

EVINRUDE®



MFE Technical Manual



BRP US Inc.
Technical Publications
250 Sea Horse Drive
Waukegan, Illinois 60085 United States



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<i>I-Command</i> ™	<i>DPL</i> ™ Lubricant
<i>Evinrude</i> ® <i>ICON</i> ™	<i>2+4</i> ® Fuel Conditioner
<i>Evinrude</i> ® / <i>Johnson</i> ® <i>XD30</i> ™ Outboard Oil	<i>Carbon Guard</i> ™
<i>Evinrude</i> ® / <i>Johnson</i> ® <i>XD50</i> ™ Outboard Oil	<i>HPF XR</i> ™ Gearcase Lubricant
<i>Evinrude</i> ® / <i>Johnson</i> ® <i>XD100</i> ™ Outboard Oil	<i>HPF PRO</i> ™ Gearcase Lubricant
<i>Gel-Seal II</i> ™	

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SAFETY NOTICE

Before working on any part of the outboard, read the following **SAFETY** information.

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

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



DANGER

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



WARNING

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



CAUTION

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

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

These safety alert signal words mean:

ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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

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

Torque wrench tightening specifications must strictly be adhered to.

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

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

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

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

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

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

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

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



DANGER

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

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



WARNING

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

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

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

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

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

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

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

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

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

Always work in a well ventilated area.

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

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

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.

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

Manufacturer's Responsibility

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

Dealer's Responsibility

When performing service on all 1999 and more recent *Evinrude/Johnson* outboards that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

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

Owner's Responsibility

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

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

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

EPA Emission Regulations

All new 1999 and more recent *Evinrude/Johnson* outboards are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new watercraft marine spark ignition outboards. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practical, returned to the original intent of the design. The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

VIA U.S. POSTAL SERVICE:

Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

VIA EXPRESS or COURIER MAIL:

Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
501 3rd St. NW
Washington, DC 20001

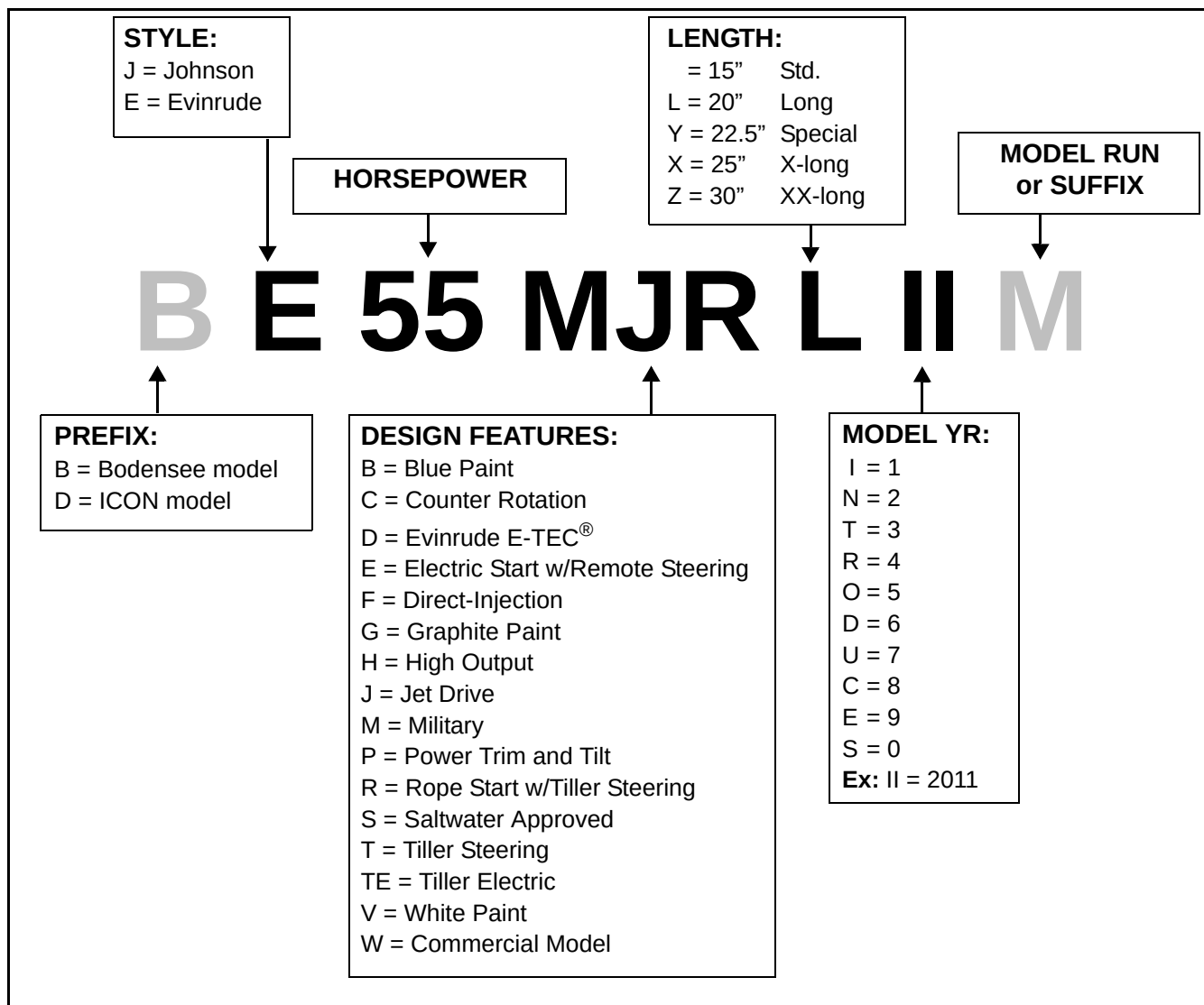
EPA INTERNET WEB SITE:

www.epa.gov

REFERENCE INFORMATION

MODEL DESIGNATION

MODEL DESIGNATION



MODELS COVERED IN THIS MANUAL

This manual covers service information on all 52.7 cubic inch (.86 L), 2-cylinder, *Evinrude MFE 55* models.

Model Number	Start	Shaft	Drive
E55MRLIIM	Rope	20"	Propeller
E55MJRLIIM	Rope	20"	Jet Pump

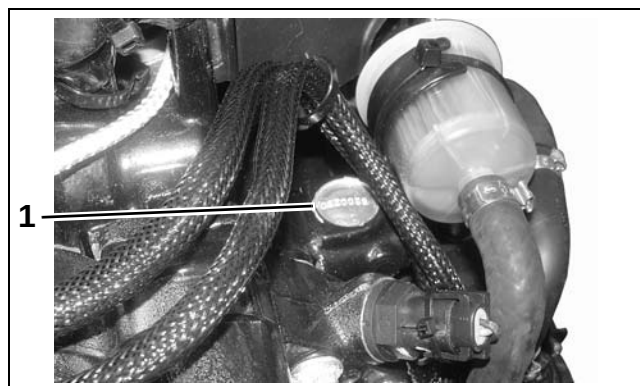
Identifying Model and Serial Numbers

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



1. Model and serial number

006611



1. Serial number

006610

SERVICE SPECIFICATIONS

MFE 55 Models		
ENGINE	Full Throttle Operating Range RPM	55 HP – 5500 to 6000 RPM
	Power	55 HP (41 kw) @ 5750 RPM
	Idle RPM in Neutral	750 ± 50 EMM Controlled
	Weight	MRL - 250 lbs. (113 kg) MJRL - 270 lbs. (122 kg))
	Lubrication	Evinrude/Johnson XD100
	Engine Type	In-line, 2 Cylinder, Two-Cycle
	Displacement	52.7 cu. in. (864 cc)
	Bore	3.601 in (91.47 mm)
	Stroke	2.588 in. (65.74 mm)
	Standard Bore	3.6005 to 3.6015 in. (91.45 to 91.48 mm)
	Top Crankshaft Journal	2.1870 to 2.1875 in. (55.55 to 55.56 mm)
	Center Crankshaft Journal	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	1.3757 to 1.3762 in. (34.94 to 34.96 mm)
	Piston Ring End Gap, Both	0.011 to 0.023 in. (0.28 to 0.58 mm)
FUEL	Fuel/Oil Control	EMM Controlled
	Starting Enrichment	EMM Controlled
	Minimum (High) Fuel Pressure	24 to 28 psi (165 to 193 kPa)
	Minimum Fuel Lift Pump Pressure	3 psi (21 kPa)
	Maximum Fuel Inlet Vacuum	4 in. Hg.
	Heavy Fuels	JP5, JP8, Jet A, Kerosene
	Gasoline Based Fuels	Gasoline, Gasohol, 87AKI (R+M)/2 or 90 RON minimum
	Emergency Fuel	Diesel DFM-F76, BioDiesel IMPORTANT: If outboard must be run on diesel, it should then be run on gasoline to clean internal components. See Fuel Requirements on p. 37 for additional information
	Additives	2+4 [®] Fuel Conditioner, Fuel System Cleaner Use of other additives may result in engine damage. See Fuel Requirements on p. 37 for additional information

MFE 55 Models		
ELECTRICAL	Minimum Battery Requirements	(with Electric Start Kit) 640 CCA (800 MCA) or 800 CCA (1000 MCA) below 32° F (0° C)
	Alternator	55-Amp system current 25-Amp available for battery charging
	Tachometer Setting	6 pulse (12 pole)
	Engine Fuse	P/N 967545 – 10 A
COOLING	Thermostat	143°F (62°C)
	Maximum Temperature	212°F (100°C)
	Water pressure	12 to 14 psi @ 5000 RPM
IGNITION	Type	Capacitor Discharge
	Firing Order	1-2
	Ignition Timing	EMM Controlled
	RPM Limit in Gear	6250
	RPM Limit in Neutral	1800
	Crankshaft Position Sensor Air Gap	Fixed
	Spark Plug	Refer to Emission Control Information Label <i>Champion</i> [†] QC10WEP @ 0.028 ± .003 in. (0.76 mm)
GEARCASE	Gear Ratio	12:32 (.375)
	Lubricant	<i>HPF PRO Gearcase Lube</i>
	Capacity	22 fl. oz. (650 ml)
	Shift Rod Height	21.38 (543 mm) ± one-half turn
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD

REFERENCE INFORMATION

STANDARD TORQUE SPECIFICATIONS

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/Johnson Genuine Parts*.

PRODUCT REFERENCE AND ILLUSTRATIONS

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

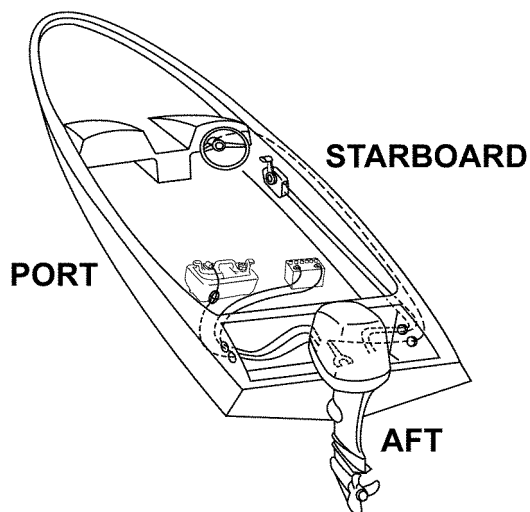
The continuing accuracy of this manual cannot be guaranteed.

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

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

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

FORWARD



Nautical Orientation

006411

SERVICE TOOLS and SHOP AIDS

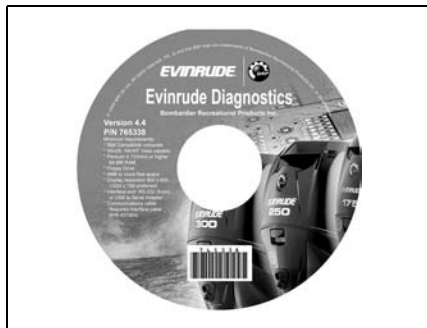
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SERVICE TOOLS AND SHOP AIDS

DIAGNOSTIC TOOLS

DIAGNOSTIC TOOLS



Diagnostic Software P/N 765338 765338



Diagnostic power supply P/N 587005 587005



Bootstrap tool P/N 586551 002276



Accessory Power Cable Kit P/N 5008092 5008092

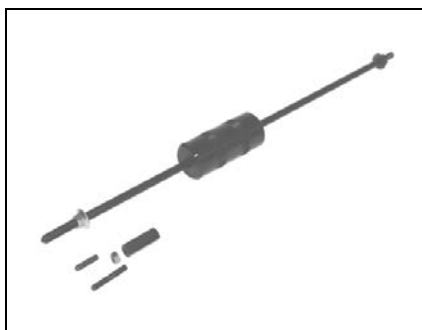


Interface cable P/N 437955 45583

UNIVERSAL TOOLS



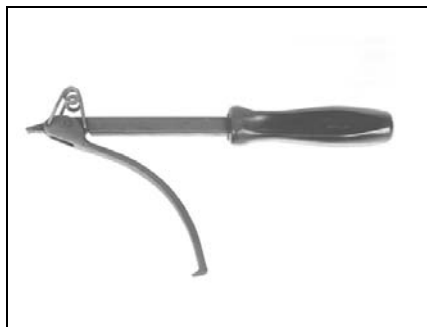
Universal Puller Set P/N 378103 32885



Slide hammer P/N 391008 CO1577



Slide hammer P/N 432128 15345



Flywheel holder P/N 771311 42938



Slide hammer adapter P/N 390898 15356



Lifting ring assembly P/N 396748 000669

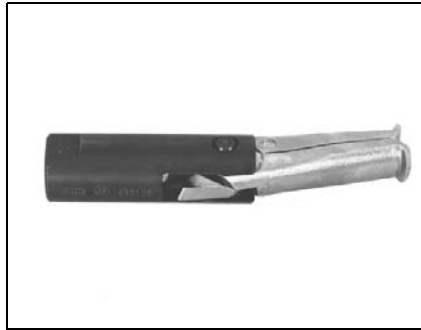
SERVICE TOOLS AND SHOP AIDS

UNIVERSAL TOOLS

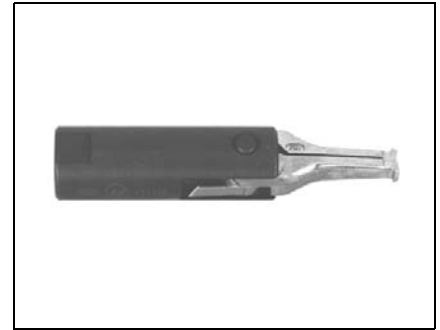
2



Small puller jaws P/N 432131 23150



Large puller jaws P/N 432129 23148



Bearing puller jaws P/N 432130 23149



Puller Bridge - 432127 23146



Syringe P/N 346936 50243



Oetiker⁺ pincers, P/N 350860 001081



Remover, ball socket P/N 342226 002584



Installer, ball socket P/N 342225 002583

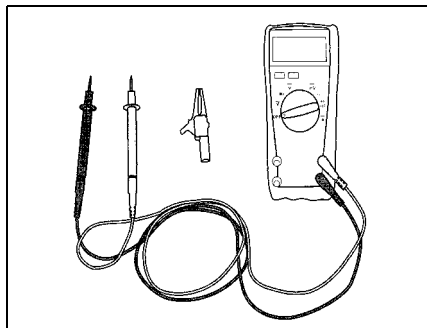


Twist-Grip™ Remover P/N 390767 COA6017



Temperature gun P/N 772018 45240

ELECTRICAL / IGNITION TOOLS



Digital multimeter DRC7265
 Ohms resolution 0.01
 Purchase through local supplier



Peak reading voltmeter 49799
 P/N 507972



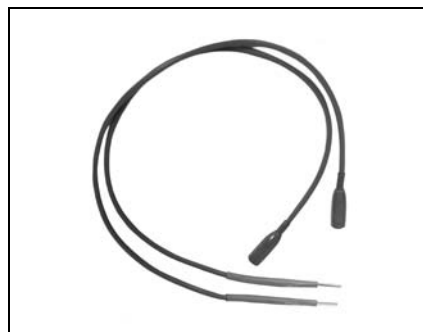
Tachometer/timing light P/N 775389 49789



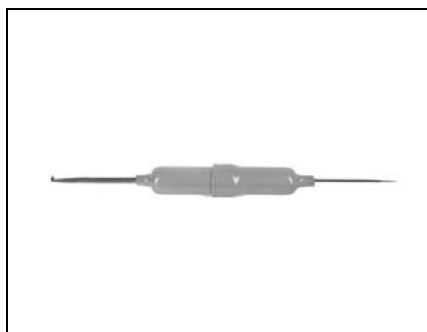
Stator Test Adapter P/N 5005799 002273



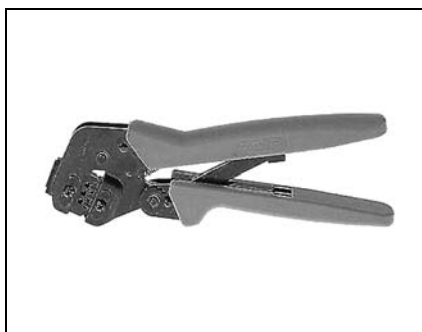
Crimping pliers P/N 322696 30387



Test probe kit P/N 342677 45241



Connector tool P/N 342667 42004

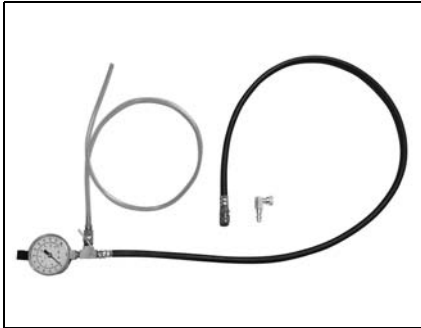


AMP Crimping Tool, P/N 777281 005514
 Replacement dies, P/N 777282



AMP⁺ connector tools 002277
 Primary Lock Tool P/N 777077
 Secondary Lock Tool P/N 777078
 Release Tool P/N 351413
 Lock Installer P/N 777079

FUEL /OIL SYSTEM TOOLS



Fuel pressure gauge (60 PSI) 005339
P/N 5007100
90° fitting, P/N 353322



Fuel pressure gauge (15 PSI) 004560
P/N 5006397
90° fitting, P/N 353322

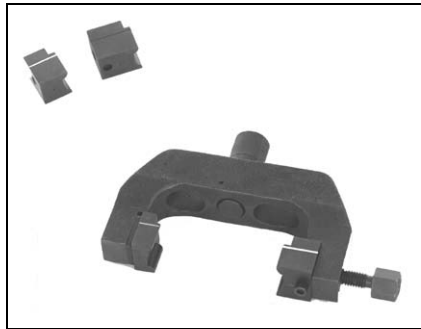


Injector Test Fitting Kit 002465
P/N 5005844

POWERHEAD TOOLS



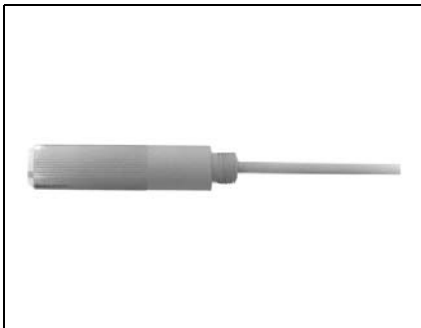
Cylinder bore gauge P/N 775589 45303



Rod cap alignment fixture 21596
P/N 396749



Crankshaft bearing and sleeve installer P/N 338647 21953B



Piston stop tool P/N 342679 46543
Replacement tip P/N 5006098



Torquing socket P/N 331638 000797



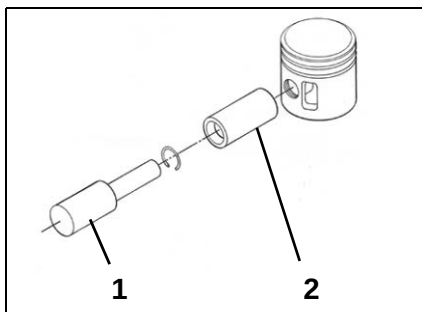
Wrist pin bearing installer 41029
P/N 336660

SERVICE TOOLS AND SHOP AIDS

GEARCASE TOOLS



Wrist pin pressing tool 23668
P/N 326356

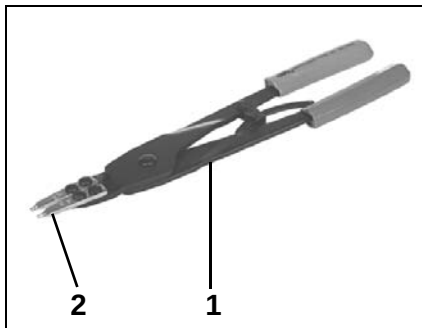


1. Wrist pin retaining ring driver DR1641
P/N 318599
2. Wrist pin cone P/N 318600

GEARCASE TOOLS



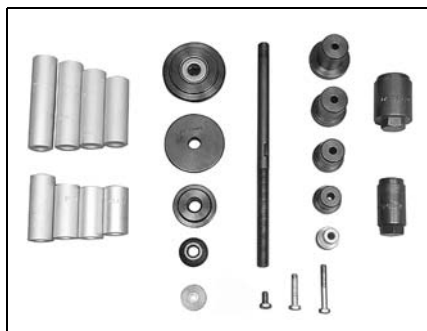
Universal Driveshaft Shimming Tool 002601
P/N 5005925
1. Lower Driveshaft Shimming Bolt
(S2 gearcase) P/N352878



1. Retaining ring pliers 2036
P/N 331045
2. Replacement tip set
P/N 395967



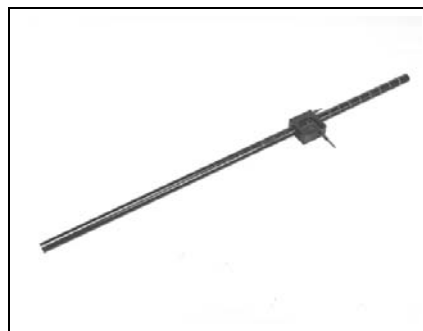
Gearcase pressure tester 49794
P/N 507977 (Stevens P/N S-34)
Gearcase vacuum tester
P/N 507982 (Stevens P/N V-34)



Universal Pinion Bearing Remover and installer kit 002805
P/N 5005927



Gearcase filler 49790
P/N 501882



Universal shift rod height gauge 32872
P/N 389997



Holding Socket P/N 334995 16302



Driveshaft seal protector P/N 312403 23692



Prop shaft housing seal installer P/N 326551 32973



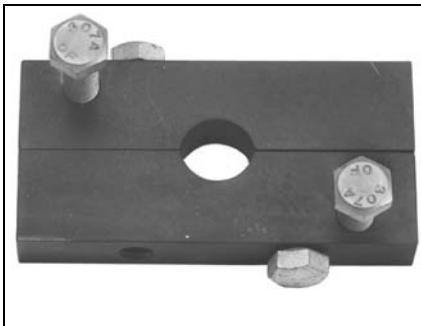
Backing plate P/N 325867 23621



Nut starting tool P/N 320675 40372



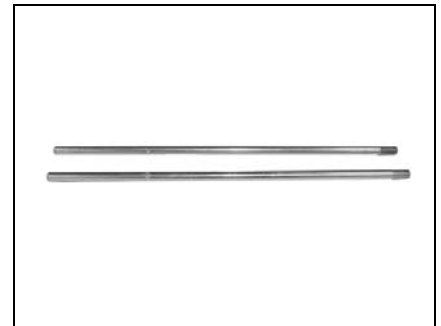
Seal Installer P/N 342665 42233



Puller P/N 387206 47254

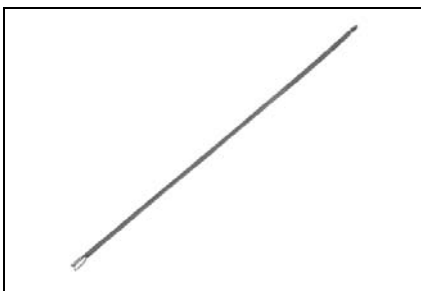


Bearing Installer P/N 326562 32962



Guide rods P/N 383175 000828

MANUAL STARTER TOOLS



Starter rope threading tool P/N 378774 23682



Starter spring winder/installer P/N 392093 CO3583

SERVICE TOOLS AND SHOP AIDS

SHOP AIDS

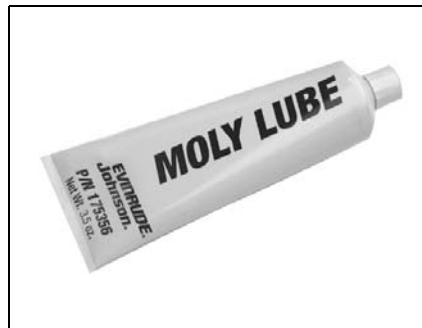
SHOP AIDS



Cleaning Solvent P/N 771087



D.P.L. Spray P/N 777183



Moly Lube P/N 175356



6 in 1 Multi-Purpose Lubricant P/N 777192



Anti-Corrosion Spray P/N 777193



Storage Fogging Oil P/N 777186



Oil - XD100™ P/N 764357



Silicone spray P/N 775630



Lubriplate† 777 P/N 317619



Engine Tuner P/N 777185



HPF PRO Gearcase Lube P/N 778755



Triple-Guard® Grease P/N 508298



Needle Bearing Grease, P/N 378642



2 + 4™ Fuel conditioner P/N 775613



Fuel System Cleaner P/N 763681



Black Neoprene Dip P/N 909570



Gel-Seal and Gasket Remover P/N 771050



Gel-Seal II P/N 327361



Starter Bendix Lube P/N 337016



Permatex† No. 2, P/N 910032



Carbon Guard™ P/N 775629



Electrical Grease P/N 503243



GE† RTV Silicone Sealant P/N 263753



Gasket Sealing Compound P/N 508235

SERVICE TOOLS AND SHOP AIDS

SHOP AIDS



Pipe Sealant with Teflon P/N 910048



Adhesive 847 P/N 776964



Locquic Primer P/N 772032



Thermal Joint Compound P/N 322170



1. Screw Lock P/N 500417
(Loctite⁺ Purple 222 equivalent)
2. Nut Lock P/N 500421
(Loctite Blue 242 Equivalent)
3. Ultra Lock P/N 500423
(Loctite Red 271 Equivalent)

INSTALLATION AND PREDELIVERY

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BOAT RIGGING

Battery Installation

IMPORTANT: MFE 55 models can be used to charge an accessory boat battery by installing a battery cable, P/N 584348, to the existing solenoid on the outboard. Also, electric start capability is available through the installation of Electric Start Kit, P/N 5005580.

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

Battery Recommendations

Outboard Model	Battery Rating
MFE 55 (With electric start kit)	640 CCA (800 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.

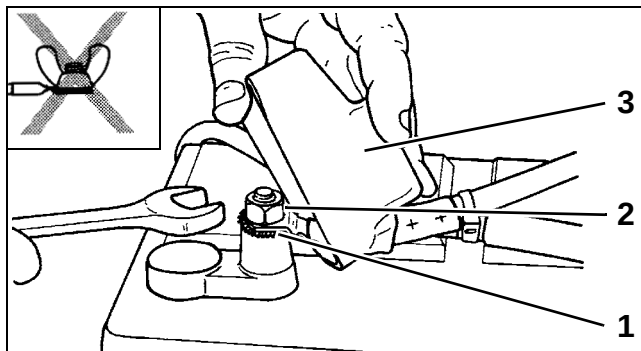
Battery Connections

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.

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

DR5103

1. Starwasher
2. Hex nut
3. Terminal Insulator

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

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

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



WARNING

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

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

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

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

Fuel Hose

All fuel hoses used for rigging outboards manufactured after January 1, 2009 must meet EPA permeation requirements for evaporative emissions.

- Use SAE J30R9, or USCG Type B1-15, fuel hose in motor well areas.
- Use USCG Type A1-15 fuel hose between permanent fuel tanks and motor well fittings in inaccessible routings.
- Compliant hoses are labeled with the applicable specification.



1. Specification
2. Date code

007944

Permanently installed fuel hoses should be as short and horizontal as possible.

Use corrosion-resistant metal clamps on permanently installed fuel hoses.

Multi-outboard applications require separate fuel tank pickups and hoses. (A fuel selector switch may be used for “kicker” motors as long as it has enough flow capacity for the larger outboard.)

Use only fuel lines (or copper tubing) that meet the **Fuel Flow Requirements** for the outboard.

INSTALLATION AND PREDELIVERY

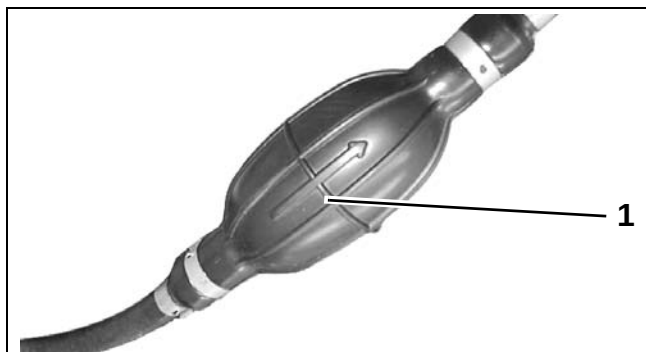
BOAT RIGGING

Fuel System Primer

Outboards require a priming system to refill the fuel system after periods of non-use. The most common priming system is a primer bulb in the fuel supply hose.

Install the primer bulb as follows:

- The primer bulb must meet the same **Fuel Flow Requirements** as the fuel hose.
- The primer bulb should be easily accessible.
- The arrow on the primer bulb must point in the direction of fuel flow.
- The fuel supply hose must allow the primer bulb to be held with the arrow pointing up during priming.



1. Arrow indicates direction of fuel flow

000124

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

Fuel Filters

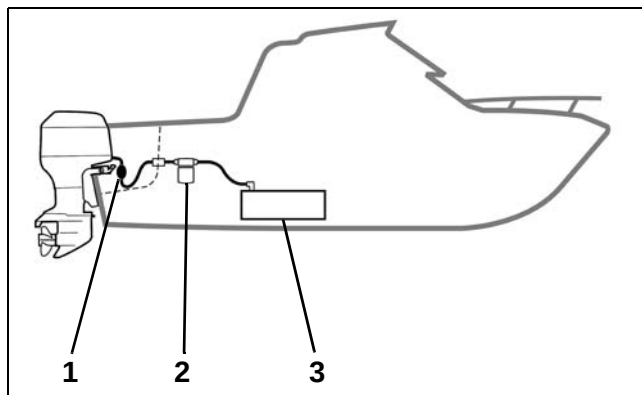
Boat-mounted fuel filters and water-separating fuel filter assemblies must meet the required fuel flow and filter specification. Refer to **Fuel Flow Requirements**.

The filter must be mounted to a rigid surface above the full level of the fuel tank and accessible for servicing.

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



174176



Typical Fuel Supply Configuration

DRC6797

1. Primer bulb
2. Water separating fuel filter
3. Anti-siphon valve, in fuel pick-up of tank

NOTICE Avoid using in-line fuel filters external to the outboard. The filter area and flow characteristics may not be adequate for high horsepower outboards.

Fuel Flow Requirements

Component	<i>MFE 55 Models</i>
Fuel tank pickup tube	5/16 in. (7.9 mm) min. I.D.
Fuel fittings	1/4 in. (6.4 mm) min. I.D.
Fuel supply hoses	5/16 in. (7.9 mm) min. I.D.
Fuel tank pickup screen	100 mesh, 304 grade stainless steel wire, 0.0045 in. wire diameter, 1 in. (25 mm) long
Antisiphon valve	2.5 in. (63.5 mm) Hg maximum pressure drop at 20 gph (76 l/hr) flow
Remote fuel filter	0.4 in. Hg maximum pressure drop at 20 gph (76 l/hr) flow, 150 in. ² (1290 cm ²) of filter area
Maximum fuel pump lift height	Fuel pump should not be located more than 30 in. (76.2 cm) above bottom of fuel tank

Oetiker Clamp Servicing

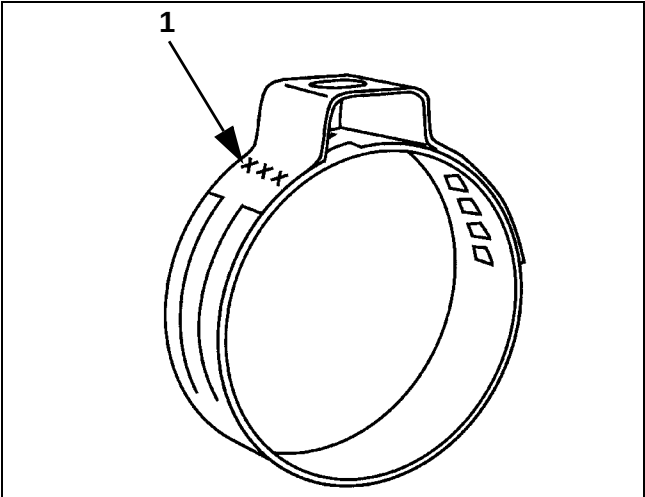
Clamp Identification

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

The selection and installation of an *Oetiker* clamp is essential in the proper sealing of hose connections. The clamp identification numbers appear on the side of the clamp, near the top of the ear. Refer to **Clamp Selection** chart for dimensions.

 **WARNING**

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

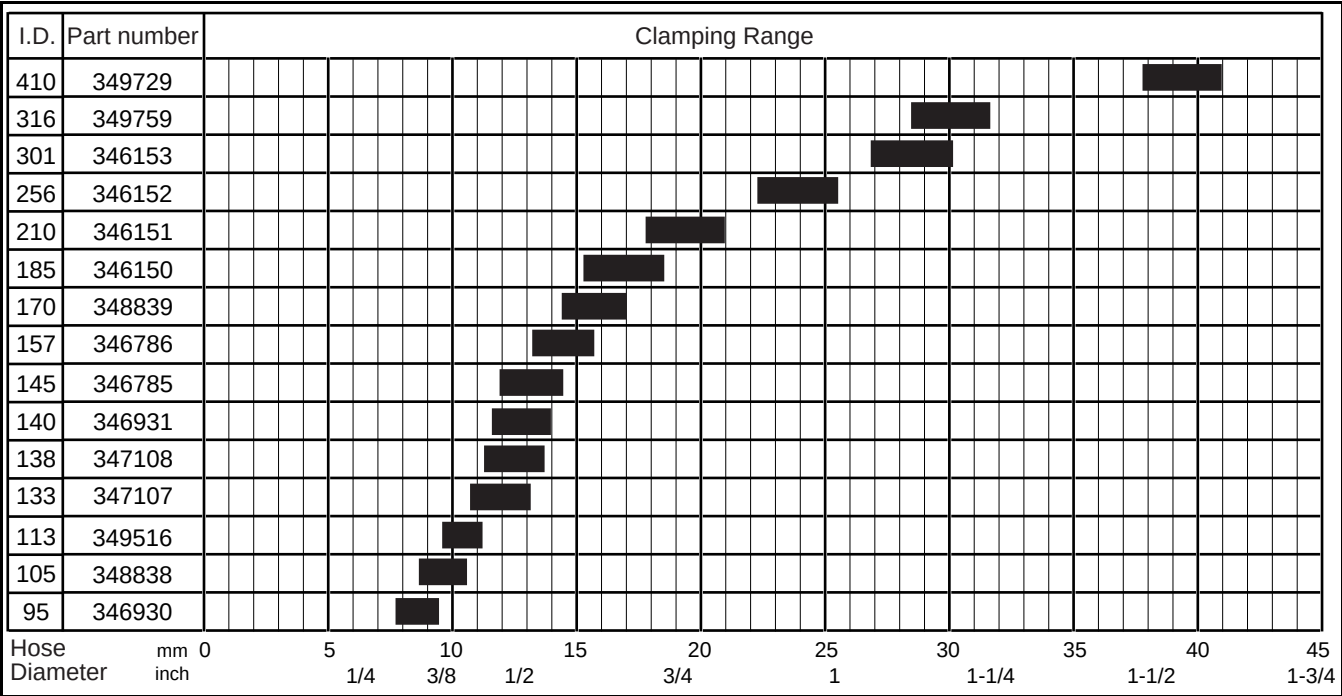


1. Clamp identification numbers 000093

Clamp Selection

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

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



008052

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.

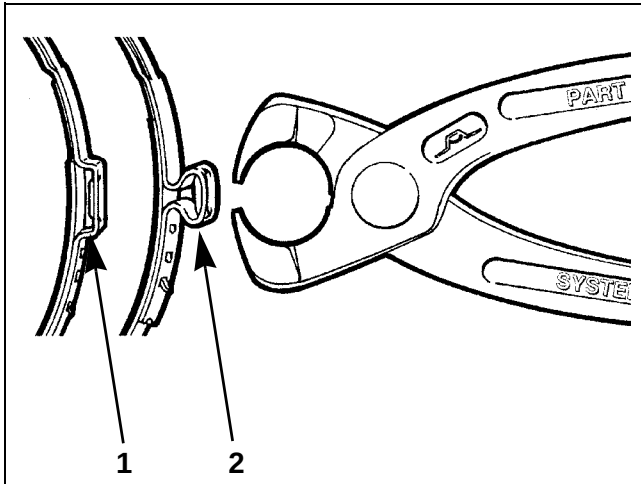
IMPORTANT: Use only *Oetiker* recommended tools to close *Oetiker* stepless clamps.

Oetiker pincers, P/N 350860, are available in the *Evinrude/Johnson Genuine Parts and Accessories Catalog*.



DP0886

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

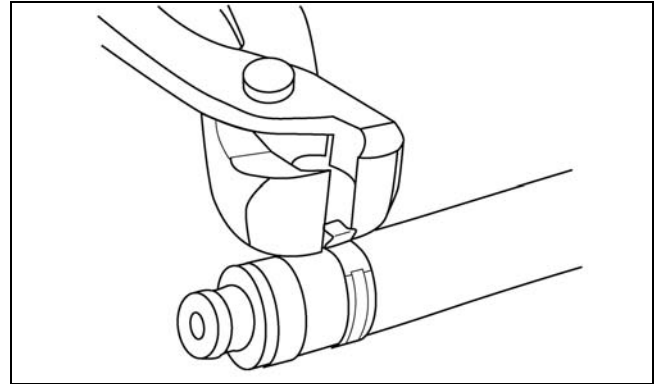


1. Open clamp
2. Closed clamp

000092

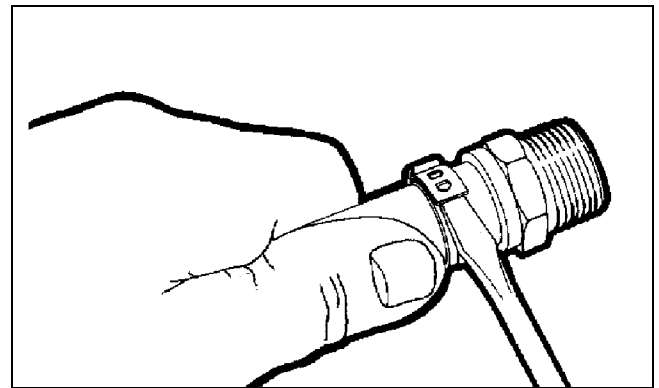
Clamp Removal

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



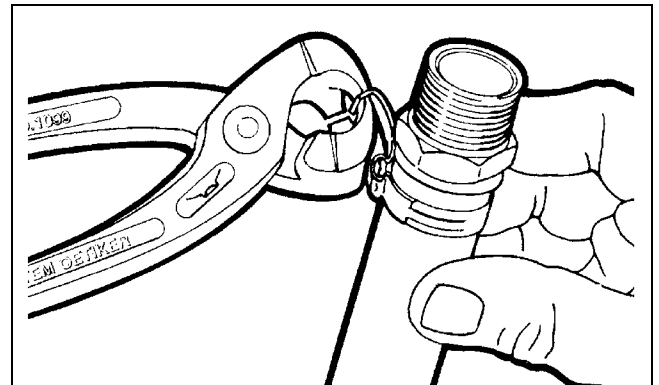
000108

Method 2: Lift end of stepless clamp with screwdriver.



000090

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



000091

OUTBOARD INSTALLATION

Hull Preparation

Maximum Capacity

WARNING

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

Before installing outboard:

- Refer to the boat manufacturer's certification label for maximum horsepower rating.
- Refer to ABYC Standards to determine the maximum horsepower capacity for boats without certification labeling.



1029A

Mounting Surface

Inspect transom surface before mounting outboard.

- The transom should meet ABYC Standards.
- The transom must be flat and cannot have any protrusions.
- The transom angle should be approximately 14 degrees.
- Check transom strength and height.

The stern brackets must contact the flat surface of the transom. Modify trim that prevents the stern brackets from resting against the transom surface. Do not modify stern brackets.

WARNING

DO NOT install an outboard on a curved or irregular surface. Doing so can wear, bind, and damage components, causing loss of control.

Transom Clearances

Make sure the transom and splash well area provide adequate clearances.

- The top edge of the transom should be wide enough to allow full steering travel. The ABYC standard for most single outboard installations is 33 in. (84 cm).
- Check cable and hose routing clearances.
- Make sure there is clearance for mounting bolts and washers. Check the inside area of the transom for obstructions prior to drilling holes.

Water Flow

Inspect the hull area directly in front of the mounting location.

- Boat-mounted equipment should not create turbulence in the water flow directly in front of the outboard's gearcase. Turbulence or disruptions in the water flow directly in front of the gearcase will affect engine cooling and propeller/impeller performance.
- Avoid locating outboard centerlines within 3 in. (76 mm) of bottom strakes on dual-outboard installations.

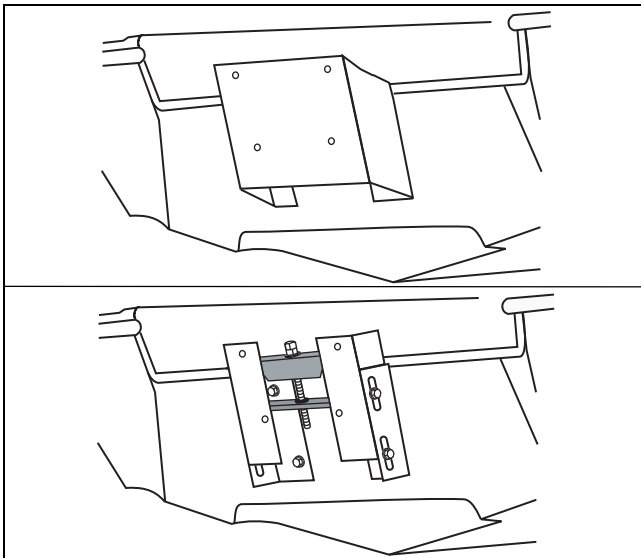
Transom Brackets and Jack Plates

When mounting an outboard on a jack plate:

- Refer to the manufacturer's recommendations for maximum weight and horsepower.
- The jack plate must provide a rigid, one-piece mounting assembly—either a solid surface, or surfaces adequately connected to prevent flexing or twisting.
- DO NOT use a jack plate constructed in two separate pieces—lack of support can twist the stern brackets, wear tilt tube bushings and thrust rollers, and bend or break components.

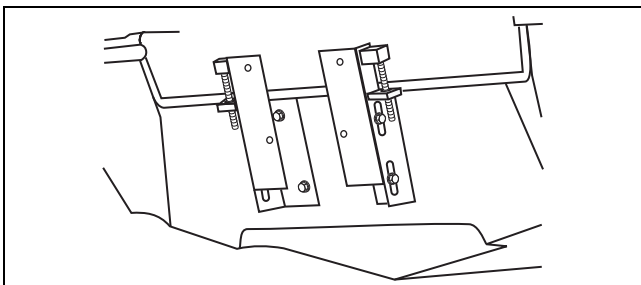
IMPORTANT: Damage caused by use of a two-piece jack plate or unstable mounting surface will not be covered by warranty.

Recommended Designs



007992 007991

Not Recommended



DR5703

Whenever possible, use mounting hardware supplied with the outboard to install jack plate on transom. Tighten to a torque of 40 ft. lbs. (54 N·m).

NOTICE To prevent damage to outboard, check installation frequently for:

- Loose mounting bolts and nuts
- Loose tilt tube or steering cable nuts
- Elongated mounting holes
- Bent or deformed washers

Replace any hardware that fails to maintain torque specifications.

Mounting Hardware

WARNING

Use all mounting hardware supplied with the outboard to help ensure a secure installation. Substituting inferior hardware can result in loss of control.

Outboard mounting hardware must meet minimum specifications for material and strength.

Outboard mounting bolts, backing plates, washers, and nuts are used to attach the outboard to the shipping pallet. If alternate bolt lengths or replacement parts are required, use only *Evinrude/Johnson Genuine Parts*.

IMPORTANT: Standard screws offered by local merchants may not provide the high strength required for outboard installations.

INSTALLATION AND PREDELIVERY

OUTBOARD INSTALLATION

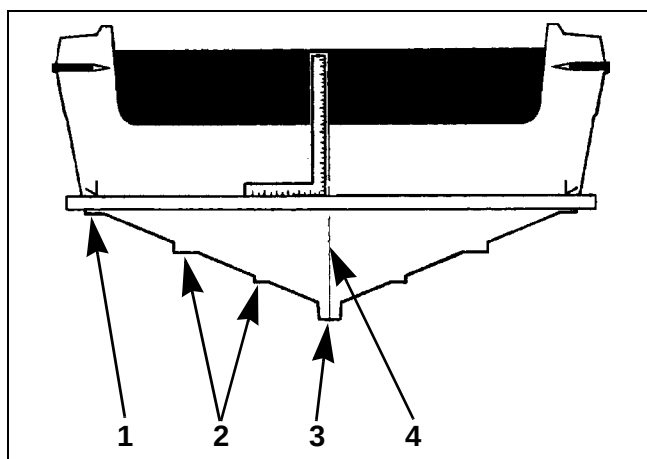
Transom Measuring and Drilling

Hull Centerline

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

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

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



1. Chine
2. Strake
3. Keel
4. Hull centerline

DR5568

Transom Height

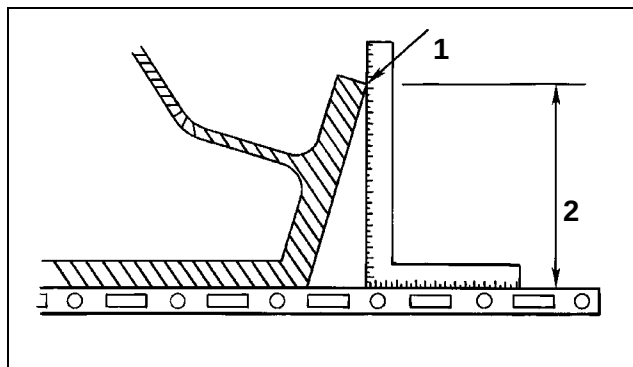
Make sure the transom height matches the length of the outboard to be installed.

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

Determine transom height by measuring from the top edge of the transom, along the centerline.

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

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



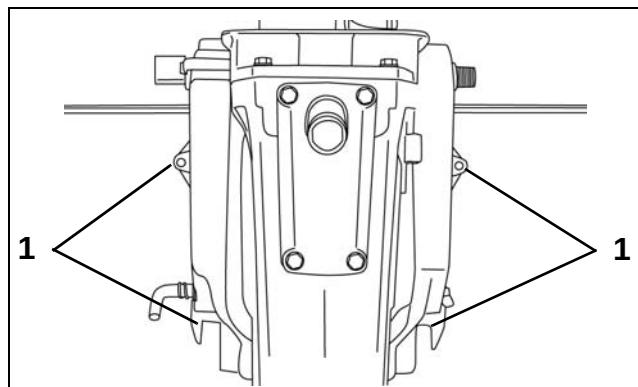
1. Top edge of transom
2. Actual transom height

DR5541

Transom Drilling Locations

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

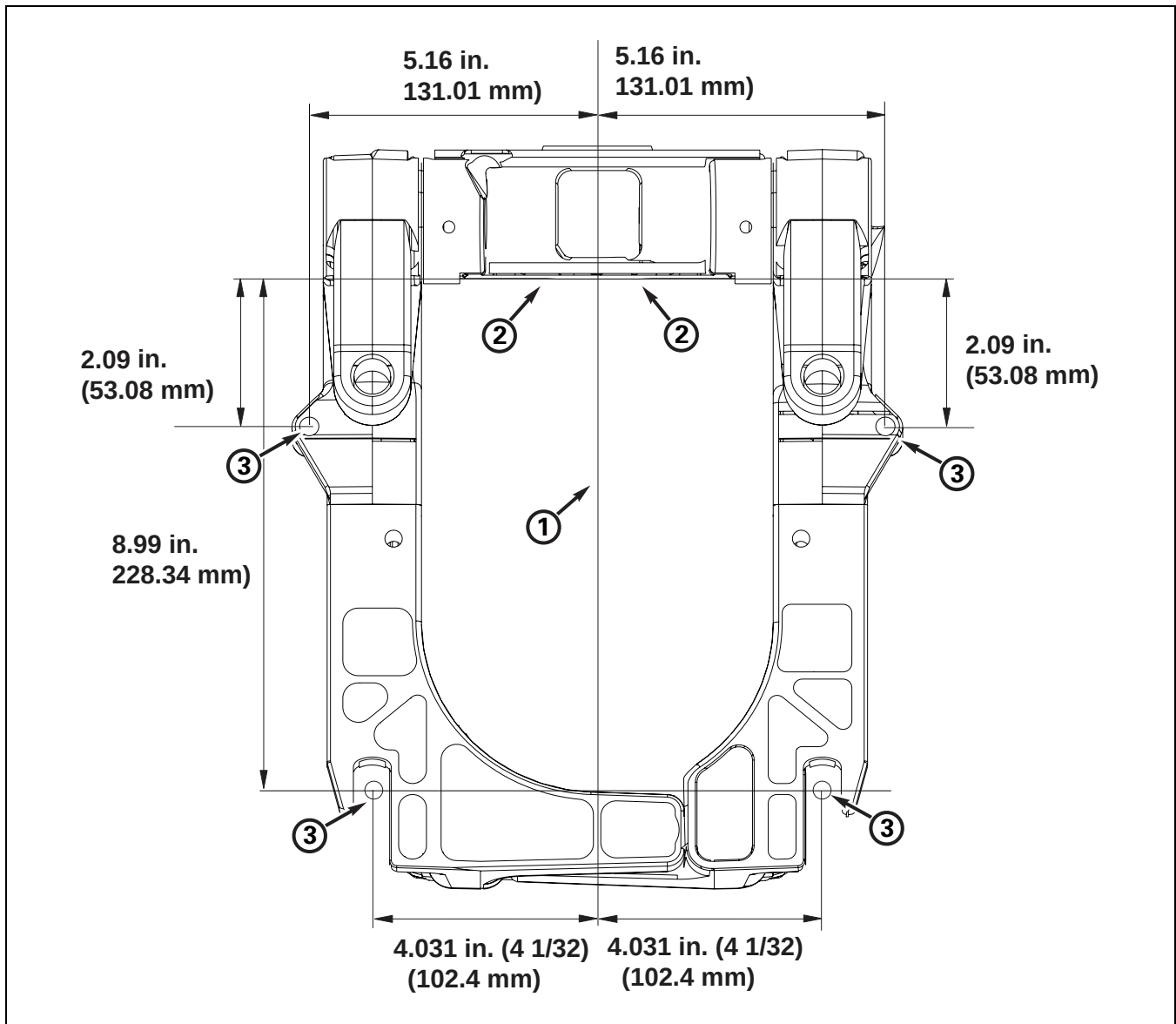
Use each stern bracket's mounting holes as a guide to drill four 11/32 in. (8.7 mm) holes through the transom.



002215

Drilling Diagram

IMPORTANT: This is not a template.

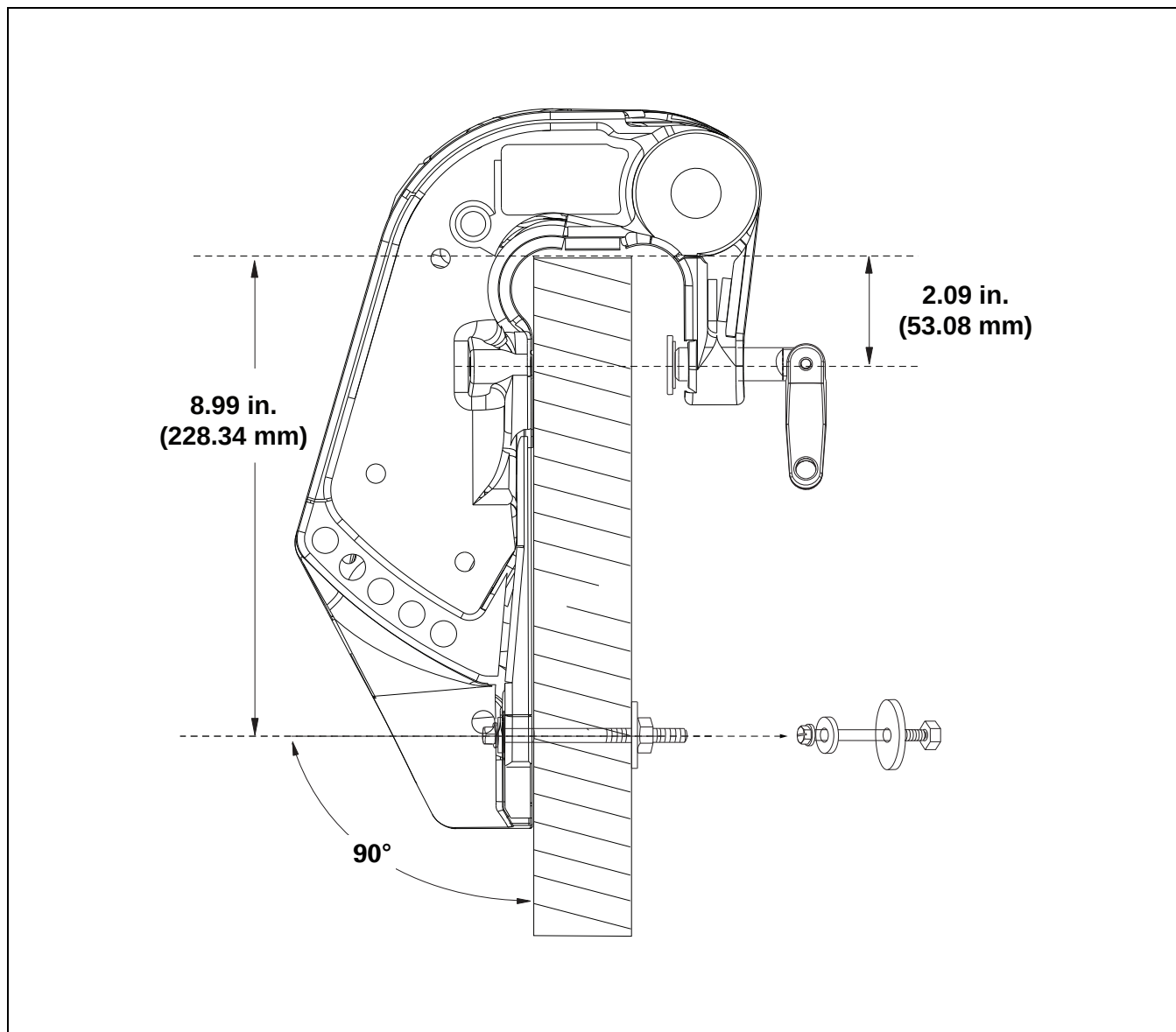


- 1. Center of Transom
- 2. Top of Transom
- 3. 5/16" Bolt Hole Locations

INSTALLATION AND PREDELIVERY

OUTBOARD INSTALLATION

IMPORTANT: This is not a template.



Lifting the Outboard

Lifting Fixtures



WARNING

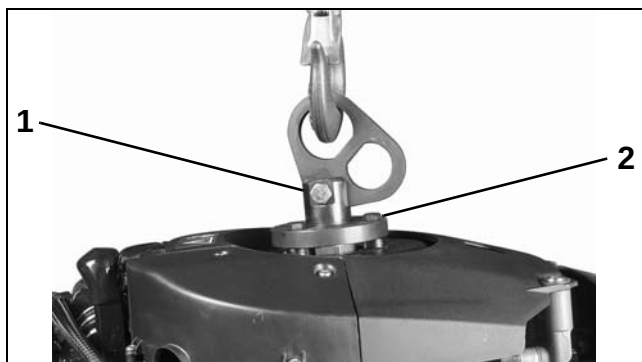
To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.

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

Use correct Lifting Fixture to lift outboard:

Model	Lifting Fixture
MFE 55	P/N 396748 with 1 1/8 in. screws

With recoil starter removed, place lifting tool on flywheel and seat the three screws completely. Refer to **RECOIL STARTER REMOVAL** on p. 265.



1. Lifting fixture
2. 1 1/8 in. screws

002098

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

Fasten appropriate chain hook to eye of tool. Carefully hoist outboard with chain.

Outboard Mounting

Mounting Height

Boat performance depends on outboard mounting height.

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

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

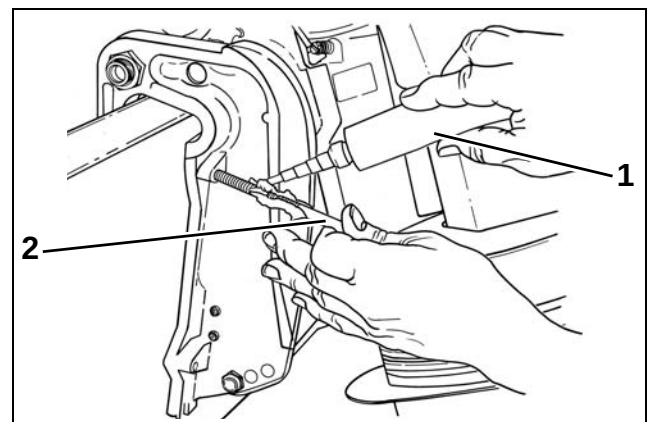
Test outboard and boat performance at different heights until the best performance is achieved.

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

Mounting Bolt Installation

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

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



1. Marine sealer
2. Bolt

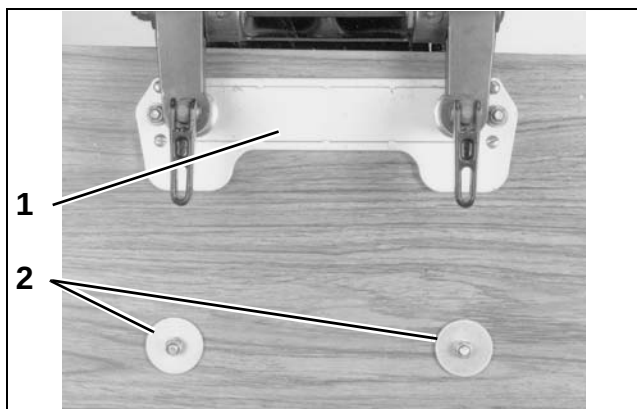
DR26500

INSTALLATION AND PREDELIVERY

OUTBOARD INSTALLATION

Use Transom Mounting Kit, P/N 394219, to protect the transom and help prevent loss of outboard. The kit includes a transom mounting plate and hardware for fastening outboard to transom.

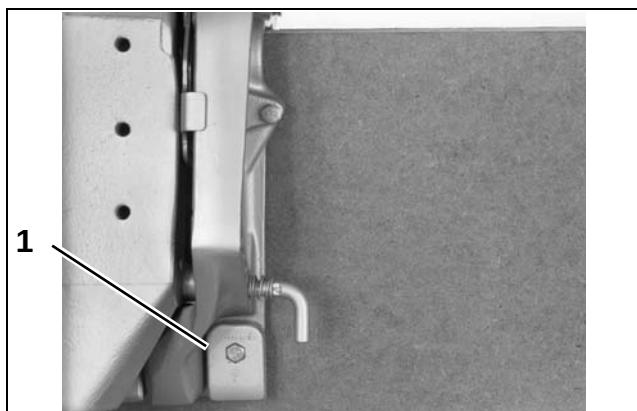
Install the mounting bolts through the stern brackets and transom. Install round backing plates and locknuts onto lower bolts and tighten securely.



1. Transom mounting plate
2. Round backing plates

18961

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



1. Clamp pad

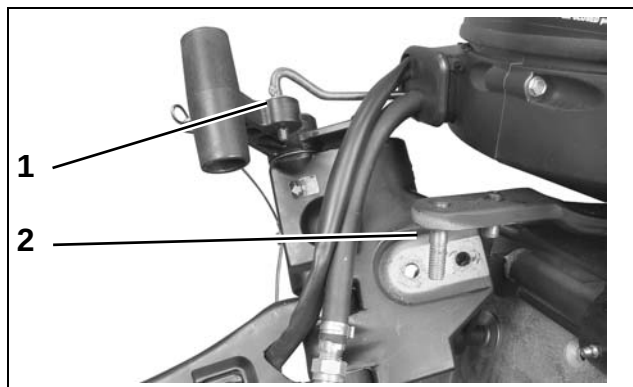
COB2505

Tiller Handle Attachment

The tiller handle can be removed without tools to minimize required storage space.

To attach tiller handle to the outboard:

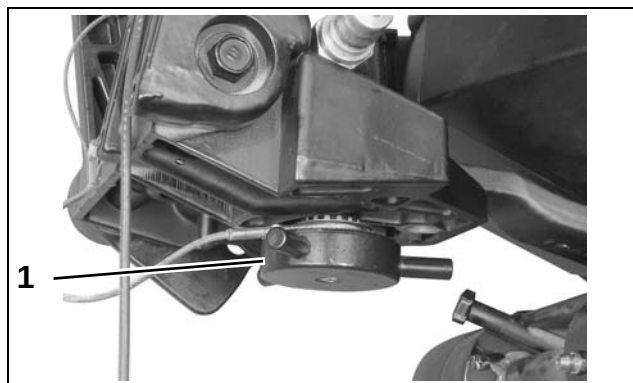
- Place shift rod through shift lever.



1. Shift rod
2. Steering arm studs

006515

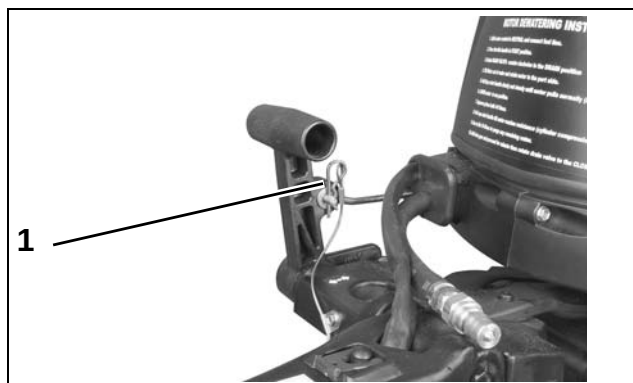
- Place tiller handle bracket on steering arm studs and secure with hand nut.



1. Hand nut

006516

- Install washer and retaining clip on shift rod.



1. Retaining clip

006517

FUEL AND OIL PRIMING

Fuel Requirements



WARNING

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

Always turn off the outboard before fueling.

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

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

Remove portable fuel tanks from the boat before fueling.

Always wipe off any fuel spillage.

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

MFE 55 models are designed to use several different fuel types. Refer to **Fuel Selector Switch** on p. 46.

Heavy Fuels:

Approved heavy fuels include:

- JP5, JP8
- Jet A,
- Kerosene

Gasoline:

Use unleaded automotive gasoline with an octane rating equal to or higher than:

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

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

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

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

Emergency Fuels:

In an emergency situation when no other fuel is available, diesel DFM-E76 or BioDiesel can be used for a maximum of ten hours **ONLY**.

Idle and low speed operation (below 3000 RPM) should be avoided to prevent spark plug fouling when operating on diesel DFM-E76 or BioDiesel.

IMPORTANT: If the outboard **MUST** be run on diesel, it should then be run on gasoline for a minimum of 20 minutes to clean internal engine components. Refer to **DE-CARBONING PROCEDURE** on p. 57.

Fuel Additives (gasoline only)

The only fuel additives approved for use are:

- Evinrude/Johnson 2+4[®] fuel conditioner
- Evinrude/Johnson Fuel System Cleaner

Use of other fuel additives can result in poor performance or engine damage.

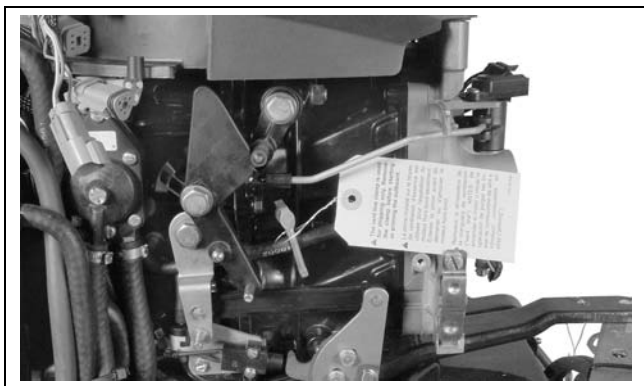
Evinrude/Johnson 2+4 Fuel Conditioner will help prevent gum and varnish deposits and will remove moisture from the fuel system. It can be used continuously and should be used during any period when the outboard is not being operated on a regular basis.

Evinrude/Johnson Fuel System Cleaner helps keep fuel injectors in good condition.

Fuel System Priming

Vent Line Clamp

Federal Regulations require that all outboards with a fuel vapor separator must be shipped with a vent line clamp installed. This clamp must be removed before priming the fuel system or starting the outboard for the first time.



002552

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

Priming the Fuel System

WARNING

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

Connect the fuel hose connector to the quick connect fitting on the outboard.

Use the primer to fill the Vapor separator.

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.

WARNING

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

Oil Requirements

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

Evinrude/Johnson XD100 is the only oil recommended for use with *MFE* models.

If *XD100* oil is not available, an oil that meets NMMA TC-W3 certification may be used in an emergency.

XD100 oil must be used when operating in temperatures under 32°F, (0°C).

Oil Injection Rate

The Engine Management Module (*EMM*) controls the rate of oil injection based on engine RPM. This rate can be adjusted for powerhead break-in. Use *Evinrude Diagnostics* software to access this feature.

Break-In Oiling

IMPORTANT: DO NOT add oil in the fuel tank on *MFE* models.

The *EMM* automatically supplies extra oil to the engine during the first two hours of operation, above 2000 RPM.

Follow these steps for outboard set-up:

- Use *Evinrude Diagnostics* software to make sure the break-in program has been started. Refer to **Oil Control Settings** on p. 89.
- The oil tank should be filled and the oil level marked for reference.

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

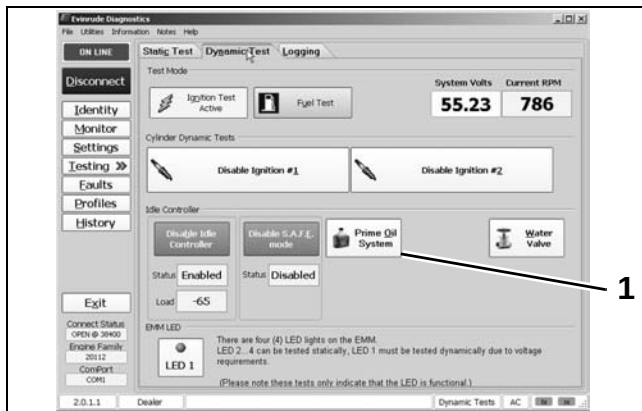
Oil Supply Priming

WARNING

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

IMPORTANT: Refer to **OPERATION** section before running outboard.

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



Dynamic Tests Screen

1. Prime oil button

006546

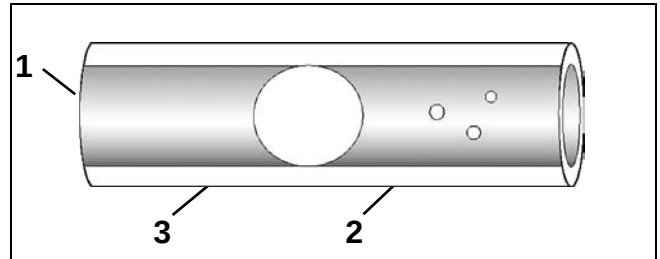
Observe oil flow through the oil distribution hoses.



1. Oil distribution hoses

008343

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



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

004398

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

Repair any oil leaks.

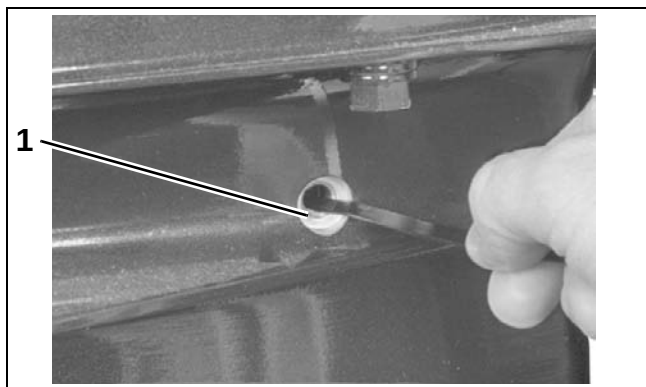
The oiling system can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to **STORAGE** on p. 66.

BEFORE START-UP

Gearcase Lubricant

With outboard vertical, check the gearcase lubricant level:

- Remove the lubricant level plug. Lubricant must be even with the bottom of the threaded hole.
- A clean tie strap can be used as a “dip stick” if the lubricant level is not obvious.
- Add *HPF PRO* gearcase lubricant as needed. Refer to **Gearcase Lubricant** on p. 61.



1. Gearcase lubricant level

000072

Oil Level

Make sure oil tank contains an adequate supply of the correct lubricant for the outboard. Refer to **Oil Requirements** on p. 38.

When starting the outboard for the first time, refer to **Oil Supply Priming** on p. 39.

RUNNING CHECKS

⚠ WARNING

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

⚠ DANGER

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

⚠ DANGER

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

IMPORTANT: Refer to **OPERATION** section before running outboard.

Fuel System

Perform running checks of the fuel system by following these steps:

- Squeeze fuel primer bulb until hard or activate electric primer. Observe all fuel hoses and connections. Repair any leaks.
- Start outboard. Inspect all hoses and connections. Repair any leaks or misrouted hoses immediately.

Emergency Stop Switch

Check emergency stop function. With outboard running at IDLE, pull safety lanyard from emergency stop switch. Outboard must stop immediately.

Control Operation

Make sure that controls can be easily moved into all gear and throttle settings. Do not shift when outboard is not running.

Start-In-Gear Prevention

WARNING

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

Start outboard and shift to FORWARD.

Turn outboard OFF while control is in FORWARD.

Try to restart the outboard. Outboard should not start.

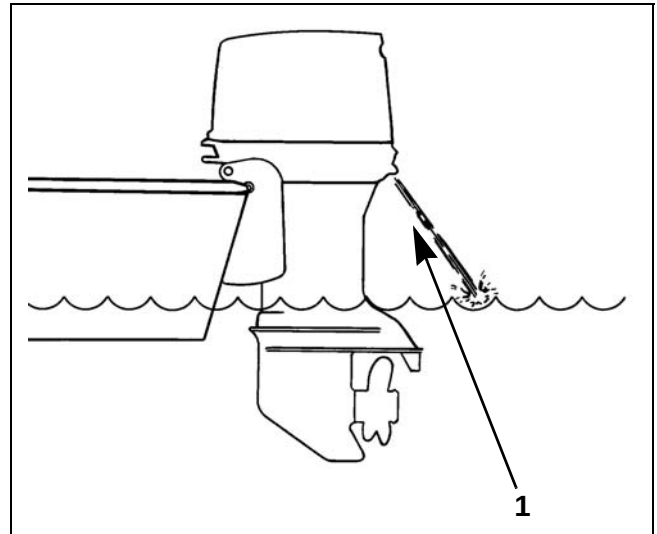
Shift back to NEUTRAL and restart outboard.

Shift to REVERSE. Turn outboard OFF while control is in REVERSE.

Try to restart the outboard. Outboard should not start.

Water Pump Overboard Indicator

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



1. Water pump overboard indicator

DRC4952

Operating Temperature

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

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

New *MFE* models are delivered ready to run from the factory and require no additional break-in by the operator.

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

Use the diagnostics software program to confirm that the break-in program has been started. Refer to **Oil Control Settings** on p. 89.

PROPELLERS – MRL Models

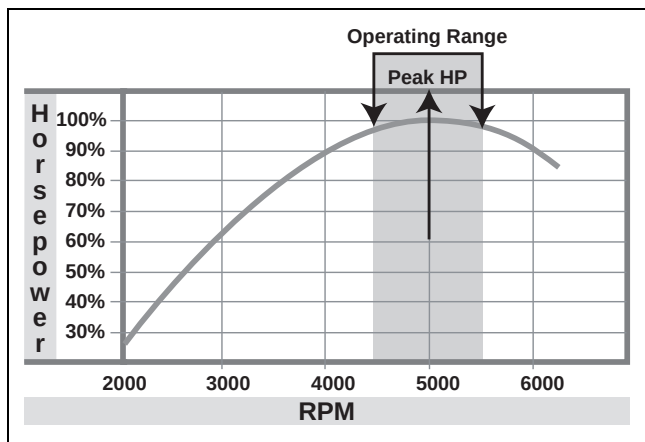
Propeller Selection

⚠ CAUTION

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

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

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



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 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 — heavy loads 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.

Propeller Hardware Installation

⚠ WARNING

To prevent accidental starting while servicing, twist and remove all spark plug leads.

Refer to **IMPELLER SERVICE, MJRL MODELS** on p. 236 for jet pump models.

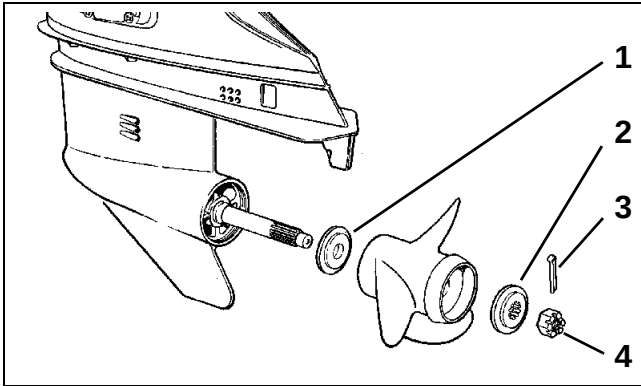
Apply *Triple Guard* grease to the entire propeller shaft before installing the propeller.

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

If installing a propeller with an interchangeable hub, assemble the propeller following instructions provided with the propeller.

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

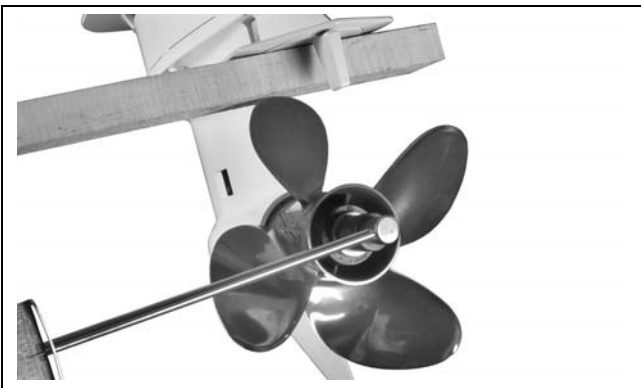
Install the spacer over the propeller shaft splines.



1. Thrust bushing
2. Spacer
3. Cotter pin
4. Propeller Nut

CO2917

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



001992

Install the propeller nut and tighten to a torque of:

- 120 to 144 in. lbs. (13.5 to 16.5 N·m)

If cotter pin holes in the nut and shaft do not align, tighten further. Do not loosen.

Install new cotter pin.

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.

WATER TEST AND FINAL 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 repowered with new outboard(s):

- Engine mounting height
- Correct propeller selection and WOT RPM

Make all needed adjustments or repairs and retest before delivery.

Engine Mounting Height 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 and repeat the process until the best acceleration and boat speed are achieved.

Fuel System Vacuum

Test boat fuel system vacuum. Refer to **Lift Pump Vacuum Test** on p. 142. 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.

INSTALLATION AND PREDELIVERY

WATER TEST AND FINAL ADJUSTMENTS

Trim Tab Adjustment (MRL)

WARNING

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

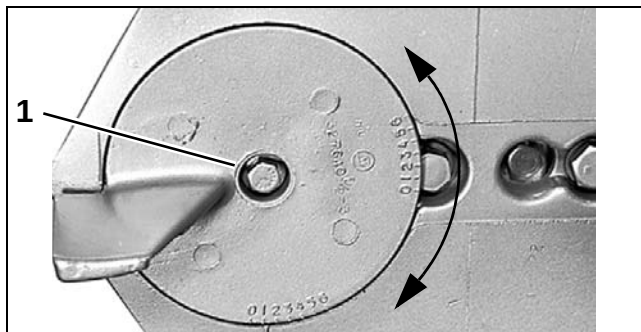
A propeller will generate steering torque when the propeller shaft is not running parallel to the water's surface. The trim tab is adjustable to compensate for this steering torque.

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

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

- With the engine OFF, loosen the trim tab screw. If the boat pulled to the right, move rear of the trim tab slightly to the right. If the boat pulled to the left, move rear of the trim tab slightly to the left.

- Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47.5 to 54 N·m).



1. Trim tab screw

COA3663

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

Outboards with High Transom Heights

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

OPERATION

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STARTING THE ENGINE

⚠ WARNING

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

⚠ DANGER

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

⚠ DANGER

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

Fuel Requirements

IMPORTANT: Refer to:

- **Fuel Requirements** on p. 37
- **Fuel System Priming** on p. 38

Oil Requirements

IMPORTANT: Refer to:

- **Oil Requirements** on p. 38
- **Oil Supply Priming** on p. 39

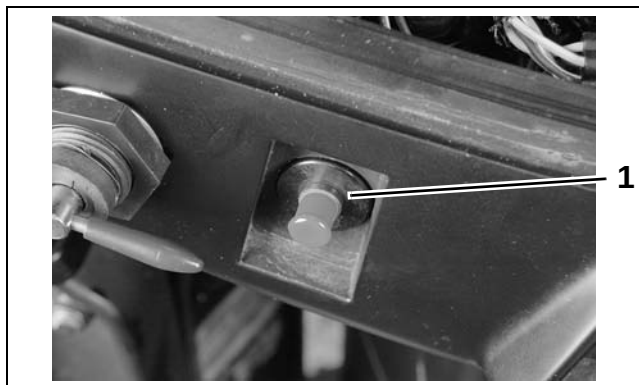
Fuel Selector Switch

⚠ CAUTION

Operation with the fuel selector switch in the wrong position could cause internal engine damage not covered by the outboard's limited warranty.

The Engine Management Module (*EMM*) includes programs to allowing the engine to run on several types of fuel. You **MUST** select the correct program for the fuel being used.

- To use jet fuel or kerosene (Heavy Fuel), press the fuel selector switch IN.
- To use gasoline, pull the fuel selector switch OUT to expose the red indicator ring.



1. Fuel selector switch OUT (red line showing).

007839

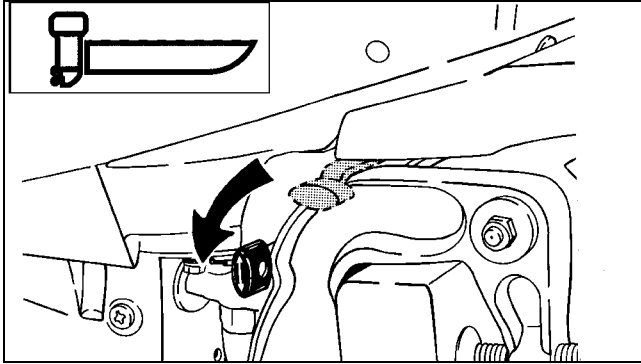
When switching from one fuel to another:

- Connect the fuel supply hose to the desired fuel supply.
- Adjust the selector switch for the new fuel.
- Restart the engine to reset the *EMM*—changing the switch has no effect while the engine is running.
- The *EMM* calculates when the previous fuel remaining in the engine has been used and switches the program at that time.
- The engine may run noticeably rough during the transition period.

IMPORTANT: Diesel is an emergency fuel **ONLY**. If diesel must be used, the fuel selector switch should be in the Heavy Fuel position.

Starting Procedure

Move the tilt/run lever to RUN position. Place motor in normal operating position.



DR4407A

Select the correct *EMM* fuel map for the fuel being used. Refer to **Fuel Selector Switch** on p. 46.

Snap fuel line connector onto engine connector.



005068

Squeeze fuel line primer bulb, outlet end up, until firm.



30924

IMPORTANT: If the fuel tank has a manual vent, be sure it is open.

Connect the clip and lanyard assembly to the emergency stop switch. Clip must be installed to start engine. Snap the lanyard to a secure place on the operator's clothing. An extra clip is stored on the steering arm.



1. Emergency stop switch
2. Extra clip

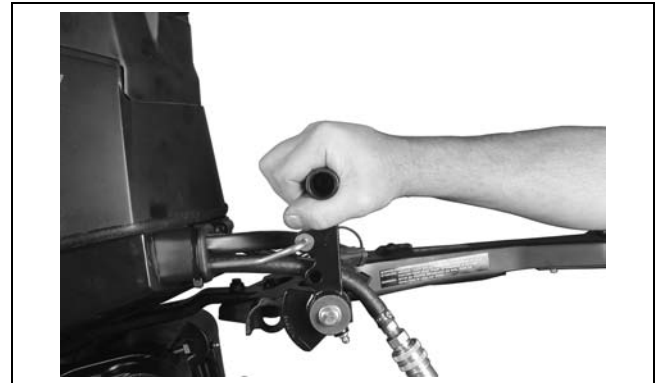
29192



DANGER

Always use the safety lanyard when operating the boat to help prevent a runaway boat and reduce the risk of personal injury or death.

Move the shift lever to NEUTRAL. The engine will NOT start in gear.

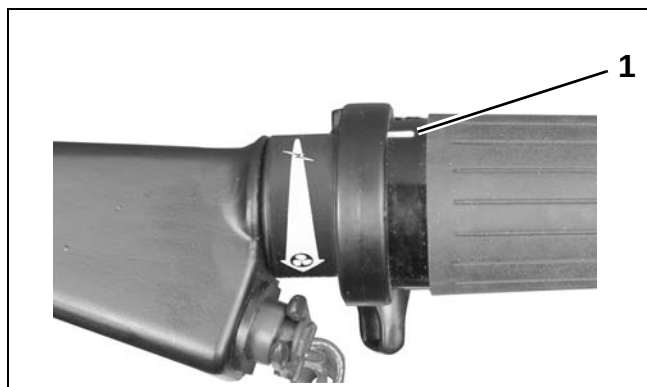


005046

OPERATION

STARTING THE ENGINE

Twist throttle grip to the slowest idle position.



1. Slow position

006518

IMPORTANT: DO NOT move the throttle from the fully closed position until the engine starts. Advancing the throttle before starting sends the wrong throttle position sensor signal to the *EMM* and will cause starting or running problems—the outboard may not accelerate above idle.

Pull starter handle slowly until starter engages, then pull hard. Short or slow pulls may not provide enough current to the *EMM* to start the engine.

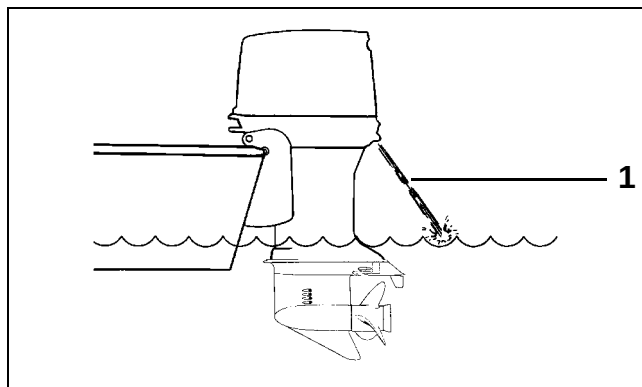


005047

Repeat, if needed, until outboard starts. To prevent damage to starter assembly, allow starter cord to rewind before releasing starter handle.

After Engine Starts

Check the water pump indicator. A steady stream of water indicates the water pump is working. If there is NOT a steady stream, STOP the engine. Refer to **Water Intake Screens** on p. 58.



1. Water pump overboard indicator

000977

Stopping the Engine

Slow engine to idle speed.

Move shift lever to NEUTRAL.

Press the stop button on the tiller handle until the outboard stops running.



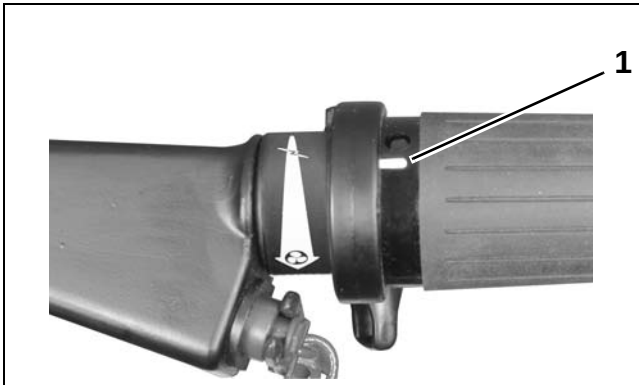
29285

SHIFTING AND SPEED CONTROL

IMPORTANT: To avoid gearcase damage:

- DO NOT try to shift motor into gear when engine is not running.
- When shifting, always wait until boat has slowed and engine is at idle speed.

With the outboard running, twist the throttle grip to shift position or slower.

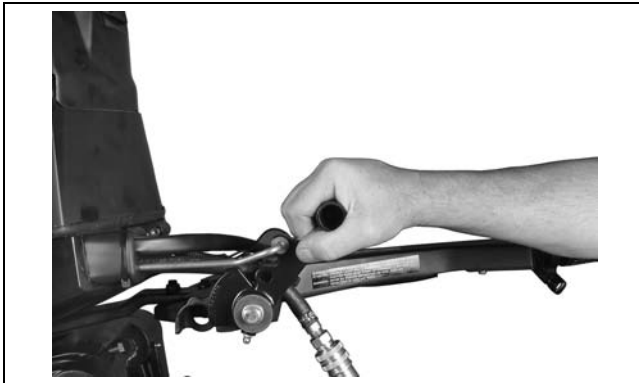


1. Shift position

006519

IMPORTANT: DO NOT shift motor with throttle control advanced beyond the shift position.

Move the shift lever with a firm, quick motion to FORWARD or REVERSE.



005048

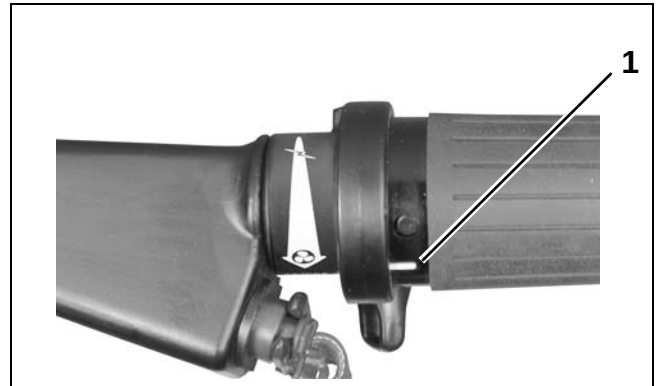
WARNING

Do not operate motor in REVERSE with the tilt/run lever in TILT. Motor may tilt out of the water, resulting in loss of control.

Speed Control

With the outboard running, turn the Twist-Grip throttle control to change engine speed.

Note: Idle speed is controlled by the EMM.



1. Fast position

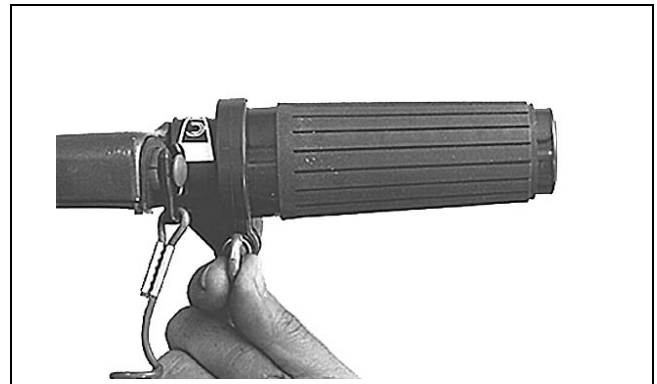
006520

Throttle Friction Adjustment

Adjust the throttle friction knob to reduce the effort required to hold a throttle setting.

WARNING

Tighten knob only enough to hold throttle at a constant engine speed. Overtightening will prevent quick throttle changes in case of emergency.



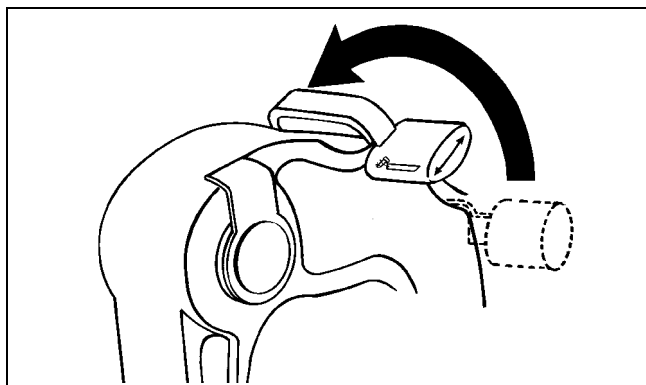
002191

MANUAL TILT

IMPORTANT: Use the tilt grip to tilt the outboard. Do not use the tiller handle as a lever.

Tilt UP

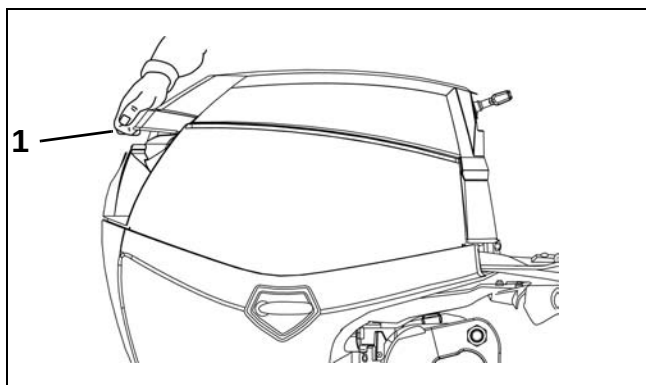
Move tilt/run lever to TILT position.



1. TILT position

DR3774

Grasp tilt strap or tilt grip on engine cover and tilt outboard to the full tilt position.



1. Tilt grip

002016

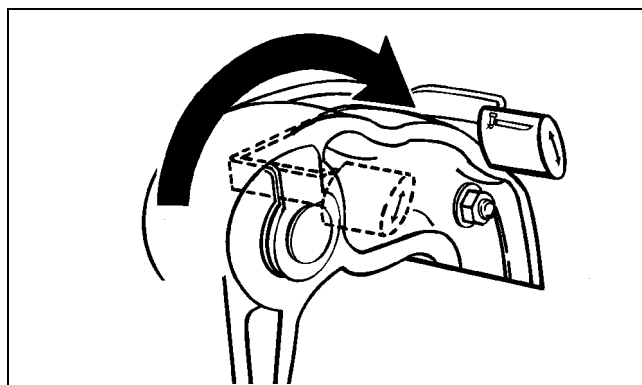
Tilt support will automatically engage.

WARNING

While engine is tilted, leave tilt lever in the TILT position. When the tilt/run lever is in the RUN position, tilt support can release unexpectedly and allow motor to drop, creating a risk of serious personal injury or loss of control.

Tilt DOWN

Move tilt/run lever to RUN position.



1. RUN position

DR3772

Grasp tilt grip on engine cover and raise outboard slightly.

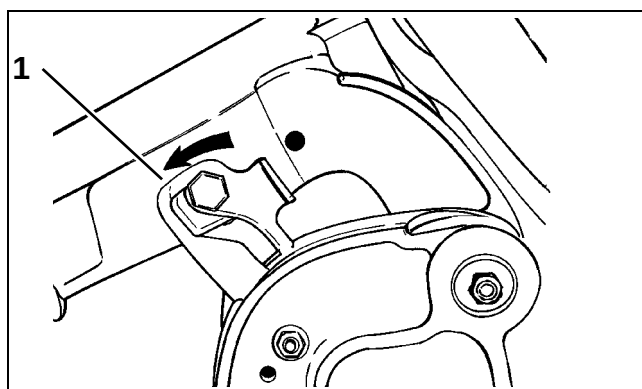
Tilt support will automatically disengage.

Slowly lower outboard to its normal operating position.

Tilt Support

Engage

Raise the outboard to full TILT position. Push tilt support bracket to "lock" position.

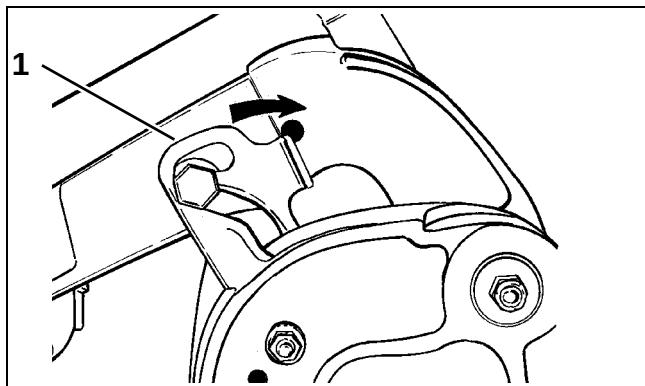


1. Tilt support bracket – lock position

DR3937

Disengage

Move tilt/run lever to RUN position. Tilt outboard fully and pull tilt support bracket to “unlock” position. Lower outboard.



1. Tilt support bracket – unlock position

DR3938

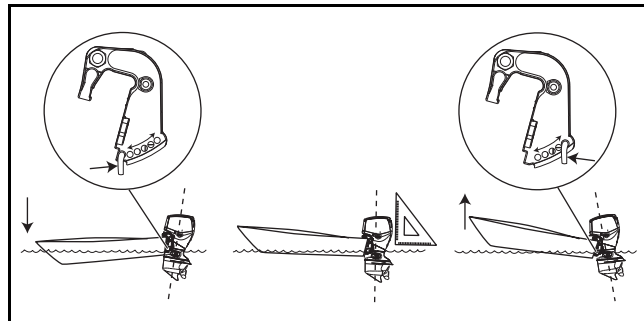
Trailer

Trailer your boat with the motor in a vertical position. If your trailer does not provide adequate road clearance, support the outboard with an accessory trailering bracket.

IMPORTANT: The outboard must be restrained when trailering. Bouncing during transport may damage the outboard and the boat's transom.

IMPORTANT: Use of the tilt support bracket when trailering may cause damage to the outboard.

MOTOR ANGLE ADJUSTMENT



007026

4

The outboard should be perpendicular to the water when the boat is underway at full speed. This adjustment can only be determined by water testing the boat. Set angle adjustment for your normal load.

Place motor in full tilt position. Refer to **Tilt Support** on page 50.

- Turn the angle adjusting rod handle up. Push in against spring so retainer will release, then slide rod assembly all the way out.
- Insert rod in desired position. Make sure rod passes through both stern brackets.
- Push in against spring and turn rod handle down. Make sure the retainer dropped into lock position.



WARNING

In rough water or crossing a wake, excessive bow-up trim may result in the boat's bow suddenly rising upward, possibly ejecting or seriously injuring occupants.

Some boat/motor/propeller combinations may cause boat instability and/or high steering torque when operated at high speed at or near the outboard's trim range limits (full bow-up or bow-down). Boat stability and steering torque can also vary in changing water conditions. If any adverse conditions occur, reduce throttle and/or adjust trim angle to maintain control.

OPERATION

DE-WATER PROCEDURE

DE-WATER PROCEDURE

The MFE outboard is not a submersible engine. However, due to the extreme operating conditions this engine may experience, a crankcase drain system has been provided to allow the engine to be de-watered should submersion occur during deployment or accidental rollover.

This system allows the operator to quickly remove water and re-start the engine in an emergency situation. In most cases, the engine can be returned to normal operation without damage.

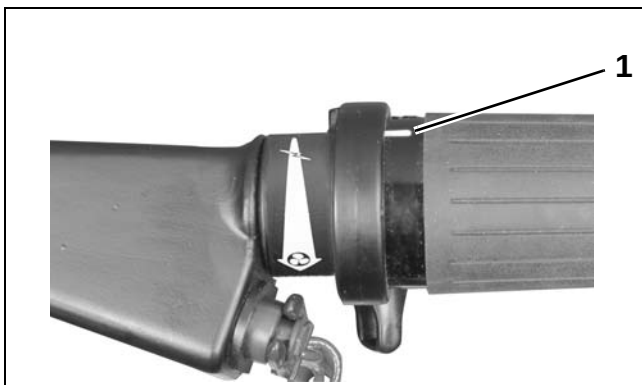
Submersion of the outboard should be avoided if possible. Damage could occur to the engine wiring harness and water could contaminate the oiling system. Extended submersion, particularly in salt water, could result in corrosion of internal components such as piston rings, cylinder sleeves, and bearings.

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

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

Place shift lever in NEUTRAL and remove the emergency stop clip and lanyard.

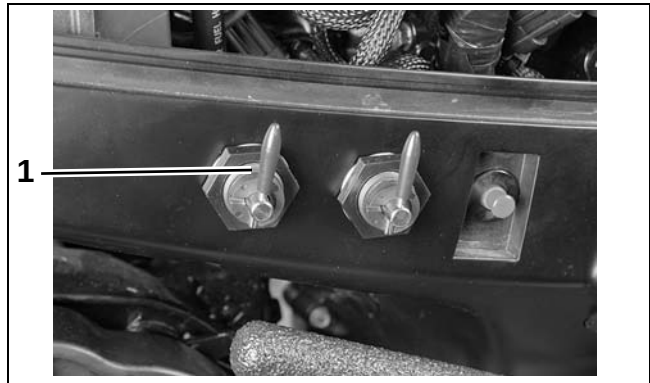
Twist throttle grip to slowest idle position.



1. Slow position

006518

Turn the drain valves forward to the DRAIN position.



1. Drain valves in drain position

007840

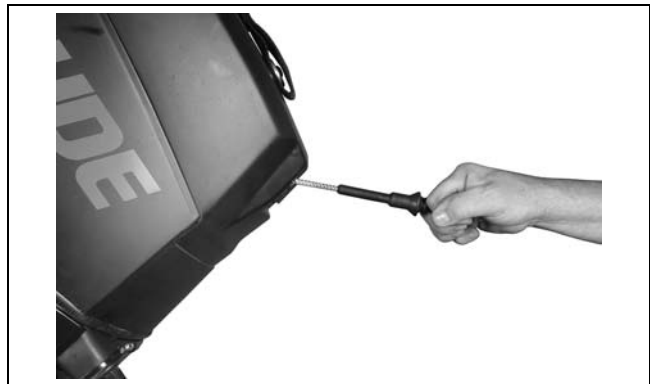
Tilt outboard to the full tilt position and turn so the drain valves are on the lowest side.



CAUTION

To avoid outboard falling during de-water procedure, tilt/run lever MUST remain in the TILT position.

Pull starter handle slowly until starter engages. Continue pulling with firm pressure to force water out of the engine.



005049

When the engine begins to turn freely, pull an additional 8-20 times. This will help drain water that might be trapped in the cylinders.

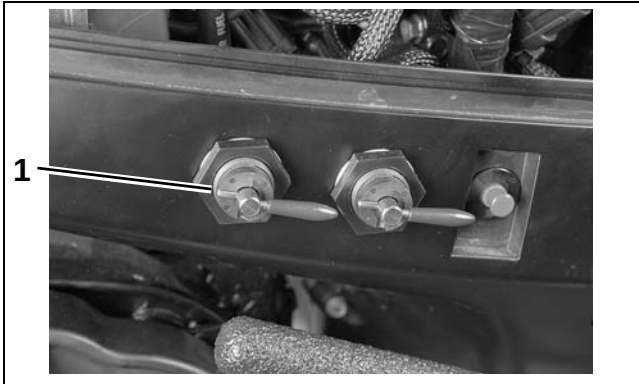
Tilt outboard to the normal running position.

Replace emergency stop clip and lanyard.

Squeeze primer bulb several times until definite resistance is felt.

With twist grip in the slowest position, pull starter handle to start engine.

After engine has run at IDLE speed for 30 to 60 seconds, turn drain valves to the RUN position.



1. Drain valves in run position

007841

IMPORTANT: DO NOT run the outboard with the drain valves in the DRAIN position for more than 3 minutes. Engine damage can result.

Continue to run under normal operating conditions (boat on plane) for at least 30 minutes (2500 RPM or above).

IMPORTANT: You MUST run the outboard after the de-water procedure to dry out internal moisture.

Stop engine and run the winterizing procedure to supply extra oil to the cylinders. Refer to **Internal Engine Treatment** on p. 66.

Post-Submersion Servicing

When an outboard has been submersed, it **MUST** be serviced before storage.

If the outboard has been in salt water:

- Run the engine for approximately five minutes in fresh water at full operating temperature. Refer to **Engine Flushing** on p. 58.
- Spray the entire engine with fresh water to remove salt deposits.

After five submersions, the flywheel must be removed and the valley between the crankshaft and the stator windings must be cleaned.

Prolonged Submersion

Prolonged submersion, or submersion at depths beyond several feet may cause engine damage.

If prolonged submersion occurs, even if the engine can be started, the engine must be disassembled and cleaned.

DO NOT attempt to start the outboard If sand or silt may have entered the engine. Disassemble and clean.

Refer to **SUBMERGED ENGINES** on p. 68.

SPECIAL OPERATING CONDITIONS

Sea Water

Fresh water flushing is recommended after use in salt, polluted or brackish water to prevent deposits from clogging the cooling passages. Refer to **Engine Flushing** on p. 58.

Check gearcase anodes for deterioration and replace, if necessary.

Weedy Water

Weeds can block the water intakes and cause engine to overheat. Weeds on the propeller/impeller will cause engine to vibrate.

Run at slow speeds and reverse engine frequently to clear weeds from propeller/impeller. Check water pump indicator often.

Freezing Weather

Before operating in freezing temperatures, check gearcase lubricant. If water is found, test gearcase for leaks and replace lubricant. Refer to gearcase **GEARCASE LEAK TEST** on p. 238.

To avoid engine damage, keep the gearcase submerged in the water at all times.

When removing engine from water, keep in an upright position until the cooling system is completely drained.

IMPORTANT: Water that leaks into gearcase or is left in the cooling system can freeze when the engine is removed from the water. This can cause serious damage.

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.

IMPORTANT: Outboards used in high hour applications require more frequent inspections and maintenance. Adjust schedule for operating and environmental conditions.

Description		Routine Inspection	Every 100 hours or annually	Every 300 hours or 3 years ⁽¹⁾
Emergency stop circuit and lanyard, check operation		✓		
Electrical and ignition wires, inspect for wear or chafing		✓		
Controls, steering and tilting; check operation		✓		
Engine mounting hardware, re-tighten		✓		
Fasteners, tighten any loosened components		✓		
Water intake screens, check condition		✓		
Cooling system; check water pump indicator		✓		
Anticorrosion anodes, check condition		✓		
Gearcase, check condition		✓		
Propeller/impeller, check condition		✓		
Fuel and oil systems, inspect and repair leaks		✓		
Check battery connections and condition (with electric start kit)		✓		
Lubricate throttle plate ⁽²⁾	A		✓	
Air Silencer, check for debris			✓	
Fuel filter, replace			✓	
De-carbon engine – required with heavy fuel use ⁽³⁾	B		✓	
Spark plugs, inspect or replace			✓	
Access EMM information, resolve any service codes				✓
Back-up EMM data to external storage device				✓
Check and lubricate all electrical connectors	C			
Gearcase lubricant, replace ⁽¹⁾	D			✓
Thermostat, inspect and check operation ⁽⁴⁾				✓
Grease fittings, lubricate ⁽⁴⁾	E			✓
Propeller shaft splines, inspect and lubricate ⁽⁴⁾	E			✓
Control cables, inspect and adjust				✓
Water pump, inspect / replace (more often if water pressure loss or overheating occurs)				✓

(1) Average use. Heavy use, or use in salt or polluted water requires more frequent inspection and maintenance.

(2) Every 20 hours in salt water applications

(3) Required after each use of emergency fuel (diesel)

(4) Annually in salt water applications

- A *6 in 1 Multipurpose Lubricant*
- B *Evinrude/Johnson Engine Tuner*
- C *Electrical Grease*
- D *HPF PRO Gearcase Lubricant*
- E *Triple-Guard Grease*

DE-CARBONING PROCEDURE

This procedure is required every 100 hours or annually for *MFE 55* outboards operated using heavy fuels, including JP5, JP8, Jet A, or kerosene.

If the outboard has been operated on an emergency fuel, such as diesel, the de-carbon procedure must be performed immediately after return from the mission.

IMPORTANT: Diesel is an emergency fuel **ONLY**. If diesel must be used, the fuel selector switch should be in the Heavy Fuel position.

For maximum benefit, the outboard should be run on unleaded gasoline during this procedure if possible.

Outboard should be on the boat and in the water. If outboard cannot be run in the water, make sure to supply adequate cooling water.

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

To prevent injury from contact with rotating propeller; remove the propeller before de-carbon procedure (MRL).

CAUTION

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

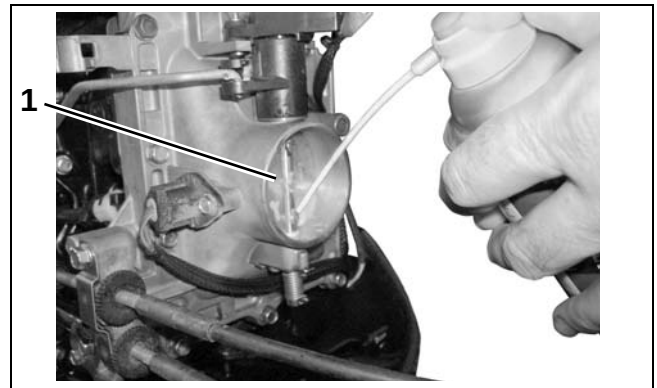
Remove air silencer.

Set the fuel selector switch to the gasoline position and run the outboard on gasoline during the de-carboning procedure.

Start and run outboard long enough to reach normal operating temperature.

Set engine speed to approximately 1500 RPM.

Spray the entire contents of a can of *Engine Tuner*, P/N 777185, into the throttle body. Do not let the engine stall until the can is empty.



1. Throttle body

007149

STOP engine and allow *Engine Tuner* to soak in powerhead for a minimum of 8 hours to 16 hours maximum.

CAUTION

DO NOT allow *Engine Tuner* to stay in powerhead for more than 16 hours. Extended exposure can damage internal engine parts.

Restart engine and run at 1500 RPM for 15 minutes.

Next, run outboard on boat, at high speed, for 30 to 60 minutes. Boat should be on plane and outboard should be running at least 2500 RPM.

If outboard will not run at high RPM, make sure that spark plugs are not fouled. Replace spark plugs if necessary. Refer to **SPARK PLUGS** on p. 63.

COOLING SYSTEM

Regularly inspect cooling system components for corrosion, damage, leaks, or restrictions:

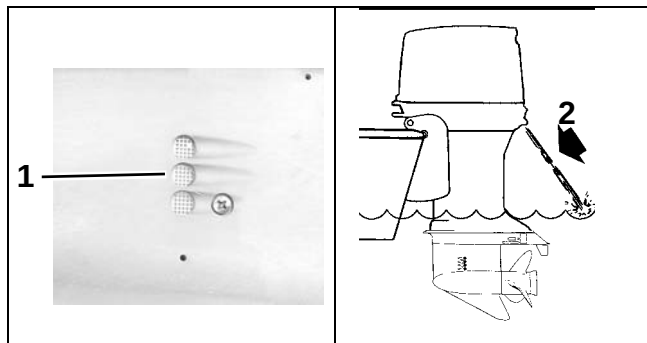
- water intake screens
- water pump
- all internal water passages
- thermostat
- all external water hoses and fittings
- vapor separator cooling passages and fittings
- EMM cooling passages and fittings
- overboard water pressure indicator.

For cooling system repairs, refer to **COOLING SYSTEM** on p. 169.

Water Intake Screens

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

Confirm function of overboard water pressure indicator.



1. Water intake screen
2. Overboard indicator

001212
drc4952arev

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).

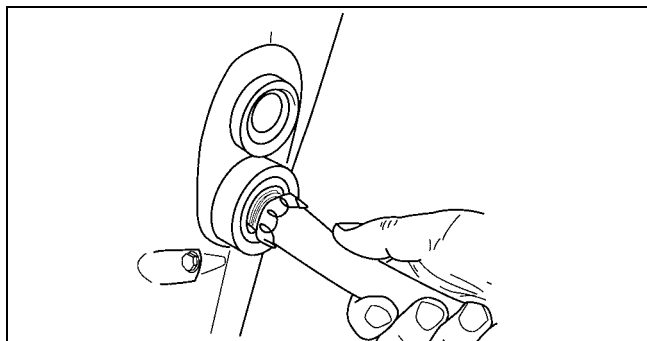
Flushing — Outboard Running

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.



002024

TTurn 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 (MRL).

Flushing — Outboard Not Running

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

Position outboard in VERTICAL position (DOWN) long enough to allow the powerhead to drain completely.

Running the Outboard Using a
Hose and Flushing Adapter



WARNING

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

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

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

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

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

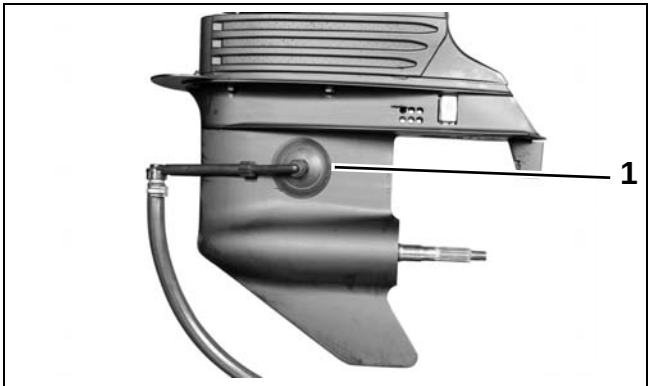
Be sure water supply is sufficient to run the engine above idle speed.

Water Supply Requirements

Model	Water Flow @ WOT
55 HP MFE	4 to 6.5 GPM ¹ (15 to 24 LPM ²)

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

Install flushing adapter onto gearcase water inlet screens.



1. Flushing adapter 008342

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

Monitor engine water pressure gauge when:

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

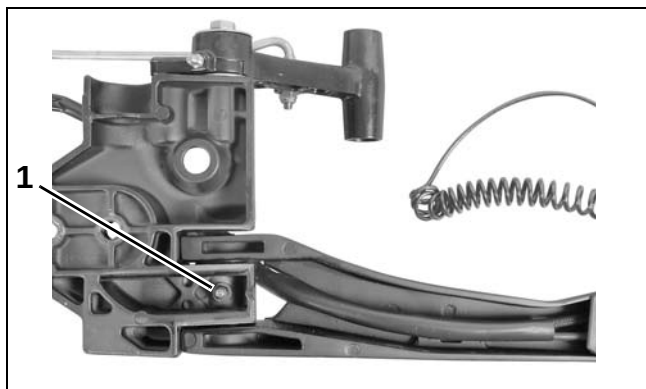
Refer to **SERVICE SPECIFICATIONS** on p. 10 for water pressure requirements.

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

LUBRICATION

Tiller Handle

Lubricate the tiller handle grease fittings with *Triple-Guard* grease.



1. Tiller handle fittings – Standard handle

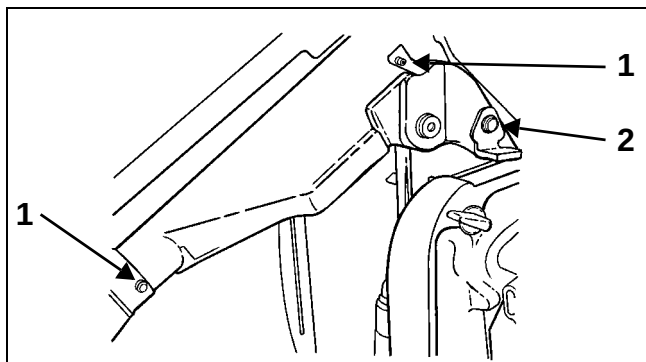
008196

Swivel Bracket and Trailing Bracket

Lubricate the swivel bracket with *Triple-Guard* grease.

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

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

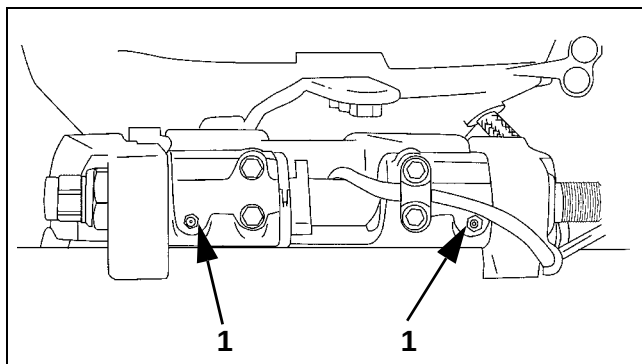


1. Grease fitting
2. Tilt support

DR31329

Tilt Tube

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



1. Tilt tube fittings

DR38798

Throttle and Shift Linkage

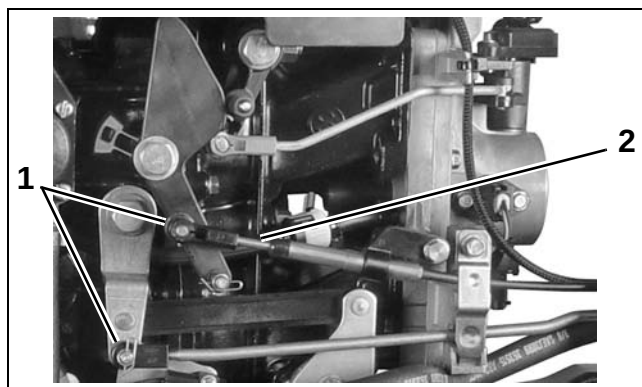
Remove throttle control cable and shift rod from lever pins.

Twist throttle grip to FULL THROTTLE position to fully extend the cable.

Apply *Triple-Guard* grease to:

- Cable attachment pins of both the throttle and shift levers.
- Inner casing of the throttle cable.

IMPORTANT: Do not lubricate throttle levers or shoulder screws.



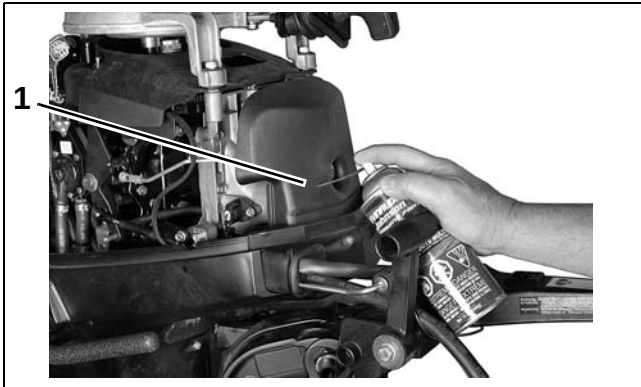
1. Attachment pins, throttle and shift
2. Inner casing, throttle cables

006526m

Return controls to the NEUTRAL/IDLE position. Install throttle cable and shift rod on lever pins. Check proper throttle and shift function.

Throttle Plate

Lubricate the throttle plate as required to prevent corrosion build-up. Spray *6 in 1 Multipurpose Lubricant* through hole in air silencer for 3 to 5 seconds.



1. Air silencer lubrication hole

007870

Propeller Shaft (MRL)

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, twist and remove all spark plug leads so the outboard cannot be started accidentally.

Remove propeller. Refer to **Propeller Hardware Installation** on p. 42.

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

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

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

Reinstall propeller hardware and propeller.

Gearcase Lubricant

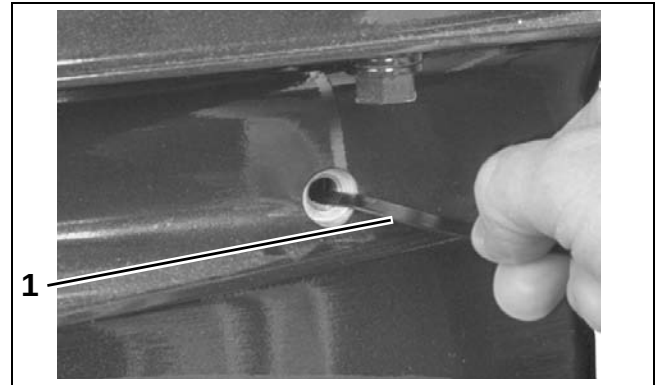
Draining



WARNING

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

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

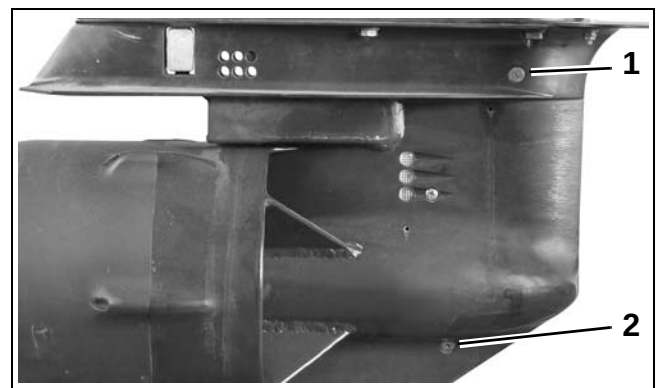


1. Tie strap

000072

If lubricant level is low, refer to **GEARCASE LEAK TEST** on p. 238.

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



1. Lubricant level plug

2. Lubricant drain/fill plug

007260

ROUTINE SERVICE

LUBRICATION

Inspection

Inspect the lubricant and the magnets on the plugs for metal chips. The presence of metal **fuzz** can indicate normal wear of the gears, bearings, or shafts within the gearcase. Metal **chips** can indicate extensive internal damage.

Inspect the lubricant for water contamination. Water can make the lubricant milky in appearance. However, normal aeration can also cause the same appearance.

To check for water contamination, put lubricant into a glass container. Allow the oil to settle for a minimum of one hour to determine if there is an abnormal amount of water in the oil.

If water is present, refer to **GEARCASE LEAK TEST** on p. 238.

Overheated lubricant will have a black color and burned odor.

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

Filling

Refer to the **INSPECTION AND MAINTENANCE SCHEDULE** on p. 56 for service frequency and recommended lubricants.

Secure the gearcase in a vertical position.

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

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

IMPORTANT: Filling the gearcase too quickly can cause air pockets and the gearcase may not fill completely.

Clean plug seal area and install the lubricant level plug and **new** seal, then the lubricant drain/fill plug and **new** seal. Tighten plugs to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



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

007278

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

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.

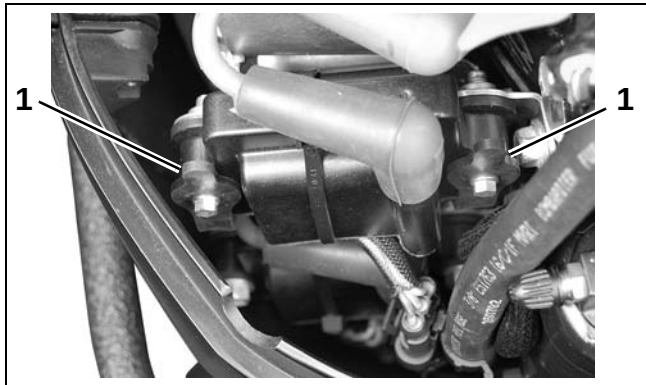
Spark Plug, <i>Champion</i>
QC10WEP @ .028 ± .003 in. (0.76 mm)

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

Removal

Use a 5/8 in. spark plug socket to remove spark plugs.

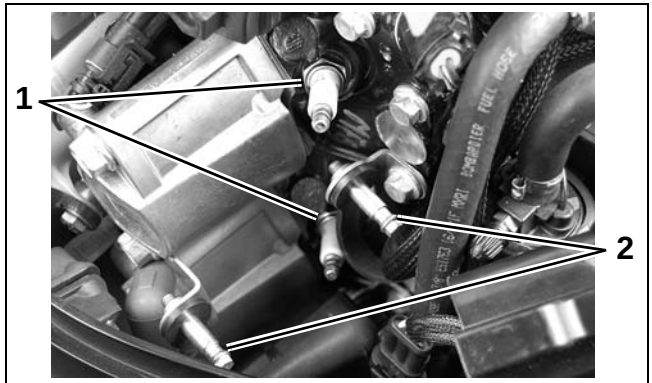
Access to the lower spark plug requires temporary removal of the upper ignition coil. Disconnect rubber mounting straps securing coil.



1. Coil mounting strap

007842

Slide coil off of mounting screws and to the side to access spark plugs.



1. Spark plugs
2. Coil mounting screws

007843

Indexing

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

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



1. Ink mark
2. Open side

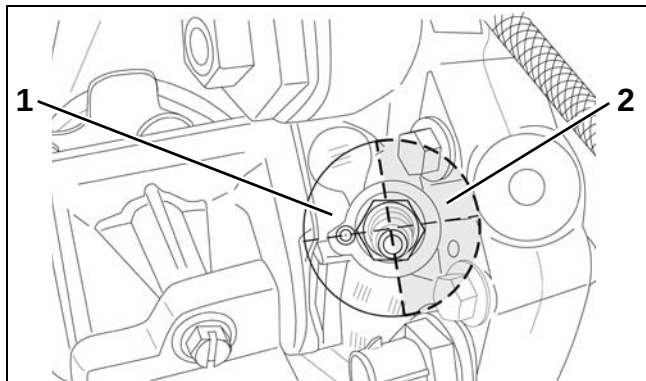
000758

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

ROUTINE SERVICE

FUEL AND OIL SYSTEMS

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



Spark Plug Indexing Diagram

002106

- 1. Unshaded area
- 2. Shaded area

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

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

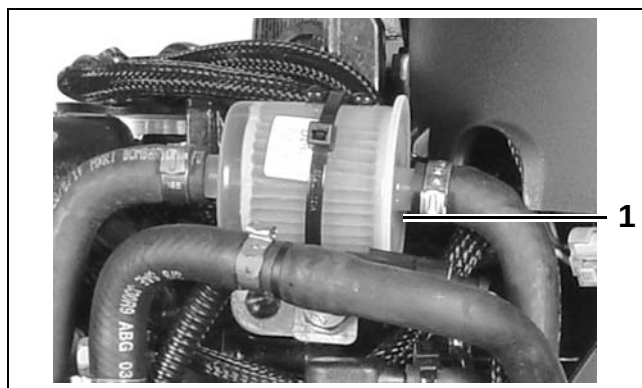
FUEL AND OIL SYSTEMS

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

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

Fuel Filter

Evinrude MFE 55 outboards are equipped with an in line fuel filter. Refer to **Fuel Filter Service** on p. 145.



1. Fuel filter

002145

Oil Filters and Oil Reservoir

Perform visual inspections to identify oiling system leaks. Make certain the oil tank is filled and oil supply is not contaminated.

Air Silencer

The air silencer maximizes air flow while minimizing noise.



002227

Cleaning of the air silencer is recommended every 100 hours to remove any accumulation of debris.

Lower engine covers must be removed to service air silencer. Refer to **LOWER COVER SERVICE** on p. 73.

Hoses and Connections

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

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



WARNING

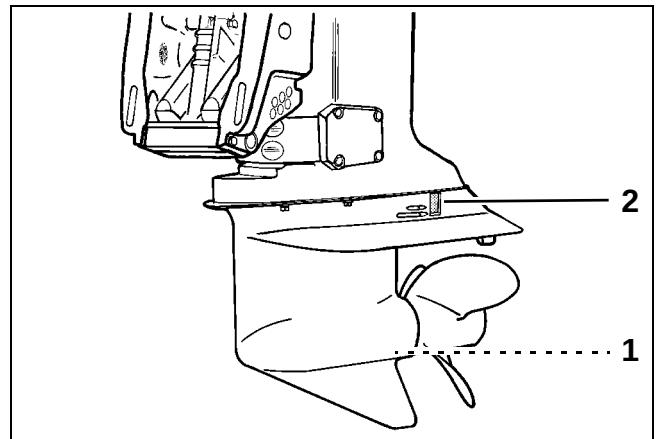
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

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 two sacrificial anodes.



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

DR5082

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

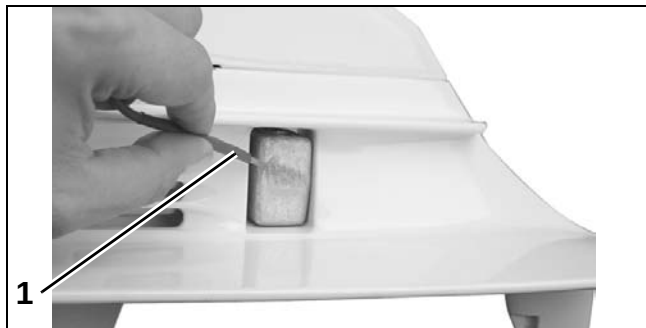
IMPORTANT: Anodes that are not eroding may not be properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

For best anode performance:

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

Testing Procedure – Continuity

Connect ohmmeter leads between engine ground and anode surface.



1. Meter lead to anode

000677

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

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

Metallic Component Protection

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

- *Anti-Corrosion Spray* provides a heavy, waxy coating to protect components.
- *“6 in 1” Multi-Purpose Lubricant* provides a thin film of anti-corrosion protection.

Exterior Finishes

Maintain the outboard's exterior finish to prevent corrosion and reduce oxidation.

- Clean regularly using clean water and mild detergent soap.
- Touch-up damage to painted surfaces promptly.

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 (gasoline only)

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

IMPORTANT: If outboard has been run with alternative fuels, it must be run with gasoline for a minimum of 20 minutes before being placed in storage.

Internal Engine Treatment

Remove the propeller (MRL), attach garden hose to flushing port and turn on water.

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

IMPORTANT: Engine MUST be in NEUTRAL throughout these procedures.

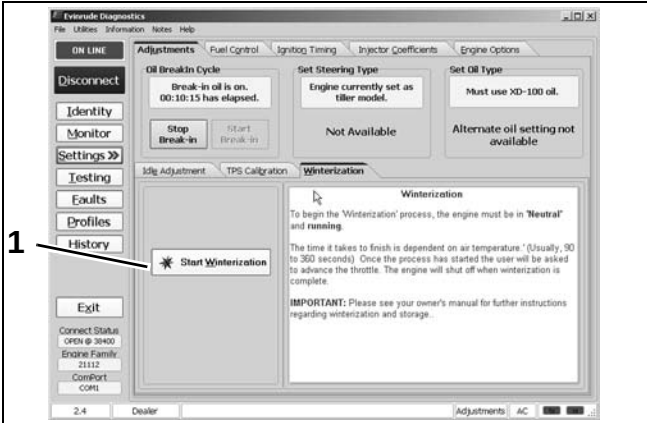
Throttle Control Method

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

IMPORTANT: If outboard runs above fast idle, immediately turn off outboard and start the procedure again.

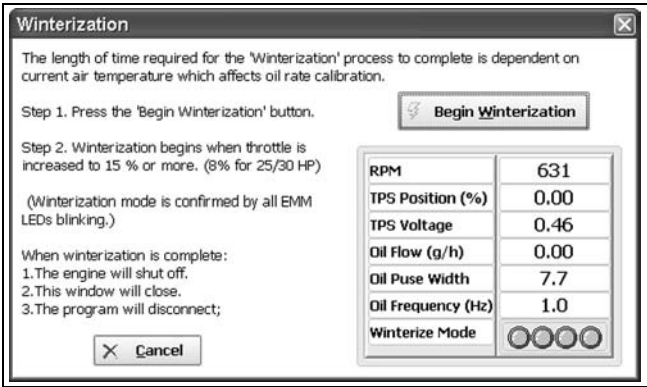
Software Control Method

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



1. Winterization start button

006622



008119

After the outboard shuts itself off, detach garden hose.

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

Additional Recommendations

- Lubricate throttle plate before placing outboard in storage. Refer to **Throttle Plate** on p. 61.
- Fill oil reservoir.
- Inspect the fuel filter. If there is debris in the fuel filter, it must be replaced.
- Replace gearcase lubricant.
- Remove and inspect propeller (MRL).
- Clean and grease propeller shaft.
- Lubricate all grease fittings and linkages.
- Inspect outboard, steering system, and controls. Replace all damaged and worn components.
- Touch up painted surfaces as needed.
- Store outboard in upright (vertical) position.
- Check for fuel leakage.

**WARNING**

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

PRE-SEASON SERVICE

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

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.

Operational Checks

- Check tiller steering operation
- Check throttle and shift controls

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

- Confirm that a steady stream of water flows from overboard indicator.



WARNING

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

SUBMERGED ENGINES

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

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

Engine Dropped Overboard (Not Running)

Rinse powerhead with clean water.

Remove spark plug leads and spark plugs.

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

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

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

Clean and inspect all electrical components. Replace damaged or corroded components prior to returning the outboard to service.

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

Drain and clean oil tank and oil injection hoses.

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

Prime fuel and oil systems. Refer to **FUEL AND OIL PRIMING** on p. 37. Make sure all oil injection hoses are clean and filled with oil.

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

Inject a small amount of outboard lubricant into spark plug holes and install new spark plugs. Refer to Spark Plug **Indexing** on p. 63.

Reinstall all removed or disconnected parts.

Use *Evinrude Diagnostics* software to:

- Initiate Break-in.
- Check fuel pump operation.
- Check injector operation (fuel and oil).
- Check timing (once outboard is running at full operating temperature).

Run outboard below 1500 RPM for one-half hour.

Engine Dropped Overboard (Running)

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

Engine Dropped Overboard (In Salt Water)

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

Prolonged Submersion (Fresh or Salt Water)

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

ROUTINE SERVICE
NOTES

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

ENGINE COVER SERVICE

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UPPER COVER SERVICE

Latch Hook Installation

Insert threaded bracket into pocket.



1. Bracket

006468

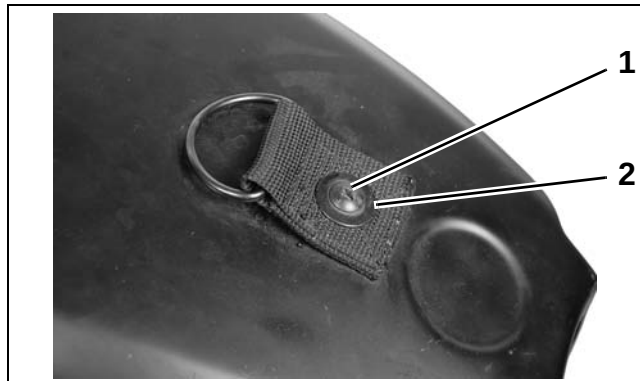
Apply *Ultra-Lock* to screw threads. Place hook into position with opening toward the front. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



006469

Tilt Assist Strap

Insert screw, with washer, through strap assembly and into upper motor cover. Strap buckle should be toward the rear.



1. Screw
2. Washer

007844

Install washer and lock nut and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



006532

LOWER COVER SERVICE

Lower Cover Removal

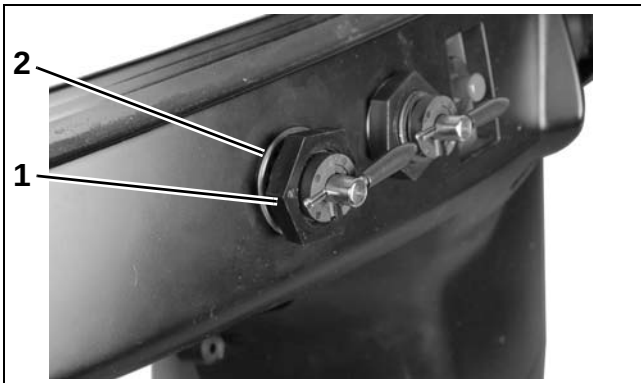
Remove four carry handle screws and bushing caps. Remove carry handle and bushings.



1. Carry handle
2. Screws

005061

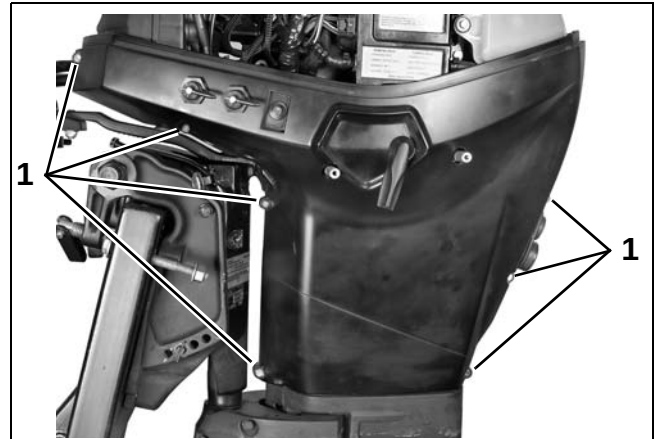
Remove nut and washer from de-water valves. Remove valves from cover.



1. Nut
2. Washer

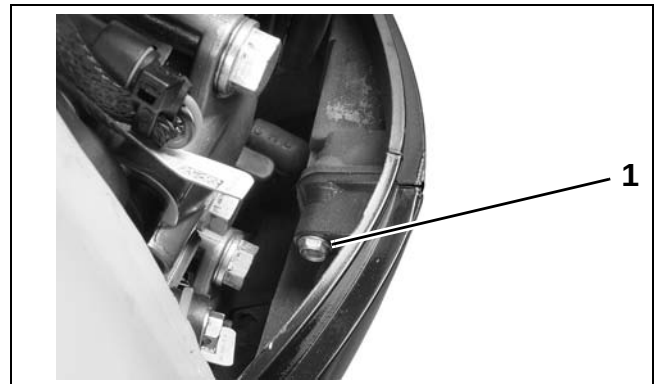
007849

Remove lower engine cover screws, including one at inside, top rear.



1. Cover screws

007845



1. Top, rear cover screw

002150

Loosen port cover slightly, and disconnect fuel selector switch connector. Then, remove port cover.



1. Fuel map switch connector

005063

Tilt the starboard cover to remove it below the grommet. Leave the grommet in place.

IMPORTANT: Cover and grommet installation is easiest if the grommet is in place first.

ENGINE COVER SERVICE

LOWER COVER SERVICE

Lower Cover Installation

Installation of lower motor covers will be easiest if the following steps are performed in sequence:

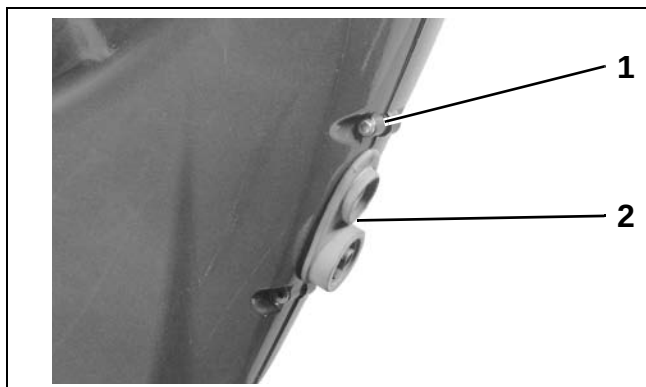
- Install air silencer on throttle body.
- Secure grommet on cables with tie strap.
- Slide starboard cover on to grommet from the bottom and then into position on outboard.
- Connect fuel map switch connector.
- Place port side cover into position on outboard.



1. Fuel map switch connector

005063

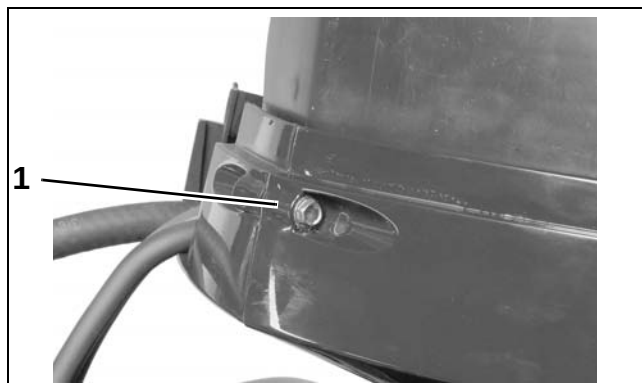
Start the screw above the exhaust relief grommet first. Tighten just enough to hold the grommet in place.



1. Start this screw first
2. Exhaust relief grommet

002157

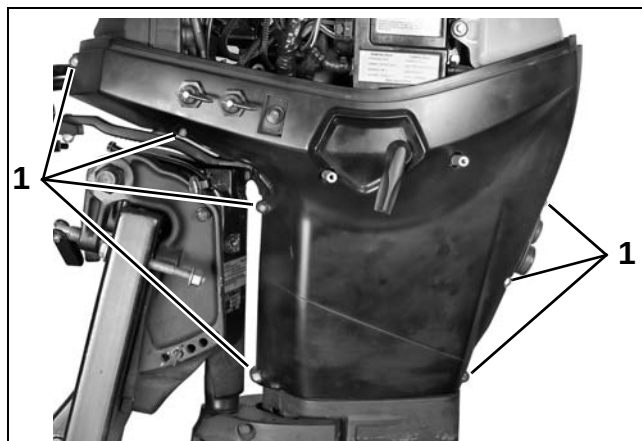
Start the top front screw next and draw cover halves together.



1. Start this screw second

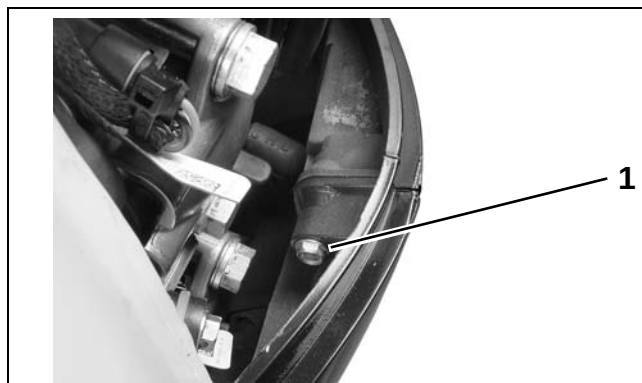
002165

Install remaining cover screws and tighten all screws to 24 to 36 in. lbs. (3 to 4 N·m).



1. Cover screws

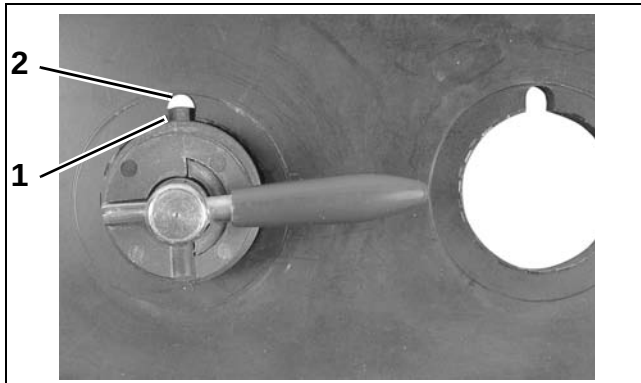
007845



1. Top, rear cover screw

002150

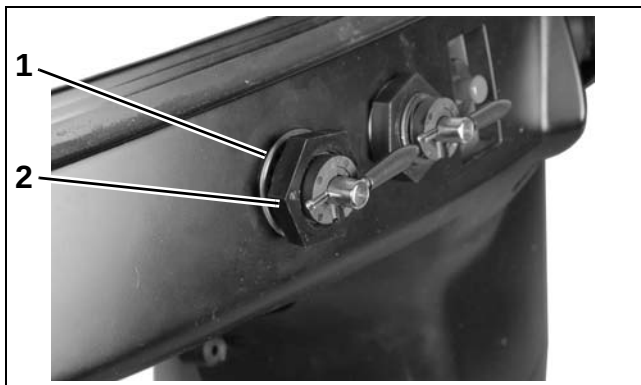
Place de-water valves through holes. Align tab of de-water valve with alignment notch as shown.



1. Tab
2. Alignment notch

008177

Install washer and nut. Tighten to a torque of 25 to 40 in. lbs. (3 to 4.5 N·m). Lever should point to the rear of the outboard when the valve is closed.



1. Washer
2. Nut

007849

Install long bushings on front cover pins and short bushings on rear pins. Install carry handle. Secure with bushing caps and screws.

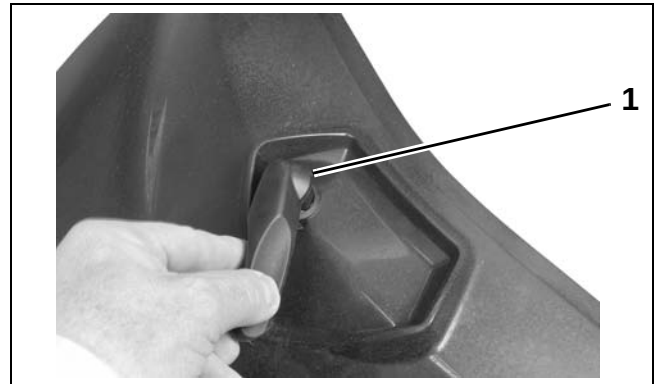


1. Carry handle
2. Screws

005061

Latch Handle Installation

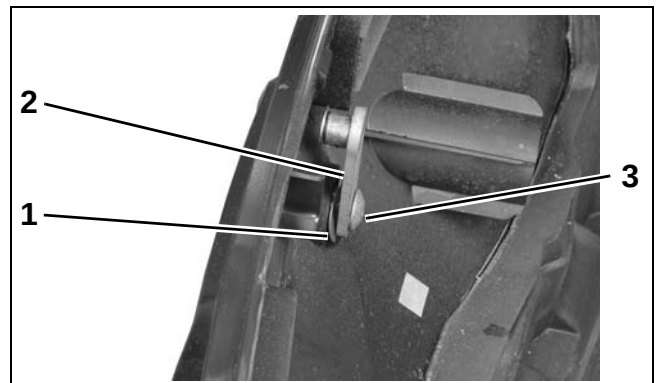
Apply a light coat of *Triple-Guard* grease to latch handle shaft. Insert handle into lower cover.



1. Triple-Guard grease

006470

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



1. Spring washer
2. Hook
3. Screw

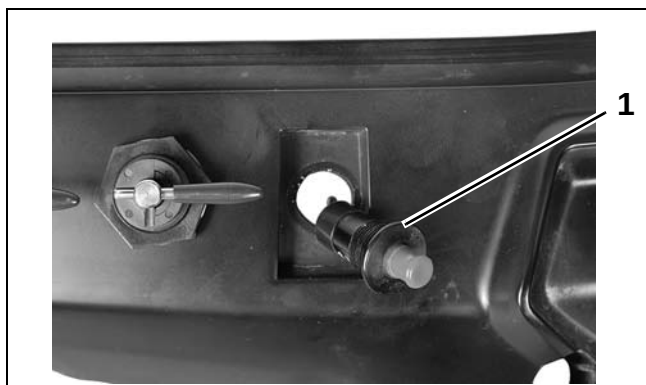
006471

ENGINE COVER SERVICE

LOWER COVER SERVICE

Fuel Selector Switch Installation

Place switch into position through cover.



1. Fuel selector switch

007846

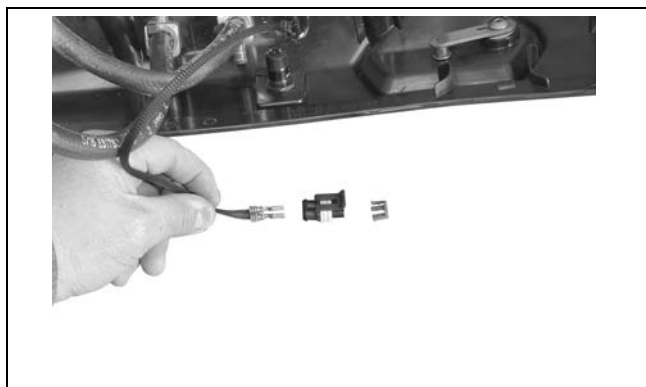
Install lock washer and nut on switch. Tighten nut to a torque of 10 to 16 in. lbs. (1 to 2 N·m).



1. Nut and washer

007847

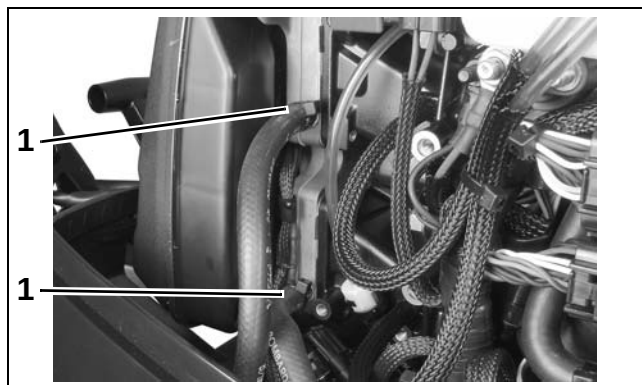
Install electrical connector. Refer to **AMP Connectors** on p. 128.



006472

De-Water Valve Service

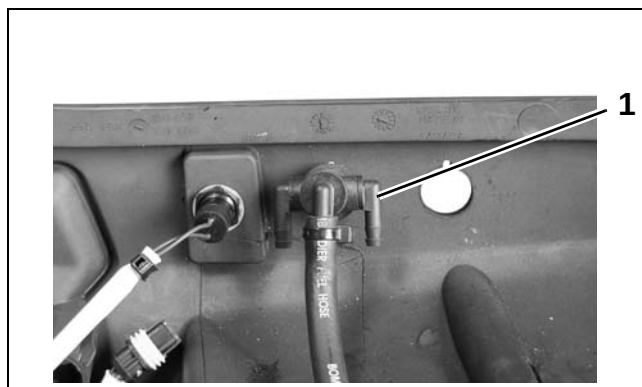
Install drain valve hoses on reed plate and secure with tie straps.



1. Drain valve hoses

005062

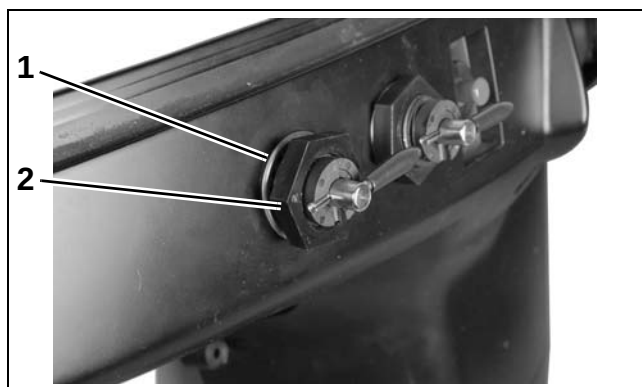
Install drain valve through cover with outlets pointed down.



1. Drain outlet

007848

Install washer and nut. Tighten to a torque of 25 to 40 in. lbs. (3 to 4.5 N·m). Lever should point to the rear of the outboard when the valve is closed.



1. Washer
2. Nut

007849

ENGINE MANAGEMENT MODULE (EMM)

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ENGINE MANAGEMENT MODULE (EMM)

DESCRIPTION

DESCRIPTION

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

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

The *MFE 55 EMM* includes programs, controlled by the fuel selector switch, that allow the engine to run on a several types of fuel. Refer to **Fuel Selector Switch** on p. 46.

EMM Functions

The *EMM* controls the following processes and functions:

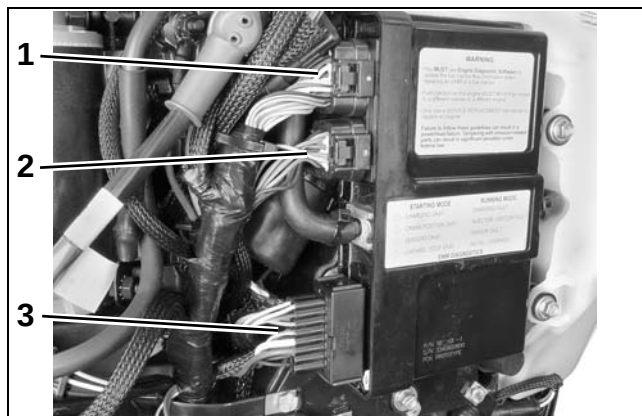
- Alternator output; 55 V and 12 V
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil injector pump activation
- Electric fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Service code creation and storage
- Warning system activation
- ROM verification,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

IMPORTANT: An Engine Monitor warning system is available for *MFE 55* models through the installation of boat harness wiring kits. Refer to *Johnson/Evinrude Genuine Parts* catalog.

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.

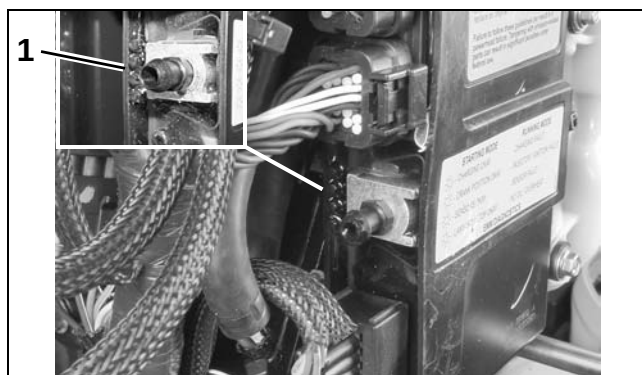


1. J1-A connector
2. J1-B connector
3. J2 connector

006487

LED Indicators

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



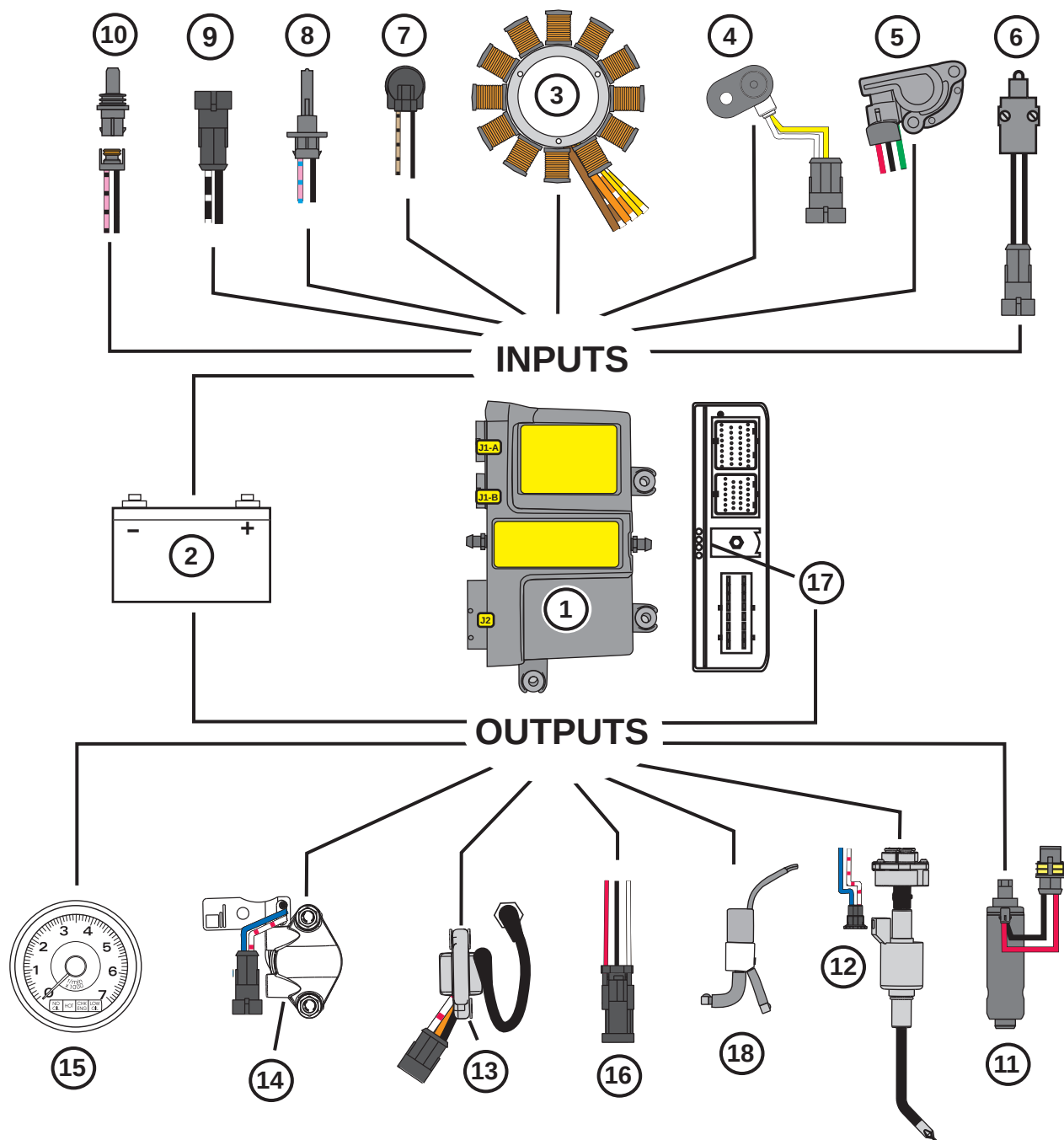
1. LED indicators
(Cooling hose removed for clarity)

002429
006467

As the outboard is being started, all four LEDs should light and then go off in sequence. If any of the LEDs does NOT light during starting, refer to **EMM LED INDICATORS** on p. 99.

When the outboard is running, all LEDs should be off. If any LED is lighted while the outboard is running, refer to **EMM LED INDICATORS** on p. 99.

EMM INPUTS AND OUTPUTS DIAGRAM



- 1. Engine Management Module (EMM)
- 2. Battery (Optional)
- 3. Stator
- 4. Crankshaft Position Sensor (CPS)
- 5. Throttle Position Sensor (TPS)
- 6. Neutral Switch
- 7. Low Oil Switch

- 8. Air Temperature Sensor (AT)
- 9. Fuel Map Switch
- 10. Engine Temperature Sensor
- 11. Fuel Pump (high pressure)
- 12. Oil Injection Pump and Manifold
- 13. Ignition Coil
- 14. Fuel Injector

- 15. Tachometer/SystemCheck Gauge (Optional)
- 16. Diagnostic Connector
- 17. LED Indicators
- 18. Exhaust Water Valve

008026m

ENGINE MANAGEMENT MODULE (EMM)

INTERNAL SENSORS

INTERNAL SENSORS

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

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

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

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

Interrupts the ignition once per 50 engine revolutions to signal the operator
Stores service code 25
<i>EMM</i> LED 4: ON (Running)
Gauge (opt) TEMP display: ON

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

Activates S.A.F.E.
Stores service code 29
<i>EMM</i> LED 4: FLASHING
Gauge (opt) TEMP display: FLASHING

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

Stores service code 24
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

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

Stores service code 23
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

55 V Circuit Sensor

Monitors the *EMM*'s 55 V alternator circuit.

If system voltage exceeds 57 volts, the *EMM*:

Stores service code 18
<i>EMM</i> LED 1: ON (Running)
Gauge (opt) CHECK ENGINE display: ON

If system voltage is less than 45 V, the *EMM*:

Stores service code 17
<i>EMM</i> LED 1: ON (Running)
Gauge (opt) CHECK ENGINE display: ON

12 V Circuit Sensor

Monitors the *EMM*'s 12 V alternator circuit.

If battery voltage exceeds 15.5 volts, the *EMM*:

Stores service code 27
<i>EMM</i> LED 1: ON (Running)
Gauge (opt) LOW BATTERY display: ON

If battery voltage is below 12.5 volts, the *EMM*:

Stores service code 26
<i>EMM</i> LED 1: ON (Running)
Gauge (opt) LOW 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 service code 78
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)

Barometric Pressure Sensor

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

If the BP sensor reads less than 13.3 KPa or greater than 119.0 KPa, or the sensor or circuit fails, the *EMM*:

Stores service code 44

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

Stores service code 45

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

Stores service code 46

EXTERNAL SENSORS

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

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

Air Temperature Sensor

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

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

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

ENGINE MANAGEMENT MODULE (EMM)

EXTERNAL SENSORS

Engine Temperature Sensor

Monitors cylinder head temperature.

If cylinder head temperature exceeds 194° F (90° C), the *EMM*:

Interrupts the ignition once per 50 engine revolutions to signal the operator
Stores service code 43
<i>EMM</i> LED 4: ON (Running)
Gauge (opt) TEMP display: ON

If cylinder head temperature exceeds 230°F (110°C), the *EMM*:

Activates <i>S.A.F.E.</i>
Stores service code 31
<i>EMM</i> LED 4: FLASHING
Gauge (opt) TEMP display: FLASHING

If sensor values are below -15°F (-26.2°C) or above 332°F (166.5°C), the *EMM*:

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

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

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

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

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

Low Oil Switch

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

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

Interrupts the ignition once per 50 engine revolutions to signal the operator
Gauge (opt) LOW OIL display: ON

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

Activates <i>S.A.F.E.</i>
Stores service code 117
<i>EMM</i> LED 4: ON (Running)
Gauge (opt) NO OIL display: ON

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

- Oil level must be above one-quarter
- 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 3 hours with NO OIL faults (codes 34 & 117), the *EMM*

Stores service code 33
<i>EMM</i> LED 4: FLASHING
Gauge (opt) NO OIL display: FLASHING

Throttle Position Sensor

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

If TPS voltage is greater than 0.78 volts when the recoil starter is pulled, the *EMM*:

Creates service code 11

If the outboard starts, the code is stored.

If code 11 is present as both a Hard Fault and a Stored Fault, refer to **Throttle Cable Adjustment** on p. 231.

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

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

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

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

Stores service code 13
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)
Gauge (opt) CHECK ENGINE display: ON

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

Stores service code 14
<i>EMM</i> LED 3: OFF (Cranking)
<i>EMM</i> LED 3: ON (Running)
Gauge (opt) CHECK ENGINE display: ON

Crankshaft Position Sensor

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

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

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

Approximate air gap between CPS and flywheel encoder ribs is .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.

Neutral Switch

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

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

Stores service code 19
<i>EMM</i> LED 3: OFF (Cranking)
Gauge (opt) CHECK ENGINE display: ON

The *Monitor* screen of the diagnostics program displays switch position, NEUTRAL or IN GEAR. Make sure switch is operating properly.

INTERNAL *EMM* FUNCTIONS

ROM Verification

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

Idle Controller

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

RPM Limiter

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

Neutral RPM Limiter

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

Exhaust Water Valve Activation

During acceleration, the *EMM* opens a valve that injects water into the exhaust housing. This water changes the tuning of the exhaust, allowing the engine to develop more midrange horsepower as the boat comes on plane.

Two conditions must be met to activate the valve:

- Throttle opening above 80%
- RPM between 2500 to 4600.

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

Engine Monitor and Warning Systems

Refer to **ENGINE MONITORING SYSTEM** on p. 84.

Refer to **S.A.F.E. WARNING SYSTEM** on p. 85.

Fault Code Creation and Storage

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

ENGINE MONITORING SYSTEM

The *MFE* Engine Monitor system warns the operator of conditions that could damage the outboard:

- LOW OIL
- *EMM* overheated
- Engine overheated

The monitor system interrupts the ignition once per 50 engine revolutions to signal the operator.

Optional External Warning System

IMPORTANT: An optional dash mounted warning system is available for *MFE* 55 models through the installation of boat harness wiring kits. Refer to the *Johnson/Evinrude Genuine Parts* catalog.

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

The *EMM* sends information about monitored functions to:

- An *I-Command*, or other *NMEA 2000* compliant CANbus network
- The *SystemCheck* Modular Wiring System (boat Harness Kit P/N 586853)
- *EMM* LED indicators

The *EMM* activates the warning horn and gauge displays as follows:

- LOW OIL means that oil in the tank is at reserve level (about 1/4 full).
- NO OIL indicates the oil tank is empty.
- WATER TEMP or HOT indicates an engine or *EMM* overheat condition.
- CHECK ENGINE or FAULT is used to indicate other fault conditions identified by the *EMM*.

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

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

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

S.A.F.E. WARNING SYSTEM

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

Code 29	Excessive <i>EMM</i> temperature
Code 31	Excessive engine temperature
Code 33	Critical NO OIL detected
Code 34	Oil injector open circuit
Code 117	NO OIL

Activation

When one of these conditions occurs, the *EMM* interrupts fuel injector and ignition operation, reducing engine speed to 2500 RPM. The dash mounted warning horn sounds and an Engine Monitor display turns on (when installed). When *S.A.F.E.* is active, the engine will run normally below 2500 RPM. Above 2500 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

ENGINE MANAGEMENT MODULE (EMM) DIAGNOSTIC SOFTWARE FUNCTIONS

DIAGNOSTIC SOFTWARE FUNCTIONS

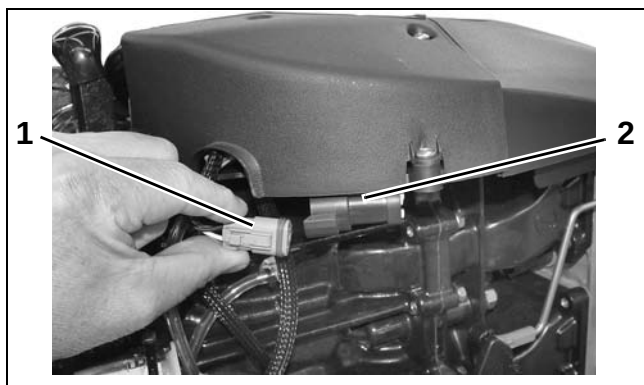
The *EMM* stores valuable information about the outboard and its running history. This information can be used for troubleshooting, for checking parts information, and for making adjustments to the system.

Use *Evinrude Diagnostics* software, version 4.5 or higher, and a laptop computer to access program information.

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

Communication

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



1. Diagnostic connector
2. Cover

004973

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

The *EMM* must turn ON before it will communicate with the computer. The *EMM* is turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.

Diagnostic communications on non-running outboards requires a power supply to the *EMM*.

Use Diagnostic Power Supply Tool, P/N 587005, to supply power to the *EMM*. The power supply uses internal 9-volt batteries.

Disconnect the tiller handle harness connector from the engine harness. Connect Power Supply Tool to the engine harness connector. Turn toggle switch to the ON position to power the *EMM*.



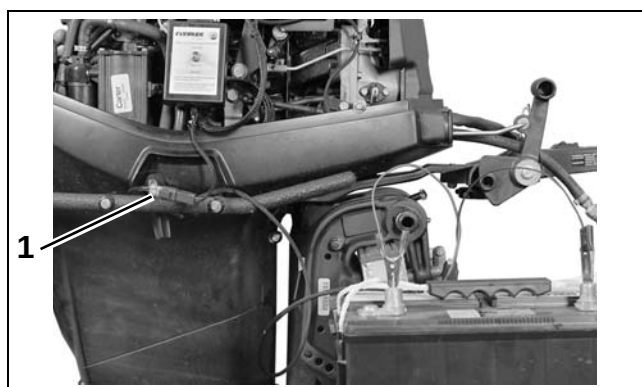
1. Power supply tool
2. Engine harness connectors

007279

IMPORTANT: Static tests require more power than the internal batteries of the tool can provide. Static tests performed using only the internal power supply batteries will produce false results.

Use Accessory Power Cable Kit, P/N 5008092, to connect an external 12 volt battery to the Power Supply Tool when performing these static tests:

- Fuel pump
- Fuel injector
- Ignition coil
- Oil injector.

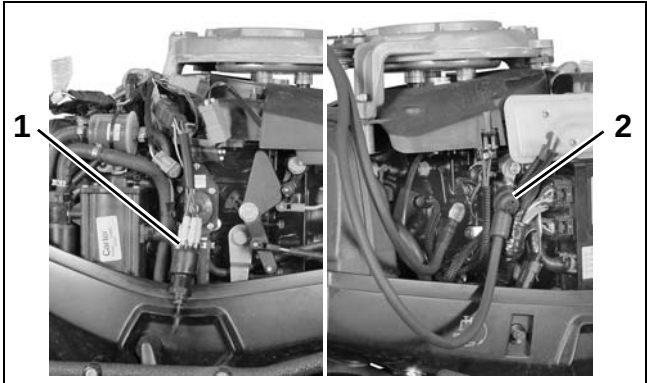


1. External power connector

007280

ENGINE MANAGEMENT MODULE (EMM) DIAGNOSTIC SOFTWARE FUNCTIONS

If Diagnostic Power Supply Tool, P/N 587005, is not available, a Battery Cable, P/N 584348, can be connected to the engine mounted solenoid. Use accessory Key Switch Assembly, P/N 176408, to control power to the *EMM*.

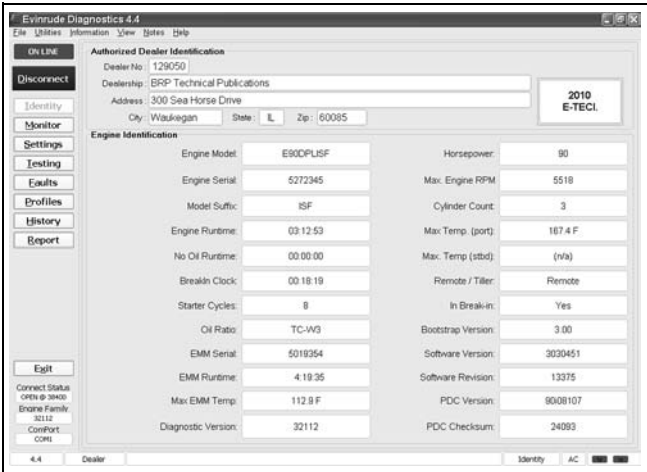


1. Accessory key switch 007281
2. Battery cable 007282

Static Information

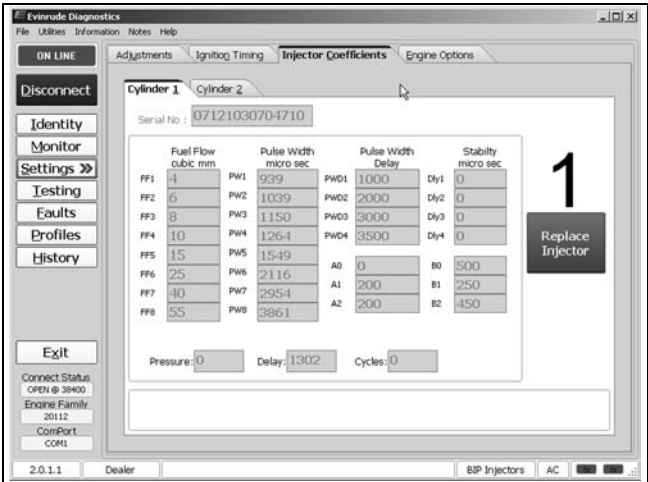
Static information is viewed when the outboard is NOT running. This includes manufacturing information.

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



Identity Screen 008078

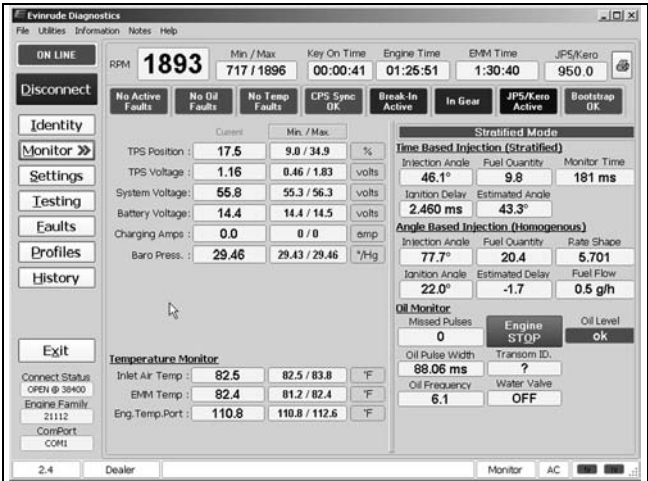
The serial number and cylinder location displayed on the *Injector Coefficients* screen must match the actual cylinder placement for each injector.



Injector Coefficients Screen 006538

Dynamic Information

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



Monitor Screen 006624

ENGINE MANAGEMENT MODULE (EMM) DIAGNOSTIC SOFTWARE FUNCTIONS

Stored Service Codes (Faults)

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

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



Stored Faults Review Screen

008098

Hard Faults

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



Hard Faults Review Screen

008081

Persistent Faults

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

Persistent faults cannot be erased.

Static Tests

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



Static Tests Screen

008099

Ignition Test

Use the diagnostics software to test each ignition circuit. Refer to **Static Ignition Test** on p. 103.

Fuel Test

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

Oil Injector

Use the diagnostics software to test the oil injection pump circuit. Refer to **OILING SYSTEM TESTS** on p. 163.

Fuel Pump

Use the diagnostics software to test the fuel pump circuit. Refer to **Fuel Pump Static Test** on p. 106.

Water Injector

This test activates the exhaust water valve solenoid. Refer to **Exhaust Water Valve Static Test** on p. 108.

Overheat

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

Oil Fault

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

Check Engine

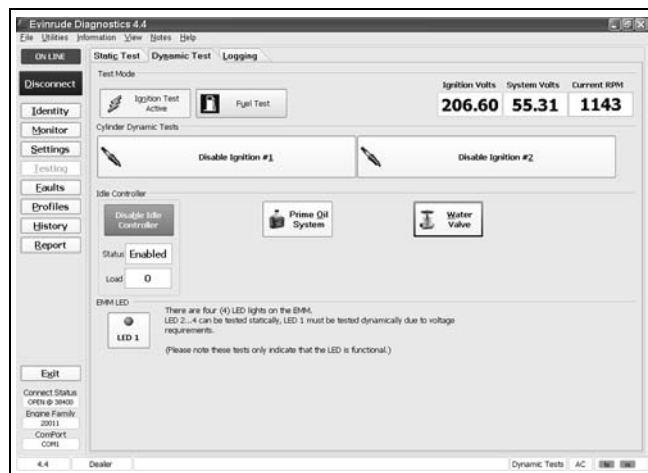
This test is used to check the “CHECK ENGINE” circuit of the Engine Monitoring system.

Tachometer

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

Dynamic Tests

Dynamic tests are performed with the outboard running.



Dynamic Tests Screen

008100

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. 98.

Fuel Test

This test momentarily disables one fuel injector circuit. By dropping one cylinder, RPM and running quality changes can be observed. Refer to **DYNAMIC TESTS** on p. 98.

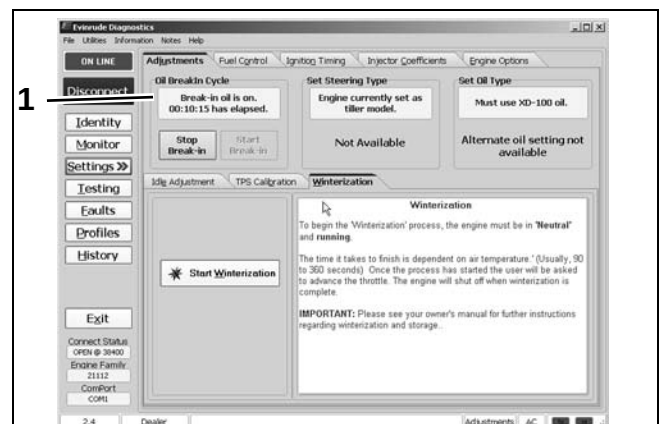
Prime Oil

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

Oil Control Settings

Powerhead Break-In

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



1. Break-in oil setting

006622

Ignition Timing

Use the *Ignition Timing* screen to check and adjust EMM timing. EMM timing must be synchronized to crankshaft position. Refer to **TIMING ADJUSTMENTS** on p. 124.

TPS Calibration

TPS Calibration synchronizes throttle plate opening with throttle position sensor voltage. Calibrate after replacing or adjusting any throttle body or throttle linkage parts. Refer to **TPS Calibration** on p. 126.

ENGINE MANAGEMENT MODULE (EMM) DIAGNOSTIC SOFTWARE FUNCTIONS

Idle Speed Control

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



1. Idle adjustment

007091

Fuel Injector Servicing

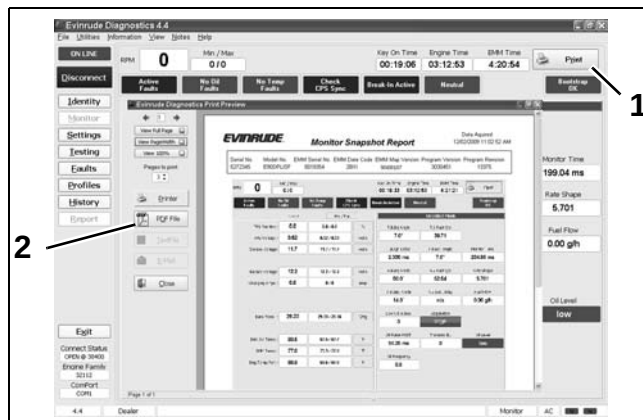
All *E-TEC* fuel injectors use software programming to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the *EMM*. DO NOT install an injector without updating the compensation software.

To install a service injector, click the “Replace” button on the *Injector Coefficients* screen and select the file for the replacement injector. Refer to **Fuel Injector Service** on p. 148.

Reports

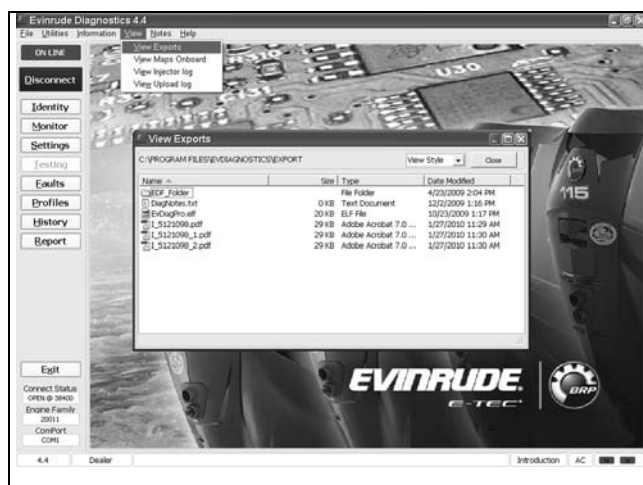
Engine reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

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



1. Print button
2. Print/Export options

008087



Engine Report data files

008095

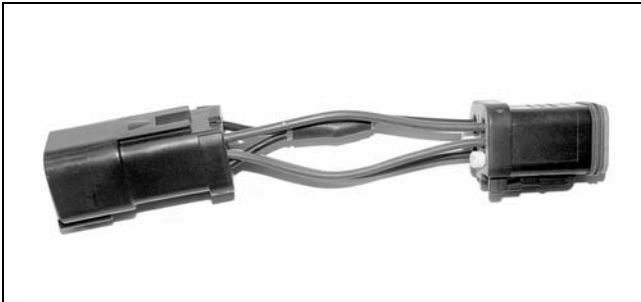
Software Replacement

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



006541

IMPORTANT: Software replacement requires the use of Bootstrap Tool, P/N 586551. Install tool between engine harness key/stop switch connector and Diagnostic Power Supply Tool, P/N 587005, as instructed by update program.



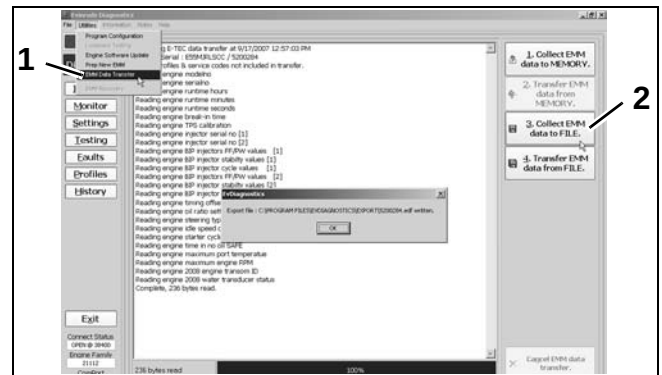
002383

EMM Transfer

EMM Transfer is used to save engine history data when the *EMM* must be replaced.

A back-up engine data file saved on an external storage device can be used to restore the outboard to service if the *EMM* is damaged.

Select *EMM Data Transfer* from the *Utilities* menu. Select the Collect *EMM* data to FILE option and follow the instructions provided with the program.



1. Select *EMM Data Transfer*
2. Select *Collect EMM data to FILE*

006642

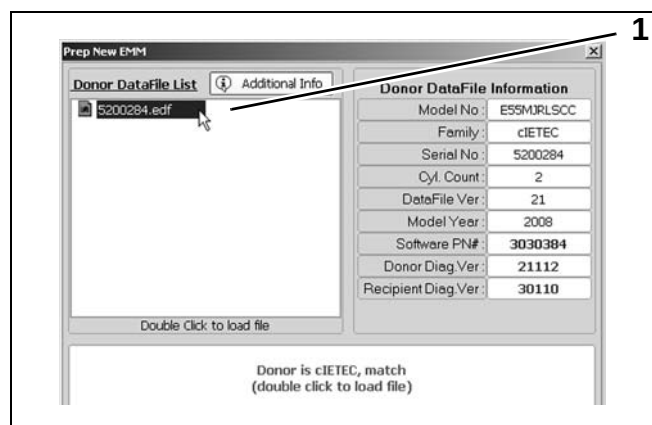
IMPORTANT: Whenever the *EMM* is replaced, *EMM* timing must be synchronized to crankshaft position. Refer to **TIMING ADJUSTMENTS** on p. 124.

ENGINE MANAGEMENT MODULE (EMM) EMM SERVICING

EMM Replacement

Before installing a new *EMM*, program information from the original *EMM* must be saved to a computer data file. Refer to **EMM Transfer** on p. 91.

After the new *EMM* is installed on the outboard, apply power to *EMM*. Select Prep New *EMM* from the *Utilities* Menu. Follow the instructions provided with the program to load engine software and transfer *EMM* data.



1. Select engine serial number file

006658

IMPORTANT: If more than one file is listed, be sure to select the engine data file (.edf) that matches the engine serial number.

IMPORTANT: Whenever the *EMM* is replaced, *EMM* timing must be synchronized to crankshaft position. Refer to **TIMING ADJUSTMENTS** on p. 124.

EMM SERVICING

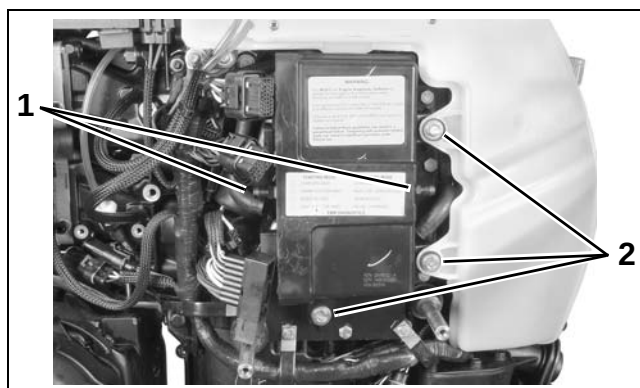
Removal

IMPORTANT: If a new *EMM* is being installed, refer to **EMM Transfer** on p. 91.

Disconnect cooling hoses from *EMM*.

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

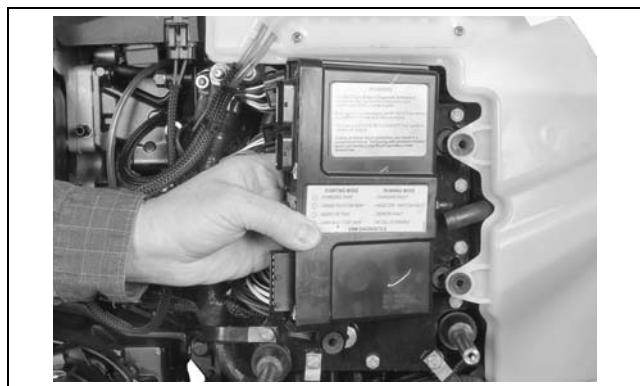
Remove three *EMM* retaining screws and washers. Remove *EMM*.



1. Cooling hose connections
2. EMM mounting screws

006476

Remove *EMM* from behind oil tank bosses.

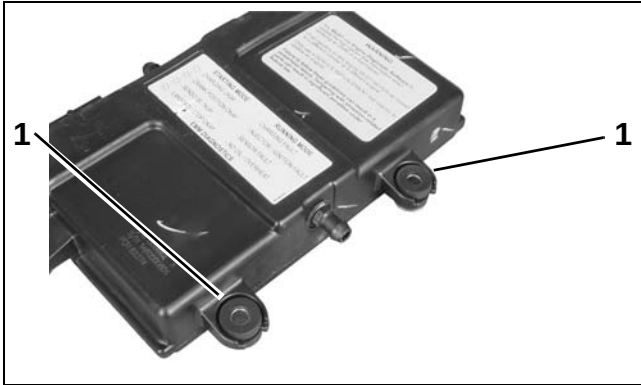


006477

Installation

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

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



1. Isolator mounts

006478

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

Install harness connectors and cooling hoses. Secure hoses with tie straps.

Technician's Notes

[illegible]

Bulletins

[illegible][illegible][illegible]

SYSTEM ANALYSIS

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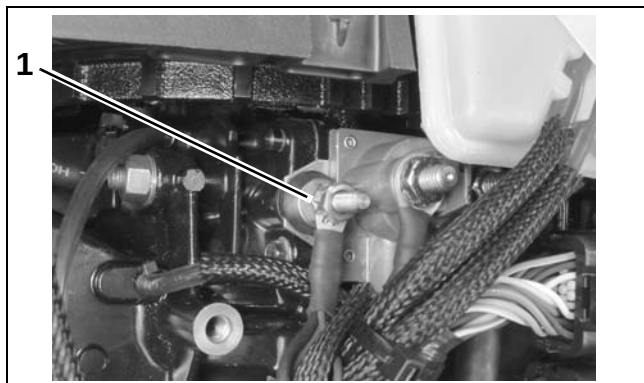
DIAGNOSTIC PROCEDURES

Visual Inspections

Inspect wiring and electrical connections. Disassemble and clean all corroded connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits.

- Refer to **ELECTRICAL HARNESS CONNECTIONS** on p. 113.
- Refer to **WIRING DIAGRAM** at the back of this manual.
- Refer to **CONNECTOR SERVICING** on p. 127.

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



1. Main engine harness ground

006489

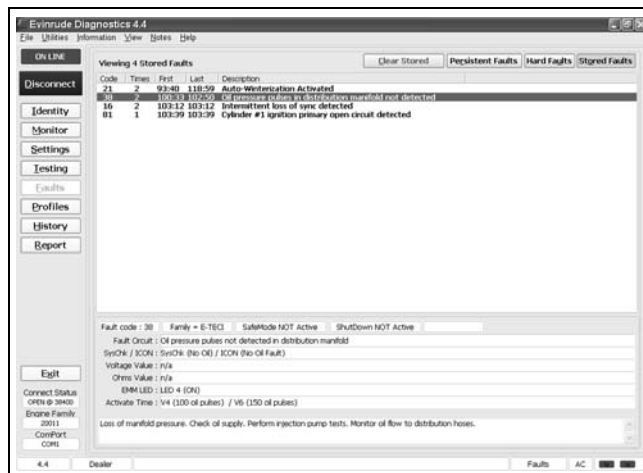
Inspect spark plugs for wear, oil fouling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.

Check the fuse and the emergency stop switch lanyard.

Operational Inspections

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

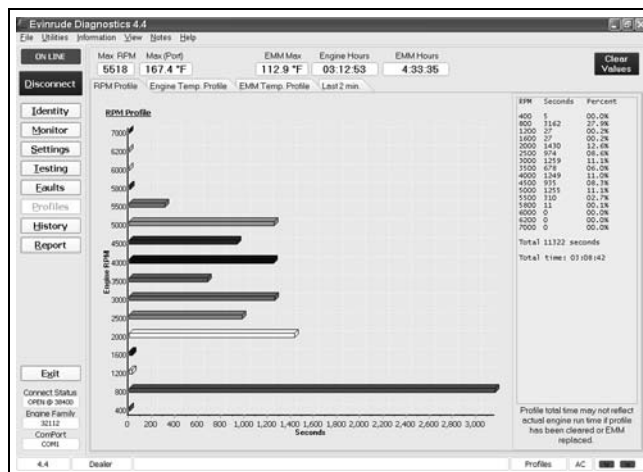
- Make sure the outboard can be cranked easily, with no mechanical binding.
- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED INDICATORS** on p. 99.
- Check the *Evinrude Diagnostics* software *Hard Faults* and *Stored Faults* screens for current service codes before troubleshooting. Correct any problems and clear the codes FIRST. Refer to **Stored Service Codes (Faults)** on p. 88.



Stored Faults Review Screen

008098

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



Profiles Screen

008088

Troubleshooting

Outboard cranks, will not start:

- Check emergency stop switch and lanyard
- Check powerhead mounted neutral switch
- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED INDICATORS** on p. 99.
- Use the *Evinrude Diagnostics* software *Stored Faults* screen to check for current service codes. If there are multiple stored sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
- Perform a Static Ignition test using *Evinrude Diagnostics* software and an inductive timing light. Refer to **Static Ignition Test** on p. 103.
- If ignition test indicates steady spark, refer to **FUEL DELIVERY TESTS** on p. 106.

Outboard runs, low on power, misfires:

- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED INDICATORS** on p. 99.
- 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. 98.
- Use an inductive timing light to check ignition and fuel injector circuits. Refer to **Running Ignition Tests** on p. 104 and **Running Fuel System Tests** on p. 107.

- 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. 98.
- Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.
- Check fuel quality and that fuel is present at injectors.
- Use the diagnostics software *Logging* function to record engine data as a problem is occurring.

Time (min)	RPM	TPS_V	Sprts/Min	Sprts/Sec	Chgs/Sec	Eng Temp (°F)	Coolant Temp (°F)	Oil Pressure (PSI)	Barometric Pressure (inHg)
5	1500	721	0	0.40	55.74	13.01	2.5	149.56	58.72
6	1800	718	0	0.40	55.74	13.01	2.5	149.56	58.72
7	2100	689	0	0.40	55.51	13.59	2.38	149.56	58.93
8	2400	691	0	0.40	54.92	13.59	2.38	149.56	58.93
9	2700	674	0.6	0.40	55.63	13.59	2.38	149.77	58.93
10	3000	675	0.5	0.7	55.74	13.59	2.75	149.77	58.93
11	3300	976	10.5	0.89	55.63	13.85	6.63	149	58.93
12	3600	1124	13.3	1.01	55.51	14.08	8.5	149.77	58.72
13	3900	1160	13.9	1.08	55.04	14.2	9.13	149.77	58.72
14	4200	1208	13.7	1.02	55	14.26	9.5	149.77	58.72
15	4500	1205	13.8	1.03	55.04	14.32	9.38	149.98	58.72
16	4800	1207	13.7	1.03	54.92	14.36	9.5	149.77	58.72
17	5100	1191	13.7	1.03	54.73	14.36	9.25	149.98	58.72
18	5400	1211	13.9	1.04	54.84	14.34	9.38	149.98	58.72
19	5700	1164	14	1.02	55.12	14.36	9.13	150.2	58.72
20	6000	1197	13.7	1.02	55.43	14.36	9.25	150.2	58.72
21	6300	1198	13.8	1.02	55.55	14.36	9.38	150.2	58.72
22	6600	1216	13.7	1.02	55.43	14.36	9.5	150.2	58.72
23	6900	1230	13.8	1.03	55.38	14.36	9.63	150.2	58.72
24	7200	1202	13.8	1.03	55.51	14.36	9.38	150.2	58.72

Logging Screen

008097

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

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

DYNAMIC TESTS

Cylinder Drop Tests

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

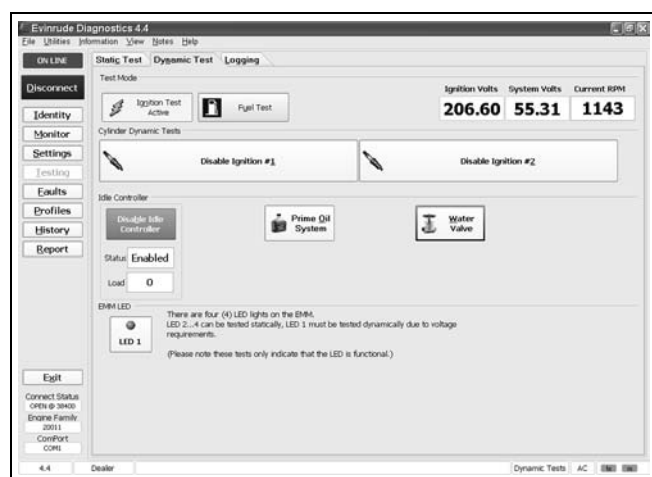
- The Dynamic Ignition test disables the ignition and fuel injection circuits to a cylinder.
- The Dynamic Fuel test momentarily disables one fuel injector circuit.

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

IMPORTANT: Test the outboard while the running quality issue is present. 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

008100

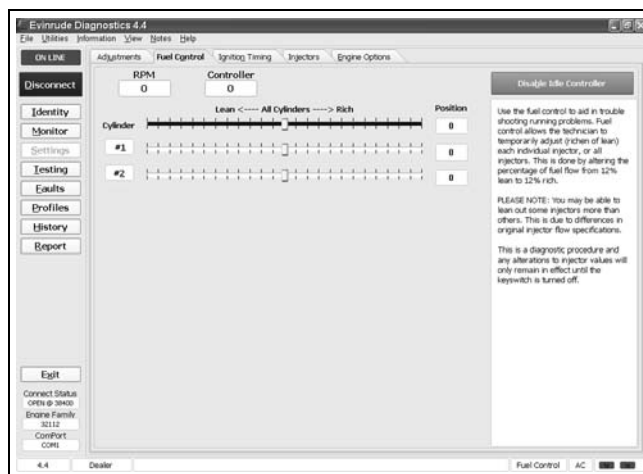
IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed. The *Dynamic Tests* screen includes a function to temporarily disable the idle controller.

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.



008089

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

- Refer to **Fuel System Pressure Test** on p. 139.
- Refer to **Running Fuel System Tests** on p. 107.

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

Inductive Amp Meter Test

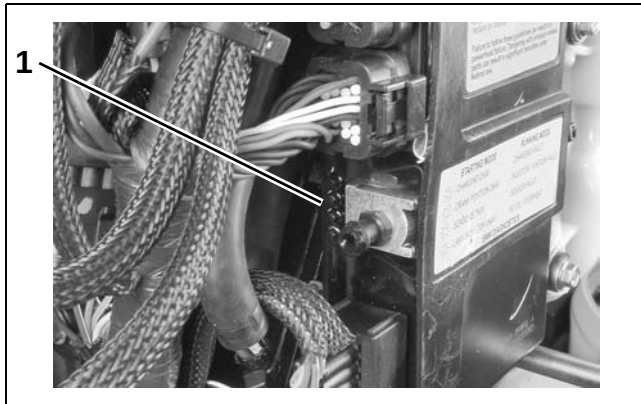
Use an inductive amp meter to monitor battery charging and current flow. Identifying erratic amperage in a circuit can be used to isolate a problem component.

EMM LED INDICATORS

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

For detailed code information, refer to the **EMM Service Code Chart** at the back of this manual.

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



1. LED indicators
(Cooling hose removed for clarity)

006467

Key ON

IMPORTANT: Diagnostic communications on non-running rope start models requires that power is supplied to the *EMM*. Refer to **Communication** on p. 86.

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

LED 3 – Sensor Circuits working.

LED 4 – Stop Circuit not grounded—okay to start. FLASHING LIGHT indicates severe overheating or no oil.

Starting

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

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

LED 2 – CRANK POSITION OKAY – input from CPS, *EMM* powered ON. For NO LIGHT, check for:

- Code 16 – CPS, intermittent loss of sync

LED 3 – SENSORS OKAY (5 V). For NO LIGHT, check for:

- Code 12 – TPS circuit fault
- Code 13 – TPS below expected range
- Code 14 – TPS above expected range
- Code 19 – In Gear
- Code 23 – *EMM* temp. sensor circuit fault
- Code 24 – *EMM* temp. below expected range
- Code 41 – temp. sensor circuit fault
- Code 42 – temp. below expected range
- Code 47 – AT sensor circuit fault
- Code 48 – AT sensor below expected range
- Code 49 – AT sensor above expected range
- Code 58 – Operating temperature not reached
- Code 78 – Sensor supply voltage fault

LED 4 – LANYARD/STOP OKAY. For NO LIGHT, check for:

- Grounded stop circuit.

For FLASHING LIGHT, check for:

- Code 29 – *EMM* temp. OVER range (flashing)
- Code 31 – Engine temp. OVER range (flashing)
- Code 33 – Excessive no oil condition (flashing)

SYSTEM ANALYSIS

EMM LED INDICATORS

Running

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

LED 1 – CHARGING FAULT:

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

LED 2 – INJECTOR/IGNITION FAULT:

- Code 51 – cylinder no. 1 injector circuit open
- Code 52 – cylinder no. 2 injector circuit open
- Code 61 – cylinder no. 1 injector circuit short
- Code 62 – cylinder no. 2 injector circuit short
- Code 81 – no. 1 ignition primary circuit open
- Code 82 – no. 2 ignition primary circuit open
- Code 90 – Water injection solenoid short
- Code 91 – fuel pump circuit open
- Code 93 – Water injection solenoid open
- Code 94 – fuel pump circuit short
- Code 101 – No. 1 ignition timing circuit shorted
- Code 102 – No. 2 ignition timing circuit shorted

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

For LIGHT ON, check for possible fault codes:

- Code 12 – TPS circuit fault
- Code 13 – TPS below expected range
- Code 14 – TPS above expected range
- Code 16 – CPS, intermittent loss of sync
- Code 23 – *EMM* temp. sensor circuit fault
- Code 24 – *EMM* temp. below expected range
- Code 41 – PORT temp. sensor circuit fault
- Code 42 – PORT temp. below expected range
- Code 47 – AT sensor circuit fault
- Code 48 – AT sensor below expected range
- Code 49 – AT sensor above expected range
- Code 58 – operating temp. not reached
- Code 78 – Sensor supply voltage fault

LED 4 – Engine overheat, *EMM* temperature or sensor, oil injection pump or sensor, “NO OIL / OVERHEAT.” For LIGHT ON, check for possible fault codes:

- Code 25 – *EMM* temp. above expected range
- Code 29 – *EMM* temp. OVER range (flashing)
- Code 31 – engine temp. OVER range (flashing)
- Code 33 – excessive NO OIL faults (flashing)
- Code 34 – oil injection pump circuit open
- Code 43 – engine overheat
- Code 117 – Critical NO OIL detected

IGNITION OUTPUT TESTS

WARNING

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.

DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.

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

Required Ignition Systems

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

Stop Circuit

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

Neutral Switch

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

Stator Output Voltage

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

EMM

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

Crankshaft Position Sensor

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

Alternator Output/System Voltage

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

Capacitor

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

Ignition Coil

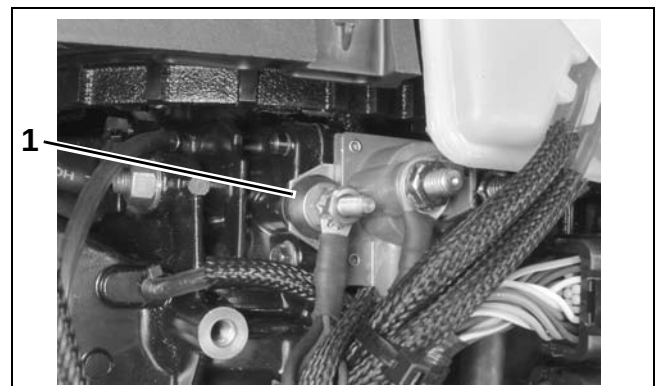
- Primary circuits are powered by system (55 V) voltage
- *EMM* provides control signal to ignition coil
- Output from ignition coil secondary winding and high tension spark plug wire.

Wiring Inspection

Visually inspect all wiring, connections, and grounds.

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

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



1. Main engine harness ground

006489

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

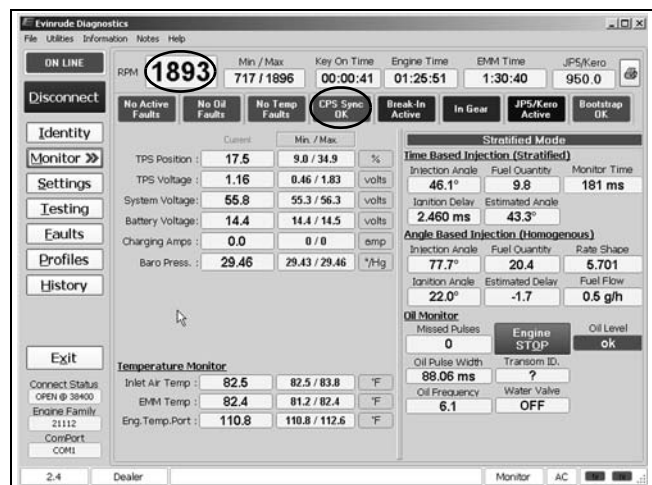
SYSTEM ANALYSIS

IGNITION OUTPUT TESTS

Crankshaft Position Sensor (CPS) Test

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

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



Engine RPM and CPS Sync displays

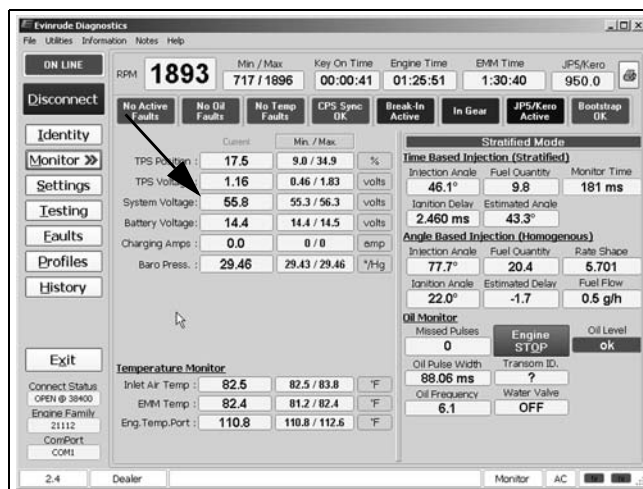
006624

If the *Monitor* screen says “Check CPS Sync,” refer to **Crankshaft Position Sensor (CPS) Test** on p. 116.

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

006624

Results:

- *EMM* ON (not running) - approximately 1 V less than battery voltage, system voltage is GOOD.
- *EMM* ON (not running) - no voltage, check 12 V power to *EMM*. Repair connection or wiring.
- RUNNING - 55 V $\pm$ 2, system voltage is GOOD.
- RUNNING - less than 55 V $\pm$ 2, check stator output to *EMM*. Repair connection or wiring. Possible faulty stator or *EMM*. Refer to **STATOR TESTS** on p. 118.

IMPORTANT: The *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. The *EMM* is turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked. On a non-running engine, power is supplied to the *EMM* by Diagnostic Power Supply Tool, P/N 587005.

Static Ignition Test

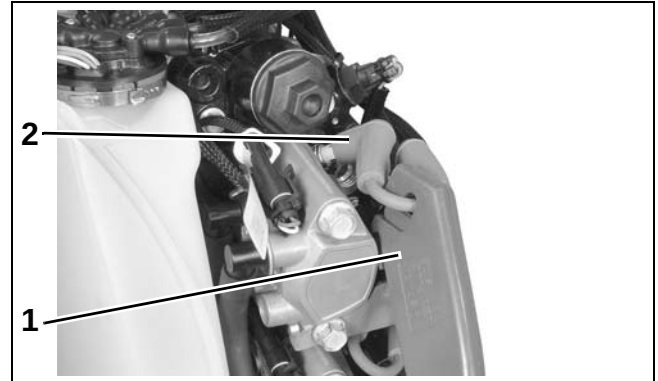
Perform the static ignition test using *Evinrude Diagnostics* software and an inductive timing light.

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply Tool, P/N 587005, with internal 9 volt batteries only. This will produce false results. Refer to **Communication** on p. 86.

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

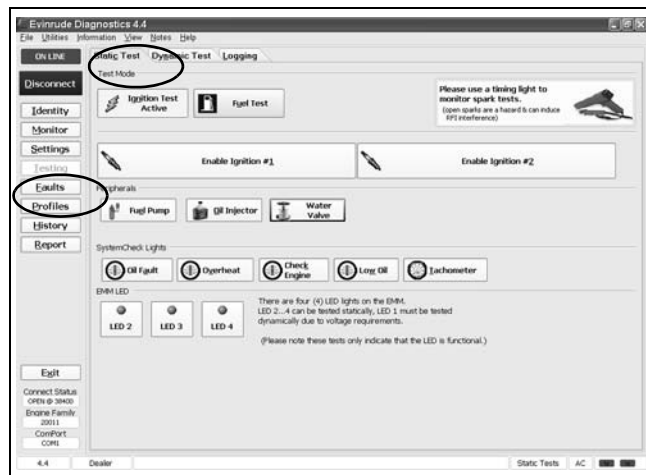
The outboard must NOT be running and the emergency stop switch lanyard must be installed.

IMPORTANT: This test is operating the ignition coil with 12 V battery power on the system voltage (55 V) circuit. An inductive probe with low sensitivity may not be able to detect the signal.



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

006492



Static Tests Screen

008099

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

Results:

No spark on one or more cylinders:

- Inspect or replace spark plugs
- Refer to **Ignition Control Circuit Tests** on p. 105
- Refer to **Ignition Coil Tests** on p. 105

Steady spark on all cylinders:

- Refer to **Running Ignition Tests** on p. 104 and **DYNAMIC TESTS** on p. 98.

SYSTEM ANALYSIS

IGNITION OUTPUT TESTS

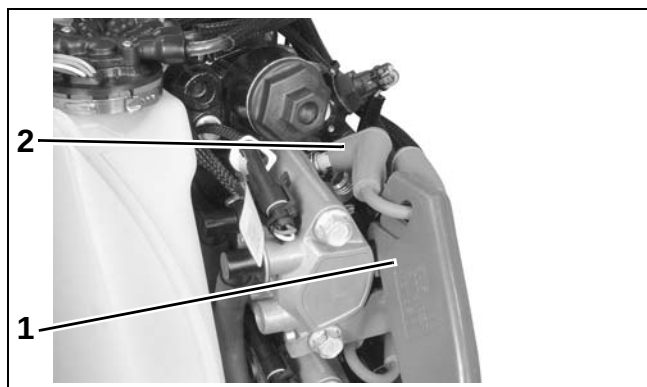
Running Ignition Tests

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. 102.

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

006492

Results:

Steady voltage and strobe, engine misfires:

- Inspect or replace spark plugs
- Refer to **FUEL DELIVERY TESTS** on p. 106
- Check for internal engine damage.

Steady voltage, erratic strobe, engine misfires:

- Inspect or replace spark plugs
- Check CPS air gap, resistance, and wiring
- Refer to **Ignition Control Circuit Tests** on p. 105
- Refer to **Ignition Coil Tests** on p. 105.

Voltages fluctuate, engine misfires:

- Inspect battery and connections
- Test capacitor and all ground connections
- Refer to **System Voltage Test** on p. 102
- Refer to **Ignition Control Circuit Tests** on p. 105
- Refer to **Ignition Coil Tests** on p. 105.

IMPORTANT: If a running problem occurs at about 2500 RPM, the outboard may be in **S.A.F.E.** Refer to **S.A.F.E. WARNING SYSTEM** on p. 85.

Ignition Control Circuit Tests

Use a digital multimeter to test the following:

- System voltage supply to ignition coil.
- Ignition control signal from *EMM*.
- Engine harness resistance.

Disconnect ignition coil connector.

Supply voltage test:

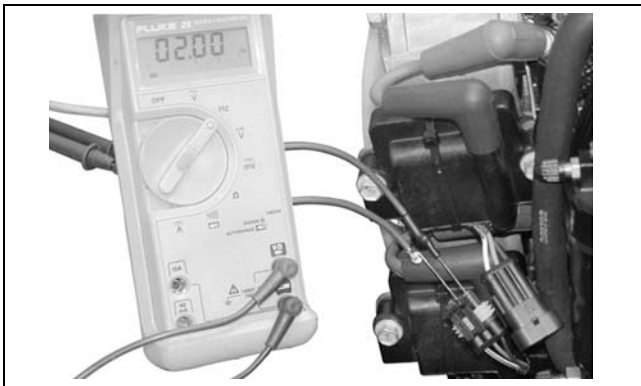
Use an appropriate adapter to connect the red meter lead to pin 3 (white/red) of the engine harness connector and the black lead to ground. With *EMM* ON (Diagnostic Power Supply Tool, P/N 587005, connected), voltage should be approximately 1 V less than battery voltage.

Control signal test:

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

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

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



006609

Harness resistance test:

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

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

If circuits test good, replace *EMM*.

Ignition Coil Tests

There are no simple ignition coil tests available. Before replacing an ignition coil, be sure:

- 55 V is supplied to the white/red wire of the ignition coil connector.
- A control signal is present on the orange wire of the ignition coil connector. Refer to **Ignition Control Circuit Tests** on p. 105.
- The black wire of the ignition coil connector provides continuity to ground.
- The secondary spark plug lead provides continuity.

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

Capacitor Test

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

Remove capacitor from electrical harness.

Use an ohmmeter set on the high ohms scale to test the capacitor. Connect the meter leads to the capacitor terminals:

- If the capacitor is working correctly, it will store energy from the meter. The resistance reading will increase until it goes to (nearly) infinity.
- If the capacitor is shorted, the reading will immediately show full continuity.
- If there is an open circuit in the capacitor, the meter will show no continuity.

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

FUEL DELIVERY TESTS

! WARNING

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

Refer to **Relieving Fuel System Pressure** on p. 144.

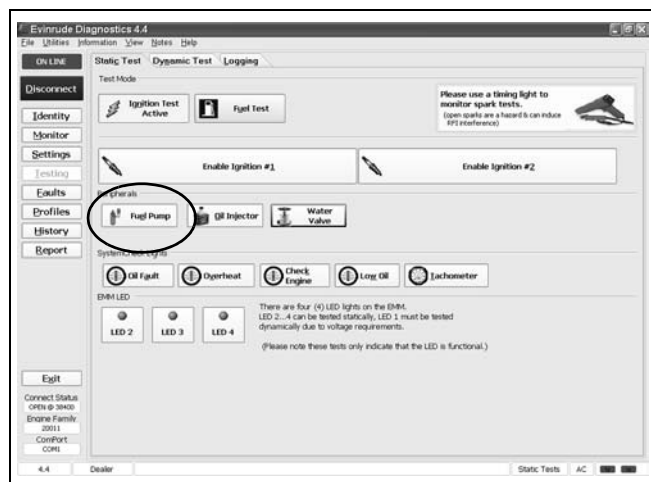
Check the *Evinrude Diagnostics* software *Stored Faults* screen for current service codes before troubleshooting. Correct any problems and clear the codes FIRST.

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

Fuel Pump Static Test

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

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply Tool, P/N 587005, with internal 9 volt batteries only. This will produce false results. Refer to **Communication** on p. 86.



Static Tests Screen

008099

If the pump does not run:

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

Voltage should be 55 V when the outboard is cranking or running.

- The *EMM* controls the fuel pump ground (brown wire). Use an ohmmeter to check continuity between pin 2 of fuel pump connector and ground. Use the fuel pump static test to activate the control function of the *EMM*. Resistance should drop as *EMM* connects the control circuit to ground.
- Refer to **Circulation Pump Resistance Test** on p. 141.

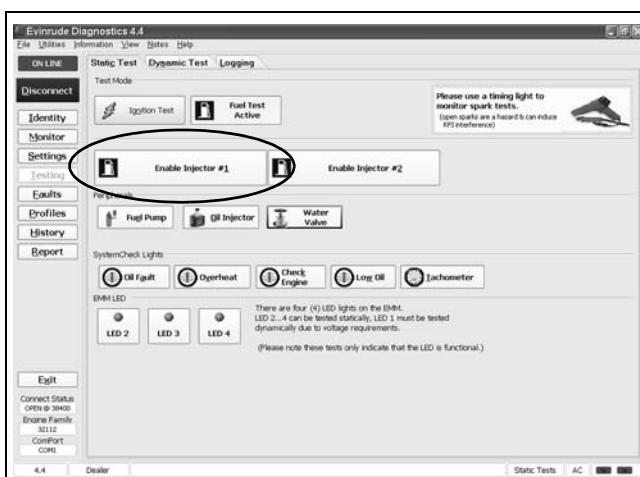
If the pump runs:

- Refer to **Fuel System Pressure Test** on p. 139.
- Refer to **Running Fuel System Tests** on p. 107.

Fuel Injector Static Test

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

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply Tool, P/N 587005, with internal 9 volt batteries only. This will produce false results. Refer to **Communication** on p. 86.



Static Tests Screen

008099

IMPORTANT: This test is operating the injectors with 12 V battery power on the system voltage (55 V) circuit. Battery must be fully charged and connections must be clean and tight. Injector activation should be carefully confirmed.

Results:

No injectors actuate:

- Use the *Monitor* screen of the diagnostics software to make sure voltage is present on the system voltage circuit.
- Refer to **Running Fuel System Tests** on p. 107.

Some injectors actuate; some do not:

- For non-working injectors, test the resistance of injector circuit between the injector connector and injector control wire at the *EMM*.
- See **Fuel Injector Resistance Test** on p. 141.

All injectors actuate:

- Refer to **Running Fuel System Tests** on p. 107.

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. 118.

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):

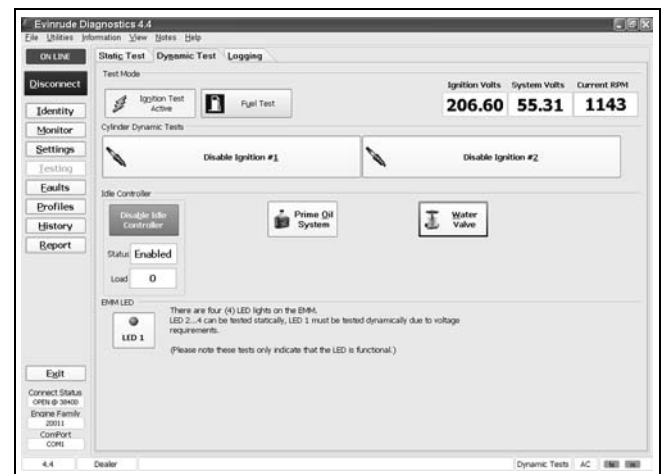
- Check stator input to *EMM*, CPS operation, and all grounds and wiring connections.
- Eliminate all other possibilities to isolate a faulty *EMM*.

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*.
- Make sure all grounds are clean and tight.
- See **Fuel Injector Resistance Test** on p. 141.

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. 98.



Dynamic Tests Screen

008100

- Refer to **Fuel Injector Pressure Test** on p. 140.
- Refer to **Fuel System Pressure Test** on p. 139.

SYSTEM ANALYSIS

EXHAUST WATER VALVE

EXHAUST WATER VALVE

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

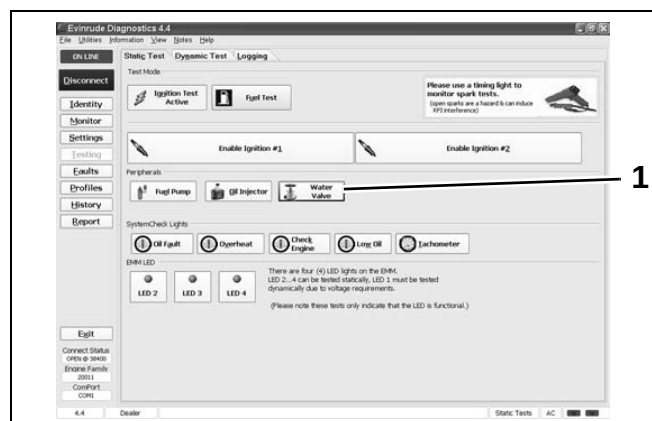
If the valve is plugged or not working, the operator may not notice a problem during slow acceleration. During rapid acceleration, the outboard will be low on power around 3200 rpm, depending on boat and load.

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

Exhaust Water Valve Static Test

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

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



Static Tests Screen

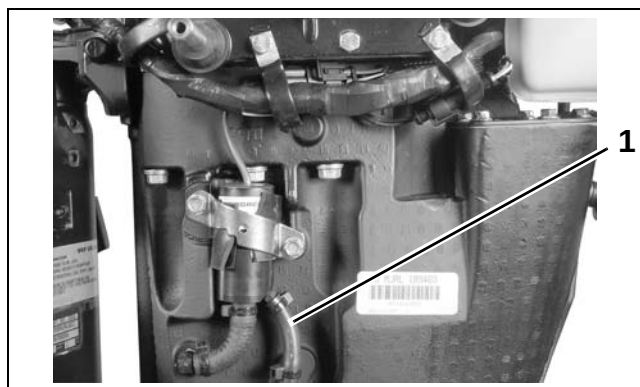
1. Water valve test button

008099

Exhaust Water Valve Dynamic Test

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

Disconnect the water valve outlet hose.



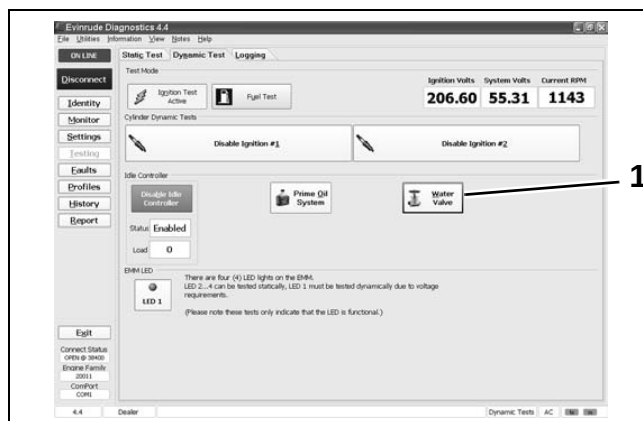
1. Water valve outlet hose

004293m

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

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

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



Dynamic Tests Screen

1. Water valve test button

008100

Results:

- No water flow—check for debris in valve assembly and water supply line. Refer to **EXHAUST WATER VALVE TEST** on p. 120.
- Water appears—make sure fitting into exhaust housing is clear.

ELECTRICAL AND IGNITION

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SERVICE CHART

5 to 8 in lbs.
(.6 to .9 N·m)

120 to 140 in lbs.
(13.5 to 16 N·m)

100 to 115 ft. lbs.
(136 to 156 N·m)

84 to 106 in lbs.
(9.5 to 12 N·m)

60 to 84 in lbs.
(7 to 9.5 N·m)

24 to 36 in lbs.
(2.7 to 4 N·m)

24 to 36 in lbs.
(2.7 to 4 N·m)

24 to 36 in lbs.
(2.7 to 4 N·m)

IMPORTANT:
DO NOT lubricate TPS
to throttle shaft surface

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

**24 to 36 in lbs.
(2.7 to 4 N·m)**

B

J

**15 to 30 ft. lbs.
(20 to 41 N·m)**

X

**60 to 84 in lbs.
(7 to 9.5 N·m)**

F

**30 to 42 in lbs.
(3.5 to 5 N·m)**

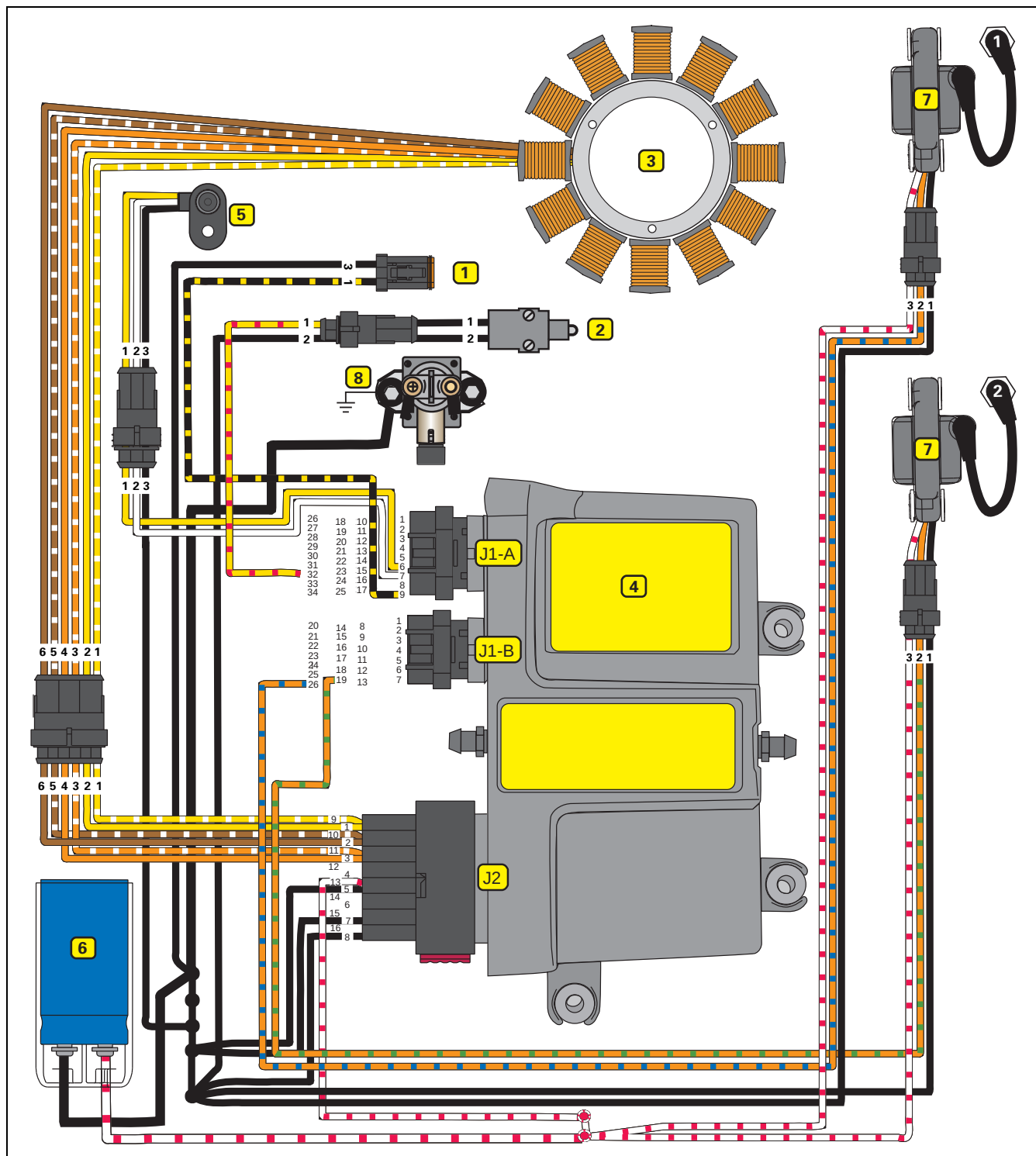
**24 to 36 in lbs.
(2.7 to 4 N·m)**

**7 to 10 in. lbs.
(0.8 to 1.1 N·m)**

A	Triple-Guard Grease
B	Gasket Sealing Compound
C	Adhesive 847
D	Moly Lube
E	Red Ultra Lock
F	Blue Nut Lock
J	Thermal Grease
T	Liquid Neoprene
X	Refer to Spark Plug Indexing on p. 63

002249a

IGNITION SYSTEM CIRCUIT DIAGRAM



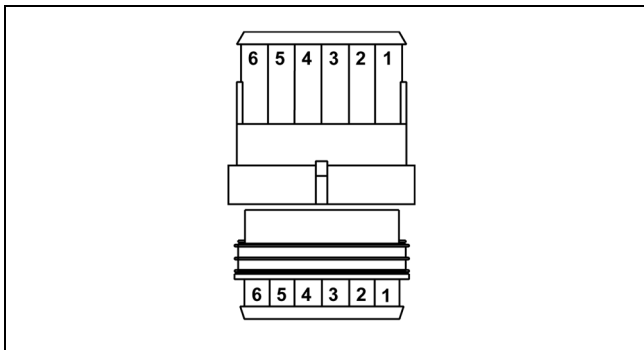
- | | | |
|------------------------------|-------------------------------|------------------------|
| 1. Key switch (stop circuit) | 4. EMM | 7. Ignition coil |
| 2. Neutral switch | 5. Crankshaft position sensor | 8. Main harness ground |
| 3. Stator | 6. Capacitor | |

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. 127.

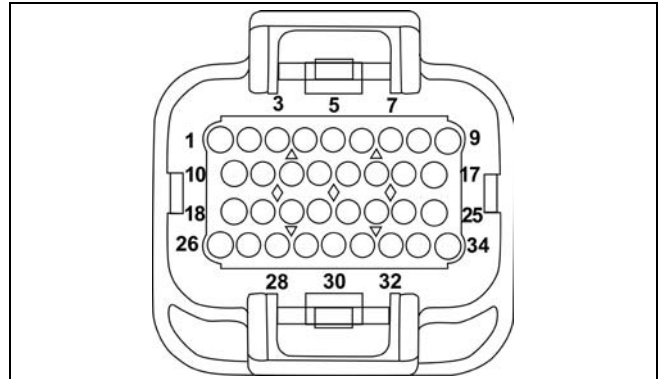
Engine Harness to Stator Connector



002025

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

EMM J1-A Connector



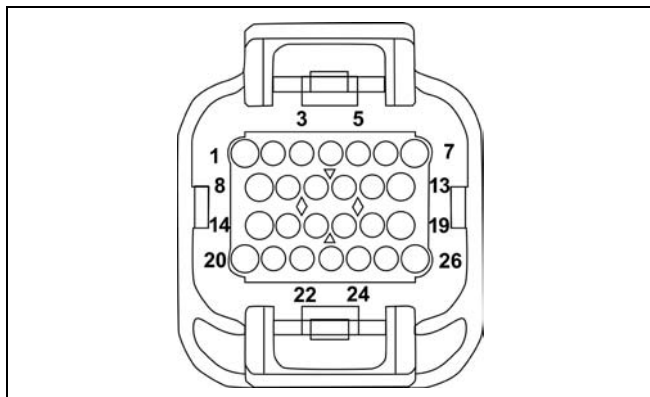
001875

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

ELECTRICAL AND IGNITION

ELECTRICAL HARNESS CONNECTIONS

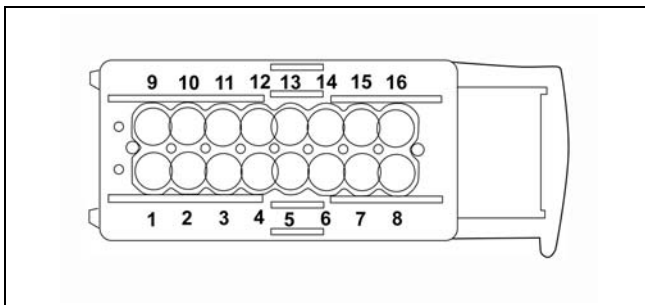
EMM J1-B Connector



001876

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

EMM J2 Connector



001877

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

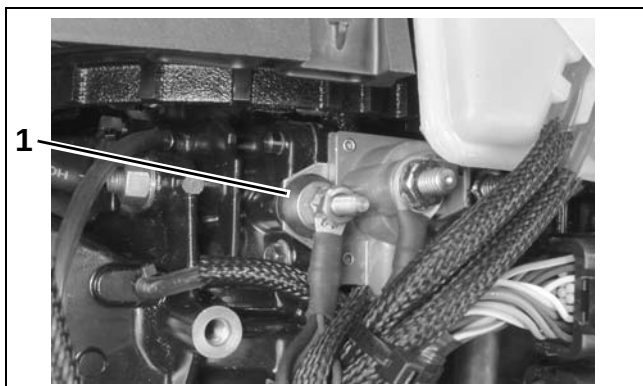
GROUND CIRCUITS

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

EMM Ground Tests

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

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



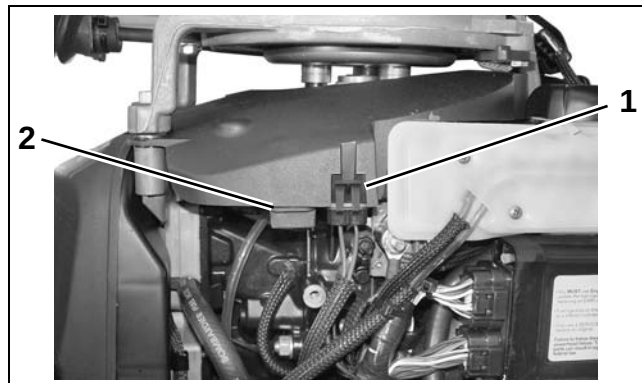
1. Main engine harness ground

006489

FUSE

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

The fuse is located on the port side of the power-head, in the flywheel cover.



1. Fuse
2. Spare fuse

005004

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

SENSOR TESTS

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

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

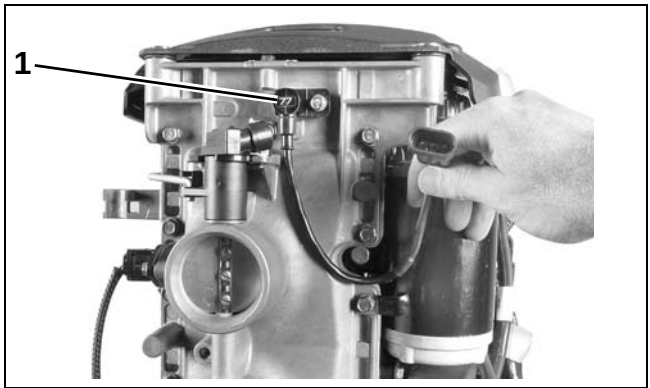
Crankshaft Position Sensor (CPS)
Test

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

Disconnect the crankshaft position sensor.

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

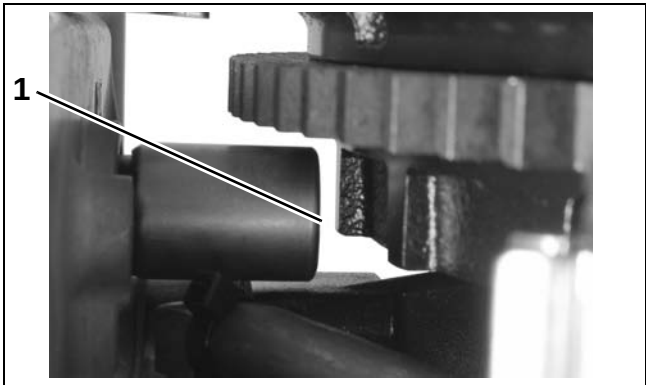
Sensor Resistance
560 Ω ± 10% @ 77°F (25°C)



1. CPS 002286

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

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



1. CPS gap 006527

Throttle Position Sensor (TPS)
Test

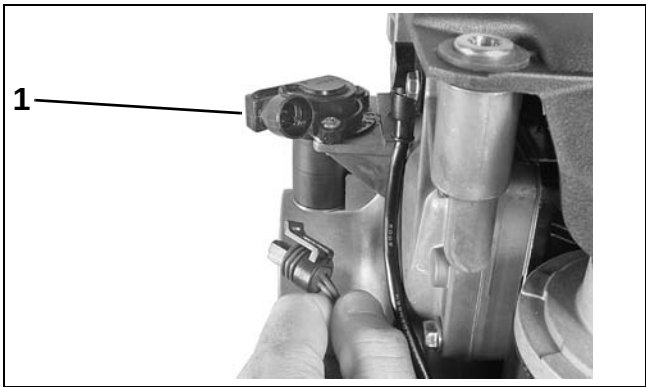
Use *Evinrude Diagnostics* software to monitor TPS voltage while the outboard is running. Voltage should change evenly as sensor lever is moved.

Remove the electrical connector from the throttle position sensor.

Use a digital multimeter to measure sensor resistance.

Sensor Resistance between “A” and “B”
3000 to 7000 Ω @ 77°F (25°C)

Sensor Resistance between “A” and “C”
4000 to 8000 Ω @ 77°F (25°C)



1. TPS 002289

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

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

Engine Temperature Sensor Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter to measure sensor resistance.

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



1. Engine temperature sensor

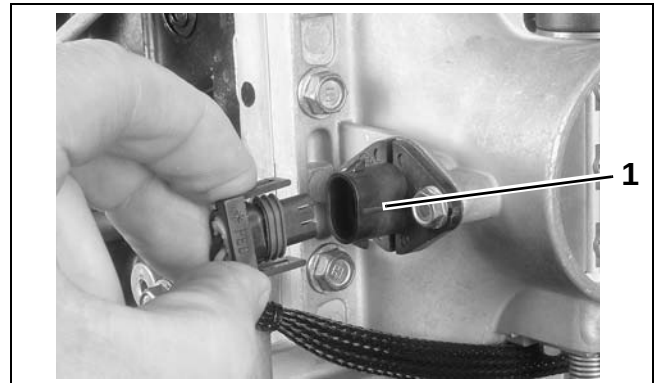
006612

Air Temperature Sensor (AT) Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter to measure sensor resistance.

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



1. AT sensor

006613

STATOR TESTS

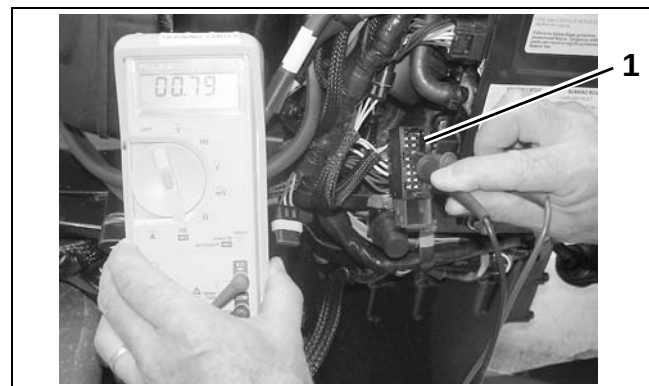
The stator consists of 3 windings (4 poles each) on a 5 inch diameter core and generates an output voltage of 55 VAC (1100 watts maximum). This voltage is converted by the *EMM* to provide 12 VDC for battery charging (3 to 5 A at 500 RPM and 25 A from 3000 RPM to WOT) and 55 VDC for fuel injector, and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

Stator Resistance Tests

Use a digital multimeter to check resistance of stator windings.

Disconnect *EMM* J2 connector from *EMM*.

Stator Winding Resistance Specification
Yellow & Yellow / white .670 ± .020 Ω @ 73°F (23°C)
Brown & Brown / white .670 ± .020 Ω @ 73°F (23°C)
Orange & Orange / white .670 ± .020 Ω @ 73°F (23°C)



1. EMM J2 Connector

002462

Connect meter leads to the following pins:

- Yellow/white and yellow (pins 9 and 1)
- Brown/white and brown (pins 10 and 2)
- Orange/white and orange (pins 11 and 3)

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

To check for a grounded winding, connect one meter lead to ground and alternately connect the other meter lead to each stator wire. Meter should read no continuity. If meter reads continuity, replace stator.

Stator Voltage Output Test

Use a Peak Reading Voltmeter, P/N 507972, to check stator output voltage. Set meter to the 50 VAC scale.

WARNING

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

Disconnect CPS. Remove spark plugs. Make sure outboard is in NEUTRAL. Refer to **SPARK PLUGS** on p. 63.

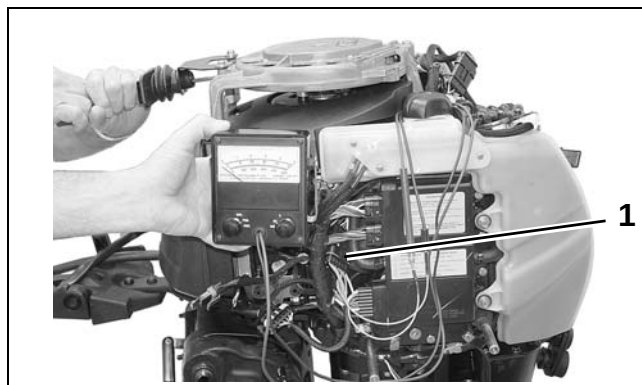
Disconnect stator (6-pin) connector from the engine harness (6-pin) connector.

Connect Stator Test Adaptor tool, P/N 5005799, to stator connector.

Connect meter leads to terminals of adaptor tool.

Rotate the flywheel with the starter rope, using a long, steady pull.

Stator output voltage should be approximately 30 VAC.



1. Stator Test Adaptor

006750

IMPORTANT: Index all spark plugs. Refer to Spark Plug **Indexing** on p. 63.

CHARGING SYSTEM TESTS

IMPORTANT: An *MFE* 55 rope start model can be used to charge an accessory boat battery by installing a battery cable, P/N 584348, to the existing solenoid on the outboard.

12 V Charging Circuit

To test the operation of the regulator in the *EMM*, you must be able to run the outboard continuously at approximately 5000 RPM, such as in a test tank or on a marine dynamometer.

The test consists of monitoring the system's response to a partially discharged battery. Use a variable load tester to discharge the battery.

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

Disconnect the battery cables at the battery.

Use an inductive amp meter or connect a 0 to 50 A ammeter in series between the red wire of engine wire harness (alternator output from *EMM*) and the positive (B+) battery cable terminal of starter solenoid.

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

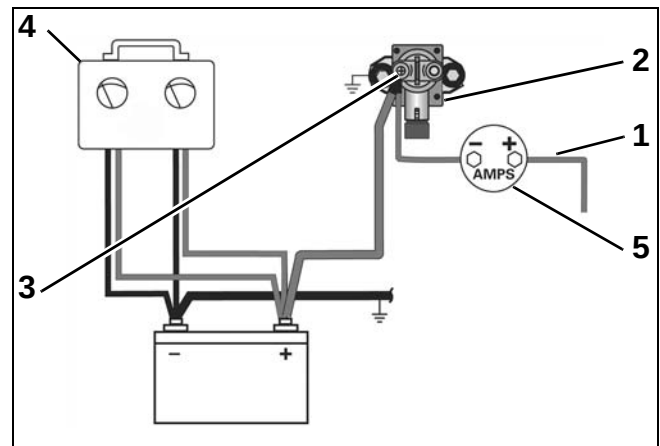
Reconnect the battery cables.

Following the manufacturer's directions, connect the variable load tester (carbon pile) across the battery terminals. *Stevens* model LB-85 and *Snap-on* model MT540D are examples of testers available.



WARNING

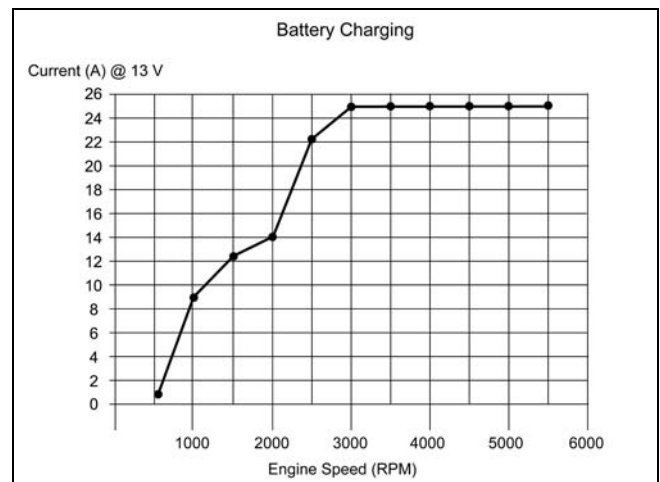
Excessive battery discharge rates might overheat battery causing electrolyte gas-sing. This might create an explosive atmosphere. Always work in a well ventilated area.



Variable Load Test Diagram

002077

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



Battery Charging Graph

002076

ELECTRICAL AND IGNITION

EXHAUST WATER VALVE TEST

Start and run the outboard at approximately 5000 RPM. Use the variable load tester to draw the battery down at a rate equivalent to the stator's full output.

- The ammeter should indicate nearly full output, approximately 25 A @ 5000 RPM.

Decrease the battery load toward 0 A.

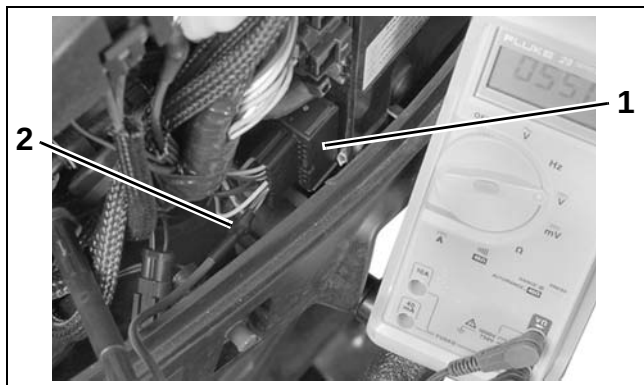
- Ammeter should show a reduced output. As the current draw decreases, the battery voltage should stabilize at approximately 14.5 V.
- If results vary, check stator BEFORE replacing the *EMM*. See **STATOR TESTS** on p. 118.

55 V Alternator Circuit

Check battery ground cable for continuity.

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

Then, use Electrical Test Probe Kit, P/N 342677, and a digital multimeter set to read 55 VDC to check voltage on white/red wires at J2 connector of *EMM*. Voltage at *EMM* connector should be 0.5 to 1 V less than battery.



1. J2 connector
2. Test probe

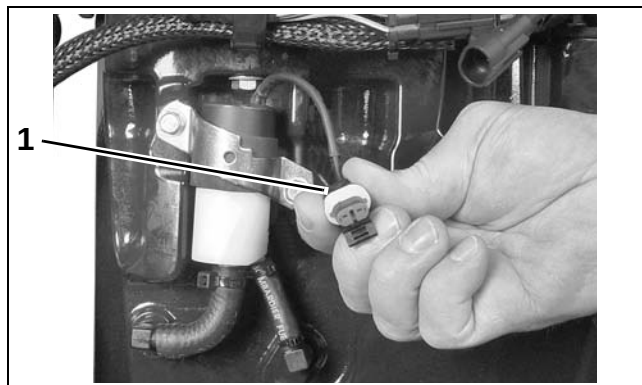
007261

With outboard running at 1000 RPM, voltage on white/red wires should be 55 V. Voltage readings at a specific speed (RPM) should be steady.

If there is any other reading, perform **STATOR TESTS** on p. 118. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or *EMM*.

EXHAUST WATER VALVE TEST

Disconnect electrical connector from water valve solenoid. Use an ohmmeter to measure solenoid resistance.



1. Water valve electrical connector

004297

Water Valve Solenoid Resistance

295 Ω $\pm$ 20 @ 77°F (25°C)

FLYWHEEL AND STATOR SERVICING

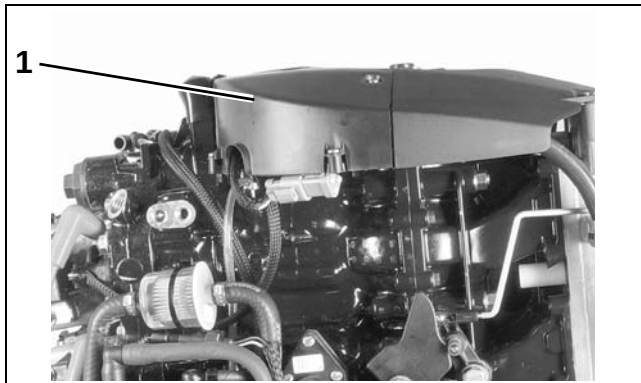
IMPORTANT: Weak flywheel magnets can cause low alternator output and affect outboard performance. Weak flywheel magnets can also cause low readings on ignition test equipment, such as a peak-reading voltmeter, which might cause unnecessary parts replacement.

An accurate test of alternator output can help determine the flywheel's condition. Refer to **CHARGING SYSTEM TESTS** on p. 119.

Flywheel Removal

Remove the recoil starter assembly. Refer to **RECOIL STARTER REMOVAL** on p. 265.

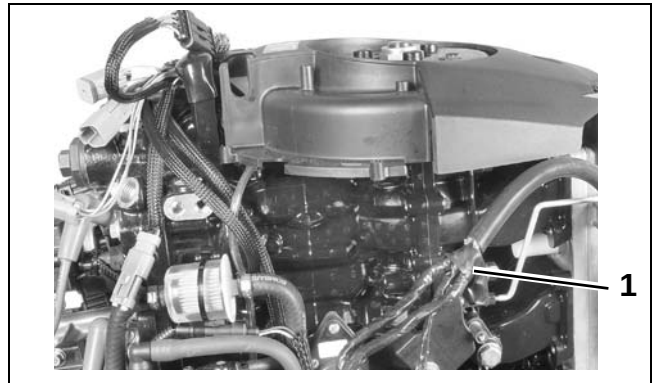
Remove the electrical cover from flywheel cover.



1. Electrical cover

002084

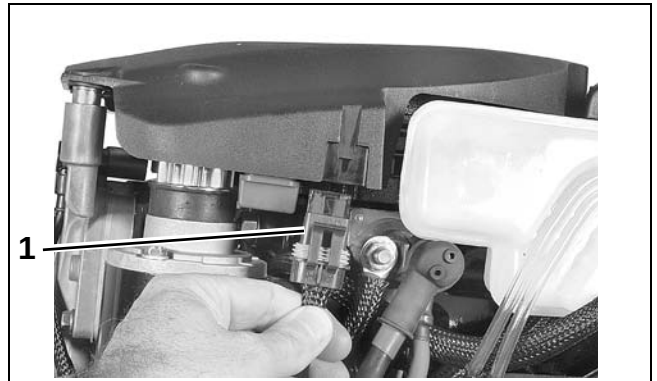
Disconnect wiring harness and remove wiring from cover.



1. MWS harness

002086

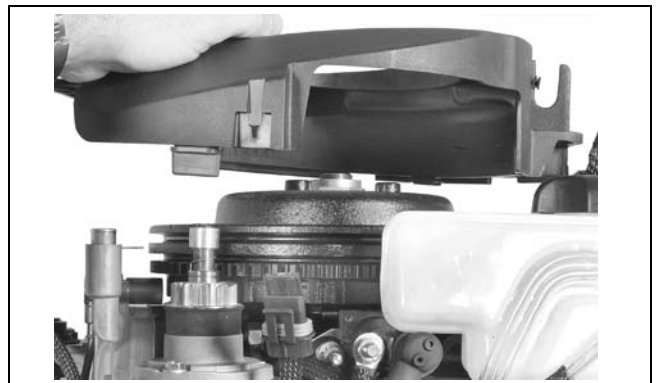
Remove fuse holder from flywheel cover.



1. Fuse holder

002094

Lift flywheel cover to remove.

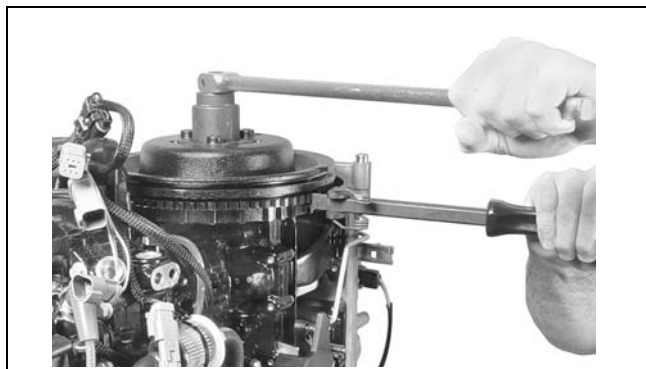


002087

ELECTRICAL AND IGNITION

FLYWHEEL AND STATOR SERVICING

Use Flywheel Holder, P/N 771311, or equivalent, and a 1 5/16 in. socket to remove flywheel nut. Discard flywheel nut.



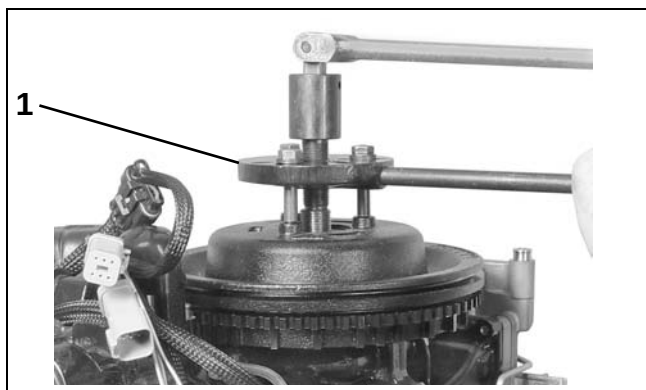
002088

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

Assemble the following components from Universal Puller Set, P/N 378103:

- Body, P/N 307636
- Screw, P/N 307637
- Handle, P/N 307638
- Three screws P/N 309492
- Three washers, P/N 307640

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



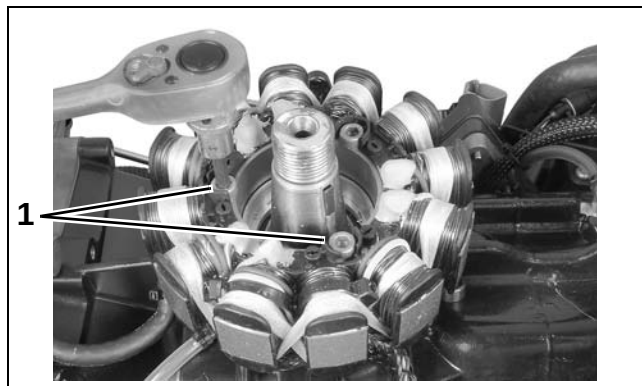
1. Universal puller

002089

Stator Service

Disconnect stator harness connector.

Remove three allen head screws to remove stator.



1. Stator screws

006486

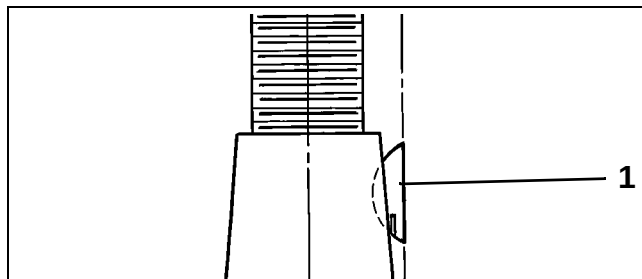
To install stator, place on cylinder block with harness toward port side of engine. Apply *Nut Lock* to screw threads. Install screws and tighten in crossing pattern to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).

Flywheel Installation

⚠ CAUTION

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

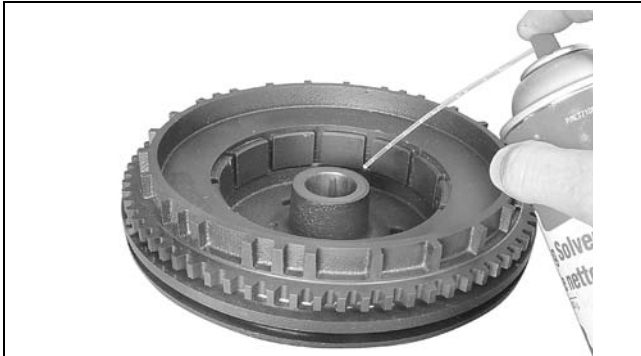
Install the outer edge of flywheel key parallel with centerline of crankshaft.



1. Flywheel key

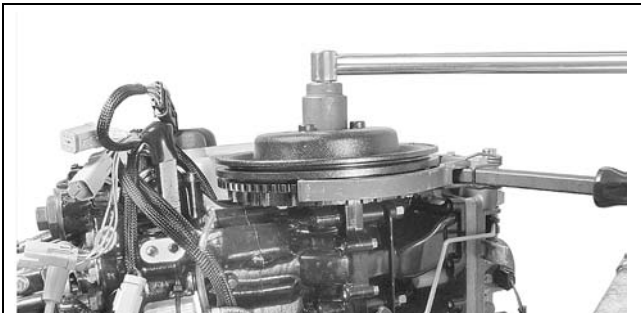
DRC2116

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



002093

Align the flywheel keyway and install flywheel. Coat the threads of flywheel nut with *Triple-Guard* grease. Install the washer and nut and tighten to a torque of 100 to 115 ft. lbs. (136 to 156 N·m).



002090

Replace flywheel cover and recoil starter.

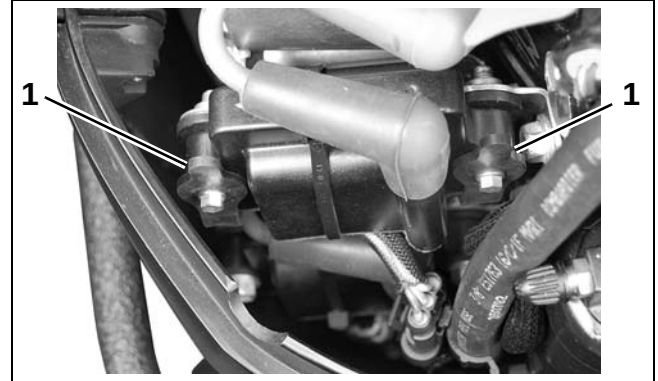
IMPORTANT: Check ignition timing after flywheel removal or replacement. Refer to **TIMING ADJUSTMENTS** on p. 124.

IGNITION COIL SERVICING

Upper Ignition Coil Service

Remove spark plug lead from ignition coil and disconnect ignition coil electrical connector.

Disconnect rubber mounting straps securing coil.



1. Coil mounting strap

007842

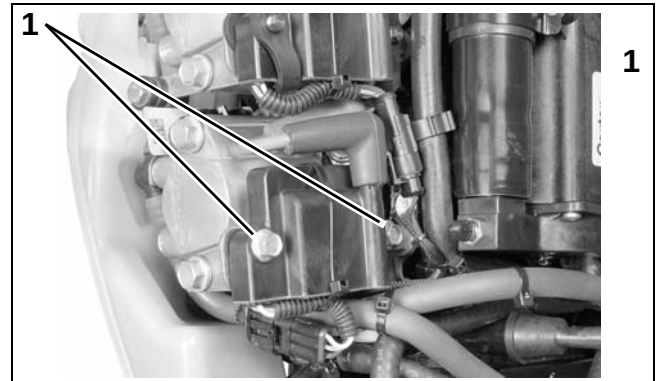
Slide coil off of mounting screws.

Lower Ignition Coil Removal

Remove spark plug lead from ignition coil and disconnect ignition coil electrical connector.

Remove two ignition coil retaining screws.

Do not lose the rubber washers between coil and bracket.



1. Screws

008344

Lower Ignition Coil Installation

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

Install remaining rubber washers on screws between coil and bracket.



1. Rubber washers

008188

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

Install spark plug lead on ignition coil and connect ignition coil electrical connector.

TIMING ADJUSTMENTS

Timing Pointer

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

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

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

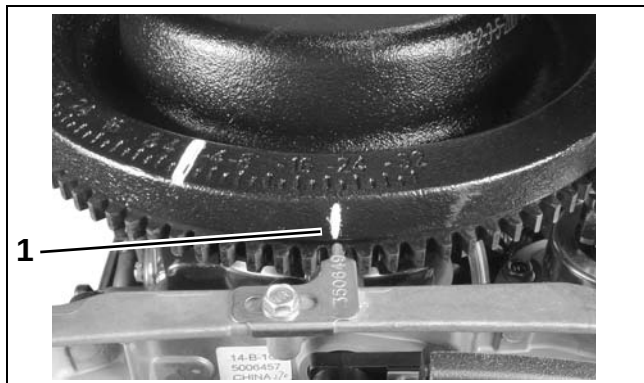
Install Piston Stop Tool, P/N 342679, into the spark plug hole of the number 1 cylinder.



1. Piston stop tool

006493

Rotate flywheel **counterclockwise** until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly against the tool. Mark the flywheel directly across from the pointer. Label this mark "A."



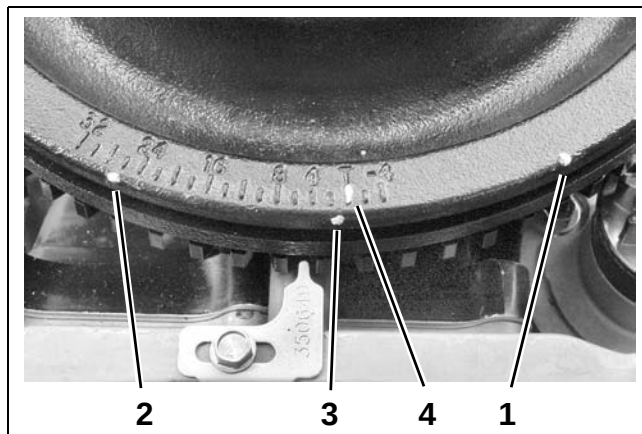
1. Timing pointer

006552

Rotate the flywheel **clockwise** until the piston contacts the tool. Mark the flywheel directly across from the pointer. Label this mark "B." Rotate flywheel **counterclockwise** slightly to release tool then remove it from spark plug hole.

Use a flexible measuring device, such as a piece of string, to find the exact center between marks "A" and "B." Measure along the edge of the flywheel. Mark and label the center point "C." If mark "C" and the cast-in TDC boss on flywheel are in alignment, the timing pointer is in the correct location.

If the pointer alignment is NOT correct, rotate the flywheel **clockwise** to align the mark "C" with the pointer. Hold the flywheel in this position. Loosen the pointer retaining screw and adjust the pointer location to align with the cast-in TDC boss on the flywheel. Tighten retaining screw.



1. Mark "A"
2. Mark "B"
3. Mark "C"
4. TDC boss

002092

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

Install spark plugs. Refer to Spark Plug **Indexing** on p. 63.

ELECTRICAL AND IGNITION

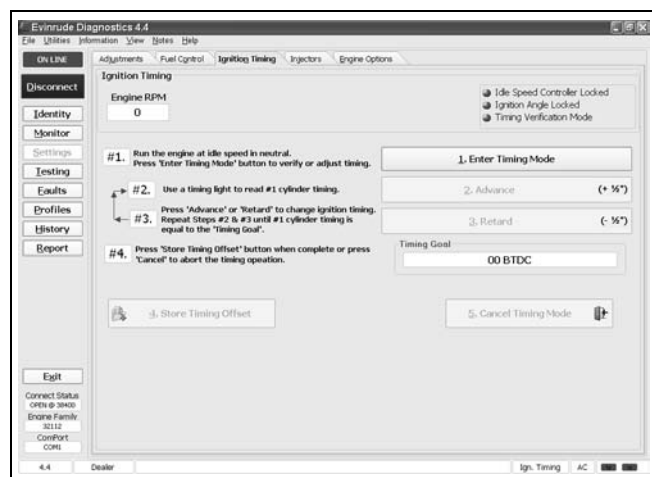
TIMING ADJUSTMENTS

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.



Ignition Timing Screen

008085

Check ignition timing after any of the following procedures:

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

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

TPS Calibration

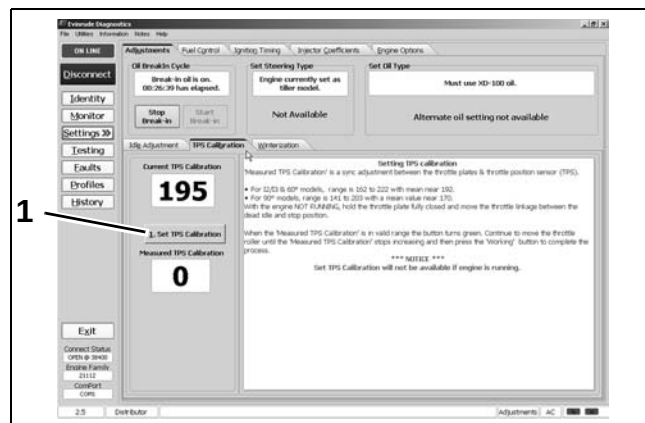
Use *Evinrude Diagnostics* software to tell the *EMM* what throttle position sensor voltage is when the throttle plates begin to open.

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

Remove the lower engine covers and air silencer.

Do NOT start the outboard.

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



1. TPS Calibration button

006647

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

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

Install the air silencer and lower engine covers.

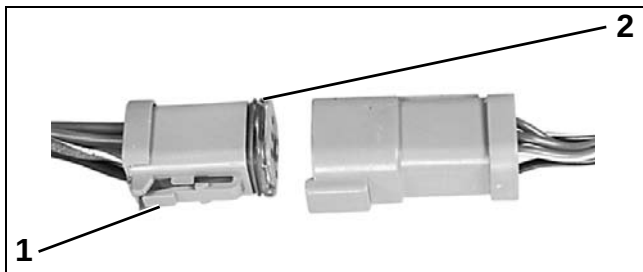
CONNECTOR SERVICING

DEUTSCH Connectors

IMPORTANT: *Electrical Grease* is recommended. Incorrect grease application can cause electrical or warning system problems.

To disconnect the connector, press the latch and pull the connectors apart.

To connect the connector, confirm that the seal is in place. Clean off any old grease and dirt from connectors. Apply a light coat of *Electrical Grease* to seal only. Push connectors together until latched.

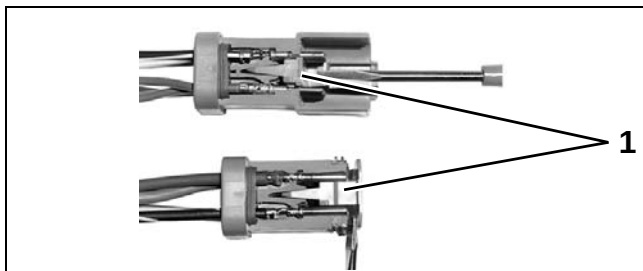


1. Latch
2. Seal

42079A

Terminal Removal

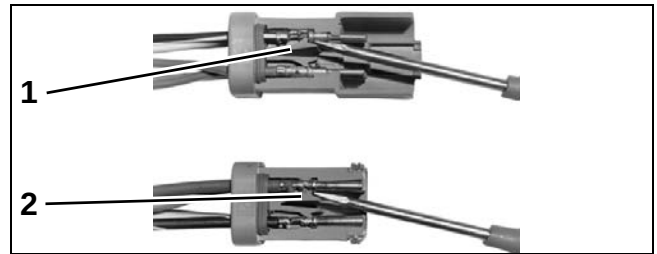
Use hook-end of Connector Service Tool, P/N 342667, to pull out wedge from receptacle, or use other end of tool to pry out wedge from plug. Use needle-nose pliers to remove wedge from 3-pin receptacle.



1. Wedge

42327

Release terminal latch and gently pull on wire.

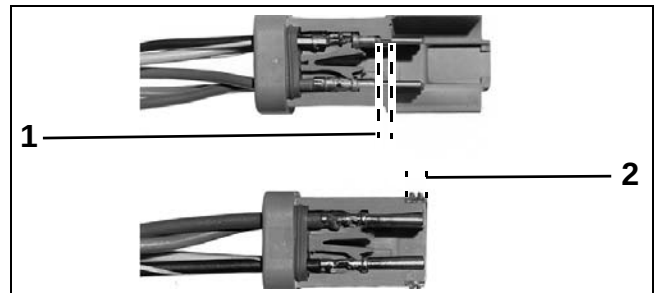


1. Terminal latch (plug)
2. Terminal latch (receptacle)

42329

Terminal Installation

Push terminal through seal until it locks into place. Fill connector with *Electrical Grease* to 1/32 in. (0.8 mm) below ledge or end of plug.



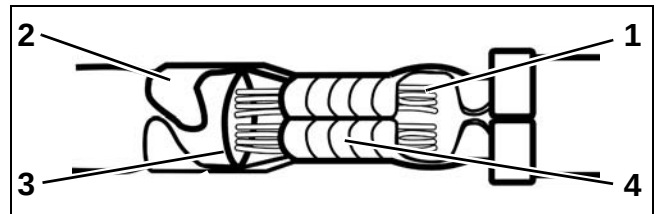
1. Ledge of plug
2. End of plug

42330

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

Crimping Terminals

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



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

DRC6205

ELECTRICAL AND IGNITION CONNECTOR SERVICING

AMP Connectors

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

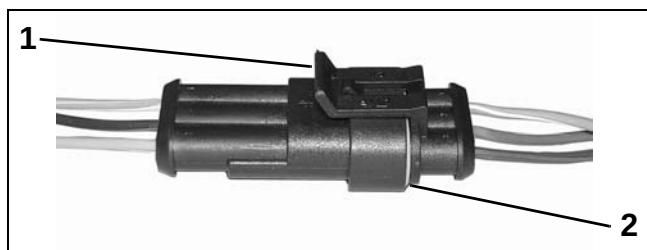
SUPERSEAL 1.5

Disconnect

Lift latch. Pull connectors apart.

Connect

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

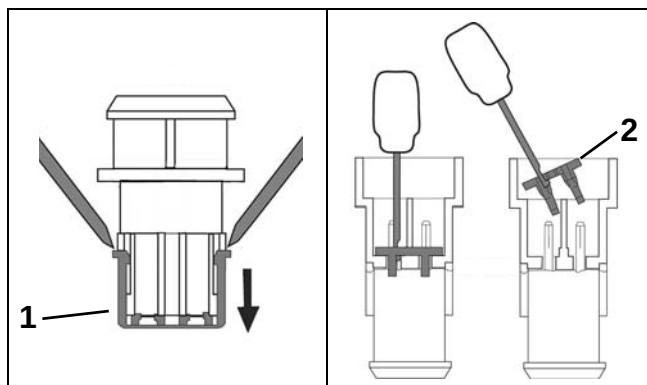


1. Latch
2. Seal

002448

Terminal Removal

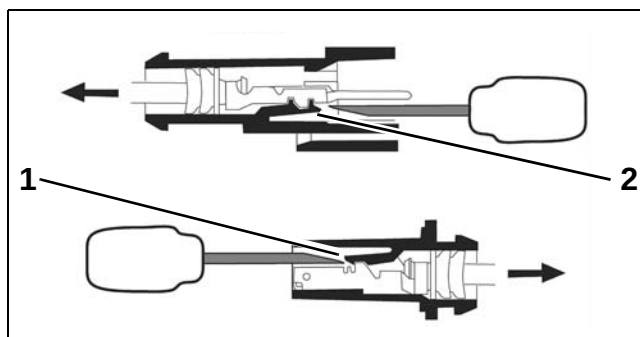
Use Secondary Lock Tool, P/N 777078, to release anti-backout device of connector housing. Next, use Primary Lock Tool, P/N 777077, to release locking tab of connector housing. Release locking tab and pull on wire to remove from connector housing.



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

002449

002450



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

002447

Terminal Installation

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



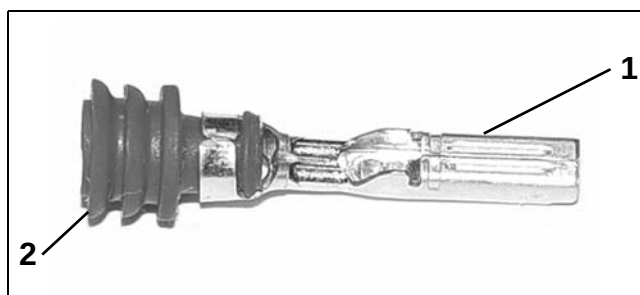
1. Terminal and seal

002451

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

Crimping Terminals

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



1. Terminal
2. Seal

002452

SUPER SEAL

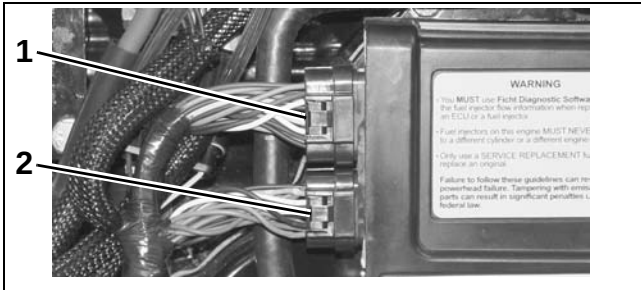
The J1-A and J1-B connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOTH latches and pull connector from plug.

Connect

Push connector into plug until latches engage.

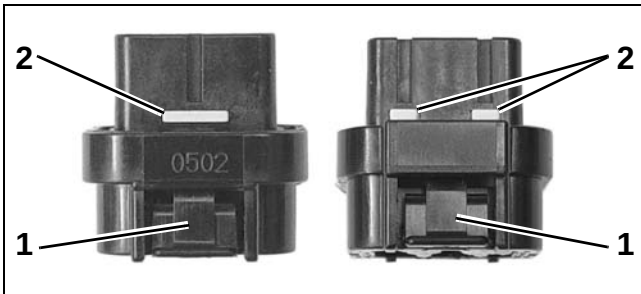


1. J1-A connector
2. J1-B connector

002118

Terminal Removal

Open lock mechanism and remove terminal from connector housing.

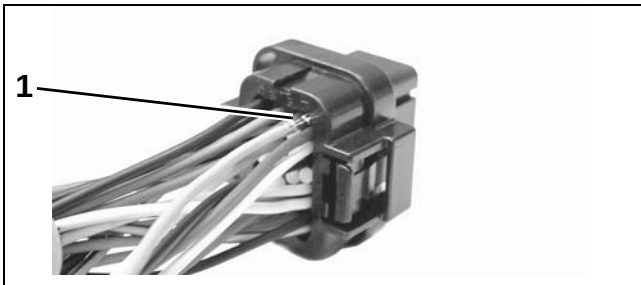


1. Latch
2. Lock mechanism

002453

Terminal Installation

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



1. Terminal

002454

POWER TIMER SERIES

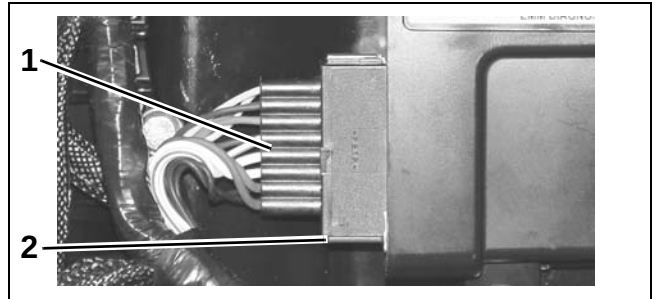
The J2 connector of the *EMM* is an *AMP Power Timer Series* connector.

Disconnect

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

Connect

Push connector until seated in plug. Close latch completely.

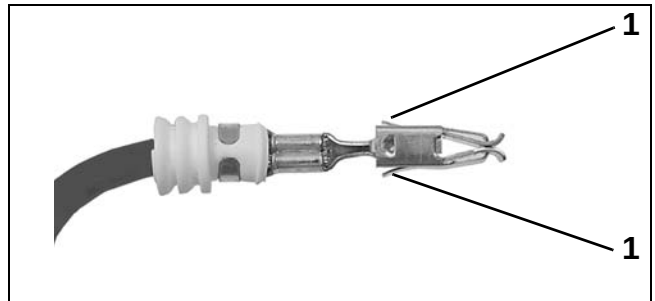


1. J2 connector
2. Latch (closed)

002120

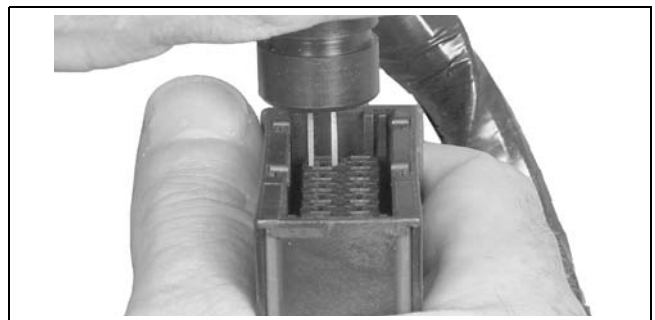
Terminal Removal

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



1. Locking mechanism(s)

002455



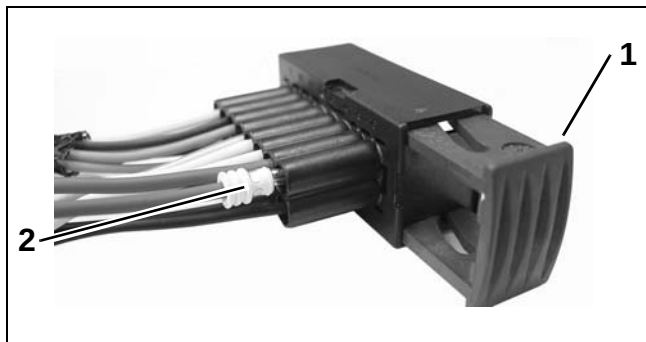
1. Terminal release tool

002313

ELECTRICAL AND IGNITION CONNECTOR SERVICING

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

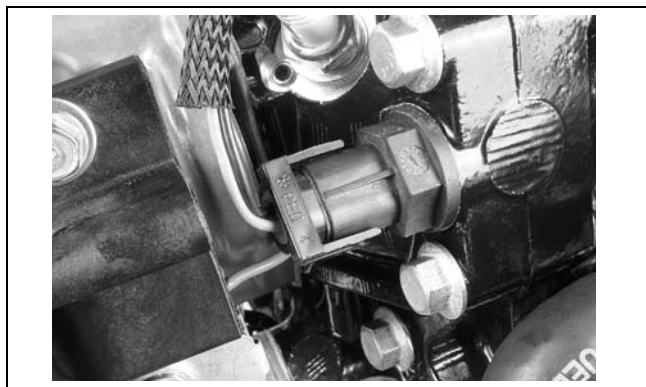
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

Disconnect

Lift latch(s). Remove connector.

Connect

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

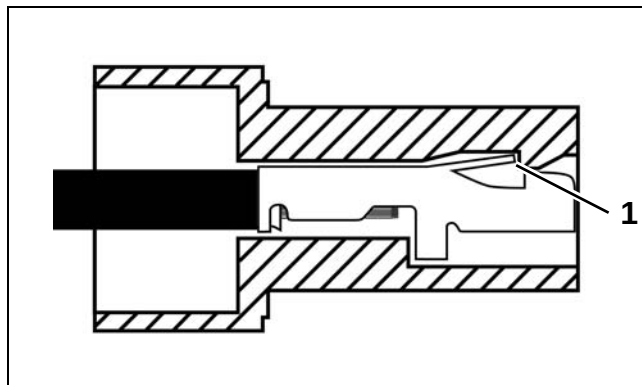


DSC02124

Terminal Removal

A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place. The terminal is removed by releasing the tab and then pushing the terminal and wire through connector housing.

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



1. Tab

DRC5940

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.

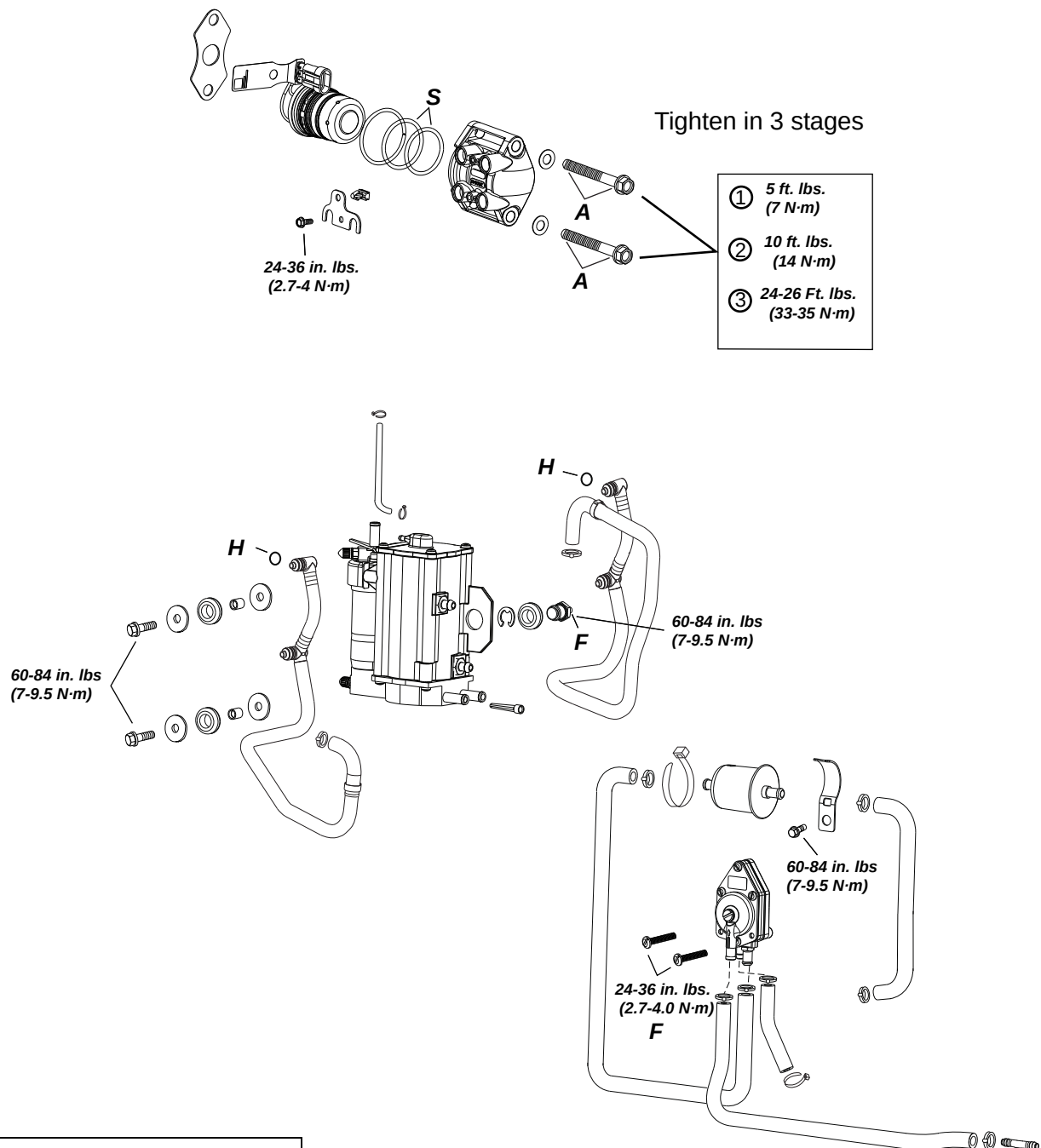
FUEL SYSTEM

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SERVICE CHART

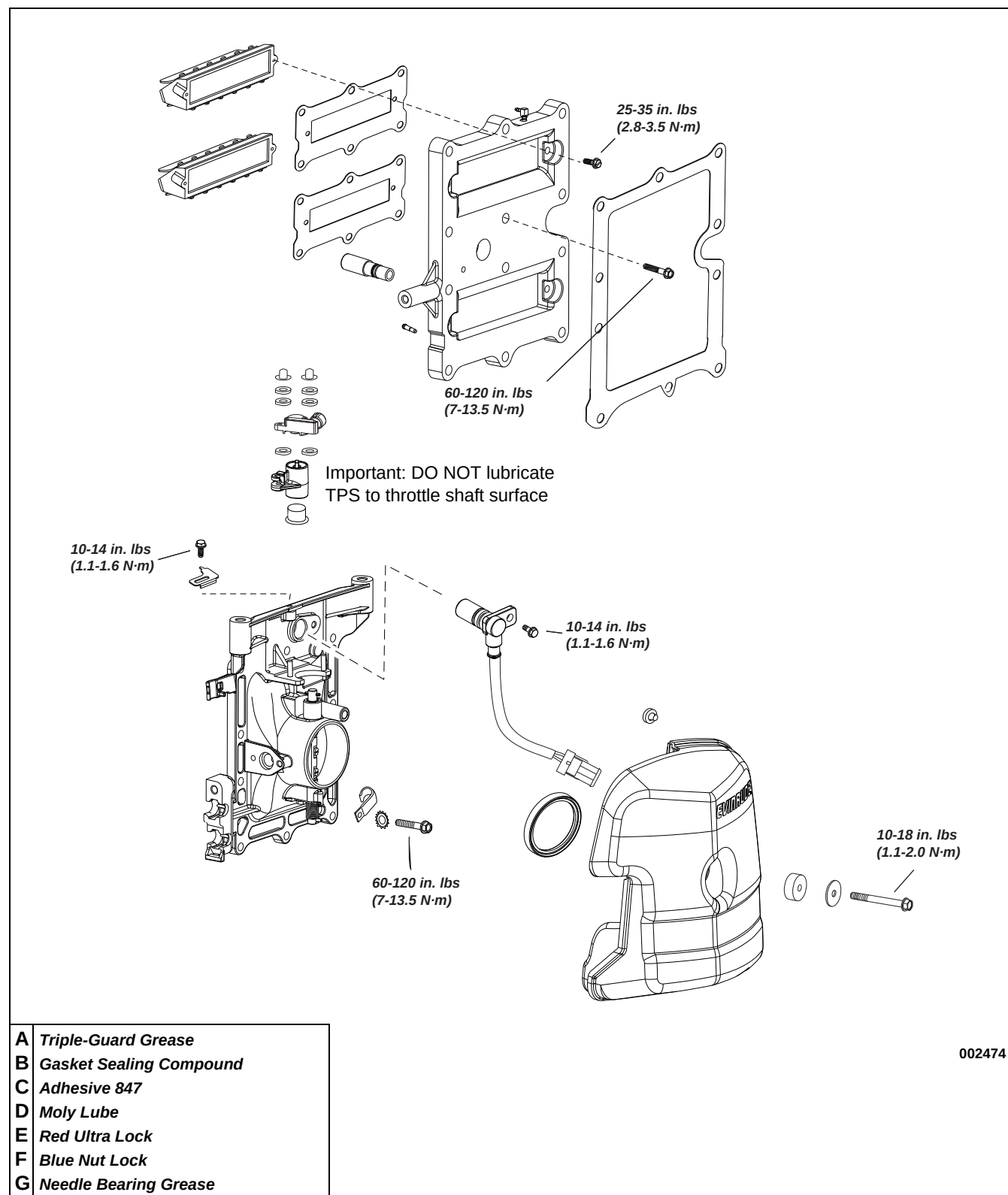
INJECTORS, VAPOR SEPARATOR, FUEL PUMP



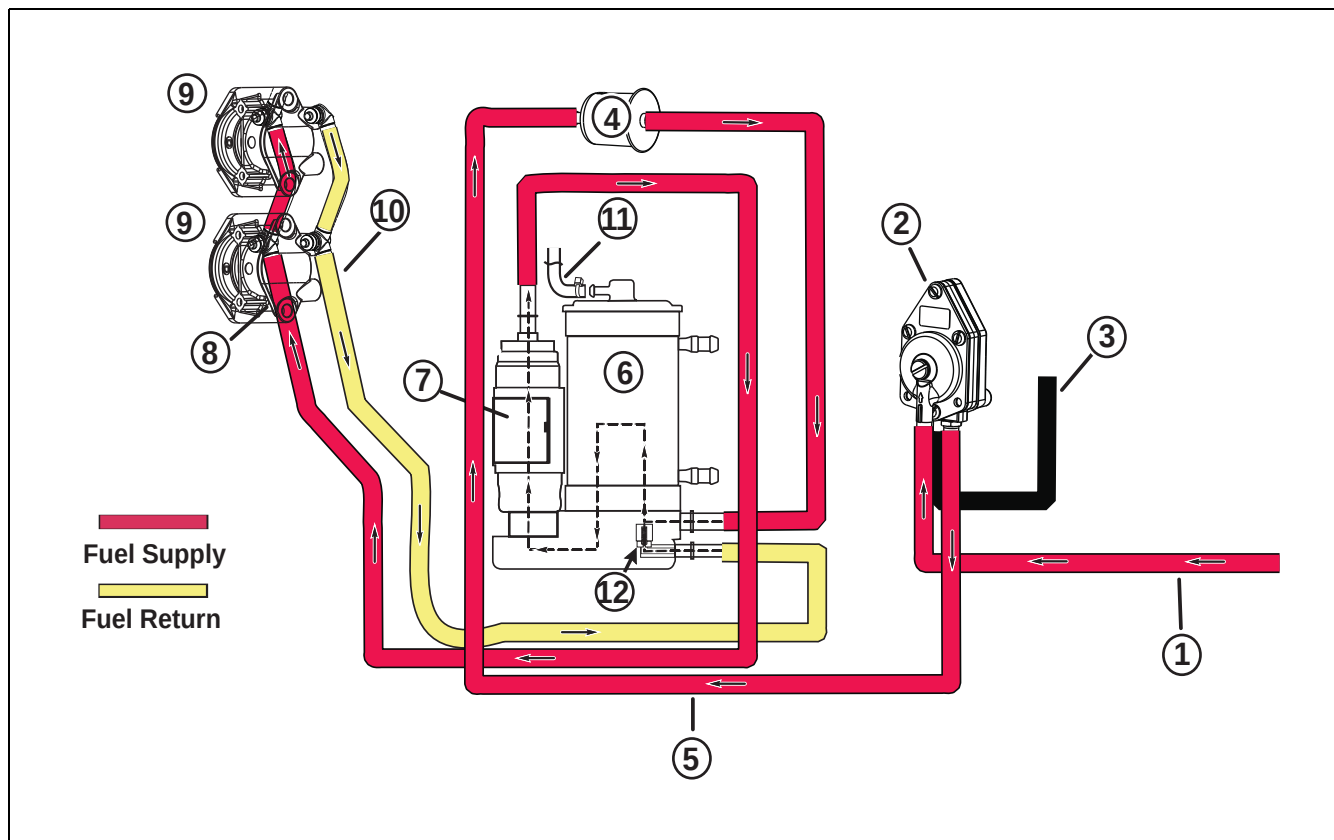
- A Triple-Guard Grease
- B Gasket Sealing Compound
- C Adhesive 847
- E Red Ultra Lock
- F Blue Nut Lock
- H Outboard Engine Lubricant
- S STP⁺ Oil Treatment

002154a

REED PLATE ASSEMBLY AND THROTTLE BODY

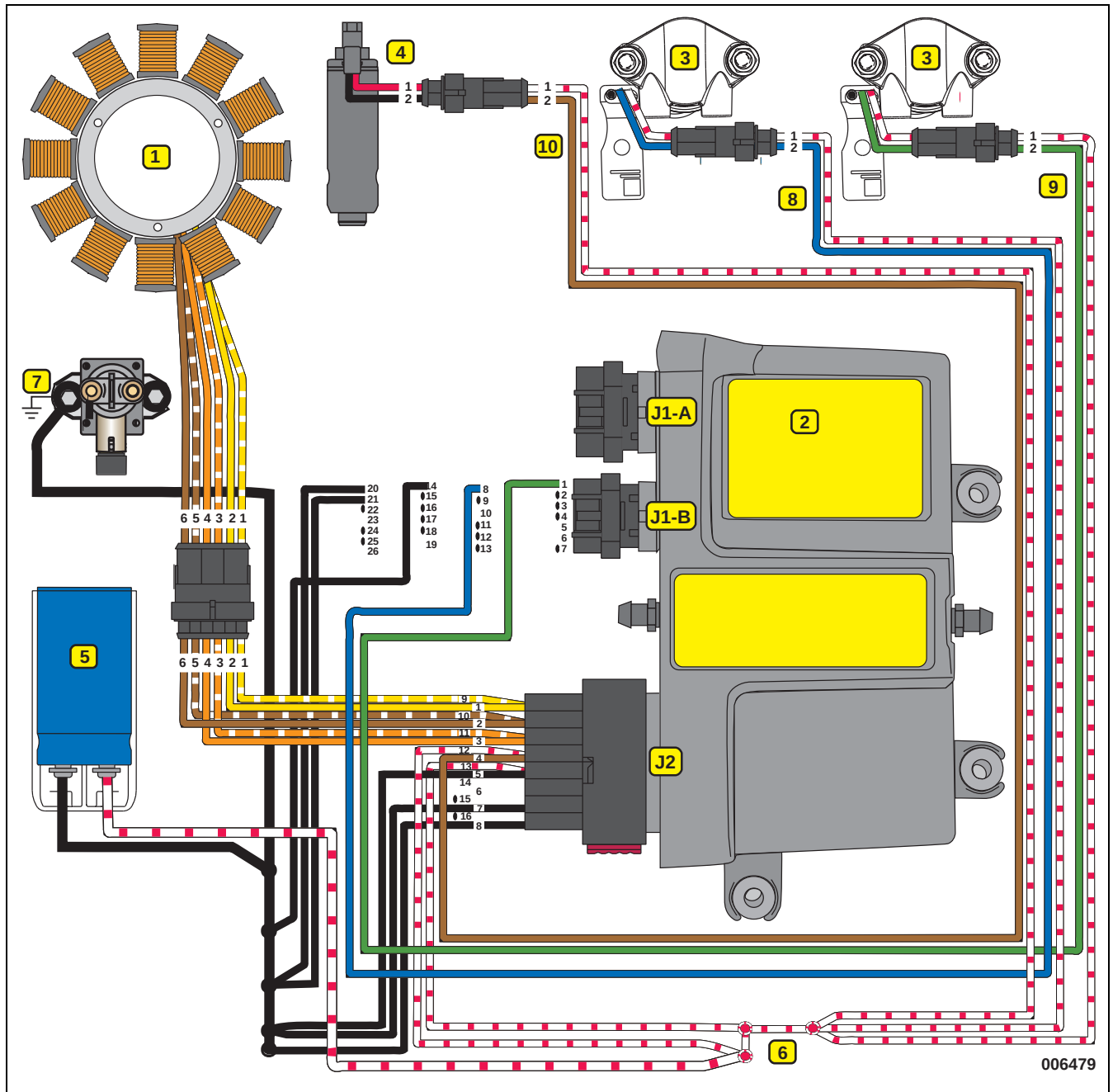


FUEL SYSTEM HOSE ROUTING



002148

FUEL SYSTEM CIRCUIT DIAGRAM



- | | | |
|--------------------------|-----------------------|-----------|
| 1. Stator | 5. Capacitor | 9. GREEN |
| 2. EMM | 6. WHITE/RED (55 V) | 10. BROWN |
| 3. Fuel injector | 7. BLACK ground wires | |
| 4. Fuel circulation pump | 8. BLUE | |

COMPONENTS

The fuel system includes the following components:

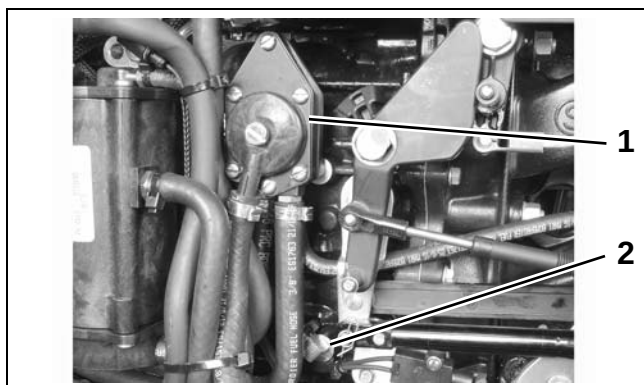
- Fuel Lift Pump
- Fuel Filter
- Vapor Separator
- Fuel Circulation Pump
- Fuel Supply Manifolds
- Fuel Injectors
- Fuel Return Manifolds

Fuel Lift Pump

The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by a pulse hose that connects to the cylinder/crank-case assembly.

Fuel lift pump pulse hose location:

- Number 2 cylinder



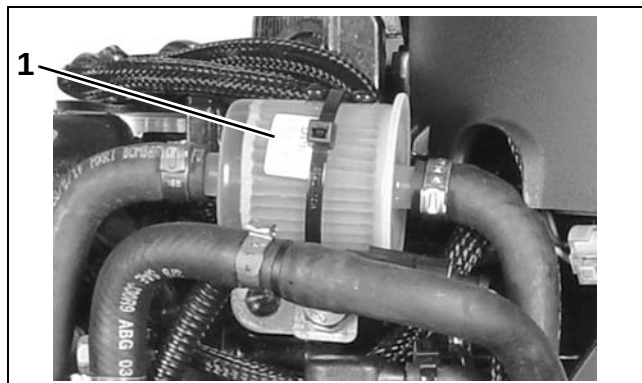
1. Fuel lift pump
2. Pulse hose fitting

006558

Vacuum from the fuel lift pump pulls fuel from the fuel tank. Once fuel reaches the pump, internal pump pressure forces the fuel from the pump through the fuel filter and into the vapor separator.

Fuel Filter

The fuel filter protects the vapor separator and the high-pressure components of the fuel system from contaminants. Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 56 for service frequency.



1. Filter

002145

Vapor Separator

The vapor separator:

- Serves as a water-cooled fuel reservoir to accumulate incoming fuel from the fuel lift pump and from the fuel return manifold.
- Contains a float controlling the venting of fuel vapors.
- Contains a fuel pressure regulator for the high pressure fuel system.

The vapor separator is serviced as an assembly and includes the fuel circulation pump.



Vapor Separator Assembly

1. Circulation pump

006555

Fuel Reservoir

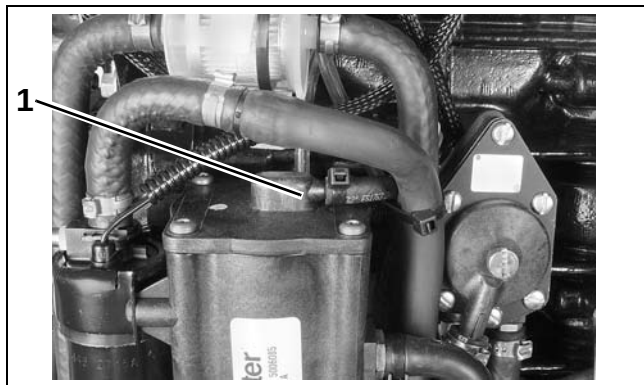
The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Cooling

Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically. Refer to **HOSE ROUTING AND WATER FLOW DIAGRAM** on p. 170.

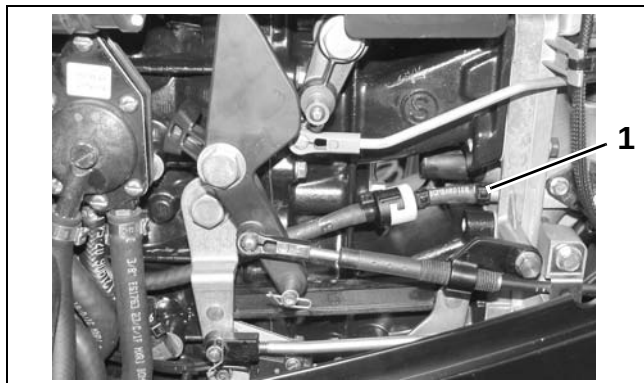
Venting

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



1. Vent

005007



1. Vent hose connection to intake

006556

The vapor separator vent is opened and closed by a float valve. The float valve moves with the fuel level in the fuel chamber. Hot fuel causes an increase in vapor pressure. This results in a lower fuel level in the vapor separator. The float valve drops and the vent opens. This allows fuel vapor

to flow to the intake manifold through the vent hose.

As the vapor pressure in the vapor separator decreases, the fuel level begins to increase. An increase in the fuel level raises the float valve and the vent closes.

Pressure Regulator

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

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

Fuel Circulation Pump

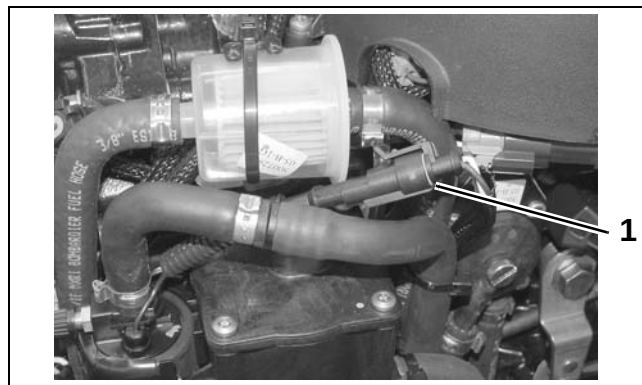
The fuel circulation pump is an electric high pressure fuel pump.

Fuel Supply

The pump is mounted to the vapor separator and draws fuel from the fuel chamber. It pumps pressurized fuel through a fuel supply manifold connected to the fuel injectors.

Electrical Circuit

The circulation pump is controlled by the *EMM* and operates on the 55 V circuit. The outboard must be cranking or running (CPS input to *EMM*) for the circulation pump to be activated. The *EMM* controls pump operation by rapidly connecting and disconnecting the pump's internal coil to ground.



1. Fuel pump electrical connector

006557

FUEL SYSTEM COMPONENTS

Fuel Manifolds

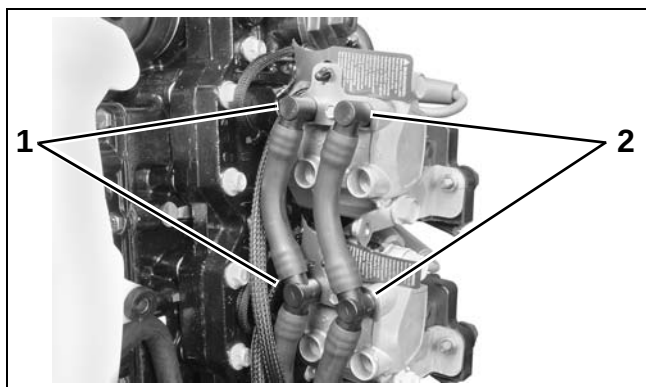
The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

Fuel Supply Manifold

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

Fuel Return Manifold

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



1. Fuel supply
2. Fuel return

006560

Fuel Injectors

Fuel injectors are fuel metering, electric solenoids (55 V) bolted directly to the cylinder head. The *EMM* controls the activation of each injector by rapidly connecting and disconnecting the injector's internal coil to ground.

Fuel Flow Compensation

The flow rate of each injector is measured as part of the manufacturing process. This information is recorded and assigned to the injector by serial number.

Then, the *EMM* is programmed to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the *EMM*. DO NOT install an injector without updating the compensation software.

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

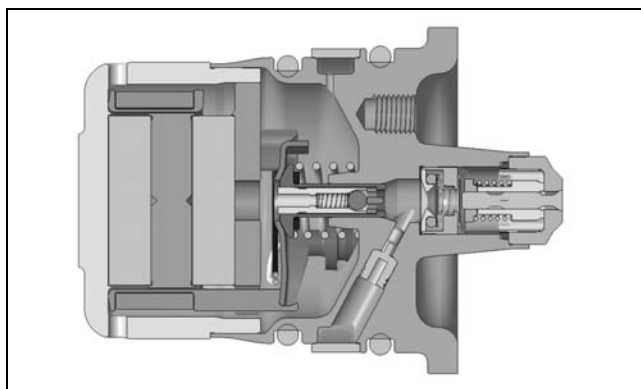
NOTICE Fuel injectors **MUST NOT** be moved from one cylinder to another. *EMM* programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply manifold.

Each injector has internal fuel passages. These passages are designed to:

- Provide fuel to the injector's injection chamber.
- Route fuel through the injector housing to cool the injector coil and armature.



006619

FUEL SYSTEM TESTS

⚠ WARNING

Use caution when working on any pressurized fuel system. Wear safety glasses and work in a well ventilated area. Extinguish all smoking materials and make certain no open flames or ignition sources exist. Before starting any fuel system service, carefully relieve fuel system pressure. Failure to properly relieve fuel system pressure can result in spraying fuel and/or excessive fuel spillage during servicing. Fuel is flammable and can be explosive under certain conditions.

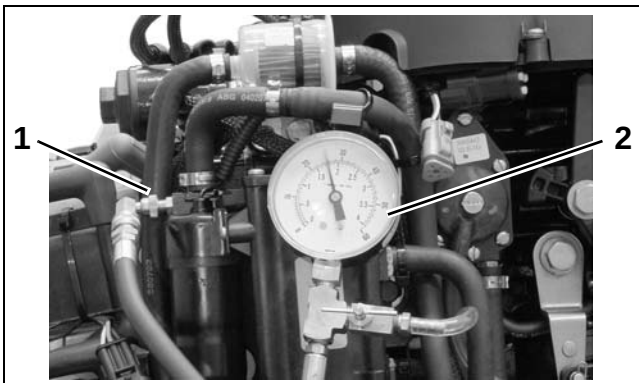
Fuel System Pressure Test

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 144.

⚠ WARNING

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

After relieving fuel system pressure, install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, to the upper fuel pressure test fitting.



1. Test fitting
2. Fuel pressure gauge

006655

START outboard and check pressure. System pressure should be 20 to 35 psi (138 to 241 kPa).

Shut OFF outboard. Monitor pressure gauge. Pressure should not drop below 15 psi (103 kPa).

IMPORTANT: If outboard does not run, prime fuel system and crank outboard; check circulation pump operation; check fuel system pressure.

Results:

Normal pressure:

- Observe pressure reading after outboard is shut OFF.
- Refer to **Lift Pump Pressure Test** on p. 141.

Pressure drops after outboard is shut OFF:

- Check for leaking fuel injector.
- Check for leaking pressure regulator.
- Check for external fuel system leak.

High pressure:

- Check for restricted filter or fuel return fitting of vapor separator, damaged pressure regulator in vapor separator, or restricted fuel return manifold.

Low pressure:

- Check fuel supply to fuel lift pump. Refer to **Lift Pump Vacuum Test** on p. 142. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted fuel filter/water separator assembly.
- Lift pump not supplying enough fuel to vapor separator. Refer to **Lift Pump Pressure Test** on p. 141.
- 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. 144.

FUEL SYSTEM

FUEL SYSTEM TESTS

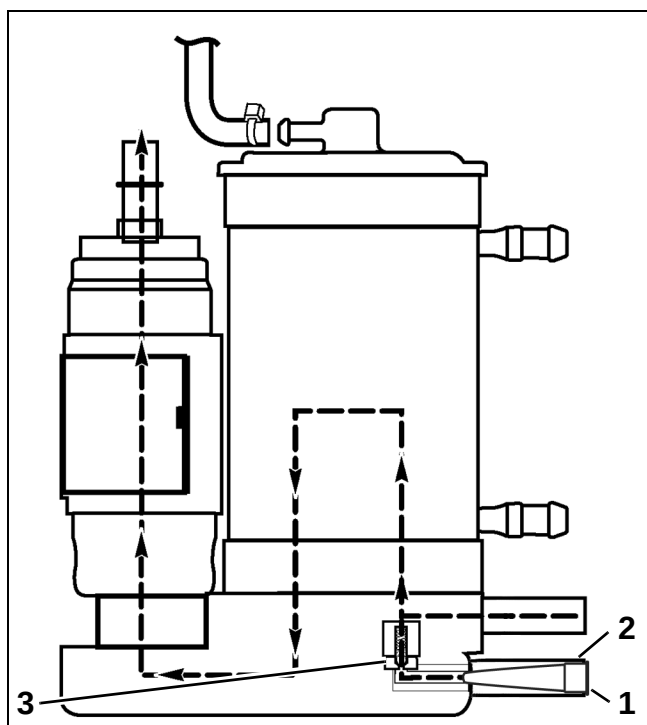
Pressure Regulator Test

Refer to **Vapor Separator Service** on p. 146 to remove vapor separator.

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

Apply oil to valve and connect pressure pump and hose to the fuel return fitting of vapor separator.

Apply pressure to check regulator operation. The pressure should open check valve at approximately 15 psi (103 kPa).



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

000249r

Vapor Separator Vent Check

Monitor the vapor separator vent hose. No fuel or a trace of fuel is acceptable. Excessive fuel discharge indicates a vapor separator vent malfunction. Monitor vent for presence of fuel during testing. Temporarily install clear tubing for monitoring. Replace vapor separator if the venting of fuel is continuous.

Fuel Injector Pressure Test

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

Loosen oil tank assembly to provide access to fuel manifolds. Refer to **Oil Tank Assembly** on p. 166.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 144.

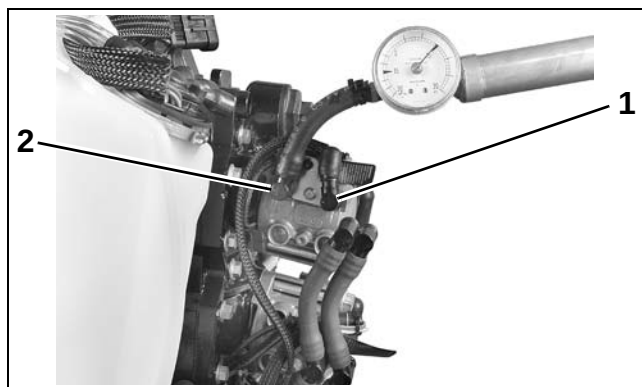


WARNING

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

IMPORTANT: Perform test with injector mounted to cylinder head and fittings installed with manifold retainer.

Use cap and tie strap to seal off outlet fitting. Connect a 0 to 30 psi (0 to 207 kPa) pressure tester to the inlet fitting. Pressurize the injector to 30 psi (207 kPa). Pressure must hold for at least five minutes.



1. Outlet fitting
2. Inlet fitting

002379

Refer to **FUEL DELIVERY TESTS** on p. 106 for additional test procedures.

Fuel Injector Resistance Test

Use a digital multimeter to measure the injector coil resistance.

Fuel Injector Coil Resistance

2 to 3 Ω @ 72°F (22°C)



006620

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

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



006621

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

Circulation Pump Resistance Test

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

Fuel Pump Resistance

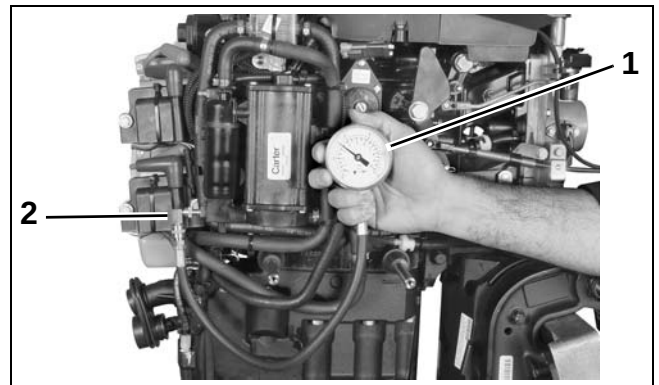
3 Ω @ 77°F (25°C)



006633

Lift Pump Pressure Test

Install a 0 to 15 psi (0 to 103 kPa) Fuel Pressure Gauge, P/N 5006397 or equivalent, to the lower fuel pressure test fitting.



1. Fuel pressure gauge
2. Test fitting

006634

Prime the fuel system and check for leaks. START outboard and run at idle speed. Hold gauge level with inlet fitting and monitor gauge for pressure reading.

Pressure should stabilize at a reading greater than 3 psi (27 kPa).

FUEL SYSTEM

FUEL SYSTEM TESTS

Results:

Normal pressure:

- Perform the **Lift Pump Vacuum Test** on p. 142. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Low pressure:

- Check pulse hoses and fittings for restrictions.
- Perform the **Lift Pump Vacuum Test** on p. 142. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.
- Check fuel flow through fuel lift pump. Use fuel primer bulb to force fuel through pump.

No pressure:

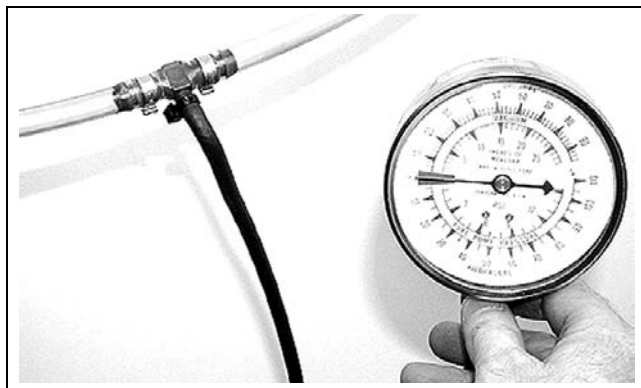
- Check pulse hoses and fittings restrictions.
- Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
- Momentarily prime or squeeze primer bulb to check gauge operation.
- Check pulse hose and fittings for restrictions.

Lift Pump Vacuum Test

Confirm fuel supply to the fuel lift pump.

Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet). Secure connections with tie straps to prevent fuel or air leaks.

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).

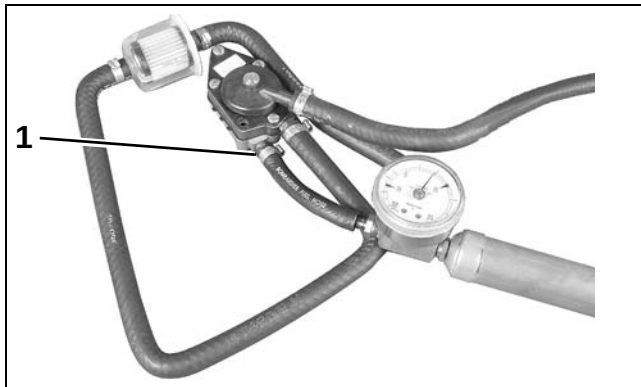
A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to **Fuel System Requirements** on p. 25 for fuel supply component requirements.

Lift Pump Diaphragm Test

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

Remove the pulse hose from the crankcase fitting.

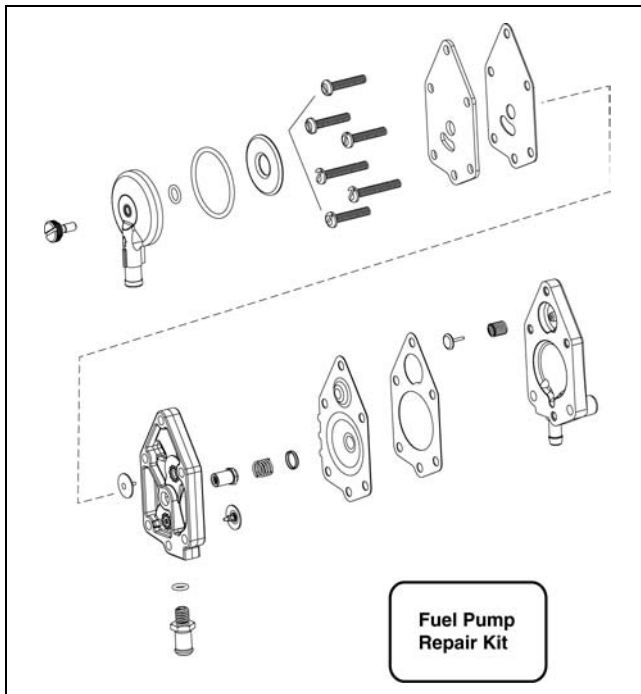
Apply 15 psi (103 kPa) to the pulse hose of the pump. Replace lift pump if pump fails to hold pressure.



1. Pulse fitting

002334a

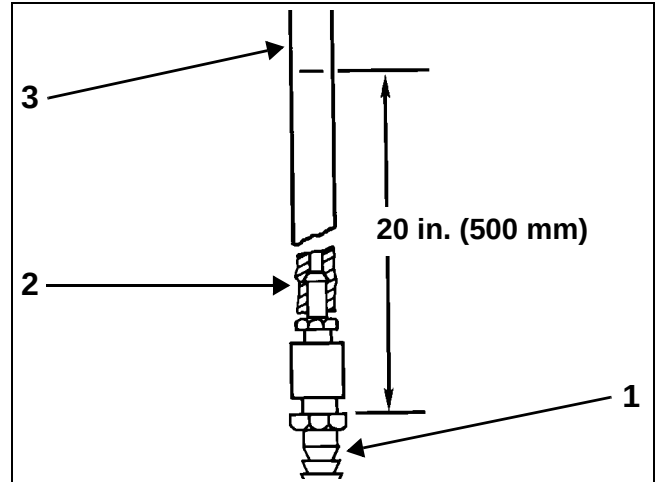
Fuel pump repair kit, P/N 438616, is available for internal service of fuel pump. Refer to instructions included with kit.



006749

Anti-Siphon Valve Test

Remove anti-siphon valve from fuel tank. Install adapter fittings and a 36 in. (91.4 cm) length of clear hose to the inlet side (tank end) of valve.



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

DR2277

Fill clear hose with water to a height of 20 in. (500 mm). Water must NOT flow through valve. An occasional drip is acceptable. Replace valve if water drips continuously.

Increase height of water to 25 in. (630 mm). Water should flow through valve as water level reaches 25 in. (630 mm). Replace the anti-siphon valve if test results are different.

FUEL COMPONENT SERVICING

WARNING

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

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

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

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

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

Relieving Fuel System Pressure

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

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

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



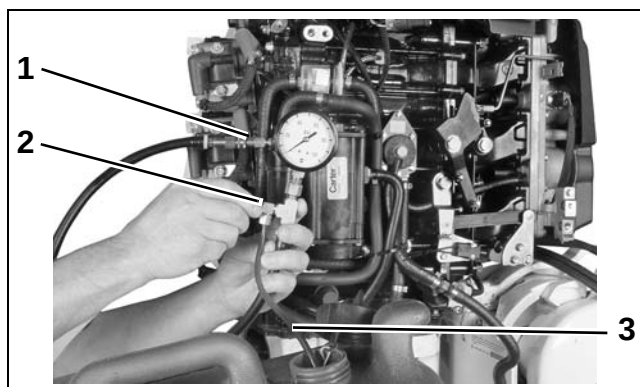
1. Shop towel

005011

Insert venting hose of gauge into a suitable container.

Slowly open gauge's venting valve.

Clean up any spilled fuel with shop towels.



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

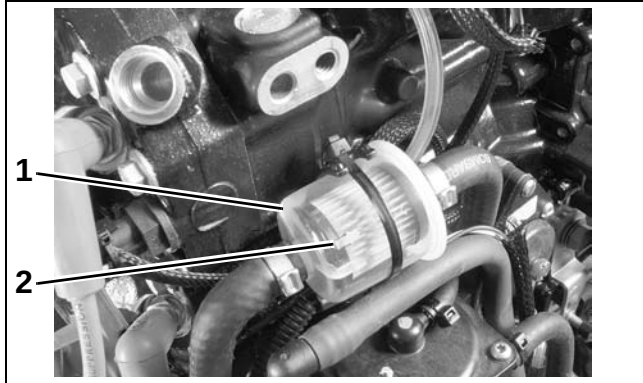
005012

Fuel Filter Service

Removal

Remove filter carefully to prevent spilling contents.

Inspect contents for any presence of water. If water is present, identify the source and correct the problem. Take additional fuel samples and drain fuel tank(s) if necessary.



1. Fuel filter
2. Arrow

002192

Installation

Install filter in fuel supply hoses. Note arrow indicating direction of fuel flow on filter. Secure filter with appropriate clamps. Refer to **Oetiker Clamp Servicing** on p. 28.

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

Run outboard and check for fuel leaks.

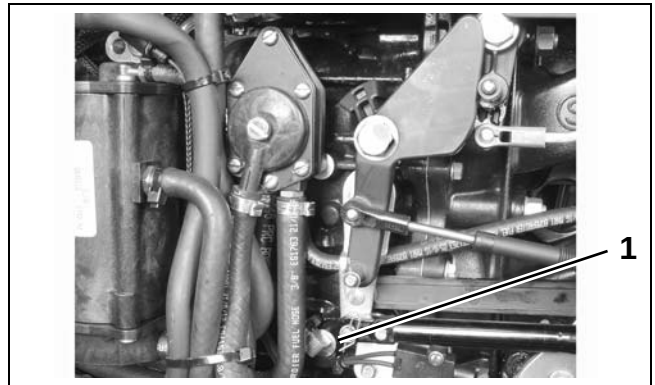
Fuel Lift Pump Service

The fuel lift pump is serviceable as a complete assembly or can be repaired with a fuel pump repair kit. Refer to parts catalog for service parts.

Removal

Disconnect the fuel hoses from the fuel pump housing. Label hoses for reassembly locations.

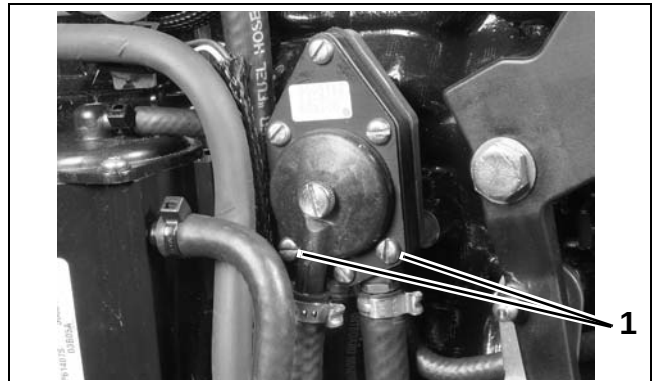
Disconnect the fuel lift pump pulse hose at the crankcase fitting.



1. Crankcase fitting

006558

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



1. Screws

002194

Fuel pump repair kit, P/N 438616, is available for internal service of fuel pump. Refer to instructions included with kit.

FUEL SYSTEM

FUEL COMPONENT SERVICING

Installation

Place fuel pump in position on crankcase. Apply *Nut Lock* to mounting screws. Tighten screws to a torque of 24 to 36 in. lbs. (2.8 to 4.0 N·m).

Connect the fuel lift pump pulse hose to the crankcase. Secure with tie strap.

Connect the fuel hoses to the fuel filter. Secure with *Oetiker* clamps.

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

Run outboard and check for fuel leaks.

Vapor Separator Service

Removal

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 144.

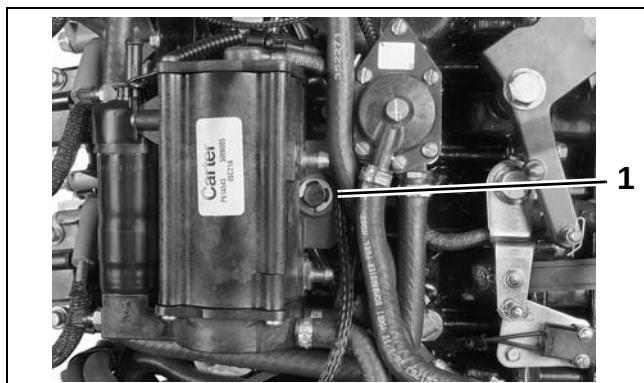
Disconnect circulation pump electrical connector.

Remove clamp and fuel supply manifold from top of circulation pump. Remove clamp and vapor vent hose from separator cover.

Remove clamps and vapor separator cooling water hoses.

Remove clamps and fuel return manifold and fuel supply hose from bottom of vapor separator.

Remove the vapor separator housing retainer clip.



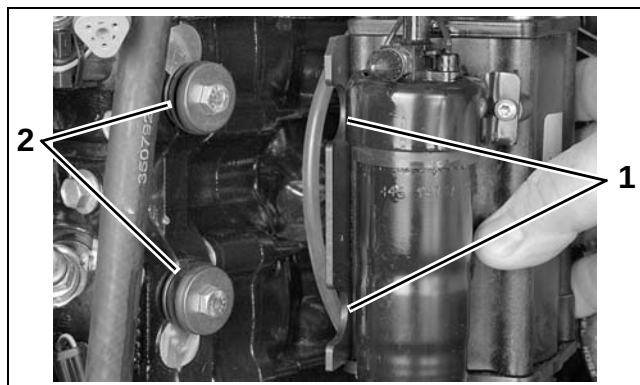
1. Retainer clip

005013

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

Installation

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



1. Notches

2. Isolator mounts

007859

Install all hoses and manifolds in original locations and secure with appropriate clamps. Refer to **Oetiker Clamp Servicing** on p. 28. Route hoses and secure with tie straps as shown.



007860

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

Run outboard and check for fuel leaks.

Fuel Manifold Service

Removal

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 144.

Remove oil tank assembly. Refer to **Oil Tank Assembly** on p. 166.

Remove clamps and disconnect the fuel manifolds as follows:

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



1. Fuel supply manifold
2. Fuel return manifold

006555

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



1. Screw

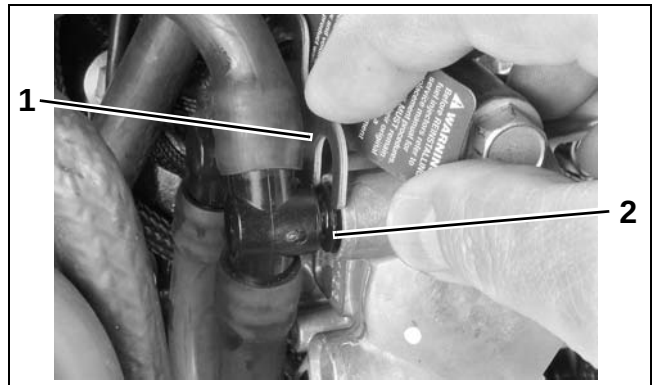
006559

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

Installation

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

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



1. Retainer
2. Manifold fitting groove

005342

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

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

Install oil tank assembly. Refer to **Oil Tank Assembly** on p. 166.

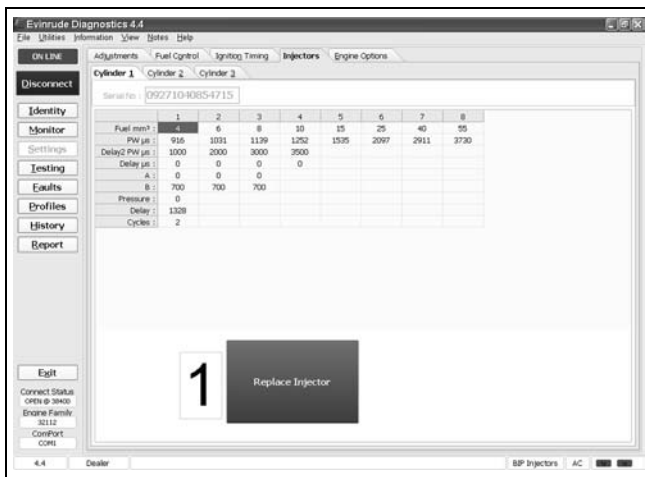
FUEL SYSTEM

FUEL COMPONENT SERVICING

Fuel Injector Service

Mark fuel injector(s) to show cylinder location(s).

NOTICE Fuel injectors must be installed in the correct cylinder locations. Use *Evinrude Diagnostics Software* to make sure that *EMM* programming matches injector positioning. The *Injector Coefficients* screen displays injector serial numbers for each cylinder.



Injector Coefficients Screen

008079

Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel manifolds. Cover the injector nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal

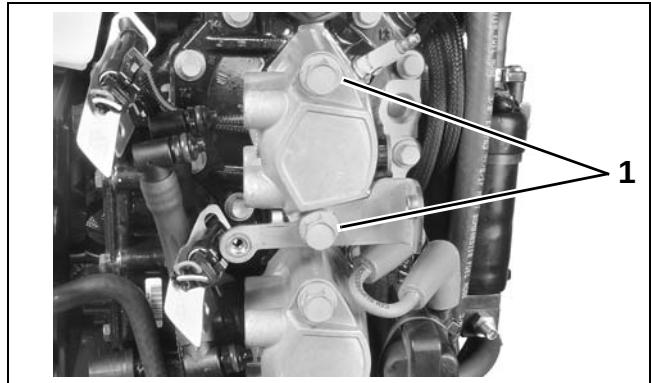
Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 144.

Remove fuel manifolds. Refer to **Fuel Manifold Service** on p. 147.

Remove the ignition coil assemblies.

Disconnect the fuel injector electrical connector.

Remove injector screws.



1. Injector screws

006561

Remove fuel injector and insulator.

Crush Ring Replacement

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

Use Slide Hammer assembly, P/N 391008, with Slide Hammer Adaptor kit, P/N 390898, to remove injector from mounting cup.

Thread adaptor and stud into face of injector. Hold mounting cup securely. Use slide hammer to separate injector from mount housing.



002345

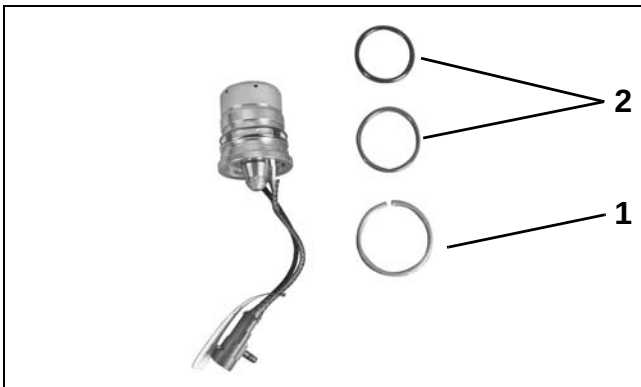
Remove adaptor from injector. Remove crush ring and O-rings from injector. Inspect and clean injec-

tor filter as required. Install new crush ring and O-rings. Lubricate O-rings with *STP⁺ Oil Treatment*.



1. Adaptor

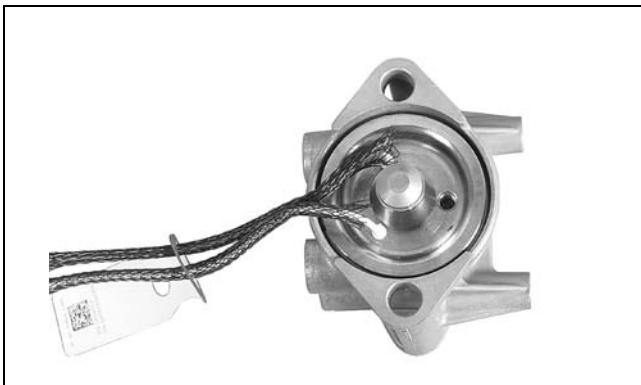
002196



1. Crush ring
2. O-rings

002317

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



002318

Installation

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

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

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

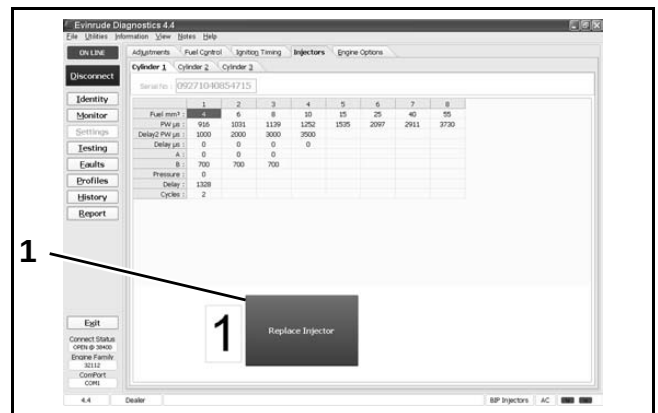
Upload Coefficient Files to *EMM*

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

Select the *Injectors* tab.

Select the cylinder tab for injector being replaced.

Select the *Replace Injector* button.



1. "Replace Injector" button

008079

FUEL SYSTEM

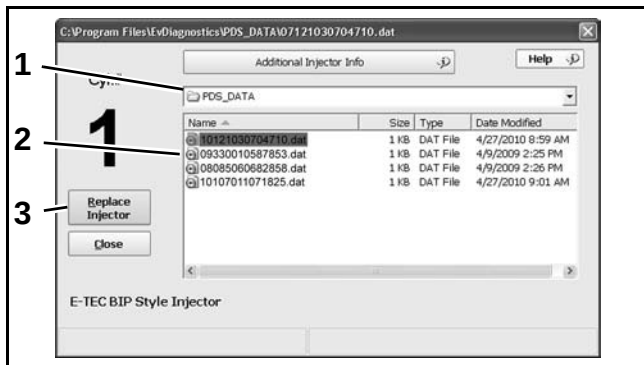
FUEL COMPONENT SERVICING

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

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

Select the correct file for the injector.

Select the *Replace Injector* button.

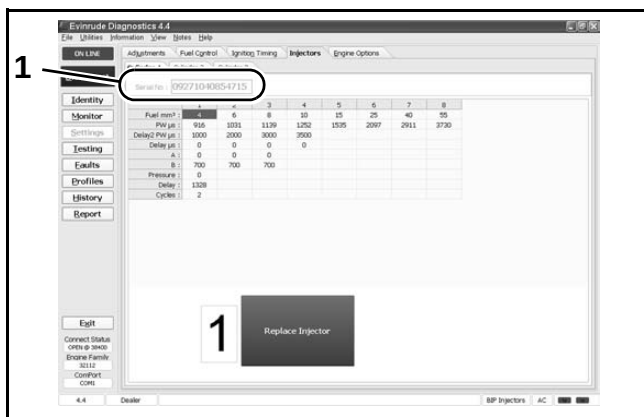


1. Navigation menu
2. Injector coefficient file
3. "Replace Injector" button

008335

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

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



1. Serial number

008079

Install Injector

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

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

CAUTION

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

Place injector and insulator in the proper cylinder location.

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

Lubricate mounting screw threads and under the head of the screw with a light coat of *Triple-Guard* grease. Install washers (one per screw) on injector retaining screws. Install screws and washers through mounting flange of injector and into cylinder head.



002316

Tighten screws in stages, starting with the lower screw.

- First torque is 5 ft. lbs. (7 N·m).
- Second torque is 10 ft. lbs. (14 N·m).
- Final torque is 24 to 26 ft. lbs. (33 to 35 N·m).



Tighten Screws in Stages

006562

Reconnect fuel injector electrical connectors.

Install the ignition coil assemblies. Tighten coil screws to a torque of 60 to 84 in. lbs (7 to 9.5 N·m).

Install fuel manifolds. Refer to **Fuel Manifold Service** on p. 147.

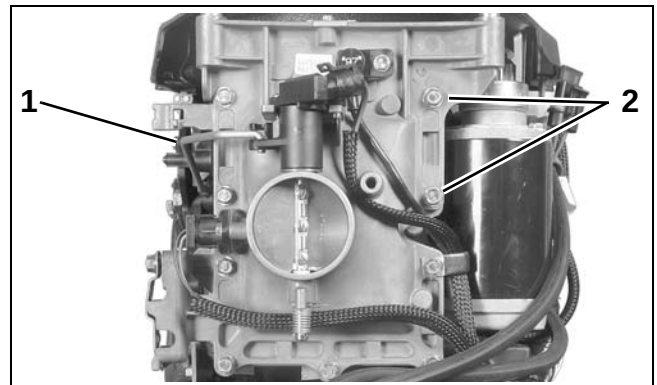
Intake Manifold Service

Removal

Disconnect vapor separator vent hose, main bearing vent hose, air temperature sensor, crankshaft position sensor, and throttle position sensor.

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

Remove throttle body screws and throttle body assembly.

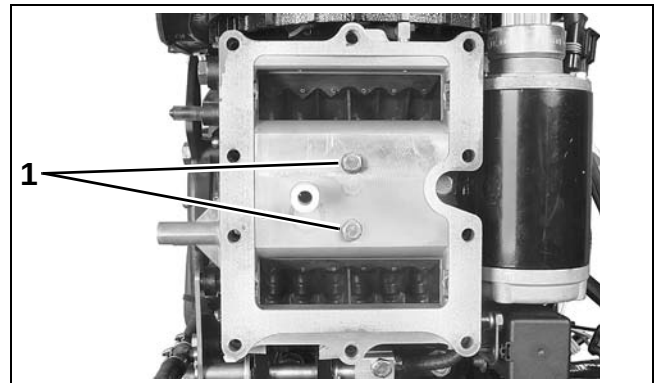


1. Link arm
2. Throttle body screws

002499

Remove gasket from throttle body.

Remove screws and reed plate assembly from the crankcase.



1. Screws

002503

FUEL SYSTEM

FUEL COMPONENT SERVICING

Disassembly

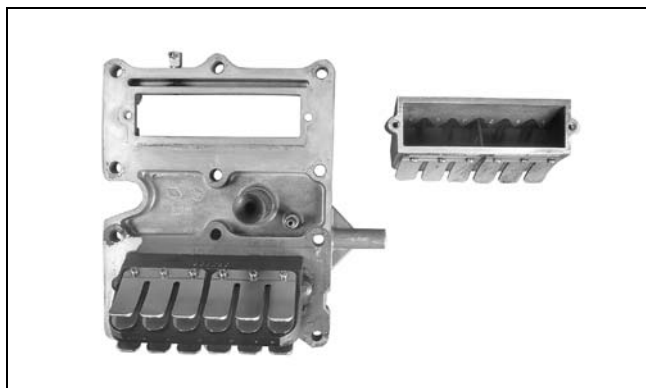
All reed plate assembly and reed valve assemblies must be cleaned prior to reassembly. DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

Remove the reed valve retainer screws and remove the assembly.



002496

Use caution to prevent damaging reed valve assemblies.



002504

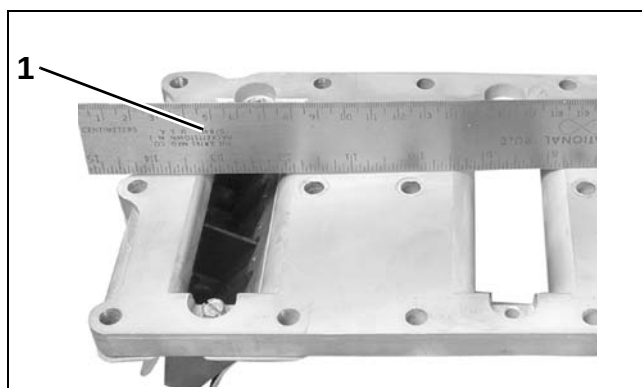
NOTICE DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

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).



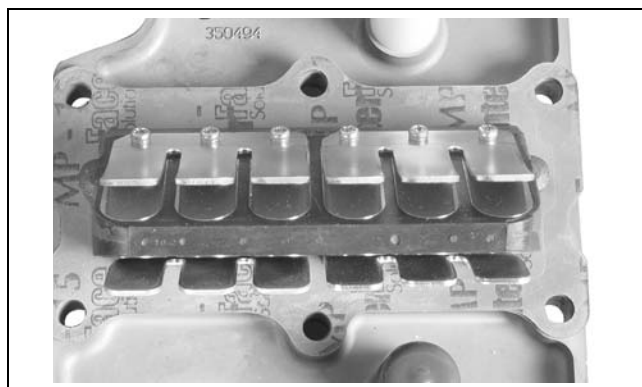
1. Straight-edge

002324

Assembly

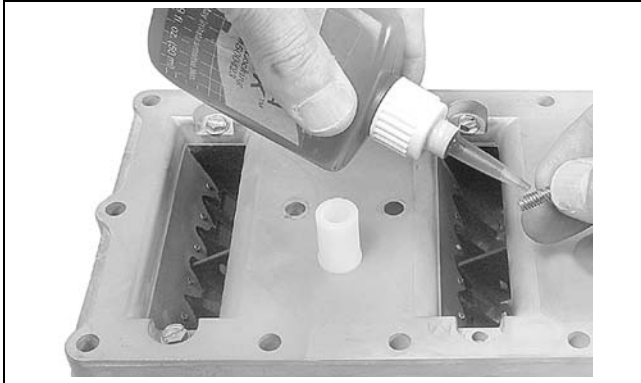
Remove old adhesive from reed valve retaining screws.

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



002333

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 25 to 35 in. lbs. (2.8 to 4.0 N·m).

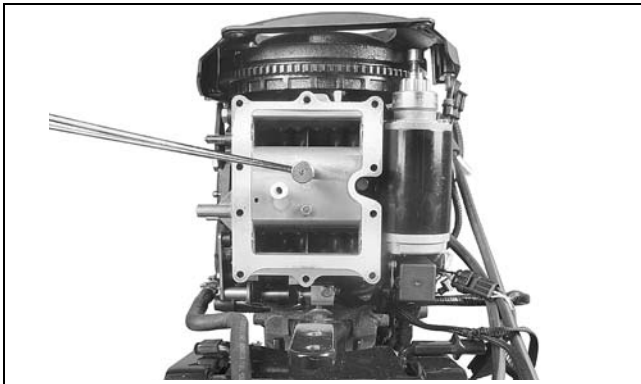


002326

Installation

Place reed plate assembly on cylinder/crankcase.

Apply *Nut Lock* to two reed plate screws. Install and tighten screws to a torque of 60 to 120 in. lbs. (7 to 13.5 N·m).

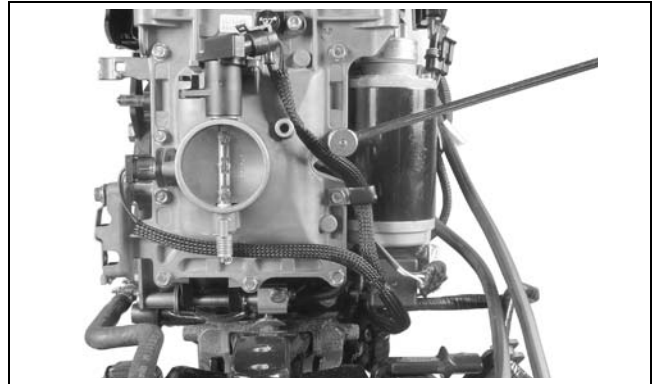


002505

Place gasket on throttle body. Install throttle body on reed plate and install **new** screws.

IMPORTANT: If old screws must be re-used, make sure all previous thread locking material is removed and apply *Nut Lock* to threads.

Tighten the center screws first and expand outward. Tighten in stages to a final torque of 60 to 120 in. lbs. (7 to 13.5 N·m).



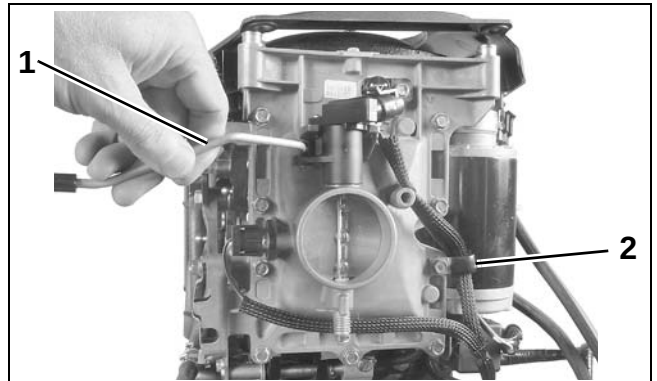
002501

Install vapor separator vent hose and main bearing vent hose. Secure with tie straps.

Install air temperature sensor, crankshaft position sensor, and throttle position sensor electrical connectors.

Connect throttle linkage.

IMPORTANT: DO NOT lubricate throttle linkages.



1. Throttle linkage
2. Clamp

002500

Refer to **TPS Calibration** on p. 126.

NOTES

Technician's Notes

[illegible]

Related Documents

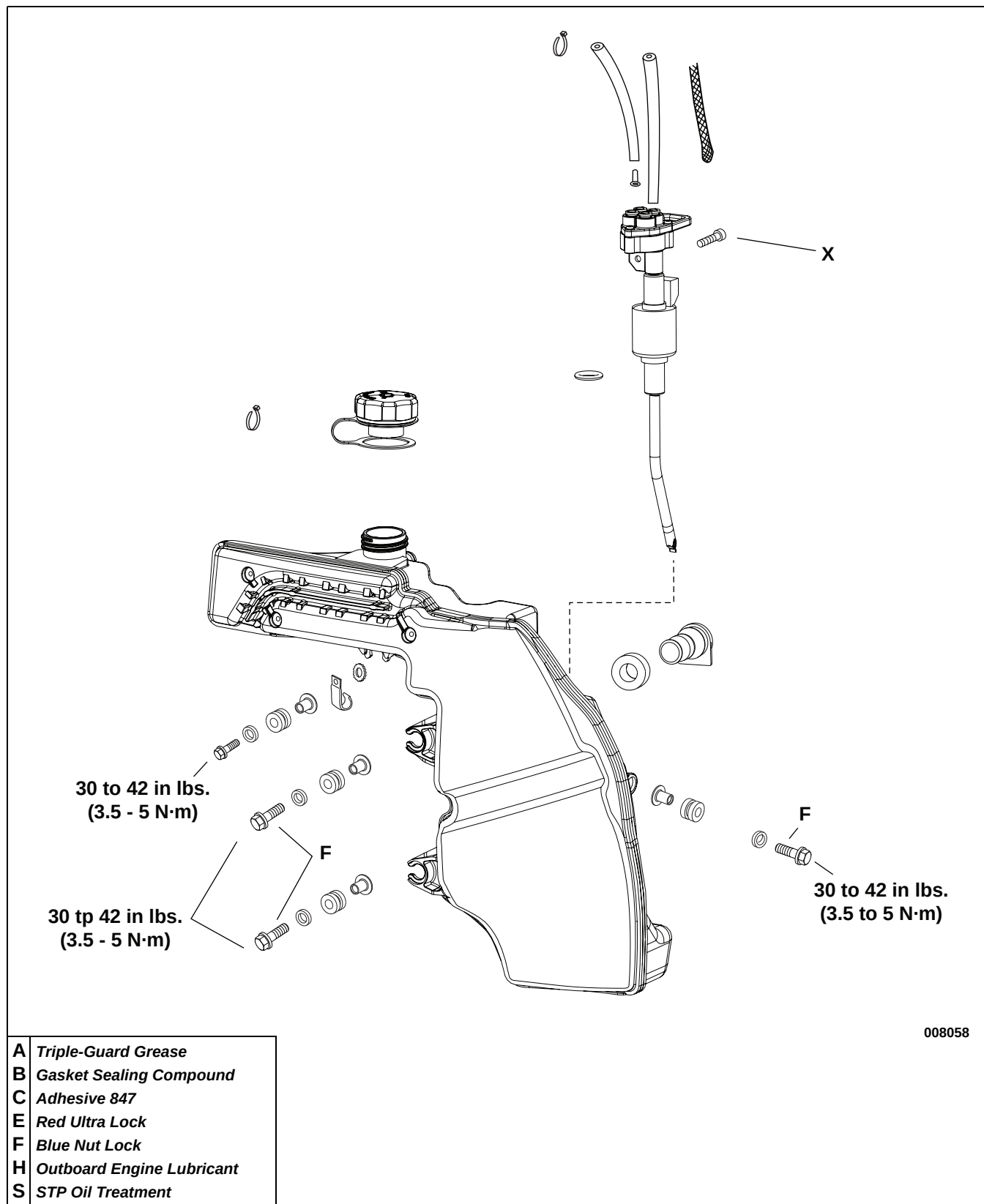
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OILING SYSTEM

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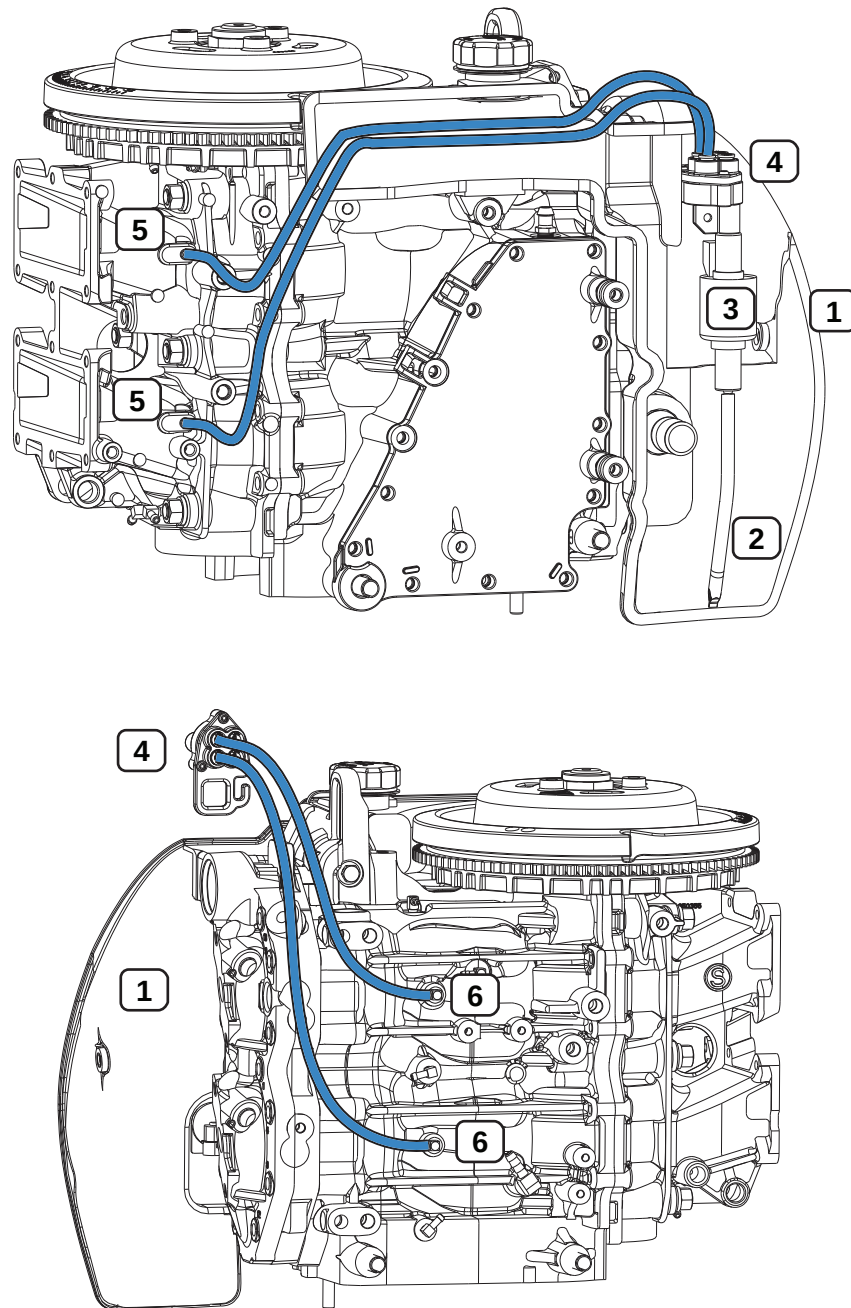
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SERVICE CHART



008058

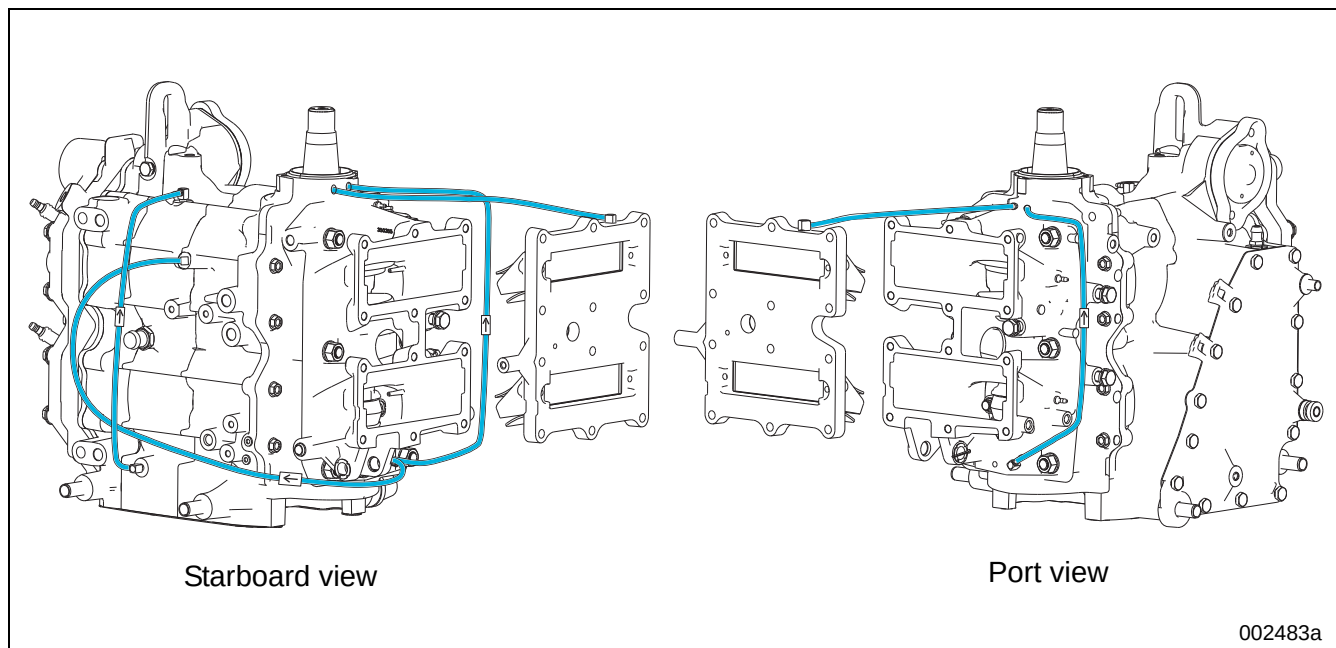
OIL SUPPLY DIAGRAMS



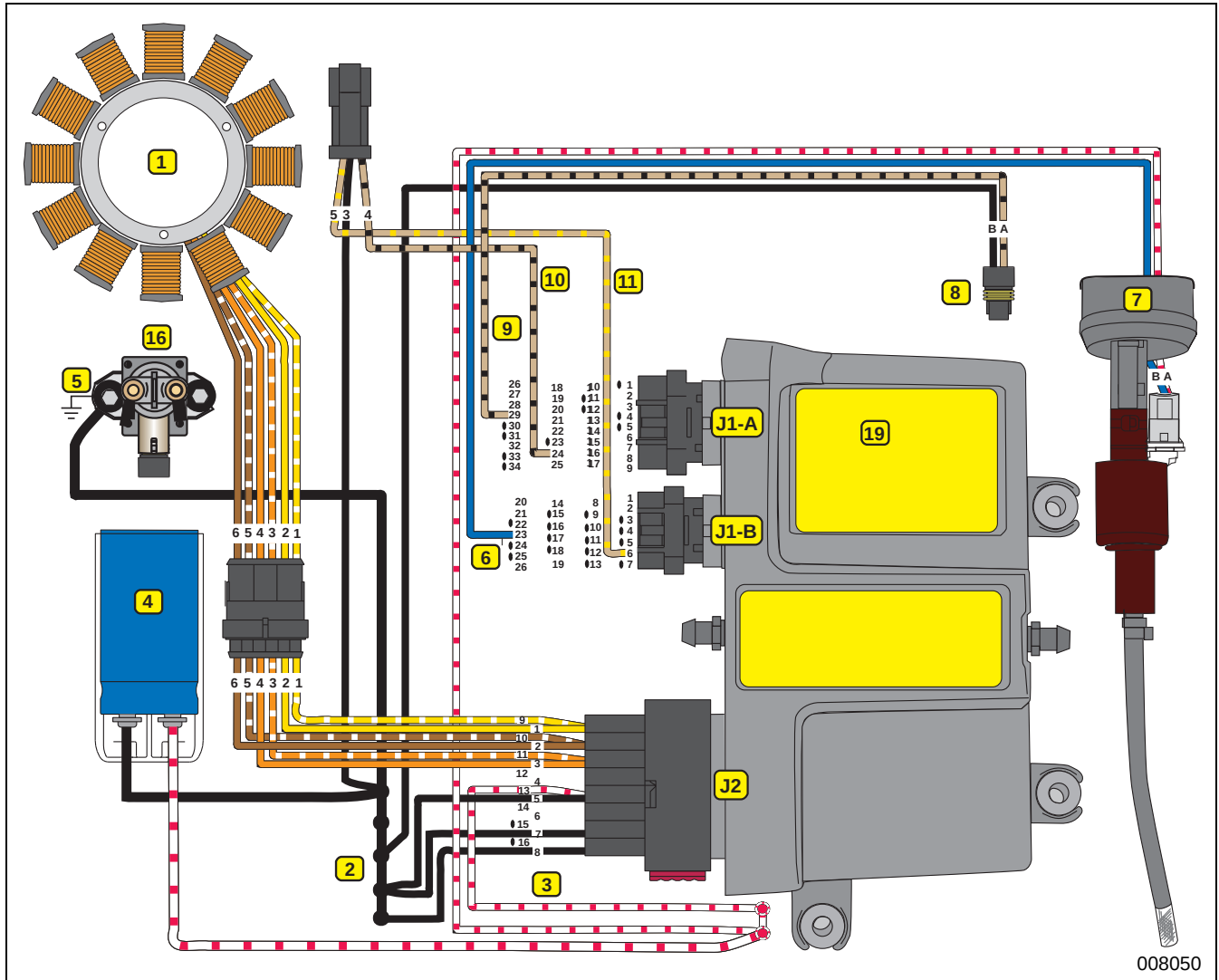
008060

- | | |
|-----------------------|-----------------------------------|
| 1. Oil tank | 4. Oil distribution manifold |
| 2. Oil pick-up/filter | 5. Crankcase oil inlet (port) |
| 3. Oil injection pump | 6. Cylinder oil inlet (starboard) |

OIL RECIRCULATION DIAGRAM



OILING SYSTEM CIRCUIT DIAGRAM



008050

1. Stator
2. Stator output (55 V)
3. Alternator grounds (BLACK)
4. Oil Injector ground (BLACK)
5. Alternator output, WHITE / RED wires (55 V)
6. Capacitor (55 V)
7. Main harness ground (BLACK)
8. 55 V to injection pump (WHITE / RED)
9. *EMM* injector control (BLUE)
10. Oil injection pump
11. Low oil switch
12. Low oil switch to *EMM* (TAN/BLACK)
13. Low oil signal to *SystemCheck* gauge (TAN/BLACK)
14. No oil signal to *SystemCheck* gauge (TAN/YELLOW)

COMPONENTS

The oiling system includes the following components:

- Oil tank
- Oil injection pump and manifold assembly
- Oil level switch
- Electrical circuit
- LOW OIL and NO OIL warning systems
- Cylinder and crankcase
- Oil recirculation system.

Oil Tank Assembly

The oil tank is mounted on the powerhead under the engine cover. Oil level must be monitored.

Oil Tank Components:

- Tank, 2 quart. (1.87 liter) capacity
- Oil pickup and filter assembly
- Oil injection pump and manifold assembly
- LOW OIL switch
- Oil distribution hoses

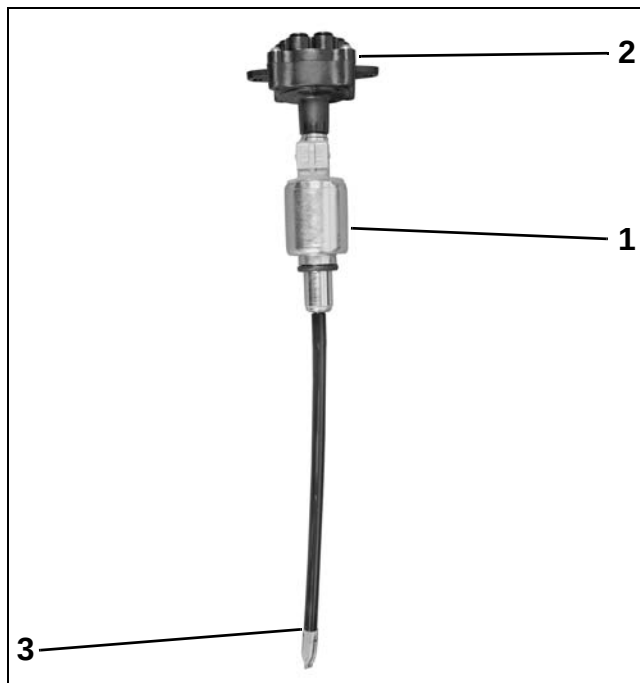


006488

Oil Injection Pump

The oil injection pump is an electric (55 V) actuator style pump. It draws oil from the oil tank and supplies pressurized oil to the oil manifold. The *EMM* supplies 55 V and controls activation of the pump.

The oil manifold distributes the oil supplied by the pump.



1. Oil injector pump
2. Oil distribution manifold
3. Pickup tube and filter

008064

Electrical Circuit (55 V)

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

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

Activates S.A.F.E.
Stores a service code 34
<i>EMM</i> LED 4: ON (Running)
Gauge (opt) NO OIL display: ON

LOW OIL Warning

IMPORTANT: The *SystemCheck* engine monitor warning system is available for *MFE* 55 models through the installation of boat Harness Kit P/N 586853.

A switch in the oil tank pick-up assembly monitors the oil level in the oil tank.

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

Interrupts the ignition once per 50 engine revolutions to signal the operator
Gauge (opt) LOW OIL display: ON

Approximate oil reserve at Low Oil activation:

- 0.45 qt. (0.43 l).

NO OIL Warning

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

Activates <i>S.A.F.E.</i>
Stores service code 117
<i>EMM</i> LED 4: ON (Running)
Gauge (opt) NO OIL display: ON

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

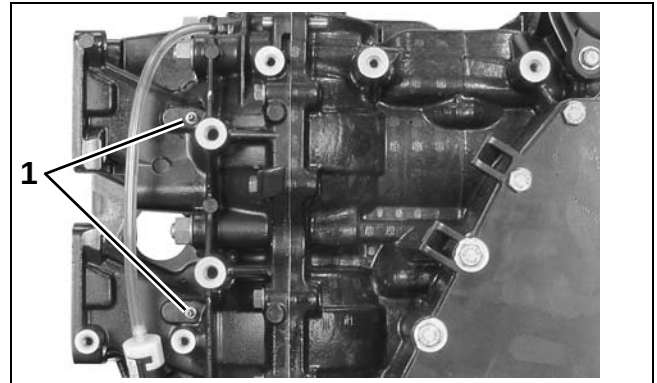
- Oil level must be above one-quarter
- The warning resets after three oil pump pulse cycles when the outboard has been stopped and restarted.

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

Stores service code 33
<i>EMM</i> LED 4: FLASHING
Gauge (opt) NO OIL display: FLASHING

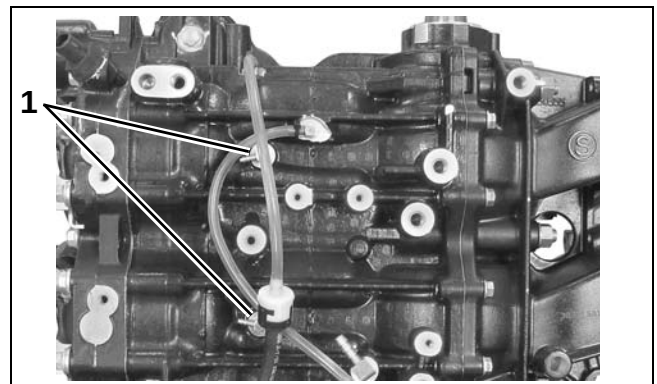
Cylinder and Crankcase

The oil distribution manifold provides crankcase lubrication through oil distribution hoses and pressed-in fittings on the crankcase and cylinder block.



1. Crankcase oil fittings

006614



1. Cylinder block oil fittings

006615

OILING SYSTEM

OIL CONTROL SETTINGS

Oil Recirculation System

External hoses and fittings, internal cylinder/crankcase passages, and intake manifold passages are used to recirculate any accumulation of oil from various locations in the powerhead. The movement of oil is controlled by check valves.

Cylinder Recirculation

Internal powerhead oil drain passages connect the intake port areas of the cylinders to circulate residual oil in the block.

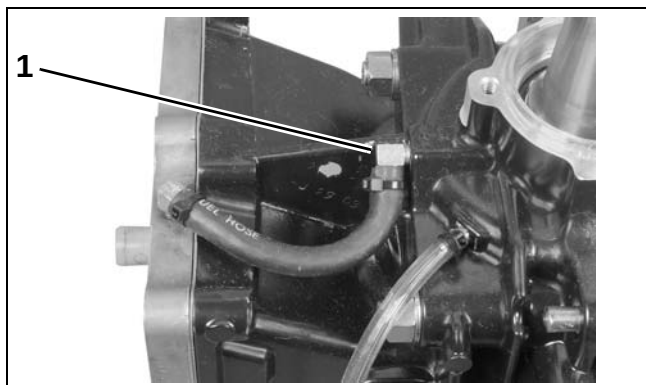
External fittings and in-line check valves on each side of the cylinder block control the movement of oil from the lower cylinder port to the upper cylinder port.

Crankcase / Main Bearing Recirculation

The movement of oil through the main bearings is controlled by internal passages, external fittings and hoses, and check valves.

Lower to upper main bearing oil flow:

- Lower main bearing cavity to internal crankcase passage to external fitting, external hoses with in-line check valve to external fitting at upper main bearing, and into upper main bearing through internal crankcase passage.
- Internal crankcase passage to external fitting in crankcase cover at upper main bearing, hose routed to reed plate fitting. This circuit vents the upper main bearing cavity to promote oil flow.



1. Upper main bearing vent

002399

Refer to the **OIL RECIRCULATION DIAGRAM** on p. 158.

OIL CONTROL SETTINGS

Oil Injection Rate

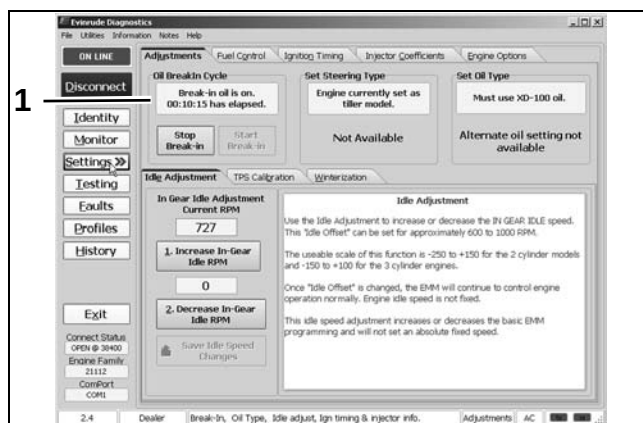
EMM programming controls the rate of oil injection based on engine RPM. This rate can be adjusted for powerhead break-in. Use *Evinrude Diagnostics* software to access this feature.

Break-In Oiling

The *EMM* automatically supplies extra oil to the engine during the first two hours of operation, above 2000 RPM.

Follow these steps for outboard set-up:

- Use *Evinrude Diagnostics* software to make sure the break-in program has been started on a new outboard.
- Use the diagnostics software to start break-in oiling after a powerhead rebuild.



1. Break-in oil setting

006627

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

Oil Priming

The oiling system of the outboard must be primed:

- When the outboard is first installed.
- Whenever the oil supply to the oil lift pump is disconnected or disrupted.
- Whenever an oiling system component is removed or replaced.

Refer to **Oil Supply Priming** on p. 39.

OILING SYSTEM TESTS

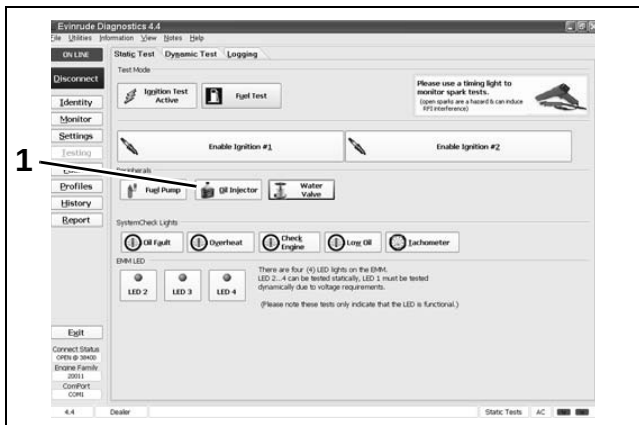
IMPORTANT: Always perform visual inspections to identify oiling system leaks. Make sure the oil tank is filled and oil supply is not contaminated.

Oil Injection Pump Static Test

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply Tool, P/N 587005, with internal 9 volt batteries only. This will produce false results. Refer to **Communication** on p. 86.

Use *Evinrude Diagnostics* software to activate the *Oil Injector* test. This test starts the *EMM* control function for the oil injection pump.

The *EMM* controls the pump by providing ground through pin 23 (blue wire) of the J1-B connector and pin 2 (blue wire) of the oil tank connector.



Static Tests Screen

1. Oil injector test button

008099

IMPORTANT: This test is operating the pump with 12 V battery power on the system voltage (55 V) circuit. The oil injection pump will not activate on 12 V.

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil tank connector (pin 2).

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

Refer to **Oil Injection Pump Voltage Test** on p. 163.

Oil Injection Pump Voltage Test

Use an appropriate test probe and a digital multi-meter calibrated to a scale that reads 55 V (DC). Voltage readings should be approximately 55 V.

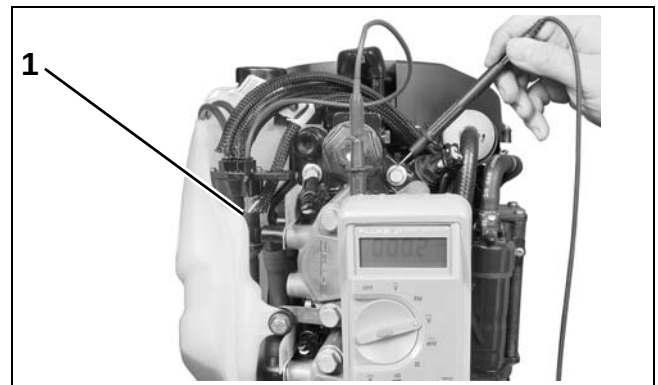
Connect negative meter lead to ground.

Connect positive meter lead to pin B (blue wire) of oil injection pump electrical connector.

Start the engine.

Use the *Prime Oil System* function of *Evinrude Diagnostic* software *Dynamic Test* screen to activate the oil pump.

- Voltage at pin B should vary up to 5 volts, as the oil pump cycles.
- If voltage at pin B is not within range, check voltage at pin A of oil tank electrical connector.
- If voltage at pin A is within range, refer to **Oil Injection Pump Resistance Test** on p. 164.
- No voltage reading at pin A, refer to **System Voltage Test** on p. 102.



1. Oil injection pump electrical connector

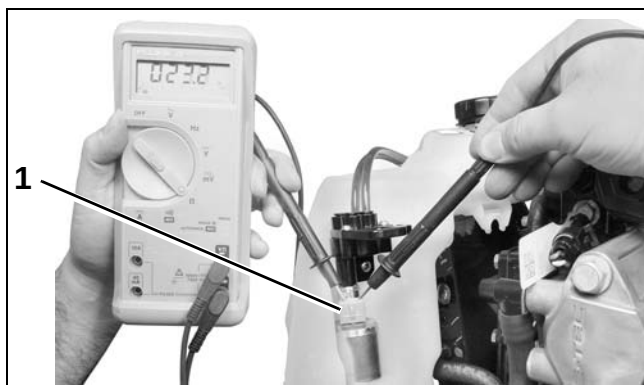
008065

Oil Injection Pump Resistance Test

Disconnect the electrical connector from the oil injection pump.

Use a digital multimeter to measure the resistance between the pins of the oil injection pump connector. Calibrate the meter to the LOW OHMS scale.

Oil Injection Pump Circuit Resistance
22 Ω



1. Oil injection pump connector

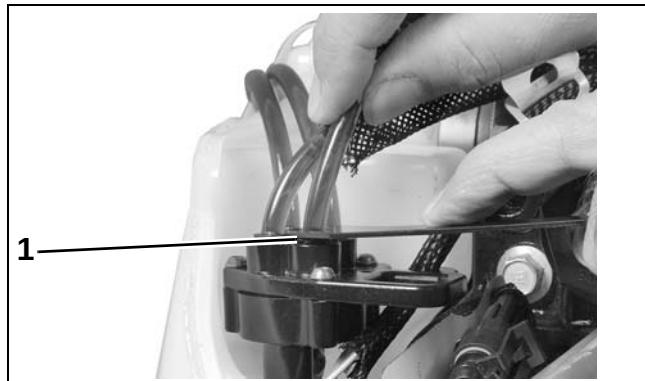
008420

Results:

- An infinite reading (∞) indicates an open circuit of the injection pump winding. Replace faulty pump.

Oil Injection Pump Function Test

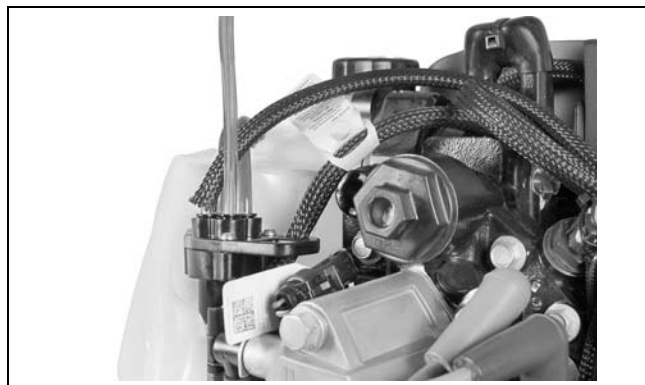
Remove oil distribution hose from fitting at oil distribution manifold. Do not lose the brass hose support.



1. Retainer mechanism

008067

Temporarily install a length of oil hose.



008068

Start the outboard and observe oil flow:

- Oil flows from hose, compare to oil flow at other distribution fittings
- If one or more fittings fail to flow oil, replace the oil injection pump assembly.

Reinstall hose into manifold.

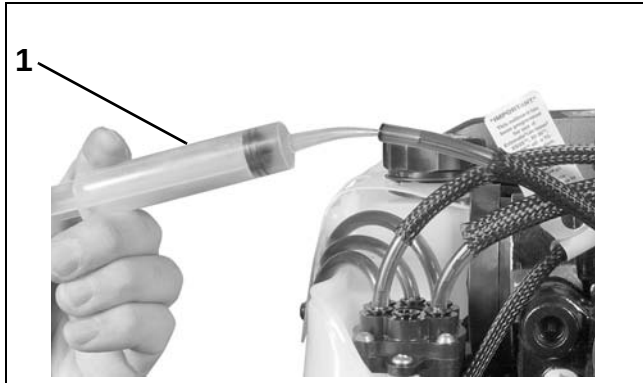
IMPORTANT: Make sure hose support is in hose and hose is fully inserted into manifold. Refer to **Oil Distribution Hoses** on p. 166.

Oil Injection Fittings Flow Test

Make sure the oil injection fittings of the cylinder and crankcase assembly allow fluid to move.

Remove oil distribution hose from oil distribution manifold.

Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.



1. Syringe

008069

LOW OIL Sending Unit Test

Remove the oil from the oil tank.

Start the outboard. The ignition should be interrupted once per 50 engine revolutions.

If the outboard has been equipped with a dash mounted Engine Monitor system, turn the key switch ON. The LOW OIL light of the warning system gauge should turn on.

Once the warning has been confirmed, refill the oil tank and start the outboard. The LOW OIL warning should stop after the oil pump cycles 3 times.

OIL COMPONENT SERVICING

WARNING

To prevent accidental starting while servicing, twist and remove spark plug leads.

Oil Distribution Hoses

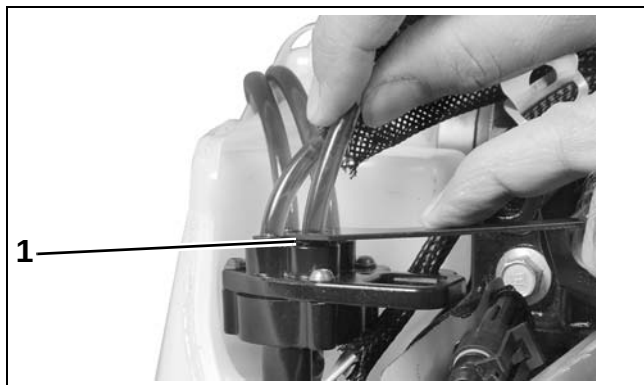
The oil distribution hoses to each cylinder **MUST** be the same length. **DO NOT** alter the length of any hoses.

Oil Distribution Hose Length:

- 20 in. (508 mm)

Removal

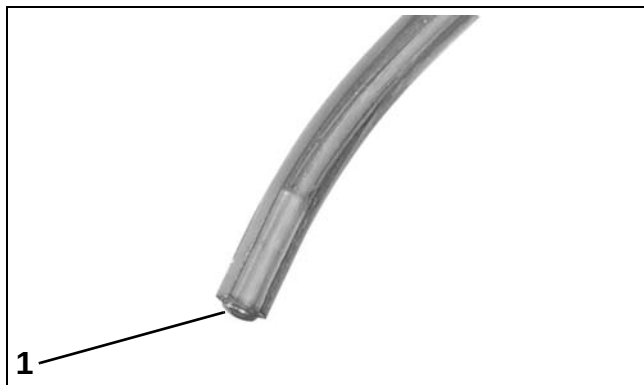
Release the hose by depressing the outer ring of the hose retaining mechanism.



1. Retainer mechanism

008067

Once hose is removed from the manifold, make sure hose support is in the end of the hose.



1. Hose support

008070

Installation

Cut Replacement Oil Hose, P/N 778708, to the correct length. Insert hose support in manifold end of hose.

IMPORTANT: **DO NOT** insert distribution hoses into manifold without a hose support.

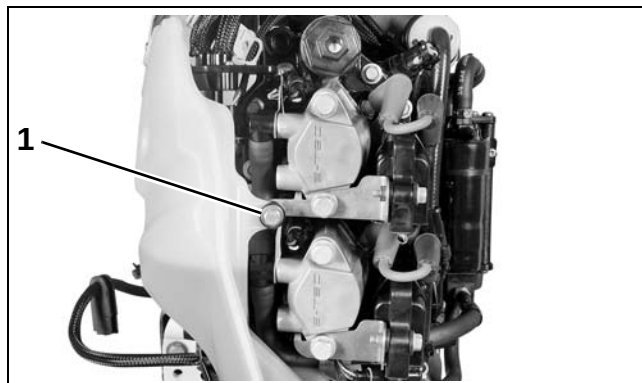
Be sure the hose is fully inserted into manifold. Insertion depth is 5/8 in. (16 mm). Visually inspect for hose supports.

Oil Tank Assembly

Removal

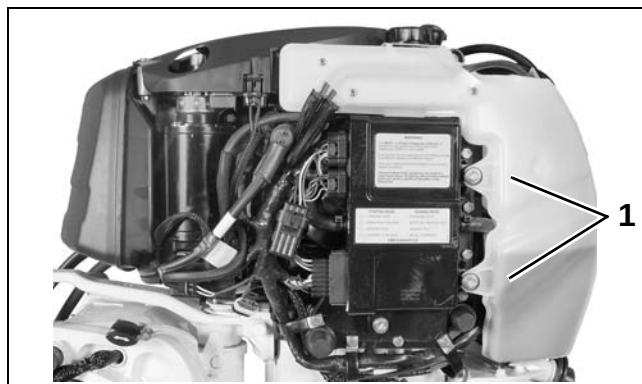
Remove engine covers and air silencer.

Remove oil tank retaining screws.



1. Screw

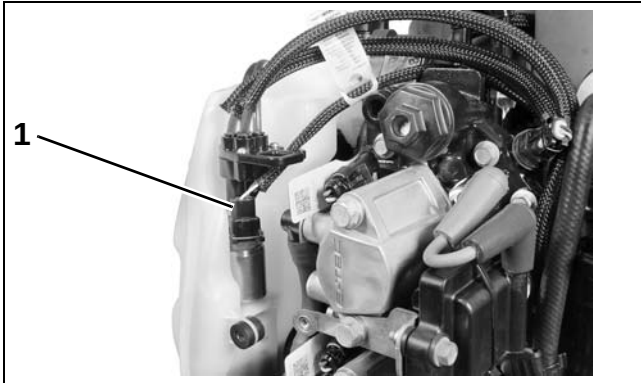
008073



1. Screws

008074

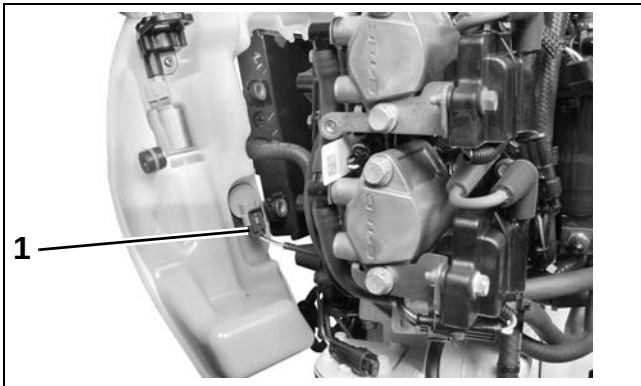
Disconnect the electrical connector to the oil injection pump and manifold assembly.



1. Oil pump connector

008075

Disconnect the electrical connector to the low oil switch.



1. Low oil switch connector

008076

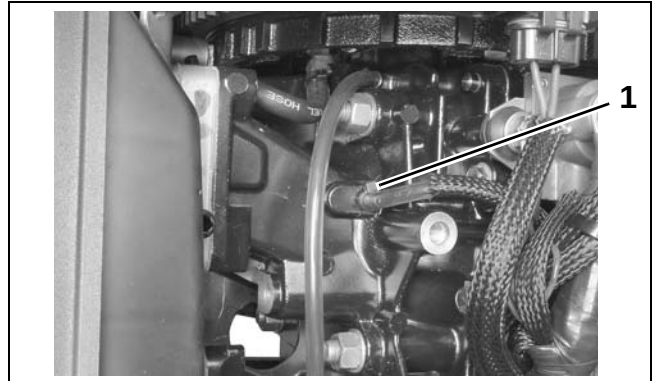
IMPORTANT: Note oil distribution hose routings before proceeding with disassembly.

Remove oil distribution hoses from the manifold.

Installation

Position oil tank assembly on powerhead. Clean mounting screws and apply *Nut Lock* to threads. Install screws and tighten to a torque of 30 to 42 in. lbs. (3.4 to 4.8 N·m).

Install protective sleeves and route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings. Refer to **OIL SUPPLY DIAGRAMS** on p. 157. Secure oil hoses to crankcase fittings with tie straps.



1. Tie strap

006573

Run outboard and check for leaks. Use *Evinrude Diagnostics* software to activate "Oil Prime." Check oil flow through oil distribution hoses. Check oil system operation and routing of oil system hoses.

Repair any oil leaks and kinked or misrouted hoses. Install air silencer and engine covers.

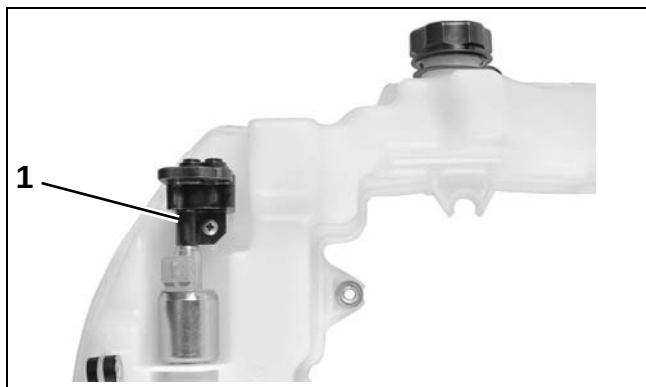
Oil Injection Pump

Removal

Remove oil distribution hoses from oil manifold. Refer to **Oil Distribution Hoses** on p. 166.

Remove oil from oil tank.

Remove oil tank. Refer to **Oil Tank Assembly** on p. 166. Remove retaining screw(s) from oil pump assembly. Twist and pull up on oil pump to remove from tank. DO NOT pull up on oil manifold.

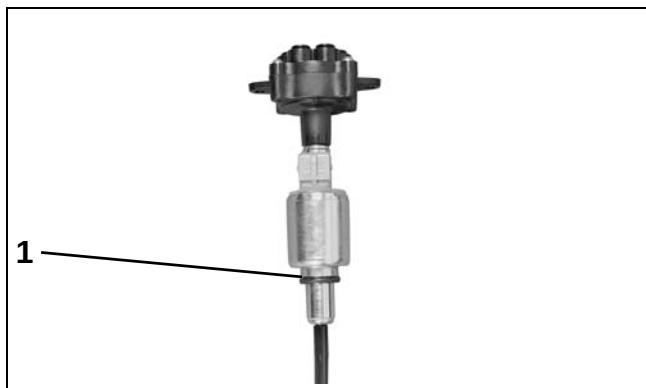


1. Screw

008180

Installation

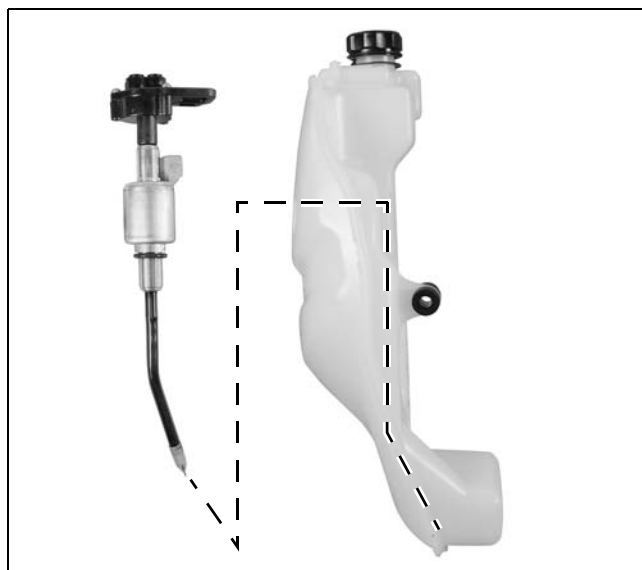
Apply a drop of outboard lubricant to a new oil pump o-ring. Install o-ring on oil pump flange.



1. O-ring

008064

Install oil pump and manifold so that bend of oil pick up assembly is positioned to follow the contour of the oil tank as shown.



008182

Install oil pump retainer screw(s). Tighten securely.

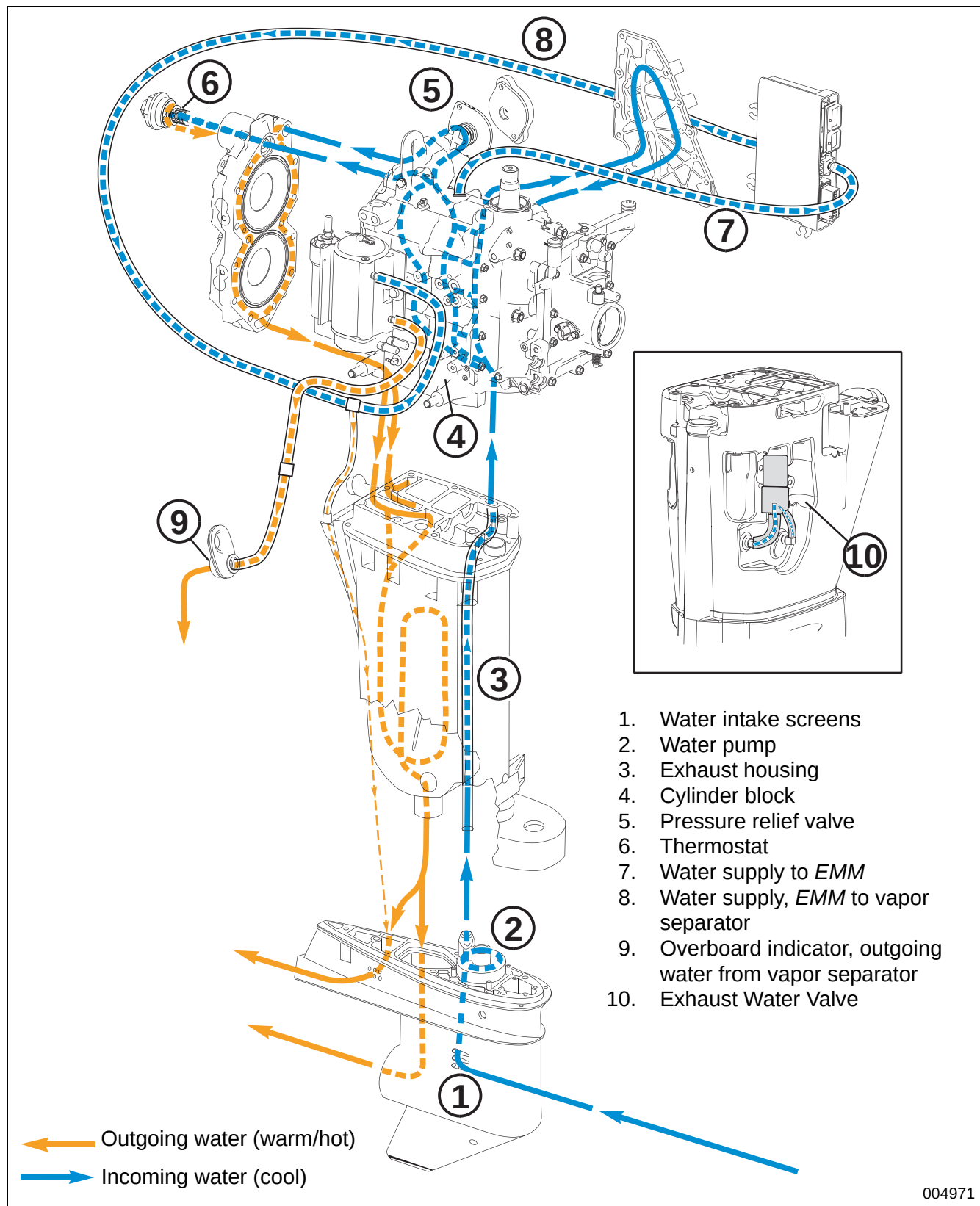
IMPORTANT: Turn self-tapping screws counter clock-wise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the oil tank.

COOLING SYSTEM

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HOSE ROUTING AND WATER FLOW DIAGRAM



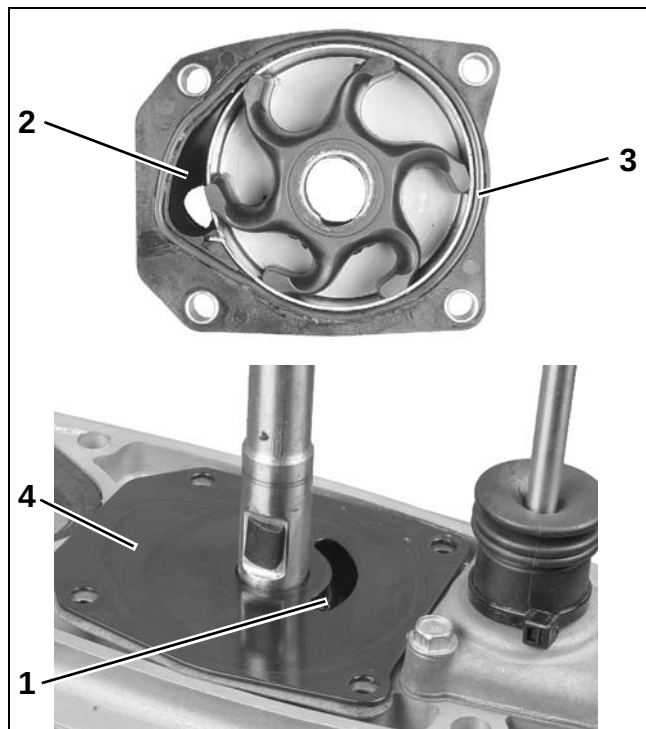
COMPONENTS

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. 242 for servicing.



1. Water inlet
2. Water outlet
3. Seal
4. Plate

001216
001217

IMPORTANT: The water pump housing includes a small hole to the rear of the water outlet. This hole provides cooling water for the tip of the exhaust passage. Be sure to use the correct parts when replacing the water pump.



1. Hole

004970

Exhaust Housing

The water pump outlet connects with passages located in the outboard's midsection. A grommet seals the water pump housing to the exhaust housing.

Water supplied to the exhaust housing provides all cooling water to the cylinder block.

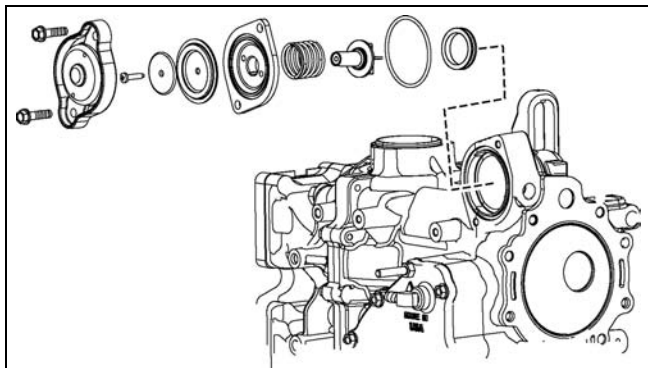
Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 1800 RPM). The pressure relief valve opens as water pressure increases. Spring tension sets the opening pressure.

Overheating: A restricted or faulty valve typically results in HIGH SPEED overheating.

COOLING SYSTEM COMPONENTS

Overcooling: Debris may prevent the valve from closing completely.



Pressure relief valve components

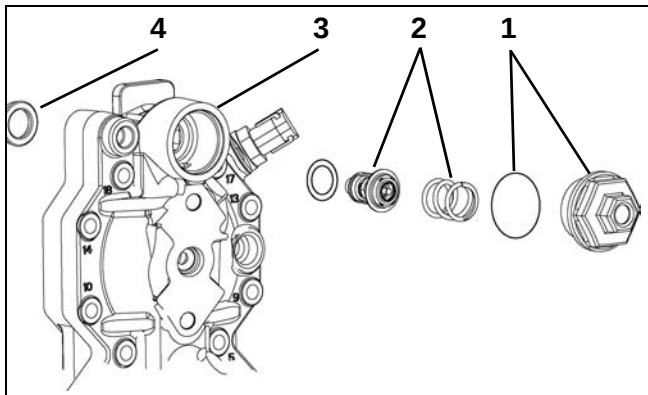
002437

Thermostat

The thermostat is used to control water flow and operating temperature at lower speeds (below 1800 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.

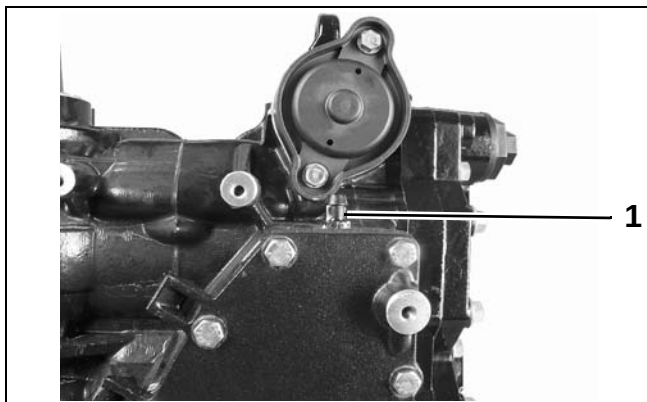


1. Cover and O-ring
2. Spring and thermostat
3. Cylinder head
4. Cylinder head seal

02439

Block Venting

A fitting and hose connected to the top of the exhaust cover allows the constant movement of water and/or air from the block. Circulated water flows through the *EMM* and vapor separator before exiting through the overboard indicator.

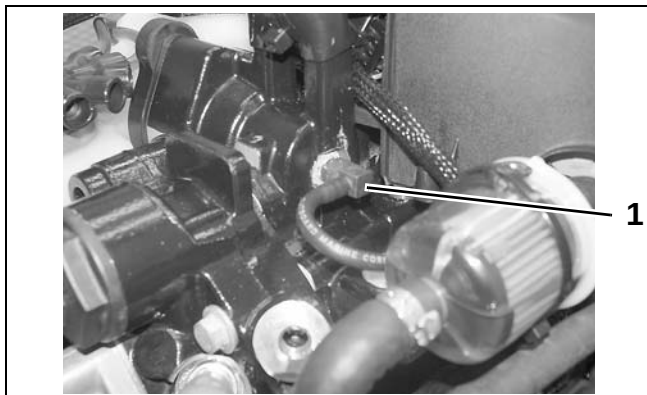


1. Fitting

002478

Water Pressure Connection

A fitting and hose for an accessory water pressure gauge can be connected at the top of cylinder block next to the pressure valve housing.



1. Fitting

002461

Refer to **THERMOSTAT SERVICING** on p. 176.

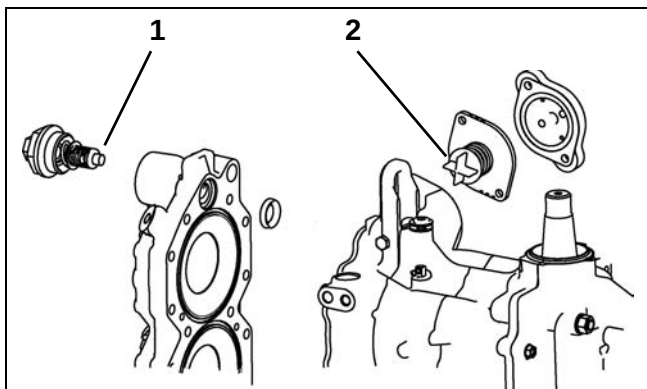
OPERATION

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 power-head damage.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cylinder block and cylinder heads is controlled by a thermostat and a pressure relief valve. The pressure valve is located in the top of the block next to the exhaust cover.



1. Thermostat
2. Pressure valve assembly

002441

The thermostat and pressure valve control the flow of water entering the vertical water passages of the cylinder head.

At low speed, the pressure valve is against the seat and the thermostat is closed. Warm water from the cylinder block gradually migrates to the thermostat pocket at the top of the cylinder head.

The thermostat opens when the water temperature reaches approximately 143°F (62°C).

When the thermostat opens, water flows down through the cylinder head to a passage in the cylinder block. Water flows through the block to the exhaust housing and then out of the outboard.

At higher speeds, water pressure opens the pressure relief valve at approximately 1800 RPM. Water flows through the valve to the cylinder head and bypasses the thermostat. All water flows through the cylinder head to the outlet passage of the block and then exits through the exhaust housing.

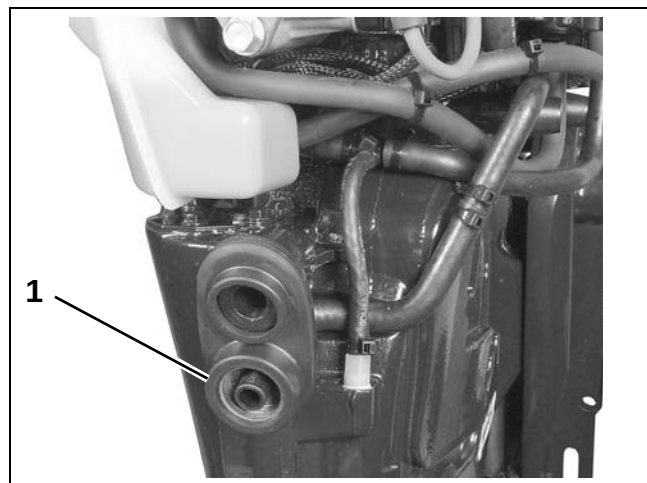
EMM and Vapor Separator Cooling

Cooling water is routed from the top of the cylinder block to the inlet fitting of the *EMM* water cavity. Cooling of the *EMM* helps to stabilize the temperatures of internal components.

IMPORTANT: Improper *EMM* cooling will activate service codes 25 and 29 and the Engine Monitor warning system. Refer to the **EMM Service Code Chart** at the back of this manual for specific service code information.

Cooling water from the *EMM* is routed to the water inlet fitting of the vapor separator water cavity. Cooling the vapor separator fuel chamber minimizes fuel vaporization.

Cooling water from the vapor separator is routed to the overboard indicator.



1. Overboard indicator

004969

ENGINE TEMPERATURE CHECK

IMPORTANT: The engine temperatures listed below are based on an intake water temperature of $70^{\circ} \pm 10^{\circ}\text{F}$ ($21^{\circ} \pm 3^{\circ}\text{C}$).

Install correct test propeller (MRL) 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, turn the key switch OFF, and twist and remove all spark plug leads so the engine cannot be started accidentally.

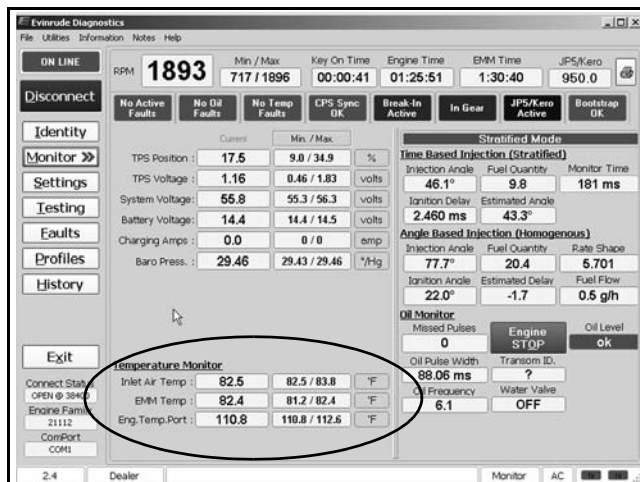
Reduce speed to IDLE for five minutes. Check IDLE operating temperature.

Increase speed to 5000 RPM and check temperature.

If engine temperatures are not within range, troubleshoot cooling system.

Software Method

Use *Evinrude Diagnostics* software to read temperature displays.



Monitor Screen

006624

Typical temperature sensor readings at IDLE speed should be $155^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($68.3^{\circ}\text{C} \pm 3^{\circ}\text{C}$).

Typical temperature sensor readings at WOT speed should be $160^{\circ}\text{F} \pm 40^{\circ}\text{F}$ ($71^{\circ}\text{C} \pm 22^{\circ}\text{C}$).

Operating temperature must not exceed 212°F (100°C).

Pyrometer Method

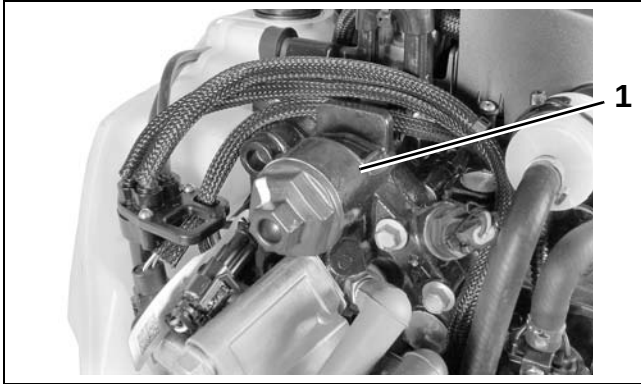
Use a Temperature Gun, P/N 772018, or a digital pyrometer to measure the outboard's operating temperatures.

Measure temperature of the thermostat housing at the top of cylinder head.

Typical pyrometer readings at IDLE speed should be $145^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($63^{\circ}\text{C} \pm 6^{\circ}\text{C}$).

Typical pyrometer readings at WOT speed should be $150^{\circ}\text{F} \pm 40^{\circ}\text{F}$ ($66^{\circ}\text{C} \pm 22^{\circ}\text{C}$).

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



Thermostat housing

008345

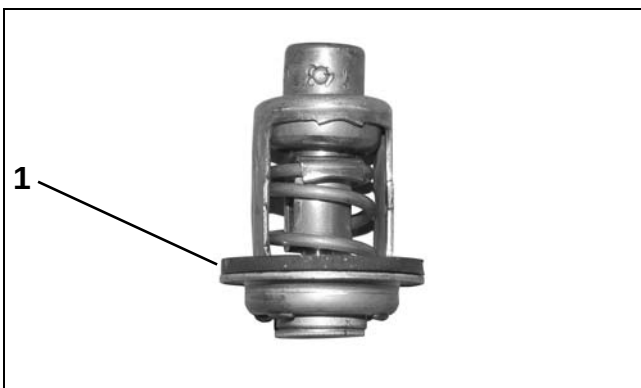
IMPORTANT: Digital pyrometer or temperature gun measurements may be slightly lower than software temperature readings.

Idle Operating Temperature Troubleshooting (Below Range)

If engine IDLE temperature is below operating range, 155°F ± 5°F (68.3°C ± 3°C), check thermostat and pressure relief valve operation.

Thermostat Inspection

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



1. Thermostat seal

006401

Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

Refer to **THERMOSTAT SERVICING** on p. 176.

Pressure Relief Valve Inspection

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

Start the outboard and check IDLE operating temperature.

If IDLE temperature is too low, check pressure relief valve plunger and seal for damage or debris that could prevent the valve from closing completely.

If IDLE temperature is still below operating range, replace pressure relief valve assembly and plunger seal.

To test pressure relief valve operation, monitor temperature at the thermostat housing with Temperature Gun, P/N 772018, or digital pyrometer.

Confirm normal IDLE operating temperature.

Slowly increase engine speed from IDLE, up through 2500 RPM.

Engine temperature should decrease from normal IDLE temperatures as pressure relief valve opens. Valve should open between 1800-2200 RPM.

If temperature decreases at a lower RPM, replace pressure relief valve assembly.

Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 177.

TEMPERATURE SENDER SERVICING

Removal

Loosen sensor and remove by hand. Use care to avoid breaking threads.



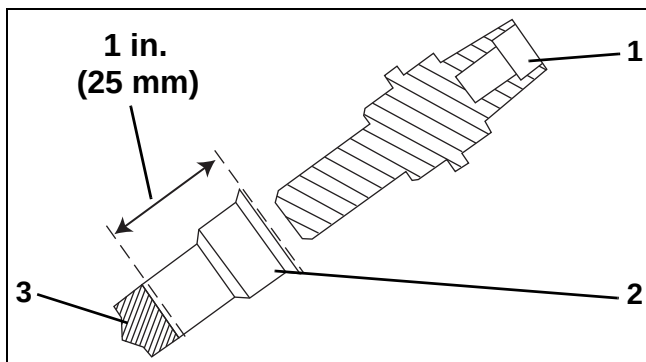
008346

Clean sensor threads, sensor, and sensor cavity.

Installation

Fill bottom of sensor cavity with 0.7 cc of *Thermal Joint Compound*, P/N 322170. Sensor cavity should be filled to 1 inch (25 mm) below the top edge of the cavity.

Install sensor. DO NOT use gasket sealing compound. SLOWLY tighten temperature sensor to a torque of 50 to 70 in. lbs. (5.6 to 8.0 N·m).



1. Temperature sensor
2. Sensor cavity
3. Thermal joint compound

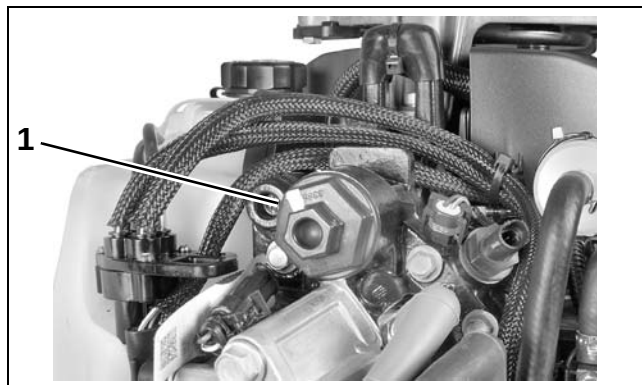
007049

Wait 10 minutes for trapped air to bleed from cavity. Thermal compound may seep past threads. Retighten sensor.

THERMOSTAT SERVICING

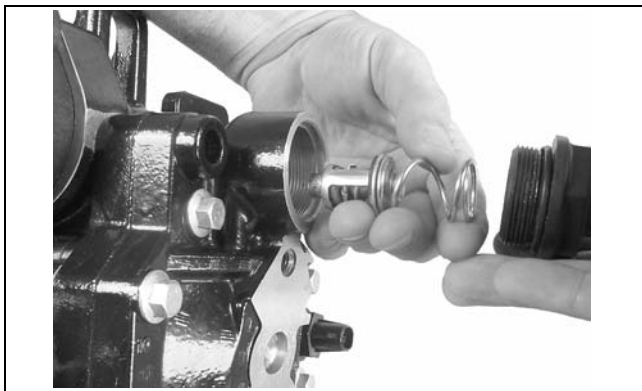
Disassembly

Remove the thermostat cover and O-ring from cylinder head.



008347

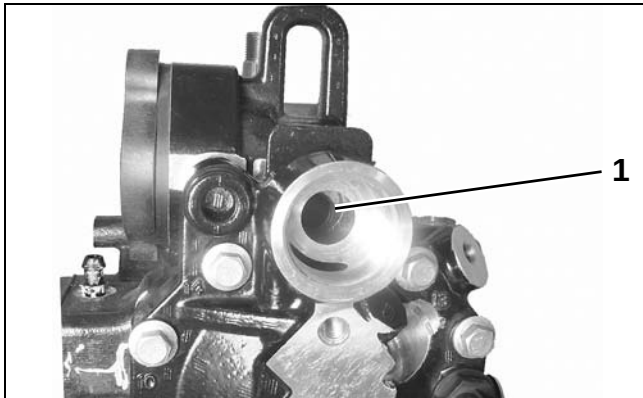
Remove spring, thermostat, and gasket.



002444

Remove the cylinder head if cylinder head thermostat seal requires replacement. Place new seal in the cylinder head with side marked "TO CYL"

HEAD" facing thermostat. Refer to **Cylinder Head Installation** on p. 197.



1. Cylinder head seal

002445

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.



000756

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

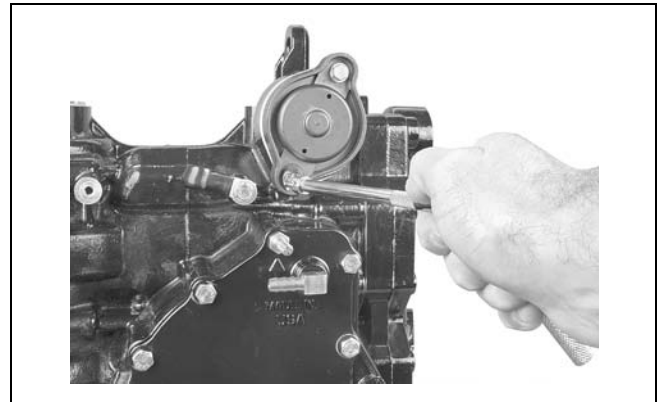
Coat threads of thermostat cover with *Gasket Sealing Compound* and install new O-ring. Install and tighten cover to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).

PRESSURE RELIEF VALVE SERVICING

The pressure relief valve assembly should be serviced at the same time as the thermostat.

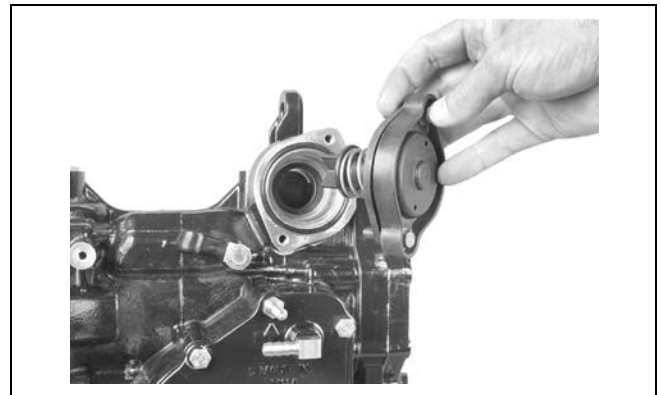
Disassembly

Remove screws and cover from pressure valve assembly.



002443

Remove the pressure relief valve assembly.



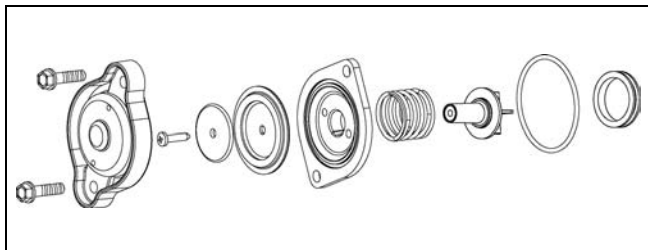
002459

COOLING SYSTEM

PRESSURE RELIEF VALVE SERVICING

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.



Pressure Relief Valve Assembly Components

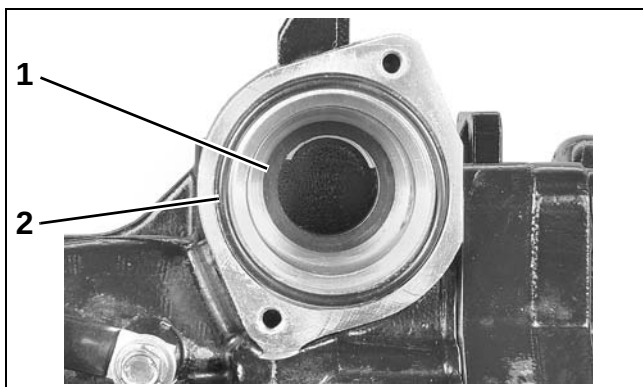
002442

Assembly

Assembly is the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

Install a **new** plunger seal squarely over ridge in housing.

Apply a light coat of *Triple-Guard* grease to a **new** cover o-ring and place in groove in housing.



1. Plunger seal
2. Cover o-ring

002458

Install valve assembly into housing.

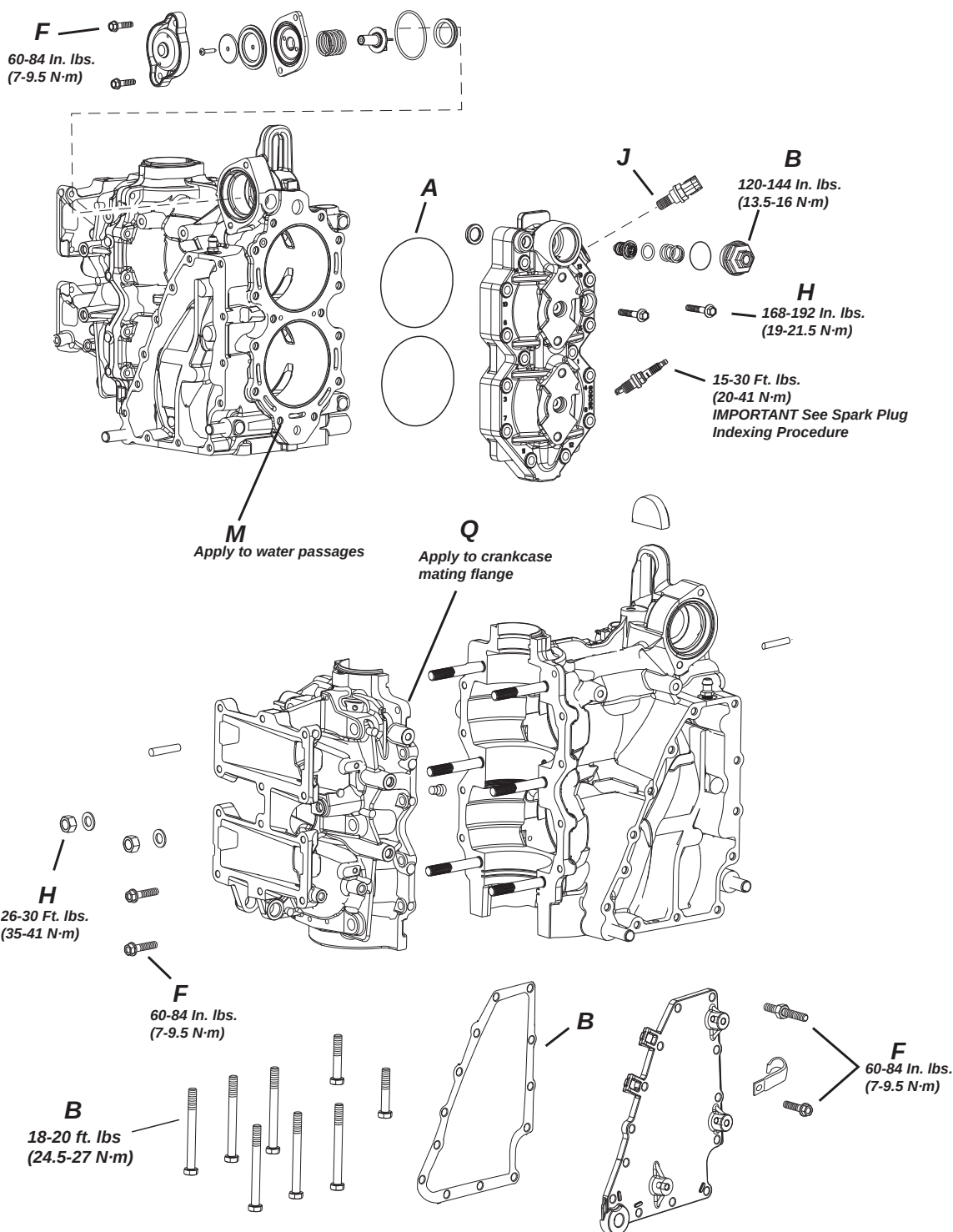
Tighten cover screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

POWERHEAD

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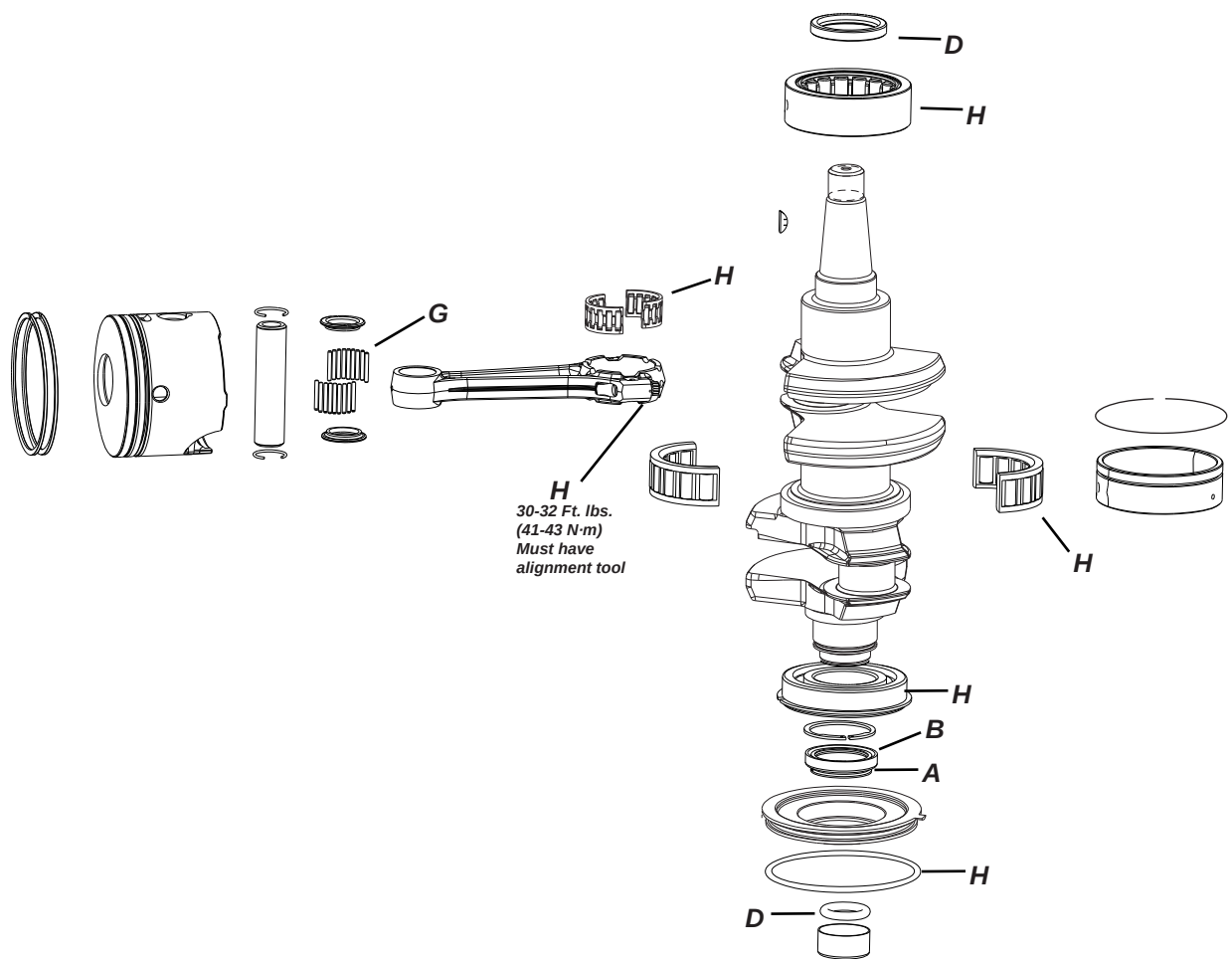
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SERVICE CHART



A Triple-Guard Grease	F Blue Nut Lock	M RTV Sealant
B Gasket Sealing Compound	G Needle Bearing Grease	P Permatex No. 2
D Moly Lube	H Outboard Lubricant	Q Gel Seal II
E Red Ultra Lock	J Thermal Grease	

002283



- A** Triple-Guard Grease
- B** Gasket Sealing Compound
- D** Moly Lube
- E** Red Ultra Lock
- F** Blue Nut Lock
- G** Needle Bearing Grease
- H** Outboard Lubricant
- P** Permatex No. 2
- Q** Gel Seal II
- Y** Extreme Pressure Grease

COMPRESSION TESTING

Start and run outboard until it achieves operating temperature, then shut OFF.

Disconnect crankshaft position sensor (CPS) connector. Remove all spark plugs.

Advance throttle linkage to WOT.

Install compression tester's hose attachment into spark plug hole (14 mm threads).

While cranking outboard with starter, note maximum pressure reading on gauge. Repeat procedure for each cylinder.

If engine shows a variation greater than 15 psi (100 kPa) between cylinders, check for:

- damaged cylinder head
- damaged pistons
- broken or stuck piston rings
- scored cylinder walls

Return throttle to idle position and reconnect CPS connector. Replace spark plugs. Refer to Spark Plug **Indexing** on p. 63.

POWERHEAD REMOVAL

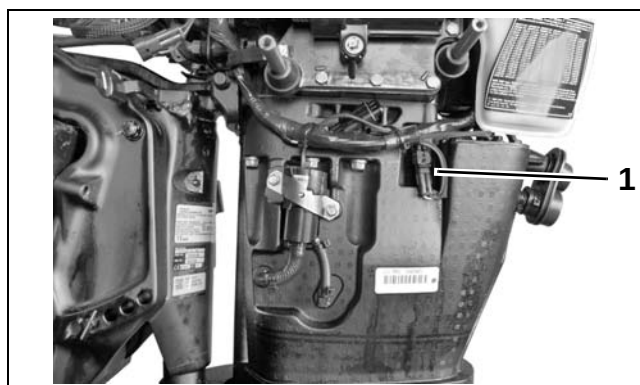
WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 144.

To prevent accidental starting while servicing, twist and remove spark plug leads.

Remove lower motor covers. Refer to **Lower Cover Removal** on p. 73.

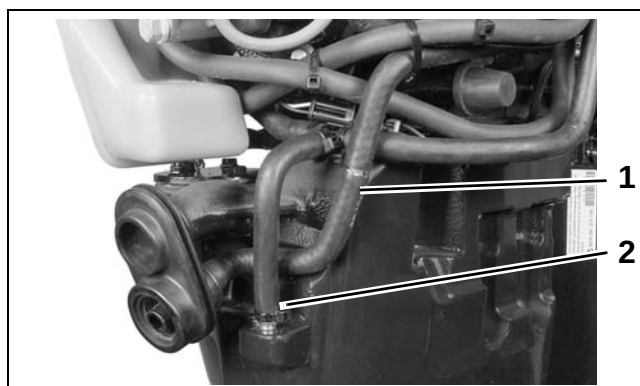
Disconnect exhaust water valve electrical connector.



1. Exhaust valve connector

008348

Disconnect cooling water hoses from exhaust housing.



1. Overboard indicator hose
2. Drain hose

004298

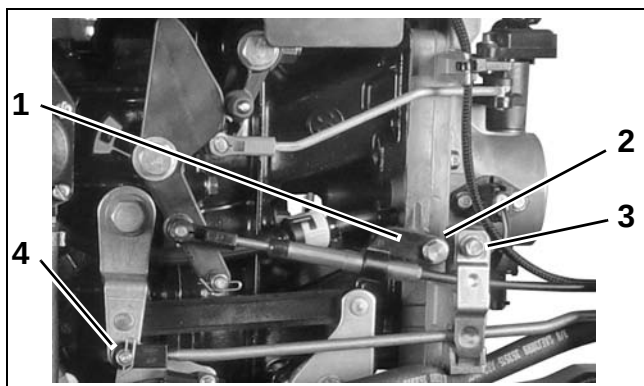
Remove pin and washer from shift rod lever to release the lower shift rod.



1. Shift rod screw

002171

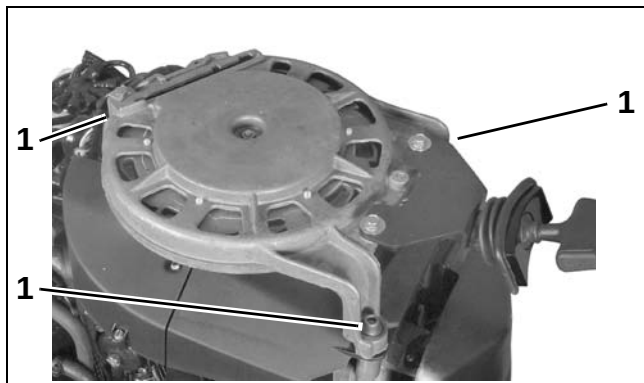
Remove throttle cable and tiller shift rod.



1. Cable anchor
2. Anchor screw
3. Cable retainer
4. Shift rod retainer

006526m

Remove the recoil starter housing and starter ratchet. Refer to **RECOIL STARTER REMOVAL** on p. 265.

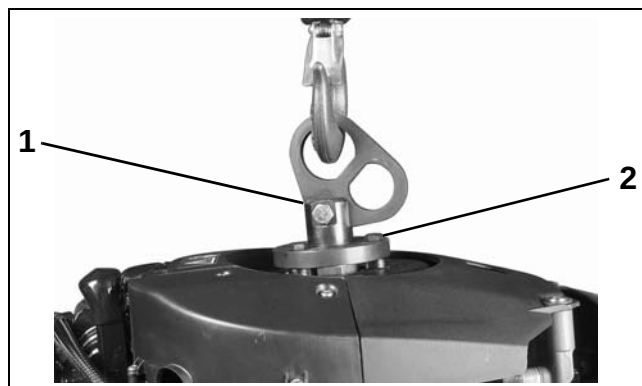


1. Starter housing screws (3)

002515

Install Lifting Fixture, P/N 396748, on flywheel and seat the three screws completely.

NOTICE Be sure to use only the 1 1/8 in. (short) screws, P/N 398067, included with the tool to avoid damage to electronic components under the flywheel.



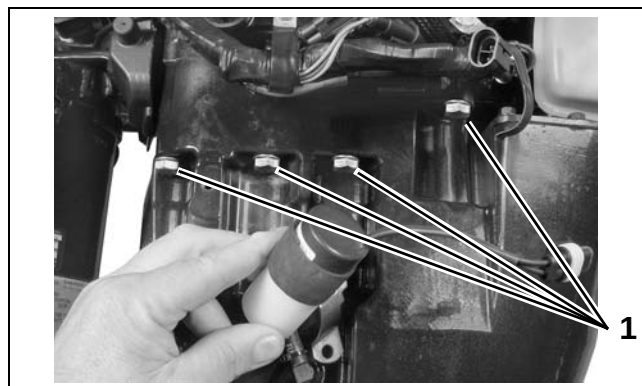
1. Lifting fixture
2. 1 1/8 in. screws

002098

Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.

Loosen the screws holding the exhaust water valve to the exhaust housing.

Move water valve aside and remove the eight exhaust housing to powerhead screws.



1. Powerhead screws

004292

Use a suitable tool to carefully separate the powerhead from exhaust housing.

IMPORTANT: Do not damage the powerhead or exhaust housing mating surfaces.

POWERHEAD DISASSEMBLY

Systems Removal

To simplify reassembly and wiring installation, lay out the various screws and clamps in the order of their proper location.

Remove the oil tank. Refer to **Oil Tank Assembly** on p. 166.

Remove fuel pump assemblies, fuel manifolds, and filter. Refer to **FUEL COMPONENT SERVICING** on p. 144.

Remove *EMM*, then electrical harness assembly. Label connectors for reassembly locations. Refer to **EMM SERVICING** on p. 92.

Remove flywheel and stator. Refer to **FLYWHEEL AND STATOR SERVICING** on p. 121.

Remove ignition coils and fuel injectors. Refer to **IGNITION COIL SERVICING** on p. 123 and **Fuel Injector Service** on p. 148.

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 all oil distribution and recirculation hoses.

Remove throttle linkage. Refer to **Throttle Linkage Removal** on p. 184.

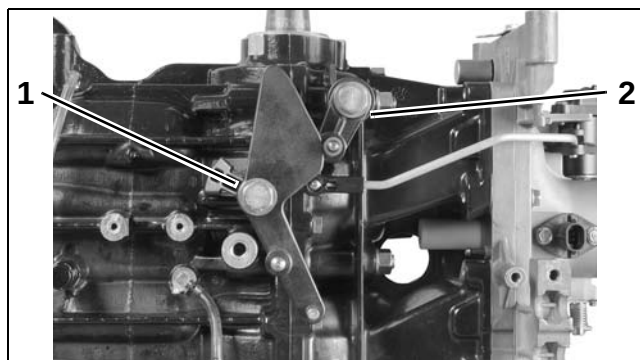
Remove shift linkage. Refer to **Shift Linkage Removal** on p. 184.

Remove the throttle body and reed plate assemblies. Refer to **Intake Manifold Service** on p. 151.

Remove pressure valve assembly. Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 177.

Throttle Linkage Removal

Remove throttle cam and throttle lever.

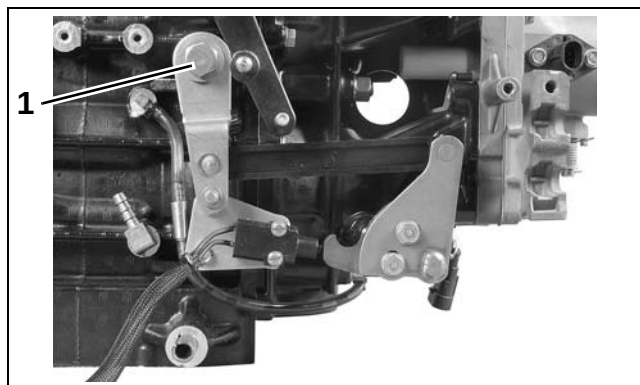


1. Throttle cam screw
2. Throttle lever screw

002245

Shift Linkage Removal

Remove shoulder screw from shift arm and retaining screw from shift rod lever. Remove the cotter pin and washer holding the shift shaft.



1. Shift arm screw

002250

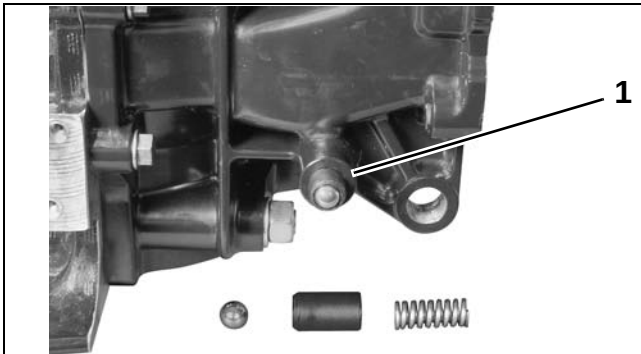


1. Shift rod lever screw
2. Cotter pin

002246

Slide entire shift linkage assembly from crankcase.

Remove the ball, guide, and spring of the shift detent assembly from the crankcase.

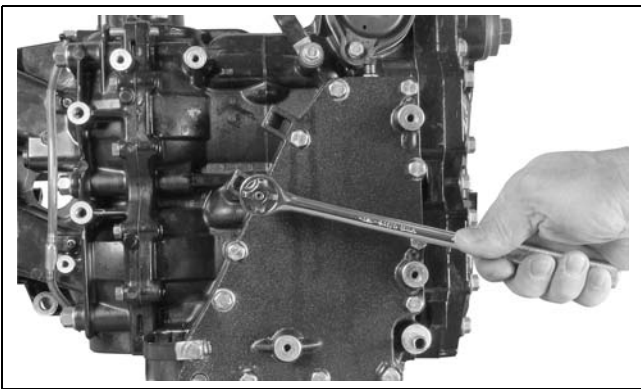


1. Shift detent assembly

002135

Crankcase Disassembly

Remove screws and carefully pry off exhaust side water cover.



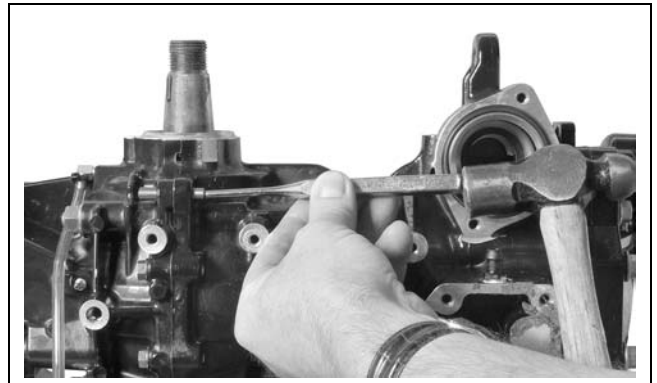
002234



WARNING

Wear safety glasses to avoid injury.

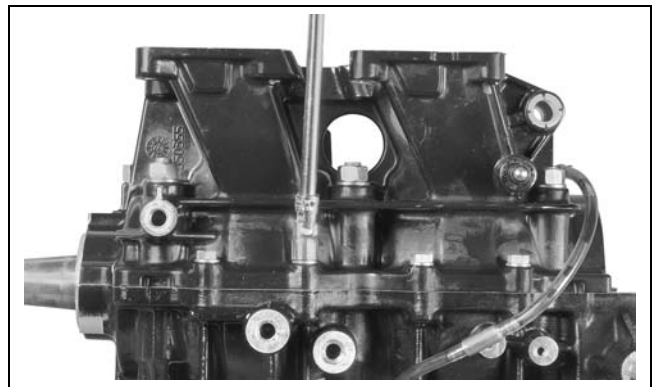
Use a 1/8 in. diameter pin punch to push crankcase taper pin toward the front of the engine.



002232

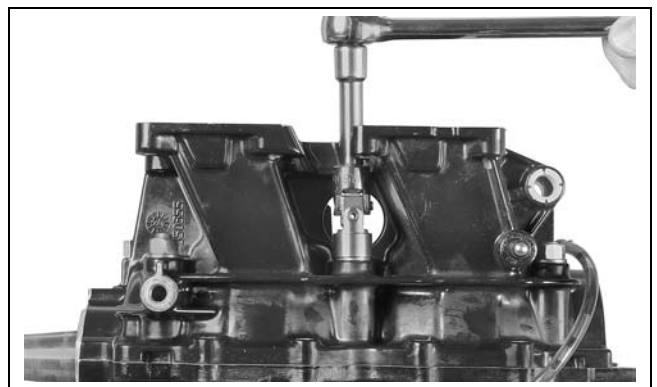
IMPORTANT: Do not use a tapered punch or any other tool that could jam in or damage the taper bore when removing the pin.

Remove crankcase flange screws.



002229

Loosen **in stages** and remove the main bearing nuts and washers.

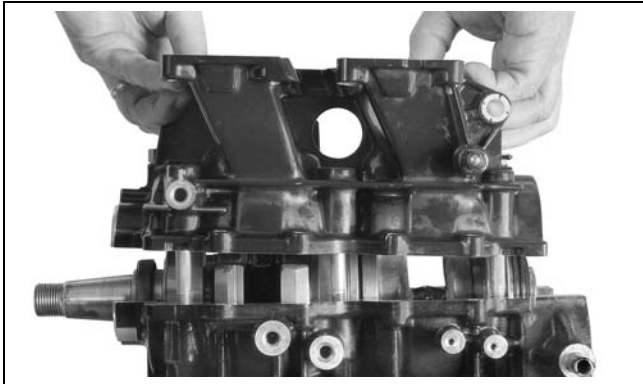


002251

POWERHEAD

POWERHEAD DISASSEMBLY

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.

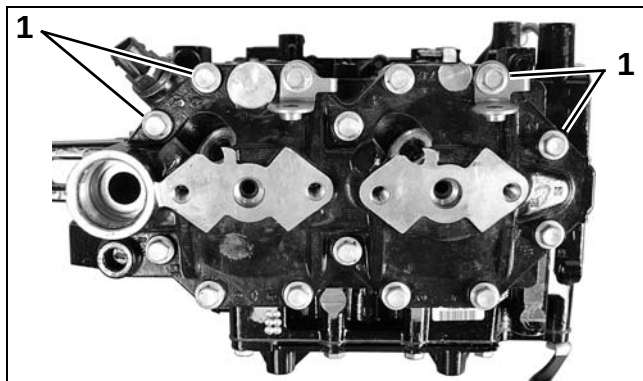


002252

Cylinder Head Removal

Remove thermostat cover and thermostat assembly. Refer to **THERMOSTAT SERVICING** on p. 176.

Loosen **in stages** and remove cylinder head screws. Remove the cylinder head. Discard o-rings and thermostat seal.



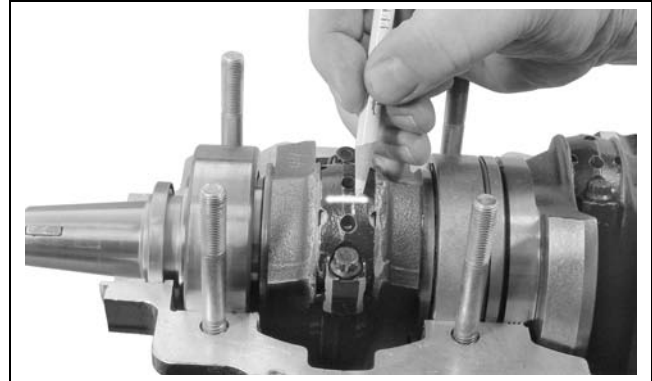
1. Cylinder head screws

007850

IMPORTANT: Do not remove fuel deflector pins from cylinder head. These parts are not serviceable. Refer to **POWERHEAD INSPECTION** on p. 191.

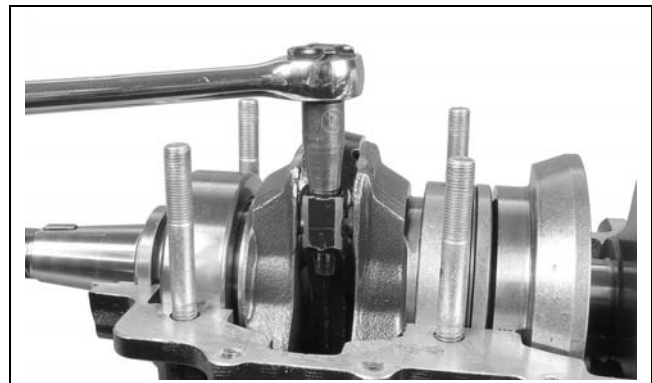
Connecting Rods and Pistons

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the top.



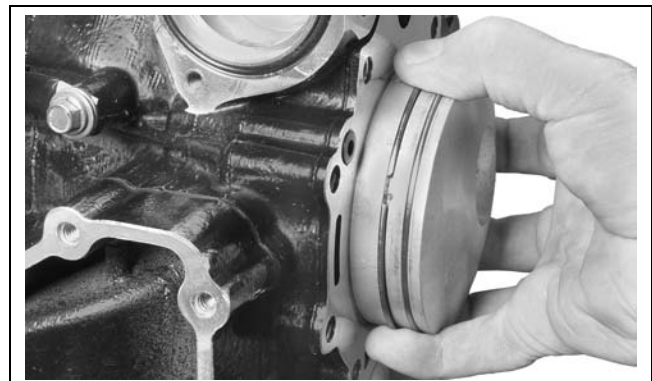
002140

Use Torquing Socket, P/N 331638, to loosen **in stages** the rod cap retaining screws. **DO NOT** remove the screws.



002123

Use one hand to support the piston, and remove the rod cap screws with your other hand. Remove each piston and rod assembly.



002141

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 that if reused, they can be reinstalled in their original positions.

Repeat steps for each remaining piston and connecting rod.

Use an appropriate ring expander to remove all piston rings from pistons. Discard the rings.



WARNING

Wear safety glasses to avoid injury.



002054

Remove wrist pin retaining rings. Discard retaining rings.



002046

The wrist pin fit is loose on both sides. Push the wrist pin through to free the piston from the connecting rod. If necessary, use Wrist Pin Pressing Tool, P/N 326356, to remove the wrist pin.

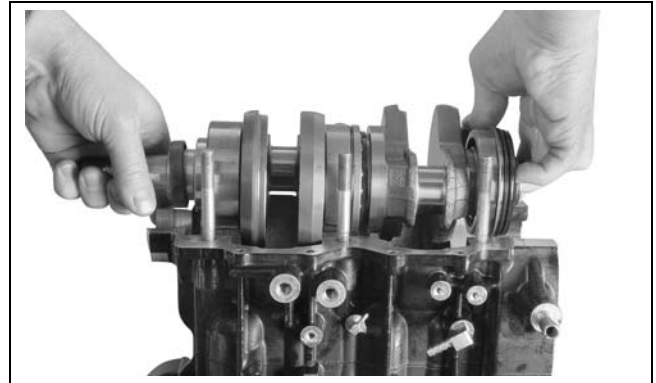


002047

Be careful not to lose any of the 28 needle bearings or the two wrist pin washers. Do not mix bearings with those from another cylinder. If any of the bearings are worn or lost, replace all 28 bearings during reassembly.

Crankshaft Removal

Carefully lift crankshaft straight up and remove from crankcase.



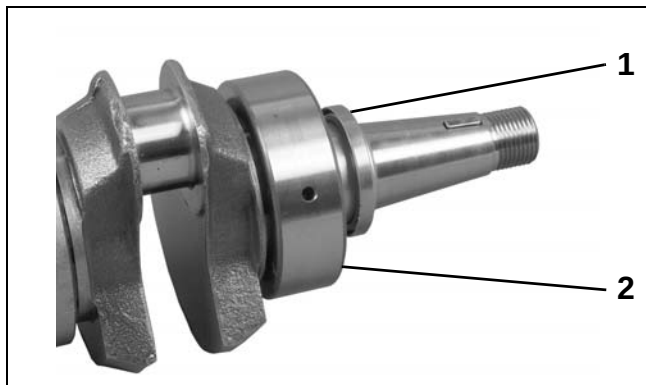
002263

Remove upper seal from crankshaft. Discard the seal. A new upper seal must be installed on assembly.

POWERHEAD

POWERHEAD DISASSEMBLY

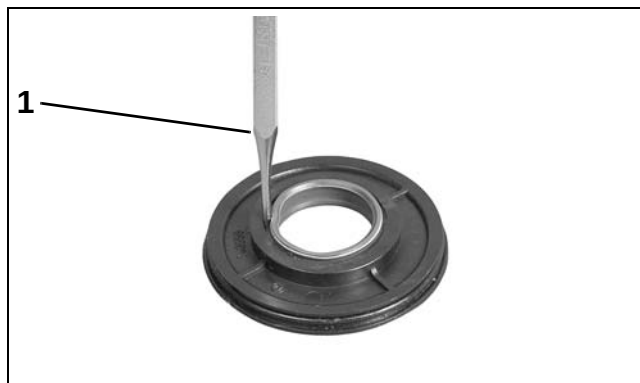
Remove the upper main bearing.



- 1. Upper oil seal
- 2. Upper main bearing

002034

Use a punch to remove the housing seal. Discard seal.



- 1. Punch

002053

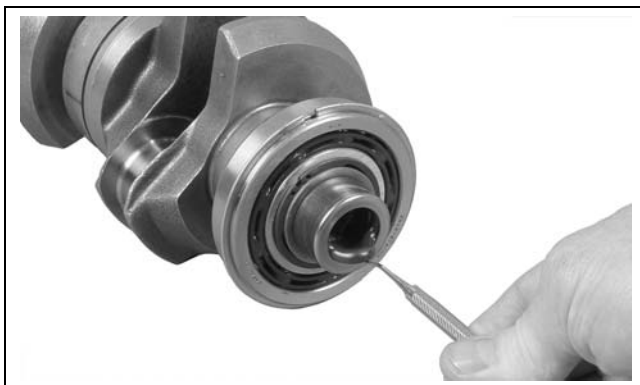
Remove the lower bearing seal housing.



002042

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.



002040

Remove the housing O-ring. Discard O-ring.



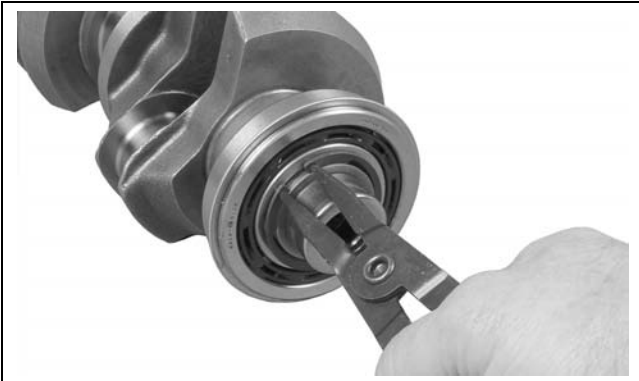
002044

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.



002041

Remove the lower main bearing only if it needs to be replaced. Use external retaining ring pliers to remove the lower bearing retaining ring.



002039

IMPORTANT: If the lower main bearing is removed from the crankshaft, it must be discarded. DO NOT reuse it.

Use a bearing separator to support the bearing, and press off the crankshaft.



002052

Remove center main bearings and split sleeves for inspection. Do not mix parts. Note location of bearings for reassembly.



24381

CYLINDER BLOCK CLEANING

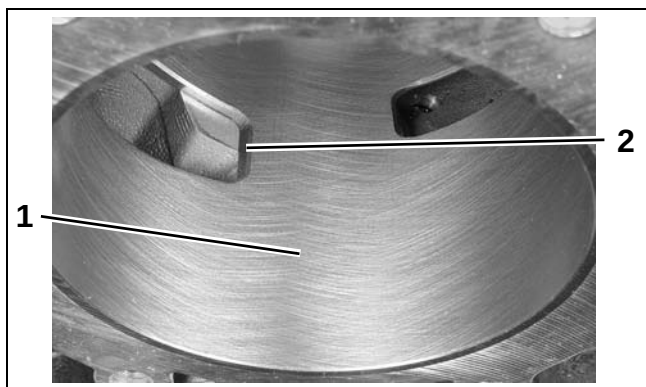
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants. Be careful to avoid damaging any machined surfaces.

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylinder head combustion chambers. Do not remove fuel deflector pins.

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 *Gel-Seal II™*

sealant from the cylinder block, crankcase, cylinder head, and water cover.

WARNING

To avoid personal injury, wear eye protection and rubber gloves when using *Gel Seal and Gasket Remover*.



002068

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. 10.

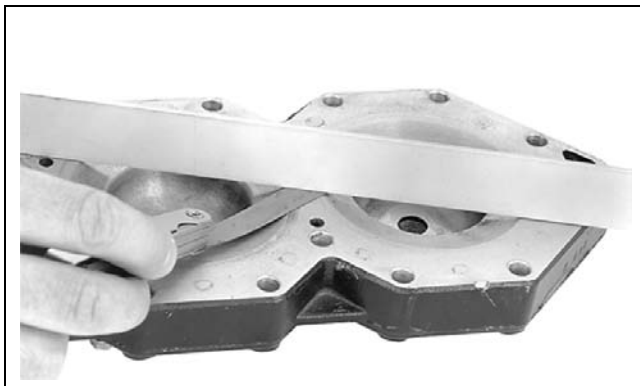
IMPORTANT: Before any inspection process can begin, all internal components must be completely clean and free of contaminants.

Visually inspect all parts. Check for unusual wear patterns, scuffing, or deterioration of aluminum parts, heat-related discoloration of bearings and bearing surfaces, and broken components.

Cylinder Head

Check for cylinder head warpage using a piece of bar stock or machinist's straightedge and a feeler gauge set.

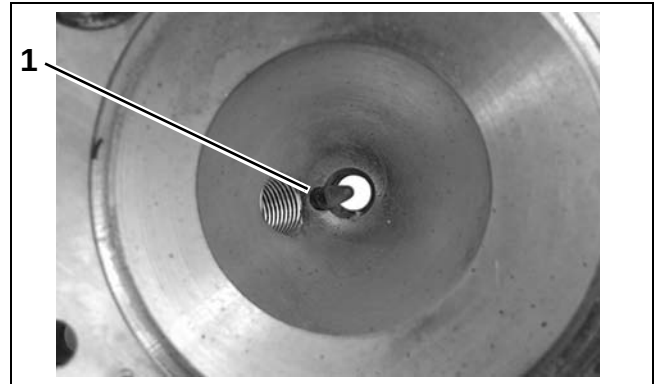
Cylinder head warpage must not exceed 0.006 in. (0.15 mm) per inch of measurement. Replace head if warpage exceeds this dimension.



24423

Check fuel deflector pins for damage.

IMPORTANT: Do not remove fuel deflector pins from cylinder head. These parts are not serviceable. Replace cylinder head if pins are damaged.

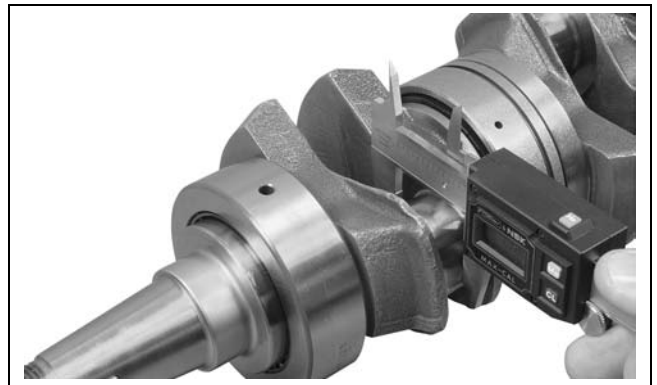


1. Deflector Pin

007284

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.



002142

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.



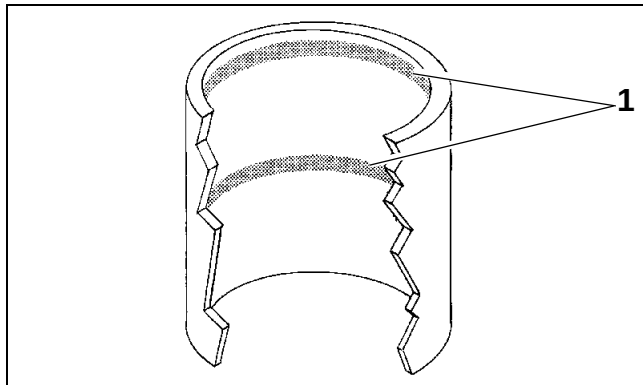
007283

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

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

The dimensional difference between the two areas is cylinder taper.

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



1. Measurement areas

DR3482

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to **SERVICE SPECIFICATIONS** on p. 10.

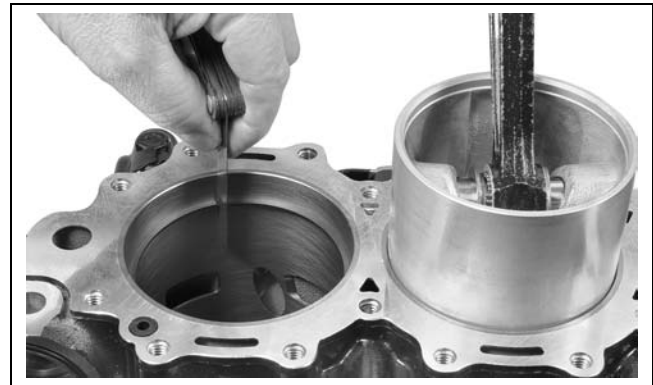
- The cylinder must not be oversized by more than 0.003 in. (0.08 mm).

Pistons

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

Piston Rings

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



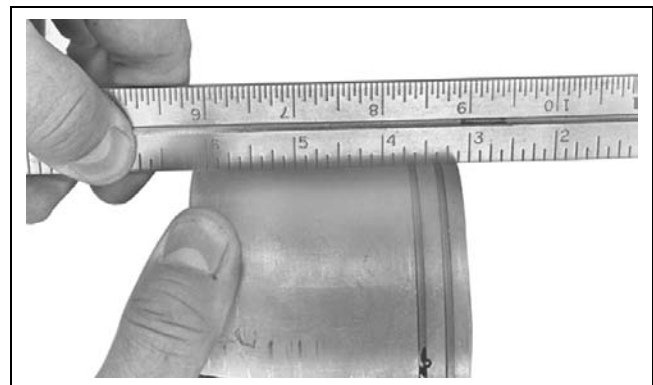
002143

Ring end gap should be:

- 0.011 to 0.023 in. (0.28 to 0.58 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

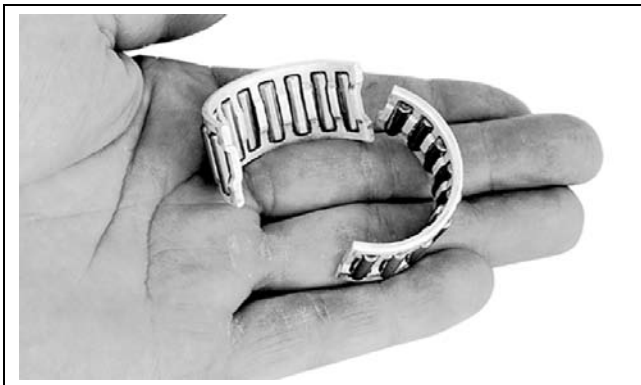
Bearings

Inspect center main bearings and split sleeves for excess wear, nicks, or scratches. Replace if necessary.



24381

Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace if necessary.



24377

POWERHEAD ASSEMBLY

IMPORTANT: Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All internal components must be perfectly clean and lightly coated with outboard lubricant.

IMPORTANT: Use new wrist pin retaining rings, gaskets, seals, and O-rings during assembly.

Crankshaft Assembly

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338647, and place a new lower main bearing onto crankshaft with lettered side facing the tool. Install bearing until it seats on the crankshaft.



002029

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338647, to drive a new sleeve onto the crankshaft until the installer contacts the lower main bearing.



002030

POWERHEAD

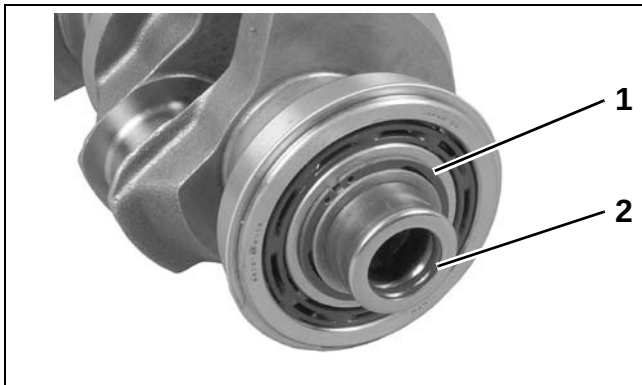
POWERHEAD ASSEMBLY

If the installer sticks on the sleeve after installation, thread Slide Hammer, P/N 391008, into installer and pull it off.

IMPORTANT: Inspect sleeve after installation. Sleeve must not be used if surface is damaged.

Use retaining ring pliers to install bearing retaining ring with sharp edge facing away from bearing.

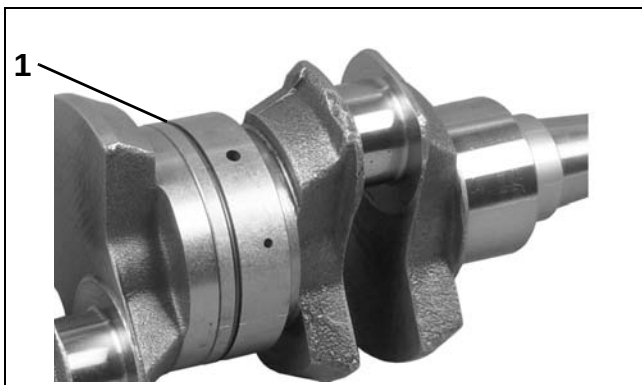
Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with *Moly Lube*. Install O-ring in sleeve.



1. Bearing retaining ring
2. O-ring

002031

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.

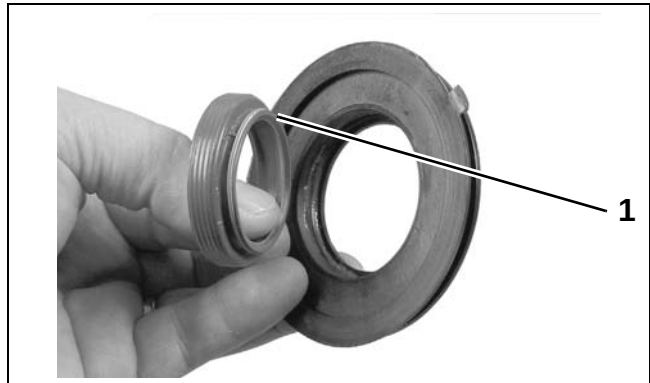


1. Groove toward driveshaft end

002032

Lightly coat the outside edge of a new lower housing seal with *Gasket Sealing Compound*. Press against outer case of the seal to install seal in the

lower housing with extended lip facing down. Lubricate seal lip with *Triple-Guard* grease.



1. Seal lip

002036



002037

Install a new O-ring on the lower housing. Before installing crankshaft into cylinder block, apply a thin coat of *Gasket Sealing Compound* to outer edge of O-ring.

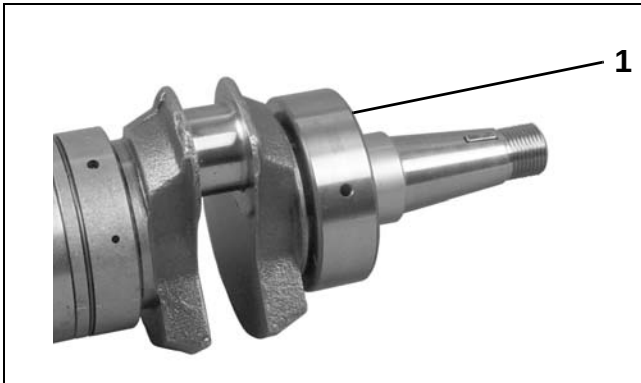
Place lower seal housing on crankshaft.



1. Lower seal housing
2. O-ring

002038

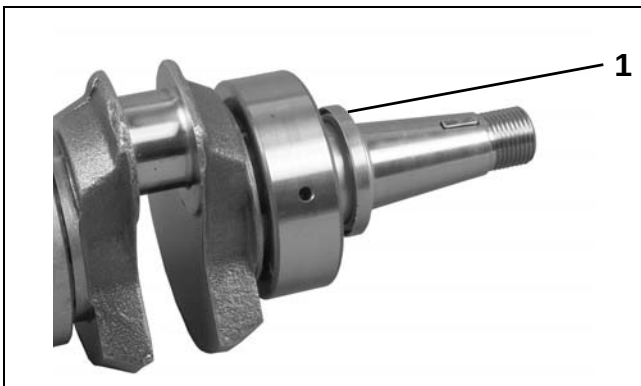
Lubricate upper main bearing with outboard lubricant and install on crankshaft.



1. Upper main bearing

002033

Pack lip of upper oil seal with *Moly Lube*. Place seal on crankshaft with lip down and enclosed face up. Do not apply sealer to outside edge of the seal.



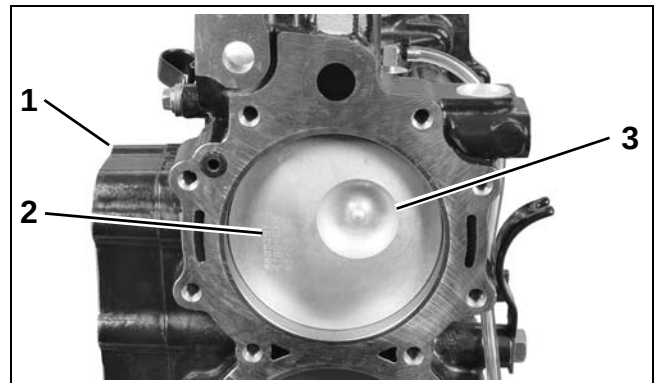
1. Upper oil seal

002034

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.

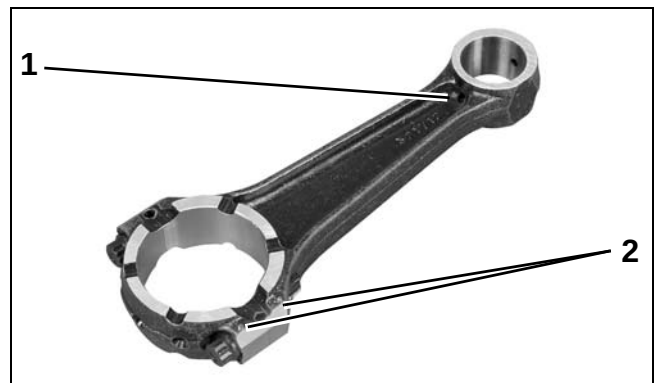
New pistons are stamped "EXH." This marking should be turned toward the exhaust side of the block. The splash bowl on the dome of the piston will be located toward the top and starboard side of the block.



- 1. Exhaust side of block
- 2. Stamped markings
- 3. Splash bowl

002049

NOTICE It is also very important that the connecting rods are installed with the alignment dots and the diagonal oil hole facing up, toward the flywheel.



- 1. Oil hole
- 2. Raised dots

002055

POWERHEAD

POWERHEAD ASSEMBLY

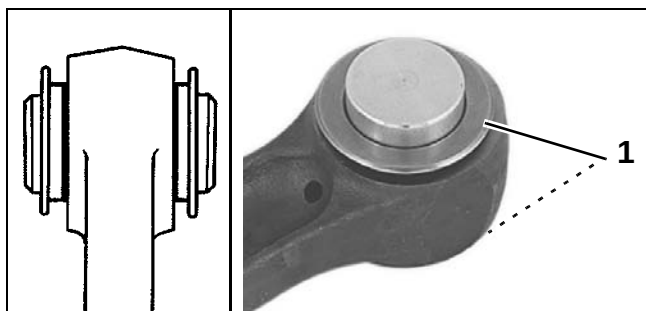
Apply *Needle Bearing Grease* to the wrist pin bearings. Install the bearings in the small end of the connecting rod. Align bearings with Wrist Pin Bearing Tool, P/N 336660.



1. 28 needle bearings
2. Wrist pin bearing tool

24903

Place the two wrist pin thrust washers on the tool with flat side of the washers facing out.

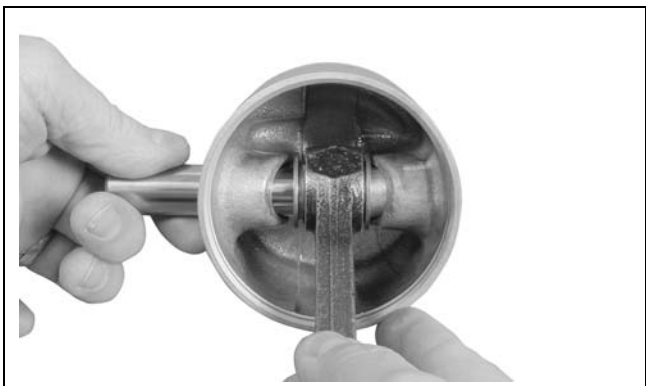


1. Wrist pin thrust washers

DR3480
24902

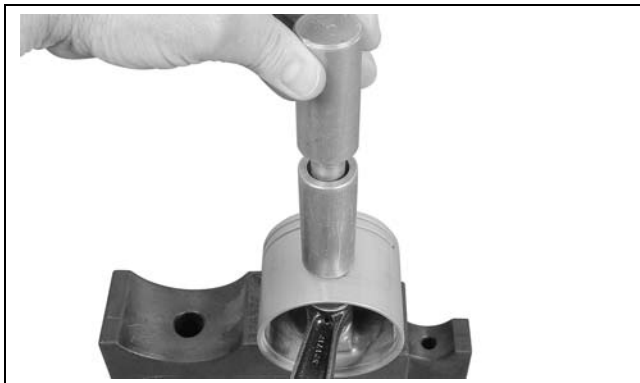
Oil the wrist pin bore and wrist pin. Place connecting rod, with bearings, washers, and tool, into the piston with the alignment dots facing the top of the piston.

Install wrist pin through piston and connecting rod, pushing bearing tool out through the piston.



002057

Use Wrist Pin Cone, P/N 318600, and Driver, P/N 318599, to install new wrist pin retaining rings in each wrist pin hole. Gap of retaining ring faces up, away from notch in piston.



002058



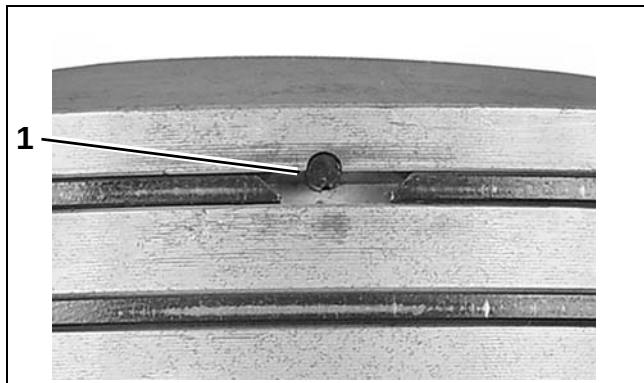
1. Gap of retaining ring
2. Notch in piston

002050

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. 191.

IMPORTANT: Be sure angled ends of piston ring fit around dowel pin.



1. Dowel pin

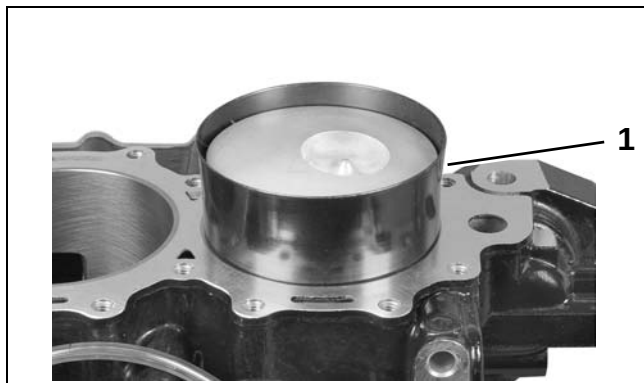
002048

NOTICE Before continuing, make sure that all *Gel-Seal II* has been removed from the cylinder block and crankcase mating flanges. If traces of hardened *Gel-Seal II* are left, main bearings could be misaligned. Refer to **CYLINDER BLOCK CLEANING** on p. 190.

Coat pistons, rings, cylinder walls, and an appropriate ring compressor with outboard lubricant.

Center connecting rod in piston and locate piston rings on dowel pins. Place appropriate ring compressor on piston.

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.



1. Ring compressor

002059

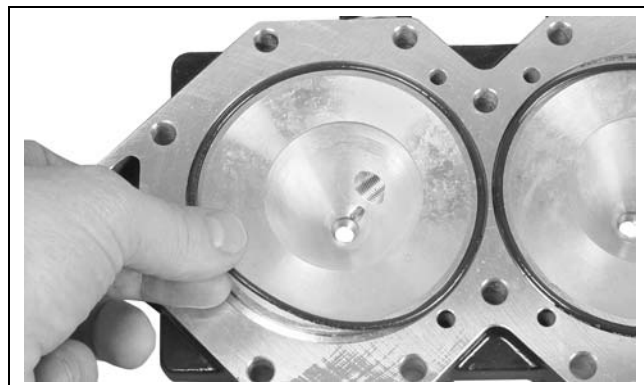
Repeat steps for each piston.

Cylinder Head Installation

Install a new thermostat seal in cylinder head with side marked "TO CYL HEAD" facing toward thermostat.

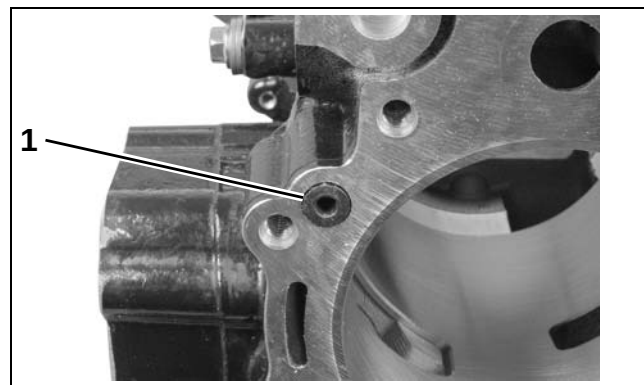
Refer to **THERMOSTAT SERVICING** on p. 176 before installing cylinder head.

Lightly lubricate new cylinder head O-rings with *Triple-Guard Grease* and install in cylinder head.



002061

Apply soapy water to water dam and insert into block.



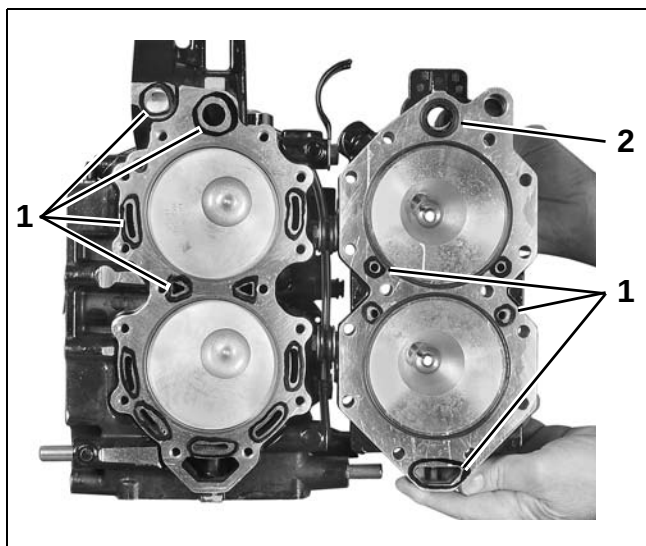
1. Water dam

002062

POWERHEAD

POWERHEAD ASSEMBLY

Apply a 1/16 in. (2 mm) bead of *RTV Adhesive* around each water passage on the block and cylinder head as shown.



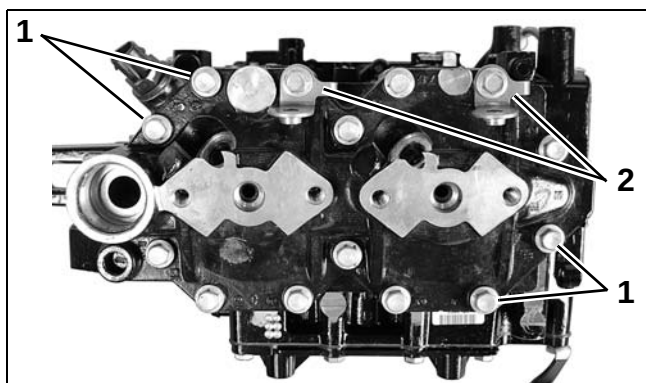
1. RTV sealant
2. Thermostat seal

002272

Install cylinder head with the thermostat toward the top. Place ignition coil brackets as shown below.

Apply outboard lubricant to screw threads and install the cylinder head screws. **DO NOT** use any sealant or locking compound on threads.

Following sequence stamped on cylinder head, tighten all screws **in stages** to a torque of 168 to 192 in. lbs. (19 to 21.7 N·m).



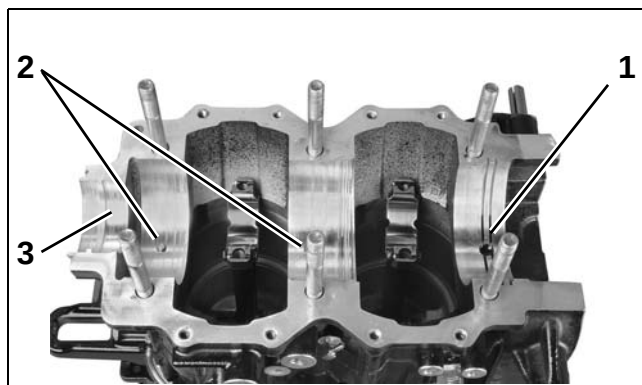
1. Cylinder head screws
2. Ignition coil bracket

007850

Crankshaft and Connecting Rod Installation

Apply *Gasket Sealing Compound* to lower oil seal groove in cylinder block. **DO NOT** put any sealer in upper seal groove.

Check that main bearing alignment dowel pins are seated in the block.



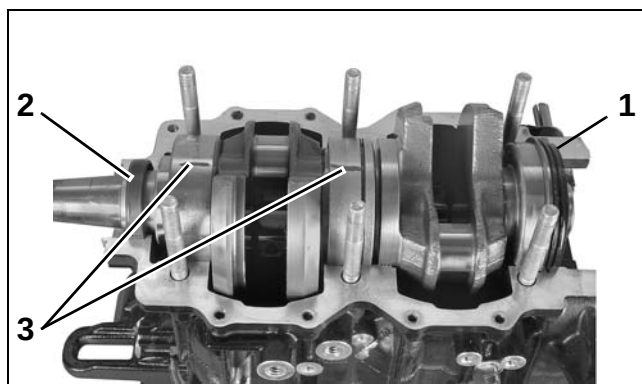
1. Gasket Sealing Compound
2. Dowel pins
3. No sealer here

002262

Push all pistons to the top of cylinders. Remove numbered connecting rod caps.

Gently lower the crankshaft into place.

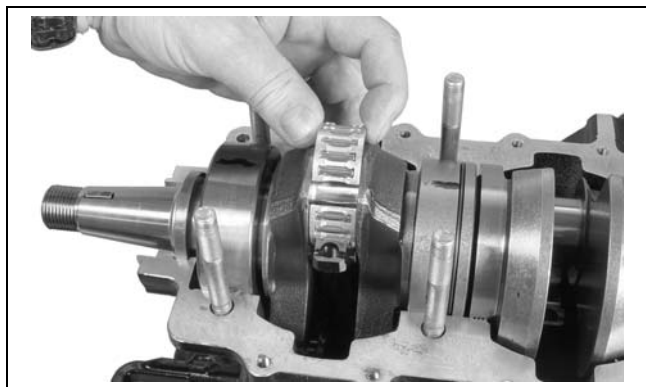
- Align tab on lower bearing seal housing with hole in crankcase.
- Align upper oil seal in groove.
- Locate each main bearing on its dowel pin. A mark placed on the bearing race opposite the dowel pin hole will help in the alignment process.



1. Lower seal housing
2. Upper oil seal
3. Alignment marks

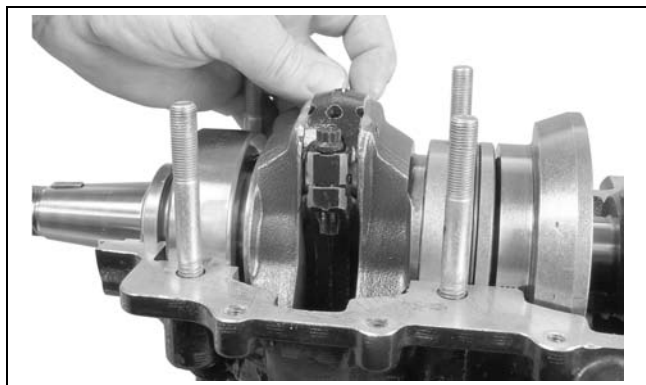
002261

Lubricate each crankpin and bearing assembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.



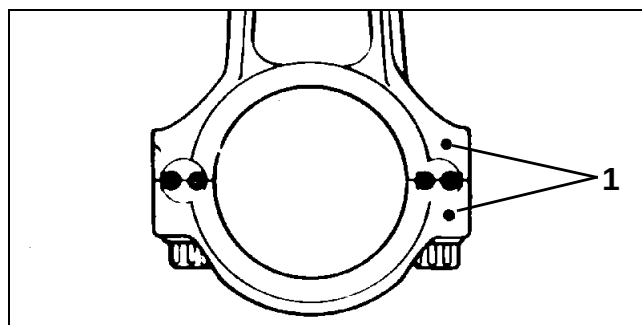
002115

Lubricate rod cap screw threads and under screw head mating surface with outboard lubricant. Align dot on rod cap with dot on the connecting rod. Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).



002116

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dots face fly-wheel.

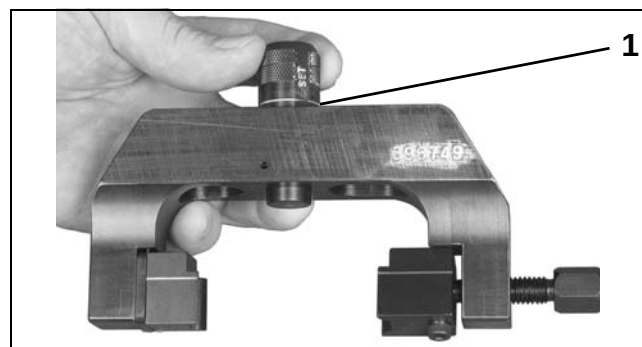


1. Alignment dots

53628

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 engagement stop with the arrow on the frame. Position stop at the center setting (one line showing). Rotate adjustment knob 180° to lock in position.



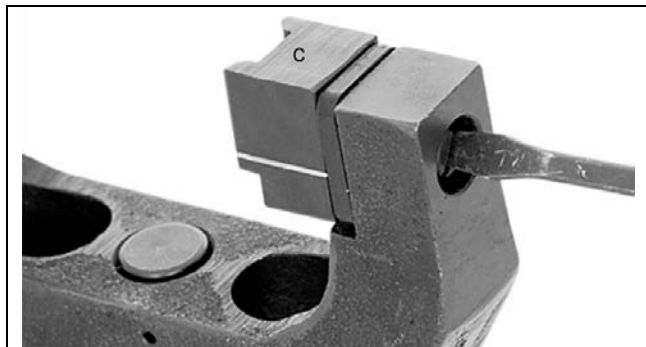
1. Center position, one line showing

002484

POWERHEAD

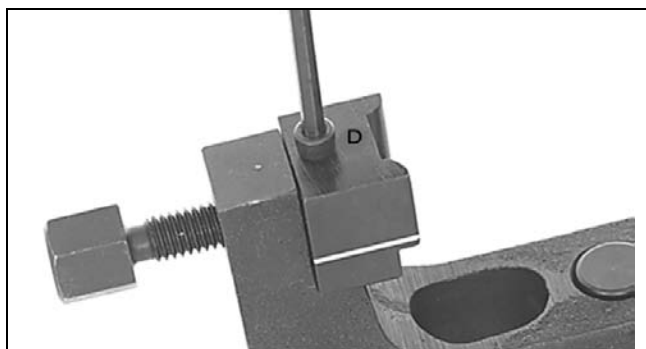
POWERHEAD ASSEMBLY

Secure restraining jaw "C" and forcing jaw "D" to frame.



Restraining Jaw "C"

21591



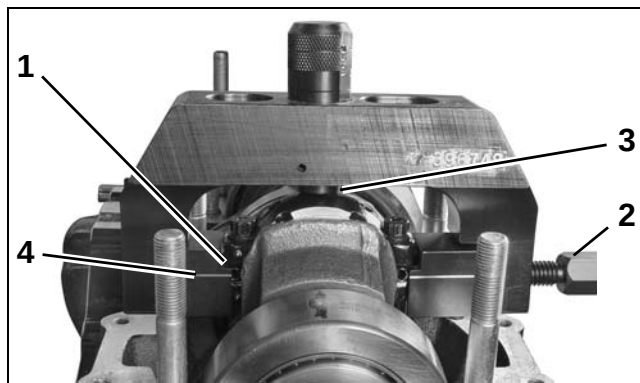
Forcing Jaw "D"

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.

- Place frame onto the connecting rod so the contact area of the jaw is centered on the side of the rod.
- Tighten forcing screw until jaws contact connecting rod.
- Slide frame down until adjustment stop contacts the rod cap. The groove lines on the jaws must be centered on the rod/crankpin diameter.

- Tighten the forcing screw to a torque of 14 to 16 in. lbs. (1.6 to 1.8 N·m).



002071

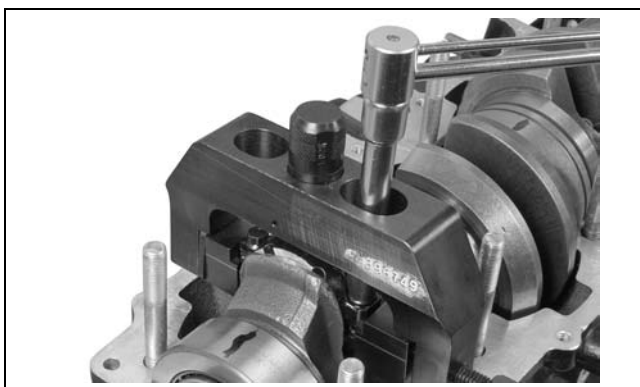
1. Contact area of jaw
2. Forcing screw
3. Adjustment stop
4. Groove line

IMPORTANT: Make sure that frame is squarely in position and that rod and cap are aligned.

Loosen both rod cap screws one-quarter turn.

Use Torquing Socket, P/N 331638, to tighten rod cap screws in three stages:

- Apply first torque of 40 to 60 in. lbs. (5 to 7 N·m) to both rod cap screws.
- Tighten screws to a torque of 14 to 16 ft. lbs. (19 to 21.7 N·m).
- Apply final torque of 30 to 32 ft. lbs. (41 to 43 N·m).

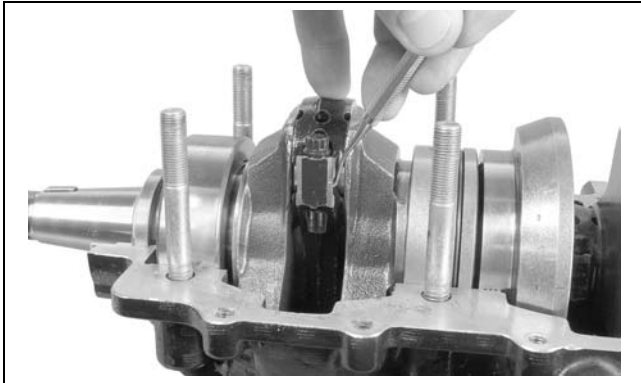


002072

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.



002117

Crankcase Assembly

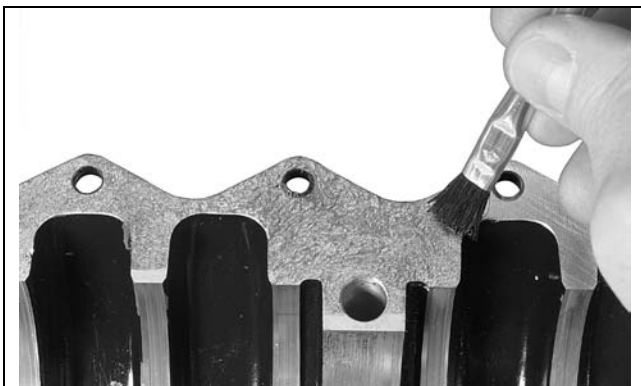
Make sure crankshaft is still seated on dowel pins before assembling crankcase.

Thoroughly clean and degrease the mating flanges of the crankcase and cylinder block with a non-petroleum based solvent, such as isopropyl alcohol or acetone, and let air dry.

IMPORTANT: DO NOT allow solvent to get on internal components. Clean only the mating flanges.

Apply *Gasket Sealing Compound* to lower oil seal groove in crankcase. DO NOT put any sealer in upper seal groove.

Use a small brush with a tapping motion to apply a thin, even coat of *Gel-Seal II* sealant to the crankcase mating flange. The sealer must not come within 1/4 in. (6.4 mm) of bearings.



Typical

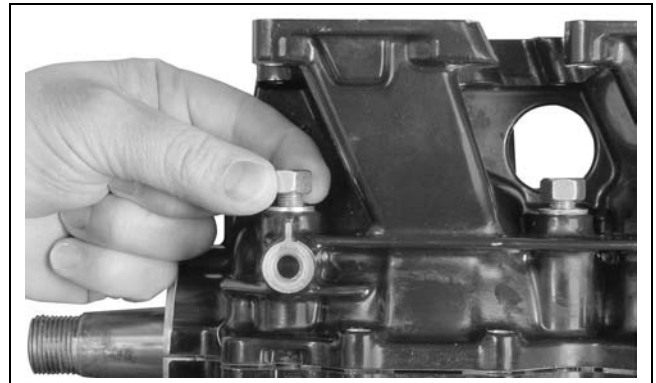
003874

IMPORTANT: *Gel-Seal II* has a shelf life of at least one year when stored at room temperature. Test the *Gel-Seal II* or replace it if the age of the tube cannot be determined. Using old *Gel-Seal II* could cause crankcase air leaks.

IMPORTANT: The use of *Locquic Primer* is NOT recommended. If primer is used, crankcase halves must be assembled and tightened within ten minutes after the *Gel-Seal II* has been applied.

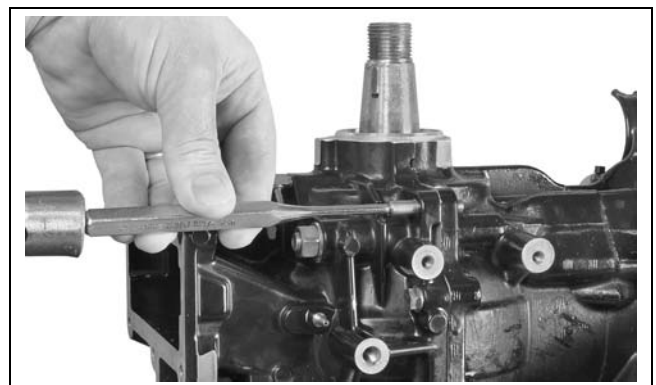
Lower the crankcase into place. Make sure that upper oil seal and lower seal housing are seated in grooves.

Apply outboard lubricant to the main bearing studs. Install nuts and washers finger tight, no more than 60 in. lbs. (7 N·m).



002271

When the crankcase is seated, install and firmly seat the crankcase taper pin.



002260

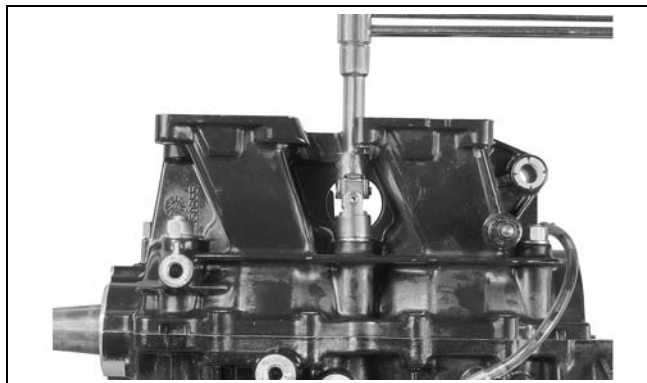
Tighten main bearing nuts **in stages** to a final torque of:

- 26 to 30 ft. lbs. (35 to 41 N·m).

POWERHEAD

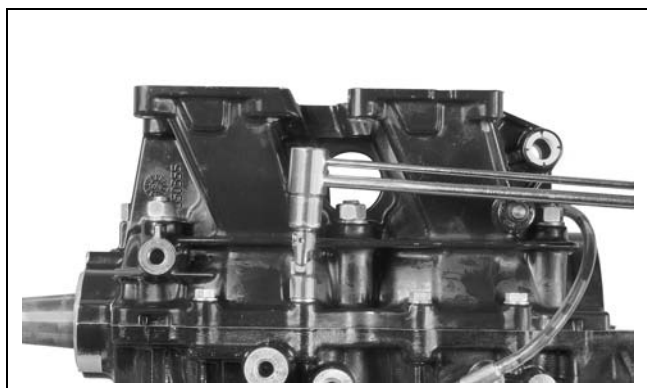
POWERHEAD ASSEMBLY

Start in the center and work outward in a spiral pattern.



002254

Apply *Nut Lock* to crankcase flange screws. Install screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



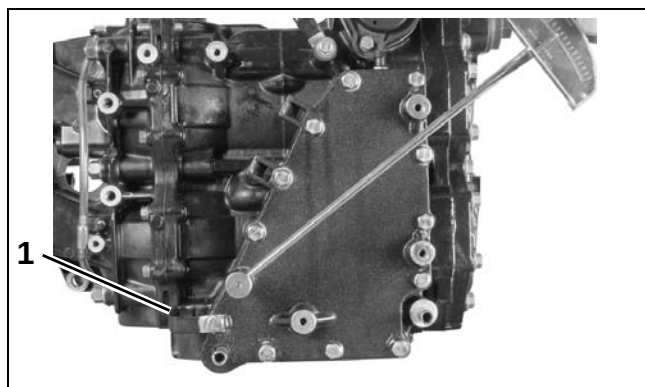
002259

Test that the crankshaft spins freely without binding.

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

Apply *Gasket Sealing Compound* to both sides of a new water cover gasket. Place gasket and cover on cylinder block.

Apply *Nut Lock* to cover screws. Position J-clamp as shown. Tighten all screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

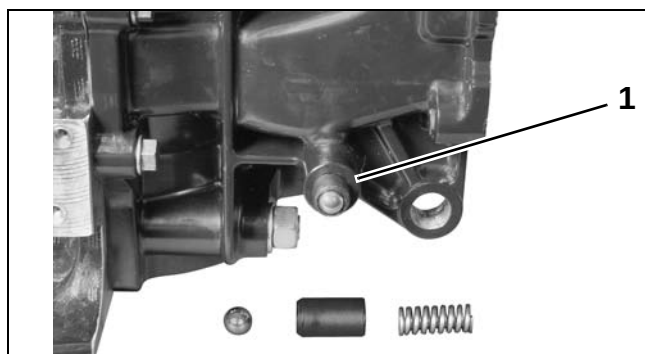


002242r

1. J-clamp

Shift Linkage Installation

Place the spring, guide, and ball of the shift detent assembly into the crankcase. Lubricate with *Triple-Guard* grease.



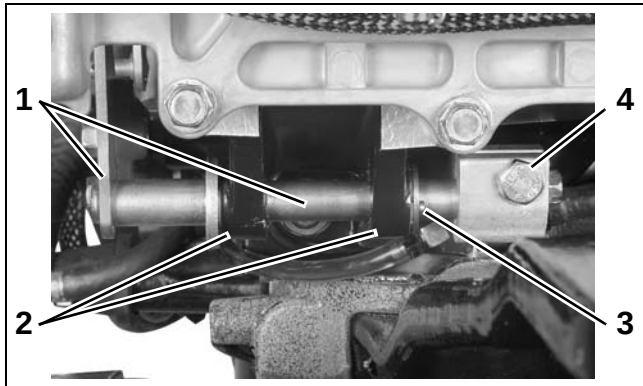
002135

1. Shift detent assembly

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

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

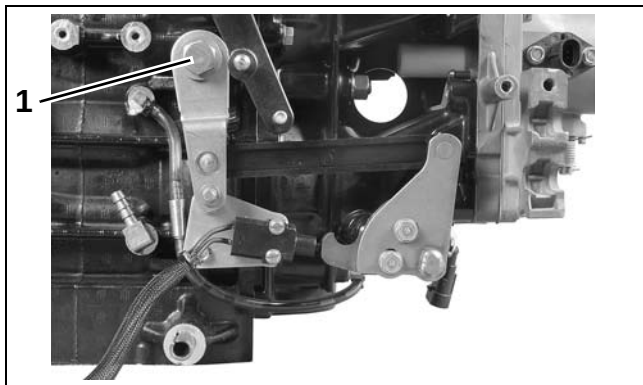
Install cotter pin and washer on the shaft. Install shift rod lever and tighten retaining screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Shift lever and shaft
2. Bushing
3. Cotter pin and washer
4. Shift rod lever screw

002246

Apply *Triple-Guard* grease to shoulder of shift arm screw and *Nut Lock* to threads. Install arm, screw, and washer and tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



1. Shift arm screw

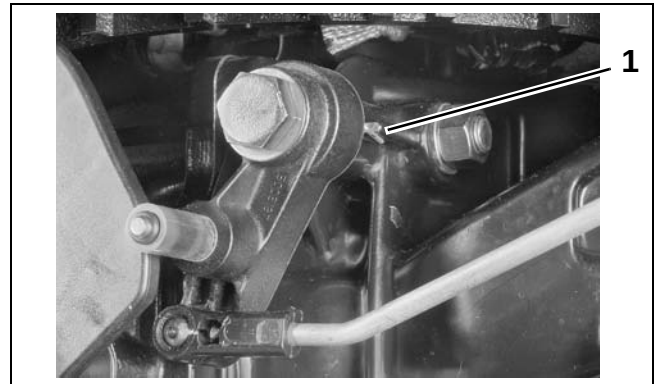
002250

Throttle Linkage Installation

Apply *Nut Lock* to threads of throttle lever screw.

Insert spring into cavity of throttle return lever.

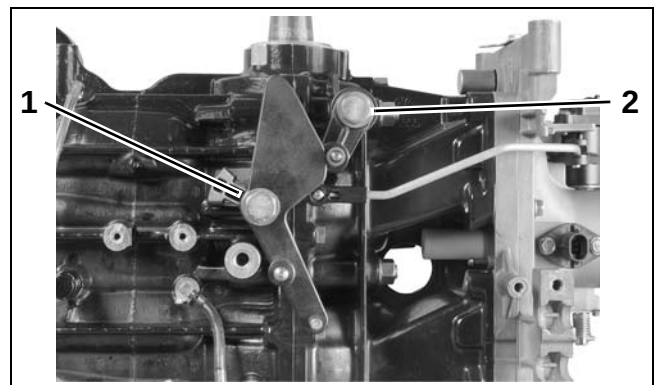
Install lever, screw, and washer on crankcase and hook spring on rib as shown. Tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



1. Hook spring here

002255

Apply *Nut Lock* to threads of throttle cam screw. Install cam, screw, and washer on cylinder block and tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



1. Throttle cam screw
2. Throttle lever screw

002245

IMPORTANT: Do not lubricate throttle levers or shoulder screws.

POWERHEAD

POWERHEAD INSTALLATION

Final Powerhead Assembly

Install the reed plate and throttle body assemblies. Refer to **Intake Manifold Service** on p. 151.

Install oil recirculating hoses and check valves. Refer to **OIL RECIRCULATION DIAGRAM** on p. 158, or **POWERHEAD VIEWS** on p. 208.

Install thermostat assembly. Refer to **THERMOSTAT SERVICING** on p. 176.

Install pressure valve assembly. Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 177.

Install shift linkage. Refer to **Shift Linkage Installation** on p. 202.

Install throttle linkage. Refer to **Throttle Linkage Installation** on p. 203.

Install fuel injectors and ignition coils. Refer to Fuel Injector **Installation** on p. 149 and **IGNITION COIL SERVICING** on p. 123.

IMPORTANT: All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Install stator and flywheel. Refer to **FLYWHEEL AND STATOR SERVICING** on p. 121.

Install electrical harness and *EMM*. Refer to **POWERHEAD VIEWS** on p. 208 and **EMM SERVICING** on p. 92.

Install fuel pump assemblies, fuel manifolds, and filter. Refer to **FUEL COMPONENT SERVICING** on p. 144.

Install the oil tank and oil injection hoses. Refer to **Oil Tank Assembly** on p. 166.



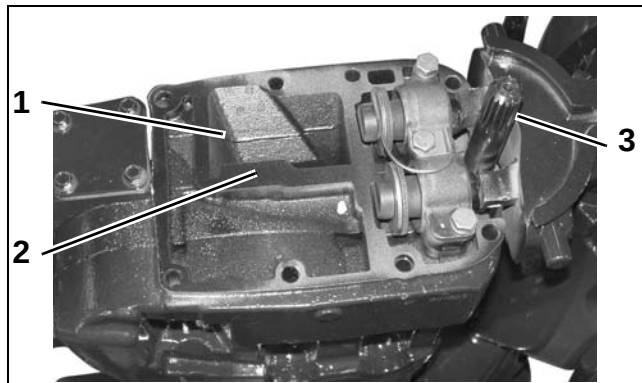
WARNING

To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

POWERHEAD INSTALLATION

Powerhead Mounting

Apply *Permatex No. 2* to both sides of a new base gasket around the exhaust port only. Install gasket on exhaust housing. To ensure proper sealing, mating surfaces must be clean and dry.

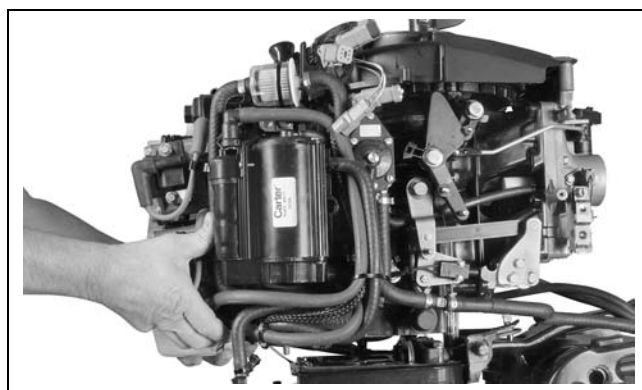


1. Exhaust port
2. Clean surface
3. Moly Lube

004972

Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

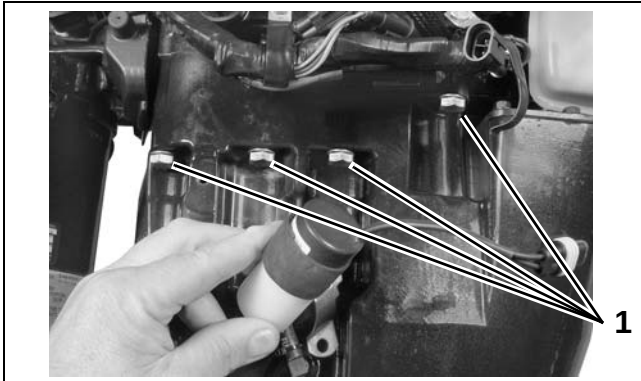
Use Lifting Fixture, P/N 396748, and hoist to slowly lower powerhead onto exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.



002269

Apply *Triple-Guard* grease to the threads, and *Gasket Sealing Compound* to the cylindrical shank of the powerhead screws.

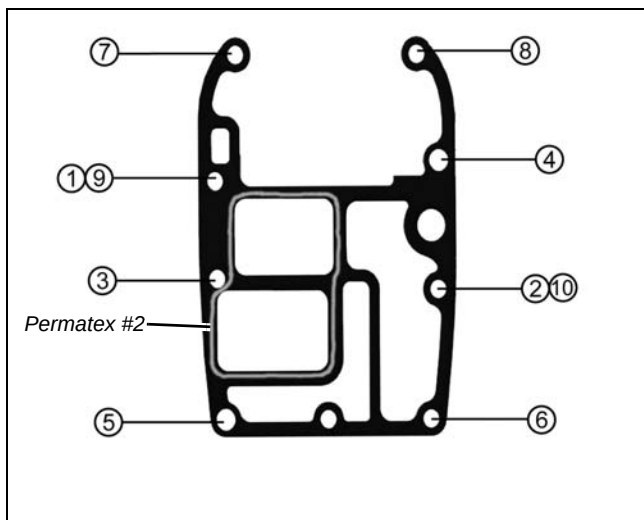
Loosely install all powerhead screws before tightening:



1. Powerhead screws

004292

Tighten the eight powerhead screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m) in the sequence shown.



Large screw torque sequence, 1 – 10

002175

IMPORTANT: Retighten powerhead mounting screws after outboard has been run at full operating temperature and allowed to cool.

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



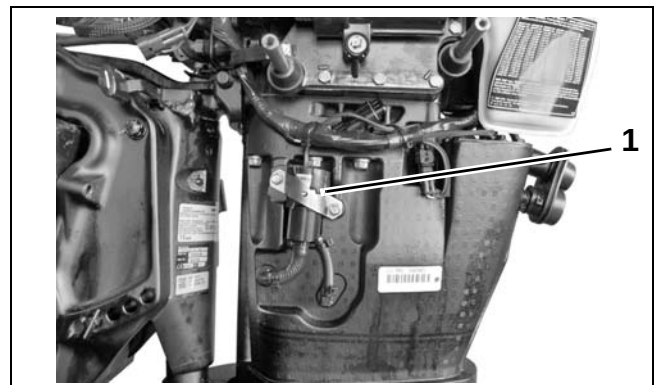
1. Shift rod screw

002171

Check shift linkage adjustment. Refer to **Shift Linkage Adjustment** on p. 207.

IMPORTANT: Make sure the gearcase shifts completely into both forward and reverse and that propeller shaft spins freely in neutral.

Apply *Nut Lock* to threads of exhaust water valve screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



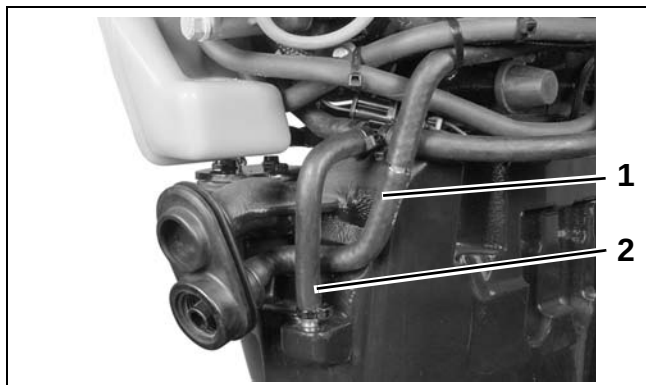
1. Exhaust water valve

008348

POWERHEAD

POWERHEAD INSTALLATION

Connect cooling water hoses to exhaust housing.

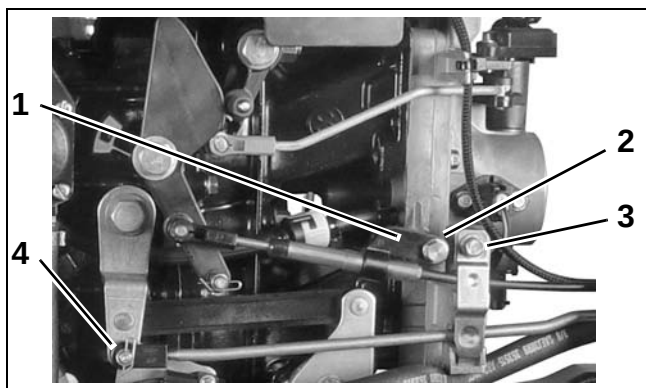


1. Overboard indicator hose
2. Drain hose

004298

Connect exhaust water valve connector. Secure cables in clamps.

Install throttle cable and tiller shift rod.

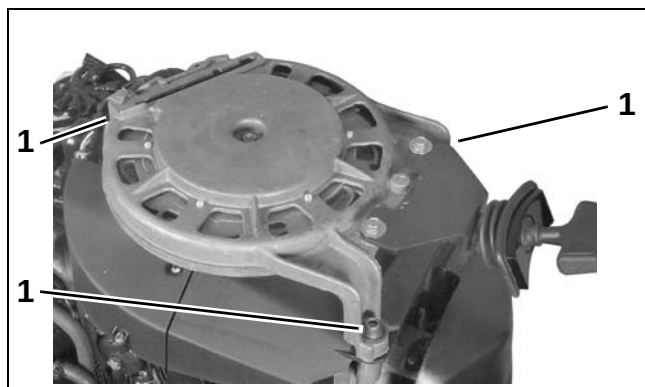


1. Cable anchor
2. Anchor screw
3. Cable retainer
4. Shift rod retainer

006526m

Refer to **Throttle Cable Adjustment** on p. 231.

Install recoil starter ratchet and housing on outboard. Refer to **RECOIL STARTER INSTALLATION** on p. 271.



1. Starter housing screws (3)

002515

Install the lower engine covers. Refer to **LOWER COVER SERVICE** on p. 73.

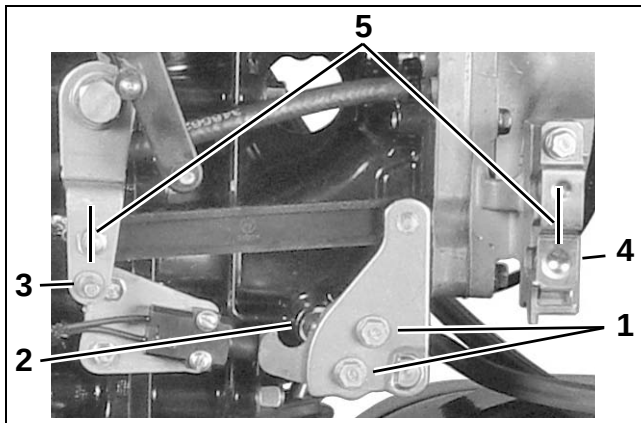
Shift Linkage Adjustment

Adjust shift linkage as follows:

- Loosen adjustment screws on shift lever.
- Be sure that ball is centered in detent assembly.
- Adjust shift lever so that the screw hole in shift rod lever lines up with the hole in the gearcase shift rod when gearcase is in neutral.
- When correctly adjusted, the shift lever will be parallel with the vertical line of the outboard, and the distance between the shift lever pin and the center of the shift cable trunnion pocket should be approximately 7 in. (17.8 cm).

IMPORTANT: The shift rod height is the most critical of these adjustments and should not be moved during this procedure. Refer to **SHIFT ROD ADJUSTMENT** on p. 244.

- Tighten adjustment screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Adjustment screws
2. Shift detent assembly
3. Shift lever pin
4. Trunnion pocket
5. 7 inch dimension

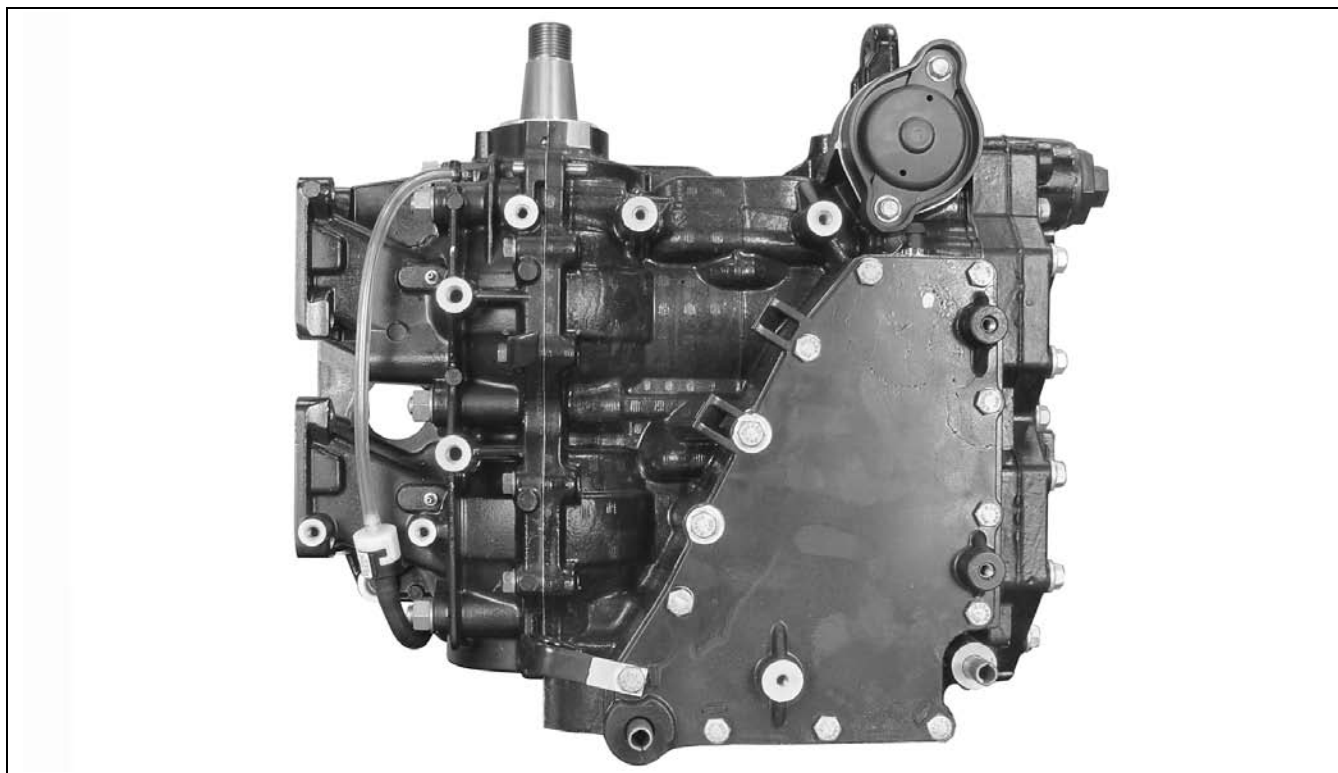
002125

Pre-Service Adjustments

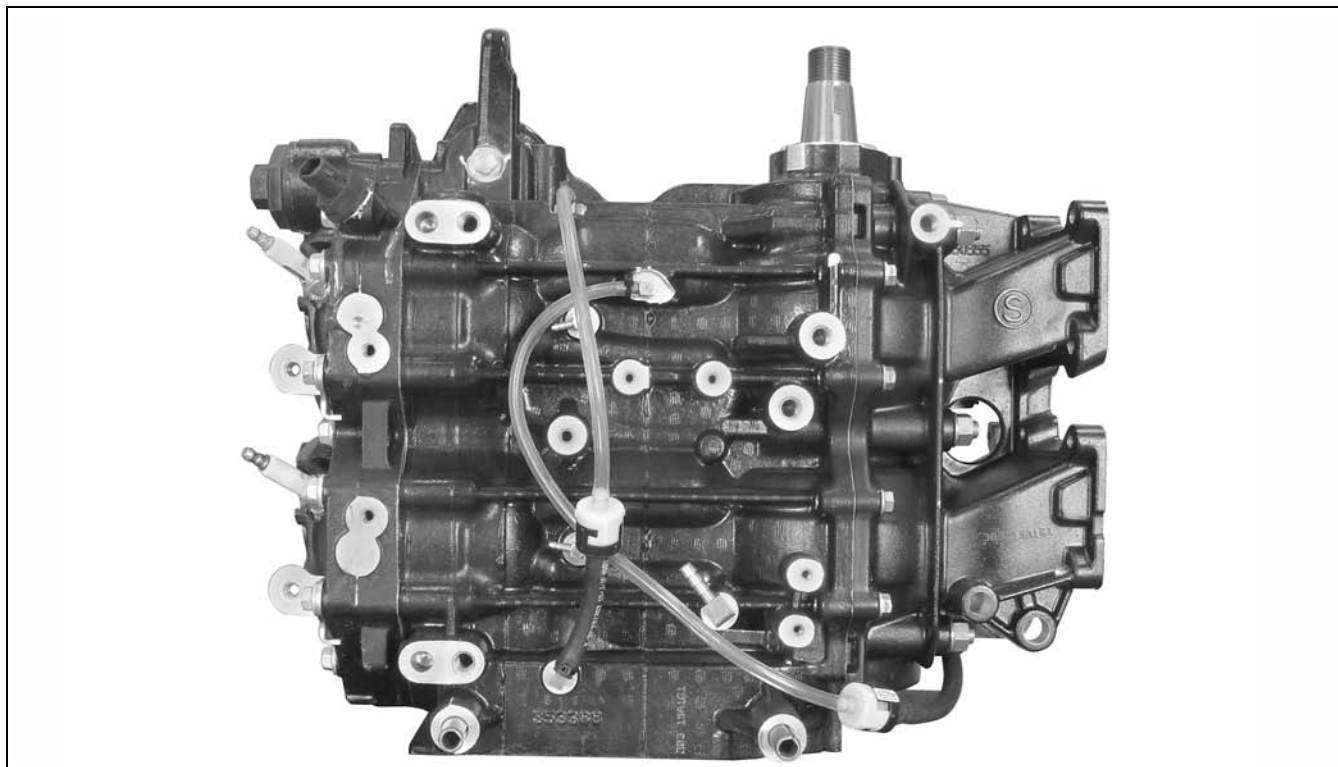
NOTICE After installing a new or rebuilt powerhead, perform the following procedures before returning outboard to service:

- Adjust timing pointer.
- Index all spark plugs. Refer to **Spark Plug Indexing** on p. 63.
- Use *Evinrude Diagnostics* software to start powerhead break-in oiling. Refer to **Powerhead Break-In** on p. 89.
- Use *Evinrude Diagnostics* software to set TPS calibration. Refer to **TPS Calibration** on p. 126.
- 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 **Oiling System Oil Supply Priming** on p. 39.
- Use *Evinrude Diagnostics* software to check engine timing. Refer to **TIMING ADJUSTMENTS** on p. 124.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Port – Hose Routings



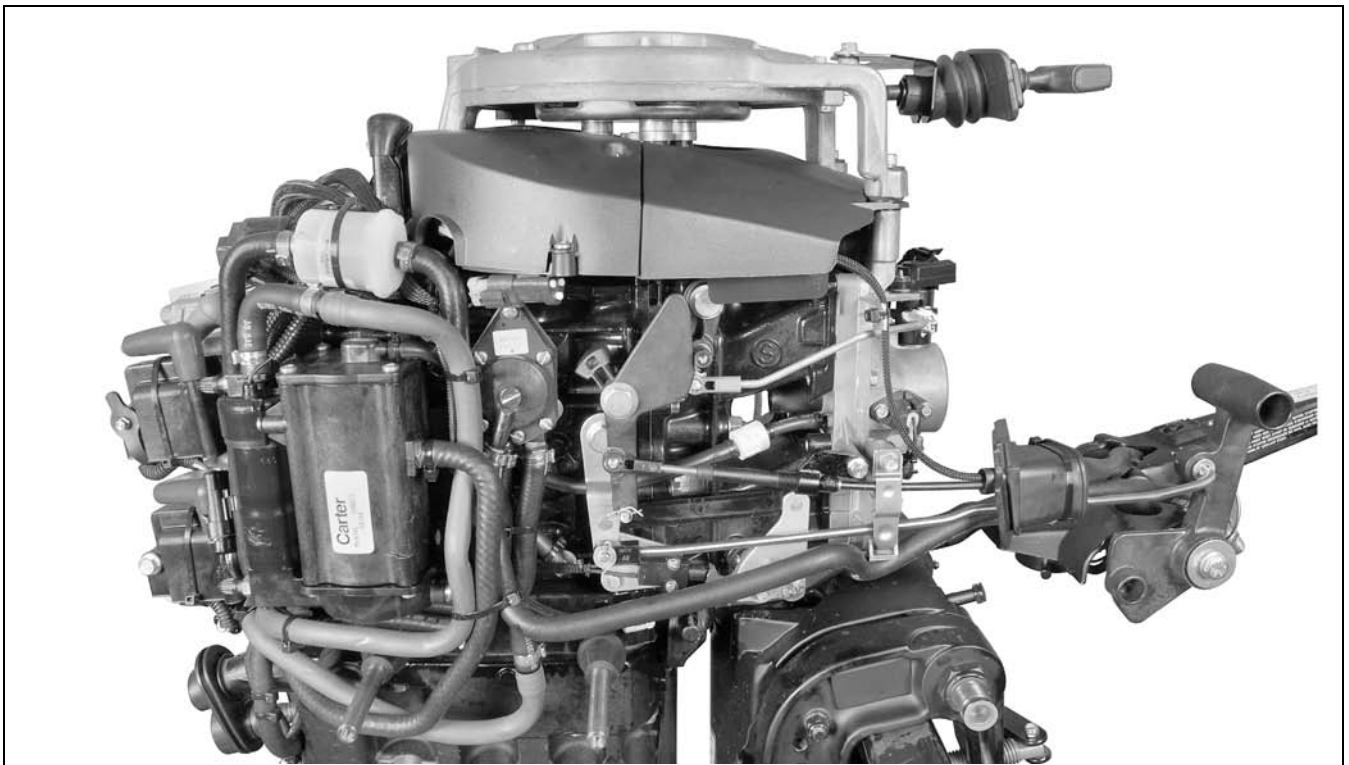
Starboard – Hose Routings



Port Dressed Powerhead

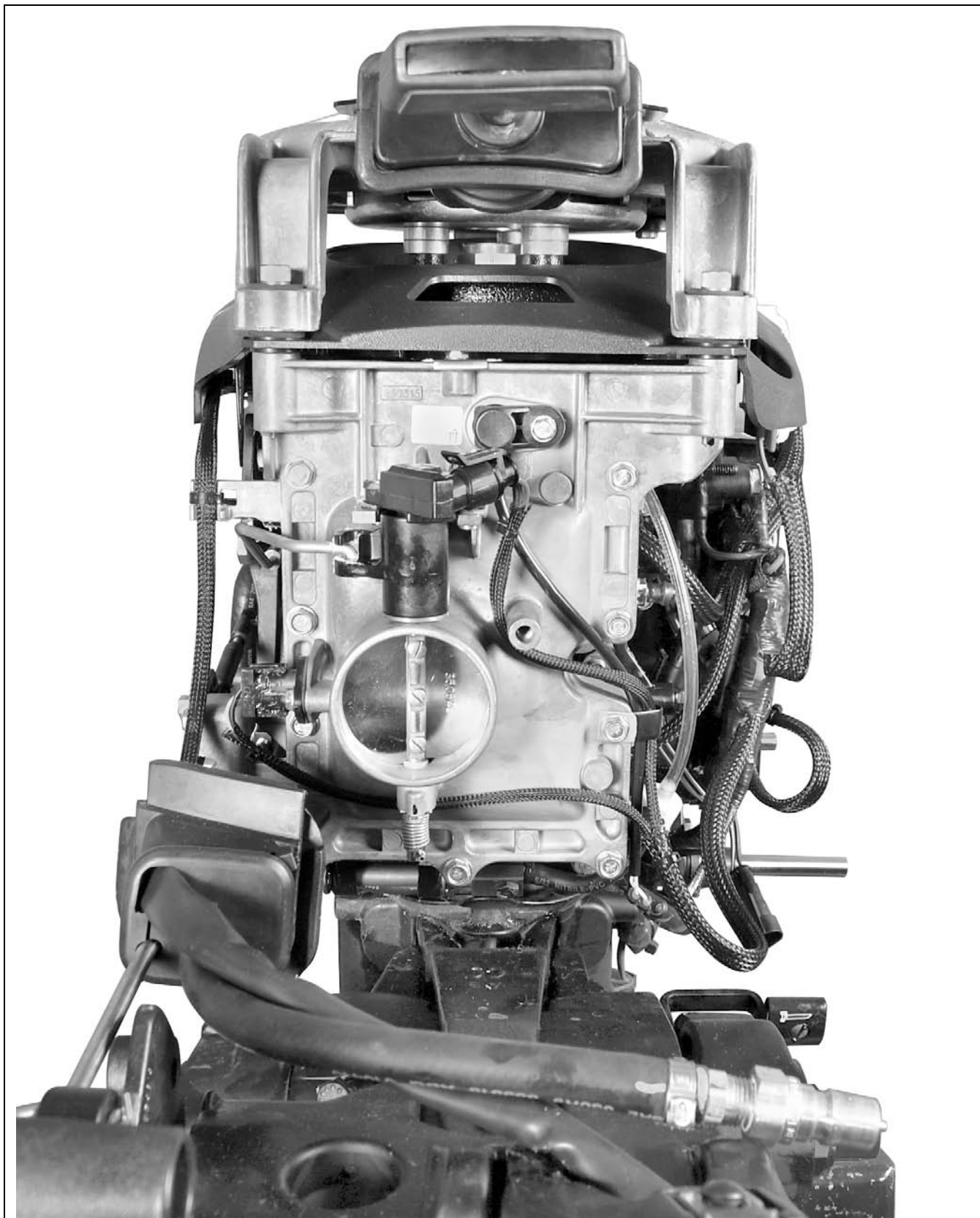


Starboard Dressed Powerhead

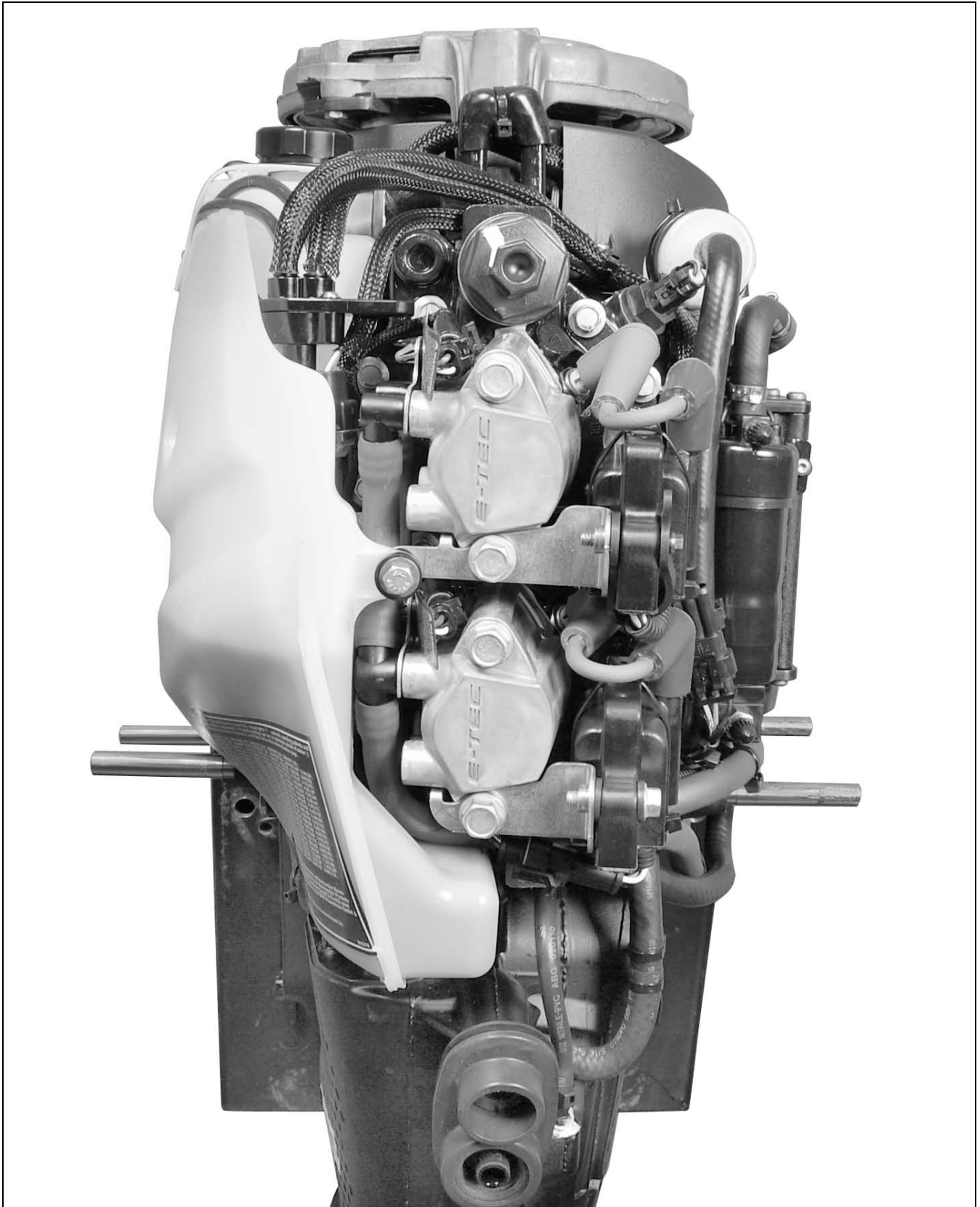


POWERHEAD
POWERHEAD VIEWS

Front

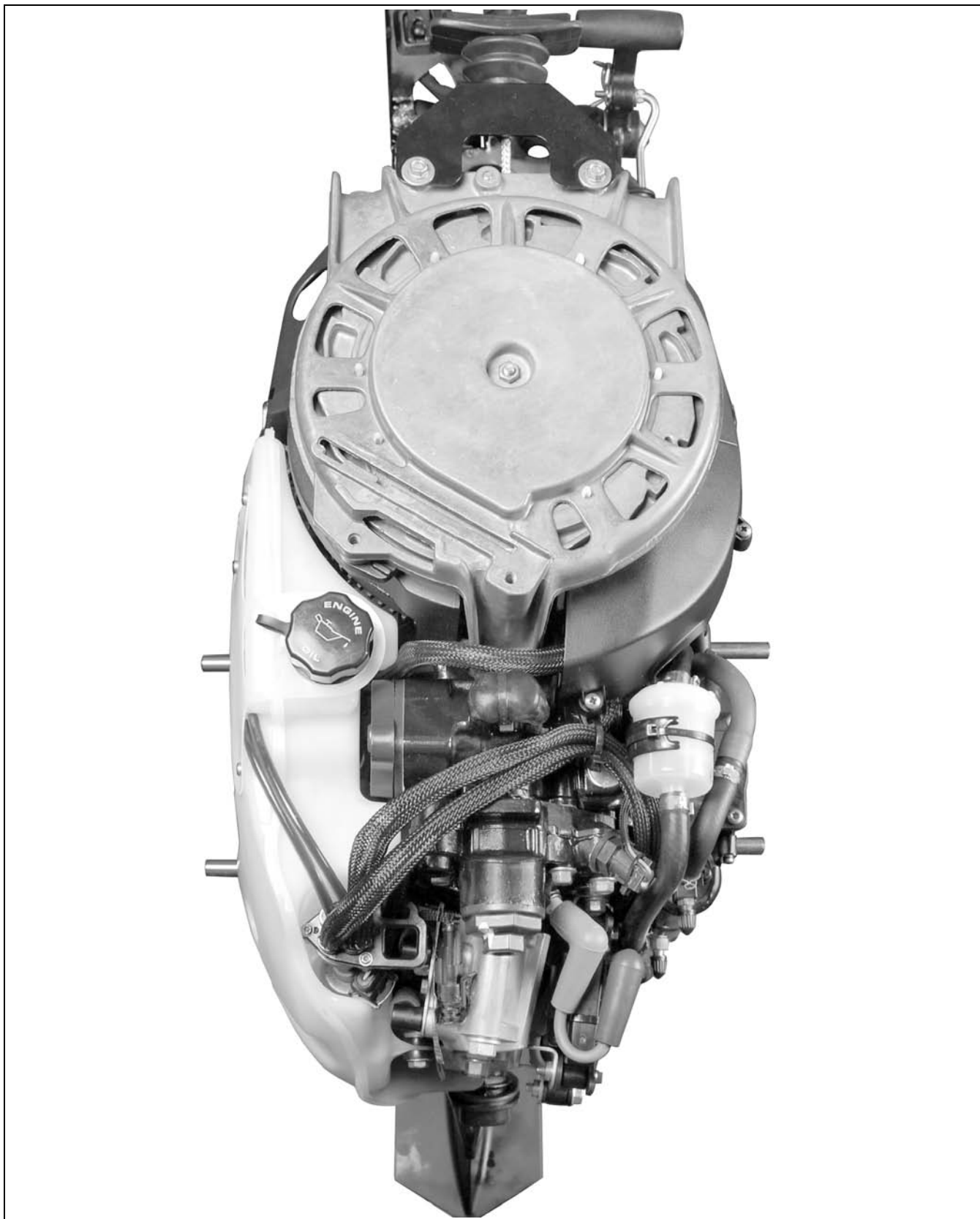


Rear



POWERHEAD
POWERHEAD VIEWS

Top



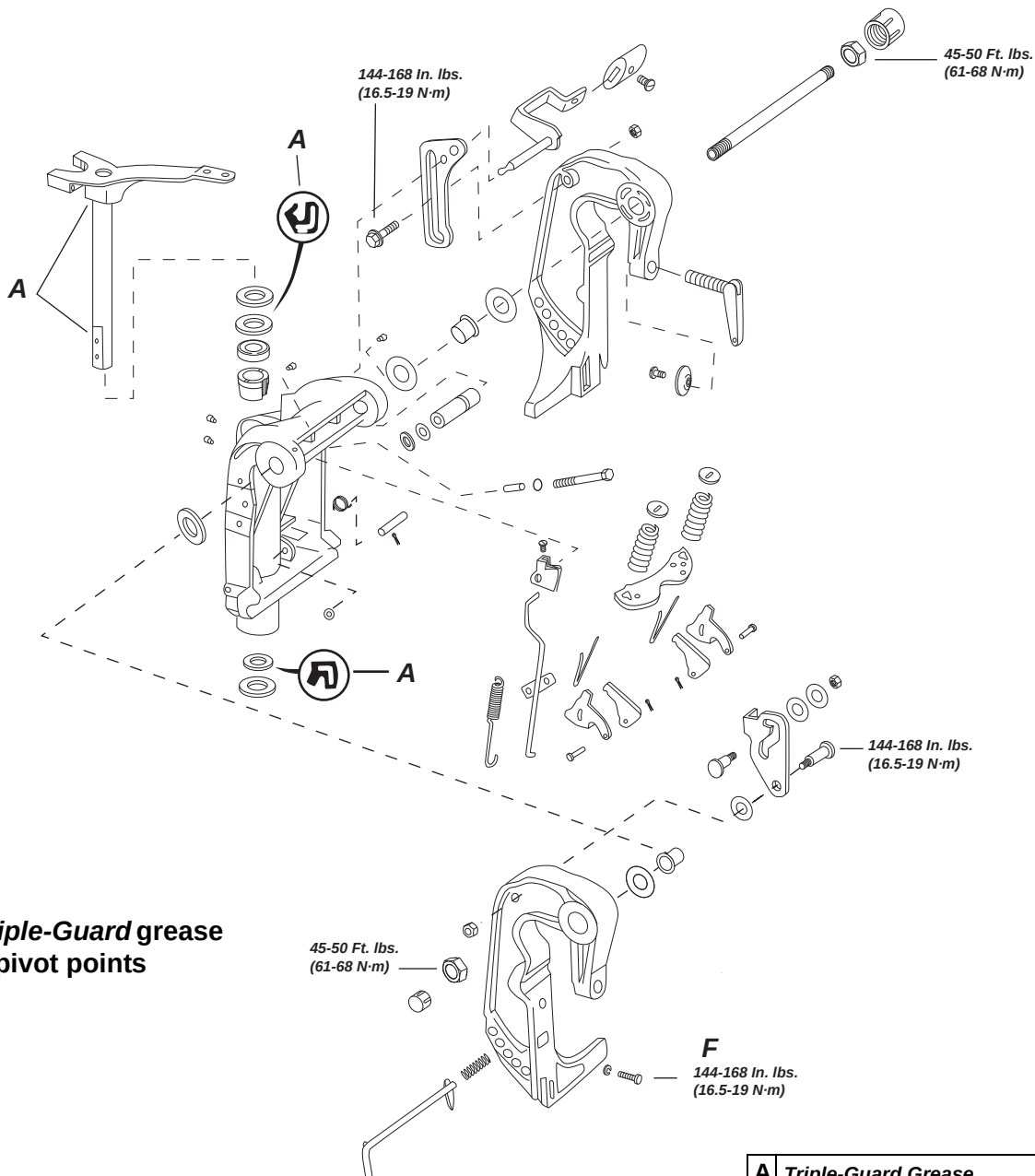
MIDSECTION

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SERVICE CHART

STERN BRACKET

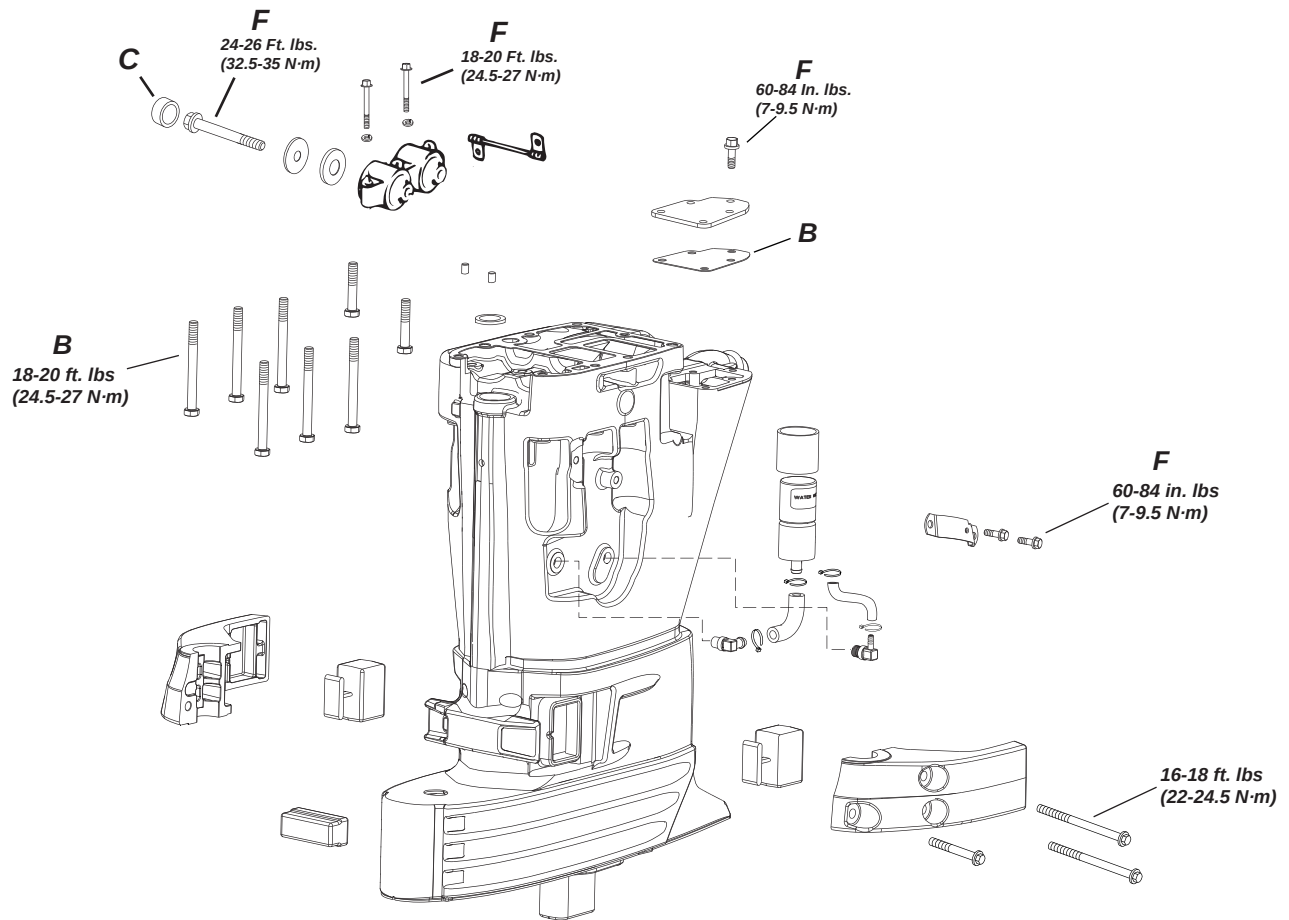


Use **Triple-Guard** grease
on all pivot points

A	Triple-Guard Grease
B	Gasket Sealing Compound
C	Adhesive 847
D	Moly Lube
E	Red Ultra Lock
F	Blue Nut Lock
G	Needle Bearing Grease
P	Permatex No. 2
Q	Gel Seal II

002221

EXHAUST HOUSING



A	<i>Triple-Guard Grease</i>
B	<i>Gasket Sealing Compound</i>
C	<i>Adhesive 847</i>
D	<i>Moly Lube</i>
E	<i>Red Ultra Lock</i>
F	<i>Blue Nut Lock</i>
G	<i>Needle Bearing Grease</i>
P	<i>Permatex No. 2</i>
Q	<i>Gel Seal II</i>

004304

EXHAUST HOUSING SERVICE

The exhaust housing contains no serviceable internal parts. The exhaust water valve and the exhaust relief muffler can both be serviced without removing the exhaust housing.

Exhaust Housing Removal

Before removing the midsection:

- Remove the gearcase. Refer to **Gearcase GEARCASE REMOVAL AND INSTALLATION** on p. 238.
- Remove the powerhead. Refer to **POWER-HEAD REMOVAL** on p. 182.

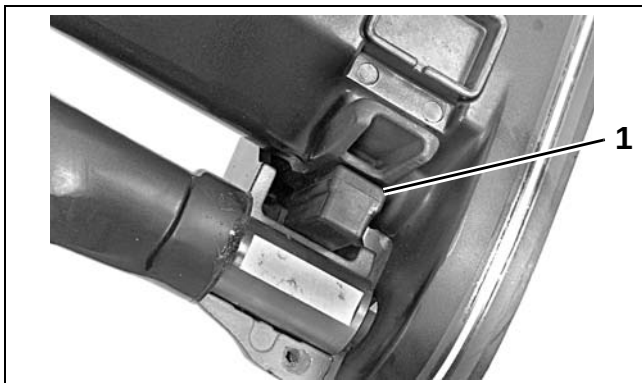
Remove the three lower mount cover screws.



17527

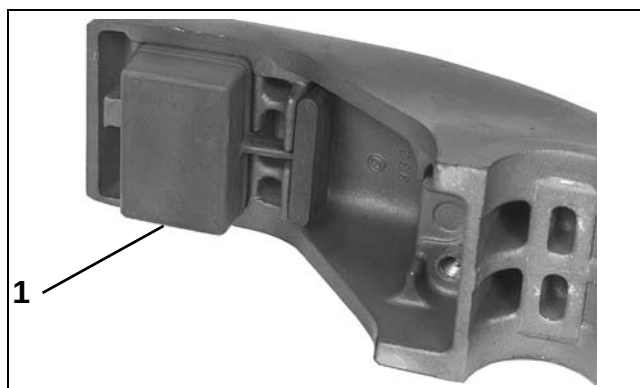
Separate lower mount covers from swivel bracket.

Check condition of the lower front mount and two lower side mounts.



1. Lower front mount

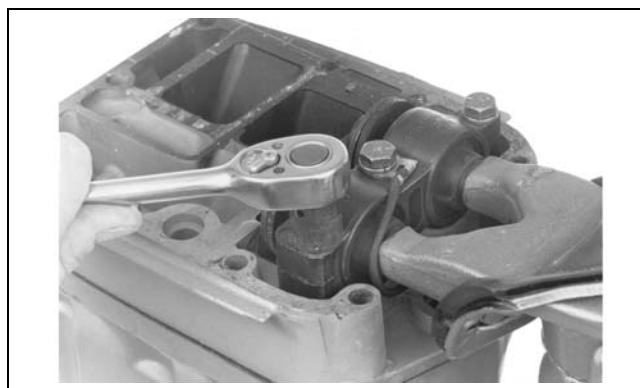
17526



1. Lower side mount

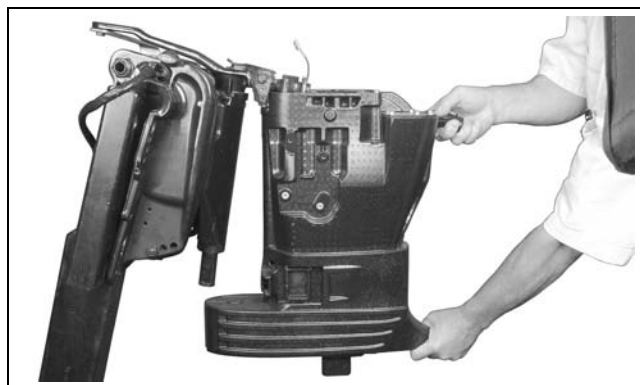
17524

Remove the three upper mount to exhaust housing screws. Be sure to support exhaust housing so it does not fall.



COA2943

Remove the exhaust housing.



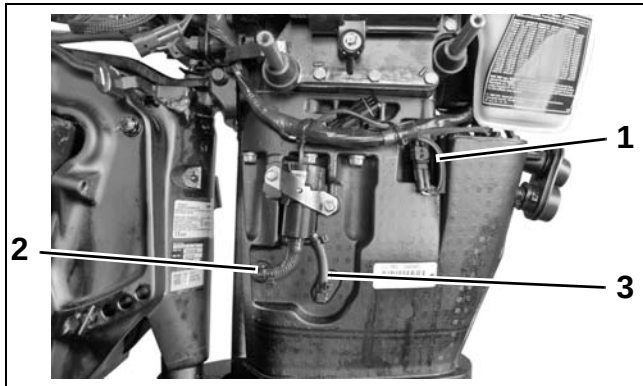
005069

Exhaust Water Valve

Disconnect water valve electrical connector.

Remove screws and bracket holding valve to exhaust housing.

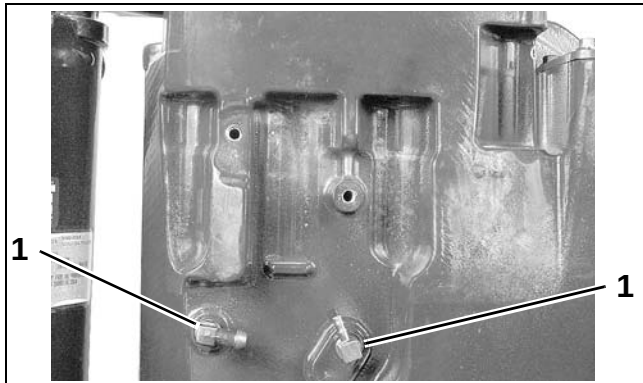
Remove tie straps and disconnect water valve hoses (3) from exhaust housing.



1. Electrical connector
2. Inlet hose
3. Outlet hose

008348

Check that all water passages are clear.



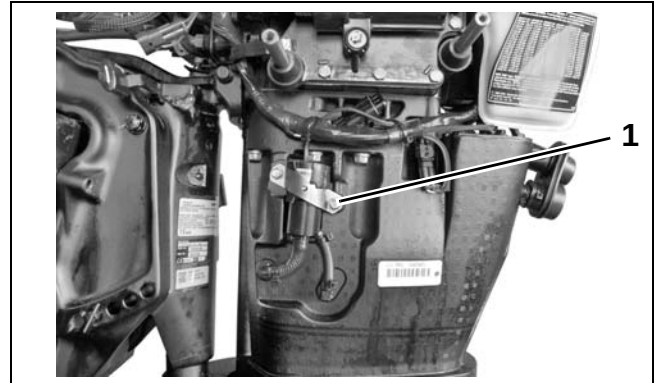
1. Fitting, water passage

004300

Install hoses to fittings on exhaust housing.

Place water valve and bracket in position.

Apply *Nut Lock* to screws, install and tighten 60 to 84 in. lbs. (7 to 9.5 N.m).

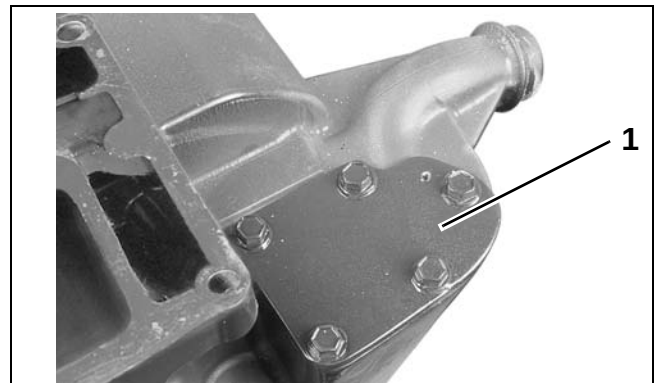


1. Exhaust water valve screws

008348

Exhaust Relief Cavity

Remove exhaust relief cavity cover to inspect for debris. Clean as needed.



1. Exhaust relief muffler cover

004301

Apply *Gasket Sealing Compound* to cover gasket and install cover.

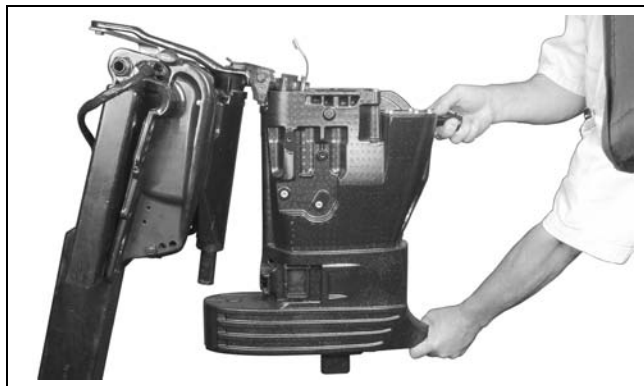
Apply *Nut Lock* to cover screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N.m).

MIDSECTION

EXHAUST HOUSING SERVICE

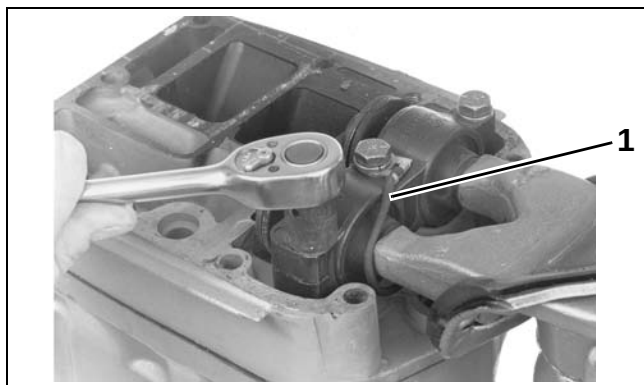
Exhaust Housing Installation

Bring the exhaust housing into position with the stern bracket.



005069

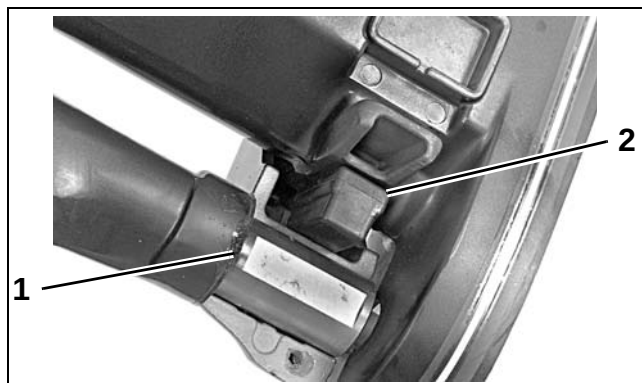
Apply *Nut Lock* to threads of the upper mount screws. Install the screws and place ground lead under the center screw. Tighten screws to a torque of 18 to 20 ft. lbs. (24.5 to 27 N·m).



1. Ground lead

COA2943

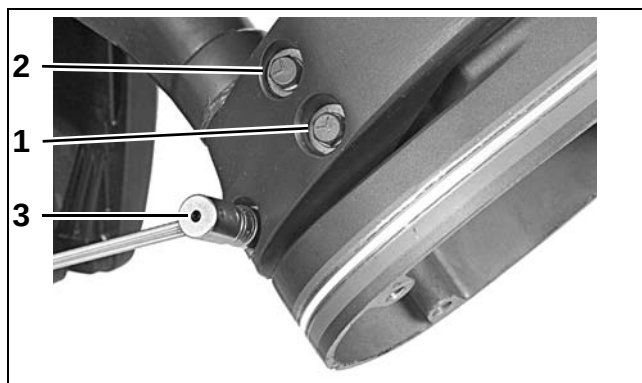
Place lower thrust washer on the steering shaft and place the lower front mount into position.



1. Thrust washer
2. Lower front mount

17526

Install lower side mount covers. Install and tighten the screws in stages to a torque of 16 to 18 ft. lbs. (22 to 24.5 N·m) following sequence shown.



Torque sequence

17528

Install gearcase. Refer to Gearcase **GEARCASE REMOVAL AND INSTALLATION** on p. 238.

Install powerhead. Refer to Powerhead **POWER-HEAD INSTALLATION** on p. 204.

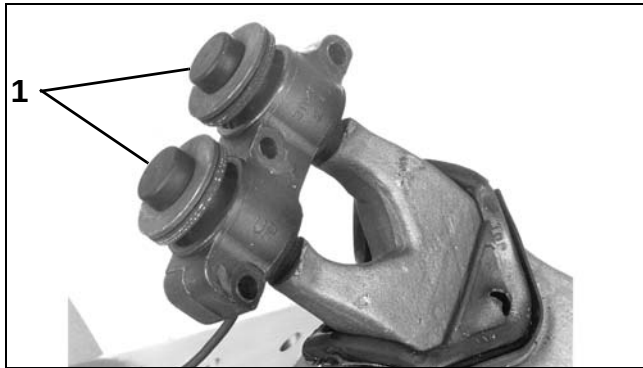
STERN BRACKET SERVICE

Clamp Screw

Inspect clamp screw assembly(s). Replace swivel plate and retainer if bent or loose. To install a new swivel plate, remove screw and old plate. Apply *Locquic Primer* to the threads of the screw and allow it to dry four to five minutes. Then apply *Ultra Lock* to threads. Install a new swivel plate with screw and tighten securely.

Stern Bracket Disassembly

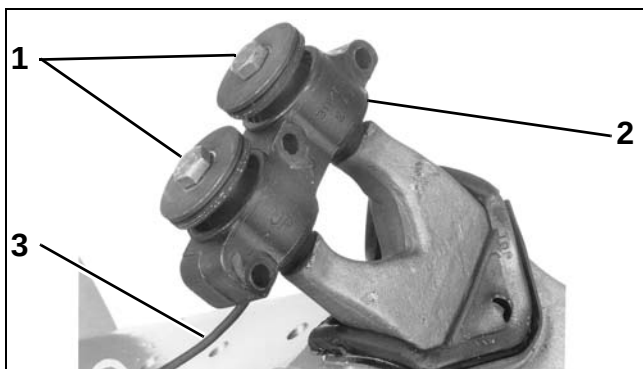
Remove bumpers from the upper mount retaining screws.



1. Bumpers

COA2949

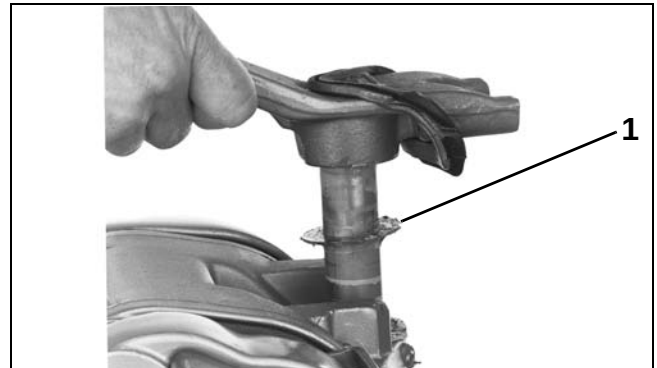
Remove screws, upper mount, and ground lead from the bracket.



1. Screws
2. Upper mount
3. Ground lead

COA2950

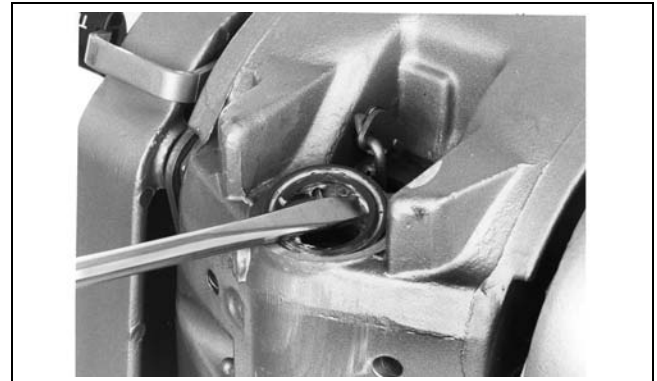
Slide the pivot shaft and upper thrust washer out of the swivel bracket.



1. Upper thrust washer

COA2956

Use an appropriate tool to pry the upper and lower seals from the swivel bracket.



COA2957

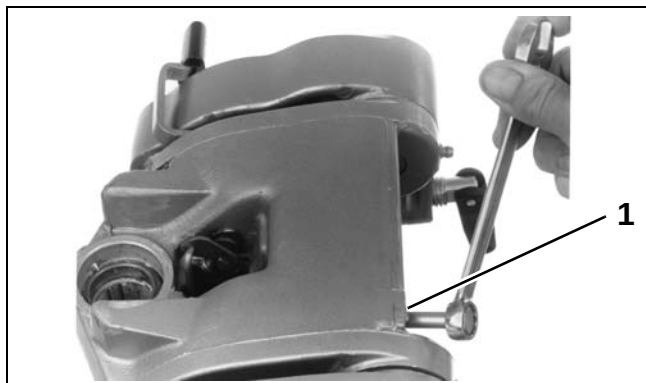


COA2958

MIDSECTION

STERN BRACKET SERVICE

Loosen the steering friction screw while pushing outward on the steering friction pin. When the pin is flush with the inside surface of the casting, remove the steering friction thrust ring.



1. Steering friction screw

COA2959

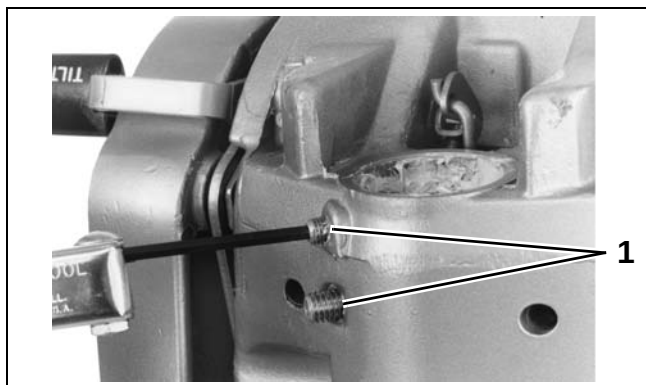


1. Steering friction pin
2. Steering friction thrust ring

COA2988

Tighten the steering friction screw until the steering friction pin can be removed. Then, remove the steering friction screw.

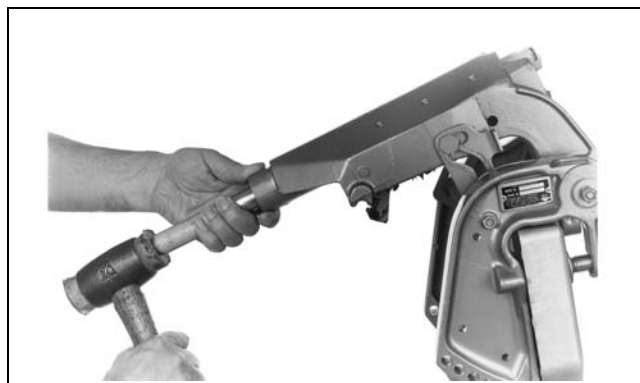
Remove the two setscrews from the swivel bracket.



1. Setscrews

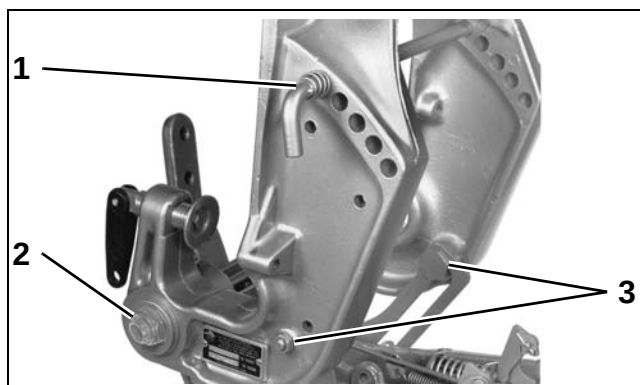
COA2961

Drive the steering friction bushing up and out of the swivel bracket.



COA2974

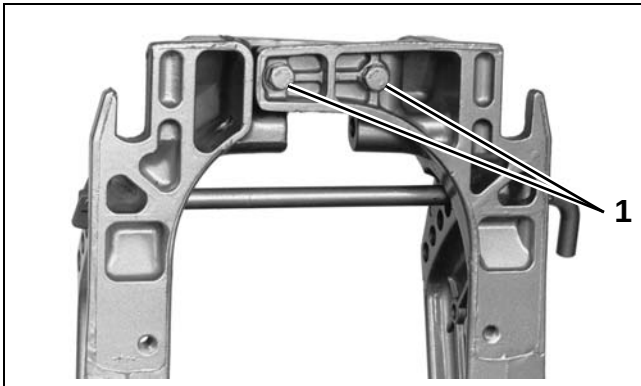
Remove the thrust rod from the stern brackets. Remove one tilt tube nut, and remove tilt tube from the stern brackets and swivel bracket. Remove the port and starboard stop link screws and nuts from the stern brackets.



1. Thrust rod
2. Tilt tube nut
3. Stop link screw and nut

COA2991R

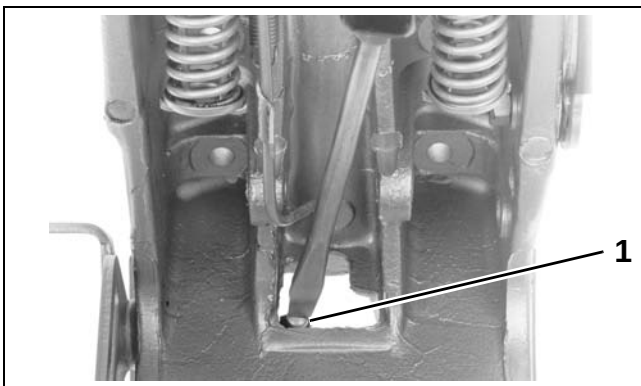
Remove the two stern bracket flange screws and separate the stern brackets from the swivel bracket.



1. Flange screws

COA2992

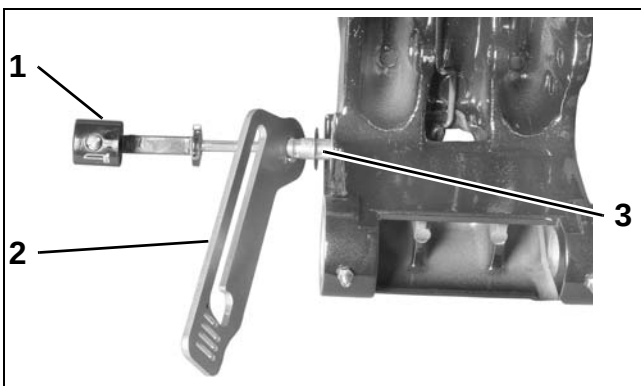
Place the tilt/run lever in the RUN position. Loosen the bellcrank setscrew.



1. Bellcrank setscrew

COA2976

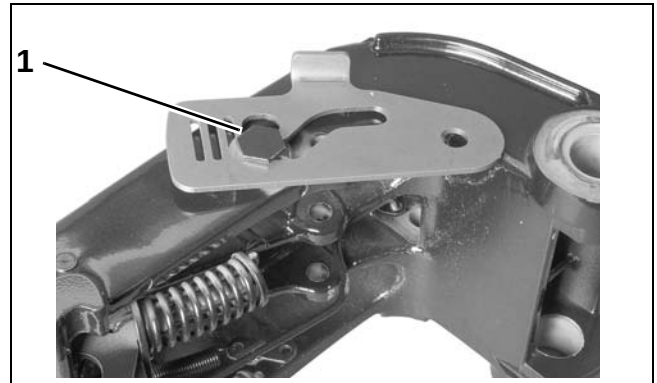
Remove the tilt/run lever, port stop link, and bushing from the swivel bracket.



1. Tilt/run lever
2. Port stop link
3. Bushing

002204

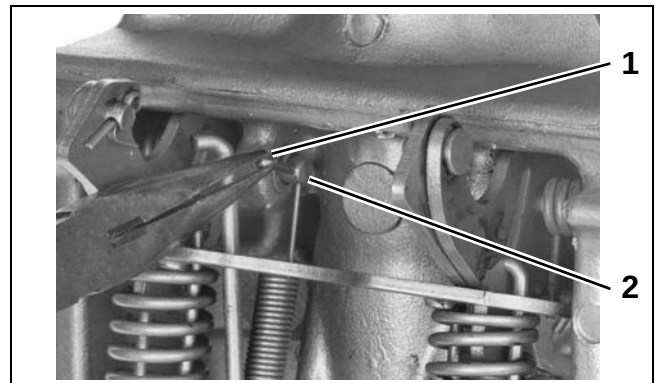
Remove the starboard stop link retaining screw and nut from the swivel bracket.



1. Starboard stop link screw

002205

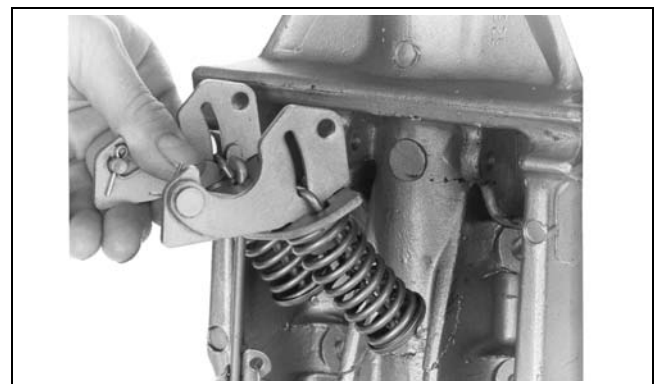
Remove the cotter pins from both reverse lock pins. Remove the reverse lock pins and springs.



1. Cotter pin
2. Reverse lock pin

COA2979

Remove the reverse lock assembly from the swivel bracket.



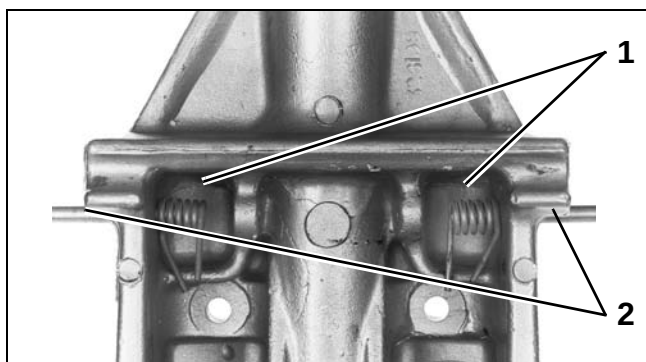
COA2980

MIDSECTION

STERN BRACKET SERVICE

Stern Bracket Assembly

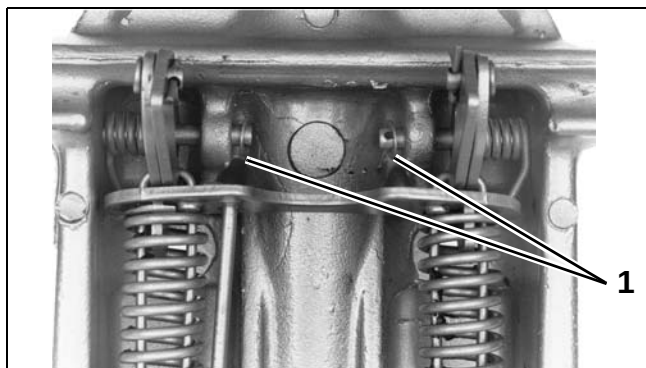
Place the reverse lock springs in the swivel bracket. Insert the reverse lock pins in the swivel bracket and part way through the reverse lock springs. Place the reverse lock assembly between the springs. Push the pins through the springs and the reverse lock assembly.



1. Reverse lock springs
2. Reverse lock pins

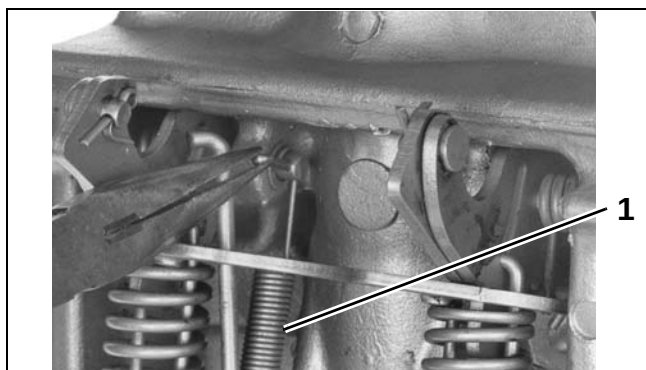
COA2981

Install the washers on the reverse lock pins. Install the link spring on the port pin. Install the two cotter pins in the reverse lock pins.



1. Washers

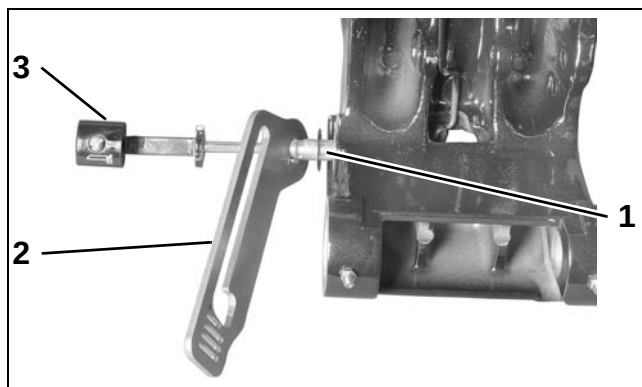
COA2982



1. Link spring

COA2979

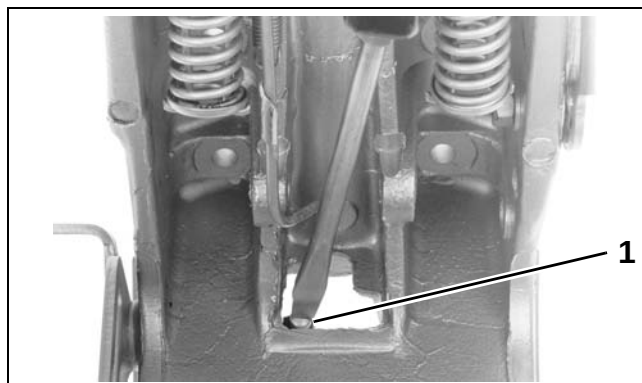
Install the bushing, the port stop link, and the tilt/run lever in the swivel bracket. The tilt/run lever should be in the RUN position.



1. Tilt/run lever
2. Port stop link
3. Bushing

002204

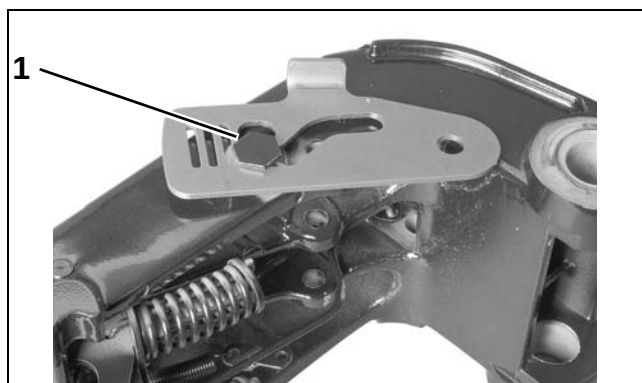
Install the wave washer and the bellcrank on the tilt/run shaft. Tighten the setscrew.



1. Bellcrank setscrew

COA2976

Install the starboard stop link on the swivel bracket. Install and tighten the screw and the nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).



1. Starboard stop link screw

002205

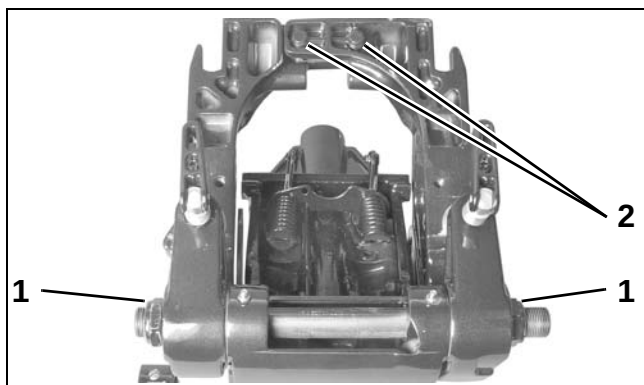
Place the swivel bracket between the stern brackets.

Install the tilt tube through the following parts and install the tilt tube nuts loosely:

- Starboard stern bracket
- Thrust washer
- Bushing
- Swivel bracket
- Bushing
- Thrust washer
- Port stern bracket

Apply *Nut Lock* to threads of the two flange screws. Install the two screws through the starboard stern bracket flange into the port stern bracket flange. Tighten the screws to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

Tighten the tilt tube nuts to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).



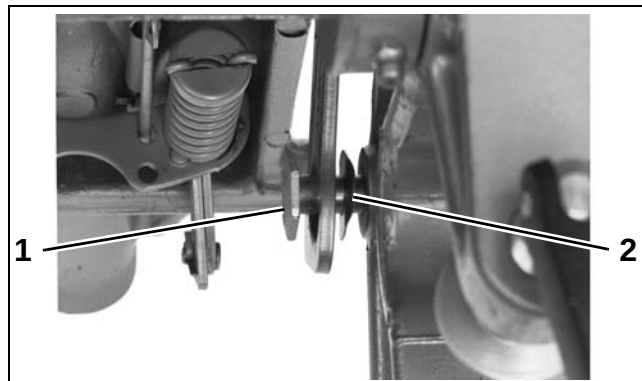
1. Tilt tube nuts
2. Flange screws

002206

Install the thrust rod in the stern brackets.

Install the larger shoulder screw through the port stop link, wave washer, and port stern bracket.

Install and tighten the nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

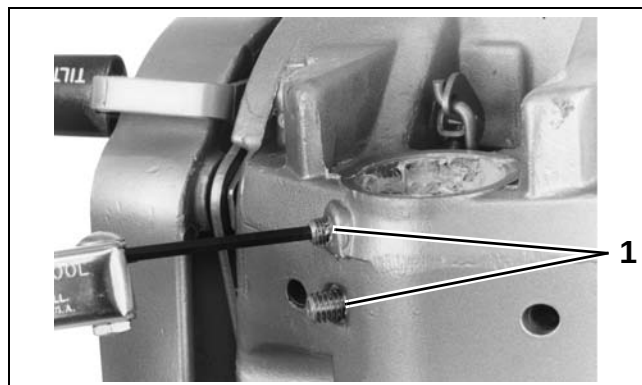


1. Port stop link screw
2. Wave washer

COA2984

Install the smaller shoulder screw through the starboard stop link and stern bracket. Install and tighten the nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

Apply *Ultra Lock* to threads of large setscrews. Install the screws in the swivel bracket so that one thread remains outside the casting.



1. Setscrews

COA2961

MIDSECTION

STERN BRACKET SERVICE

Place the steering friction bushing in the swivel bracket with groove in line with the setscrews.



COA2986

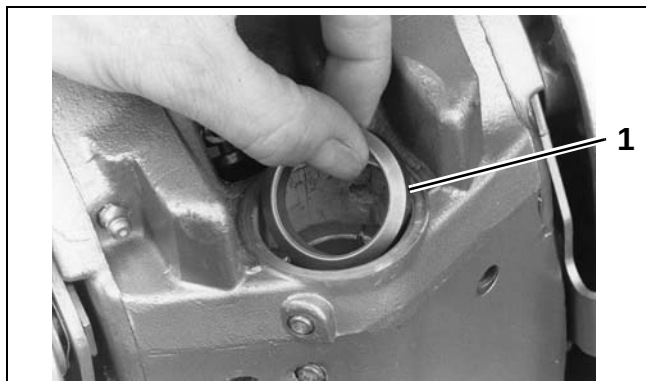
Apply *Triple-Guard* grease to the steering friction pin. Install the pin in the swivel bracket flush with inside surface. The pin should point up.



1. Steering friction pin

COA2988

Install the steering friction thrust ring, bevel side up, in the swivel bracket. Thread the steering friction screw in the swivel bracket. Turn the screw until the steering friction pin makes contact with top of the thrust ring. Do not tighten the screw.

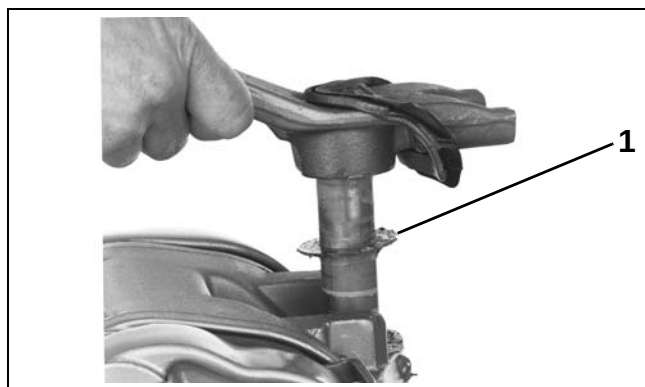


1. Steering friction thrust ring

COA2987

Install new upper and lower seals in the swivel bracket with lips of seals facing away from the bracket.

Slide the upper thrust washer on the pivot shaft. Slide the pivot shaft through the swivel bracket.

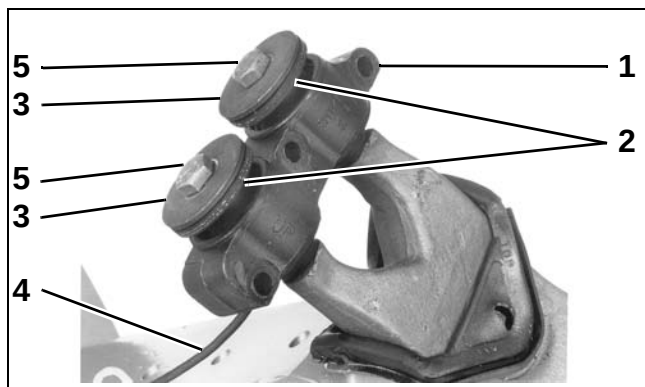


1. Upper thrust washer

COA2956

Lubricate the swivel bracket through the four lubrication fittings with *Triple-Guard* grease.

Apply *Nut Lock* to threads of the upper mount to steering arm screws. Position the upper rubber mount, the upper mount washers, and the retaining washers on the steering arm with the word "UP" on the mount facing up. Be sure to place the ground lead between the mount (starboard side) and the steering arm. Install and tighten the mount retaining screws to a torque of 24 to 26 ft. lbs. (32.5 to 35 N·m).



1. Upper mount
2. Upper mount washers
3. Retaining washers
4. Ground lead
5. Retaining screws

COA2950

Place the mount screw bumpers on the upper mount screws.

Tilt Assist Cylinder

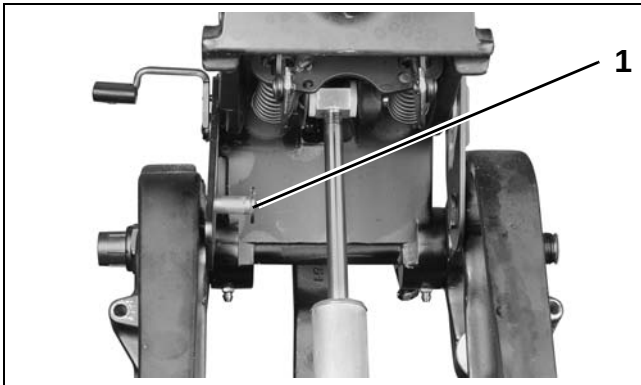
The tilt assist cylinder can be replaced without disassembly of the stern brackets.



WARNING

Support the outboard with a suitable hoist.

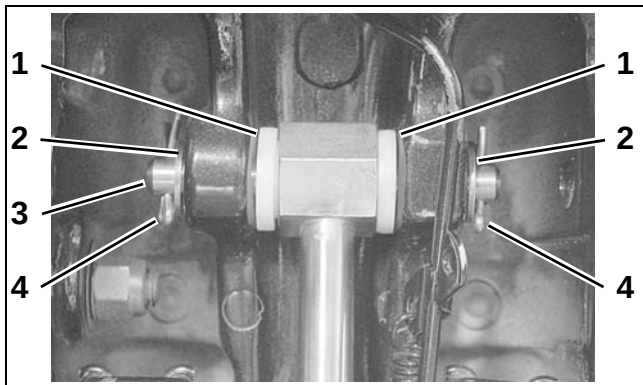
Remove port stop link screw. Push port stop link down to clear upper pivot pin access hole.



1. Stop link screw

006651

Remove both cotter pins and washers. Use appropriate tool to remove upper pivot pin.

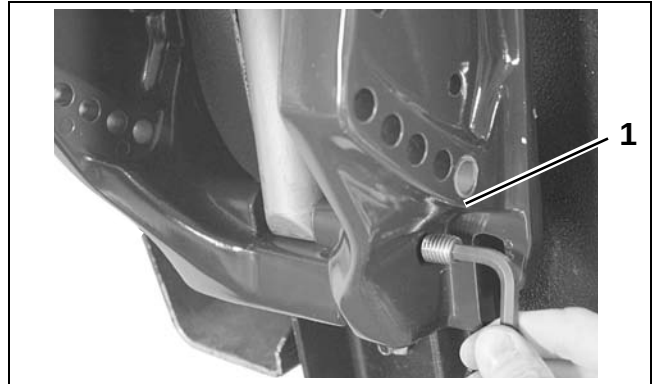


- 1. Bushings
- 2. Washers
- 3. Pivot pin
- 4. Cotter pins

003939

The starboard stern bracket includes an access hole for the lower tilt pin.

Remove set screw from starboard stern bracket lower pivot pin access hole and use an appropriate tool to remove lower pivot pin.



1. Lower pivot pin access hole

004260

If lower pivot cannot be removed because of corrosion or damage, stern brackets may need to be disassembled.



003940

Assembly is the reverse of disassembly. Install **new** cotter pins in upper pivot pin. Install a **new** set screw in starboard stern bracket lower pivot pin access hole and tighten securely.

TILLER HANDLE SERVICE

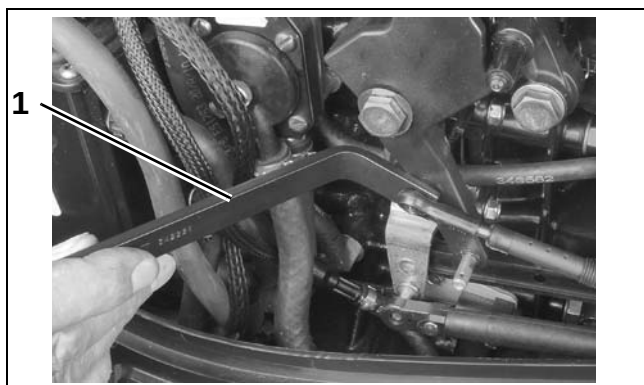
Removal



WARNING

To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

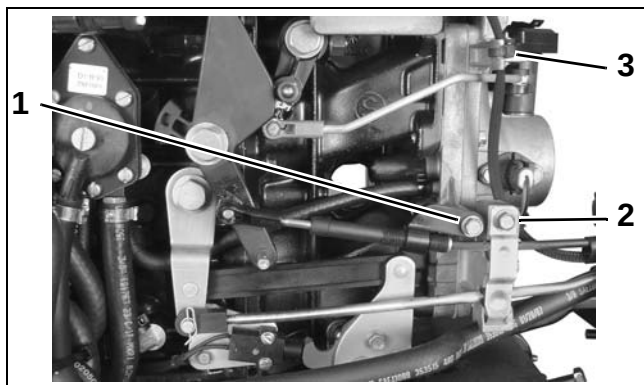
Use Ball Socket Remover tool, P/N 342226, to unsnap the throttle cable clip from the throttle lever.



1. Remover tool

005121

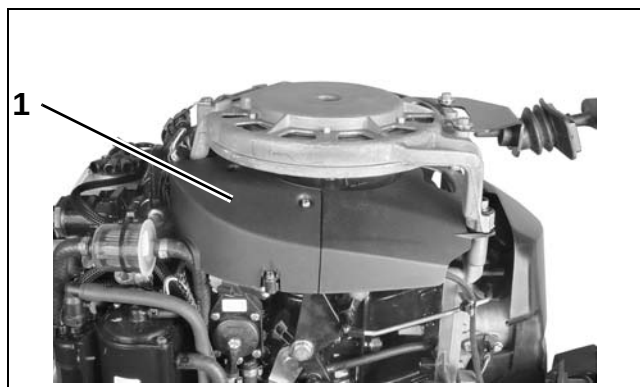
Remove the throttle cable anchor screw and washer. Loosen throttle cable retainer screw. And, remove the tie strap holding the tiller handle electrical harness.



1. Cable anchor screw and washer
2. Cable retainer screw
3. Tie strap

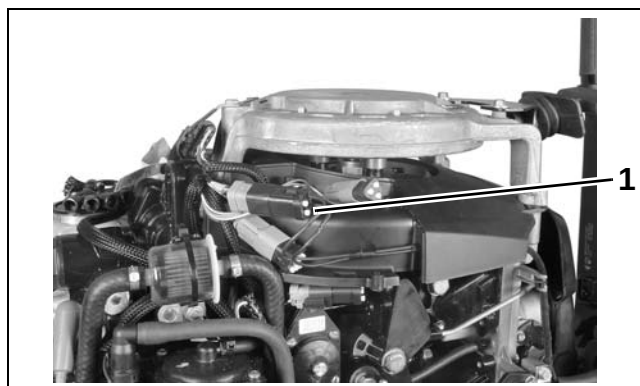
006526

Remove the electrical cover.



002509

Disconnect the electrical harness coming from the tiller handle.

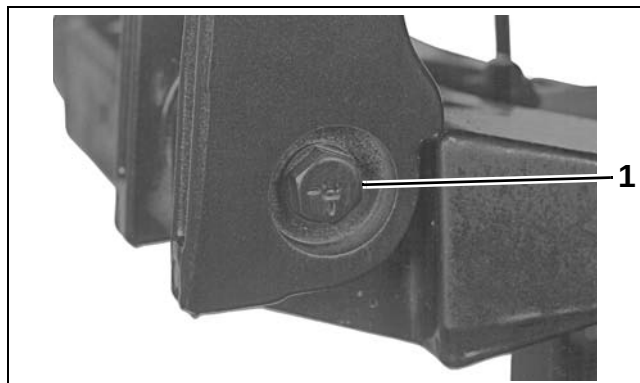


1. Electrical harness connector

002511

Remove throttle cable and wires from grommet in lower engine cover.

Remove the screw attaching steering handle. Remove handle.



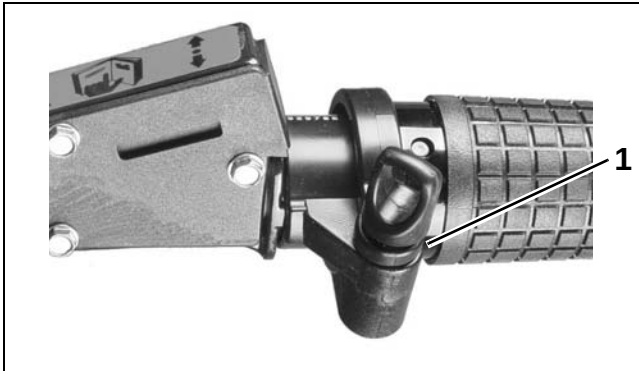
1. Screw

31194

Disassembly

Loosen throttle friction control so there is no restriction on grip.

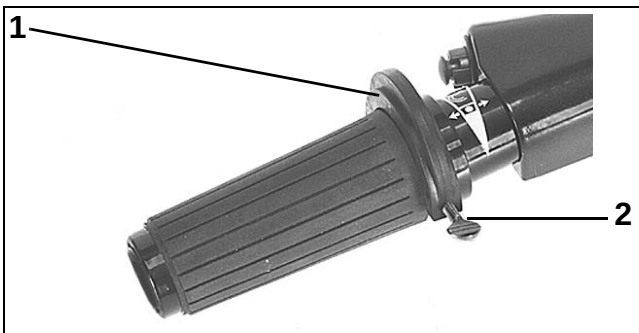
IMPORTANT: Do not back screw out completely. Nut is under spring tension.



1. Throttle friction control

001259

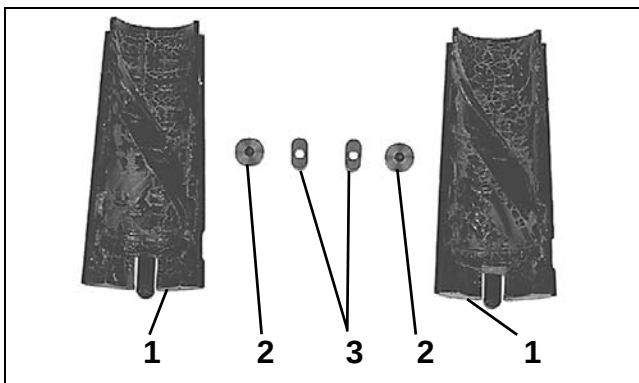
Use *Twist-Grip Remover*, P/N 390767, to depress the grip detents. Tighten screw and remove the grip by pulling grip.



1. Twist-Grip Remover
2. Screw

002189

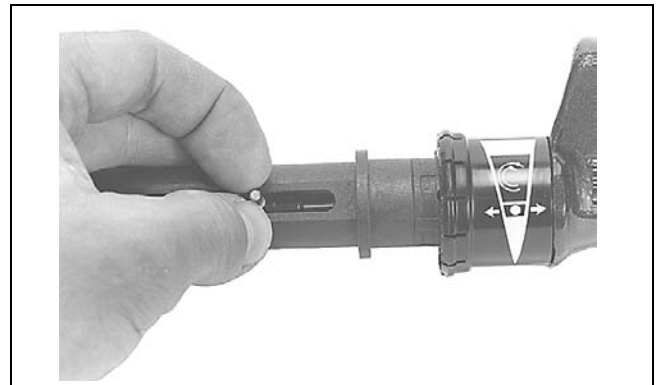
Remove the helix halves, rollers, and guides.



1. Helix halves
2. Rollers
3. Guides

COA2674

Pull the throttle pin out of the cable.



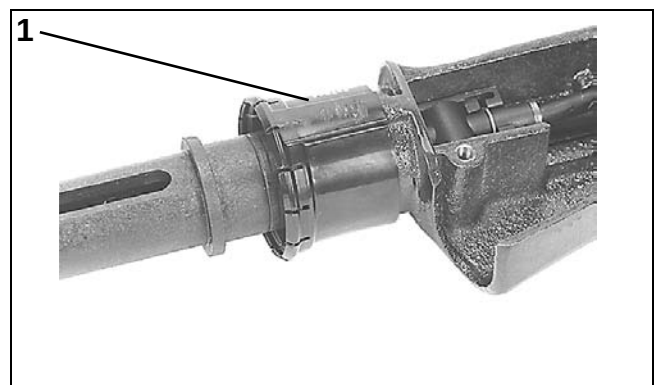
24294

Remove stop switch cover screws and cover/stop switch assembly.



24288

Remove the throttle control plate.



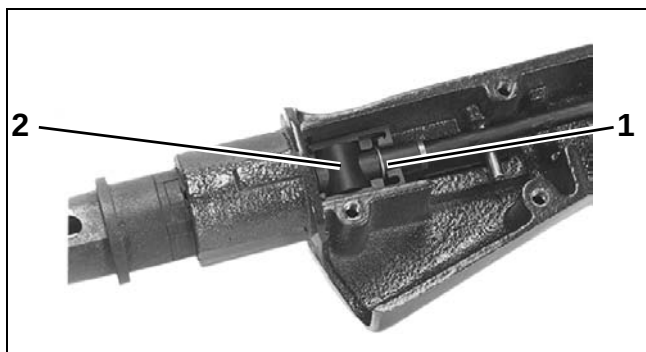
1. Throttle control plate

24287

MIDSECTION

TILLER HANDLE SERVICE

Remove the throttle cable retaining clip. Pry the cable trunnion out of the steering handle and remove cable.

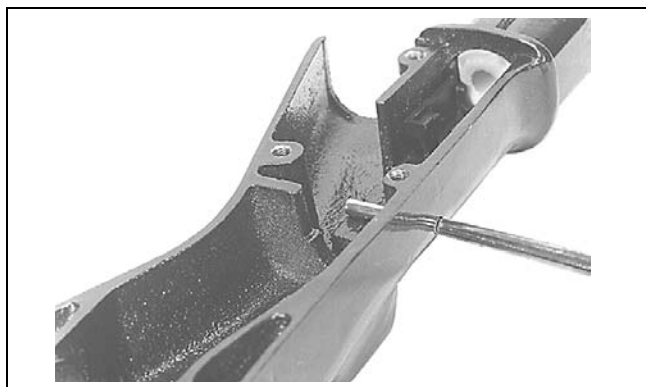


1. Retaining clip
2. Cable trunnion

24286

IMPORTANT: DO NOT remove the inner handle except to replace it.

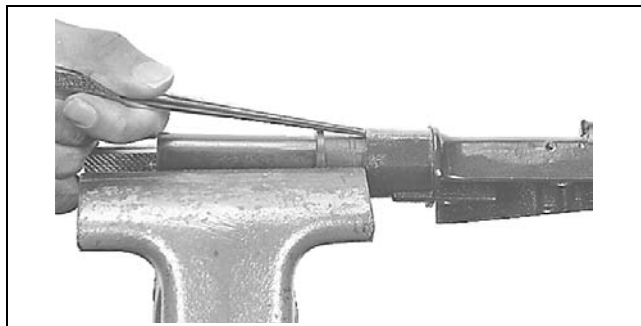
Use a punch and mallet to drive out the steel pin holding the inner handle into the steering handle.



24285

Remove the plastic inner handle from the metal outer handle by driving the outer handle off with a mallet and a punch. Inner handle is bonded to the

outer handle. After removing, chip away remnants of inner handle.



24284

Remove throttle cable seal from the inner handle.

Inspection

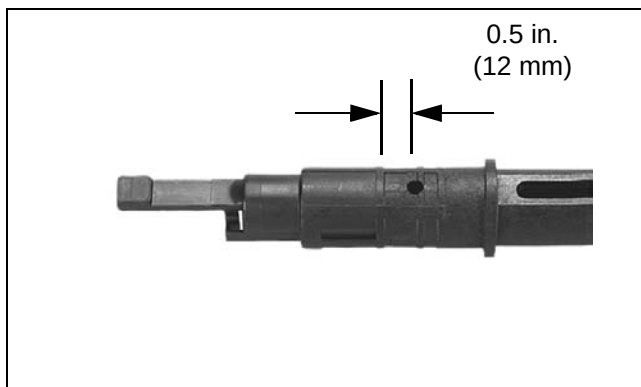
Inspect the throttle cable for kinks and wear. Replace if necessary.

Inspect the steering handle components for wear, cracks, or damage. Replace parts if necessary.

Assembly

Install the throttle cable seal in inner handle.

If removed, apply *Loctite Depend 300* adhesive to inner handle at areas shown.



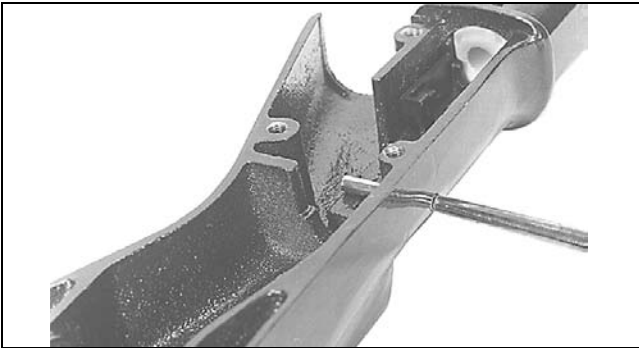
20849

Install the metal outer handle over the plastic inner handle and drive the outer handle into place.



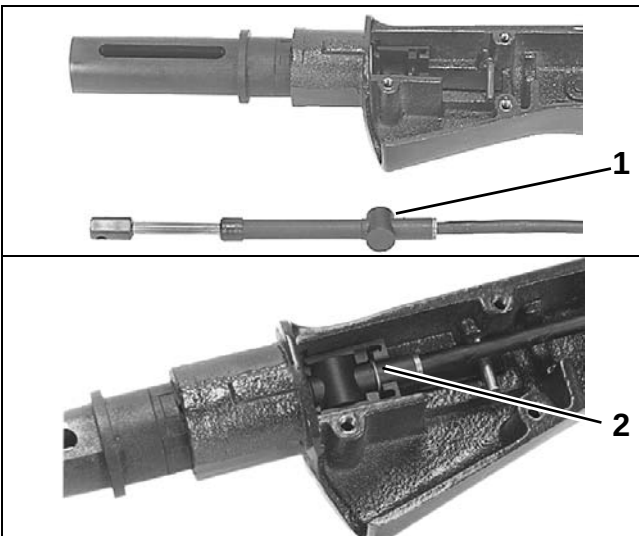
31202

Secure tab of the inner handle into recess of the outer handle with the steel pin.



24285

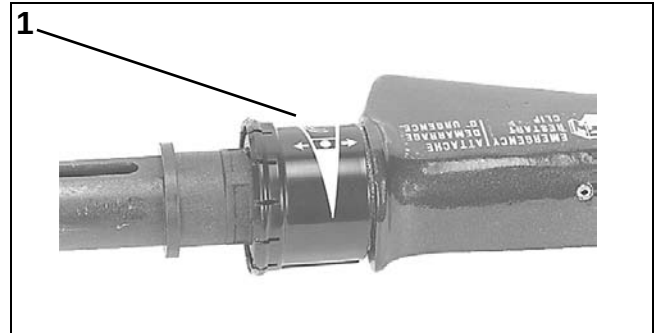
Install the handle end of the throttle cable. Snap the throttle cable trunnion into the recess in the handle. Install the retainer clip.



1. Throttle cable trunnion
2. Retainer clip

24282
24286

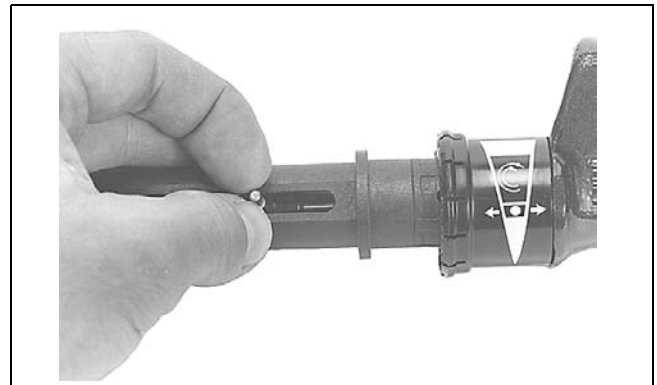
Install the throttle control plate on outer handle.



1. Throttle control plate

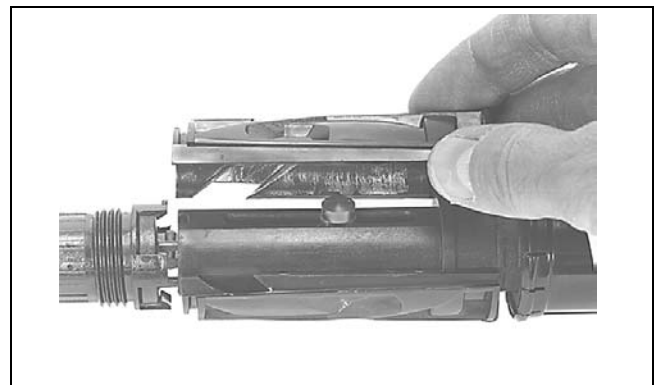
24295

Push the throttle cable pin through the end of the throttle cable.



24294

Lubricate end of the pin, guides, rollers, helix grooves, and inner handle guide slot with *Moly Lube*. Place the guides over the roller pin and into the slots of the inner handle. Place the rollers on the ends of the roller pin. Assemble the helix halves on the handle and slide the grip over the helix.

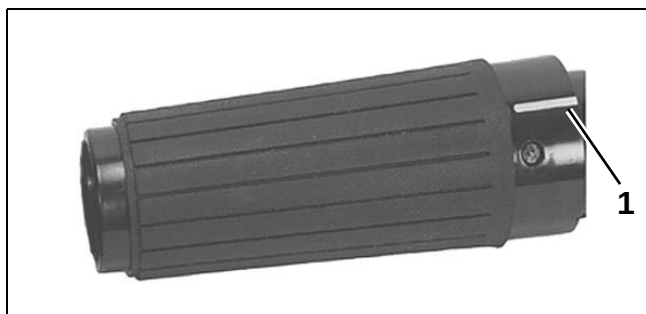


24293

MIDSECTION

TILLER HANDLE SERVICE

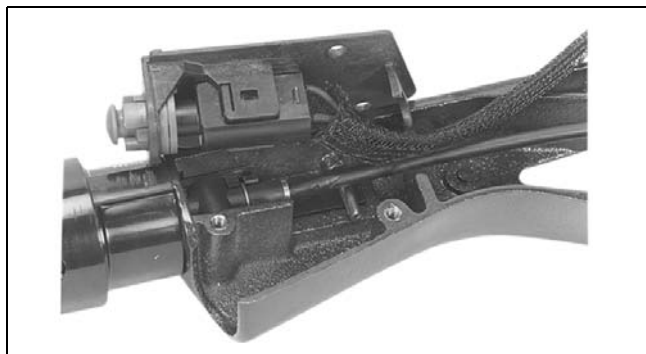
Be sure the twist-grip's speed indicator line is positioned with the speed range symbol on the handle. Snap the grip into place.



1. Indicator line

002190

Slide the protective sleeve over the stop switch leads and throttle cable and install stop switch cover.



24291



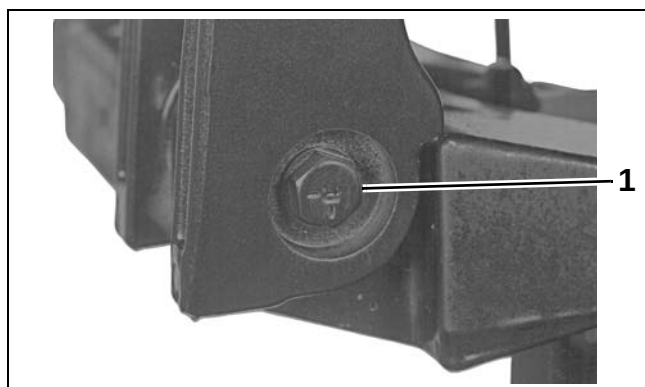
24288

Installation

Apply *Triple-Guard* grease to the two steering handle bushings. Place the bushings into the steering bracket. Attach the steering handle to the bracket. Tighten screw to a torque of 36 to 40 ft. lbs. (49 to 54 N·m).

CAUTION

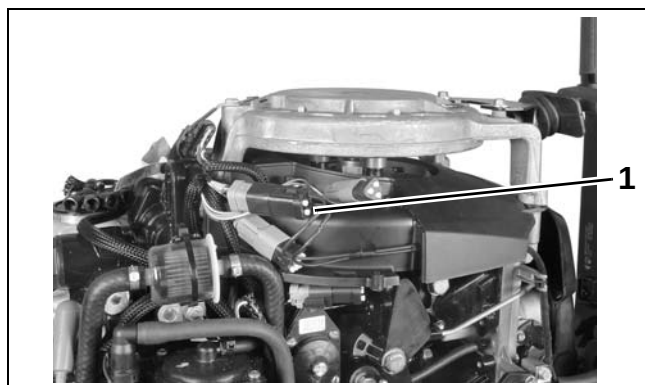
The steering handle nut must have a nylon patch for locking. Replace the nut if it has lost its locking feature. Tighten the nut so the steering handle can be pivoted and maintained in any position.



1. Screw

31194

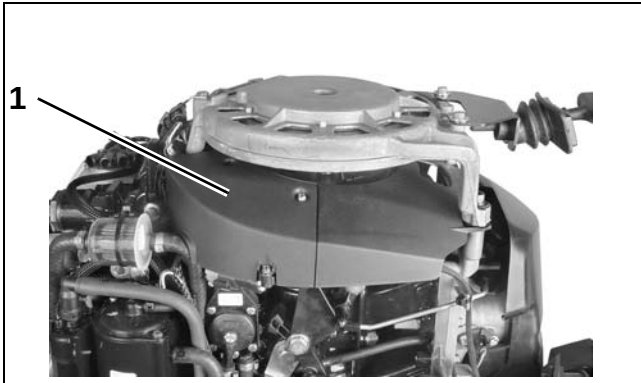
Route throttle cable and electrical harness through grommet in lower motor cover. Connect harness to engine wiring harness.



1. Electrical harness connector

002511

Install electrical cover.



002509

Throttle Cable Adjustment

Place throttle cable in position. Use Ball Socket Installer tool, P/N 342225, to snap throttle cable connector onto throttle cam pin.



1. Installer tool

005106

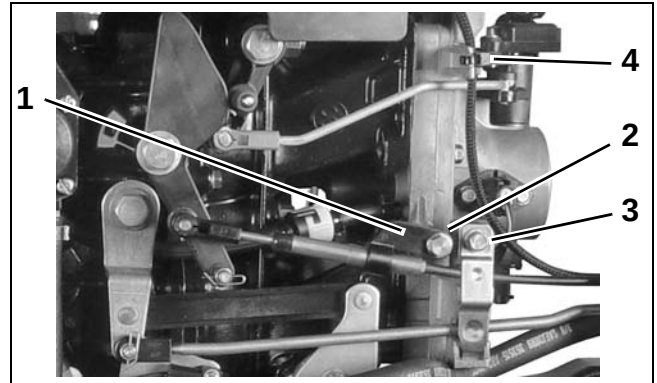
Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle body boss. Then, rotate anchor four turns toward the end of the cable.

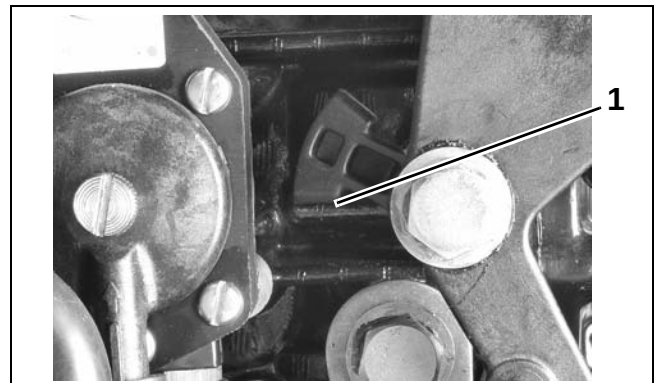
Install washer, cable anchor, and cable anchor screw on throttle body boss. Tighten screw securely.

Secure electrical harness with tie strap.



1. Cable anchor
2. Boss
3. Cable retainer
4. Tie strap

006526m



5. Throttle stop

005114



1. Turn anchor four turns toward cable end.

006564

IMPORTANT: Rotate twist grip. Make sure throttle cam goes to full throttle without bending cable, and still returns to IDLE stop.

MIDSECTION AND TILLER ADJUSTMENTS

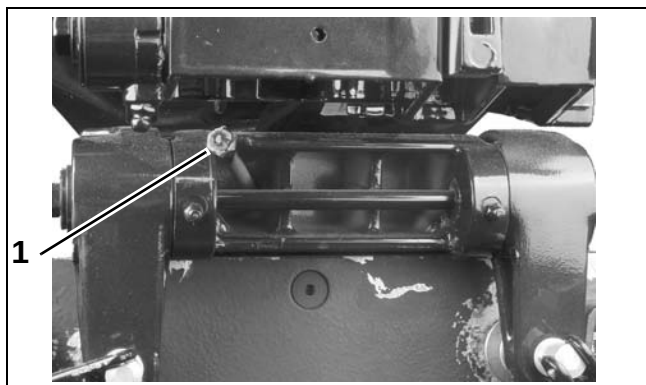
Steering Friction Adjustment

Tiller models are equipped with a steering friction adjustment. Steering friction is not required when remote steering is used.

Adjust steering friction with outboard mounted to boat by loosening or tightening the adjustment screw. Steering friction should be adjusted so a slight drag is felt when turning.

WARNING

Do not overtighten. The steering friction screw is not intended to allow “hands off” steering.



1. Steering friction adjustment

001256

Throttle Friction Adjustment

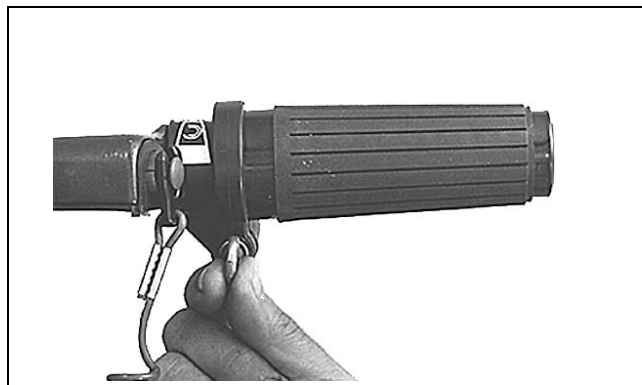
Tiller models are equipped with a throttle friction adjustment knob located on the steering handle. Tighten the knob to reduce the effort required to hold a throttle setting.

Turn the knob:

- clockwise to increase friction
- counterclockwise to decrease friction

WARNING

Tighten knob only enough to hold throttle at a constant engine speed. Overtightening will prevent quick throttle change in case of emergency.



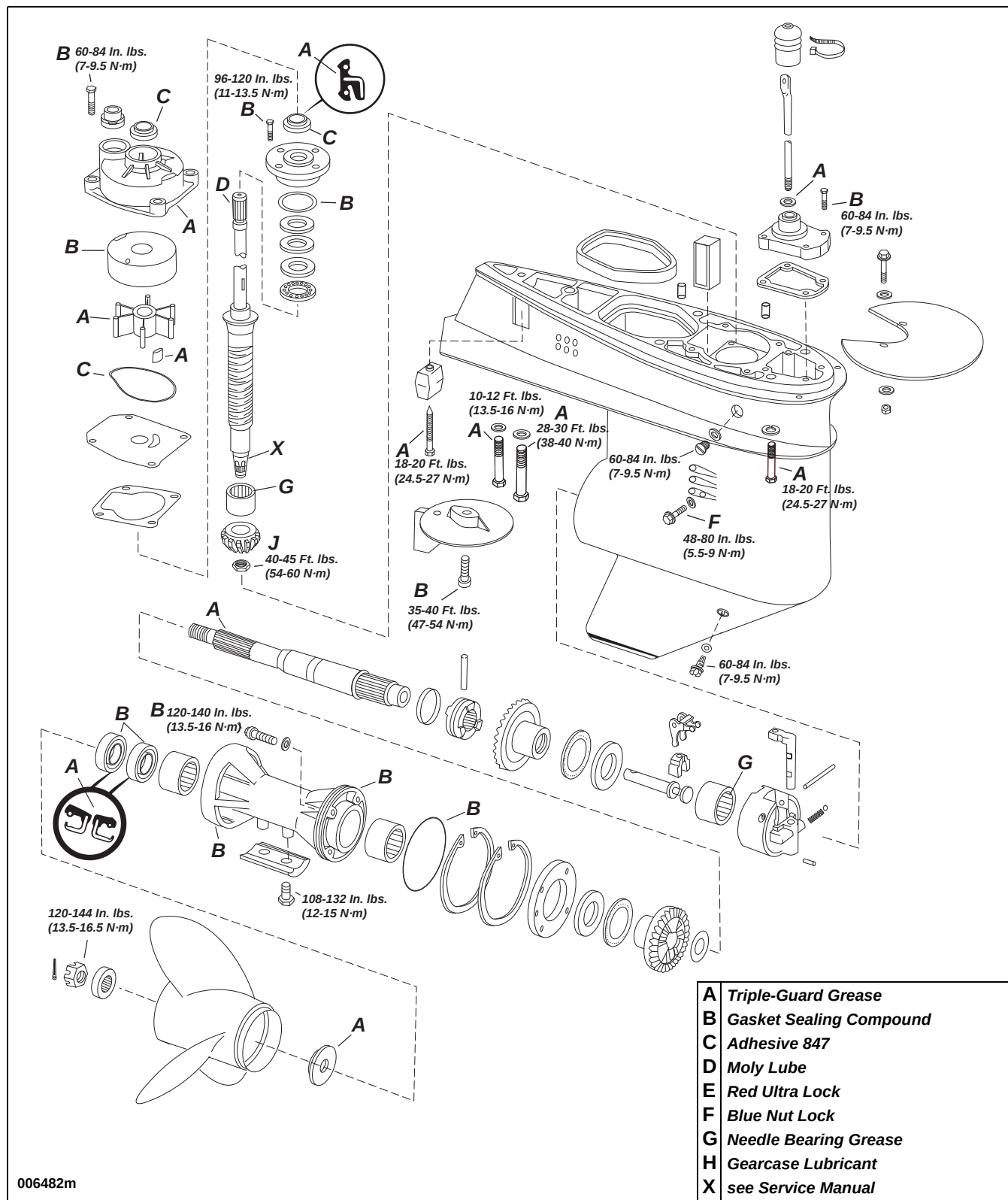
002191

GEARCASE

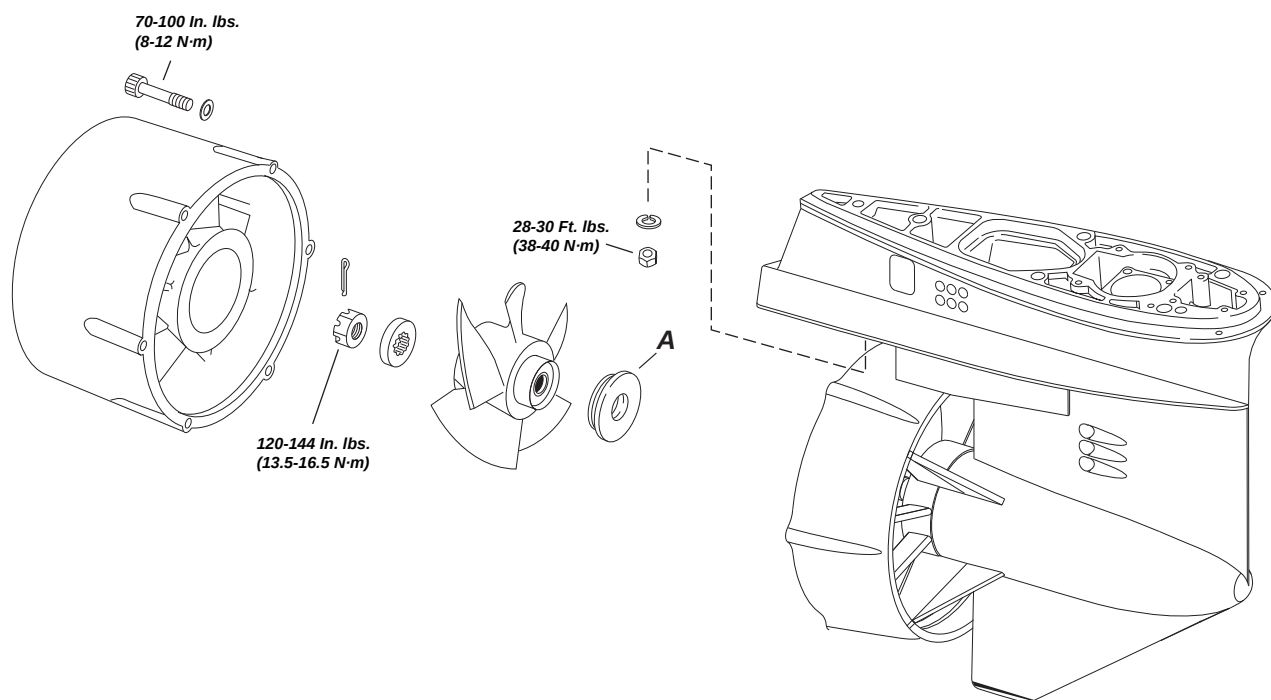
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SERVICE CHART



006482m



- A** Triple-Guard Grease
- B** Gasket Sealing Compound
- C** Adhesive M
- D** Moly Lube
- E** Red Ultra Lock
- F** Blue Nut Lock
- G** Sea Lube Bearing Lubricant
- R** DPL Penetrating Lubricant

PROPELLER SERVICE, MRL MODELS

Inspection

Carefully examine propeller and outboard for the following:

- Damaged blades and signs of propeller cavitation (burned paint, etc.)
- Spun or overheated inner hub
- Worn or twisted splines and inadequate lubricant
- Damaged or missing converging ring (if applicable)
- Damage to outer hub area
- Worn, missing, or incorrect thrust washer and spacer
- Correct size and style
- Check for bent or damaged propeller shaft and twisted splines.

Refer to **Propeller Hardware Installation** on p. 42.

WARNING

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and disconnect the battery positive (+) cable so the outboard cannot be started accidentally.

IMPELLER SERVICE, MJRL MODELS

Inspection

WARNING

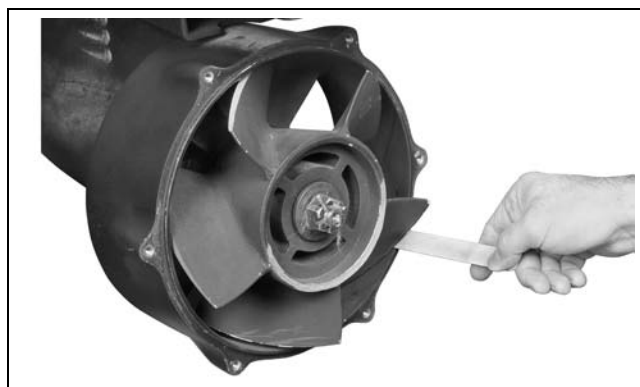
To prevent accidental starting while servicing, twist and remove all spark plug leads.

Use a 3/16 Ballhex driver to remove the six impeller housing screws. Remove the impeller housing.



006650

Insert a 1/8 in. shim between the impeller and the impeller housing. If the shim moves freely for the entire length of the impeller blade tip on any of the blades, the impeller is worn and must be replaced.



006644

Rotate the impeller 30° and repeat the inspection.

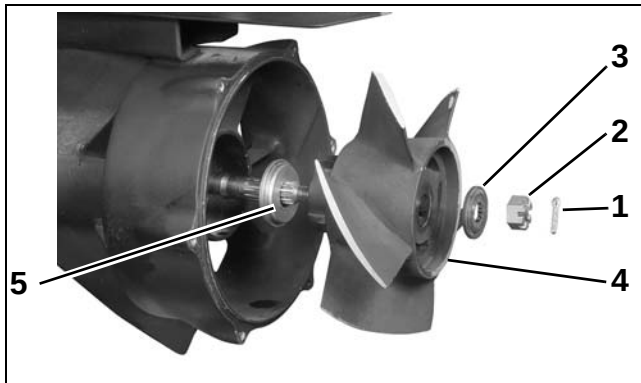
Removal

Wedge a block of wood between impeller blade and starboard side of the gearcase. Remove the cotter pin and loosen the impeller nut.



007851

Remove the nut, spacer, impeller, and thrust bushing.



006638

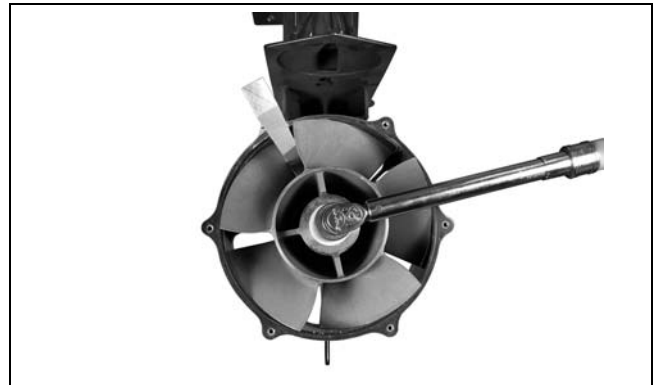
1. Cotter pin
2. Impeller nut
3. Spacer
4. Impeller
5. Thrust bushing

Installation

Apply a small amount of *Triple-Guard* grease to the impeller shaft splines. Place the thrust bushing in the impeller and then slide the assembly onto the impeller shaft.

Install the spacer on splines of the impeller shaft.

Wedge a block of wood between impeller blade and port side of the gearcase. Install and tighten the impeller nut to a torque of 120 to 140 in. lbs. (14 to 16 N·m).

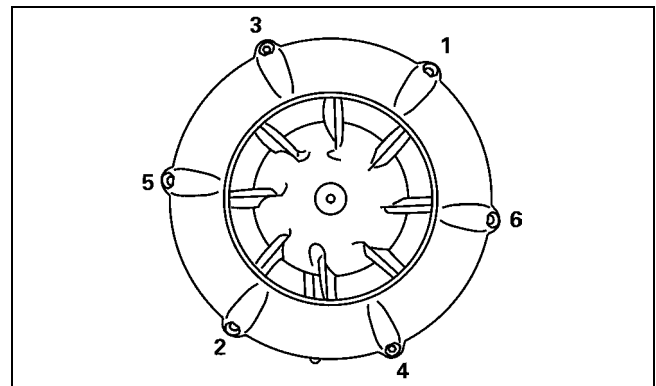


007852

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

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

Install the impeller housing, and following sequence shown, tighten screws **in stages** to a torque of 70 to 100 in. lbs. (8 to 12 N·m).



DRC7178

GEARCASE

GEARCASE LEAK TEST

GEARCASE LEAK TEST

Drain lubricant before testing.

Use Gearcase Pressure Tester, P/N 507977. Install lubricant drain/fill plug and seal, thread pressure test gauge fitting and seal in lubricant level hole.

Pressurize 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leak.

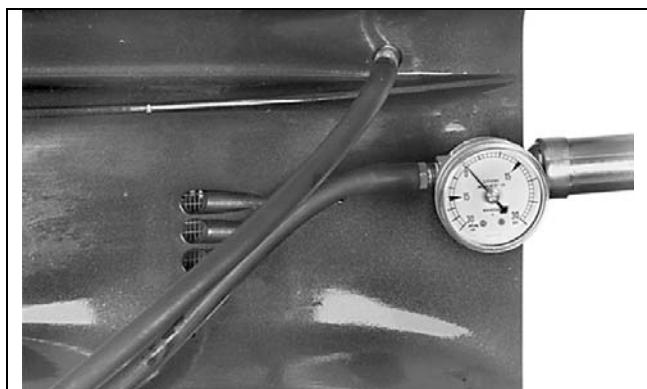
If the gauge does not indicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leaks.

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

To prevent accidental starting while servicing, twist and remove all spark plug leads.

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

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

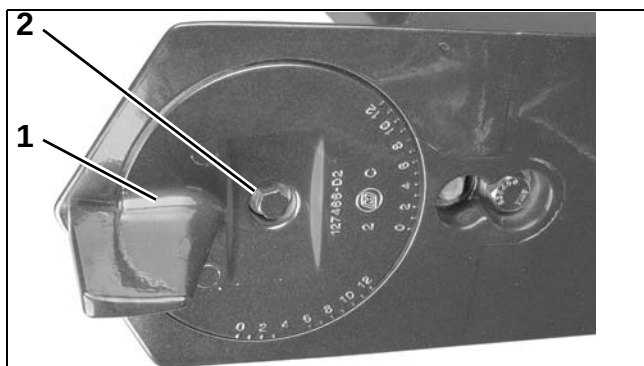


1. Shift rod screw

002171

MRL MODELS

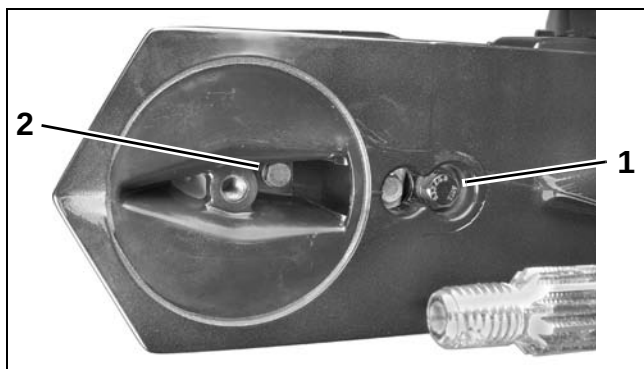
Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw and trim tab from the gearcase.



1. Trim tab
2. Trim tab retaining screw

001996

Remove the forward screw with washer and recessed retaining screw.



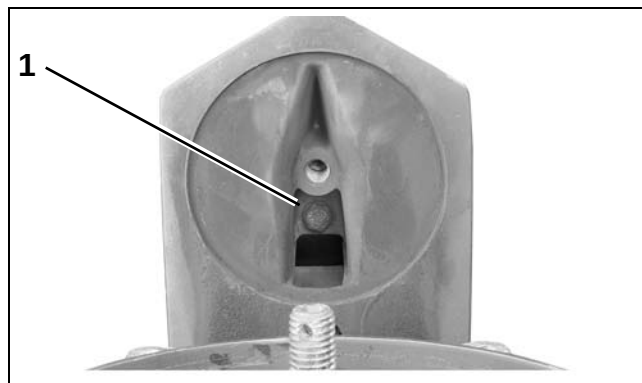
1. Forward screw
2. Recessed screw

001995

MJRL MODELS

Remove the impeller housing and impeller assembly. Refer to **IMPELLER SERVICE, MJRL MODELS** on p. 236.

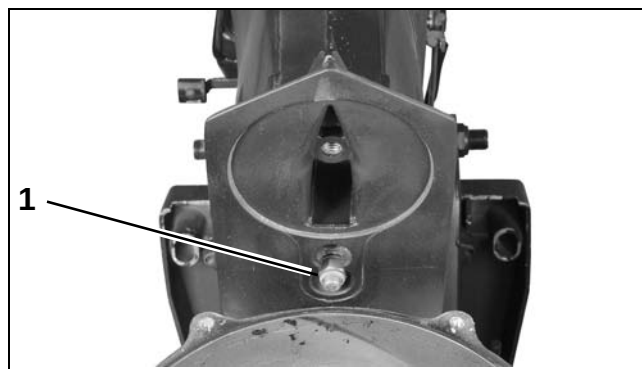
Remove the recessed retaining screw from the gearcase.



1. Screw

006653

Remove nut and washer.

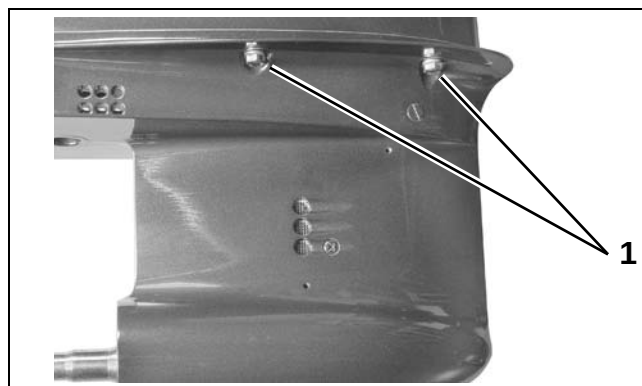


1. Nut

006652

ALL MODELS

Remove the four gearcase retaining screws.



1. Gearcase retaining screws

001994

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

GEARCASE

GEARCASE REMOVAL AND INSTALLATION

Gearcase Installation

WARNING

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

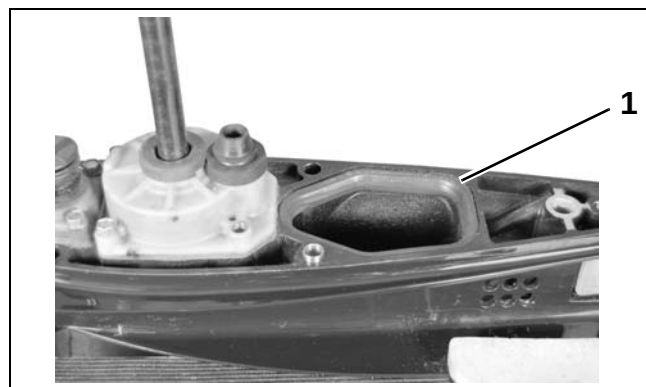
NOTICE Before installing gearcase, shift rod adjustment **MUST** be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 244.

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



30385

Apply *Adhesive 847* to the exhaust housing seal's outer surface. Place the seal in the gearcase exhaust cavity. Apply *Triple-Guard* grease to the seal's inner surfaces.



1. Exhaust housing seal

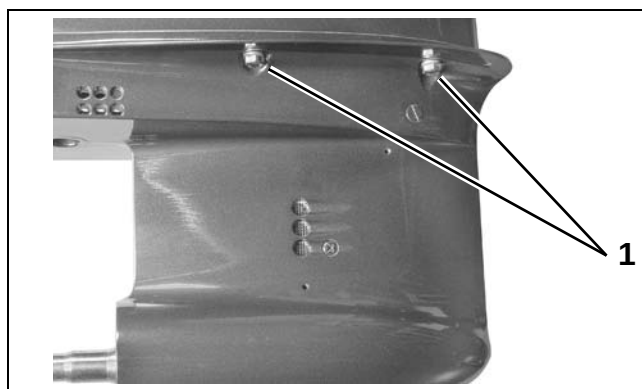
008354

Slide the gearcase into place, making sure:

- Driveshaft engages the crankshaft—rotate flywheel if necessary
- Inner exhaust housing installs correctly
- Shift rod does not turn and is positioned properly in shift shaft connection area.

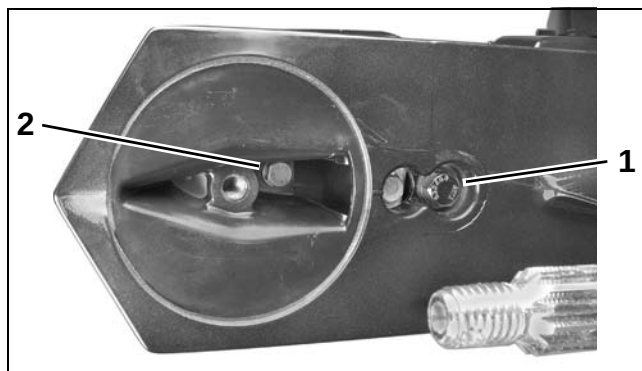
Apply *Triple-Guard* grease to threads of the gearcase retaining screws. Tighten the screws to a torque of:

- **3/8 in.** screws – 18 to 20 ft. lbs. (24 to 27 N·m)
- **7/16 in.** screw – 28 to 30 ft. lbs. (38 to 40 N·m)
- **5/16 in.** screw – 10 to 12 ft. lbs. (13.5 to 16 N·m)



1. 3/8 in. screws

001994

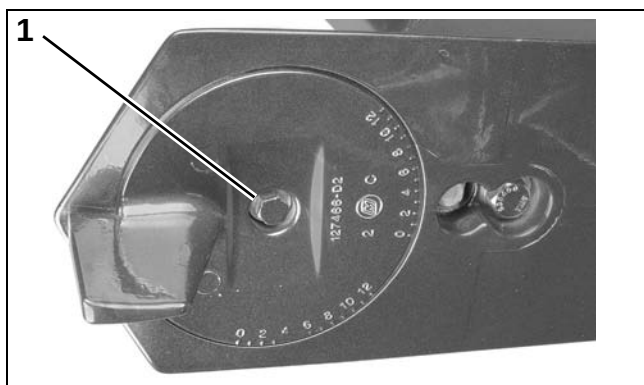


1. 7/16 in. screw
2. 5/16 in screw

001995

MRL MODELS

Apply *Triple-Guard* grease to threads of the trim tab screw. Install and align the trim tab with the index marks noted prior to disassembly. Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m). For adjustment, refer to **Trim Tab Adjustment (MRL)** on p. 44.

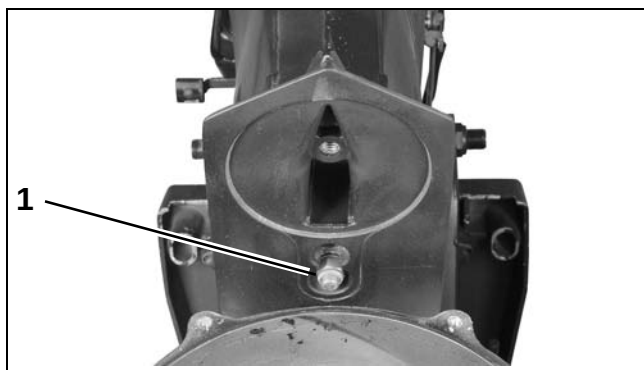


1. Trim tab screw

001996

MJRL MODELS

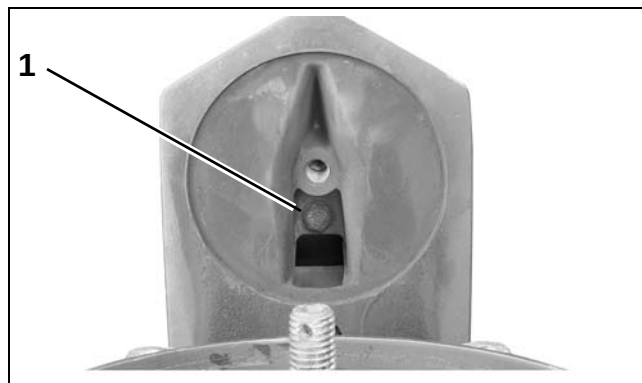
Install nut and washer. Tighten to a torque of 28 to 30 ft. lbs. (38 to 40 N·m).



1. Nut

006652

Install recessed retaining screw. Tighten to a torque of 10 to 12 ft. lbs. (13.5 to 16 N·m).

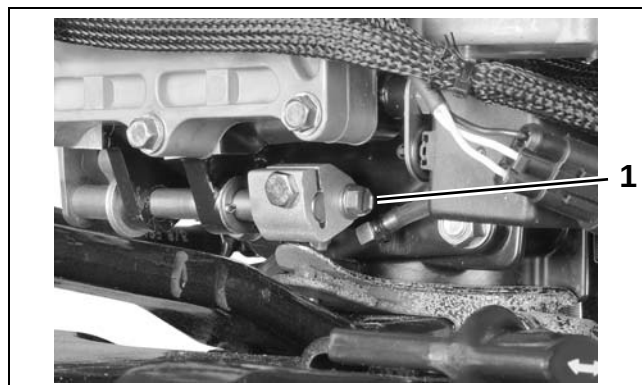
1. Exhaust pipe
2. Retaining screw

006653

Install the impeller assembly and impeller housing. Refer to **IMPELLER SERVICE, MJRL MODELS** on p. 236.

ALL MODELS

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Shift rod screw

002171

**WARNING**

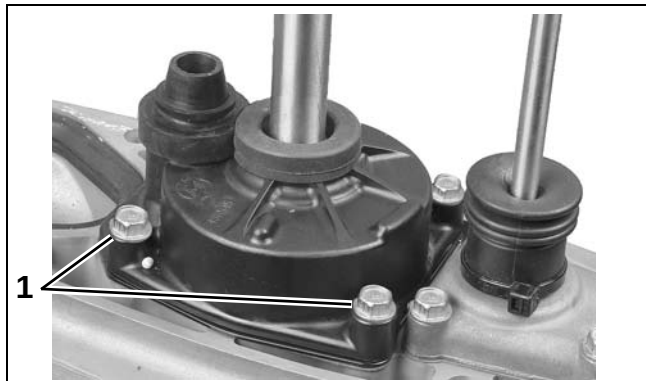
To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

IMPORTANT: During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

WATER PUMP SERVICE

Disassembly

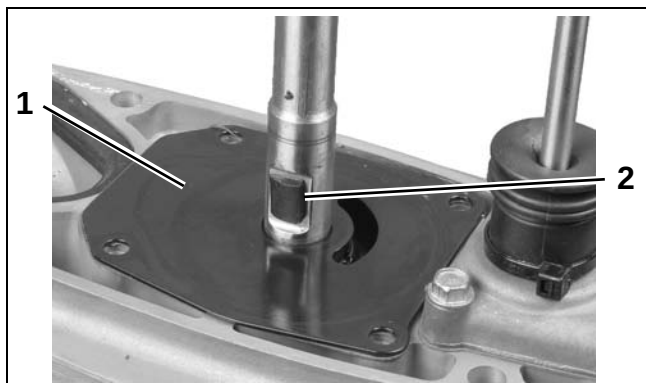
Remove the four impeller housing screws.



1. Impeller housing screws

001203

Slide the water pump off the driveshaft. Remove the impeller key, impeller plate, and gasket. Discard the gasket.



1. Impeller plate
2. Drive key

001214

Remove all the parts from the housing.

Inspection

Check impeller for overheating, hub separation, and other wear or damage.

Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.

Make sure gasket surface is clean and smooth.

Assembly

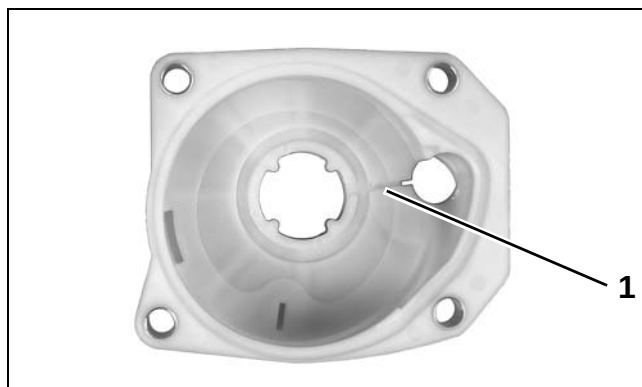
Lightly coat the exterior rim of the impeller cup with *Gasket Sealing Compound*. Install the cup in the impeller housing. The cup locks in place in the housing with a square index tab.



1. Index tab

001215

IMPORTANT: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.

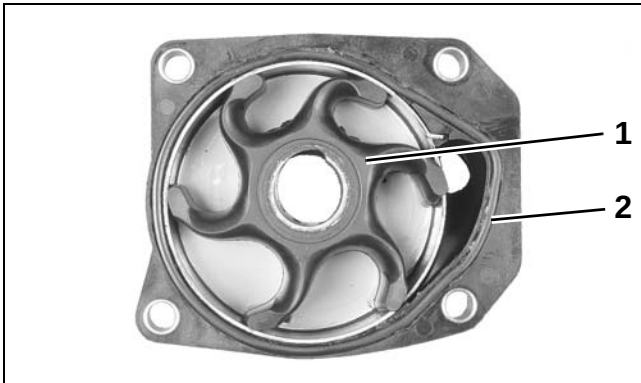


1. Air bleed groove

006415

Lightly coat the inside of the liner with *Triple-Guard* grease. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller key facing out.

Apply a thin bead of *Adhesive 847* in the seal groove, and install the special shaped O-ring seal.

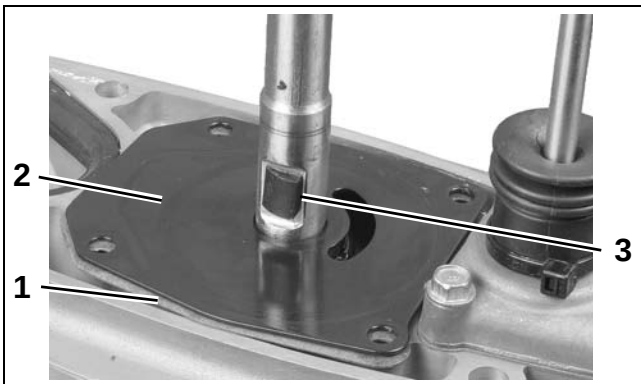


1. Impeller
2. O-ring seal

001216

Apply *Gasket Sealing Compound* to both sides of a new impeller plate gasket. Install the gasket and impeller plate.

Apply *Triple-Guard* grease to temporarily hold impeller key in place.



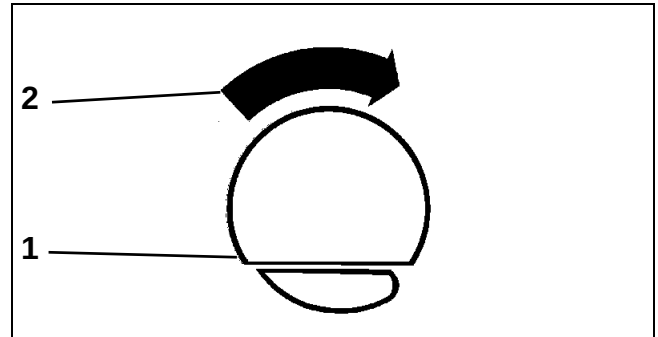
1. Impeller plate gasket
2. Impeller plate
3. Drive key

001217

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

slide water pump down over key. Be sure impeller key does not fall out of position.



1. Sharp edge of drive key
2. Direction of driveshaft rotation

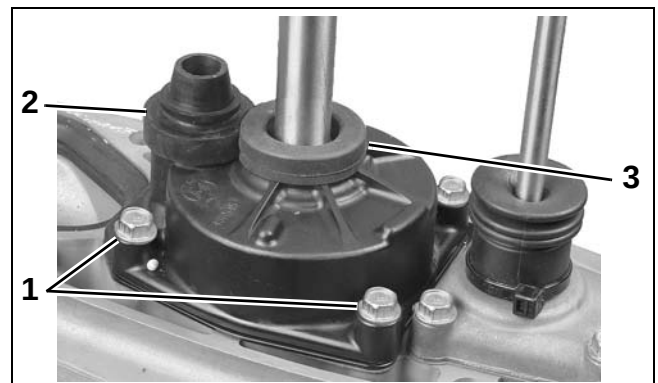
CO2995

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 60 to 84 in. lbs. (7 to 9.5 N·m).

Install the water tube grommet on the impeller housing.

Apply a thin bead of *Adhesive 847* to groove of the impeller housing grommet. Install the grommet on the impeller housing.



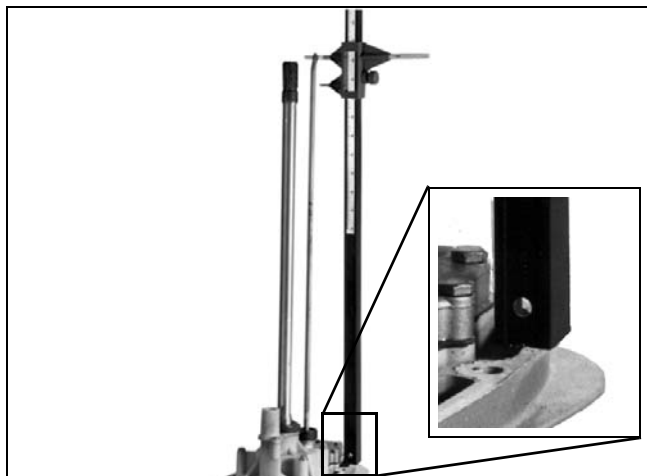
1. Housing screws
2. Water tube grommet
3. Impeller housing grommet

001203

NOTICE Before installing gearcase, shift rod adjustment **MUST** be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 244.

SHIFT ROD ADJUSTMENT

Check the shift rod height from the shift rod hole to the surface of the gearcase using Universal Shift Rod Height Gauge, P/N 389997.



COA6166

With the gearcase in NEUTRAL, rotate the shift rod up or down as necessary for correct adjustment. Once correct height is achieved, rotate rod one half turn or less to direct offset to the rear.

Shift Rod Height:

- 21.38 in. (543 mm) $\pm$ One-Half Turn

GEARCASE DISASSEMBLY

Pre-Disassembly Inspection



WARNING

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

IMPORTANT: Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller/impeller and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant** on p. 61.

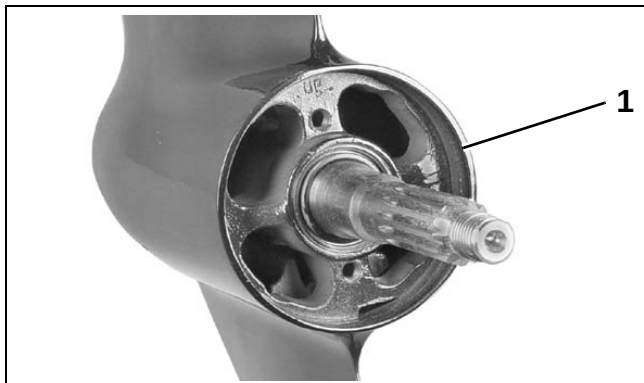
Remove gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 238.

Remove water pump. Refer to **WATER PUMP SERVICE** on p. 242.

Before disassembling the gearcase, examine the following:

- **Gearcase Housing** — Check for visible damage to skeg, strut, anti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- **Propeller Shaft** — Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- **Shift Rod** — Check for misadjusted, bent, or binding rod. A misadjusted shift rod height can cause shift difficulty, loss of boat and outboard control, and gearcase damage.

- **Hydrostatic Seal Grooves** — Must be in good condition to help prevent propeller ventilation.



1. Hydrostatic seal grooves

002217

- **Gearcase Anodes** — If anodes have eroded to two-thirds their original size, they must be replaced.



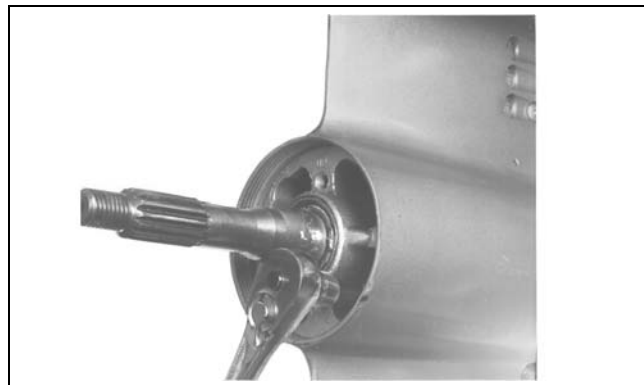
1. Gearcase anode

002014

- **Drive Shaft** — Check splines for visible damage, twisting and wear. Severe spline wear indicates the exhaust housing or gearcase has been distorted, possibly by impact damage.
- **Water Intake Screens** — Check for damage and blockage. If screens cannot be cleaned, they must be replaced. Different screens are available and should not be mixed. Refer to correct model parts manual for listing and description.

Propeller Shaft Bearing Housing Removal

Use a 5/16 in. thin wall socket to remove the four screws with O-rings holding the propeller shaft bearing housing.



COA3571

Remove the propeller shaft bearing housing from the gearcase using the following:

- Puller body, screw, and handle from Universal Puller Set, P/N 378103.
- Two 5/16-18 x 8 in. screws, P/N 316982, from Universal Puller Set, P/N 378103.



9437

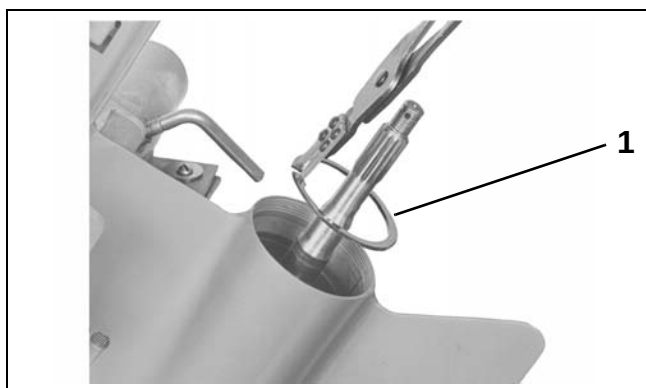
GEARCASE

GEARCASE DISASSEMBLY

Remove the two retaining rings using Retaining Ring Pliers, P/N 331045.

CAUTION

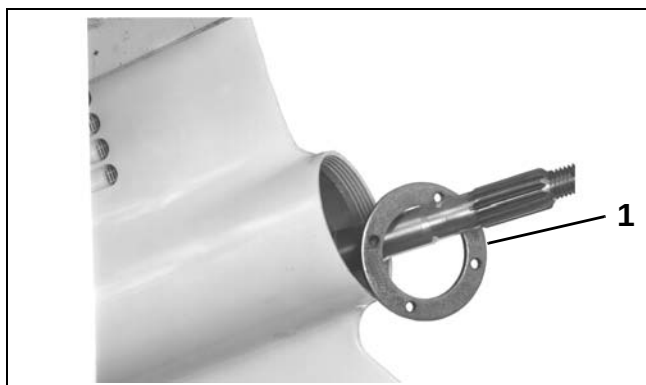
Retaining rings are under extreme pressure during removal and installation. To prevent personal injury, wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers. After the retaining rings are removed far enough from the gearcase to clear the housing, release the tension on the pliers while retaining ring is still around the propeller shaft.



1. Retaining ring

9438

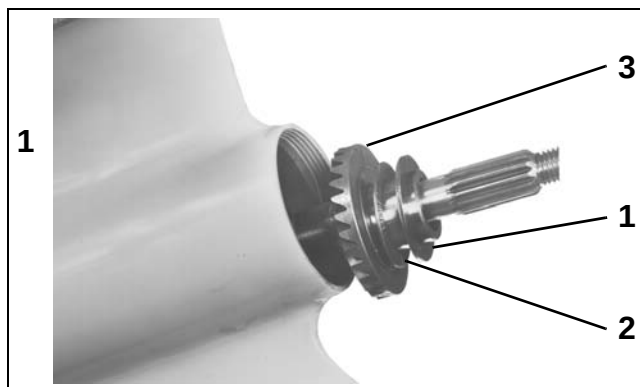
Remove the retainer plate from the gearcase.



1. Retainer plate

COA3513

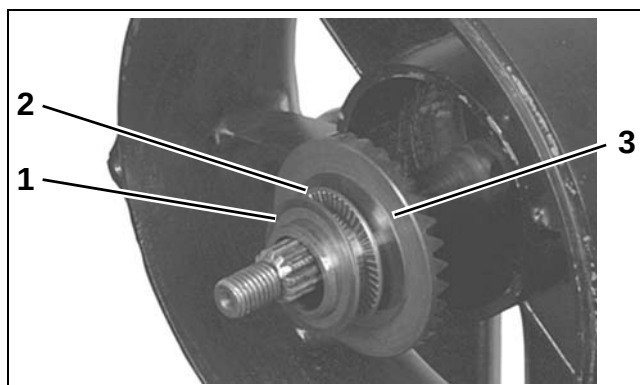
Remove the larger thrust washer, thrust bearing, and reverse gear from the gearcase. Remove the smaller thrust washer located in front of the gear.



MRL Models

1. Larger thrust washer
2. Thrust bearing
3. Reverse gear

COA3514



MJRL Models

1. Larger thrust washer
2. Thrust bearing
3. Reverse gear

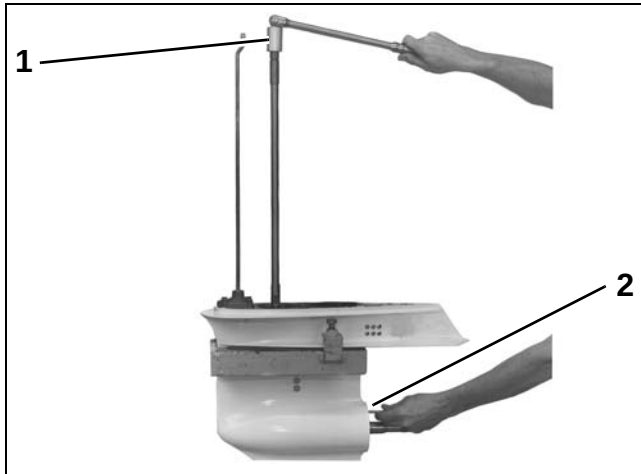
DP0754

Pinion Gear and Driveshaft Removal

Adjust the shift rod to move the clutch dog as far forward as possible. This will help ease removal of the pinion nut.

Use Driveshaft Holding Socket, P/N 334995, and an 11/16 in. open-end wrench to loosen and remove the pinion nut from the bottom of the

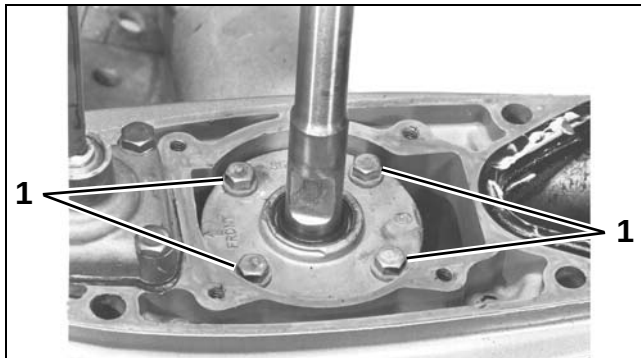
driveshaft. Pad handle of the wrench to prevent damage to gearcase.



1. Holding socket
2. 11/16 Wrench

COA3573T

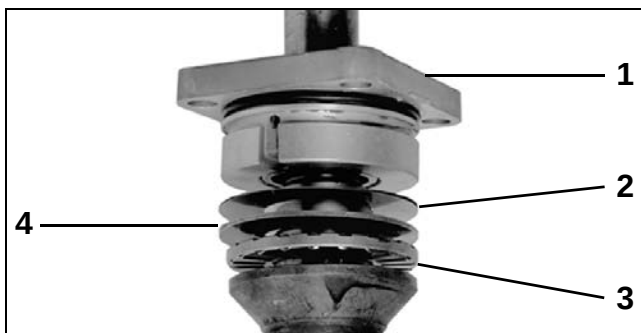
Remove the four driveshaft bearing housing screws.



1. Driveshaft bearing housing screws

COA3671

Remove the driveshaft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



1. Bearing housing
2. Shims
3. Thrust bearing
4. Thrust washer

COA3558

If driveshaft cannot be removed, refer to **Locked Driveshaft Removal on p. 247**.

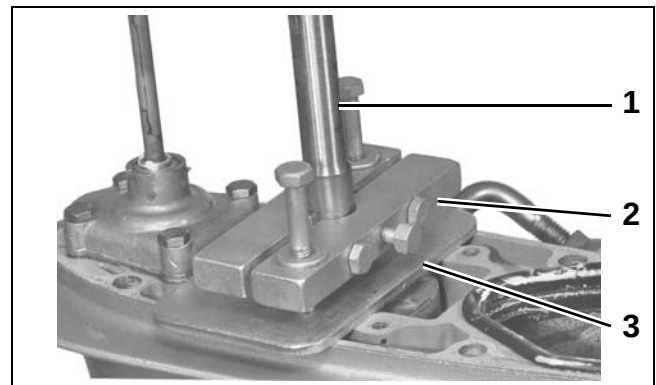
Remove the pinion gear from the gearcase.



COA3159

Locked Driveshaft Removal

The driveshaft to pinion taper is a locking taper. If necessary, use Puller, P/N 387206, and Backing Plate, P/N 325867, to break the lock. Install the tools as shown by clamping them around the driveshaft with the tool's setscrew aligned with the impeller drive key slot. Tighten the setscrew into the slot. Alternately tighten the two vertical screws against the backing plate inserted between the puller and the gearcase until the driveshaft pops loose from the pinion.



1. Drive shaft
2. Puller
3. Backing plate

COA3664

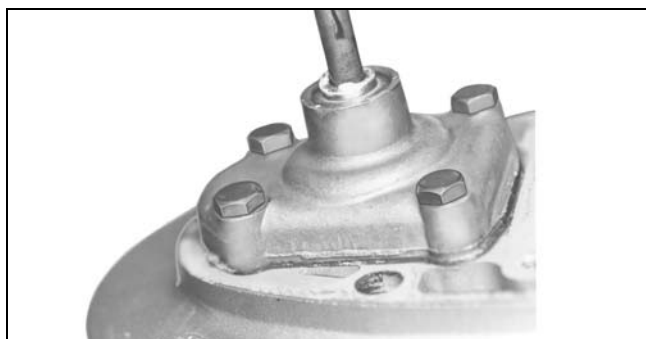
GEARCASE

SHIFTER, BEARING AND SEAL SERVICE

Shift Housing, Gear and Propeller Shaft Removal

Push down on the shift rod. This will move the detent lever downward to clear the inside of the gearcase when the shaft assembly is pulled out. Unscrew the shift rod from the detent lever. Remove screws, cover, and shift rod from the gearcase.

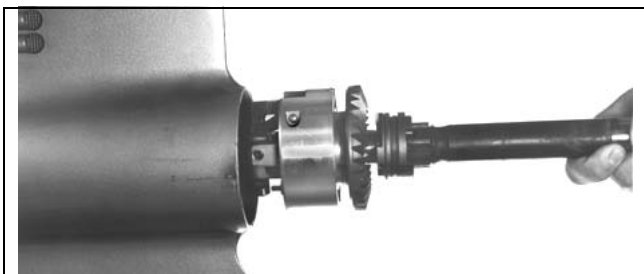
Discard the cover gasket. Remove and discard the shift rod O-ring from inside of cover.



COA3666

IMPORTANT: Make sure oil fill/drain plug is removed from gearcase.

Remove propeller shaft assembly from gearcase.



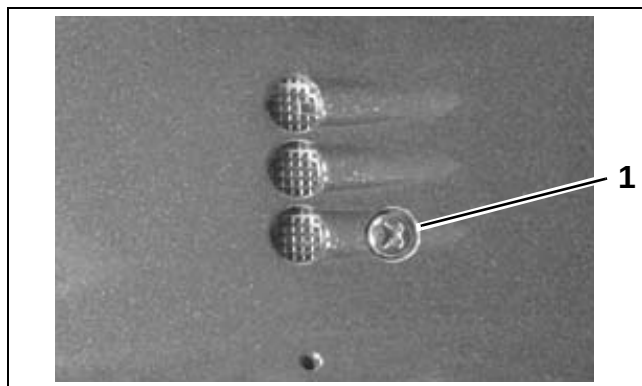
COA3575

SHIFTER, BEARING AND SEAL SERVICE

Pinion Bearing Removal

Inspect the pinion bearing for damage without removing it. If the bearing is removed for any reason, it must be replaced.

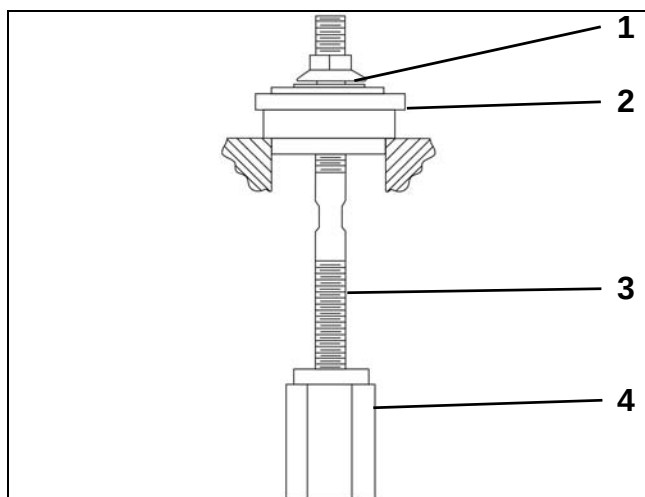
If the pinion bearing must be replaced, remove the bearing retaining screw from the gearcase. Discard the O-ring from the screw.



1. Bearing retaining screw

001997

Assemble Pinion Bearing Remover and Installer, P/N 5005927, in the gearcase as follows:



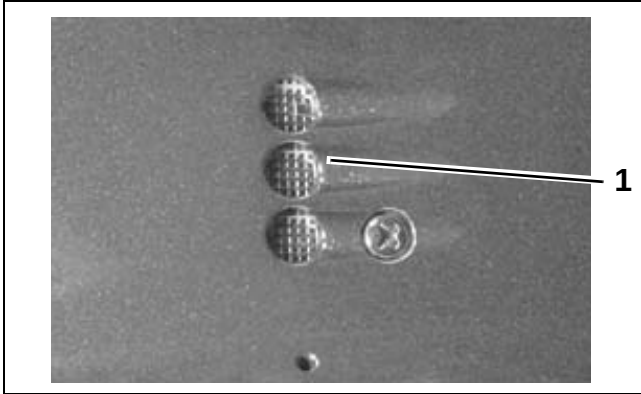
1. Flange Nut, P/N 326586
2. Plate, P/N 391260
3. Rod, P/N 326582
4. Remover, P/N 326580

813305

Use a 1 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise and draw the bearing up from the housing.

Water Intake Screen

Inspect the water intake screen for blockage and remove it by depressing the tabs on either side of the screen and pushing upward.



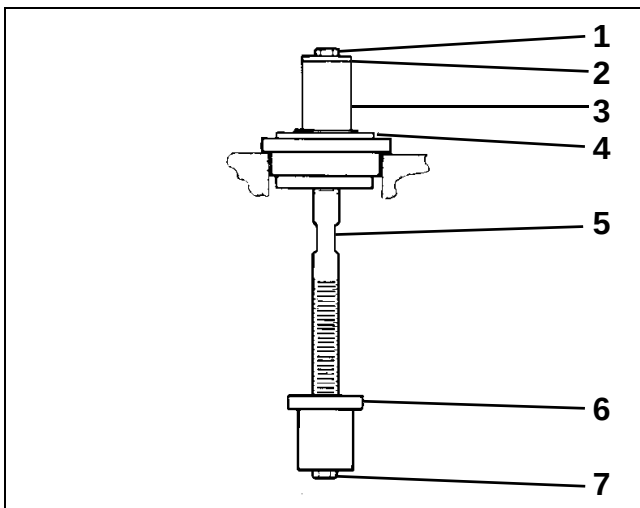
1. Water intake screen

001997

Pinion Bearing Installation

Install the water intake screen. Drop it into the water intake cavity and use a suitable tool to push it down as far as it will go.

Assemble Pinion Bearing Remover and Installer, P/N 5005927, as shown:



1. 1/4-20 X 1/2 in. Hex head screw
2. 1 in. O.D. Flat washer
3. Spacer, P/N 326584
4. Plate, P/N 391260
5. Rod, P/N 326582
6. Installer, P/N 326575
7. 1/4-20 X 1 1/4 in. Hex head screw

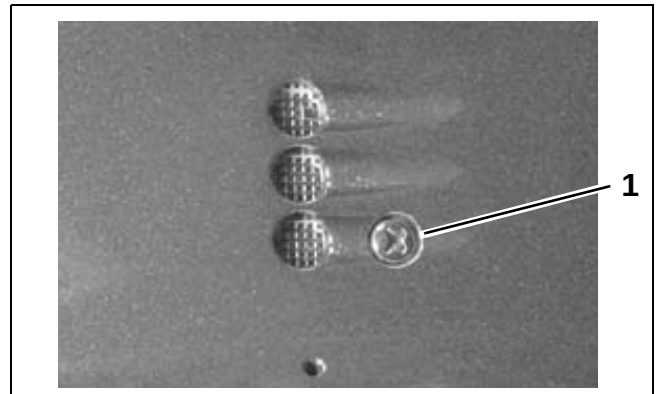
824182

IMPORTANT: Spacers are different sizes and cannot be interchanged.

Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Place a new O-ring on the pinion bearing retaining screw. Apply *Gasket Sealing Compound* to O-ring and *Nut Lock* to screw threads. Install the screw and tighten to a torque of 48 to 80 in. lbs. (5.5 to 9.0 N·m).



1. Bearing retaining screw

001997

Shift Housing Disassembly



WARNING

Wear safety glasses to avoid injury.

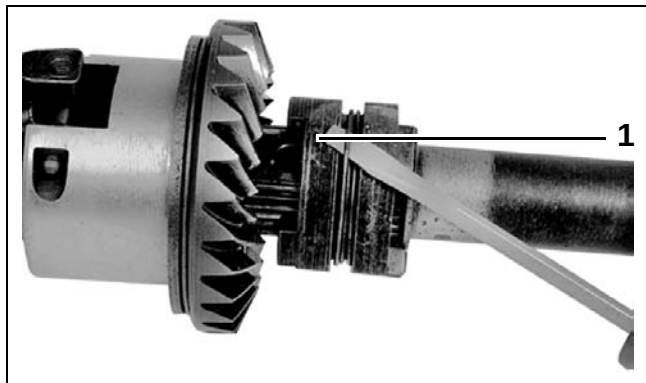
IMPORTANT: The shift housing and forward gear bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by

GEARCASE

SHIFTER, BEARING AND SEAL SERVICE

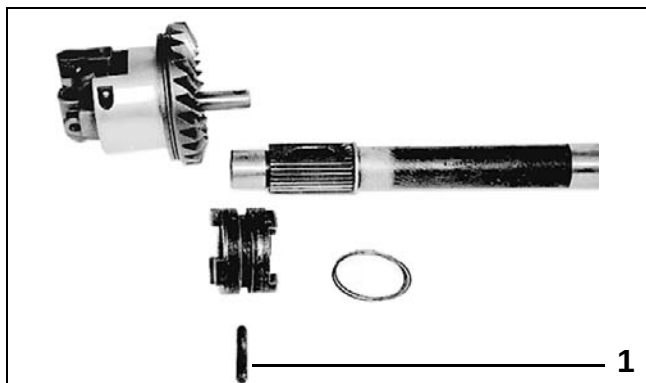
unwrapping it from around the clutch dog. **Discard the spring.**



1. Clutch dog spring

COA3560

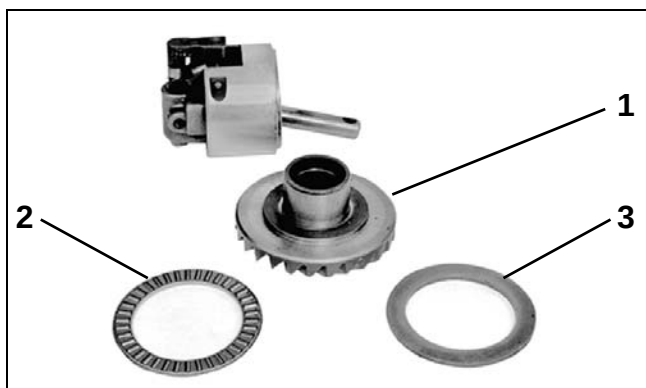
Push the pin out of the clutch dog. Remove all parts.



1. Pin

COA3561

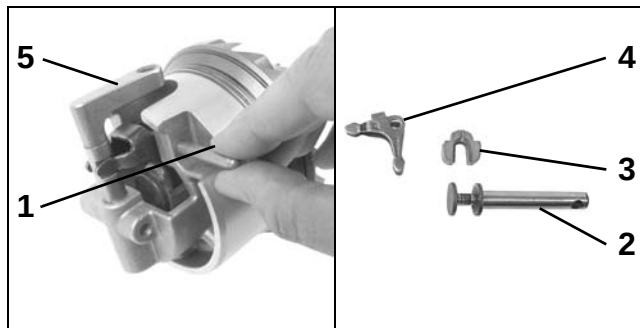
Remove the gear, thrust bearing, and thrust washer from the shift housing.



1. Gear
2. Thrust bearing
3. Thrust washer

COA3562

Remove the shift lever pin from the housing. Remove shift shaft, cradle and shift lever. Move shifter detent as needed to help ease removal of parts.



1. Shift lever pin
2. Shift shaft
3. Cradle
4. Shift lever
5. Shifter detent

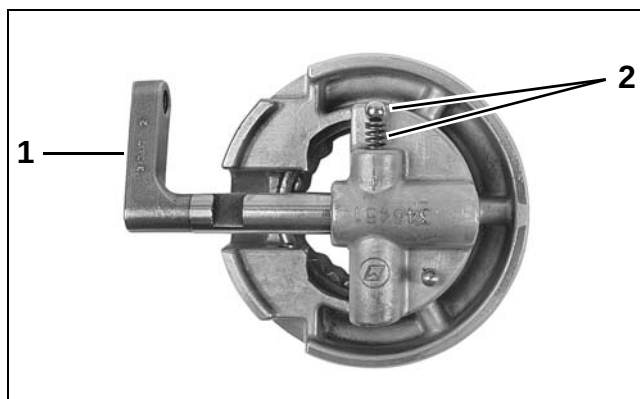
DSC02449

DSC02489

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

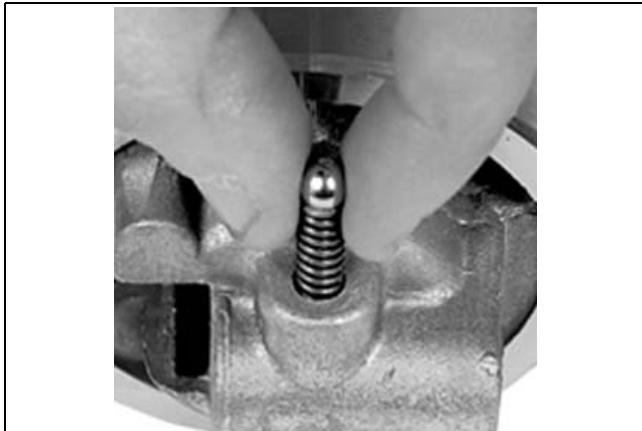
DSC02518

Remove the detent ball and spring.

Shift Housing Assembly

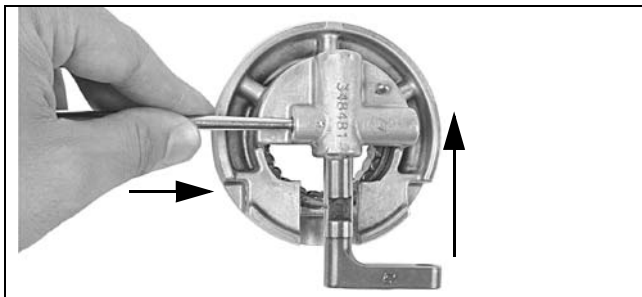
IMPORTANT: Clean and inspect all parts before beginning assembly procedures. Replace any damaged parts.

Lightly coat the detent ball and spring with *Needle Bearing* grease. Insert the spring in the housing, then the ball.



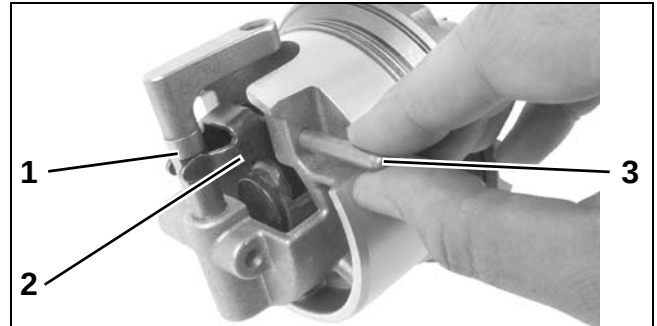
4518

Insert shifter detent at 90° angle into the housing as shown, while depressing the ball and spring with a suitable tool. Once the shifter detent is past the ball, remove the tool and position detent to engage NEUTRAL position.



DSC02506

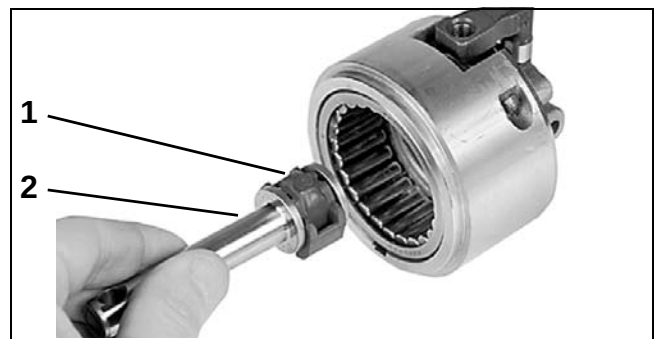
With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



1. Shifter detent
2. Shift lever
3. Pin, shift lever

DSC02449

Rest the cradle on the shift shaft.



1. Cradle
2. Shift shaft

4512

Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEUTRAL position to hold the cradle and shaft in position.



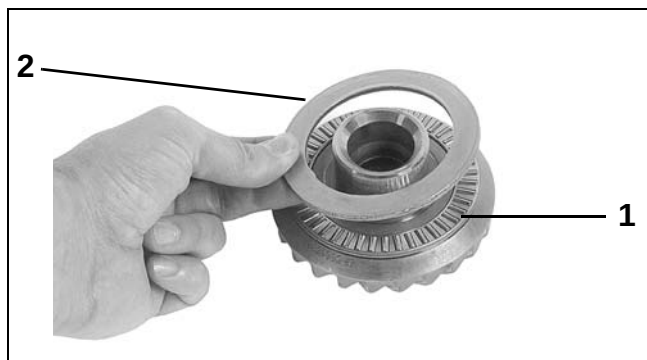
001219

GEARCASE

SHIFTER, BEARING AND SEAL SERVICE

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.

NOTICE Bearing and washer must be installed in the correct order.

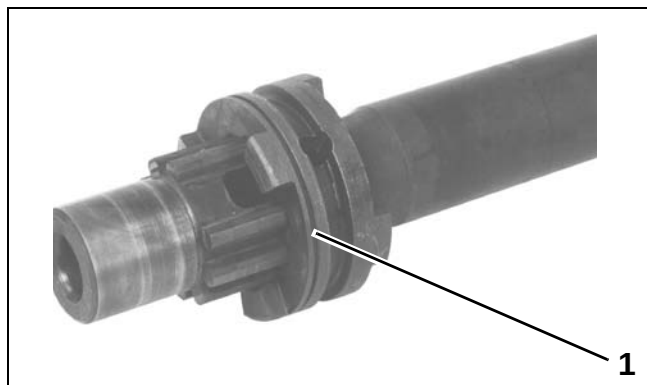


1. Thrust bearing
2. Thrust washer

DSC02297

Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog with grooved end toward the forward end of the shaft.

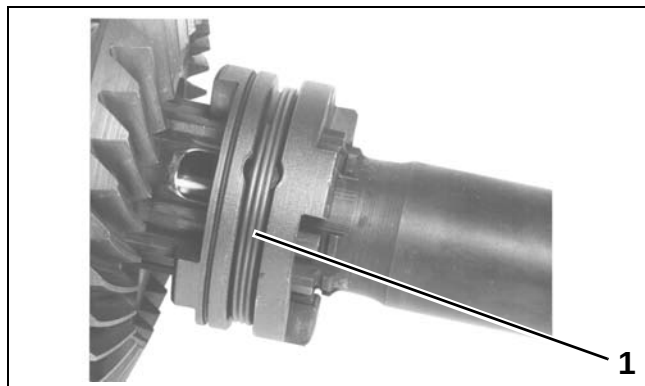
NOTICE The clutch dog is not symmetrical. If installed backward, it will not fully engage and will immediately damage itself and the gears.



1. Grooved end

COA3591

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

COA3592

Driveshaft Bearing Housing Service

The driveshaft bearing is not serviceable. Replace the bearing housing assembly if the bearing is worn or damaged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Remove the driveshaft bearing housing seal using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seal.



14155

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.

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.

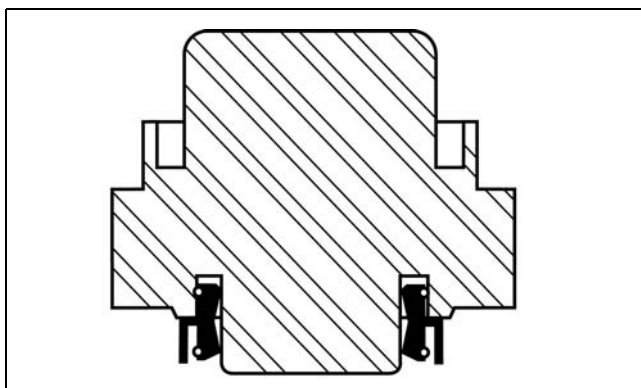


1. O-ring (top groove)
2. Oil passage

14156

Apply *Adhesive 847* to casing of new seal before installing.

Use Seal Installer, P/N 342665 to install seal in bearing housing with the exposed lip facing away from housing. Apply *Triple-Guard* grease to seal lips.



DRC5720

Propeller Shaft Bearing Housing Service

Rear Seal Removal

Remove seals using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.



21047

Bearing Removal

IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

Remove rear bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.



21045

Remove front bearing using Puller Bridge, P/N 432127, and Bearing Puller, P/N 432130. Place the puller plate on top of the housing to sup-

GEARCASE

SHIFTER, BEARING AND SEAL SERVICE

port the bridge, and tighten jaws securely behind the bearing.



21067

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

001220

Discard the bearing housing O-ring. Clean the housing and bearings in solvent and dry thoroughly. If bearings were not replaced, rotate the needles to check for freedom of movement.

Inspect O-ring groove. Sand off any sharp edges that might cut O-ring. Remove any nicks or burrs on front of bearing housing.



1. O-ring groove

DSC02291

Thoroughly clean the four bearing housing retaining screws in solvent. Discard the O-rings.

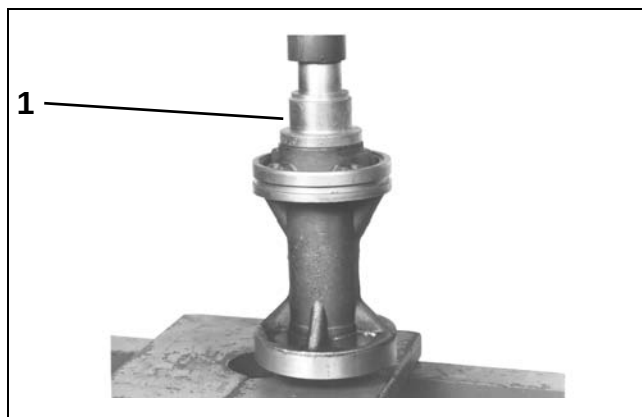
Bearing Installation

Oil, then install new bearings in bearing housing.

Place the **lettered end** of the bearing case on the bearing installer, then press the bearing into the housing until the tool seats. When installed, the lettered end of the bearing should be visible.

Bearing Installation Tool:

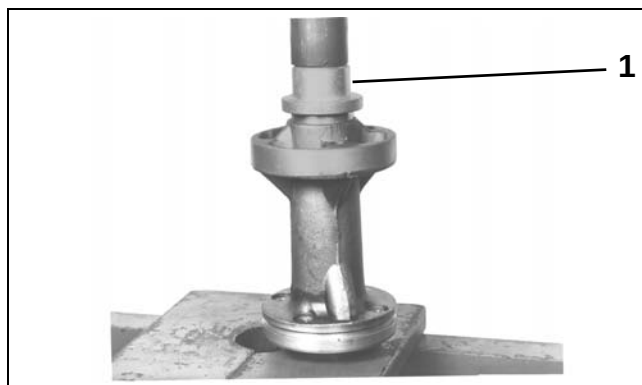
- P/N 326562



Forward Bearing

1. Bearing installation tool

COA3579



Rear Bearing

1. Bearing installation tool

COA3580

Rear Seal Installation

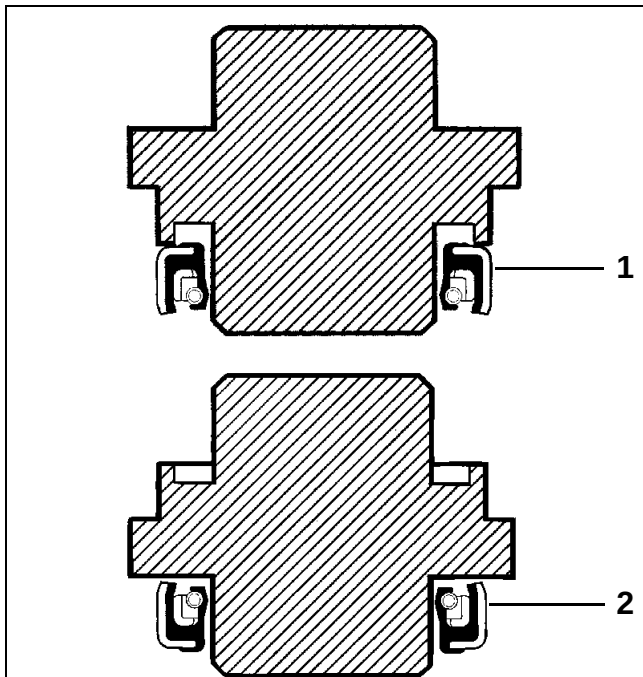
Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

Seal Installation Tool:

- P/N 326551

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



1. Inner seal
2. Outer seal

DR2061
DR2062

Apply *Triple-Guard* grease to seal lips.

DRIVESHAFT SHIMMING

NOTICE If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is adjusted by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion, or drive-shaft, it is necessary to properly shim the assembly to restore the correct clearance.

Use Driveshaft Shimming Kit, P/N 5005925.

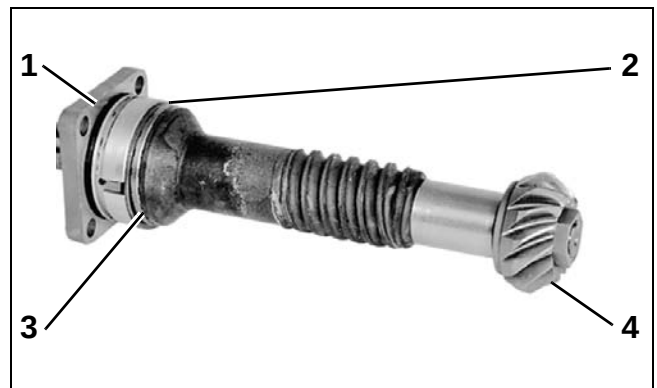
Shim gauge bars are precision made and should be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the drive-shaft. Use Driveshaft Seal Protector, P/N 312403, 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 40 to 45 ft. lbs. (54 to 60 N·m).

IMPORTANT: The original pinion nut may be used for shimming, but must **NOT** be used in final assembly.



1. Driveshaft bearing housing
2. Thrust washer
3. Thrust bearing
4. Pinion

COA3565

GEARCASE

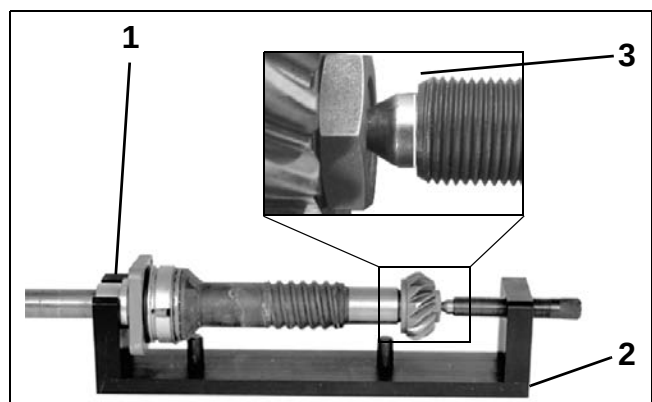
DRIVESHAFT SHIMMING

Select correct collar and shim gauge bar from kit:

- Collar: P/N 328363
- Shim gauge bar: P/N 328366

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.

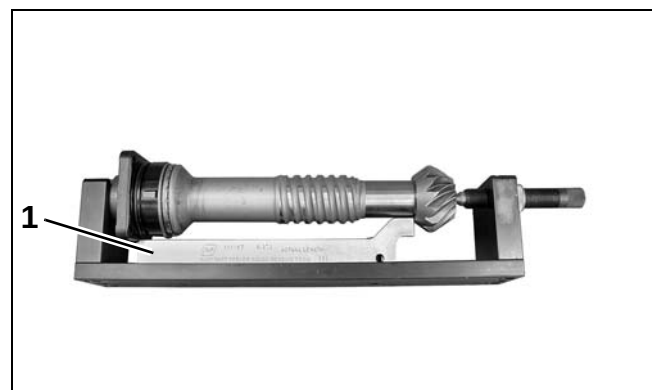


1. Collar
2. Tool base
3. Groove

COA3566
DSC00326

Rotate the driveshaft several revolutions to seat bearings.

Lay the tool base on its side. Place the shim gauge bar against guide pins of the tool base.



1. Shim gauge bar

005416

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating **just the bearing housing**. Use a feeler gauge to measure clearance

between the gauge bar and the bearing housing between each pair of screw holes. Replace the bearing housing and repeat check if variance is greater than 0.004 in. (0.010 mm).

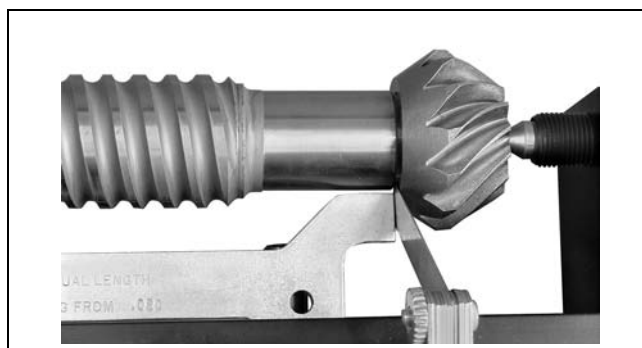
Check squareness of the pinion to the driveshaft. Hold the shim gauge bar against the bearing housing (between the screw holes) while rotating **just the driveshaft and pinion assembly**. Measure clearance between the gauge bar and the pinion at several locations. If variance is greater than 0.002 in. (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 312403.

Check clearance again. The measurement between the gauge bar and pinion should be 0.020 in. (0.508 mm).



005417

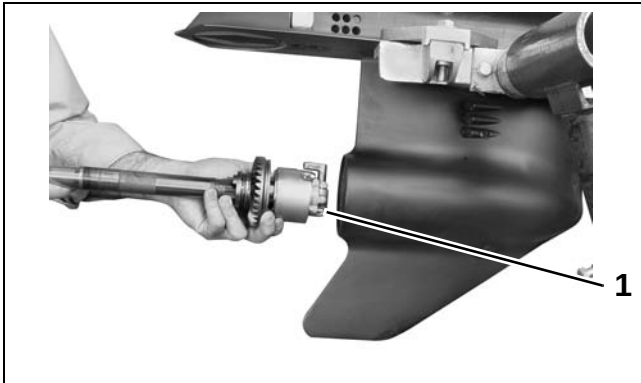
Remove the nut and pinion from the driveshaft. Discard the nut.

GEARCASE ASSEMBLY

Shift Housing, Gear, and Propeller Shaft Installation

Push shifter detent into farthest downward position. Tip the rear of the gearcase slightly downward to assist in the installation of the shaft assembly.

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully into the gearcase while aligning shift housing pin with hole in forward end of gearcase housing.



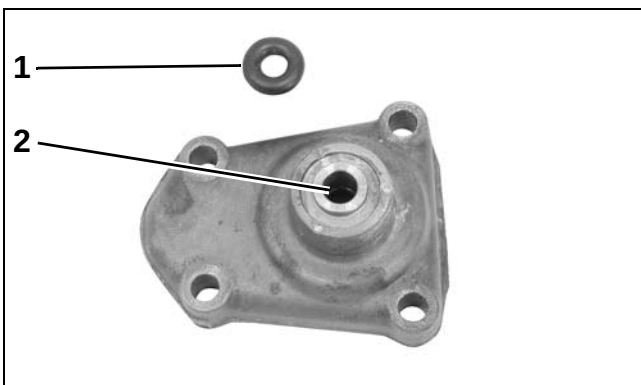
1. Pin

006648

Shift Rod Housing Installation

Lubricate a new shift rod cover O-ring with *Triple-Guard* grease. Install the O-ring into the shift rod cover.

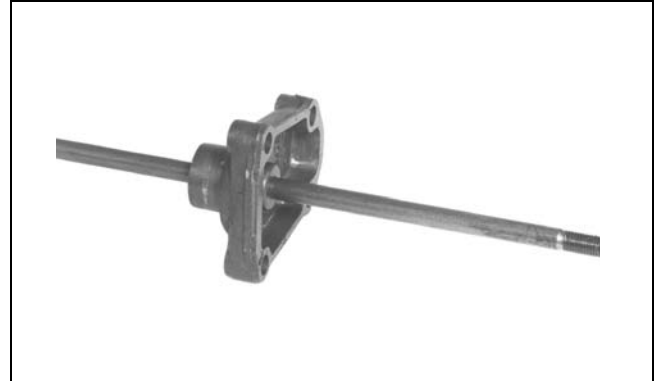
IMPORTANT: Make sure O-ring is fully seated in groove.



1. O-ring
2. Groove

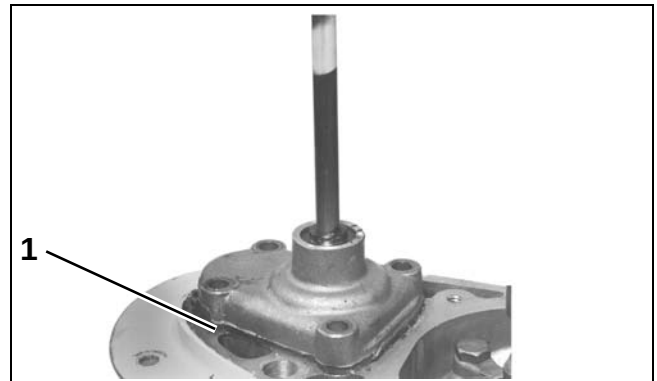
006649

Apply *Triple-Guard* grease to the threaded end of the shift rod and insert it through the cover. Turn the shift rod while pushing it through the cover to avoid damaging the O-ring.



COA3544

Apply *Gasket Sealing Compound* to both sides of a new shift rod cover gasket. Place the gasket on the gearcase. Thread the shift rod into the shifter detent about four turns.



1. Cover gasket

COA3545

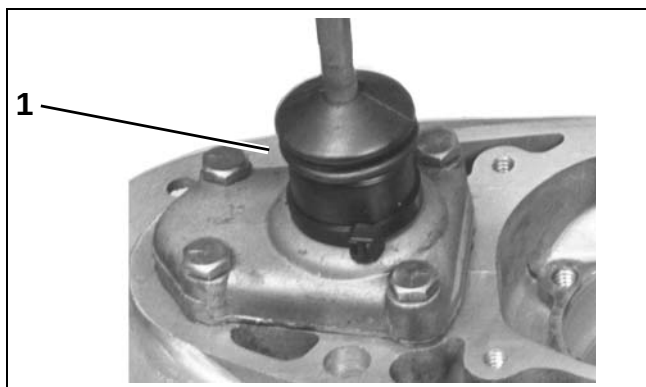
Move shift rod from side to side while pushing on the propeller shaft to ensure proper alignment of the bearing housing locator pin into the pin hole in the gearcase.

Apply *Gasket Sealing Compound* to the threads of the shift rod cover screws. Tighten the screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

GEARCASE

GEARCASE ASSEMBLY

Place the cover seal on the shift rod cover.



1. Cover seal

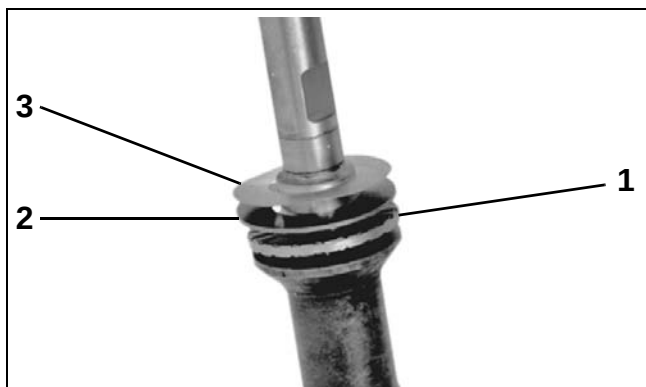
002514

Pinion Gear and Driveshaft Installation

Refer to **DRIVESHAFT SHIMMING** on p. 255 before proceeding.

Install new seals in driveshaft bearing housing. Refer to **Driveshaft Bearing Housing Service** on p. 252.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.

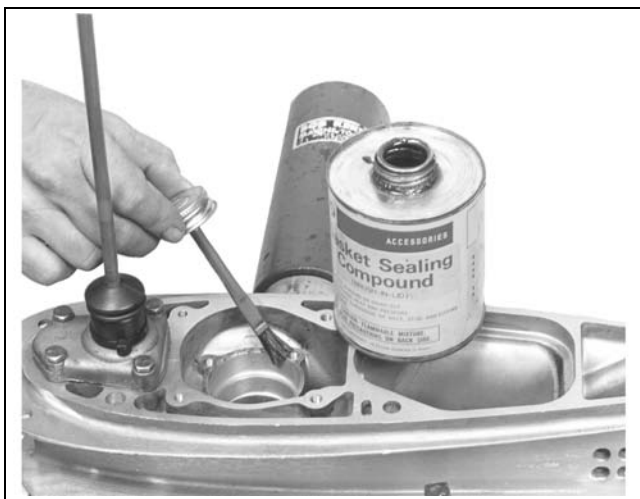


- 1. Thrust bearing
- 2. Thrust washer
- 3. Shim(s)

COA3168

Lightly apply *Gasket Sealing Compound* to the gearcase area that contacts mounting flange of

the driveshaft bearing housing. Do not coat inside bearing housing bore surface of the gearcase.



6207

Adjust shift rod to move clutch dog as far forward as possible. Be sure excess grease is removed from the pinion bearing.

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

Place the pinion gear into the gearcase. Insert the driveshaft into the gearcase and through the pinion gear.

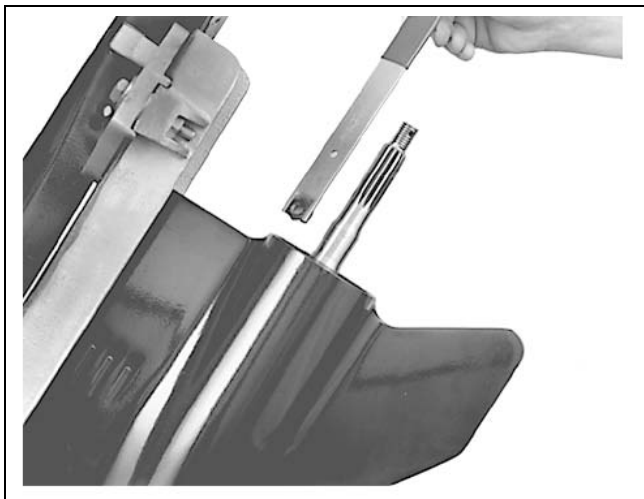
Using Driveshaft Seal Protector, P/N 312403, slide the driveshaft bearing housing onto the driveshaft and into position in the gearcase. Align the embossed word "FRONT" toward the shift rod. Do not install screws at this time.



1. Seal protector

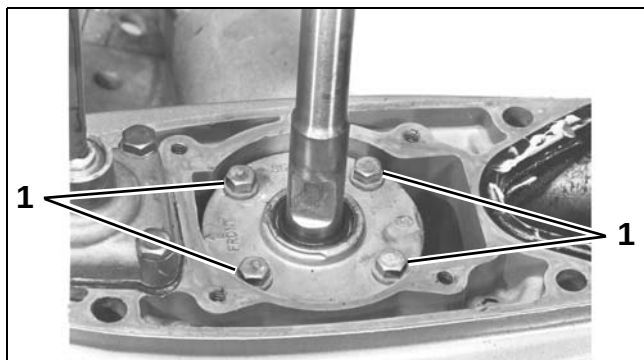
COA3130

Lightly coat the threads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 320675, to install nut on the driveshaft. Turn the driveshaft by hand to thread the nut on to shaft.



33220

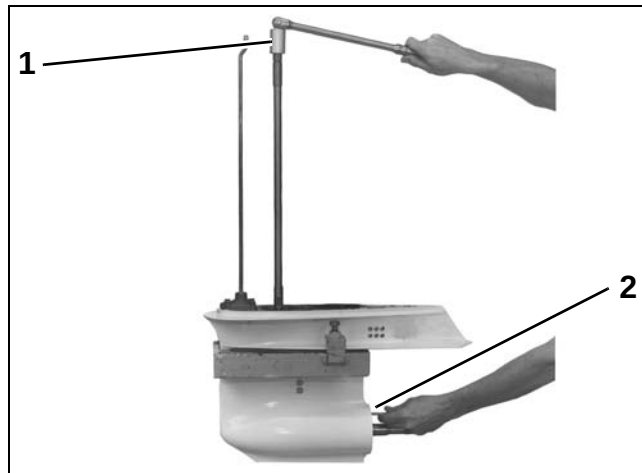
Apply *Gasket Sealing Compound* to the threads of the driveshaft bearing housing screws. Tighten screws **in stages** to a torque of 96 to 120 in. lbs. (11 to 14 N·m).



1. Driveshaft bearing housing screws

COA3671

Use Driveshaft Holding Socket, P/N 334995, and an 11/16 in. open-end wrench, to tighten the pinion nut to a torque of 40 to 45 ft. lbs. (54 to 60 N·m). Pad handle of the wrench to prevent damage to gearcase.

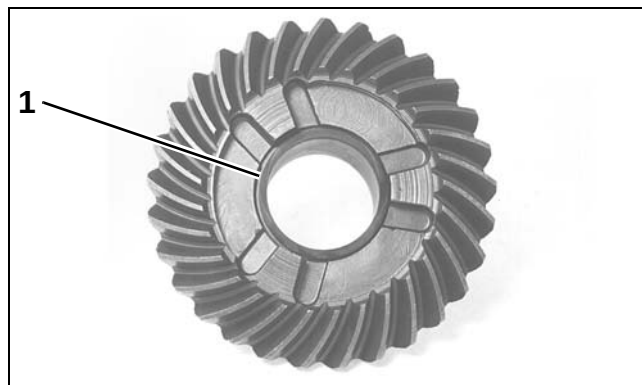


1. Holding socket
2. 11/16 Wrench

COA3573T

Propeller Shaft Bearing Housing and Gear Installation

Place the small thrust washer in recess of the reverse gear.



1. Small thrust washer

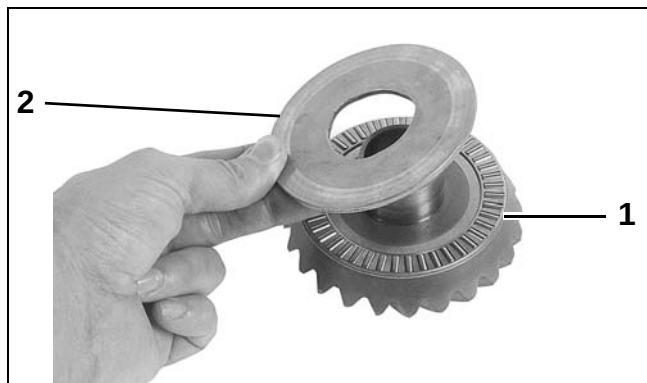
COA3597

Oil and install thrust bearing and larger thrust washer on hub of reverse gear. Slide the gear

GEARCASE

GEARCASE ASSEMBLY

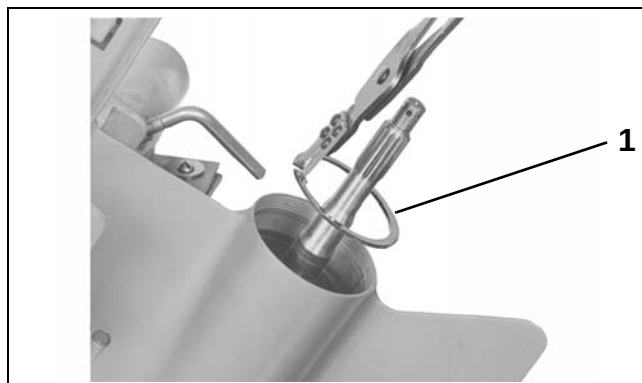
assembly onto the propeller shaft until it engages the pinion gear.



- 1. Thrust bearing
- 2. Thrust washer

DSC02295

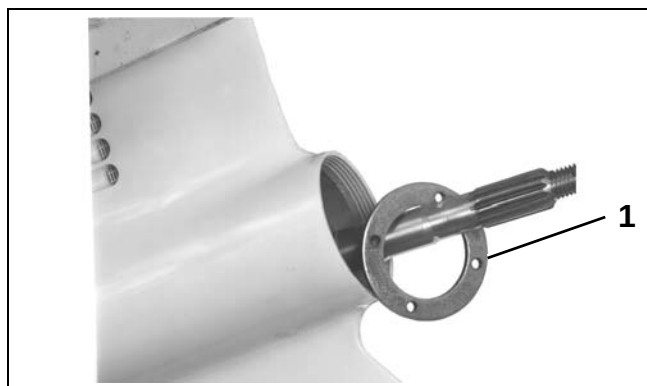
Make sure the retaining rings are seated in the grooves in the gearcase.



- 1. Retaining ring

9438

Slide the bearing housing retainer plate into position over the propeller shaft.



- 1. Retaining ring

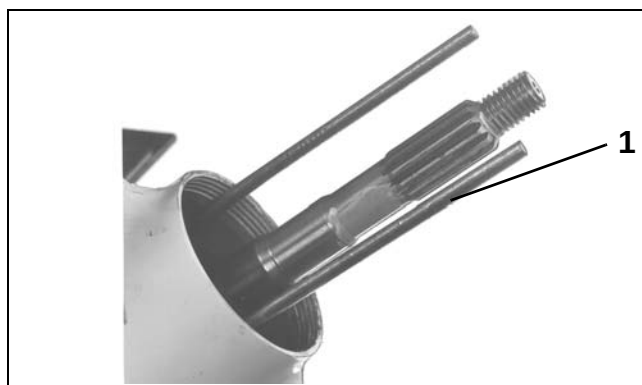
COA3513

Using Retaining Ring Pliers, P/N 331045, install the two retaining rings.

CAUTION

Retaining rings are under extreme pressure during installation. Wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers.

Thread two Guide Pins, P/N 383175, into the retainer plate to align holes in the plate with holes in the propeller shaft bearing housing. Do not thread guide pins more than two turns into the retainer plate.



- 1. Guide pin

COA3550

Install O-ring in groove in the bearing housing. Lightly apply *Gasket Sealing Compound* to the O-ring flange and aft support flange of the bearing housing. Do not allow sealer to contact either forward thrust surface or bearings in the housing.

Align the bearing housing on the guide pins with the word "UP" toward the top. Place the housing into gearcase and tap the housing with a soft face mallet to seat the O-ring.

Apply *Gasket Sealing Compound* to the threads and seals of the four propeller housing retaining screws. Install two of the screws into the bearing housing finger tight. Remove the guide pins and install the remaining two screws. Tighten all four screws to a torque of 120 to 140 in. lbs. (14 to 16 N·m).

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- **GEARCASE LEAK TEST** on p. 238
- **WATER PUMP SERVICE** on p. 242
- **SHIFT ROD ADJUSTMENT** on p. 244
- **GEARCASE REMOVAL AND INSTALLATION** on p. 238
- **Gearcase Lubricant** on p. 61
- **Propeller Hardware Installation** on p. 42
- **IMPELLER SERVICE, MJRL MODELS** on p. 236
- **Trim Tab Adjustment (MRL)** on p. 44.

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

MANUAL STARTER

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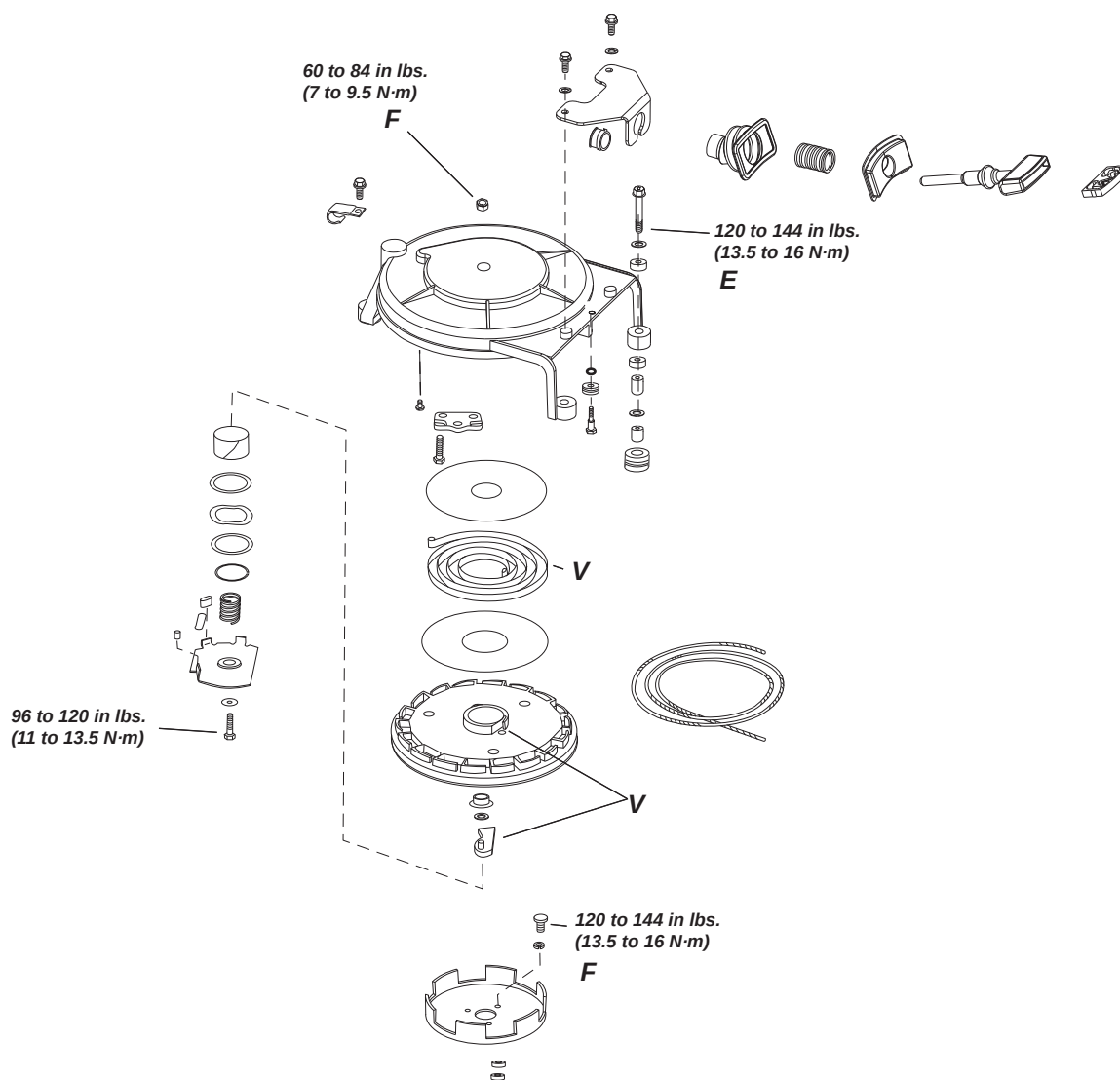
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SERVICE CHART



E	Red Ultra Lock
F	Blue Nut Lock
V	Lubriplate 777

003724

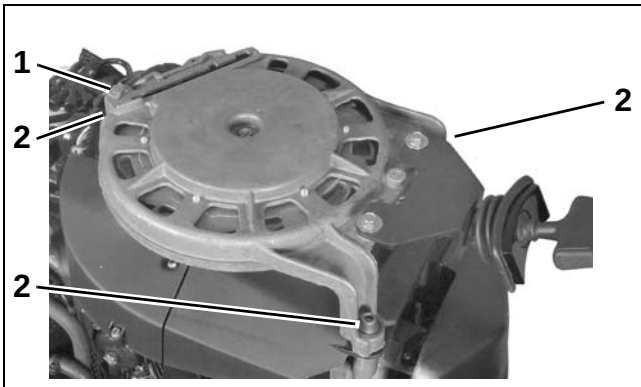
RECOIL STARTER REMOVAL

⚠ WARNING

To prevent accidental starting while servicing, twist and remove all spark plug leads.

Remove the clamp holding the oiling system wiring harness.

Remove the three starter housing screws and washers.

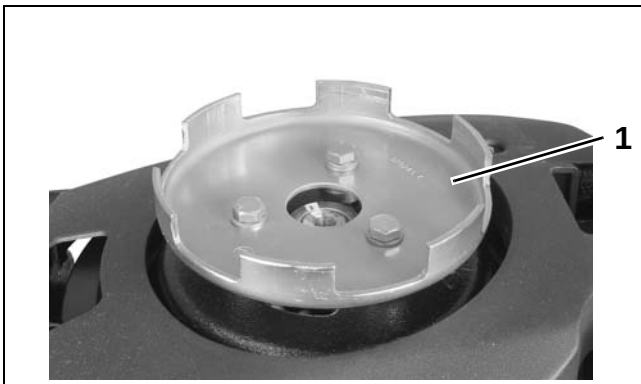


1. Clamp
2. Starter housing screws (3)

002515

Lift starter housing from outboard.

Remove three screws and remove starter ratchet from flywheel.



1. Ratchet

006483

RECOIL STARTER DISASSEMBLY

⚠ WARNING

Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

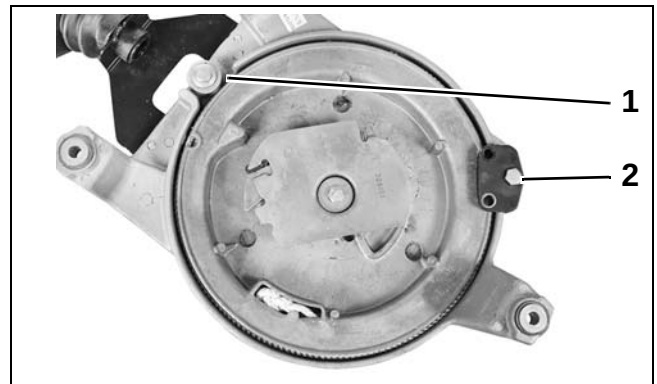
Pull the starter rope out far enough to tie a slip knot in the rope. Remove the end of the starter rope from the handle anchor and remove the handle. Release the slip knot and ease the rope back in until the rewind spring is fully unwound. If necessary, remove the starter handle bracket from the starter housing.



1. Slip knot
2. Rope anchor

007853

Remove the rope guide and pulley support from the starter housing.

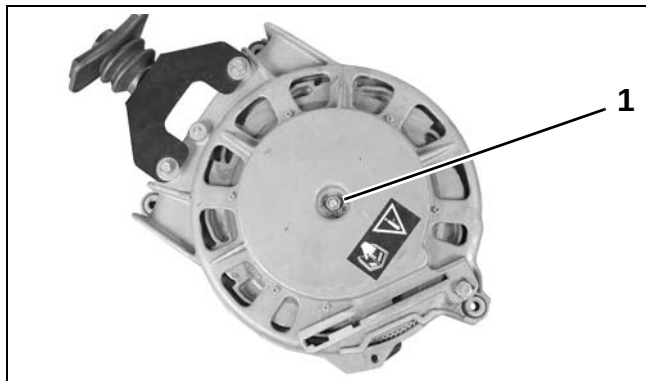


1. Rope guide
2. Pulley support

007854

MANUAL STARTER RECOIL STARTER DISASSEMBLY

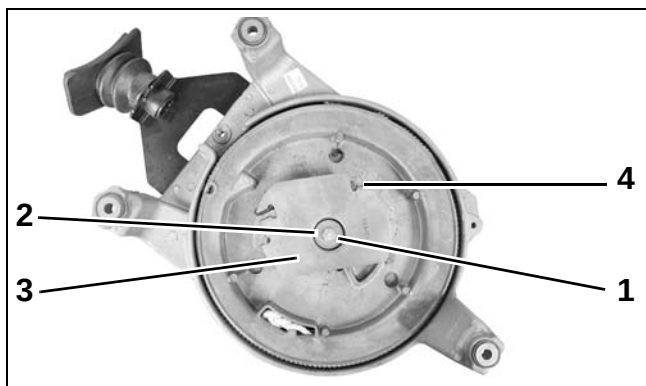
Remove the nut from the starter pawl retaining screw.



1. Nut

007855

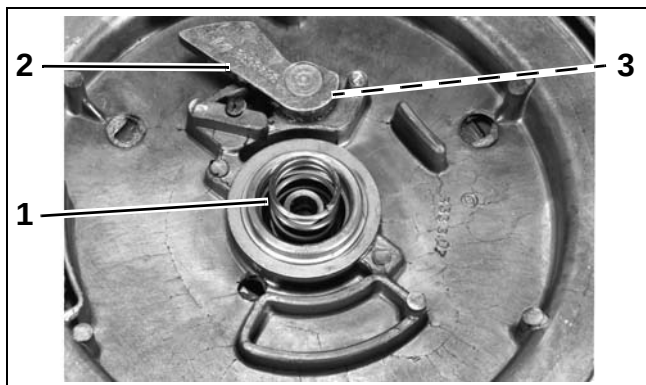
Remove the starter pawl retaining screw, washer, and starter pawl plate with plate return spring from the starter assembly.



1. Screw
2. Washer
3. Plate
4. Spring

007856

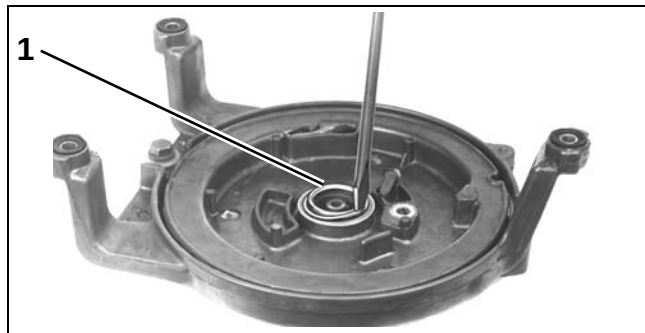
Remove starter housing spring and starter pawl with spring washer from the starter assembly.



1. Spring
2. Starter pawl
3. Spring washer (under starter pawl)

34855

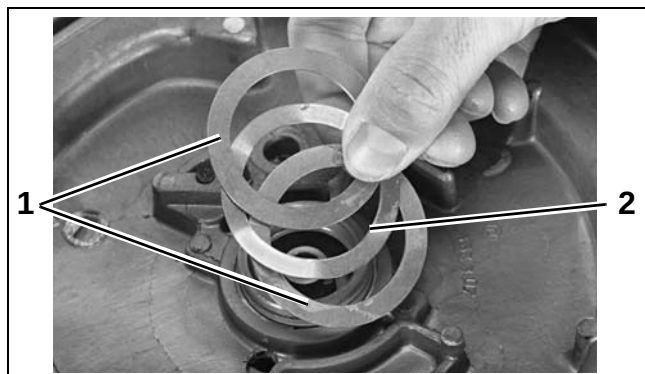
Use a screwdriver to pry open the pulley lock ring, and remove ring from the starter.



1. Lock ring

COA1368

Remove the friction plates and friction plate spring washer.



1. Friction plates
2. Friction plate spring washer

34854

Hold the pulley in the starter housing while turning the starter over, legs down. Hold fingers clear of the pulley and jar the starter housing against a bench to dislodge the rewind spring and pulley. Remove the pulley bushing from the pulley.



007857

RECOIL STARTER CLEANING AND INSPECTION

Wash metal components in solvent and dry with compressed air.

Inspect the rewind spring for broken end loops and weak tension.

Examine the starter pawl for wear.

Inspect the starter components for wear. Replace as necessary.

Inspect starter rope. Replace rope if frayed. Cut new rope 96.5 in. (245 cm) in length. Fuse ends of rope to a length of 1/2 in. (12 mm).

Examine the pulley and the starter housing. Look for sharp edges and rough surfaces that could fray the starter rope. File and polish to remove.

Examine the starter and starter lockout parts. Replace any worn or damaged parts.

RECOIL STARTER ASSEMBLY

WARNING

Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

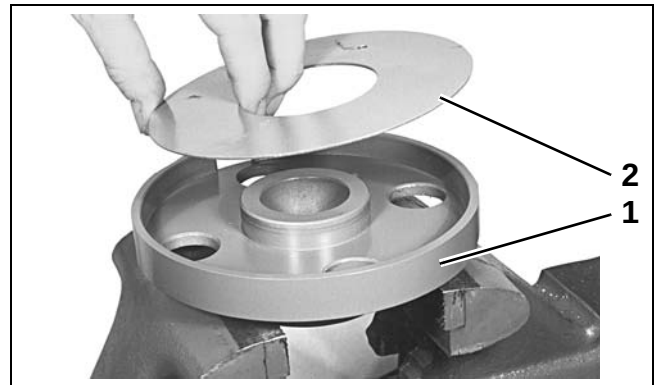
Place starter spring shield and pulley bushing into the starter housing.



1. Shield

COA1360

Clamp base of Starter Spring Winder and Installer, P/N 392093, in a vise. Insert release plate into spring winder base.



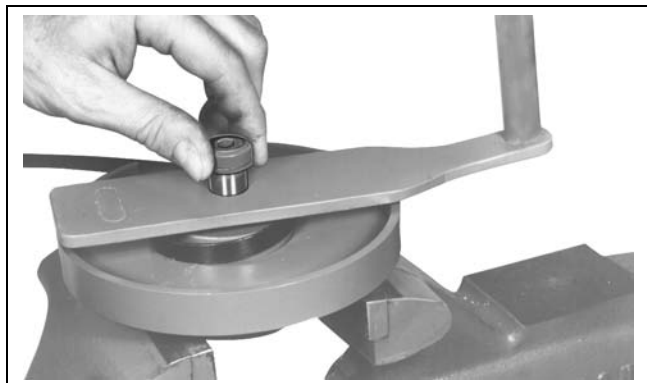
1. Base
2. Plate

CO3593

MANUAL STARTER

RECOIL STARTER ASSEMBLY

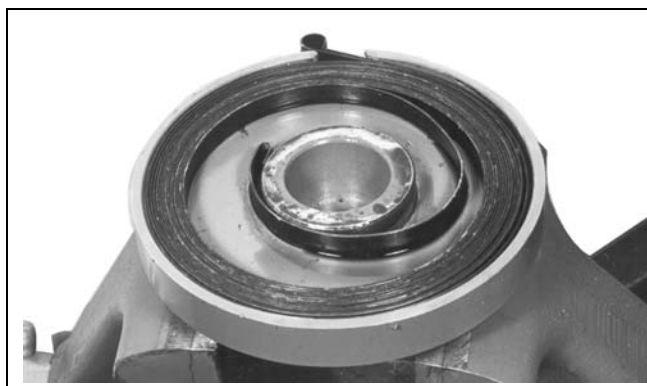
Apply *Triple-Guard* grease or *Lubriplate 777* to the rewind spring. Install the rewind spring into the spring winder base with open loop of spring facing inward. Insert the pin of the crank and pin assembly into the loop of the rewind spring. Secure the crank and pin assembly to the starter winder base with the crank retainer screw.



CO3591

Rotate the crank and pin assembly in the direction shown on the tool. Wind the spring into the starter winder base until end of spring contacts the starter winder base.

Remove the crank retainer screw and the crank and pin assembly from the starter winder base. Remove the starter winder base from the vise.



CO3589

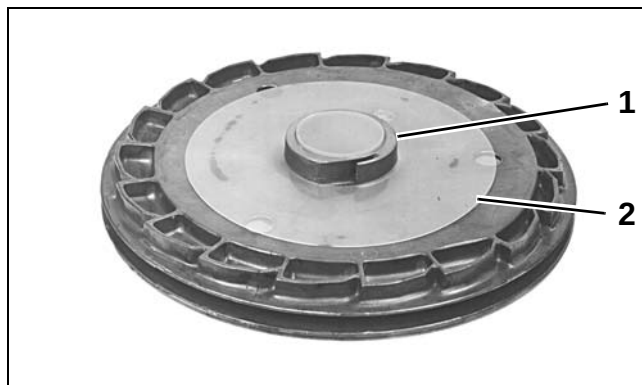
Install the rewind spring into the starter housing. Locate the outer loop of the rewind spring on the pin in the starter housing. Press down through the holes in the spring winder base to transfer the rewind spring into the starter housing.



1. Outer loop
2. Pin

CO3584

Apply *Triple-Guard* grease or *Lubriplate 777* to the pulley bushing. Install the pulley bushing in the pulley. Place the pulley shim on the pulley.

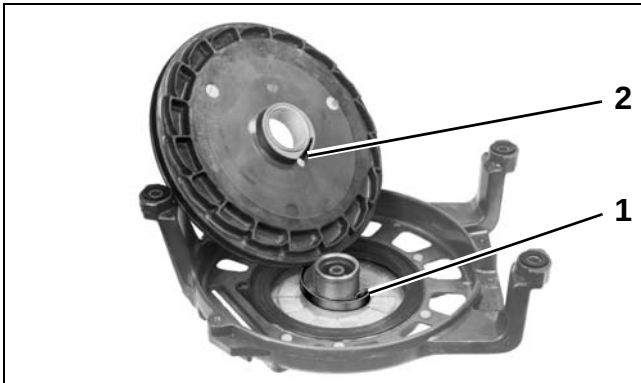


1. Bushing
2. Shim

COA1364

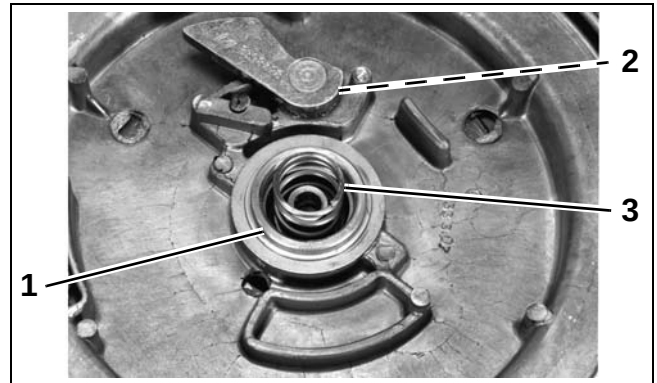
Bend the inside loop of the rewind spring in toward the center of the starter housing. Place the

inner loop of the spring in the slot of the pulley, and install the pulley in the starter housing.



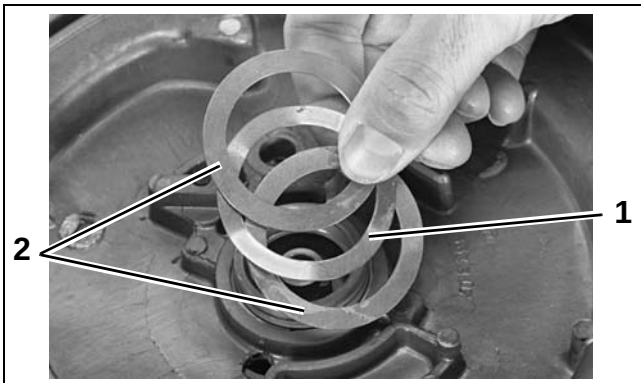
1. Inside loop
2. Slot
COA1365

Place the starter housing spring in the starter housing.



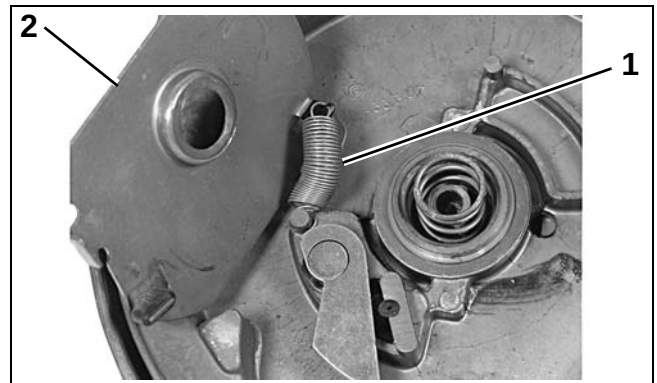
1. Lock ring
2. Spring washer (under starter pawl)
3. Spring
COA1361

Place the friction plate spring washer between the two friction plates on the pulley hub. Secure the friction plate and friction plate spring washer with the pulley lock ring.



1. Friction plate spring washer
2. Friction plates
34854

Install the starter pawl plate return spring on the starter pawl plate. Press the other end of spring on the boss of the pulley. Position the starter pawl plate on the pulley.



1. Spring
2. Plate
46767

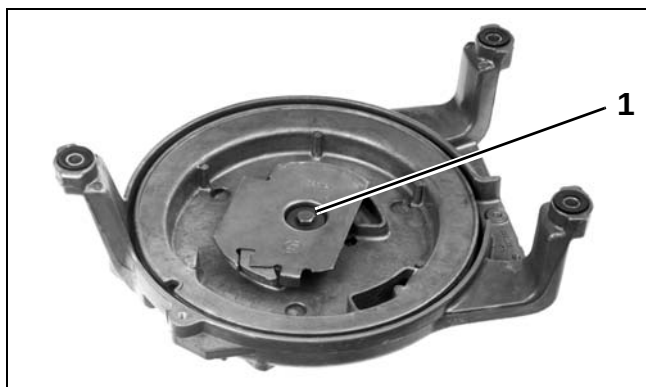
Make sure the starter pawl bushing is installed in the pulley. Apply *Triple-Guard* grease or *Lubriplate* 777 to boss of the starter pawl. Place spring washer on the boss of the starter pawl. Place the starter pawl in the pulley.

Clean threads of the starter pawl plate retaining screw and nut to remove adhesive.

MANUAL STARTER

RECOIL STARTER ASSEMBLY

Install the starter pawl plate retaining screw and washer into the starter housing. Tighten screw to a torque of 96 to 120 in. lbs. (11 to 13.5 N·m).

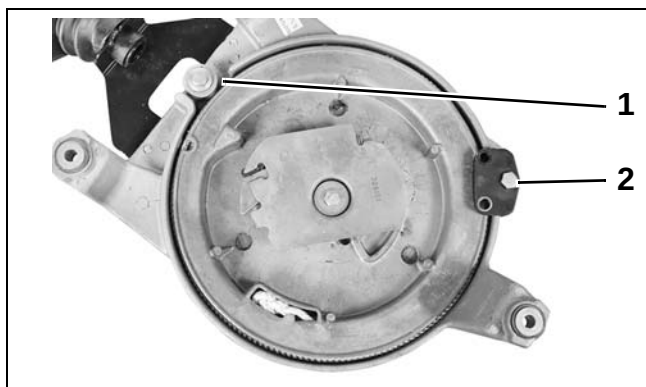


1. Screw

COA1375

Spray threads of starter pawl plate retaining screw and nut with *Locquic Primer*. Apply *Nut Lock* to the threads of the nut. Install and tighten the nut securely.

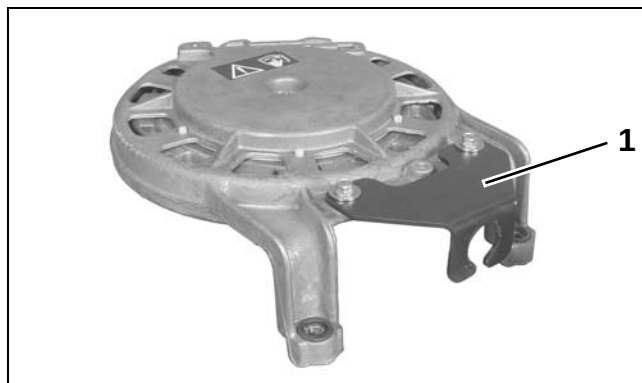
Install the rope guide and pulley support to the starter housing. Tighten the screws securely.



1. Rope guide
2. Pulley support

007854

If removed, install the starter handle bracket to the starter housing. Tighten screws securely.



1. Starter handle bracket

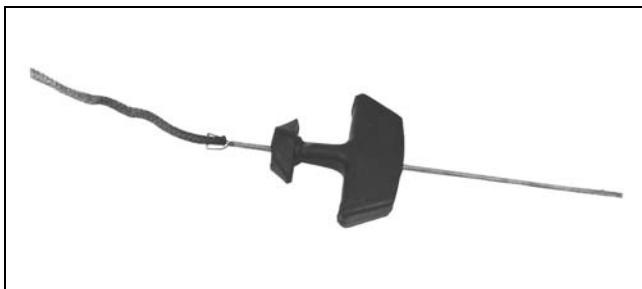
002517

Tie a knot in one end of the starter rope. With the starter housing upside down on a bench, wind the pulley counterclockwise until the rewind spring is tight.

Back off the rewind spring until the rope cavity of the pulley is aligned with the rope guide. Thread the starter rope through the pulley, rope guide, and outlet in the starter handle bracket.

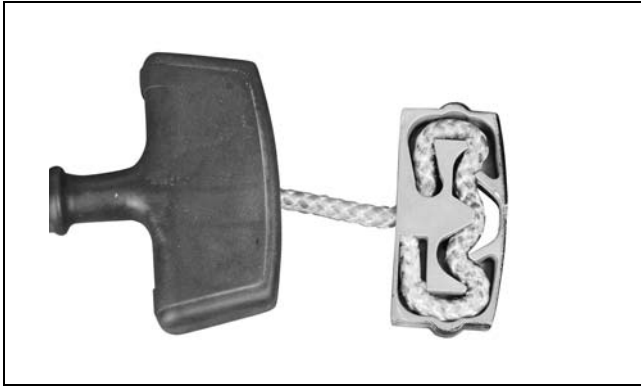
Seat the knotted end of the starter rope in the pulley. Tie a slip knot in the starter rope to hold rope in position.

Apply *Triple-Guard* grease or *Lubriplate 777* to the handle end of the starter rope. Using Starter Rope Threading Tool, P/N 378774, thread the starter rope through the handle.



COA1373

Press the starter rope into the channel of the rope anchor, with end of starter rope firmly against end of channel. Press the anchor into the handle.



007858

Check operation of the starter pawl when the starter rope is pulled out. The starter pawl should extend when the starter rope is pulled and retract when the starter rope recoils.

RECOIL STARTER INSTALLATION

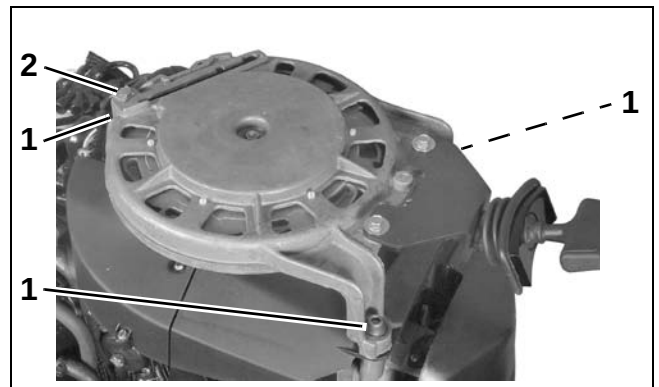
Apply *Nut Lock* to the threads of starter ratchet screws. Install washers and ratchet on flywheel. Tighten screws to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



006654

Place the starter assembly onto the outboard. Install the starter housing retaining screws, washers, and bushings. Be sure to place washers between the starter housing and the flywheel cover. Apply *Ultra Lock* to threads and tighten the three starter housing screws to a torque of 120 to 144 in. lbs. (14 to 16 N·m).

Install clamp for oiling system wiring harness.



1. Starter housing screws
2. Clamp

002515

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

TROUBLE CHECK CHART

OUTBOARD WILL NOT START

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard does not turn over	Seized powerhead or gearcase	Check and repair as needed
	Powerhead hydro-locked	Check cylinders for water
Outboard turns slowly	Partially seized powerhead or gearcase	Check and repair as needed

TROUBLE CHECK CHART
OUTBOARD WILL NOT START

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.
	In gear	Make sure outboard is in neutral
	No fuel	Check for fuel in fuel tank
	Water in fuel	Check fuel filter, sample fuel from fuel return manifold.
	Contaminated or poor fuel quality	Check or replace fuel supply
	Fuel supply restricted	Check primer, anti-siphon valve, and fuel pick-up. Use primer to fill vapor separator with fuel.
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Low or no fuel pressure to injectors	Check fuel manifold pressure, refer to FUEL SYSTEM
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Fuel injectors not working	Check voltage at injectors
	Excessive fuel or oil, engine flooded	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent, refer to FUEL SYSTEM
	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
	Ignition	Check ignition, refer to SYSTEM ANALYSIS
	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
	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)
	Neutral switch, tiller models	Check neutral switch operation

OUTBOARD HARD TO START

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard eventually starts, may or may not run properly once started	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check or replace fuel supply
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to FUEL SYSTEM
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low or no alternator output (55 V)	Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS
	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM
	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS
	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 FUEL SYSTEM .
	<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, refer to POWERHEAD
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

TROUBLE CHECK CHART
OUTBOARD WILL NOT SHUT OFF

OUTBOARD WILL NOT SHUT OFF

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard starts and runs, normal performance while running	Stop circuit wiring	Check <i>EMM</i> LED indicators. Check wire harness (black/yellow) and 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 SYSTEM ANALYSIS
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to FUEL SYSTEM
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Injector electrical circuit or control function	Check voltage at injectors, refer to SYSTEM ANALYSIS
	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs
	Weak or erratic ignition output	Check ignition, refer to SYSTEM ANALYSIS
	Internal powerhead damage	Check and repair as needed

OUTBOARD STARTS, LOW MAXIMUM RPM

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
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 AND PREDELIVERY
Performance of outboard at lower speeds appears normal	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Contaminated or poor quality fuel	Check or replace fuel supply
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low alternator output (55 V)	Check voltage on 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS
	Fuel injector electrical circuit or control function	Check voltage at injectors, refer to FUEL SYSTEM
	Restricted or leaking fuel injectors	Check injectors, refer to FUEL SYSTEM
	Low fuel pressure	Check circulation pump operation, refer to FUEL SYSTEM
	EMM 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 quality	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 diagnostics program to check
	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	Incorrect, fouled, or worn spark plugs	Replace spark plugs
May be erratic or inconsistent	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check and replace fuel supply
	Low or erratic fuel pressure	Check pressure, refer to FUEL SYSTEM
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM
	Faulty wiring, connections, grounds, or CPS air gap	Check all grounds, connections, and wiring. Check CPS air gap.
	Low alternator output (55 V)	Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	<i>EMM</i> program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS
	Restricted engine exhaust	Check and repair as needed
Audible noise	Internal powerhead damage	Check and repair as needed
	Damaged gearcase	Inspect gearcase and lubricate

SERVICE PARTS

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SERVICE PARTS

ABOUT THIS CATALOG

BRP US Inc. reserves the right to make changes at any time, without notice, to features, specifications, and model availability. The right is also reserved to change any specification or part, at any time, without incurring any obligation to update older models. The information in this catalog is based on the latest specifications available at the time of publication.

Illustrations used in this catalog may not depict actual models or equipment, but are intended as representative views for reference only. Certain features, equipment or accessories shown in this catalog might not be found on or included with all models in all marketing areas.

IMPORTANT: This catalog is a part reference. Refer to the appropriate Service Manual for service and maintenance information. Use the engine model number, including any suffix letter, when indentifying parts in this catalog.

PARTS LIST REFERENCE

Following Example for Reference Only

a	1	584348	BATTERY CABLE, 10ft. (3.0M) (DR Models Only)	1	d
	2	351839	SCREW, Starter to C/C	New 1	e
	3	586774	STARTER SOLENOID Assy (Solenoid Assy. Included on DR, DE & DP)	1	f
	4	N/A	*DRIVE KIT	NS 1	
	5	586103	**GROMMET, Starter solenoid mount	Opt. 2	g
b	6	345512	BOLT, Double endddeed-Harness ground	A 1	c
c	A	Only used on WR, WPR Models			

a	"N/A" Indicates part is NOT AVAILABLE or NOT AVAILABLE individually.
b	"*" Indicates parts are included in the preceding assembly. EXAMPLE SHOWN: (Ref #3) – P/N 586774 includes (Ref #4) – P/N 586101 and (Ref #5) – "GROMMET." Also, (Ref #4) P/N 586101 includes (Ref #5) – "GROMMET."
c	"A" Upper case alpha characters used as callout indicate additional part information is shown at the bottom of the list.
d	Additional part information.
e	" New " Indicates part and/or part number has been added or changed from previous model year.
f	" NS " Indicates part is Not Shown in illustration.
g	" Opt " Indicates part is an OPTIONAL or ACCESSORY part.

WARNING

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

MODEL FEATURES

All Models				
Design	System	Charging	Engine	
2 Cyl, In-line 52.7 cu. in.	E-TEC	25 Amp	.86 L, 52.7 cu. in.	
Model Specific				
Model	Gearcase	Shaft	Color	Description
E55MRLIIM	12:32 / 0.375 F	20"	Black	Manual Tilt, Tiller Steering, Rope Start
E55MJRLIIM	12:32 / 0.375 F	20"	Black	Manual Tilt, Tiller Steering, Rope Start, Jet Drive

PARTS SHIPPED WITH ENGINE "IN BOX"

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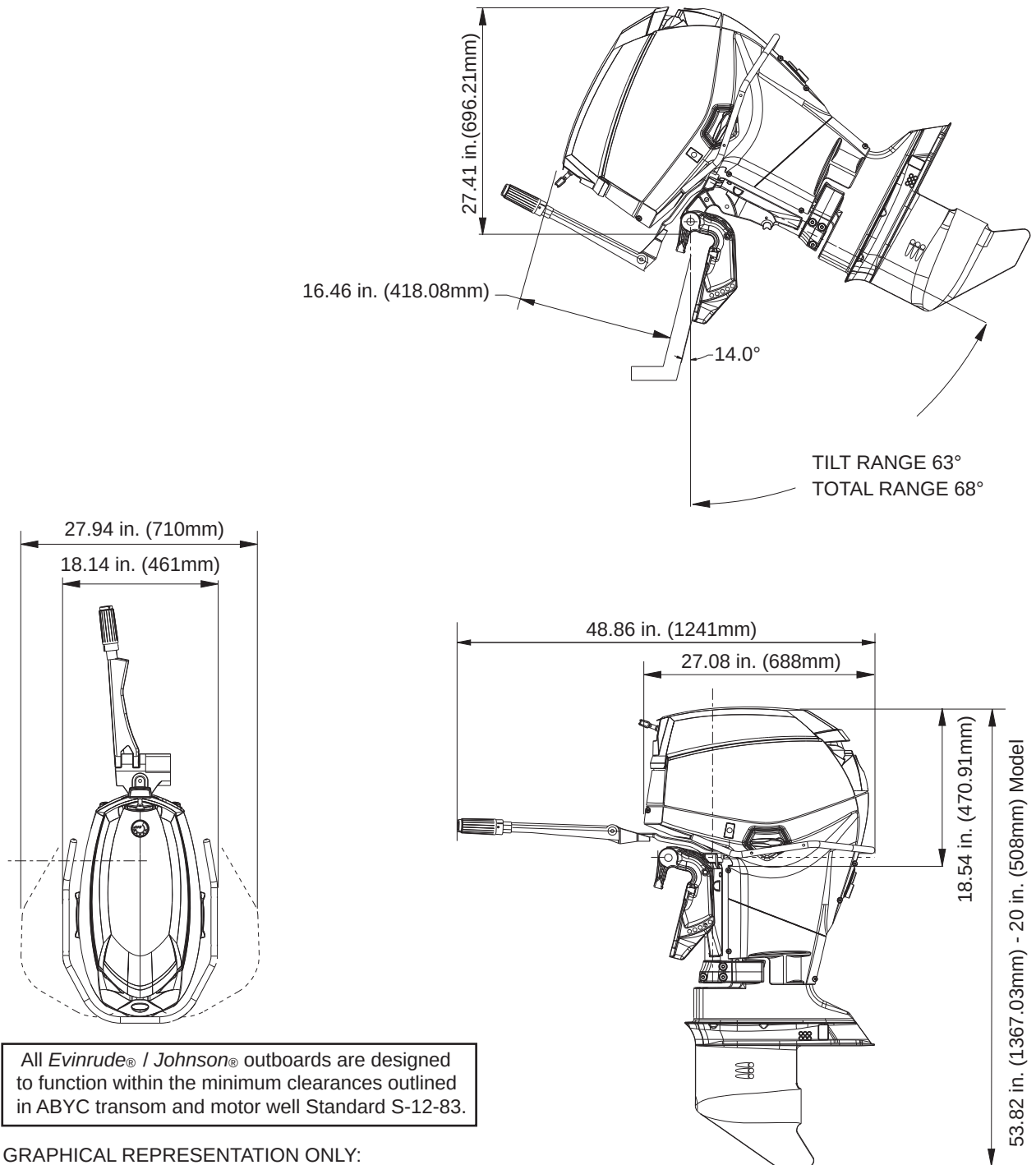
<i>P/N</i>	<i>Name of Part</i>	<i>Qty</i>
215996	OPERATOR'S GUIDE - ENGLISH	1
763302	PROPELLER – MRL Models	1
349238	IMPELLER & BUSHING - Spare – MJRL	1
5005034	PROPELLER HARDWARE KIT	1
127084	*BUSHING, THRUST	1
314502	*PIN, COTTER	1
315810	*SPACER, PROPELLER NUT	1
314503	*NUT, PROPELLER	1
394219	TRANSOM MOUNT KIT	
310702	*NUT, LOCK	4
315774	*PAD	2
328594	*PLATE, TRANSOM	1
303776	*SCREW	4
334427	*SCREW	4
203360	*TIE STRAP	1
309192	*WASHER, FLAT	2
315776	*WASHER	2
5006365	FUEL HOSE & PRIMER BULB	1
5007314	TOOL KIT	1

PAINT

Color	Spray Can	PPG Paint Codes Paint / Catalyst	Application
PRIMER	777172	–	Midsection & Gearcase
PRIMER (Black)	–	SEP61993 / W29585	All
BLACK (Gloss)	777179	W28610 / W28792	Engine cylinder/crankcase
BLACK (Military)	351066	W43653 / W26790	Covers, Midsection, & Gearcase

PROFILE DRAWING

18



All Evinrude® / Johnson® outboards are designed to function within the minimum clearances outlined in ABYC transom and motor well Standard S-12-83.

GRAPHICAL REPRESENTATION ONLY:

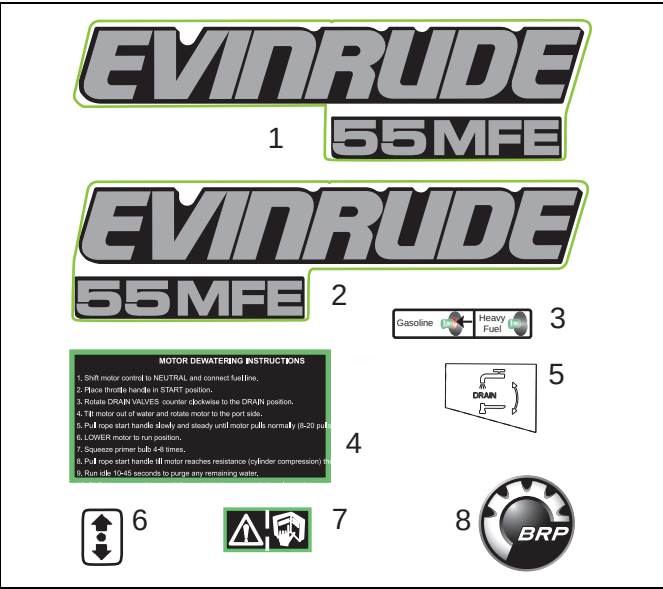
ALL DIMENSIONS $\pm 1/4$ in. (6.35mm)

ALL MEASUREMENTS BASED ON:

TRANSOM ANGLE 14°

TRANSOM THICKNESS 2 3/4 in. (68.58mm) MAXIMUM

DECALS

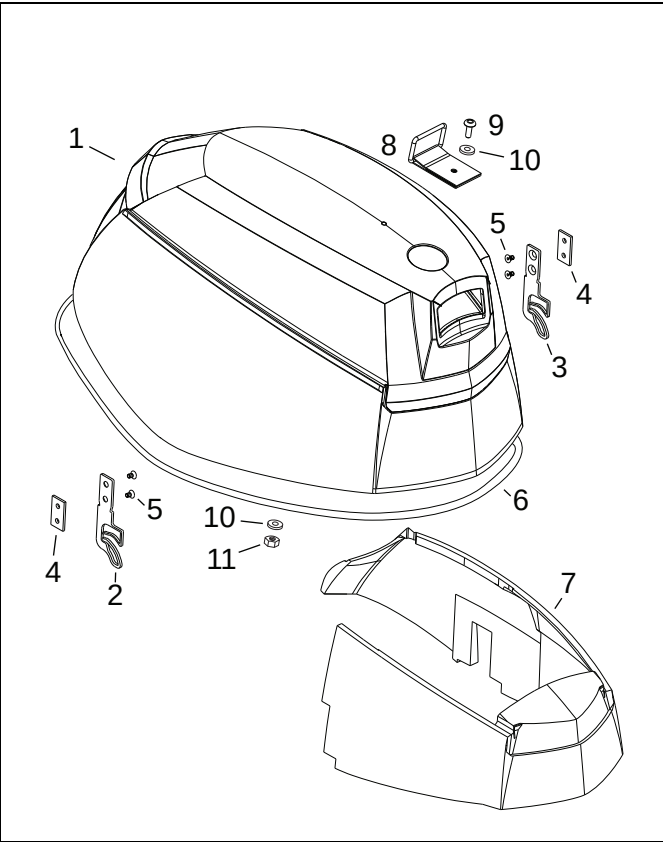


EPC4161

Ref	P/N	Name of Part	Qty
-	5006351	DECAL SET	1
1	N/A	*EVINRUDE 55 MFE - Port	A 1
2	N/A	*EVINRUDE 55 MFE - Stbd	A 1
3	352948	*DECAL, Fuel selector	1
4	N/A	*DE-WATER INSTRUCTIONS	A 1
5	N/A	*DE-WATER VALVES	1
6	333979	SHIFT, Instruction	1
7	334435	OWNER, Attention	1

A Included with "ENGINE COVER Assy"

ENGINE COVER



EPC4162

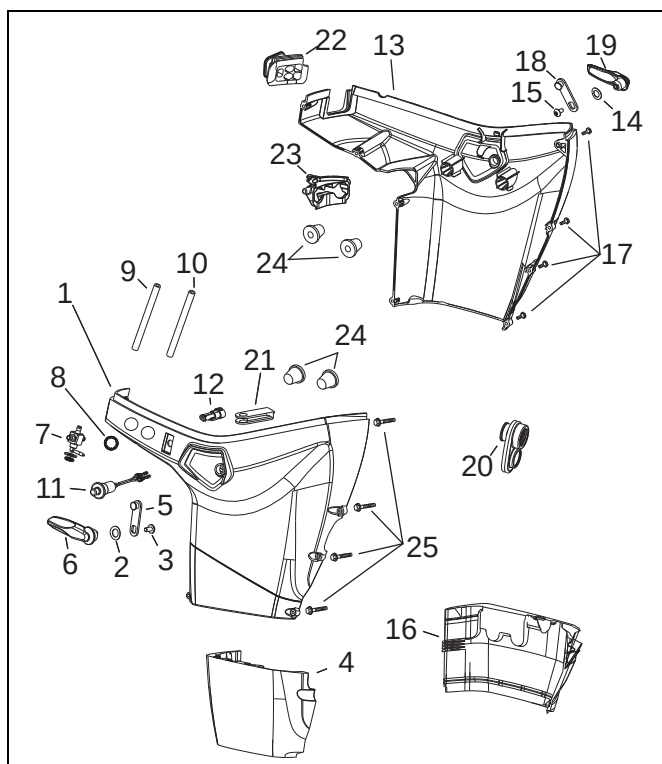
Ref	P/N	Name of Part	Qty
1	285643	ENGINE COVER Assy	A 1
2	350664	*HOOK, Latch-Starboard	1
3	350665	*HOOK, Latch-Port	1
4	350966	*BRACKET, Latch	2
5	351033	*SCREW, Bracket	4
6	350667	*SEAL	1
7	351127	*INSULATION, Sound	1
8	352845	*STRAP	1
9	343505	*SCREW, Strap	1
10	328700	*WASHER, Strap screw	2
11	313022	*NUT, Strap screw	1
N	351993	*SEAL, Rear edge guard	1

A Includes decals

LOWER ENGINE COVER

EPC4395

Ref	P/N	Name of Part	Qty
1	5008115	LOWER COVER Assy, PORT	1
2	330234	*WASHER, Spring	1
3	342191	*SCREW, Latch	1
4	351837	*INSULATION, Sound-PORT	1
5	5005290	*LATCH	1
6	5007009	*LATCH HANDLE	1
7	5004335	*VALVE, De-Watering	2
8	349889	*RETAINING RING, Water valve	2
9	333382	*HOSE, De-Watering - Front	1
10	333631	*HOSE, De-Watering - Rear	1
NS	320107	*TIE STRAP, Hoses	2
11	5006330	*SWITCH Assy, Multi-fuel	1
12	3011153	*CONNECTOR, 2-Position plug	1
13	5006333	LOWER COVER Assy, STBD	1
14	330234	*WASHER, Spring	1
15	342191	*SCREW, Latch	1
16	351838	*INSULATION, Sound - STBD	1
17	353002	*INSERT, Nut	8
18	5005290	*LATCH	1
19	5007009	*LATCH HANDLE	1
20	354162	GROMMET, Overboard indicator	1
21	331896	SEAL, T/T leads plug	1
22	351376	GROMMET	1
23	350501	GROMMET, Steering arm	1
24	352815	MOUNT, Lower cover	4
25	351152	SCREW, PORT to STBD cover	8



18

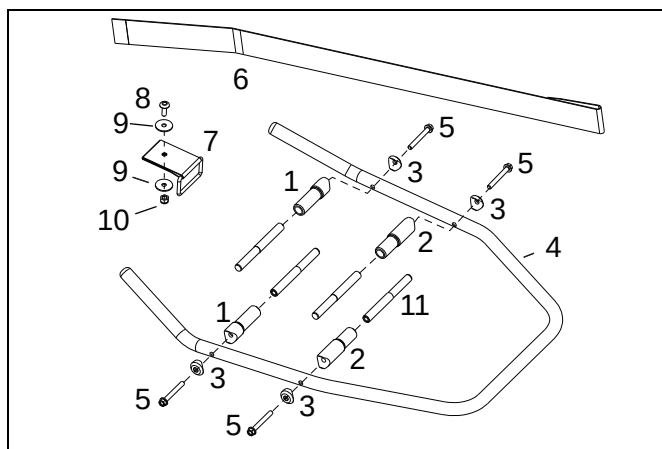
CARRY HANDLE

EPC4279

Ref	P/N	Name of Part	Qty
1	352353	BUSHING, Carry handle - Front	2
2	352428	BUSHING, Carry handle - Rear	2
3	352430	CAP, Carry handle bushings	4
4	352346	HANDLE, Carry	1
5	355060	SCREW, Carry handle	4
6	352370	STRAP	1
7	352845	STRAP	A 1
8	343505	SCREW, Strap	A 1
9	328700	WASHER, Strap screw	A 2
10	313022	NUT, Strap screw	A 1
11	352352	STUD, Lower cover/Handle mount	B 4

A Included in ENGINE COVER Assy

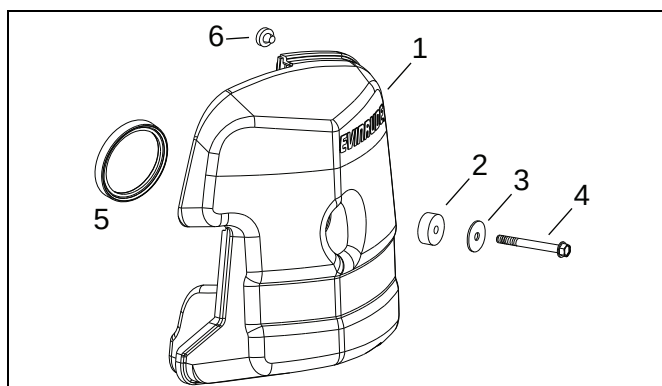
B Included in CYLINDER/CRANKCASE Assy



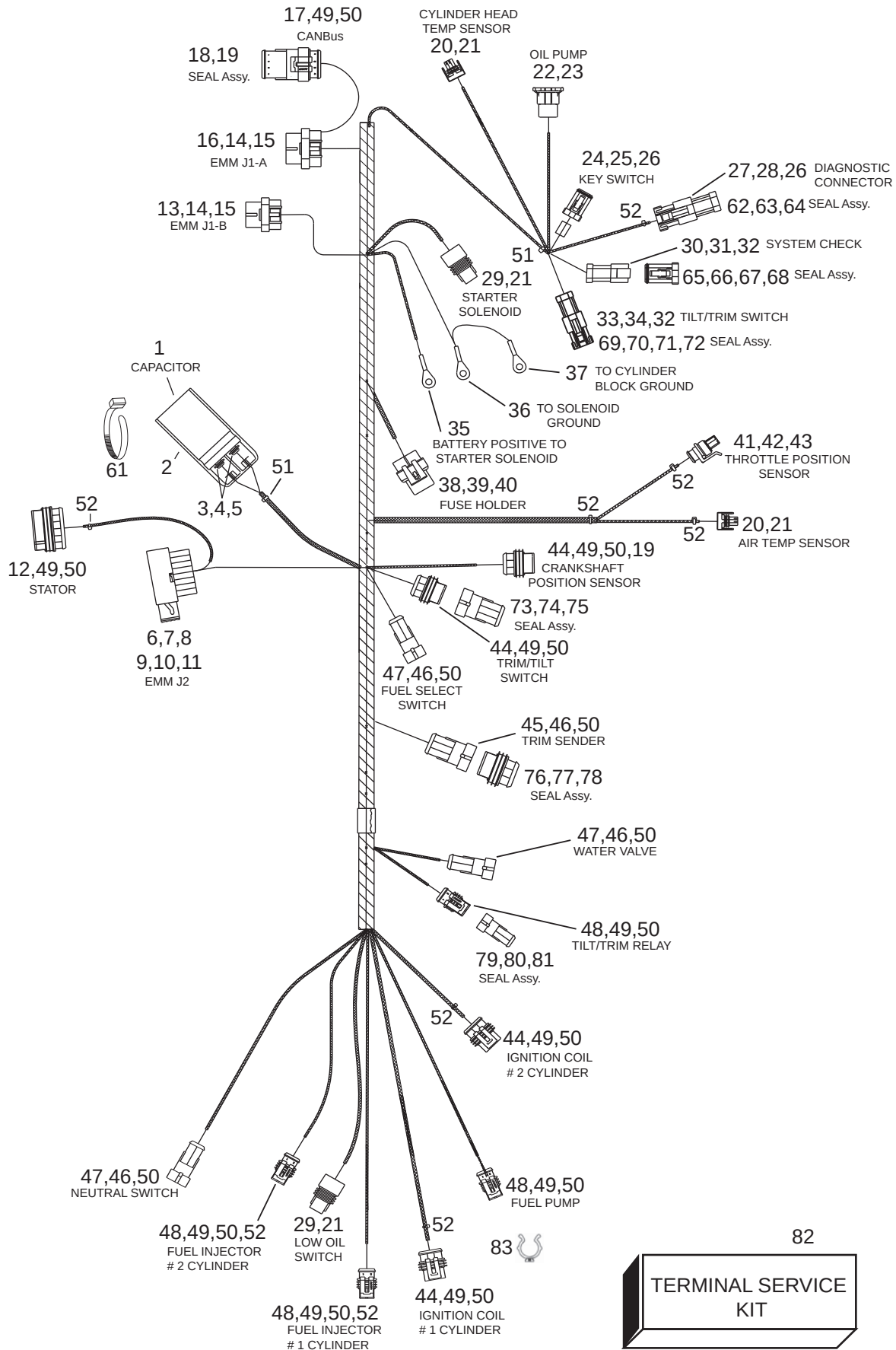
AIR SILENCER

EPC4163

Ref	P/N	Name of Part	Qty
1	5006745	AIR SILENCER Assy	1
2	340840	SEAL, Air silencer fastener	1
3	511421	WASHER, Air silencer fastener	1
4	337574	FASTENER, Air silencer	1
5	350548	SEAL, Air silencer to throttle body	2
6	314021	BUMPER, Air silencer	2



ENGINE ELECTRICAL HARNESS ASSEMBLY



ENGINE ELECTRICAL HARNESS ASSEMBLY

EPC4430

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
-	587051	ENGINE HARNESS Assy	New 1	38	3011258	*CONNECTOR, Fuse	1
1	3010449	*CAPACITOR	1	39	514035	*TERMINAL, Receptacle	2
2	514889	*COVER	1	40	967545	*FUSE, 10 AMP	1
3	512550	*TERMINAL, Ring-#10	2	41	3011446	*CONNECTOR & SEAL, 3 Position plug	1
4	332067	*SCREW	2	42	3011448	*TERMINAL, Socket	3
5	327283	*LOCKWASHER	4	43	3011447	*SEAL,WIRE	3
6	3011161	*CONNECTOR & SEAL, 16 Position plug	1	44	3011155	*CONNECTOR & SEAL, 3 Position plug	4
7	3011166	*TERMINAL - 14 Gauge	3	45	3011156	*CONNECTOR, 3 Position cap	1
8	3011350	*SEAL,WIRE-12 Gauge	3	46	3011148	*CONTACT, Male - tab	A 9
9	3011174	*TERMINAL - 18 Gauge	11	47	3011154	*CONNECTOR & SEAL, 2 Position cap	3
10	3011175	*SEAL,WIRE - 18 Gauge	11	48	3011153	*CONNECTOR & SEAL, 2 Position plug	4
11	3011168	*PLUG, Sealing	2	49	3011147	*CONTACT, Female - receptacle	A 29
12	3011157	*CONNECTOR & SEAL, 6 Position plug	1	50	3011149	*SEAL,WIRE	36
13	3011169	*CONNECTOR & SEAL, 26 Position plug	1	51	320107	*TIE STRAP	2
14	3011171	*TERMINAL	35	52	317893	*TIE STRAP	9
15	3011173	*PLUG, Cavity	25	61	907833	TIE STRAP, Capacitor mounting	2
16	3011170	*CONNECTOR & SEAL, 34 Position plug	1	62	586072	CONNECTOR Assy, Diagnostic cover	1
17	3011420	*CONNECTOR & SEAL, 4 Position plug	1	63	514686	*CONNECTOR, 3 Pin receptacle	1
18	3011421	*CONNECTOR, 4 Position cap	1	64	514690	*PLUG, Sealing	3
19	3011150	*PLUG, Sealing	5	65	586076	SEAL Assy, System check	1
20	3011523	*CONNECTOR & SEAL, 2-Pin plug	2	66	514683	*LOCKWEDGE, 6 Socket plug	1
21	3010125	*TERMINAL, Socket	8	67	514687	*CONNECTOR, 6 Socket plug	1
22	514582	*CONNECTOR, 2 Position plug	New 1	68	514690	*SEAL, Plug	6
23	514583	*TERMINAL	New 2	69	586111	SEAL Assy, Trim/tilt switch	1
24	3011328	*CONNECTOR & SEAL, 6 Socket plug	1	70	514681	*LOCK WEDGE, 3 Socket plug	1
25	514683	*LOCKWEDGE-6 Socket plug	1	71	514685	*CONNECTOR, 3 Socket plug	1
26	514680	*TERMINAL, Socket	9	72	514690	*SEAL, Plug	3
27	3011326	*CONNECTOR & SEAL, 3 Socket plug	1	73	586811	SEAL Assy, Trim & tilt	1
28	514681	*LOCK WEDGE, 3 Socket plug	1	74	3011150	*PLUG, Sealing	3
29	3010123	*CONNECTOR & SEAL, 2-Socket plug	2	75	3011156	*CONNECTOR, 3 Position cap	1
30	3011327	*CONNECTOR, 6 Pin receptacle	1	76	586813	SEAL Assy, Trim sender	1
31	514684	*LOCK,WEDGE-6 Pin receptacle	1	77	3011150	*PLUG, Sealing	3
32	514679	*TERMINAL, Pin	9	78	3011155	*CONNECTOR, 3 Position cap	1
33	3011329	*CONNECTOR, 3 Pin receptacle	1	79	586812	SEAL Assy, Trim & tilt relay	1
34	514682	*LOCKWEDGE-3 Pin receptacle	1	80	3011150	*PLUG, Sealing	2
35	204053	*TERMINAL, Ring -.312 in. dia. (79mm)	1	81	3011154	*CONNECTOR, 2 Position cap	1
36	204363	*TERMINAL, Ring -.250 in. dia. (63mm)	1	82	777283	TERMINAL SERVICE KIT (AMP Style)	1
37	600138	*TERMINAL, Ring -.250 in. dia. (63mm)	1	83	3011450	CLIP, Connector to hose	1

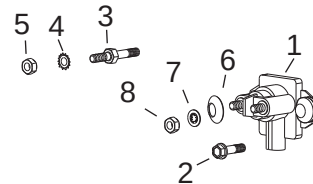
A Included in accessory Terminal Service Kit P/N 777283.

18

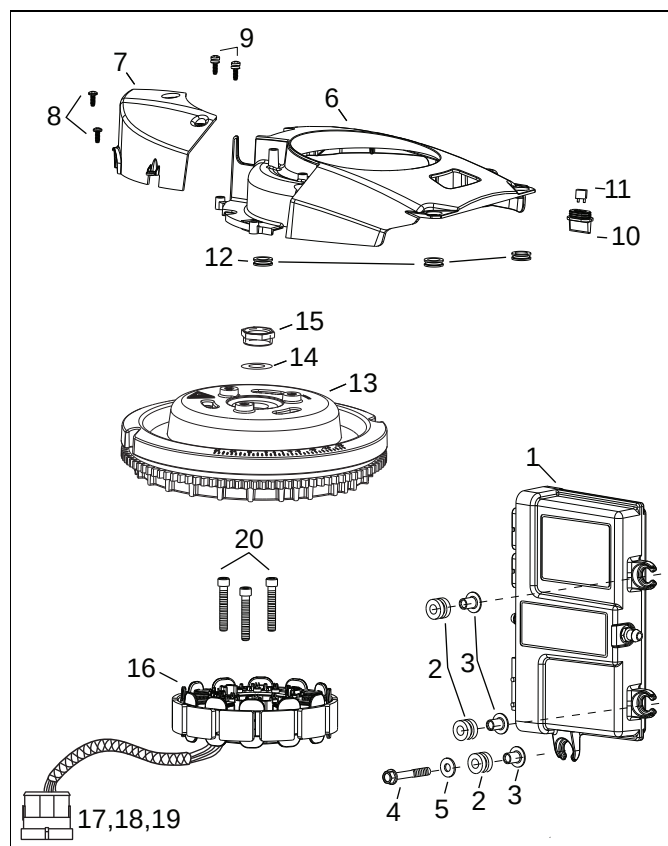
SOLENOID

EPC4396

Ref	P/N	Name of Part	Qty
1	587020	STARTER SOLENOID Assy <i>Included on ALL models.</i>	1
2	331979	SCREW, Starter solenoid to C/C	1
3	341512	BOLT, Double ended-solenoid	1
4	328701	LOCK WASHER, Double ended bolt	1
5	328740	NUT, Double ended bolt - ground	1
6	354046	WASHER, Retaining, motor cable	1
7	331259	WASHER LOCK, Starter solenoid	1
8	321472	NUT, Starter solenoid cable	1



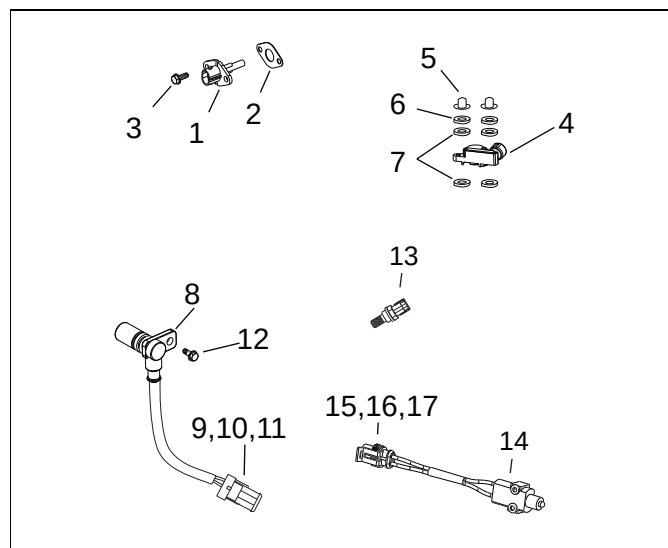
EMM, FLYWHEEL & STATOR



EPC3706a

Ref	P/N	Name of Part	Qty
1	586970	EMM (Call Dealer Support Services)	1
2	333040	ISOLATOR, EMM to water cover	3
3	338558	SPACER, Isolator-EMM mounting	3
4	333710	SCREW, Lower-EMM to cover	1
5	328703	WASHER, EMM mounting	1
6	354106	FLYWHEEL COVER	1
7	350854	COVER, Electrical connectors	1
8	315656	SCREW, Elec.cover	2
9	351618	SCREW, Elec.cover	2
10	514022	RETAINER, Spare fuse	1
11	967545	FUSE, Spare 10 AMP	1
12	350973	GROMMET, Cover	3
13	586964	FLYWHEEL	1
14	330441	WASHER, Flywheel nut	1
15	329267	NUT, Flywheel	1
16	586949	STATOR Assy	1
17	3011148	*CONTACT, Tab	6
18	3011149	*SEAL, Lead	6
19	3011158	*CONNECTOR, 6 position	1
20	350992	SCREW, Stator to C/C	3

SENSORS



EPC4128

Ref	P/N	Name of Part	Qty
1	3010673	SENSOR, Air temperature	A 1
2	350805	GASKET, Air temperature sensor	1
3	332226	SCREW, Air temperature sensor	2
4	5006484	SENSOR, Throttle position (TPS)	A 1
5	352129	*NUT, TPS push	2
6	336197	*WASHER, TPS	2
7	352122	*WASHER, TPS Isolation	4
8	587014	SENSOR, Crankshaft position (CPS)	A 1
9	3011148	*CONTACT TAB	1
10	3011149	*SEAL, Wire	2
11	3011156	*CONNECTOR, 3 position	1
12	332226	SCREW, CPS	1
13	3010674	ENGINE TEMPERATURE SENSOR	B 1
14	586780	SWITCH, Neutral	C 1
15	3011147	*CONTACT, Receptacle	2
16	3011225	*SEAL, Wire	2
17	3011153	*CONNECTOR, 2 position	1

A See "INTAKE MANIFOLD ASSEMBLY"

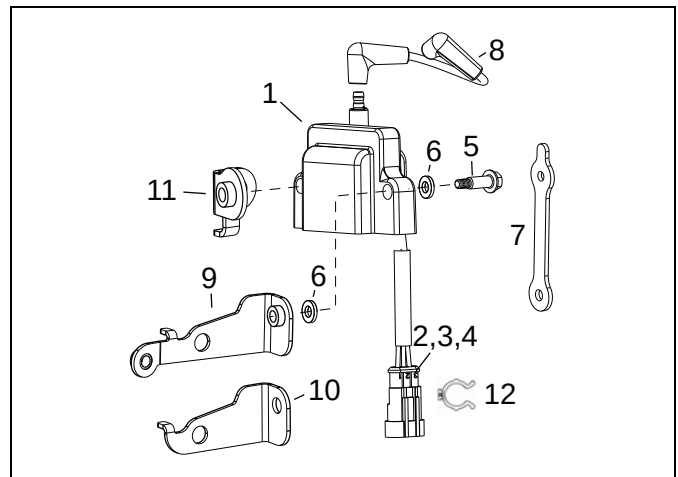
B See "CYLINDER HEAD"

C See "THROTTLE & SHIFT LINKAGE"

IGNITION COIL

EPC4397

Ref	P/N	Name of Part	Qty
1	586980	IGNITION COIL	2
2	3011149	*SEAL, Lead	3
3	3011148	*TERMINAL, Pin	3
4	3011156	*CONNECTOR, 3 pin terminal	1
5	354614	SCREW, Ignition coil - upper	2
5	353545	SCREW, Ignition coil - lower	2
6	353540	WASHER, Ignition coil screw (lower)	4
7	354615	STRAP, Upper coil mounting	2
8	5007408	HIGH TENSION LEAD Assy	2
9	353422	BRACKET, Ignition coil mounting, upper	1
10	353646	BRACKET, Ignition coil mounting, lower	1
11	353431	BRACKET, Ignition coil to cylinder head	2
12	3011450	CLIP, Connector	1
NS	320107	TIE STRAP, Ignition coil leads to hose	2
NS	907833	TIE STRAP, Ignition coil leads to coil	2

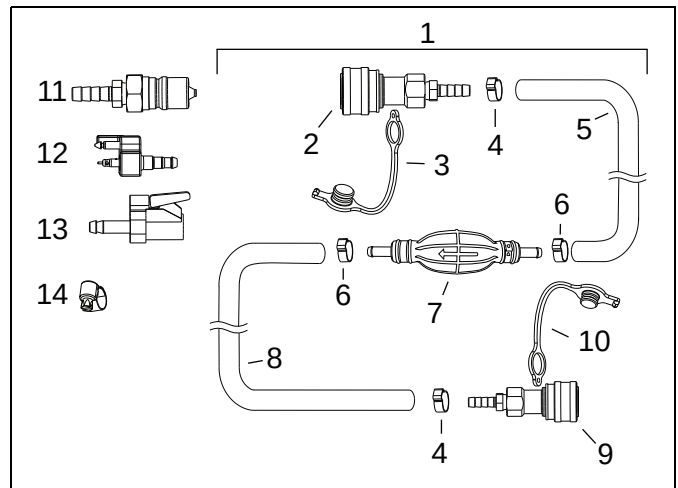


FUEL HOSE & PRIMER BULB

18

EPC4349

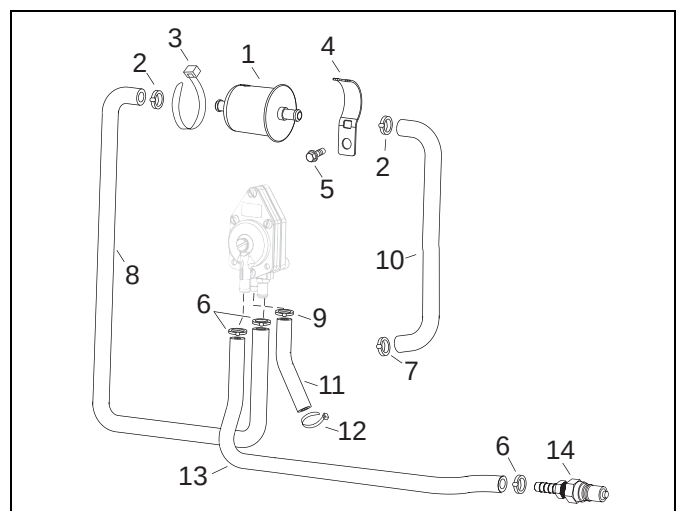
Ref	P/N	Name of Part	Qty
-	5006365	FUEL HOSE & CONNECTOR KIT	1
1	5006364	*FUEL HOSE & PRIMER Assy	1
2	5006363	** CONNECTOR, Female, fuel (1.4" O.D.)	1
3	352397	** PLUG, Dust (0.8" O.D.)	1
4	123112	** CLAMP	2
5	772564	** HOSE, Bulk roll (length 19.5")	1
6	346786	** CLAMP	2
7	775638	** BULB, Primer	1
8	772564	** HOSE, Bulk roll (length 108")	1
9	5005527	** CONNECTOR, Female, fuel (1.14" O.D.)	1
10	349776	** PLUG, Dust (0.78" O.D.)	1
11	5007579	*CONNECTOR, Male, fuel tank	1
12	438793	*CONNECTOR, Outboard	1
13	775640	*CONNECTOR, Fuel hose	1
14	982115	*CLAMP	1



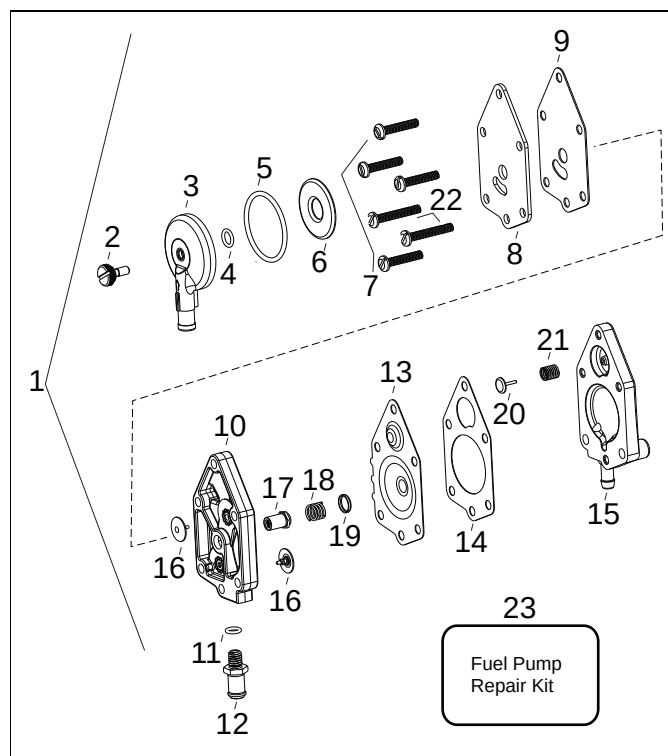
FUEL FILTER

EPC4125a

Ref	P/N	Name of Part	Qty
1	5007335	FILTER, Fuel	1
2	346150	*HOSE CLAMP, 18.5mm	2
3	907833	*TIE STRAP, Fuel filter to clamp	1
4	351009	CLAMP, Fuel filter to C/C	1
5	319590	SCREW, Fuel filter clamp to C/C	1
6	346150	HOSE CLAMP, 18.5mm	3
7	348839	HOSE CLAMP, 17mm	1
8	350792	HOSE, Fuel pump to fuel filter	1
9	346785	CLAMP, Pump pulse (14.5mm)	1
10	355122	HOSE, Fuel filter to vapor separator	1
11	772572	HOSE, Fuel pulse (Bulk Roll)	AR
12	320107	TIE STRAP, Fuel pump pulse hose	1
13	353515	HOSE, Connector to fuel pump	1
14	5006348	CONNECTOR, Fuel inlet	1
NS	320107	TIE STRAP, Fuel hoses	1



FUEL LIFT PUMP

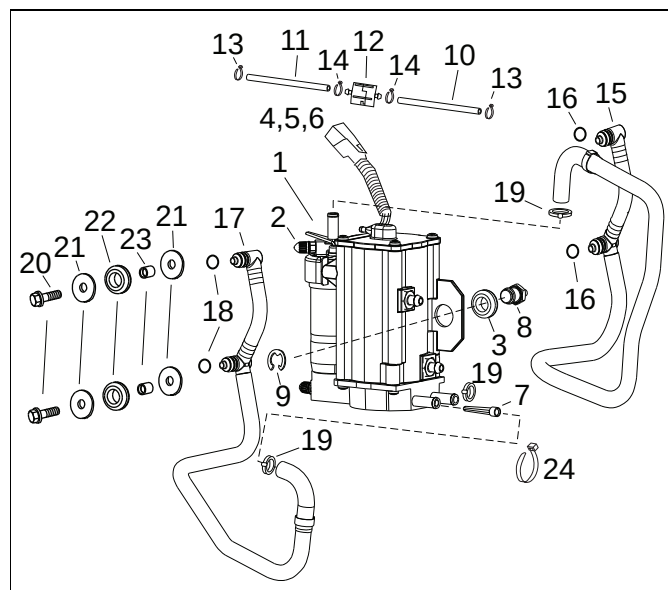


EPC3700

Ref	P/N	Name of Part	Qty
1	5005462	FUEL LIFT PUMP Assy	1
2	330061	*SCREW, Inlet cap	1
3	335335	*CAP, Inlet	1
4	324660	*O-RING, Inlet screw	A 1
5	319528	*O-RING, Cap	A 1
6	312675	*SCREEN, Filter	1
7	329892	*SCREW, Housing	4
8	N/A	*COVER, Fuel pump	1
9	N/A	*GASKET, Cover	A 1
10	N/A	*HOUSING, Valve	1
11	353769	*O-RING, Outlet fitting	1
12	350971	*FITTING, Outlet	1
13	332678	*DIAPHRAGM	A 1
14	N/A	*GASKET, Diaphragm to outer hsg	A 1
15	N/A	*HOUSING & FITTING Assy	1
16	335334	*VALVE, Check	A 2
17	312676	*NUT, Tee	1
18	315255	*SPRING, Diaphragm	1
19	304094	*SUPPORT, Diaphragm spring	1
20	N/A	*SUPPORT, Air dome spring	A 1
21	N/A	*SPRING, Air dome	1
22	314417	SCREW, Pump to C/C	2
23	438616	REPAIR KIT, Fuel lift pump	1

A Included in "FUEL PUMP REPAIR KIT" P/N 438616

FUEL PUMP & VAPOR SEPARATOR



EPC4411m

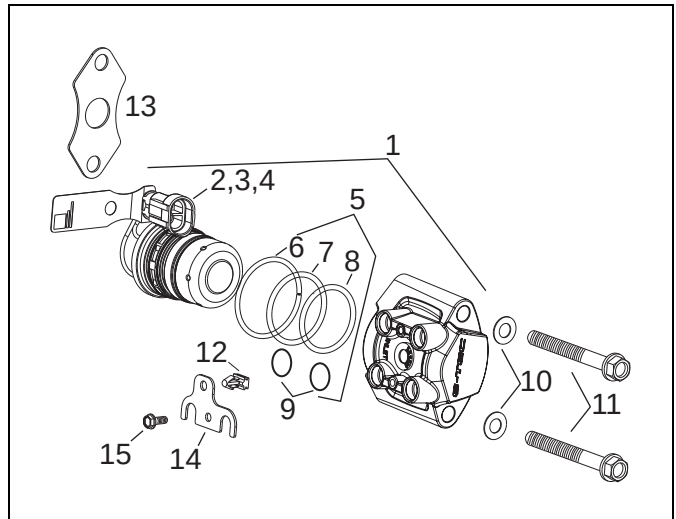
Ref	P/N	Name of Part	Qty
1	5008072	FUEL VAPOR SEPARATOR/PUMP	1
2	126341	*CAP, Pressure test fitting	2
3	329518	*GROMMET, Vapor separator mount	1
4	3011148	*CONTACT, Male tab	2
5	3011149	*SEAL, Wire	2
6	3011154	*CONNECTOR, 2 Position cap	1
7	354190	*FILTER, Fuel return	1
8	344848	STUD MOUNT, Vapor separator to C/C	1
9	510487	RING RETAINING, Stud	1
10	352765	HOSE, Separator vent to check valve	1
11	772571	HOSE, Chk vlv to reed plate (bulk hose)	1
12	348478	CHECK VALVE, Vapor separator vent	1
13	317893	TIE STRAP, Vapor separator vent hose	1
13	320107	TIE STRAP, Vent hose to throttle body	1
14	317893	TIE STRAP, Vent check valve	2
15	5008347	FUEL RAIL Assy, Supply	1
16	350779	*O-RING, Fuel rail	2
17	5008346	FUEL RAIL Assy, Return	1
18	350779	*O-RING, Fuel rail	2
19	348839	HOSE CLAMP, 17mm	3
20	302325	SCREW, Vapor separator to C/C	2
21	328700	WASHER, Vapor separator to C/C	4
22	329518	GROMMET, Vapor separator to C/C	2
23	335328	SPACER, Grommet	2
24	320107	TIE STRAP, Fuel rail	4

FUEL INJECTOR

EPC4282

Ref	P/N	Name of Part	Qty
1	5007147	FUEL INJECTOR Assy	2
2	3011154	*CONNECTOR, 2 pin terminal	1
3	3011148	*TERMINAL, Pin	2
4	3011149	*SEAL, Lead	2
5	5007017	*INJECTOR SEAL KIT	A 1
6	352809	**RING, Crush	1
7	N/A	**O-RING, Outer injector	1
8	N/A	**O-RING, Inner injector	1
9	350779	**O-RING, Fuel rail	2
10	328708	*WASHER, Injector screw	2
11	350995	*SCREW, Injector to cylinder head	2
12	3011292	*ANCHOR, Elec connector to bracket	2
13	351125	INSULATOR, Fuel injector to cyl head	2
14	350775	BRACKET, Fuel rail to housing	2
15	315287	SCREW, Bracket to housing	2

A Included in Powerhead Gasket Set, P/N 5005907

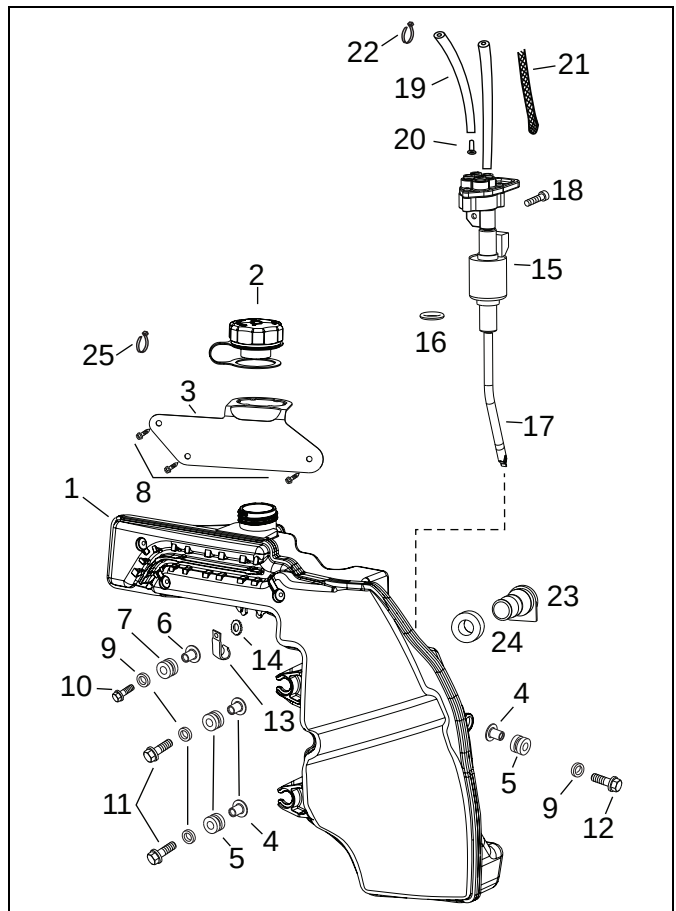


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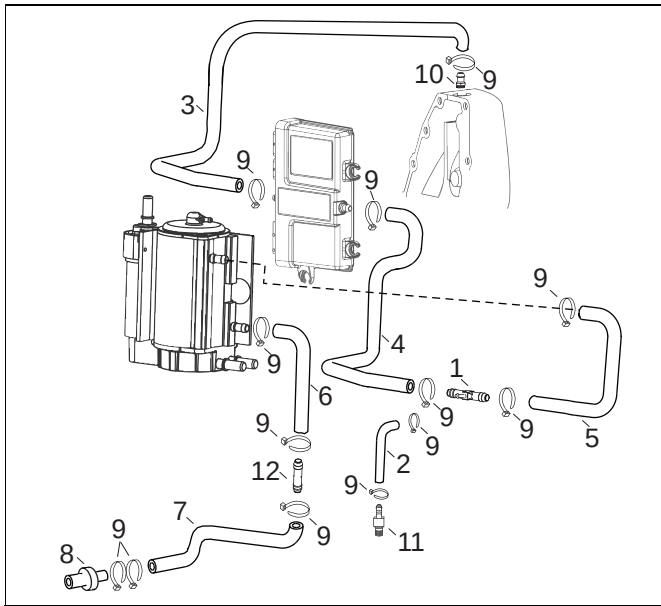
OIL TANK & PUMP

EPC4394

Ref	P/N	Name of Part	Qty
1	5007951	OIL TANK Assy	1
2	5008406	*OIL CAP Assy	1
3	355234	*RETAINER, Oil tank hose	1
4	338558	*SPACER, Flanged	3
5	333040	*ISOLATOR	3
6	338558	SPACER, Flanged	1
7	333040	ISOLATOR	1
8	343245	SCREW, Oil hose retainer	3
9	328703	WASHER, Oil tank mount	4
10	331025	SCREW, Oil tank	1
11	325115	SCREW, Oil tank/EMM mount	2
12	341011	SCREW, Oil tank to coil bracket	1
13	330151	CLAMP, Harness to oil tank boss	1
14	328701	LOCKWASHER, Harness clamp	1
15	5007950	PUMP & MANIFOLD Assy.	1
16	338513	*O-RING, Oil Pump to tank	1
17	5007961	*TUBE AND SCREEN Assy	1
18	328649	SCREW, Oil pump to tank	1
19	778708	HOSE, Oil (.093in. - Bulk Roll 25 ft.)	4
20	349898	SUPPORT, Hose	4
21	512937	SLEEVE, Braided oil to intake manifold	2
21	350323	SLEEVE, Braided oil to cyl block	2
22	317893	TIE STRAP, Hose to fitting	4
23	352874	SWITCH, Oil level	1
24	353920	GROMMET, Level switch	1
25	320107	TIE STRAP, Oil hoses	2
25	320107	TIE STRAP, Pump leads to harness	A 1
25	317893	TIE STRAP, Pump leads to hose	A 1



COOLING HOSES



EPC3703

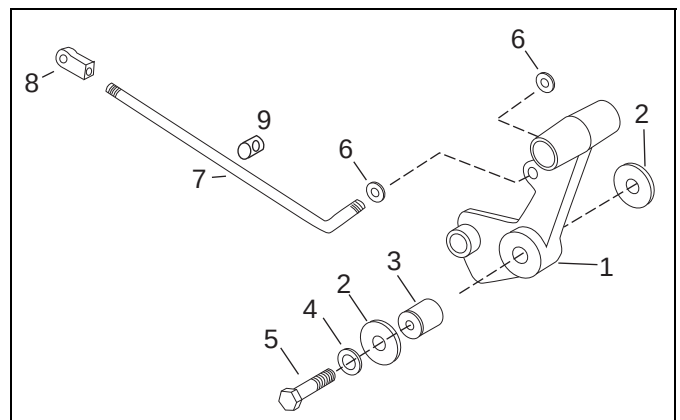
Ref	P/N	Name of Part	Qty
1	338896	FITTING, Water hose tee	1
2	333387	HOSE, Tee to exhaust water exit	1
3	350999	HOSE, C/C water to EMM	1
4	351265	HOSE, EMM water outlet to tee	1
5	351266	HOSE, Tee to separator water inlet	1
6	351267	HOSE, Separator outlet water to tee	1
7	351268	HOSE, Tee to water exit fitting	1
8	350819	FITTING, Water exit	1
9	320107	TIE STRAP	13
10	330272	FITTING, Upper C/C water	1
11	326712	FITTING, Exhaust housing water	1
12	352433	FITTING, Water hose	1

18

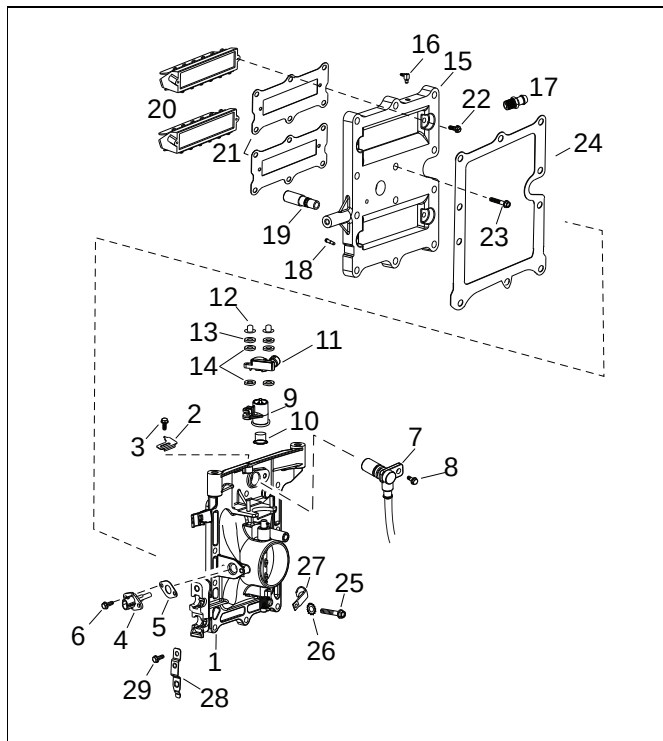
Ref	P/N	Name of Part	Qty
1	347338	SCREW, Cam to intake	1
2	553766	WASHER, Screw to throttle cam	1
3	5005239	THROTTLE CAM	1
4	908398	WASHER, Throttle cam to C/C	1
5	5005625	LINK, Cam to shaft-TPS	1
6	347338	SCREW, Throttle lever to C/C	1
7	127386	WASHER, Screw to throttle lever	1
8	324678	O-RING, Roller sleeve	1
9	432639	ROLLER, Cam	1
10	5005187	THROTTLE LEVER	1
11	908398	WASHER, Throttle lever to C/C	1
12	353036	SPRING, Throttle lever return	1
13	333774	CLIP	3
14	350895	SCREW, Shift arm to C/C	1
15	553766	WASHER, Screw to shift lever	1
16	5006419	SHIFT LEVER	1
17	331224	LINK, Shift shaft to shift lever	1
18	330265	WASHER, Lever to C/C	1
19	315081	BUSHING, Shift lever	1
20	332226	SCREW, Safety switch mount	2
21	350611	BRACKET, Neutral switch	1
22	328724	SCREW, Detent to shift lever	2
23	5005238	LEVER & SHAFT Assy, Shift	1
24	340955	DETENT, Shift lever	1
25	315164	BALL, Shift detent	1
26	334241	GUIDE, Shift detent ball	1
27	334338	SPRING, Detent guide	1
28	312708	BUSHING, Shift shaft lever	2
29	350614	LEVER, Shift shaft to rod	1
30	328695	SCREW, Shift lever	1
31	302290	WASHER, Shift lever to rod	1
32	327590	SCREW PIN, Shift lever to rod	1
33	586780	SWITCH, Neutral	A 1
34	334192	SCREW, Switch to bracket	2
35	303851	WASHER, Neutral switch to bracket	2
36	202026	WASHER, Shift shaft to C/C	1
37	330145	PIN, Shift lever to C/C	1

This exploded view diagram illustrates the assembly of a mechanical component, likely a bracket or arm. The parts are numbered 1 through 37. The assembly process involves attaching various fasteners (bolts, nuts, washers, and pins) to structural components. Key sub-assemblies include a lever arm (10) with a roller (12) and a long curved arm (5). The main body (23) features a complex internal structure with multiple mounting points for pins (13, 14, 15, 16, 17, 18, 19, 20, 21, 22) and a cable or hose connection (33, 34, 35). The final assembly is secured with a cover plate (29) and a locking mechanism (30, 31, 32, 36, 37).

Ref	P/N	Name of Part	Qty
1	334814	LEVER, Shift	1
2	327400	WASHER	2
3	334815	BUSHING, Shift lever	1
4	330266	WASHER	1
5	318611	SCREW, Shift lever	1
6	328703	WASHER	2
7	354997	SHIFT ROD	1
8	334119	CONNECTOR, Shift rod	1
9	334373	BUSHING, Shift rod trunnion	1



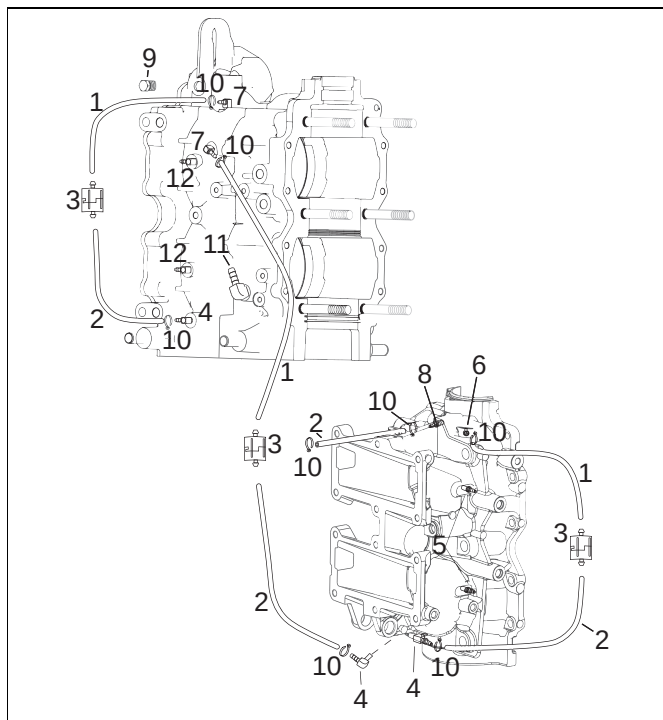
INTAKE MANIFOLD ASSEMBLY



EPC4127

Ref	P/N	Name of Part	Qty
1	5008407	THROTTLE BODY Assy	1
2	350649	*POINTER, Timing	1
3	332226	*SCREW, Timing pointer	1
4	3010673	*SENSOR, Air temperature	1
5	350805	*GASKET, Air temperature sensor	A 1
6	332226	*SCREW, Air temperature sensor	2
7	587014	*SENSOR, Crankshaft position (CPS)	1
8	332226	*SCREW, CPS	1
9	5005188	*THROTTLE LEVER	1
10	350970	*BUSHING, Throttle lever	1
11	5006484	*SENSOR, Throttle position (TPS)	1
12	352129	**NUT, TPS push	2
13	336197	**WASHER, TPS	2
14	352122	**WASHER, TPS Isolation	4
15	352739	REED PLATE Assy	1
16	348471	FITTING, Upper C/C vent to reed plate	1
17	330272	FITTING, De-Watering drain	2
18	349181	FITTING, Reed plate vent to Vap. Sep.	1
19	351216	FITTING, Reed plate-idle air inlet	1
20	397336	REED VALVE Assy	2
21	352743	GASKET, Reed plate to C/C	A 2
NS	317893	TIE STRAP, Vent hose	1
22	333677	SCREW, Reed valve to reed plate	4
23	324334	SCREW, Reed plate to C/C	2
24	350552	GASKET, Throttle body to reed plate	A 1
25	353064	SCREW, Throttle body/reed plate to C/C	10
26	328701	LOCK WASHER, Clamp	1
27	310441	CLAMP, CPS lead	1
28	350657	RETAINER, Trunnion	1
29	328724	SCREW	1
NS	320107	TIE STRAP, Stop switch leads	1
NS	317893	TIE STRAP, De-watering hose to fitting	2
A Included in Powerhead Gasket Set, P/N 5005907			

CYLINDER/CRANKCASE FITTINGS & OIL RECIRCULATION HOSES



EPC4283

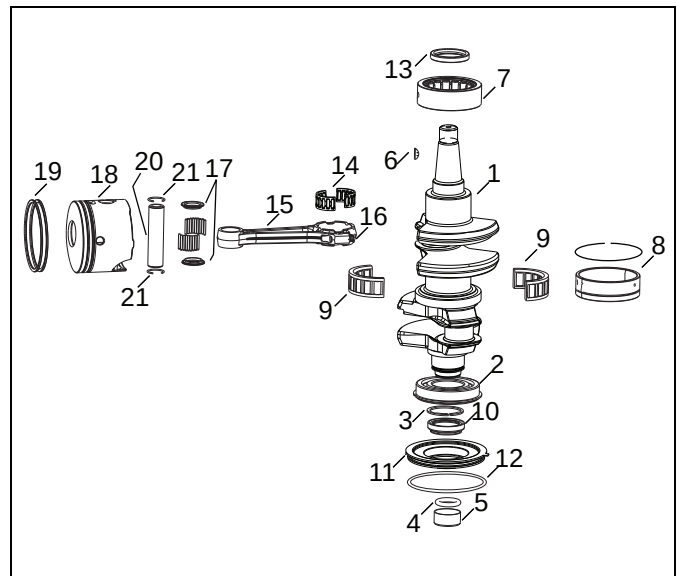
Ref	P/N	Name of Part	Qty
1	778708	HOSE, Oil (.093in. - Bulk Roll 25 ft.)	3
2	772571	HOSE, Oil (5/32in. - Bulk Roll 25 ft.)	4
3	348478	CHECK VALVE, In line oil recirculation	3
4	348471	FITTING, Oil recirculation elbow	3
5	344821	FITTING, Oil inlet	2
6	328932	FITTING, Oil recirculation-upper	1
7	346137	FITTING, Oil recirculation elbow	2
8	348471	FITTING, Oil recirculation-upper vent	1
9	332135	PLUG, Water pressure	1
10	317893	TIE STRAP	8
11	345854	FITTING, Fuel pulse	1
12	346137	FITTING, Oil inlet, sleeve	2

CRANKSHAFT & PISTONS

EPC3711

Ref	P/N	Name of Part	Qty
1	5005189	CRANKSHAFT & BEARING Assy	1
2	433503	*BEARING, Lower crankshaft	1
3	326047	*RETAINING RING, Brg to crank-lower	1
4	350630	*O-RING, Sleeve to crankshaft	A 1
5	337030	*SLEEVE, Crankshaft	A 1
6	307480	KEY, Flywheel to crankshaft	1
7	5005268	BEARING, Upper crankshaft	1
8	352960	BEARING RACE, Center main clip and	1
9	5007190	BEARING, Center main	1
10	337085	SEAL, Lower crankshaft seal hsg	A 1
11	340559	HOUSING, Lower seal	1
12	338518	O-RING, Seal hsg-lower-cyl block	A 1
13	351082	SEAL OIL, Crankshaft-upper	A 1
14	387787	BEARING, Connecting rod	2
15	5006383	CONNECTING ROD	2
16	308186	*SCREW, Connecting rod	2
17	395627	BEARING, Wrist pin	2
18	5007545	PISTON & RING Assy-Std	2
19	5000819	*PISTON RING-Standard	1
20	327861	*WRIST PIN	2
21	317831	*RING RETAINING, Wrist pin to piston	4

A Included in Powerhead Gasket Set, P/N 5005907



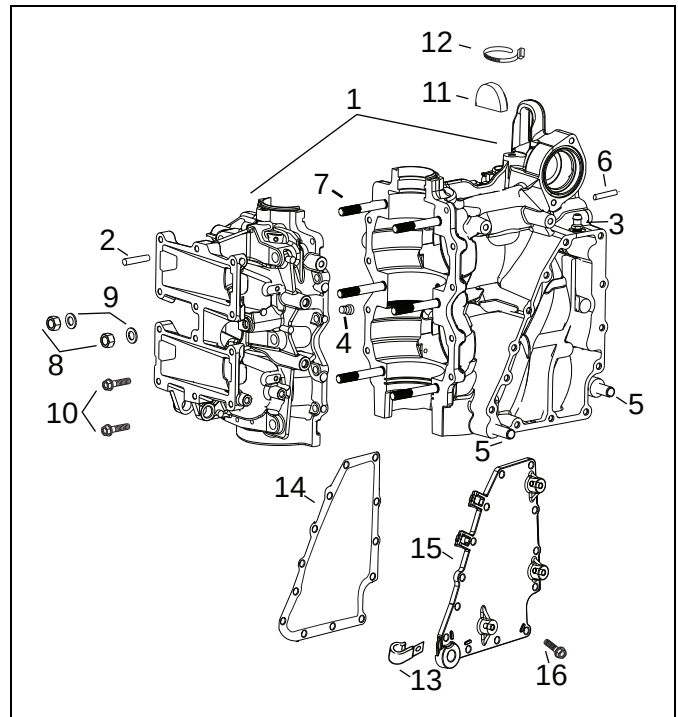
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CYLINDER & CRANKCASE

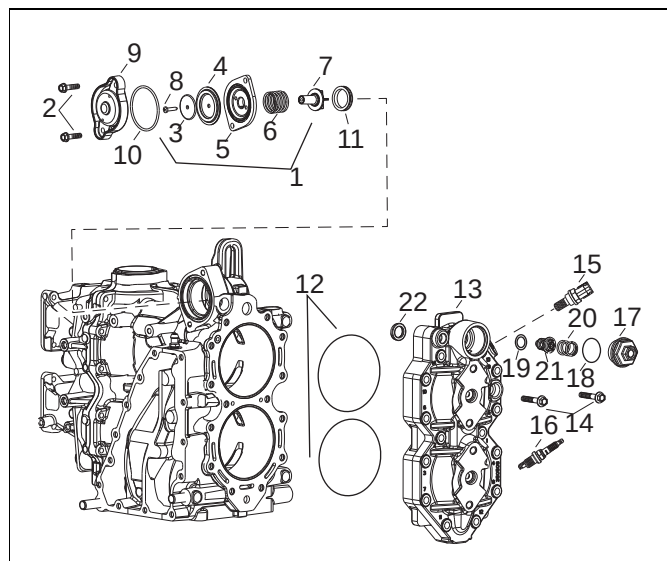
EPC3710

Ref	P/N	Name of Part	Qty
1	5006356	CYLINDER/CRANKCASE Assy	1
2	305070	*TAPER PIN, Crankcase to cyl assy	1
3	330272	*FITTING, Cyl water hose to EMM	1
4	304178	*DOWEL PIN, Main crankshaft bearing	2
5	352352	*STUD, Lower cover/Handle mount	4
6	346237	*WATER DAM, Cylinder assy	1
7	350836	*STUD, Cyl to C/C	6
8	320372	*NUT, C/C Stud	6
9	306405	*WASHER, C/C Stud nut	6
NS	348471	*FITTING, Oil recirculation elbow	A 4
NS	344821	*FITTING, Oil inlet	A 2
NS	328932	*FITTING, Oil recirculation-upper	A 1
NS	346137	*FITTING, Oil recirculation elbow	A 4
NS	332135	*PLUG, Water pressure	A 1
NS	345854	*FITTING, Fuel pulse	A 1
10	324334	SCREW, Crankcase to cylinder assy	8
11	351329	CAP, Protective	1
12	320107	TIE STRAP, Cap to lifting eye	1
13	310439	CLAMP, Harness	1
14	350629	GASKET, Water cover	1
15	350628	WATER COVER	1
16	302325	SCREW, Water cover	13
NS	330151	CLAMP, Harness to oil tank boss	1
NS	328701	LOCKWASHER, Harness clamp	1
NS	5005907	POWERHEAD GASKET & SEAL KIT	1

A See CYLINDER/CRANKCASE FITTINGS



CYLINDER HEAD & THERMOSTAT



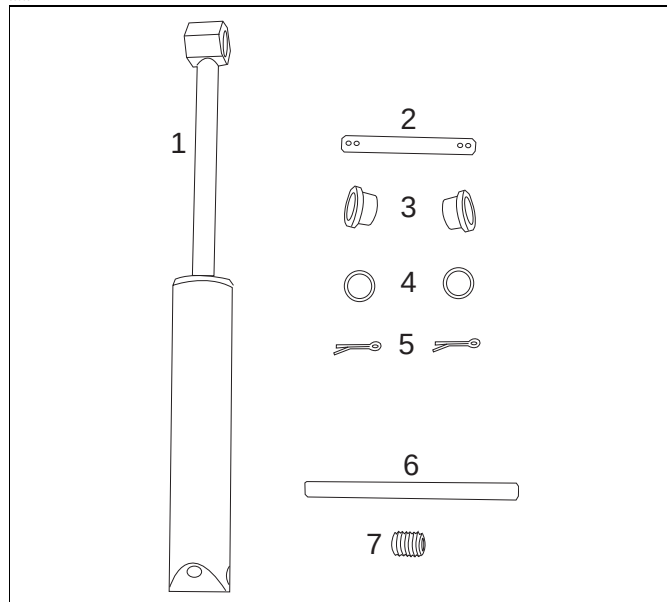
EPC3709

Ref	P/N	Name of Part	Qty
1	5006465	VALVE Assy, Cooling pressure relief	1
2	328649	*SCREW, Pressure relief valve cover	1
3	347243	*SUPPORT, Diaphragm	1
4	347244	*DIAPHRAGM	1
5	347240	*PLATE, Housing	1
6	352544	*SPRING, Valve	1
7	347238	*PLUNGER, Valve	1
8	909533	SCREW, Pressure relief valve cover	2
9	347241	COVER, Pressure relief valve	1
10	354759	O-RING, Valve to C/C	A 1
11	347245	SEAL, Plunger to C/C	A 1
12	335523	O-RING, Cylinder head	A 2
13	5006341	CYLINDER HEAD	1
14	351081	SCREW, Cylinder head	14
15	3010674	ENGINE TEMPERATURE SENSOR	1
NS	317893	TIE STRAP, Sensor connector	1
16	5007419	SPARK PLUG (QC10WEP)	2
17	338632	THERMOSTAT COVER	1
18	331188	O-RING, Thermostat cover	A 1
19	339044	GASKET, T-Stat to cylinder head	A 1
20	351145	SPRING, T-Stat cover to T-Stat	1
21	5005440	THERMOSTAT Assy	1
22	335981	SEAL, T-Stat cylinder head to C/C	A 1

A Included in Powerhead Gasket Set, P/N 5005907

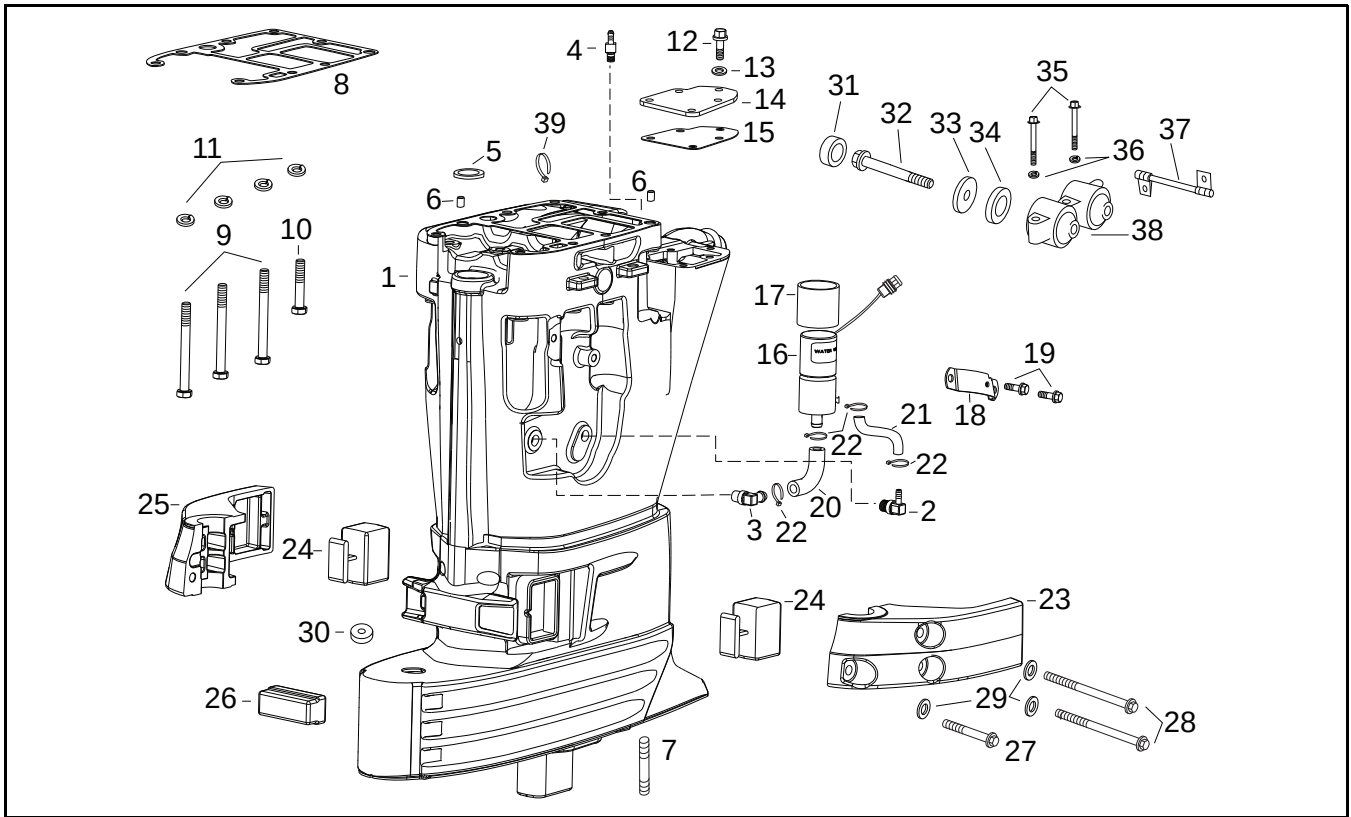
TILT ASSIST CYLINDER

5006341



EPC4266

Ref	P/N	Name of Part	Qty
-	5006139	TILT ASSIST KIT	1
1	172908	CYLINDER ASSY	1
2	351272	PIN, Upper pivot	1
3	329904	BUSHING, Upper pivot	2
4	308688	WASHER, Upper pivot pin	2
5	552906	COTTER PIN, Upper pivot	2
6	122877	PIN, Lower pivot	1
7	352207	SET SCREW	1



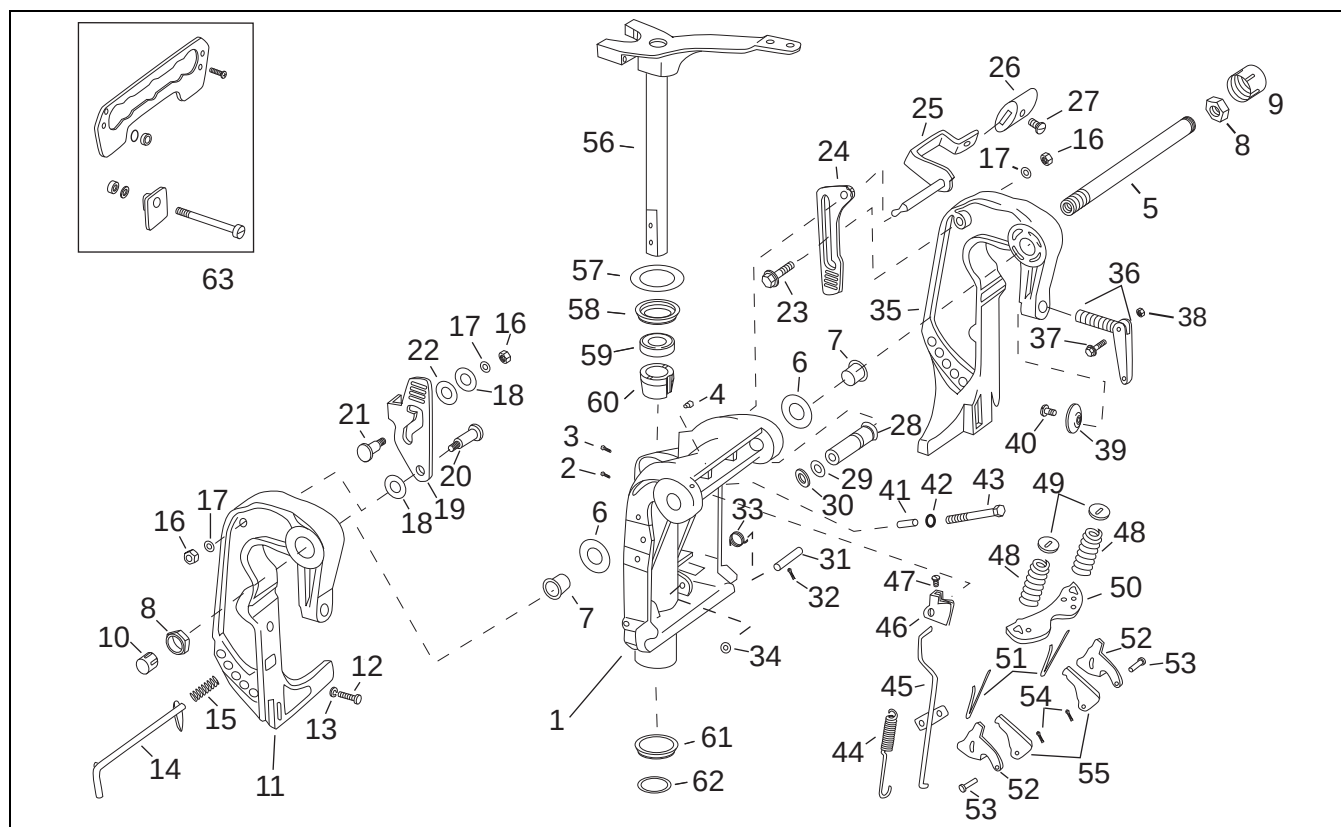
EPC4429m

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
1	5008276	EXHAUST HOUSING - MJRL models	1	20	333446	HOSE, Water inlet	1
1	5008274	EXHAUST HOUSING - MRL models	1	21	352480	HOSE, Water outlet	1
2	321886	*FITTING, Water outlet	1	22	320107	TIE STRAP	4
3	331894	*FITTING, Water inlet	1	23	351316	MOUNT BRACKET, Port	1
4	326712	*FITTING, Water inlet	1	24	333764	MOUNT, Lower	2
5	332205	*SEAL, Driveshaft to hsg	1	25	351317	MOUNT BRACKET, Starboard	1
6	350942	*PIN, Exhaust housing	2	26	332421	MOUNT, Bracket front	1
7	348843	*STUD, Exhaust housing to gearcase	1	27	339823	SCREW, Mount bracket	1
8	351018	GASKET, Exhaust hsg to powerhead	1	28	339822	SCREW, Mount bracket	2
9	352529	SCREW, Exhaust hsg to powerhead	6	29	306470	LOCK WASHER, Lower mount	3
10	352530	SCREW, Exhaust hsg to powerhead	2	30	321452	GROMMET, Shift rod	1
11	309192	WASHER, hsg to powerhead	8	31	313581	BUMPER, Mount screw	2
12	329217	SCREW, Exhaust relief cover	5	32	317648	SCREW, Upper mount	2
13	328702	WASHER, Exhaust relief cover	5	33	321232	RETAINING WASHER	2
14	351769	COVER, Exhaust relief	1	34	313580	WASHER, Upper mount	2
15	351768	GASKET, Exhaust relief cover	1	35	306423	SCREW, Upper mount anchor	3
16	5006129	VALVE, Water	1	36	306470	LOCK WASHER, Upper mount	2
17	352041	GROMMET, Water valve	1	37	582494	LEAD Assy, Steering arm to adapter	1
18	330153	CLAMP, Water valve	1	38	436470	RUBBER MOUNT, Upper	1
19	329217	SCREW, Water valve	2	39	320107	TIE STRAP, Harness	2

A MJRL Models only

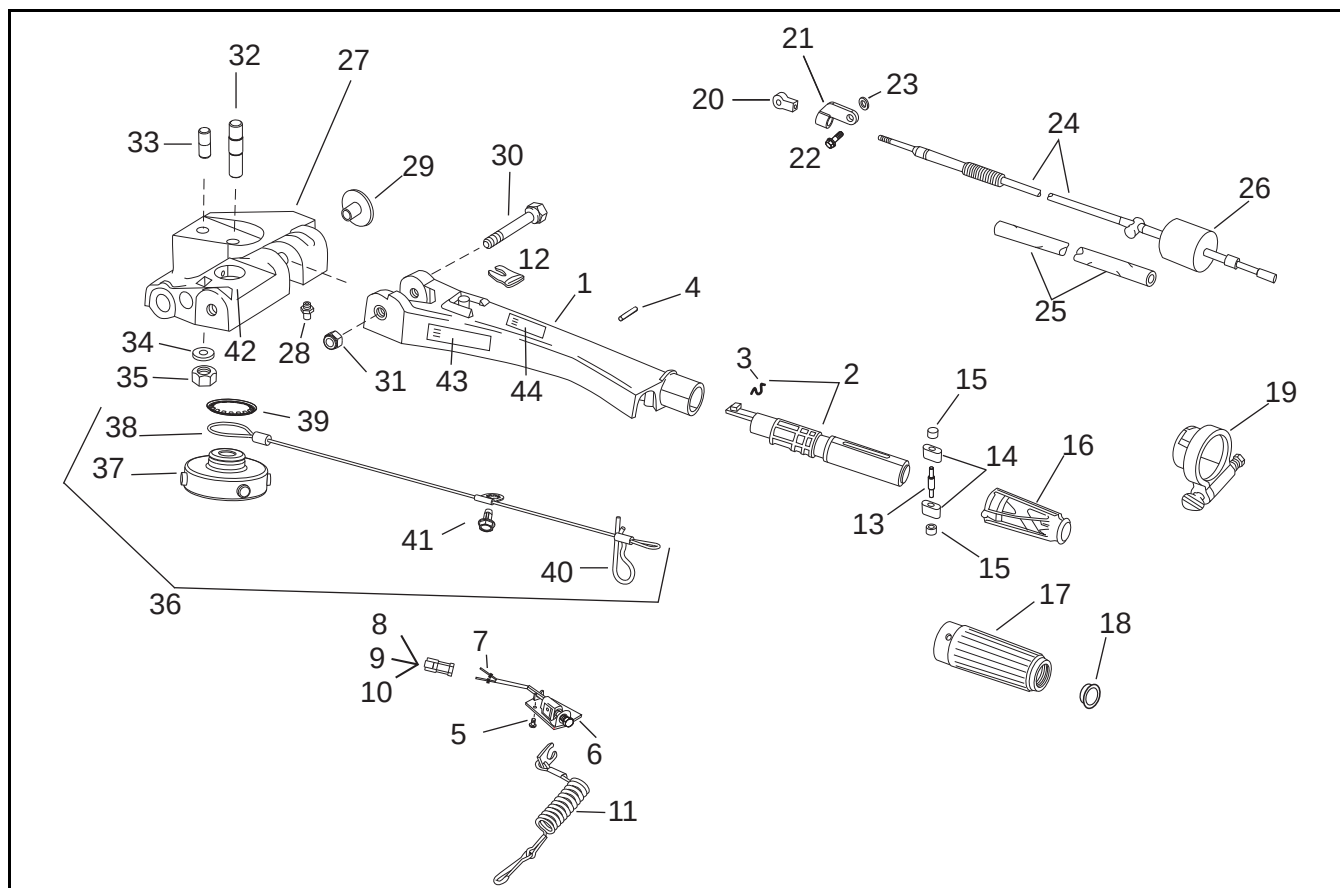
B Included in Powerhead Gasket Set, P/N 5005907

STERN & SWIVEL BRACKET



EPC4165

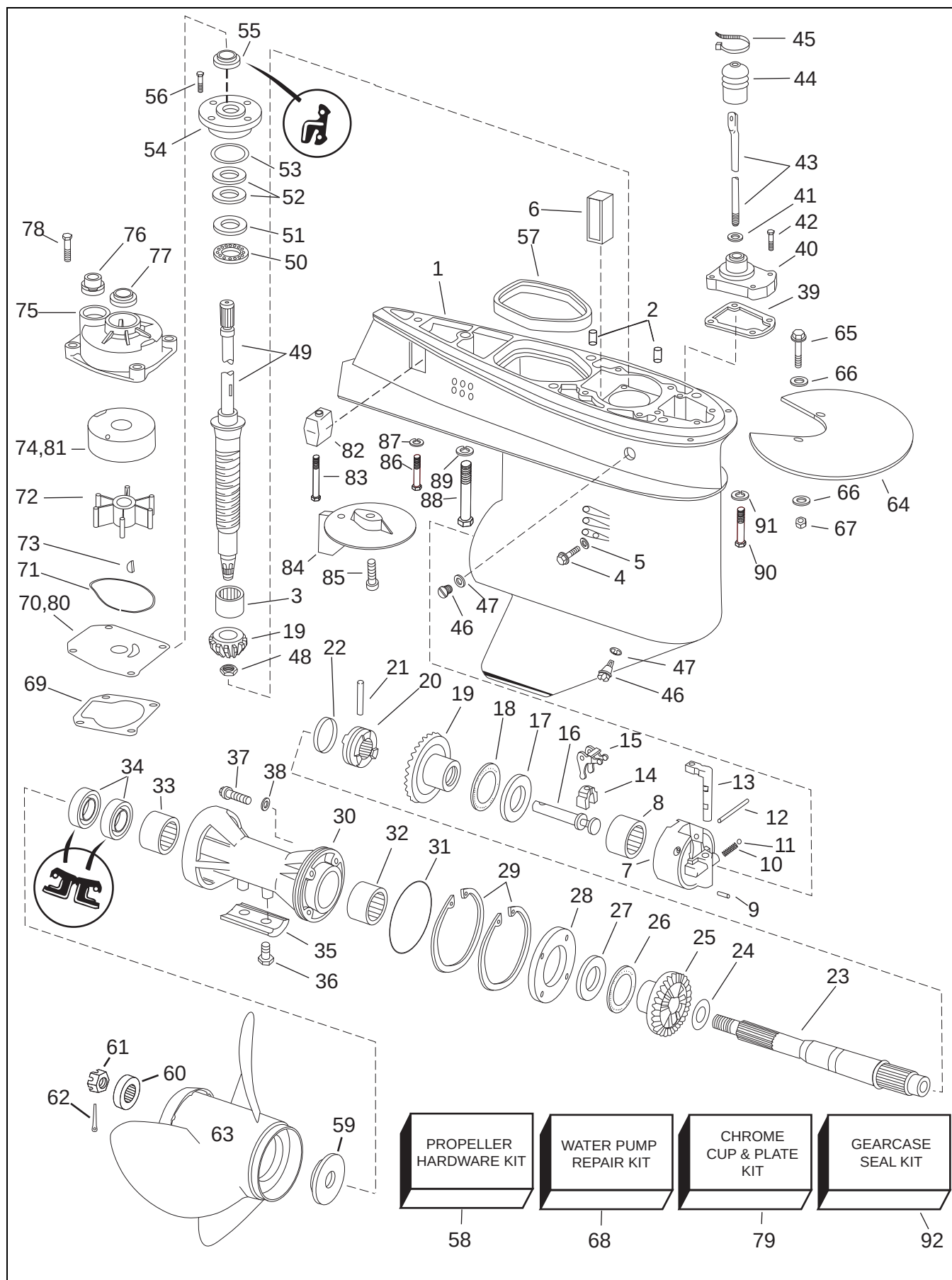
Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
1	351319	SWIVEL BRACKET	1	33	315967	SPRING, Link	2
2	317419	SCREW, Bushing to bracket	1	34	125545	WASHER, Pin	2
3	313607	FITTING, Lube	4	35	350624	STERN BRACKET, Port	1
4	317416	SCREW, Thrust ring	1	36	5005731	CLAMP SCREW & HANDLE Assy	2
5	351896	TILT TUBE	1	37	353382	*SCREW, Handle	1
6	317782	THRUST WASHER, Stern bracket	2	38	121470	*NUT, Lock	1
7	319787	BUSHING, Swivel bracket to tilt tube	2	39	337018	*SWIVEL PLATE	1
8	335554	NUT, Tilt tube	2	40	334003	*SCREW, Plate	1
9	337586	WIPER NUT	1	41	317418	PIN, Steering friction	1
10	317894	CAP	1	42	326956	O-RING, Steering friction	1
11	352294	STERN BRACKET, Starboard	1	43	350988	SCREW, Steering friction	1
12	552940	SCREW, Stern bracket	2	44	321426	SPRING, Reverse lock	1
13	306470	LOCK WASHER	2	45	387531	ROD & BRACKET Assy	1
14	436212	THRUST ROD Assy	1	46	351248	BELLCRANK	1
15	307068	SPRING, Thrust rod	1	47	304013	SET SCREW	1
16	313990	NUT, Stop link screw	3	48	313817	SPRING, Reverse lock	2
17	330179	WASHER	3	49	314007	CUP, Reverse lock spring	2
18	553766	SPRING WASHER, Stop link	2	50	321234	PLATE, Reverse lock	1
19	351218	STOP LINK, Starboard	1	51	315965	RETAINER, Spring	2
20	351271	SCREW, Stop link to stern bracket	1	52	315964	LINK, Reverse lock	2
21	351270	SCREW, Stop link to swivel bracket	1	53	315962	PIN, Link to lever	2
22	303864	WASHER, Stop link, starboard	1	54	305650	COTTER PIN	2
23	351269	SCREW, Stop link	1	55	333871	LEVER, Locking	2
24	351217	STOP LINK & Assy, Port	1	56	5005161	STEERING ARM & SHAFT Assy	1
25	5005691	LEVER, SHAFT & PIN Assy	1	57	318295	THRUST WASHER, Upper	1
26	329012	KNOB, Tilt & reverse lock handle	1	58	317776	SEAL, Upper	1
27	318238	SCREW, Knob	1	59	317415	THRUST RING, Steering friction	1
28	351264	BUSHING	1	60	317412	BUSHING, Upper	1
29	351320	SPRING WASHER, Lever & shaft	1	61	318298	SEAL, Lower	1
30	351321	WASHER, Lever & shaft Assy.	1	62	318296	THRUST WASHER, Lower	1
31	315961	PIN, Link to bracket	2	63	394219	TRANSOM MOUNT KIT	1
32	333774	CLIP, Stop link	2				



EPC4336

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
1	437144	HANDLE Assy, Tiller steering	1	24	5007771	THROTTLE CABLE	1
2	397001	*INNER HANDLE	1	25	323912	TUBING, Cable	1
3	332089	**CLIP, Retainer	1	26	329063	SEAL, Throttle cable	1
4	334960	*PIN, Inner steering handle	1	27	355221	STEERING ARM BRACKET, Tiller	1
5	336481	*SCREW	3	28	313607	FITTING, Lube	1
6	586792	STOP SWITCH Assy	1	29	325452	BUSHING	2
7	514679	*TERMINAL	2	30	350989	SCREW	1
8	514688	CONNECTOR, 6 Pin	1	31	307160	LOCK NUT	1
9	514684	LOCKWEDGE, 6 Pin	1	32	354090	STUD, Bracket to steering arm - front	1
10	514690	PLUG, Sealing	4	33	354091	STUD, Bracket to steering arm - rear	1
11	398602	CLIP & LANYARD Assy	1	34	319453	WASHER, Bracket to steering arm - rear	1
12	333499	CLIP, Emergency start	1	35	315077	LOCK NUT	1
13	329880	PIN	1	36	5006413	HAND NUT & LANYARD Assy	1
14	329879	GUIDE	2	37	5004600	*NUT Assy.	1
15	329881	ROLLER	2	38	5004599	*LANYARD Assy	1
16	339722	HELIX	2	39	349889	*RING, Retaining	1
17	436216	TWIST GRIP	1	40	330941	*PIN, Shift rod retainer	1
18	342933	PLUG, Twist grip cap	1	41	328724	SCREW, Hand nut lanyard	1
19	5008076	THROTTLE FRICTION Assy	1	42	333979	DECAL, Gearshift	1
20	334153	CONNECTOR, Throttle cable	1	43	333978	DECAL, Start warning	1
21	334083	ANCHOR, Throttle cable	1	44	352948	DECAL, Fuel selector	1
22	329160	SCREW, Shoulder anchor	1	NS	335299	DECAL, Emergency clip	1
23	328739	WASHER, Anchor	1				

GEARCASE – MRL MODELS



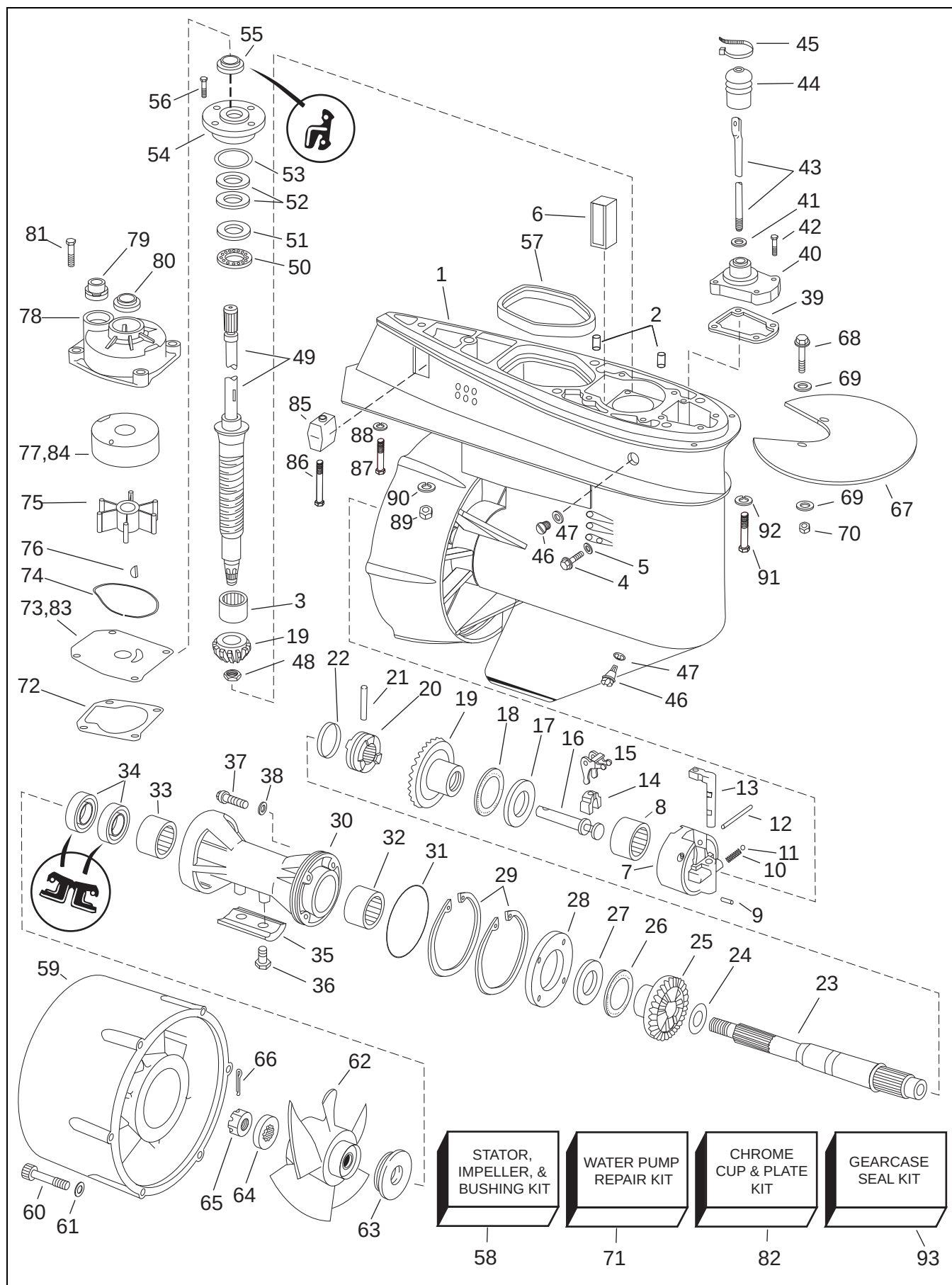
GEARCASE – MRL MODELS

EPC4129a

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
-	5006331	GEARCASE Assy - BLACK	1	47	311598	**WASHER	1
1	5005458	*GEARCASE & BEARING Assy	1	48	313339	*NUT, Pinion to driveshaft	1
2	350943	**PIN, Alignment	2	49	5005342	*DRIVESHAFT Assy	1
3	382343	**BEARING, Pinion	1	50	385068	*THRUST BEARING Assy	1
4	324852	**RETAINING SCREW & SEAL	1	51	317230	*THRUST WASHER	1
5	332584	***WASHER, Seal ring	1	52	323889	*SHIM, 0.003 in. (0.07mm)	AR
6	314175	**SCREEN, Water intake	1	52	323890	*SHIM, 0.004 in. (0.10mm)	AR
7	391365	*BEARING HOUSING Assy, Forward	1	52	317232	*SHIM, 0.005 in. (0.12mm)	AR
8	382407	**FORWARD GEAR BEARING Assy	1	53	313754	*O-RING, Bearing housing	A 1
9	331880	**PIN, Housing to gearcase	1	54	385087	*BEARING HOUSING Assy	1
10	911961	**SPRING, Detent	1	55	342786	**SEAL, Driveshaft	A 1
11	327345	**BALL, Detent	1	56	909386	*SCREW, Housing to gearcase	4
12	320145	*PIN, Lever to housing	1	57	324937	*SEAL, Gearcase to inner exh. hsg.	A 1
13	330701	*DETENT, Shifter	1	58	5005034	PROPELLER HARDWARE KIT	1
14	334163	*CRADLE, Shifter	1	59	127084	*BUSHING, THRUST	1
15	324037	*LEVER, Shift	1	60	315810	*SPACER, PROPELLER NUT	1
16	326668	*SHAFT, Shift dog	1	61	314503	*NUT, PROPELLER	1
17	324766	*THRUST WASHER, Forward gear	1	62	314502	*PIN, COTTER	1
18	385043	*THRUST BEARING, Forward gear	1	63	765181	PROPELLER	1
19	398522	*GEAR SET, Forward, Pinion	1	64	352345	SPLASH GUARD	1
		(0.375 Ratio (12/32))		65	341011	SCREW, Splash guard	2
20	318303	*SHIFTER, Clutch dog	1	66	328703	WASHER, Splash guard screw	4
21	313448	*PIN, Clutch dog	1	67	313022	NUT, Splash guard to gearcase	2
22	324369	*SPRING, Clutch dog pin	1	68	5006511	WATER PUMP REPAIR KIT	1
23	439153	*PROPELLER SHAFT Assy	1	69	336530	*GASKET, Water pump	1
24	316484	*THRUST WASHER, Shifter	1	70	341038	*PLATE, Impeller housing	1
25	318353	*GEAR, Reverse	1	71	324981	*SEAL, Impeller housing	A 1
26	382408	*THRUST BEARING	1	72	396725	*IMPELLER & KEY Assy	1
27	313447	*THRUST WASHER	1	73	334897	**KEY, Impeller to driveshaft	1
28	313453	*RETAINER PLATE, Bearing housing	1	74	340619	*CUP, Impeller housing	1
29	313445	*RETAINING RING	2	75	5006259	*IMPELLER HOUSING	1
30	434391	*BEARING HOUSING Assy	1	76	333758	*GROMMET, Water tube	1
31	313446	**O-RING, Bearing housing	A 1	77	341732	*GROMMET, Housing	1
32	382407	**REVERSE GEAR BEARING Assy	1	78	328725	*SCREW, Impeller housing, short	4
33	379504	**PROPSHAFT BEARING Assy	1	79	389145	CHROME CUP & PLATE KIT	Opt. 1
34	330137	**SEAL	A 2	80	341187	*PLATE, Chrome impeller housing	1
35	431708	**ANODE, Bearing housing	1	81	341186	*CUP, Chrome impeller hsg	1
36	908158	**SCREW, Anode	2	82	436745	ANODE & INSERT, Gearcase	1
37	320041	*SCREW, Housing to gearcase	A 4	83	328096	SCREW	1
38	332584	**SEAL	1	84	127466	TRIM TAB, Gearcase	1
39	314082	*GASKET, Cover to gearcase	A 1	85	313715	SCREW, Trim tab	1
40	387336	*COVER Assy	1	86	306503	SCREW, Short	1
41	318372	**O-RING, Shift rod	A 1	87	306470	LOCK WASHER, Short screw	1
42	328725	*SCREW, Cover to gearcase	4	88	331998	SCREW, Long	1
43	350622	*SHIFT ROD	1	89	330265	LOCK WASHER, Long screw	1
44	317922	*SEAL, Shift rod	1	90	552968	SCREW, Gearcase to housing	4
45	320107	*TIE STRAP, Seal to rod	1	91	330266	LOCK WASHER	4
46	318544	*SCREW, Fill & drain plug	A 2	92	5000309	GEARCASE SEAL KIT	1

A Contents of Gearcase Seal Kit

GEARCASE – MJRL MODELS



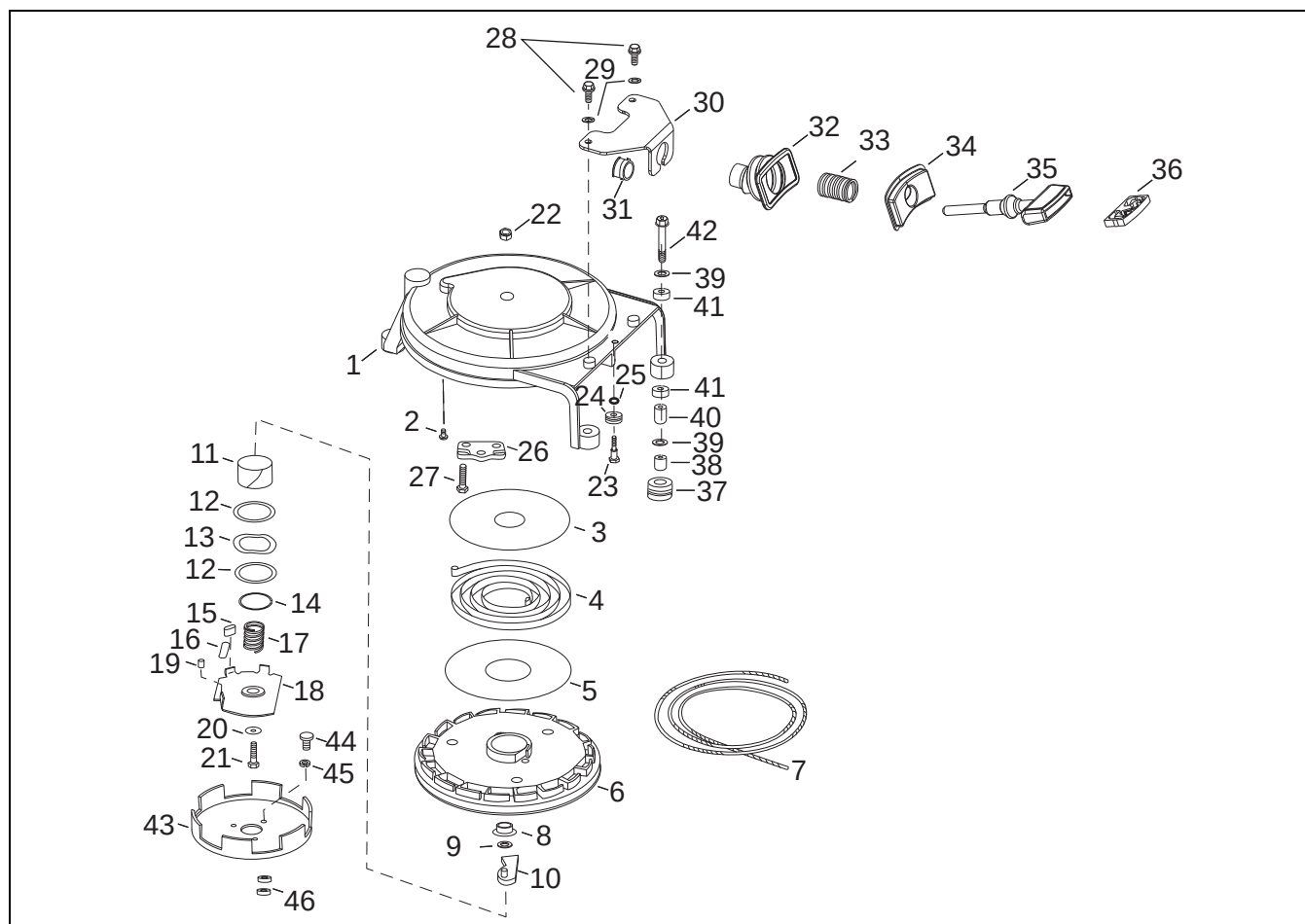
GEARCASE – MJRL MODELS

EPC4129p

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
-	5008131	GEARCASE, ROTOR & PUMP Assy	1	47	311598	***WASHER	1
1	5007686	*GEARCASE Assy	1	48	313339	**NUT, Pinion to driveshaft	1
1	5007685	**GEARCASE & BEARING Assy	1	49	5005342	**DRIVESHAFT ASSY.	1
2	350943	***PIN, Gearcase to exh hsg	2	50	385068	**THRUST BEARING ASSY.	1
3	382343	***BEARING, Pinion	1	51	317230	**THRUST WASHER	1
4	324852	***RETAINING SCREW & SEAL	1	52	323889	**SHIM, 0.003 in. (0,07mm)	AR
5	332584	***WASHER, Seal ring	1	52	323890	**SHIM, 0.004 in. (0,10mm)	AR
6	314175	***SCREEN, Water intake	1	52	317232	**SHIM, 0.005 in. (0,12mm)	AR
7	391365	**BEARING HOUSING ASSY.	1	53	313754	**O-RING, Bearing housing	A 1
8	382407	***FORWARD GEAR BEARING Assy	1	54	385087	**BEARING HOUSING ASSY.	1
9	331880	***PIN, Housing to gearcase	1	55	342786	***SEAL	A 1
10	911961	***SPRING, Detent	1	56	909386	**SCREW, Housing to gearcase	4
11	327345	***BALL, Detent	1	57	324937	**SEAL, Gearcase to inner exh. hsg.	A 1
12	320145	**PIN, Lever to housing	1	58	5008177	*STATOR, IMPELLER, & BUSHING KIT	1
13	330701	**DETENT, Shifter	1	59	5007560	**STATOR HOUSING	1
14	334163	**CRADLE, Shifter	1	60	344722	**SCREW, Stator housing	6
15	324037	**LEVER, Shift	1	61	344775	**WASHER, Stator hsg screw	6
16	326668	**SHAFT, Shift dog	1	62	349238	**IMPELLER & BUSHING Assy	1
17	324766	**THRUST WASHER, Forward gear	1	63	127084	**THRUST BUSHING	1
18	385043	**THRUST BEARING, Forward gear	1	64	315810	**SPACER, Impeller nut	1
19	398522	**GEAR SET, Forward, Pinion	1	65	314503	**NUT, Impeller	1
		(0.375 Ratio (12/32))		66	314502	**PIN, Impeller nut	1
20	318303	**SHIFTER, Clutch dog	1	67	352345	SPLASH GUARD	1
21	313448	**PIN, Clutch dog	1	68	341011	SCREW, Splash guard	2
22	324369	**SPRING, Clutch dog pin	1	69	328703	WASHER, Splash guard screw	4
23	439153	**PROPELLER SHAFT ASSY.	1	70	313022	NUT, Splash guard to gearcase	2
24	316484	**THRUST WASHER, Shifter	1	71	5006511	WATER PUMP REPAIR KIT	1
25	318353	**GEAR, Reverse	1	72	336530	*GASKET, Water pump	1
26	382408	**THRUST BEARING	1	73	341038	*PLATE, Impeller housing	1
27	313447	**THRUST WASHER	1	74	324981	*SEAL, Impeller housing	1
28	313453	**RETAINER PLATE, Bearing housing	1	75	396725	*IMPELLER & KEY Assy	1
29	313445	**RETAINING RING	2	76	334897	**KEY, Impeller to driveshaft	1
30	434391	**BEARING HOUSING ASSY.	1	77	340619	*CUP, Impeller housing	1
31	313446	***O-RING, Bearing housing	A 1	78	5006259	*IMPELLER HOUSING	1
32	382407	***REVERSE GEAR BEARING Assy	1	79	333758	*GROMMET, Water tube	1
33	379504	***PROPSHAFT BEARING Assy	1	80	341732	*GROMMET, Housing	1
34	330137	***SEAL	A 2	81	328725	*SCREW, Impeller housing, short	4
35	431708	***ANODE, Bearing housing	1	82	389145	CHROME CUP & PLATE KIT	Opt. 1
36	908158	***SCREW, Anode	2	83	341187	*PLATE, Chrome impeller housing	1
37	320041	**SCREW, Housing to gearcase	A 4	84	341186	*CUP, Chrome impeller hsg	1
38	332584	***SEAL	1	85	436745	ANODE & INSERT, Gearcase	1
39	314082	**GASKET, Cover to gearcase	A 1	86	328096	SCREW	1
40	387336	**COVER ASSY.	1	87	306503	SCREW, Short	1
41	318372	***O-RING, Shift rod	A 1	88	306470	LOCK WASHER, Short screw	1
42	328725	**SCREW, Cover to gearcase	4	89	353926	NUT, Exhaust housing stud	1
43	350622	**SHIFT ROD	1	90	202026	LOCK WASHER, Stud	1
44	317922	**SEAL, Shift rod	1	91	552968	SCREW, Gearcase to housing	4
45	320107	**TIE STRAP, Seal to rod	1	92	330266	LOCK WASHER	4
46	318544	**SCREW, Fill & drain plug	2	93	5000309	GEARCASE SEAL KIT	1

A Contents of Gearcase Seal Kit

RECOIL STARTER



EPC3723

Ref	P/N	Name of Part	Qty	Ref	P/N	Name of Part	Qty
-	5007351	RECOIL STARTER Assy	1	23	327768	*SCREW, Rope guide pulley	1
1	332910	*HOUSING, Starter	1	24	438103	*PULLEY & O-RING ASSY.	1
2	121266	*GLIDER, Housing to pulley	6	25	339543	**O-RING, Rope guide	1
3	325429	*SHIELD, Housing spring	1	26	341171	*SUPPORT, Pulley	1
4	325431	*SPRING, Starter	1	27	908158	*SCREW, Support	1
5	326131	*SHIELD, Pulley spring	1	28	329217	*SCREW, Handle plate	2
6	394604	*PULLEY, Starter	1	29	331249	*WASHER, Handle bracket to housing	2
7	772578	*ROPE, Starter (7/32in. - Bulk Roll 100') (Qty 1) - length 96 1/2 in. (2.5M)	AR	30	351347	*BRACKET, Handle support	1
8	311015	*BUSHING, Pawl	1	31	321243	*BUSHING, grommet to bracket	1
9	326964	*WASHER, Pawl bushing to pawl	1	32	204911	*GROMMET, Handle to cover	1
10	398228	*PAWL, Starter pulley	1	33	204913	*SPRING, Handle grommet	1
11	341063	*BUSHING, Pulley	1	34	353658	*PLATE, Handle support	1
12	340817	*WASHER, Pulley retaining	2	35	334633	*HANDLE, Starter	1
13	309515	*WASHER, Retaining washer to pulley	1	36	304235	*ANCHOR, Rope	1
14	326119	*RING RETAINING, Pulley	1	37	350973	GROMMET, Flywheel cover	3
15	331929	*SLEEVE, Pawl plate	1	38	351299	BUSHING, Flywheel cover	3
16	326132	*SPRING, Pawl plate return	1	39	321465	WASHER, Starter housing	6
17	326120	*SPRING, Pawl plate to housing	1	40	326129	SLEEVE, Housing to C/C	3
18	432111	*PULLEY PLATE & SLEEVE Assy	1	41	326130	GROMMET, Starter housing screw	6
19	334350	**SLEEVE, Plate	1	42	351517	SCREW, Starter hsg	3
20	328700	*WASHER, Pawl plate to housing	1	43	329245	RATCHET, Flywheel	1
21	331979	*SCREW, Pawl plate to hsg	1	44	307718	SCREW, Ratchet	3
22	328741	*NUT, Pawl plate	1	45	301250	WASHER, Ratchet to flywheel	3
				46	910095	SPACER, Ratchet to flywheel	6

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NOTES

Technician's Notes

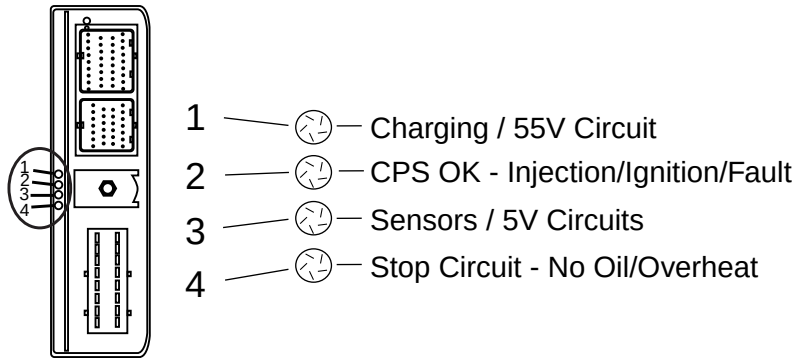
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Related Documents

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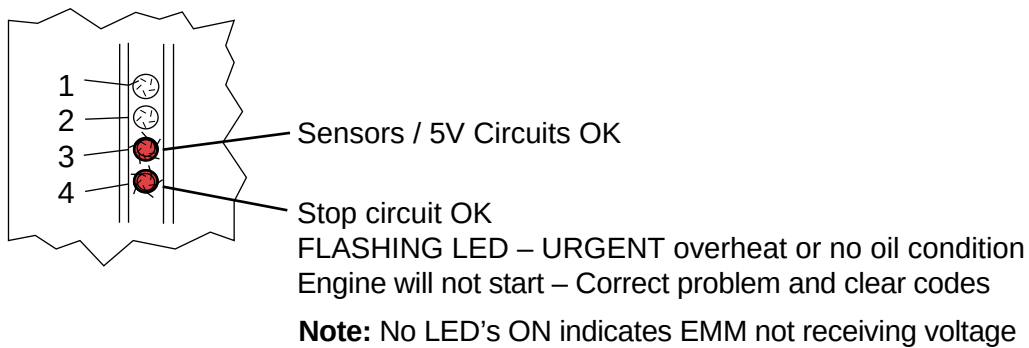
EMM LED Diagnostic Indicators

MFE Models

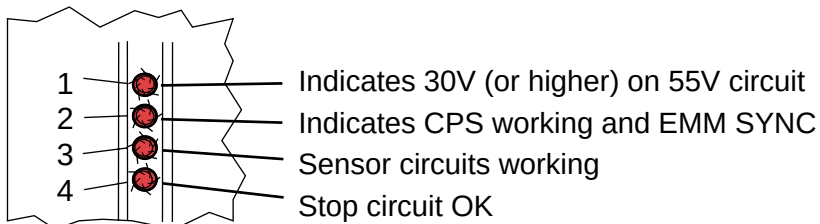


For more information, refer to **SYSTEM ANALYSIS** in the Service Manual.

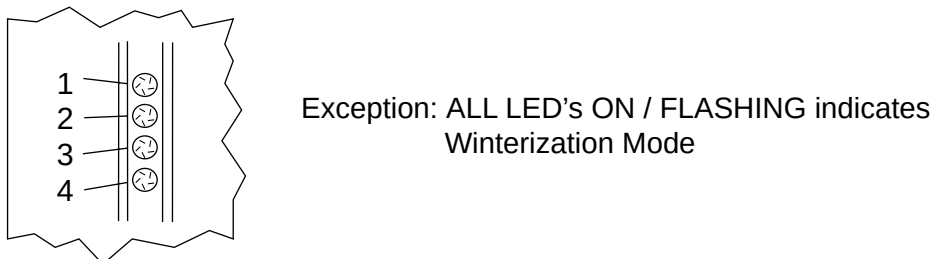
EMM ON : LED's illuminate to indicate circuit function
(Diagnostic power supply connected)



STARTING : LED's illuminate to indicate circuit function

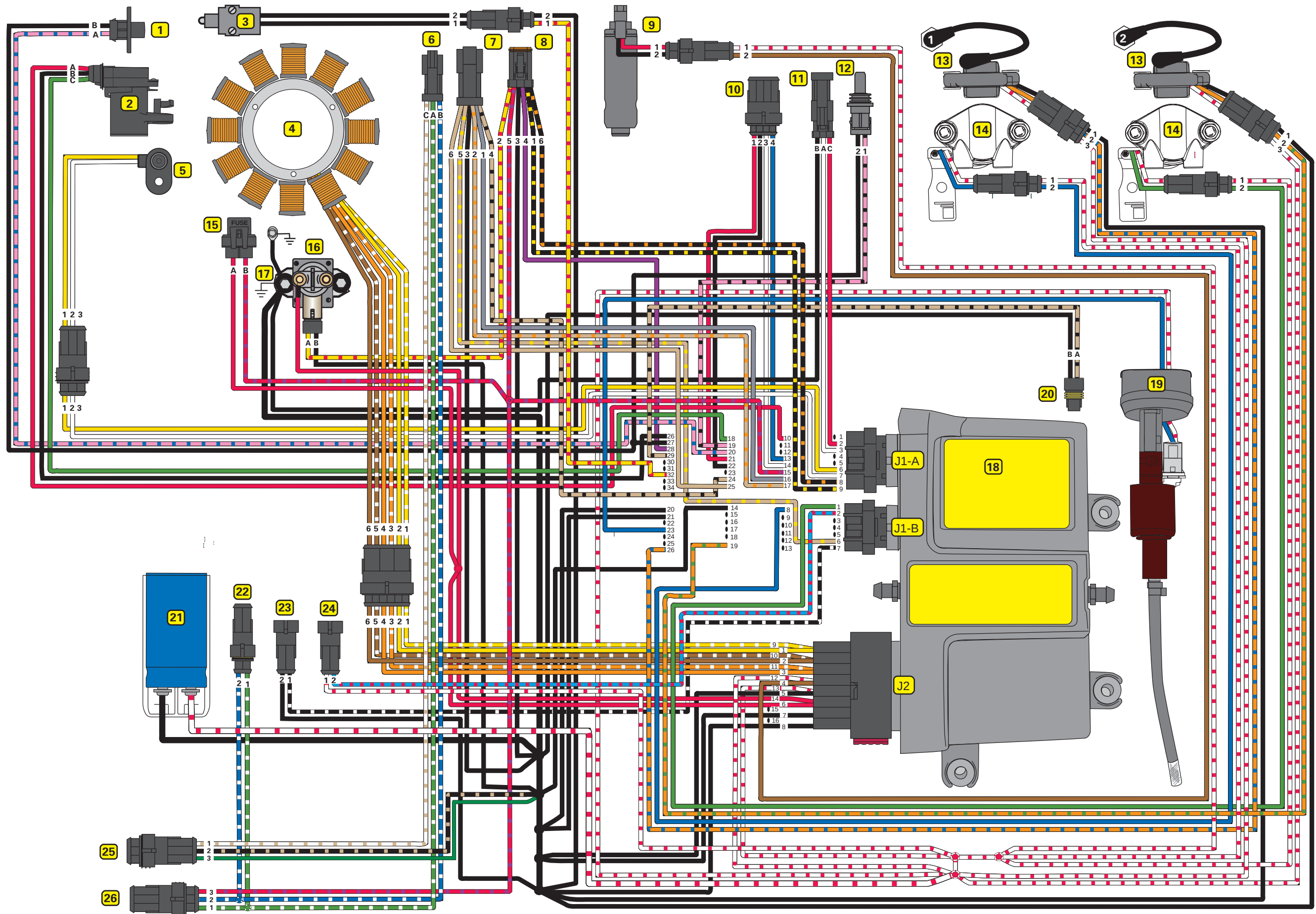


RUNNING : LED's illuminate to indicate circuit fault



55 HP MFE

1. Air Temperature Sensor
2. Throttle Position Sensor
3. Neutral Switch
4. Stator
5. Crankshaft Position Sensor
6. Trim/Tilt Connector
7. SystemCheck Connector
8. Tiller/Key Switch Connector
9. High Pressure Fuel Pump
10. CANbus Connector
11. Diagnostic Connector
12. Temperature Sensor
13. Ignition Coil
14. Fuel Injector
15. Fuse (10 Amp)
16. Starter Solenoid
17. Main Harness Ground
18. EMM
19. Oil Injector
20. Low Oil Switch
21. Capacitor
22. Trim/Tilt Relay Connector
23. Fuel Map Switch Connector
24. Water Valve Connector
25. Trim Sending Unit Connector
26. Trim/Tilt Switch Connector



EVINRUDE 55 MFE EMM SERVICE CODE CHART

CODE	EMM CIRCUIT/SENSOR	INTERNAL SENSOR	ACTIVE WARNING	S.A.F.E.	EMM LED DISPLAY	BOAT HARNESS/GAUGE WARNING DISPLAY (Optional)	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION
11	Throttle Position Sensor (TPS) out of idle range				-	-	2 seconds	TPS Voltage > 0.78 V with key ON (or cranking). Becomes stored fault when outboard starts. When both hard and stored faults are present, check for improperly adjusted throttle cable.
12	Throttle Position Sensor (TPS) circuit fault				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	0.8 seconds	TPS Voltage: < 0.14 V, or > 4.92 V. Engine limited to idle speed. Check sensor resistance—3000 Ω(between pins A and B) & 4000 Ω (between pins A and C)
13	TPS below range				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	TPS Voltage < 0.2 V. Check linkage and IDLE stop.
14	TPS above range				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	TPS Voltage > 4.85 V. Check linkage and WOT stop.
15	ROM (EMM program)	✓			-	-	-	ROM “CHECKSUM” failure. Check software program number in EMM. Reload or replace with proper program.
16	Crankshaft Position Sensor (CPS) Intermittent loss of SYNC				LED 2: OFF (Cranking) LED 3: ON (Running)	-	10 instances	EMM counts losses of synchronization with crankshaft speed. Check CPS mounting and resistance. Air gap range: 00.036 to 0.110 in. (1 to 2.8 mm), nominal 0.073 in. (1.85 mm) Resistance: 560 Ω ± 10% @ 77°F (25°C)
17	55 V circuit BELOW range	✓			LED 1: ON (Running)	CHECK ENGINE	1 minute	System Voltage < 45 V. Perform stator/charging tests.
18	55 V circuit ABOVE range	✓			LED 1: ON (Running)	CHECK ENGINE	1 minute	System Voltage > 57 V. Perform stator/charging tests. Check for loose connections in 55 V circuit. Check capacitor.
19	Start-in-gear				LED 3: OFF (Cranking)	CHECK ENGINE	-	Attempted engine start while in gear (EMM in tiller mode). Engine will not start.
21	Winterization activated				All LEDs FLASHING	All Lights FLASHING	-	Engine is speed limited, and stops after 360 oil pulses. Refer to Maintenance or Operator’s Guide.
23	EMM Temperature Sensor circuit fault	✓			LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	EMM Temperature < -71° F (-57.4° C), or > 313° F (156° C).
24	EMM Temperature BELOW range	✓			LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	EMM Temperature < -22 ° F (-30° C).
25	EMM Temperature ABOVE range	✓	✓		LED 4: ON (Running)	WATER TEMP/HOT	8 seconds	EMM Temperature > 176°F (80°C). Engine misfires once per 50 crankshaft revolutions. See Code 29.
26	12 V circuit BELOW range	✓			LED 1: ON (Running)	LOW BATTERY	5 minutes	Battery voltage < 12.5 V. Perform stator/charging tests.
27	12 V circuit ABOVE range	✓			LED 1: ON (Running)	LOW BATTERY	5 minutes	Battery voltage > 15.5 V. Check battery connections and wiring.
29	EMM Temperature OVER range	✓		✓	LED 4: FLASHING	WATER TEMP/HOT (FLASHING)	4 seconds	EMM Temperature > 212° F (100° C). Engine limited to 2500 RPM. Check outboard and EMM cooling systems.
31	Engine temperature OVER range			✓	LED 4: FLASHING	WATER TEMP/HOT (FLASHING)	8 seconds	Engine Temperature > 230° F (110° C). Engine limited to 2500 RPM. Check cooling system. Check temperature sensor resistance—9000 to 11000 Ω @ 77°F (25°C).
33	Critical NO OIL detected	✓		✓	LED 4: FLASHING	NO OIL (FLASHING)	3 hours	Outboard has run three hours with code 34 or 117. Engine limited to 2500 RPM. Failure is imminent.
34	Oil injection pump circuit OPEN			✓	LED 4: ON (Running)	NO OIL	4 seconds	Engine limited to 2500 RPM. Check oil injection pump circuit resistance—22 Ω.
41	Engine Temperature Sensor circuit fault				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Engine Temperature < -15° F (-26.2° C), or > 332° F (166.5° C). Check sensor and circuit resistance—9000 to 11000 Ω @ 77°F (25°C).
42	Engine Temperature BELOW range				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Engine Temperature < -4° F (-20° C). Check thermostat and pressure relief valve.
43	Engine Temperature ABOVE range		✓		LED 4: ON (Running)	WATER TEMP/HOT	8 seconds	Engine Temperature > 194° F (90° C). Engine misfires once per 50 crankshaft revolutions. Check cooling system.
44	Barometric Pressure (BP) Sensor circuit fault	✓			-	-	8 seconds	Pressure < 3.9 in. Hg (13.3 kPa), or > 35.1 in. Hg (119.0 kPa). Make sure EMM BP sensor tube is NOT plugged. Check atmospheric condition for comparison. Clear code and retest.
45	BP Sensor BELOW range	✓			-	-	8 seconds	Pressure < 20.7 in. Hg (70 kPa).
46	BP Sensor ABOVE range	✓			-	-	8 seconds	Pressure > 31 in. Hg (105 kPa).
47	Air Temperature (AT) circuit fault				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	Air temperature < -58° F (-49.9° C), or > 218° F (103.2° C). Check sensor and circuit resistance—9000 to 11000 Ω @ 77°F (25°C).
48	Air Temperature BELOW range				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Air temperature < -22° F (-30° C).
49	Air Temperature ABOVE range				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Air temperature > 158° F (70° C).
51	Fuel injector circuit #1 OPEN				LED 2: ON (Running)	-	2 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).
52	Fuel injector circuit #2 OPEN				LED 2: ON (Running)	-	2 seconds	
58	Operating temperature not reached				LED 3: OFF (Cranking) / ON (Running)	-	10 minutes	Engine temperature < 104° F (40° C) with engine speed < 2300 RPM. Check thermostat and pressure relief valve.
61	Fuel injector circuit #1 SHORTED				LED 2: ON (Running)	-	8 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).
62	Fuel injector circuit #2 SHORTED				LED 2: ON (Running)	-	8 seconds	
78	Sensor supply voltage fault	✓			LED 3: OFF (Cranking) / ON (Running)	-	10 seconds	Sensor voltage < 4.75 V. Check sensors and related wiring. Check for pinched or chafed wiring.
81	Ignition timing circuit #1 OPEN				LED 2: ON (Running)	-	10 instances	EMM counts failed ignition events. Check wiring. Test with known good ignition coil.
82	Ignition timing circuit #2 OPEN				LED 2: ON (Running)	-	10 instances	
90	Water injection solenoid SHORTED				LED 2: ON (Running)	-	8 seconds	Check circuit resistance—295 Ω ± 20 @ 77°F (25°C).
91	Fuel pump circuit OPEN				LED 2: ON (Running)	-	8 seconds	Check pump/circuit resistance—2 to 3 Ω @ 77°F (25°C).
93	Water injection solenoid OPEN				LED 2: ON (Running)	-	8 seconds	Check circuit resistance—295 Ω ± 20 @ 77°F (25°C).
94	Fuel pump circuit SHORTED				LED 2: ON (Running)	-	2 seconds	Check pump/circuit resistance—2 to 3 Ω @ 77°F (25°C).
101	Ignition timing circuit #1 SHORTED				LED 2: ON (Running)	-	20 instances	EMM counts failed ignition events. Check wiring. Test with known good ignition coil.
102	Ignition timing circuit #2 SHORTED				LED 2: ON (Running)	-	20 instances	
117	Critical LOW OIL detected	✓		✓	LED 4: ON (Running)	NO OIL	4800 Pulses	EMM counts oil pump pulses after LOW OIL switch closes. Engine limited to 2500 RPM. Stop outboard and add oil to tank. Warning resets after three oil pump pulses.

NOTE: Always note service codes before clearing codes. Clear stored codes using diagnostic software. Clearing some codes requires turning EMM “OFF” and then “ON” again.

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