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Technical Publications
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<i>S.A.F.E.</i> ™	<i>Moly Lube</i> ™

Service Manual

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For complete outboard rigging and control installation information, refer to the current **Evinrude E-TEC G2 Installation and Predelivery Guide**.

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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* 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 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
Ω	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
CAN	Controller Area Network
CCA	Cold Cranking Amps
CFR	Code of Federal Regulations
CPS	Crankshaft Position Sensor

DPS	Dynamic Power Steering
ETB	Electronic Throttle Body
ETC	Electronic Throttle Controller
EGT	Exhaust Gas Temperature
EMM	Engine Management Module
EPA	Environmental Protection Agency
ESC	Electronic Shift Controller
FNR	Forward, Neutral, Reverse
FWD	Forward
HPS	Helm Pressure Sensor
ICOMIA	International Council of Marine Industry Associations
ID	Inside Dimension
LED	Light Emitting Diode
MCA	Marine Cranking Amps
MWS	Modular Wiring System
NMEA	National Marine Electronics Assoc.
OOC	Out Of Correlation
PBLC	Public (<i>NMEA 2000</i>) Network
PPS	Pump Pressure Sensor
PRVT	Private (Remote Control) Network
PTPS	Port Steering Pressure Sensor
REV	Reverse
ROM	Read Only Memory
S.A.F.E.	Speed Adjusting Failsafe Electronics
SAC	Start Assist Circuit
SAE	Society Of Automotive Engineers
SPS	Shift Position Sensor
STPS	Starboard Steering Pressure Sensor
STS	Steering Position Sensor
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

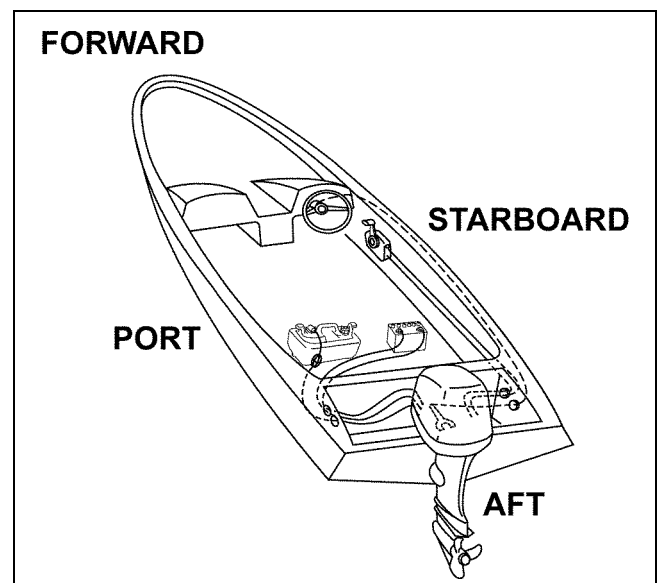
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of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

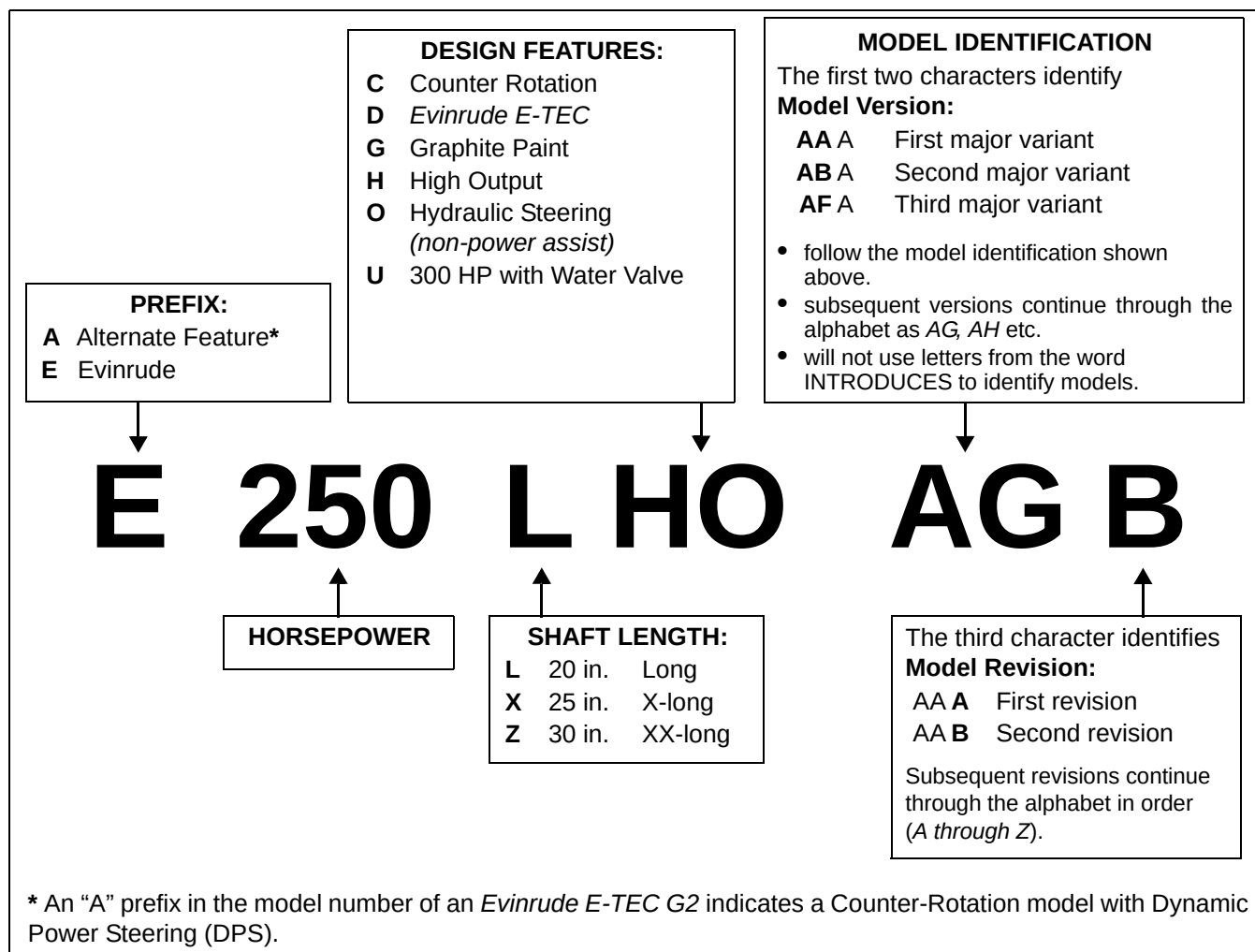
U.S. Environmental Protection Agency
Office of Transportation and Air Quality
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

EPA Internet Web Site:

www.epa.gov/otaq

Model Designation

Engine Identification

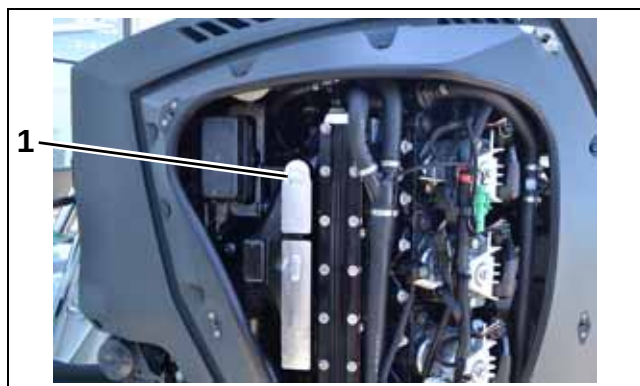


Model and serial numbers are located on the swivel bracket and on the powerhead.



1. Model and serial number

009146



1. Serial number

009147

Models Covered

This service manual covers information on the following *Evinrude E-TEC G2*, 210 cubic inch (3.4 L), 74° V6, models, starting with serial numbers:

AB models, s/n 5410201

AF models, s/n 5421512

AG and newer models, s/n 5437485

HP	Model Number	Shaft Length	Gearcase		Steering	Graphics	Standard Features	Special Features
			Style	Gear Ratio				
200	E200LHA_ _	20	SLX	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E200LHOA_ _	20	SLX	13:24/0.542/1.85:1	Hydraulic	Custom H.O.	Digital EST ²	H.O.
	E200XHAB_ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	H.O. Standard	Digital EST ²	H.O.
	E200XHCAB_ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	H.O. Standard	Digital EST ²	H.O.
	A200XHCA_ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	CR/DPS ³ , H.O.
225	E225X_ _ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E225XC_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	Standard	Digital EST ²	
225H	E225LH_ _ _	20	SLX	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E225XH_ _ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E225XCH_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E225LHO_ _ _	20	SLX	13:24/0.542/1.85:1	Hydraulic	Custom H.O.	Digital EST ²	H.O.
250	E250X_ _ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E250Z_ _ _	30	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E250XC_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	Standard	Digital EST ²	
	A250XC_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	CR/DPS ³
	E250ZC_ _ _	30	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	Standard	Digital EST ²	
	A250ZC_ _ _	30	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	CR/DPS ³
250H	E250LH_ _ _	20	SLX	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E250XH_ _ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E250XCH_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Custom H.O.	Digital EST ²	H.O.
	E250LHO_ _ _	20	SLX	13:24/0.542/1.85:1	Hydraulic	Custom H.O.	Digital EST ²	H.O.
300	E300LU_ _ _	20	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E300XU_ _ _	25	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E300ZU_ _ _	30	SLX	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	
	E300XCU_ _ _	25	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	Standard	Digital EST ²	
	A300XCU_ _ _	30	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	CR/DPS ³
	E300ZCU_ _ _	30	SLX Counter Rotation	13:24/0.542/1.85:1	Hydraulic	Standard	Digital EST ²	
	A300ZCU_ _ _	30	SLX Counter Rotation	13:24/0.542/1.85:1	DPS ¹	Standard	Digital EST ²	CR/DPS ³

1. Dynamic Power Steering 2. Digital Electronic Shift & Throttle 3. Alternative Feature: Counter-Rotation model with DPS

Reference Information

Service Specifications

Service Specifications

HP	200	225	250	250 H.O.	300
Engine					
Full Throttle Operating Range	5400-6000 RPM	5400-6000 RPM	5400-6000 RPM	5400-6000 RPM	5400-6000 RPM
Power	200 HP (147.1 kw) @ 5500 RPM	225 HP (165.5 kw) @ 5500 RPM	250 HP (183.9 kw) @ 5500 RPM	250 HP (183.9 kw) @ 5750 RPM	300 HP (220.6 kw) @ 5750 RPM
Idle RPM in NEUTRAL	500 ± 50 RPM				
Idle RPM in Gear	500 ± 50 RPM				
Weight (may vary depending on model)	20 in. (L) Models 537 lbs. (244 kg) 25 in. (X) Models 558 lbs. (253 kg) 30 in. (Z) Models 570 lbs. (259 kg)				
Lubricant	– Preferred Lubricant <i>Evinrude XD100, Evinrude XD50</i> – Acceptable Lubricant Synthetic TC-W3 NMMA-certified oil				
Capacity	2.0 gallons (7.5 liters)				
Engine Type	74° V 6-Cylinder Loop-Charged				
Displacement	210 cu. in. (3.4 L, 3441 cm ³)				
Bore	3.854 in. (97.89 mm)				
Stroke	3.000 in. (76 mm)				
Standard Bore	3.8535 to 3.8550 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)				

HP	200	225	250	250 H.O.	300
Fuel / Oil System					
Fuel/Oil Ratio	EMM Controlled				
Starting Enrichment	EMM Controlled				
Preferred Fuel	Regular unleaded gasoline				
Acceptable Fuel	Use unleaded regular gasoline. The use of unleaded gasoline containing alcohol above the percentage specified by government regulations is not recommended. Do NOT use Fuel labeled "E85." Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.				
Minimum Octane	87 AKI (R+M)/2 or 90 RON				
Fuel Pressure (minimum) – Lift Pump –High Pressure Pump	6 psi (41 kPa) @ idle 26 to 32 psi (179 to 220 kPa) @ 5500				
Fuel Pressure (maximum) – Lift Pump –High Pressure Pump	3 psi (21 kPa) @ 5500 RPM 34 to 40 psi (234 to 275 kPa) @ idle RPM				
Maximum Fuel Inlet Vacuum	4 in. Hg. (13.5 kPa)				
Fuel Filters – Inline – Water Separating	P/N 357797 P/N 502906				
Fuel Additives	2+4 Fuel Conditioner, Fuel System Cleaner. Use of other additives may result in engine damage.				
Electrical System					
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.				
Analog Tachometer Setting	6 pulse (12 pole)				
Charging Isolator	Integral, Terminal on Engine Harness				
Engine Fuses	3 Amp MINIFUSE, P/N 3011805, 5 Amp MINIFUSE, P/N 514764, 10 Amp MINIFUSE, P/N 514766, 30 Amp MINIFUSE, P/N 3011729				
Engine Relays – Starter – B+ to 55 V System	12V 35A SPDT, P/N 3011790 12V 35A SPDT, P/N 3011790				
Cooling System					
Thermostat	143°F (62°C)				
Maximum Temperature	203°F (95°C)				
Water pressure – Idle – @ 5500 RPM	5 to 8 psi (34 to 55 kPa) > 25 psi (>172 kPa)				
Pressure Relief Valve (open)	28 psi (193 kPa) (approximate)				

Reference Information

Service Specifications

HP	200	225	250	250 H.O.	300
Ignition System					
Type	Inductive Discharge				
Firing Order	1-2-3-4-5-6				
Ignition Features	EMM Controlled				
RPM Limit (in gear)	6250 RPM				
Crankshaft Position Sensor Air Gap	Fixed				
Spark Plug	Champion [†] QC8WEPI @ 0.028 ± 0.003 in. (0.71 mm)				
Gearcase					
Gear Ratio	“SLX” Type Gearcase: 13:24 (.542) (1.85:1)				
Lubricant	HPF Pro Gearcase Lubricant				
Capacity	– Standard Rotation Gearcase only – 38.9 fl. oz. (1180 ml) Gearcase, vent hose and oil reservoir 45.6 fl. oz. (1350 ml) – Counter Rotation Gearcase only – 39 fl. oz. (1154 ml) Gearcase, vent hose and oil reservoir 44.7 fl. oz. (1324 ml)				
Shift Rod Height	N/A				
Trim & Tilt System					
Lubrication	Power Trim/Tilt Fluid, P/N767969				
Fluid Capacity	24 fl. oz. (710 ml)				
Trim Range	0° to 21° (-6° to 15°)				
Tilt Range	22° to 81° (16° to 75°)				
Steering System					
Hydraulic Steering Fluid	SeaStar Hydraulic fluid, P/N 770891				
Fluid Capacity (NOT including helm or hydraulic hoses)	10 oz. (300 ml) (approximate)				
Steering Range (lock to lock)	–32° to +32°, 64° Total (see engine Profile Drawing)				

Routine Service

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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 500 hours or every 5 years ⁽¹⁾		
	Routine Inspection		
	Engine Care Product		
Anodes (anti-corrosion), check condition		✓	✓
Back pressure probe, replace			✓
Batteries, check connections and condition		✓	✓
Cooling system; check water pump indicator / water pressure		✓	✓
Displays & gauges, self-test/warning horn, check operation		✓	✓
Emergency cut-off switch(es) and tether cord, check operation		✓	✓
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, inspect level	A	✓	
Gearcase lubricant, replace	A		✓
Grease fittings, lubricate ⁽³⁾	C		✓
Oil filter, replace			✓
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 <i>EMM</i> information, resolve any fault codes			✓
Spark plugs, replace ⁽²⁾			✓
Steering system, inspect fluid level, check hydraulic hose condition, check operation	D		✓
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 G2* outboards.

A	<i>HPF Pro</i> Gearcase Lubricant	D	Hydraulic Fluid, P/N 770891.
B	<i>Power Trim/Tilt Fluid</i> , P/N 767969		<i>Anti-Corrosion Spray</i>
C	<i>Triple-Guard</i> Grease		<i>"6 in 1" Multi-Purpose Lubricant</i>

Maintenance

Batteries

⚠ 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

Outboard Model	Battery Rating
200–300 HP	675 CCA (845 MCA), or 800 CCA (1000 MCA) below 32°F (0°C) 107 amp-hr in extreme applications

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.

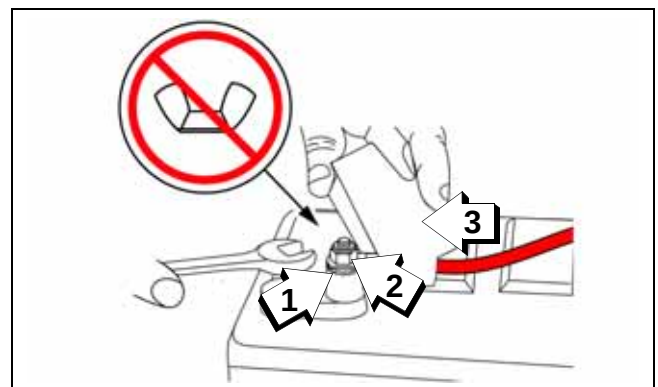
Connecting the Battery

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 starwasher 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

1. Starwasher
2. Hex nut
3. Terminal Insulator

009166

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.

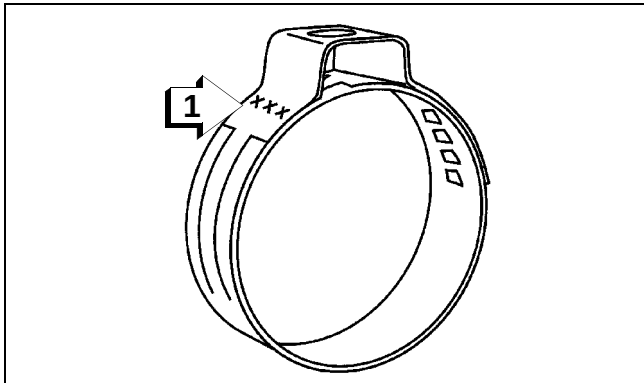
See the **Oetiker Clamp Chart** on p. 54.

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 **Oetiker Clamp Chart** on p. 54 chart for clamp dimensions.



1. Clamp identification numbers

000093

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.

Refer to **Oetiker Clamp Chart** on p. 54.

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.

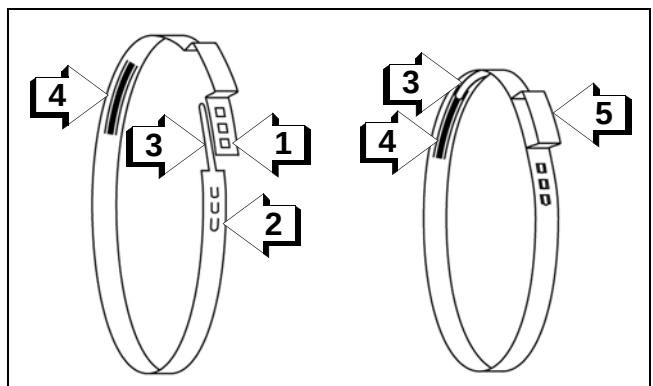
Oetiker pincers, P/N 787145, are available in the *Evinrude Genuine Parts and Accessories Catalog*.



787145

- Position correct size clamp over hose.
- Install hose on fitting.

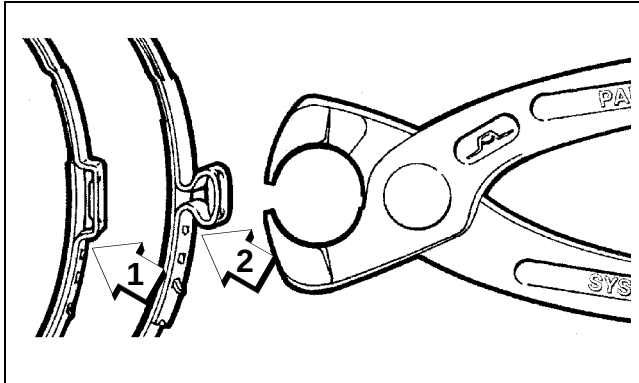
Larger size *Oetiker* clamps may come apart during handling. To reassemble the clamp, connect the end loop to the end hook. Make sure the alignment tab is installed into the alignment slot.



1. End loop
2. End hook
3. Alignment tab
4. Alignment slot
5. Correctly assembled clamp

009095

- Close clamp ear fully with *Oetiker* pincers (pliers).

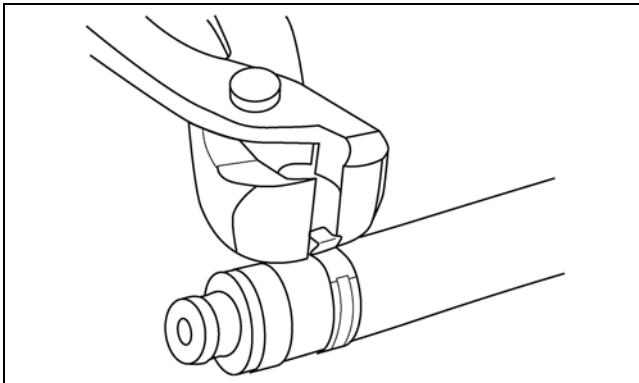


1. Open clamp
2. Closed clamp

000092

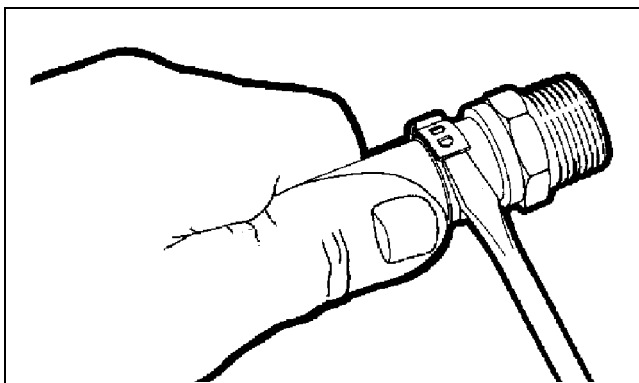
Clamp Removal

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



000108

Method 2: Lift end of stepless clamp with screwdriver.



000090

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

Cooling System

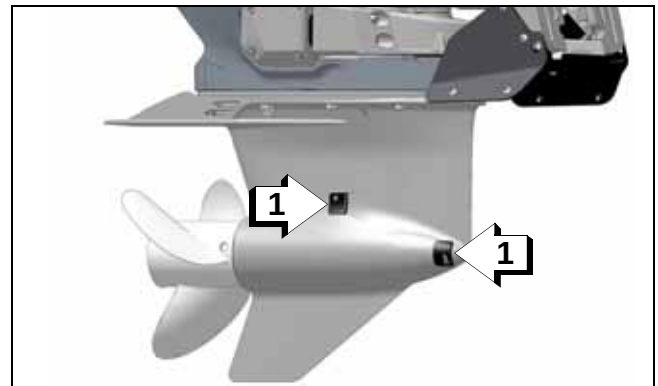
Check the condition of cooling system components regularly:

- 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.



1. Water intake screens

009041

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.

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

Routine Service Maintenance

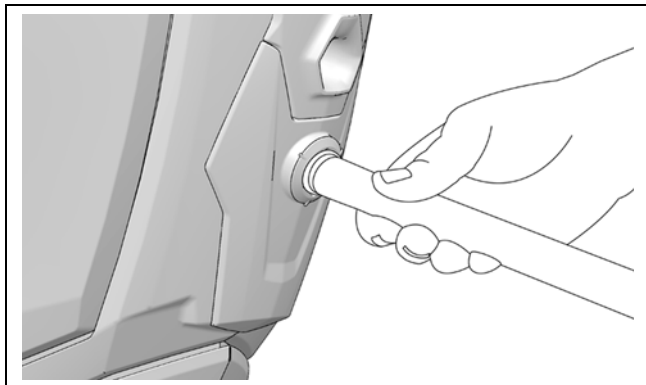
Flushing — Outboard Running

⚠ WARNING

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

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

Thread garden hose into flushing port.



009071

Turn water supply on.

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

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

Reinstall propeller.

Flushing — Outboard Not Running

Place outboard in VERTICAL (DOWN) position.

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.

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

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 position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Remove propeller. Refer to **Propeller Hardware Installation** on p. 360.

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

Refer to the **Inspection and Maintenance Schedule** on p. 16 for service frequency.

Lubricant Level

Remove the starboard side panel.

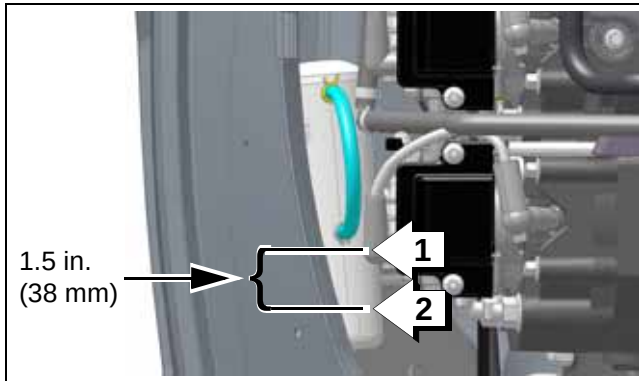
IMPORTANT: ALWAYS check the fill level of the gearcase lubricant at the oil reservoir before removing the drain/fill plug.



1. Lubricant reservoir

009140

- Lubricant level should be between the marks as shown.



Lubricant Level
1. Maximum
2. Minimum
009141

If lubricant level is low, refer to **Gearcase Leak Test** on p. 361.

Draining

⚠ CAUTION

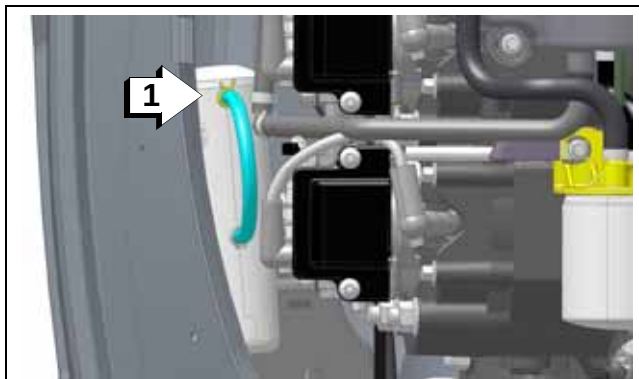
Gearcase lubricant may be under pressure and/or hot if outboard was recently operated or if gearcase lubricant is above the *Maximum* level.

Wear safety glasses and take precautions to avoid injury when removing vent hose from reservoir upper fitting.

ENVIRONMENTAL NOTE

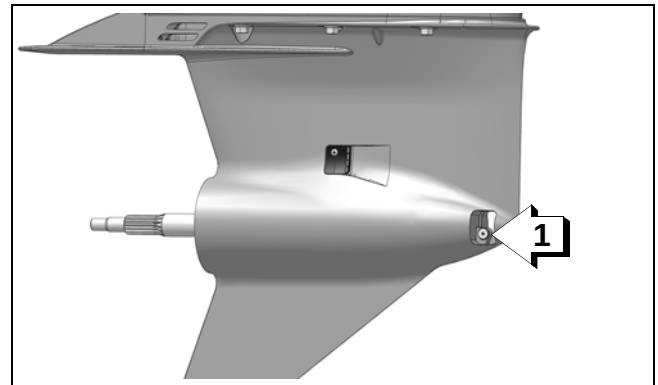
Dispose of used oil or oil contaminated towels in an environmentally responsible manner, or according to local regulations.

Carefully remove vent hose from the reservoir upper fitting.



1. Vent hose upper fitting
009141

Remove the low water intake screens. Then remove the lubricant drain/fill plug. Drain the lubricant from the gearcase into a suitable container.



1. Lubricant drain/fill plug
009165

Trim the engine up slightly to completely drain lubricant from the gearcase. Use shop towels to clean up any spilled oil.

Inspection

Inspect the lubricant 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 clear 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** on p. 361.

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 **Service Specifications** on p. 12 for lubricant capacities.

Routine Service Maintenance

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

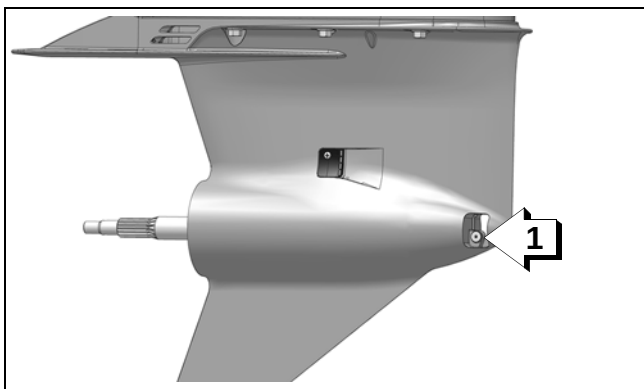
Secure the gearcase in a vertical position.

Use Gearcase Filler, P/N 501882, to slowly fill the gearcase with *HPF PRO* lubricant until lubricant level in the reservoir is between the marks as shown in **Lubricant Level** on p. 20.

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 drain/fill plug and a **new** seal. Tighten the plug to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

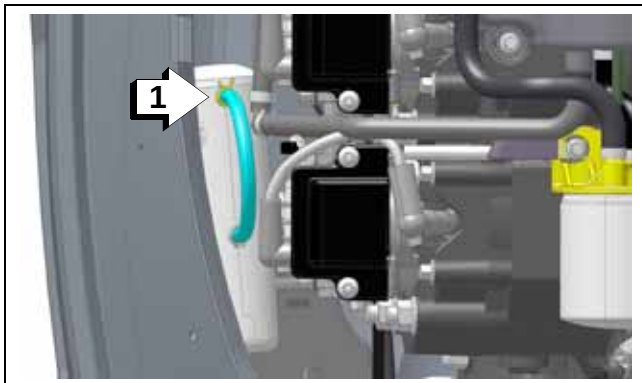
Install the water screens. Tighten the screw to a torque of 10 to 14 in. lbs. (1.2 to 1.6 N·m).



1. Lubricant drain/fill plug

009165

Install the vent hose on the reservoir upper fitting.



1. Vent hose upper fitting

009141

Install the starboard side panel.

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>
QC8WEPI @ 0.028 ± 0.003 in. (0.76 mm)

Removal

Remove the engine cover panels. Remove spark plugs and inspect condition.

Starboard Spark Plugs

Remove the spark plug leads from the spark plugs.

Use a spark plug socket, extension and wrench to remove the spark plugs.

Port Spark Plugs

Remove the spark plug leads from the ignition coils.

Use an 8 mm socket to remove the screw and washer from the ignition coil mounting brackets.

Move the ignition coil and bracket assemblies to the side as shown.



009244

Remove the spark plug leads from the spark plugs.

Use the spark plug socket and a combination wrench to remove the spark plugs.

Installation

The cylinder heads of *Evinrude E-TEC G2* models are manufactured with indexed spark plug threads. **QC8WEPI** spark plugs do NOT require indexing of the spark plug.

Set spark plug gap on new, replacement spark plugs.

Apply *Triple-Guard* grease to the gasket surface of the spark plug.

Use a spark plug socket to install spark plug hand tight. Make sure the gasket of the spark plug is contacting the cylinder head.

Install a wrench on the spark plug socket and continue to tighten a new spark plug approximately 180 degrees, or a re-used spark plug approximately 45 degrees.

Apply *Dielectric Grease*, P/N 503243 to the ribbed portion of the spark plug ceramic and to the opening of the spark plug cover to prevent corrosion.

Install the spark plug leads onto the spark plugs.

Additional Steps for Port Spark Plugs

Clean all old *Ultra Lock* from the threads of the coil mounting bracket screws.

Starting with the bottom, move the ignition coil and brackets into place. Make sure the spark plug lead is accessible.

Apply *Ultra Lock* to the threads of the coil mounting bracket screw.

Install the washer and screw. Tighten the screw to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).

Apply *Dielectric Grease*, P/N 503243, to the ignition coil cover. Install the spark plug lead onto the ignition coil.

Repeat the previous steps to install the middle and then the upper ignition coil and bracket assemblies.

Install the port and starboard engine cover panels.

Fuel and Oil Systems

⚠ WARNING

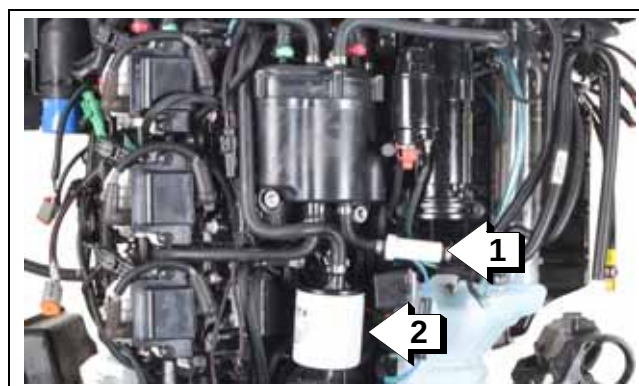
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

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

Replacement filter elements are available through *Evinrude Genuine Parts*.

Fuel Filters

Evinrude E-TEC G2 model outboards are equipped with an inline fuel filter and a water-sensing, water-separating fuel filter. Refer to **Fuel Component Servicing** on p. 168.



1. Inline fuel filter
2. Water-separating fuel filter

009186

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.

Routine Service Maintenance

A serviceable oil filter is located in the oil supply line between the on-engine oil tank and rear oil pump.



1. Inline oil filter

009238

Hoses and Connections

Check condition of all hoses and connections in both the fuel and oil systems:

- Visually inspect all components.
- Observe all clamps, hoses, and connections while outboard is running.
- Replace all damaged components.
- Repair all leaks.

Exhaust Pressure Fitting

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



1. Exhaust pressure fitting

009239

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.

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



Engine Monitor Screen

009242

1. Barometric and Exhaust pressure readings

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.

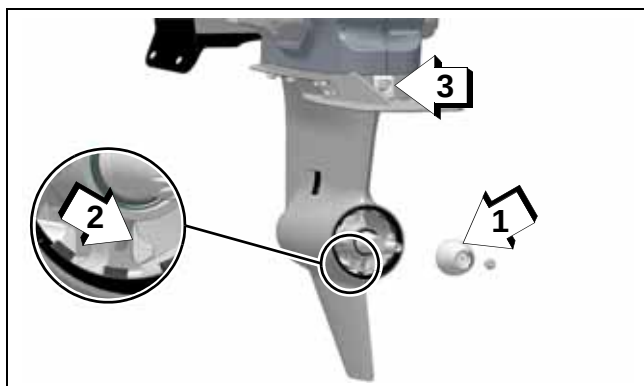
Replace exhaust pressure fittings that are blocked and cannot be de-carbonized.

Anti-Corrosion Protection

Sacrificial Anodes

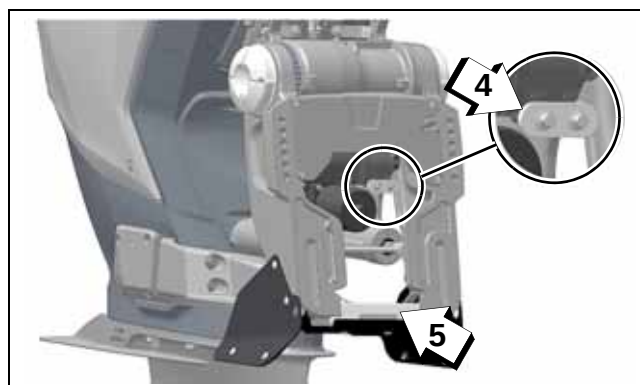
Galvanic corrosion occurs in fresh or salt water. Salt, brackish, and polluted water can accelerate corrosion. "Sacrificial" anodes are intended to protect the underwater metal components of the outboard from galvanic corrosion.

Outboards are equipped with five sacrificial anodes.



1. Propeller shaft anode
2. Bearing housing anode
3. Gearcase housing anode

009240



4. Trim and tilt housing anode
5. Stern bracket anode

009241

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

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

For best anode performance:

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

Testing Procedure – Continuity

Connect ohmmeter leads between engine ground and anode surface.

The meter should show little or no resistance. If resistance is high, check the following:

- Remove the anode and clean the area where the anode is installed
- Clean the mounting screws
- Install the anode and test again.

Metallic Component Protection

Protect metal components on outboards from corrosion. Use the following products to minimize corrosion:

- *Anti-Corrosion Spray*
- *"6 in 1" Multi-Purpose Lubricant*

Routine Service Maintenance

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.

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 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 G2 models are designed to be self-winterizing using one of the following methods:

Throttle Control Method

1. With the key switch in the OFF position move the control lever(s) to the FORWARD wide open throttle position.
2. Turn the key switch to ON and wait a minimum of three seconds.
3. Attempt to start the outboard three times within three seconds (the starter will not engage or crank the outboard).
4. Move the lever to NEUTRAL and start the outboard(s).
5. Run the outboards at idle for a minimum of three seconds.
6. With the outboard(s) running, attempt to start the outboard three times within three seconds

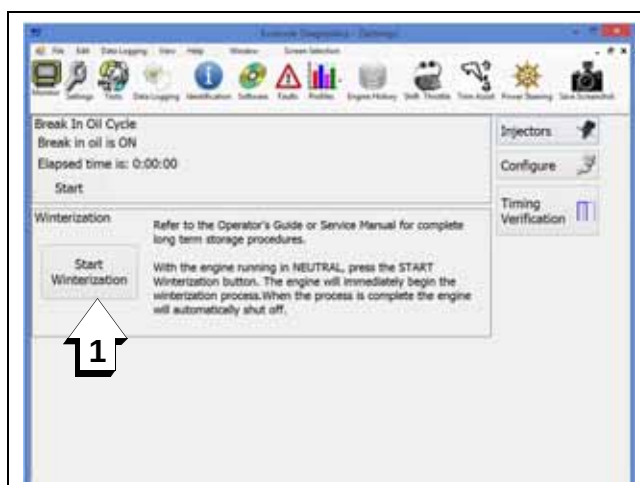
(the starter will not engage or crank the outboard).

7. The remote control will send the winterization message to each outboard. Only running outboard(s) will be winterized.
8. The outboard(s) will automatically shut off when the process is complete.

IMPORTANT: During the winterization process, the remote control will ignore all throttle, gear, and switch operations. The control WILL acknowledge Key OFF or Emergency Stop commands.

Software Control Method

Winterization can also be run using *Evinrude Diagnostics* software v 6.1 or higher. With the outboard running, start the process at the *Settings* screen and follow the instructions.



1. Winterization start button

009243

Digital Gauge Method

The *ICON Touch 7.0 CTS*, *4.3 CTS*, *3.5C*, *Pro 5* inch and *I-Command 3.5* inch digital gauges provide a winterize feature for *Evinrude E-TEC G2* models.

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

To access the winterize feature, use the:

- "Menu", then "Settings" feature (*ICON Touch 7.0 CTS*, or *ICON Touch 4.3 CTS*)
- "Mode Select" feature (*ICON 3.5C*)
- "Mode" button (*ICON Pro 5* inch)
- "Menu" button (*I-Command 3.5* inch)



ICON Touch 7.0 CTS

356596-36

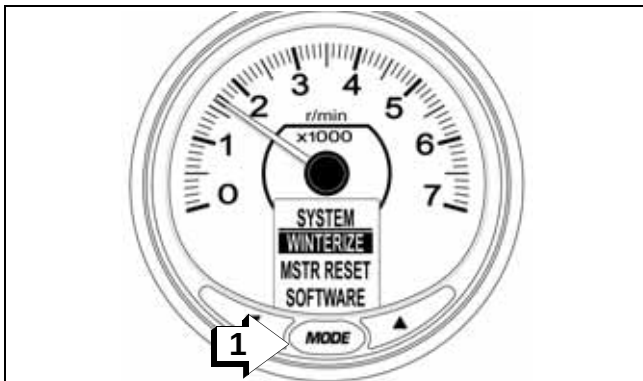
1. Menu/Settings
2. Winterize Tab



ICON 3.5C

216762-12

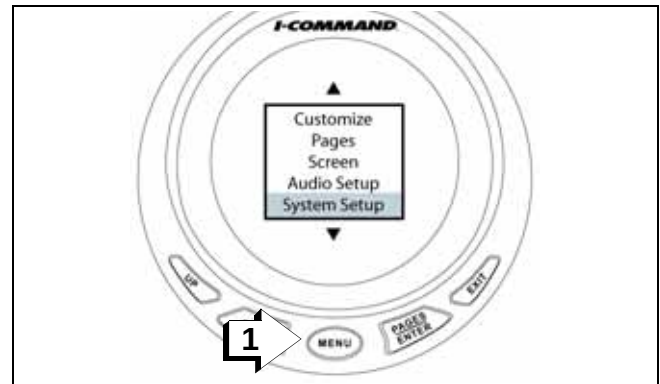
1. Mode Select



ICON Pro 5 inch Digital Gauge

008686

1. Mode button



I-Command 3.5 inch Digital Gauge

008191

1. Menu button

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

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

Additional Recommendations

- Top off oil reservoir.
- Remove and inspect propeller.
- Clean and grease propeller shaft.
- Inspect outboard, steering system, and controls. Replace all damaged and worn components.
- Touch up painted surfaces as needed. Coat outer painted surfaces with automotive wax.
- Remove battery(s) from boat. Store in a cool, dry location. Periodically charge battery(s) while stored. Refer to manufacturer's maintenance recommendations when servicing batteries.
- Store outboard in upright (vertical) position.
- Check for fuel leakage.

⚠ WARNING

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

Pre-Season Service

⚠ 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.

Operational Checks

- Refer to **Operational Checks** on p. 39
- 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.

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.

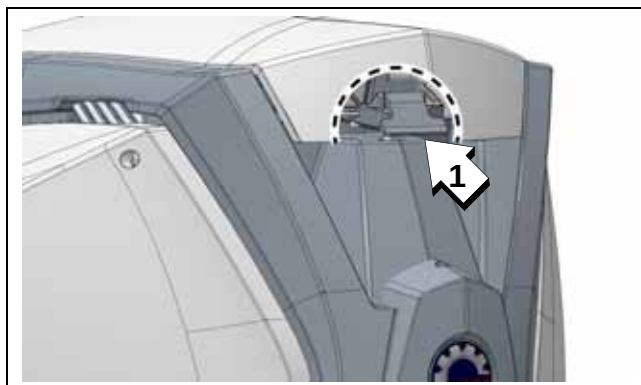
⚠ WARNING

To avoid personal injury, or damage to the engine, boat or other property, install the lifting fixture completely into the flywheel.

To properly install the fixture, carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do **NOT** cross-thread or over-torque the fixture

After the lifting fixture is installed, turn the flywheel clockwise until the off-set lifting eye of the fixture is in line to the back of the engine.

Release the rear latch to remove the top cap of the engine cover.



1. Rear latch

009099

Use Lifting Fixture, P/N 357667, to lift the outboard. The centerline lifting eye is used to lift the

complete engine. The off-set lifting eye is used to remove and install the powerhead.



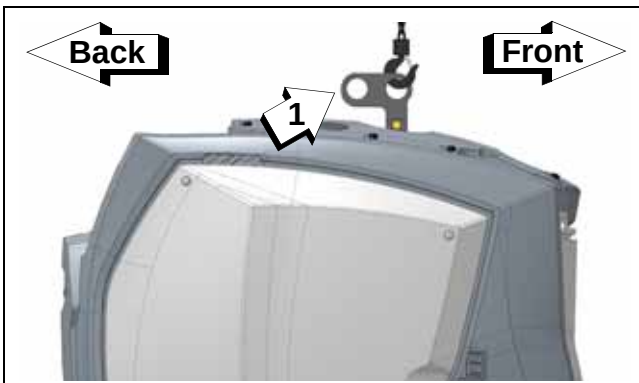
Lifting Fixture, P/N 357667

357667

1. Centerline lifting eye
2. Off-set lifting eye

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

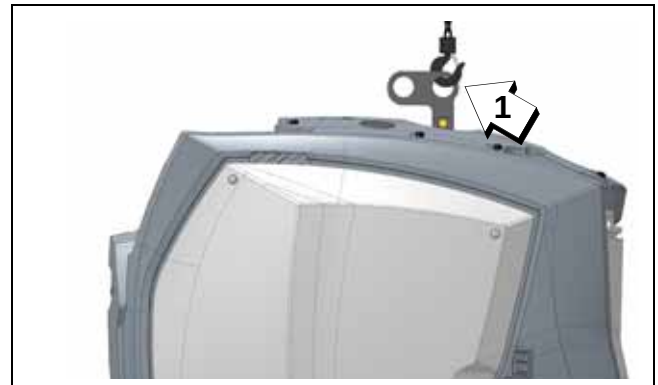
Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.



1. Fixture aligned front to back

009100

Fasten appropriate chain hook to the centerline lifting eye of the tool.



1. Centerline lifting eye

009100

Plug Installation

NOTICE

Install plugs as indicated. Plugs MUST be installed to prevent water entry and/or engine performance issues.

Install the following plugs from the Owner's Kit:

1. Apply *Triple Guard* grease to the threads of the flywheel. Then install the Flywheel Thread Plug, P/N 357323 to protect the threads from corrosion.



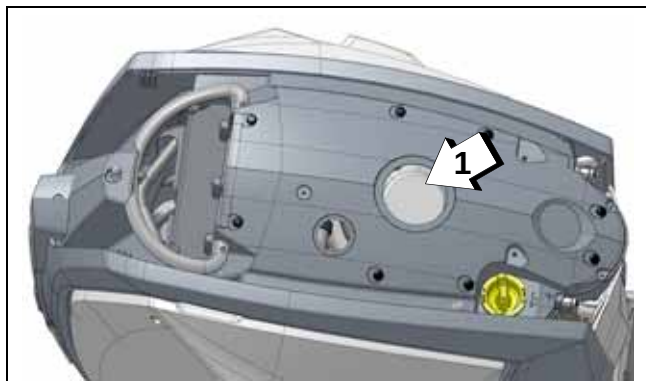
1. Flywheel thread protector

009102

Routine Service

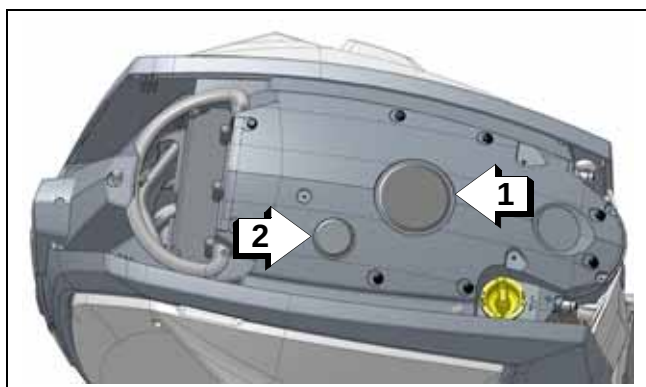
Rigging Information

2. Install the 3.5 inch Air Duct Plug, P/N 357310, to help cool the stator.



1. 3.5 inch air duct plug 009103

3. Install the 4.0 inch Center Frame Plug, P/N 356050, and the 2.0 inch Timing Pointer Plug, P/N 356468, to provide correct air flow to the engine.



1. 4 inch center frame plug
2. 2 inch timing pointer plug 009104

Rigging Information

Rigging related information in this section supports re-installation after completing service procedures.

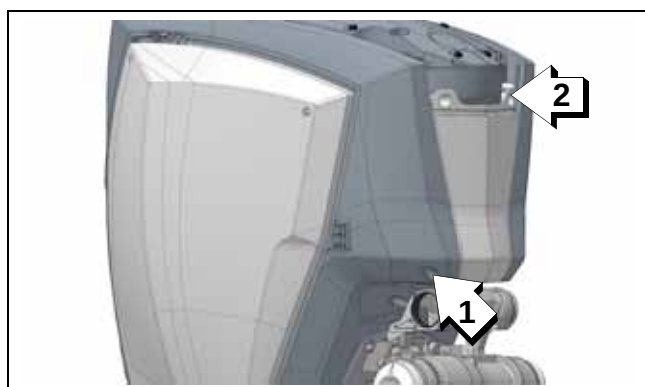
Use the current **Evinrude E-TEC G2 Installation and Predelivery Guide** for complete installation details if installing a new engine package.

Rigging Center

Evinrude E-TEC 74° V6 models utilize a central rigging center. All buss cables, hydraulic steering hoses, fuel and oil hoses and related rigging enter the rigging center through a cable entryway.

The cable entryway is configured for starboard cable entry but can be adapted for port cable entry if needed.

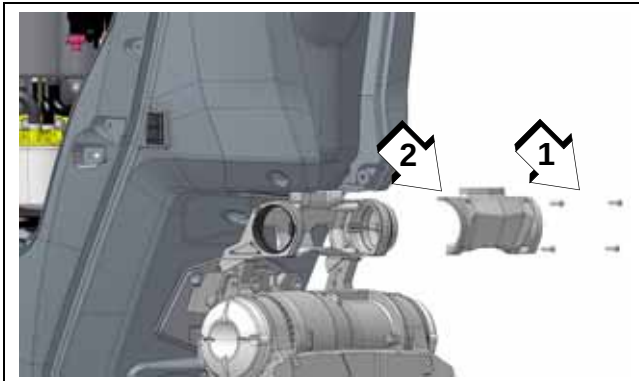
Remove the two lower screws, then remove the two upper screws (front) retaining the engine cover.



1. Lower screws
2. Upper screws (front) 009105

Remove the front engine cover to access the rigging center.

Remove four screws from the cable entry cover. Remove the rigging center covers.



1. Four screws
2. Rigging center cable entry cover

009106

Rigging Hose Requirement

NOTICE

A 12 in. (304.8 mm) or longer length of rigging hose such as P/N 770392, or P/N 770393 is **REQUIRED** to prevent damage to buss cables, hoses, harnesses or other wiring entering the outboard rigging center.

Rigging Hose Options

Allow one rigging hose per engine. The rigging hose can enter from the starboard or port side.

Buss Cable, Hoses, Wire Routing and Connections

NOTICE

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

All hydraulic steering hoses, battery cables, buss cables, fuel and oil hoses and related rigging enter the rigging center through a cable entryway.

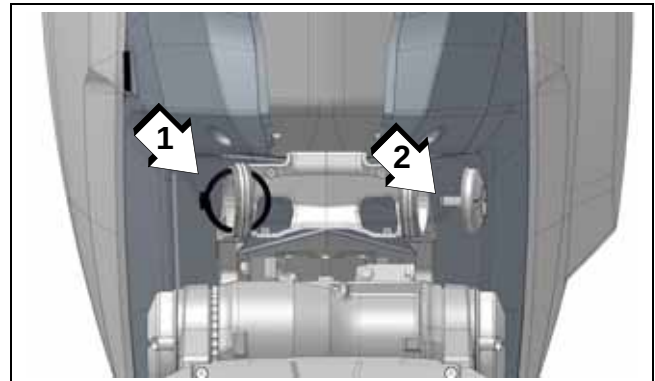
The cable entryway is configured for starboard cable entry but can be adapted for port cable entry if needed.

To remove the rigging hose retainer: Turn the retainer 90° as shown. Pull to remove from the cable entryway.

To remove the cap:

Twist the cap one-quarter turn, then release the tabs from the inside of the cable entryway.

Install the retainer and cap on the desired side. After installing the cap, be sure to twist the cap one-quarter turn.



1. Rigging hose retainer
2. Tabs on cap

009117-2

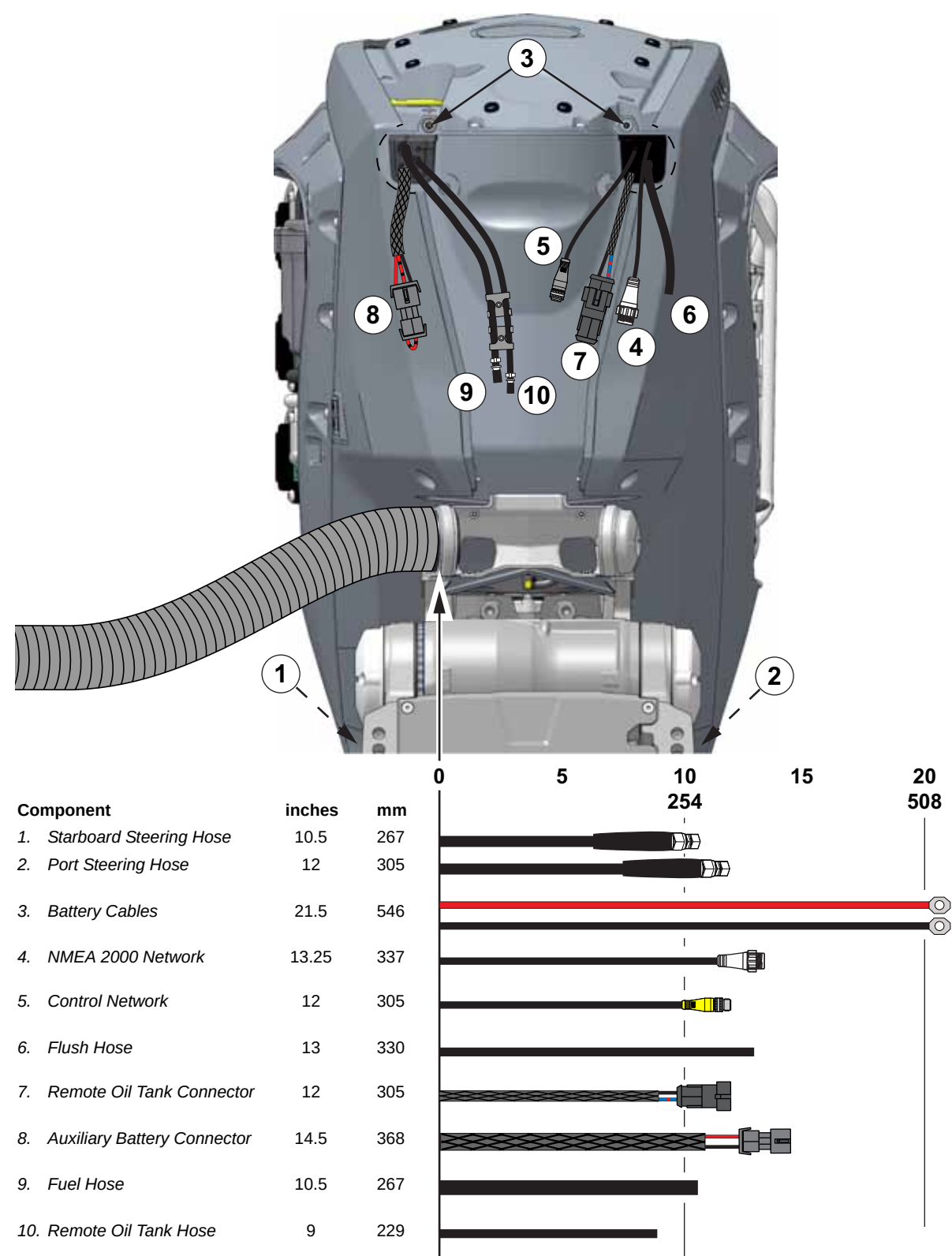
Hose and cable lengths are measured from the cable entryway to the connection point in the rigging center. Refer to **Rigging Center Hose and Cable Lengths** on p. 32.

Route all steering hoses, battery cables, fuel and oil hoses, buss cables, and optional accessories such as auxiliary battery charging cable, or remote oil tank hose from the boat through a protective conduit into the rigging center cable entry.

When installing hoses and cables through the flexible tubing, install in this order:

1. steering hoses
2. battery cables
3. fuel hose
4. optional oil or flush hoses
5. buss cables
6. optional accessory connections

Rigging Center Hose and Cable Lengths



009137

Hydraulic Steering Hoses

⚠ WARNING

Incorrect connection of hydraulic hoses will cause the engine to steer in the opposite direction of the helm input.

This can result in loss of boat control and injury to the occupants.

Hydraulic Hose Routing

First install the hydraulic steering hoses through the flexible conduit.

NOTICE

Install steering hose anti-kink retainer, P/N 357893 from the owners kit to prevent hydraulic hose damage.

Next, install steering hose anti-kink retainer onto the:

- PORT hydraulic hose **IF** the port cable entry is used.
- STARBOARD hydraulic hose **IF** the starboard cable entry is used (*shown*).

IMPORTANT: Make sure the steering hose anti-kink retainer is installed on the hydraulic hose as shown:

- anti-kink retainer should touch the strain relief on the hydraulic hose.
- anti-kink retainer should be positioned to prevent the hydraulic hose from chafing against the rigging center.



1. Anti-kink retainer

009108

Then route the hydraulic steering hoses through the rigging center as shown. Take care NOT to kink the hoses during installation.

Hydraulic Hose Connections

Connect the PORT hydraulic hose from the helm to the PORT hydraulic steering fitting on the stern bracket. Tighten the nut by hand until fittings are seated.

Connect the STARBOARD hydraulic hose from the helm to the hydraulic steering fitting on the STARBOARD stern bracket. Tighten the nut by hand until fittings are seated.

Tighten both hydraulic hose fittings to a torque of 15 ft. lbs (20.3 N·m).

Connections

Also see **Rigging Center Connections** on the next page.

1. Install the positive (+) battery cable to the positive stud on the starboard side of the top frame. Tighten nut to a torque of 120 to 144 in.lb. (13.5 to 16.5 N·m).
2. Install the negative (–) battery cable to the negative stud on the port side of the top frame. Tighten nut to a torque of 60 to 84 in.lb. (7 to 9.5 N·m).
3. Connect the fuel supply hose from fuel tank to hose fitting on the outboard. Secure hose with *Oetiker* clamp.
4. If installing optional remote oil tank, connect the oil supply hose from the oil tank to the fitting on the outboard. Secure hose with *Oetiker* clamp.
5. Connect the remote control network buss cable to the outboard's buss cable. Refer to **Network Connections** on p. 34.
6. Connect the *NMEA 2000* buss cable from a tee in the boat to the outboard's *NMEA 2000* buss cable.
7. If installing optional remote oil tank, remove the protective cover from the harness on the outboard. Connect the electrical connector from the oil tank to the connector on the outboard.
8. If installing optional auxiliary battery charging kit, remove plug from outboard harness and discard plug. Connect the auxiliary battery charge cable to the connector on the outboard.

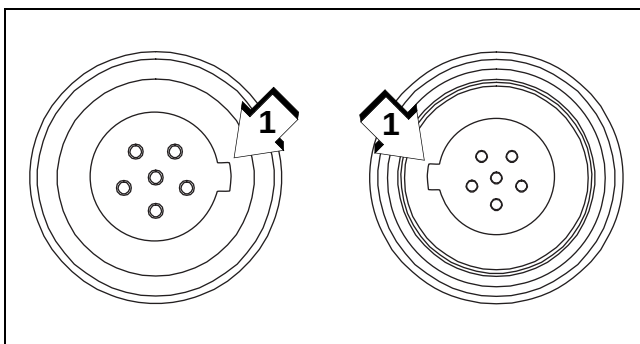
Network Connections

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

Do NOT use *Dielectric Grease* on buss cable connectors.

To assemble the connectors:

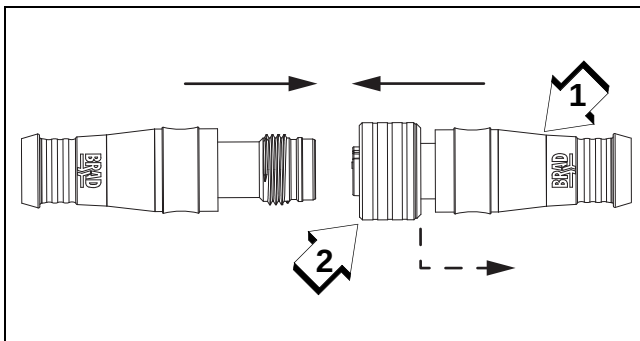
- Use the tabs to carefully align buss cable connectors.
- Look at the tabs to ensure connector alignment prior to making the connection. Do not rotate connectors until they align. This could result in a mismatched connection. It is possible for each pin to enter a socket even if the tabs are misaligned.
- Carefully align pins and sockets of connectors. Do NOT force connectors together.



1. Tabs

009138

- Pull back the coupler of the female buss connector as the connectors are joined. Do NOT force connectors together.



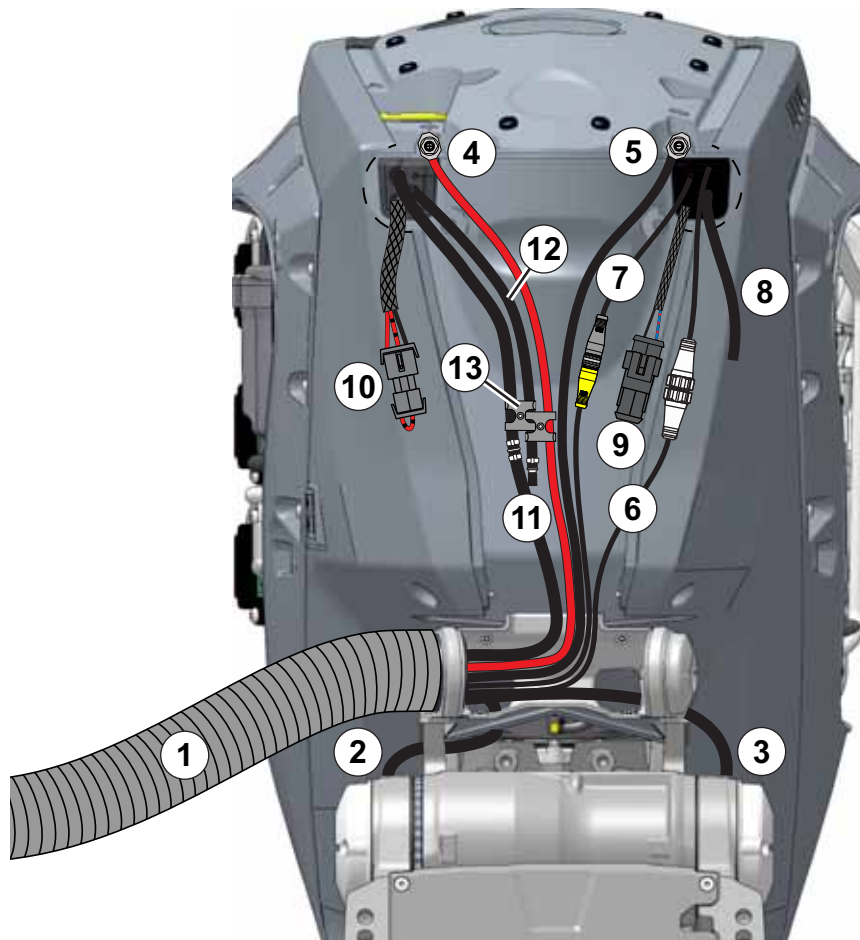
1. Female buss connector

2. Coupler

009139

- Release the coupler to lock the connectors together.
- Gently try to pull the connectors apart to ensure they are locked together.

Rigging Center Connections



Rigging Center

1. Flexible Conduit
2. Starboard Steering Hose
3. Port Steering Hose
4. Positive (+) Battery Stud
5. Negative (-) Battery Stud
6. NMEA 2000 Network Cable
7. Remote Control Network Cable
8. Engine Flushing Hose (optional)
9. Remote Oil Tank Electrical Connector (optional)
10. Auxiliary Battery Charge Connector (optional)
11. Fuel Supply Hose
12. Remote Oil Tank Oil Hose (optional)

009118

Routine Service

Rigging Information

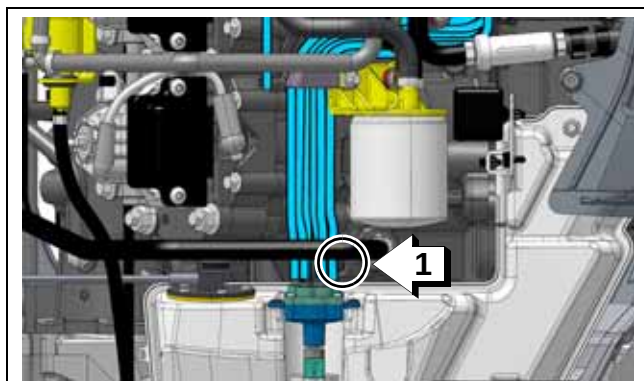
Water Pressure Connection

To send water pressure data to the *EMM*, along with an *NMEA 2000* display, install 50 psi Water Pressure Transducer Kit, P/N 5008640.

Water pressure readings in excess of 40 psi (275 kpa) are possible at boat speeds in excess of 50 mph (80 kph/43 kts).

Remove the accessory water pressure plug from the engine. Refer to the installation instructions provided with the water pressure transducer kit.

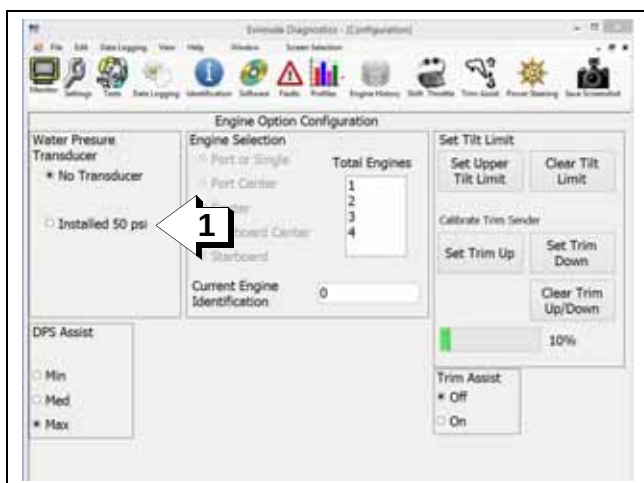
IMPORTANT: Use the fittings and hose supplied with the kit. Do NOT install the transducer directly into the block.



1. Accessory water pressure plug

009119

Use the *Configuration* screen of *Evinrude Diagnostics* software v6.1 to set the water pressure transducer.

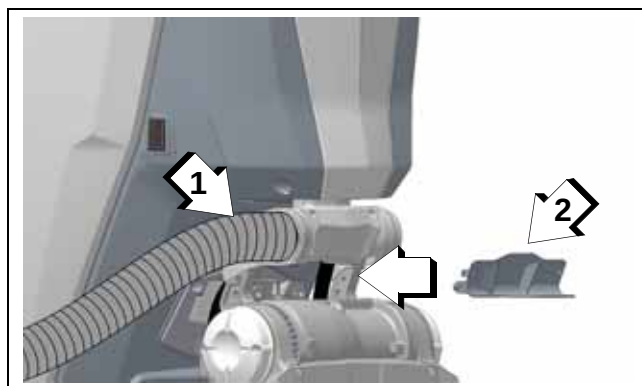


1. Water pressure transducer

009237

Connect the transducer lead to the engine wiring harness connector.

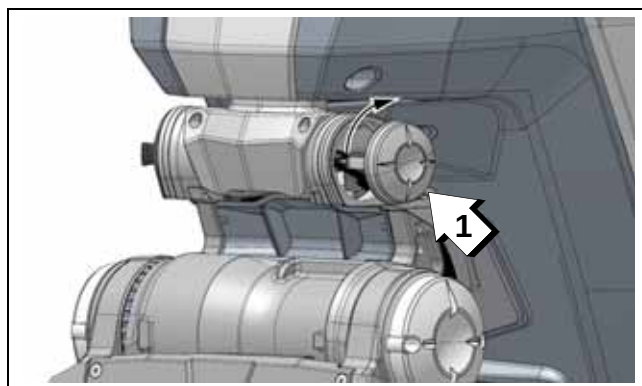
Install the rigging hose to the entry port of the rigging center. Install the cover into place below the cable entryway.



1. Rigging hose installation
2. Cover

009094

If removed, install cable entryway end cap. Turn the end cap 90° to lock it into place.



1. Rigging center end cap

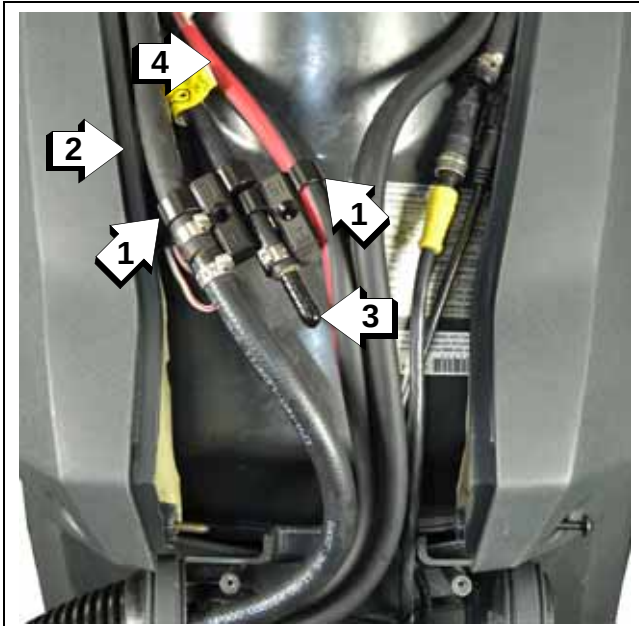
009391

Hose and Cable Clips

After completing connections, re-position the two clips, P/N 352531, from the fuel and oil supply hoses as shown:

- Attach one clip to the fuel hose and oil supply hose.
- Attach the second clip to the oil supply hose and positive battery cable.

Make sure the crimp of each *Oetiker* clamp is positioned forward and cannot cut into or chafe any other cable or hose.



1. Clips
2. Fuel hose
3. Oil supply hose
4. Positive battery cable

009168

Make sure there is loose slack in all hoses and cables.

- If port cable entry is used, slack should be to the starboard side of the cable entryway.
- If starboard cable entry is used, slack should be to the port side of the cable entryway (*shown below*).



1. Slack

009169

Hoses and cables should NOT bind or be pulled taut when engine is in a full turn.

Install cover on cable entryway with four screws. Make sure cables are not pinched between cable entryway cover and housing.



1. Cables NOT pinched

009170

Install the front engine cover. Install the two upper screws (front) first, then install the two lower screws.



1. Upper screws (front)
2. Lower screws

009105

Before Start-Up

Gearcase Lubricant

With outboard vertical, check the gearcase lubricant level:

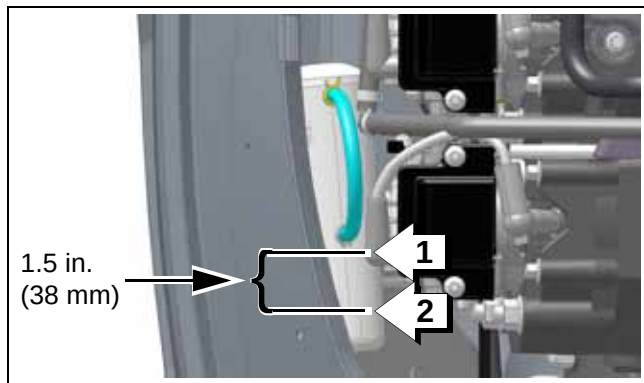
- Inspect the lubricant level in the lubricant reservoir.



1. Lubricant reservoir

009140

- Lubricant level should be between the marks as shown.



Lubricant Level

1. Maximum
2. Minimum

009141

Add **HPF PRO** gearcase lubricant if needed.

2-Stroke Engine Oil Level

Make sure the outboard is in the vertical position when checking oil level. Use the digital gauge or display to check the oil level. Make sure the on-board oil tank contains an adequate supply of the correct lubricant for the outboard. Refer to **Recommended Lubricants** on p. 192.

Trim and Tilt Fluid

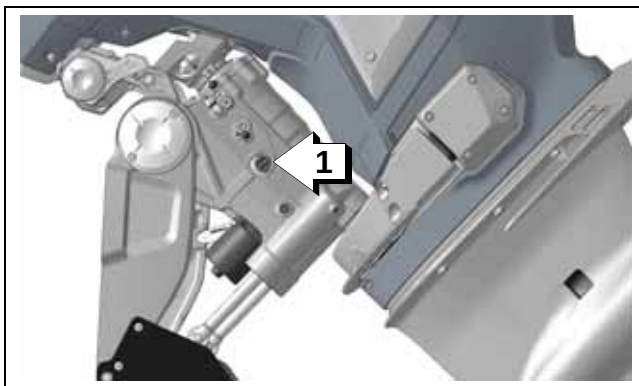
⚠ CAUTION

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

The trim and tilt system is filled, tested and sealed at the factory. It is **NOT** necessary to check fluid level.

Check the fluid level **ONLY** if the trim and tilt is **NOT** operating normally:

- Tilt the outboard to the full UP position.
- Remove filler cap and check fluid level.
- Add **Power Trim/Tilt Fluid, P/N 767969**, as needed, to bring level to the bottom of the fill plug threads.



1. Filler cap

009127

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.

CAUTION

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

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.

Remote Control Operation

Make sure that control can be easily moved into all gear and throttle settings.

Emergency Stop / Key Switch

Check emergency stop function. With outboard running at IDLE, pull safety lanyard from emergency stop switch. Outboard must stop immediately. If equipped, be sure to check emergency stop function of second station.

Digital Displays and Gauges

Complete basic set up of digital display or gauges. Configure engine and fuel tank, set fuel tank capacity etc. Refer to User's Guide.

Tachometer Pulse Setting (*SystemCheck*)

Confirm accuracy of tachometer reading.

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

Outboard Model	Tachometer Setting
15–300 HP	6 Pulse or 12 Pole

Engine Monitoring System

Attach emergency stop lanyard.

Turn key switch to the ON position.

Evinrude Touch-Screen Display — The touch screen system will run a start up sequence and then display the *Evinrude* welcome page. When the start up sequence is complete, the default digital display will appear.

ICON — The *ICON* system self-tests by sounding a beep. The *ICON* tachometer and speedometer LCD screens display SELF TEST MODE IN OPERATION. When the self test is complete, the gauges will beep a final time and then display SELF TEST COMPLETE!

I-Command — The *I-Command* system self-tests by displaying the *Evinrude E-TEC* welcome screen, followed by the default digital display.

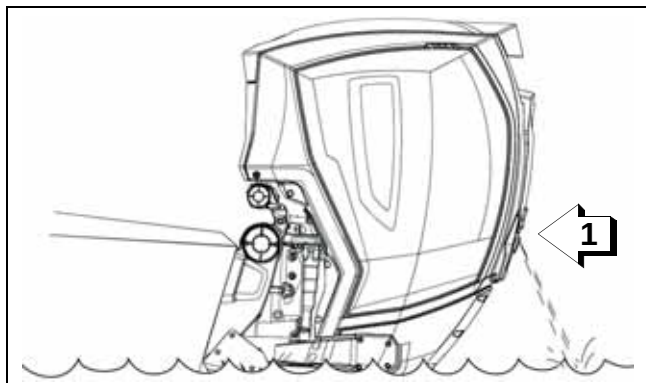
Routine Service

Propellers

SystemCheck — The *SystemCheck* monitor self-tests by sounding a half-second beep. *SystemCheck* gauges self-test by turning the indicator lights on simultaneously, then off in sequence.

Water Pump Overboard Indicator

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



1. Water pump overboard indicator

009128

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.

Leaks

Perform running checks of the as follows:

- Start outboard.
- Inspect all fuel hoses and connections.
- Inspect all oil hoses and connections.
- Inspect all cooling water hoses and connections.
- Repair any leaks or misrouted hoses immediately.

Idle Speed

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

Break-In

Evinrude E-TEC outboards require no break in. When the outboard is delivered, refer the customer to the Oiling System information in the *Operator's Guide*.

Propellers

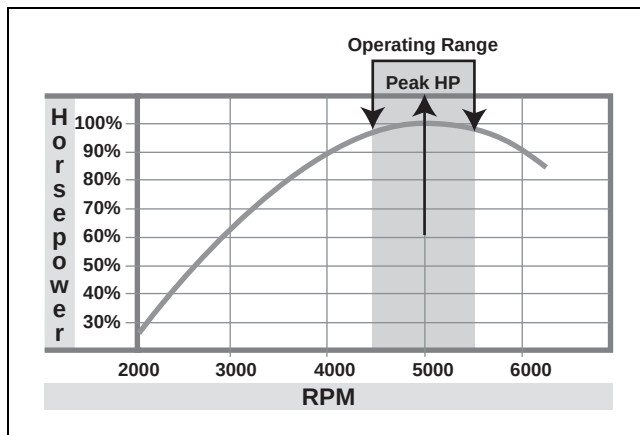
Propeller Selection

⚠ CAUTION

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

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

The correct propeller, under normal load conditions, will allow the engine to run near the mid-point of the RPM operating range at full throttle. Refer to **SERVICE SPECIFICATIONS** in the *Service Manual* for RPM range.



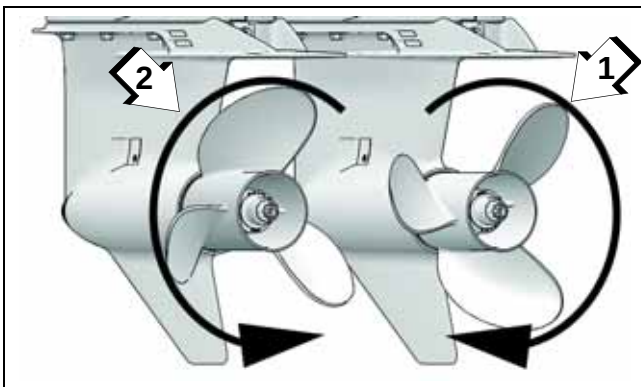
008329

NOTICE

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

When selecting a propeller, consider the following:

- Use an accurate tachometer to determine the engine's full-throttle RPM.
- The outboard should be trimmed for top speed.
- Select a propeller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load.
- Occasionally, one propeller will not cover a wide range of boat applications — water skiing to high speed performance boating. In such cases, it might be necessary to have a propeller for each situation.
- Refer to the *Evinrude Genuine Parts and Accessories Catalog* for propeller styles and sizes.
- Right-hand propellers are considered standard rotation propellers. When propelling a boat forward, the propeller rotates in a right-hand (clockwise) direction as viewed from the rear.
- Left-hand propellers are considered counter-rotation propellers. When propelling a boat forward, the propeller rotates in a left-hand (counterclockwise) direction as viewed from the rear.



1. Right-hand rotation (clockwise)
2. Left-hand rotation (counterclockwise)

009079

⚠ WARNING

For multiple outboard installations always check to be sure propellers are installed on the correct engines before aggressively operating the boat.

Propeller Hardware Installation

⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

IMPORTANT: *Evinrude E-TEC G2* outboards REQUIRE Propeller Hub Kit, P/N 767683, and Nut & Keeper Assembly, P/N 5008966.

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

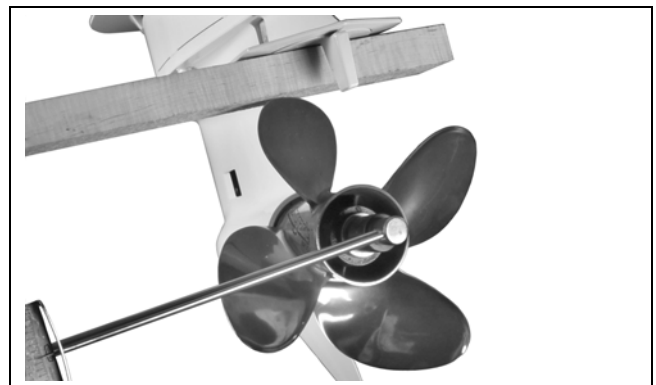
Install thrust bushing onto propeller shaft with taper of bushing matching taper of shaft.

Install the bushing and sleeve into the propeller.

Align splines of propeller and shaft. Push propeller until seated on the thrust bushing.

Install the spacer over the propeller shaft splines.

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



001992

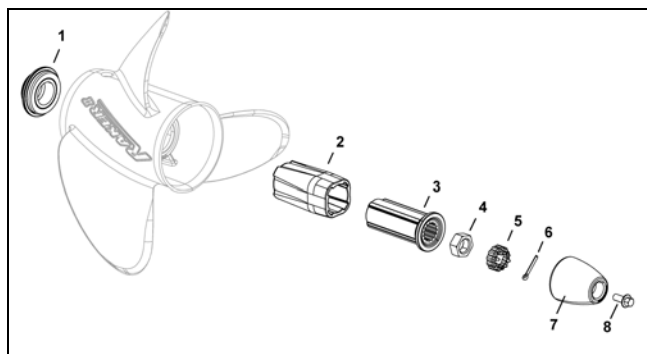
Install the propeller nut. Tighten to a torque of 70 to 80 ft. lbs. (95 to 109 N·m).

Install the keeper, then install a new cotter pin.

Routine Service

Adjustments

Install the anode and screw on the propeller shaft. Tighten the screw to 177 to 204 in. lbs. (20 to 23 N·m).



1. Thrust bushing
2. Torsion bushing
3. Bushing and sleeve
4. Propeller nut
5. Keeper
6. Cotter pin
7. Anode
8. Screw

009129

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

Adjustments

An in the water test is required to make sure the outboard(s) and boat are rigged correctly, propeller selection is correct, and that all accessories function properly.

Pay special attention to the following, especially if the boat is re-powered with new outboard(s):

- Engine mounting height
- Jack plate adjustment
- Correct propeller selection and WOT RPM
- Fuel system vacuum
- Engine water pressure/optional water screens

Make all needed adjustments or repairs and retest before delivery.

When ready for delivery, give all instruction sheets, operating instructions and user guides provided with accessories to the owner. Advise the owner of any special operation or maintenance information contained in the instructions.

IMPORTANT: Complete the Predelivery Checklist and obtain owner's signature at the time of delivery. The Predelivery Checklist must be kept on file for seven years.

Engine Mounting Height and Jack Plate Adjustment

Goals include:

- Engine RPM within the full throttle operating range
- Best acceleration and top speed
- No excessive ventilation while boat is coming onto plane.

Start with the engine lower on the transom. Make a test run, taking note of engine RPM, water pressure, trim level and boat speed.

Raise the engine or jack plate and repeat the process until the best acceleration and boat speed are achieved.

Fuel System Vacuum

Test fuel system vacuum. Refer to **Fuel Lift Pump Vacuum Test** on p. 163. 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.

Engine Water Pressure

Check engine water pressure. Confirm adequate water pressure at all engine speeds and in turns.

If water pressure falls below acceptable levels, adjust outboard alignment (multiple engine installations).

Trim & Tilt

The trim and tilt functions of *Evinrude E-TEC G2* outboards are controlled by the engine *EMM*.

IMPORTANT: Activating any trim button while the key switch is in the OFF position will briefly turn on the system. This will cause the electric fuel pump to run and the remote control and any displays or gauges to turn on. There will be a short delay before the trim system operates. This is normal. The system will turn off after a few seconds of non-use.

Tilt Limit Setting

⚠ 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 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 setting will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.

Check the tilt limit 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, set the tilt limit to reduce full-tilt position.

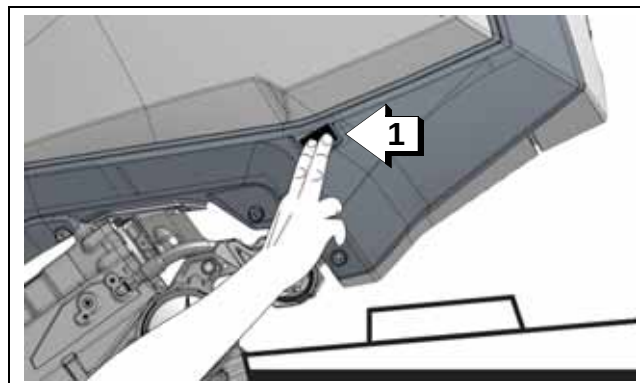
To prevent damage to equipment, provide additional motor well clearance when needed. Consider either changing the outboard mounting position or modifying the boat if the possibility for interference and damage exists.

Manual Method

You **MUST** use the trim switch on the starboard engine cover to set the tilt limit with this method.

Tilt the engine up to the desired maximum tilt position.

Then, simultaneously press and hold for at least three seconds, both the up and down trim buttons.



1. Press and hold for at least three seconds, both the up and down trim buttons

009142

Check your adjustment — tilt the outboard fully and adjust further, if necessary. Check after each adjustment.

Routine Service

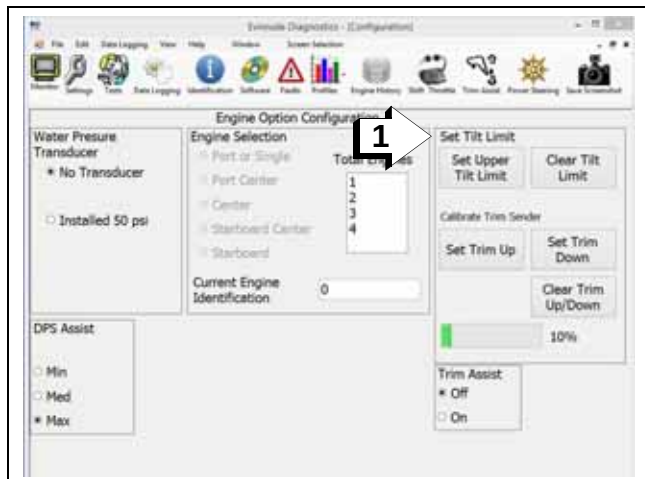
Adjustments

To change or clear this setting, tilt the engine to the full down position.

Then, simultaneously press and hold for at least three seconds, both the up and down trim buttons.

Diagnostic Software Method

Your Dealer must use *Evinrude Diagnostic* software v 6.1 or higher to limit maximum tilt-up.



1. Set Tilt Limit

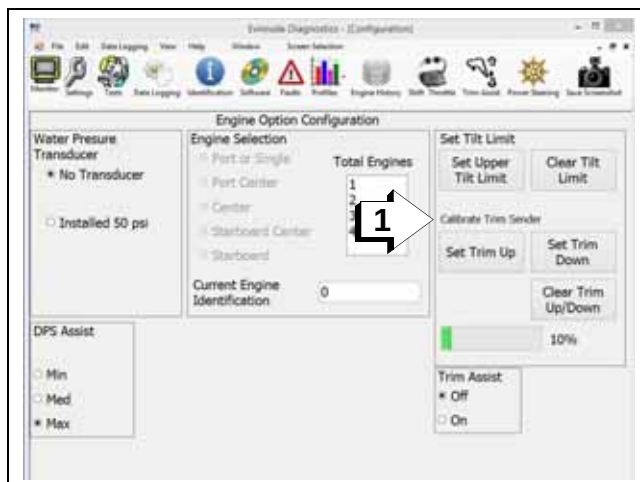
009143

Check your adjustment — tilt the outboard fully and adjust further, if necessary. Check after each adjustment.

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

Trim Gauge Calibration

Observe the trim gauge. If needed, use *Evinrude Diagnostics* software v 6.1 or higher to calibrate the upper and lower trim range of the gauge.



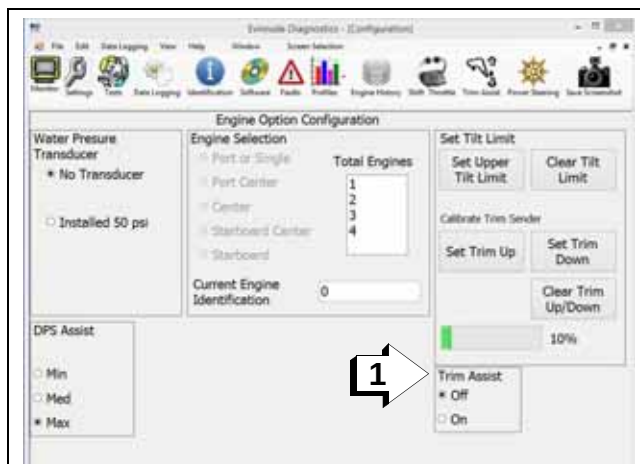
1. Calibrate Trim Sender

009237

i-Trim

Evinrude E-TEC G2 outboards are equipped with *i-Trim*, an automatic trim-assist feature. By default, this feature is disabled from the factory.

Use the *Evinrude ICON-Touch* or *ICON CS* digital display to enable *i-Trim*. If the boat is not equipped with an *ICON* digital display, use the *Configuration* screen of *Evinrude Diagnostics* software v 6.1 or higher to enable trim assist.



1. Trim Assist

009237

To activate the *i-Trim*:

- the key switch must be in the ON position

- use the trim/tilt switch to trim the engine to the full DOWN position.

During operation, the outboard will automatically trim up or down to an acceptable trim angle based on pre-programmed parameters.

Use the trim/tilt switch on the control lever to fine tune to an optimum trim angle.

IMPORTANT: Use of the trim/tilt switch to manually adjust the outboard trim angle will temporarily deactivate i-Trim.

To reactivate *i-Trim*:

- use the trim/tilt switch to trim the engine to the full down position
- bring the engine to idle speed.

Dynamic Power Steering (DPS)

⚠ WARNING

The DPS system of AFA and newer outboards **REQUIRES** calibration when:

- installing multiple outboards (initial installation)
- replacing a DPS module
- replacing a steering pressure sensor
- replacing a steering position sensor

Failure to complete DPS system calibration can result in damage to the tie bar(s) and/or the transom of the boat due to overloading.

Refer to DPS System Calibration on p. 309.

Most *Evinrude E-TEC G2* models are equipped with Dynamic Power Steering (DPS). DPS offers three power steering assist levels.

Power Steering Assist Levels

⚠ WARNING

Selection of power steering assist level is operator preference.

Be aware that changing the power steering assist level can affect boat handling.

After changing the level of power steering assist, operate the boat with care to become familiar with any changes in boat handling characteristics.

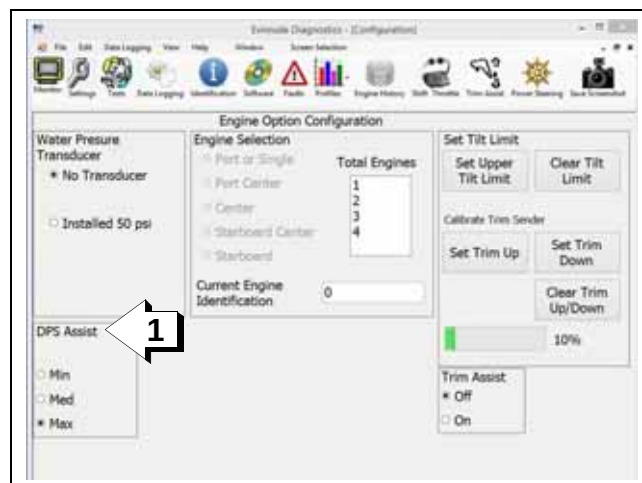
IMPORTANT: At engine speeds below 4500 RPM, **ALL** power steering assist levels provide the same rate of assist.

As engine speed increases above 4500 RPM, assist levels progressively decrease.

The factory default assist level is “Minimum”. Use the *Evinrude ICON-Touch* or *ICON CS* digital display to change the power steering assist level.

Refer to the *Evinrude ICON-Touch* or *ICON CS* user’s guide.

If the boat is not equipped with an *ICON* digital display, use the *Configuration* screen of *Evinrude Diagnostics* software v 6.1 or higher to change the power steering assist level.



1. DPS Assist

009237

Multiple Outboard Alignment

NOTICE

Multiple outboard installations using AFA and newer outboards **REQUIRE** steering position sensor calibration.

Refer to Steering Position Sensor Calibration (AFA and Newer Models Only) on p. 310.

Failure to complete steering sensor calibration on multiple engine applications can result in damage to the tie bar(s) and/or the transom of the boat due to overloading.

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

Routine Service

Adjustments

Incorrect outboard alignment could cause one or more of the following:

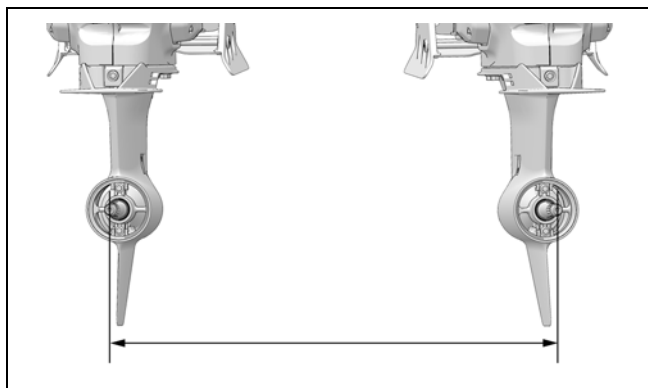
- Propeller ventilation
- Reduction of top speed
- Improper boat tracking
- Engine overheat and powerhead damage

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

Measure Alignment

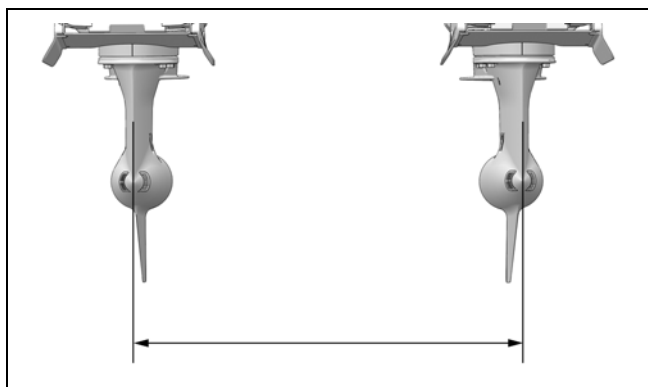
The “toe-in” (gearcase leading edges closer together than propeller shaft centers) or “toe-out” (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:

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



009130

- Measure between leading edges of gearcase.



009131

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 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

Submerged Engines

Once an outboard has been submerged 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 Submerged (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 *Dielectric Grease*, P/N 503243, 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. 160 and **Oil Supply Priming** on p. 196. 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 Installation** on p. 23.

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 Submerged (Running)

Follow the same procedures as **Engine Submerged (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 Submerged (In Salt Water)

Follow the same procedures used for **Engine Submerged (Not Running)** and **Engine Submerged (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 Submerged (Not Running)** and **Engine Submerged (Running)**.

Routine Service

Filling and Bleeding the Hydraulic Steering System

Filling and Bleeding the Hydraulic Steering System

Hydraulic Steering Fluid

⚠ WARNING

Use **ONLY** approved hydraulic fluids.

Non-approved fluids can cause steering system damage, or reduced steering control.

This can result in loss of boat control and injury to the occupants.

Use **ONLY** Hydraulic Fluid, P/N 770891.

Single Station / Single Engine Steering Installations

The following instructions describe the fill and bleed procedure for a single engine installation. For multiple engine installations refer to **Single Station / Multiple Engine Installations** on p. 50

Manual Method

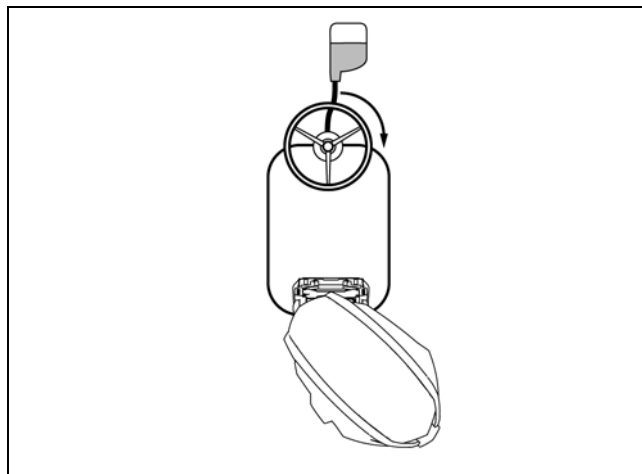
Also refer to the instructions provided with the hydraulic steering helm pump.

IMPORTANT: Turn the key switch to the ON position for models with DPS.

IMPORTANT: Make sure the engine is trimmed to the full DOWN position before beginning this procedure. Air will NOT bleed completely from the steering system if the engine is even slightly trimmed up.

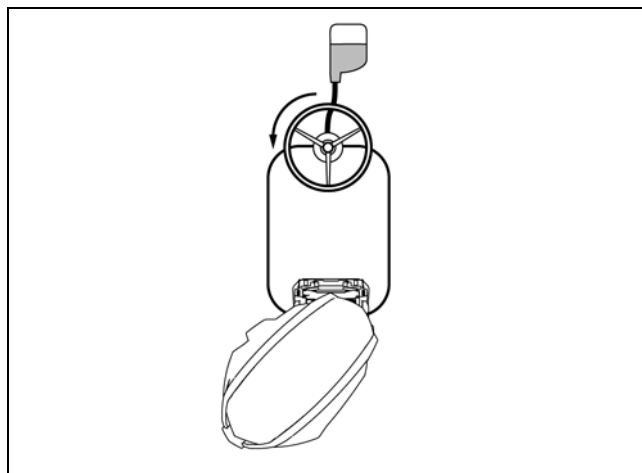
1. Remove the filler cap from the helm.
2. Install the threaded end of the filler tube (supplied with helm) into the helm.
3. Fill the helm with the recommended fluid. Fluid should always be visible in the filler tube. Use additional bottles of fluid as needed. Do NOT proceed with the next step until the helm is full of fluid.

4. Turn the steering wheel clockwise until engine is turned fully to STARBOARD and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.



009110

5. Turn the steering wheel counter-clockwise until engine is turned fully to PORT and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.



009111

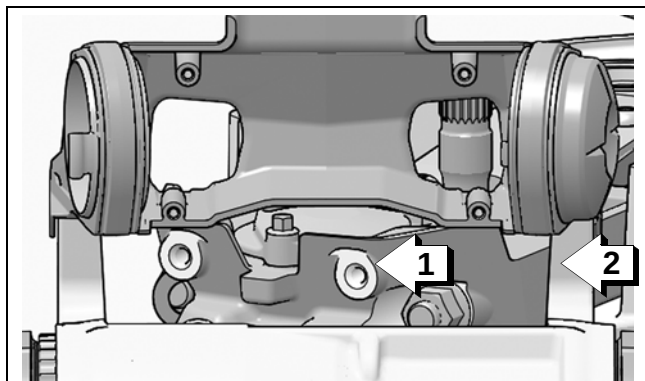
6. Install the Steering Lock Tool, P/N 357717, to hold engine in full PORT turn.



Steering Lock Tool, P/N 357717

357717

7. Use a shipping bracket screw to attach the long end of the steering lock tool to the steering arm.
Attach the short end of the tool to the stern bracket using the provided nut and washer.



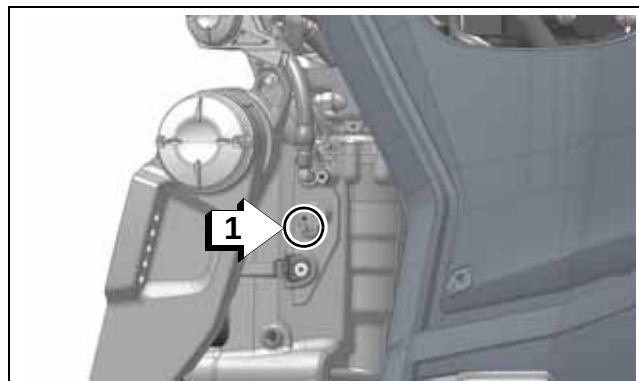
1. Steering arm
2. Stern bracket

009112

Attach a length of clear hose to the LOWER bleed valve. Use an appropriate container to catch fluid flowing from the bleed valve.

8. Open the LOWER bleed valve **one-half** turn.
Then turn the steering wheel clockwise.
– Continue turning the steering wheel clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.

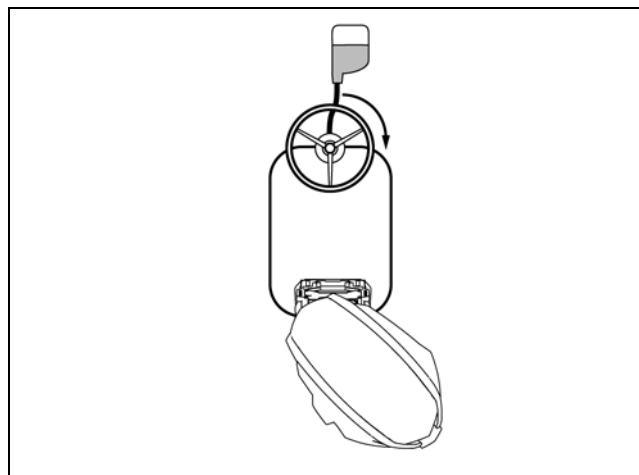
- Be sure to maintain fluid level at the helm/reservoir.



1. Lower bleed valve

009109

9. Close the LOWER bleed valve.
10. Then remove the steering lock tool.
11. Turn the steering wheel clockwise until engine is turned fully to STARBOARD and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.

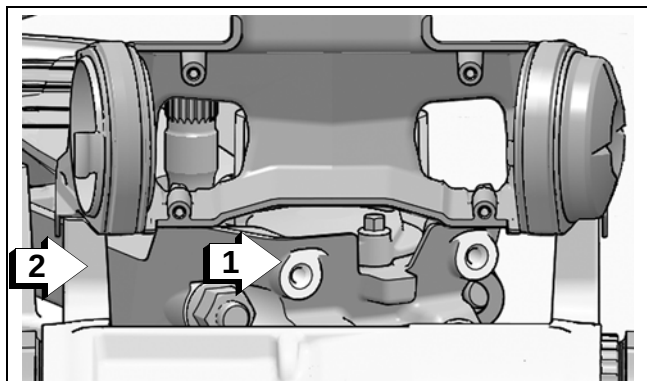


009110

Routine Service

Filling and Bleeding the Hydraulic Steering System

12. Install the steering lock tool, P/N 357717, to hold engine in full STARBOARD turn.

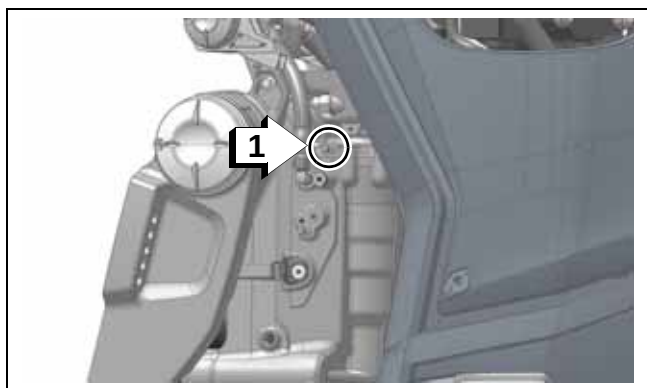


1. Steering arm
2. Stern bracket

009113

Attach the length of clear hose to the UPPER bleed valve.

13. Open the UPPER bleed valve **one-half** turn. Then turn the steering wheel counter-clockwise.
- Continue turning the steering wheel counter-clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.
 - Be sure to maintain fluid level at the helm/reservoir.



1. Upper bleed valve

009109

14. Close the UPPER bleed valve.
15. Tighten both bleed valves to a torque of 84 to 120 in.lb. (9.5 to 13.5 N·m).
16. Remove the steering lock tool.
17. Remove the filler tube from the helm. Install the fill cap on the helm, tighten securely.
18. Proceed to **Steering System Checks** on p. 52.

Single Station / Multiple Engine Installations

Filling and bleeding multiple engine installations is similar to single engine installations.

Follow the instructions starting on page 48 in this order:

- Complete steps 1 through 7.
- Starting with the STARBOARD engine, perform steps 8 and 9.
- Leave the steering lock tool in place.
- Repeat steps 8 and 9 on each engine:
 - Bleed one engine at a time.
 - Work on engines from starboard to port until the LOWER bleed valve on all engines has been bled.
- Proceed with steps 10 through 12.
- Starting with the starboard engine, perform steps 13 and 14.
- Leave the steering lock tool in place.
- Repeat steps 13 and 14 on each engine:
 - Bleed one engine at a time.
 - Work on engines from starboard to port until the LOWER bleed valve on all engines has been bled.
- Complete the process with steps 15 through 17.

Power Purge Method

A *Teleflex Power Purge* system can be used to bleed the steering system. Make sure the purging unit has the correct hydraulic fluid. See **Hydraulic Steering Fluid** on p. 48. Purge the steering system manually if the fluid in the purging unit is a non-approved or unknown type. See **Manual Method** on p. 48.

IMPORTANT: Turn the key switch to the ON position for models with DPS.

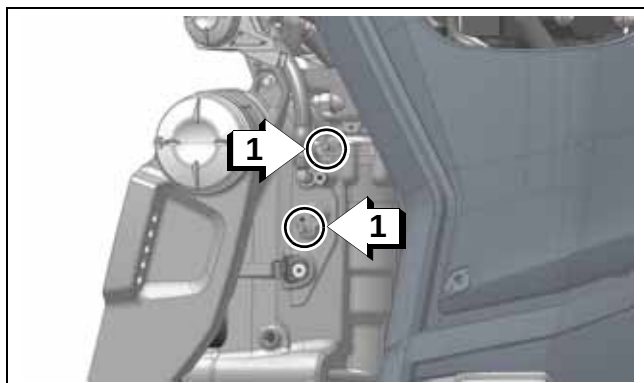
If installing dual outboards a *Teleflex Dual Cylinder Purging Kit* is also required.



Teleflex Power Purge Jr.

009114

1. Remove the fill cap from the helm. Connect the hydraulic fluid supply line of the purging unit to the helm.
2. Connect the hydraulic fluid return lines of the purging unit to the two bleed valves of the steering system.



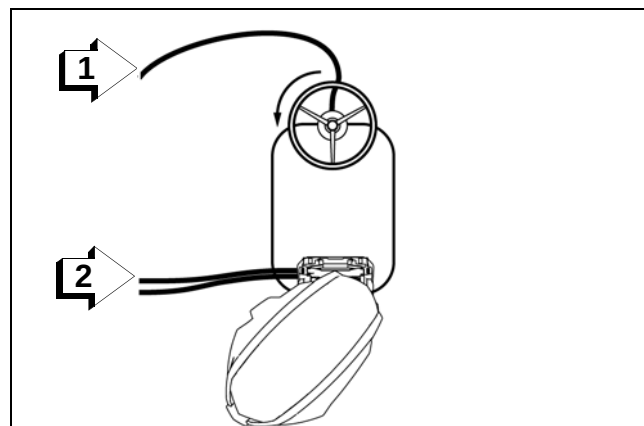
1. Bleed valves

009109

3. Loosen both bleed valves **one-half** turn. Then turn the purge unit ON.

After air bubbles are no longer visible:

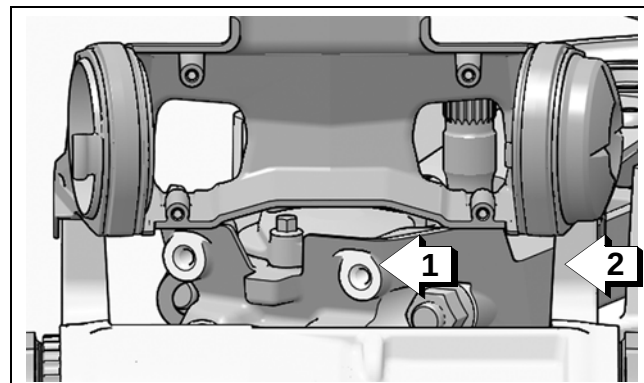
4. Turn the steering wheel counter-clockwise until engine is turned fully to PORT and resistance is felt.



1. Hydraulic fluid supply line
2. Hydraulic fluid return lines

009116

5. Install the steering lock tool, P/N 357717, to hold engine in full PORT turn.
6. Use a shipping bracket screw to attach the long end of the steering lock tool to the steering arm. Attach the short end of the tool to the stern bracket using the provided nut and washer.



1. Steering arm
2. Stern bracket

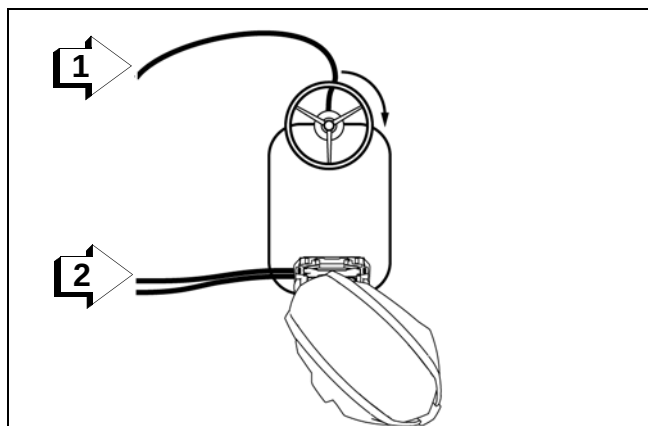
009112

6. Rotate the steering wheel both clockwise and counter-clockwise until air bubbles are no longer visible.
7. Remove the steering lock tool.

Routine Service

Filling and Bleeding the Hydraulic Steering System

- Turn the steering wheel clockwise until engine is turned fully to STARBOARD and resistance is felt.

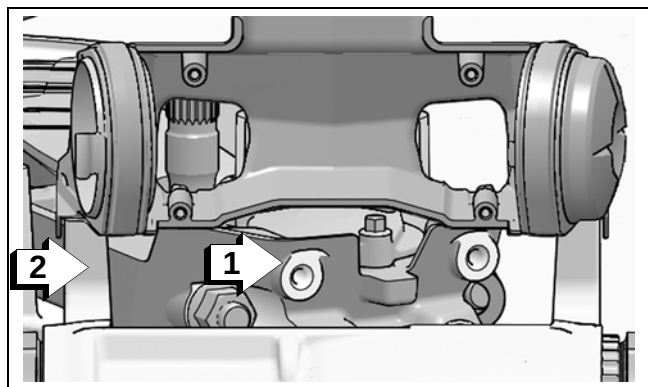


1. Hydraulic fluid supply line
2. Hydraulic fluid return lines

009115

- Install the steering lock tool, P/N 357717, to hold engine in full STARBOARD turn.

Use a shipping bracket screw to attach the long end of the steering lock tool to the steering arm. Attach the short end of the tool to the stern bracket using the provided nut and washer.



1. Steering arm
2. Stern bracket

009113

- Rotate the steering wheel both clockwise and counter-clockwise until air bubbles are no longer visible.
- Tighten both bleed valves to a torque of 84 to 120 in.lb. (9.5 to 13.5 N·m). Then turn the purge unit OFF.
- Disconnect the return lines of the power purge from the two bleed valves of the steering system.
- Disconnect the hydraulic fluid supply line of the power purge from the helm.

- Install the fill cap on the helm, tighten securely.
- Perform **Steering System Checks**.

Steering System Checks

- Turn steering wheel to PORT. After engine is turned fully to PORT, apply enough force to the steering wheel to exceed the pressure relief valve pressure of the helm.
- While pressure is maintained on helm, check all PORT lines and fittings for leaks.
- Turn steering wheel to STARBOARD. After engine is turned fully to STARBOARD, apply enough force to the steering wheel to exceed the pressure relief valve pressure of the helm.
- While pressure is maintained on helm, check all STARBOARD lines and fittings for leaks.
- Repair all leaks. Repeat steps 1 through 4 before continuing.
- Cycle the steering system from full PORT turn to full STARBOARD turn several times. Definite resistance should be felt when the steering wheel is turned full PORT or full STARBOARD.

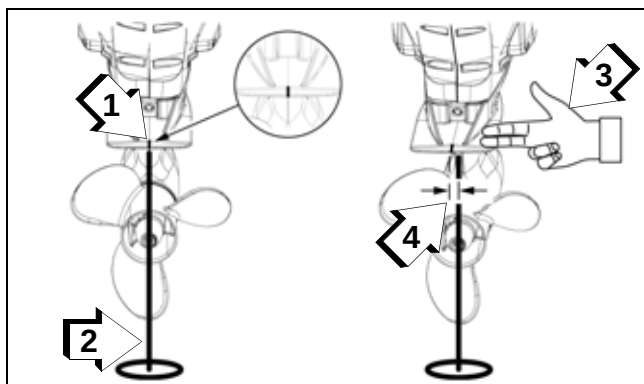
IMPORTANT: If definite resistance is NOT felt, or if steering feels loose or "soft" wait 15 minutes and repeat the bleeding process.

- Check the fluid level of the helm pump and fill per the manufacturers recommendation.
- Check mechanical free play.

Some free play movement of the steering system is normal. To check mechanical free play:

- Make sure the anti-ventilation plate of the gearcase is approximately level.
- Make a mark in the center/rear of the anti-ventilation plate of the gearcase.
- Center a stationary object, such as a length of threaded rod attached to a plate, behind the mark on the gearcase to serve as a reference point.
- Use two fingers to push the gearcase to port.

- Measure and record the distance between the mark and the reference point.

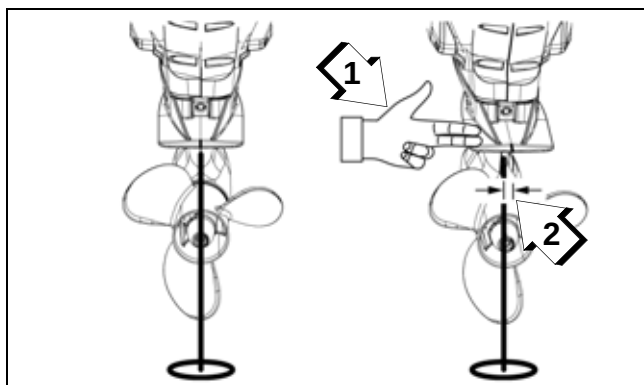


Mechanical Free Play Measurement

009427

1. Mark
2. Reference point object
3. Push against gearcase
4. Measurement

- Use two fingers to push the gearcase to starboard.



Mechanical Free Play Measurement

009428

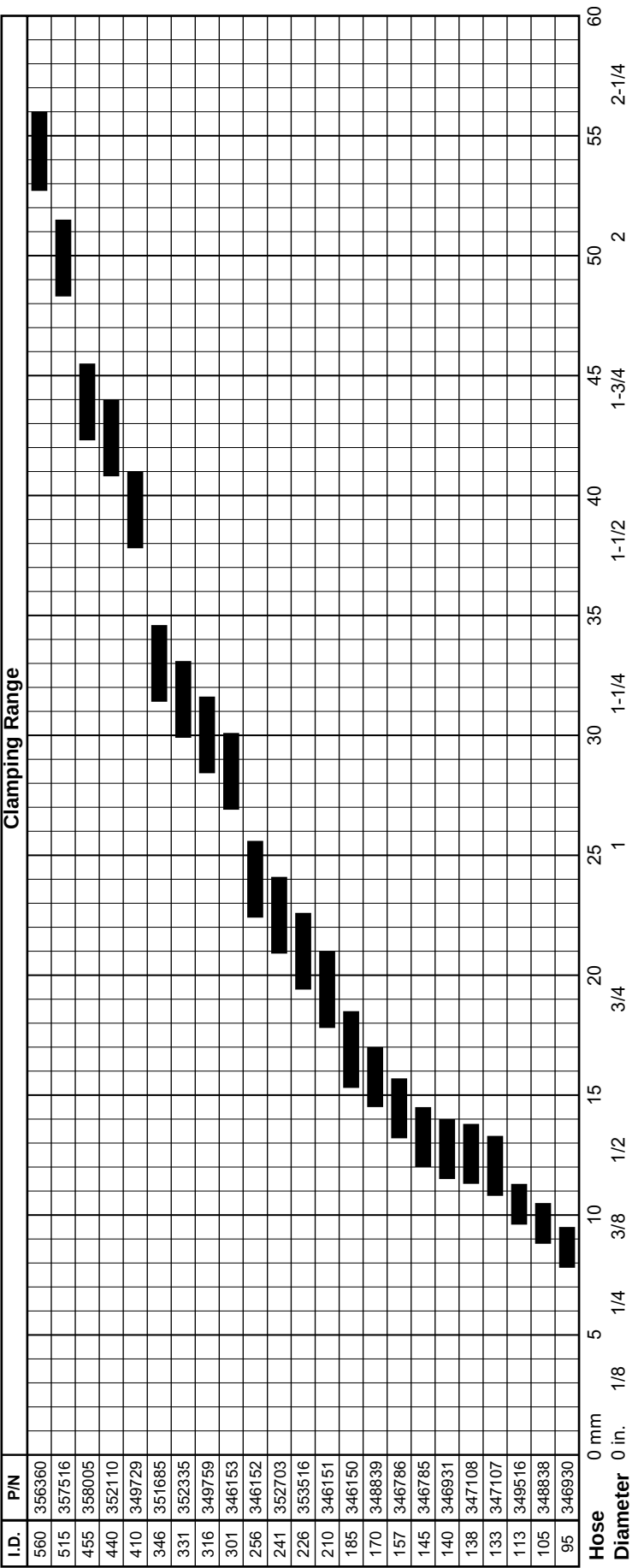
1. Push against gearcase
2. Measurement

- Measure and record the distance between the mark and the reference point.

Add the measurements. The result should not exceed approximately 0.59 in. (15 mm).

If the result exceeds this dimension, additional bleeding may be required. Push the gearcase to port, until the steering mechanism bumps the mechanical stop. Then push steadily with increasing force. Repeat to starboard. Definite resistance should be felt in both directions. If after bumping the mechanical stop the gearcase continues to move in the direction it is being pushed, or it feels loose or "soft" repeat the bleeding process.

Oetiker Clamp Chart



Extra-Large Clamps

I.D.	P/N	Clamping Range
995	356019	96.3 to 99.5 mm (3.79 to 3.92 in.)
695	352868	66.3 to 69.5 mm (2.61 to 2.73 in.)
605	351159	57.3 to 60.5 mm (2.25 to 2.38 in.)

Engine Cover and Frame Service

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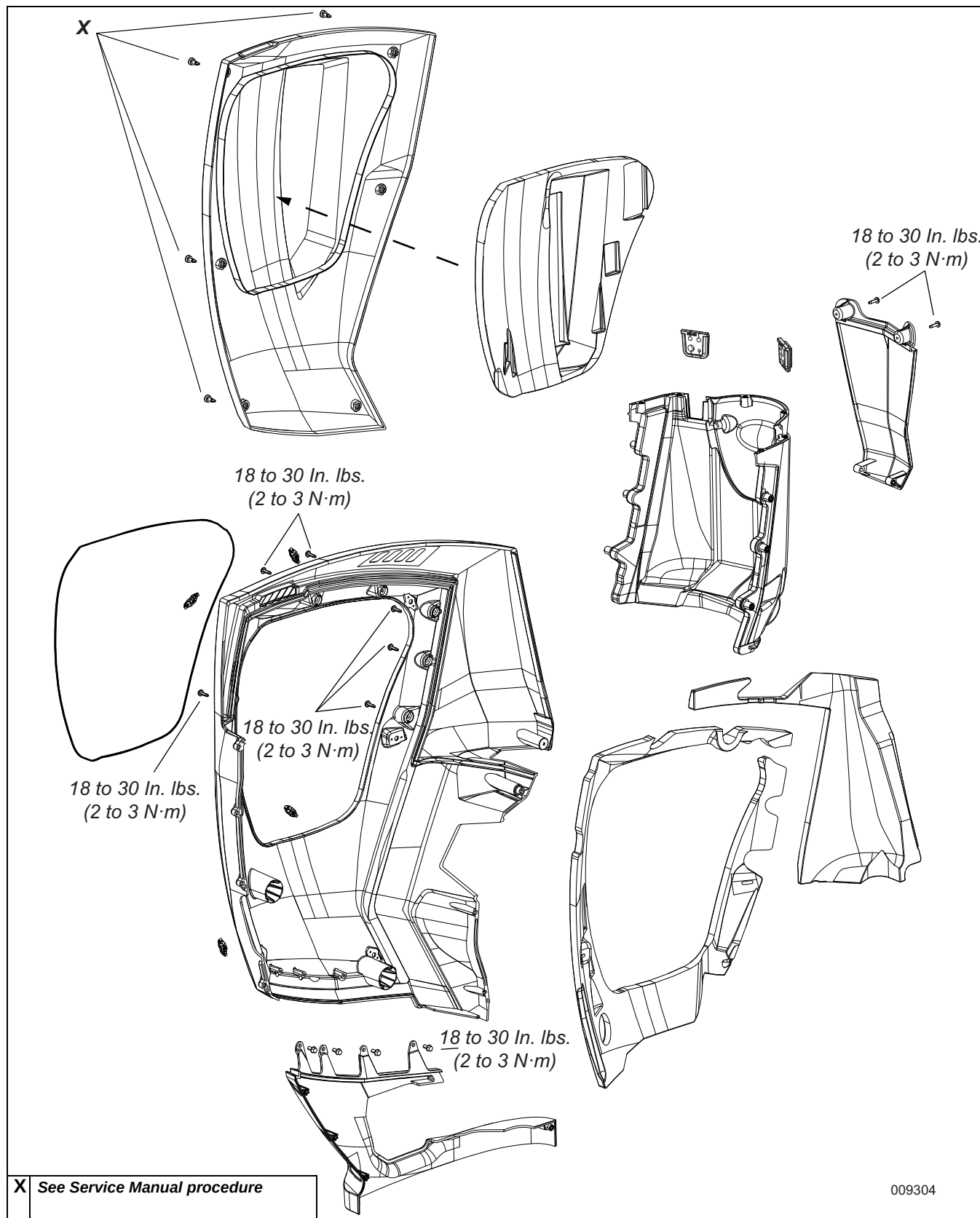
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3

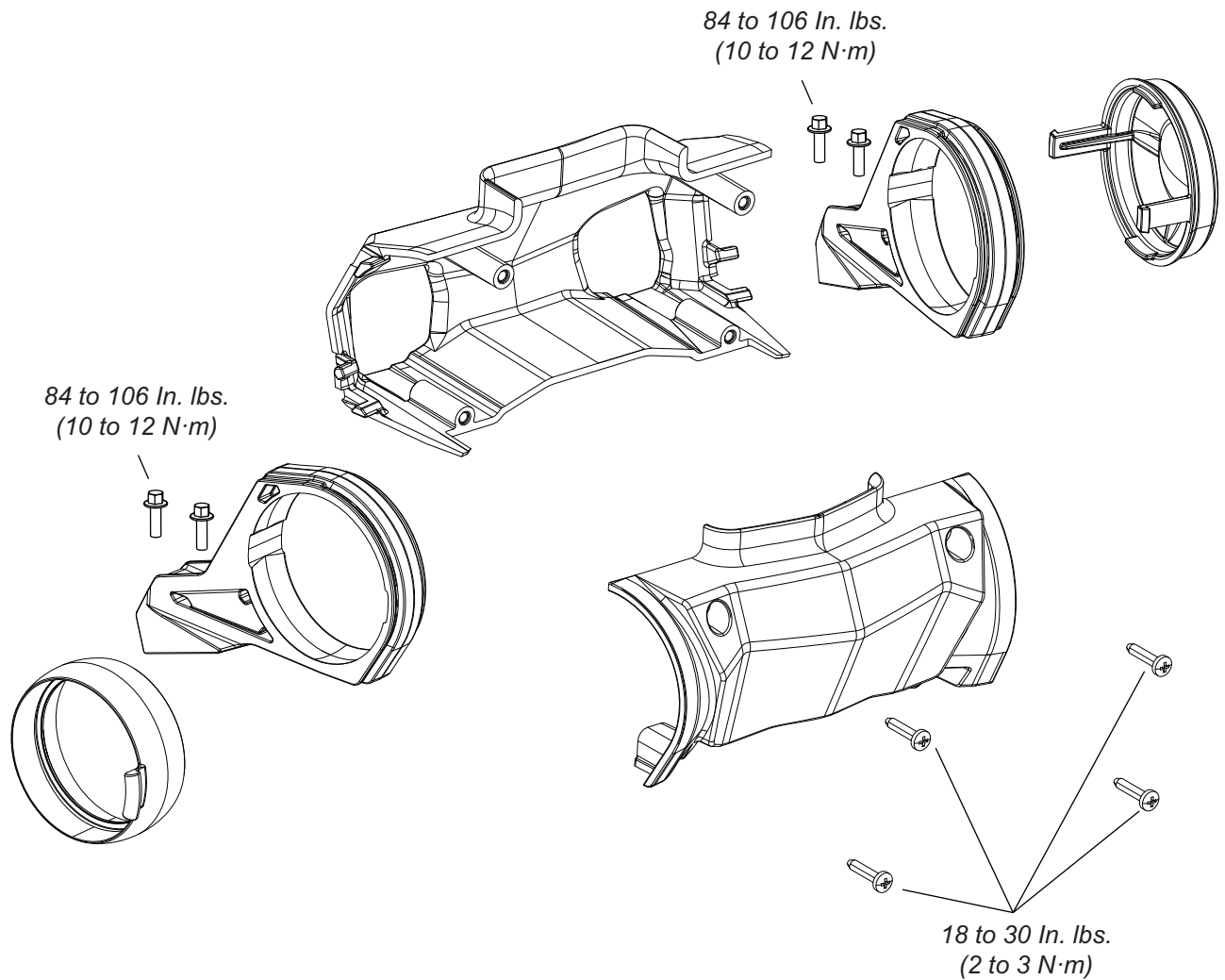


Port Cover and Frame, Front Cover and Frame



Rigging Center

3



009315

Cover Removal

Lift up on rear latch to release



1. Rear Latch

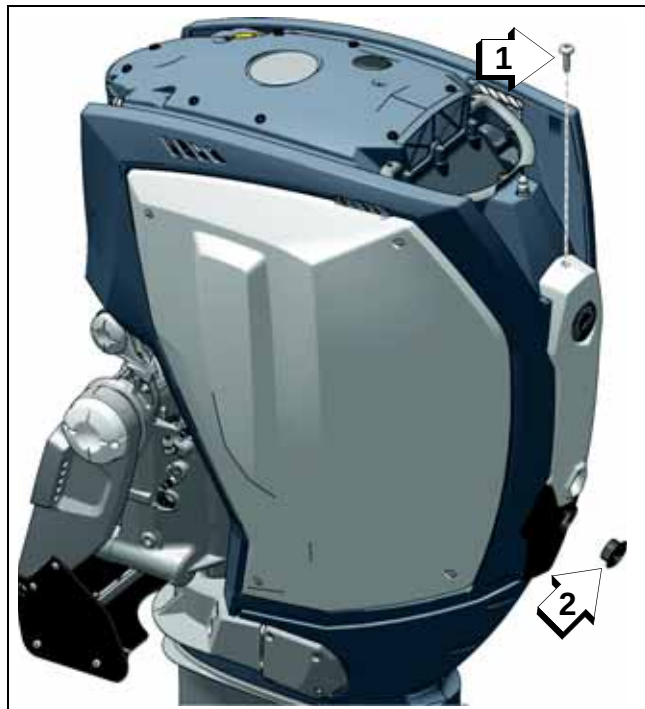
5008559_04

Remove the top cover.



5008559_05

Remove one screw at the top of the rear cover.
Unscrew and remove the retainer.



1. Screw
2. Retainer

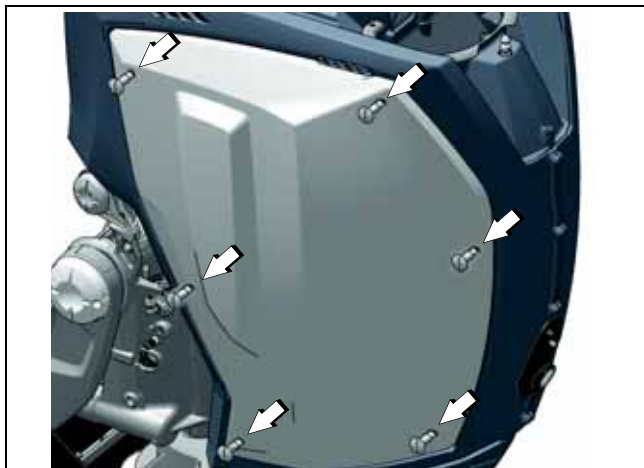
5008559_06

Remove the rear cover.



5008559_07

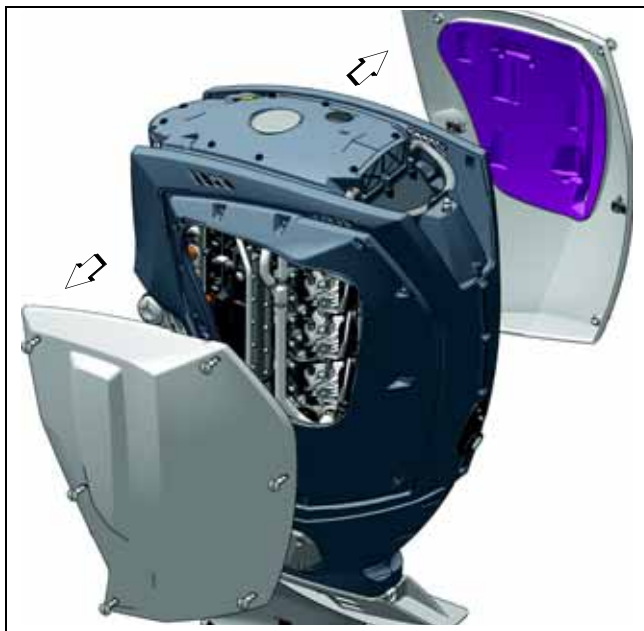
Loosen the port and starboard side cover screws one-quarter turn.



Port Side Shown
(screws enlarged to show detail)

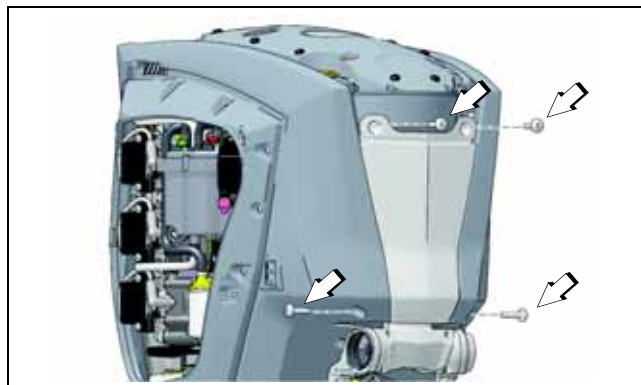
5008559_08

Remove the side covers.



5009420_03-09

Remove the four front cover screws.



Screws (enlarged to show detail)

5009420_03-10

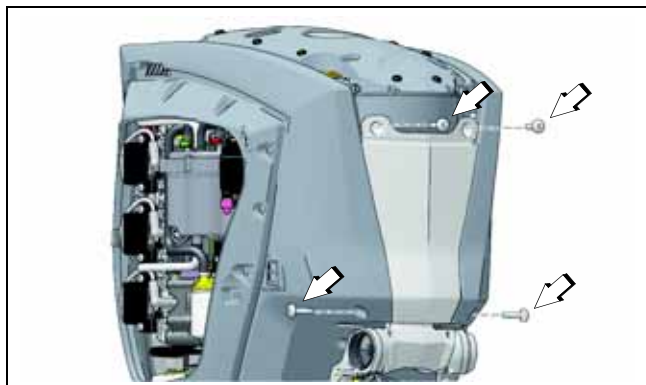
Remove the front cover.



5009420_03-11

Cover Installation

Install the front cover. Install the upper screws first. Tighten the screws 18 to 30 in. lbs. (2 to 3 N·m).



5009420_03-10

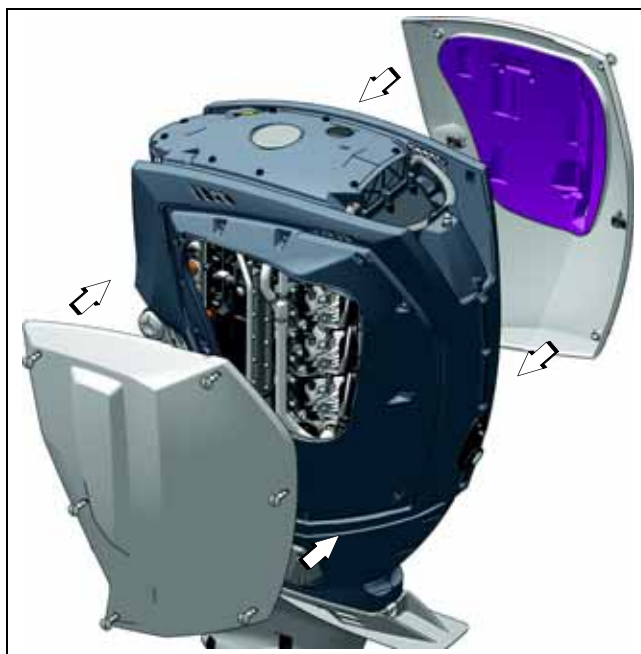
Apply Silicone Spray, P/N 775630, onto a shop towel and liberally apply to the port and starboard rubber seals.



1. Rubber seal

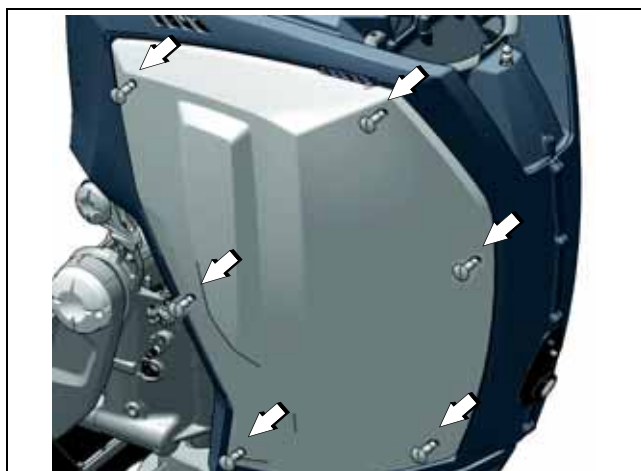
5008559_19

Install the port and starboard covers.



5009420_03-09

Tighten the port and starboard side cover screws one-quarter turn.



Port Side Shown

5008559_08

Install the rear cover.



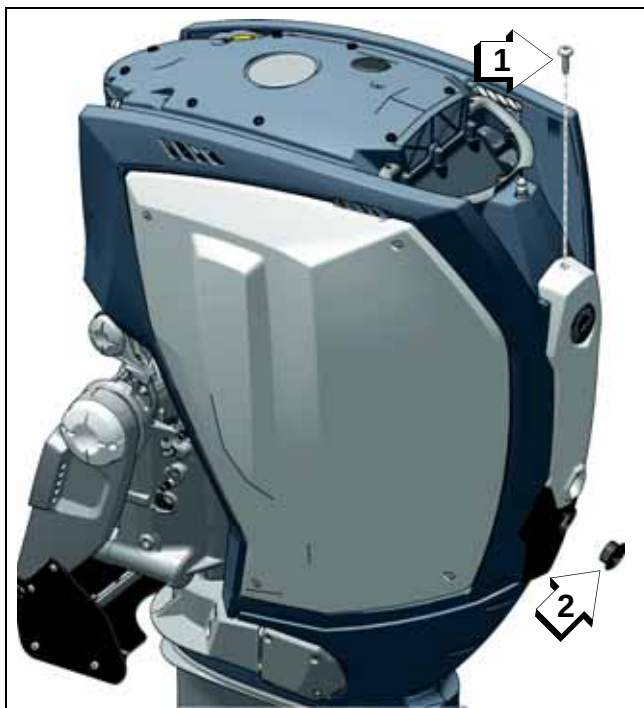
5008559_07

Install the top cover.



5008559_05

Install one screw at the top of the rear cover. Tighten the screw 18 to 30 in. lbs. (2 to 3 N·m). Install the retainer.



1. Screw
2. Retainer

5008559_06

Push down on the rear of the top cover to secure the latch.

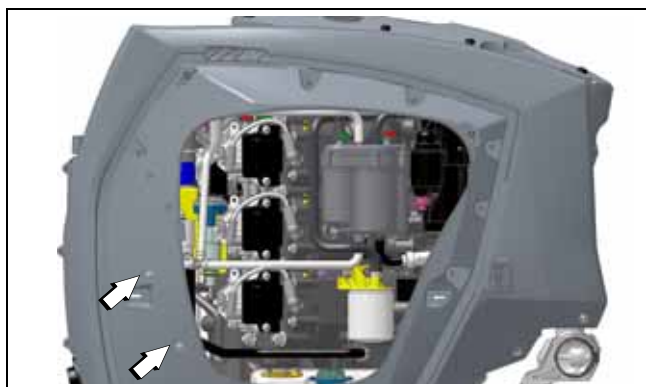


5008559_05

Frame Removal

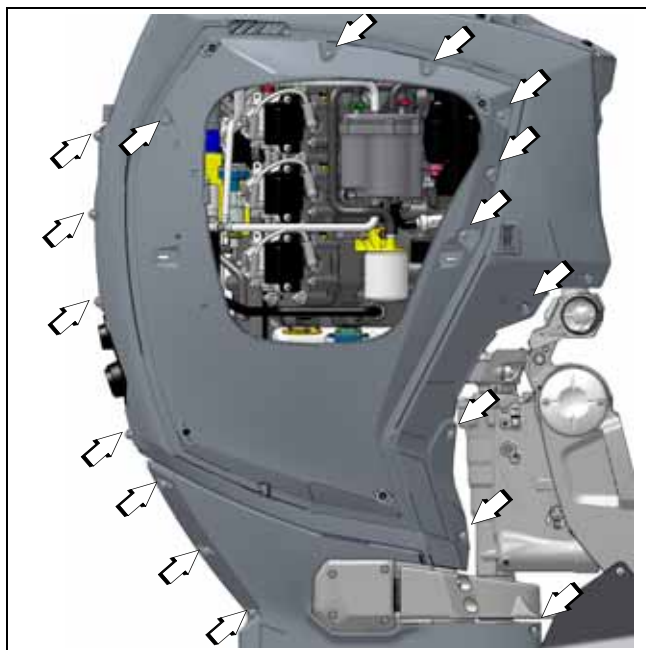
Starboard, Port, and Front Frame Removal

Use a #2 *Posi-drive* screwdriver to remove two self-tapping screws which retain the gearcase oil reservoir.



5008559_12A

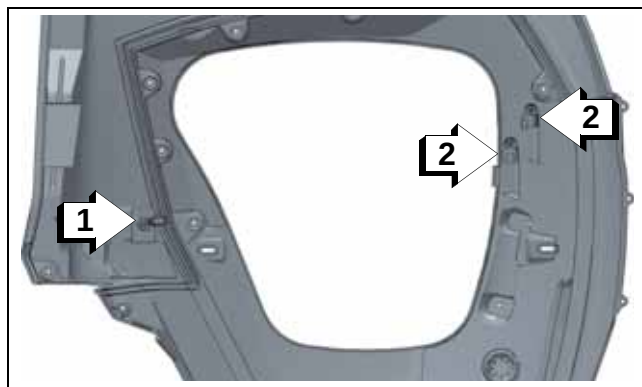
Remove the 17 starboard frame screws.



5008559_12

Pull the starboard frame slightly away from the center frame.

Disconnect the trim and tilt switch connector. Remove the two *Deutsch* connectors from their protective caps.



1. Trim and Tilt connector
2. Protective caps

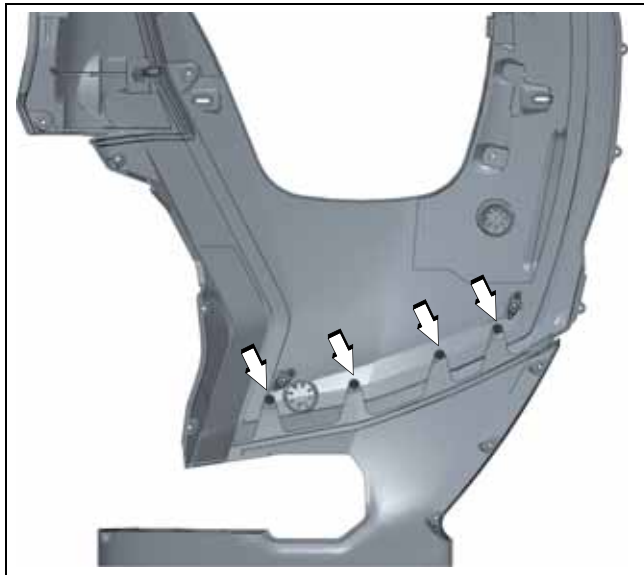
5008559_17

Remove the starboard frame and lower exhaust housing cover.



5008559_16

Remove the four starboard exhaust housing cover screws.



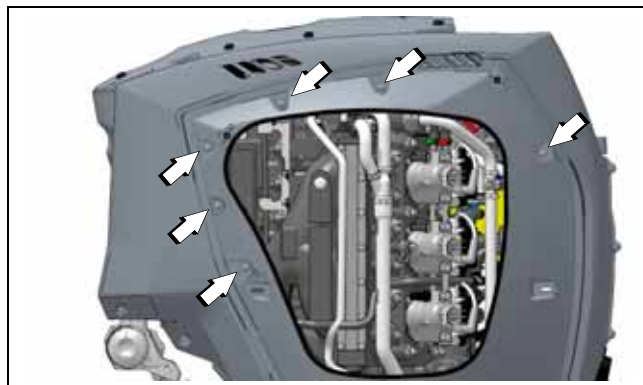
5008559_17

Remove the starboard exhaust housing cover.



5008559_18

Remove the six port frame screws.



5008559_19

Remove the port frame and port exhaust housing cover.

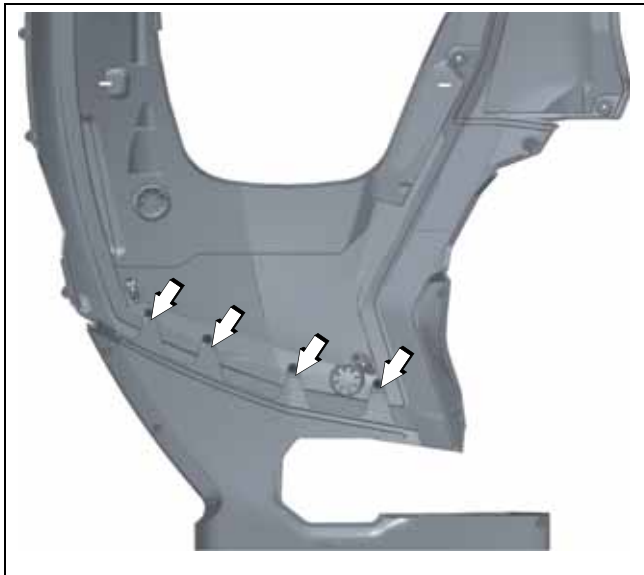


5008559_20

Engine Cover and Frame Service

Frame Removal

Remove the four port exhaust housing cover screws.



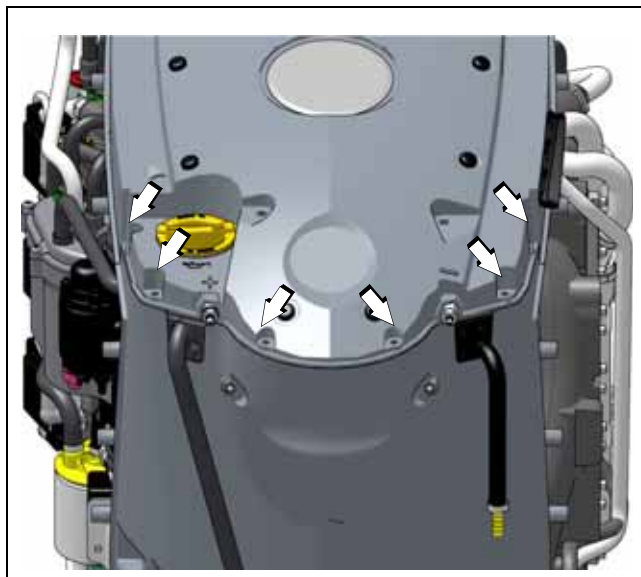
5008559_21

Remove the port exhaust housing cover.



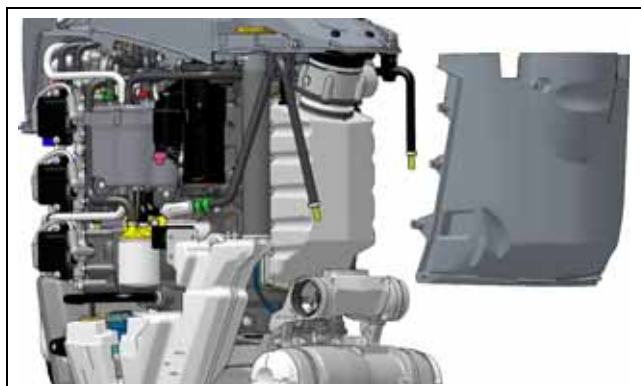
5008559_22

Remove the six front cover screws.



5008559_23

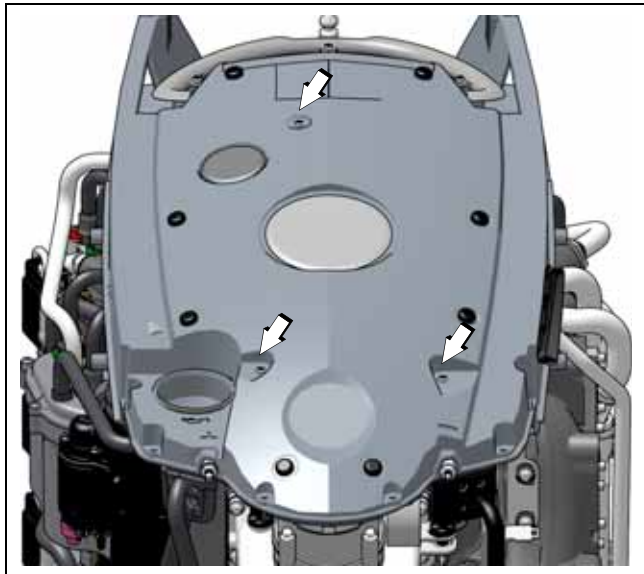
Move the front cover away from the powerhead, Remove the rigging grommets from the front cover. Remove the front cover.



5008559_24

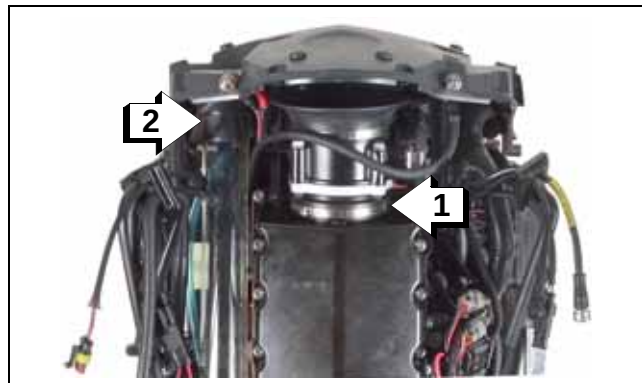
Center Frame Removal

Use a #2 *Posi-drive* screwdriver and remove the three center frame screws.



5008559_25

Remove the throttle body and upper oil fill tube clamps.

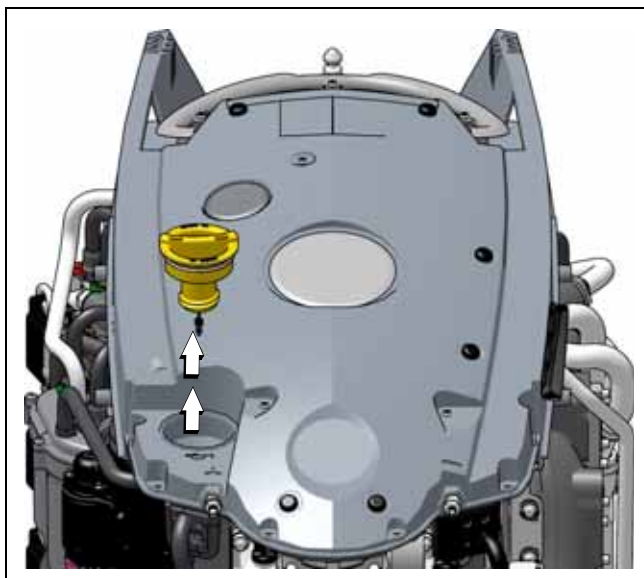


1. Throttle body clamp
2. Oil fill tube clamp

009173

3

Remove the oil fill cap.

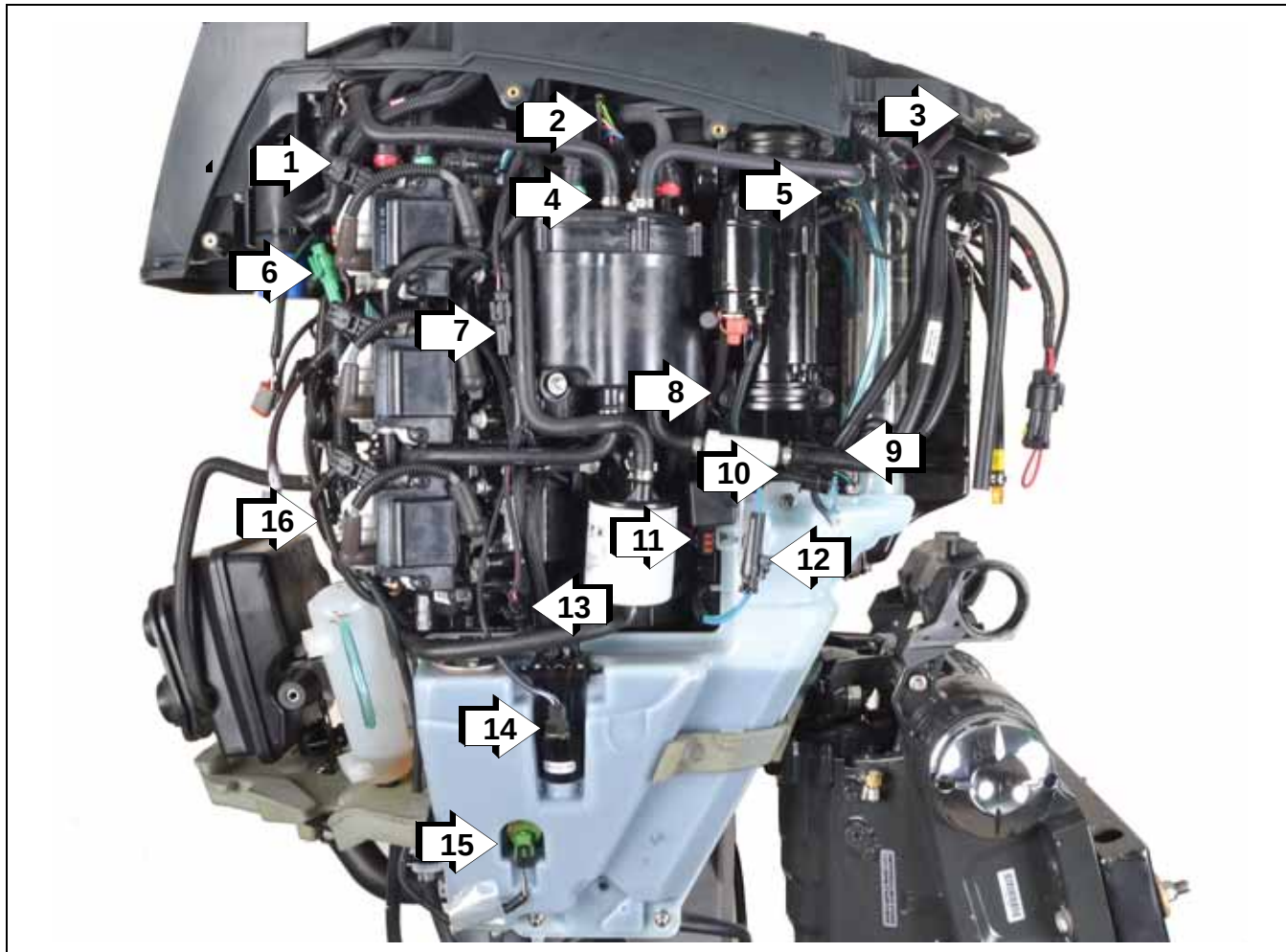


5008559_26

Engine Cover and Frame Service

Frame Removal

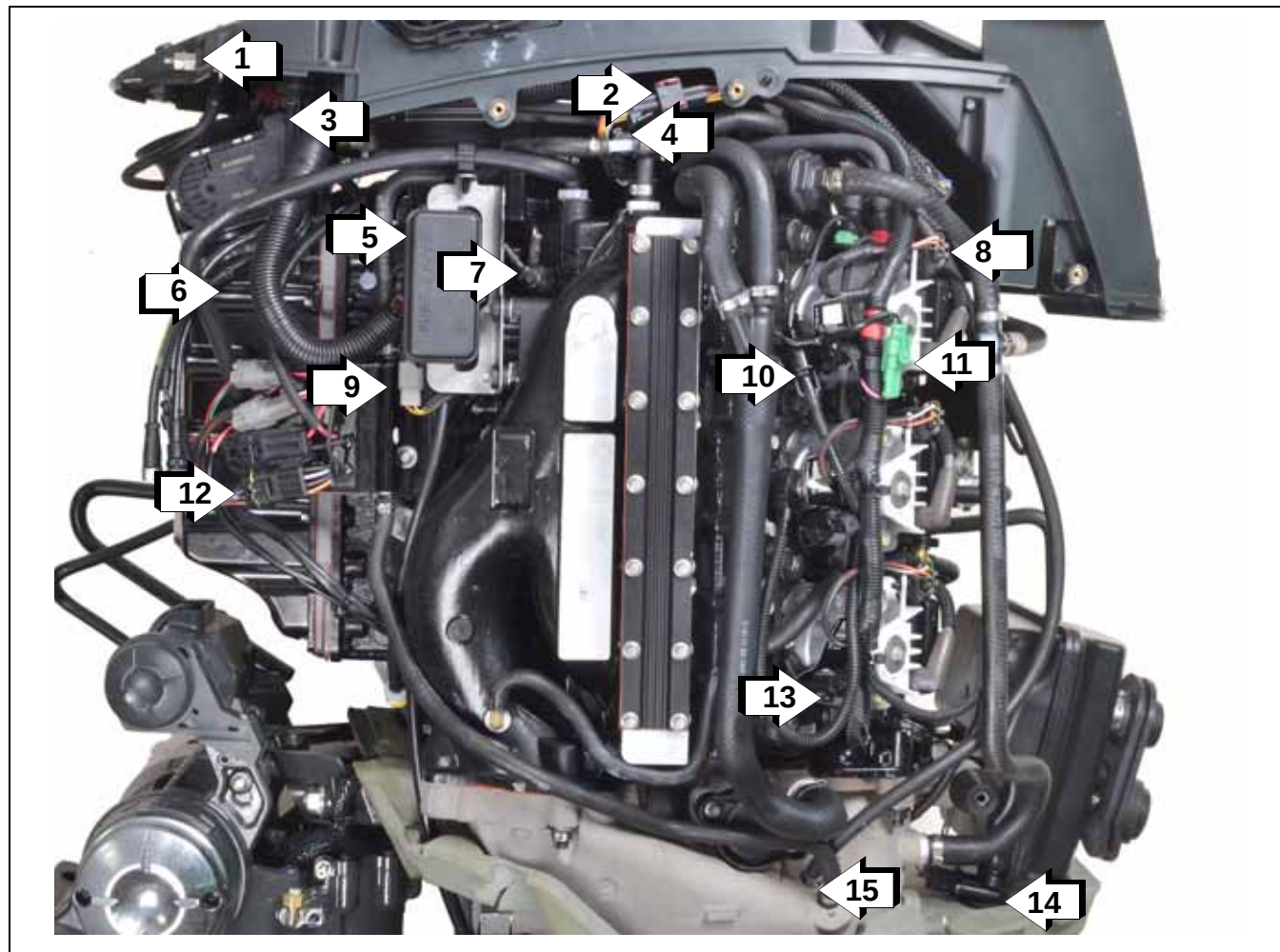
Disconnect the starboard side electrical connectors and hoses:



1. Ignition coil connectors (3X)
2. Vapor separator and fuel pump assembly connector (remove clip from fuel rail)
3. Positive battery cable
4. Vapor separator cooling hose
5. Vapor separator vent solenoid connector
6. Temperature sensor connector
7. Water-in-fuel sensor connector
8. Engine grounds
9. Trim sender connector
10. Trim switch connector
11. Water pressure sensor connector (if optional sensor is installed)
12. Trim relay connector
13. Oil level sensor connector
14. Crankcase oil pump connector
15. Low oil switch connector
16. Fuel injector connectors (3X)

009174

Disconnect the port side electrical connectors and hoses.



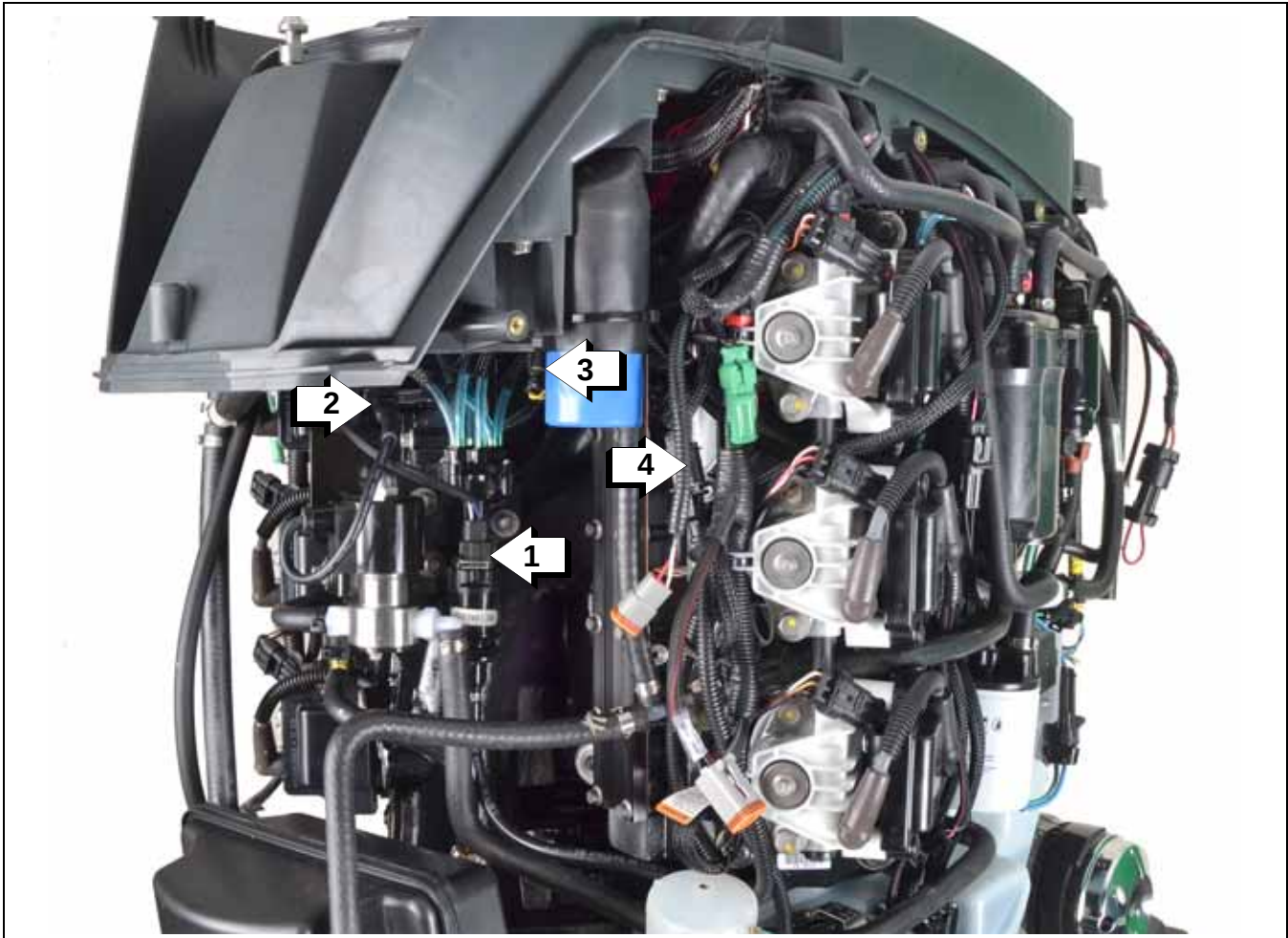
1. Starter ground cable
2. Stator connector
3. Throttle body connector (remove throttle body assembly to access)
4. EMM cooling hose
5. Fuse box (remove from bracket - remove connector from back of box)
6. Air temperature sensor connector
7. Engine grounds
8. Ignition coil connectors (3X)
9. Shift actuator connector
10. Knock sensor connector
11. Temperature sensor connector
12. Dynamic power steering module connector (lower connector only)
13. Fuel injector connectors (3X)
14. Exhaust temperature sensor connector
15. Exhaust back pressure hose

009175

Engine Cover and Frame Service

Frame Removal

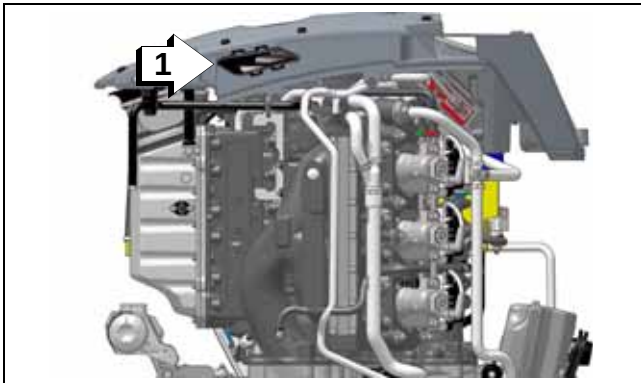
Disconnect the rear electrical connectors.



1. *Cylinder oil pump connector*
2. *Water valve connector*
3. *Crankshaft position sensor connector*
4. *Knock sensor connector (starboard)*

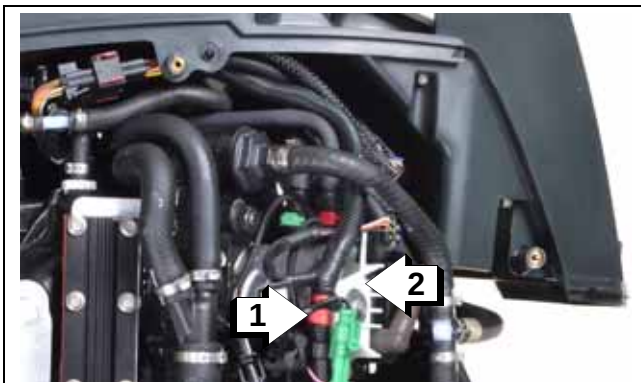
009176

Push the air duct inward to remove it from the center frame.



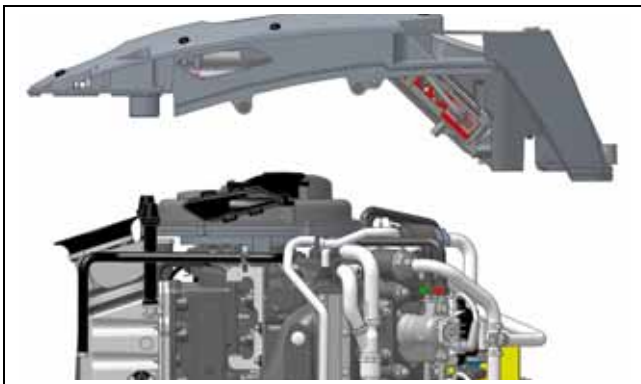
1. Air duct 009296

Remove the tie strap from each ignition coil bracket.



1. Tie strap
2. Fuel injector mounts 009299

Remove the center frame (wire harness not shown).



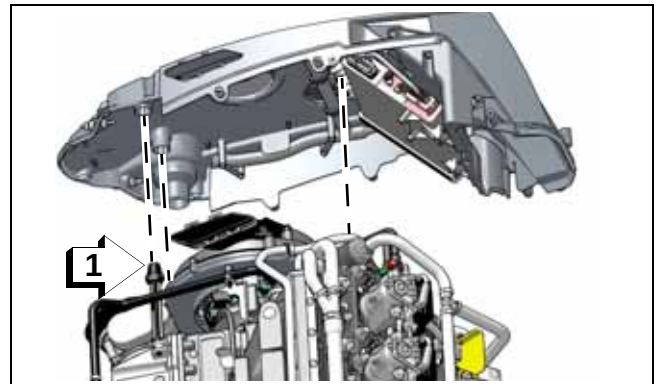
009297

Frame Installation

Center Frame Installation

Locate the center frame on the powerhead mounts.

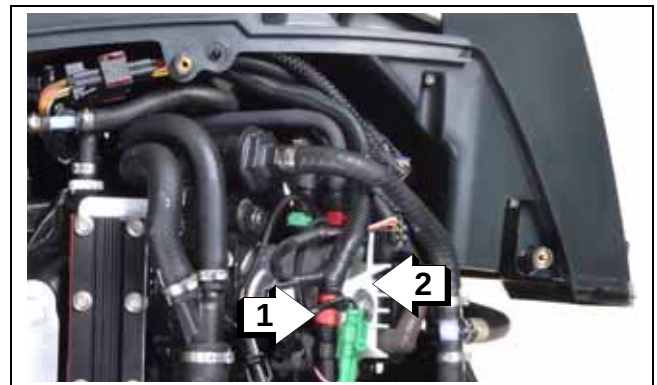
Align the air duct extension opening with the center frame opening.



1. Center frame mounts (port side shown) 009298

Align the red tape marker on the port side of the harness to the upper ignition coil bracket as shown. Secure the harness to each ignition coil bracket with tie strap, P/N 320107.

IMPORTANT: Hand tighten the tie strap. Do not use a tie strap gun.



1. Red tape
2. Fuel injector mounts 009299

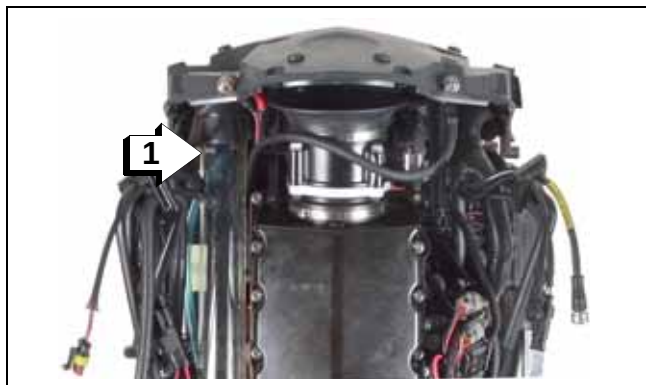
Repeat on starboard side.

Engine Cover and Frame Service

Frame Installation

Install the oil fill hose to the center frame.

- Secure with one 51.5 mm *Oetiker* clamp if oil fill hose is clear.
- Secure with one 56.0 mm *Oetiker* clamp if oil fill hose is black.



1. Oil fill hose

009173

Assemble all port side electrical connectors and hoses. Refer to the Powerhead section for port side reference views.

IMPORTANT: Route and secure all connectors and hoses to prevent chafing and contact with sharp surfaces.

- Stator connector
- Crankshaft position sensor connector
- Starter ground cable
- Throttle body connector -place wire in clip (assemble the throttle body to the air plenum, secure with one 99.5 mm *Oetiker* clamp)
- Air temperature sensor connector
- Engine grounds (tighten the ground screw to 84 to 106 in.lb. (9.5 to 12 N·m))
- Dynamic power steering module connector (lower connector only)
- Exhaust back pressure hose
- Muffler temperature sensor connector
- Knock sensor connector
- Fuse box connector (assemble the fuse box to the bracket)
- Temperature sensor connector
- Ignition coil connectors (3X)
- Fuel injector connectors (3X)
- *EMM* cooling hose (secure with one 15.7 mm *Oetiker* clamp)
- Shift actuator connector

Assemble all starboard side electrical connectors and hoses. Refer to the Powerhead section for starboard side reference views.

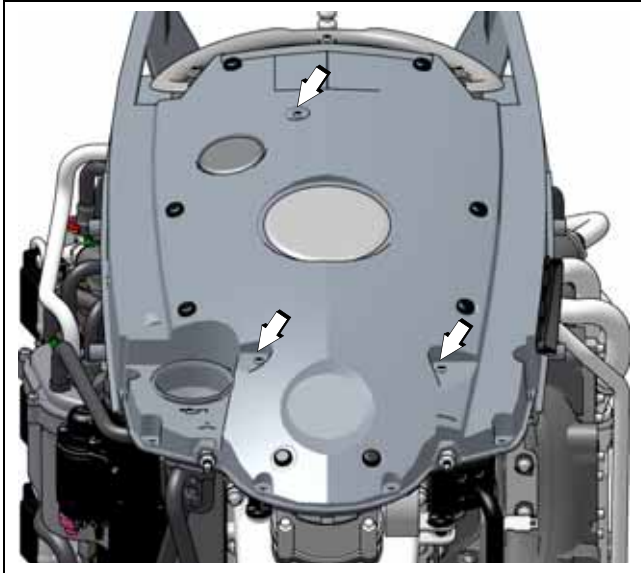
IMPORTANT: Route and secure all connectors and hoses to prevent chafing and contact with sharp surfaces.

- Ignition coil connectors (3X)
- Vapor separator and fuel pump assembly connector (install clip to fuel rail)
- Positive battery cable connections (starter, battery charging, and DPS power cables)
- Crankcase oil pump connector
- Oil level sensor connector
- Vapor separator cooling hose
- Vapor separator vent solenoid connector
- Temperature sensor connector
- Water-in-fuel sensor connector (snap the clip to the convoluted tubing)
- Starboard block ground
- Cylinder oil pump connector
- Trim sender connector
- Trim switch connector
- Water valve connector
- Water pressure sensor connector (if the optional sensor is not installed, place the connector under the trim relay)
- Trim relay connector
- Cylinder oil pump
- Low oil switch connector
- Fuel injector connectors (3X)
- Knock sensor connector

Use a #2 *Posi-drive* screwdriver and install the center frame screws.

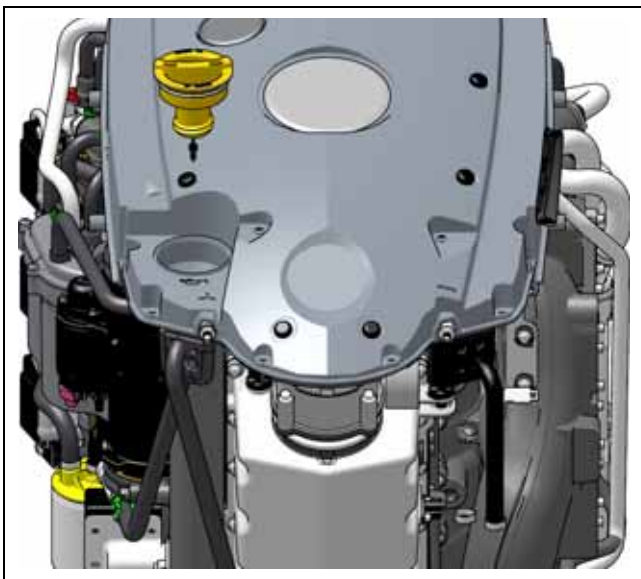
IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Tighten the screws securely.



5008559_25

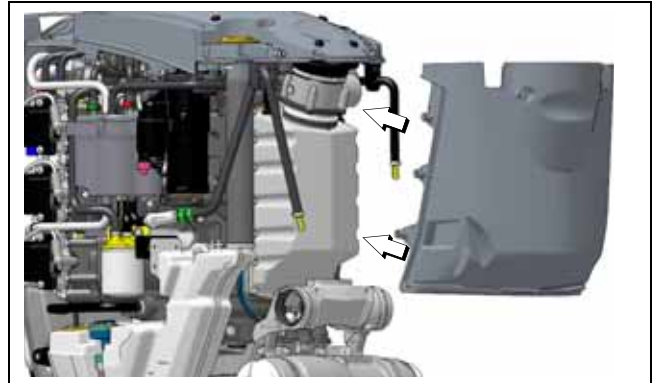
Install the oil fill cap.



5008559_26

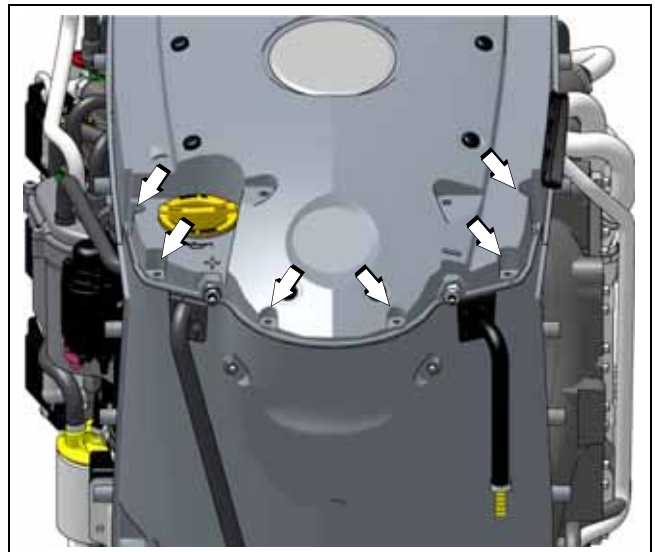
Front, Port, and Starboard Frame Installation

Place the frame on the front of the powerhead. Insert the rigging grommets in to the frame.



5008559_24

Install the six front frame screws, tighten to a torque of 18 to 30 in. lbs. (2 to 3 N·m).

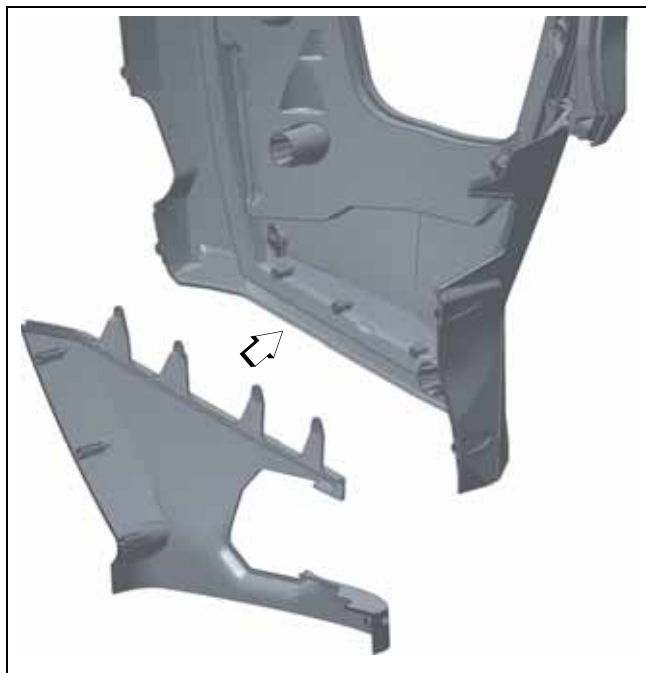


5008559_23

Engine Cover and Frame Service

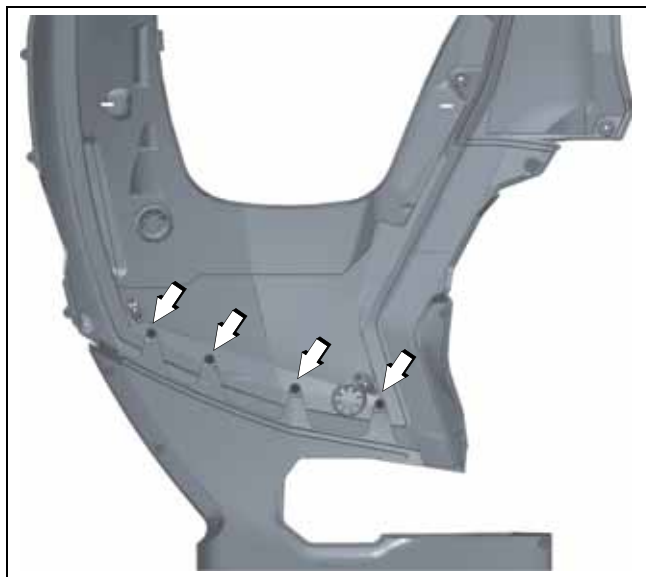
Frame Installation

Assemble the port exhaust housing cover.



5008559_22

Tighten the four screws to a torque of 18 to 30 in. lbs. (2 to 3 N·m).



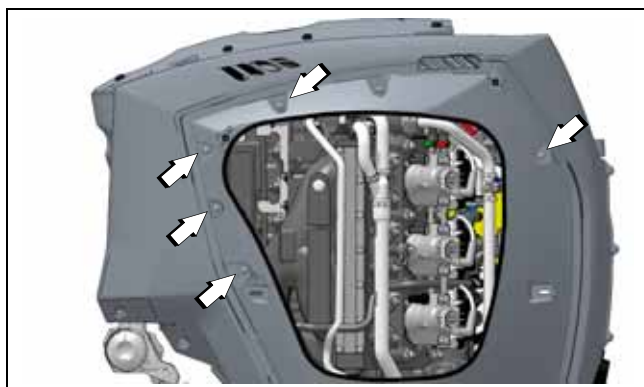
5008559_21

Install the port frame and lower port exhaust housing cover to the outboard. Seat the frame into the groove of the exhaust grommet.



5008559_20

Tighten the six port frame screws to a torque of 18 to 30 in. lbs. (2 to 3 N·m).



5008559_19

Assemble the starboard lower exhaust cover to the Starboard frame. Tighten the four screws to a torque of 18 to 30 in. lbs. (2-3 N·m).



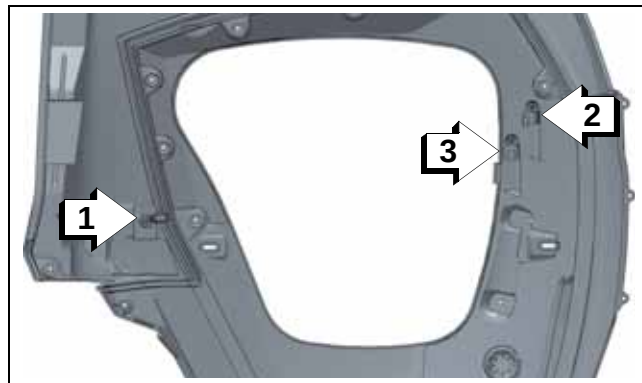
5008559_18

Place the starboard frame and starboard exhaust housing cover on the starboard side of the outboard. Align the frame with the groove in the exhaust grommet.



5008559_16

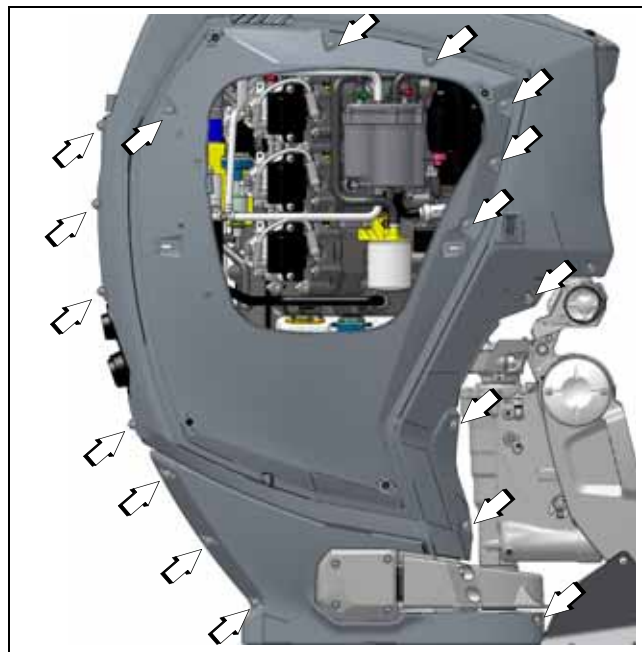
Connect the tilt and trim connector. Assemble the two *Deutsch* connectors to the bosses on inside of the starboard frame. Place the starboard frame on the outboard. Seat the frame in the groove of the exhaust grommet.



1. Trim and Tilt connector
2. two *Deutsch* connector bosses

5008559_17

Assemble the 17 frame screws, tighten to a torque of 18 to 30 in. lbs. (2 to 3 N·m).



5008559_12

Assemble the gearcase oil reservoir to the inside of the starboard frame. Use a #2 *Posi-drive* screwdriver to tighten the self-tapping screws.

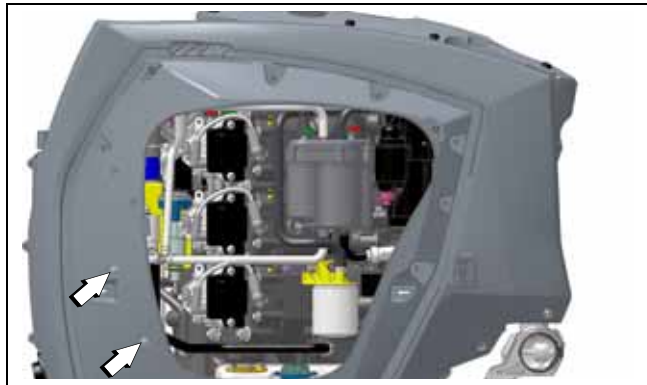
IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to

Engine Cover and Frame Service

Frame Installation

tighten. Failure to follow this procedure can damage the threads of the gearcase oil reservoir.

Tighten the screws securely.



5008559_12A

Engine and Control Systems

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Engine Management Module (EMM)

The Engine Management Module (EMM) is a water-cooled controller. It controls engine management and engine-related remote control functions.

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:

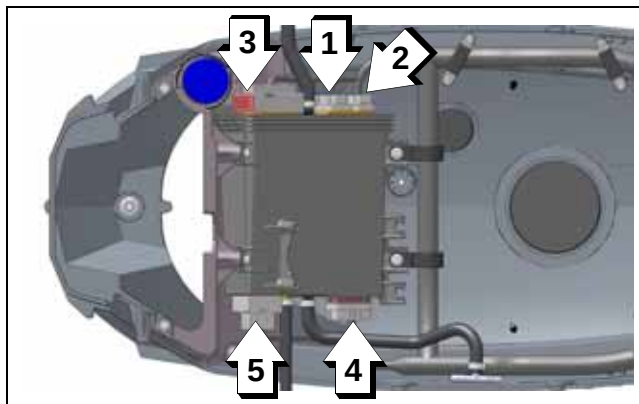
- Alternator output; 55 V and 12 V
- Start Assist Circuit (SAC) voltage boost
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil pump activation
- Electric fuel lift pump control
- Electric high pressure fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Fault code creation and storage
- Warning system activation
- ROM verification, self-test
- Cold starting
- Output of diagnostic data
- Tachometer signal
- RPM profile and engine hours
- Oil pump activation
- Anti-knock compensation
- Electronic throttle control
- Electronic shift control
- Dynamic Power Steering

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, J3, J4.
- Stator to *EMM* connections; one 6-pin AMP and J2 connector.



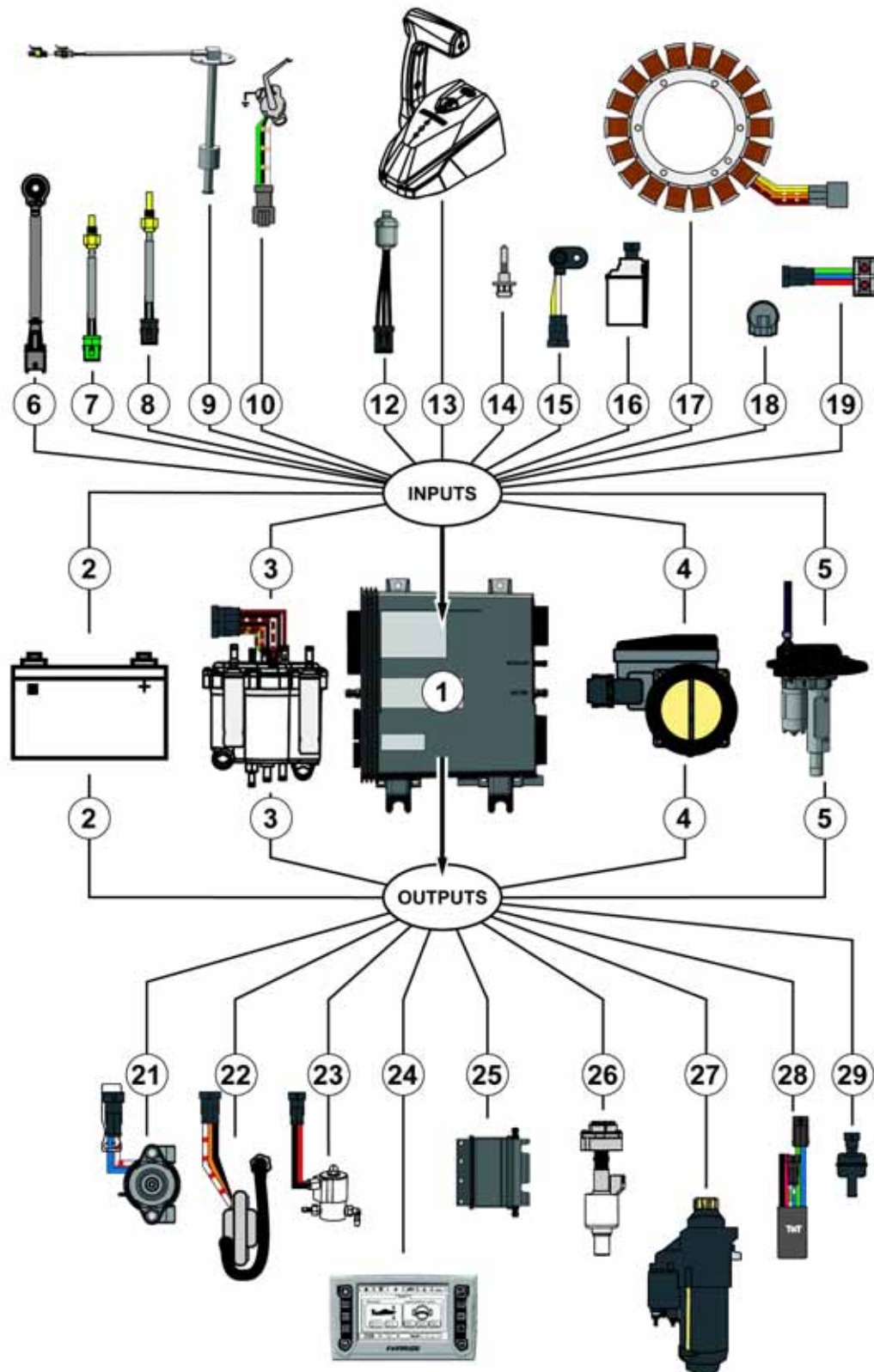
009332

1. J1-A connector
2. J1-B connector
3. J2 connector
4. J3 connector
5. J4 connector

EMM Inputs and Outputs Diagram

1. *EMM*
2. 12 VDC Battery
3. Fuel Vapor Separator
4. Electronic Throttle Body
5. Shift Actuator
6. Knock Sensor (2)
7. Engine Temperature Sensor (2)
8. Exhaust Temperature Sender
9. Engine Oil Level Sender
10. Trim Sender
11. (reserved for future use)
12. DPS Pressure Sensors
13. Digital Remote Control
14. Intake Air Temperature Sensor
15. Crankshaft Position Sensor
16. Water in Fuel Sensor
17. Stator
18. Low Oil Switch
19. Trim Switch
20. (reserved for future use)
21. Fuel Injector (6)
22. Ignition Coil (6)
23. Water Valve
24. Digital Displays & Gauges
25. Dynamic Power Steering Module
26. Oil Pumps
27. Starter Solenoid & Motor
28. Trim & Tilt Relay
29. Vapor Vent Solenoid

EMM Inputs and Outputs Diagram



Engine Control Systems

Sensor inputs and internal *EMM* controllers are used to control the outboard's engine operation.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** for a complete list of all engine fault codes.

Internal Sensors

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 fault code 25
Engine Monitor: TEMP display ON

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

Activates SHUTDOWN
Stores fault code 29
Engine Monitor: TEMP display ON

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. 89.

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

Stores fault code 24

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 fault code 23

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 fault code 18
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 fault code 17
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 fault code 27
Engine Monitor: 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 fault code 26
Engine Monitor: BATTERY display ON

5 V Circuit Sensor

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

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

Stores fault code 78

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 fault code 44

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

Stores fault code 45

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

Stores fault 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 fault code 87

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

Stores fault code 88

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

Stores fault code 89

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 **Fault 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 fault codes.

Air Temperature Sensor

The air temperature sensor monitors the air temperature at the plenum.

If the AT sensor temperature value is below -22° F (-30° C), the *EMM*:

Stores fault code 48

Engine Monitor: TEMP display ON

If the AT sensor temperature value exceeds 158° F (70° C), the *EMM*:

Stores fault code 49

Engine Monitor: TEMP display ON

If the AT sensor circuit fails, the *EMM*:

Stores fault code 47

Engine Monitor: TEMP display ON

Exhaust Temperature Sensor

The exhaust temperature (EGT) sensor monitors the exhaust temperature at the exhaust adapter.

If the EGT sensor circuit fails (exhaust temperature less than 60°F (20°C) for 5 seconds), the *EMM*:

Stores fault code 134

Engine Monitor: CHECK ENGINE display ON

If the EGT sensor temperature value exceeds:

- 122°F (50 °C), less than 1500 RPM
- 122 to 149°F (50 to 65 °C), less than 2500 RPM
- 149 to 194°F (65 to 90 °C), less than 3750 RPM
- 194°F (90 °C), greater than 3750 RPM

the *EMM*:

Activates S.A.F.E. (limited to 1000 RPM)

Stores fault code 136

Engine Monitor: CHECK ENGINE display ON

Engine Temperature Sensor

Monitors cylinder head temperature.

If cylinder head temperature exceeds 194° ±3°F (90° ±1.6°C) above 3500 RPM for 3 seconds, the *EMM*:

Stores fault code 43 (port sensor)

Stores fault code 69 (starboard sensor)

Engine Monitor: TEMP display ON

Engine and Control Systems

Engine Control Systems

If the cylinder head temperature exceeds 212° F (100° C) below 3500 RPM, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores fault code 40 (port sensor)
Stores fault code 70 (starboard sensor)
Engine Monitor: TEMP display ON

If cylinder head temperature exceeds 239° F (115° C) for 3 seconds, the *EMM*:

Activates SHUTDOWN
Stores fault code 31
Engine Monitor: TEMP display ON

The outboard will not restart until the engine temperature returns to normal. Refer to **Shutdown Mode** on p. 89.

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

Stores fault code 41 (port sensor)
Stores fault code 67 (starboard sensor)

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

Stores fault code 42 (port sensor)
Stores fault code 68 (starboard sensor)

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

Stores fault code 58 (port sensor)
Stores fault code 59 (starboard sensor)

Low Oil Level Switch

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

If the oil level falls below 25% capacity, the *EMM*:

Engine Monitor: OIL display ON

After LOW OIL is displayed, the *EMM* counts oil pump pulse cycles again. When it reaches 20,000 pulses, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores fault code 117
Engine Monitor: OIL display ON

To recover from *S.A.F.E.* mode:

- Oil level must be above 25%
- The warning resets after three oil pump pulse cycles when the outboard has been stopped and restarted.

If outboard has been run for more than 5 hours with NO OIL faults (codes 34, 36 or 117), the *EMM*:

Activates SHUTDOWN
Stores fault code 33
Engine Monitor: OIL display ON

Oil Level Sensor

The oil level sensor monitors the oil level in the oil tank and provides information to a digital gauge display. Due to the contour of the on-engine oil tank, oil level accuracy may vary up to 5% as oil is consumed from the tank.

If the oil level sensor signal falls BELOW range, the *EMM* signals:

Stores fault code 112

If the oil level sensor signal is ABOVE range, the *EMM*:

Stores fault code 113

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 fault code 16

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 fault code 1-6 (code indicates cyl)
Engine Monitor: CHECK ENGINE display ON

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

Stores fault code 7 (port sensor)
Stores fault code 8 (starboard sensor)
Engine Monitor: CHECK ENGINE display ON

Internal *EMM* Functions

ROM Verification

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

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 fault code 77

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 the TPS is advanced from idle position.

Electronic Throttle Controller

Refer to **Electronic Throttle Controller** on p. 84.

Electronic Shift Controller

Refer to **Electronic Shift Controller** on p. 86.

Dynamic Power Steering

Refer to **Dynamic Power Steering (DPS)** on p. 301.

Engine and Control Systems

Throttle, Shift and Steering Control Systems

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. 88.

Refer to **S.A.F.E.** on p. 89.

Refer to **Shutdown Mode** on p. 89.

Fault Code Creation and Storage

Refer to the **Fault Code Chart** at the back of this manual for a complete list of all engine fault codes.

Throttle, Shift and Steering Control Systems

Shift and throttle information is transmitted and received between the *EMM* and *ICON II* remote control system via a dedicated Controller Area Network (CANbus), known as the remote control network, or private network. For safety, information is also shared on a *NMEA 2000* network as backup.

Sensor inputs and internal *EMM* controllers are used to control the operation of the outboard's shift and throttle functions.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** for a complete list of all control system fault codes.

Reprogramming or replacement may be required to resolve *EMM* related issues.

Electronic Throttle Controller

The *EMM* receives inputs from the remote control via the remote control network. The *EMM* transmits the input signals to the Electronic Throttle Controller (ETC). The ETC processes the inputs and sends signals to the Electronic Throttle Body (ETB). The ETB converts the signals to movement of the throttle plate. The ETB consists of a motor assembly, throttle plate and two Throttle Position Sensors (TPS), "TPS A" and "TPS B".

Each TPS receives a voltage signal from the *EMM*. As the throttle lever is rotated, the *EMM* receives a return voltage signal through a second wire. A third wire provides a ground circuit back to the *EMM*.

TPS A and TPS B voltages are correlated. As the throttle plate opens, TPS A voltage increases and TPS B voltage decreases. As the throttle plate closes, TPS A voltage decreases and TPS B voltage increases.

The *EMM* monitors the TPS connections and voltages on the remote control network.

If communication from co-processor to processor is lost for more than 250 milliseconds, the *EMM*:

Activates S.A.F.E.
Stores fault code 162
Engine Monitor: CHECK ENGINE display ON

If co-processor safety messages are not being received, or if co-processor cannot disable driver, the *EMM*:

Activates S.A.F.E.
Stores fault code 183
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the TPS voltage. If TPS A voltage is less than 0.17 V, the *EMM*:

Stores fault code 163

If TPS A voltage is greater than 4.92 V, the *EMM*:

Stores fault code 164

If TPS B voltage is less than 0.07 V, the *EMM*:

Stores fault code 165

If TPS B voltage is greater than 4.82 V, the *EMM*:

Stores fault code 166

If TPS correlated voltages are out of range, the *EMM*:

Activates S.A.F.E.
Stores fault code 167
Engine Monitor: CHECK ENGINE display ON

If TPS A voltage is outside of 0.25 V to 1.47 V or TPS B voltage is outside 3.53 V to 4.75 V at key on, the TPS is out of idle range. The *EMM*:

Stores fault code 168

If signal from TPS A and TPS B are lost, the *EMM*:

Activates S.A.F.E.
Stores fault code 175
Engine Monitor: CHECK ENGINE display ON

If sensor reference voltage is fluctuating, but a sensor fault is NOT detected, the *EMM*:

Activates S.A.F.E.
Stores fault code 182
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors remote control lever position for out of range values. If the communication message values are greater than 1000 or less than 65535, the *EMM*:

Activates S.A.F.E.
Stores fault code 172
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ETC motor circuit. If the *EMM* detects the ETC circuit is OPEN, the *EMM*:

Activates S.A.F.E.
Stores fault code 173
Engine Monitor: CHECK ENGINE display ON

If the *EMM* detects excessive current draw, the *EMM*:

Activates S.A.F.E.
Stores fault code 174
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the throttle plate position. The throttle plate position is compared to the commanded position. If the difference is greater than 7% while the commanded position is not changing, the *EMM*:

Activates S.A.F.E.
Stores fault code 179
Engine Monitor: CHECK ENGINE display ON

Engine and Control Systems

Throttle, Shift and Steering Control Systems

The *EMM* monitors how much effort is required to move the throttle plate. When the 20ms duty cycle sum is greater than 5500, the throttle plate requires too much effort to move. The *EMM*:

Activates S.A.F.E.
Stores fault code 180
Engine Monitor: CHECK ENGINE display ON

If the key is turned on but the engine is not immediately started, the *EMM* checks throttle plate movement. If the throttle plate cannot close less than or equal to 10%, or if it cannot open greater than or equal to 80%, the throttle plate is not functioning correctly. The *EMM*:

Activates S.A.F.E.
Stores fault code 191
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ETC driver voltage, temperature and current. If any of these values are out of range, the *EMM*:

Activates S.A.F.E.
Stores fault code 181
Engine Monitor: CHECK ENGINE display ON

Electronic Shift Controller

The *EMM* receives inputs from the remote control via the remote control network. The *EMM* transmits the input signals to the Electronic Shift Controller (ESC). The ESC processes the inputs and transmits signals to the shift actuator. The shift actuator consists of a motor assembly, a Shift Position Sensor (SPS), and a NEUTRAL switch. The motor assembly drives the mechanical shift mechanism, while the SPS and NEUTRAL switch send actual gear position back to the *EMM*.

The *EMM* monitors the Shift Position Sensor (SPS).

If the SPS voltage is less than 0.25 V, the *EMM*:

Activates S.A.F.E.
Stores fault code 195
Engine Monitor: CHECK ENGINE display ON

If the SPS voltage is greater than 4.75 V, the *EMM*:

Activates S.A.F.E.
Stores fault code 196
Engine Monitor: CHECK ENGINE display ON

If the shift actuator cannot achieve the commanded gear, the *EMM*:

Activates S.A.F.E.
Activates SHUTDOWN (if NEUTRAL cannot be achieved)
Stores fault code 204
Engine Monitor: CHECK ENGINE display ON

If the SPS position differs from the NEUTRAL switch position, the *EMM*:

Activates SHUTDOWN
Stores fault code 201
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors for undesired actuator movement when the actuator is in FORWARD, NEUTRAL, or REVERSE. If movement is detected, the *EMM*:

Activates SHUTDOWN
Stores fault code 205
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the shift actuator NEUTRAL switch.

If the NEUTRAL switch voltage is less than 0.5 V, the *EMM*:

Activates S.A.F.E.
Stores fault code 197
Engine Monitor: CHECK ENGINE display ON

If the NEUTRAL switch voltage is greater than 4.5 V, the *EMM*:

Activates S.A.F.E.
Stores fault code 198
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors shift calibration. If the FORWARD or REVERSE calibration exceeds the limits saved in the *EMM*, the *EMM*:

Activates SHUTDOWN
Stores fault code 199
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ESC driver current. If the current exceeds 50 A, the *EMM*:

Activates SHUTDOWN
Stores fault code 200
Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ESC motor circuit.

If the *EMM* detects the ESC motor circuit is OPEN, the *EMM*:

Activates SHUTDOWN
Stores fault code 203
Engine Monitor: CHECK ENGINE display ON

If ESC motor current exceeds 8 A when moving into NEUTRAL, the *EMM*:

Activates SHUTDOWN
Stores fault code 207
Engine Monitor: CHECK ENGINE display ON

Engine Monitor System

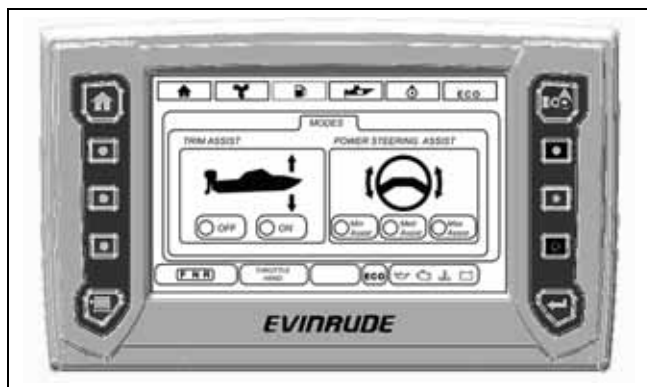
All remote controlled outboards, 40 HP and above, must be equipped with an engine monitoring system to warn the operator of conditions that could damage the outboard.

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:

- Digital displays and gauges
- *SystemCheck* analog gauges

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 ***Evinrude E-TEC G2 Installation and Predelivery Guide***.



Digital Touch-Screen Display

009062

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 **Fault 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. Digital displays and gauges will self test as follows:

Evinrude ICON Touch 7.0 and 4.3 CTS — The touch screen displays a “booting” screen, followed by the *Evinrude* logo and then the default home page.

ICON — The *ICON* gauge sounds a beep. The tachometer and speedometer LCD screens display SELF TEST MODE IN OPERATION. When the self test is complete, the gauges will beep a final time, then display SELF TEST COMPLETE!

I-Command — The *I-Command* system displays the *Evinrude* E-TEC welcome screen, followed by the tachometer display.

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

SystemCheck — The *SystemCheck* monitor sounds a beep. The *SystemCheck* gauge indicator lights turn on simultaneously, then off in sequence.

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.

Warning System

S.A.F.E.

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	Description
1 – 6	Excessive knock detected
17	Alternator 55 V below expected range
18	Alternator 55 V above expected range
25	EMM temperature above expected range
34	Crankcase oil pump OPEN circuit
36	Cylinder oil pump OPEN circuit
40	Cylinder head temperature above expected range—low speed
43	PORT Cylinder head temperature above expected range
69	STARBOARD cylinder head temperature above expected range
70	Cylinder head temperature above expected range—low speed
117	Critical LOW OIL detected
132	Vapor separator upper level switch OPEN circuit
133	Vapor separator lower level switch OPEN circuit
136	Exhaust Temperature above limit
137	Vapor separator low fuel level detected
162	ETC shutdown
167	ETC TPS Signal OOC
172	ETC lever Position out of range
173	ETC motor OPEN circuit
174	ETC motor excessive current
175	ETC TPS stability performance
179	ETC running error fault
180	ETC running effort fault
181	ETC drive status fault
182	ETC system critical fault
183	Controller level monitoring error
191	ETC step response failure
204	ESC Cannot achieve desired gear

Activation

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

Recovery

The engine will operate in S.A.F.E. as long as the fault condition exists. To recover normal operation, two conditions must be met:

- Sensor or switch readings must be back within limits
- The *EMM* must be reset—stop and restart

Shutdown Mode

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

Conditions that initiate shutdown

Code	Description
15	ROM checksum error
29	Excessive <i>EMM</i> temperature
31	Excessive engine temperature
33	Excessive NO OIL condition
57	High RPM with low TPS setting
199	SHIFT calibration invalid
200	ESC driver status flag
201	ESC Position Sensors OOC
203	ESC Motor OPEN circuit
204	ESC Cannot achieve desired gear
205	ESC System Critical Fault
207	ESC Motor excessive current

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.

Engine and Control Systems

Diagnostic Software Functions

- Check for internal fuel leakage from a leaking injector or vapor separator vent hose.

⚠ WARNING

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

Recovery

To recover from shutdown mode, the *EMM* must NOT detect the related fault at start-up.

After any code is cleared using diagnostics software the *EMM* must be turned OFF and ON again.

Shutdown related to code 29 and 31:

- Engine will NOT restart until the *EMM* and/or engine temperature to return to normal.
- Correct the cooling problem.
- Use *Evinrude Diagnostics* software to clear fault code 29 or 31.

Shutdown related to code 33:

- Engine will restart and run for 1 minute before it shuts down again.
- To correct the problem fill the oil tank and prime the oil system. Refer to **Oil Supply Priming** on p. 196.
- Use *Evinrude Diagnostics* software to clear fault code 33.

Shutdown related to code 57:

- Engine will NOT restart until problem is corrected.
- Find and correct the problem that caused the fault BEFORE clearing the *Occurred fault* code.
- Requires the removal of the *Occurred fault* code. Use *Evinrude Diagnostics* software to clear fault code 57.

Shutdown related to codes 199, 200, 201, 203, 204, 205, or 207:

- Engine will NOT restart until problem is corrected.
- Find and correct the problem that caused the fault BEFORE clearing the *Occurred fault* code.

Note: Engine will re-start after key switch is cycled, as long as the fault is not active.

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 service adjustments to the engine.

Use *Evinrude Diagnostics* software, version 6.1 or higher, and a laptop computer to access program information.

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

Communication

Evinrude E-TEC G2 models communicate diagnostic information over the *NMEA 2000* network. An MPI-2 Adapter, P/N 767994, is required.

Connect the *NMEA 2000 connector* to a Tee, P/N 764151, in the *NMEA 2000* network. Connect the USB connector of the MPI-2 interface card directly to the computer’s USB port.



MPI-2 Adapter, P/N 767994

1. NMEA 2000 network connector
2. USB connector

766690

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/black) of the *EMM* J1-B connector.

Identification

The *Identification* screen displays the engine model and serial numbers as well as other manufacturing information. The outboard model and serial numbers displayed on the *Identification* screen must match the identification label on the outboard swivel bracket.



Identification Screen

009281

Engine Monitor Information

The *Engine Monitor* screen displays dynamic information while the outboard is running. Changes in data, such as voltages or temperatures, are shown as they happen.



Engine Monitor Screen

009242

Faults and Fault Codes

An abnormal condition that occurs is known as a fault. There are three types of faults:

- *Active Fault* – A fault that currently exists. Active faults become occurred faults only if the outboard is running.
- *Occurred Fault* – A fault that occurred while the engine was running at some point in time.
- *Historical Fault* – An historical record of occurred faults. Historical faults cannot be cleared.

A fault code and corresponding fault code number are generated for monitored conditions. Refer to the **Fault Code Chart** for a complete list of all fault codes.

Active Faults

The *Active Faults* screen displays the code number, the number of times the event occurred, and number of occurrences.



Active Faults Screen

009283

Engine and Control Systems

Diagnostic Software Functions

Occurred Faults

The *Occurred Faults* screen displays the code number, the number of times the event occurred, and operating hours of first and last occurrences.



Occurred Faults Review Screen

009282

Historical Faults

The *Historical Faults* screen displays 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 Screen

009288

Settings

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.



Settings Screen

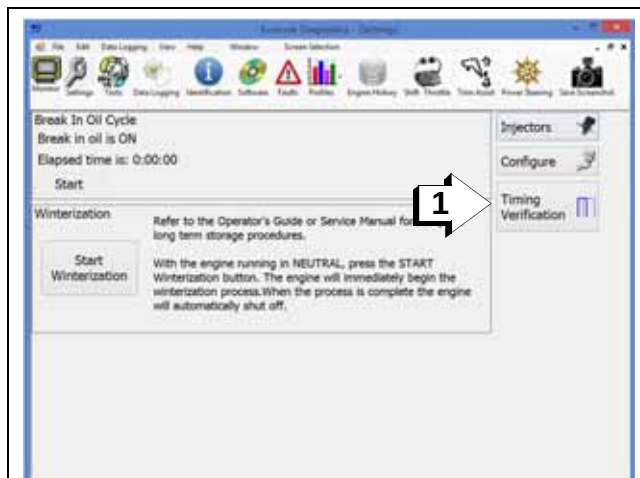
009243

1. Break-in oil setting

Ignition Timing

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

Refer to **Timing Adjustments** on p. 136.



Settings Screen

009423

1. Timing Verification

Check timing after replacing a powerhead, crankshaft or flywheel.

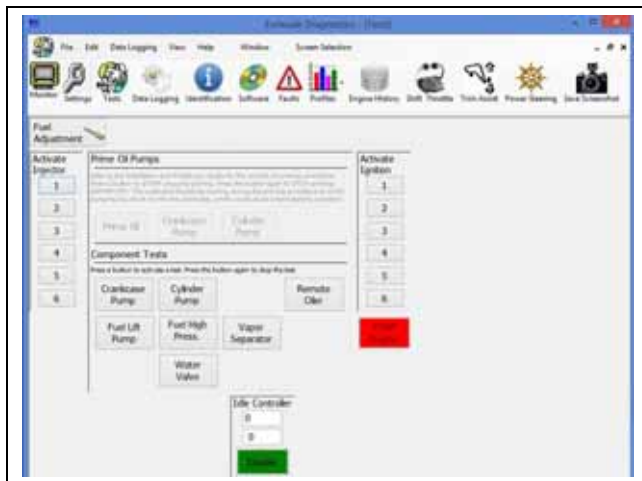
IMPORTANT: Make sure the timing pointer is set and the outboard reaches operating temperature before making adjustments.

Tests

The Tests screen displays both static and dynamic tests. The appropriate buttons are active depending on whether the outboard is running or not running.

Static Tests

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



Tests Screen (Static Mode)

009225

Ignition Test

Use the diagnostics software to test each ignition circuit. Refer to **Ignition System Static Test** on p. 105.

Injector Test

Use the diagnostics software to test each fuel injector circuit. Refer to **Fuel Injector Static Test** on p. 106.

Oil Pumps

Use the diagnostics software to test the oil pump circuits. Refer to **Oiling System Tests** on p. 198.

Fuel Pumps

Use the diagnostics software to test the fuel lift pump and fuel circulation pump circuits. Refer to **Fuel Pump Static Test** on p. 105.

Dynamic Tests

Dynamic tests are performed with the outboard running.



Tests Screen (Dynamic Mode)

009124

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. 108.

Injector 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. 108.

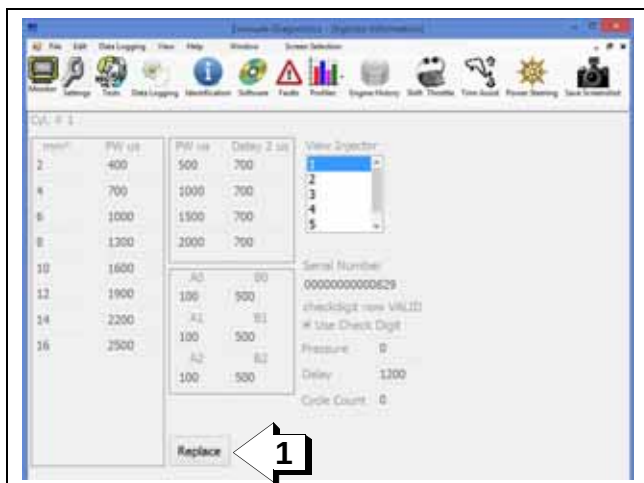
Prime Oil

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

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.

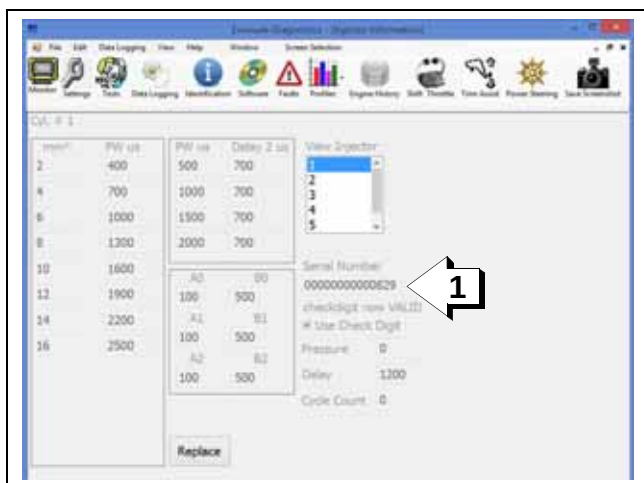
To install a service injector, click the “Replace” button on the *Injector Information* screen and select the file for the replacement injector. Refer to **Fuel Injector Service** on p. 174.



Injector Information Screen
1. Replace button

009285

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



Injector Information Screen
1. Injector serial number

009285

History and Reports

Engine history and 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.

From the *History* screen:

- Press the *Create EDF* button to create an engine data file. Engine data files are required when replacing an *EMM*.
- Press the *Running History* button to view the *Last Two Minutes* data.
- Press the *Create Report* button to create a new report (must be connected to/communicating with the engine *EMM*).
- Press *Open Exports Folder* to view saved reports.
- Press *Show Selected Report* to view a report selected from the Engine History Records List.



History Screen

009292

Software

Various 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 from:

- *Update EMM* to update engine management software
- *Load Co-processor firmware* to update the *EMM* co-processor
- *Load Steering firmware* to update a DPS module
- *EMM Transfer* to save and transfer engine history data when the *EMM* must be replaced

Follow the instructions provided with the program.



Software Screen

009287

EMM Servicing

IMPORTANT: If a new *EMM* is being installed, refer to **Software** on p. 95.

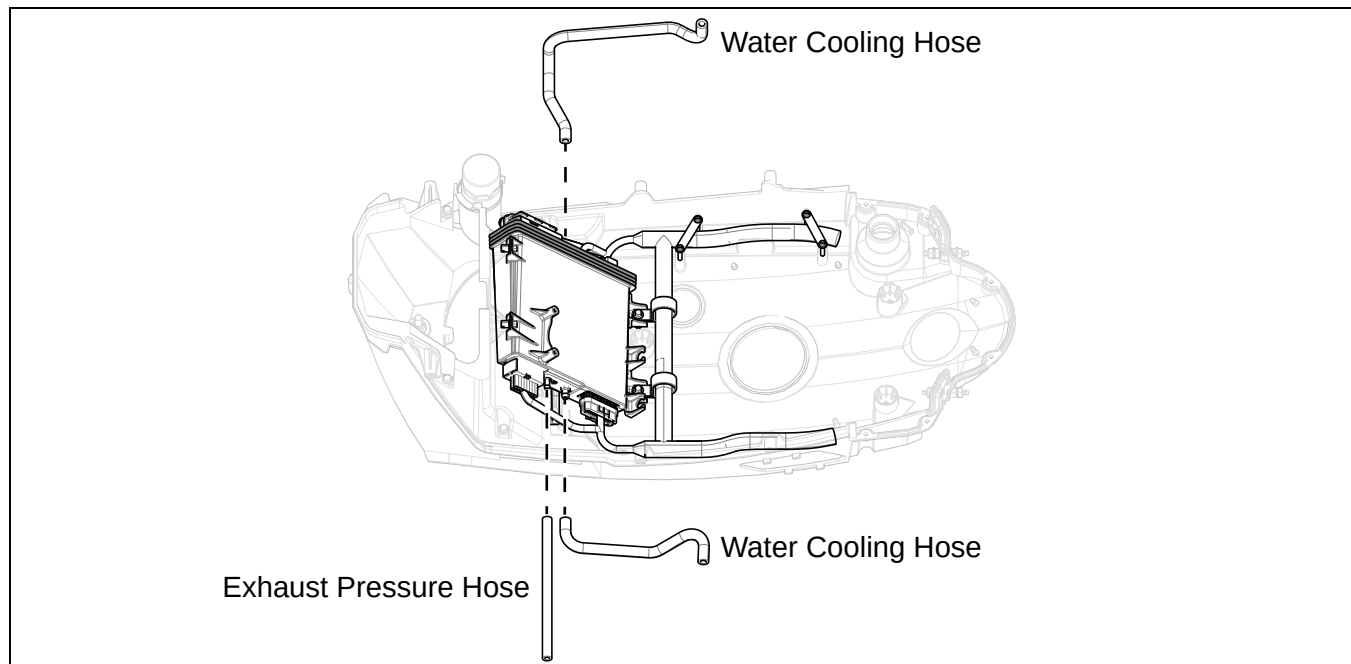
Removal

Removal and installation of the *EMM* requires removal of the engine covers and frames.

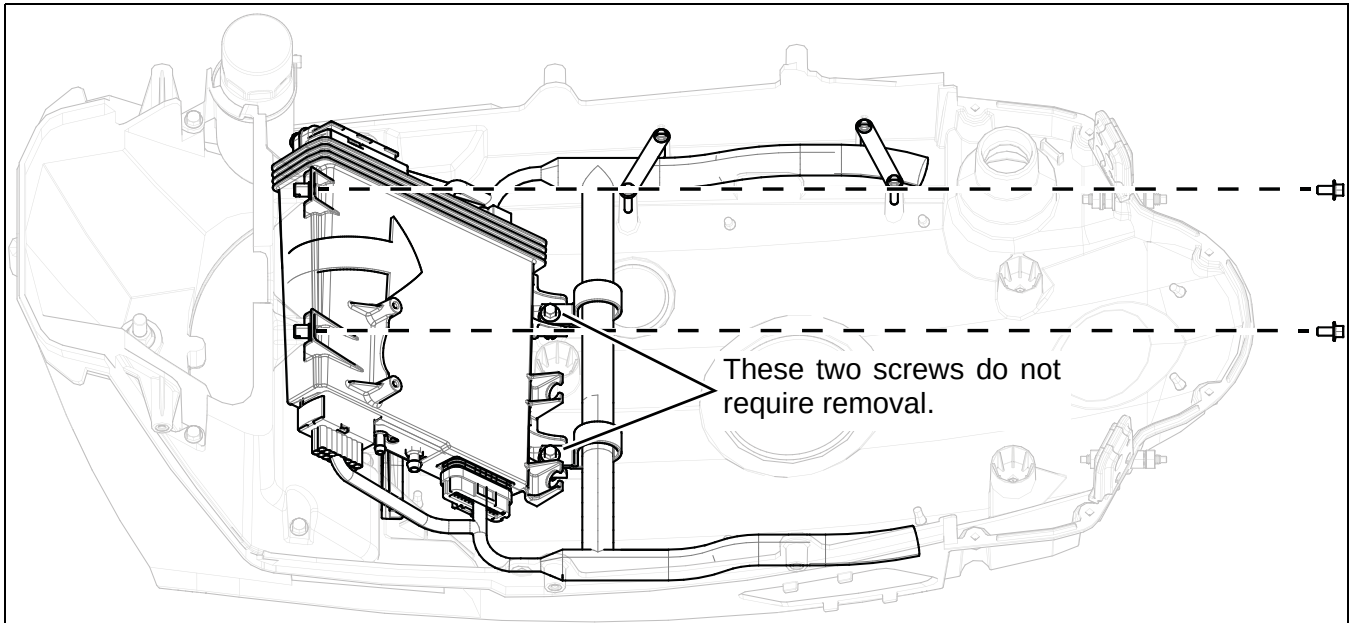
- See **Engine Cover and Frame Service** on p. 55.

After covers and frames are removed from the engine continue with the procedure on the next page.

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

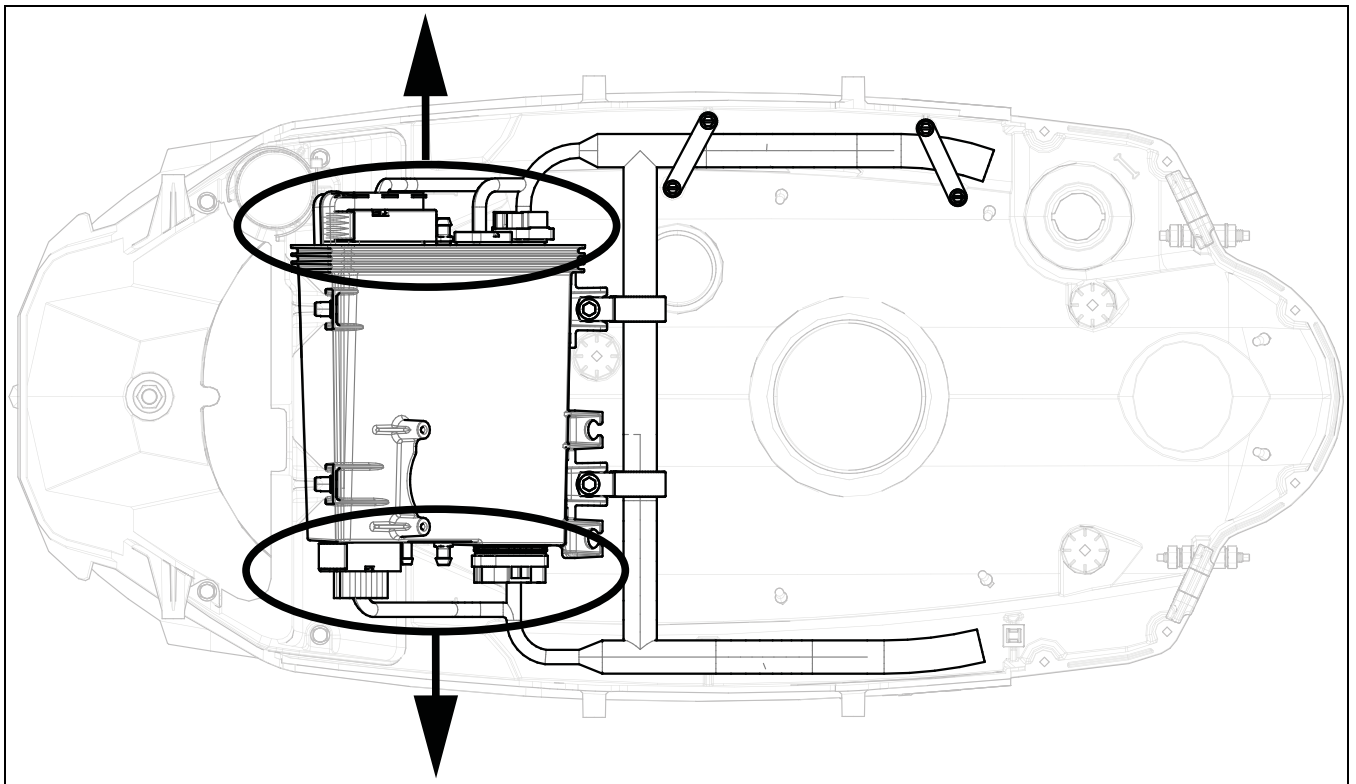


Remove *EMM* mounting screws (2X). Rotate *EMM* away from frame as shown.



4

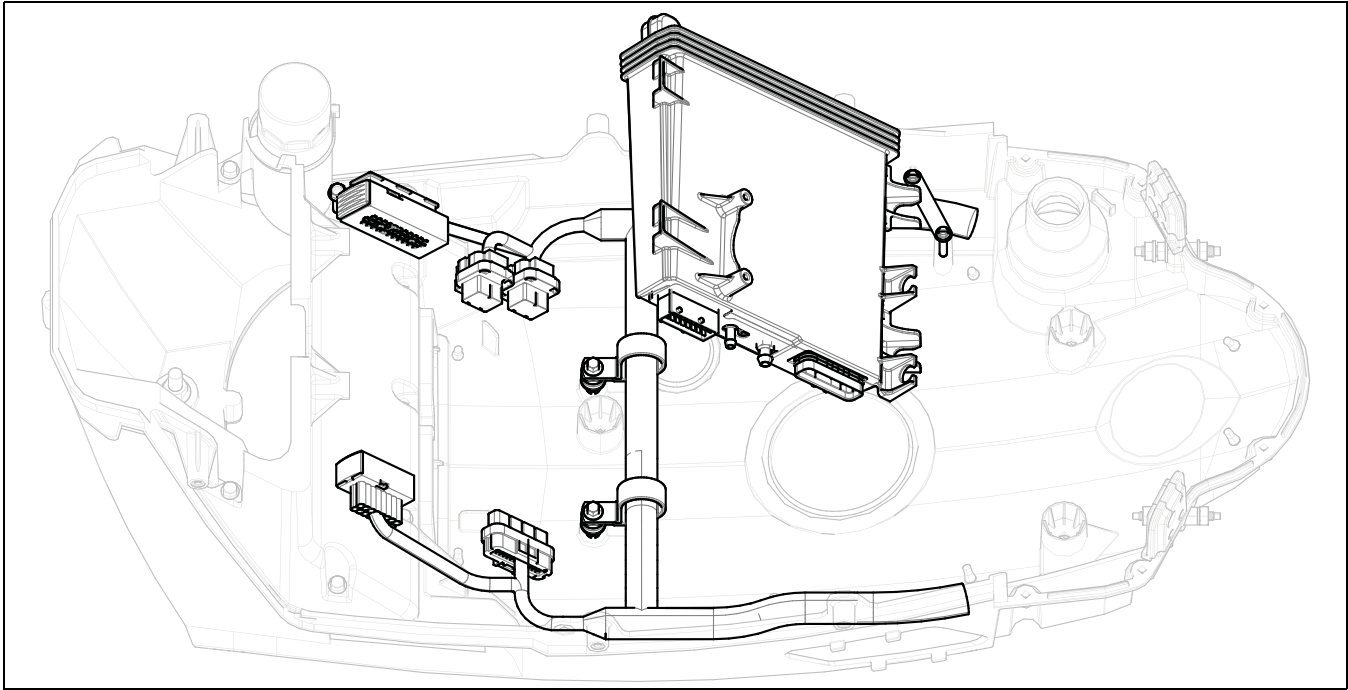
Disconnect J1-A, J1-B, J2, J3 and J4 connectors from *EMM*.



Engine and Control Systems

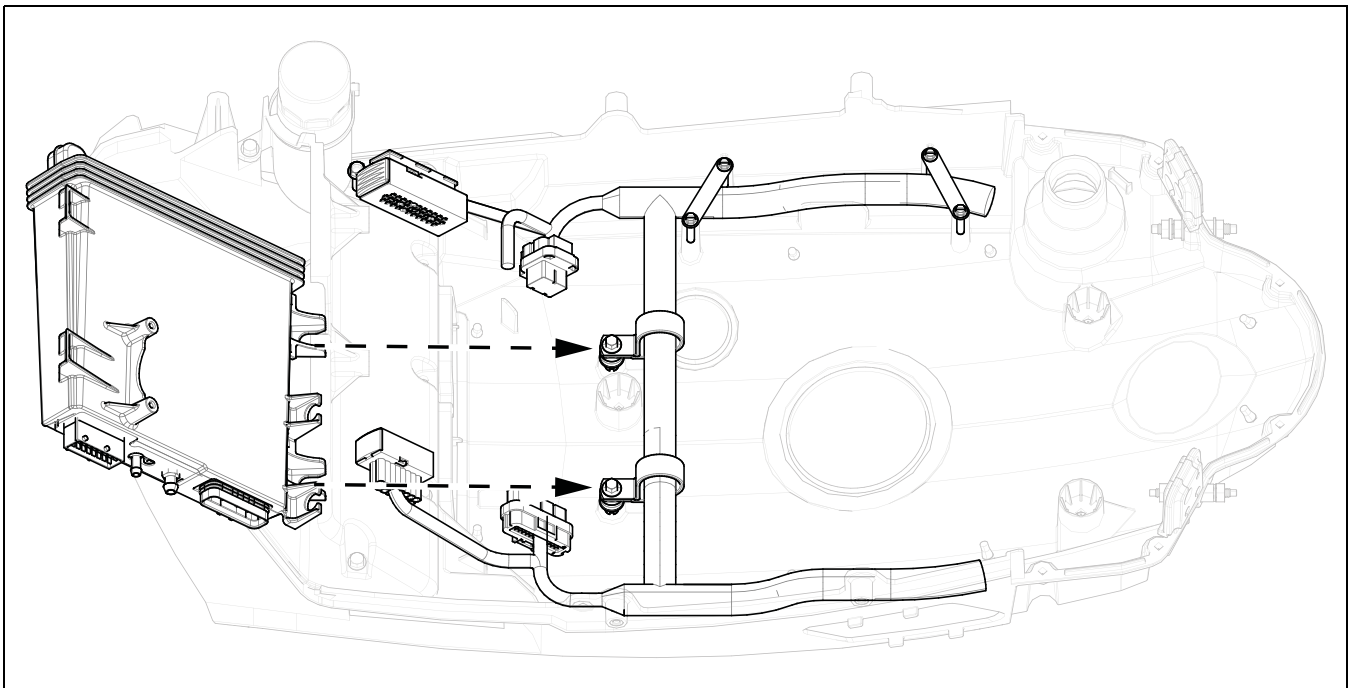
EMM Servicing

Remove *EMM* from frame.



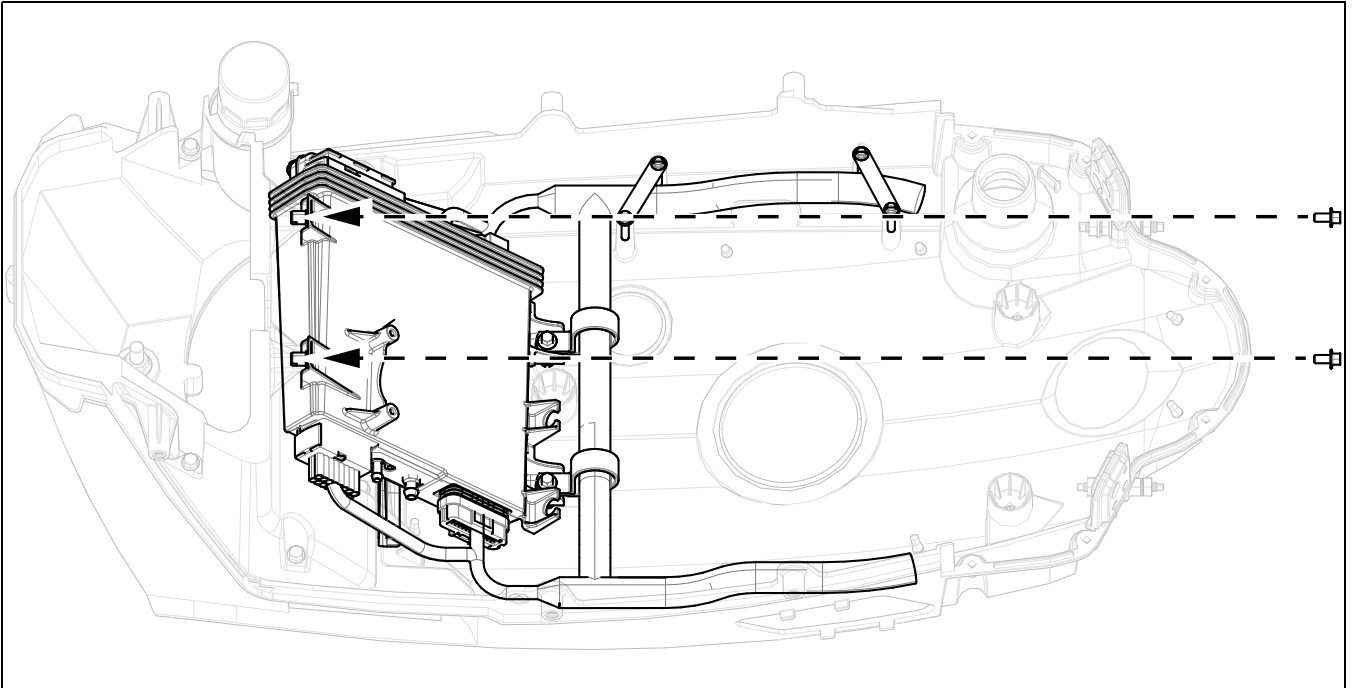
Installation

Align slots in bottom side of *EMM* case with isolator mounts on the frame. Slide *EMM* into position.



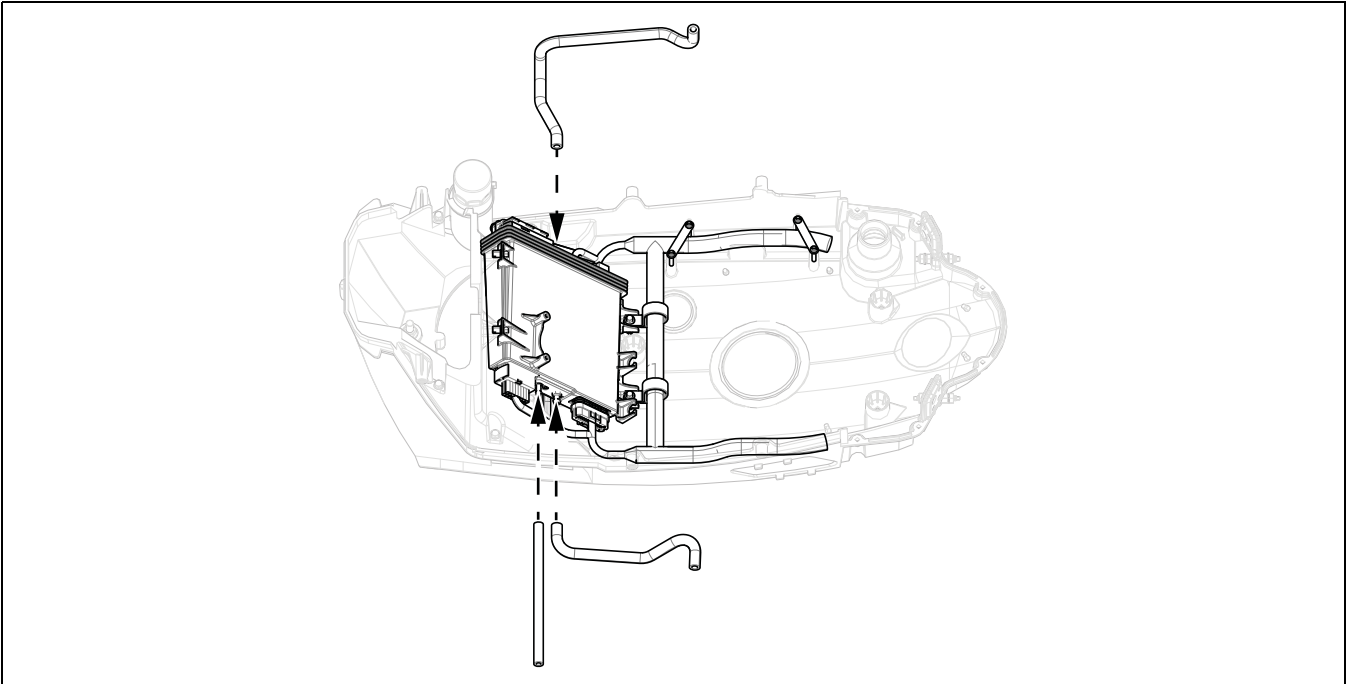
Install J1-A, J1-B, and J2, J3, and J4 connectors.

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



4

Install exhaust pressure hose and water cooling hoses. Secure each hose with one 15.7 mm Oetiker clamp, P/N 346786.



After the *EMM* is installed onto the center frame, install of the frames and engine covers.

- See **Engine Cover and Frame Service** on p. 55.

Technician's Notes

[illegible][illegible]

System Analysis

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 Fuel System Static Tests 105

 Oil System Static Tests 106

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 Cylinder Drop Tests 107

 Fuel Control Adjustment 108

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. 112.
- Refer to **WIRING DIAGRAM** at the back of this manual.
- Refer to **Connector Servicing** on p. 139.

Make sure all ground connections are clean and tight. Refer to **Ground Circuits** on p. 115.

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 fuses and the emergency stop switch lanyard.

Diagnostic Software Inspections

Before running the outboard, use *Evinrude Diagnostics* software v 6.1 or higher to review information saved in the *EMM*.

Correct any problems and clear any fault codes before further troubleshooting. Refer to **Faults and Fault Codes** on p. 91.

Faults

Check the *Faults Screen*. Press the *Active Faults* button to view existing faults.

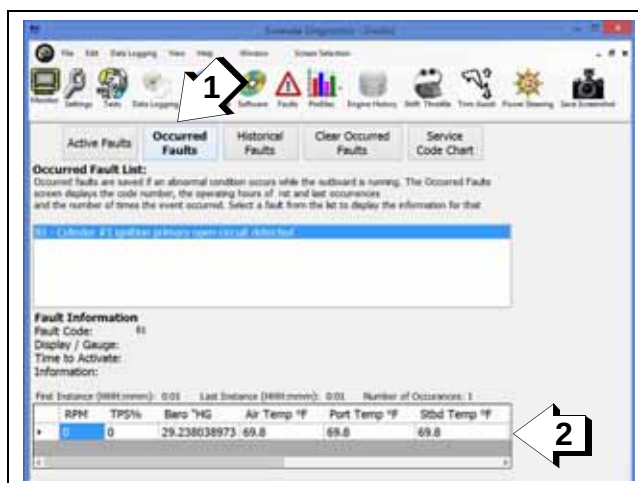
The *Active Faults* screen displays fault codes that currently exist. An active fault becomes an occurred fault only if the outboard is running.



Active Faults Screen
1. *Active Faults* button
2. *Information*

009282

Press the *Occurred Faults* button to view detailed information about the operating conditions of the engine at the time the fault code was set.



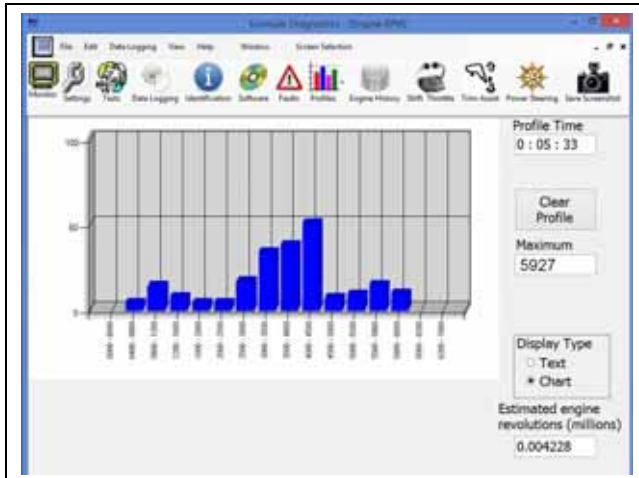
Occurred Faults Screen
1. *Occurred Faults* button
2. *Detailed information*

009282

Profiles

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

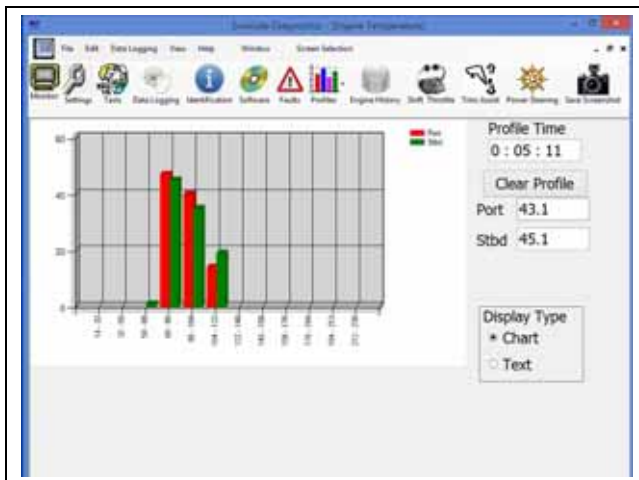
- Check the *RPM Profile* for long periods of low speed operation or periods of over-revving rpm.



RPM Profile

009290

- Check the *Engine Temperature Profile* for evidence of cold running or overheating.



Engine Temperature Profile

009291

History and Reports

View engine history and save reports from the *History* screen. Reports save a snap-shot of current engine and sensor conditions.

From the *History* screen:

- Press the *Create EDF* button to create an engine data file. Engine data files are required when replacing an *EMM*.
- Press the *Running History* button to view the *Last Two Minutes* of engine run history.
- Press the *Create Report* button to create a new report (must be connected to/communicating with the engine *EMM*).

- Press *Open Exports Folder* to view saved reports.
- Press *Show Selected Report* to view a report selected from the Engine History Records List.



History Screen

009292

- The *Last Two Minutes* report is generated and saved as part of the Engine Report. Engine run-time values during the last two minutes of operation above 1500 rpm is collected once per second. The newest record is first on the list. As each new record is added, the oldest record is removed.

Time	RPM	TPS	Temp °F	V/Vital	Rough	OIL	Time	RPM	TPS	Temp °F	V/Vital	Rough	OIL
0	3000	0	91.4	1.55	000000	0	-60	0	10	32	1.00	000000	0
-1	3100	0	91.4	1.55	000000	0	-61	0	10	32	1.00	000000	0
-2	3000	0	91.4	1.55	000000	0	-62	0	10	32	1.00	000000	0
-3	2900	0	91.4	1.55	000000	0	-63	0	10	32	1.00	000000	0
-4	2800	0	91.4	1.55	000000	0	-64	0	10	32	1.00	000000	0
-5	2700	0	89.6	1.55	000000	0	-65	0	10	32	1.00	000000	0
-6	2600	0	89.6	1.55	000000	0	-66	0	10	32	1.00	000000	0
-7	2500	0	89.6	1.55	000000	0	-67	0	10	32	1.00	000000	0
-8	2400	0	89.6	1.55	000000	0	-68	0	10	32	1.00	000000	0
-9	2300	0	89.6	1.55	000000	0	-69	0	10	32	1.00	000000	0
-10	2200	0	89.6	1.55	000000	0	-70	0	10	32	1.00	000000	0
-11	2100	0	89.6	1.55	000000	0	-71	0	10	32	1.00	000000	0
-12	2000	0	89.6	1.55	000000	0	-72	0	10	32	1.00	000000	0
-13	1900	0	87.8	1.55	000000	0	-73	0	10	32	1.00	000000	0
-14	1800	0	87.8	1.55	000000	0	-74	0	10	32	1.00	000000	0
-15	1700	0	89.6	1.55	000000	0	-75	0	10	32	1.00	000000	0
-16	1600	0	87.8	1.55	000000	0	-76	0	10	32	1.00	000000	0
-17	1500	0	87.8	1.55	000000	0	-77	0	10	32	1.00	000000	0
-18	1400	0	87.8	1.55	000000	0	-78	0	10	32	1.00	000000	0
-19	1300	0	87.8	1.55	000000	0	-79	0	10	32	1.00	000000	0
-20	1200	0	87.8	1.55	000000	0	-80	0	10	32	1.00	000000	0
-21	1100	0	89.6	1.55	000000	0	-81	0	10	32	1.00	000000	0
-22	1000	0	87.8	1.55	000000	0	-82	0	10	32	1.00	000000	0
-23	900	0	87.8	1.55	000000	0	-83	0	10	32	1.00	000000	0
-24	800	0	87.8	1.55	000000	0	-84	0	10	32	1.00	000000	0
-25	700	0	87.8	1.55	000000	0	-85	0	10	32	1.00	000000	0
-26	600	0	87.8	1.55	000000	0	-86	0	10	32	1.00	000000	0

Last Two Minutes

009295

Operational Inspections

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

- Make sure the outboard can be cranked easily, with no mechanical binding.

System Analysis

Diagnostic Procedures

Data Logging

Run the outboard in the water at all speeds. Be sure to run at any report problem engine speeds to confirm actual symptoms. Inspection should include the following:

- Use the diagnostics software *Logging* function to record engine data as a problem is occurring.



Logging Screen

009293

Troubleshooting

Outboard will not crank, starter does not operate:

- Check condition of battery and cables (main battery switch and cables). Make sure battery cables are not reversed.
- Confirm that switched B+ is present at "A" terminal (purple wire) of starter solenoid with key switch in the ON position.
- Refer to **Electric Starter Tests** on p. 131. Repair starter or start circuit as needed.

Outboard cranks, will not start:

- Check emergency stop switch and lanyard
- Use the *Evinrude Diagnostics* software *Faults* screens to check for current fault codes. If there are multiple occurred sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
- Perform a Static Ignition test using *Evinrude Diagnostics* software and an inductive timing light. Refer to **Ignition System Static Test** on p. 105.
- If ignition test indicates steady spark, refer to **Fuel System Static Tests** on p. 105.

Outboard runs, low on power, misfires:

- 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. 108.
- Use an inductive timing light to check ignition and fuel injector circuits. Refer to **Running Ignition Tests** on p. 122 and **Running Fuel System Tests** on p. 160.
- 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. 108.
- 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.
- 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.

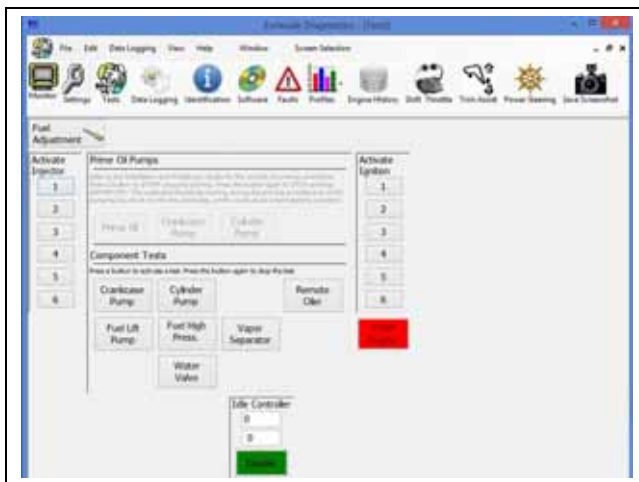
Static Tests

Ignition System Static 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.

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

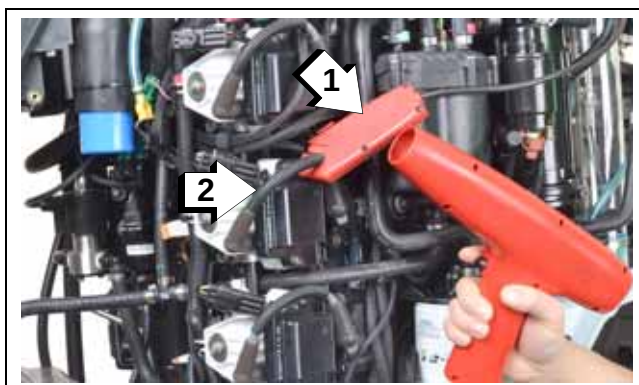


Testing, Static Test Screen

009225

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

009363

Results:

No spark on one or more cylinders:

- Inspect or replace spark plugs
- Refer to **Ignition Circuit Tests** on p. 123
- Refer to **Ignition Coil Tests** on p. 123.

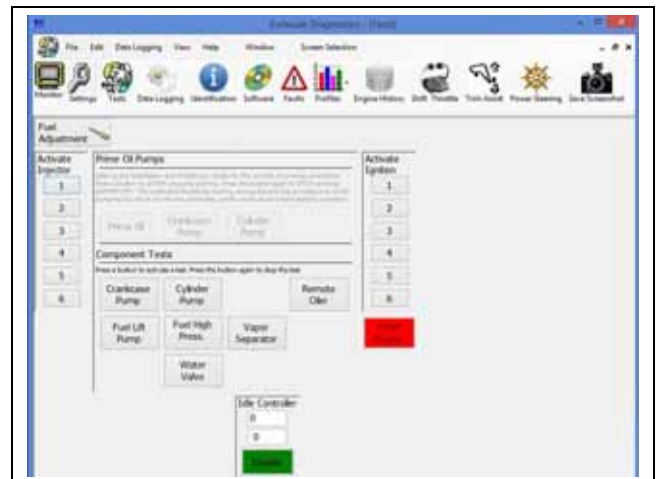
Steady spark on all cylinders:

- Refer to **Running Ignition Tests** on p. 122 and **Dynamic Tests** on p. 108.

Fuel System Static Tests

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

009225

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 **Fuel Circulation Pump Resistance Test** on p. 166.

If the pump runs:

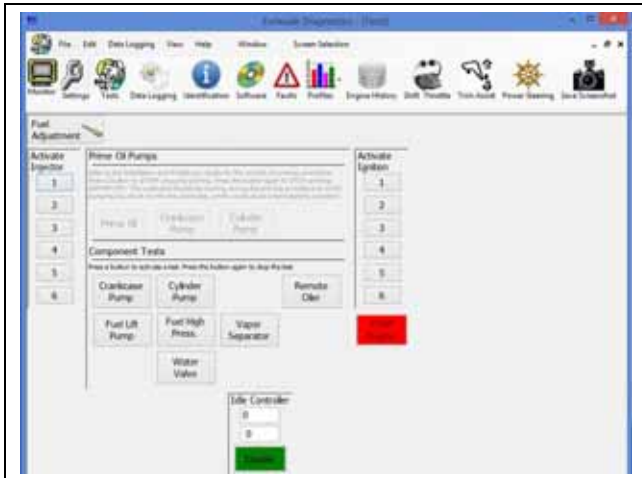
- Refer to **Fuel System Pressure Tests** on p. 160.
- Refer to **Running Fuel System Tests** on p. 160.

System Analysis

Static Tests

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

009225

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. 160.

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. 167.

All injectors actuate:

- Refer to **Running Fuel System Tests** on p. 160.

Oil System Static Tests

Crankcase Oil Pump Static Test

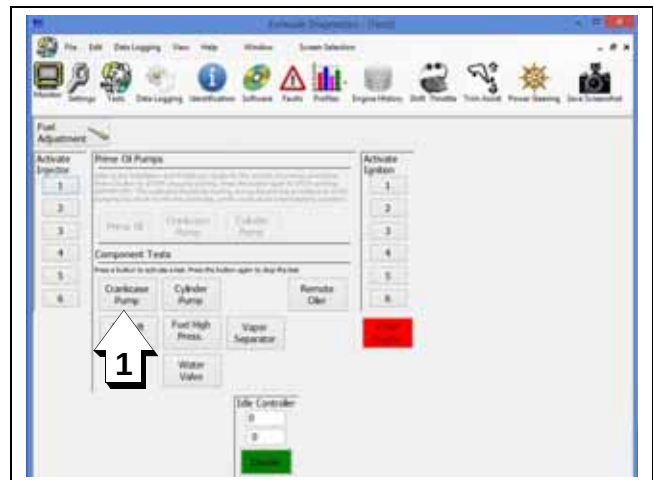
IMPORTANT: Static tests operate the oil pumps with 30 V on the system voltage (55 V) circuit. The start assist circuit (SAC) of the *EMM* converts battery voltage (12 V) to 30 V of system voltage. The battery **MUST** be fully charged and connections must be clean and tight.

Oil pump activation should be carefully confirmed. Listen for an audible click from the oil pump when it is activated.

Crankcase Oil Pump Static Test

The *EMM* controls the pump by providing ground through pin 20 (blue wire) of the J1-B connector and pin B (blue wire) of the oil pump connector.

Use the *Crankcase Pump* test of *Evinrude Diagnostic* software *Tests* screen to activate the oil pump. This test activates the *EMM* control function for the oil pump.



Tests Screen

1. Crankcase Pump button

009225

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil pump connector (pin B).

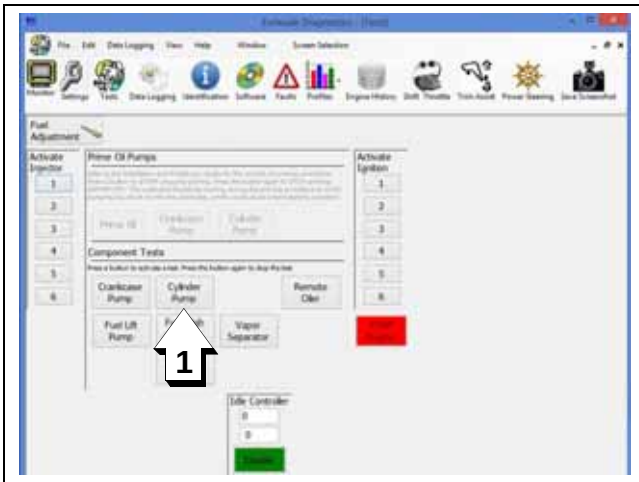
Results:

- If the light flashes, the *EMM* and oil pump circuits are not at fault.
- If the light does not flash, refer to **Oil Pump Electrical Tests** on p. 198.

Cylinder Oil Pump Static Test

The *EMM* controls the pump by providing ground through pin 10 (blue/orange wire) of the J3 connector and pin B (blue/orange wire) of the oil pump connector.

Use the *Cylinder Pump* test of *Evinrude Diagnostics* software *Tests* screen to activate the oil pump. This test activates the *EMM* control function for the oil pump.



Tests Screen

1. Cylinder Pump button

009225

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil pump connector (pin B).

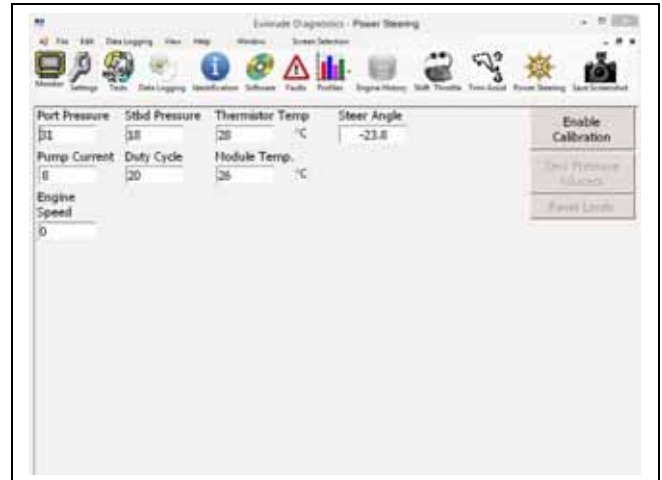
Results:

- If the light flashes, the *EMM* and oil pump circuits are not at fault.

If the light does not flash, refer to **Oil Pump Electrical Tests** on p. 198.

Dynamic Power Steering (DPS)

Use the Power Steering screen of *Evinrude Diagnostics* software to observe DPS system reactions while turning the steering wheel.



Power Steering Screen

009401

Dynamic Tests

Cylinder Drop Tests

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

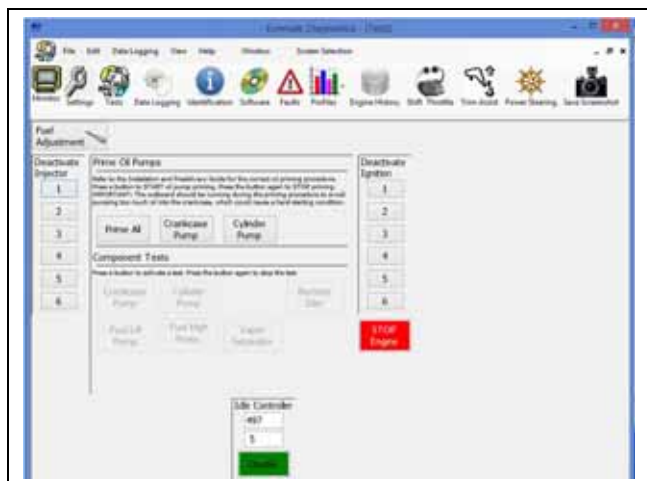
- The Dynamic Ignition test disables the ignition and fuel injection circuits to a cylinder.
- The Dynamic Fuel test momentarily disables one fuel injector circuit.

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

009124

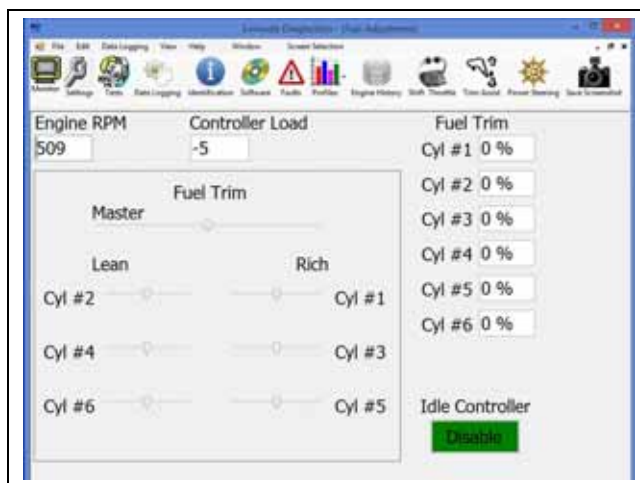
IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed. The *Dynamic Tests* screen includes a function to temporarily disable the idle controller.

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.



009294

If the outboard run quality improves with a fuel control adjustment, eliminate other possibilities before replacing an injector:

- Refer to **Fuel System Tests** on p. 160.
- Refer to **Running Fuel System Tests** on p. 160.

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

Electrical and Ignition

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Service Charts

Modules and Sensors

The diagrams illustrate the assembly and torque specifications for various automotive components:

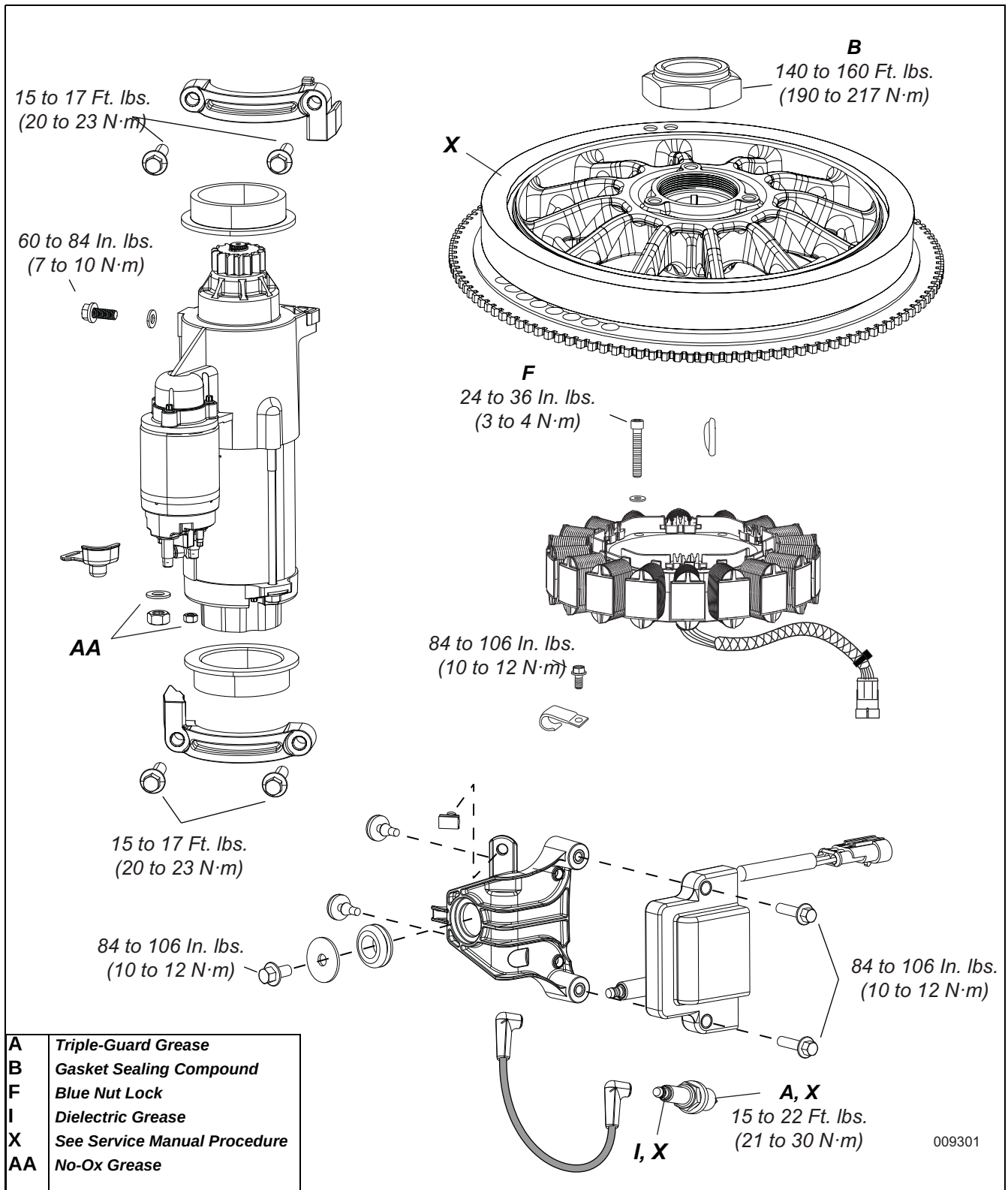
- Top Left:** A control module with a connector. Torque: 18 to 30 in. lbs. (2 to 3 N·m).
- Top Center:** A sensor assembly. Torque: 12 to 18 in. lbs. (2 to 3 N·m).
- Top Right:** A long cable assembly. Torque: 12 to 18 in. lbs. (2 to 3 N·m).
- Far Right:** A sensor assembly. Torque: 84 to 106 in. lbs. (10 to 12 N·m).
- Middle Left:** A sensor assembly. Torque: 15 to 17 Ft. lbs. (20 to 23 N·m).
- Middle Center:** A sensor assembly. Torque: 22 to 30 in. lbs. (2.5 to 3 N·m).
- Middle Right:** A sensor assembly. Torque: 35 to 60 in. lbs. (4 to 6 N·m).
- Bottom Left:** A sensor assembly. Torque: 35 to 60 in. lbs. (4 to 6.7 N·m).
- Bottom Center:** A sensor assembly. Torque: 144 to 168 in. lbs. (17 to 19 N·m).
- Bottom Right:** A complex assembly. Torque: 84 to 106 in. lbs. (10 to 12 N·m).

Legend:

L	Pipe Thread Sealing Compound
Z	Thermal Joint Compound
AA	No-Ox Grease

009300

Electrical and Ignition

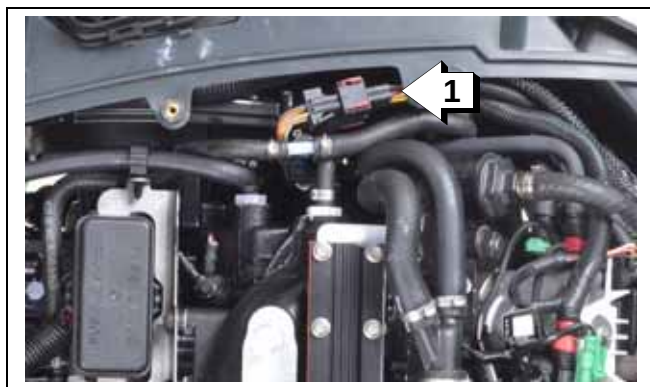


Electrical Harness Connections

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. 139.

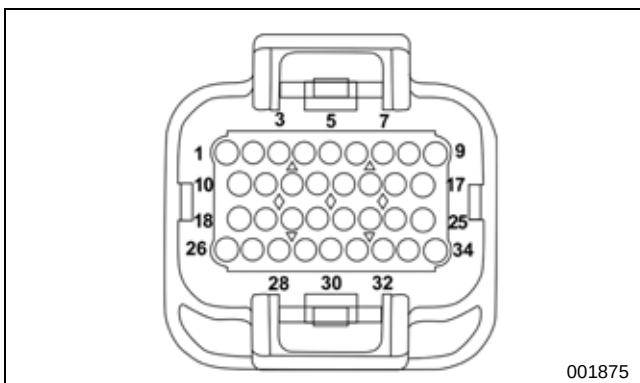
Engine Harness to Stator Connector



009175

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

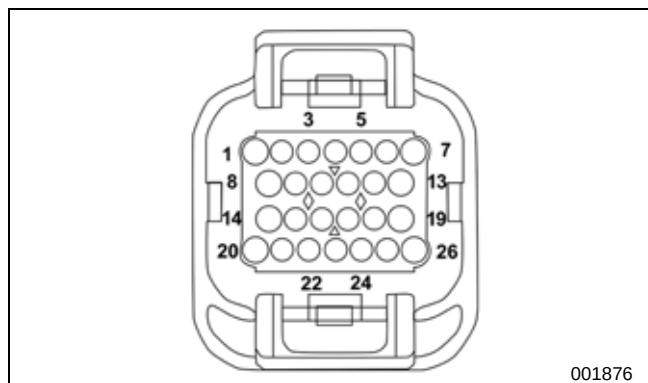
EMM J1-A Connector



001875

Pin No.	Description of Circuit	Wire Color
1	Trim send IN	White/Tan
2	Manufacturing connector	Red
3	Manufacturing connector	White
4	Trim sender bond	Dark Green
5	Manufacturing connector	Black
6	Crankshaft position sensor (CPS)	Yellow
7	Ground, CPS (digital)	Yellow/White
8	Key Switch (Bootstrap)	Blk/Orange
9	Stop circuit	Blk/Yellow
10	ETB, +5 V	Red/White
11	ETB, Ground (analog)	Black/White
12	Engine temperature sensor, port	Pink/Black
13	Ground (analog)	Black/White
14	Shift Actuator, Ground (analog)	Black/White
15	Water pressure, +5 V	Pink
16	Ground (analog)	Black/White
17	Engine temp sensor, Starboard Ground (analog)	Black/White
18	TPS A	Green/Yellow
19	Engine temp sensor, starboard	Pink/Black
20	Air temperature sensor	Pink/Blue
21	Water in Fuel	Pink/Green
22	Oil level sender	Pink
23	Fused +12 V	Red/Purple
24	empty	
25	empty	
26	TPS B	Green/Orange
27	Shift Actuator +5 V	Red/White
28	Water pressure +5 V	Red/White
29	Shift actuator positive	Yellow/Black
30	Trim sender +5 V	Red/White
31	empty	
32	empty	
33	empty	
34	empty	

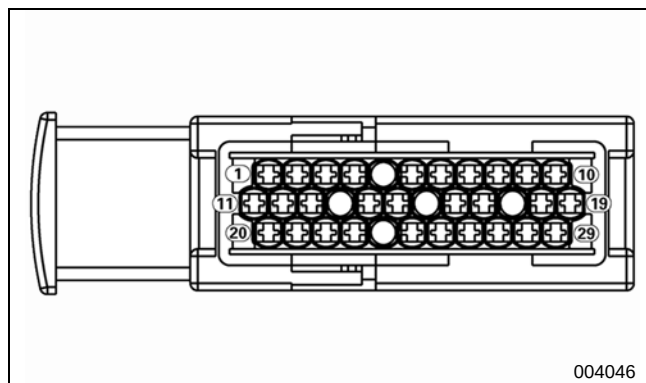
EMM J1-B Connector



001876

Pin No.	Description of Circuit	Wire Color
1	Injector, cylinder 3	Purple
2	Injector, cylinder 5	Green
3	Fused B+ (12V)	Red/Purple
4	Trim UP signal to trim relay	Blue/White
5	Trim DOWN signal to trim relay	Green/White
6	Ignition, cylinder 3	Orange/Purple
7	empty	
8	Injector, cylinder 1	Blue
9	Trim switch, UP	Blue/Black
10	Trim switch, DOWN	Green/Black
11	Shift actuator, neutral feedback	Yellow/Red
12	empty	
13	empty	
14	EMM signal to start relay	Yellow/Red
15	empty	
16	empty	
17		
18	Fused B+ (12V) to 55V relay	Purple/Yellow
19	Ignition, cylinder 1	Orange/Blue
20	Oil pump, crankcase	Blue
21	Switched B+ (12V), wake-up	Purple/Black
22	empty	
23	Low oil switch	Tan/White
24	Fuel level, upper	Brown/Orange
25	Ignition, cylinder 5	Orange/Green
26	Fuel level, lower	Brown/Blue

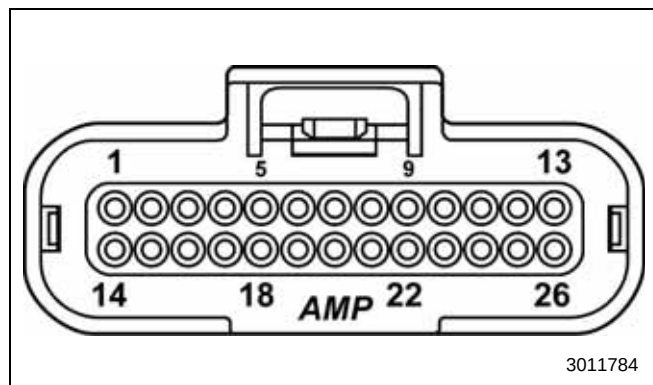
EMM J2 Connector



004046

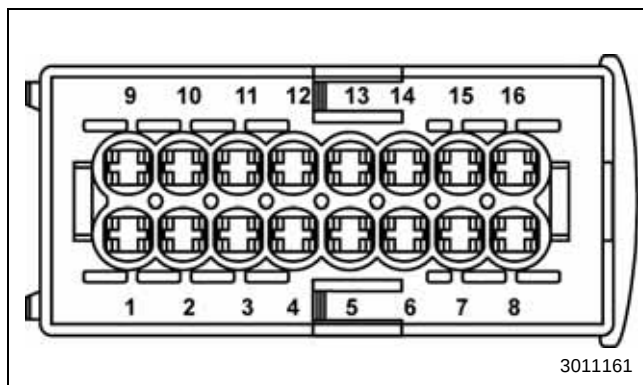
Pin No.	Description of Circuit	Wire Color
1	B+	Red
2	B+	Red
3	Isolated B+	Red/Black
4	Battery ground	Black
5	Battery ground	Black
6	empty	
7	Winding 1S	Yellow
8	Winding 2S	Brown
9	Injector, generator ground	Black
10	Winding 3S	Orange
11	B+	Red
12	B+	Red
13	Isolated B+	Red/Black
14	Battery ground	Black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

EMM J3 Connector



Pin No.	Description of Circuit	Wire Color
1	CAN low (NMEA 2000)	Dark Blue
2	CAN high (NMEA 2000)	White
3	CAN low (remote control network)	Dark Blue
4	CAN high (remote control network)	White
5	Exhaust temperature sensor	Pink/Yellow
6	empty	
7	CAN supply + (NMEA 2000)	Red
8	CAN ground (NMEA 2000)	Black
9	Water Valve (250 H.O., 300 HP only)	Blue/Yellow
10	Oil pump, cylinder	Blue/Orange
11	Injector, cylinder 6	Dark Green
12	Injector, cylinder 4	Purple
13	Injector, cylinder 2	Dark Blue
14	Knock sensor +, starboard	Gray/Red
15	Knock sensor +, port	Gray/Orange
16	Knock sensor, digital ground	Gray/Black
17	empty	
18	Ignition, cylinder 6	Orange/Green
19	Ignition, cylinder 4	Orange/Purple
20	Ignition, cylinder 2	Orange/Blue
21	empty	
22	empty	
23	empty	
24	empty	
25	CAN high, power steering	Brown/Orange
26	CAN low, power steering	Orange/Black

EMM J4 Connector



Pin No.	Description of Circuit	Wire Color
1	empty	
2	empty	
3	empty	
4	Fuel vapor vent solenoid	Brown/Yellow
5	empty	
6	+12V	Purple/White
7	Shift actuator, ground	Yellow/Green
8	Shift actuator +	Yellow/Blue
9	empty	
10	empty	
11	empty	
12	Fuel lift pump	Brown/White
13	Fuel circulation pump	Brown
14	Remote oil pump	Dark Blue/Red
15	Electronic throttle body, motor+	Gray/Blue
16	Electronic throttle body, motor ground	Gray/White

Ground Circuits

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

EMM Ground Tests

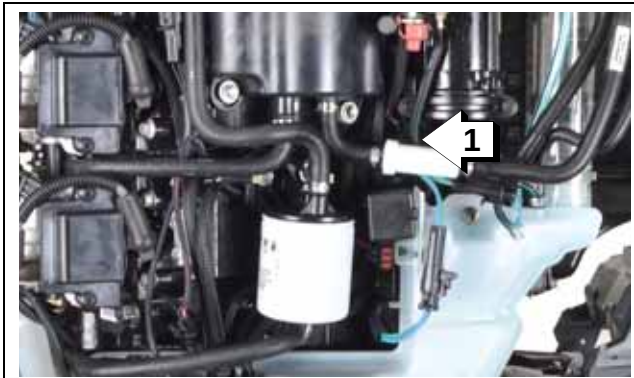
Disconnect the battery cables at the battery.

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

Additional Ground Tests

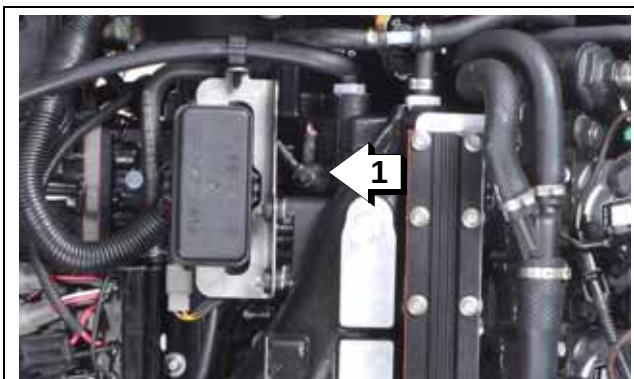
Check connections and continuity at the following locations:

- Main battery ground terminal.
- Check continuity between ground terminals at port and starboard main harness grounds.



1. Main engine harness ground (Starboard)
Located behind inline fuel filter

009174



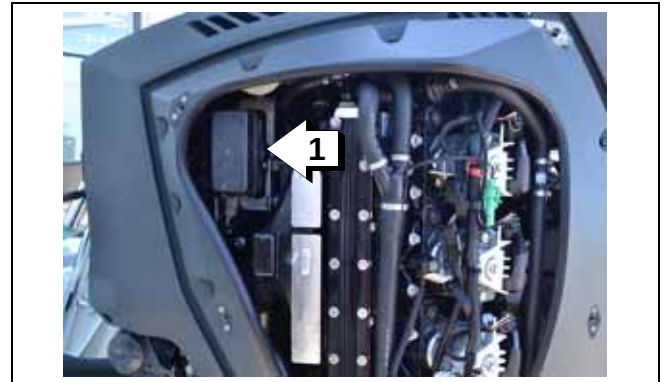
1. Main engine harness ground (Port)

009175

Fuses

The engine harness circuits are protected by automotive style minifuses and relays.

A fuse panel is located on the port side of the powerhead, fastened to a bracket near the front of the powerhead.



1. Fuse panel

009147

IMPORTANT: Repeat failures of fuses 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 and Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

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

Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

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

Air Temperature Sensor (AT) Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor resistance.

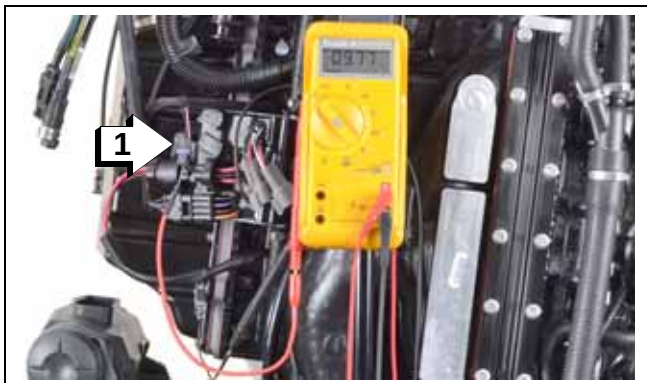
AT Sensor Resistance
680 Ω $\pm$ 5.25% @ 212°F (100°C)
10000 Ω $\pm$ 1.5% @ 77°F (25°C)
32654 Ω $\pm$ 3.0% @ 32°F (0°C)

Air Temperature Sensor Circuit Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.



1. Engine harness connector (AT sensor)

009362

Air Temperature Sensor Circuit Resistance

Wire	Pin	Result
PINK/BLUE	A	9700 Ω $\pm$ 200 Ω
BLACK/WHITE	B	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Crankshaft Position Sensor (CPS) Operation 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*.



Engine Monitor Screen, Engine RPM Display

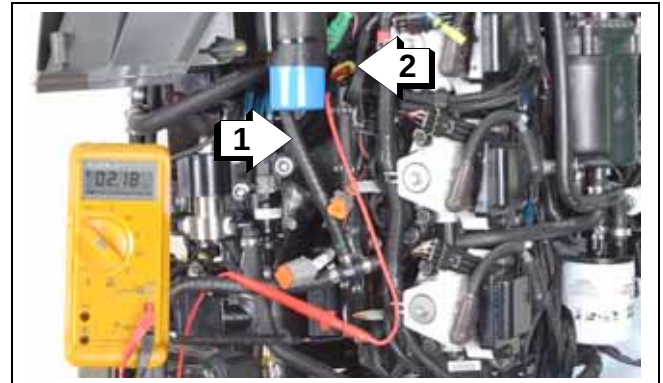
009242

CPS Circuit Test

Remove the electrical connector from the CPS.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the meter lead to the CPS engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.



1. Cooling water hose

009353

2. Engine harness connector (CPS)

Crankshaft Position Sensor (CPS) Resistance Test

Disconnect the crankshaft position sensor. The CPS connector is clipped to the cooling water hose (see following picture).

Use a digital multimeter with appropriate test probe leads to measure sensor resistance between the yellow and white wires.

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

The CPS is mounted to the cylinder block 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).

CPS Circuit Resistance

Wire	Pin	Result
YELLOW	1	2000 Ω $\pm$ 300 Ω
YELLOW/WHITE	2	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Engine Temperature Sensor Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor resistance.

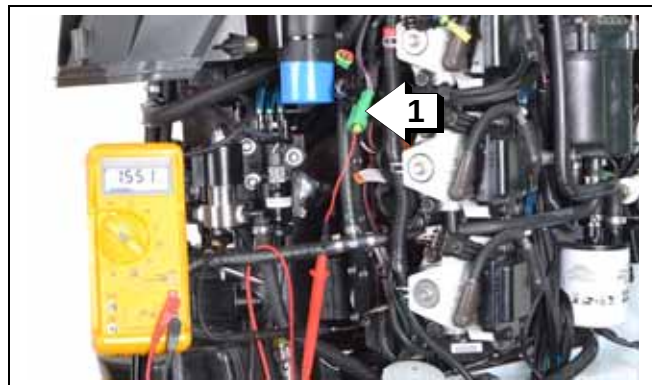
Engine Temperature Sensor Resistance	
680 $\Omega \pm 5\%$ @ 212°F (100°C)	
10000 $\Omega \pm 1\%$ @ 77°F (25°C)	
32654 $\Omega \pm 2.5\%$ @ 32°F (0°C)	

Engine Temperature Circuit Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.



1. Engine harness connector (engine temperature sensor) 009357

Engine Temperature Sensor Circuit Resistance		
Wire	Pin	Result
PINK/BLACK	2	1500 $\Omega \pm 200 \Omega$
BLACK/WHITE	1	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Exhaust Temperature Sensor (EGT) Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor resistance.

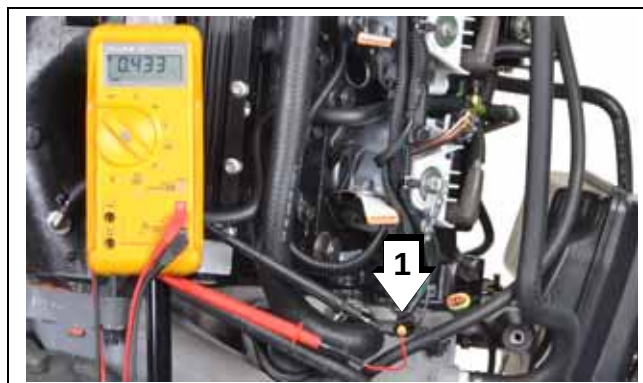
AT Sensor Resistance	
680 $\Omega \pm 5.25\%$ @ 212°F (100°C)	
10000 $\Omega \pm 1.5\%$ @ 77°F (25°C)	
32654 $\Omega \pm 3.0\%$ @ 32°F (0°C)	

Exhaust Temperature Circuit (EGT) Test

Remove the electrical connector from the exhaust temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.



1. Engine harness connector (EGT sensor) 009359

Exhaust Temperature Sensor Circuit Resistance		
Wire	Pin	Result
PINK/YELLOW	2	430 $\Omega \pm 100 \Omega$
BLACK/WHITE	1	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Knock Sensor Test

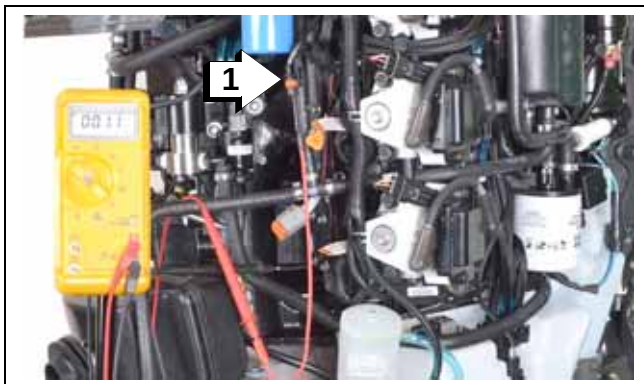
There are no tests for the knock sensor. If *Evinrude Diagnostics* reports Fault Code 7 or 8, replace with a new sensor.

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

Knock Sensor Circuit Test

There are no tests for the knock sensor signal wires. Use a digital multimeter with appropriate test probe leads to measure sensor ground circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.



1. Engine harness connector (knock sensor)

009354

Knock Sensor Ground Circuit Resistance		
Wire	Pin	Result
GRAY/BLACK	A	< 1 Ω

Ignition System

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 to check for fault codes before troubleshooting. Correct any problems and clear the codes FIRST.

Required 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 activation, injector activation, 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 pumps, fuel injectors, and the ignition circuits 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.

6



Electrical and Ignition

Ignition System

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 $0.0\ \Omega$.

Check that all engine wire harness grounds have continuity to the cylinder/crankcase. See **Ground Circuits** on p. 115.

Clean or repair all ground circuits, wiring, and connections as needed.

Ignition System Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Before continuing make sure the CPS is operating. Refer to **Crankshaft Position Sensor (CPS) Operation Test** on p. 117. If the *Monitor* screen says "Check CPS Sync," refer to **Crankshaft Position Sensor (CPS) Resistance Test** on p. 117.

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 Display

009242

Results:

- *EMM* ON (not running): $30\text{ V} \pm 2$, system voltage is GOOD.
- *EMM* ON (not running): less than $30\text{ V} \pm 2$, check 12 V power to *EMM*. Repair connection or wiring. Possible fault in *EMM* SAC circuit.
- RUNNING: $55\text{ V} \pm 2$, system voltage is GOOD.
- RUNNING: less than $55\text{ V} \pm 2$, check stator output to *EMM*. Repair connection or wiring. Possible faulty stator or *EMM*. Refer to **Stator Tests** on p. 125.

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.

Running Ignition Tests

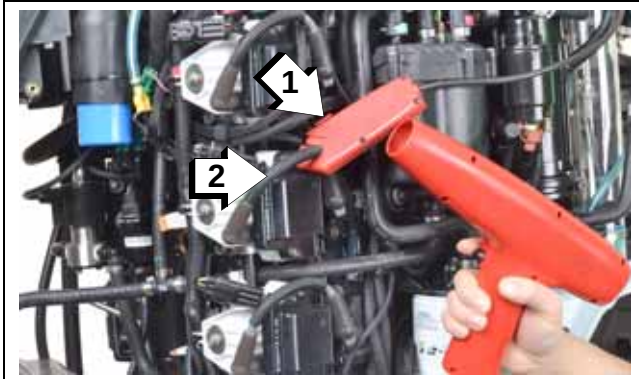
Use *Evinrude Diagnostics* software to monitor system voltage (55 V).

- Voltage readings at a specific speed (RPM) should be steady.
- Refer to **System Voltage Test** on p. 122.

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

009363

Results:

Steady voltage and strobe, engine misfires:

- Inspect or replace spark plugs
- Refer to **Static Tests** on p. 105.
- Check for internal engine damage.

Steady voltage, erratic strobe, engine misfires:

- Inspect or replace spark plugs
- Check CPS resistance.
- Refer to **Ignition Circuit Tests** on p. 123.
- Refer to **Ignition Coil Tests** on p. 123.

Voltages fluctuate, engine misfires:

- Inspect battery and connections
- Test capacitor and all ground connections.
- Refer to **System Voltage Test** on p. 122
- Refer to **Ignition Circuit Tests** on p. 123.
- Refer to **Ignition Coil Tests** on p. 123.

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.** on p. 89.

Ignition Coil Tests

There are no 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 Circuit Tests** on p. 123.
- 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.

Ignition Circuit Tests

Ignition 55V Circuit Voltage Test

Use a digital multimeter calibrated to a scale that reads 55 V (DC) to measure voltage between the ignition coil electrical connector and engine ground.

Disconnect ignition coil connector.

Connect negative meter lead to ground. Use an appropriate test probe lead to connect positive meter lead to pin 3 (white/red wire) of engine harness electrical connector.

Turn the key switch to the ON position. Observe voltage at pin 3.

- Voltage should be approximately 30 V.

Start the engine. Observe voltage at pin 3.

- The voltage at pin 3 should be approximately 55 V.

Note: This will result in an Ignition Coil OPEN Circuit fault code.

Results:

- No voltage reading, confirm 55V Circuit Resistance. Refer to **Ignition 55V Circuit Resistance Test** on p. 123.
- No voltage reading, refer to **System Voltage Test** on p. 122.

Ignition 55V Circuit Resistance Test

Disconnect the electrical connector from the ignition coil.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the 55V circuit.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table.

Electrical and Ignition

Ignition System

Connect the negative meter lead to the red/white wire of a known good circuit such as a fuel injector.

Ignition 55V Circuit Resistance		
Wire	Pin	Result
WHITE/RED	3	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Ignition Ground Circuit Resistance Test

Use a digital multimeter with appropriate test probe leads to measure the ground circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Ignition Ground Circuit Resistance		
Wire	Pin	Result
BLACK	1	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

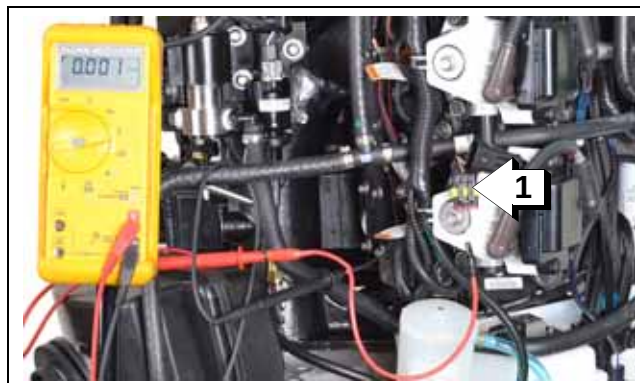
Ignition Control Circuit Voltage Test

Disconnect the electrical connector from the ignition coil.

Use a digital multimeter with appropriate test probe leads to measure signal circuit voltage.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect

the negative meter lead to engine ground. Turn the key switch to the ON position.



1. Engine harness connector (ignition coil)

009358

Ignition Circuit Voltage		
Wire	Pin	Result
ORANGE/BLUE (upper cylinder)	2	5 to 7 VDC
ORANGE/PURPLE (middle cylinder)	2	
ORANGE/GREEN (lower cylinder)	2	

Capacitor Test

IMPORTANT: Make sure the capacitor is discharged before testing.

Disconnect the 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.

Stator Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

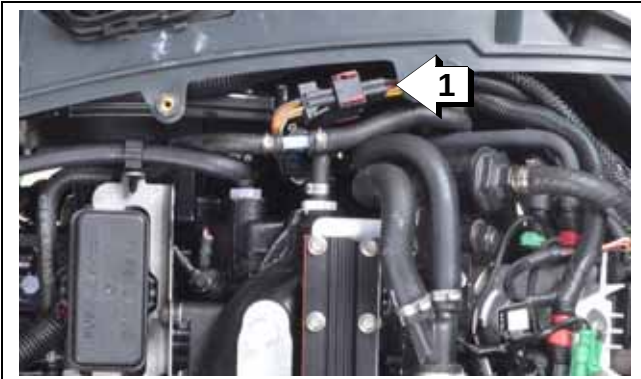
NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

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 provides 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 with appropriate test probe leads to check resistance of stator windings.

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



1. Stator connector

009175

Use an appropriate adapter to connect the meter leads to the following pins of the stator connector:

Stator Winding Resistance		
Wire	Pin	Result
YELLOW YELLOW/WHITE	1	0.512 ± 0.020 Ω @ 73°F (23°C)
	4	
ORANGE ORANGE/WHITE	2	0.512 ± 0.020 Ω @ 73°F (23°C)
	5	
BROWN BROWN/WHITE	3	0.512 ± 0.020 Ω @ 73°F (23°C)
	6	

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

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

⚠ WARNING

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

Use a voltmeter to check the stator output voltage. Set meter to read 110 VAC output. Disconnect the CPS.

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

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

Connect meter leads to terminals of adapter tool.

With a fully charged battery, crank the 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

Electrical and Ignition

Charging System Tests

- 62 VAC at 300 RPM



1. Stator Test Adapter

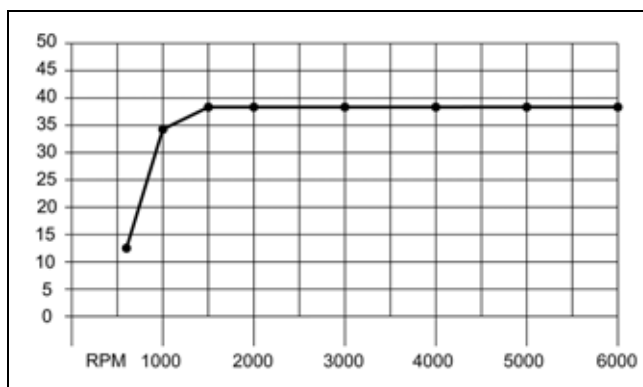
009360

Charging System Tests

The charging system provides 12 VDC for battery charging. Alternator total output, or *GROSS* output is:

- 10 A at 500 RPM
- 50 A from 2000 RPM to WOT.

Charging system available output to the battery, or *NET* output is shown in the following graph:



Battery Charging Current (Net) @ 14 VDC

009339

Use *Evinrude Diagnostics* software to monitor battery voltage and *GROSS* charge current.



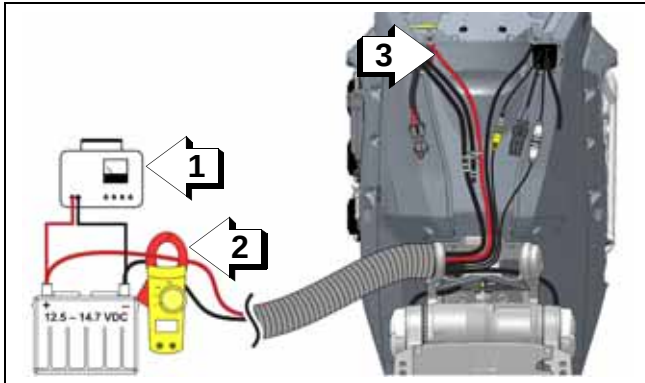
Engine Monitor Screen

009242

1. Main and auxiliary battery voltage display
2. Main and auxiliary charge current display

Use an inductive amp meter to monitor *NET* charge current at the battery. *Fluke*[†], *Snap-On*[†] or various other digital meters should be available through local tool suppliers.

Connect an inductive amp meter to the positive (B+) battery cable at the battery.



Variable Load Test Diagram

009340

1. Variable load tester
2. Inductive ammeter (optional)
3. Battery cable (B+)

12 V Charging Circuit

⚠ WARNING

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

To test the operation of the regulator in the *EMM*, and amperage output of the charging system you must be able to run the outboard continuously at approximately 2000 RPM, such as in a test tank or on a marine dynamometer.

Monitor the charging system's response to a partially discharged battery. Use a variable load tester (carbon pile) 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.

IMPORTANT: This outboard has dual output charging. Each output is isolated and regulated. Each output is approximately 20 A (*NET*). Combined output is approximately 40 A (*NET*).

Following the manufacturer's directions, connect the variable load tester across the battery terminals.

Start and run the outboard at approximately 2000 RPM. Use the variable load tester to draw the bat-

tery down at a rate equivalent to the stator's full output.

- The ammeter should indicate nearly full output, approximately 40 A (or 20 A if the auxiliary battery charge is installed).

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. 125.

Auxiliary Battery Charge Circuit

The auxiliary battery charge feature requires Auxiliary Battery Charge Kit, P/N 5009079 (or equivalent) and it must be protected by a 50 A fuse or circuit breaker at the battery.

Use *Evinrude Diagnostics* software to monitor battery voltage and charge current.

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.

Start and run the outboard at approximately 2000 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 20 A above 1500 RPM.

Decrease the battery load toward 0 A.

- Ammeter should show a reduced output. As the current draw decreases, the battery voltage should stabilize at approximately 14.5 V.
- If results vary, check stator **BEFORE** replacing the *EMM*. See **Stator Tests** on p. 125.

Electrical and Ignition

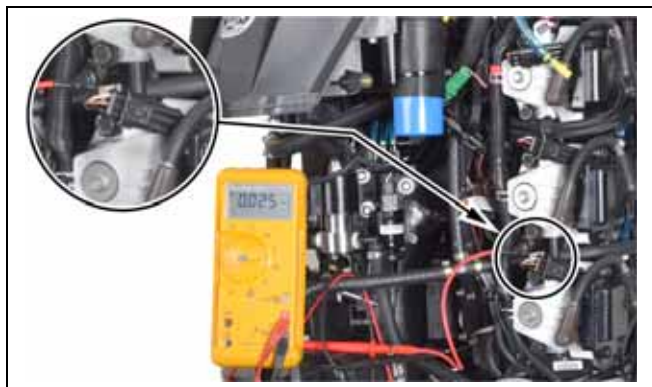
Charging System Tests

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 an ignition coil or fuel injector electrical connector.



1. 55V circuit (Ignition coil connector)

009370

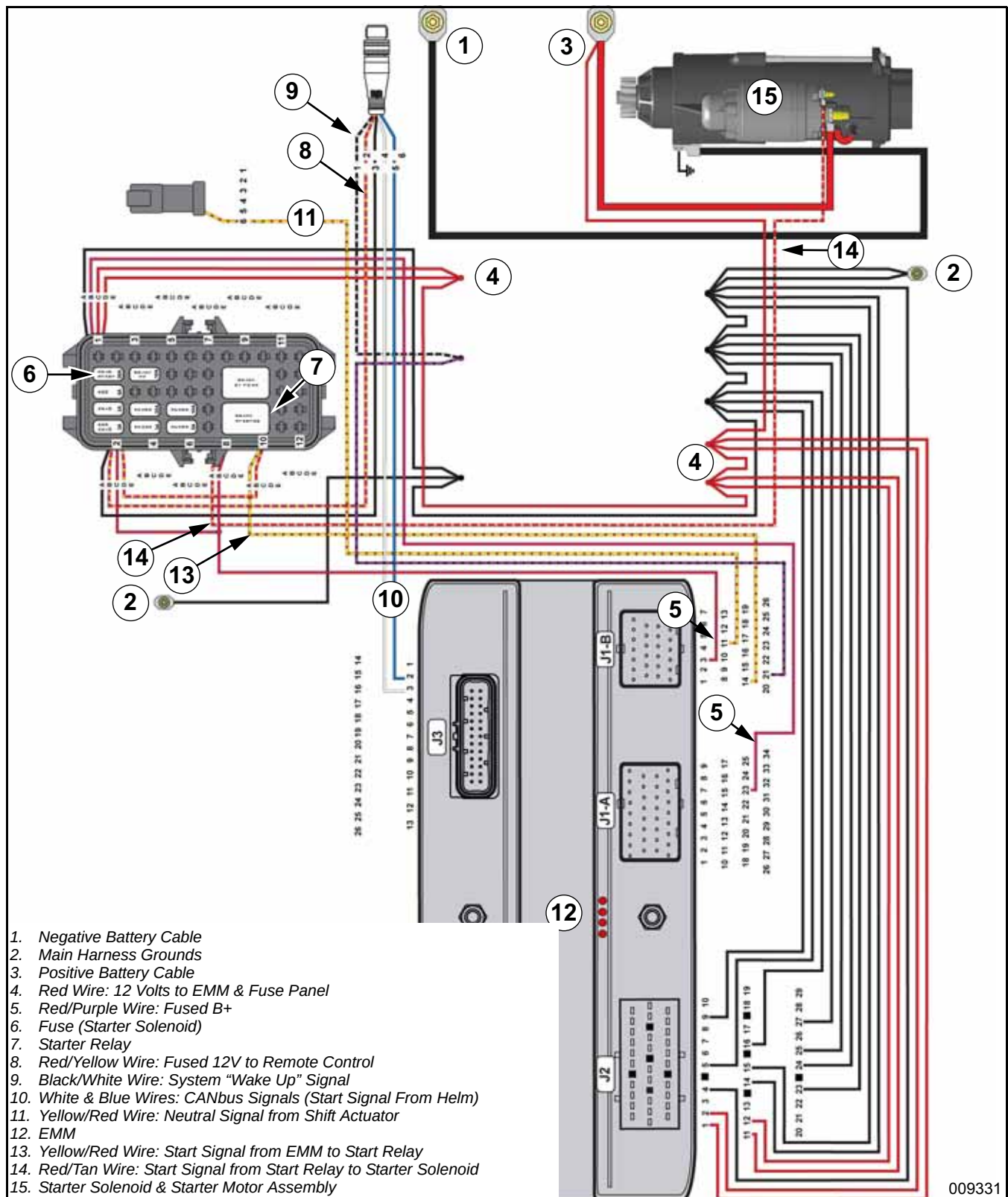
Acceptable Alternator Circuit Test Readings	
Key switch ON	approximately 30 VDC
Engine running	approximately 55 VDC

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. 125. 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



009331

Electrical and Ignition

Electric Start Circuit

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 start switch, and *EMM*.

Refer to the ***Evinrude E-TEC G2 Installation and Predelivery Guide*** for battery, terminal, and cable requirements.

Wiring

The positive (B+) battery cable connects to the positive terminal stud in the engine rigging center.

The positive terminal stud:

- Connects a cable to the large terminal of the starter solenoid.
- Provides 12 V to the engine harness (red wire) and the fuse panel terminals 1C and 1D.

The negative (B-) battery cable connects to the negative terminal stud in the engine rigging center. A cable connects this terminal to a ground terminal on the starter. The main harness ground is provided through the starter mounting screws.

Engine Wire Harness

Contains the following circuits:

Red/purple wires:

- Fuse Panel terminal 2C, provides fused 12 V to the START RELAY coil (terminal 8B) and to the *EMM* J1-B connector terminal 3.
- *EMM* J1-A connector terminal 23, provides 12 V to HELM fuse (terminal 1B). This circuit is always "ON".

Red/yellow wires:

- Fuse Panel terminal 2B, provides 12 V to the remote control.
- Fuse Panel terminal 2D, provides high current 12 V to the START RELAY.

Yellow/red wires:

- *EMM* J1-B connector terminal 11, Provides NEUTRAL signal from the shift actuator to the *EMM*.

- *EMM* J1-B connector terminal 14, Provides the start signal from the *EMM* to the start relay.

Red/tan wire:

- Provides the start signal voltage from the start relay fuse panel terminal 8A to the starter solenoid.

Remote Control CANbus Harness

Contains the following circuits:

Red/yellow wire:

- Provides 12 V from the HELM fuse (terminal 2B) to the remote control.

Black wire:

- Provides HELM ground.

Black/yellow wire:

- Engine STOP circuit.

Blue and white wires:

- Provides CANbus data signal (low and high) to/from the *EMM*.

Black/white wire:

- Turns ON the *EMM*.

Key Switch ON Position

When the key switch is turned to the ON position the remote control black/white wire provides 12 V to the purple/black wire (*EMM* J1-B connector terminal 21) and turns ON the *EMM*.

Start Command

1. Key Switch Start: Grounds terminal S of the key switch, which signals remote control to transmit the START signal to the engine *EMM*.

2. Push Button Start Switches: Sends a digital signal to the remote control to transmit the START signal to the engine *EMM*.

Then:

- If the remote control is in the NEUTRAL position, the START command is transmitted over the remote control and *NMEA 2000* networks to the *EMM*.
- The *EMM* checks for NEUTRAL signal from the shift actuator. If the *EMM* detects the NEUTRAL signal, it grounds the yellow/red wire (*EMM* J1-B connector, terminal 14). This energizes the START RELAY, providing 12 V to the starter solenoid.

Electric Starter Tests

⚠ WARNING

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

Confirm the following BEFORE beginning any tests on the starting system:

- Battery voltage at the battery is a minimum of 12 V.
- Turn key switch to the ON position, does the fuel pump run?
 - Yes, the remote control and *EMM* are ON.
 - No, the *EMM* is OFF. Check remote control network and connections. Check tether cord is attached to emergency stop switch (second station in dual station application).
- Check the remote control gear position indicator LEDs. The remote control MUST be in NEUTRAL, the engine will NOT crank if in gear.

Starter Voltage Test

Use a digital multimeter to check battery voltage at the battery. Crank the engine and record the voltage.

Use a digital multimeter to check voltages at the starter.

Connect the positive meter lead to the battery (B) terminal on the starter. Connect the negative meter lead to the ground terminal on the starter housing.



1. Ground terminal on the starter housing

009380

Results:

- Recorded battery voltage ± 0.5 V: Readings are GOOD.

- Less than recorded battery voltage: Check positive and negative cable connections at the starter, center frame and at the battery.

Connect the positive meter lead to the start (S) terminal on the starter. Connect the negative meter lead to the ground terminal on the starter housing. Crank the engine.

Results:

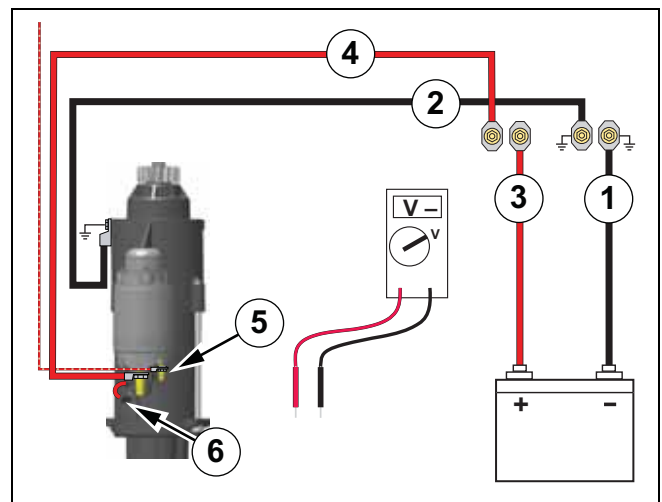
- Recorded battery voltage ± 0.5 V: Readings are GOOD.
- Less than recorded battery voltage: Check 30 A fuse and start relay.

Starter Voltage Drop Test

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

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

- Activate the starter motor and record the voltage reading.



1. Negative battery cable (battery to rigging center)
2. Negative battery cable (rigging center to starter housing)
3. Positive battery cable (battery to rigging center)
4. Positive battery cable (rigging center to solenoid "B" terminal)
5. Solenoid "S" terminal
6. Starter cable

009338

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

- Activate the starter motor and record the voltage reading.

Electrical and Ignition

Tilt/Trim Relay Test

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

- Activate the starter motor and record the voltage reading.

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

- Activate the starter motor and record the voltage reading.

Results:

If the voltage reading from any step 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.

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

009186

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 B+ connection to TNT motor.

Refer to **Tilt and Trim Module Diagram**.

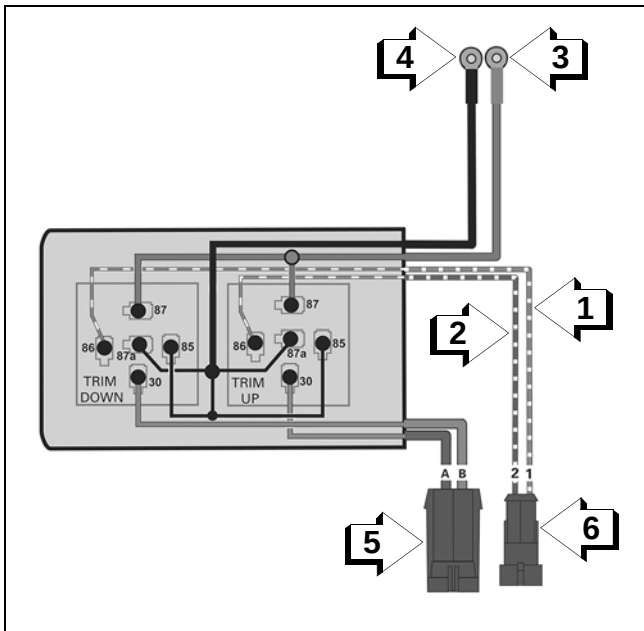
Test Procedure

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

Flywheel and Stator Servicing

NOTICE

Perform the timing verification procedure after flywheel replacement.

Refer to Timing Adjustments on p. 136.

IMPORTANT: Weak flywheel magnets can cause low alternator output and affect outboard performance.

An accurate test of alternator output can help determine the flywheel's condition. Refer to **Charging System Tests** on p. 126.

Flywheel Removal

⚠ WARNING

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

Removal and installation requires removal of the engine covers and frames.

- See **Cover Removal** on p. 60.
- See **Frame Removal** on p. 64.
- See **Center Frame Removal** on p. 67.

Use a #2 *Posi-Drive* screwdriver to remove the six screws from the air duct cover. Then remove the air duct cover.



009333

Electrical and Ignition

Flywheel and Stator Servicing

Use Flywheel Socket, P/N 357715, to remove flywheel nut. Discard the flywheel nut.



1. Flywheel Socket, P/N 357715

009334

Use Flywheel Puller, P/N 357714, to remove the flywheel. Apply *Moly Lube* grease to the threads of the puller pressing screw and the center hole of the crankshaft.

Install the puller body into the flywheel 50 mm threads at least 6 full turns.



Flywheel Puller, P/N 357714

1. Puller body

009335

If the 50 mm threads of the flywheel are damaged, install the puller flange onto the puller body. Then

attach the flywheel puller to the flywheel with three puller screws.



Flywheel Puller, P/N 357714

1. Puller flange
2. Puller body
3. Puller screws (3)

009335

Hold the puller body with a wrench, and tighten the pressing screw until the flywheel releases. Turn the center screw and lift the flywheel off of the crankshaft.

Flywheel Installation

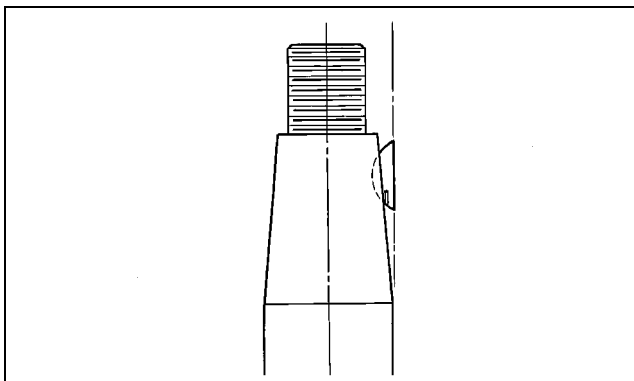
⚠ CAUTION

To avoid injury, keep hands and fingers clear from underside of flywheel. Flywheel can snap toward stator with great magnetic force.

NOTICE

Use a new flywheel nut to install the flywheel.

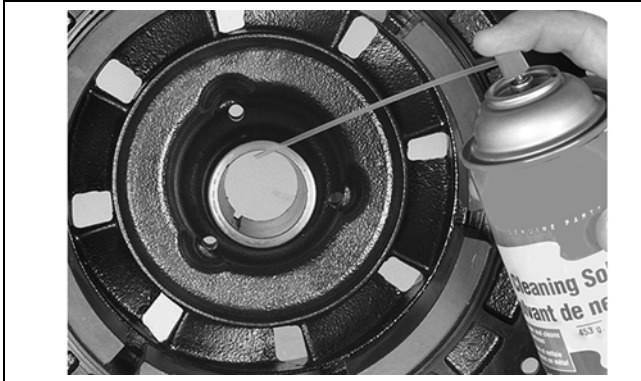
Install the outer edge of flywheel key parallel with centerline of crankshaft.



1. Flywheel key

DRC2116

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 key-way and install the flywheel. Coat the threads of a new 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).

Stator Service

Remove six allen head screws to remove stator.



1. Stator screws

009337

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).

Ignition Coil Servicing

Ignition Coil Removal

Remove spark plug lead from the spark plug.

Disconnect ignition coil electrical connector.

Remove the screw and washer retaining the ignition coil bracket.



1. Screw and washer

009369

Make note of wire routing before removing the coil from the mounting bracket. Remove the two screws.



1. Wire routing
2. Screws

007207

Ignition Coil Installation

Installation is the reverse of removal.

Tighten screws to a torque of 84 to 106 in. lb. (10 to 12 N·m). Install spark plug lead on ignition coil and spark plug. Connect the ignition coil electrical connector.

Timing Adjustments

NOTICE

Make sure the timing pointer is set and the outboard reaches operating temperature **BEFORE** making any timing adjustments.

Ignition timing is set at the factory and does NOT require routine adjustment.

Check ignition timing after any of the following procedures:

- Powerhead replacement
- Crankshaft replacement
- Flywheel replacement

Timing Pointer

⚠ WARNING

To prevent accidental starting while servicing, remove the key from the key switch. Disconnect the battery cables at the battery.

NOTICE

The timing pointer is **NOT** set at the factory and **MUST** be set **BEFORE** making any timing adjustments.

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 the plugs from the center frame, air duct and flywheel. Remove the spark plugs.

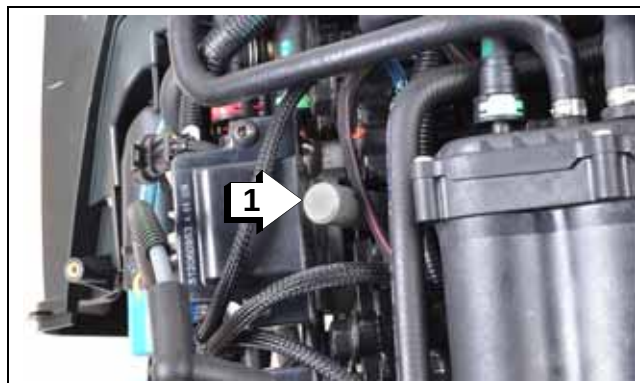
Use Flywheel Nut Socket, P/N 357715, to rotate the flywheel clockwise past the 28° ATDC mark on the flywheel.



1. Flywheel Nut Socket, P/N 357715

009368

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

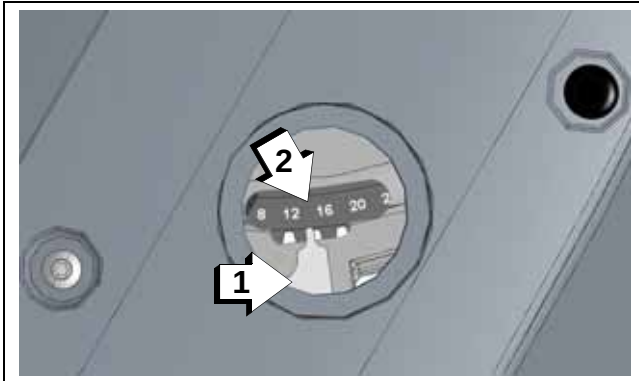


1. Piston stop tool

009361

1. Rotate flywheel **counterclockwise** until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly against the tool. It is **NOT** necessary to force the piston against the tool.

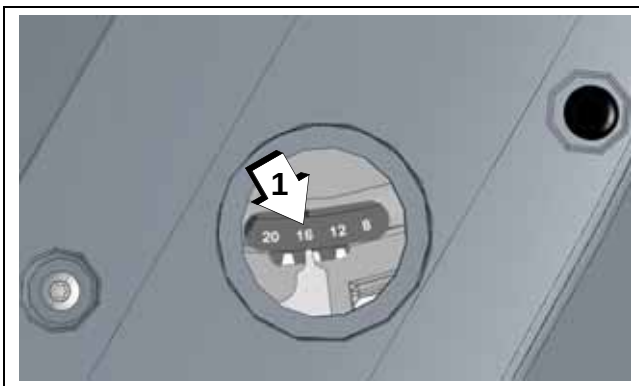
2. Record the degrees ATDC on the flywheel directly across from the pointer.



1. Timing pointer
2. Record the degrees on the flywheel

009365

3. Rotate the flywheel **clockwise** until the piston contacts the tool.
4. Record the degrees BTDC on the flywheel directly across from the pointer.



1. Record the degrees on the flywheel

009366

5. Add the number of degrees recorded in step 2 to the number of degrees recorded in step 4 to obtain the degree *Range*. Then divide the *Range* by 2 to obtain the *Result*.

Example:

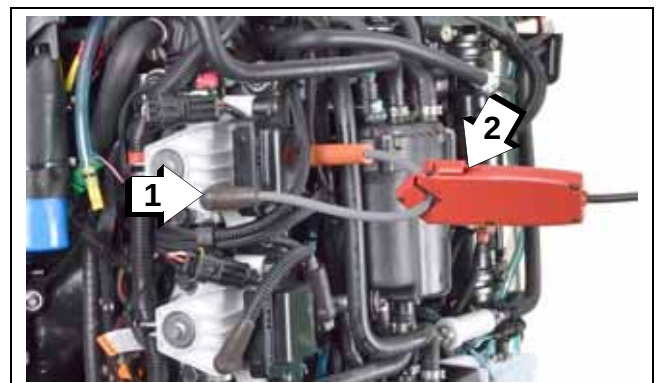
	14° ATDC
	+16° BTDC
	30°
Range	
	÷ 2
	15°
Result	

6. With the piston against the tool, adjust the pointer to read the result from **Step 5**.
7. – Rotate the flywheel **counterclockwise** until the piston contacts the tool. Record the degrees ATDC on the flywheel.
– Rotate the flywheel **clockwise** until the piston contacts the tool. Record the degrees BTDC on the flywheel.
– The timing pointer is correctly centered when the piston contacts the tool at the **Step 5** result, at both the ATDC and BTDC positions.
8. Rotate the flywheel **counterclockwise** slightly to release tool then remove it from spark plug hole.

Install the spark plugs. Refer to **Spark Plugs** on p. 22.

Install Timing Lead, P/N 587316, onto the #1 cylinder coil and spark plug as shown. Connect the timing light pick up to the timing lead.

IMPORTANT: Keep the timing light pick up a minimum of 2 inches (51 mm) away from the ignition coil during the timing verification procedure.



1. Timing Lead, P/N 587316
2. Timing light pick up a minimum of 2 inches (51 mm) away from the ignition coil

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

009367

When the timing verification procedure is complete, remove the timing lead from cylinder number 1 spark plug and ignition coil. Then reinstall the spark plug lead.

Reinstall the plugs into the flywheel, air duct and center frame. Refer to **Plug Installation** on p. 29.

Electric Starter Servicing

Starter Removal

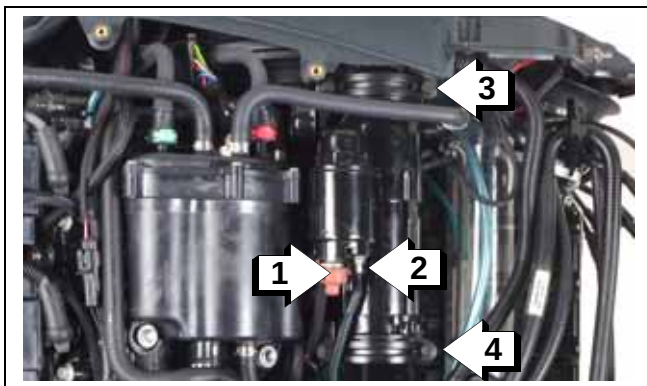
IMPORTANT: Do not clean the starter drive while the starter motor and drive are installed on the powerhead. The cleaning agent could drain into the starter motor, washing dirt from the drive into the starter bearings and commutator.

Disconnect the battery cables at the battery.

Remove the red/tan wire from the “S” terminal on the solenoid. Remove the positive (+) cable from the “B” terminal on the solenoid.

Remove the two upper and two lower starter mounting screws. Lift and remove the starter.

Remove the ground cable from the starter housing.



009175

1. “B” terminal
2. “S” terminal
3. Upper mounting screws
4. Lower mounting screws

Starter Installation

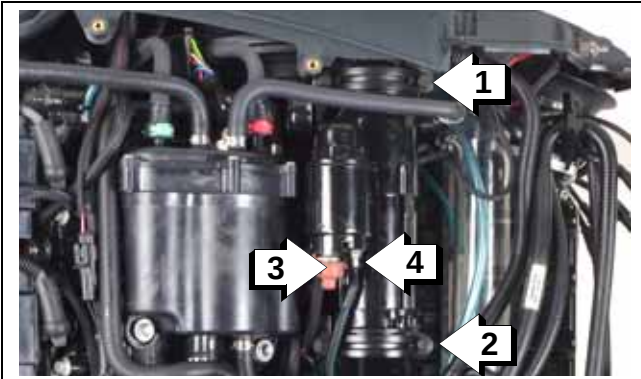
Install the ground cable to the starter housing. Tighten the screw to a torque of 60 to 84 in. lbs. (7 to 10 N·m).

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. Tighten screws to a torque of 15 to 17 ft. lbs. (20 to 23 N·m).

Attach the positive (+) cable to the “B” terminal on the solenoid with lock washer and nut; tighten securely.

Attach the red/tan wire to the “S” terminal on the solenoid with lock washer and nut; tighten securely.



1. Upper mounting screws
2. Lower mounting screws
3. “B” terminal
4. “S” terminal

009175

Coat the terminal connections with *No-Ox Grease*, P/N 768230.

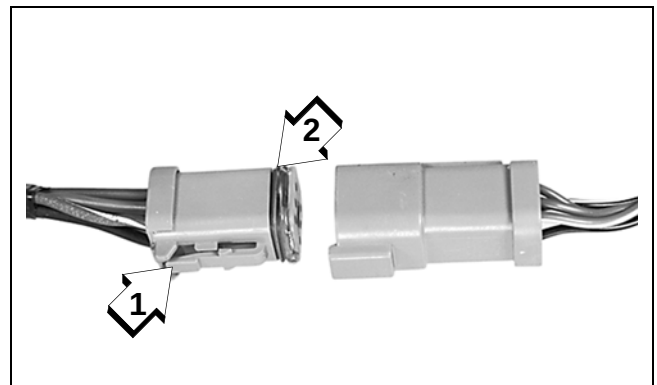
Connector Servicing

DEUTSCH Connectors

IMPORTANT: *Dielectric Grease*, P/N 503243 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 *Dielectric Grease*, P/N 503243, to the **seal** only. Push connectors together until latched.

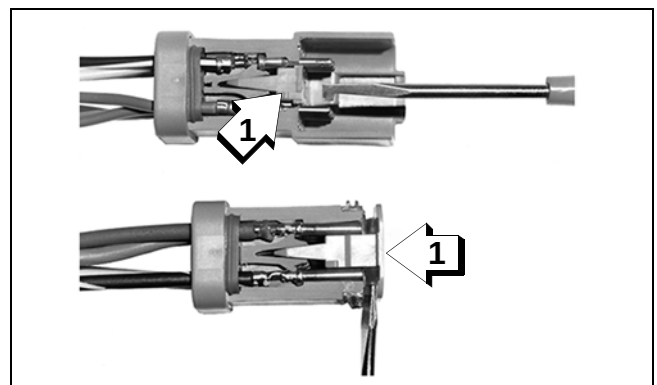


1. Latch
2. Seal

42079A

Terminal Removal

Use hook-end of Connector Service Tool, P/N 342667, to pull out the lock-wedge from the receptacle. Use other end of the tool to pry out the lock-wedge from the plug. Use needle-nose pliers to remove lock-wedge from 3-pin receptacle.

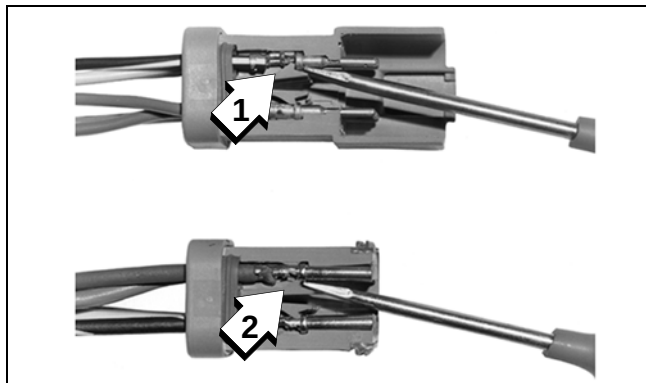


1. Wedge

42327

Electrical and Ignition Connector Servicing

Release terminal latch and gently pull on wire.

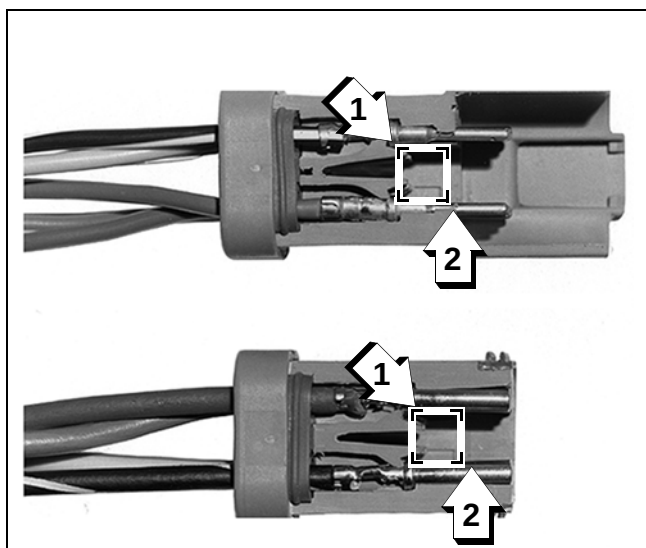


1. Terminal latch (receptacle)
2. Terminal latch (plug)

423293

Terminal Installation

Push terminal through seal until it locks into place. Fill the lock-wedge cavity to the end of the plug (approximately 1/32 inch {0.8 mm}), with *Dielectric Grease*, P/N 503243.



1. Lock-wedge cavity
2. End of plug

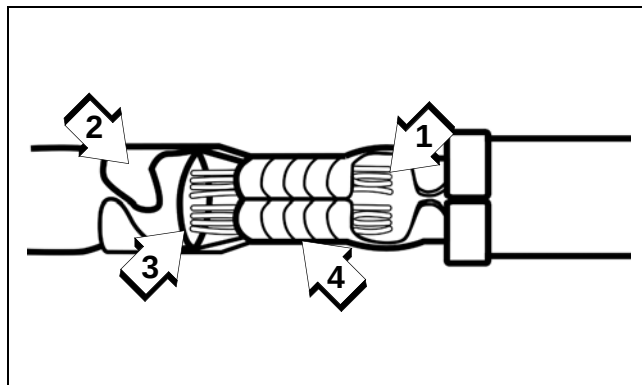
42330

Push the lock-wedge in until latched. The 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. Dielectric 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.



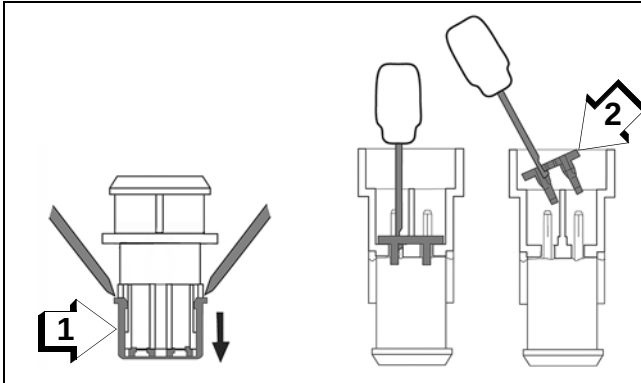
1. Latch
2. Seal

002448

Terminal Removal

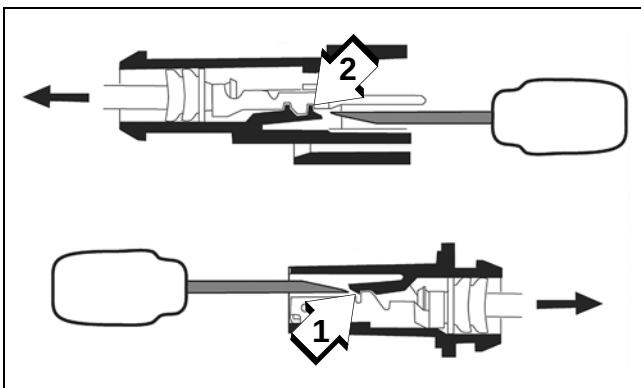
Use Secondary Lock Tool, P/N 777078, to release the locking device of the connector housing. Next,

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. Locking device, plug
2. Locking device, receptacle

002449
002450

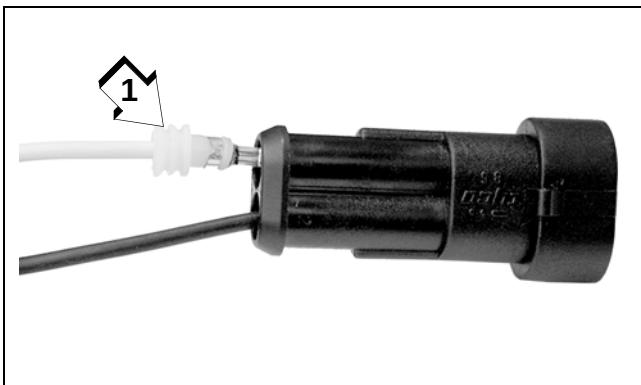


1. Locking tab, plug
2. Locking tab, receptacle

002447

Terminal Installation

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



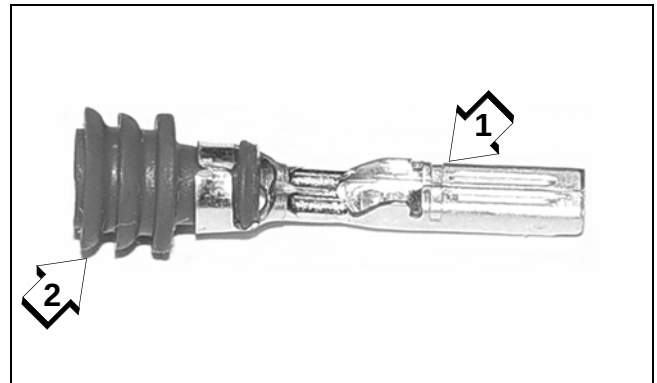
1. Terminal and seal

002451

Align locking 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
2. Seal

002452

SUPER SEAL

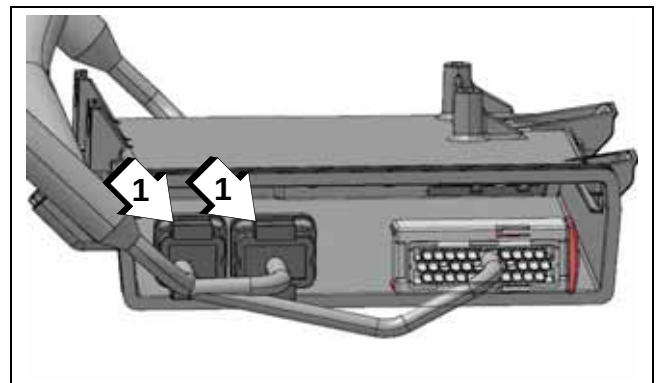
The J1-A, J1-B and J3 connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOTH latches and pull connector from plug.

Connect

Push connector into plug until latches engage.



J1A and J1B Connectors

1. Latch

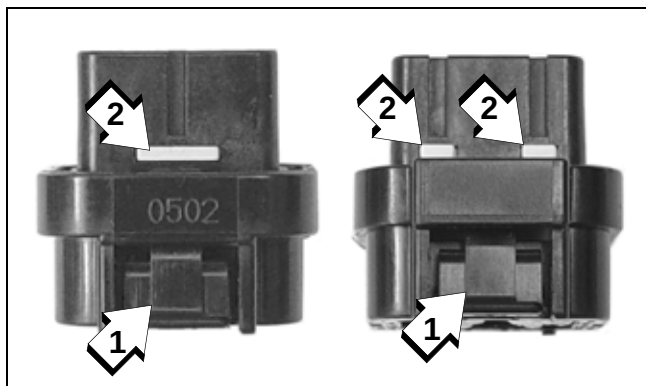
009382

Electrical and Ignition

Connector Servicing

Terminal Removal

Open lock mechanism and remove terminal from connector housing.

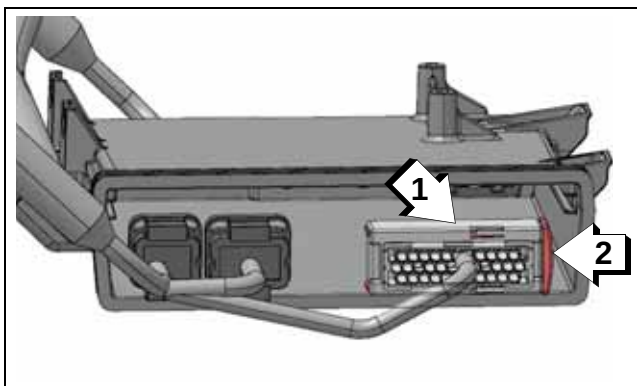


1. Latch
2. Lock mechanism

002453

Connect

Push connector until seated in plug. Close latch completely.

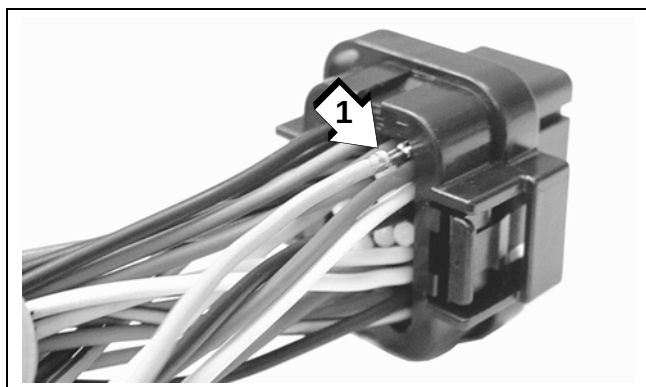


1. J2 connector
2. Latch (closed)

002120

Terminal Installation

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

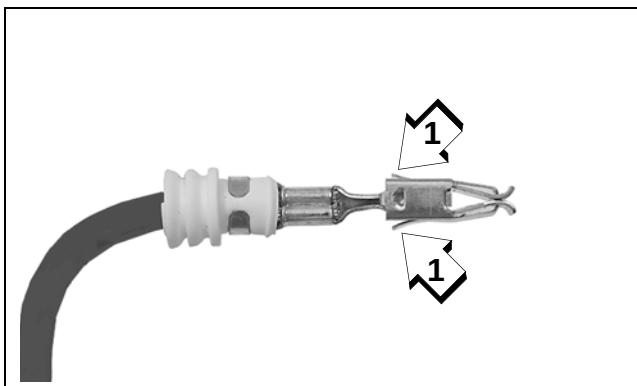


1. Terminal

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)

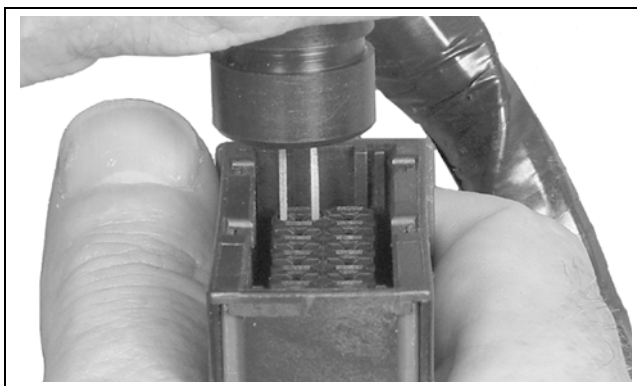
002455

POWER TIMER SERIES

The J2 and J4 connectors of the EMM are AMP Power Timer Series connectors.

Disconnect

Use a screw driver to open latch. Pull connector from plug.

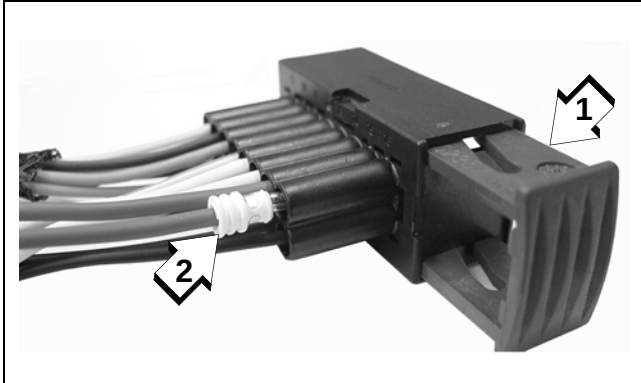


1. Terminal release tool

002313

Terminal Installation

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



1. Latch
2. Terminal with seal

002456

Packard Connectors

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

Disconnect

Lift latch(es). Remove connector.

Connect

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



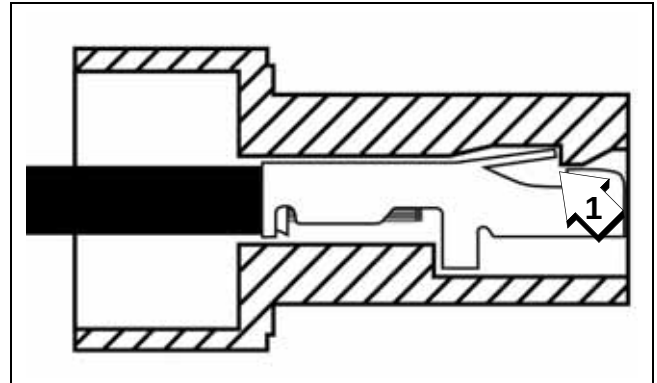
009384

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 releas-

ing 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

DRC5940a

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.



002304

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]

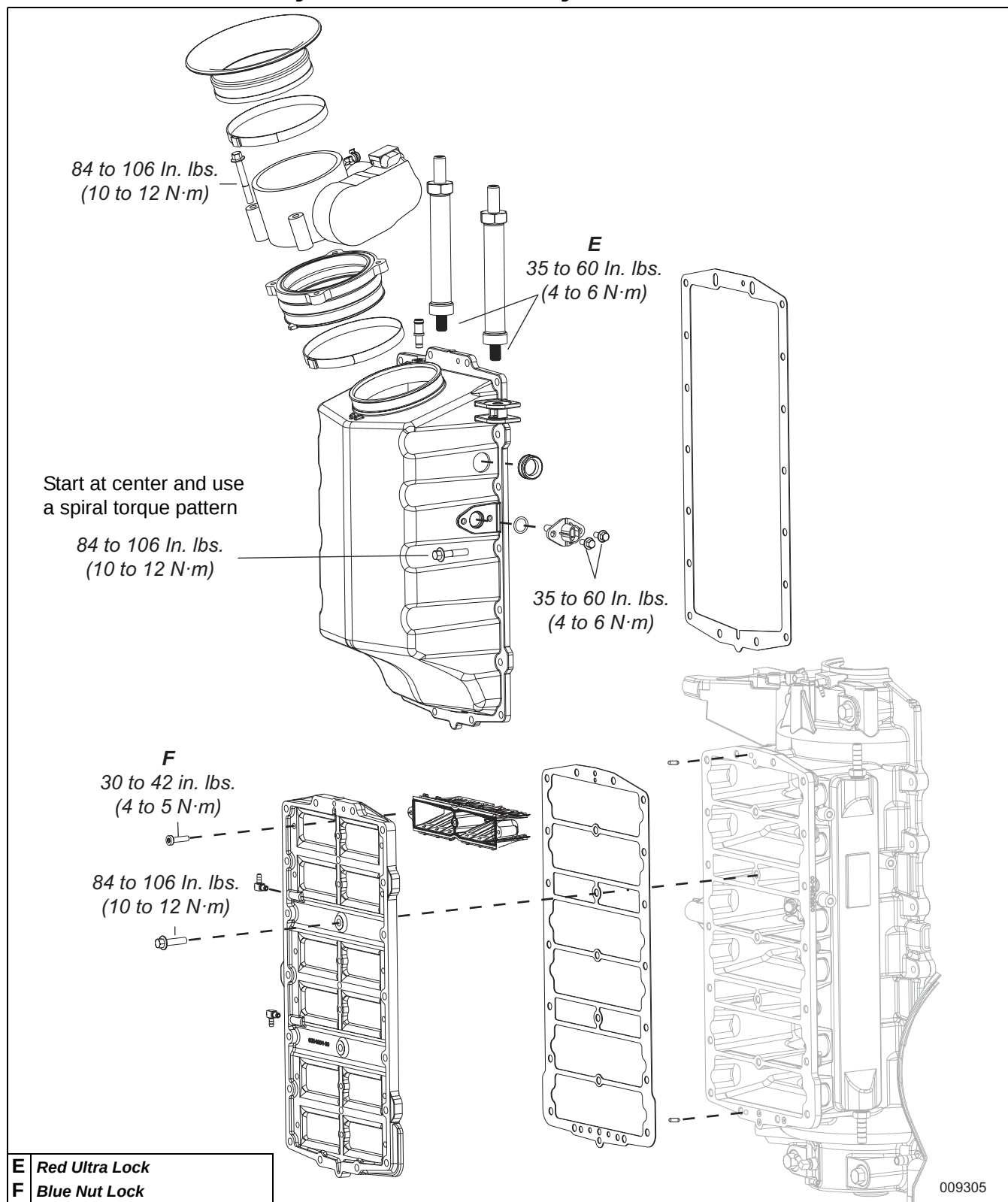
Fuel System

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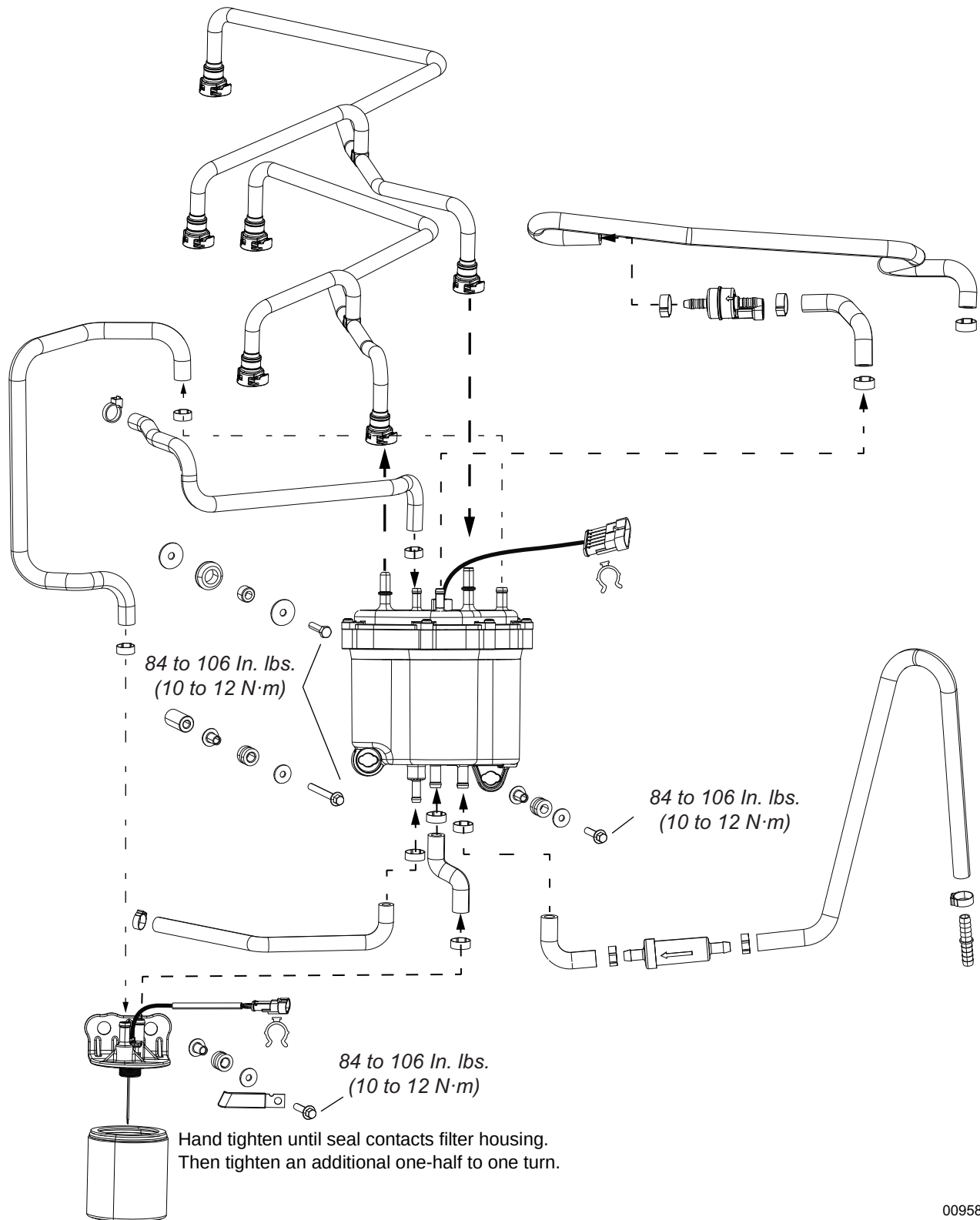
Service Charts

Reed Plate Assembly and Throttle Body



Fuel Pump and Vapor Separator, Fuel Filter and Fuel Rails

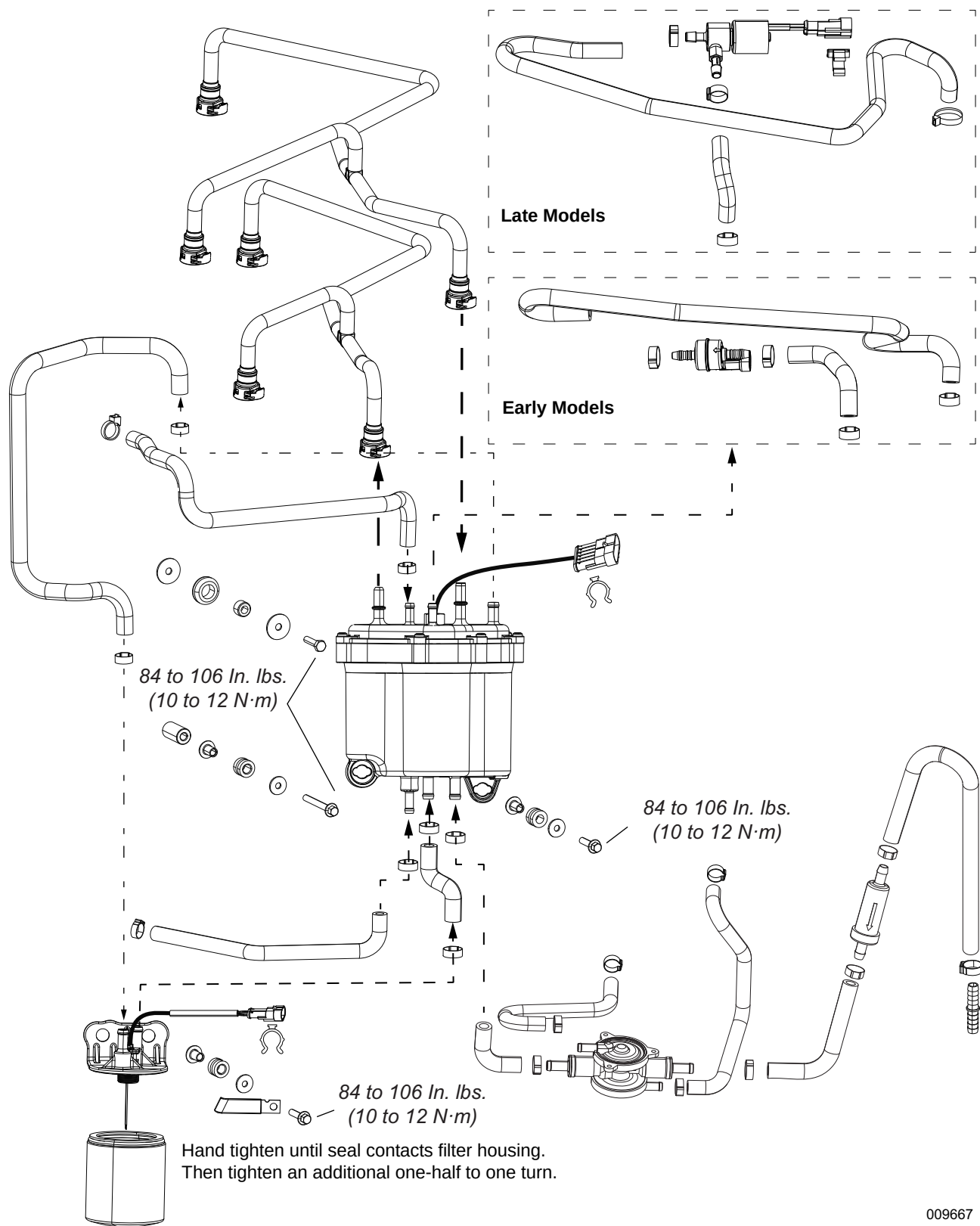
ABA & AFA Models



009586

Fuel Pump and Vapor Separator, Fuel Filter and Fuel Rails

AGA & Newer Models



Fuel Injectors

Tighten in 3 stages

1 60 to 84 In. lbs.
(7 to 10 N·m)

2 120 In. lbs.
(14 N·m)

3 24 to 26 Ft. lbs.
(33 to 35 N·m)

84 to 106 In. lbs.
(10 to 12 N·m)

A, X

H

S

A

H

H

H

84 to 106 In. lbs.
(10 to 12 N·m)

009307

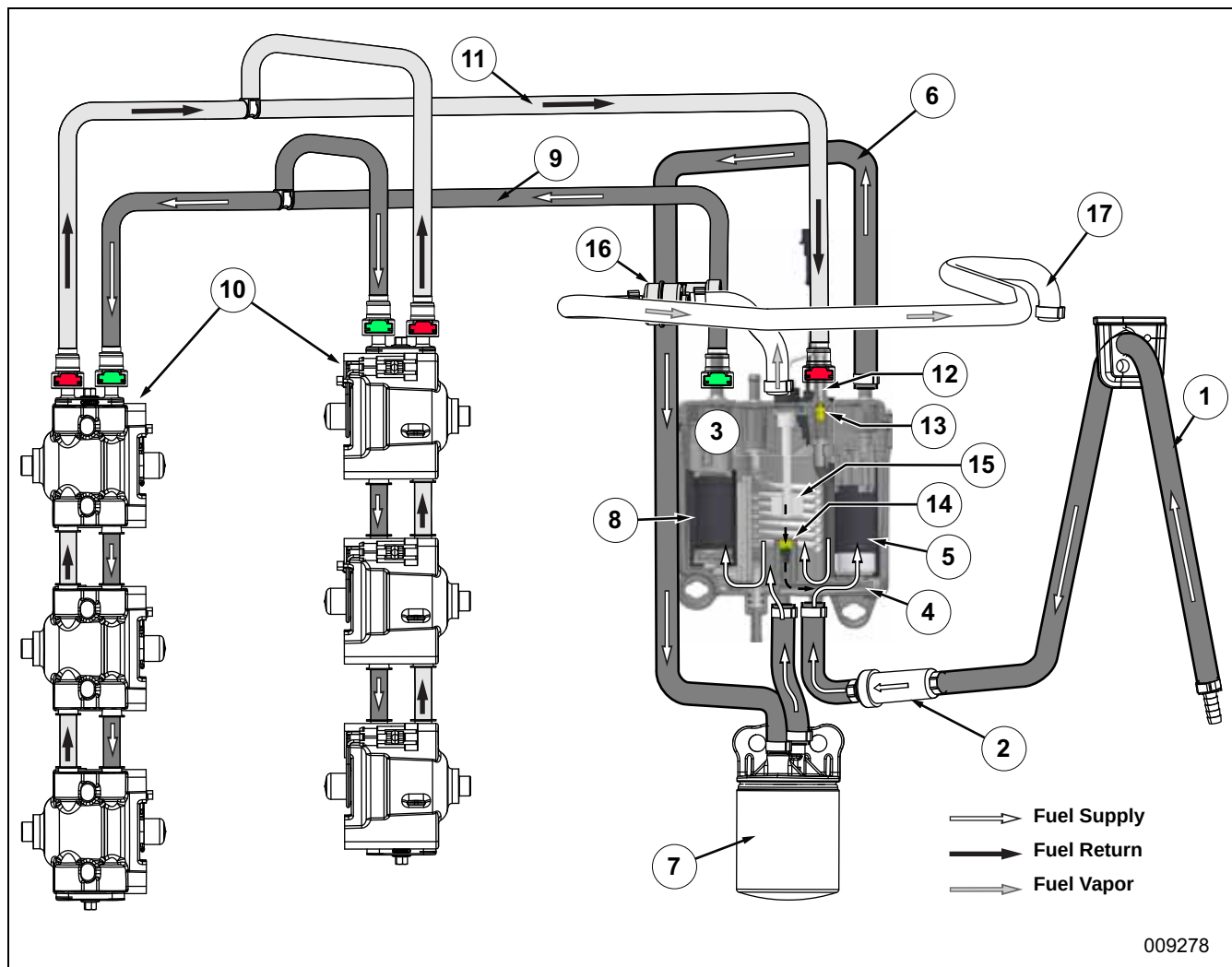
7

A	Triple-Guard Grease
H	Outboard Engine Lubricant
S	STP Oil Treatment
X	See Service Manual

Fuel System

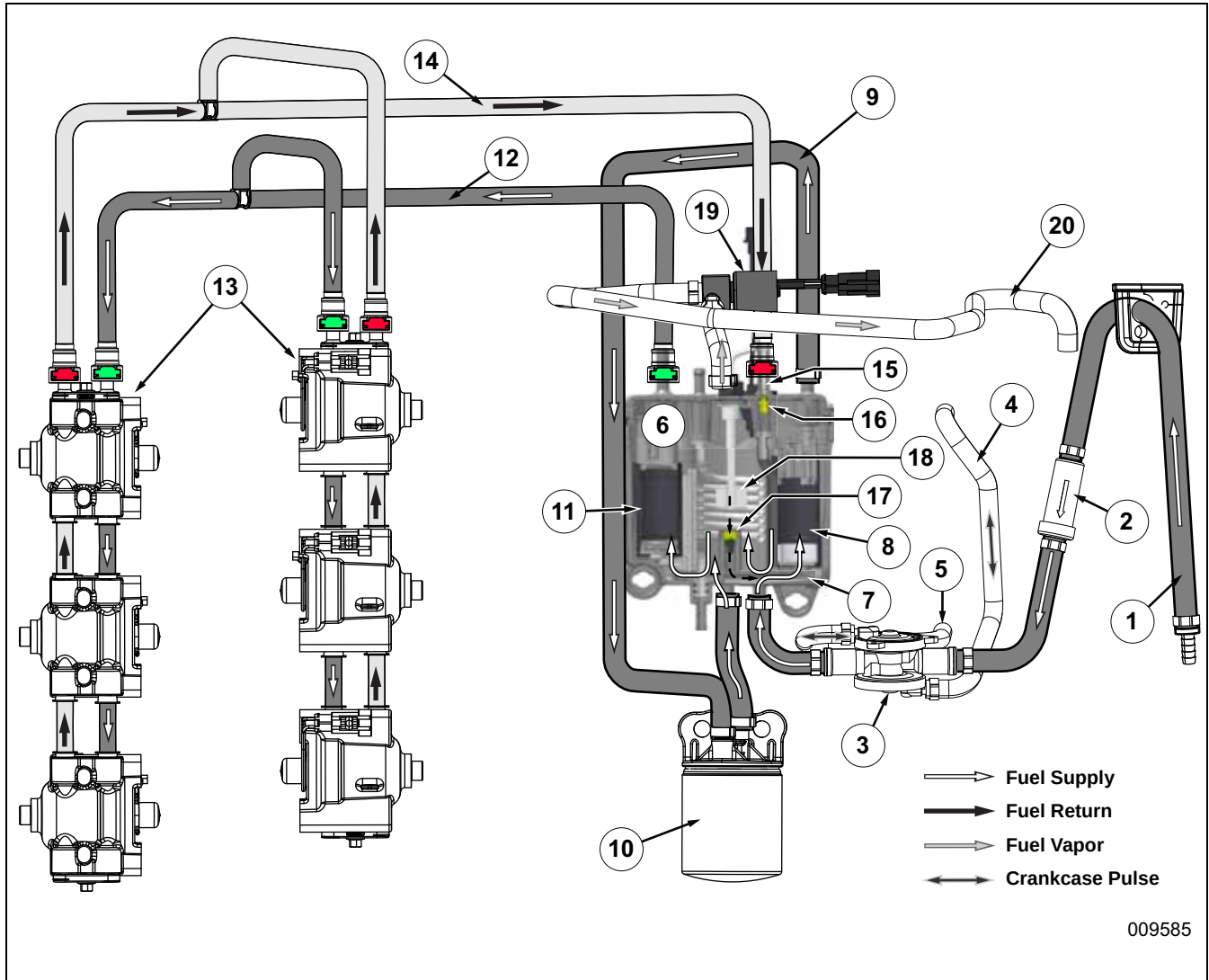
Fuel System Flow Diagram (AB, AF Models)

Fuel System Flow Diagram (AB, AF Models)



- | | |
|---|--|
| 1. Fuel supply from boat fuel system | 10. Fuel injector(s) |
| 2. Inline fuel filter (250 micron) | 11. Fuel return rail (red connector) |
| 3. Fuel pump/vapor separator assembly | 12. Fuel return filter |
| 4. Internal passage | 13. Pressure regulator (high pressure) |
| 5. Electric fuel lift pump | 14. Pressure regulator (low pressure) |
| 6. Fuel supply hose to water separating fuel filter | 15. Fuel level float |
| 7. Water separating fuel filter (10 micron) | 16. Fuel vapor vent solenoid |
| 8. Electric fuel circulation pump | 17. Fuel vapor vent hose to plenum |
| 9. Fuel supply rail (green connector) | |

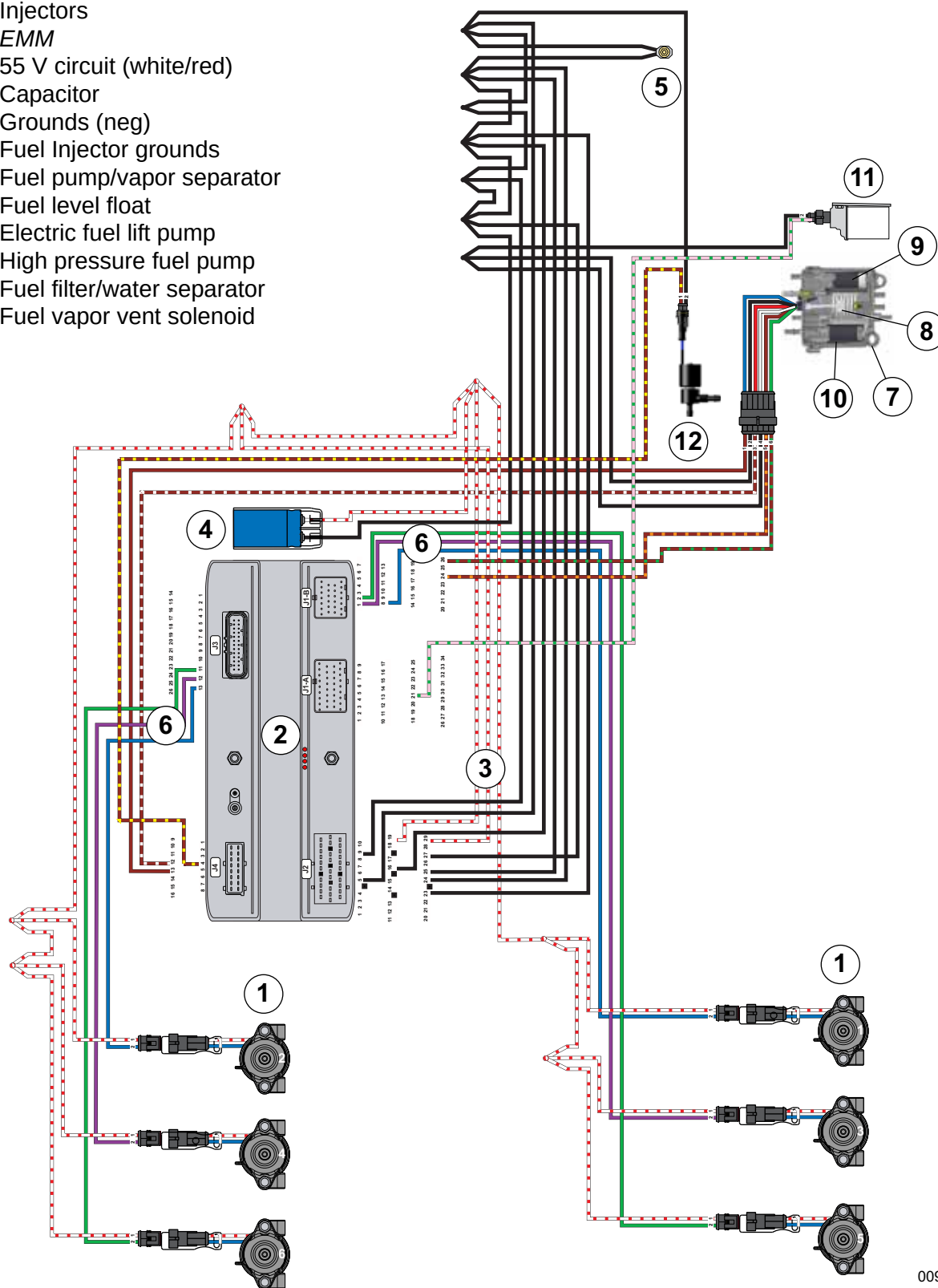
Fuel System Flow Diagram (AG & Newer)



- | | |
|---|--|
| 1. Fuel supply from boat fuel system | 11. Electric fuel circulation pump |
| 2. Inline fuel filter (250 micron) | 12. Fuel supply rail (green connector) |
| 3. Fuel lift pump (crankcase pulse) | 13. Fuel injector(s) |
| 4. Pulse hose to cylinder #1 | 14. Fuel return rail (red connector) |
| 5. Pulse hose to cylinder #4 | 15. Fuel return filter |
| 6. Fuel pump/vapor separator assembly | 16. Pressure regulator (high pressure) |
| 7. Internal passage | 17. Pressure regulator (low pressure) |
| 8. Electric fuel lift pump | 18. Fuel level float |
| 9. Fuel supply hose to water separating fuel filter | 19. Fuel vapor vent solenoid |
| 10. Water separating fuel filter (10 micron) | 20. Fuel vapor vent hose to plenum |

Fuel System Circuit Diagram

1. Injectors
2. EMM
3. 55 V circuit (white/red)
4. Capacitor
5. Grounds (neg)
6. Fuel Injector grounds
7. Fuel pump/vapor separator
8. Fuel level float
9. Electric fuel lift pump
10. High pressure fuel pump
11. Fuel filter/water separator
12. Fuel vapor vent solenoid



009279

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.

Permanent Fuel Tanks

Permanent fuel tanks must be properly vented outside of the hull.

Remote fuel tank gas fills must be grounded.

Fuel tank pickups should include an anti-siphon valve to prevent fuel flow if a leak occurs in the fuel distribution system.

Portable Fuel Tanks

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

	200 – 300 HP
Fuel tank pickup tube; minimum I.D.	3/8 in. (9.5 mm)
Fuel fittings; minimum I.D.	9/32 in. (7.1 mm)
Fuel supply hoses; minimum I.D.	3/8 in. (9.5 mm)
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 30 gph (114 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 spilled fuel.

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.

Recommended Fuel

Use unleaded gasoline with an AKI (R+M)/2 octane rating of 87, or an RON octane rating of 90.

Fuel blending varies by country and region. Your outboard has been designed to operate using the recommended fuels; however, 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 blended fuels attract and hold moisture which may lead to fuel phase separation and can result in engine performance problems or engine damage.
- Use of fuel containing alcohol above the percentage specified by government regulation can result in the following problems in outboard engines and fuel system components:
 - Vapor lock or fuel starvation
 - Starting and operating difficulties
 - Deterioration of rubber or plastic parts
 - Corrosion of metal parts
 - Damage to internal engine parts
- Inspect for fuel leaks or other fuel system abnormalities if you suspect the presence of

alcohol in gasoline exceeds the current government regulation limits.

Use in North America

NOTICE

Do NOT use fuel from fuel pumps labeled E85. Never experiment with other fuels.

The use of unleaded gasoline containing alcohol above the percentage specified by government regulations is not recommended.

Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit P/N 174176, is strongly recommended.

Use Outside North America

The use of unleaded gasoline containing alcohol above the percentage specified by local government regulations is not recommended.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit P/N 174176, is strongly recommended.

Additives

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

***Evinrude* 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* Fuel System Cleaner** will help keep fuel injectors in optimal operating condition.

Components

The fuel system includes the following components:

- Mechanical Fuel Lift Pump (AGA & newer models only)
- Fuel Pump & Vapor Separator Assembly
- Water Separating Fuel Filter
- Fuel Supply Rails
- Fuel Injectors
- Fuel Return Rails
- Fuel Vapor Vent Solenoid

Mechanical Fuel Lift Pump (AGA & Newer)

The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by two pulse hoses connected to the cylinder/crank-case assembly. Pulse hose locations are cylinders 1 and 4.

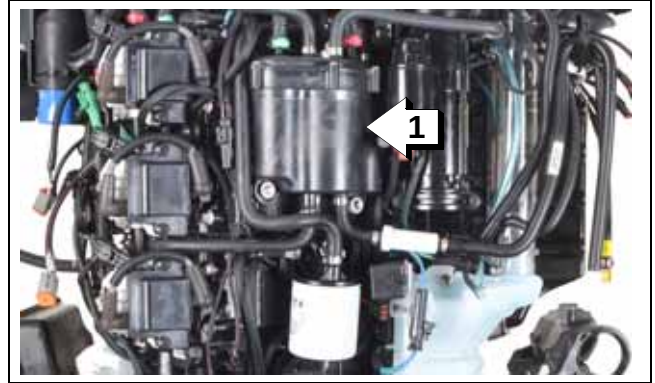
Vacuum from the fuel lift pump pulls fuel from the boat fuel tank through an inline 250 micron filter. Once fuel reaches the pump, internal pump pressure supplies fuel to the vapor separator.

Fuel Pump & Vapor Separator Assembly

The fuel pump and vapor separator assembly houses the following fuel system components in one package:

- Electric fuel lift pump
 - roller vane pump
 - (runs with Pulse Width Modulation (PWM))
 - functions as the fuel lift pump on ABA and AFA outboard models
 - functions to raise fuel pressure on AGA and newer outboard models
- Vapor separator assembly
 - water-cooled fuel reservoir to accumulate incoming fuel from the fuel lift pump and from the fuel return rail
 - micro switches control venting of fuel vapors
 - Low pressure regulator
 - High pressure regulator

- Electric fuel circulation pump
 - composite turbine impeller pump
 - runs 100% duty cycle
- Filter (fuel return rail fitting)



1. Fuel pump & vapor separator assembly

009186

Electric Fuel Lift Pump

The electric fuel lift pump utilizes a roller vane for reliability.

Fuel Supply (ABA, AFA Models)

The pump is mounted inside the vapor separator and draws fuel from the boat fuel tank through an inline 250 micron filter.

Fuel Supply (AGA & Newer Models)

The pump is mounted inside the vapor separator. Fuel from the boat fuel tank is supplied through the mechanical fuel lift pump.

All Models

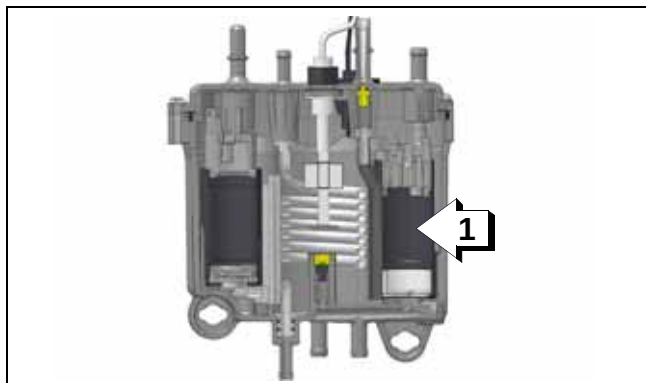
Fuel is pressurized to 7 to 15 psi (48 to 103 kPa) and flows through a hose to a 10 micron water separating fuel filter and into the fuel reservoir.

Electrical Circuit

The electric fuel lift pump is controlled by the *EMM* and operates on the 12 V circuit. The pump activates for 10 seconds when the *EMM* powers up (assumes the fuel system is primed, see **Fuel**

Fuel System Components

System Priming on p. 160). The fuel pump runs continuously during engine operation.



1. Fuel lift pump

009185

The *EMM* monitors the fuel pump electrical circuit.

- If the pump is disconnected (open circuit), the *EMM*:

Stores fault code 157

Engine Monitor CHECK ENGINE display: ON

- If the circuit current is beyond the specified range (short circuit), the *EMM*:

Stores fault code 158

Engine Monitor CHECK ENGINE display: ON

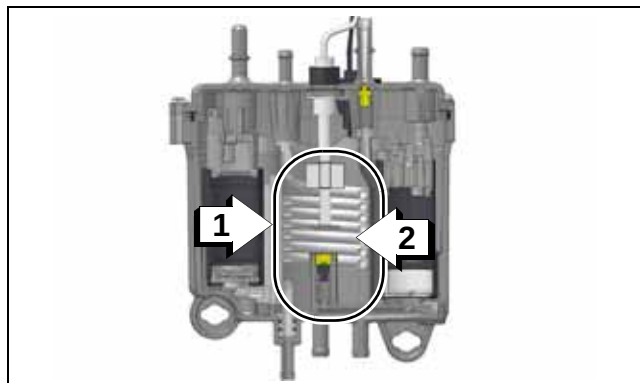
Fuel Reservoir

The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Cooling

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

separator self-drains when the outboard is stored vertically.

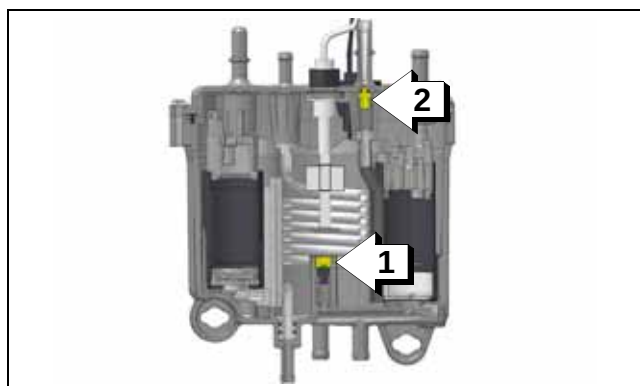


1. Fuel reservoir
2. Cooling passage

009185

Pressure Regulators

Fuel pressure regulators help maintain consistent fuel pressure in the fuel system. See the **Fuel System Flow Diagram (AG & Newer)** on p. 151.



Fuel Pressure Regulators
1. Low pressure regulator
2. High Pressure regulator

009185

Low Pressure Regulator

A low pressure regulator maintains approximately 7 to 15 psi (48 to 103 kPa) of fuel pressure in the low pressure side of the fuel system.

When the fuel pressure in the reservoir exceeds the pressure regulator setting the regulator opens. Fuel then flows through the regulator and an internal passage to the fuel lift pump. Fuel is cycled by the lift pump until pressure is restored to normal levels.

High Pressure Regulator

Fuel returning from the injectors enters the fuel reservoir of the vapor separator through a pres-

sure regulator. The pressure regulator maintains approximately 24 to 34 psi (165 to 234 kPa) of fuel pressure to the fuel injectors in the high pressure side of the fuel system.

Fuel Circulation Pump

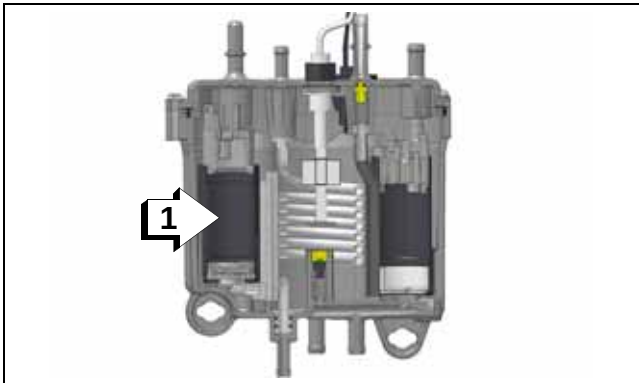
The fuel circulation pump is an electric high pressure fuel pump.

Fuel Supply

The pump is mounted inside the vapor separator and draws fuel from the fuel chamber. It pumps pressurized fuel through a fuel supply rail 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 for 10 seconds when the *EMM* powers up. The fuel circulation pump runs continuously during engine operation.



1. Fuel circulation pump

009185

The *EMM* monitors the fuel circulation pump electrical circuit.

- If the circulation pump is disconnected (open circuit), the *EMM*:

Stores fault code 91

Engine Monitor CHECK ENGINE display: ON

- If the circuit current is beyond the specified range (short circuit), the *EMM*:

Stores fault code 92

Engine Monitor CHECK ENGINE display: ON

Fuel Vapor Venting

The fuel vapor vent solenoid regulates fuel level in the reservoir.



1. Vapor vent solenoid

009199

The *EMM* controls fuel vapor vent solenoid operation based on inputs from the fuel level micro switches.

Electrical Circuit

The *EMM* monitors the fuel vapor vent solenoid electrical circuit.

- If the vent solenoid is disconnected (open circuit), the *EMM*:

Stores fault code 159

Engine Monitor CHECK ENGINE display: ON

- If the circuit current is beyond the specified range (short circuit), the *EMM*:

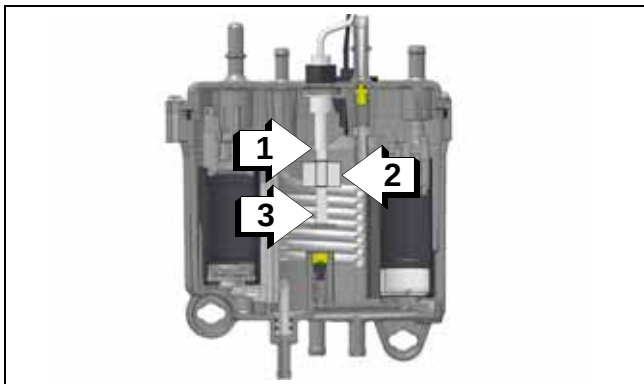
Stores fault code 160

Engine Monitor CHECK ENGINE display: ON

Fuel System Components

Fuel Level

The fuel level in the reservoir is regulated by the fuel vapor vent solenoid.



1. Upper fuel level micro switch (approximate location) 009185
2. Fuel level float
3. Lower fuel level micro switch (approximate location)

Electrical Circuit

The *EMM* monitors the fuel level micro switches.

When the lower micro switch closes, the *EMM* opens the fuel vapor vent solenoid, allowing vapor to escape as the fuel lift pump adds fuel to the reservoir.

If the lower micro switch remains closed beyond the specified range (5 seconds) {assumes the fuel system is primed}, the *EMM*:

Activates S.A.F.E.
Stores fault code 137
Engine Monitor CHECK ENGINE display: ON

If the lower micro switch circuit voltage is disconnected (open circuit), the *EMM*:

Stores fault code 133
Engine Monitor CHECK ENGINE display: ON

When the upper micro switch closes, the *EMM* closes the fuel vapor vent solenoid, preventing vapor and fuel from escaping.

If the upper micro switch circuit voltage is disconnected (open circuit), the *EMM*:

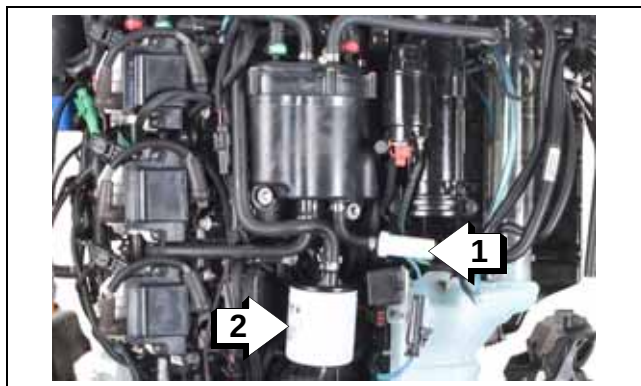
Activates S.A.F.E.
Stores fault code 132
Engine Monitor CHECK ENGINE display: ON

Fuel Filters

Fuel filters protect the fuel lift pump, vapor separator and the high-pressure components of the fuel system from contaminants.

A 250 micron inline filter and a 10 micron water separating fuel filter are installed. A water in fuel sensor is mounted in the housing of the water separating fuel filter.

Refer to **Inspection and Maintenance Schedule** on p. 16 for service frequency.



1. Inline fuel filter 009186
2. Water separating fuel filter

Electrical Circuit

The *EMM* monitors the water in fuel electrical circuit. If the circuit is activated, the *EMM*:

Stores fault code 37
Engine Monitor CHECK ENGINE display: ON

Fuel Rails

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

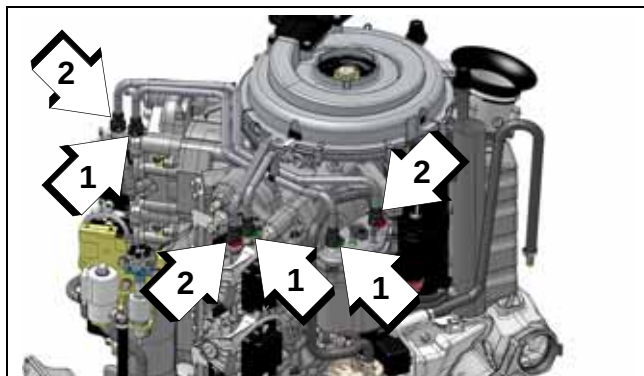
Fuel Supply Rail

The fuel supply rail supplies pressurized fuel to the inlet port of each fuel injector. The fuel supply rails can be identified by the green locking device on each connector fitting.

Fuel Return Rail

The fuel return rail provides a route for fuel passing through the fuel injectors to flow back to the fuel chamber of the fuel pump & vapor separator assembly.

The fuel return rails can be identified by the red locking device on each connector fitting.



1. Fuel supply rail
2. Fuel return rail

009197

Fuel Injectors

Fuel injectors are fuel metering, electric voice coil actuators (55 V) bolted directly to the cylinder head.

Electrical Circuit

The *EMM* controls the activation of each injector by connecting and disconnecting the injector's internal coil to ground.

The *EMM* monitors the fuel injector electrical circuit. If the injector is disconnected (open circuit), the *EMM*:

Stores fault code 51 – 56 (second digit identifies cylinder)

Engine Monitor CHECK ENGINE display: ON

Fuel Flow Compensation

The flow rate of each injector is measured as part of the manufacturing process. This information is recorded and assigned to the injector by serial number.

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. This software allows the *EMM* to be repro-

grammed for this injector's unique fuel flow characteristics.

NOTICE

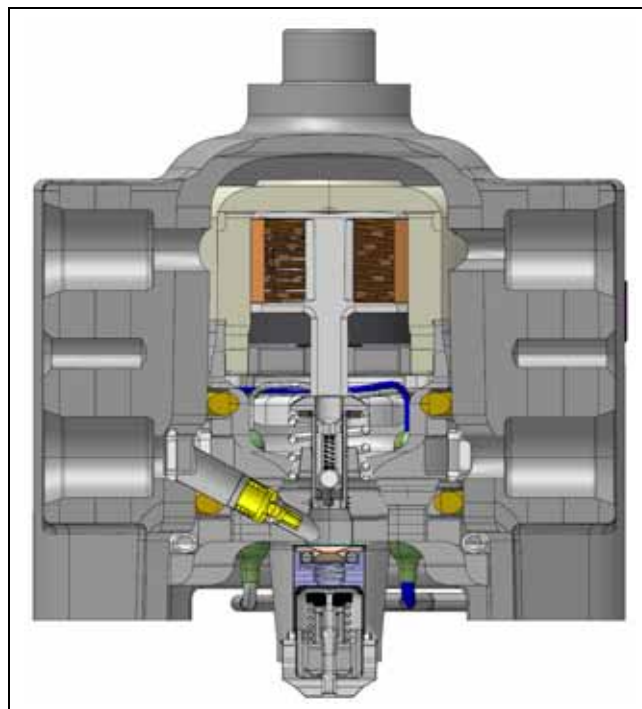
Fuel injectors **MUST NOT** be moved from one cylinder to another. *EMM* programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply rail.

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.



009187

Fuel System Priming

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. 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.

NOTICE

A fuel primer bulb is **NOT** required and should **NOT** be installed on *Evinrude E-TEC G2* models.

Evinrude E-TEC G2 models are equipped with an electric fuel lift pump. The electric fuel lift pump runs continuously up to 1 minute when the vapor separator low fuel switch is active.

Make sure the battery is fully charged and reads a minimum of 12 VDC. Turn the Master Power / Key Switch to the ON position to start the fuel priming process.

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.

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 spilling during servicing. Fuel is flammable and can be explosive under certain conditions.

Fuel System Pressure Tests

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. 168.

Check the *Evinrude Diagnostics* software *Occurred Faults* screen for current fault codes before troubleshooting. Correct any problems and clear the codes **FIRST**.

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

Use shop towels to clean up any spilled fuel.

ENVIRONMENTAL NOTE

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

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. 125.

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):

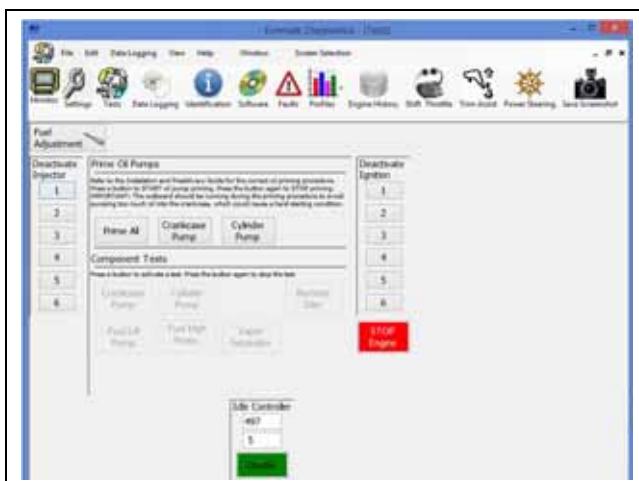
- Check stator input to *EMM*, CPS operation, and all grounds and wiring connections.
- Eliminate all other possibilities to isolate a faulty *EMM*.

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. 167.

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. 108.



Dynamic Tests Screen

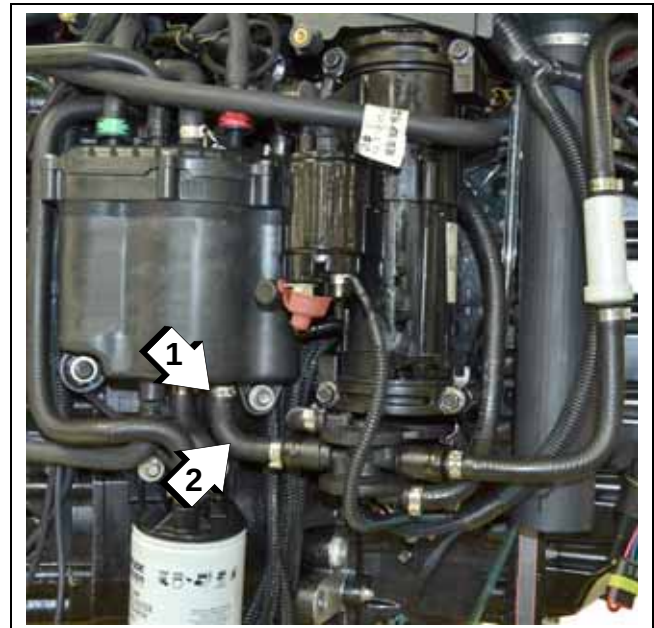
008115

Refer to **Fuel System Pressure Tests** on p. 160.

Mechanical Fuel Pump Pressure Test

Remove the *Oetiker* clamp at the vapor separator inlet. Then remove the hose from the vapor separator.

Temporarily install a 0 to 15 psi (0 to 103 kPa) Fuel Pressure Gauge, P/N 5006397 or equivalent, between the short hose and the vapor separator inlet.



1. Oetiker clamp
2. Short hose

009595

Prime the fuel system and check for leaks. START the outboard and run at idle speed. Hold the gauge level with inlet fitting and monitor the gauge for pressure reading.

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

Results:

Normal pressure

- Perform the **Fuel Lift Pump Vacuum Test** on p. 163. 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 **Fuel Lift Pump Vacuum Test** on p. 163. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Fuel System

Fuel System Tests

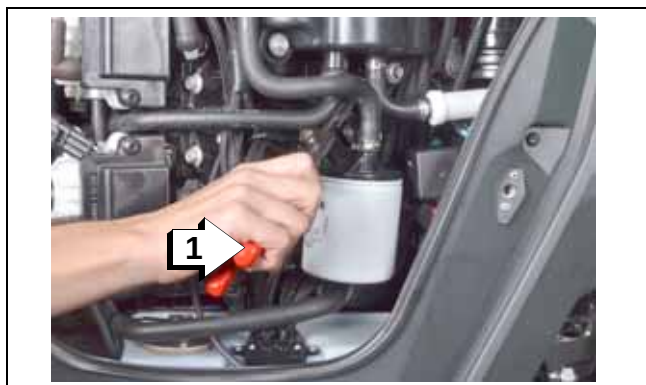
- Check fuel flow through fuel lift pump. Use fuel primer bulb to force fuel through pump.

No pressure

- Momentarily prime or squeeze primer bulb to check gauge operation.
- Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
- Check pulse hoses and fittings restrictions.

Electric Fuel Pump Pressure Test

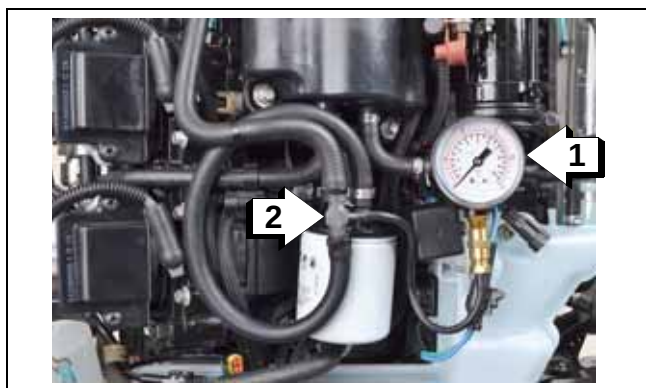
Install hose pinching pliers on the short hose between the fuel filter bracket to the vapor separator assembly. This will prevent fuel from draining out of the vapor separator.



1. Hose pinching pliers

009201

Temporarily install a 0 to 15 psi (0 to 103 kPa) Fuel Pressure Gauge, P/N 5006397 or equivalent, and T-fitting between the intermediate fuel pump outlet and the fuel supply hose to the water separating fuel filter.



1. Fuel pressure gauge
2. T-fitting

009202

Remove the hose pinching pliers.

Prime the fuel system and check for leaks. START the outboard and run at idle speed. Hold the fuel pressure gauge level with the fuel inlet fitting and monitor the gauge for pressure reading.

Pressure should stabilize and gauge must not indicate less than 6 psi (41 kPa).

Results:

Normal pressure

- Perform the **Fuel Lift Pump Vacuum Test** on p. 163. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Low pressure

- Perform the **Fuel Lift Pump Vacuum Test** on p. 163. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.
- Check fuel flow through fuel lift pump.

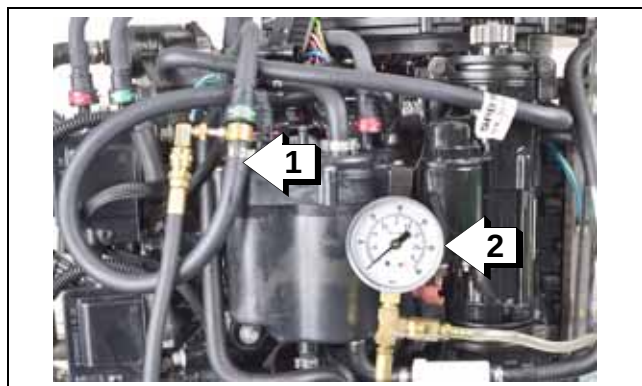
No pressure

- Check fuel flow through fuel lift pump.

Fuel Circulation Pump Pressure Test

Install Fuel Pressure Test Adapter, P/N 357713, on the fuel pump and vapor separator assembly and to the fuel connector on the fuel rail.

Install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, to the fitting on the fuel pressure test adapter.



1. Fuel Pressure Test Adapter, P/N 357713
2. Fuel pressure gauge

009200

Running Outboard

START the outboard and check pressure. System pressure should be 24 to 34 psi (165 to 234 kPa) @ idle RPM.

Shut OFF outboard. Monitor pressure gauge.

Non-Running Outboard

If the outboard does not run, turn the key switch to the ON position to prime the fuel system. Crank outboard; check circulation pump operation; check fuel system pressure.

Results:

Normal pressure

- Observe pressure reading after outboard is shut OFF. Pressure should not drop below 15 psi (103 kPa).

Pressure continues to drop below 15 psi (103 kPa) 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 rail.

Low pressure

- Check fuel supply to fuel lift pump. Refer to **Fuel Lift Pump Vacuum Test** on p. 163. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted inline fuel filter.
- Restricted fuel filter/water separator assembly.
- Lift pump not supplying adequate fuel to vapor separator. Refer to **Mechanical Fuel Pump Pressure Test** on p. 161.
- 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. 168.

Fuel Lift Pump Vacuum Test

Confirm fuel supply to the fuel lift pump.

Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet). Secure connections to prevent fuel or air leaks.

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.



000243

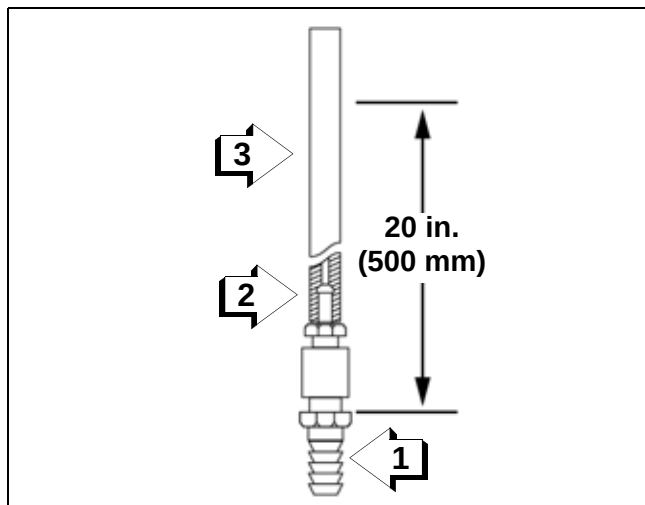
START outboard and run at FULL THROTTLE for at least two minutes. Monitor clear vinyl hose for the presence of air. Air bubbles indicate a faulty hose, connection, or fuel tank pick-up. Repair, if necessary, before proceeding.

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. 153 for fuel supply component requirements.

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 inches (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 inches (630 mm). Water should flow through valve as water level reaches 25 inches (630 mm). Replace the anti-siphon valve if test results are different.

Fuel System Electrical Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Fuel system electrical circuits are dependent on wiring and connections, *EMM* supplied current and component resistance. The supplied current flows through the wiring circuit and component before returning to the *EMM*.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using a diode test. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Vapor Vent Solenoid Resistance Test

Disconnect the battery cables at the battery. Remove the electrical connector from the vapor vent solenoid.

Use a digital multimeter with appropriate test probe leads to measure the solenoid coil resistance.

Vapor Vent Solenoid Coil Resistance

17 to 23 Ω @ 72°F (22°C)



009203

Vapor Vent Solenoid Circuit Test

Remove the electrical connector from the vapor vent solenoid.

Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.

Connect the negative meter lead to the wire listed in the table, connect the positive meter lead to engine ground.

Vapor Vent Solenoid Circuit Diode Test		
Wire	Pin	Result
BROWN/YELLOW	1	approximately 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the vapor vent solenoid ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Vapor Vent Solenoid Ground Circuit Resistance		
Wire	Pin	Result
BLACK	2	$< 1 \Omega$

Results:

- An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Electric Fuel Lift Pump Resistance Test

Disconnect the battery cables at the battery. Remove the electrical connector from the fuel pump and vapor separator assembly.

Use a digital multimeter with appropriate test probe leads to measure the fuel pump coil resistance.

Connect the black meter lead to the black wire, connect the red meter lead to the red wire.

Fuel Pump Resistance
$< 10 \Omega$ @ 77°F (25°C)



Electric Fuel Pump Circuit Test

Remove the electrical connector from the fuel pump and vapor separator assembly.

Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.

Connect the negative meter lead to the wire listed in the table, connect the positive meter lead to engine ground.

Fuel Pump Circuit Diode Test		
Wire	Pin	Result
BROWN/WHITE	3	approximately 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel System

Fuel System Tests

Use a digital multimeter to measure the resistance of the fuel pump and vapor separator assembly electrical connector and engine ground.

Fuel Pump Ground Circuit Resistance		
Wire	Pin	Result
BLACK	2	< 1 Ω

Results:

An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Circulation Pump Resistance Test

Disconnect the battery cables at the battery. Remove the electrical connector from the fuel pump and vapor separator assembly.

Use a digital multimeter with appropriate test probe leads to measure the fuel pump coil resistance.

Connect the black meter lead to the black wire, connect the red meter lead to the blue wire.

Fuel Circulation Pump Resistance
<10 Ω @ 77°F (25°C)



Fuel Circulation Pump Circuit Test

Remove the electrical connector from the fuel pump and vapor separator assembly.

Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.

Connect the negative meter lead to the wire listed in the table, connect the positive meter lead to engine ground.

Fuel Circulation Pump Circuit Diode Test		
Wire	Pin	Result
BROWN	1	approximately 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel pump and vapor separator ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Fuel Circulation Pump Ground Circuit Resistance		
Wire	Pin	Result
BLACK	2	< 1 Ω

Results: An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Level Switch Circuit Test

Remove the electrical connector from the fuel pump and vapor separator assembly.

Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.

Connect the negative meter lead to the wire listed in the table, connect the positive meter lead to engine ground.

Fuel Level Switch Circuit Diode Test		
Wire	Pin	Result
BROWN/GREEN	6	1.5 to 3.0 VDC
BROWN/ORANGE	5	

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel level switch ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Fuel Level Switch Ground Circuit Resistance		
Wire	Pin	Result
BLACK	4	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Injector Resistance Test

Disconnect the battery cables at the battery. Remove the electrical connector from the fuel injector.

Use a digital multimeter with appropriate test probe leads to measure the injector coil resistance.

Fuel Injector Coil Resistance
2 to 3 Ω @ 72°F (22°C)



009203

Fuel Injector Circuit Test

Remove the electrical connector from the fuel injector.

Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.

Connect the negative meter lead to the wire listed in the table, connect the positive meter lead to engine ground.

Fuel Injector Signal Circuit Diode Test		
Wire	Pin	Result
BLUE	2	approximately 0.5 VDC
PURPLE	2	
GREEN	2	

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel injector 55V circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to the red/white wire of a known good circuit such as an oil pump.

Fuel Injector 55V Circuit Resistance		
Wire	Pin	Result
WHITE/RED	1	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

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 spilled fuel.

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

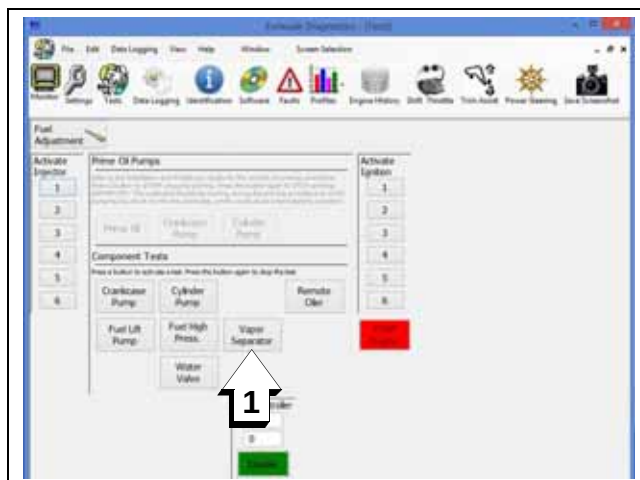
IMPORTANT: Minimize fuel system pressure prior to disassembly.

Remove the propeller from the outboard. Then disconnect the electrical connector of the fuel pump and vapor separator assembly.

Start and run the outboard at IDLE for several seconds and STOP the outboard. If the outboard does NOT run, crank for 10 seconds.

Disconnect the battery cables at the battery.

Use the *Tests* screen of *Evinrude Diagnostic* software v 6.1 or higher. Select the *Vapor Separator* button to activate the fuel vapor vent solenoid.



1. Vapor Separator button

009225

Fuel Filter Service

Disconnect the battery cables at the battery.

Remove fuel filters carefully to prevent spilling the filter's contents.

Use shop towels to clean up any spilled fuel.

ENVIRONMENTAL NOTE

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

Inspect fuel filter 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.

Water Separating Fuel Filter

IMPORTANT: Replace the water separating fuel filter when replacing a vapor separator.

Removal

Install hose pinching pliers on the short hose between the fuel filter bracket to the vapor separator assembly. This will prevent fuel from draining out of the vapor separator.



1. Hose pinching pliers

009201

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

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.

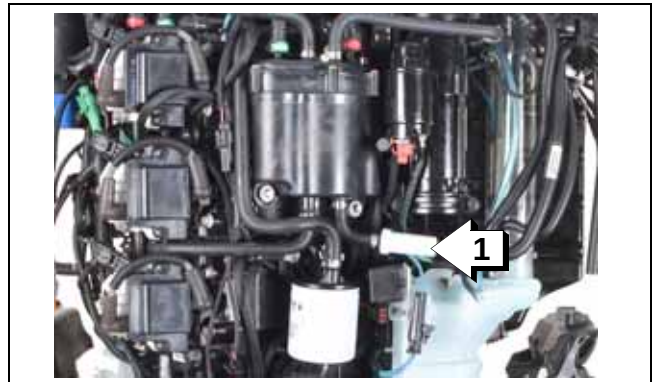
Hand tighten until seal contacts filter housing. Then tighten an additional one-half to one turn. Remove the hose pinching pliers from the fuel hose.

Connect the battery cables at the battery.

Run the outboard and check for fuel leaks.

Inline Fuel Filter

Removal



1. Inline fuel filter

009186

Installation

Install filter in fuel supply hoses. Note arrow indicating direction of fuel flow on filter. Secure filter with new *Oetiker* clamps.

Connect the battery cables at the battery.

Run the outboard and check for fuel leaks.

Mechanical 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.

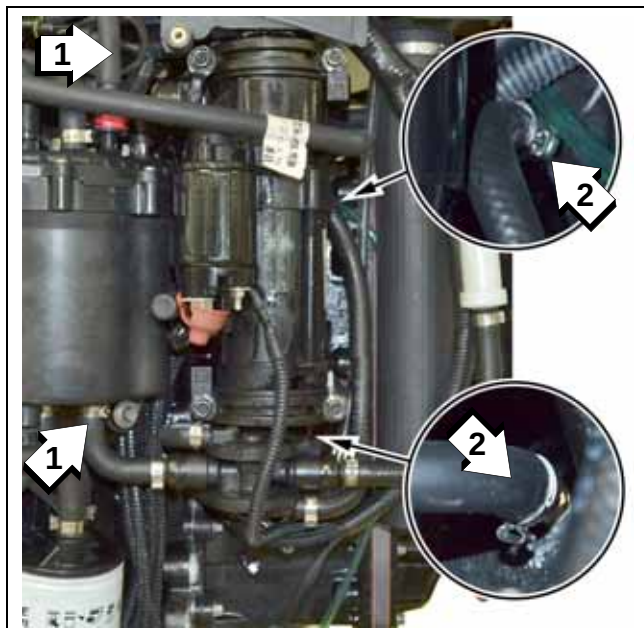
Disconnect the fuel inlet hose at the rigging center.

Disconnect the fuel outlet hose at the vapor separator.

Fuel System

Fuel Component Servicing

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



1. Fuel outlet hose at the vapor separator
2. Pulse hoses at the crankcase fittings

009588

Remove the fuel lift pump and hoses as an assembly.

Installation

Connect the fuel lift pump pulse hoses to the crankcase. Secure with new *Oetiker* clamps.

Connect the fuel outlet hose to the vapor separator. Secure with a new *Oetiker* clamp.

Connect the fuel inlet hose in the rigging center. Secure with a new *Oetiker* clamp.

Connect battery cables.

Run outboard and check for fuel leaks.

Vapor Separator Service

IMPORTANT: Replace the water separating fuel filter when replacing a vapor separator.

Removal

⚠ WARNING

When servicing the fuel system, always shift the outboard to **NEUTRAL** position, turn the key switch **OFF** and remove the key, so the outboard cannot be started accidentally.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 168.

Disconnect the battery cables at the battery.

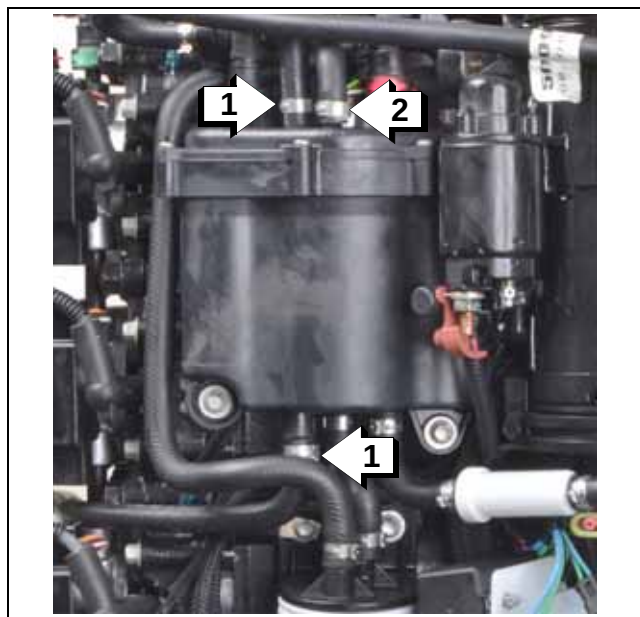
Remove the engine top, front and rear covers. Remove the starboard side panel. Remove the starboard frame. Refer to **Engine Cover and Frame Service** on p. 55.

Use a #2 *Posi-drive* screwdriver to remove the three screws retaining the center frame to the frame mounts.

Disconnect vapor separator electrical connector.

Carefully remove the *Oetiker* clamps from the:

- upper & lower water cooling hoses.
- vapor separator vent outlet hose.
- fuel inlet hose at the rigging center.



1. Upper & lower water cooling hoses
2. Vapor separator vent outlet hose

009217

Place shop towels to catch any spilled fuel. Then remove the following hoses:

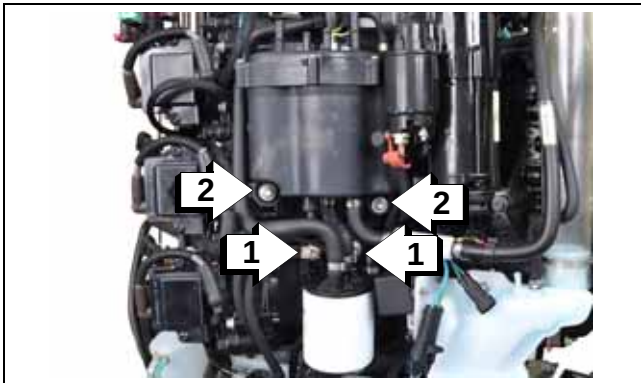
- upper & lower water cooling hoses.
- vapor separator vent outlet hose.
- fuel inlet hose from the boat fuel supply hose.
- pulse hoses from the fuel lift pump (AGA & newer models)

Disconnect the fuel rails from the vapor separator. Refer to **Quick Connector Locking Fittings** on p. 172.

Use shop towels to wipe up any spilled fuel.

Remove the vapor separator, fuel filter bracket and remaining hoses as an assembly:

- Remove the two fuel filter bracket mounting screws and washers.
- Remove the two lower vapor separator mounting screws and washers.
- Remove the vapor separator, fuel filter bracket and hoses from the engine.



1. Fuel filter bracket mounting screws and washers
2. Vapor separator mounting screws and washers

009207

Place the assembly in a large tray or other suitable container to catch the fuel from the vapor

separator. A full assembly can hold over 32 oz. (1 L) of fuel.



009206

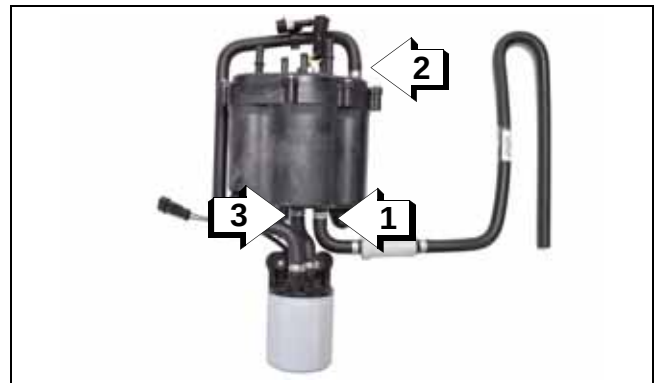
ENVIRONMENTAL NOTE

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

Take the assembly to a work bench or other suitable work surface.

Carefully remove *Oetiker* clamps from:

- inlet hose from inline fuel filter
- outlet hose from fuel lift pump
- inlet hose from water separating fuel filter



1. Inlet hose from inline fuel filter
2. Outlet hose from fuel lift pump
3. Inlet hose from water separating fuel filter

009218

Then remove the hoses.

Installation

⚠ WARNING

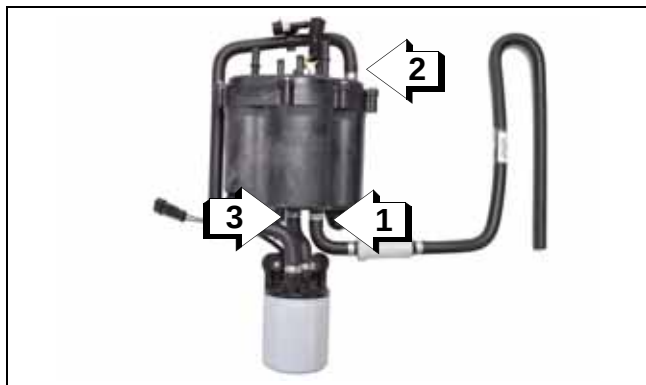
After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

Fuel System

Fuel Component Servicing

Install the following hoses with new *Oetiker* clamps:

- inlet hose from inline fuel filter
- outlet hose from fuel lift pump
- inlet hose from water separating fuel filter

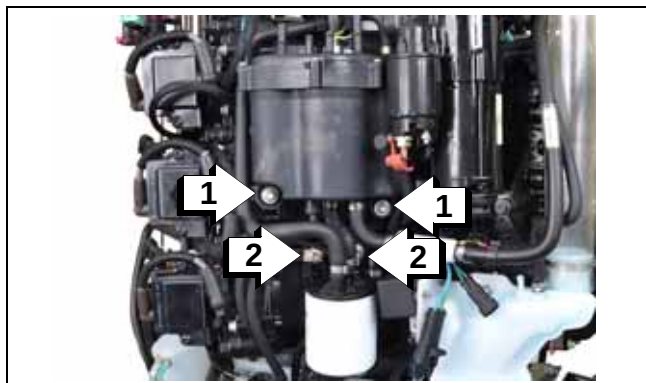


1. Inlet hose from inline fuel filter
2. Outlet hose from fuel lift pump
3. Inlet hose from water separating fuel filter

009218

Install the vapor separator, fuel filter bracket and hoses on the engine:

- Install the two lower vapor separator mounting screws and washers. Tighten the screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
- Install the two fuel filter bracket mounting screws and washers. Tighten the screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).



1. Vapor separator mounting screws and washers
2. Fuel filter bracket mounting screws and washers

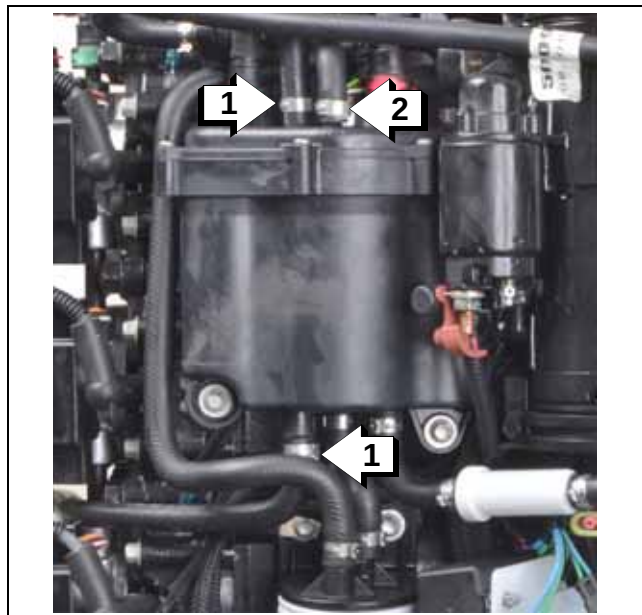
009207

Connect the fuel rails to the vapor separator. Refer to **Quick Connector Locking Fittings** on p. 172.

Install the following hoses with new *Oetiker* clamps:

- upper & lower water cooling hoses
- vapor separator vent outlet hose

- fuel inlet hose at the rigging center



1. Upper & lower water cooling hoses
2. Vapor separator vent outlet hose

009217

Connect the electrical connector to the vapor separator.

Use a #2 *Posi-drive* screwdriver to install the center frame screws.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Connect battery cables at the battery.

Prime the fuel system and check for fuel leaks. Repair all leaks.

Supply water to the engine. Start and run the outboard and check for fuel leaks. Repair all leaks before returning the outboard to service.

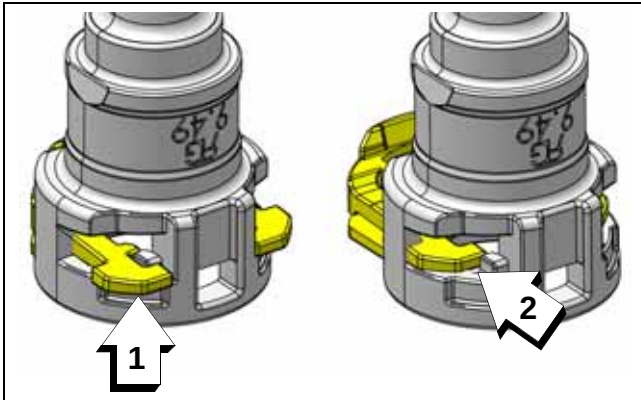
Install starboard frame. Install the engine top, front and rear covers. Install the starboard side panel. Refer to **Engine Cover and Frame Service** on p. 55.

Fuel Rail Service

Quick Connector Locking Fittings

The fuel rails are equipped with quick connector locking fittings. Lift the two tabs of the locking

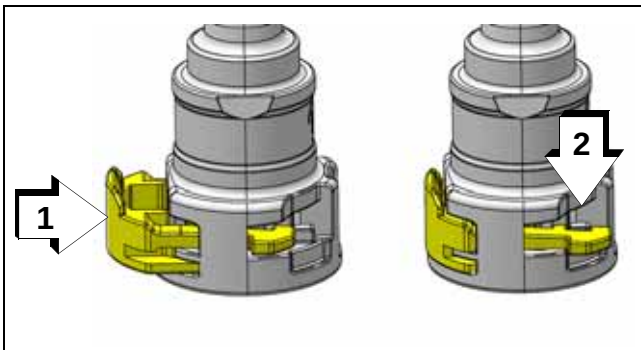
device and push to unlock the quick connector fittings.



1. Lift tabs
2. Push tabs to unlock

009195

Push the locking device to lock the quick connector fittings. Make sure tabs are in the locked position.



1. Push locking device
2. Tab in locked position

009196

Removal

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 168.

⚠ WARNING

When servicing the fuel system, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Disconnect the battery cables at the battery.

Remove the engine top, front and rear covers. Remove the port and starboard side panels.

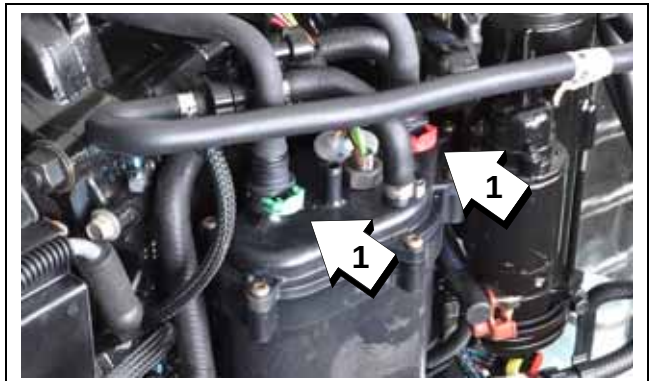
Remove the starboard frame. Next remove the port frame, then remove the front frame.

Use a #2 *Posi-drive* screwdriver to remove the three screws retaining the center frame to the frame mounts.

Remove the center frame. Refer to **Engine Cover and Frame Service** on p. 55.

Unlock and remove the quick connectors from the fuel pump & vapor separator assembly.

Use shop towels to wipe up any spilled fuel.



1. Quick connector fittings

009216

Unlock the quick connectors from the fuel injectors.

Remove the quick connectors from the fuel injectors.

Use shop towels to wipe up any spilled fuel, then remove the connectors from the fuel injectors.

ENVIRONMENTAL NOTE

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

Remove the fuel rails from the engine.



009215

Fuel System

Fuel Component Servicing

Installation

⚠ WARNING

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.

Check condition of the sealing o-rings on fuel rail fittings. Lubricate o-rings with outboard lubricant.

Position the fuel rails on the engine.

Install the fuel rail fittings on to the fuel fittings of the upper fuel injectors.

- The fuel supply rail uses green locking devices. Position the fuel supply rail on the fitting closest to the cylinder head.
- The fuel return rail uses a red locking device. Position the fuel return rail on the fitting farthest from the cylinder head.

Install the fuel rail fittings on to the fuel fittings of the fuel pump & vapor separator assembly.

- The fuel supply rail uses green locking devices. Position the fuel supply rail on the rearward fitting of the vapor separator.
- The fuel return rail uses a red locking device. Position the fuel return rail on the forward fitting of the vapor separator.

Make sure fittings are fully seated. Push the locking device to lock the quick connector fittings. Make sure tabs are in the locked position.



009220

Install the center frame. Use a #2 *Posi-drive* screwdriver to install the center frame screws.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to

tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Next, install the front frame.

Connect the battery cables at the battery.

Prime the fuel system and check for fuel leaks. Repair all leaks.

Supply water to the engine. Start and run the outboard and check for fuel leaks. Repair all leaks before returning the outboard to service.

Install the port frame, followed by the starboard frame.

Install the port and starboard side panels, engine front, top and rear covers. Refer to **Engine Cover and Frame Service** on p. 55.

Fuel Injector Service

Mark fuel injectors to show cylinder locations.

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.



Injector Coefficients Screen

009285

Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel rails. Cover the injector

nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal

⚠ WARNING

When servicing the fuel system, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 168.

Disconnect the battery cables at the battery.

Remove the engine top, front and rear covers. Remove the port and starboard side panels.

Use a #2 *Posi-drive* screwdriver to remove the three screws retaining the center frame to the frame mounts.

Remove the port and/or starboard frames as required.

Remove the ignition coils:

- Disconnect the electrical connectors from each ignition coil.
- Remove the ignition coil bracket retaining screws and washers.

Disconnect the electrical connector from each fuel injector.

Remove fuel rails from the bank of fuel injectors. Refer to **Fuel Rail Service** on p. 172.

Use shop towels to catch any spilled fuel.

ENVIRONMENTAL NOTE

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

Remove the fuel injectors from the cylinder head as follows:

1. BOTTOM fuel injector: remove the upper screw completely, then loosen the lower screw several turns (do NOT remove the lower screw).
2. MIDDLE injector: remove BOTH screws.

3. TOP injector: remove the lower screw completely, then loosen the upper screw several turns (do NOT remove upper screw).
4. Remove the upper screw from the TOP injector. Support the injector bank in place on the cylinder head.
5. Continue to support the injector bank in place while removing the lower screw from the BOTTOM injector.



After the lower screw is detached from the cylinder head, remove the bank of fuel injectors from the cylinder head.

Use a suitable container to drain fuel from the injectors.



Take the bank of fuel injectors to a work bench or other suitable work surface.

Remove fuel injector insulators from the cylinder head.

Fuel Injector Bank Disassembly

Separate the injectors from the injector bank.

Fuel System

Fuel Component Servicing

To separate the injectors:

- Carefully pull each injector to separate it from the fuel tubes.



009210

- Remove the screw retaining the fuel fitting to the top injector. Then remove the fitting from the injector.
- Remove the screw retaining the fuel fitting to the bottom injector. Then remove the plug fitting from the injector.
- Remove the o-rings from the fuel fitting, each fuel tube and the plug fitting.

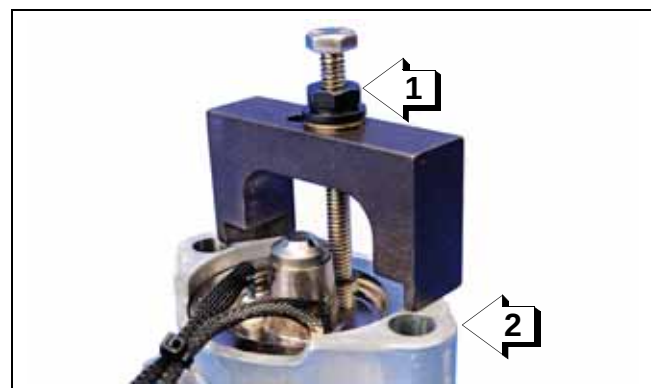
Crush Ring Replacement

NOTICE

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

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

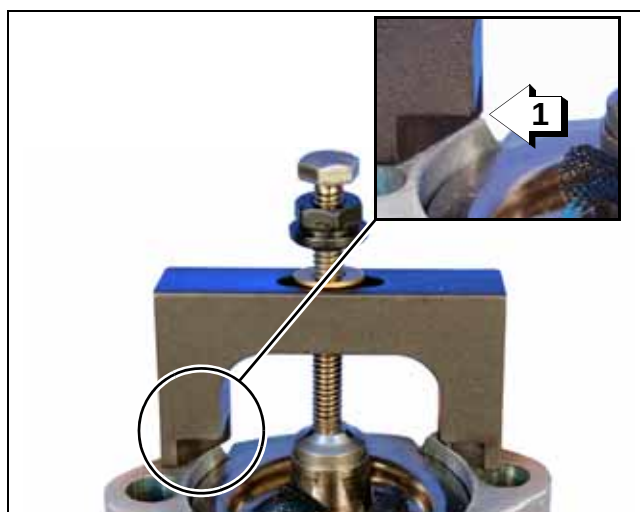
Turn the nut of the fuel injector puller counter-clockwise several turns. Place the fuel injector puller on the fuel injector housing.



1. Puller nut
2. Fuel injector housing

008795

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.



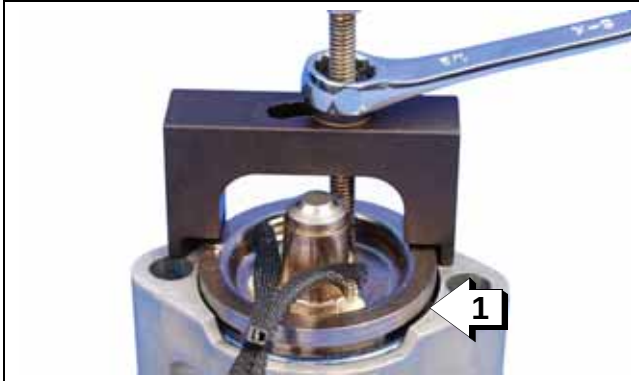
1. 1/4-20 threaded hole

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.

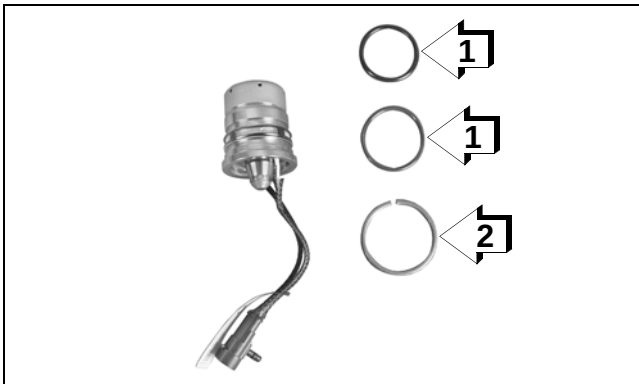
Turn the puller nut until the fuel injector is removed from the fuel injector housing.



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



1. O-rings
2. Crush ring 002317

Installation

⚠ WARNING

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.

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*.

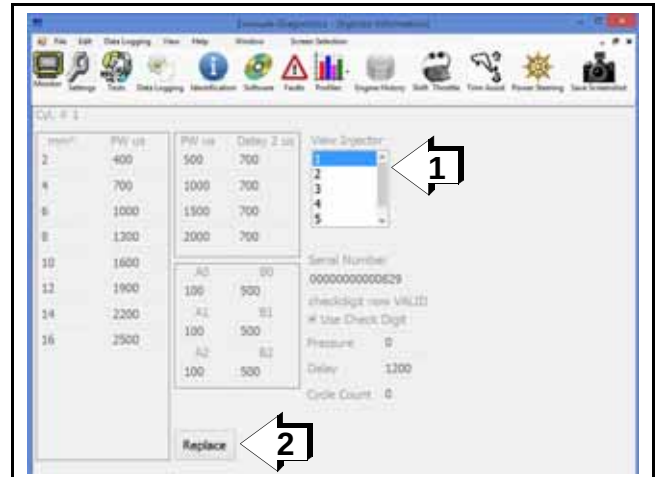
Coefficient data can be downloaded from the *Evinrude* dealer website. Refer to the instructions provided with the injector kit.

Upload Coefficient Files to *EMM*

Use the *Evinrude Diagnostics* software, v 6.1 or higher *Settings* screen to upload the coefficient file to the *EMM*.

Select the *Injectors* tab.

From the *View Injector* window, select the cylinder for the injector being replaced. Then select the *Replace* button.



1. "View Injector" window
2. "Replace" button 009285

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

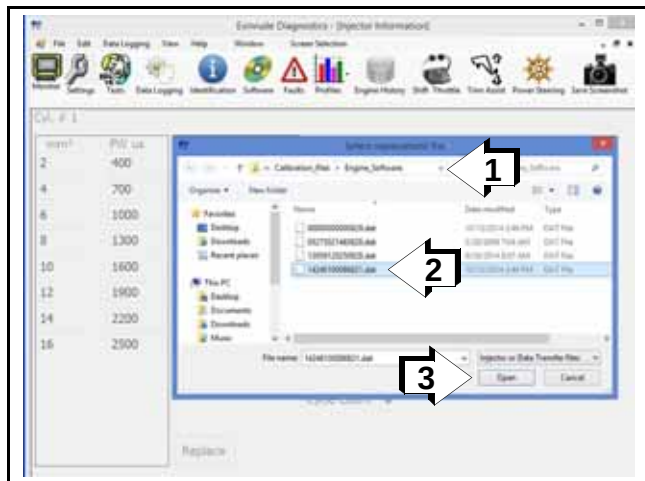
The coefficient file name must match the serial number of the injector.

Select the correct file for the injector.

Fuel System

Fuel Component Servicing

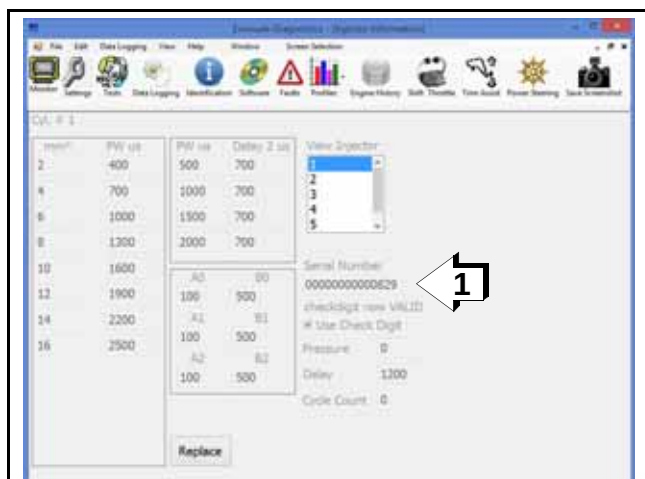
Select the *Open* button.



1. Drop down menu
2. Injector coefficient file
3. "Open" button

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

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



1. *Injector serial number*

Install Injector

NOTICE

Confirm injector location when assembling the injector bank. Refer to cylinder location marks made earlier. Improper injector installation can result in powerhead failure.

Assemble the injector bank:

- Install new o-rings on the fuel fitting, each fuel tube and the plug fitting.
- Apply 2-stroke outboard oil to the o-rings.
- Install the fuel fitting in the top injector.
- Install the retaining screw and tighten to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
- Install the plug fitting in the bottom injector.
- Install the retaining screw and tighten to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
- Align the injectors with the fuel tubes and press together until fully seated.



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

- Injector
- Cylinder head
- Screws
- Threaded areas

⚠ CAUTION

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

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

Lubricate mounting screw threads and under the head of the screw with a light coat of *Triple-Guard*

grease. Install washers (one per screw) on injector retaining screws.



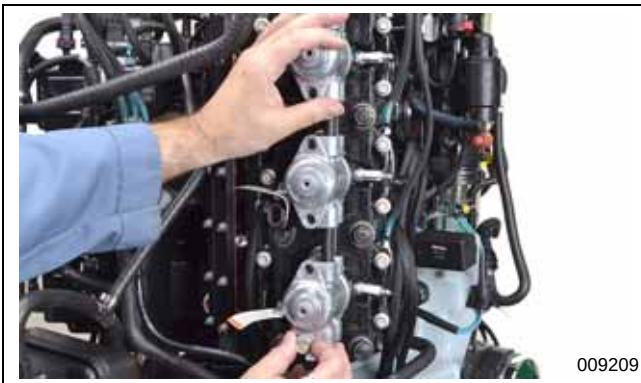
002316

Install screws and washers through mounting flange of injector and into cylinder head.

Place insulators over injectors and screws.

Place the injector bank into position on the cylinder head.

1. Support the injector bank in place on the cylinder head.
2. Install the lower screw into the BOTTOM injector and cylinder head FIRST.



009209

3. Install the upper screw into the TOP injector and cylinder head SECOND.
4. Then install remaining screws.

Tighten screws in stages, starting with the lower screw.

- First torque is 60 to 84 in.lbs. (7 to 9 N·m)
- Second torque is 120 in. lbs. (14 N·m)

- Final torque is 24 to 26 ft. lbs. (33 to 35 N·m).



Tighten Screws in Stages

009214

Install fuel rails. Refer to **Fuel Rail Service** on p. 172.

Connect the electrical connectors to the fuel injectors.

Install the ignition coils:

- Position the ignition coil & bracket assemblies onto each injector.
- Install the ignition coil bracket washers & retaining screws.
- Connect the electrical connectors to the ignition coils.

Use a #2 *Posi-drive* screwdriver to install the center frame screws.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Connect the battery cables at the battery.

Prime the fuel system and check for fuel leaks. Repair all leaks.

Supply water to the engine. Start and run the outboard and check for fuel leaks. Repair all leaks before returning the outboard to service.

Install the port and/or starboard frames.

Install the engine front, top and rear covers. Install the side panels. Refer to **Engine Cover and Frame Service** on p. 55.

Throttle Valve Service

Removal

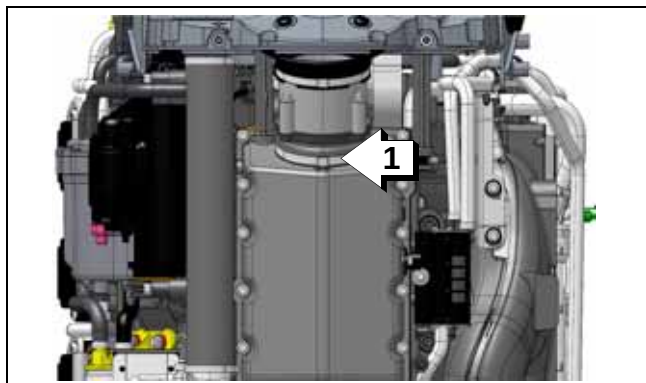
Disconnect the battery cables at the battery.

Remove the engine top, front and rear covers.
Remove the port and starboard side panels.

Remove the port and starboard frames. Then remove the front frame. Refer to **Engine Cover and Frame Service** on p. 55.

Use a #2 *Posi-drive* screwdriver to remove the three screws retaining the center frame to the frame mounts.

Remove the 99.5 mm *Oetiker* clamp retaining the throttle valve to the plenum.



1. 99.5 mm *Oetiker* clamp

009188

Remove the throttle valve from the plenum.
Remove the throttle valve harness from its retainer and disconnect the electrical connector.

Installation

Connect the electrical connector to the throttle valve. Then install the throttle valve harness into its retainer.

Install the throttle valve on to the plenum. Secure the throttle valve to the plenum with a new 99.5 mm *Oetiker* clamp.

Use a #2 *Posi-drive* screwdriver to install the center frame screws.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Install the front frame. Then install the port and starboard frames.

Install the engine front, top cover and rear covers.
Install the port and starboard side panels. Refer to **Engine Cover and Frame Service** on p. 55.

Connect the battery cables at the battery.

Intake Manifold Service

Removal

Disconnect the battery cables at the battery.

Remove the engine top, front and rear covers.
Remove the port and starboard side panels.

Remove the port and starboard frames.

Disconnect all cables and hoses at the engine.

Then remove the front frame. Refer to **Engine Cover and Frame Service** on p. 55.

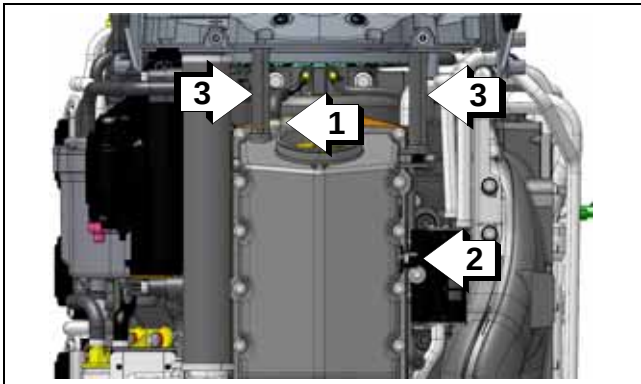
Remove the four retaining screws from the rigging housing and remove the rigging housing.

Use a #2 *Posi-drive* screwdriver to remove the three screws retaining the center frame to the frame mounts.

Remove the throttle valve from the plenum, see **Throttle Valve Service** on p. 180.

Remove the:

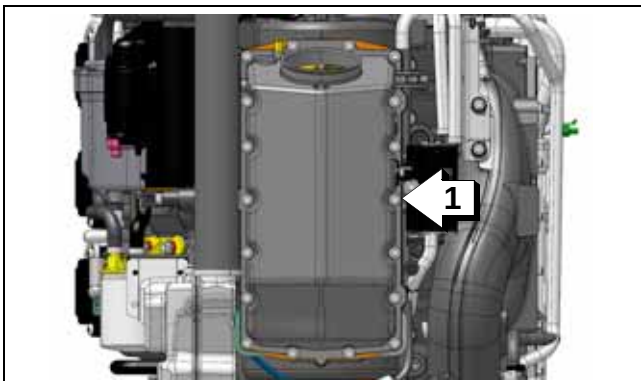
- center frame spacers and mounts from the plenum.
- *Oetiker* clamp from the vapor solenoid vent hose, then remove the vent hose from the plenum.
- electrical connector from the air temperature sensor.



1. *Oetiker* clamp and vent hose
2. Electrical connector
3. Center frame spacers and mounts

009189

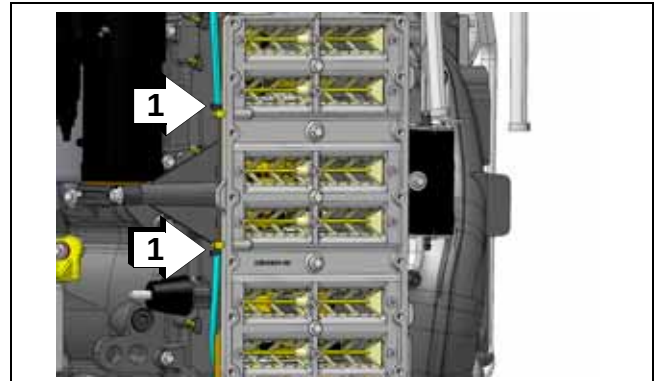
Remove 18 retaining screws from the plenum, then remove the plenum and gasket.



1. 18 retaining screws

009190

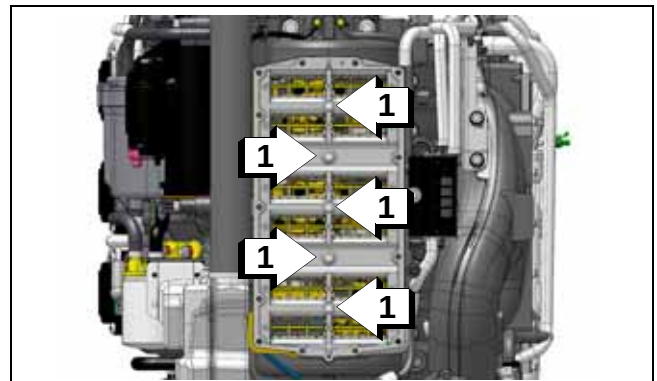
Remove the tie straps and oil recirculation hoses from the reed plate assembly.



1. Tie straps and oil recirculation hoses (oil fill hose removed for clarity)

009191

Remove 5 retaining screws from the reed plate assembly, then remove the reed plate and gasket from the crankcase.



1. 5 screws

009192

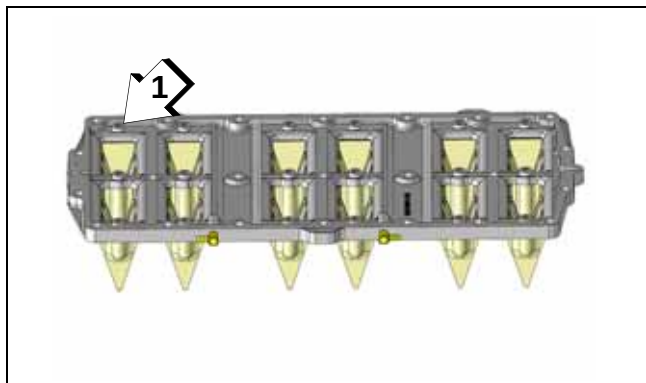
Disassembly

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.

Fuel System

Fuel Component Servicing

Remove the reed valve retainer screws and remove the assembly.



1. Reed valve retainer screws

009193

Use caution to prevent damaging reed valve assemblies.

NOTICE

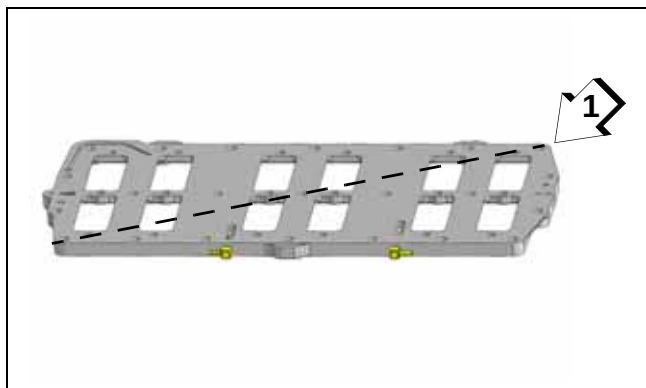
DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

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).



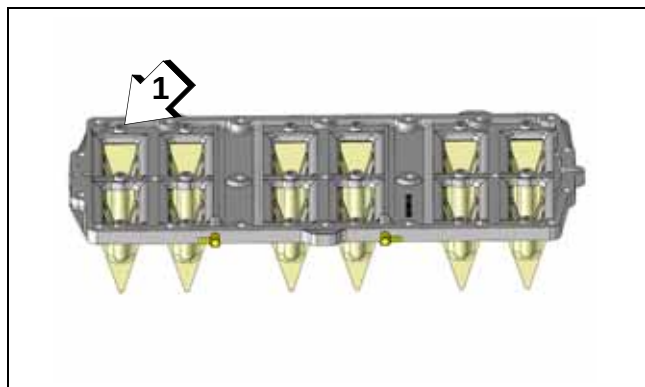
1. Straight-edge

009194

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).



1. Reed valve retainer screws

009193

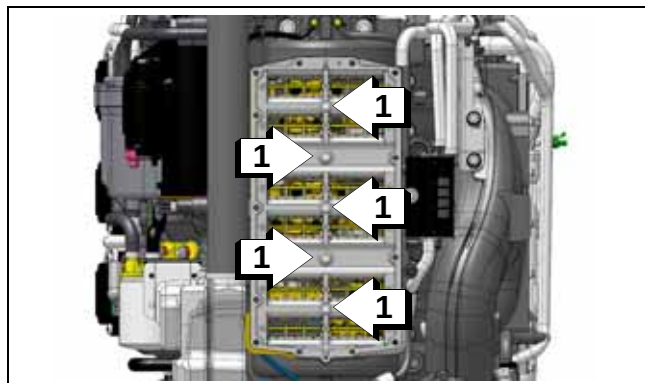
Installation

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

Place reed plate assembly on cylinder/crankcase.

Install all screws.

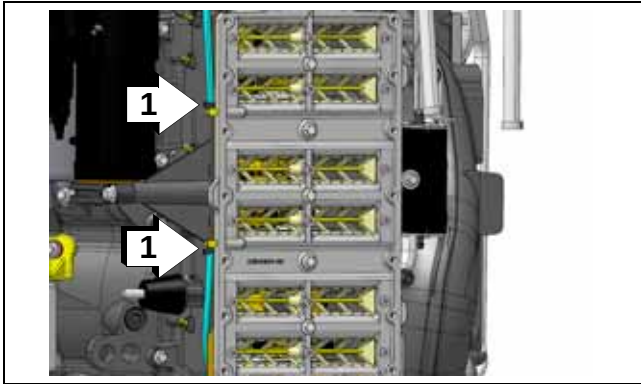
Tighten the center screws first and expand outward. Tighten in stages to a final torque of 84 to 106 in. lbs. (10 to 12 N·m).



1. 5 screws

009192

Install the oil recirculation hoses on to the reed plate assembly. Secure with new tie straps, P/N 317893.

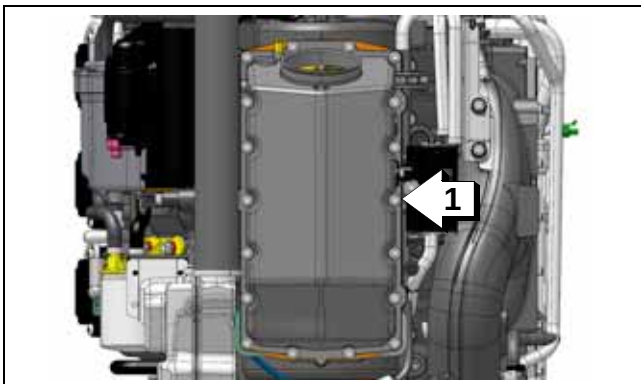


1. Tie straps and oil recirculation hoses
(oil fill hose removed for clarity)

009191

Place a new gasket on the plenum. Install the plenum on the reed plate and install 18 screws.

Tighten the center screws first and expand outward. Final torque is 84 to 106 in. lbs. (10 to 12 N·m).



1. 18 retaining screws

009190

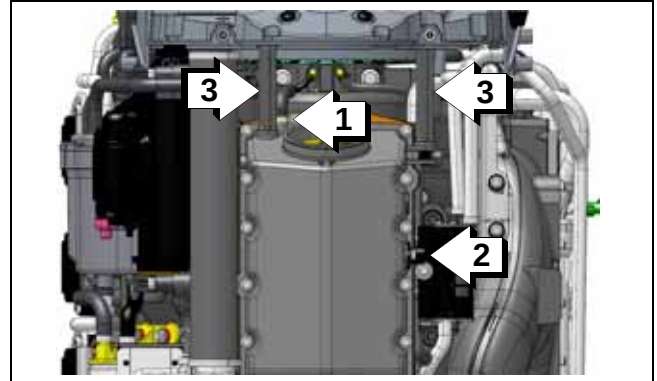
Install the center frame spacers and mounts on the plenum.

Tighten spacers to a torque of 35 to 60 in. lbs. (4 to 6 N·m).

Connect the electrical connector to the air temperature sensor.

Install the vent hose on the plenum and secure with a new 15.7 mm *Oetiker* clamp.

Install the throttle valve on the plenum, see **Throttle Valve Service** on p. 180.



1. Oetiker clamp and vent hose
2. Electrical connector
3. Center frame spacers and mounts

009189

Use a #2 *Posi-drive* screwdriver to install the center frame screws.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the center frame mounts.

Install the front frame

Install the rigging housing with four retaining screws.

Install the port and starboard frames.

Connect all cables and hoses at the engine. Refer to the ***Evinrude E-TEC G2 Installation and Pre-delivery Guide***.

Install the engine front, top cover and rear covers. Install the port and starboard side panels.

Refer to **Engine Cover and Frame Service** on p. 55.

Connect the battery cables at the battery.

Notes

Technician's Notes

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Related Documents

[illegible]

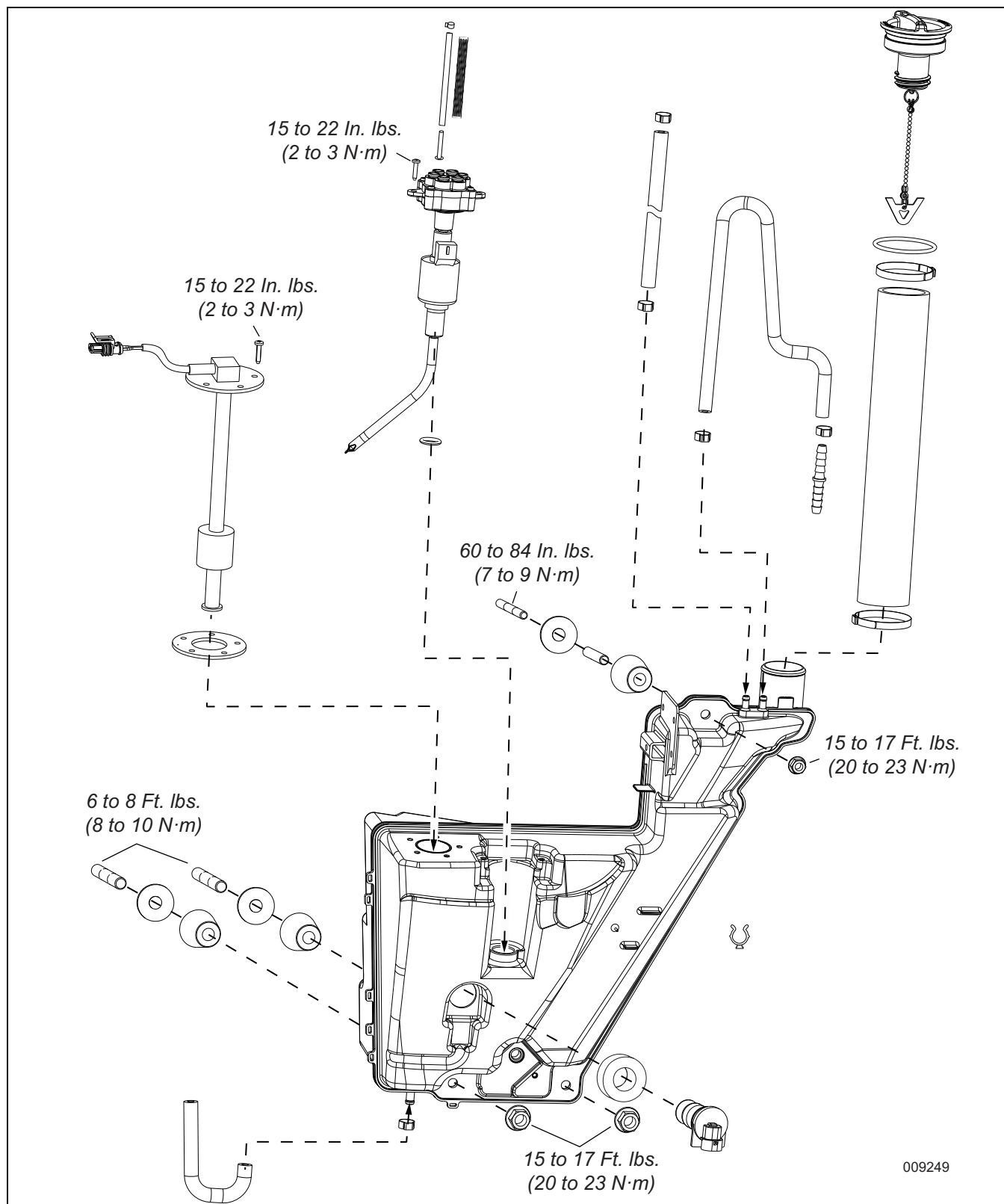
Oiling System

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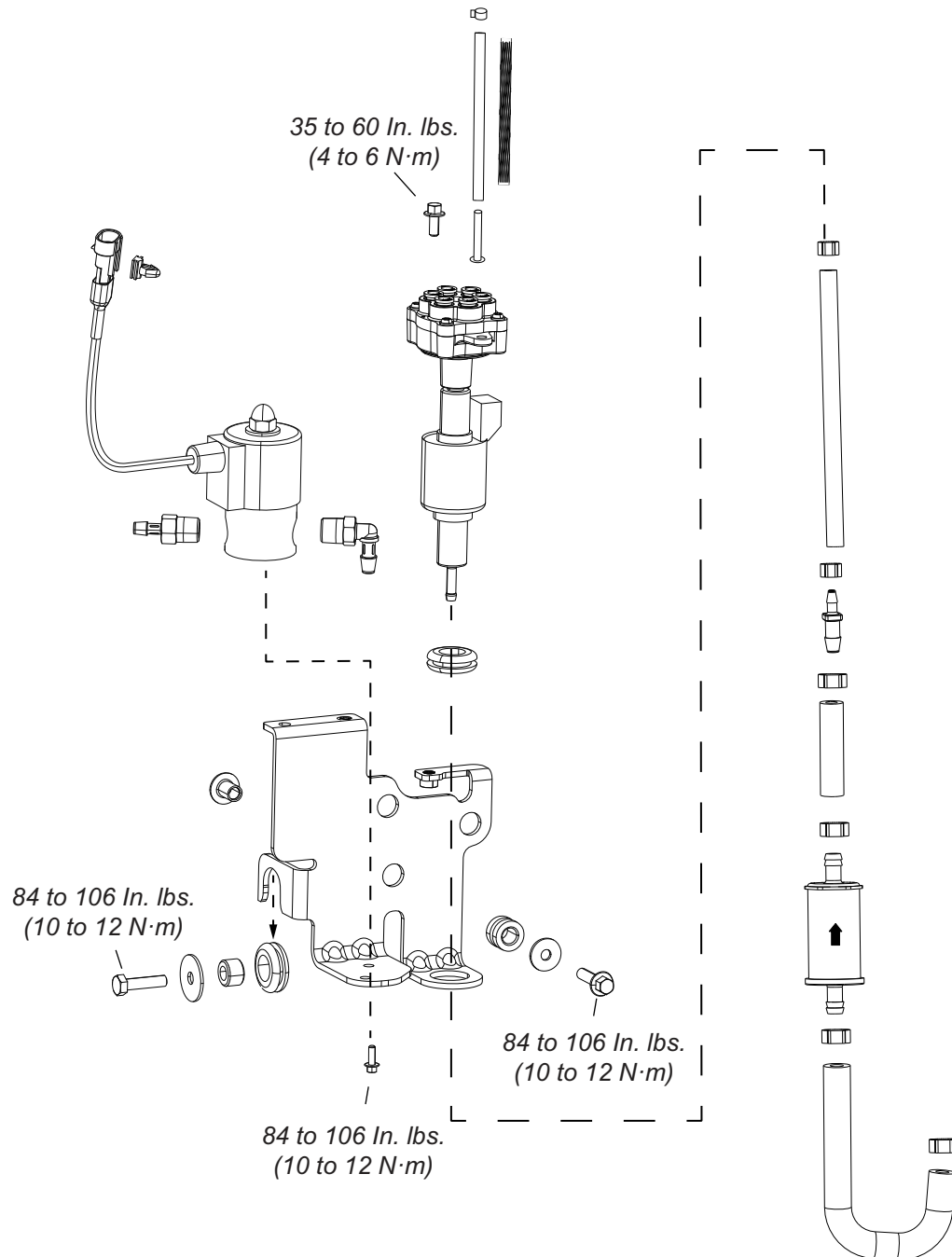
Service Charts

Oil Tank Assembly

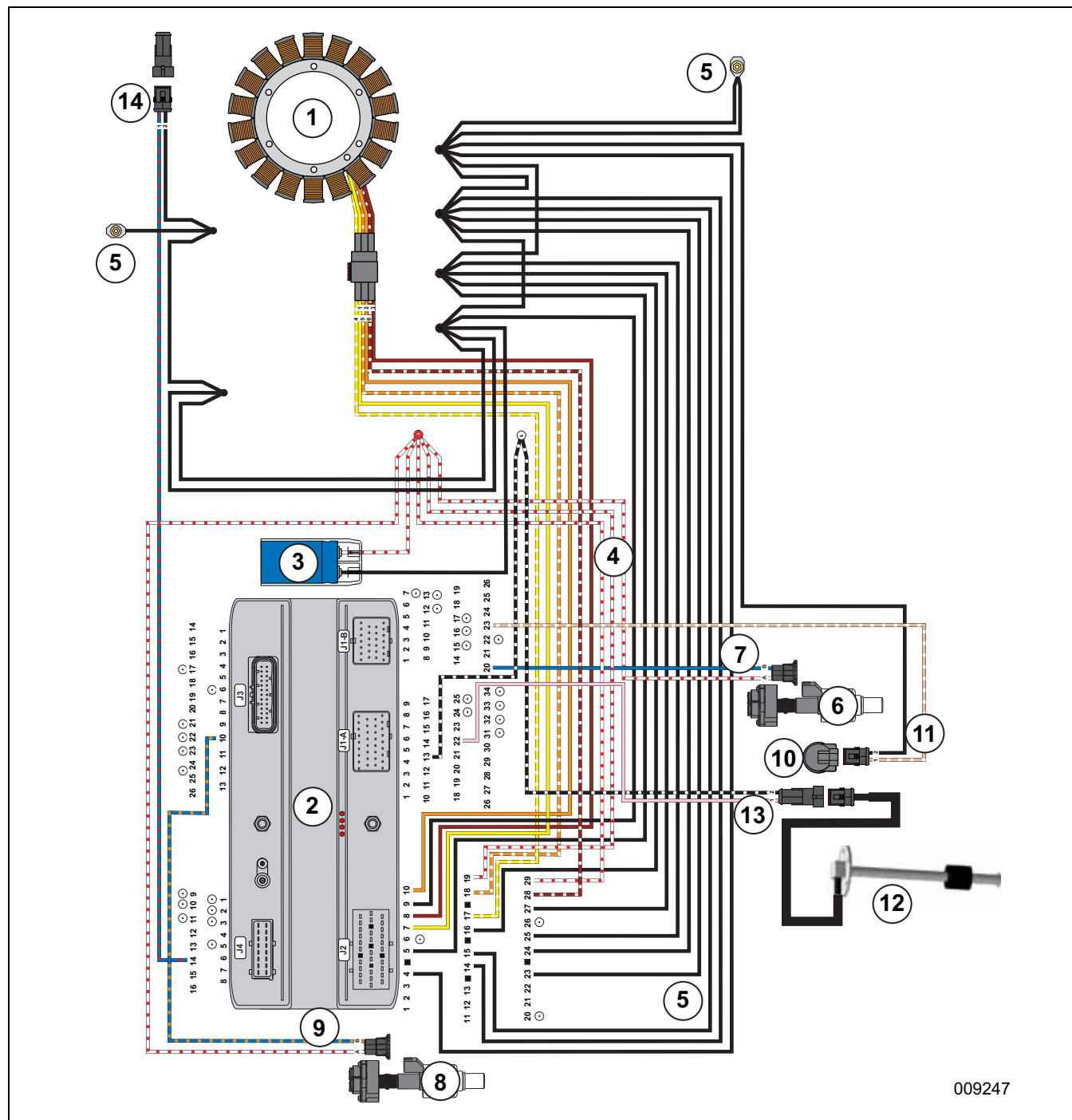


009249

Cylinder Oil Pump Assembly



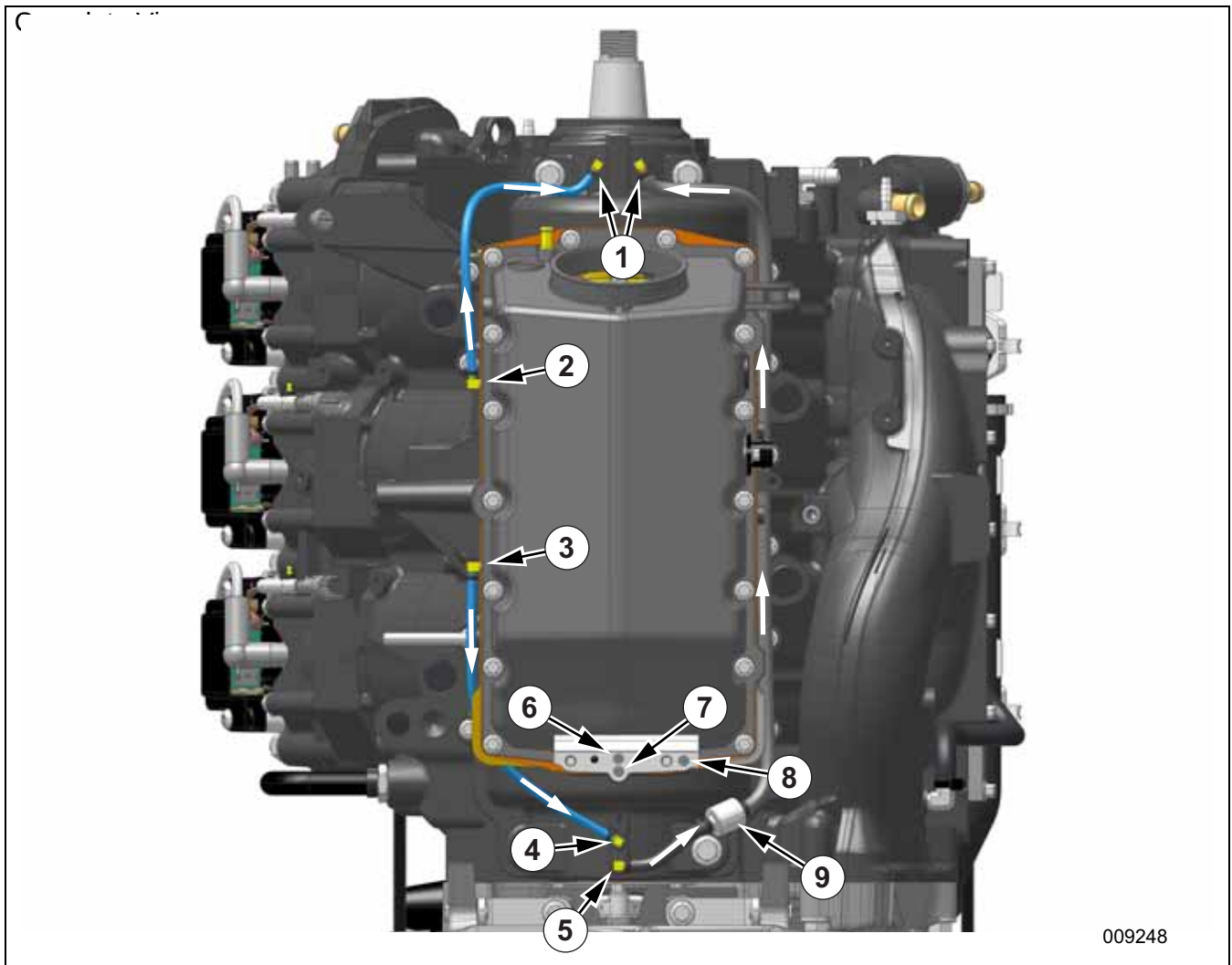
Oiling System Circuit Diagram



009247

- | | |
|--------------------------------------|--|
| 1. Stator | 8. Cylinder Oil Pump |
| 2. EMM | 9. Cylinder Oil Pump control (BLUE/ORANGE) |
| 3. Capacitor | 10. LOW Oil Switch |
| 4. 55 V Circuit (WHITE/RED) | 11. LOW OIL Signal (TAN/WHITE) |
| 5. Grounds, NEG (BLACK) | 12. Oil Level Sender |
| 6. Crankcase Oil Pump | 13. Oil Level Signal (PINK) |
| 7. Crankcase Oil Pump control (BLUE) | 14. Remote Oil Pump Electrical Connector |

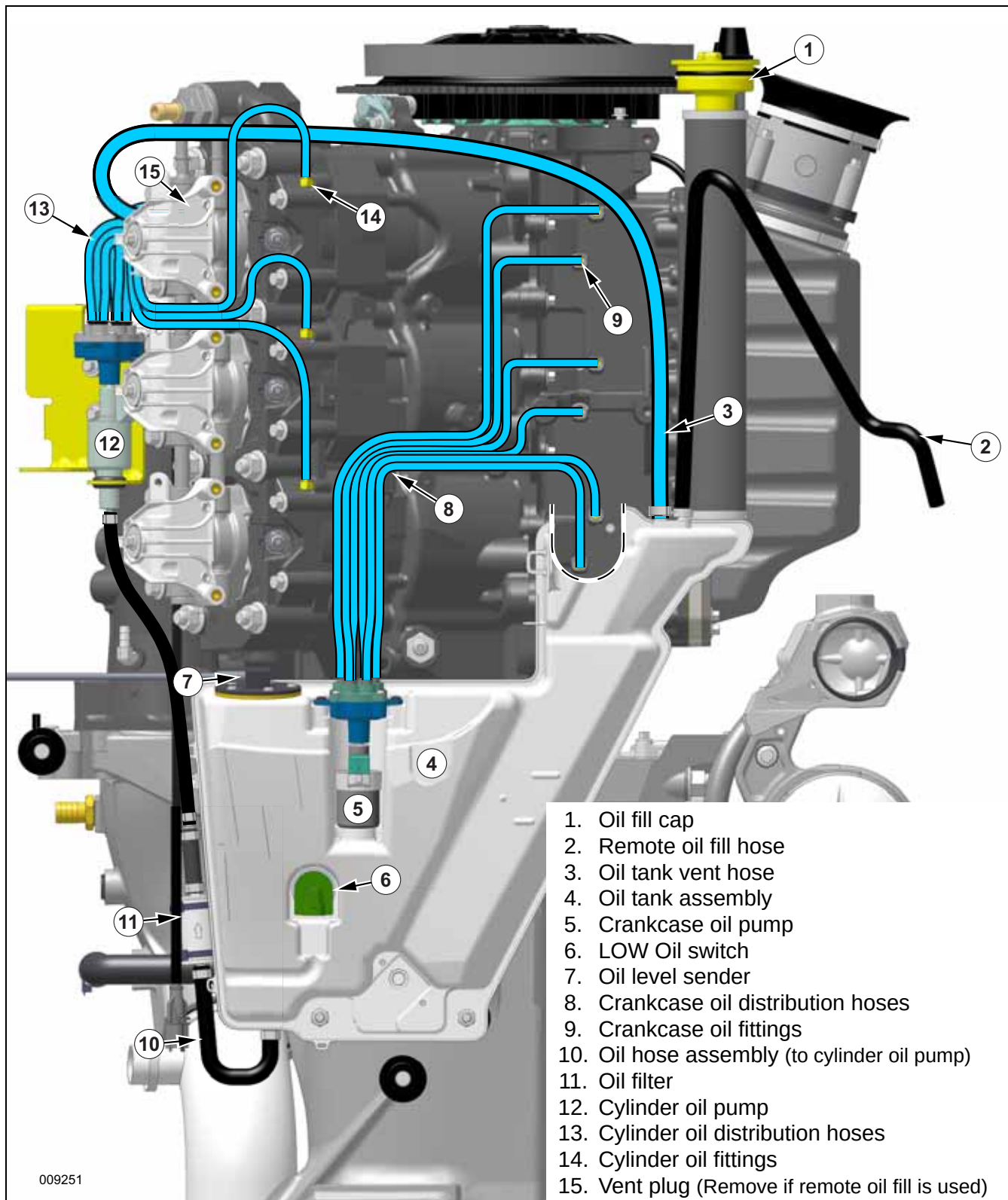
Oil Recirculation Diagram



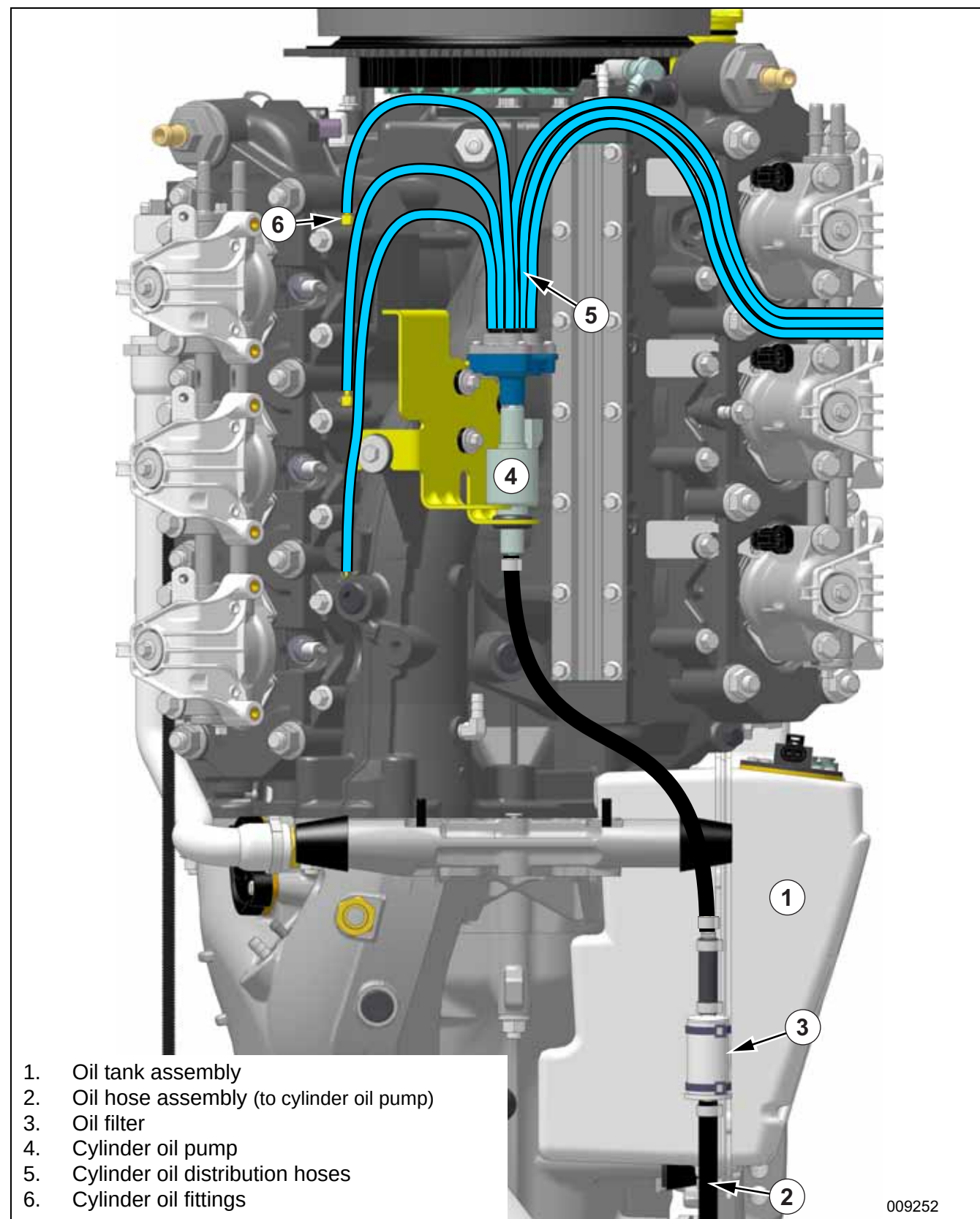
1. Oil inlet fitting upper main bearing
2. Check valve out (reed plate #2 cylinder)
3. Check valve out (reed plate #4 cylinder)
4. Oil inlet fitting to lower main bearing
5. Oil outlet fitting from lower main bearing
6. Check valve out (reed plate #6 cylinder) to lower main bearing
7. Check valve from area in inside plenum to lower main bearing
8. Check valve out (reed plate #5 cylinder) to lower main bearing
9. Check valve from lower main bearing to upper main bearing

Oil Supply Diagrams

200, 225, 250 HP, 250 H.O., 300 HP Models - Starboard



200, 225, 250 HP, 250 H.O., 300 HP Models - Rear



Oil Requirements

NOTICE

If the outboard will be operated in temperatures below freezing (32°F, 0°C), use *Evinrude XD100*.

Recommended Lubricants

NOTICE

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

Evinrude XD100, or *XD50* outboard oils are recommended for use in *Evinrude E-TEC G2* outboards. If these oils are not available, use a TC-W3 certified SYNTHETIC oil.

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

Checking Oil Level

Make sure the outboard is in the vertical position when checking oil level. Use the digital gauge or display to check the oil level.

Optional Remote Oil Tank Kits

The following optional accessory kits are available for use with *Evinrude E-TEC G2* models:

- Remote Oil Tank Kit, 1.8 gallons (6.8 liters), P/N 5008571
- Remote Oil Tank Kit, 3.0 gallons (11.3 liters), P/N 5008572
- Oil Tank Pick-up Kit, P/N 767686, for the 10 gallon (37.8 liters) capacity oil tank.

Components

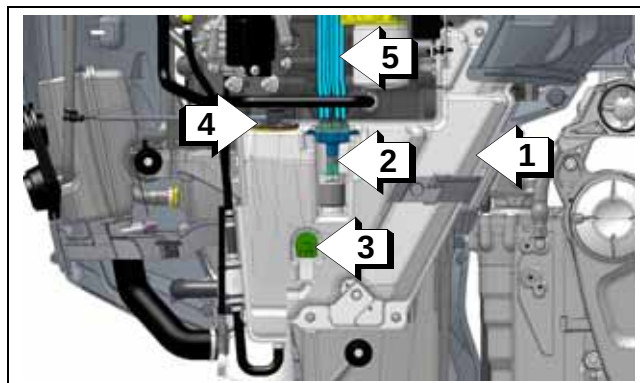
The oiling system consists of the following components:

- Oil tank
- Crankcase oil pump and manifold assembly
- Electrical circuit
- Oil level sender
- LOW OIL switch
- LOW OIL and NO OIL warning systems
- Cylinder oil pump and manifold assembly
- Oil recirculation system

Oil Tank Assembly

The oil tank is located on the starboard side of the engine and the oil level must be monitored.

Oil Tank Components:

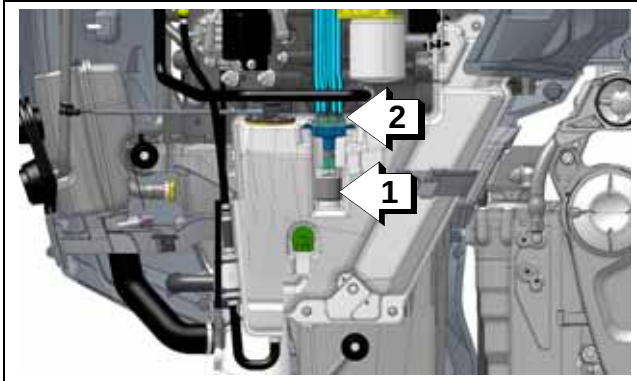


- Oil Tank Assembly**
1. Tank, 2.0 gallon capacity
 2. Oil pickup and filter assembly
 3. LOW OIL switch
 4. Oil level sender
 5. Oil distribution hoses

009226

Crankcase Oil Pump

The crankcase oil pump is an electric actuator style pump. The *EMM* supplies 55 V and controls activation of the pump. The pump draws oil from the oil tank and supplies pressurized oil to the oil manifold.



1. Oil pump
2. Oil manifold

009226

The oil manifold distributes the oil supplied by the oil pump to the crankcase.

Electrical Circuit (55 V)

The oil pump 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.

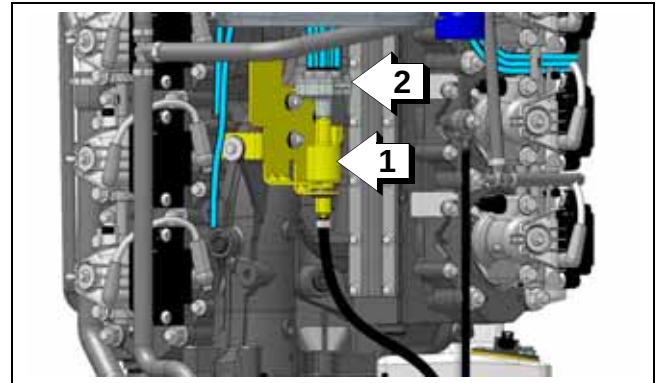
The *EMM* monitors the oil pump electrical circuit. If the *EMM* detects an open circuit in the harness or oil pump, the *EMM*:

Activates S.A.F.E.
Stores fault code 34
Engine Monitor NO OIL display: ON

Cylinder Oil Pump

The cylinder oil pump is an electric actuator style pump. The *EMM* supplies 55 V and controls activation of the pump. The pump draws oil from the

oil tank through a hose and filter assembly and supplies pressurized oil to the oil manifold.



1. Oil pump
2. Oil manifold

009227

The oil manifold distributes the oil supplied by the oil pump to the cylinder sleeves.

Electrical Circuit (55 V)

The cylinder oil pump 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 pump electrical circuit. If the circuit is open, the *EMM*:

Activates S.A.F.E.
Stores fault code 36
Engine Monitor No OIL display: ON

Oil Level Sender

An oil level sender mounted in the oil tank monitors oil level and transmits oil level information to a *NMEA 2000* network.

If equipped with *ICON Touch* digital displays, the oil level sender signals the *ICON Touch* display to activate the LOW OIL warning through a *NMEA2000* network. See **LOW OIL Warning** on p. 194.

Oiling System

Components

LOW OIL Switch

An oil level switch in the oil tank assembly monitors the oil level in the oil tank.

Oil Warning System

LOW OIL Warning

If the oil level falls below 25% capacity, the *EMM* signals:

Engine Monitor LOW OIL display: ON*

Approximate oil reserve at LOW OIL activation is 2.0 qt. (1.9 l).

***Note:** If equipped with *ICON Touch* digital displays, the sending unit in the oil tank signals the *ICON Touch* display to activate the LOW OIL warning through a *NMEA2000* network.

NO OIL Warning

When the oil level falls below 25%, the *EMM* begins counting oil pump pulse cycles. When it reaches:

- 20,000 pulses

the *EMM*:

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

Stores fault code 117

Engine Monitor NO OIL display: ON

To recover from *S.A.F.E.* mode:

- Oil level must be above 25%
- The warning resets after three oil pump pulse cycles when the outboard has been stopped and restarted.

If outboard has been run for more than 5 hours with NO OIL faults (codes 34 & 117), the *EMM*:

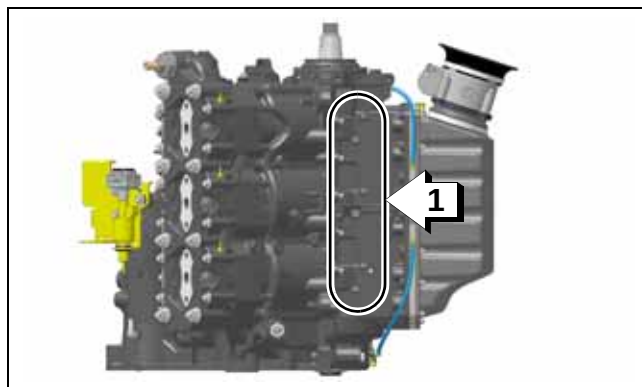
Activates SHUTDOWN

Stores fault code 33

Engine Monitor NO OIL display: FLASHING

Cylinder and Crankcase

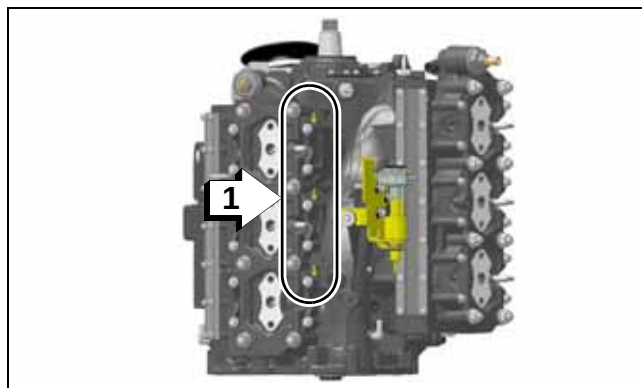
The crankcase oil manifold provides crankcase lubrication through oil distribution hoses and pressed-in fittings at the front of the crankcase, starboard side.



1. Pressed-in fitting

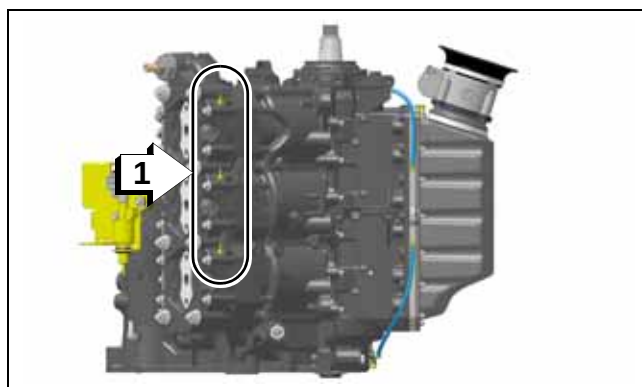
009222

The cylinder oil pump and 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/rear

009223



1. Cylinder sleeve oil fittings – starboard

009222

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.

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 check valve and internal passage from the area inside the plenum
- a check valve and external hose from the reed plate of cylinder number 4
- a check valve and internal passage from the reed plate of cylinder number 5
- a check valve and internal passage from the reed plate of cylinder number 6

The upper main bearing receives oil through a check valve and external hose from the reed plate of cylinder number 2.

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.

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 to the fuel tank on *Evinrude E-TEC* models.

The *EMM* automatically supplies extra oil to the engine for the first two hours above 2000 RPM.

Follow these steps for outboard set-up:

- Use *Evinrude Diagnostics* software, v 6.1 or higher to make sure the break-in program has been started.
- Use the diagnostics software to start break-in oiling after a powerhead rebuild.



Settings Screen
1. Break-in oil setting

009224

Oil Supply Priming

⚠ WARNING

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

The oil system of *Evinrude E-TEC G2* outboards is primed at the factory.

Priming the oiling system is only required if:

- The oil tank is run out of oil; or
- The oil system is disassembled for service or parts replacement.

After refilling an empty oil tank or servicing the oil system, air **MUST** be removed from the system before operating the outboard.

Use *Evinrude Diagnostic* software v 6.1 or higher to prime the oil system.

Oil Pump Priming

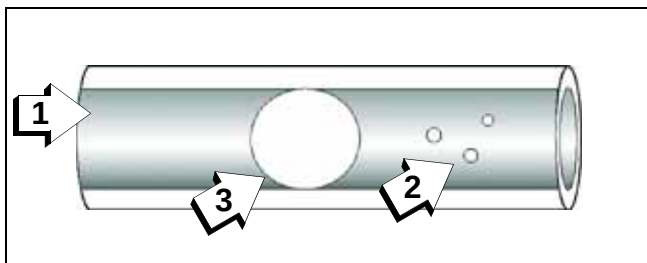
NOTICE

The oiling system **MUST** be primed to avoid engine damage from a lack of lubrication.

Use the *Tests/Prime Oil Pumps* function in *Evinrude Diagnostics* software to make sure air is completely purged from the oil system.

Priming Procedure

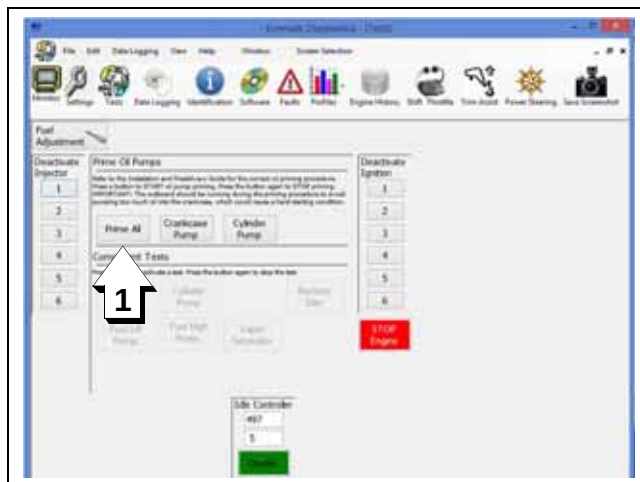
Observe oil flow through ALL oil distribution hoses during the priming procedure. Small air bubbles are acceptable. Large air bubbles must be eliminated through continued priming.



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

004398

1. Start the outboard.
2. Use the *Prime All* button of the *Tests* screen to start the oil priming sequence.



Tests Screen
1. Prime All button

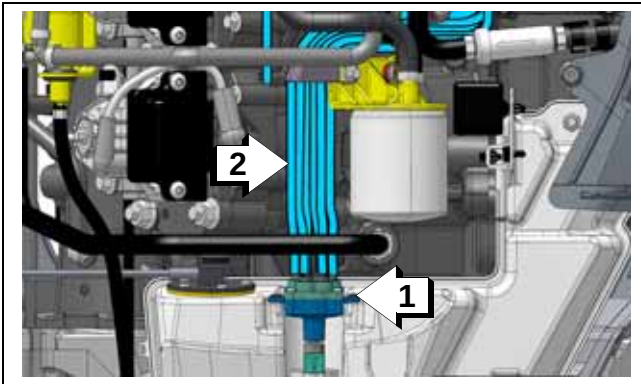
009124

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.

3. Observe oil flow through all oil distribution hoses. Air must be purged during the priming procedure.
4. After the *Prime All Oil Pumps* sequence is complete, inspect the oil distribution hoses for the:
 - crankcase oil pump
 - cylinder 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.

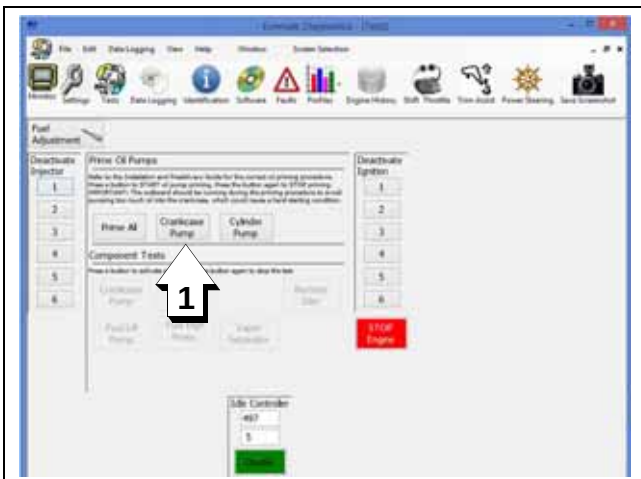
5. Inspect for air bubbles in the crankcase oil distribution hoses.
 - If air bubbles ARE present, proceed to **step 6**.
 - If air bubbles are NOT present proceed to **step 7**.



1. Crankcase oil pump
2. Oil distribution hoses

009119

6. Use the *Crankcase Pump* button of the *Tests* screen to prime the crankcase oil pump.



Tests Screen

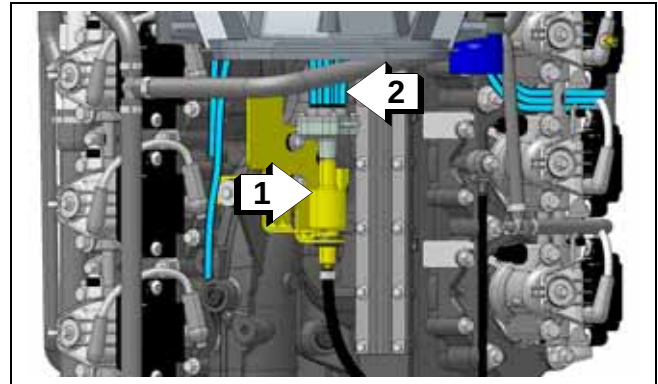
1. Crankcase Pump button

009124

Observe oil flow through the crankcase oil distribution hoses. Repeat **steps 5** and **6** until all air is purged from the crankcase oil distribution hoses.

Continue to the next step.

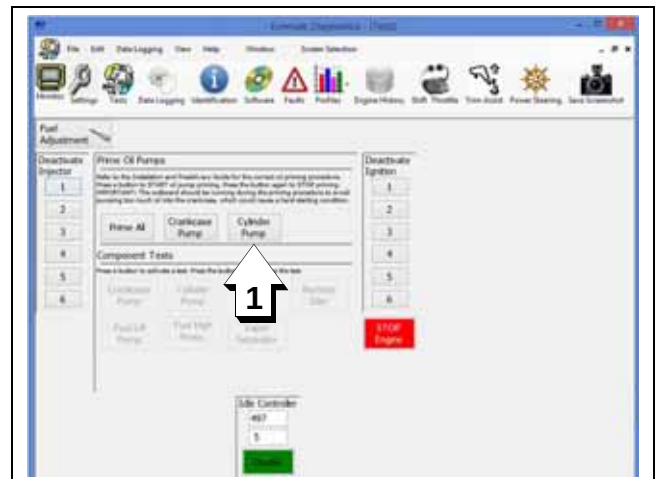
7. Inspect for air bubbles in the cylinder oil distribution hoses.
 - If air bubbles ARE present, proceed to **step 8**.
 - If air bubbles are NOT present the oil pump priming procedure is complete.



1. Cylinder oil pump
2. Oil distribution hoses (blue)

009125

8. Use the *Cylinder Pump* button of the *Tests* screen to prime the cylinder oil pump.



Tests Screen

1. Cylinder Pump button

009124

Observe oil flow through the cylinder oil distribution hoses. Repeat **steps 7** and **8** until all air is purged from the cylinder oil distribution hoses.

Repair any oil leaks.

The oiling system on these models can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to the **Operator's Guide**.

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 Pump Electrical Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Oil system electrical circuits are dependent on wiring and connections, *EMM* supplied current and component resistance. The supplied current flows through the wiring circuit and component before returning to the *EMM*.

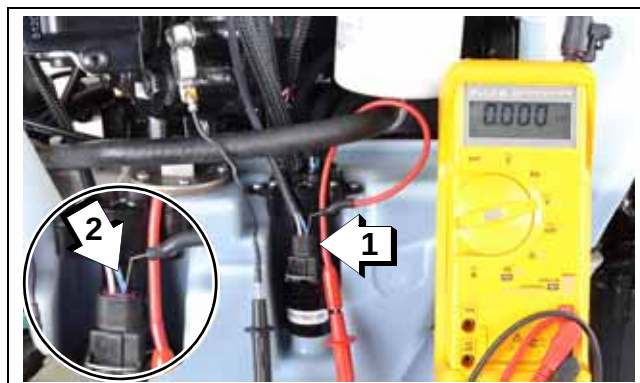
Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Crankcase Oil Pump

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.

Connect negative meter lead to ground.

Use an appropriate test probe lead to connect positive meter lead to pin B (blue wire) of oil pump electrical connector.



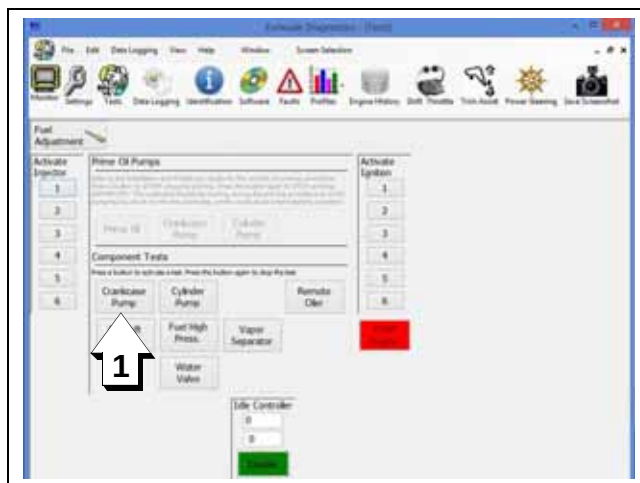
1. Oil pump
2. Pin B (blue wire)

009245

Turn the key switch to the ON position. Observe voltage at pin B.

- Voltage at pin B should be approximately 30 V.

Use the *Crankcase Pump* button of *Evinrude Diagnostic* software *Tests* screen to activate the oil pump.



Tests Screen

1. Crankcase Pump button

009225

Observe voltage at pin B.

- Voltage at pin B should drop as the oil pump cycles.

Check the control signal while the *Oil Injector* test is running. Set the digital multimeter to the frequency setting or the Hertz (Hz) scale.

- Meter should read 130 to 150 Hz.

Acceptable Oil Pump Test Readings	
Key switch ON	approximately 30 VDC
Control signal	130 to 150 Hz
Engine running	approximately 55 VDC

Results:

- If voltage and control signal readings at pin B are within range, the *EMM* and wiring are not at fault.
- If voltage at pin B is not within range, check voltage at pin A (white/red wire) of oil pump electrical connector.

Connect positive meter lead to pin A (white/red wire) of oil pump electrical connector. Observe voltage at pin A.

- Voltage at pin A should be approximately 30 V.

Start the engine. Observe voltage at pin A.

- The voltage at pin A should be approximately 55 V.

Results:

- If voltage is not within range, refer to **Oil Pump Circuit Tests** on p. 200, and **Oil Pump Resistance Test** on p. 201.
- No voltage reading should result in Code 34; Crankcase Oil Pump Open Circuit. Refer to **System Voltage Test** on p. 122.

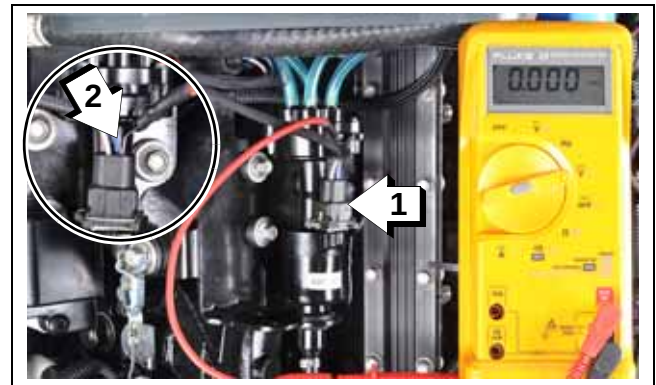
Cylinder Oil Pump

The *EMM* controls the pump by providing ground through pin 10 (blue/orange wire) of the J3 connector and pin B (blue/orange wire) of the oil pump connector.

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.

Connect negative meter lead to ground.

Use an appropriate test probe lead to connect positive meter lead to pin B (blue/orange wire) of oil pump electrical connector.



1. Oil pump
2. Pin B (blue/orange wire)

009246

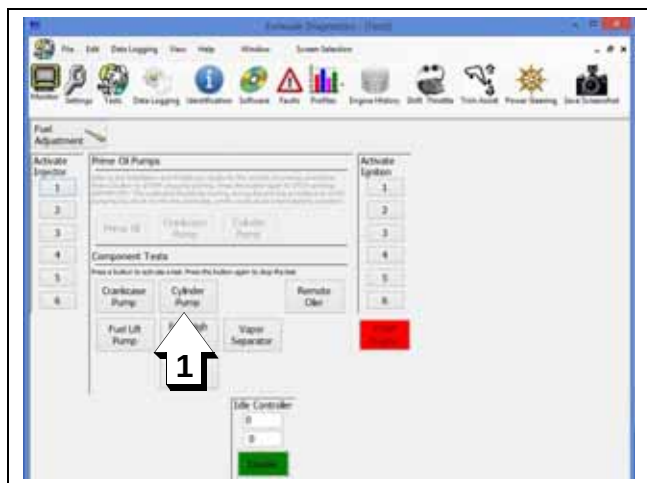
Turn the key switch to the ON position. Observe voltage at pin B.

- Voltage at pin B should be approximately 30 V.

Oiling System

Oiling System Tests

Use the *Cylinder Pump* function of *Evinrude Diagnostic* software Tests screen to activate the oil pump.



Tests Screen
1. Cylinder Pump button

009225

- Voltage at pin B 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 150 to 170 Hz.

Acceptable Cylinder Oil Pump Test Readings	
Key switch ON	approximately 30 VDC
Control signal	150 to 170 Hz
Engine running	approximately 55 VDC

Results:

- If voltage and control signal readings (Hz) at pin B are within range, the *EMM* and wiring are not at fault.
- If voltage at pin B is not within range, check voltage at pin A (white/red wire) of the oil pump electrical connector.

Connect positive meter lead to pin A (white/red wire) of oil pump electrical connector. Observe voltage at pin A.

- The voltage at pin A should be approximately 30 V.

Start the engine. Observe voltage at pin A.

- The voltage at pin A should be approximately 55 V.

Results:

- If voltage at pin A is within range, refer to **Oil Pump Resistance Test** on p. 201.
- No voltage reading should result in Code 36; Cylinder Oil Pump Open Circuit. Refer to **System Voltage Test** on p. 122.

Oil Pump Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

The oil pump circuit test can be performed on either the crankcase or cylinder oil pump.

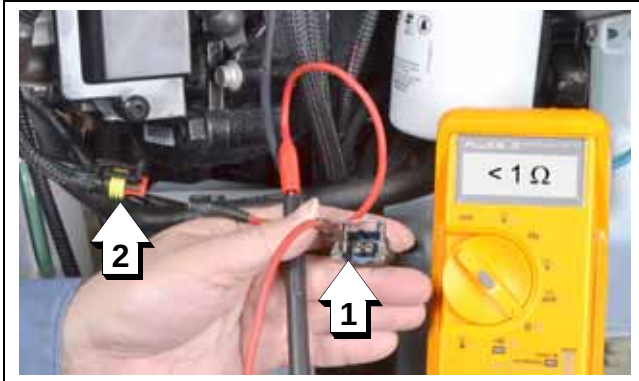
IMPORTANT: The complete oil pump electrical circuit includes *EMM* alternator output, the engine wire harness, the pump winding and connectors, and the oil injector control circuit of the *EMM*. Check continuity of all wiring and connections.

Disconnect the battery cables at the battery. Disconnect the electrical connector from the oil pump.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil pump 55V circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect

the negative meter lead to the red/white wire of a known good circuit such as a fuel injector.



Oil Pump Connector
1. Pin A, 55 V, red/white wire
2. Known good circuit (fuel injector shown)

009230

Oil Pump 55V Circuit Resistance		
Wire	Pin	Result
WHITE/RED	A	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check continuity of wiring and connections. Repair or replace faulty wiring.

Use the diode test function of a digital multimeter to check the signal circuit.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.



Oil Pump Connector
1. Black meter lead to pin B, blue or blue/orange wire
2. Red meter lead to engine ground

009229

Oil Pump Signal Circuit (Diode Test)		
Wire	Pin	Result
BLUE (Crankcase Oil Pump)	B	approximately 0.5 VDC
BLUE/ORANGE (Cylinder Oil Pump)	B	

Results:

- No reading (OL or ∞) indicates an open circuit.
 - A reading of zero (0) indicates an short circuit.
- Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Oil Pump Resistance Test

Disconnect the battery cables at the battery. Disconnect the electrical connector from the oil pump.

Use a digital multimeter with appropriate test probe leads to measure the resistance between the pins of the oil pump connector.



1. Oil pump connector

009231

Oil Pump Resistance
20 to 22 Ω

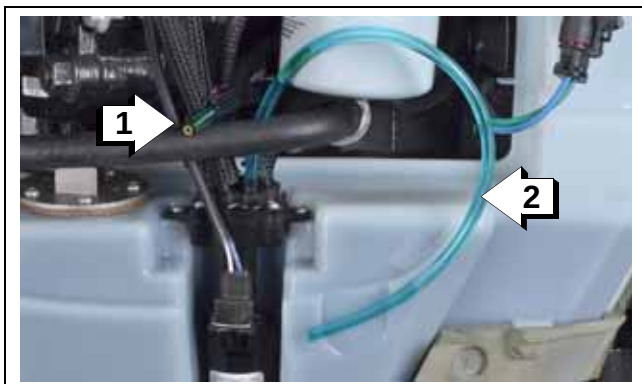
Results:

- An infinite reading (∞) indicates an open circuit of the pump winding.

Replace faulty pump.

Oil Pump Function Test

Remove oil distribution hose from oil manifold. Refer to **Oil Distribution Hoses** on p. 204. Temporarily install a length of oil hose, P/N 778708.



1. Oil distribution hose removed from oil manifold
2. Oil Hose, P/N 778708

009315

Running Test

Start the outboard and observe oil flow. Confirm that a small amount of oil is discharged while pump is activated.

Static Test

Use the *Evinrude Diagnostics* software oil pump test to activate the oil pump. Confirm that a small amount of oil is discharged while pump is activated.

Results:

- Oil flows from distribution hose, compare to oil flow at other distribution hoses.
- If one or more fittings fail to discharge oil, replace the oil pump assembly.

After completing the tests, remove the temporary oil hose, then install the oil distribution hose(s).

Prime the oil system. Refer to **Oil Supply Priming** on p. 196.

Oil Fittings Flow Test

Make sure the oil 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.

Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.

LOW OIL Switch 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.

Start the engine. The LOW OIL warning should stop when the oil level exceeds 25% of oil tank's capacity and the oil pump activates three times.

LOW OIL Switch Circuit Test

Remove the electrical connector from the LOW OIL switch.

Use the diode test function of a digital multimeter to check the signal circuit.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

LOW OIL Level Switch Circuit Diode Test		
Wire	Pin	Result
TAN/WHITE	1	2.1 VDC $\pm$ 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the LOW OIL switch ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

LOW OIL Switch Ground Circuit Resistance		
Wire	Pin	Result
BLACK	2	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Oil Level Sender Resistance Test

Remove the electrical connector from the oil level sender. Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil level sender.

Oil Level Sender Resistance		
Float Position	Pin	Result
Up (Full)	–	30 Ω
Down (Empty)	–	240 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Oil Level Sender Circuit Test

Remove the electrical connector from the oil level sender.

Use the diode test function of a digital multimeter to check the signal circuit.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

Oil Level Sender Circuit Diode Test		
Wire	Pin	Result
PINK	1	approximately 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.

- A reading of zero (0) indicates an short circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil level sender ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Oil Level Sender Ground Circuit Resistance		
Wire	Pin	Result
BLACK/WHITE	2	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Oil Component Servicing

⚠ WARNING

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

Oil Distribution Hoses

ENVIRONMENTAL NOTE

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

IMPORTANT: If replacing oil distribution hoses, note hose routings before proceeding with disassembly.

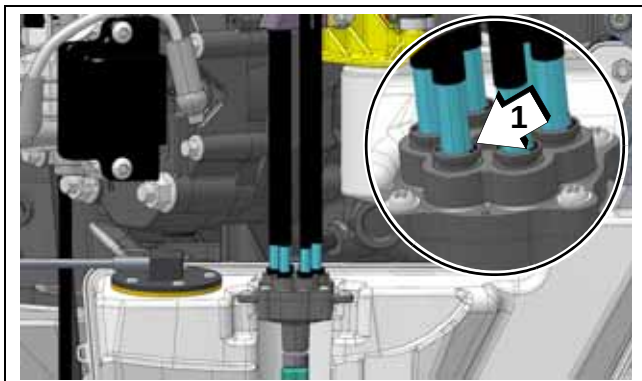
The oil distribution hoses from each manifold **MUST** be the same length. **DO NOT** alter the length of any hoses.

Oil Distribution Hose Length

Crankcase oil manifold to crankcase fittings	20 in. (508 mm)
Cylinder oil manifold to cylinder block fitting	21.75 in. (552.45 mm)

Removal

Release the hose by depressing the outer ring of the hose retaining mechanism.



1. Retainer mechanism

009228

After the hose is removed from the manifold, make sure hose support is in the end of the hose.



1. Hose support

007333

Cut tie straps and remove oil distribution hoses from the oil delivery fittings.

Installation

Cut Replacement Oil Hose, P/N 778708, to the correct length. Insert hose support in manifold end of hose.

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.

Route oil distribution hoses from the oil manifold to the oil delivery fittings as they were before removal. Refer to **Oil Supply Diagrams** on p. 190.

- Connect oil hoses to crankcase oil fittings and fasten with tie straps.
- Connect oil hoses to cylinder oil fittings on the cylinder head and fasten with tie straps.

Prime the oil system. Refer to **Oil Supply Priming** on p. 196.

Check oil flow through oil distribution hoses. Run the outboard and check for leaks.

Repair any oil leaks.

Install the starboard frame. Then install the engine top cover, rear cover and starboard side panel. Refer to **Engine Cover and Frame Service** on p. 55.

Oil Tank Servicing

ENVIRONMENTAL NOTE

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

Oil Tank Removal

Disconnect the battery cables at the battery.

Remove the engine top cover, rear cover and starboard side panel. Remove the starboard frame. Refer to **Engine Cover and Frame Service** on p. 55.

Remove oil from the oil tank. Use shop towels to clean up any spilled oil.

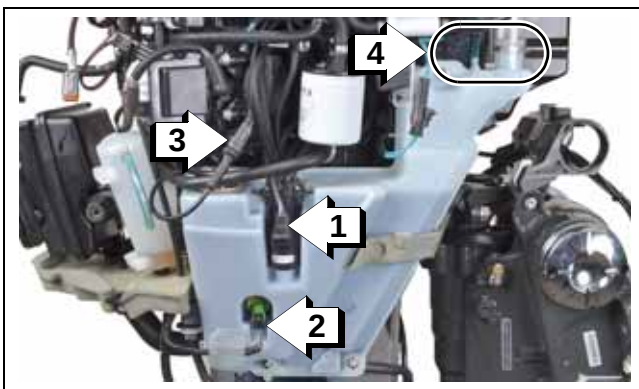
Disconnect the electrical connectors from the:

- Oil pump
- Low oil switch
- Oil level sender

Remove the *Oetiker* clamps from:

- Oil fill tube
- Remote oil fill hose
- Oil vent hose

Remove the hoses from their fittings.

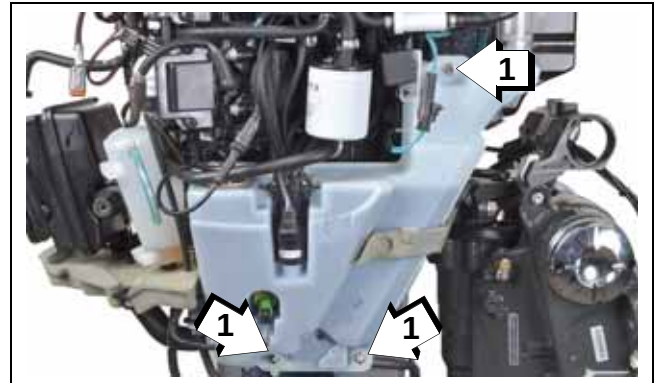


1. Oil pump
2. Low oil switch
3. Oil level sender
4. Oetiker clamps and hoses

009233

Remove the oil distribution hoses from the oil manifold. Refer to **Oil Distribution Hoses** on p. 204.

Remove the nuts retaining the oil tank. Then remove the oil tank from its mounting studs.



1. Retaining nuts

009233

Oil Tank Installation

Place the oil tank on its mounting studs. Install the three retaining nuts and tighten to a torque of 15 to 17 ft. lbs. (20 to 23 N·m).

Install the oil fill tube, the remote oil fill hose and the oil vent hose on their fittings. Secure the hoses with new *Oetiker* clamps.

Install the oil distribution hoses into the oil manifold. Refer to **Oil Distribution Hoses** on p. 204.

Connect the electrical connectors to the:

- Oil pump
- Low oil switch
- Oil level sender

Fill the oil tank with the recommended oil. Prime the oil system. Refer to **Oil Supply Priming** on p. 196.

Check oil flow through oil distribution hoses. Check oil system operation and routing of oil hoses. Run the outboard and check for leaks.

Repair any oil leaks and any kinked or misrouted hoses.

Install the starboard frame. Then install the engine top cover, rear cover and starboard side panel. Refer to **Engine Cover and Frame Service** on p. 55.

Crankcase Oil Pump

ENVIRONMENTAL NOTE

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

Removal

Disconnect the battery cables at the battery.

Remove the engine top cover, rear cover and starboard side panel. Remove the starboard frame. Refer to **Engine Cover and Frame Service** on p. 55.

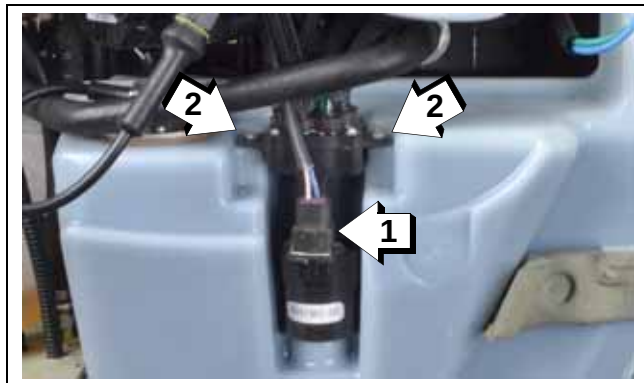
Remove oil from the oil tank. Use shop towels to clean up any spilled oil.

Disconnect the electrical connector from the oil pump.

Remove the oil distribution hoses from the oil manifold.

IMPORTANT: If replacing oil distribution hoses, note hose routings before proceeding with disassembly. Refer to **Oil Distribution Hoses** on p. 204.

Remove retaining screws from oil pump assembly. Twist and pull up on oil pump to remove from tank. **DO NOT** pull up on oil manifold.



1. Electrical connector
2. Retaining screws

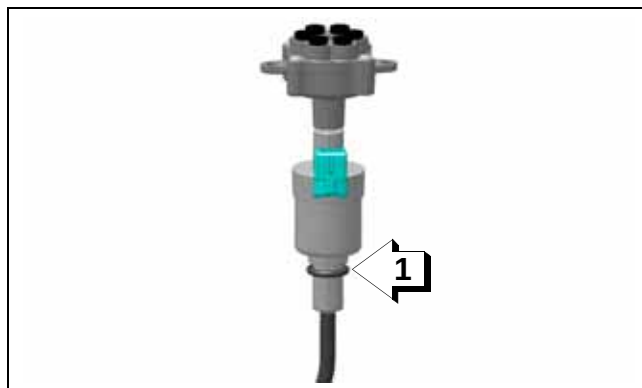
009232

Remove the oil pump assembly.

IMPORTANT: The oil pump and manifold is an assembly and cannot be serviced as individual components.

Installation

Apply a drop of outboard lubricant to a new oil pump o-ring. Install o-ring on oil pump flange.



1. O-ring

009422

Install oil pump retainer screws. Tighten securely.

IMPORTANT: Turn self-tapping screws counter clock-wise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the oil tank.

Reconnect the electrical connector.

Install the oil distribution hoses into the oil manifold. Refer to **Oil Distribution Hoses** on p. 204.

Fill the oil tank with the recommended oil. Prime the oil system. Refer to **Oil Supply Priming** on p. 196.

Check oil flow through oil distribution hoses. Check oil system operation and routing of oil hoses. Run the outboard and check for leaks.

Repair any oil leaks and any kinked or misrouted hoses.

Install the starboard frame. Then install the engine top cover, rear cover and starboard side panel. Refer to **Engine Cover and Frame Service** on p. 55.

Cylinder Oil Pump

ENVIRONMENTAL NOTE

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

Removal

Disconnect the battery cables at the battery.

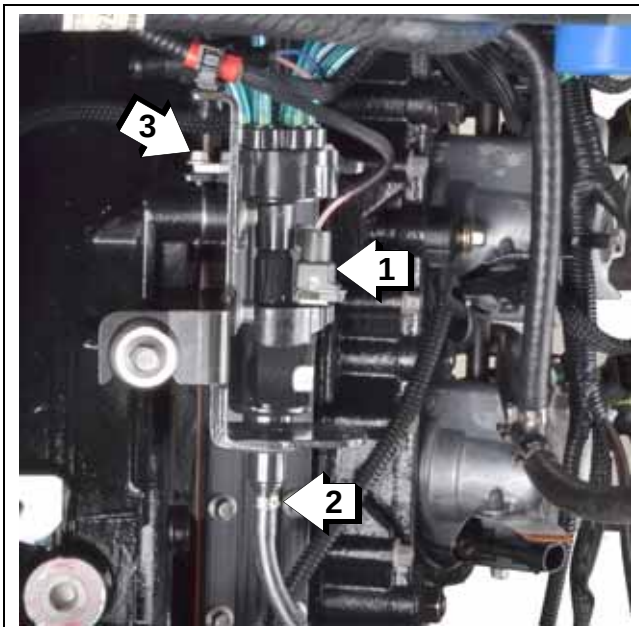
Remove the engine top cover, rear cover and starboard side panel. Remove the starboard frame. Refer to **Engine Cover and Frame Service** on p. 55.

Disconnect the electrical connector from the cylinder oil pump.

Remove the *Oetiker* clamp and oil supply hose from the inlet fitting of the oil pump. Remove oil distribution hoses from the cylinder oil pump. Use shop towels to clean up any spilled oil.

IMPORTANT: If replacing oil distribution hoses, note hose routings before proceeding with disassembly. Refer to **Oil Distribution Hoses** on p. 204.

Remove the screw retaining the oil pump.



1. Electrical connector
2. Oetiker clamp and oil supply hose
3. Screw

009234

Remove the oil pump assembly.

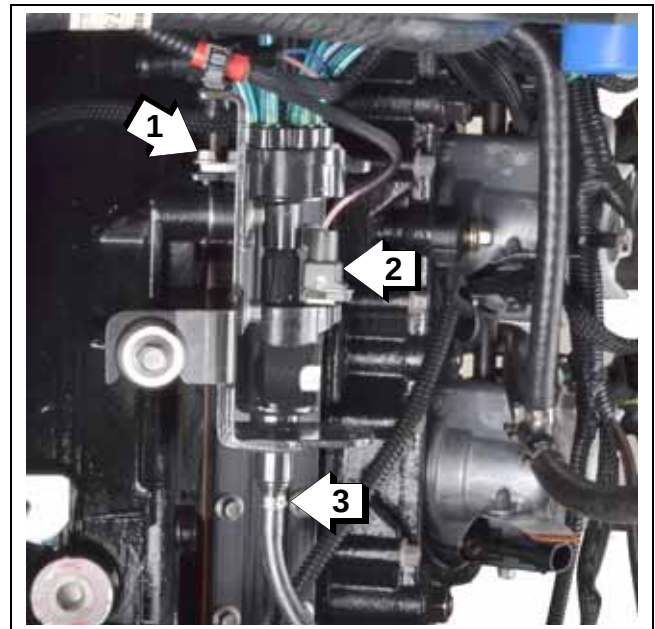
IMPORTANT: The cylinder oil pump and manifold is an assembly and cannot be serviced as individual components.

Installation

Install the oil pump into the bracket. Install the screw and tighten to a torque of 35 to 60 in. lbs. (4 to 6 N·m).

Connect the electrical connector.

Connect the oil supply hose to the inlet fitting of the oil pump. Fasten with a new *Oetiker* clamp.



1. Screw
2. Electrical connector
3. Oil supply hose and Oetiker clamp

009234

Connect the battery cables at the battery.

Prime the oil system. Refer to **Oil Supply Priming** on p. 196.

Check oil flow through oil distribution hoses. Run the outboard and check for leaks.

Repair any oil leaks.

Install the starboard frame. Then install the engine top cover, rear cover and starboard side panel. Refer to **Engine Cover and Frame Service** on p. 55.

Notes

Technician's Notes

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Related Documents

[illegible]

Cooling System

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Water Flow and Hose Routing Diagrams

Water Flow

Refer to the water flow diagram on the next page, or in the **Diagrams** section of this manual.

Cooling water (1) flows from the gearcase water inlet screens to the water pump (2). From the water pump, cooling water flows through a water tube (3) inside the exhaust housing (4) to the exhaust adapter (5).

From the exhaust adapter, water flows into the cylinder block (6). After the cylinder block water passages have filled, some water exits through a water filter (7) at the top of the block and flows to a tee fitting. From the tee fitting, water to cool the DPS module (8) flows through a hose and fitting to the exhaust adapter. This water cools the exhaust and then exits through the propeller hub (24). Water to cool the EMM (9) and vapor separator (10) exits the overboard indicator (11).

Some water from the exhaust adapter also cools the exhaust manifolds (13 & 14[†]). Vents (15) at the top of the exhaust manifolds allow any air to purge from the cooling system. Air and water exiting the vents flow to the overboard indicator (11).

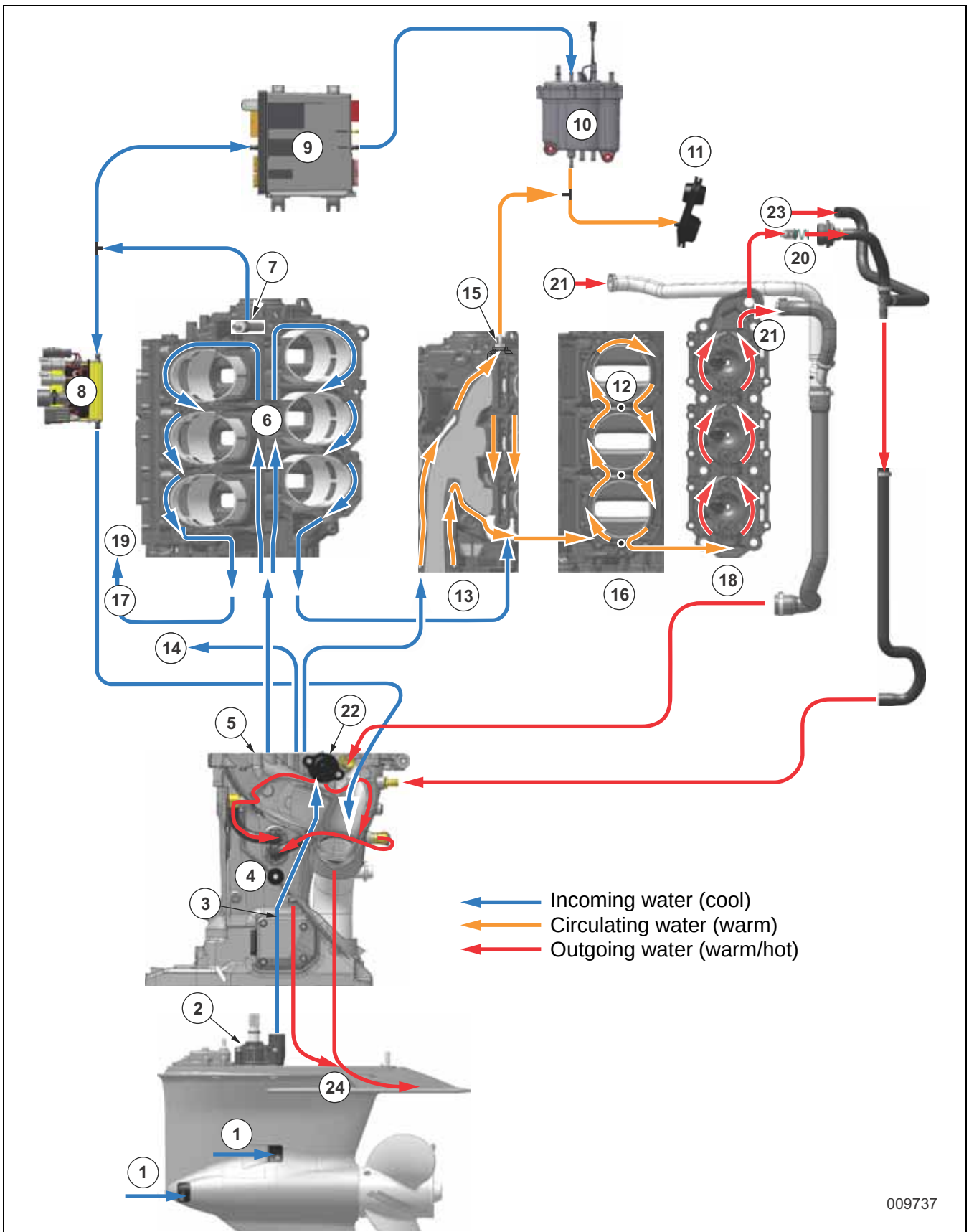
Water dams (12) in the cylinder block (6) direct water to cool the starboard & port cylinder sleeves (16 & 17[†]) then flows into the bottom of the cylinder heads (18 & 19[†]). After the cylinder head water passages fill, water flows out through a fitting (21) on the port side of each cylinder head. A hose assembly carries the water to the port side of the exhaust adapter (5).

When the engine reaches operating temperature, the thermostats (20 & 23[†]) open. Water from the thermostats flows through a hose assembly to the rear of the exhaust adapter (5).

When the engine is accelerated and water pressure reaches approximately 28 psi (193 kPa), the water pressure relief valve (22) opens and water flows out of the valve and into the exhaust housing (4).

All water flowing to the exhaust housing and exhaust adapter (4 & 5) exits through the water outlets at the top of the gearcase.

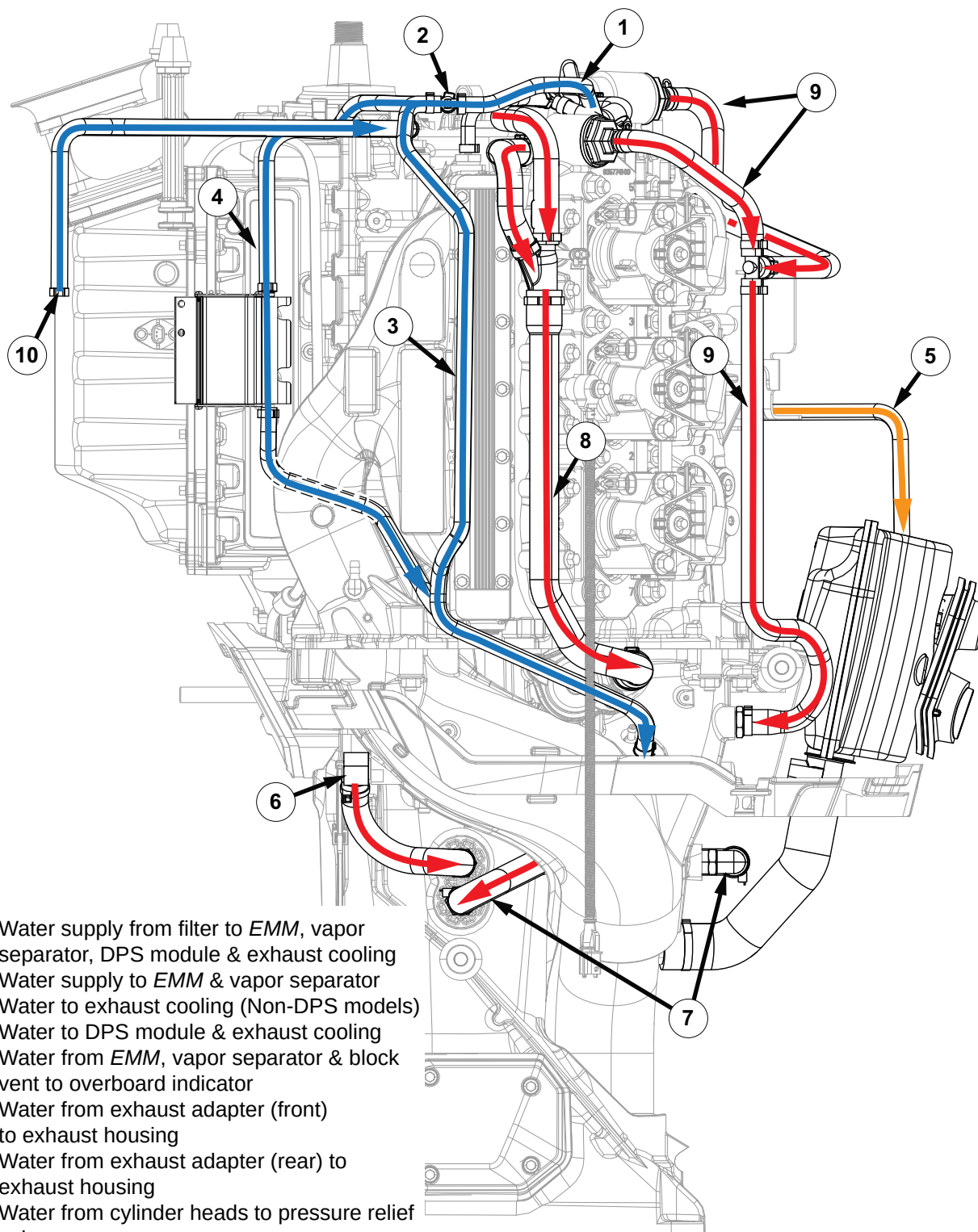
[†]**NOTE:** Port exhaust manifold, sleeves and cylinder head are NOT shown. Water flow to port exhaust manifold, sleeves and cylinder head follows a path similar to the starboard side.



Cooling System

Water Flow and Hose Routing Diagrams

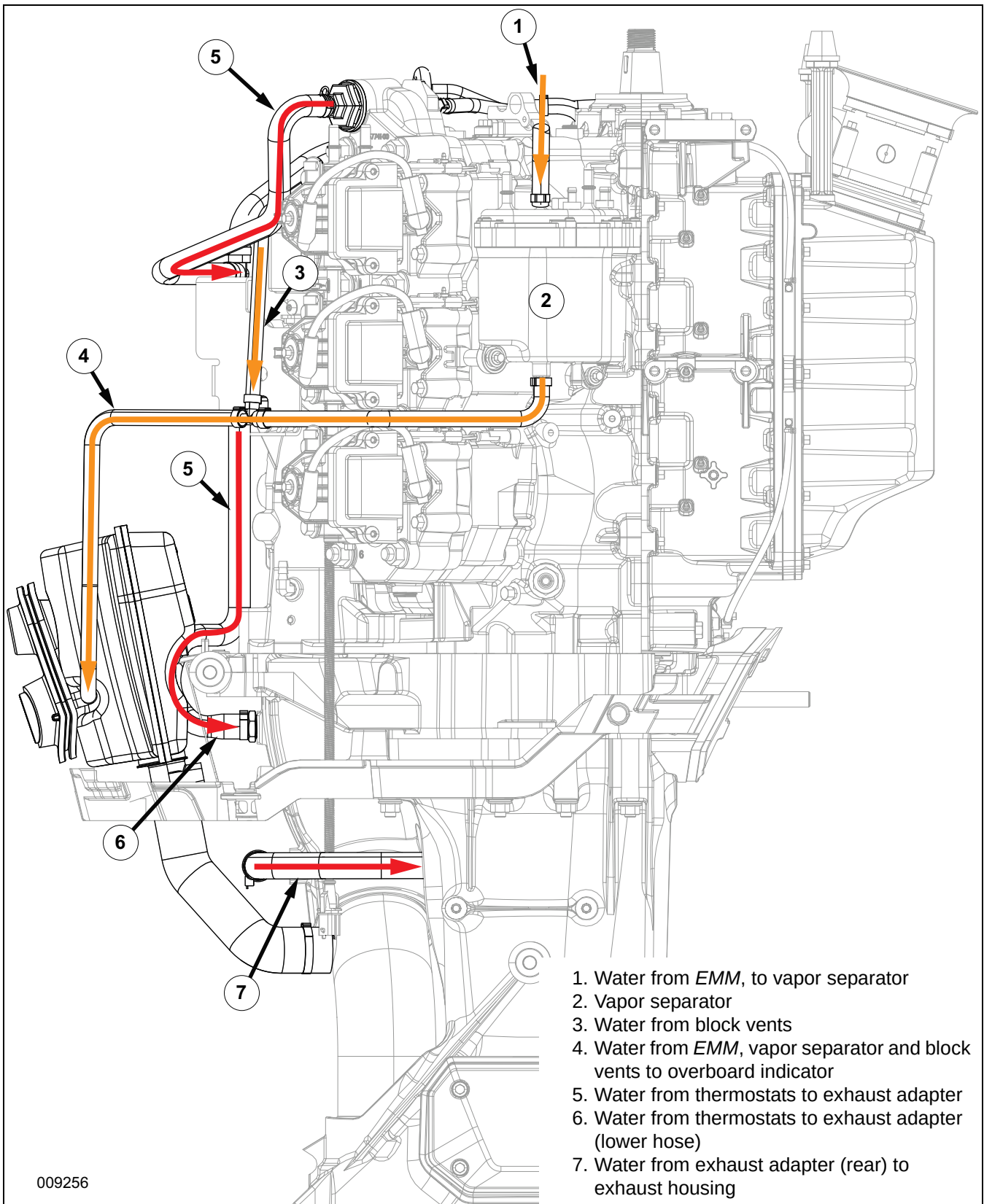
Cooling Hose Routing Diagram - Port



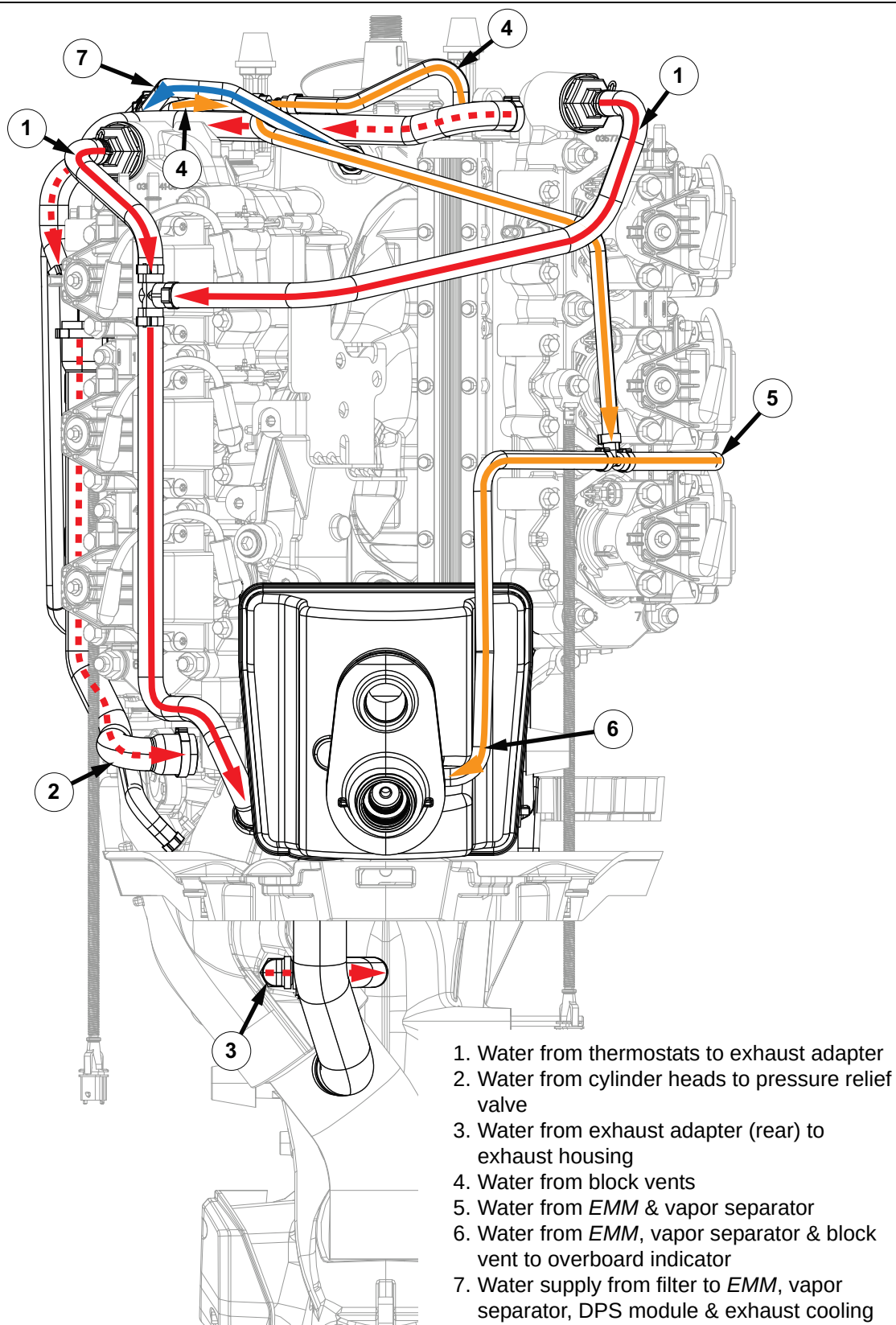
1. Water supply from filter to EMM, vapor separator, DPS module & exhaust cooling
2. Water supply to EMM & vapor separator
3. Water to exhaust cooling (Non-DPS models)
4. Water to DPS module & exhaust cooling
5. Water from EMM, vapor separator & block vent to overboard indicator
6. Water from exhaust adapter (front) to exhaust housing
7. Water from exhaust adapter (rear) to exhaust housing
8. Water from cylinder heads to pressure relief valve
9. Water from thermostats to exhaust adapter
10. Flush port (water inlet)

009255

Cooling Hose Routing Diagram - Starboard

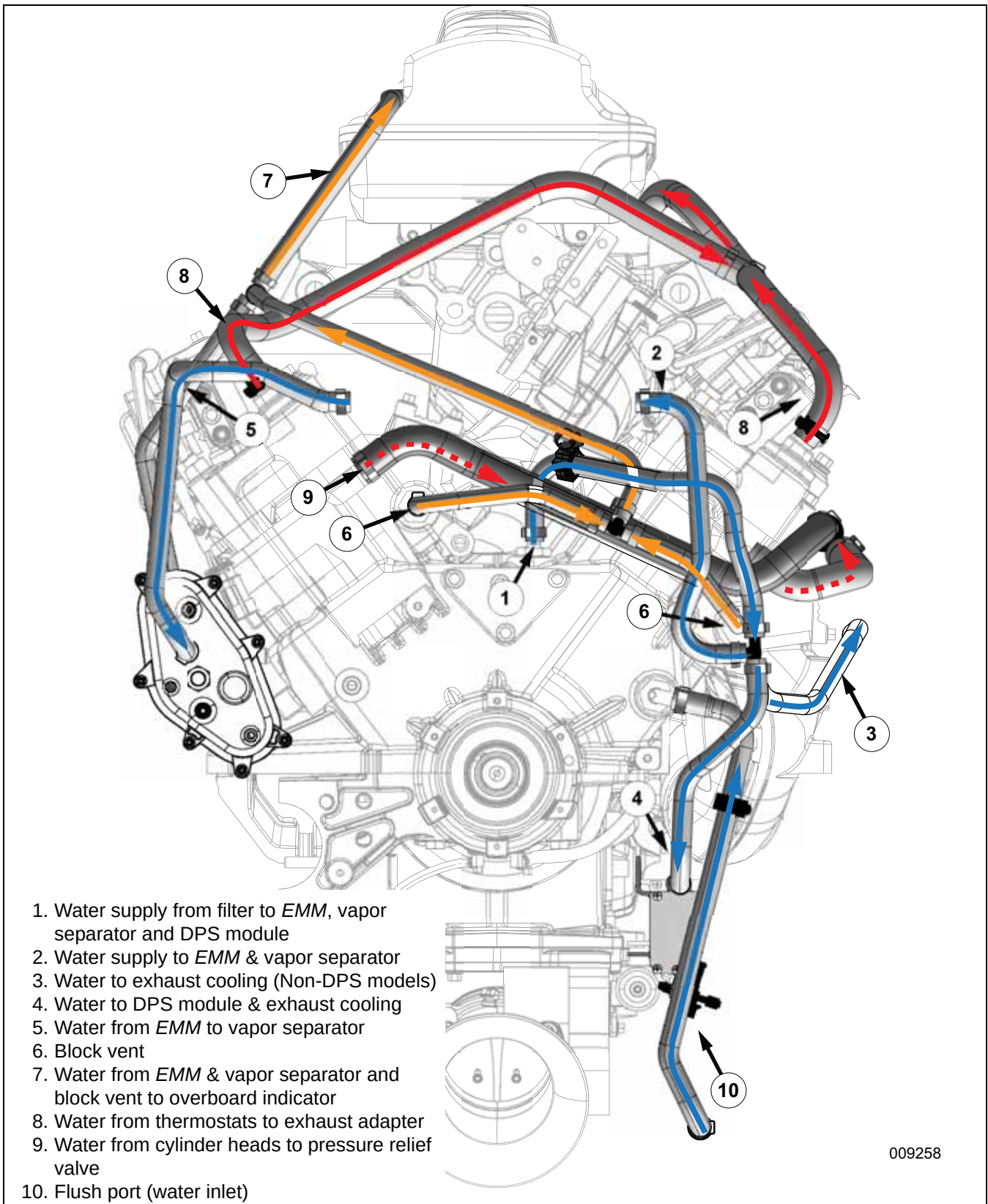


Cooling Hose Routing Diagram - Rear



009257

Cooling Hose Routing Diagram - Top



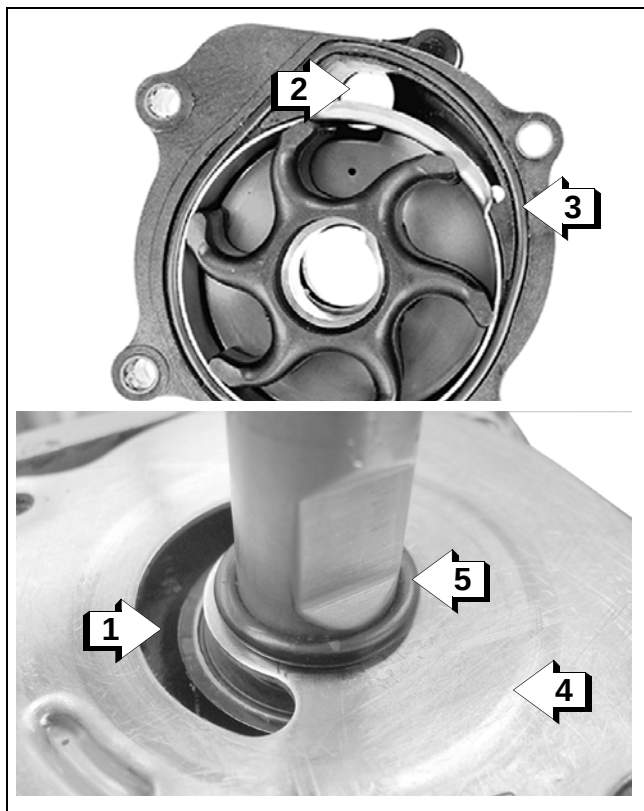
Components

Water Pump and Intakes

External water intakes mounted in the gearcase housing collect water and must supply the inlet side of the water pump with an unrestricted and unaerated water supply. Water is drawn into the water pump through a hole in the lower plate of the water pump assembly. All cooling water to the powerhead is provided by the water pump.

- A nylon wedge (impeller key) is used to engage the impeller bushing and driveshaft.
- The nylon impeller housing with liner must seal against a separate water pump plate.
- The bottom plate **MUST** seal to gearcase.
- The pump operates as a positive displacement pump at **LOW** speeds (below 1500 RPM) and as a centrifugal pump at **HIGHER** speeds.

Refer to **Water Pump Service** on p. 365 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 a water tube and hose assembly located in the outboard's mid-section. O-rings seal the water tube to the water pump housing. Hose clamps secure the water supply hose to the water tube and a fitting in the exhaust adapter.

Water supplied to the water tube provides all cooling water to the cylinder block.

Exhaust Adapter

- 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.



1. Exhaust Adapter

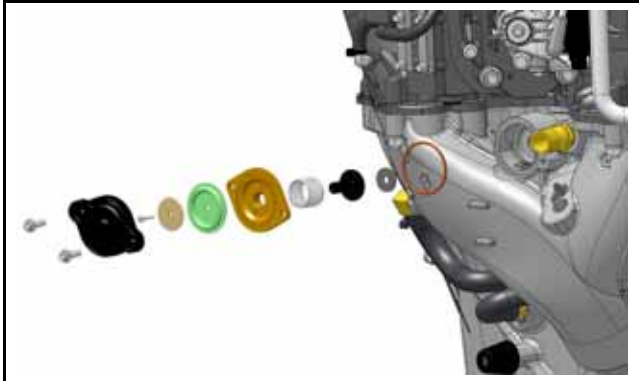
009259

Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 2500 to 3000 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.

Overcooling: Debris may prevent the valve from closing completely.



Pressure Relief Valve

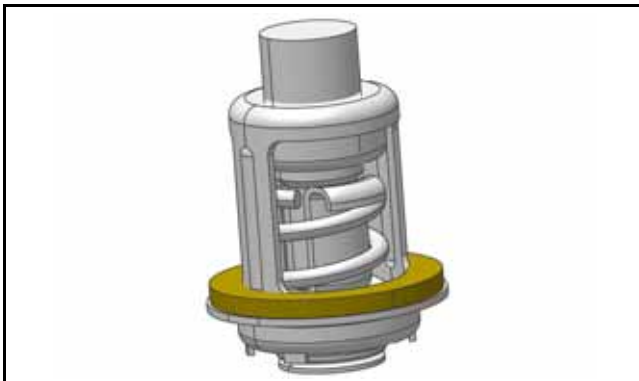
009260

Thermostats

Thermostats control water flow and operating temperature at lower speeds (below 2500 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.



Thermostat

009261

Block Venting

A fitting and hose from the top of the exhaust manifold on the cylinder block allows the constant movement of water and/or air from the block. Circulated water flows through a hose and tee-fitting, exiting through the overboard indicator.

Operation

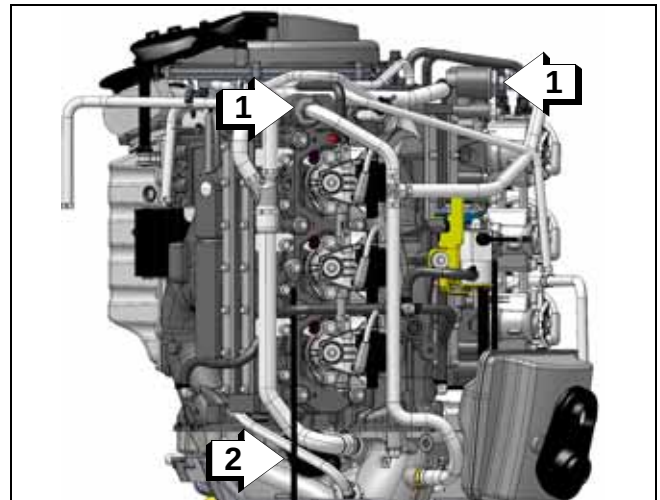
All models use a two-stage cooling system design. The cooling system is dependent on water pump pressure and controlled by thermostat and pressure valve operation.

NOTICE

Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cooling system is controlled by two thermostats and one pressure valve. The pressure valve is connected by hoses to the top of each cylinder head.



1. Thermostats
2. Pressure valve assembly

009262

The thermostats and pressure valve control the flow of water leaving the water passages of the cylinder heads.

Cooling System

Engine Temperature Check

At low speed, the pressure valve is closed and the thermostats regulate water to flow to maintain a temperature of approximately 143°F (62°C).

Water from the thermostat flows out of the cylinder heads through a hose, to the exhaust adapter, exhaust housing and then out of the outboard.

At higher speeds, water pressure opens the pressure valve at approximately 2500 to 3000 RPM. Water bypasses the thermostats and then flows through the pressure valve. Water from the pressure valve flows through internal passages of the exhaust adapter to the exhaust housing and then exits through the gearcase water outlets.

This pressure controlled water outlet circuit provides a high flow rate of discharge water during high speed operation.

EMM and Vapor Separator Cooling

Cooling water is routed from the top of the cylinder block, through a water filter 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 fault codes 25 and 29 and the Engine Monitor warning system. Refer to the **EMM Fault Code Chart** at the back of this manual for specific fault code information.

Cooling water from the *EMM* is routed to the water inlet fitting of the vapor separator water cavity. Cooling the vapor separator fuel chamber minimizes fuel vaporization.

Cooling water from the vapor separator is routed to the overboard indicator.

Engine Temperature Check

IMPORTANT: The engine temperatures listed in this section are based on an intake water temperature of 70° ± 10°F (21° ± 3°C).

Install correct test propeller and place outboard in a test tank or in the water. Start outboard and run at 3000 RPM in FORWARD gear for at least five minutes. Remember, running outboards at high speeds in test tanks may disrupt water flow to gearcase water intakes. Make sure the outboard has adequate water flow.

CAUTION

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

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.

Software Method

Use the *Monitor* screen of *Evinrude Diagnostics* software v 6.1 or higher, to read temperature displays.



Engine Monitor Screen

009242

Typical temperature displays at IDLE speed should be $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($60^{\circ}\text{C} \pm 6^{\circ}\text{C}$)

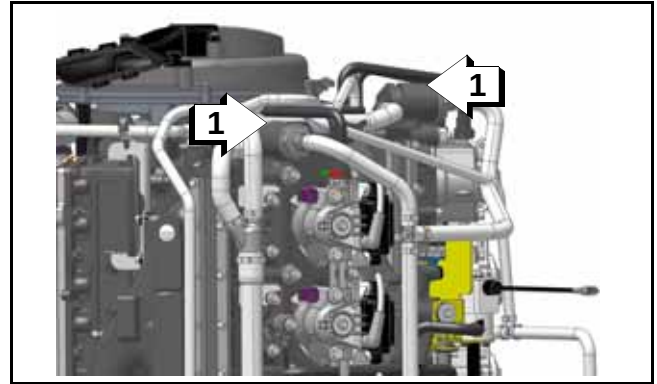
Typical temperature displays at WOT speed should be $150^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($66^{\circ}\text{C} \pm 6^{\circ}\text{C}$)

Operating temperature must not exceed 203°F (95°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

004339

Typical pyrometer readings at IDLE speed should be $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($60^{\circ}\text{C} \pm 6^{\circ}\text{C}$)

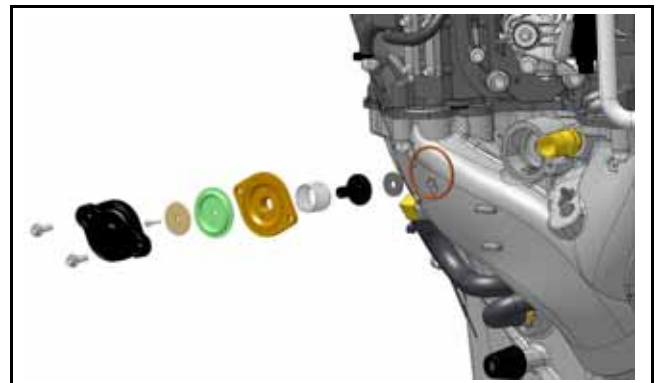
IMPORTANT: If you get low or inaccurate readings with a digital pyrometer, coat the probe location with *Thermal Joint Compound*, P/N 322170.

Idle Operating Temperature Troubleshooting (Below Range)

If engine IDLE temperature is below operating range $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($60^{\circ}\text{C} \pm 6^{\circ}\text{C}$), 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 the sealing surface in the exhaust adapter.



Pressure Relief Valve

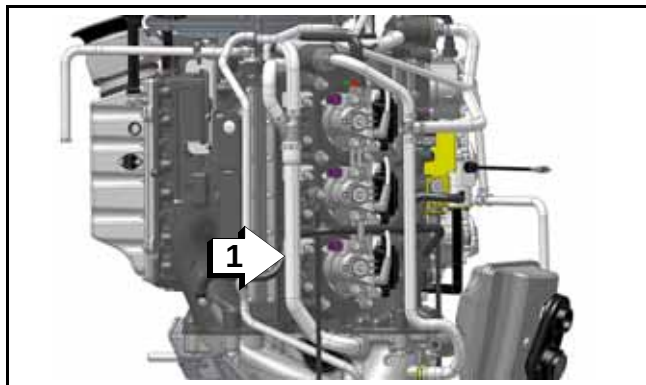
009260

Cooling System

Engine Temperature Check

Start the outboard and check IDLE operating temperature.

If IDLE temperature is too low, pinch off the water hose from the cylinder heads to the pressure relief valve.



1. Outlet hose

009263

Use hose pinching pliers (acquired through local tool source) to prevent hose damage.



Hose Pinching Pliers

009253

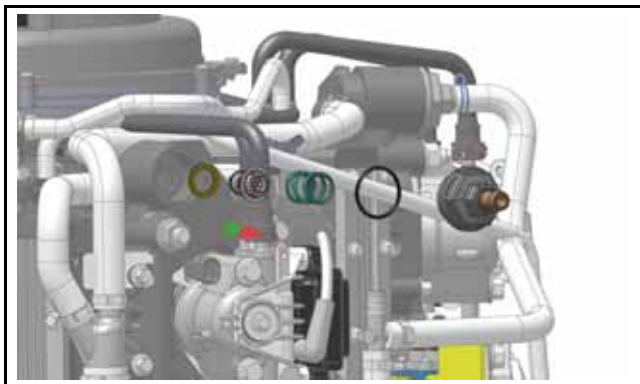
Start the outboard and check IDLE operating temperature using *Evinrude Diagnostics* software, v 6.1 or higher.

If IDLE temperature increases to specific operating range, $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($60^{\circ}\text{C} \pm 6^{\circ}\text{C}$), after pinching off hoses and eliminating water flow to the pressure relief valve, the pressure relief valve is leaking. Clean or replace the pressure relief valve as needed.

If IDLE temperature is still below operating range with hoses pinched off, inspect thermostats and thermostat seals.

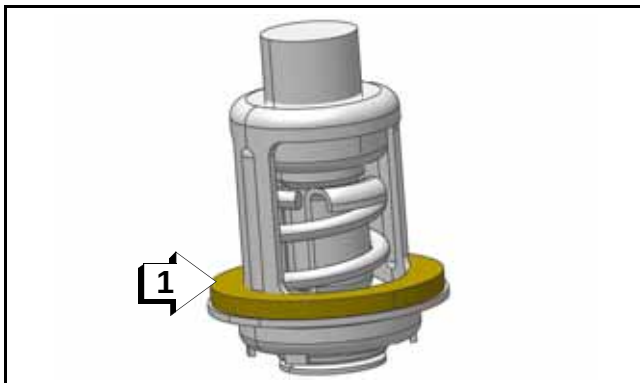
Thermostats

Remove thermostat cover(s) and inspect thermostat(s).



009264

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



1. Seal, thermostat

009261

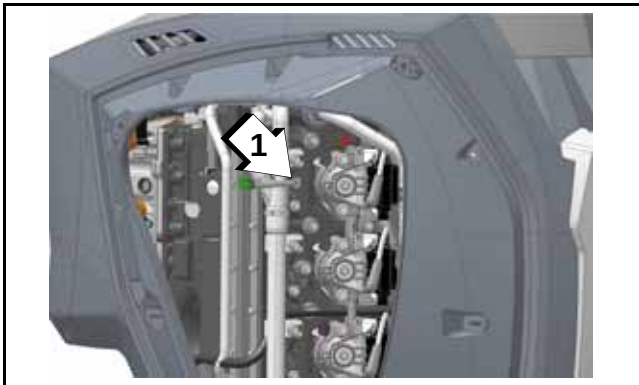
Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

Component Servicing

Temperature Sensor Servicing

Removal

Loosen sensor and remove by hand. Use care to avoid breaking threads.



1. Temperature sensor

009265

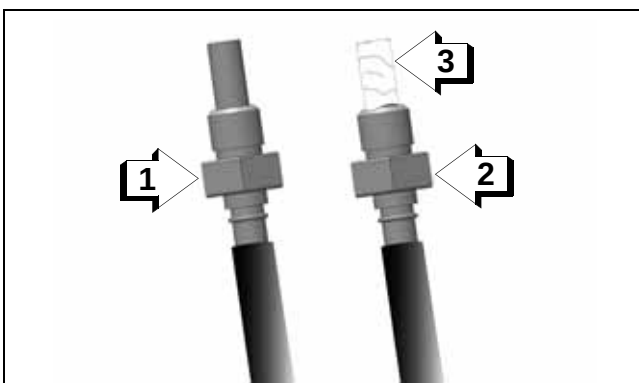
Clean sensor threads, sensor, and sensor cavity.

Installation

Apply a small amount of *Thermal Joint Compound*, P/N 322170, into the bottom of the sensor cavity.

Install the sensor hand tight. Remove the sensor and check thermal joint compound coverage on the sensor probe.

Thermal joint compound should cover at least 75% of the length to the sensor probe.



1. Temperature sensor

2. Temperature sensor with thermal joint compound

3. Thermal joint compound

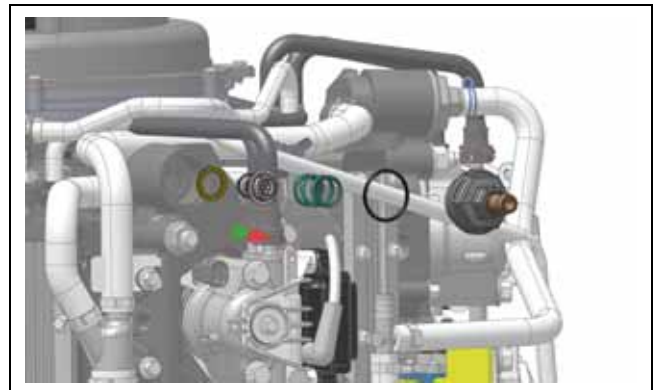
009266

SLOWLY tighten temperature sensor to a torque of 12 to 18 in. lbs. (1.35 to 2.0 N·m). Wait 10 minutes for trapped air to bleed from cavity. Thermal compound may seep past threads. Re tighten sensor.

Thermostat Servicing

Disassembly

Remove the thermostat cover and O-ring from cylinder head.



009264

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.



009267

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 *Gasket Sealing Compound*. Install and

Cooling System

Component Servicing

tighten the cover to a torque of 120 to 144 in. lbs. (13.5 to 16.5 N·m).

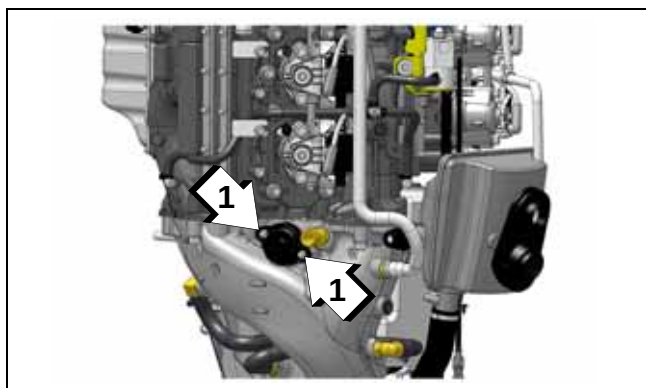
Pressure Relief Valve Servicing

The pressure relief valve assembly should be serviced at the same time as the thermostats.

Disassembly

It is NOT necessary to remove hose clamps and hoses from the exhaust adapter.

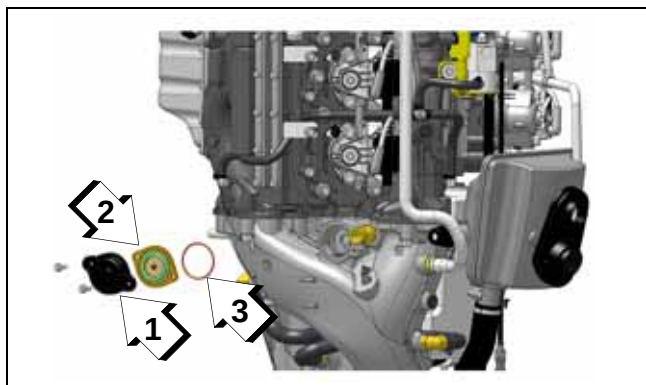
Remove the screws securing the pressure valve cover to the exhaust adapter.



1. Screws

009268

Remove the pressure valve cover, pressure valve assembly and o-ring from the exhaust adapter.



- 1. Cover
- 2. Pressure valve assembly
- 3. O-ring

009269

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from exhaust adapter and other parts.

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

Install valve on powerhead. Tighten nuts to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Evinrude **ICON II Remote Control System**

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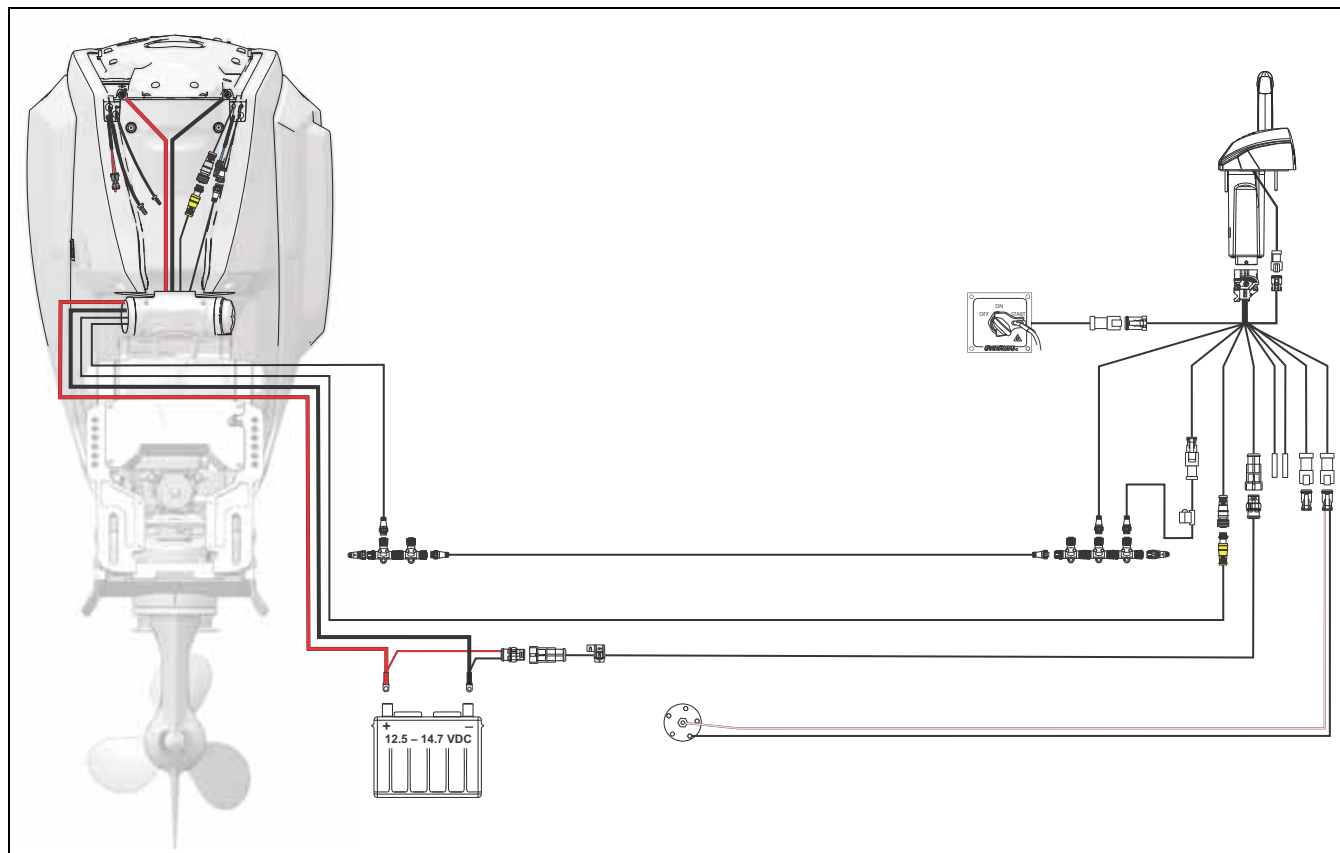
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Components

The *ICON II* remote control system includes the following components:

- *ICON II* remote control(s)
- Remote control (private) network
- *NMEA 2000* network
- Up to four *Evinrude E-TEC G2 74° V6* outboards



Typical Installation

Single outboard system with single lever binnacle remote control shown

009373

ICON II Remote Control

ICON II remote controls are electronic shift and throttle remote control systems which manage all engine control functions through a low-voltage, digital data network.

Sensor inputs and internal *EMM* controllers are used to control the operation of the outboard's shift and throttle functions.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** for a complete list of all control system fault codes.

ICON II remote controls are available in the following configurations:

- Single Lever Binnacle Mount, use in single outboard, single or dual station installations
- Concealed Side Mount, use in single outboard installations. May be used with an optional accessory foot throttle.
- Dual Lever Binnacle Mount, use in multiple outboard (up to 4), single or dual station installations.

Remote Control (Private) Network

Shift and throttle information is transmitted and received between the *EMM* and *ICON II* remote control system via a dedicated Controller Area Network (CANbus), known as the remote control network, or private network.

The remote control network is powered directly from the battery. The network may include backbone buss cables, backbone extension cables, one or more 6-port hubs, or accessories. Refer to the *Evinrude E-TEC G2 Installation and Pre-delivery Guide*.

NMEA 2000 Network

For safety, the remote control data is also shared on a *NMEA 2000* network as backup.

Outboard *EMM*

The *EMM* receives shift, throttle and other control information from the *ICON II* remote control.

Shift and throttle controllers internal to the *EMM* activate the shift actuator and the electronic throttle body assembly to the positions commanded by the remote control. Also see **Electronic Shift Controller** on p. 86 and **Electronic Throttle Controller** on p. 84.

If the *ICON II* remote control cannot communicate with the *EMM*, all remote control LED indicators flash until control levers and shift actuators are in NEUTRAL.

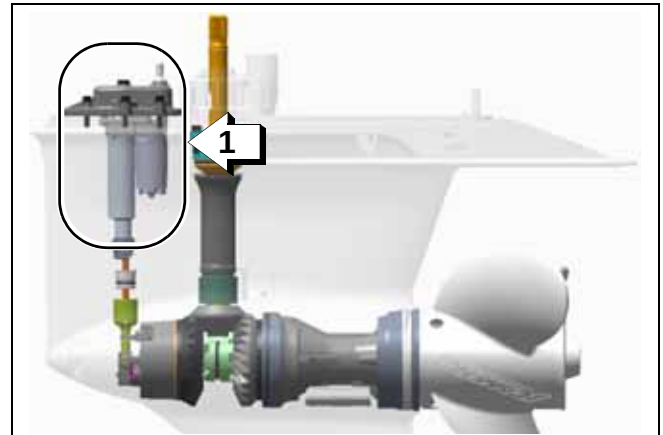
Then, the NEUTRAL indicator LED for the outboard that has a fault flashes. The *EMM*:

Activates NEUTRAL idle mode
Stores remote control fault codes: 21, 24, 27, or 30.

Shift Actuator

The shift actuator converts electronic signals from the Electronic Shift Controller (ESC) in the *EMM* into the mechanical motion required to shift the outboard into and out of gear.

Also see **Shift Actuator** on p. 369.



1. Shift actuator

009372

If the shift actuator cannot achieve the commanded gear, the FORWARD, NEUTRAL or REVERSE indicator LED flashes to indicate which gear position is affected. The *EMM*:

Activates S.A.F.E.
Stores <i>EMM</i> fault code 204
Engine Monitor: CHECK ENGINE display ON

The outboard will shutdown if NEUTRAL cannot be achieved.

Throttle Valve Assembly

The electronic throttle body assembly converts electronic signals sent from the Electronic Throttle Controller (ETC) in the *EMM* into the mechanical motion required to move the throttle plate.

Also see **Electronic Throttle Controller** on p. 84.



1. Throttle valve assembly

009173

If the ETC cannot communicate with the electronic throttle body for more than 250 milliseconds, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores <i>EMM</i> fault code 162
Engine Monitor: CHECK ENGINE display ON

If the throttle plate cannot achieve the commanded position, the *EMM*:

Activates <i>S.A.F.E.</i>
Stores <i>EMM</i> fault code 179
Engine Monitor: CHECK ENGINE display ON

System Settings and Diagnostics

Use *Evinrude Diagnostic* software, v 6.1 or higher to communicate with the remote control. Refer to **Communication** on p. 90.

Diagnostic software can change configuration settings, view identification information and stored faults, monitor control functions or update software.

Multiple Engine Instancing

Multiple outboard installations require the transom position of each outboard be identified.

Engine identity is set and stored in the *EMM* of each outboard. By default the *EMM* of all outboards is set to instance zero (0) at the factory. Outboards are identified as Instance 0 through 3, from port to starboard, up to four outboards.

Engine identity of each outboard must be set manually or with *Evinrude Diagnostics* software v 6.1 or higher. Use the following chart to assign the engine instance number to the outboard's position on the transom.

Identity Numbers Chart					
	Transom Position				
	Port	Port Center	Center	Starboard Center	Starboard
Number of Outboards	Port	Port Center	Center	Starboard Center	Starboard
1	0				
2	0				1
3	0		1		2
4	0	1		2	3

If duplicate engine identity numbers are detected, the affected outboard's NEUTRAL indicator LED will flash rapidly.

Manual Instancing Method

⚠ WARNING

Do NOT vary from this procedure.

Pressing any other button on the remote control or switch panels other than the STOP switch or turning the key OFF will exit from this process.

This can cause the system to react unpredictably. If any other button is pressed accidentally, turn the key switch OFF and start the procedure over.

When manually setting engine instance, start with the port outboard and work toward the starboard outboard. Follow these steps EXACTLY:

1. With the key switch off, disconnect the remote control (private) network cables from all outboards.
2. Push and hold the SYNC button while turning the key switch ON. Continue holding the SYNC button for at least 2 seconds.
3. Connect the remote control (private) network cable to the first (port) outboard, powering the *EMM*. Then press the STOP button for that outboard. The control will send an instance message with appropriate instance to the *EMM*.
4. After setting the instance on outboard #1, disconnect the private network cable from outboard #1. Connect the private network cable to outboard #2. Then press the STOP button for outboard #2.

If this installation has more than two outboards, go to the step 5. If this is a dual outboard installation, go to step 7.

5. After setting the instance on outboard #2, disconnect the private network cable from outboard #2. Connect the private network cable to outboard #3. Then press the STOP button for outboard #3.

If this installation has more than three outboards go to the step 6. If this is a triple outboard installation, go to step 7.

6. After setting the instance on outboard #3, disconnect the private network cable from out-

board #3. Connect the private network cable to outboard #4. Then press the STOP button for outboard #4.

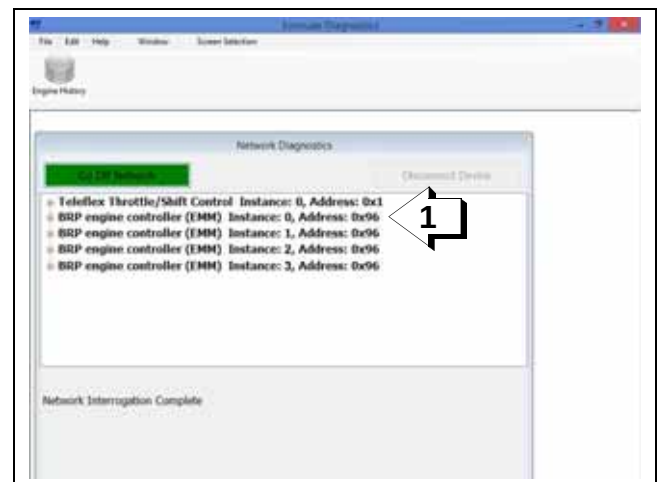
7. After setting the instance on the last outboard, turn the key switch OFF. Connect the private network cable to all outboards. Then turn the key switch ON to complete the instancing process.

Diagnostic Software Method

Before beginning, record the model number and serial number from the serial number tag of each outboard. Note the transom position of each outboard.

Use *Evinrude Diagnostics* software v 6.1 or higher to set engine instance.

1. Connect the PC to the *NMEA 2000* network. Turn the key switch ON. Open the *Evinrude Diagnostics* software program.
2. From the *Device List* select the *EMM* for the first outboard.



1. Device List

009161

Evinrude ICON II Remote Control System System Settings and Diagnostics

3. Select the *Identification* screen and note the model number and serial number of the outboard.



Identification Screen

009281

Compare the information on the *Identification* screen to the serial number tag to determine the outboard transom position and engine instance. See the **Identity Numbers Chart** on p. 226.

Close the *Identification* screen.

4. Next select the *Settings* screen. Then select the *Configure* button.

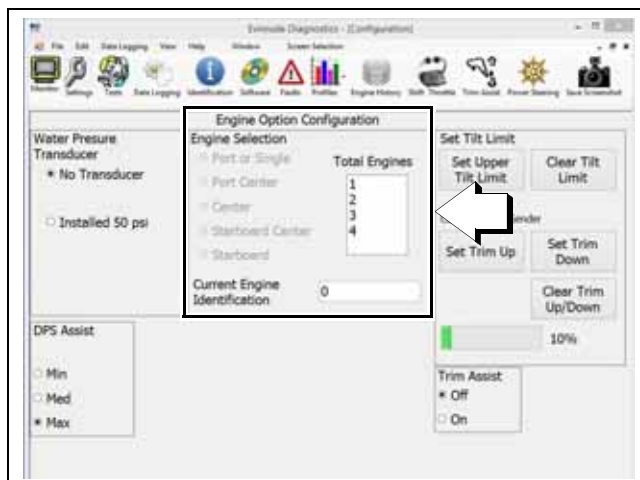


Settings Screen

009243

5. Under *Engine Option Configuration*, select the total number of engines.

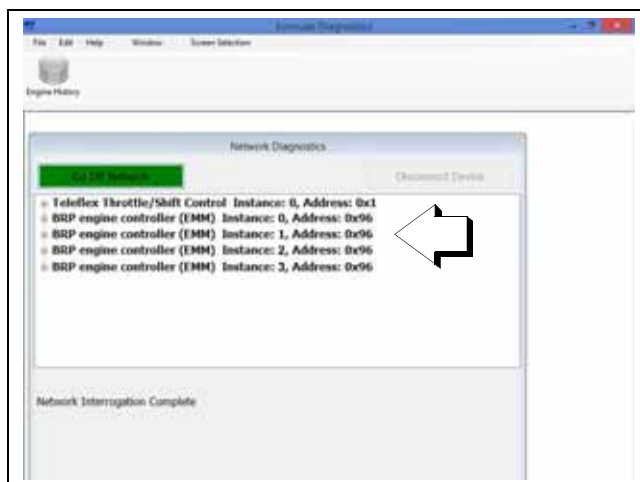
6. Then select the engine's transom position from the available *Engine Selection* list.



Engine Option Configuration

009237

7. Close the *Configuration* screen. Then close the *Settings* screen.
8. From the *Device List* select *Disconnect Device*.
9. From the *Device List* select the *EMM* for the next outboard.



Device List

009161

10. Repeat steps 3 through 9 for each outboard.
11. After engine identity has been set for each outboard, turn the key switch OFF and back ON to complete the procedure.

Connecting to each *EMM* and confirm the instance of each outboard is correctly set according to transom position.

Remote Control Configuration

Select the *Config* button to make remote control configurations changes or calibrate the remote control lever(s).

After making setting selections, be sure to press the *Save Changes* button.

To calibrate the remote control lever(s), press the *Initiate* button to start the procedure.

Following the on-screen prompts, move the control lever to the directed position, then press the *Set Position* button.



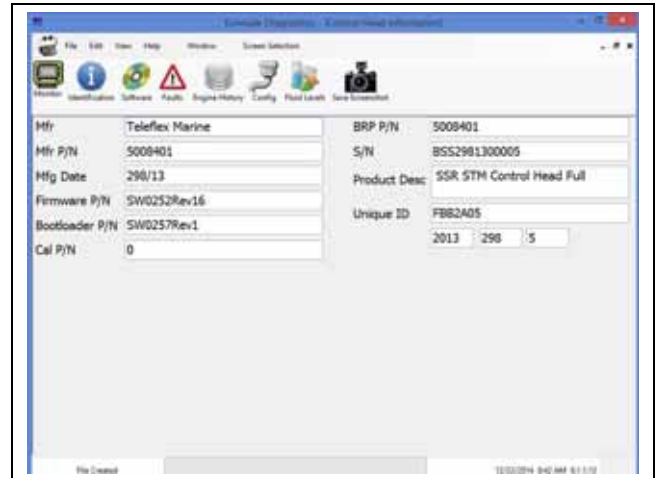
Remote Control Configuration Screen

009385

1. Save Changes button
2. Initiate calibration button
3. Set Position button

Remote Control Identity

Select the *Identification* button to view identification information.



Remote Control Identity Screen

009389

Fluid Level Configuration

Select the *Fluid Levels* button to configure fuel or oil level sensors connected to the remote control network.

After making selections, be sure to press the *Save Configuration* button for the selected fluid channel.



Remote Control Fluid Levels Configuration Screen

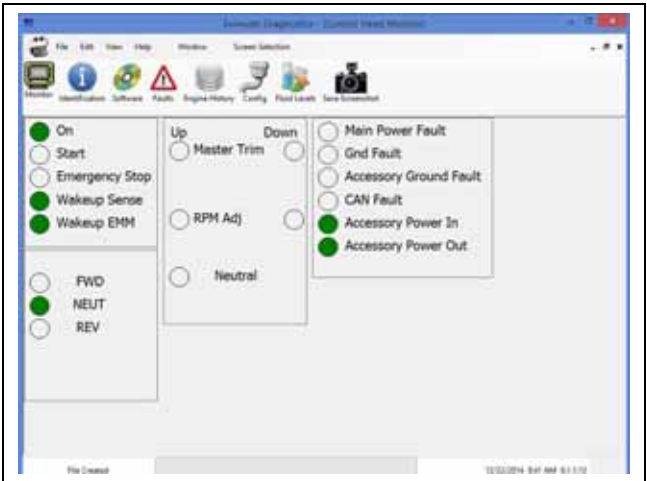
009386

1. Save Configuration button

If equipped, fluid levels can also be configured using an *Evinrude ICON Touch* digital display. See the **User's Guide** for the digital display.

Remote Control Monitor

Select the *Monitor* button to view certain power faults and remote control functions. On-screen indicators will illuminate when the related function on the remote control is activated.



Remote Control Monitor Screen 009388

Remote Control Faults

Select the *Faults* button to view any remote control fault codes.



Remote Control Faults Screen 009387

ICON II System NEUTRAL Idle Mode

The following conditions will cause the *ICON II* system to enter NEUTRAL idle mode:

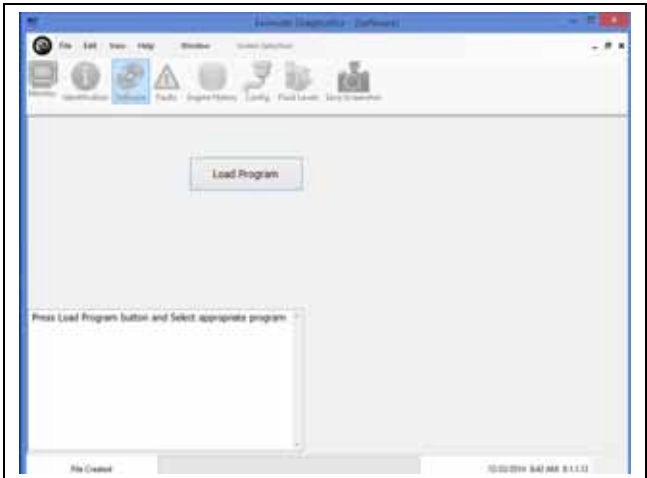
- Remote control lever sensor failure
- Foot throttle sensor failure
- Loss of communication with the *EMM*

The *EMM*:

Activates NEUTRAL idle mode
Stores remote control fault code between 1 and 12; or, 21, 24, 27, or 30.
Engine Monitor: CHECK ENGINE display ON

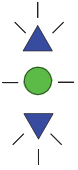
Remote Control Software

Select the *Software* button to upload software to the remote control. Press the *Load Software* button and follow the on-screen prompts.



Remote Control Software Screen 009390

ICON II System Fault Detection

Type	Description	Response	Indication
Condition Code or Warning	A conditional fault requiring remedial action to correct that does not affect normal operation. Example: Attempt to start outboard(s) with control lever(s) not in NEUTRAL.	Response based on condition - upon resolution the system will resume full performance.	Condition specific warning message appears on digital display.
Controllable	Faults that allows for a fully controllable remedial action. Example: Low battery voltage.	Informational only.	
Critical	Faults that result in the inability to accurately determine critical outboard commands. Example: Communication between the control and outboard(s) EMM(s) is lost.	Commanded lever and gear positions become unavailable. Outboards set to S.A.F.E. mode.	Control LEDs flash five times per second.  Warning message appears on digital display.

A critical fault will prevent normal operation and result in the system entering a failed state. The control will:

- send “not available” data in the throttle and gear messages
- deactivate SYNC, NEUTRAL and Throttle Warm-Up modes
- send the fault message and store the fault in the remote control memory
- flash the appropriate remote control LED(s) five times per second

When the control detects the outboard(s) are in NEUTRAL idle and the working lever(s) are in NEUTRAL, the system returns to normal operation.

Technician's Notes

[illegible][illegible]

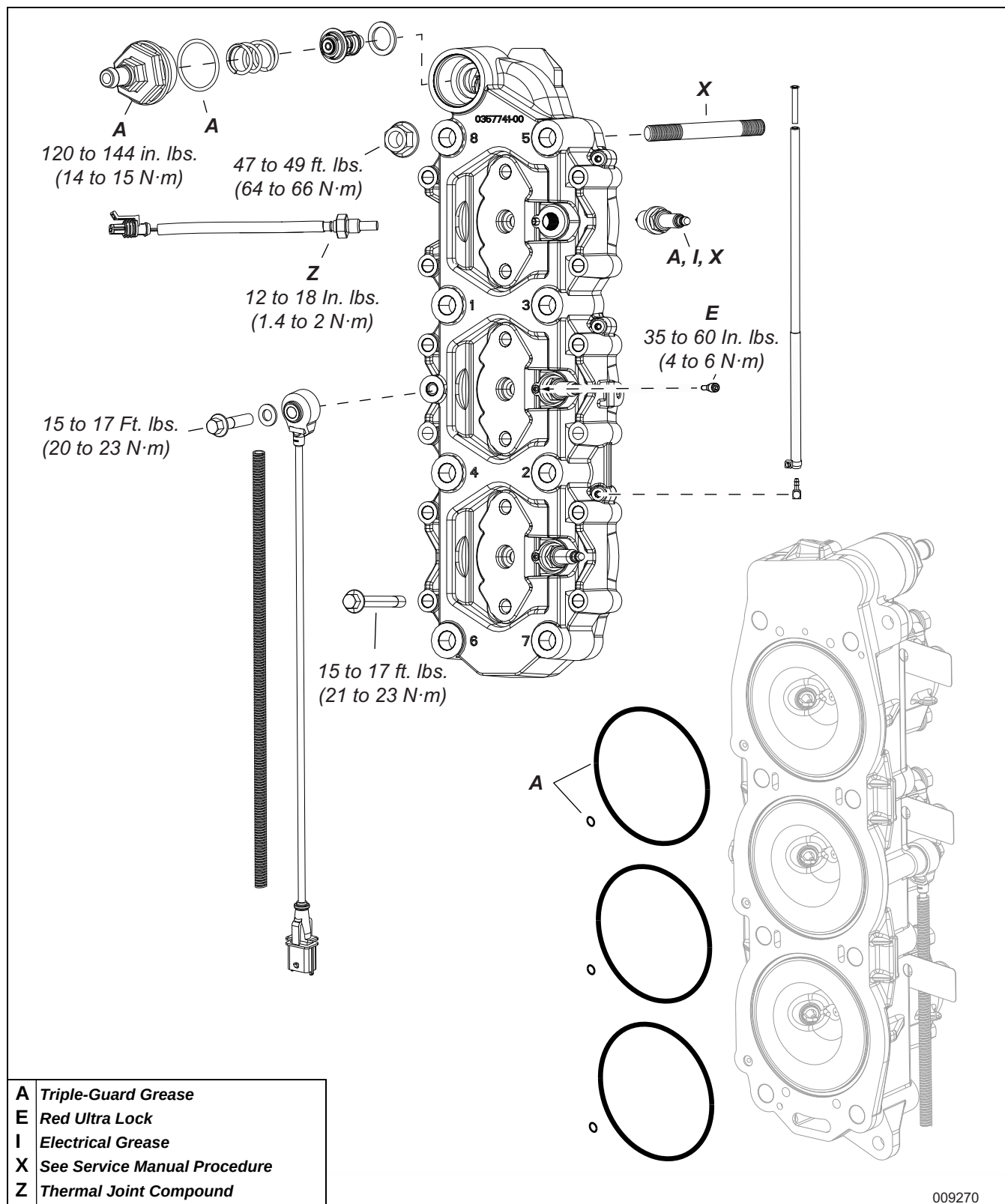
Powerhead

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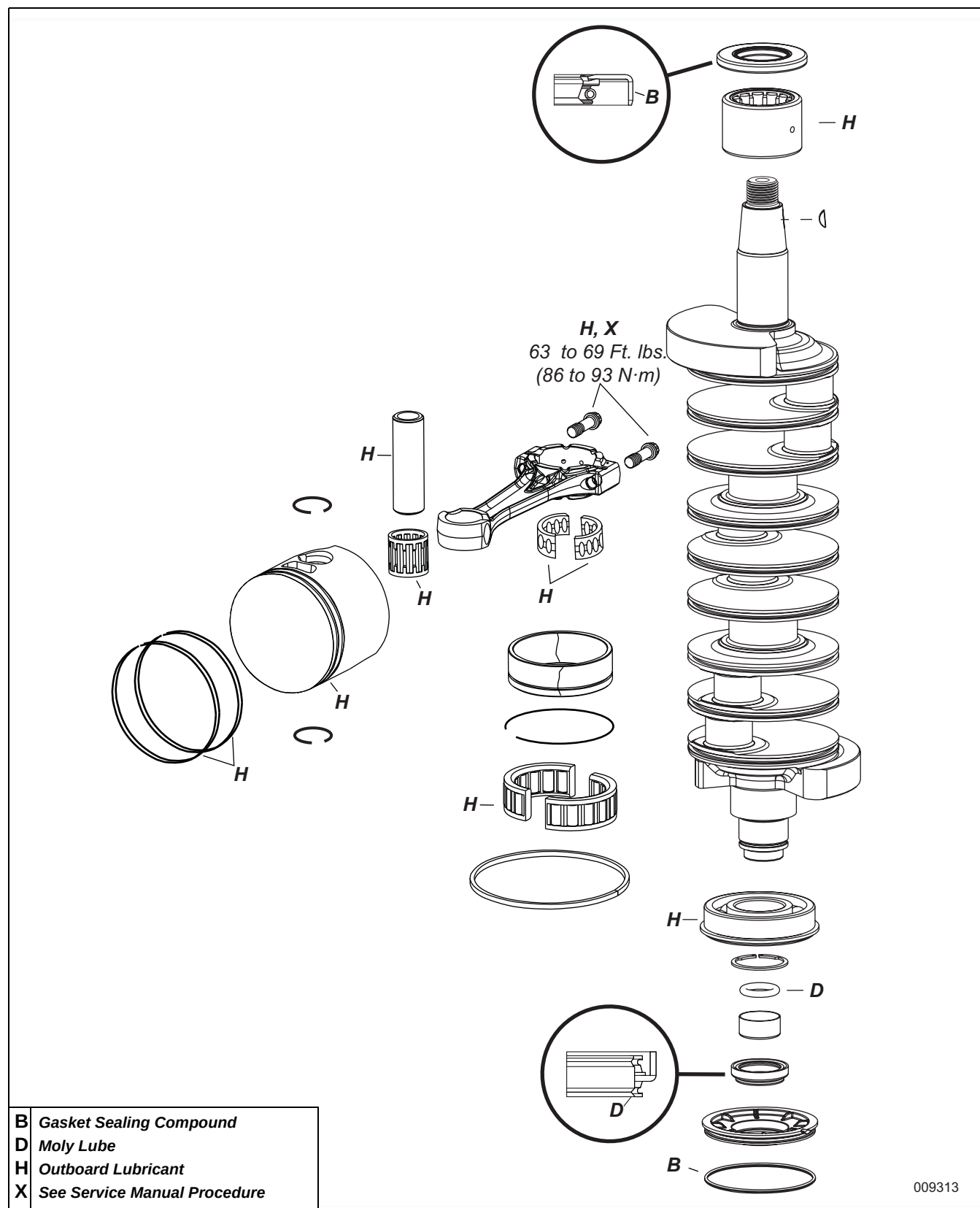
Service Charts

Cylinder Head

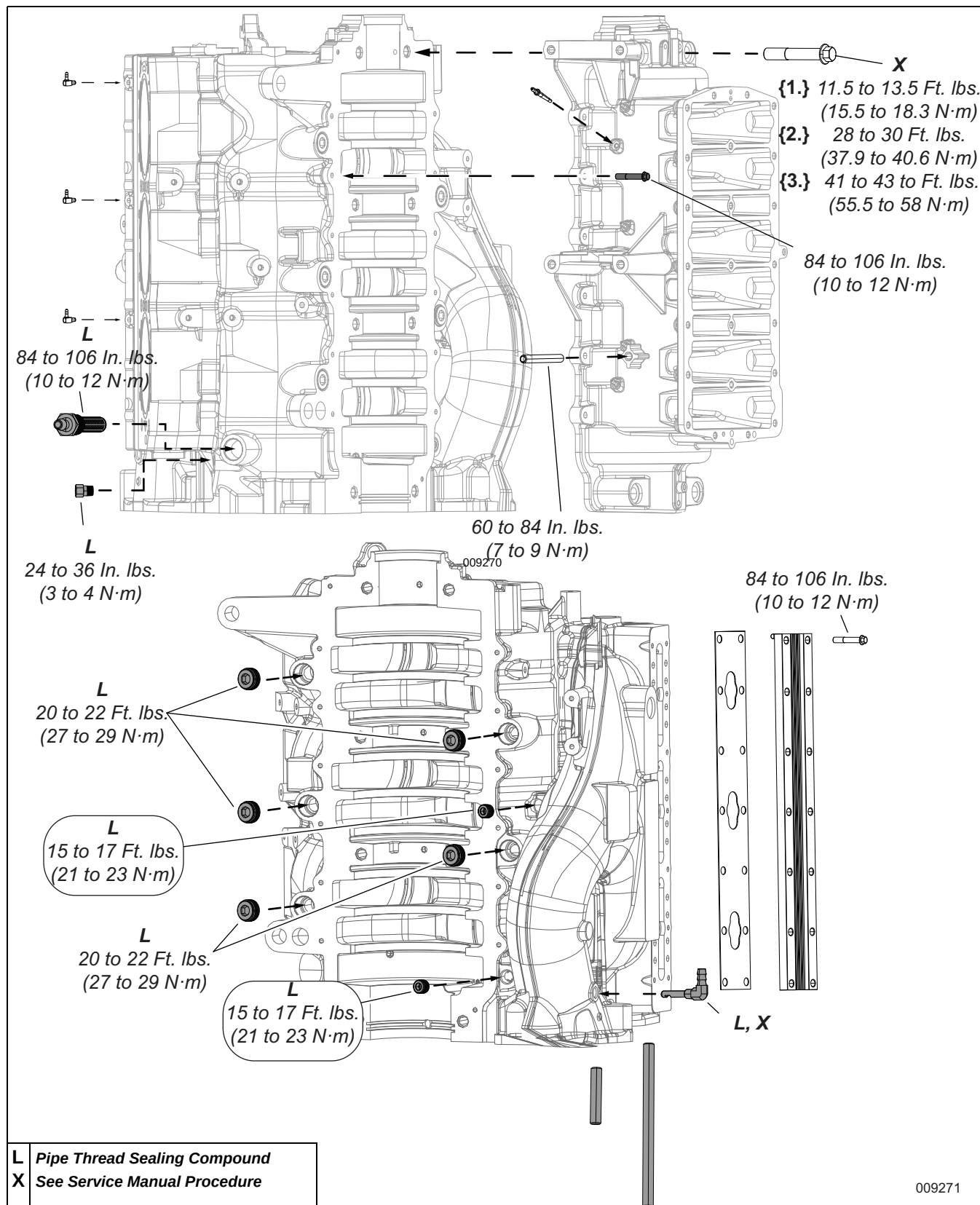


009270

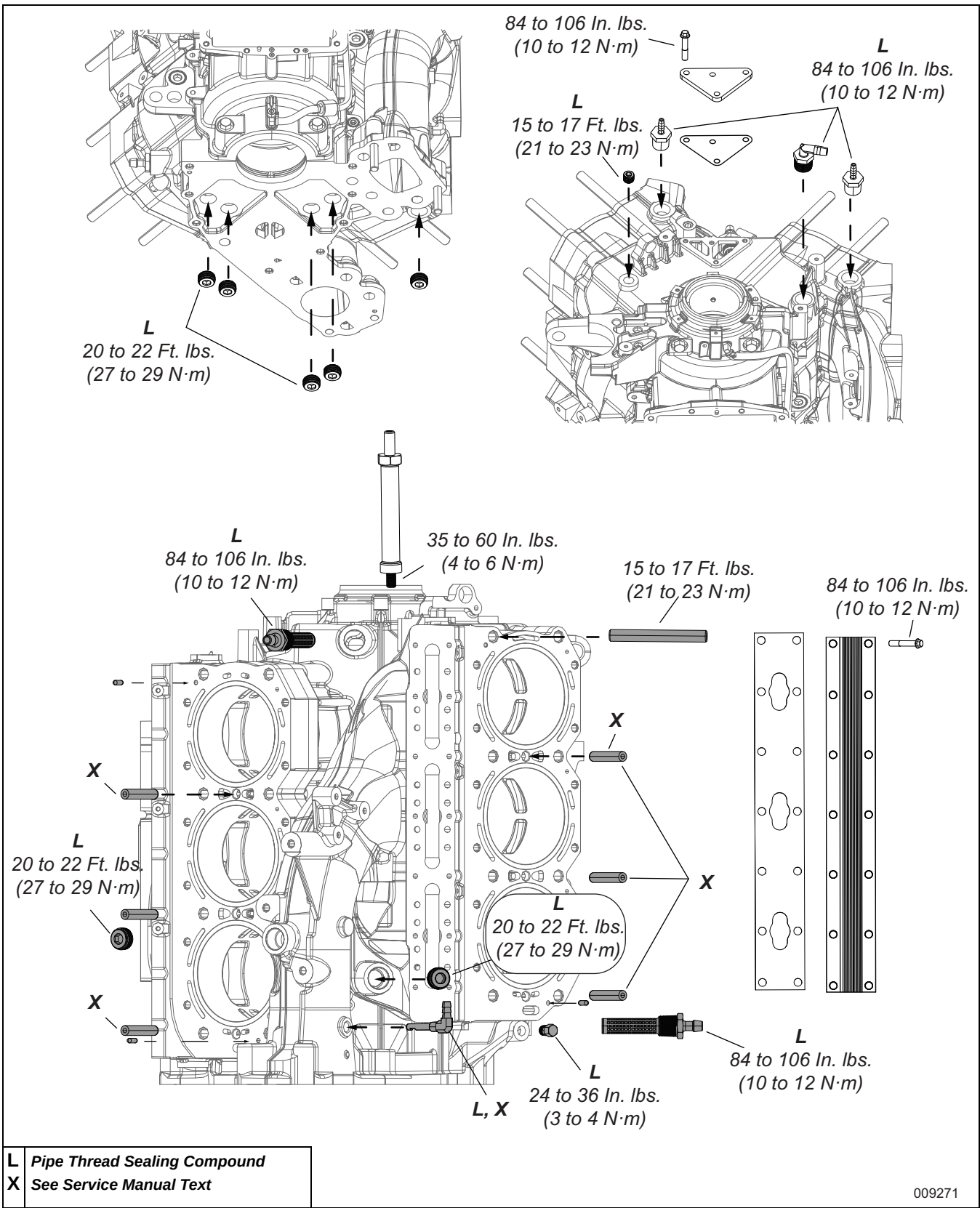
Crankshaft and Pistons



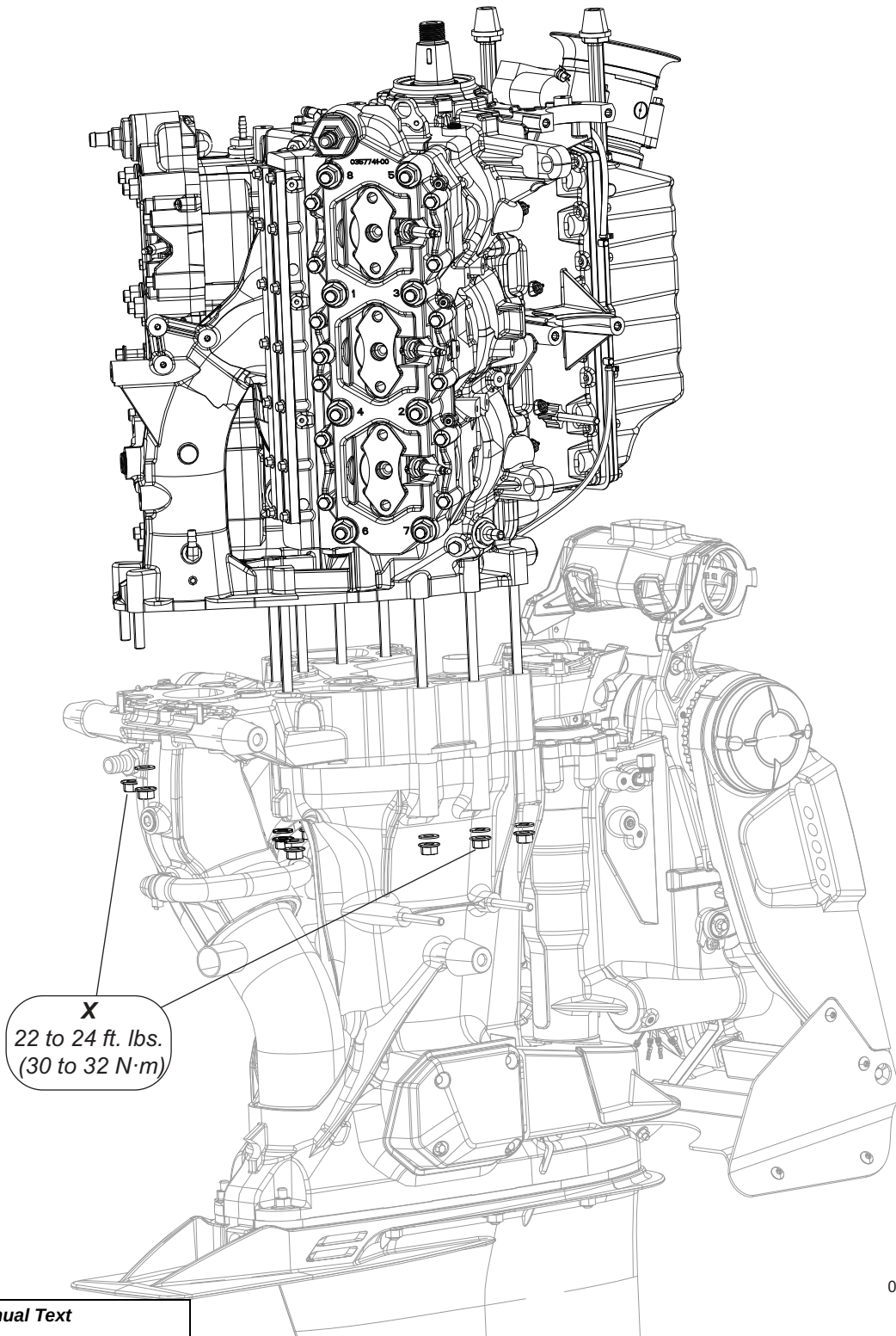
Cylinder and Crankcase (Port, Starboard, Front)



Cylinder and Crankcase (*Bottom, Top, Rear*)



Cylinder and Crankcase to Exhaust Adapter and Exhaust Housing



009272

X See Service Manual Text

Compression Testing

Start and run outboard until it achieves operating temperature, then shut OFF.

Disconnect crankshaft position sensor (CPS) connector. Remove all spark plugs.

Install compression tester's hose attachment into spark plug hole (14 mm threads).

Turn the key switch to the ON position.

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.

Powerhead Removal

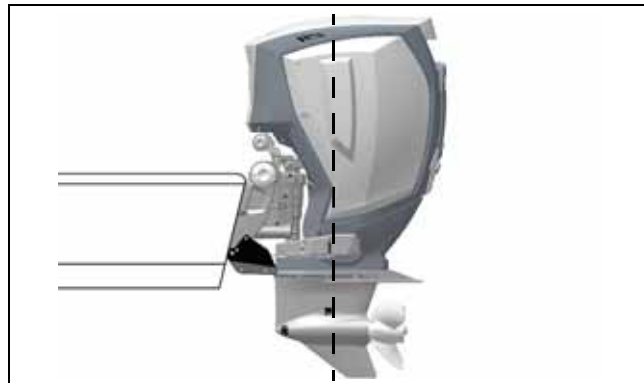
⚠ WARNING

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.

To prevent accidental starting while servicing, twist and remove spark plug leads.

Procedure

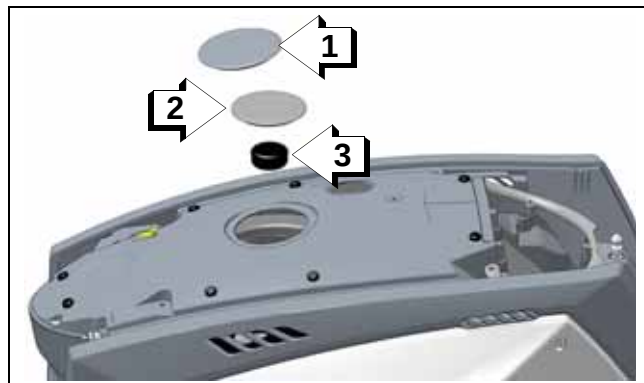
IMPORTANT: Before removing the powerhead trim the engine to the vertical position.



Engine in Vertical Position

009167

Remove the top engine cover. Then remove the 4 inch plug from the center frame. Next remove the 3.5 inch plug from the air duct and the thread protector from the flywheel threads.



1. 4 inch plug
2. 3.5 inch plug
3. Thread protector

009168

Remove the front cover. Then disconnect all cables, buss cables and hoses from the engine.

Remove the rear cover, starboard and port frames and front frame. Refer to **Engine Cover and Frame Service** on p. 55.

Remove the rigging grommets from the powerhead.

Powerhead

Powerhead Removal

Starboard

Remove the following hose clamps and hoses:

1. 51.5 mm clamp – Oil fill hose (upper), remove the hose from the center (top) frame.
2. 10.5 mm clamp – Oil tank vent hose, remove the hose from the oil tank.
3. 14.5 mm clamp – Remote oil fill hose, remove the hose from the oil tank.

Disconnect the electrical connectors from the following:

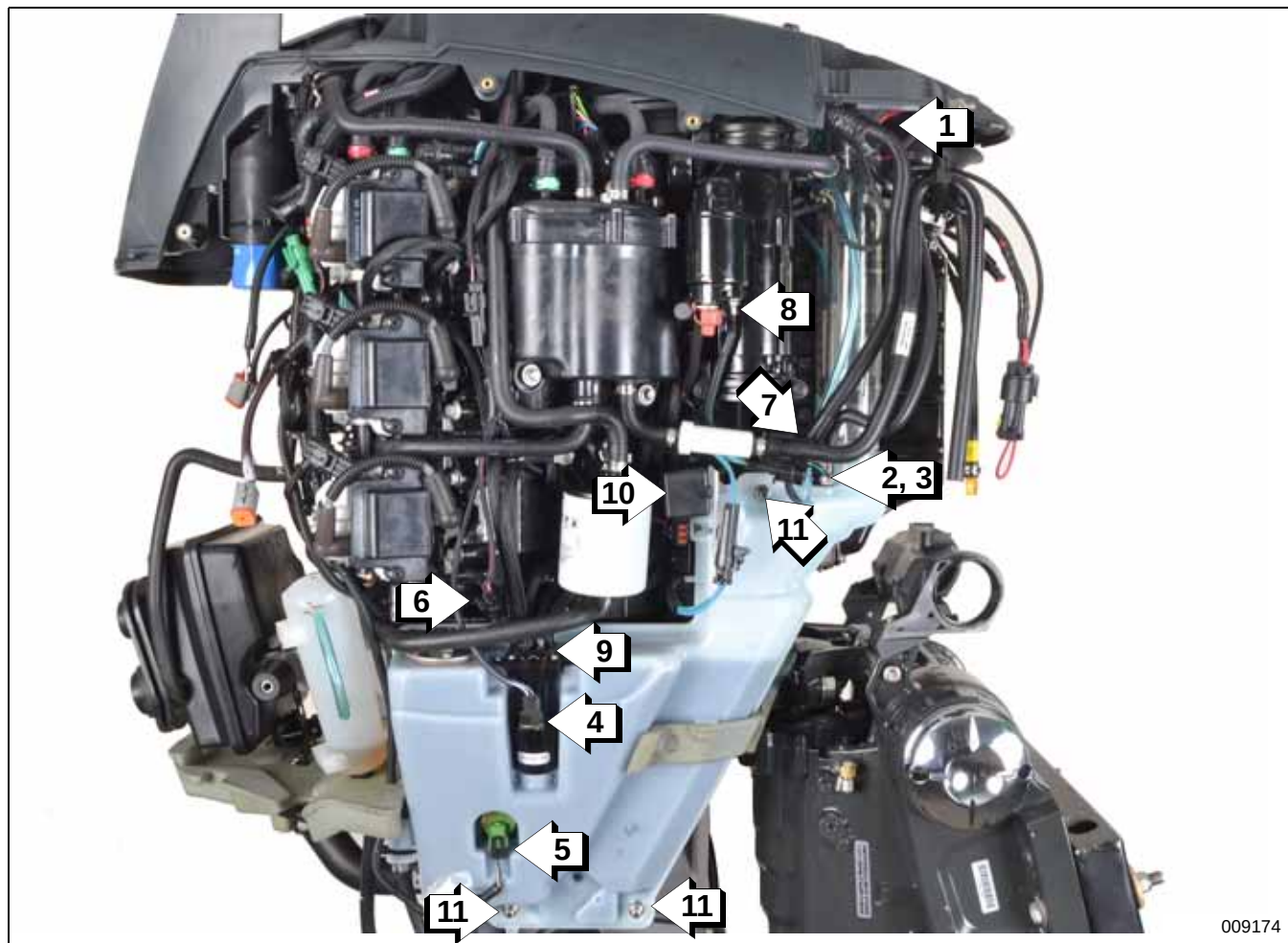
4. Crankcase oil pump (oil tank).
5. Low oil switch (oil tank).

6. Oil level sender (oil tank).

7. Trim relay, three *Amp* connectors and two 2 ring terminals (1 ground on the block and 1 on the starter solenoid).
8. Starter solenoid (small ring terminal).
9. Remove the 6 oil supply hoses from the crankcase oil pump.

Remove the following:

10. The trim relay from the oil tank.
11. The three nuts and washers retaining the oil tank. Then remove the oil tank



009174

Port

Remove the following hose clamps and hoses:

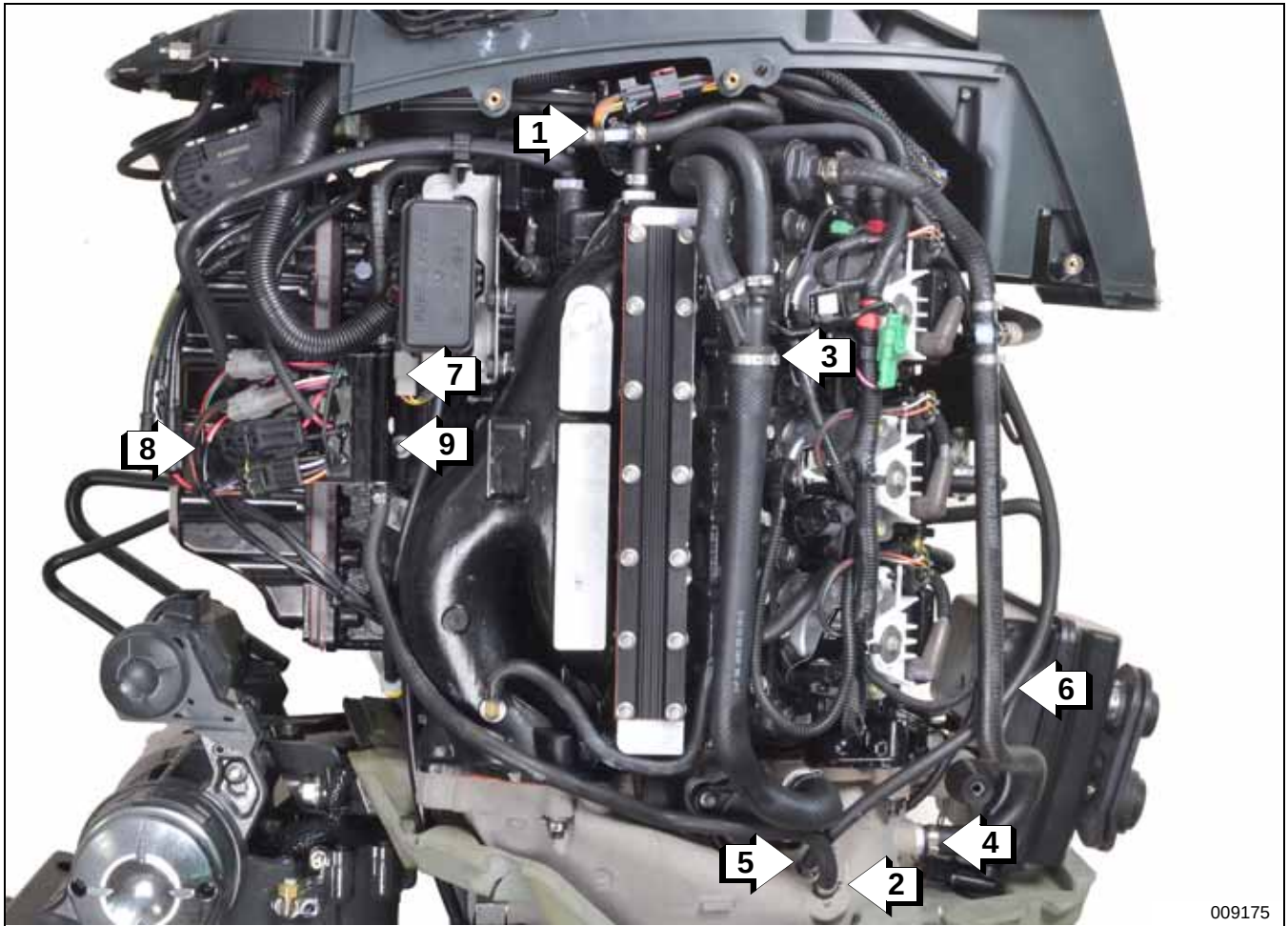
1. 15.7 mm Tee fitting, hose from tee fitting to DPS module, remove the hose from the tee fitting.
2. 15.7 mm Hose, DPS module to adapter, remove the hose from the adapter fitting.
3. 34.6 mm Y-fitting hose to adapter, remove the hose from the Y-fitting.
4. 21.0 mm Tee fitting/ thermostat hose to adapter, remove the hose from adapter fitting.
5. Tie strap Exhaust back pressure hose, remove the hose from adapter fitting.

Disconnect the electrical connectors from the following:

6. Exhaust temperature sensor
7. Shift actuator
8. DPS module

Remove the following:

9. The three nuts and washers retaining the DPS module. Then remove the DPS module and cooling hoses as an assembly.



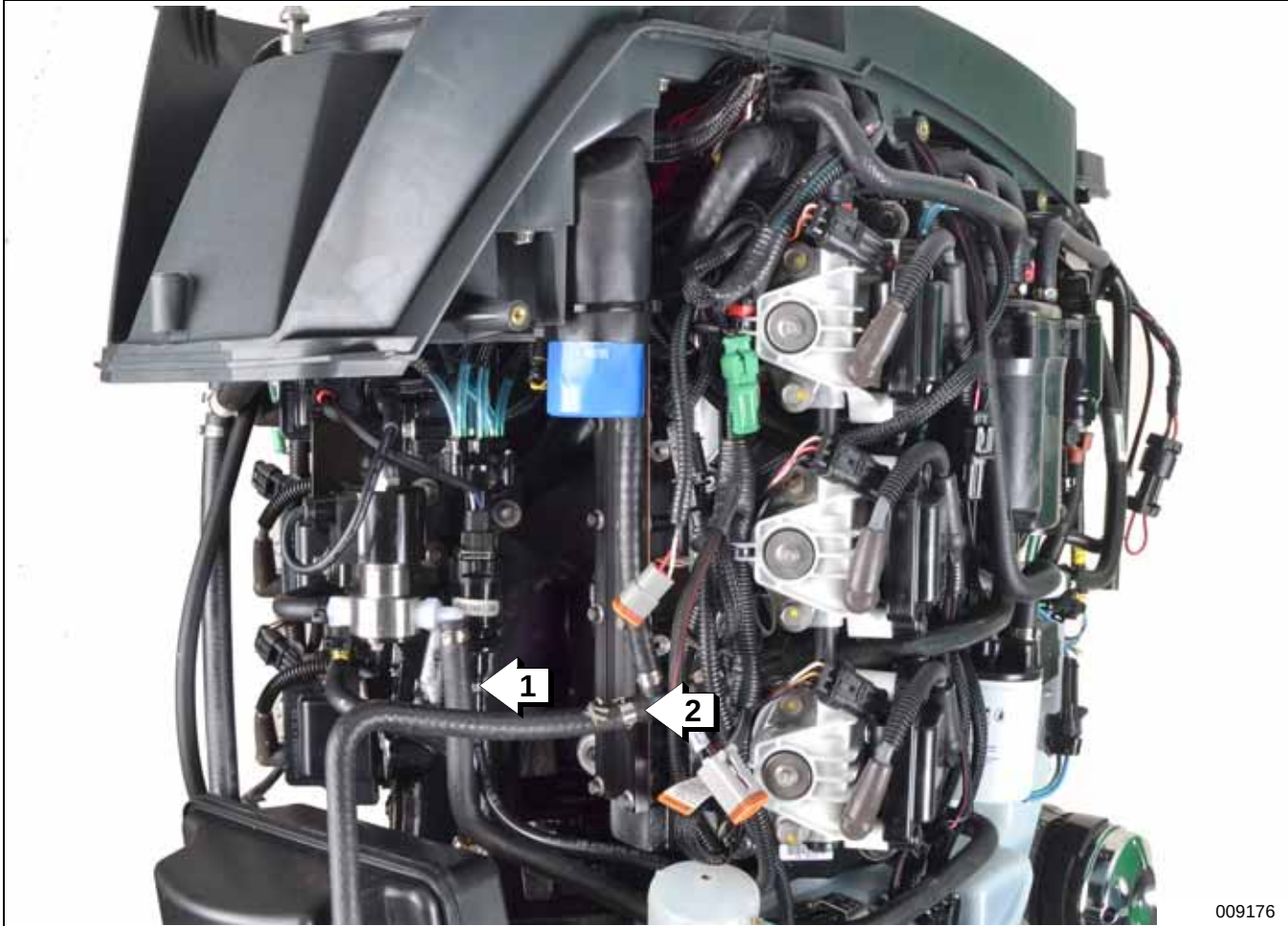
Powerhead

Powerhead Removal

Rear

Remove the following hose clamps and hoses:

1. 10.5 mm Rear oil pump(s) hose(s), remove the supply hose from the oil pump.
2. 15.7 mm Tee fitting, hose to overboard indicator, remove hose from tee fitting.



009176

Lifting the Powerhead

⚠ WARNING

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

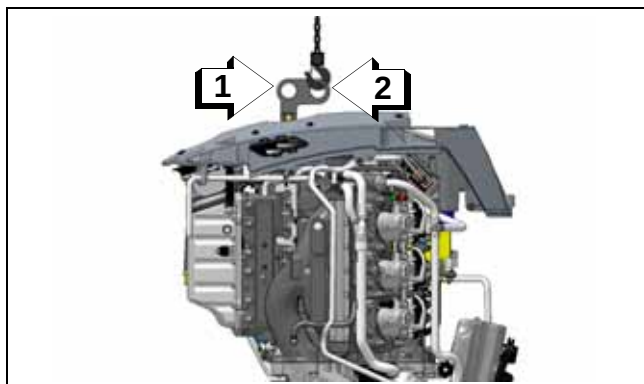
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

Use Engine Lifting Fixture, P/N 357667, to lift the powerhead from the adapter. Use the centerline lifting eye to lift the complete engine. Use the off-set lifting eye to remove and install the powerhead, or to support the engine and remove and install the stern and swivel bracket assembly.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.

Make sure the off-set lifting eye is to the REAR of the engine. Fasten appropriate chain hook to the off-set lifting eye.

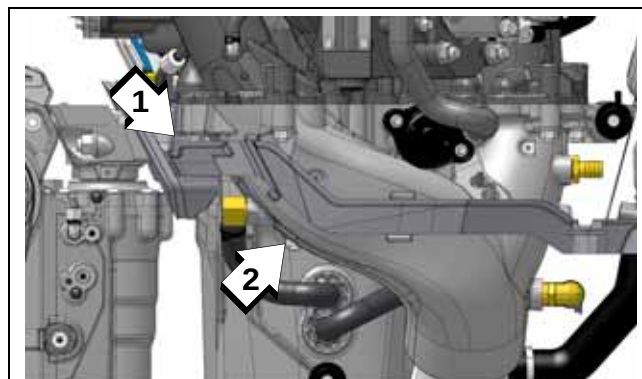


1. Centerline lifting eye
2. Off-set lifting eye (to REAR of engine)

009177

Remove the 12 nuts and washers retaining the powerhead to the exhaust adapter and exhaust housing.

On the port side, there are four nuts and washers on the exhaust adapter and four nuts and washers on the exhaust housing.

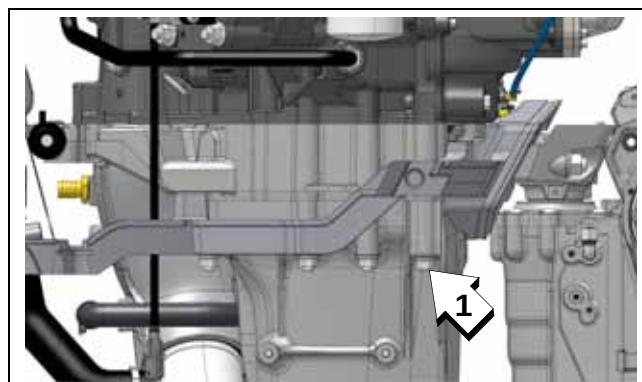


Port

1. Four nuts and washers on the exhaust adapter
2. Four nuts and washers on the exhaust housing

009178

On the starboard side, there are four nuts and washers on the exhaust housing.



Starboard

1. Four nuts and washers on the exhaust housing

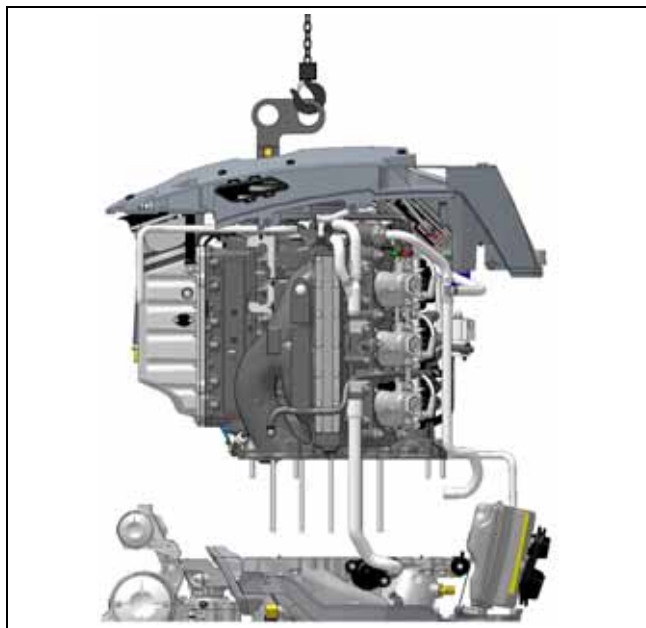
009179

Carefully lift the powerhead from the exhaust adapter. The powerhead should lift easily. If the powerhead does not lift easily, check for any fas-

Powerhead

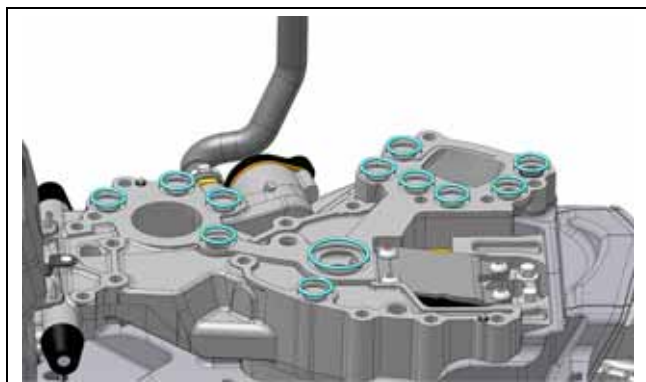
Powerhead Disassembly

teners or hose connections that may have been overlooked during the removal procedures.



009180

Remove the old o-rings from the exhaust adapter.



O-Rings

009181

Clean the adapter with solvent.

⚠ WARNING

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

Secure the powerhead in a suitable engine stand.

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 center frame, *EMM* and engine harness as an assembly. Refer to **Center Frame Removal** on p. 67.

Remove the ignition coil brackets and ignition coils. Refer to **Ignition Coil Servicing** on p. 135.

Remove fuel pump assemblies, fuel filter housing, and fuel rails, and injectors. Refer to **Fuel Component Servicing** on p. 168.

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 the electric starter. Refer to **Starter Removal** on p. 138.

Remove the rear oil pump and oil circulation hoses. Refer to **Oil Component Servicing** on p. 204.

Remove the exhaust water valve (if equipped). Refer to **Exhaust Water Valve Component Service** on p. 281.

Remove the cooling water hoses.

Remove the flywheel and stator. Refer to **Flywheel and Stator Servicing** on p. 133.

Remove the plenum and reed plate assemblies. Refer to **Intake Manifold Service** on p. 180.

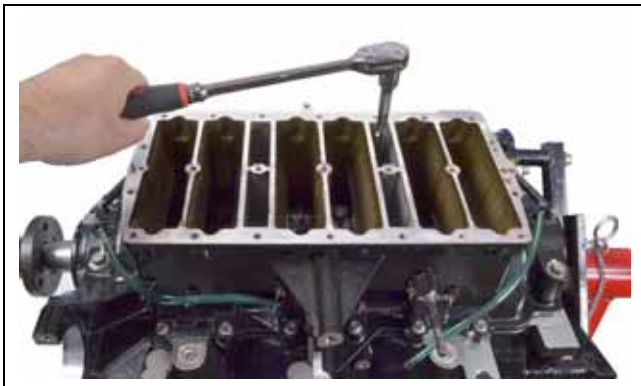
Crankcase Disassembly

Remove crankcase flange screws.



009668

Loosen **in stages**, and remove the main bearing screws and nuts.



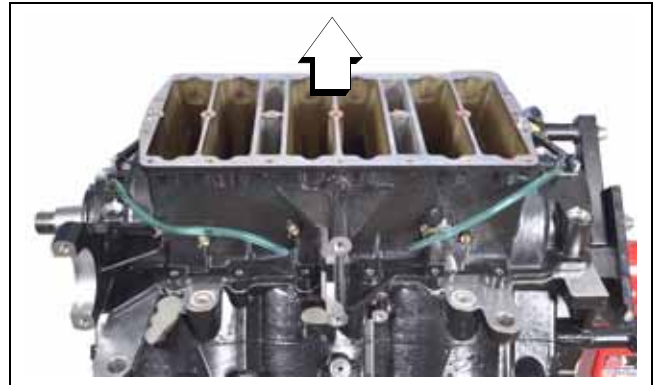
009669

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.



009692

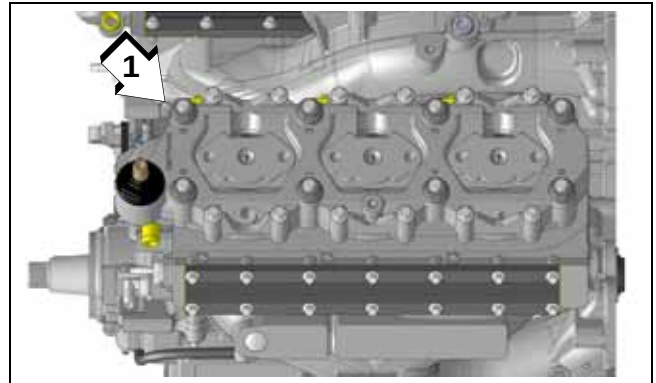
Carefully remove the crankcase from the cylinder block to avoid damaging the crankshaft seal rings.



009689

Cylinder Head Removal

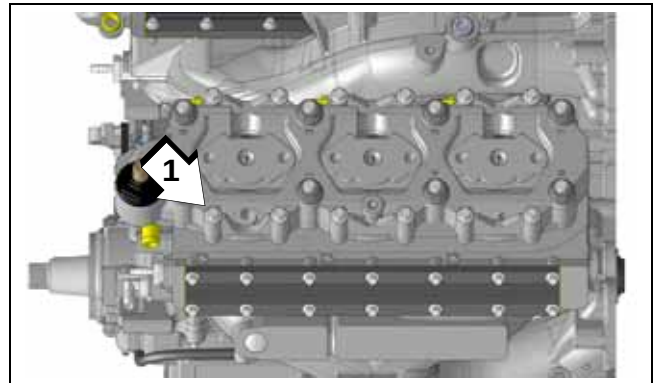
Loosen **in stages** and remove 8 cylinder head retaining nuts.



1. 8 cylinder head retaining nuts

009681

Loosen **in stages** and remove 12 cylinder head retaining screws. Remove the cylinder head.



1. 12 cylinder head retaining screws

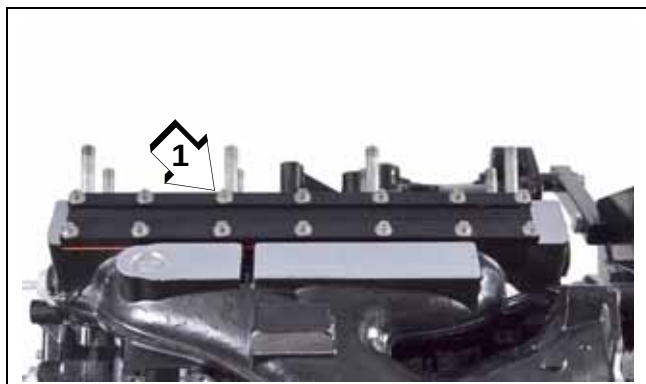
009681

Powerhead

Powerhead Disassembly

Deck Cover Removal

Remove 14 deck cover screws.



1. Deck cover screws

009733

Remove the deck cover and gasket.

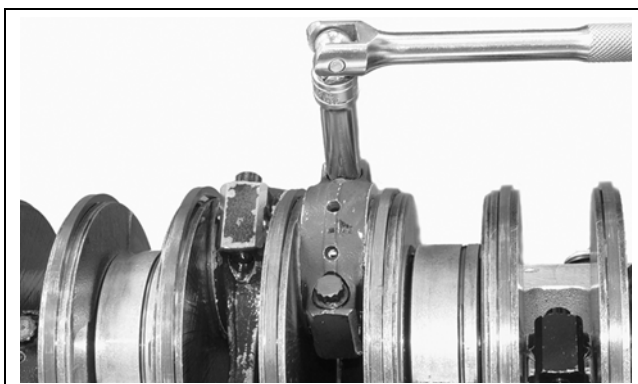
Connecting Rods and Pistons

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the flywheel.



000825

Use Torquing Socket, P/N 346187, to loosen **in stages** the rod cap retaining screws. **DO NOT** remove the screws.



000825

Use one hand to support the piston, and remove the rod cap screws with your other hand. Remove each piston and rod assembly.



009708

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.

IMPORTANT: Identify all internal components so 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.



009691

Remove wrist pin retaining rings. Discard retaining rings.



009682

Use Wrist Pin Pressing Tool, P/N 396747, to remove wrist pin.



1. Driver, P/N 396747

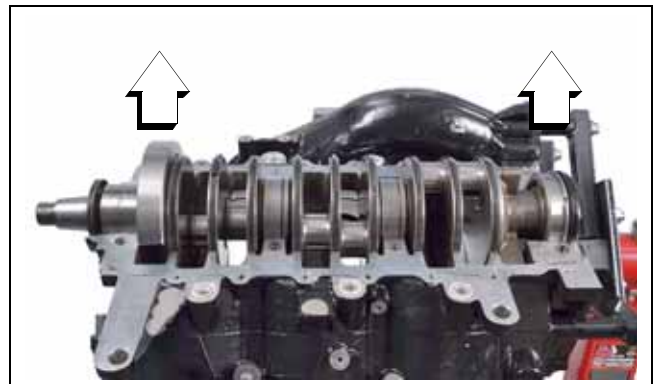
009683

Crankshaft Removal

⚠ WARNING

Wear safety glasses to avoid injury.

Carefully lift crankshaft straight up and remove from crankcase.



009690

Remove upper seal from crankshaft. Discard the seal. A new upper seal must be installed on assembly.



009671

Remove the upper crankshaft bearing.



009672

Powerhead

Powerhead Disassembly

Remove the lower bearing seal housing.



1. Bearing retaining screws

009673

Remove the housing O-ring. Discard O-ring.



002044

Use a punch to remove the housing seal. Discard seal.



002053

Inspect housing and replace if necessary.

Remove the O-ring from crankshaft sleeve and inspect it. Replace the O-ring if it is not in good condition.



009674

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.



009675

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 its original location.



009676

Remove center main bearings and split sleeves for inspection. DO NOT mix parts. Identify each bearing for installation in its original location.



009677

Powerhead Studs

Removal

Use a stud remover/installer tool (obtain locally) to remove studs.

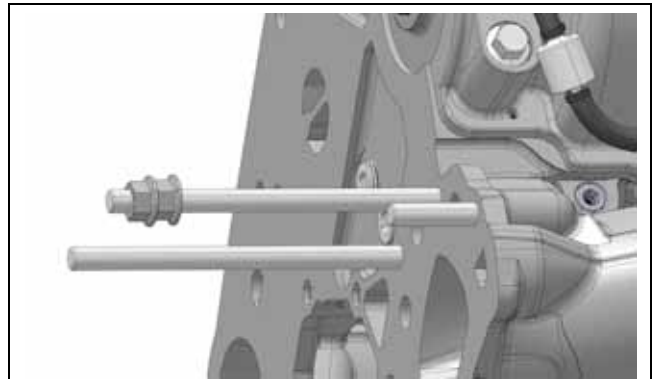


Stud Remover/installer Tool

009430

If a stud remover/installer tool is not available, two powerhead retaining nuts can be used for an alternative method of removal.

Install a powerhead retaining nut fully onto the stud. Then install a second nut and tighten it against the first. Place a wrench on the first nut and turn counter-clockwise to remove the stud.



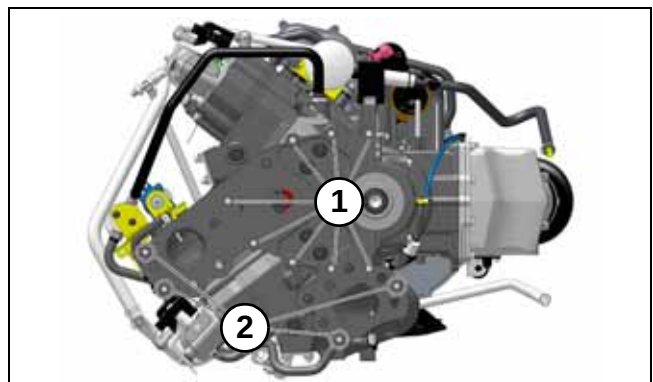
1. Powerhead retaining nuts

009429

Installation

Use a stud remover/installer tool (obtain locally) to install studs. If a stud remover/installer tool is not available, two powerhead retaining nuts can be used for an alternative method of installation.

Install eight studs – M10 x 170 mm, and four studs – M10 x 60 mm, in the locations shown:



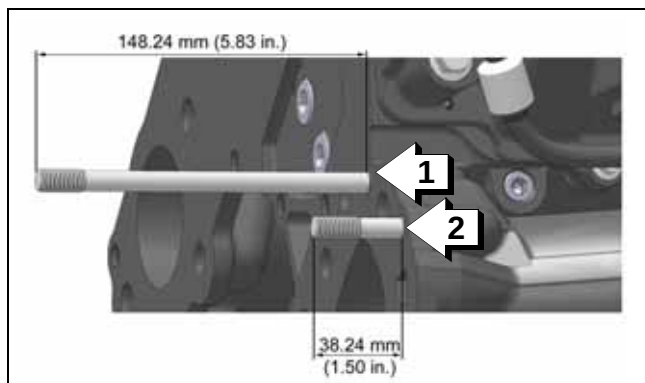
Stud Locations
1. M10 x 170 mm
2. M10 x 60 mm

009183

Powerhead

Cylinder Block Cleaning

Install studs into the block to the dimensions shown:

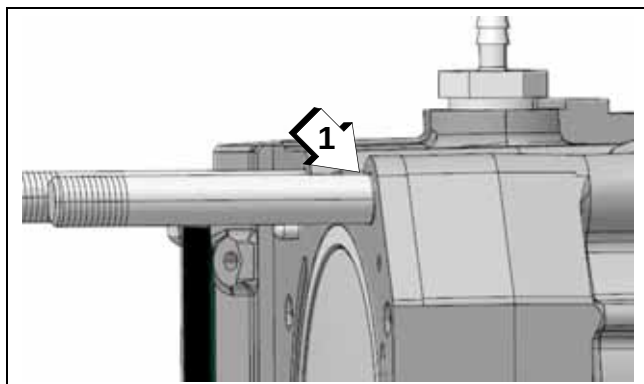


Stud Installation

1. M10 x 170 mm, 148.24 mm (5.83 in.)
2. M10 x 60 mm, 38.24 mm (1.50 in.)

009184

Install cylinder head studs until the threads of the studs are fully into the block as shown.



Stud Installation

1. Threads of studs fully into block

009729

Cylinder Block Cleaning

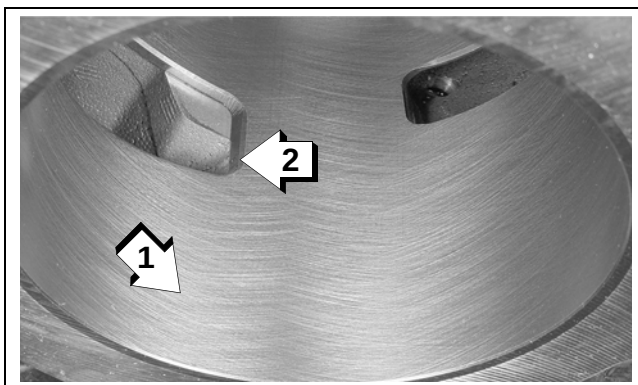
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants.

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylinder head combustion chambers.

If cylinder walls are glazed from extended use, use a rigid, medium grit cylinder hone to resurface walls. Use slow RPM for best oil retention and ring sealing. When finished, a cross hatch pattern of 22 to 32° should be visible in the cylinder wall. The pattern should be uniform in both directions.

IMPORTANT: To avoid piston or cylinder block damage, restore the chamfer to all port edges using a ball hone or other suitable tool.



1. Crosshatch pattern in cylinder wall
2. Chamfered port edge

002067

Use *Gel Seal and Gasket Remover* to remove all traces of gaskets, adhesives, and *Threebond* sealant from the cylinder block and crankcase.

⚠ WARNING

To avoid personal injury, wear eye protection and rubber gloves when using *Gel Seal and Gasket Remover*.



009693

Carefully remove any carbon accumulation from the tops and ring grooves of the piston using *Engine Tuner*. A ring groove cleaning tool can be made by breaking an old ring and grinding an angle on its end. Do not damage ring grooves while cleaning.

Thoroughly wash entire cylinder block and crankcase with warm, soapy water to remove all traces of contaminants.

Air dry cylinder block and crankcase. Blow all holes and passageways with compressed air.

⚠ WARNING

To avoid personal injury, wear eye protection and set compressed air pressure at less than 25 psi (172 kPa).

Cover the cylinder walls with a liberal amount of outboard lubricant to prevent corrosion.

Powerhead Inspection

For dimensions, refer to **Service Specifications** on p. 12.

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 the cylinder head if warpage exceeds this dimension.



009684

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.

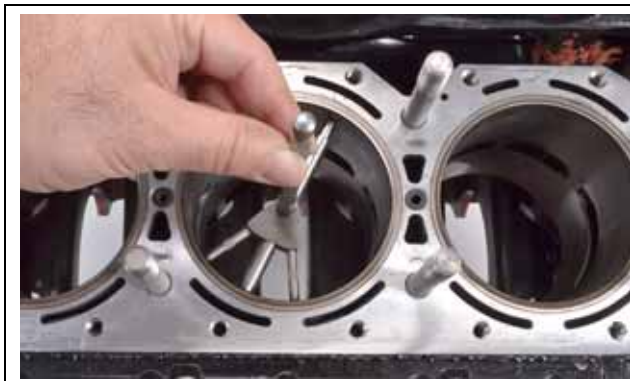
Install seal rings in their original positions on crankshaft after inspection.



009685

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

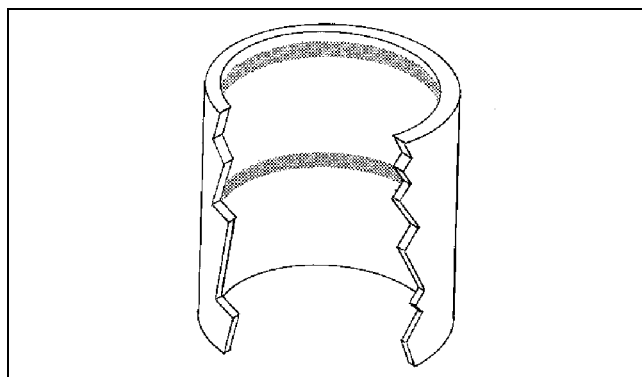
009695

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

DR1119

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to **Service Specifications** 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.



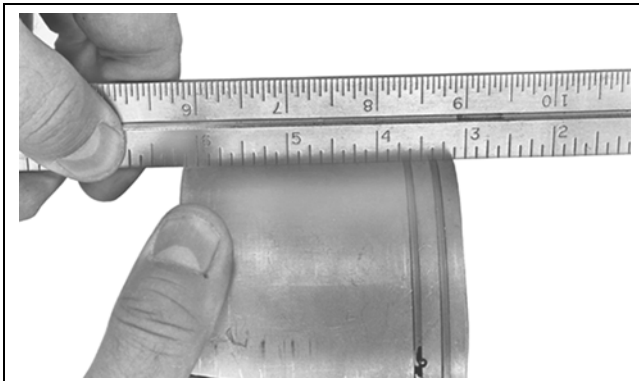
009694

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.



009678

Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace if necessary.



009696

Powerhead Assembly

IMPORTANT: Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All internal components must be perfectly clean and lightly coated with outboard lubricant.

IMPORTANT: Use new wrist pin retaining rings, gaskets, seals, and O-rings during assembly.

Crankshaft Assembly

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338649, and place a new lower main bearing onto crankshaft with lettered side facing the tool. Install bearing until it seats on the crankshaft.

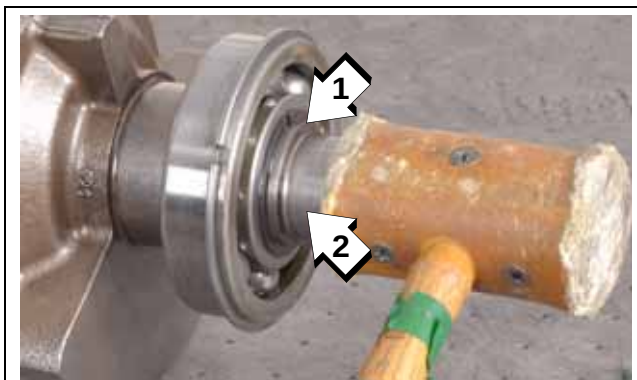
Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338649, to drive a new sleeve onto the crankshaft until the installer contacts the lower main bearing.



009679

If the installer sticks on the sleeve after installation, thread Slide Hammer, P/N 391008, into installer and pull it off.

The sleeve must contact the flange on the bottom of the crankshaft. Use a small soft-faced mallet to gently tap the sleeve into place.



1. Flange
2. Sleeve

009720

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.



009680

Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with *Moly Lube*. Install O-ring in sleeve.



009710

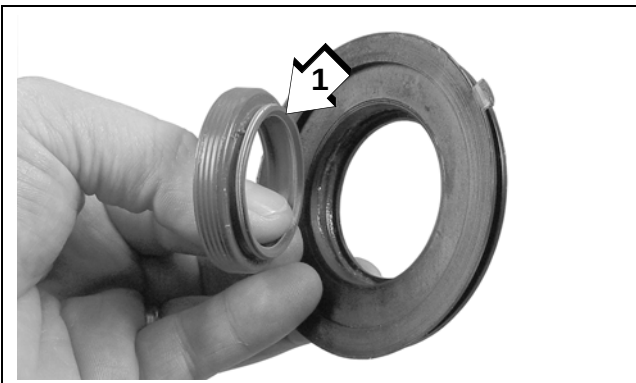
Lubricate the center main bearings and split sleeves with outboard lubricant and install them in their original positions. The split sleeve ring grooves must face toward driveshaft (lower) end of crankshaft when installed.



1. Split sleeve ring grooves toward driveshaft

009730

Lightly coat the outside edge of a new lower seal with *Gasket Sealing Compound*. Press against the outer case of the seal to install the seal into the housing. The extended lip of the seal **MUST** face down. Lubricate the seal lip with *Triple Guard* grease.



1. Seal, extended lip

002036



1. Seal lip

002037

Install a new o-ring on the lower housing. Apply a thin coat of *Gasket Sealing Compound* to the o-ring.



009711

Apply a thin coat of *Triple Guard* grease to the extended lip of the seal, then place the lower seal housing on the crankshaft.



009713

Thoroughly clean the upper seal area of the crankshaft. Apply a thin coat of *Gasket Sealing Compound* to the outer edge of a new upper seal then place the seal on the crankshaft.



009712

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 "EXH." These markings should be turned toward the exhaust (PORT) side of the block.

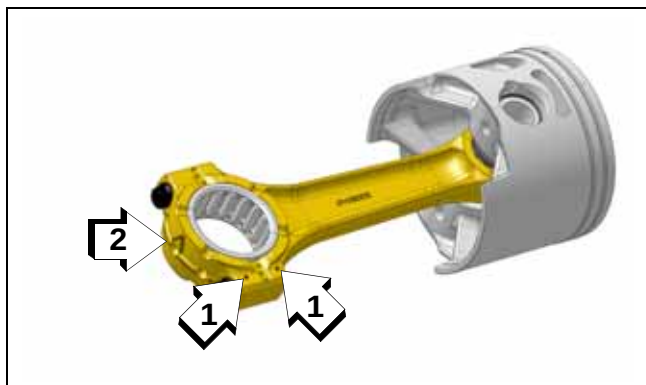


1. Stamped markings to PORT

009722

NOTICE

Connecting rods **MUST** be installed with the alignment dots and arrow on the cap facing up, toward the flywheel.

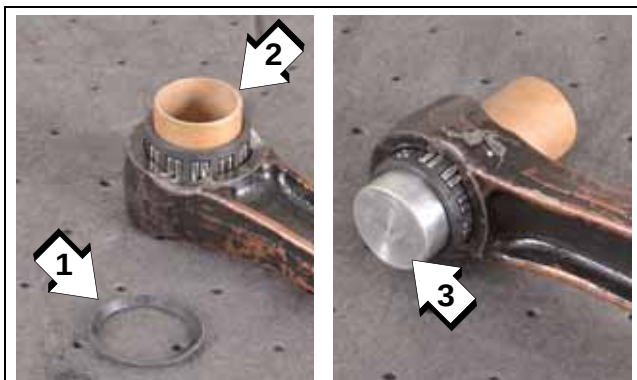


1. Alignment dots
2. Arrow on the cap facing up

009706

Insert a new wrist pin bearing into the connecting rod. Remove the outer needle retaining band. Leave the cardboard center retainer in place.

Insert Bearing Installer, P/N 338646, into the connecting rod. Remove the cardboard retainer as the tool is installed.



1. Retaining band
2. Cardboard center retainer
3. Bearing Installer, P/N 338646

009698
009699

Apply outboard lubricant to the wrist pin bore, wrist pin bearings and wrist pin.



1. Wrist pin bore
2. Wrist pin bearings
3. Wrist pin

009697

Install wrist pin into the piston.

Place the connecting rod with bearing into the piston.

IMPORTANT: Make sure:

- to hold the bearing installer in place to prevent bearing needles from falling out of place.
- the alignment dots on the connecting rod are facing the top of the piston.

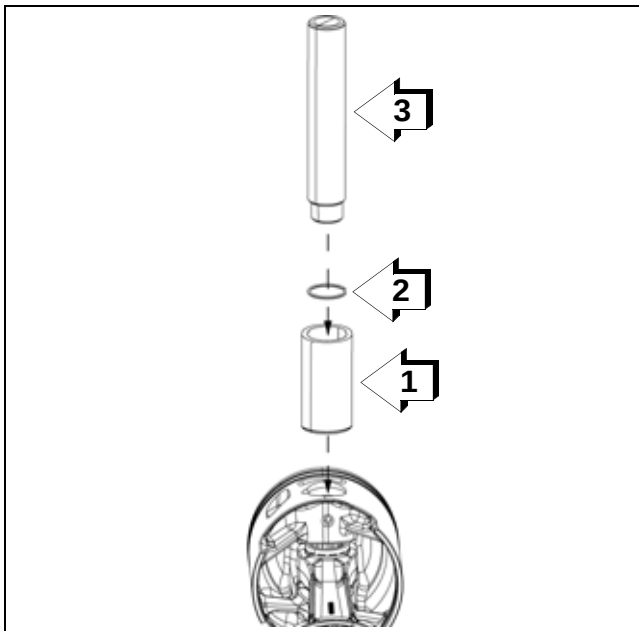
Use Driver, P/N 396747, to install the wrist pin through the piston, pushing the bearing installer out through the piston.



1. Driver, P/N 396747

009700

Use Wrist Pin Cone, P/N 331913, and Driver, P/N 396747, to install new wrist pin retaining rings in each wrist pin hole. Make sure the gap of each retaining ring faces away from the notch in the piston.

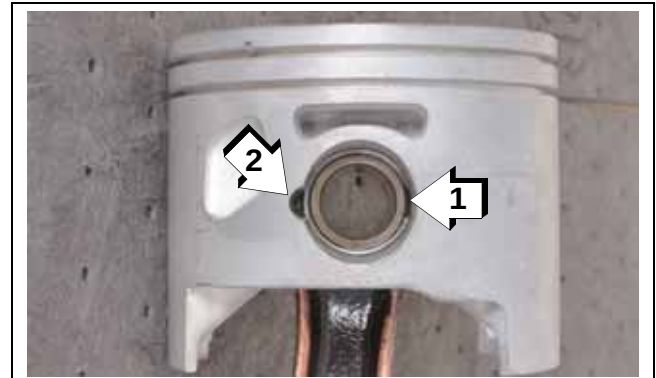


1. Wrist Pin Cone, P/N 331913

2. Wrist pin retaining ring

3. Driver, P/N 396747

009707



1. Gap in retaining ring

2. Notch in piston

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. 251.

IMPORTANT: Be sure gap of ring fits squarely around dowel pin.



009702

NOTICE

Before continuing, make sure that all Three-bond sealant has been removed from the cylinder block and crankcase mating flanges. If traces of hardened sealant are left, main bearings could be misaligned. Refer to Cylinder Block Cleaning on p. 250.

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.

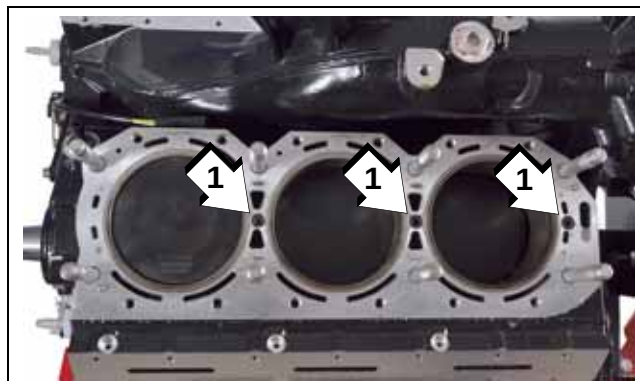
Powerhead

Powerhead Assembly

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.



Apply soapy water to water dams and insert into block.

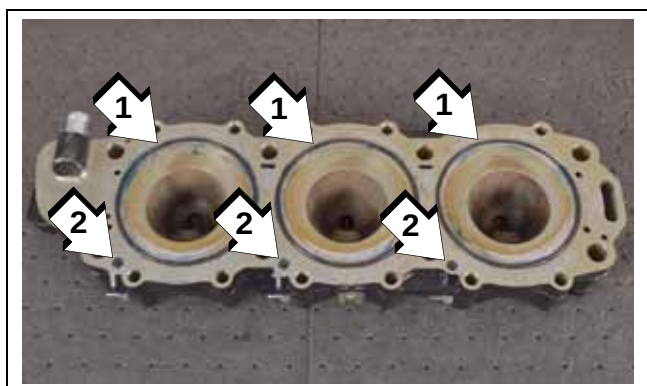


1. Water dams

Cylinder Head Installation

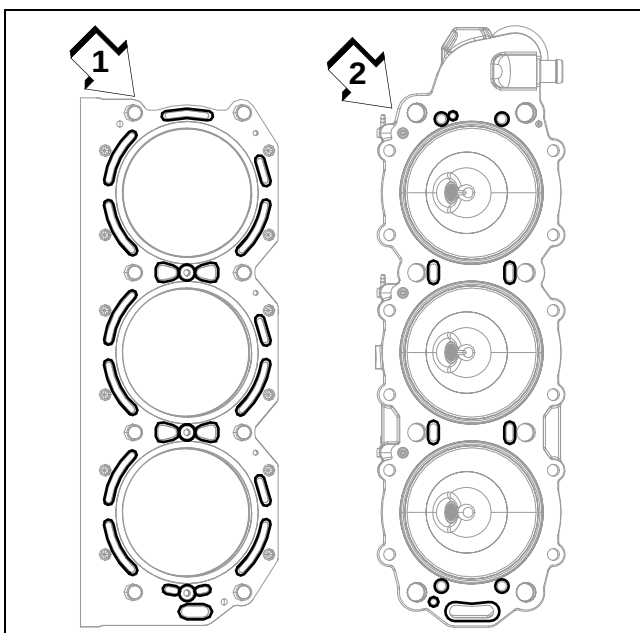
Apply *Triple Guard* grease to the o-rings.

Place the cylinder and oil passage o-rings on the cylinder head as shown. Make SURE the oil passages are NOT blocked.



1. Cylinder o-rings
2. Oil passage o-rings

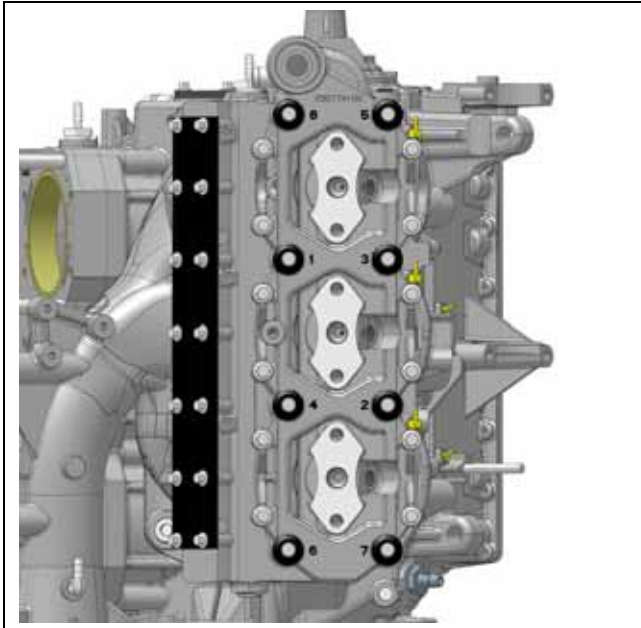
Apply a thin bead of RTV around each of the water passages on the block and cylinder head as shown:



1. Cylinder block
2. Cylinder head

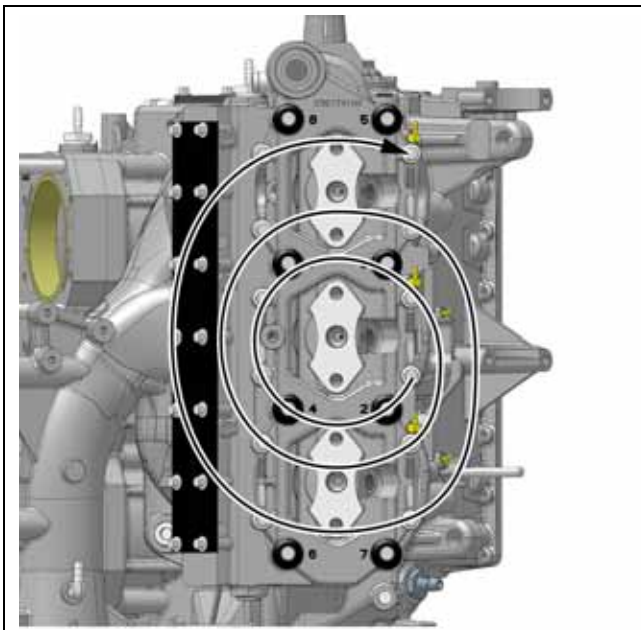
Install cylinder head with the thermostat toward the top. Apply *Triple-Guard* grease to threads and install the 8 cylinder head nuts and 12 screws. DO NOT use any sealant on threads

Following the sequence stamped on the cylinder head, tighten all 8 nuts in stages to a torque of 47 to 49 ft. lbs. (64 to 66 N·m).



009725

Tighten all 12 screws in a spiral pattern to a torque of 15 to 17 ft. lbs. (21 to 23N·m).

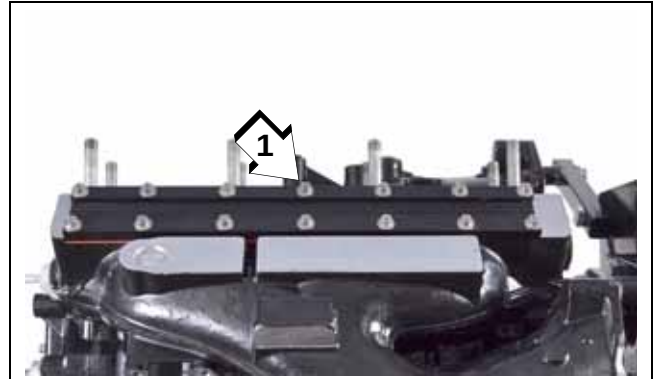


009726

Deck Cover Installation

Install a new deck cover gasket, then install the deck cover. Install 14 deck cover screws. Start in

the center and work outward in a spiral pattern and tighten to a torque of 84 to 106 in. lbs. (10 to 12 N·m).



1. Deck cover screws

009733

Crankshaft and Connecting Rods

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.
- Tap the crankshaft upward with a rawhide mallet to seat crankshaft and lower crankcase head.



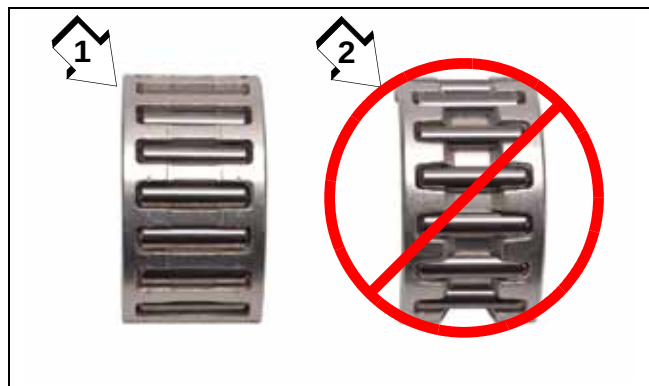
009714

IMPORTANT: *Evinrude E-TEC G2* models use connecting rod bearing halves containing 9 needle

Powerhead

Powerhead Assembly

bearings each. Do NOT substitute earlier *Evinrude E-TEC* connecting rod bearing halves which contain only 8 needle bearings each.



1. G2 Connecting rod bearing half
2. G1 Connecting rod bearing half

009686

Carefully pull connecting rod up to crankshaft and install bearing halves. Lubricate each crankpin and bearing assembly with outboard lubricant.



009715

Lubricate rod cap screw threads and under screw head mating surface with outboard lubricant. Apply outboard lubricant to screw hole threads in rod, and to screw head mating surface on cap.

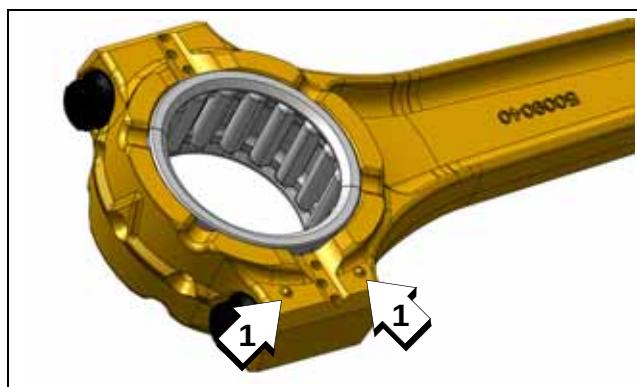
Align dot on rod cap with dot on the connecting rod.

Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).



009716

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dots face fly-wheel.



1. Alignment dots

009717

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-

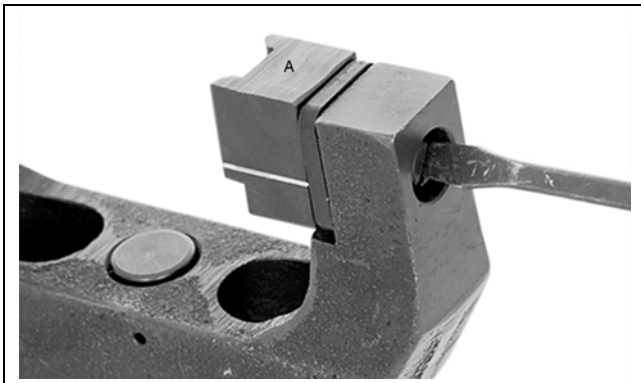
est setting (two lines showing). Rotate adjustment knob 180° to lock the stop in position.



1. Adjustment stop, highest setting

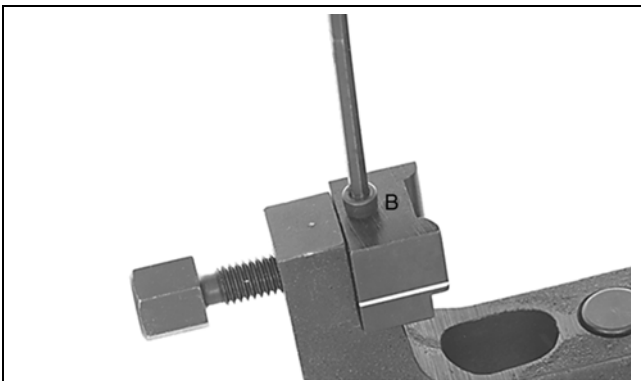
2287

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.



1. Adjustment stop
2. Groove line

21589

- Tighten the forcing screw to a torque of 23 in. lbs. (2.5 N·m).



009705

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).

Powerhead

Powerhead Assembly

- Apply final torque of 60 to 65 ft. lbs. (81 to 88 N·m).



009718

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.



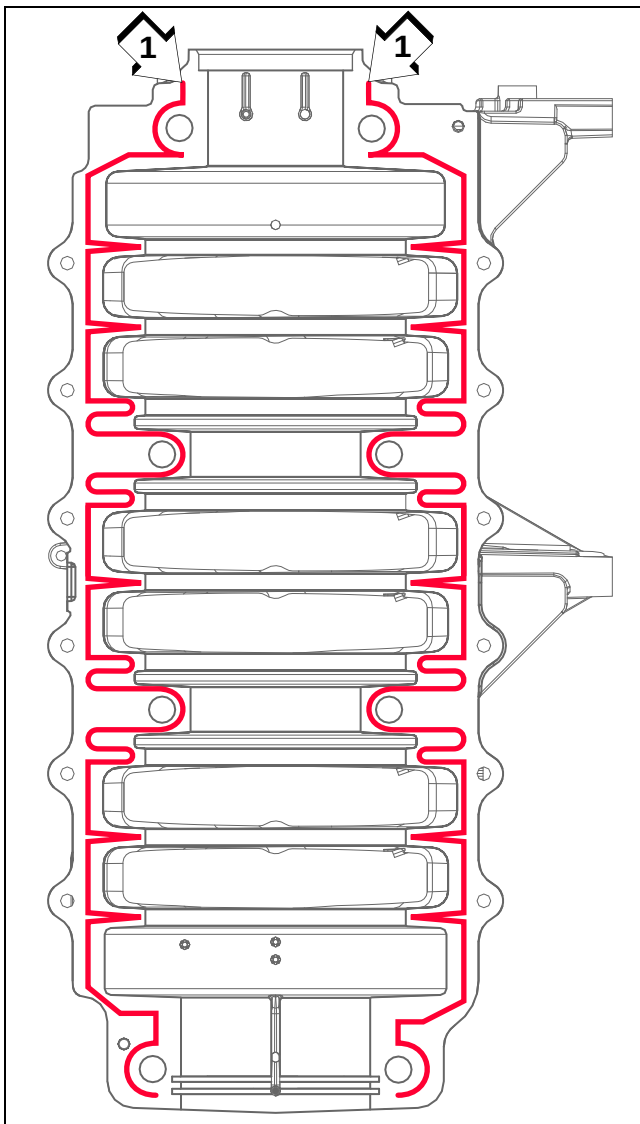
009719

Crankcase Assembly

Thoroughly clean and degrease the mating flanges of the crankcase and cylinder block with a non-petroleum based solvent, such as isopropyl alcohol or acetone, and let air dry.

IMPORTANT: DO NOT allow solvent to get on internal components. Clean only the mating flanges.

Apply an even 1/8 inch (3 mm) bead of *Threebond 1217H* sealant, P/N 768611, to the crankcase mating flange in the pattern shown below. The sealant must not come within 1/4 in. (6.4 mm) of bearings.



Threebond 1217H Sealant
1. Even 1/8 inch (3 mm) bead

009732

Lower the crankcase into place.

Install main bearing screws finger tight, no more than 60 in. lbs. (7 N·m).

Tighten main bearing screws **in three stages**:

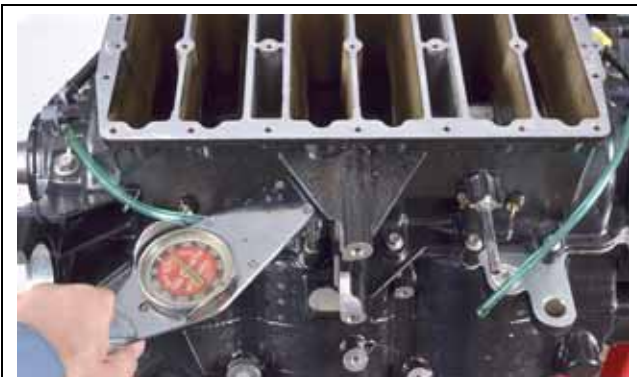
- 11.5 to 13.5 ft. lbs. (15.5 to 18.3 N·m)
- 28 to 30 ft. lbs. (37.9 to 40.6 N·m)
- 41 to 43 ft. lbs. (55.5 to 58 N·m)

Start in the center and work outward in a spiral pattern.



Install the crankcase flange screws.

Start in the center and work outward in a spiral pattern and tighten to a torque of 84 to 108 in. lbs. (9.5 to 12 N·m).



Test that the crankshaft spins freely without binding.

IMPORTANT: After powerhead has been assembled, allow at least two hours for *Threebond 1217H* sealant to cure before running outboard.

Final Powerhead Assembly

Install the reed plate assemblies and plenum. Refer to **Intake Manifold Service** on p. 180.

Install the stator and flywheel. Refer to **Flywheel and Stator Servicing** on p. 133.

Install the rear oil pump and oil circulation hoses. Refer to **Oil Component Servicing** on p. 204.

Install the cooling water hoses.

Install the exhaust water valve (if equipped). Refer to **Exhaust Water Valve Component Service** on p. 281.

Install the electric starter. Refer to **Starter Removal** on p. 138.

Install fuel pump assemblies, fuel filter housing, and fuel rails, and injectors. Refer to **Fuel Component Servicing** on p. 168.

IMPORTANT: All injectors must be reinstalled in their original location. Improper injector installation can result in powerhead failure.

Install the ignition coil brackets and ignition coils. Refer to **Ignition Coil Servicing** on p. 135.

Install the center frame, *EMM* and engine harness as an assembly. Refer to **Center Frame Installation** on p. 71.

WARNING

To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

Powerhead Installation

Pre-Service Adjustments

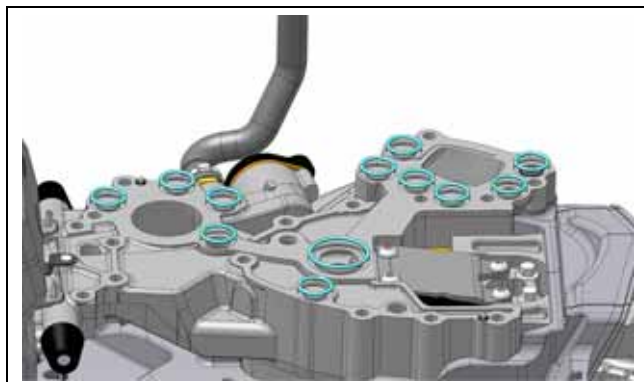
NOTICE

After installing a new or rebuilt powerhead, perform the following procedures before returning outboard to service:

- Adjust timing pointer.
- Use *Evinrude Diagnostics* software to start powerhead break-in oiling. Refer to **Powerhead Break-In** on p. 92.
- Use *Evinrude Diagnostics* software to set TPS calibration. Refer to.
- 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. 196.
- Use *Evinrude Diagnostics* software to check engine timing. Refer to **Timing Adjustments** on p. 136.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Powerhead Installation

Install the 12 new o-rings onto the exhaust adapter.



O-Rings

009181

Remove the replacement powerhead from the shipping container.

⚠ 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.

Use Engine Lifting Fixture, P/N 357667, to lift the powerhead. Use the off-set lifting eye to lift the powerhead.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

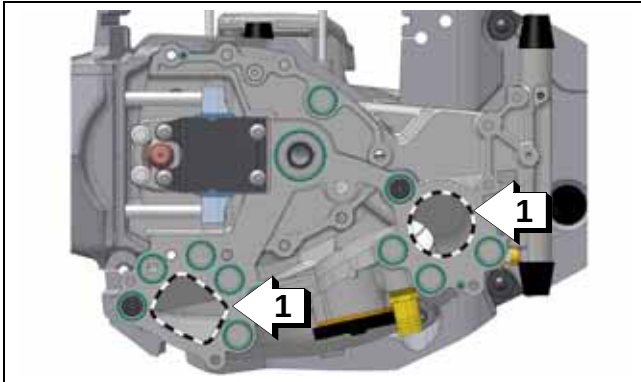
Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.

Make sure the off-set lifting eye is to the REAR of the engine. Fasten appropriate chain hook to the off-set lifting eye.



009182

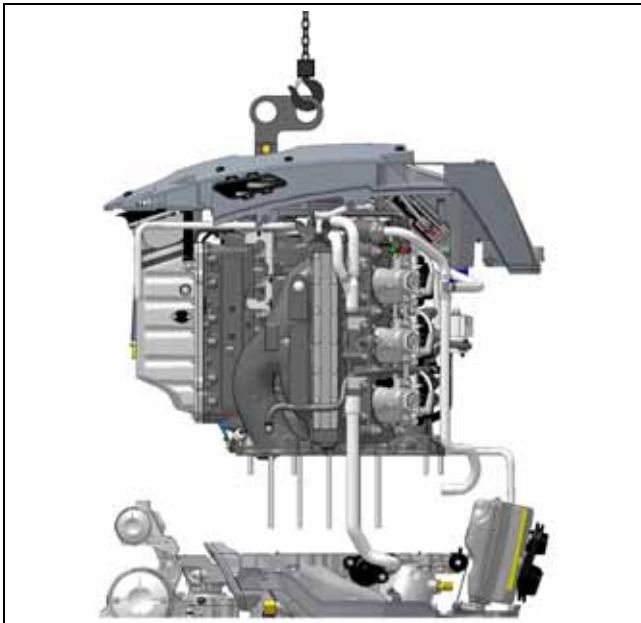
Apply a 1/4 in. (6 mm) bead of high-temperature RTV, such as *Permatex #26BR* around the exhaust passage areas.



1. Apply high-temperature RTV

009236

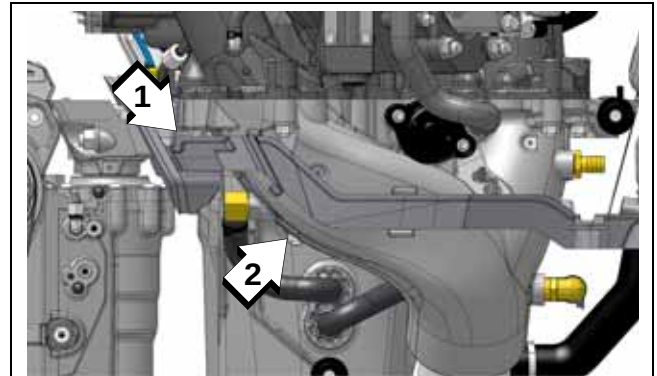
Slowly lower the powerhead into position. Carefully guide the mounting studs of the powerhead into the exhaust adapter and exhaust housing.



009180

Install the 12 washers and nuts to retain the powerhead to the exhaust adapter and exhaust housing.

On the port side, there are four washers and nuts on the exhaust adapter and four washers and nuts on the exhaust housing.

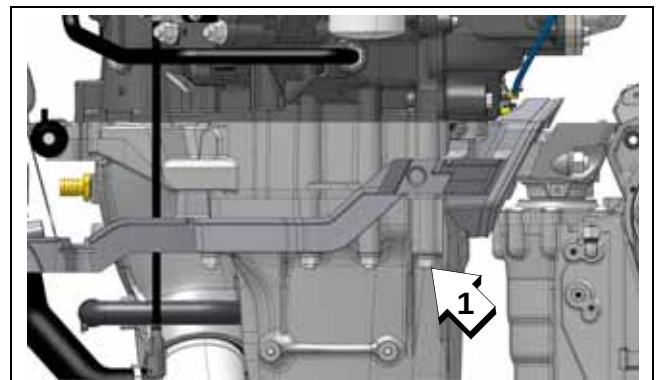


009178

Port

1. Four nuts and washers on the exhaust adapter
2. Four nuts and washers on the exhaust housing

On the starboard side, there are four washers and nuts on the exhaust housing.



009179

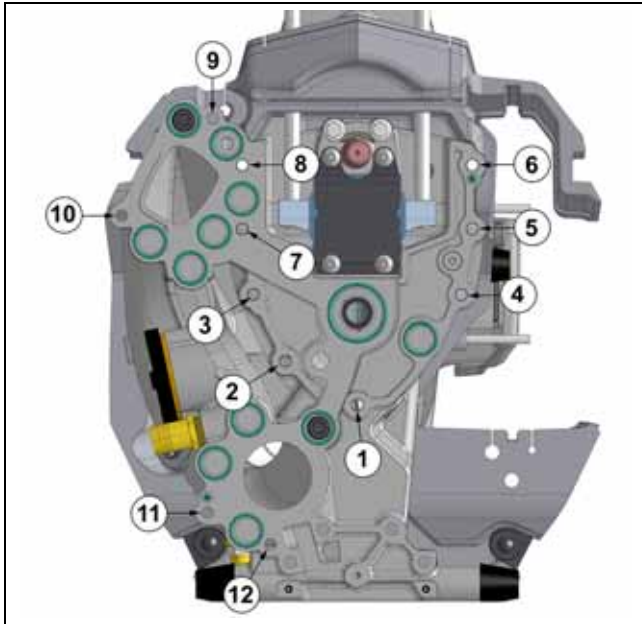
Starboard

1. Four nuts and washers on the exhaust housing

Powerhead

Powerhead Installation

Tighten the nuts in the sequence shown to a torque of 22 to 24 ft. lbs. (30 to 32 N·m).



Torque Sequence

009235

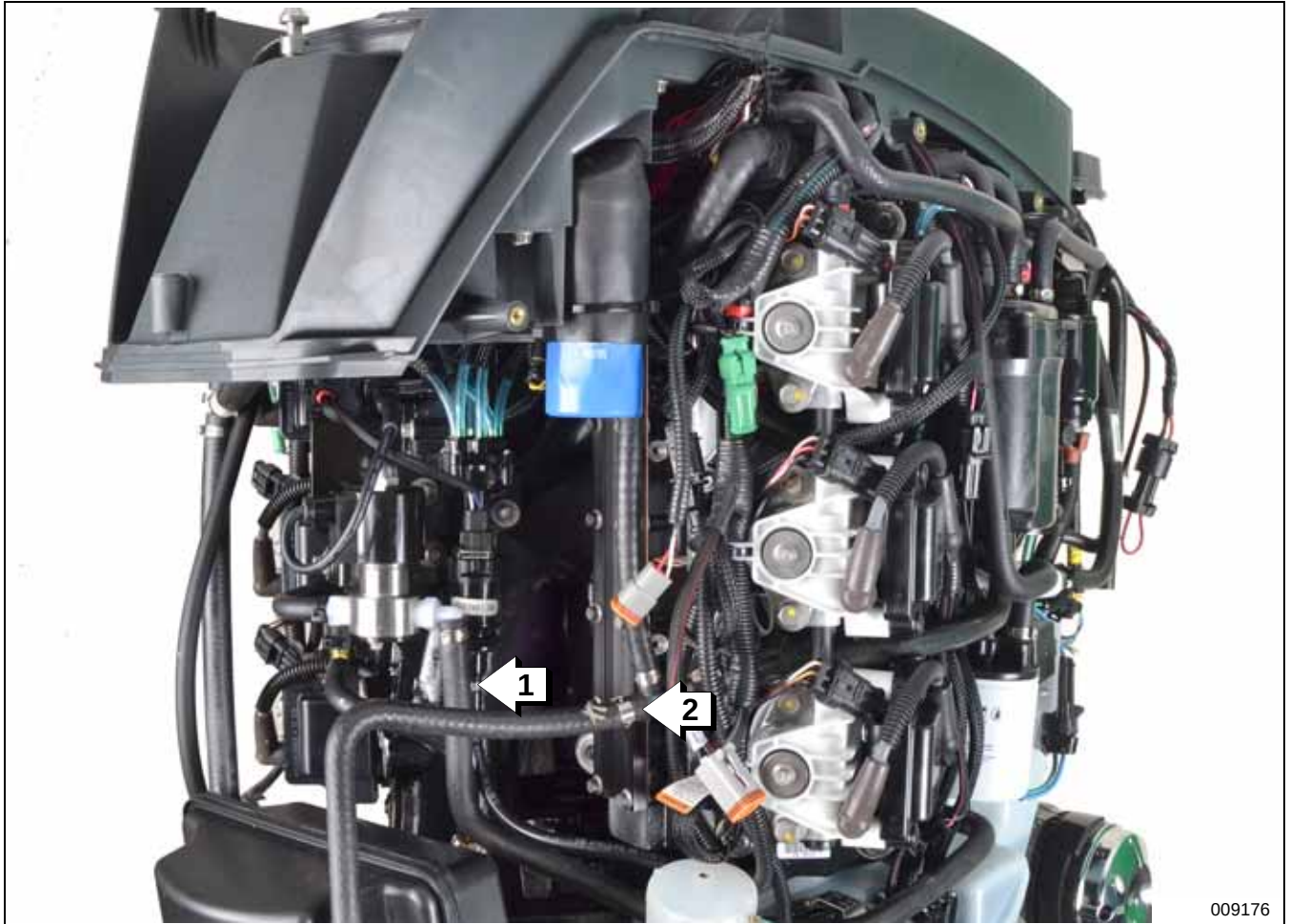
Wait 5 minutes, then re-tighten the nuts. Use the same sequence and tighten to a torque of 22 to 24 ft. lbs. (30 to 32 N·m).

Remove the lift ring from the powerhead.

Rear

Install the following hoses and hose clamps:

1. Install the supply hose to the oil pump, secure with a new 10.5 mm *Oetiker* clamp.
2. Install the overboard indicator to the tee fitting, secure with a new 15.7 mm *Oetiker* clamp.



Powerhead

Powerhead Installation

Port

Install the following:

1. The DPS module and cooling hose assembly.

Install the following hoses and hose clamps:

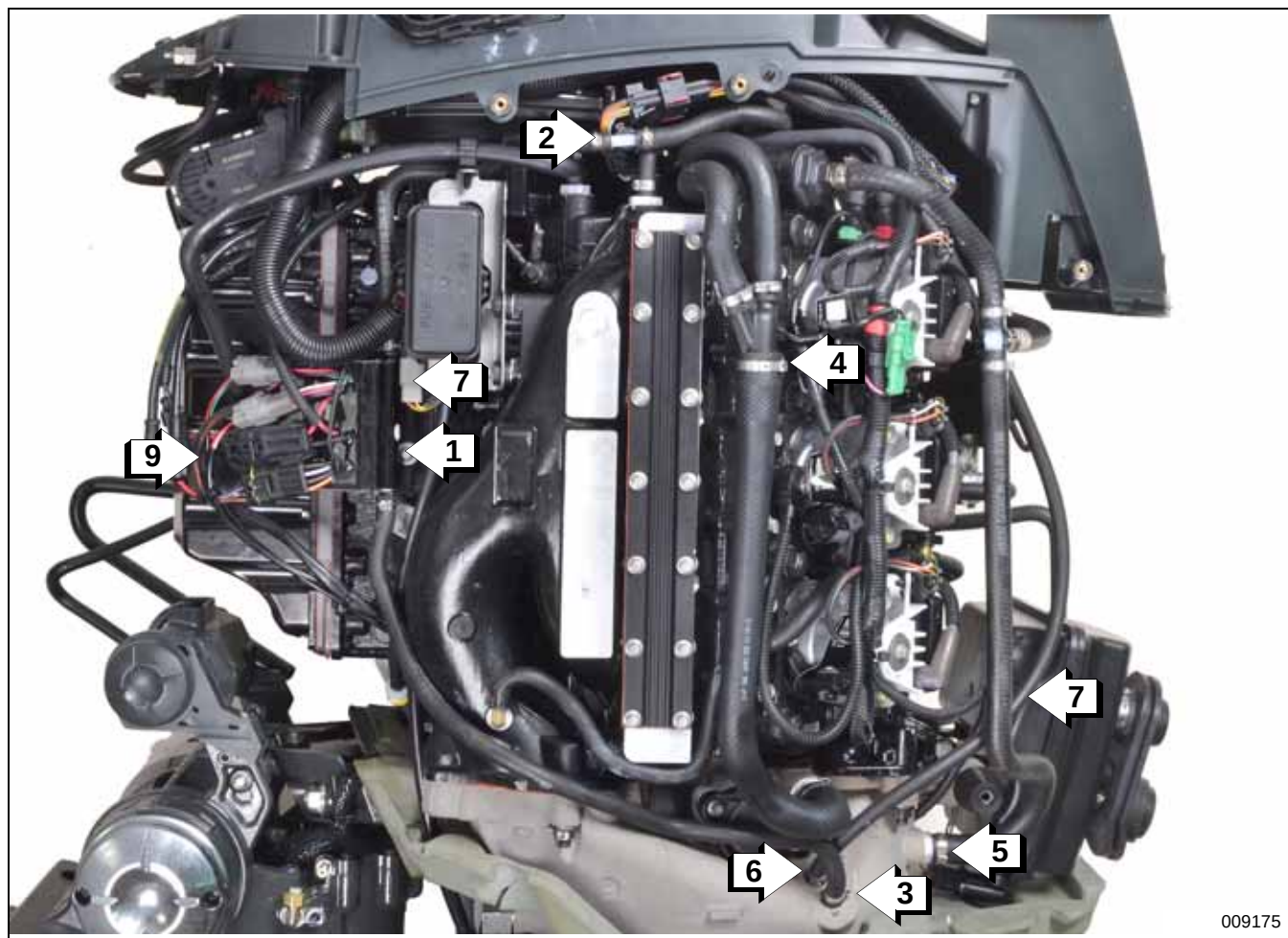
2. The DPS module cooling hose to the tee fitting, secure with a new 15.7 mm *Oetiker* clamp.
3. The exhaust cooling hose (DPS module to exhaust adapter) to the adapter fitting, secure with a new 15.7 mm *Oetiker* clamp.
4. The Y-fitting to the exhaust adapter hose, secure with a new 34.6 mm *Oetiker* clamp.

5. The thermostat hose to the exhaust adapter fitting, secure with a new 21.0 mm *Oetiker* clamp.

6. The exhaust back pressure hose to the exhaust adapter fitting, secure with a new tie strap.

Connect the electrical connectors to the following:

7. Exhaust temperature sensor
8. Shift actuator
9. DPS module



009175

Starboard

Install the following:

1. The oil tank. Install the three washers and retaining nuts on the oil tank. Tighten the nuts to a torque of 15 to 17 ft. lbs. (20 to 23 N·m).
2. The trim relay on the oil tank.
3. The 6 oil supply hoses from the crankcase to the oil pump.

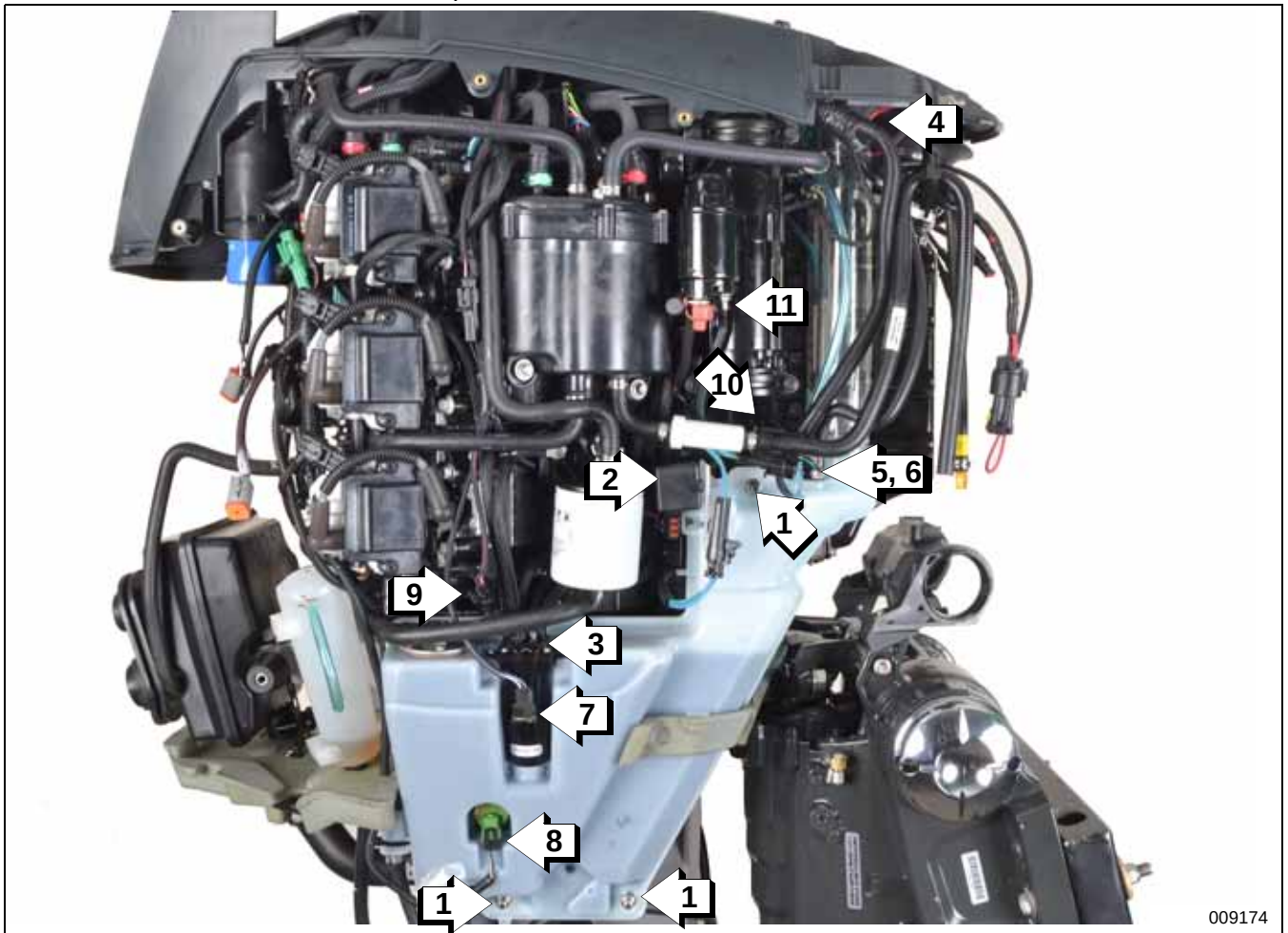
Install the following hoses and hose clamps:

4. The oil fill hose on to the center (top) frame, secure with a new 51.5 mm *Oetiker* clamp.
5. The oil tank vent hose on to the oil tank, secure with a new 10.5 mm *Oetiker* clamp.

6. The remote oil fill hose on to the oil tank, secure with a new 14.5 mm *Oetiker* clamp.

Connect the electrical connectors to the following:

7. Crankcase oil pump (oil tank).
8. Low oil switch (oil tank).
9. Oil level sender (oil tank).
10. Trim relay, three *Amp* connectors and two 2 ring terminals (1 ground on the block and 1 on the starter solenoid).
11. Starter solenoid (small ring terminal).



Powerhead

Powerhead Installation

Install the rigging grommets on the powerhead hoses and buss cables.

Refer to **Engine Cover and Frame Service** on p. 55.



1. Rigging grommets

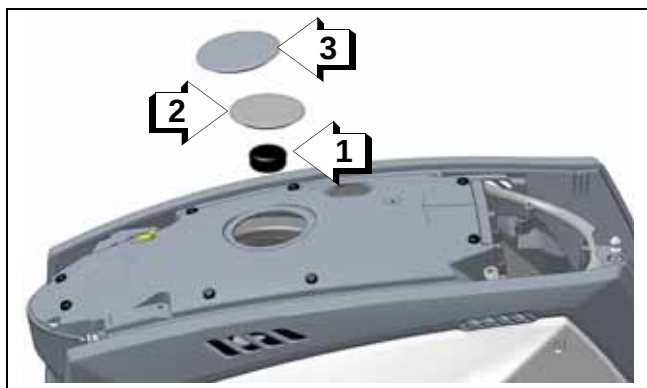
009173

NOTICE

Install plugs as indicated. Plugs MUST be installed to prevent water entry and/or engine performance issues.

Make sure plugs are securely installed to prevent loosening during engine operation.

Apply *Triple Guard* grease to the threads of the flywheel, then install the thread protector into the flywheel threads. Next install the 3.5 inch plug into the air duct and install the 4 inch plug into the center frame last.



1. Thread protector

2. 3.5 inch plug

3. 4 inch plug

009425

Insert the grommets into the front frame, then install the front frame.

Install the port and starboard frames.

Install the rear covers

Connect all cables, buss cables and hoses from the engine. Then install the front cover.

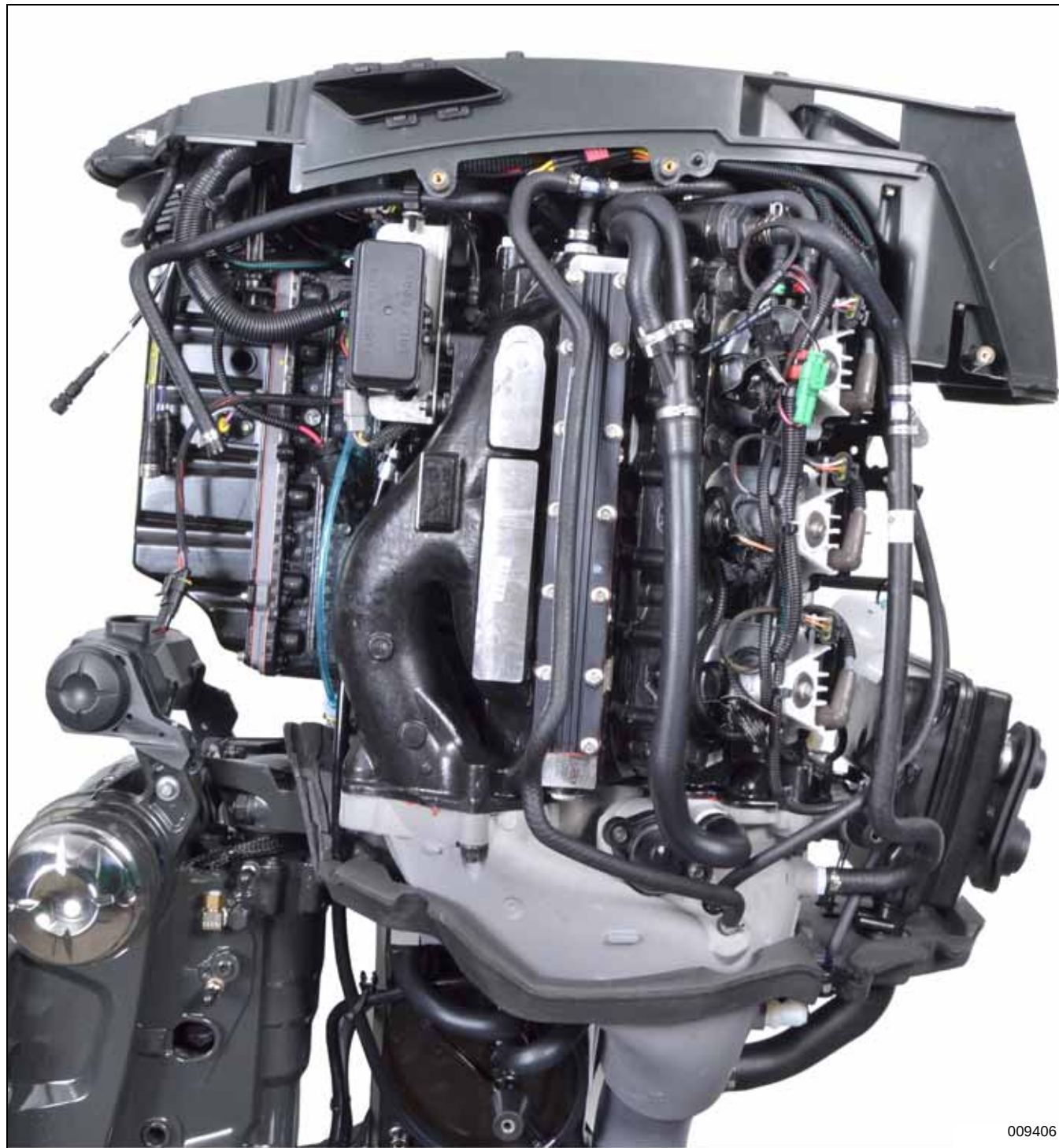
Powerhead Views

Starboard



009375

Port – Non-DPS Models



009406

Port – DPS Models



009374

Rear – 200, 225, 250 HP Models



009407

Rear – 250 H.O., 300 HP Models



009376

Front – Frame Removed



009379

Front – Frame Installed

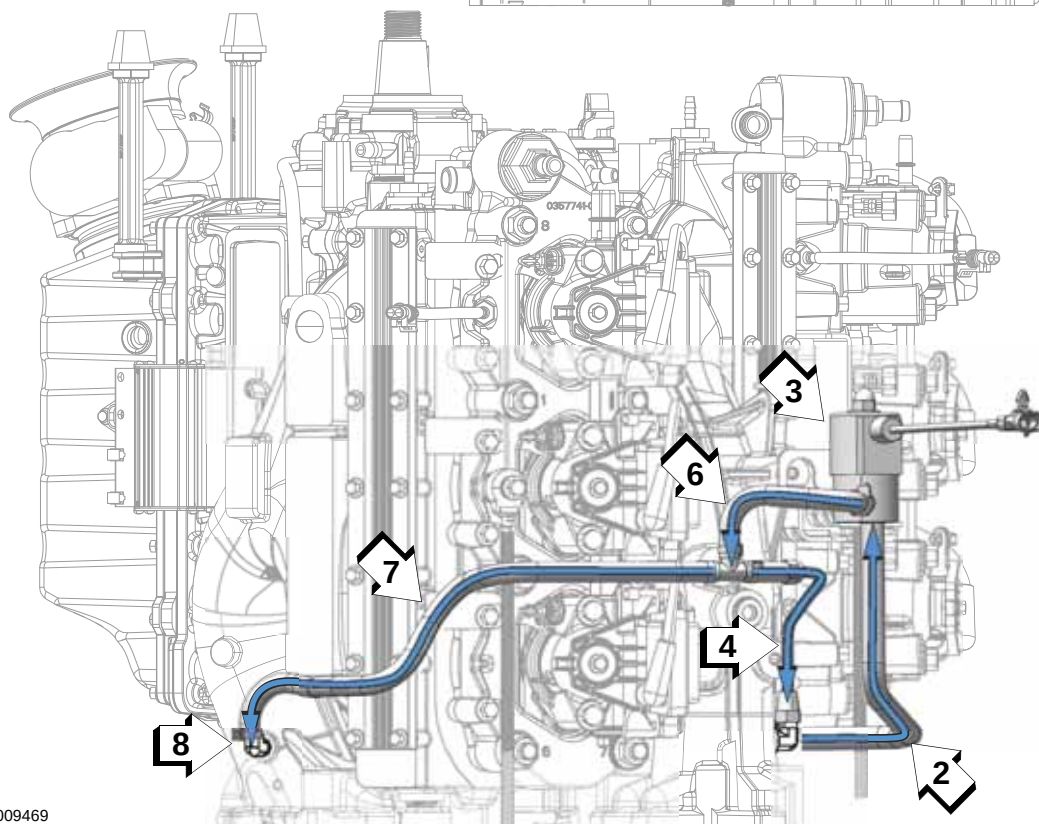
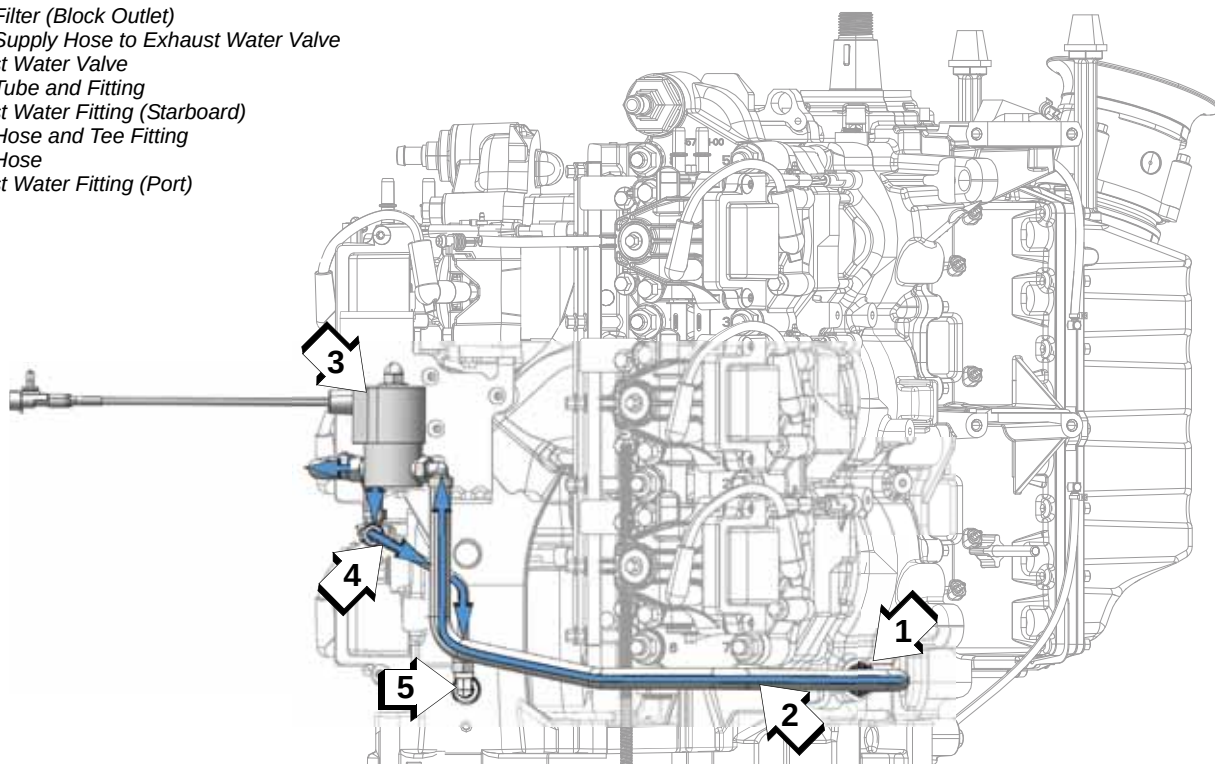


009378

Exhaust Water Valve

Water Flow

1. Water Filter (Block Outlet)
2. Water Supply Hose to Exhaust Water Valve
3. Exhaust Water Valve
4. Water Tube and Fitting
5. Exhaust Water Fitting (Starboard)
6. Water Hose and Tee Fitting
7. Water Hose
8. Exhaust Water Fitting (Port)



009469

009469

Exhaust Water Valve Operation

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

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

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

Exhaust Water Valve Tests

Static Test

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

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

Dynamic Test

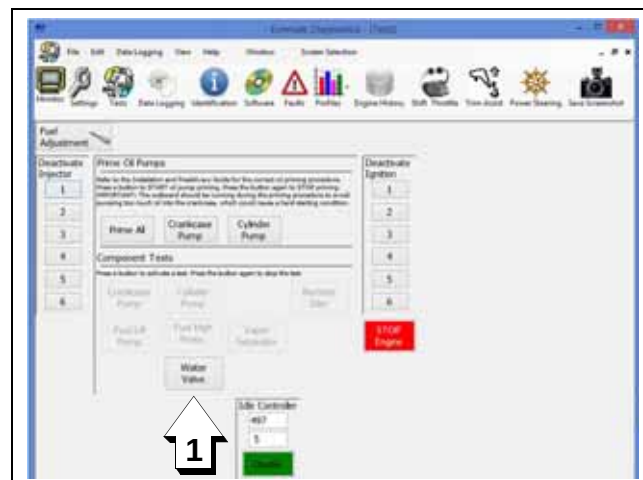
Use the diagnostics program to perform a dynamic test of the water valve while the outboard is running.

Disconnect the water valve outlet hoses.

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

With the outboard idling, activate the *Water Valve* test and check for water flow. A steady stream of

water should flow from the hose while the test is running.



1. Water Valve Test

009124

Check engine water pressure. At 5 psi (34 kPa), water should flow at a rate of 64 to 128 ounces / minute (550 to 750cc / minute).

Results:

- No water flow—check for debris in valve assembly water supply line and water filter. Refer to **Circuit Tests** on p. 279.

Water appears—make sure fittings into exhaust runners are clear.

Circuit Tests

55 Volt Circuit

Use a digital multimeter with appropriate test probe leads to measure the resistance of the exhaust water valve 55V circuit.

Make sure the key switch is OFF.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to the red/white wire of a known good circuit such as a fuel injector.

Exhaust Water Valve 55V Circuit Resistance		
Wire	Pin	Result
WHITE/RED	A	< 1 Ω

Powerhead
Exhaust Water Valve

Results:

- An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check continuity of wiring and connections. Repair or replace faulty wiring.

Signal Circuit

Use the diode test function of a digital multimeter to check the signal circuit.

Make sure the key switch is OFF.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

Exhaust Water Valve Signal Circuit (Diode Test)		
Wire	Pin	Result
BLUE YELLOW	B	approximately 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
 - A reading of zero (0) indicates a short circuit.
- Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Water Valve Resistance Test

Disconnect the battery cables at the battery. Disconnect the electrical connector from the exhaust water valve.

Use a digital multimeter with appropriate test probe leads to measure the resistance between the pins of the exhaust water valve connector.



1. Exhaust water valve connector

009468

Exhaust Water Valve Resistance
16 to 18 Ω

Results:

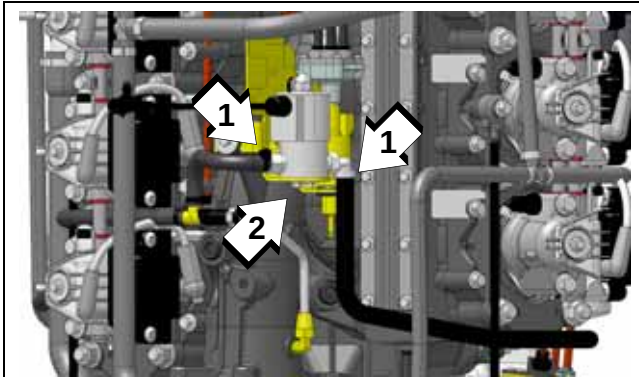
- An infinite reading (∞) indicates an open circuit of the pump winding.

Replace faulty exhaust water valve.

Exhaust Water Valve Component Service

Water Valve

Remove the hose clamps from the water valve. Remove the two retaining screws from the bottom of the water valve, then remove the valve from the bracket.



1. Hose clamps
2. Screws

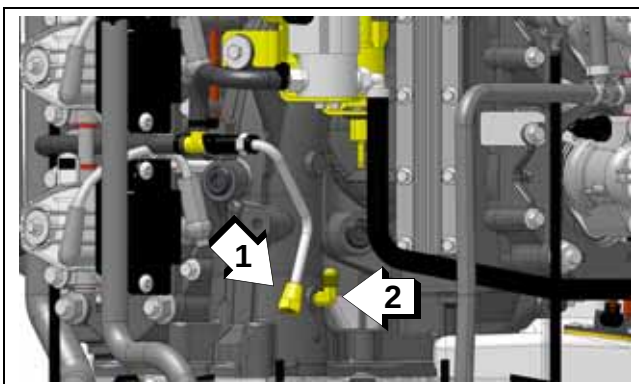
009470

Installation is the reverse of removal.

Install the two screws first and tighten to a torque of 36 to 60 In. Lbs. (4 to 7 N·m). Install new hose clamps.

Exhaust Water Fittings

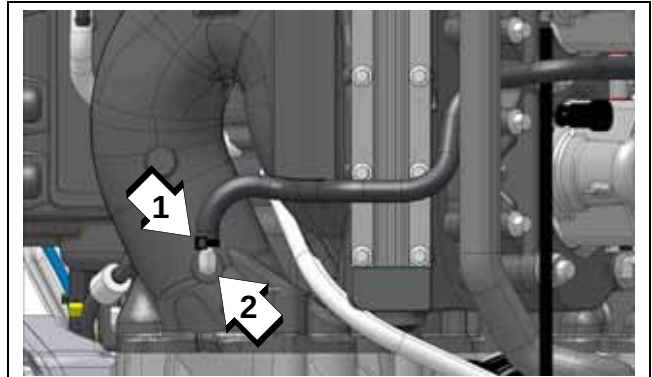
Starboard: Loosen the water tube fitting from the exhaust water fitting. Remove the exhaust water fitting from the exhaust runner.



1. Water tube fitting
2. Exhaust water fitting

009471

Port: Remove the hose clamp from the exhaust water fitting. Remove the exhaust water fitting from the exhaust runner.



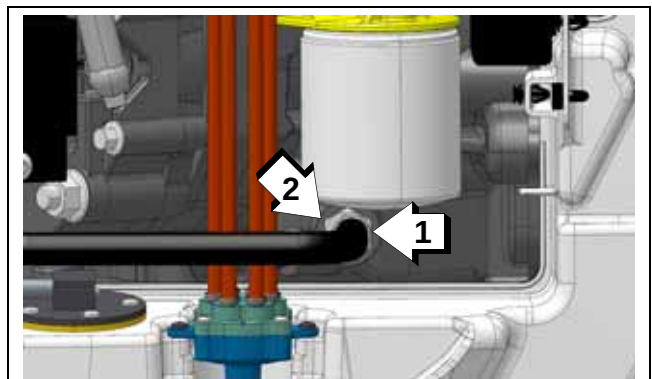
1. Hose clamp
2. Exhaust water fitting

009472

Installation is the reverse of removal. Apply *Pipe Thread Sealing Compound*, P/N 764806, or equivalent to the threads of the exhaust water fittings. Tighten water fittings securely. Make sure the exhaust water fittings hose or water tube attachments are oriented in the UP position.

Water Filter

Remove the hose clamp from the water supply hose. Then remove the water filter from the block.



1. Hose clamp
2. Water filter

009471

Installation is the reverse of removal. Apply *Pipe Thread Sealing Compound*, P/N 764806, or equivalent to the threads of the water filter. Tighten to a torque of 84 to 106 In. lbs. (10 to 12 N·m). secure water supply hose with a new hose clamp.

Technician's Notes

[illegible][illegible]

Exhaust Housing & Adapter

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 Exhaust Adapter Removal 287

 Exhaust Adapter Installation 289

 Exhaust Water Cooling Fitting 290

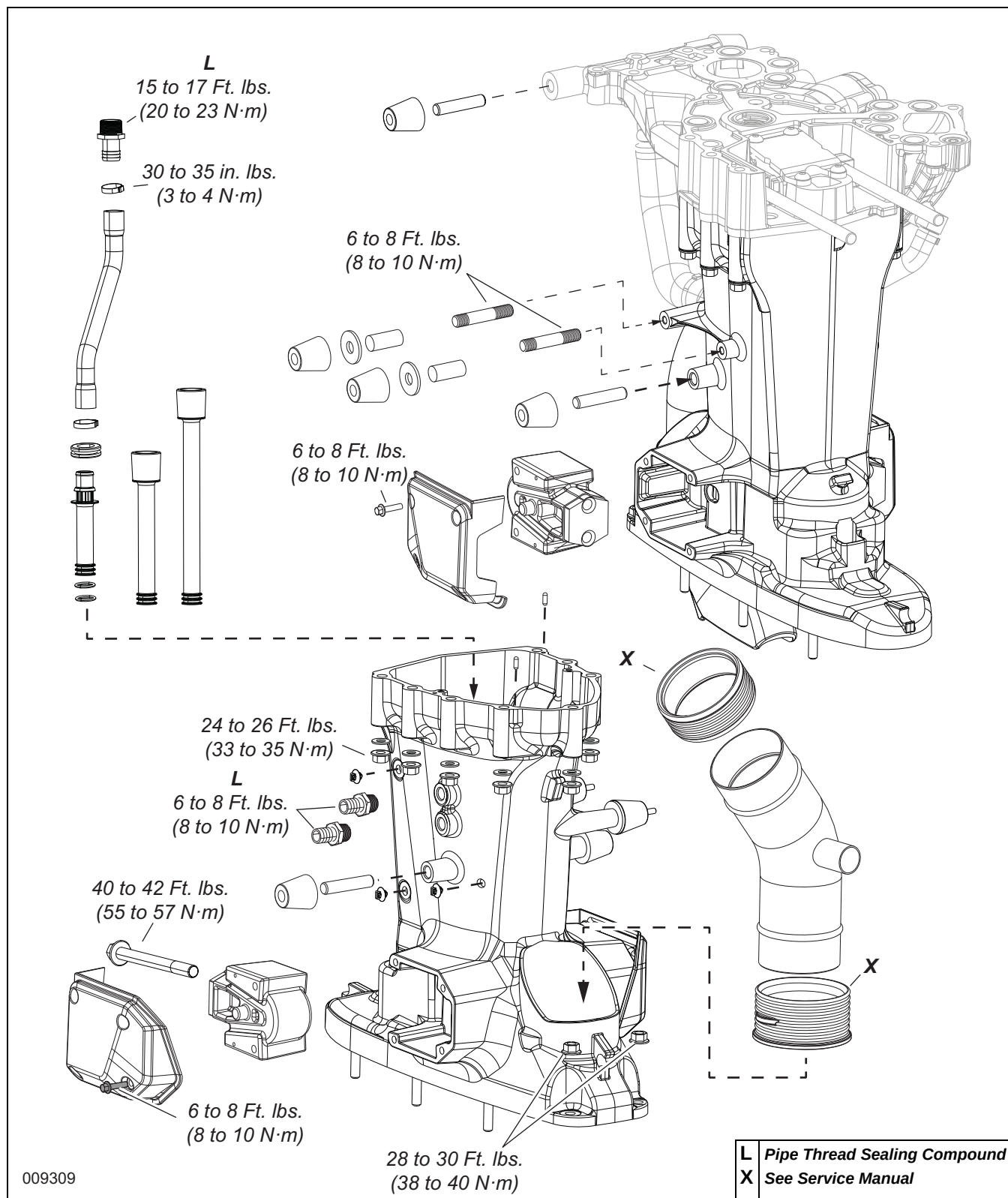
 Upper Mount Service 291

 Lower Mount Service 291

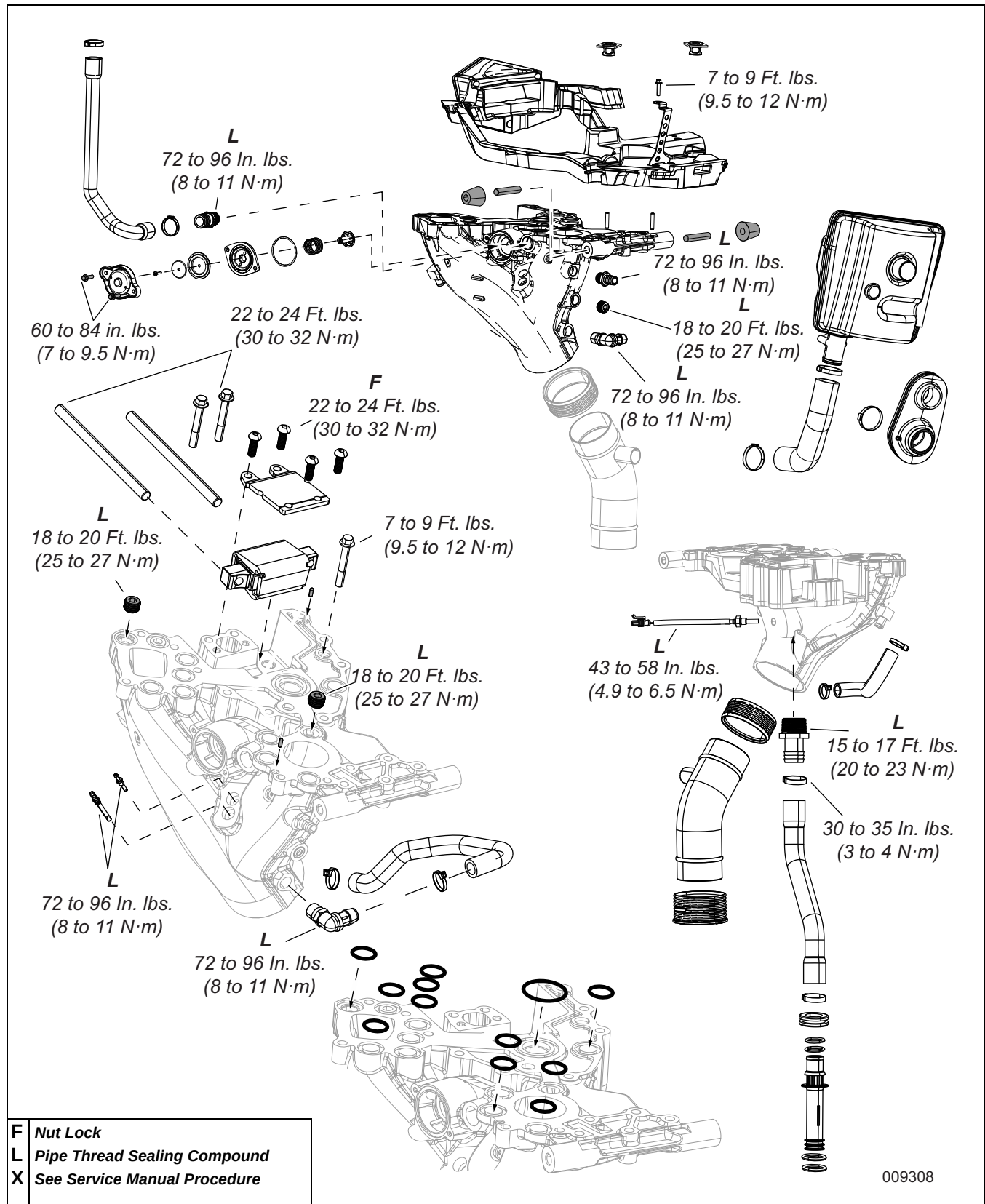
 Exhaust Relief Muffler Assembly 292

Service Charts

Exhaust Housing



Adapter and Muffler



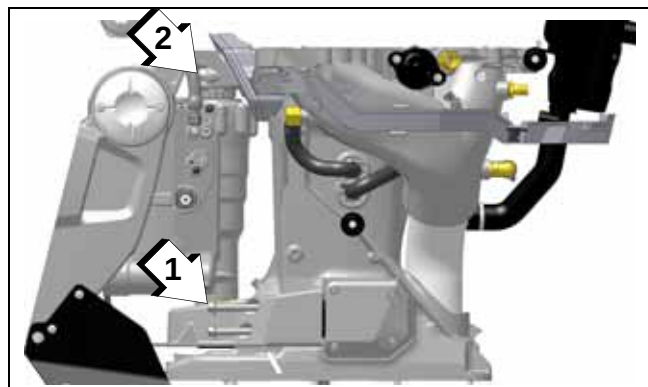
Exhaust Housing Service

Exhaust Housing Removal

Before removing the exhaust housing, remove the:

- Gearcase. Refer to **Gearcase Removal** starting on p. 361.
- Powerhead. Refer to **Powerhead Removal** starting on p. 239.
- Oil tank assembly. Refer to **Oil Tank Removal** starting on p. 205.

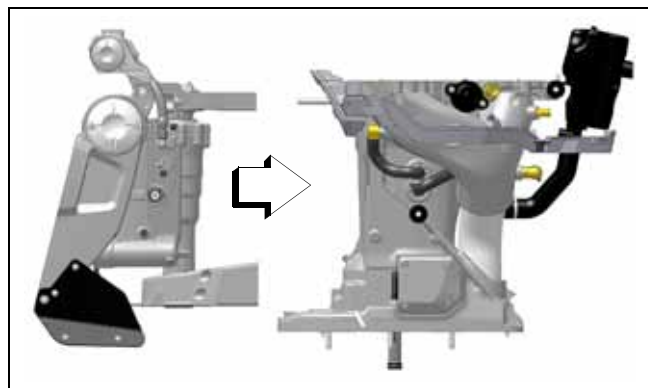
Remove and discard four lower mount screws. Remove the two upper mount nuts and washers.



1. Four lower mount screws
2. Two upper mount nuts and washers

009341

Remove the exhaust housing and adapter from the swivel bracket assembly.



009342

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.

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

Before checking the exhaust housing for distortion:

- Remove the exhaust adapter.
- Remove the gearcase retaining studs.
- 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.

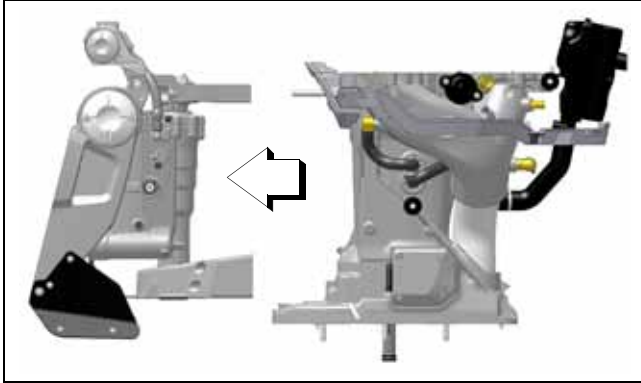
IMPORTANT: A distorted exhaust housing will cause the upper driveshaft splines to wear excessively and will damage the crankshaft splines.



009352

Exhaust Housing Installation

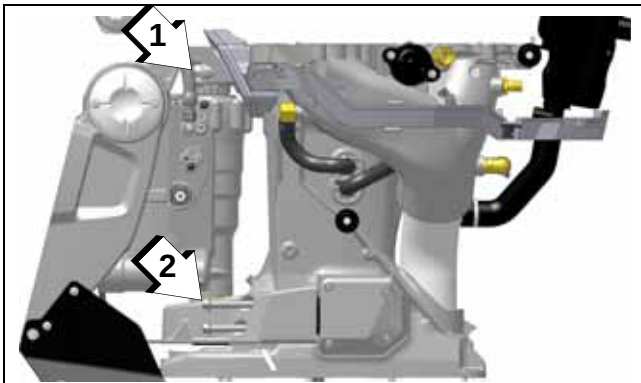
Align the exhaust housing and adapter onto the swivel bracket assembly.



009342

Install the two upper mount washers and nuts. Install the four lower mount screws.

Tighten the upper mount nuts to a torque of. Tighten the lower mount screws to a torque of.



1. Two upper mount nuts and washers
2. Four lower mount screws

009341

Install the:

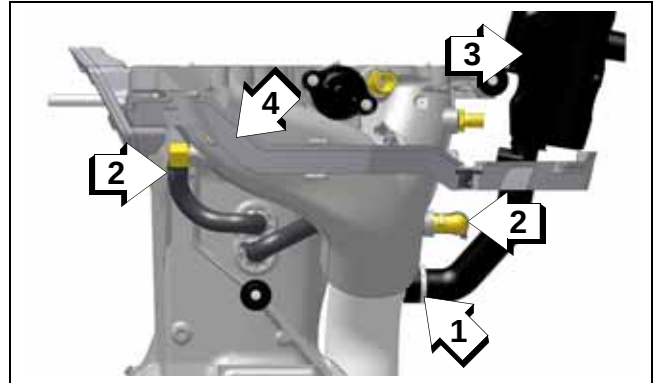
- Powerhead. Refer to **Powerhead Installation** starting on p. 264.
- Gearcase. Refer to **Gearcase Gearcase Removal and Installation** starting on p. 361.
- Oil tank assembly. Refer to **Oil Tank Installation** starting on p. 205.

Exhaust Adapter Removal

Remove the exhaust hosing and adapter from the swivel bracket. Refer to.

Remove one hose clamp and two tie straps. Then remove the hoses from the hose fittings.

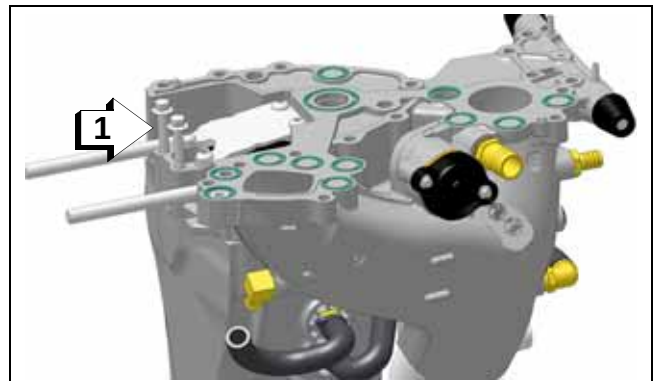
Next remove the muffler and hose from the exhaust pipe. Then carefully remove the foam gasket from the adapter



1. Hose clamp
2. Tie straps
3. Muffler
4. Foam gasket

009343

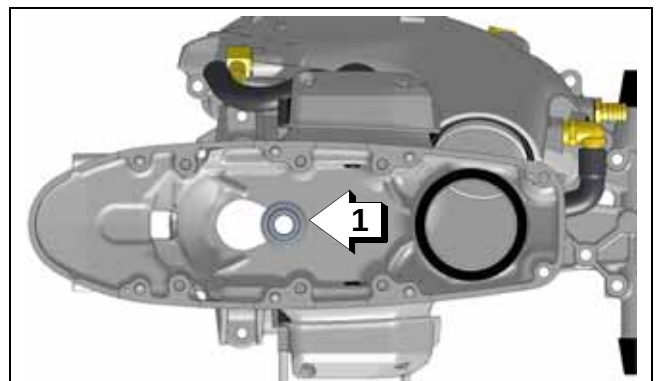
Remove the two adapter screws.



1. Two adapter screws

009344

From the bottom of the exhaust housing, push the water tube forward to release it from the casting.



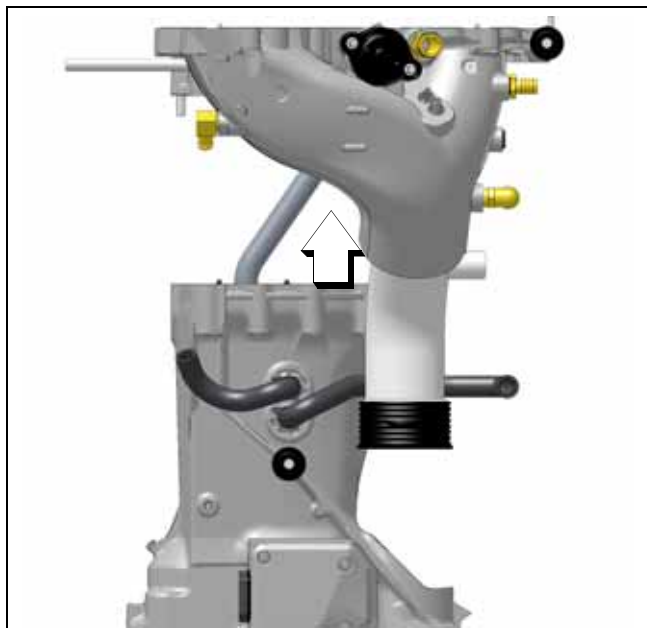
1. Water tube

009345

Exhaust Housing & Adapter

Exhaust Housing Service

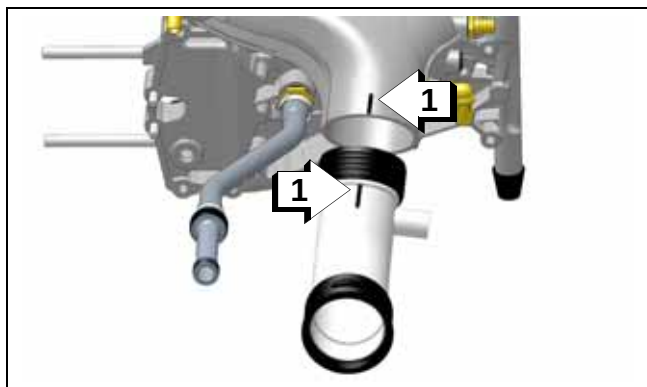
Lift the adapter and exhaust pipe from the exhaust housing.



009346

Exhaust Pipe

Make a mark on the exhaust pipe and adapter to reference the position of the exhaust hose fitting. Remove the exhaust pipe from the adapter.



1. Mark

009350

Installation is the reverse of removal. Lubricate the seals with soapy water. Align the mark on the exhaust pipe with the mark on the adapter and insert the exhaust pipe into the adapter.

Cooling Water Hose and Tube

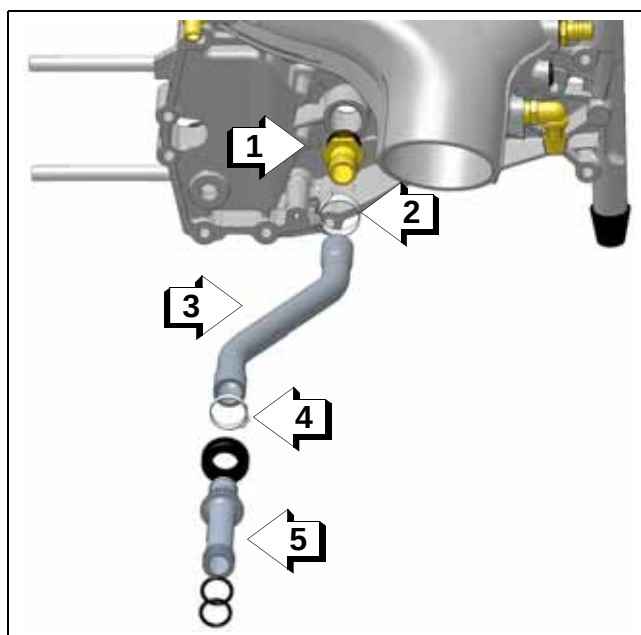
Remove the hose clamps to service the hose and tube assembly.

Installation is reverse of removal. If fitting is removed, apply *Pipe Thread Sealant* to the threads of the fitting.

Tighten the fitting to a torque of 15 to 17 ft. lbs. (20 to 23 N·m).

Attach the hose to the fitting with a new hose clamp. Tighten the hose clamp to a torque of 30 to 35 ft. lbs. (3 to 4 N·m).

Attach the tube to the hose with a new *Oetiker* clamp.

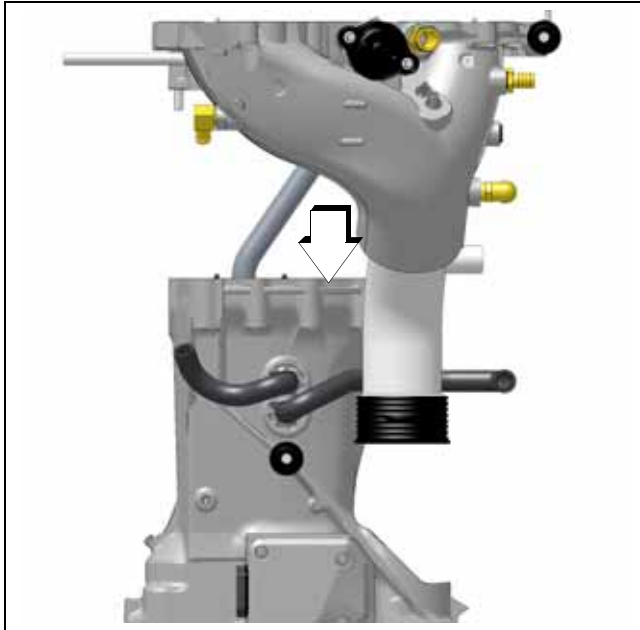


1. Fitting
2. Hose clamp
3. Hose
4. Oetiker clamp
5. Tube

009351

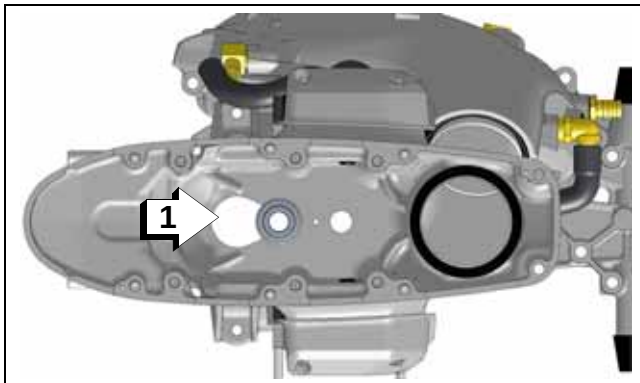
Exhaust Adapter Installation

Install the adapter and exhaust pipe into the exhaust housing.



009346

From the bottom of the exhaust housing, align the water tube into the large opening. Then push it rearward to install it into the casting.

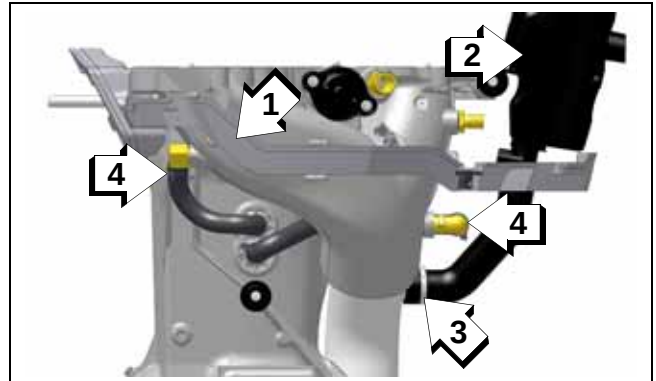


1. Large opening

009345

Carefully install the foam gasket onto the adapter. Next install the muffler and hose from the exhaust pipe. Secure the muffler hose to the exhaust pipe with a new *Oetiker* clamp. Then install the two

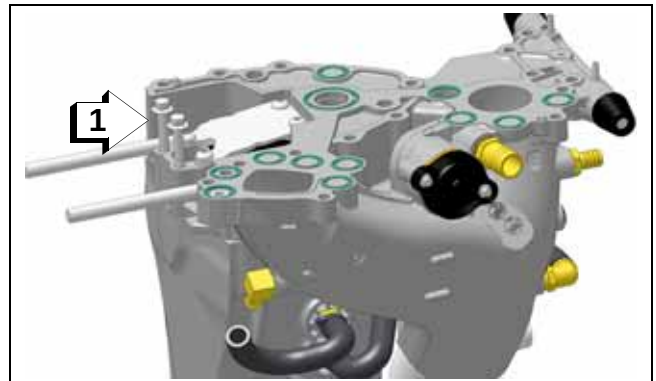
hoses onto the hose fittings. Secure with tie straps.



1. Foam gasket
2. Muffler
3. Hose clamp
4. Tie straps

009343

Install the two adapter screws. Tighten to a torque of 22 to 24 Ft. lbs. (30 to 32 N·m).



1. Adapter screws

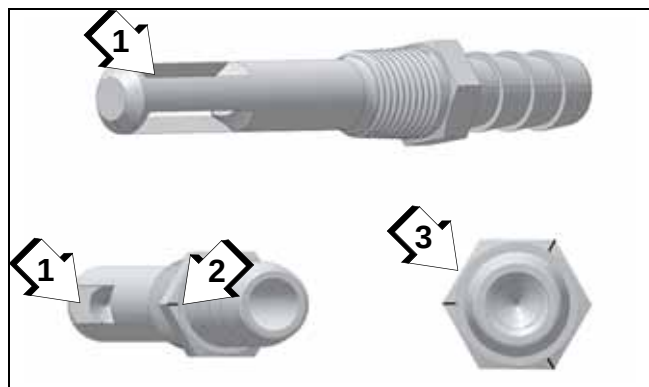
009344

Exhaust Water Cooling Fitting

Remove the hose clamp and cooling hose, then remove the fitting.

IMPORTANT: The cooling fitting has three machined spray slots and **MUST** be indexed to spray toward the exhaust temperature sensor.

Make three index marks on the hex of the fitting aligned with each spray slot.



1. Spray slots
2. Index mark aligned with spray slot
3. Hex of fitting with 3 index marks

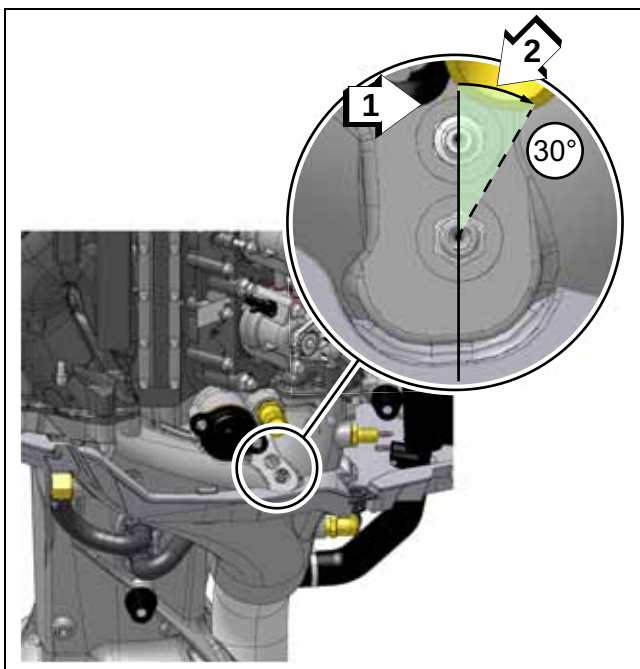
009687

Apply *Pipe Thread Sealant* to the threads of the fitting. Install the fitting and tighten to a torque of 72 In. lbs. (8 N·m). Check the index marks.

Correct indexing is achieved when one of the index marks is aligned with, or up to 30° past the exhaust back pressure probe.

Continue tightening the fitting a little at a time, until an index mark is in the desired area, as shown.

Do NOT exceed a torque of 96 In. lbs. (11 N·m).



1. Exhaust back pressure probe
2. Index mark in this area

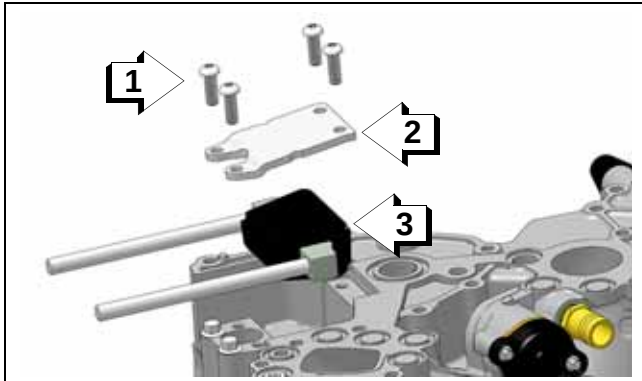
009688

Install the cooling hose and secure with a new *Oetiker* clamp.

Upper Mount Service

Remove the exhaust housing and adapter from the swivel bracket. refer to **Exhaust Housing Removal** starting on p. 286.

Remove the four screws from the upper mount plate, then remove the plate. Lubricate the mount with soapy water and carefully pry at both sides to remove.



1. Screws
2. Plate
3. Upper mount and studs

009347

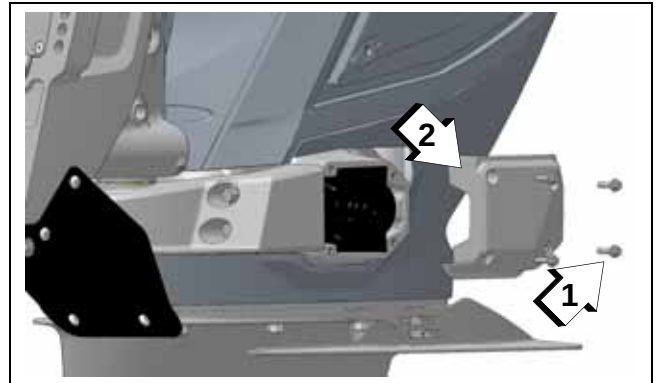
Installation is the reverse of removal. Lubricate the mount with soapy water and press into place in the exhaust adapter. Install the plate and four screws.

Tighten the screws to a torque of 22 to 24 ft. lbs. (30 to 32 N·m).

Lower Mount Service

Note: It is NOT necessary to remove the exhaust housing and adapter from the swivel bracket to service the lower mounts.

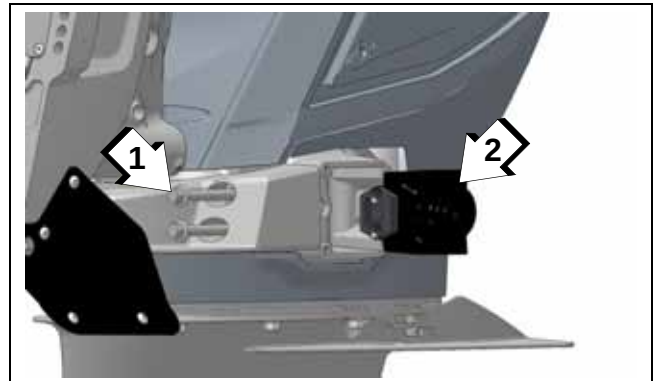
Remove the four screws and lower mount covers and inspect the lower mounts.



1. Four screws
2. Mount cover

009348

If replacement is necessary, remove the two screws from the front of the lower mount. Lubricate the mount with soapy water and carefully pry at both ends to remove.



1. Front mount screws
2. Lower mount

009349

Installation is the reverse of removal. Lubricate the lower mounts with soapy water and press into the exhaust housing with the "OUTSIDE" mark facing outward.

Install the two screws into the front of the mount. Install the mount cover and four screws. Tighten the two front mount screws to a torque of 40 to 42 ft. lbs. (55 to 57 N·m).

Tighten the four mount cover screws to a torque of 6 to 8 ft. lbs. (8 to 10 N·m).

Exhaust Housing & Adapter

Exhaust Housing Service

Exhaust Relief Muffler Assembly

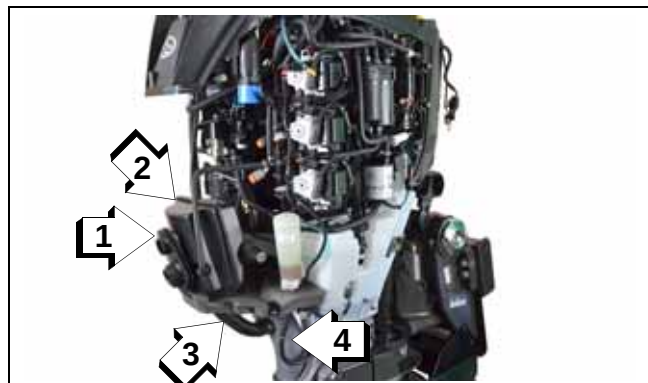
The exhaust relief muffler is located at the rear of the adapter housing and concealed by the engine covers and frames.



1. Exhaust relief

009355

The exhaust relief grommet connects directly to the muffler assembly. The muffler assembly connects to the exhaust relief hose from the exhaust pipe.

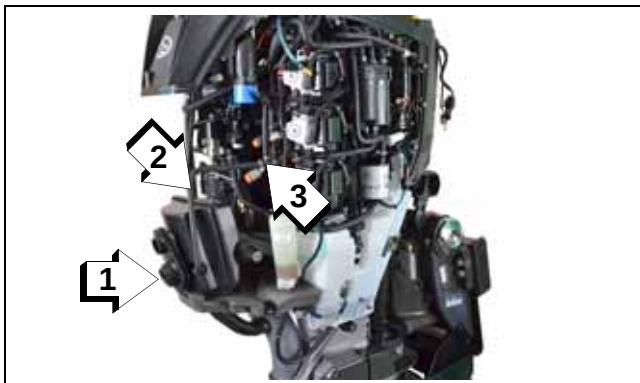


1. Exhaust relief grommet
2. Muffler assembly
3. Exhaust relief hose
4. Exhaust pipe

009356

The overboard indicator and flush port in the exhaust relief grommet connect to a water hose.

A tee-fitting distributes water to two hoses. One hose supplies flushing water to the vapor separator, *EMM* and *DPS* module and exits into the exhaust adapter. A second hose supplies flushing water to a fitting at the top of the block. Refer to **Cooling Hose Diagrams** starting on p. 212.



1. Overboard indicator and flush port
2. Water hose
3. Tee fitting

009356

Periodically inspect hoses and connections for condition. Replace muffler or hoses as needed.

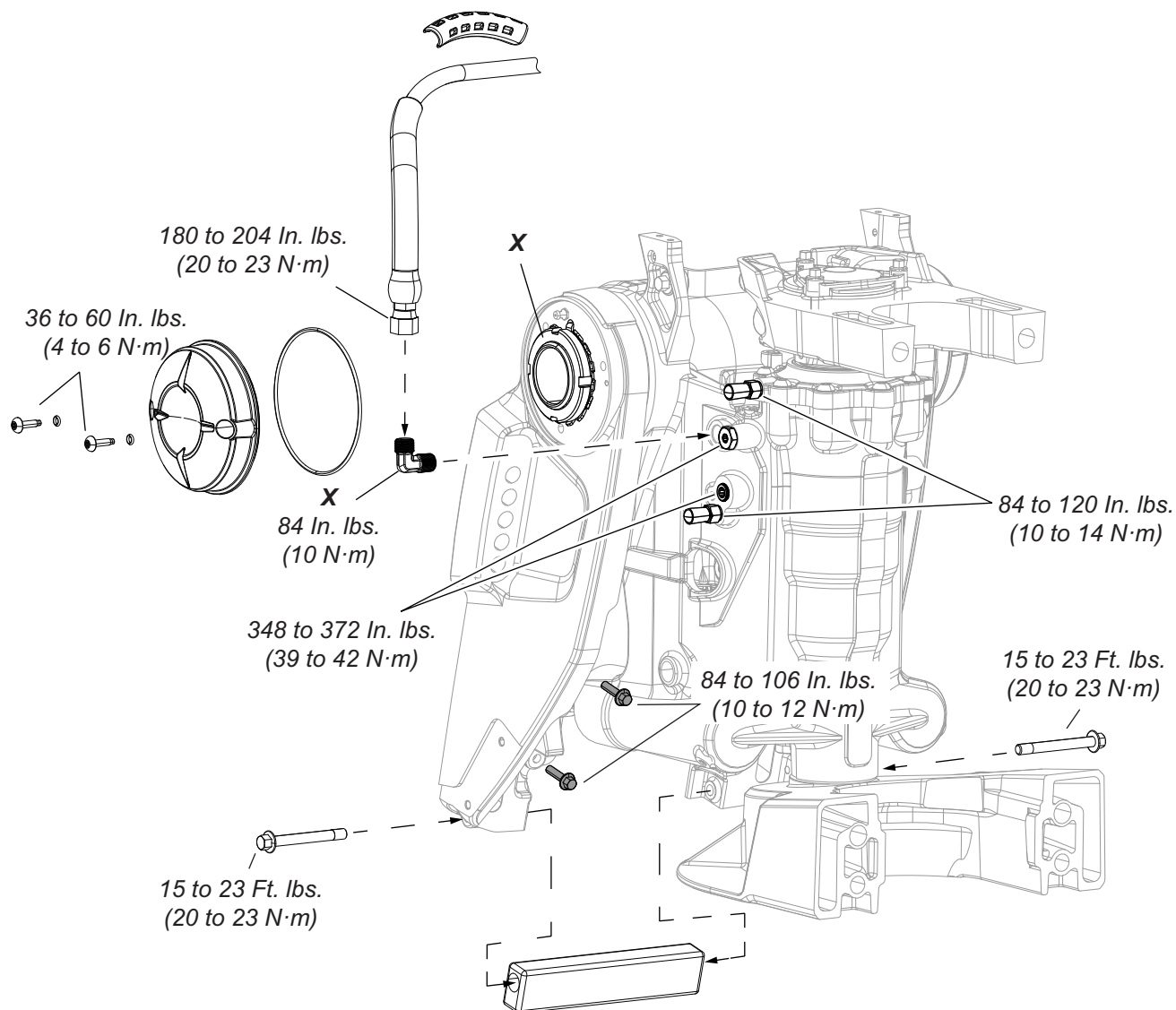
Stern and Swivel

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Service Charts

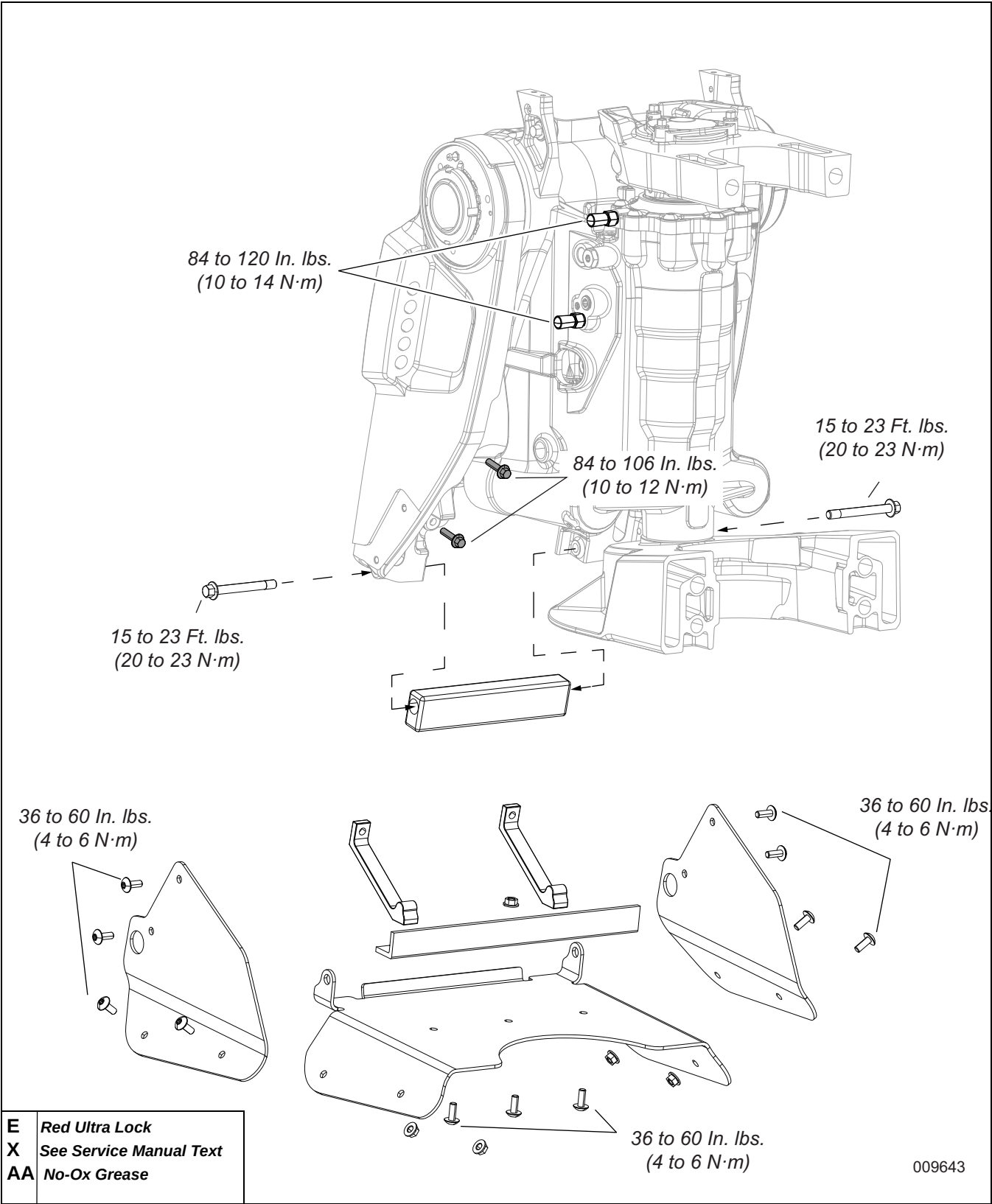
Stern & Swivel



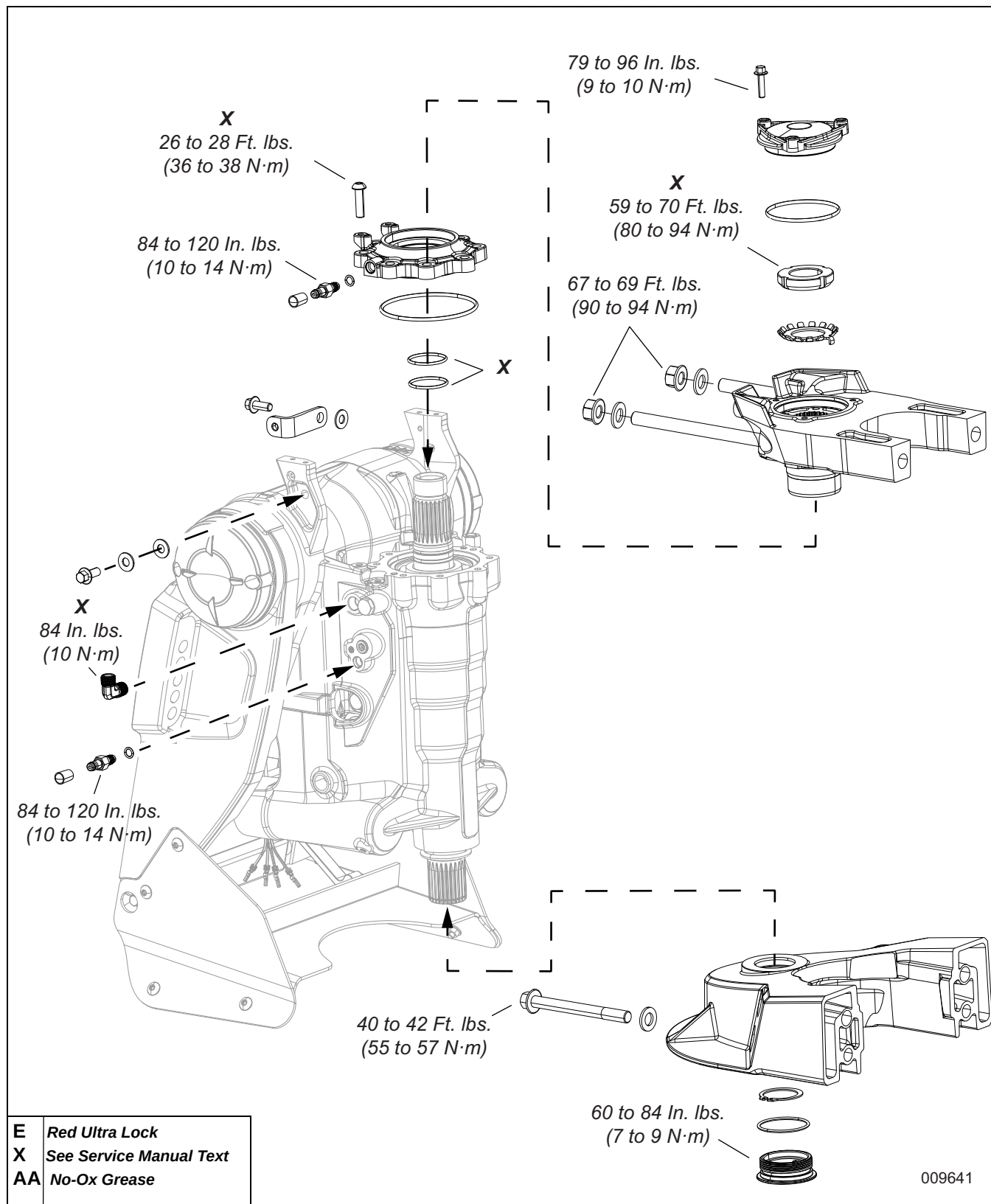
009640

E	Red Ultra Lock
X	See Service Manual Text
AA	No-Ox Grease

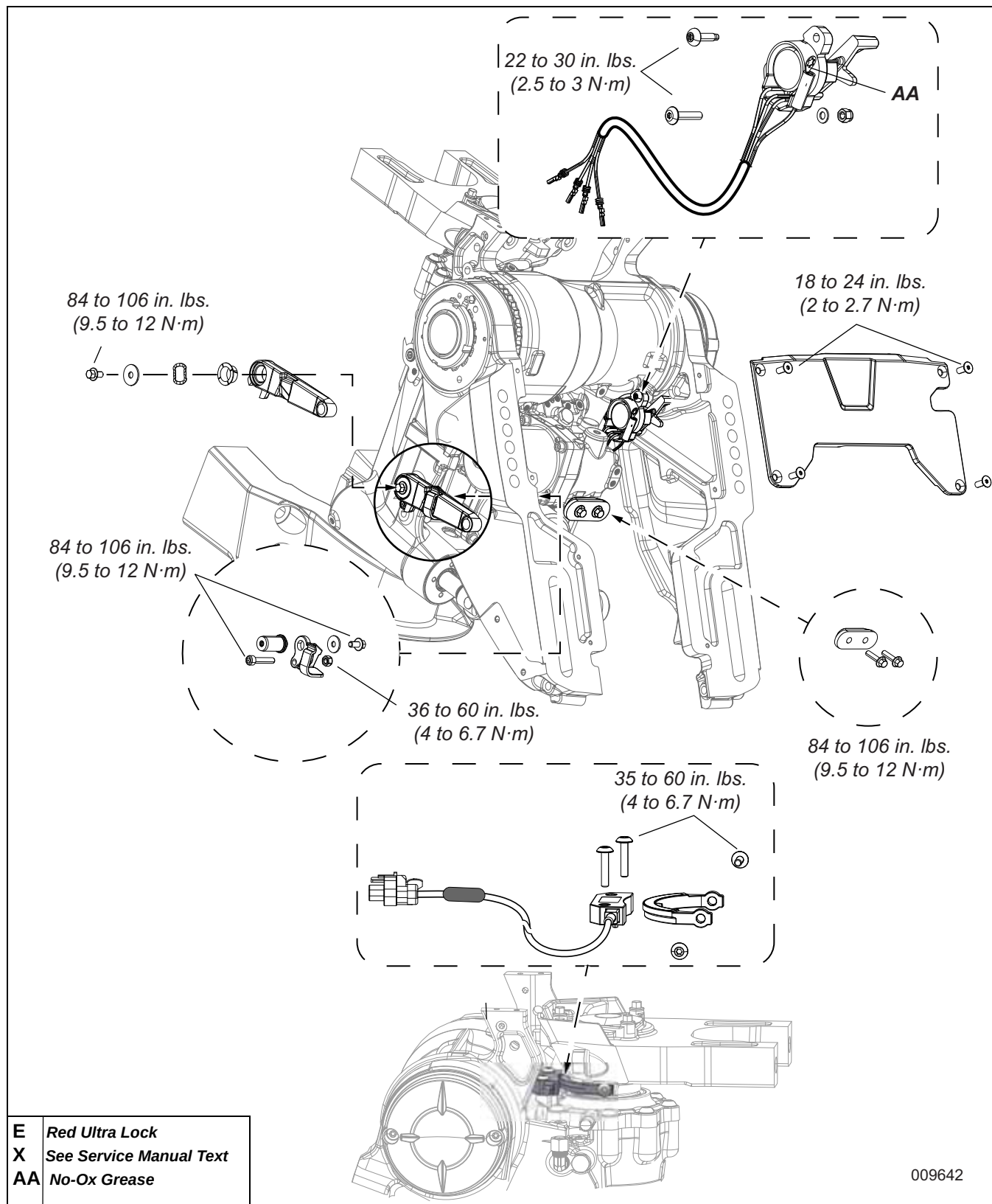
Spray Plate, Covers and Anode



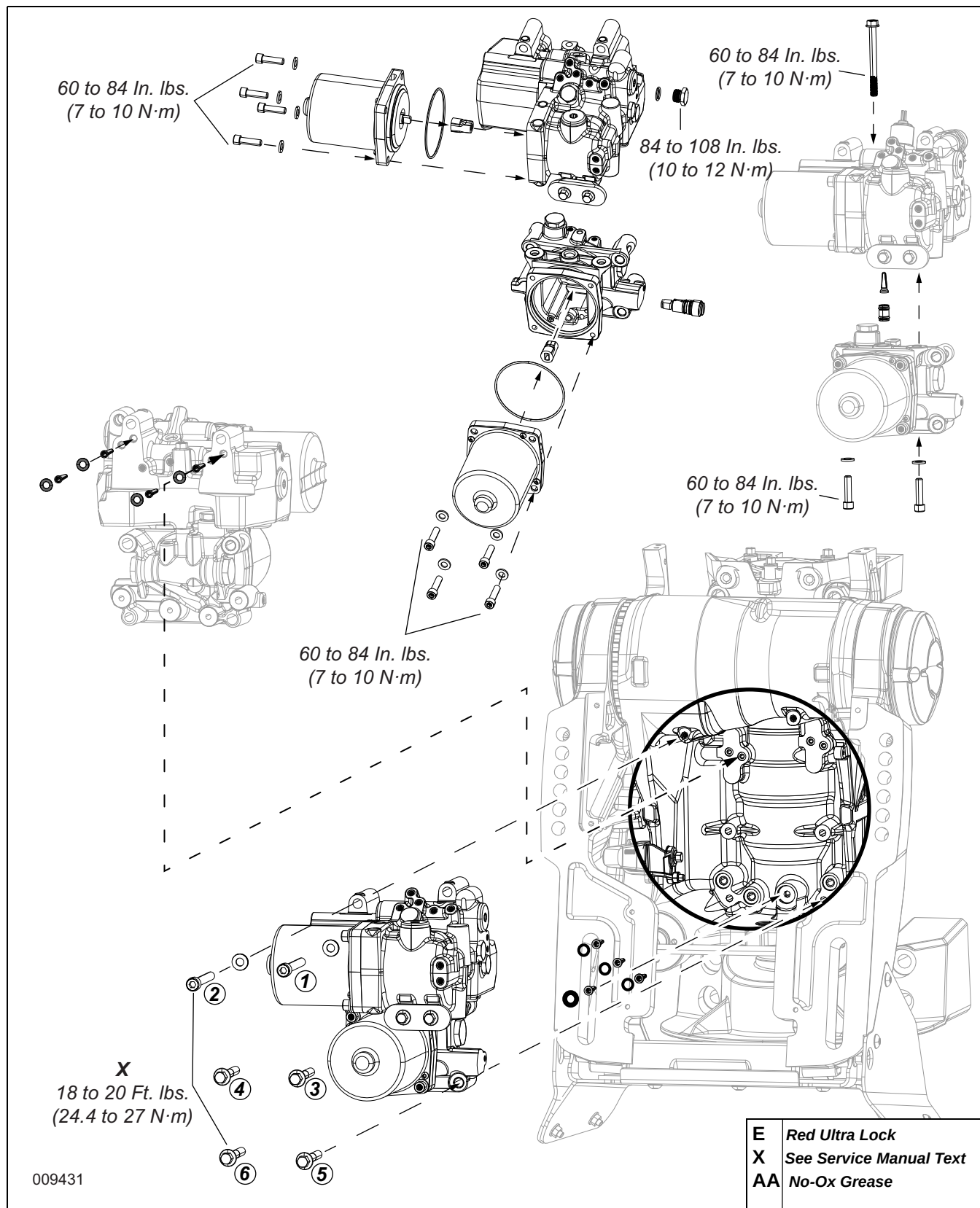
Steering Arm, End Cap and Lower Bracket



Stern & Swivel Bracket Attachments

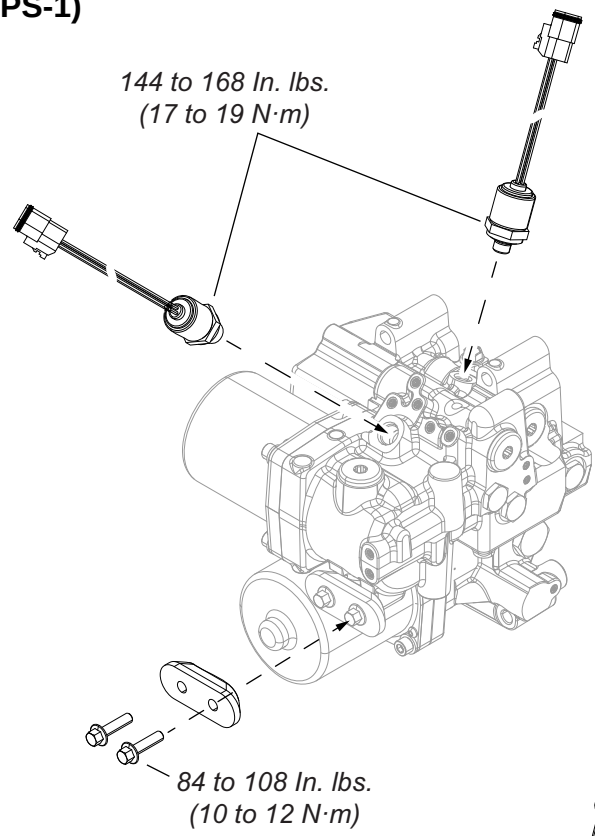


DPS Manifold Assembly

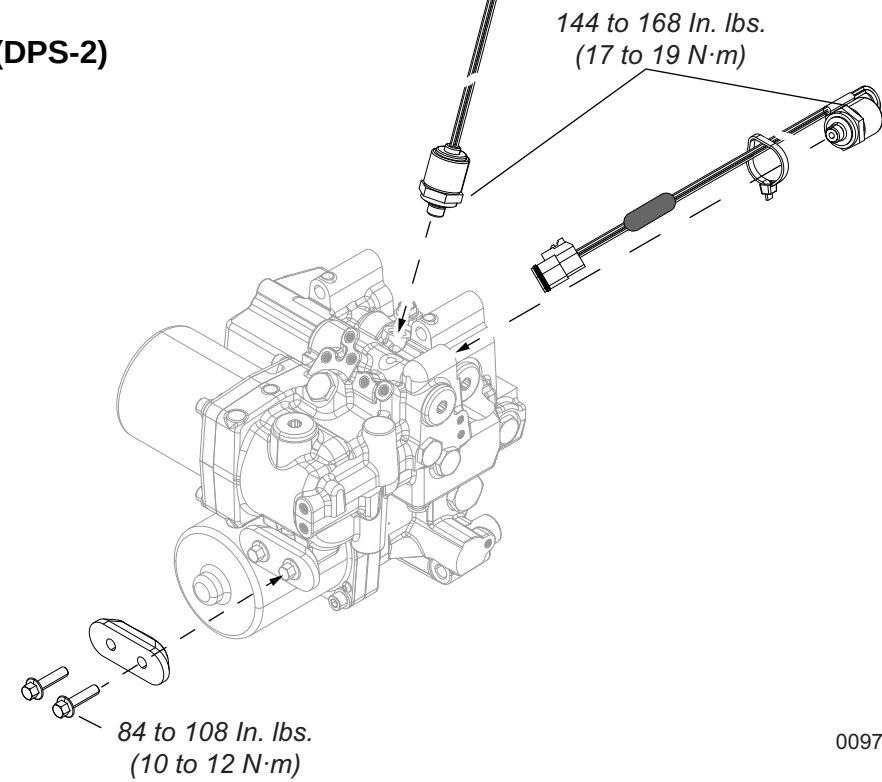


DPS Pressure Sensors

ABA Models (DPS-1)



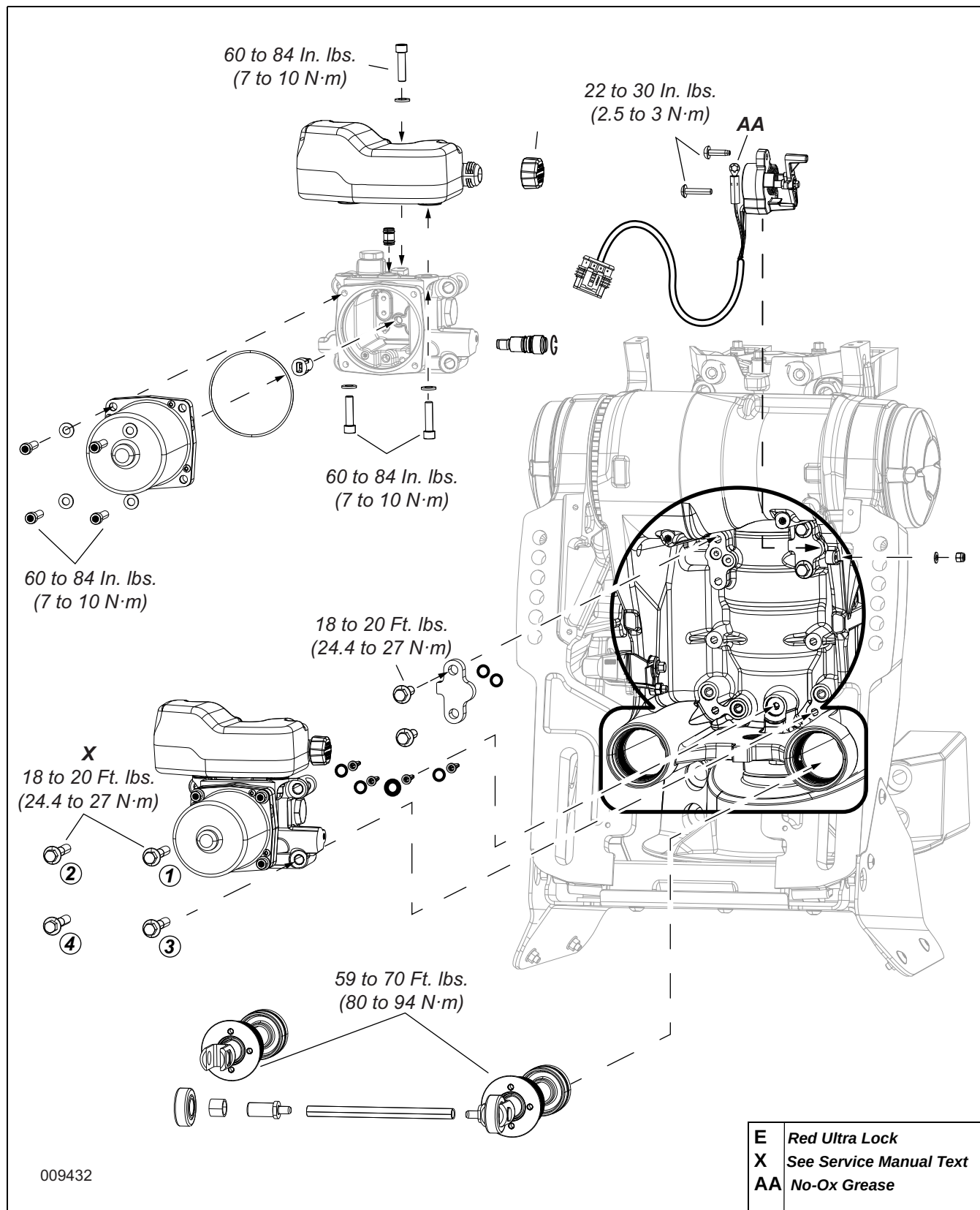
AFA & Newer Models (DPS-2)



E	Red Ultra Lock
X	See Service Manual Text
AA	No-Ox Grease

009748

Trim & Tilt Manifold Assembly (Non-DPS Models)



Dynamic Power Steering (DPS)

The DPS system consists of a hydraulic steering helm, hydraulic hoses, hydraulic fluid, the DPS module, and a hydraulic DPS steering pump assembly.

The DPS module monitors and controls the DPS system. The *EMM* monitors the DPS module, stores fault codes and activates the engine monitor should a fault code be generated.

Also refer to the **DPS Troubleshooting Tables** and **Fault Code Table** at the end of this manual

If the DPS motor circuit is OPEN, the *EMM*:

Stores fault code 211
Engine Monitor: CHECK ENGINE display ON

If DPS motor current exceeds allowed limit, the *EMM*:

Stores fault code 216
Engine Monitor: CHECK ENGINE display ON

If DPS module supply voltage is less than 5 volts, the *EMM*:

Stores fault code 217
Engine Monitor: CHECK ENGINE display ON

If DPS module temperature exceeds 176° F (80° C), the *EMM*:

Stores fault code 218
Engine Monitor: CHECK ENGINE display ON

ABA Models (DPS-1)

The DPS system of **ABA** engine models includes a 500 psi (3447 kPa) helm pressure sensor and a 2000 psi (13790 kPa) pump pressure sensor.

As the steering wheel is turned hydraulic fluid in the helm begins moving through the steering system.

The helm pressure sensor signals the DPS module of an increase in hydraulic pressure in the direction of the turn. The DPS module then turns ON the DPS pump providing steering assistance.

As the outboard approaches the steering system stop, the pump pressure sensor signals the DPS module of an increase in hydraulic pressure beyond normal steering load. The DPS module then turns OFF the DPS pump to maximize system efficiency.

The DPS Module monitors Helm Pressure Sensor (HPS) voltage and Pump Pressure Sensor (PPS) voltage.

If HPS voltage is less than 0.12 V, the *EMM*:

Stores fault code 212
Engine Monitor: CHECK ENGINE display ON

If HPS voltage is greater than 4.6 V, the *EMM*:

Stores fault code 213
Engine Monitor: CHECK ENGINE display ON

If HPS voltage, or PPS voltage is less than 0.12 V, the *EMM*:

Stores fault code 214
Engine Monitor: CHECK ENGINE display ON

If HPS voltage, or PPS voltage is greater than 4.6 V, the *EMM*:

Stores fault code 215
Engine Monitor: CHECK ENGINE display ON

AFA & Newer Models (DPS-2)

The DPS system of **AFA** and newer engine models includes 1500 psi (10342 kPa) port and starboard helm pressure sensors and a steering position sensor.

As the steering wheel is turned hydraulic fluid in the helm begins moving through the steering system.

One helm pressure sensor signals the DPS module of an increase in hydraulic pressure in the direction of the turn. The DPS module then

Stern and Swivel

Dynamic Power Steering (DPS)

detects a pressure differential between the two pressure sensors and turns ON the DPS pump providing steering assistance.

The DPS module also monitors the steering position sensor. As the outboard approaches the steering system stop, the DPS module turns OFF the DPS pump to maximize system efficiency.

The DPS Module monitors Port Pressure Sensor (PTPS) voltage and Starboard Pressure Sensor (STPS) voltage.

If PTPS voltage is less than 0.12 V, the *EMM*:

Stores fault code 212
Engine Monitor: CHECK ENGINE display ON

If PTPS voltage is greater than 4.6 V, the *EMM*:

Stores fault code 213
Engine Monitor: CHECK ENGINE display ON

If STPS voltage is less than 0.12 V, the *EMM*:

Stores fault code 214
Engine Monitor: CHECK ENGINE display ON

If STPS voltage is greater than 4.6 V, the *EMM*:

Stores fault code 215
Engine Monitor: CHECK ENGINE display ON

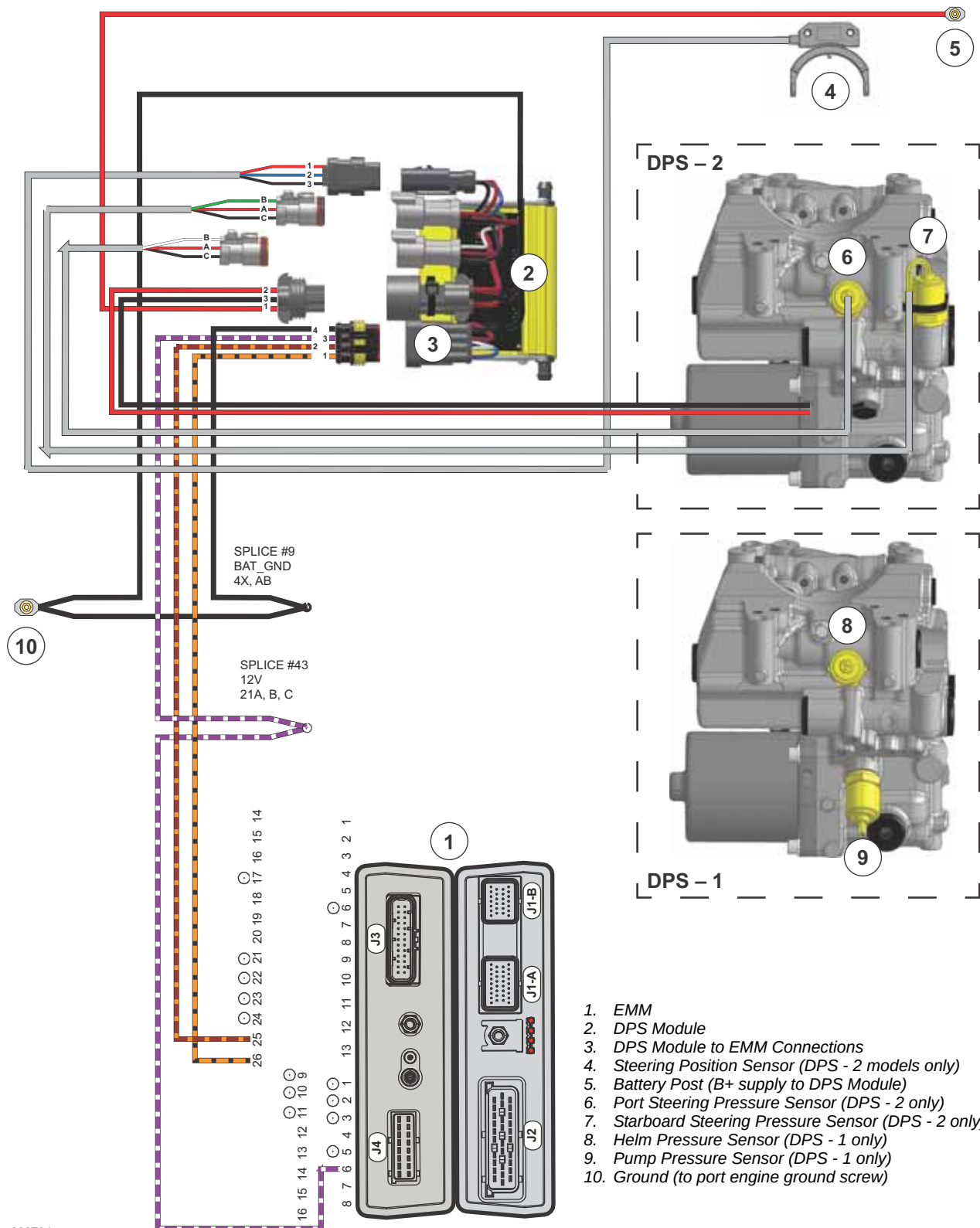
If Steering Sensor (STS) voltage is less than 0.12 V, the *EMM*:

Stores fault code 220
Engine Monitor: CHECK ENGINE display ON

If STS voltage is greater than 4.88 V, the *EMM*:

Stores fault code 221
Engine Monitor: CHECK ENGINE display ON

DPS Electrical Circuit Diagram



009734

DPS System Tests

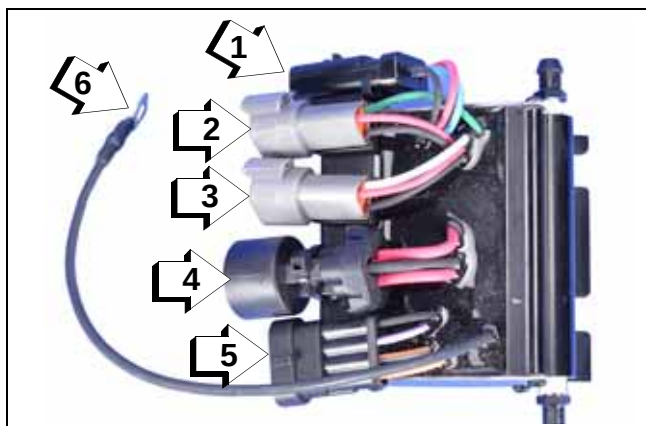
NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

The DPS module circuits can be tested on or off the outboard.

Disconnect the battery cables at the battery. Disconnect the electrical connectors from the DPS module.



DPS Module Connectors

009402

1. Steering Position
2. Pressure Sensor 2
3. Pressure Sensor 1
4. Steering Motor
5. CANbus (communication)
6. Ground (to port engine ground screw)

Steering Ground Circuits

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Connect the positive meter lead to the DPS Module connector/ wire listed in the table.

Connect the negative meter lead to engine ground.

DPS Module Ground Circuit

Connector/ Wire	Pin	Result
Steering Position/ Black	3	<1 Ω
Pressure Sensor 2 / Black	C	
Pressure Sensor 1 / Black	C	

Results:

- Readings as listed in table indicate circuit is good.
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

Steering Supply Circuits

Use the diode test function of a digital multimeter to check the supply circuits.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

DPS Module Steering Supply Circuit (Diode Test)

Connector/Wire	Pin	Result
Steering Position/ Red	1	approximately 0.5 VDC
Pressure Sensor 2 / Red	A	
Pressure Sensor 1 / Red	A	
Steering Motor/ Red	2	1.2 to 1.4 VDC
Steering Motor/ Red	1	1.4 to 1.55 VDC

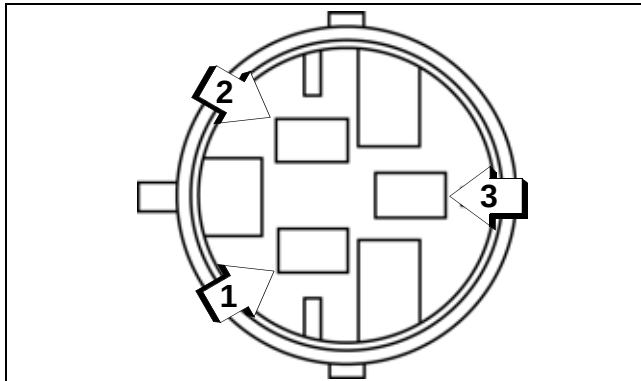
Results:

- Readings as listed in table indicate circuit is good.
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

Steering Motor Circuits

Use the diode test function of a digital multimeter to check the steering motor circuit.



Steering Motor Connector

1. Pin 1 (lower, Module B+)
2. Pin 2 (upper, Motor B+)
3. Pin 3 (middle, black wire)

009403

Connect the meter leads as listed in the table below.

DPS Motor Circuit (Diode Test)		
Meter Lead	Pin	Result
Positive meter lead to:	2	approximately 0.5 VDC
Negative meter lead to:	1	
Negative meter lead to:	2	open load
Positive meter lead to:	1	
Negative meter lead to:	3	2.43 VDC
Positive meter lead to: Engine ground	—	

Results:

- Readings as listed in table indicate circuit is good.
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Replace faulty module.

Steering Sensor Circuits

Use the diode test function of a digital multimeter to check the signal circuit.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

DPS Module Sensor Circuits (Diode Test)		
Connector/Wire	Pin	Result
Steering Position/ Blue	2	approximately 0.5 VDC
Pressure Sensor 2 / Green	B	
Pressure Sensor 1 / White	B	

Results:

- Readings as listed in table indicate circuit is good.
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Replace faulty module.

CANbus Circuit

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Connect the positive meter lead to the DPS Module connector/ wire listed in the table.

Connect the negative meter lead to engine ground.

CANbus Circuit Resistance Test		
Connector/Wire	Pin	Result
CAN (Orange/Black)	1	120 Ω
CAN (Brown/Orange)	2	
CAN (Purple/White)	3	N/A
CAN (Black)	4	<1 Ω

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

Replace faulty module.

Steering Pressure Sensor Tests

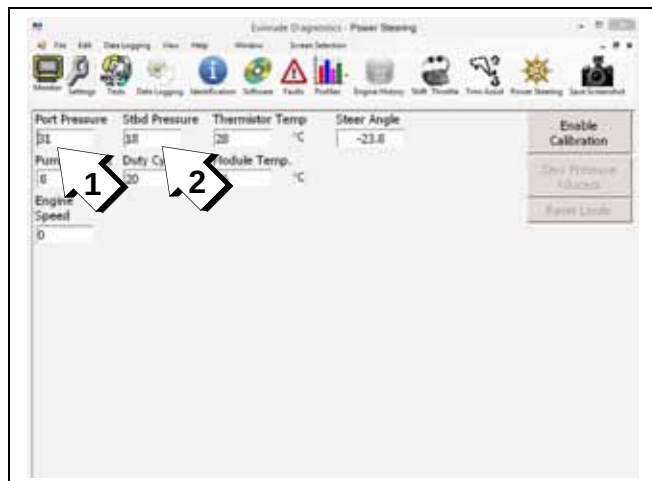
Use *Evinrude Diagnostics* software v 6.1 or higher to observe *Port Pressure* and *Starboard Pressure*.

Stern and Swivel

Steering Position Sensor Service

Turn the steering wheel fully to PORT. While holding the steering wheel against the stop, observe *Port Pressure*. Then turn the steering wheel fully to STARBOARD. While holding the steering wheel against the stop, observe *Starboard Pressure*.

Pressure should be approximately 1000 psi (6895 kPa) for a standard helm, or 1500 psi (10342 kPa) for a *Pro-Series* or *SVS-Series* helm.

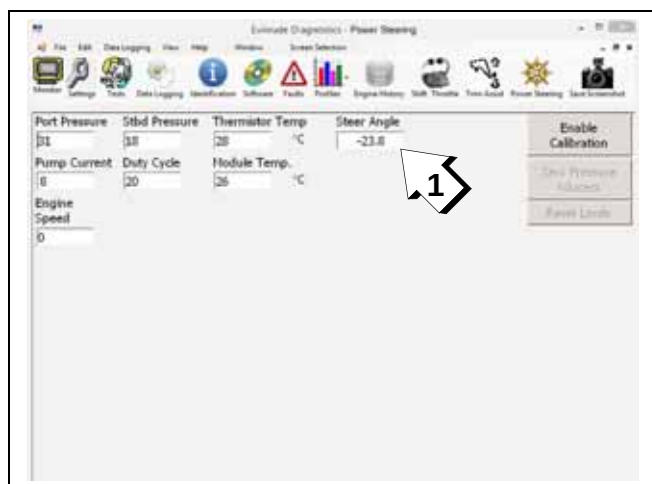


1. Port Pressure
2. Starboard Pressure

009401

Steering Position Sensor Test

Use *Evinrude Diagnostics* software v 6.1 or higher to observe steering angle while turning the steering wheel.



1. Steering Angle

009401

Steering Position Sensor Service

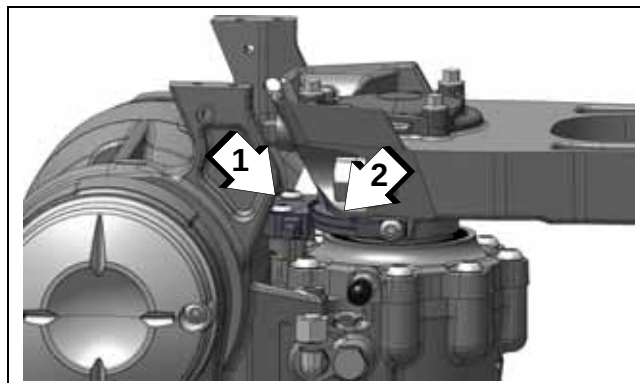
Remove two screws from the sensor and two screws from the magnet.

NOTICE

The steering position sensor includes a sensor and a magnet which is a matched set.

When replacing a steering position sensor, replace **BOTH** the sensor and magnet.

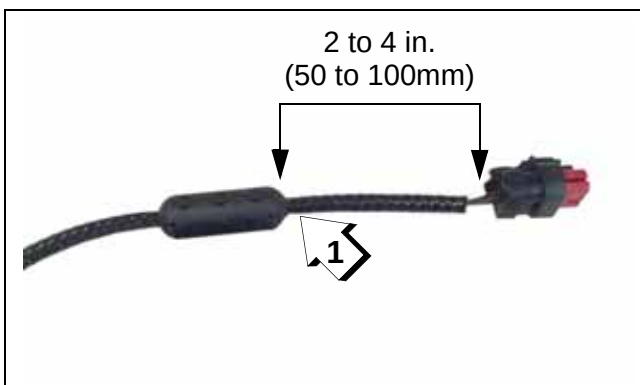
Assembly is the reverse of disassembly. Tighten all screws to a torque of 35 to 60 in. lbs. (4 to 6.7 N·m).



1. Sensor
1. Magnet

009745

IMPORTANT: The steering position sensor uses a clamp-on ferrite suppressor. Remove the suppressor from the old sensor. Install the suppressor on the sleeve of the new sensor, within 2 to 4 in. (50 to 100 mm) of the electrical connector.



1. Ferrite suppressor

009747

IMPORTANT: Calibrate the DPS system after installing the steering position sensor. Refer to **DPS System Calibration** on p. 309.

DPS Module Service

Cover and Frame Removal

Remove the top, port, front and rear covers. Next remove the port and front frames. Refer to **Engine Cover and Frame Service** on p. 55.

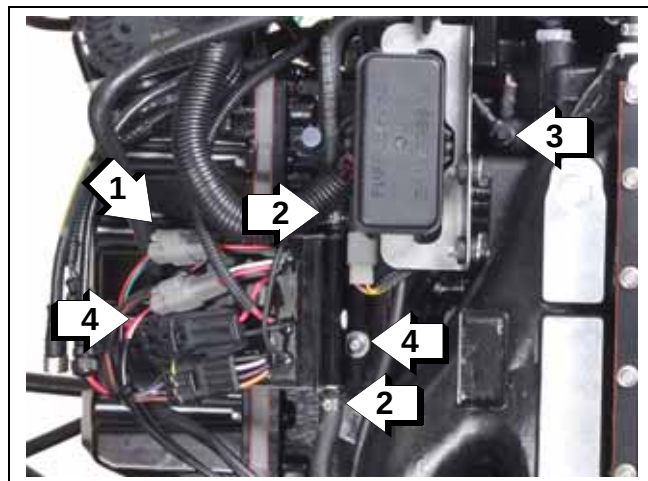
DPS Module Removal

Disconnect the electrical connectors from the DPS module.

Remove the *Oetiker* clamps from the upper and lower cooling hoses, then remove the cooling hoses from the DPS module.

Remove the ground wire from the ground screw on the engine block.

Remove the three DPS module mounting screws and washers.



1. Electrical connectors
2. Oetiker clamps and cooling hoses
3. Ground screw
4. Mounting screws

009393

Remove the DPS module from the engine.

DPS Module Installation

If installing the DPS module on an ABA engine model, install the Connector and Seal Assembly, P/N 587328, on the steering position sensor connector.



1. Connector and seal
2. Steering position sensor connector

009394

Install the DPS module onto the engine.

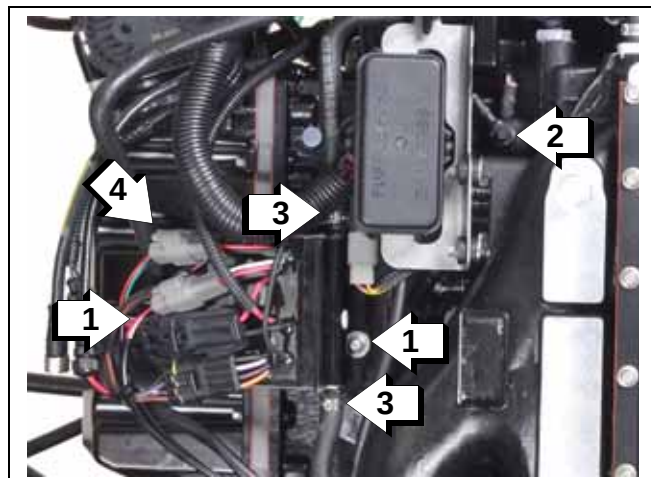
Install the three DPS module washers and mounting screws. Tighten the screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).

Install the ground wire onto the ground screw of the engine block. Tighten the screw to a torque of 84 to 106 in.lb. (9.5 to 12 N·m).

Install the cooling hoses onto the DPS module. Secure the hoses with new 15.7 mm *Oetiker* clamps.

Stern and Swivel DPS Module Service

Connect the electrical connectors to the DPS module.



1. Mounting screws
2. Ground screw
3. Cooling hoses and Oetiker clamps
4. Electrical connectors

009393

DPS Software Installation

NOTICE

Installing incorrect DPS software will cause:

- Fault codes 220 and 221 on ABA models
- DPS pump to run continuously on AFA models

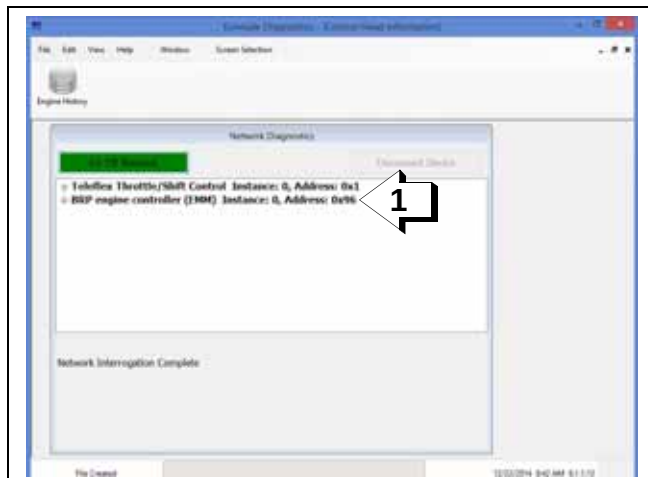
Upload the correct software to replacement DPS modules after installing the DPS module on the engine. Refer to the table below.

Engine Model	Version	Revision
ABA (DPS-1)	3030541	34025
AFA & newer (DPS-2)	3030559	35139 or higher
AFA & newer <i>i-Dock</i> installation only	3030559	35139A or higher

Use *Evinrude Diagnostics* software v 6.1 or higher to upload DPS software.

Connect the MPI-2 and adapter cable to the laptop and to the *NMEA 2000* network. Turn the key switch to the ON position, then start the diagnostic program.

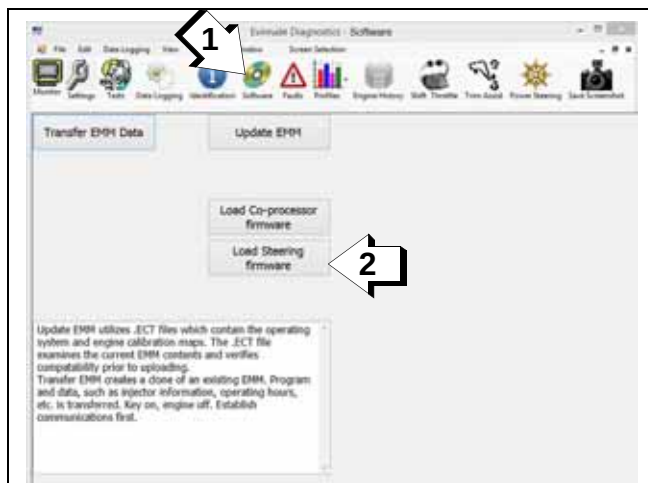
After the program connects to the network, select from the device list the *Engine Controller (EMM)*.



1. Engine controller

009392

When the diagnostic program connects to the outboard, select the *Software* button, then select the *Load Steering Firmware* button.



1. Software button
2. Load Steering Firmware button

009287

A pop-up window will appear. Select the correct software from the list. Then follow the on-screen prompts to install the software into the DPS module.

After the software is installed, turn the key switch OFF and then ON to complete the process.

DPS System Calibration

⚠ WARNING

The DPS system of AFA and newer outboards **REQUIRES** calibration when:

- installing multiple outboards (initial installation)
- replacing a DPS module
- replacing a steering pressure sensor
- replacing a steering position sensor

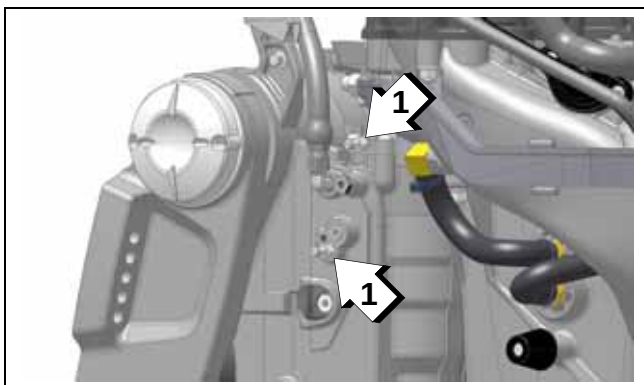
Failure to complete DPS system calibration can cause damage to the tie bar(s) and/or the transom of the boat due to overloading.

Steering Pressure Sensor Calibration (AFA and Newer Models Only)

IMPORTANT: Calibrate the pressure sensor when:

- replacing a DPS module
- replacing a steering pressure sensor

Connect a piece of tubing to each bleed valve. Insert the open end of the tubing into a container appropriate for collecting hydraulic steering fluid.



1. Bleed valves

009396

Open the both bleed valves at least one-half turn to relieve pressure on the hydraulic steering system.

Wipe up any spilled steering fluid with shop towels.

ENVIRONMENTAL NOTE:

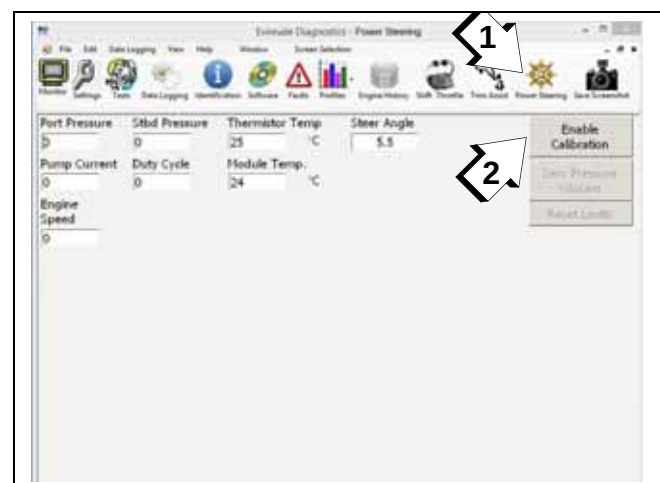
Dispose of contaminated shop towels according to local environmental regulations.

Use *Evinrude Diagnostics* software v 6.1 or higher to calibrate steering pressure sensors.

Connect the MPI-2 and adapter cable to the laptop and the *NMEA 2000* network. Turn the key switch to the ON position, then start the diagnostic program.

After the program connects to the network, select from the device list the *Engine Controller (EMM)*. Then select the *Power Steering* button.

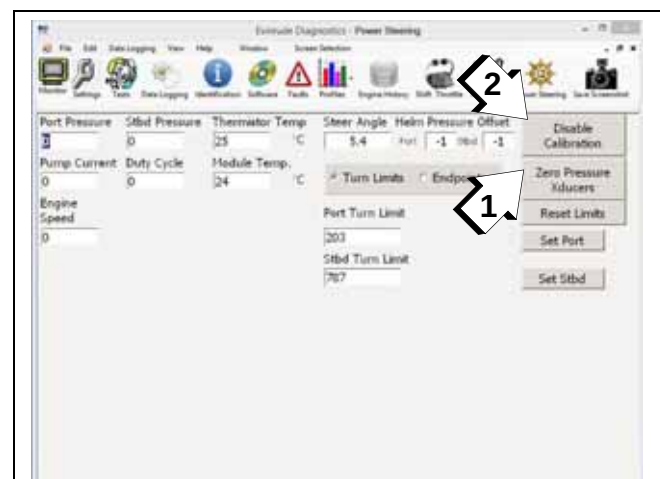
1. Select *Enable Calibration*, The power steering pump is disabled while in calibration mode.



1. Enable Calibration

009397

2. Select *Zero Pressure Sensors*. The button will deactivate while setting the ZERO point. Wait for the button to activate BEFORE continuing.
3. Select *Disable Calibration* to save the setting and re-enable the power steering pump.



1. Zero Pressure Sensors
2. Disable Calibration

009398

Stern and Swivel

DPS Module Service

Bleed the steering system. Refer to **Filling and Bleeding the Hydraulic Steering System** on p. 48.

Steering Position Sensor Calibration (AFA and Newer Models Only)

IMPORTANT: Calibrate the steering position sensor when:

- replacing a DPS module
- replacing a steering position sensor

Use *Evinrude Diagnostics* software v 6.1 or higher to calibrate the steering position sensor.

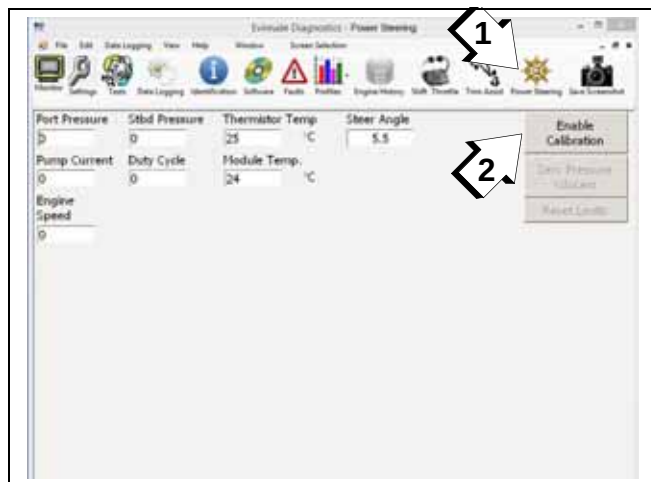
Single Outboard Installation

Single outboard installations require calibration of the **End Point** only.

Connect the MPI-2 and adapter cable to the laptop and the *NMEA 2000* network. Turn the key switch to the ON position, then start the diagnostic program.

After the program connects to the network, select from the device list the *Engine Controller (EMM)*. Then select the *Power Steering* button.

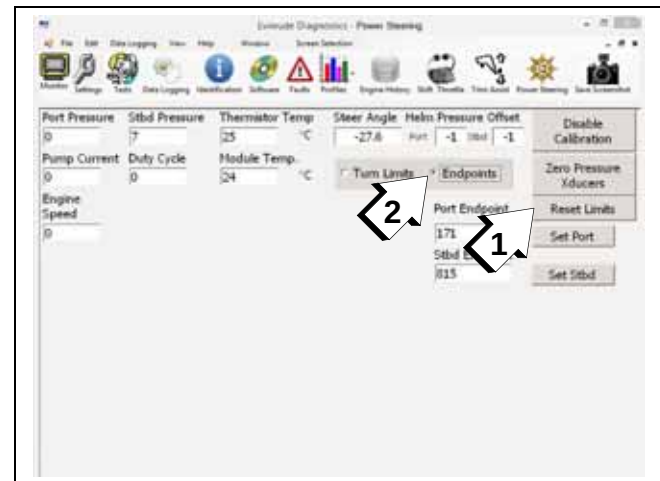
1. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.



1. Enable Calibration

009397

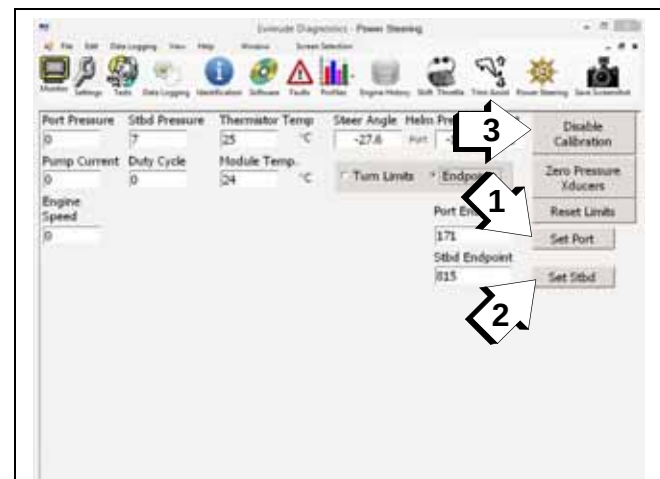
2. Press *Reset Limits*. Then be SURE to select *End Points*.



1. Reset Limits
2. End Points

009399

3. Turn the steering wheel until the outboard is turned fully to PORT. Then press the *Set Port* button. The button will deactivate while setting the PORT end point. Wait for the button to activate BEFORE continuing.
4. Turn the steering wheel until the outboard is turned fully to STARBOARD. Then press the *Set Starboard* button. The button will deactivate while setting the STARBOARD end point. Wait for the button to activate BEFORE continuing.
5. Select *Disable Calibration* to save the settings and re-enable the power steering pump.



1. Set Port
2. Set Starboard
3. Disable Calibration

009399

Test the steering system. See **Steering System Test** on p. 313.

Multiple Outboard Installations (AFA and Newer Models Only)

NOTICE

Failure to complete steering sensor calibration on multiple engine applications can result in damage to the tie bar(s) and/or the transom of the boat due to overloading.

For installations with two DPS equipped outboards:

- The power steering pumps of both engines must NOT run during the calibration procedure.
- The diagnostics software will disable the pump for outboard being calibrated.
- Disconnect the battery cables at the battery for the second DPS equipped outboard.

Failure to disable the power steering pump of the second outboard can damage the outboard and or tie bar(s).

IMPORTANT: Calibrate the steering position sensors on multiple engine installations when:

- installing outboards for the first time
- replacing a DPS module
- replacing a steering position sensor

Multiple outboard installations REQUIRE calibration of each DPS equipped outboard. Calibrate the **End Point** of both outboards FIRST. Then calibrate the **Turn Limit** of both outboards.

Calibrate End Points

NOTICE

Calibrating end points requires disconnecting the tie bar(s). During this procedure outboards could contact, resulting in damage to the engine covers. Have an assistant manually move outboards to prevent damage.

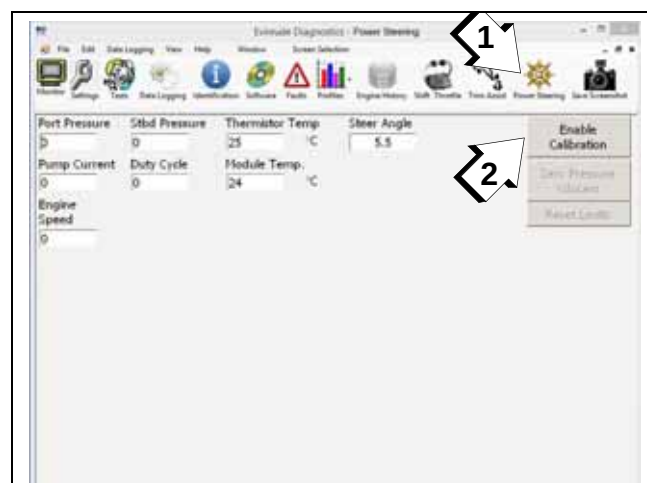
Before calibrating End Points:

- disconnect the tie bar(s) from the outboards
- in installations with two DPS outboards disconnect the battery cables at the battery for the SECOND DPS outboard

Connect the MPI-2 and adapter cable to the laptop and the NMEA 2000 network. Turn the key switch to the ON position, then start the diagnostic program.

After the program connects to the network, select from the device list the *Engine Controller (EMM)* for the FIRST DPS outboard. Then select the *Power Steering* button.

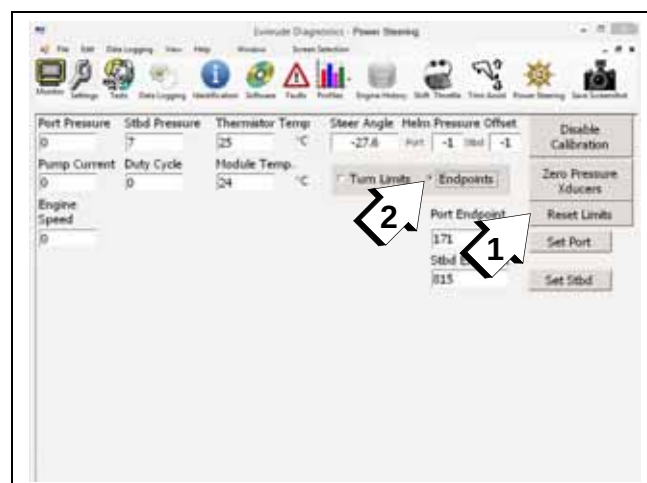
1. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.



1. *Enable Calibration*

009397

2. Press *Reset Limits*. Then be SURE to select **End Points**.



1. *Reset Limits*
2. *End Points*

009399

3. Slowly turn the steering wheel until the outboard is turned fully to PORT.

Stern and Swivel

DPS Module Service

IMPORTANT: Make sure outboards do not contact. Slowly turn the steering wheel, while an assistant manually moves the disconnected outboards.

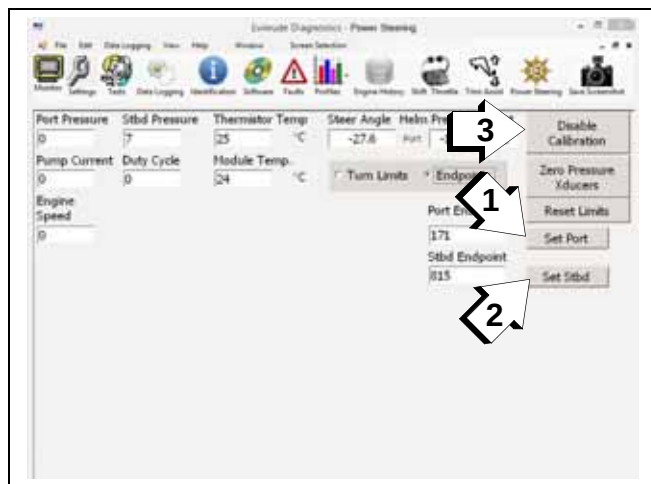
4. Then press the *Set Port* button. The button will deactivate while saving the PORT end point. Wait for the button to activate BEFORE continuing.

5. Slowly turn the steering wheel until the outboard is turned fully to STARBOARD.

IMPORTANT: Make sure outboards do not contact. Slowly turn the steering wheel, while an assistant manually moves the disconnected outboards.

6. Then press the *Set Starboard* button. The button will deactivate while saving the STARBOARD end point. Wait for the button to activate BEFORE continuing.

7. Select *Disable Calibration* to save the setting and re-enable the power steering pump.



1. *Set Port*
2. *Set Starboard*
3. *Disable Calibration*

009399

Before calibrating the SECOND DPS outboard:

- turn the key switch to the OFF position.
- disconnect the battery cables at the battery for the FIRST DPS outboard
- connect the battery cables at the battery for the SECOND DPS outboard
- Turn the key switch to the ON position

Start the diagnostic program. After the program connects to the network, select from the device list the *Engine Controller (EMM)* for the SECOND DPS outboard. Then select the *Power Steering* button.

8. Repeat steps 1 through 7 for the SECOND DPS outboard.

After completing end points calibration, calibrate the turn limits. See **Calibrate Turn Limits** on p. 312.

Calibrate Turn Limits

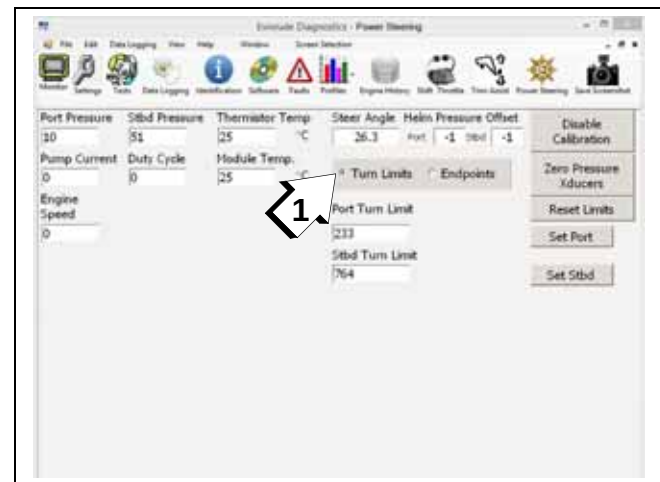
Before calibrating Turn Limits:

- connect tie bar(s) to the outboards
- adjust outboard alignment
- in 3 or 4 outboard installations disconnect the battery cables at the battery for the SECOND DPS model outboard

Turn the key switch to the ON position, then start the diagnostic program.

After the program connects to the network, select from the device list the *Engine Controller (EMM)* for the FIRST DPS outboard. Then select the *Power Steering* button.

1. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.
2. Then be SURE to select **Turn Limits**.



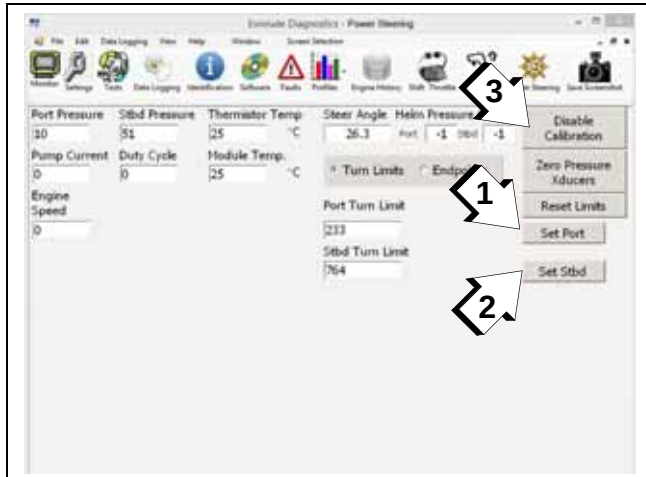
1. *Turn Limits*

009400

2. Turn the steering wheel until the outboards are turned fully to PORT. Then press the *Set Port* button. The button will deactivate while setting the PORT turn limit. Wait for the button to activate BEFORE continuing.
3. Turn the steering wheel until the outboards are turned fully to STARBOARD. Then press the *Set Starboard* button. The button will deactivate while setting the STARBOARD turn limit.

Wait for the button to activate BEFORE continuing.

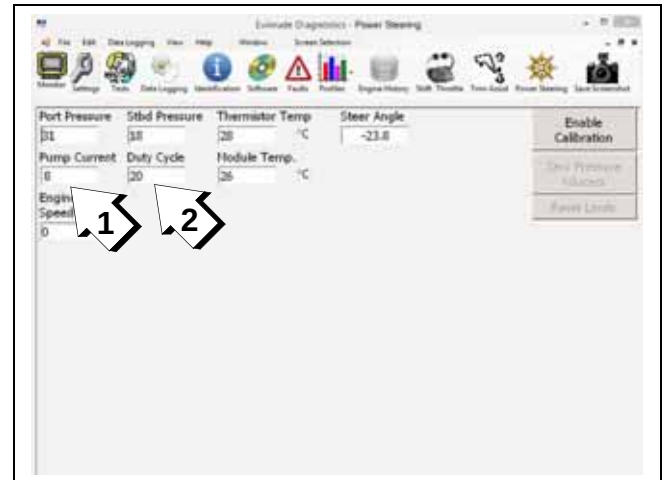
4. Select *Disable Calibration* to save the settings and re-enable the power steering pump.



1. Set Port
2. Set Starboard
3. Disable Calibration

009400

screen of *Evinrude Diagnostics* software to monitor the pump *Current* and *Duty Cycle*.



1. Pump Current
2. Duty Cycle

009401

These values should be zero when the pump is NOT running.

Before calibrating the SECOND DPS outboard:

- turn the key switch to the OFF position.
- disconnect the battery cables at the battery for the FIRST DPS outboard
- connect the battery cables at the battery for the SECOND DPS outboard
- Turn the key switch to the ON position

4. Repeat steps 1 through 5 for the SECOND DPS outboard.

Connect the battery cables at the battery, then test the steering system. See **Steering System Test** below.

Steering System Test

Turn the steering wheel fully to PORT. The power steering pump should run, then shut OFF when the engine is turned fully to PORT.

Turn the steering wheel fully to STARBOARD. The power steering pump should run, then shut OFF when the engine is turned fully to STARBOARD.

In some installations it may be difficult to hear the power steering pump run. Use the *Power Steering*

Cover and Frame Installation

Install the front and port frames. Then install the top, port, front and rear covers. Refer to **Engine Cover and Frame Service** on p. 55.

DPS Manifold Service

NOTICE

Service procedures of hydraulic manifolds **MUST** occur in a clean, dust-free environment.

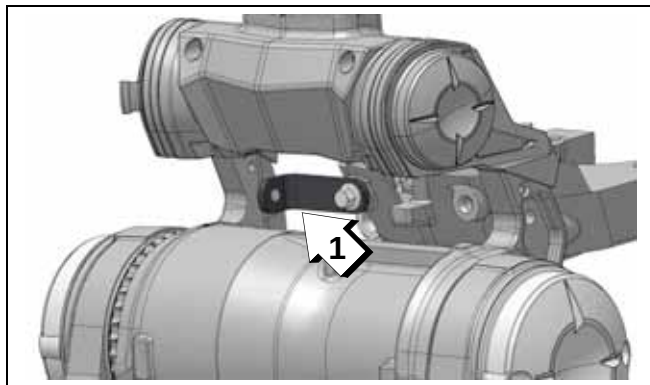
When cleaning components use lint-free shop towels.

Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

Remove the engine from the stern and swivel bracket. Then remove the stern and swivel bracket from the boat and place it on a suitable work bench. Refer to **Stern & Swivel Bracket Removal** on p. 334.

Removal

Install a shipping bracket with two screws to prevent the engine from turning and spilling additional hydraulic steering fluid.

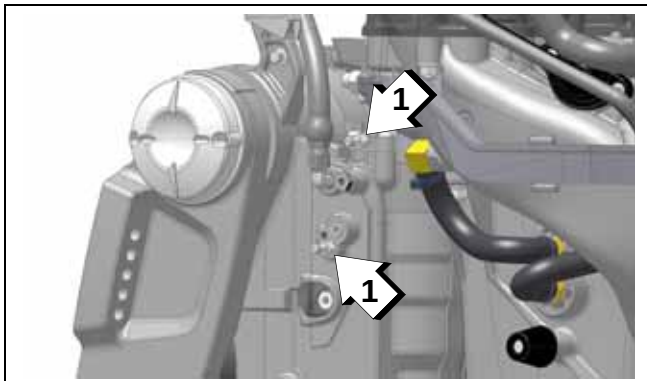


1. Shipping bracket

009439

If the shipping bracket holes do not align with the stern or swivel brackets open the steering system bleed valves one-half turn. This will allow the

swivel bracket to pivot. After the shipping bracket is installed, close the bleed valves



1. Bleed valves

009396

Wipe off any spilled hydraulic fluid.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Place the stern and swivel bracket in a clean work area. Place oil absorbent mats or shop towels in a large pan. Place the pan on a work bench and place the stern and swivel bracket in the pan.



1. Large pan

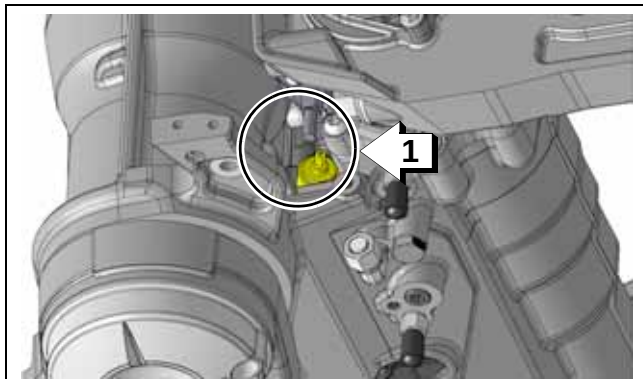
2. Oil absorbent mats

009490

A quantity of hydraulic oil will spill as the manifold assembly is removed from the swivel bracket.

Position electrical wiring to the port side of the stern and swivel bracket for removal. Wiring must

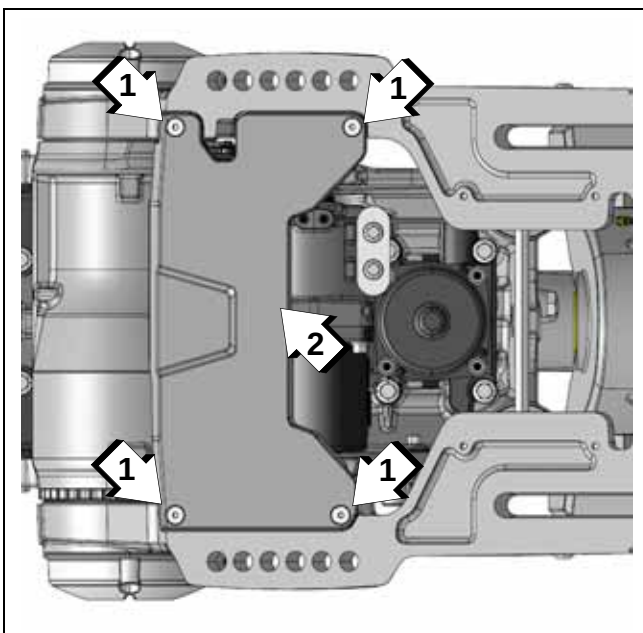
pass through the area shown. Do NOT attempt to remove wiring at this time.



1. Wiring pass-through area

009446

Remove the four screws retaining the plate to the stern brackets. Then remove the plate.



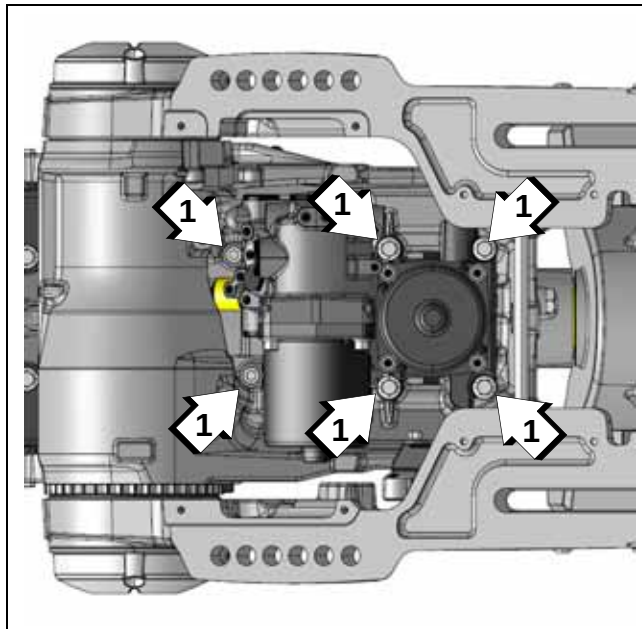
1. Screw
2. Plate

009433

Remove the trim sender from the port stern bracket. Do NOT remove the trim sender wires at this time. Refer to **Trim Sender Service** on p. 344.

Remove the two cap screws and washers retaining the DPS manifold and the four hex screws

retaining the trim manifold. The DPS and trim manifolds are removed as one assembly.



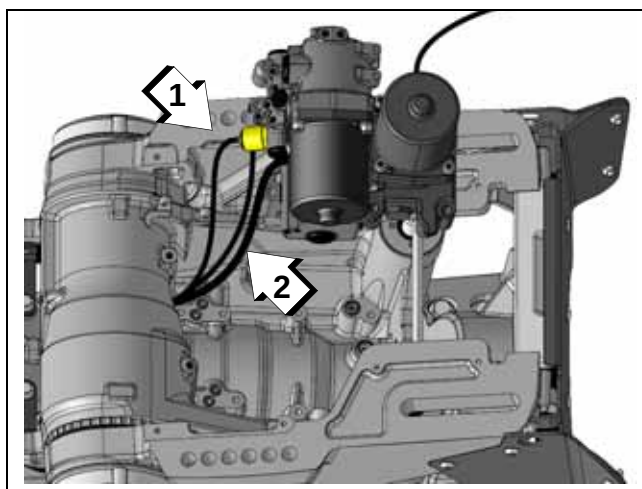
1. Screws

009433

Carefully remove the manifold assembly from the outboard. Use shop towels to wipe up spilled hydraulic oil.

After the manifold is removed, carefully remove leads and cables through the port side of the swivel bracket in this order:

- trim sender lead
- trim motor cable
- steering pressure sensor leads
- DPS motor cable



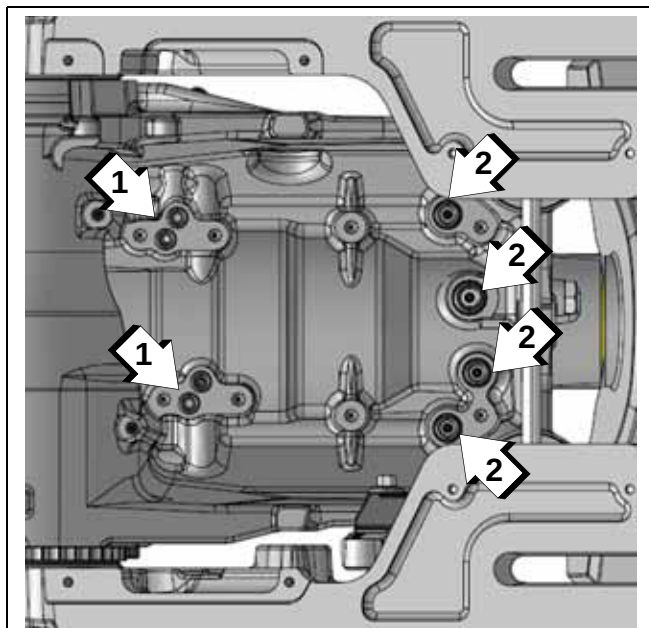
1. Steering pressure sensor leads
2. DPS motor cable

009433

Stern and Swivel DPS Manifold Service

Remove the four DPS manifold o-rings from the swivel bracket.

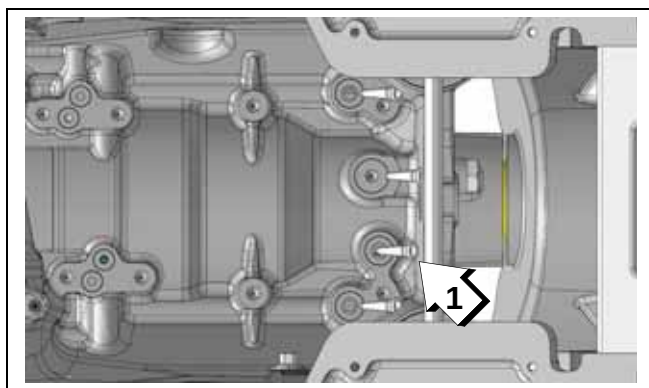
Remove the four trim manifold o-rings from the swivel bracket.



1. Four DPS manifold o-rings
2. Four trim manifold o-rings and filters

009433

Remove the four trim and tilt filters from the swivel bracket.



1. Filters

009441

Cleaning and Inspection

NOTICE

Apply cleaning solvent to lint-free shop towels to clean hydraulic oil residue from all surfaces.

Do NOT spray cleaning solvent on the swivel bracket. Solvent can seep into oil passages resulting in contamination of hydraulic fluids.

Use lint-free shop towels to wipe up spilled hydraulic fluid.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Installation

NOTICE

Make sure ALL mating surfaces of the DPS/TNT manifolds and stern and swivel bracket are COMPLETELY CLEAN AND FREE OF ALL DEBRIS.

Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

Service replacement manifold assemblies may have filters installed, or included in the packaging.

IMPORTANT: Identify filters and o-rings. Ensure filters and o-rings are installed in their correct locations before installing the DPS / Trim and Tilt manifold assembly.

The **DPS Manifold** uses:

- 4 Filters, P/N 357367, which are 1 in. (25.4 mm) long.
- 4 O-rings, P/N 326956, which are 0.237 in. (6 mm) inside diameter, x 0.103 in (2.6 mm) thick.

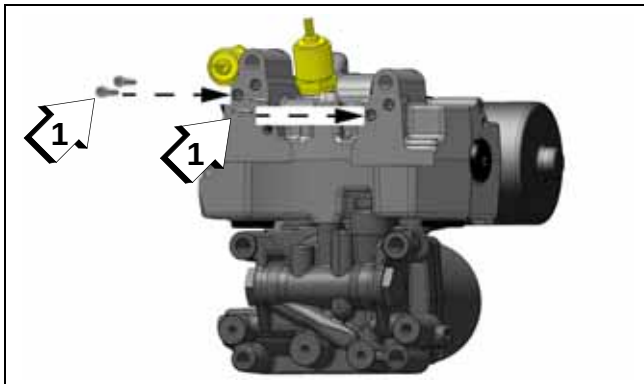
The **Trim and Tilt Manifold** uses:

- 4 Filters, P/N 356937, which are 0.875 in. (22.4 mm) long,

- 3 O-rings, P/N 326956, which are 0.299 in. (7.6 mm) inside diameter, x 0.103 in (2.6 mm) thick.
- 1 O-ring P/N 318372, which is 0.306 in (7.8 mm) inside diameter x 0.179 in. (4.5 mm) thick.

IMPORTANT: Install o-rings DRY. Do NOT use grease or adhesives to hold o-rings in position.

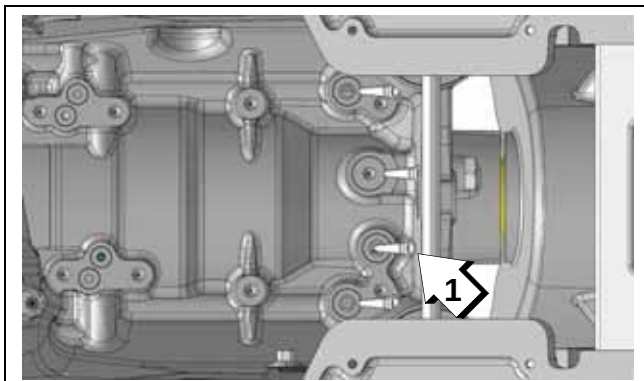
If the filters ARE installed into the DPS manifold, skip this step. If the filters are NOT installed, install four filters into the DPS manifold as shown.



1. Filters

009444

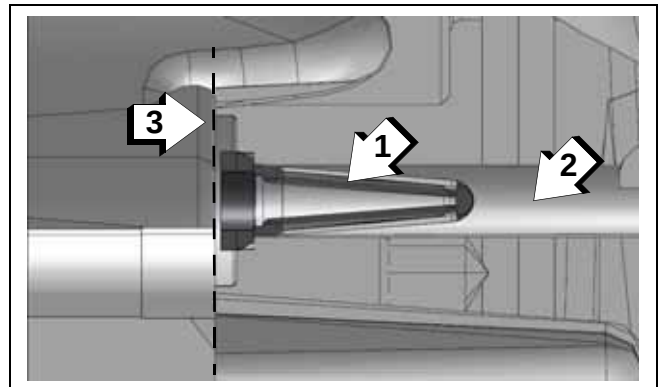
Insert a new filter into the each swivel bracket oil passage for the trim and tilt circuit.



1. Filters

009441

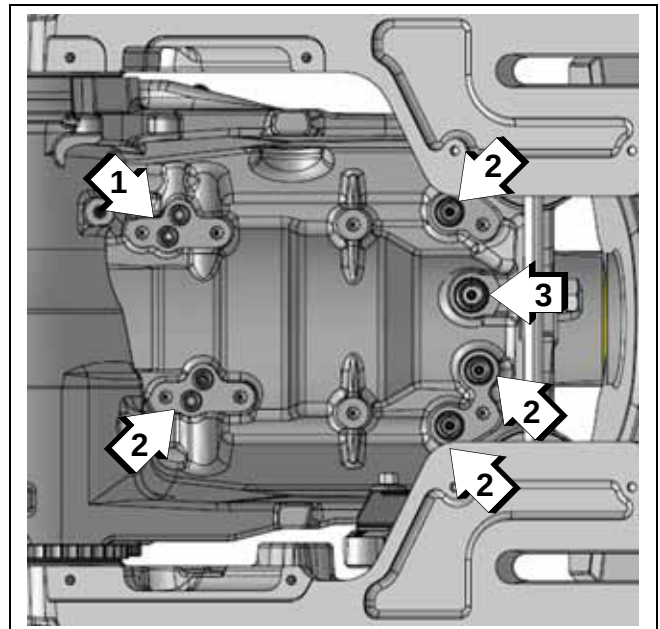
Continue to push the filter into the oil passage until the filter is just below the mating surface.



1. Filter
2. Oil passage (cross-sectioned view)
3. Mating surface

009442

Place the four DPS o-rings on the swivel bracket. Then place the four trim and tilt manifold o-rings on the swivel bracket and over the filters. Install the large diameter o-ring in the position shown.



1. DPS manifold o-rings
2. Trim and tilt manifold o-rings
3. Large o-ring

009433

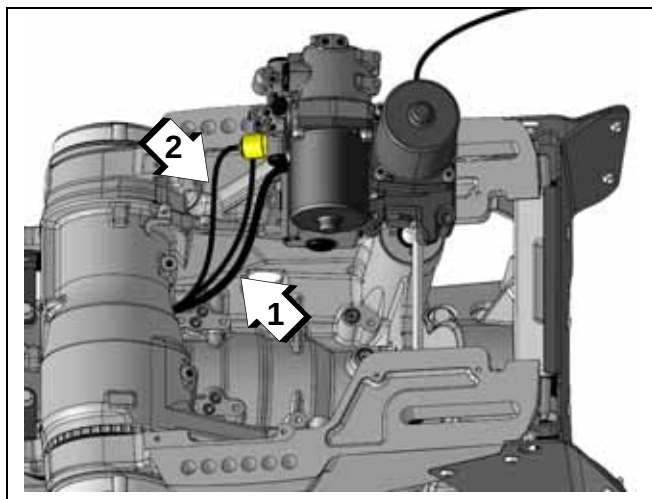
Position the manifold assembly close to the swivel bracket.

Stern and Swivel

DPS Manifold Service

Carefully install leads and cables through the port side of the swivel bracket in this order:

- DPS motor cable
- steering pressure sensor leads
- trim sender lead
- trim motor cable

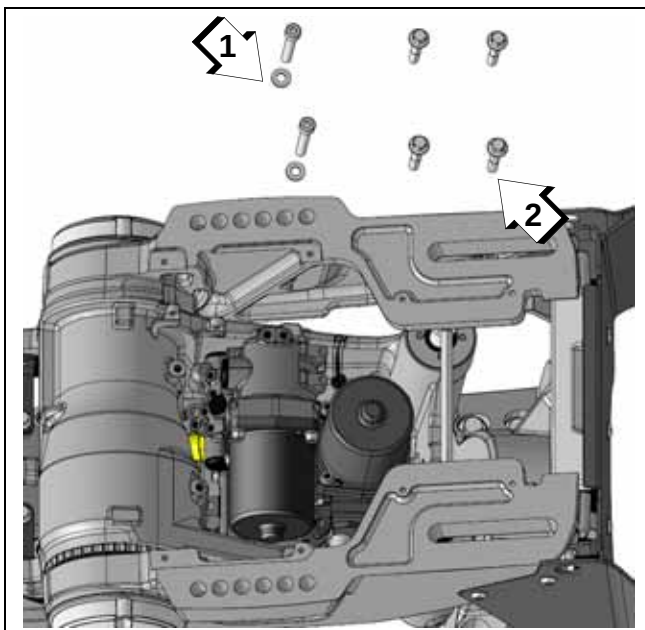


1. DPS motor cable
2. Steering pressure sensor leads

009433

Carefully place the manifold assembly into position on the swivel bracket. Take care to keep o-rings in position.

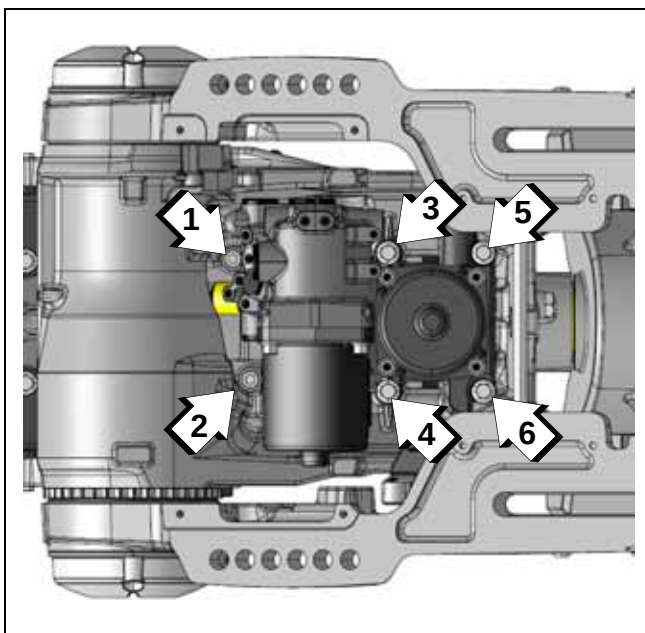
Install the two cap screws and washers into the DPS manifold and the four hex screws into the trim manifold.



1. Two cap screws and washers
2. Four hex screws

009433

Tighten screws in the sequence shown to a torque of 18 to 20 Ft. lbs. (24.4 to 27 N·m).

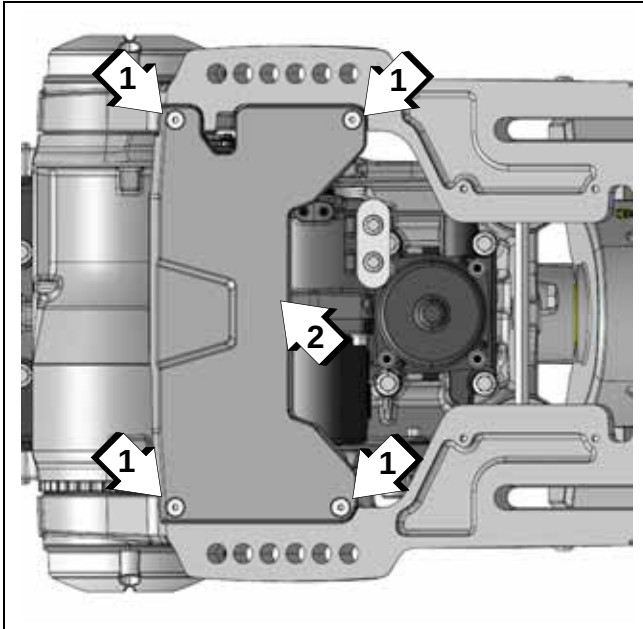


Tightening Sequence

009433

Install the trim sender on the port stern bracket. Refer to **Trim Sender Service** in the correct **Service Manual**.

Install the plate to the stern brackets with four screws. Tighten screws to a torque of 18 to 24 in. lbs. (2 to 2.7 N·m).

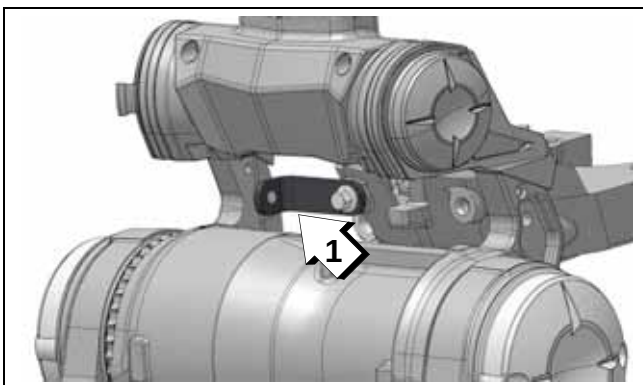


1. Plate
2. Screws

009433

Install the stern and swivel bracket on the boat, then install the engine to the stern and swivel bracket. Refer to **Stern & Swivel Bracket Installation** on p. 337.

Then remove the shipping bracket and two screws from the outboard.



1. Shipping bracket

009439

Fill and bleed the steering system.

Refer to **Filling and Bleeding the Hydraulic Steering System** on p. 48.

Calibrate the steering pressure sensors on AFA and newer models.

Refer to **Steering Pressure Sensor Calibration (AFA and Newer Models Only)** on p. 309.

Fill and bleed the trim and tilt system. refer to **Filling the Trim and Tilt System** on p. 332.

Confirm the trim and tilt fluid level is correct. Refer to **Trim and Tilt Fluid Level** on p. 332.

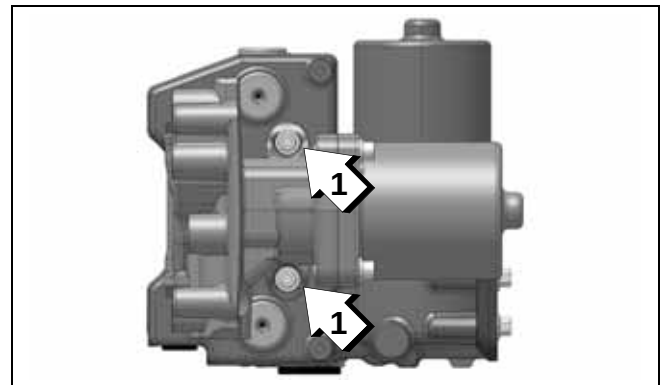
Install the port, starboard and front frames, and engine covers. Refer to **Engine Cover and Frame Service** on p. 55.

Disassembly

Service of the DPS manifold requires removal from the outboard. Refer to **DPS Module Removal** on p. 307.

Separate the DPS manifold from the trim manifold:

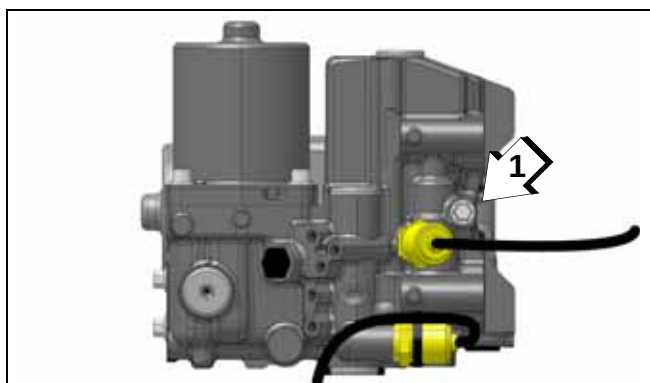
- Remove two screws and washers from the bottom of the trim manifold
- Remove one screw from the top of the DPS manifold



Bottom Of Trim Manifold
1. Two screws and washers

009454

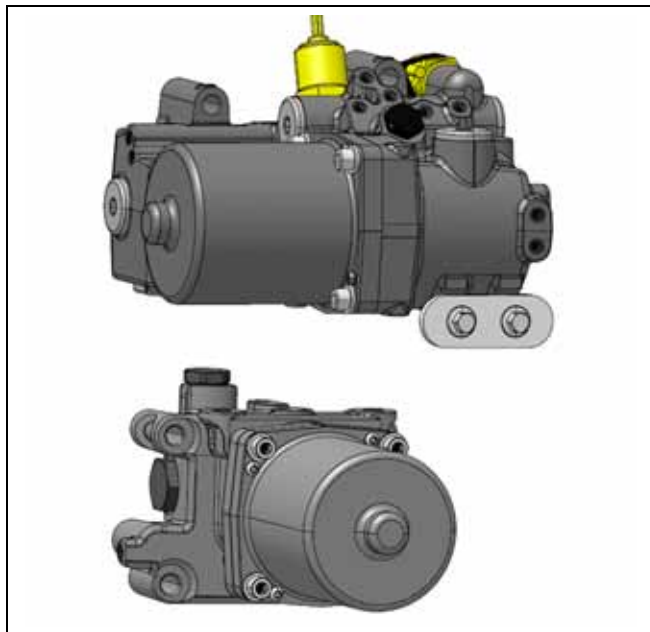
Stern and Swivel DPS Manifold Service



Top of DPS Manifold
1. Screw

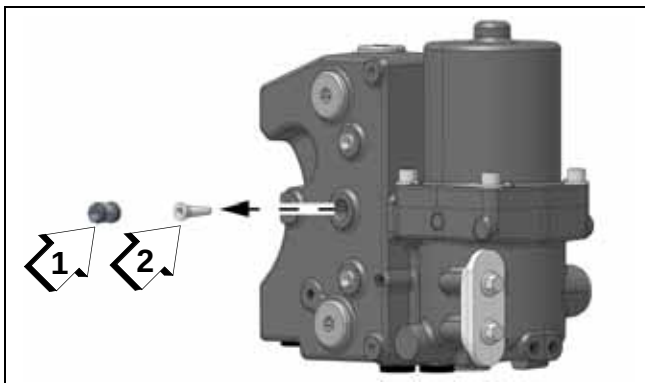
009455

Carefully separate the manifolds.



009456

Remove the tube and o-rings from the bottom of the DPS manifold. Then remove the filter.



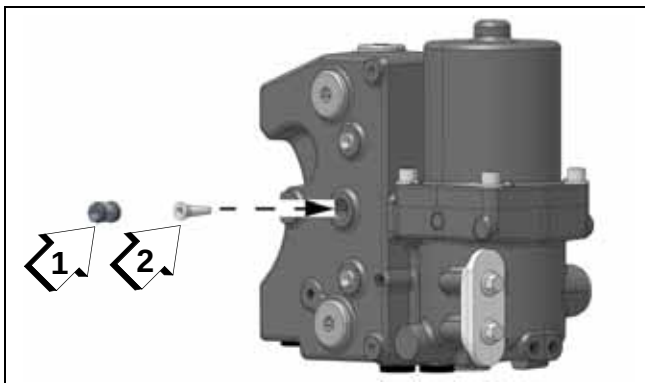
1. Tube and o-rings
2. Filter

009457

Clean and dry all parts thoroughly.

Assembly

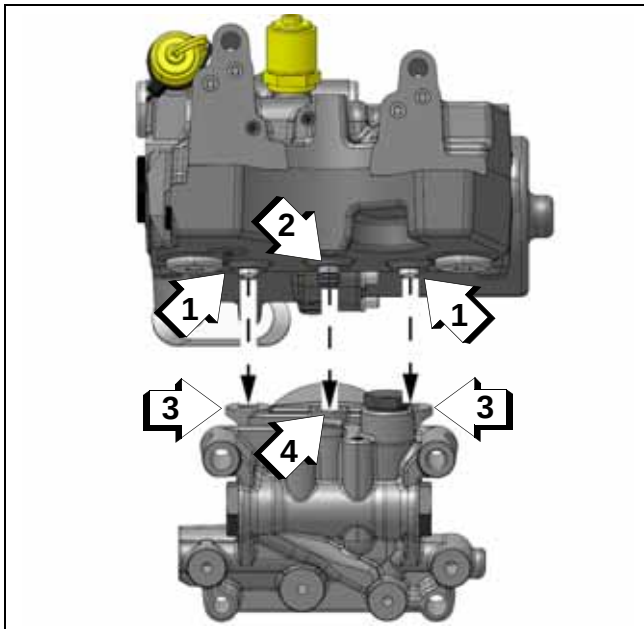
Install a new filter into the manifold. Apply a drop of *Power Trim/Tilt Fluid*, P/N 767969, to the o-rings of a new tube and o-ring assembly. Install the tube and o-rings into the manifold.



1. Filter
2. Tube and o-rings

009461

Align the sleeves, and tube and o-rings of the DPS manifold with the screw bosses, and fluid passage of the trim manifold.

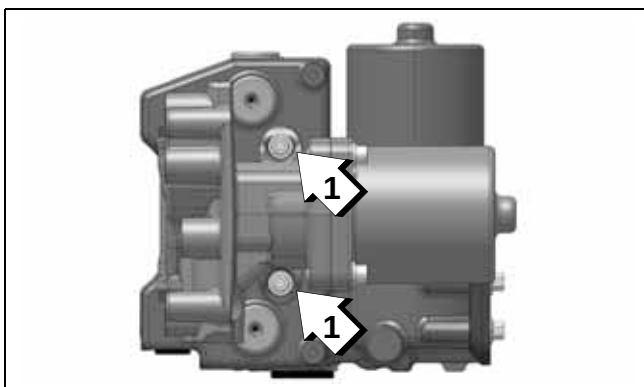


1. Sleeves
2. Tube and o-rings
3. Retaining screw bosses
4. Fluid passage

009462

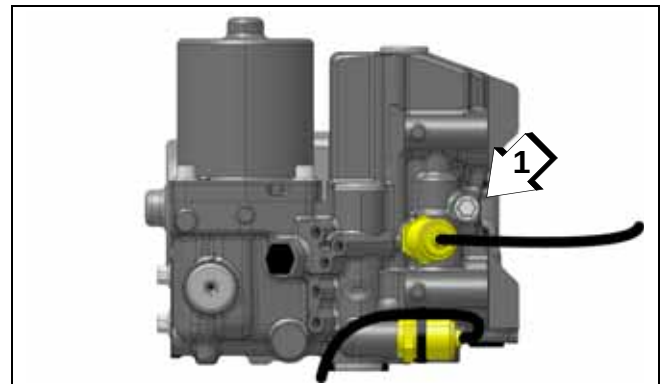
Assemble the manifolds.:

- Install two screws and washers from the bottom of the trim manifold
- Install one screw from the top of the DPS manifold



Bottom Of Trim Manifold
1. Two screws and washers

009454



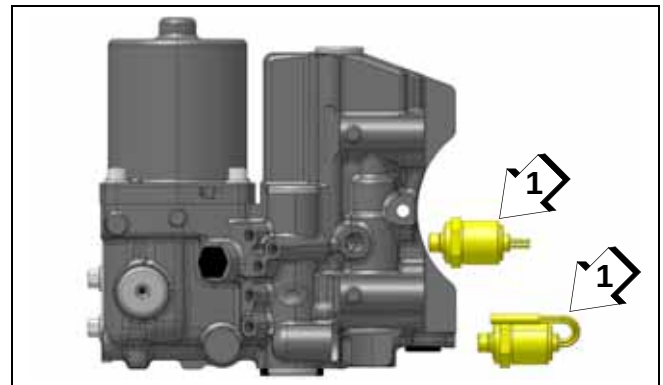
Top of DPS Manifold
1. Screw

009455

Tighten the screws to a torque of 60 to 84 In. lbs. (7 to 10 N·m).

Steering Pressure Sensors

Remove the steering pressure sensors as required for replacement.



1. Steering pressure sensors

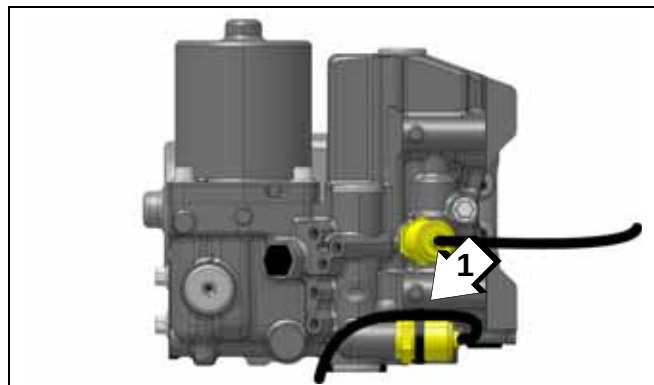
009458

Install sensors and tighten to a torque of 144 to 168 In. lbs. (17 to 19 N·m).

Stern and Swivel

DPS Manifold Service

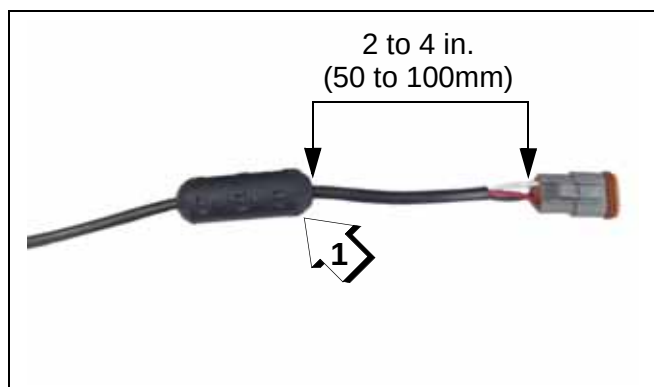
Install tie strap, P/N 320107 to secure sensor lead to sensor as shown.



1. Tie strap

009455

IMPORTANT: DPS-2 Pressure sensors use a clamp-on ferrite suppressor. Remove the suppressor from the old sensor. Install the suppressor on the sleeve of the new sensor, within 2 to 4 in. (50 to 100 mm) of the electrical connector.



1. Ferrite suppressor

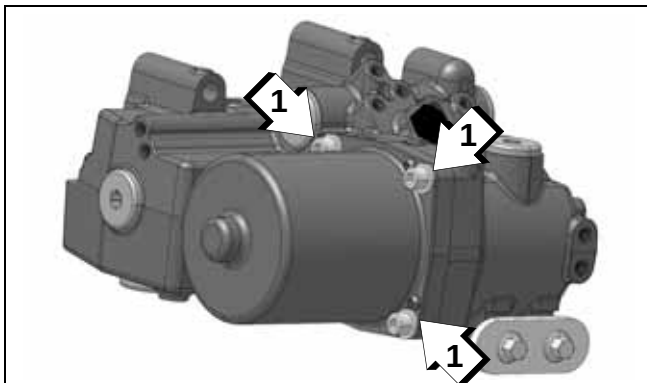
009746

Be sure to calibrate the steering pressure sensors after the DPS manifold is re-installed on the out-board.

Refer to **Steering Pressure Sensor Calibration (AFA and Newer Models Only)** on p. 309.

Electric Motor

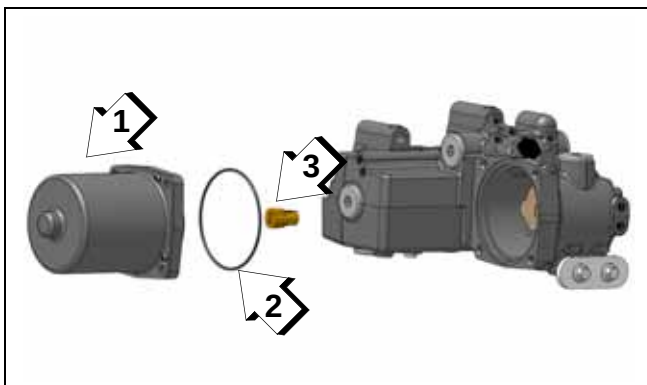
Remove the four screws and washers retaining the electric motor to the manifold housing.



1. Screws and washers (3 shown)

009459

Remove the electric motor, o-ring and coupler from the manifold housing.



1. Electric motor
2. O-ring
3. Coupler

009460

Clean and dry all parts thoroughly.

Assembly is the reverse of disassembly. Tighten screws to a torque of 60 to 84 In. lbs. (7 to 10 N·m)

Trim & Tilt System Service

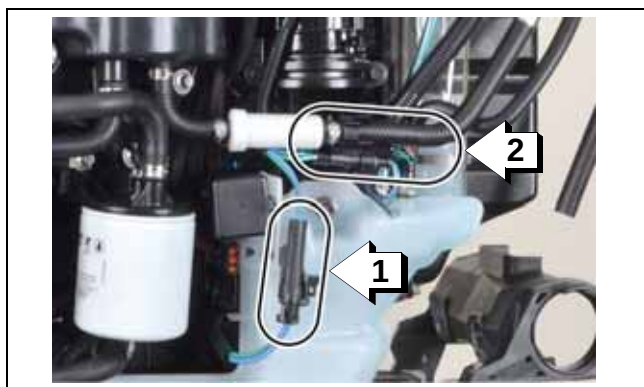
Trim & Tilt Manifold Service

Procedure

Disconnect the battery cables at the battery.

Remove the engine covers, port, starboard and front frames. Refer to **Engine Cover and Frame Service** on p. 55.

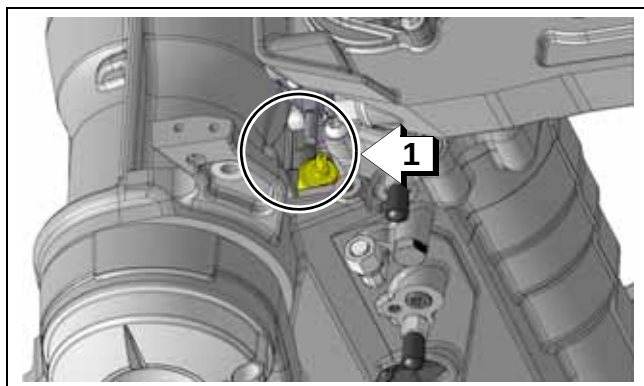
Disconnect the trim motor and trim sender electrical connectors (starboard side).



1. Trim motor electrical connector
2. Trim sender electrical connectors

009171

Position electrical wiring to the port side of the engine for removal. Wiring must pass through the area shown. Do NOT attempt to remove wiring at this time.

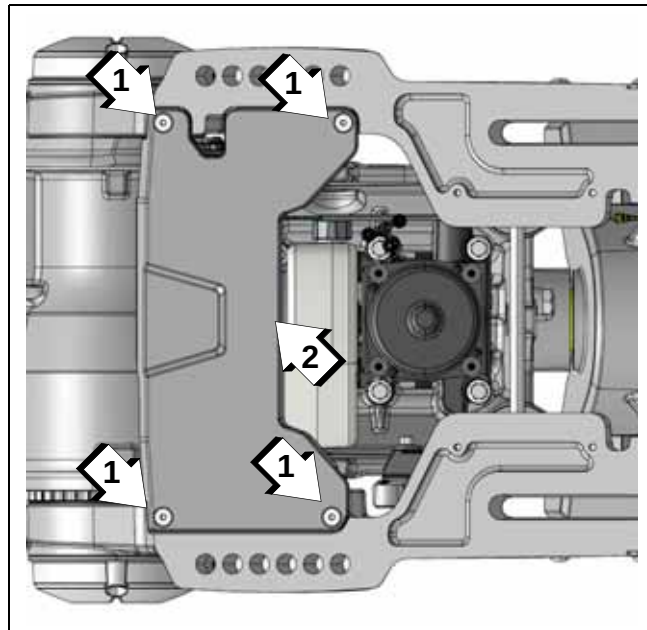


1. Wiring pass-through area

009446

Outboard Removed from Boat

If the outboard is removed from the boat, remove the four screws retaining the plate to the stern brackets. Then remove the plate.



1. Screw
2. Plate

009448

Outboard Installed on Boat

⚠ WARNING

Support the outboard by the gearcase in the UP position, with a suitable hoist.

When servicing the trim and tilt manifold, the outboard will drop from the tilted position.

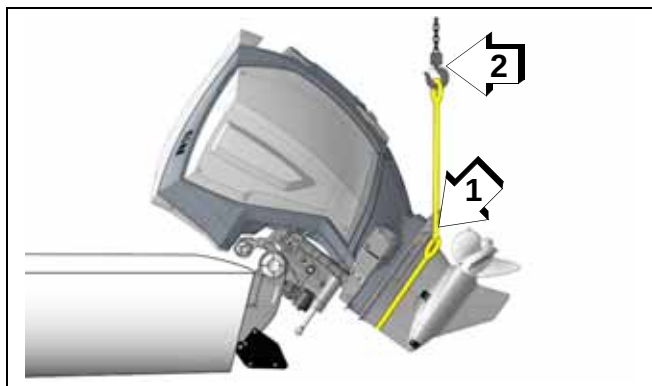
Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

If the engine is installed on the boat, tilt the outboard to the full tilt UP position.

Stern and Swivel

Trim & Tilt System Service

Use a strap and an appropriate hoist to support the outboard by the gearcase. The outboard will drop when the trim and tilt manifold is removed.



1. Strap
2. Hoist

009576

Removal

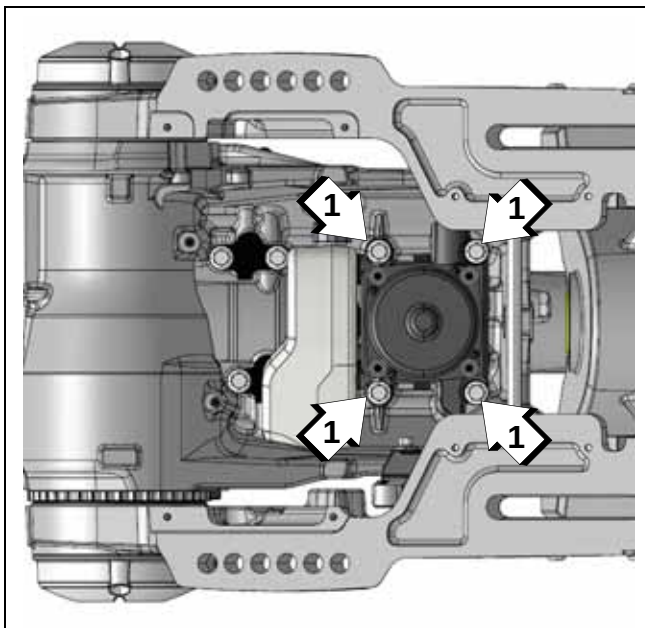
Remove the trim sender from the port stern bracket. Do NOT remove the trim sender wires at this time. Refer to **Trim Sender Service** on p. 344.

Place a large pan under the outboard to catch hydraulic oil as the manifold assembly is removed from the swivel bracket.

ENVIRONMENTAL NOTE

Dispose of used oil and contaminated shop towels in an environmentally responsible manner, or in according to local regulations.

Remove the four hex screws retaining the trim manifold.

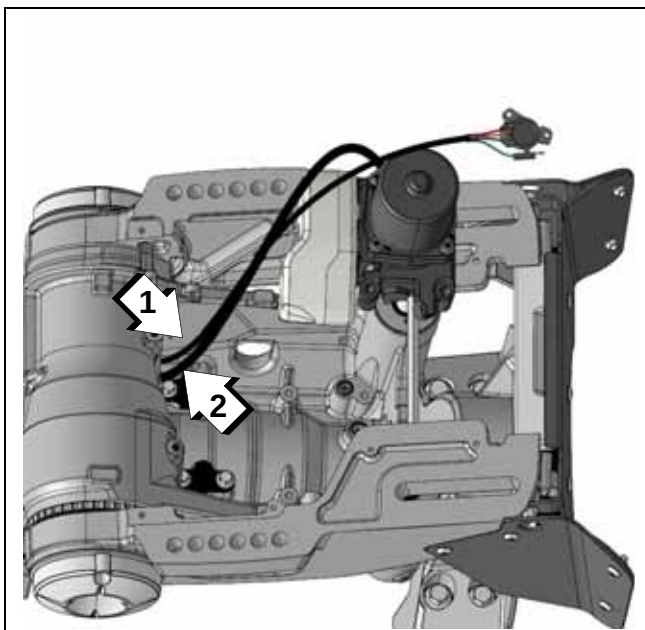


1. Screws

009449

Carefully remove the manifold assembly from the outboard. Use shop towels to wipe up spilled hydraulic oil.

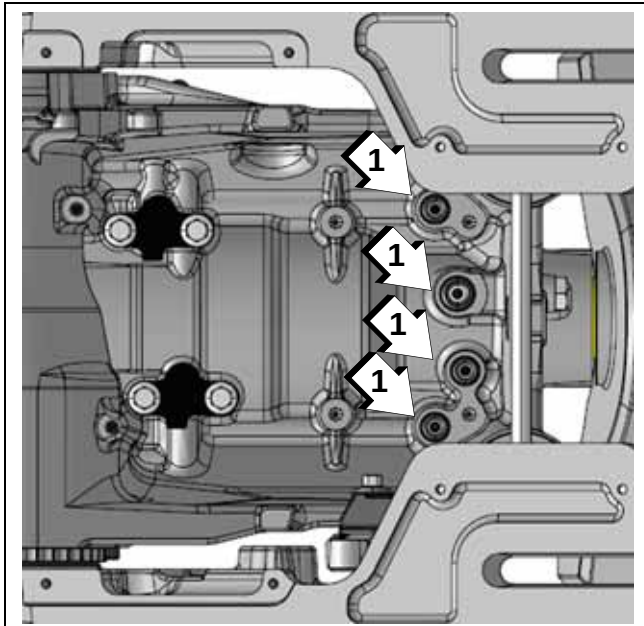
As the manifold is removed, carefully remove the trim sender leads and trim motor cable through the port side of the swivel bracket.



1. Trim sender leads
2. Trim motor cable

009450

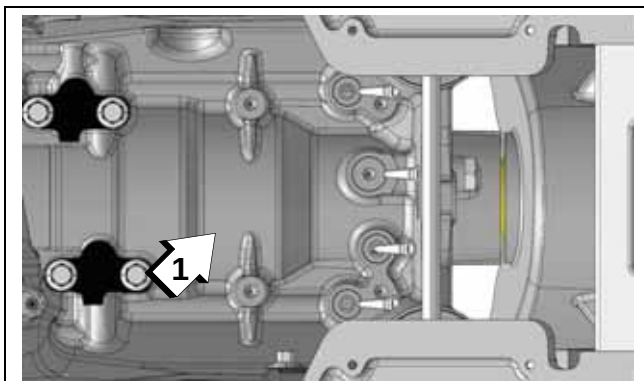
Remove the four trim manifold o-rings from the swivel bracket.



1. Four trim manifold o-rings and filters

009451

Remove the four trim and tilt filters from the swivel bracket.



1. Filters

009441

Installation

Service replacement manifold assemblies may have filters installed, or included in the packaging. Be sure to install new filters and o-rings before installing the trim and tilt manifold assembly.

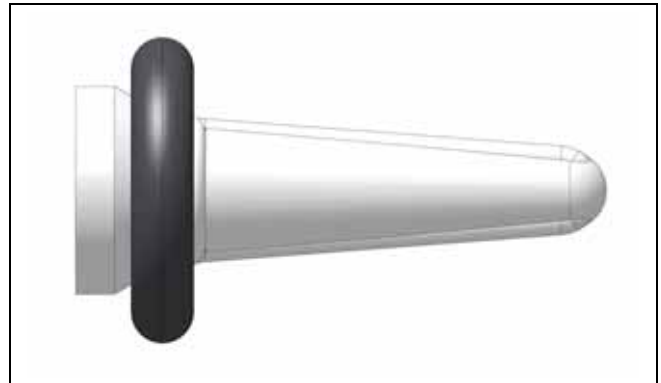
IMPORTANT: Identify filters and o-rings and ensure they are installed in the correct locations.

The **Trim and Tilt Manifold** uses:

- 4 Filters, P/N 356937, which are 0.875 in. (22.4 mm) long,

- 3 O-rings, P/N 326956, which are 0.299 in. (7.6 mm) inside diameter, x 0.103 in. (2.6 mm) thick
- 1 O-ring P/N 318372, which is 0.306 in. (7.8 mm) inside diameter x 0.179 in. (4.5 mm) thick.

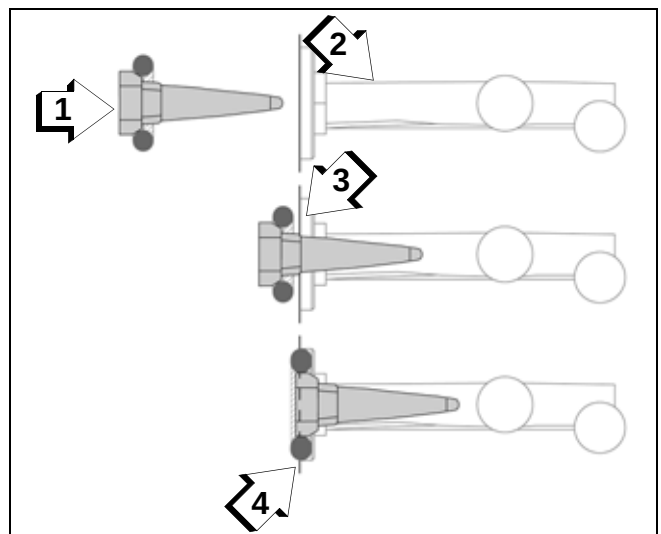
Install one o-ring on each oil filter as shown.



1. Filters

009443

Insert a filter and o-ring into each oil passage. Continue to push the filter and o-ring into the oil passage until the o-ring expands into the recessed seal area. The filter should protrude slightly to hold the o-ring in position.



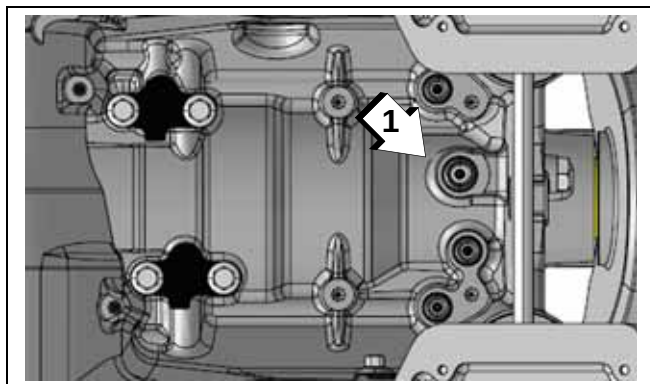
1. Filter and o-ring
2. Oil passage (sectioned view)
3. Recessed seal area
4. Filter and o-ring in position

009442

Stern and Swivel

Trim & Tilt System Service

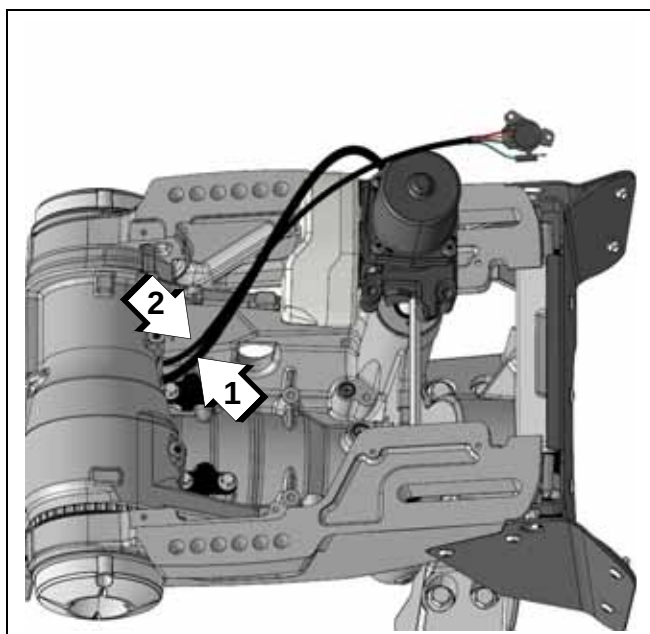
Install four filters and o-rings into the swivel bracket. Install the large diameter o-ring in the position shown.



1. Large o-ring

009433

Position the manifold assembly close to the swivel bracket. Install the trim motor cable and trim sender lead through the port side of the swivel bracket.

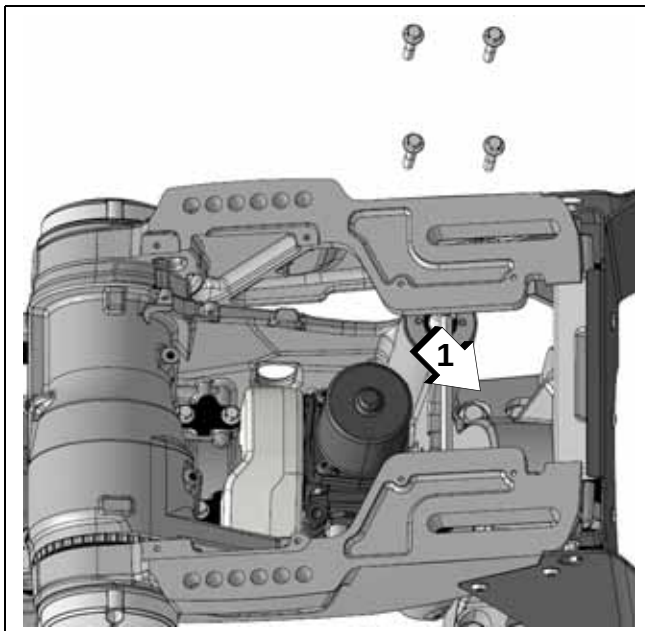


1. Trim motor cable
2. Trim sender leads

009450

Carefully place the manifold assembly into position on the swivel bracket. Take care to keep o-rings in position on the swivel bracket.

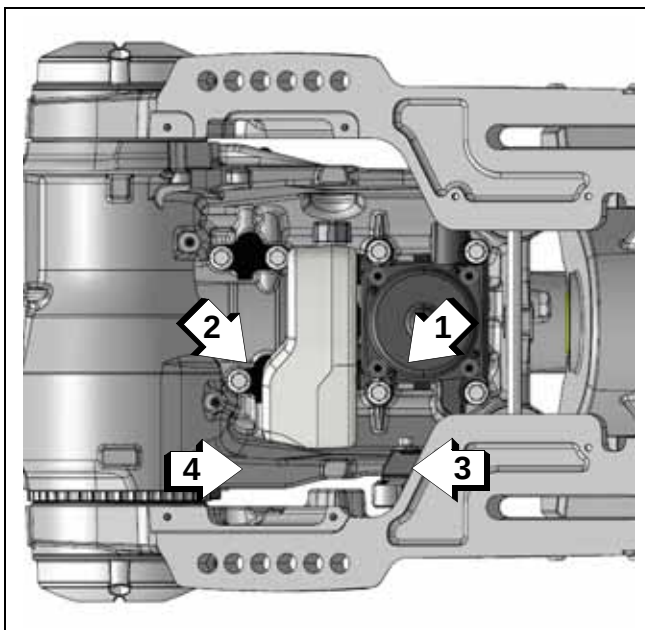
Install the four hex screws into the trim manifold.



1. Four hex screws

009433

Tighten screws in the sequence shown to a torque of 18 to 20 Ft. lbs. (24.4 to 27 N·m).

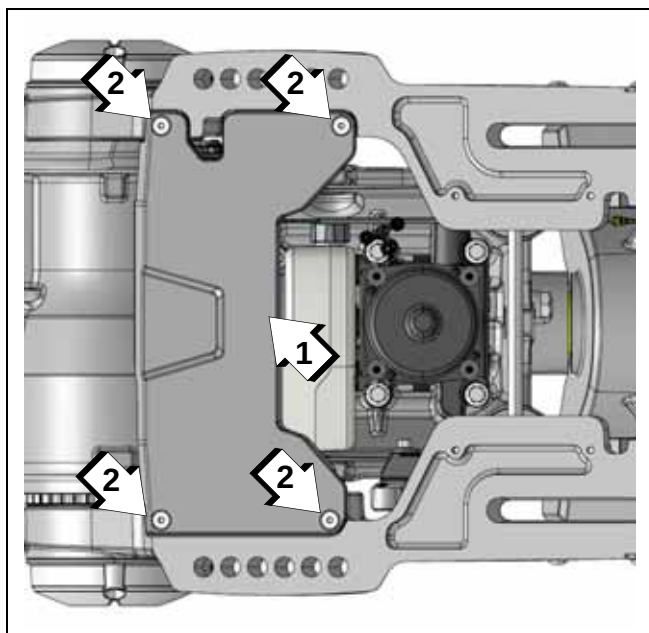


Tightening Sequence

009449

Install the trim sender on the port stern bracket. Refer to **Trim Sender Service** on p. 344.

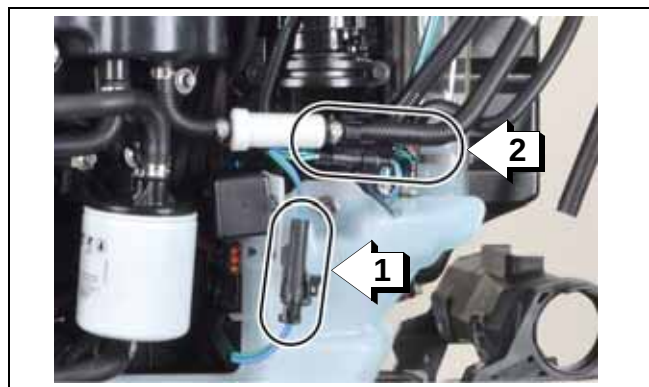
If removed, install the plate to the stern brackets with four screws. Tighten screws to a torque of 18 to 24 in. lbs. (2 to 2.7 N·m).



1. Plate
2. Screws

009448

Connect the trim motor and trim sender electrical connectors (starboard side).



1. Trim motor electrical connector
2. Trim sender electrical connectors

009171

Connect the battery cables at the battery.

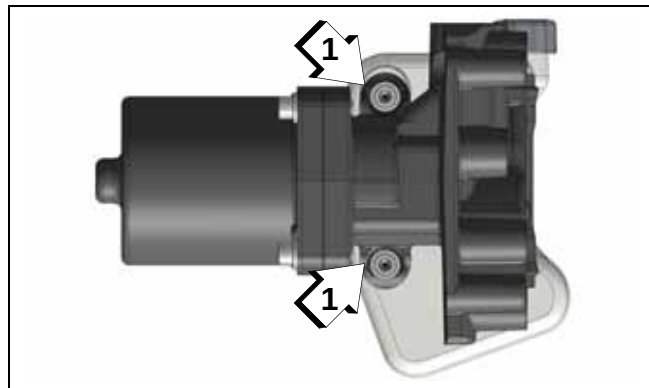
Install the port, starboard and front frames, and engine covers. Refer to **Engine Cover and Frame Service** on p. 55.

Manifold Disassembly

Service of the trim and tilt manifold requires removal from the outboard. Refer to **Trim & Tilt Manifold Service** on p. 323.

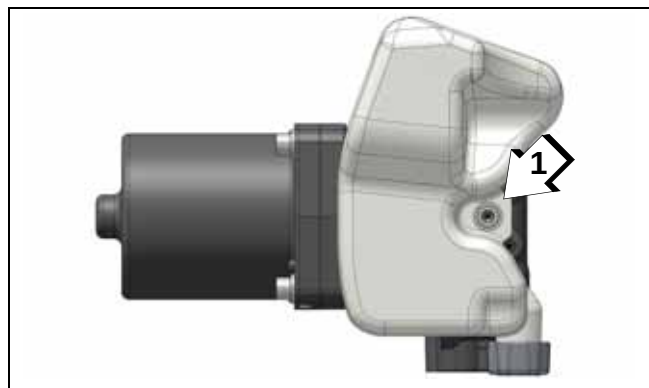
Separate the fluid reservoir from the trim manifold:

- Remove two screws and washers from the bottom of the trim manifold
- Remove one screw and washer from the top of the trim reservoir



- Bottom Of Trim Manifold**
1. Two screws and washers

009464



- Top of Trim Reservoir**
1. Screw and washer

009463

Stern and Swivel

Trim & Tilt System Service

Carefully separate the reservoir from the manifold.



009465

Inspect the tube and o-ring in the manifold. Replace the tube and o-rings if the o-rings show signs of damage.



1. Tube and o-rings

009465

Clean and dry all parts thoroughly.

Manifold Assembly

Apply a drop of *Power Trim/Tilt Fluid*, P/N 767969, to the o-rings of a new tube and o-ring assembly. Install the tube and o-rings into the manifold.



1. Tube and o-rings

009465

Align the screw bosses, and fluid passage of the trim reservoir with the screw bosses, and the tube and o-rings of the trim manifold.

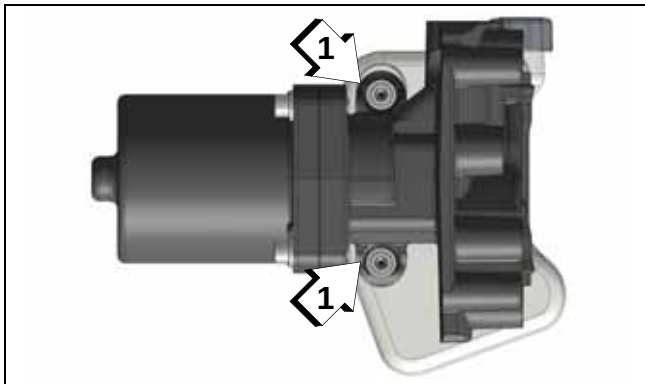


1. Retaining screw bosses (reservoir)
2. Fluid passage
3. Retaining screw bosses (manifold)
4. Tube and o-rings

009462

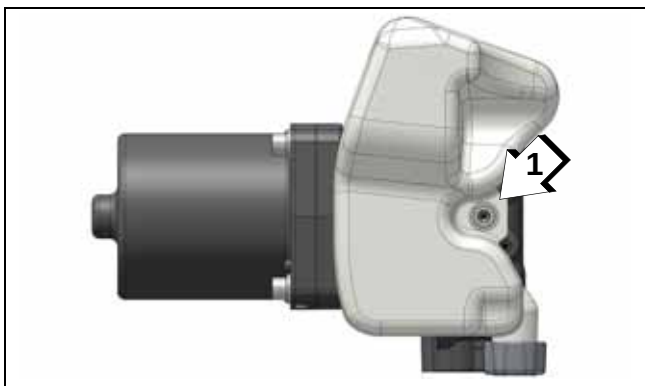
Assemble the manifolds:

- Install two screws and washers from the bottom of the trim manifold
- Install one screw and washer from the top of the trim reservoir.



Bottom Of Trim Manifold
1. Two screws and washers

009464



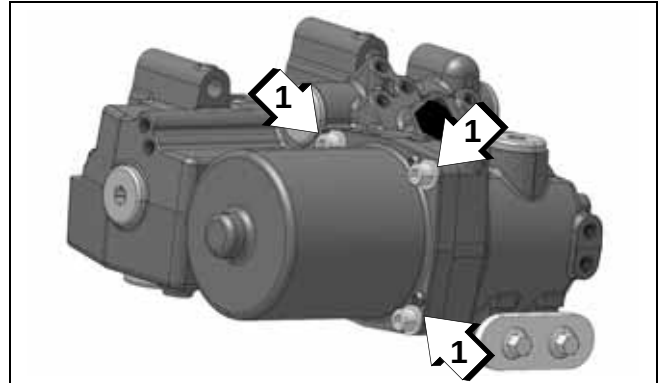
Top of Trim Reservoir
1. Screw and washer

009463

Tighten the screws to a torque of 60 to 84 In. lbs. (7 to 10 N·m).

Electric Motor

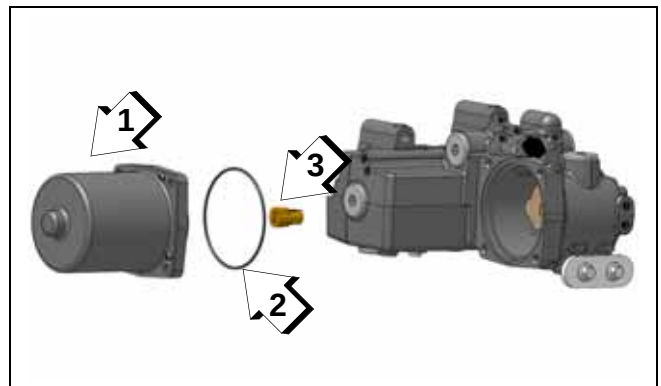
Remove the four screws and washers retaining the electric motor to the manifold housing.



1. Screws and washers (3 shown)

009459

Remove the electric motor, o-ring and coupler from the manifold housing.



1. Electric motor
2. O-ring
3. Coupler

009460

Clean and dry all parts thoroughly.

Assembly is the reverse of disassembly.

Tighten screws to a torque of 60 to 84 In. lbs. (7 to 10 N·m)

Trim Rod Service

NOTICE

Service procedures of hydraulic trim and tilt systems **MUST** occur in a clean, dust-free environment.

When cleaning components use lint-free shop towels.

Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

Removal

⚠ WARNING

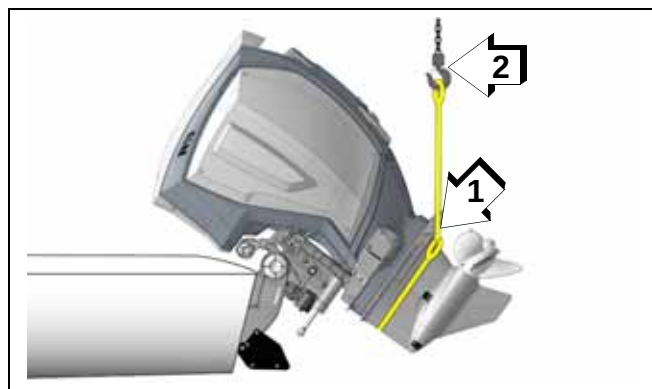
Support the outboard by the gearcase in the UP position, with a suitable hoist.

When servicing the trim rods, the outboard will drop from the tilted position.

Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

Tilt the outboard to the full tilt UP position.

Use a strap and an appropriate hoist to support the outboard by the gearcase. The outboard will drop when hydraulic pressure on the trim and tilt system is released.

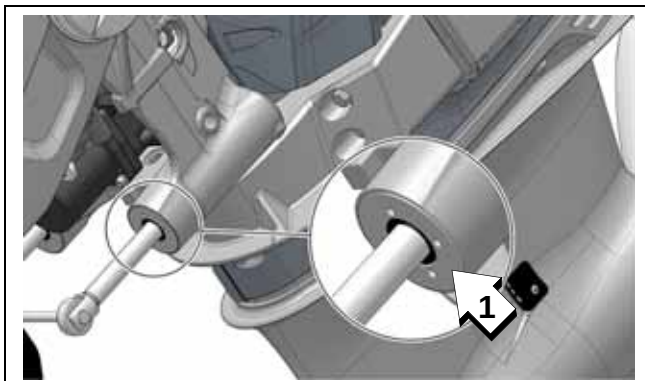


1. Strap
2. Hoist

009576

Place an appropriate pan under the outboard to catch spilled hydraulic fluid.

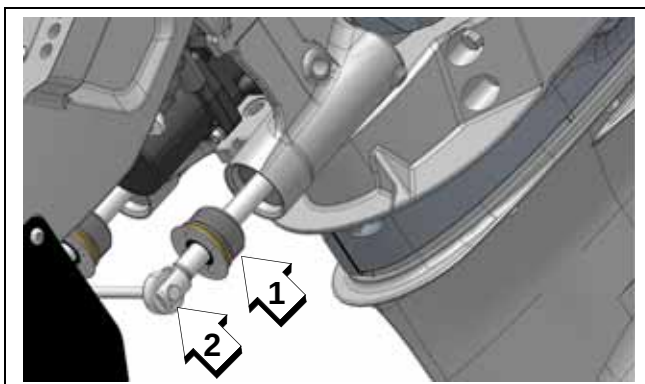
Use Spanner Wrench, P/N 912084, or Spanner Wrench, P/N 359080, to remove the trim rod end caps.



1. Trim rod end cap (Port side shown)

009577

Remove end caps from both trim cylinders. Slide the end caps towards the trim rollers.

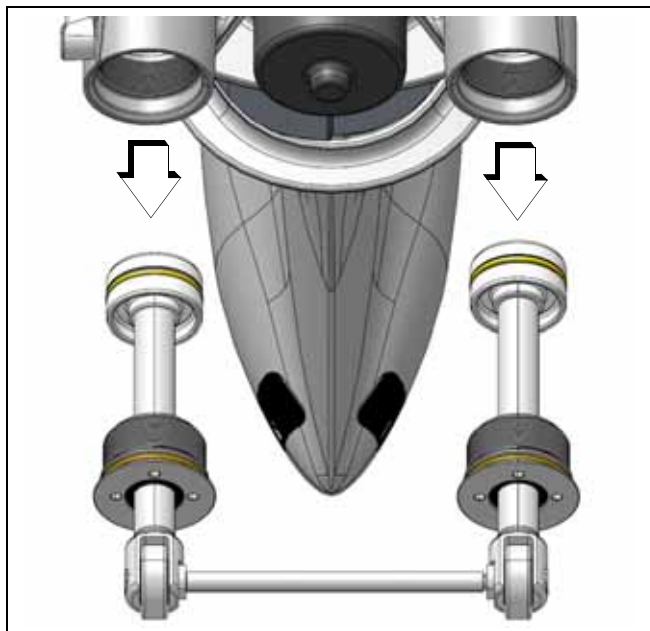


1. Trim rod end cap
2. Trim roller

009578

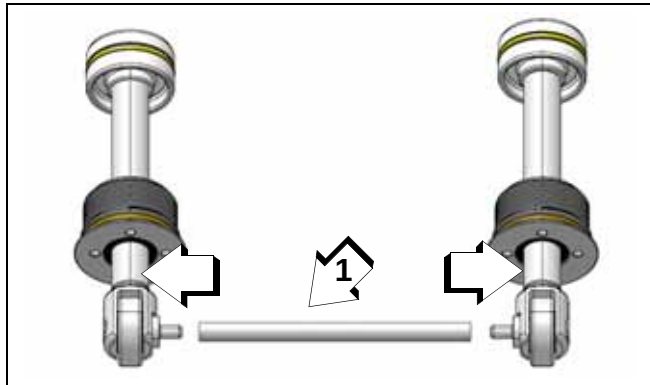
Disconnect the battery cables at the battery, to prevent accidental operation of the trim system during servicing.

Slide both trim rod assemblies out of the trim cylinders at the same time.



009579

Separate the trim rod assemblies from the tube.



1. Tube

009580

Cleaning and Inspection

NOTICE

Apply cleaning solvent to lint-free shop towels to clean hydraulic oil residue from all surfaces.

Do NOT spray cleaning solvent on the swivel bracket or into the trim cylinders. Solvent can seep into oil passages resulting in contamination of hydraulic fluids.

Use lint-free shop towels to wipe up spilled hydraulic fluid.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Make sure there are no burrs or debris in the trim cylinder bores, end cap threads, trim rods, pistons or seals.

Installation

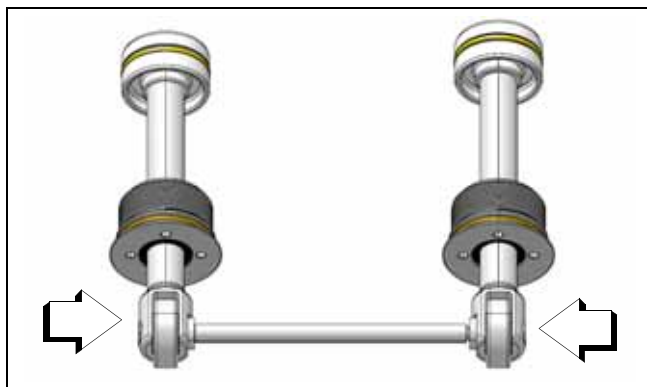
NOTICE

Make sure **ALL** surfaces of the trim rod cylinders and replacement trim rod assemblies are **COMPLETELY CLEAN AND FREE OF ALL DEBRIS**.

Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

Apply *Power Trim/Tilt Fluid*, P/N 767969, to the trim cylinder bores and to trim pistons and seals.

Assemble the tube and trim rods.

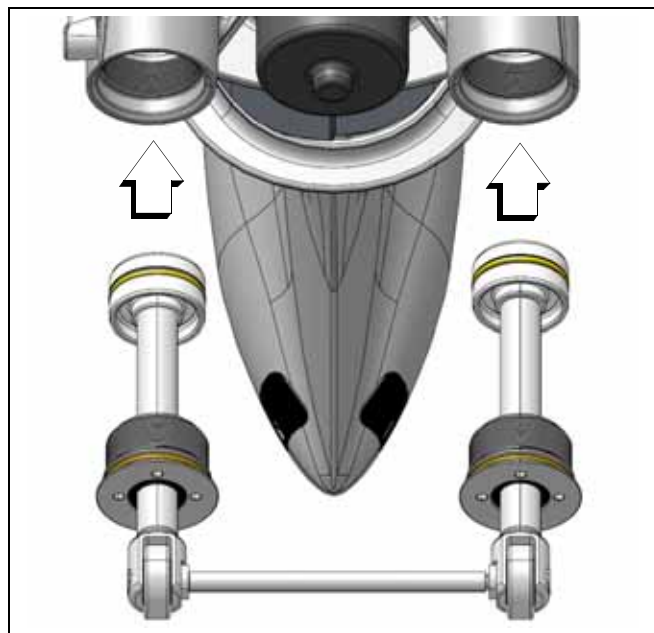


00958

Stern and Swivel

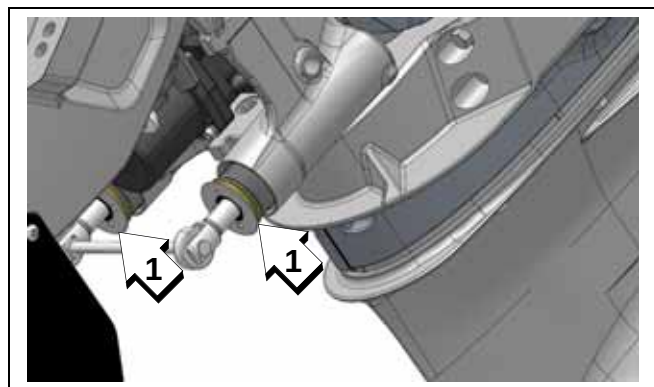
Trim & Tilt System Service

Slide both trim rod assemblies into of the trim cylinders at the same time. Push the assemblies into the bore approximately 1.5 inches (38 mm).



009579

Slide the end caps towards the trim cylinders. Start the end caps by hand.



1. Trim rod end caps

009582

Use Spanner Wrench, P/N 912084, or Spanner Wrench, P/N 359080, to tighten the trim rod end caps to a torque of 59 to 70 Ft. lbs. (80 to 94 N·m).

Slowly lower the hoist supporting the outboard and remove the strap from the gearcase.

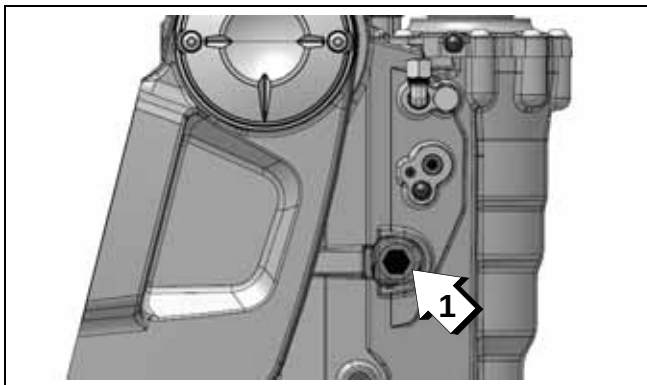
Connect the battery cables at the battery.

Filling the Trim and Tilt System

Place an appropriate container under the outboard to catch spilled fluid. Remove the filler cap.

Note: Use a 16 mm hex socket to remove the filler cap on DPS models.

Use a CLEAN funnel and hose to add *Power Trim/Tilt Fluid*, P/N 767969, to the reservoir. Do NOT re-install the filler cap at this time.



1. Trim reservoir cap

009447

Turn the key switch ON. Use the trim switch to cycle the trim system up and down.

Continue to add fluid and cycle the trim and tilt system until the trim and tilt system begins to operate normally. There should be no abnormal noise, such as air in the system, or erratic movement during operation.

Check for trim/tilt fluid leaks. Repair leaks BEFORE continuing.

The outboard MUST be able to reach the full tilt UP position BEFORE checking for correct fluid level.

IMPORTANT: Do NOT allow the engine covers to contact the splashwell of the boat. Damage to covers can occur.

Trim and Tilt Fluid Level

⚠ CAUTION

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

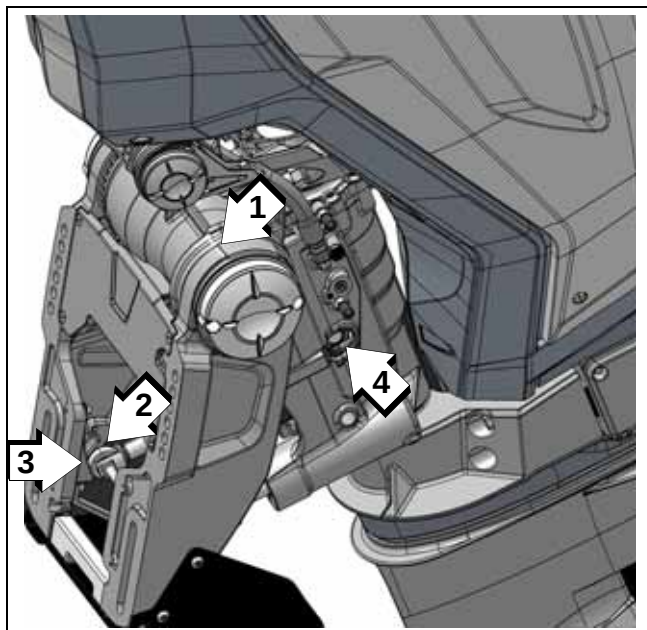
NOTICE

Over-filling of the trim and tilt reservoir can damage seals or o-rings resulting in trim fluid leaks and loss of trim system operation.

Non-DPS Models

Trim the outboard up until the casting line on the stern bracket aligns with the casting line on the tilt shaft. In this position, the trim rollers should just touching the trim ramps.

IMPORTANT: The outboard **MUST** be in this position to check fluid level. Any other position will result in under-filling or over-filling of the reservoir.



Casting Line on Stern Bracket and Tilt Shaft

009483

1. Casting line on stern bracket and tilt shaft
2. Trim roller
3. Trim ramp
4. Reservoir cap

Check the fluid level. Fluid should be level to the bottom of the fill plug threads.

Use a **CLEAN** funnel and hose to add *Power Trim/Tilt Fluid*, P/N 767969, to bring the fluid level to the bottom of the fill plug threads.

Do **NOT** over-fill. If the reservoir is over-full, allow fluid to run into an appropriate container until the fluid level is to the bottom of the fill plug threads.

Clean the reservoir cap. Verify that the o-ring seal is installed in the cap. Lubricate the o-ring with clean hydraulic fluid. Carefully install the cap. Do **NOT** cross-thread the cap. Tighten it securely. Do **NOT** over-tighten the cap.

Clean up spilled fluid with shop towels.

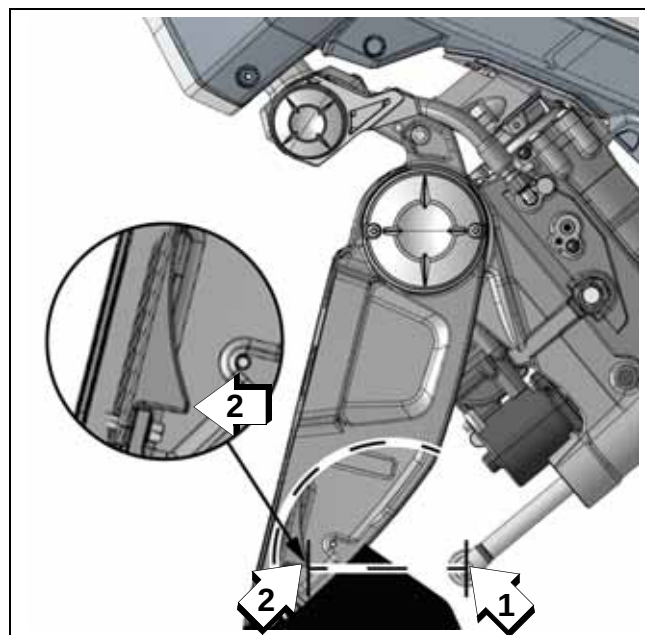
ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

DPS Models

Trim the outboard **UP** until the center of the roller shaft is 6–3/8 inches (162 mm) from the end of the trim ramp.

IMPORTANT: The outboard **MUST** be in this position to check fluid level. Any other position will result in under-filling or over-filling of the reservoir.



**Center of Roller Shaft 6–3/8 in. (161.925 mm)
From End of Trim Ramp**

009484

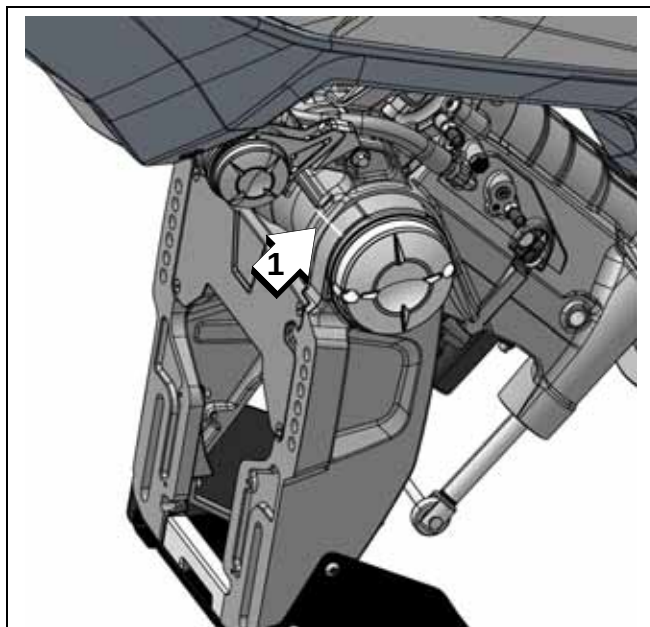
1. Center of roller shaft
2. End of trim ramp (cut-away view shown)

Use a wax pencil (china marker) to make a reference mark across the tilt shaft and stern bracket. This will be helpful in returning to the correct position for checking fluid level. The trim and tilt **MUST**

Stern and Swivel

Stern & Swivel Bracket

be cycled through the entire range to continue filling it with fluid and to purge air from the system.



Mark on Tilt Shaft and Stern Bracket
1. Reference mark across tilt shaft and stern bracket

009484

Check the fluid level. Fluid should be level to the bottom of the fill plug threads.

Use a CLEAN funnel and hose to add *Power Trim/Tilt Fluid*, P/N 767969, to bring the fluid level to the bottom of the fill plug threads.

Do NOT over-fill. If the reservoir is over-full, allow fluid to run into an appropriate container until the fluid level is to the bottom of the fill plug threads.

Clean the reservoir cap. Verify that the o-ring seal is installed in the cap. Lubricate the o-ring with clean hydraulic fluid. Install the cap and tighten it securely. Do NOT over-tighten the cap.

Clean up spilled fluid with shop towels.

ENVIRONMENTAL NOTE

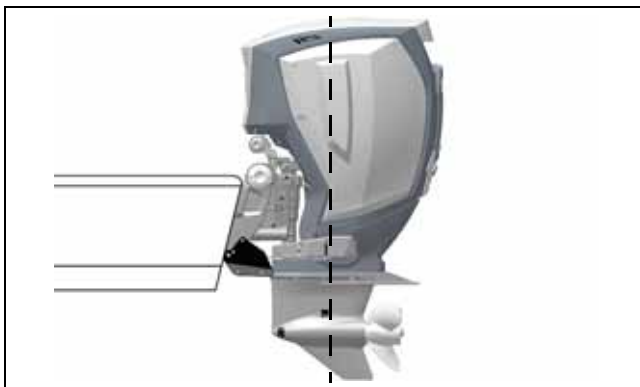
Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Use a clean shop towel to remove wax pencil reference marks made on the outboard.

Stern & Swivel Bracket

Removal

IMPORTANT: Trim the engine to the vertical position BEFORE beginning the stern and swivel bracket removal procedure.



Engine in Vertical Position

009167

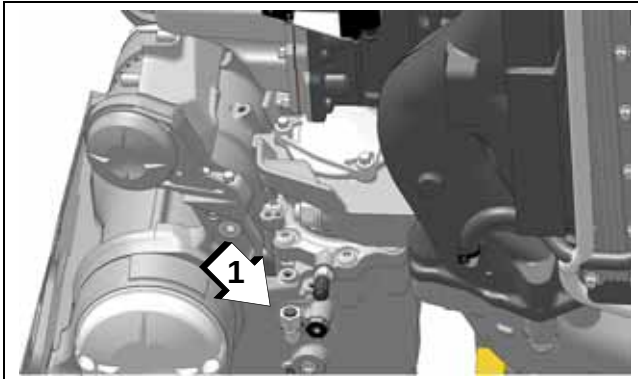
Remove the top engine cover. Remove the front cover.

Disconnect the battery cables at the battery. Then disconnect all cables, buss cables and hoses from the engine.

Remove the rear cover, starboard and port frames and front frame. Refer to **Engine Cover and Frame Service**.

Carefully disconnect the port and starboard hydraulic steering hoses from the stern and swivel assembly.

Use shop towels to clean up spilled steering fluid. Install plug and nut assembly in the hose fittings of the stern and swivel assembly.



1. Plug and cap assembly

009423

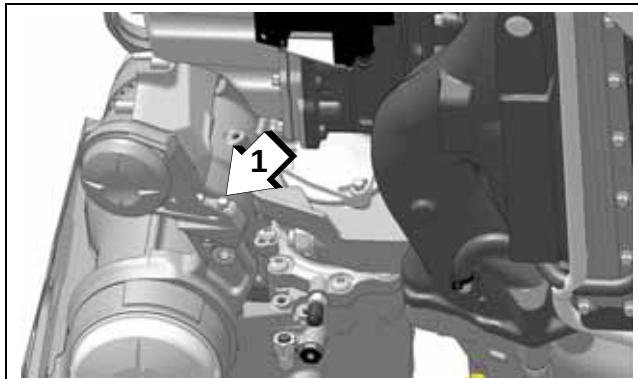
Install plugs in the hydraulic hose fittings to prevent steering fluid from leaking.

Wipe off any spilled steering fluid.

ENVIRONMENTAL NOTE

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

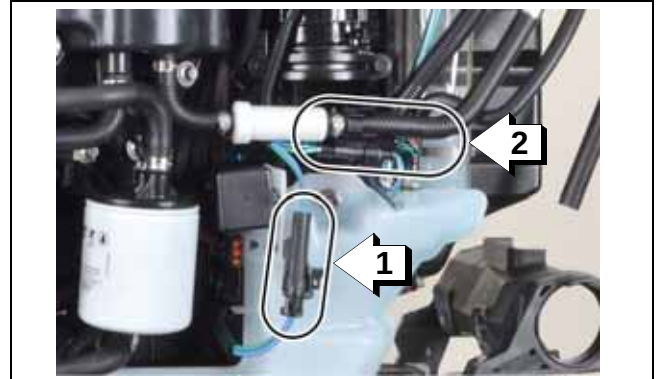
Remove the four screws retaining the rigging center. Then remove the rigging center.



1. Screws (port side shown)

009424

Disconnect the electrical connectors for the trim motor and trim sender.



1. Trim motor electrical connector
2. Trim sender electrical connectors

009171

Note the routing of the harnesses for the trim motor and trim sender. Pull the harnesses back to the stern and swivel bracket.

If equipped, disconnect the electrical connectors from the DPS module.



1. DPS module electrical connectors

009172

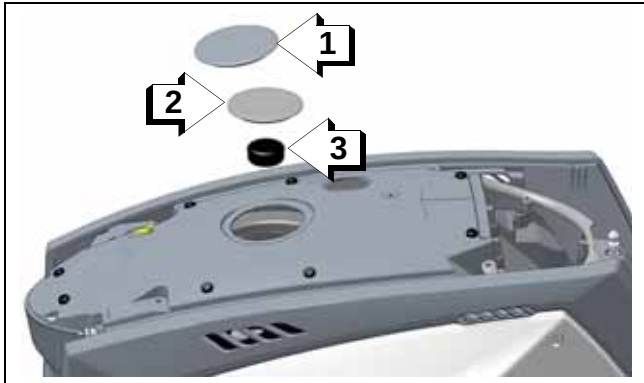
Note the routing of the harnesses for the DPS motor and sensor. Pull the harnesses back to the stern and swivel bracket.

Remove the 4 inch plug from the center frame. Next remove the 3.5 inch plug from the air duct.

Stern and Swivel

Stern & Swivel Bracket

Then remove the thread protector from the flywheel threads.

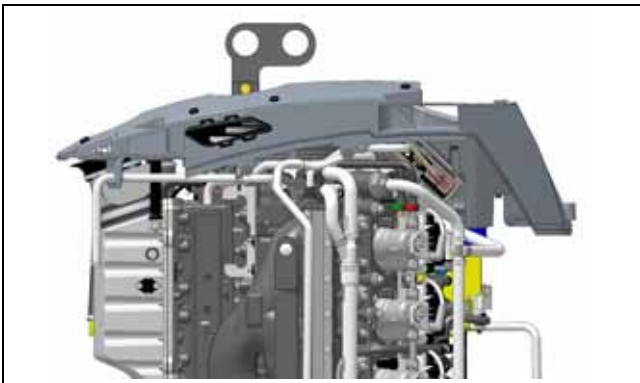


1. 4 inch plug
2. 3.5 inch plug
3. Thread protector

009425

Install Engine Lifting Fixture, P/N 357667, completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.



009274

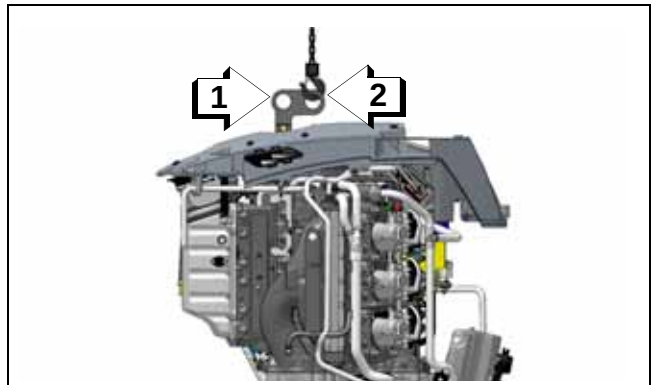
⚠ WARNING

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.

Make sure the off-set lifting eye is aligned to the REAR of the engine.

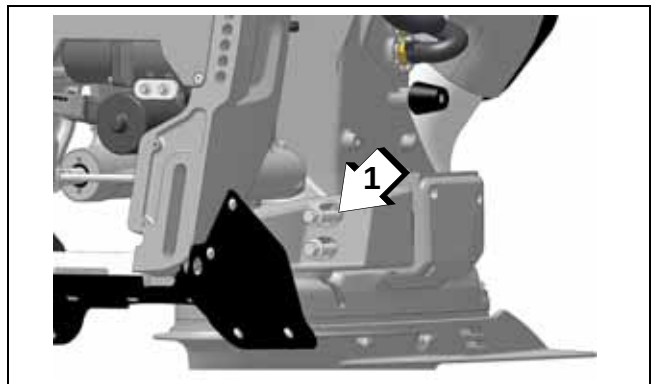
Use the off-set lifting eye to support the engine. Fasten an appropriate chain hook to the off-set lifting eye.



1. Centerline lifting eye
2. Off-set lifting eye (to REAR of engine)

009177

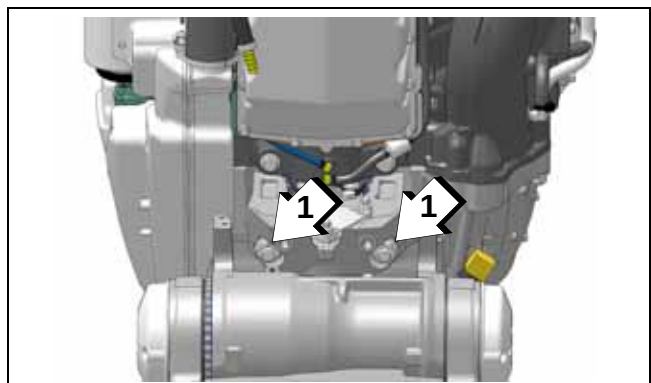
Remove the four lower mount bolts.



1. Lower mount bolts (port side shown)

009275

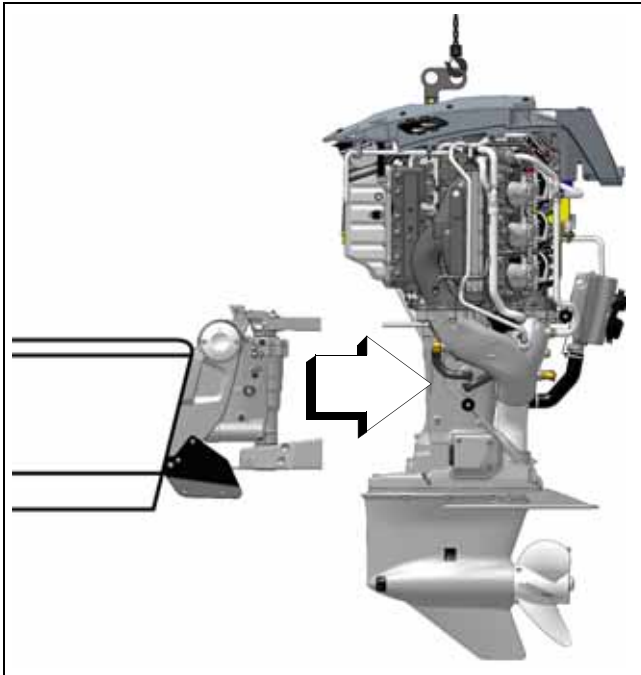
Remove the two retaining nuts and washers from the upper mount studs.



1. Nuts

009276

Separate the supported engine from the stern & swivel assembly.



009277

Support the stern and swivel assembly.

Remove the four mounting bolts. Then remove the stern and swivel assembly.

Clean all old marine sealant from the transom of the boat.

Installation

⚠ WARNING

If either side of the transom deforms or cracks when the bolts are tightened to their recommended torque, the transom construction may not be adequate or may be deteriorated.

Structural failure of the transom could result in loss of boat control and injury to the occupants.

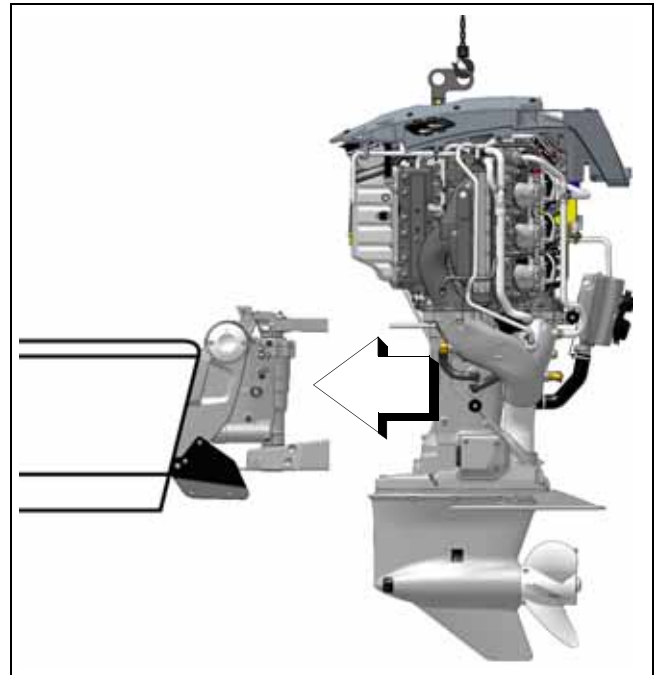
IMPORTANT: Use a marine sealant rated for above or below waterline use. RTV silicone is not approved for below waterline use. Polyurethane sealants are not easily removed and may damage outboard or boat mounting surfaces.

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

Install the stern and swivel assembly with the four mounting bolts. Install all washers and nuts.

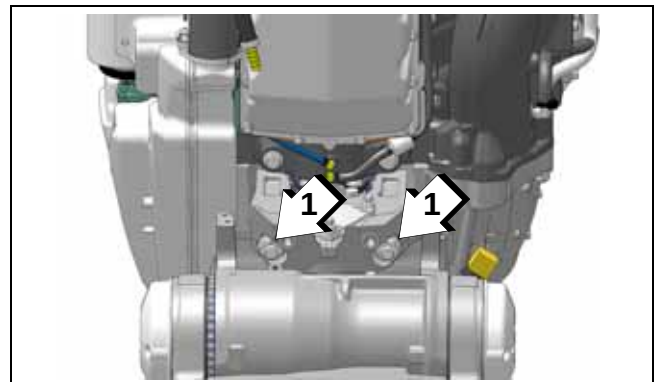
Tighten mounting bolts and nuts to a torque of 40 ft. lbs. (54 N·m).

Align the engine assembly with the stern and swivel assembly.



009277

Install the two washers and retaining nuts on to the upper mount studs.



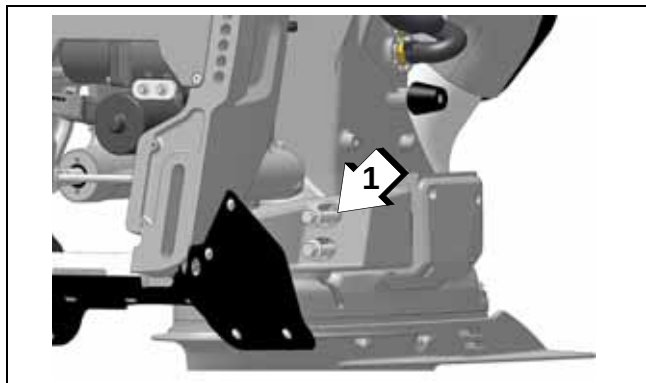
1. Nuts

009276

Stern and Swivel

Stern & Swivel Bracket

Install the 4 lower mount bolts.



1. Lower mount bolts (port side shown)

009275

Tighten the nuts to a torque of 67 to 69 ft. lbs. (91 to 93 N·m).

Tighten the lower mount bolts to a torque of 40 to 42 ft. lbs. (55 to 57 N·m).

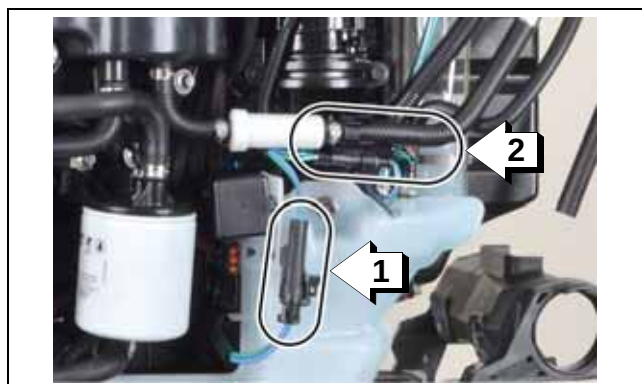
If equipped, route the DPS harnesses to the DPS module. Connect the electrical connectors.



1. DPS module electrical connectors

009172

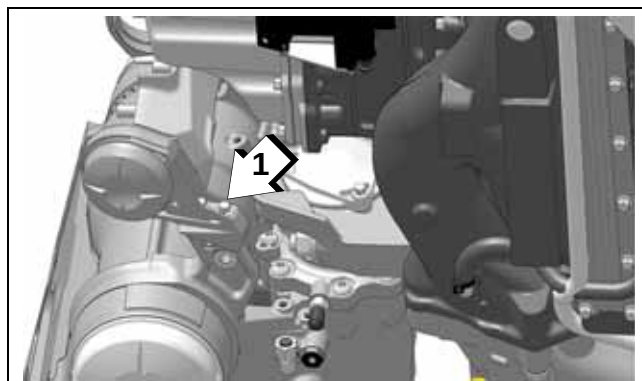
Route the harnesses for the trim motor and trim sender to the starboard side of the engine. Connect the electrical connectors.



1. Trim motor electrical connector
2. Trim sender electrical connectors

009171

Install the rigging center with four screws. Tighten screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).



1. Screws (port side shown)

009424

Install the front frame, starboard and port frames and rear cover. Refer to **Engine Cover and Frame Service**.

Next, re-connect all cables, buss cables and hoses to the engine. Refer to **Rigging Information** on p. 30.

Install the front engine cover.

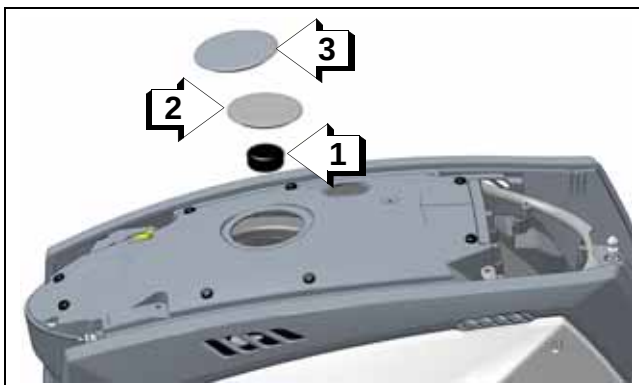
Remove the Lifting Fixture, P/N 357667, from the flywheel.

NOTICE

Install plugs as indicated. Plugs MUST be installed to prevent water entry and/or engine performance issues.

Make sure plugs are securely installed to prevent loosening during engine operation.

Install the thread protector into the flywheel threads. Then install the 3.5 inch plug into the air duct. Next install the 4 inch plug into the center frame.



1. Thread protector
2. 3.5 inch plug
3. 4 inch plug

009425

Install the top cover.

Fill and bleed the hydraulic steering system.

Refer to **Filling and Bleeding the Hydraulic Steering System** on p. 48.

Stern Bracket Service

Removal

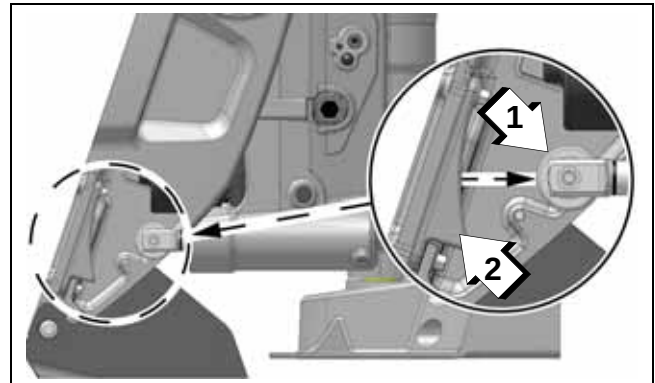
IMPORTANT: BEFORE beginning this procedure, make sure the outboard is tilted fully down. The trim rod and roller assemblies **MUST** be fully retracted into the trim cylinders.

Remove the engine from the stern and swivel bracket assembly. Refer to **Removal** on p. 334.

Next, loosen the manual release valve and tilt the swivel bracket up slightly. Close the manual

release valve. Make sure the trim rollers are **NOT** touching the ramps.

If the trim rollers are touching the ramps, hydraulic pressure will make removal of the stern bracket(s) difficult.

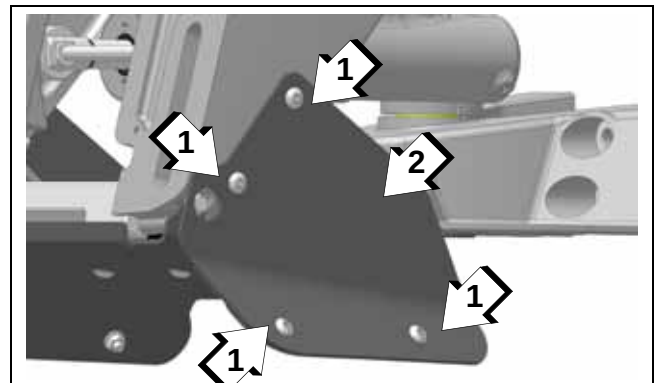


1. Trim roller
2. Ramp (port side shown)

009666

Then remove the stern and swivel assembly from the boat.

Remove the four screws from each spray plate cover and remove the spray plate covers.



1. Screws
2. Spray plate cover (port side shown)

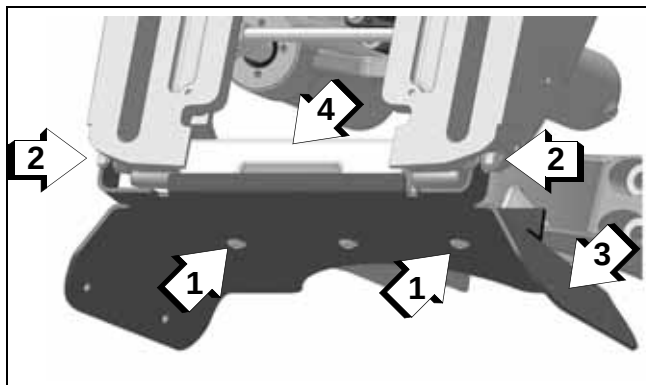
009628

Remove two screws from the bottom of the spray plate and the two upper screws retaining the spray

Stern and Swivel

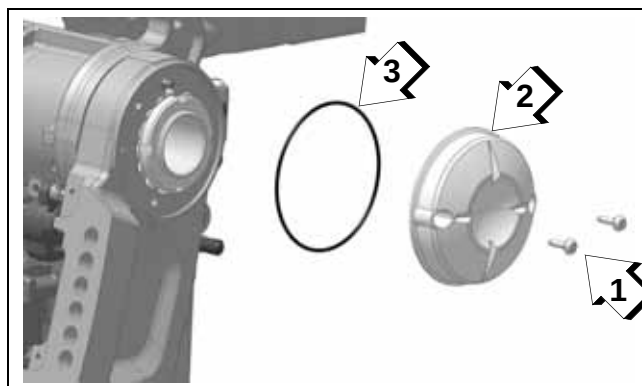
Stern & Swivel Bracket

plate and anode. Remove the spray plate and anode.



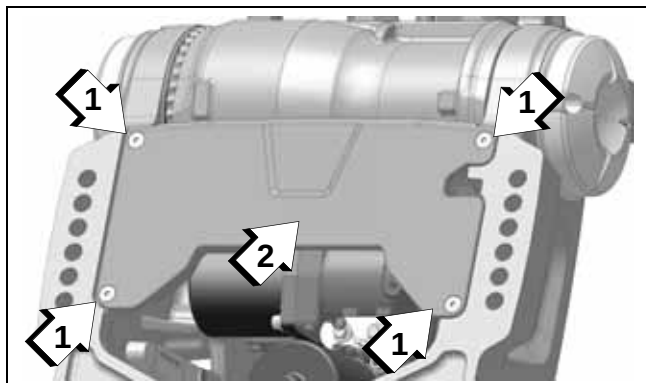
1. Bottom screws
 2. Upper screws
 3. Spray plate
 4. Anode
- 009629

Remove the two screws and o-rings from the stern bracket cover. Remove the cover and large o-ring.



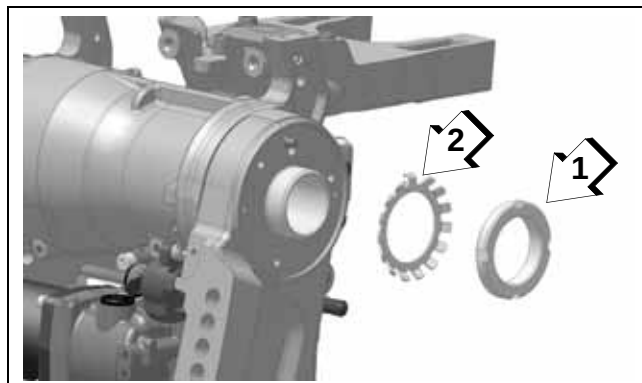
1. Screws and o-rings
 2. Cover
 3. Large o-ring
- 009631

Remove the four screws from the stern bracket plate and remove the plate.



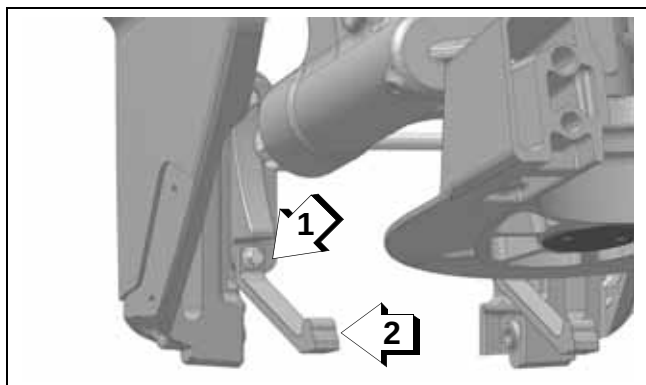
1. Screws
 2. Stern bracket plate
- 009630

Use a punch and hammer to bend the locking tab from the spanner nut slot. Use Spanner Socket, P/N 359225, to remove the spanner nut. Remove the locking washer.



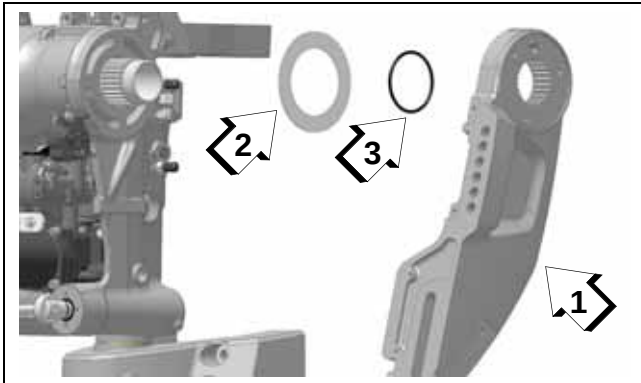
1. Spanner nut
 2. Locking washer
- 009633

Remove the lower ramp bracket screw and lower bracket.



1. Screw
 2. Bracket
- 009632

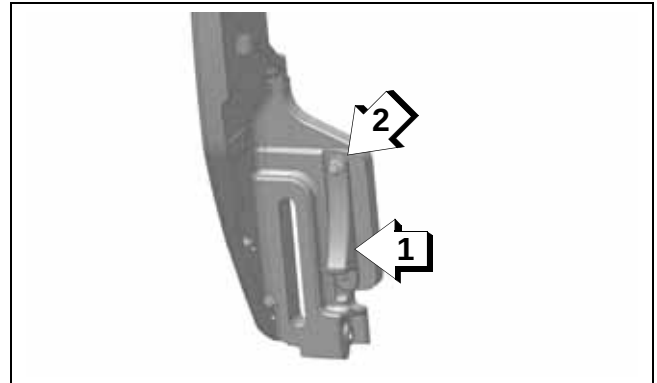
Remove the stern bracket from the tilt shaft. Remove the thrust washer and o-ring.



1. Stern bracket
2. Thrust washer
3. O-ring

009634

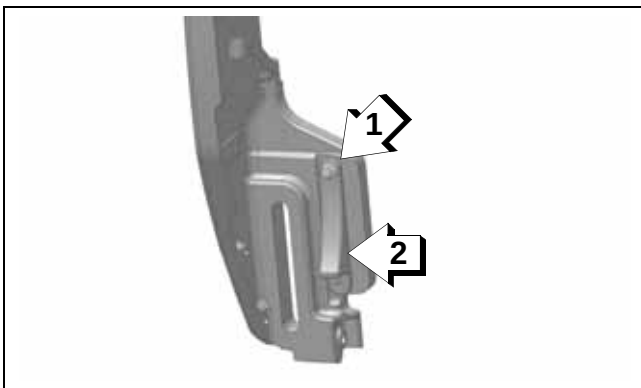
the ramp bracket. The screw will be tightened later.



1. Ramp bracket
2. Screw

009635

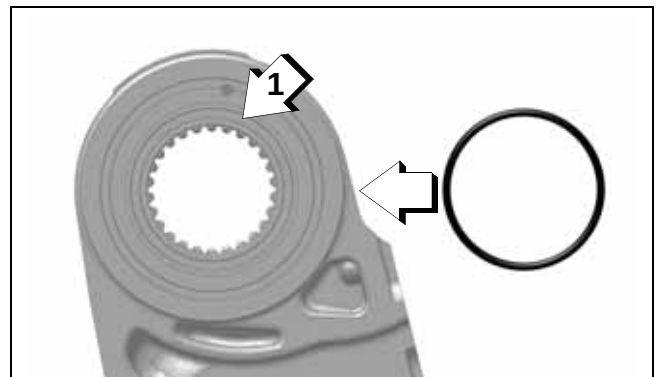
Remove the upper screw from the ramp bracket and remove the ramp bracket.



1. Screw
2. Ramp bracket

009635

Apply a light coating of *Triple Guard Grease* into the o-ring groove on the inside of the stern bracket. Install the o-ring into the groove.



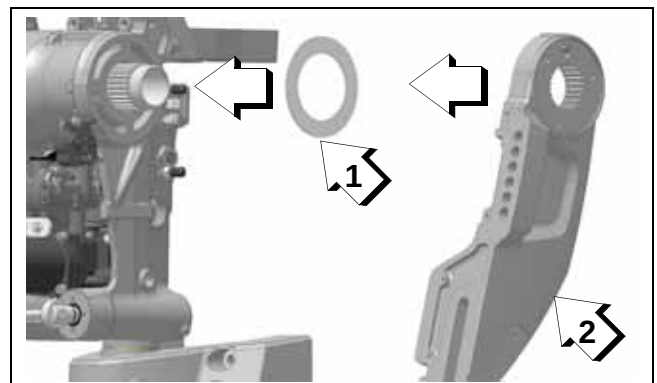
1. O-ring groove

009636

Installation

Place the ramp bracket in position on the stern bracket. Loosely install the upper screw to retain

Place the thrust washer onto the tilt shaft. Then install the stern bracket and o-ring on the tilt shaft. Make sure the o-ring stays in place on the stern bracket.



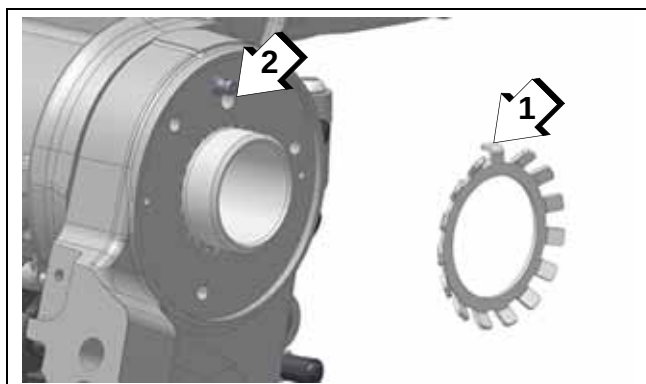
1. Thrust washer
2. Stern bracket

009637

Stern and Swivel

Stern & Swivel Bracket

Install the locking washer on the tilt shaft. Make sure the locating tab is inserted into the locating hole.

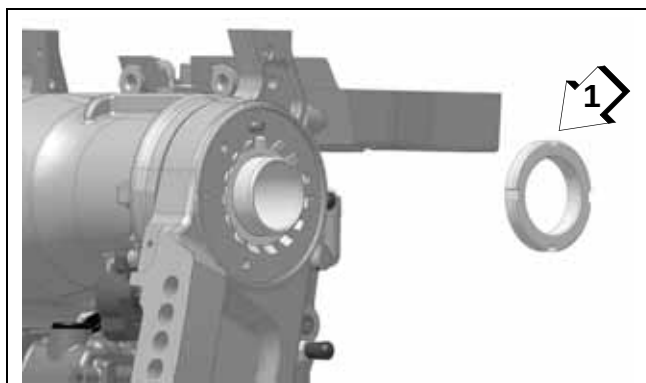


1. Locating tab
2. Locating hole

009638

Install the spanner nut. Use Spanner Socket, P/N 359225, to tighten as follows:

- torque to 63 ft.lbs. (85 N·m).
- loosen spanner nut.
- torque to 30 to 35 ft.lbs. (41 to 47 N·m).
- if needed, continue to tighten until a slot in the spanner nut is aligned with a locking tab on the washer.



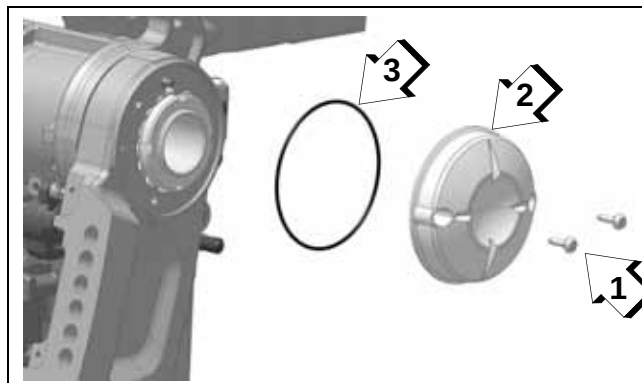
1. Spanner nut

009639

Use a suitable tool to bend the locking tab into the spanner nut.

Install the large o-ring and cover. Install the two screws and o-rings to secure the stern bracket cover.

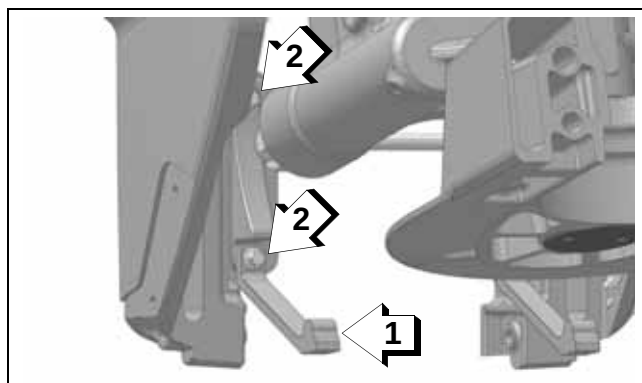
Tighten screws to a torque of 30 to 60 in.lbs. (4 to 6 N·m).



1. Large o-ring
2. Cover
3. Screws and o-rings

009631

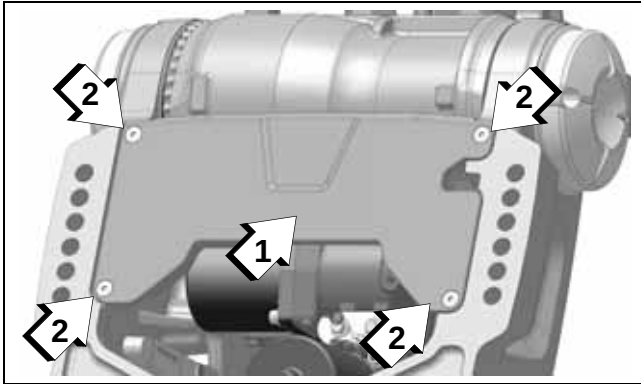
Install the lower bracket, then install the lower ramp bracket screw. Tighten the upper and lower ramp bracket screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).



1. Bracket
2. Screws

009632

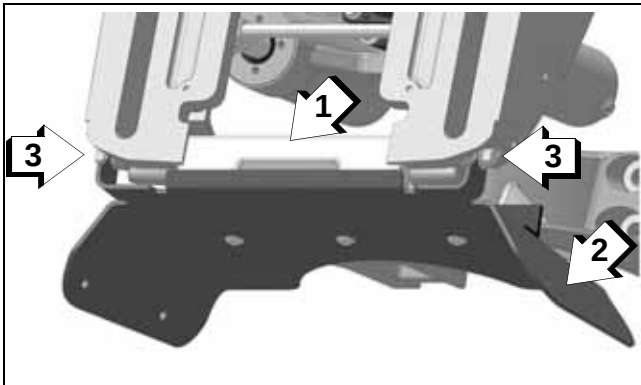
Install the stern bracket plate. Install the four screws and tighten to a torque of 18 to 24 in.lbs. (2 to 2.7 N·m).



1. Stern bracket plate
2. Screws

009630

Loosely install the anode and spray plate with two upper screws.



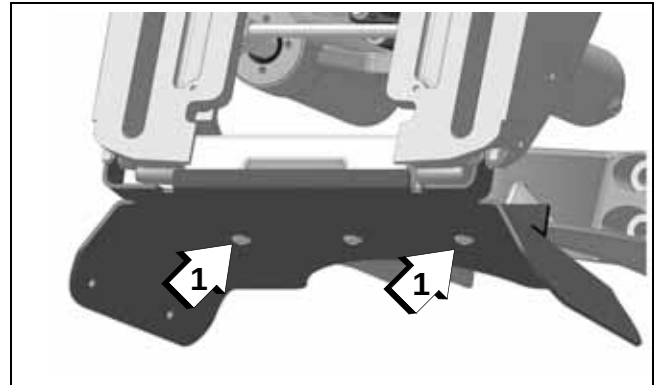
1. Anode
2. Spray plate
3. Upper screws

009629

Position the spray plate and install the two screws in the bottom of the spray plate.

Tighten the upper screws to a torque of 15 to 23 ft.lbs. (20 to 23 N·m).

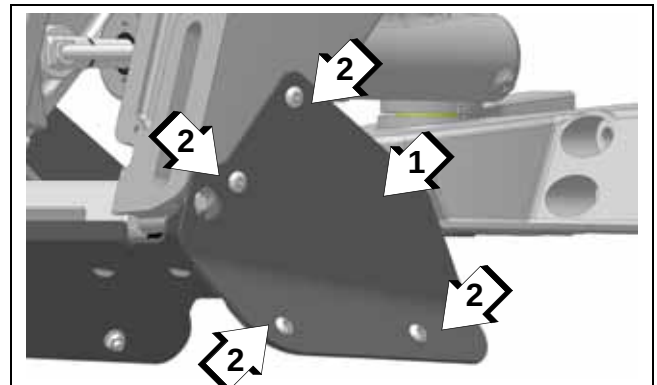
Tighten the bottom screws to a torque of 30 to 60 in.lbs. (4 to 6 N·m).



1. Screws
2. Spray plate
3. Anode

009629

Install the spray plate cover with four screws. Tighten the screws to a torque of 30 to 60 in.lbs. (4 to 6 N·m).



1. Spray plate cover (port side shown)
2. Screws

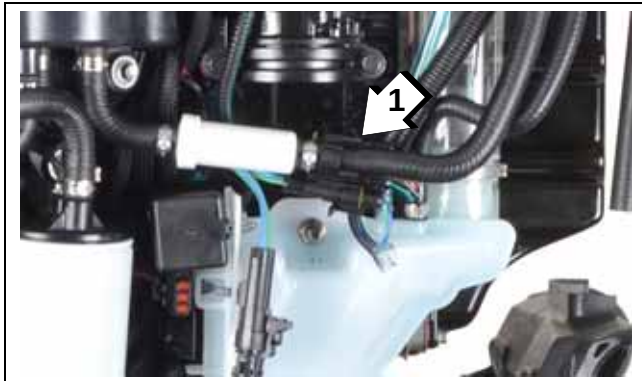
009628

Install the stern and swivel assembly on the boat. Then install the engine on the stern and swivel bracket assembly. Refer to **Installation** on p. 337.

Trim Sender Service

Removal

Disconnect the trim sender electrical connector.

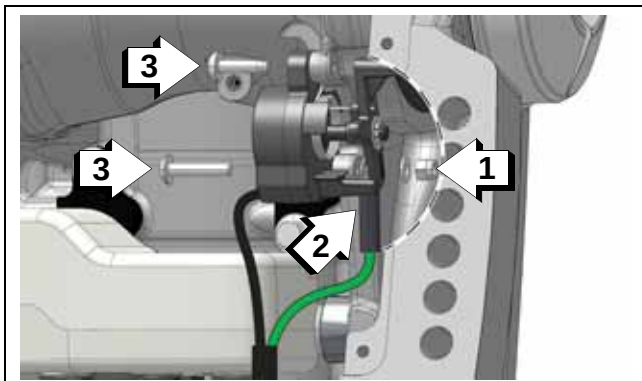


1. Trim sender electrical connectors

009171

Remove the nut, washer and ring terminal from the lower screw.

Then remove both screws and the trim sender from the swivel bracket.



1. Nut and washer
2. Ring terminal
3. Screws

009466

Installation

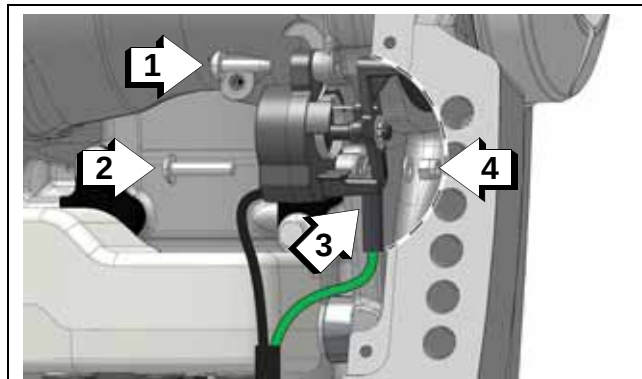
Position the trim sender on the swivel bracket. Loosely install the upper screw to keep the trim sender in position.

Install the lower screw into the trim sender and through the boss on the swivel bracket.

Apply *No-Ox Grease*, P/N 768230 to the ring terminal. Then install the ring terminal over the lower screw. Install the washer and nut on the lower screw.

Tighten both screws to a torque of 22 to 30 in. lbs. (2.5 to 3 N·m).

Apply *No-Ox Grease*, P/N 768230 over the ring terminal, washer and nut.



1. Upper screw
2. Lower screw
3. Ring terminal
4. Washer and nut

009466

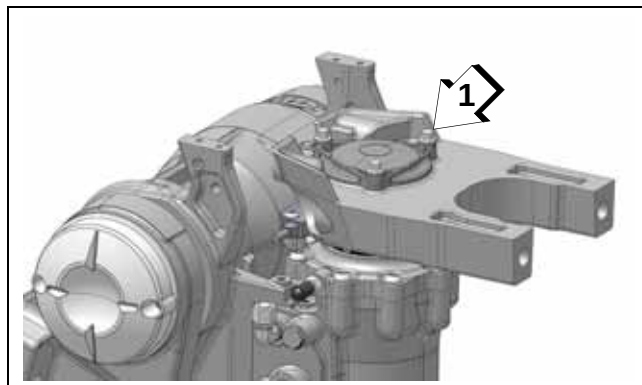
Steering Arm, End Cap and Lower Bracket Service

Removal

The engine must be removed from the stern and swivel bracket assembly to complete these procedures. Refer to **Removal** on p. 334. Removal of the stern and swivel bracket from the boat for these procedures is optional.

Steering Arm Removal

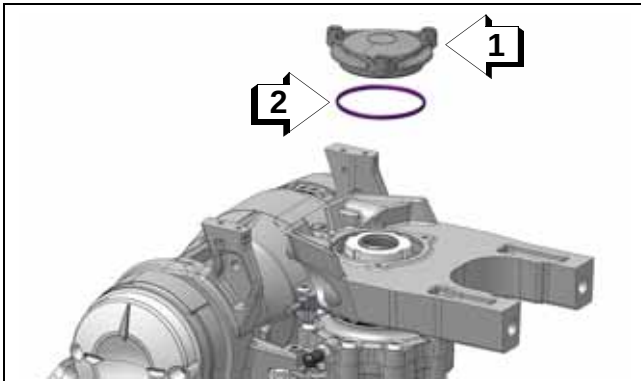
Remove the three screws from the steering arm cover.



1. Screws

009644

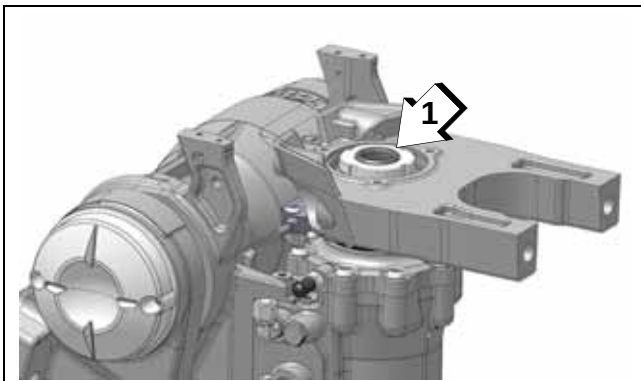
Remove the cover and o-ring



1. Cover
2. O-ring

009645

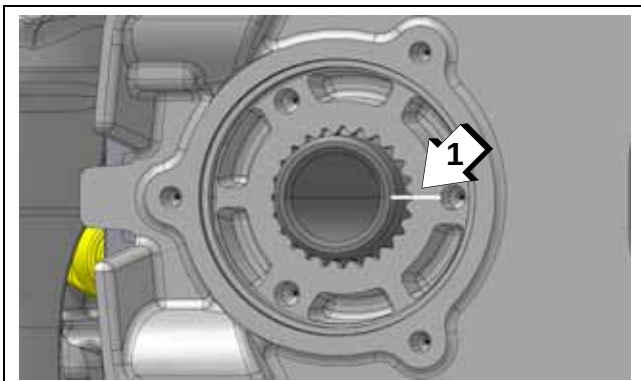
Use Spanner Socket, P/N 359224, to remove the spanner nut.



1. Spanner nut

009646

Remove the locking washer. Then make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.



1. Alignment mark

009655

Remove the steering arm from the steering shaft.



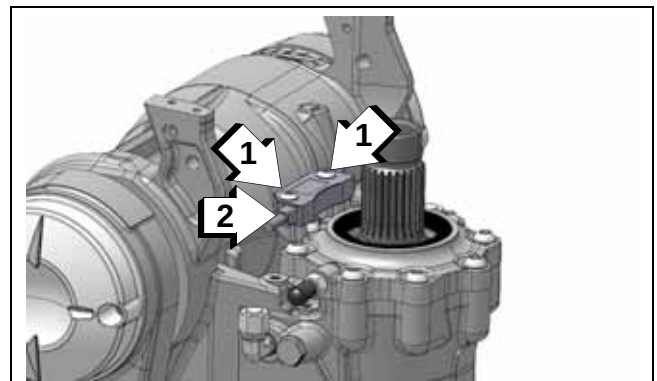
1. Steering arm

009647

End Cap Removal

Remove the steering arm from the steering shaft. Refer to **Steering Arm Removal** on p. 344.

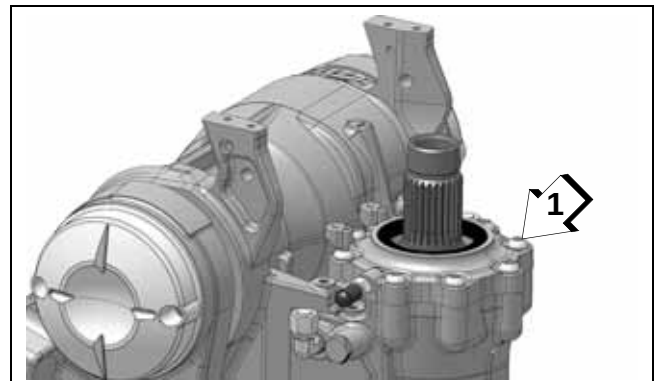
Remove the two screws retaining the steering position sensor, and remove the steering position sensor.



1. Screws
2. Steering Position Sensor

009648

Use a T-40 Torx driver to remove the eight screws retaining the end cap assembly.



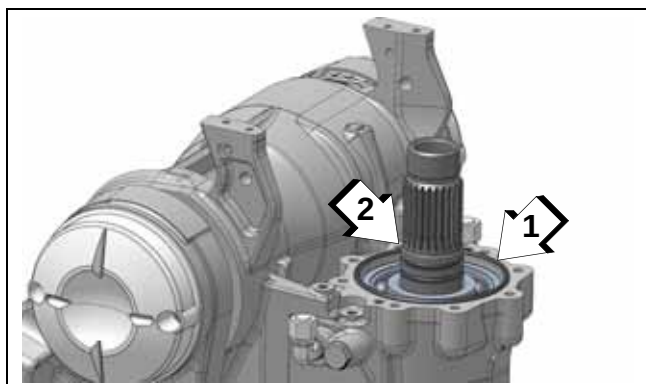
1. Screws

009648

Stern and Swivel

Stern & Swivel Bracket

Remove the large o-ring from the end cap bore. Remove the two small o-rings from the steering shaft.

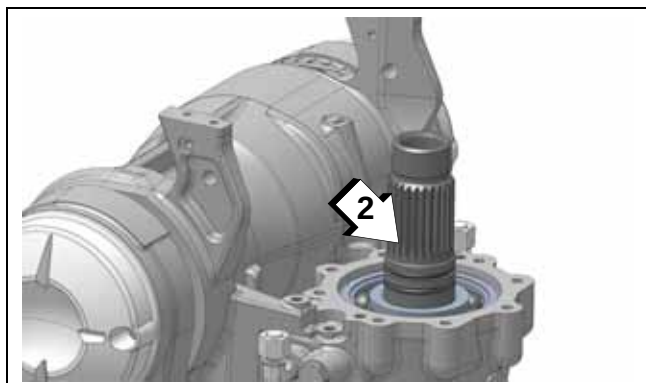


1. Large o-ring
2. Two small o-rings

009649

End Cap Installation

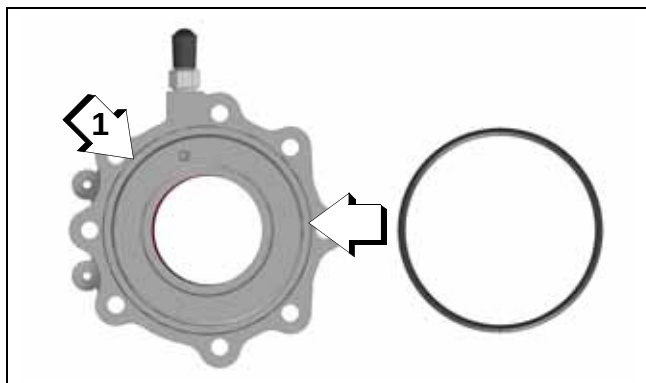
Apply Hydraulic Steering Fluid, P/N 770891, to two new o-rings. Install the o-rings on the steering shaft.



1. O-rings

009658

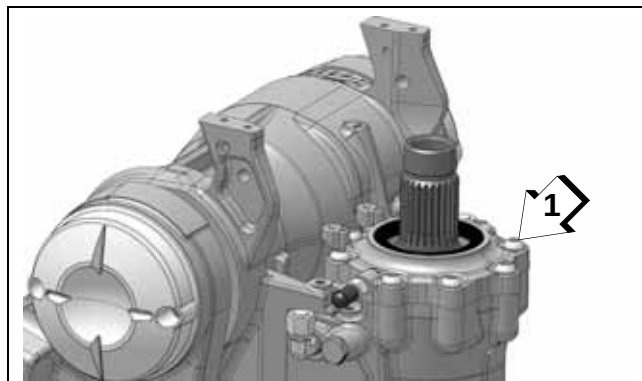
Apply *Triple Guard Grease* to a new o-ring, and install the o-ring in the groove in the end cap.



1. Groove in end cap

009657

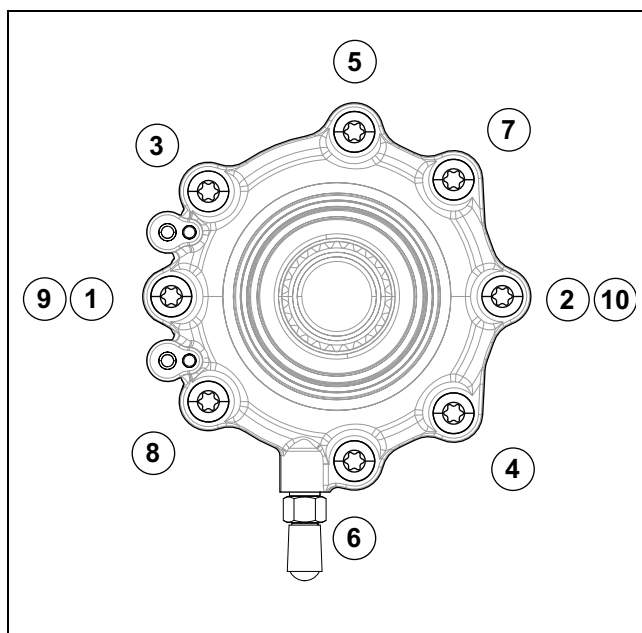
Install the end cap assembly and install the eight screws hand-tight.



1. Screws

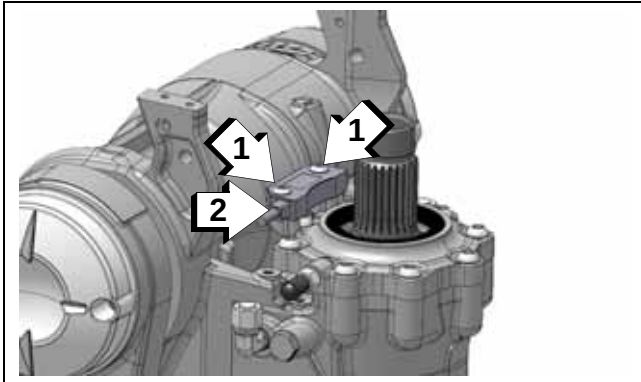
009648

Use a T-40 *Torx* driver to tighten the screws in the order shown to a torque of 26 to 28 ft.lbs. (36 to 38 N·m).



009659

Install the steering position sensor with two screws. Tighten the screws to a torque of 35 to 60 In.lbs. (4 to 6.7 N·m).



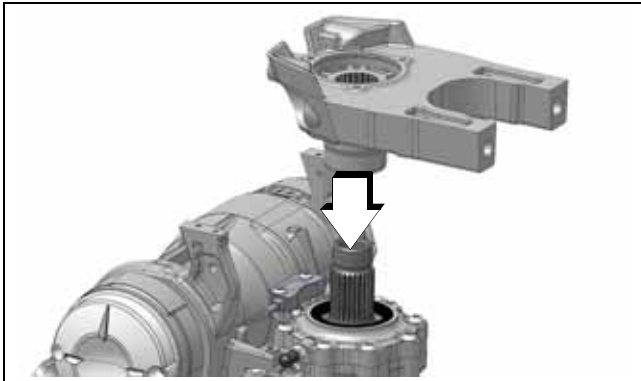
1. Screws
2. Steering Position Sensor

009648

Install the steering arm on the steering shaft. Refer to the next section.

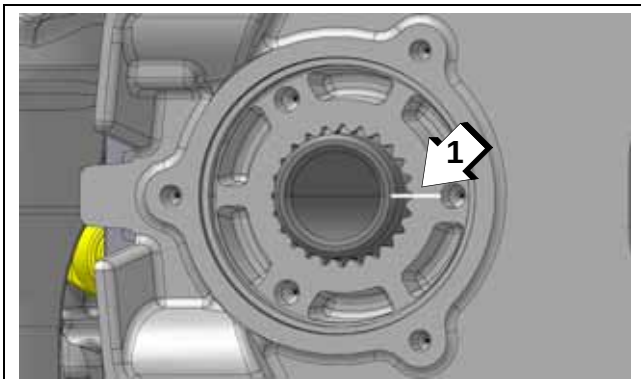
Steering Arm Installation

Install the steering arm on the steering shaft.



009647

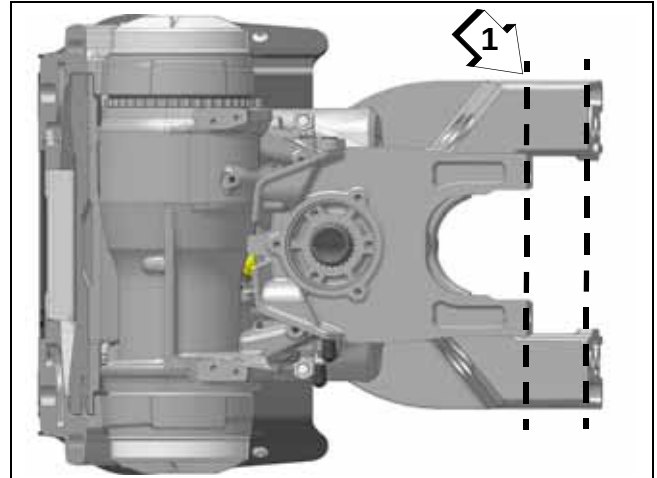
Make sure to align the marks previously made on the splined steering shaft and steering arm.



1. Alignment mark

009655

If installing a new service replacement part, align the mounting surface of the steering arm with the mounting surface of the lower bracket.

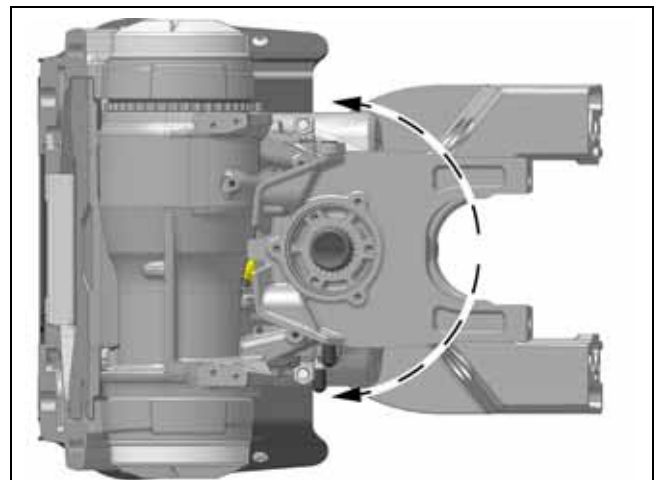


1. Mounting surfaces

009660

After the steering arm is in place, turn the steering arm fully to port and fully to starboard.

IMPORTANT: The steering arm MUST turn an equal amount in both directions. Remove and re-align the steering arm if turn radius is not equal.

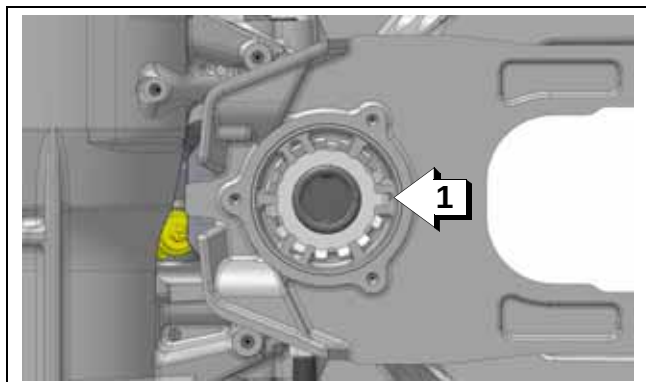


009661

Stern and Swivel

Stern & Swivel Bracket

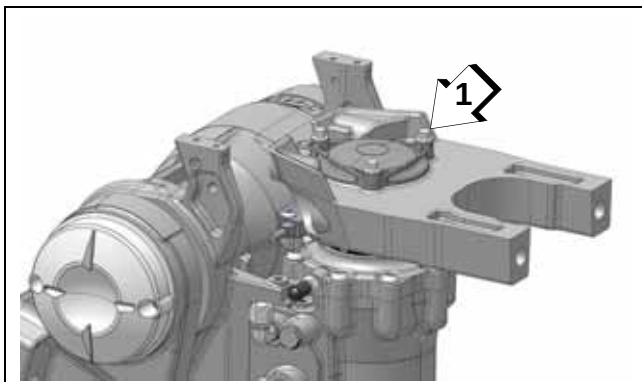
Place the locking washer over the steering shaft with the locating tab in the hole at the rear of the steering arm.



1. Locating tab

009654

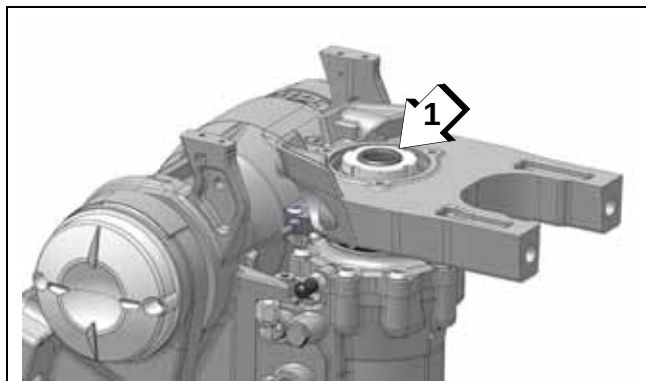
Install the three screws in the steering arm cover. Tighten screws to a torque of 79 to 96 In.lbs. (9 to 10 N·m).



1. Screws

009644

Use Spanner Socket, P/N 359224, to install the spanner nut. Tighten the spanner nut to a torque of 59 to 70 Ft.lbs. (80 to 94 N·m)



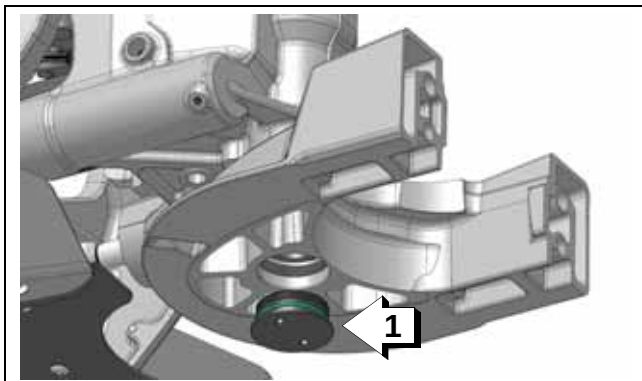
1. Spanner nut

009646

Install the engine on the stern and swivel bracket assembly. Refer to **Installation** on p. 337.

Lower Bracket Removal

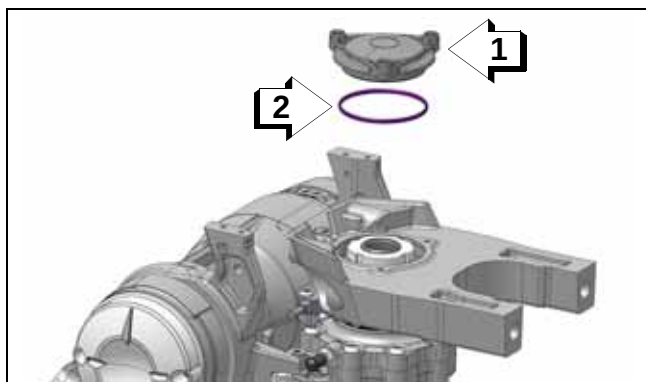
Use Spanner Wrench, P/N 912084, to remove the lower cover and o-ring.



1. Lower cover and o-ring

009650

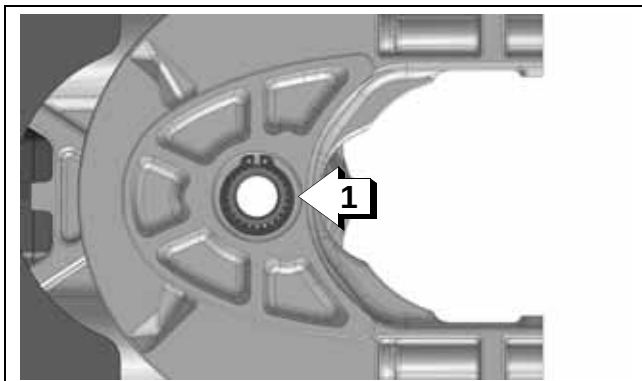
Install the cover and o-ring.



1. Cover
2. O-ring

009645

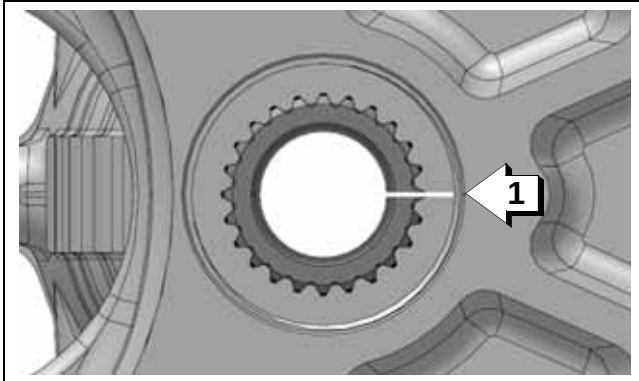
Use a bent-jaw retaining ring pliers to remove the retaining ring.



1. Retaining ring

009651

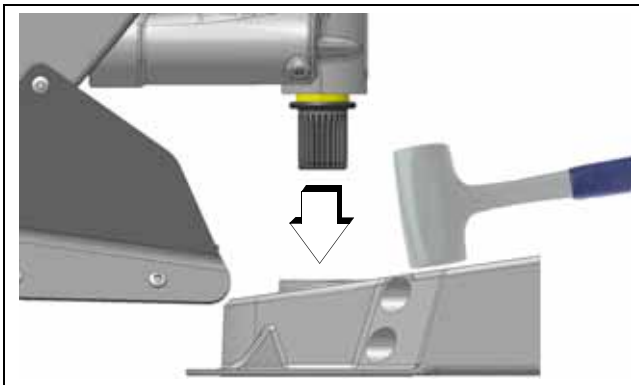
Make an alignment mark on the splined steering shaft and lower bracket to aid re-assembly.



1. Alignment mark

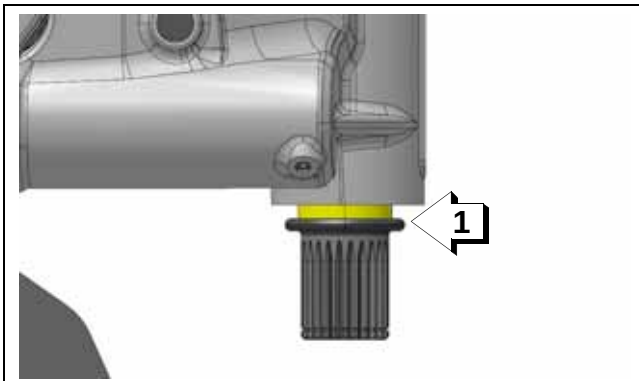
009661

Use a soft-faced mallet or soft-faced dead-blow hammer to remove the lower bracket from the shaft.



009652

Remove the o-ring from the shaft.



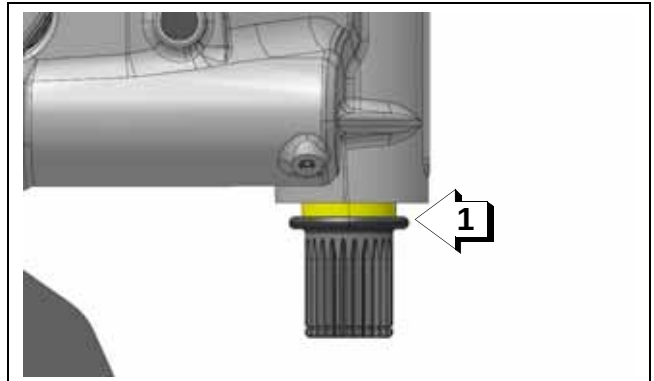
1. O-ring

00963

Clean the splines on the steering shaft and lower bracket. Inspect for any burrs, especially in the area of snap ring groove on the shaft. Carefully clean up any burrs with a small file.

Lower Bracket Installation

Install a new o-ring on the shaft.

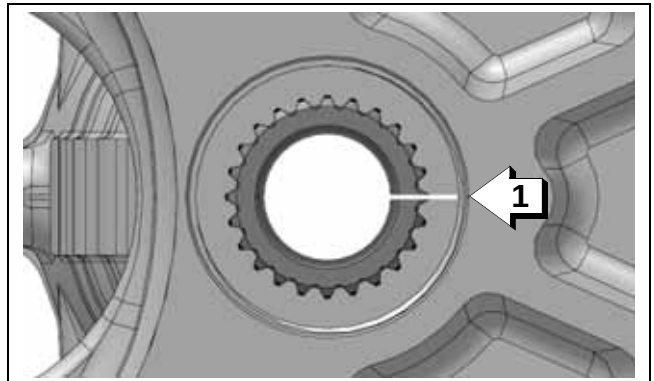


1. O-ring

00963

Install the lower bracket on the steering shaft.

Make sure to align the marks previously made on the splined steering shaft and lower bracket.



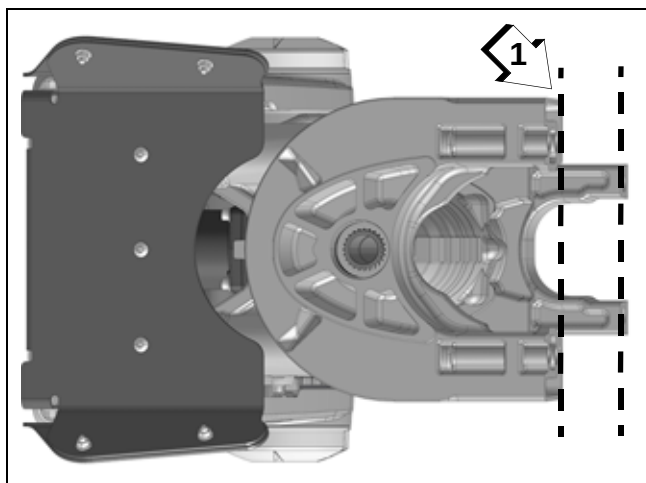
1. Alignment mark

009661

Stern and Swivel

Stern & Swivel Bracket

If installing a new service replacement part, align the mounting surface of the lower bracket with the mounting surface of the steering arm.

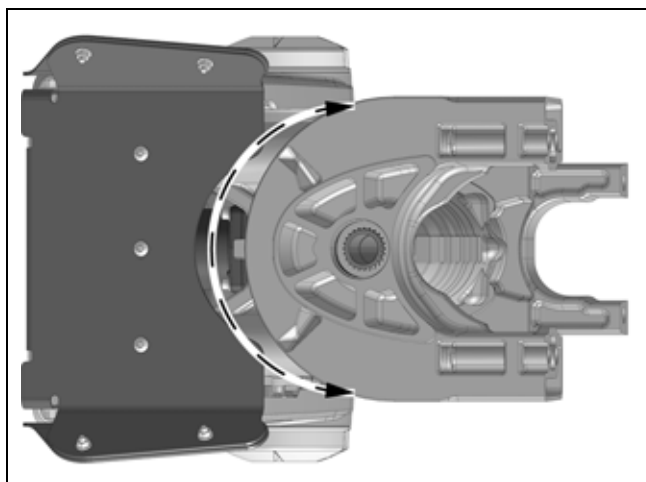


1. Mounting surfaces

009664

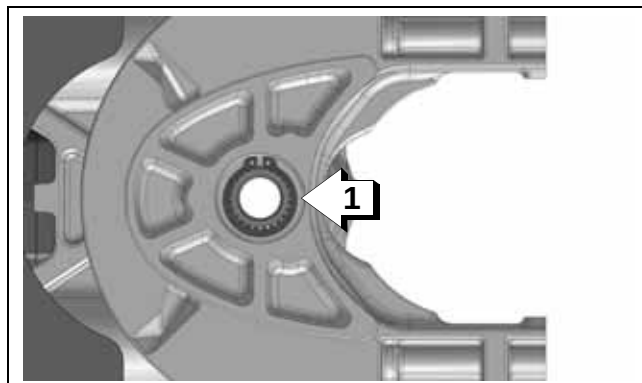
After the lower bracket is in place, turn the bracket fully to port and fully to starboard.

IMPORTANT: The bracket **MUST** turn an equal amount in both directions. Remove and re-align the bracket if steering is not equal.



009665

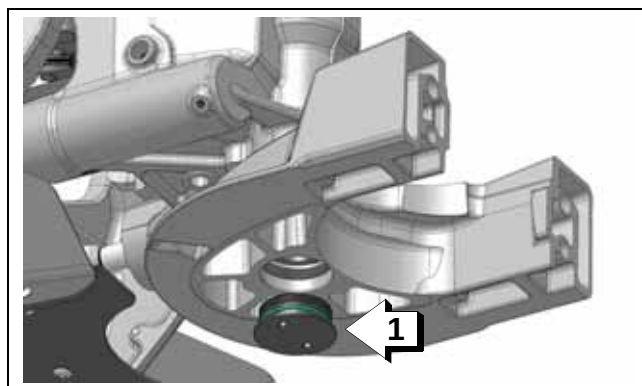
Use a bent-jaw retaining ring pliers to install the retaining ring.



1. Retaining ring

009651

Use Spanner Wrench, P/N 912084, to install the lower cover and o-ring. Tighten to a torque of 60 to 84 In.lbs. (7 to 9 N·m).



1. Lower cover and o-ring

009650

Gearcase

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Gearcase

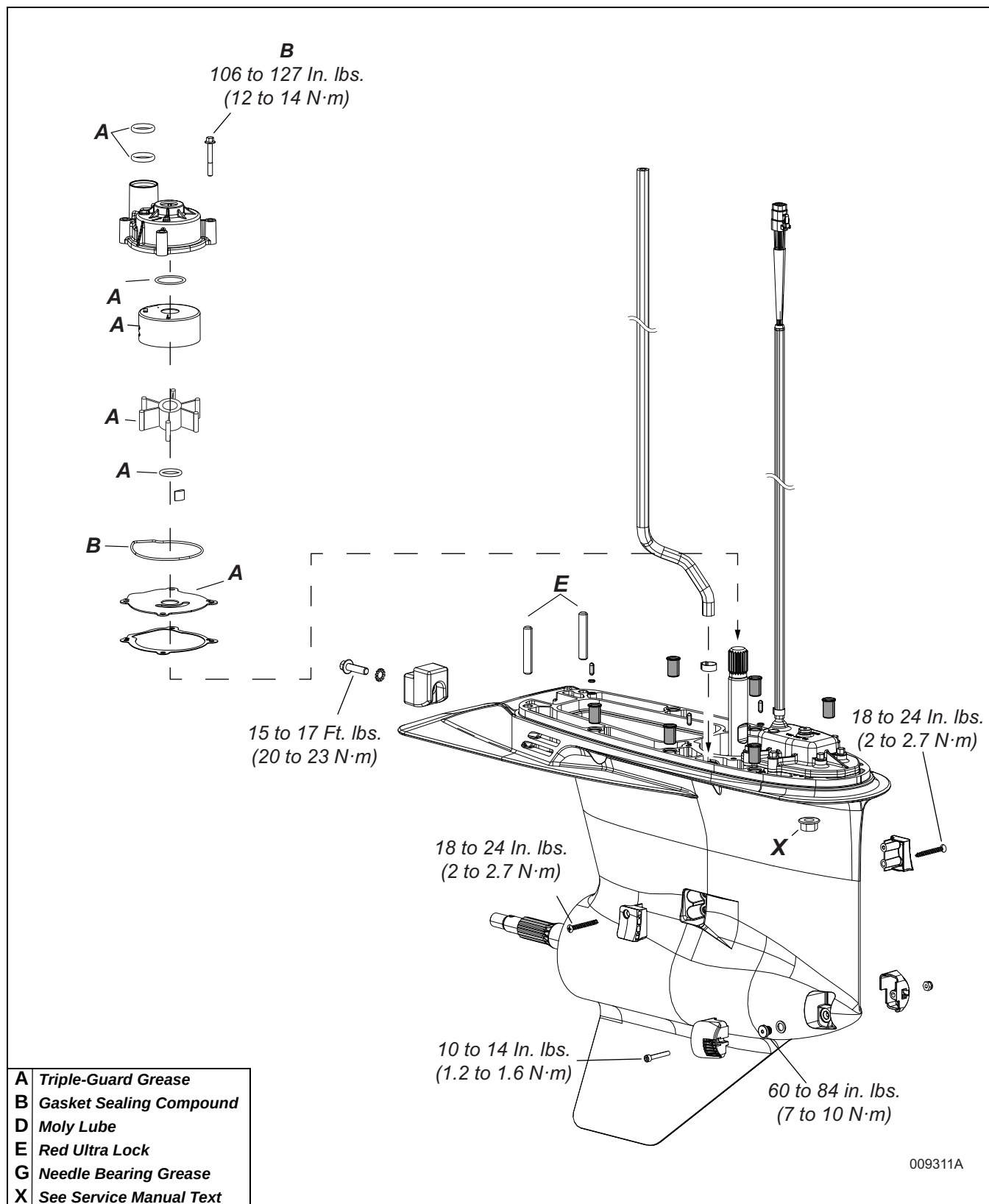
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Gearcase – Counter Rotation

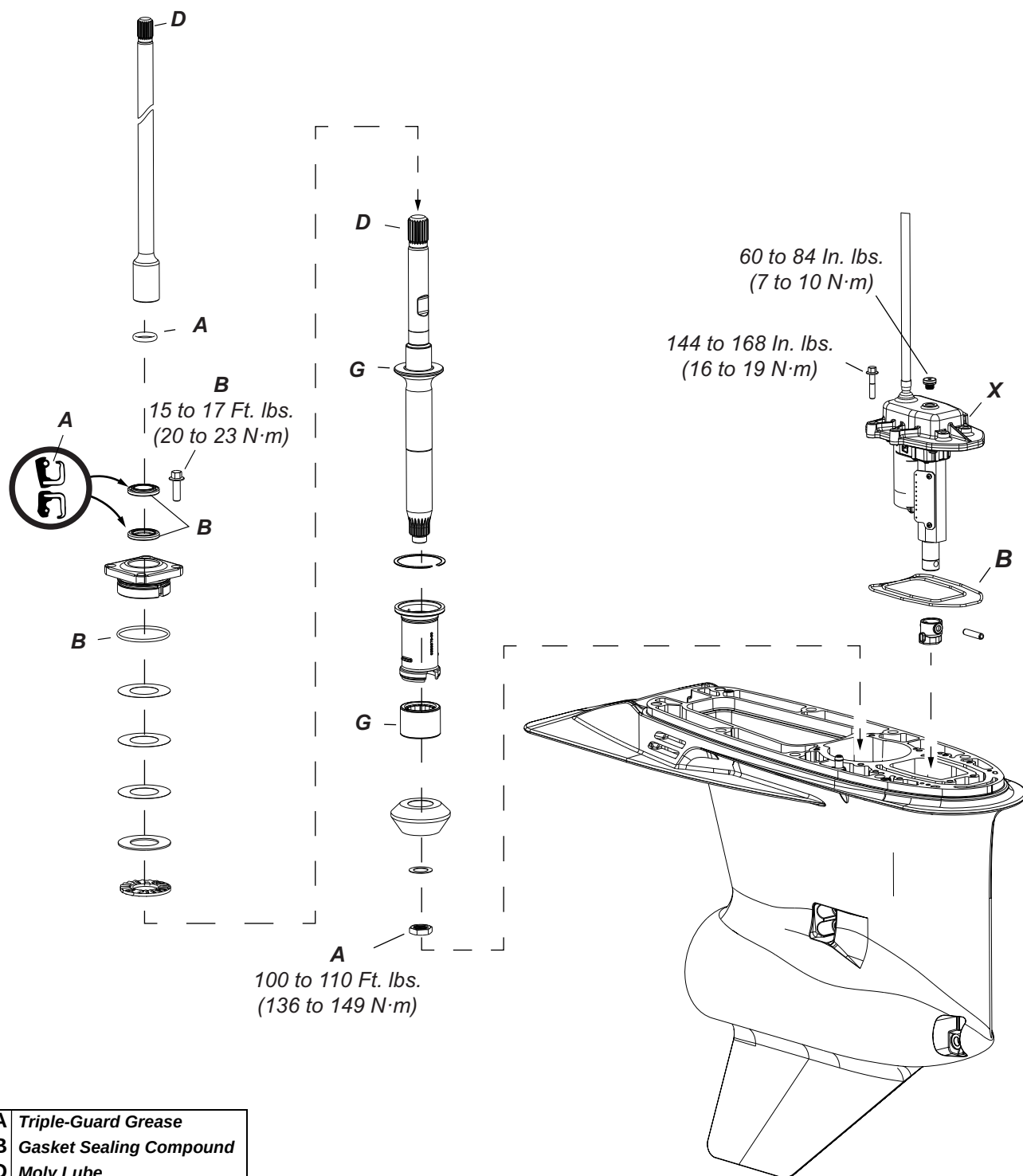
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Water Pump and Gearcase Housing

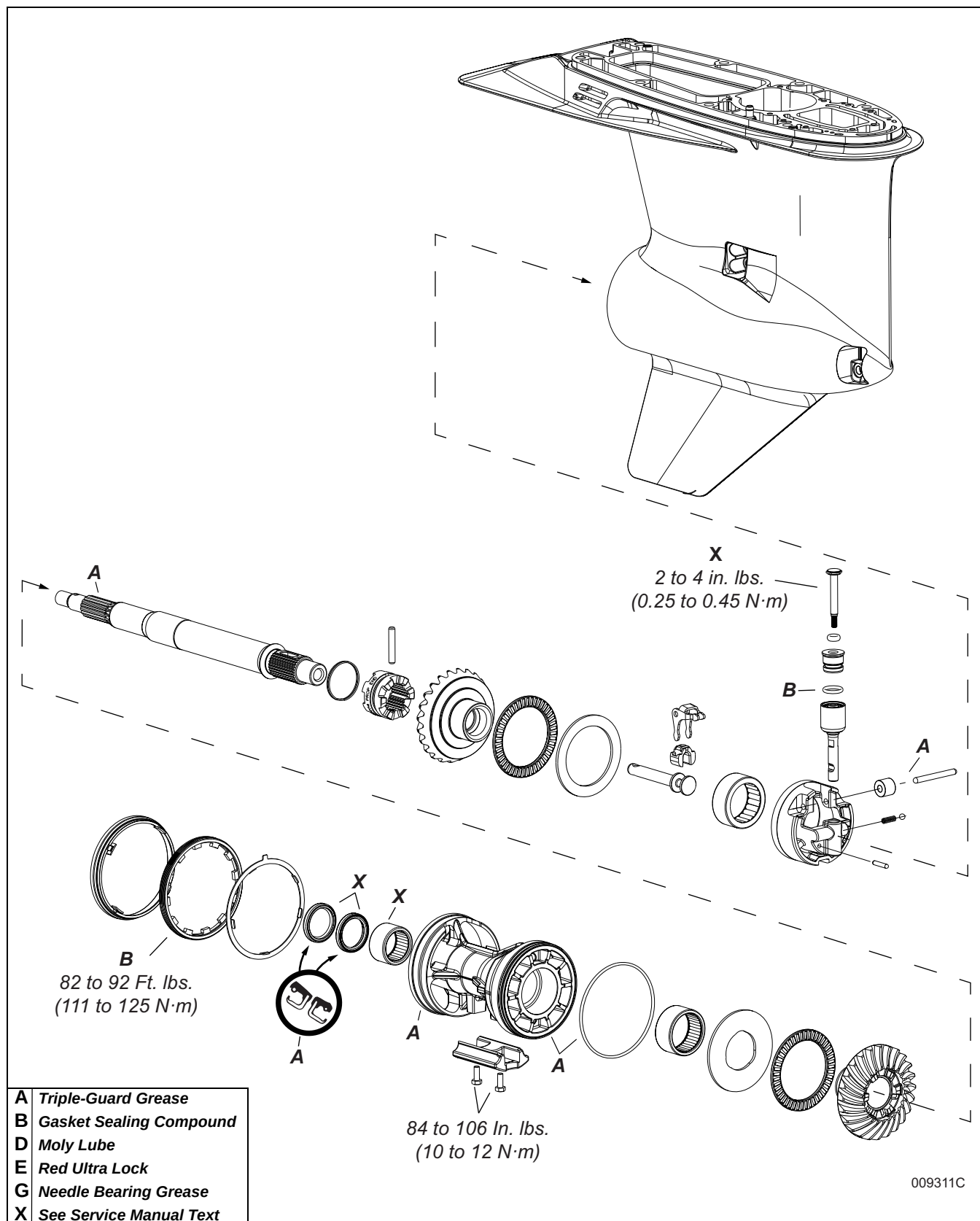


Driveshaft and Shift Actuator

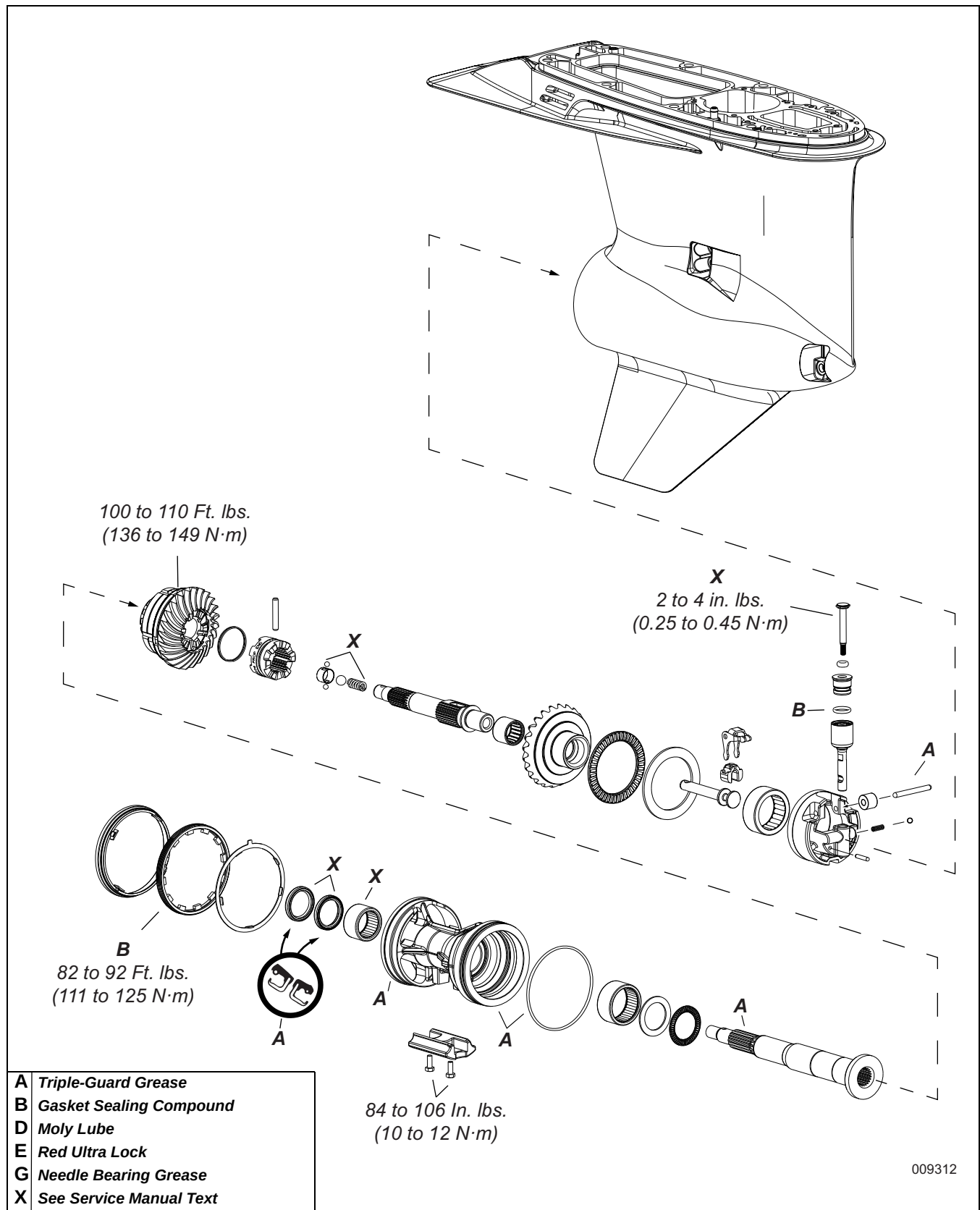


009311B

Standard Rotation Propeller Shaft



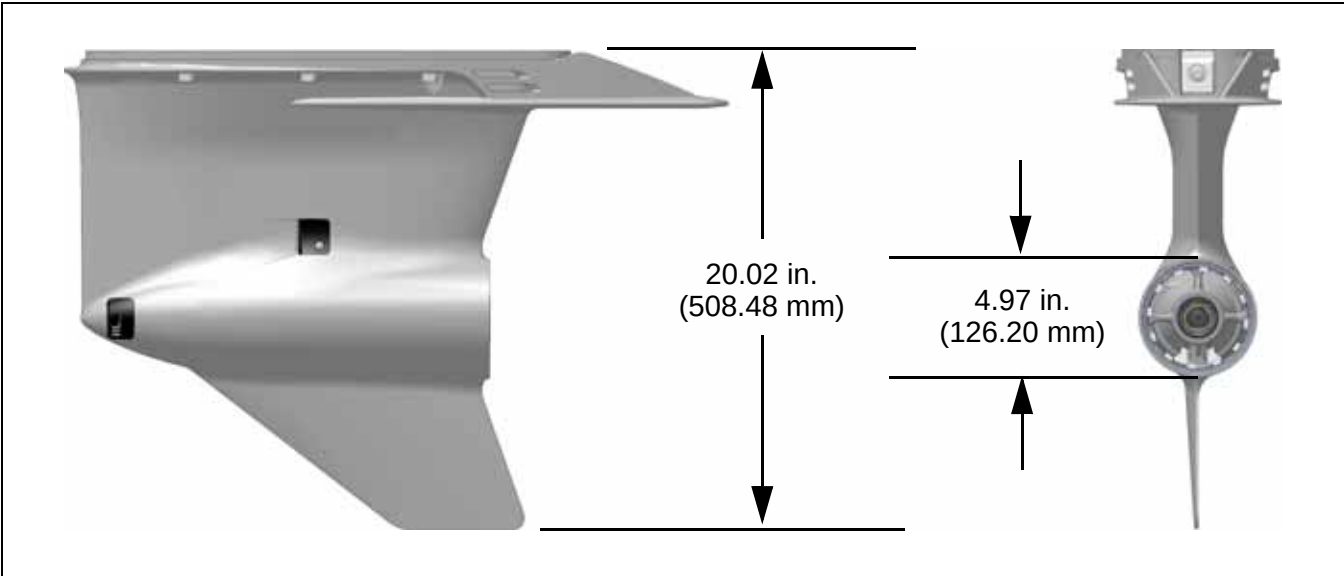
Counter Rotation Propeller Shaft



Gearcase Type

Outboard Model	Housing Type	Description of Features	Gear Ratio
Standard Rotation 20 in. 25 in. 30 in.	"SLX"	Front water inlets and straight leading edge, pressed in propeller shaft bearing housing with retaining spanner nut and locking ring, heavy duty standard rotation gear set, pressed in forward bearing housing.	13:24 (.542)
Counter Rotation 25 in. / 30 in.		Front water inlets and straight leading edge, pressed in propeller shaft bearing housing with retaining spanner nut and locking ring, "CR" shafts, bearings and heavy duty counter rotation gear set, pressed in forward bearing housing.	13:24 (.542)

Housing Profile



5008933-03

Propeller Service

⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Inspection

Carefully examine propeller and outboard for the following:

- Damaged blades and signs of propeller cavitation (burned paint, etc.)
- Spun or overheated inner hub
- Worn or twisted splines and inadequate lubricant
- Damage to outer hub area
- Worn, missing, or incorrect thrust washer and spacer
- Correct size and style
- Check for bent or damaged propeller shaft and twisted splines.

Refer to **Propeller Hardware Installation** on p. 360.

Propeller Selection

NOTICE

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

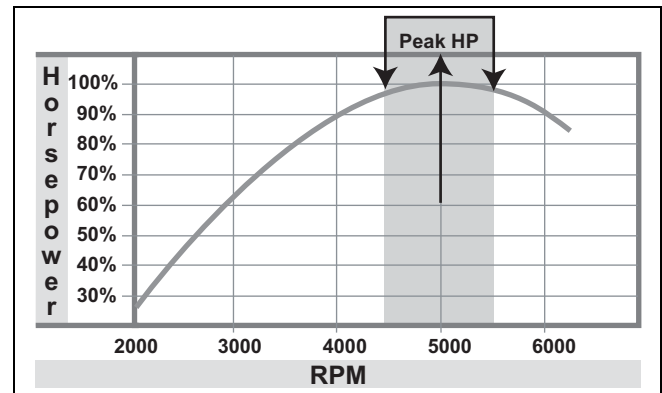
If the propeller blades have too much pitch, the engine will operate below the recommended full throttle operating range.

If the propeller blades have too little pitch, the engine will operate above the recommended full throttle operating range.

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

The correct propeller, under normal load conditions, will allow the engine to run near the mid-

point of the RPM operating range at full throttle. Refer to **Service Specifications** on p. 12.



009316

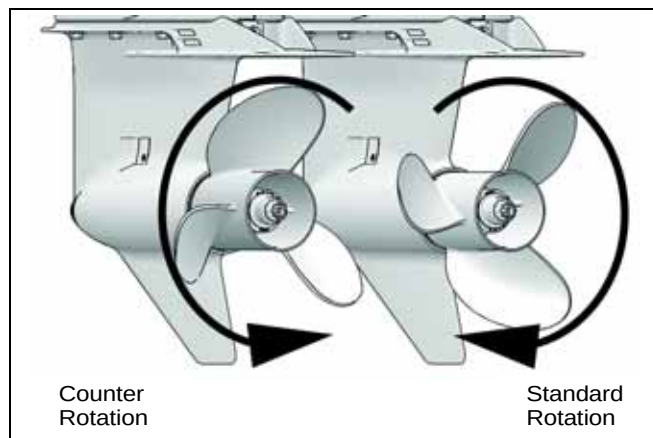
When selecting a propeller, consider the following:

- Use an accurate tachometer to determine the engine's full-throttle RPM.
- The outboard should be trimmed for top speed.
- Select a propeller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load.
- Occasionally, one propeller will not cover a wide range of boat applications — water skiing to high speed performance boating. In such cases, it might be necessary to have a propeller for each situation.
- Refer to the *Evinrude/Johnson Genuine Parts and Accessories Catalog* for propeller styles and sizes.
- Right-hand propellers are considered standard rotation propellers. When propelling a boat forward, the propeller rotates in a right-hand (clockwise) direction as viewed from the rear.
- Left-hand propellers are considered counter-rotation propellers. When propelling a boat for-

Gearcase

Propeller Service

ward, the propeller rotates in a left-hand (counterclockwise) direction as viewed from the rear.



5008933-04

⚠ WARNING

For multiple-outboard installations, always check to be sure propellers are installed on the correct engines before aggressively operating the boat.

Propeller Hardware Installation

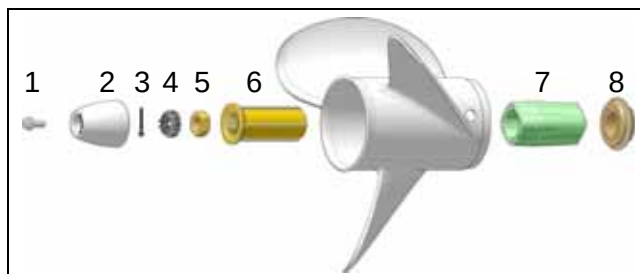
⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

IMPORTANT: Depending on propeller style, different thrust bushings, spacers, and cotter pin keepers are used. See the *Evinrude/Johnson Genuine Parts and Accessories Catalog* for correct propeller hardware.

Apply *Triple Guard* grease to the splines of the propeller shaft before installing the propeller.

When installing a propeller with an interchangeable hub, follow the instructions provided with the propeller.



5008933-05

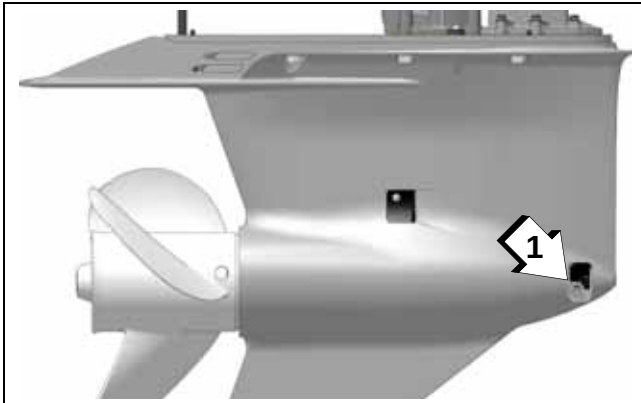
1. Anode screw
2. Anode
3. Cotter pin
4. Keeper
5. Nut
6. Thrust bushing
7. Torsion bushing
8. Thrust washer

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

Gearcase Leak Test

Remove the drain/fill screw and drain the lubricant before testing. Refer to **Gearcase Lubricant** on p. 38.

Install Gearcase Pressure Tester, P/N 507977, into the gearcase drain/fill.



1. Gearcase drain/fill

5008933-06

Install hose pinching pliers on the gearcase vent hose. Pressurize the gearcase to 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leak.

If the gauge does not indicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leaks.

Make necessary repairs and repeat test.

Install Gearcase Vacuum Tester, P/N 507982. Apply 3 to 5 in. of vacuum (76 to 127 mm) Hg. with pump.

If vacuum gauge indicates leakage, apply oil around suspected seal. If leak stops or oil is drawn in, seal is defective.

Repeat test, gearcase must hold minimum of 15 in. vacuum (381 mm) Hg.

Gearcase Removal and Installation

Gearcase Removal

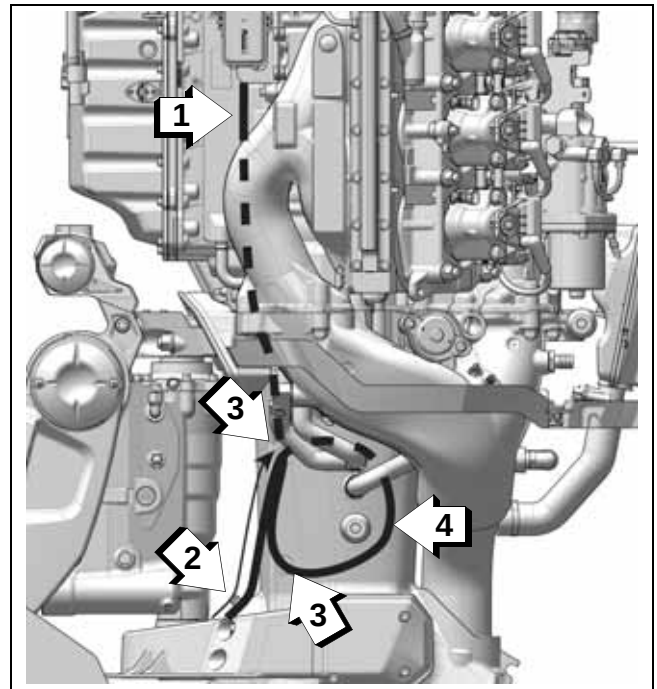
⚠ WARNING

During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboards weight with a suitable hoist or the trailering lever during service.

IMPORTANT: Make sure the gearcase is shifted into NEUTRAL.

Remove the port and starboard covers and frames. Refer to **Engine Cover and Frame Service** on p. 55.

Remove all tie straps retaining the shift actuator cable in the locations shown:



Tie Strap Locations (20 Inch "L" Model Shown)

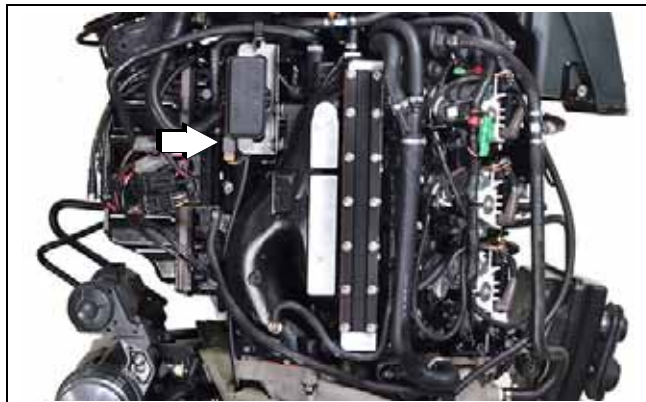
5008933-07

1. Below shift actuator cable connector
2. Exhaust housing boss
3. Shift actuator cable retention (all models)
4. Shift actuator cable retention (20 inch "L" and 25 inch "X" models only)

Gearcase

Gearcase Removal and Installation

Disconnect the shift actuator cable from the engine harness.



5008933-10

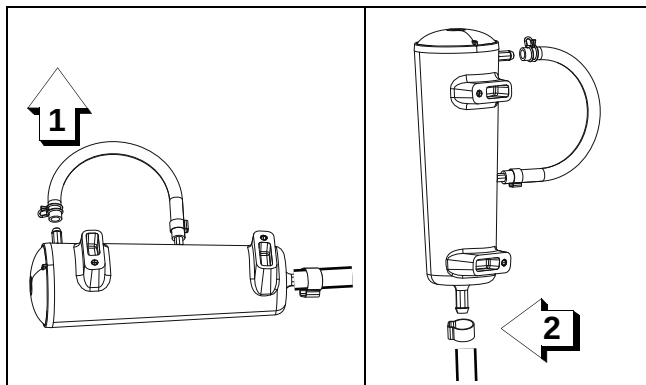
⚠ CAUTION

Gearcase lubricant may be under pressure and/or hot if outboard was recently operated or if gearcase lubricant is above the *Maximum* level.

Wear safety glasses and take precautions to avoid injury when removing vent hose from reservoir upper fitting.

Turn the reservoir horizontal with the hose fittings facing upward as shown. Then remove the vent hose from the upper fitting to relieve gearcase pressure.

Remove the clamp from the gearcase oil reservoir hose. Then remove the hose from the gearcase oil reservoir. Drain the oil into a suitable container. Plug the end of the oil reservoir hose.

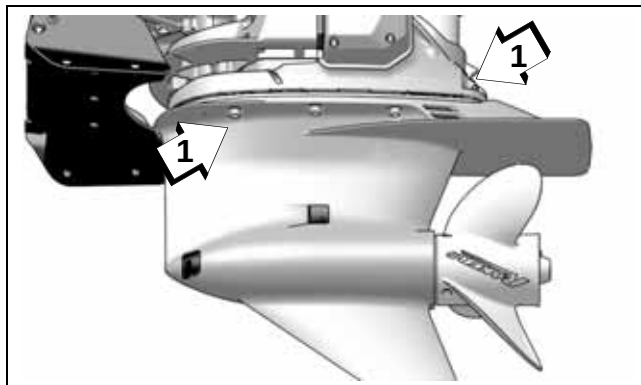


Gearcase Oil Reservoir

1. Remove the vent hose from the upper fitting
2. Remove hose from the gearcase oil reservoir.

5008933-11

Remove the eight gearcase mounting nuts.



1. Gearcase mounting nuts (Port side shown)

5008933-12

Remove the gearcase assembly and the upper driveshaft. If the upper driveshaft does not come off with the gearcase, remove it from the exhaust housing.

Gearcase Installation

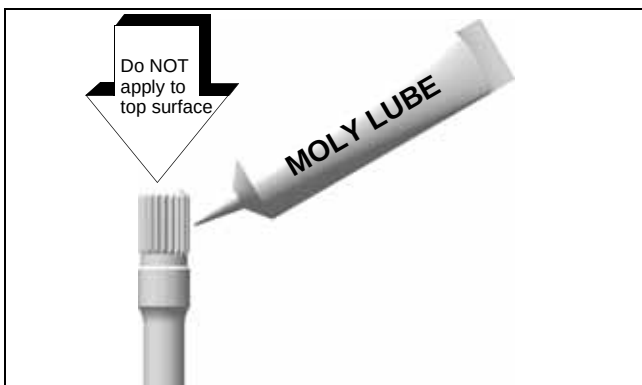
⚠ WARNING

During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboards weight with a suitable hoist or the trailering lever during service.

NOTICE

Use *Evinrude Diagnostics* software (version 6.1 or later) to calibrate the shift actuator when installing a new gearcase or a new shift actuator. Failure to calibrate the shift actuator can result in damage to the shift actuator.

Coat the splines of the upper and lower driveshafts with *Moly Lube*.



5008933-13

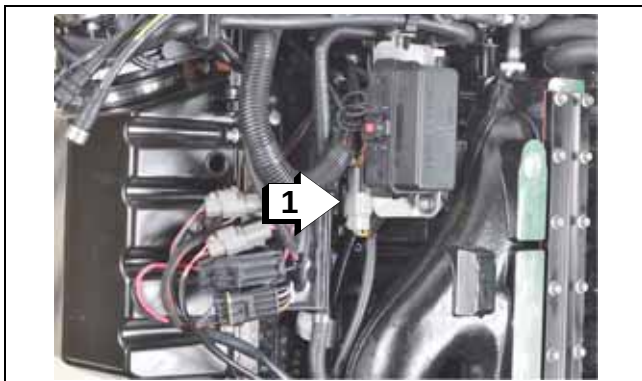
Install the upper driveshaft on to the lower drive-shaft.



009326

Shift the gearcase into FORWARD gear:

- Temporarily connect the shift actuator cable to the engine harness.
- Turn the key switch to the ON position. Do **NOT** start the engine.
- Rotate the propeller shaft while a helper shifts the remote control into FORWARD gear.



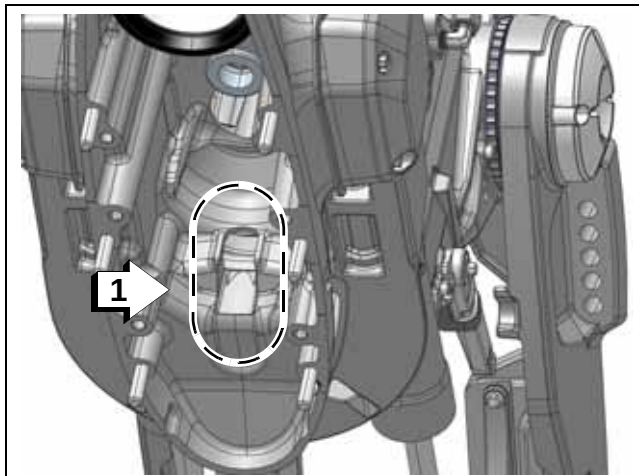
1. Shift actuator cable temporarily connected to the engine harness

009172

After shifting the gearcase into FORWARD gear, turn the key switch to the OFF position. Then disconnect the shift actuator cable from the engine harness.

Route the oil hose and shift actuator cable through the opening at the front of the exhaust housing.

The oil hose is routed to starboard, the actuator cable to port.



1. Opening

5008933-14A

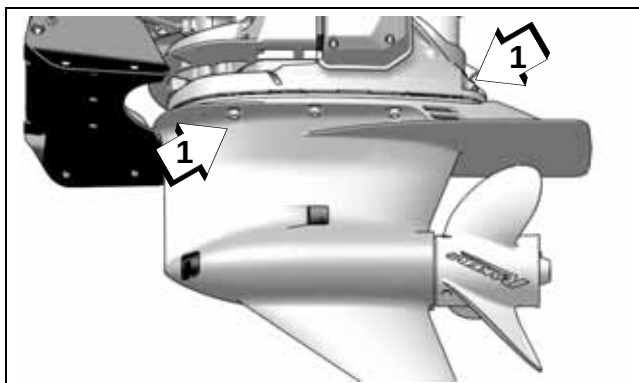
Install the gearcase to the outboard.

Slide the gearcase into place, making sure:

- Driveshaft engages the crankshaft.
- Water tube enters the water pump.
- Lower inner exhaust housing installs correctly.

Install the eight gearcase mounting nuts.

- Tighten black nuts to 29 lbs·ft (39 N·m).
- Tighten silver nuts to 38 lbs·ft (52 N·m).



1. Gearcase mounting nuts (Port side shown)

5008933-12

Gearcase

Gearcase Removal and Installation

⚠ WARNING

Failure to properly tighten gearcase nuts with a torque wrench could lead to gearcase damage or loss, resulting in loss of control and possible personal injury.

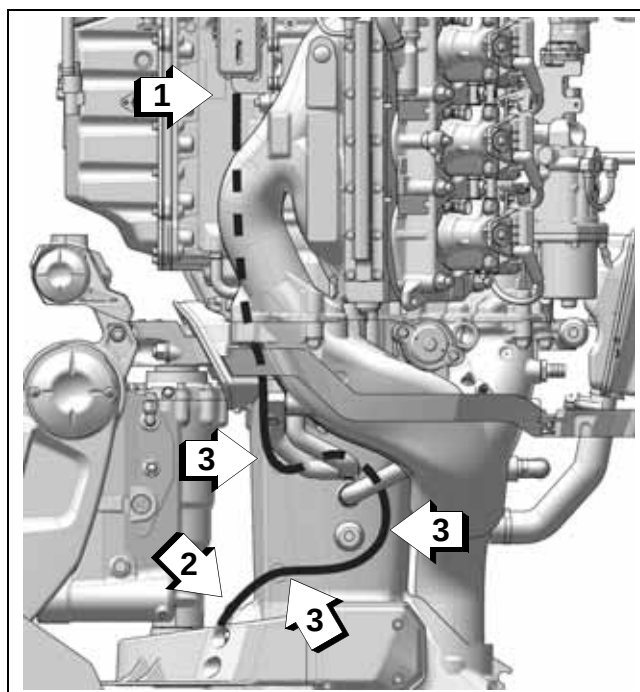
Nut torque should be checked regularly, especially in high-speed applications, or any time propeller damage has occurred.

Refer to the following images for correct shift actuator cable routing.

Route the shift actuator cable and connect it to the engine harness.

IMPORTANT: Install one tie strap to secure the shift actuator cable and vent hose to the exhaust housing. Do NOT pinch the vent hose by over-tightening the tie strap

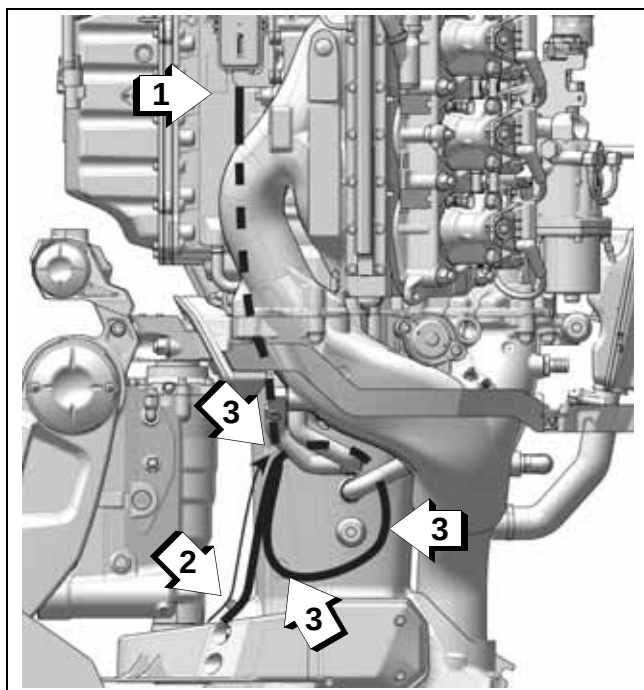
Install the remaining tie straps to retain the shift actuator cable.



5008933-08

25 Inch "X" Models

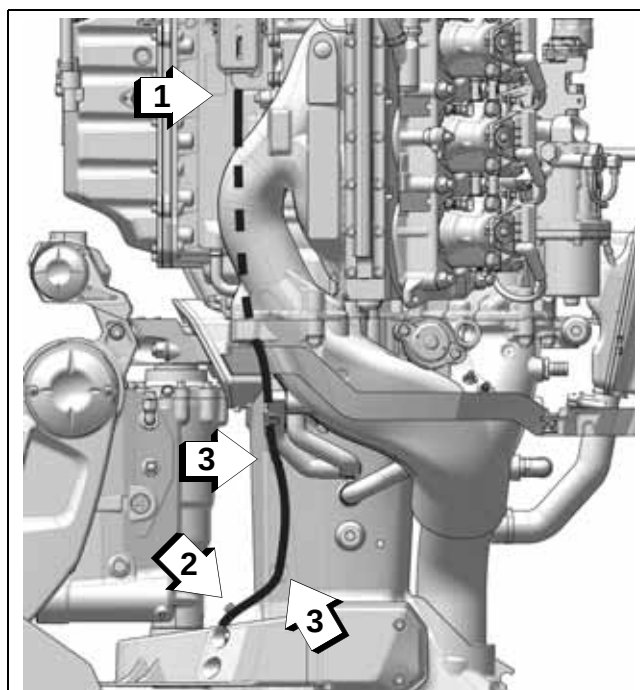
1. Shift actuator cable connector
2. Vent hose and shift actuator cable
3. Shift actuator cable



5008933-07

20 Inch "L" Models

1. Shift actuator cable connector
2. Vent hose and shift actuator cable
3. Shift actuator cable

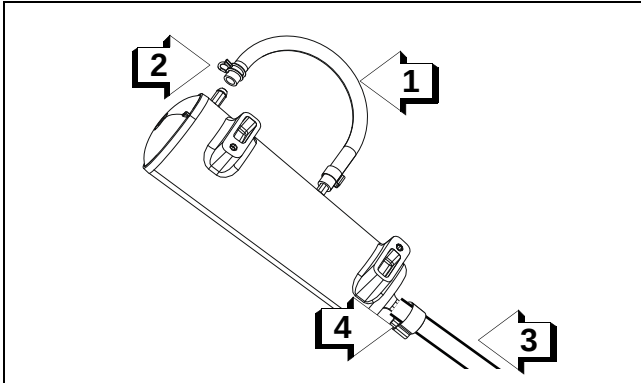


5008933-09

30 Inch "Z" Models

1. Shift actuator cable connector
2. Vent hose and shift actuator cable
3. Shift actuator cable

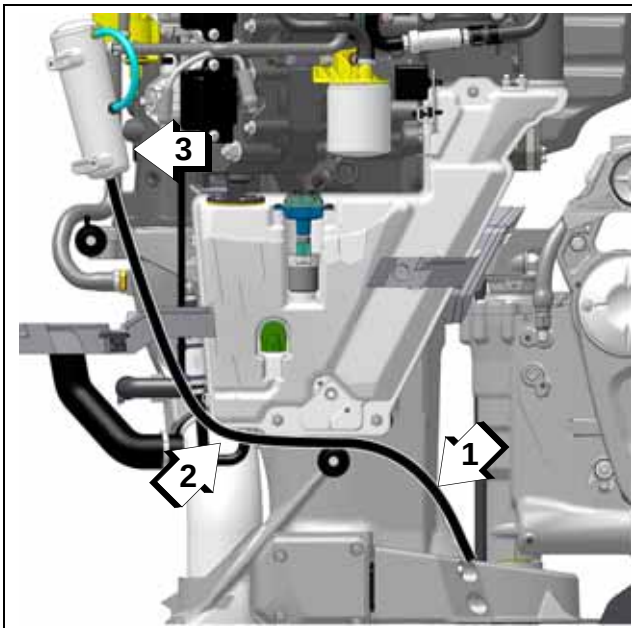
Install the oil reservoir vent hose to the top of the oil reservoir, secure with spring clamp. Install the oil hose on to the bottom of the oil reservoir with a new 15.7 mm Oetiker clamp.



1. Oil reservoir vent hose
2. Spring clamp
3. Oil hose
4. Oetiker clamp

5008933-15

Route the oil reservoir hose from the gearcase to the oil reservoir with a direct continuous rise as shown. Do NOT allow low points. Any low points will prevent the gearcase from venting properly.



1. Oil reservoir hose
2. Continuous rise
3. Oil reservoir

009328

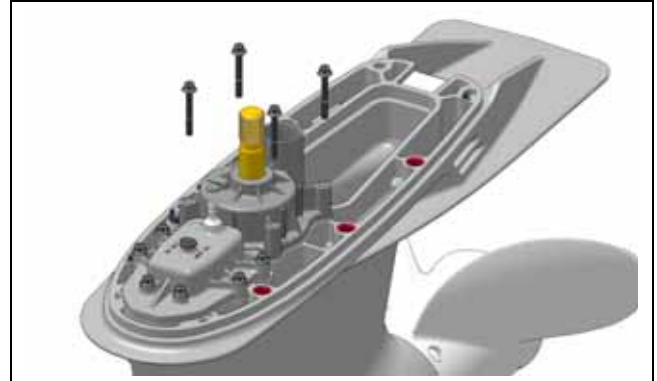
Be sure to calibrate the shift actuator if installing a new gearcase or shift actuator.

Install the frames and covers. Refer to **Engine Cover and Frame Service** on p. 55.

Water Pump Service

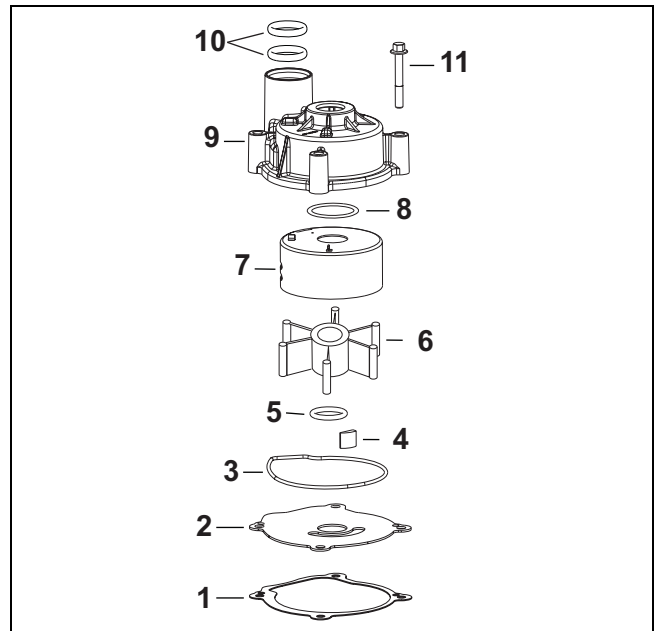
Disassembly

Remove the four impeller housing screws.



5008933-16

Slide the water pump off the driveshaft. Remove the impeller key, O-ring, impeller plate, and gasket. Discard the gasket. Remove all the parts from the housing.



1. Gasket
2. Plate
3. Housing seal
4. Key
5. O-ring
6. Impeller
7. Cup
8. Seal ring
9. Housing
10. Water tube o-rings
11. Screw (4X)

5008933-17

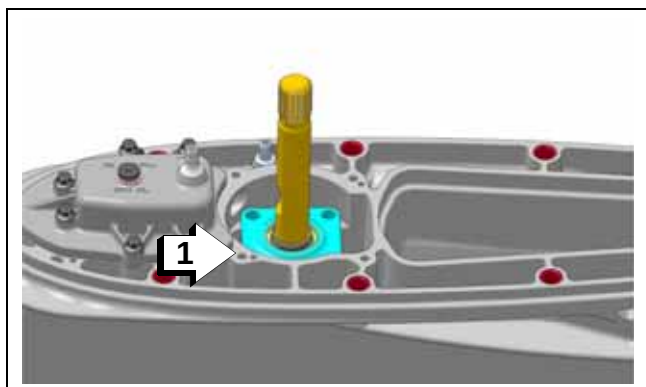
Inspection

Check impeller for overheating, hub separation, and other wear or damage.

Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.

Make sure gasket surface is clean and smooth.



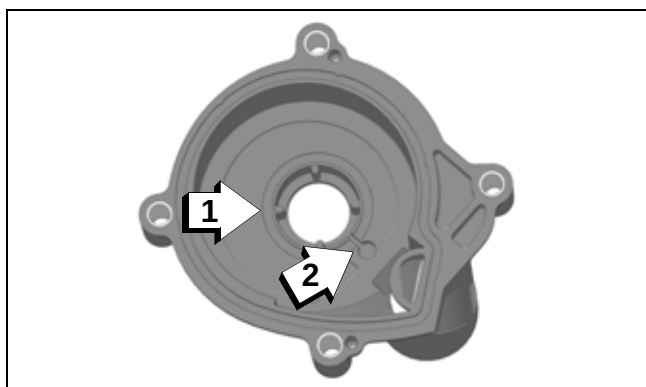
1. Gasket surface

5008933-18

Assembly

Apply a drop of *Adhesive 847* in the o-ring groove.

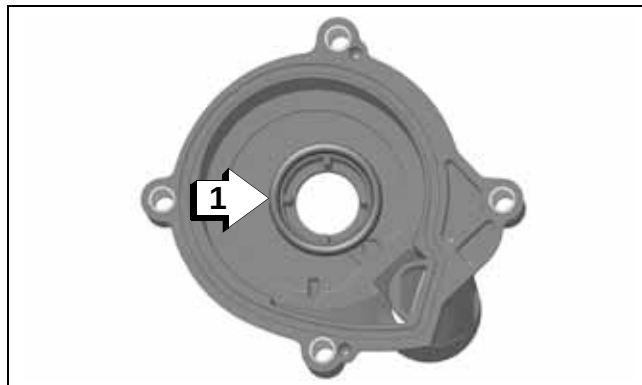
Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.



1. O-ring groove
2. Air bleed groove

5008933-19

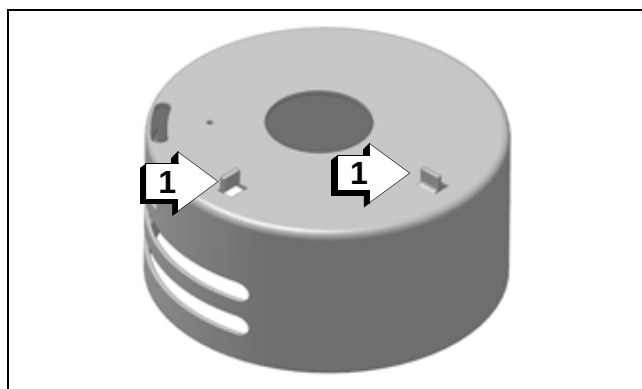
Install the o-ring in the impeller housing.



1. O-ring

5008933-20

Lightly coat the exterior rim of the impeller cup with *Triple Guard* grease. Install the cup in the impeller housing. The cup locks in place in the housing with two square index tabs.

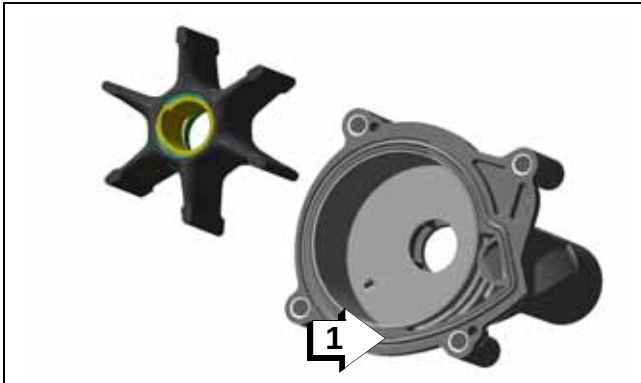


1. Index tabs

5008933-21

Lightly coat the of the vanes of the impeller with *Triple-Guard* grease. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller key facing out.

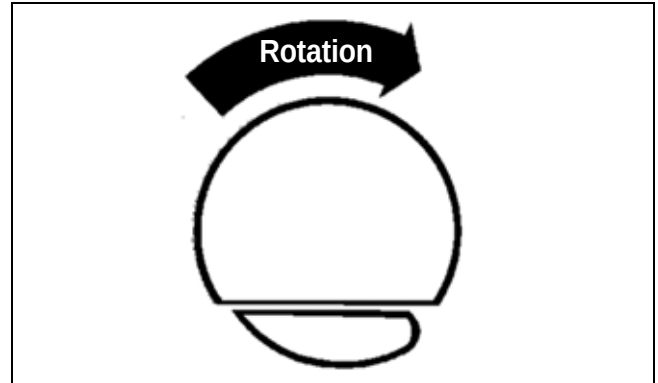
Apply *Gasket Sealing Compound* to the housing seal and install it into the impeller housing.



1. Seal

5008933-22

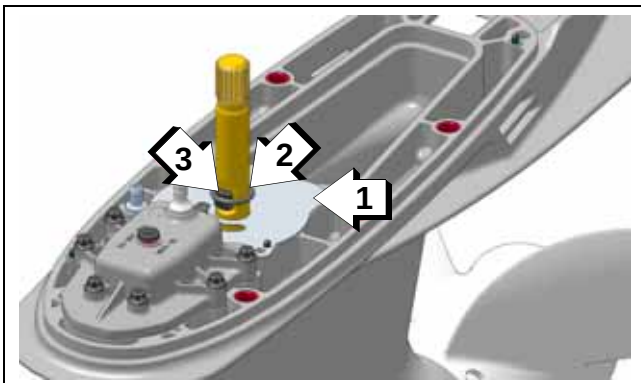
slide water pump down over key. Be sure impeller key does not fall out of position.



5008933-24

Apply *Gasket Sealing Compound* to both sides of a new impeller plate gasket. Install the gasket and impeller plate. Lightly coat the top side of the impeller plate with *Triple Guard* grease.

Apply *Triple-Guard* grease to a new impeller o-ring. Slide the o-ring down the driveshaft and half way over installed impeller key to temporarily hold key in place.



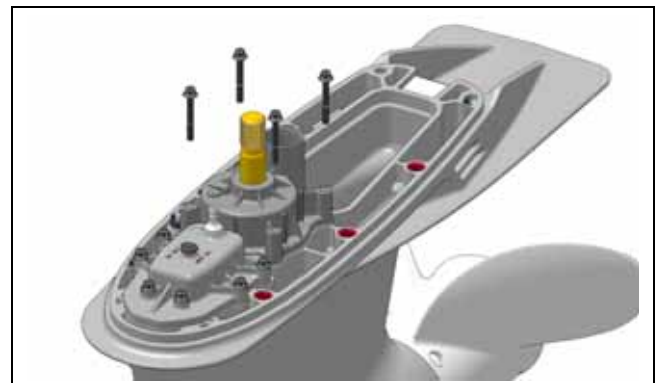
1. Impeller plate
2. O-ring
3. Key

5008933-23

NOTICE

Make sure the impeller engages the impeller key. Serious powerhead damage will result if impeller key is not in place.

Align the impeller housing with the gearcase. Apply *Gasket Sealing Compound* to threads of the four impeller housing screws. Install the screws and tighten to a torque of 106 to 127 In. lbs. (12 to 14 N·m).



5008933-16

The sharp edge of the key is the leading edge in clockwise rotation.

Slide the water pump down the driveshaft. Align impeller slot with the impeller key. Rotate the driveshaft to engage the key with the impeller, and

Gearcase

Shift Rod Adjustment

Shift Rod Adjustment

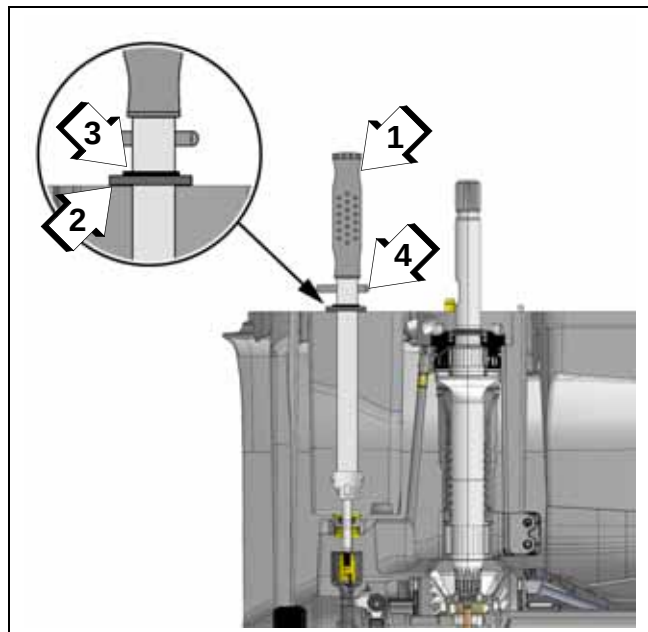
Use Shift Rod Installer, P/N 358162, to check shift rod height.

Install the plate on the gearcase housing with two screws (provided).

Install the tool onto the shift rod. Make sure the gearcase is in the NEUTRAL position. If needed, rotate the propeller shaft and use the tool to push or pull the shift rod to the NEUTRAL position.

Turn the handle of the tool clockwise to lower, or counter-clockwise to raise the shift rod height.

Shift rod height is correct when the clip on the tool contacts the plate. Turn the handle $\pm 1/2$ turn so the pin is oriented forward/aft. This ensures the hex of the shift rod is aligned to accept coupler of the shift actuator.



Shifter Rod Adjustment

009592

1. Shift Rod Installer and Adjustment Tool, P/N 358162
2. Plate
3. Clip
4. Pin

Turn the propeller shaft and pull the shift rod up until the clutch dog fully engages gear. The shift rod **MUST** be in the up position to install the shift actuator.

Remove the tool from the gearcase.

Alternate Adjustment Method

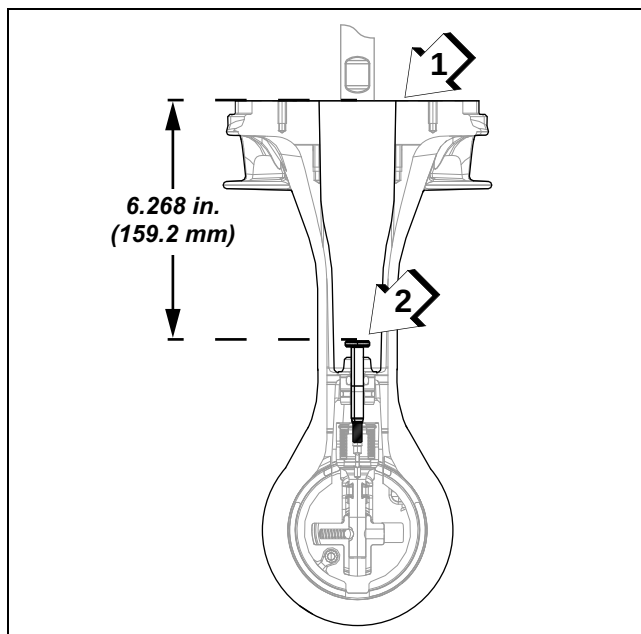
If the Shift Rod Installer, P/N 358162, is not available, this alternate method may be used.

Make sure the gearcase is in the NEUTRAL position. If needed, rotate the propeller shaft and use a suitable tool to push or pull the shift rod to the NEUTRAL position.

Turn the shift rod clockwise to lower, or counter-clockwise to raise the shift rod height.

Shift rod height is correct when dimension from the top surface of the gearcase housing to the top of the shift rod is 6.268 in. (159.2 mm).

Turn the shift rod $\pm 1/4$ turn so the hex of the shift rod is oriented forward/aft. This ensures the hex of the shift rod is aligned to accept coupler of the shift actuator.



Shifter Rod Adjustment

009597

1. Top surface of gearcase housing
2. Top of shift rod

Shift Actuator

Control Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests.

NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Remove the electrical connector from the shift actuator.

Make sure the key switch is OFF.

Use the diode test function of a digital multimeter to check the shift actuator circuits. Use an appropriate test probe lead to connect the negative meter lead to the wire listed in the table, connect the positive meter lead to an engine ground.



1. Engine harness connector (shift actuator)

009377

Shift Actuator Circuit Diode Test		
Wire	Pin	Result
Yellow/Blue	1	approximately 0.5 VDC
Yellow/Green	2	approximately 0.5 VDC
Red/White	3	0.11 to 0.125 VDC
Yellow/Black	4	2.1± 0.5 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Shift Actuator Ground Circuit

Use a digital multimeter with appropriate test probe leads to measure the ground circuit resistance. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Shift Actuator Ground Circuit Resistance		
Wire	Pin	Result
Black/White	5	< 1 Ω

Results:

An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Neutral Circuit

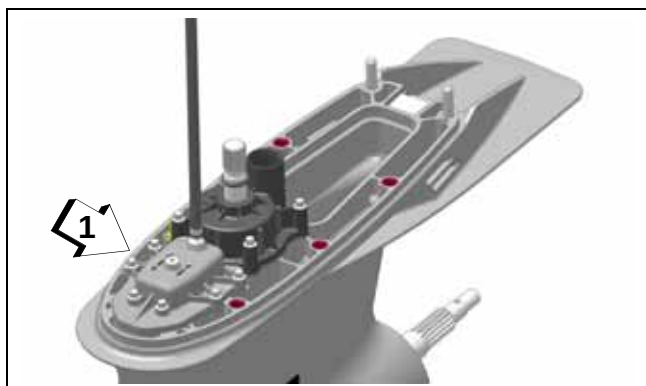
There are no tests for the neutral circuit.

Shift Actuator Service

Shift Actuator Removal

Remove the gearcase, refer to **Gearcase Removal** on p. 361.

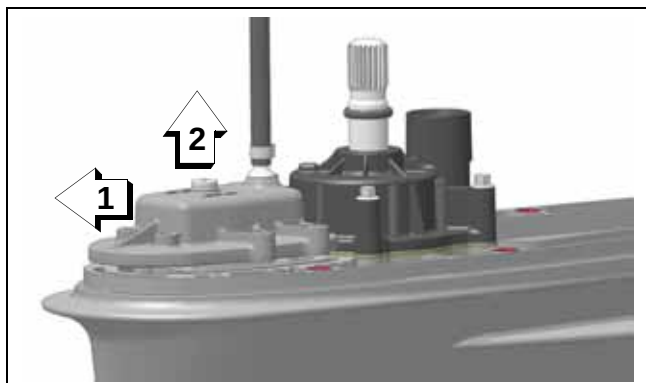
Remove the six screws retaining the shift actuator to the gearcase housing.



1. Screws

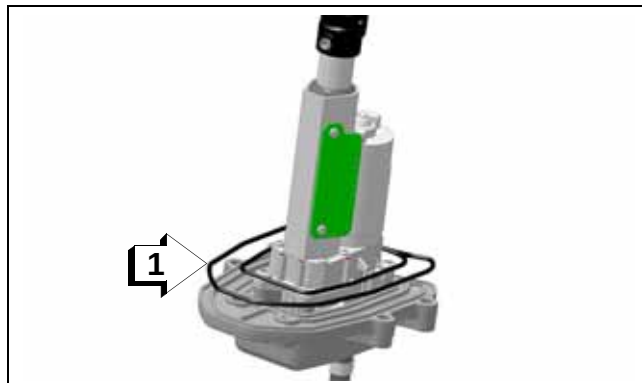
009317

Lightly tap the shift actuator with a soft mallet to loosen it. Then slide the shift actuator forward and lift to remove.



009318

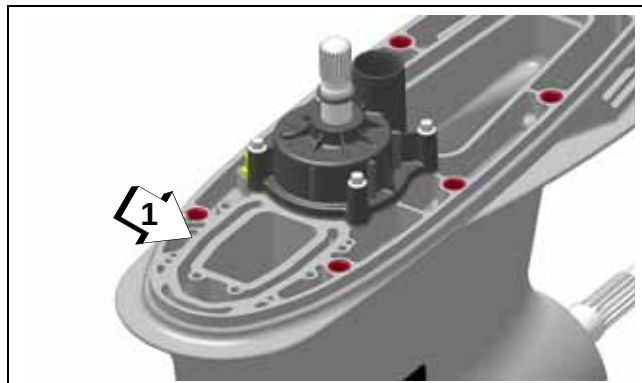
Remove the shift actuator seal and discard it.



1. Seal

009319

Remove all old gasket sealing compound from the shift actuator and gearcase housing.



1. Gearcase housing

009320

Shift Actuator Installation

NOTICE

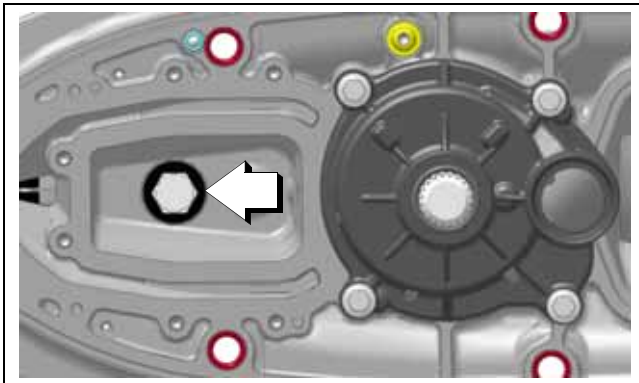
Check shift rod height **BEFORE** installing the shaft actuator. Refer to Shift Rod Adjustment on p. 368.

NOTICE

Use *Evinrude Diagnostics* software (version 6.1 or later) to calibrate the shift actuator when installing a new gearcase or shift actuator. Failure to calibrate the shift actuator can result in damage to the shift actuator.

IMPORTANT: The shift actuator **MUST** be in NEUTRAL. Make SURE:

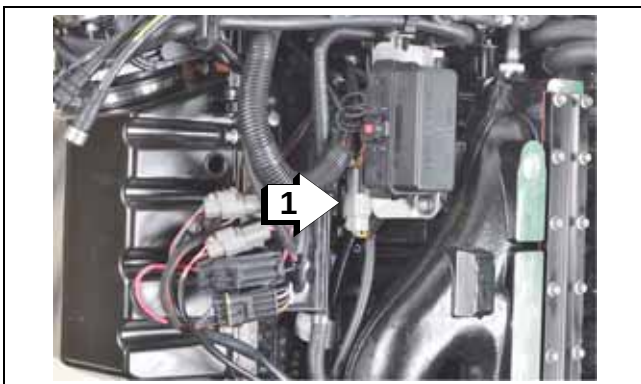
- STANDARD rotation gearcase is in FORWARD
 - COUNTER-ROTATION gearcase is in REVERSE
1. Verify the correct gear position. Rotate the propeller shaft while lifting the lower shift rod.
 2. Make certain the hex on the lower shift rod is aligned directly forward / backward as shown:



Hex on Lower Shift Rod

009321

3. Verify the shift actuator is in NEUTRAL:
4. Temporarily connect the shift actuator cable to the engine harness.
5. Turn the key switch to the ON position. Do **NOT** start the engine.
6. Shift the remote control into NEUTRAL.

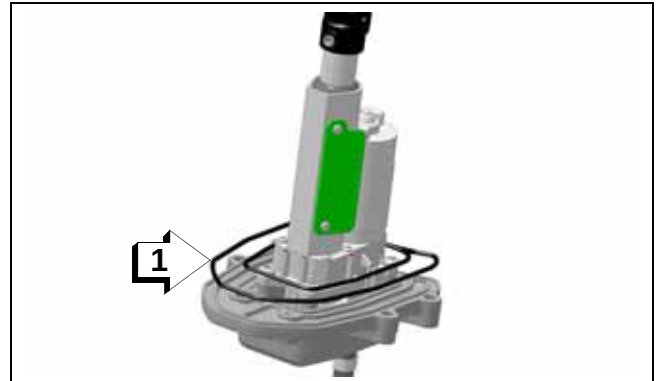


1. Shift actuator cable temporarily connected to the engine harness

009172

After verifying the shift actuator is in NEUTRAL, turn the key switch to the OFF position. Then disconnect the shift actuator cable from the engine harness.

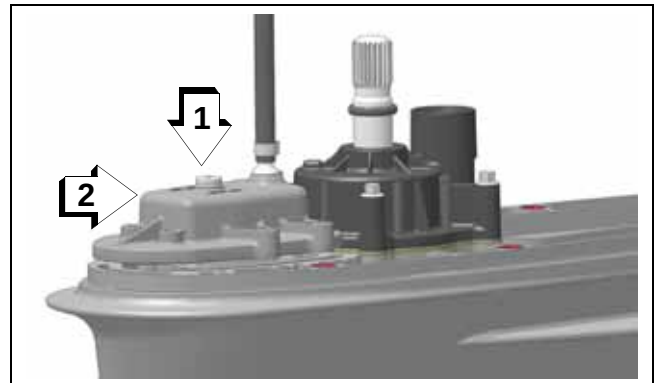
Apply *Gasket Sealing Compound* to a new shift actuator seal and install the seal.



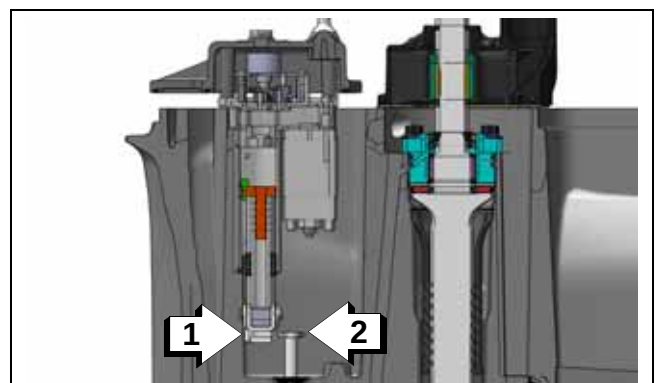
1. Seal

009319

Lower the shift actuator into the gearcase cavity, then slide rearward to capture the lower shift rod.



009318



1. Shift actuator
2. Lower shift rod

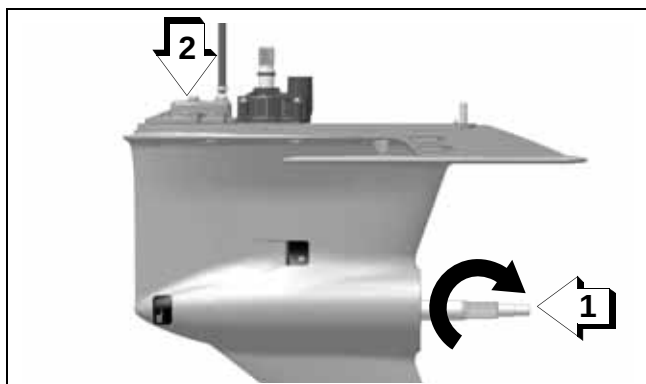
009322

IMPORTANT: Verify the shift actuator is connected to the lower shift rod by lifting the shift actuator.

Gearcase

Shift Actuator Calibration

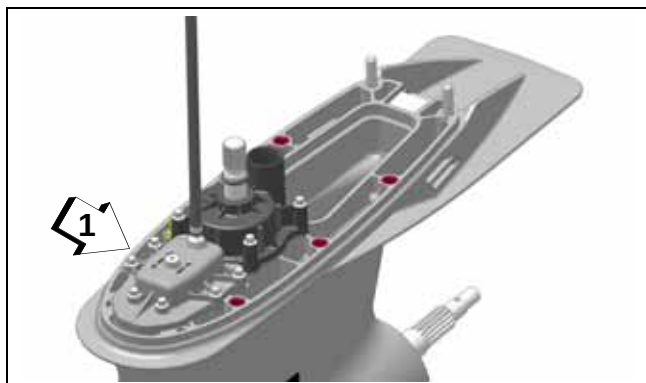
Rotate the propeller shaft while carefully pushing down on the actuator to shift the gearcase into neutral. Do NOT force the actuator.



1. Rotate propeller shaft
2. Push down on shift actuator

009323

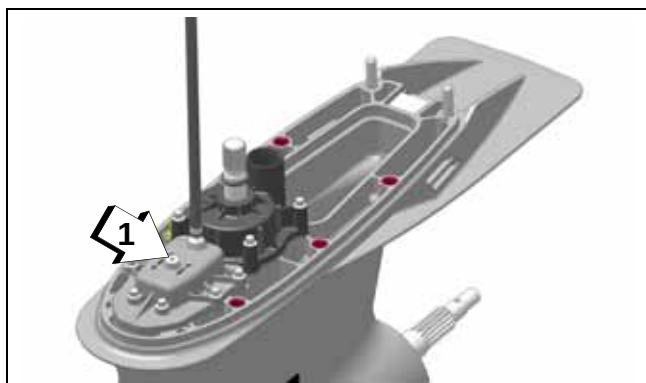
Apply *Ultra Lock* to the shift actuator retaining screws. Install the six screws and tighten to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).



1. Screws

009317

Remove the plug from the top of the shift actuator.



1. Plug

009317

IMPORTANT: This is an air chamber. Do NOT fill with oil.

Install a gearcase pressure tester and pressurize to 16 to 18 PSI for 5 to 10 minutes. If the shift actuator does not hold pressure, repair any leaks.

After confirming there are no leaks, remove the gearcase pressure tester.

NOTICE

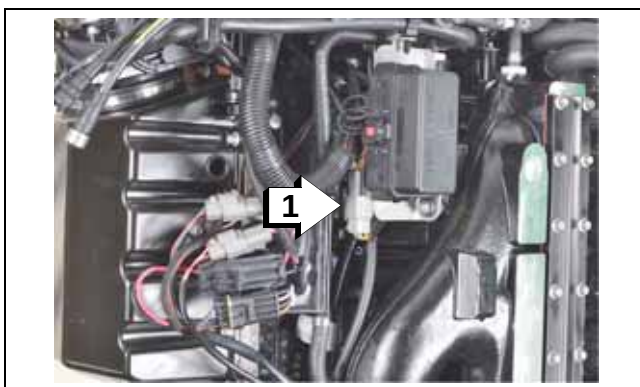
Make sure the gasket is installed on the plug and the plug is tightened securely. Water intrusion into the shift actuator cavity will damage the shift actuator.

Reinstall the plug in the top of the shift actuator. Tighten the plug to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Shift Actuator Calibration

Calibrate the shift actuator:

1. If the gearcase is removed from the outboard, temporarily connect the shift actuator cable to the engine harness.
2. Turn the key switch to the ON position. Do **NOT** start the engine.



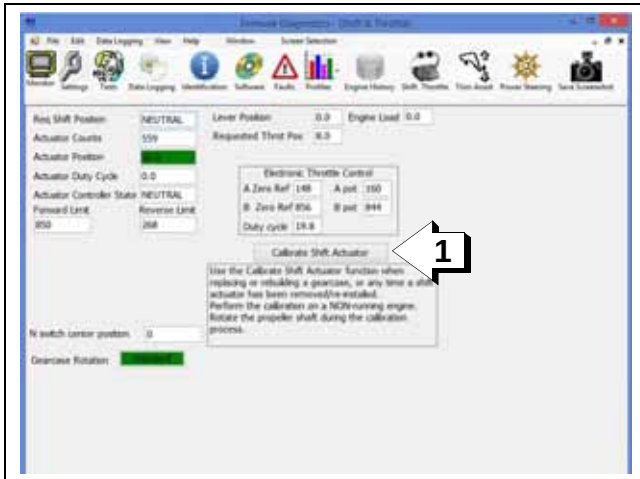
1. Shift actuator cable temporarily connected to the engine harness

009172

2. Use *Evinrude Diagnostic* software v 6.1 or higher to calibrate the shift actuator.
 - Select the *Shift Throttle* screen.
 - Rotate the propeller shaft until the calibration

procedure is complete.

- Select the *Calibrate Shift Actuator* button.



1. Calibrate Shift Actuator button

009325

After completing the calibration, turn the key switch to the OFF position.

IMPORTANT: If the gearcase is removed from the outboard, it must be shifted into FORWARD gear before it is installed. Review **Gearcase Installation** on p. 362, then disconnect the shift actuator cable from the engine harness.

Install the gearcase, refer to **Gearcase Installation** on p. 362.

Gearcase Disassembly (Standard Rotation)

Pre-Disassembly Inspection

⚠ WARNING

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

IMPORTANT: Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant** on p. 20.

Remove gearcase as described in **Gearcase Removal** on p. 361.

Remove water pump as described in **Water Pump Service** on p. 365.

Remove the shift actuator as described in **Shift Actuator Removal** on p. 370.

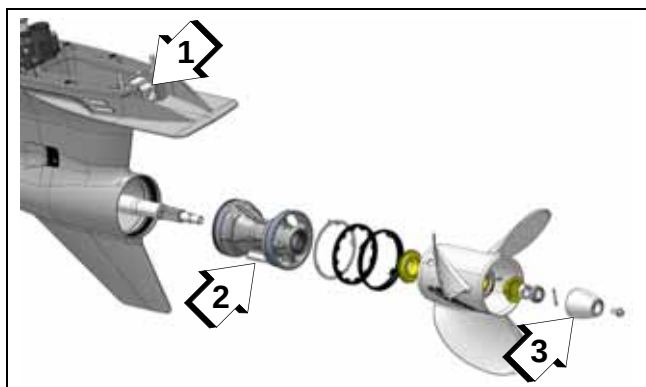
Before disassembling the gearcase, examine the following:

- **Gearcase Housing** — Check for visible damage to skeg, strut, anti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- **Propeller Shaft** — Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- **Shift Actuator** — Check for water or oil in the shift actuator cavity.

Gearcase

Gearcase Disassembly (Standard Rotation)

- **Gearcase Anodes** — If anodes have eroded to two-thirds their original size, they must be replaced.



1. Gearcase housing anode
2. Bearing housing anode
3. Propeller shaft anode

009497

- **Drive Shaft** — Check splines for visible damage, twisting and wear. Severe spline wear indicates the exhaust housing or gearcase has been distorted, possibly by impact damage.
- **Water Intake Screens** — Check for damage and blockage. If screens cannot be cleaned, they must be replaced. Refer to the correct parts catalog.

Propeller Shaft Bearing Housing and Reverse Gear Removal

The propeller shaft bearing housing of SLX-Type gearcases is **PRESSED** into gearcase housing.

Use two flat-blade screwdrivers to remove the ventilation ring from the gearcase. Insert the blade of a small screwdriver into one of the tabs of the ventilation ring. Carefully pry inward, toward the propeller shaft. Use a larger screwdriver to pry the

ventilation ring up, then remove the ventilation ring.



1. Pry tab inward
2. Pry ventilation ring up

009529

Use a punch to bend the tab of the locking ring down.



009530

Use Spanner Nut Wrench, P/N 358165, with a breaker bar to loosen the spanner nut. Turn the nut counter-clockwise to loosen.



1. Spanner Nut Wrench, P/N 358165

009554

Once the spanner nut is loose, use the wrench to remove the spanner nut by hand.



1. Spanner Nut Wrench, P/N 358165

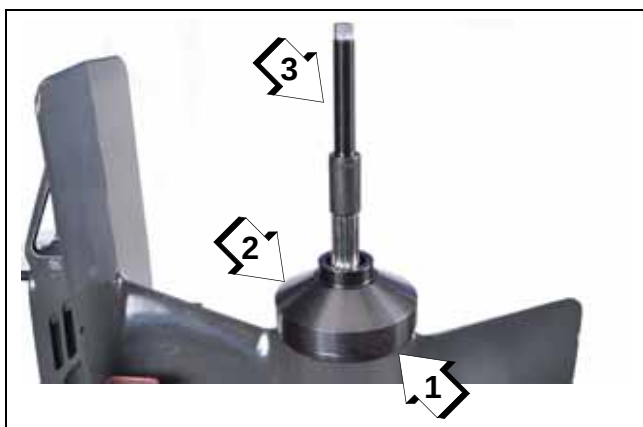
009531

Use the Propeller Shaft Bearing Housing Puller Kit, P/N 354060, with Puller Stud, P/N 358294, to remove the propeller shaft bearing housing from the gearcase using:

DO NOT use tools designed to push on the propeller shaft. Pushing force against the propeller shaft could damage the forward gear thrust bearing or thrust washer.

IMPORTANT: Make SURE the shift actuator is removed BEFORE beginning this procedure.

Place the Adapter, P/N 354178, on the gearcase, followed by the Puller, P/N 354177, Then install the Puller Stud, P/N 358294, onto the propeller shaft until seated.



1. Adapter, P/N 354178
2. Puller, P/N 354177
3. Puller Stud, P/N 358294

009532

Install Puller Tube Assembly, P/N 354175, over the puller stud. Hold the puller stud with a wrench

and turn the nut clockwise to remove the bearing housing.



009533

Pull the propeller shaft and bearing housing far enough to loosen the PRESSED bearing housing from the gearcase housing.



009534

Remove the bearing housing, thrust washer, thrust bearing, and reverse gear from gearcase.



009535

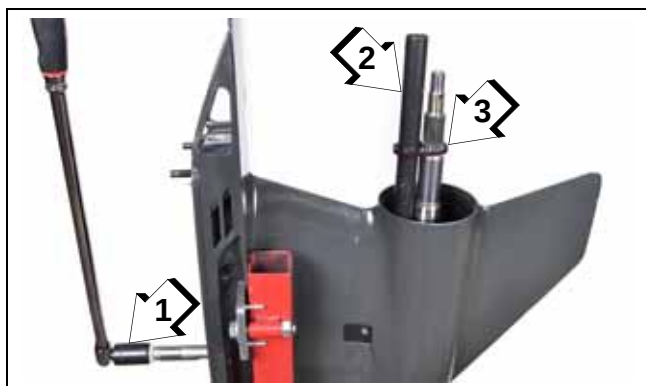
Gearcase

Gearcase Disassembly (Standard Rotation)

Pinion Gear and Lower Driveshaft Removal

Use the Shift Rod Installer Tool, P/N 358162, to lift the shift rod and move the clutch dog as far forward as possible. This will help ease removal of the pinion nut.

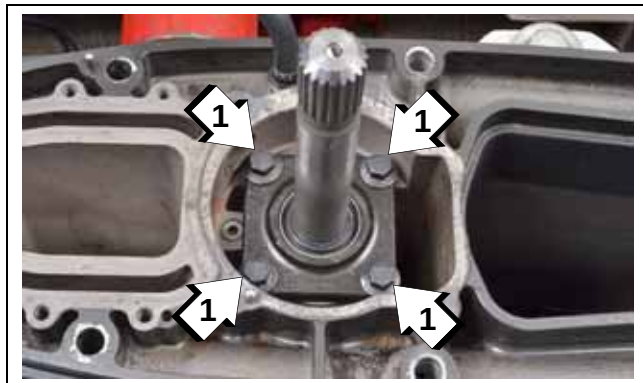
Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Wrench, P/N 334455, and Wrench Retainer, P/N 341438, to loosen and remove the pinion nut from the bottom of the driveshaft. Pad handle of holder to prevent damage to gearcase.



1. Driveshaft Holding Socket, P/N 311875
2. Pinion Nut Wrench, P/N 334455
3. Wrench Retainer, P/N 341438

009536

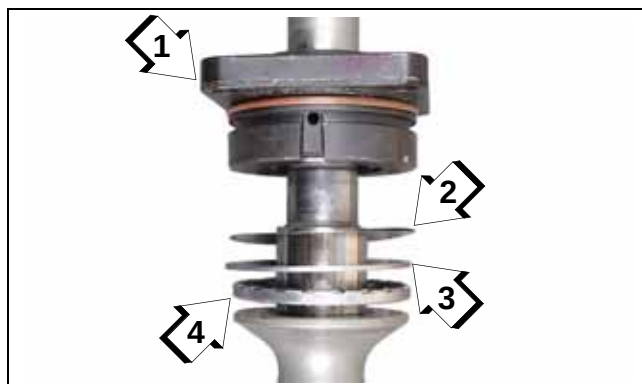
Remove the four driveshaft bearing housing screws.



1. Driveshaft bearing housing screws

009494

Remove the driveshaft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



009514

If driveshaft cannot be removed, refer to **Locked Driveshaft Removal**.

Remove the pinion gear from the gearcase.

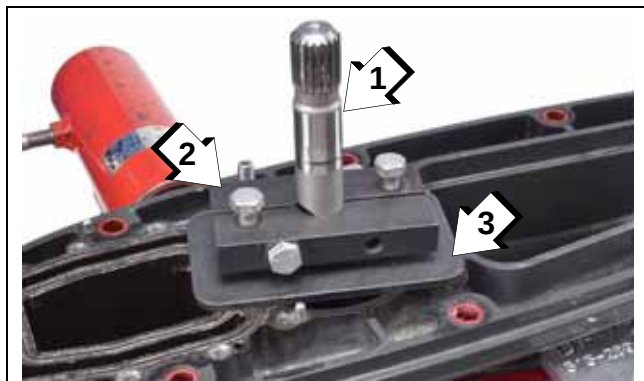


009538

Locked Driveshaft Removal

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

inserted between the puller and the gearcase until the driveshaft pops loose from the pinion.



1. Drive shaft
2. Puller
3. Backing plate

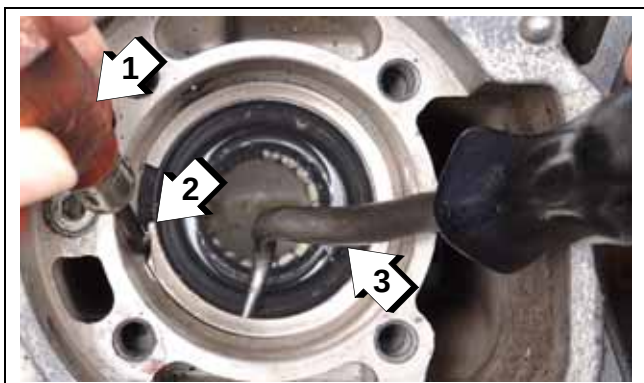
009537

Oil Pump Service

The SLX-Type gearcase uses an Archimedes Screw Pump, to circulate oil through the gearcase.

Removal

Insert the blade of a small screw driver between the notch in the retaining ring and the gearcase housing. Turn the screw driver to move the end of the retaining ring from its retaining groove. Use a curved pick to work the snap ring up from the retaining groove. Remove the snap ring from the drive shaft bore.



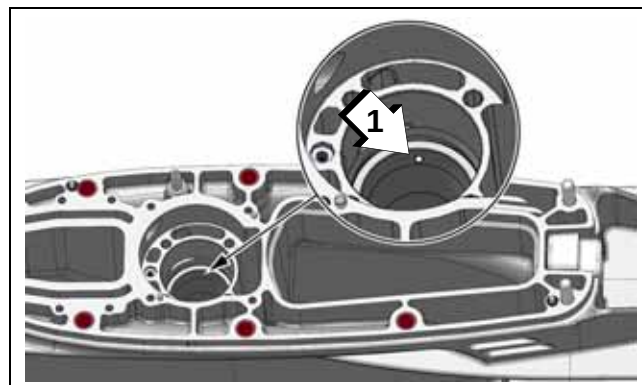
1. Screw driver
2. Snap ring notch
3. Pick

009500

If the pinion bearing is being removed, the oil pump can be removed with the pinion bearing, using the pinion bearing removal procedure. See **Pinion Bearing Removal** on p. 380.

If the pinion bearing will not be removed, use a Slide Hammer, P/N 432128, or P/N 391008, with Puller Jaws, P/N 432129, to remove the oil pump.

Locate the hole in the oil pump. Align the puller jaws with the oil hole.



Oil Pump (Installed)

1. Oil hole

009575

Tighten the rod of the slide hammer to expand the puller jaws into the recessed area at the bottom of the pump. This will prevent the Archimedes screw of the pump from being damaged.



Oil Pump (Removed)

1. Oil hole
2. Puller jaws

009571

Gearcase

Gearcase Disassembly (Standard Rotation)

Installation

IMPORTANT: Make sure the pinion bearing is installed BEFORE installing the oil pump.

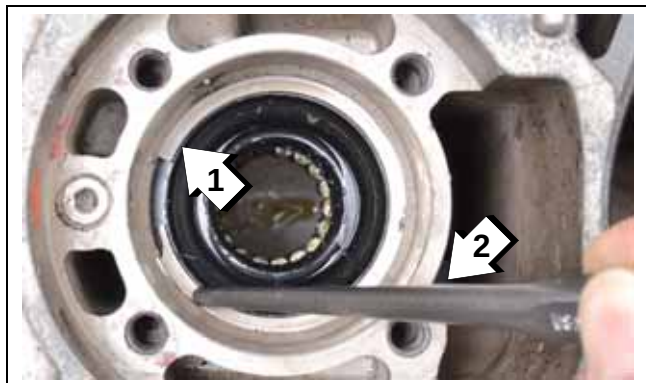
Use Installer, P/N 358521, to install the oil pump. Align the oil pump with the hole to the STARBOARD side of the gearcase housing as shown.



009572

Place the tapered end of the installer into the oil pump. Push by hand to install the oil pump. A light tap with a hammer handle to seat the oil pump.

Install one end of the retaining ring into its retaining groove. Use a punch to work the retaining ring into the groove.



1. Snap ring
2. Punch

009501

Propeller Shaft and Forward Gear Removal

NOTICE

This procedure **REQUIRES** replacement of the shift lever and shift cradle.

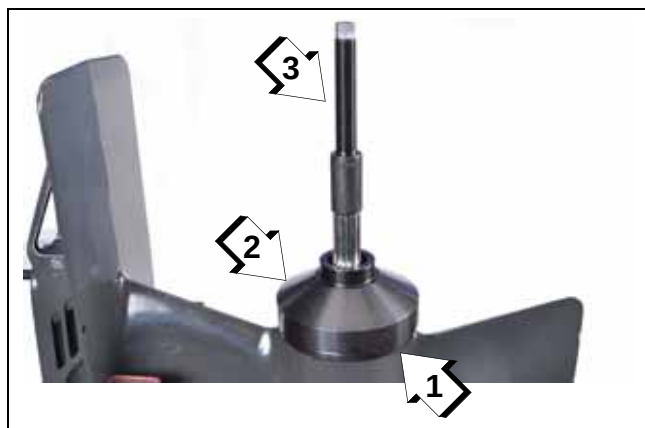
The shift lever and shift cradle are damaged during disassembly and must **NOT** be re-used. Re-use of these parts will result in a future part failure.

Use the Shift Rod Installer Tool, P/N 358162, to push down on the shift rod. This will move the detent lever downward to clear the inside of the gearcase when the shaft assembly is pulled out.

Use the tool to remove the shift rod from the detent lever.

Use Propeller Shaft Bearing Housing Puller Kit, P/N 354060, to remove the propeller shaft and forward gear from the gearcase.

Place the Adapter, P/N 354178, on the gearcase, followed by the Puller, P/N 354177. Then install the Puller Stud, P/N 358294, onto the propeller shaft until seated.



1. Adapter, P/N 354178
2. Puller, P/N 354177
3. Puller Stud, P/N 358294

009532

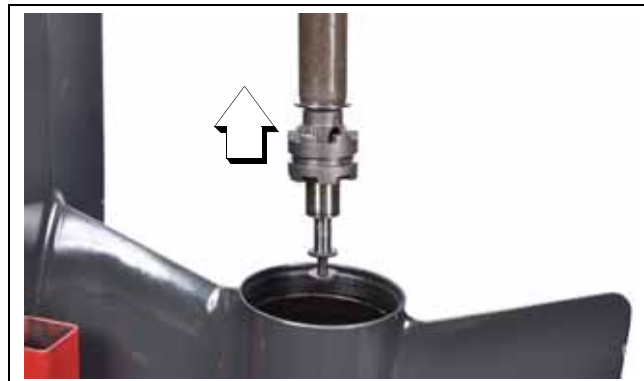
Install Puller Tube Assembly, P/N 354175, over the puller stud. Hold the puller stud with a wrench

and turn the nut clockwise remove the propeller shaft.



009533

Remove propeller shaft assembly, then remove the forward gear from the gearcase.



009539

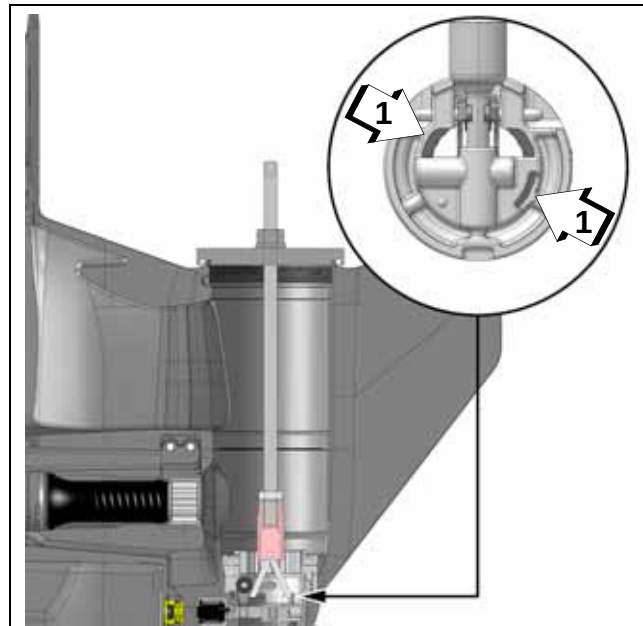
IMPORTANT: When the propeller shaft is removed, the clutch dog shift shaft will be removed with the propeller shaft. This will damage the shift lever and shift cradle. do **NOT** re-use these parts.

After the propeller shaft is removed, remove the forward gear, thrust bearing and thrust washer.

Shift Housing Removal

Use Puller Tool, P/N 358520, with Puller Jaws, P/N 432129, and Puller Wrench, P/N 334359, to remove the shifter housing.

Align the puller jaws beneath the shifter housing in the position shown.



Shifter Housing FORWARD view

1. Puller jaws position

009528

Use the puller wrench to hold the puller jaws in position, while tightening the puller rod with a wrench.

Place the puller plate over the rod and install the puller nut. Use a wrench to hold the rod, while turning the puller nut with a wrench.



1. Puller plate

009540

Gearcase

Shifter, Bearing and Seal Servicing

When the shifter housing is released from the gearcase housing, use the puller tool to remove the bearing housing from the gearcase.



009540

Remove the tool from the shifter housing.

Remove bearing rollers and any other parts from the gearcase housing.

Water Intake Screens

Remove and clean side water intake screens. Replace if damaged.



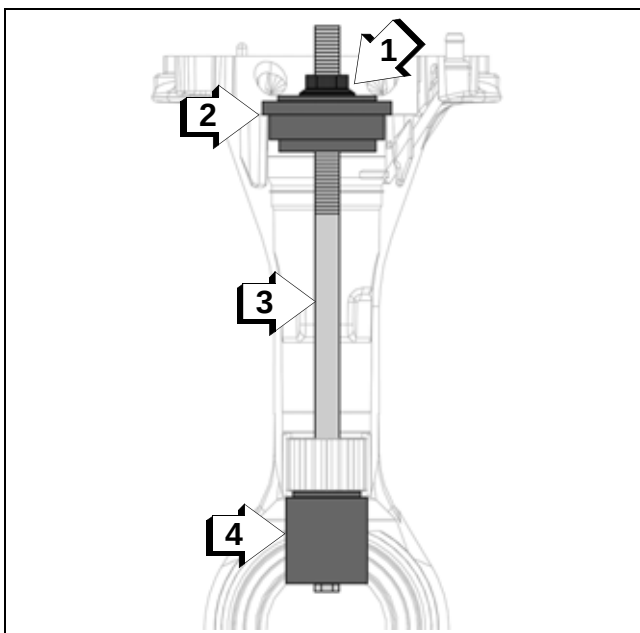
1. Water intake screen

009587

Shifter, Bearing and Seal Servicing

Pinion Bearing Removal

Assemble the following components of the Pinion Bearing Remover and Installer, P/N 5005927, in the gearcase as follows:



009496

Pinion Bearing Remover Components

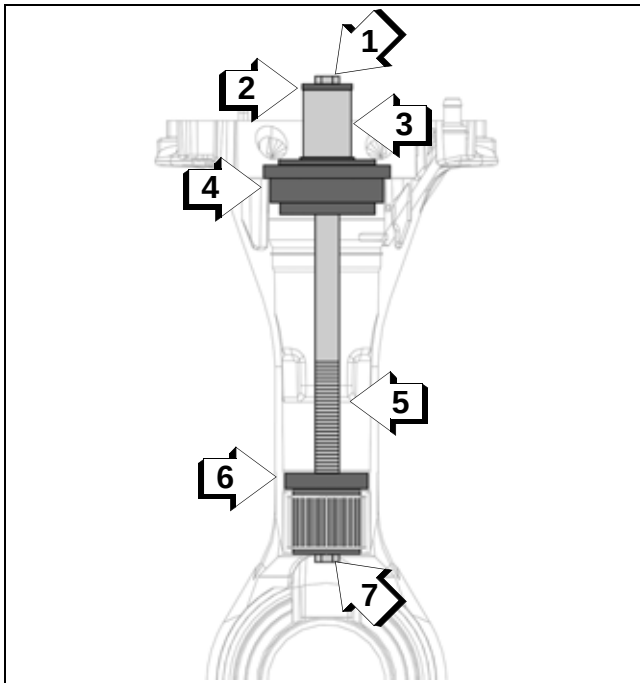
1. Flange nut, P/N 326586
2. Plate, P/N 391260
3. Rod, P/N 326582
4. Remover, P/N 326579

Use a 7/8 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise. Draw the bearing up from the housing.

Pinion Bearing Installation

Apply gear lubricant to the housing bore and the outside diameter of the bearing race. Assemble

the following components of the Pinion Bearing Remover and Installer, P/N 5005927, as shown:



Pinion Bearing Installer Components

009495

1. 1/4-20 X 1 1/2 in. Hex head screw
2. 1 in. O.D. Flat washer
3. Spacer; P/N 326585
4. Plate and Bearing P/N 391260
5. Rod P/N 326582
6. Installer/Remover, P/N 350958
7. 1/4-20 X 1 1/4 in. Hex head screw

IMPORTANT: Spacers are different sizes and cannot be interchanged.

Apply *Needle Bearing* grease to the needle bearings and insert them into the bearing case.

Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

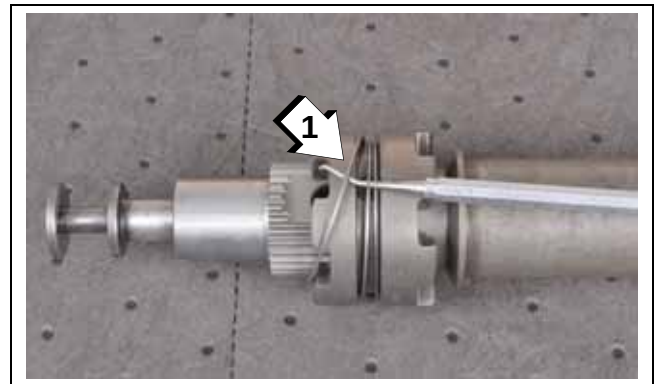
IMPORTANT: The pinion bearing is tapered so that, when installed correctly, its shape compensates for stresses in the gearcase and allows full bearing contact. Whenever a gearcase is disassembled, the pinion bearing should be checked to ensure that it has been installed with the lettering facing up.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Remove the tool.

Propeller Shaft Disassembly

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring.**



1. Clutch dog spring

009520

Push the pin out of the clutch dog. Remove all parts.



1. Pin

009521

Gearcase

Shifter, Bearing and Seal Servicing

Shift Housing Disassembly

⚠ WARNING

Wear safety glasses to avoid injury.

IMPORTANT: The shifter housing and forward bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

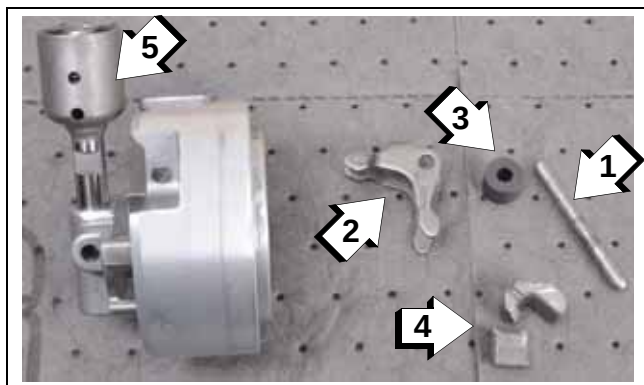
Remove the shift lever pin from the housing.



1. Shift lever pin

009556

Remove the shift lever, magnet and cradle. Move the shifter detent as needed to help ease removal of parts.



1. Shift lever pin
2. Shift lever
3. Magnet
4. Cradle
5. Shifter detent

009518

NOTICE

Discard the shift cradle and shift lever. New parts **MUST** be used during installation.

During removal the shift lever will bend and the cradle will crack and could break.

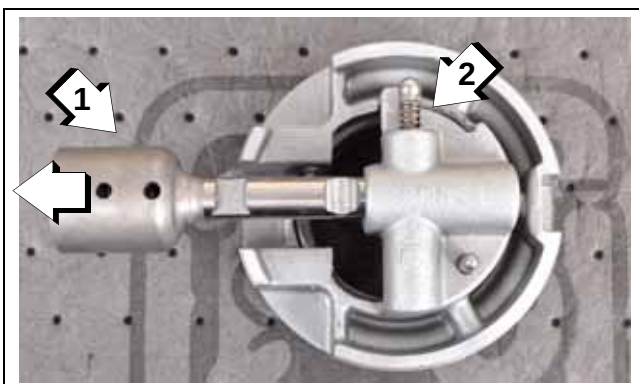
Even if parts appear to be in good condition, re-use will result in failure in a short period of time.



⚠ WARNING

Wear safety glasses to avoid personal injury. The detent ball and spring and come out with great force.

Wrap the housing with a shop cloth to catch ball and spring. Rotate the shifter detent 90° in either direction, then pull the detent out of the housing.



1. Shifter detent
2. Ball and spring

009516

Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection.

Shift Housing Assembly

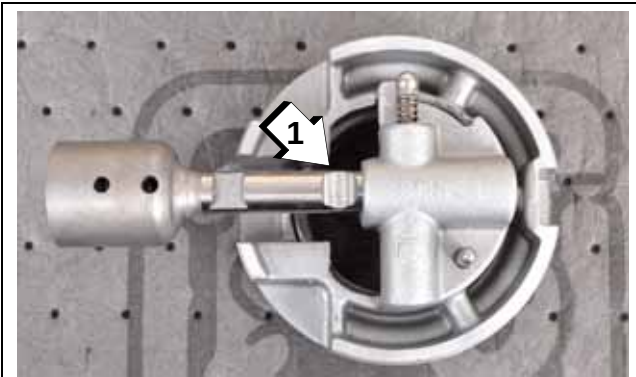
IMPORTANT: Clean and inspect all parts before beginning assembly procedures. Replace any damaged parts.

Lightly coat the detent ball and spring with *Needle Bearing* grease. Insert the spring in the housing, then the ball.



009523

Insert shifter detent into the housing. Position the NEUTRAL detent at a 90° angle as shown.

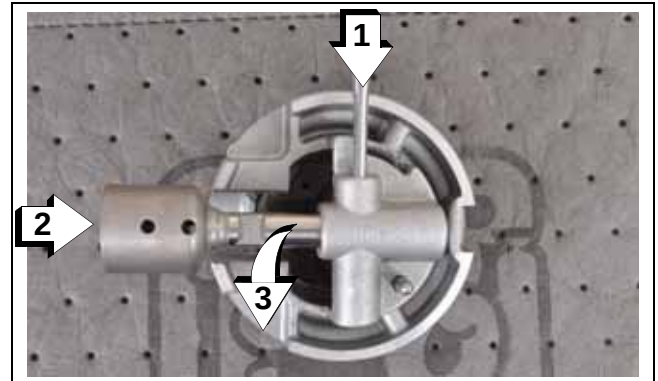


1. NEUTRAL detent

009516

Depress the ball and spring with a suitable tool. Then push the shifter detent is past the ball, and remove the tool.

Rotate the shifter detent 90° to position the detent to engage the ball in the NEUTRAL position.



1. Depress ball and spring
2. Push shifter detent
3. Rotate 90°

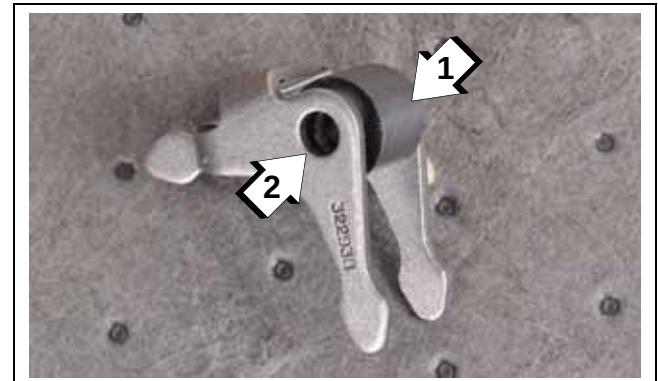
009515

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case.



009517

Install the magnet into the shift lever, aligning the hole in the magnet with the holes on the shift lever.



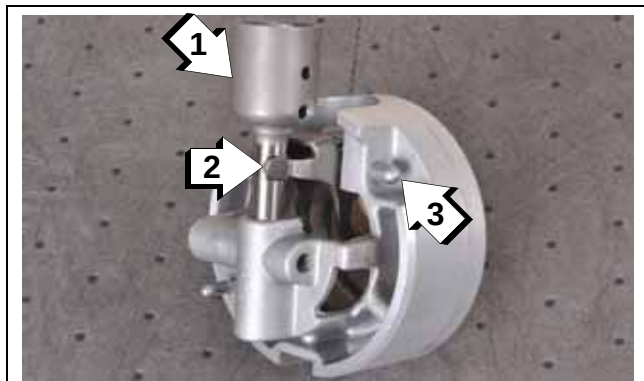
1. Magnet
2. Hole on shift lever

009524

Gearcase

Shifter, Bearing and Seal Servicing

With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



1. Shifter detent
2. Shift lever
3. Pin, shift lever

009556

Rest the cradle on the shift shaft.

Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEUTRAL position to hold the cradle and shaft in place.



1. Cradle
2. Shift shaft

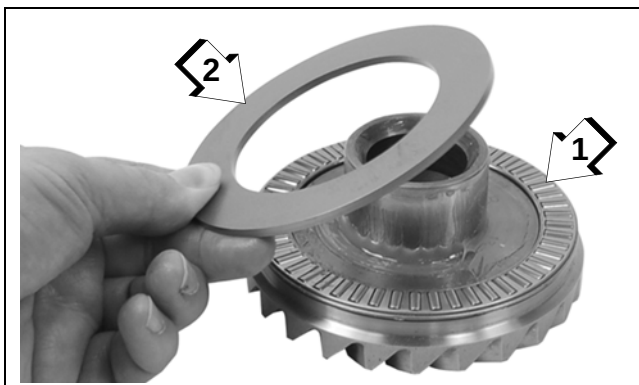
009525

Coat thrust bearing and thrust washer with *Needle Bearing grease*. Place the bearing on the back of the gear. Set the washer on top of the thrust bear-

ing. Insert the gear, bearing, and washer into the bearing housing.

NOTICE

Bearing and washer must be installed in the correct order.



1. Thrust bearing
2. Thrust washer

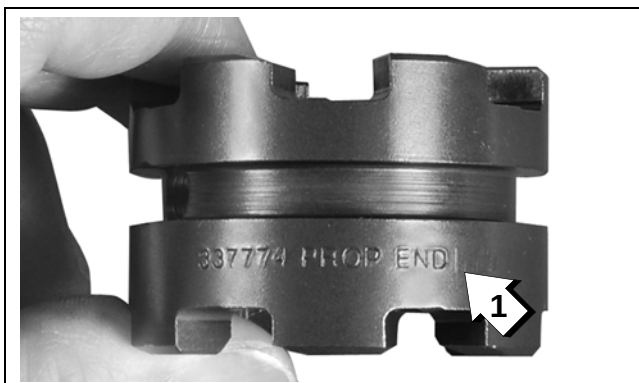
006905

Install the forward gear, thrust bearing and thrust washer into the shift housing assembly. Verify the assembly of the shift shaft, cradle and shift lever.

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

NOTICE

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



1. "PROP END"

006906

Slide the propeller shaft onto the shift shaft, align the hole in the shaft with the hole in the clutch dog, install the pin and then, a **new** clutch dog retaining spring. Place three coils over each end

of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring

006907

Shift Rod Bushing Service

Removal

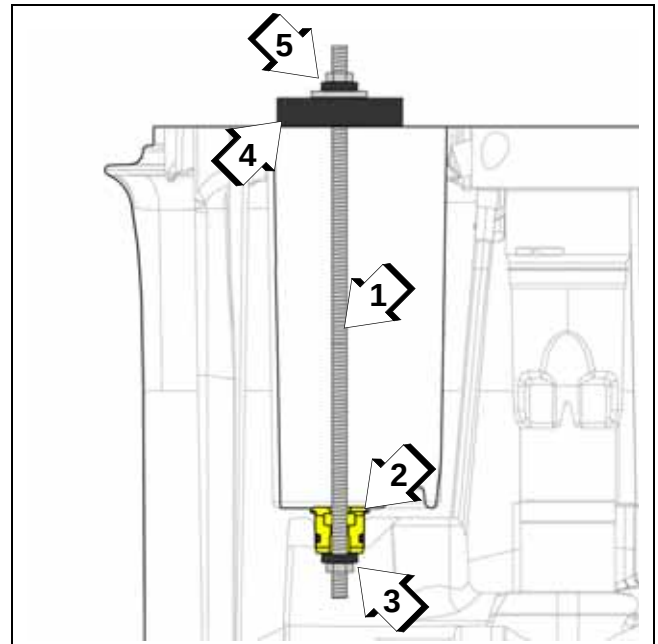
Use the following tools to remove the shift rod bushing:

- Puller plate from Puller Tool, P/N 358520
- 2 washers from Universal Puller, P/N 378103
- Threaded rod, 5/16 or 1/4 in diameter x 15 in long (8 or 6 mm diameter x 380 mm long)
- 2 nuts to fit threaded rod
- 2 fender washers to fit threaded rod

Assemble the threaded rod and tools as follows:

1. Insert the threaded rod into the shift rod bushing.
2. Place 1 washer from universal puller on to the rod, then install 1 nut on the rod.
3. Place the puller plate over the threaded rod. Next, place 2 fender washers and 1 washer from universal puller on the rod. Then install the nut.

4. Align the plate across the top of the gearcase so the threaded rod pulls the bushing straight, as the nut is tightened.
5. Tighten the nut with a wrench until the bushing is removed from the bore of the gearcase housing.



Shift Rod Bushing Removal (cut-away view)

009498

1. Threaded rod
2. Shift rod bushing
3. Washer from universal puller and nut
4. Puller plate
5. 2 Fender washers, washer from universal puller and nut

Use a pick to remove the inner and outer o-rings from the shift rod bushing.

Installation

Install new inner and outer o-rings on the bushing.

Use Shift Rod Bushing Installer, P/N 358997, to install the bushing into the gearcase housing.

Apply *Triple Guard* grease to the tip of the tool. Insert the tool through the shift rod bushing.

Apply Gasket Sealing Compound to the outer o-ring. Then align the bushing in the gearcase housing.

Use a hammer to drive the bushing into the gearcase. The top of the bushing should be flush to

Gearcase

Shifter, Bearing and Seal Servicing

slightly below the surface at the bottom of the shift actuator cavity.



009573

Driveshaft Bearing Housing Service

The driveshaft bearing is not serviceable. Replace the bearing housing assembly if the bearing is worn or damaged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Seal Removal

Remove the driveshaft bearing housing seals using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seals.



006894

Remove and discard the O-ring from the bearing housing.

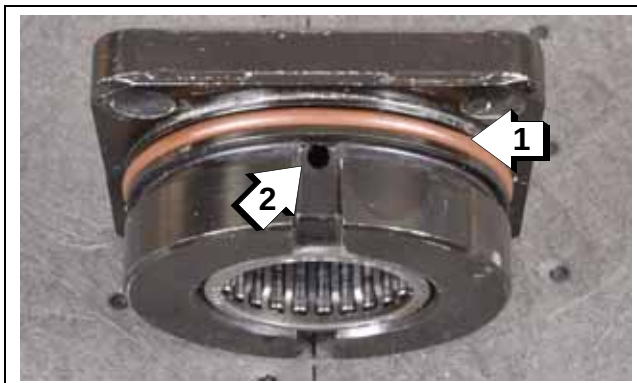
Clean the bearing housing in solvent to remove sealer from the seal bore and the O-ring groove.

Seal Installation

Lightly apply *Gasket Sealing Compound* to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

NOTICE

Do not install the O-ring in the bearing housing's bottom groove. The bottom groove is an oil passage. Gearcase damage could result.



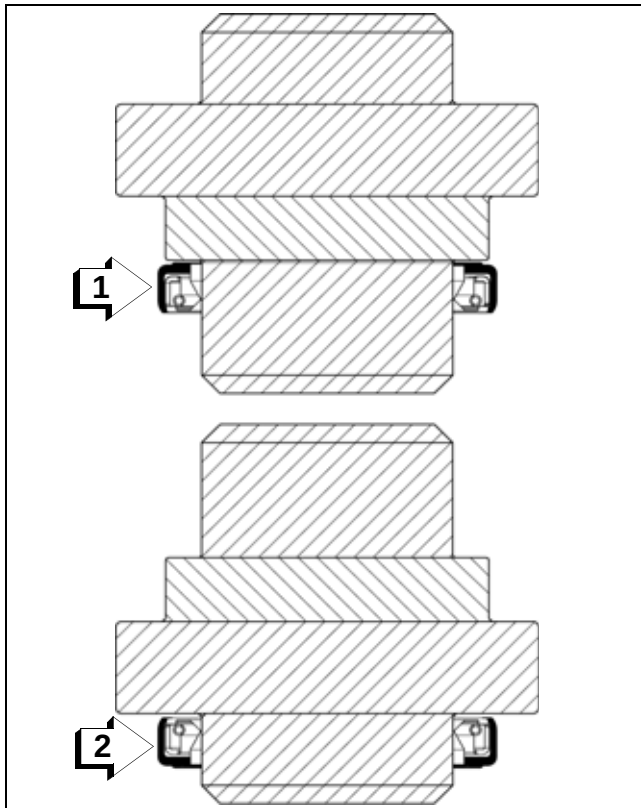
1. O-ring (top groove)
2. Oil passage

009526

Apply *Gasket Sealing Compound* to metal casings of new seals before installing.

Use Seal Installation Tool, P/N 330268, to install new seals back to back in bearing housing. Install inner seal with lip facing toward bearing housing, then the outer seal with lip facing away from bear-

ing housing. Apply *Triple-Guard* grease to seal lips.



1. Inner seal
2. Outer seal

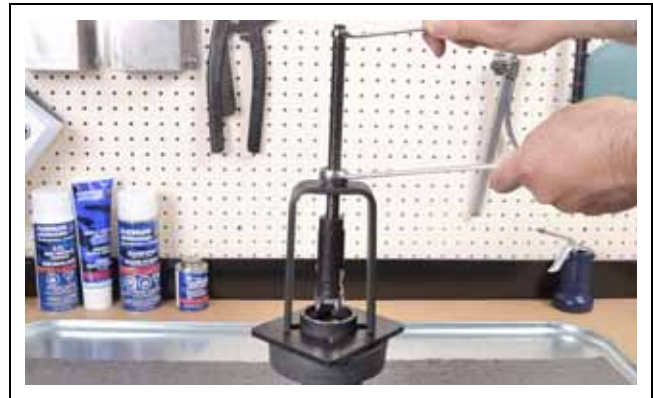
009513

Propeller Shaft Bearing Housing Service

Rear Seal Removal - Early Models

Remove seals using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131. Position the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.

If necessary, use an electric heat gun to warm the housing to aid in seal removal.



009502

Rear Seal Removal - Late Models

Late models use a retaining ring to improve seal retention.

Insert the blade of a small screw driver between the notch in the retaining ring and the bearing housing. Turn the screw driver to move the end of the retaining ring from its retaining groove. Use a curved pick to work the snap ring up from the retaining groove. Remove the snap ring.



1. Retaining ring notch

009593

Gearcase

Shifter, Bearing and Seal Servicing

Remove seals as described in **Rear Seal Removal - Early Models**.

Bearing Removal - Early Models

IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

Remove either bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Rest the puller plate on top of the housing to support the bridge, and tighten the jaws securely behind the bearing.

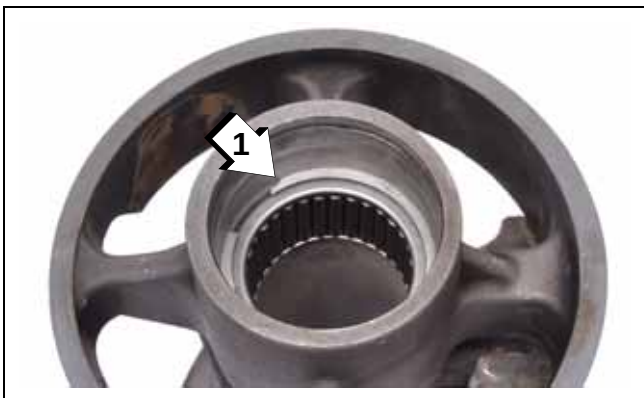


009503

Bearing Removal - Late Models

Late models use a retaining ring to improve bearing retention.

Insert the blade of a small screw driver between the notch in the retaining ring and the bearing housing. Turn the screw driver to move the end of the retaining ring from its retaining groove. Use a curved pick to work the snap ring up from the retaining groove. Remove the snap ring.

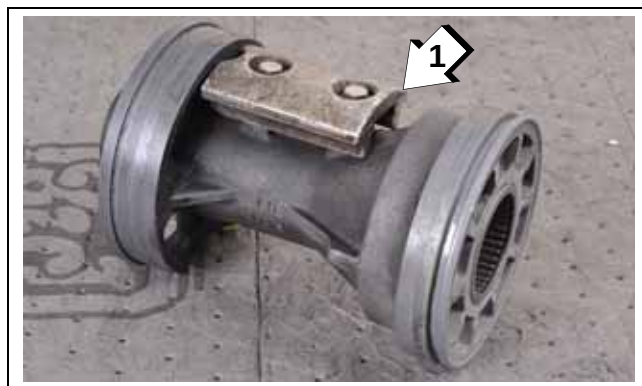


1. Retaining ring notch

009594

Remove bearing as described in **Bearing Removal - Early Models**.

Inspect the bearing housing anode. Replace anode if it is reduced to two-thirds of original size. Tighten screws to a torque of 108 to 132 in. lbs. (12 to 15 N·m).



1. Anode

009504

Discard the bearing housing o-ring. Clean the housing and bearings in solvent and dry thoroughly. If bearings were not replaced, rotate the needles to check for freedom of movement.

Inspect the o-ring groove. Use emery cloth to remove any sharp edges that might cut the o-ring. Remove any nicks or burrs on front of bearing housing.



1. O-ring groove

009504

Bearing Installation

Oil, then install new bearings in bearing housing.

Place the **lettered end** of the bearing case on the bearing installer, then press the bearing into the housing until the tool seats. When installed, the lettered end of the bearing should be visible.

Standard Rotation Housing

Bearing Installation Tools:

- P/N 358167 – front bearing



Front Bearing
1. Bearing installation tool

009505

- P/N 358168 – rear bearing



Rear Bearing
1. Bearing installation tool

009506

Counter Rotation housing

Bearing Installation Tool:

- P/N 432401 – front bearing



Front Bearing
1. Bearing installation tool

006945

- P/N 358168 – rear bearing

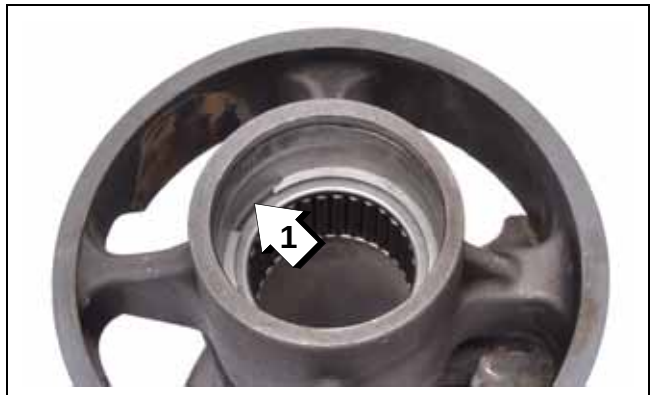


Rear Bearing
1. Bearing installation tool

009506

Rear Bearing Retaining Ring Installation - Late Models Only

Install one end of the retaining ring into its retaining groove. Use a punch to work the retaining ring into the groove.



1. Retaining ring in groove

009594

Gearcase

Shifter, Bearing and Seal Servicing

Rear Seal Installation

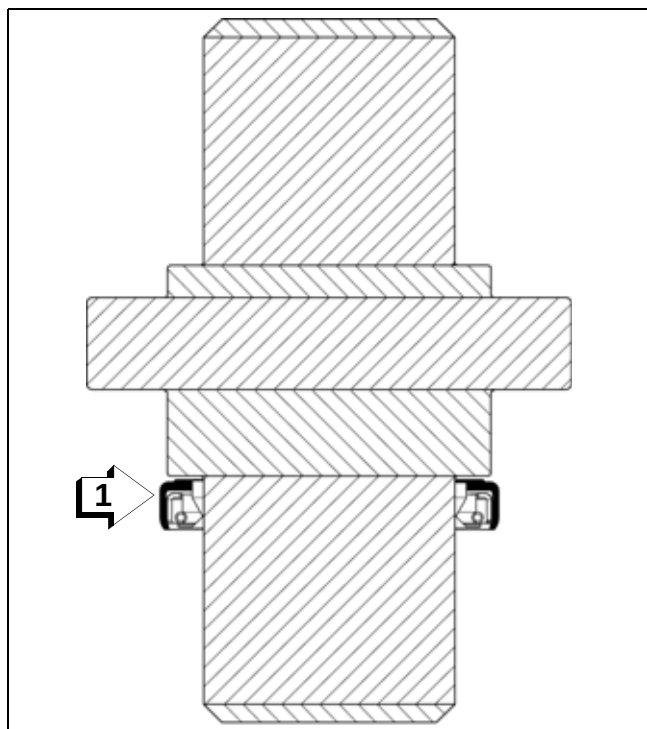
Sparingly apply *Loc-Tite 7649 Primer* to the seal bore of the bearing housing. Sparingly apply *Loc-Tite 609* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

Seal Installation Tool:

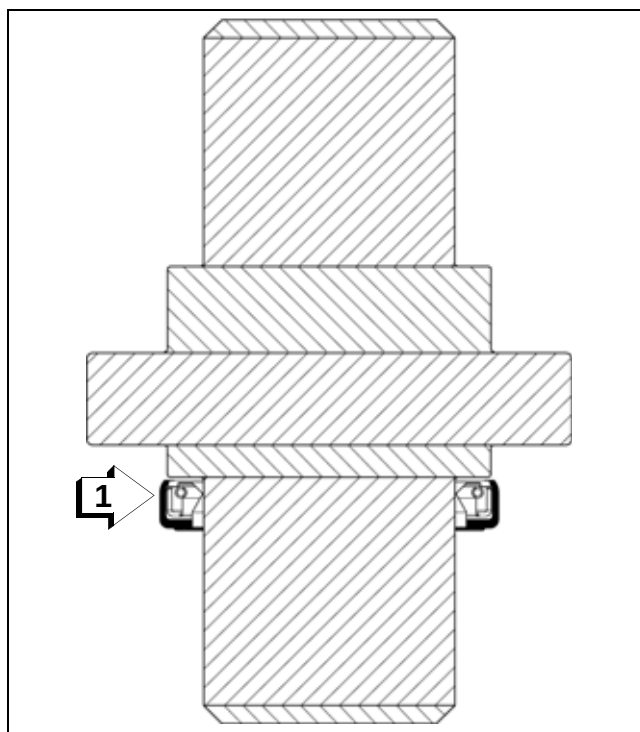
- P/N 358169

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



1. Inner seal

009499



1. Outer seal

009499

Apply *Triple-Guard* grease to seal lips.

Retaining Ring Installation - Late Models Only

Install one end of the retaining ring into its retaining groove. Use a punch to work the retaining ring into the groove.



1. Retaining ring in groove

009593

Driveshaft Shimming

NOTICE

If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is achieved by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion, or driveshaft, it is necessary to properly shim the assembly to restore factory clearance.

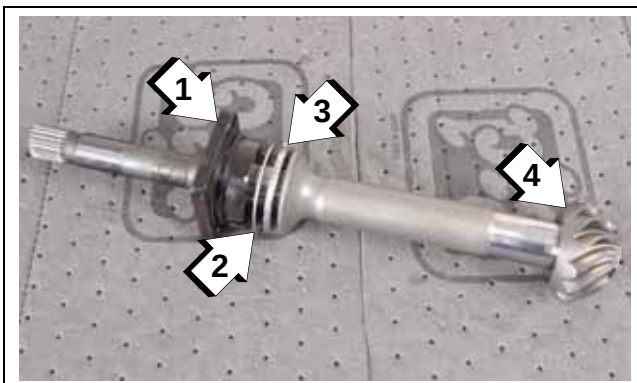
Use Driveshaft Shimming Tool, P/N 5005925.

Shim gauge bars are precision made and should be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 318674, when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with out-board lubricant and tighten to a torque of 100 to 110 ft. lbs. (136 to 149 N·m).



1. Driveshaft bearing housing
2. Thrust washer
3. Thrust bearing
4. Pinion gear

009507

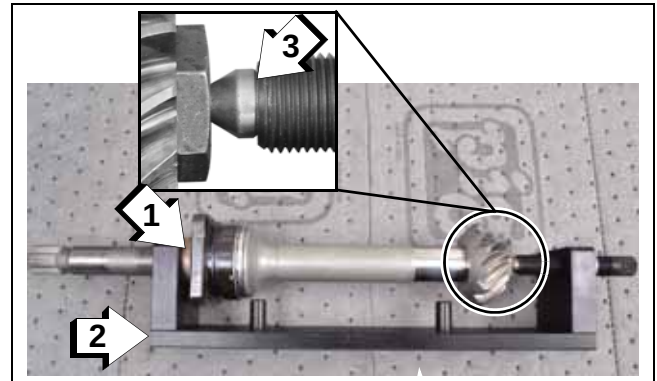
IMPORTANT: The original pinion nut may be used for shimming, but must **NOT** be used in final assembly.

Select collar, P/N 341440, and the correct shim gauge bar:

- “SLX”: Shim gauge bar, P/N 358164

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.

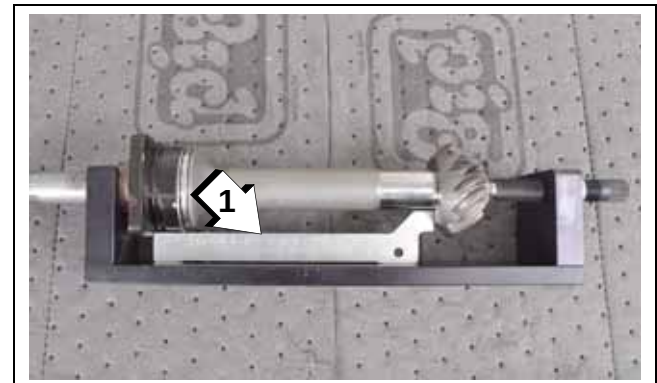


1. Collar
2. Tool base
3. Groove

006913
009508

Rotate the driveshaft several revolutions to seat bearings.

Lay the tool base on its side. Position the shim gauge bar against guide pins of the tool base.



1. Shim gauge bar

009509

Gearcase

Gearcase Assembly

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating **just the bearing housing**. Use a feeler gauge to measure clearance between the gauge bar and the bearing housing between each pair of screw holes. Replace the bearing housing and repeat check if variance is greater than 0.004 in. (0.101 mm).

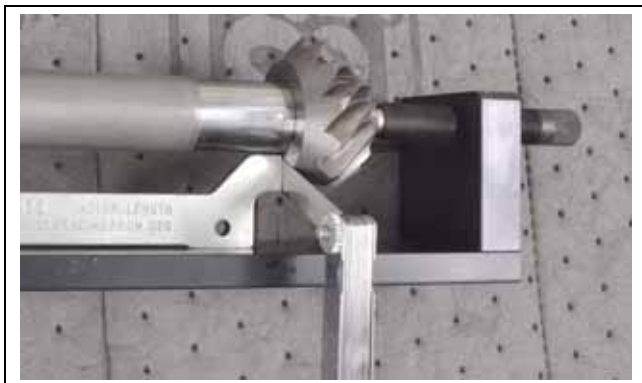
Check squareness of the pinion to the driveshaft. Hold the shim gauge bar against the bearing housing (between the screw holes) while rotating **just the driveshaft and pinion assembly**. Measure clearance between the gauge bar and the pinion at several locations. If variance is greater than 0.002 in. (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 318674.

Check clearance again. The measurement between the gauge bar and pinion should be 0.020 in. (0.508 mm).



009510

Remove the nut and pinion from the driveshaft. Discard the nut.

Gearcase Assembly

Water Intake Screens

Install water intake screens. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Water intake screen

009587

Shift Housing, Gear, and Propeller Shaft Installation

Apply *Triple Guard* grease the rear edge of the shifter housing as shown.



1. Triple Guard grease applied to rear edge of shifter housing

009588

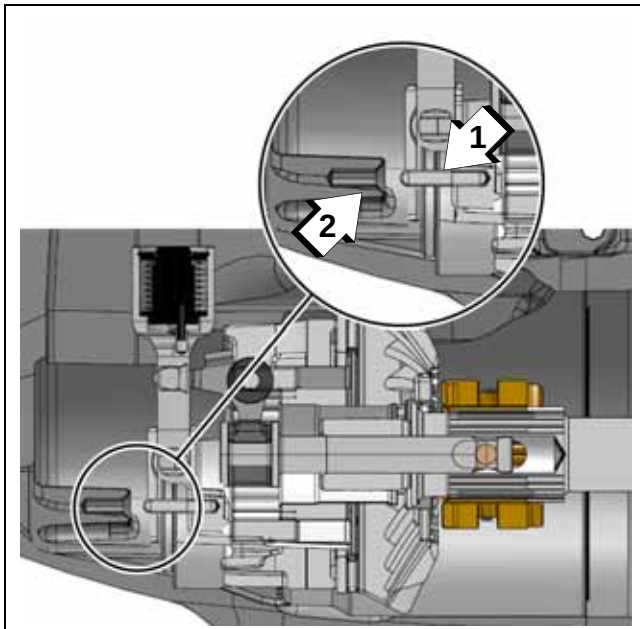
Push shifter detent into farthest downward position. Tip the rear of the gearcase slightly down-

ward to assist in the installation of the shaft assembly.



009542

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully into the gearcase. Make sure the alignment pin on the shifter housing is aligned with the hole in forward end of gearcase housing.



1. Alignment pin
2. Hole

009570

Make sure the shifter detent will align with the shift rod bushing. Look through the shift rod bushing to confirm the shifter detent will align with the shift rod. Misalignment will prevent installation of the shift rod.

Install Press Fixture Nose, P/N 358161 onto Gearcase Press Fixture, P/N 354059. Place Forward

Bearing Press Fixture, P/N 358163, over propeller shaft and into gearcase housing.

Align and level the gearcase assembly in the fixture as shown. Secure the fixture to a floor press.



1. Press Fixture Nose Piece, P/N 358161
2. Gearcase Press Fixture, P/N 354059
3. Forward Bearing Press Fixture, P/N 345822

009543

Press until the shifter housing is seated.

Use the Shift Rod Installer Tool, P/N 358162, to install the shift rod.

Pinion Gear and Driveshaft Installation

Refer to **Driveshaft Shimming** on p. 391.

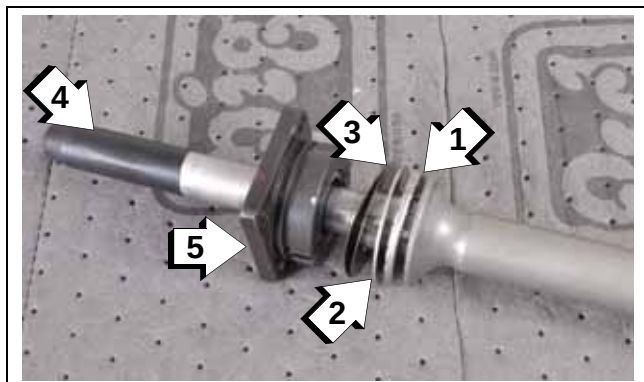
Install new seals in driveshaft bearing housing. Refer to **Driveshaft Bearing Housing Service** on p. 386.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.

Gearcase

Gearcase Assembly

Using Driveshaft Seal Protector, P/N 318674, slide the driveshaft bearing housing onto the driveshaft and into position in the gearcase.



1. Thrust bearing
2. Thrust washer
3. Shim(s)
4. Driveshaft Seal Protector, P/N 318674
5. Driveshaft bearing housing

009511

Use the Shift Rod Installer Tool, P/N 358162, to move clutch dog as far forward as possible. Be sure excess grease is removed from the pinion bearing.

Washer must be snapped into recess of pinion gear.



1. Washer

006922

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

Place the pinion gear into the gearcase.

Insert the driveshaft into the gearcase and through the pinion gear. Be **SURE** the oil passage

of the drive shaft bearing housing is facing **FORWARD** or **AFT**.



1. Oil passage

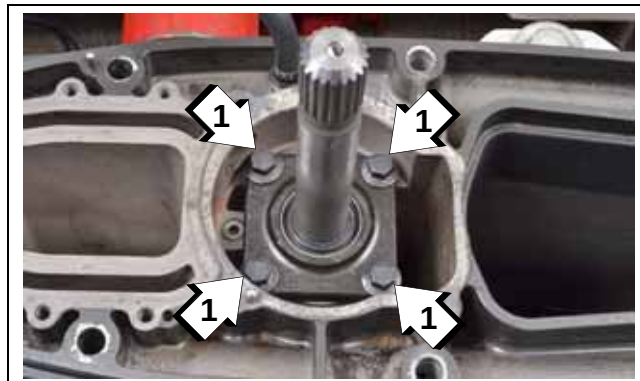
009527

Lightly coat the threads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 342216, to install nut on the driveshaft. Turn the driveshaft by hand to thread the nut on to shaft.



009546

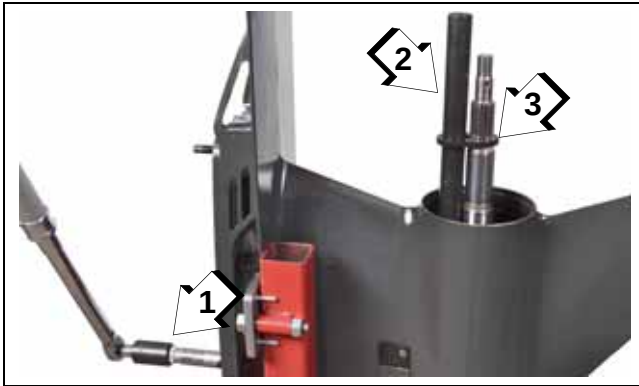
Apply *Gasket Sealing Compound* to the threads of the driveshaft bearing housing screws. Tighten screws **in stages** to a torque of 15 to 17 ft. lbs. (20 to 23 N·m).



1. Driveshaft bearing housing screws

009494

Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Wrench, P/N 334455, and Wrench Retainer, P/N 341438, to tighten the pinion nut to a torque of 100 to 110 ft. lbs. (136 to 149 N·m). Pad handle of holder to prevent damage to gearcase.



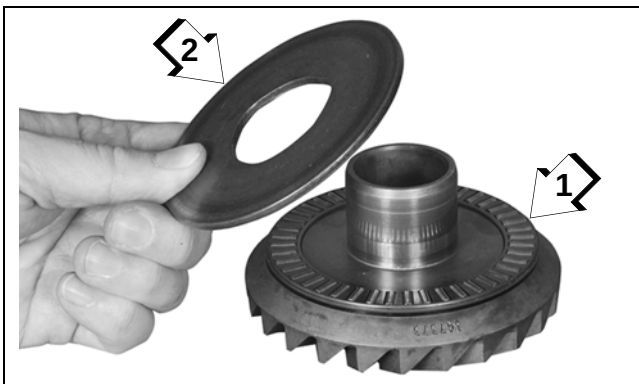
1. Driveshaft Holding Socket, P/N 311875
2. Pinion Nut Wrench, P/N 334455
3. Wrench Retainer, P/N 341438

009545

Propeller Shaft Bearing Housing and Gear Installation

IMPORTANT: The propeller shaft bearing housing on the SLX-Type gearcase is **PRESSED** into the gearcase housing.

Oil and install thrust bearing and thrust washer on hub of reverse gear. Slide the gear assembly onto the propeller shaft until it engages the pinion gear.



1. Thrust bearing
2. Thrust washer

006925

Lightly apply *Triple Guard Grease* to a new bearing housing o-ring. Install o-ring in the groove in

the housing. Grease both machined side surfaces of bearing housing.



1. Machined side surfaces

009512

Place the bearing housing into the gearcase. Align the vertical ribs of the propeller shaft bearing housing with the back rib gearcase and skeg, as shown.



1. Vertical ribs
2. Back rib of gearcase housing
3. Skeg

009493

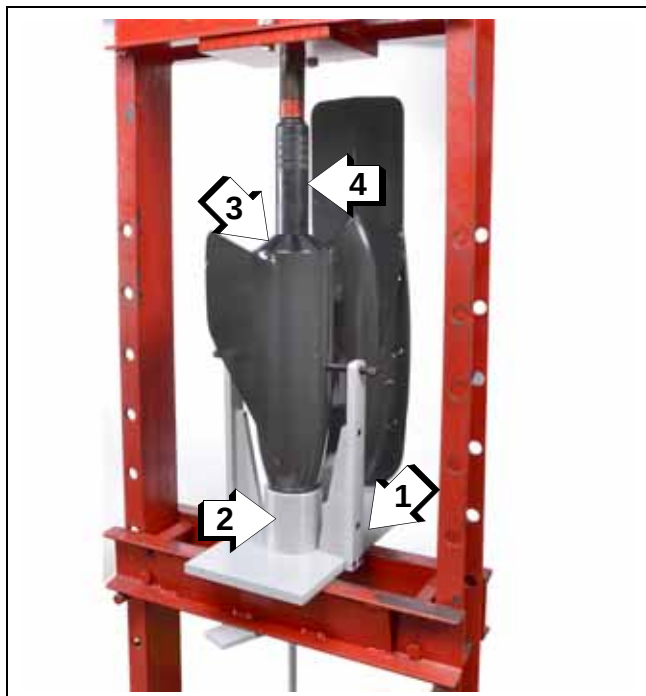
Use Gearcase Press Fixture, P/N 354059, with Press Fixture Nose, P/N 358161, and an appropriate floor press (10 ton or greater) to install housing into gearcase.

Place Propeller Shaft Bearing Housing Installer, P/N 358295, and Installer Handle, P/N 345822, onto gearcase.

Gearcase

Gearcase Assembly

Align and level gearcase assembly in fixture as shown. Secure fixture to floor press.

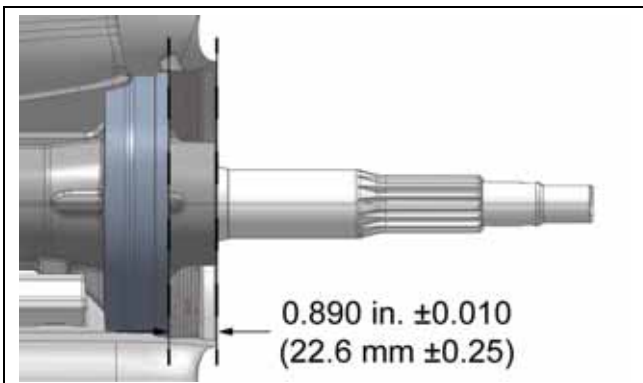


1. Gearcase Press Fixture, P/N 354059
2. Press Fixture Nose Piece, P/N 358161
3. Propeller Shaft Bearing Housing Installer, P/N 358295
4. Handle P/N 345822

009547

Housing must be completely seated in gearcase to install the spanner nut.

Check bearing housing press dimension is 0.890 in. ± 0.010 (22.6 mm ± 0.25) below gearcase housing.



Bearing Housing Press Dimension (cut-away view)

009492

Install a new locking ring with the alignment tab in the hole at the top of the housing.



Locking Ring Installation

1. Locking ring
2. Alignment tab

0099548

Apply *Gasket Sealing Compound* to threads of a new spanner nut. Start the spanner nut by hand. Then use Spanner Nut Wrench, P/N 358165, to tighten the spanner nut.



1. Spanner Nut Wrench, P/N 358165

009531

Tighten the spanner nut to a torque of 82 to 92 ft. lbs. (111 to 125 N·m).



009549

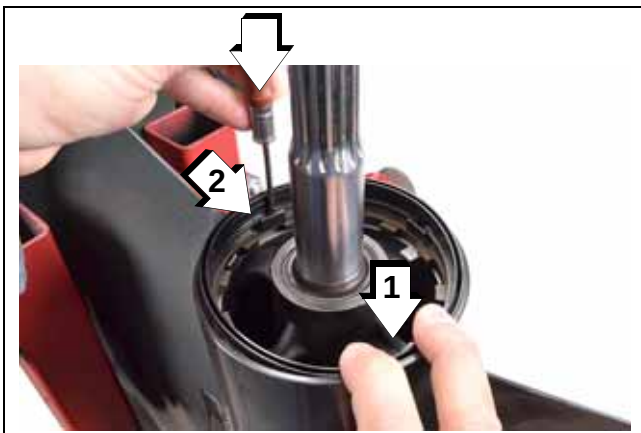
Use an appropriate tool to bend one locking tab into the spanner nut.



1. Tab

009590

Install the ventilation ring. Hold down on the ventilation ring. Insert a small flat-blade screwdriver into the slot of the ventilation ring. Carefully push the slot toward the propeller shaft, then push down to snap the ventilation ring into place.



1. Hold ventilation ring down
2. Ventilation ring slot

009591

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- **Gearcase Leak Test** on p. 361
- **Water Pump Service** on p. 365
- **Shift Rod Adjustment** on p. 368
- **Shift Actuator Installation** on p. 370
- **Gearcase Lubricant** on p. 20
- **Propeller Hardware Installation** on p. 360

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

Gearcase Disassembly (Counter Rotation)

IMPORTANT: Counter rotation (CR) gearcases use unique components and require different service procedures. Use care when working on counter rotation gearcases. DO NOT interchange parts between standard and counter rotation models. Identify gearcase type prior to disassembly. Make sure the “CR” marking is on the end of the propeller shaft.

Pre-Disassembly Inspection

Refer to **Pre-Disassembly Inspection** on p. 373.

Propeller Shaft, Propeller Shaft Bearing Housing and Forward Gear Removal

IMPORTANT: The propeller shaft bearing housing on the SLX-Type gearcase is **PRESSED** into gearcase housing.

Use two flat-blade screwdrivers to remove the ventilation ring from the gearcase. Insert the blade of a small screwdriver into one of the tabs of the ventilation ring. Carefully pry inward, toward the propeller shaft. Use a larger screwdriver to pry the ventilation ring up, then remove the ventilation ring.



1. Pry tab inward
2. Pry ventilation ring up

009529

Gearcase

Gearcase Disassembly (Counter Rotation)

Use a punch to bend the tab of the locking ring down. Use Spanner Nut Wrench, P/N 358165, to remove the spanner nut.



009530

Use Spanner Nut Wrench, P/N 358165, with a breaker bar to loosen the spanner nut. Turn the nut counter-clockwise to loosen.



1. Spanner Nut Wrench, P/N 358165

009554

Once the spanner nut is loose, use the wrench to remove the spanner nut by hand.



1. Spanner Nut Wrench, P/N 358165

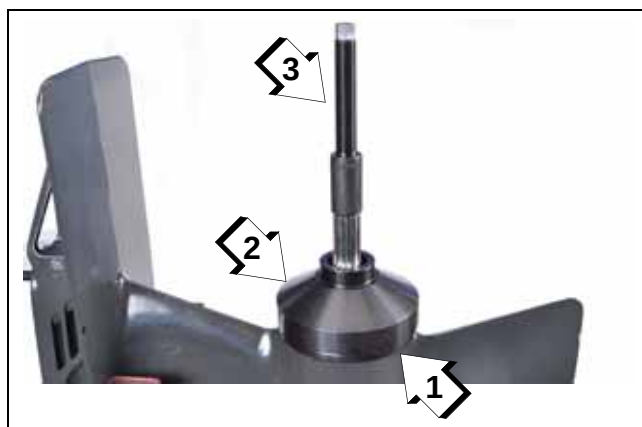
009531

Use the Propeller Shaft Bearing Housing Puller Kit, P/N 354060, with Puller Stud, P/N 358294, to remove the propeller shaft bearing housing from the gearcase using:

IMPORTANT: Make SURE the shift actuator is removed BEFORE beginning this procedure.

DO NOT use tools designed to push on the propeller shaft. Pushing force against the propeller shaft could damage the forward gear thrust bearing or thrust washer.

Place the Adapter, P/N 354178, on the gearcase, followed by the Puller, P/N 354177, Then install the Puller Stud, P/N 358294, onto the propeller shaft until seated.



1. Adapter, P/N 354178
2. Puller, P/N 354177
3. Puller Stud, P/N 358294

009532

Install Puller Tube Assembly, P/N 354175, over the puller stud. Hold the puller stud with a wrench and turn the nut clockwise to remove the bearing housing.



009533

Pull the propeller shaft and bearing housing far enough to loosen the **PRESSED** bearing housing from the gearcase housing.



009534

Remove propeller shaft, bearing housing and forward gear as an assembly from the gearcase.



009557

Pinion Gear Removal and Driveshaft Servicing

Refer to **Pinion Gear and Lower Driveshaft Removal** on p. 376.

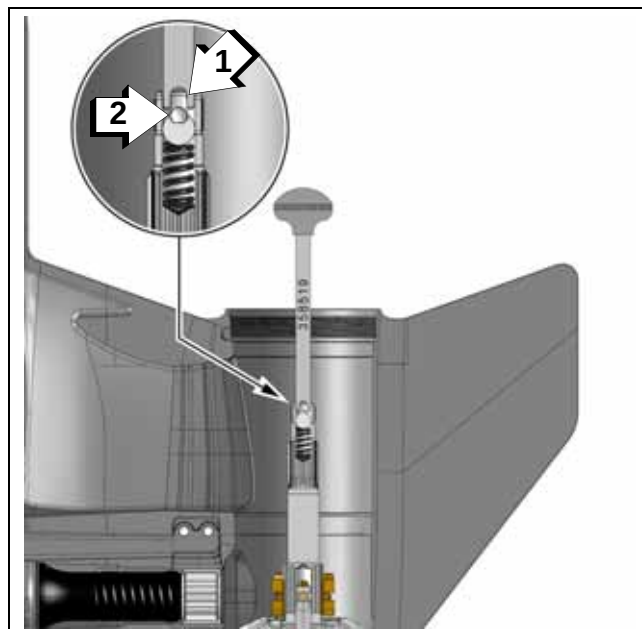
Clutch Shaft and Reverse Gear Removal

WARNING

Wear safety glasses to avoid personal injury. The detent balls and spring can come out with great force.

Use Ball/Detent Remover Installer, P/N 358519, remove the sleeve, detent balls and spring from the clutch shaft.

Align the slots in the tool end with the small detent balls.



1. Slots
2. Small detent balls

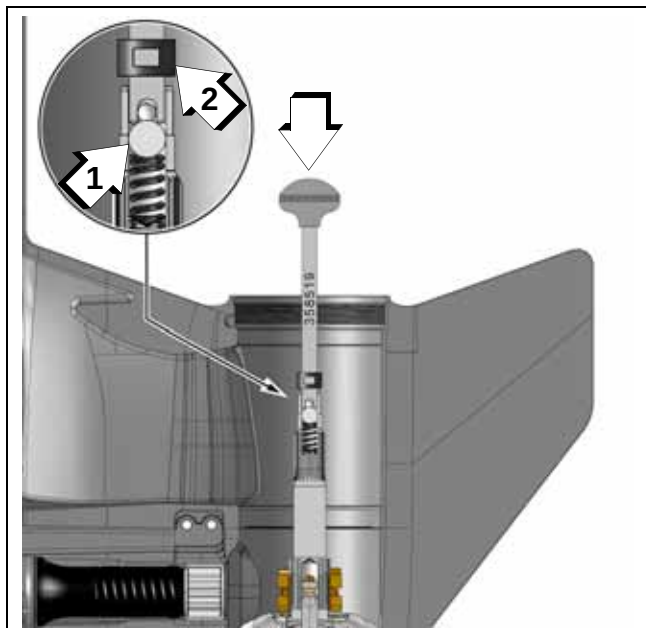
009550

Push the tool on the large detent ball to release pressure from the two small detent balls and sleeve. While holding pressure on the tool, slide the sleeve off of the clutch shaft. Slowly release pressure on the tool and remove the tool and

Gearcase

Gearcase Disassembly (Counter Rotation)

sleeve from the gearcase. Then remove the detent balls and spring from the clutch shaft.



1. Large detent ball
2. Sleeve

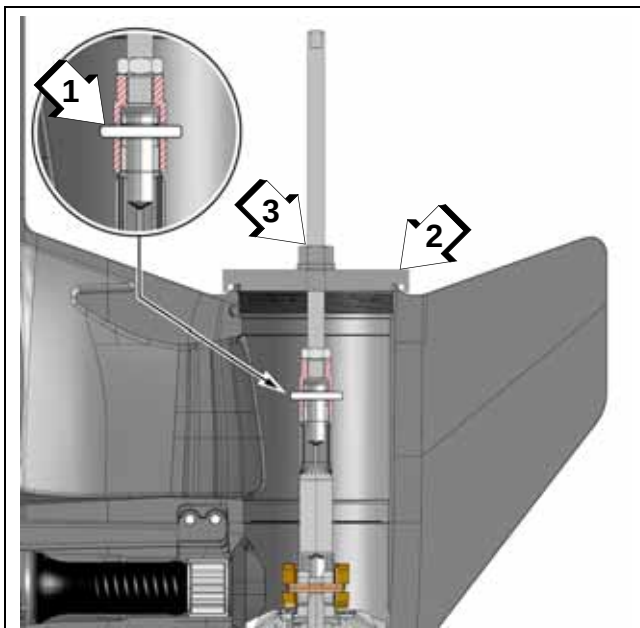
009553

Use Puller Adapter, P/N 358520, remove the clutch shaft.

Align the holes in the puller adapter with the detent ball holes in the clutch shaft.

Insert a 0.25 in. (6 mm) diameter x 1.25 in. (32 mm) long pin or bolt (obtain locally) through the holes. Place the puller plate over the puller rod and install the puller nut. Hold the rod with a

wrench and tighten the nut to remove the clutch shaft.



Counter Rotation Models

1. Pin through holes in puller adapter and clutch shaft
2. Puller plate
3. Puller nut

009551

The reverse gear may, or may not come out with the clutch shaft assembly.

After removing the clutch shaft, remove the reverse gear (if needed), thrust bearing and thrust washer.



Clutch Shaft Assembly

009555

Shift Housing Removal

Refer to **Shift Housing Removal** on p. 379.

Water Intake Screens

Remove and clean side water intake screens. Replace if damaged.



1. Water intake screen

009587

Shifter, Bearing and Seal Servicing

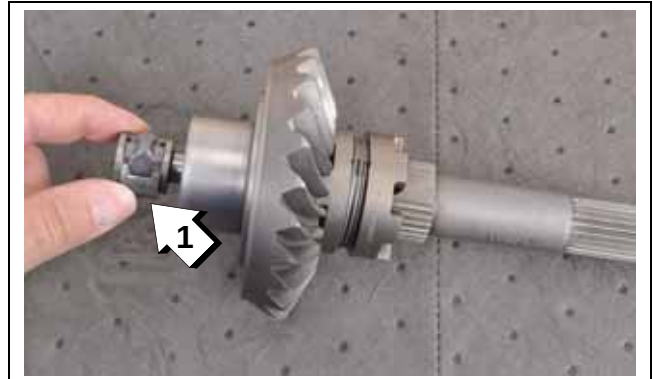
Shift Housing Disassembly

⚠ WARNING

Wear safety glasses to avoid injury.

IMPORTANT: The shift housing and bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

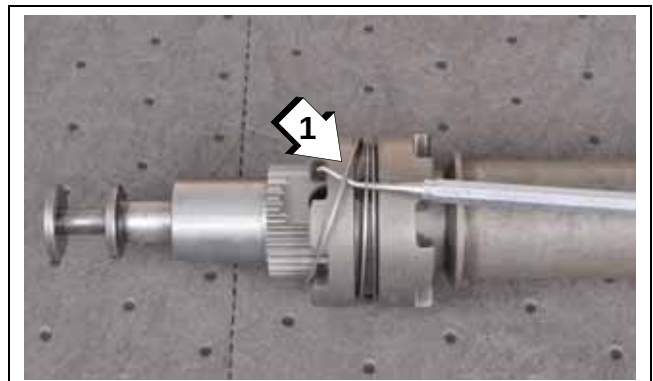
If the reverse gear came out with the clutch shaft, remove the cradle and gear from the clutch shaft.



1. Clutch dog spring

009558

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring.**



1. Clutch dog spring

009520

Gearcase

Shifter, Bearing and Seal Servicing

Push the pin out of the clutch dog. Remove all parts.



1. Pin

009559

IMPORTANT: The shift housing supports the reverse gear on counter rotation gearcases.

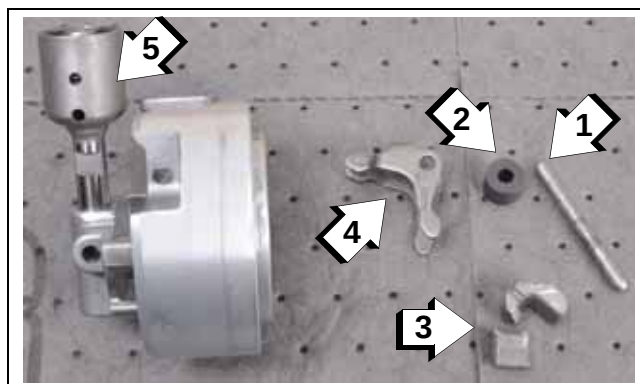
Remove the shift lever pin from the housing.



1. Shift lever pin

009556

Remove the magnet, shift shaft, cradle and shift lever. Move shifter detent as needed to help ease removal of parts.



1. Shift lever pin
2. Magnet
3. Cradle
4. Shift lever
5. Shifter detent

009518

NOTICE

Discard the shift cradle and shift lever. New parts **MUST** be used during installation.

During removal the shift lever will bend and the cradle will crack and could break.

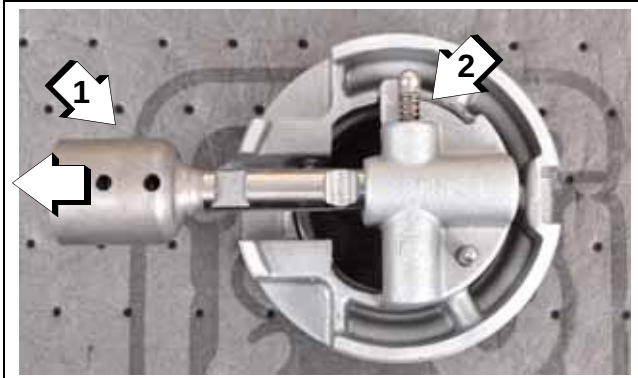
Even if parts appear to be in good condition, re-use will result in failure in a short period of time.



⚠ WARNING

Wear safety glasses to avoid personal injury. The detent ball and spring come out with great force.

Wrap the housing with a shop cloth to catch the ball and spring. Rotate the shifter detent 90° in either direction, then pull the detent out of the housing.



1. Shifter detent
2. Ball and spring

009516

Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection.

Shift Housing Assembly

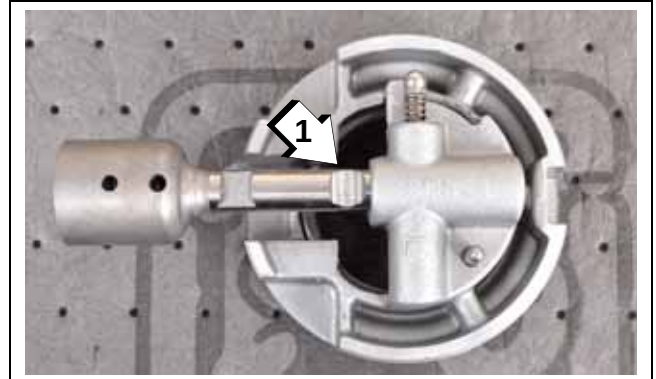
IMPORTANT: Clean and inspect all parts before beginning assembly procedures. Replace any damaged parts.

Lightly coat the detent ball and spring with *Needle Bearing* grease. Insert the spring in the housing, then the ball.



009523

Insert shifter detent into the housing. Position the NEUTRAL detent at a 90° angle as shown.

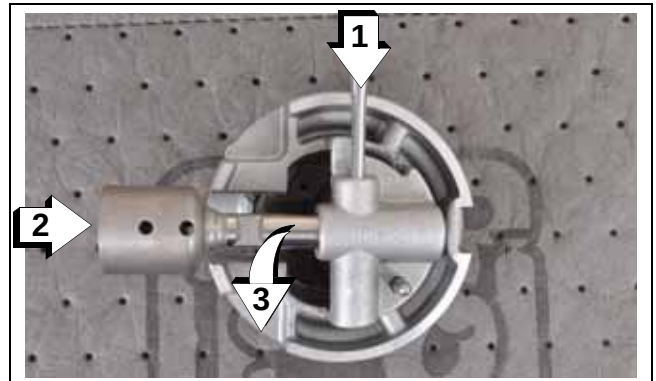


1. NEUTRAL detent

009516

Depress the ball and spring with a suitable tool. Then push the shifter detent is past the ball, and remove the tool.

Rotate the shifter detent 90° to position the detent to engage the ball in the NEUTRAL position.



1. Depress ball and spring
2. Push shifter detent
3. Rotate 90°

009515

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case.

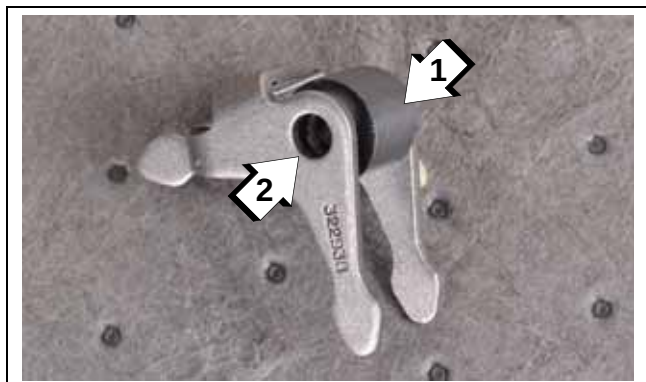


009517

Gearcase

Shifter, Bearing and Seal Servicing

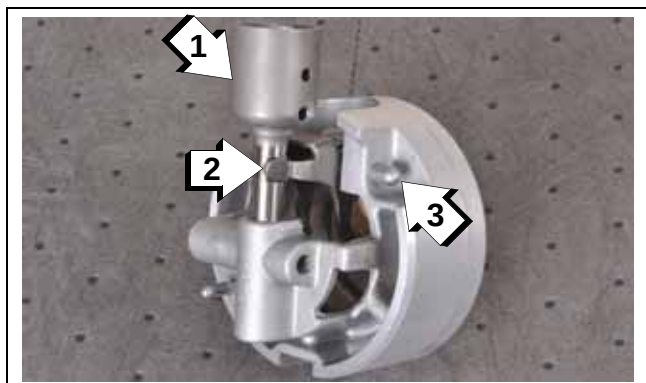
Install the magnet into the shift lever, aligning the hole in the magnet with the holes on the shift lever.



1. Magnet
2. Hole on shift lever

009524

With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



1. Shifter detent
2. Shift lever
3. Pin, shift lever

009556

Rest the cradle on the shift shaft.

Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEU-

TRAL position to hold the cradle and shaft in place.



1. Cradle
2. Shift shaft

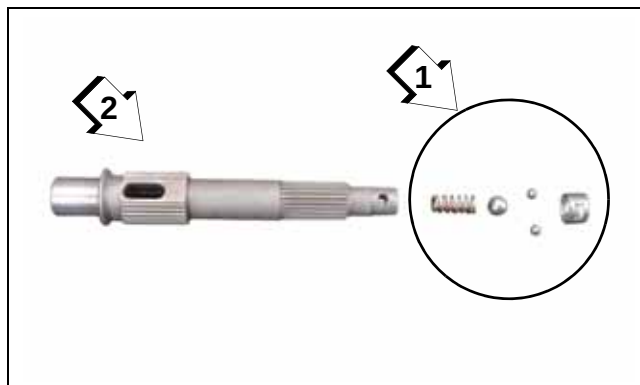
009525

Coat thrust bearing and thrust washer with *Needle Bearing* grease. Place the bearing on the back of the gear. Set the washer on top of the thrust bearing. Insert the gear, bearing, and washer into the bearing housing.

⚠ WARNING

Wear safety glasses to avoid injury.

If these parts are damaged or removed, a new service kit should be installed. Refer to parts catalog for kit part number.



1. Clutch Shaft Retainer Kit
2. Clutch Shaft

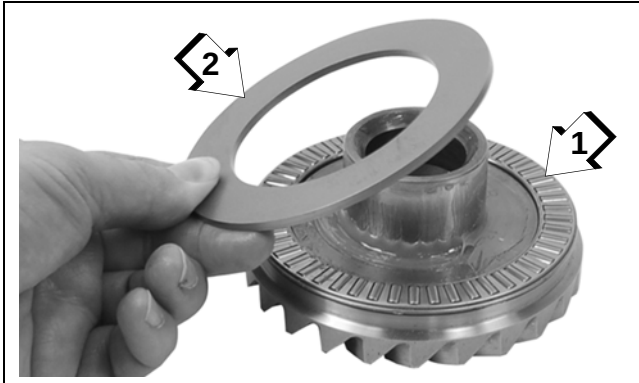
009560

Coat thrust bearing and thrust washer with *Needle Bearing* grease. Place the bearing on the back of the gear. Set the washer on top of the thrust bear-

ing. Insert the gear, bearing, and washer into the bearing housing.

NOTICE

Bearing and washer must be installed in the correct order.



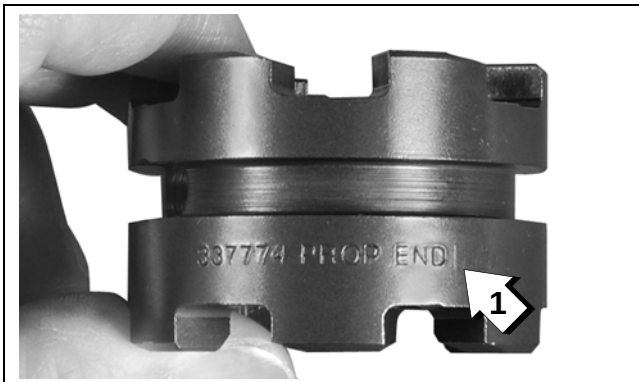
1. Thrust bearing
2. Thrust washer

006905

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

NOTICE

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

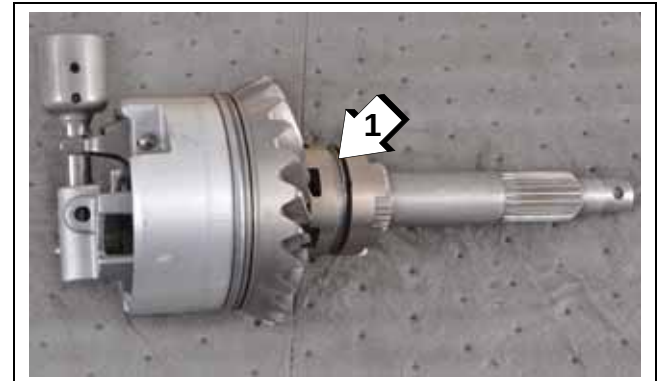


1. "PROP END"

006906

Slide the propeller shaft onto the shift shaft, align the hole in the shaft with the hole in the clutch dog, install the pin and then, a **new** clutch dog retaining spring. Place three coils over each end

of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring

009574

Pinion Bearing

Refer to **Pinion Bearing Installation** on p. 380.

Propeller Shaft Bearing Housing and Forward Gear

Disassembly

Remove and discard the bearing housing O-ring.

Remove the anode and discard if more than two-thirds deteriorated.

Clamp the propeller shaft bearing housing by the anode bosses in a vise, as shown. Remove the forward gear bearing housing assembly from propeller shaft bearing housing. Use Spanner Wrench, P/N 432400, to unscrew in a counter-clockwise direction.



009561

Gearcase

Shifter, Bearing and Seal Servicing

Remove the shim(s).



006852

Inspect the forward gear and bearing housing assembly for excessive wear or damage.



006853

Push propeller shaft out of the bearing housing.



009562

Remove the thrust washer and thrust bearing.



1. Thrust washer
2. Thrust bearing

009563

Inspect the bearing housing anode. Replace anode if it is reduced to two-thirds of original size. Tighten screws to a torque of 108 to 132 in. lbs. (12 to 15 N·m).



1. Anode

009568

Discard the bearing housing o-ring. Clean the housing and bearings in solvent and dry thoroughly. If bearings were not replaced, rotate the needles to check for freedom of movement.

Inspect the o-ring groove. Use emery cloth to remove any sharp edges that might cut the o-ring.

Remove any nicks or burrs on front of bearing housing.



1. O-ring groove

009568

For seal and bearing service refer to **Propeller Shaft Bearing Housing Service** on p. 387.

Assembly

Position the forward gear bearing housing assembly on a flat, level surface. (Mirror or glass can be used.) Use depth gauge to measure distance from flange of housing to flat surface as shown.



1. Flange

009564

Add the appropriate shims to create a dimension of 0.140 in. (3.556 mm).

To determine thickness of shims; use the following example:

$$\begin{aligned} & \underline{1.389 \text{ in. reading on the gauge}} \\ & + \underline{0.011 \text{ in. shims required}} \\ & = \underline{1.400 \text{ in. required dimension}} \end{aligned}$$

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

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



1. Thrust bearing
2. Thrust washer

009565

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



009566

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

Apply gearcase lubricant to the threads of the forward gear bearing housing.

Gearcase

Driveshaft Shimming

Install forward gear assembly with correct shims in bearing housing.



1. Shim(s)

009567

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

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



009569

Driveshaft Shimming

NOTICE

If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is achieved by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion, or driveshaft, it is necessary to properly shim the assembly to restore factory clearance.

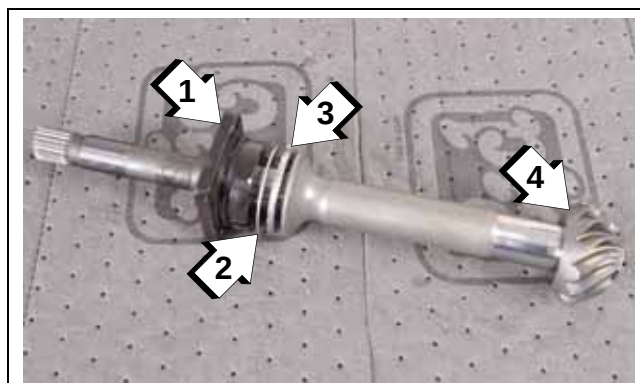
Use Driveshaft Shimming Tool, P/N 5005925.

Shim gauge bars are precision made and should be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 318674, when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with out-board lubricant and tighten to a torque of 100 to 110 ft. lbs. (136 to 149 N·m).



1. Driveshaft bearing housing
2. Thrust washer
3. Thrust bearing
4. Pinion gear

009507

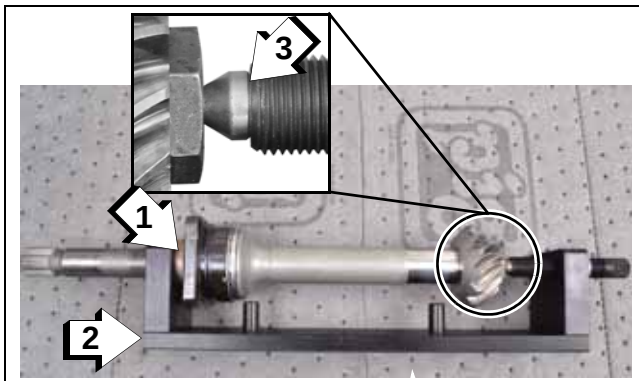
IMPORTANT: The original pinion nut may be used for shimming, but must **NOT** be used in final assembly.

Select collar, P/N 341440, and the correct shim gauge bar:

- “SLX”: Shim gauge bar, P/N 358164

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.

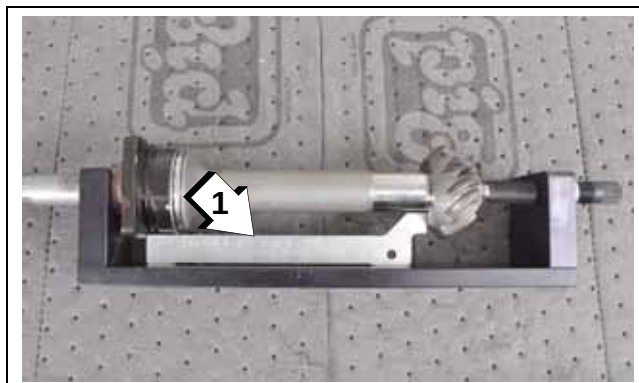


1. Collar
2. Tool base
3. Groove

006913
009508

Rotate the driveshaft several revolutions to seat bearings.

Lay the tool base on its side. Position the shim gauge bar against guide pins of the tool base.



1. Shim gauge bar

009509

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating **just the bearing housing**. Use a feeler gauge to measure clearance between the gauge bar and the bearing housing between each pair of screw holes. Replace the bearing housing and repeat check if variance is greater than 0.004 in. (0.101 mm).

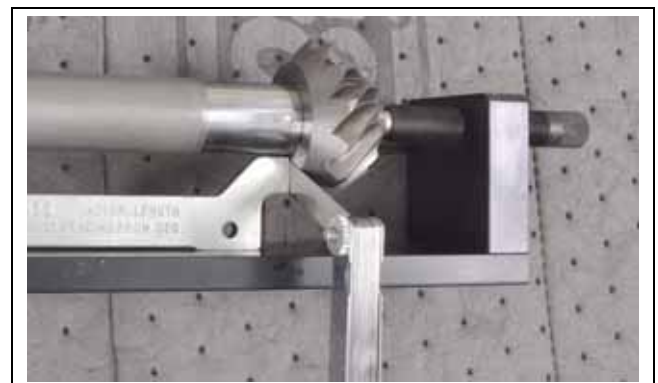
Check squareness of the pinion to the driveshaft. Hold the shim gauge bar against the bearing housing (between the screw holes) while rotating **just the driveshaft and pinion assembly**. Measure clearance between the gauge bar and the pinion at several locations. If variance is greater than 0.002 in. (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 318674.

Check clearance again. The measurement between the gauge bar and pinion should be 0.020 in. (0.508 mm).



009510

Remove the nut and pinion from the driveshaft. Discard the nut.

Gearcase Assembly

Water Intake Screens

Install water intake screens. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Water intake screen

009587

Shift Housing, Gear, and Propeller Shaft Installation

Apply *Triple Guard* grease the leading edge of the shifter housing as shown.



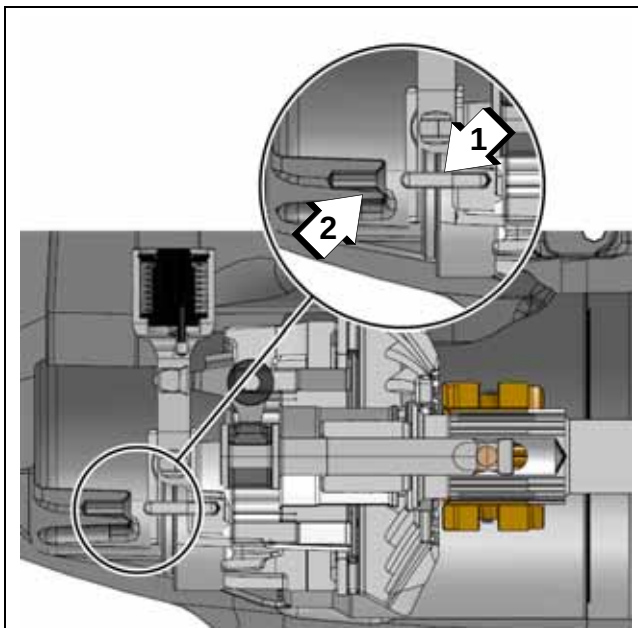
1. Triple Guard grease applied to leading edge of shifter housing

009587

Push shifter detent into farthest downward position. Tip the rear of the gearcase slightly downward to assist in the installation of the shaft assembly.

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully into the gearcase. Make sure the align-

ment pin on the shifter housing is aligned with the hole in forward end of gearcase housing.



1. Alignment pin
2. Hole

009570

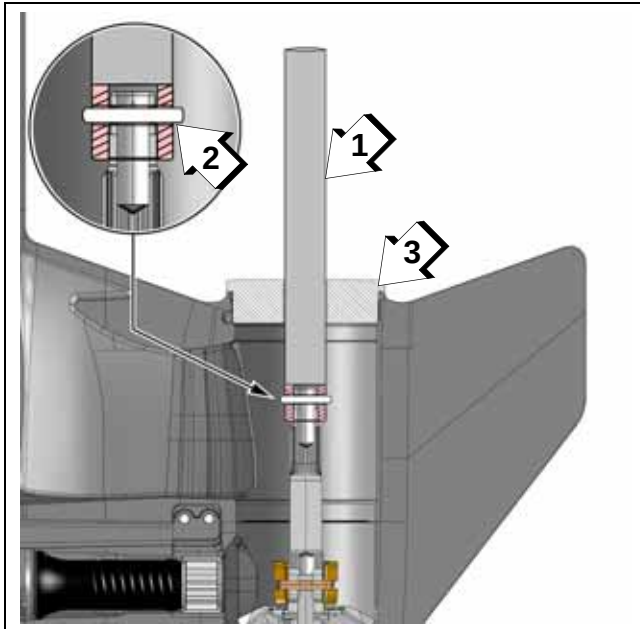
Make sure the shifter detent will align with the shift rod bushing. Look through the shift rod bushing to confirm the shifter detent will align with the shift rod. Misalignment will prevent installation of the shift rod.

Use Installer, P/N 359079, to install the clutch shaft and shifter housing assembly.

Align the holes in the installer with the detent ball holes in the clutch shaft.

Insert a 0.25 in. (6 mm) diameter x 1.25 in. (32 mm) long pin or bolt (obtain locally) through the holes. Place Forward Bearing Press Fixture,

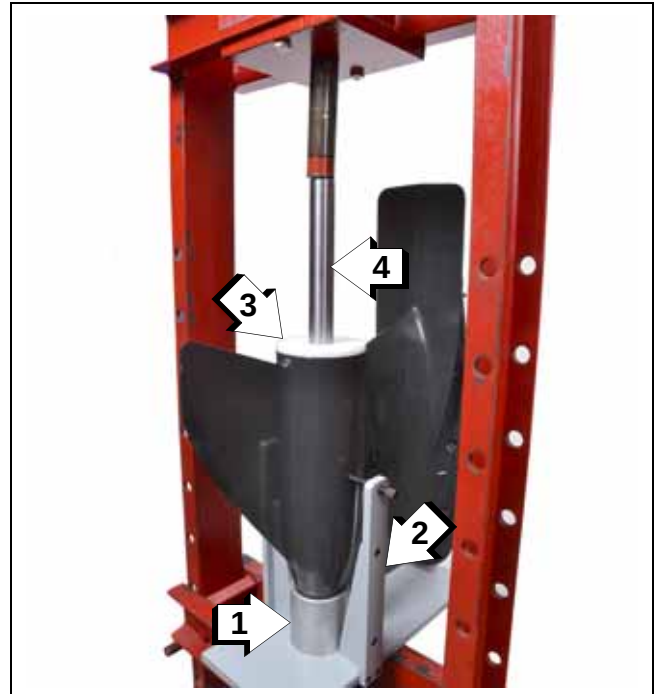
P/N 358163, over propeller shaft and into gearcase housing.



1. Installer, P/N 359079
 2. Pin
 3. Forward Bearing Press Fixture, P/N 358163
- 009584

Install Press Fixture Nose, P/N 358161, onto Gearcase Press Fixture, P/N 354059.

Align and level the gearcase assembly in the fixture as shown. Secure the fixture to a floor press.



1. Press Fixture Nose Piece, P/N 358161
 2. Gearcase Press Fixture, P/N 354059
 3. Forward Bearing Press Fixture, P/N 345822
 4. Clutch Shaft & Shifter Installer, P/N 358079
- 009589

Press until the shifter housing is seated.

Use the Shift Rod Installer Tool, P/N 358162, to install the shift rod.

Use Ball/Detent Remover Installer, P/N 358519, to install the detent balls, spring and the sleeve, into the clutch shaft.

Install the spring and large detent ball into the clutch shaft. Then place the two small detent balls into the clutch shaft.

Place the sleeve over the tool.

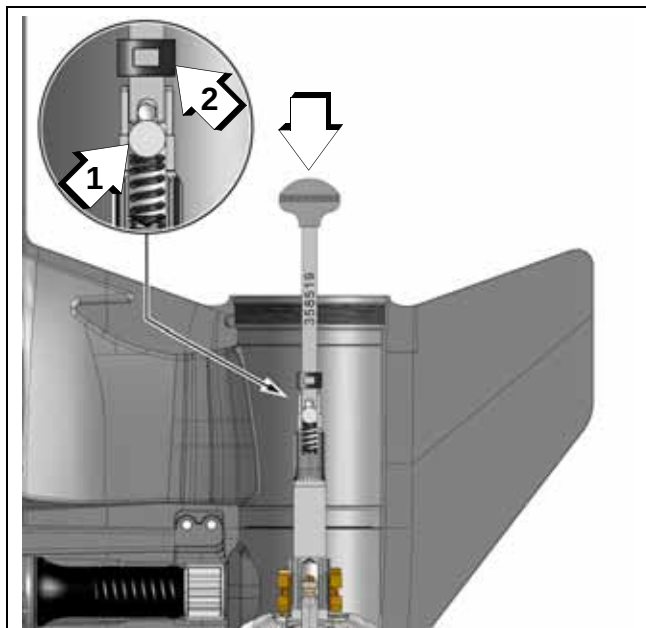
Use the tool to align the detent balls with the holes in the clutch shaft.

Then push the tool on the large detent ball. When the small detent balls are aligned, slide the sleeve onto the clutch shaft while holding pressure on the

Gearcase

Gearcase Assembly

tool. Slowly release pressure on the tool and remove the tool from the gearcase.



1. Large detent ball
2. Sleeve

009553

Pinion Gear and Driveshaft Installation

Refer to **Pinion Gear and Driveshaft Installation** on p. 393.

Propeller Shaft, Propeller Shaft Bearing Housing and Gear Installation

IMPORTANT: The propeller shaft bearing housing on SLX-Type gearcase is **PRESSED** into the gearcase housing.

Lightly apply *Triple Guard Grease* to a new bearing housing O-ring. Install the O-ring in the groove

in the housing. Grease the machined side surfaces of bearing housing.



009512

Place the bearing housing into the gearcase. Align the vertical ribs of the propeller shaft bearing housing with the gearcase back rib and skeg, as shown.



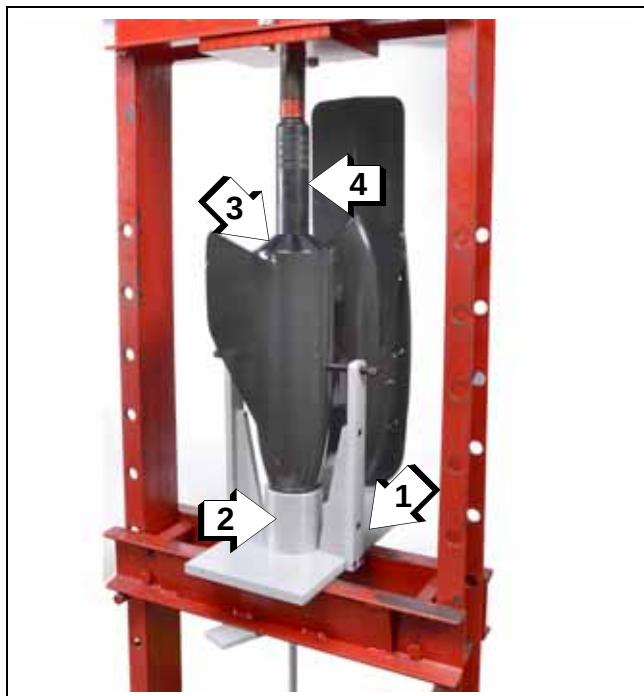
1. Vertical ribs
2. Back rib of gearcase housing
3. Skeg

009493

Use Gearcase Press Fixture, P/N 354059, with Press Fixture Nose, P/N 358161, and an appropriate floor press (10 ton or greater) to install housing into gearcase.

Place Propeller Shaft Bearing Housing Installer, P/N 358295, and Installer Handle, P/N 345822, onto gearcase.

Align and level gearcase assembly in fixture as shown. Secure fixture to floor press.

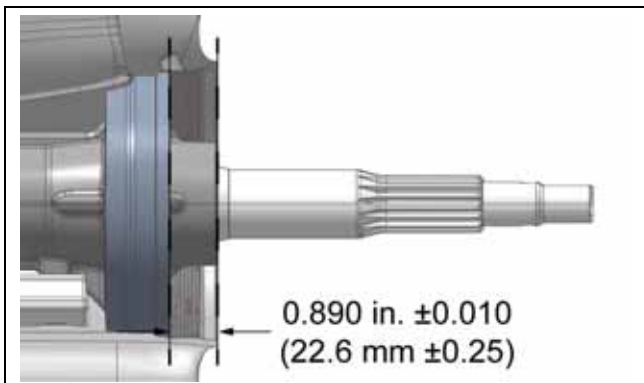


1. Gearcase Press Fixture, P/N 354059
2. Press Fixture Nose Piece, P/N 358161
3. Propeller Shaft Bearing Housing Installer, P/N 358295
4. Handle P/N 345822

009547

Housing must be completely seated in gearcase to install the spanner nut.

Check bearing housing press dimension is 0.890 in. ± 0.010 (22.6 mm ± 0.25) below gearcase housing.



Bearing Housing Press Dimension (cut-away view)

009492

Install a new locking ring with the alignment tab in the hole at the top of the housing.



Locking Ring Installation

1. Locking ring
2. Alignment tab

0099548

Apply *Gasket Sealing Compound* to threads of a new spanner nut. Start the spanner nut by hand. Then use Spanner Nut Wrench, P/N 358165, to tighten the spanner nut.



1. Spanner Nut Wrench, P/N 358165

009531

Tighten the spanner nut to a torque of 82 to 92 ft. lbs. (111 to 125 N·m).



009549

Gearcase

Gearcase Assembly

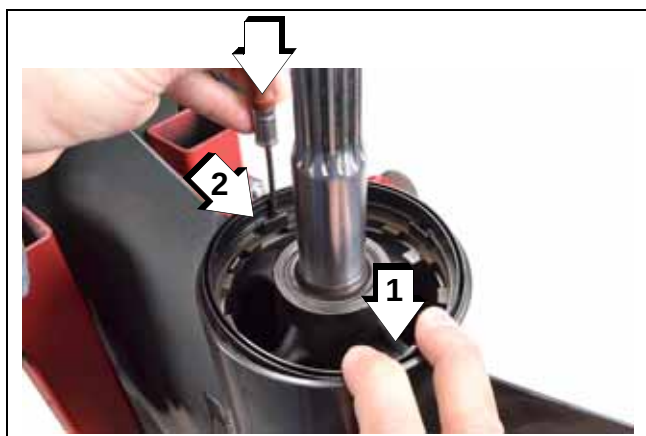
Use an appropriate tool to bend one locking tab into the spanner nut.



1. Tab

009590

Install the ventilation ring. Hold down on the ventilation ring. Insert a small flat-blade screwdriver into the slot of the ventilation ring. Carefully push the slot toward the propeller shaft, then push down to snap the ventilation ring into place.



1. Hold ventilation ring down
2. Ventilation ring slot

009591

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- **Gearcase Leak Test** on p. 361
- **Water Pump Service** on p. 365
- **Shift Rod Adjustment** on p. 368
- **Shift Actuator Installation** on p. 370
- **Gearcase Lubricant** on p. 20
- **Propeller Hardware Installation** on p. 360

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

Safety

S

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Marine Products and the Safety of People Who Use Them

⚠ WARNING

This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

- Product user is informed; and
- Products are safe and reliable.

It is up to you, the people who...

- Rig boats;
- Fix machinery; and
- Maintain equipment

...to keep the products safe **and** reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

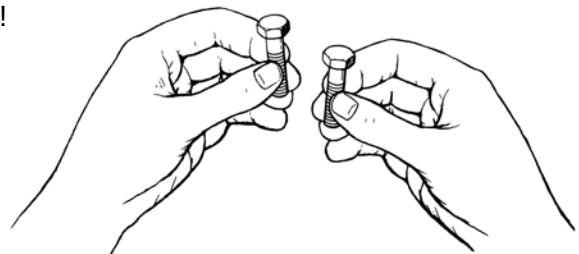
First!

A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS

"They look the same, but are they the same?"

- Same size?
- Same strength?
- Same material?
- Same type?

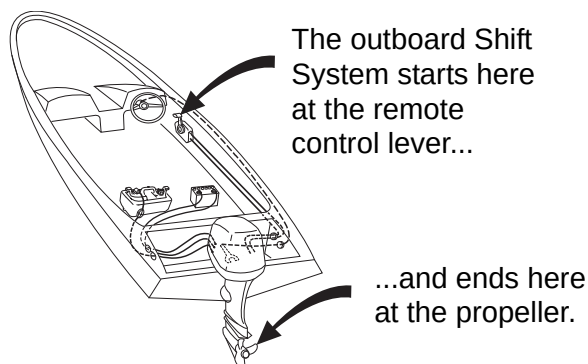


Don't substitute unless **you know** they are the **same** in **all** characteristics.

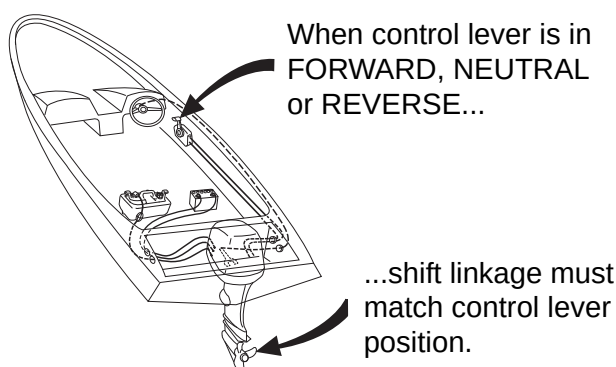
Second!

- Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.

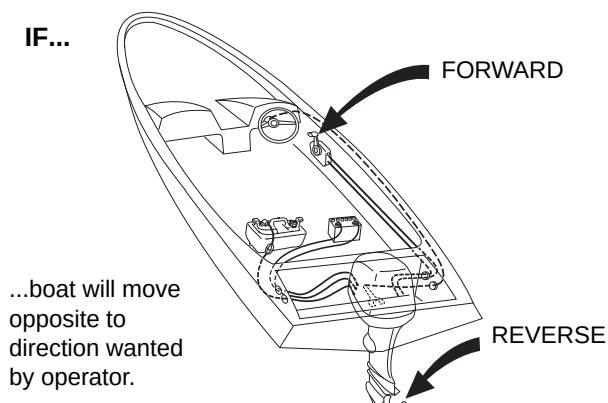
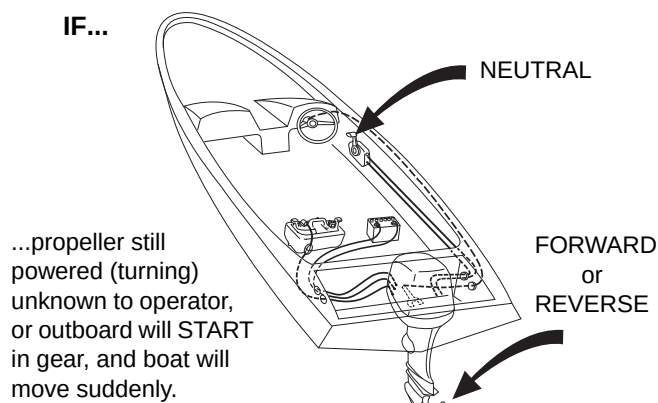
Outboard Shift Systems and Safety



What is most important?



What could happen?



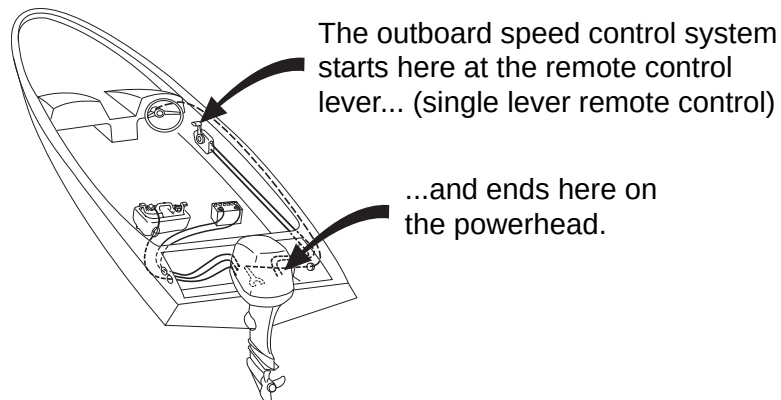
How can loss of shift control be minimized?

When rigging or after servicing

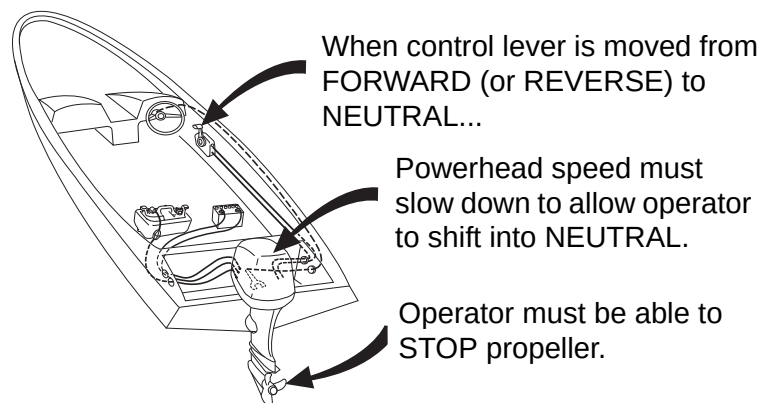
Read, understand, and follow manufacturer's instructions

- 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**

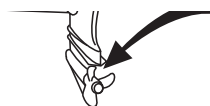
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else.
- Make sure full throttle can be obtained so Operator will not overload parts.

Safety

Marine Products and the Safety of People Who Use Them

Outboard Steering Control System and Safety

The outboard steering system starts here at the steering wheel...



...and ends here at the trim tab on the outboard.

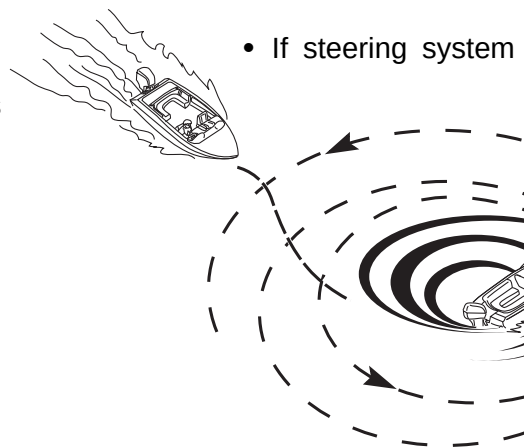
What is most important?

The steering system:

- Must not come apart;
- Must not jam; and
- Must not be sloppy or loose.

What could happen?

comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.



- If steering system

- 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.



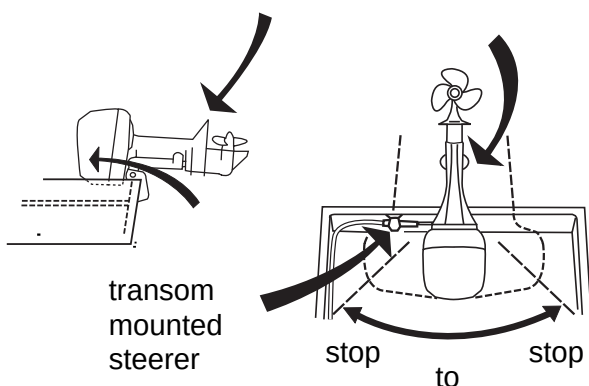
How can loss of steering control be minimized?

**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.

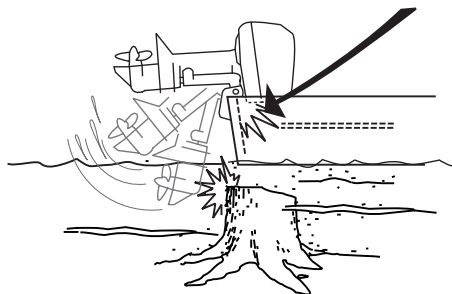


Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

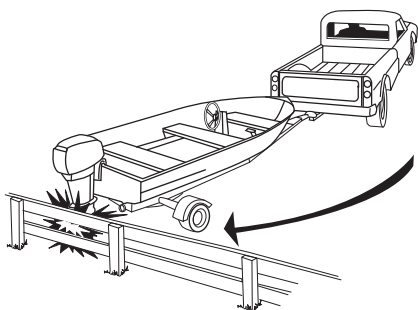
During this procedure, steering parts:

- 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.

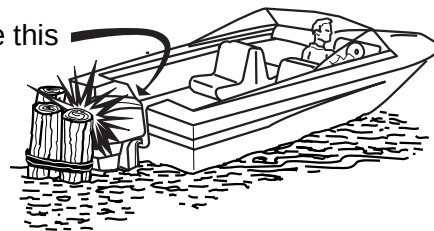


Check for damaged parts. Blows to the outboard like this



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.

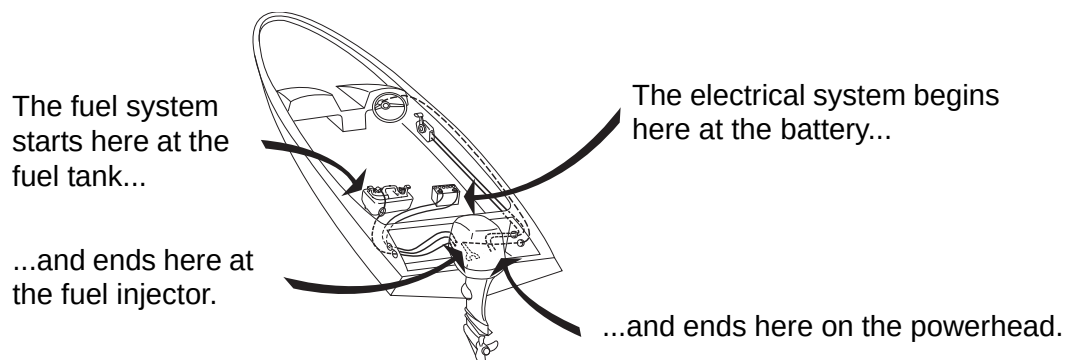


Replace damaged parts. If weakened, parts could fail later on the water when least expected.

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.

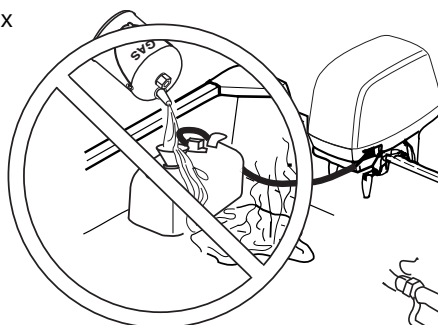
What could happen?

- **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.

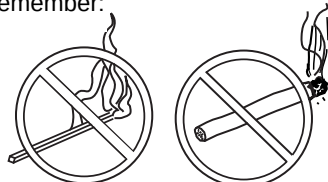
When mixing and refueling, always mix gas and oil outside...



Always fill the tank outside the boat

Fumes are hard to control. They collect and hide in the bottom of the boat.

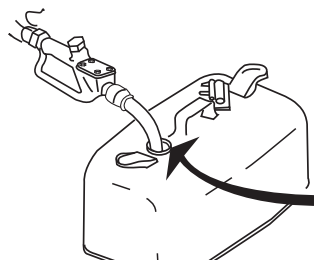
Remember:



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.

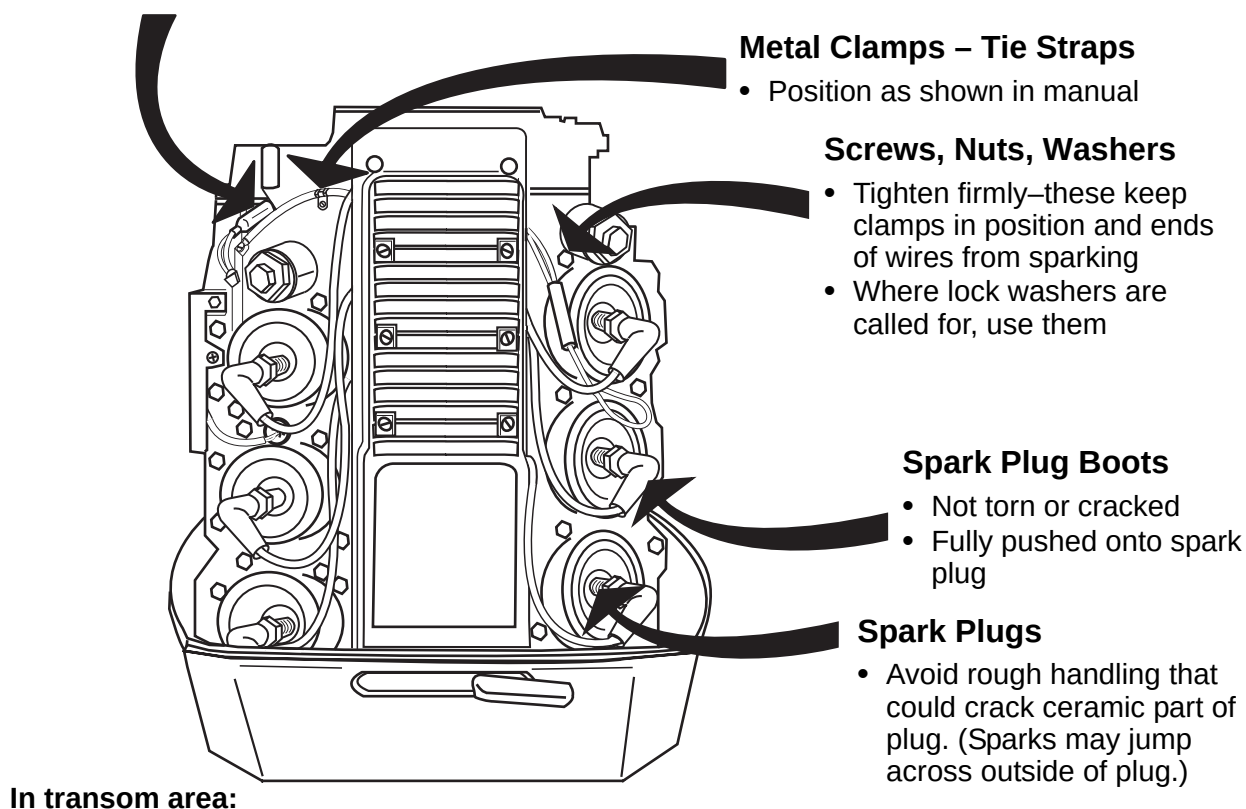
If electrical parts are replaced or even removed from the outboard, check the following:

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

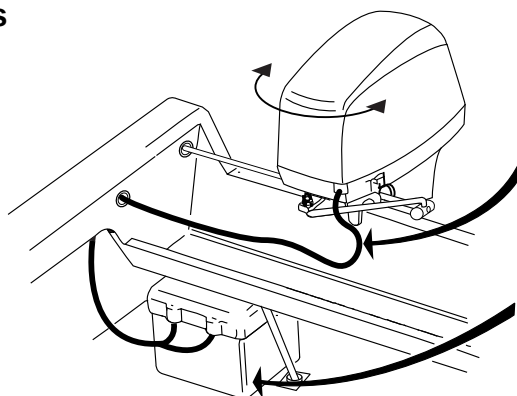
Sleeves, boots, shields

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



All Connections

- Clean
- Tight
(Prevents sparks)



Safety

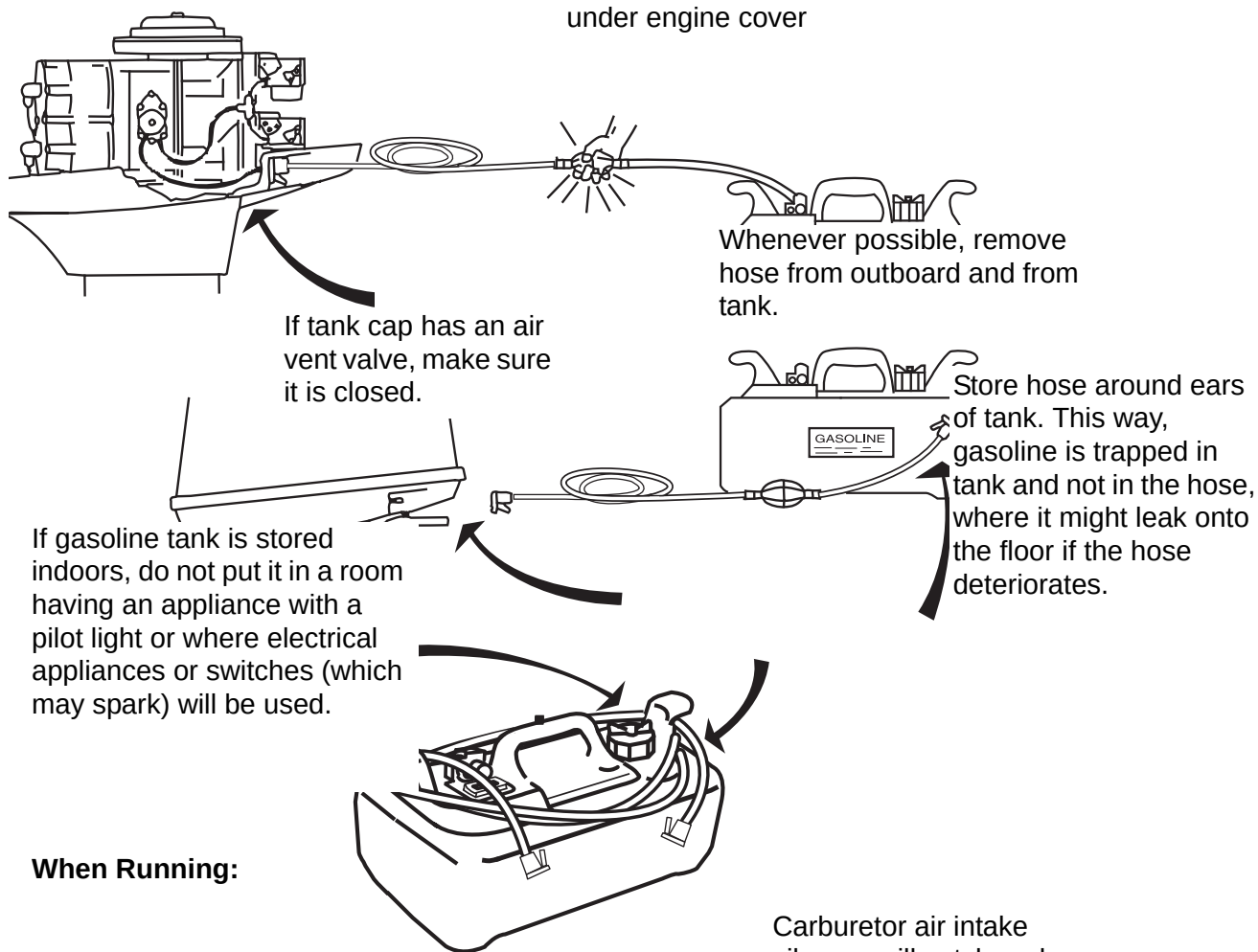
Marine Products and the Safety of People Who Use Them

After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When Storing:

Squeeze until
bulb feels hard

Check for leaks
under engine cover



When Running:

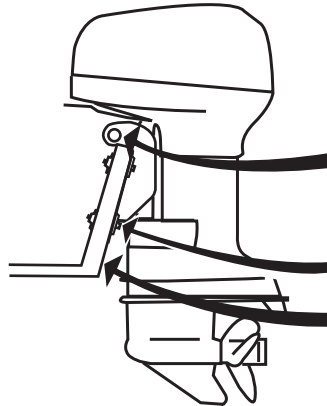
Carburetor air intake
silencer will catch and
hold fuel which may flood
into engine if carburetor
float sticks.



- Make sure silencer and its gaskets are on engine and drain hose is in place.
- Air silencer mounting screws are special lock screws. Use only the special screws.

Outboard Mounting System and Safety

The mounting system includes:

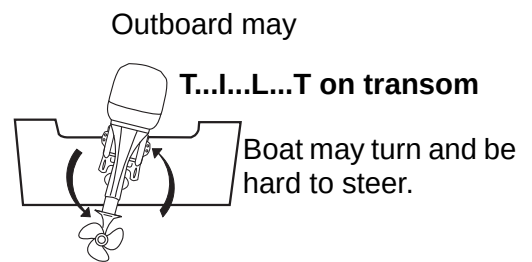
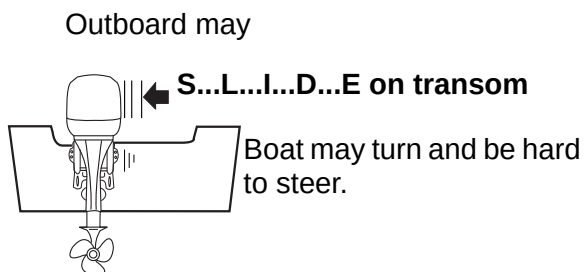


- outboard parts
- bolts, nuts, and washers
- boat's transom

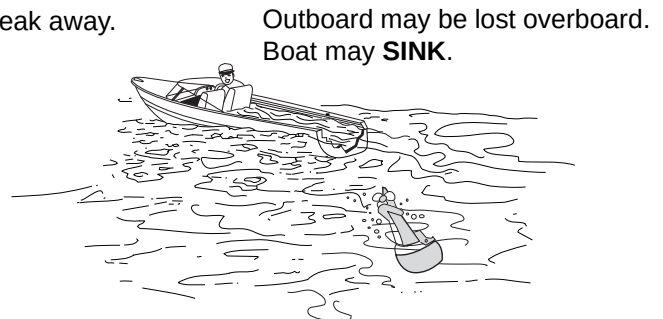
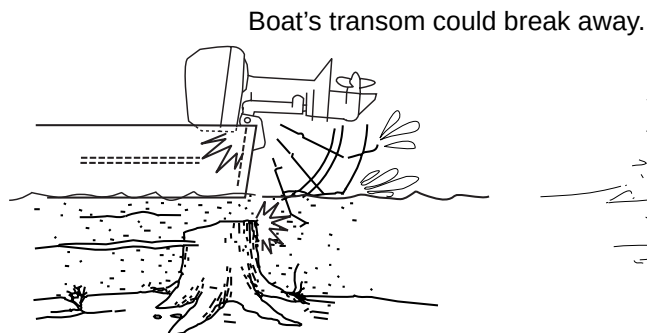
What is most important?

- 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.



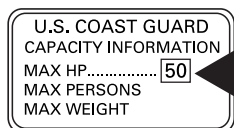
How Can Loss of Mounting Be Minimized?

- **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

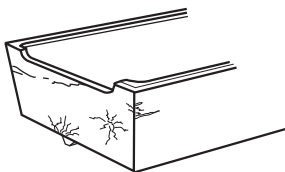


If boat plate shows...

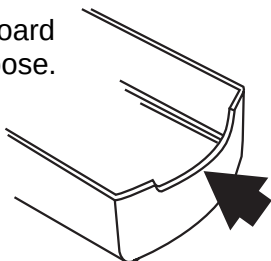
Use only



When rigging or fixing any boat, if transom looks weak, tell the owner.

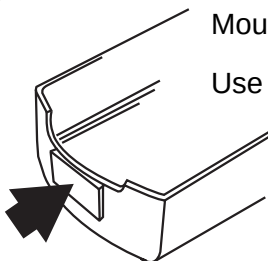


If transom is curved, outboard may come loose.



Mount on flat surface only.

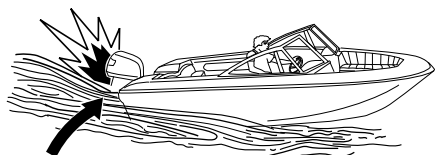
Use shims to make surface flat.



Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

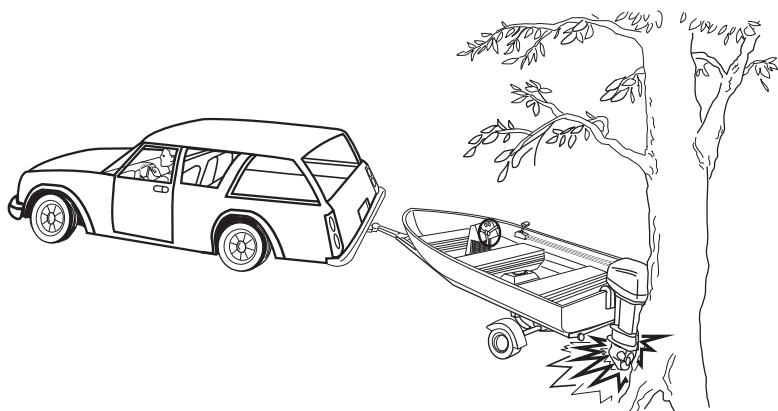


If owner tells you "I hit something really hard..."



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."

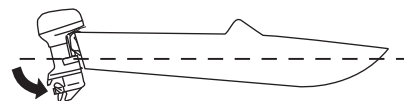
Check for a slow, heavy squash to the outboard.

- 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

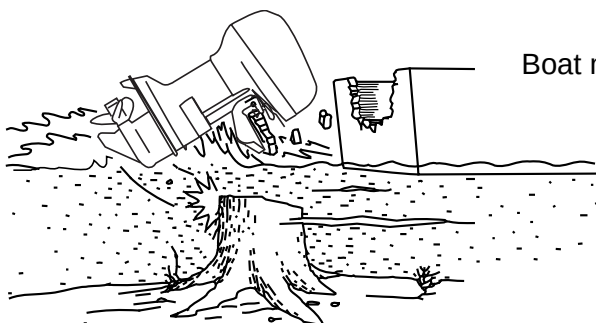
What is most important?

- 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?

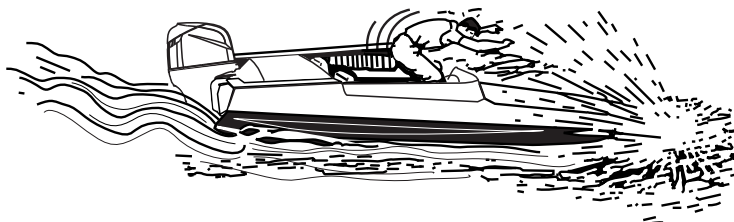
Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.



Boat may **SINK**.

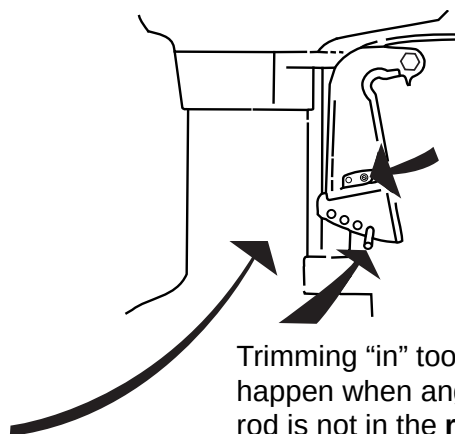


At high speeds, sudden trimming in too far may dive boat under water or spin it around.



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).

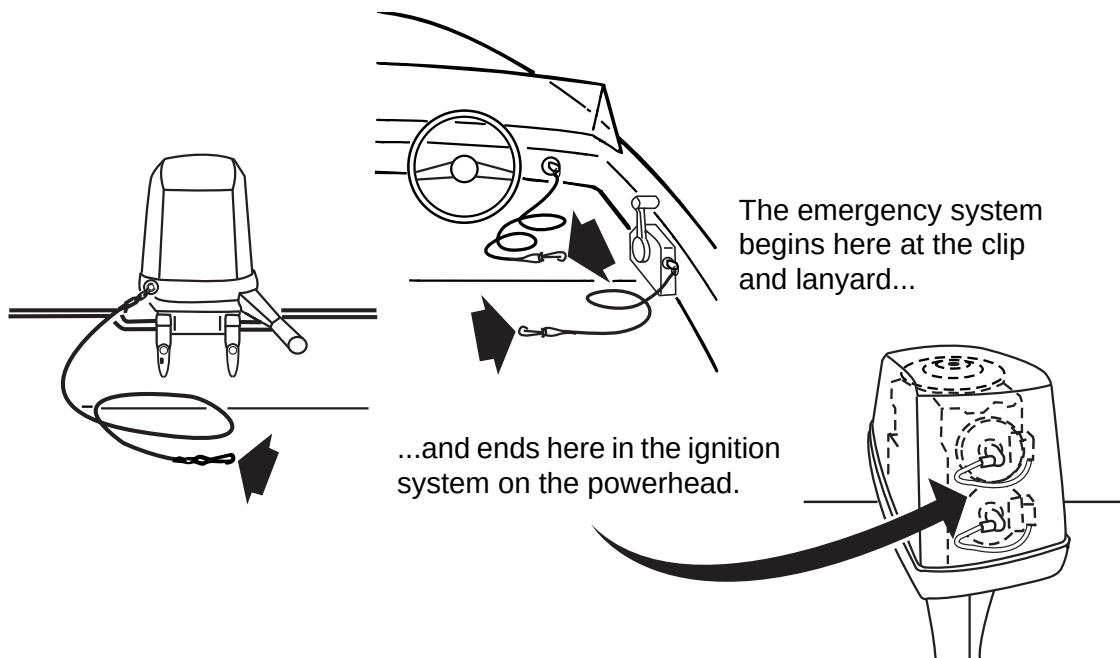
If left open, outboard has no shock protection.

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

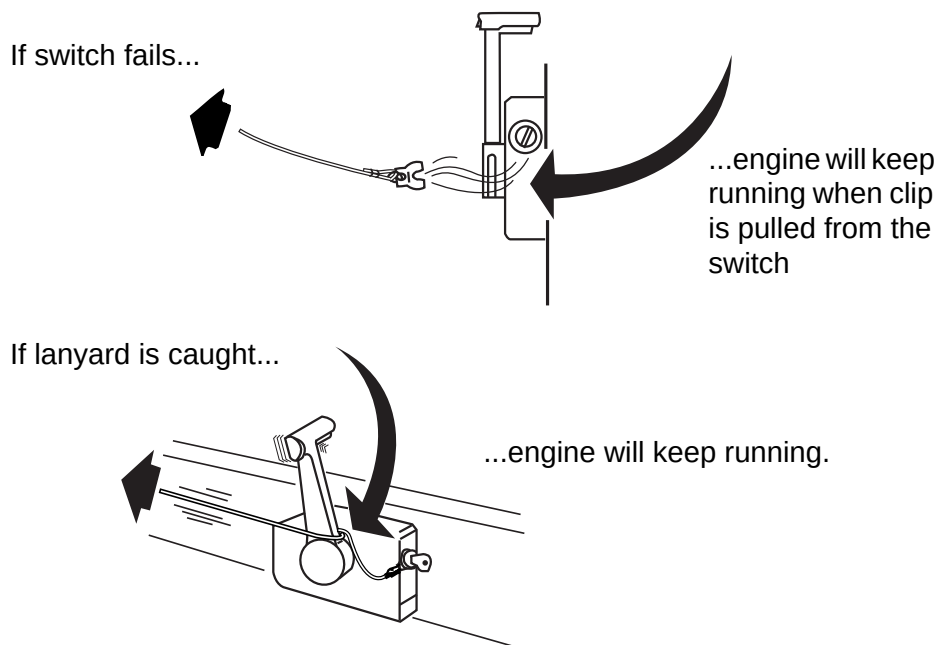
Outboard Emergency Stop System and Safety



What is most important?

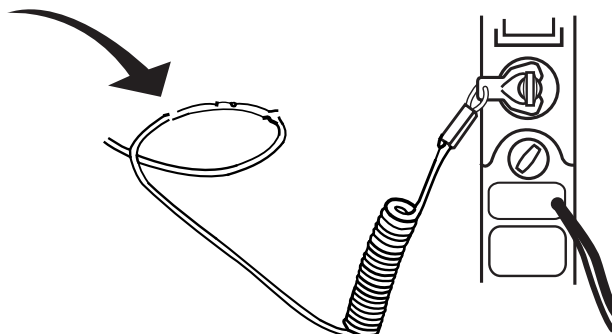
- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

What could happen?

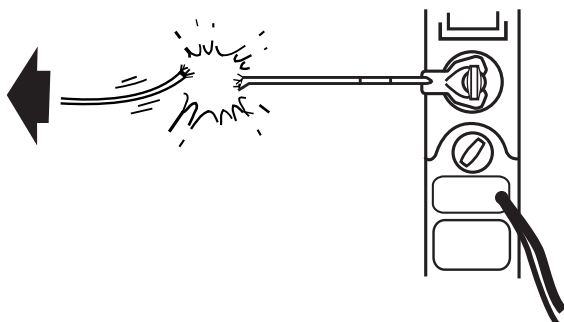


What could happen?

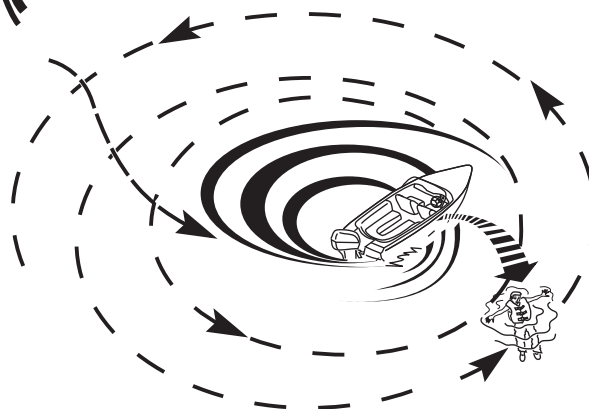
If lanyard is cut or frayed...



...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)

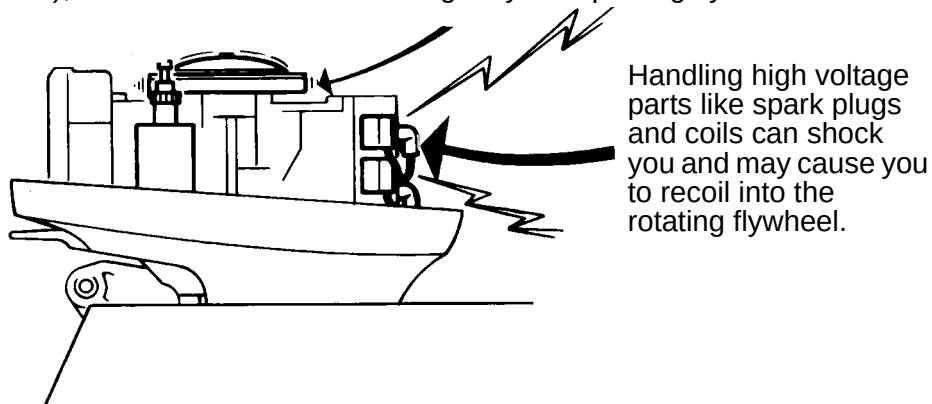
- Make sure shop aids have extra capacity, and keep them in good repair.

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

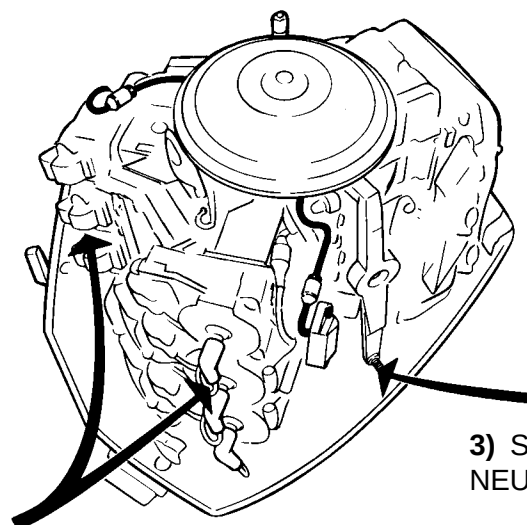
When you do things that turn the flywheel like:

- 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



NO SPARK



NO START



NO SURPRISES

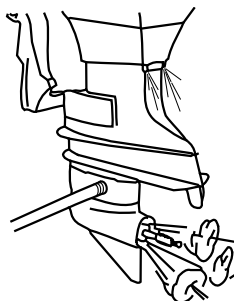
Running outboard too fast (Overspeeding)

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

Running too fast can happen when:

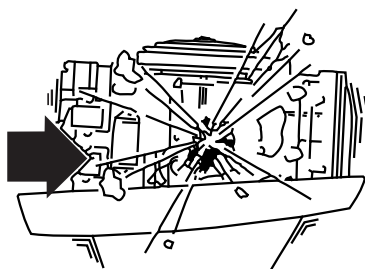
1) Using a flushing device...

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

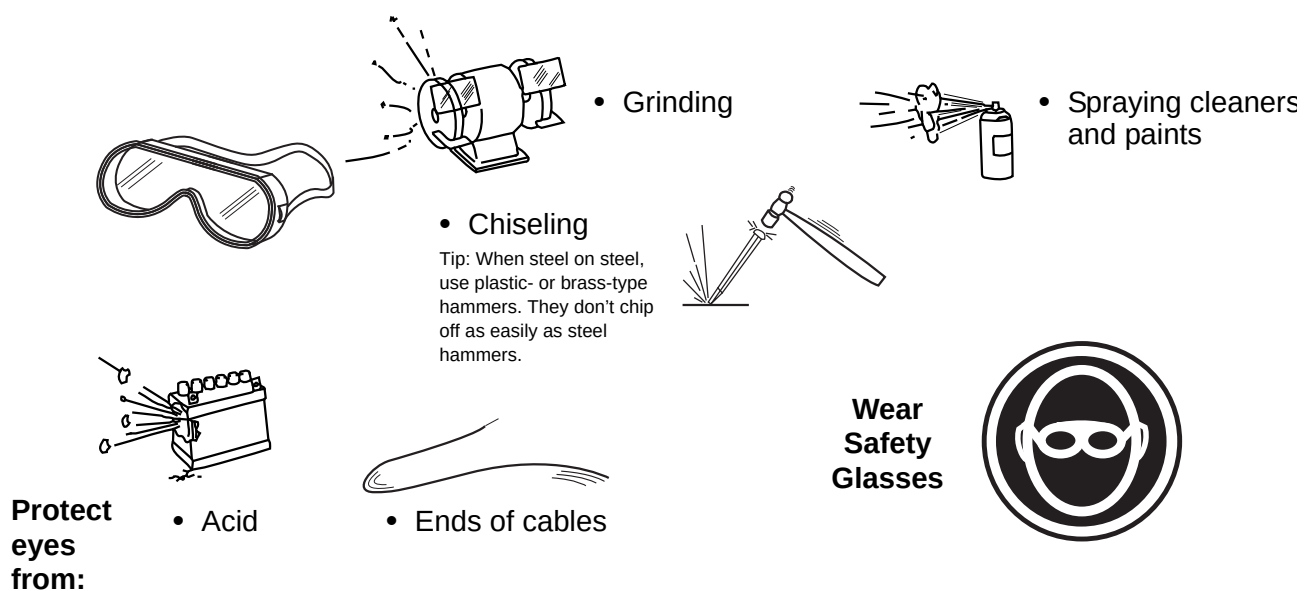
Running outboards: Propellers

⚠ DANGER

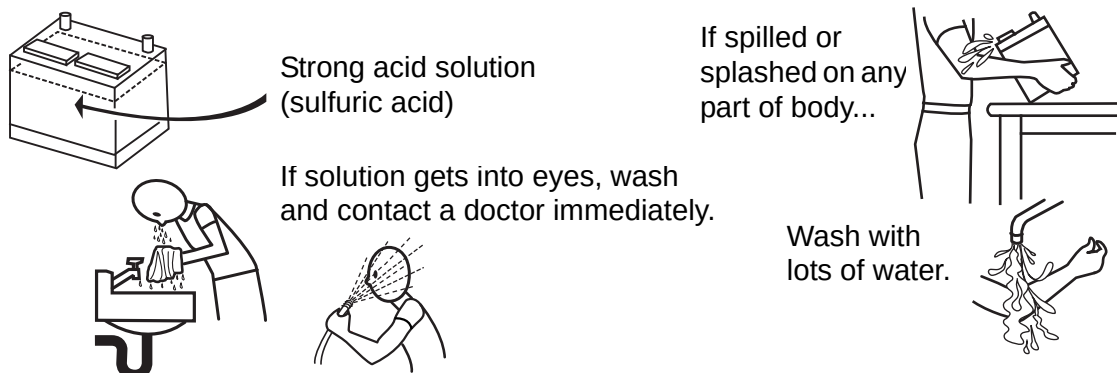
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

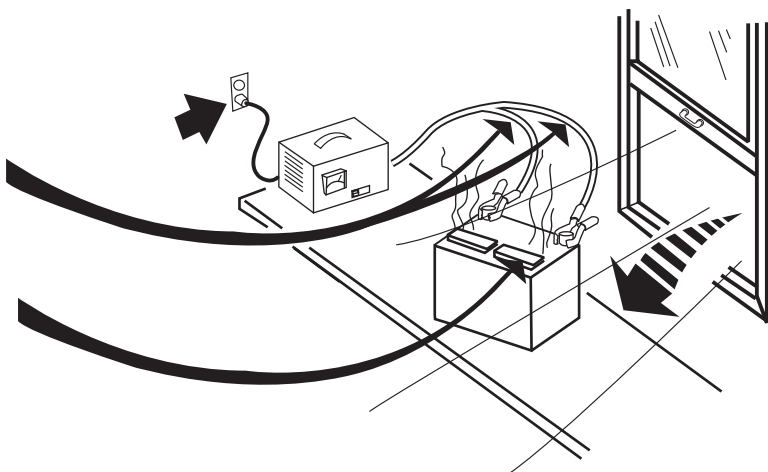


Handling Lead/Acid Batteries



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**.



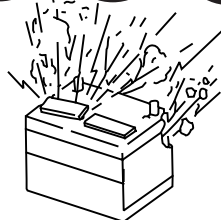
Battery gas is explosive!

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

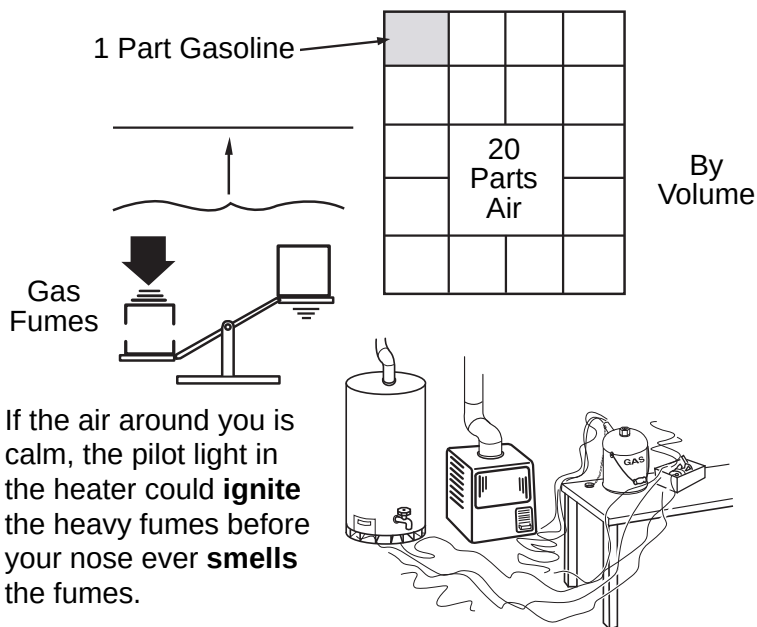
Marine Products and the Safety of People Who Fix Them

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.

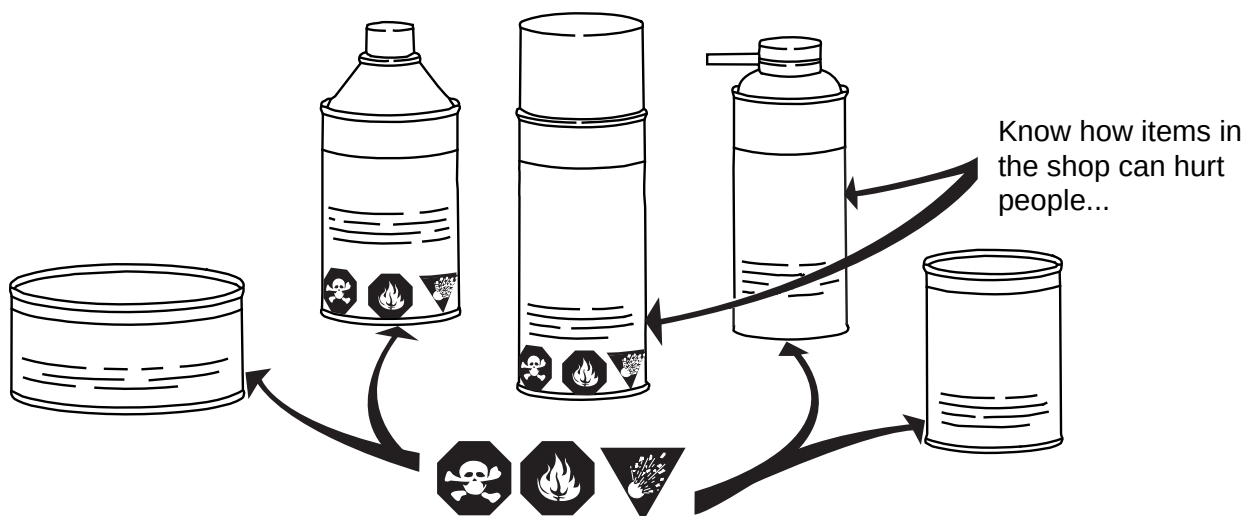
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel **ONLY**, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **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

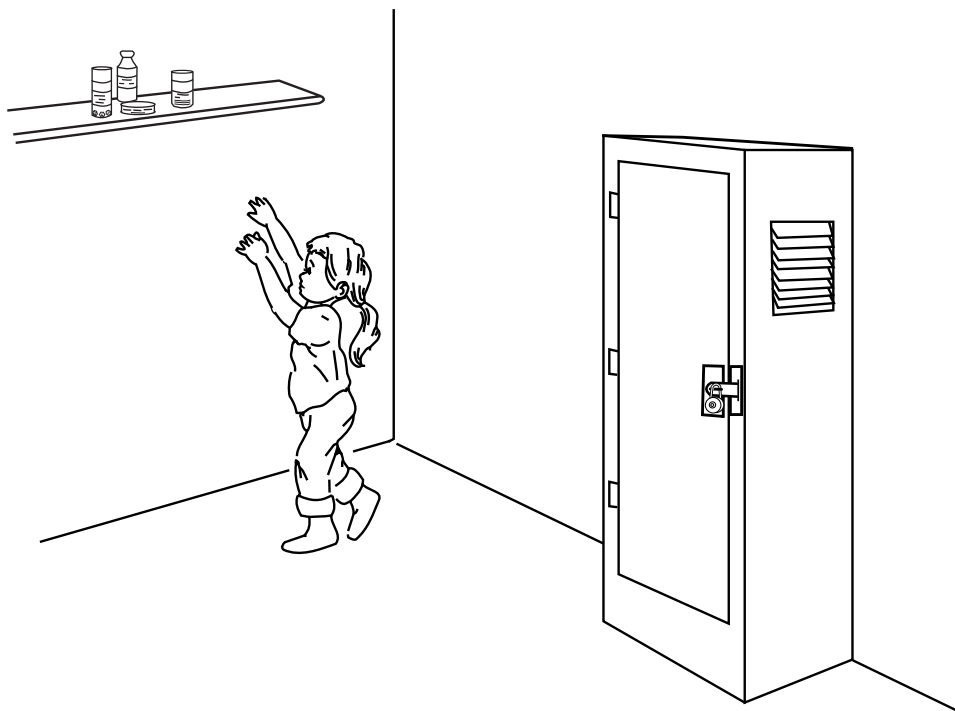


READ

- "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?

Trouble Check Chart

Outboard Will Not Start

T

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	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

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 anti-siphon valve, and fuel pick-up. Prime fuel system 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 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

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).
	<i>EMM</i> 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 v 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 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> fault codes and check SystemCheck 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 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

Trouble Check Chart

Outboard Surges, Runs Rough

Outboard Surges, Runs Rough

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
1200 RPM and above	<i>S.A.F.E.</i>	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 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
	Propping	Change propeller type or size as needed
Audible noise	Internal powerhead damage	Check and repair as needed
	Damaged gearcase	Inspect gearcase and lubricate

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