crimping Terminals
Strip insulation back 3/16 in. (5 mm). Position end of wire strands in terminal past the wire crimp area and the end of insulation in the insulation crimp area of the terminal.

Capture all wire strands in crimp; leave no loose strands. Crimp wire and insulation securely using crimping pliers.
FUEL SYSTEM

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FUEL SYSTEM
SERVICE CHART

SERVICE CHART

INJECTORS, VAPOR SEPARATOR, FUEL PUMP

Tighten in 3 stages

1. 5 ft. lbs. (7 N·m)
2. 10 ft. lbs. (14 N·m)
3. 24-26 Ft. lbs. (33-35 N·m)

A Triple-Guard Grease
B Gasket Sealing Compound
C Adhesive 847
E Red Ultra Lock
F Blue Nut Lock
H Outboard Engine Lubricant
S STP Oil Treatment
REED PLATE ASSEMBLY AND THROTTLE BODY

25-35 in. lbs (2.8-3.5 n·m)
60-120 in. lbs (7-14 n·m)
10-14 in. lbs (1.1-1.6 n·m)
60-120 in. lbs (7-14 n·m)

Important: DO NOT lubricate TPS to throttle shaft surface

| A | Triple-Guard Grease |
| B | Gasket Sealing Compound |
| C | Adhesive 847 |
| D | Moly Lube |
| E | Red Ultra Lock |
| F | Blue Nut Lock |
| G | Needle Bearing Grease |
1. Fuel supply from boat fuel system
2. Fuel lift pump (2 to 8 psi)
3. Pulse hose from cylinder/crankcase
4. Fuel filter
5. Fuel supply to vapor separator
6. Vapor separator
7. Electric fuel circulation pump (20 to 30 psi)
8. Fuel supply manifold
9. Fuel injector(s)
10. Fuel return manifold
11. Vent hose to intake manifold
12. Pressure regulator (high pressure)
1. Stator
2. EMM
3. Fuel injector
4. Fuel circulation pump
5. Capacitor
6. WHITE/RED (55 V)
7. BLACK ground wires
8. BLUE
9. GREEN
10. BROWN
FUEL SYSTEM
COMPONENTS

COMPONENTS

The fuel system includes the following components:
• Fuel Lift Pump
• Fuel Filter
• Vapor Separator
• Fuel Circulation Pump
• Fuel Supply Manifolds
• Fuel Injectors
• Fuel Return Manifolds

Fuel Lift Pump
The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by a pulse hose that connects to the cylinder/crankcase assembly.

Fuel lift pump pulse hose location:
• Number 2 cylinder

Vacuum from the fuel lift pump pulls fuel from the fuel tank. Once fuel reaches the pump, internal pump pressure forces the fuel from the pump through the fuel filter and into the vapor separator.

Fuel Filter
The fuel filter protects the vapor separator and the high-pressure components of the fuel system from contaminants. Refer to INSPECTION AND MAINTENANCE SCHEDULE on p. 66 for service frequency.

Vapor Separator
The vapor separator:
• Serves as a water-cooled fuel reservoir to accumulate incoming fuel from the fuel lift pump and from the fuel return manifold.
• Contains a float controlling the venting of fuel vapors.
• Contains a fuel pressure regulator for the high pressure fuel system.

The vapor separator is serviced as an assembly and includes the fuel circulation pump.
Fuel Reservoir
The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Cooling
Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically. Refer to HOSE ROUTING AND WATER FLOW DIAGRAMS on p. 190.

Venting
The fuel vapor vent regulates fuel vapor pressure in the reservoir. As the vapor pressure in the vapor separator decreases, the fuel level begins to increase. An increase in the fuel level raises the float valve and the vent closes.

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.

Fuel Supply
The pump is mounted to the vapor separator and draws fuel from the fuel chamber. It pumps pressurized fuel through a fuel supply manifold connected to the fuel injectors.

Electrical Circuit
The circulation pump is controlled by the EMM and operates on the 55 V circuit. The outboard must be cranking or running (CPS input to EMM) for the circulation pump to be activated. The EMM controls pump operation by rapidly connecting and disconnecting the pump’s internal coil to ground.
FUEL SYSTEM
COMPONENTS

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.

Fuel Injectors
Fuel injectors are fuel metering, electric solenoids (55 V) bolted directly to the cylinder head. The EMM controls the activation of each injector by rapidly connecting and disconnecting the injector’s internal coil to ground.

Fuel Flow Compensation
The flow rate of each injector is measured as part of the manufacturing process. This information is recorded and assigned to the injector by serial number.

Then, the EMM is programmed to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the EMM. DO NOT install an injector without updating the compensation software.

Each service injector includes its fuel flow information on a 3.5 in. floppy disk. This software allows the EMM to be reprogrammed for this injector’s unique fuel flow characteristics.

IMPORTANT: Fuel injectors MUST NOT be moved from one cylinder to another. EMM programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply
Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply manifold.

Each injector has internal fuel passages. These passages are designed to:
• Provide fuel to the injector’s injection chamber
• Route fuel through the injector housing to cool the injector coil and armature
FUEL SYSTEM TESTS

WARNING
Use caution when working on any pressurized fuel system. Wear safety glasses and work in a well ventilated area. Extinguish all smoking materials and make certain no open flames or ignition sources exist. Before starting any fuel system service, carefully relieve fuel system pressure. Failure to properly relieve fuel system pressure can result in spraying fuel and/or excessive fuel spillage during servicing. Fuel is flammable and can be explosive under certain conditions.

Fuel System Pressure Test
Relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 166.

WARNING
Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.

After relieving fuel system pressure, install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, to the upper fuel pressure test fitting.

START outboard and check pressure. System pressure should be 20 to 35 psi (138 to 241 kPa).

Shut OFF outboard. Monitor pressure gauge. Pressure should not drop below 15 psi (103 kPa).

IMPORTANT: If outboard does not run, prime fuel system and crank outboard; check circulation pump operation; check fuel system pressure.

Results:
Normal pressure:
• Observe pressure reading after outboard is shut OFF
• Refer to Lift Pump Pressure Test on p. 163

Pressure drops after outboard is shut OFF:
• Check for leaking fuel injector.
• Check for leaking pressure regulator.
• Check for external fuel system leak.

High pressure:
• Check for restricted filter or fuel return fitting of vapor separator, damaged pressure regulator in vapor separator, or restricted fuel return manifold.

Low pressure:
• Check fuel supply to fuel lift pump. Refer to Lift Pump Vacuum Test on p. 164. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
• Restricted fuel filter/water separator assembly.
• Lift pump not supplying enough fuel to vapor separator. Refer to Lift Pump Pressure Test on p. 163.
• If the above tests are good and vapor separator remains full of fuel, check for damaged circulation pump. Replace vapor separator assembly.

No pressure:
• Check electrical circuit and ground connections for circulation pump.
• If voltage is present and pump does not run, repair connection or replace vapor separator assembly.

Relieve fuel system pressure before removing fuel pressure gauge. Refer to Relieving Fuel System Pressure on p. 166.
FUEL SYSTEM
FUEL SYSTEM TESTS

Pressure Regulator Test
Refer to Vapor Separator Service on p. 168 to remove vapor separator.

Make sure filter is not clogged. Clean or replace as needed.

Apply oil to valve and connect pressure pump and hose to the fuel return fitting of vapor separator.

Apply pressure to check regulator operation. The pressure should open check valve at approximately 15 psi (103 kPa).

Fuel Injector Pressure Test
This test requires Injector Test Fitting kit, P/N 5005844.

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 166.

IMPORTANT: Perform test with injector mounted to cylinder head and fittings installed with manifold retainer.

Use cap and tie strap to seal off outlet fitting. Connect a 0 to 30 psi (0 to 207 kPa) pressure tester to the inlet fitting. Pressurize the injector to 30 psi (207 kPa). Pressure must hold for at least five minutes.

Refer to FUEL DELIVERY TESTS on p. 114 for additional test procedures.

Vapor Separator Vent Check
Monitor the vapor separator vent hose. No fuel or a trace of fuel is acceptable. Excessive fuel discharge indicates a vapor separator vent malfunction. Monitor vent for presence of fuel during testing. Temporarily install clear tubing for monitoring. Replace vapor separator if the venting of fuel is continuous.

1. Filter
2. Fuel return fitting
3. Pressure regulator

WARNING
Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.
Fuel Injector Resistance Test
Disconnect the battery cables at the battery.
Use a digital multimeter to measure the injector coil resistance.

| Fuel Injector Coil Resistance | 2 to 3 Ω @ 72°F (22°C) |

Use a digital multimeter with appropriate adapter leads to measure the injector circuit resistance.

Measure resistance between pin 2 of injector connector and the appropriate pin location of EMM J1-B connector. Refer to engine wiring diagram for specific EMM J1-B connector pin location for the injector circuit being tested.

Circulation Pump Resistance Test
Disconnect the battery cables at the battery.
Use a digital multimeter to measure the fuel pump circuit and coil resistance.

| Fuel Pump Resistance | 3 Ω @ 77°F (25°C) |

Lift Pump Pressure Test
Install a 0 to 15 psi (0 to 103 kPa) Fuel Pressure Gauge, P/N 5006397 or equivalent, to the lower fuel pressure test fitting.

Prime the fuel system and check for leaks. START outboard and run at idle speed. Hold gauge level with inlet fitting and monitor gauge for pressure reading.

Pressure should stabilize at a reading greater than 3 psi (27 kPa).
FUEL SYSTEM
FUEL SYSTEM TESTS

Results:
Normal pressure:
• Perform the Lift Pump Vacuum Test on p. 164. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Low pressure:
• Check pulse hoses and fittings for restrictions.
• Perform the Lift Pump Vacuum Test on p. 164. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.
• Check fuel flow through fuel lift pump. Use fuel primer bulb to force fuel through pump.

No pressure:
• Check pulse hoses and fittings restrictions.
• Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
• Momentarily prime or squeeze primer bulb to check gauge operation.
• Check pulse hose and fittings for restrictions.

Lift Pump Vacuum Test
Confirm fuel supply to the fuel lift pump.

Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet). Secure connections with tie straps to prevent fuel or air leaks.

IMPORTANT: Do not use fuel primer bulb, manual fuel primer, or electric fuel pump primer to restart outboard. A positive pressure in the fuel supply could damage some vacuum gauges.

START outboard and run at FULL THROTTLE for at least two minutes. Monitor clear vinyl hose for the presence of air. Air bubbles indicate a faulty hose, connection, or fuel tank pick-up. Repair, if necessary, before proceeding.

There should be no air or vapor bubbles visible in the clear hose. The maximum inlet fuel vacuum should not exceed 4 in. Hg. (13.5 kPa) at the inlet to the fuel lift pump under any operating conditions (IDLE to WOT).

A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to Fuel System Requirements on p. 32 for fuel supply component requirements.
Lift Pump Diaphragm Test

Perform this test only if a damaged pump is suspected. This test does not confirm the performance of internal fuel pump check valves.

Remove the pulse hose from the crankcase fitting.

Apply 15 psi (103 kPa) to the pulse hose of the pump. Replace lift pump if pump fails to hold pressure.

Anti-Siphon Valve Test

Remove anti-siphon valve from fuel tank. Install adapter fittings and a 36 in. (91.4 cm) length of clear hose to the inlet side (tank end) of valve.

Fill clear hose with water to a height of 20 in. (500 mm). Water must NOT flow through valve. An occasional drip is acceptable. Replace valve if water drips continuously.

Increase height of water to 25 in. (630 mm). Water should flow through valve as water level reaches 25 in. (630 mm). Replace the anti-siphon valve if test results are different.
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 before 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 fuel pump/vapor separator assembly.

Insert venting hose of gauge into a suitable container.

Slowly open gauge’s venting valve.

Clean up any spilled fuel with shop towels.

---

1. Shop towel
2. Venting valve
3. Venting hose

---

1. Test fitting
2. Venting valve
3. Venting hose
**Fuel Filter Service**

**Removal**
Disconnect the battery cables at the battery.

Remove filter carefully to prevent spilling contents.

Inspect contents for any presence of water. If water is present, identify the source and correct the problem. Take additional fuel samples and drain fuel tank(s) if necessary.

**Installation**
Install filter in fuel supply hoses. Note arrow indicating direction of fuel flow on filter. Secure filter with appropriate clamps. Refer to Oetiker Clamp Servicing on p. 36.

Squeeze primer bulb to prime fuel system. Hold pressure on bulb and check for fuel leaks.

Connect battery cables.

Run outboard and check for fuel leaks.

---

**Fuel Lift Pump Service**

The fuel lift pump is serviceable as a complete assembly or can be repaired with a fuel pump repair kit. Refer to parts catalog for service parts.

**Removal**
Disconnect the battery cables at the battery.

Disconnect the fuel hoses from the fuel pump housing.

Disconnect the fuel lift pump pulse hose at the crankcase fitting.

**Installation**
Loosen the fuel lift pump mounting screws. Remove the fuel lift pump as an assembly.

Place fuel pump in position on crankcase. Apply Nut Lock to mounting screws. Tighten screws to a torque of 24 to 36 in. lbs. (2.8 to 4.0 N·m).

Connect the fuel lift pump pulse hose to the crankcase. Secure with tie strap.
Connect the fuel hoses to the fuel filter. Secure with Oetiker clamps.

Squeeze primer bulb to prime fuel system. Hold pressure on bulb and check for fuel leaks.

Connect battery cables.

Run outboard and check for fuel leaks.

**Vapor Separator Service**

**Removal**

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 166.

Disconnect circulation pump electrical connector.

Remove clamp and fuel supply manifold from top of circulation pump. Remove clamp and vapor vent hose from separator cover.

Remove clamps and vapor separator cooling water hoses.

Remove clamps and fuel return manifold and fuel supply hose from bottom of vapor separator.

Remove the vapor separator housing retainer clip.

Remove vapor separator/fuel pump from the mounting stud and slide vapor separator housing from the grooves of the isolator mounts.

**Installation**

Installation is the reverse of removal. Pay close attention when performing the following additional tasks.

Install all hoses and manifolds to original locations and secure with appropriate clamps. Squeeze primer bulb to prime fuel system. Hold pressure on bulb and observe for fuel leaks.

Run outboard and check for fuel leaks.

**Fuel Manifold Service**

**Removal**

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 166.

Remove oil tank assembly. Refer to Oil Tank Assembly on p. 187.

Remove clamps and disconnect the fuel manifolds as follows:
- Fuel supply manifold to circulation pump.
- Fuel return manifold to vapor separator.
Fuel System
Fuel Component Servicing

Remove fuel manifold retainer screws and remove retainers from fuel injectors.

1. Screw

Disconnect fuel manifold fittings from fuel injector ports, then remove the manifold assemblies.

Installation
Check condition of sealing O-rings on fuel manifold fittings. Lubricate O-rings with outboard lubricant and insert fuel manifold fittings into injector. Both fittings must be fully seated into the injector fuel ports.

Install retainer and screw. Retainer must engage the outer groove of the manifold fittings.

Install the fuel manifolds to the fuel pump assembly and secure with clamps:
- Fuel supply manifold to circulation pump.
- Fuel return manifold to vapor separator.

Install oil tank assembly. Refer to Oil Tank Assembly on p. 187.

Fuel Injector Service
Mark fuel injectors to show cylinder locations.

**IMPORTANT:** Fuel injectors must be installed in the correct cylinder locations. Use Evinrude Diagnostics Software to make sure that EMM programming matches injector positioning. The Injector Coefficients screen displays injector serial numbers.

Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel manifolds. Cover the injector nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal
Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 166.

Remove fuel manifolds. Refer to Fuel Manifold Service on p. 168.

Remove the ignition coil assemblies.

Disconnect the fuel injector electrical connector.
FUEL SYSTEM
FUEL COMPONENT SERVICING

Remove injector screws.

Remove fuel injector and insulator.

Crush Ring Replacement

**IMPORTANT:** Injector crush rings must be replaced if injector is installed in a different head or cylinder location.

Use Slide Hammer assembly, P/N 391008, with Slide Hammer Adaptor kit, P/N 390898, to remove injector from mounting cup.

Thread adaptor and stud into face of injector. Hold mounting cup securely. Use slide hammer to separate injector from mount housing.

Remove adaptor from injector. Remove crush ring and O-rings from injector. Inspect and clean injector filter. Install new crush ring and O-rings. Lubricate O-rings with *STP† Oil Treatment.*

Install injector into mount housing. Press on injector face until injector seats in mount housing.
Installation

IMPORTANT: All injectors must be installed in the correct cylinder by serial number. Improper injector installation can result in powerhead failure.

Installation of replacement injectors requires the use of diagnostics software and fuel flow data supplied with all replacement injectors on 3.5 in. floppy disk.

The following items and their mating surfaces must be cleaned prior to reassembly:
- Injector
- Cylinder head
- Adapter
- Screws
- Threaded areas.

![CAUTION]

All injector components must be clean to ensure correct torque tightening specifications. To prevent fuel leakage, carefully follow these installation instructions.

Place injector and insulator in the proper cylinder location.

IMPORTANT: Be careful not to pinch any wiring or hoses during assembly.

Lubricate mounting screw threads and under the head of the screw with a light coat of Triple-Guard grease. Install washers (one per screw) on injector retaining screws. Install screws and washers through mounting flange of injector and into cylinder head.

Tighten screws in stages, starting with the lower screw.
- First torque is 5 ft. lbs. (7 N·m).
- Second torque is 10 ft. lbs. (14 N·m).
- Final torque is 24 to 26 ft. lbs. (33 to 35 N·m).

Reconnect fuel injector electrical connectors.

Install the ignition coil assemblies.

Install fuel manifolds. Refer to Fuel Manifold Service on p. 168.

IMPORTANT: Install injector service data (3.5 in. floppy disk) by using the Injector Replacement Utility of Evinrude Diagnostics software. Check the Injector Coefficients screen to make sure that all injectors are positioned properly.
FUEL SYSTEM
FUEL COMPONENT SERVICING

Intake Manifold Service

Removal
Disconnect throttle link arm.
Remove throttle body screws and throttle body assembly.

Disassembly
All reed plate assembly and reed valve assemblies must be cleaned prior to reassembly. DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

Remove the reed valve retainer screws and remove the assembly.

IMPORTANT: DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.
Inspection
Inspect the leaf plate assemblies for damage or contamination:
- Leaf plates must not be distorted.
- Leaf valve must not be cracked or chipped.
- Leaf plate stops must not be distorted or loose.
- Leaf plate assemblies must be clean.

Inspect the intake manifold. All gasket surfaces must be cleaned, smooth, and free of nicks. Use a machinist’s straight-edge to check flatness in all directions. Surface must be flat, ±0.004 in. (0.10 mm).

Assembly
Remove old adhesive from reed valve retaining screws.

Install gasket on reed plate assembly. DO NOT use sealer on the gasket.

Installation
Place reed plate assembly on cylinder/crankcase.

Apply Nut Lock to screws. Install all screws.

Tighten the center screws first and expand outward. Tighten in stages to a final torque of 60 to 120 in. lbs. (7 to 13.5 N·m).
Place gasket on throttle body. Install throttle body on reed plate and install screws.

Tighten the center screws first and expand outward. Final torque is 60 to 120 in. lbs. (7 to 13.5 N·m).

Install upper main bearing vent hose and secure with tie strap.

Connect throttle linkage and electrical connectors. Place clamp as shown.

Refer to TPS Calibration on p. 143.

**IMPORTANT:** DO NOT lubricate throttle linkages.
# OILING SYSTEM

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OILING SYSTEM
SERVICE CHART

SERVICE CHART

A Triple-Guard Grease
B Gasket Sealing Compound
C Adhesive 847
E Red Ultra Lock
F Blue Nut Lock
H Outboard Engine Lubricant
S STP Oil Treatment

30 - 42 in lbs. (3.5 - 5 N·m)

30 - 42 in lbs. (3.5 - 5 N·m)
1. Oil tank
2. Oil pick-up/filter
3. Oil injection pump
4. Oil distribution manifold
5. Crankcase oil inlet (port)
6. Cylinder oil inlet (starboard)
OILING SYSTEM
OIL RECIRCULATION DIAGRAM

OIL RECIRCULATION DIAGRAM

Starboard view

Port view
1. Stator
2. Stator output (55 V)
3. Alternator grounds (BLACK)
4. Oil Injector ground (BLACK)
5. Alternator output, WHITE / RED wires (55 V)
6. Capacitor (55 V)
7. Main harness ground (BLACK)
8. 55 V to injection pump (WHITE / RED)
9. EMM injector control (BLUE)
10. Oil injection pump
11. Low oil switch
12. Low oil switch to EMM (TAN/BLACK)
13. Low oil signal to SystemCheck gauge (TAN/BLACK)
14. No oil signal to SystemCheck gauge (TAN/YELLOW)
The oiling system includes the following components:

- Oil tank
- Oil injection pump and manifold assembly
- Electrical circuit
- LOW OIL and NO OIL warning systems
- Cylinder and crankcase
- Oil recirculation system.

**Oil Tank Assembly**

The oil tank is mounted on the powerhead under the engine cover. Oil level must be monitored.

Oil Tank Components:
- Tank, 2 quart. (1.9 liter) capacity
- Oil pickup and filter assembly
- Oil injection pump and manifold assembly
- LOW OIL sending unit
- Oil distribution hoses

**Oil Injection Pump**

The oil injection pump is an electric (55 V) actuator style pump. It draws oil from the oil tank and supplies pressurized oil to the oil manifold. The EMM supplies 55 V and controls activation of the pump.

The oil manifold distributes the oil supplied by the pump.

**Electrical Circuit (55 V)**

The oil injector is powered by the 55 V electrical circuit. The EMM controls pump operation by rapidly connecting and disconnecting the pump’s internal coil to ground.

The EMM monitors the oil injection pump electrical circuit. If circuit voltage is beyond the specified range, or the circuit is open, the EMM:

<table>
<thead>
<tr>
<th>Activates S.A.F.E.</th>
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<td>EMM LED 4: ON (Running)</td>
<td>Engine Monitor NO OIL display: ON</td>
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LOW OIL Warning

A sending unit in the oil tank pick-up assembly monitors the oil level in the oil tank.

If the oil level falls below one-quarter capacity, the EMM signals:

- Engine Monitor LOW OIL display: ON

Approximate oil reserve at Low Oil activation:
- 0.45 qt. (0.43 l).

NO OIL Warning

When the oil level falls below one-quarter, the EMM begins counting oil pump pulse cycles. When it reaches 4800 pulses, the EMM:

- Activates S.A.F.E.
- Stores service code 117
- EMM LED 4: ON (Running)
- Engine Monitor NO OIL display: ON

To recover from S.A.F.E. mode, the oil pump must cycle for a minimum of three pulses with the oil level above one-quarter.

If outboard has been run for more than 3 hours with NO OIL faults (codes 34 & 117), the EMM:

- Activates SHUTDOWN
- Stores service code 33
- EMM LED 4: FLASHING
- Engine Monitor NO OIL display: FLASHING

Cylinder and Crankcase

The oil distribution manifold provides crankcase lubrication through oil distribution hoses and pressed-in fittings on the crankcase and cylinder block.

1. Crankcase oil fittings

1. Cylinder block oil fittings
Oil Recirculation System
External hoses and fittings, internal cylinder/crankcase passages, and intake manifold passages are used to recirculate any accumulation of oil from various locations in the powerhead. The movement of oil is controlled by check valves.

Cylinder Recirculation
Internal powerhead oil drain passages connect the intake port areas of the cylinders to circulate residual oil in the block.

External fittings and in-line check valves on each side of the cylinder block control the movement of oil from the lower cylinder port to the upper cylinder port.

Crankcase / Main Bearing Recirculation
The movement of oil through the main bearings is controlled by internal passages, external fittings and hoses, and check valves.

Lower to upper main bearing oil flow:
• Lower main bearing cavity to internal crankcase passage to external fitting, external hoses with in-line check valve to external fitting at upper main bearing, and into upper main bearing through internal crankcase passage.
• Internal crankcase passage to external fitting in crankcase cover at upper main bearing, hose routed to reed plate fitting. This circuit vents the upper main bearing cavity to promote oil flow.

Oil Priming
The oiling system of the outboard must be primed:
• When the outboard is first installed.
• Whenever the oil supply to the oil lift pump is disconnected or disrupted.
• Whenever an oiling system component is removed or replaced.

Refer to Oil Supply Priming on p. 56.

Oiling Rates
EMM programming controls the rate of oil injection based on engine RPM. This rate can be adjusted for the grade of oil being used, and also for powerhead break-in. Use Evinrude Diagnostics software to access these features.

Refer to Oil Injection Rate on p. 55.

Break-in Oiling
The EMM automatically supplies extra oil to the engine during the first two hours of operation, above 2000 RPM.
• Use Evinrude Diagnostics software to make sure the break-in program has been started on a new outboard.
• Use the diagnostics software to start break-in oiling after a powerhead rebuild.

IMPORTANT: The operator must monitor the oil tank level to confirm oil consumption. This may require several hours of operation above idle speed.
OILING SYSTEM TESTS

IMPORTANT: Always perform visual inspections to identify oiling system leaks. Make sure the oil tank is filled and oil supply is not contaminated.

Oil Injection Pump Static Test

IMPORTANT: Static tests are performed with the outboard not running.

Use Evinrude Diagnostics software to activate the Oil Injector test. This test starts the EMM control function for the oil injection pump.

The EMM controls the pump by providing ground through pin 23 (blue wire) of the J1-B connector and pin 2 (blue wire) of the oil tank connector.

IMPORTANT: This test is operating the pump with 12 V battery power on the system voltage (55 V) circuit. The oil injection pump will not activate on 12 V.

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil tank connector (pin 2).

If the light flashes, the EMM and oil injection circuits are not at fault.

Refer to Oil Injection Pump Voltage Test on p. 183.

Oil Injection Pump Voltage Test

Check voltage at pin 1 (white/red wire) of oil tank electrical connector.

Acceptable voltage readings:
- Key switch ON: slightly less than 12 V
- Outboard running: 55 V

Results:
- If voltage is not within range, refer to Oil Injection Pump Circuit Resistance Test on p. 184.
- No voltage reading, refer to System Voltage Test on p. 110.

Monitor the voltage on the oil injector circuit at pin 2 (blue wire) of oil tank connector with outboard running at 1500 RPM.

Use an appropriate test probe and a digital multimeter calibrated to a scale that reads 55 V (DC). Connect positive meter lead to pin 2 and negative meter lead to ground.

Voltage reading should be approximately 55 V, and drop approximately 5 V as EMM actuates oil injection pump.
Oil Injection Pump Circuit Resistance Test

**IMPORTANT:** The complete oil injection pump electrical circuit includes EMM alternator output, the engine wire harness, the injection pump winding and connectors, and the oil injector control circuit of the EMM. Check continuity of all wiring and connections.

Disconnect the battery cables at the battery.

Use an appropriate test probe to make a connection to pin 1 of the oil injection pump connector.

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

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Results:
- An infinite reading (∞) indicates an open circuit. Isolate the faulty wiring, connection, or injection pump winding. Repair faulty wiring or replace faulty pump.
- For a higher than expected reading, test resistance of the injection pump. If injection pump resistance reading is approximately 22 Ω, injection pump winding is good. Isolate faulty component. Repair faulty wiring or replace faulty component and retest.

Oil Injection Pump Function Test

Remove oil distribution hose from fitting at oil distribution manifold. Do not lose the brass hose support.

Temporarily install a length of oil hose.

Start the outboard and observe oil flow:
- Oil flows from hose, compare to oil flow at other distribution fittings
- If one or more fittings fail to flow oil, replace the oil injection pump assembly.

Reinstall hose into manifold.

**IMPORTANT:** Make sure hose support is in hose and hose is fully inserted into manifold. Refer to Oil Distribution Hoses on p. 186.
Oil Injection Fittings Flow Test
Make sure the oil injection fittings of the cylinder and crankcase assembly allow fluid to move.
Remove oil distribution hose from oil distribution manifold.
Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.

LOW OIL Sending Unit Test
Remove the oil from the oil tank.
Turn the key switch ON. The dash mounted Engine Monitor system should show a LOW OIL warning.
Once the warning has been confirmed, refill the oil tank and start the outboard. The LOW OIL warning should stop after the oil pump cycles 3 times.
OILING SYSTEM
OIL COMPONENT SERVICING

OIL COMPONENT SERVICING

⚠️ WARNING ⚠️

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

Oil Distribution Hoses
The oil distribution hoses to each cylinder MUST be the same length. DO NOT alter the length of any hoses.

Oil Distribution Hose Length:
• 20 in. (508 mm)

Removal
Release the hose by depressing the outer ring of the hose retaining mechanism.

1. Retainer mechanism
2. Hose support

1. Hose support

Once hose is removed from the manifold, make sure hose support is in the end of the hose.

DSC00291

Installation
Cut Replacement Oil Hose, P/N 778708, to the correct length. Insert hose support in manifold end of hose.

IMPORTANT: DO NOT reinsert the hose into manifold without the hose support.

Be sure the hose is fully inserted into manifold. Insertion depth is 5/8 in. (16 mm). Visually inspect for hose supports.
Oil Tank Assembly

Removal
Disconnect the battery cables at the battery.
Remove engine covers and air silencer.
Disconnect the electrical connector to the oil injection pump and manifold assembly.

IMPORTANT: Note oil distribution hose routings before proceeding with disassembly.

Remove oil distribution hoses from the crankcase fittings.
Remove oil tank retaining screws.

Installation
Position oil tank assembly on powerhead. Clean mounting screws and apply Nut Lock to threads. Install screws and tighten to a torque of 30 to 42 in. lbs. (3.5 to 5 N·m).

Install protective sleeves and route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings. Refer to OIL SUPPLY DIAGRAMS on p. 177. Secure oil hoses to crankcase fittings with tie straps.

Run outboard and check for leaks. Use Evinrude Diagnostics software to activate “Oil Prime.” Check oil flow through oil distribution hoses. Check oil system operation and routing of oil system hoses.

Repair any oil leaks and kinked or misrouted hoses. Install air silencer and engine covers.
## NOTES

### Technician’s Notes

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# COOLING SYSTEM

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Hose Routing and Water Flow Diagrams

1. Water intake screen
2. Water pump
3. Exhaust housing
4. Cylinder block
5. Pressure relief valve
6. Thermostat
7. Water supply to EM separator
8. Water supply, EM separator
9. Overboard indicator
10. Exhaust Water Valve

60, 65 HP

Outgoing water (warm/hot)
Incoming water (cool)
COMPONENTS

Water Pump and Intakes
External water intakes mounted in the gearcase housing collect water and must supply the inlet side of the water pump with an unrestricted and unaerated water supply. Water is drawn into the water pump through a hole in the lower plate of the water pump assembly. All cooling water to the powerhead is provided by the water pump.
• A nylon wedge (impeller key) is used to engage the impeller bushing and driveshaft.
• The nylon impeller housing with liner must seal against a separate water pump plate.
• The bottom plate MUST seal to gearcase.
• The pump operates as a positive displacement pump at LOW speeds (below 1500 RPM) and as a centrifugal pump at HIGHER speeds.

Refer to WATER PUMP SERVICE on p. 278 for servicing.

IMPORTANT: The water pump housing includes a small hole to the rear of the water outlet. This hole provides cooling water for the tip of the exhaust passage. Be sure to use the correct parts when replacing the water pump.

Exhaust Housing
The water pump outlet connects with passages located in the outboard’s midsection. A grommet seals the water pump housing to the exhaust housing.

Water supplied to the exhaust housing provides all cooling water to the cylinder block.

Pressure Relief Valve
A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 1800 RPM). The pressure relief valve opens as water pressure increases. Spring tension sets the opening pressure.

Overheating: A restricted or faulty valve typically results in HIGH SPEED overheating.
COOLING SYSTEM
COMPONENTS

Overcooling: Debris may prevent the valve from closing completely.

Thermostat
The thermostat controls water flow and operating temperature at lower speeds (below 1800 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.

Block Venting
A fitting and hose connected to the top of the exhaust cover allows the constant movement of water and/or air from the block. Circulated water flows through the EMM and vapor separator before exiting through the overboard indicator.

Water Pressure Connection
A fitting and hose for an accessory water pressure gauge can be connected at the top of the cylinder block next to the pressure valve housing.
OPERATION

All models use a two-stage cooling system design. The cooling system is dependent on water pump pressure and controlled by thermostat and pressure valve operation.

IMPORTANT: Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cylinder block and cylinder heads is controlled by a thermostat and a pressure relief valve. The pressure valve is located in the top of the block next to the exhaust cover.

At higher speeds, water pressure opens the pressure relief valve at approximately 1800 RPM. Water flows through the valve to the cylinder head and bypasses the thermostat. All water flows through the cylinder head to the outlet passage of the block and then exits through the exhaust housing.

EMM and Vapor Separator Cooling

Cooling water is routed from the top of the cylinder block to the inlet fitting of the EMM water cavity. Cooling of the EMM helps to stabilize the temperatures of internal components.

IMPORTANT: Improper EMM cooling will activate service codes 25 and 29 and the Engine Monitor warning system. Refer to the EMM Service Code Chart at the back of this manual for specific service code information.

Cooling water from the EMM is routed to the water inlet fitting of the vapor separator water cavity. Cooling the vapor separator fuel chamber minimizes fuel vaporization.

Cooling water from the vapor separator is routed to the overboard indicator.
ENGINE TEMPERATURE CHECK

IMPORTANT: The engine temperatures listed below are based on an intake water temperature of 70° ± 10°F (21° ± 3°C).

Install correct test propeller and place outboard in a test tank or in the water. Start outboard and run at 3000 RPM in FORWARD gear for at least five minutes. Remember, running outboards at high speeds in test tanks may disrupt water flow to gearcase water intakes. Make sure the outboard has adequate water flow.

Reduce speed to IDLE for five minutes. Check IDLE operating temperature.

Increase speed to 5000 RPM and check temperature.

If engine temperatures are not within range, troubleshoot cooling system.

If engine temperature tests within range, but the SystemCheck gauge indicates a “WATER TEMP” warning, refer to WATER TEMP/ HOT Circuit Test on p. 138.

Software Method
Use Evinrude Diagnostics software to read temperature displays.

Monitor Screen

Typical temperature sensor readings at IDLE speed should be 155°F ± 5°F (68.3°C ± 3°C).

Typical temperature sensor readings at WOT speed should be 160°F ± 40°F (71°C ± 22°C).

Operating temperature must not exceed 212°F (100°C).

Pyrometer Method
Use a Temperature Gun, P/N 772018, or a digital pyrometer to measure the outboard’s operating temperatures.

Measure temperature of the thermostat housing at the top of cylinder head.

Typical pyrometer readings at IDLE speed should be 145°F ± 10°F (63°C ± 6°C).

Typical pyrometer readings at WOT speed should be 150°F ± 40°F (66°C ± 22°C).

CAUTION

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and twist and remove all spark plug leads so the engine cannot be started accidentally.

Monitor Screen

006539
COOLING SYSTEM
ENGINE TEMPERATURE CHECK

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

**IMPORTANT:** Digital pyrometer or temperature gun measurements may be slightly lower than software temperature readings.

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

If engine IDLE temperature is below operating range, 155°F ± 5°F (68.3°C ± 3°C), check thermostat and pressure relief valve operation.

**Thermostat Inspection**

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

Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

Refer to **THERMOSTAT SERVICING** on p. 196.

**Pressure Relief Valve Inspection**

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

Start the outboard and check IDLE operating temperature.

If IDLE temperature is too low, check pressure relief valve plunger and seal for damage or debris that could prevent the valve from closing completely.

If IDLE temperature is still below operating range, replace pressure relief valve assembly and plunger seal.

To test pressure relief valve operation, monitor temperature at the thermostat housing with Temperature Gun, P/N 772018, or digital pyrometer.

Confirm normal IDLE operating temperature.

Slowly increase engine speed from IDLE, up through 2500 RPM.

Engine temperature should decrease from normal IDLE temperatures as pressure relief valve opens. Valve should open between 1800-2200 RPM.

If temperature decreases at a lower RPM, replace pressure relief valve assembly.

Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 197.
THERMOSTAT SERVICING

Disassembly
Remove the thermostat cover and O-ring from cylinder head.

Remove spring, thermostat, and gasket.

Remove the cylinder head if cylinder head thermostat seal requires replacement. Place new seal in the cylinder head with side marked “TO CYL HEAD” facing thermostat. Refer to Cylinder Head Installation on p. 217.

1. Cylinder head seal

Inspection
Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.

Assembly
Assembly is the reverse of disassembly. Pay close attention when performing the following additional tasks.

Coat threads of thermostat cover with Gasket Sealing Compound and install new O-ring. Install and tighten cover to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).
PRESSURE RELIEF VALVE SERVICING

The pressure relief valve assembly should be serviced at the same time as the thermostat.

Disassembly

Remove screws and cover from pressure valve assembly.

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following additional tasks.

Install a new plunger seal squarely over ridge in housing.

Apply a light coat of Triple-Guard grease to a new cover o-ring and place in groove in housing.

Install valve assembly into housing. Tighten cover screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).
## NOTES

### Technician’s Notes

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# POWERHEAD

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POWERHEAD
SERVICE CHART

SERVICE CHART

F 60-84 In. lbs. (7-9.5 N·m)

B 120-144 In. lbs. (13.5-16 N·m)

H 168-192 In. lbs. (19-21.5 N·m)

IMPORTANT See Spark Plug Indexing Procedure

15-30 Ft. lbs. (20-41 N·m)

A 18-20 ft. lbs. (24.5-27 N·m)

G 18-20 ft. lbs. (24.5-27 N·m)

B 60-84 In. lbs. (7-9.5 N·m)

M Apply to water passages

F 60-84 In. lbs. (7-9.5 N·m)

M Apply to water passages

H 26-30 Ft. lbs. (35-41 N·m)

A Apply to crankcase mating flange

J Apply to crankcase mating flange

B 60-84 In. lbs. (7-9.5 N·m)

A Apply to water passages

F 60-84 In. lbs. (7-9.5 N·m)

M Apply to water passages

H 26-30 Ft. lbs. (35-41 N·m)

H 168-192 In. lbs. (19-21.5 N·m)

M RTV Sealant

J Thermal Grease

Q Extreme Pressure Grease

P Permatex No. 2

Y Extreme Pressure Grease

002283

A Triple-Guard Grease
B Gasket Sealing Compound
D Moly Lube
E Red Ultra Lock
F Blue Nut Lock
G Needle Bearing Grease
H Outboard Lubricant
J Thermal Grease
M RTV Sealant
P Permatex No. 2
Q Gel Seal II
Y Extreme Pressure Grease
H 30-32 Ft. lbs. (41-43 N·m) Must have alignment tool
POWERHEAD REMOVAL

**WARNING**

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

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

Remove lower motor covers. **Lower Cover Removal** on p. 82.

Disconnect power trim connectors and exhaust water valve electrical connector (60, 65).

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

Disconnect cooling water hoses from exhaust housing.

---

1. Connectors
2. Overboard indicator hose
3. Drain hose
4. Shift rod screw

---
ROPE START MODELS

Remove the recoil starter housing and starter ratchet. Refer to RECOIL STARTER REMOVAL on p. 311.

Install Lifting Fixture, P/N 396748, on flywheel and seat the three screws completely.

IMPORTANT: Be sure to use only the 1 1/8 in. (short) screws, P/N 398067, included with the tool to avoid damage to electronic components under the flywheel.

Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.

Loosen the screws holding the exhaust water valve to the exhaust housing.

Move water valve aside and remove the eight exhaust housing to powerhead screws.

Use a suitable tool to carefully separate the powerhead from exhaust housing.

IMPORTANT: Do not damage the powerhead or exhaust housing mating surfaces.
POWERHEAD DISASSEMBLY

General
To simplify reassembly and wiring installation, lay out the various screws and clamps in the order of their proper location.

Remove the electric starter. Refer to Starter Removal on p. 144.

Remove the oil tank. Refer to Oil Tank Assembly on p. 187.

Remove fuel pump assemblies, fuel manifolds, and filter. Refer to FUEL COMPONENT SERVICING on p. 166.

Remove EMM and electrical harness assembly. Refer to EMM SERVICING on p. 102.

Remove flywheel and stator. Refer to FLYWHEEL AND STATOR SERVICING on p. 139.

Remove ignition coils and fuel injectors. Refer to Fuel Injector Service on p. 169.

IMPORTANT: Mark injectors for cylinder location before removal. All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Remove throttle linkage. Refer to Throttle Linkage Removal on p. 204.

Remove shift linkage. Refer to Shift Linkage Removal on p. 204.

Remove the throttle body and reed plate assemblies. Refer to Intake Manifold Service on p. 172.

Remove pressure valve assembly. Refer to PRESSURE RELIEF VALVE SERVICING on p. 197.

Throttle Linkage Removal
Remove throttle cam and throttle lever.

1. Throttle lever screw
2. Throttle return lever

002245

Shift Linkage Removal
Remove shoulder screw from shift arm and retaining screw from shift rod lever. Remove the cotter pin and washer holding the shift shaft.

1. Shift lever screw

002250

Slide entire shift linkage assembly from crank-case.
Remove the ball, guide, and spring of the shift detent assembly from the crankcase.

Crankcase Disassembly
Remove screws and exhaust side water cover.

Loosen in stages and remove the main bearing nuts and washers.

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.

WARNING
Wear safety glasses to avoid injury.

Use a 1/8 in. diameter pin punch to push crankcase taper pin toward the front side of the engine.
Cylinder Head Removal
Remove thermostat cover and thermostat assembly. Refer to THERMOSTAT SERVICING on p. 196.

Loosen in stages and remove cylinder head retaining screws. Remove the cylinder head. Discard thermostat seal and O-rings.

Connecting Rods and Pistons
Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the flywheel.

Use Torquing Socket, P/N 331638, to loosen in stages the rod cap retaining screws. DO NOT remove the screws.

Use one hand to support the piston, and remove the rod cap screws with your other hand. Remove each piston and rod assembly.

IMPORTANT: Reattach each rod cap to its rod as soon as the piston is removed. Each cap is unique and can only be installed on its mated rod. Do not allow rod to contact inside surface of cylinder or crankshaft.

IMPORTANT: Identify all internal components so that if reused, they can be reinstalled in their original positions.

Repeat steps for each remaining piston and connecting rod.
Use an appropriate ring expander to remove all piston rings from pistons. Discard the rings.

**WARNING**

Wear safety glasses to avoid injury.

Remove wrist pin retaining rings. Discard retaining rings.

The wrist pin fit is loose on both sides. Push the wrist pin through to free the piston from the connecting rod. If necessary, use Wrist Pin Pressing Tool, P/N 326356, to remove the wrist pin bearing.

Be careful not to lose any of the 28 needle bearings or the two wrist pin washers. If any of the bearings are worn or lost, replace all 28 bearings during reassembly.

**Crankshaft Removal**

Carefully lift crankshaft straight up and remove from crankcase.

Remove upper seal from crankshaft. Discard the seal. A new upper seal must be installed on assembly.
POWERHEAD DISASSEMBLY

Remove the upper main bearing.

Use a punch to remove the housing seal. Discard seal.

Inspect housing and replace if necessary.

Remove O-ring from crankshaft sleeve and inspect it. Replace the O-ring if it is not in good condition.

Remove the lower bearing seal housing.

Remove the housing O-ring. Discard O-ring.
Inspect the crankshaft sleeve and replace if necessary. To remove the sleeve, use Slide Hammer, P/N 432128, and Large Puller Jaws, P/N 432129.

Remove the lower main bearing only if it needs to be replaced. Use external retaining ring pliers to remove the lower bearing retaining ring.

**IMPORTANT:** If the lower main bearing is removed from the crankshaft, it must be discarded. DO NOT reuse it.

Use a bearing separator to support the bearing, and press off the crankshaft.

Remove center main bearings and split sleeves for inspection. DO not mix parts. Note location of bearings for reassembly.
POWERHEAD
CYLINDER BLOCK CLEANING

CYLINDER BLOCK CLEANING

IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants.

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylinder head combustion chambers.

If cylinder walls are glazed from extended use, use a rigid, medium grit cylinder hone to resurface walls. Use slow RPM for best oil retention and ring sealing. When finished, a cross hatch pattern of 22 to 32° should be visible in the cylinder wall. The pattern should be uniform in both directions.

IMPORTANT: To avoid piston or cylinder block damage, restore the chamfer to all port edges using a ball hone or other suitable tool.

Use Gel Seal and Gasket Remover to remove all traces of gaskets, adhesives, and Gel-Seal II™ sealant from the cylinder block and crankcase.

Carefully remove any carbon accumulation from the tops and ring grooves of the piston using Engine Tuner. A ring groove cleaning tool can be made by breaking an old ring and grinding an angle on its end. Do not damage ring grooves while cleaning.

Thoroughly wash entire cylinder block and crankcase with warm, soapy water to remove all traces of contaminants.

Air dry cylinder block and crankcase. Blow all holes and passageways with compressed air.

Cover the cylinder walls with a liberal amount of outboard lubricant to prevent corrosion.
POWERHEAD INSPECTION

For dimensions, refer to SERVICE SPECIFICATIONS on p. 10.

IMPORTANT: Before any inspection process can begin, all internal components must be completely clean and free of contaminants.

Visually inspect all parts. Check for unusual wear patterns, scuffing, or deterioration of aluminum parts, heat-related discoloration of bearings and bearing surfaces, and broken components.

Cylinder Head

Check for cylinder head warpage using a piece of bar stock or machinist’s straightedge and a feeler gauge set.

Cylinder head warpage must not exceed 0.006 in. (0.15 mm) per inch of measurement. Replace head if warpage exceeds this dimension.

Crankshaft

Measure the diameter of each crankpin and main bearing journal. The lower main bearing journal would only be measured if the bearing was removed for another reason.

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 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).

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to SERVICE SPECIFICATIONS on p. 10.
• The cylinder must not be oversized by more than 0.003 in. (0.08 mm).

**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.

**IMPORTANT:** Ring end gap increases approximately 0.003 in. (0.076 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 or just below the surface of piston. Rings must move freely in piston ring groove.

**Bearings**
Inspect center main bearings and split sleeves for excess wear, nicks, or scratches. Replace if necessary.

Ring end gap should be:
• 0.011 to 0.023 in. (0.28 to 0.58 mm)
Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace if necessary.

**POWERHEAD ASSEMBLY**

**IMPORTANT:** Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All internal components must be perfectly clean and lightly coated with outboard lubricant.

**IMPORTANT:** Use new wrist pin retaining rings, gaskets, seals, and O-rings during assembly.

**Crankshaft Assembly**

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338647, and place a new lower main bearing onto crankshaft with lettered side facing the tool. Install bearing until it seats on the crankshaft.

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338647, to drive a new sleeve onto the crankshaft until the installer contacts the lower main bearing.
POWERHEAD
POWERHEAD ASSEMBLY

If the installer sticks on the sleeve after installation, thread Slide Hammer, P/N 391008, into installer and pull it off.

IMPORTANT: Inspect sleeve after installation. Sleeve must not be used if surface is damaged.

Use retaining ring pliers to install bearing retaining ring with sharp edge facing away from bearing.

Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with Moly Lube. Install O-ring in sleeve.

Lubricate the center main bearings and split sleeves with outboard lubricant and install them in their original positions. The split sleeve ring grooves must face toward driveshaft (lower) end of crankshaft when installed.

Lightly coat the outside edge of a new lower housing seal with Gasket Sealing Compound. Press against outer case of the seal to install seal in the lower housing with extended lip facing down. Lubricate seal lip with Triple-Guard grease.

Install a new O-ring on the lower housing. Before installing crankshaft into cylinder block, apply a thin coat of Gasket Sealing Compound to outer edge of O-ring.

Place lower seal housing on crankshaft.
Lubricate upper main bearing with outboard lubricant and install on crankshaft.

Pack lip of upper oil seal with Moly Lube. Place seal on crankshaft with lip toward driveshaft and enclosed face toward flywheel. Do not apply sealer to outside edge of the seal.

**Pistons and Connecting Rods**

**IMPORTANT:** It is very important that the pistons in this engine are installed in the correct location and direction.

New pistons are stamped “EXH.” This marking should be turned toward the exhaust side of the block. The splash bowl on the dome of the piston will be located toward the flywheel and opposite the exhaust port.

**IMPORTANT:** It is also very important that the connecting rods are installed with the alignment dots and the diagonal oil hole facing up, toward the flywheel.

Apply Needle Bearing Grease to the wrist pin bearings. Install the bearings in the small end of
the connecting rod. Align bearings with Wrist Pin Bearing Tool, P/N 336660.

Place the two wrist pin thrust washers on the tool with flat side of the washers facing out.

Oil the wrist pin bore and wrist pin. Place connecting rod, with bearings, washers, and tool, into the piston with the alignment dots facing the top of the piston.

Install wrist pin through piston and connecting rod, pushing bearing tool out through the piston.

Use Wrist Pin Cone, P/N 318600, and Driver, P/N 318599, to install new wrist pin retaining rings in each wrist pin hole. Gap of retaining ring faces up, away from notch in piston.

Installing Pistons
When all pistons and connecting rods are assembled, install piston ring sets. Be sure rings are installed in the cylinder used to test ring end gap. Refer to POWERHEAD INSPECTION on p. 211.
IMPORTANT: Be sure gap of ring fits squarely around dowel pin.

IMPORTANT: Before continuing, make sure that all Gel-Seal II has been removed from the cylinder block and crankcase mating flanges. If traces of hardened Gel-Seal II are left, main bearings could be misaligned. Refer to CYLINDER BLOCK CLEANING on p. 210.

Coat pistons, rings, cylinder walls, and Ring Compressor, P/N 336314, with outboard lubricant.

Center connecting rod in piston and locate piston rings on dowel pins. Place appropriate ring compressor on piston.

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.

Apply soapy water to water dam and insert into block.

Repeat steps for each piston.

Cylinder Head Installation

Install a new thermostat seal in cylinder head with side marked “TO CYL HEAD” facing toward thermostat.

Refer to THERMOSTAT SERVICING on p. 196 before installing cylinder head.

Lightly lubricate new cylinder head O-rings with Triple-Guard grease and install in cylinder head.
Apply a 1/16 in. (2 mm) bead of RTV Adhesive around each water passage on the block and cylinder head as shown (13 locations).

Install cylinder head with the thermostat toward the top. Apply outboard lubricant to threads and install the cylinder head screws. DO NOT use any sealant on threads.

Following sequence on cylinder head, tighten all screws in stages to a torque of 168 to 192 in. lbs. (19 to 21.5 N·m).

Crankshaft and Connecting Rod Installation

Rotate cylinder block so crankcase mating flange is facing up.

Apply Gasket Sealing Compound to lower oil seal groove in cylinder block. DO NOT put any sealer in upper seal groove.

Check that main bearing alignment dowel pins are seated in the block.

Push all pistons to the top of cylinders. Remove numbered connecting rod caps.

Gently lower crankshaft into place.
- Align tab on lower bearing seal housing with hole in crankcase.
- Align upper oil seal in groove.
- Locate each main bearing on its dowel pin. A mark placed on the bearing race opposite the
dowel pin hole will help in the alignment process.

Lubricate each crankpin and bearing assembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.

Lubricate rod cap screw threads and under screw head mating surface with outboard lubricant. Align dot on rod cap with dot on the connecting rod.

Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dots face flywheel.

IMPORTANT: Tightening rod cap screws without Alignment Fixture, P/N 396749, or using an incorrect procedure could cause permanent damage to the connecting rod and crankshaft. To maintain accurate torque values, keep torque wrench extension length to a minimum.

Install Rod Cap Alignment Fixture, P/N 396749, before tightening rod cap screws. Align the flat marked “SET” on the rod engagement stop with the arrow on the frame. Position stop at the center
setting (one line showing). Rotate adjustment knob 180° to lock in position.

Secure restraining jaw “C” and forcing jaw “D” to frame.

Apply a light coat of outboard lubricant to the corners of the connecting rod and rod cap. Place frame on connecting rod using the following procedure.

- Position frame onto the connecting rod so the contact area of the jaw is centered on the side of the rod.

- Tighten forcing screw until jaws contact connecting rod.
- Slide frame down until adjustment stop contacts the rod cap. The groove lines on the jaws must be centered on the rod/crankpin diameter.
- Tighten the forcing screw to a torque of 14 to 16 in. lbs. (1.6 to 1.8 N·m).

IMPORTANT: Make sure that frame is squarely in position and that rod and cap are aligned.

Loosen both rod cap screws one-quarter turn.

Use Torquing Socket, P/N 331638, to tighten rod cap screws in three stages:
- Apply first torque of 40 to 60 in. lbs. (5 to 7 N·m) to both rod cap screws.
- Tighten screws to a torque of 14 to 16 ft. lbs. (19 to 21.7 N·m).
- Apply final torque of 30 to 32 ft. lbs. (41 to 43 N·m).
**IMPORTANT:** If a new screw is used, it must be installed as above. Then, it must be removed, re-lubricated, and installed again.

Loosen forcing screw and remove the frame.

Test at least three corners of the rod and cap joint with a pick. Joint must be smooth with no step.

---

**Crankcase Assembly**

Thoroughly clean and degrease the mating flanges of the crankcase and cylinder block with a non-petroleum based solvent, such as isopropyl alcohol or acetone, and let air dry.

**IMPORTANT:** DO NOT allow solvent to get on internal components. Clean only the mating flanges.

Apply *Gasket Sealing Compound* to lower oil seal groove in crankcase. DO NOT put any sealer in upper seal groove.

Use a small brush with a tapping motion to apply a thin, even coat of *Gel-Seal II* sealant to the crankcase mating flange. The sealer must not come within 1/4 in. (6.4 mm) of bearings.

**IMPORTANT:** *Gel-Seal II* has a shelf life of at least one year when stored at room temperature. Test the *Gel-Seal II* or replace it if the age of the tube cannot be determined. Using old *Gel-Seal II* could cause crankcase air leaks.

**IMPORTANT:** The use of *Locquic Primer* is NOT recommended. If primer is used, crankcase halves must be assembled and tightened within ten minutes after the *Gel-Seal II* has been applied.

Lower the crankcase into place. Make sure that upper oil seal and lower seal housing are seated in grooves.

Apply outboard lubricant to the main bearing studs. Install nuts and washers finger tight, no more than 60 in. lbs. (7 N·m).
When the crankcase is seated, install and firmly seat the crankcase taper pin.

Tighten main bearing nuts in stages to a final torque of:
• 26 to 30 ft. lbs. (35 to 41 N·m).

Start in the center and work outward in a spiral pattern.

Apply Nut Lock to crankcase flange screws. Install crankcase flange screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

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.

Apply Gasket Sealing Compound to both sides of a new water cover gasket. Position gasket and cover on cylinder block.

Apply Nut Lock to cover screws. Position J-clamps as shown. Tighten all screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).
Shift Linkage Installation

Place the spring, guide, and ball of the shift detent assembly into the crankcase. Lubricate with *Triple-Guard* grease.

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 and detent of the shift lever assembly. Guide shaft through bushings in crankcase.

Install cotter pin and washer on the shaft. Install shift rod lever and tighten retaining screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Throttle Linkage Installation

Apply *Nut Lock* to threads of throttle lever screw.

Insert spring into cavity of throttle return lever.

Install lever, screw, and washer on crankcase and hook spring on rib as shown. Tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).
Apply *Nut Lock* to threads of throttle cam screw. Install cam, screw, and washer on cylinder block and tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).

1. Throttle lever screw
2. Throttle return lever

**IMPORTANT:** Do not lubricate throttle levers or shoulder screws.

---

**Final Powerhead Assembly**

Install the reed plate and throttle body assemblies. Refer to *Intake Manifold Service* on p. 172.

Install oil recirculating hoses and check valves. Refer to *OIL RECIRCULATION DIAGRAM* on p. 178, or *POWERHEAD VIEWS* on p. 228.

Install pressure valve assembly. Refer to *PRESSURE RELIEF VALVE SERVICING* on p. 197.

Install shift linkage. Refer to *Shift Linkage Installation* on p. 223.

Install throttle linkage. Refer to *Throttle Linkage Installation* on p. 223.

Install fuel injectors and ignition coils. Refer to *Fuel Injector Installation* on p. 171.

**IMPORTANT:** All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Install stator and flywheel. Refer to *FLYWHEEL AND STATOR SERVICING* on p. 139.

Install electrical harness, then install *EMM*. Refer to *EMM SERVICING* on p. 102.

Install fuel pump assemblies, fuel manifolds, and filter. Refer to *FUEL COMPONENT SERVICING* on p. 166.

Install the oil tank and oil injection hoses. Refer to *Oil Tank Assembly* on p. 187.

Install the electric starter. Refer to *Starter Installation* on p. 148.

---

**WARNING**

To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.
POWERHEAD INSTALLATION

Powerhead Mounting

Apply Permatex No. 2 to both sides of a new base gasket around the exhaust port only. Install gasket on exhaust housing. To ensure proper sealing, mating surfaces must be clean and dry.

Coat the driveshaft splines with Moly Lube. Do not apply lubricant to end of driveshaft.

Slowly lower powerhead onto exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.

Apply Triple-Guard grease to the threads, and Gasket Sealing Compound to the shank of the powerhead screws.

Loosely install all powerhead screws before tightening:

Tighten the eight powerhead screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m) in the sequence shown.

IMPORTANT: Retighten powerhead mounting screws after outboard has been run at full operating temperature and allowed to cool.
POWERHEAD
POWERHEAD INSTALLATION

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Check shift linkage adjustment. Refer to Shift Linkage Adjustment on p. 227.

IMPORTANT: Make sure the gearcase shifts solidly into both forward and reverse and that propeller shaft spins freely in neutral.

Apply Nut Lock to threads of exhaust water valve screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Connect cooling water hoses to exhaust housing.

Connect the power trim connectors and exhaust water valve connector (60, 65). Secure cables in clamps.

ROPE START MODELS

Install recoil starter ratchet and housing on outboard. Refer to RECOIL STARTER INSTALLATION on p. 317.

Install the lower engine covers. Refer to LOWER COVER SERVICE on p. 82.
IMPORTANT: Perform the following procedures before returning outboard to service:

- Index all spark plugs. Refer to Spark Plug Indexing on p. 76.
- Adjust timing pointer and check engine timing. Refer to TIMING ADJUSTMENTS on p. 142.
- Use Evinrude Diagnostics software to start powerhead break-in oiling. Refer to Powerhead Break-In on p. 98.
- Prime oiling system. Refer to Oiling System Oil Supply Priming on p. 56.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Shift Linkage Adjustment

Adjust shift linkage as follows:

- Loosen adjustment screws on shift lever.
- Be sure that ball is centered in detent assembly.
- Adjust shift lever so that the screw hole in shift rod lever lines up with the hole in the gearcase shift rod when gearcase is in neutral.
- When correctly adjusted, the shift lever will be parallel with the vertical line of the outboard, and the distance between the shift lever pin and the center of the shift cable trunnion pocket should be approximately 7 in. (17.8 cm).

IMPORTANT: The shift rod height is the most critical of these adjustments and should not be moved during this procedure. Refer to SHIFT ROD ADJUSTMENT on p. 280.

- Tighten adjustment screws to 60 to 84 in. lbs. (7 to 9.5 N·m).
Port Short Block

Starboard Short Block
Port Dressed Powerhead

Starboard Dressed Powerhead
POWERHEAD
POWERHEAD VIEWS

Port Rope Start Models

Starboard Rope Start Models
Front
POWERHEAD
POWERHEAD VIEWS

Rear
Top
Top, Rope Start Models
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Use Triple-Guard grease on all pivot points.
**Stern Bracket—Manual Tilt Models**

Use *Triple-Guard* grease on all pivot points.
**Exhaust Housing**

- **A**: Triple-Guard Grease
- **B**: Gasket Sealing Compound
- **C**: Adhesive 847
- **D**: Moly Lube
- **E**: Red Ultra Lock
- **F**: Blue Nut Lock
- **G**: Needle Bearing Grease
- **P**: Permatex No. 2
- **Q**: Gel Seal II

**Torque Values**

- **B**: 16-18 ft. lbs (22-24.5 N·m)
- **C**: 18-20 ft. lbs (24.5-27 N·m)
- **F**: 60-84 in. lbs (7-9.5 N·m)
- **F**: 60-84 in. lbs (7-9.5 N·m)

**004304**
TILLER HANDLE (LONG)

- **A**: Triple-Guard Grease
- **D**: Moly Lube
- **F**: Blue Nut Lock

**Steering Friction Device**
- Optional on 2-Cylinder Models

**Torque Specifications**
- 18-20 Ft. lbs. (24.5-27 N·m)
- 24-36 In. lbs. (2.7-4 N·m)
- 36-48 In. lbs. (4.5-5.4 N·m)
- 20-30 In. lbs. (2.3-3.4 N·m)
- 60-84 In. lbs. (7-9.5 N·m)
- 60-84 In. lbs. (7-9.5 N·m)
- 18-20 Ft. lbs. (24.5-27 N·m)

**Connections**
- Switched 12V For CANbus
- To Engine Key Switch Connector
- To Engine SystemCheck Connector
- To Remote SystemCheck Harness
- Stop Switch
- Start Switch
- Trim Switch
- To Remote Key Switch
- To Remote Trim Gauge
TILT TUBE SERVICE

The tilt tube may be serviced without major disassembly of the outboard using Tilt Tube Service Kit, P/N 434523.

Removal

WARNING

Support the outboard with a suitable hoist.

Remove the nut from the starboard side.

Thread the spacer from Tilt Tube Service Kit, P/N 434523, onto the starboard end of the tilt tube.

Thread steering cable wiper nut from tilt tube. Thread the adapter from Tilt Tube Service Kit, P/N 434523, onto the port end of the tilt tube.

Thread Slide Hammer, P/N 432128, into the adapter until at least 2 in. (51 mm) of thread are engaged.

Pull tilt tube from stern bracket with the slide hammer. When tilt tube clears the port stern bracket, remove tilt tube from the spacer.
Installation

Thread starboard end of tilt tube into the spacer.

Thread the adapter onto port end of tilt tube.

Use a wood or leather mallet to tap the tilt tube into position.

Make sure the lock tab is in correct position.

Install the starboard locknut.

⚠️ **WARNING**

Replace locknut if definite resistance is not felt.

Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

Replace steering cable wiper nut on port end of tilt tube.
EXHAUST HOUSING SERVICE

The exhaust housing contains no serviceable internal parts. The exhaust water valve and the exhaust relief muffler can both be serviced without removing the exhaust housing.

Exhaust Housing Removal

Before removing the midsection:
- Remove the gearcase. Refer to Gearcase GEARCASE REMOVAL AND INSTALLATION on p. 276.

Remove the three lower mount cover screws. Separate lower mount covers from swivel bracket. Check condition of the lower front mount and two lower side mounts. Replace if deteriorated or damaged.

Remove exhaust housing from stern bracket.
Exhaust Water Valve

Disconnect water valve electrical connector.

Remove screws and bracket holding valve to exhaust housing.

Remove tie straps and disconnect water valve hoses (3) from exhaust housing.

Check that all water passages are clear.

Install hoses to fittings on exhaust housing.

Place water valve and bracket in position.

Apply Nut Lock to screws, install and tighten 60 to 84 in. lbs. (7 to 9.5 N.m).

Exhaust Relief Muffler

Remove exhaust relief muffler cover to inspect filter element. Clean or replace as needed.

Apply Gasket Sealing Compound to cover gasket and install cover.

Apply Nut Lock to cover screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N.m).
Exhaust Housing Installation

Bring the exhaust housing into position with the stern bracket.

Apply *Nut Lock* to threads of the upper mount screws. Install the screws and place ground lead under the center screw. Tighten screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m).

Place lower thrust washer on the steering shaft and place the lower front mount into position.

Install lower side mount covers. Install and tighten the screws in stages to a torque of 16 to 18 ft. lbs. (22 to 24 N·m) following sequence shown.

Install gearcase. Refer to Gearcase *GEARCASE REMOVAL AND INSTALLATION* on p. 276.

Install powerhead. Refer to Powerhead *POWER-HEAD INSTALLATION* on p. 225.
STERN BRACKET – Power Tilt Models

Stern Bracket Disassembly (Power Tilt)

Remove the bumpers from the upper mount retaining screws. Remove the screws, upper mount, and ground lead from the bracket.

To separate the swivel bracket from the stern bracket, remove one tilt tube nut.

Remove the tie bar to separate the two stern brackets.

Check the condition of the anode. Replace the anode if it has been reduced to two-thirds its original size.
Stern Bracket Assembly (Power Tilt)

Assemble the tie bar to the stern brackets. Place the ground lead and starwasher between the port stern bracket and tie bar.

Lubricate the swivel bracket bushings with Triple-Guard grease. Place the bushings in the swivel bracket.

Position the swivel bracket between the stern brackets. Place a thrust washer between each of the stern brackets and the swivel bracket.

Install the tilt tube. Tighten the tilt tube nuts 40 to 45 ft. lbs. (54 to 61 N·m), then back off 1/8 to 1/4 turn.

Apply Nut Lock to threads of the upper mount to steering arm screws. Install the mount and tighten the screws 24 to 26 ft. lbs. (32.5 to 35 N·m). Make sure to place the ground lead under the starboard screw.

Apply a liberal amount of Adhesive 847 to heads of the upper mount screws.

Place the bumpers on the upper mount screws.
STERN BRACKET – Manual Tilt Models

Clamp Screw
Inspect clamp screw assemblies. Replace swivel plate and retainer if bent or loose. To install a new swivel plate, remove screw and old plate. Apply Locquic Primer to the threads of the screw and allow it to dry four to five minutes. Then apply Ultra Lock to threads. Install a new swivel plate with screw and tighten securely.

Stern Bracket Disassembly (Manual Tilt)
Remove bumpers from the upper mount retaining screws.

Remove screws, upper mount, and ground lead from the bracket.

Loosen the steering friction screw while pushing outward on the steering friction pin. When the pin
is flush with the inside surface of the casting, remove the steering friction thrust ring.

Drive the steering friction bushing up and out of the swivel bracket.

Remove the thrust rod from the stern brackets. Remove one tilt tube nut, and remove tilt tube from the stern brackets and swivel bracket. Remove the port and starboard stop link screws and nuts from the stern brackets.

Tighten the steering friction screw until the steering friction pin can be removed. Then, remove the steering friction screw.

Remove the two setscrews from the swivel bracket.
Remove the two stern bracket flange screws and separate the stern brackets from the swivel bracket.

Place the tilt/run lever in the RUN position. Loosen the bellcrank setscrew.

Remove the tilt/run lever, port stop link, and bushing from the swivel bracket.

Remove the starboard stop link retaining screw and nut from the swivel bracket.

Remove the cotter pins from both reverse lock pins. Remove the reverse lock pins and springs.

Remove the reverse lock assembly from the swivel bracket.
Stern Bracket Assembly (Manual Tilt)

Place the reverse lock springs in the swivel bracket. Insert the reverse lock pins in the swivel bracket and part way through the reverse lock springs. Place the reverse lock assembly between the springs. Push the pins through the springs and the reverse lock assembly.

Install the washers on the reverse lock pins. Install the link spring on the port pin. Install the two cotter pins in the reverse lock pins.

Install the wave washer and the bellcrank on the tilt/run shaft. Tighten the setscrew.

Install the starboard stop link on the swivel bracket. Install and tighten the screw and the nut to a torque of 144 to 168 in. lbs. (16 to 19 N-m).
Place the swivel bracket between the stern brackets.

Install the tilt tube through the following parts and install the tilt tube nuts loosely:
- Starboard stern bracket
- Thrust washer
- Bushing
- Swivel bracket
- Bushing
- Thrust washer
- Port stern bracket

Apply Nut Lock to threads of the two flange screws. Install the two screws through the starboard stern bracket flange into the port stern bracket flange. Tighten the screws to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

Tighten the tilt tube nuts to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

Install the thrust rod in the stern brackets.

Install the larger shoulder screw through the port stop link, wave washer, and port stern bracket. Install and tighten the nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

Apply Ultra Lock to threads of large setscrews. Install the screws in the swivel bracket so that one thread remains outside the casting.
Place the steering friction bushing in the swivel bracket with groove in line with the setscrews.

Apply *Triple-Guard* grease to the steering friction pin. Install the pin in the swivel bracket flush with inside surface. The pin should point up.

Install the steering friction thrust ring, bevel side up, in the swivel bracket. Thread the steering friction screw in the swivel bracket. Turn the screw until the steering friction pin makes contact with top of the thrust ring. Do not tighten the screw.

Install new upper and lower seals in the swivel bracket with lips of seals facing away from the bracket.

Slide the upper thrust washer on the pivot shaft. Slide the pivot shaft through the swivel bracket.

Lubricate the swivel bracket through the four lubrication fittings with *Triple-Guard* grease.

Apply *Nut Lock* to threads of the upper mount to steering arm screws. Position the upper rubber mount, the upper mount washers, and the retaining washers on the steering arm with the word “UP” on the mount facing up. Be sure to place the ground lead between the mount (starboard side) and the steering arm. Install and tighten the mount retaining screws to a torque of 24 to 26 ft. lbs. (32.5 to 35 N·m).

Place the mount screw bumpers on the upper mount screws.
Tilt Assist Cylinder

The tilt assist cylinder can be replaced without disassembly of the stern brackets.

⚠️ WARNING ⚠️

Support the outboard with a suitable hoist.

Remove port stop link screw. Push port stop link down to clear upper pivot pin access hole.

Remove both cotter pins and washers. Use appropriate tool to remove upper pivot pin.

If lower pivot cannot be removed because of corrosion or damage, stern brackets may need to be disassembled.

Assembly is the reverse of disassembly. Install new cotter pins in upper pivot pin. Install a new set screw in starboard stern bracket lower pivot pin access hole and tighten securely.
TILLER HANDLE
SERVICE – Standard

Removal

**WARNING**

To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

Remove the throttle cable anchor screw and washer. Loosen throttle cable retainer screw. And, remove the tie strap holding the tiller handle electrical harness.

1. Cable anchor screw and washer
2. Cable retainer screw
3. Clip
4. Tie strap

Use Remover tool, P/N 342226, to unsnap the throttle cable clip from the throttle lever.

Remove the electrical cover.

1. **Electrical cover**

Disconnect the electrical harness coming from the tiller handle.

1. **Electrical harness connector**

Remove throttle cable and wires from grommet in lower engine cover.

Remove the screw attaching steering handle.

Remove handle.

1. **Screw**
Disassembly

Loosen throttle friction control so there is no restriction on grip.

**IMPORTANT:** Do not back screw out completely. Nut is under spring tension.

Use *Twist-Grip Remover*, P/N 390767, to depress the grip detents. Tighten screw and remove the grip by pulling grip.

Pull the throttle pin out of the cable.

Remove stop switch cover screws and cover/stop switch assembly.

Remove the throttle control plate.

Remove the helix halves, rollers, and guides.
Remove the throttle cable retaining clip. Pry the cable trunnion out of the steering handle and remove cable.

**IMPORTANT:** DO NOT remove the inner handle except to replace it.

Use a punch and mallet to drive out the steel pin holding the inner handle into the steering handle.

Remove the plastic inner handle from the metal outer handle by driving the outer handle off with a mallet and a punch. Inner handle is bonded to the outer handle. After removing, chip away remnants of inner handle.

Remove throttle cable seal from the inner handle.

**Inspection**

Inspect the throttle cable for kinks and wear. Replace if necessary.

Inspect the steering handle components for wear, cracks, or damage. Replace parts if necessary.

Refer to **Emergency Stop Switch Test** on p. 134 to test stop switch.

**Assembly**

Install the throttle cable seal in inner handle.

If removed, apply *Loctite Depend 300* adhesive to inner handle at areas shown.
Install the metal outer handle over the plastic inner handle and drive the outer handle into place.

Secure tab of the inner handle into recess of the outer handle with the steel pin.

Install the handle end of the throttle cable. Snap the throttle cable trunnion into the recess in the handle. Install the retainer clip.

Install the throttle control plate on outer handle.

Push the throttle cable pin through the end of the throttle cable.

Lubricate end of the pin, guides, rollers, helix grooves, and inner handle guide slot with Moly Lube. Place the guides over the roller pin and into the slots of the inner handle. Place the rollers on the ends of the roller pin. Assemble the helix halves on the handle and slide the grip over the helix.
Be sure the twist-grip's speed indicator line is positioned with the speed range symbol on the handle. Snap the grip into place.

Slide the protective sleeve over the stop switch leads and throttle cable and install stop switch cover.

Installation

Apply *Triple-Guard* grease to the two steering handle bushings. Place the bushings into the steering bracket. Attach the steering handle to the bracket. Tighten screw to a torque of 36 to 40 ft. lbs. (49 to 54 N·m).

**CAUTION**

The steering handle nut must have a nylon patch for locking. Replace the nut if it has lost its locking feature. Tighten the nut so the steering handle can be pivoted and maintained in any position.

Route throttle cable and electrical harness through grommet in lower motor cover. Connect harness to engine wiring harness.

Install electrical cover.
Throttle Cable Adjustment

Place throttle cable in position. Use Ball Socket Installer tool, P/N 342225, to snap throttle cable connector onto throttle lever.

Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle body boss. Then, rotate anchor four turns toward the end of the cable.

Install washer, cable anchor, and cable anchor screw on throttle body boss. Tighten screw securely.

Secure electrical harness with tie strap.

1. Installer tool

Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle body boss. Then, rotate anchor four turns toward the end of the cable.

Install washer, cable anchor, and cable anchor screw on throttle body boss. Tighten screw securely.

Important: Rotate twist grip. Make sure throttle cam goes to full throttle without bending cable, and still returns to IDLE stop.
Removal

**WARNING**

To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

Use Remover tool, P/N 342226, to unsnap the throttle cable clip from the throttle lever.

Remove the throttle cable anchor screw and washer. Remove retainer clip from shift cable. Remove cable retainer. Cut the tie strap holding the tiller handle electrical harness.

Remove the electrical cover.

Disconnect the electrical harness coming from the tiller handle.

Rope Start models

- 1. Electrical harness connector

Tiller Electric models

- 1. Electrical harness connectors

Remove shift and throttle cables and wire harness from grommet in lower engine cover.
Remove locknuts from screws on top of steering arm.

Remove the screws attaching tiller bracket to steering arm. Remove tiller bracket and handle.

**Disassembly**

Loosen throttle friction control so there is no restriction on grip.

**IMPORTANT:** Do not back screw out completely. Nut is under spring tension.

Remove seven screws and bottom cover of tiller handle.

Remove stop switch cover screws, unplug stop switch electrical connector and remove stop switch assembly.
MIDSECTION
TILLER HANDLE SERVICE – LONG HANDLE

Disconnect trim switch connector. Remove connector from trim switch wires. Refer to CONNECTOR SERVICING on p. 148.

Use Twist-Grip Remover, P/N 390767, to depress the grip detents. Tighten screw and remove the grip by pulling grip.

Remove the helix halves, rollers, and guides.

Pull the throttle pin out of the cable.

Remove the throttle friction control.

Remove the throttle cable retaining clip. Pry the cable trunnion out of the steering handle and remove cable.

The trim switch wiring can now be removed from the inner handle.

Remove the screw and washer retaining the inner handle tab.
Use an appropriate tool to carefully pry up on the inner handle retaining tab.

Remove cotter pin from shift handle pin. Remove shift cable.

Use a wooden dowel and a soft mallet to remove the inner handle.

Remove shift handle screw and washer. Remove shift handle, bushing and washer.

Remove shift cable retainer from shift cable trunnion.

Remove shift handle detent ball, spring and guide.
MIDSECTION
TILLER HANDLE SERVICE – LONG HANDLE

Remove the shift pin if necessary.

**Inspection**

Inspect the throttle cable for kinks and wear. Replace if necessary.
Inspect the shift cable for kinks and wear. Replace if necessary.
Inspect the steering handle components for wear, cracks, or damage. Replace parts if necessary.

Refer to **Emergency Stop Switch Test** on p. 134 to test stop switch.

**Assembly**

Apply *Nut Lock* to threads of shift pin and install shift pin into shift handle. Tighten to a torque of 18 to 22 ft. lbs. (24.5 to 29 N·m).

Coat detent ball, spring and guide with *Triple-Guard* grease and install into shift handle. Place one washer on shift handle mounting boss.

Coat bushing and washer with *Triple-Guard* grease. Apply *Nut Lock* to threads of screw.

Install shift handle on tiller handle and tighten screw to a torque of 18 to 20 ft. lbs. (24.5 to 27 N·m).
Install shift cable on shift pin with a new cotter pin. Secure tab of the inner handle into the outer handle. Tab must be flush with the back of the flange and top of tab must be flush with top of flange.

Install shift cable retainer on shift cable trunnion. Apply Nut Lock on the screw threads, install the washer and screw.

Use a soft-faced mallet to install the inner handle. IMPORTANT: Turn self-tapping screw counterclock-wise until threads of screw engage threads of screw boss. Failure to follow this procedure will damage the screw boss threads. Once threads are engaged, tighten screw so that there is no space between tab, washer and screw. Top of tab MUST be flush with top of flange.
Install the throttle control plate on outer handle.

Install trim switch wiring through inner steering handle.

**IMPORTANT:** Trim switch wiring must NOT be twisted through the throttle twist grip or inner tiller handle / wire guide.

Insert wire guide into inner steering handle.

Wire guide should slide easily into place. If any binding is felt, inspect trim switch wiring for twisting. If wire guide is forced into place, it WILL damage trim switch wiring.

Make sure trim switch wiring is NOT twisted before proceeding.
Install the handle end of the throttle cable. Snap the throttle cable trunnion into the recess in the handle. Install the retainer clip.

Push the throttle cable pin through the end of the throttle cable.

Lubricate end of the pin, guides, rollers, helix halves, and inner handle guide slot with *Moly Lube*.

Place the guides over the roller pin and into the slots of the inner handle. Place the rollers on the ends of the roller pin.

Assemble the helix halves on the handle and slide the grip over the helix.

Carefully pull trim switch wires through inner tiller handle as twist grip assembly is installed.

Install trim switch connector. Refer to *CONNECTOR SERVICING* on p. 148.
Be sure the twist-grip's speed indicator line is positioned with the speed range symbol on the handle. Snap the grip into place.

Install stop switch assembly and connect to harness.

Install bottom cover of tiller handle with seven screws.

---

Installation

The steering arm can be positioned straight, or angled 15° port or starboard by moving the adjustment plate.

Place tiller bracket on steering arm from the bottom. Thread steering arm screws, with washers, into steering arm and tighten to a torque of 18 to 20 ft.lbs. (24.5 to 27 N·m).

Install locknuts on screws on top of steering arm. Hold screws with wrench and tighten locknuts to a torque of 18 to 20 ft.lbs. (24.5 to 27 N·m).
Control Cable Installation

**IMPORTANT:** DO NOT complete final attachment of cables to shift and throttle levers until all cables, wires, and hoses have been routed and grommet has been placed into the lower engine cover.

### Shift Cable Adjustment

Pull firmly on shift cable casing to remove backlash. With outboard and tiller handle shift lever in NEUTRAL, place the cable trunnion into the lower anchor pocket. Adjust the trunnion nut so the casing fits onto the shift lever pin.

Secure shift cable to the shift lever pin. For proper installation, review the following steps:

- Place washer on pin.
- Position retainer clip with straight section on the bottom and angled section on the top.
- Use long nose pliers to insert straight section of clip into linkage pin hole.
- Push the clip towards the hole while lifting on the curved end with the pliers.
- Be sure retainer clip fully engages the pin.
- Lock the retainer by moving the angled section **behind** the straight section.

**Locked Retainer Clip**
1. Angled section **behind** straight section

---

Route shift and throttle cables and electrical harness through grommet in lower motor cover. Connect harness to engine wiring harness.

Use tie strap to secure harness to throttle body bracket.

**Rope Start models**
1. Electrical harness connector
002511

**Tiller Electric models**
1. Electrical harness connectors
001999

1. Shift lever pin
2. Trunnion nut
002100

**Bracket**
006314

1. Electrical harness connector
1. Electrical harness connectors
002511
001999
Throttle Cable Adjustment

Place throttle cable in position. Use Ball Socket Installer tool, P/N 342225, to snap throttle cable connector onto throttle lever.

Install washer, cable anchor, and cable anchor screw on throttle body boss. Tighten screw securely.

Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle body boss. Then, rotate anchor four turns toward the end of the cable.

IMPORTANT: Rotate twist grip. Make sure throttle cam goes to full throttle without bending cable, and still returns to IDLE stop.
MIDSECTION AND TILLER ADJUSTMENTS

Steering Friction Adjustment

Tiller models are equipped with a steering friction adjustment. Steering friction is not required when remote steering is used.

Adjust steering friction with outboard mounted to boat by loosening or tightening the adjustment screw. Steering friction should be adjusted so a slight drag is felt when turning.

**WARNING**

- Do not overtighten. The steering friction screw is not intended to allow “hands off” steering.

Throttle Friction Adjustment

Tiller models are equipped with a throttle friction adjustment knob located on the steering handle. Tighten the knob to reduce the effort required to hold a throttle setting.

Turn the knob:
- clockwise to increase friction
- counterclockwise to decrease friction

**WARNING**

- Tighten knob only enough to hold throttle at a constant engine speed. Overtightening will prevent quick throttle change in case of emergency.
### Technician’s Notes

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# GEARCASE

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PROPELLER SERVICE

Inspection
Carefully examine propeller and outboard for the following:
• Damaged blades and signs of propeller cavitation (burned paint, etc.)
• Spun or overheated inner hub
• Worn or twisted splines and inadequate lubricant
• Damaged or missing converging ring (if applicable)
• Damage to outer hub area
• Worn, missing, or incorrect thrust washer and spacer
• Correct size and style
• Check for bent or damaged propeller shaft and twisted splines.

Refer to Propeller Hardware Installation on p. 61.

GEARCASE LEAK TEST

Drain lubricant before testing.

Install lubricant drain/fill plug and seal, thread pressure test gauge fitting and seal in lubricant level hole.

Pressurize 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leak.

If the gearcase pressure gauge does not indicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leakage.

Make necessary repairs and repeat test.

Install vacuum test gauge. Apply 3 to 5 in. of vacuum (76 to 127 mm) Hg. with pump.

Check for leaks.

If leakage occurs, apply oil around suspected seal. If leak stops or oil is drawn in, that seal is defective.

Repeat test, gearcase must hold minimum of 15 in. vacuum (381 mm) Hg.

WARNING

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and disconnect the battery positive (+) cable so the outboard cannot be started accidentally.

GEARCASE
GEARCASE REMOVAL AND INSTALLATION

Gearcase Removal

WARNING

To prevent accidental starting while servicing, twist and remove all spark plug leads.

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.

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

Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw and trim tab from the gearcase.

Remove the forward screw with washer and recessed retaining screw.

Remove the four gearcase retaining screws.

Remove the gearcase assembly from the exhaust housing, being careful not to bend the shift rod.

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 installing gearcase, shift rod adjustment MUST be checked. Refer to SHIFT ROD ADJUSTMENT on p. 280.

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

Apply Adhesive 847 to the exhaust housing seal's inner surface. Place the seal on the exhaust housing. Apply Triple-Guard grease to the seal's outer surfaces.

Slide the gearcase into place, making sure:
- Driveshaft engages the crankshaft.
- Inner exhaust housing installs correctly.
- Shift rod does not turn and is positioned properly in shift shaft connection area.

Apply Gasket Sealing Compound to threads of the gearcase retaining screws. Tighten the screws to a torque of:
- **3/8 in.** screws – 18 to 20 ft. lbs. (24 to 27 N·m)
- **7/16 in.** screw – 28 to 30 ft. lbs. (38 to 40 N·m)
- **5/16 in.** screw – 10 to 12 ft. lbs. (13.5 to 16 N·m)

Apply Gasket Sealing Compound to threads of the trim tab screw. Install and align the trim tab with the index marks noted prior to disassembly. Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m). For adjustment, refer to Trim Tab Adjustment on p. 63.
Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

**IMPORTANT:** During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

---

**WARNING**

To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

---

**WATER PUMP SERVICE**

**Disassembly**

Remove the four impeller housing screws.

Slide the water pump off the driveshaft. Remove the impeller drive cam, impeller plate, and gasket. Discard the gasket.

Remove all the parts from the housing.

**Inspection**

Check impeller for overheating, hub separation, and other wear or damage.

Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.
Assembly

Lightly coat the exterior rim of the impeller cup with Gasket Sealing Compound. Install the cup in the impeller housing. The cup locks in place in the housing with a square index tab.

IMPORTANT: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.

Lightly coat the inside of the liner with Triple-Guard grease. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller cam facing out.

Apply a thin bead of Adhesive 847 in the seal groove, and install the special shaped O-ring seal.

Apply Gasket Sealing Compound to both sides of a new impeller plate gasket. Install the gasket and impeller plate.

Apply Triple-Guard grease or Adhesive 847 to temporarily hold drive cam in place.

The sharp edge of the cam is the leading edge in clockwise rotation.

Slide the water pump down the driveshaft. Align impeller slot with the impeller cam. Rotate the driveshaft to engage the impeller cam with the
impeller, and slide water pump down over cam. Be sure impeller cam does not fall out of position.

**SHIFT ROD ADJUSTMENT**

Check the shift rod height from the shift rod hole to the surface of the gearcase using Universal Shift Rod Height Gauge, P/N 389997.

**IMPORTANT:** Before installing gearcase, shift rod adjustment MUST be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 280.

With the gearcase in NEUTRAL, rotate the shift rod up or down as necessary for correct adjustment. Once correct height is achieved, rotate rod one half turn or less to direct offset to the rear.

**Shift Rod Height:**
- 21.38 in. (543 mm) ± One-Half Turn
GEARCASE

GEARCASE DISASSEMBLY

Pre-Disassembly Inspection

**WARNING**

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

**IMPORTANT:** Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in Gearcase Lubricant on p. 71.

Remove gearcase. Refer to Gearcase Removal and Installation on p. 276.

Remove water pump. Refer to Water Pump Service on p. 278.

Before disassembling the gearcase, examine the following:

- **Gearcase Housing** — Check for visible damage to skeg, strut, anti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- **Propeller Shaft** — Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- **Shift Rod** — Check for misadjusted, bent, or binding rod. A misadjusted shift rod height can cause shift difficulty, loss of boat and outboard control, and gearcase damage.
- **Hydrostatic Seal Grooves** — Must be in good condition to help prevent propeller ventilation.
- **Gearcase Anodes** — If anodes have eroded to two-thirds their original size, they must be replaced.
- **Drive Shaft** — Check splines for visible damage, twisting and wear. Severe spline wear indicates the exhaust housing or gearcase has been distorted, possibly by impact damage.
- **Water Intake Screens** — Check for damage and blockage. If screens cannot be cleaned, they must be replaced. Different screens are available and should not be mixed. Refer to correct model parts manual for listing and description.
Propeller Shaft Bearing Housing Removal

Use a 5/16 in. thin wall socket to remove the four screws with O-rings holding the propeller shaft bearing housing.

Remove the propeller shaft bearing housing from the gearcase using the following:
- Puller body, screw, and handle from Universal Puller Set, P/N 378103.
- Two 5/16-18 x 8 in. screws, P/N 316982, from Universal Puller Set, P/N 378103.

Remove the two retaining rings using Retaining Ring Pliers, P/N 331045.

**CAUTION**
Retaining rings are under extreme pressure during removal and installation. To prevent personal injury, wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers. After the retaining rings are removed far enough from the gearcase to clear the housing, release the tension on the pliers while retaining ring is still around the propeller shaft.

Remove the retainer plate from the gearcase.
Remove the larger thrust washer, thrust bearing, and reverse gear from the gearcase. Remove the smaller thrust washer located in front of the gear.

Pinion Gear and Driveshaft Removal

Adjust the shift rod to move the clutch dog as far forward as possible. This will help ease removal of the pinion nut.

Use Driveshaft Holding Socket, P/N 334995, and an 11/16 in. open-end wrench to loosen the pinion nut from the bottom of the driveshaft. Pad handle of the wrench to prevent damage to gearcase.

Remove pinion nut and driveshaft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.

If driveshaft cannot be removed, refer to Locked Driveshaft Removal on p. 284.

Remove the pinion gear and pinion nut from the gearcase.
Locked Driveshaft Removal
The driveshaft to pinion taper is a locking taper. If necessary, use Puller, P/N 387206, and Backing Plate, P/N 325867, to break the lock. Install the tools as shown by clamping them around the driveshaft with the tool’s setscrew aligned with the impeller drive cam slot. Tighten the setscrew into the slot. 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.

Discard the cover gasket. Remove and discard the shift rod O-ring from inside of cover.

![Driveshaft Removal](COA3666)

1. Drive shaft
2. Puller
3. Backing plate

Shift Housing, Gear and Propeller Shaft Removal
Push down on the shift rod. This will move the detent lever downward to clear the inside of the gearcase when the shaft assembly is pulled out. Unscrew the shift rod from the detent lever. Remove screws, cover, and shift rod from the gearcase.

![Shift Housing Removal](COA3575)

**IMPORTANT:** Make sure oil fill/drain plug is removed from gearcase.

Remove propeller shaft assembly from gearcase.
INTERNAL GEARCASE SERVICE

Pinion Bearing Removal

Inspect the pinion bearing for damage without removing it. If the bearing is removed for any reason, it must be replaced.

If the pinion bearing must be replaced, remove the bearing retaining screw from the gearcase. Discard the O-ring from the screw.

Assemble Pinion Bearing Remover and Installer, P/N 391257, in the gearcase as follows:

1. Bearing retaining screw
2. Flange Nut, P/N 326586
3. Rod, P/N 326582
4. Remover, P/N 326580

Use a 1 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise and draw the bearing up from the housing.

Water Intake Screen

Inspect the water intake screen for blockage and remove it by depressing the tabs on either side of the screen and pushing upward.

Assemble Pinion Bearing Remover and Installer, P/N 391257, as shown:

1. Water intake screen
2. Flange Nut, P/N 326586
3. Plate, P/N 391260
4. Rod, P/N 326582
5. Installer, P/N 326575
6. 1/4-20 X 1 1/4 in. Hex head screw

IMPORTANT: Spacers are different sizes and cannot be interchanged. Be sure to use the correct part number.

Pinion Bearing Installation

Install the water intake screen. Drop it into the water intake cavity and use a suitable tool to push it down as far as it will go.

Assemble Pinion Bearing Remover and Installer, P/N 391257, as shown:
GEARCASE
INTERNAL GEARCASE SERVICE

Place the bearing on the installer tool with the lettered side of the bearing facing the top of the gearcase. Use Needle Bearing grease to hold the bearing on the tool.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Place a new O-ring on the pinion bearing retaining screw. Apply Gasket Sealing Compound to O-ring and Nut Lock to screw threads. Install the screw and tighten to a torque of 48 to 80 in. lbs. (5.5 to 9.0 N·m).

Shift Housing Disassembly

**WARNING**

Wear safety glasses to avoid injury.

**IMPORTANT:** The shift housing and forward gear bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring.**

Push the pin out of the clutch dog. Remove all parts.

Remove the gear, thrust bearing, and thrust washer from the shift housing.
Remove the shift lever pin from the housing. Remove shift shaft, cradle and shift lever. Move shifter detent as needed to help ease removal of parts.

Wrap the housing with a shop cloth to catch ball and spring. Rotate the shifter detent 90° in either direction, then pull the detent out of the housing.

Lightly coat the detent ball and spring with Needle Bearing grease. Insert the spring in the housing, then the ball.

Insert shifter detent at 90° angle into the housing as shown, while depressing the ball and spring with a suitable tool. Once the shifter detent is past the ball, remove the tool and position detent to engage NEUTRAL position.

Remove the detent ball and spring.
With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.

Coat thrust bearing and thrust washer with Needle Bearing grease. Place the bearing on the back of the gear. Set the washer on top of the thrust bearing. Insert the gear, bearing, and washer into the bearing housing.

**IMPORTANT:** Bearing and washer must be installed in the correct order.

Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog with grooved end toward the forward end 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.

Rest the cradle on the shift shaft.

Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEUTRAL position to hold the cradle and shaft in position.
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. Place three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.

Clean the bearing housing in solvent to remove sealer from the seal bore and the O-ring groove.

Lightly apply *Gasket Sealing Compound* to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

**IMPORTANT:** Do not install the O-ring in the bearing housing's bottom groove. The bottom groove is an oil passage. Gearcase damage could result.

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**Driveshaft Bearing Housing Service**

The driveshaft bearing is not serviceable. Replace the bearing housing assembly if the bearing is worn or damaged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Remove the driveshaft bearing housing seal using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seal.

Apply *Gasket Sealing Compound* to metal casings of new seal before installing.

Use Seal Installer, P/N 342665 to install seal in bearing housing with the exposed lip facing away from housing. Apply *Triple-Guard* grease to seal lips.

Remove and discard the O-ring from the bearing housing.
Propeller Shaft Bearing Housing Service

Rear Seal Removal
Remove seals using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.

Bearing Removal

IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

Remove rear bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.

Inspect the bearing housing anode. Replace anode if it is reduced to two-thirds of original size. Tighten screws to a torque of 108 to 132 in. lbs. (12 to 15 N·m).

Remove front bearing using Puller Bridge, P/N 432127, and Bearing Puller, P/N 432130. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.

Discard the bearing housing O-ring. Clean the housing and bearings in solvent and dry thoroughly. If bearings were not replaced, rotate the needles to check for freedom of movement.

Inspect O-ring groove. Sand off any sharp edges that might cut O-ring. Remove any nicks or burrs on front of bearing housing.
Thoroughly clean the four bearing housing retaining screws in solvent. Discard the O-rings.

**Bearing Installation**

Oil, then install new bearings in bearing housing.

Place the **lettered end** of the bearing case on the bearing installer, then press the bearing into the housing until the tool seats. When installed, the lettered end of the bearing should be visible.

**Bearing Installation Tool:**
- P/N 326562

**Rear Seal Installation**

Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

**Seal Installation Tool:**
- P/N 326551

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.

Apply *Triple-Guard* grease to seal lips.
DRIVESHAFT SHIMMING

IMPORTANT: If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is adjusted by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion, or driveshaft, it is necessary to properly shim the assembly to restore the correct clearance.

Use Driveshaft Shimming Tool, P/N 5005925.

Shim gauge bars are precision made and should be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 312403, when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with outboard lubricant and tighten to a torque of 40 to 45 ft. lbs. (54 to 60 N·m).

IMPORTANT: The original pinion nut may be used for shimming, but must NOT be used in final assembly.

Select correct collar and shim gauge bar:
- Collar: P/N 328363
- Shim gauge bar: P/N 328366

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.

Rotate the driveshaft several revolutions to seat bearings.

Lay the tool base on its side. Place the shim gauge bar against guide pins of the tool base.

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating just the bearing housing. Use a feeler gauge to measure clearance.
between the gauge bar and the bearing housing between each pair of screw holes. Replace the bearing housing and repeat check if variance is greater than 0.004 in. (0.010 mm).

Check squareness of the pinion to the driveshaft. Hold the shim gauge bar against the bearing housing (between the screw holes) while rotating just the driveshaft and pinion assembly. Measure clearance between the gauge bar and the pinion at several locations. If variance is greater than 0.002 in. (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

**IMPORTANT:** Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 312403.

Check clearance again. The measurement between the gauge bar and pinion should be 0.020 in. (0.508 mm).

Remove the nut and pinion from the driveshaft. Discard the nut.

---

**GEARCASE ASSEMBLY**

**Shift Housing, Gear, and Propeller Shaft Installation**

Push shifter detent into farthest downward position. Tip the rear of the gearcase slightly downward to assist in the installation of the shaft assembly.

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully into the gearcase while aligning shift housing pin with hole in forward end of gearcase housing.

**Shift Rod Housing Installation**

Lubricate a new shift rod cover O-ring with Triple-Guard grease. Install the O-ring into the shift rod cover.

**IMPORTANT:** Make sure O-ring is fully seated in groove.
Apply *Triple-Guard* grease to the threaded end of the shift rod and insert it through the cover. Turn the shift rod while pushing it through the cover to avoid damaging the O-ring.

![Cover gasket](image1)

Apply *Gasket Sealing Compound* to both sides of a new shift rod cover gasket. Place the gasket on the gearcase. Thread the shift rod into the shifter detent about four turns.

![Cover gasket](image2)

Move shift rod from side to side while pushing on the propeller shaft to ensure proper alignment of the bearing housing locator pin into the pin hole in the gearcase.

Apply *Gasket Sealing Compound* to the threads of the shift rod cover screws. Tighten the screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Place the cover seal on the shift rod cover.

![Cover seal](image3)

**Pinion Gear and Driveshaft Installation**

Refer to *DRIVESHAFT SHIMMING* on p. 292 before proceeding.

Install new seals in driveshaft bearing housing. Refer to *Driveshaft Bearing Housing Service* on p. 289.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.

![Thrust bearing and shims](image4)

Lightly apply *Gasket Sealing Compound* to the gearcase area that contacts mounting flange of
the driveshaft bearing housing. Do not coat inside bearing housing bore surface of the gearcase.

Adjust shift rod to move clutch dog as far forward as possible. Be sure excess grease is removed from the pinion bearing.

**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.

Place the pinion gear into the gearcase. Insert the driveshaft into the gearcase and through the pinion gear.

Using Driveshaft Seal Protector, P/N 312403, slide the driveshaft bearing housing onto the driveshaft and into position in the gearcase. Align the embossed word “FRONT” toward the shift rod. Do not install screws at this time.

Lightly coat the threads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 320675, to install nut on the driveshaft. Turn the driveshaft by hand to thread the nut on to shaft.

Apply *Gasket Sealing Compound* to the threads of the driveshaft bearing housing screws. Tighten screws **in stages** to a torque of 96 to 120 in. lbs. (11 to 14 N·m).

Use Driveshaft Holding Socket, P/N 334995, and an 11/16 in. open-end wrench, to tighten the pinion nut to a torque of 40 to 45 ft. lbs. (54 to 60s
GEARCASE
GEARCASE ASSEMBLY

N·m). Pad handle of the wrench to prevent damage to gearcase.

Propeller Shaft Bearing Housing and Gear Installation

Place the small thrust washer in recess of the reverse gear.

Oil and install thrust bearing and larger thrust washer on hub of reverse gear. Slide the gear assembly onto the propeller shaft until it engages the pinion gear.

Slide the bearing housing retainer plate into position over the propeller shaft.

Using Retaining Ring Pliers, P/N 331045, install the two retaining rings.

CAUTION

Retaining rings are under extreme pressure during installation. Wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers.
Make sure the retaining rings are seated in the grooves in the gearcase.

Install O-ring in groove in the bearing housing. Lightly apply Gasket Sealing Compound to the O-ring flange and aft support flange of the bearing housing. Do not allow sealer to contact either forward thrust surface or bearings in the housing.

Align the bearing housing on the guide pins with the word “UP” toward the top. Place the housing into gearcase and tap the housing with a soft face mallet to seat the O-ring.

Apply Gasket Sealing Compound to the threads and seals of the four propeller housing retaining screws. Install two of the screws into the bearing housing finger tight. Remove the guide pins and install the remaining two screws. Tighten all four screws to a torque of 120 to 140 in. lbs. (14 to 16 N·m).

To complete gearcase assembly, refer to:
• GEARCASE LEAK TEST on p. 275
• WATER PUMP SERVICE on p. 278
• SHIFT ROD ADJUSTMENT on p. 280
• GEARCASE REMOVAL AND INSTALLATION on p. 276
• Gearcase Lubricant on p. 71
• Propeller Hardware Installation on p. 61
• Trim Tab Adjustment on p. 63.

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.
## NOTES

### Technician’s Notes

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# TRIM AND TILT

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SYSTEM DESCRIPTION

The hydraulic unit consists of a manifold that contains all valving, fluid reservoir, pump, motor, and cylinder.

The hydraulic unit pivots on the lower thrust rod and the piston rod attaches to the underside of the swivel bracket.

As the cylinder begins to extend, the first 15° of outboard movement is considered the trim range. As the cylinder continues to extend, the remaining 50° of outboard movement is considered the tilt range. Total outboard movement is 65°.

The outboard can be manually raised or lowered through its entire trim and tilt range by opening the manual release valve a minimum of three turns. When this cycle is complete, the manual release valve must be closed and tightened to a torque of 45 to 55 in. lbs. (5 to 6 N·m) before normal operation can be resumed.

A trim gauge can be purchased for the outboard. The gauge's sending unit is located on the port side of the swivel bracket.

When the outboard is tilted for long periods of time or trailered in the tilted position, the outboard's weight must be mechanically supported. The outboard is equipped with trailering locks. When they are engaged, the cylinder must be retracted until the trailering locks are firmly seated on the stern brackets.
ROUTINE INSPECTIONS

General
Check for external signs of fluid leakage. Correct causes as necessary.

Check the battery and make sure it is in good operating condition.

Reservoir Fluid
Check reservoir fluid level at least every three years or 300 operating hours. System capacity is approximately 15.2 fl. oz. (450 ml).

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

Refer to Trim and Tilt on p. 73 for filling procedure.

Manual Release Valve
Check the manual release valve with a torque wrench.

IMPORTANT: The valve must be tightened to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

Stern Brackets
Inspect the stern brackets for binding.

Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

ELECTRICAL CIRCUIT TESTS

Relay Testing
When the trim-UP button is pressed, the UP relay is energized and connects the blue trim motor wire to the battery positive (+) terminal. The green trim motor wire remains grounded. When the button is released, the blue trim motor wire returns to a grounded position.

When the trim-DOWN button is pressed, the DOWN relay is energized and connects the green trim motor wire to the battery positive (+) terminal. The blue motor wire remains grounded. When the button is released, the green trim motor wire returns to a grounded position.

Refer to TILT/TRIM RELAY TEST on p. 135 for relay testing procedure.

Trim and Tilt Motor Current Draw Tests
Careful analysis of the electric motor’s current draw and trim/tilt unit operating speed aids evaluation of the electric motor and certain mechanical components.

Use a battery rated at 360 CCA (50 Ah) or higher that is in good condition and fully charged to perform this test.

IMPORTANT: Specifications are for static hydraulic tests. DO NOT attempt to perform the following tests while the boat is moving.
TRIM AND TILT
ELECTRICAL CIRCUIT TESTS

Connect a 0 to 100 A DC ammeter in series between the battery side of the starter solenoid and the red lead to the trim/tilt relay module.

![Diagram of ammeter connection](image)

1. Red lead

Observe ammeter and a stopwatch while running hydraulic unit through several complete cycles.

Compare test results to the values listed:

<table>
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<tr>
<th>Mode</th>
<th>Normal Current Draw</th>
<th>Time in Seconds</th>
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<tr>
<td>Stall UP</td>
<td>11 to 16 Amps</td>
<td>–</td>
</tr>
<tr>
<td>Stall DOWN</td>
<td>16 to 22 Amps</td>
<td>–</td>
</tr>
<tr>
<td>Full Range UP</td>
<td>–</td>
<td>13 to 19</td>
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<tr>
<td>Full Range DOWN</td>
<td>–</td>
<td>10 to 16</td>
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Test results include three basic possibilities:

A. Low current draw – Check for:
   - Valves leaking
   - Pump damaged
   - O-rings leaking

B. High current draw – Check for:
   - Pump binding
   - Motor binding
   - Valves sticking
   - Relief valve springs damaged

C. Normal current draw, slow operating speed – Check for:
   - Damaged pump control piston
   - Malfunctioning check valves

Trim and Tilt Motor No Load Test

**IMPORTANT:** Securely fasten motor in a suitable fixture before proceeding with this test.

Use a battery rated at 360 CCA (50 Ah) or higher that is in good condition and fully charged to perform this test.

Connect a 0 to 25 A ammeter in series with the battery positive (+) terminal, ammeter red lead toward terminal.

Attach or hold a vibration or mechanical tachometer to the motor while performing this test.

Monitor motor RPM and current draw.

![Motor RPM and current draw](image)

The motor shaft must rotate clockwise, as viewed from the pump end, when positive (+) is applied to the blue lead, and negative (–) is connected to green lead.
The motor shaft must rotate counterclockwise, as viewed from the pump end, when positive (+) is applied to the green lead, and negative (–) is applied to the blue lead.

If test results vary, replace the motor.

**Trim Gauge Test**

**STEP 1**

Turn key switch ON. Using a voltmeter, check for voltage between the trim gauge “I” and “G” terminals.
- If no voltage, check condition of instrument harness, key switch, and engine 20 A fuse.
- If voltage is shown, go to **STEP 2**.

**STEP 2**

Remove the white/tan lead from the trim gauge “S” terminal. With key switch ON, gauge should indicate full-trim DOWN position. Now connect a jumper wire between terminals “S” and “G.” Gauge should indicate full-trim UP position.
- If results are different, replace the trim gauge.

- If results agree, refer to **Trim Sender Test**.

**Trim Sender Test**

**IMPORTANT:** To avoid immediate meter damage, never apply an ohmmeter to an electrical circuit where voltage is present.

Disconnect the 3-pin Deutsch connector between the instrument harness and engine trim harness. Connect an ohmmeter between the white/tan wire, terminal “C,” of the engine harness and a clean engine ground.

With the outboard fully DOWN, meter must show a reading above 80 ohms.

With the outboard fully UP, meter must show a reading below 10 ohms.
- If results agree, refer to **Trim Gauge Test** on p. 303.
- If results are different, replace trim sender.
SERVICING

Removal

Raise the outboard and engage the tilt support.

Remove the blue and green wires from pump motor connector housing.

Remove the spring clip from the cylinder pin.

Thread Adapter, P/N 340624, onto Slide Hammer, P/N 391008. Screw the adapter into the cylinder pin and remove the pin.

Remove one of the 3/4 in. locknuts from the angle adjustment rod. Remove the rod from the stern brackets.

Remove the unit from the stern brackets far enough to remove the ground lead from the pump motor mounting screw.

Disassembly

Thoroughly clean the unit before disassembling. Scrub all outside surfaces with a stiff brush and hot, soapy water to prevent surface dirt from contaminating internal parts.

Always use a lint free shop cloth when handling power trim/tilt components.

If painting the unit is required, paint it after it is completely assembled. Painting of individual components may cause flakes of paint to enter the
hydraulic passages during assembly. Tape the trim/tilt piston rods before painting.

**WARNING**

There may be high pressure behind some power trim valves. To avoid injury when removing manual release valve, be sure to cover valve with a shop cloth until the pressure is released. Wear safety glasses.

**IMPORTANT:** Before removing manual release valve, relieve pressure by fully extending cylinder. Screw the manual release valve in. Remove the retaining ring using a small pick or screwdriver.

Inspect the manual release valve. Discard the O-rings on the housing.

Remove the four large motor flange retaining screws. Remove the motor and discard O-ring.

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

Position the motor on the manifold and install the four screws and lock washers. Tighten the screws to a torque of 35 to 52 in. lbs. (4 to 6 N·m).

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).

Install retaining ring in groove.

Fill the oil reservoir up to the fill plug with Evinrude/Johnson Biodegradable TNT Fluid. Install the fill plug.
Run the motor, then recheck oil level. Cycle the unit several times and check the oil level when the cylinder is fully extended. Oil should be level with bottom of fill port. Install and tighten the fill plug to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

Install the ground lead. Position the hydraulic unit between the stern brackets.

Lubricate the angle adjustment rod with *Triple-Guard* grease. Install the rod. Tighten the locknuts to a torque of 20 to 25 ft. lbs. (27 to 34 N·m).

Connect the pump motor wires.

Lubricate the cylinder pin with *Triple-Guard* grease. Align the cylinder into the swivel bracket. Install the cylinder pin.

Secure the cylinder pin with cotter clip.

**Installation**

Lubricate the cylinder and thrust rod bushings with *Triple-Guard* grease. Install the bushings.
ADJUSTMENTS

Refer to Trim Sending Unit Adjustment on p. 62.
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Red Ultra Lock

Blue Nut Lock

Lubriplate 777
RECOIL STARTER REMOVAL

WARNING
To prevent accidental starting while servicing, twist and remove all spark plug leads.

Remove the clamp holding the oiling system wiring harness.

Remove the three starter housing screws and washers.

Lift starter housing from outboard.

Remove three screws and remove starter ratchet from flywheel.

RECOIL STARTER DISASSEMBLY

WARNING
Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

Pull the starter rope out far enough to tie a slip knot in the rope. Untie the end knot of the starter rope and remove the handle. Release the slip knot and ease the rope back in until the rewind spring is fully unwound. If necessary, remove the starter handle bracket from the starter housing.

Remove the rope guide shoulder screw and guide from the starter housing.
MANUAL STARTER
RECOIL STARTER DISASSEMBLY

Remove the nut from the starter pawl retaining screw.

1. Nut

Remove the starter pawl retaining screw, washer, and starter pawl plate with plate return spring from the starter assembly.

1. Screw
2. Washer
3. Plate
4. Spring

Remove starter housing spring and starter pawl with spring washer from the starter assembly.

1. Spring
2. Starter pawl
3. Spring washer (under starter pawl)

Use a screwdriver to pry open the pulley lock ring, and remove ring from the starter.

1. Lock ring

Remove the friction plates and friction plate spring washer.

1. Friction plates
2. Friction plate spring washer

Hold the pulley in the starter housing while turning the starter over, legs down. Hold fingers clear of the pulley and jar the starter housing against a bench to dislodge the rewind spring and pulley. Remove the pulley bushing from the pulley.
RECOIL STARTER CLEANING AND INSPECTION

Wash metal components in solvent and dry with compressed air.

Inspect the rewind spring for broken end loops and weak tension.

Examine the starter pawl for wear.

Inspect the starter components for wear. Replace as necessary.

Inspect starter rope. Replace rope if frayed. Cut new rope 96.5 in. (245 cm) in length. Fuse ends of rope to a length of 1/2 in. (12 mm).

Examine the pulley and the starter housing. Look for sharp edges and rough surfaces that could fray the starter rope. File and polish to remove.

Examine the starter and starter lockout parts. Replace any worn or damaged parts.

RECOIL STARTER ASSEMBLY

WARNING
Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

Place starter spring shield into the starter housing.

1. Shield

Clamp base of Starter Spring Winder and Installer, P/N 392093, in a vise. Insert release plate into spring winder base.

1. Base
2. Plate
Apply *Triple-Guard* grease or *Lubriplate 777* to the rewind spring. Install the rewind spring into the spring winder base with open loop of spring facing inward. Insert the pin of the crank and pin assembly into the loop of the rewind spring. Secure the crank and pin assembly to the starter winder base with the crank retainer screw.

Rotate the crank and pin assembly in the direction shown on the tool. Wind the spring into the starter winder base until end of spring contacts the starter winder base.

Remove the crank retainer screw and the crank and pin assembly from the starter winder base. Remove the starter winder base from the vise.

Install the rewind spring into the starter housing. Locate the outer loop of the rewind spring on the pin in the starter housing. Press down through the holes in the spring winder base to transfer the rewind spring into the starter housing.

Apply *Triple-Guard* grease or *Lubriplate 777* to the pulley bushing. Install the pulley bushing in the pulley. Place the pulley shim on the pulley.

Bend the inside loop of the rewind spring in toward the center of the starter housing. Place the
inner loop of the spring in the slot of the pulley, and install the pulley in the starter housing.

Place the friction plate spring washer between the two friction plates on the pulley hub. Secure the friction plate and friction plate spring washer with the pulley lock ring.

Make sure the starter pawl bushing is installed in the pulley. Apply Triple-Guard grease or Lubriplate 777 to boss of the starter pawl. Place spring washer on the boss of the starter pawl. Place the starter pawl in the pulley.

Place the starter housing spring in the starter housing.

Install the starter pawl plate return spring on the starter pawl plate. Press the other end of spring on the boss of the pulley. Position the starter pawl plate on the pulley.

Clean threads of the starter pawl plate retaining screw and nut to remove adhesive.
Install the starter pawl plate retaining screw and washer into the starter housing. Tighten screw to a torque of 96 to 120 in. lbs. (11 to 13.5 N·m).

Spray threads of starter pawl plate retaining screw and nut with Locquic Primer. Apply Nut Lock to the threads of the nut. Install and tighten the nut securely.

Install the rope guide and shoulder screw to the starter housing. Tighten the screw securely.

If removed, install the starter handle bracket to the starter housing. Tighten screws securely.

Tie a knot in one end of the starter rope. With the starter housing upside down on a bench, wind the pulley counterclockwise until the rewind spring is tight.

Back off the rewind spring until the rope cavity of the pulley is aligned with the rope guide. Thread the starter rope through the pulley, rope guide, and outlet in the starter handle bracket.

Seat the knotted end of the starter rope in the pulley. Tie a slip knot in the starter rope to hold rope in position.

Apply Triple-Guard grease or Lubriplate 777 to the handle end of the starter rope. Using Starter Rope Threading Tool, P/N 378774, thread the starter rope through the handle and insert.

Tie a knot in the end of the rope.

Check operation of the starter pawl when the starter rope is pulled out. The starter pawl should extend when the starter rope is pulled and retract when the starter rope recoils.
RECOIL STARTER INSTALLATION

Apply *Nut Lock* to the threads of starter ratchet screws. Install washers and ratchet on flywheel. Tighten screws to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).

Place the starter assembly onto the outboard. Install the starter housing retaining screws, washers, and lock washers. Be sure to place washers between the starter housing and the flywheel cover. Apply *Ultra Lock* to threads and tighten the three starter housing screws to a torque of 120 to 144 in. lbs. (14 to 16 N·m).

Install clamp for oiling system wiring harness.
## Technician’s Notes

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MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM

WARNING
This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

• Product user is informed; and
• Products are safe and reliable.

It is up to you, the people who...

• Rig boats;
• Fix machinery; and
• Maintain equipment

...to keep the products safe and reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

First!
A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS
“They look the same, but are they the same?”

• Same size?
• Same strength?
• Same material?
• Same type?

Don’t substitute unless you know they are the same in all characteristics.

Second!

• Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
• When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.
• When the outboard is returned to the boat, use only the special nuts and bolts to hold remote steering, shift, and throttle cables to the outboard.
Outboard Shift Systems and Safety

The outboard Shift System starts here at the remote control lever...

...and ends here at the propeller.

What is most important?

When control lever is in FORWARD, NEUTRAL or REVERSE...

...shift linkage must match control lever position.

What could happen?

IF...

...propeller still powered (turning) unknown to operator, or outboard will START in gear, and boat will move suddenly.

IF...

...boat will move opposite to direction wanted by operator.

How can loss of shift control be minimized?

Read, understand, and follow manufacturer’s instructions

- Follow warnings marked “△” closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure propeller does just what the operator wants and nothing else.
- Do not shift gears on a stopped outboard. Adjustments can be lost and parts weakened.

When rigging or after servicing
Outboard Speed Control System and Safety

What is most important?

When control lever is moved from FORWARD (or REVERSE) to NEUTRAL...

Powerhead speed must slow down to allow operator to shift into NEUTRAL.

Operator must be able to STOP propeller.

What could happen?

If Operator cannot slow down the outboard or shift into NEUTRAL gear (stop propeller), Operator could panic and lose control of boat.

How can loss of speed control be minimized?

Read, understand, and follow manufacturer’s instructions
- Follow warnings marked “Δ” closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else.
- Make sure full throttle can be obtained so Operator will not overload parts.
Outboard Steering Control System and Safety

The steering system:
• Must not come apart;
• Must not jam; and
• Must not be sloppy or loose.

What could happen?

• If steering system comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.

• If steering jams, operator may not be able to avoid obstacles. Operator could panic.

• If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high speed), loose steering could lead to loss of boat control.
How can loss of steering control be minimized?

- Use a steering system recommended by the outboard manufacturer which meets Marine Industry Safety Standards (ABYC).
- **Read, understand, and follow** manufacturer’s instructions
- Follow warnings marked “Δ” closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Keep parts moving freely. Lubricate parts as shown in manual.
- Use the bolts, nuts and washers supplied with steering attachment kits—they are a special locking type that will not loosen, rust, or weaken.

**Transom Mounted Steering Systems – Check to Uncover Possible Trouble!**

Tilt outboard into boat, then turn it.

During this procedure, steering parts:
- Must not bind; and
- Must not touch other boat, outboard, or accessory parts in transom area.

**Why?** A hard blow to the outboard’s gearcase can result in damage to steering parts.

Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

Check for damaged parts. Blows to the outboard like this

or this can put heavy loads on steering parts. Look for:
- Cracked parts, including steering parts, swivel brackets, and transom brackets;
- Bent parts; and
- Loose nuts and bolts.

Replace damaged parts. If weakened, parts could fail later on the water when least expected.
Outboard Fuel, Electrical System, and Safety

What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

What could happen?

- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

- **Read, understand, and follow** manufacturer's instructions.
- Follow warnings marked “△” closely.
- **Do not** substitute fuel or electrical systems parts with other parts which may look the same. Some electrical parts, like starter motors, are of special design to prevent stray sparks outside their cases.
- Replace wires, sleeves, and boots which are cracked or torn or look in poor condition.

Remember:

- Do not use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.
- If you use a funnel, it has to be metal to ground the spout to the tank.
- Always fill the tank outside the boat.
- Fumes are hard to control. They collect and hide in the bottom of the boat.
- To avoid those static electric sparks, ground (touch) the spout against the tank.
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.)

**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

In transom area:
After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

**When Storing:**
- Make sure silencer and its gaskets are on engine and drain hose is in place.
- Air silencer mounting screws are special lock screws. Use only the special screws.
- Squeeze until bulb feels hard
- Check for leaks under engine cover
- If tank cap has an air vent valve, make sure it is closed.
- Whenever possible, remove hose from outboard and from tank.
- Store hose around ears of tank. This way, gasoline is trapped in tank and not in the hose, where it might leak onto the floor if the hose deteriorates.

If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used.

**When Running:**
- Carburetor air intake silencer will catch and hold fuel which may flood into engine if carburetor float sticks.

- Make sure silencer and its gaskets are on engine and drain hose is in place.
- Air silencer mounting screws are special lock screws. Use only the special screws.
Outboard Mounting System and Safety

What is most important?
• Outboard must stay in position on boat’s transom.

What could happen?

- Outboard may S...L...I...D...E on transom
  Boat may turn and be hard to steer.

- If outboard hits something solid and does not stay on the transom, boat occupants may be injured from the outboard or its parts entering the boat.

- Outboard may T...I...L...T on transom
  Boat may turn and be hard to steer.

- Boat’s transom could break away.

- Outboard may be lost overboard.
  Boat may SINK.

How Can Loss of Mounting Be Minimized?
• Read, understand, and follow manufacturer’s instructions.
• Follow warnings marked “ △ ” closely.
SAFETY

If weakened, parts could fail later on the water, when not expected

When rigging or fixing any boat, if transom looks weak, tell the owner. If transom is curved, outboard may come loose.

Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

If owner tells you “I hit something really hard...” Check for a high speed blow to the lower unit.

OR...

“I was backing up and I think the outboard may have hit a tree or something.” Check for a slow, heavy squash to the outboard.

• Look for damaged parts and loosened nuts and bolts in both the steering and mounting systems. Replace damaged parts.
Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety

What is most important?

- Shock absorption system must always be ready to absorb some blows to the lower parts of the outboard.
- Outboard must not trim in too far suddenly.

What can happen?
Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.

How can possible conditions be minimized?

- Read, understand, and follow manufacturer’s instructions.
- Follow warnings marked “△” closely.
- Test your work whenever possible.
- If oil leaks are seen in service areas, determine source. Keep reservoir filled.
- If outboard is hydraulic tilt/trim model, always return rod to hole position determined by boat operator and make sure angle adjusting rod retain is in locked position.

Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).
If left open, outboard has no shock protection.

Trimming “in” too far can happen when angle adjusting rod is not in the right hole or is not in any hole (lost).
Outboard Emergency Stop System and Safety

What is most important?

- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

What could happen?

If switch fails...

...engine will keep running when clip is pulled from the switch

If lanyard is caught...

...engine will keep running.
What could happen?

If lanyard is cut or frayed...

...lanyard or clip may break when pulled...

If engine does NOT stop when lanyard is pulled, an operator thrown from the boat could be hit as boat circles area. Or, boat may not turn but leave area as a runaway. Operator may drown and boat WILL run into something.

How can failure of the emergency stop system be minimized?

- Read, understand, and follow manufacturer’s instructions
- Follow warnings marked “⚠️” closely.
- Assemble parts carefully.
- Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.
- Locate control box and other items in area to keep lanyard from being caught.
- ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.
SAFETY

Summing up

Now you know some things that can take the joy out of boating.

No doubt about it—proper safety takes time!
• Reading and understanding instructions
• Re-reading warnings marked “△”
• Putting parts together correctly
• Making correct adjustments
• Testing your work

And making sure
• Worn or damaged parts are replaced
• Replaced parts are like originals in every way
• Customer is told of things which need attention

But, do you really want the alternative?
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

**Handling Outboards**

**When lifting outboards**

Some outboards have a fixed lift bracket bolted to the powerhead. Because outboard will want to hang like this when off the floor...

If engine does not have fixed lifting bracket and you use Universal Puller, P/N 378103, and Lifting Eye, P/N 321537, or Lifting Eye and Adapter Assembly, P/N 396748...

...use only the special hardened screws and washers from the set.

Outboard can drop suddenly if hoist or engine stand are in poor shape, or too small for the job.

Regular screws are not strong enough. Screws may break and outboard may drop suddenly.

- Make sure shop aids have extra capacity, and keep them in good repair.
Running outboard with engine cover removed

Engine cover is a guard. When you remove cover/guard to work on the outboard, remember: loose clothing (open shirt sleeves, neckties), hair, jewelry (rings, watches, bracelets), hands and arms can be caught by the spinning flywheel.

Handling high voltage parts like spark plugs and coils can shock you and may cause you to recoil into the rotating flywheel.

• Two people working together on a live outboard must look out for each other. Never, ever, use the key to start the outboard before signaling your partner. He may be leaning over the outboard with hands on the flywheel, handling a “hot” electrical part, or near the propeller.

Outboard starting at the wrong time

When you do things that turn the flywheel like:
• Off-season storage fogging (oiling) of outboard;
• Removing propeller with a powered tool;
• Electrical system checks;
• Servicing the flywheel; or
• Any other actions ALWAYS...

1) Turn key switch OFF
2) Twist and remove ALL spark plug leads
3) Shift to NEUTRAL

Check prop shaft. Is outboard really in NEUTRAL?

NO SPARK ➔ NO START ➔ NO SURPRISES
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.

Running outboards: Exhaust fumes

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<td>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.</td>
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• 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.
DANGER
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off. Always shut off the engine when near people in the water.

Eye protection

Eyes need protection when:

- Grinding

- Spraying cleaners and paints

- Chiseling
  Tip: When steel on steel, use plastic- or brass-type hammers. They don’t chip off as easily as steel hammers.

- Acid

- Ends of cables

Wear Safety Glasses
Handling Lead/Acid Batteries

Strong acid solution (sulfuric acid)

If solution gets into eyes, wash and contact a doctor immediately.

If spilled or splashed on any part of body...

Wash with lots of water.

Charging lead acid batteries

1) Attach and remove these cables with charger UNPLUGGED from 110 V wall socket. (This prevents shocks if charger is defective.)

2) Observe correct polarity when connecting these larger leads.

3) Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. Make sure vents are open. If clogged, pressure inside may build. Battery may EXPLODE.

Battery gas is explosive!

While charging or discharging, remember:
- No smoking
- No flames
- No sparks

Never remove charger cables from battery posts. It is a sure way to make a lot of sparks in an area surrounded by battery gas.

After charging:
- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.
Gasoline – Handle With Care!

Gasoline vapor and air mixtures explode easily and violently when mixed as shown...

When you smell ANY odor of gasoline, explosion is possible.

Gasoline fumes are heavy and will sink to the lowest point in the boat or room and will STAY there, WAITING...

What can you do?

Store gasoline in sturdy, approved, sealed gas can and keep outside.

- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, not for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, immediately:
  - Put out open flames, cigarettes, sparking devices;
  - Wipe up spill or leak;
  - Get towels and rags outside fast;
  - Open doors and windows; and
  - Check lowest area for fumes.

Be aware of items in and around repair area which can ignite fumes. Control them if fumes are smelled.
- Matches, cigarettes, blow torches, welders
- Electric motors (with unsealed cases)
- Electric generators (with unsealed cases)
- Light switches
- Appliance pilot lights or electric igniters (furnace, dryer, water heaters)
- Loose wires on running outboards
- Other variables which may ignite fumes

How many of these are in your repair area?
Hazardous Products

Know how items in the shop can hurt people...

READ
• “How and where to use”
• “How to give First Aid.” Have recommended First Aid materials on hand should an emergency arise
• “How to dispose of can”

It’s all on the back of the can or bottle label.

And remember: Little children are very curious and will try to taste everything so keep containers away from children!
Safety Awareness Test
The Technician's Safety Awareness Test....

1) Did you read this Safety section from page S–1 to page S–24?

2) Are you ready to take responsibility for the safe maintenance practices and procedures of your repair shop, co-workers, and technicians?

3) Do you understand all the safety precautions and instructions contained in this entire service manual?

4) Will you follow all safety warnings, precautions, instructions and recommendations outlined in this service manual?

5) Do you understand that the service manual as a whole and this Safety section, in particular, contain essential information to help prevent personal injury and damage to equipment and your customers?

6) Have you received training related to common shop safety practices to protect yourself and others around you?

7) When replacement parts are required, will you use *Evinrude®/Johnson® Genuine Parts* or parts with equivalent characteristics, including type, strength and material?

8) Are you ready to follow the recommendations in this service manual before you service any boat or outboard?

9) Do you understand that safety-related accidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?
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### OUTBOARD WILL NOT START

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<th>POSSIBLE CAUSE</th>
<th>PROCEDURE</th>
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<td>Outboard does not turn over</td>
<td>Battery switch not ON</td>
<td>Check battery switch operation</td>
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<tr>
<td></td>
<td>Discharged battery</td>
<td>Check battery, recharge or replace</td>
</tr>
<tr>
<td></td>
<td>Battery cables and connections</td>
<td>Clean and tighten connections. Check for voltage drop in starter circuit.</td>
</tr>
<tr>
<td></td>
<td>Faulty connection or ground, damaged electrical harness</td>
<td>Check all grounds, connections and wiring</td>
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<tr>
<td></td>
<td>Fuse (10 A)</td>
<td>Check wiring, then replace faulty fuse</td>
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<td></td>
<td>Wiring harness</td>
<td>Check for 12 V at terminal “B” of key switch</td>
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<td></td>
<td>Key switch</td>
<td>Check key switch operation</td>
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<tr>
<td></td>
<td>Starter solenoid</td>
<td>Check wiring and test solenoid</td>
</tr>
<tr>
<td></td>
<td>Starter or bendix/drive gears</td>
<td>Check starter, inspect bendix/drive gears</td>
</tr>
<tr>
<td></td>
<td>Seized powerhead or gearcase</td>
<td>Check and repair as needed</td>
</tr>
<tr>
<td>Outboard turns slowly</td>
<td>Discharged battery</td>
<td>Check battery, recharge or replace</td>
</tr>
<tr>
<td></td>
<td>Battery cables and connections</td>
<td>Clean and tighten connections. Check voltage drop in starter circuit.</td>
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<tr>
<td></td>
<td>Powerhead hydro-locked</td>
<td>Check cylinders for water</td>
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<tr>
<td></td>
<td>Partially seized powerhead or gearcase</td>
<td>Check and repair as needed</td>
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<tr>
<td></td>
<td>Starter or bendix/drive gears</td>
<td>Check starter, inspect bendix/drive gears</td>
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### OUTBOARD WILL NOT START

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<td>Outboard turns over</td>
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<td>Stop circuit grounded</td>
<td>Check wiring and emergency stop switch. Check the safety lanyard is installed and stop circuit is not grounded.</td>
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<td>In gear—Tiller models</td>
<td>Make sure outboard is in neutral</td>
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<td>No Fuel</td>
<td>Check for fuel in fuel tank</td>
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<td>Water in fuel</td>
<td>Check fuel filter, sample fuel from fuel return manifold.</td>
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<tr>
<td>Contaminated or poor fuel quality</td>
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<tr>
<td>Fuel supply restricted</td>
<td>Check primer, anti-siphon valve, and fuel pick-up. Use primer to fill vapor separator with fuel.</td>
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<tr>
<td>Air in fuel system</td>
<td>Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)</td>
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<tr>
<td>Low or no fuel pressure to injectors</td>
<td>Check fuel manifold pressure, refer to FUEL SYSTEM</td>
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<tr>
<td>Incorrect, fouled, or worn spark plugs</td>
<td>Replace spark plugs</td>
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<td>Fuel injectors not working</td>
<td>Check voltage at injectors</td>
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<td>Check capacitor and 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
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<td>Check battery, recharge or replace</td>
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<td>Battery cables and connections</td>
<td>Clean and tighten connections, check voltage drop on high amperage circuit</td>
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<td>Check starter, inspect bendix/drive gears</td>
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<td>Check water separator/fuel filter, sample fuel from fuel return manifold test port</td>
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<td>Check or replace fuel supply</td>
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<tr>
<td>Air in fuel system</td>
<td>Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)</td>
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<td>Incorrect, fouled, or worn spark plugs</td>
<td>Replace spark plugs</td>
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<tr>
<td>Low fuel pressure</td>
<td>Check pressure, refer to FUEL SYSTEM</td>
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<td>Fuel supply restricted</td>
<td>Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks</td>
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<tr>
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<td>Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
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<tr>
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<td>Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
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<td>Restricted or leaking fuel injector(s)</td>
<td>Check injectors, refer to FUEL SYSTEM</td>
<td></td>
</tr>
<tr>
<td>Weak or erratic ignition operation</td>
<td>Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
<td></td>
</tr>
<tr>
<td>Crankshaft Position Sensor (CPS)</td>
<td>Check CPS air gap and EMM LED indicators</td>
<td></td>
</tr>
<tr>
<td>Excessive fuel or oil, engine flooding</td>
<td>Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent. Refer to SYSTEM ANALYSIS.</td>
<td></td>
</tr>
<tr>
<td>EMM program, timing, or operation</td>
<td>Check EMM program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs</td>
<td></td>
</tr>
<tr>
<td>Internal powerhead damage</td>
<td>Check and repair as needed</td>
<td></td>
</tr>
<tr>
<td>Leaking cylinder/crankcase, intake manifold, or reed valves</td>
<td>Check and repair as needed</td>
<td></td>
</tr>
</tbody>
</table>
## TROUBLE CHECK CHART
### OUTBOARD WILL NOT SHUT OFF

<table>
<thead>
<tr>
<th>OBSERVATION</th>
<th>POSSIBLE CAUSE</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outboard starts and runs, normal performance while running</td>
<td>Key switch or wire harness ground</td>
<td>Check key switch and ground to key switch, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td>Stop circuit wiring</td>
<td></td>
<td>Check EMM LED indicators. Check wire harness (black/yellow) and key/stop switch(s).</td>
</tr>
<tr>
<td>EMM failure</td>
<td></td>
<td>Check EMM LED indicators and eliminate stop circuit as possible cause. Stop wire (black/yellow) has 4.0 VDC from EMM with key on or outboard running.</td>
</tr>
</tbody>
</table>

## OUTBOARD STARTS AND STALLS

<table>
<thead>
<tr>
<th>OBSERVATION</th>
<th>POSSIBLE CAUSE</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outboard may not run for more than a few seconds</td>
<td>Faulty wiring, connections, or grounds</td>
<td>Check all grounds, connections, and wiring</td>
</tr>
<tr>
<td>Incorrect, fouled, or worn spark plugs</td>
<td></td>
<td>Replace spark plugs</td>
</tr>
<tr>
<td>Low or no alternator output (55 V)</td>
<td></td>
<td>Check voltage on 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td>Capacitor or 55 V circuit wiring</td>
<td></td>
<td>Check capacitor and 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td>Contaminated or poor fuel quality</td>
<td></td>
<td>Check or replace fuel supply</td>
</tr>
<tr>
<td>Low fuel pressure</td>
<td></td>
<td>Check pressure, refer to FUEL SYSTEM</td>
</tr>
<tr>
<td>Air in fuel system</td>
<td></td>
<td>Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)</td>
</tr>
<tr>
<td>Fuel supply restricted</td>
<td></td>
<td>Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks</td>
</tr>
<tr>
<td>Injector electrical circuit or control function</td>
<td></td>
<td>Check voltage at injectors, refer to SYSTEM ANALYSIS</td>
</tr>
<tr>
<td>Restricted or leaking fuel injector(s)</td>
<td></td>
<td>Check injectors, refer to FUEL SYSTEM</td>
</tr>
<tr>
<td>EMM program, timing, or operation</td>
<td></td>
<td>Check EMM program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs</td>
</tr>
<tr>
<td>Weak or erratic ignition output</td>
<td></td>
<td>Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td>Internal powerhead damage</td>
<td></td>
<td>Check and repair as needed</td>
</tr>
</tbody>
</table>
# TROUBLE CHECK CHART
## OUTBOARD STARTS, LOW MAXIMUM RPM

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

## EXCESSIVE SMOKING

<table>
<thead>
<tr>
<th>OBSERVATION</th>
<th>POSSIBLE CAUSE</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>May coincide with increased oil consumption (normal if occurs after winterization)</td>
<td>Contaminated or poor fuel quality</td>
<td>Check or replace fuel supply</td>
</tr>
<tr>
<td></td>
<td>Excessive fuel or oil consumption</td>
<td>Check fuel system for fuel supply air leaks or leaking fuel injectors</td>
</tr>
<tr>
<td></td>
<td>Outboard in break-in mode</td>
<td>Use diagnostics program to check</td>
</tr>
<tr>
<td></td>
<td>Outboard mounted too low</td>
<td>Check installation height of outboard</td>
</tr>
<tr>
<td></td>
<td>Vapor separator vent</td>
<td>Check vapor separator assembly for proper venting/float valve operation</td>
</tr>
<tr>
<td></td>
<td>Faulty/leaking fuel injector(s)</td>
<td>Check injectors, refer to FUEL SYSTEM</td>
</tr>
<tr>
<td></td>
<td>Damaged fuel lift pump</td>
<td>Check for internal leaks</td>
</tr>
</tbody>
</table>
# TROUBLE CHECK CHART
## OUTBOARD SURGES, RUNS ROUGH

<table>
<thead>
<tr>
<th>OBSERVATION</th>
<th>POSSIBLE CAUSE</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 RPM and above</td>
<td>S.A.F.E.</td>
<td>Access EMM fault codes</td>
</tr>
<tr>
<td></td>
<td>Incorrect, fouled, or worn spark plugs</td>
<td>Replace spark plugs</td>
</tr>
<tr>
<td></td>
<td>Water in fuel system</td>
<td>Check water separator/fuel filter, sample fuel from fuel return manifold test port</td>
</tr>
<tr>
<td></td>
<td>Contaminated or poor fuel quality</td>
<td>Check and replace fuel supply</td>
</tr>
<tr>
<td></td>
<td>Low or erratic fuel pressure</td>
<td>Check pressure, refer to FUEL SYSTEM</td>
</tr>
<tr>
<td></td>
<td>Air in fuel system</td>
<td>Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)</td>
</tr>
<tr>
<td></td>
<td>Fuel supply restricted</td>
<td>Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks</td>
</tr>
<tr>
<td></td>
<td>Restricted or leaking fuel injector(s)</td>
<td>Check injectors, refer to FUEL SYSTEM</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring, connections, grounds, or CPS air gap</td>
<td>Check all grounds, connections, and wiring. Check CPS air gap.</td>
</tr>
<tr>
<td></td>
<td>Low alternator output (55 V)</td>
<td>Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td></td>
<td>EMM program, timing, or operation</td>
<td>Check EMM program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs</td>
</tr>
<tr>
<td></td>
<td>Weak or erratic ignition operation</td>
<td>Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td></td>
<td>Capacitor or 55 V circuit wiring</td>
<td>Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION</td>
</tr>
<tr>
<td></td>
<td>Restricted engine exhaust</td>
<td>Check and repair as needed</td>
</tr>
<tr>
<td>Audible noise</td>
<td>Internal powerhead damage</td>
<td>Check and repair as needed</td>
</tr>
<tr>
<td></td>
<td>Damaged gearcase</td>
<td>Inspect gearcase and lubricate</td>
</tr>
</tbody>
</table>
Hose Routing and Water Flow Diagram
40 – 65 E-TEC Inline 2 Cylinder

1. Intake water screens
2. Water pump
3. Water tube
4. Cylinder block
5. Pressure valve
6. Thermostat
7. Water supply to EMM
8. Water supply, EMM to vapor separator
9. Overboard indicator, outgoing water from vapor separator
10. Water valve

Outgoing water (warm/hot)
Incoming water (cool)
CANbus Keyswitch/TNT Wiring Harness

A. Trim down
B. Trim up
C. Trim sender

1. Stop circuit
2. Start solenoid
3. Ground (B-)
4. Switched B+ (12V)
5. Battery + (12V)
6. Choke

Switched B+ (12V)
10 Amp Fused

Ground (B-)

47 ohm 1/4 watt resistor
Lanyard Switch / Emergency Stop Circuits

Single Outboard

Dual Outboards
MWS Key Switch and Neutral Safety Switch

OFF

ON

START

000691
1. Air Temperature Sensor
2. Throttle Position Sensor
3. Neutral Switch
4. Stator
5. Crankshaft Position Sensor
6. Trim/Tilt Connector
7. SystemCheck Connector
8. Key Switch Connector
9. High Pressure Fuel Pump
10. CANbus Connector
11. Diagnostic Connector
12. Temperature Sensor
13. Ignition Coil
14. Fuel Injector
15. Fuse (10 Amp)
16. Starter Solenoid
17. Main Harness Ground
18. Electric Starter
19. EMM
20. Oil Injector
21. Low Oil Switch
22. Trim/Tilt Relay Module
23. Capacitor
24. Trim/Tilt Motor
25. Water Valve Connector
26. Trim Sending Unit
27. Trim/Tilt Switch

40 – 65 HP E-TEC
Evinrude E-TEC
EMM LED Diagnostic Indicators

In-line Models

1. Charging / 55V Circuit
2. CPS OK - Injection/Ignition/Fault
3. Sensors / 5V Circuits
4. Stop Circuit - No Oil/Overheat

V Models

1. Charging / 55V Circuit
2. CPS OK - Injection/Ignition/Fault
3. Sensors / 5V Circuits
4. Stop Circuit - No Oil/Overheat

For more information, refer to SYSTEM ANALYSIS in the Service Manual.

KEY ON: LED’s illuminate to indicate circuit function

1. Start assist circuit (SAC) OK (V models only)
2. Sensors / 5V Circuits OK
   FLASHING LED – URGENT condition – Code 57
   Engine will not start – Correct problem and clear codes
3. Stop circuit OK
   FLASHING LED – URGENT overheating or no oil condition
   Engine will not start – Correct problem and clear codes

Note: No LED’s ON indicates EMM not receiving battery voltage or Recoil Start model.

STARTING: LED’s illuminate to indicate circuit function

1. Indicates 30V (or higher) on 55V circuit
2. Indicates CPS working and EMM SYNC
3. Sensor circuits working
4. Stop circuit OK

RUNNING: LED’s illuminate to indicate circuit fault

1. Exception: ALL LED’s ON / FLASHING indicates Winterization Mode
<table>
<thead>
<tr>
<th>CODE</th>
<th>EMM CIRCUIT/SENSOR</th>
<th>INTERNAL SENSOR</th>
<th>SAFE SHUT DOWN</th>
<th>EMM LED DISPLAY</th>
<th>DASHBOARD GAUGE WARNING DISPLAY</th>
<th>TIME TO ACTIVATE</th>
<th>SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Throttle Position Sensor (TPS)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2 seconds</td>
<td>TPS Voltage &gt; 0.78 V with key ON (or cranking), becomes stored fault when outboard starts. When both hard and stored faults are present, check for improperly adjusted throttle cable.</td>
</tr>
<tr>
<td>12</td>
<td>Throttle Position Sensor (TPS) circuit fault</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>CHECK ENGINE</td>
<td>0.8 seconds</td>
<td>TPS Voltage: &lt; 0.14 V, or &gt; 4.92 V. Engine limited to idle speed. Check sensor resistance—3000 Ω (between pins A and B) &amp; 4000 Ω (between pins A and C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>TPS below range</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>CHECK ENGINE</td>
<td>8 seconds</td>
<td>TPS Voltage &lt; 0.2 V, Check linkage and IDLE stop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>TPS above range</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>CHECK ENGINE</td>
<td>8 seconds</td>
<td>TPS Voltage &gt; 4.85 V. Check linkage and WOT stop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>ROM (EMM program)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>Check software program number in EMM. Reload or replace with proper program.</td>
</tr>
<tr>
<td>16</td>
<td>Crankshaft Position Sensor (CPS) intermittent loss of SYNC</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>-</td>
<td>10 instances</td>
<td>EMM counts losses of synchronization with crankshaft speed. Check CPS mounting and resistance. Air gap range: 0.0036 to 0.110 in. (1 to 2.8 mm), nominal 0.073 in. (1.85 mm) Resistance: 590 Ω ± 10% @ 77°F (25°C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>55 V circuit BELOW range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 1: ON (Running)</td>
<td>CHECK ENGINE</td>
</tr>
<tr>
<td>18</td>
<td>55 V circuit ABOVE range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 1: ON (Running)</td>
<td>CHECK ENGINE</td>
</tr>
<tr>
<td>19</td>
<td>Start-in-gear</td>
<td>LED 3: OFF (Cranking)</td>
<td>CHECK ENGINE</td>
<td>-</td>
<td>-</td>
<td>Engine is speed limited, and stops after 300 oil pulses. Refer to Maintenance or Operator’s Guide.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Winterization activated</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Engine is speed limited, and stops after 300 oil pulses. Refer to Maintenance or Operator’s Guide.</td>
</tr>
<tr>
<td>21</td>
<td>Engine Temperature Sensor circuit fault</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>Engine Temperature BELOW range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 4: OFF (Cranking)</td>
<td>CHECK ENGINE</td>
</tr>
<tr>
<td>23</td>
<td>Engine Temperature ABOVE range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 1: ON (Running)</td>
<td>LOW BATTERY</td>
</tr>
<tr>
<td>24</td>
<td>Engine Temperature OVER range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 1: ON (Running)</td>
<td>LOW BATTERY</td>
</tr>
<tr>
<td>25</td>
<td>Critical NO OIL detected</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 4: FLASHING</td>
<td>WATER TEMP/HOT (FLASHING)</td>
</tr>
<tr>
<td>26</td>
<td>Oil injection pump circuit OPEN</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 4: OFF (Cranking)</td>
<td>NO OIL (FLASHING)</td>
</tr>
<tr>
<td>27</td>
<td>Engine Temperature Sensor circuit fault</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>Engine Temperature BELOW range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>-</td>
</tr>
<tr>
<td>29</td>
<td>Engine Temperature ABOVE range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>LED 4: ON (Running)</td>
<td>WATER TEMP/HOT</td>
</tr>
<tr>
<td>30</td>
<td>Barometric Pressure (BP) Sensor circuit fault</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>31</td>
<td>BP Sensor BELOW range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>32</td>
<td>BP Sensor ABOVE range</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>33</td>
<td>Air Temperature (AT) circuit fault</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>34</td>
<td>Air Temperature BELOW range</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>35</td>
<td>Air Temperature ABOVE range</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CODE</td>
<td>EMM CIRCUIT/SENSOR</td>
<td>INTERNAL SENSOR</td>
<td>SAFETY SHUTDOWN</td>
<td>EMM LED DISPLAY</td>
<td>DASHBOARD GAUGE WARNING DISPLAY</td>
<td>TIME TO ACTIVATE</td>
<td>SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION</td>
</tr>
<tr>
<td>------</td>
<td>-------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-------------------------------</td>
<td>----------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>51</td>
<td>Fuel injector circuit #1 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>2 seconds</td>
<td>Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Fuel injector circuit #2 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>2 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Fuel injector circuit #3 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>2 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>High RPM with low TPS setting</td>
<td>✓ ✓</td>
<td>LED 3: Flashing</td>
<td>CHECK ENGINE (FLASHING)</td>
<td>10 seconds</td>
<td>TPS &lt; 5% and RPM &gt; 3000. Engine SHUTDOWN. WILL NOT restart until code has been cleared. The problem could be caused by uncontrolled fuel entering the engine. DO NOT attempt to start the outboard until the problem has been found and repaired.</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Operating temperature not reached</td>
<td>LED 3: OFF (Cranking) / ON (Running)</td>
<td>-</td>
<td>10 minutes</td>
<td>Engine temperature &lt; 104°F (40°C) with engine speed &lt; 2300 RPM. Check thermostat and pressure relief valve.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Fuel injector circuit #1 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td>Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Fuel injector circuit #2 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Fuel injector circuit #3 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Ignition timing circuit #1 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>10 instances</td>
<td>EMM counts failed ignition events. Check wiring. Test with known good ignition coil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Ignition timing circuit #2 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>10 instances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Ignition timing circuit #3 OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>10 instances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>Fuel pump circuit OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td>Check circuit resistance—295 ± 20 @ 77°F (25°C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>Water injection solenoid OPEN</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td>Check circuit resistance—295 ± 20 @ 77°F (25°C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>Water injection solenoid CLOSED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>8 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Fuel pump circuit SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>2 seconds</td>
<td>Check pump/circuit resistance—2 to 3 Ω @ 77°F (25°C).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Ignition timing circuit #1 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>20 instances</td>
<td>EMM counts failed ignition events. Check wiring. Test with known good ignition coil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Ignition timing circuit #2 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>20 instances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>Ignition timing circuit #3 SHORTED</td>
<td>LED Z: ON (Running)</td>
<td>-</td>
<td>20 instances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>Critical LOW OIL detected</td>
<td>✓ ✓</td>
<td>LED 4: OFF (Running)</td>
<td>NO OIL</td>
<td>4800 Pulses (2 Cyl) 6000 Pulses (3 Cyl)</td>
<td>EMM counts oil pump pulses after LOW OIL switch closes. Engine limited to 1200 RPM. Stop outboard and add oil to tank. Warning resets after three oil pump pulses.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Always note service codes before clearing codes. Clear stored codes using diagnostic software. Clearing some codes requires turning EMM "OFF" and then "ON" again.