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<i>Evinrude</i> ® / <i>Johnson</i> ® XD100™ Outboard Oil	HPF PRO™ Gearcase Lubricant

Original Instructions

Service Manual

Contents

Section	Page
1 Reference Information	3
2 Routine Service	17
3 Engine Cover Service	53
4 Engine Management Module (EMM)	57
5 System Analysis	75
6 Electrical and Ignition	89
7 Fuel System	131
8 Oiling System	159
9 Cooling System	189
10 <i>Evinrude</i> ICON Remote Control System	201
11 Powerhead	221
12 Midsection	265
13 Trim and Tilt	287
Safety	S-321
Index	I-345
Trouble Check Chart	T-353
Diagrams	

IMPORTANT: For complete outboard rigging and control installation information, refer to the **Predelivery and Installation Guide** included with the service manual set.

All special tools referenced in this manual can be found in the **Special Tools Guide**, included with the service manual set.

Reference Information

Table of Contents

Safety Notice 4

Abbreviations Used In This Manual 6

 Units of Measurement 6

 List of Abbreviations 6

Standard Torque Specifications 7

Product Reference and Illustrations 7

Emission-Related Installation Instructions 8

Model Designation 10

 Engine Identification 10

 Models Covered 11

Service Specifications 90° 3.3 L Models 12

Service Specifications 90° 3.4 L Models 14

Wire Size Table 16

Safety Notice

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

This publication is written for qualified, factory-trained technicians who are already familiar with the use of *Evinrude/Johnson* Special Tools. The included information is not a substitute for work experience. It is an organized guide for reference, repair, and/or maintenance.

The following symbols and/or signal words may be used in this document:

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

NOTICE

Indicates an instruction which, if not followed, could severely damage engine components or other property.

These safety alert signal words mean:

ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

IMPORTANT: Identifies information that controls correct assembly and operation of the product.

ENVIRONMENTAL NOTE

A note which provides tips and behaviors related to protecting the environment.

DO NOT perform any work until you have read and understood these instructions completely.

Torque wrench tightening specifications must strictly be adhered to.

Should removal of any locking fastener (lock tabs, locknuts, or patch screws) be required, always replace with a new one.

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

Always wear EYE PROTECTION AND APPROPRIATE GLOVES when using power tools.

Unless otherwise specified, engine must be OFF when performing this work.

Always be aware of parts that can move, such as flywheels, propellers, etc.

Some components may be HOT. Always wait for engine to cool down before performing work.

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.

This document may be translated into other languages. In the event of any discrepancy, the English version shall prevail.

⚠ 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.

Reference Information

Abbreviations Used In This Manual

Abbreviations Used In This Manual

Units of Measurement

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

List of Abbreviations

ABYC	American Boat & Yacht Council
ATDC	after top dead center
AT	air temperature sensor
BPS	barometric pressure sensor
BTDC	before top dead center
CCA	cold cranking amps
CFR	Code of Federal Regulations
CPS	crankshaft position sensor
EMM	Engine Management Module
EPA	Environmental Protection Agency
ICOMIA	International Council of Marine Industry Associations
ID	Inside dimension
MCA	marine cranking amps
MWS	modular wiring system
NMEA	National Marine Electronics Assoc.
ROM	read only memory
S.A.F.E.	speed adjusting failsafe electronics
SAC	start assist circuit
SAE	Society of Automotive Engineers
SYNC	synchronization
TDC	top dead center
TPS	throttle position sensor
USCG	United States Coast Guard
WOT	wide open throttle
WTS	water temperature sensor

Standard Torque Specifications

Size	In. Lbs.	Ft. Lbs.	N·m
No. 6	7–10	0.58–0.83	0.8–1.1
No. 8	15–22	1.25–1.83	1.7–2.5
No. 10	24–36	2–3	2.7–4.0
No. 12	36–48	3–4	4.0–5.4
1/4 in.	60–84	5–7	7–9.5
5/16 in.	120–144	10–12	13.5–16.5
3/8 in.	216–240	18–20	24.5–27
7/16 in.	336–384	28–32	38–43.5
M3	15–22	1.25–1.83	1.7–2.5
M4	24–35	2–2.9	2.7–4.0
M5	35–60	2.9–5	4.0–6.8
M6	84–106	7–8.8	9.5–12
M8	177–204	14.7–17	20–23
M10	310–336	25.8–28	35–38

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 Genuine Parts*.

Product Reference and Illustrations

1

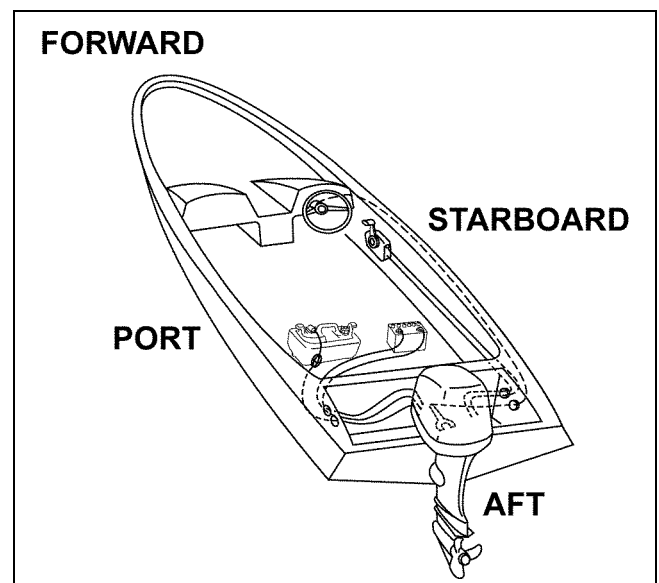
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of 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

Emission-Related Installation Instructions

Failing to follow these instructions when installing a certified engine in a vessel violates federal law (40 CFR 1068.105 (b)), subject to fines or other penalties as described in the Clean Air Act.

A repair shop or person of the owner's choosing may maintain, replace, or repair emission control devices and systems. These instructions do not require components or service by BRP or authorized Evinrude dealers. Although an authorized Evinrude dealer has the in-depth technical knowledge and tools to service Evinrude outboard engines, the emission-related warranty is not conditioned on the use of an authorized Evinrude dealer or any other establishment with which BRP has a commercial relationship.

For emission-related warranty claims, BRP is limiting the diagnosis and repair of emission-related parts to authorized Evinrude dealers. For more information, please refer to the US EPA EMISSION-RELATED WARRANTY contained in the **Operator's Guide**. Proper maintenance is the owner's responsibility. A warranty claim may be denied if, among other things, the owner or operator caused the problem through improper maintenance or use.

You must follow the instructions for fuel requirements in the FUEL REQUIREMENTS section of this manual. Even if gasoline containing greater than ten volume percent ethanol is readily available, the US EPA has issued a prohibition against the use of gasoline containing greater than 10 vol% ethanol that applies to this engine. The use of gasoline containing greater than 10 vol% ethanol with this engine may harm the emission control system.

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* 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* 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:

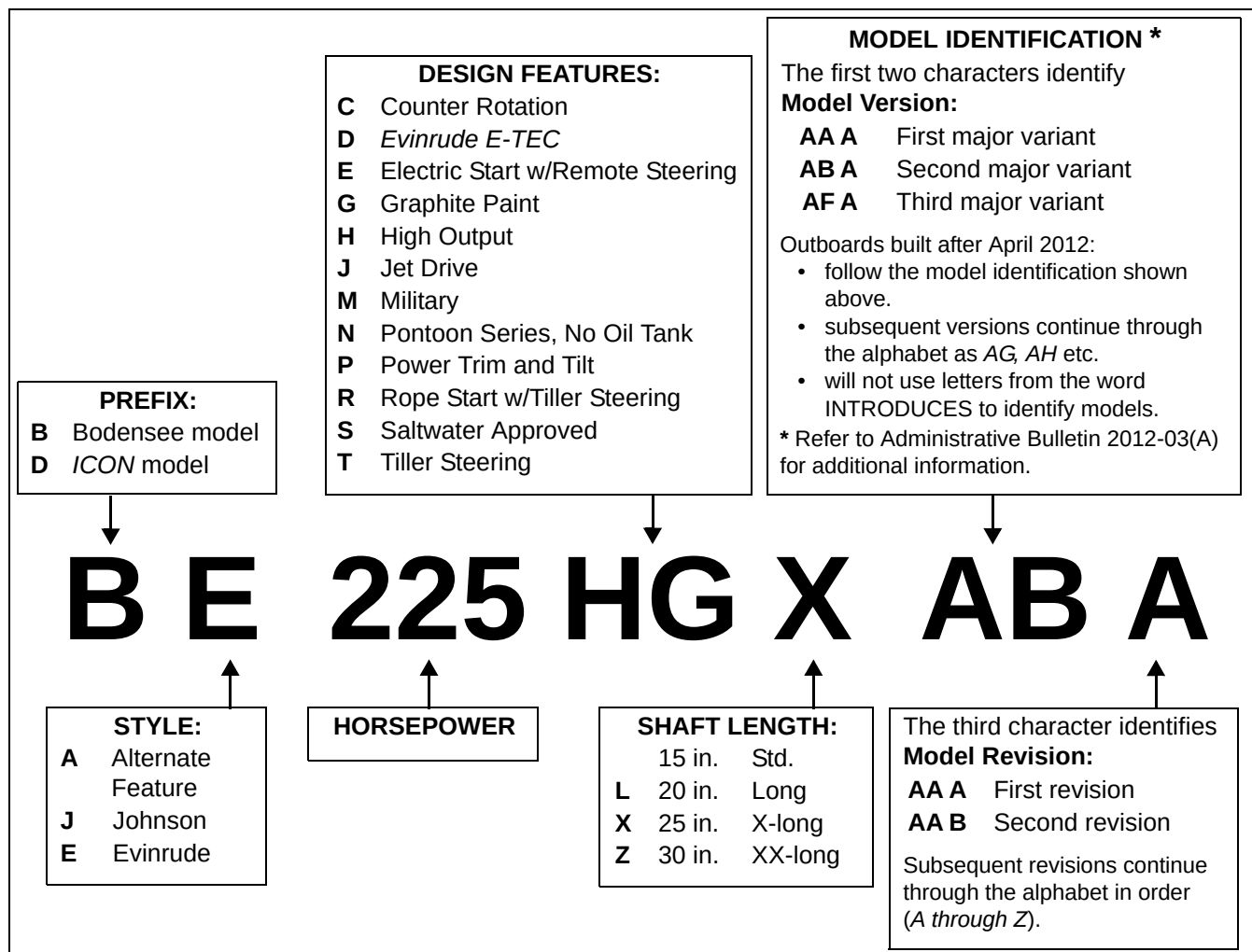
U.S. Environmental Protection Agency
Office of Transportation and Air Quality
Certification Division
Gasoline Engine Compliance Center
2000 Traverwood Drive
Ann Arbor, MI 48105

EPA Internet Web Site:

www.epa.gov/otaq

Model Designation

Engine Identification



Model and serial numbers are located on the swivel bracket and on the powerhead.



1. Model and serial number
2. Serial number

010518
006828

Models Covered

This manual covers service information on the following *Evinrude E-TEC* models:

- 200.1 cubic inch (3.3 L) 90° V6, starting with serial number 5370453.
- 210 cubic inch (3.4 L), 90° V6, starting with serial number 5368446.

HP	Model Number	Color	Shaft Length	Gearcase		Styling	Special Features
				Type	Gear Ratio		
200 H.O.	E200HSLAB_	White	20 in.	M2	13:24 / .542 / 1.85:1	Standard	H.O.
	E200DHLAB_	Blue	20 in.	M2	13:24 / .542 / 1.85:1	Standard	H.O.
	E200DHXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	H.O.
	E200HGLAB_	Graphite	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E200HCXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	H.O.
	DE200XCAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	H.O., EST ²
	DE200HXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	H.O., EST ²
225	E225DPXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	
	E225DCXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	
	E225HSLAB_	White	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E225DHLAB_	Blue	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E225GHLAB_	Graphite	25 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E225DHXAB_	Blue	25 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E225HGXAB_	Graphite	25 in.	M2	13:24 / .542 / 1.85:1	Standard	
	DE225CXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	EST ²
	DE225PXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	EST ²
250	E250DPXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	
	DE250PXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	EST ²
	E250DCXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	
	DE250CXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	EST ²
	E250DPZAB_	White	30 in.	M2	13:24 / .542 / 1.85:1	Standard	
	DE250PZAB_	White	30 in.	M2	13:24 / .542 / 1.85:1	Standard	EST ²
	E250DCZAB_	White	30 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	
	DE250CZAB_	White	30 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	EST ²
250 H.O.	E250HSLAB_	White	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E250DHLAB_	Blue	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E250DHXAB_	Blue	25 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E250HGLAB_	Graphite	20 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
	E250HGXAB_	Graphite	25 in.	M2	13:24 / .542 / 1.85:1	H.O.	H.O.
300	DE300PXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	EST ²
	DE300CXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	EST ²
	DE300PZAB_	White	30 in.	M2	13:24 / .542 / 1.85:1	Standard	EST ²
	DE300CZAB_	White	30 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	EST ²
	E300DSLAB_	White	20 in.	M2	13:24 / .542 / 1.85:1	Standard	
	E300DPXAB_	White	25 in.	M2	13:24 / .542 / 1.85:1	Standard	
	E300DGXAB_	Graphite	25 in.	M2	13:24 / .542 / 1.85:1	Standard	
	E300DCXAB_	White	25 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	
	E300DPZAB_	White	30 in.	M2	13:24 / .542 / 1.85:1	Standard	
	E300DCZAB_	White	30 in.	M2 ¹	13:24 / .542 / 1.85:1	Standard	

1. Counter Rotation 2. Electronic Shift & Throttle

Reference Information

Service Specifications 90° 3.3 L Models

Service Specifications 90° 3.3 L Models

	HP	200, 225, 250
ENGINE	Full Throttle Operating Range	5250–6000 RPM
	Power	200 HP: (147.1 kw) @ 5700 RPM 225 HP: (165.5 kw) @ 5700 RPM 250 HP: (183.9 kw) @ 5700 RPM
	Idle RPM in Gear	500 ± 50
	Weight (may vary depending on model)	20 in. (L) Models: 503 lbs. (228 kg) 25 in. (X) Models: 524 lbs. (238 kg) 30 in. (Z) Models: 530 lbs. (240 kg)
	Lubrication	<i>Evinrude/Johnson XD100 Oil</i> Refer to Recommended Lubricants on p. 168
	Engine Type	90° V 6-Cylinder Loop-Charged
	Displacement	200.1 cu. in. (3279 cm ³)
	Bore	3.854 in (97.89 mm)
	Stroke	2.858 in. (72.60 mm)
	Standard Bore	3.8535 to 3.8545 in. (97.87 to 97.90 mm) To bore oversize, add piston oversize dimension to standard bore
	Top Crankshaft Journal	1.6199 to 1.6204 in. (41.15 to 41.16 mm)
	Center Crankshaft Journals	2.1870 to 2.1875 in. (55.55 to 55.56 mm)
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)
	Rod Crankpin	1.4995 to 1.5000 in. (38.09 to 38.106 mm)
	Piston Ring End Gap, Both	0.022 to 0.028 in. (0.57 to 0.72 mm)
	Fuel/Oil Ratio	<i>EMM</i> Controlled
	Starting Enrichment	<i>EMM</i> Controlled
FUEL	Preferred Fuel	Regular unleaded gasoline
	Acceptable Fuel	See Fuel Requirements on p. 138 for additional information.
	Minimum (High) Fuel Pressure @ IDLE RPM – 500 ± 50	22 to 28 psi (152 to 193 kPa)
	Minimum Fuel Lift Pump Pressure @ IDLE RPM – 500 ± 50	3 psi (21 kPa)
	Maximum Fuel Inlet Vacuum	4 in. Hg. (13.5 kPa)
	Minimum Octane	87 AKI (R+M)/2 or 90 RON
	Additives	<i>2+4[®] Fuel Conditioner, Fuel System Cleaner</i> Use of other additives may result in engine damage. See Fuel Requirements on p. 138 for additional information.

	HP	200, 225, 250
ELECTRICAL	Minimum Battery Requirements	675 CCA (845 MCA); or 750 CCA (940 MCA) below 32°F (0°C) (Use a 107 amp-hr battery for extreme applications.)
	Alternator	Dual Voltage 50 Amp with Voltage Regulator and Battery Isolation. Refer to Predelivery and Installation Guide for multiple battery applications.
	Tachometer Setting	6 pulse (12 pole)
	Charging Isolator	Integral, Terminal on Engine Harness
	Engine Fuse	P/N 967545 – 10 A
COOLING	Thermostat	143°F (62°C)
	Maximum Temperature	190°F (88°C)
	Water pressure	15 to 17 psi @ 5000 RPM
IGNITION	Type	Capacitor Discharge
	Firing Order	1-2-3-4-5-6
	Ignition Features	EMM Controlled
	RPM Limit	6050
	Crankshaft Position Sensor Air Gap	Fixed
	Spark Plug	Champion [†] QC8WEP @ 0.028 ± 0.003 in. (0.71 mm) Refer to Electronic Parts Catalog (EPC)
GEARCASE	Gear Ratio	“M2” Type Gearcase: 13:24 (.542) (1.85:1)
	Lubricant	HPF Pro Gearcase Lubricant
	Capacity	“M2” Type Gearcase: 38.9 fl. oz. (1150 ml) “M2” Type – Counter Rotation: 35.8 fl. oz. (1060 ml)
	Shift Rod Height	20 in. (L) Models: 21 29/32 (556.25 mm) ± one-half turn 25 in. (X) Models: 26 29/32 (683.25 mm) ± one-half turn 30 in. (Z) Models: 31 29/32 (810.25 mm) ± one-half turn
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD
POWER TRIM/TILT	Lubrication	Power Trim/Tilt & Power Steering Fluid or GM Dexron [†] II Automatic Transmission Fluid
	Fluid Capacity	21 fl. oz. (622 ml)
	Trim Range	0° to 21°
	Tilt Range	22° to 75°
	Tilt UP Stall Pressure	1500 psi (10342 kPa)
	Tilt IN Stall Pressure	800 psi (5516 kPa)

Reference Information

Service Specifications 90° 3.4 L Models

Service Specifications 90° 3.4 L Models

	HP	250, 300
ENGINE	Full Throttle Operating Range	5300–6000 RPM
	Power	250 HP: (183.9 kw) @ 5600 RPM 300 HP: (220.6 kw) @ 5600 RPM
	Idle RPM in Gear	500 ± 50
	Weight (may vary depending on model)	20 in. (L) Models: 507 lbs. (230 kg) 25 in. (X) Models: 528 lbs. (239 kg) 30 in. (Z) Models: 534 lbs. (242 kg)
	Lubrication	<i>Evinrude/Johnson XD100 Oil</i> Refer to Recommended Lubricants on p. 168
	Engine Type	90° V 6-Cylinder Loop-Charged
	Displacement	210.0 cu. in. (3441 cc)
	Bore	3.854 in (97.89 mm)
	Stroke	3.000 in. (76.20 mm)
	Standard Bore	3.8535 to 3.8545 in. (97.87 to 97.90 mm) To bore oversize, add piston oversize dimension to standard bore
	Top Crankshaft Journal	1.6199 to 1.6204 in. (41.15 to 41.16 mm)
	Center Crankshaft Journals	2.1870 to 2.1875 in. (55.55 to 55.56 mm)
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)
	Rod Crankpin	1.4995 to 1.5000 in. (38.09 to 38.106 mm)
	Piston Ring End Gap, Both	0.022 to 0.028 in. (0.57 to 0.72 mm)
FUEL	Fuel/Oil Ratio	<i>EMM</i> Controlled
	Starting Enrichment	<i>EMM</i> Controlled
	Preferred Fuel	Regular unleaded gasoline
	Acceptable Fuel	See Fuel Requirements on p. 138 for additional information.
	Minimum (High) Fuel Pressure @ IDLE RPM – 500 ± 50	22 to 28 psi (152 to 193 kPa)
	Minimum Fuel Lift Pump Pressure @ IDLE RPM – 500 ± 50	3 psi (21 kPa)
	Maximum Fuel Inlet Vacuum	4 in. Hg. (13.5 kPa)
	Minimum Octane	87 AKI (R+M)/2 or 90 RON
	Additives	<i>2+4[®] Fuel Conditioner, Fuel System Cleaner</i> Use of other additives may result in engine damage. See Fuel Requirements on p. 138 for additional information.

	HP	250, 300
ELECTRICAL	Minimum Battery Requirements	675 CCA (845 MCA); or 750 CCA (940 MCA) below 32°F (0°C) (Use a 107 amp-hr battery for extreme applications.)
	Alternator	Dual Voltage 50 Amp with Voltage Regulator and Battery Isolation. Refer to Predelivery and Installation Guide for multiple battery applications.
	Tachometer Setting	6 pulse (12 pole)
	Charging Isolator	Integral, Terminal on Engine Harness
	Engine Fuses	P/N 967545 – 10 A
COOLING	Thermostat	143°F (62°C)
	Maximum Temperature	190°F (88°C)
	Water pressure	18 to 25 psi @ 5000 RPM
IGNITION	Type	Capacitor Discharge
	Firing Order	1-2-3-4-5-6
	Ignition Features	EMM Controlled
	RPM Limit	6050
	Crankshaft Position Sensor Air Gap	Fixed
	Spark Plug	Champion [†] QC8WEP @ 0.028 ± 0.003 in. (0.71 mm) Refer to Electronic Parts Catalog (EPC)
GEARCASE	Gear Ratio	“M2” Type Gearcase: 13:24 (.542) (1.85:1)
	Lubricant	HPF Pro Gearcase Lubricant
	Capacity	“M2” Type Gearcase: 38.9 fl. oz. (1150 ml) “M2” Type – Counter Rotation: 35.8 fl. oz. (1060 ml)
	Shift Rod Height	20 in. (L) Models: 21 29/32 (556.25 mm) ± one-half turn 25 in. (X) Models: 26 29/32 (683.25 mm) ± one-half turn 30 in. (Z) Models: 31 29/32 (810.25 mm) ± one-half turn
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD
POWER TRIM/TILT	Lubrication	Power Trim/Tilt & Power Steering Fluid or GM Dexron [†] II Automatic Transmission Fluid
	Fluid Capacity	21 fl. oz. (622 ml)
	Trim Range	0° to 21°
	Tilt Range	22° to 75°
	Tilt UP Stall Pressure	1500 psi (10342 kPa)
	Tilt IN Stall Pressure	800 psi (5516 kPa)

Reference Information

Wire Size Table

Wire Size Table

This table provides closest equivalent size cross references between American and metric wire sizes.

American Wire Gauge

American Wire Gauge (AWG) is a standardized wire gauge system used in North America to identify the diameter of round, electrically conducting wire. Increasing gauge numbers result in decreasing wire diameters.

The AWG of a stranded wire is determined by the total cross sectional area of the conductor. Because there are small gaps between the strands, stranded wire will always have a slightly larger overall diameter than a solid wire of the same AWG.

Metric Wire Size

Metric wire size is also standardized. Metric wire size is determined by the number of strands of wires expressed in millimeters (mm) and the total cross sectional area of the conductor, expressed as square millimeters (mm²).

Example: 41/1.63 means forty-one strands of wire, each with a 1.63 mm diameter. This example has a cross sectional area of 2.08 mm².

AWG	Number of Wire Strands ⁽¹⁾	Conductor		
		Wire Strand Diameter ⁽²⁾		Cross Section ⁽³⁾
		(in.)	(mm)	(mm ²)
6/0	3335	0.58	14.73	170.3
5/0	2646	0.517	13.12	135.1
4/0	2109	0.46	11.7	107
3/0	1665	0.41	10.4	85
2/0	1330	0.365	9.26	67.4
1/0	1064	0.325	8.25	53.5
1	836	0.289	7.35	42.4
2	664	0.258	6.54	33.6
3	523	0.229	5.83	26.7
4	420	0.204	5.19	21.1
5	329	0.182	4.62	16.8
6	266	0.162	4.11	13.3
7	206	0.144	3.66	10.5
8	168	0.128	3.26	8.36
9	130	0.114	2.91	6.63
10	105	0.102	2.59	5.26
11	82	0.0907	2.3	4.17

AWG	Number of Wire Strands ⁽¹⁾	Conductor		
		Wire Strand Diameter ⁽²⁾		Cross Section ⁽³⁾
		(in.)	(mm)	(mm ²)
12	65	0.0808	2.05	3.31
13	52	0.072	1.83	2.62
14	41	0.0641	1.63	2.08
15	32	0.0571	1.45	1.65
16	26	0.0508	1.29	1.31
17	21	0.0453	1.15	1.04
18	16	0.0403	1.02	0.823
19	13	0.0359	0.912	0.653
20	10	0.032	0.812	0.518
21	8	0.0285	0.723	0.41
22	6	0.0253	0.644	0.326
23	5	0.0226	0.573	0.258
24	4	0.0201	0.511	0.205
25	3	0.0179	0.455	0.162
27	2	0.0142	0.361	0.102
30	1	0.01	0.255	0.0509

Notes: (1) 30 AWG (0.255 mm) conductor diameter
(2) Single wire strand diameter
(3) Total area cross section of all wire strands

Routine Service

Table of Contents

Inspection and Maintenance Schedule	18
Lifting the Outboard	19
Outboard Rigging Connections	20
Cable, Hose, and Wire Routing	21
Control Cable Installation	22
Battery Cable Connections	23
SystemCheck Harness Connections	23
<i>I-Command</i> Network Connections	24
<i>ICON</i> Network Connections	25
Water Pressure Gauge	26
Battery and Battery Connections	27
Oetiker Clamp Servicing	29
Adjustments	30
Tilt Limit Switch Adjustment	30
Trim Sending Unit Adjustment	31
Trim Tab Adjustment	32
Dual-Outboard Alignment	32
Operational Checks	34
Cooling System	35
Engine Flushing	35
Running the Outboard Using a Hose and Flushing Adapter	36
Lubrication	38
Steering System	38
Tilt Tube	38
Swivel Bracket and Trailing Bracket	38
Throttle and Shift Linkage	38
Propeller Shaft	39
Gearcase Lubricant	39
Trim and Tilt	40
Spark Plugs	41
Indexing	41
Fuel and Oil Systems	42
Fuel Filter	42
Oil Filters and Oil Reservoir	42
Hoses and Connections	43
Exhaust Pressure Fitting	43
Operation Test	43
Cleaning	44
Anti-Corrosion Protection	44
Gearcase Removal and Installation	45
Storage	48
Pre-Season Service	50
Submerged Engines	51
Oetiker Clamp Chart	52

Routine Service

Inspection and Maintenance Schedule

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.

Description of Service	Every 300 hours or every 3 years ⁽¹⁾		
	Routine Inspection		
	Engine Care Product		
Anodes (anti-corrosion), check condition		✓	✓
Back pressure probe, replace			✓
Batteries, check connections and condition		✓	✓
Control cables, inspect and adjust			✓
Cooling system; check water pump indicator / water pressure		✓	✓
Displays & gauges, self-test/warning horn, check operation		✓	✓
Electrical and ignition wires, inspect for wear or chafing			✓
Emergency cut-off switch(es) and tether cord, check operation		✓	✓
EMM, access EMM information, resolve any service codes			✓
Engine Monitor self-test and warning horn, check		✓	
Engine to transom mounting hardware, re-tighten (40 ft. lbs.)			✓
Fuel and oil systems, inspect and repair leaks ⁽²⁾		✓	✓
Fuel filters, replace			✓
Gearcase and water inlet screens, check condition		✓	✓
Gearcase lubricant, replace	A		✓
Grease fittings, lubricate ⁽³⁾	C		✓
Oil filter, replace			✓
Power tilt or power trim and tilt system, check operation	B		✓
Propeller, check condition		✓	✓
Propeller shaft splines, inspect and lubricate ⁽³⁾	C		✓
Remote control system and switches (START/STOP, Trim etc.) check operation		✓	
Fault codes, access EMM information, resolve any fault codes			✓
Spark plugs, replace ⁽²⁾			✓
Starter pinion shaft, inspect and lubricate ⁽³⁾			✓
Steering: Cable systems, inspect and lubricate	C		✓
Steering: Hydraulic systems, inspect fluid level, check hydraulic hose condition, check operation	E		✓
Thermostats, inspect and check operation ⁽²⁾			✓
Water pump, replace (more frequent if water pressure loss or overheating occurs)			✓

(1) 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

Engine Care Products

The engine care products listed in the table below are referenced in this service manual, and are recommended for use with *Evinrude E-TEC* outboards.

	Engine Care Product	Notes
A	HPF Pro Gearcase Lubricant	Containers available in various sizes, see PAC Catalog
B	Biodegradable TNT Fluid, P/N 763439	Use only in Power Trim & Tilt System of 3-cylinder models
B	Power Trim/Tilt Fluid, P/N 775612	Use only in Power Tilt System of all other models
C	Triple-Guard Grease, P/N 508298	
D	Starter Bendix Lube, P/N 337016	IMPORTANT: Use no other products
E	Hydraulic Fluid, P/N 770891	
	Anti-Corrosion Spray	
	"6 in 1" Multi-Purpose Lubricant	

Lifting the Outboard

⚠ WARNING

To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.

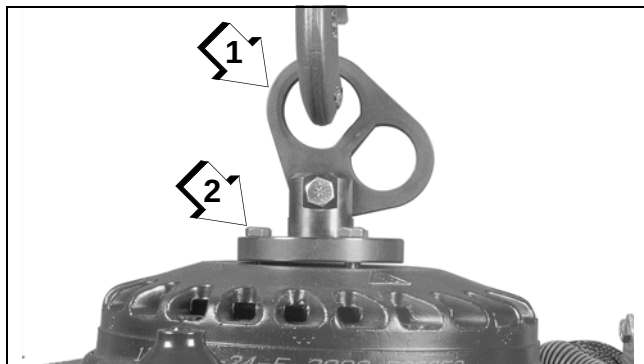
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

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

Use correct Lifting Fixture to lift outboard:

Model	Lifting Fixture
90° V6	P/N 396748 with 1 3/4 in. screws

Place lifting tool on flywheel and seat the three screws completely.



1. Lifting fixture
2. 1 3/4 in. screws (Qty. 3)

002419

Outboard Rigging Connections

IMPORTANT: For complete outboard rigging and remote control installation information, refer to the **Predelivery and Installation Guide** included with the service manual set.

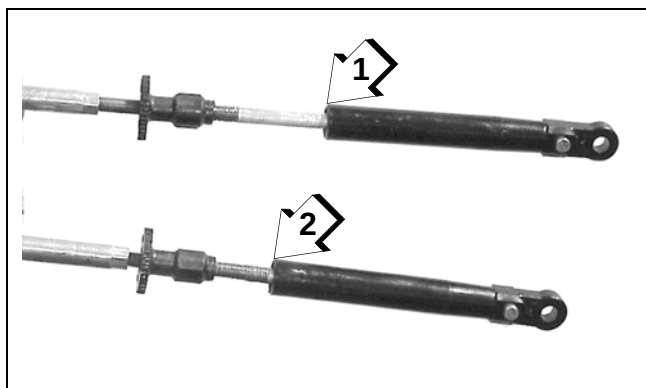
Common Practices – All Models

Control Cable Identification

IMPORTANT: Identify control cable function 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.



1. Shift cable casing guide extended to midpoint
2. Throttle cable casing guide retracted

DP0811

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



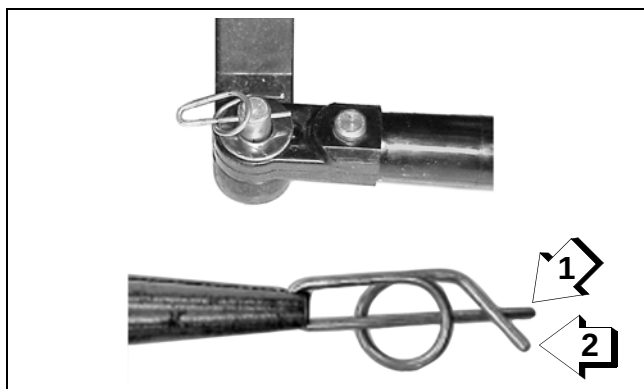
30501

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:

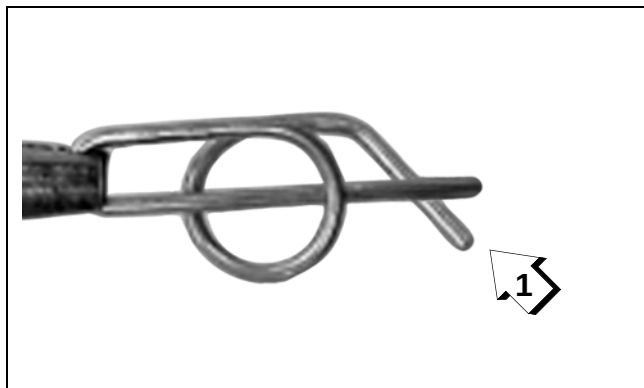
- Place washer on pin.
- Position retainer clip with straight section on the bottom and angled section on the top.
- Use long nose pliers to insert straight section of clip into linkage pin hole.



1. Straight section
2. Angled section

010302

- 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

010303

Cable, Hose, and Wire Routing

⚠ CAUTION

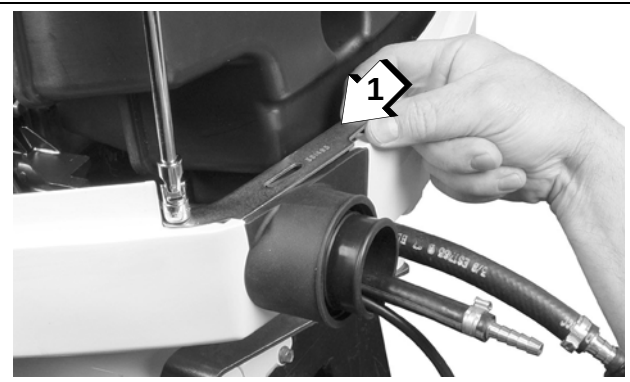
To prevent accidental starting while servicing, disconnect the battery cables at the battery. Disconnect the Crankshaft Position Sensor (CPS).

NOTICE

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

Refer to **Control Cable Identification** on p. 20.

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



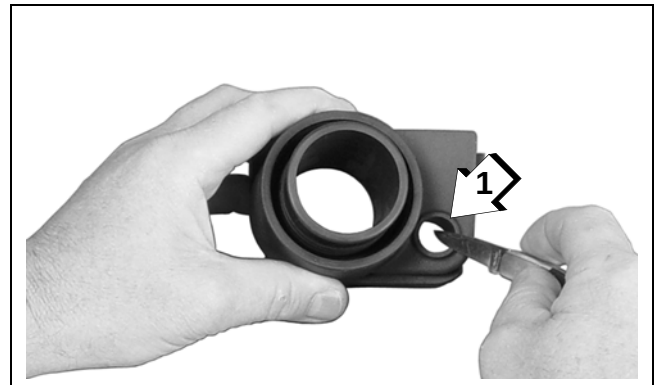
1. Grommet retaining bracket

003964

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

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

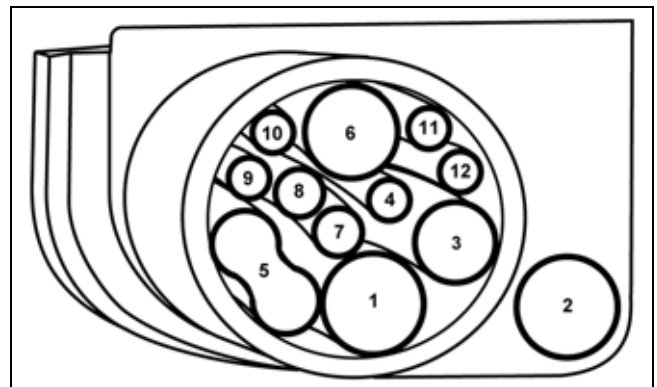
To route the fuel hose outside the sleeve, trim the material covering the alternate fuel hose slot in the grommet.



1. Alternate fuel hose location

003970

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

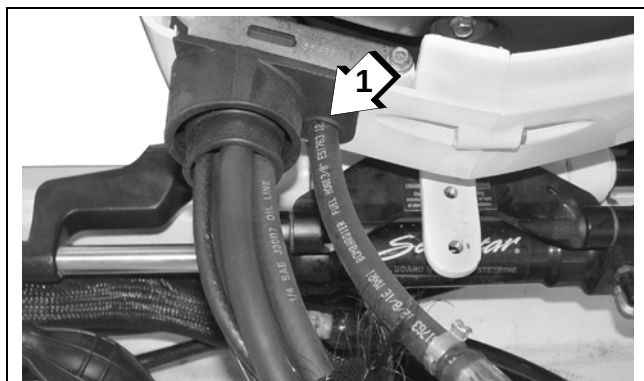


1. Fuel supply hose
2. Fuel supply hose--alternate location
3. Oil supply hose
4. Oil tank sending unit harness
5. Battery cables
6. Main wire harness (MWS)
7. Shift cable
8. Throttle cable
9. Accessory charge wires
10. I-Command harness
11. Water pressure hose
12. Speedometer hose

000095

Routine Service

Outboard Rigging Connections



1. Alternate fuel hose location

003971

The main wiring harness, battery cables, oil tank sending unit harness, and any *ICON* or *I-Command* network cables should be routed along the same path to the starboard side of the powerhead. Secure all cables with clamps.

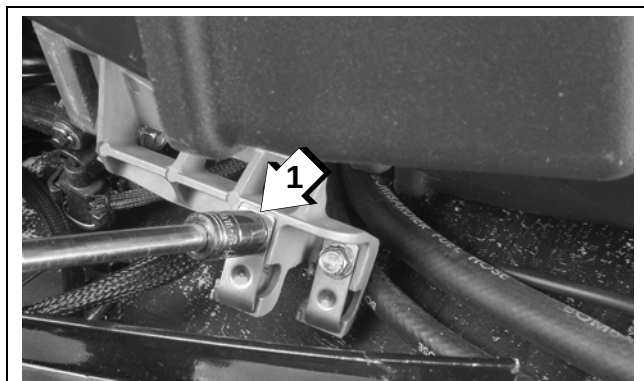


003974

Control Cable Installation

Refer to **Control Cable Identification** on p. 20.

Remove control cable trunnion covers and cable attachment hardware.



1. Trunnion covers

005037

Shift Cable Installation and Adjustment

Place the shift cable on the shift lever pin and install the washer and retainer clip. Refer to **Cable Retainer Clip Installation** on p. 20.

IMPORTANT: Do not bend or deform clip.

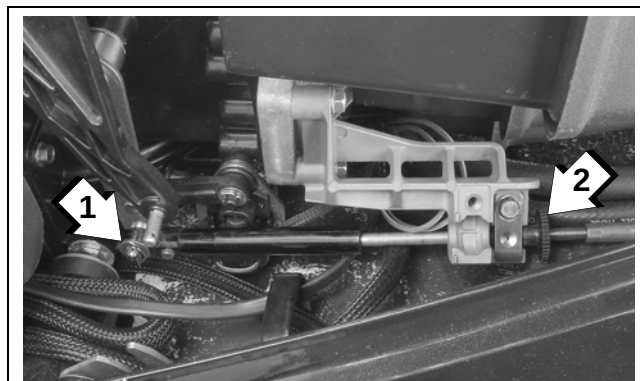
Make sure the remote control, gearcase, shift linkage, and shift cable are in NEUTRAL.

Hold the shift linkage in NEUTRAL.

Push and pull on the shift cable and observe the cable slack. Hold the casing guide in the center of the slack.

Adjust shift cable trunnion to align with center of the trunnion block. Place cable trunnion in trunnion block.

Install trunnion cover and screw. Tighten screw to a torque of 60 to 80 in. lbs. (7 to 9 N·m).



1. Shift cable retainer clip and washer
2. Shift cable trunnion

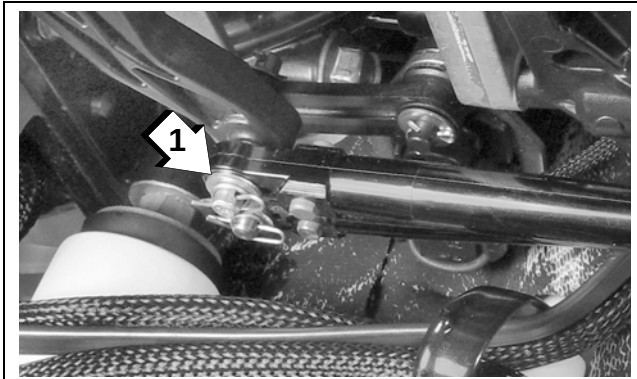
005038

Throttle Cable Installation and Adjustment

With remote control lever in NEUTRAL, pull firmly on throttle cable casing to remove slack.

Place throttle cable on throttle lever pin and install washer and retainer clip. Refer to **Cable Retainer**

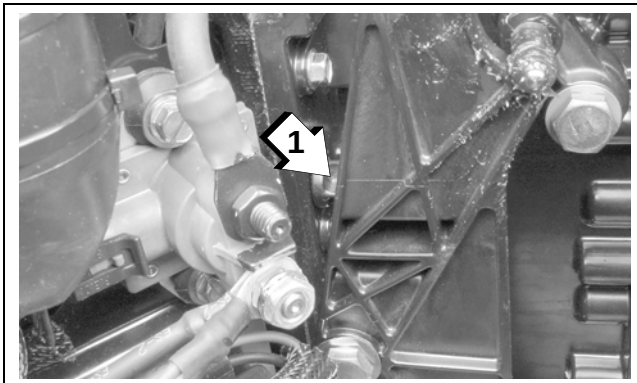
Clip Installation on p. 20.



1. Throttle cable retainer clip and washer

003967

Make sure that idle stop of the throttle lever is against the crankcase.



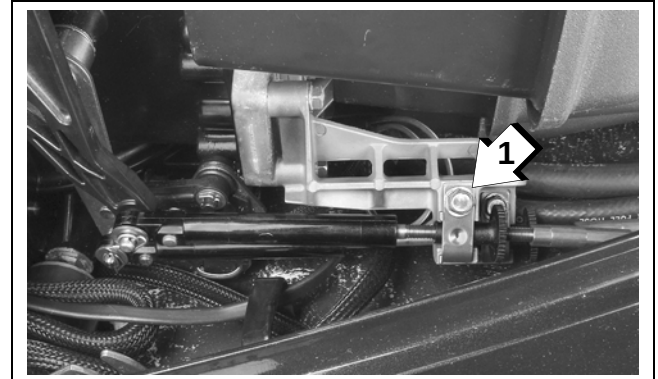
1. Throttle lever stop

003968

Adjust the throttle cable trunnion to align with the trunnion block. Place the cable trunnion in the trunnion block.

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.

Install trunnion cover and screw. Tighten screw to a torque of 60 to 80 in. lbs. (7 to 9 N·m).

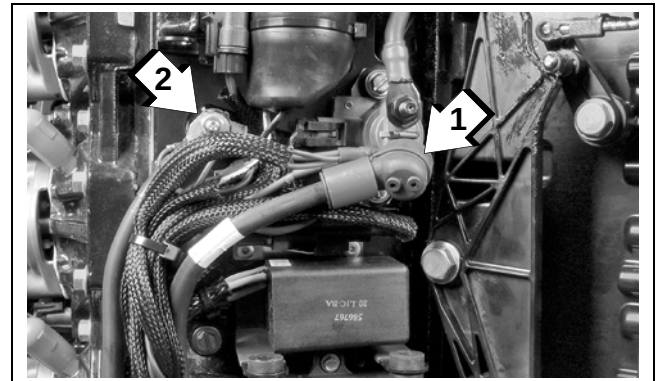


1. Trunnion cover and screw, throttle cable

005039

Battery Cable Connections

Install battery cables on starter solenoid and main ground stud.



1. Positive (+) battery connection
2. Ground (-) connection

003975

SystemCheck Harness Connections

NOTICE

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

Routine Service

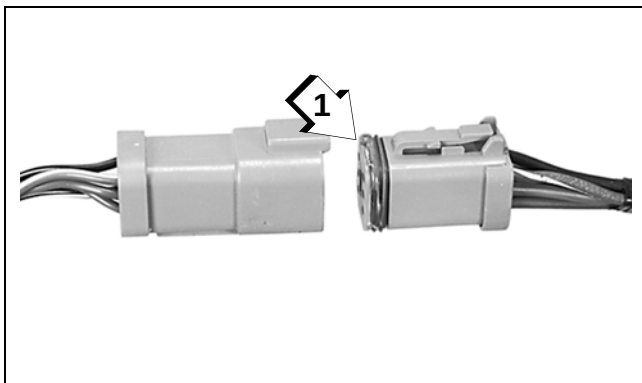
Outboard Rigging Connections

Remove harness connector cover.



003972

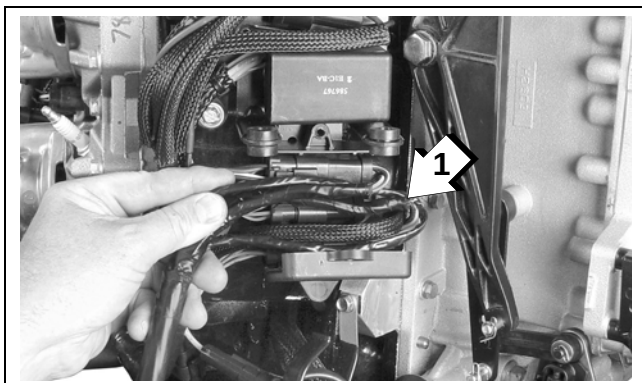
Before installing electrical connectors, check that the seal is in place. Clean off any dirt from connectors. Apply a light coat of *Electrical Grease* to the seal only. **DO NOT** fill connectors with *Electrical Grease*.



1. Seal

42079A

Connect outboard main wire harness to boat wire harness. Secure connectors in bracket. Refer to the diagram inside of the electrical cover.



1. Harness connections

003973

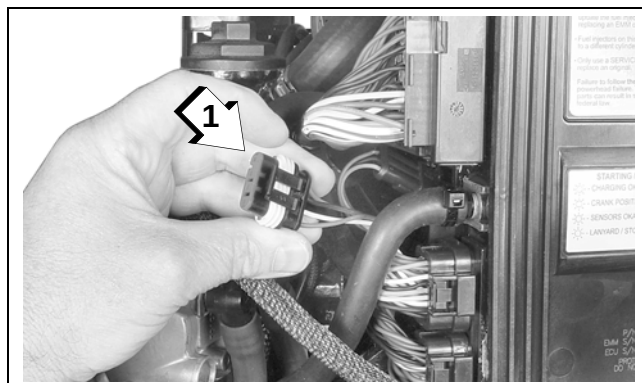
Replace harness connector cover.

I-Command Network Connections

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

If using an *Evinrude ICON* control system, the *I-Command* Engine Interface Cable, Power Supply Kit, and Ignition and Trim Harness are not required. Connect the *I-Command* network directly to the *ICON* gateway module. Refer to the ***ICON Remote Control System Installation Guide***.

If using a mechanical control system, connect the *I-Command* Engine Interface Cable to the *EMM* CANbus connector.



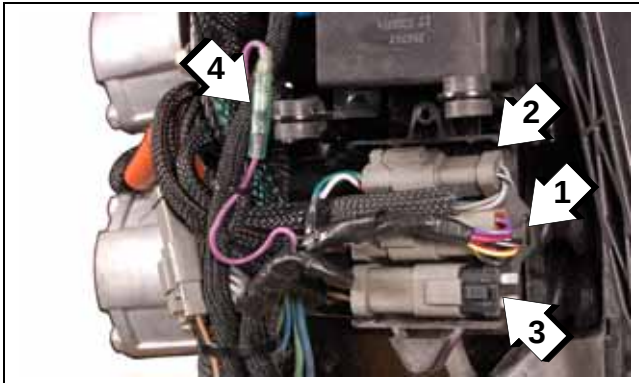
1. EMM CANbus connector

004265

Use an *I-Command* Ignition and Trim 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 connecting to an existing *I-Command* Classic network, connect the purple wires between the *I-Command* Ignition and Trim Harness and the *I-Command* Engine Interface Cable. This connection supplies power to the network when the key

switch is on. *I-Command* Digital networks do not use this connection.



1. I-Command Ignition connector
2. Trim/Tilt connector
3. SystemCheck connector (with seal)
4. Network power supply connector (Deutsch style networks)

006862

Route the harnesses around the starboard side of the powerhead along the same path as the battery cables.

For an *I-Command* oil level display, an accessory CANbus oil level sender must be installed in the oil tank. Connect the sender to the *I-Command* network. Refer to the *I-Command* Digital Network Guide.

Use *Evinrude Diagnostics* software to adjust network settings in the EMM. From the *Settings* screen, select *Engine Options*.



Engine Options Screen

008563

ICON Network Connections

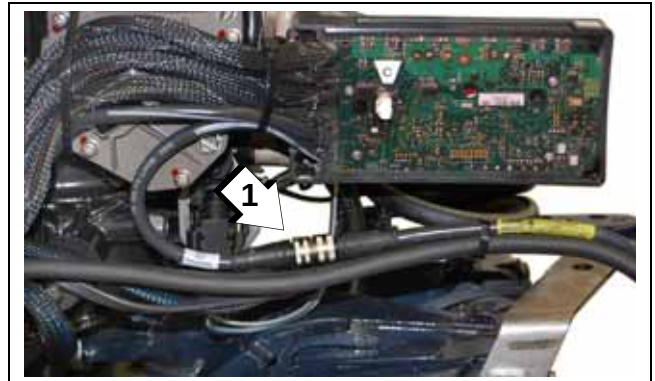
NOTICE

Do not connect boat accessories to the key switch of an *ICON* system. Connecting accessories to the key switch can cause low current, resulting in erratic operation of the remote control system.

If the outboard is equipped for an *Evinrude ICON* control system, connect the outboard to the network as follows.

Refer to the *ICON Remote Control System Installation Guide*.

Connect the buss cable from the rear network hub to the outboard's network harness.



1. ICON network connector

008001

IMPORTANT: Do not force connectors or locking rings. Properly aligned connectors assemble easily.

Do not use *Electrical Grease* on *ICON* buss cable connectors.

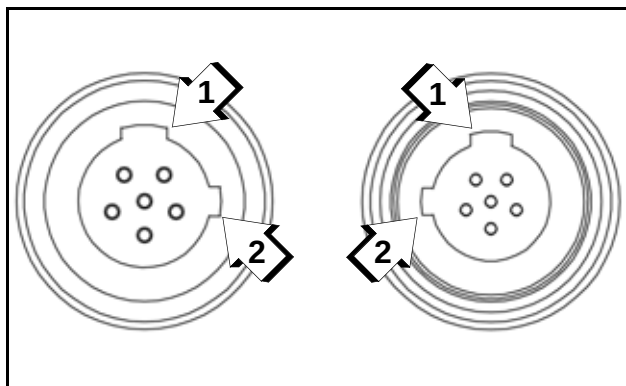
To assemble the connectors:

- Use the large tabs and small tabs to carefully align buss cable connectors.
- Carefully align pins and sockets of connectors. Do NOT force connectors together.

Routine Service

Outboard Rigging Connections

- Tighten locking rings of buss connectors finger tight. Do NOT use locking rings to force connectors together.



1. Large tabs
2. Small tabs

007883

Do not rotate connectors until they align. This could result in a mismatched connection. It is possible for each pin to enter a socket even if the tabs are misaligned. Look at the tabs to ensure connector alignment prior to making the connection.

Engine Monitor information is distributed to an *ICON* or *I-Command* network through the *ICON* gateway module. Refer to the ***I-Command Digital Network Guide***.

The *ICON* Harness and Relay Kit, P/N 765296, must be used to provide power to boat accessories that require switched B+. This kit is used in place of connecting accessories to the "A" terminal of the key switch. Accessories connected to the accessory power relay should not exceed 7 amps.

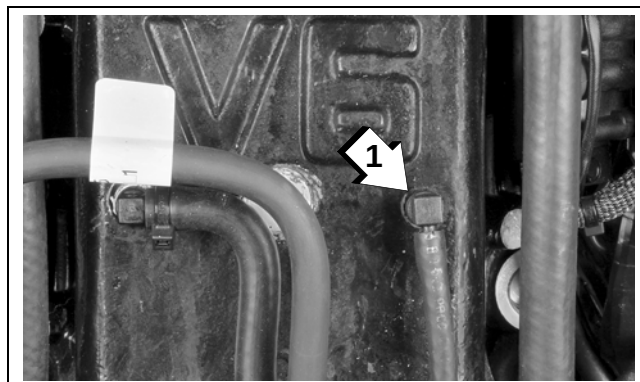
For more information, refer to the ***ICON Remote Control System Installation Guide***.

Water Pressure Gauge

To display engine water pressure, install a water pressure hose fitting in the cylinder block as shown.

Use *Pipe Sealant with Teflon* on the threads of the hose fitting. Refer to installation instructions supplied with gauge.

Route the water pressure hose around the starboard side of the powerhead along the same path as the battery cables.



1. Water pressure hose fitting

005035

For an *I-Command* water pressure display, several water pressure sensor kits are available. Refer to the ***Evinrude/Johnson Genuine Parts and Accessories*** catalog.

To send water pressure data to the *EMM*, along with an *I-Command* display, install a water pressure transducer kit.

Water pressure readings in excess of 40 psi (275 kPa) are possible for 90° V6 models at boat speeds in excess of 50 mph (80 kph/43 kts).

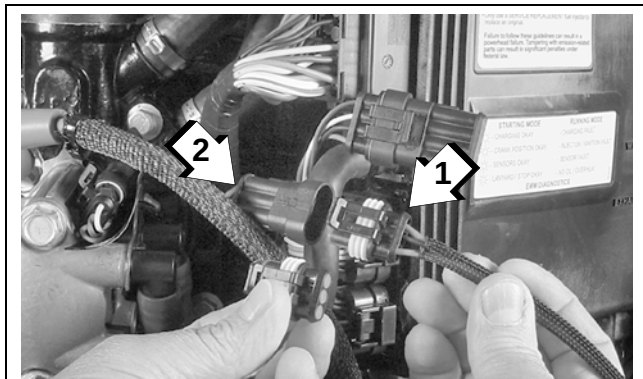
Use 50 psi Water Pressure Transducer Kit, P/N 5008640.



1. Water pressure transducer

008131

Connect the transducer lead to the engine wiring harness connector.



1. Water pressure transducer lead
2. Engine harness connector

004120

Battery and Battery Connections

⚠ WARNING

Battery electrolyte is acidic—handle with care. If electrolyte contacts any part of the body, immediately flush with water and seek medical attention.

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

Battery Recommendations

The battery charging system of *Evinrude* outboards is designed for use with lead acid type batteries only, including "AGM" and "Gel" type batteries. If other battery types, such as lithium ion batteries are used with an *Evinrude* outboard, installation of additional equipment may be required as defined by the battery manufacturer.

⚠ WARNING

American Boat and Yacht Council (ABYC) specifications state:

"Lithium Ion Battery systems pose different risks from those encountered with lead acid batteries and should only be installed and maintained in accordance with manufacturer's recommendations."

Failure to follow the battery manufacturer recommendations may cause the battery to fail, resulting in a fire or explosion, property damage, and serious injury or death.

When installing lithium ion batteries, installers **MUST** correctly install the batteries and the required battery chargers specified by the battery manufacturer. Upon delivery, be sure to advise customers that lithium ion batteries and battery chargers **MUST** be properly maintained and review the battery manufacturer's instructions with the customer.

Routine Service

Battery and Battery Connections

Outboard Model	Battery Rating
200 H.O. – 300 HP	640 CCA (800 MCA) or 800 CCA (1000 MCA) below 32° F (0° C)

Battery Location

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.

Battery Connections

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.

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.

Disconnecting the Battery

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.

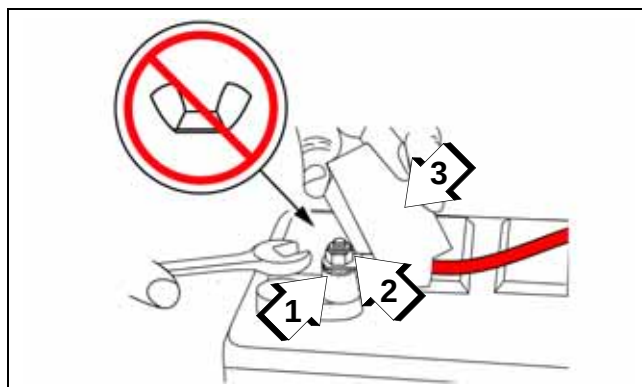
Connecting the Battery

NOTICE

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

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



Marine Style Battery Post

DR5103

1. Starwasher
2. Hex nut
3. Terminal Insulator

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

Oetiker Clamp Servicing

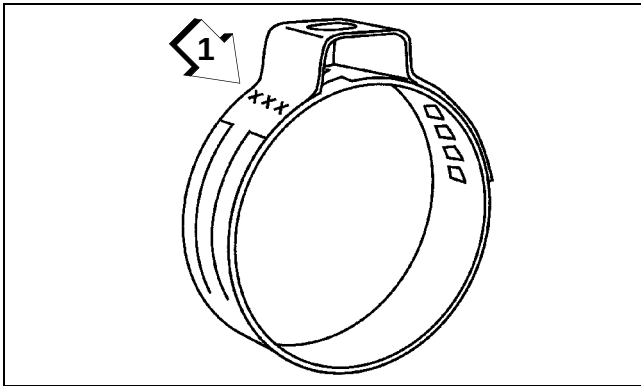
⚠ WARNING

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

Clamp Identification

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 on the side of the clamp, near the top of the ear. Refer to **Clamp Selection** chart for dimensions.



Clamp Selection

To select the correct size *Oetiker* clamp, measure the outside diameter of the hose when installed on the fitting.

Choose a clamp so that the outside diameter of the hose is approximately in the middle of the clamping range of the clamp.

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.

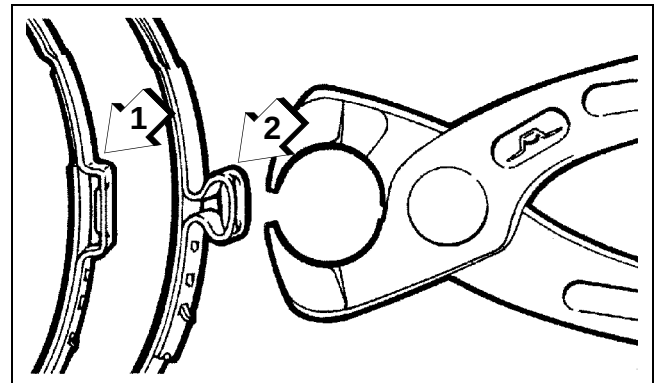
Oetiker pincers are available in the *Evinrude/Johnson Genuine Parts and Accessories Catalog*.



1.

DP0886

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

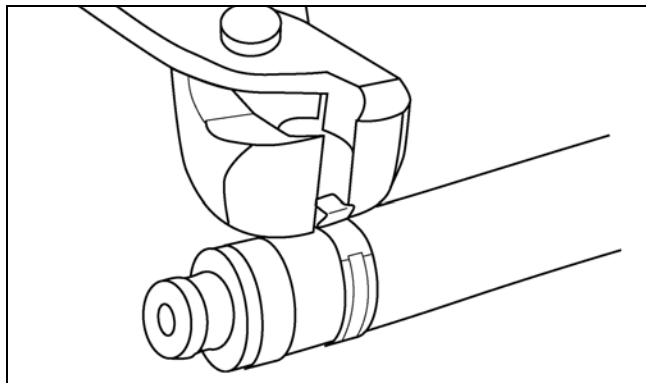


1. Open clamp
2. Closed clamp

000092

Clamp Removal

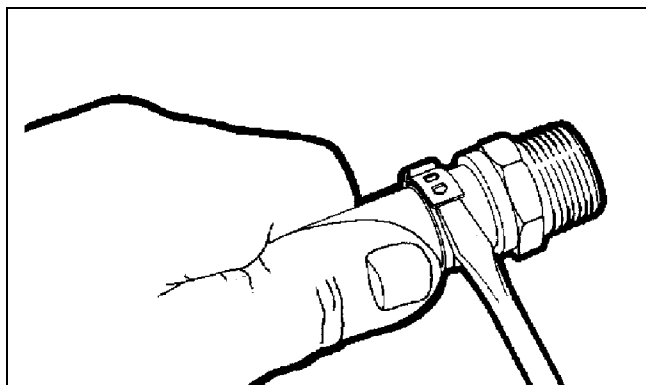
Method 1: Position *Oetiker* pincers across clamp ear and cut clamp.



1.

000108

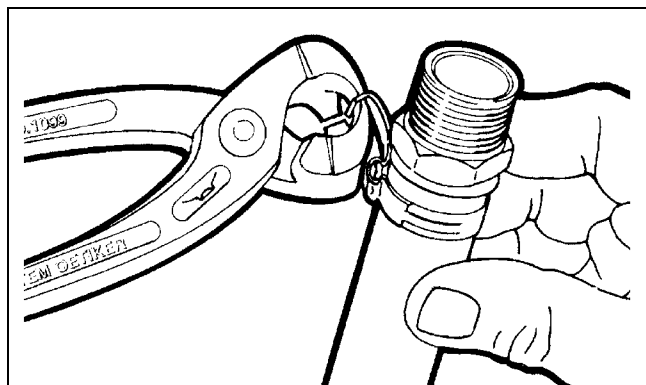
Method 2: Lift end of stepless clamp with screw-driver.



1.

000090

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



1.

000091

Adjustments

Tilt Limit Switch Adjustment

⚠ WARNING

If the outboard does not clear all boat parts when tilted fully or turned side to side, safety related parts could be damaged in the course of such outboard movement. Injuries could result from loss of boat control.

⚠ WARNING

Adjusting the tilt limit cam will NOT prevent the outboard from tilting fully and contacting the motor well if the gearcase hits an object at high speed. Such contact could damage the outboard and boat and injure boat occupants.

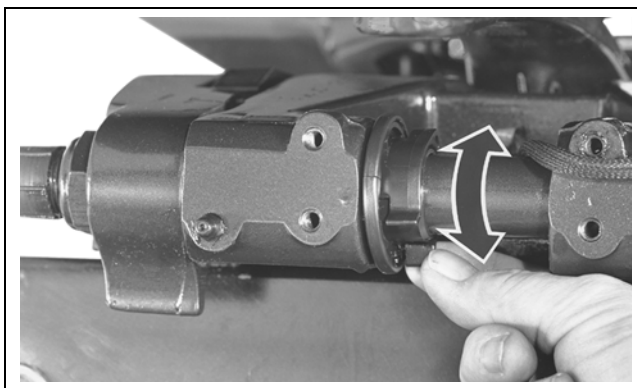
NOTICE

The tilt limit cam will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.

Adjust the tilt limit switch on all new outboard installations.

Check the clearance between outboard(s) and the boat's motor well and transom area. Tilt outboard(s) to highest point of clearance and turn the steering system lock to lock.

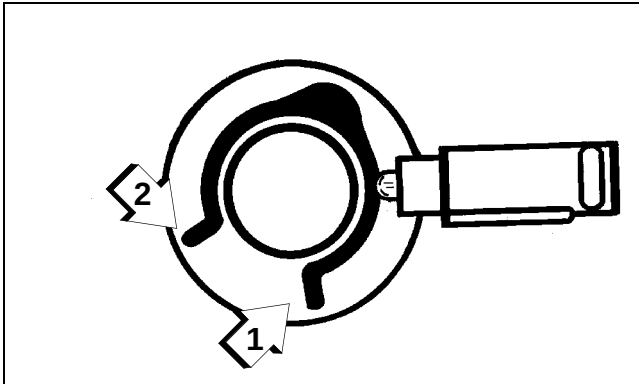
If the outboard contacts the boat's motor well when fully tilted, adjust the tilt limit cam to reduce full-tilt position.



DR3916

Place the outboard in normal operating position.

Rotate the LOWER adjustment tab UP to reduce the maximum tilt. Rotate the UPPER adjustment tab DOWN to increase the maximum tilt position.



1. Lower adjustment tab
2. Upper adjustment tab

DR4268

Check the adjustment by tilting the outboard fully.

Repeat this procedure until the tilt limit switch stops the outboard's upward travel before it contacts the motor well.

To prevent damage to equipment, provide additional motor well clearance when needed. Consider either changing the outboard mounting position or modifying the boat if the possibility for interference and damage exists.

Trim Sending Unit Adjustment

⚠ WARNING

To avoid personal injury, do not adjust the sending unit eccentric cam while the engine is being tilted.

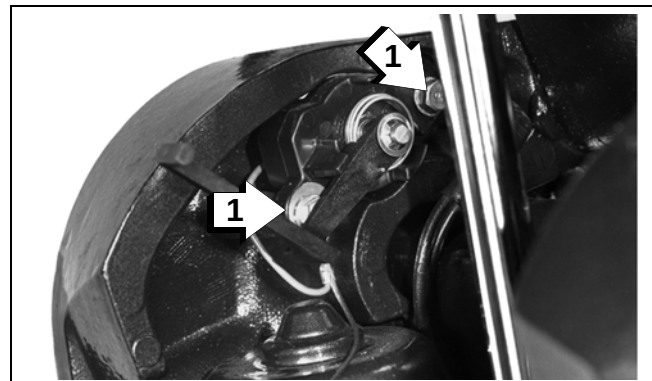
Tilt the outboard and engage the tilt support.

Temporarily install a thrust rod, P/N 436541, in the number 3 hole.



29072

Loosen the sending unit screws, to allow the sending unit to pivot.

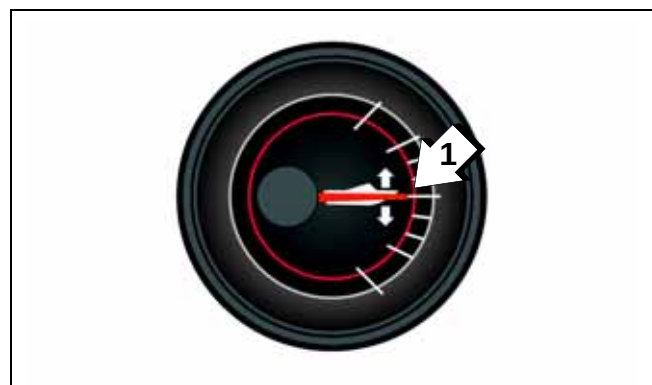


1. Screws

27339

Disengage the tilt support. Lower the outboard against the thrust rod.

Observe the trim gauge. If the needle does not show center position, tilt the outboard up and adjust the sending unit by pivoting it up or down.



1. Needle at center position

000662

Routine Service

Adjustments

Lower the outboard against the thrust rod to check adjustment. Repeat adjustment, if necessary.

After adjustment is correct, tilt the outboard up, tighten the two sending unit screws, and remove the thrust rod.

Trim Limiter Rod

⚠ WARNING

When the outboard is returned to the customer, the trim limiter rod must be installed and in the same location as it was when the motor was brought in for service. Leaving the trim limiter rod out, or changing the adjustment, could allow the motor to unexpectedly trim in too far and cause loss of control.

The trim limiter rod prevents excessive trim down.

As the engine is trimmed to the full down position, the bow of the boat goes deeper into the water.

- If the trim limiter rod is left out, the bow could plow into the water causing the boat to “bow steer” resulting in a loss of control.
- If the trim limiter rod is set too far out, the propeller could ventilate, resulting in poor acceleration when the boat is coming onto plane.

Set the trim limiter rod to prevent excessive trim down and provide good acceleration. The trim limiter rod can be used to prevent the gearcase or spray deflector from contacting the transom.

Trim Tab Adjustment

⚠ WARNING

Improper trim tab adjustment can cause difficult steering and loss of control.

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.

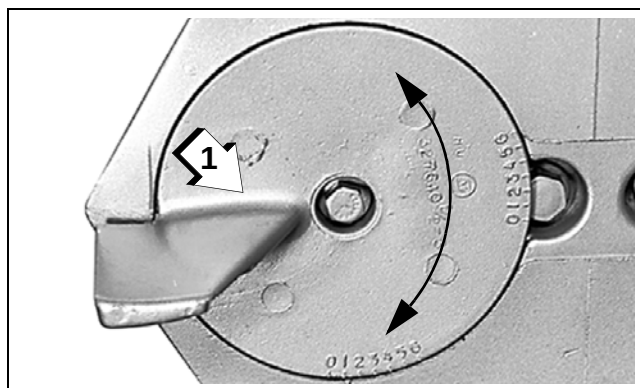
IMPORTANT: A single trim tab adjustment will relieve steering effort under only one set of speed, outboard angle and load conditions. No single adjustment can relieve steering effort under all conditions.

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

- With the remote control in NEUTRAL and 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 as follows:

- **200 – 300 HP:** 35 to 40 ft. lbs. (47 to 54 N·m).



1. Trim tab screw

COA3663

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.

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:

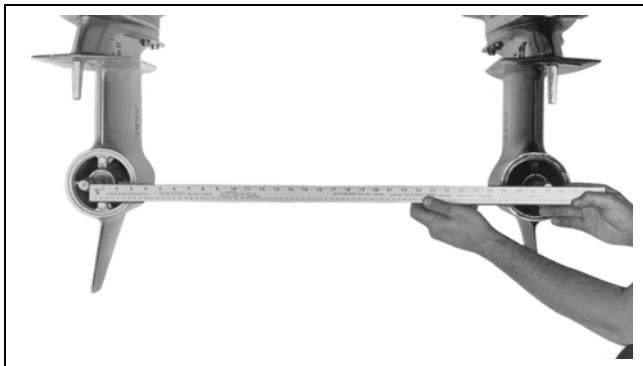
- Propeller ventilation
- Reduction of top speed
- Improper boat tracking
- Engine overheat and powerhead damage

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

Measure Alignment

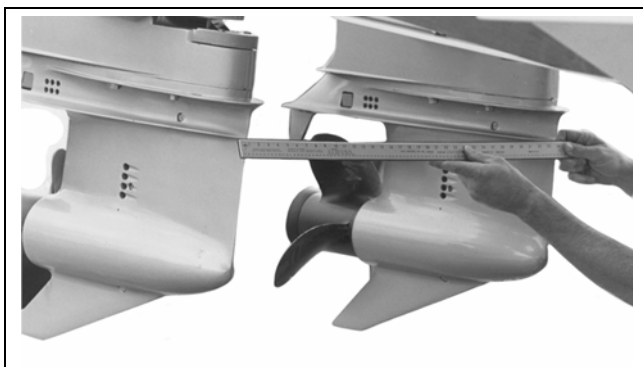
The “toe-in” (gearcase leading edges closer together than propeller shaft centers) or “toe-out” (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:

- Position outboards straight with the anti-ventilation plates parallel with the bottom of the boat.
- Measure between propeller shaft centers.



6365

- Measure between leading edges of gearcase.



6340

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.

Operational Checks

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.

WARNING

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.

NOTICE

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

Engine Monitoring System

Attach emergency stop lanyard.

SystemCheck

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.

I-Command

Turn key switch to ON.

The *Evinrude E-TEC* screen should appear, followed by the tachometer display.

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.

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 starter will not operate when the outboard is 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

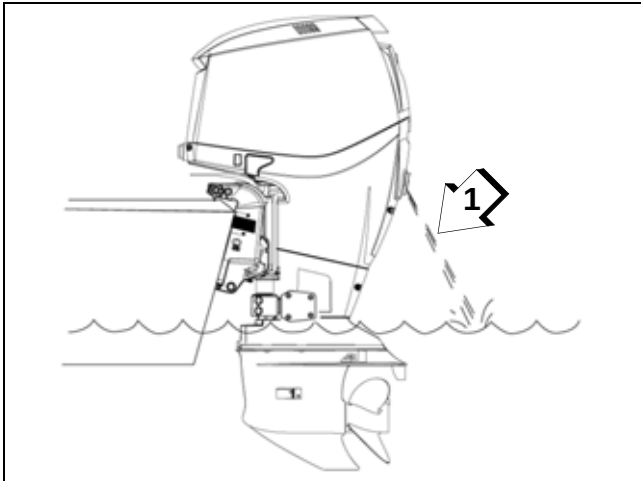
Confirm accuracy of tachometer reading.

- Adjust dial on back of tachometer to required setting (the outboard should not be running).

Outboard Model	Tachometer Setting
200–300 HP	6 Pulse or 12 Pole

Water Pump Overboard Indicator

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



1. Water pump overboard indicator

008469B

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 90° 3.3 L Models** on p. 12.

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.

Cooling System

Check the condition of cooling system components regularly:

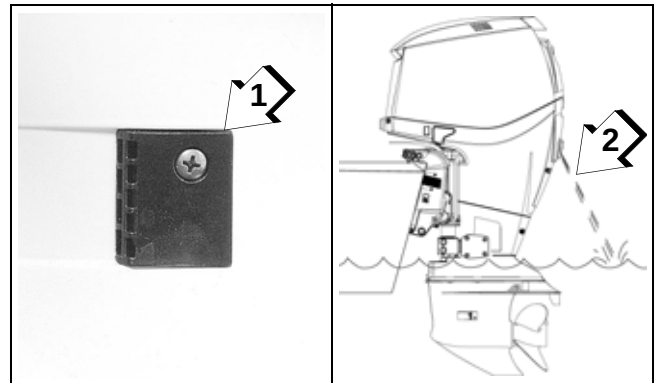
- water intake screens
- water pump
- all internal water passages
- thermostats
- all external water hoses and fittings
- vapor separator cooling passages and fittings
- EMM cooling passages and fittings
- overboard water pressure indicator.

Water Intake Screens

Inspect condition of water intake screens. Clean or replace as needed.

Confirm function of overboard water pressure indicator.

Clean or replace plug and nozzle as needed.



1. Water intake screen
2. Overboard indicator

DSC02220a
008470A

Engine Flushing

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.

Routine Service

Cooling System

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

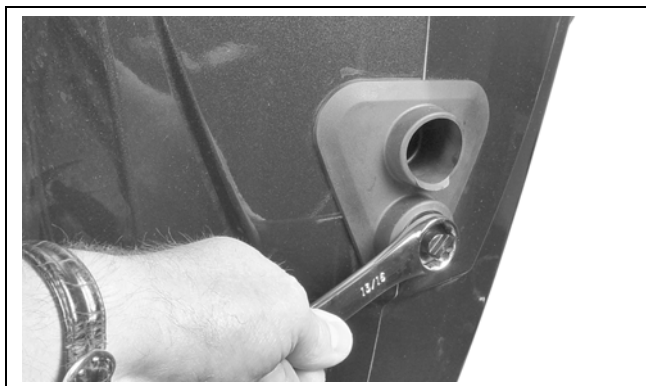
Flushing — Outboard Running

⚠ WARNING

To prevent injury from contact with rotating propeller, remove the propeller before running engine with a flushing adapter.

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

Remove plug and nozzle (overboard indicator) from the flushing port.



1.

004263

Thread garden hose into flushing port.



1.

004264

Turn water supply on.

Run outboard at IDLE only until full operating temperature is reached.

Reinstall plug and nozzle. Position the plug and nozzle to allow the water stream to be seen from the helm.

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

Reinstall propeller.

Flushing — Outboard Not Running

Outboard can be in VERTICAL (DOWN) or TILTED (UP) position.

Remove plug and nozzle (overboard indicator) from the flushing port.

Thread garden hose into flushing port.

Turn water supply ON.

Flush outboard for at least five minutes.

Turn off water supply and remove garden hose.

Reinstall plug and nozzle. Position the plug and nozzle to allow the water stream to be seen from the helm.

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

Running the Outboard Using a Hose and Flushing Adapter

⚠ WARNING

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

A flushing adapter may be used to provide cooling water when running the outboard to:

- Flush the engine
- Run for an extended period of time, such as when performing diagnostic work
- Run the engine on a dynamometer
- Prepare the outboard for storage.

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

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

Be sure water supply is sufficient to run the engine above idle speed.

Water Supply Requirements

Model	Water Flow @ WOT
200–250 HP (3.3 L)	20 to 25 GPM ¹ (75 to 94 LPM) ²
250–300 HP (3.4 L)	25 to 30 GPM ¹ (94 to 113 LPM) ²

1. GPM: Gallons per minute
2. LPM: Liters per minute

Install flushing adapter onto gearcase water inlet screens.

NOTICE

Temporarily cover the small holes on the front of M2-Type gearcases with waterproof tape to make sure enough water travels to the power-head. Water can drain from auxiliary inlets, resulting in engine overheating.



M2-Type Gearcase
1. Water-proof tape
2. Flushing adapter

008358

A steady stream of water should flow from the overboard indicator while the engine is running.

Monitor engine water pressure gauge when:

- Engine speed is above 3000 RPM
- Running engine on a dynamometer.

Refer to **Service Specifications 90° 3.3 L Models** on p. 12 for water pressure requirements.

NOTICE

Engine will overheat if normal water pressure is not maintained. Temporarily install an engine water pressure gauge if not equipped with one.

Be sure to remove waterproof tape from auxiliary water inlets.

NOTICE

Engine will overheat if auxiliary water inlets are restricted when outboard is back in service.

Lubrication

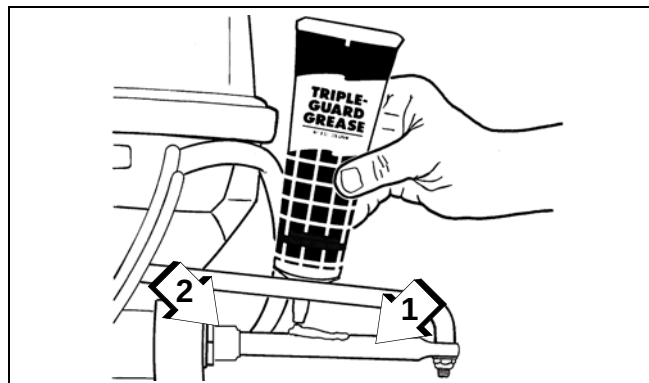
Steering System

⚠ WARNING

Failure to re-grease 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.

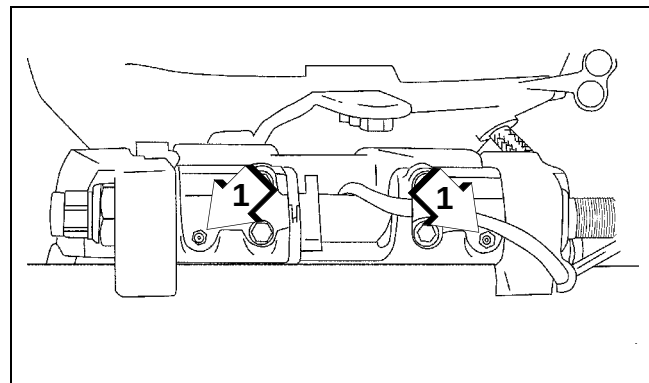


1. Steering cable
2. Wiper nut

DR29546

Tilt Tube

Lubricate the tilt tube grease fittings with *Triple-Guard* grease.



1. Tilt tube fittings

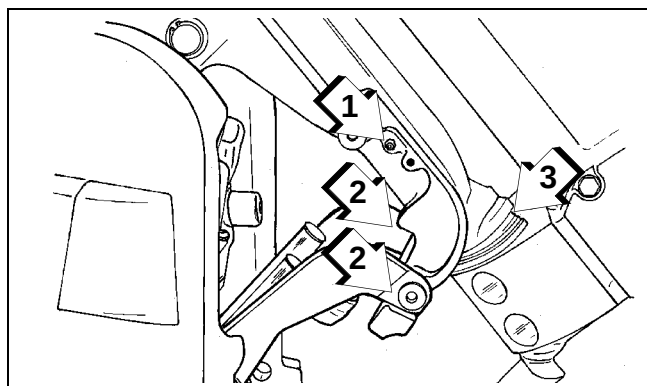
DR38798

Swivel Bracket and Trailing 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 trailing bracket with *Triple-Guard* grease.



1. Grease fitting
2. Pivot points
3. Lower swivel bracket area

DR5073

Throttle and Shift Linkage

Disconnect the battery cables at the battery.

Remove cable trunnion cover. Carefully, remove throttle and shift cables from trunnion block.

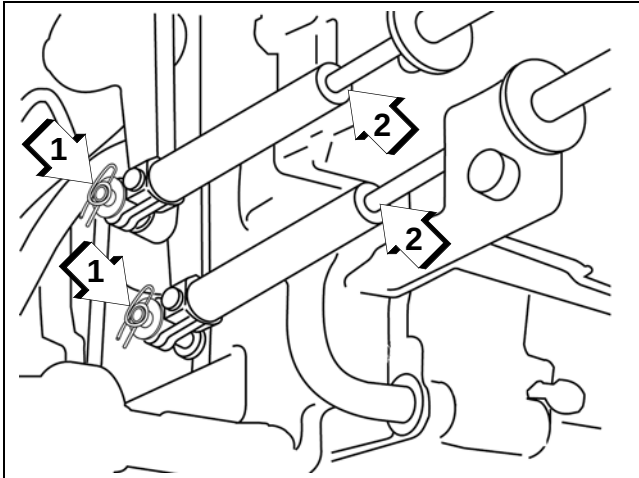
IMPORTANT: DO NOT disturb cable trunnion adjustments.

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

Apply *Triple-Guard* grease to:

- Pivot and slide area of the shift interrupt switch bracket
- Cable attachment pins of both the throttle and shift levers

- Inner casings of both the throttle and shift cables.



1. Attachment pins, throttle and shift cables
2. Inner casings, throttle and shift cables

DRC6500GE

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 Crankshaft Position Sensor (CPS) to prevent accidental starting.

Remove propeller. Refer to **Propeller Hardware Installation** in the **Gearcase** service manual.

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.

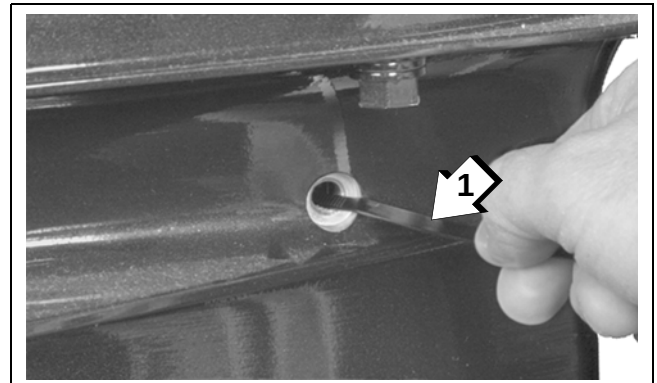
Gearcase Lubricant

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.

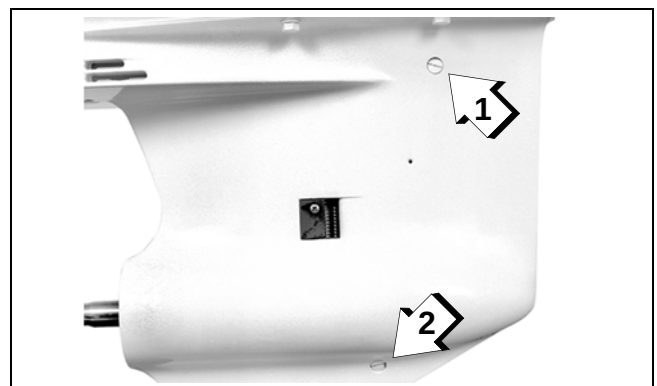


1. Tie strap

000072

If lubricant level is low, refer to **Gearcase Leak Test** in the **Gearcase** service manual.

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



1. Lubricant level plug
2. Lubricant drain/fill plug

39514

Routine Service

Lubrication

Inspection

Inspect the lubricant 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.

If water is present, refer to **Gearcase Leak Test** In the **Gearcase** service manual.

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. 18 for service frequency and recommended lubricants.

Secure the gearcase in a vertical position.

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

Use Gearcase Filler, P/N 501882, to slowly fill the gearcase with *HPF PRO* lubricant through the drain/fill hole until it appears at the oil level hole.

IMPORTANT: 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 plugs to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Lubricant level plug
2. Lubricant drain/fill plug

002386

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

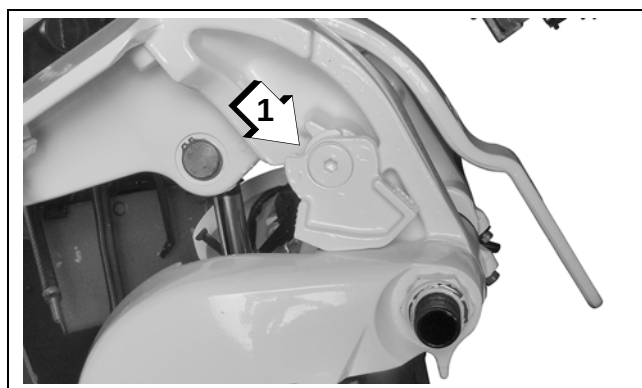
Trim and Tilt

⚠ CAUTION

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

Check reservoir fluid level every three years or every 300 operating hours.

- System capacity is approximately 21 fl. oz. (620 ml).
- Tilt the outboard and engage the tilt support.

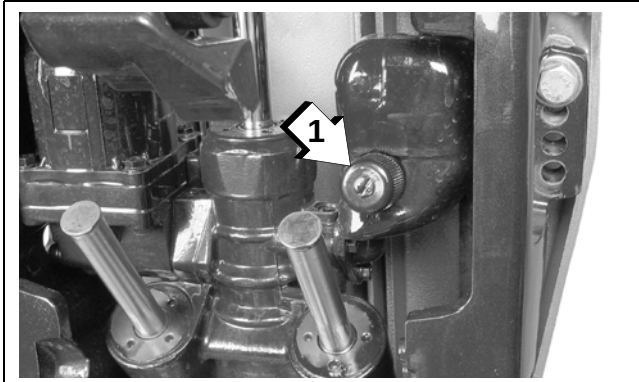


1. Tilt support bracket

002279

- Remove filler cap and check fluid level.

- **Three Ram System**—Add *Power Trim/Tilt Fluid* or *GM Dexron II*, as needed, to bring level to the bottom of the fill plug threads.



Three Ram System
1. Fill cap

004277

Install the filler cap 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.

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.

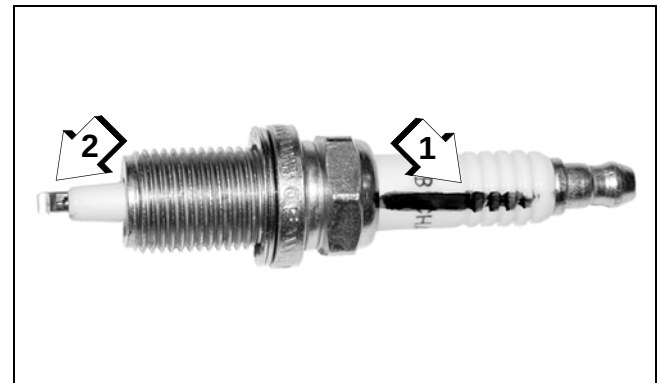
Spark Plug, <i>Champion</i>
QC8WEP @ 0.028 ± 0.003 in. (0.76 mm)

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

Indexing

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

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



1. Ink mark
2. Open side

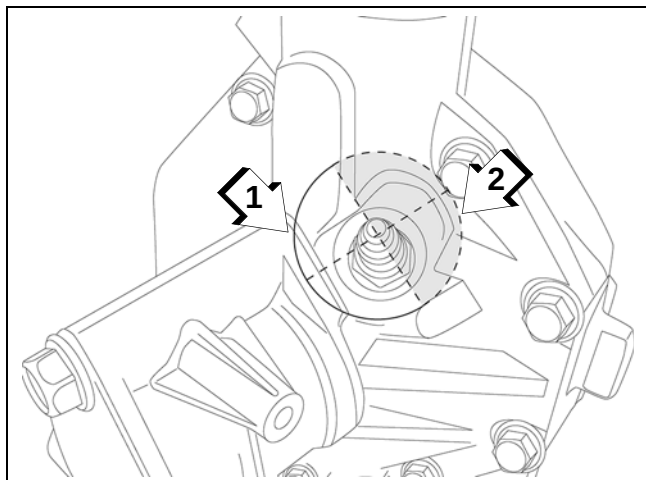
000758

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

Routine Service

Fuel and Oil Systems

If the mark is in unshaded area do not tighten any more.



Spark Plug Indexing Diagram

1. Unshaded area
2. Shaded area

004294

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

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

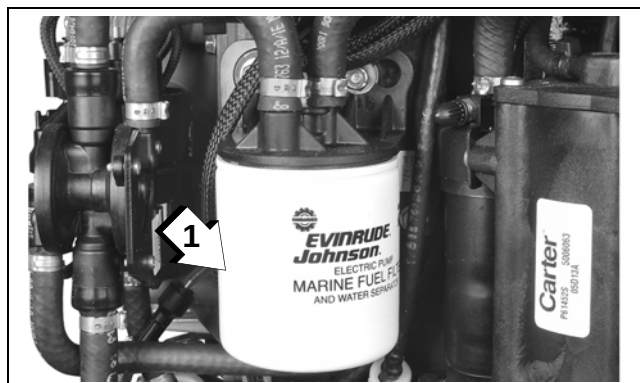
Fuel and Oil Systems

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 V-model outboards are equipped with a water-sensing, water-separating fuel filter. Refer to **Fuel Component Servicing** on p. 147.



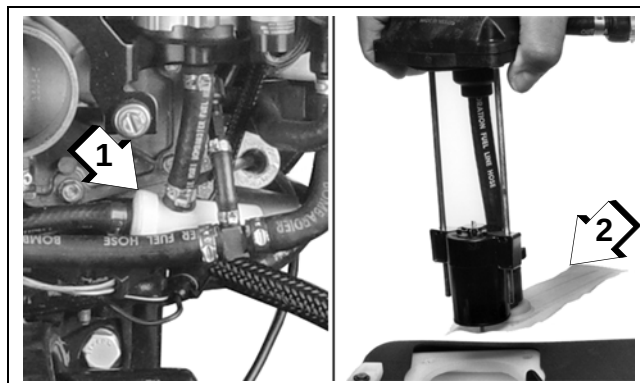
1. Water-separating fuel filter

005022

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.

Serviceable oil filters are located in the oil injection tank, and in the oil supply line before the oil lift pump(s).



1. Filter, oil supply line
2. Filter, oil injection tank

010366

Air Silencer

The air silencer on *Evinrude* outboards maximizes air flow while minimizing noise.



004218

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

Hoses and Connections

WARNING

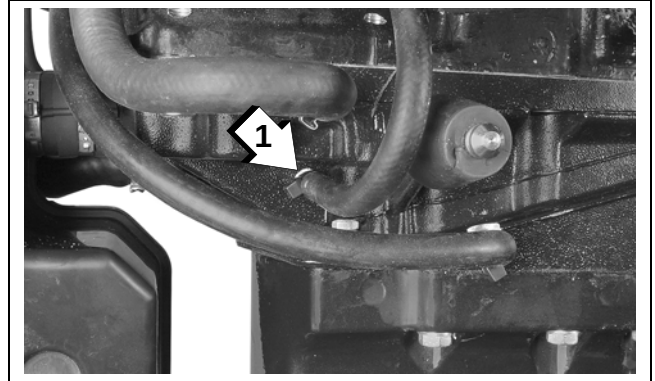
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

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.

Exhaust Pressure Fitting

The exhaust pressure fitting is threaded into the adapter housing and protrudes into the inner exhaust.



1. Exhaust pressure fitting

005026

A hose is routed from this fitting to the *EMM*. Due to carbon accumulation in the exhaust, this fitting must be periodically de-carbonized or replaced.

Operation Test

Use the *Evinrude Diagnostics* software *Monitor* screen to confirm:

- barometric pressure reading; and
- changes in exhaust pressure reading.

With key ON, outboard NOT running, make sure the barometric pressure reading reflects actual atmospheric conditions.

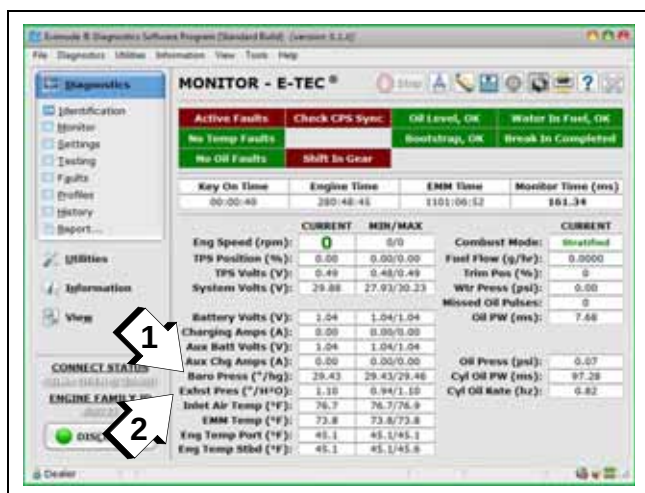
If barometric pressure reading is inaccurate, remove exhaust/barometric pressure hose from *EMM*. Retest and observe engine *Monitor* screen. If barometric pressure reading is accurate with hose removed, replace hose and diaphragm assembly. and inspect exhaust fitting for restriction.

With key ON, outboard NOT running, the exhaust pressure sensor reading should be close to zero. With the outboard running, make sure the exhaust pressure reading changes with throttle setting. This reading will vary, based on actual outboard exhaust pressure conditions.

Routine Service

Anti-Corrosion Protection

If the exhaust pressure readings are not as described, clean or replace exhaust pressure fittings.



Engine Monitor Screen
1. Barometric pressure reading
2. Exhaust pressure reading

008566

Cleaning

⚠ WARNING

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

Cleaning with *Engine Tuner* maintenance product can dissolve carbon build-up.

Spray *Engine Tuner* through the fitting and allow it to soak for four to six hours.

Use compressed air to blow through the fitting. Limit the air pressure to 25 psi (170 kPa). Confirm movement of air through fitting.

IMPORTANT: Fitting does restrict air movement.

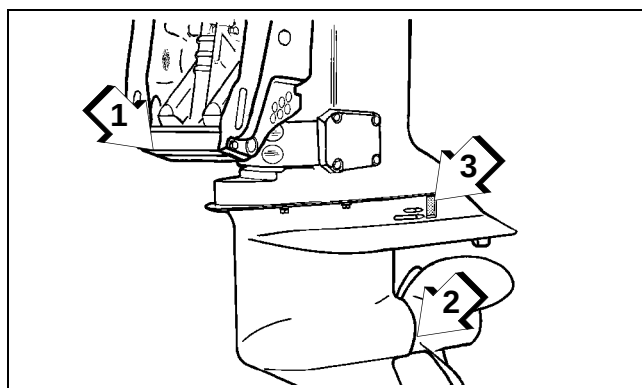
Replace exhaust pressure fittings that are blocked and cannot be decarbonized.

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.



1. Stern bracket anode
2. Propeller shaft bearing housing anode (inside of gearcase housing)
3. Gearcase housing anode

DR5082

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

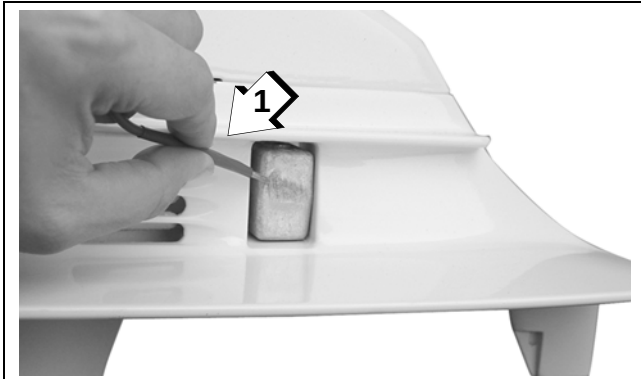
IMPORTANT: Anodes that are not eroding may not be properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

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.



1. Meter lead to anode

000677

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.
- Protect moving components with appropriate lubricants.

Gearcase Removal and Installation

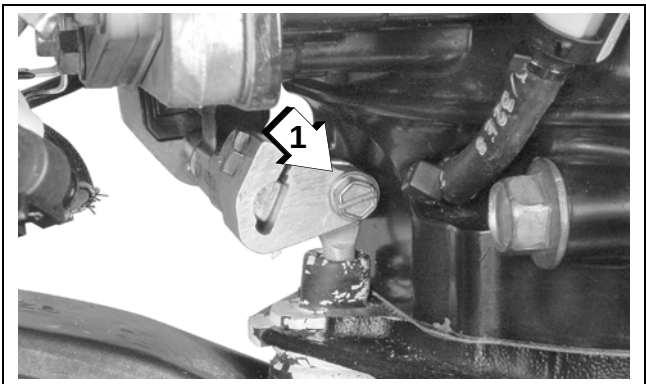
Gearcase Removal

⚠ WARNING

Turn the key switch OFF, and disconnect the Crankshaft Position Sensor (CPS), to prevent accidental starting while servicing.

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.

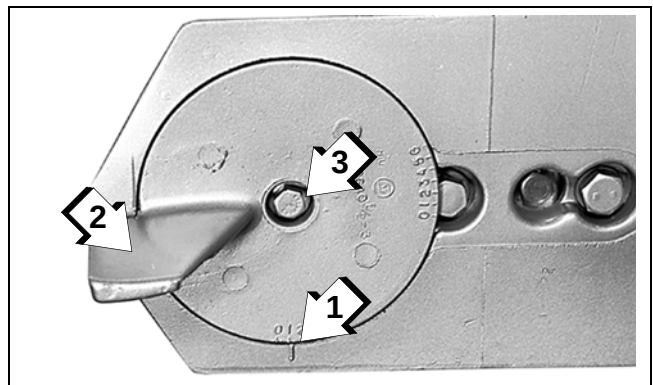
Remove pin and washer from shift rod lever to release the lower shift rod.



1. Shift rod pin

004241

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.



1. Index mark

2. Trim tab

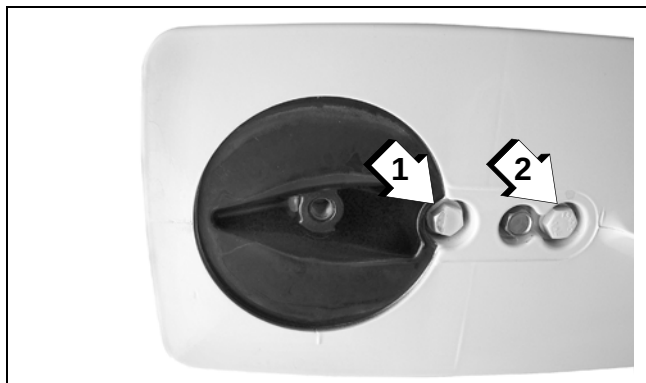
3. Trim tab retaining screw

COA3663

Routine Service

Gearcase Removal and Installation

Remove the 3/8-16 in. screw and washer, and remove 7/16-14 x 3.5 in. screw and washer.

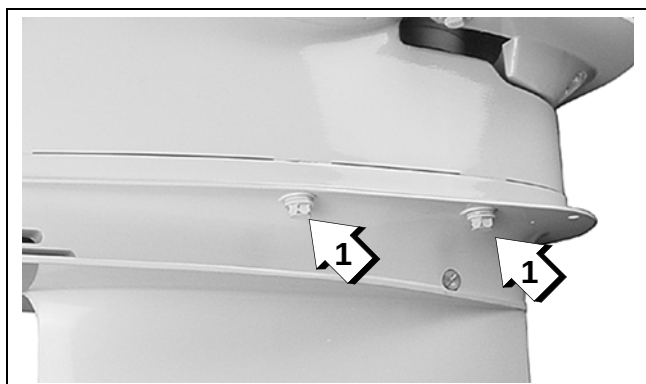


O, L, 2 M2 Type Gearcases

1. 3/8-16 x 3.5 in. screw
2. 7/16-14 x 3.5 in. screw

006869

Remove the four 3/8-16 x 1.75 in. gearcase retaining screws and washers.



1. Gearcase retaining screws

001990

Remove the gearcase assembly from the exhaust housing, being careful not to bend the shift rod.

Gearcase Installation

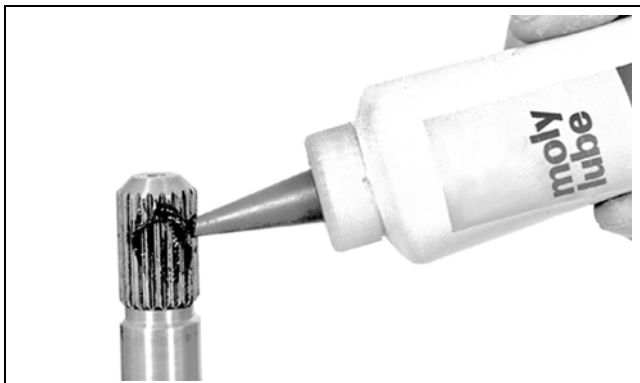
⚠ WARNING

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.

NOTICE

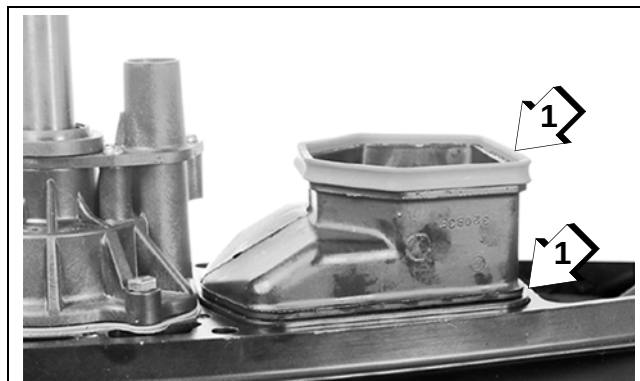
Before installing gearcase, shift rod adjustment **MUST** be checked. Refer to Shift Rod Adjustment on p. 324.

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



30385

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



20 inch Models
1. Lower exhaust seals

32002



25 & 30 inch Models
1. Lower exhaust seals

001985

Slide the gearcase into place, making sure:

- Driveshaft engages the crankshaft.
- Water tube enters the water pump.
- Lower inner exhaust housing installs correctly.
- Shift rod does not turn and is positioned properly in the shift rod lever below the crankcase.

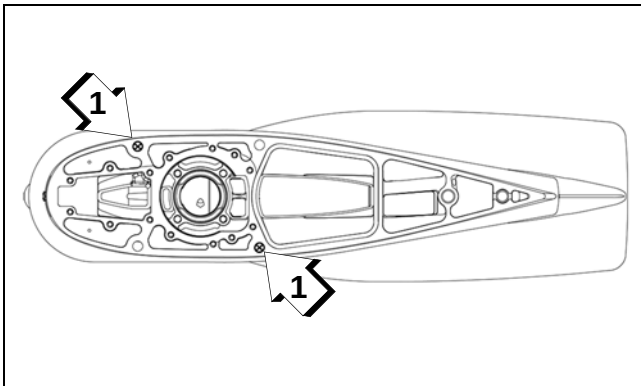
Some outboard models include hollow alignment pins between the exhaust housing and gearcase.

If outboard is not equipped with alignment pins, use Gearcase Alignment Kit, P/N 5007231, to accurately align gearcase housing to exhaust housing. Position alignment bolts (2) as indicated.



Alignment Bolt(s)

005401



1. Position of alignment bolts (2)

005402

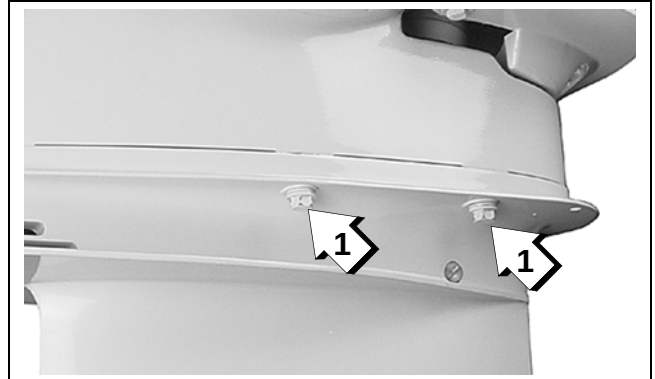
Replace alignment bolts with mounting screws after all other gearcase mounting screws are installed.

IMPORTANT: New gearcase screws are treated with a thread-locking material. Apply *Triple-Guard* grease to threads to ensure that the correct clamping force is achieved when tightening—If a previously installed screw is re-used, use a wire brush to remove any old thread-locking material or corro-

sion and lubricate threads with *Triple-Guard* grease.

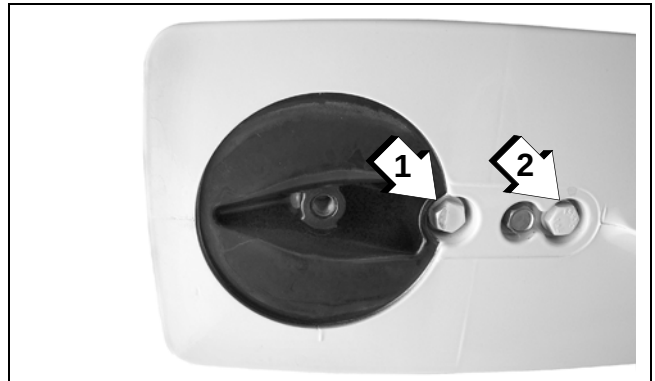
Install screws and washers and tighten to a torque of:

- **3/8 in.** screws – 26 to 28 ft. lbs. (35 to 38 N·m)
- **7/16 in.** screws – 45 to 50 ft. lbs. (61 to 68 N·m)



1. 3/8 in. screws

001990



O, L2, M2 Type Gearcases

1. 3/8-16 x 3.5 in. screw
2. 7/16-14 x 3.5 in. screw

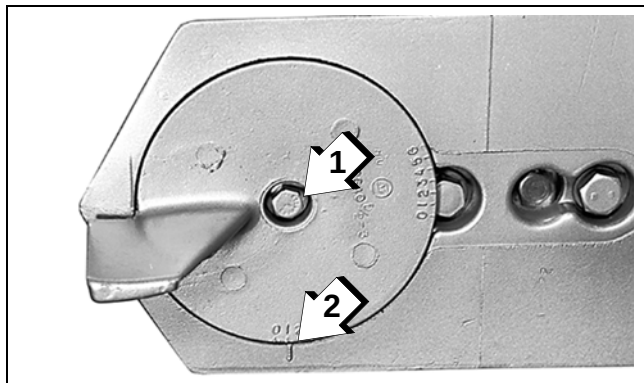
006869

Apply *Triple-Guard* grease to threads of the trim tab screw. Install gasket on "M2"-type gearcases. 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 Adjust-**

Routine Service

Storage

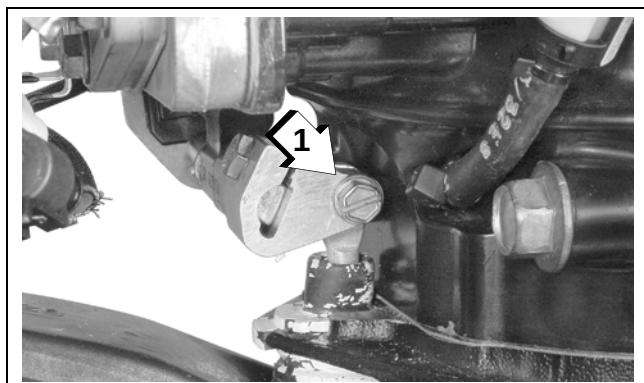
ment on p. 32.



1. Trim tab screw
2. Index mark

COA3663

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).



1. Shift rod pin

004241

WARNING

To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

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

- **Mechanical Remote Controls:** Fully advance throttle control 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 to two minutes).
- **ICON Remote Controls:** Turn Master Power/Key Switch ON. Press the **N** switch. Fully advance the control lever and then start the outboard.
- After approximately 15 seconds, move throttle control lever to IDLE position.
- Wait another 15 seconds. At this point, advance throttle to FULL (in neutral). Digital gauge will indicate that outboard is in winterize mode.
- Outboard will automatically go to fast idle and fog itself. Allow outboard to run until digital

gauge indicates winterization complete and outboard shuts off (about one to two minutes).

IMPORTANT: If the digital gauge does not indicate winterization mode active, or outboard runs above fast idle, immediately turn off outboard and start the procedure again.

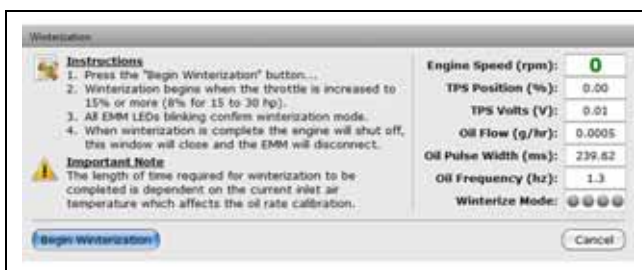
Software Control Method

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

008564



008565

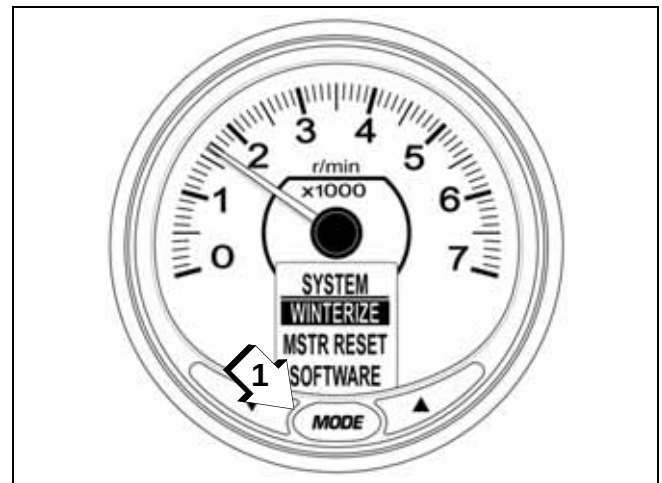
After the outboard shuts itself off, turn key switch OFF, then detach garden hose.

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

Digital Gauge Method

The *ICON Pro 5 inch* and *I-Command 3.5 inch* digital gauges provide a winterize feature for 2008 and newer V4 and V6 models.

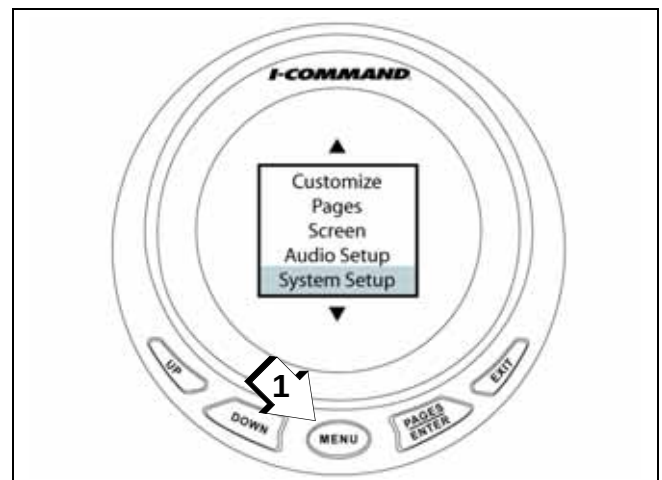
Use the “Mode” button (*ICON Pro 5 inch*), or “Menu” button (*I-Command 3.5 inch*) to access the winterize feature.



ICON Pro 5 inch Digital Gauge

008686

1. Mode button



I-Command 3.5 inch Digital Gauge

008191

1. Menu button

- Refer to the digital gauge user's guide for complete instructions.

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.

Pre-Season Service

WARNING

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

If the outboard was removed from the boat for storage, make sure it is reinstalled with factory specified hardware. Refer to the **Predelivery and Installation Guide**.

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

- Refer to **Operational Checks** on p. 34
- Steering system
- Remote controls
- All other accessories and instrumentation

Check Oil Injection Tank

- Inspect the oil tank for leaks.

Check Fuel System

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

Water Pump

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

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 System Priming** on p. 142 and **Oil Supply Priming** on p. 175. 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. 41.

Reinstall all removed or disconnected parts.

Use *Evinrude Diagnostics* software to:

- Start break-in oiling
- 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.

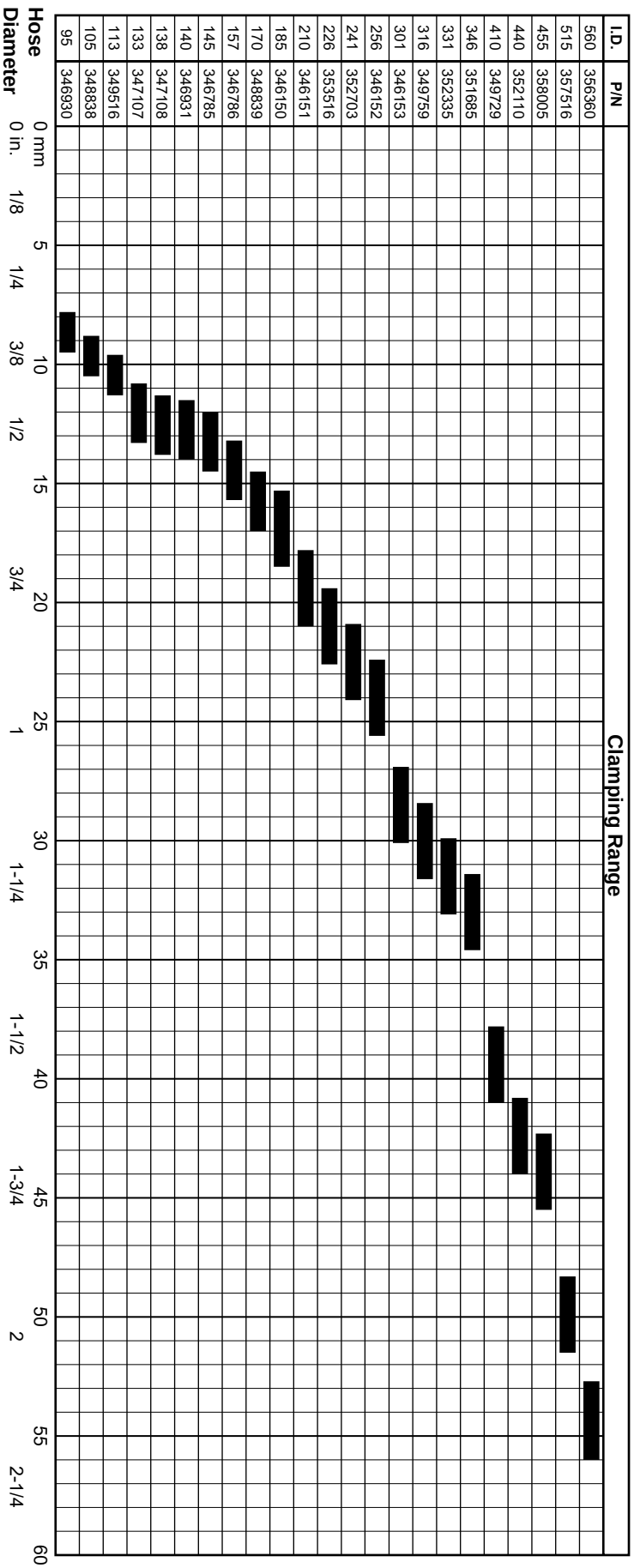
Engine Dropped Overboard (In Salt Water)

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)**.

Oetiker Clamp Chart



Extra-Large Clamps

I.D.	P/N	Clamping Range
995	3560/19	96.3 to 99.5 mm (3.79 to 3.92 in.)
845	3568/57	81.3 to 84.5 mm (3.20 to 3.32 in.)
695	3528/68	66.3 to 69.5 mm (2.61 to 2.73 in.)
605	3511/59	57.3 to 60.5 mm (2.25 to 2.38 in.)

008458 Rev E.

Engine Cover Service

Table of Contents

Upper Cover Service	54
Latch Hook Installation	54
Upper Cover Cap Replacement	54
Lower Cover Service	55
Lower Cover Removal	55
Lower Cover Installation	55
Latch Handle Installation	56
Trim Switch Installation	56

Upper Cover Service

Latch Hook Installation

Place hook into position on bracket.



006962

Apply *Ultra-Lock* to screw threads. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



006963

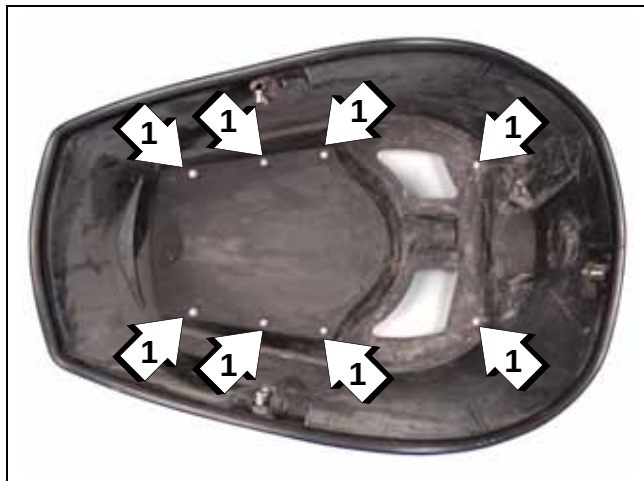
Upper Cover Cap Replacement

Place new upper cap into position.



006815

Tighten self-tapping screws to a torque of 24 to 36 in. lbs. (2.7 to 4 N·m).



1. Upper cap screws

006964

Lower Cover Service

Lower Cover Removal

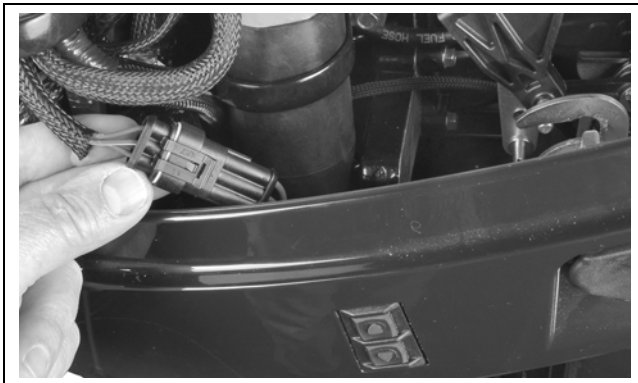
Remove lower engine cover screws.



1. Lower cover screws

005242

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



005246

Lower Cover Installation

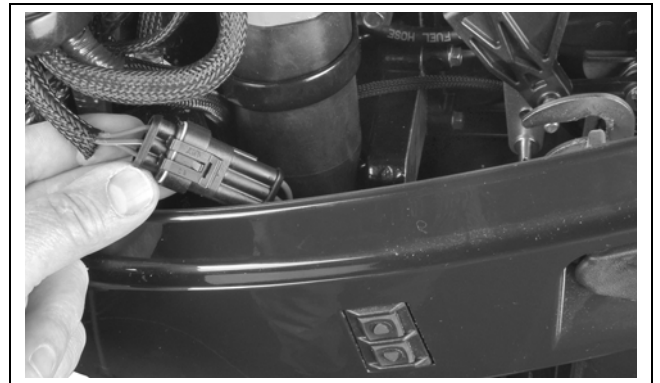
Install the lower engine covers and tighten all screws to a torque of 24 to 36 in. lbs. (3 to 4 N·m).



1. Lower cover screws

005242

Connect trim/tilt switch connector.



005246

Engine Cover Service

Lower Cover Service

Latch Handle Installation

Apply a light coat of *Triple-Guard* grease to latch handle shaft. Insert handle into lower cover.



1. Triple-Guard grease

006827

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).



006821

Trim Switch Installation

Place switch into position through cover.



006746

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



006747

Install electrical connector. Refer to **Connector Servicing** on p. 125.



006748

Engine Management Module (*EMM*)

Table of Contents

Description	56
Internal Sensors	57
<i>EMM</i> Temperature Sensor	57
55 V Circuit Sensor	57
12 V Circuit Sensor	57
5 V Circuit Sensor	58
Barometric Pressure Sensor	58
Exhaust Pressure Sensor	58
External Sensors	59
Air Temperature Sensor	59
Engine Temperature Sensor	59
Oil Pressure Sensor	59
Throttle Position Sensor	60
Crankshaft Position Sensor	60
Knock Sensor	61
Neutral/Shift Interrupt Switch	61
Internal <i>EMM</i> Functions	62
Start Assist Circuit (SAC)	62
ROM Verification	62
Idle Controller	62
RPM Limiter	62
Neutral RPM Limiter	62
Engine Monitor and Warning Systems	62
Fault Code Creation and Storage	62
Engine Monitor System	63
S.A.F.E. Warning System	64
Shutdown Mode	65
Diagnostic Software Functions	65
Communication	65
Static Information	66
Dynamic Information	66
Occurred Faults	66
Active Faults	67
Historical Faults	67
Static Tests	67
Dynamic Tests	68
Oil Control Settings	68
Ignition Timing	69
TPS Calibration	69
Fuel Injector Servicing	69
Reports	70
Software Replacement	71
<i>EMM</i> Transfer	71
<i>EMM</i> Servicing	72

Engine Management Module (EMM)

Description

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 saved in the *EMM*.

EMM Functions

The *EMM* controls the following processes and functions:

- Alternator output; 55 V and 12 V
- Start Assist Circuit (SAC) voltage boost
- 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
- Shift interrupt function
- Anti-knock compensation

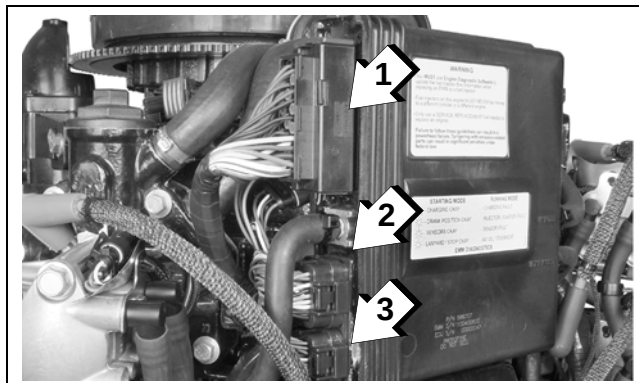
EMM Connections

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.



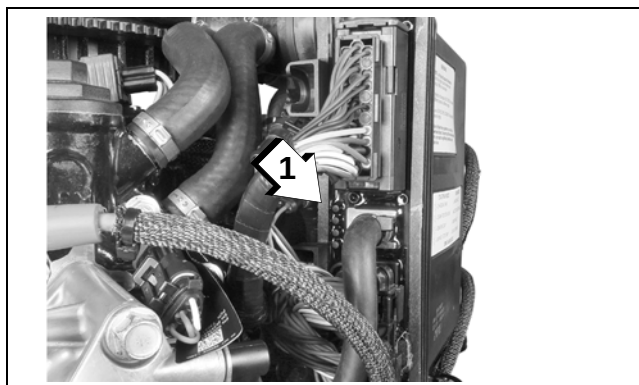
1. J2 connector
2. J1-A connector
3. J1-B connector

004197

LED Indicators

The *EMM* has LED indicators located next to the electrical connectors that provide information related to various electrical circuits.

IMPORTANT: LED 1 is toward the top of the outboard (Closest to *EMM* J2 connector).



1. LED indicators

004198

When the ignition key is turned ON, LEDs 1, 3 and 4 should light, indicating that the SAC circuit, 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. 80.

When the outboard is running, all LEDs should be off. If any LED is lighted while the outboard is running, refer to **EMM LED Indicators** on p. 80.

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

Activates SHUTDOWN
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. 67.

If *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 sensor reads less than -67°F (-55°C) or greater than 311°F (155°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 less than 45 V between 500 and 1000 RPM, or is less than 52 V 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 less than 12 V below 2000 RPM, or is less than 12.5 V above 2000 RPM, the *EMM*:

Stores service code 26
EMM LED 1: ON (Running)
Engine Monitor LOW BATTERY display: ON

Engine Management Module (EMM)

Internal Sensors

5 V Circuit Sensor

Monitors the *EMM*'s 5 V sensor circuit.

If sensor voltage is less than 4.75 volts, the *EMM*:

Stores service code 78
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

Barometric Pressure Sensor

Supplies the *EMM* with barometric pressure reading to compensate for changes in altitude and air density.

If the BP sensor reads less than 13 KPa or greater than 119.0 KPa, or the sensor or circuit fails, the *EMM*:

Stores service code 44

If the BP sensor reads less than 70 KPa, the *EMM*:

Stores service code 45

If the BP sensor reads greater than 105 KPa, the *EMM*:

Stores service code 46

Exhaust Pressure Sensor

The exhaust pressure sensor monitors exhaust pressure during all running conditions to compensate for engine loads.

If the sensor reads less than –85 in. water, or greater than 85 in. water, or the sensor or circuit fails, the *EMM*:

Stores service code 87
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

If exhaust pressure is less than 40 in. water, the *EMM*:

Stores service code 88
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

If exhaust pressure is greater than 80 in. water, the *EMM*:

Stores service code 89
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

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

The air temperature sensor monitors the air temperature at the throttle body.

If the AT sensor voltage is out of the expected range, or the sensor or circuit fails, the *EMM*:

Stores service code 47, 48, or 49
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

Engine Temperature Sensor

Monitors cylinder head temperature.

If cylinder head temperature exceeds 212° F (100° C) below 2000 RPM, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 40 (port sensor)
Stores service code 70 (stbd sensor)
<i>EMM</i> LED 4: ON (Running)
Engine Monitor TEMP display: ON

If cylinder head temperature exceeds 185°F (85°C) above 2000 RPM for 60 seconds, the *EMM*:

Stores service code 43 (port sensor)
Stores service code 69 (stbd sensor)
<i>EMM</i> LED 4: ON (Running)
Engine Monitor TEMP display: ON

If cylinder head temperature exceeds 194°F (90°C) above 2000 RPM for 3 seconds, the *EMM*:

Activates <i>S.A.F.E.</i>

If cylinder head temperature exceeds 248°F (120°C) for 3 seconds, the *EMM*:

Activates SHUTDOWN
Stores service code 31
<i>EMM</i> LED 4: FLASHING
Engine Monitor TEMP display: FLASHING

The outboard will not restart until the engine temperature returns to normal. Refer to **Shutdown Mode** on p. 67.

If sensor values are less than -13°F (-25°C), or greater than 329°F (165°C), the *EMM*:

Stores service code 41 (port sensor)
Stores service code 67 (stbd sensor)
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

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

Stores service code 42 (port sensor)
Stores service code 68 (stbd sensor)
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

If cylinder head does not reach operating temperature (122°F / 50°C below 1000 RPM) in 10 minutes, the *EMM*:

Stores service code 58 (port sensor)
Stores service code 59 (stbd sensor)
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

Engine Management Module (EMM)

External Sensors

Oil Pressure Sensor

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

If the sensor does not detect pressure for 150 pump cycles (3.3 L models), or 75 pump cycles (3.4 L models), the *EMM*:

Activates S.A.F.E.
Stores service code 38
<i>EMM</i> LED 4: ON (Running)
Engine Monitor NO OIL display: ON

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

Activates SHUTDOWN
Stores a service code 33
<i>EMM</i> LED 4: FLASHING
Engine Monitor NO OIL display: FLASHING

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

If the sensor reads out of the expected range, or the sensor or circuit fails, the *EMM*:

Stores service code 71
<i>EMM</i> LED 3: ON (Running)

If the sensor circuit indicates below expected range (<.4 V), the *EMM*:

Stores service code 72
<i>EMM</i> LED 3: ON (Running)

If the sensor circuit indicates above expected range (> 4.6 V), the *EMM*:

Stores service code 73
<i>EMM</i> LED 3: ON (Running)

Throttle Position Sensor

The throttle position 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*.

If TPS voltage is greater than 0.65 V when the key is turned to ON, the *EMM*:

Creates service code 11

If the outboard is started, the code is saved.

If the key ON voltage is greater than 0.78 V when the engine is started, speed is limited to idle.

If code 11 is present as both a Active Fault and a Occurred Fault, refer to **Control Cable Installation** on p. 22.

If the TPS or TPS circuit fails (less than 0.14 volts or greater than 4.92 volts), the *EMM*:

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

Crankshaft Position Sensor

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:

- **Below 2000 RPM:** 5 occurrences
- **Above 2000 RPM:** 1 occurrences

the *EMM*:

Stores service code 16
<i>EMM</i> LED 2: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

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

Use the *Evinrude Diagnostics* software *Monitor* screen 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.

Knock Sensor

Knock sensors (one per cylinder head) detect the presence of knock (pre-ignition or detonation) during the combustion cycle.

When knock is detected, the *EMM* temporarily increases fuel flow and retards ignition timing for the affected cylinder.

If knock continues, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 1-6 (code indicates cyl)
Engine Monitor CHECK ENGINE display: ON

If the sensor circuit is OPEN, the *EMM*:

Stores service code 7 (port sensor)
Stores service code 8 (stbd sensor)
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)
Engine Monitor CHECK ENGINE display: ON

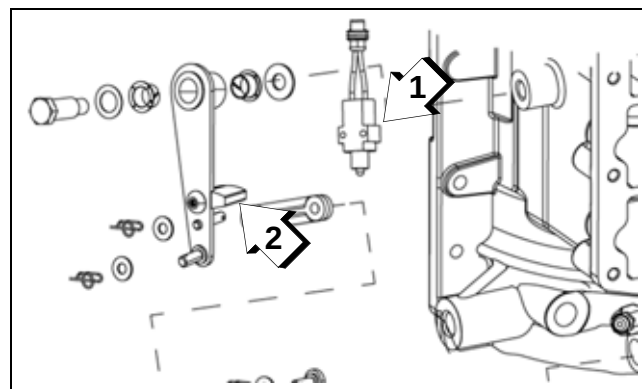
Neutral/Shift Interrupt Switch

A switch mounted on the powerhead signals the *EMM* when the shift linkage is moved from FORWARD or REVERSE into NEUTRAL.

A cam on the powerhead shift arm closes the switch in NEUTRAL, completing a ground circuit to the *EMM*. This signal is used to control:

- Neutral RPM limit
- Shift Interrupt function.

The shift interrupt function shuts off fuel and spark to three cylinders for approximately one second to reduce drivetrain loads and ease shifting, then immediately restores normal engine operation. The switch must be released to its open position before the shift interrupt function can be activated again. This circuit does not function above 2500 RPM.



1. Switch, neutral/shift interrupt
2. Cam

008366

If the switch is stuck in the closed position, the *EMM*:

Stores service code 28
<i>EMM</i> LED 3: ON (Running)

Internal *EMM* Functions

Start Assist Circuit (SAC)

When the ignition key is ON, the *EMM* Start Assist Circuit (SAC) boosts battery voltage (12 V) to 30 V on the system (55 V) circuit.

If the SAC circuit current exceeds 2 Amps, or if the SAC voltage is less than 20 V, the *EMM*:

Stores service code 77
<i>EMM</i> LED 1: ON (Running)

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 1100 RPM.

Engine Monitor and Warning Systems

Refer to **Engine Monitor System** on p. 65.

Refer to **S.A.F.E. Warning System** on p. 66.

Refer to **Shutdown Mode** on p. 67.

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 Monitor System

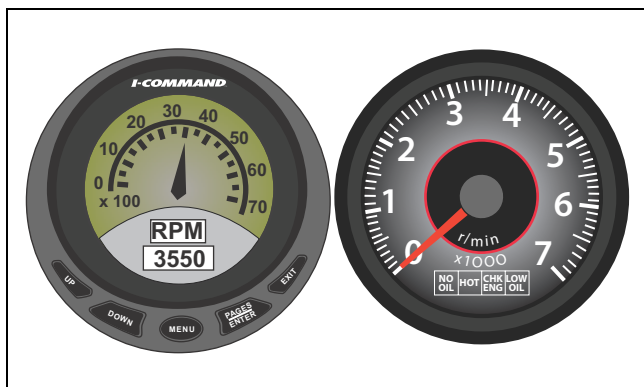
All remote controlled outboards, 40 HP and above, must be equipped with an engine monitoring system to warn the operator of conditions that could damage the outboard.

The engine monitor system includes sensors on the outboard and oil tank, a warning horn, a dash-mounted display, and related wiring.

The outboard's *EMM* sends information about monitored functions to:

- *SystemCheck* gauges
- An *I-Command* or *ICON* display
- *EMM* LED indicators.

IMPORTANT: Operating the outboard without an engine monitor will void the warranty for failures related to monitored functions. For information about boat mounted Information Display System options, refer to the current **Predelivery and Installation Guide** included with the service manual set.



Typical *I-Command* and *SystemCheck* gauges

007988

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, or the oil system is damaged.
- WATER TEMP 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.

Note: The warning horn does NOT sound in an *I-Command* installation.

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. 109.

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	<i>EMM</i> temperature above expected range
Code 34	Oil injector open circuit
Code 36	Oil injector open circuit (cylinder oil pump, 3.4 L models only)
Code 38	No oil pressure feedback
Code 40	Cylinder head temperature above expected range—low speed
Code 43	PORT Cylinder head temperature above expected range
Code 69	STARBOARD cylinder head temperature above expected range
Code 70	Cylinder head temperature above expected range—low speed
Code 107	ICON control communication error
Code 108	ICON system fail-safe mode
Code 109	ICON control head failure
Code 111	ICON ESM communication error
Code 149	ICON throttle actuator sensor fault
Code 150	ICON throttle actuator motion fault
Code 151	ICON shift actuator sensor fault
Code 152	ICON shift actuator motion fault

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 return to normal limits
- The throttle setting must return to IDLE

IMPORTANT: Under some conditions, normal operation may not be restored, or the lights of the *SystemCheck* gauge may not turn OFF.

- Some *ICON* fault conditions require the *ICON* system be reset.
- The *SystemCheck* gauge requires power OFF to reset

If either of these conditions exist, turn the key switch OFF, then restart the engine.

Shutdown Mode

⚠ 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.

Outboard “shutdown” will occur if specific faults are detected by the *EMM*.

Conditions that initiate shutdown

Code 29	Excessive <i>EMM</i> temperature
Code 31	Excessive engine temperature
Code 33	Excessive NO OIL condition
Code 57	High RPM with low TPS setting

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. 143. 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.

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 occurred 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 *Occurred* service code. Use *Evinrude Diagnostics* software to clear a code 57 or 33.

Diagnostic Software Functions

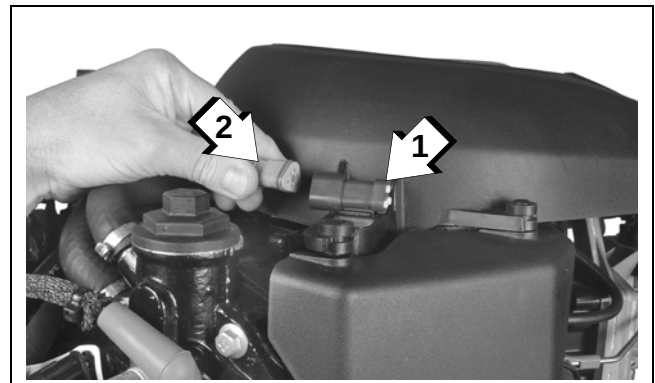
The *EMM* saves valuable information about the outboard and its running history. This information can be used for troubleshooting, for checking parts information, and for making adjustments to the system.

Use *Evinrude Diagnostics* software, version 5.1 or higher, 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).



1. Cover
2. Engine harness diagnostic connector

005021

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 ON. Switched B+ (12 V) enters the *EMM* at pin 21 (purple) of the *EMM* J1-B connector.

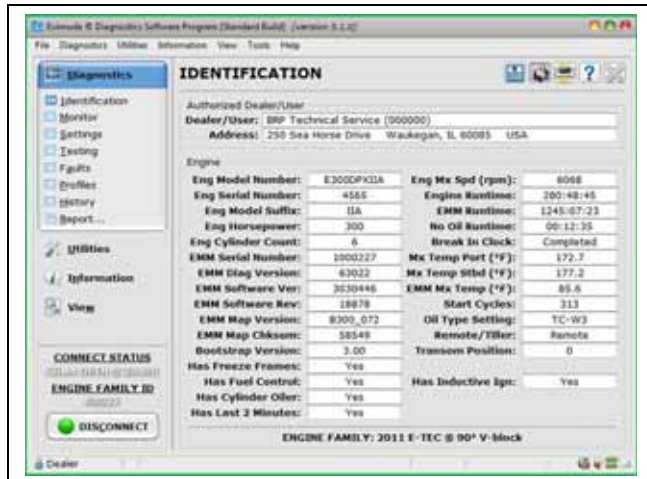
The *EMM* is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.

Engine Management Module (EMM) Diagnostic Software Functions

Static Information

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

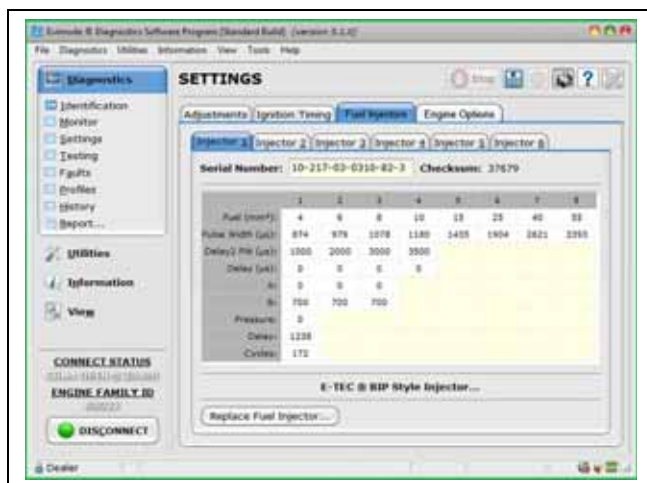
The outboard model and serial numbers displayed on the *Identity* screen must match the identification label on the outboard swivel bracket.



Identity Screen

008567

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



Injector Coefficients Screen

008568

Dynamic Information

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



Engine Monitor Screen

008566

Occurred Faults

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

The *Occurred 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.



Occurred Faults Review Screen

008584

Active Faults

An active fault is a service code that currently exists. Active faults become occurred faults only if the outboard is running.



Active Faults Review Screen

008585

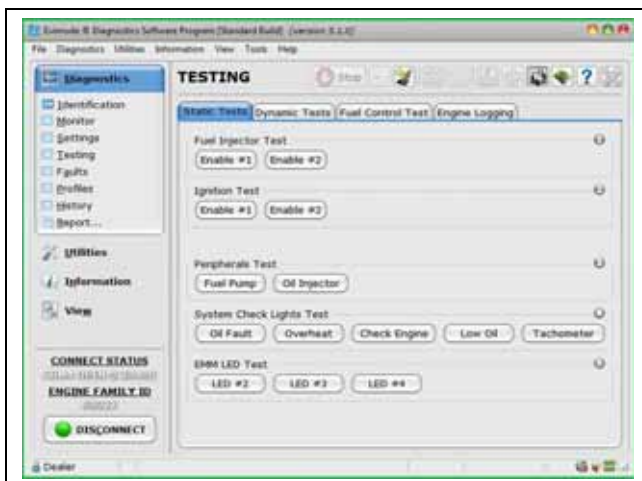
Historical Faults

The *Historical Faults* screen keeps a history of all previous occurred codes, including code number, the number of times the event occurred, and operating hours of the last occurrence.

Historical faults cannot be erased.

Static Tests

Static Tests allow diagnostic testing of system components while the outboard is NOT running.



Static Tests Screen

008569

Ignition Test

Use the diagnostics software to test each ignition circuit. Refer to **Static Ignition Test** on p. 85.

Fuel Test

Use the diagnostics software to test each fuel injector circuit. Refer to **Fuel Injector Static Test** on p. 82.

Oil Injector

Use the diagnostics software to test the oil injection pump circuit. Refer to **Oiling System Tests** on p. 178.

Fuel Pump

Use the diagnostics software to test the fuel pump circuit. Refer to **Fuel Pump Static Test** on p. 82.

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.

Engine Management Module (EMM)

Diagnostic Software Functions

Dynamic Tests

Dynamic tests are performed with the outboard running.



Dynamic Tests Screen

008570

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. 79.

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. 79.

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

NOTICE

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

Set Oil Type

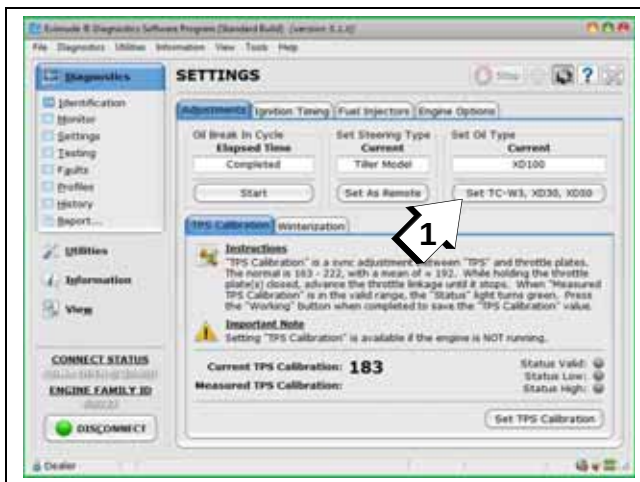
The TC-W3 oil type setting is the standard setting for all outboards. Set TC-W3 for:

- 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



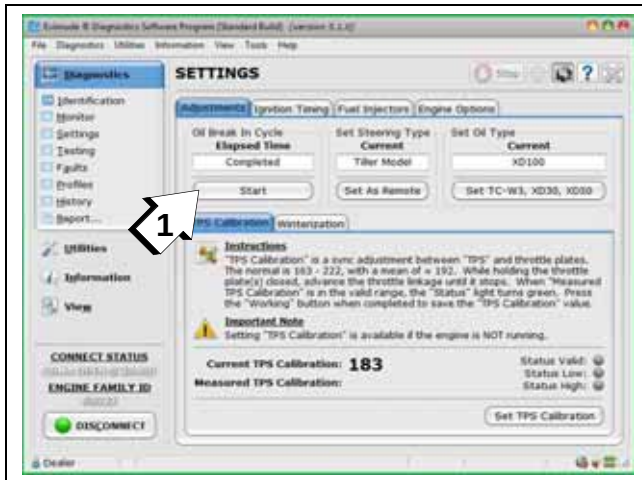
1. Oil control setting

008571

Powerhead Break-In

Use the diagnostic software to initiate break-in oiling. Break-in is a predetermined oiling program

that runs for two hours of outboard operation, above 2000 RPM.



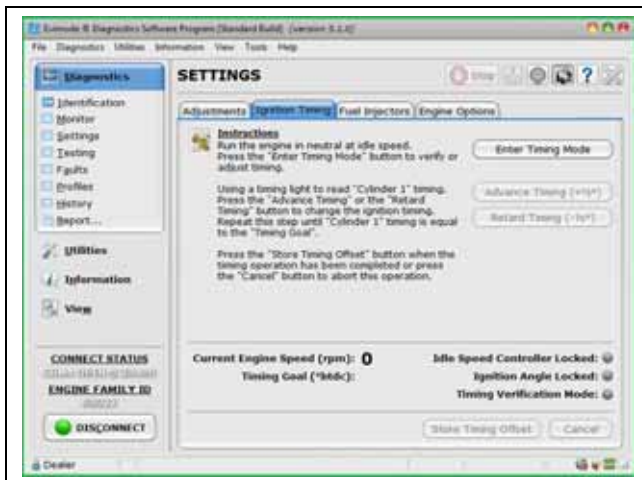
1. Break-in oil setting

008108

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. 115.



008572

Check timing after any of the following procedures:

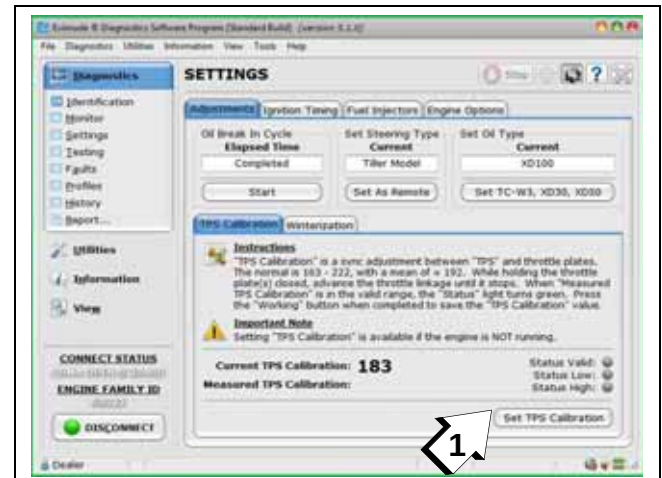
- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- EMM replacement
- EMM software replacement

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. 116.



1. TPS Calibration button

008571

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

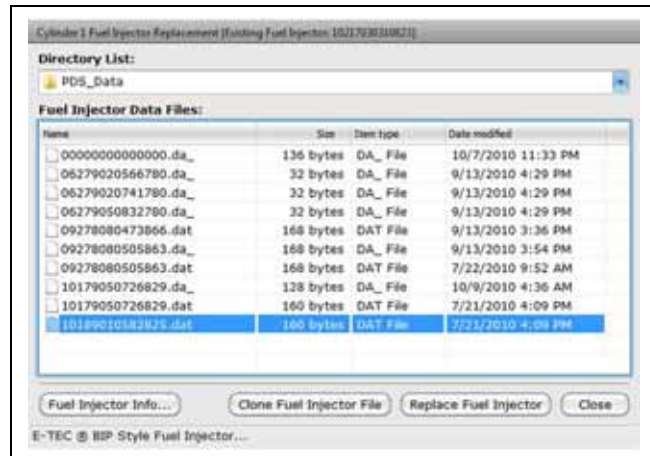
Fuel Injector Servicing

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

Diagnostic Software Functions

Fuel Injector Service on p. 151.

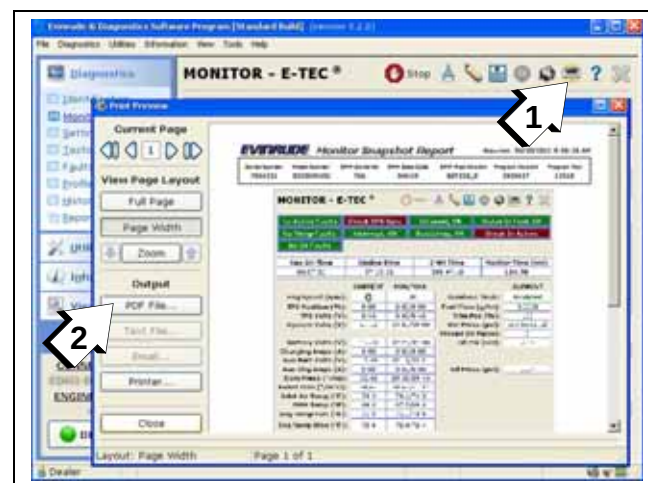


008573

Reports

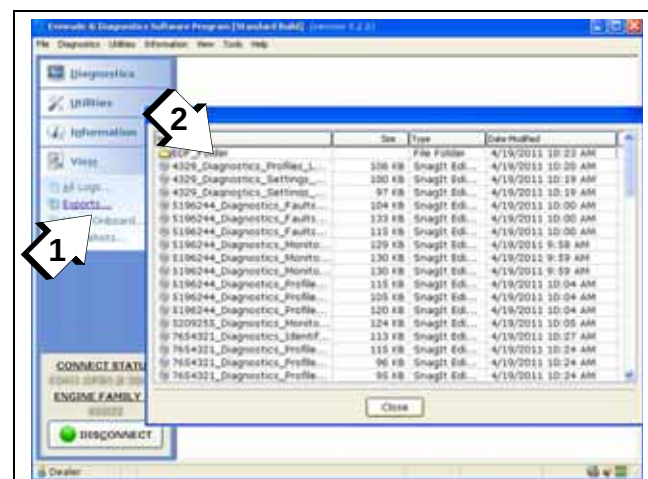
Engine reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

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



008592

1. *Print button*
2. *Print/Export options*



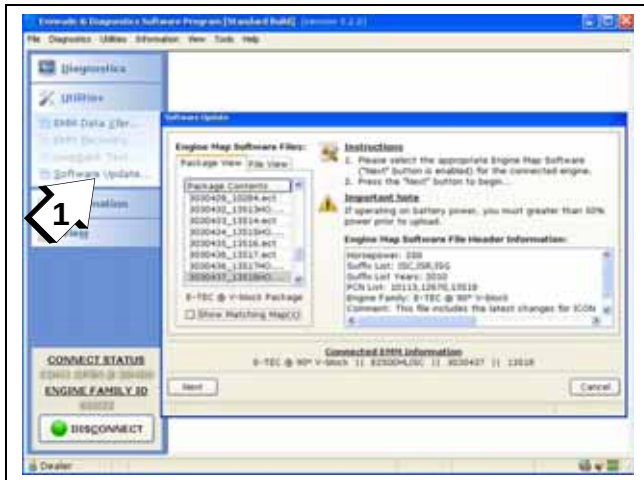
008593

- ### Engine Report data files
1. Exports button
 2. Data files

Software Replacement

Engine Management Software is loaded into the *EMM* at the factory. Periodically, a new program may be available to enhance the operation of an outboard.

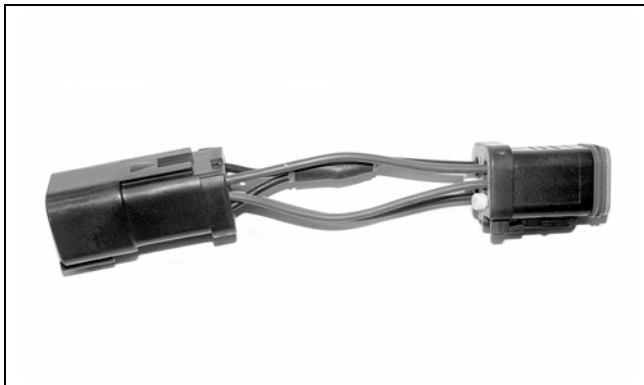
Select *Engine Software Update* from the *Utilities* menu and refer to the instructions provided with the program.



1. Software Update button

008594

IMPORTANT: Software replacement requires the use of Bootstrap Tool, P/N 586551. Install tool between engine and boat harness key/stop switch connectors as instructed by update program.

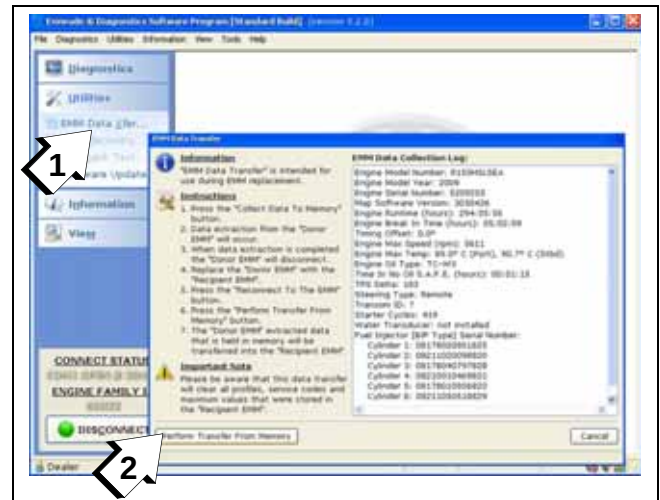


002383

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 *Perform Transfer From Memory* and follow the instructions provided with the program.



1. Select EMM Data Transfer

008495

2. Select Perform Transfer From Memory

IMPORTANT: Whenever the *EMM* is replaced, *EMM* timing must be synchronized to crankshaft position. Refer to **Timing Adjustments** on p. 115.

EMM Servicing

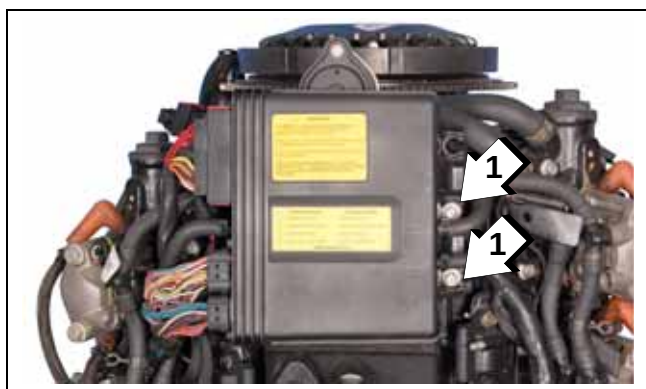
IMPORTANT: If a new *EMM* is being installed, refer to **EMM Transfer** on p. 73.

Removal

Disconnect exhaust pressure hose and cooling hoses from *EMM*.

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

Remove two *EMM* retaining screws.



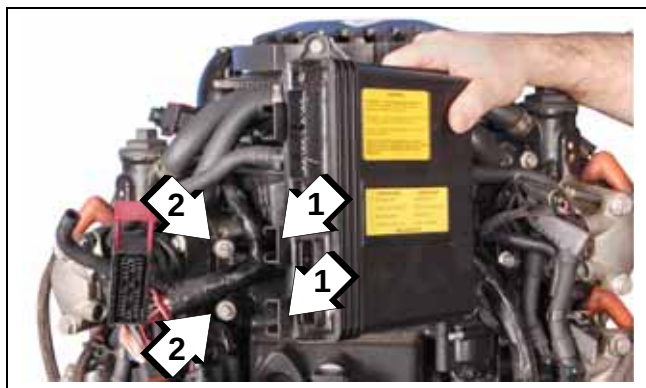
1. EMM mounting screws

006967

Lift *EMM* away and to the starboard side.

Installation

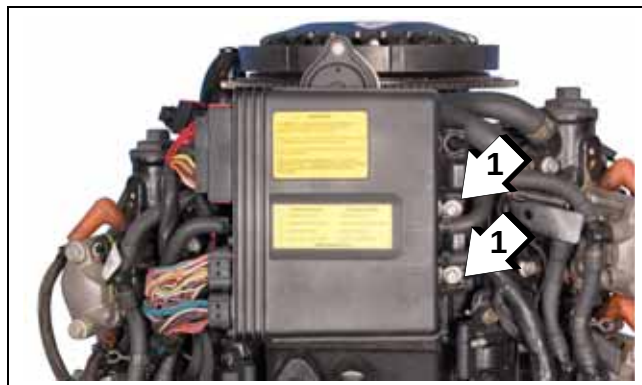
Align slots in starboard side of *EMM* case with isolator mounts on cylinder block. Slide *EMM* into position.



1. EMM mounting slots
2. Isolator mounts

006968

Install two *EMM* retaining screws. Tighten screws 12 to 16 in. lbs. (1.5 to 2 N·m).



1. EMM mounting screws

006967

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

Install exhaust pressure hose and cooling hoses. Secure with tie straps.

System Analysis

Table of Contents

Diagnostic Procedures	74
Visual Inspections	74
Diagnostic Inspections	74
Operational Inspections	75
Troubleshooting	75
Dynamic Tests	77
Cylinder Drop Tests	77
Fuel Control Adjustment	77
Inductive Amp Meter Test	77
EMM LED Indicators	78
Key ON	78
Starting	78
Running	78
Fuel Delivery Tests	80
Fuel Pump Static Test	80
Fuel Injector Static Test	80
Running Fuel System Tests	81
Ignition Output Tests	82
Required Ignition Systems	82
Wiring Inspection	82
Crankshaft Position Sensor (CPS) Test	83
System Voltage Test	83
Static Ignition Test	83
Running Ignition Tests	84
Ignition Control Circuit Tests	85
Ignition Coil Tests	85
Capacitor Test	85

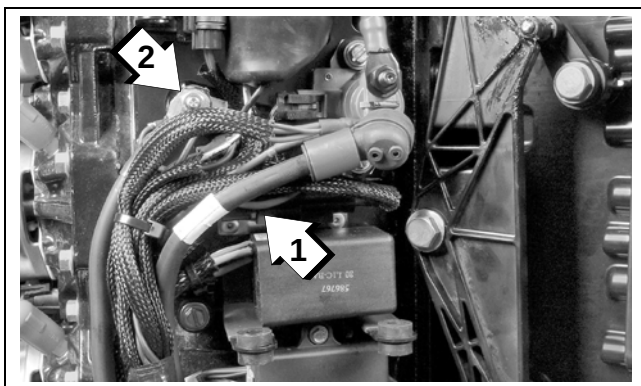
Diagnostic Procedures

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. 93.
- Refer to **WIRING DIAGRAM** at the back of this manual.
- Refer to **Connector Servicing** on p. 125.

Make sure all ground connections are clean and tight. Refer to **Ground Circuits** on p. 95.



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

004183

Inspect spark plugs for wear, oil fouling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.

Check the fuse and the emergency stop switch lanyard.

Diagnostic Inspections

Before running the outboard, use *Evinrude Diagnostics* software to review historical information saved in the *EMM*.

- Check the *Evinrude Diagnostics* software *Active Faults* and *Occurred Faults* screens for current service codes.

The *Active Fault* screen displays detailed information about any currently occurring fault codes.

The *Occurred Fault* screen displays detailed information about the operating conditions of the engine at the time the code was set.

- Correct any problems and clear the codes before further troubleshooting. Refer to **Occurred Faults** on p. 68.



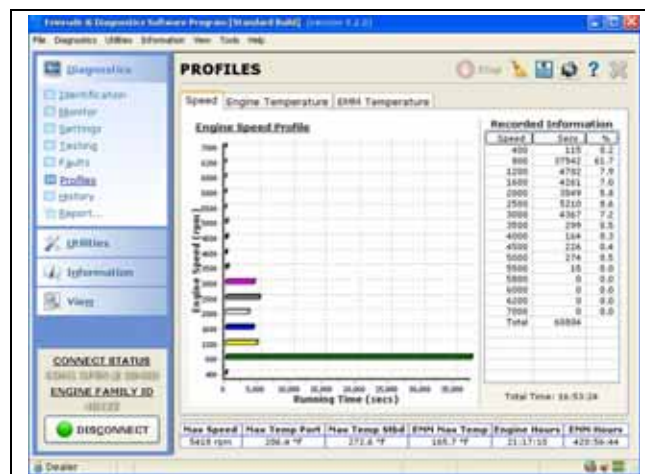
Occurred Faults Review Screen

008584

1. Detailed information

Review information about how the outboard has been operated using the *Profiles* screens.

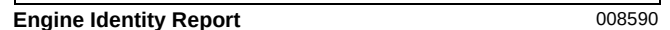
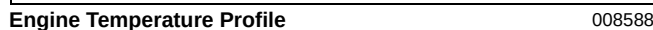
- Check the *RPM Profile* for long periods of low speed operation or periods of over-revving rpm.



RPM Profile

008587

- The *Engine Identity Report* provides a snap-shot of current engine and sensor conditions. From the *Identity* screen, press the *Print* button. Next, press *Printer* to print, or *PDF File* to save the report.



- Last Two Minutes Profile 008589

Run the outboard to confirm actual symptoms before performing any unnecessary procedures. Inspection should include the following:

- Outboard will not crank, starter does not operate:**

- ### Outboard cranks, will not start:

- Check emergency stop switch and lanyard
- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED Indicators** on p. 80.
- Use the *Evinrude Diagnostics* software *Occurred Faults* screen to check for current service codes. If there are multiple occurred sensor

System Analysis

Diagnostic Procedures

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. 85.
- If ignition test indicates steady spark, refer to **Fuel Delivery Tests** on p. 82.

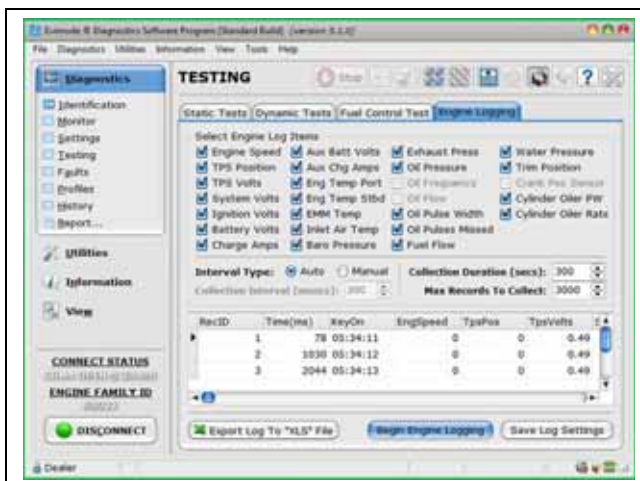
Outboard runs, low on power, misfires:

- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED Indicators** on p. 80.
- 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.

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

- Use the diagnostics software *Dynamic Tests* to isolate a faulty cylinder. See **Dynamic Tests** on p. 79.
- Use an inductive timing light to check ignition and fuel injector circuits. Refer to **Running Ignition Tests** on p. 86 and **Running Fuel System Tests** on p. 83.
- 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. 79.
- 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.



Logging Screen

008574

- AFTER all the above inspections, if the cause of a running quality problem still cannot be identified, perform a compression test to check for internal powerhead damage.

IMPORTANT: Remove a cylinder head or disassemble the engine only as a last resort.

Dynamic Tests

Cylinder Drop Tests

Use the *Evinrude Diagnostics* software *Dynamic Tests* to momentarily disable one cylinder while the outboard is running.

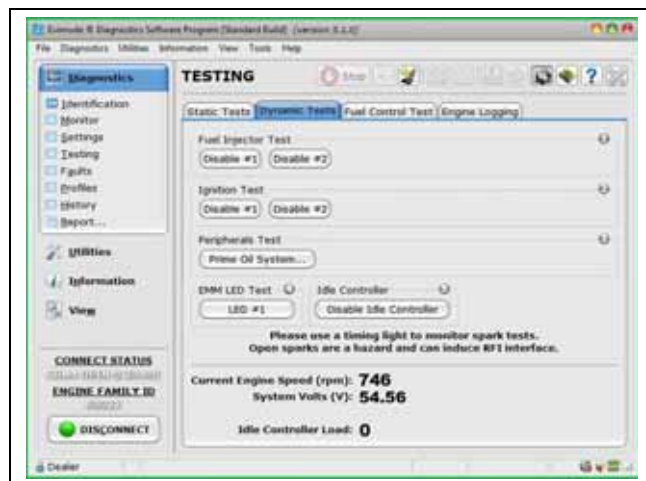
- The Dynamic Ignition test disables the ignition and fuel injection circuits to a cylinder.
- The Dynamic Fuel test momentarily disables one fuel injector circuit.

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 digital multimeter to check voltage changes on electrical circuits.



Dynamic Tests Screen

008570L

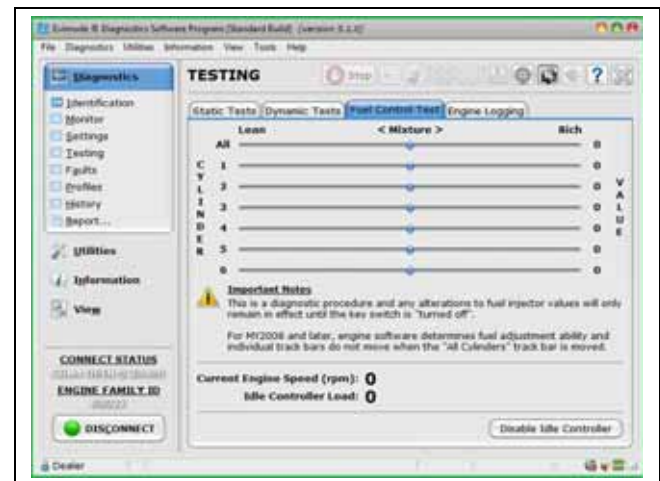
IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed. The *Dynamic Tests* screen includes a function to temporarily disable the idle controller.

Fuel Control Adjustment

Use this test is 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.



008575

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. 143.
- Refer to **Running Fuel System Tests** on p. 83.

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

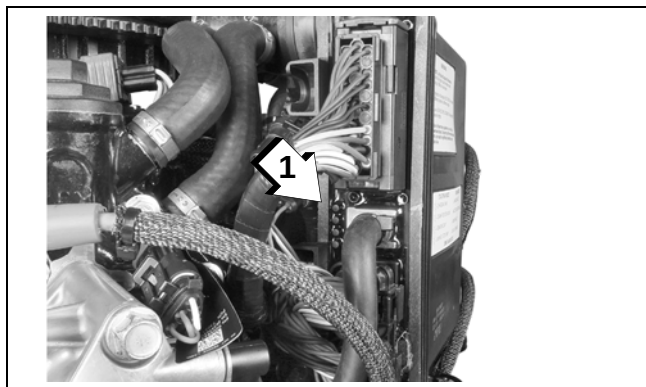
Inductive Amp Meter Test

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 J2 connector).



1. LED indicators

004198

Key ON

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

LED 1 – SAC Circuit working – 30 V present on 55 V circuit.

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. For NO LIGHT, check for:

- Code 77– SAC circuit fault

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 7 – PORT Knock sensor circuit fault
- Code 8 – STBD Knock sensor circuit fault
- Code 12 – TPS circuit fault
- Code 13 – TPS below expected range
- Code 14 – TPS above expected range
- Code 23 – *EMM* temp. sensor circuit fault
- Code 24 – *EMM* temp. below expected range
- Code 37 – Water in fuel
- Code 41 – Port temp. sensor circuit fault
- Code 42 – Port 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 temp. not reached, port
- Code 59 – Operating temp. not reached, stbd
- Code 67 – Stbd temp. sensor circuit fault
- Code 68 – Stbd temp. below expected range
- Code 71 – oil pressure circuit fault detected
- Code 72 – oil pressure below expected range
- Code 73 – oil pressure above expected range
- Code 74 – water pressure circuit fault detected
- Code 75 – water pressure below range
- Code 76 – water pressure above range
- Code 78 – sensor supply voltage fault
- Code 79 – starter solenoid circuit open
- Code 87 – Exhaust pressure circuit fault
- Code 88 – Exhaust pressure low
- Code 89 – Exhaust pressure high

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

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
- Code 77 – SAC circuit fault

LED 2 – INJECTOR/IGNITION FAULT:

- Code 51 – No. 1 injector circuit open
- Code 52 – No. 2 injector circuit open
- Code 53 – No. 3 injector circuit open
- Code 54 – No. 4 injector circuit open
- Code 55 – No. 5 injector circuit open
- Code 56 – No. 6 injector circuit open
- Code 61 – No. 1 injector circuit short
- Code 62 – No. 2 injector circuit short
- Code 63 – No. 3 injector circuit short
- Code 64 – No. 4 injector circuit short
- Code 65 – No. 5 injector circuit short
- Code 66 – No. 6 injector circuit short
- Code 81 – No. 1 ignition coil circuit open
- Code 82 – No. 2 ignition coil circuit open
- Code 83 – No. 3 ignition coil circuit open
- Code 84 – No. 4 ignition coil circuit open
- Code 85 – No. 5 ignition coil circuit open
- Code 86 – No. 6 ignition coil circuit open
- Code 91 – Fuel pump circuit open
- Code 92 – Exhaust valve circuit open
- Code 94 – Fuel pump circuit short
- Code 101 – No. 1 ignition timing circuit shorted
- Code 102 – No. 2 ignition timing circuit shorted
- Code 103 – No. 3 ignition timing circuit shorted
- Code 104 – No. 4 ignition timing circuit shorted
- Code 105 – No. 5 ignition timing circuit shorted
- Code 106 – No. 6 ignition timing circuit shorted

LED 3 – Sensor circuits (5 V), “SENSOR FAULT.”

For LIGHT ON, check for possible fault codes:

- Code 1 – No. 1 cylinder excessive knock
- Code 2 – No. 2 cylinder excessive knock
- Code 3 – No. 3 cylinder excessive knock
- Code 4 – No. 4 cylinder excessive knock
- Code 5 – No. 5 cylinder excessive knock
- Code 6 – No. 6 cylinder excessive knock
- Code 7 – PORT Knock sensor circuit fault
- Code 8 – STBD Knock sensor circuit fault
- 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 28 – Shift switch malfunction
- Code 37 – Water in fuel
- Code 41 – PORT temp. sensor circuit fault
- Code 42 – PORT 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 – PORT operating temp. not reached
- Code 59 – STBD operating temp. not reached
- Code 67 – STBD temp. sensor circuit fault
- Code 68 – STBD temp. below expected range
- Code 71 – oil pressure circuit fault detected
- Code 72 – oil pressure below expected range
- Code 73 – oil pressure above expected range
- Code 74 – water pressure circuit fault detected
- Code 75 – water pressure below range
- Code 76 – water pressure above range
- Code 78 – sensor supply voltage fault
- Code 79 – starter solenoid circuit open
- Code 87 – exhaust pressure circuit fault
- Code 88 – exhaust pressure below range
- Code 89 – exhaust pressure above range
- Code 97 – Intermittent switched B+ detected

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 38 – oil pressure feedback not detected
- Code 40 – engine overheat, low rpm
- Code 43 – PORT temp. above expected range
- Code 69 – STBD temp. above expected range
- Code 70 – engine overheat, low rpm

Fuel Delivery Tests

⚠ WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.

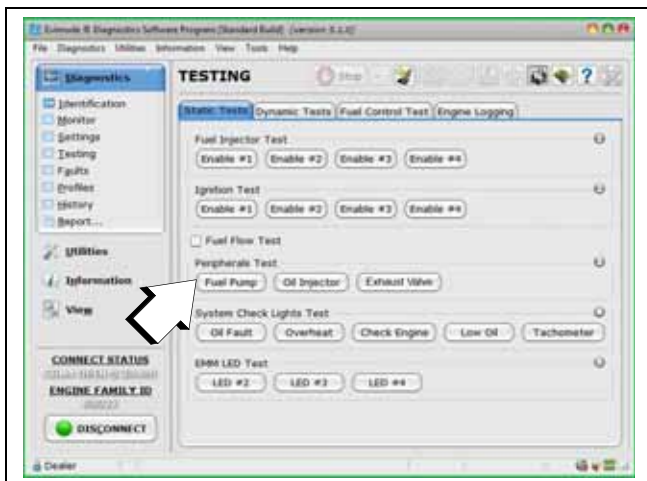
Refer to **Relieving Fuel System Pressure** on p. 147.

Check the *Evinrude Diagnostics* software *Occurred 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.



Static Tests Screen

008569

If the pump does not run:

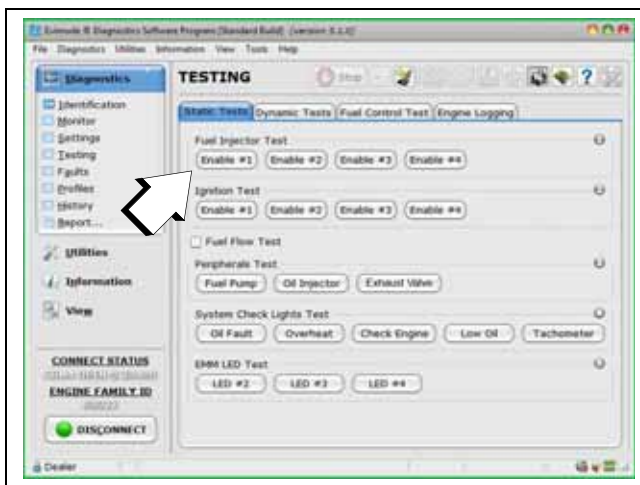
- The *EMM* controls power to the fuel pump (purple/black wire). Check voltage at pin 1 of fuel pump connector. Voltage should be 12 V when KEY is first ON, when fuel pump test activated, or when outboard is cranking or running.
- Use an ohmmeter to check continuity between pin 2 of fuel pump connector and ground.
- Refer to **Circulation Pump Resistance Test** on p. 145.

If the pump runs:

- Refer to **Fuel System Pressure Test** on p. 143.
- Refer to **Running Fuel System Tests** on p. 83.

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.



Static Tests Screen

008569

IMPORTANT: This test is operating the injectors with 30 V on the system voltage (55 V) circuit. The start assist circuit (SAC) of the *EMM* converts battery voltage (12 V) to 30 V of system voltage. 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. 83.

Some injectors actuate; some do not:

- For non-working injectors, 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. 144.

All injectors actuate:

- Refer to **Running Fuel System Tests** on p. 83.

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. 99.

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*.

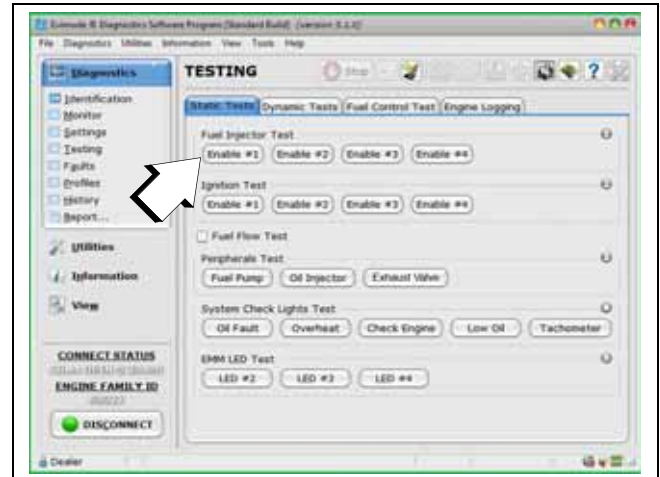
Irregular or no light activation on some injector wires:

- 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. 144.

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. 79.



Dynamic Tests Screen

008570

- Refer to **Fuel Injector Pressure Test** on p. 144.
- Refer to **Fuel System Pressure Test** on p. 143.

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 *Occurred Faults* screen to check for current service codes before troubleshooting. Correct any problems and clear the codes FIRST.

Required Ignition Systems

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

Stop Circuit

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

Battery

- Battery switched B+ input to power up *EMM*
- Battery B+ input to Start Assist Circuit (SAC) of *EMM*

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 ignition timing.
- Start Assist Circuit (SAC) converts battery voltage (12 V) to 30 V for system circuit (55 V).

Crankshaft Position Sensor

- Provides *EMM* with input.

- Outboard cranking speed exceeds 75 RPM and a steady CPS signal is generated.

Alternator Output/System Voltage

- System voltage from *EMM* (white/red) provides 55 VDC to the oil injection pump, the fuel injectors, and the ignition module of *EMM*.

Capacitor

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

Ignition Coil

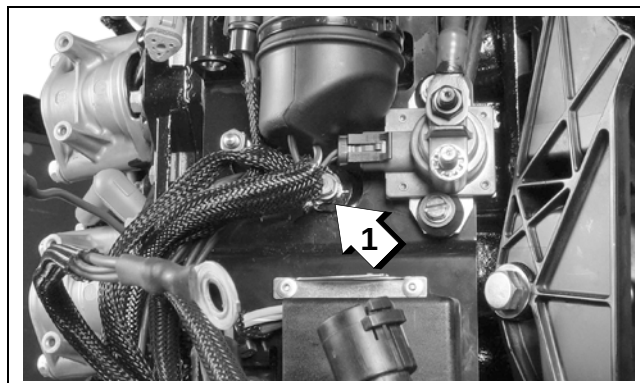
- Primary circuits are powered by system (55 V) voltage
- *EMM* provides control signal to ignition coil
- Output from ignition coil secondary winding and high tension spark plug wire.

Wiring Inspection

Visually inspect all wiring, connections, and grounds.

Use a digital 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.



1. Main engine harness ground

004128

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*.



Engine Monitor Screen, Engine RPM display

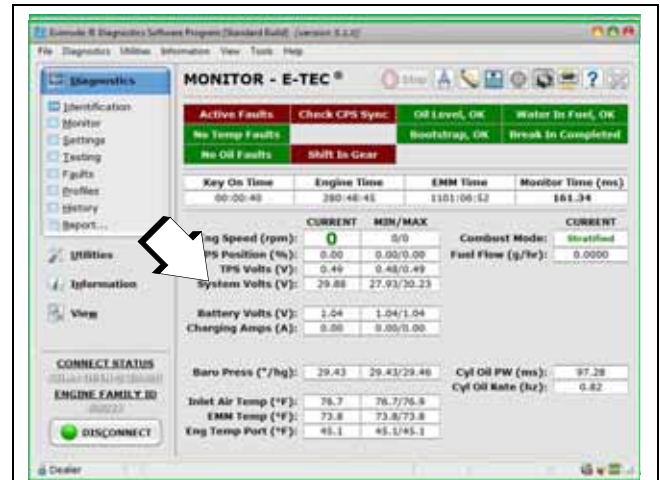
008566

If the *Monitor* screen says "Check CPS Sync," refer to **Crankshaft Position Sensor (CPS) Test** on p. 96.

System Voltage Test

The ignition system is powered by the 55 V system.

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



Engine Monitor Screen, System Voltage

008566

Results:

- *EMM* ON (not running) - 30 V $\pm$ 2, system voltage is GOOD.
- *EMM* ON (not running) - less than 30 V $\pm$ 2, check 12 V power to *EMM*. Repair connection or wiring. Possible fault in *EMM* SAC circuit.
- RUNNING - 55 V $\pm$ 2, system voltage is GOOD.
- RUNNING - less than 55 V $\pm$ 2, check stator output to *EMM*. Repair connection or wiring. Possible faulty stator or *EMM*. Refer to **Stator Tests** on p. 98.

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

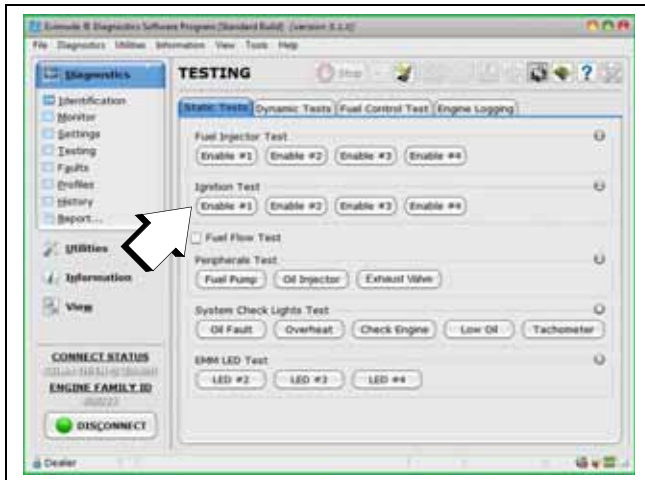
Perform the static ignition test using *Evinrude Diagnostics* software and an inductive timing light.

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

System Analysis

Ignition Output Tests

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

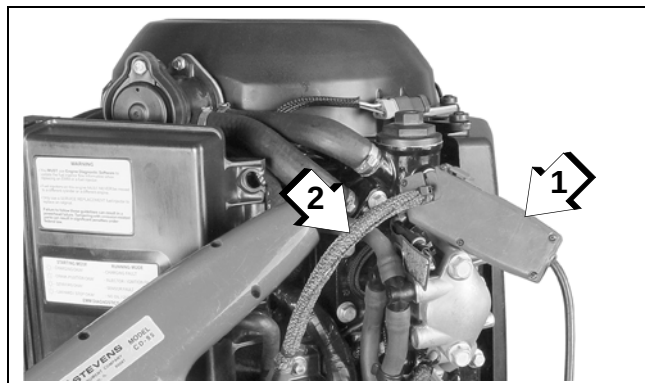


Testing, Static Test Screen

008569

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.

IMPORTANT: You may need to remove shielding from wire if pickup does not read signal.



1. Timing light pick-up
2. Spark plug lead

004255

Results:

No spark on one or more cylinders:

- Inspect or replace spark plugs
- Refer to **Ignition Control Circuit Tests** on p. 87
- Refer to **Ignition Coil Tests** on p. 87.

Steady spark on all cylinders:

- Refer to **Running Ignition Tests** on p. 86 and **Dynamic Tests** on p. 79.

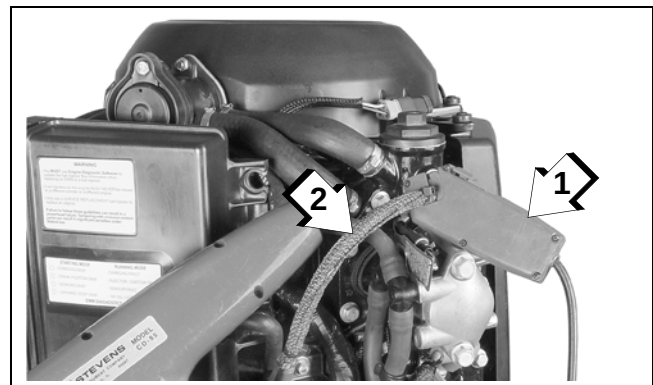
Running Ignition Tests

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. 85.

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.



1. Timing light pick-up
2. Spark plug lead

004255

Results:

Steady voltage and strobe, engine misfires:

- Inspect or replace spark plugs
- Refer to **Fuel Delivery Tests** on p. 82.
- Check 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. 87.
- Refer to **Ignition Coil Tests** on p. 87.

Voltages fluctuate, engine misfires:

- Inspect battery and connections
- Test capacitor and all ground connections.
- Refer to **System Voltage Test** on p. 85
- Refer to **Ignition Control Circuit Tests** on p. 87.
- Refer to **Ignition Coil Tests** on p. 87.

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. 66.

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:

Use an appropriate adapter to connect the red meter lead to pin 3 (white/red) of the engine harness connector and the black lead to ground. With *EMM* ON, voltage should be approximately 30 V.

Control signal test:

Set meter to the Hz scale to check ignition control signal.

Use an appropriate adapter to 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 (black) and repeat test to confirm harness ground.



006609

Harness resistance test:

If control signal is NOT present, calibrate multimeter to low ohms scale. Use appropriate adapters on meter leads to avoid damaging harness connectors.

With *EMM* 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. 87.
- 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.

Remove capacitor from electrical harness.

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.

Notes

Technician's Notes

[illegible]

Related Documents

[illegible]

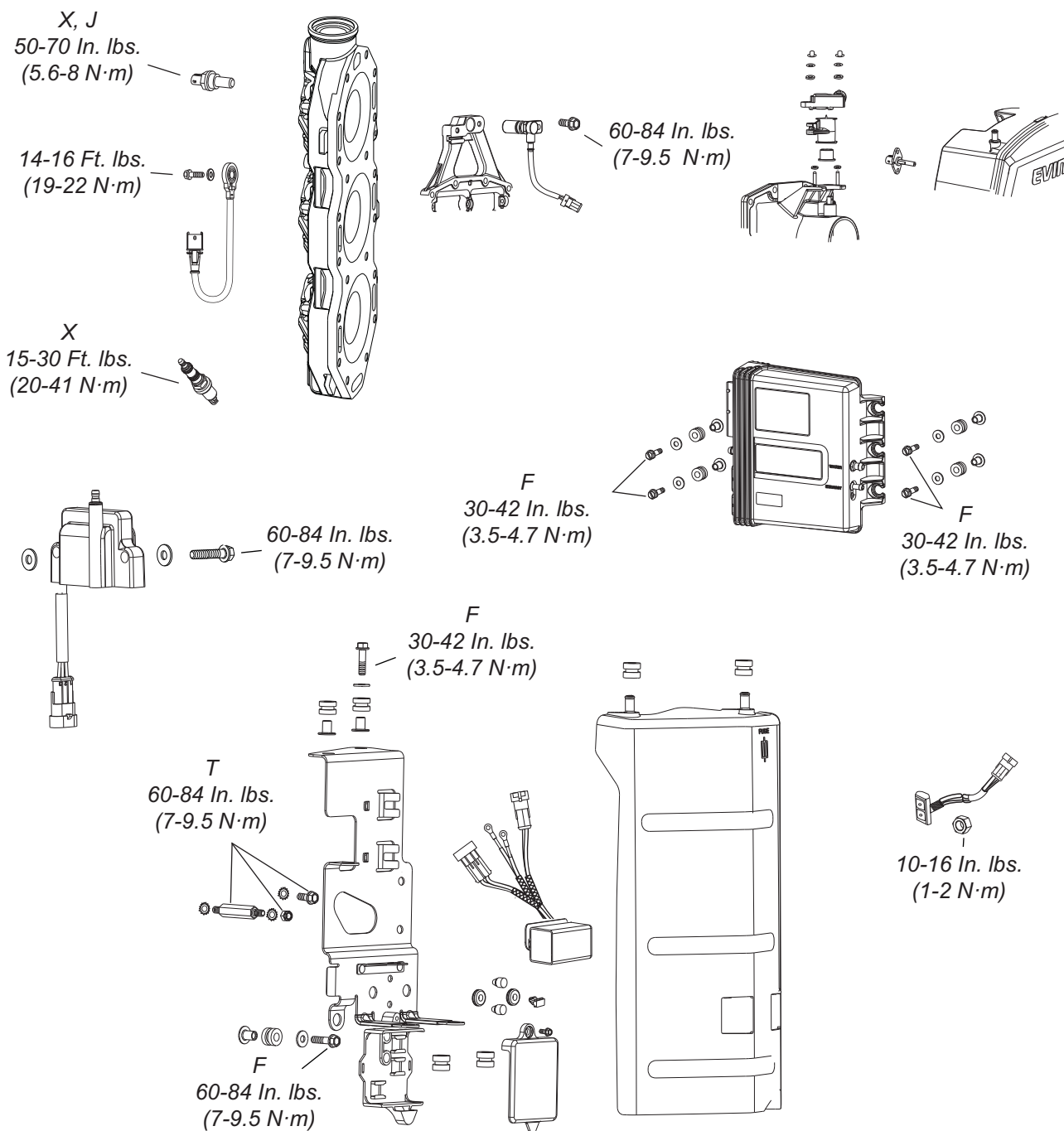
Electrical and Ignition

Table of Contents

Service Charts	90
Ignition System Circuit Diagram	92
Electrical Harness Connections	93
Ground Circuits	95
Fuse	96
Sensor Tests	96
Crankshaft Position Sensor (CPS) Test	96
Throttle Position Sensor (TPS) Test	97
Engine Temperature Sensor Test	97
Air Temperature Sensor (AT) Test	97
Knock Sensor Test	98
Stator Tests	98
Charging System Tests	99
12 V Charging Circuit	99
Auxiliary Battery Charge Wire	100
55 V Alternator Circuit	101
Electric Start Circuit	102
Electric Start Tests	104
Remote Control Switch Tests	106
Tilt/Trim Relay Test	108
SystemCheck Circuit Tests	109
Tachometer Circuit Tests	111
Flywheel and Stator Servicing	112
Flywheel Removal	112
Stator Service	112
Flywheel Installation	112
Ignition Coil Servicing	114
Ignition Coil Removal	114
Ignition Coil Bracket Removal	114
Ignition Coil Bracket Installation	114
Ignition Coil Installation	114
Timing Adjustments	115
Timing Pointer	115
Timing Verification	116
TPS Calibration	116
Electric Starter Servicing	118
Connector Servicing	125
<i>Deutsch</i> Connectors	125
<i>AMP</i> Connectors	126
<i>Packard</i> Connectors	129

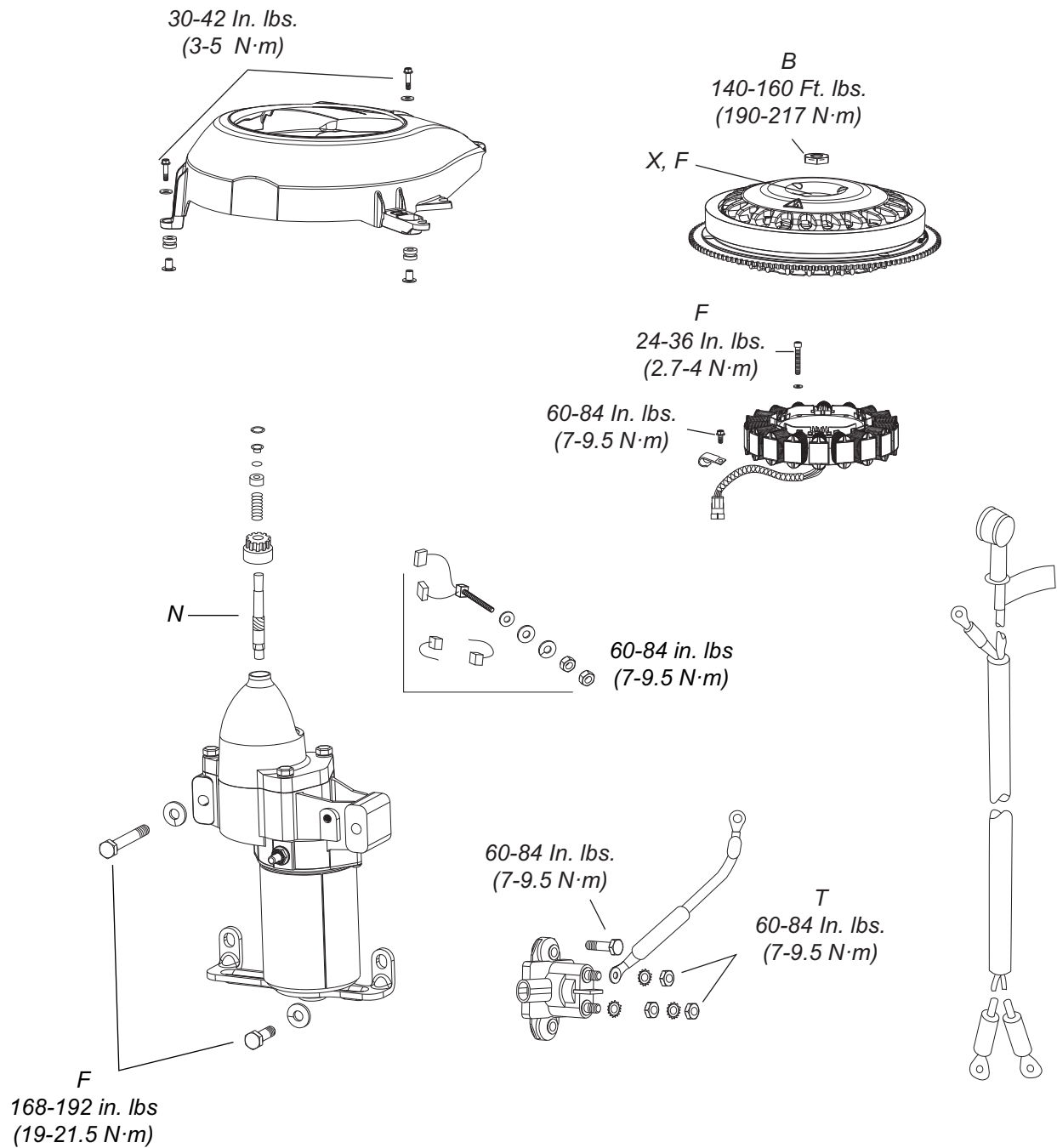
Service Charts

IMPORTANT: Do NOT lubricate TPS to throttle shaft surface.



004116R

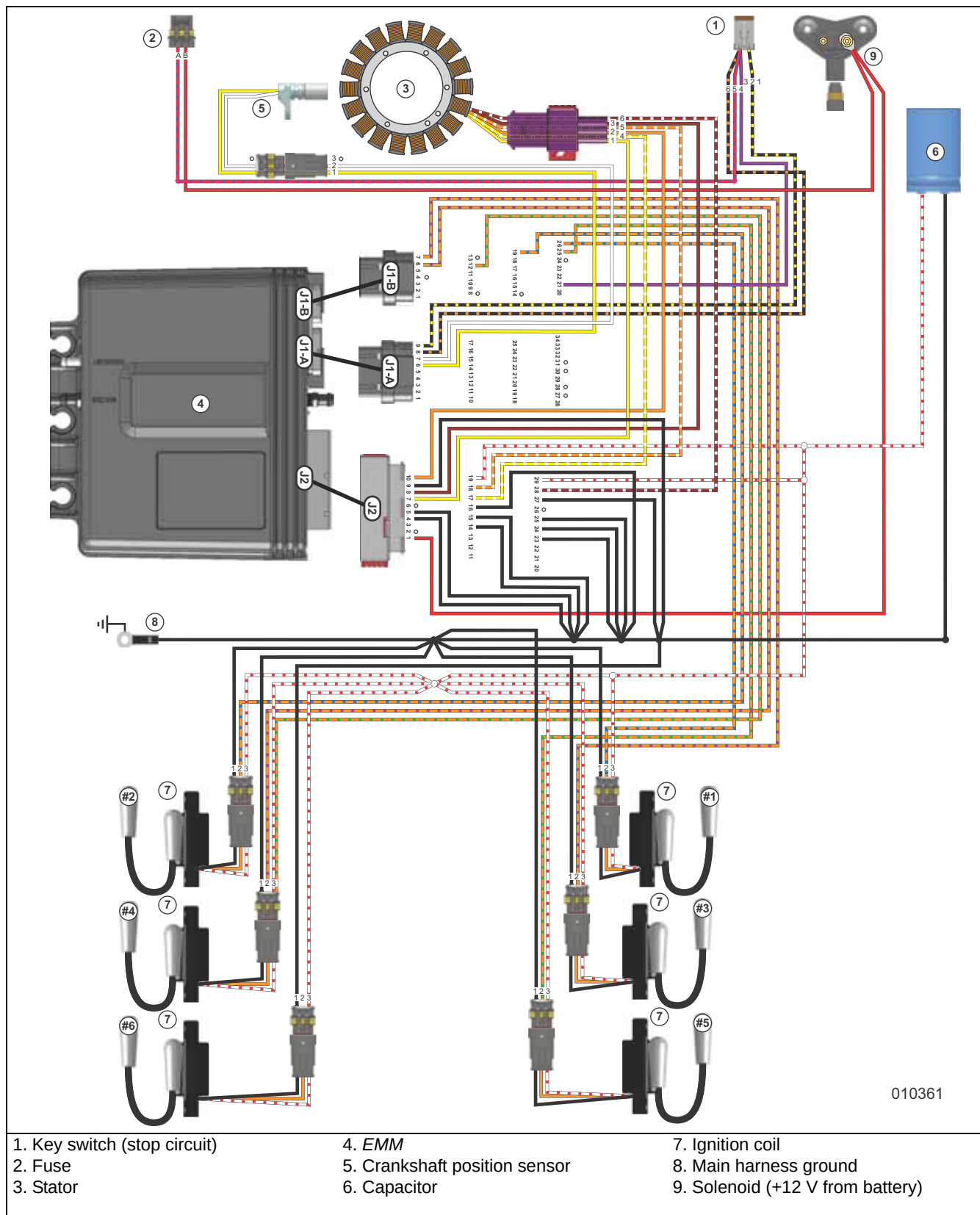
A Triple-Guard Grease	D Moly Lube	T Liquid Neoprene
B Gasket Sealing Compound	E Red Ultra Lock	X see Service Manual
C Adhesive 847	F Blue Nut Lock	Y Thermal Joint Compound



008030B

A Triple-Guard Grease	D Moly Lube	N Starter Bendix Lube
B Gasket Sealing Compound	E Red Ultra Lock	T Liquid Neoprene
C Adhesive 847	F Blue Nut Lock	X see Service Manual

Ignition System Circuit Diagram

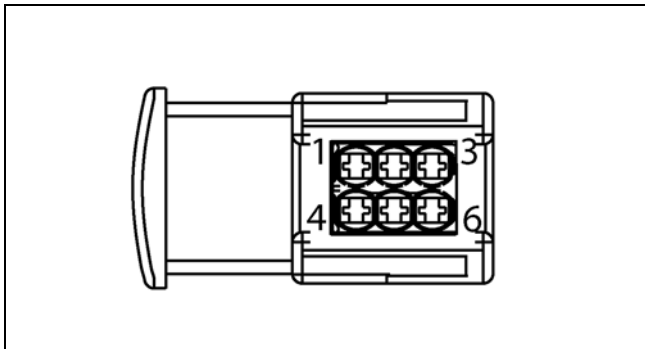


Electrical Harness Connections

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. 125.

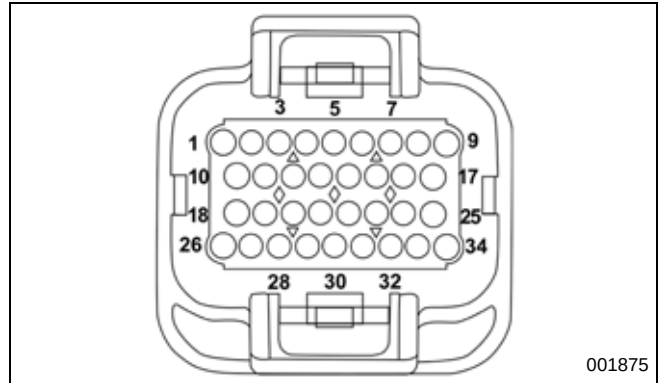
Engine Harness to Stator Connector



004050

Pin No.	Description of Circuit	Wire Color
1	Stator winding (1S)	Yellow
2	Stator winding (3S)	Orange
3	Stator winding (2S)	Brown
4	Stator winding (1F)	Yellow /White
5	Stator winding (3F)	Orange/White
6	Stator winding (2F)	Brown/White

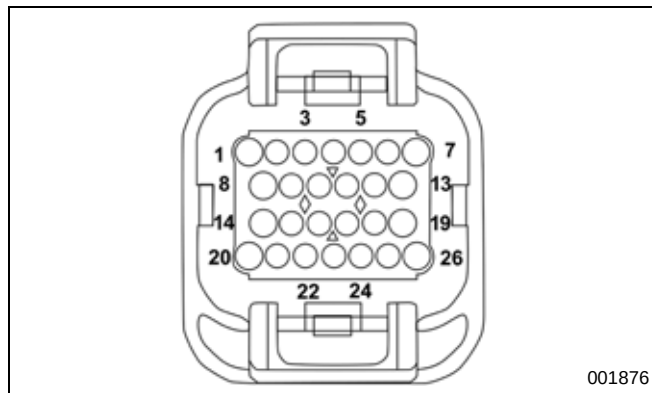
EMM J1-A Connector



001875

Pin No.	Description of Circuit	Wire Color
1	Oil Pressure sensor	Tan/White
2	Diagnostic connector	Red
3	Diagnostic connector	White
4	Ground, water in fuel (digital)	Black
5	Oil level switch	Tan/Black
6	Crankshaft position sensor (CPS)	Yellow
7	Ground, CPS (digital)	White
8	Bootstrap connector (programming)	Blk/Orange
9	Stop circuit	Blk/Yellow
10	Sensors 5 V	Red
11	Ground (analog)	Black
12	Engine temperature sensor, port	Pink/Black
13	CANbus, NET-L	Blue
14	CANbus, NET-H	White
15	Water pressure	Pink
16	Tachometer	Gray
17	CHECK ENGINE signal, <i>SystemCheck</i>	Tan/Orange
18	TPS	Green
19	Engine temperature sensor, starboard	Pink/Black
20	Air temperature sensor	Pink/Blue
21	CANbus, NET-S	Red
22	CANbus, NET-C	Black
23	Water in fuel	Pink/Green
24	NO OIL signal, <i>SystemCheck</i>	Tan/Yellow
25	WATER TEMP signal, <i>SystemCheck</i>	Tan
26	Start signal	Yellow/Red
27	Ground, knock sensors	Tan/Blue
28	vacant	
29	Shift switch (shift linkage)	Black/Yellow
30	Knock sensor, stbd	Yellow/Green
31	Knock sensor, port	Yellow/Blue
32	Trim sender, IN	White/Tan
33	Trim sender, OUT	White/Tan
34	LOW OIL signal, <i>SystemCheck</i>	Tan/Black

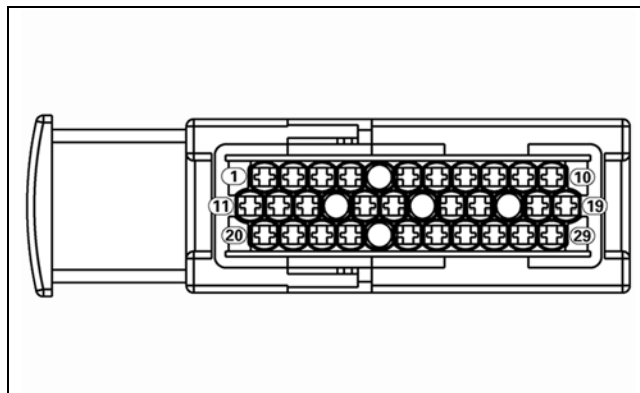
EMM J1-B Connector



001876

Pin No.	Description of Circuit	Wire Color
1	Injector, cylinder 1	Blue
2	Injector, cylinder 2	Blue
3	Injector, cylinder 3	Purple
4	Rear oil injector control (ground)	Blue/Red
5	Fuel pump	Red/White
6	Ignition, cylinder 4	Orange/Purple
7	Ignition, cylinder 3	Orange/Purple
8	Injector, cylinder 6	Green
9	Injector ground	Black
10	Injector ground	Black
11	Starter solenoid OUT	Brown/White
12	vacant	
13	Ignition, cylinder 5	Orange/Green
14	Injector, cylinder 5	Green
15	Injector ground	Black
16	Injector ground	Black
17	Trim relay, UP	Blue/White
18	Trim relay, DOWN	Green/White
19	Ignition, cylinder 2	Orange/Blue
20	Injector, cylinder 4	Purple
21	Switched B+ (12V)	Purple
22	Injector ground	Black
23	Oil solenoid	Blue
24	Rear oil injector +12 V	Red/Yellow
25	Ignition, cylinder 6	Orange/Green
26	Ignition, cylinder 1	Orange/Blue

EMM J2 Connector



004046

Pin No.	Description of Circuit	Wire Color
1	B+	Red
2	vacant	
3	Isolated B+	Red/Black
4	Battery ground	Black
5	Battery ground	Black
6	vacant	
7	Winding 1S	Yellow
8	Winding 2S	Brown
9	Injector, generator ground	Black
10	Winding 3S	Orange
11	B+	Red
12	B+	Red
13	Isolated B+	Red/Black
14	Battery ground	Black
15	Battery ground	Black
16	Battery ground	Black
17	Winding 1F	Yellow/White
18	Winding 3F	Orange/White
19	+55V	White/Red
20	B+	Red
21	Isolated B+	Red/Black
22	Isolated B+	Red/Black
23	Battery ground	Black
24	Battery ground	Black
25	Battery ground	Black
26	vacant	
27	Injector, generator ground	Black
28	Winding 2F	Brown/White
29	+55V	White/Red

Ground Circuits

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

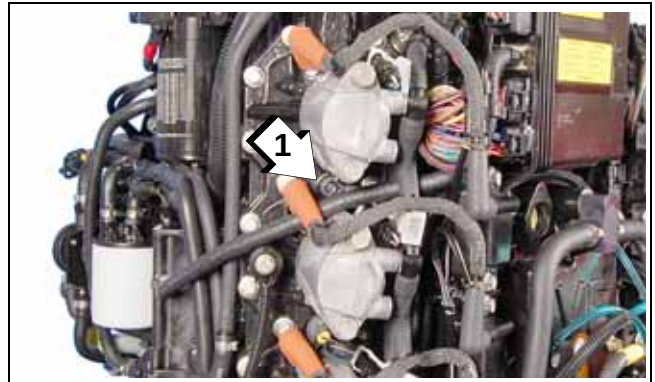
EMM Ground Tests

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 4, 5, 9, 14, 15, 16, 23, 24, 25 and 27 of *EMM* J2 connector and the main harness ground.
- Injector circuit grounds: Check continuity between terminal pins 9 and 27 of the *EMM* J2 connector and the main harness ground; and between terminal pins 9, 10, 15, 16 and 22 of the *EMM* J1-B connector and the main harness ground.
- Sensor circuit grounds: Check continuity between terminal pins 4 and 11 of the *EMM* J1-A connector and the appropriate sensor ground connections. Refer to wiring diagrams.

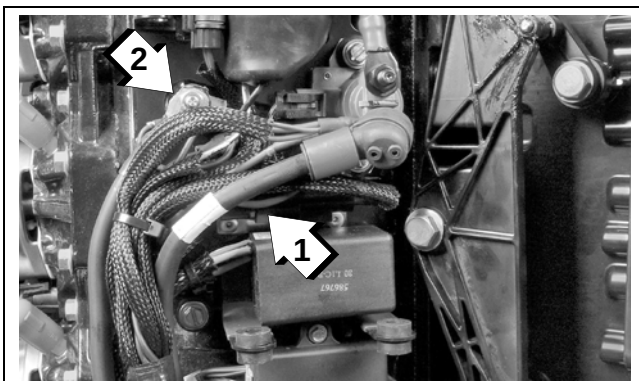
- Check continuity between ground terminals at port cylinder head ground screw and the main harness ground.



1. Ground, port cylinder head

007172

6



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

004183

Additional Ground Tests

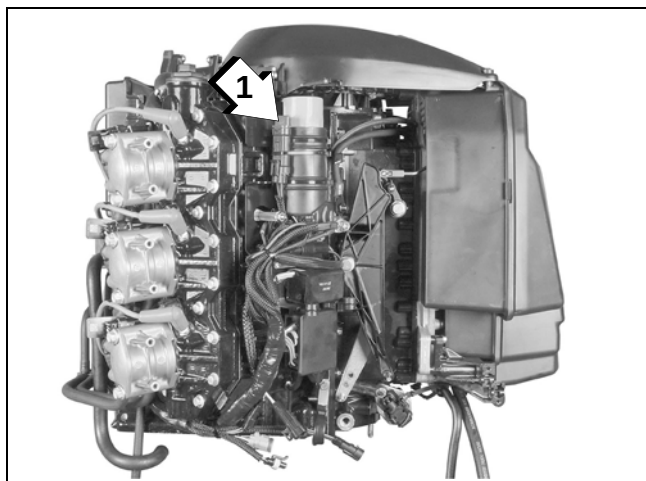
Check connections and continuity at the following locations:

- Trim and Tilt module ground at main ground terminal.

Fuse

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

The fuse is located on the starboard side of the powerhead, fastened to the capacitor.



1. Fuse

004080

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.

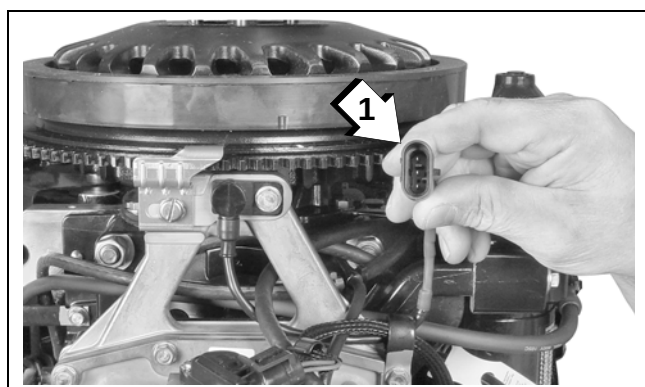
Crankshaft Position Sensor (CPS) Test

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*.

Disconnect 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.

Sensor Resistance
560 Ω $\pm$ 10% @ 77°F (25°C)

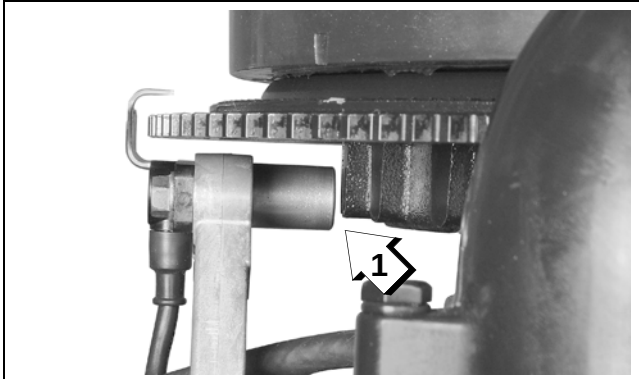


1. CPS Connector

004199

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

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



1. CPS gap

004200

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.

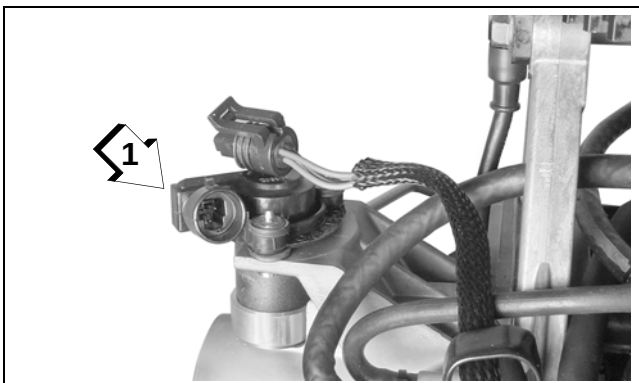
Use a digital multimeter to measure sensor resistance.

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

3000 to 7000 Ω @ 77°F (25°C)

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

4000 to 8000 Ω @ 77°F (25°C)



1. TPS

004256

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.

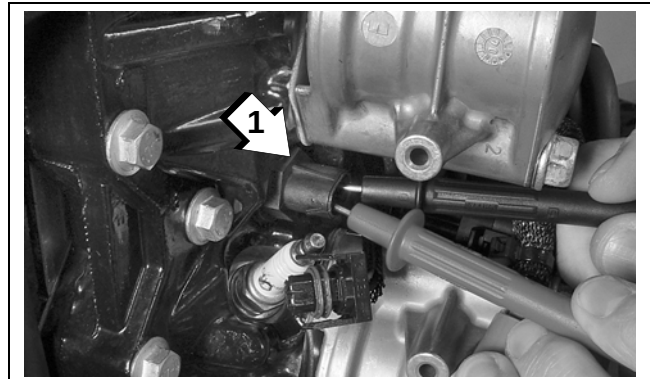
Use a digital multimeter to measure sensor resistance.

Engine Temperature Sensor Resistance

680 Ω $\pm$ 5% @ 212°F (100°C)

10000 Ω $\pm$ 1% @ 77°F (25°C)

32654 Ω $\pm$ 2.5% @ 32°F (0°C)



1. Engine temperature sensor (2)

004196

Air Temperature Sensor (AT) Test

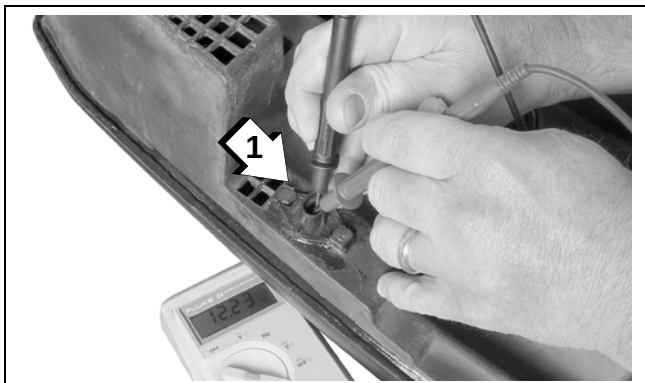
Remove the electrical connector from the air temperature sensor.

Electrical and Ignition

Stator Tests

Use a digital multimeter to measure sensor resistance.

AT Sensor Resistance
680 $\Omega \pm 5.25\%$ @ 212°F (100°C)
10000 $\Omega \pm 1.5\%$ @ 77°F (25°C)
32654 $\Omega \pm 3.0\%$ @ 32°F (0°C)



1. AT sensor

004216

Knock Sensor Test

There are no tests for the knock sensor. If *Evinrude Diagnostics* reports Service Code 7 or 8, replace with a new sensor.

Make sure sensor retaining screw is tightened to a torque of 14 to 16 ft. lbs. (19 to 22 N·m).

Stator Tests

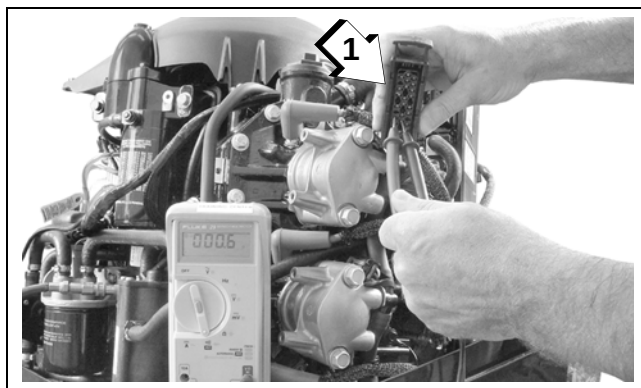
The stator consists of 3 windings (6 poles each) on a 7 inch diameter core and generates an output voltage of 55 VAC (1700 watts maximum). This voltage is converted by the *EMM* and used to provide 12 VDC for battery charging (10 A at 500 RPM and 50 A from 2000 RPM to WOT) and 55 VDC for fuel injector, fuel and oil pump operation. The ignition module of *EMM* is also powered by the 55 VDC output.

Stator Resistance Tests

Use a digital multimeter to check resistance of stator windings.

Disconnect *EMM* J2 connector from *EMM*.

Stator Winding Resistance
Yellow & Yellow / white .512 $\pm .020 \Omega$ @ 73°F (23°C)
Brown & Brown / white .512 $\pm .020 \Omega$ @ 73°F (23°C)
Orange & Orange / white .512 $\pm .020 \Omega$ @ 73°F (23°C)



1. EMM J2 Connector

004325

Connect meter leads to the following pins:

- Yellow/white and yellow (pins 17 and 7)
- Brown/white and brown (pins 28 and 8)
- Orange/white and orange (pins 18 and 10)

IMPORTANT: A reading of less than 2 ohms is acceptable. Make sure meter is calibrated to read 1 ohm or less.

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 voltmeter to check the stator output voltage. Set meter to read 110 VAC output.

⚠ WARNING

To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Disconnect CPS.

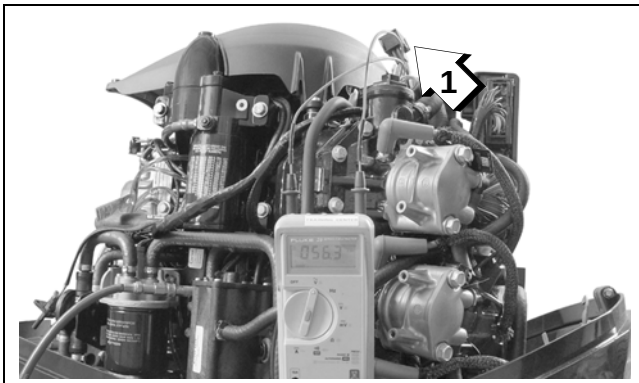
Disconnect stator (6-pin) connector from the engine harness (6-pin) connector.

Connect Stator Test Adaptor tool, P/N 5006211, to stator connector.

Connect meter leads to terminals of adaptor tool.

With a fully charged battery, crank outboard (100 RPM minimum) and observe meter reading:

- 20 VAC at 100 RPM
- 30 VAC at 150 RPM
- 42 VAC at 200 RPM
- 52 VAC at 250 RPM
- 62 VAC at 300 RPM



1. Stator Test Adaptor

004326

Charging System Tests

⚠ WARNING

Excessive battery discharge rates might overheat battery causing electrolyte gas-sing. This might create an explosive atmosphere. Always work in a well ventilated area.

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 voltage to operate. Before proceeding, make sure there is at least 7 V on the positive terminal of the starter solenoid.

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(s) of engine wire harness (alternator output from *EMM*) and the positive (B+) battery cable terminal of starter solenoid.

IMPORTANT: This outboard has dual output charging. Each output is isolated and regulated. Each output is 25 A. Combined output is approximately 50 A. Refer to engine wiring diagram.

Fluke[†] model 334 or 336, *Snap-On*[†] model MT110 or EETA501, and various other amp meters should be available through local tool suppliers.

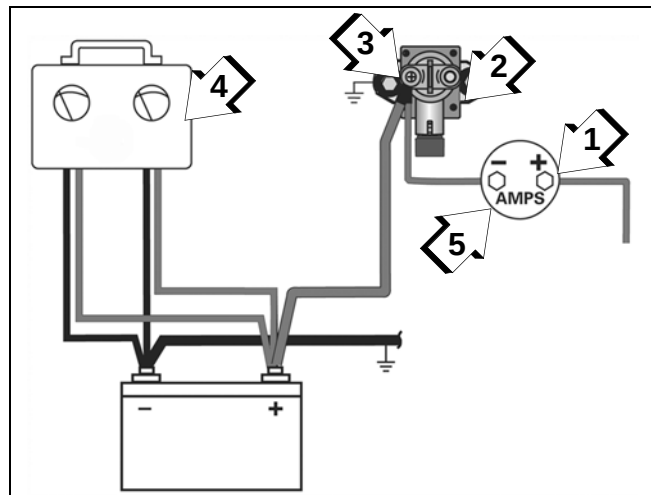
Reconnect the battery cables.

Following the manufacturer's directions, connect the variable load tester (carbon pile) across the battery terminals. *Stevens* model LB-85 and

Electrical and Ignition

Charging System Tests

Snap-On model MT540D are examples of testers available.



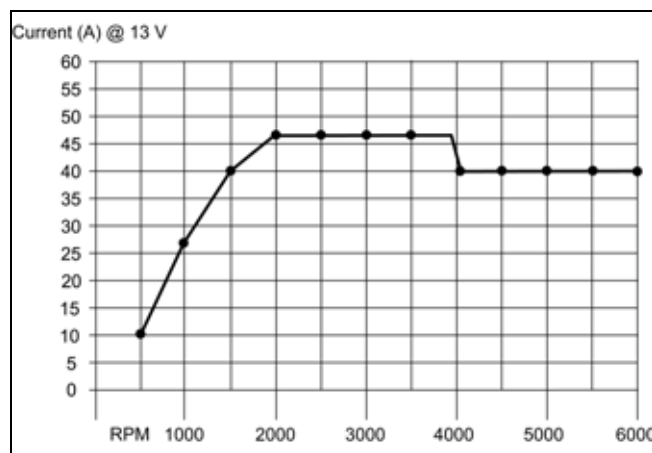
Variable Load Test Diagram

002077

1. Red wires (alternator output from EMM)
2. Starter solenoid
3. Battery cable terminal (B+)
4. Variable load tester
5. Ammeter

Start and run the outboard at approximately 3500 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 50 A (or 25 A for each output) between 2000 and 4000 RPM.
- Above 4000 RPM, charging output is reduced to 40 A.



Battery Charging Graph

004286

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. See **Stator Tests** on p. 98.

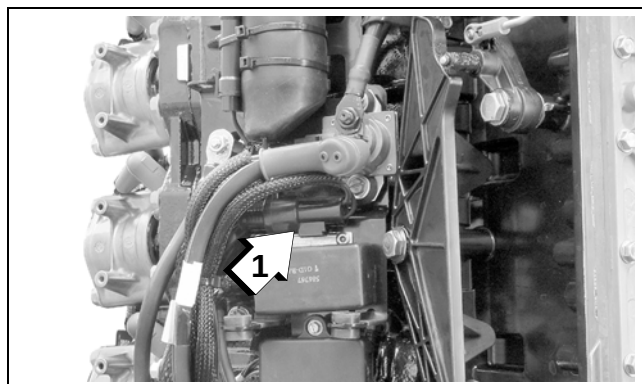
Auxiliary Battery Charge Wire

The auxiliary battery charge feature requires auxiliary battery charge kit, P/N 5006253 (or equivalent).

IMPORTANT: Disconnect all accessories from the auxiliary battery. Auxiliary battery must read a minimum of 8.5 V at the beginning of these tests and remain connected to the outboard during the tests.

Check battery ground cable for continuity.

With the key switch OFF, check battery voltage at auxiliary battery, then check voltage at auxiliary battery connection. If the readings are not the same, replace wire to auxiliary battery. The auxiliary battery wire must be at least 10-gauge and it must be protected by a 50 A fuse or circuit breaker at the battery.



1. Auxiliary battery charge wire connection

004329

With outboard running at 1000 RPM, voltage must read higher than with key OFF and increase steadily to approximately 14.5 V as the outboard RPM increases.

If there is no increase, turn the key switch to OFF and test red/black wire between the EMM and auxiliary battery connection.

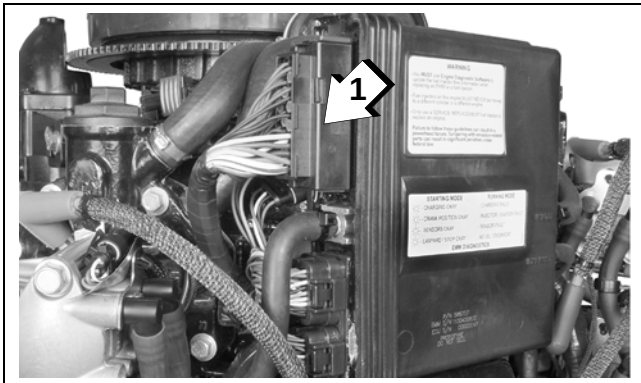
- Continuity indicates faulty output from EMM. Check 12 V alternator output **before** replacing EMM for faulty auxiliary battery, charge isolator circuit.
- No continuity indicates faulty wiring.

55 V Alternator Circuit

Check battery ground cable for continuity.

With the key switch ON, check battery voltage at battery (12 V).

Then, use Electrical Test Probe Kit, P/N 342677, and a digital multimeter set to read 55 VDC to check voltage on white/red wires at J2 connector of *EMM*. Voltage at *EMM* connector should be approximately 30 V.



1. J2 connector of EMM

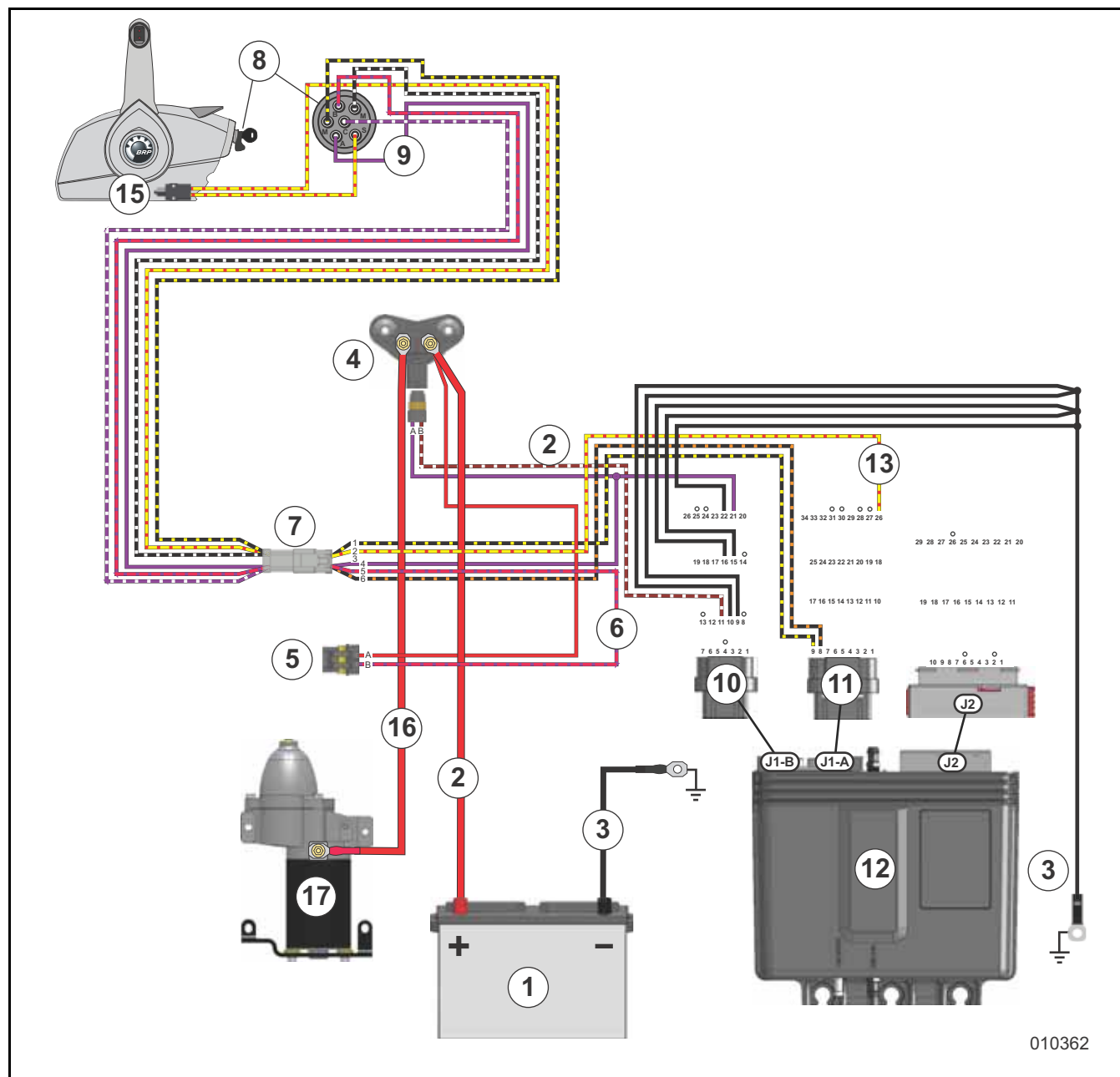
004197

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. 98. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or *EMM*.

Electric Start Circuit

Start Circuit Diagram



- | | |
|------------------------------|--|
| 1. Marine battery | 10. 26-pin J1-B EMM connector |
| 2. RED wire (POS) | 11. 34-pin J1-A EMM connector |
| 3. BLACK wire (NEG) | 12. Engine Management Module (EMM) |
| 4. Starter solenoid | 13. YELLOW/RED wire, start |
| 5. Fuse (10 amp) | 14. BROWN/WHITE wire, start signal |
| 6. RED/PURPLE wire | 15. Neutral Safety Switch (remote control) |
| 7. Key switch connectors | 16. RED starter motor cable |
| 8. Ignition switch | 17. Electric starter motor |
| 9. PURPLE wire (switched B+) | |

Start Circuit Operation

The starter must engage and turn the flywheel. The outboard must crank a minimum of 100 RPM to start. Normal cranking speed is approximately 175 RPM.

Starter performance depends on the following:

- Proper battery and cable capacity.
- Clean, tight cable connections.
- Solenoid activation through the key switch, neutral safety switch, and *EMM*.

Refer to **Predelivery and Installation Guide** 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 next to starter solenoid.

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 solenoid (terminal “A”) and *EMM*.
- Yellow/red wire provides switched 12 V to *EMM*.
- Brown/white wire from terminal 11 of *EMM* J1-B connector provides switched ground (NEG) to starter solenoid (terminal “B”).

Instrument Wire Harness

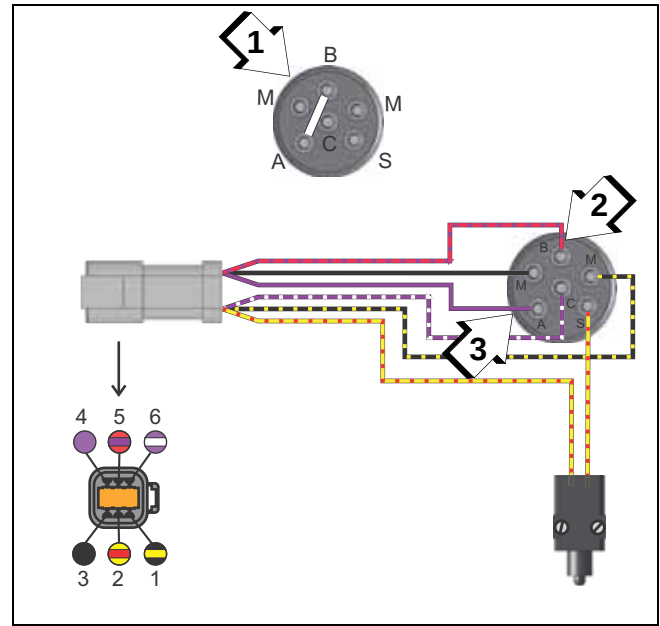
Contains the following circuits:

- 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 *EMM* (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 21 of *EMM* J1-B connector. *EMM* turns ON.
- *EMM* provides 12 V to terminal “A” of starter solenoid.



1. Key switch, ON position – Continuity between terminals “B” and “A”
2. Terminal “B”, 12 V (Red/purple)
3. Terminal “A”, 12 V (Purple)

000691

Key Switch, START Position

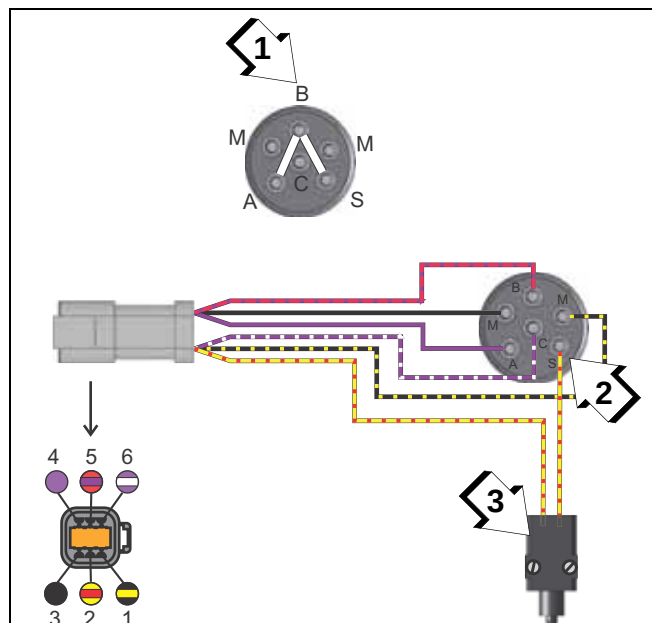
Key switch START:

- 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 terminal 26 of *EMM* J1-A connector.

Electrical and Ignition

Electric Start Tests

- EMM grounds brown/white wire to activate solenoid.



1. Ignition switch, START position – Continuity between terminals “B” and “A”; “B” and “S”
2. Terminal “S”, 12 V
3. Neutral safety switch

000691R

Electric Start Tests

Starter Solenoid Test

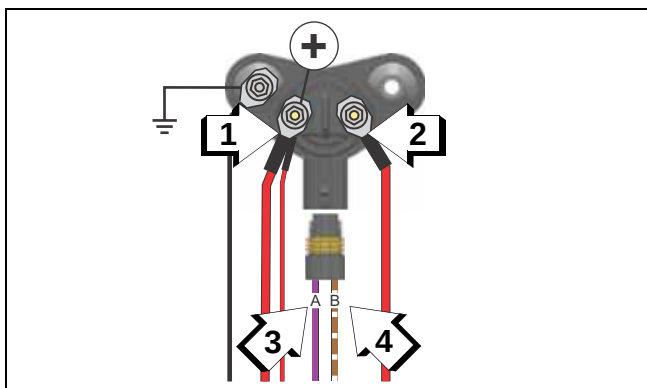
Disconnect the B+ (POS) battery cable at the battery.

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.



1. Starter positive cable (+) terminal
2. Battery positive (B+) cable terminal
3. “A” terminal (purple)
4. “B” terminal (brown/white)

004121

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.

After re-installing the solenoid, coat all wires and terminals with *Black Neoprene Dip*.

Starter Voltage Drop Test

⚠ WARNING

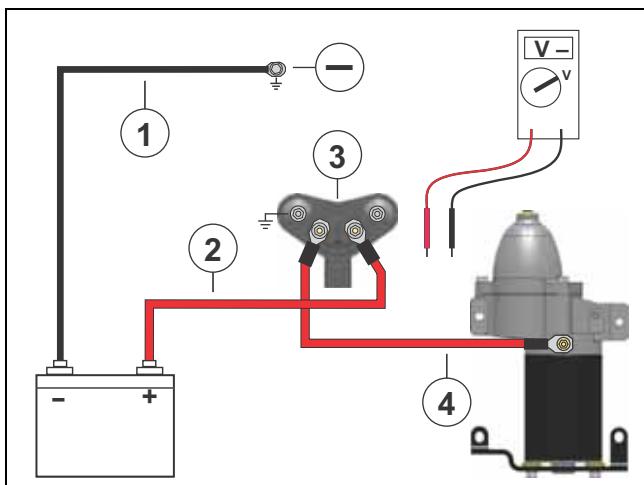
To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Use a digital voltmeter to measure the voltage drop on each section of the start circuit.

If any voltage reading is greater than 0.5 VDC check that connections are clean, tight and free of corrosion. Clean or replace any corroded or damaged cables or connections.

STEP 1: Connect voltmeter positive (+) lead to the terminal for the negative (–) battery cable at powerhead. Connect voltmeter negative (–) lead to negative (–) battery post.

- Activate starter motor and observe voltage reading.



1. Negative battery cable
2. Positive battery cable
3. Solenoid
4. Starter cable

008464A

STEP 2: Connect positive (+) lead to battery positive (+) terminal. Connect negative (–) lead to starter solenoid terminal.

- Activate starter motor and observe voltage reading.

STEP 3: First, activate starter motor. Connect positive (+) lead to starter solenoid terminal. Connect negative (–) lead to opposite starter solenoid terminal.

- Observe voltage reading.

STEP 4: Connect positive (+) lead to starter cable of solenoid terminal. Connect negative (–) lead to starter motor terminal.

- Activate starter motor and observe voltage reading.

No Load Current Draw Test

Securely fasten starter in a vise or suitable fixture before proceeding with this check.

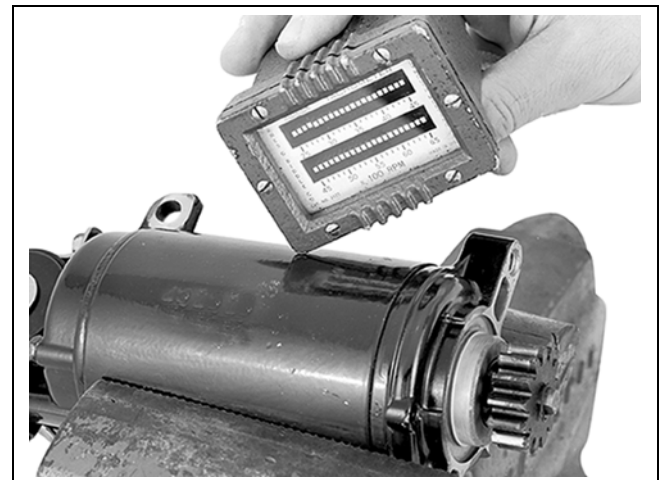
Use a battery rated at 500 CCA (60 amp-hr) or higher that is in good condition and fully charged.

IMPORTANT: The driven gear and pinion assembly must be removed for this test.

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.



TYPICAL

24083

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.

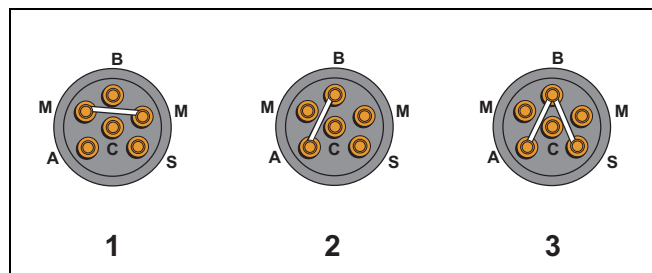
Accessory Terminal (A) – Make sure the key switch is OFF. Connect the ohmmeter or continuity light between terminals “B” (battery) and “A” (accessory) of key switch. Meter must indicate NO continuity.

Turn switch ON. Meter must indicate continuity.

Turn key switch to START. Meter must continue to indicate continuity.

Starter Terminal (S) – Hold key switch at START. Connect meter between terminal “B” and terminal “S.” Meter should indicate continuity.

IMPORTANT: The choke function or terminal “C” of the key switch is NOT used.



1. OFF
2. ON
3. START

010304

Neutral Start Circuit Test

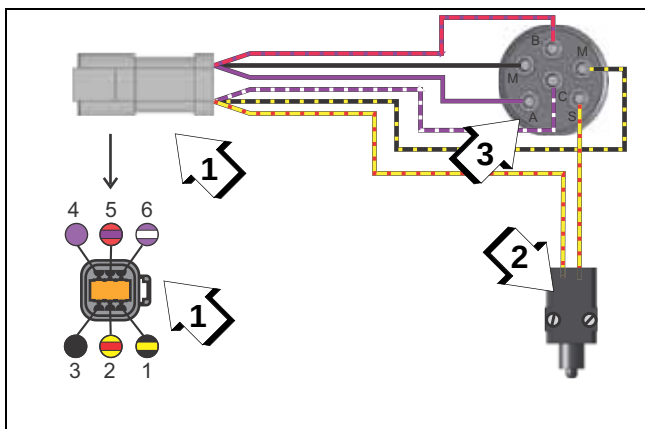
Use an ohmmeter or continuity light to test the continuity of the circuit while positioning the remote control in NEUTRAL, FORWARD, and REVERSE.

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.



1. Key switch harness connector
2. Neutral start switch
3. Key switch

000443

IMPORTANT: Reconnect shift cable and MWS instrument harness connector to key switch harness connector.

Neutral Start Switch Test

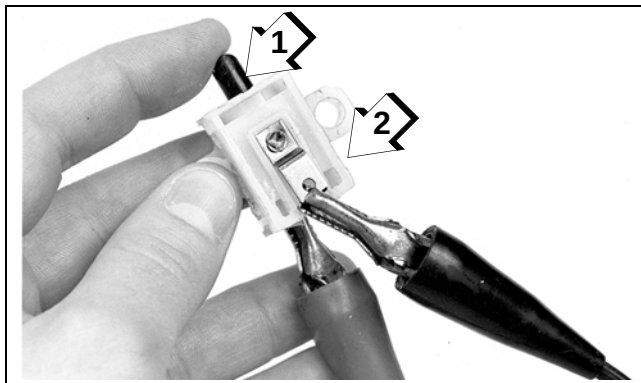
Use an ohmmeter or a continuity light to test neutral start switch operation.

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.



TYPICAL
1. Plunger
2. Neutral start switch

3224

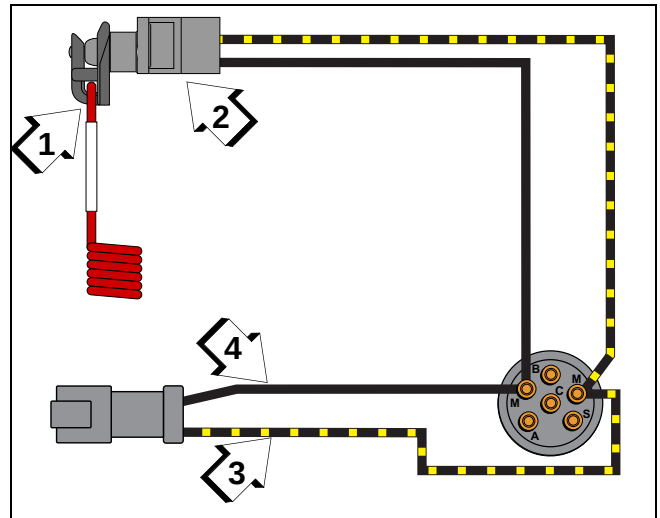
Replace switch if results are incorrect.

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).



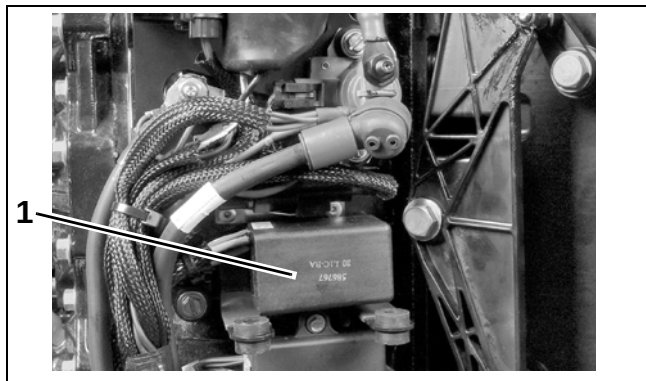
1. Lanyard and clip assembly
2. Emergency stop switch, separate from key switch
3. Stop circuit wire (black/yellow)
4. Ground wire (black)

000444

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.

Tilt/Trim Relay Test

The tilt and trim (TNT) module contains the circuitry and relays required for power trim and tilt operation.



1. Tilt and trim module

004183

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 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**.

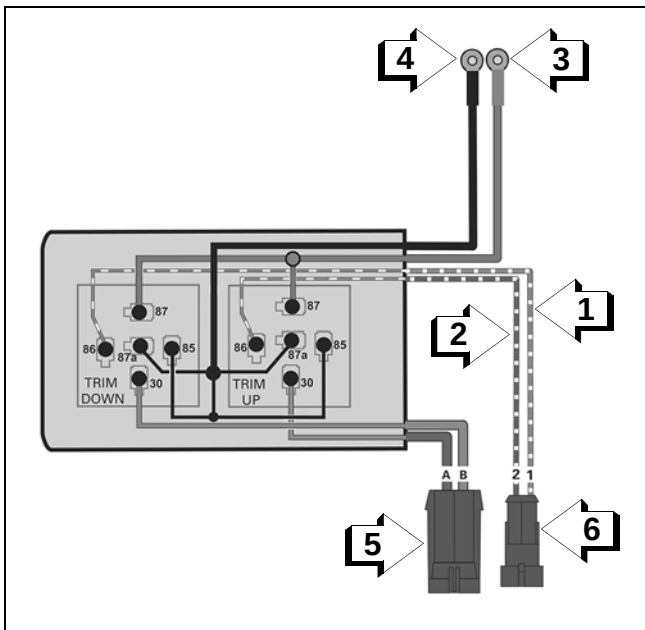
Test Procedure

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

002063

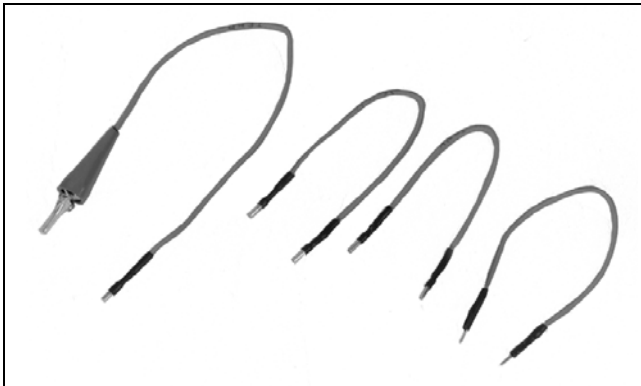
1. Green/white wire
2. Blue/white wire
3. B+, red wire
4. B-, black wire
5. TNT motor connector
6. TNT switch connector

SystemCheck Circuit Tests

Make sure the *SystemCheck* engine monitor can alert 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.



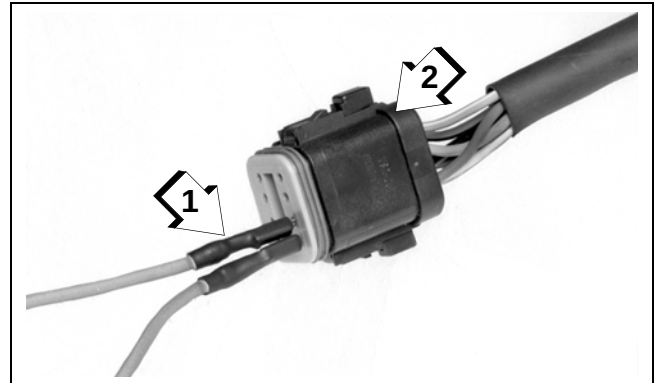
42811

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).



1. Test adapter(s)
2. Connector, SystemCheck gauge

42761

- 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.

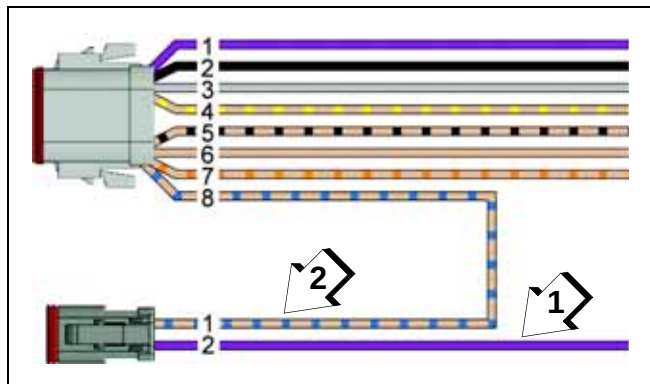
If the lights worked, but the warning horn did not sound for one-half second, turn the key switch OFF. Disconnect the warning horn 2-pin connector. Substitute a known good warning horn. Turn the key switch ON.

- 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

Electrical and Ignition

SystemCheck Circuit Tests

the two connectors, replace *SystemCheck* gauge.



1. Purple wire
2. Tan/blue wire

DRC6280

Turn the key switch OFF and reconnect all disconnected circuits.

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.

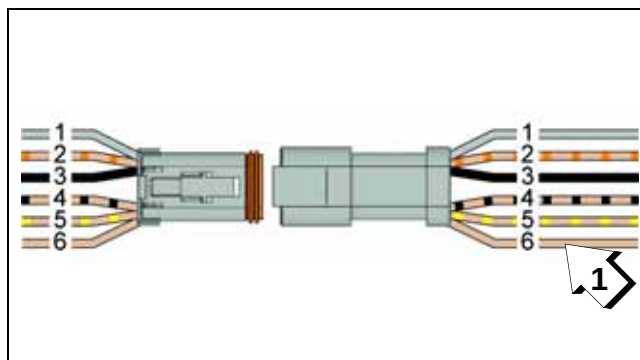
- If the CHECK ENGINE light is not on, test circuit for continuity. Check continuity of the MWS instrument harness (tan/orange wire).
- Check continuity of the engine wire harness between terminal 2 (tan/orange wire) of the *SystemCheck* connector and pin 17 of the *EMM* J1-A connector.

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.



1. Tan wire (pin 6 of engine harness)

002079

Turn the key switch ON. After the normal self-test sequence, the gauge WATER TEMP / HOT indicator should stay on.

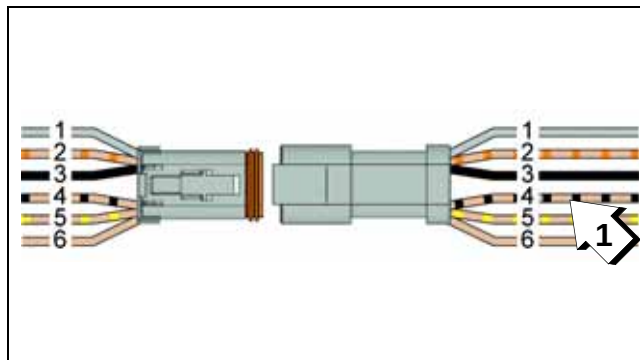
- If LED is not on, test circuit for continuity. Test for continuity of both the engine harness (tan wire) and the MWS instrument harness (tan wire).

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. 97.

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.



1. Tan / black wire (pin 4 of engine harness)

002079

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.

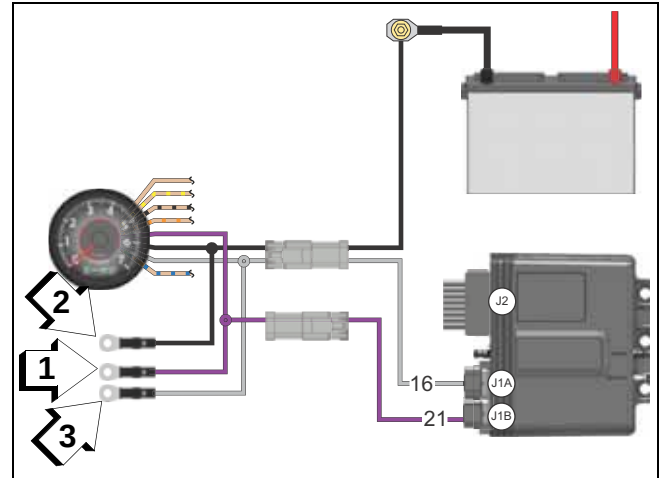
Turn the key switch ON. After the normal self-test sequence, the NO OIL light should stay on.

- 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.



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

004287

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.

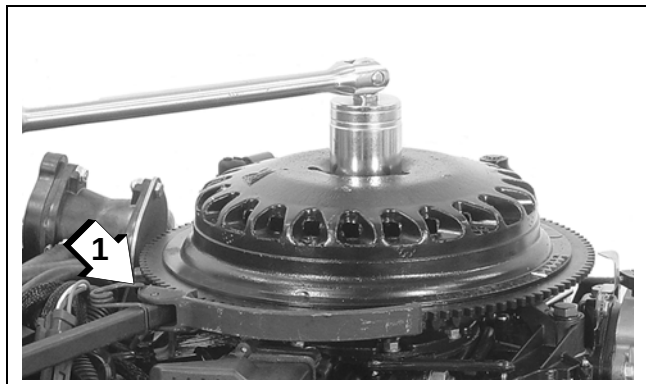
An accurate test of alternator output can help determine the flywheel's condition. Refer to **Charging System Tests** on p. 99.

Flywheel Removal

WARNING

To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Use Flywheel Holder, P/N 771311, or equivalent, and a 1 7/16 in. socket to remove flywheel nut. Discard flywheel nut.



1. Flywheel holder

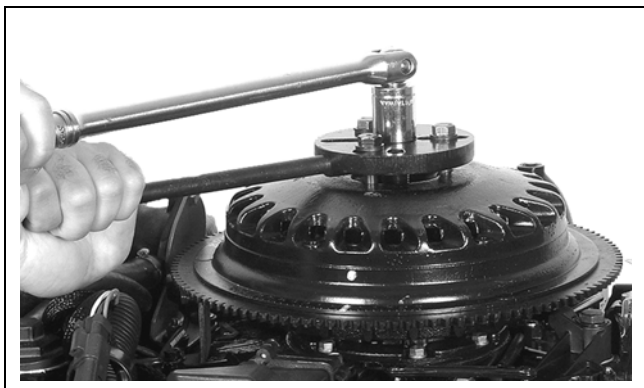
000774

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

Apply *Moly Lube* grease to the threads of the puller pressing screw, P/N 307637, and the center hole of the crankshaft.

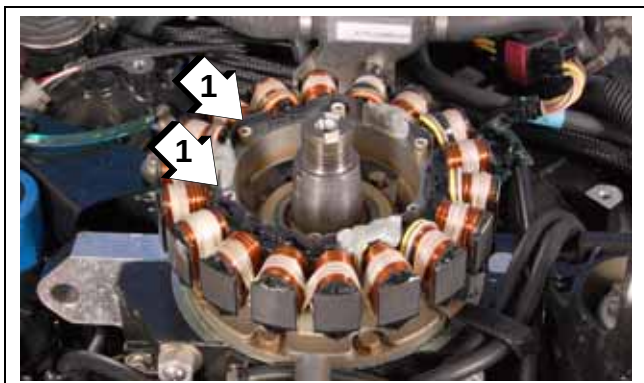
Place the puller on flywheel with body flat side up. Attach the puller body with the three shoulder screws and washers. Hold puller body with handle, and tighten pressing screw until flywheel releases. Turn the center screw and lift the flywheel off of the crankshaft.



000772

Stator Service

Remove six allen head screws to remove stator.



1. Stator screws

006864

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 24 to 36 in. lbs. (3 to 4 N·m).

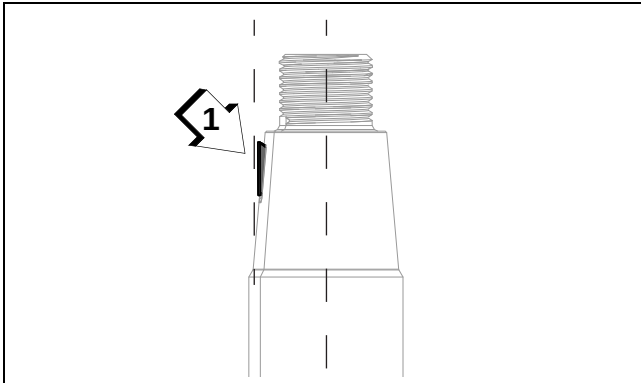
Flywheel Installation

CAUTION

To avoid injury, keep hands and fingers clear from the underside of the flywheel.

The magnets on the flywheel can cause the flywheel to move unexpectedly and rapidly toward the stator with great force.

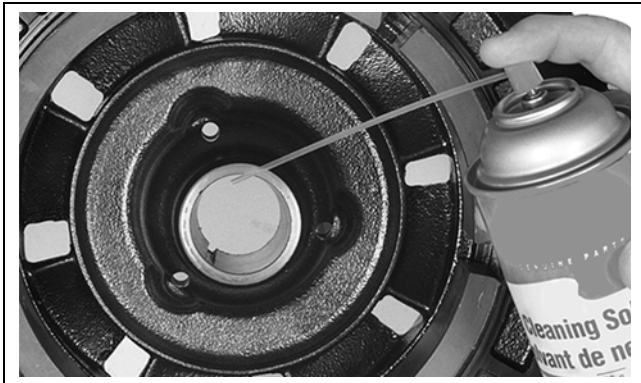
Install the outer edge of flywheel key parallel with centerline of crankshaft.



1. Flywheel key

009754

Thoroughly clean the crankshaft and flywheel tapers with *Cleaning Solvent* and let dry.



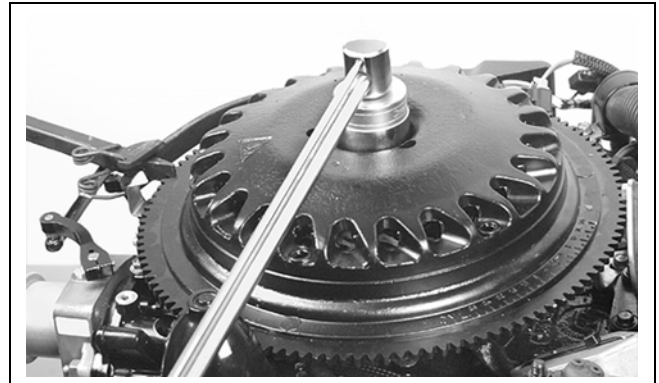
49623

Apply a thin, even coat of *Nut Lock* to the inside taper of the flywheel.

IMPORTANT: DO NOT over apply *Nut Lock* on flywheel taper. This prevents *Nut Lock* from migrating into upper seal of crankshaft.

Align the flywheel keyway and install the flywheel. Coat the threads of the flywheel nut with *Gasket*

Sealing Compound. Install the nut and tighten to a torque of 140 to 160 ft. lbs. (190 to 217 N·m).



DP0567

IMPORTANT: Perform the timing verification procedure after flywheel removal or replacement. Refer to **Timing Adjustments** on p. 115.

Ignition Coil Servicing

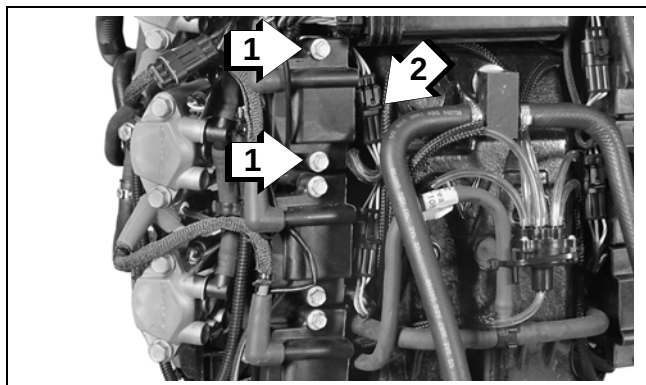
Ignition Coil Removal

Remove spark plug lead from ignition coil.

Disconnect ignition coil electrical connector.

Remove two ignition coil retaining screws.

Do not lose the rubber washers between coil and bracket.



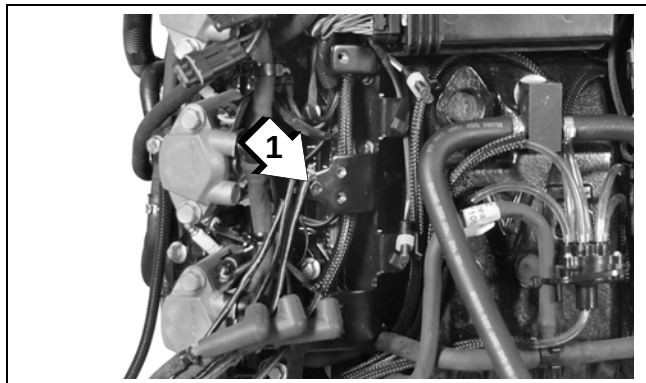
1. Screws
2. Connector

007204

Ignition Coil Bracket Removal

Remove all ignition coils from bracket.

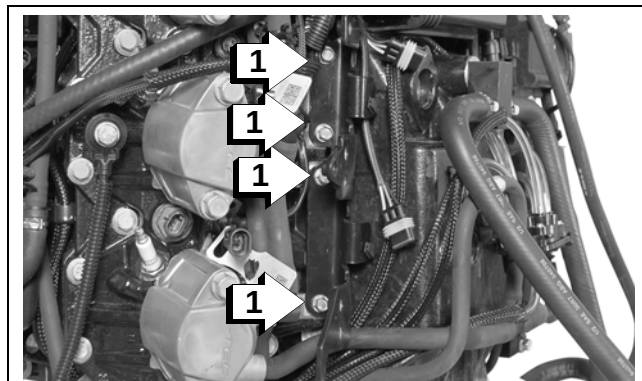
Remove spark plug lead ground screw.



1. Ground screw

007205

Remove four screws and bracket.



1. Screws

007206

Ignition Coil Bracket Installation

Install bracket with four screws. Tighten screws to a torque of 60 to 84 in. lb. (7 to 9.5 N·m).

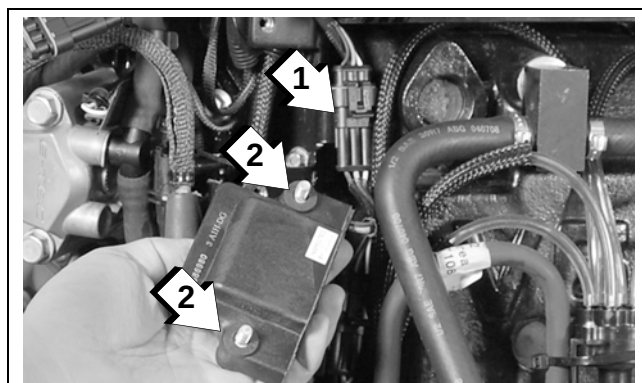
Install spark plug leads with ground screw. Tighten screw securely.

Ignition Coil Installation

Connect ignition coil electrical connector. Place electrical connector on its retainer.

Install one rubber washer on each screw. Install screw through ignition coil.

Install remaining rubber washers on screws between coil and bracket.



1. Electrical connector
2. Rubber washers

007207

Install coil with washers on bracket.

Tighten screws to a torque of 60 to 84 in. lb. (7 to 9.5 N·m).

Install spark plug lead on ignition coil.

Timing Adjustments

Timing Pointer

⚠ WARNING

To prevent accidental starting of outboard:

- Disconnect the battery cables at the battery.
- Disconnect crankshaft position sensor (CPS).

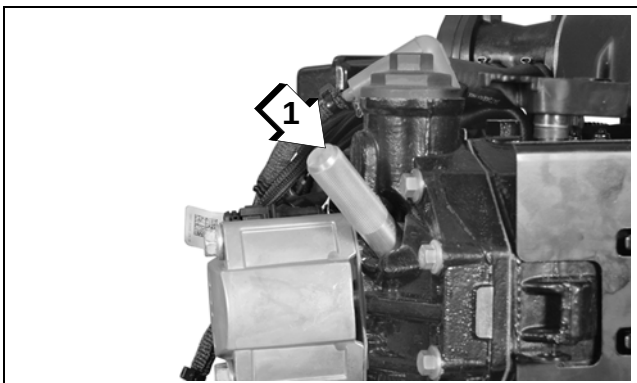
The timing pointer must be adjusted to indicate top dead center (TDC) of the number 1 piston. This reference to the position of the number 1 piston is used to synchronize the electronic timing controlled by the *EMM* with the mechanical position of the number 1 piston.

Always check timing pointer adjustment before using the *Evinrude Diagnostics* software Timing Verification procedure.

Disconnect the battery cables at the battery.

Remove spark plugs. Rotate the flywheel clockwise to approximately 30° ATDC.

Install Piston Stop Tool, P/N 342679, into the spark plug hole of the number 1 cylinder.

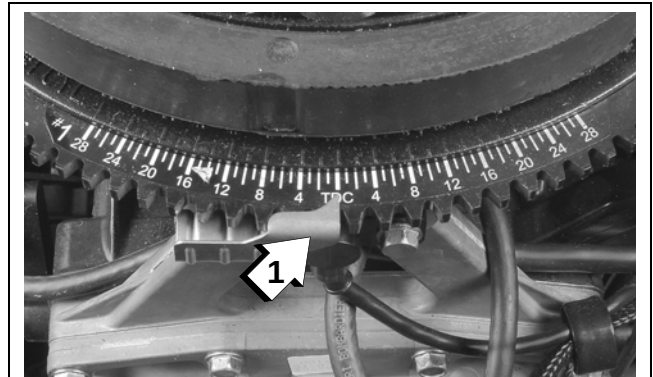


1. Piston stop tool

007208

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."



1. Timing pointer

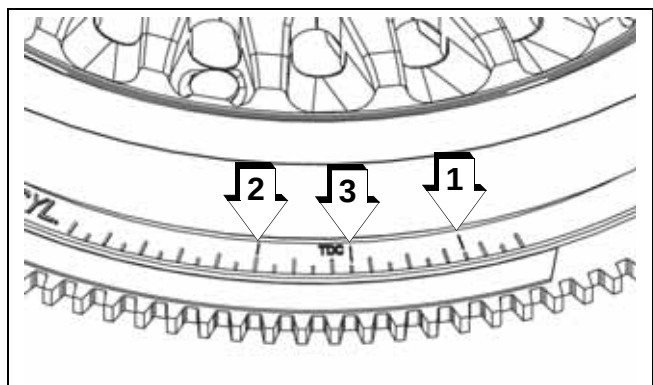
005025

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, such as a piece of string, 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.



1. Mark "A"
2. Mark "B"
3. Mark "C"

010367

Electrical and Ignition

Timing Adjustments

Repeat the entire adjustment process to make sure pointer is aligned correctly.

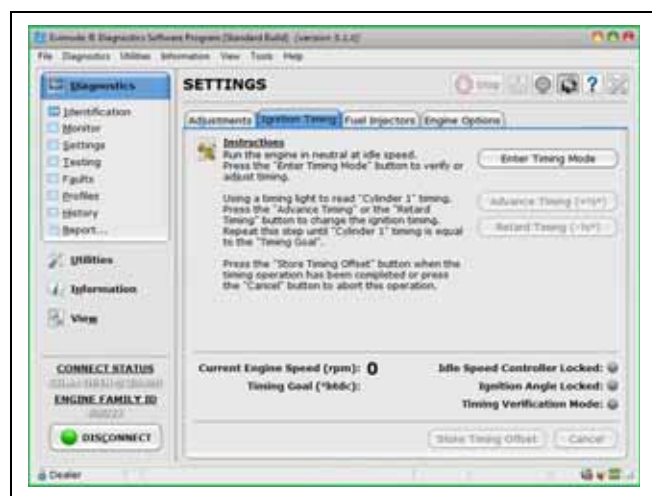
Install spark plugs. Refer to Spark Plug **Indexing** on p. 41.

Timing Verification

Use *Evinrude Diagnostics* software to synchronize the mechanical timing of the outboard with the electronic timing of the *EMM*.

Start the outboard.

Use the *Settings/Ignition Timing* screen of the diagnostics software and follow the on-screen instructions.



Timing Adjustment Screen

008572

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.

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

Remove the air silencer.

⚠ WARNING

To prevent accidental starting of the outboard disconnect crankshaft position sensor (CPS).

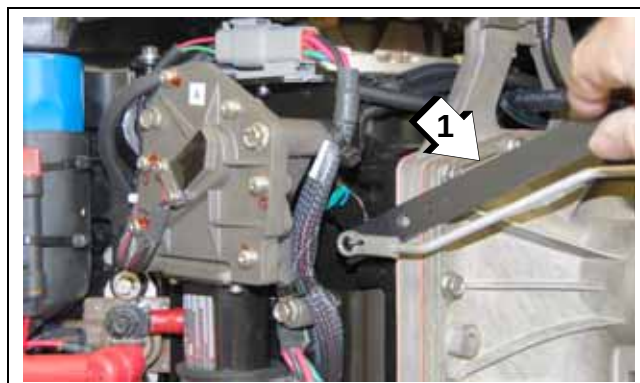
Turn the key switch to the ON position. Do NOT start the outboard.

Models with ICON Electronic Shift and Throttle

Rotate the propeller shaft and use the *ICON* remote control to shift the outboard into FORWARD gear. Rotate the propeller shaft to confirm the outboard is in FORWARD gear.

Fully advance the throttle. The throttle actuator should move the throttle plates to the wide open throttle position.

Use Ball Socket Remover, P/N 342226, to remove throttle link from actuator arm.



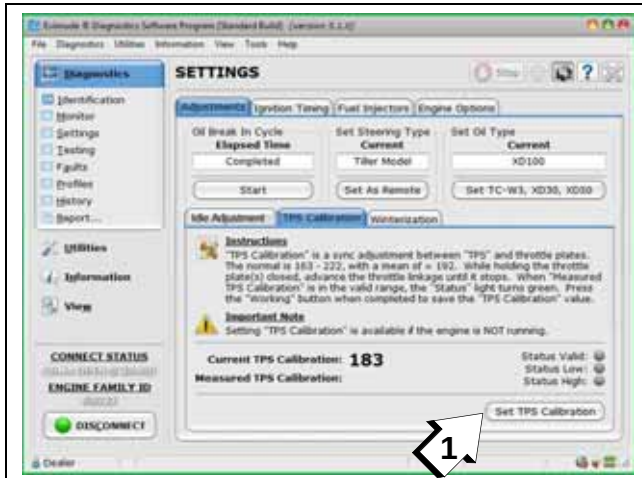
1. Ball socket remover

008034

Allow the throttle plates to return to the idle position.

All Models

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



1. TPS Calibration button

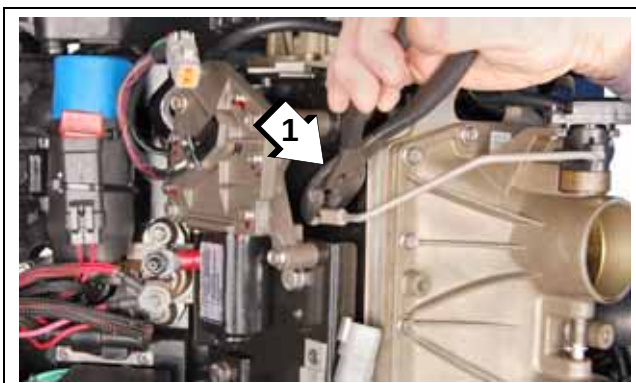
008571

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.

Models with ICON Electronic Shift and Throttle

Use Ball Socket Installer, P/N 342225, to install throttle link onto actuator arm.



1. Ball socket installer

007303

Return the *ICON* remote control to the NEUTRAL position. The throttle actuator should move the throttle plates to the idle position.

Electric Starter Servicing

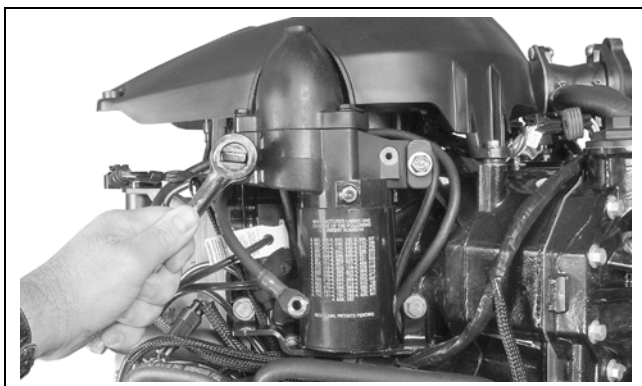
Starter Removal

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 the starter positive (+) cable from post on starter.

Remove the four frame and bracket mounting screws. Lift and remove the starter.



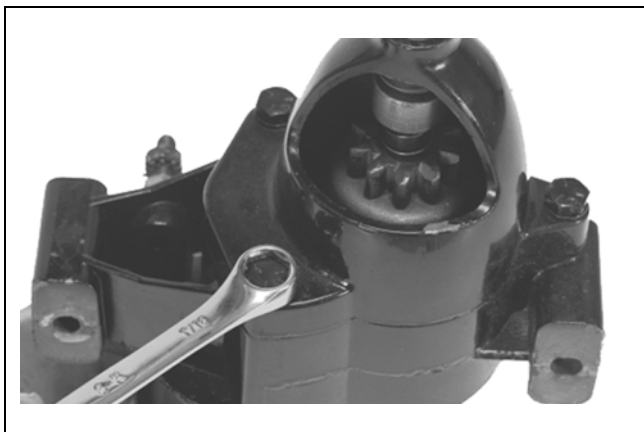
004181

Loosen the two nuts used to fasten the starter bracket. Remove the nuts and bracket.



30374

Remove the screws, lock washers, and pinion housing.



30373

Starter Disassembly

Lift and remove the wave washer and bushing.



30372

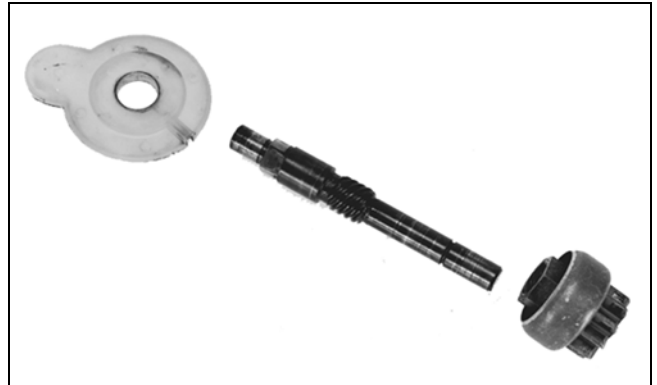
Place an appropriate-sized deep socket on the spacer.

Hit the socket with a mallet to lower the spacer and expose the retaining ring under the spacer.



30371

Remove pinion and plastic weather cover from pinion shaft.



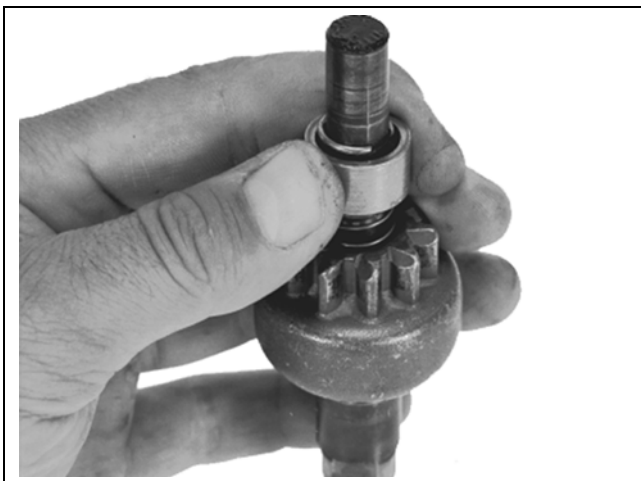
30368

Remove the driven gear and thrust washer.



30367

6

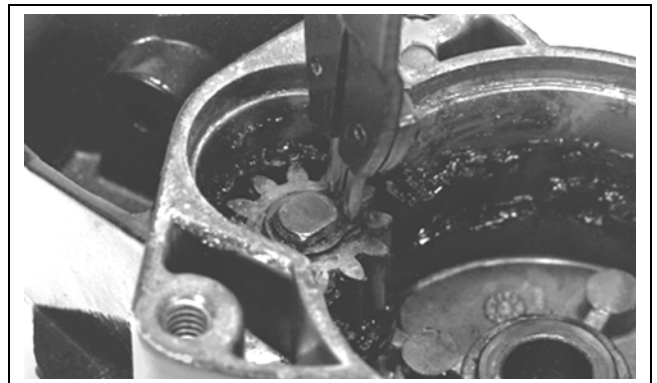


30360

Remove the retaining ring, spacer, and spring from pinion shaft.



30369



30366

Electrical and Ignition

Electric Starter Servicing

Remove the two thru-bolts. Mark the end cap orientation, and remove the cap.



30365

Gently tap the starter frame with a rubber mallet to loosen it.

Find the insulator cap (end of the shaft or inside the end cap). Inspect and replace, if necessary.



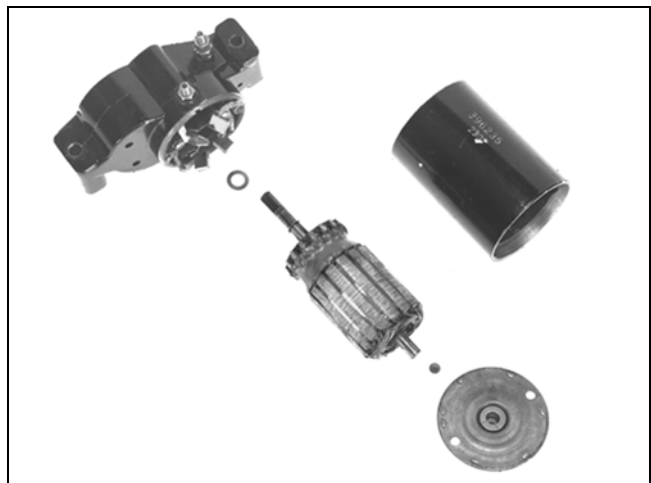
30354B

Note the alignment marks by the positive terminal stud. Hold the armature in place, and slide the frame away from the gear housing.



30352

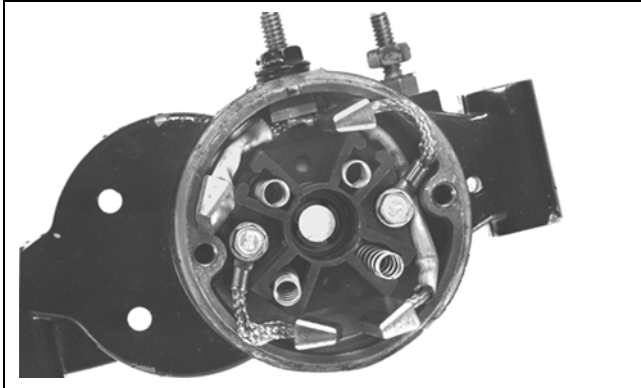
Slowly remove the armature and thrust washer. Do not lose the brush springs.



30351

Starter Cleaning and Inspection

Inspect the brushes for wear and damage. Replace brushes if damaged or worn. Replace weak brush springs.



30349

Inspect and replace locating ring on armature shaft, if necessary.

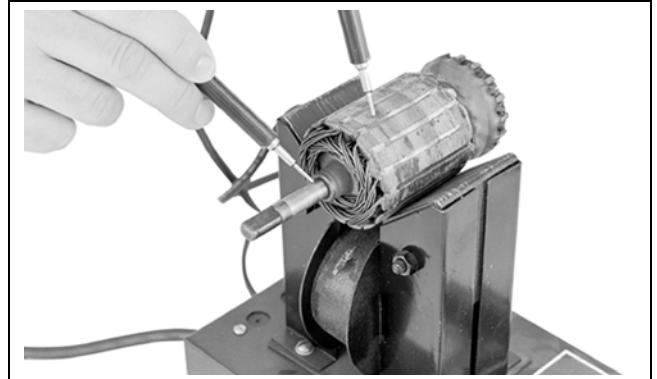


30345

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 the 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.



TYPICAL

24058

Check permanent magnets. 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. 105.



TYPICAL

24057

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.

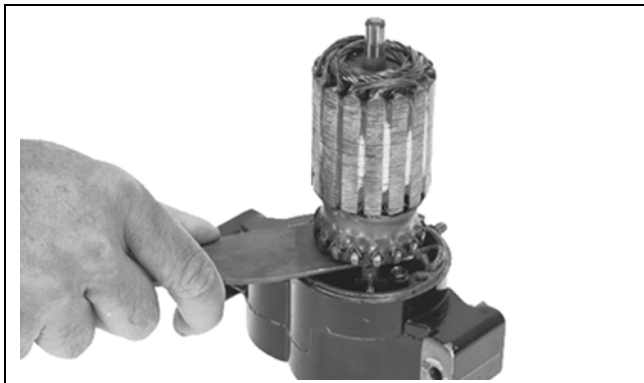
Inspect and replace end cap thrust washer if distorted or worn excessively.

Inspect and replace armature shaft snap ring if worn or distorted.

Starter Assembly

IMPORTANT: If removed, apply *Locquic Primer* and *Screw Lock* to the brush card screws before installing.

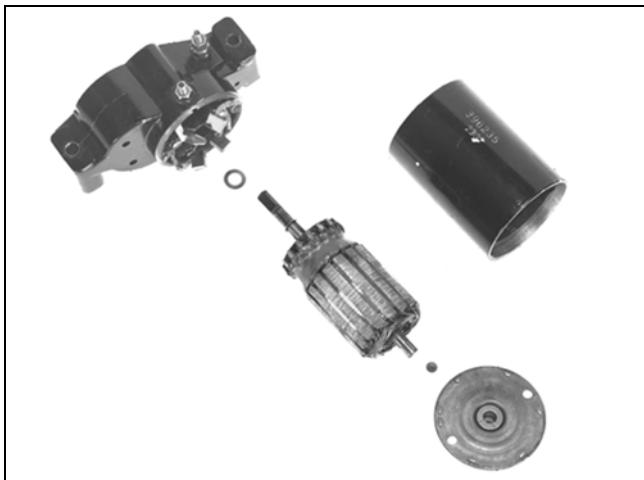
Route the brush leads and install the springs and brushes. Compress the spring with a modified putty knife.



30364

IMPORTANT: Incorrect orientation of the brushes could damage the starter or cause reverse rotation.

Apply *Moly Lube* to the armature bushing. Install the thrust washer and armature.



30351

Align the starter frame and make sure the long alignment mark matches the mark next to the positive terminal stud on the gear housing.

Push the armature down firmly and slide the frame into place. Align the notches in the gear housing and frame.



30352

Install insulator cap on end of shaft.



30354B

Apply a light coat of *Moly Lube* to the end cap bearing, and install the end cap.

Install the two thru-bolts. Tighten to a torque of 50 to 65 in. lbs. (5.6 to 7.3 N·m).



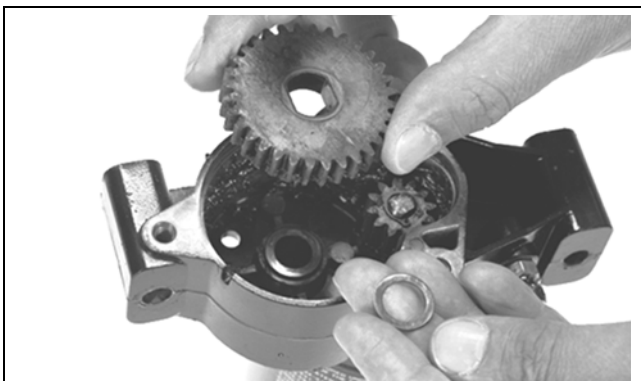
30363

Lightly coat the drive gear with *Triple-Guard* grease, and install it on the armature shaft. Install the retaining ring (flat side up) with No. 2 external retaining ring pliers.



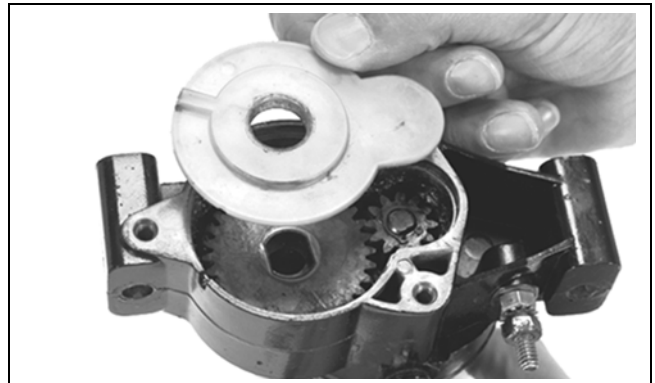
30366

Lightly coat the gear housing bearing with *Moly Lube*. Lightly coat the driven gear with *Triple-Guard* grease. Install the thrust washer and driven gear.



30362

Install the weather cover.



30361

If removed, install the spring and spacer (large diameter up) on the pinion shaft. Secure with retaining ring. Install bushing and wave washer (convex side down).



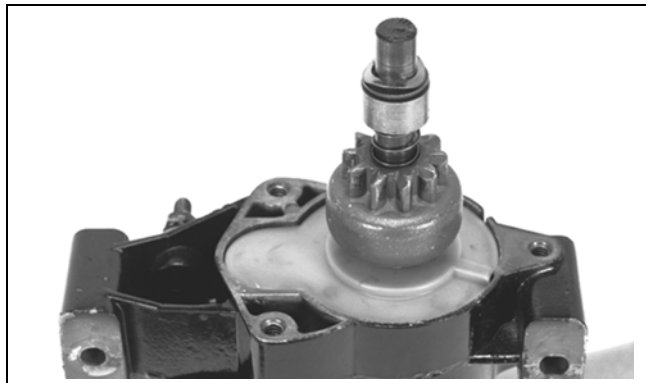
30369

Lightly coat the pinion shaft splines (helix) with *Starter Bendix Lube*. Lower the pinion into place

Electrical and Ignition

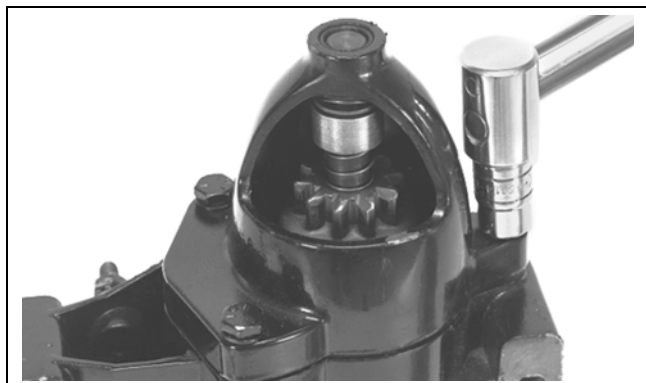
Electric Starter Servicing

without displacing the driven gear or thrust washer.



30359

Lightly coat the pinion housing bearing with *Starter Bendix Lube*, and install the pinion housing screws and lock washers. Tighten the screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



30358

Install the bracket. Apply *Nut Lock* to the thru-bolts. Install the nuts and tighten to a torque of 50 to 65 in. lbs. (5.6 to 7.3 N·m).



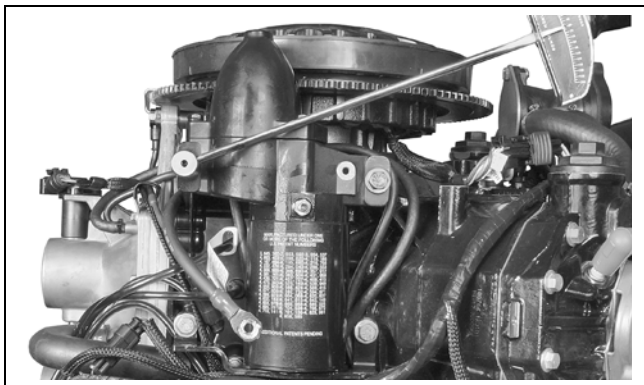
30357

To test the assembly and operation of the starter, refer to **No Load Current Draw Test** on p. 105.

Starter Installation

Apply *Locquic Primer* and *Nut Lock* to the threads of the four starter mounting screws. Position the starter and install the screws and lock washers.

First, tighten the top two screws, then the bottom two screws, to a torque of 168 to 192 in. lbs. (19.0 to 21.5 N·m).



004201

Attach starter positive (+) cable to post with lock washer and nut; tighten securely. Coat connections with *Black Neoprene Dip*.

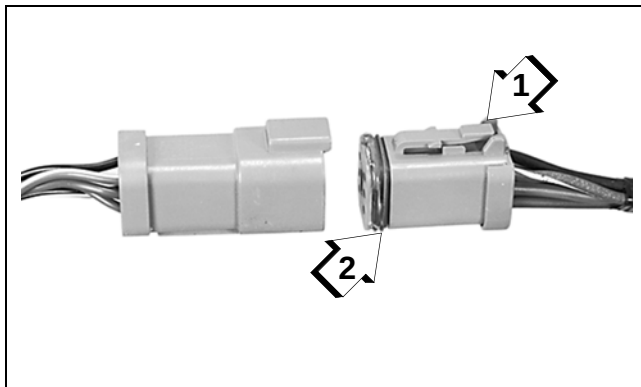
Connector Servicing

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 only. Push connectors together until latched.



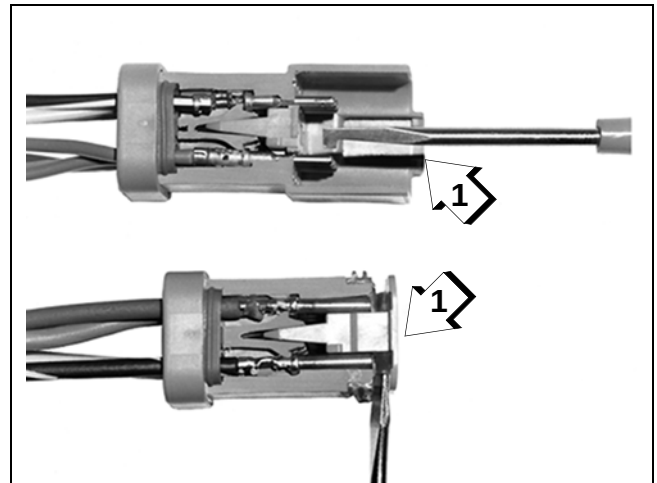
1. Latch
2. Seal

42079A

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.

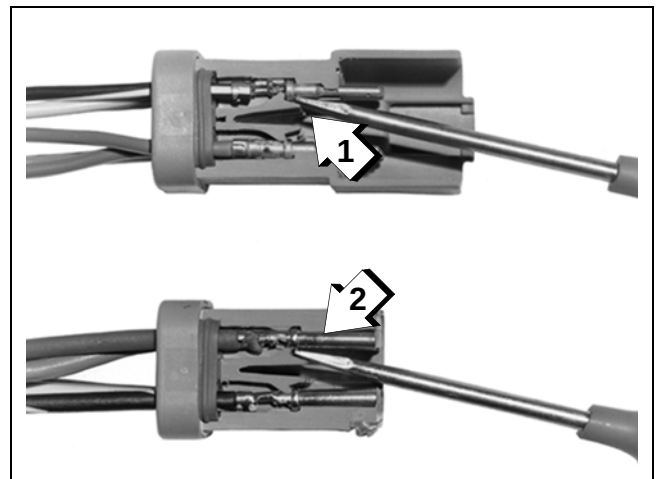
Use needle-nose pliers to remove wedge from 3-pin receptacle.



1. Wedge

42327

Release terminal latch and gently pull on wire.



1. Terminal latch (receptacle)
2. Terminal latch (plug)

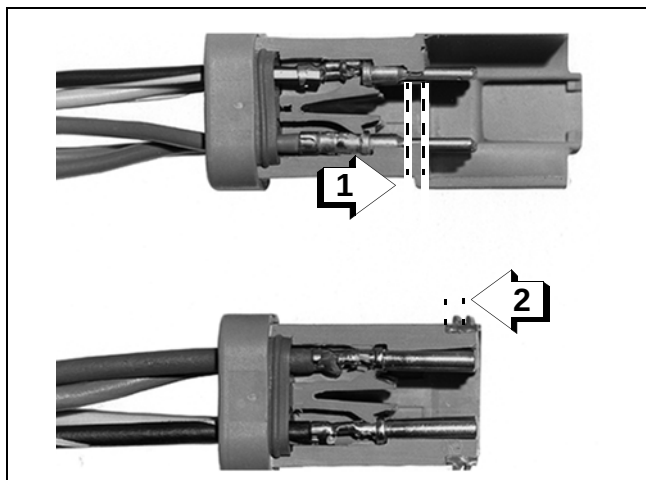
42329

Electrical and Ignition

Connector Servicing

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.



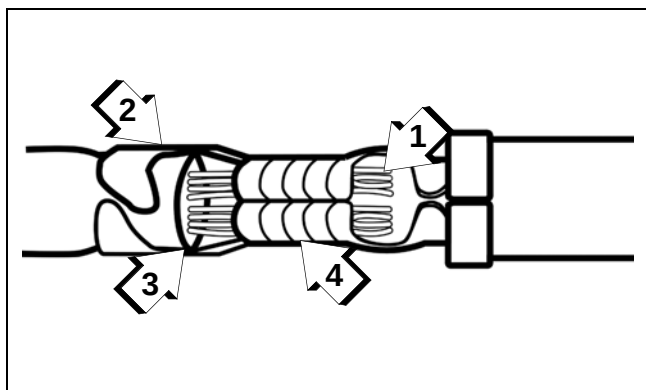
1. Ledge of plug
2. End of plug

42330

Push wedge in until latched. Wedge in 2-pin receptacle is not symmetrical; position latch shoulders next to terminals.

Crimping Terminals

Strip insulation back 3/16 in. (5 mm). Place terminal in 18-gauge notch of Crimping Pliers, P/N 322696. Position end of wire strands in terminal past wire crimp area, and position end of insulation past insulation crimp area. Capture all wire strands in crimp; leave no loose strands. Crimp wire securely. Do not solder. Crimp insulation in 14/16-gauge notch of crimping pliers.



1. End of wire strands
2. Insulation crimp area
3. End of insulation
4. Wire crimp area

DRC6205

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.

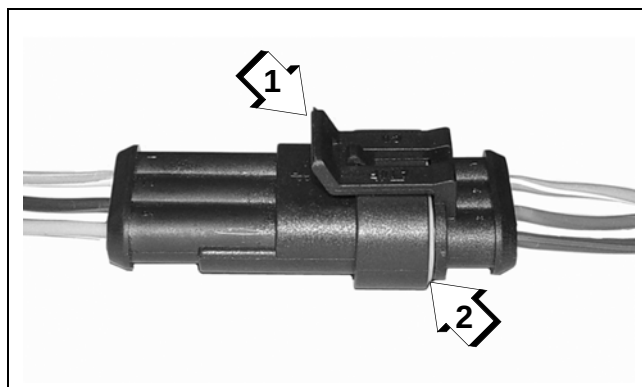
Superseal 1.5

Disconnect

Lift latch. Pull connectors apart.

Connect

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



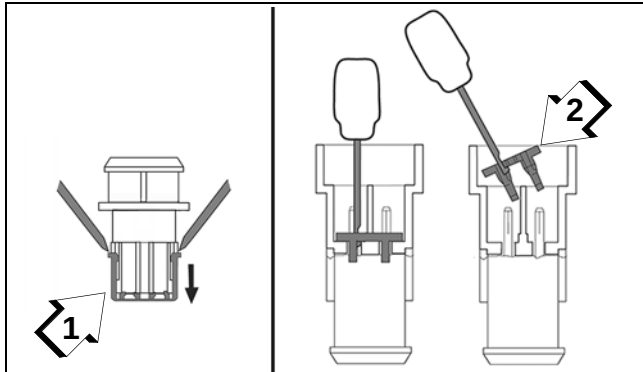
1. Latch
2. Seal

002448

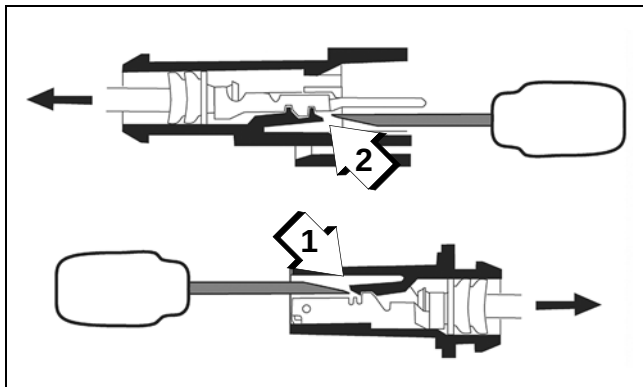
Terminal Removal

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

tab and pull on wire to remove from connector housing.



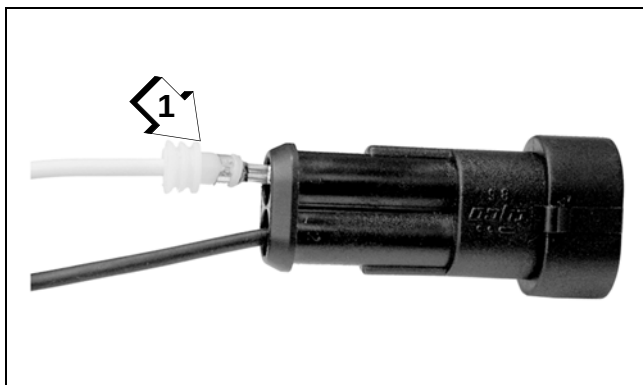
1. Anti backout device, plug 002449
2. Anti backout device, receptacle 002450



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

Terminal Installation

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

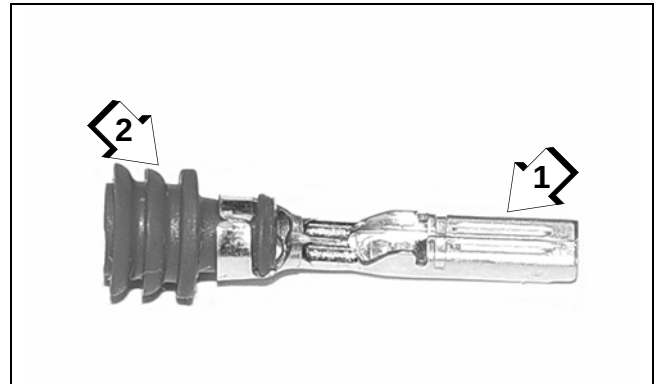


1. Terminal and seal 002451

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

Crimping Terminals

Crimping *Superseal 1.5* terminals requires *AMP Crimp Tool* with dies, P/N 777281.



1. Terminal 002452
2. Seal

Super Seal

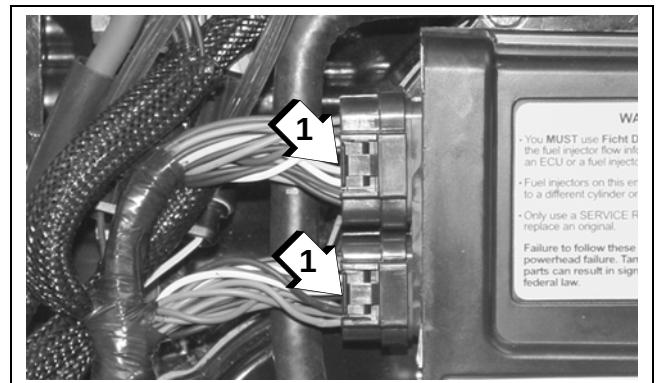
The J1-A and J1-B connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOTH latches and pull connector from plug.

Connect

Push connector into plug until latches engage.



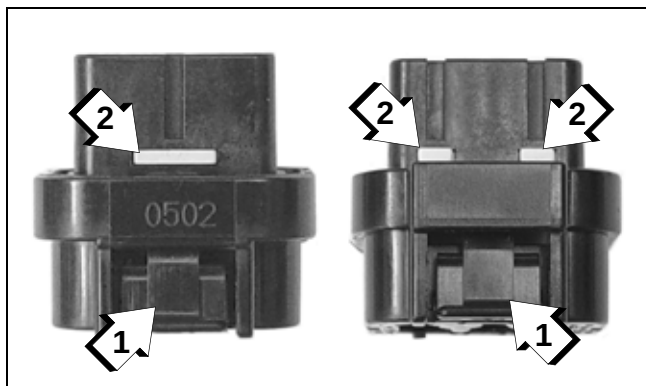
1. Latch 002118

Electrical and Ignition

Connector Servicing

Terminal Removal

Open lock mechanism and remove terminal from connector housing.

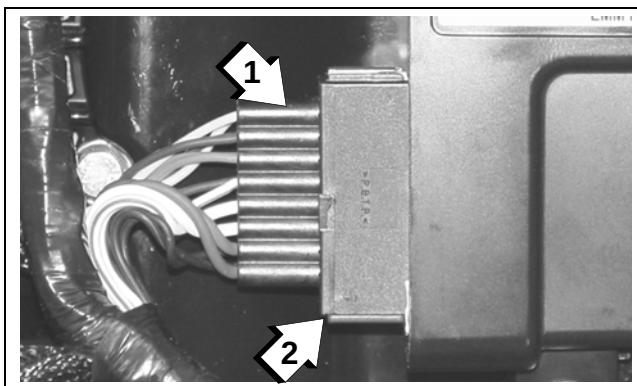


1. Latch
2. Lock mechanism

002453

Connect

Push connector until seated in plug. Close latch completely.

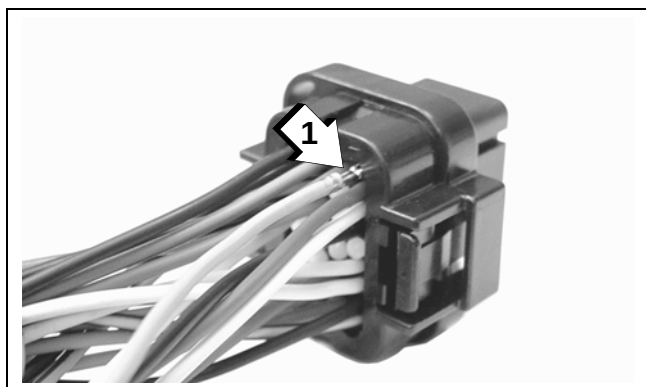


1. J2 connector
2. Latch (closed)

002120

Terminal Installation

Push terminal through seal until it is seated in connector housing. Close lock mechanism.

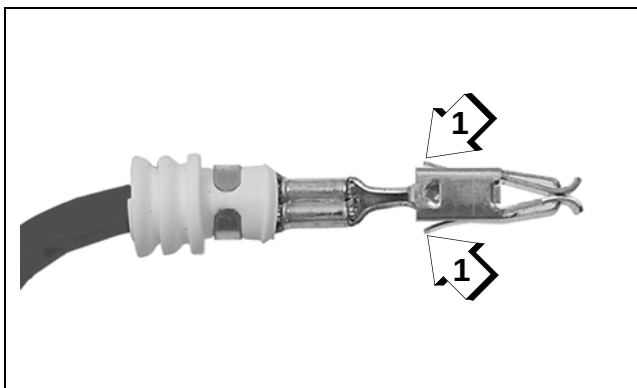


1. Terminal

002454

Terminal Removal

Use Terminal Release Tool, P/N 351413, to release BOTH locking mechanisms of connector. Pull terminal from housing.



1. Locking mechanism(s)

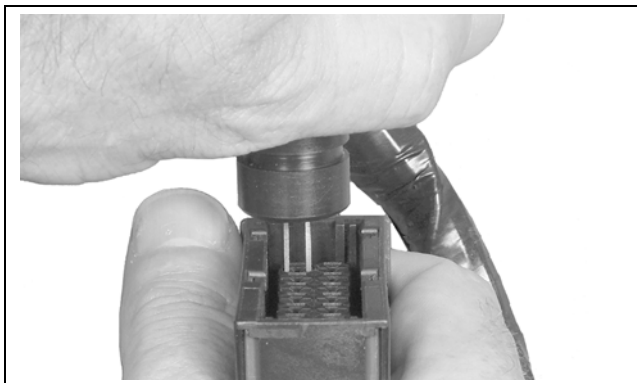
002455

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.

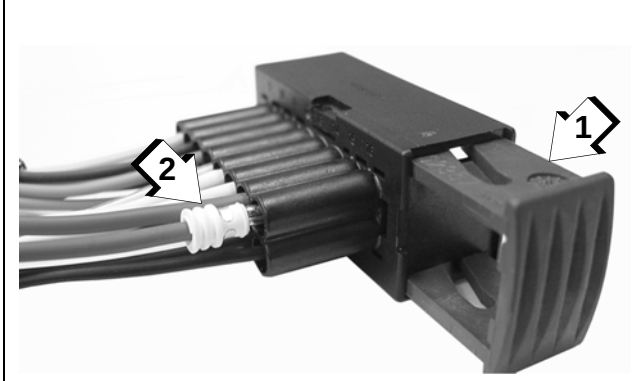


1. Terminal release tool

002313

Terminal Installation

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



1. Latch
2. Terminal with seal

Packard Connectors

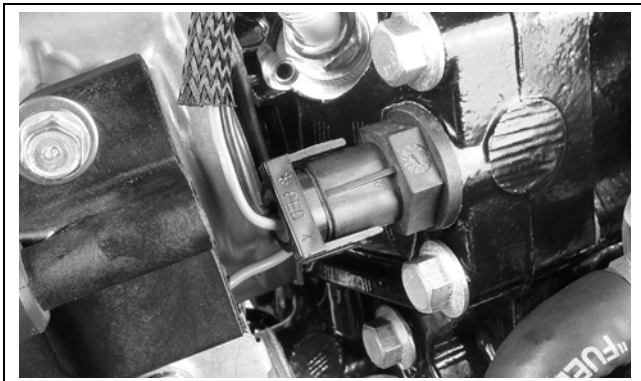
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

Disconnect

Lift latch(s). Remove connector.

Connect

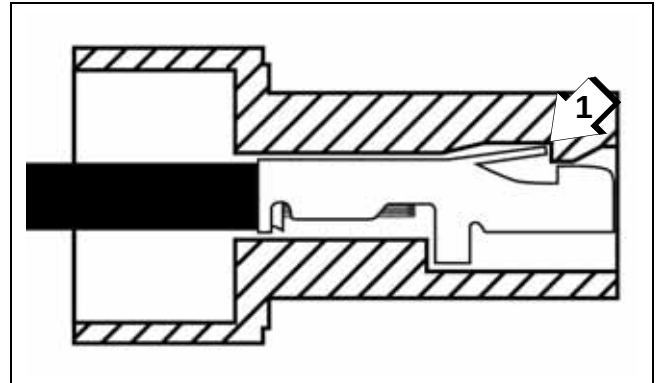
Confirm the seal is in place. Push connector onto housing until latched.



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 releasing the tab and then pushing the terminal and wire through connector housing.

Insert a thin tool into the connector above the terminal to release tab.



1. 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.

Technician's Notes

[illegible][illegible]

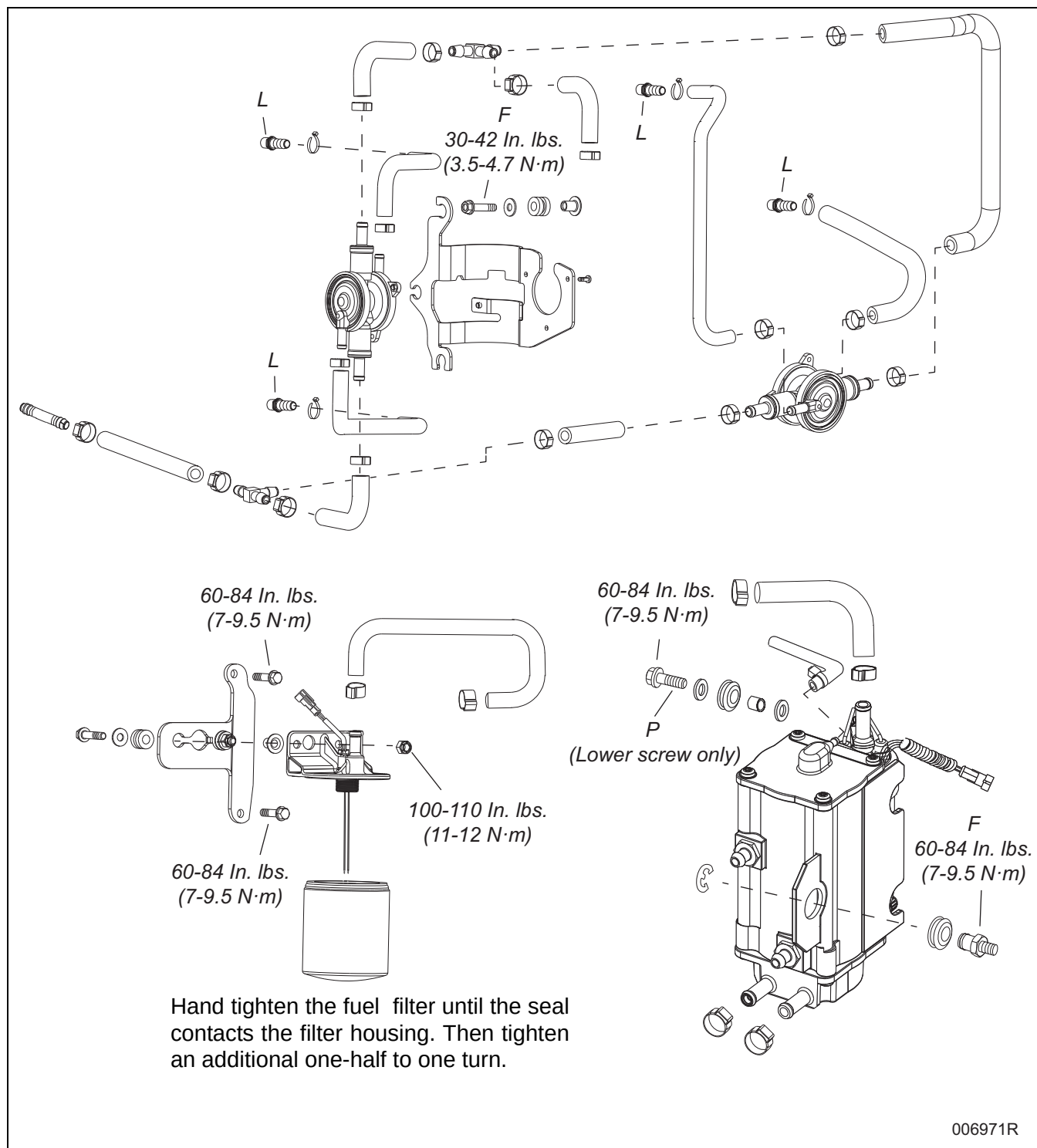
Fuel System

Table of Contents

Service Charts	132
Fuel System Hose Routing	135
Fuel System Circuit Diagram	136
Fuel System Requirements	137
Regulations and Guidelines	137
Portable Fuel Tanks	137
Fuel Flow Requirements	137
Fuel Requirements	138
Components	139
Fuel Lift Pump	139
Fuel Filter	139
Vapor Separator	139
Fuel Circulation Pump	140
Fuel Manifolds	140
Fuel Injectors	141
Fuel System Priming	142
Vent Line Clamp	142
Priming the Fuel System	142
Fuel System Tests	143
Fuel System Pressure Test	143
Pressure Regulator Test	143
Vapor Separator Vent Check	144
Fuel Injector Pressure Test	144
Fuel Injector Resistance Test	144
Circulation Pump Resistance Test	145
Lift Pump Pressure Test	145
Lift Pump Vacuum Test	146
Lift Pump Diaphragm Test	146
Anti-Siphon Valve Test	146
Fuel Component Servicing	147
Relieving Fuel System Pressure	147
Fuel Filter Service	147
Fuel Lift Pump Service	148
Vapor Separator Service	149
Fuel Manifold Service	149
Fuel Injector Service	151
Intake Manifold Service	154

Service Charts

Fuel Pump, Fuel Filter, Vapor Separator

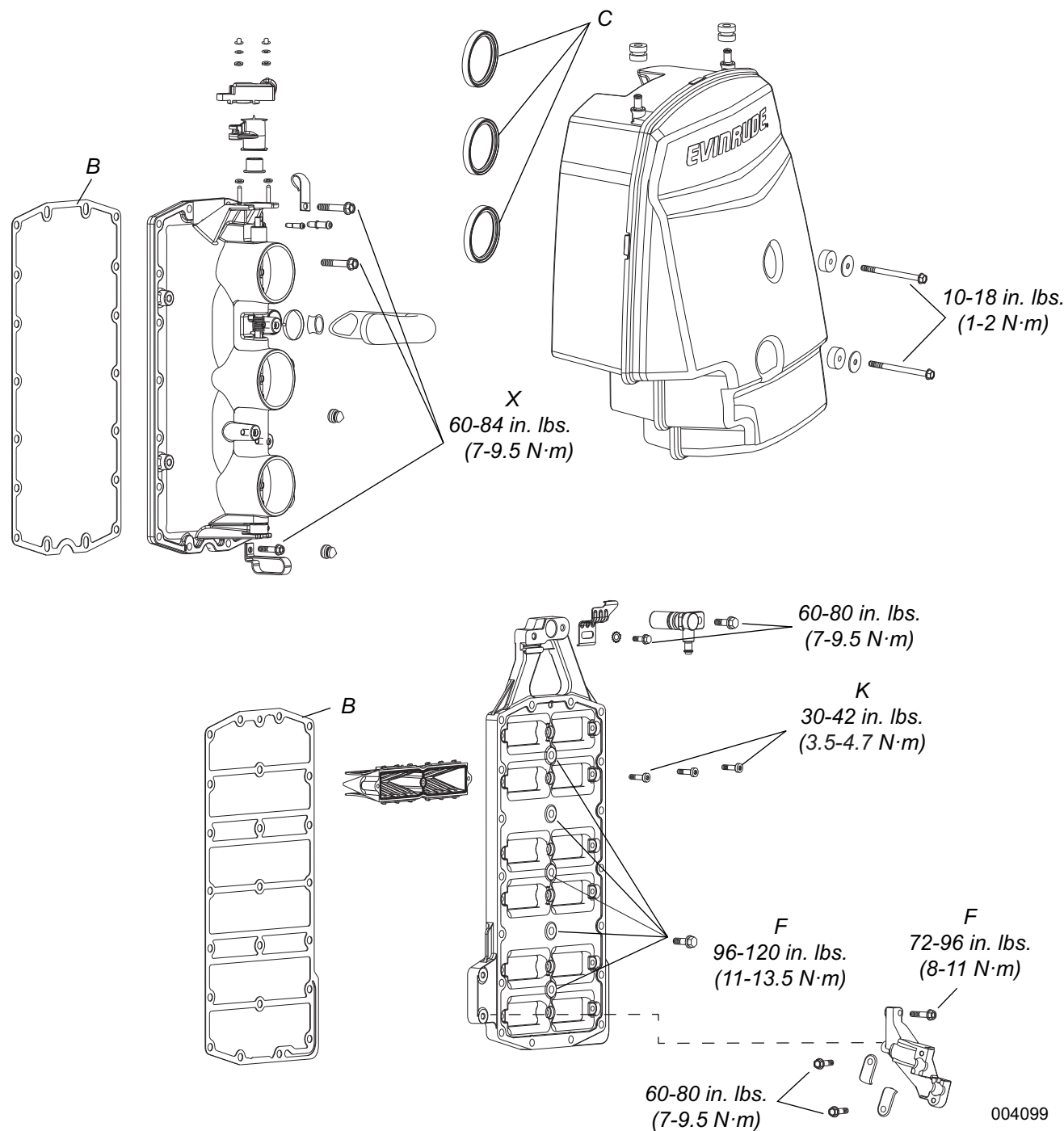


A Triple-Guard Grease	E Red Ultra Lock	L Pipe Thread Sealing Compound
B Gasket Sealing Compound	F Blue Nut Lock	X see Service Manual
C Adhesive 847	H Outboard Engine Lubricant	

Reed Plate Assembly and Throttle Body

IMPORTANT: Do NOT lubricate TPS
to throttle shaft surface.

Bond seals to air silencer

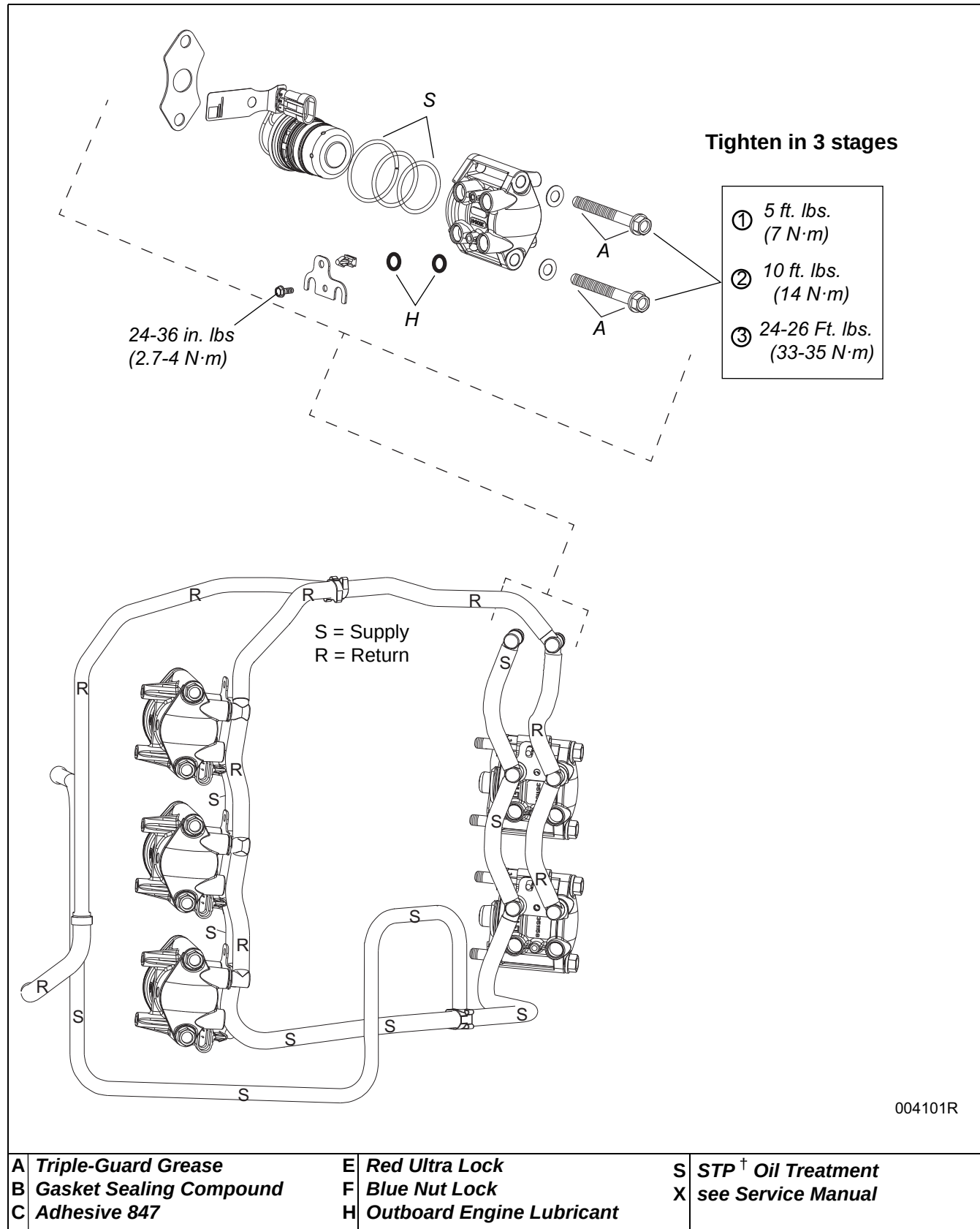


A Triple-Guard Grease
B Gasket Sealing Compound
Adhesive 847

D Moly Lube
E Red Ultra Lock
F Blue Nut Lock

G Needle Bearing Grease
K Purple Screw Lock
X see Service Manual

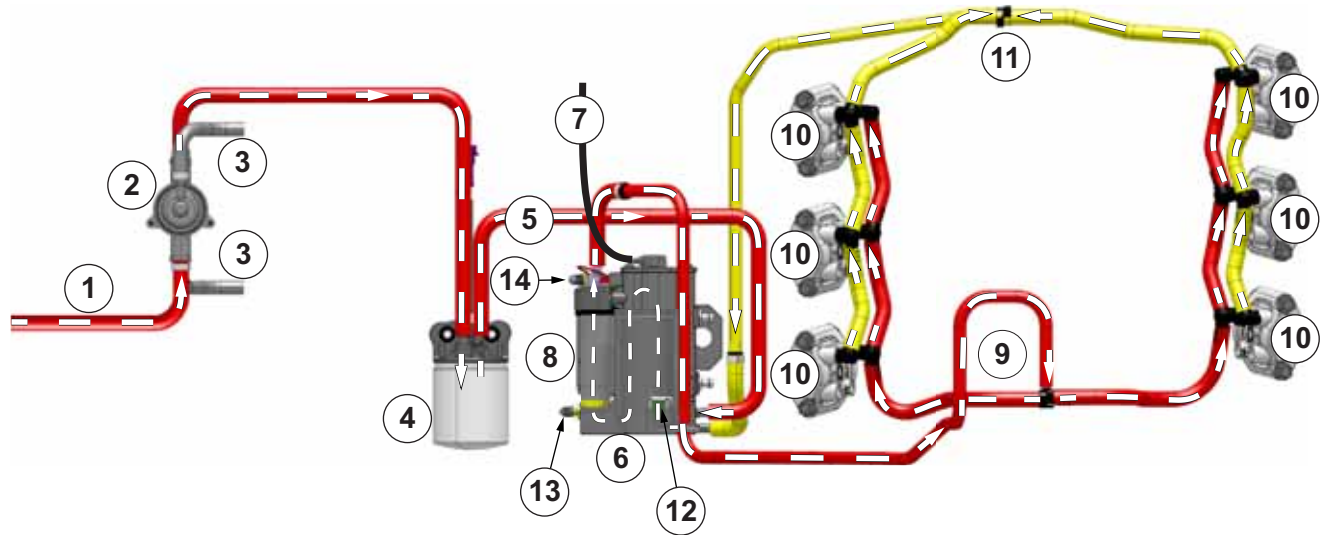
Fuel Manifolds and Injector



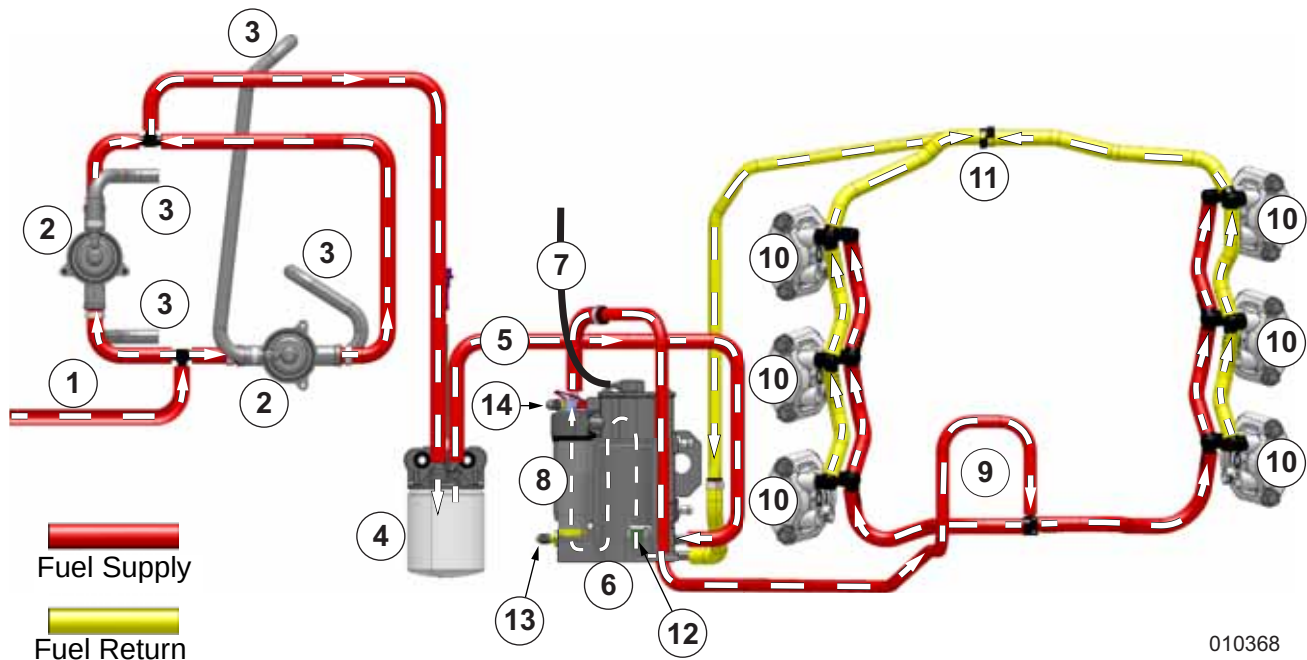
004101R

Fuel System Hose Routing

3.3 L Models



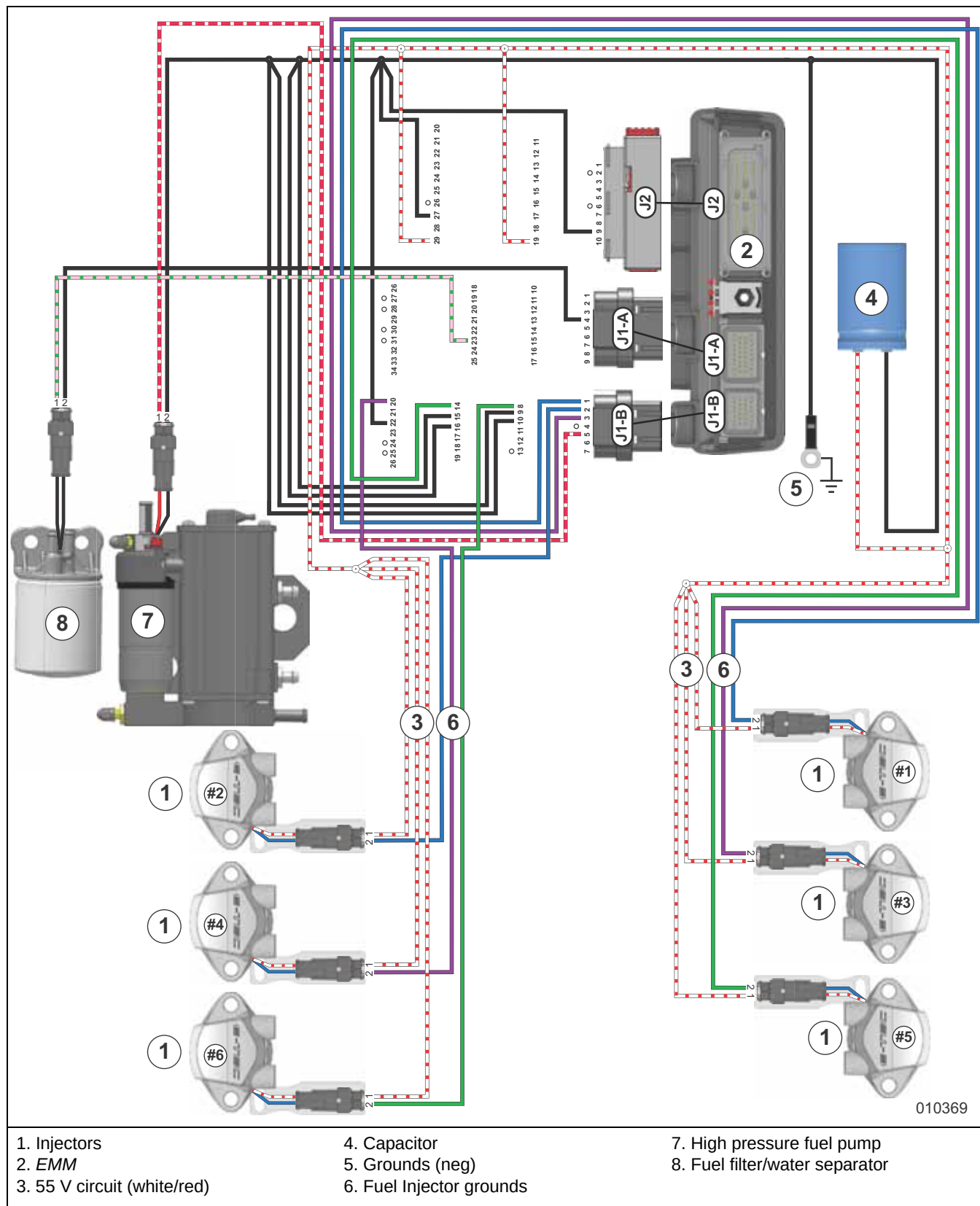
3.4 L Models



1. Fuel supply from boat fuel system
2. Fuel lift pump (2 to 8 psi)
3. Pulse hose(s) from cylinder/crankcase
4. Water separating fuel filter
5. Fuel supply to vapor separator
6. Vapor separator
7. Vent hose to throttle body

8. Electric fuel circulation pump (20 to 35 psi)
9. Fuel supply manifold
10. Fuel injector(s)
11. Fuel return manifold
12. Pressure regulator (high pressure)
13. Test fitting (low pressure)
14. Test fitting (high pressure)

Fuel System Circuit Diagram



Fuel System Requirements

Regulations and Guidelines

Vessel manufacturer, and/or installer of an EPA certified outboard, must meet minimum specifications for boat fuel systems established by:

- U.S. Environmental Protection Agency (EPA)
 - 40 CFR 1045.112
 - 40 CFR 1060
- U.S. Coast Guard (USCG)
 - 33 CFR 183
- American Boat & Yacht Council (ABYC)
 - Standard H-24
 - Standard H-25.

Portable Fuel Tanks

WARNING

If engine is equipped with a quick-disconnect fuel hose, you **MUST** disconnect the fuel hose from the engine and the fuel tank to prevent fuel leaks:

- Whenever the engine is **NOT** being used
- Whenever the engine is being trailered
- Whenever the engine is in storage.

NOTE: A small amount of fuel may be released when the fuel connector is disconnected.

Store portable fuel tanks in well-ventilated areas, away from heat sources and open flames. Close the vent screw of the fuel tank cap, if equipped, to prevent escape of fuel or fuel vapors which could accidentally ignite. Do not allow disconnected fuel hoses to leak fuel.

NOTICE

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.

Fuel Flow Requirements

	15 – 30 HP	40 – 90 HP	115 – 300 HP
Fuel tank pickup tube	1/4 in. (6.4 mm) min. ID	5/16 in. (7.9 mm) min. ID	3/8 in. (9.5 mm) min. ID
Fuel fittings	5/32 in. (4.1 mm) min. ID	1/4 in. (6.4 mm) min. ID	9/32 in. (7.1 mm) min. ID
Fuel supply hoses	1/4 in. (6.4 mm) min. ID	3/8 in. (9.5 mm) min. ID	3/8 in. (9.5 mm) min. ID
All Models			
Fuel tank pickup screen	100 mesh, 304 grade stainless steel wire, 0.0045 in. wire diameter, 1 in. (25 mm) long		
Antisiphon valve	2.5 in. (63.5 mm) Hg maximum pressure drop at 20 gph (76 l/hr) flow		
Remote fuel filter	0.4 in. Hg maximum pressure drop at 20 gph (76 l/hr) flow, 150 in. ² (1290 cm ²) of filter area		
Maximum fuel pump lift height	Fuel pump should not be located more than 30 in. (76.2 cm) above bottom of fuel tank		

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.

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

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 optimal operating condition.

Components

The fuel system includes the following components:

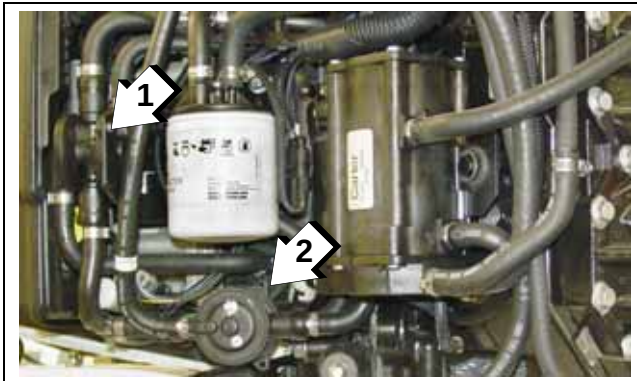
- Fuel Lift Pump
- Fuel Filter
- Vapor Separator
- Fuel Circulation Pump
- Fuel Supply Manifolds
- Fuel Injectors
- Fuel Return Manifolds

Fuel Lift Pump

The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by two pulse hoses that connect to the cylinder/crankcase assembly.

Fuel lift pump pulse hose locations:

- **Front mounted pump:** cylinders 3 and 6
- **Side mounted pump:** cylinders 2 and 5



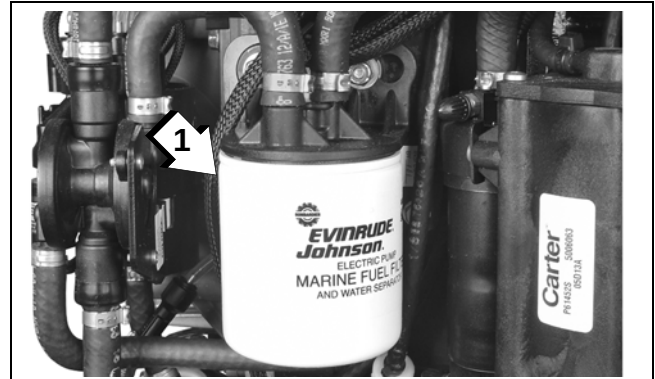
1. Front mounted pump
2. Side mounted pump

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. 18 for service frequency.



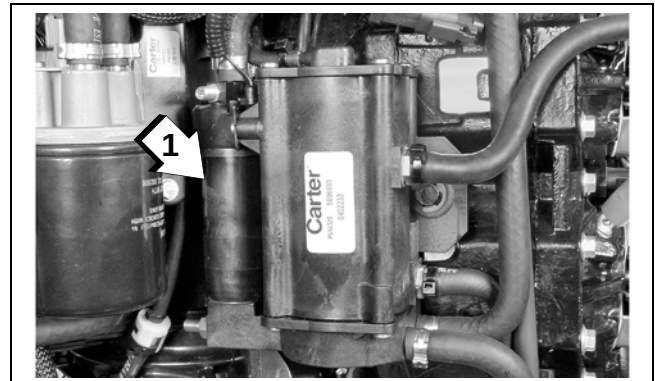
1. Filter

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.



Vapor Separator Assembly
1. 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

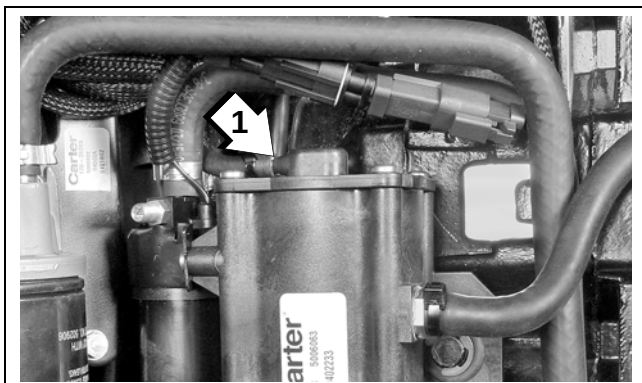
Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the

Fuel System Components

separator self-drains when the outboard is stored vertically. Refer to **Hose Routing and Water Flow Diagram 3.3 L** on p. 190.

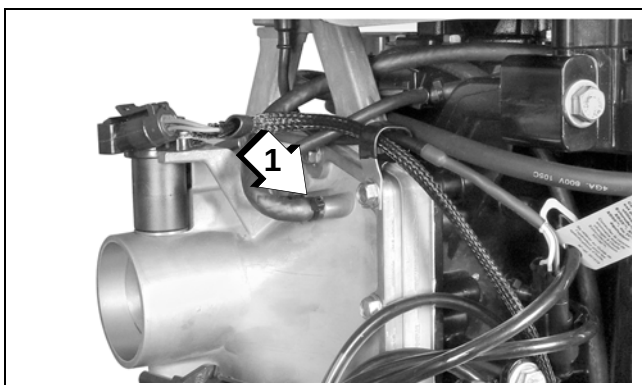
Venting

The fuel vapor vent regulates fuel vapor pressure in the reservoir.



1. Vent

004187



1. Vent hose connection to intake

004188

The vapor separator vent is opened and closed by a float valve. The float valve moves relative to the fuel level in the fuel chamber. Hot fuel causes an increase in vapor pressure. This results in a lower fuel level in the vapor separator. The float valve drops and the vent opens. This allows fuel vapor to flow to the intake manifold through the vent hose.

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.

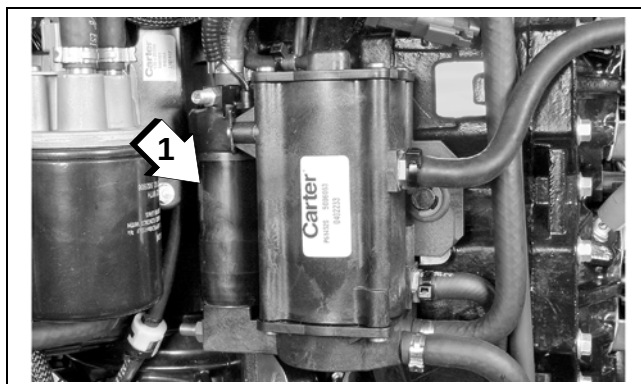
Pressure Regulator

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.



Vapor Separator Assembly

1. Circulation pump

004186

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 12 V circuit. The circulation pump is activated momentarily when the *EMM* powers up. The *EMM* controls pump operation by rapidly connecting and disconnecting the pump's internal coil to ground.

Fuel Manifolds

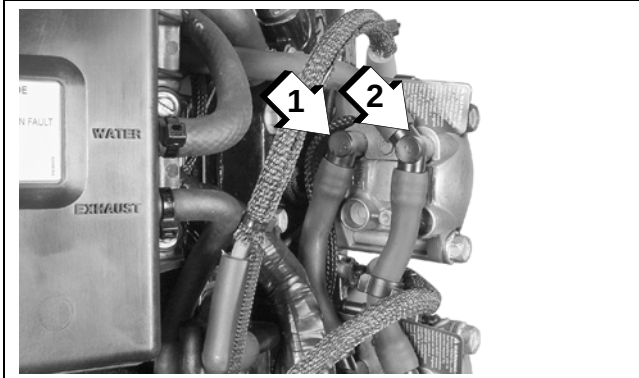
The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

Fuel Supply Manifold

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

Fuel Return Manifold

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



1. Inlet ports
2. Return ports

004246

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

NOTICE

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.

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.

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.

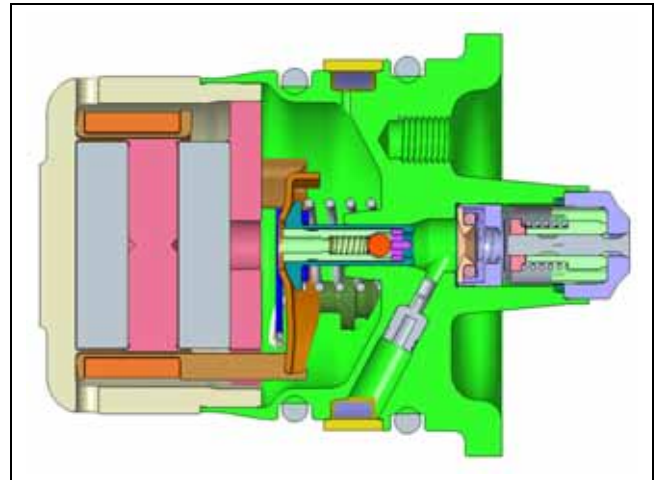
Each service injector includes its fuel flow information on a 3.5 in. floppy disk. This software allows the *EMM* to be reprogrammed for this injector's unique fuel flow characteristics.

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.

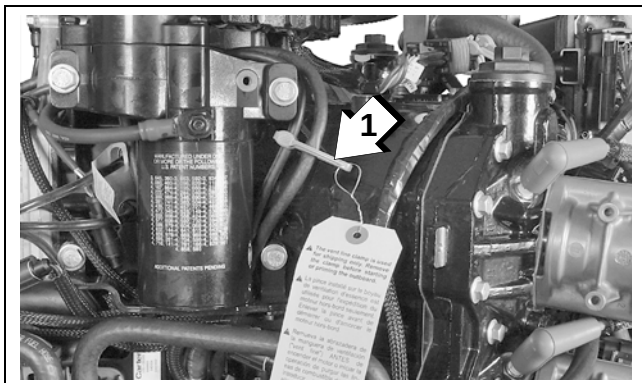


006619

Fuel System Priming

Vent Line Clamp

Federal Regulations require that all outboards with 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.



1. Clamp

004223

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

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

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

Priming the Fuel System

⚠ 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.

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 vapor separator.

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.

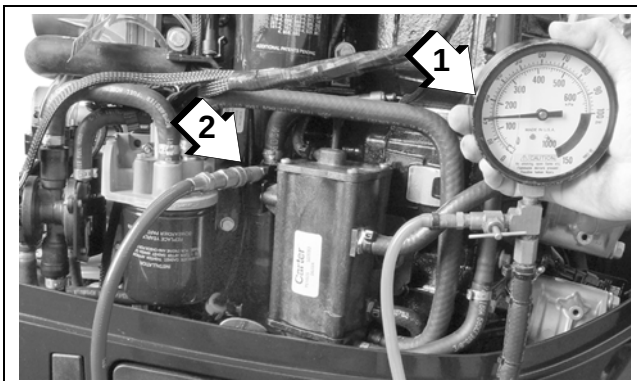
Fuel System Pressure Test

⚠ WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.

Relieve fuel system pressure. See **Relieving Fuel System Pressure** on p. 147.

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.



1. Fuel pressure gauge
2. Test fitting

004324

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. 145.

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. 146. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted fuel filter/water separator assembly.
- Lift pump not supplying adequate fuel to vapor separator. Refer to **Lift Pump Pressure Test** on p. 145.
- 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. 147.

Pressure Regulator Test

Refer to **Vapor Separator Service** on p. 149 to remove vapor separator.

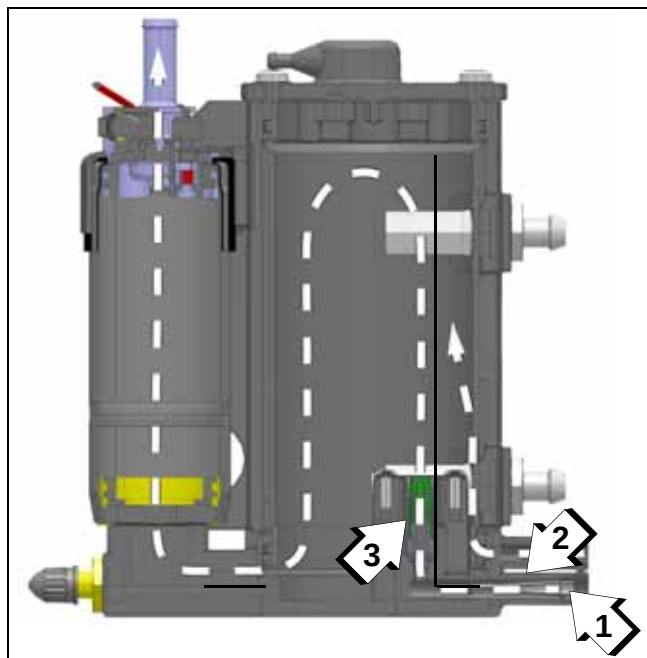
Make sure filter is not clogged. Clean or replace as needed.

Fuel System

Fuel System Tests

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).



1. Filter
2. Fuel return fitting
3. Pressure regulator

000249

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.

Fuel Injector Pressure Test

⚠ WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.

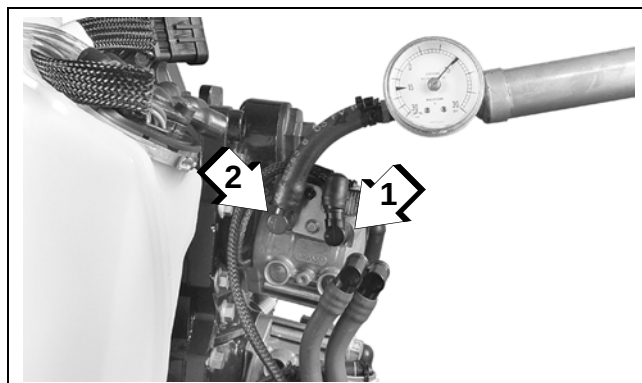
This test requires Injector Test Fitting kit, P/N 5005844.

Disconnect the battery cables at the battery.

Relieve fuel system pressure. See **Relieving Fuel System Pressure** on p. 147.

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.



1. Outlet fitting
2. Inlet fitting

002379

Refer to **Fuel Delivery Tests** on p. 82 for additional test procedures.

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)



006865

Use a digital multimeter with appropriate adapter leads to measure resistance of the complete injector circuit, including injector and associated wiring.

Measure resistance between pin 1 (white/red) of injector connector (connected) and the appropriate pin location of *EMM* J1-B connector (disconnected). Refer to engine wiring diagram for specific *EMM* J1-B connector pin location for the injector circuit being tested (blue, purple or green).



004342

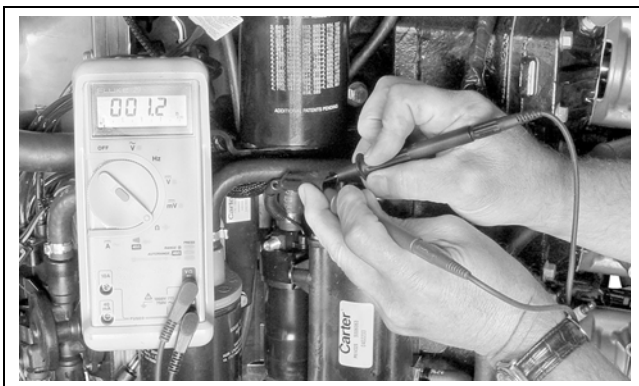
Resistance should be the same as, or slightly higher than, the injector alone.

Circulation Pump Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter with appropriate adapter leads to measure the fuel pump circuit and coil resistance.

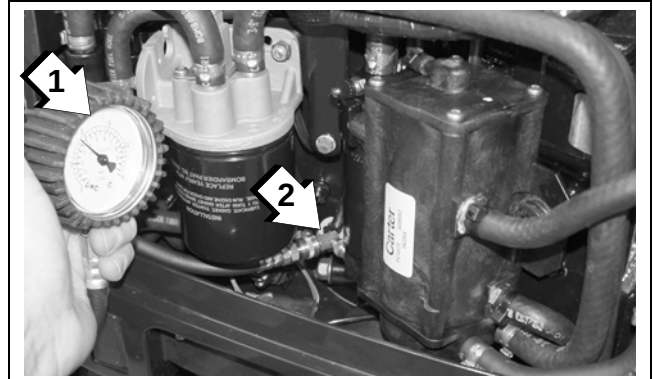
Fuel Pump Resistance
3 Ω @ 77°F (25°C)



004217

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.



1. Fuel pressure gauge
2. Test fitting

004587

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 and gauge must not indicate less than 4 psi (27 kPa).

Results:

Normal pressure

- Perform the **Lift Pump Vacuum Test** on p. 146. 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. 146. 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.

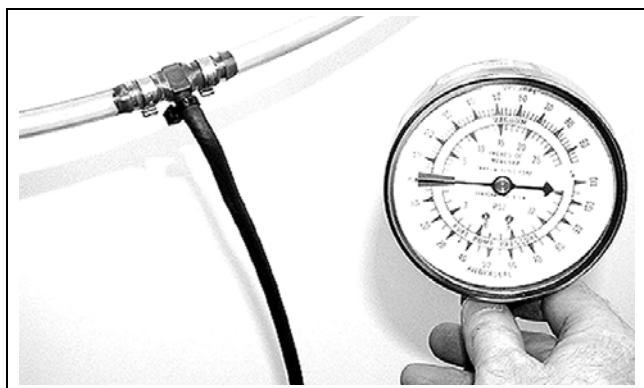
Lift Pump Vacuum Test

NOTICE

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.

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.



000243

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).

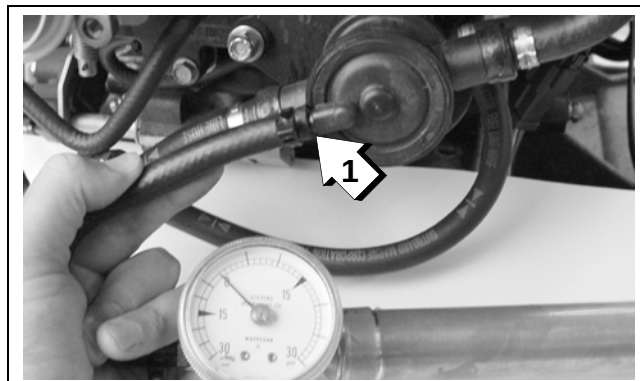
A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to **Fuel System Requirements** on p. 137 for fuel supply component requirements.

Lift Pump Diaphragm Test

Perform this test only if a damaged pump is suspected. This test does not check the performance of internal fuel pump check valves.

Remove both pulse hoses from the crankcase fittings.

Apply 15 psi (103 kPa) to each of the pulse hoses of the pump. Replace lift pump if either side of pump fails to hold pressure.

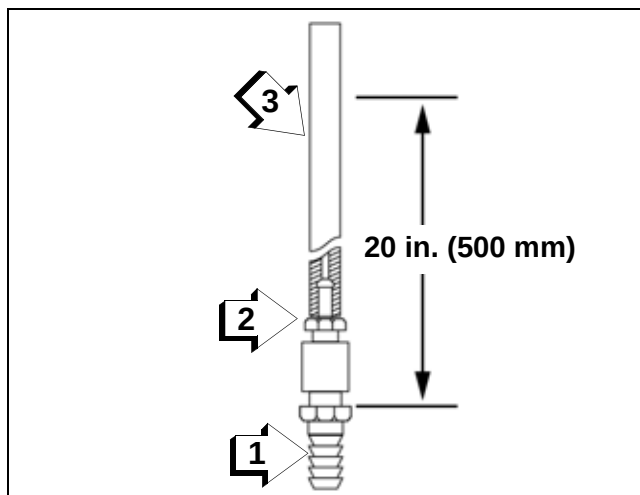


1. Pulse fitting

000670

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.



1. Anti-siphon valve
2. Adapter fitting
3. Clear hose

DR2277

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

Disconnect the battery cables at the battery.

Wrap a shop towel completely around the pressure test valve while connecting fitting from Fuel

Pressure Gauge, P/N 5007100, to top test fitting of fuel pump/vapor separator assembly.



1. Shop towel

004335

Insert venting hose of gauge into a suitable container.

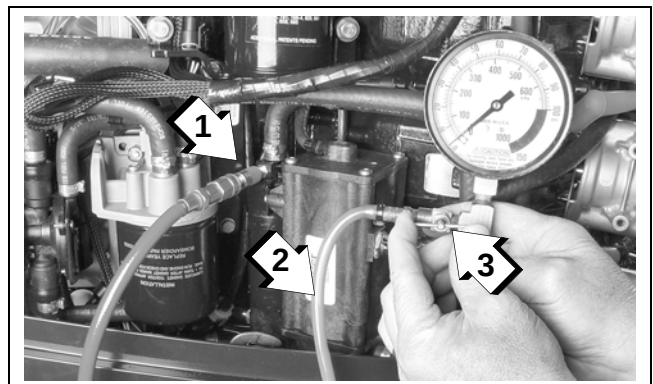
Slowly open gauge's venting valve.

Clean up any spilled fuel with shop towels.

ENVIRONMENTAL NOTE

Dispose of fuel contaminated towels in an environmentally responsible manner, or according to local regulations.

7



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

004334

Fuel Filter Service

Removal

Disconnect the battery cables at the battery.

Use an appropriate filter wrench to turn the filter in a counterclockwise direction. Remove the filter carefully to prevent spilling the filter's contents.

Fuel System

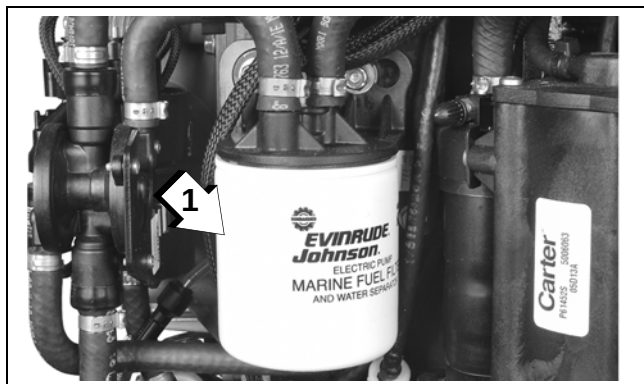
Fuel Component Servicing

Clean up any spilled fuel with shop towels.

ENVIRONMENTAL NOTE

Dispose of fuel contaminated towels in an environmentally responsible manner, or according to local regulations.

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.



1. Fuel filter

005022

Installation

Lubricate filter seal with outboard lubricant and position filter on threaded mounting tube of filter bracket. Take care not to damage water in fuel sensor probe. Turn filter clockwise onto the tube until seated against the bracket.

Tighten filter approximately 3/4 turn after the gasket contacts the bracket.

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. Refer to parts catalog for service parts.

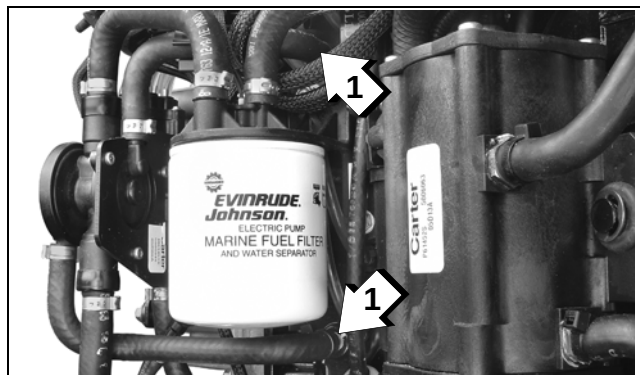
Removal

Disconnect the battery cables at the battery.

Disconnect the fuel supply hose from the in-line fitting.

Disconnect the fuel outlet hose from tee.

Disconnect the fuel lift pump pulse hoses at the crankcase fittings.

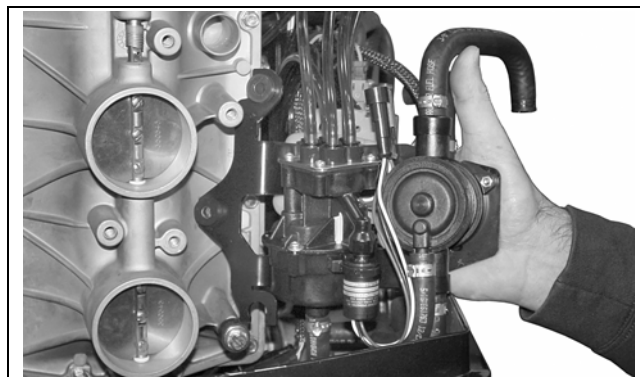


1. Pulse hose crankcase fitting

005028

Remove clamp screw, clamp, and oil injection pump from fuel pump bracket.

Loosen the fuel lift pump mounting screws. Remove the fuel lift pump and bracket as an assembly.



004333

Clean up any spilled fuel with shop towels.

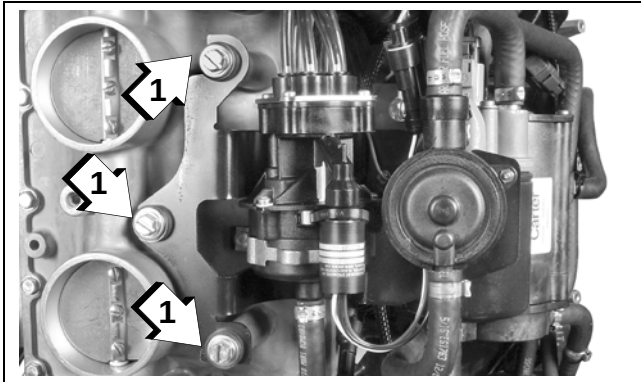
ENVIRONMENTAL NOTE

Dispose of fuel contaminated towels in an environmentally responsible manner, or according to local regulations.

Installation

Place fuel pump bracket, with rubber isolator mounts, in front of the throttle body.

Apply *Nut Lock* to screws and install screws into throttle body. Tighten screws to a torque of 24 to 36 in. lbs. (2.8 to 4.0 N·m).



1. Screws

004220

Connect the fuel lift pump pulse hoses to the crankcase. Secure with tie straps.

Connect the fuel outlet hose to the fuel filter. Secure with *Oetiker* clamp.

Connect the fuel supply hose to the in-line fitting. Secure with *Oetiker* clamp.

Squeeze primer bulb to prime fuel system. Hold pressure on bulb and check for fuel leaks.

Install oil injection pump on bracket with clamp and screw.

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. 147.

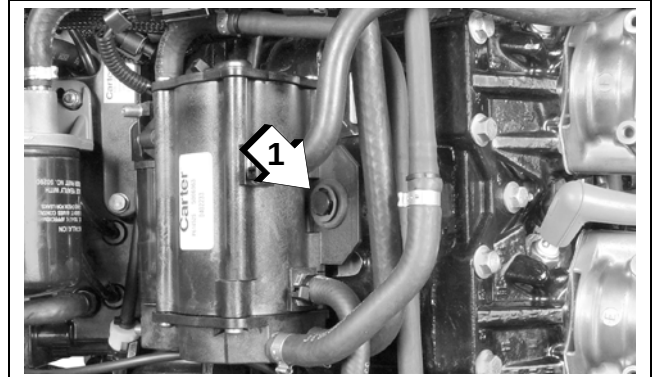
Disconnect circulation pump electrical connector.

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.



1. Retainer clip

004189

Remove vapor separator/fuel pump from the mounting stud and slide vapor separator housing from the grooves of the isolator mounts.

Installation

Slide the vapor separator bracket notches into grooves of the isolator mounts. Install forward isolator of vapor separator on mounting stud and secure with retainer clip.

Install all hoses and manifolds in original locations and secure with appropriate clamps. Squeeze primer bulb to prime fuel system. Hold pressure on bulb and observe for fuel leaks.

Connect battery cables.

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. 147.

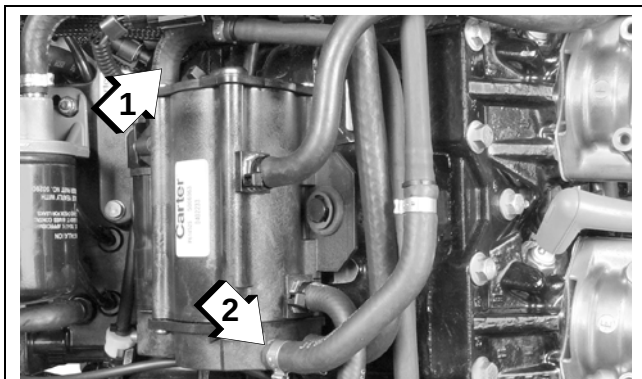
Remove clamps and disconnect the fuel manifolds as follows:

- Fuel supply manifold to circulation pump

Fuel System

Fuel Component Servicing

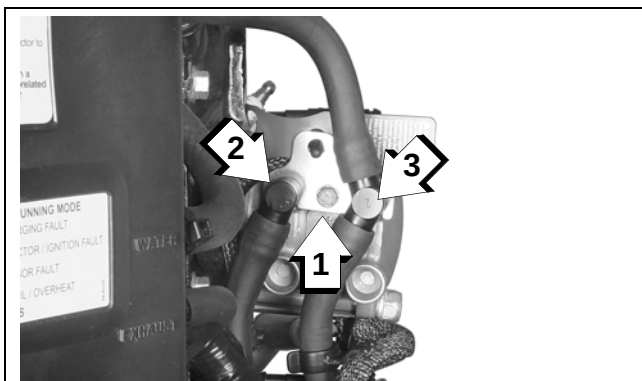
- Fuel return manifold to vapor separator



1. Fuel supply manifold
2. Fuel return manifold

004189

Remove fuel manifold retainer screws and remove retainers from fuel injectors.



1. Retainer screw
2. Fuel supply manifold fitting
3. Fuel return manifold fitting

004266

Disconnect fuel manifold fittings from fuel injector ports, then remove the manifold assemblies.

Clean up any spilled fuel with shop towels.

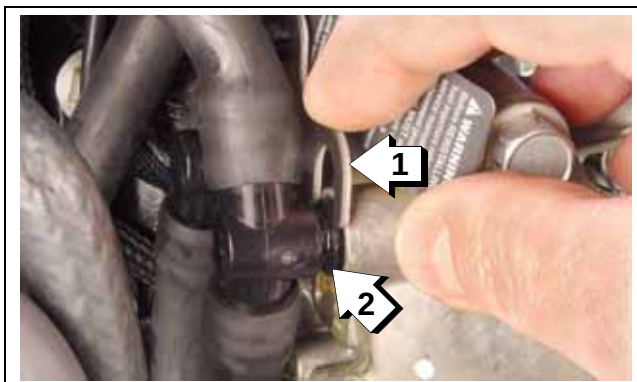
ENVIRONMENTAL NOTE

Dispose of fuel contaminated towels in an environmentally responsible manner, or according to local regulations.

Installation

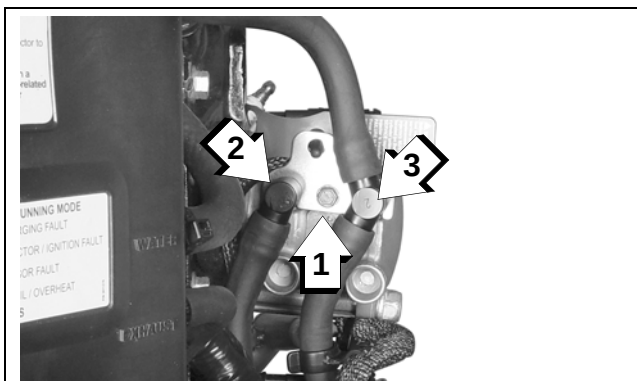
Check condition of sealing O-rings on fuel manifold fittings. Lubricate O-rings with outboard lubricant and insert fuel manifold fittings into injector. Both fittings must be fully seated into the injector fuel ports.

Install retainer in the outer groove of the manifold fittings. Install and tighten screw to a torque of 24 to 36 in. lbs. (2.7 to 4 N·m).



1. Retainer
2. Manifold fitting groove

005342



1. Retainer screw
2. Fuel supply manifold fitting
3. Fuel return manifold fitting

004266

Install the fuel manifolds to the fuel pump assembly and secure with clamps:

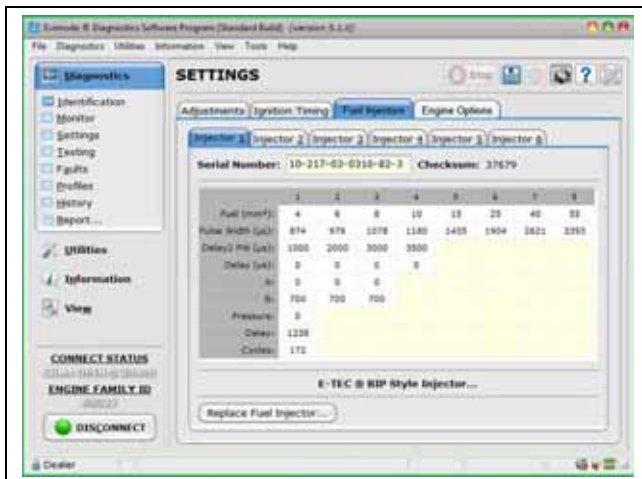
- Fuel supply manifold to circulation pump.
- Fuel return manifold to vapor separator.

Fuel Injector Service

NOTICE

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 for each cylinder.

Mark fuel injectors to show cylinder locations.



Injector Coefficients Screen

008568

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

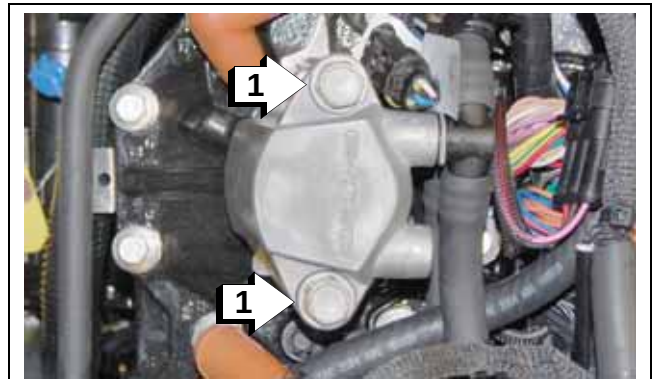
Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 147.

Remove fuel manifolds. Refer to **Fuel Manifold Service** on p. 149.

Disconnect the fuel injector electrical connector.

Remove injector screws.



1. Injector screws

008195

Remove fuel injector and insulator.

Clean up any spilled fuel with shop towels.

ENVIRONMENTAL NOTE

Dispose of fuel contaminated towels in an environmentally responsible manner, or according to local regulations.

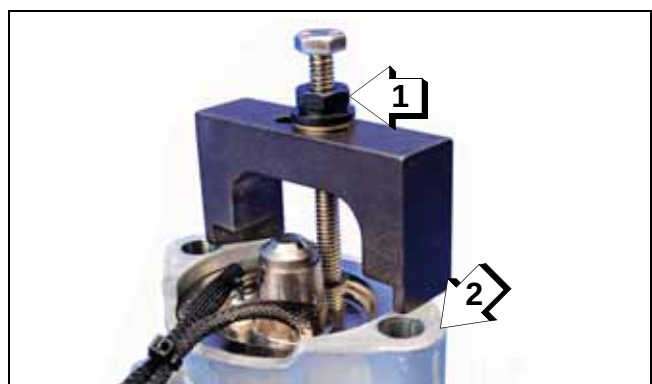
Crush Ring Replacement

NOTICE

Injector crush rings must be replaced if injector is installed in a different head or cylinder location.

Use Injector Puller Kit, P/N 356461, to remove injector from mounting cup.

Turn the nut of the fuel injector puller counter-clockwise several turns. Place the fuel injector puller on the fuel injector housing.



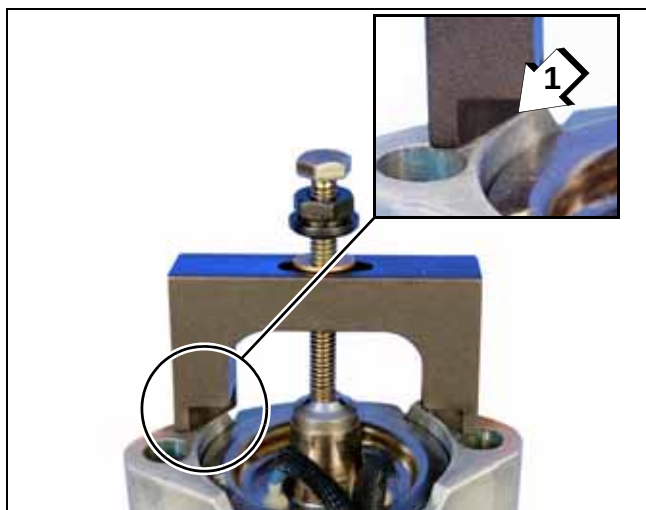
1. Puller nut
2. Fuel injector housing

008795

Fuel System

Fuel Component Servicing

Align the angled edges of both sides of the tool base with the edge of the fuel injector housing as shown.



1. Angled edge of the tool base

008796
008797

Thread the puller screw into the fuel injector 1/4-20 threaded hole until it seats.



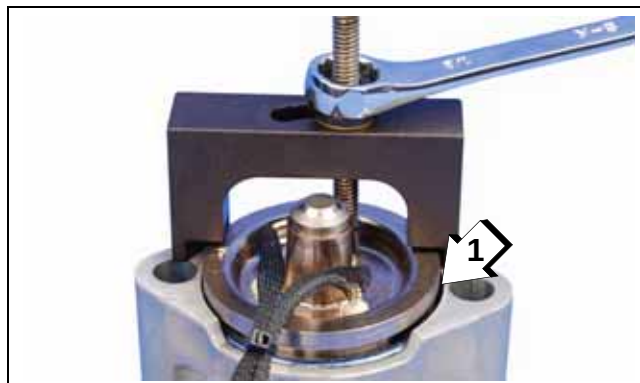
1. 1/4-20 threaded hole

008798

Turn puller nut clockwise until it contacts the puller base.

Use a 1/2 inch (13 mm) wrench to continue turning the puller nut clockwise.

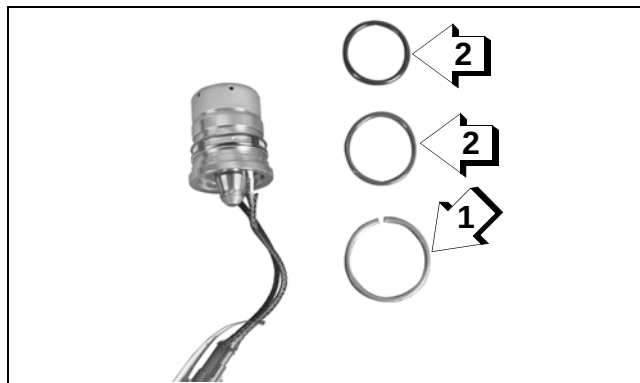
Turn the puller nut until the fuel injector is removed from the fuel injector housing.



1. Fuel injector removed from fuel injector housing

008799

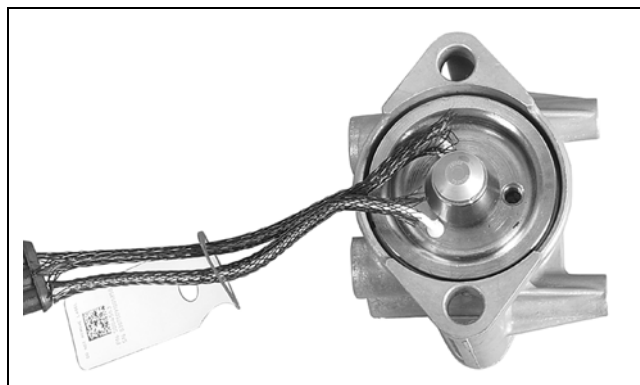
Remove fuel injector puller from injector. Remove crush ring and O-rings from injector. Inspect and clean injector filter. Install new crush ring and O-rings. Lubricate O-rings with *STP⁺ Oil Treatment*.



1. Crush ring
2. O-rings

002317

Install injector into mount housing. Press on injector face until injector seats in mount housing.



002318

Installation

NOTICE

All injectors must be installed in the correct cylinder by serial number. Improper injector installation can result in powerhead failure.

Installation of a replacement injector requires that coefficient data for the new injector is uploaded to the *EMM*.

Coefficient data for some replacement injectors is supplied on a computer disk shipped with the injector. If a disk is not included with the injector, coefficient data can be downloaded from the *Evinrude/Johnson* dealer website. Refer to the instructions provided with the injector kit.

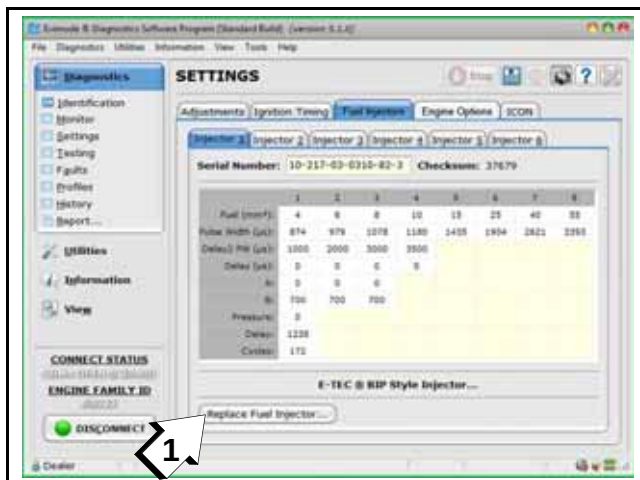
Upload Coefficient Files to *EMM*

Use the *Evinrude Diagnostics* software *Settings* screen to upload the coefficient file to the *EMM*.

Select the *Injectors* tab.

Select the cylinder tab for injector being replaced.

Select the *Replace Injector* button.



1. "Replace Injector" button

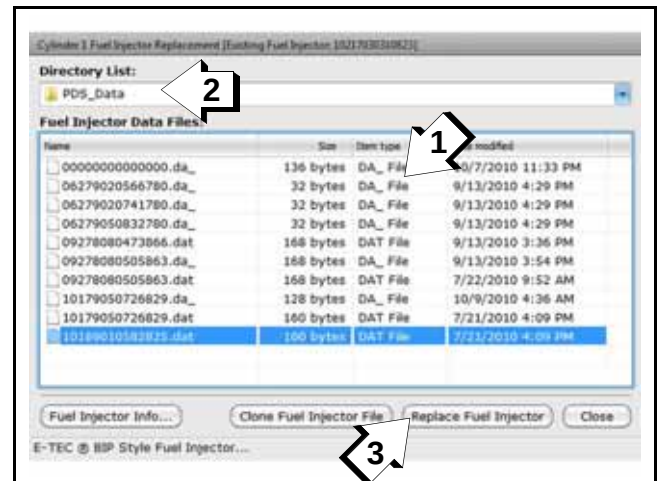
008568A

Use the drop down menu to navigate to the saved coefficient file location.

The coefficient file name must match the serial number of the injector.

Select the correct file for the injector.

Select the *Replace Injector* button.



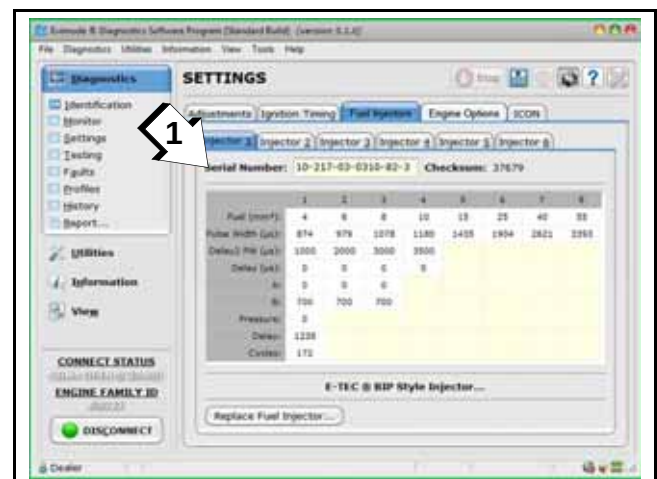
1. Navigation menu
2. Injector coefficient file
3. "Replace Injector" button

008573

After the upload is complete, the program will return to the *Cylinder* tab.

Make sure the serial number displayed on the screen matches the serial number printed on the serial number label of the replacement injector.

7



1. Serial number

008568A

Install Injector

CAUTION

All injector components must be clean to ensure correct torque tightening specifications. To prevent fuel leakage, carefully follow these installation instructions.

The following items and their mating surfaces must be cleaned before reassembly:

Fuel System

Fuel Component Servicing

- Injector
- Cylinder head
- Adapter
- Screws
- Threaded areas

Place injector and insulator in the proper cylinder location.

IMPORTANT: Be careful not to pinch any wiring or hoses during assembly.

IMPORTANT: FASTENER LUBRICATION:

- Do NOT lubricate black-colored screws. A solid film lubricant is applied at the factory.
- Lubricate all other 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.

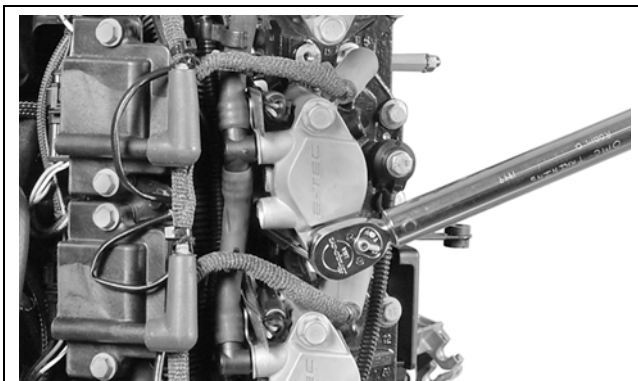


002316

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).



Tighten Screws in Stages

007210

Reconnect fuel injector electrical connectors.

Install fuel manifolds. Refer to **Fuel Manifold Service** on p. 149.

Intake Manifold Service

Removal

Disconnect vapor separator vent hose, throttle position sensor connector, and throttle link arm.

Use Ball Socket Remover Tool, P/N 342226, to remove throttle link arm.

Remove crankshaft position sensor from reed plate assembly.

Remove oil/fuel pump bracket.

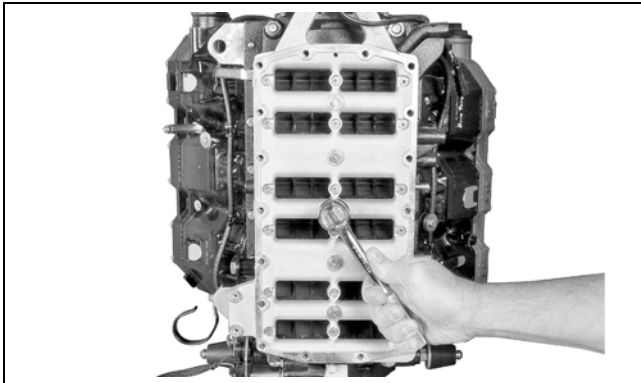
Remove throttle body screws and throttle body assembly.



004258

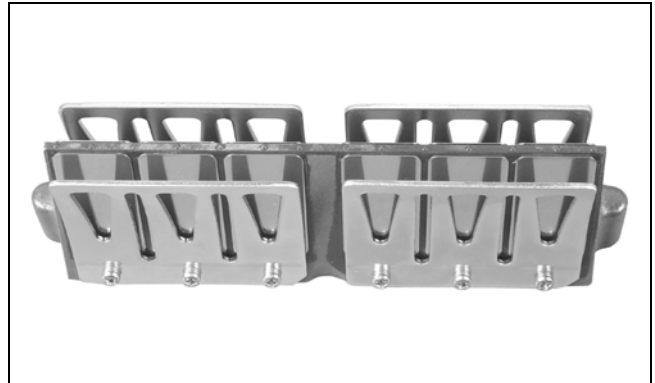
Remove gasket from throttle body.

Remove screws and reed plate assembly from the crankcase.



004190

Use caution to prevent damaging reed valve assemblies.

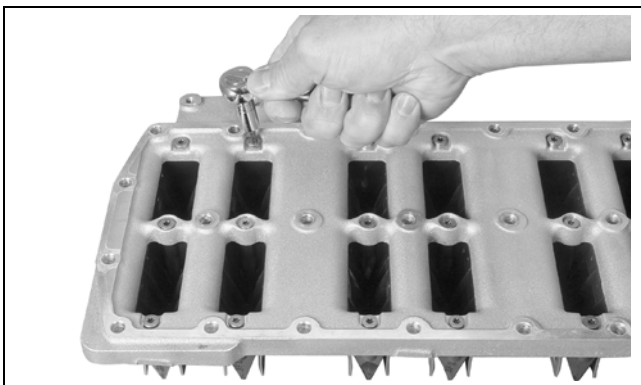


004192

Disassembly

All reed plate assembly and reed valve assemblies must be cleaned before 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.



004191

NOTICE

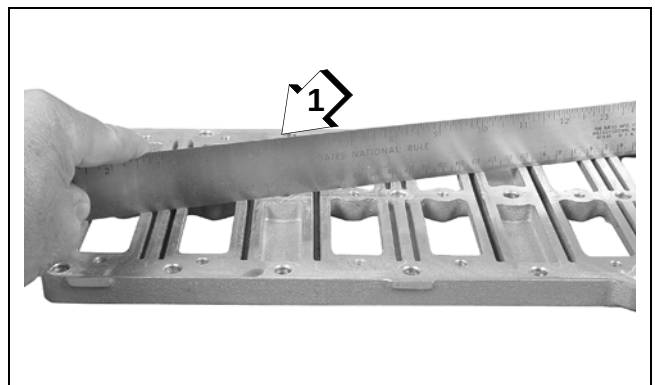
DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

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 and a feeler gauge to check flatness in all directions. Surface must be flat, ± 0.004 in. (0.10 mm).



1. Straight-edge

004193

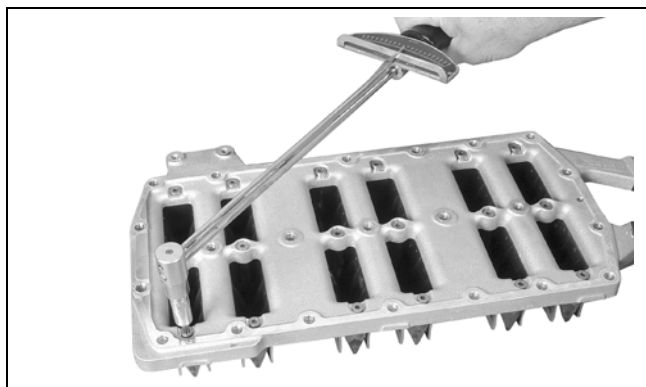
Fuel System

Fuel Component Servicing

Assembly

Remove old adhesive from reed valve retaining screws.

Prime screw threads with *Locquic Primer* and let dry. Apply *Nut Lock* to threads. Position reed valve on reed plate and install screws. Tighten screws to a torque of 30 to 42 in. lbs. (3.5 to 4.7 N·m).



004194

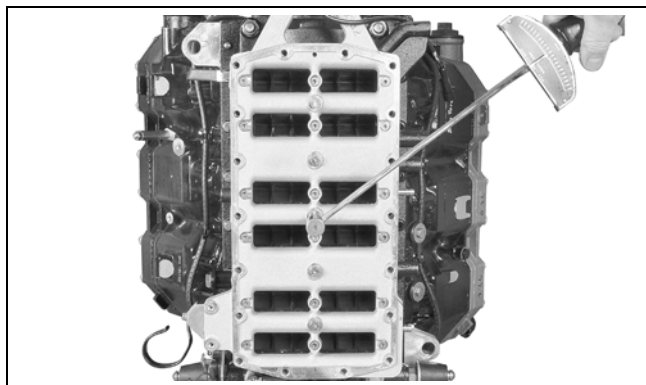
Installation

Install gasket on reed plate assembly. DO NOT use sealer on the gasket.

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 96 to 120 in. lbs. (11 to 13.5 N·m).



004205

Place gasket on throttle body. Install throttle body, with oil pump bracket on reed plate and install screws.

Tighten the center screws first and expand outward. Final torque is 60 to 84 in. lbs. (7 to 9.5 N·m).



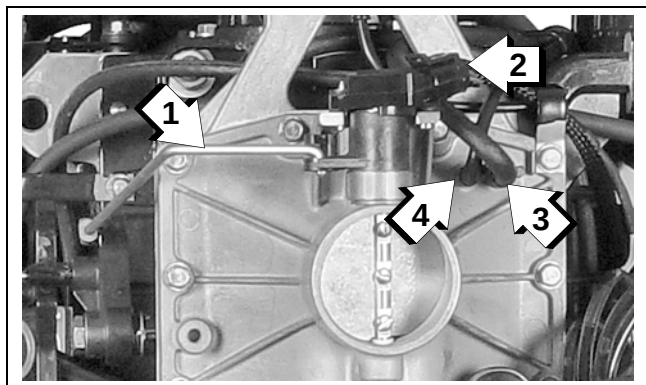
004257

Install crankshaft position sensor.

Install vapor separator vent hose and oil recirculation hose. Secure with tie straps.

Connect throttle linkage and throttle position sensor connector.

IMPORTANT: DO NOT lubricate TPS to throttle shaft surface.

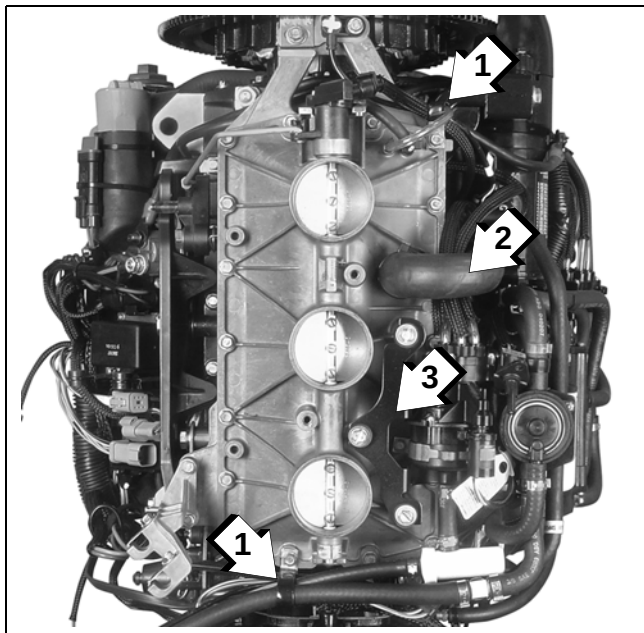


004248

1. Throttle linkage
2. TPS electrical connector
3. Vapor separator vent hose
4. Oil recirculation hose

Install oil/fuel pump bracket. Tighten screws 30 to 42 in. lbs. (3.5 to 4.7 N·m).

Position clamps as shown.



1. Clamps
2. Idle air hose
3. Oil/fuel pump bracket

006990

Refer to **TPS Calibration** on p. 116.

Notes

Technician's Notes

[illegible]

Related Documents

Bulletins	
Instruction Sheets	
Other	

Oiling System

Table of Contents

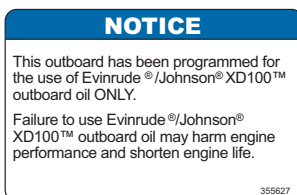
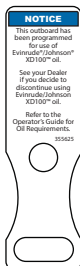
Service Chart	160
Oiling System Circuit Diagram	161
Oil Supply Diagrams	162
Oil Recirculation Diagrams	166
Oil System Requirements	168
Recommended Lubricants	168
Components	168
Oil Tank Assembly	168
Oil Injection Pump	168
Electrical Circuit (55 V)	169
Oil Pressure Sensor	169
Rear Oil Manifold (3.3 L models)	170
Rear Oil Pump (3.4 L models)	170
Electrical Circuit (12 V)	170
LOW OIL Warning	170
NO OIL Warning	170
Cylinder and Crankcase	170
Oil Recirculation System	171
Oil Control Settings	173
Oil Injection Rate	173
Break-In Oiling	174
Oil Supply Priming	175
Oiling System Tests	178
Oil Injection Pump Static Test	178
Oil Injection Pump Voltage Tests	178
Oil Injection Pump Circuit Resistance Test	179
Cylinder Oil Pump Voltage Tests	180
Cylinder Oil Pump Resistance Test	181
Oil Supply Vacuum Test	181
Oil Injection Pump Function Test	182
Oil Injection Fittings Flow Test	182
LOW OIL Sending Unit Test	183
Oil Component Servicing	183
Oil Distribution Hoses	183
Oil Injection Pump	184
Rear Oil Pump	185

Service Chart

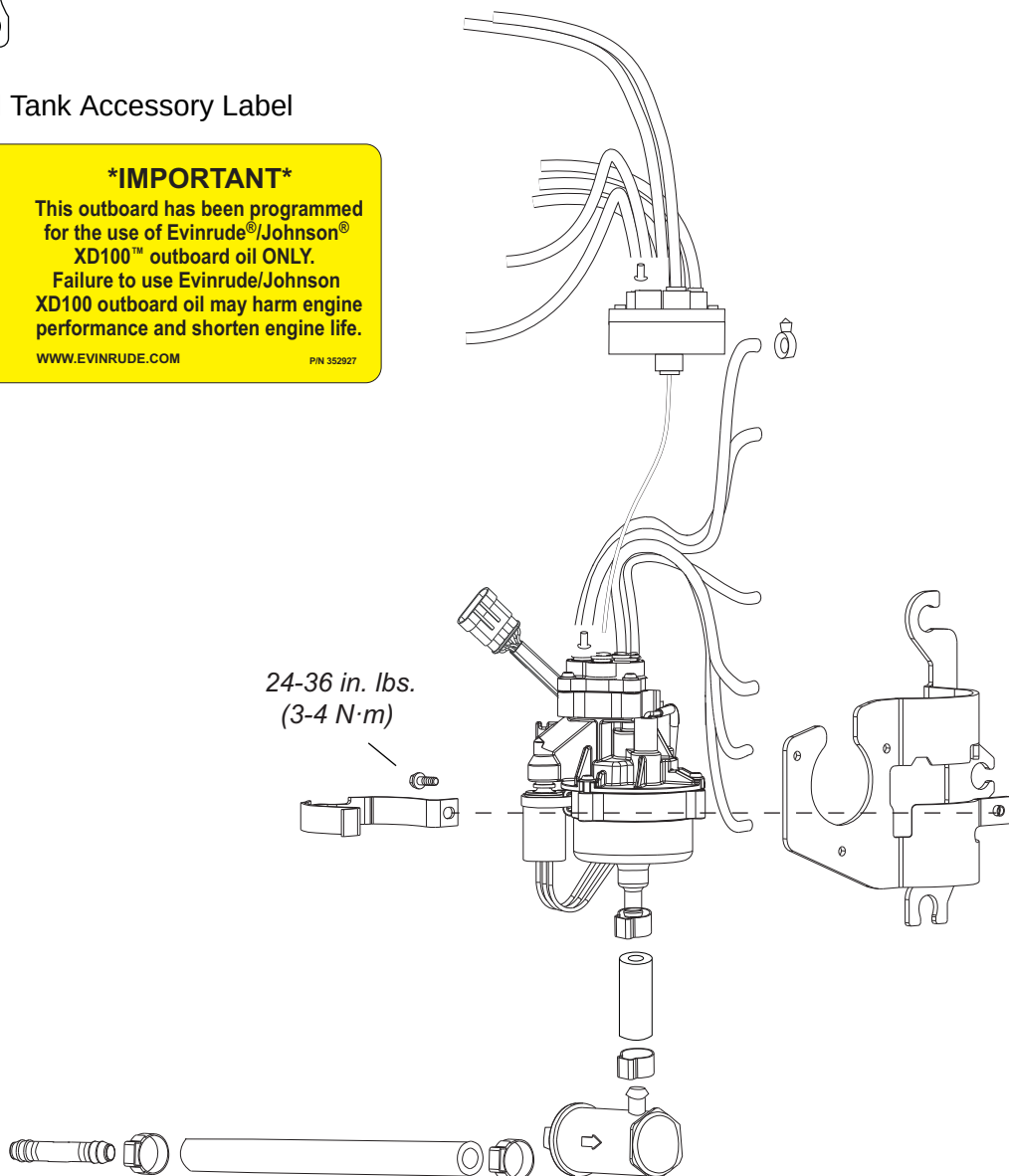
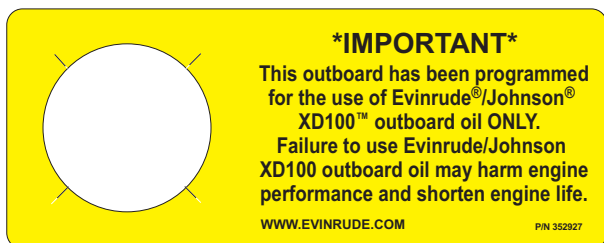
Engine Oil Programming Labels

XD30, XD50 XD100

Boat Label

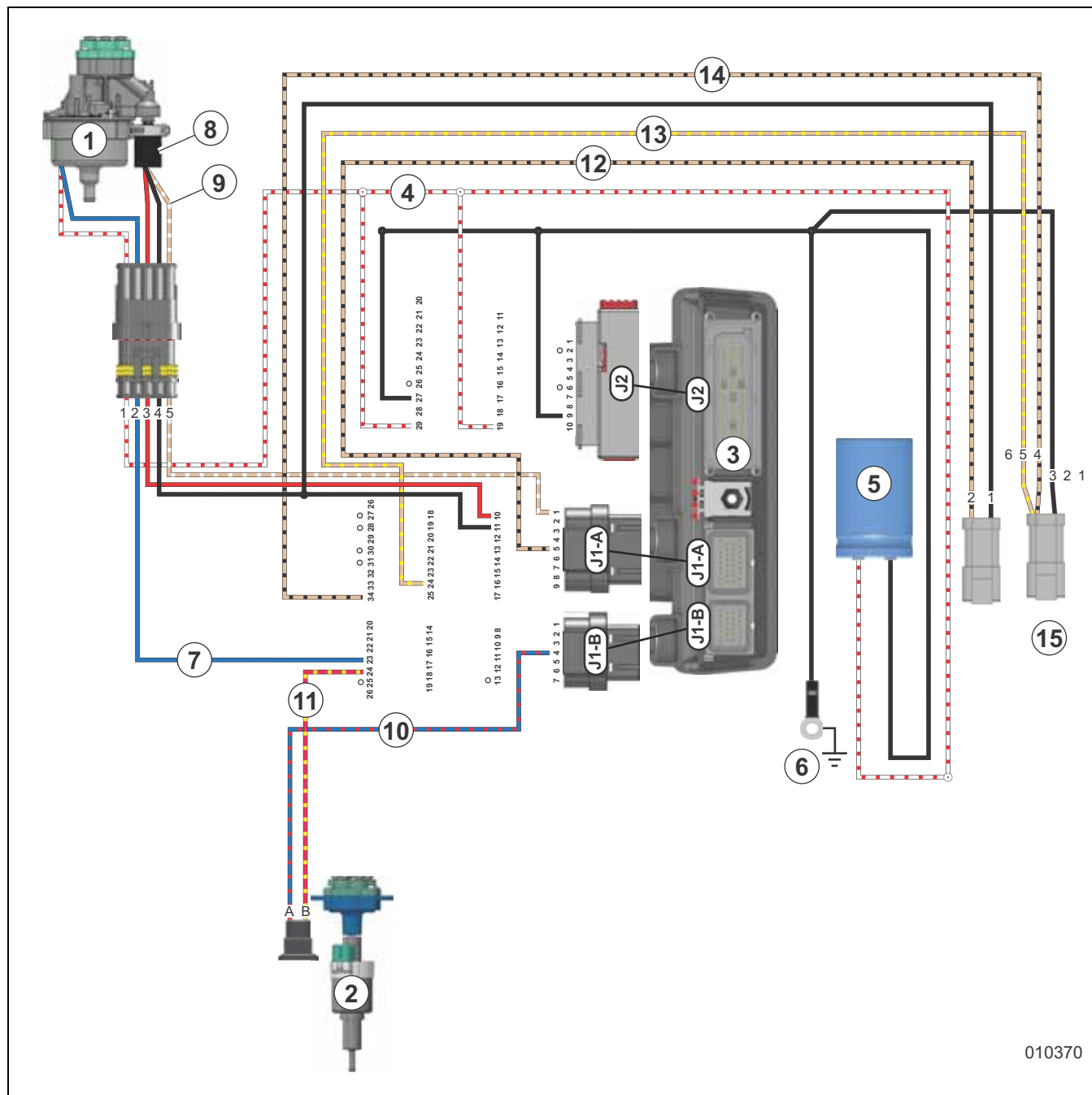


XD100 Oil Tank Accessory Label



004097R

Oiling System Circuit Diagram



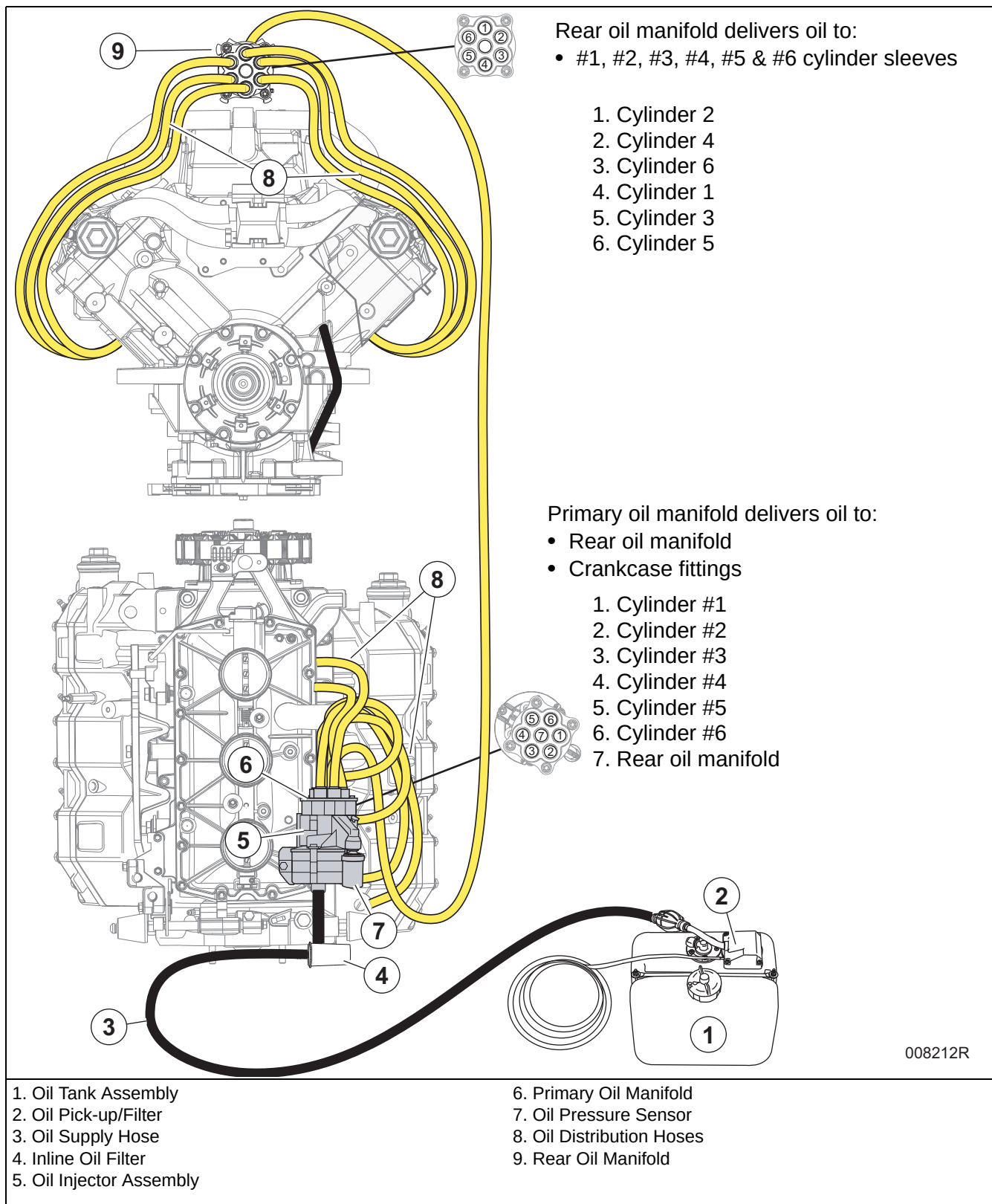
1. Crankcase Oil Injection Pump
2. Cylinder Oil Injection Pump (3.4 L models only)
3. EMM
4. 55 V circuit (White/Red)
5. Capacitor
6. Grounds NEG (Black)
7. EMM to Oil Pump (Blue)
8. Oil Pressure Sensor, +5V analog (Red)

9. Oil Pressure Sensor Signal (Tan/White)
10. Rear Oil Injector control (Blue/Red) (3.4 L models only)
11. Rear Oil Injector +12 V (Red/Yellow) (3.4 L models only)
12. LOW Oil Switch (Tan/Black)
13. LOW Oil Signal (Tan/Yellow)
14. NO Oil Signal (Tan/Black)
15. SystemCheck Connector

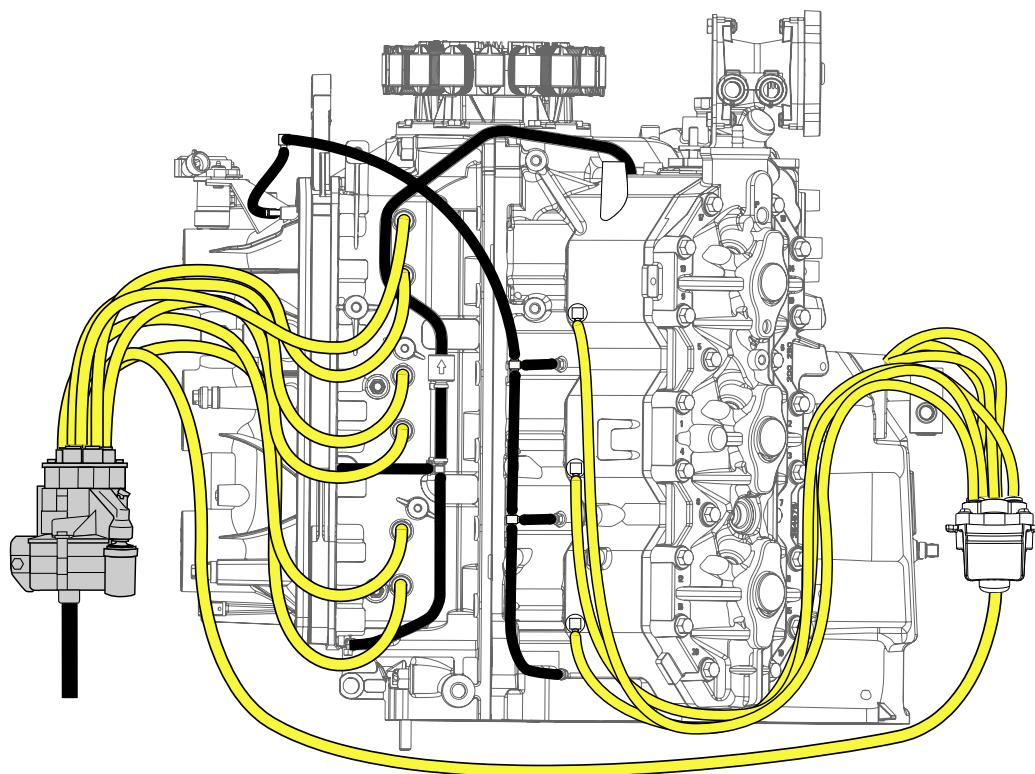
010370

Oil Supply Diagrams

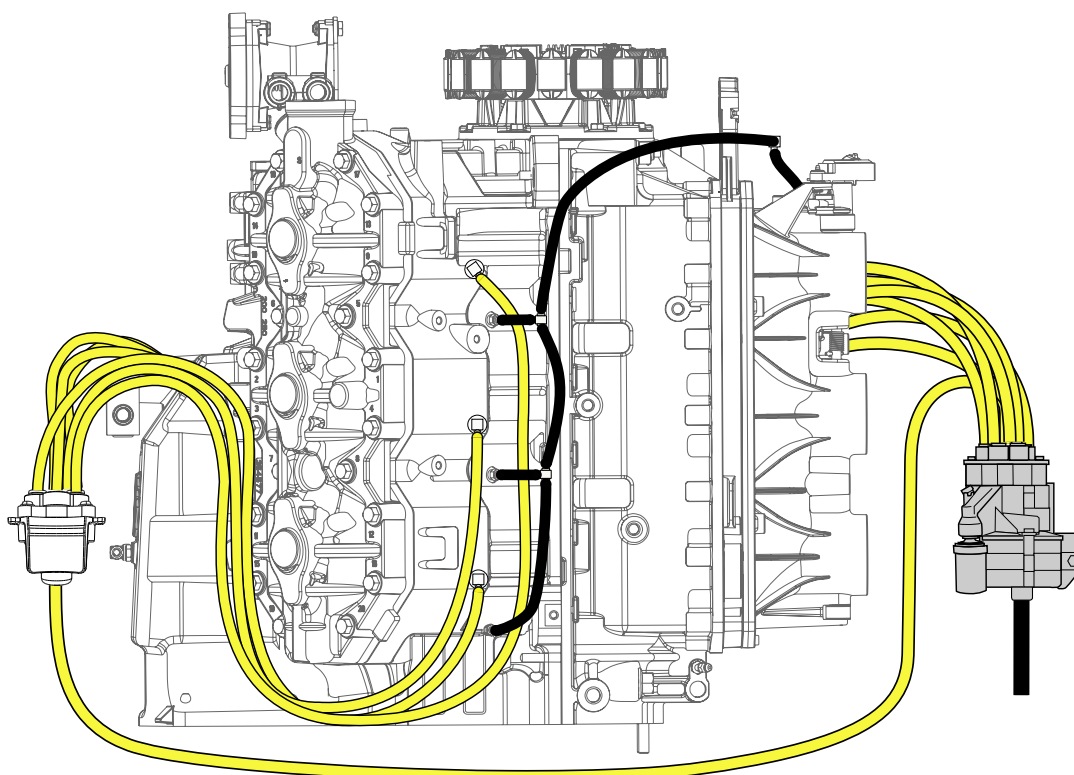
200 – 250 HP (3.3 L) Models



Port Side View



Starboard Side View

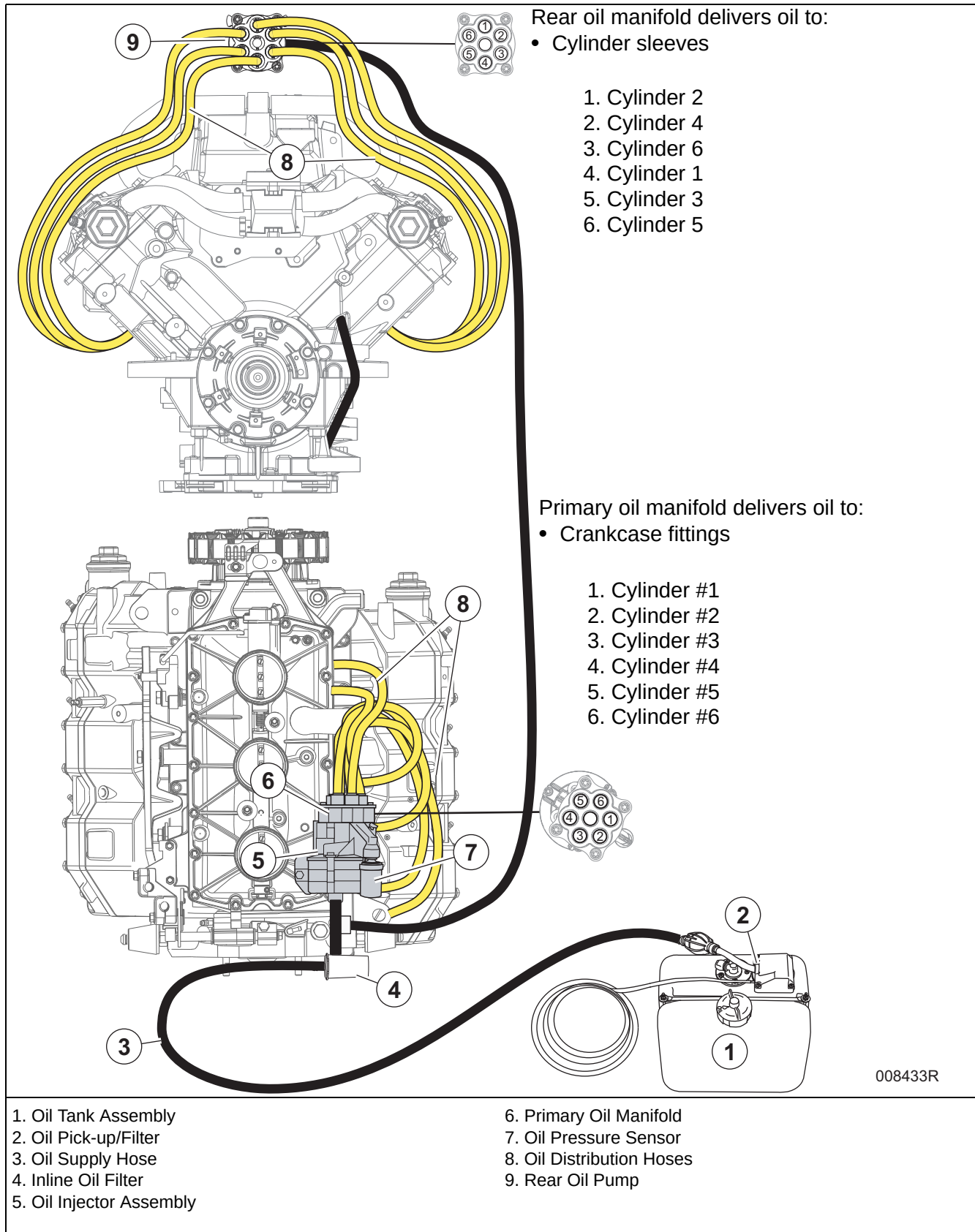


008208R

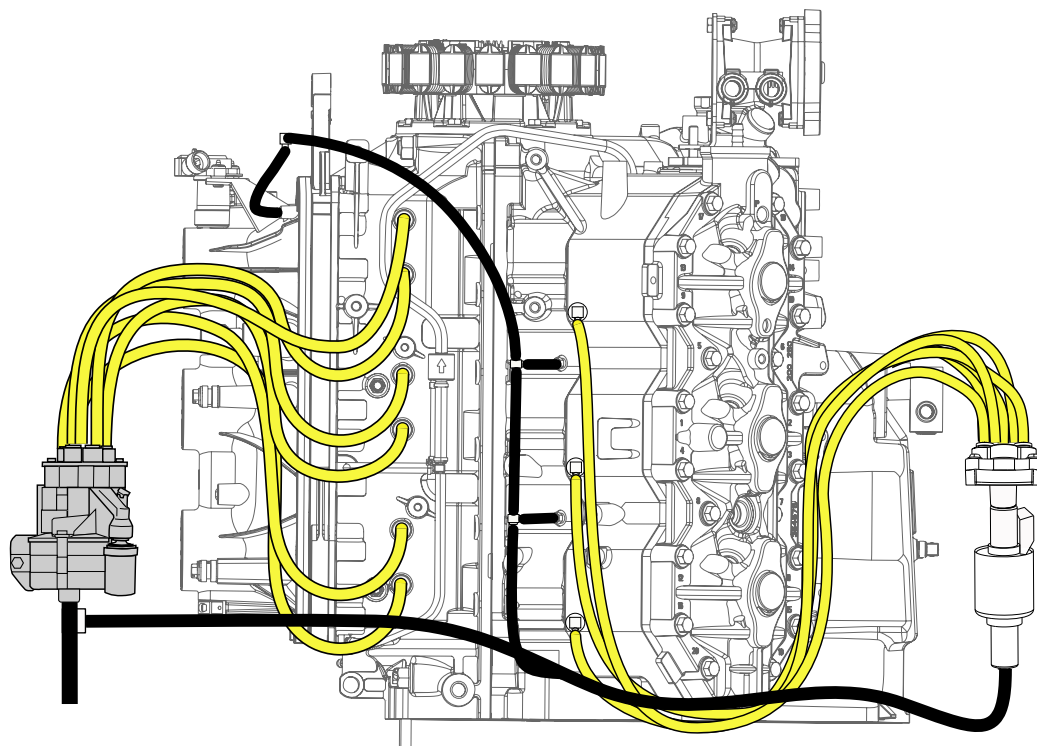
Oiling System

Oil Supply Diagrams

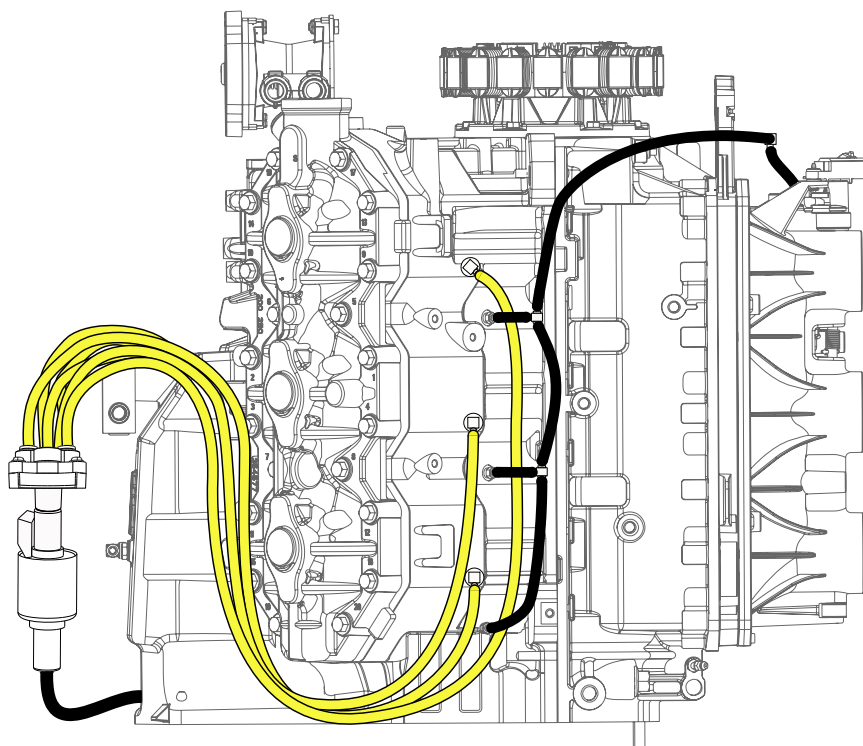
250 – 300 HP (3.4 L) Models



Port Side View



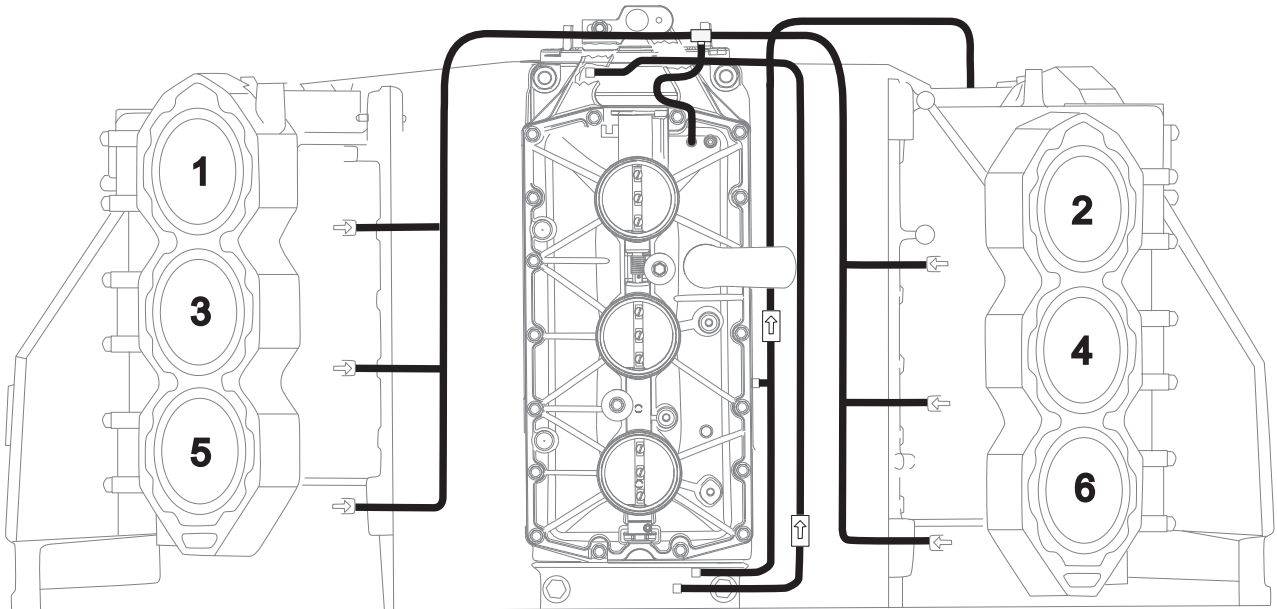
Starboard Side View



008432R

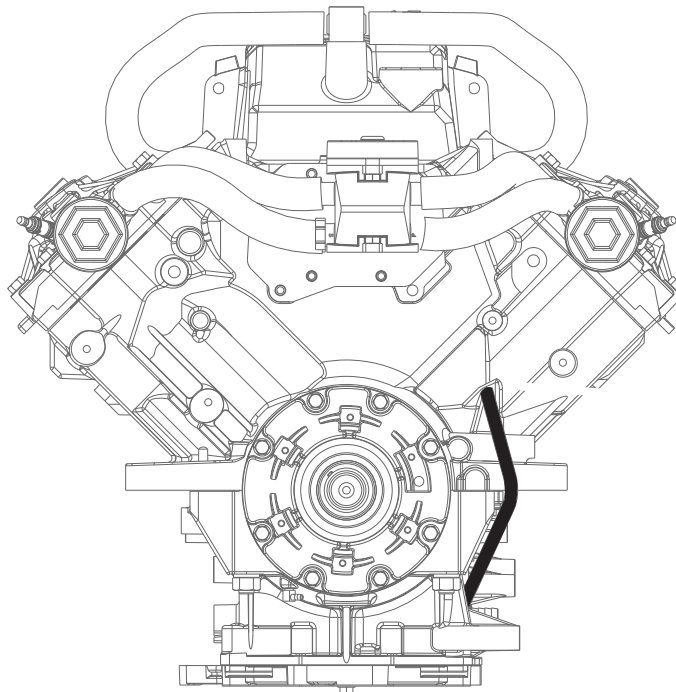
Oil Recirculation Diagrams

Complete View



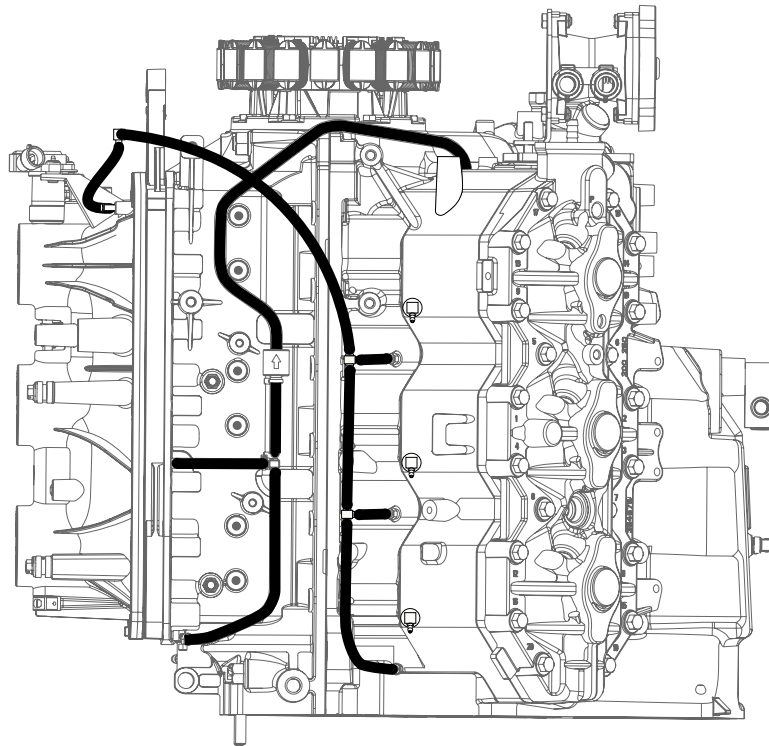
008205R

Top View

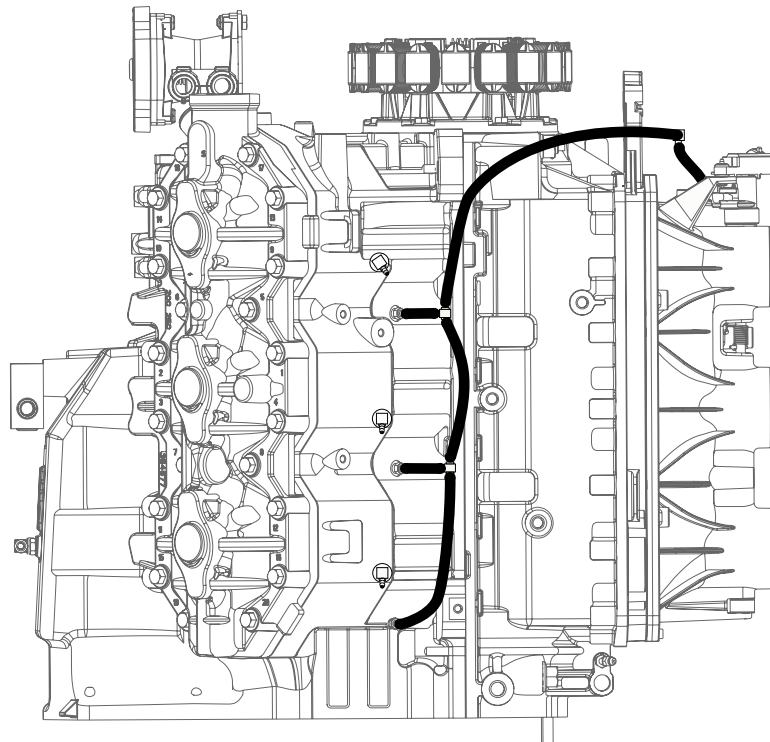


008206R

Port View



Starboard View



008207R

Oil System Requirements

NOTICE

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

Recommended Lubricants

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.

Components

The oiling system consists of the following components:

- Oil tank
- Oil injection pump and manifold assembly
- Oil pressure sensor
- Electrical circuit
- LOW OIL and NO OIL warning systems
- Cylinder and crankcase
- Rear oil manifold assembly (3.3 L models)
- Rear oil pump (3.4 L models)
- Oil recirculation system

Oil Tank Assembly

The oil tank must be properly positioned and the oil level must be monitored. Refer to the **Predelivery and Installation Guide**.

Oil Tank Components:

- Tank, 1.8 or 3.0 gallon capacity
- Oil pickup and filter assembly
- LOW OIL sending unit
- Mounting bracket and hardware
- Protective cover (1.8 gallon tank only)
- Primer bulb and supply hose.



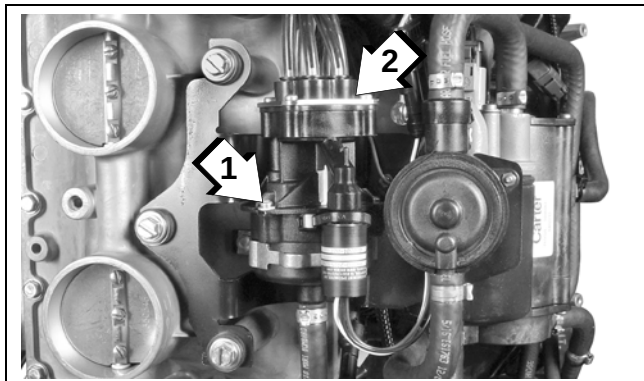
1.8 Gallon Oil Tank Kit

44839B

Oil Injection Pump

The oil injection pump is an electric (55 V) actuator style pump. It draws oil from the oil tank through the oil supply hose [25 ft. (7.6 m) maximum] and supplies pressurized oil to the oil mani-

fold. The *EMM* supplies 55 V and controls activation of the pump.



1. Oil injection pump
2. Oil manifold

004220

The oil manifold distributes the oil supplied by the oil injection pump to the crankcase. On 3.3 L models oil is also distributed to the rear oil manifold.

Electrical Circuit (55 V)

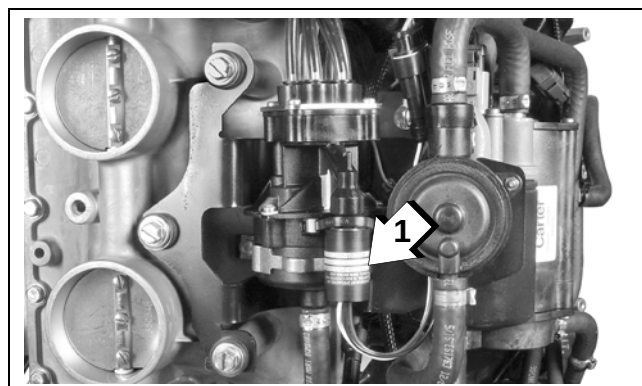
The oil injector is powered by the 55 V electrical circuit. The *EMM* controls pump operation by rapidly connecting and disconnecting the pump's internal coil to ground.

The *EMM* monitors the oil injection pump electrical circuit. If circuit voltage is beyond the specified range (open circuit), the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 34
<i>EMM</i> LED 4: ON (Running)
Engine Monitor NO OIL display: ON

Oil Pressure Sensor

The oil pressure sensor reacts to changes in oil manifold pressure. The *EMM* supplies and monitors electrical current to the sensor.



1. Oil pressure sensor

04220

- The sensor provides an output voltage to the *EMM* based on oil manifold pressures.
- 5 VDC Input on RED wire
- 0.5 - 4.5 V Output on TAN / WHITE wire
- Ground on BLACK wire

The *EMM* monitors the oil pressure sensor's electrical circuit. If circuit voltage is beyond the specified range ($< 0.15\text{ V}$, $> 4.85\text{ V}$), the *EMM*:

Stores service code 71
<i>EMM</i> LED 3: ON (Running)

If oil pressure is below expected range ($< 0.4\text{ V}$), the *EMM*:

Stores service code 72
<i>EMM</i> LED 3: ON (Running)

If oil pressure is above expected range ($> 4.6\text{ V}$), the *EMM*:

Stores service code 73
<i>EMM</i> LED 3: ON (Running)

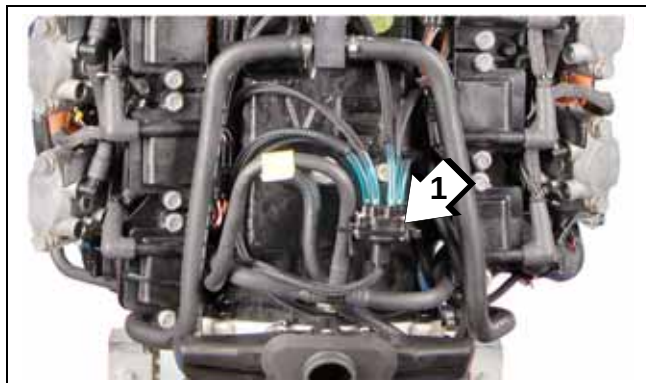
Refer to **Oil Pressure Sensor** on p. 62.

Oiling System

Components

Rear Oil Manifold (3.3 L models)

The rear oil manifold receives oil from the primary manifold and distributes it to the cylinder sleeves.

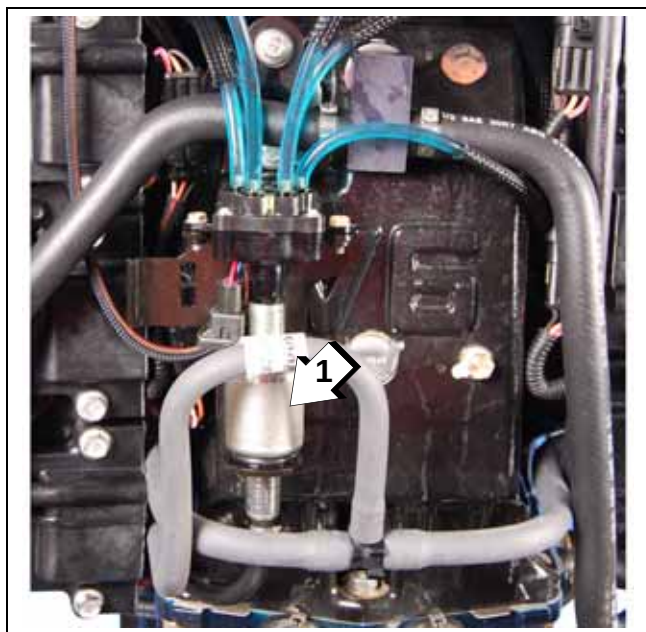


1. Rear oil manifold

008203

Rear Oil Pump (3.4 L models)

The oil injection pump is an electric (12 V) actuator style pump. It draws oil from a fitting at the oil injection pump and supplies pressurized oil to the cylinder sleeves. The *EMM* supplies 12 V and controls activation of the pump



1. Rear oil pump

008444

Electrical Circuit (12 V)

The rear oil pump is powered by the 12 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 the circuit is open, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 36
<i>EMM</i> LED 4: ON (Running)
Engine Monitor No OIL display: ON

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

An optional oil tank sending unit kit is available to display actual oil level through an *I-Command* network.

NO OIL Warning

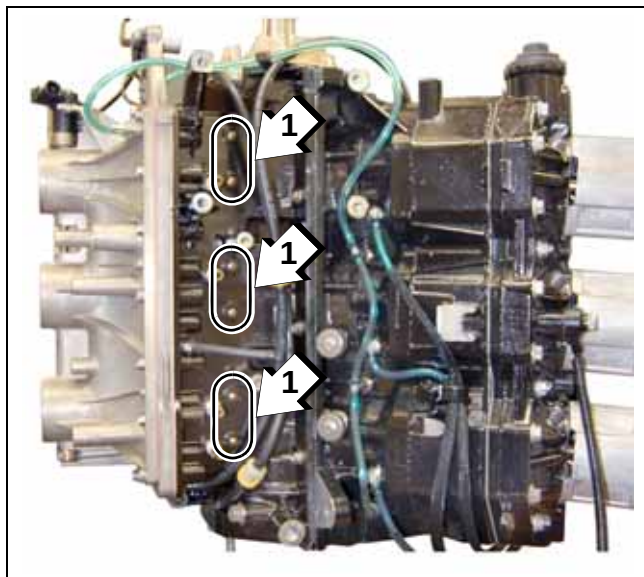
The *EMM* monitors the electrical circuit of the oil pressure sensor. If the sensor or circuit fails, or if there is a lack of oil pressure in the oil distribution manifold, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 38
<i>EMM</i> LED 4: ON (Running)
Engine Monitor NO OIL display: ON

Cylinder and Crankcase

The primary oil distribution manifold provides crankcase lubrication through oil distribution

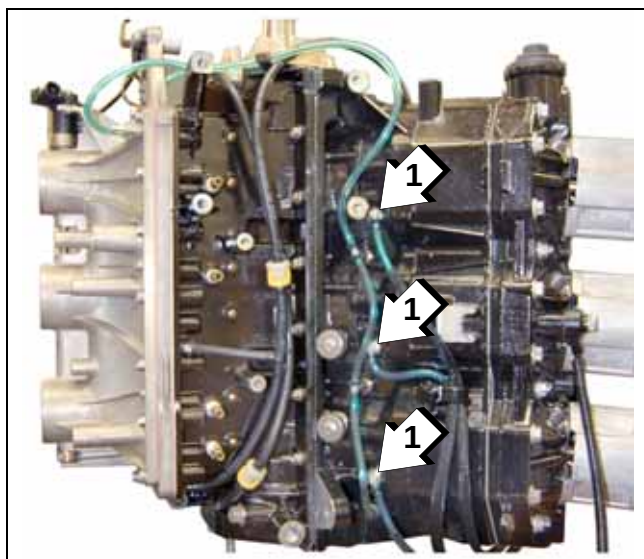
hoses and pressed-in fittings at the front of the crankcase, port side.



1. Pressed-in fitting

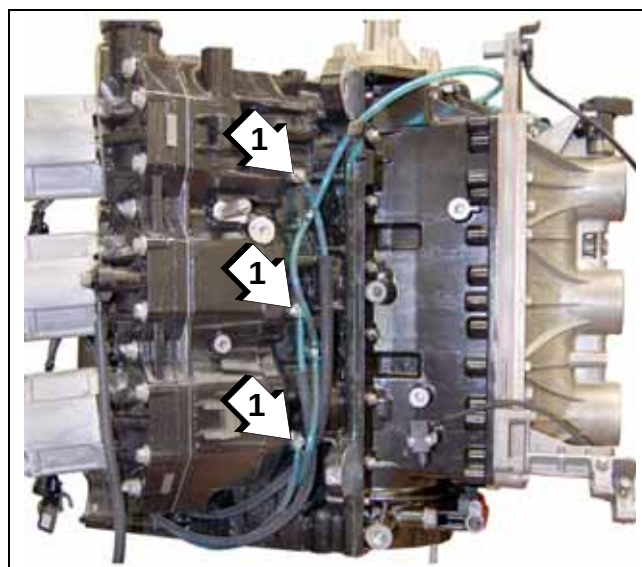
008456

The rear oil distribution manifold provides lubrication for each cylinder. Each cylinder of the cylinder/crankcase has a pressed-in fitting which is connected to an oil distribution hose.



1. Cylinder sleeve oil fittings – port

008456



1. Cylinder sleeve oil fittings – stbd

008457

Oil Recirculation System

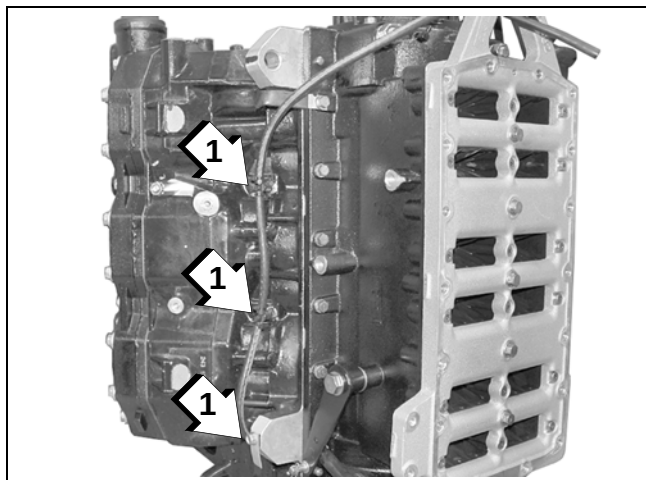
External hoses and fittings, internal cylinder/crankcase passages, and intake manifold passages are used to recirculate any accumulation of oil from various locations in the powerhead. The movement of oil is controlled by check valves.

Cylinder Recirculation

Internal powerhead oil drain passages connect the lowest point of the intake port area of the cylinder block to external check valves. External hoses connect these check valves to a hose fitting pressed into the top of the intake manifold / throttle body. Intake manifold vacuum draws any accumulation of oil from the intake port area of the

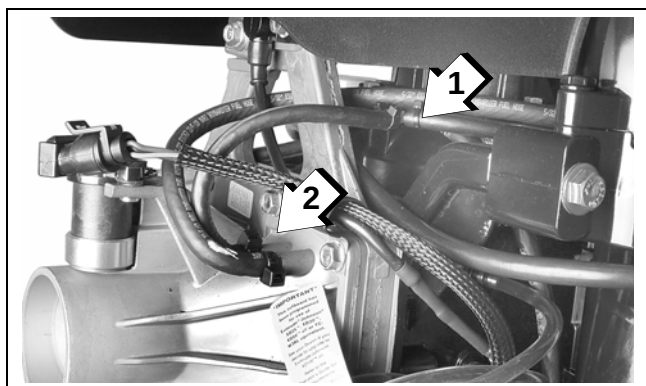
Oiling System Components

cylinders into the incoming air stream in front of the top reed valve.



1. Check valves

004337

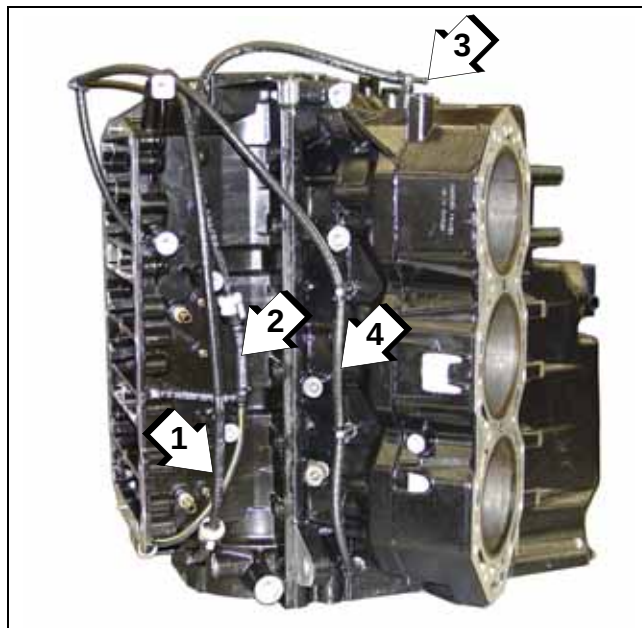


1. Recirculation hose
2. Hose fitting

004336

Check valves pressed into the crankcase below #4 and #6 reed valve assemblies connect to

hoses which route to a fitting at the top of the block, above #2 cylinder.



1. Lower to upper main bearing oiling circuit
2. Idle oil circuit
3. Tee fitting
4. Cylinder recirculation circuit

005043

Crankcase / Main Bearing Recirculation

The movement of oil through the main bearings is controlled by internal passages, external fittings and hoses, and an in-line check valve.

Both center main bearings receive oil through grooved passages in the crankcase. Oil migrates to the bearings from the crankcase areas of the higher cylinders.

The lower main bearing receives oil through a grooved passage in the crankcase.

Lower to upper main bearing oil flow

Oil moves from the lower main bearing cavity through an internal crankcase passage to an external fitting. External hoses with an in-line check valve connect to a fitting at the upper main bearing, which leads to the upper main bearing through an internal crankcase passage.

Oil Control Settings

NOTICE

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.

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 used 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 (commercial or harsh conditions, racing or other high performance operation).
- Use this setting with XD100 outboard oil in extreme applications

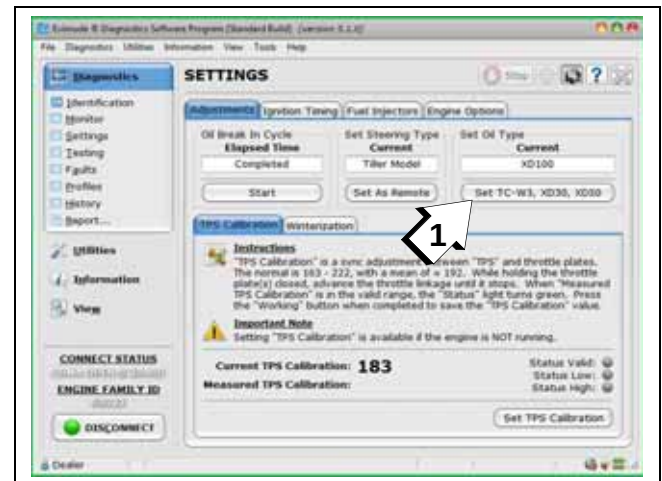
The XD100 setting provides an option to run the outboard at a reduced oil injection rate. This setting **REQUIRES** the use of *Evinrude XD100* outboard lubricant and is not recommended for all applications.

IMPORTANT: The XD100 setting is not available on all models.

Use the XD100 setting for:

- Conventional use (runabouts, cruisers)

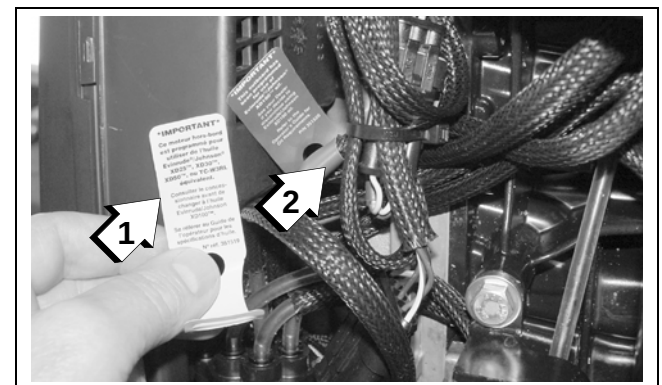
- Moderate applications



1. Oil control setting

008571

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



1. Evinrude/Johnson XD30 outboard lubricant (TC-W3) **YELLOW label** 004964
2. Evinrude/Johnson XD100 outboard lubricant (Premium) **BLUE label (Installed)**

An XD100 Outboard Oil Decal, P/N 352369, is available to label boats equipped with outboards

Oiling System

Oil Control Settings

that have been programmed for the reduced oil injection ratio.

NOTICE

This outboard has been programmed for the use of Evinrude®/Johnson® XD100™ outboard oil ONLY.

Failure to use Evinrude®/Johnson® XD100™ outboard oil may harm engine performance and shorten engine life.

355627

XD100 Outboard Oil Decal

355627

Install decals in a highly visible location, such as one of the following:

- Dashboard/deck of boat, next to key switch
- Deck of boat, next to the remote oil fill
- Deck of boat, next to oil tank assembly
- Oil tank cover
- Cover of oil tank compartment
- Attach to oil tank or oil fill cap.

IMPORTANT: Make sure the engine label and boat decals match *EMM* programming.

Break-In Oiling

NOTICE

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

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

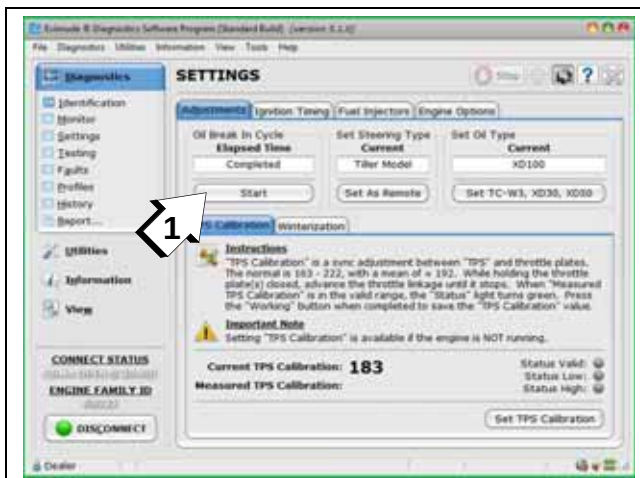
The *EMM* automatically supplies extra oil to the engine as follows:

- 90° V6: First two hours above 2000 RPM

Follow these steps for outboard set-up:

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.



1. Break-in oil setting

008571

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.

Oil Hose Priming

Insert the oil supply hose from the oil tank into a suitable container. Squeeze the oil primer bulb until oil flows from the oil tank into the container.

Once oil supply hose from the oil tank is filled with oil, connect the hose to the oil supply fitting on outboard and secure with *Oetiker* clamp.

Oil Pump Priming

Squeeze the oil primer bulb until oil flows from the oil supply hose, through the oil filter, and into the crankcase oil pump (front oil pump).

IMPORTANT: Inspect oil filter to make sure it is filled with oil. All air must be eliminated from the oil filter during priming procedure.

Continue to squeeze the oil primer bulb until oil flows through the front oil pump, into the oil distribution hoses, and to the crankcase fittings.

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

250 – 300 HP (3.4 L) Models

NOTICE

The software priming function must be used along with the primer bulb for two reasons:

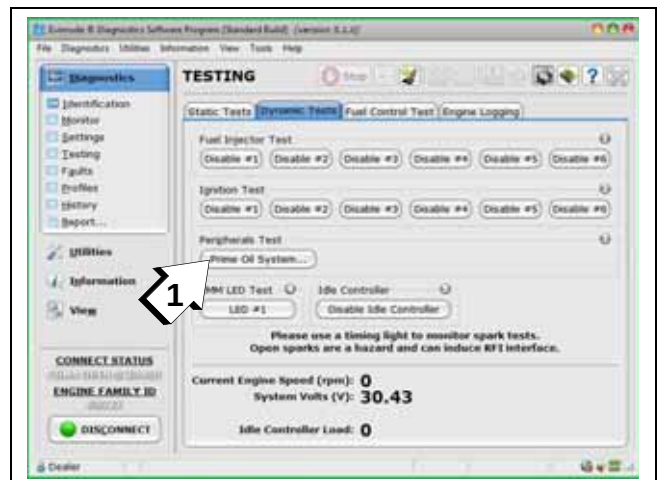
- The primer bulb alone will not move oil through the rear pump assembly unless the pump is running.
- The pump assembly cannot prime itself until it has been filled with oil.

Start the outboard. Use the oil priming functions in the software to make sure the system is completely primed.

IMPORTANT: The outboard should be running during the priming procedure to avoid pumping too much oil into the crankcase, which could cause a hard-starting condition.

Prime the rear oil pump FIRST (cylinder oil pump).

Use the *Prime Cylinder Oiler* button of the *Dynamic Test* screen to prime the rear oil pump.

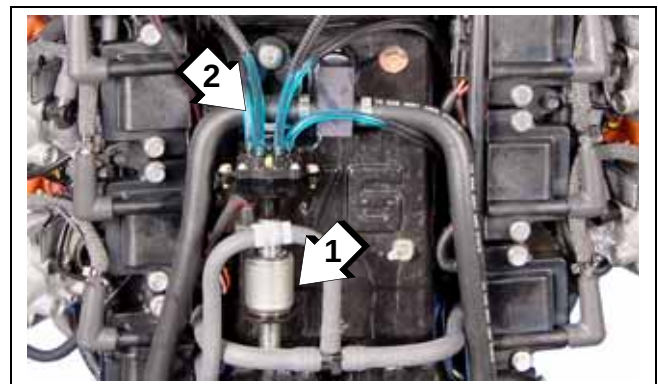


Dynamic Tests Screen
1. Prime Oil System button

008570L

8

With the *Prime Cylinder Oiler* function activated, continue to squeeze the oil primer bulb until oil flows through the oil distribution hoses of the rear oil pump.



1. Cylinder oil pump
2. Oil distribution hoses

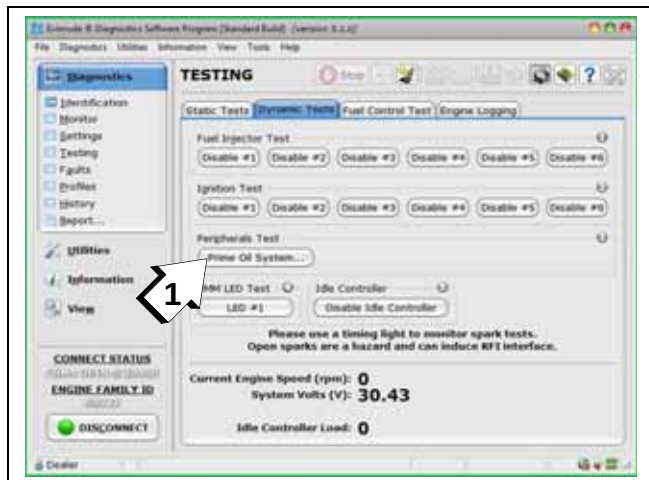
008391

Prime the front oil pump assembly LAST.

Oiling System

Oil Supply Priming

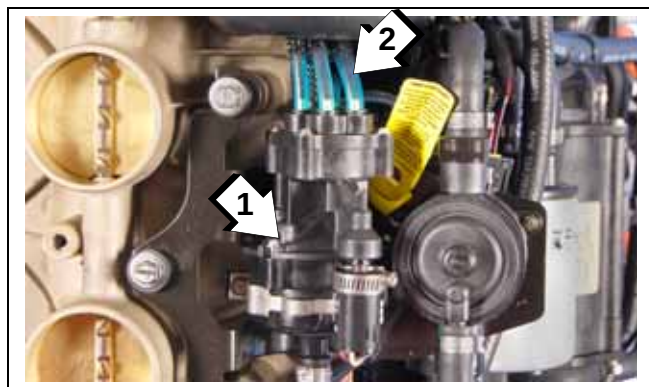
Use the *Prime Oil System* button of the *Dynamic Test* screen to prime the front oil pump.



Dynamic Tests Screen
1. *Prime Oil System* button

008570L

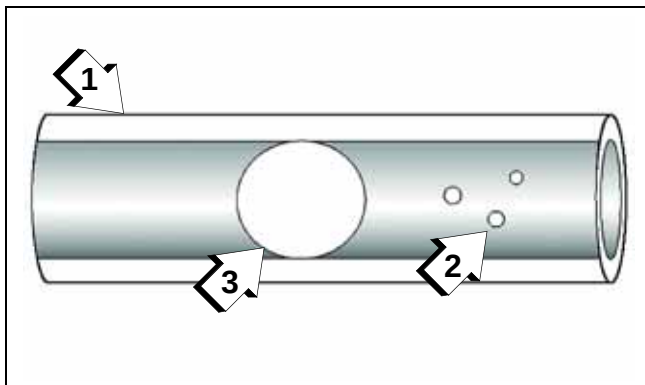
Observe oil flow through all oil distribution hoses. Air must be purged during the priming procedure.



1. Crankcase oil pump
2. Oil distribution hoses

008392

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



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

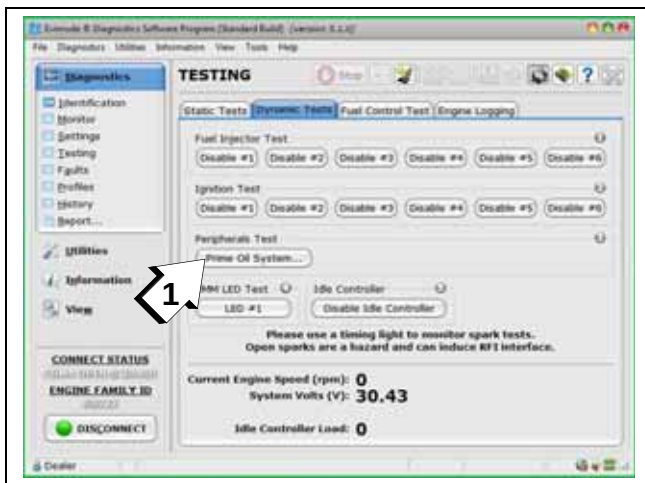
004398

Repair any fuel or oil leaks.

200 – 250 HP (3.3 L) Models

Start the outboard. Use the oil priming function in the software to make sure the system is completely primed.

Use the *Prime Oil System* button of the *Dynamic Test* screen to prime the oil pump.

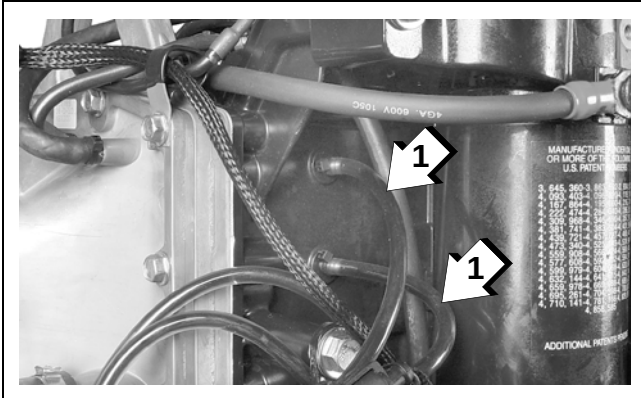


Dynamic Tests Screen
1. *Prime Oil System* button

008570

Observe oil flow through all oil distribution hoses. Air must be purged during the priming procedure.

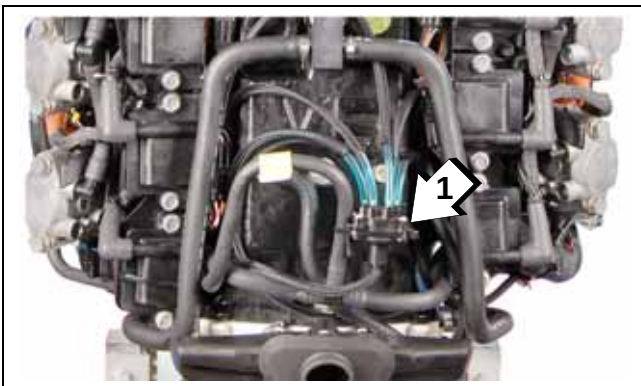
The oiling system on these models can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to **Storage** on p. 48.



1. Oil distribution hoses

004224

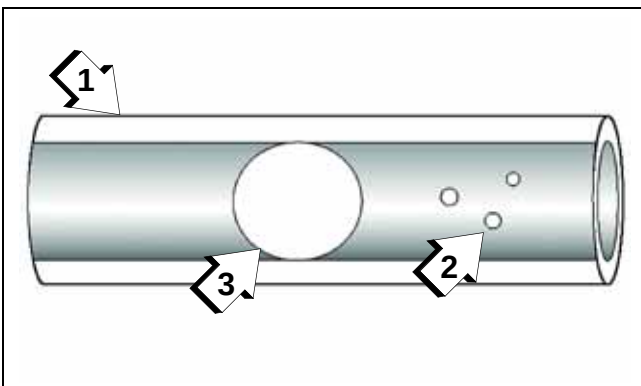
Make sure that oil flows through the rear oil distribution manifold to the cylinder block fittings.



1. Rear oil distribution manifold

008203

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



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

004398

Repair any fuel or oil leaks.

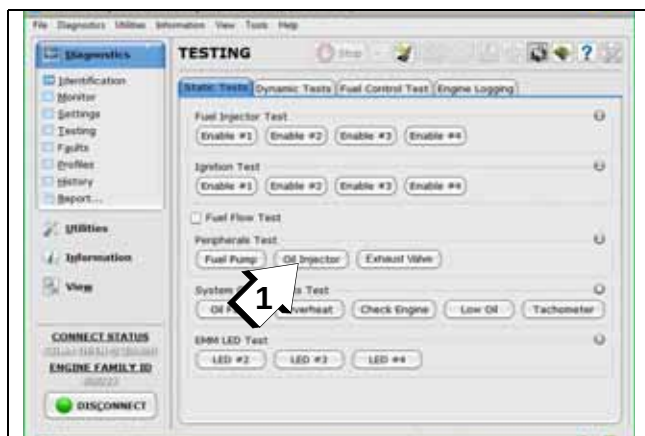
Oiling System Tests

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

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 pump connector.

Use *Evinrude Diagnostics* software to activate the *Oil Injector* test. This test starts the *EMM* control function for the oil injection pump.



Static Tests Screen
1. Oil injector test button

008579

IMPORTANT: This test is operating the pump with 30 V on the system voltage (55 V) circuit. The start assist circuit (SAC) of the *EMM* converts battery voltage (12 V) to 30 V of system voltage. Battery must be fully charged and connections must be clean and tight. Pump activation should be carefully confirmed. Listen for an audible click from the oil injection pump when it is activated.

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil pump connector (pin 2).

If the light flashes, the *EMM* and oil injection circuits are not at fault.

Refer to **Oil Injection Pump Voltage Tests** on p. 178.

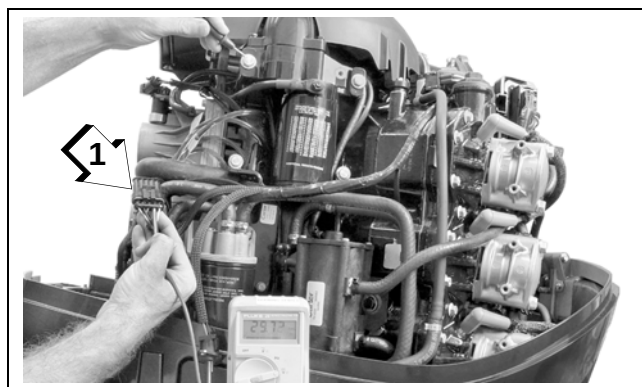
Oil Injection Pump Voltage Tests

Use a digital multimeter calibrated to a scale that reads 55 V (DC) to measure voltage between the oil pump electrical connector and engine ground.

Acceptable Oil Injection Pump Test Readings	
Key switch ON	approximately 30 VDC
Control signal	approximately 10 Hz
Engine running	approximately 55 VDC

Connect negative meter lead to ground.

Use an appropriate test probe to connect positive meter lead to pin 2 (blue wire) of oil injection pump electrical connector.



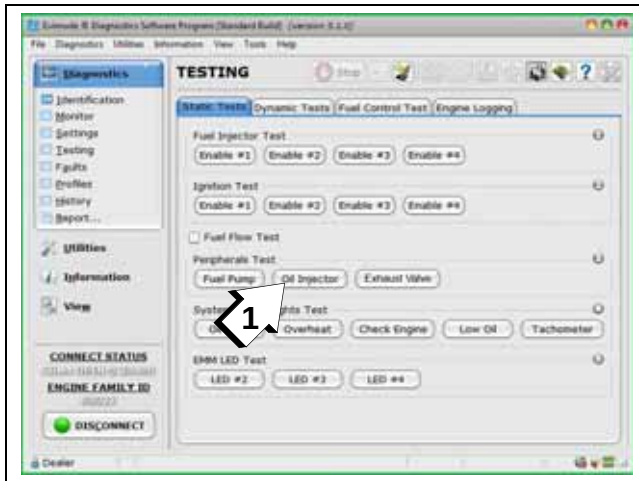
1. Oil injection pump connector (pin 2)

004344

Turn the key switch to the ON position. Observe voltage at pin 2.

- Voltage at pin 2 should be approximately 30 V.

Use the *Oil Injector* test of *Evinrude Diagnostic* software *Static Test* screen to activate the oil pump.



Static Tests Screen
1. Oil injector test button

008579

Observe voltage at pin 2.

- Voltage at pin 2 should drop as the oil pump cycles.

Check the control signal while the *Oil Injector* test is running. Set the digital multimeter to the Hertz (Hz) scale.

- Meter should read approximately 10 Hz.

Results:

- If voltage and control signal readings at pin 2 are within range, the *EMM* and wiring are not at fault.
- If voltage at pin 2 is not within range, check voltage at pin 1 (white/red wire) of oil pump electrical connector.

Connect positive meter lead to pin 1 (white/red wire) of oil injection pump electrical connector. Observe voltage at pin 1.

- Voltage at pin 1 should be approximately 30 V.

Start the engine. Observe voltage at pin 1.

- The voltage at pin 1 should be approximately 55 V.
- If voltage is not within range, refer to **Oil Injection Pump Circuit Resistance Test** on p. 179.
- No voltage reading, refer to **System Voltage Test** on p. 85.

Oil Injection Pump Circuit Resistance Test

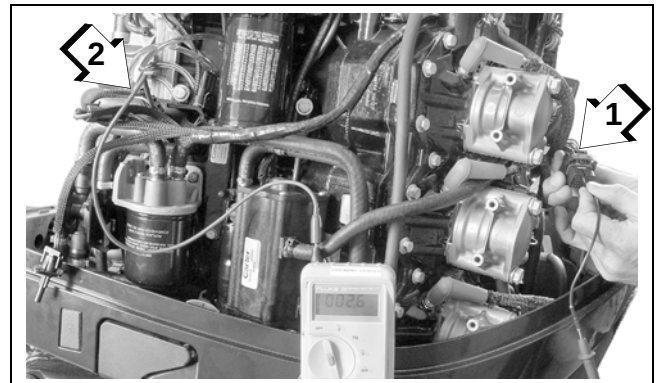
IMPORTANT: The complete oil injection pump electrical circuit includes *EMM* alternator output, the engine wire harness, the injection pump winding and connectors, and the oil injector control circuit of the *EMM*. Check continuity of all wiring and connections.

Disconnect the battery cables at the battery.

Disconnect J1-B connector from *EMM*. Use a digital multimeter with appropriate adapter leads to measure the resistance between pin 23 (blue) of the *EMM* J1-B connector and pin 1 (white/red) of the oil injection pump connector. Calibrate the meter to the LOW OHMS scale.

Oil Injection Pump Circuit Resistance

2 to 3 Ω



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

004343

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check continuity of wiring, connections, 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 within range, injection pump winding is good. Isolate faulty component. Repair faulty wiring or replace faulty component and retest.

Cylinder Oil Pump Voltage Tests

The *EMM* controls the pump by providing ground through pin 4 (blue/red wire) of the J1-A connector and pin A (blue/red wire) of the oil pump connector.

Use an appropriate test probe and a digital multimeter calibrated to a scale that reads 12 V (DC).

Acceptable Cylinder Oil Pump Test Readings	
Key switch ON	approximately 12 VDC
Control signal	approximately 2 Hz
Engine running	approximately 12 VDC

Connect negative meter lead to ground.

Connect positive meter lead to pin A (blue/red wire) of oil injection pump electrical connector.



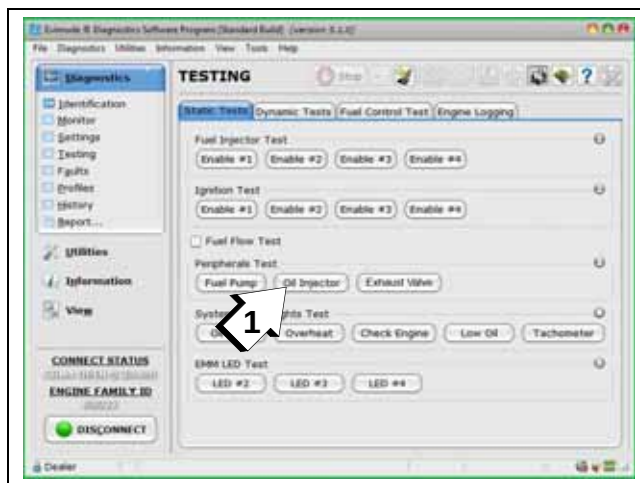
1. Oil injection pump connector

008445

Turn the key switch to the ON position. Observe voltage at pin A.

- Voltage at pin A should be approximately 12 V.

Use the *Cylinder Oiler Test* function of *Evinrude Diagnostic* software Static Test screen to activate the cylinder oil pump.



Static Tests Screen

008579

1. Oil injector test button

- Voltage at pin A should vary (drop), as the oil pump cycles.

Check the control signal while the *Oil Injector* test is running. Set the digital multimeter to the Hertz (Hz) scale.

- Meter should read approximately 2 Hz.

Results:

- If voltage and control signal readings (Hz) at pin A are within range, the *EMM* and wiring are not at fault.
- If voltage at pin A is not within range, check voltage at pin B (red/yellow wire) of the oil pump electrical connector.

Connect positive meter lead to pin B (red/yellow wire) of oil injection pump electrical connector. Observe voltage at pin B.

- The voltage at pin B should be approximately 12 V.

Start the engine. Observe voltage at pin B.

- The voltage at pin B should be approximately 12 V.
- If voltage at pin B is within range, refer to **Cylinder Oil Pump Resistance Test** on p. 181.
- No voltage reading at pin B, check continuity between pin B of oil pump electrical connector and pin 24 of *EMM* J1-B connector.

Cylinder Oil Pump Resistance Test

Disconnect the battery cables at the battery.

Disconnect the electrical connector from the oil injection pump.

Use a digital multimeter to measure the resistance between the pins of the oil pump connector. Calibrate the meter to the LOW OHMS scale.

Oil Injection Pump Resistance
5–6 Ω



1. Oil injection pump connector

008446

Results:

An infinite reading (∞) indicates an open circuit of the injection pump winding. Replace faulty pump.

Oil Supply Vacuum Test

⚠ WARNING

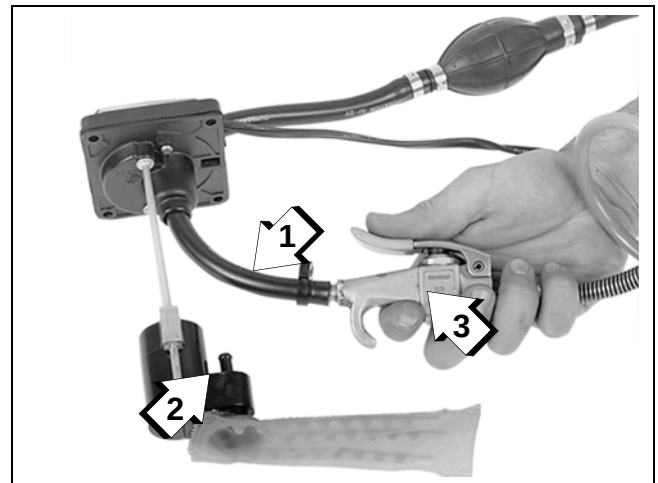
Wear safety glasses to avoid personal injury, and set compressed air pressure to less than 25 psi (172 kPa).

Remove the oil pick-up assembly from the oil tank.

Carefully remove the pickup filter and flush with a mild solvent to remove any contamination. Reinstall filter.

Carefully remove the oil hose from the oil pickup and remove the oil supply hose from the oil injection pump.

Use low pressure air to purge oil from hose.



1. Oil hose
2. Oil pickup
3. Low pressure air

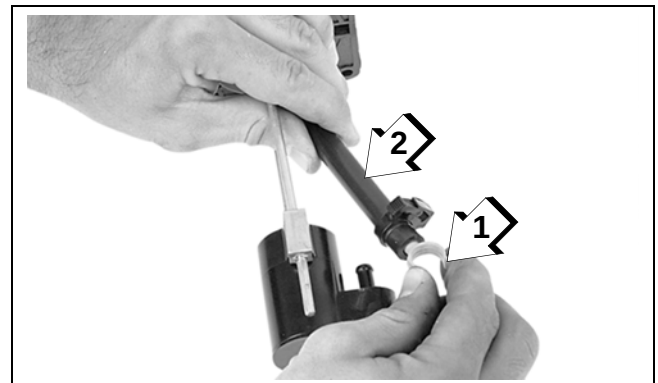
12306

Clean up any spilled oil with shop towels.

ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

Use Plug/Holder, P/N 329661, and clamp to plug the pickup end of the hose.



1. Plug/holder
2. Oil hose

12307

Attach a vacuum tester to the outboard side of oil supply hose and draw 7 in. Hg (24 kPa) vacuum on the hose for at least five minutes. Repair or replace any leaking components. Reinstall the oil hose.

Oiling System

Oiling System Tests

Check height of pickup assembly.

Pickup Assembly Height	
1.8 gallon tank	6.84 to 6.96 in. (174 to 177 mm)
3.0 gallon tank	8.74 to 8.86 in. (222 to 225 mm)



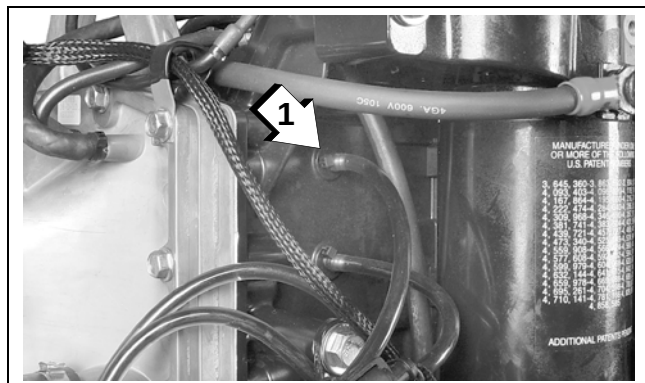
Height of Oil Pickup Assembly

COB5657A

Place a **new** seal on oil tank and reinstall pickup with filter into oil tank. Install and tighten screws.

Oil Injection Pump Function Test

Remove oil distribution hose from fitting at crankcase. Squeeze oil supply primer bulb to provide oil to injection pump.



1. Crankcase fitting

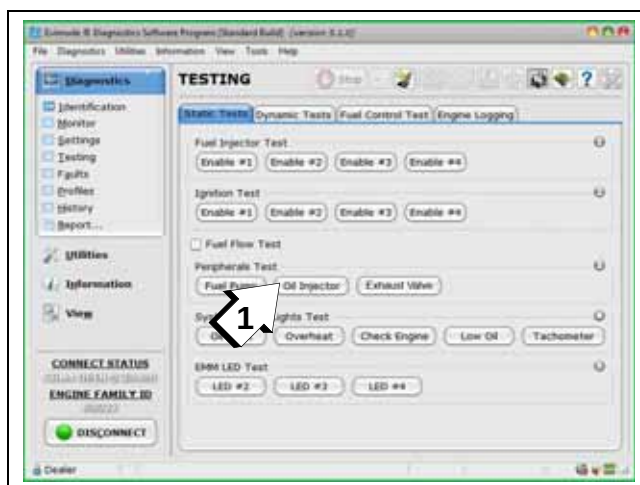
004224

Running Test

Start the outboard and observe oil flow. Confirm that a small amount of oil is discharged while injection pump is activated.

Static Test

Use the *Evinrude Diagnostics* software oil injector test to activate injector. Confirm that a small amount of oil is discharged while injection pump is activated.



Static Tests Screen

1. Oil injector test button

008579

Clean up any spilled oil with shop towels.

ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

Results:

- Oil flows from distribution hose, compare to oil flow at other distribution hoses.
- If one or more hoses fail to discharge oil, check for a kinked or restricted hose before replacing the oil injection pump assembly.

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 crankcase fitting. Temporarily install a length of oil hose on the fitting.

Clean up any spilled oil with shop towels.

ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.

LOW OIL Sending Unit Test

Remove 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. The LOW OIL warning should stop when the oil level exceeds one-quarter of oil tank's capacity.

Oil Component Servicing

⚠ WARNING

To prevent accidental starting while servicing, disconnect the Crankshaft Position Sensor (CPS)

Oil Distribution Hoses

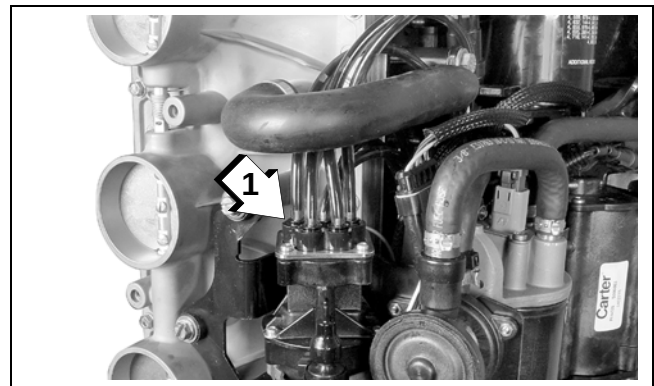
The oil distribution hoses from each manifold **MUST** be the same length. **DO NOT** alter the length of any hoses.

Oil Distribution Hose Length	
Primary oil manifold to cylinder block fitting	12 in. (305 mm)
Rear oil manifold to cylinder block fitting	32 in. (812 mm)
Primary oil manifold to rear oil manifold*	32 in. (812 mm)

*Primary oil manifold to rear oil manifold hose has a 0.160 in. I.D. and does NOT use a hose support.

Removal

Release the hose by depressing the outer ring of the hose retaining mechanism.



1. Retainer mechanism

004295

Clean up any spilled oil with shop towels.

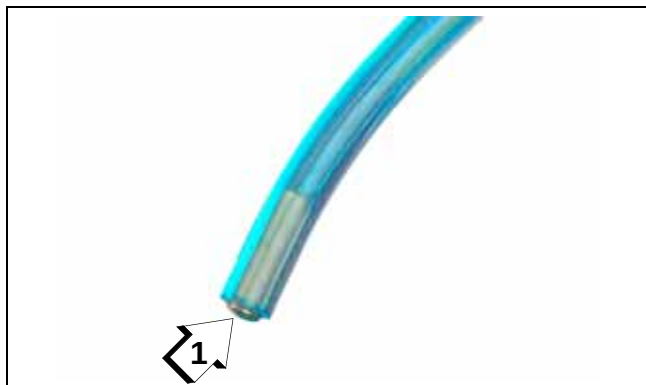
ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

Oiling System

Oil Component Servicing

Once hose is removed from the manifold, make sure hose support is in the end of the hose.



1. Hose support

008070

Installation

Cut Replacement Oil Hose, P/N 778708, to the correct length. Insert hose support in manifold end of hose. (Primary manifold to rear manifold hose does not use a hose support.)

IMPORTANT: DO NOT insert distribution hoses into manifold without a 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 Injection Pump

Removal

Disconnect the battery cables at the battery.

Remove engine cover and air silencer.

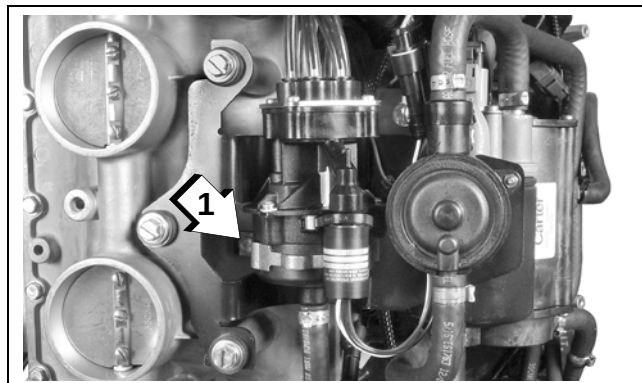
Remove the oil supply hose from the fitting (inlet) of the oil injection pump.

Disconnect the electrical connector.

IMPORTANT: Note oil distribution hose routings before proceeding with disassembly. Center hose from primary oil manifold connects to oil to inlet of rear oil manifold.

Remove oil distribution hoses from the crankcase fittings.

Remove oil injection pump clamp screw.



1. Clamp screw

004220

Remove the oil injection pump assembly.

Clean up any spilled oil with shop towels.

ENVIRONMENTAL NOTE

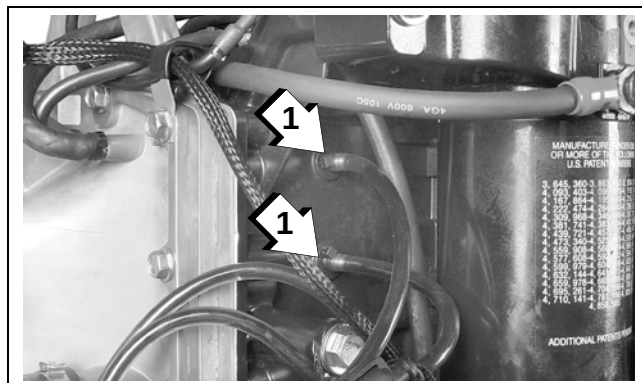
Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

IMPORTANT: The oil injection pump and manifold is an assembly and cannot be serviced as individual components.

Installation

Route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings as they were before removal. Refer to **Oil Supply Diagrams** on p. 162.

Connect oil hoses to crankcase fittings and fasten with tie straps.



1. Crankcase fitting

004224

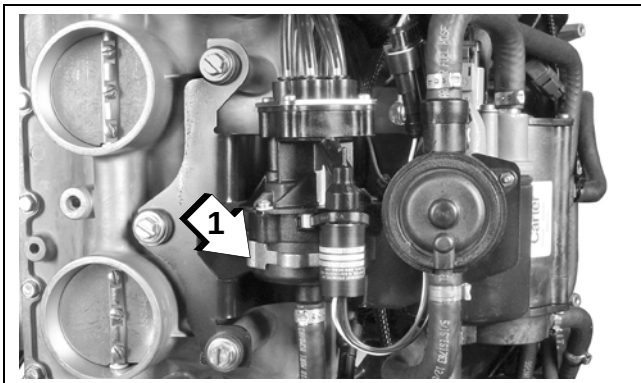
Connect oil hose to rear oil manifold.



1. Oil to rear manifold

007148

Install oil pump on bracket with clamp and retaining screw. Tighten to a torque of 24 to 36 in. lbs. (3 to 4 N·m).



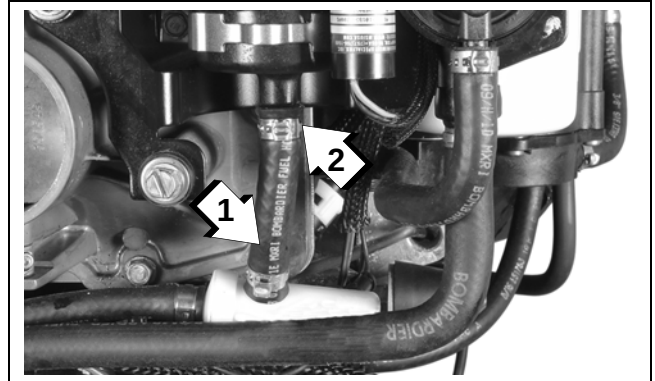
1. Clamp

004220

Reconnect the electrical connector.

IMPORTANT: Use oil primer bulb to purge air from oil supply hose before reconnecting hose to oil pump.

Reconnect oil supply hose to the inlet fitting of oil pump. Fasten with *Oetiker* clamp.



1. Oil supply hose
2. Oetiker clamp

005519

Make sure oiling system is primed. Check oil flow through oil distribution hoses. Check oil system operation and routing of oil hoses. Refer to **Oil Supply Priming** on p. 175.

Run the outboard and check for leaks.

Repair any oil leaks and any kinked or misrouted hoses.

Rear Oil Pump

Removal

Disconnect the battery cables at the battery.

Remove engine cover.

Remove the oil supply hose from the fitting (inlet) of the oil pump.

Disconnect the electrical connector.

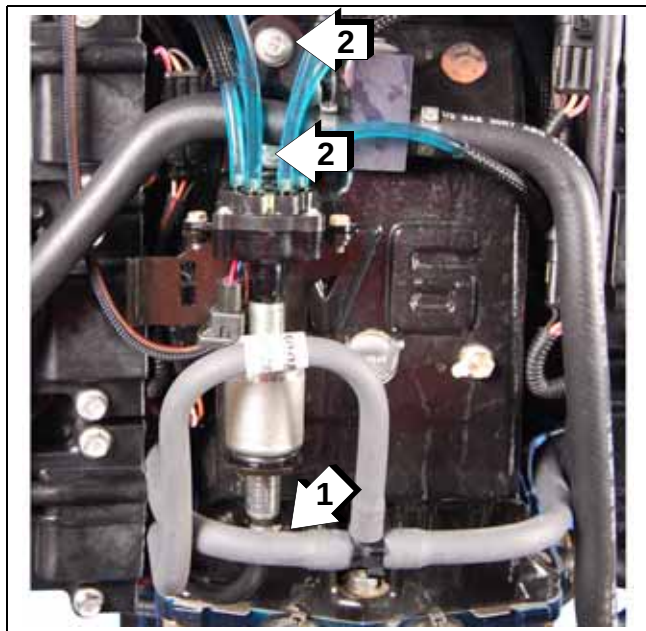
IMPORTANT: Note oil distribution hose routings before proceeding with disassembly.

Remove oil distribution hoses from the crankcase fittings.

Oiling System

Oil Component Servicing

Remove two mounting bracket screws.



1. Fitting (inlet)
2. Mounting bracket screws

008444

Remove the oil injection pump assembly.

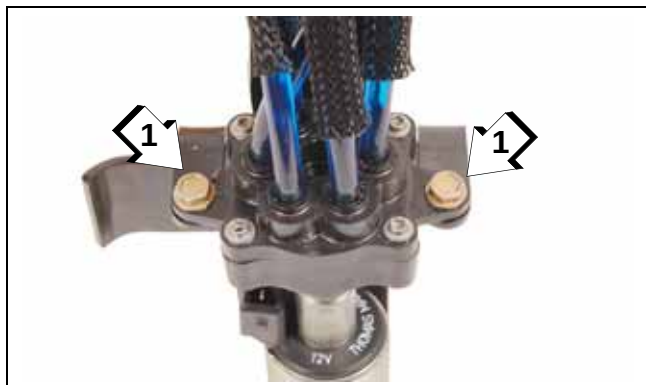
Clean up any spilled oil with shop towels.

ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

IMPORTANT: The rear oil pump and manifold is an assembly and cannot be serviced as individual components.

Remove two screws to remove oil pump assembly from mounting bracket.



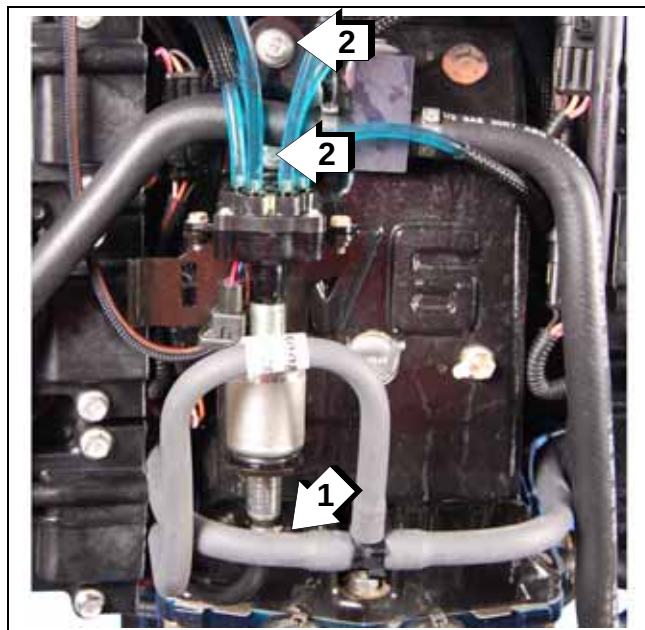
1. Screws

008476

Installation

Clean threads of screws and apply *Nut Lock* to threads. Install oil pump assembly into mounting bracket with two screws. Tighten screws to a torque of 24 to 36 in. lbs. (2.7 to 4 N·m).

Install the oil injection pump and bracket with two mounting bracket screws. Tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

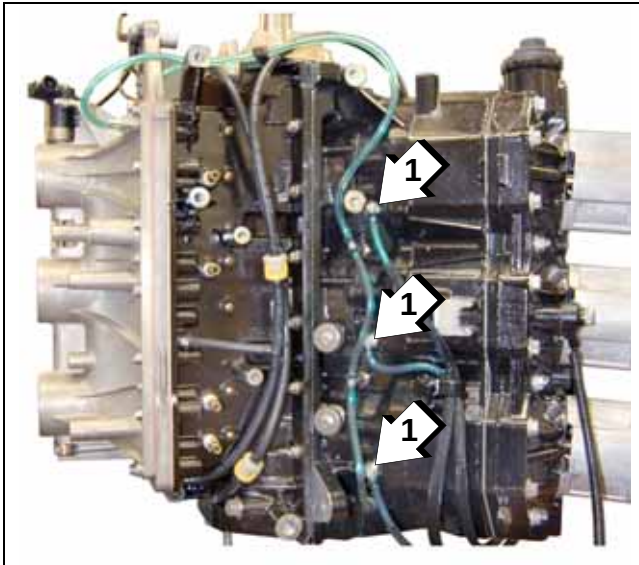


1. Fitting (inlet)
2. Mounting bracket screws

008444

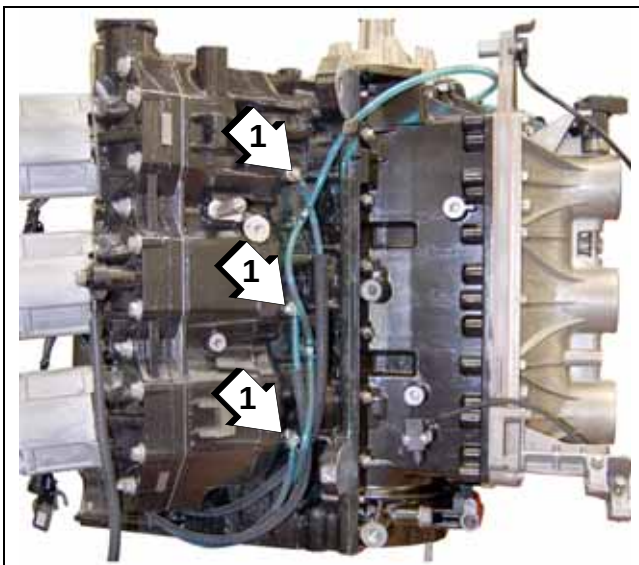
Route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings as they were before removal. Refer to **Oil Supply Diagrams** on p. 162.

Connect oil hoses to cylinder sleeve oil fittings on the crankcase and fasten with tie straps.



1. Cylinder sleeve oil fittings – port

008456

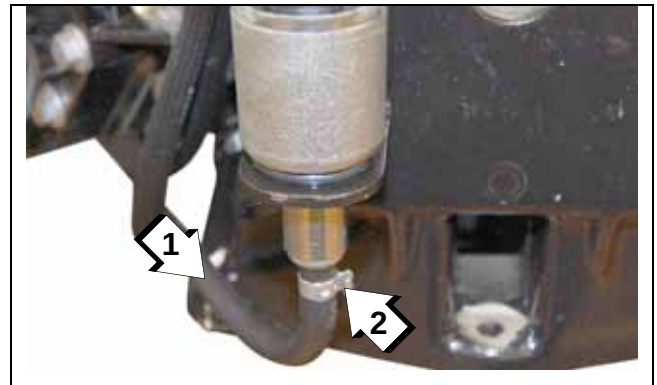


1. Cylinder sleeve oil fittings – stbd

008457

Connect the electrical connector.

Reconnect the oil supply hose to the inlet fitting of the oil pump. Fasten with *Oetiker* clamp. Orient clamp as shown.



1. Oil supply hose
2. Oetiker clamp

008477

Connect the battery cables at the battery.

Make sure oiling system is primed. Check oil flow through oil distribution hoses. Check oil system operation and routing of oil hoses. Refer to **Oil Supply Priming** on p. 175.

Run the outboard and check for leaks.

Repair any oil leaks and any kinked or misrouted hoses.

Install engine cover.

Notes

Technician's Notes

[illegible]

Related Documents

Bulletins	
Instruction Sheets	
Other	

Cooling System

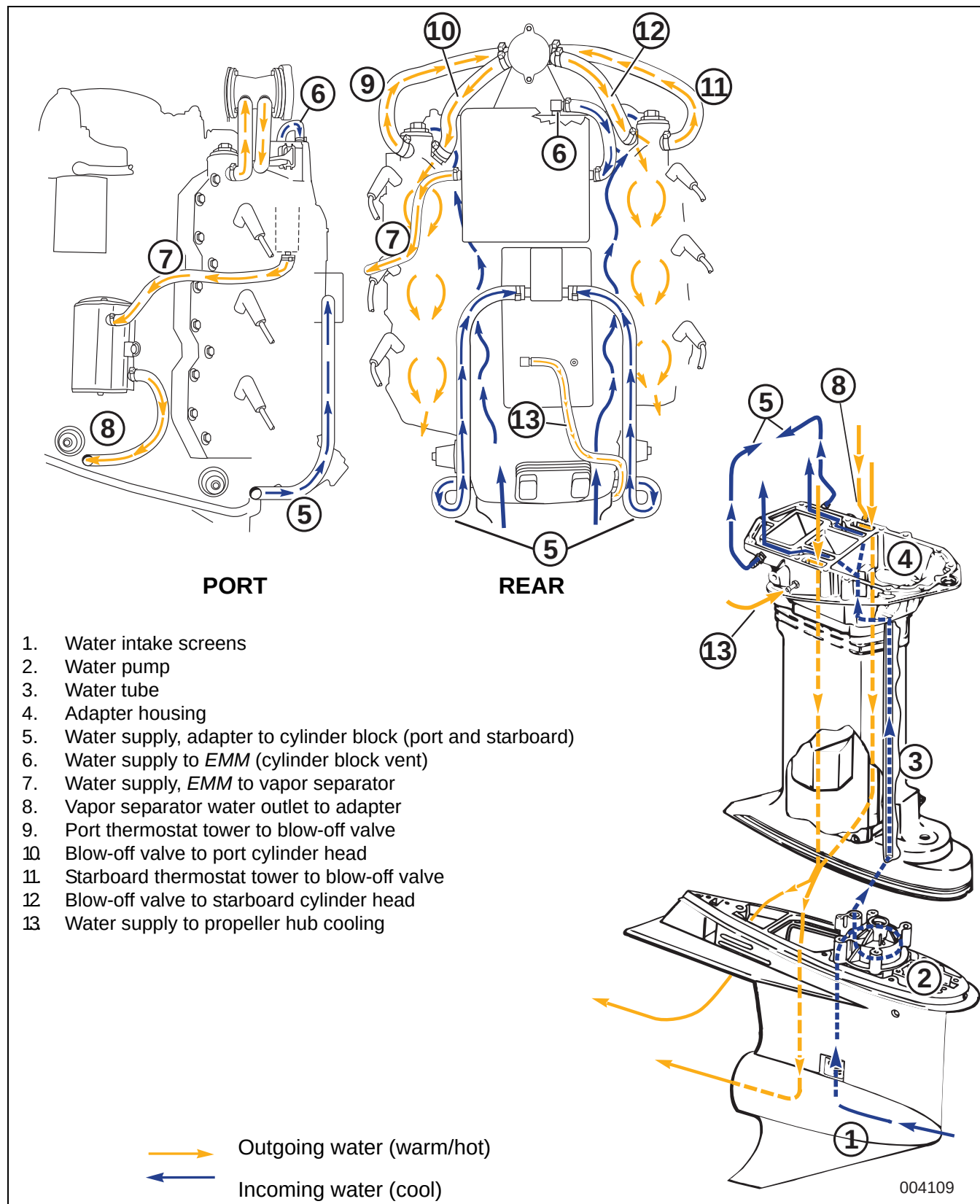
Table of Contents

Hose Routing and Water Flow Diagram 3.3 L	190
Hose Routing and Water Flow Diagram 3.4 L	191
Components	192
Water Pump and Intakes	192
Water Supply Tube	192
Adapter Housing	192
Pressure Relief Valve	193
Thermostats	193
Block Venting	193
Operation	194
Cylinder Block / Cylinder Head Cooling	194
<i>EMM</i> and Vapor Separator Cooling	195
Engine Temperature Check	195
Software Method	196
Pyrometer Method	196
Idle Operating Temperature Troubleshooting (Below Range)	196
Temperature Sensor Servicing	198
Removal	198
Installation	198
Thermostat Servicing	199
Disassembly	199
Inspection	199
Assembly	199
Pressure Relief Valve Servicing	199
Disassembly	199
Inspection	199
Assembly	200

Cooling System

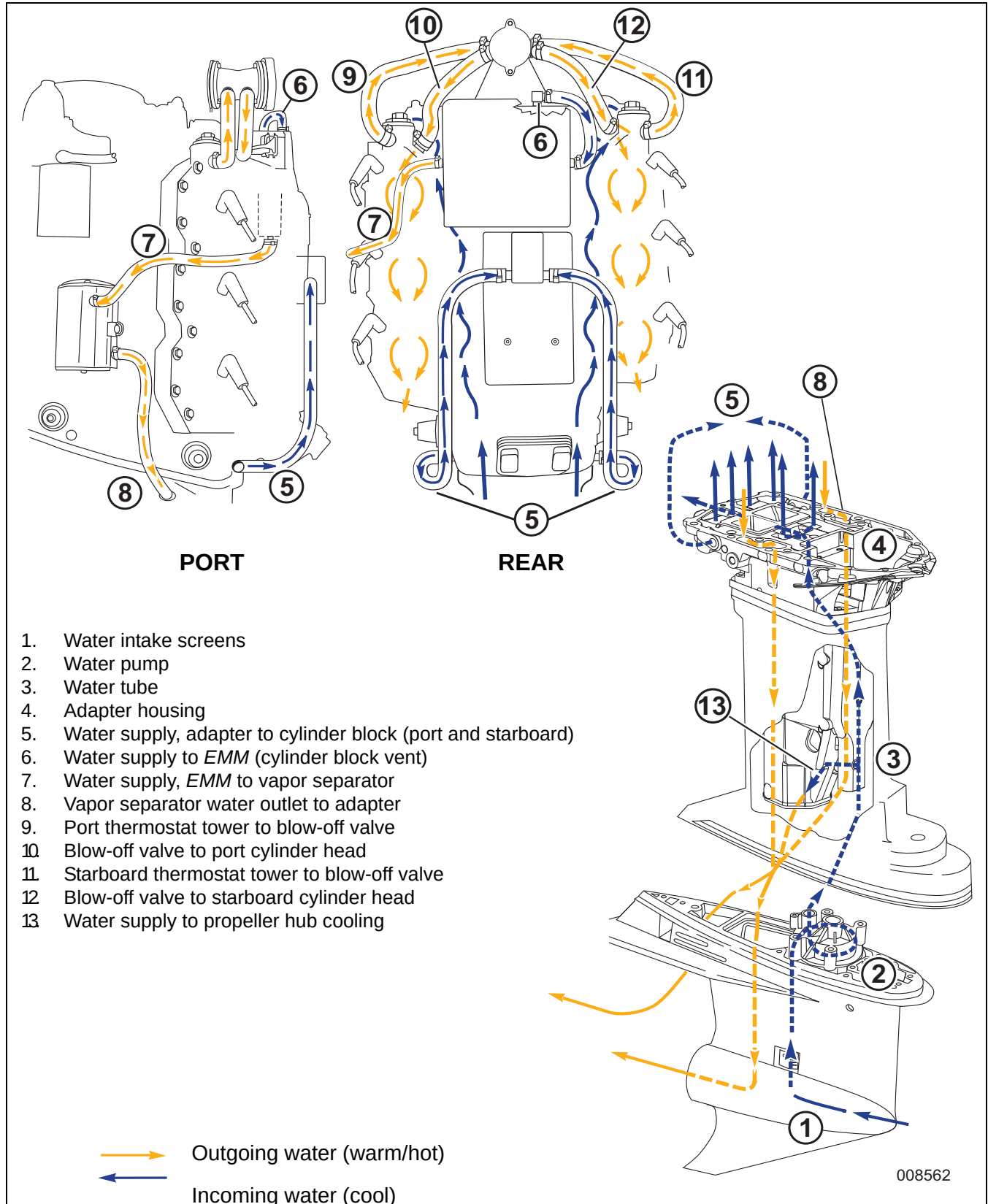
Hose Routing and Water Flow Diagram 3.3 L

Hose Routing and Water Flow Diagram 3.3 L



004109

Hose Routing and Water Flow Diagram 3.4 L



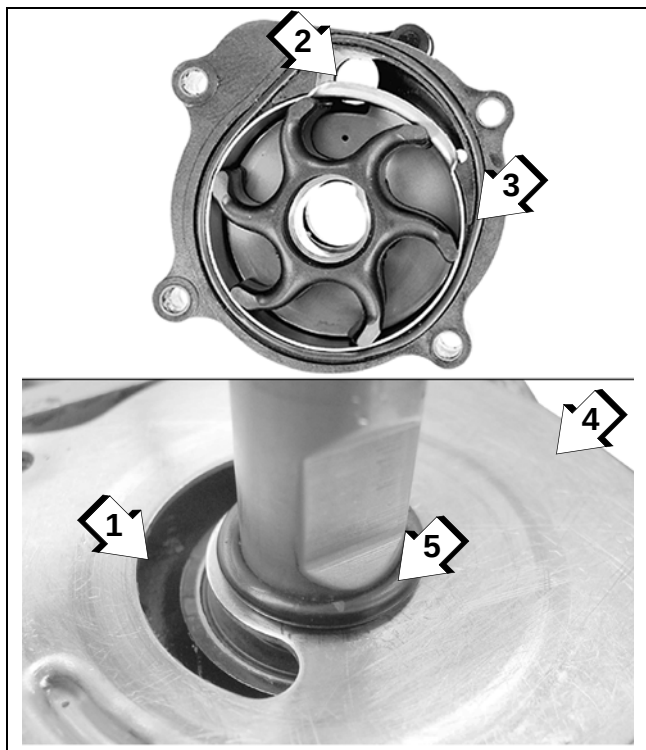
Components

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** in the **Gearcase** service manual for water pump servicing.



(Impeller key removed for clarity)

1. Water inlet
2. Water outlet
3. Seal
4. Plate
5. O-ring

000697
DSC02328

Water Supply Tube

The water pump outlet connects with the water supply tube located in the outboard's midsection. Grommets seal the water tube to the water pump housing and the inner exhaust housing.

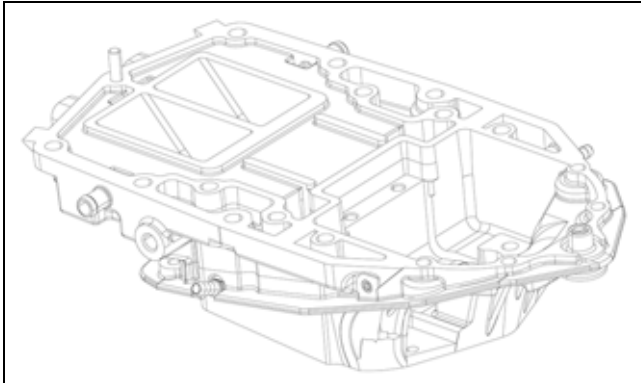
On 3.3 L models, the water tube fastens to the inner exhaust housing with a water plate and screws.

Water supplied to the water tube provides all cooling water to the adapter housing and cylinder block.

Adapter Housing

- Adapts the cylinder/crankcase assembly (powerhead) to the exhaust housing and the water tube.
- Provides water passages which route incoming and outgoing cooling water.

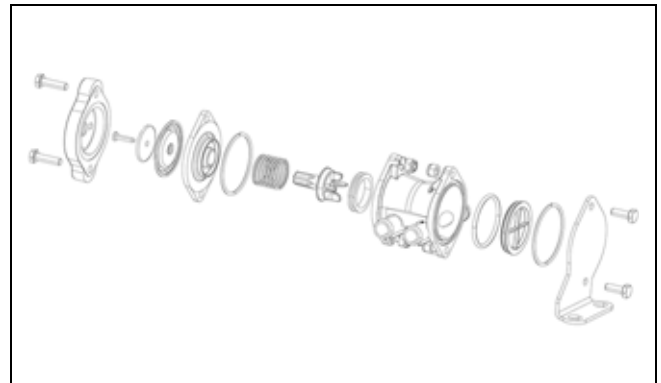
- Provides exhaust passages which connect to the gearcase.



Adapter housing – 3.3 L models

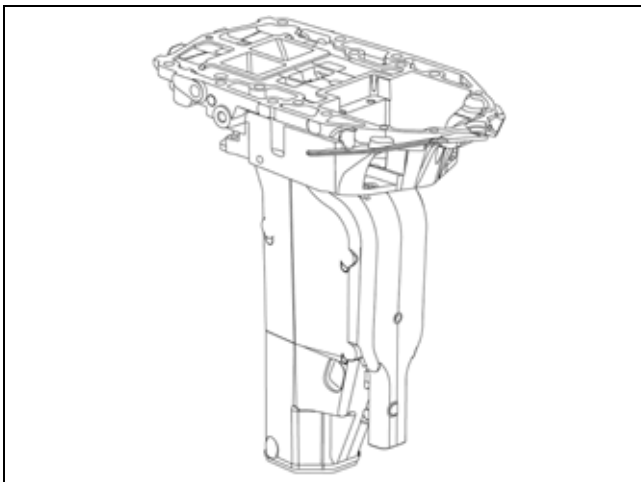
000695

Overcooling: Debris may prevent the valve from closing completely.



Pressure Relief Valve Components

DRC8113



Adapter housing – 3.4 L models

006991

Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 1200 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.

Thermostats

Thermostats control water flow and operating temperature at lower speeds (below 1200 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.



Thermostat

DSC02335

Block Venting

A fitting and hose from the top of the block 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.

Operation

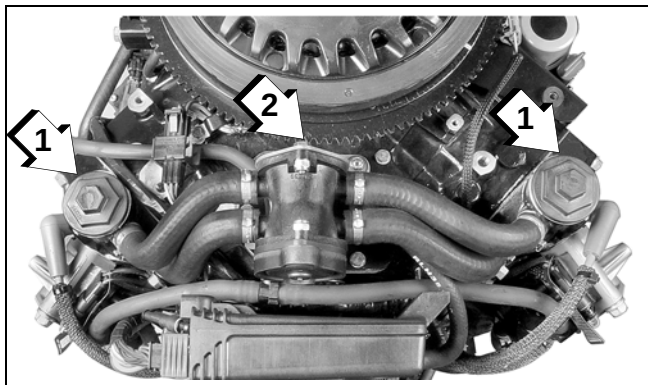
NOTICE

Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

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.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cylinder block and cylinder heads is controlled by two thermostats and one external pressure valve. The pressure valve is connected by hoses to the top of each cylinder head.



1. Thermostats
2. Pressure valve assembly

004269

The thermostats and pressure valve control the flow of water entering the vertical water passages of the cylinder heads.

At low speed, the pressure valve is against the seat and the thermostats are closed. Warm water from the cylinder block gradually migrates to the thermostat pocket at the top of each cylinder head.

The thermostat opens when the water temperature reaches approximately 143°F (62°C).

When the thermostat opens, water flows down through the cylinder head to a passage in the cylinder block. Water flows through the block to the exhaust housing and then out of the outboard.

At higher speeds, water pressure opens the pressure relief valve at approximately 1200 RPM. Water flows through the valve and bypasses the thermostats. Hoses route the water flow from the pressure valve to the vertical water passages below the thermostats. All water flows through the cylinder heads to the outlet passages of the block and then exits through the adapter housing.

This pressure controlled water outlet circuit provides a “high flow” discharge of water during high speed operation.

This cooling system configuration provides “balanced cooling” at higher RPM by using one pressure valve to control the discharge of water through both cylinder heads.

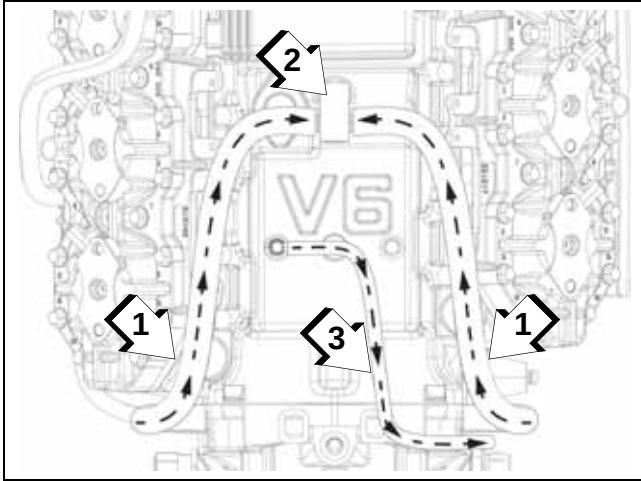
Additional Cooling

Two external water supply hoses direct water flow into the exhaust (plenum) area of the cylinder block. The water reduces exhaust runner temperatures and circulates through the cylinder block.

The base gasket limits water flow to the base of the block and diverts water flow to the rear port and rear starboard fittings of the adapter housing.

On 3.3 L models, a third external water hose directs water flow from the exhaust housing of the cylinder block to an exhaust passage at the

adapter. The water reduces inner exhaust temperatures and cools the propeller hub.



3.3 Liter Models
1. External water supply hoses
2. Exhaust (plenum)
3. Inner exhaust cooling hose

000698r

On 3.4 L models, propeller hub cooling water flows through an internal passage of the inner 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 adapter/exhaust housing.

Engine Temperature Check

⚠ CAUTION

When servicing the propeller, always shift the outboard to **NEUTRAL**, turn the key switch **OFF**, and disconnect the Crankshaft Position Sensor (CPS) to prevent accidental engine starting.

IMPORTANT: The engine temperatures listed below are based on an intake water temperature of $70^{\circ} \pm 10^{\circ}\text{F}$ ($21^{\circ} \pm 3^{\circ}\text{C}$).

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.

Check temperature on both sides of powerhead.

If engine temperature is not within range, troubleshoot cooling system.

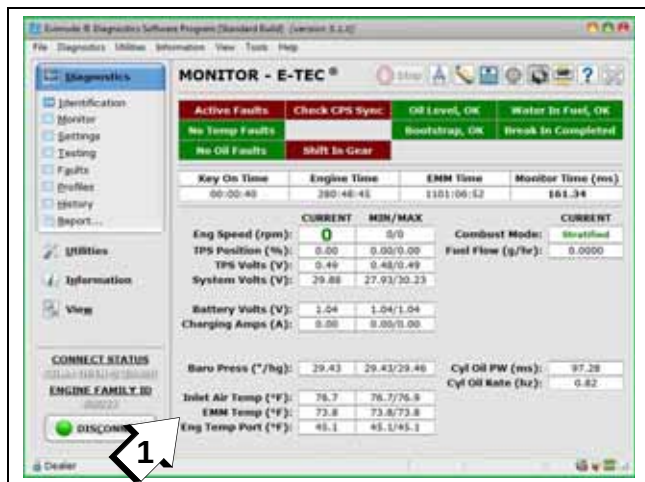
If engine temperature tests within range, but the engine monitor display indicates a "WATER TEMP" warning, refer to **WATER TEMP/ HOT Circuit Test** on p. 110.

Cooling System

Engine Temperature Check

Software Method

Use *Evinrude Diagnostics* software to read temperature displays.



Engine Monitor Screen

008104

Typical temperature displays at IDLE speed should be $160^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($71^{\circ}\text{C} \pm 6^{\circ}\text{C}$)

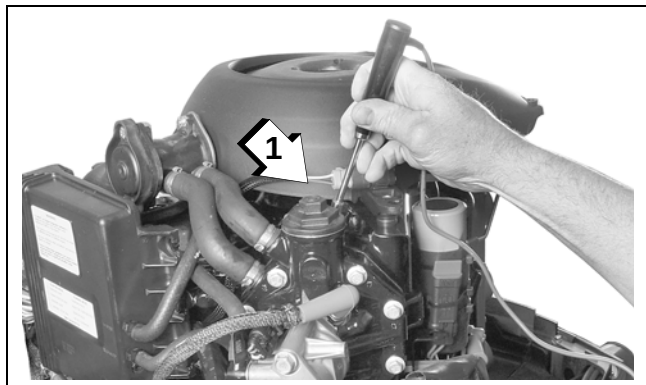
Typical temperature displays at WOT speed should be $150^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($66^{\circ}\text{C} \pm 8^{\circ}\text{C}$)

Operating temperature must not exceed 194°F (90°C).

Pyrometer Method

Use a Temperature Gun, P/N 772018, or a digital pyrometer to measure the outboard's operating temperatures.

Measure temperature at the top of cylinder block, next to the thermostat housing and cylinder head. Check temperature on both sides of powerhead.



1. Top of cylinder block (starboard side)

004339

Typical pyrometer readings at IDLE speed should be $143^{\circ}\text{F} \pm 15^{\circ}\text{F}$ ($62^{\circ}\text{C} \pm 8^{\circ}\text{C}$)

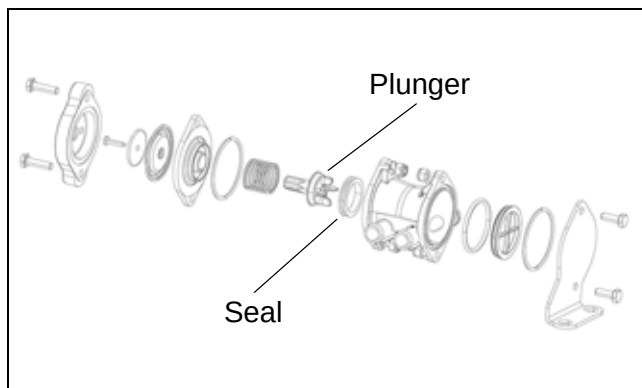
IMPORTANT: If you get low or inaccurate readings with a digital pyrometer, coat the probe location with *Thermal Joint Compound*, P/N 322170.

Idle Operating Temperature Troubleshooting (Below Range)

If engine IDLE temperature is below operating range $160^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($71^{\circ}\text{C} \pm 6^{\circ}\text{C}$), check thermostat and pressure relief valve operation.

Pressure Relief Valve

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

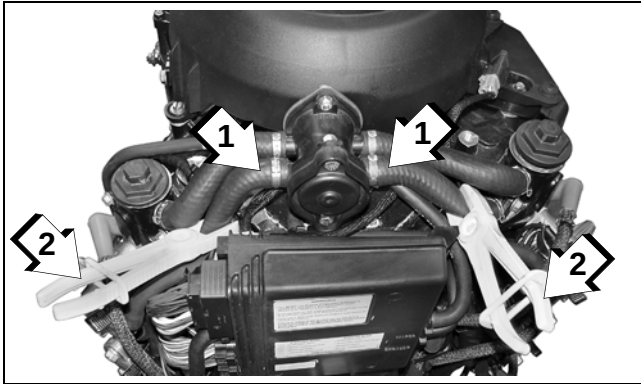


Pressure Relief Valve

DRC8113

Start the outboard and check IDLE operating temperature.

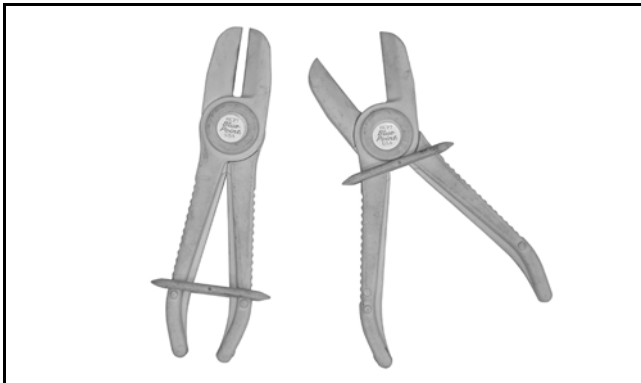
If IDLE temperature is too low, pinch off the water outlet hoses from pressure relief valve to cylinder heads.



1. Outlet hoses
2. Pliers

DSC00827

Use hose pinching pliers (acquired through local tool source) to prevent hose damage.



Hose Pinching Pliers

DSC00830

Start the outboard and check IDLE operating temperature using *Evinrude Diagnostics* software program.

If IDLE temperature increases to specific operating range, $160^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($71^{\circ}\text{C} \pm 6^{\circ}\text{C}$), after pinching off hoses and eliminating water flow to the cylinder heads, pressure relief valve is leaking. Replace pressure relief valve.

If IDLE temperature is still below operating range with hoses pinched off, inspect thermostats and thermostat seals.

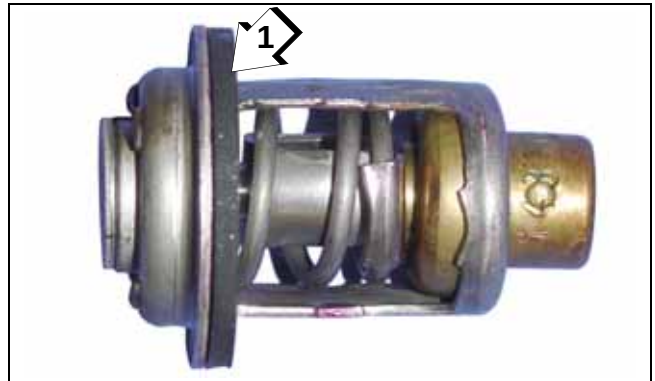
Thermostats

Remove thermostat cover(s) and inspect thermostat(s).



004338

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



1. Seal, thermostat

DSC02335

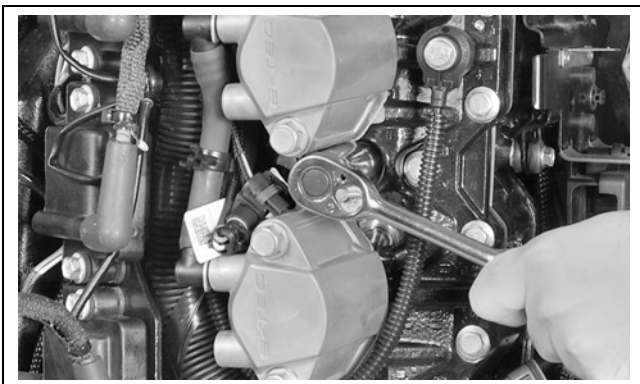
Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

Temperature Sensor Servicing

Wait 10 minutes for trapped air to bleed from cavity. Thermal compound may seep past threads. Retighten sensor.

Removal

Loosen sensor and remove by hand. Use care to avoid breaking threads.



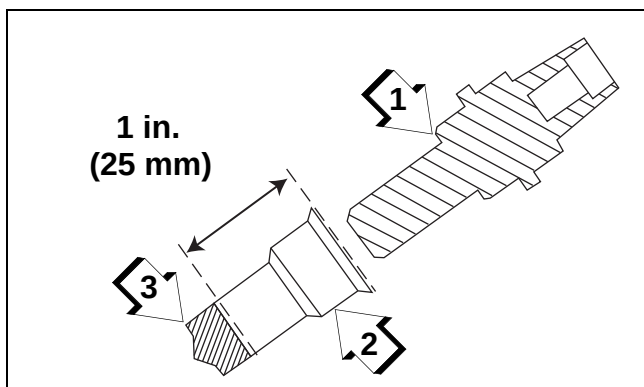
007209

Clean sensor threads, sensor, and sensor cavity.

Installation

Fill bottom of sensor cavity with 0.7 cc of *Thermal Joint Compound*, P/N 322170. Sensor cavity should be filled to 1 inch (25 mm) below the top edge of the cavity.

Install sensor. DO NOT use gasket sealing compound. SLOWLY tighten temperature sensor to a torque of 50 to 70 in. lbs. (5.6 to 8.0 N·m).



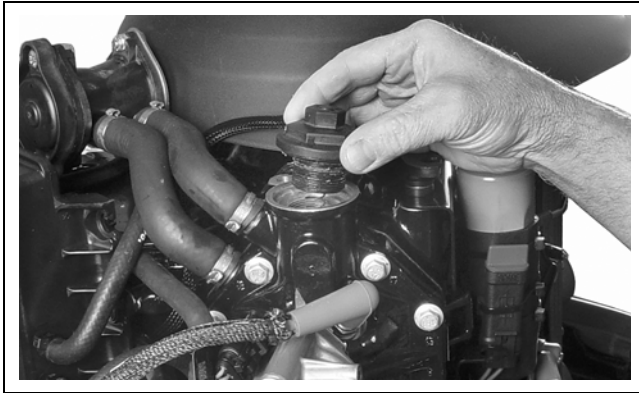
1. Temperature sensor
2. Sensor cavity
3. Thermal joint compound

007049

Thermostat Servicing

Disassembly

Remove the thermostat cover and O-ring from cylinder head.

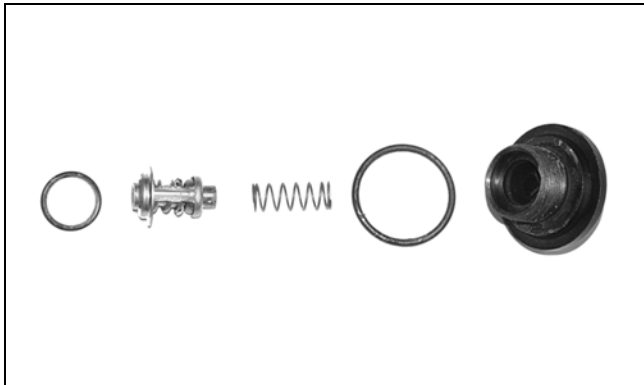


004338

Remove spring, thermostat, and gasket.

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.



000757

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

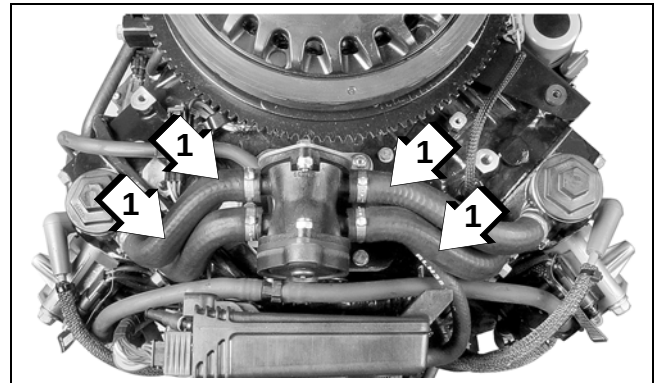
Coat threads of each cylinder head thermostat cover with *Triple Guard* grease. Install and tighten the cover to a torque of 120 to 144 in. lbs. (13.5 to 16.5 N·m).

Pressure Relief Valve Servicing

The pressure relief valve assembly should be serviced at the same time as the thermostats.

Disassembly

Remove hose clamps and hoses from pressure valve.

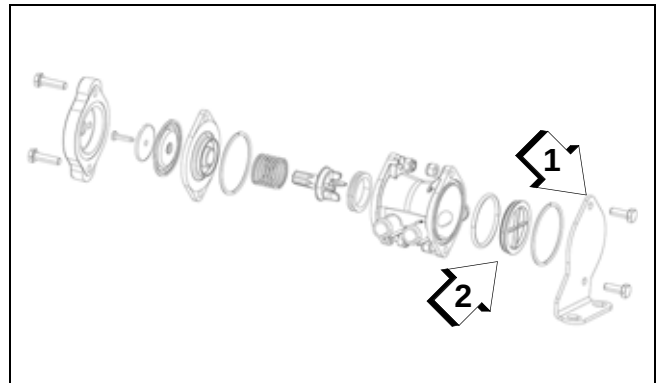


1. Hoses

004269

Remove screws securing the bracket to powerhead. Remove the pressure valve housing.

Remove the bracket and the cap from the housing. Remove the pressure valve assembly.



1. Bracket
2. Cap

DRC8113

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.

Cooling System

Pressure Relief Valve Servicing

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

Tighten bracket and cap screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Install valve on powerhead. Tighten nuts to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Install hoses and secure with clamps.

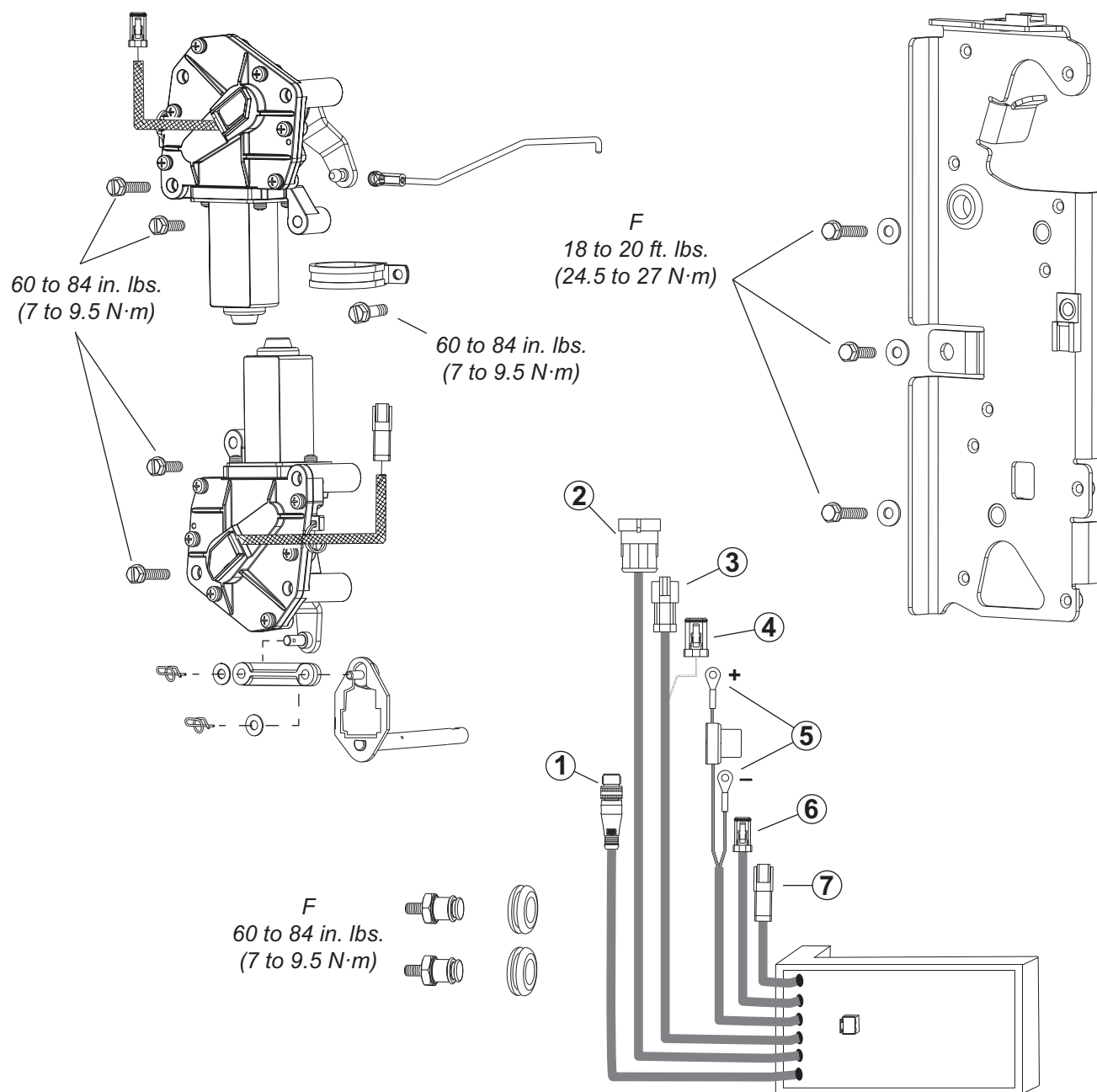
Evinrude ICON Remote Control System

Table of Contents

Service Chart	202
Components	203
Electronic Servo Module (ESM)	203
Shift Actuator	203
Throttle Actuator	204
ICON System Failsafe Mode	204
ICON Component Servicing	205
Electronic Servo Module (ESM)	205
Shift Actuator	208
Throttle Actuator	210
ICON System Settings	212
Set Engine Identity (Instance)	212
Calibrate Actuator Stroke	213
ICON System Faults	216
Recoverable Faults	216
Non-recoverable Faults	217
ICON System Fault Code Chart	218

Service Chart

- | | |
|---|---------------------------------------|
| 1. ICON buss cable connector | 5. ESM power supply |
| 2. ESM to EMM connector | 6. ESM to shift actuator connector |
| 3. ESM to engine harness key switch connector | 7. ESM to throttle actuator connector |
| 4. ESM to trim/tilt connector | |



008091R

F Blue Nut Lock

X See service manual

Components

The *ICON* remote control system consists of the following components:

- *ICON* remote control and boat network
- One, two, three, four or five outboards
- Electronic Servo Module (ESM)
- Shift Actuator
- Throttle Actuator

Electronic Servo Module (ESM)

The Electronic Servo Module (ESM) receives shift, throttle and other control information from the *ICON* remote control.

The ESM activates the shift and throttle actuators to the positions commanded by the remote control.



Electronic Servo Module (ESM)

007525

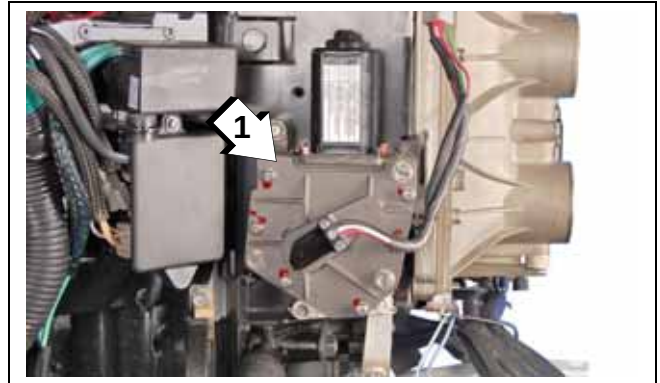
If the *ICON* remote control cannot communicate with the ESM, all LED indicators flash until control levers and shift actuators are in NEUTRAL.

Then, the NEUTRAL indicator LED for the outboard that has a fault flashes. The *EMM*:

Activates S.A.F.E.
Stores service code 108 and 111
Engine Monitor display: RPM reduction, ICON fault 111, see dealer

Shift Actuator

The shift actuator converts electronic signals from the ESM into the mechanical motion required to shift the outboard into and out of gear.



Shift Actuator

008505

If the shift actuator sensor cannot determine gear position, all LED indicators flash until control levers and shift actuators are in NEUTRAL.

Then, the NEUTRAL indicator LED for the engine that has a fault flashes. The *EMM*:

Activates S.A.F.E.
Stores service code 108 and 151
Engine Monitor display: RPM reduction, ICON fault 151, see dealer

If the shift actuator is unable to move to a commanded position, the FORWARD, NEUTRAL or REVERSE indicator LED flashes to indicate which gear position is affected. The *EMM*:

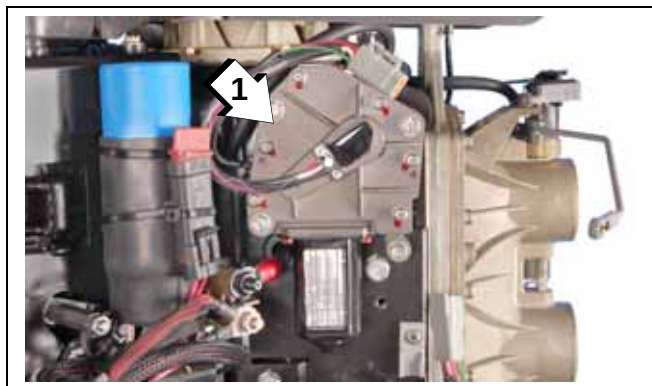
Activates S.A.F.E.
Stores service code 108 and 152
Engine Monitor display: RPM reduction, ICON fault 152, see dealer

Evinrude ICON Remote Control System

Components

Throttle Actuator

The throttle actuator converts electronic signals from the ESM into the mechanical motion required to move the throttle of the outboard.



Throttle Actuator

007302

If the throttle actuator sensor cannot determine throttle position, all LED indicators flash until control levers and shift actuators are in NEUTRAL. Then, the NEUTRAL indicator LED for the engine that has a fault flashes. The *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 108 and 149
Engine Monitor display: RPM reduction, <i>ICON</i> fault 149, see dealer

If the throttle cannot move toward open position, the FORWARD or REVERSE indicator LED flashes (depending on gear position when fault occurred).

If the throttle cannot move toward closed position, all LED indicators flash until control levers and shift actuators are in NEUTRAL.

Then, the NEUTRAL indicator LED for the engine that has a fault flashes. The *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 108 and 150
Engine Monitor display: RPM reduction, <i>ICON</i> fault 150, see dealer

ICON System Failsafe Mode

Fault code 108 will appear with another code that explains why the engine(s) entered RPM reduction. The *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 108
Engine Monitor display: RPM reduction, <i>ICON</i> fault 108, see dealer

ICON Component Servicing

⚠ WARNING

To prevent accidental starting while servicing:

- Disconnect the battery cables at the battery.
- Disconnect the Crankshaft Position Sensor (CPS).

Electronic Servo Module (ESM)

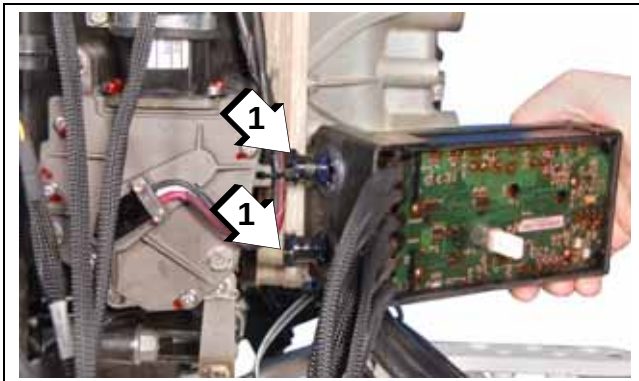
Disconnect the battery cables at the battery.

Removal

Disconnect the:

- ICON buss cable from ESM
- ESM CANbus harness from EMM
- ESM throttle actuator harness
- ESM shift actuator harness
- ESM power supply harness from solenoid and ground stud

Remove the ESM from studs.

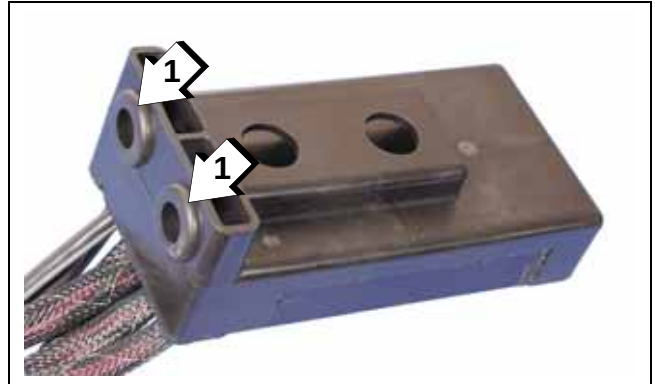


1. Studs

008506

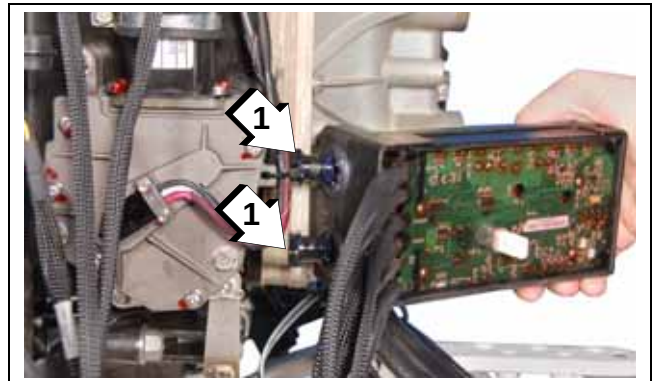
Installation

Install grommets on ESM. Apply soapy water to grommets and push assembly on to studs.



1. Grommets

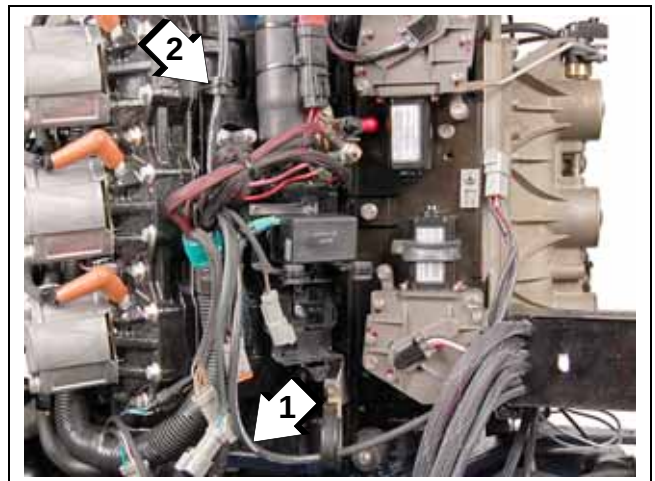
007500



1. Studs

008506

Route the CANbus harness from the ESM to the EMM as shown on the starboard side of outboard. Install grommet in notch on the electrical bracket.



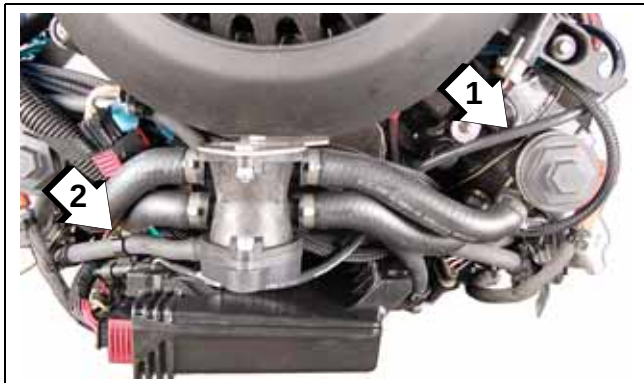
1. CANbus harness
2. Grommet

007495

Evinrude ICON Remote Control System

ICON Component Servicing

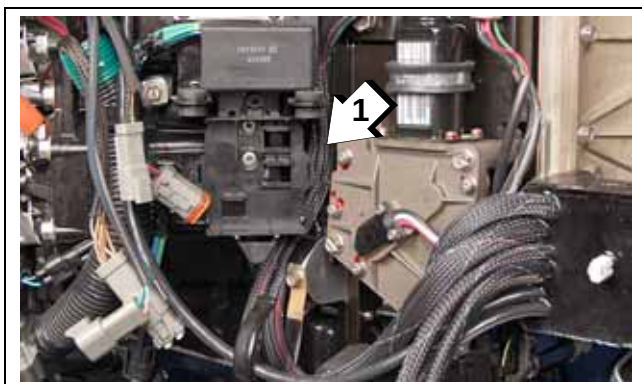
Continue harness routing under pressure relief valve hoses to *EMM* connector. Clip connector to fuel rail. Make sure harness is not strained and does not rub against *EMM* mounting boss.



1. CANbus harness
2. Connector clip

007502

Route ESM to actuator harnesses between actuator plate and engine electrical bracket as shown.



1. ESM to actuator harnesses

007496

Route the throttle actuator harness behind and over the oil recirculation hose as shown. Connect

to harness from ESM and attach to clip on mounting plate.

NOTICE

Make sure the oil recirculation hose is not pinched during assembly.



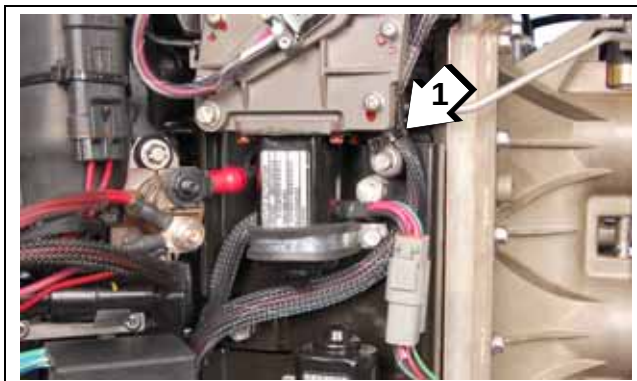
1. Harness
2. Hose

007497

Secure ESM to throttle actuator harness with tie strap, P/N 320107.

Route ESM to shift actuator harness behind throttle actuator and over throttle actuator harness. Attach to clip on mounting plate.

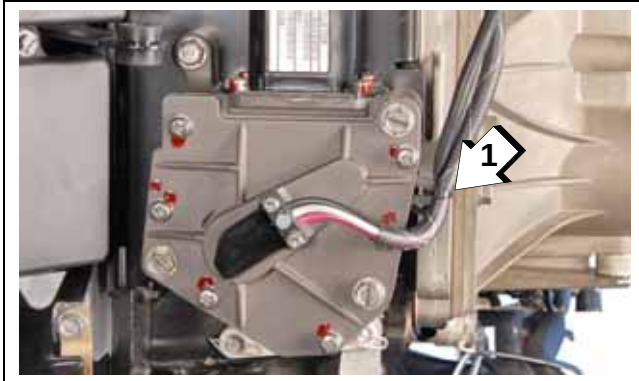
Install clamp over actuator motor and secure to plate with screw. Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Throttle harness tie strap

007498

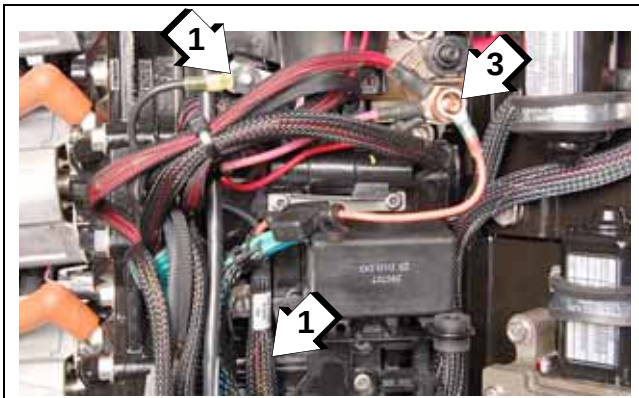
Secure shift actuator harness with tie strap, P/N 317893.



1. Shift harness tie strap

008514

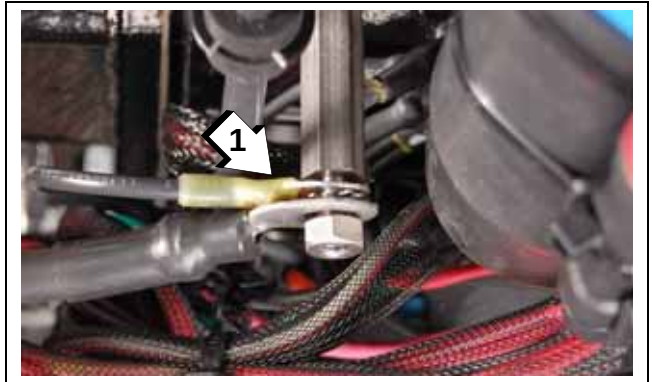
Route ESM power supply harness behind trim relay harness. Route negative (–) terminal to battery ground stud and positive (+) terminal to solenoid.



1. ESM Power supply harness
2. Ground stud
3. Solenoid

007499

Install ESM ground, star washer, battery cable, and nut on main ground stud. Tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. ESM Ground

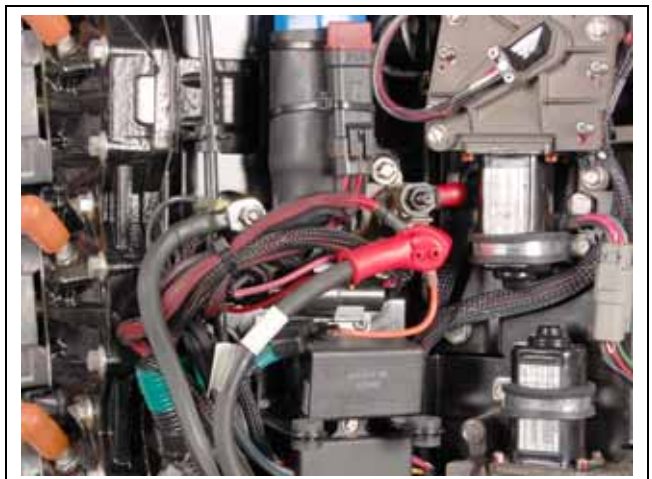
007507

Install copper crush washer over ESM positive ring terminal. Then, install star washer, battery cable, and nut. Tighten nut to a torque of 60 to 84 in. lbs (7 to 9.5 N·m).



1. Copper washer

007508



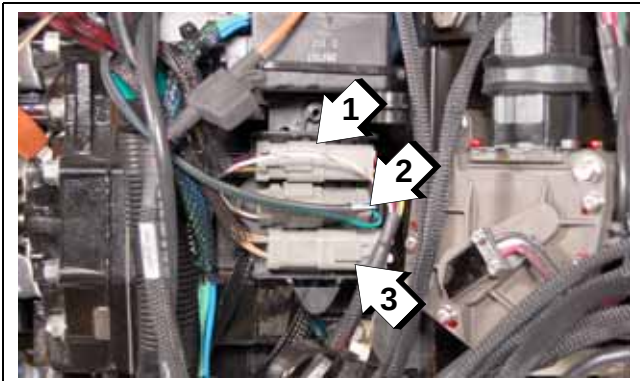
007526

Evinrude ICON Remote Control System

ICON Component Servicing

Connect ESM harness to engine harness key switch and trim/tilt connectors.

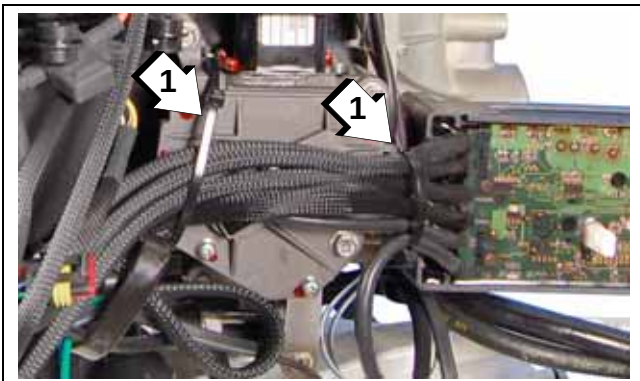
Secure connectors in bracket as shown and install connector cover.



1. Key switch connector
2. Trim/tilt connector
3. SystemCheck connector

008507

Route all ESM harnesses as shown and secure to shift actuator with long tie straps, P/N 907833.



1. Long tie straps

008508

Install electrical bracket cover.



007525

IMPORTANT: Calibrate shift and throttle actuators. Refer to **Calibrate Actuator Stroke** on p. 213.

Shift Actuator

Removal

Disconnect the battery cables at the battery.

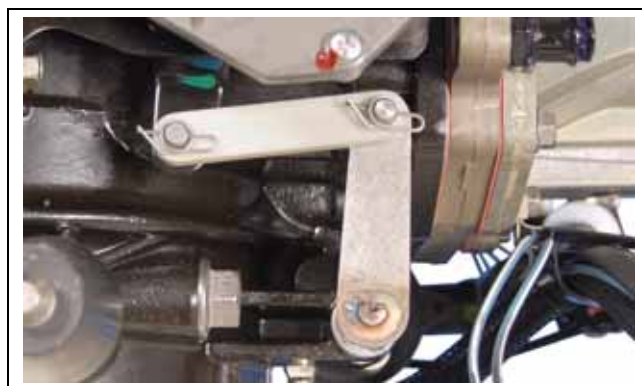
Remove electrical bracket cover.

Observe and note all wire routings before disassembling.



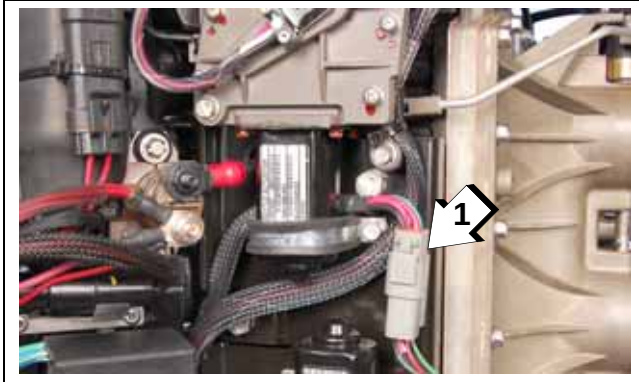
007525

Remove clips and washers from the shift link.
Remove the shift link.



008509

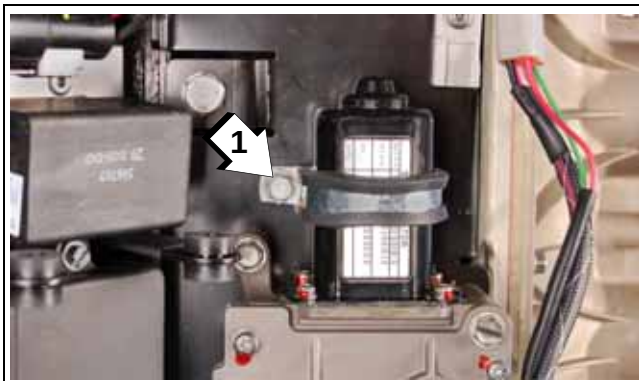
Remove the shift actuator connector from the clip on the mounting plate. Disconnect the shift actuator harness.



1. Shift actuator connector

007498

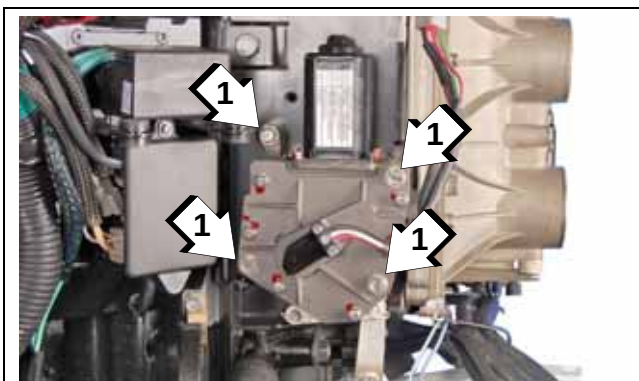
Remove the clamp retaining screw.



1. Clamp retaining screw

007301

Remove the four shift actuator retaining screws.



1. Shift actuator retaining screws

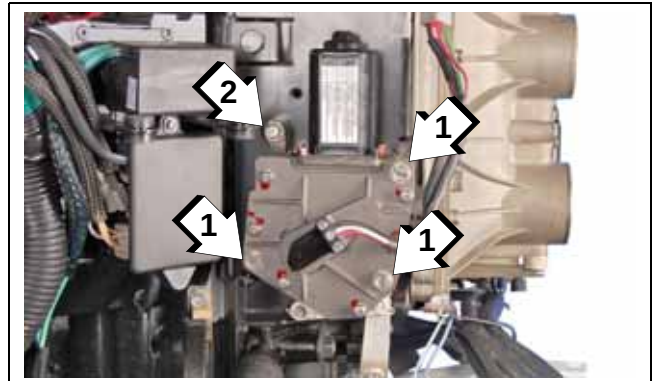
008505

Installation

Remove old adhesive from clamp retaining screw and shift actuator retaining screws.

Apply *Nut Lock* to the threads of the screws.

Install shift actuator on mounting plate with three long screws and one short screw. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Long screws
 2. Short screw

008505

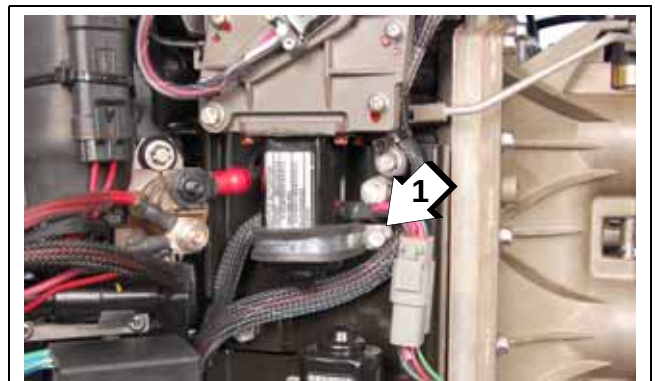
Place clamp over actuator motor. Install and tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Clamp retaining screw

007301

Connect the shift actuator harness. Attach to clip on mounting plate.



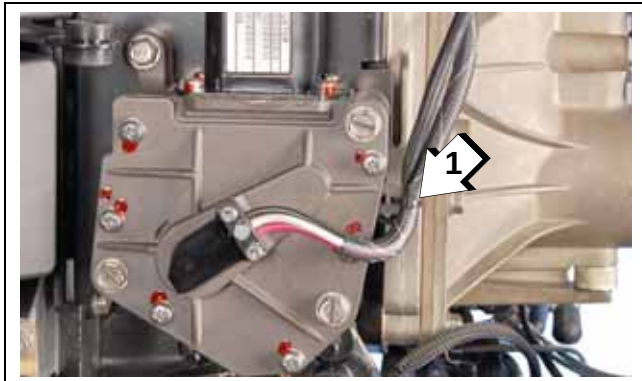
1. ESM to shift actuator harness

007498

Evinrude ICON Remote Control System

ICON Component Servicing

Secure shift actuator harness with tie strap, P/N 317893.



1. Shift harness tie strap

007872

Route all ESM harnesses as shown and secure to shift actuator with tie straps, P/N 907833.



1. Large tie straps

008508

IMPORTANT: Do not install shift link until the calibration procedure has been completed. Refer to **Calibrate Actuator Stroke** on p. 213.

Throttle Actuator

Removal

Disconnect the battery cables at the battery.

Remove the flywheel cover. Remove the electrical bracket cover.

Observe and note all wire routings before disassembling.



007525

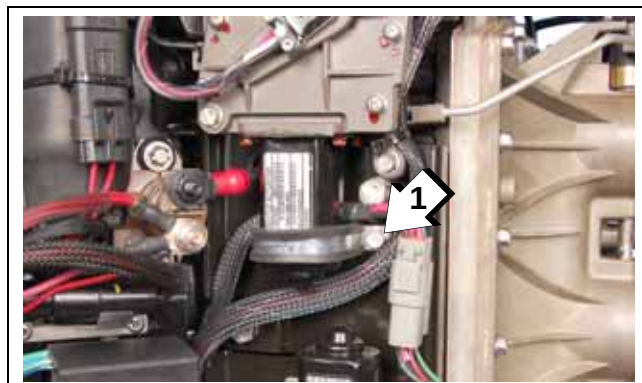
Remove the throttle actuator connector from the clip on the mounting plate. Disconnect the throttle actuator harness.



1. Throttle actuator connector

007497

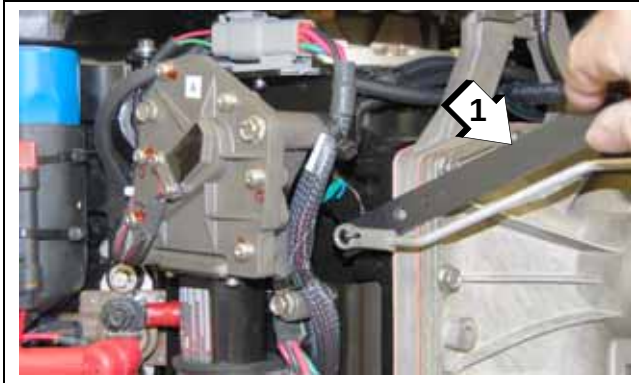
Remove the clamp retaining screw.



1. Clamp retaining screw

007498

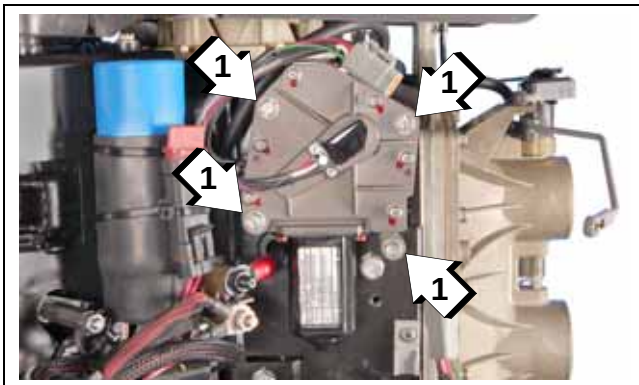
Use Ball Socket Remover tool, P/N 342226, to remove throttle link from actuator arm.



1. Ball Socket Remover tool, P/N 342226

008034

Remove the four throttle actuator retaining screws.



1. Throttle actuator retaining screws

007302

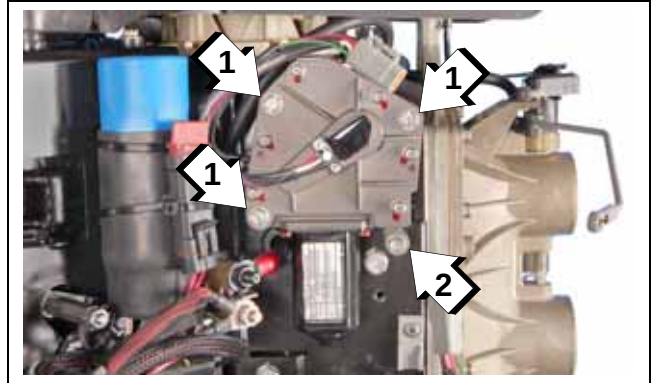
Installation

Remove old adhesive from clamp retaining screw and shift actuator retaining screws.

Apply *Nut Lock* on the threads of the screws.

Install throttle actuator on mounting plate with three long screws and one short screw. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

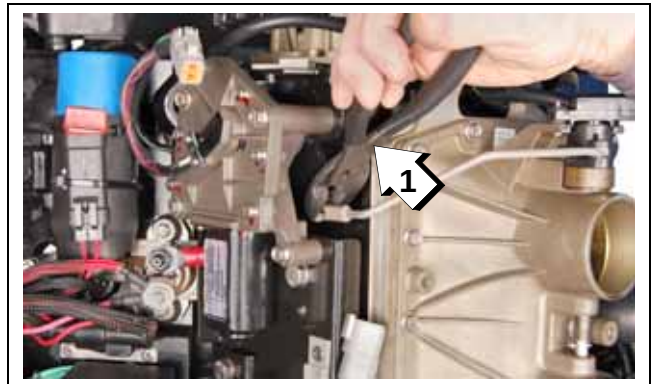
Do not install clamp until wiring harnesses have been secured.



1. Long screws
2. Short screw

007302

Use Ball Socket Installer tool, P/N 342225, to snap throttle link onto actuator arm.



1. Ball Socket Installer tool, P/N 342225

007303

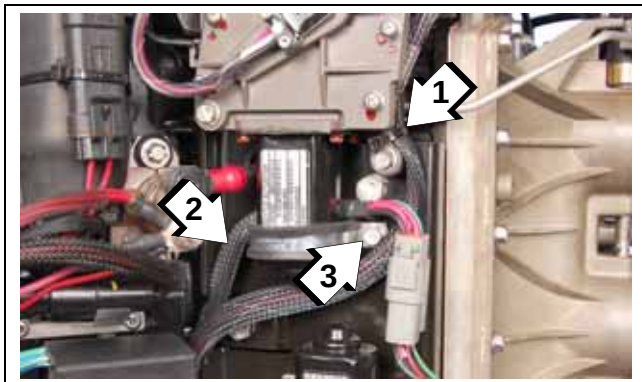
Secure ESM to throttle actuator harness with tie strap, P/N 320107.

Route ESM to shift actuator harness behind throttle actuator and over throttle actuator harness.

Evinrude ICON Remote Control System

ICON System Settings

Place clamp over actuator motor. Install and tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



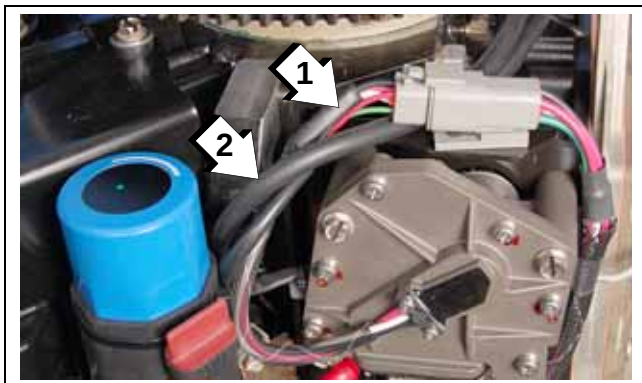
1. Tie strap
2. ESM to shift actuator harness
3. Clamp retaining screw

007498

Route the throttle actuator harness behind and over the oil recirculation hose as shown. Connect the throttle actuator harness. Attach to clip on mounting plate.

NOTICE

Make sure the oil recirculation hose is not pinched during assembly.



1. Throttle actuator harness
2. Oil recirculation hose

007497

IMPORTANT: Calibrate actuator. Refer to **Calibrate Actuator Stroke** on p. 213.

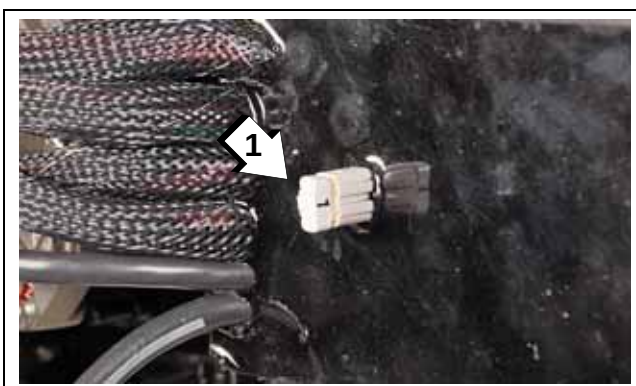
ICON System Settings

Set Engine Identity (Instance)

In a multi-engine application, the transom position of the outboard must be identified on the network.

Engine identity is set by an Engine Identity Plug installed in the ESM. Outboards are identified as Instance 0 through 4, from port to starboard, up to five engines.

Each identity plug is stamped with its instance number.



1. Engine Identity plug

007505

If the outboard is a single engine or the port engine in a multi-engine application, no changes are required.

For all other outboards, engine identity must be set by replacing the original plug (0) with the plug that corresponds to the outboard's position on the transom.

Number of Outboards	Identity Numbers				
	Port	Port Center	Center	Starboard Center	Starboard
1	0				
2	0				1
3	0		1		2
4	0	1		2	3
5	0	1	2	3	4

IMPORTANT: The Engine Identity Plug overrides any previous *EMM* instance setting.

Calibrate Actuator Stroke

⚠ CAUTION

After installation, dealer **MUST** use Evinrude Diagnostics software, version 5.1 or higher, to calibrate the actuators for correct throttle and shift stroke.

Failure to calibrate shift stroke will lead to gearcase failure and possible loss of boat control not covered by warranty.

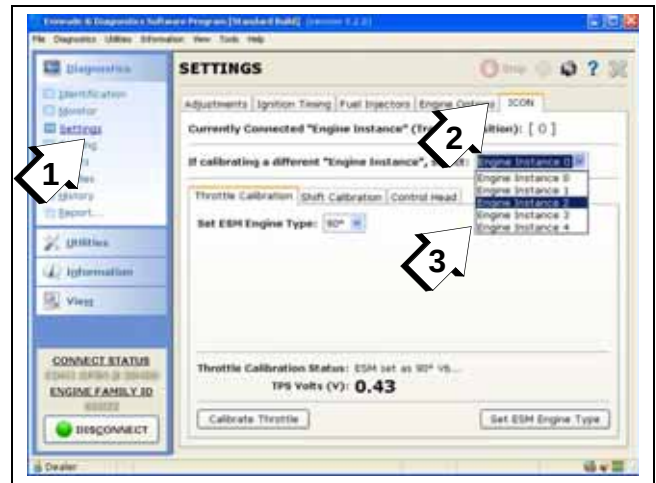
The Evinrude *ICON* actuators do NOT require periodic calibration. The shift and/or throttle actuator **MUST** be calibrated when the following services are performed on engines equipped with electronic shift and throttle:

- Replacement of throttle or shift actuator
- Replacement of Electro Servo Module (ESM)
- Replacement of Throttle Position Sensor (TPS)
- Throttle or shift linkage removal/installation
- Powerhead removal/installation
- Gearcase removal/installation

To calibrate the actuators, use the *ICON* tab of the Evinrude Diagnostics Settings screen.

In a multi-engine application, all outboards can be calibrated through one connection. Use the *Engine Instance* menu to select the engine instance on the screen.

IMPORTANT: If the *ICON* tab is not available, make sure the engine management software has been updated to the correct revision.

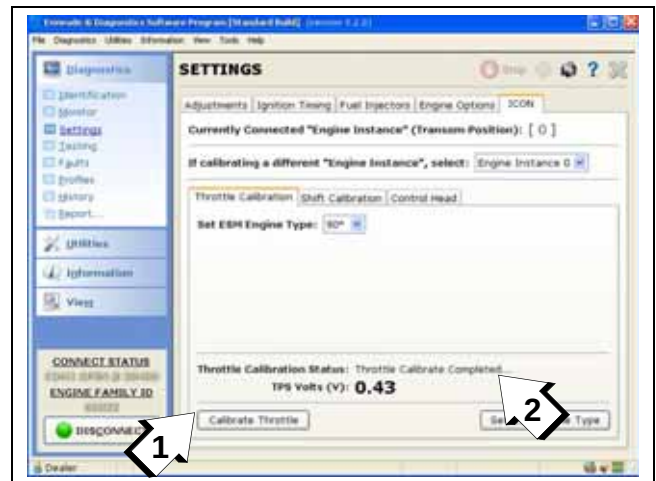


1. Settings
2. *ICON* tab
3. Engine instance menu

008578

Throttle Actuator Stroke

To set throttle stroke, click the *Calibrate Throttle* button. The actuator arm will move forward and back to find the mechanical limits of the throttle linkage. Evinrude Diagnostics reports when the process is complete.



1. Calibrate Throttle button
2. Process complete message

008583

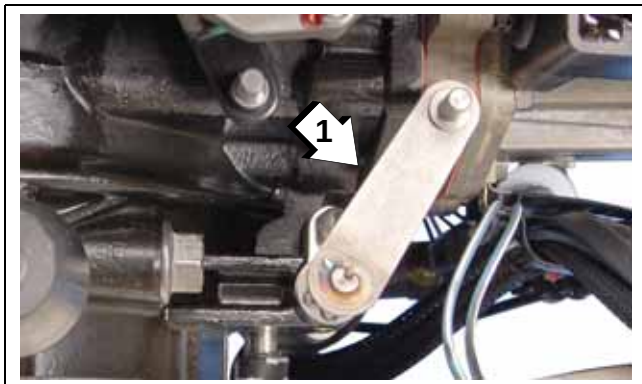
Shift Actuator Stroke

To set forward gear shift stroke:

Evinrude ICON Remote Control System

ICON System Settings

- With the shift link disconnected, rotate the propeller and manually shift the outboard into forward gear with the shift lever.
- When the link and pins are exactly aligned, install the link and click the Save button. The actuator will move to the neutral position.

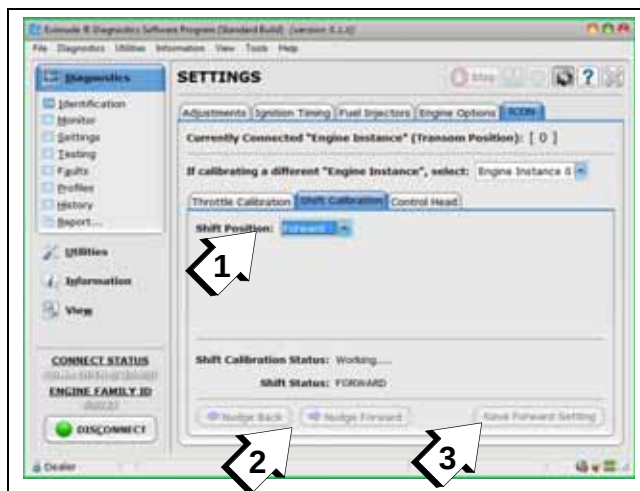


1. Shift lever in forward

008510

IMPORTANT: Make sure the gear is fully engaged and the lever is all the way forward.

- Select FORWARD under *Shift Position* on the *ICON* screen. The actuator arm will move forward.
- Use the *Nudge* buttons to move the actuator arm forward or backward until the shift link aligns with the actuator arm and shift lever pins.



1. Shift position
2. Nudge buttons
3. Save button

008579

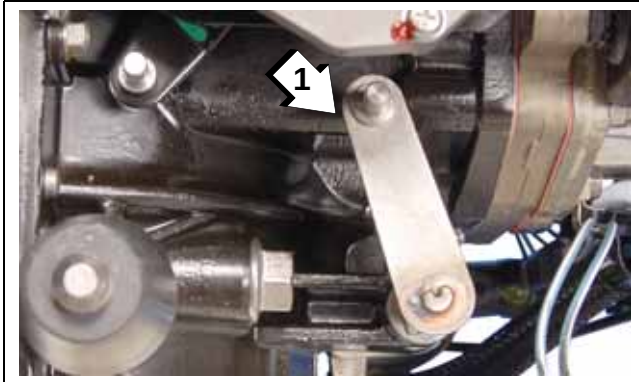


008511

To set reverse gear shift stroke:

- Remove shift link.

- With the shift link disconnected, rotate the propeller and manually shift the outboard into reverse gear with the shift lever.



1. Shift lever in reverse

008512

IMPORTANT: Make sure the gear is fully engaged and the lever is all the way to the rear.

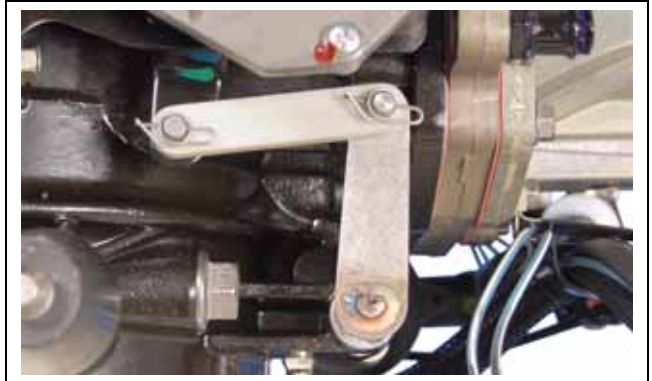
- Select REVERSE button under *Shift Position* on the *ICON* screen. The actuator arm will move backward. Use the *Nudge* buttons to align the shift link.
- When the link and pins are exactly aligned, install the link and click the *Save* button. The actuator will move to the neutral position.



008513

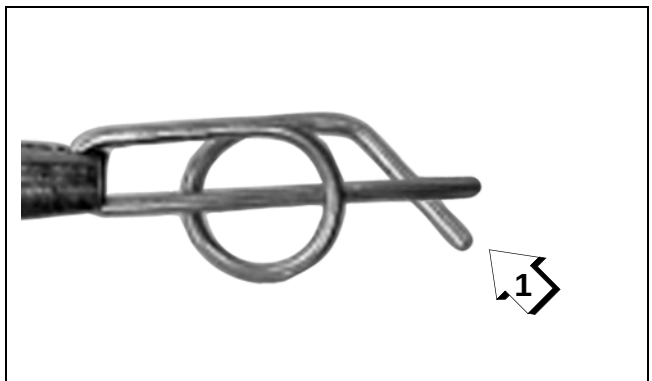
After forward and reverse strokes have been calibrated, the ESM calculates neutral position.

Install the shift link and secure with retainer clips and washers.



008509

Lock the retainers by moving the angled section **behind** the straight section.



Locked Retainer Clip

1. Angled section behind straight section

010303

NOTICE

When installation is complete, shift the outboard with the remote control (while rotating propeller). Rotate the propeller shaft back and forth to ensure the face of the clutch dog contacts the gear in both forward and reverse.

With the outboard in **NEUTRAL**, make sure the propeller shaft turns freely with no contact between the clutch dog and gears.

ICON System Faults

The *ICON* System exhibits two types of faults: **Recoverable** and **Non-recoverable**. *ICON* System faults are visually indicated by the remote control, the switch panels, the gateway, and the 6-port hub LED's. *ICON* System faults are also displayed on the *Faults* page of Evinrude *Diagnostics* and on the *NMEA 2000* gauges.

Recoverable Faults

Recoverable faults are Motion or Over-Current errors which occur on a throttle or shift actuator. A motion error occurs when the *ESM* is attempting to move an actuator from one position to another, but the actuator does not move. An over-current error occurs when the *ESM* is moving an actuator and the actuator draws too much current.

When recoverable faults are detected the remote control continues to send shift, throttle, trim, and start/stop commands as normal.

During a recoverable fault, the *ICON* System:

- Flashes a gear LED of the affected engine one time per second to indicate the gear position command that caused the fault.
- Sends a fault message to the outboard *EMM*. The *EMM* then sends a "Check Engine" message to the *NMEA 2000* gauges.
- Stops shift or throttle actuator movement at the point where the fault occurred
- Will NOT activate *S.A.F.E.*

When all control levers are put in NEUTRAL, the *ICON* System

- Stops flashing the FORWARD and NEUTRAL gear LED's
- Continues to flash the NEUTRAL LED of the faulty engine one time per second
- Allows shift or throttle actuator movement to continue up to the point where the fault occurred

Fault	Cause	Binnacle Control LED's (flashing)	CSM Remote Control Switch Panel LED (flashing)	Control Lever Position
FWD Shift	Motion or over-current error occurred while moving shift actuator from NTL to FWD	FWD	NTL	Move control lever back to NTL
REV Shift	Motion or over-current error occurred while moving shift actuator from NTL to REV	REV	NTL	Move control lever back to NTL
NTL Shift	Motion or over-current error occurred while moving shift actuator from FWD or REV to NTL	NTL	NTL	Move control lever to original position (FWD or REV)
Throttle Movement	Motion or over-current error occurred while moving throttle actuator when in FWD or REV	FWD LED if lever is in FWD	NTL	Move control lever toward idle and beyond the position where the fault occurred
		REV LED if lever is in REV	NTL	

Non-recoverable Faults

When a non-recoverable fault occurs, the *ICON* System:

- Flashes all gear position LED's of the affected engine five times per second
- Sends a fault message to the outboard *EMM*, which in turn sends a "Check Engine" message to the *NMEA 2000* gauges
- Activates *S.A.F.E.*
- Moves throttle actuators to idle, and shift actuators to NEUTRAL, if they are functional

When all control levers are put in NEUTRAL and all engines are in NEUTRAL-idle, the *ICON* System:

- Stops flashing the FORWARD and NEUTRAL gear LED's
- Flashes the NEUTRAL LED of the faulty engine five times per second if the condition is *ESM* or actuator related
- Turns OFF all gear LED's of the failed remote control lever, if the fault is lever-related
- Disables the faulty control lever or *ESM*
- Allows unaffected control levers and *ESM*'s to operate normally
- Retains SYNC function for non affected engines

If a port control lever has failed, starboard lever becomes the lead for SYNC.

If starboard control lever has failed, port lever becomes the lead for SYNC.

Station transfer is not allowed when a non-recoverable fault is present. The *ICON* System remains in this state until power is reset.

Operation stops if the control lever fails on a single binnacle or concealed side mount remote control.

ICON System Fault Code Chart

Use this chart and *Evinrude Diagnostics* software to identify *ICON* Remote Control System fault codes. Use the *ICON System Troubleshooting Flowcharts* to resolve a problem on an *ICON* System. Refer to the *Evinrude ICON System Troubleshooting Guide*.

Fault Code Description	LED Indicators	Possible Causes and Flowchart Reference
107 Remote Control Communication Error The outboard's <i>EMM</i> has not received a message from the remote control for more than 1.5 seconds. The fault message is generated by the outboard's <i>EMM</i> .	Gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	Remote control is not powered ON. The remote control buss cable is damaged or not connected. A remote control buss cable extension is damaged or not connected. 6-port hub LED is not ON 6-port hub connection port is damaged. Remote Control Power Check (Chart 5)
108 RPM Reduction (S.A.F.E.) Code 108 always appears with fault codes 107, 109, 111, 149 and 151. The fault message is sent from the remote control to the outboard's <i>EMM</i> .	Gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	Remote control not communicating with <i>ESM</i> . Remote control lever failure. <i>ESM</i> not communicating with remote control. Throttle actuator sensor failure Shift actuator sensor failure. See <i>Evinrude Diagnostics</i> or the service manual for other <i>S.A.F.E.</i> fault codes not caused by the <i>ICON</i> System. <i>ICON</i> System Fault Check (Chart 11)
109 Remote Control Lever Fault The remote control lever potentiometer resistance is out of range. The fault message is sent from the remote control to the outboard's <i>EMM</i> .	Gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	Remote control lever potentiometer failure. If this code is present, replace the remote control.

Evinrude ICON Remote Control System
ICON System Fault Code Chart

Fault Code Description	LED Indicators	Possible Causes and Flowchart Reference
110 Trim Switch Module Communication Fault Remote control cannot communicate with trim and tilt switch panel (3, 4, or 5 engines only). The fault message is sent from the remote control to the outboard's <i>EMM</i> .	None	Trim and tilt switch panel harness is damaged or not connected to the remote control. Trim and tilt switch panel harness is damaged or not connected to the switch panel. Trim and tilt switch panel circuit failure. Remote control is programmed with the wrong part number. Trim Panel Check (Chart 12) Remote Control Part Number Check (Chart 4)
111 ESM Communication Fault Remote control has detected a communication fault message from the <i>ESM</i> . The fault message is sent from the remote control to the outboard's <i>EMM</i> .	All gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	30A fuse for the <i>ESM</i> has failed. The <i>ESM</i> buss cable is damaged or not connected to the 6-port hub. The <i>ESM</i> buss cable extension is damaged or not connected to the 6-port hub. 6-port hub LED is not ON 6-port hub connection port is damaged. <i>ESM</i> instance plug numbers are duplicated. <i>ESM</i> Check (Chart 16)
149 Throttle Actuator Sensor Fault The <i>ESM</i> has lost the throttle actuator position sensor signal. The fault message is sent from the <i>ESM</i> to the outboard's <i>EMM</i> .	All gear position LED's flash five times per second. All gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	RFI due to excessive spark plug gap, damaged or worn spark plugs. The actuator and the <i>ESM</i> are not connected. The actuator and <i>ESM</i> connectors are damaged. The wiring of the actuator and <i>ESM</i> connectors are in the wrong locations. Throttle actuator position sensor failed. Throttle Actuator Sensor Check (Chart 17)

Evinrude ICON Remote Control System

ICON System Fault Code Chart

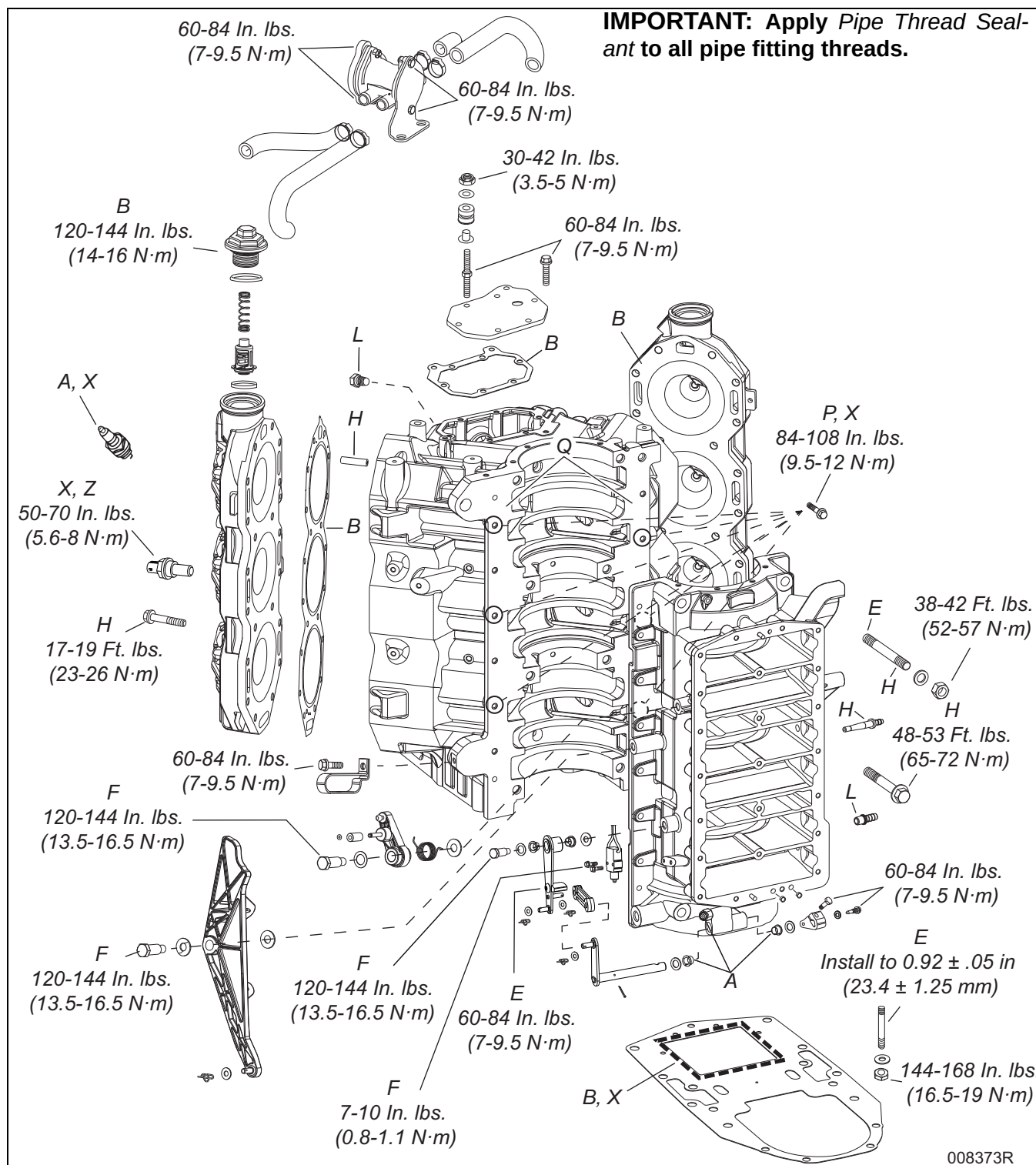
Fault Code Description	LED Indicators	Possible Causes and Flowchart Reference
150 Throttle Actuator Motion Fault The <i>ESM</i> tries to move the throttle actuator, but it will not attain the commanded position. This is caused by a motion or over-current error from the actuator. The fault message is sent from the <i>ESM</i> to the outboard's <i>EMM</i> .	FORWARD or REVERSE LED flashes (depending on gear position when fault occurred). With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash one time per second.	Throttle link arm from <i>ICON</i> add-on kit is not assembled to the outboard. Throttle linkage components are damaged or their movement is blocked. Starter cable is not correctly routed behind the actuator mounting plate. Throttle actuator has failed. Throttle Actuator Motion Check (Chart 17)
151 Shift Actuator Sensor Fault The <i>ESM</i> has lost the shift actuator position sensor signal. The fault message is sent from the <i>ESM</i> to the outboard's <i>EMM</i> .	All gear position LED's flash five times per second. With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash five times per second.	RFI due to excessive spark plug gap, damaged or worn spark plugs. The actuator and the <i>ESM</i> are not connected. The actuator and <i>ESM</i> connectors are damaged. The wiring of the actuator and <i>ESM</i> connectors are in the wrong locations. Shift actuator position sensor failed. Shift Actuator Sensor Check (Chart 18)
152 Shift Actuator Motion Fault The <i>ESM</i> tries to move the shift actuator, but it will not attain the commanded position. This is caused by a motion or over-current error on the actuator itself. The fault message is sent from the <i>ESM</i> to the outboard's <i>EMM</i> .	FORWARD or REVERSE LED flashes (depending on gear position when fault occurred). With the remote control lever in NEUTRAL, the NEUTRAL LED of the affected engine continues to flash one time per second.	<i>ICON</i> shift link is not assembled to the outboard. Shift linkage components are damaged or their movement is blocked. Shift stroke is not calibrated correctly. Shift actuator has failed. Shift Actuator Motion Check (Chart 20)

Powerhead

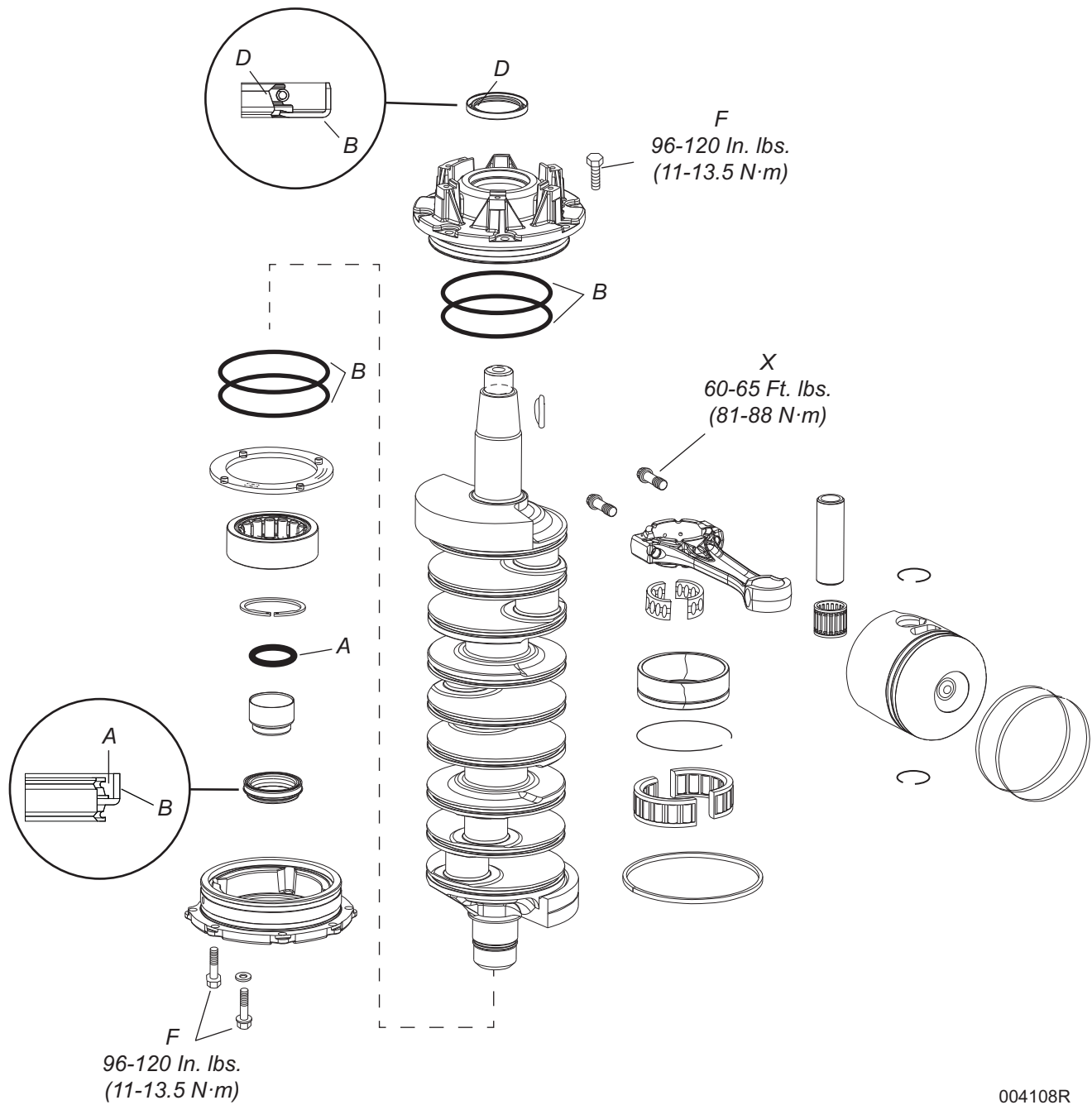
Table of Contents

Service Charts	222
Taper Pin Tool	224
Piston Pin Retainer Tool	224
Compression Testing	225
Powerhead Removal	225
Powerhead Disassembly	227
Systems Removal	227
Throttle Linkage Removal	228
Shift Linkage Removal	228
Crankcase Disassembly	228
Cylinder Head Removal	229
Connecting Rods and Pistons	230
Crankshaft Removal	231
Cylinder Block Cleaning	233
Powerhead Inspection	234
Powerhead Assembly	237
Crankshaft Assembly	237
Pistons and Connecting Rods	239
Cylinder Head Installation	241
Crankshaft and Connecting Rods	241
Crankcase Assembly	244
Shift Linkage Installation	245
Throttle Linkage Installation	246
Final Powerhead Assembly	246
Powerhead Installation	247
Pre-Service Adjustments	250
Powerhead Views	251
Port Hose Routings – 3.3 L models	251
Starboard Hose Routings – 3.3 L models	252
Port Hose Routings – 3.4 L models	253
Starboard Hose Routings – 3.4 L models	254
Port – 3.3 L models	255
Starboard – 3.3 L models	256
Port – 3.4 L models	257
Starboard – 3.4 L models	258
Front – 3.3 L models	259
Front – 3.4 L models	260
Rear – 3.3 L models	261
Rear – 3.4 L models	262
Top	263
Starboard – <i>ICON</i> models	264

Service Charts



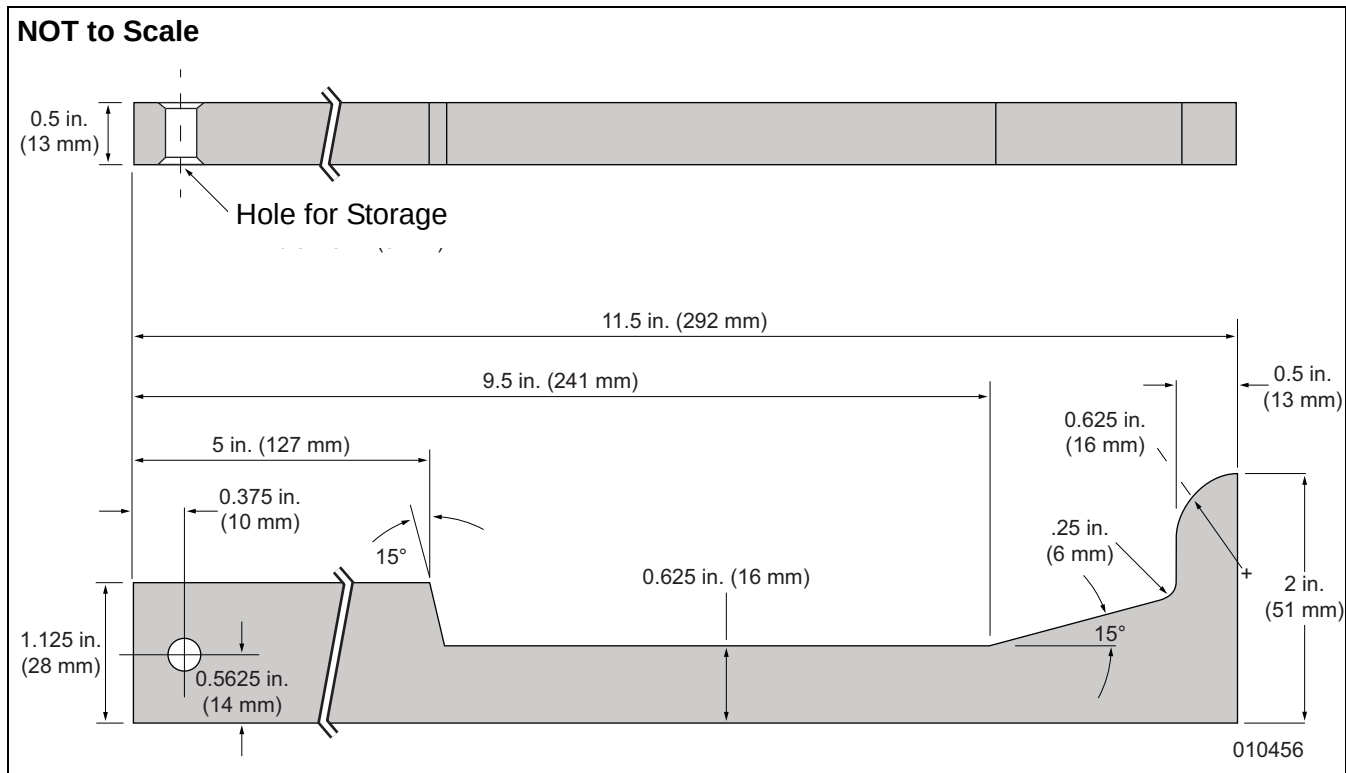
A Triple-Guard Grease	F Blue Nut Lock	P Permatex #2
B Gasket Sealing Compound	H Outboard Lubricant	Q Gel Seal II
D Moly Lube	L PST Sealing Compound	X See Service Manual Procedure
E Red Ultra Lock	M RTV Sealant	Z Thermal Joint Compound



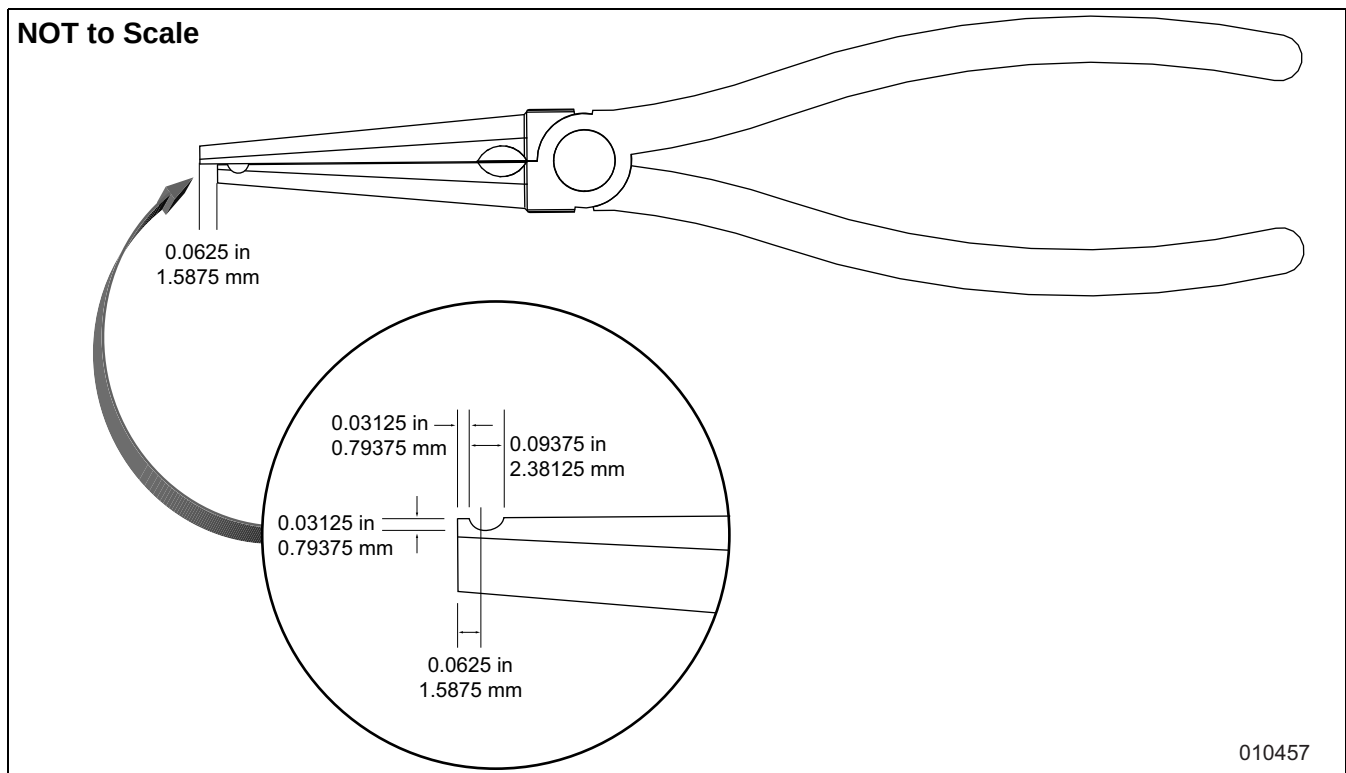
004108R

A Triple-Guard Grease	D Moly Lube	G Needle Bearing Grease
B Gasket Sealing Compound	E Red Ultra Lock	M RTV Sealant
C Adhesive 847	F Blue Nut Lock	X See Service Manual Procedure

Taper Pin Tool



Piston Pin Retainer Tool



Compression Testing

Start and run outboard until it achieves operating temperature, then shut OFF.

Disconnect crankshaft position sensor (CPS) connector. Remove all spark plugs.

Advance throttle linkage to WOT.

Install compression tester's hose attachment into spark plug hole (14 mm threads).

While cranking outboard with starter, note maximum pressure reading on gauge. Repeat procedure for each cylinder.

If engine shows a variation greater than 15 psi (100 kPa) between cylinders, check for:

- damaged cylinder head
- damaged pistons
- broken or stuck piston rings
- scored cylinder walls

Return throttle to idle position and reconnect CPS connector. Replace spark plugs. Refer to Spark Plug **Indexing** on p. 41.

Powerhead Removal

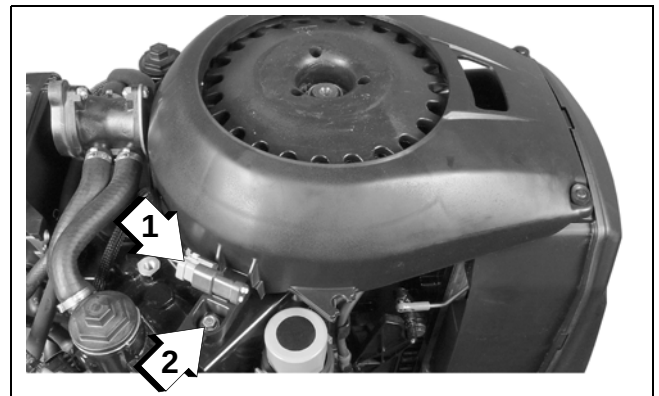
WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 168.

Disconnect the Crankshaft Position Sensor (CPS) to prevent accidental starting while servicing.

Remove lower motor covers. **Lower Cover Service** on p. 55.

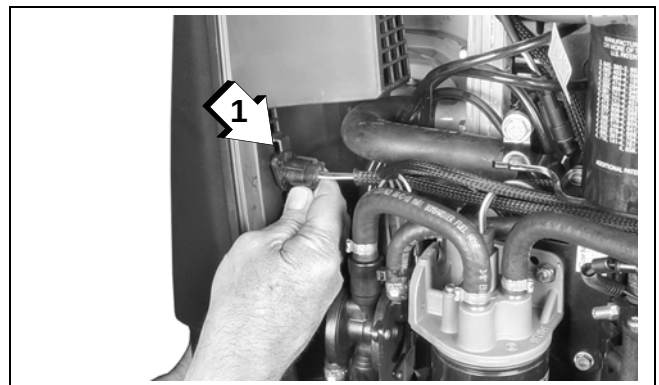
Disconnect diagnostic connector from clip and remove flywheel cover.



1. Diagnostic connector
2. Flywheel cover screw

004237

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



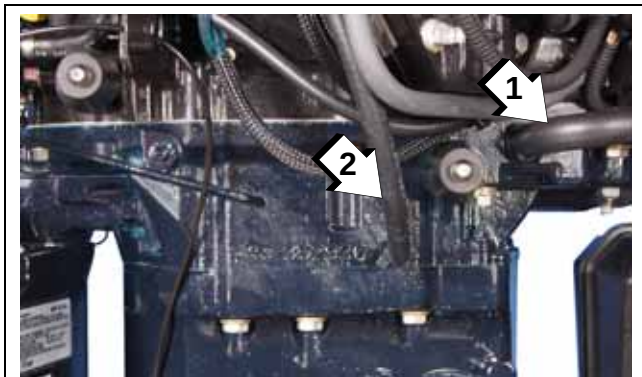
1. Air temperature sensor

004219

Powerhead

Powerhead Removal

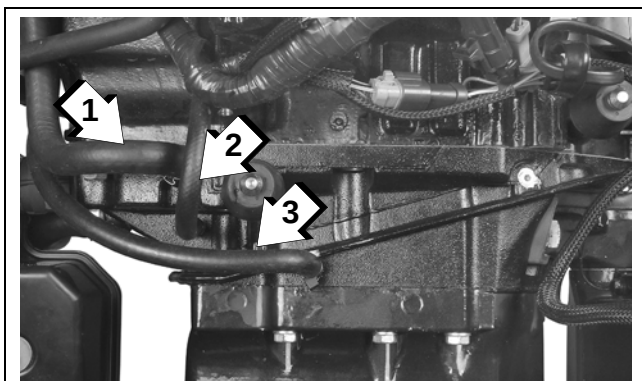
Remove water hoses and exhaust back pressure hose from adapter.



Port Side

1. Cooling hose (to exhaust plenum)
2. Cooling hose (from vapor separator)

008443

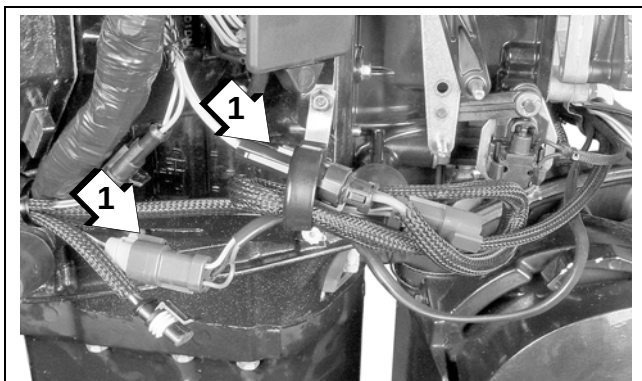


Starboard side

1. Cooling hose (to exhaust plenum)
2. Exhaust back pressure hose (to EMM)
3. Cooling hose (from block) – 3.3 L models

005042

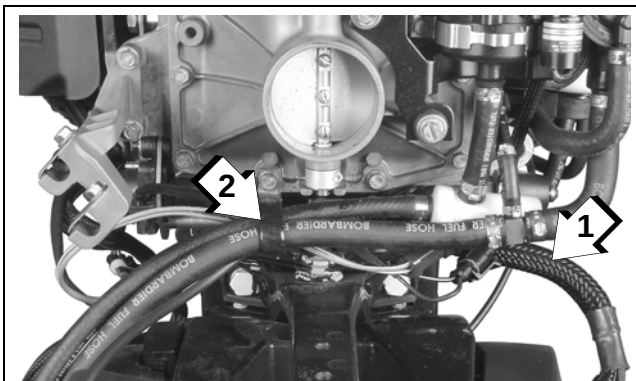
Disconnect power trim connectors.



1. Trim/tilt connectors

004251

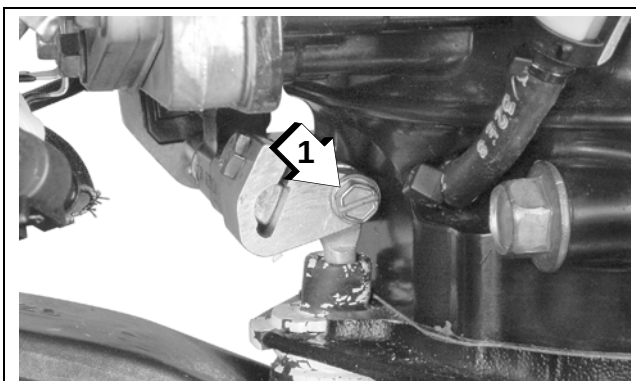
Remove trim/tilt harness from clamp.



1. Trim harness
2. Clamp

005041

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



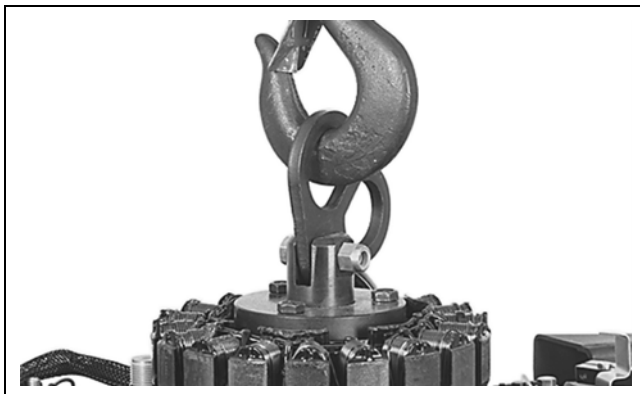
1. Shift rod pin

004241

Remove flywheel. Refer to **Flywheel Removal** on p. 112.

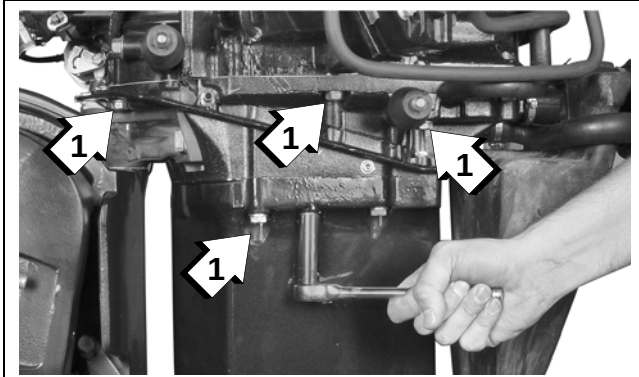
Securely fasten Lifting Fixture, P/N 396748, to crankshaft threads.

Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.



48758

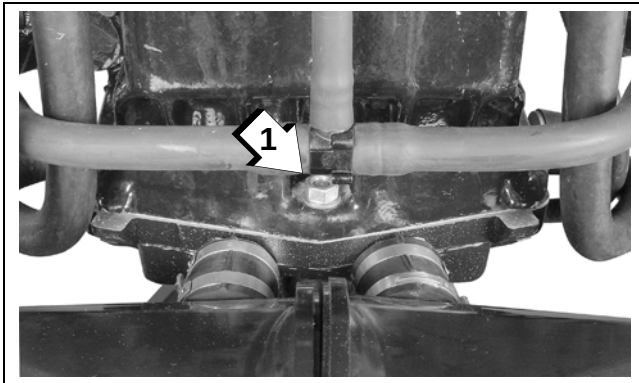
Remove all powerhead retaining screws and nuts.



1. Screws and nuts

004240

Remove the rear powerhead nut.



1. Rear powerhead nut

004252

Use a suitable tool to carefully separate the powerhead from exhaust housing.

IMPORTANT: Do not damage the powerhead adapter mating surfaces when separating.

Powerhead Disassembly

Systems Removal

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. 118.

Remove fuel pump assemblies, fuel manifolds, and filter. Refer to **Fuel Component Servicing** on p. 147.

Remove *EMM* and electrical harness assembly. Refer to **EMM Servicing** on p. 74.

Remove stator. Refer to **Stator Service** on p. 112.

Remove oil pump, rear oil manifold, and oil circulation hoses. Refer to **Oil Component Servicing** on p. 183.

Remove ignition coils and fuel injectors. Refer to **Fuel Injector Service** on p. 151.

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. 228.

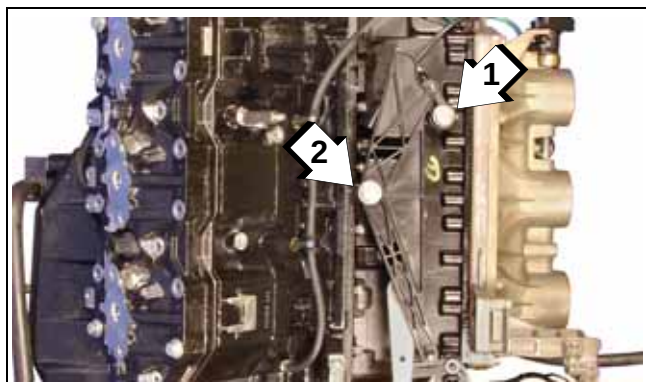
Remove shift linkage. Refer to **Shift Linkage Removal** on p. 228.

Remove the throttle body and reed plate assemblies. Refer to **Intake Manifold Service** on p. 154.

Remove pressure valve assembly. Refer to **Pressure Relief Valve Servicing** on p. 199.

Throttle Linkage Removal

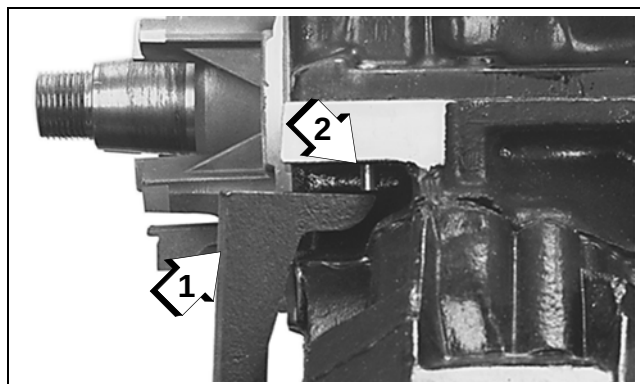
Remove throttle cam and throttle lever.



1. Throttle cam screw
2. Throttle lever screw

006866

IMPORTANT: Do not use a tapered punch or any other tool that could jam in or damage the taper bore when removing the pin.

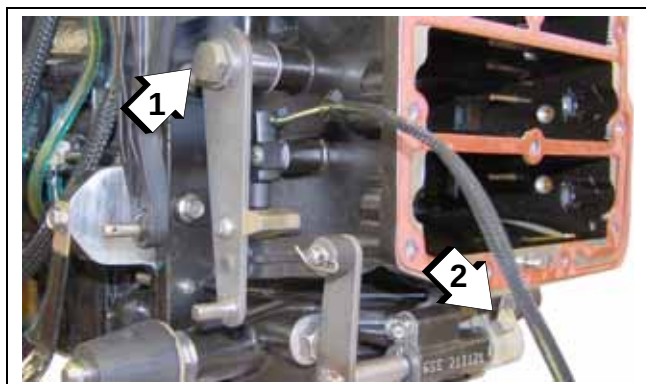


1. Tool
2. Taper pin

49428

Shift Linkage Removal

Remove shoulder screw from shift arm and retaining screw from shift rod lever



1. Shift arm screw
2. Shift rod lever screw

008455

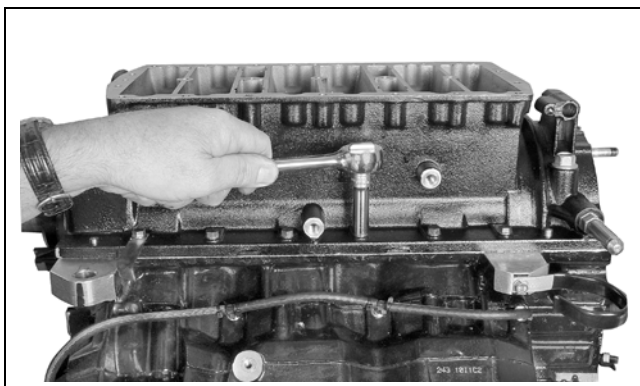
Slide entire shift linkage assembly from crankcase.

Remove Neutral/Shift Interrupt Switch from cylinder block.

Crankcase Disassembly

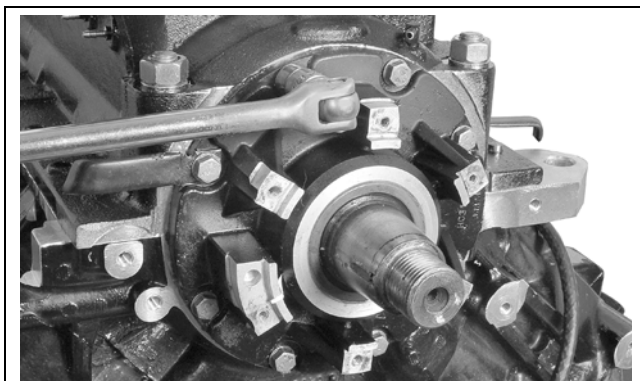
Use the **Taper Pin Tool** on p. 224, or equivalent, to push the crankcase taper pins toward the front side of the engine.

Remove crankcase flange screws.



004139

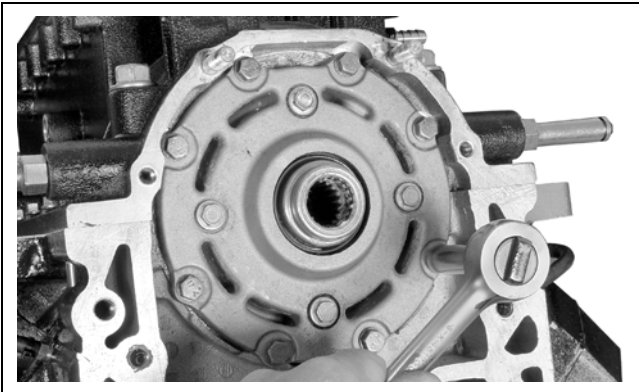
Remove the upper crankcase head screws.



004140

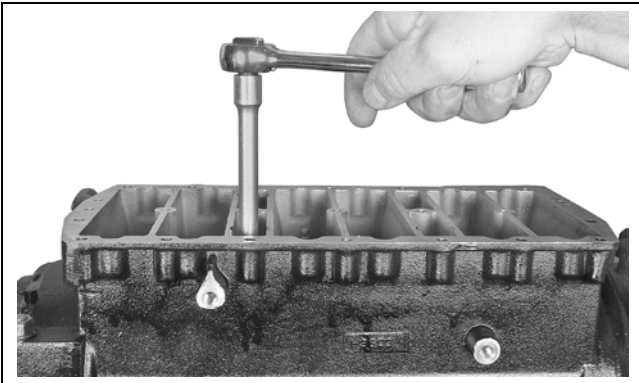
Remove the lower crankcase head screws.

IMPORTANT: DO NOT remove the four inside retaining screws on the lower crankcase head.



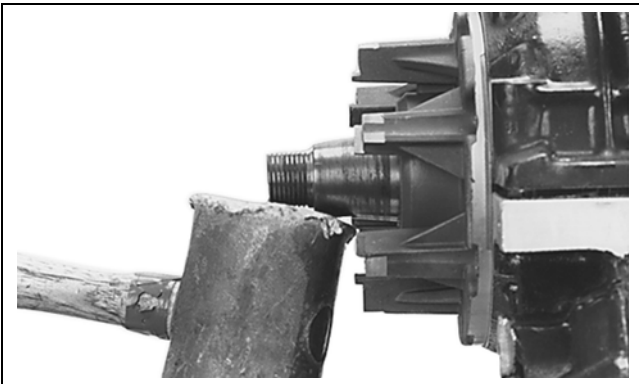
004146

Loosen **in stages**, and remove the main bearing screws and nuts.



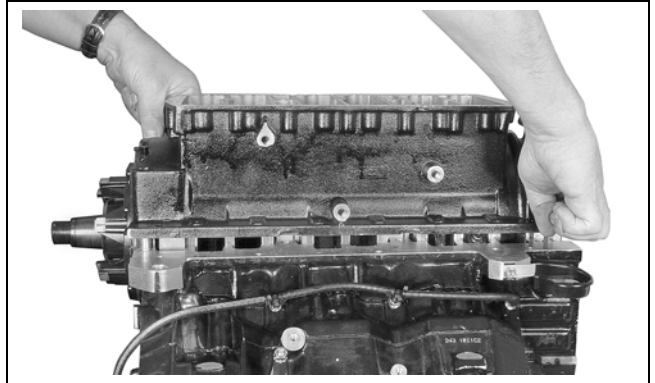
004136

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.



49429

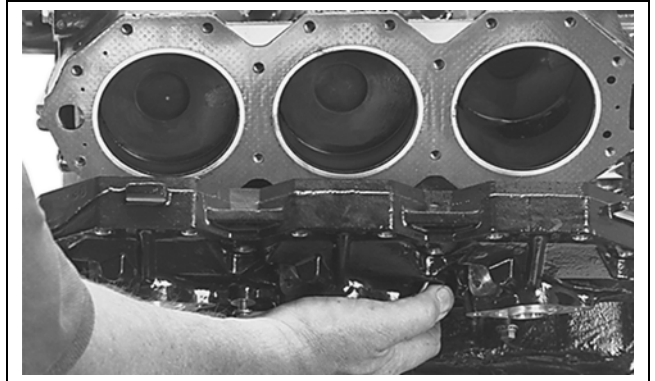
Carefully remove the crankcase from the cylinder block to avoid damaging the crankshaft seal rings.



004137

Cylinder Head Removal

Loosen **in stages** and remove cylinder head retaining screws. Remove the cylinder head.



49431

Connecting Rods and Pistons

NOTICE

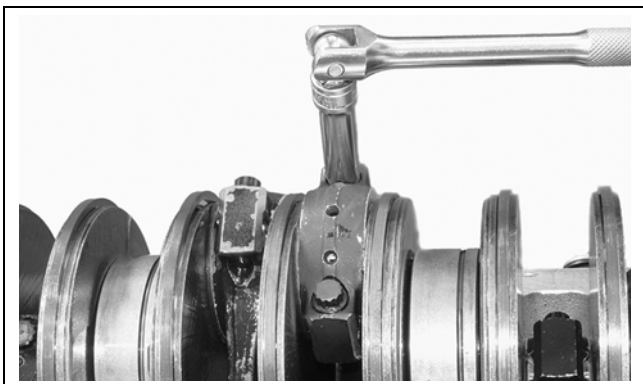
Reattach each rod cap to its rod as soon as the piston is removed. Each cap is unique and can only be installed on its mated rod. Do not allow rod to contact inside surface of cylinder or crankshaft.

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the flywheel.



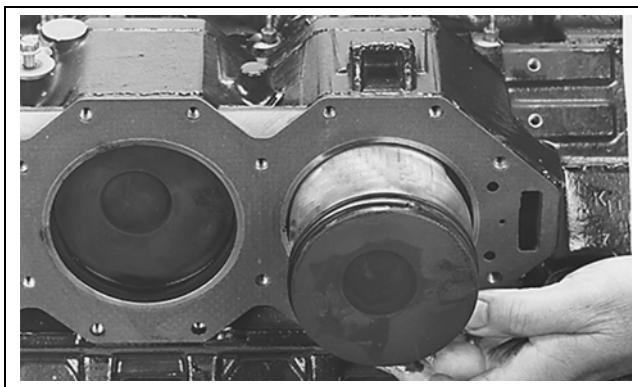
009721

Use Torquing Socket, P/N 346187, to loosen **in stages** the rod cap retaining screws. **DO NOT** remove the screws.



000823

Use one hand to support the piston, and remove the rod cap screws with your other hand. Remove each piston and rod assembly.



49432

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.

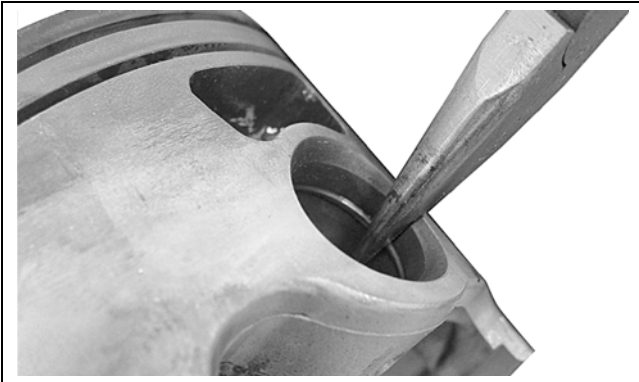
⚠ WARNING

Wear safety glasses to avoid injury.



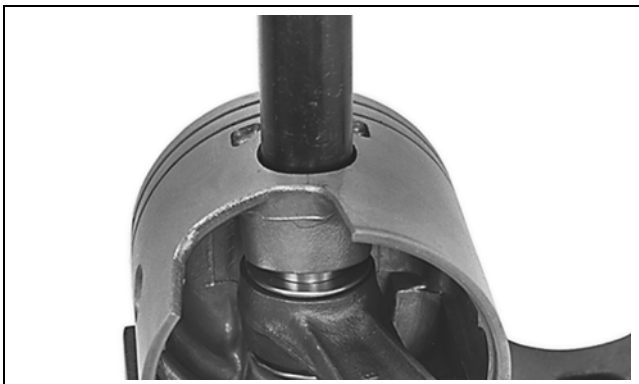
46519

Use a **Piston Pin Retainer Tool** on p. 224, or equivalent to remove wrist pin retaining rings. Discard retaining rings.



000689

Use Wrist Pin Pressing Tool, P/N 396747, to remove wrist pin.



1. Driver, P/N 396747

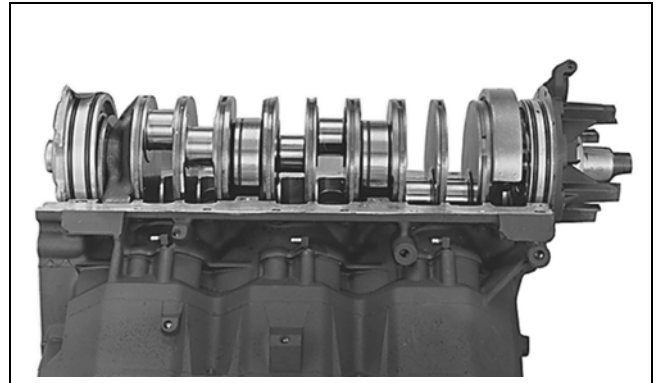
31806

Crankshaft Removal

⚠ WARNING

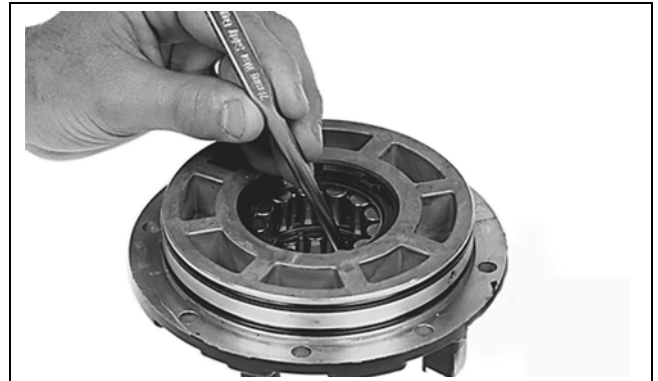
Wear safety glasses to avoid injury.

Carefully lift crankshaft straight up and remove from crankcase.



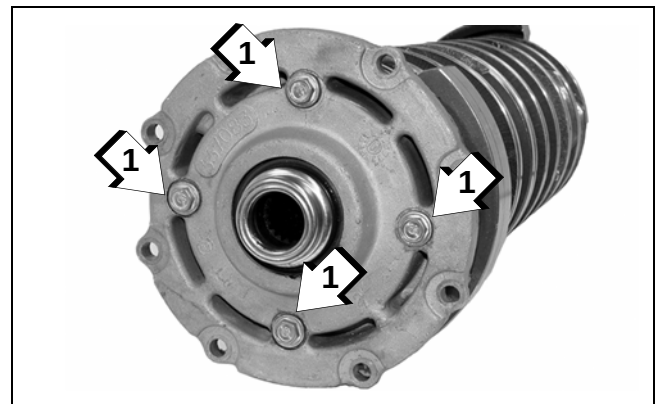
31809

Use a punch to remove the upper crankshaft seal. Remove and discard two crankcase head O-rings.



0865

If the lower crankcase head is to be resealed or the lower main bearing replaced, remove the four bearing retainer screws. While rotating the crankcase head, gently tap on the flange and remove the head.



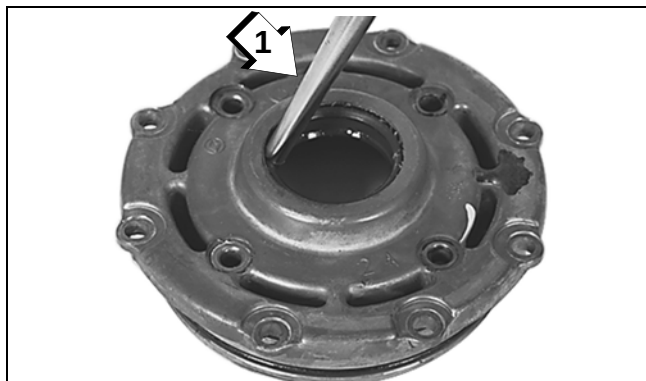
1. Bearing retaining screws

000830

Powerhead

Powerhead Disassembly

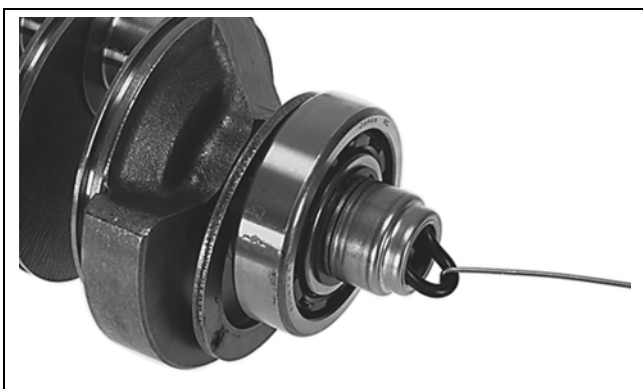
Use a punch to remove the lower crankshaft seal. Remove and discard two crankcase head O-rings.



1. Drift punch

30297

Remove the O-ring from crankshaft sleeve and inspect it. Replace the O-ring if it is not in good condition.



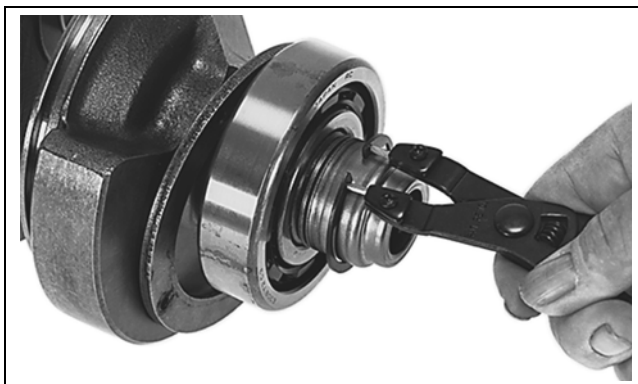
30057

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.



30056

Remove the lower main bearing only if it needs to be replaced. Use external retaining ring pliers to remove the lower main bearing retaining ring.



30069

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.



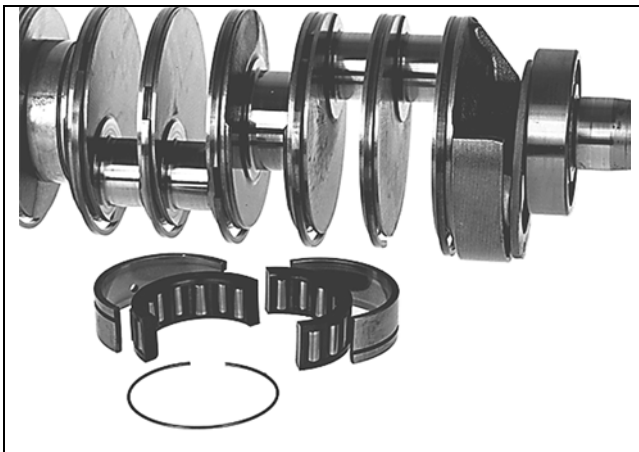
30291

Remove and inspect crankcase seal rings. Identify each ring for installation in original location.



5198

Remove center main bearings and split sleeves for inspection. DO NOT mix parts. Note location of bearings for reassembly.



5195

Cylinder Block Cleaning

⚠ WARNING

To avoid personal injury, wear eye protection and rubber gloves when using *Gel Seal and Gasket Remover*.

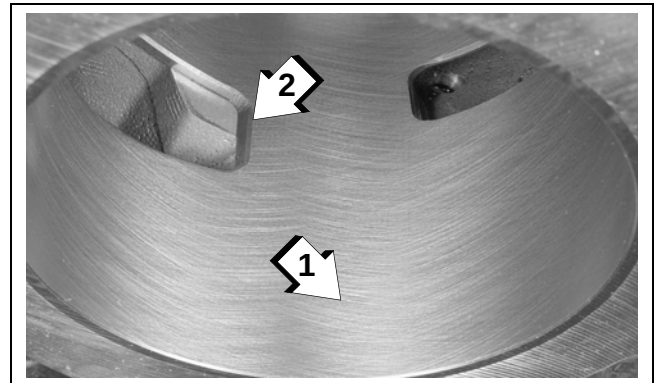
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants.

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.



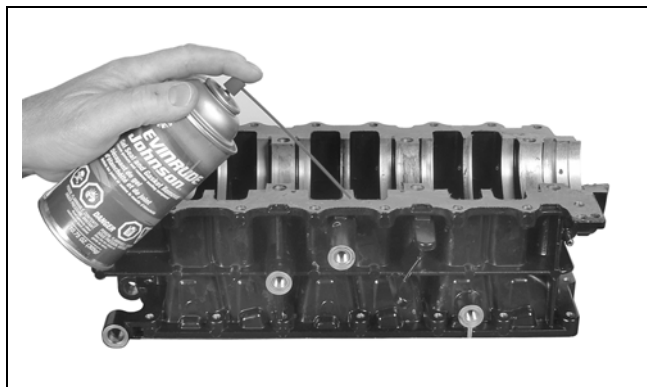
1. Crosshatch pattern in cylinder wall
2. Chamfered port edge

002067

Powerhead

Powerhead Inspection

Use *Gel Seal and Gasket Remover* to remove all traces of gaskets, adhesives, and *Gel-Seal II™* sealant from the cylinder block and crankcase.



TYPICAL

005296

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.

WARNING

To avoid personal injury, wear eye protection and set compressed air pressure at less than 25 psi (172 kPa).

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 90° 3.3 L Models** on p. 12.

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 0.003 in. (0.08 mm) per inch of measurement. Replace head if warpage exceeds this dimension.



49425

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.

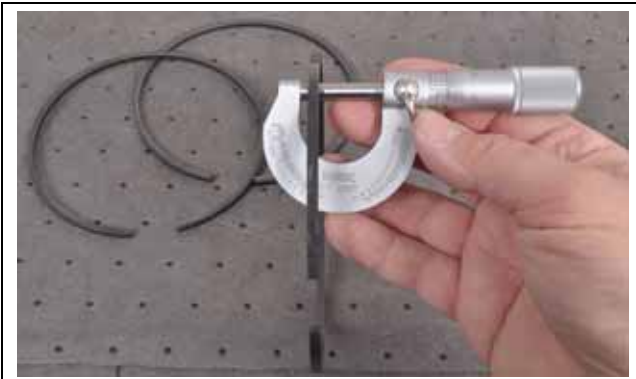


009709

Visually inspect crankcase seal rings for wear, grooves, or chipping. If rings appear worn, use a micrometer to measure ring thickness.

Replace rings that are less than 0.154 in. (3.9 mm) thick.

Install seal rings in their original positions on crankshaft after inspection.



1936

Cylinder Bore

Use a Cylinder Bore Gauge to inspect each cylinder bore for an out-of-round, oversize, or tapered

condition. Be sure the gauge is perfectly square in the bore when measuring.



Measure as shown

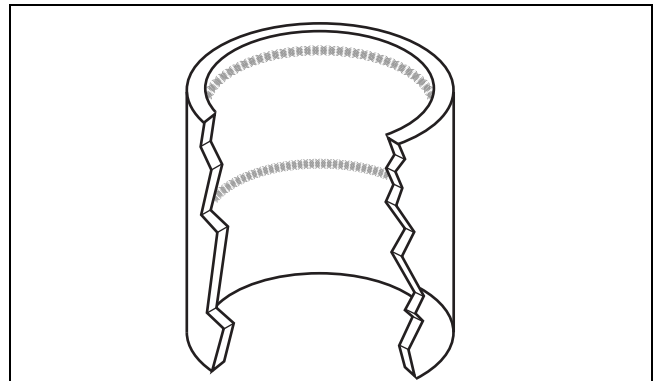
007283

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

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

The dimensional difference between the two areas is cylinder taper.

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



1. Cylinder taper

010357

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to **Service Specifications 90° 3.3 L Models** on p. 12.

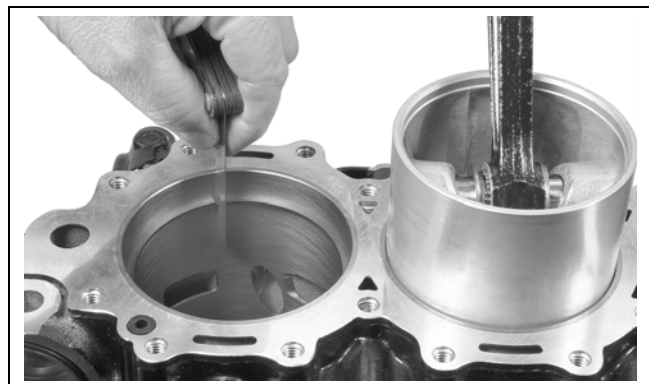
- The cylinder must not be oversized by more than 0.003 in. (0.08 mm).

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.



TYPICAL

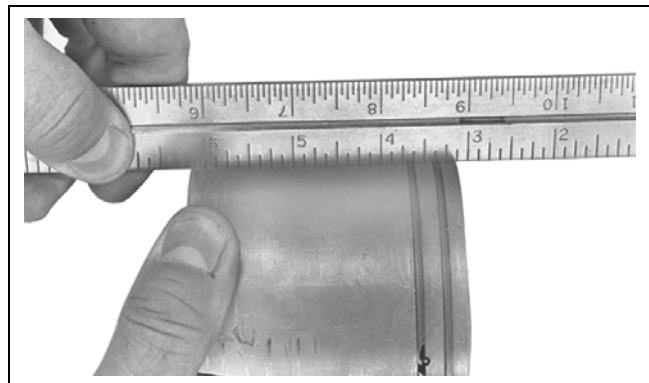
002143

Ring end gap should be:

- 0.022 to 0.028 in. (0.56 to 0.71 mm)

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.

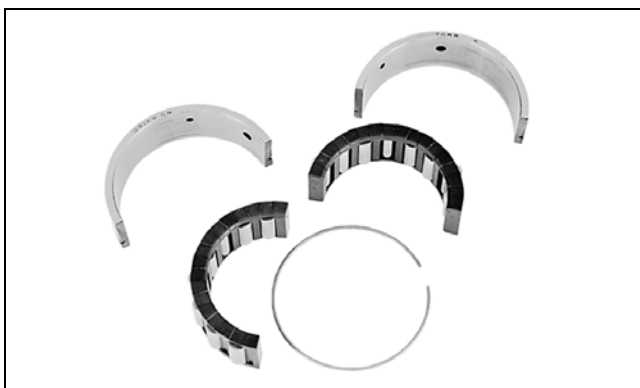
Use a machinist's straightedge to check for proper ring clearance. Position piston rings on piston. Push rings into groove and hold straightedge against the side of the piston. Rings must be even or just below the surface of piston. Rings must move freely in piston ring groove.



31796

Bearings

Inspect center main bearing and split sleeves for excess wear, nicks, or scratches. Replace if necessary.



24381

Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace, if necessary.



24377

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

Place bearing retainer plate, flat side down, on lower end of crankshaft.



1. Bearing retainer plate

30077

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338649, 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 338649, to drive a new sleeve onto the crankshaft until the installer contacts the lower main bearing.



30074

If the installer sticks on the sleeve after installation, thread Slide Hammer, P/N 391008, into installer and pull it off.



30072

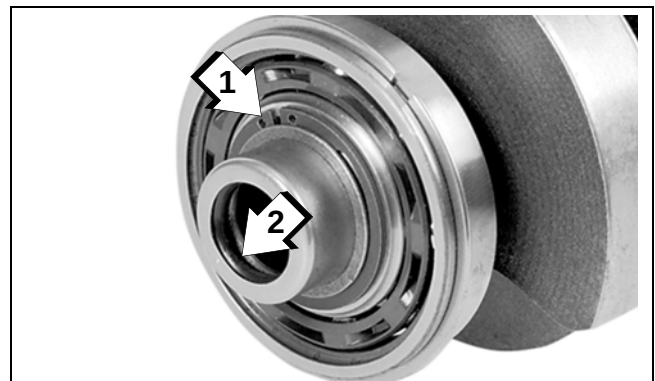
IMPORTANT: Inspect sleeve after installation. Sleeve must not be used if surface is damaged.

Use retaining ring pliers to install bearing retaining ring with sharp edge facing away from bearing.



30061

Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with *Moly Lube*. Install O-ring in sleeve.

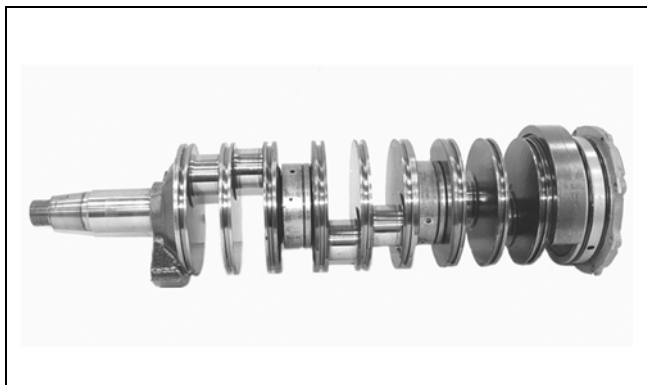


30071

Powerhead

Powerhead Assembly

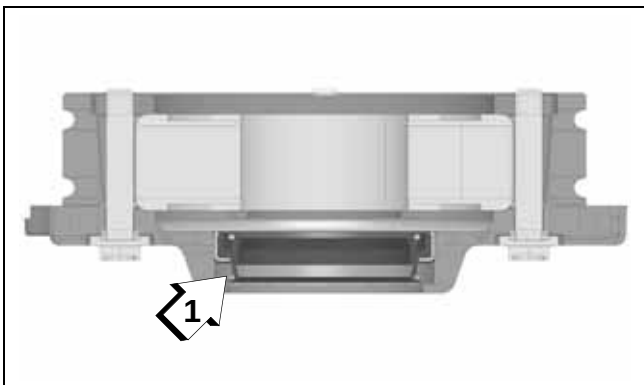
Lubricate the center main bearings and split sleeves with outboard lubricant and install them in their original positions. The split sleeve ring grooves must face toward driveshaft (lower) end of crankshaft when installed.



1.

000829

Lightly coat the outside edge of a new crankshaft seal with *Gasket Sealing Compound*. Use Seal Installation Tool, P/N 325453, to install seal in lower crankcase head with extended lip of seal facing down. Coat seal lips with *Triple-Guard* grease.



1. Seal, extended lip

DRC5798

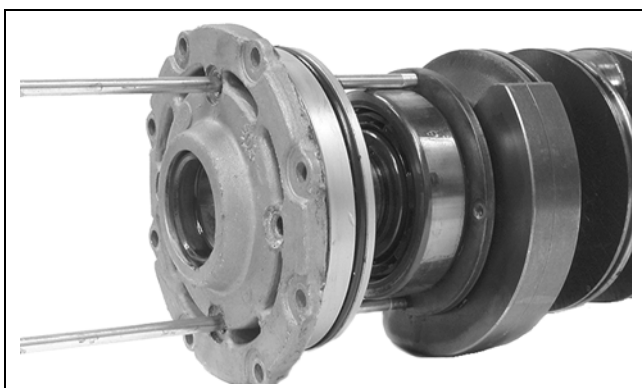
Lightly coat two new O-rings with *Gasket Sealing Compound* and install on lower crankcase head. Keep sealer away from oil passage.



1. Oil passage

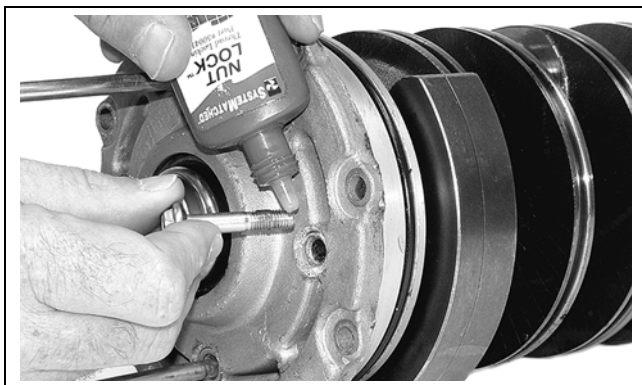
004132

Use threaded rods or Guide Rods, P/N 383175, to align retainer plate with crankcase head. Slide crankcase head onto crankshaft until seated around lower main bearing.



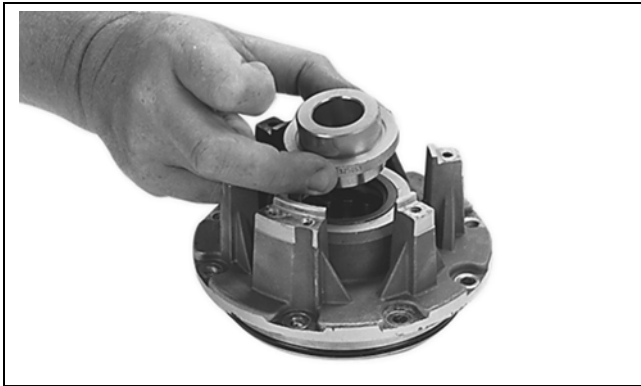
000826

Install new seals on the four bearing retainer screws. Apply *Nut Lock* to the threads of the screws and tighten to a torque of 96 to 120 in. lbs. (11 to 13.5 N·m).



000827

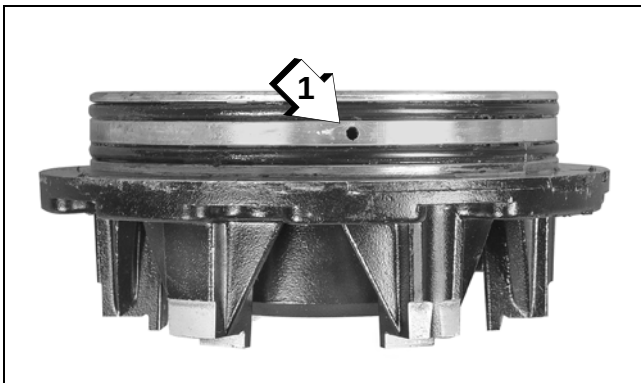
Lightly coat the outside edge of a new upper seal with *Gasket Sealing Compound*. Use the flat end of Seal Installation Tool, P/N 325453, to install seal flush in upper crankcase head with the lip facing down. Coat the seal lip with *Triple-Guard* grease.



1. Seal installer, P/N 325453

49597

Lightly coat two new O-rings with *Gasket Sealing Compound*, and install on upper crankcase head. Keep sealer away from oil passage.



1. Oil passage

004131

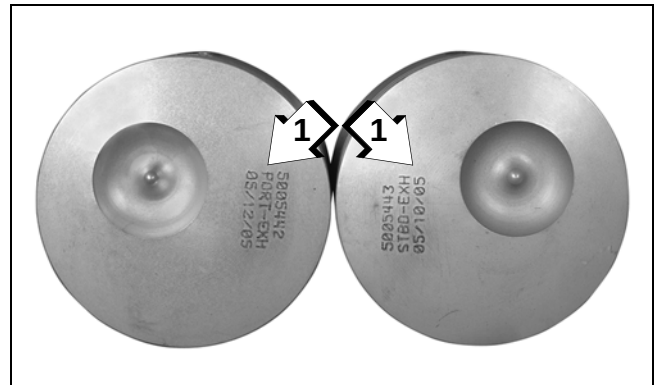
Pistons and Connecting Rods

NOTICE

It is very important that the pistons in this engine are installed in the correct location and direction. Engine damage will occur if installed incorrectly.

New pistons are stamped "PORT" or "STBD," and "EXH." These markings should be turned toward the exhaust side (center) of the block. The splash

bowl on the dome of the piston will be located toward the flywheel and opposite the exhaust port.



1. Stamped markings

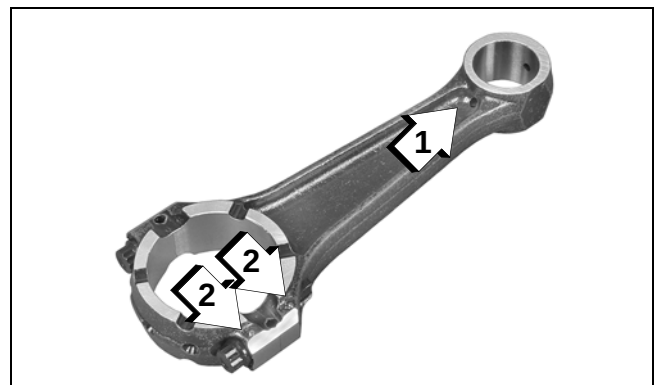
005283

Apply outboard lubricant to the wrist pin bearings. Install the bearings in the wrist pin bore.

Oil the wrist pin bore and wrist pin. Place connecting rod with bearing into the piston with the alignment dots facing the top of the piston.

NOTICE

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.



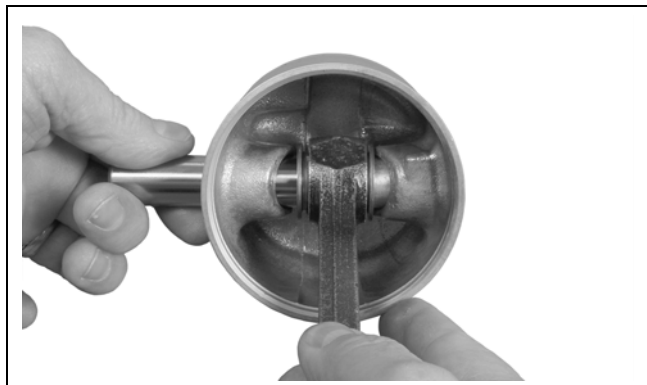
1. Oil hole
2. Raised dots

002055

Powerhead

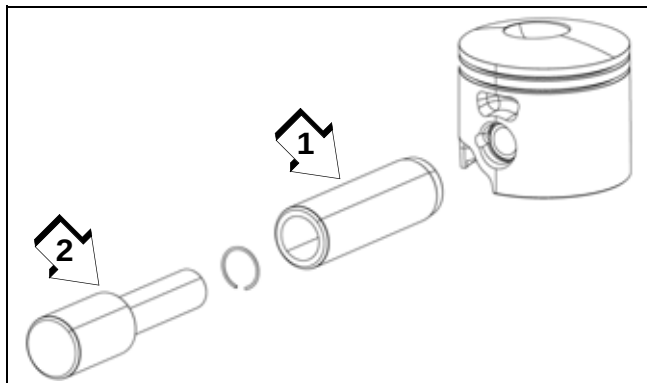
Powerhead Assembly

Install wrist pin through piston and connecting rod.



002057

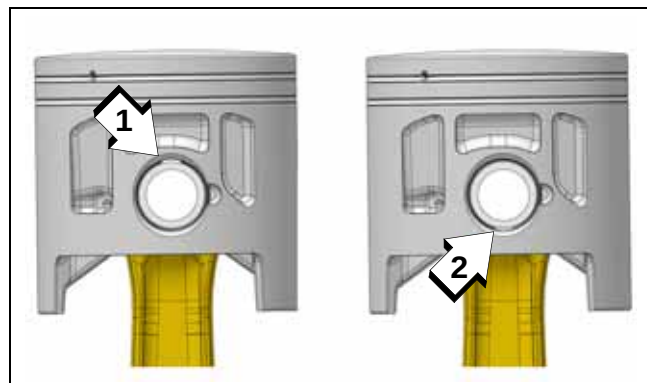
Use Wrist Pin Cone, P/N 331913, and Driver, P/N 396747, to install new wrist pin retaining rings in each wrist pin hole.



1. Wrist Pin Cone, P/N 331913
2. Driver, P/N 396747

DR1641

IMPORTANT: When installing retaining rings, make sure the gap of each retaining ring faces UP toward the TOP of the piston, or DOWN toward the BOTTOM of the piston.



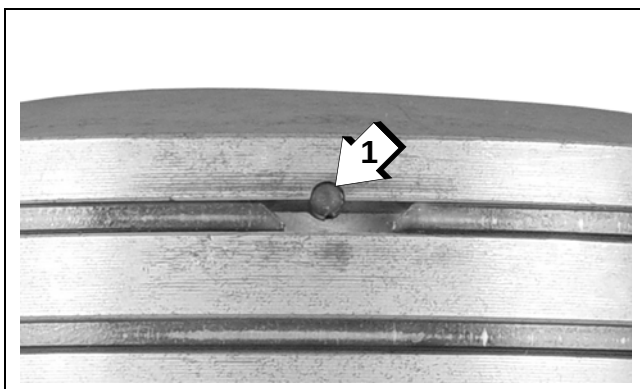
1. Gap in retaining ring UP
2. Gap in retaining ring DOWN

009701

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. 234.

IMPORTANT: Be sure gap of ring fits squarely around dowel pin.



002048

NOTICE

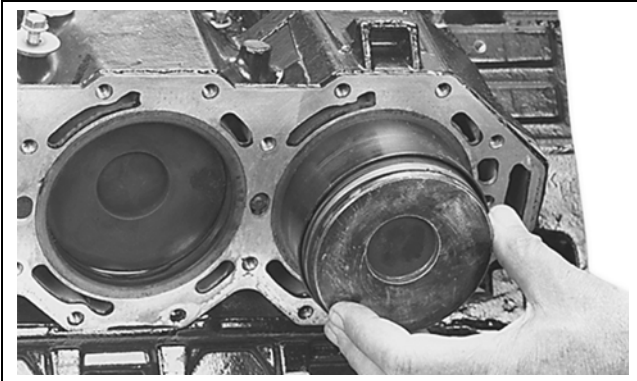
Before continuing, make sure that all Gel-Seal II has been removed from the cylinder block and crankcase mating flanges. If traces of hardened Gel-Seal II are left, main bearings could be misaligned. Refer to **Cylinder Block Cleaning** on p. 233.

Coat pistons, rings, cylinder walls, and ring compressor 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 con-

necting rod through cylinder block to avoid scratching cylinder wall.

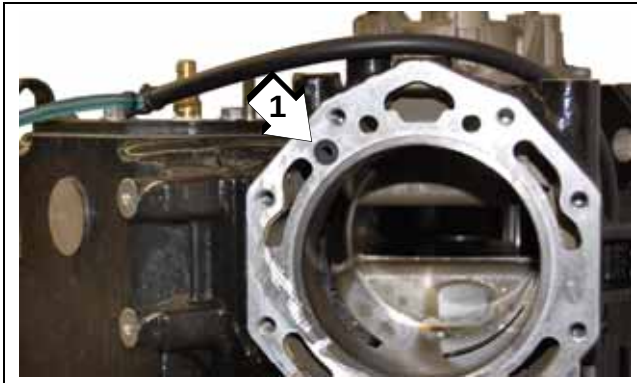


49435

Cylinder Head Installation

Lightly coat both sides of a new cylinder head gasket with *Gasket Sealing Compound*. Place gasket on cylinder block following instructions printed on gasket.

Apply soapy water to water dam and insert into block.

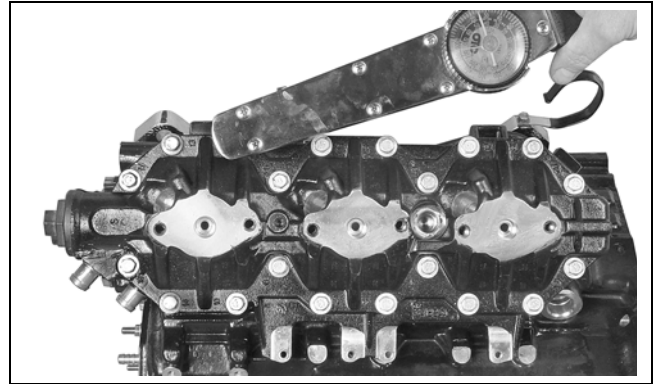


1. Water dam

006965

Install cylinder head with the thermostat toward the top. Apply *Triple-Guard* grease to threads and install the cylinder head screws. DO NOT use any sealant on threads

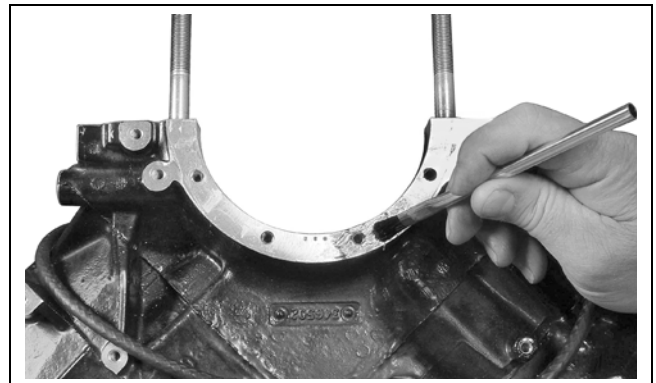
Following sequence stamped on cylinder head, tighten all screws in stages to a torque of 17 to 19 ft. lbs. (23 to 26 N·m).



004133

Crankshaft and Connecting Rods

Lightly coat the cylinder block upper and lower crankcase head flange surfaces with a thin layer of *Gel-Seal II*.



004130

Check that main bearing alignment dowel pins are seated in the block.

Push all pistons to the top of cylinders. Remove the numbered connecting rod caps and hold the connecting rods to the outside with rubber bands.

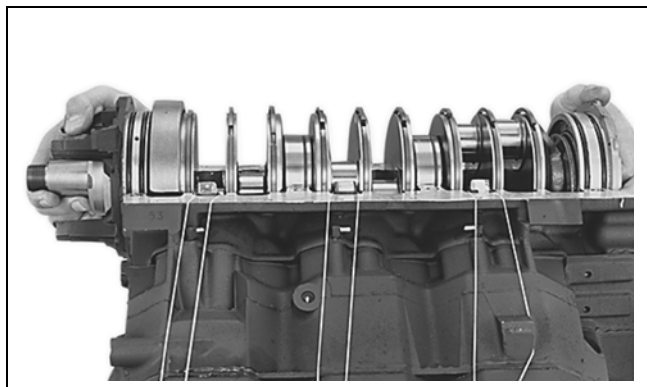
Gently lower crankshaft into place.

- Turn all crankcase seal ring gaps to face up.
- 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.

Powerhead

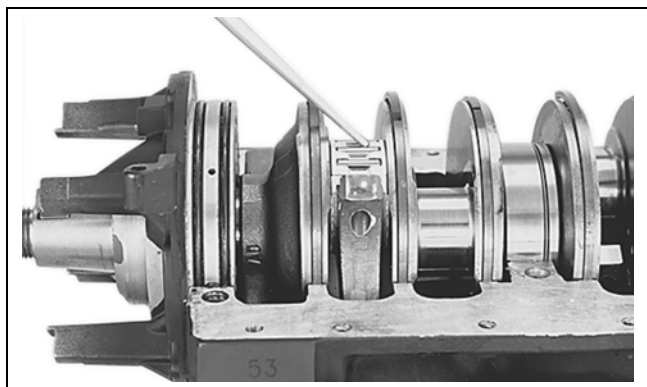
Powerhead Assembly

- Tap the crankshaft upward with a rawhide mallet to seat crankshaft and lower crankcase head.
- Loosely secure upper and lower crankcase heads with two screws.



31828

Lubricate each crankpin and bearing assembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.

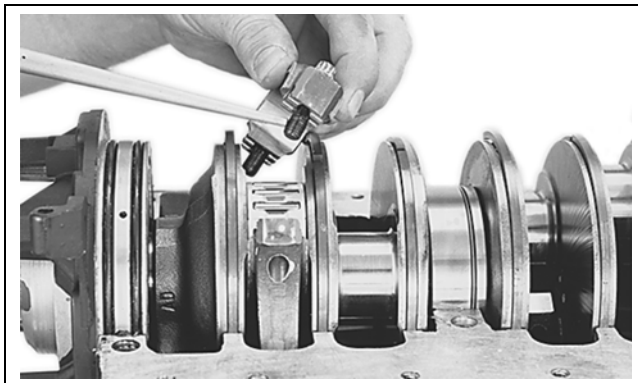


31827

Lubricate rod cap screw threads and under screw head mating surface with a light coat of *Triple-Guard* grease. Apply outboard lubricant to screw hole threads in rod, and to screw head mating surface on cap.

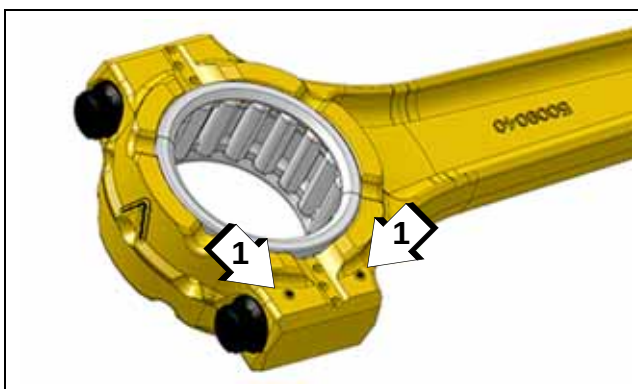
Align dot on rod cap with dot on the connecting rod.

Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).



31826

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dots face fly-wheel.



1. Alignment dots

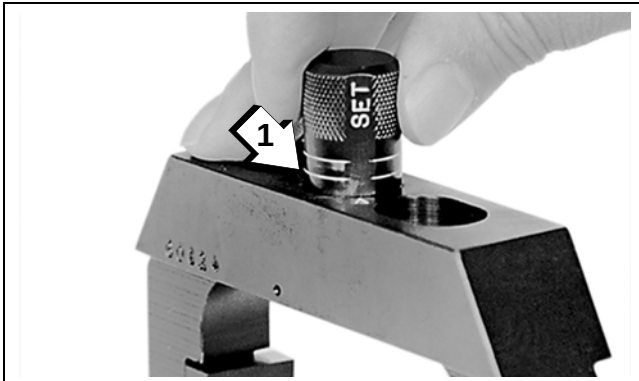
010307

NOTICE

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 adjustment stop with the arrow on the frame. Position the stop at the high-

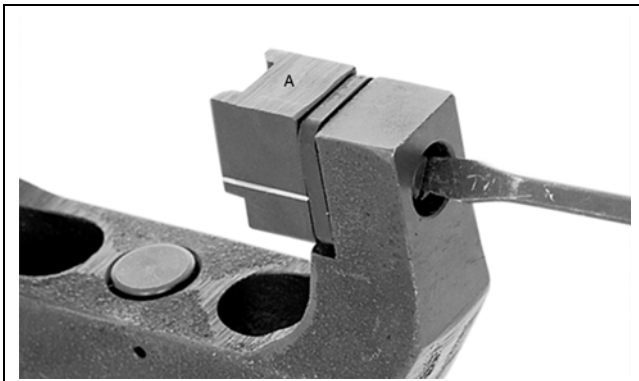
est setting (two lines showing). Rotate adjustment knob 180° to lock the stop in position.



1. Adjustment stop, highest setting

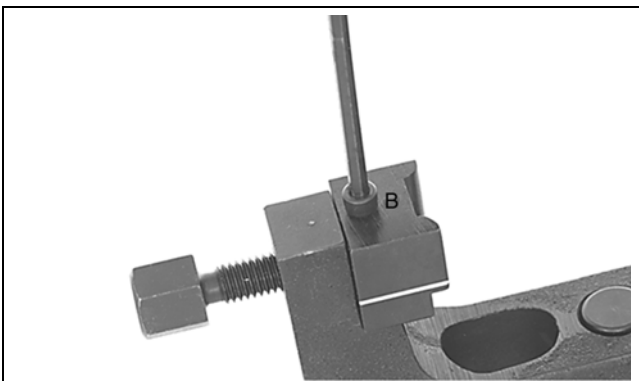
2287

Secure restraining jaw "A" and forcing jaw "B" to frame.



Restraining Jaw "A"

21591



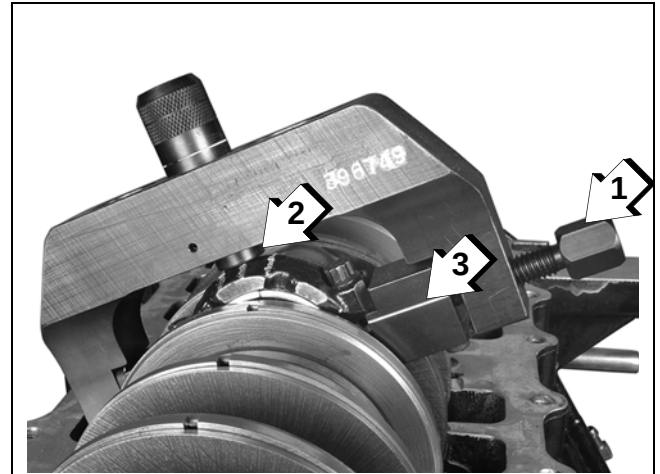
Forcing Jaw "B"

21594

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 23 in. lbs. (2.5 N·m).



1. Forcing screw
2. Adjustment stop
3. Groove line

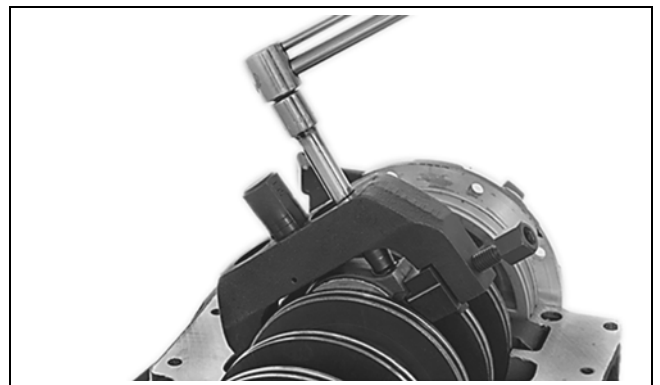
005297

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 346187, 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 20 to 22 ft. lbs. (27 to 30 N·m).
- Apply final torque of 60 to 65 ft. lbs. (81 to 88 N·m).



21605

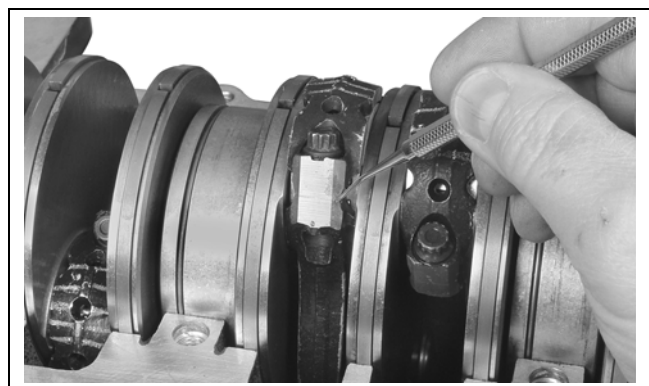
Powerhead

Powerhead Assembly

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.



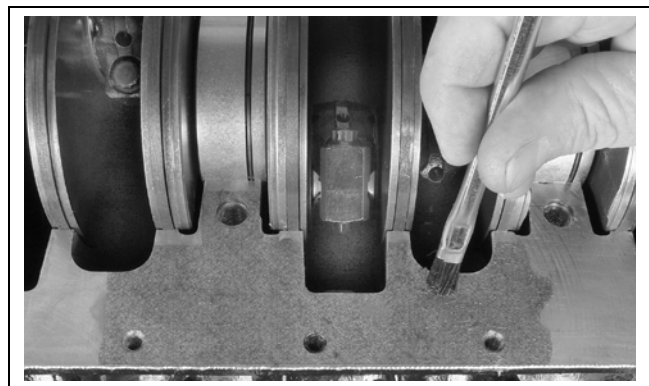
005300

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.

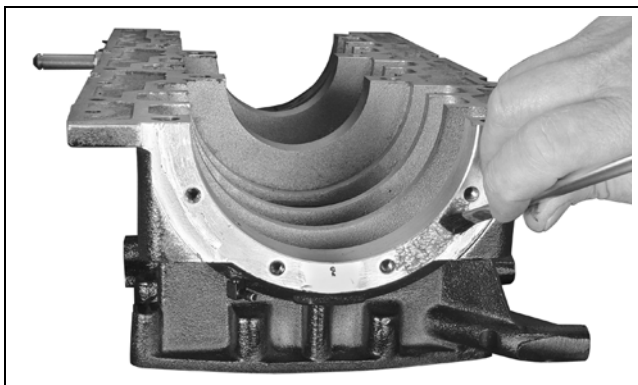
IMPORTANT: DO NOT allow solvent to get on internal components. Clean only the mating flanges.

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.



004127

Lightly coat the upper and lower crankcase head flange surfaces with a thin layer of *Gel-Seal II*.



004134

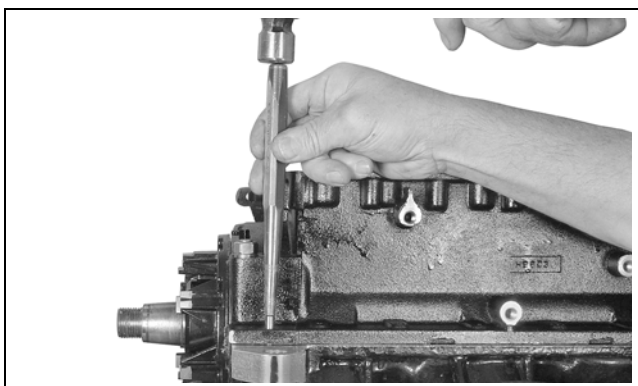
IMPORTANT: *Gel-Seal II* has a shelf life of at least one year when stored at room temperature. Test the *Gel-Seal II* or replace it if the age of the tube cannot be determined. Using old *Gel-Seal II* could cause crankcase air leaks.

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.

Install main bearing screws and nuts finger tight, no more than 60 in. lbs. (7 N·m).

When the crankcase is seated, install and firmly seat both crankcase taper pins.

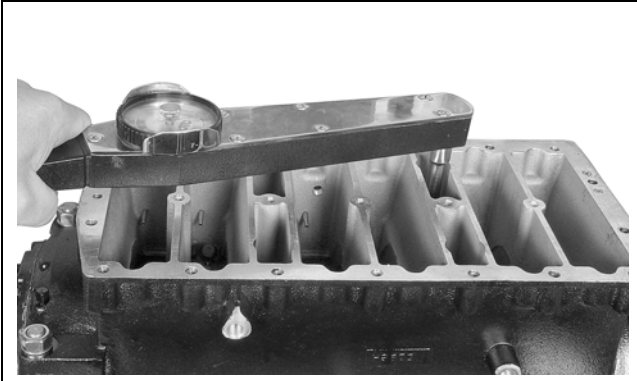


004135

Tighten main bearing screws and nuts **in stages** to a final torque of:

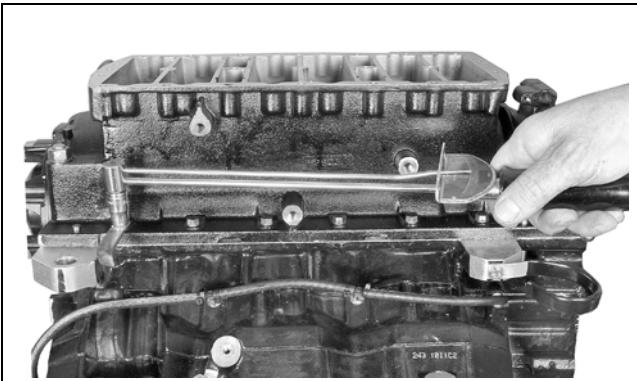
- Screws – 48 to 53 ft. lbs. (65 to 72 N·m)
- Nuts – 38 to 42 ft. lbs. (52 to 57 N·m)

Start in the center and work outward in a spiral pattern.



004141

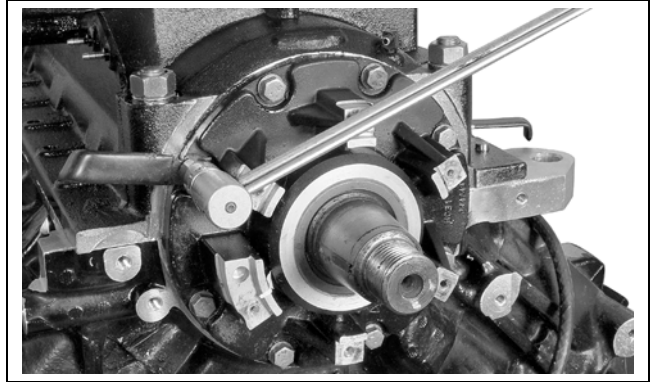
Apply *Permatex No. 2* to crankcase flange screws where threaded hole is open to crankcase. Install screws and tighten to a torque of 84 to 108 in. lbs. (9.5 to 12 N·m).



004138

Test that the crankshaft spins freely without binding.

Apply *Nut Lock* to the upper and lower crankcase head screws. Install and tighten screws to a torque of 96 to 120 in. lbs. (11 to 13.5 N·m).

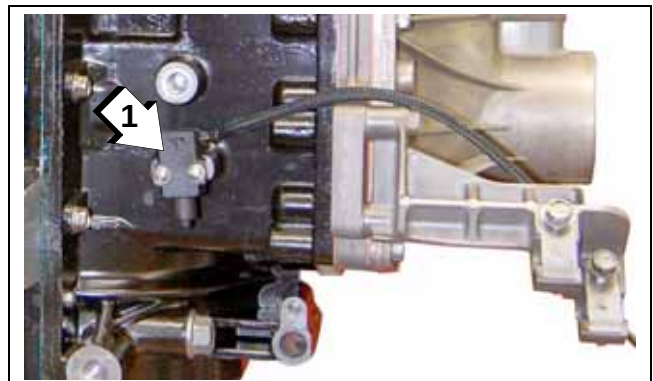


004142

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

Shift Linkage Installation

Install Neutral/Shift Interrupt switch. Apply *Nut Lock* to screw threads and tighten to a torque of 7 to 10 in. lbs. (0.8 to 1.1 N·m).



1. Neutral/Shift Interrupt switch

008451

If removed, install cam on shift arm. Apply *Ultra Lock* to screw threads and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

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

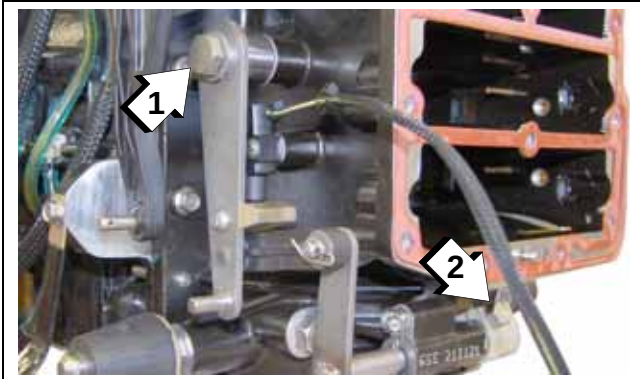
Apply *Triple-Guard* grease to the shaft of the shift lever assembly. Guide shaft through bushings in crankcase.

Powerhead

Powerhead Assembly

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

Apply *Triple-Guard* grease to shoulder of shift arm screw and *Nut Lock* to threads. Install arm, screw, and washer and tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16.5 N·m).



1. Shoulder screw
2. Shift rod lever retaining screw

008455

Throttle Linkage Installation

Apply *Nut Lock* to threads of throttle lever screw.

Insert spring into cavity of throttle 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 16.5 N·m).

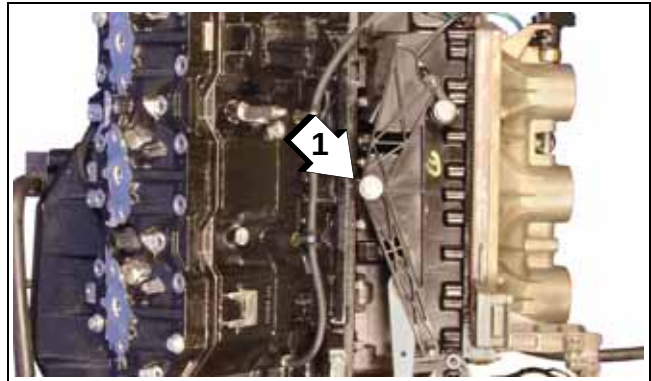


1. Throttle lever spring

006966

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 16.5 N·m).



1. Throttle cam screw

006866

IMPORTANT: Do not lubricate throttle levers or shoulder screws.

Final Powerhead Assembly

⚠ WARNING

To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

Install the reed plate and throttle body assemblies. Refer to **Intake Manifold Service** on p. 154.

Install oil recirculating hoses and check valves. Refer to **Oil Recirculation Diagrams** on p. 166, or **Powerhead Views** on p. 251.

Install pressure valve assembly. Refer to **Pressure Relief Valve Servicing** on p. 199.

Install shift linkage. Refer to **Shift Linkage Installation** on p. 245.

Install throttle linkage. Refer to **Throttle Linkage Installation** on p. 246.

Install fuel injectors and ignition coils. Refer to **Fuel Injector Installation** on p. 153.

IMPORTANT: All injectors must be reinstalled in their original location. Improper injector installation can result in powerhead failure.

Install oil pump, rear oil manifold, and oil injection hoses. Refer to **Oil Component Servicing** on p. 183.

Install stator. Refer to **Stator Service** on p. 112.

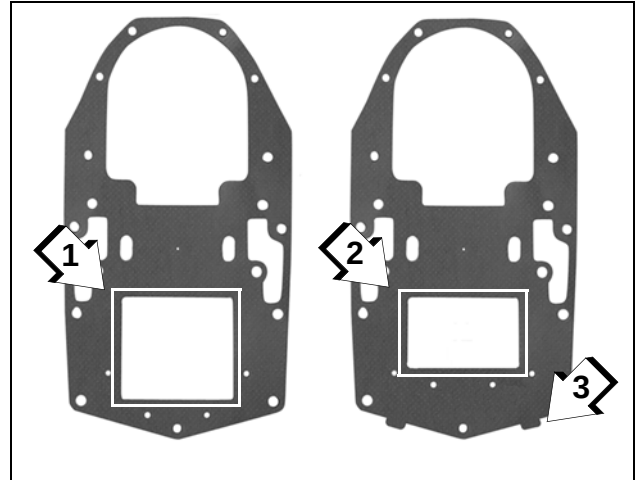
Install electrical harness and *EMM*. Refer to **EMM Servicing** on p. 74.

Install fuel pump assemblies, fuel manifolds, and filter. Refer to **Fuel Component Servicing** on p. 147.

Install the electric starter. Refer to **Starter Installation** on p. 124.

Powerhead Installation

Apply *Permatex No. 2* to both sides of a new base gasket around the exhaust port only. Install gasket on adapter. To ensure proper sealing, mating surfaces must be clean and dry.



Crankcase to Adaptor Gaskets

008324

1. Exhaust port area – 3.3 L models
2. Exhaust port area – 3.4 L models
3. Identification tab (3.4 L models only)

Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

Use Lifting Fixture, P/N 396748, and hoist to slowly lower powerhead onto exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.



48758

Apply *Gasket Sealing Compound* to the threads of all powerhead screws.

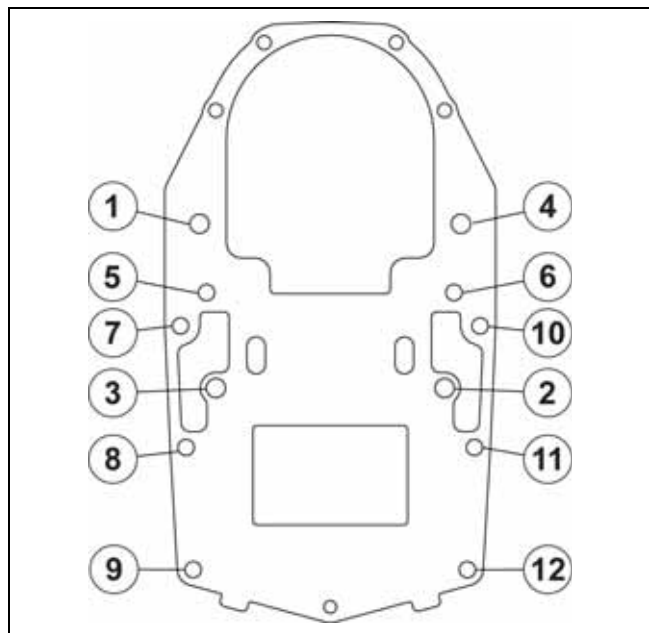
Loosely install all fasteners before tightening.

Powerhead

Powerhead Installation

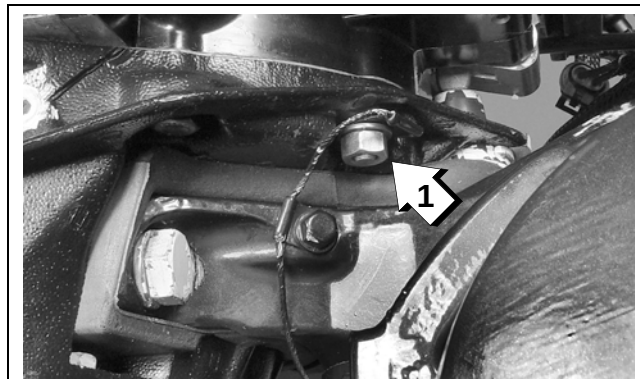
Tighten the 3/8 in. diameter powerhead screws to a torque of 20 to 22 ft. lbs. (27 to 30 N·m) in the sequence shown.

Tighten the 5/16 in. diameter powerhead screws to a torque of 144 to 168 in. lbs. (16.5 to 19 N·m) in the sequence shown.

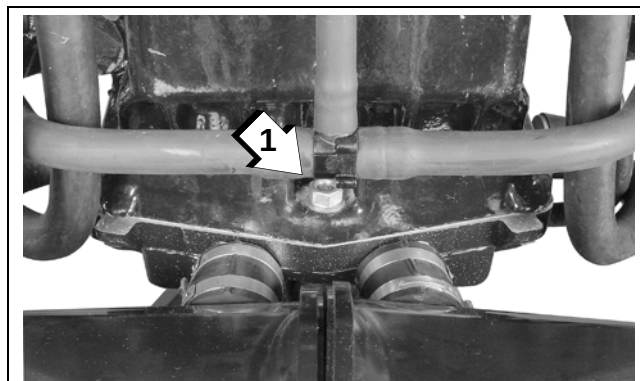


IMPORTANT: Retighten powerhead mounting screws after outboard has been run at full operating temperature and allowed to cool.

Install two front and one rear powerhead nuts. Tighten nuts 144 to 168 in. lbs. (16.5 to 19 N·m).

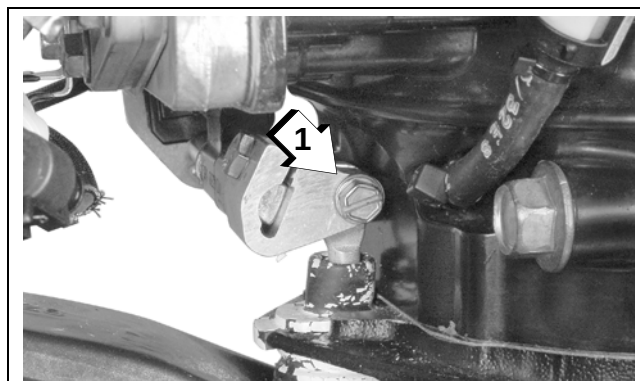


1. Front powerhead nut (2)



1. Rear powerhead nut

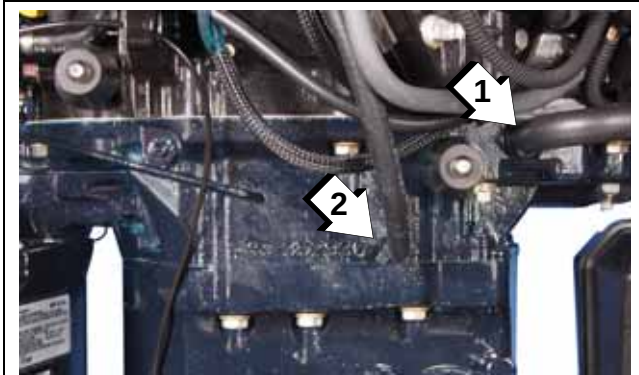
Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Shift rod pin

IMPORTANT: Make sure the gearcase shifts solidly into both forward and reverse and that propeller shaft spins freely in neutral.

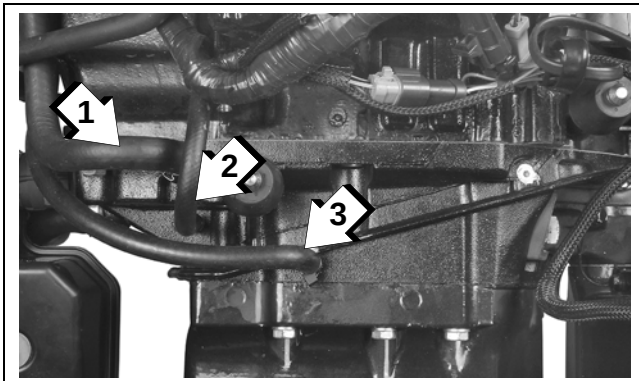
Install water hoses and exhaust back pressure hose.



Port side

1. Cooling hose (from exhaust plenum)
2. Cooling hose (from vapor separator)
3. Speedometer hose

008443



Starboard side

1. Cooling hose (to exhaust plenum)
2. Exhaust back pressure hose (to EMM)
3. Cooling hose (from block) – 3.3 L models

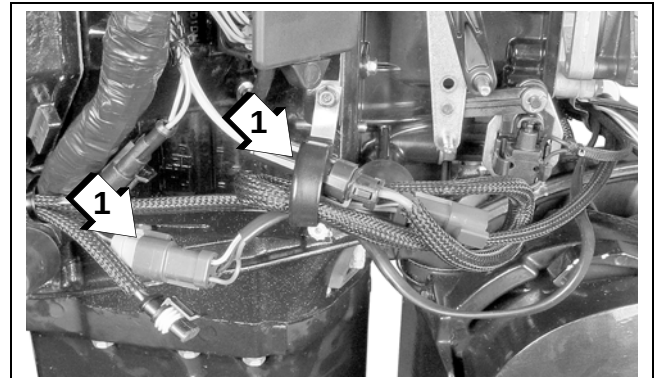
005042

Route power trim harness through clamp and connect to engine harness.



1. Trim harness
2. Clamp

006992

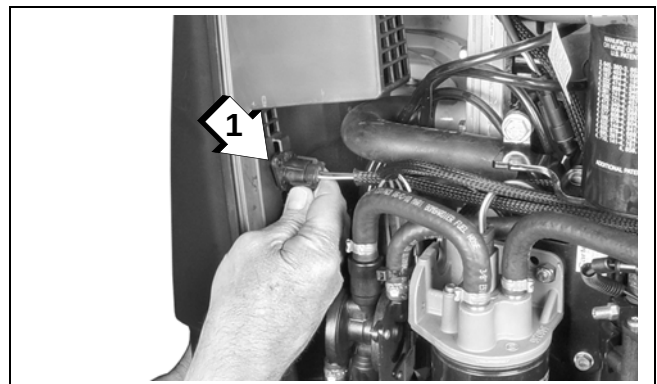


1. Trim/tilt connectors

004251

Install flywheel. Refer to **Flywheel Installation** on p. 112.

Install air temperature sensor, air silencer, and flywheel cover. Tighten flywheel cover screws to a torque of 30 to 42 in. lbs. (3.5 to 5 N·m).



1. Air temperature sensor

004219

Install the lower engine covers. Refer to **Lower Cover Service** on p. 55.

Powerhead

Powerhead Installation

Pre-Service Adjustments

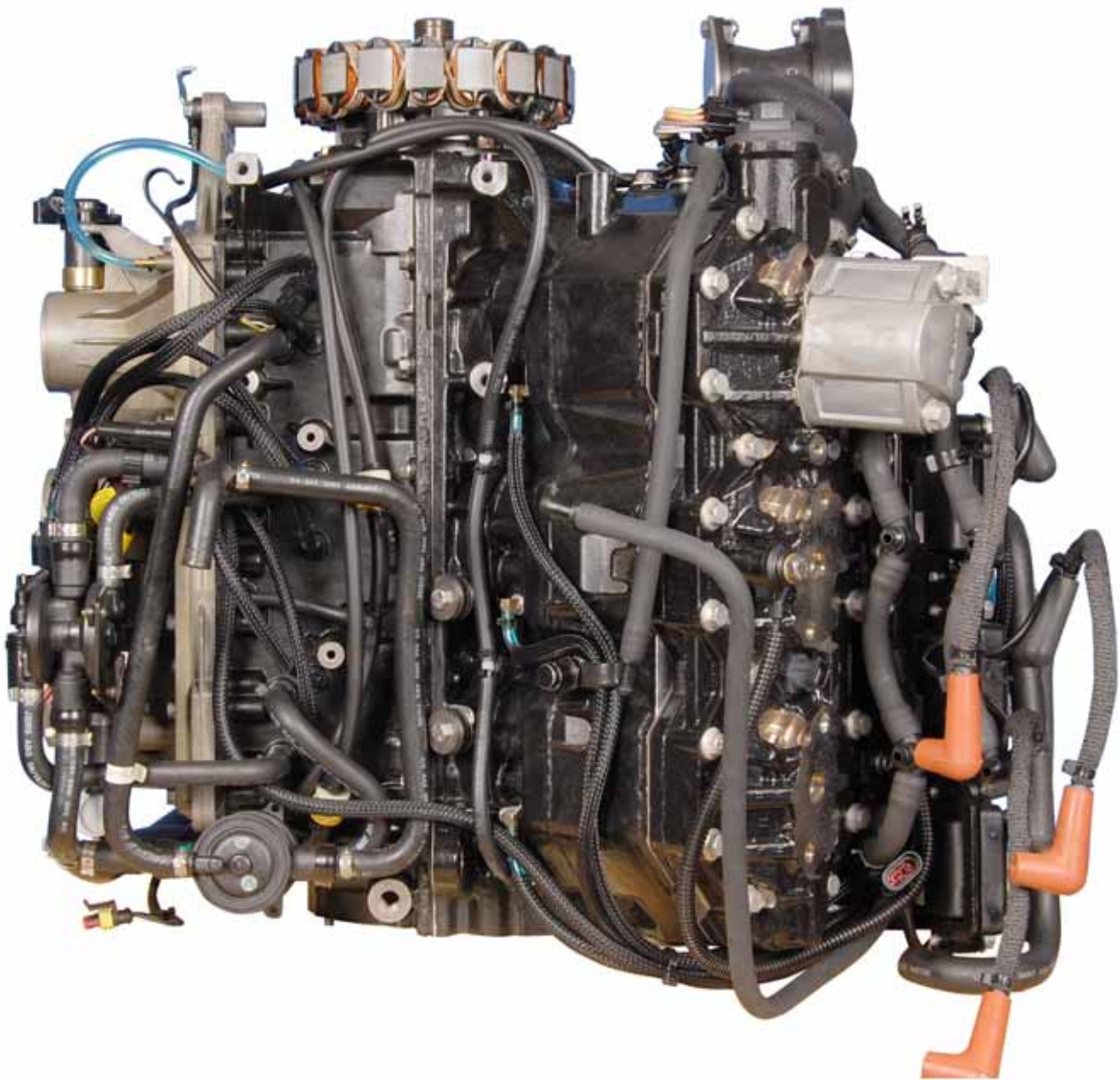
NOTICE

After installing a new or rebuilt powerhead, perform the following procedures before returning outboard to service:

- Adjust timing pointer.
- Index all spark plugs. Refer to **Spark Plug Indexing** on p. 41.
- Use *Evinrude Diagnostics* software to start powerhead break-in oiling. Refer to **Powerhead Break-In** on p. 70.
- Use *Evinrude Diagnostics* software to set TPS calibration. Refer to **TPS Calibration** on p. 116.
- **ICON Models:** Use *Evinrude Diagnostics* software to calibrate shift and throttle actuator stroke. Refer to **Calibrate Actuator Stroke** on p. 213.
- Use *Evinrude Diagnostics* software to make sure engine management software version and revision are current. Update as required.
- Prime fuel system.
- Prime oiling system. Refer to **Oil Supply Priming** on p. 175.
- Use *Evinrude Diagnostics* software to check engine timing. Refer to **Timing Adjustments** on p. 115.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Powerhead Views

Port Hose Routings – 3.3 L models



007153

Starboard Hose Routings – 3.3 L models



007154

Port Hose Routings – 3.4 L models



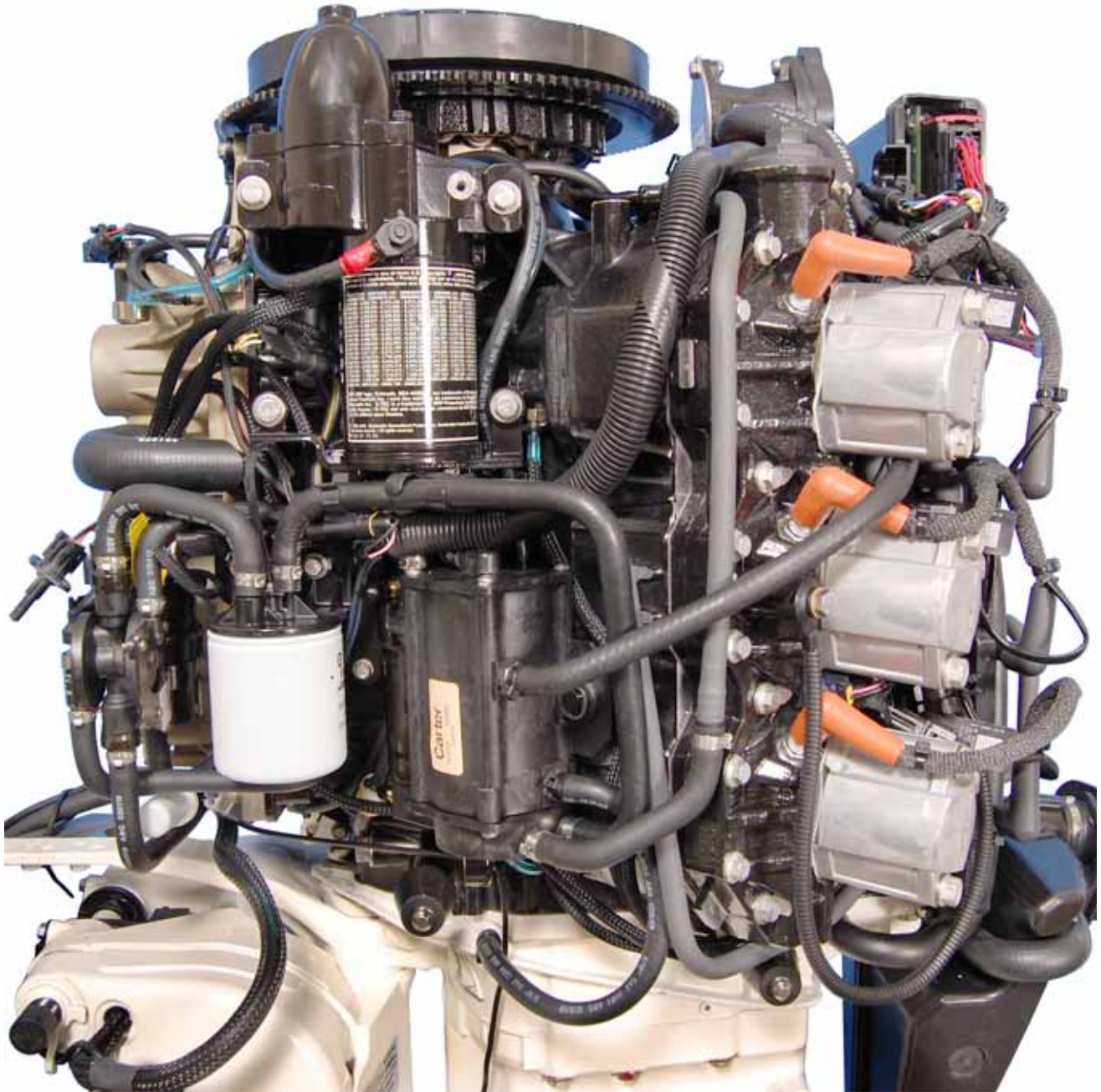
008503

Starboard Hose Routings – 3.4 L models



008502

Port – 3.3 L models



008448

Starboard – 3.3 L models



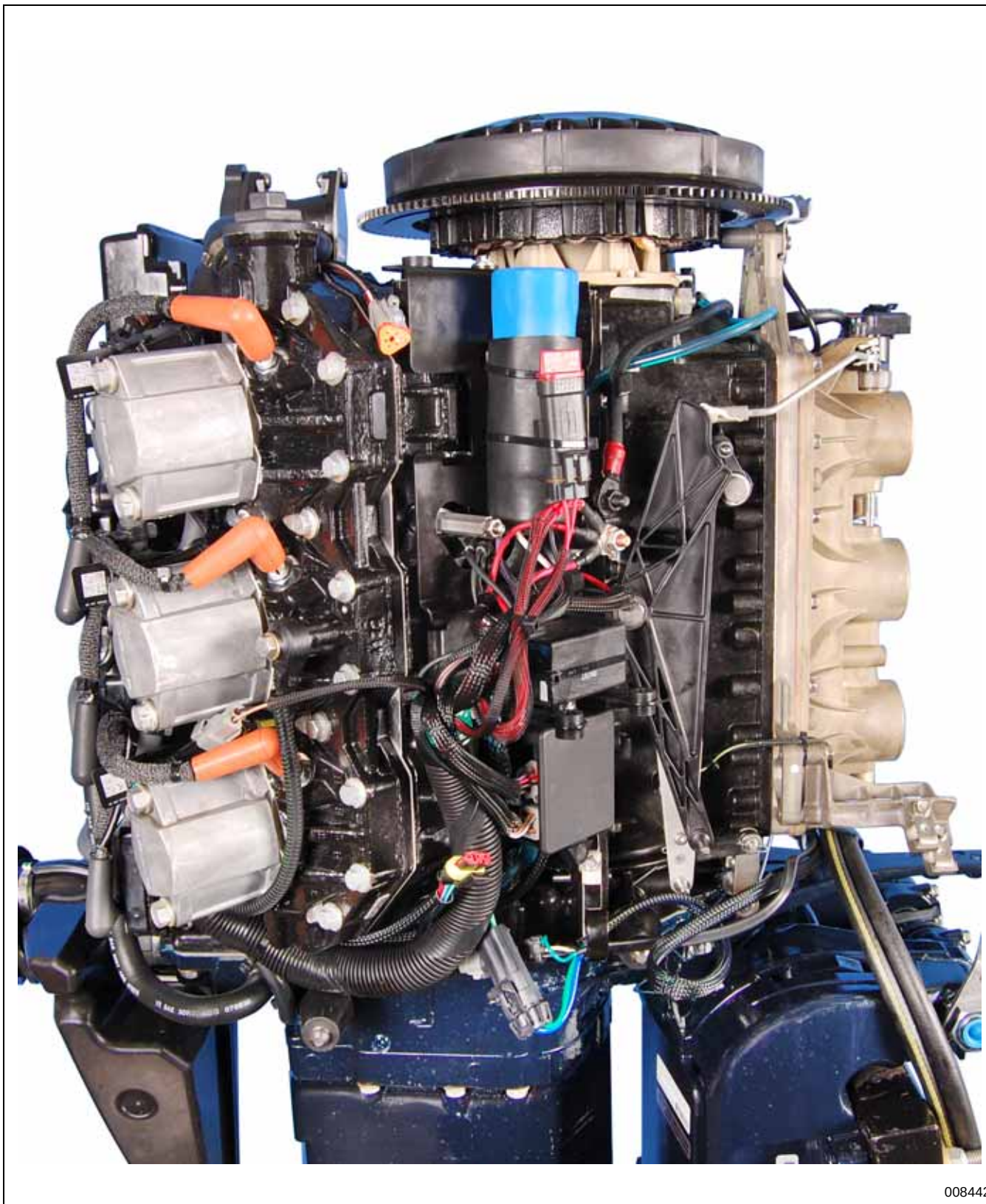
008449

Port – 3.4 L models



008441

Starboard – 3.4 L models



008442

Front – 3.3 L models



008450

Front – 3.4 L models



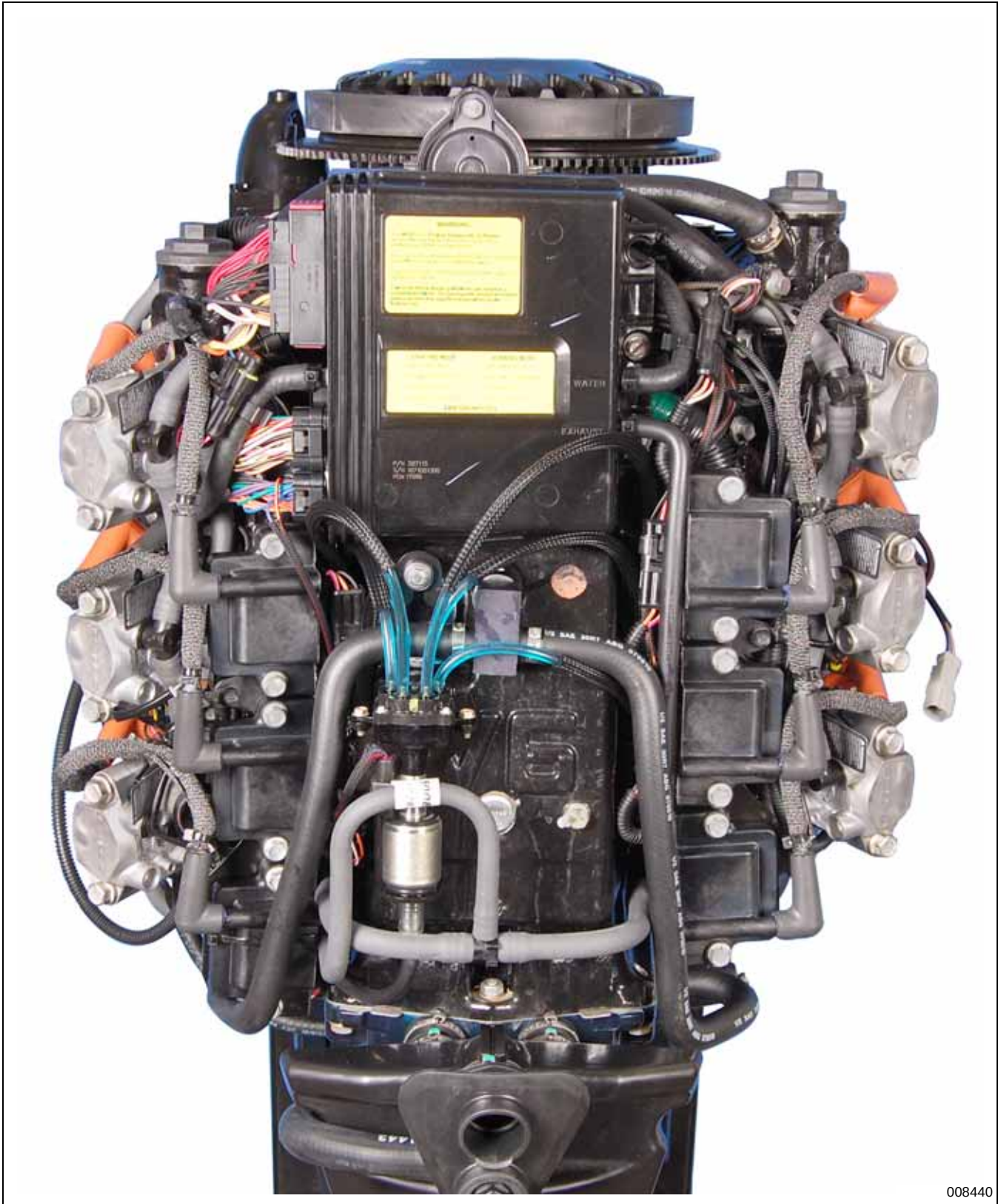
008439

Rear – 3.3 L models



007142

Rear – 3.4 L models



008440

Top



008438

Starboard – *ICON* models



008504

Midsection

Table of Contents

Service Charts	266
Exhaust Housing – 3.3 L models	266
Exhaust Housing – 3.4 L models	267
Stern Bracket	268
Muffler	269
Tilt Tube	270
Removal	270
Installation	271
Exhaust Housing Service	272
Exhaust Housing Removal	272
Lower Mount Service	272
Exhaust Housing Installation	273
Exhaust Housing Disassembly – 3.3 L models	274
Exhaust Housing Disassembly – 3.4 L models	275
Cleaning and Inspection	275
Exhaust Housing Assembly – 3.3 L models	276
Exhaust Housing Assembly – 3.4 L models	279
Stern Bracket	281
Stern Bracket Disassembly	281
Stern Bracket Assembly	283
Exhaust Relief Muffler Assembly	286

Exhaust Housing – 3.4 L models

Assembly Torque Specifications:

- F:** 22-24 Ft. lbs. (30-33 N·m)
- F:** 120-144 In. lbs. (14-16 N·m)
- Q:** 9-12 Ft. lbs. (12-16 N·m)
- E:** 40-42 Ft. lbs. (54-57 N·m)
- B:** 144-168 In. lbs. (16-19 N·m)
- C:** 60-84 In. lbs. (7-9.5 N·m)
- B:** 144-168 In. lbs. (16-19 N·m)
- F:** 60-84 In. lbs. (7-9.5 N·m)
- Q:** 60-84 In. lbs. (7-9.5 N·m)
- B:** 20-22 Ft. lbs. (27-30 N·m)
- 156-180 In. lbs. (18-20 N·m)**

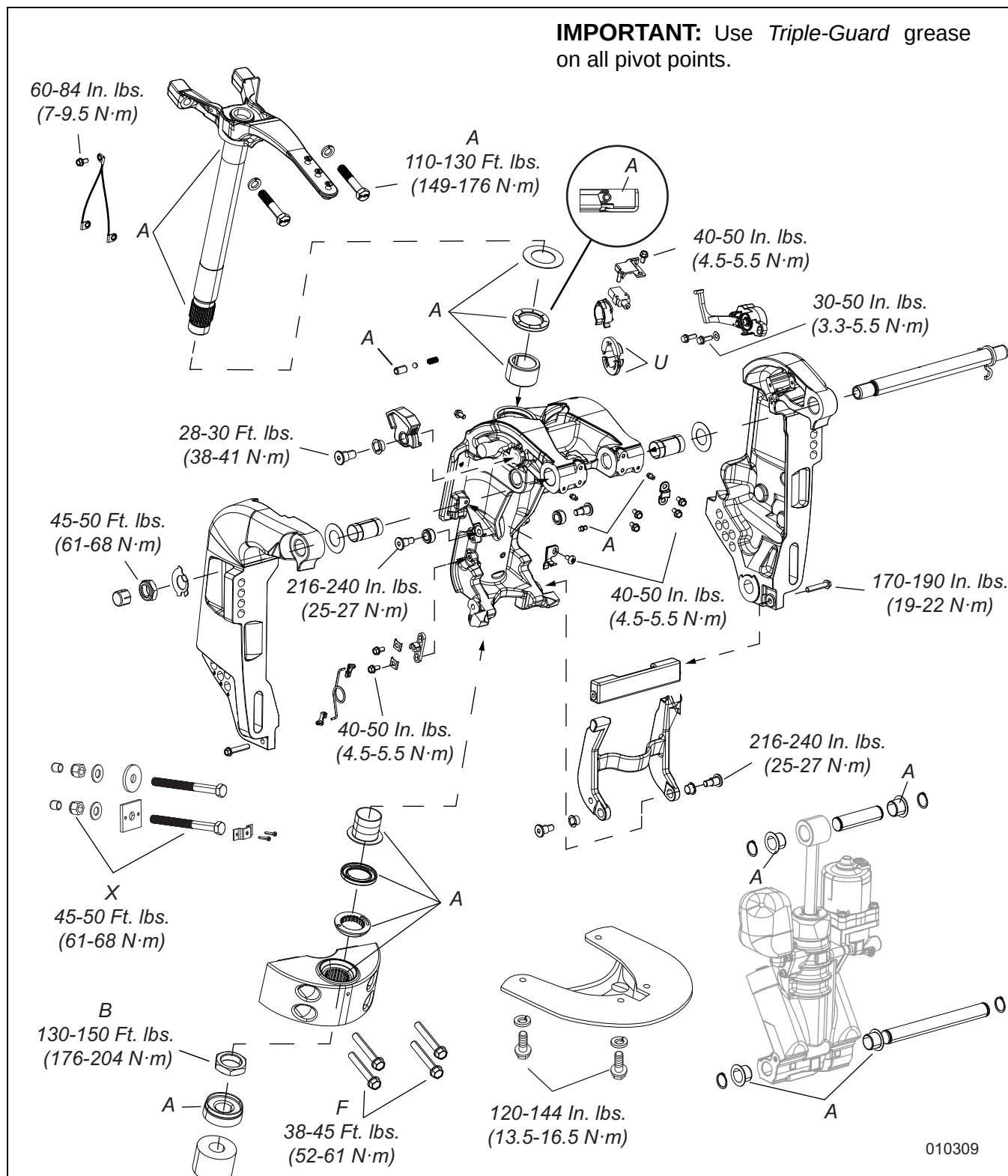
Legend:

A Triple-Guard Grease	E Red Ultra Lock	P Permatex #2
B Gasket Sealing Compound	F Blue Nut Lock	Q Gel Seal II
C Adhesive 847	L Pipe Thread Sealant	X See Service Manual Procedure

004107BTR

Stern Bracket

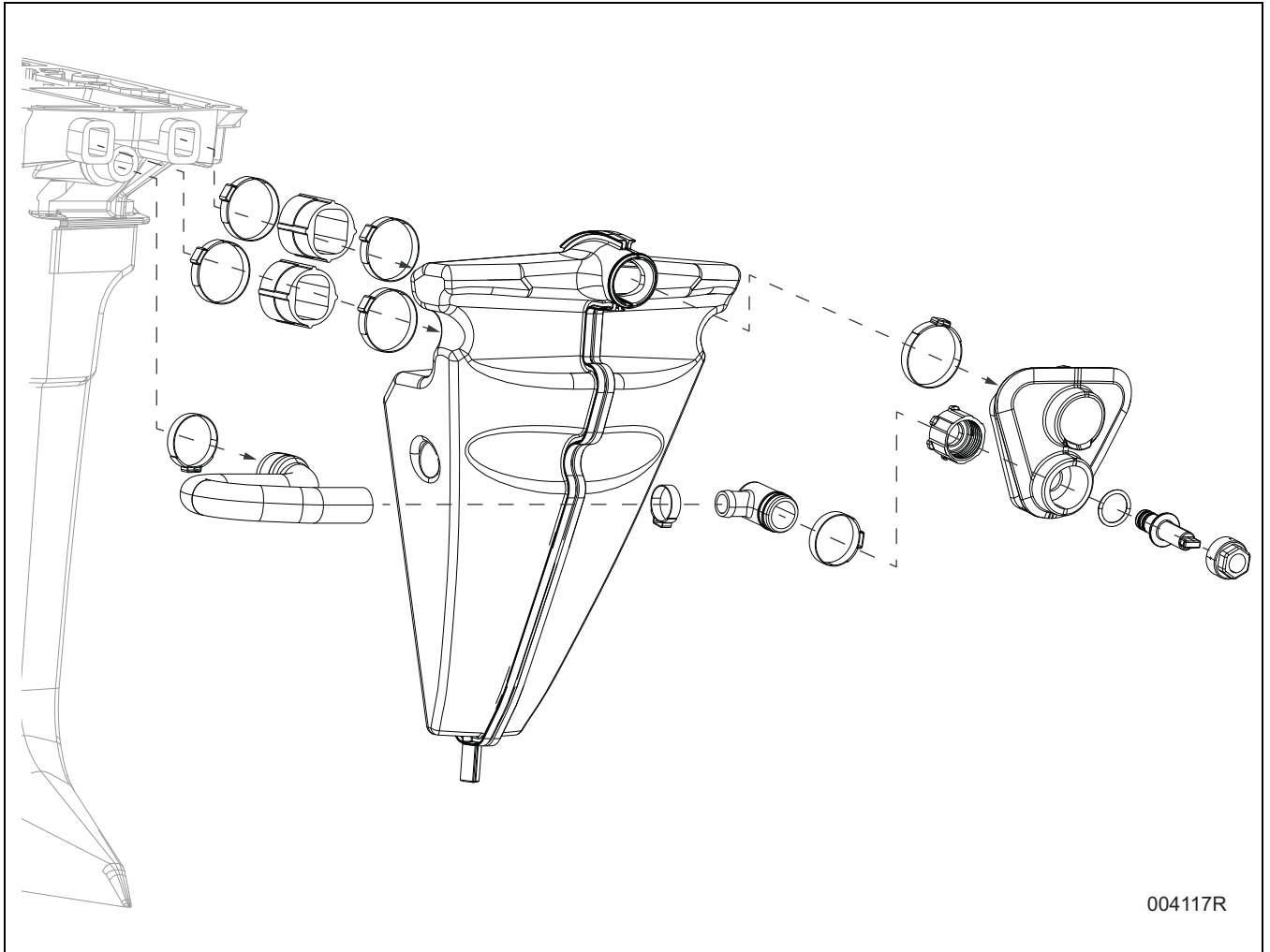
IMPORTANT: Use *Triple-Guard* grease on all pivot points.



010309

A <i>Triple-Guard Grease</i>	F <i>Blue Nut Lock</i>	Y <i>Extreme Pressure Grease</i>
B <i>Gasket Sealing Compound</i>	U <i>Instant Bonding Adhesive</i>	
E <i>Red Ultra Lock</i>	X <i>See Service Manual Procedure</i>	

Muffler



Midsection

Tilt Tube

Tilt Tube

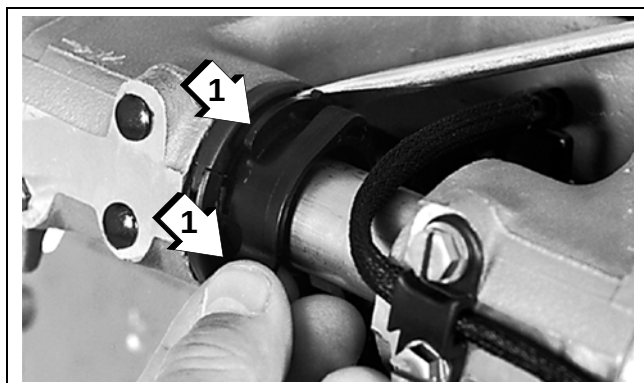
The tilt tube may be serviced without major disassembly of the outboard using Tilt Tube Service Kit, P/N 434523.

Removal

⚠ WARNING

Support the outboard with a suitable hoist.

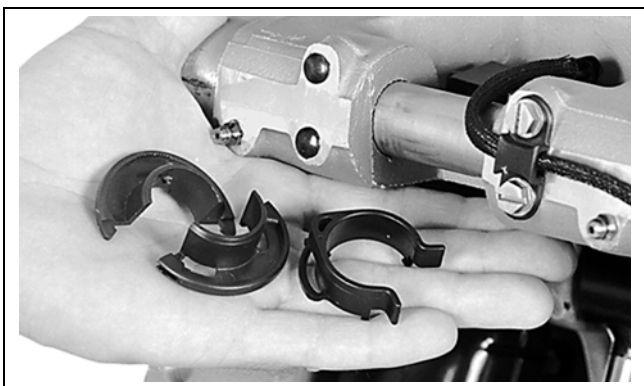
Pull the locking tabs on the tilt limit cam loose from the collar.



1. Locking tabs

30749

Remove the cam and collar from the tilt tube.



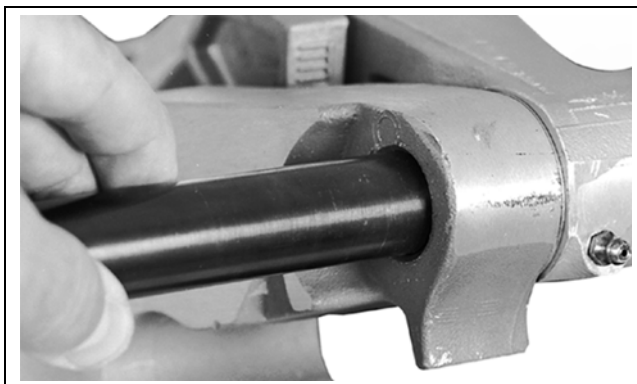
30748

Remove the nut from the starboard side.



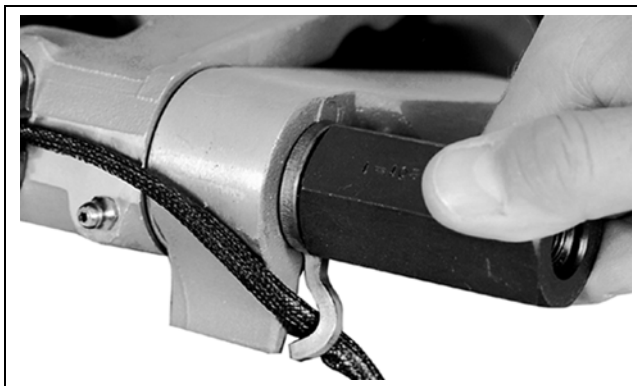
30747

Thread the spacer from Tilt Tube Service Kit, P/N 434523, onto the starboard end of the tilt tube.



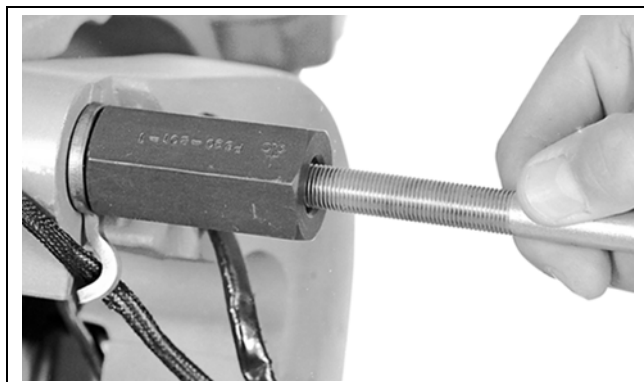
30746

Remove 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.



30745

Thread Slide Hammer, P/N 432128, into the adapter until at least 2 in. (51 mm) of thread are engaged.



30744

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

⚠ WARNING

Replace locknut if definite resistance is not felt.

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.



30743

Make sure the lock tab is in correct position.

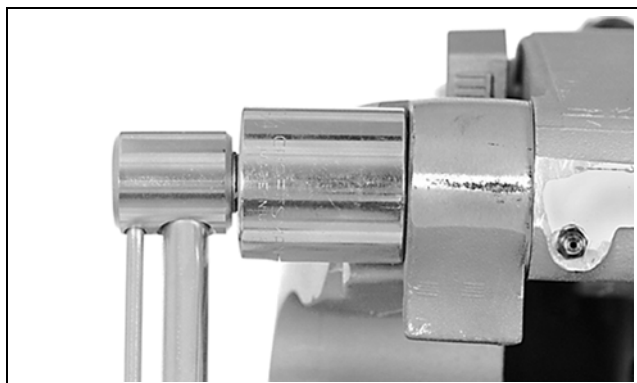


1. Lock tab

30742

Install the starboard locknut.

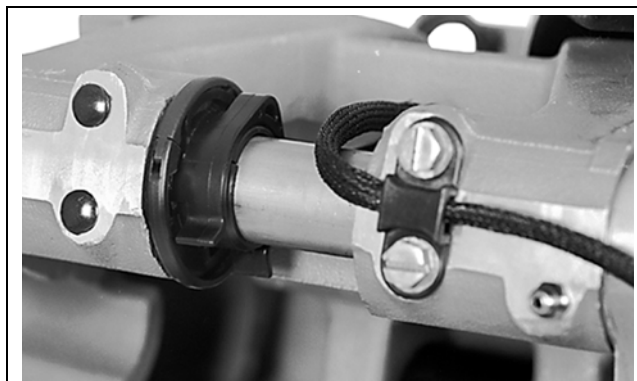
Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).



30741

Replace steering cable wiper nut on port end of tilt tube.

Apply one drop of instant bonding adhesive in receiving channels of tilt limit switch collar and install collar and tilt cam on tilt tube. Be sure locating tab on collar fits in hole on tilt tube.



30750

Exhaust Housing Service

Exhaust Housing Removal

Before removing the exhaust housing:

- Remove the gearcase. Refer to **Gearcase Removal and Installation** on p. 45.
- Remove the powerhead. Refer to **Powerhead Removal** on p. 225.

Remove and discard four lower mount screws.



20" Models

23036



25" Models

32590

Remove the steering arm ground lead and screw.

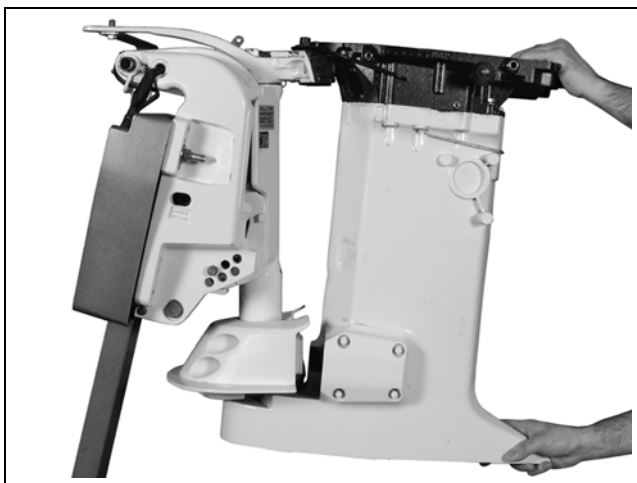
Remove two upper mount screws.



1. Ground lead (removed)

32589

Remove the exhaust housing.



006979

Lower Mount Service

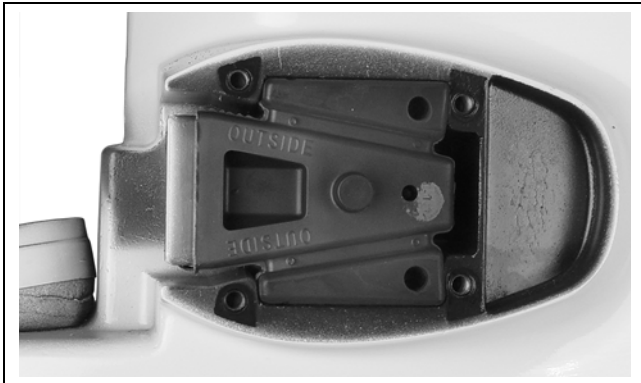
Remove lower mount covers and inspect the lower mounts.

If replacement is necessary, lubricate mount with soapy water and carefully pry at both ends to remove.



32578

If removed, coat the lower mounts with soapy water and press into the exhaust housing with the "OUTSIDE" mark facing outward.



23033

Install the mount covers. Apply *Nut Lock* to screws, install washers and screws, and tighten to a torque of 156 to 180 in. lbs. (18 to 20 N·m).



32579

Exhaust Housing Installation

Bring the exhaust housing into position with the stern bracket.

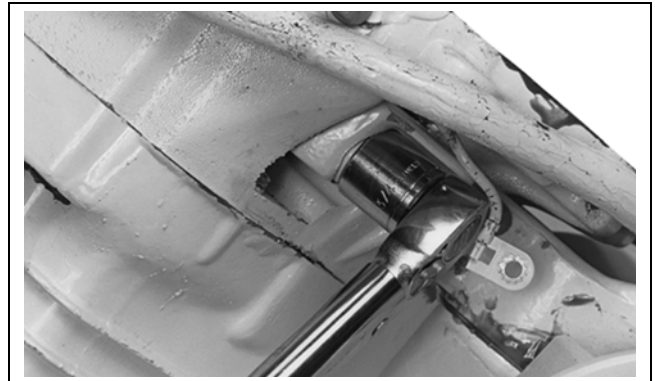
Install four **new** lower mount screws with lock-patch. Tighten screws to a torque of 38 to 45 ft. lbs. (51 to 61 N·m).



Lower Mount Screws

32590

Apply *Ultra Lock* to upper mount screws and tighten to a torque of 64 to 72 ft. lbs. (87 to 98 N·m).

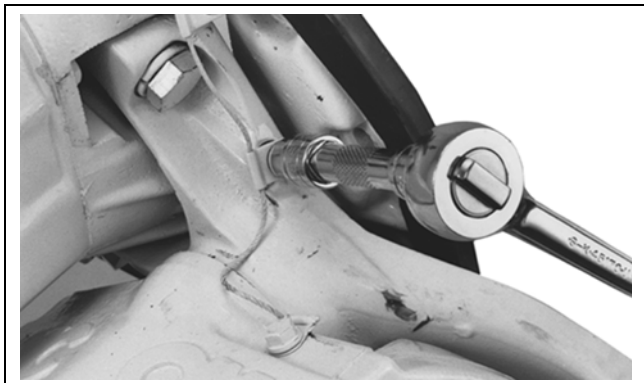


7716

Midsection

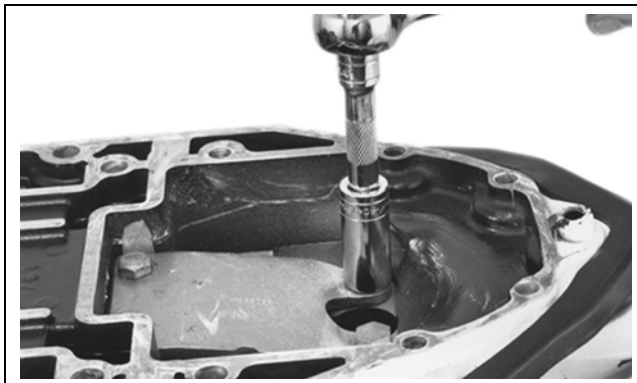
Exhaust Housing Service

Attach the ground lead and lockwasher to the star-board side of the steering arm.



32586

Loosen and remove the upper mount plate screws and remove the mount plate.



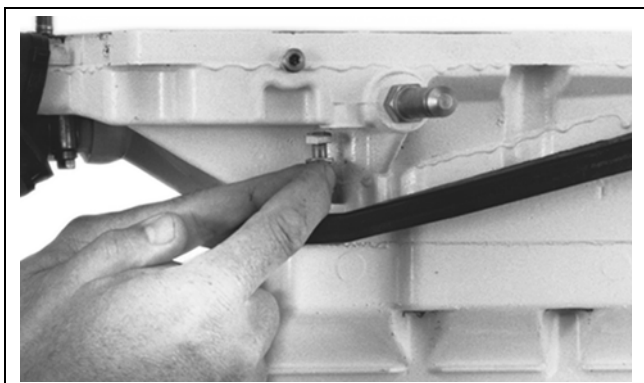
32588

Install gearcase. Refer to **Gearcase Removal and Installation** on p. 45.

Install powerhead. Refer to **Powerhead Installation** on p. 247.

Exhaust Housing Disassembly – 3.3 L models

Remove two front adapter to outer exhaust housing screws. Remove three nuts at rear of the adapter.

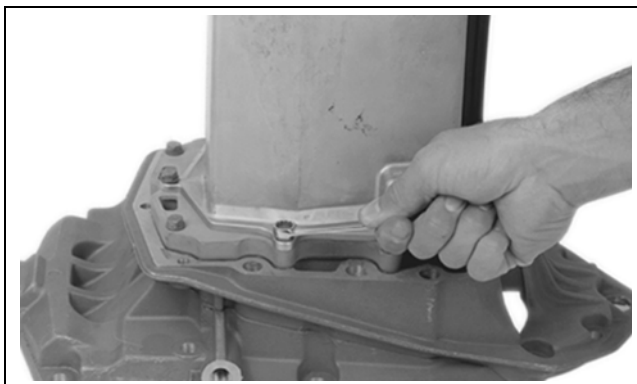


32580

Lubricate the upper mount with soapy water and pry up to remove it from the adapter housing.

Lift the adapter/inner exhaust housing out of the exhaust housing.

Mark the water tube for correct reassembly location. Remove six inner exhaust housing screws. Remove the inner exhaust housing.

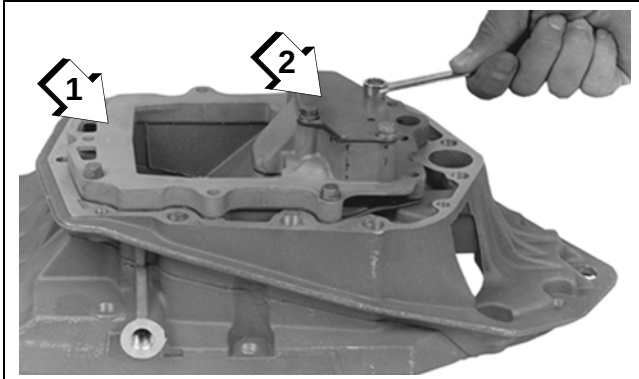


13638

Remove the water tube and grommet from the inner exhaust housing. Discard the grommet.

Loosen retaining screws and remove the cover from water plate.

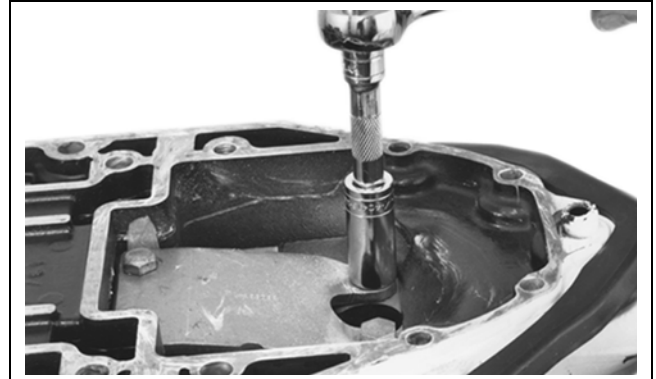
Loosen retaining screws and remove water plate from the adapter.



1. Cover
2. Water plate

13641

Loosen and remove the upper mount plate screws and remove the mount plate.



32588

Exhaust Housing Disassembly – 3.4 L models

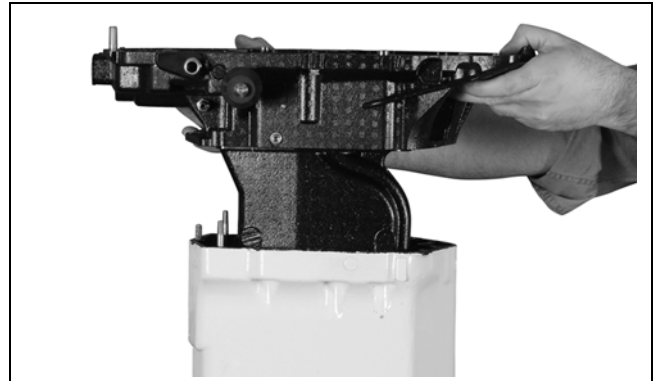
Remove two front adapter to outer exhaust housing screws.



006980

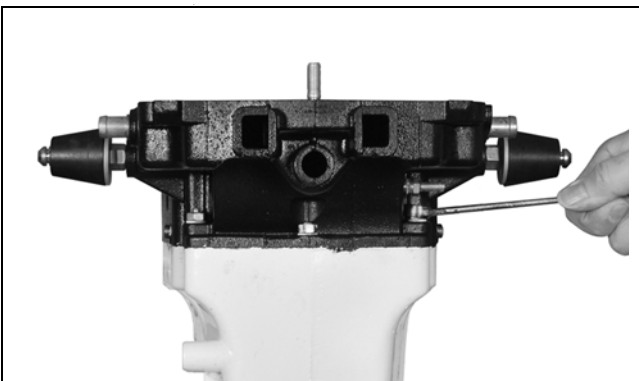
Lubricate the upper mount with soapy water and pry up to remove it from the adapter housing.

Lift the adapter/inner exhaust housing out of the exhaust housing.



006981

Remove three nuts at rear of the adapter.



006978

Cleaning and Inspection

⚠ WARNING

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

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

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

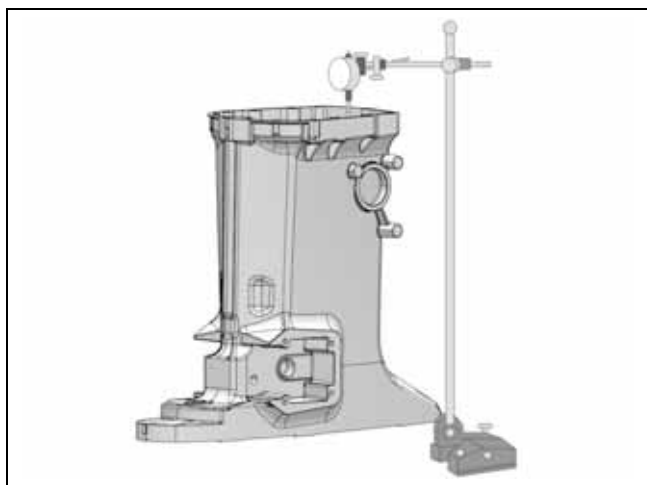
Midsection

Exhaust Housing Service

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

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

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



010358

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

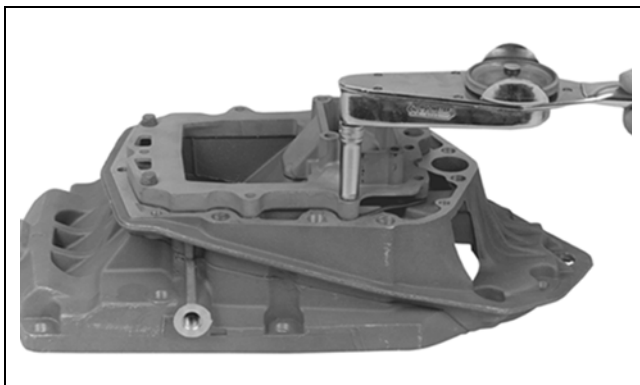
Exhaust Housing Assembly –

3.3 L models

Lightly coat both sides of a new gasket with *Gasket Sealing Compound* and install the gasket and water plate.

Apply *Gasket Sealing Compound* to threads of the water plate retaining screws. Install with washers

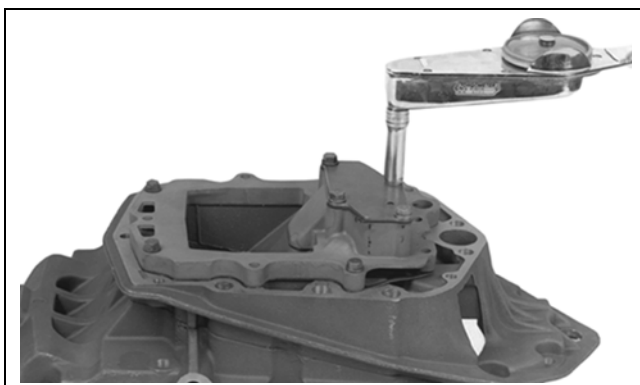
and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



13644

Apply *Adhesive 847* to the water plate surface, then place the cover on the water plate.

Apply *Gasket Sealing Compound* to threads of cover retaining screws. Install with washers and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



13642

Coat the outside diameter of a new water tube grommet with *Adhesive 847*. Install grommet in the inner exhaust housing. Install the water tube.



7715

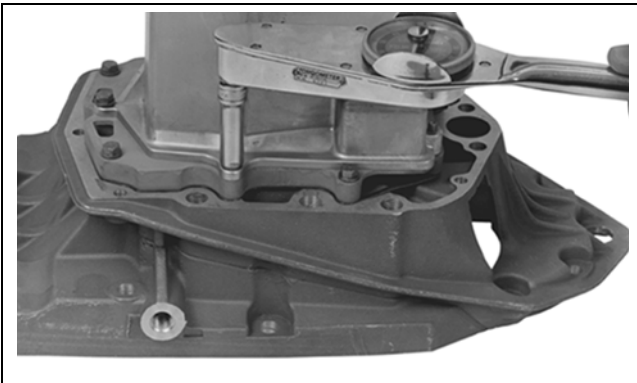
Apply *Adhesive 847* to the bottom flange of the inner exhaust housing. Install a new seal. Apply *Triple-Guard* grease to outer seal surface.



7713

Lightly coat both sides of a new inner exhaust housing gasket with *Gasket Sealing Compound* and install it.

Install the inner exhaust housing. Coat inner exhaust housing screws with *Gasket Sealing Compound* and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



13639

Install a new inner exhaust housing seal. Apply *Adhesive 847* to the seal groove.



13640

Clean and degrease the adapter housing and outer exhaust housing mating surfaces with *Cleaning Solvent*. Apply *Gel-Seal II* sealant to the adapter flange of the exhaust housing.



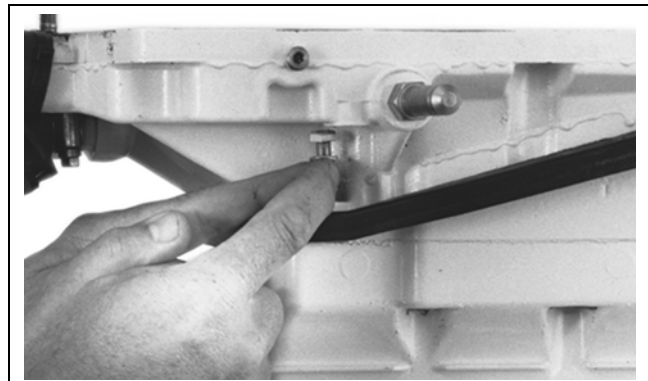
13692

Midsection

Exhaust Housing Service

Place the adapter/inner exhaust housing into the exhaust housing. Align the water tube.

Loosely install the small retaining screws, nuts, and washers.

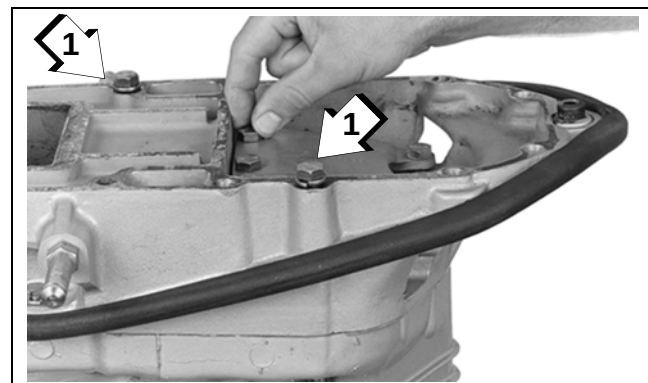


32580

Lubricate the upper mount with soapy water and push into place in the adapter housing. The mount radius must face aft with the "TOP" mark facing up.

Apply *Locquic Primer* and *Nut Lock* to the upper mount plate screws and install the plate and screws loosely. Install the ground lead and star washer under the forward starboard screw.

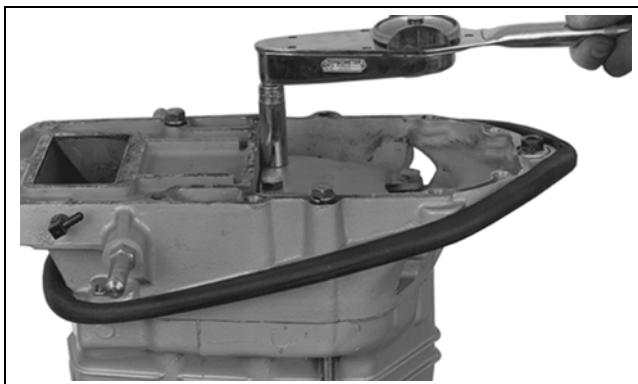
Align the outer exhaust housing and adapter by placing two powerhead mounting screws through their holes.



1. Powerhead mounting screws

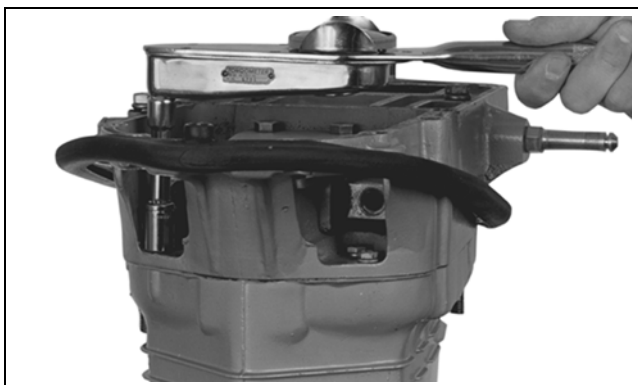
13689

Install four mount plate screws and washers and tighten to a torque of 22 to 24 ft. lbs. (30 to 33 N·m).



13690

Tighten the small adapter to exhaust housing screws and nuts to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



13691

Exhaust Housing Assembly – 3.4 L models

Apply *Adhesive 847* to the bottom flange of the inner exhaust housing. Install a new seal. Apply *Triple-Guard* grease to outer seal surface.



006984

Install grommet and water tube in the inner exhaust housing.



1. Water tube grommet

006982

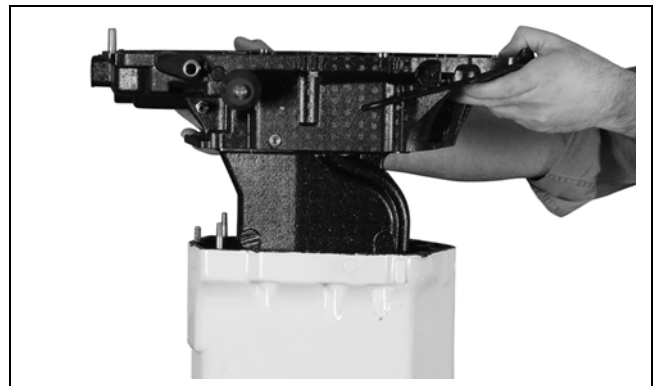
Clean and degrease the adapter housing and outer exhaust housing mating surfaces with

Cleaning Solvent. Apply *Gel-Seal II* sealant to the adapter flange of the exhaust housing.



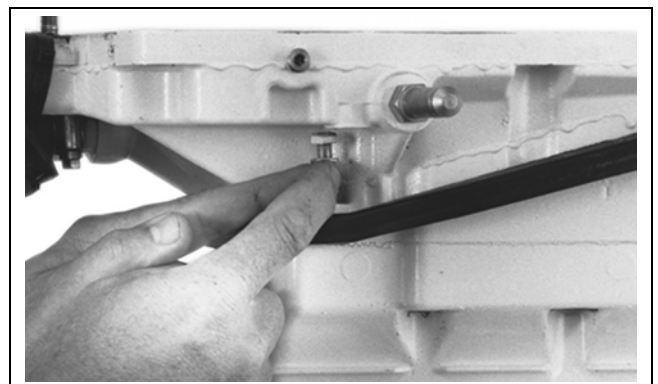
13692

Place the adapter/inner exhaust housing into the exhaust housing. Guide the water tube through the hole in the outer housing.



006981

Loosely install the small retaining screws, nuts, and washers.



32580

Lubricate the upper mount with soapy water and push into place in the adapter housing. The mount

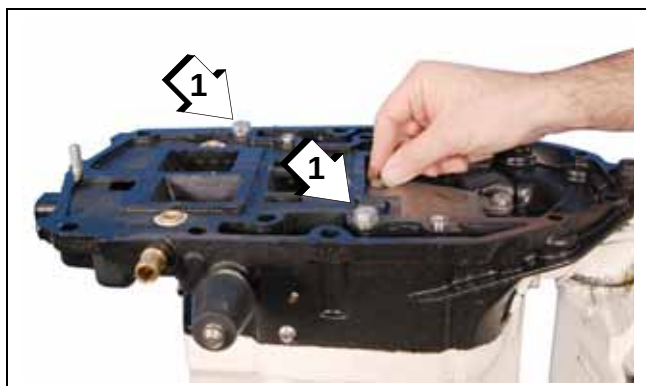
Midsection

Exhaust Housing Service

radius must face aft with the "TOP" mark facing up.

Apply *Locquic Primer* and *Nut Lock* to the upper mount plate screws and install the plate and screws loosely. Install the ground lead and star washer under the forward starboard screw.

Align the outer exhaust housing and adapter by placing two powerhead mounting screws through their holes.



1. Powerhead mounting screws

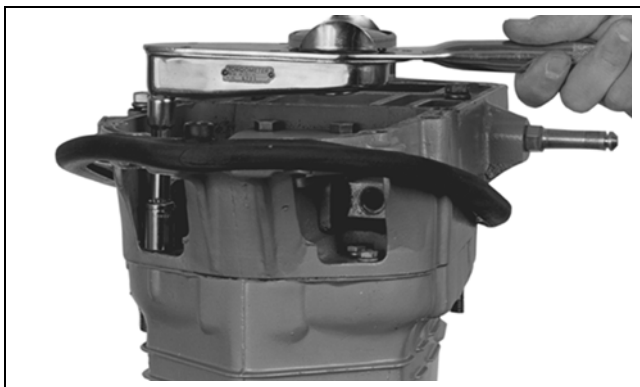
006985

Install four mount plate screws and washers and tighten to a torque of 22 to 24 ft. lbs. (30 to 33 N·m).



006986

Tighten the small adapter to exhaust housing screws and nuts to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



13691

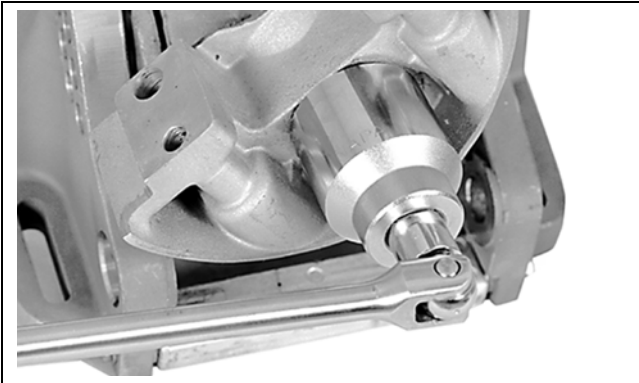
Stern Bracket

Stern Bracket Disassembly

Before servicing the stern bracket:

- Remove gearcase. Refer to **Gearcase Removal and Installation** on p. 45.
- Remove powerhead. Refer to **Powerhead Removal** on p. 225.
- Remove exhaust housing. Refer to **Exhaust Housing Removal** on p. 272.
- The power trim/tilt unit must be removed. Refer to **Trim and Tilt Servicing** on p. 305.

Remove and discard steering shaft locknut.



30738

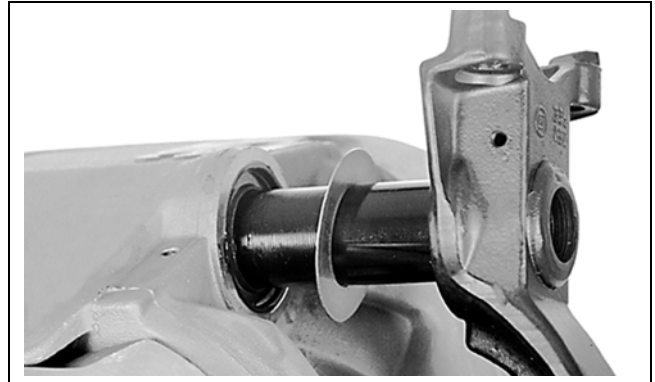
Remove the lower mount bracket and keeper.



Lower mount bracket – 20" Models

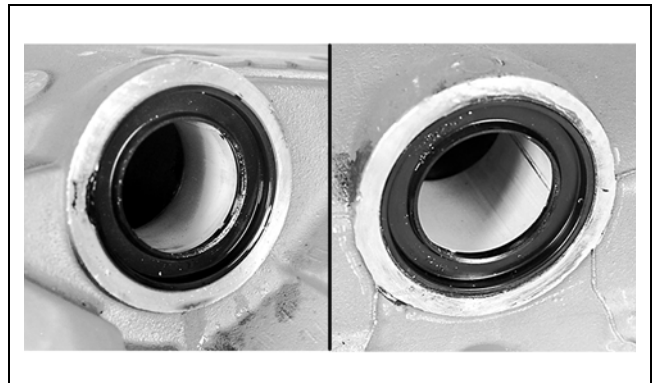
30736

Remove the steering shaft and thrust washer. It may be necessary to tap the steering shaft out using a wood dowel and mallet.



30735

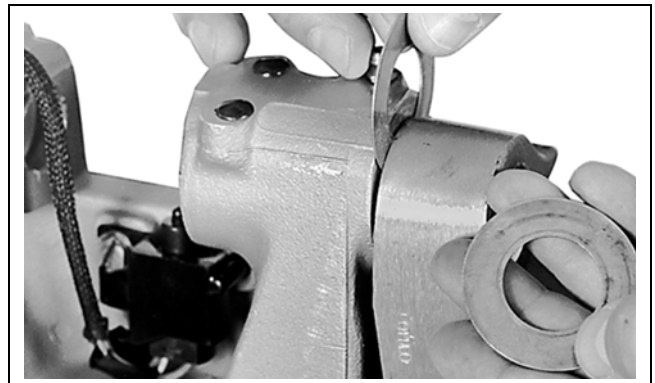
Pry out upper and lower steering shaft seals and discard. Remove the upper and lower steering shaft bushings.



010312

Remove the tilt tube. Refer to **Tilt Tube** on p. 270.

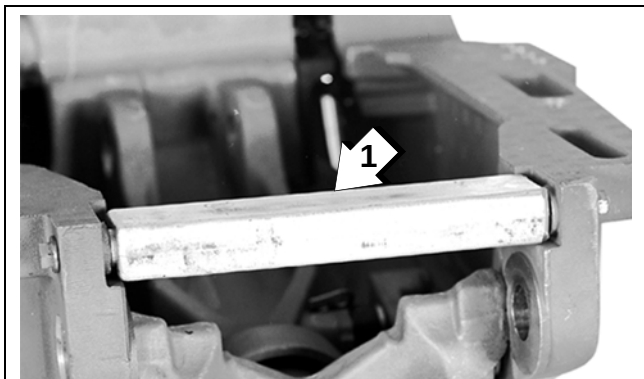
Remove the two tilt tube washers.



30763

Midsection Stern Bracket

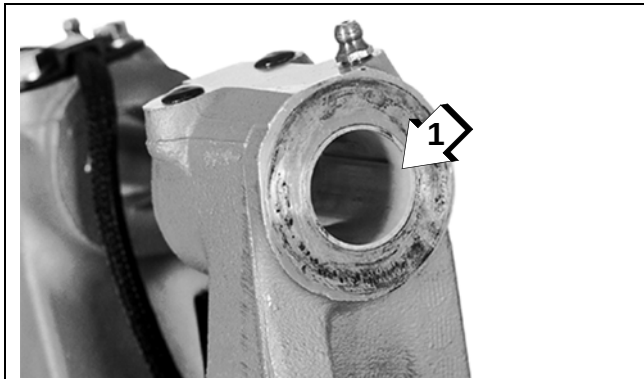
Remove the anode.



1. Anode

30762

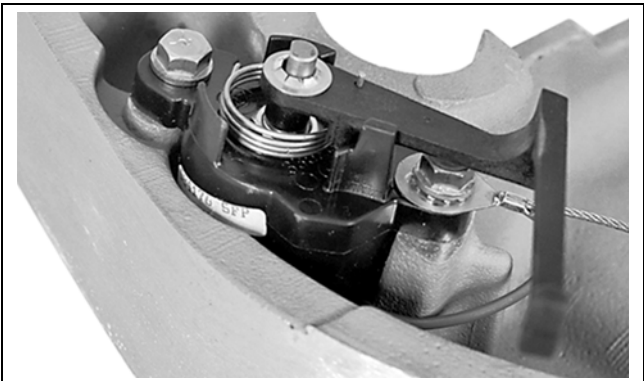
Remove the swivel bracket. Inspect and, if necessary, replace the tilt tube bushings.



1. Tilt tube bushing

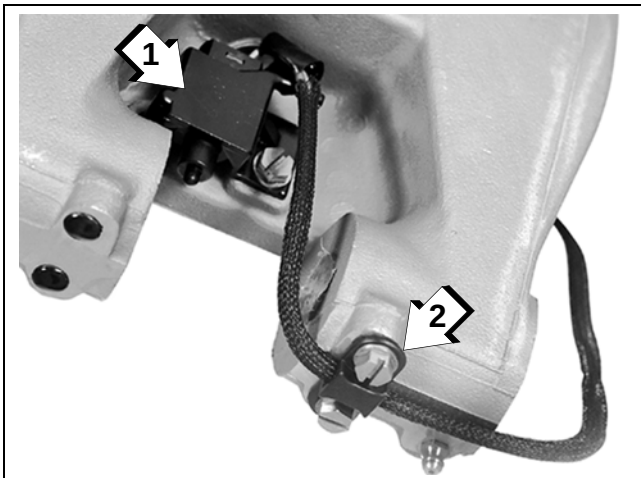
30761

Remove the trim sender unit from the port stern bracket and pull its wires through the braided tube.



30760

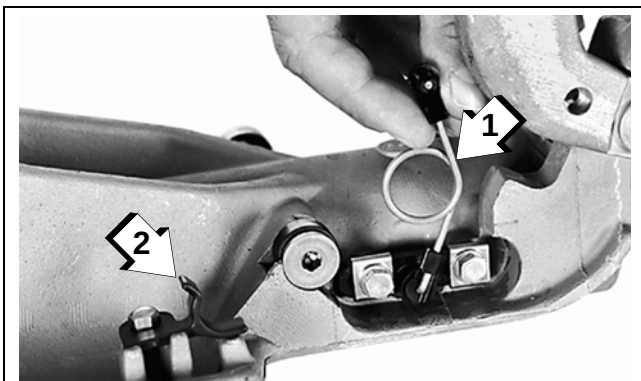
Remove the tilt limit switch and retainer from the swivel bracket.



1. Tilt limit switch
2. Retainer

30758

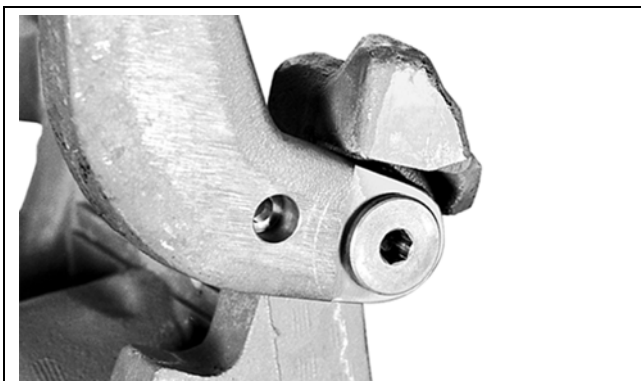
Disconnect the trail lock spring and remove it from the swivel bracket. Remove trail arm retainer.



1. Trail lock spring
2. Trail arm retainer

30756

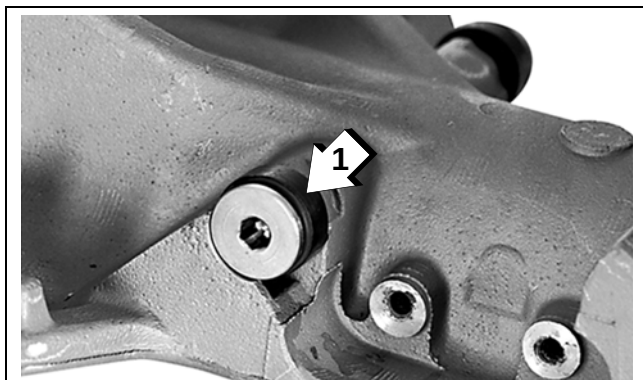
Remove the trail lock arm and bushings from the swivel bracket.



1. Trail lock bushing

30755

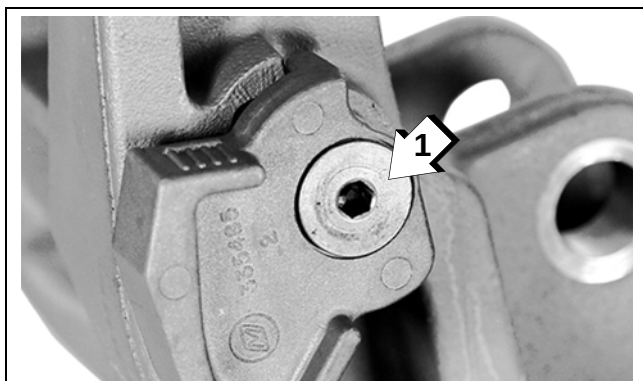
Remove the two trim rod rollers from the swivel bracket. Discard the screws. New screws **MUST** be used when installing the trim rod rollers.



1. Trim rod roller

30754

Remove the tilt support and bushing from the swivel bracket and inspect the detent roller and spring.



1. Tilt support bushing

30753

Stern Bracket Assembly

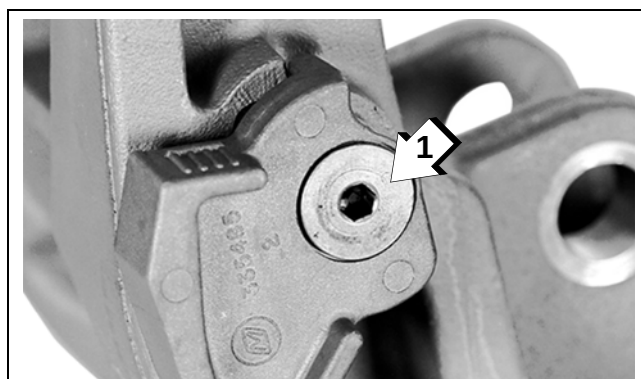
IMPORTANT: Before proceeding, make sure all components have been thoroughly cleaned. Replace any seals that have been removed. Inspect all thrust washers and bushings for evidence of deterioration.

Install the detent roller and spring and the tilt support with bushing in the swivel bracket. Tighten

bushing to a torque of 28 to 30 ft. lbs. (38 to 41 N·m).



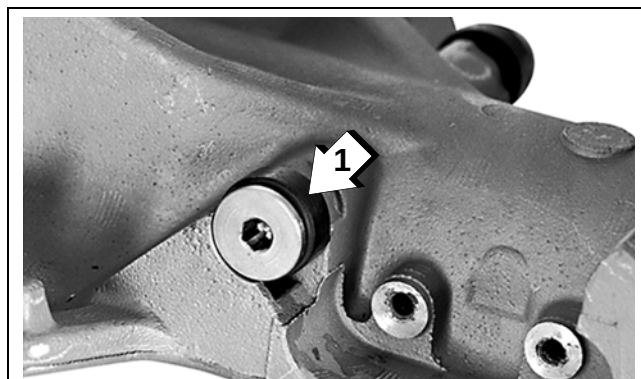
30752



1. Tilt support bushing

30753

Apply *Ultra Lock* (red) to the threads of NEW trim rod roller screws. Install the two trim rod rollers on the swivel bracket. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



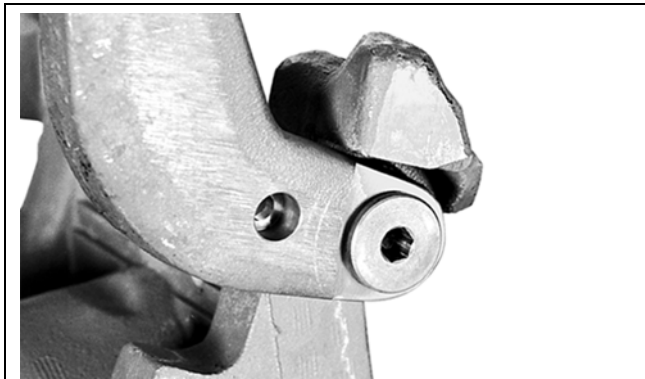
1. Trim rod roller

30754

Midsection

Stern Bracket

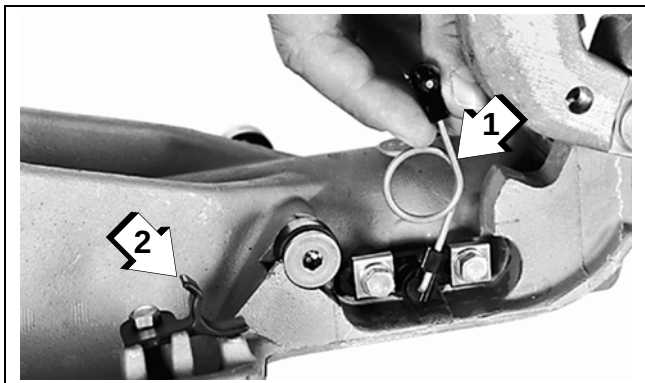
Install the trail lock and bushings in the swivel bracket. Apply *Ultra Lock* (red) to the threads of the screws. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



1. Trail lock bushing

30755

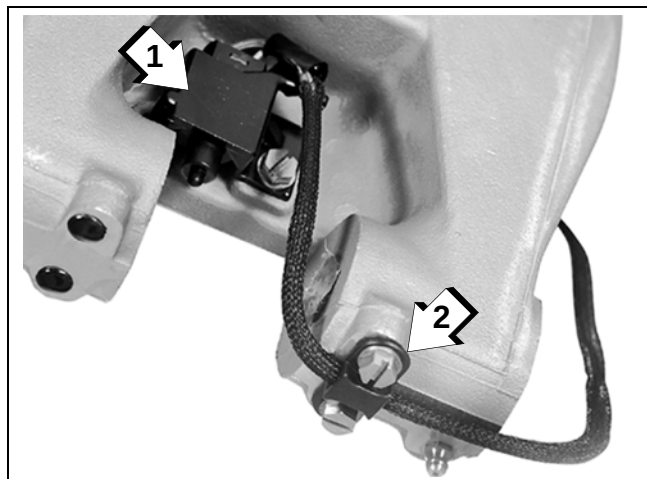
Install the trail lock spring in the swivel bracket and connect the spring to the trail lock.



1. Trail lock spring
2. Trail arm retainer

30756

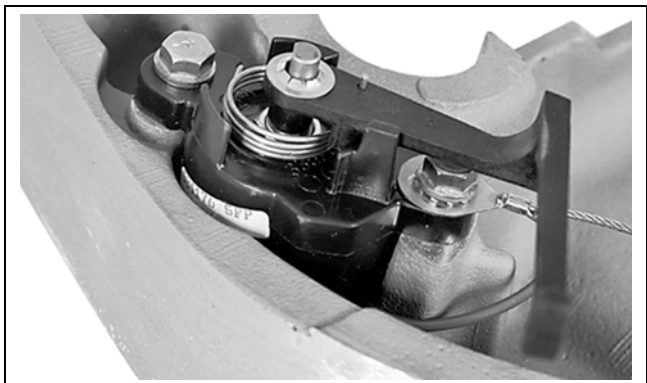
Install the tilt limit switch and retainer on the swivel bracket. Tighten screws to a torque of 40 to 50 in. lbs. (4.5 to 5.5 N·m).



1. Tilt limit switch
2. Retainer

30758

Route the trim sender wires through the braided tube, and install the sender unit in the port stern bracket.

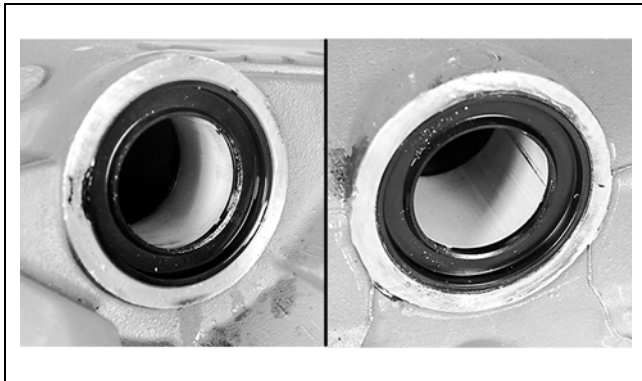


30760

Install the upper and lower steering shaft bushings and new seals in the swivel bracket. Both seal lips face out.

- Coat the outside surfaces of seals with *Gasket Sealing Compound*.

- Coat the bushings and seal lips with *Triple-Guard* grease.



010312

Coat tilt tube bushings with *Triple-Guard* grease and, if removed, install them in the swivel bracket.

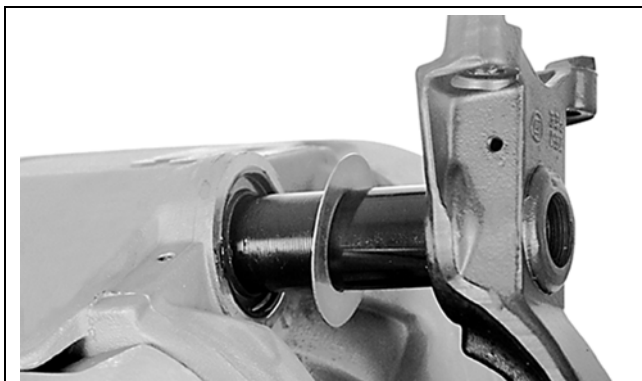


30761

Place the swivel bracket between the stern brackets and install the anode.

Install the tilt tube and tilt limit cam. Refer to **Tilt Tube** on p. 270.

Install the steering shaft and thrust washer.



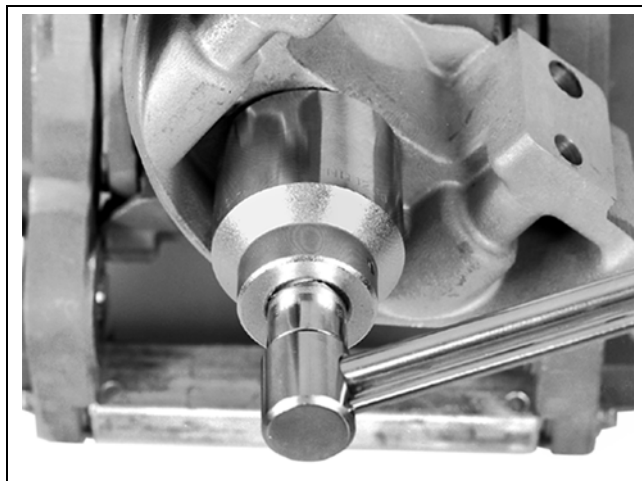
30735

Install the steering shaft keeper. Apply *Locquic Primer* and *Nut Lock* to the splines of the steering shaft and lower mount bracket.



30736

Install the lower mount bracket and a new locking nut with its unstaked side facing the mount bracket. Align the bracket with the steering arm and tighten the nut to a torque of 130 to 150 ft. lbs. (176 to 204 N·m).



30767

Fill the swivel bracket with *Triple-Guard* grease through the grease fitting on the bracket's port side. Lubricate the tilt tube, swivel bracket, and stern brackets through the two forward grease fittings.

Install the exhaust housing. Refer to **Exhaust Housing Installation** on p. 273.

Midsection

Exhaust Relief Muffler Assembly

Exhaust Relief Muffler Assembly

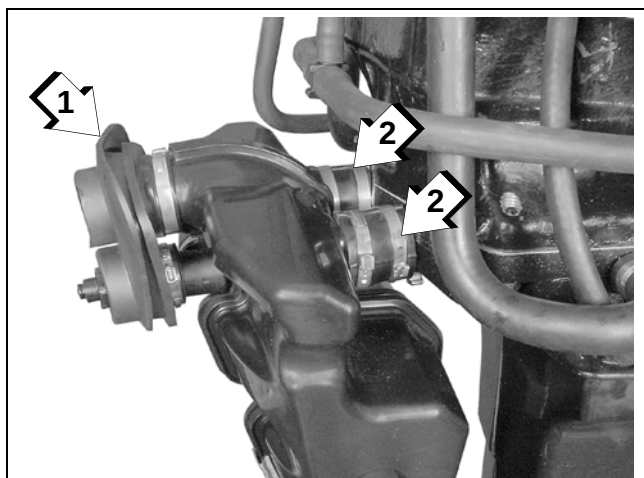
The exhaust relief muffler is located at the rear of the adapter housing and concealed by the lower motor covers. The exhaust relief grommet connects directly to the muffler assembly.



1. Exhaust relief grommet

004122

The muffler assembly connects to the exhaust relief hoses from the adapter housing assembly.

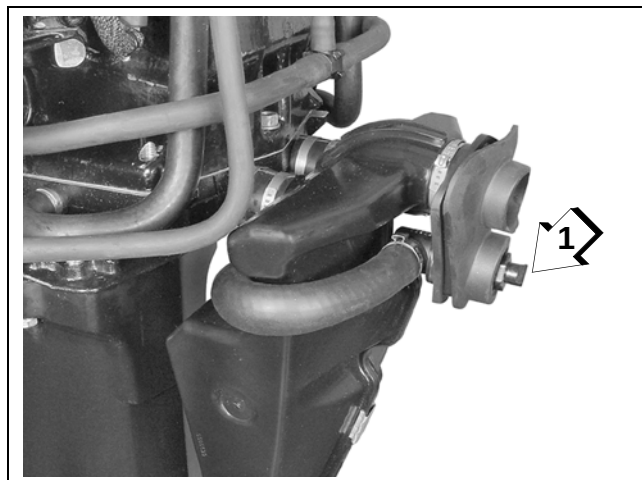


1. Exhaust relief grommet

2. Exhaust relief hoses

004226

housing assembly with a hose. This hose is not connected to the muffler assembly.



1. Overboard indicator and flush port

004225

Periodically inspect hoses and connections for condition. Replace muffler or hoses as needed.

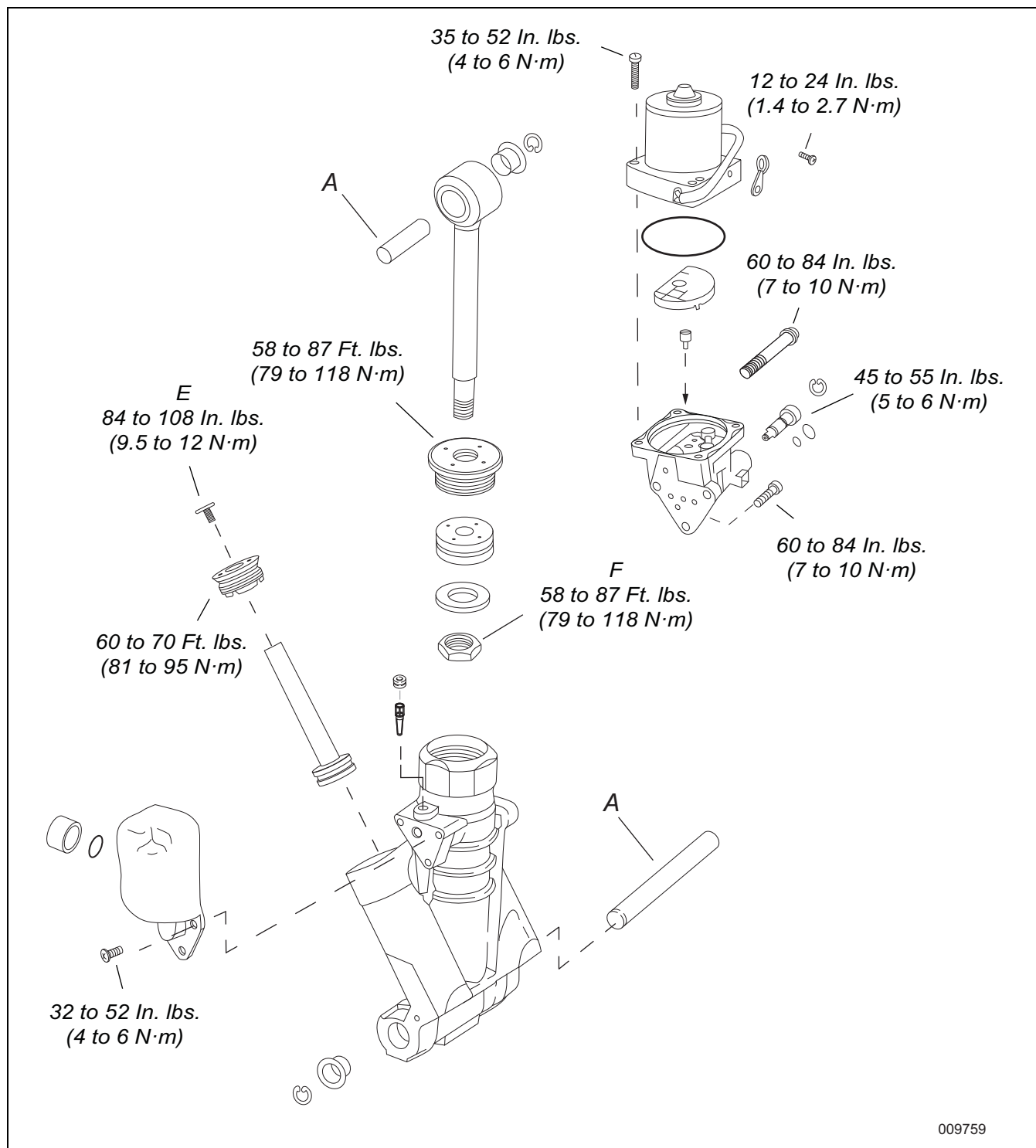
Trim and Tilt

Table of Contents

Service Charts	288
System Description	289
Modes Of Operation	290
Trim-OUT / Tilt-UP Mode	290
Tilt-DOWN / Trim-IN Mode	291
Impact Relief	292
Shallow Water Drive Tilt Relief	293
Thermal Expansion Relief	293
Manual Release – UP	294
Manual Release – DOWN	295
Routine Inspections	296
General	296
Reservoir Fluid	296
Manual Release Valve	296
Stern Brackets	296
Troubleshooting	296
Electrical Circuit Tests	300
Relay Testing	300
Trim and Tilt Motor Current Draw Tests	300
Trim and Tilt Motor No Load Test	301
Trim Gauge Test	301
Trim Sender Test	302
Trim and Tilt Replacement	303
Trim and Tilt Servicing	305
Disassembly	305
Tilt Piston Removal	308
Tilt Piston Identification	309
Tilt Piston Assembly	309
Tilt Rod Assembly	310
Trim Rod Removal	312
Trim Rod Assembly	313
Manifold and Reservoir Installation	314
Trim Rod Installation	315
Tilt Rod Installation	316
Motor Installation	316

Service Charts

25 in. V4 Models and All V6 Models with Three Piston System)



A Triple-Guard Grease
E Red Ultra Lock
F Blue Nut Lock

W TNT Fluid, P/N 767969

System Description

The power trim/tilt hydraulic system is completely contained between the outboard's stern brackets.

The system consists of:

- Electric motor
- Oil reservoir
- Pump manifold assembly
- Cylinder body assembly

Optimal boat and outboard performance can be achieved by adjusting (trimming) the angle of outboard propeller thrust. The first 15° of outboard movement is considered trim range.

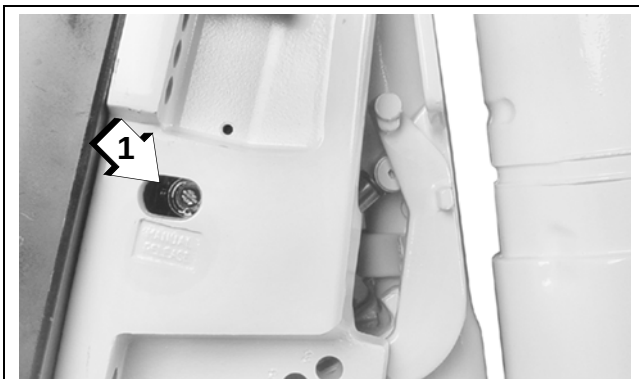
Outboard movement beyond the trim range is considered tilting. Tilting of the outboard may be desired for shallow water drive and for trailering/storage. The tilt cylinder moves the outboard through the tilt range (final 50°).

A tilt relief valve limits the propeller thrust load that will be supported by the unit in tilt range. As pressure increases, the outboard will tilt down to the top of the trim range.

IMPORTANT: When in tilt range, make sure water is available to gearcase water pickups.

Manual Adjustment

The outboard can be manually raised or lowered through the entire trim and tilt range by opening the manual release valve a minimum of three turns. The manual release valve must be closed and torqued 45 to 55 in. lbs. (5 to 6 N·m) to hold the outboard in position and before normal operation can be resumed.



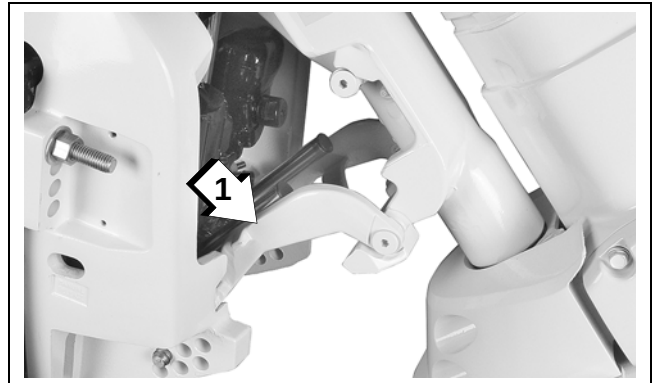
1. Manual release valve

001988

Trailering Bracket and Tilt Support

Use the trailering bracket to support the outboard when trailering in the tilted position. This bracket protects the hydraulic system from damage.

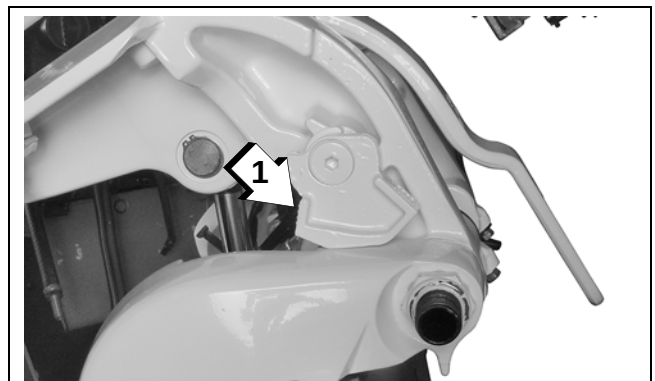
Tilt the outboard up fully, engage the bracket, then tilt the outboard down until the bracket is firmly in position.



1. Trailering Bracket

001987

For mooring or storing the boat with the outboard tilted, a tilt support is provided to support the outboard.



1. Tilt Support

002279

IMPORTANT: The tilt support must not be used to support the outboard while trailering.

Modes Of Operation (Three Piston System)

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

Trim-OUT / Tilt-UP Mode

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

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

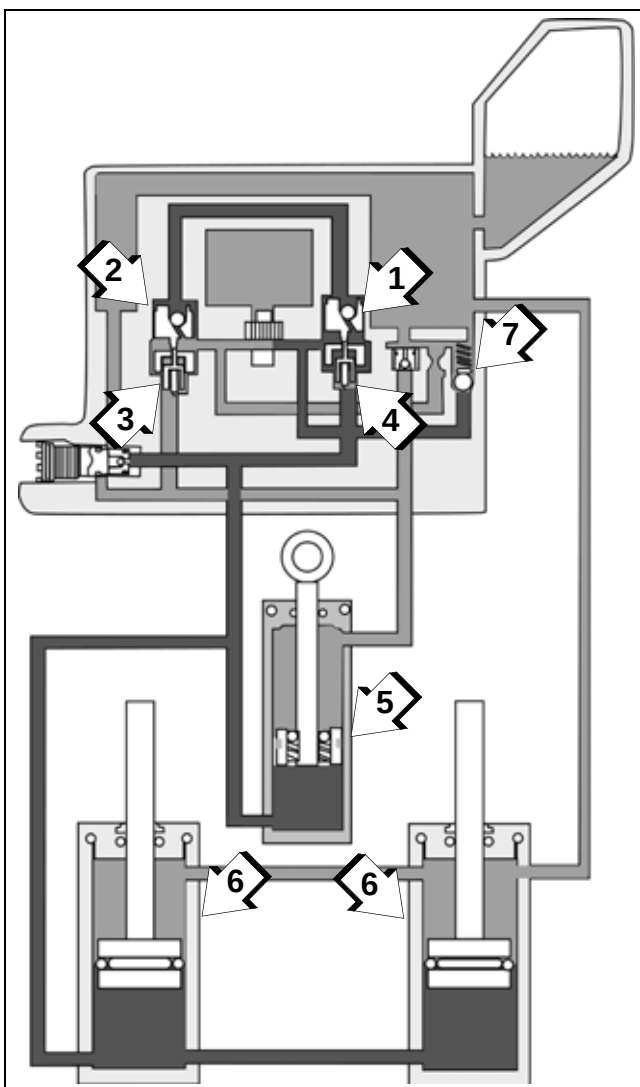
Fluid pressure pushes the UP check valve off its seat, and fluid passes through the valve to the bottom of all cylinders, pushing the pistons UP.

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

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

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

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



DRC3462

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

Tilt-DOWN / Trim-IN Mode

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

Fluid pressure passes through the DOWN shuttle valve to the UP shuttle valve, which mechanically opens the UP check valve.

Fluid pressure pushes the DOWN check valve off its seat and fluid passes through the valve to the top of the tilt cylinder, moving the tilt piston DOWN.

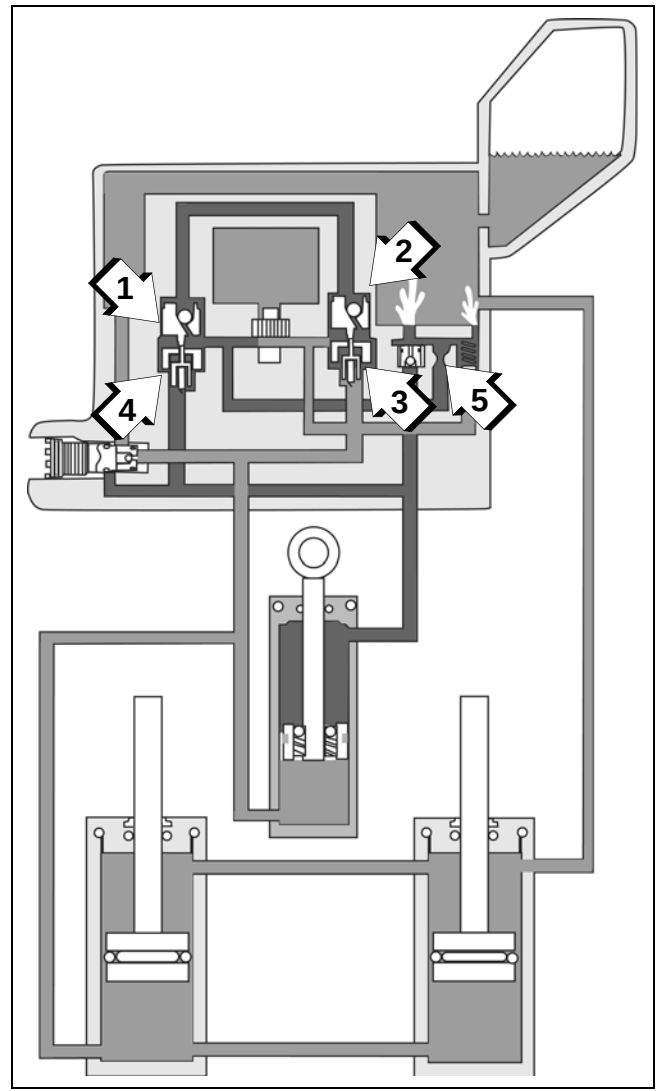
When the swivel bracket contacts the top of the trim rods, the mechanical force of the tilt cylinder pulling the outboard down also pushes the trim pistons down. Fluid is pulled from the reservoir to the top of the trim cylinders.

Fluid from the bottom of the cylinders returns through the open UP check valve to the pump.

In the tilt range, all of the fluid from the bottom of the tilt cylinder returns through the UP check valve to the pump. Since more fluid is returning to the pump than is required to fill the top of the cylinder, the excess fluid is vented through the DOWN relief orifice to the reservoir.

In the trim range, fluid from the bottom of all the cylinders is routed to the pump, which feeds only the top of the tilt cylinder. All of the excess fluid vents through the DOWN relief orifice to the reservoir.

When all cylinders are completely retracted, all of the pump output vents through the DOWN relief orifice to the reservoir at stall pressure (approximately 800 psi (5516 kPa)).



1. Down shuttle valve
2. Up shuttle valve
3. Up check valve
4. Down check valve
5. Down relief orifice

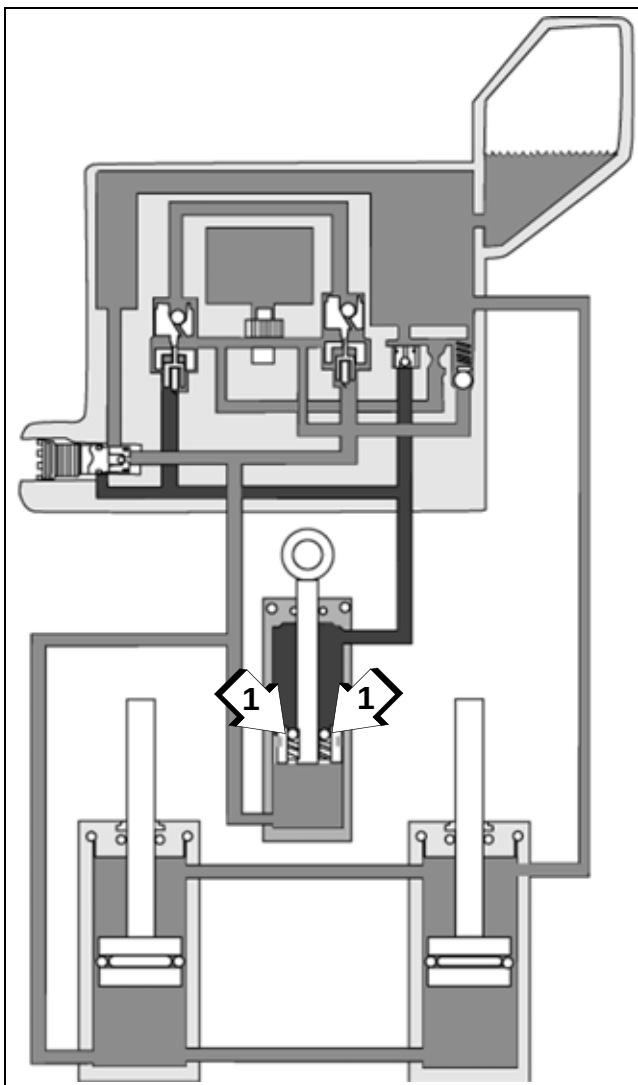
DRC3463

Impact Relief

Should the gearcase hit an underwater object and the outboard suddenly tilts up, the tilt cylinder extends. The fluid above the piston is compressed, producing high pressure.

This high pressure fluid passes through the impact relief valves in the tilt piston, dissipating much of the energy of the impact.

To return the outboard to its original position, the hydraulic unit must be operated in the DOWN direction.



1. Impact relief valves

DRC3467

Shallow Water Drive Tilt Relief

If the outboard exceeds idle RPM while operating in shallow water drive mode (tilted up beyond the trim range), increased pressure beneath the tilt piston forces fluid through the tilt relief valve built into the manual release valve.

Fluid flows from below the tilt piston, through the tilt relief valve, and to the reservoir.

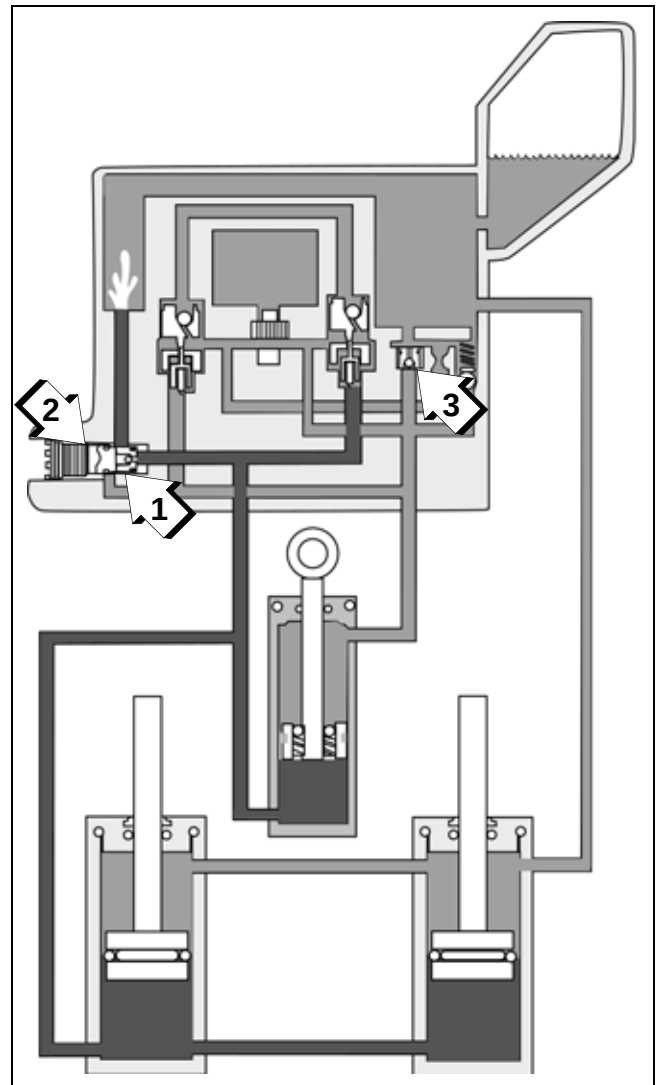
As the tilt piston moves down, the filter valve opens and allows fluid to flow from the reservoir to the top of the tilt cylinder.

The outboard will tilt down to the top of the trim range.

Thermal Expansion Relief

Ambient air temperature increase can cause fluid expansion within the hydraulic assembly. If the fluid expands when stored in the tilt range, the fluid under all of the pistons (and above the tilt piston) cannot expand, so its pressure increases.

If the pressure gets high enough to push the ball of the tilt relief valve off its seat, the excess pressure is vented to the reservoir.



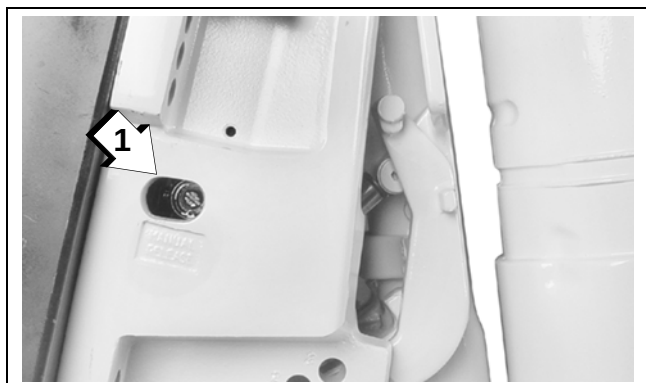
1. Tilt relief valve
2. Manual release valve
3. Filter valve

DRC3465

Manual Release – UP

The outboard can be positioned manually by first opening (loosening) the manual release valve.

Open the manual release valve (turn it slowly counterclockwise) with a screwdriver, about 3 1/2 turns, until it lightly contacts its retaining ring.



1. Manual release valve

001988

When the manual release valve is opened and the outboard is manually raised, fluid flows from the top of the tilt cylinder to the manual release valve. The fluid may pass through the manual release valve to the bottom of the tilt cylinder, or return to the reservoir. Additional fluid may be drawn from the bottom of the trim cylinders, which retract and draw additional fluid from the reservoir to the tops of the cylinders.

Trimming Outboard OUT

Pull gearcase out farther than the desired final position (up into the tilt range, if necessary).

Close the manual release valve.

Manually, push the gearcase in (or down) until it is supported by the trim system.

Open the manual release valve only enough to let the outboard trim in to desired position.

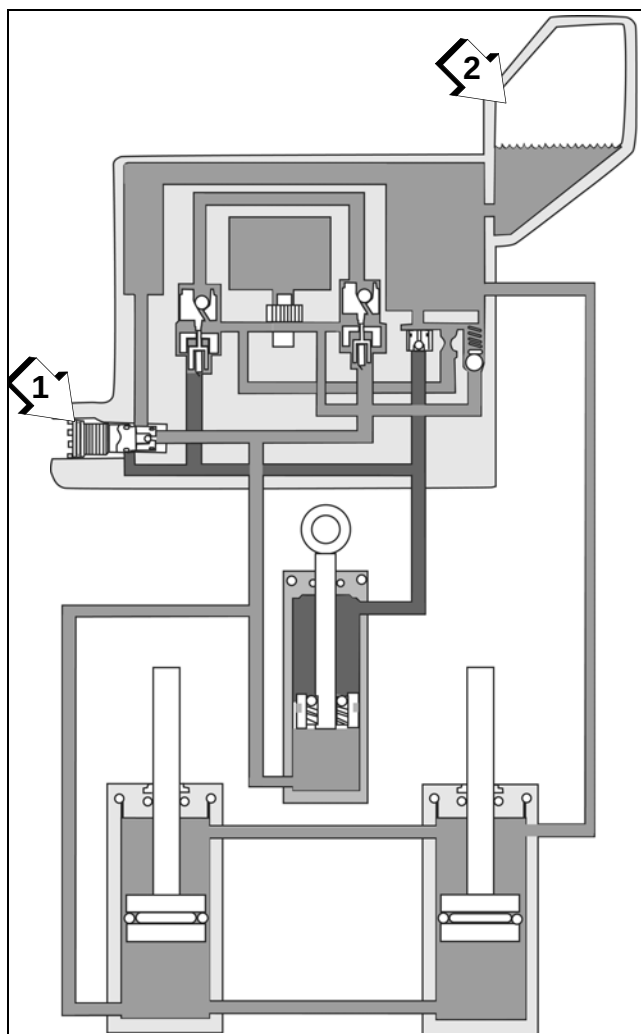
Tilting Outboard UP

⚠ WARNING

Do not attempt to hold the outboard up by closing the manual release valve. The outboard must be held manually, and lowered to the trim range manually, after it has been tilted up manually. The outboard can drop to the trim range if the support is removed.

Tilt outboard up and hold it with a suitable hoist or engage either its tilt support or trailering bracket.

Close the manual release valve firmly. The manual release valve must be closed to enable the trim/tilt unit to function.



1. Manual release valve
2. Reservoir

DRC3464

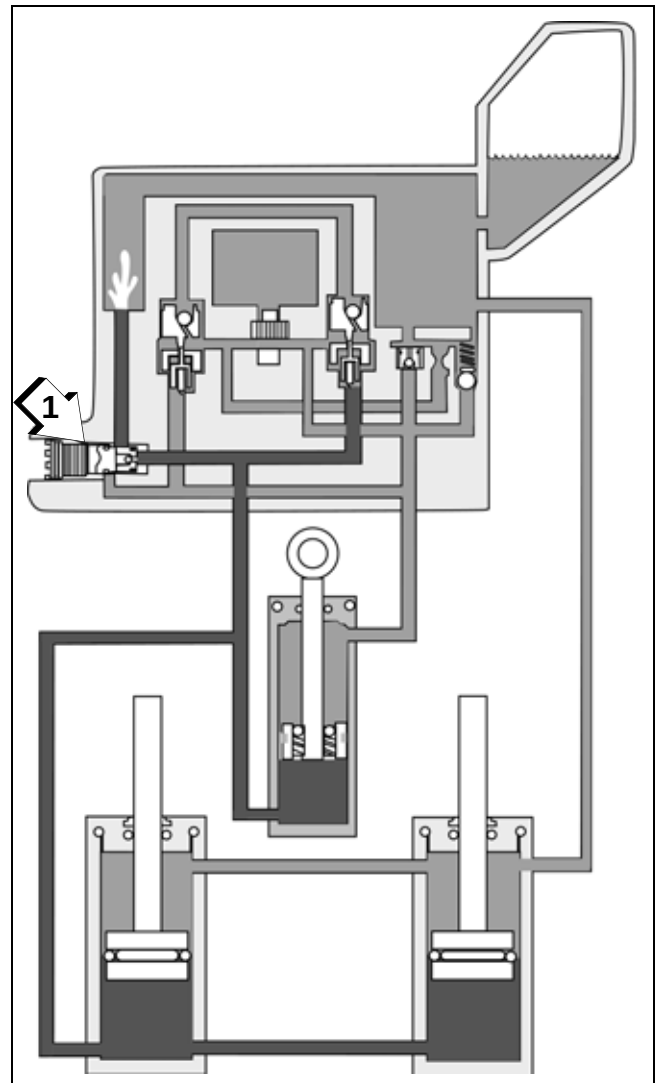
Manual Release – DOWN

When the manual release valve is opened and the outboard is manually tilted down or trimmed in, fluid flows from the bottom of the tilt cylinder (in the tilt range), or from the bottom of all of the cylinders (in the trim range), and past the manual release valve.

Fluid flows from the bottom of the tilt cylinder (in the tilt range) to the top of the tilt cylinder. The excess fluid, equal to the volume of the piston rod, is vented to the reservoir.

In the trim range, the fluid from the bottom of all three cylinders is vented to the reservoir, except for the amount required to fill the top of the tilt cylinder.

After opening the manual release valve, close it firmly. The manual release valve must be closed to enable the trim/tilt unit to function.



1. Manual release valve

DRC3465

Routine Inspections

General

Check for external signs of fluid leakage. Correct causes as necessary.

Check the battery to be sure it is in good operating condition.

Reservoir Fluid

Check reservoir fluid level every three years or every 300 operating hours. System capacity is approximately 21 fl. oz. (620 ml).

Refer to **Trim and Tilt** on p. 43 for filling procedure.

Manual Release Valve

Check the manual release valve with a torque wrench.

IMPORTANT: Tighten valve 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).

Troubleshooting

If the power trim/tilt system has malfunctioned and the cause has not been determined, the **Symptoms Chart** on p. 297 should help locate the problem.

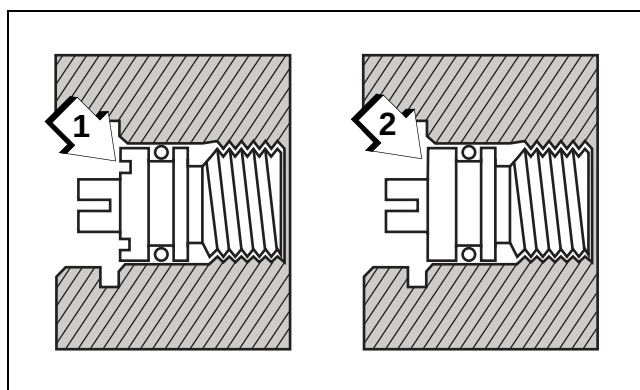
Keep a manual release valve and a valve body in stock for troubleshooting. Use these parts when the **Service Procedures** on p. 297 call for the substitution of known good parts.

If the trim/tilt does not work, and its motor neither runs nor hums, troubleshoot the problem by referring to **Tilt/Trim Relay Test** on p. 112.

If the outboard tilts part way up but not smoothly, or with a constant sound, there is probably air in the system due to low fluid. Fill reservoir and bleed (purge air from) the system.

To test for mechanical binding, open the manual release valve and manually tilt the motor up and down. If parts are binding, refer to **Midsection** section.

If a V4 model will not lower from shallow water drive position at any throttle setting, or if a V6 model will not stay in shallow water drive and drops down at fast idle, the wrong manual release valve may be installed. Check for the identification groove in the face of the valve.



1. Grooves (V4 Models)
2. No grooves (V6 Models)

010359

If the outboard does not tilt as high as it should, and the tilt motor **TURNS OFF** at maximum tilt (does not sound like it is stalled at the maximum tilt position), adjust the tilt limit switch higher and

retest. Refer to **Tilt Limit Switch Adjustment** on p. 33.

Symptoms Chart

If any of these symptoms describe the unit, follow the indicated Service Procedures, in the order listed, to locate and correct the problem.

Symptom	Service Procedures
Unit will not move in either direction.	1, 2, 3, 4, 6
Unit runs slowly in one direction, normal speed in other direction.	1, 2, 6
Unit runs slowly. (if low hours) (if high hours)	1, 2, 7 1, 2, 5, 7
Unit leaks DOWN and/or will not hold trim position against thrust in forward.	1, 2, 6
Unit leaks both UP and DOWN – Leaks down in tilt range and/or will not hold trim position against thrust in forward or reverse.	1, 2, 7
Unit will not trim/tilt one way, but works the other way. Unit will not run DOWN, but runs UP; or it runs DOWN, but will not run UP.	2, 3, 6

Service Procedures

STEP 1

Be sure the manual release valve is closed. If NOT, torque to 45 to 55 in. lbs. (5 to 6 N·m).

STEP 2

Temporarily install a known good manual release valve and retest. If symptoms remain, original valve is not the problem. Reinstall original valve.

If symptoms disappear, the original valve was faulty. Remove temporary valve and replace with correct new valve.

STEP 3

Go to **Tilt/Trim Relay Test** on p. 112 to determine if problem is power supply.

STEP 4

Remove trim motor and check condition of drive coupling. If coupling is damaged, replace it.

STEP 5

Temporarily install a known good pump manifold assembly and retest. If symptoms remain, original assembly is not the problem. Reinstall original assembly.

If symptoms disappear, the original pump manifold assembly was faulty. Remove temporary assembly and replace it with correct one.

STEP 6

Install replacement pump manifold assembly and retest. If all symptoms are not corrected, reconsider the problem using the new symptoms.

STEP 7

Install O-ring kit. Look for any cylinder damage. Look for chips in fluid or impact valves. Look for other abnormal conditions. If all symptoms are not corrected, reconsider the problem using the new symptoms.

Pressure Leakdown Test

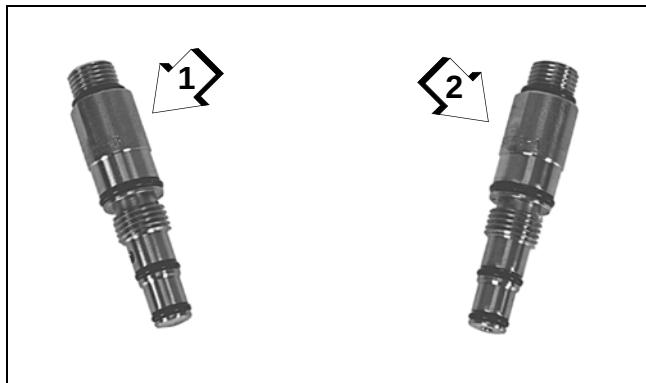
Before servicing a hydraulic unit, it should be pressure tested to determine the unit's malfunction. This test must be performed with the hydraulic unit removed from the outboard and mounted in a vise or holding fixture.

Power Trim/Tilt Service Kit, P/N 434524, allows testing of trim/tilt operation and component condition.

- The "A" adapter, P/N 336658, checks operation of the UP circuit.

Trim and Tilt Troubleshooting

- The “B” adapter, P/N 336659, checks operation of the DOWN circuit.



1. A Adapter
2. B Adapter

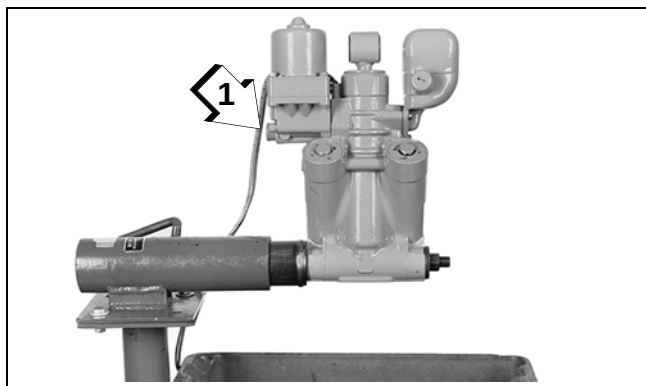
27340

This kit does not include a gauge and collar assembly. Gauge and collar assembly shipped with Power Trim/Tilt Service Kit, P/N 390010, will work. Gauge and Collar Assembly, P/N 983975, is also available.

Be sure to use a fully charged battery.

STEP 1

Screw the manual release valve in the hydraulic unit until it is seated. Place a large drain pan under the unit to catch hydraulic fluid.

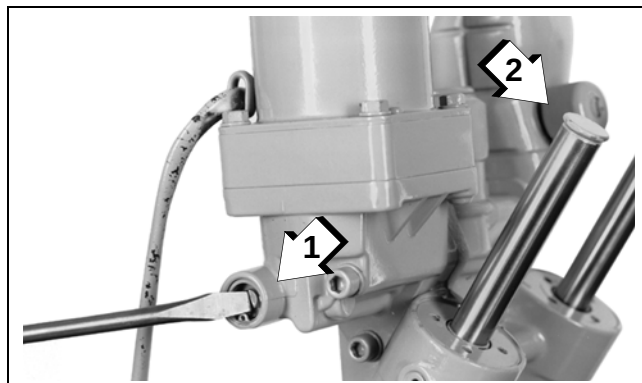


1. Manual release valve

41736

Operate the unit to the full UP position, then run the unit down momentarily to reduce pressure. Loosen the reservoir cap one full turn. Loosen the manual release valve three turns. Some fluid will

bypass the reservoir cap. These steps will relieve the pressure in the unit.



1. Manual release valve
2. Reservoir cap

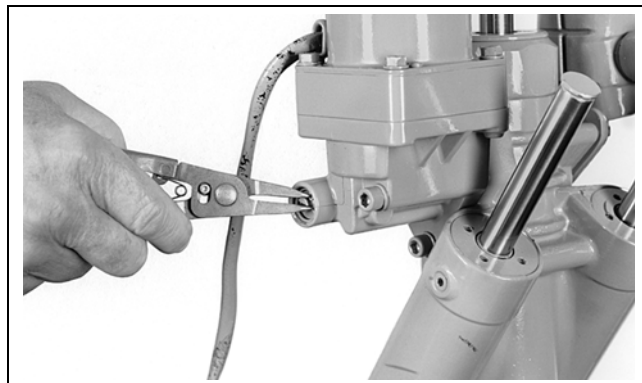
41739

Clean up any spilled hydraulic fluid with shop towels.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated towels in an environmentally responsible manner, or according to local regulations.

Remove the manual release valve retaining ring using retaining ring pliers.



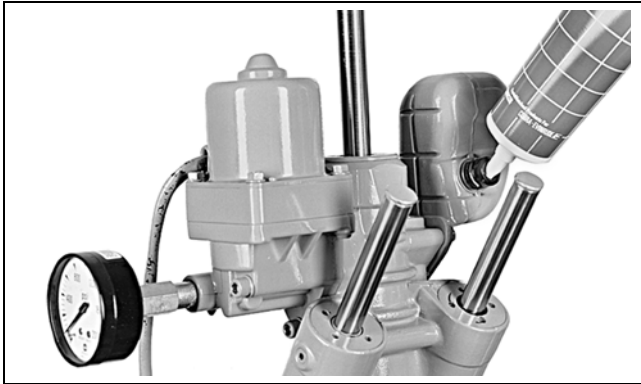
41754

Remove the manual release valve. Install pressure gauge and adapter “A” to check problems in the UP circuit.

IMPORTANT: Torque gauge and adapter lightly to 5 to 10 in. lbs. (0.6 to 1.2 N·m). Excessive torque might damage adapter or O-rings.

Cycle the unit down and up several times to purge air. With all rods fully extended, run the unit down momentarily to reduce pressure. Check fluid level

again, and add fluid if necessary. Remember that all rods must be completely extended to check fluid level.



41757

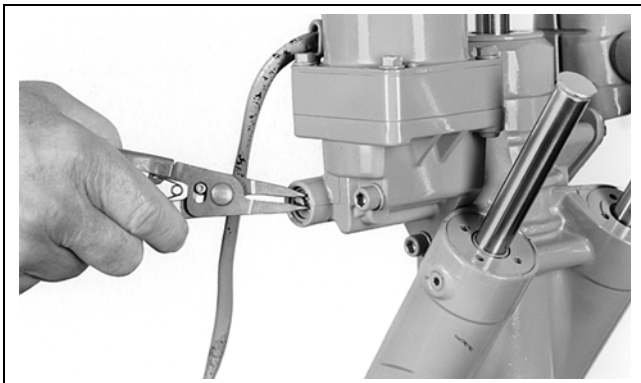
Starting with the tilt cylinder fully retracted, run the unit UP.

- The gauge should show 0 to 200 psi (0 to 1379 kPa) as the tilt cylinder is extending.
- The gauge should show 1400 to 1600 psi (9653 to 11032 kPa) as the unit stalls.
- Release the switch and watch for a pressure drop. The stall pressure reading must not drop more than 200 psi (1379 kPa) after motor stops.

If results vary from the above limits, there is a problem in the UP circuit. Refer to **Modes Of Operation** on p. 290 for circuit description.

STEP 2

Remove the manual release valve retaining ring using retaining ring pliers.



41754

Remove the manual release valve. Install pressure gauge and adapter "B" to check problems in the DOWN circuit. Cycle the unit down and up several times to purge air. With all rods fully

extended, run the unit down momentarily to reduce pressure. Check fluid level again, and add fluid if necessary. Remember that all rods must be completely extended to check fluid level.

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

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

If results vary from the above limits, there is a problem in the DOWN circuit. Refer to **Modes Of Operation** on p. 290 for circuit description.

⚠ CAUTION

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

Check fluid level again and add fluid, if necessary.

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. 112 for relay testing procedure.

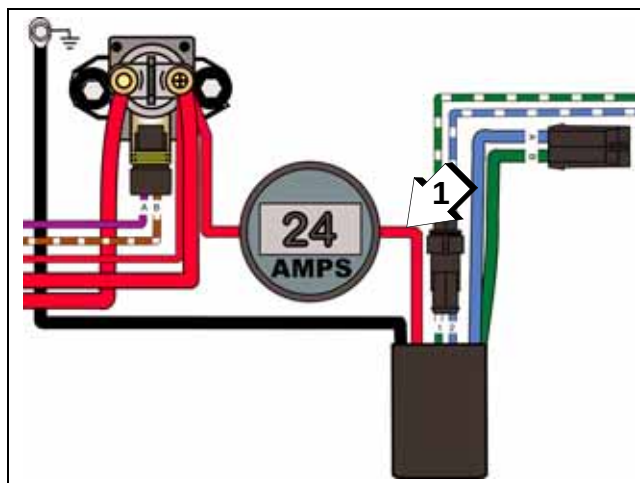
Trim and Tilt Motor Current Draw Tests

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.

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.



1. Red lead

005441

Observe ammeter and a stopwatch while running hydraulic unit through several complete cycles.

Compare test results to the values listed:

Three piston system

Mode	Normal Current Draw	Time in Seconds
Trim-OUT (Trim range)	22 A	14
Tilt-UP Stall	80 A	N/A
Trim-IN (Trim range)	16 A	7
Trim-IN Stall	35 to 45 A	N/A

Test results include three basic possibilities:

A. Low current draw – Check for:

- Valves leaking
- Pump damaged
- O-rings leaking
- Manual release valve damaged
- Relief valve springs weak
- Check valves fouled or damaged

B. High current draw – Check for:

- Pump binding

- Motor binding
- Cylinder binding
- Valves sticking

C. Normal current draw, slow operating speed – Check for:

- Manual release valve damaged
- Impact valves damaged
- Check valve or shuttle valve malfunctioning

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 50 A ammeter in series with the battery positive (+) terminal, ammeter red lead toward battery.

Attach or hold a vibration or mechanical tachometer to the motor while performing this test.

Monitor motor RPM and current draw.

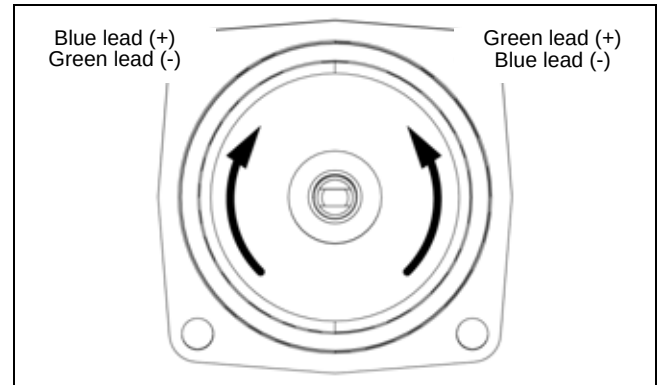


30957

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

applied to the green lead, and negative (–) is applied to the blue lead.



DR4238r

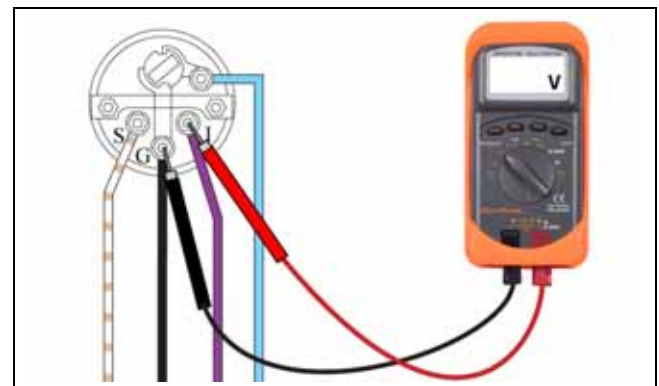
If test results vary, replace the motor.

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, go to **STEP 2**.



DRC6245

STEP 2

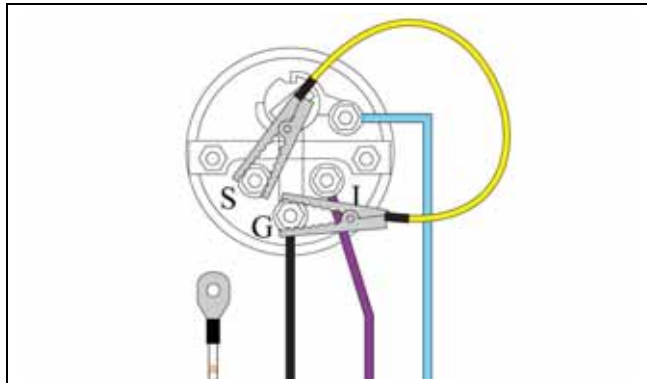
Remove the white/tan lead from the trim gauge “S” terminal. With key switch ON, gauge should indicate full-trim DOWN position. Now connect a jumper wire between terminals “S” and “G.” Gauge should indicate full-trim UP position.

- If results are different, replace the trim gauge.

Trim and Tilt

Electrical Circuit Tests

- If results agree, refer to **Trim Sender Test** on p. 302.



DRC6246A

Trim Sender Test

IMPORTANT: To avoid immediate meter damage, never apply a multimeter to an electrical circuit where voltage is present.

Disconnect the 3-pin connector between the instrument harness and engine trim harness.

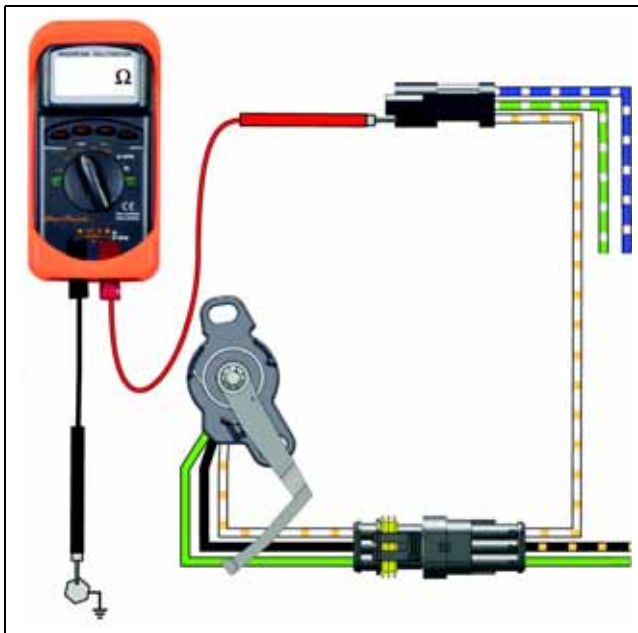
Connect an ohmmeter between the white/tan wire, terminal "C," of the engine harness and a clean engine ground.

With the outboard fully DOWN, meter must show a reading above 80 W.

With the outboard fully UP, meter must show a reading below 10 W.

- If results agree, refer to **Trim Gauge Test** on p. 301.

- If results are different, replace trim sender.



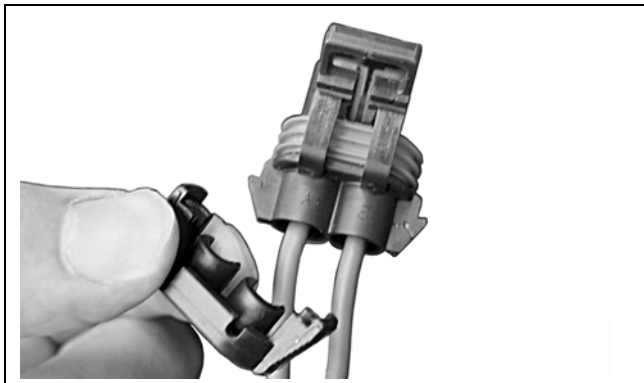
DRC6247

Trim and Tilt Replacement

Removal

Raise the outboard and engage the tilt support.

Remove the rubber grommet from the blue/green trim/tilt cable connector.



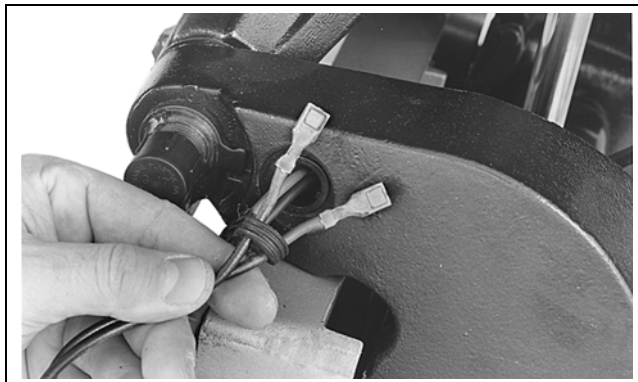
000686

Remove the terminals from the connector by using a suitable tool to depress the tab. While the tab is depressed, pull on the wire from the rear of the connector to release it from the connector.



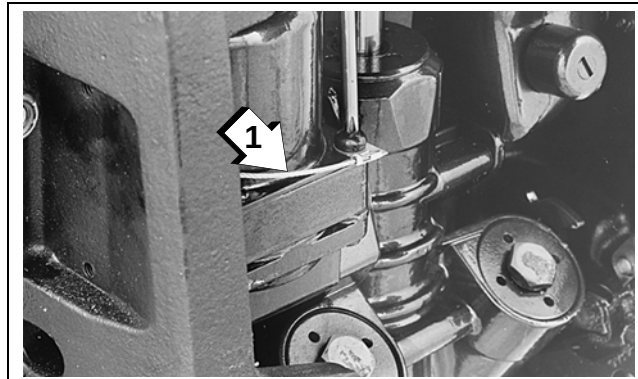
000687

Separate the trim/tilt unit wires in the braided tube to permit removal through the hole in the stern bracket.



25078

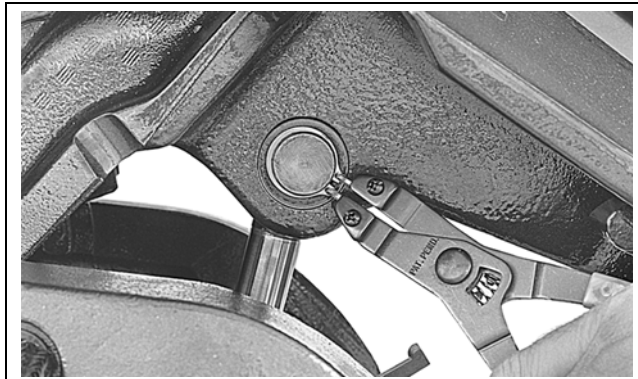
Remove the ground wire from the trim/tilt unit.



1. Ground wire

25057

Remove the external snap rings from the upper pin.

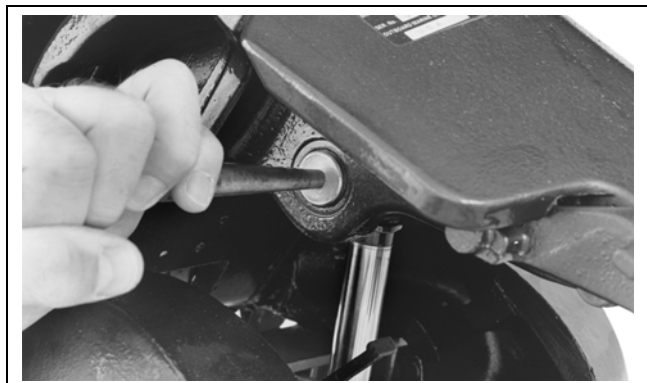


25064

Trim and Tilt

Trim and Tilt Replacement

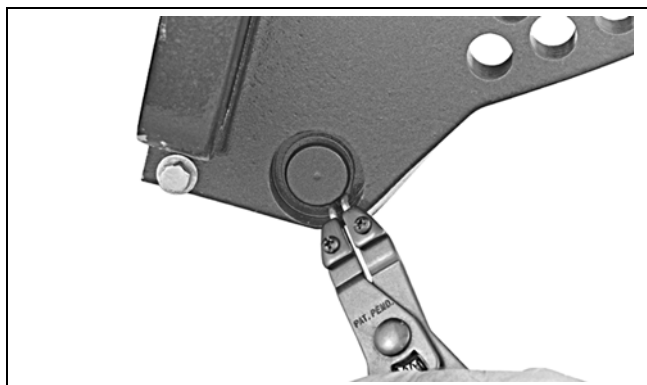
Use a punch to remove the upper pin.



25065

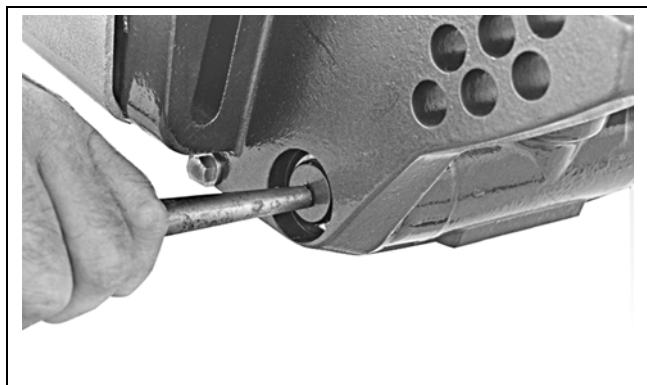
Retract the tilt cylinder rod.

Remove the external snap rings from the lower pin.



25077

Use a punch to remove the lower pin and remove the trim/tilt unit from the stern brackets.

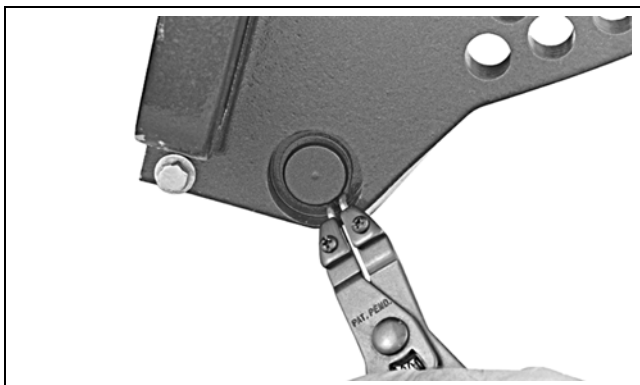


25076

Installation

Place trim/tilt unit into position. Apply *Triple-Guard* grease to the lower pin and install the pin.

Install external snap rings on lower pin with sharp edge of ring facing out.

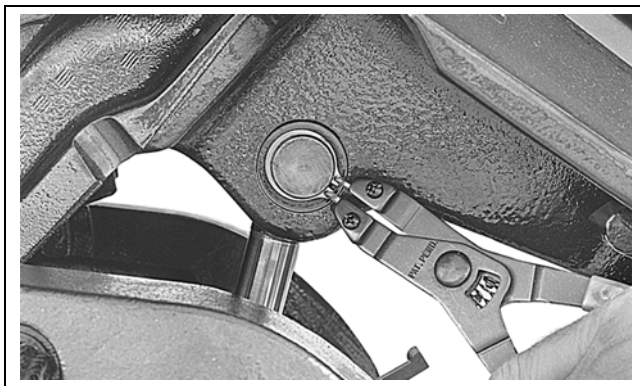


25077

Loosen the manual release valve if necessary and extend tilt cylinder rod to match with holes in swivel bracket.

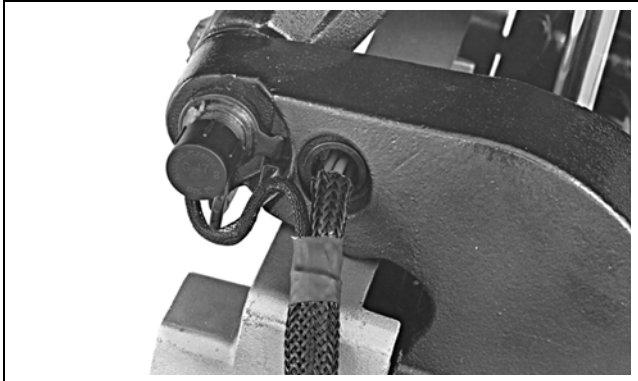
Apply *Triple-Guard* grease to upper pin and install the pin.

Install external snap rings onto upper pin with sharp edge facing out.



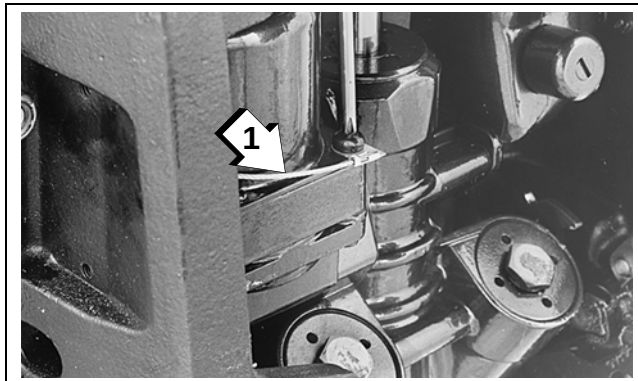
25064

Place trim/tilt wires in braided tube and install through hole in the stern bracket.



25079

Attach the ground wire to the trim/tilt unit.

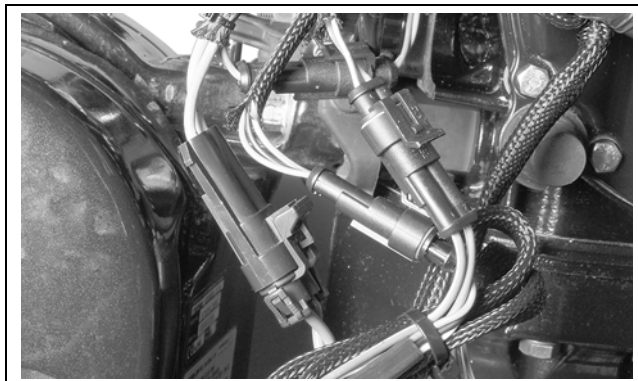


1. Ground wire

25057

Release the tilt support and lower the outboard. Tighten the manual release valve to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

Install connector on trim/tilt cable and reconnect trim connectors to engine wire harness.



002152

Trim and Tilt Servicing

Disassembly

⚠ WARNING

Before removing the manual release valve, operate the unit to the full UP position, then run the unit down momentarily and loosen the reservoir cap one full turn.

To avoid personal injury, always wear eye protection when servicing the hydraulic unit. Since there might be significant residual pressure behind some components, cover each component with a shop cloth as you remove it.

⚠ CAUTION

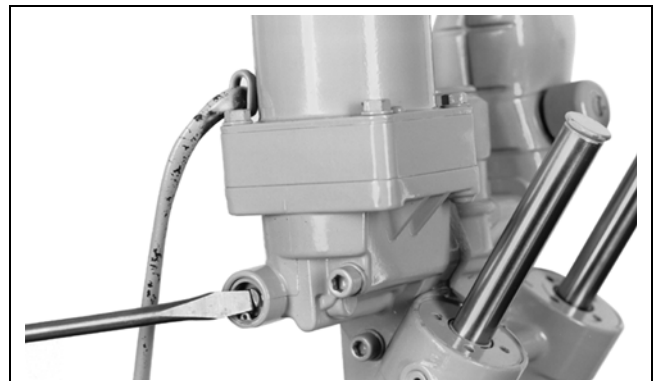
Do not apply heat to the cylinder body or cylinders. Excessive heat can cause high pressure leaks or failure of parts.

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.

Screw the manual release valve in. Remove the retaining ring using retaining ring pliers. Remove the manual release valve.

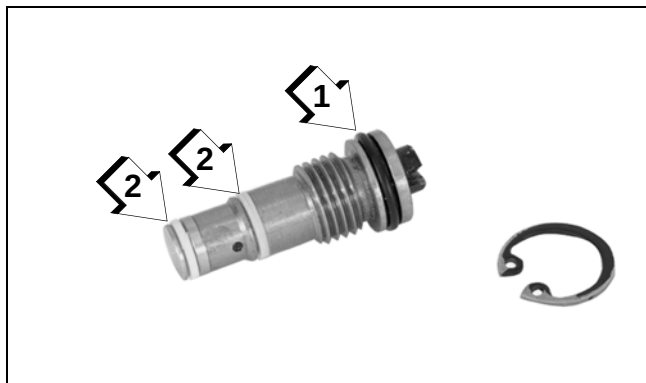


41739

Trim and Tilt

Trim and Tilt Servicing

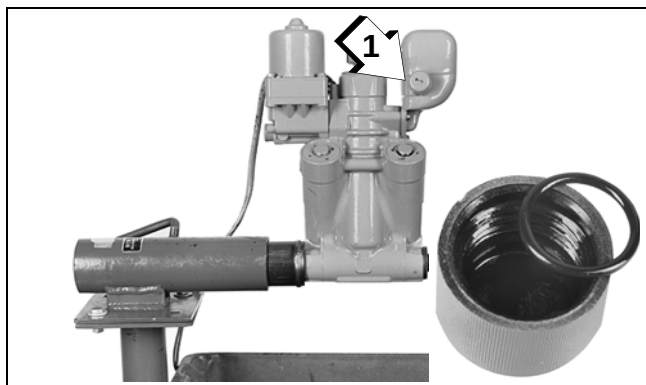
Inspect O-ring and two plastic split rings on the manual release valve for nicks and cuts. Inspect tip of valve for damage. The two plastic split rings are not available separately. If rings are damaged, replace the manual release valve.



1. O-ring
2. Plastic split rings

22863

Remove reservoir cap and drain the fluid into a container. Inspect the O-ring in the cap.



1. Reservoir cap

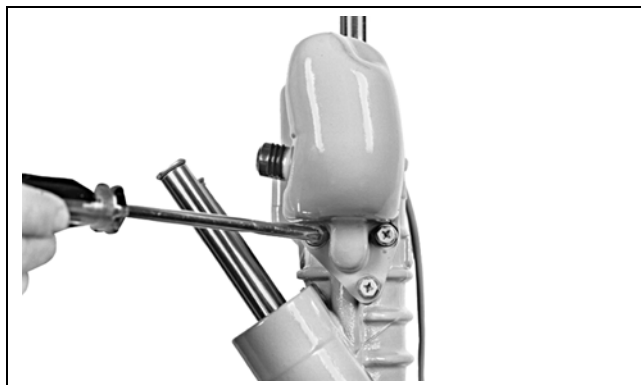
41736
41751

Clean up any spilled hydraulic fluid with shop towels.

ENVIRONMENTAL NOTE

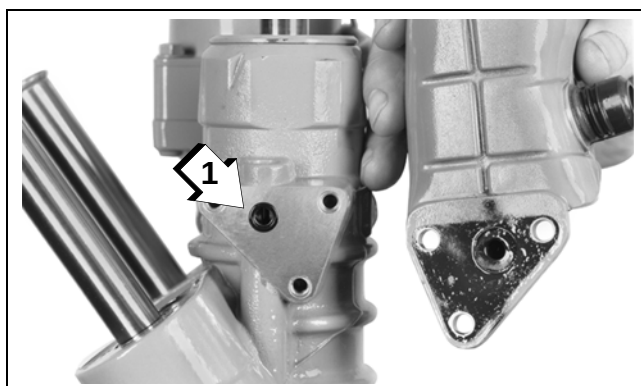
Dispose of spilled hydraulic fluid or contaminated towels in an environmentally responsible manner, or according to local regulations.

Remove the three *Pozidrive* screws securing the reservoir to cylinder body. Remove reservoir.



41753

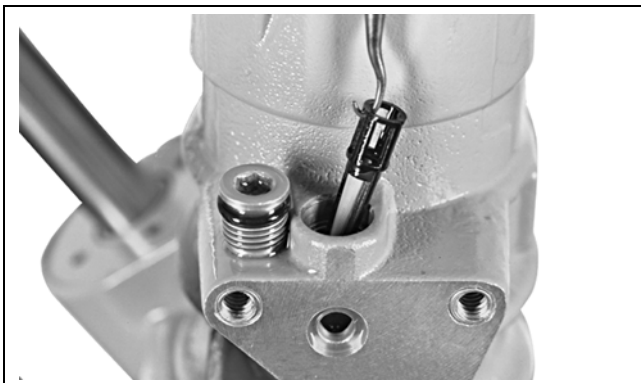
Remove the reservoir O-ring from the cylinder body. Check machined surfaces for nicks and scratches.



1. O-ring

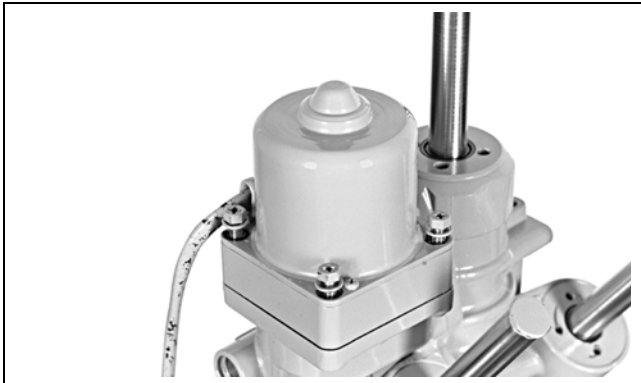
41759

Use a 6 mm hex wrench to remove the plug from the cylinder body. Inspect the O-ring and the filter. Replace, if necessary.



41787

Remove the four screws securing motor to pump manifold assembly.



41760

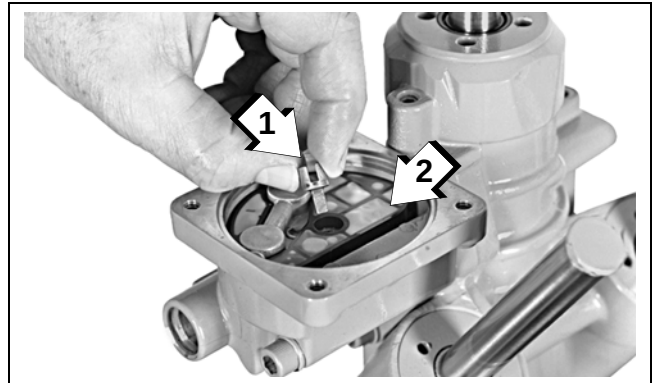
Remove the wire shield from the pump manifold. Remove the motor and inspect the motor O-ring and the O-ring on the cable connector.



22878

Remove and inspect the coupler. Remove the filter screen from the pump manifold. Check the machined surfaces on the manifold for nicks and scratches. The pump manifold is not serviceable. Do not remove the pump or any control valves from the manifold. Clean the screen with a mild

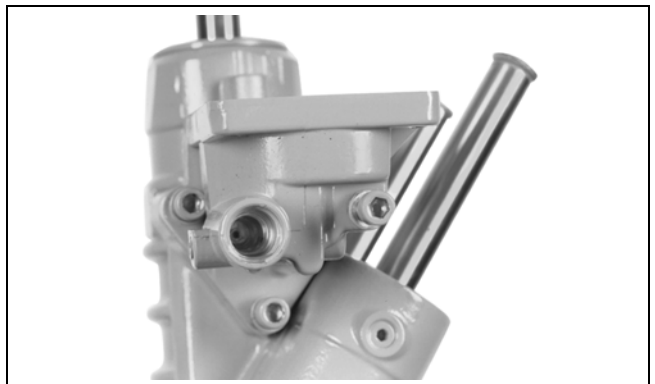
solvent and inspect it for tears, clogging, or other damage.



1. Coupler
2. Filter screen

41763

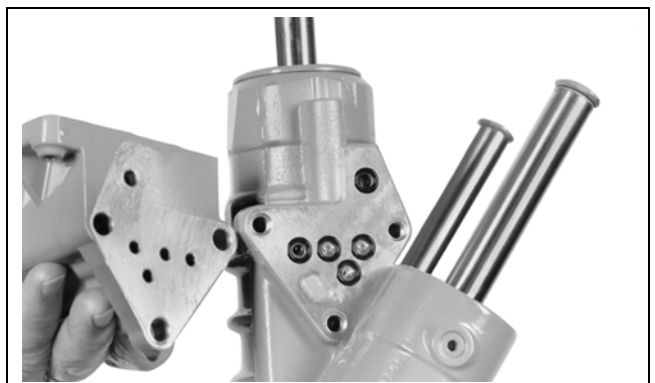
Remove the three Allen head screws securing the pump manifold assembly to cylinder body.



41798

IMPORTANT: Individual parts in the pump manifold assembly are not available separately. Do not remove pump or any control valves from the body.

Remove the manifold. Remove five O-rings from cylinder body. Check machined surfaces for nicks and scratches.



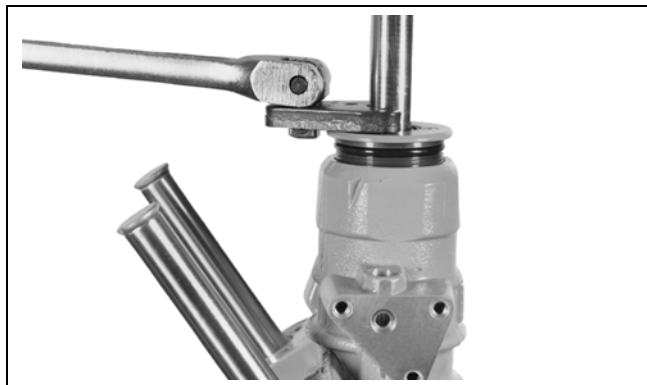
41799

Trim and Tilt

Trim and Tilt Servicing

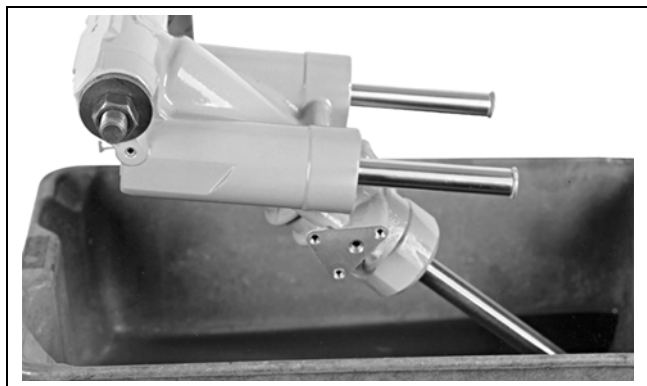
Tilt Piston Removal

Use Tilt Cylinder End Cap Remover/Installer, P/N 326485, or Universal Spanner Wrench, P/N 912084, and a breaker bar, to unscrew the tilt rod end cap.



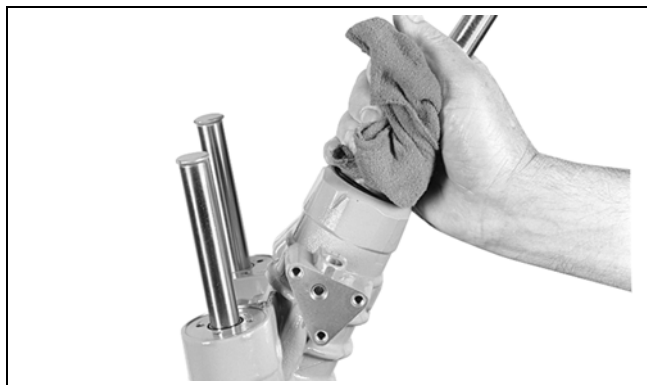
41788

Drain the fluid from above the piston.



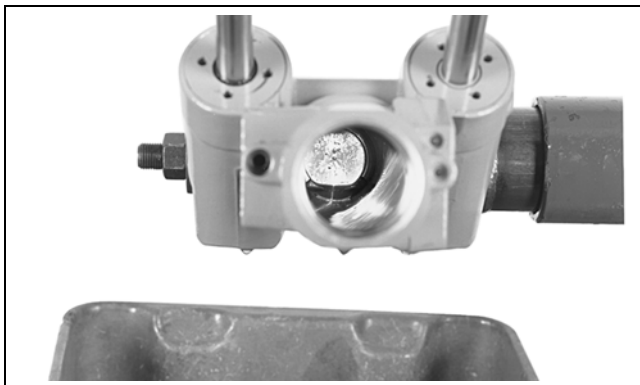
41789

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



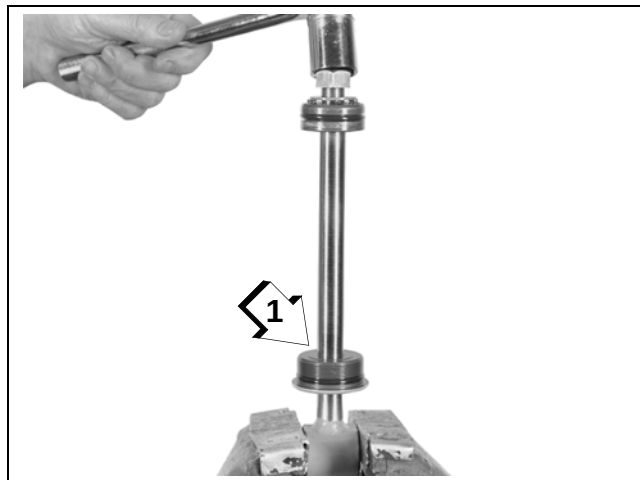
41765

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



41767

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



1. End cap

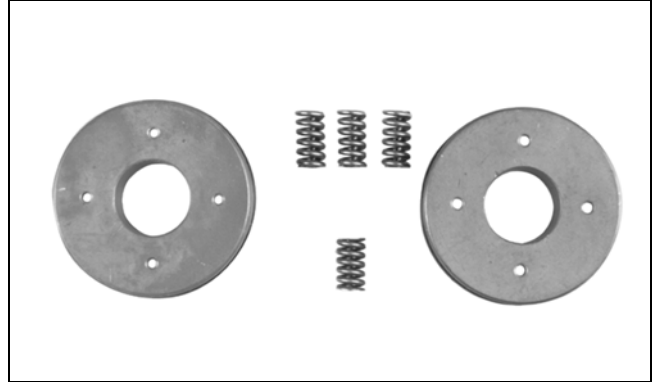
41781

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



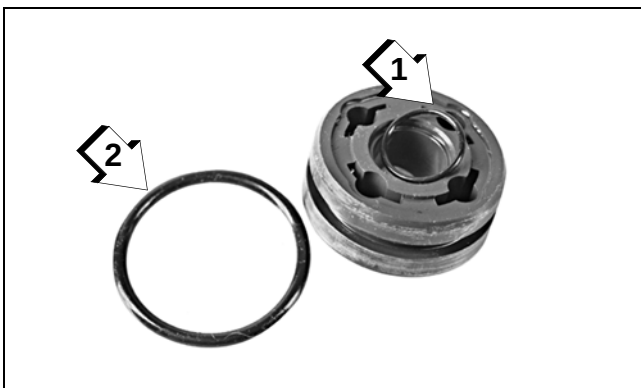
41784

Three of the four springs are one length, and the fourth spring is shorter. On assembly, the shorter spring can be positioned in any hole in the piston.



41882

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



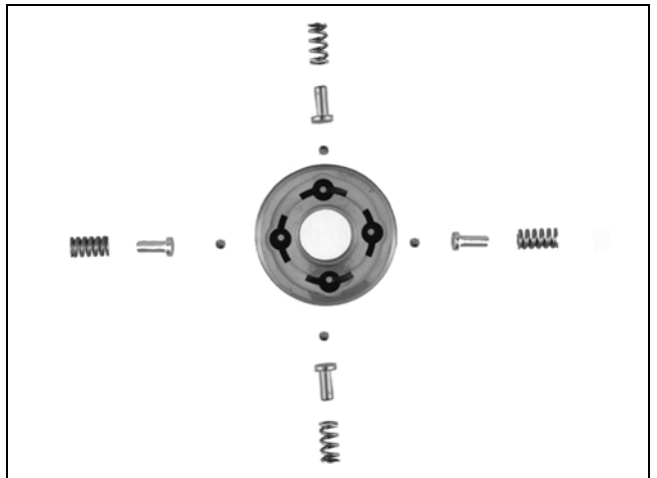
1. Small inner O-ring
2. Large outer O-ring

41819

Tilt Piston Assembly

Piston check balls and plungers are identical. Lubricate and install a new outer O-ring on the tilt piston. Place one ball, one plunger, and one spring in each hole in the piston as indicated.

Three of the four springs are one length, and the fourth spring is shorter. On assembly, the shorter spring can be positioned in any hole in the piston. Set piston aside.



41818

Tilt Piston Identification

⚠ WARNING

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

Trim and Tilt

Trim and Tilt Servicing

Use a screwdriver to carefully pry the scraper out of the end cap. Discard the scraper. Remove and discard the large outer O-ring.



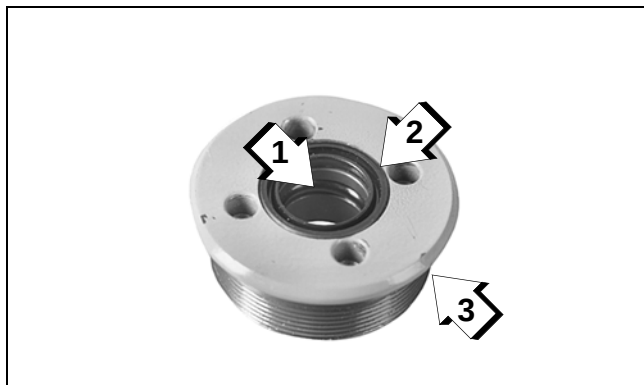
41791

Remove and discard inner O-ring of the end cap.



41792

the lip facing out. Lubricate and install a new O-ring on the outside of the end cap.



1. Inner O-ring
2. Lip
3. Outer O-ring

41795

Use a wire brush to clean all thread-locking material from the threads on the tilt rod.



41821

Tilt Rod Assembly

Clean the end cap thoroughly, then lubricate and install a new O-ring in the end cap. Lubricate and install a new scraper. The scraper is installed with

Lubricate the inside surface of the end cap. Lubricate and install Tilt Cylinder Seal Protector, P/N 326005. Use a deep-well socket and a plastic mallet to drive the end cap onto the rod, then

remove the seal protector. Slide the end cap down the tilt rod.



1. Tilt Cylinder Seal Protector

41824

Remove any lubricant from the threads on the tilt rod, prime with *Locquic Primer*, and let dry. Slide the piston assembly onto the tilt rod. Place a new rod O-ring over the threads.



1. O-ring

41816

Clean any thread-locking material from the threads on the inside of the nut. Spray threads of with *Locquic Primer* and let dry. Apply a small amount of *Nut Lock* to the threads. Slide the

washer over the threads and install the nut. Torque to 58 to 87 ft. lbs. (79 to 118 N·m).



41783

To ensure that the tilt piston has been properly assembled and the impact relief balls are properly seated, apply *Power Trim/Tilt & Steering Fluid* on top of the tilt piston. Fluid should not leak past the impact relief balls while seated. If fluid does leak, disassemble the piston assembly and inspect the relief ball seats. Set the tilt rod assembly aside.



41828

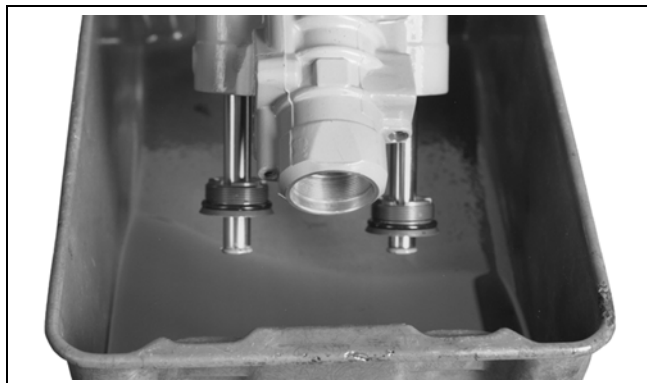
Trim Rod Removal

Unscrew trim cylinder end caps using Trim Cylinder End Cap Remover/Installer, P/N 436710, or Universal Spanner Wrench, P/N 912084, and a breaker bar. Small pins must be used in the spanner wrench.



41829

Slide the caps to the end of the rods. Drain the fluid from the top of the pistons.



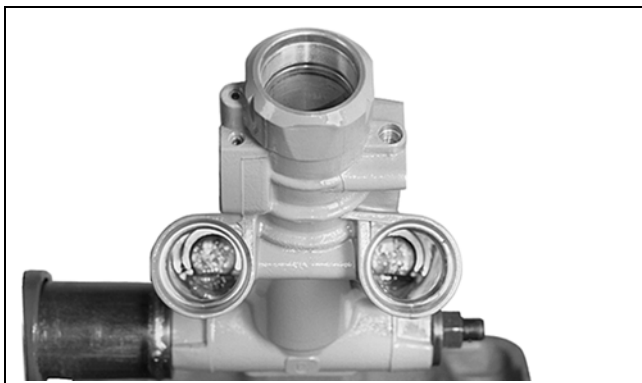
41837

Slowly pull each piston out with a rag wrapped around the rod and the top of the cylinder.



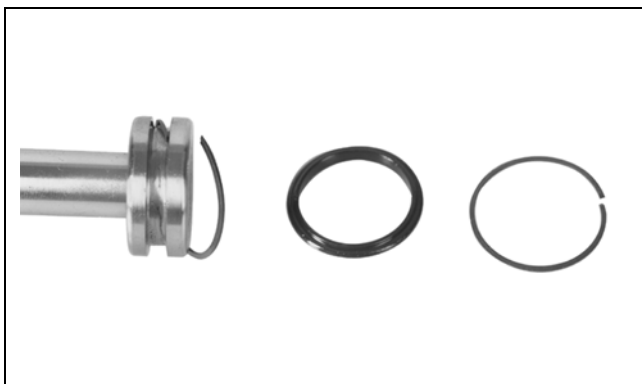
41838

Drain the remaining fluid from the cylinders. Inspect both bores of the trim cylinders for excessive scoring. If one or both trim bores are scored or damaged, the hydraulic assembly must be replaced.



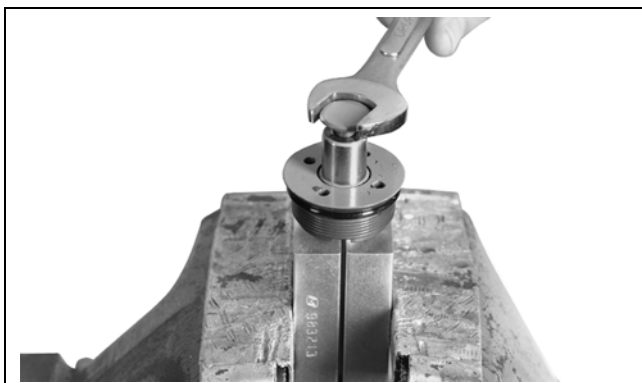
41840

Remove and discard both back-up rings and the O-ring from each trim rod piston.



41841

Using Hydraulic Cylinder Rod Holder, P/N 983213, clamp the rod tightly in a vise. Remove the thrust pad from the trim rod, then remove the end cap.



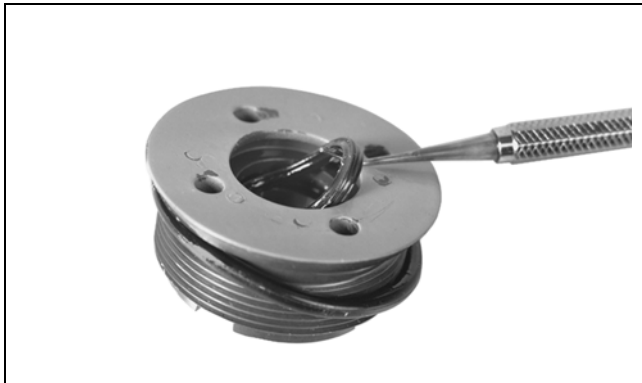
41842

Remove the rod from the vise. Use a small screwdriver to carefully pry the scraper out of the end cap. Discard the scraper.



41843

Use a suitable tool to remove the inner quad-ring and the outer O-ring. Discard the quad-ring and O-ring.

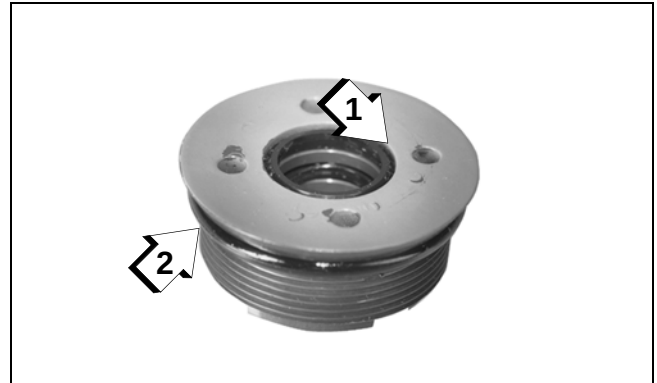


41844

Trim Rod Assembly

Lubricate and install a new quad-ring and scraper in the end cap. Install the scraper with the bevel

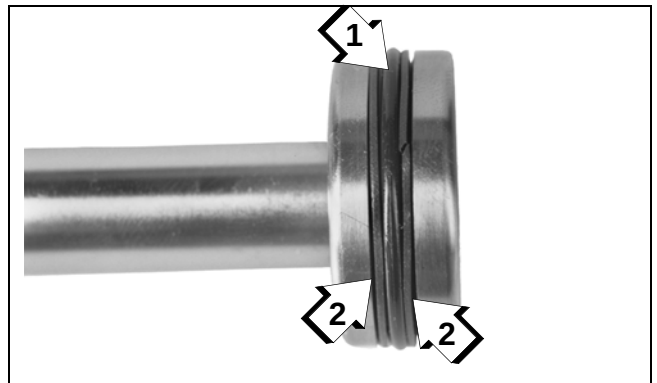
facing out. Lubricate and install a new O-ring on the outside of the end cap.



1. Bevel
2. O-ring

41845

Lubricate and install a new O-ring and two new back-up rings on the trim rod piston. Place one back-up ring on each side of the O-ring. Position the open end of the back-up rings 180° apart.



1. O-ring
2. Back-up rings

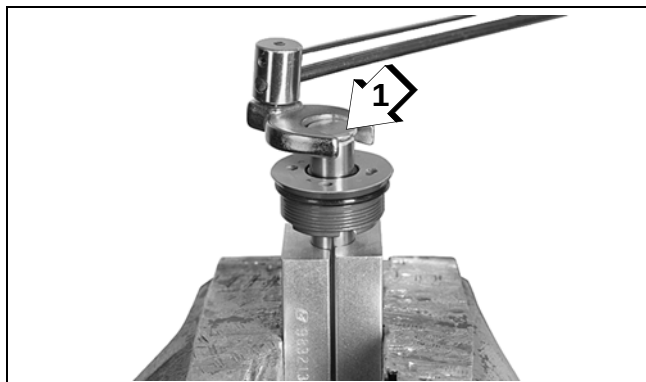
41847

Use Hydraulic Cylinder Rod Holder, P/N 983213, to clamp the rod tightly in a vise. Lubricate the cap and rod, then slide the end cap onto the rod.

Trim and Tilt

Trim and Tilt Servicing

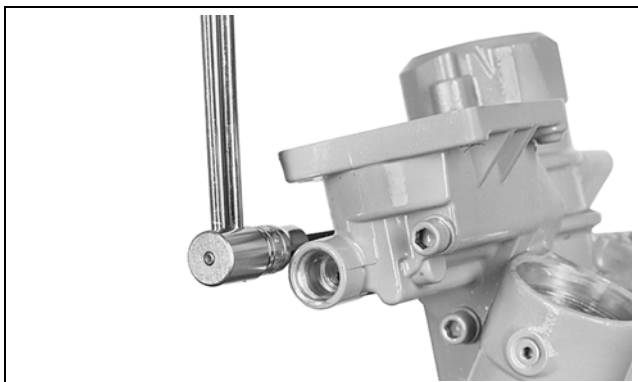
Apply *Ultra Lock* (red) to the threads of the thrust pads. Install thrust pads and tighten to a torque of 84 to 108 in. lbs. (9.5 to 12 N·m).



1. Thrust pad

41848

Attach the valve pump assembly to the cylinder body with three *Pozidriv* screws. Torque screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



41850

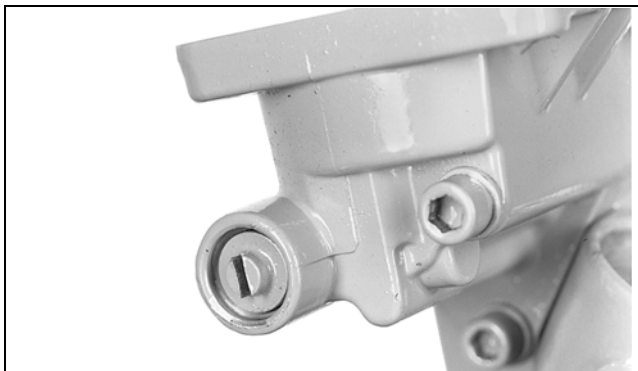
Manifold and Reservoir Installation

Lubricate five new manifold body O-rings. Place them in the cylinder body.



41849

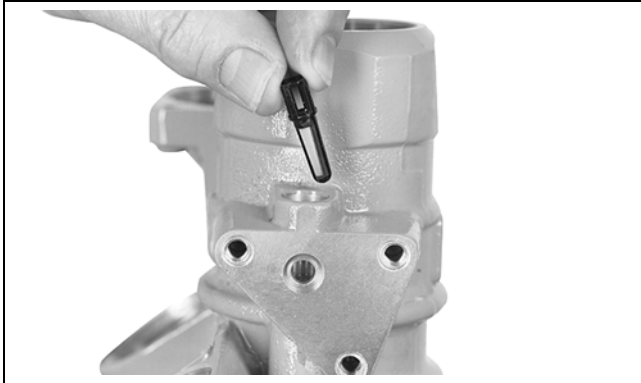
Oil and install the manual release valve. Thread the valve just past the snap ring groove. Do not install the snap ring at this time. The valve will be removed later for the **Pressure Leakdown Test** on p. 297.



41851

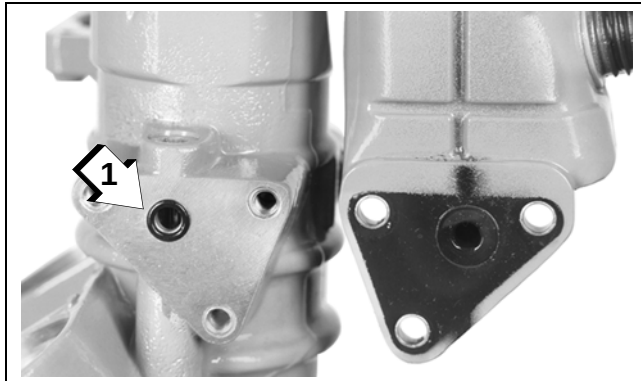
Install the reservoir filter screen in the cylinder body. Make sure that the screen is seated. Use a

6 mm Allen wrench to install the plug. Tighten the plug securely.



41863

Lubricate and place a new reservoir O-ring in the cylinder body.



1. O-ring

41865

Attach the reservoir to the cylinder body with three *Pozidriv* screws. Torque the screws to 35 to 52 in. lbs. (4.0 to 5.9 N·m).



41866

Trim Rod Installation

Lubricate the trim rod pistons. Place the rod assemblies into the body. Push them in until the end caps just clear the tops of the cylinders. Fill the cylinders with *Power Trim/Tilt & Steering Fluid*. Failure to fill the cylinders could cause difficulty in purging air from the unit.



41867

Clean up any spilled hydraulic fluid with shop towels.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated towels in an environmentally responsible manner, or according to local regulations.

Screw the trim rod end caps into the cylinder body. Use Trim Cylinder End Cap Remover/Installer, P/N 436710, or Universal Spanner Wrench, P/N 912084. Tighten caps to a torque of 60 to 70 ft. lbs. (81 to 95 N·m).



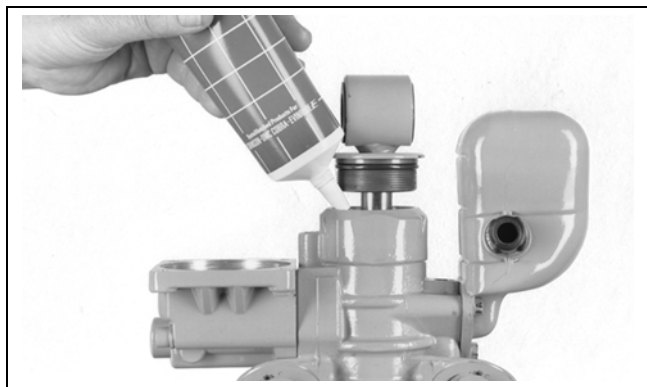
41868

Trim and Tilt

Trim and Tilt Servicing

Tilt Rod Installation

Lubricate the tilt rod piston. Slide the end cap all the way up on the rod assembly. Place the piston end of the rod assembly into the cylinder body. Push it in until the end cap just clears the cylinder top. Leave enough room to pour fluid into the cylinder. Fill the cylinder with *Power Trim/Tilt & Steering Fluid*. Failure to fill the cylinder could cause difficulty purging air from the unit.



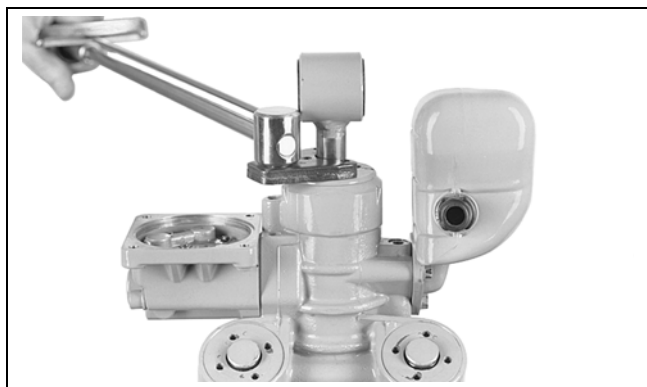
41869

Clean up any spilled hydraulic fluid with shop towels.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated towels in an environmentally responsible manner, or according to local regulations.

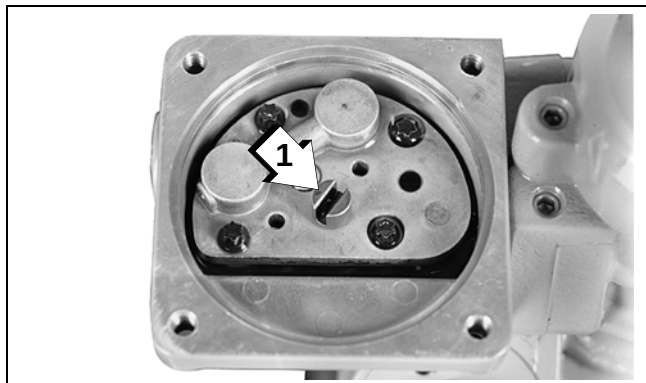
Screw tilt cylinder end cap into cylinder body. Use Tilt Cylinder End Cap Remover/Installer, P/N 326485, or Universal Spanner Wrench, P/N 912084. Torque cap to 58 to 87 ft. lbs. (79 to 118 N·m).



41870

Motor Installation

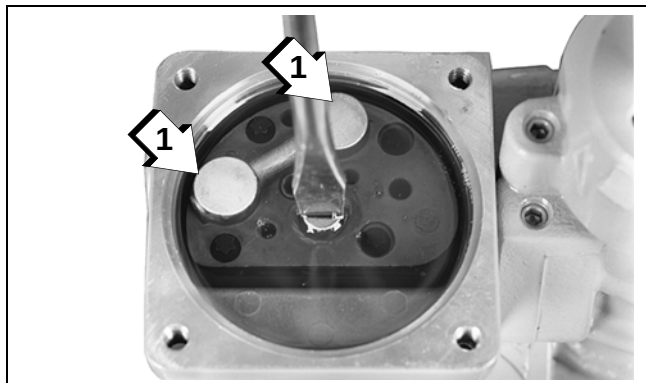
Position the pump manifold so the pump mounting surface is level. Install the coupler into the pump.



1. Coupler

41852

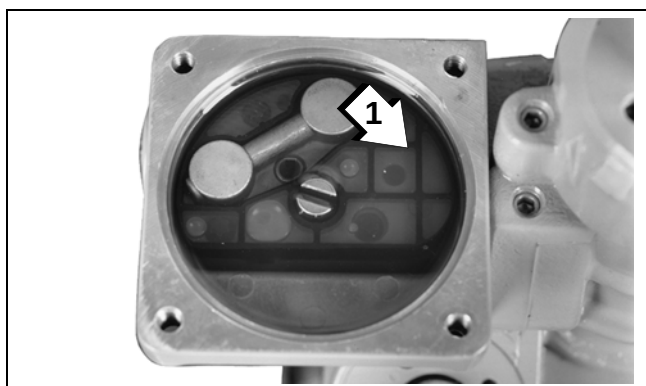
Fill the pump cavity with *Power Trim/Tilt & Steering Fluid* up to the top of the two bosses. Rotate the coupler clockwise and then counterclockwise until no more air bubbles come out of the pump.



1. Bosses

41854

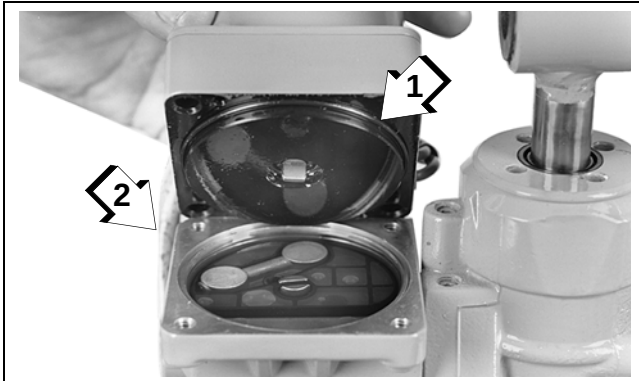
Install the filter screen.



1. Filter screen

41856

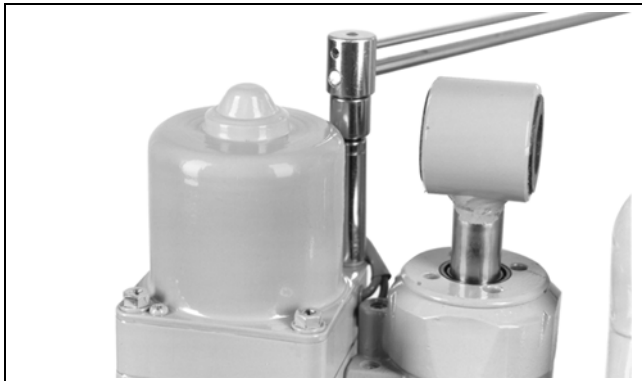
Lubricate and place a new O-ring on the motor. Make sure the cable is on the transom side of the unit; align the coupler slot with the motor shaft. Place the motor on the pump manifold assembly.



1. O-ring
2. Cable

41857

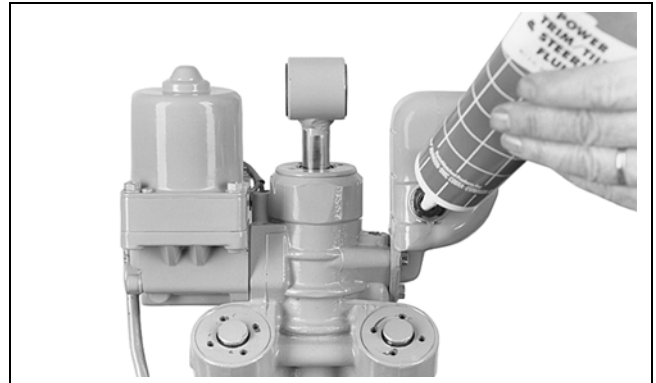
Install the four motor screws. Tighten the screws to a torque of 35 to 52 in. lbs. (4.0 to 5.9 N·m).



41858

Fill the reservoir to the bottom of the fill hole with *Power Trim/Tilt & Steering Fluid*. Install and tighten the reservoir cap. Turn the manual release

valve in until it seats. Cycle the unit up and down several times to purge air.



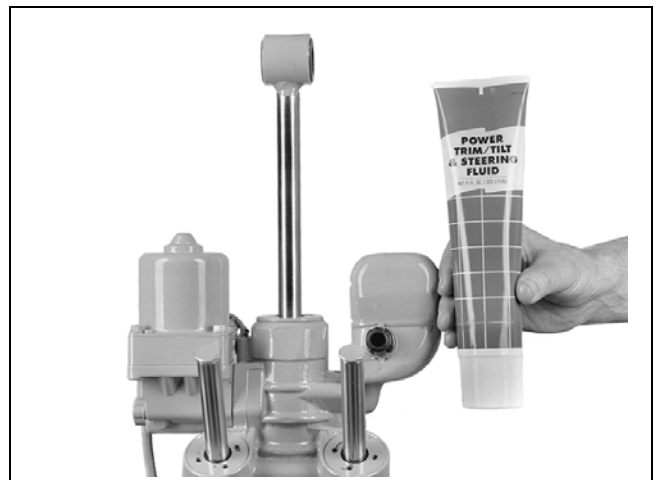
41859

Clean up any spilled hydraulic fluid with shop towels.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated towels in an environmentally responsible manner, or according to local regulations.

Operate the unit to the full UP position, then run down momentarily to release pressure. Check the fluid level again and add fluid, if necessary. Remember that all rods must be completely up to check the fluid level. Test the unit by performing the **Pressure Leakdown Test** on p. 297.



41885

Trim and Tilt

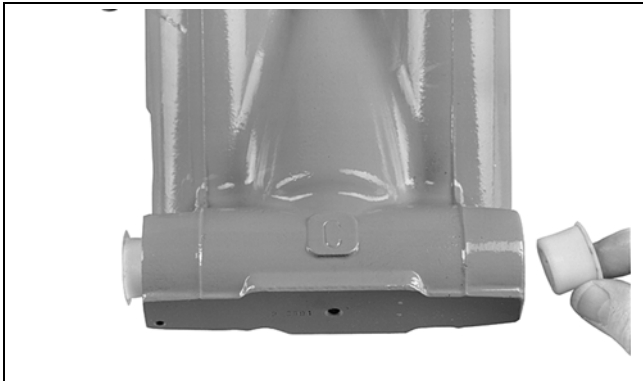
Trim and Tilt Servicing

Check the tilt rod bushings. Replace them if they are worn excessively.



41888

Check the bushings on the bottom of the manifold body. Replace them if they are worn excessively.



41878

Check system operation in both trim and tilt range.

Safety

S

Table of Contents

Marine Products and The Safety Of People Who Use Them	S-323
Outboard Shift Systems and Safety	S-324
Outboard Speed Control System and Safety	S-325
Outboard Steering Control System and Safety	S-326
Outboard Fuel, Electrical System, and Safety	S-328
Outboard Mounting System and Safety	S-331
If weakened, parts could fail later on the water, when not expected	S-332
Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety	S-333
Outboard Emergency Stop System and Safety	S-334
Summary	S-336
Marine Products and the Safety of People Who Fix Them	S-337
Handling Outboards	S-337
Handling Lead/Acid Batteries	S-341
Gasoline – Handle With Care!	S-342
Hazardous Products	S-343
Safety Awareness Test	S-344

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.

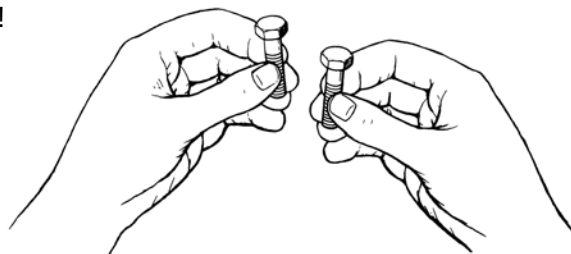
First!

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?

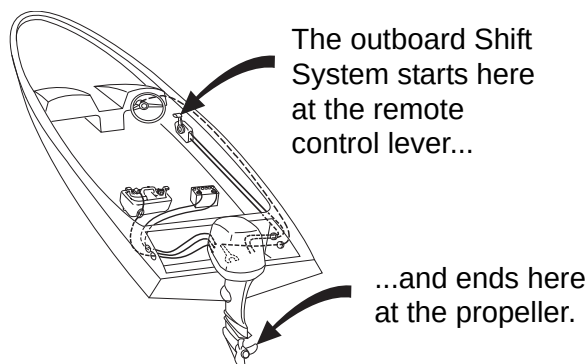


Don't substitute unless **you know** they are the **same** in **all** characteristics.

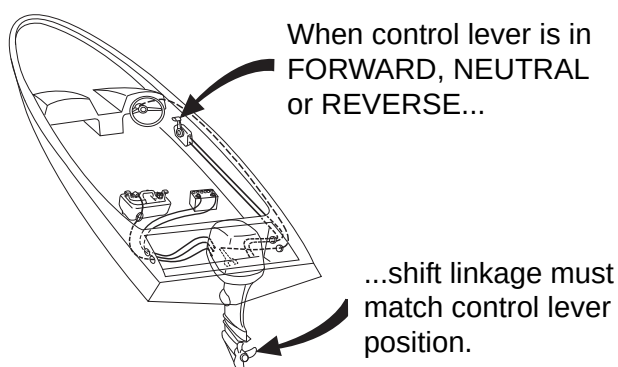
Second!

- 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.

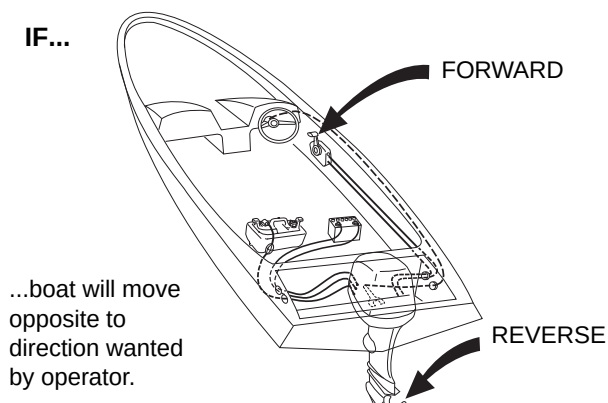
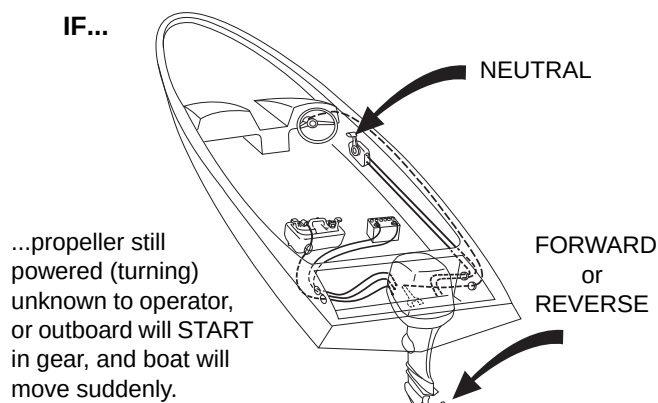
Outboard Shift Systems and Safety



What is most important?



What could happen?



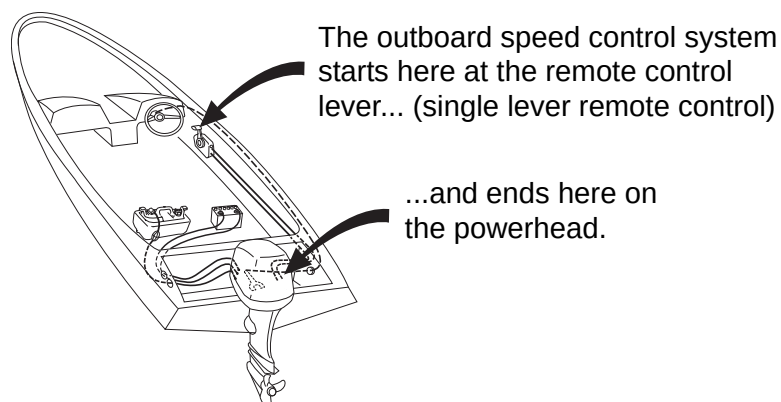
How can loss of shift control be minimized?

When rigging or after servicing

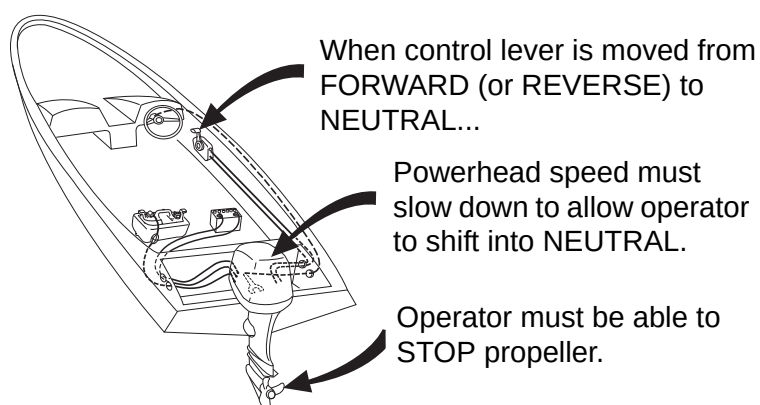
Read, understand, and follow manufacturer's instructions

- 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.

Outboard Speed Control System and Safety



What is most important?



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?

When rigging or after servicing

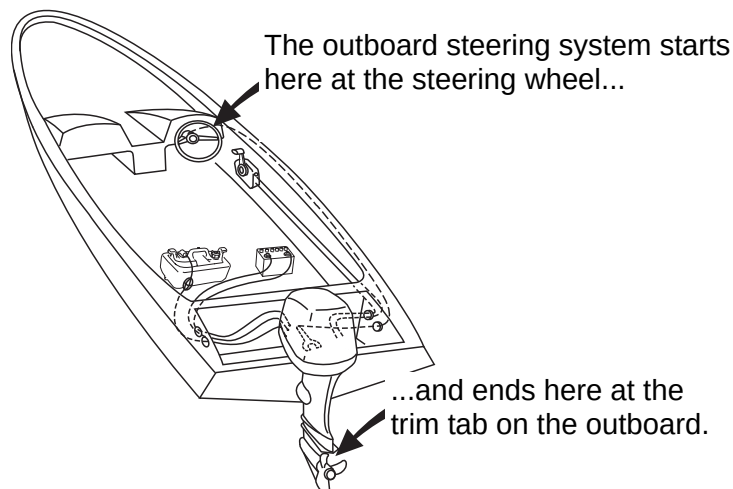
Read, understand, and follow manufacturer's **instructions**

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure 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.

Safety

Marine Products and The Safety Of People Who Use Them

Outboard Steering Control System and Safety



What is most important?

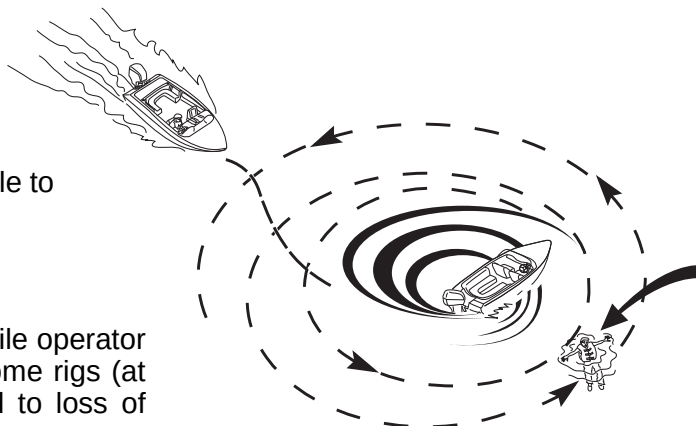
The steering system:

- 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.



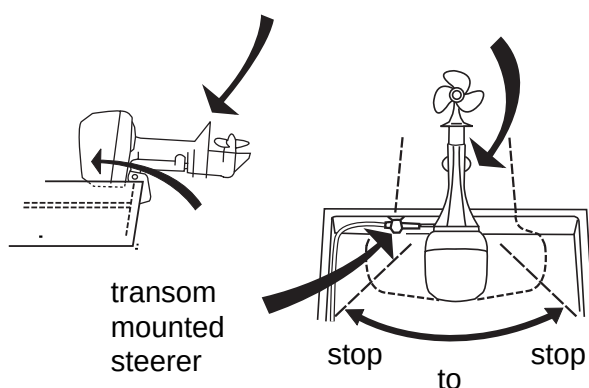
How can loss of steering control be minimized?

When rigging or after servicing

- 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 "⚠" 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.

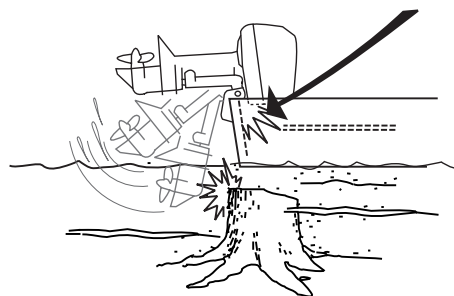


Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

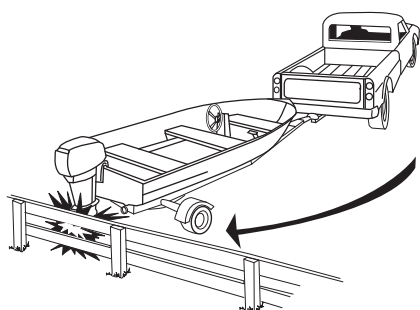
During this procedure, steering parts:

- 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.

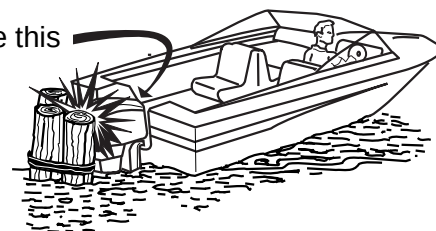


Check for damaged parts. Blows to the outboard like this



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.

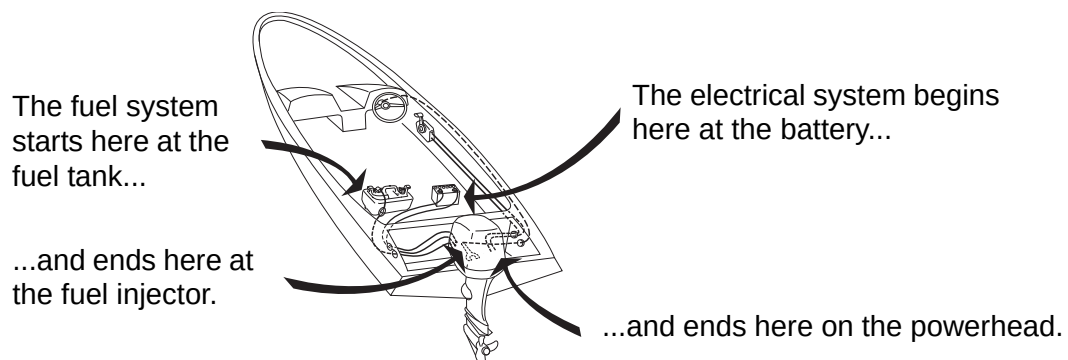


Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Safety

Marine Products and The Safety Of People Who Use Them

Outboard Fuel, Electrical System, and Safety



What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

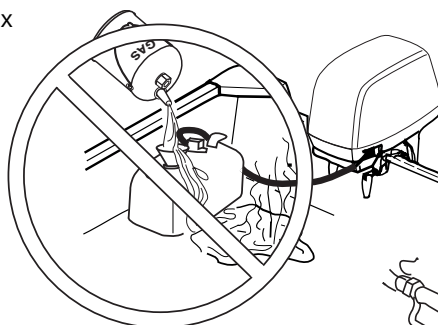
What could happen?

- **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.

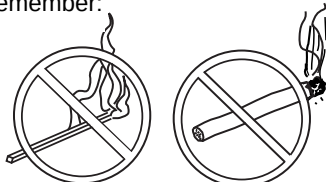
When mixing and refueling, always mix gas and oil outside...



Always fill the tank outside the boat

Fumes are hard to control. They collect and hide in the bottom of the boat.

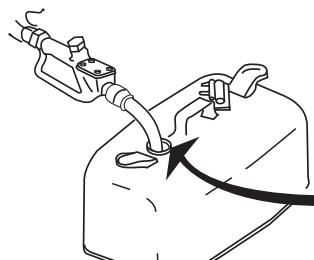
Remember:



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



To avoid those static electric sparks, ground (touch) the spout against the tank.

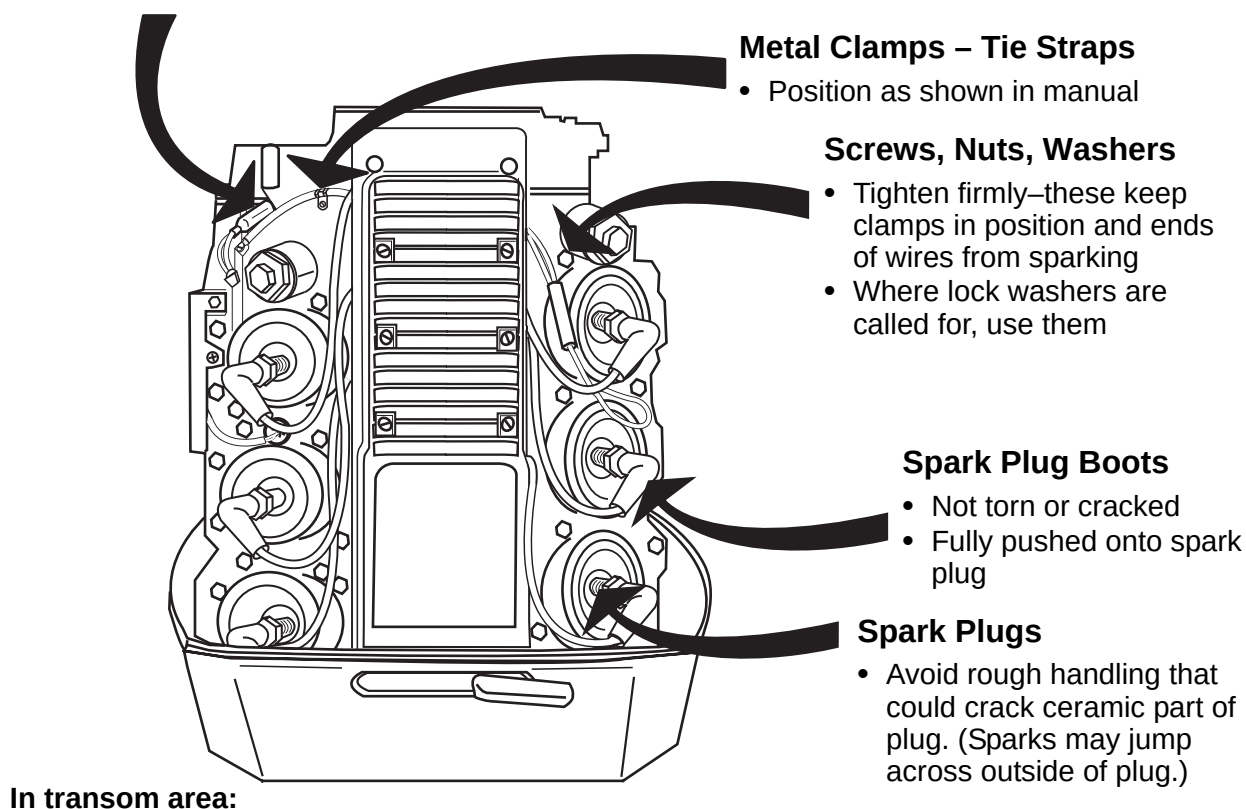
If electrical parts are replaced or even removed from the outboard, check the following:

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

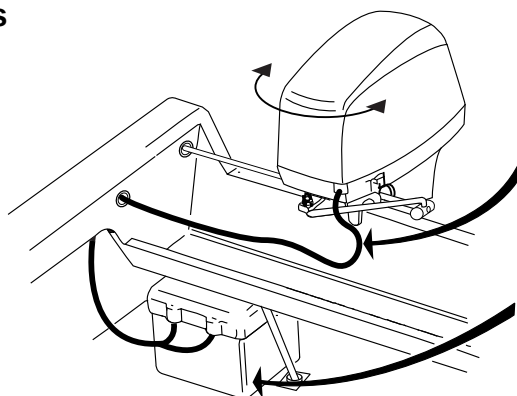
Sleeves, boots, shields

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



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

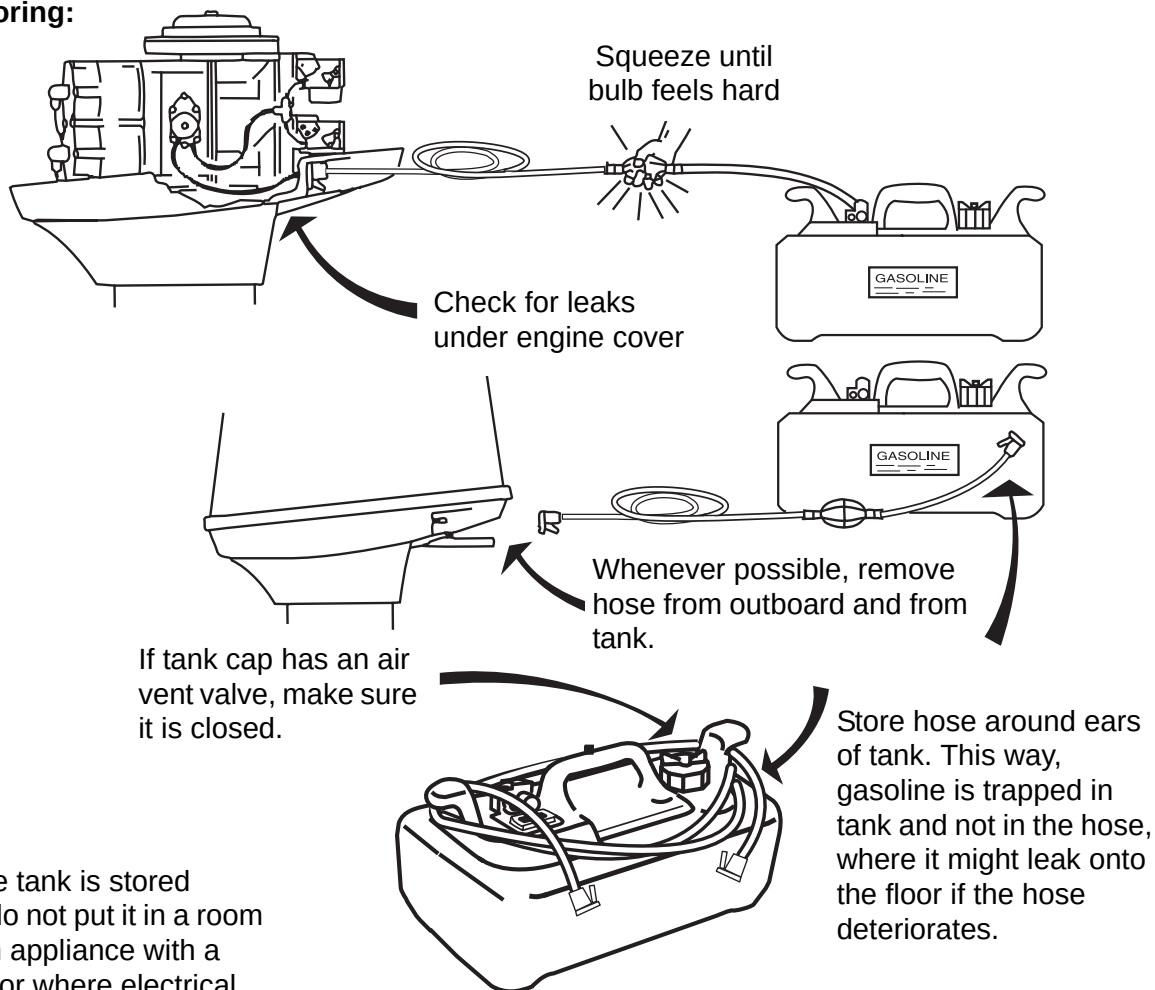
- Secure in approved battery box or battery tray
- Battery terminals insulated
- No strain on cables

Safety

Marine Products and The Safety Of People Who Use Them

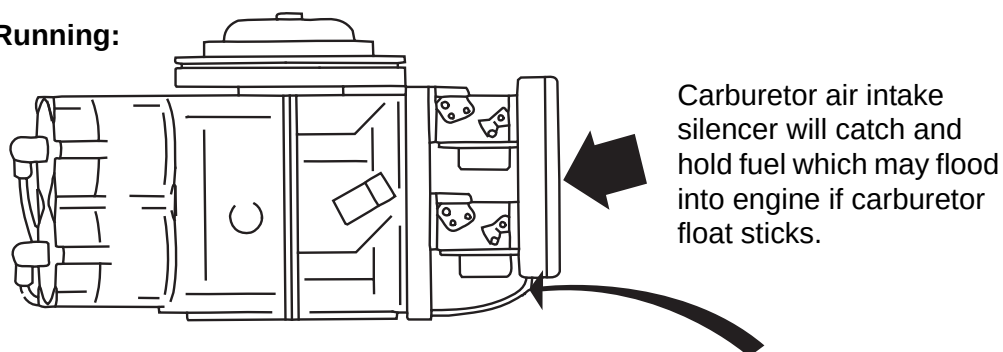
After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When Storing:



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.

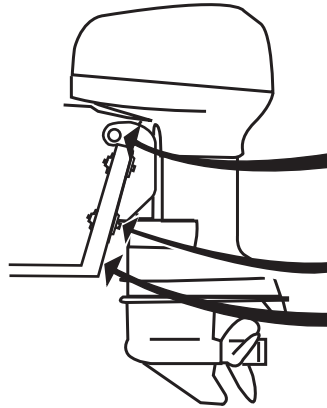
When Running:



- 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

The mounting system includes:

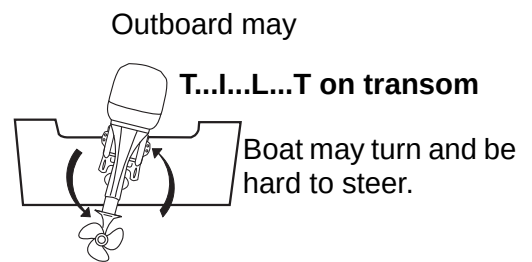
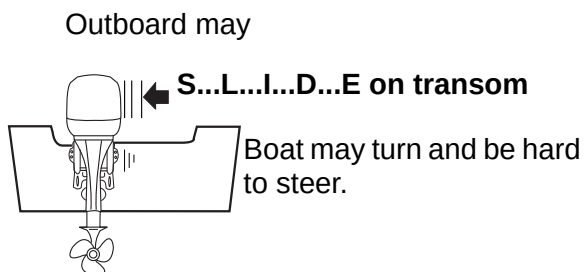


- outboard parts
- bolts, nuts, and washers
- boat's transom

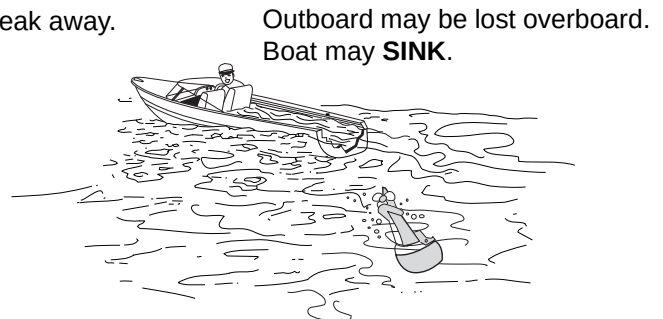
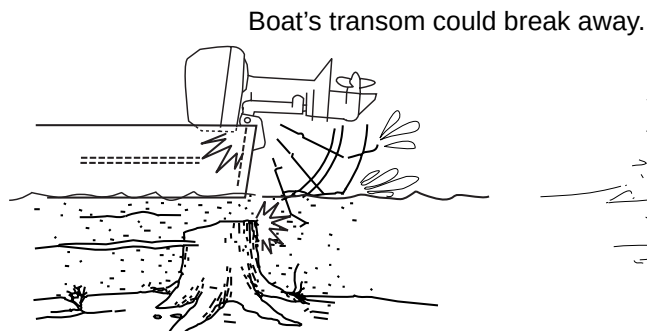
What is most important?

- Outboard must **stay** in position on boat's transom.

What could happen?



- 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.



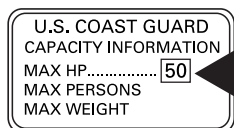
How Can Loss of Mounting Be Minimized?

- **Read, understand, and follow** manufacturer's **instructions**.
- Follow warnings marked "⚠" closely.

Safety

Marine Products and The Safety Of People Who Use Them

If weakened, parts could fail later on the water, when not expected

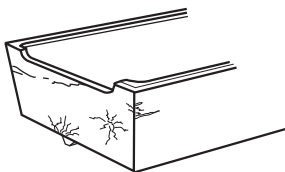


If boat plate shows...

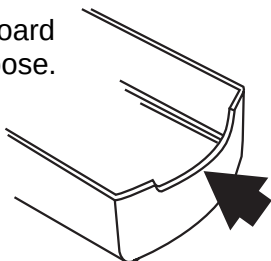
Use only



When rigging or fixing any boat, if transom looks weak, tell the owner.

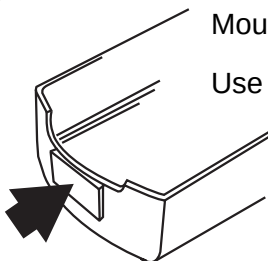


If transom is curved, outboard may come loose.



Mount on flat surface only.

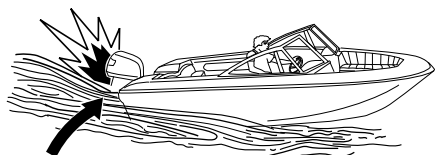
Use shims to make surface flat.



Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

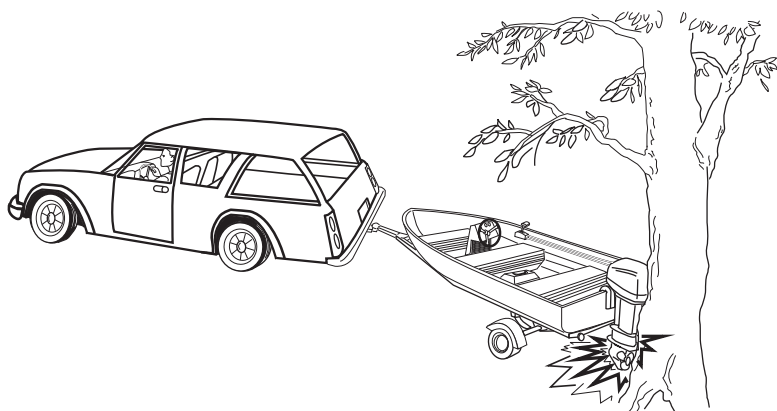


If owner tells you "I hit something really hard..."



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."

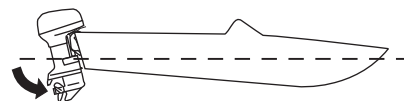
Check for a slow, heavy squash to the outboard.

- 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

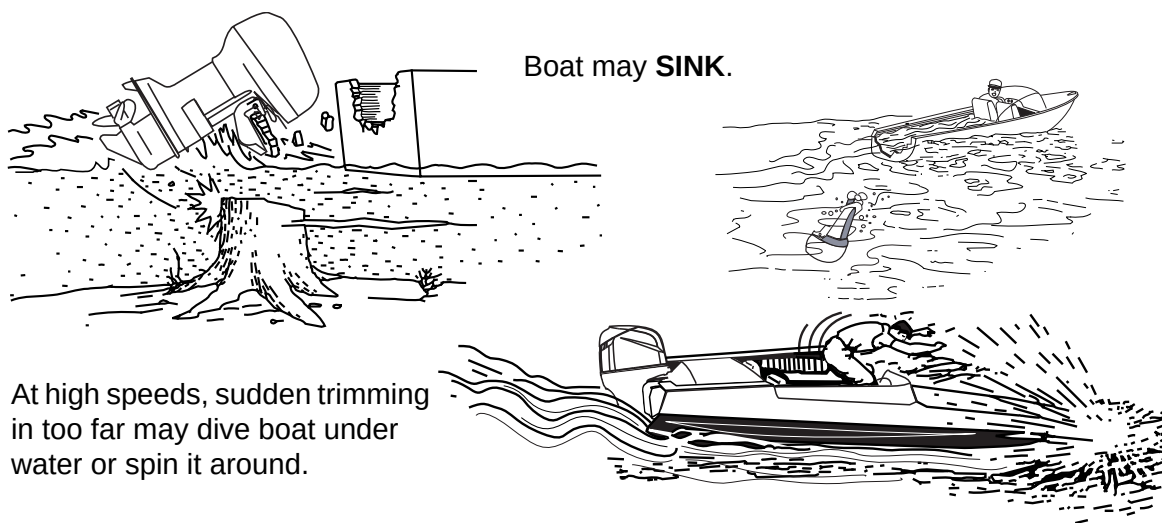
What is most important?

- 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.

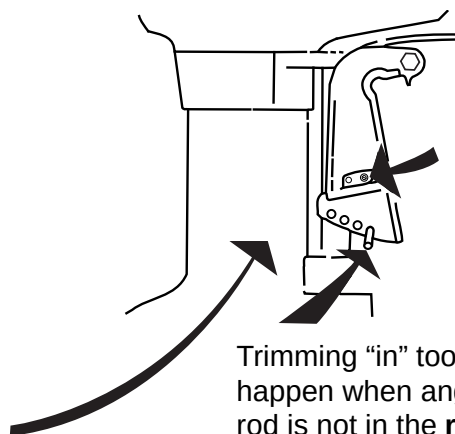


Boat may **SINK**.

At high speeds, sudden trimming in too far may dive boat under water or spin it around.

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).

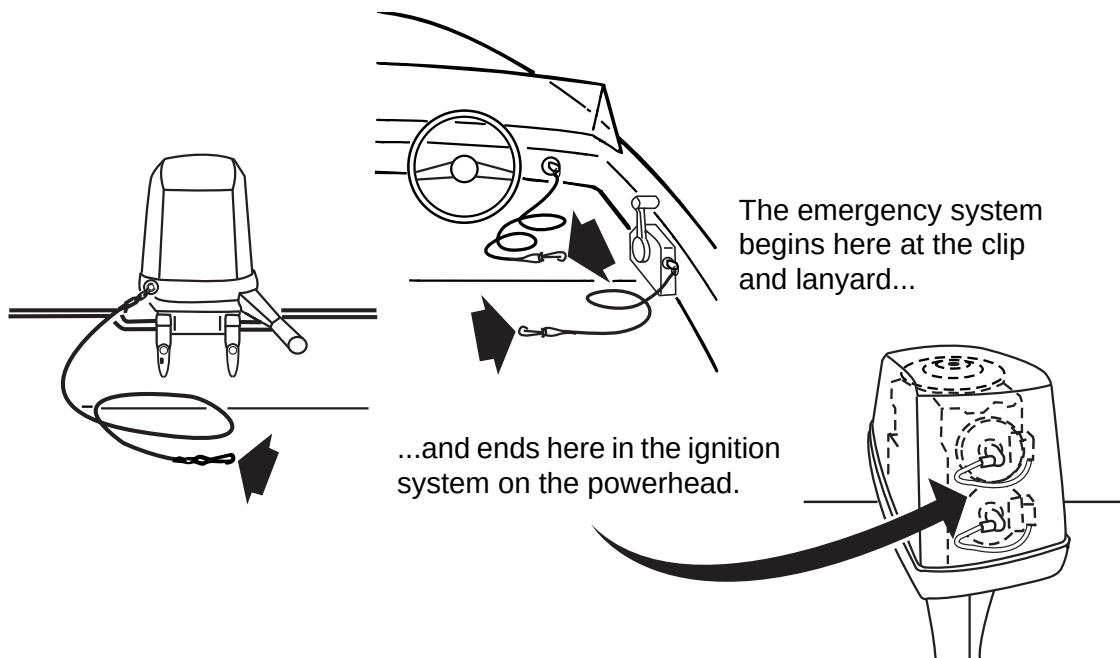
If left open, outboard has no shock protection.

Trimming "in" too far can happen when angle adjusting rod is not in the **right** hole or is not in **any** hole (lost).

Safety

Marine Products and The Safety Of People Who Use Them

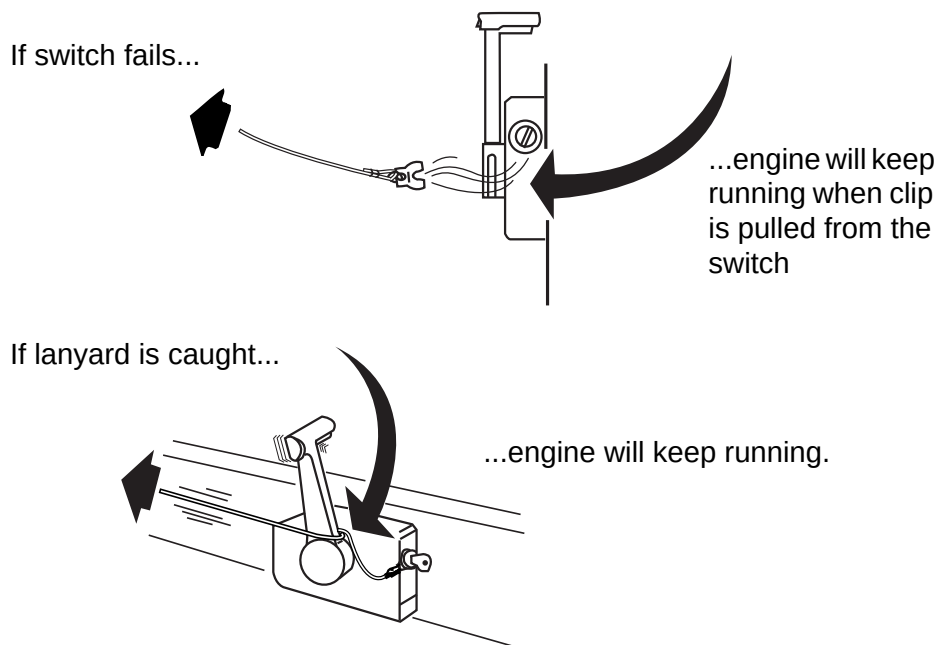
Outboard Emergency Stop System and Safety



What is most important?

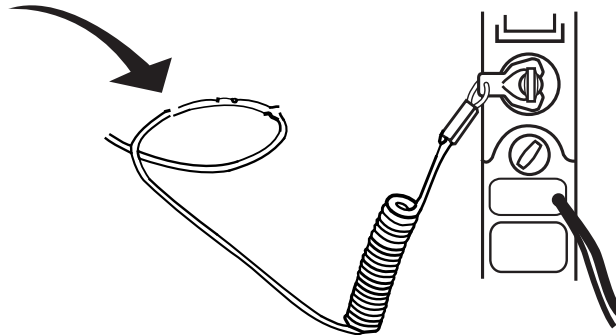
- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

What could happen?

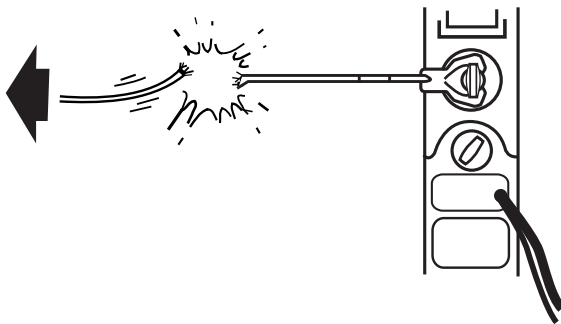


What could happen?

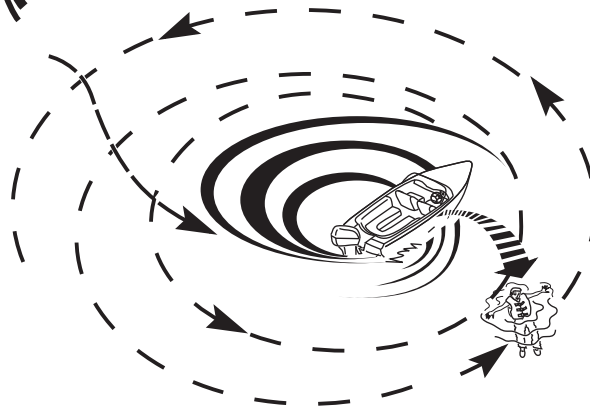
If lanyard is cut or frayed...



...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?

- When rigging or after servicing**
- **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

Marine Products and The Safety Of People Who Use Them

Summary

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?

Marine Products and the Safety of People Who Fix Them

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.

Center of gravity

Stand Clear!
It might hit you as it swings.

Regular screws are not strong enough. Screws may break and outboard may drop suddenly.

300 lbs.
(136.1 kg)

V6
455 lbs.
(206.4 kg)

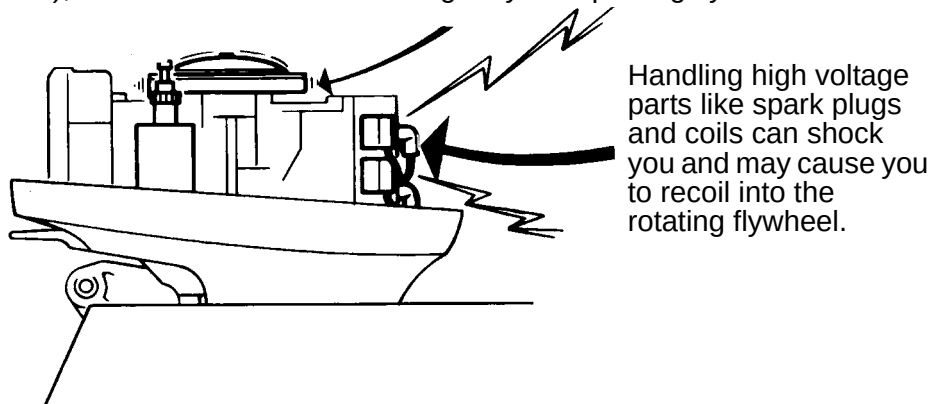
- Make sure shop aids have extra capacity, and keep them in good repair.

Safety

Marine Products and the Safety of People Who Fix Them

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.



- 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

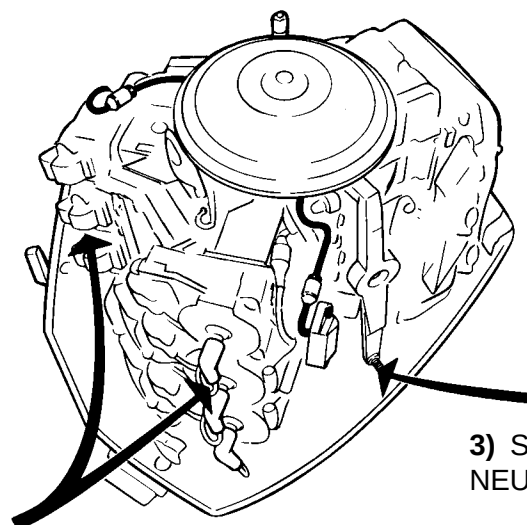
When you do things that turn the flywheel like:

- 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

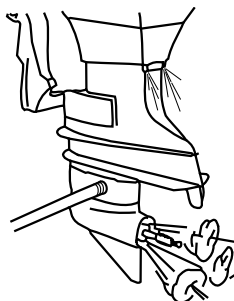
Running outboard too fast (Overspeeding)

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

Running too fast can happen when:

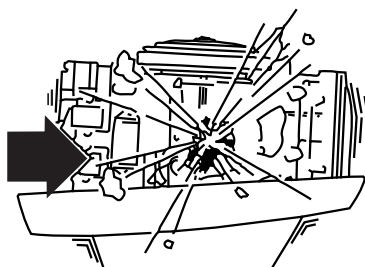
1) Using a flushing device...

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.



Use the right test wheel.

Running outboards: Exhaust fumes

⚠ DANGER

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

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

Safety

Marine Products and the Safety of People Who Fix Them

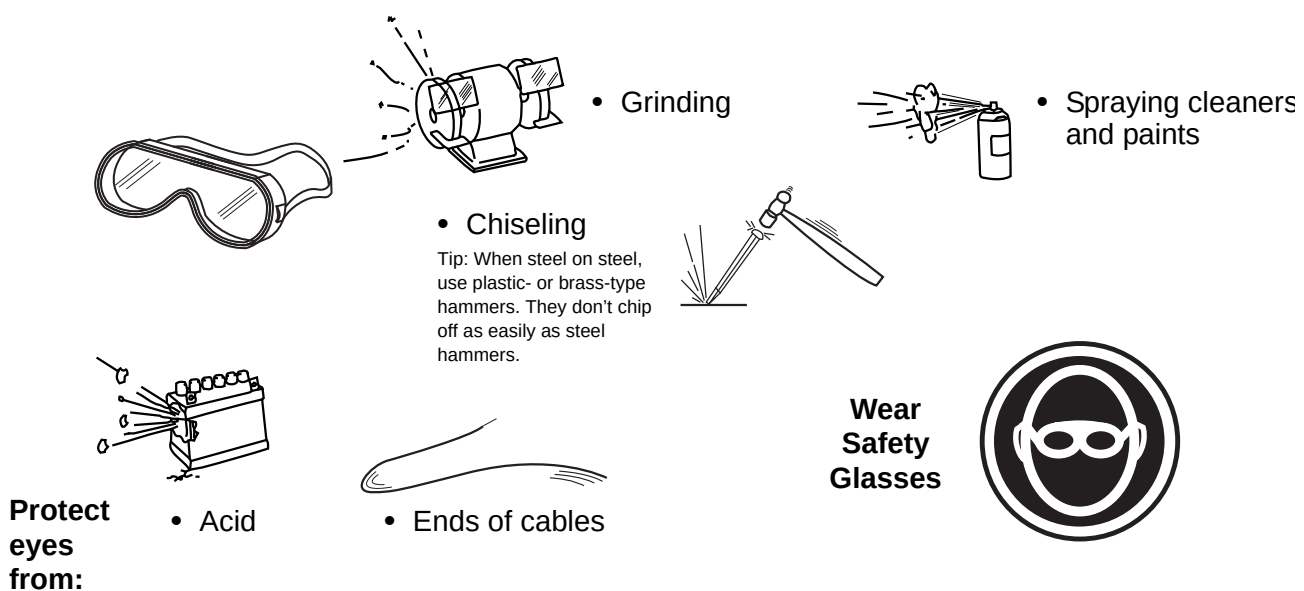
Running outboards: Propellers

⚠ DANGER

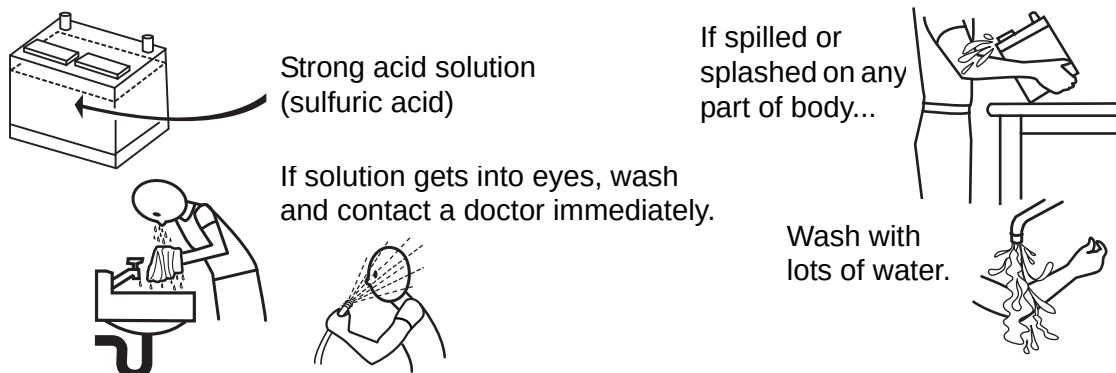
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

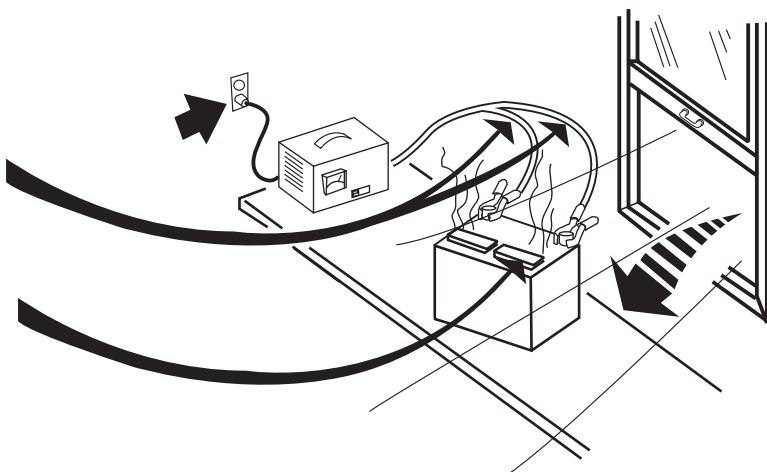


Handling Lead/Acid Batteries



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**.



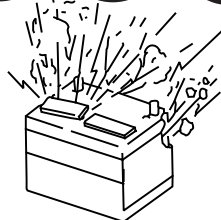
Battery gas is explosive!

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.



DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.



After charging:

- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

Safety

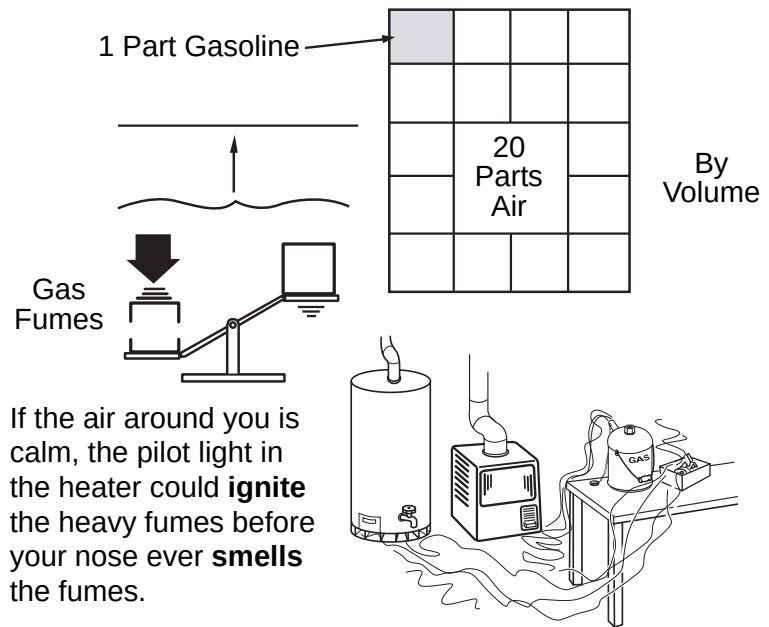
Marine Products and the Safety of People Who Fix Them

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.

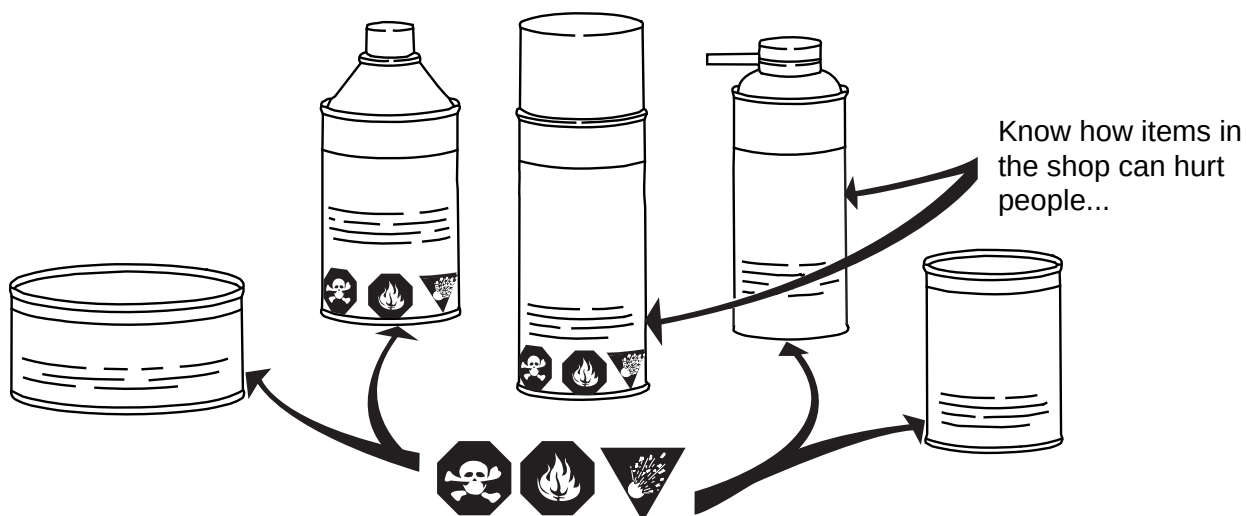
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel **ONLY**, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **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 ignitors (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

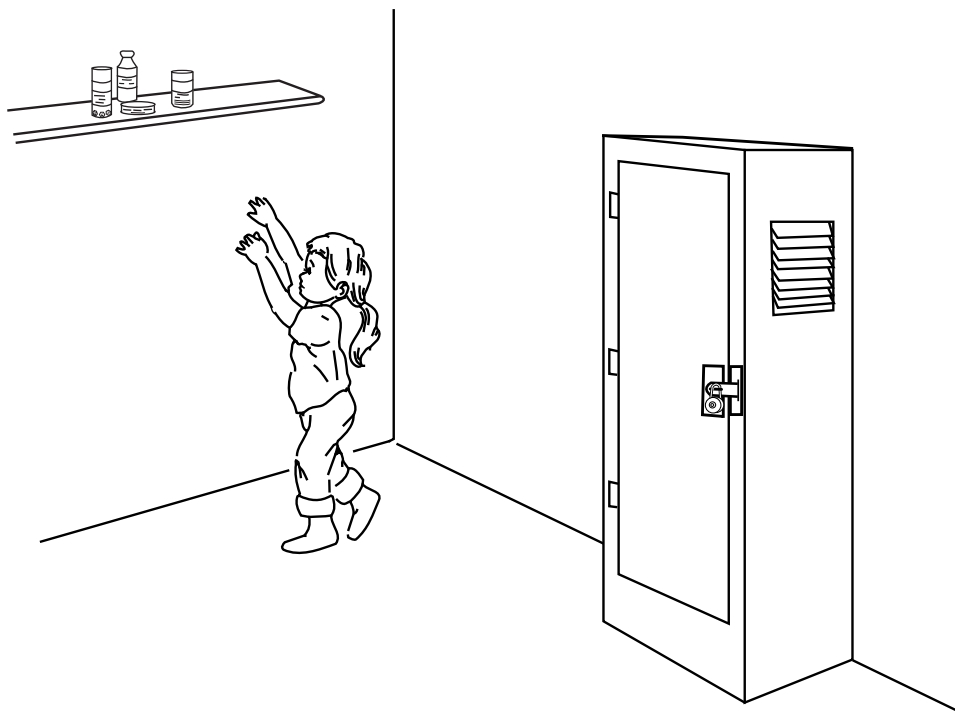


READ

- "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?

Index

A

Abbreviations 6

Accessories

- I-Command* Water Pressure Transducer Kit, P/N 765353 26
- XD100* Outboard Oil Decal, P/N 352369 173

Adapter Housing 192

- Service 272

Adjustments

- Control Cable 22
- Tilt Limit Switch 30
- Timing 115
- Timing Pointer 115
- TPS Calibration 71, 116
- Trim Sending Unit 31
- Trim Tab 32

Air Silencer

- Description 43
- Removal 225

Air Temperature Sensor

- Connections 93
- Description 61
- Resistance Test 97

Alternator Circuit Test 101

AMP Connector Servicing 126

Anodes

- Anti-Corrosion 44
- Continuity Check 45
- Stern Bracket 282, 285

B

Barometric Pressure Sensor 60

Batteries

- Charging System Tests 99
- Connections 27
- Lithium Ion Warning 27
- Maintenance 27, 28
- Requirements 13, 15, 27
- Storage 50

Bearing

- Connecting Rod 242
- Crankshaft 237, 238

Break-In

- EMM* Programming 174, 250
- Oiling 174
- Procedure 70

C

Cable, Hose, and Wire Routing 21

Capacitor Test 87

Connecting Rods

- Installation on Crankshaft 241, 242
- Installation on Piston 239
- Orientation 242
- Removal from Crankshaft 230

Control Cable

- Adjustments 22
- Installation 22

Cooling System

- Components 192
- Cylinder Block Venting 193
- EMM* and Vapor Separator Cooling 195
- Engine Temperature Check 192
- Flushing 35
- Hose Routing and Water Flow 190, 191
- Operating Temperatures 35
- Operation 194
- Pressure Relief Valve 193, 199
- Running on a hose 36
- Thermostats 193, 199
- Vapor Separator 139
- Water Intake Screens 35

Corrosion

- Anodes 282, 285
- Cylinder walls 234
- Long Term Storage 48
- Steering Cable 38

Corrosion Protection 45

Cover Service 54

Crankcase

- Assembly 244
- Disassembly 228

Crankshaft

- Assembly 237
- Bearings 236
- Disassembly 231
- Inspection 235
- Installation 241

Crankshaft Position Sensor

- Description 63
- Operation Test 85
- Resistance Test 96

Cylinder Bore

- Honing 233
- Inspection 235

Cylinder Head

- Inspection 234
- Installation 241
- Removal 229

D**Deutsch Connector Servicing** 125**Diagnostic Procedures**

- Dynamic Tests 79
- Fuel Delivery Tests 82
- Ignition Tests 84
- LED Indicators 80
- Strategy 76

Diagnostic Software

- Break-In Programming 70, 174
- Communication with Outboard 67
- Crankshaft Position Sensor 85
- Cylinder Drop Tests 79
- Diagnostic Procedures Overview 76
- Fuel Injector Programming 71
- Fuel Pump Test 82
- I-Command* Settings 25
- Oil Injector Test 178, 179
- Oiling Rate 70, 175
- Reports 72
- Sensor Monitoring 96
- Static Ignition Test 85
- Timing Verification 71, 116
- TPS Calibration 71, 116

Dual-Outboard

- Alignment 32
- I-Command* Settings 25

E**Electrical Circuits**

- EMM* Pin Locations 93
- Fuse 96
- Ground Circuits 95
- Key Switch 103
- Start Circuit 102
- SystemCheck 108, 109

Electrical Connectors 125

- AMP* Connectors 126
- Deutsch* Connectors 125
- Packard* Connectors 129

Electrical Harness

- Connections 23, 24, 25
- Pin Locations 93

Emergency Stop Switch

- Operation Check 34
- Test 107

Emissions Information 7, 8***EMM***

- 12 V Circuit Sensor 59
- Connections 58
- Diagnostics 67, 76, 80
- Fuel Injector Servicing 71
- Functions 58, 64
- LED Indicators 80
- Pin Locations 93
- Reports 72
- Sensors 59, 61
- Service Codes 68
- Servicing 74
- Software Replacement 73
- Timing Verification 116
- TPS Calibration 71
- Transfer 73

Engine Monitor

- Description 65
- Low Oil Warning 183
- No Oil Warning 170
- Operation Check 34

Engine Temperature Check 192

Engine Temperature Sensor

- Description 61
- Resistance Test 97

Exhaust Housing

- Assembly 276, 279
- Cleaning and Inspection 275
- Disassembly 274, 275
- Installation 273
- Removal 272

Exhaust Pressure Fitting 43**Exterior Finish Protection 45****F****Flushing, Cooling System 35, 36****Flywheel**

- Installation 112
- Removal 112
- Servicing 112

Fuel Filter

- Installation 148
- Removal 147

Fuel Injectors

- Crush Ring Replacement 151
- EMM Programming 71, 153
- Injector Puller Kit 151
- Installation 153
- Removal 151
- Tests 144, 145

Fuel System

- Additives 138
- Components 139
- Filter 139, 147
- Fuel Circulation Pump 140
- Fuel Filter 42, 147
- Fuel Lift Pump 139, 146, 148
- Fuel Manifolds 149
- Fuel Requirements 138
- Hose Routing 135
- Injector Servicing 151
- Intake Manifold 154
- Minimum Octane 138
- Pressure Tests 143
- Priming 142
- Relieving Pressure 147
- Requirements 137
- Troubleshooting 143

Vapor Separator 139, 149

Fuse 96**G****Gauges**

- Tachometer 34
- Trim Gauge Test 301

Gearcase

- Installation 46
- Lubricant 39
- Removal 45

Grommet 21**H****Honing 233****Hoses**

- Inspection 43
- Oil Distribution 183
- Oil Recirculation System 171
- Routing, Cooling System 190, 191
- Routing, Fuel System 135

I***I-Command***

- System settings 25
- Water Pressure Gauge 26

I-Command Network

- Outboard connections 24

ICON Component Servicing

- Electronic Servo Module (ESM) 205
- Shift Actuator 208
- Throttle Actuator 210

ICON Network

- Outboard connections 25

ICON Remote Control System

- Components 203
- Electronic Servo Module (ESM) 203
- Shift Actuator 203
- Throttle Actuator 204

ICON System Failsafe Mode 218***ICON System Faults 216***

- ICON System Failsafe Mode 204
- ICON System Fault Code Chart 218
- Non-recoverable Faults 217
- Recoverable Faults 216

ICON System Settings

- Calibrate Actuator Stroke 213
- Set Engine Identity (Instance) 212
- Shift Actuator Stroke 213
- Throttle Actuator Stroke 213

Idle Controller 64**Ignition**

- Electrical Circuits 92
- Ignition Coil Servicing 114
- Ignition Coil Tests 87
- Primary Circuit Resistance Test 87
- Required Systems 84
- Running Tests 86
- Static Ignition Test 85
- Timing 71

Intake Manifold

- Assembly 156
- Disassembly 155
- Inspection 155
- Installation 156
- Removal 154

K**Key Switch**

- Circuit Tests 106
- Operation Check 34
- Start Circuit 103

Knock Sensor 64, 98**L****LED Indicators 80****Lower Cover**

- Installation 55
- Removal 55

Lubrication

- Engine Oil 168
- Gearcase 39
- Propeller Shaft 39
- Swivel Bracket 38
- Throttle and Shift Linkage 38
- Tilt Tube 38
- Trailing Bracket 38
- Trim and Tilt 40

M**Maintenance and Inspection Schedule 18****Midsection**

- Stern Bracket Servicing 281
- Tilt Tube Servicing 270

Models

- Included Models 11
- Model Designation 10
- Serial Number Location 10

Motor Mounts

- Lower Mount Servicing 272, 273, 279
- Upper Mount Servicing 274, 275, 278, 280

N**Neutral Start Switch**

- Tests 106

Neutral Switch 63**New Engines**

- Outboard Rigging Procedure 20

O**Oetiker Clamp**

- Clamp Selection Chart 52
- Clamp Servicing 29

Oil Injector

- Description 168
- Electrical Circuit (40 V) 169
- Electrical Tests 178
- Functional Test 182
- Installation 184, 186
- Removal 184, 185

Oil Pressure Sensor

- Description 169

Oil Pump, Rear 170

- Description 170
- Electrical Circuit 170
- Electrical Tests 180
- Installation 185
- Removal 185

Oil Tank 168**Oiling Rate 70, 173****Oiling System**

- Components 168
- Electrical Circuits 161
- Engine Lubricant 168
- New Engine Set-Up 168
- Oil Distribution Hose Replacement 183
- Oil Filters 42

Oil Pressure Sensor 62
 Oil Recirculation 166, 171
 Oil Supply and Distribution 162
 Oiling Rate 70
 Priming 175
 Servicing 183
 Tests 178

P

Packard Connector Servicing 129

Piston Rings

End Gap 240
 Inspection 236
 Installation 240
 Removal 230

Pistons

Assembly 239
 Inspection 236
 Installation 240
 Removal 230

Powerhead

Assembly 237
 Cleaning 233
 Cylinder Compression Testing 225
 Disassembly 227
 Inspection 234
 Installation 247
 Removal 225
 Views 251

Predelivery Checks 34

Pre-Season Service 50

Pressure Relief Valve, Cooling System 199

Priming

Fuel System 142
 Oiling System 175

Propeller Safety 5

Propeller Shaft

Lubrication 39

R

Relays

Trim and Tilt 108, 300

Remote Controls

Cable Adjustment 22
 Cable Installation 22

Rigging

Outboard 20

RPM Limit 62, 64

S

S.A.F.E.

Description 66
 Oil Pressure 62
 Temperature 59, 61
 Voltage 59

Sensors

Air Temperature Sensor 61, 97
 Barometric Pressure Sensor 60
 Crankshaft Position Sensor 63, 85, 96
EMM 59
 Engine Temperature Sensor 61, 97, 198
 Exhaust Pressure Sensor 43, 60
 Knock sensor 64, 98
 Oil Pressure 62, 169
 Tests 96
 Throttle Position Sensor 62, 97, 116

Service Charts

Electrical and Ignition 90
 Fuel System 132
 ICON Remote Control System 202
 Midsection 266
 Oiling System 160
 Powerhead 222

Shift Actuator Removal 208

Shift Interrupt Switch 63

Shift Linkage

Installation 245
 Lubrication 38
 Removal 228

Spark Plugs

Gap 41
 Indexing 41
 Recommendation 41
 Replacement 41
 Service 41

Specifications

Starter

Circuit Description 102
 Current Draw Test 105
 Installation 124
 Servicing 118

INDEX

Solenoid Test 104
Voltage Drop Test 104
Start-In-Gear Protection 34, 106

Stator

Resistance Test 98
Servicing 112
Voltage Output Test 99

Steering System

Lubrication 38
Steering Arm and Shaft 281, 284

Stern Bracket

Assembly 283
Disassembly 281

Stop Circuit 107

Storage 48

Submerged Engines 51

Switches

Key Switch 106

Swivel Bracket

Installation 285
Lubrication 38
Removal 282

System Check

Circuits 108, 109
Oil System Warnings 170
Outboard connections 23
Tests 109, 110, 111
Winterization Procedure 48

T

Tachometer

Pulse Setting 34
Test 111

Taper Pin Tool 224

Temperature

Operating 35, 195
Operation below freezing 168
Sensors 61

Temperature Sender

Service 198

Temperature Sensor

Description 59

Thermostat

Assembly 199
Description 193
Disassembly 199

Inspection 199

Temperature 13, 15

Throttle Actuator Removal 210

Throttle Linkage

Installation 246
Lubrication 38
Removal 228

Throttle Position Sensor

Calibration 116
Description 62
Resistance Test 97

Tilt Limit Switch

Adjustment 30
Cam Installation 270, 271

Tilt Support 289

Tilt Tube

Installation 271
Lubrication 38
Removal 270

Timing Adjustments

Timing Pointer 115
Timing Verification 116
TPS Calibration 116

Tools

Ball Socket Remover tool, P/N 342226 154
Bootstrap Tool, P/N 586551 73
Connector Service Tool, P/N 342667 125
Crankshaft Bearing/Sleeve Installer, P/N 338649 237
Crimp Tool, AMP 127
Crimping Pliers, P/N 322696 126
Diagnostic Interface Cable, P/N 437955 67
Electrical Test Probe Kit, P/N 342677 101
Flywheel Holder, P/N 771311 112
Fuel Pressure Gauge, P/N 5006397 145
Fuel Pressure Gauge, P/N 5007100 143
Gauge and Collar Assembly, P/N 983975 298
Gearcase Alignment Kit, P/N 5007231 47
Gearcase Filler, P/N 501882 40
Guide Rods, P/N 383175 238
Hydraulic Cylinder Rod Holder, P/N 983213 312, 313
Injector Puller Kit, P/N 356461 151
Injector Test Fitting Kit, P/N 5005844 144
Large Puller Jaws, P/N 432129 232

Lifting Fixture, P/N 396748 226, 247
Oetiker Pincers, P/N 787145 29
 Piston Pin Retainer Pin Tool 224
 Piston Stop Tool, P/N 342679 115
 Plug/Holder, P/N 329661 181
 Primary Lock Tool, P/N 777077 126
 Rod Cap Alignment Fixture, P/N 396749
 242
 Seal Installation Tool, P/N 325453 238, 239
 Secondary Lock Installer, P/N 777079 127
 Secondary Lock Tool, P/N 777078 126
 Slide Hammer, P/N 391008 237
 Slide Hammer, P/N 432128 232, 271
 Stator Test Adaptor, P/N 5006211 99
 Syringe, P/N 346936 183
 Taper Pin Tool 224
 Temperature Gun, P/N 772018 196
 Terminal Release Tool, P/N 351413 128
 Thermal Joint Compound, P/N 322170 196
 Tilt Cylinder End Cap Remover/Installer, P/
 N 326485 308, 316
 Tilt Cylinder Seal Protector, P/N 326005
 310
 Tilt Tube Service Kit, P/N 434523 270
 Torquing Socket, P/N 346187 230, 243
 Trim Cylinder End Cap Remover/Installer,
 P/N 436710 312, 315
 Trim/Tilt Service Kit, P/N 390010 298
 Trim/Tilt Service Kit, P/N 434524 297
 Universal Puller Set, P/N 378103 112
 Universal Spanner Wrench, P/N 912084
 308, 312, 315, 316
 Wrist Pin Cone, P/N 331913 240
 Wrist Pin Pressing Tool, P/N 396747 231
 Wrist Pin Retaining Ring Driver, P/N
 396747 240

Torque Charts

see Service Charts

TPS Calibration 71, 116

Trailing Bracket 289

Lubrication 38

Trim and Tilt

Assembly 309, 313
 Circuits 108
 Disassembly 305, 312
 Electrical Circuit Tests 108

Fluid 317
 Inspection 296
 Lubrication 40
 Modes of Operation 290
 Motor Installation 316
 Pressure Leakdown Test 297
 Removal 303
 Reservoir Fluid 296
 Tilt Piston Identification 309
 Troubleshooting 296, 300

Trim Gauge Test 301

Trim Sender

Adjustment 31
 Test 302

Trim Tab

Adjustment 32
 Installation 47
 Removal 45

Troubleshooting

Charging System Tests 99
 Cylinder Drop Tests 79
 Diagnostic Procedures 76
 Fuel Control Adjustment 79
 Fuel System 143
 Ignition 84, 86
 Inductive Amp Meter Test 79
 Oiling System 178
 Outboard Excessive Smoking 357
 Outboard Hard to Start 355
 Outboard Starts and Stalls 356
 Outboard Starts, Low Maximum RPM 357
 Outboard Surges, Runs Rough 358
 Outboard Will Not Start 353
 Outboard Won't Shut Off 356
 Strategy 77
 Timing Light Test 79
 Trim and Tilt 296, 300
 Trouble Check Chart 353

U

Upper Mount

Installation 278, 280
 Removal 274, 275

INDEX

V

Vapor Separator

Description 139

Installation 149

Removal 149

Voltage Drop Test 104

W

Water Intake Screens 35

Inspection 35

Water Pressure Gauge 26

Water Pump

Description 192

Water Supply Tube 192

Winterizing 48

Wiring Harness Connections 24

Wrist Pin

Installation 239

Removal 231

Trouble Check Chart

Outboard Will Not Start

Observation	Possible Cause	Procedure
Outboard does not turn over	Battery switch not ON	Check battery switch operation
	Discharged battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections. Check for voltage drop in starter circuit.
	Faulty connection or ground, damaged electrical harness	Check all grounds, connections and wiring
	Fuse (10 A)	Check wiring, then replace faulty fuse
	Wiring harness	Check for 12 V at terminal "B" of key switch
	Key switch	Check key switch operation
	Starter solenoid	Check wiring and test solenoid
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears
	Seized powerhead or gearcase	Check and repair as needed
Outboard turns slowly	Discharged battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections. Check voltage drop in starter circuit.
	Powerhead hydro-locked	Check cylinders for water
	Partially seized powerhead or gearcase	Check and repair as needed
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears

T

Outboard Will Not Start

Observation	Possible Cause	Procedure
Outboard turns over	Stop circuit grounded	Check wiring and emergency stop switch. Check the safety lanyard is installed and stop circuit is not grounded.
	No Fuel	Check for fuel in fuel tank
	Water in fuel	Check fuel filter, sample fuel from fuel return manifold.
	Contaminated or poor fuel quality	Check or replace fuel supply
	Fuel supply restricted	Check primer, anti-siphon valve, and fuel pick-up. Use primer to fill vapor separator with fuel.
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Low or no fuel pressure to injectors	Check fuel manifold pressure, refer to Fuel System
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Fuel injectors not working	Check voltage at injectors
	Excessive fuel or oil, engine flooded	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent, refer to System Analysis
	Low or no 55 V alternator output	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuits, refer to System Analysis and Electrical and Ignition
	Ignition	Check ignition, refer to System Analysis and Electrical and Ignition
	CPS input to <i>EMM</i> , no sync	Check RPM reading while cranking
	No ignition system primary voltage output from <i>EMM</i> to ignition coils	Check cranking RPM (300 minimum), refer to System Analysis
	Low or no compression	Check compression
	Water in engine	Check condition of spark plugs and cylinders
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector information (by location and serial number)

Outboard Hard To Start

Observation	Possible Cause	Procedure
Outboard eventually starts, may or may not run properly once started	Weak battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections, check voltage drop on high amperage circuit
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check or replace fuel supply
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to Fuel System
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low or no alternator output (55 V)	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to System Analysis and Electrical and Ignition
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	Weak or erratic ignition operation	Check ignition, refer to System Analysis and Electrical and Ignition
	Crankshaft Position Sensor (CPS)	Check CPS air gap and <i>EMM</i> LED indicators
	Excessive fuel or oil, engine flooding	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent. Refer to System Analysis .
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Internal powerhead damage	Check and repair as needed
	Low compression	Check compression
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

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Outboard Will Not Shut Off

Observation	Possible Cause	Procedure
Outboard starts and runs, normal performance while running	Key switch or wire harness ground	Check key switch and ground to key switch, refer to System Analysis and Electrical and Ignition
	Stop circuit wiring	Check <i>EMM</i> LED indicators. Check wire harness (black/yellow) and key/stop switch(s).
	EMM failure	Check <i>EMM</i> LED indicators and eliminate stop circuit as possible cause. Stop wire (black/yellow) has 4.0 VDC from <i>EMM</i> with key on or outboard running.

Outboard Starts and Stalls

Observation	Possible Cause	Procedure
Outboard may not run for more than a few seconds	Faulty wiring, connections, or grounds	Check all grounds, connections, and wiring
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low or no alternator output (55 V)	Check voltage on 55 V circuits, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit, refer to System Analysis and Electrical and Ignition
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to Fuel System
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Injector electrical circuit or control function	Check voltage at injectors, refer to System Analysis
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs
	Weak or erratic ignition output	Check ignition, refer to System Analysis and Electrical and Ignition
	Internal powerhead damage	Check and repair as needed

Outboard Starts, Low Maximum Rpm

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

Excessive Smoking

Observation	Possible Cause	Procedure
May coincide with increased oil consumption (normal if occurs after winterization)	Contaminated or poor fuel	Check or replace fuel supply
	Excessive fuel or oil consumption	Check fuel system for fuel supply air leaks or leaking fuel injectors
	Outboard in break-in mode	Use diagnostic program to confirm
	Outboard mounted too low	Check installation height of outboard
	Vapor separator vent	Check vapor separator assembly for proper venting/float valve operation
	Faulty/leaking fuel injector(s)	Check injectors, refer to Fuel System
	Damaged fuel lift pump	Check for internal leaks

Outboard Surges, Runs Rough

Observation	Possible Cause	Procedure
1200 RPM and above	S.A.F.E.	Access <i>EMM</i> fault codes
May be erratic or inconsistent	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check and replace fuel supply
	Low or erratic fuel pressure	Check pressure, refer to Fuel System
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	Faulty wiring, connections, grounds, or CPS air gap	Check all grounds, connections, and wiring. Check CPS air gap.
	Low alternator output (55 V)	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Weak or erratic ignition operation	Check ignition, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to System Analysis and Electrical and Ignition
	Restricted engine exhaust	Check and repair as needed
Audible noise	Propping	Change propeller type or size as needed
	Internal powerhead damage	Check and repair as needed
	Damaged gearcase	Inspect gearcase and lubricate