EVINRUDE®

E-TEC®

BRP

Service Manual

75, 90 HP

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

Printed in the United States.

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INTRODUCTION

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SAFETY INFORMATION

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

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

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

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

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

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

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

These safety notices mean:

ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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

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

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

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

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

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

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

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

DANGER

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

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

WARNING

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

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

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

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

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

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

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

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

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

Always work in a well ventilated area.

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

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
CPS	crankshaft position sensor
EMM	Engine Management Module
ICOMIA	International Council of Marine Industry Associations
MCA	marine cranking amps
MWS	modular wiring system
NMEA	National Marine Electronics Assoc.
NTC	negative temperature coefficient
PTC	positive temperature coefficient
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
WOT	wide open throttle
WTS	water temperature sensor

ENGINE EMISSIONS INFORMATION

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

Manufacturer's Responsibility

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

Dealer's Responsibility

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

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

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

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

Owner's Responsibility

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

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

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

EPA Emission Regulations

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

VIA U.S. POSTAL SERVICE:

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

VIA EXPRESS or COURIER MAIL:

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

EPA INTERNET WEB SITE:

www.epa.gov

MODEL DESIGNATION

STYLE:
J = Johnson
E = Evinrude

LENGTH:

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

PREFIX

HORSEPOWER

MODEL RUN or SUFFIX

B E 200 DP X SC A

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

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

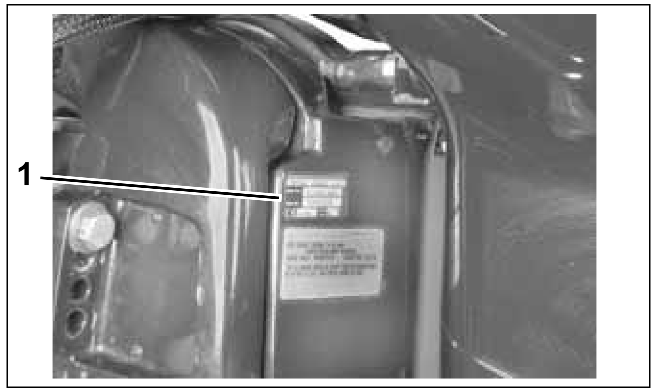
MODELS COVERED IN THIS MANUAL

This manual covers service information on all 79 cubic inch, 3-Cylinder *Evinrude E-TEC* ® models.

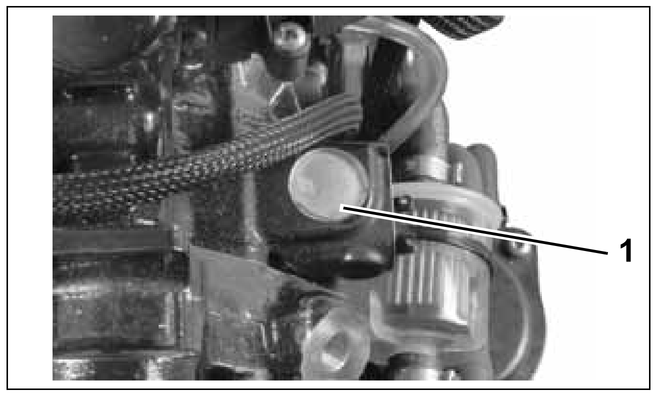
Model Number	Shaft	Color	Gearcase
E75DPLSCB	20”	BL	“S”
E75DSLSCS	20”	WH	“S”
E90DPLSCB	20”	BL	“S”
E90DSLSCM	20”	WH	“S”
E90DPXSCB	25”	WH	“O”
E90WDELSCS	20”	BL	“S”
E90WDEXSCS	25”	WH	“O”

Identifying Model and Serial Numbers

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



1. *Model and serial number* 002147



1. *Serial number* 002226

SERVICE SPECIFICATIONS

75 – 90 HP E-TEC Models		
ENGINE	Full Throttle Operating Range RPM	4500 to 5500 RPM
	Power	75 HP (56 kw) @ 5000 RPM 90 HP (67.1 kw) @ 5000 RPM
	Idle RPM in Gear	700 ± 50 *EMM* Controlled
	Idle RPM in Neutral	600 ± 50 *EMM* Controlled
	Test Propeller	**(L) Models:** P/N 386246 **(X) Models:** P/N 387388
	Weight (may vary depending on model)	**(L) Models:** 320 lbs. (145 kg) **(X) Models:** 335 lbs. (152 kg)
	Lubrication	*Evinrude/Johnson XD100, XD50, XD30*; or NMMA TC-W3 certified
	Engine Type	In-line, 3 Cylinder, Two-Cycle
	Displacement	79.1 cu. in. (1296 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) To bore oversize, add piston oversize dimension to standard bore
	Top Crankshaft Journal	2.1870 to 2.1875 in. (55.55 to 55.56 mm)
	Center Crankshaft Journals	2.1870 to 2.1875 in. (55.55 to 55.56 mm)
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)
	Rod Crankpin	1.3757 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.
	Minimum Octane	87 AKI (R+M)/2 or 90 RON
	Additives	*2+4 ® Fuel Conditioner*, *Fuel System Cleaner* Use of other additives may result in engine damage.
		See **Fuel Requirements** on p. 51 for additional information

75 – 90 HP E-TEC Models			
ELECTRICAL	Minimum Battery Requirements	640 CCA (800 MCA) **or** 800 CCA (1000 MCA) below 32° F (0° C)	
	Alternator	25-Amp fully regulated	
	Tachometer Setting	6 pulse (12 pole)	
	Engine Fuse	P/N 967545 – 10 A	
COOLING	Maximum Temperature	212°F (100°C)	
	Thermostat	143°F (62°C)	
	Water pressure	16 psi minimum @ 5000 RPM	
IGNITION	Type	Capacitor Discharge	
	Firing Order	1-2-3	
	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	
		Champion † QC10WEP @ 0.028 ± .003 in. (0.71 mm)	
GEARCASE	Gear Ratio	**20 in. (L) Models:** 13:26 (.500) **25 in. (X) Models:** 12:27 (.444)	2:1 2.25:1
	Lubricant	*HPF XR Gearcase Lube*	
	Capacity	**20 in. (L) Models:** 31.6 fl. oz. (935 ml) **25 in. (X) Models:** 32.8 fl. oz. (970 ml)	
	Shift Rod Height	**20 in. (L) Models:** 21.25 (539.75 mm) ± one-half turn **25 in. (X) Models:** 26.25 (666.75 mm) ± one-half turn	
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD	
POWER TRIM/TILT	Lubrication	**Single Piston System**–*Evinrude/Johnson* Biodegradable TNT Fluid	
	Fluid Capacity	21 fl. oz. (620 ml)	
	Trim Range	0° to 15°	
	Tilt Range	16° to 65°	

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

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

⚠ WARNING ⚠

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

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

PRODUCT REFERENCE AND ILLUSTRATIONS

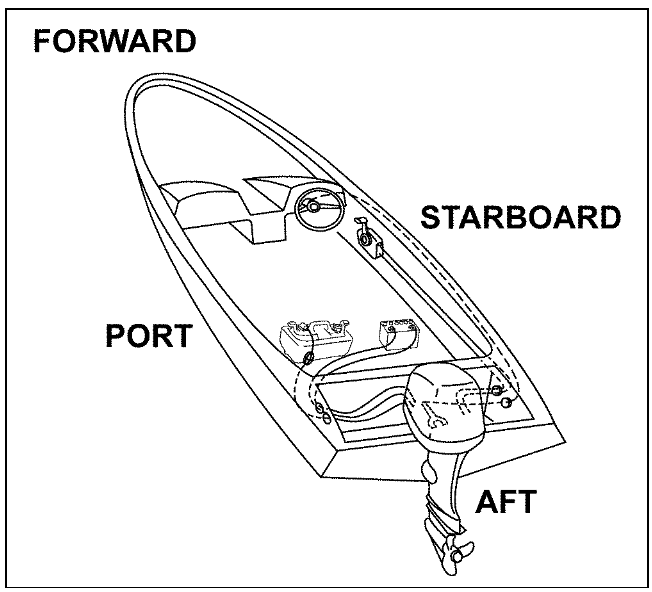
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of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

The continuing accuracy of this manual cannot be guaranteed.

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

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

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



Nautical Orientation 006411

SPECIAL TOOLS

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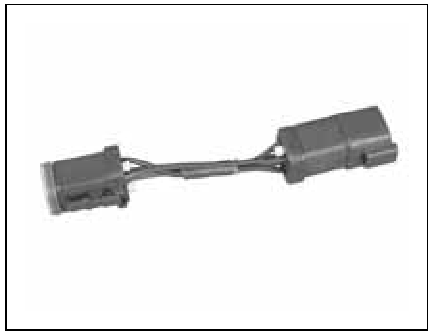
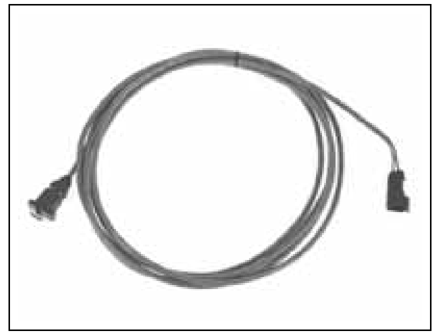
DIAGNOSTIC TOOLS

Diagnostic Software P/N 764642 764642



Bootstrap tool P/N 586551 002276



Interface cable P/N 437955 45583

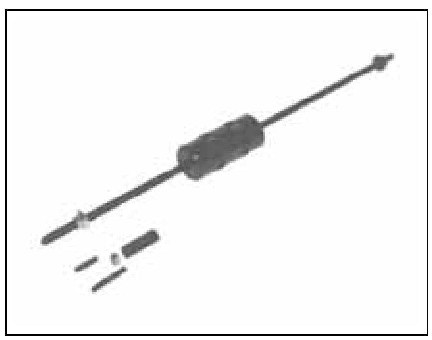
UNIVERSAL TOOLS

Universal Puller Set P/N 378103 32885

Lifting eye P/N 321537 23701

Lifting ring assembly P/N 396748 000669

Flywheel holder P/N 771311 42938

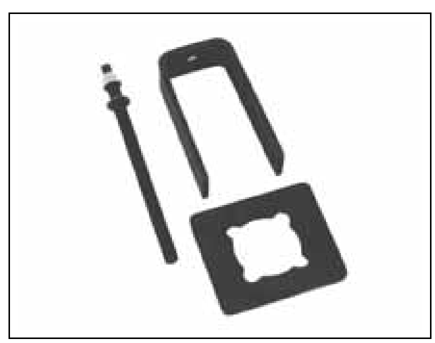


Slide hammer P/N 391008 CO1577

Slide hammer P/N 432128 15345

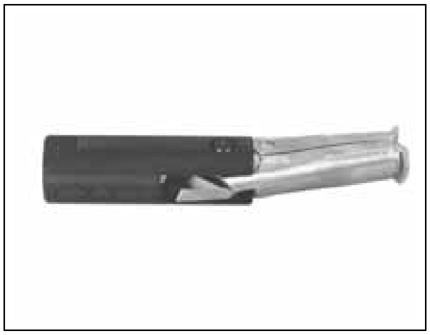
Slide hammer adapter P/N 340624 39435

Slide hammer adapter P/N 390898 15356

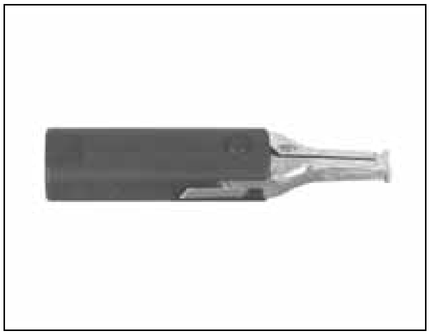


Puller Bridge – 432127 23146

Small puller jaws P/N 432131 23150

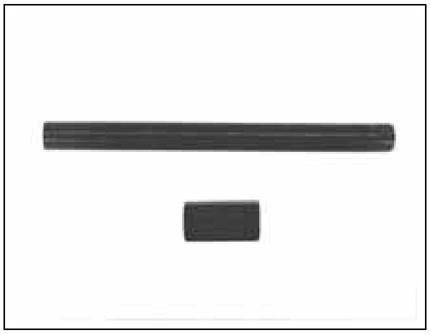


Large puller jaws P/N 432129 23148



Bearing puller jaws P/N 432130 23149

Tilt tube nut wrench P/N 342680 46879

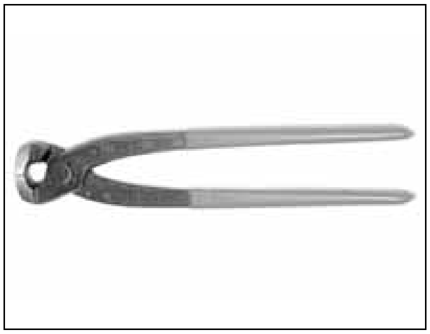


Tilt tube service kit P/N 434523 33249

Syringe P/N 346936 50243

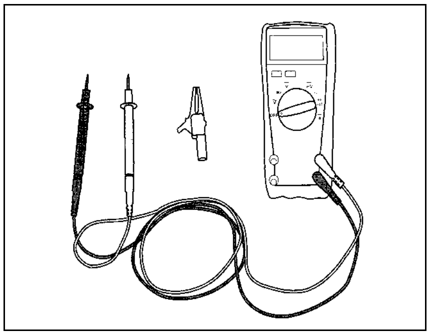
Temperature gun P/N 772018 45240

Fresh water flusher P/N 500542 50110



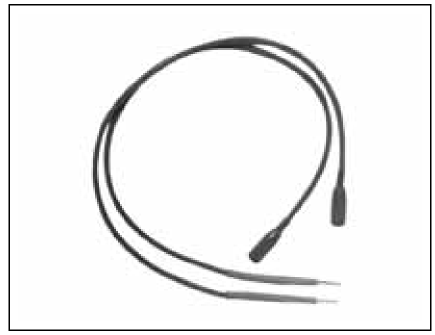
Oetiker† *pincers, P/N 787145* 001081

ELECTRICAL / IGNITION TOOLS

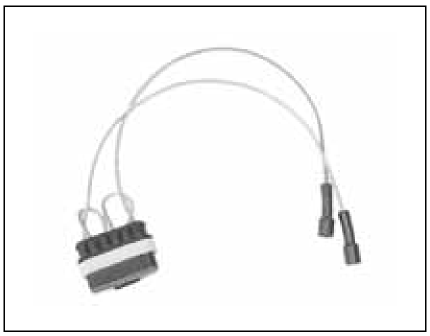


Digital multimeter DRC7265
Ohms resolution 0.01
Purchase through local supplier

Peak reading voltmeter 49799
P/N 507972



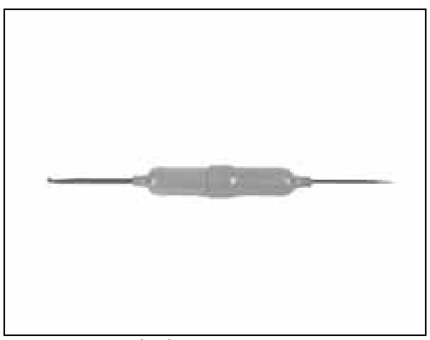
Test probe kit P/N 342677 45241



Stator Test Adapter P/N 5005799 002273

Crimping pliers P/N 322696 30387

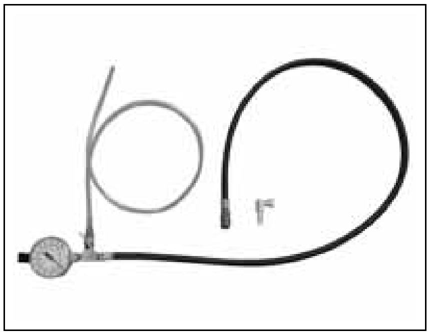
Tachometer/timing light P/N 507980 49789



Connector tool P/N 342667 42004

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



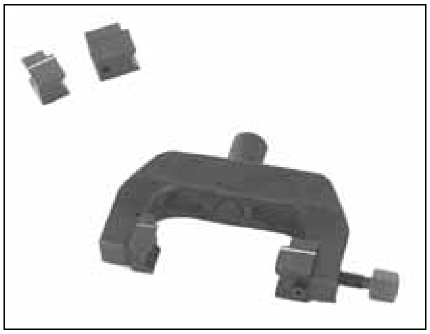
Fuel pressure gauge (60 PSI) P/N 5007100 90° fitting, P/N 353322 005339

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

Injector test fitting kit P/N 5005844 002465

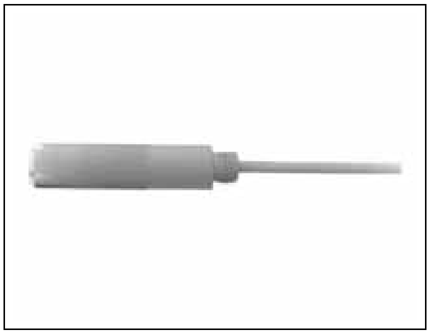
POWERHEAD TOOLS

Cylinder bore gauge P/N 771310 45303



Rod cap alignment fixture P/N 396749 21596

Crankshaft bearing and sleeve installer P/N 338647 21953**B**

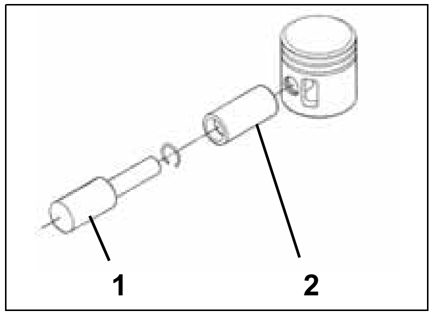


Piston stop tool P/N 342679 Replacement tip P/N 5006098 46543

Torquing socket P/N 331638 000797

Wrist pin bearing installer P/N 336660 41029

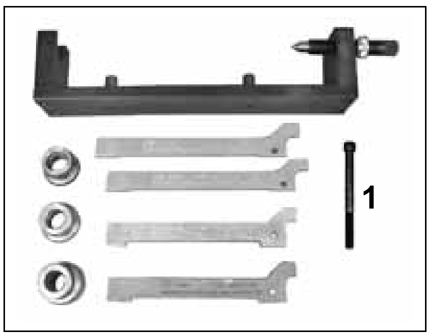
Wrist pin pressing tool 23668
P/N 326356



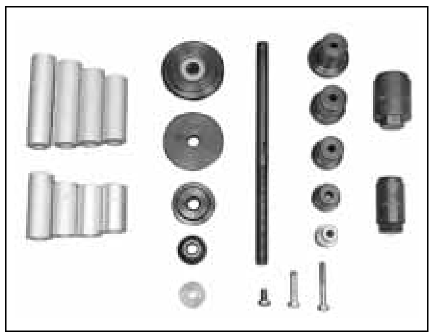
1. *Wrist pin retaining ring driver P/N 318599* DR1641
2. *Wrist pin cone P/N 318600*

Ring compressor – standard CO3768
·P/N 336314

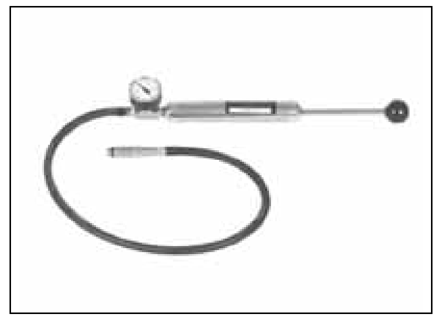
GEARCASE TOOLS



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

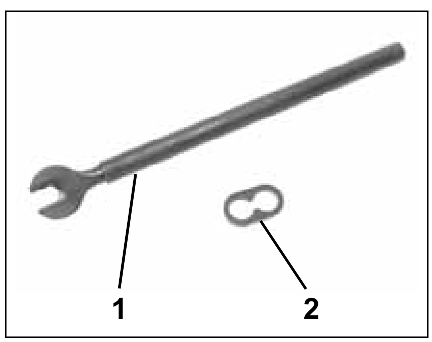


Universal Pinion Bearing Remover 002805
and installer kit P/N 5005927



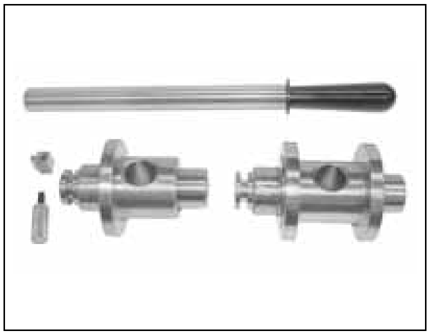
Gearcase pressure tester 49794
P/N 507977 (Stevens P/N S-34)
Gearcase vacuum tester
P/N 507982 (Stevens P/N V-34)

Gearcase filler 49790
P/N 501882

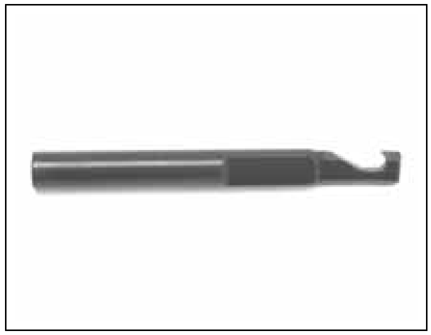


1. *Pinion nut holder P/N 334455* 40371
2. *Wrench retainer P/N 341438*

Universal shift rod height gauge 32872
P/N 389997



Gearcase Alignment Gauge Kit P/N 5006349 004315



Lower Driveshaft Puller P/N 342681 47257

Bearing Installer P/N 326562 32962

Gauging Head, “S” Type Gearcases, P/N 352879 005072

Driveshaft seal protector P/N 318674 23692

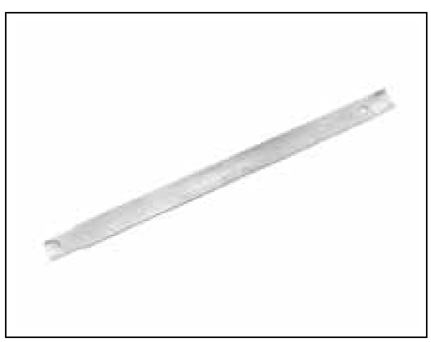
Prop shaft bearing installer P/N 339750 32880

Backing plate P/N 325867 23621

Driveshaft socket P/N 311875 23261

Prop shaft housing seal installer P/N 326551, P/N 336311 32973

Driveshaft Puller P/N 390706 32884



Pinion nut starting tool P/N 342216 40372

Seal installation tool P/N 330268 32924

TRIM AND TILT TOOLS

Tilt cylinder end cap remover P/N 352932, for single-piston tilt systems 005340

Spanner wrench P/N 912084 32213

SHOP AIDS

Cleaning Solvent P/N 771087

D.P.L. Spray P/N 777183

Oil - XD30™ P/N 777219

"6 in 1" Multi-Purpose Lubricant P/N 777192

Oil - XD50™ P/N 777225

HPF XR™ Gear Lube P/N 778755

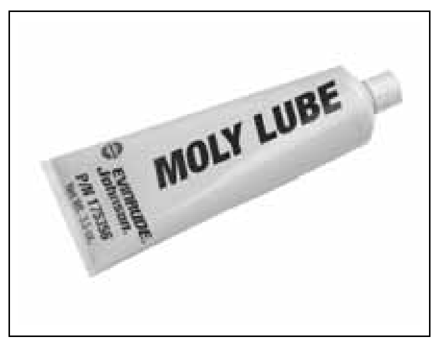
Oil - XD100™ P/N 777118

Anti-Corrosion Spray P/N 777193

HPF PRO Gearcase Lube P/N 778755

Engine Tuner P/N 777185

Silicone spray P/N 775630



Moly Lube P/N 175356

Storage Fogging Oil
P/N 777186

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

Electrical Grease P/N 503243

Lubriplate† 777 P/N 317619

Black Neoprene Dip P/N 909570

2 + 4™ Fuel conditioner P/N 775613

Triple-Guard® Grease P/N 508298

Starter Bendix Lube P/N 337016

Gel-Seal and Gasket Remover P/N 771050

Needle Bearing Grease, P/N 378642

Biodegradeable TNT Fluid
P/N 763439

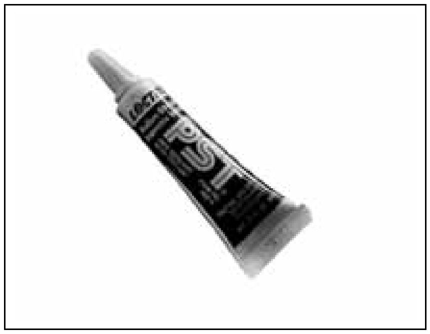
Permatex† No. 2, P/N 910032

RTV Silicone Sealant P/N 263753

Gasket Sealing Compound P/N 317201

Thermal Joint Compound P/N 322170

Fuel System Cleaner P/N 777184



Pipe Sealant with Teflon P/N 910048

Instant Bonding Adhesive P/N 509955

Gel·Seal II P/N 327361

Locquic Primer P/N 772032

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)*

Carbon Guard™ P/N 775629

Adhesive 847 P/N 776964

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

INSTALLATION AND PREDELIVERY

TABLE OF CONTENTS

BOAT RIGGING

Remote Controls

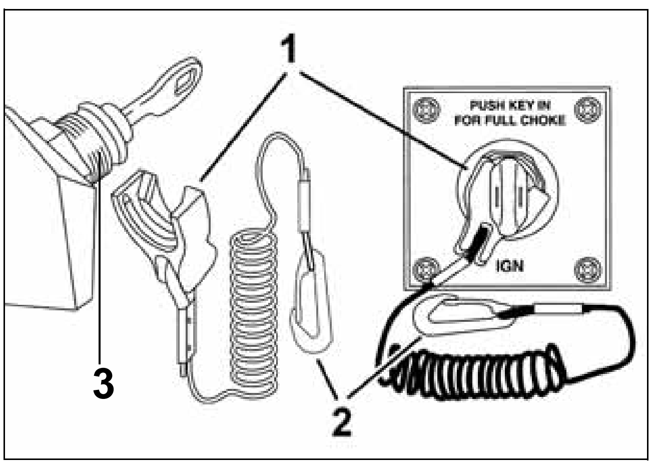
Control Selection

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

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

The remote control and wiring harness combination must have the following features:

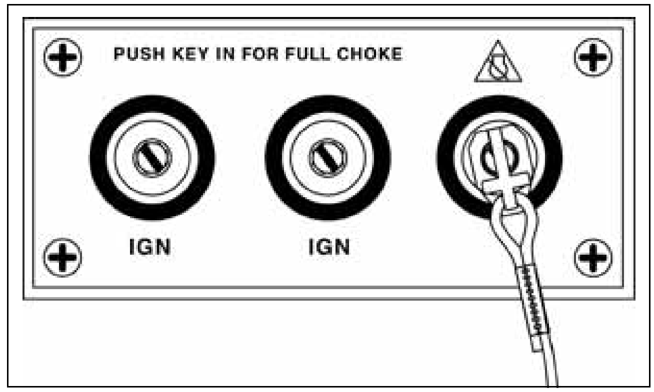
- Start-in-gear prevention
- Emergency stop / key switch
- Shift stroke must measure 1.125 to 1.330 in. (28.6 to 33.8 mm) between NEUTRAL and FORWARD
- Throttle stroke must PUSH for open
- Connections for engine monitor warning system.



1. *Emergency stop clip*
2. *Safety lanyard*
3. *Key switch with emergency stop feature*

002817

- Dual-outboard controls require separate key switches with a single emergency stop switch.



Dual-outboard key switches with emergency stop switch DRC40118

> ⚠ **WARNING** ⚠
>
> **Always install and recommend use of an emergency stop/key switch. Doing so will reduce the risk of personal injury or death should the operator fall away from the controls or out of the boat.**

Engine Monitoring System

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

Refer to **ENGINE MONITORING SYSTEM** on p. 93.

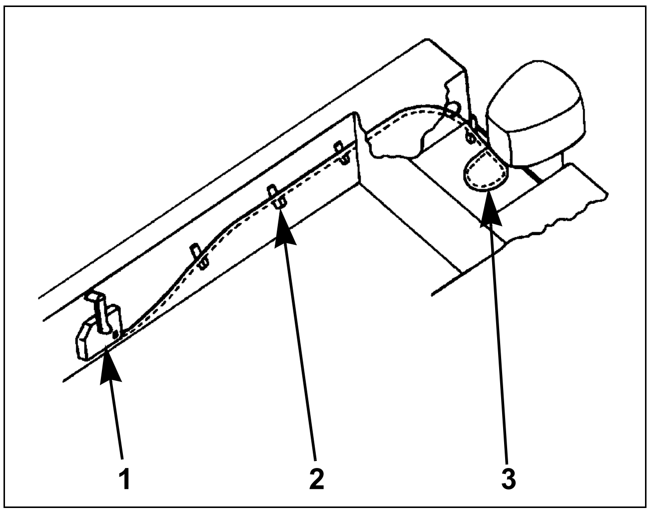
Control Installation

Plan the installation of remote controls carefully, following all instructions provided with the remote control.

Make sure the following items are checked:

- Correct length, type and quality of control cables and wiring harnesses
- Proper routing of cables and harnesses
- Slack in front of the outboard for remote control cables
- Positioning and securing of cables and harnesses along their lengths to prevent movement or damage.

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



1. *Surface side-mount remote control* DR4277
2. *Cable support*
3. *12 in. (30 cm) cable loop at front of outboard*

IMPORTANT: Cables of the proper length, style, and quality that are correctly installed and adjusted will eliminate most control-related operational problems.

Battery Installation

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

Minimum 12 Volt Battery Recommendations

Outboard Model	Battery Rating
40–90 HP	640 CCA (800 MCA), **or** 800 CCA (1000 MCA) below 32° F (0° C) 107 amp-hr in extreme applications

Location and Preparation

Proper installation will prevent battery movement while underway.

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

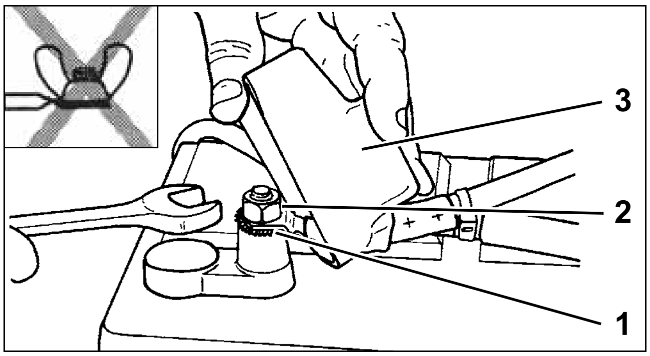
⚠ WARNING ⚠

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

Connections

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

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



Marine Style Battery Post DR5103
1. *Starwasher*
2. *Hex nut*
3. *Terminal Insulator*

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

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

Battery Cable Requirements

Evinrude outboards are shipped with stranded copper battery cables for typical installations in which the starting battery is positioned close to the transom.

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

	40–250 HP
1 to 10 Ft. (.3 to 3 m)	4 Gauge
11 to 15 Ft. (3.4 to 4.6 m)	2 Gauge
16 to 20 Ft. (4.9 to 6.1 m)	1 Gauge

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

Battery Switches and Multiple Batteries

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

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

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

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

Typical battery functions

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

Primary

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

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

Secondary

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

Accessory

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

Battery Switch Requirements

Battery switches must meet the following requirements.

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

Battery Switch Location

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

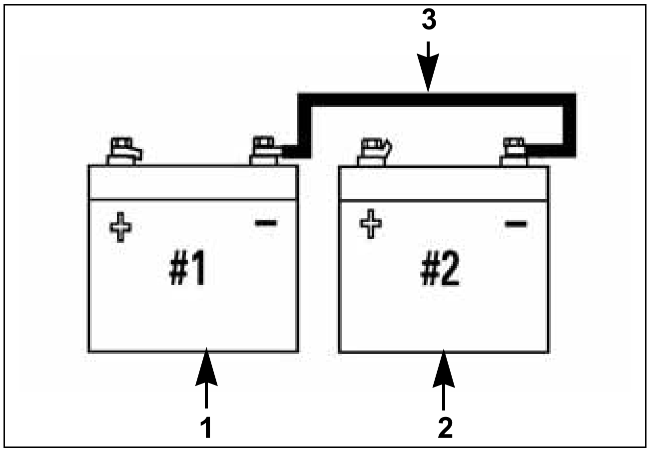
IMPORTANT: Insulate all battery positive (+) terminals to prevent shorting.

Battery Switch Operation

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

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

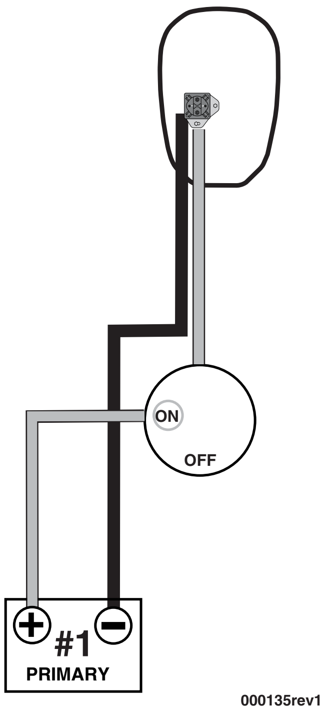
IMPORTANT: The negative (–) terminals of a multiple 12-volt battery installation must be connected together.



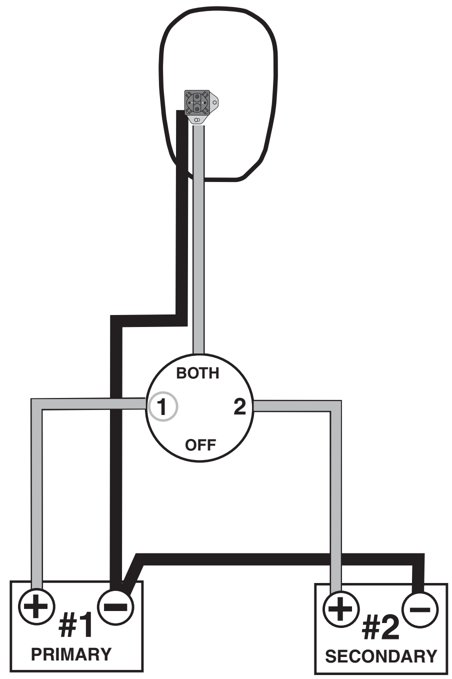
1. *Starting battery (primary)* DRC7284
2. *Accessory battery (secondary)*
3. *Cable connecting negative (–) battery terminals*

Battery and Switch Wiring Diagrams

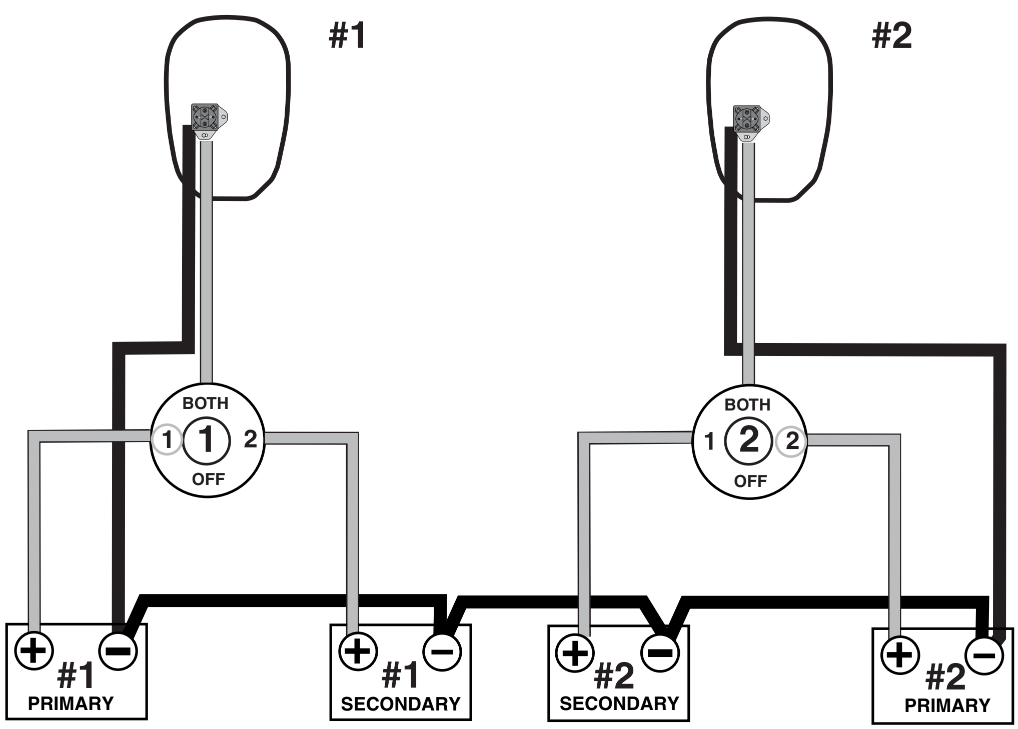
One outboard: Battery disconnect



One outboard: One primary starting battery; one secondary battery

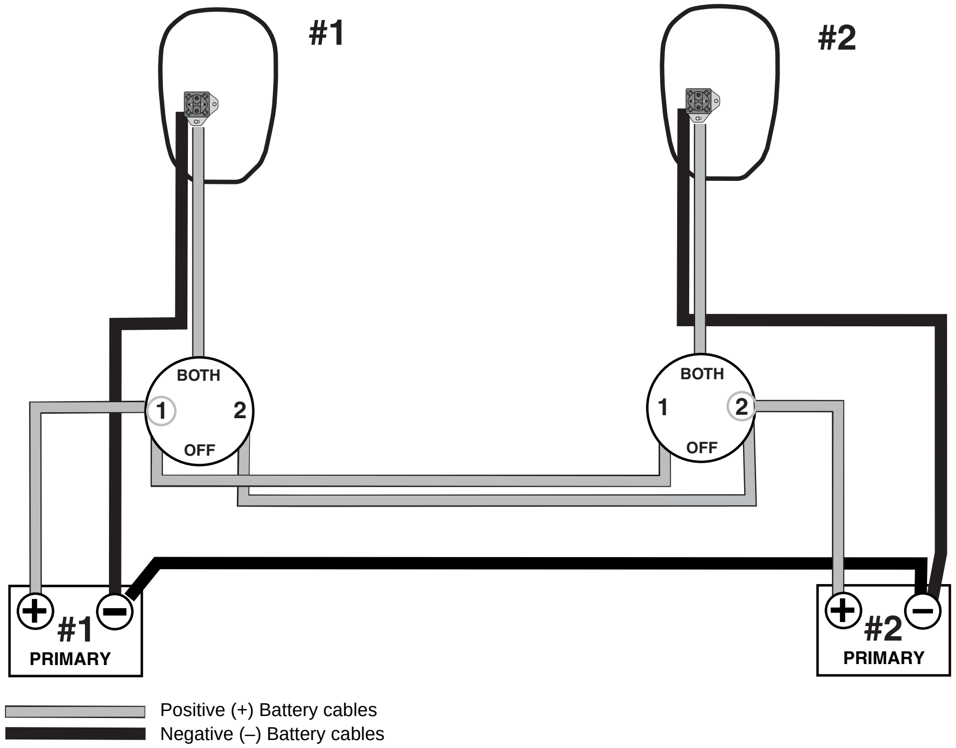


Two outboards: Two starting batteries for each outboard



Positive (+) Battery cables
Negative (–) Battery cables

Two outboards: One primary starting battery for each outboard



Fuel System Requirements

Overview

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

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

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

Fuel Hose

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

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

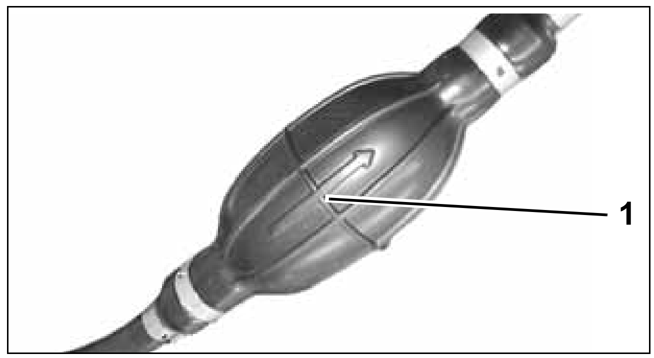
Fuel System Primer

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

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

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

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



1. *Arrow indicates direction of fuel flow* 000124

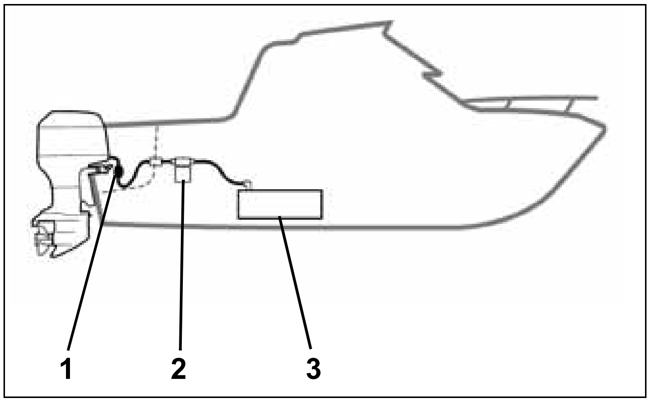
An alternative to a primer bulb is a U.S. Coast Guard approved marine primer pump. Electric primer pumps offer the convenience of outboard priming from a dash-mounted momentary switch.

Fuel Filters

Boat-mounted fuel filters and water-separating fuel filter assemblies must meet the required fuel flow and filter specification. 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.

0070



Typical Fuel Supply Configuration DRC6797

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

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

Portable Fuel Tanks

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

Outboard Fuel System Recommendations

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

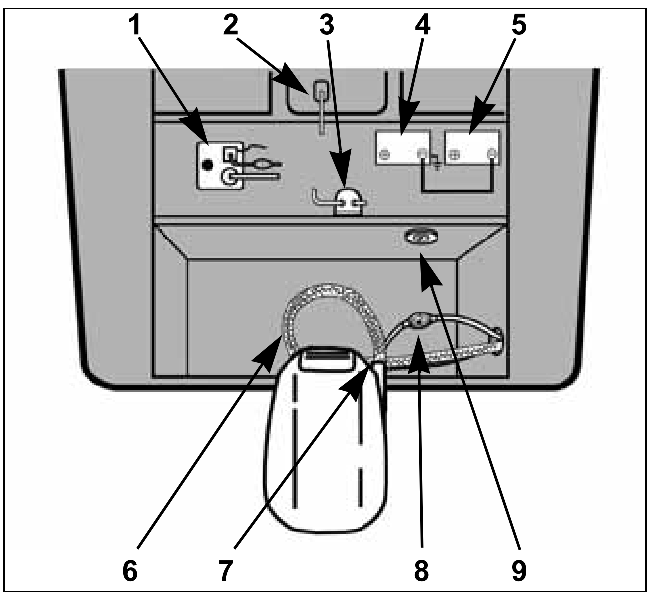
Cable and Hose Installation

Before installation, identify all required wiring, cables, and hoses:

- Throttle and shift cables
- Instrument harnesses
- Battery cables and switches
- Oil tank sender harness
- Fuel supply hose
- Primer bulb or primer pump
- Oil supply hose

Determine whether any additional wiring or hoses will be needed for accessory gauges or batteries:

- Speedometer pick-up hose
- Mechanical water pressure gauge hose
- Accessory battery charging kit
- CANbus adapter harnesses
- CANbus water pressure sensor kit
- CANbus oil level sensor kit



Typical outboard installation DRC6487

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

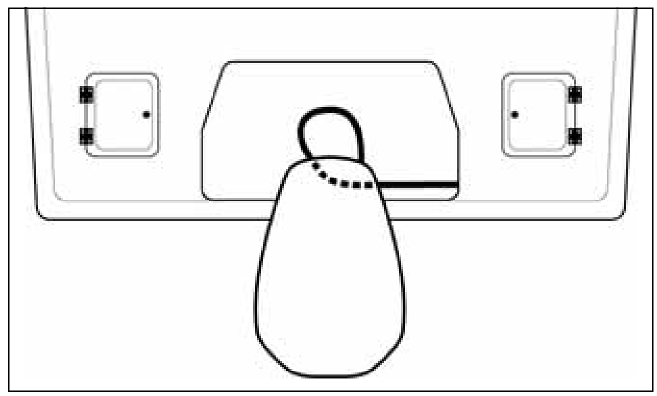
Cable and Wire Harness Routing

⚠ WARNING ⚠

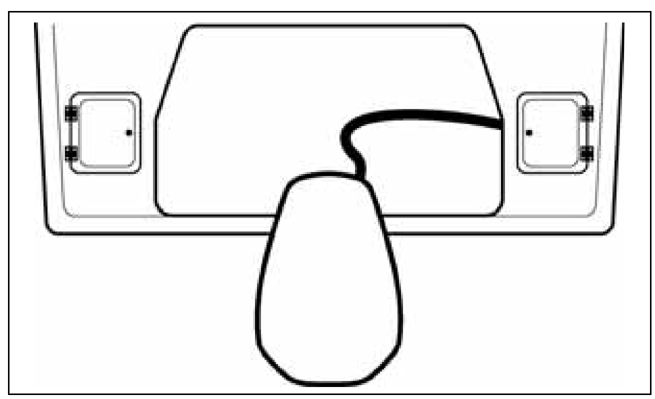
Improper installation and routing of outboard controls could wear, bind, and damage components, causing loss of control.

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

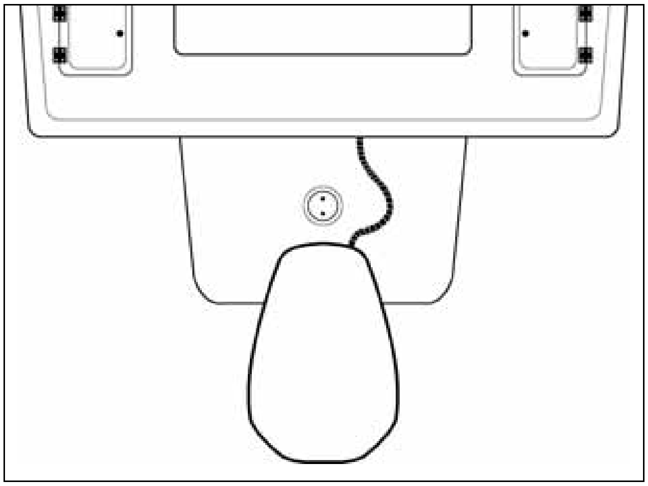
All cables, wiring, and hoses must be long enough to provide adequate slack. Check clearances at all possible combinations of trim angles and steering positions.



Typical Small Splash Well DRC7799



Typical Large Splash Well DRC7797



Typical Engine Bracket DRC7798A

Protective Sleeve/Conduit

Make sure all cables, wiring, and hoses have been identified and fitted to the appropriate lengths. Refer to **OUTBOARD RIGGING** on p. 46.

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

Battery Cables

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

When routing battery cables, be sure to:

- Route cables through the protective sleeve.
- Use the most direct path to route the battery cables to the battery or battery switch.

Fuel Hose

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

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

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

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

IMPORTANT: Do not permanently fasten this connection until the boat's fuel system has been primed.

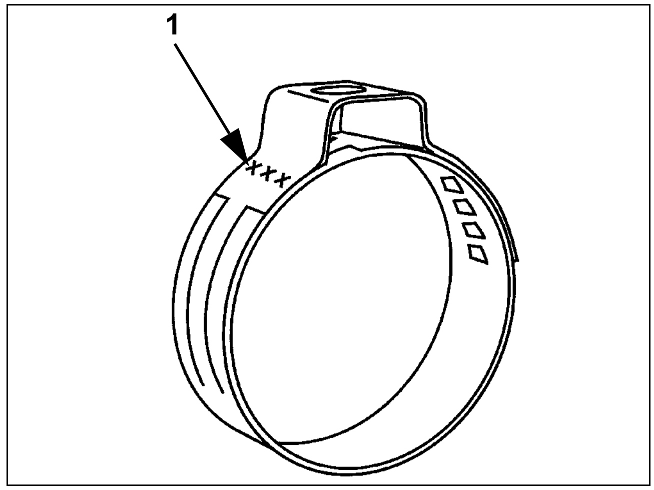
Oetiker Clamp Servicing

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

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

⚠ WARNING ⚠

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



1. *Clamp identification numbers* 000093

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

Oetiker Stainless Steel Stepless Clamps

CLAMP NO.		NOMINAL O.D.		INCHES		MILLIMETERS	
Replacement	Clamp I.D.	Inches	MM	Open	Closed	Open	Closed
346930	95	3/8	9.5	0.374	0.307	9.5	7.8
348838	105	13/32	10.5	0.413	0.346	10.5	8.8
349516	113	7/16	11.3	0.445	0.378	11.3	9.6
347107	133	1/2	13.3	0.524	0.425	13.3	10.8
347108	138	17/32	13.8	0.543	0.449	13.8	11.3
346931	140	34/64	14	0.551	0.453	14	11.5
346785	145	9/16	14.5	0.571	0.472	14.5	12
346786	157	5/8	15.7	0.618	0.52	15.7	13.2
348839	170	11/16	17	0.669	0.571	17	14.5
346150	185	23/32	18.5	0.728	0.602	18.5	15.3
346151	210	13/16	21	0.827	0.701	21	17.8
346152	256	1	25.6	1.008	0.882	25.6	22.4
346153	301	1 3/16	30.1	1.185	1.063	30.1	26.9
349759	316	1 1/4	31.6	1.244	1.122	31.6	28.4
349729	410	1 5/8	41	1.614	1.492	41	37.9

Clamp Installation

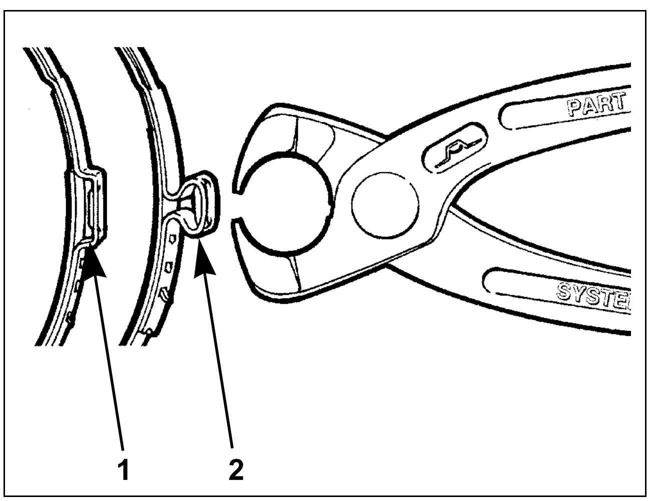
A constant stress should be applied to close the ear clamps. This method ensures a positive stress on the hose and does not result in excessive compression or expansion of the band material.

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

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

DP0886

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

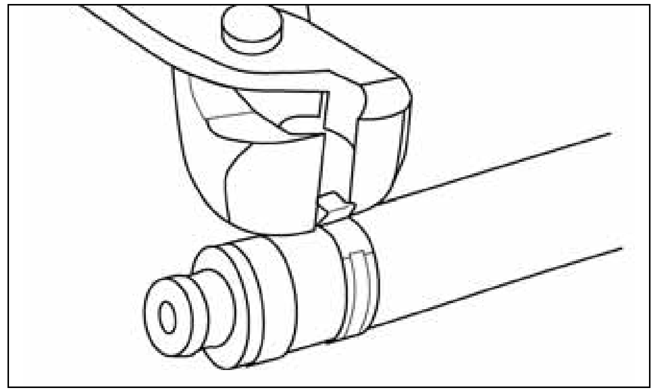


1. *Open clamp*
2. *Closed clamp*

000092

Clamp Removal

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



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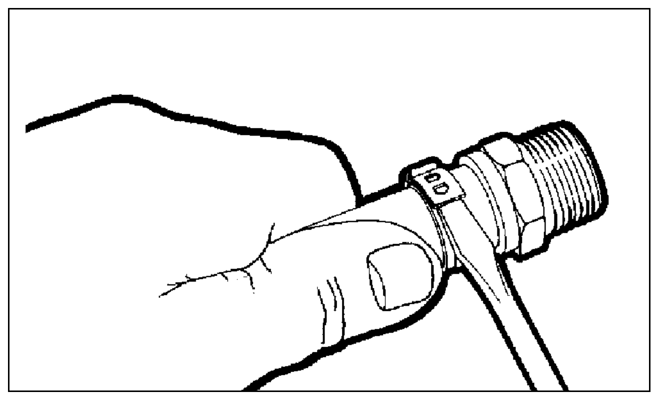
Method 2: Lift end of stepless clamp with screwdriver.



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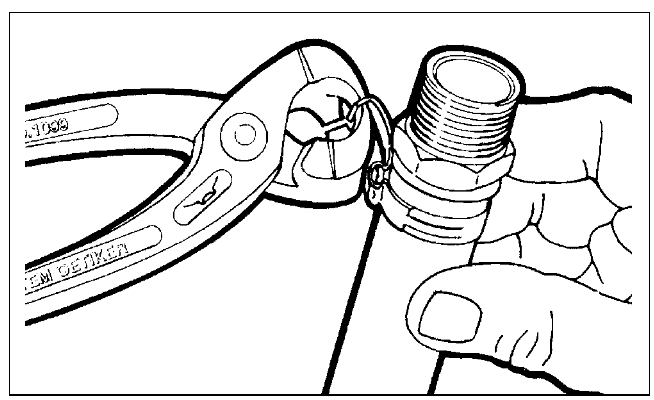
Method 3: Use *Oetiker* pincers (pliers) to grip clamp. Pull clamp off of connection and discard.



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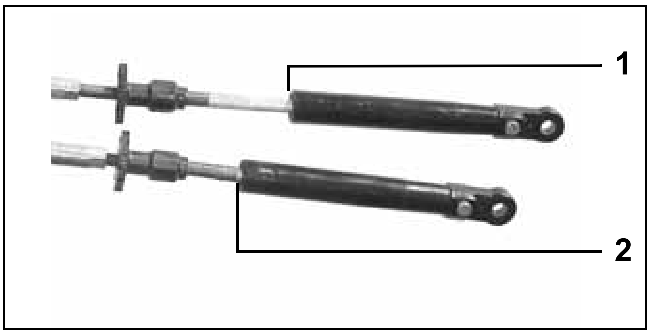
Control Cable Identification

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

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



1. *Shift cable casing guide extended to midpoint* DP0811
2. *Throttle cable casing guide retracted*

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

30501

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

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

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 before drilling holes.

Water Flow

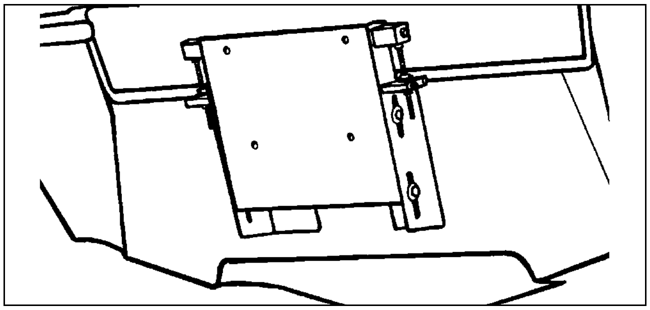
Inspect the hull area directly in front of the mounting location.

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

Transom Brackets and Jack Plates

When mounting an outboard on boats equipped with transom brackets or jack plates, refer to the manufacturer's recommendations.

- Confirm maximum weight and horsepower capacities.
- Jack plate assemblies must provide a one-piece mounting surface to support the outboard.



DR5704

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.

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

Refer to the outboard's parts catalog for alternate length mounting bolts or replacement parts.

- Use only *Evinrude/Johnson Genuine Parts* or parts of equivalent type, strength, and material.
- Use the mounting hardware provided with outboard whenever possible.

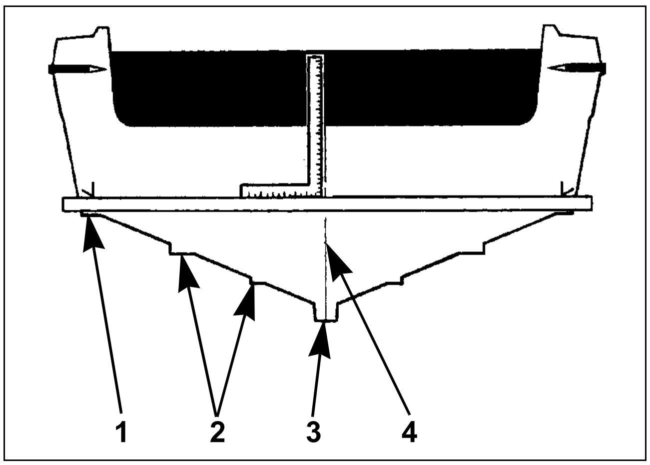
Transom Measuring and Drilling

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

Dual-Outboard Centerlines

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

2 and 3 cylinder	22 in. (559 mm)
V4 and V6	26 in. (660 mm)

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

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

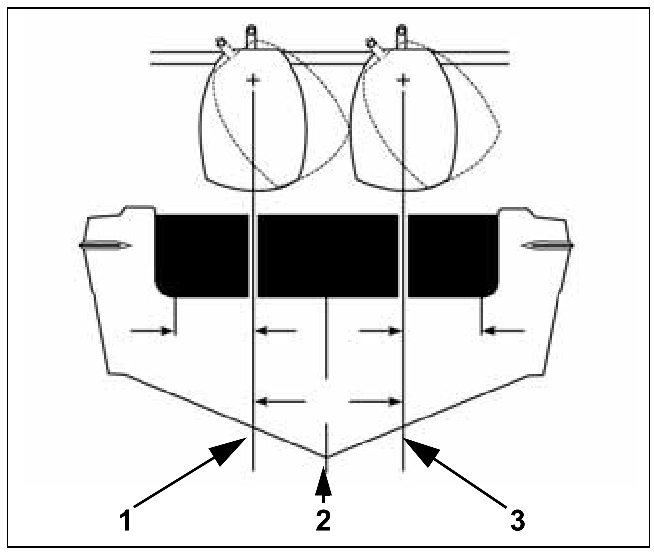
IMPORTANT: Some steering systems may require additional spacing. Refer to steering system manufacturer for recommendations.

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

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

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

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



1. *Port centerline*
2. *Hull centerline*
3. *Starboard centerline*

DRC5527B

Transom Height

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

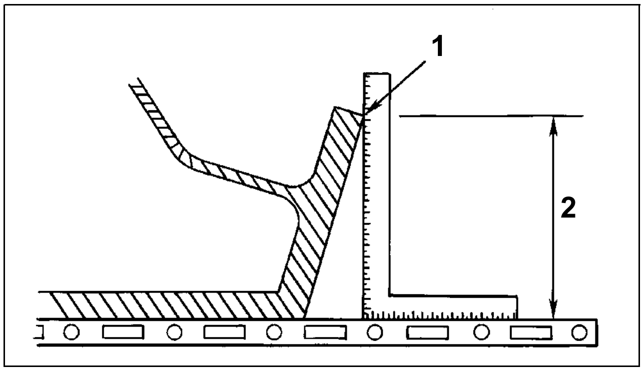
- A 19 to 21 in. (48.3 to 53.3 cm) transom height uses a 20 in. (50.8 cm) shaft outboard.
- The shaft length of the outboard being installed should come close to matching the transom height of the boat.

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

For dual-outboard installations, transom height should be measured at the outboard centerlines.

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

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



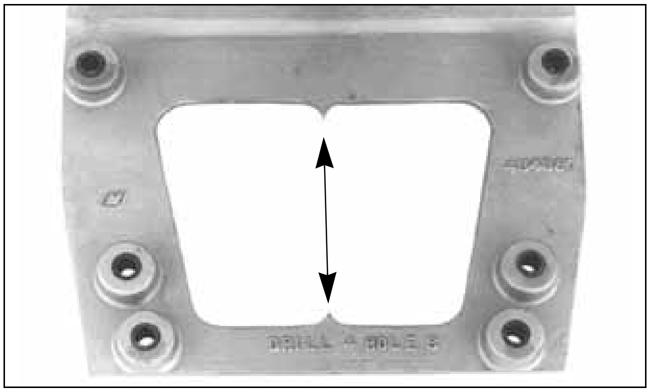
1. *Top edge of transom* DR5541
2. *Actual transom height*

Transom Drilling Locations

All models use the standard ABYC 4-Bolt mounting pattern.

Transom drill fixture, P/N 434367 or P/N 385368, may be used as a guide for correct hole placement. If drill fixture is unavailable, refer to **Drilling and Hardware Diagrams** on p. 42 for measurements.

Position drill fixture on top of transom or bracket and align indicator points with centerline.



Transom drill fixture P/N 434367 (heavy duty) 24496

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

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

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

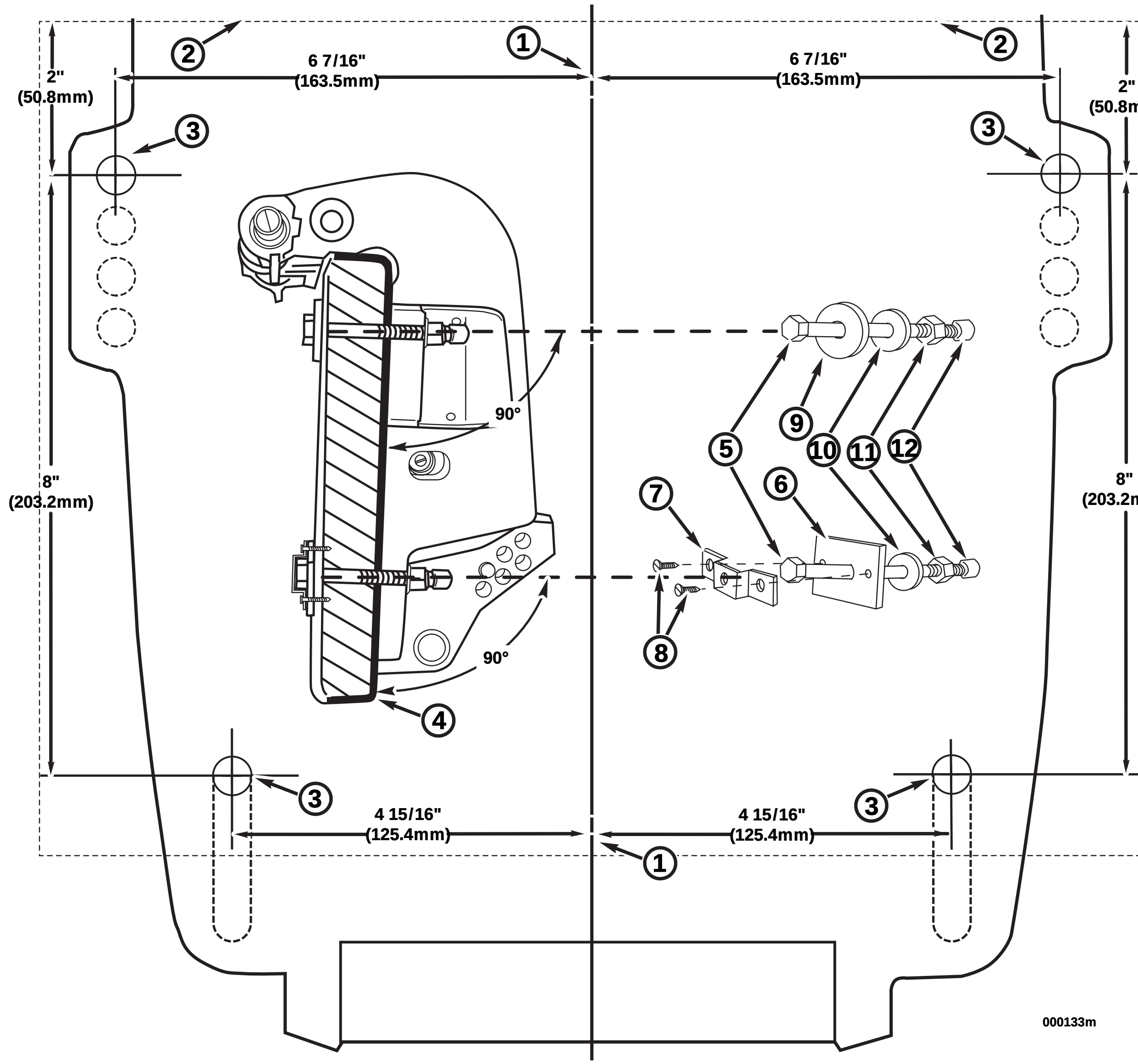
Before drilling any mounting holes:
- Make sure the hole locations provide enough clearance for mounting bolts and washers.
- Check the inside area of the transom for obstructions.
- Check transom height(s) at centerlines.

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

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

Drilling and Hardware Diagrams

IMPORTANT: This is not a template.



			Quantity	
1. Center of Transom	**5.** Bolt *		4	* Choose from the following bolt sizes:
2. Top of Transom	**6.** 318272 Plate		2	327053 3 in. (76 mm)
3. 1/2” Bolt Hole Locations	**7.** 318273 Retainer		2	318573 3 1/2 in. (89 mm)
4. Outside of Transom	**8.** 319886 Screw		4	313327 4 in. (102 mm)
	9. 307238 Washer		2	336676 4 1/2 in. (114 mm)
	10. 320248 Washer		4	331578 5 in. (127 mm)
	11. 313623 Nut		4	321577 6 in. (152 mm)
	12. 318572 Cap		4	

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.

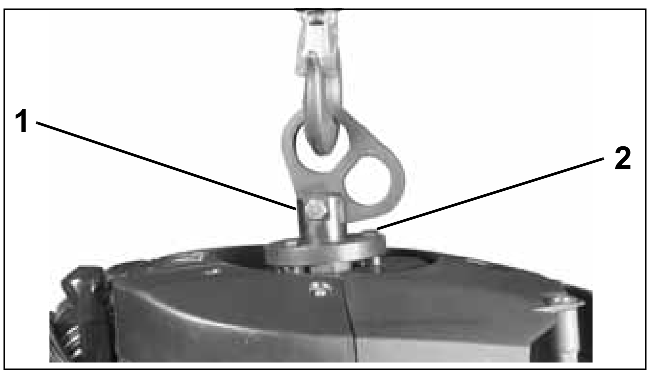
Remove shipping carton.

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

Use correct Lifting Fixture to lift outboard:

Model	Lifting Fixture
40–90 HP	P/N 396748 with 1 1/8 in. screws

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



1. *Lifting fixture* 002098
2. *1 1/8 in. screws*

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

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

Steering Systems

Mechanical Cables

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

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

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

ABYC-approved Mechanical Steering Cable 5873

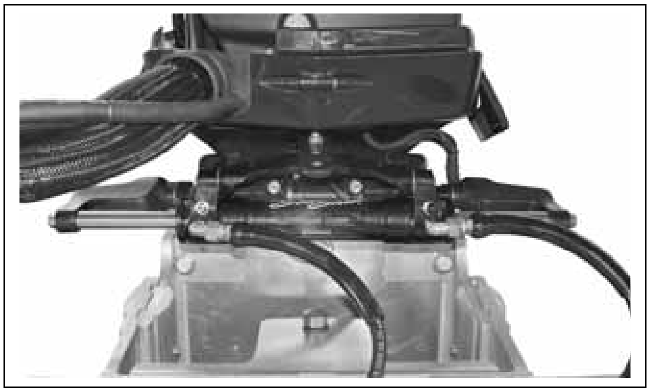
IMPORTANT: Install steering cable through tilt tube **before** mounting outboard on transom. Tighten nut securely.

WARNING
DO NOT use cable over pulley steering on 40 HP and larger outboards.

Manual Hydraulic Steering

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

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



TYPICAL Manual Hydraulic Steering 004948

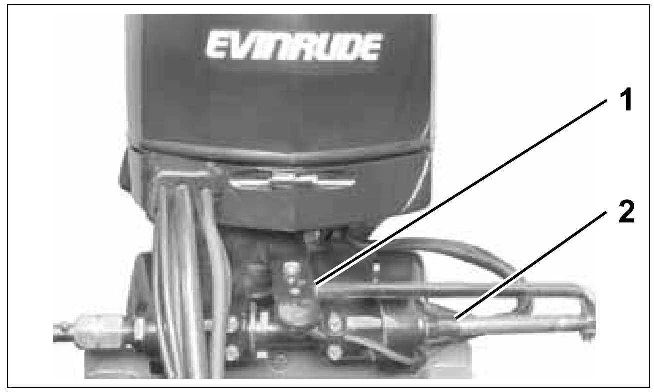
IMPORTANT: Some hydraulic steering systems require additional centerline spacing in dual-outboard installations. Refer to steering system manufacturer's recommendations and to **Dual-Outboard Centerlines** on p. 40.

Drag Links

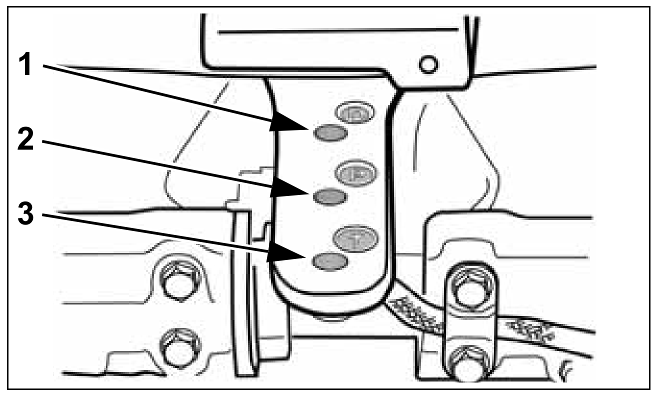
Use the correct drag link to allow full steering travel:

Model	Drag Link
75–90 HP	P/N 175125

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



1. *Drag link connection* 002097
2. *Wiper nut*



1. *Rear Location (D)–Steering drag link connection* DRC7162
2. *Middle Location (P)–Power steering connection (Refer to manufacturer's instructions for hydraulic steering systems.)*
3. *Front Location (T)–Bar connection (multiple outboard installations)*

Outboard Mounting

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

Mounting Height

Boat performance depends on outboard mounting height.

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

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

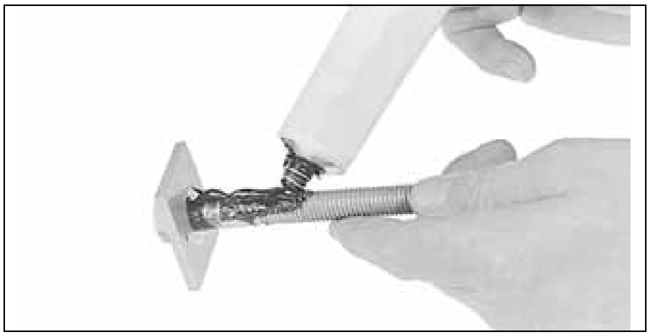
Test outboard and boat performance at different heights until the best performance is achieved.

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

Mounting Bolt Installation

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

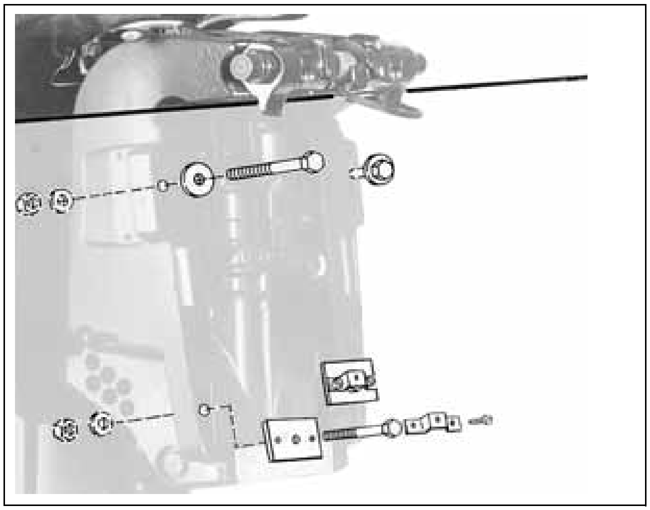
Apply marine sealer under hex heads of bolts, on the mounting plates, and to the bolt shanks.



0078A

Assemble transom mounting plates on mounting bolts.

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



DR5536

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

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

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

⚠ WARNING ⚠

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

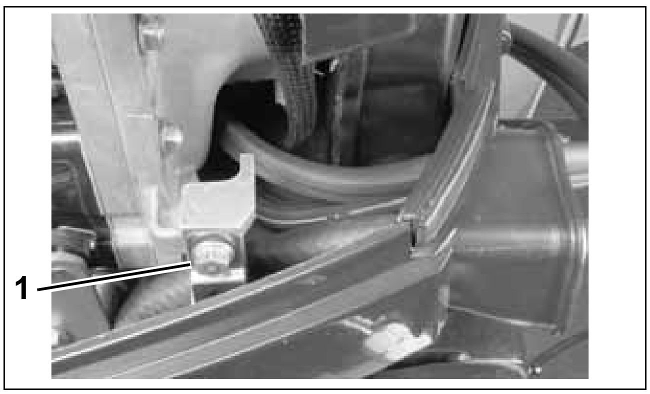
OUTBOARD RIGGING

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

Cable, Hose, and Wire Routing

Refer to **Control Cable Identification** on p. 38.

Remove cable retainer from anchor block. Apply *Triple-Guard* grease to both anchor block pockets.

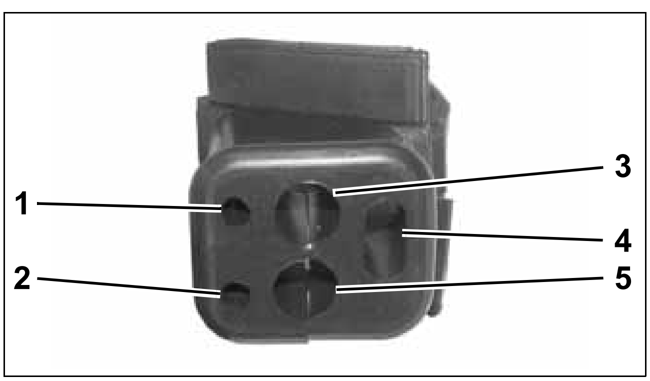


1. *Cable retainer*

002099

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

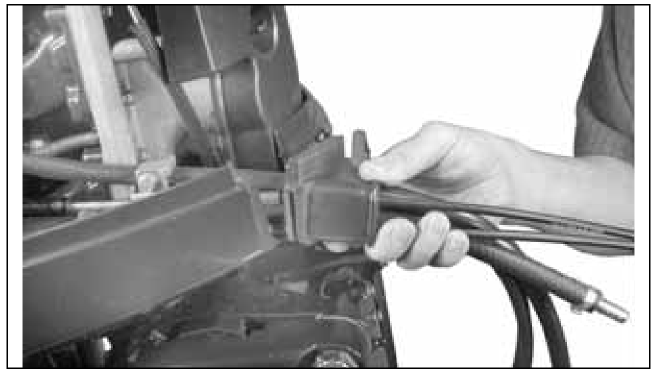
Apply soapy water to the inside surfaces of grommet and install cables and fuel line as shown:



1. *Throttle cable*
2. *Shift cable*
3. *Main wiring harness*
4. *Battery cable*
5. *Fuel line*

001998

Place the grommet into position in the lower engine cover.



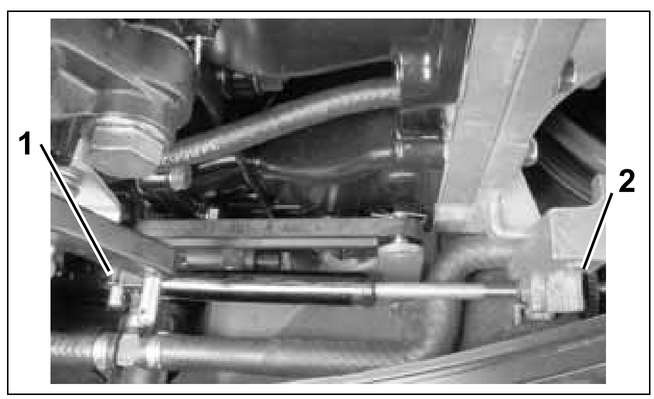
002104

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

Control Cable Adjustments

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

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



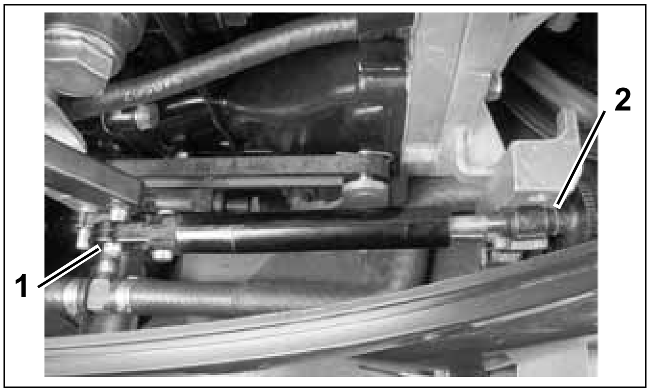
1. *Shift lever pin*
2. *Trunnion nut*

002100

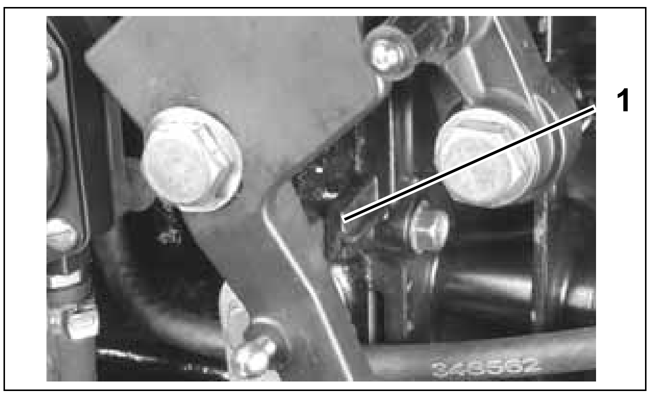
If there are not enough threads on the shift cable for the adjustment, or if the gearcase does not shift fully into FORWARD or REVERSE, refer to **SHIFT ROD ADJUSTMENT** on p. 266.

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

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



1. *Throttle lever pin* 002101
2. *Trunnion nut*



1. *Throttle stop* 005111

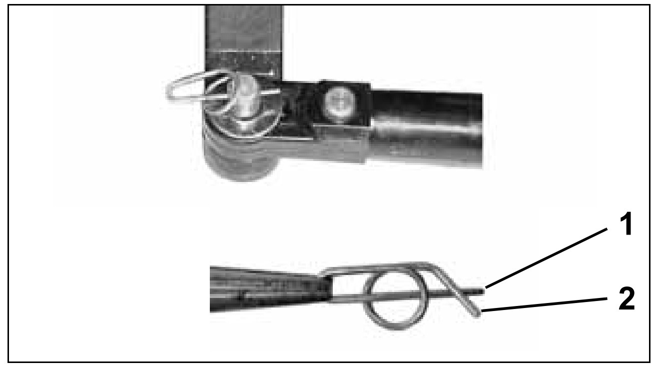
IMPORTANT: Move control handle to FORWARD and pull back slowly to NEUTRAL. Make sure the engine throttle lever is against the stop. If not, remove slack by adjusting cable trunnion.

Cable Retainer Clip Installation

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

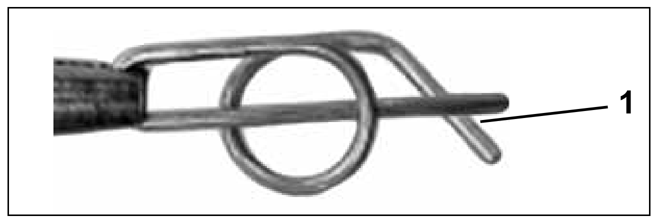
For proper installation, review the following steps:

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



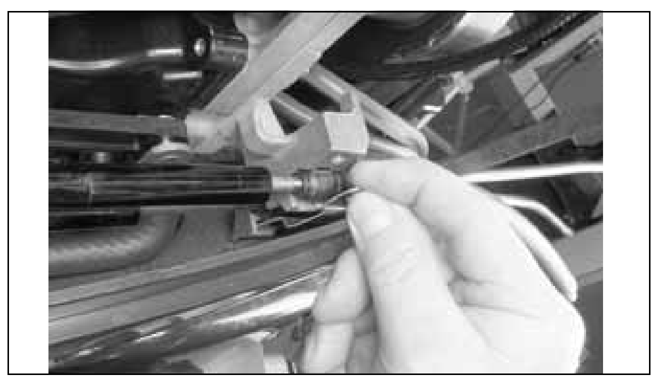
1. *Straight section* DP0818
2. *Angled section* DP0817

- Push the clip towards the hole while lifting on the curved end with the pliers.
- Be sure retainer clip fully engages the pin.
- Lock the retainer by moving the angled section **behind** the straight section.



Locked Retainer Clip DP0817A
1. *Angled section behind straight section*

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



002103

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

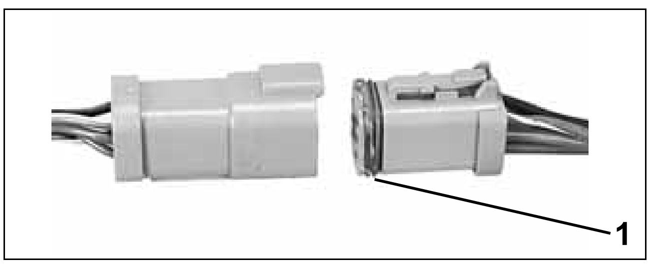
Electrical Harness Connections

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

1. *Recess*
2. *Tie strap*

002011

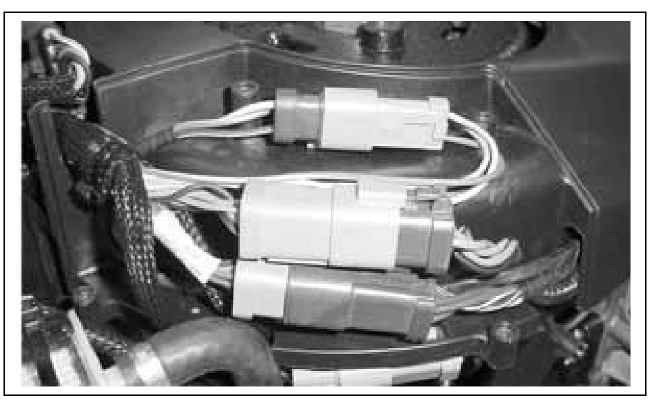
Before installing electrical connectors, check that the seal is in place. Clean off any dirt from connectors. Apply a light coat of *Electrical Grease*™ to the seal.



1. *Seal*

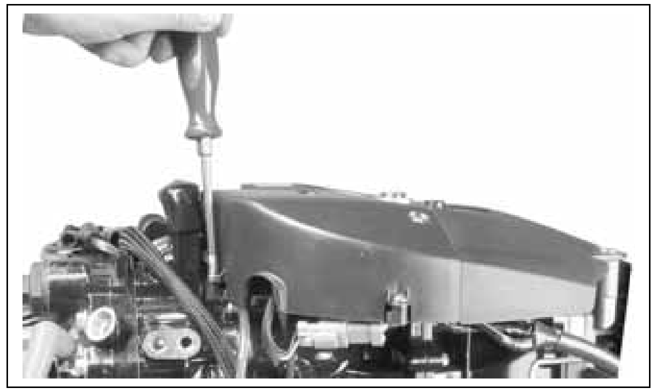
42079A

Arrange connectors in flywheel cover.



001999

Install electrical cover and secure with screws.

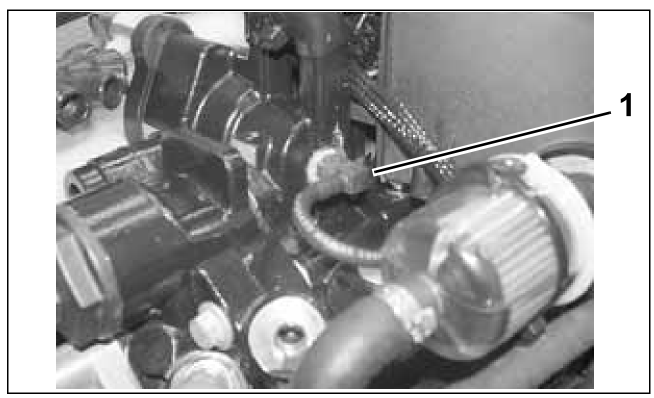


002102

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

Water Pressure Gauge

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



1. *Water pressure hose fitting*

002461

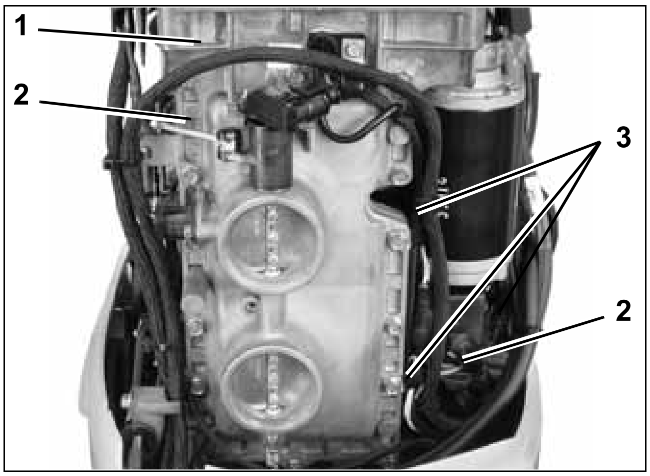
CANbus Connections

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

Remove lower motor covers. Remove air silencer.

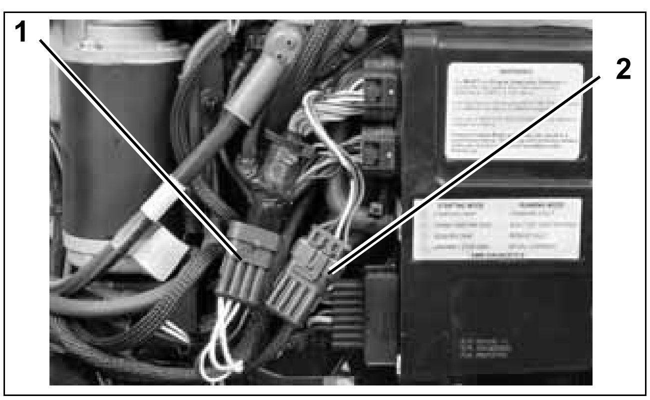
Route CANbus network harness around the front of the throttle body, following the path of the TPS wiring, and behind the battery cable. Loosely install tie straps as shown.

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



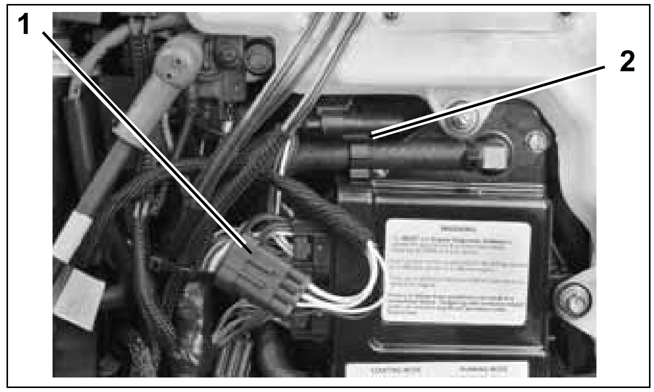
1. *Flywheel cover* 006742
2. *Harness routing*
3. *Tie straps*

Remove protective cap from the *EMM* CANbus connector and connect to the CANbus network harness.



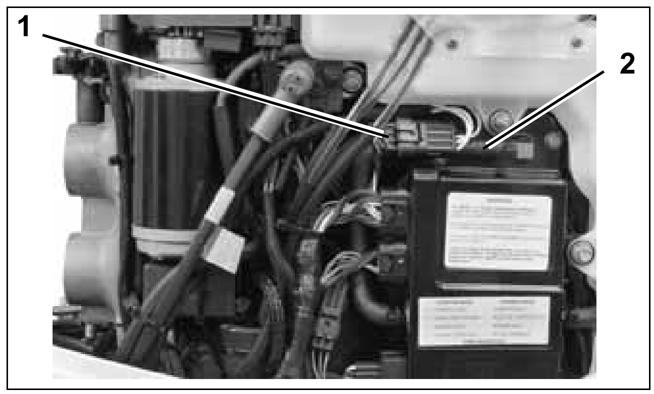
1. *Canbus network connector* 006735
2. EMM *CANbus connector and cap*

EMM CANbus connector cap is clipped to *EMM* cooling water hose. Remove clip from cap and install on CANbus harness connector.



1. *Canbus harness connector* 006743
2. EMM *CANbus connector cap and clip*

Install clip and connector to hose.

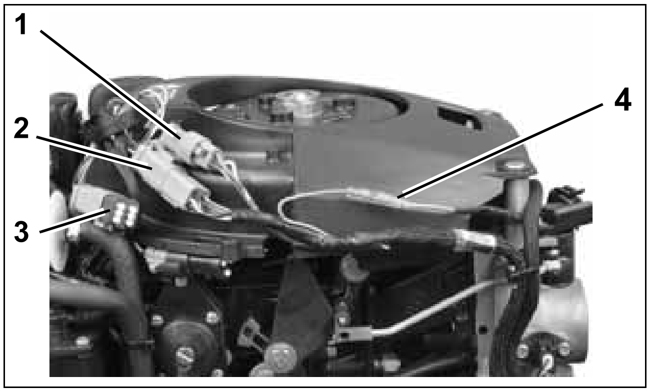


1. *CANbus connectors* 006744
2. EMM *cooling water hose*

Adjust harness routing as needed and secure tie straps.

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

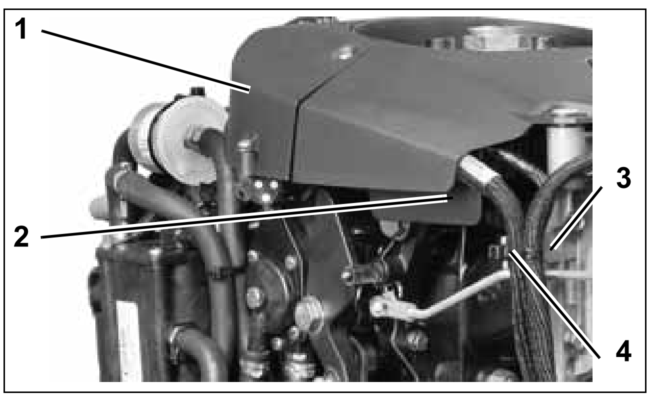
If installing a *Deutsch*-style network, connect the purple wire from the CANbus Ignition Harness to the CANbus network harness. This connection supplies power to the network when the key switch is on. Quick Connect-style network does NOT use this connection.



1. *Trim/Tilt connector*
2. *CANbus Ignition connector*
3. SystemCheck *connector (with seal)*
4. Deutsch-*style harness power connector*

006734

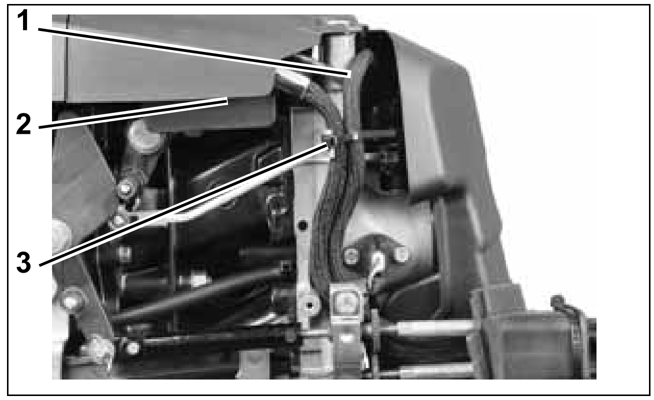
Route CANbus ignition harness through wire channel in flywheel cover. Install electrical cover. Make sure both harnesses are in front of the tab and tighten the tie strap.



1. *Electrical cover*
2. *Wire channel*
3. *Tab*
4. *Tie strap*

006737

Install air silencer and check that CANbus network harness is not pinched behind air silencer. Make sure both harnesses are in front of tab and CAN-bus ignition harness is in wire channel.



1. *CANbus* EMM *harness*
2. *Wire channel*
3. *Tab*

006739

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

Engine Options Screen 006542

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.

Minimum Octane

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

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

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

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

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

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

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

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

Additives

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

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

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

Fuel System Priming

Vent Line Clamp

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

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.**

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

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

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

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

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

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

Oil Requirements

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

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

Engine Lubricant Below 32°F (0°C)

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

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

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

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

The "LOW OIL" warning should not display.

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

Refer to **ENGINE MONITORING SYSTEM** on p. 93.

Oil Injection Rate

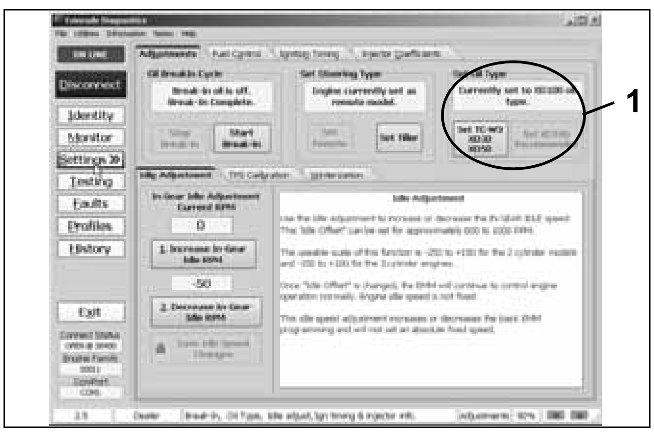
The Engine Management Module (*EMM*) controls the oil injection rate based on engine RPM. This rate can be adjusted for the type of oil being used, and also for powerhead break-in. Use *Evinrude Diagnostics* software to access these features.

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

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

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

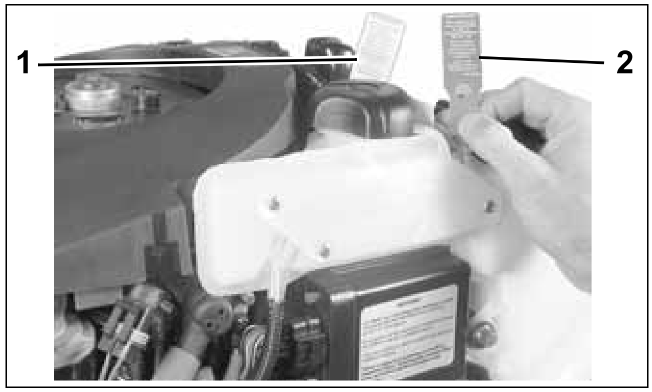
Use the *XD100* setting for:
- Conventional use (runabouts, cruisers)
- Moderate applications



1. *Oil control setting* 006540

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

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



1. Evinrude/Johnson XD30 *outboard lubricant (TC-W3)* ***YELLOW label*** 002507
2. Evinrude/Johnson XD100 *outboard lubricant (Premium)* ***BLUE label (Installed)***

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

***XD100* Outboard Oil Decal** 004522

Install decals in a highly visible location, such as one of the following:
- Dashboard/deck of boat, next to key switch
- Deck of boat, next to the remote oil fill
- Deck of boat, next to oil tank assembly
- Oil tank cover
- Cover of oil tank compartment
- Attach to oil tank or oil fill cap.

IMPORTANT: Make sure the engine label and boat decals match *EMM* programming.

Break-In Oiling

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

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

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

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

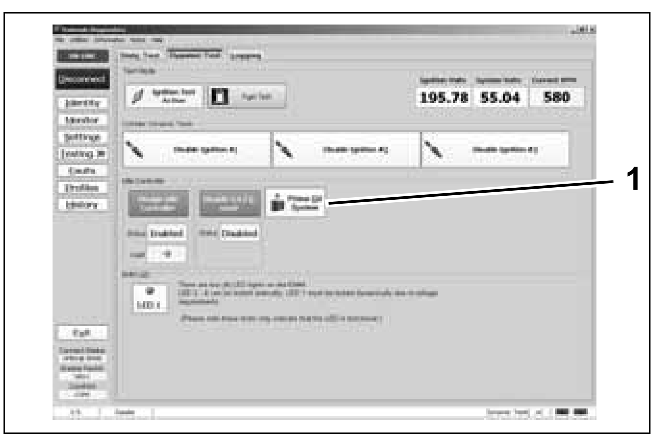
Oil Supply Priming

⚠ WARNING ⚠

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

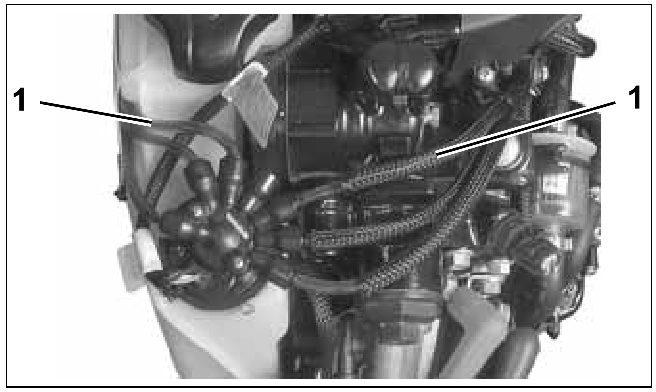
Use *Evinrude Diagnostics* software to make sure the *EMM* is programmed for the type of oil being used.

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



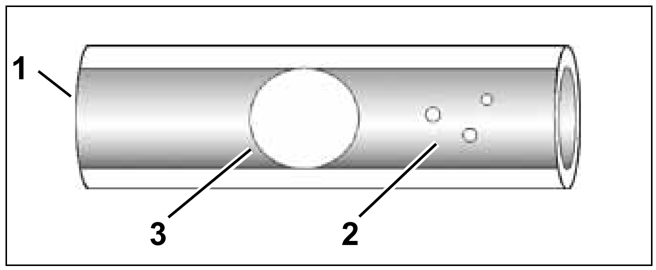
Dynamic Tests Screen 006769
1. *Prime Oil button*

Observe oil flow through the oil distribution hoses.



1. *Oil distribution hoses* 006767

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



1. *Oil distribution hose* 004398
2. *Small bubbles*
3. *Large bubbles*

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

Repair any fuel or oil leaks.

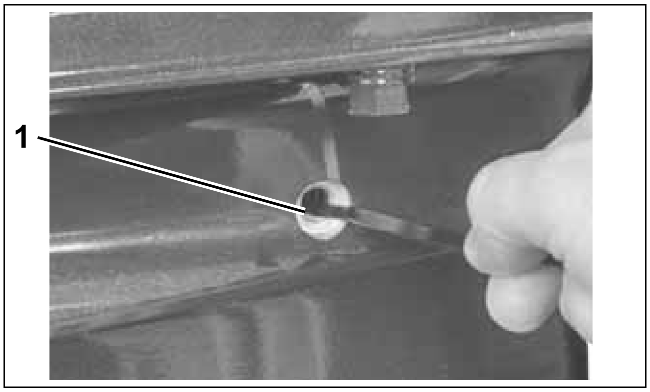
The oiling system can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to **STORAGE** on p. 77.

BEFORE START-UP

Gearcase Lubricant

With outboard vertical, check the gearcase lubricant level:

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



1. *Gearcase lubricant level* 000072

Oil Level

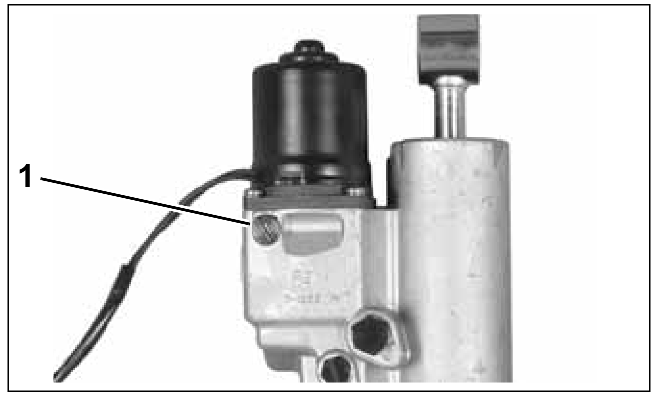
Make sure oil tank contains an adequate supply of the correct lubricant for the outboard and that the LOW OIL warning has been tested. Refer to **Oil Requirements** on p. 52.

When starting the outboard for the first time, refer to **Oil Supply Priming** on p. 54.

Trim and Tilt Fluid

Make sure trim and tilt reservoir is full before running outboard:

- Tilt the motor up and engage the tilt support.
- Remove filler cap and check fluid level.



Single Ram Trim System 004278
1. *Fill cap*

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

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

⚠ WARNING ⚠

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

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.

Engine Monitoring System

Attach emergency stop lanyard.

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

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

Fuel System

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

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

Emergency Stop / Key Switch

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

Remote Control Operation

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

Start-In-Gear Prevention

⚠ WARNING ⚠

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

Start outboard and shift to FORWARD.

Turn outboard OFF while control is in FORWARD.

Try to restart the outboard. Outboard should not start.

Shift back to NEUTRAL and restart outboard.

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

Try to restart the outboard. Outboard should not start.

Tachometer Pulse Setting

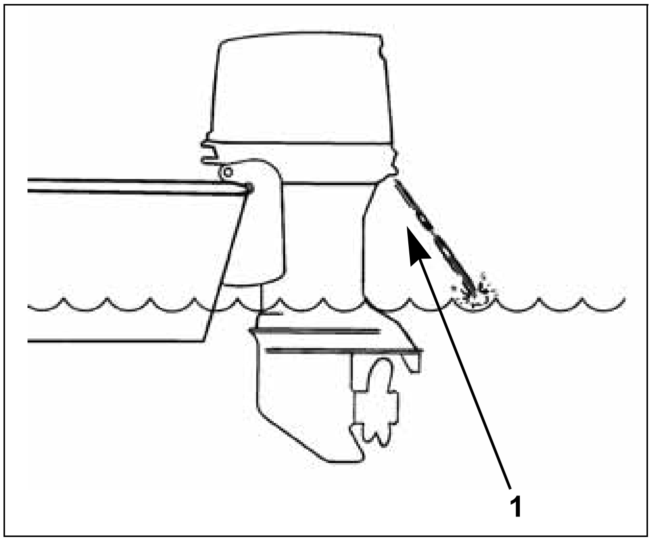
Confirm accuracy of tachometer reading.

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

Outboard Model	Tachometer Setting
40–250 HP	6 Pulse or 12 Pole

Water Pump Overboard Indicator

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



1. *Water pump overboard indicator* 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.

Idle Speed

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

Break-In

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

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

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

PROPELLERS

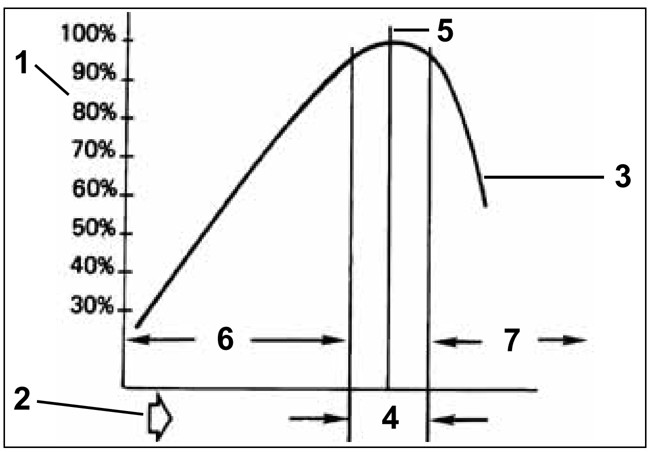
Propeller Selection

CAUTION

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

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

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



1. *Percentage of horsepower* DR1261
2. *Engine RPM*
3. *Horsepower curve*
4. *Full throttle operating range*
5. *Midpoint of full throttle operating range*
6. *Engine is overloaded at full throttle*
7. *Engine is overspeeding at full throttle*

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

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

Propeller Hardware Installation

⚠ WARNING ⚠

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

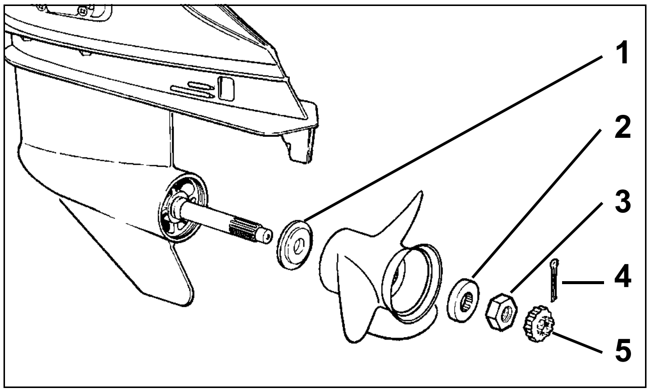
Apply *Triple-Guard* grease to the entire propeller shaft before installing the propeller.

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

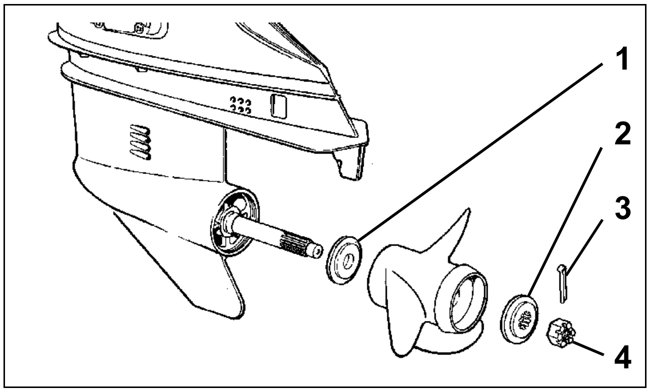
Install propeller on propeller shaft by aligning splines and pushing until seated on the thrust bushing.

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

Install the spacer, engaging the propeller shaft splines.

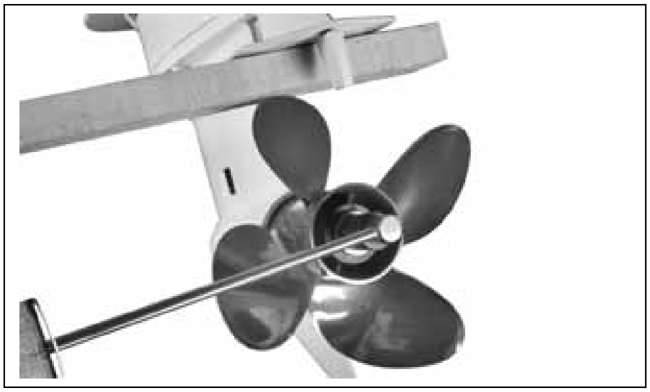


Models with cotter pin "keeper" DR4028
1. *Thrust Bushing*
2. *Spacer*
3. *Propeller Nut*
4. *Cotter Pin*
5. *Keeper*



Models without cotter pin "keeper" CO2917
1. *Thrust bushing*
2. *Spacer*
3. *Cotter pin*
4. *Propeller Nut*

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



001992

Install the propeller nut and tighten to a torque of:
- With Keeper – 70 to 80 ft. lbs. (95 to 109 N·m)
- Without Keeper – 120 to 144 in. lbs. (13.6 to 16.3 N·m)

If cotter pin holes in the propeller nut (Without Keeper) and propeller shaft are not aligned, tighten the nut until they are in line. Do not loosen.

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

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

FINAL ADJUSTMENTS

Tilt Limit Switch Adjustment

WARNING

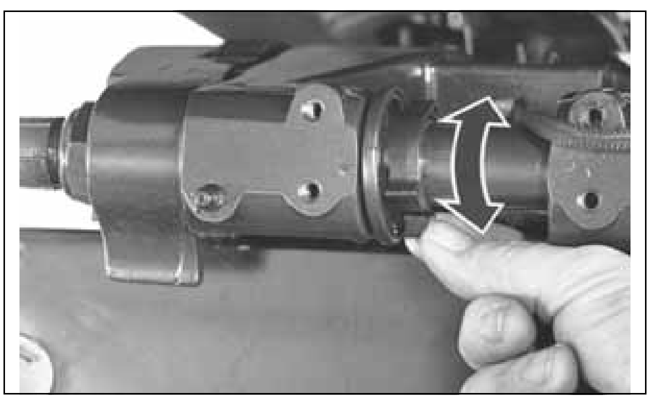
If the outboard does not clear all boat parts when tilted fully or turned side to side, safety related parts could be damaged in the course of such outboard movement. Injuries could result from loss of boat control.

Adjust the tilt limit switch on all new outboard installations.

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

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

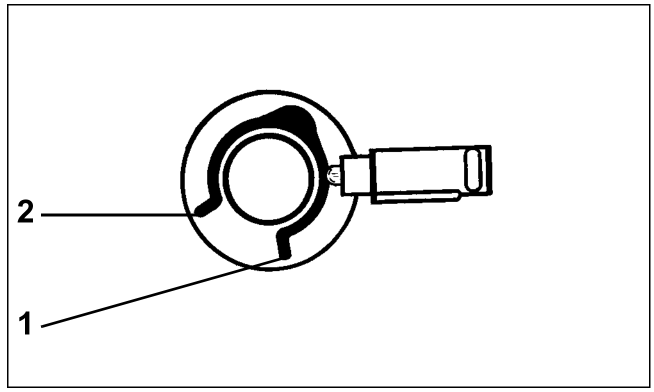
IMPORTANT: The tilt limit cam will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.



DR3916

Place the outboard in normal operating position.

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



1. *Lower adjustment tab*
2. *Upper adjustment tab*

DR4268

Check the adjustment by tilting the outboard fully.

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

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

WARNING

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

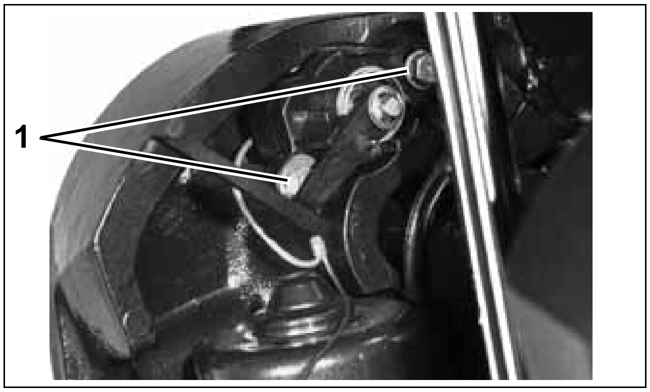
Trim Sending Unit Adjustment

Tilt the outboard and engage the tilt support.

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

29072

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



1. *Screws* 27339

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

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

1. *Needle at center position* 000662

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

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

WARNING

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

Trim Tab Adjustment

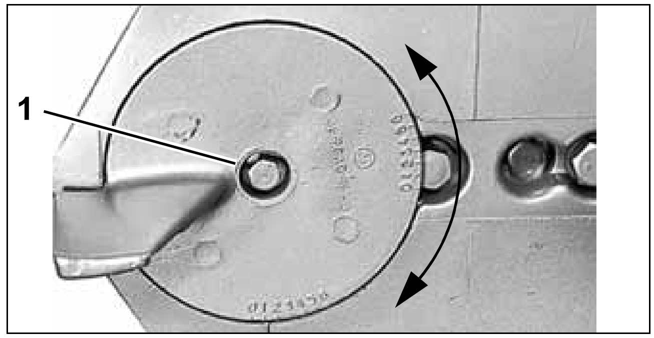
⚠ WARNING ⚠

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

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

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

If the boat pulls to the left or right when its load is evenly distributed, adjust the trim tab as follows:
- With the engine OFF, loosen the trim tab screw. If the boat pulled to the right, move rear of the trim tab slightly to the right. If the boat pulled to the left, move rear of the trim tab slightly to the left.
- Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m).



1. Trim tab screw COA3663

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

Outboards with High Transom Heights

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

Dual Standard Rotation Outboards

Move both trim tabs equally and in the same direction.

Dual Outboards, One Counter and One Standard Rotation

Set both trim tabs to the center position.

Dual-Outboard Alignment

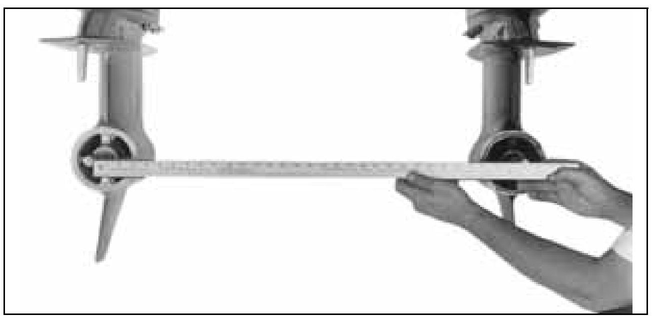
Dual outboards must be connected with a tie bar and adjusted to align the outboards for correct water flow to the gearcases and propellers.

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

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

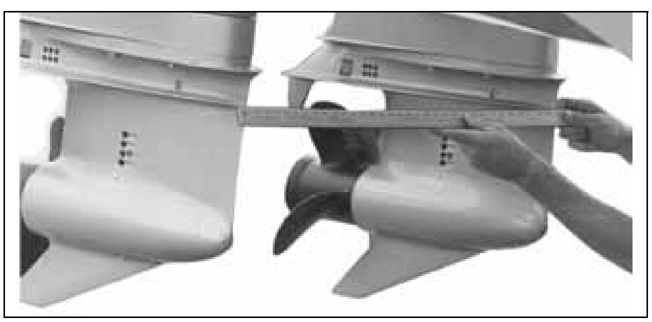
Measure Alignment

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



6365

- Measure between leading edges of gearcase.



6340

Alignment Adjustment

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

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

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

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

Confirm Alignment

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

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

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

MAINTENANCE

TABLE OF CONTENTS

INSPECTION AND MAINTENANCE SCHEDULE

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

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

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

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

A *HPF XR* Gearcase Lubricant
HPF Pro in high performance or commercial applications

B Power Trim/Tilt Fluid (Three ram hydraulic systems)
Biodegradeable TNT Fluid (Single ram hydraulic systems)

C *Triple-Guard* Grease

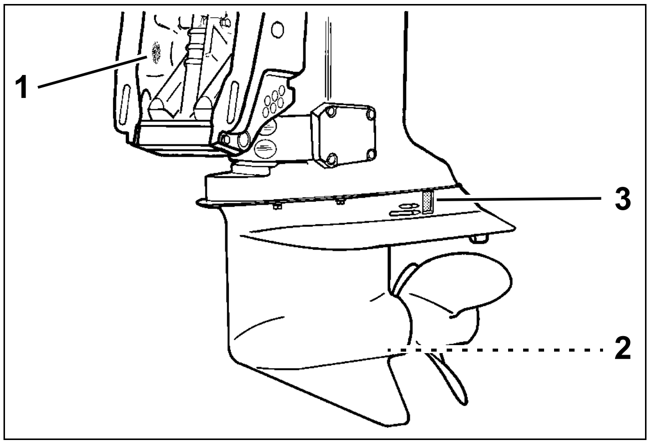
D Starter Bendix Lube Only, P/N 337016

ANTI-CORROSION PROTECTION

Sacrificial Anodes

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

Outboards are equipped with three sacrificial anodes.



1. *Stern bracket anode* DR5082
2. *Propeller shaft bearing housing anode (inside of gearcase housing)*
3. *Gearcase housing anode*

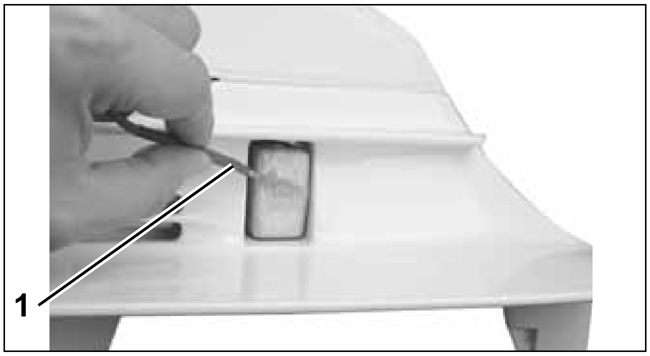
Visually inspect anodes and metal components below water level. Erosion of anodes is normal and indicates the anodes are functioning properly.

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

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

Testing Procedure – Continuity

Connect ohmmeter leads between engine ground and anode surface.



1. *Meter lead to anode* 000677

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

Metallic Component Protection

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

Exterior Finishes

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

COOLING SYSTEM

Check the condition of cooling system components regularly:

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

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

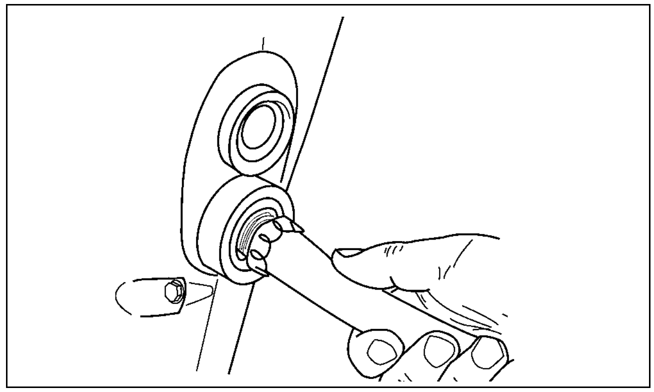
WARNING

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

Refer to **Propeller Hardware Installation** on p. 59.

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

Thread garden hose into flushing port.



002024

Shift the outboard to NEUTRAL with the propeller removed.

Turn water supply on.

START outboard. Run it at IDLE only.

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

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

Reinstall propeller.

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.

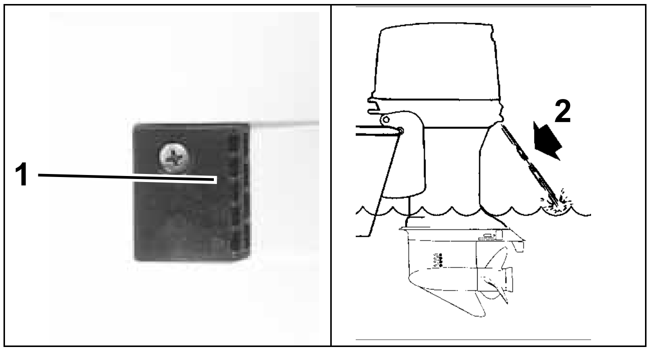
Turn off water supply and remove garden hose.

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

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*

DSC02220a
drc4952arev

Additional Maintenance

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

LUBRICATION

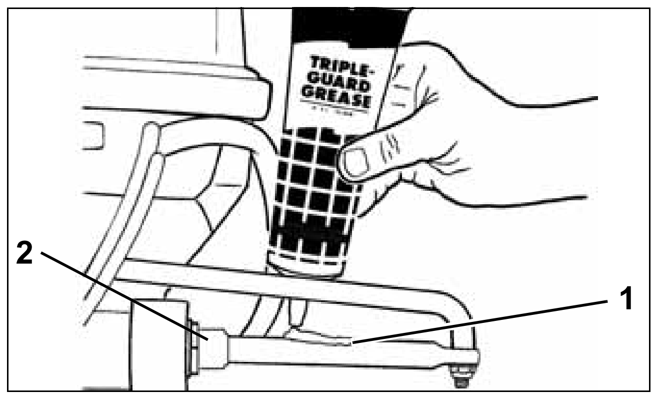
Steering System

⚠ WARNING ⚠

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

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

Use an appropriate cleaning solvent to remove corrosion and dirt from output end of cable prior to coating it with grease. Make sure wiper nut is installed and not damaged.



1. *Steering cable*
2. *Wiper nut*

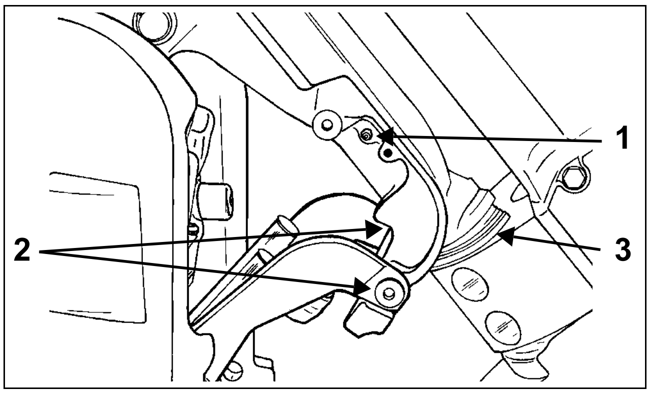
DR29546

Swivel Bracket and Trailering Bracket

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

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

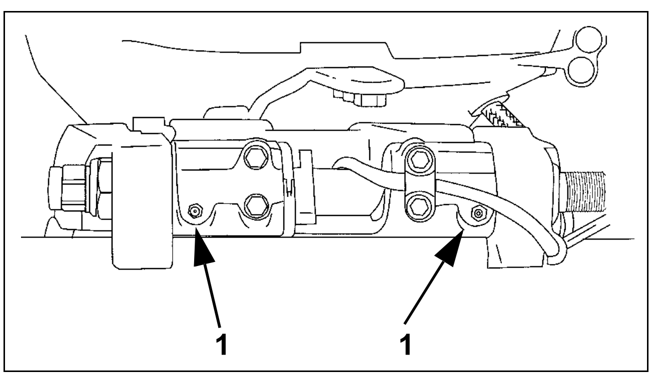
Coat the pivot points of the trailering bracket with *Triple-Guard* grease.



1. *Grease fitting* DR5073
2. *Pivot points*
3. *Lower swivel bracket area*

Tilt Tube

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



1. *Tilt tube fittings* DR38798

Throttle and Shift Linkage

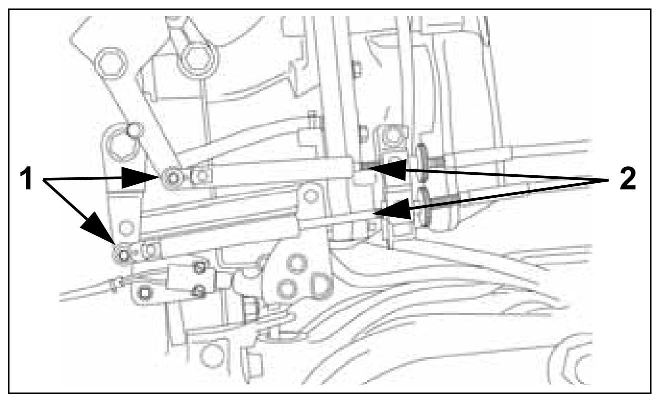
Disconnect the battery cables at the battery.

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

IMPORTANT: DO NOT disturb cable trunnion adjustments.

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

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



1. *Attachment pins, throttle and shift cables* 002214
2. *Brass inner casings, throttle and shift cables*

Shift the remote control to the NEUTRAL/IDLE position.

Install control cables.

Check proper throttle and shift function.

Propeller Shaft

Debris from the water can become lodged around propeller shaft. Frequent inspection can minimize potential gearcase damage.

WARNING

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

Remove propeller. Refer to **Propeller Hardware Installation** on p. 59.

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.

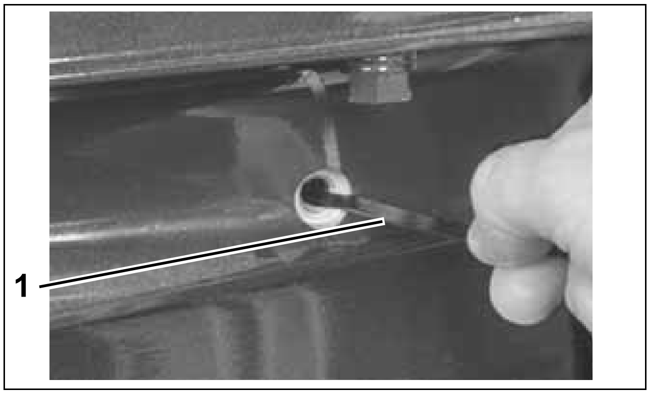
Gearcase Lubricant

Draining

WARNING

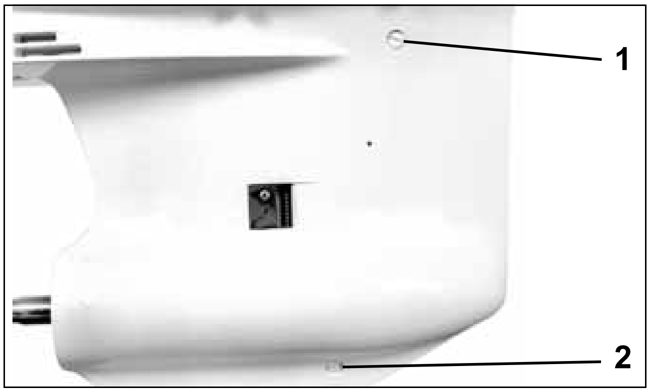
Gearcase lubricant may be under pressure and/or hot. If plug is removed from a recently operated outboard, take precautions to avoid injury.

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

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



1. Lubricant level plug 39514
2. Lubricant drain/fill plug

Inspection

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

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

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

Refer to **GEARCASE LEAK TEST** on p. 260.

Overheated lubricant will have a black color and burned odor.

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

Filling

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

Secure the gearcase in a vertical position.

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

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

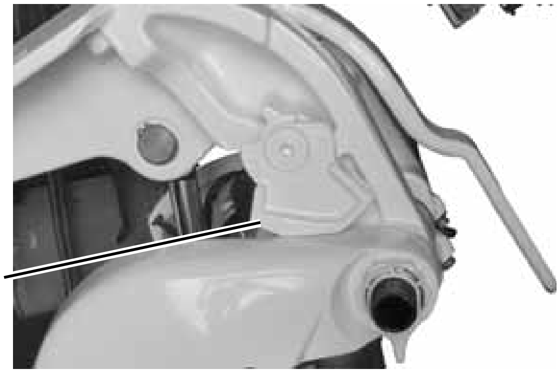
1. *Lubricant level plug* 002386
2. *Lubricant drain/fill plug*

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

Trim and Tilt

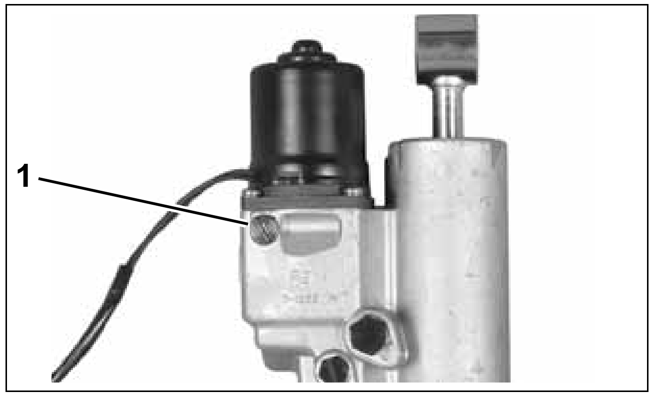
Check reservoir fluid level every three years or every 300 operating hours. System capacity is approximately 21 fl. oz. (620 ml).

- Tilt the outboard and engage the tilt support.



1. *Tilt support bracket* 002279

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



Single Ram Trim System 004278
1. *Fill cap*

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

WARNING

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

3

BATTERY AND BATTERY CONNECTIONS

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

WARNING

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

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

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

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

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

IMPORTANT: DO NOT secure battery cables with wing nuts.

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

WARNING

Keep 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 covers.

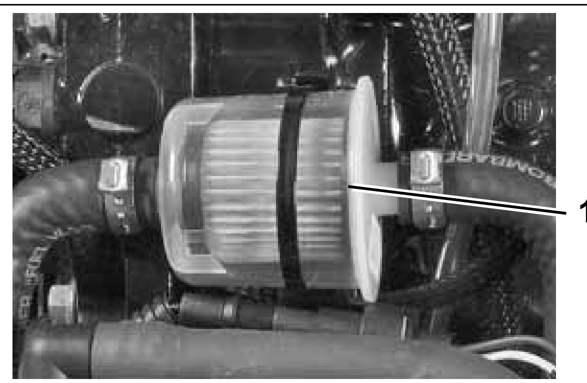
FUEL AND OIL SYSTEMS

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

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

Fuel Filter

Evinrude E-TEC 40–90 HP outboards are equipped with an in-line fuel filter. Refer to **FUEL COMPONENT SERVICING** on p. 166.



1. *In-line 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 on *Evinrude* outboards maximizes air flow while minimizing noise.

002158

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

Hoses and Connections

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

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

⚠ WARNING ⚠

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

3

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, *Champion*
QC10WEP @ 0.028 ± 0.003 in. (0.71 mm)

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

Removal

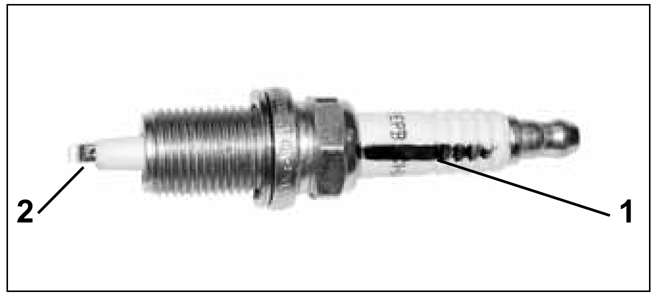
Remove ignition coil above spark plug to gain access. When reinstalling coils, tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

006521

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.

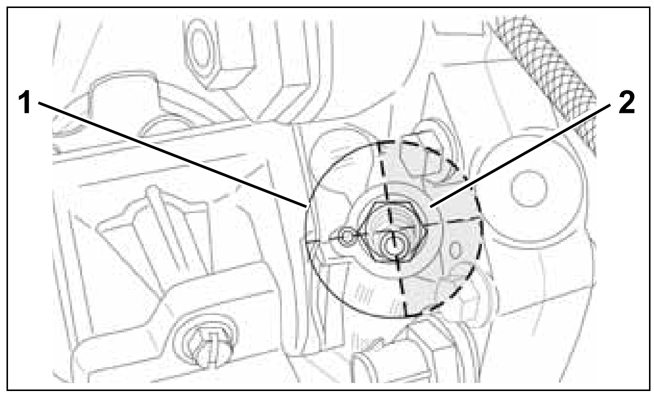


1. *Ink mark*
2. *Open side*

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).

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



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 the torque of 30 ft. lbs. (41 N·m) is reached, the spark plug cannot be indexed for that cylinder. Try another spark plug and repeat the steps above.

STORAGE

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

Fuel System Treatment

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

Internal Engine Treatment

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

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

IMPORTANT: Engine MUST be in NEUTRAL throughout these procedures.

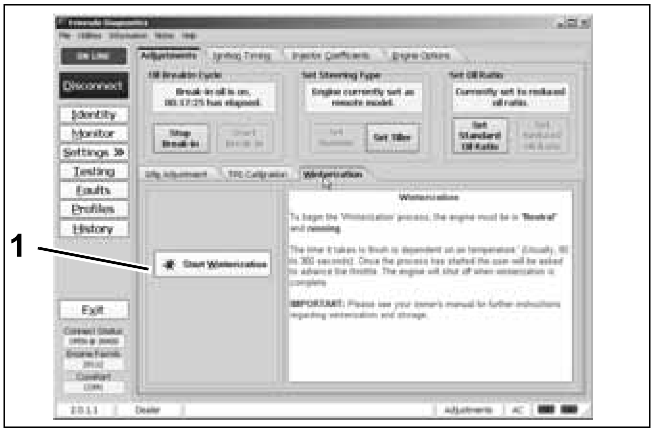
Throttle Control Method

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

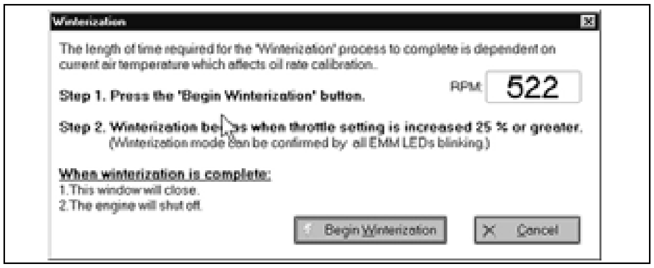
IMPORTANT: If *SystemCheck* lights do not flash, or outboard runs above fast idle, immediately turn off outboard and start the procedure again.

Software Control Method

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



1. *Winterization start button* 006544



005149

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

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

Additional Recommendations

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

⚠ WARNING ⚠

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

PRE-SEASON SERVICE

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

Outboard Mounting Bolts

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

Gearcase Lubricant

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

Battery(s)

- Replace batteries that cannot be charged.

Power Trim and Tilt

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

Operational Checks

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

Check Oil Injection Tank

- Inspect the oil tank for leaks.

Check Fuel System

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

Water Pump

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

⚠ WARNING ⚠

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

SUBMERGED ENGINES

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

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

Engine Dropped Overboard (Not Running)

Disconnect the battery cables at the battery.

Rinse powerhead with clean water.

Remove spark plug leads and spark plugs.

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

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

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

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

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

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

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

Prime oil system and fuel system. Refer to **FUEL AND OIL PRIMING** on p. 51. Make sure all oil injection hoses are clean and filled with oil.

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

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

Reinstall all removed or disconnected parts.

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

Run outboard below 1500 RPM for one-half hour.

Engine Dropped Overboard (Running)

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

Engine Dropped Overboard (In Salt Water)

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

Prolonged Submersion (Fresh or Salt Water)

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

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

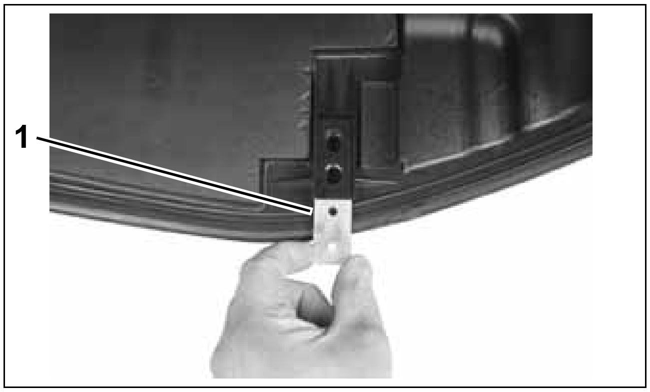
ENGINE COVER SERVICE

TABLE OF CONTENTS

UPPER COVER SERVICE

Latch Hook Installation

Insert threaded bracket into pocket.



1. *Bracket* 006468

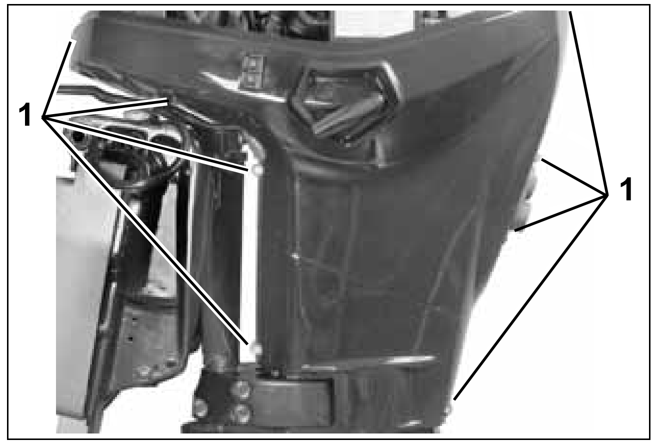
Apply *Ultra-Lock* to screw threads. Place hook into position with opening toward the front. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

006469

LOWER COVER SERVICE

Lower Cover Removal

Remove lower engine cover screws.



1. *Lower cover screws* 002168

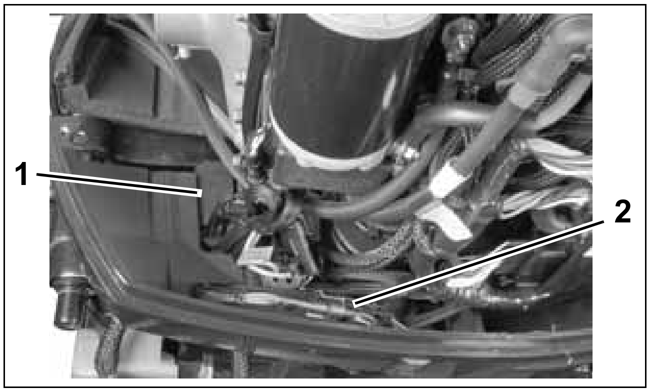
Loosen port side cover slightly, and disconnect trim/tilt switch connector. Then, remove port and starboard covers.

1. *Trim/tilt switch connector* 002151

Lower Cover Installation

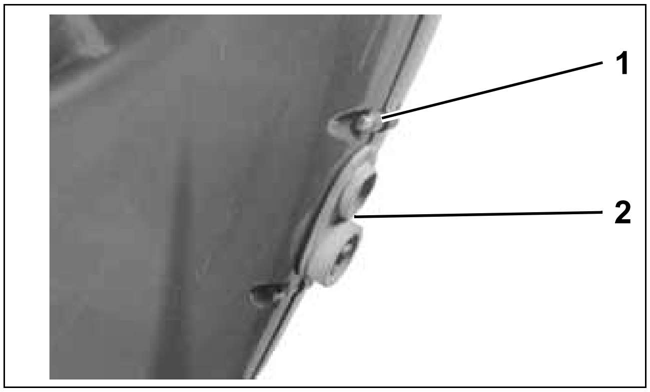
Installation of lower motor covers will be easier if the following steps are performed in order:

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



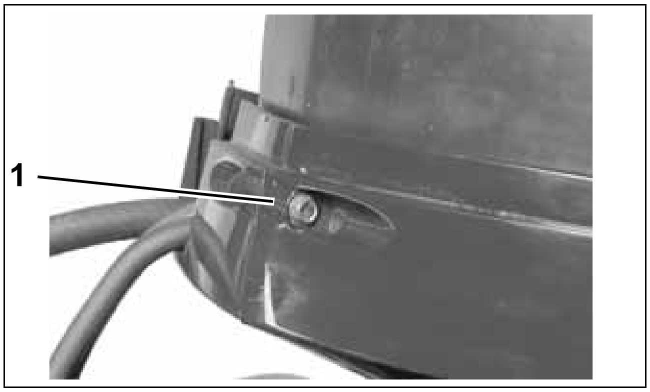
1. *Trim cable grommet* 002156
2. *Trim/tilt switch connector*

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



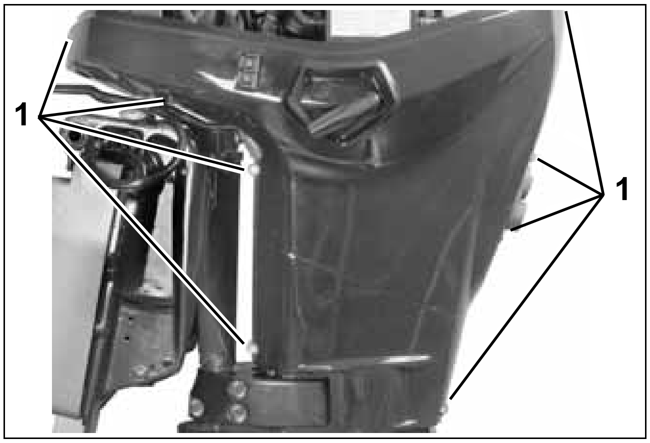
1. *Start this screw first* 002157
2. *Exhaust relief grommet*

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



1. *Start this screw second* 002165

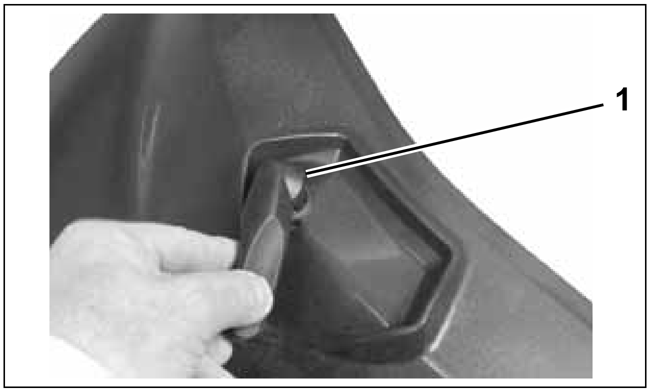
Install remaining cover screws and tighten all screws to a torque of 24 to 36 in. lbs. (3 to 4 N·m).



1. *Lower cover screws* 002168

Latch Handle Installation

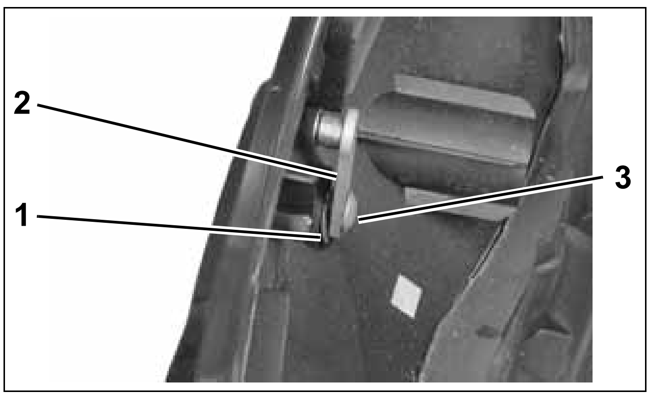
Apply a light coat of *Triple-Guard* grease to latch handle shaft. Insert handle into lower cover.



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

Trim Switch Installation

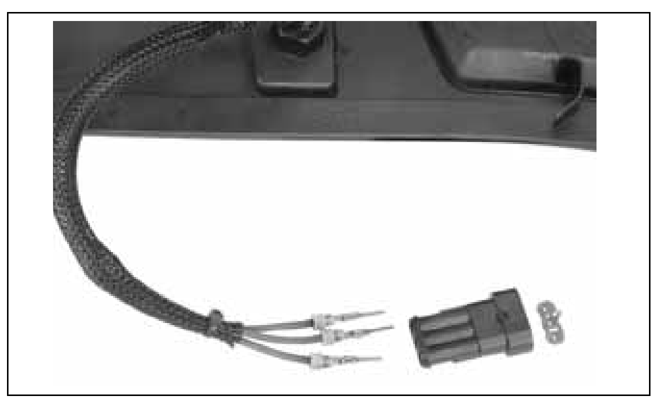
Place switch into position through cover.

006746

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

006747

Install electrical connector. Refer to **CONNECTOR SERVICING** on p. 148.



006748

ENGINE MANAGEMENT MODULE (*EMM*)

TABLE OF CONTENTS

5

DESCRIPTION

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

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

EMM Functions

The *EMM* controls the following processes and functions:

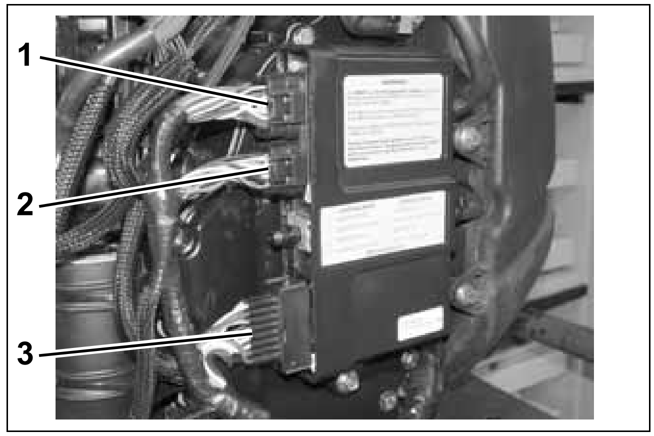
- Alternator output; 55 V and 12 V
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil injector pump activation
- Electric fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Service code creation and storage
- Warning system activation
- ROM verification,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

EMM Connections

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

Make sure *EMM* connections are clean and tight.

- Engine wire harness to *EMM* connectors; J1-A, J1-B, J2
- Stator to *EMM* connections; one 6-pin *AMP* and J2 connector.



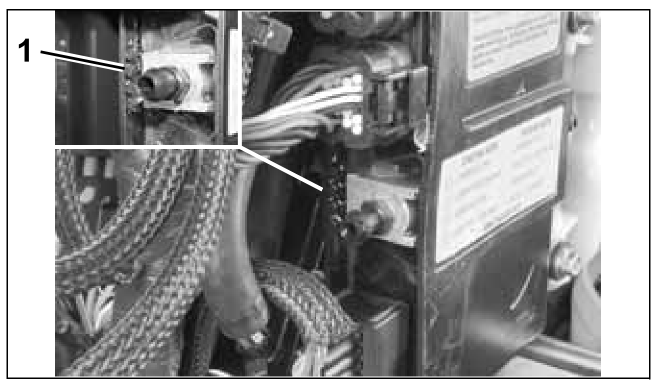
1. *J1-A connector*
2. *J1-B connector*
3. *J2 connector*

002424

LED Indicators

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

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



1. *LED indicators*
   (Cooling hose removed for clarity)

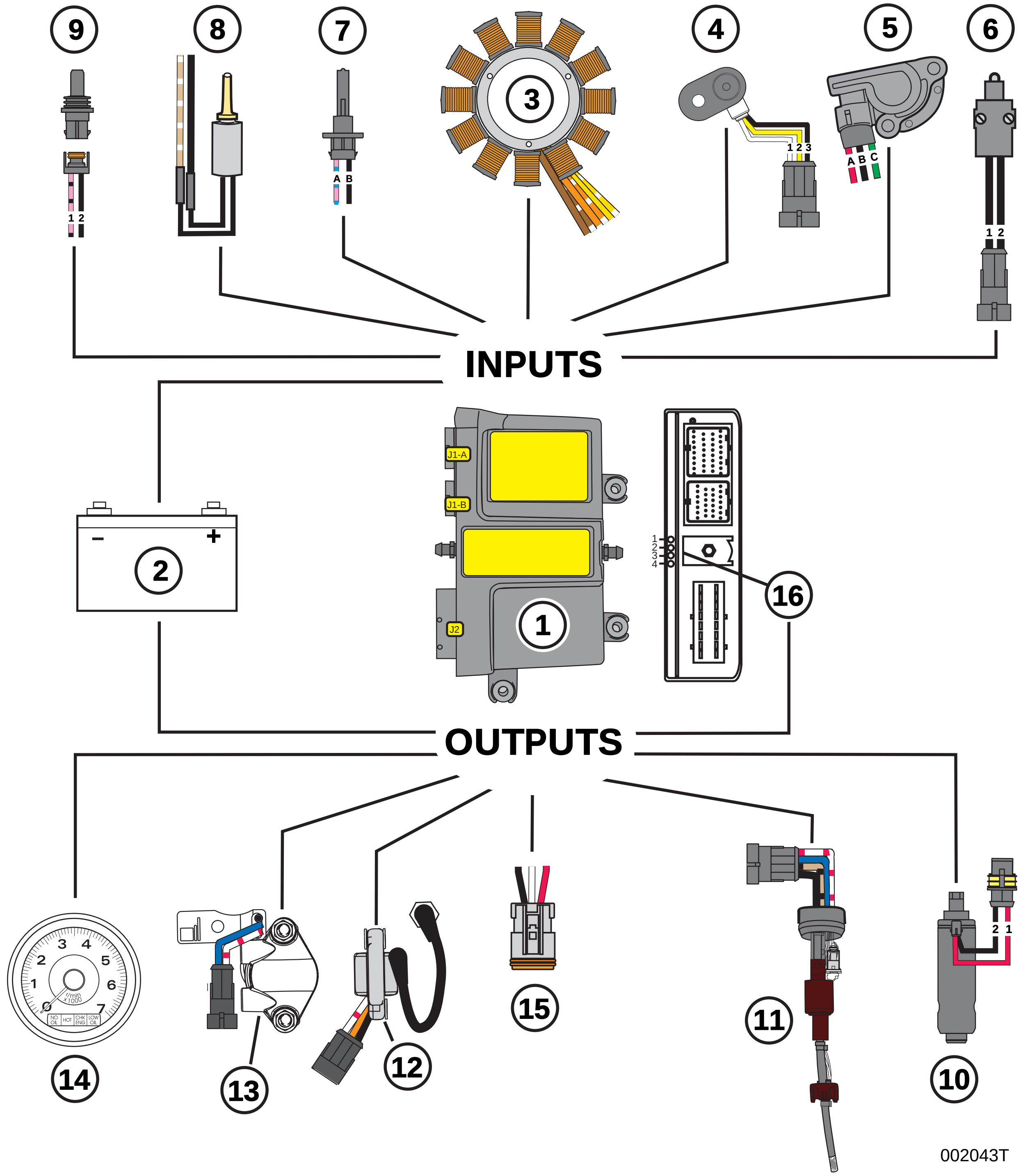
002429
006467

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

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

When the outboard is running, all LEDs should be off. If any LED is lighted while the outboard is running, refer to **EMM LED INDICATORS** on p. 107.

EMM INPUTS AND OUTPUTS DIAGRAM



1. Engine Management Module (*EMM*)
2. Battery (12 volt)
3. Stator
4. Crankshaft Position Sensor (CPS)
5. Throttle Position Sensor (TPS)
6. Neutral Switch
7. Air Temperature Sensor (AT)
8. Oil Pressure Switch (component of 11)
9. Engine Temperature Sensor
10. Fuel Pump (high pressure)
11. Oil Injection Pump and Manifold
12. Ignition Coil
13. Fuel Injector
14. Tachometer/*SystemCheck* Gauge
15. Diagnostic Connector
16. LED Indicators

INTERNAL SENSORS

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

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

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

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

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

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

Activates SHUTDOWN
Stores service code 29
EMM LED 4: FLASHING
Engine Monitor TEMP display: FLASHING

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

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

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

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

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

55 V Circuit Sensor

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

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

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

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

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

12 V Circuit Sensor

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

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

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

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

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

Barometric Pressure Sensor

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

If the BP sensor reads below 13.3 KPa or above 119.0 KPa, or the sensor or circuit fails, the *EMM:*

Stores service code 44

If the BP sensor reads below 70 KPa, the *EMM:*

Stores a service code 45

If the BP sensor reads above 105 KPa, the *EMM:*

Stores service code 46

EXTERNAL SENSORS

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

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

Air Temperature Sensor

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

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

Stores service code 47
EMM LED 3: OFF (Cranking)
EMM LED 3: ON (Running)
Engine Monitor CHECK ENGINE display: ON

Engine Temperature Sensor

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

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

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

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

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

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

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

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

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

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

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

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

Low Oil Switch

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

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

Engine Monitor LOW OIL display: ON

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

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

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

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

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

Throttle Position Sensor

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

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

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

Creates service code 11

If the outboard starts, the code is stored.

If code 11 is present as both a Hard Fault and a Stored Fault, refer to **Control Cable Adjustments** on p. 46.

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

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

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

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

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

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

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

Crankshaft Position Sensor

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

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

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

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

Approximate air gap between CPS and flywheel ribs is .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 for NEUTRAL or IN GEAR. Tiller models use the switch for start in gear protection. Fuel and ignition functions are turned off if the neutral switch is not closed.

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

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

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

INTERNAL *EMM* FUNCTIONS

ROM Verification

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

Idle Controller

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

RPM Limiter

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

Neutral RPM Limiter

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

Engine Monitor and Warning Systems

Refer to **ENGINE MONITORING SYSTEM** on p. 93.

Refer to **S.A.F.E. WARNING SYSTEM** on p. 94.

Refer to **SHUTDOWN MODE** on p. 94.

Fault Code Creation and Storage

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

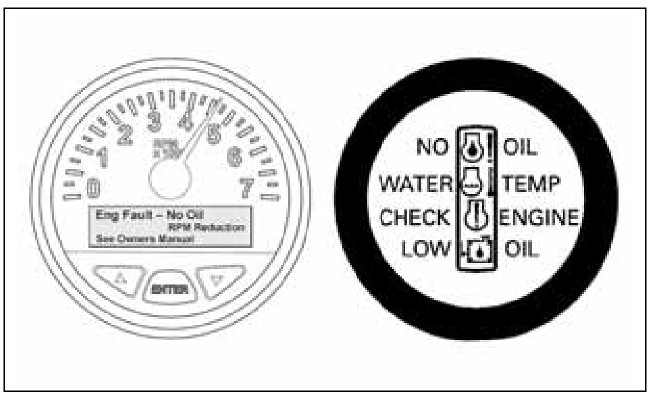
ENGINE MONITORING SYSTEM

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

The *EMM* sends information about monitored functions to:

- An *I-Command*, or other *NMEA 2000* compliant CANbus network
- The *SystemCheck* Modular Wiring System (MWS)
- *EMM* LED indicators

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



Typical *I-Command* and *SystemCheck* gauges 006707

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 fault codes.

System Self-Test

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

Service Mode

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

Engine Running

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

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

S.A.F.E. WARNING SYSTEM

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

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

Activation

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

Recovery

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

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

SHUTDOWN MODE

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

Code 29	Excessive *EMM* temperature
Code 31	Excessive engine temperature
Code 33	Excessive NO OIL condition
Code 57	High RPM with low TPS setting

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

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

⚠ WARNING ⚠

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

Recovery

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

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

DIAGNOSTIC SOFTWARE FUNCTIONS

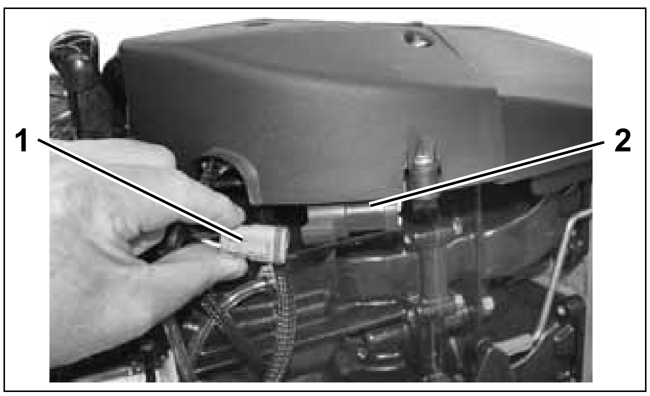
The *EMM* stores valuable information about the outboard and its running history. This information can be used for troubleshooting, for checking parts information, and for making adjustments to the system.

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

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

Communication

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



1. *Diagnostic connector* 004973
2. *Cover*

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

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

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

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.

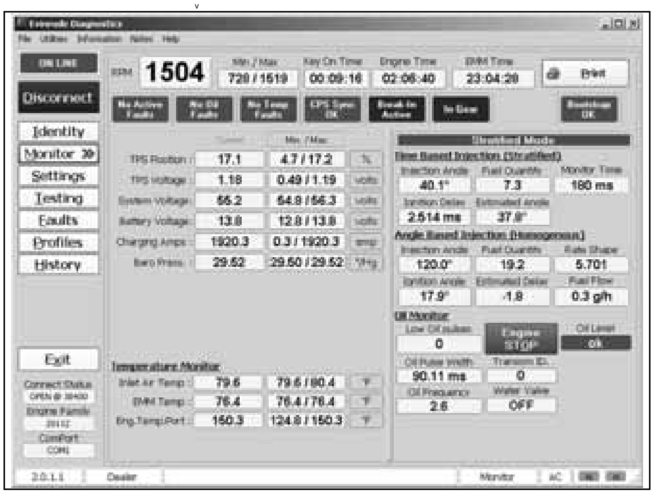
Identity Screen 006770

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

Injector Coefficients Screen 006771

Dynamic Information

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

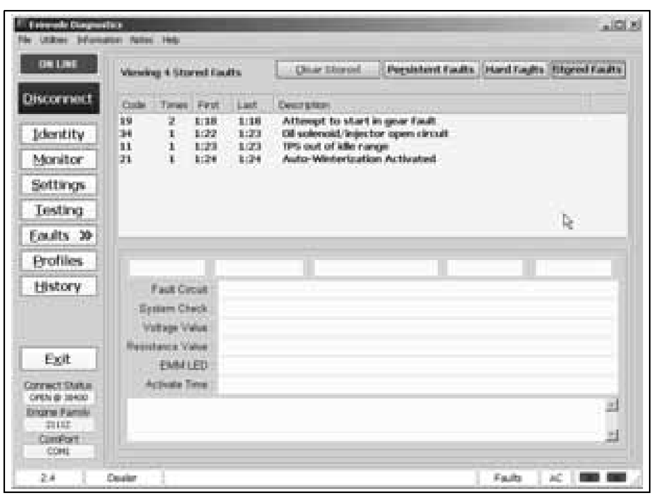


Engine Monitor Screen 006539

Stored Service Codes (Faults)

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

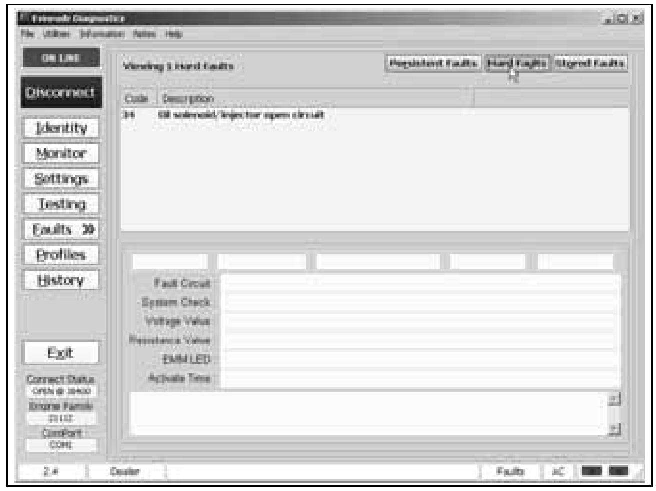
The *Stored Faults* screen of the diagnostics software shows the code number, the number of times the event occurred, and operating hours of first and last occurrences.



Stored Faults Review Screen 006625

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 006626

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 006772

Ignition Test

Use the diagnostics software to test each ignition circuit. Refer to **Static Ignition Test** on p. 111.

Fuel Test

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

Oil Injector

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

Fuel Pump

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

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 006769

Ignition Test

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

Fuel Test

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

Prime Oil

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

Oil Control Settings

Set Oil Type

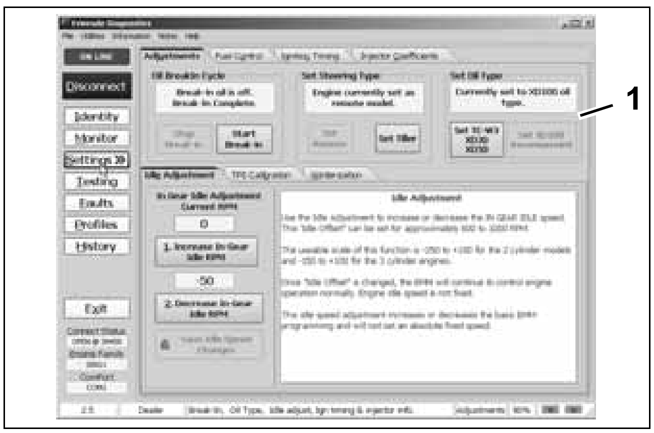
The TC-W3 oil type setting is the standard setting for all outboards. Set TC-W3 for:

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

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

Use the *XD100* setting for:

- Conventional use (runabouts, cruisers)
- Moderate applications

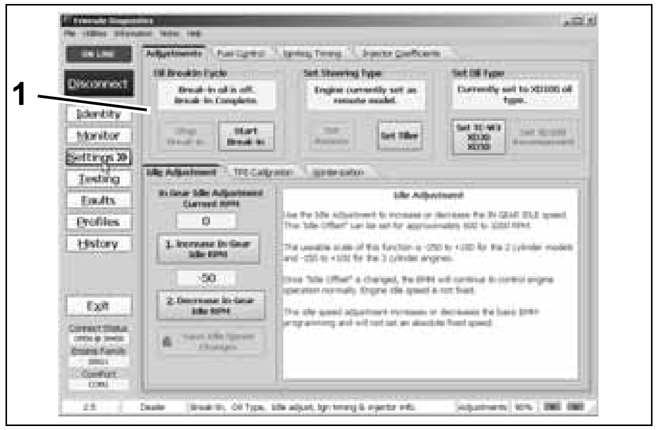


1. *Oil control setting* 006540

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

Powerhead Break-In

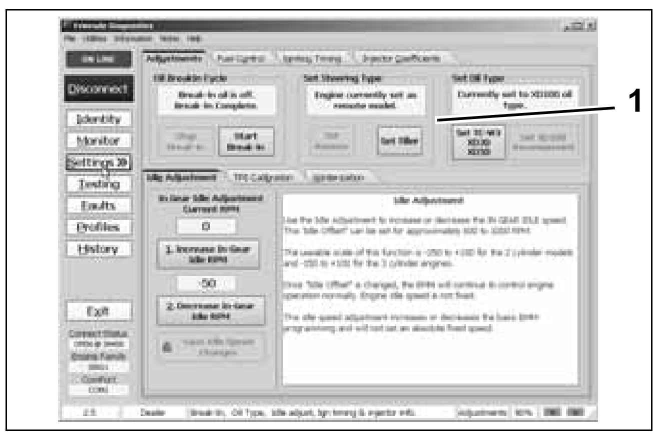
Use the diagnostics software to start break-in oiling after a powerhead rebuild. The break-in oiling program runs for two hours of outboard operation, above 2000 RPM.



1. *Break-in oil setting* 006540

Tiller/Remote Programming

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



1. *Starter mode setting* 006540

Ignition Timing

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

Refer to **TIMING ADJUSTMENTS** on p. 142.

006547

Check timing after any of the following procedures:

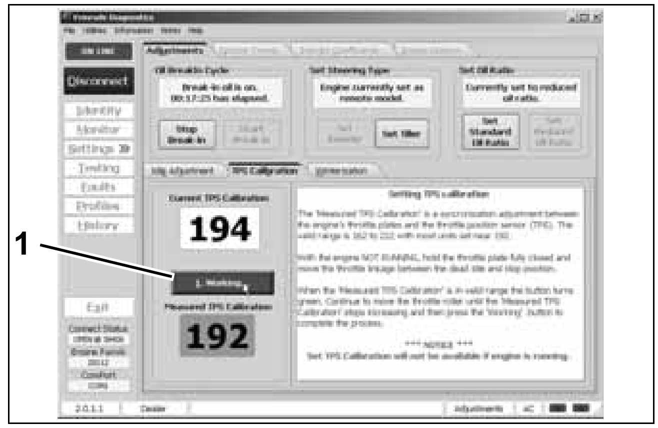
- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- *EMM* replacement
- *EMM* software replacement

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

TPS Calibration

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

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

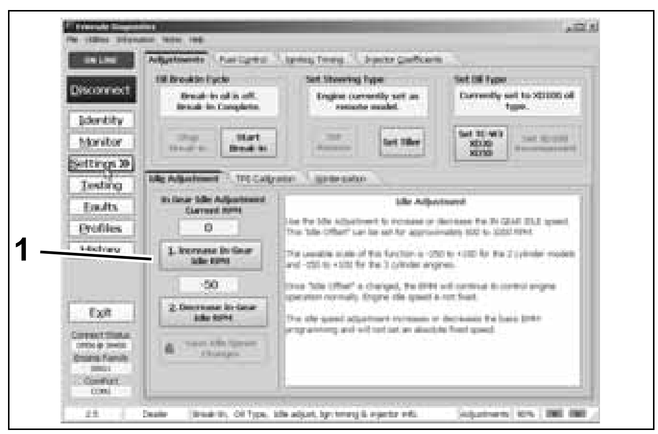


1. *TPS Calibration button* 006548

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

Idle Speed Control

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

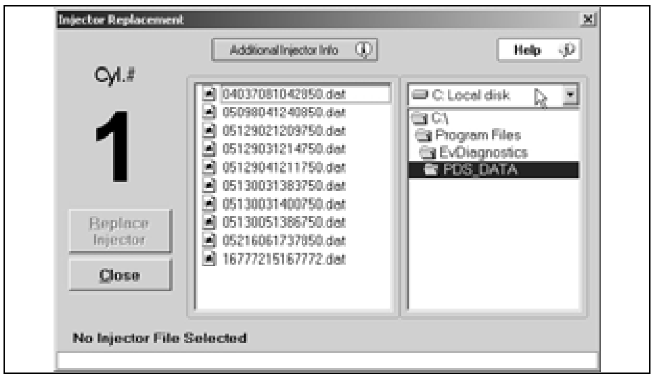


1. *Idle adjustment* 006540

Fuel Injector Servicing

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

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

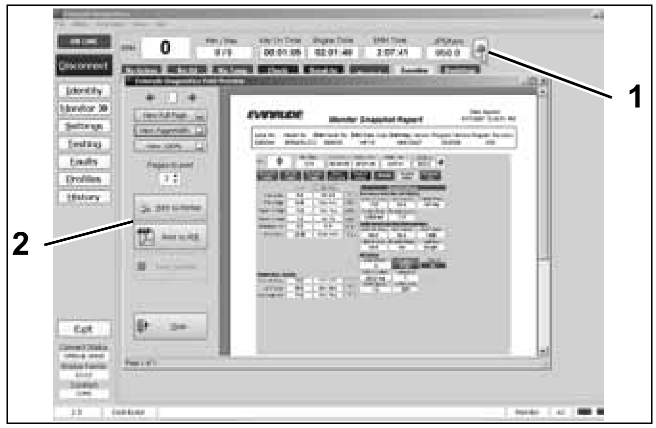


005157

Reports

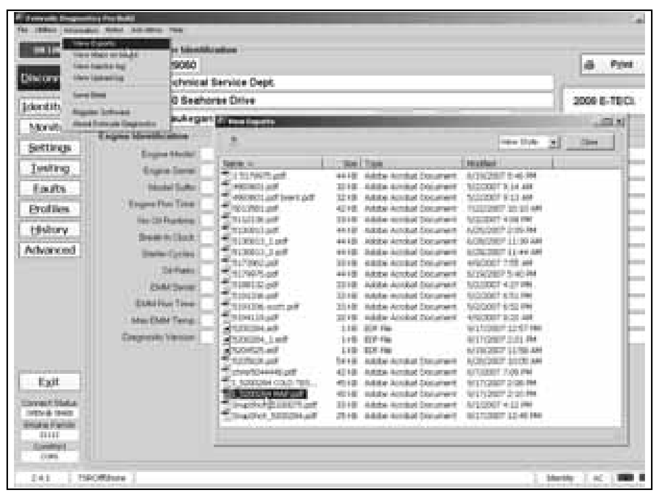
Engine reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

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*

006639

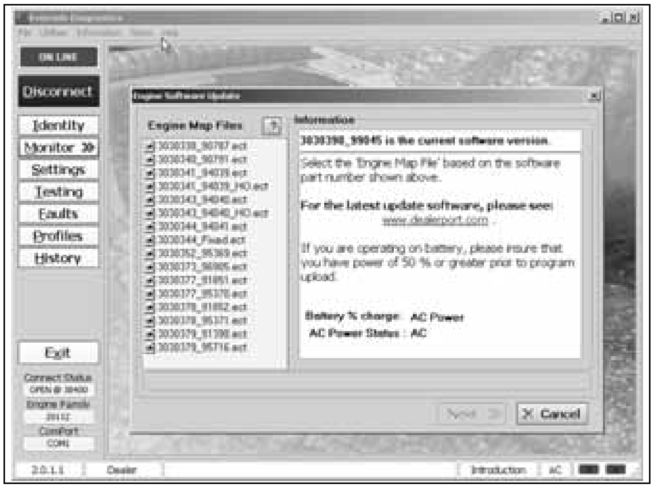


Engine Report data files

006640

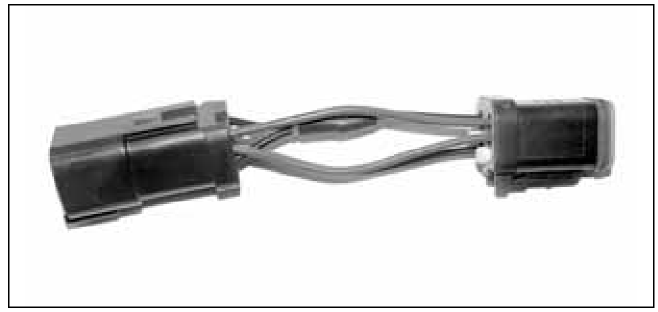
Software Replacement

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



006541

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



002383

EMM Transfer

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

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

5

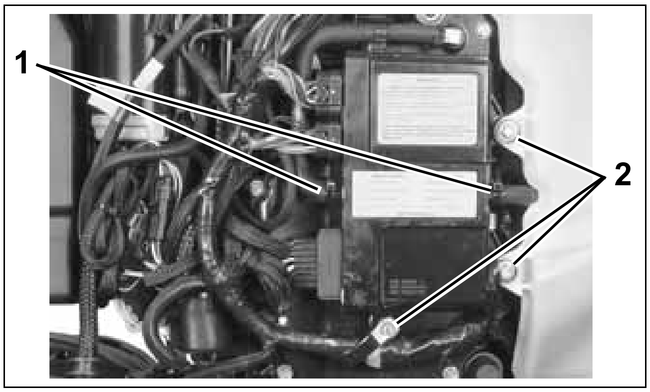
EMM SERVICING

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

Disconnect cooling hoses from *EMM*.

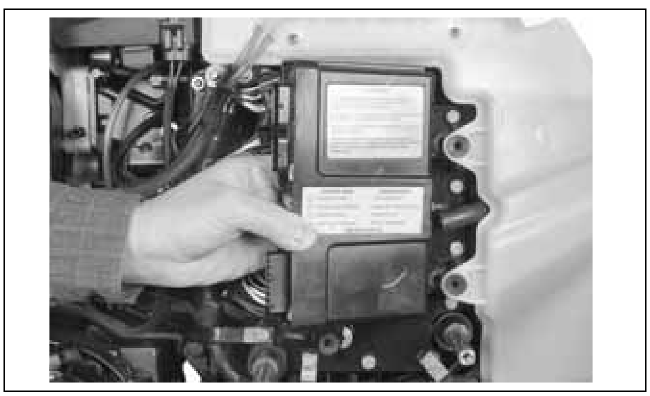
Disconnect J1-A, J1-B, and J2 connectors.

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



1. *Cooling hose connections* 006779
2. EMM *mounting screws*

Remove *EMM* from behind oil tank bosses.

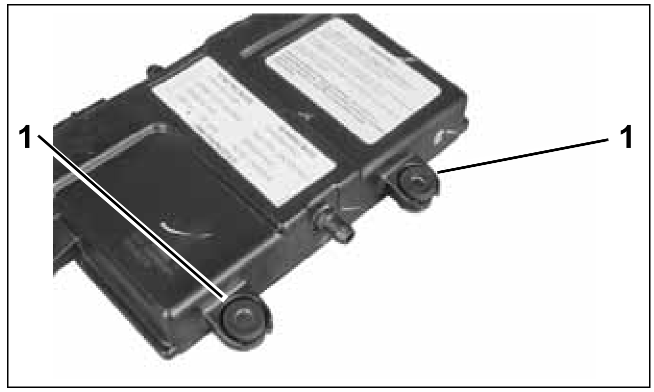


006477

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.

SYSTEM ANALYSIS

TABLE OF CONTENTS

6

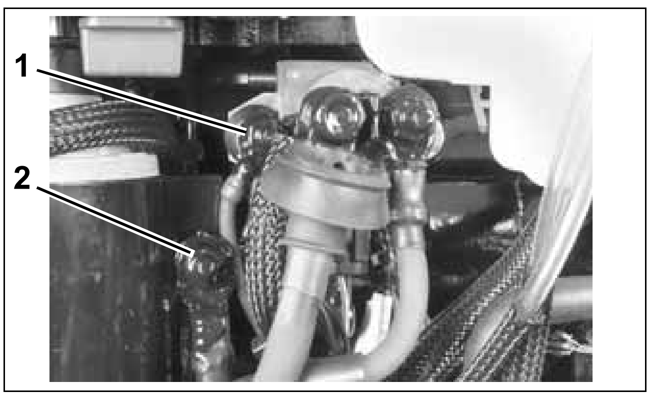
DIAGNOSTIC PROCEDURES

Visual Inspections

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

- Refer to **ELECTRICAL HARNESS CONNECTIONS** on p. 121.
- Refer to **WIRING DIAGRAM** at the back of this manual.
- Refer to **CONNECTOR SERVICING** on p. 148.

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



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

002292

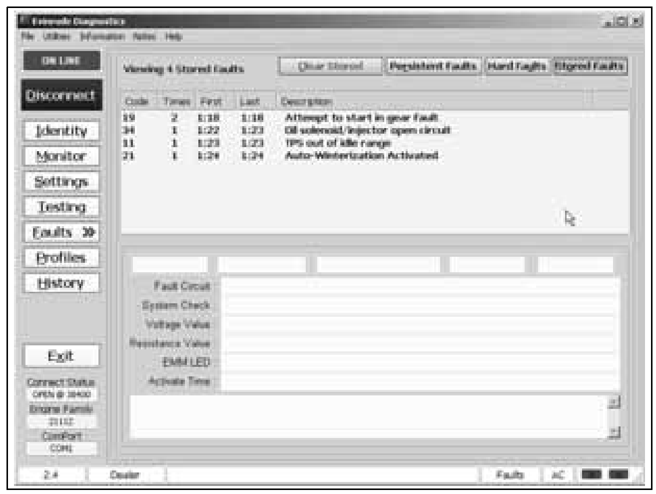
Inspect spark plugs for wear, oil fowling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.

Check the fuse and the emergency stop switch lanyard.

Operational Inspections

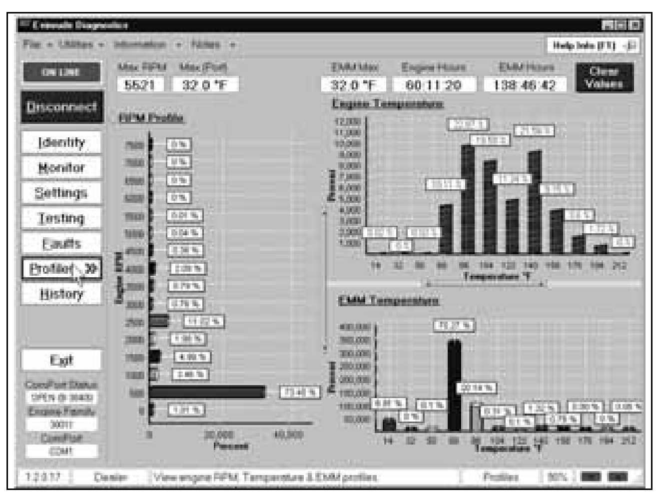
Run the outboard to confirm actual symptoms before performing any unnecessary procedures. Inspection should include the following:

- 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. 107.
- Check the *Evinrude Diagnostics* software *Hard Faults* and *Stored Faults* screens for current service codes. Correct any problems and clear the codes before further troubleshooting. Refer to **Stored Service Codes (Faults)** on p. 96.



Stored Faults Review Screen 006625

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



Profiles Screen 005170

Troubleshooting

Outboard will not crank, starter does not operate:

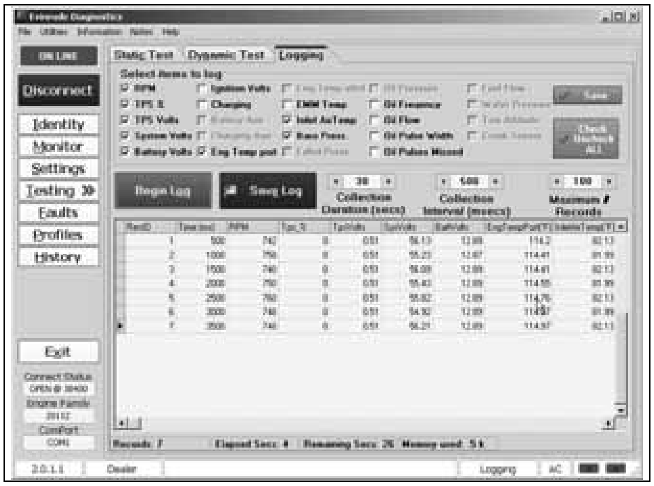
- Check condition of battery and cables (main battery switch and cables). Make sure battery cables are not reversed.
- Confirm that switched B+ is present at “A” terminal (yellow/red wire) of starter solenoid with key switch in the START position.
- Check ground at “B” terminal harness connection.
- Refer to **ELECTRIC START TESTS** on p. 131. Repair starter or start circuit as needed.

Outboard cranks, will not start:

- Check emergency stop switch and lanyard
- Check powerhead mounted neutral switch
- Check the *EMM* LED Indicators for system status information. Refer to **EMM LED INDICATORS** on p. 107.
- Use the *Evinrude Diagnostics* software *Stored Faults* screen to check for current service codes. If there are multiple stored sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
- Perform a Static Ignition test using *Evinrude Diagnostics* software and an inductive timing light. Refer to **Static Ignition Test** on p. 111.
- If ignition test indicates steady spark, refer to **FUEL DELIVERY TESTS** on p. 114.

Outboard runs, low on power, misfires:

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



Logging Screen 006549

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

DYNAMIC TESTS

Cylinder Drop Tests

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

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

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

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

Dynamic Tests can be used with:

- A timing light to determine how other cylinders are affected by one cylinder being "dropped"; or
- A voltmeter to check voltage changes on electrical circuits.

Dynamic Tests Screen 006773

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.

006774

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

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

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

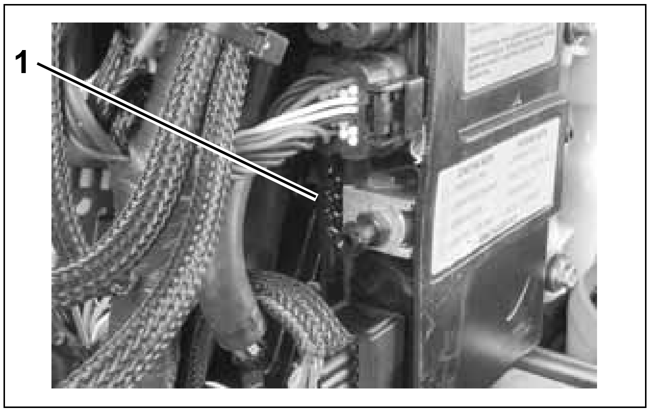
Inductive Amp Meter Test

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

EMM LED INDICATORS

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

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



1. *LED indicators* 006467

Key ON

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

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

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

Starting

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

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

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

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

For FLASHING LIGHT, check for Code 57.

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

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

6

Running

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

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

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

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

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

IGNITION OUTPUT TESTS

⚠ DANGER ⚠

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

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

Ignition System Requirements

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

Stop Circuit

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

Neutral Switch

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

Stator Output Voltage

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

EMM

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

Crankshaft Position Sensor

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

Alternator Output/System Voltage

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

Capacitor

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

Ignition Coil

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

Wiring Inspection

Visually inspect all wiring, connections, and grounds.

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

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

1. *Ground stud* 002292

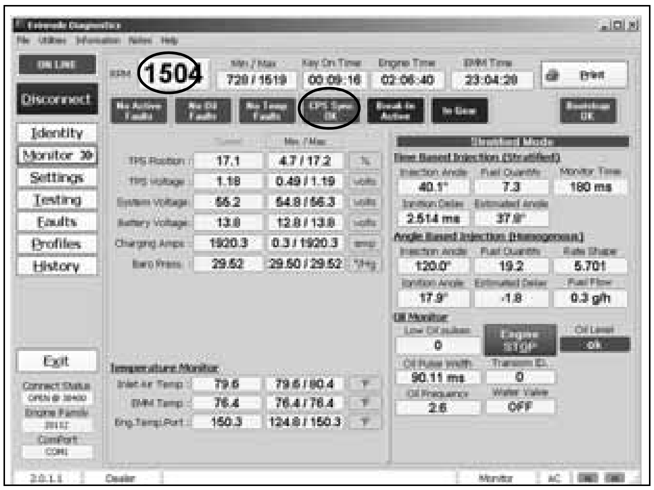
Clean or repair all ground circuits, wiring, and connections as needed.

6

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*.



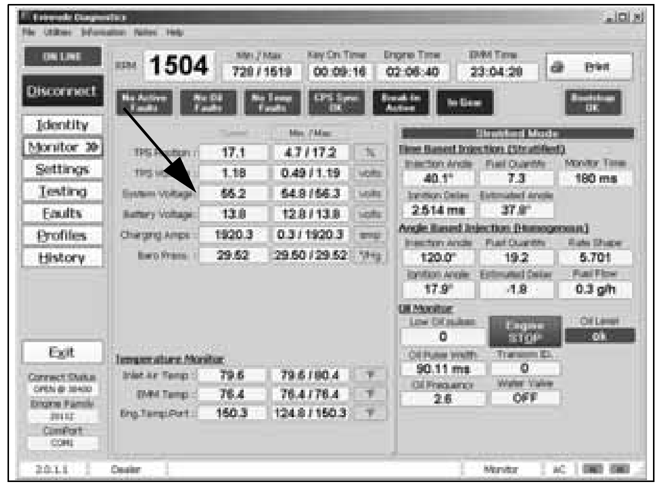
Engine RPM and CPS Sync displays 006539

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

System Voltage Test

The ignition system is powered by the 55 V system.

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



Monitor Screen, System voltage 006539

Results:

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

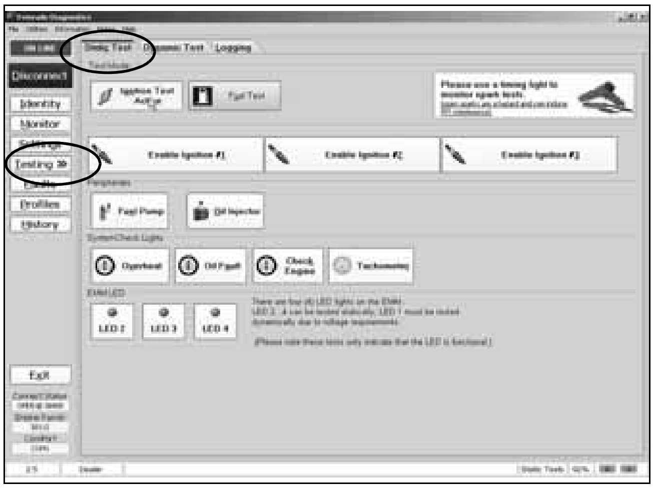
IMPORTANT: The *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. Power is normally supplied to the *EMM* when the key switch is turned ON. The *EMM* is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.

Static Ignition Test

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

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

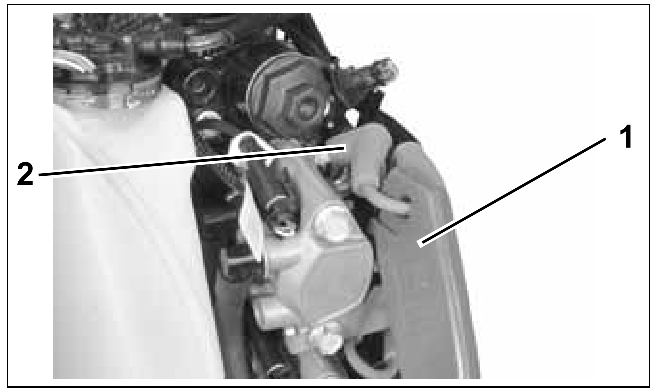
The outboard must NOT be running and the emergency stop switch lanyard must be installed.



Static Tests Screen 006772

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

IMPORTANT: 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

Results:

No spark on one or more cylinders:

- Inspect or replace spark plugs
- Refer to **Ignition Control Circuit Tests** on p. 113
- Refer to **Ignition Coil Tests** on p. 113

Steady spark on all cylinders:

- Refer to **Running Ignition Tests** on p. 112 and **DYNAMIC TESTS** on p. 106.

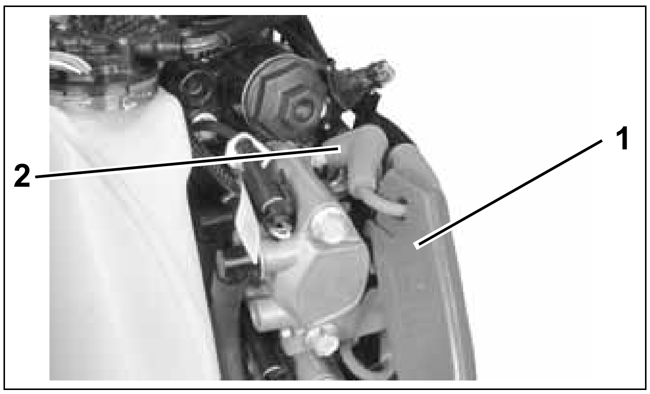
Running Ignition Tests

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

- Voltage readings at a specific speed (RPM) should be steady.
- Refer to **System Voltage Test** on p. 110.

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

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



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. 114
- Inspect for internal engine damage.

Steady voltage, erratic strobe, engine misfires:

- Inspect or replace spark plugs
- Check CPS air gap and resistance.
- Refer to **Ignition Control Circuit Tests** on p. 113
- Refer to **Ignition Coil Tests** on p. 113.

Voltages fluctuate, engine misfires:

- Inspect battery and connections
- Test capacitor and all ground connections.
- Refer to **System Voltage Test** on p. 110
- Refer to **Ignition Control Circuit Tests** on p. 113
- Refer to **Ignition Coil Tests** on p. 113.

IMPORTANT: If a running problem occurs at about 1200 RPM, the outboard may be in *S.A.F.E.* Refer to **S.A.F.E. WARNING SYSTEM** on p. 94.

Ignition Control Circuit Tests

Use a digital multimeter to test the following:
- System voltage supply to ignition coil.
- Ignition control signal from *EMM*.
- Engine harness resistance.

Disconnect ignition coil connector.

Supply voltage test:

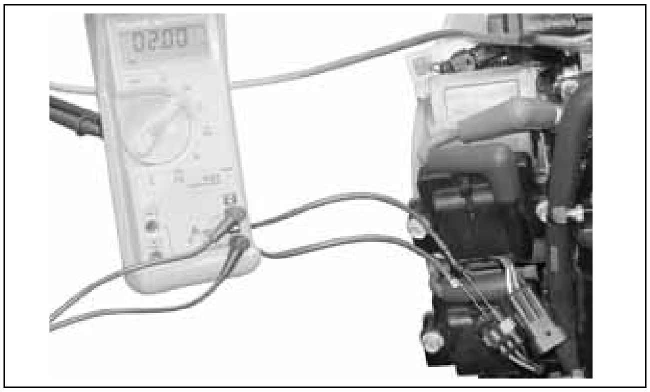
Connect the red meter lead to pin 3 (white/red) of the engine harness connector and the black lead to ground. With KEY ON, voltage should be approximately 1 V less than battery voltage.

Control signal test:

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

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

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



006609

Harness resistance test:

If control signal is NOT present, calibrate multimeter to low ohms scale.

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

If circuits test good, replace *EMM*.

Ignition Coil Tests

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

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

Capacitor Test

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

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

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

FUEL DELIVERY TESTS

> ⚠ **WARNING** ⚠
>
> **Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.**

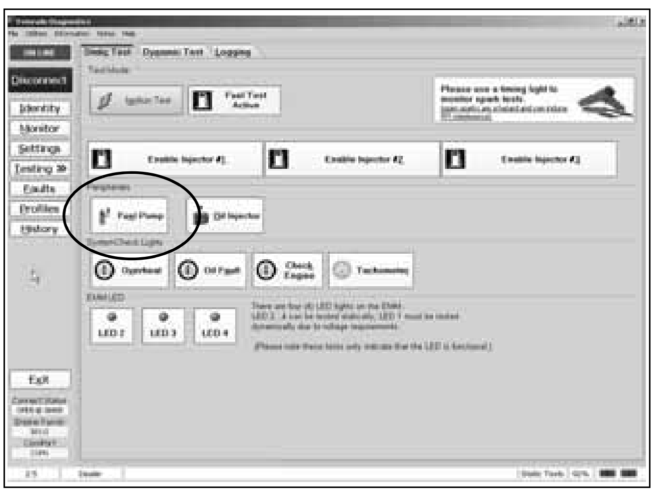
Refer to **Relieving Fuel System Pressure** on p. 166.

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

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

Fuel Pump Static Test

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



Static Tests Screen 006775

If the pump does not run:

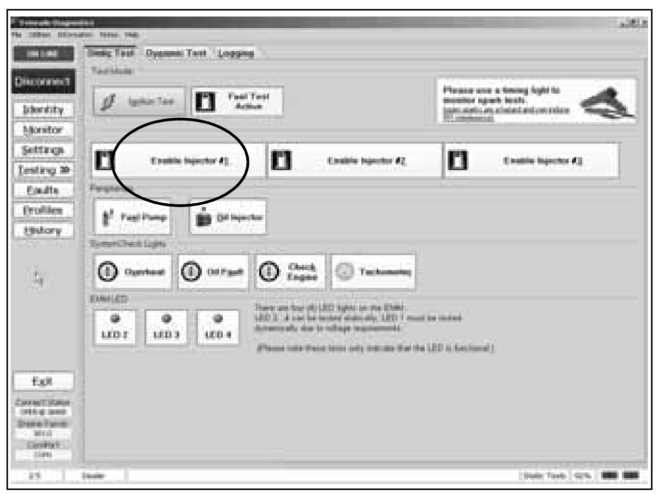
- Check voltage at pin 1 of fuel pump connector. Voltage should be slightly less than 12 V with KEY ON, or when fuel pump test is activated. Voltage should be 55 V when the outboard is cranking or running.
- The *EMM* controls the fuel pump ground (brown wire). Use an ohmmeter to check continuity between pin 2 of fuel pump connector and ground. Use the fuel pump static test to activate the control function of the *EMM*. Resistance should drop as *EMM* connects the control circuit to ground.
- Refer to **Circulation Pump Resistance Test** on p. 163.

If the pump runs:

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

Fuel Injector Static Test

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



Static Tests Screen 006775

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

Results:

No injectors actuate:
- Use the *Monitor* screen of the diagnostics software to make sure voltage is present on the system voltage circuit.
- Refer to **Running Fuel System Tests** on p. 115.

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

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

Running Fuel System Tests

Run or crank the outboard.

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

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

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

Results:

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

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

Steady light activation on all injector wires and consistent voltage readings, *EMM* injector control function is good:
- Use the diagnostics software *Dynamic Fuel Test* to isolate a faulty cylinder. See **DYNAMIC TESTS** on p. 106.

Dynamic Tests Screen 006554

- Refer to **Fuel Injector Pressure Test** on p. 162.
- Refer to **Fuel System Pressure Test** on p. 161.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

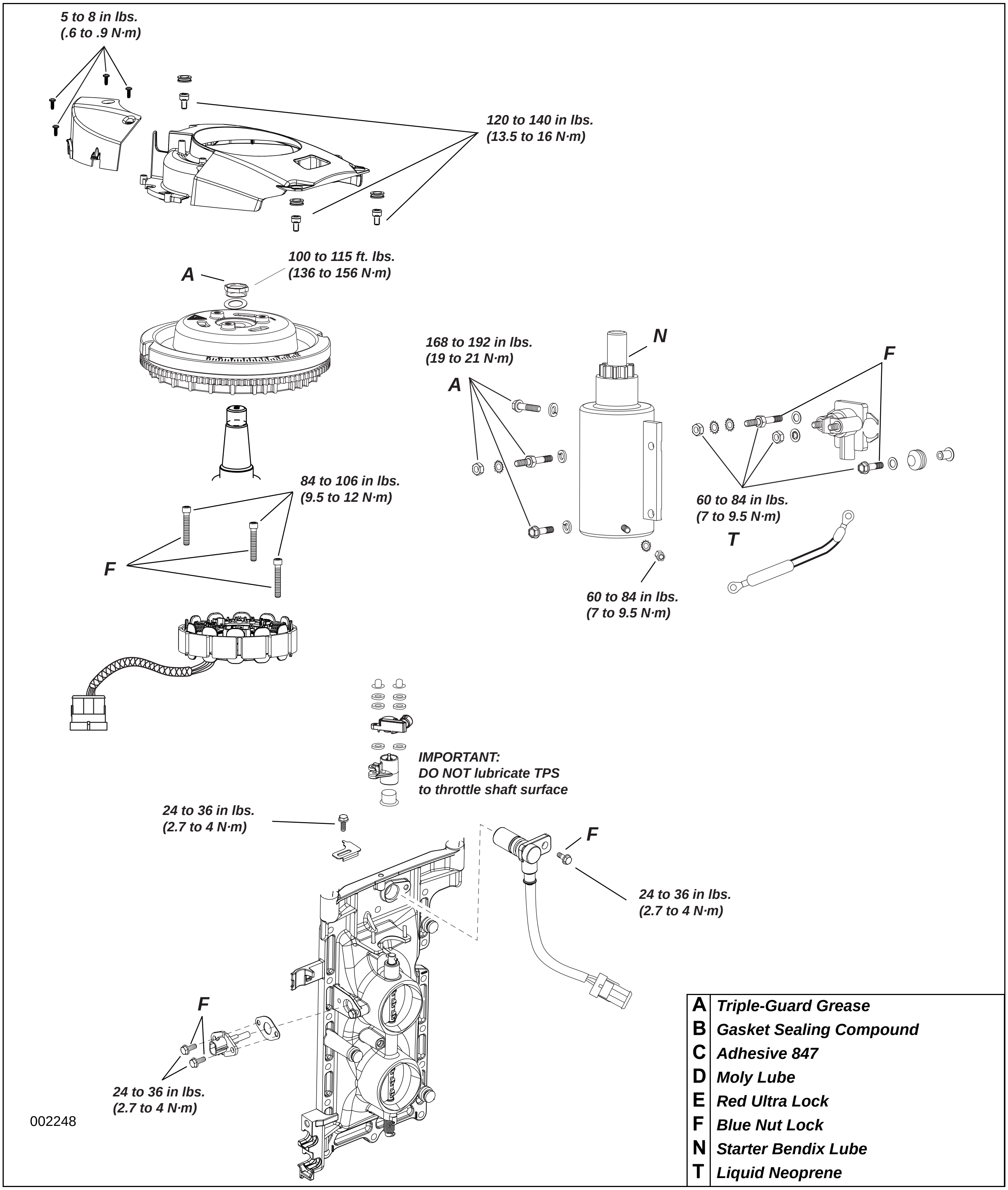
ELECTRICAL AND IGNITION

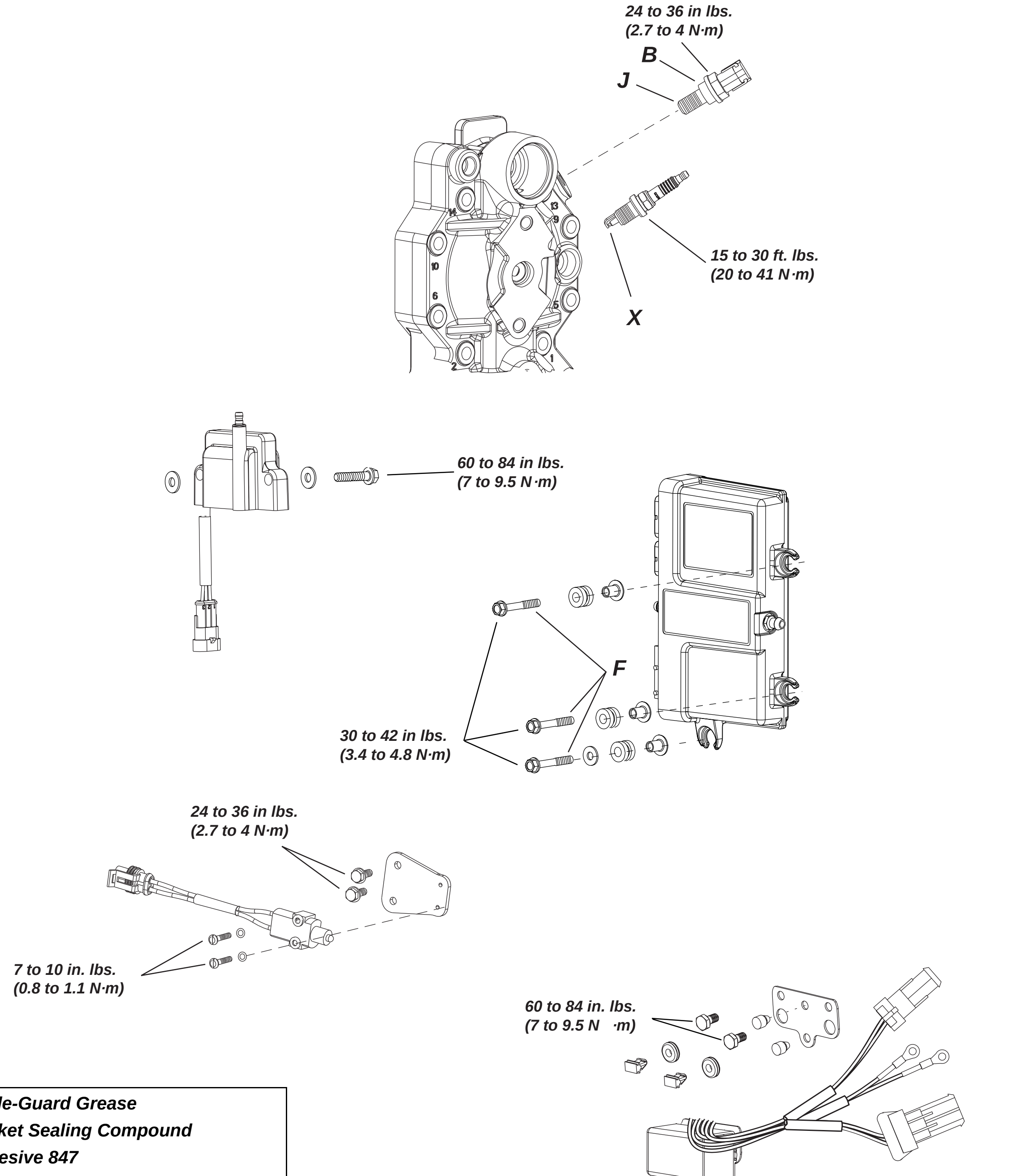
TABLE OF CONTENTS

7

SERVICE CHART

75 – 90 HP MODELS





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	*See Service Manual Text*

7

DASH CONNECTIONS, INSTRUMENT HARNESS

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

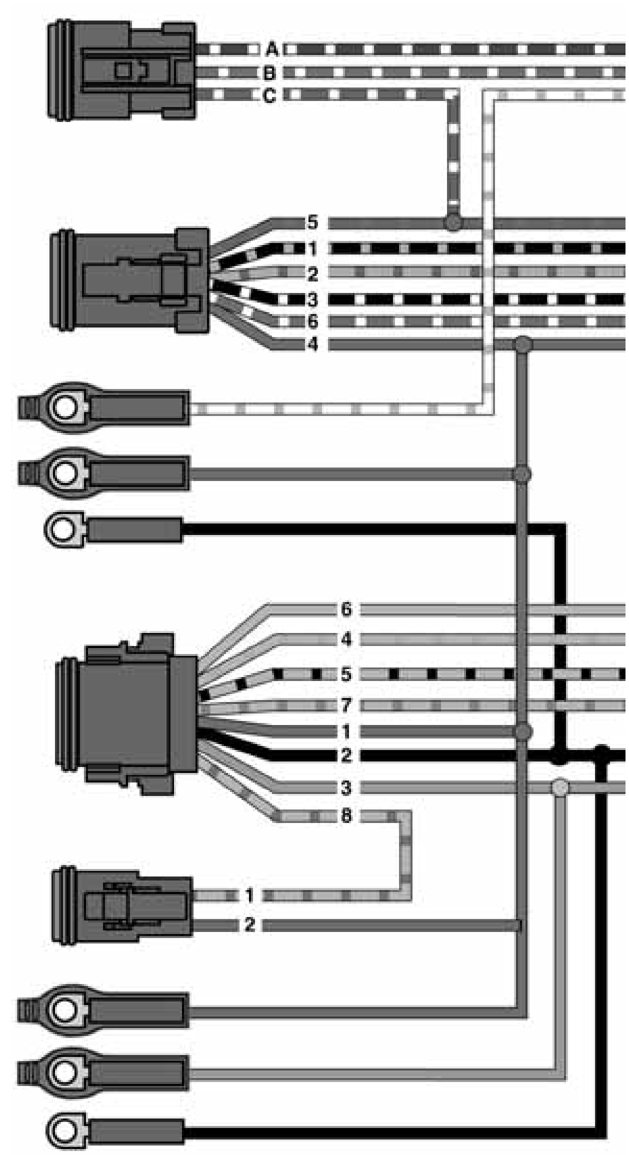
6-pin connector – Connect to a pre-wired remote control or to a dash-mounted key switch.

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

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

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

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



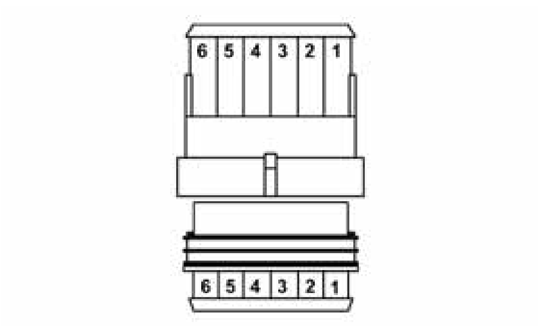
Instrument Harness Diagram DRC6165R

ELECTRICAL HARNESS CONNECTIONS

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

Refer to **CONNECTOR SERVICING** on p. 148.

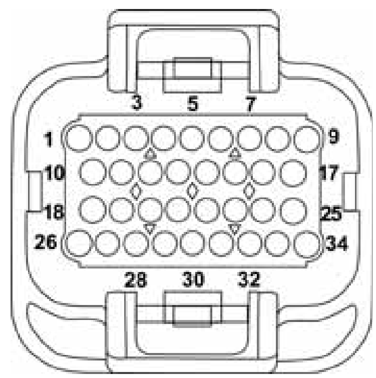
Engine Harness to Stator Connector



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

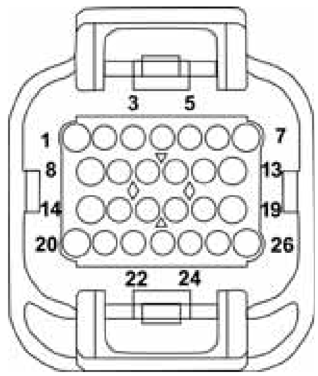


001875

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, *SystemCheck*	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, *SystemCheck*	Tan/Black
25	WATER TEMP signal, *SystemCheck*	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	

7

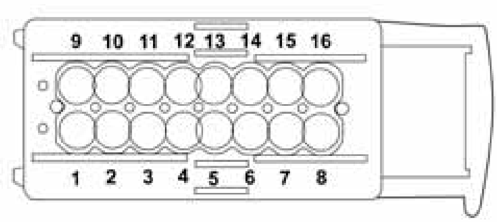
EMM J1-B Connector



001876

Pin No.	Description of Circuit	Wire Color
1	Injector, cylinder 2	Purple
2	Injector, cylinder 3	Green
3	vacant	
4	vacant	
5	vacant	
6	NO OIL signal, *SystemCheck*	Tan/Yellow
7	Ignition, cylinder 3	Orange/Green
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/Purple
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

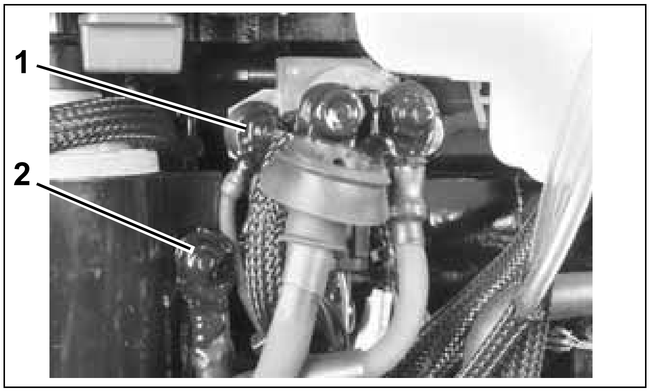
All ground circuits are essential to reliable outboard performance. Make sure all ground connections are clean and tight. Refer to wiring diagrams for specific wiring details.

EMM Ground Tests

Disconnect the battery cables at the battery.

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

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



1. *Main harness ground* 002292
2. *Ground stud (battery)*

Additional Ground Tests

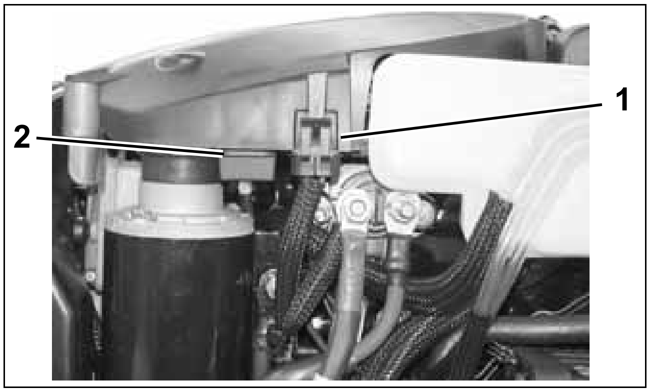
Check connections and continuity at the following locations:

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

FUSE

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

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



1. *Fuse* 005004
2. *Spare fuse*

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.

7

SENSOR TESTS

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

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

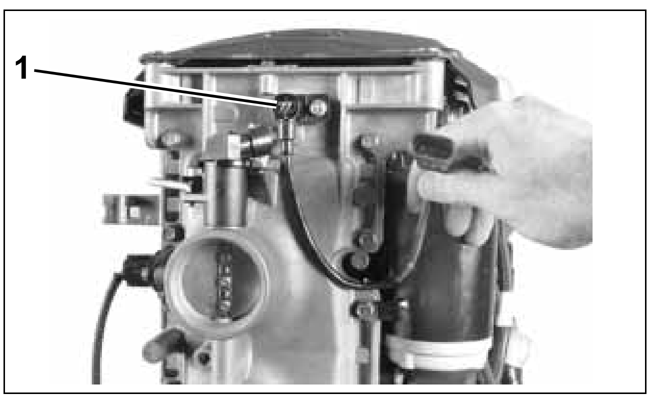
Crankshaft Position Sensor (CPS) Test

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

Remove the electrical connector from the crankshaft position sensor.

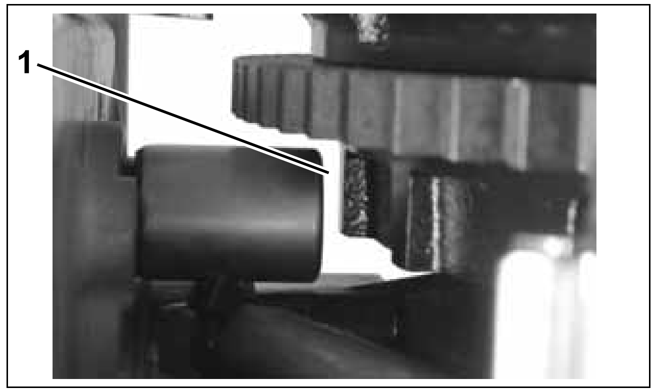
Use a digital multimeter to measure sensor resistance between the yellow and white wires. The complete circuit can be tested by measuring between pins 6 and 7 of the *EMM* J1-A connector.

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



1. *CPS* 002286

The CPS is mounted to throttle body housing and requires no adjustment. Air gap or clearance to flywheel is fixed at approximately 0.073 in. (1.85 mm). The acceptable clearance is 0.036 to 0.110 in. (1 to 2.8 mm).



1. *CPS gap* 006527

Throttle Position Sensor (TPS) Test

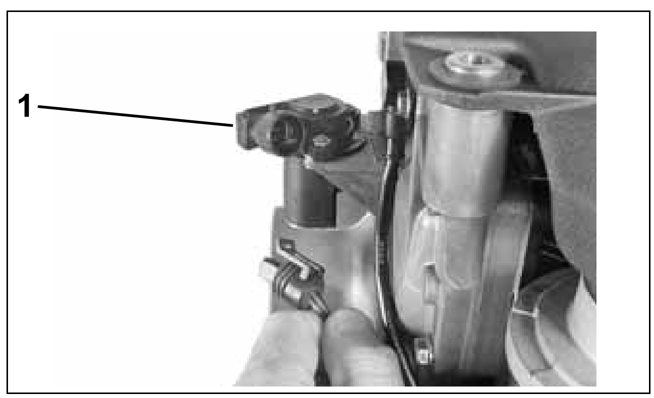
Use *Evinrude Diagnostics* software to monitor TPS voltage while the outboard is running. Voltage should change evenly as sensor lever is moved.

Remove the electrical connector from the throttle position sensor.

Use a digital multimeter to measure sensor resistance.

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

Sensor Resistance (between “A” and “C”)
> 4000 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.

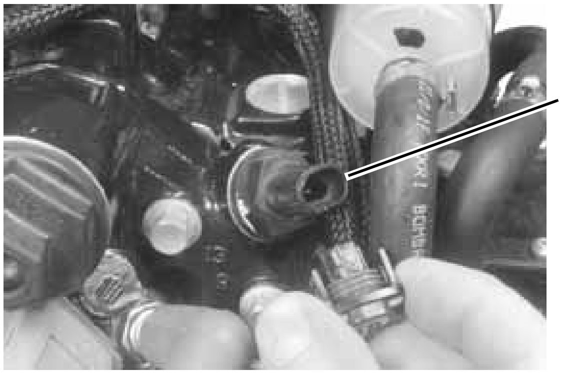
Connect red meter lead on terminal “B” and black meter lead to terminal “C.” Rotate the sensor lever. Resistance reading must change evenly as the sensor lever is moved.

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
9000 to 11000 Ω @ 77°F (25°C)



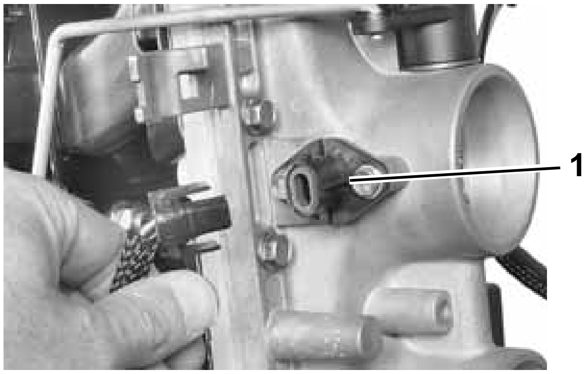
1. *Engine temperature sensor* 006612

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
9000 to 11,000 Ω @ 77°F (25°C)



1. *AT sensor* 002287

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 digital multimeter to check stator output voltage. Set meter to read 110 VAC output.

⚠ WARNING ⚠

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

Disconnect CPS.

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.

With a fully charged battery, crank outboard (300 RPM minimum) and observe meter reading:
- 30 VAC at 300 RPM
- 40 VAC at 400 RPM
- 55 VAC above 500 RPM

1. *Stator Test Adaptor* 002396

CHARGING SYSTEM TESTS

12 V Charging Circuit

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

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

IMPORTANT: The regulator requires battery voltage on the red wire to operate. Before proceeding, make sure there is battery voltage on the connector red wire when key is ON.

Disconnect the battery cables at the battery.

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

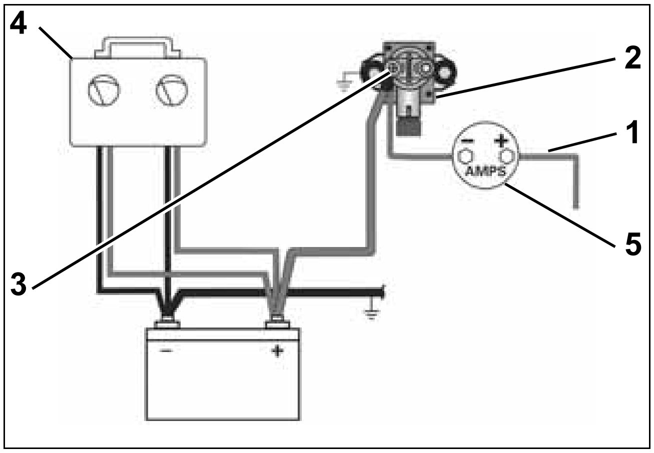
Fluke† model 334 or 336, *Snap-On*† model MT110 or EETA501, and various other amp meters should be available through local tool suppliers.

Reconnect the battery cables.

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

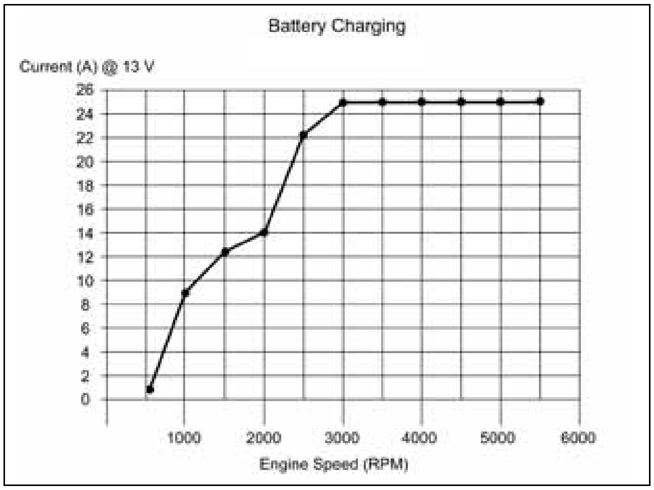
WARNING

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



Variable Load Test Diagram 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

7

Start the outboard and run it 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.

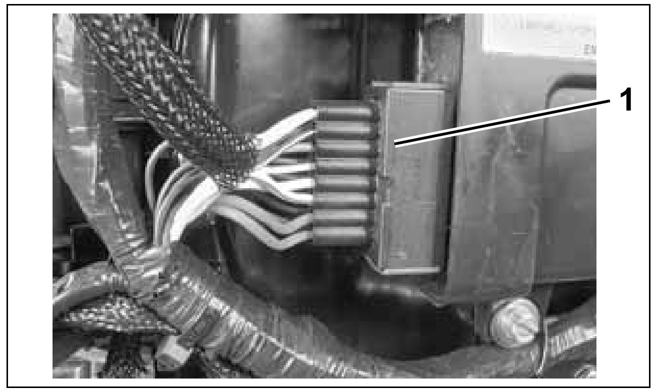
Decrease the battery load toward 0 A.

- 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. 126.

55 V Alternator Circuit

Check battery ground cable for continuity.

With the key switch ON, check battery voltage at battery (12 V), then check voltage on white/red wires at J2 connector of *EMM*. Use Electrical Test Probe Kit, P/N 342677 and a multimeter set to read 55 VDC. Voltage at *EMM* connector should be 0.5 to 1 V less than battery.



1. *J2 connector of* EMM 002291

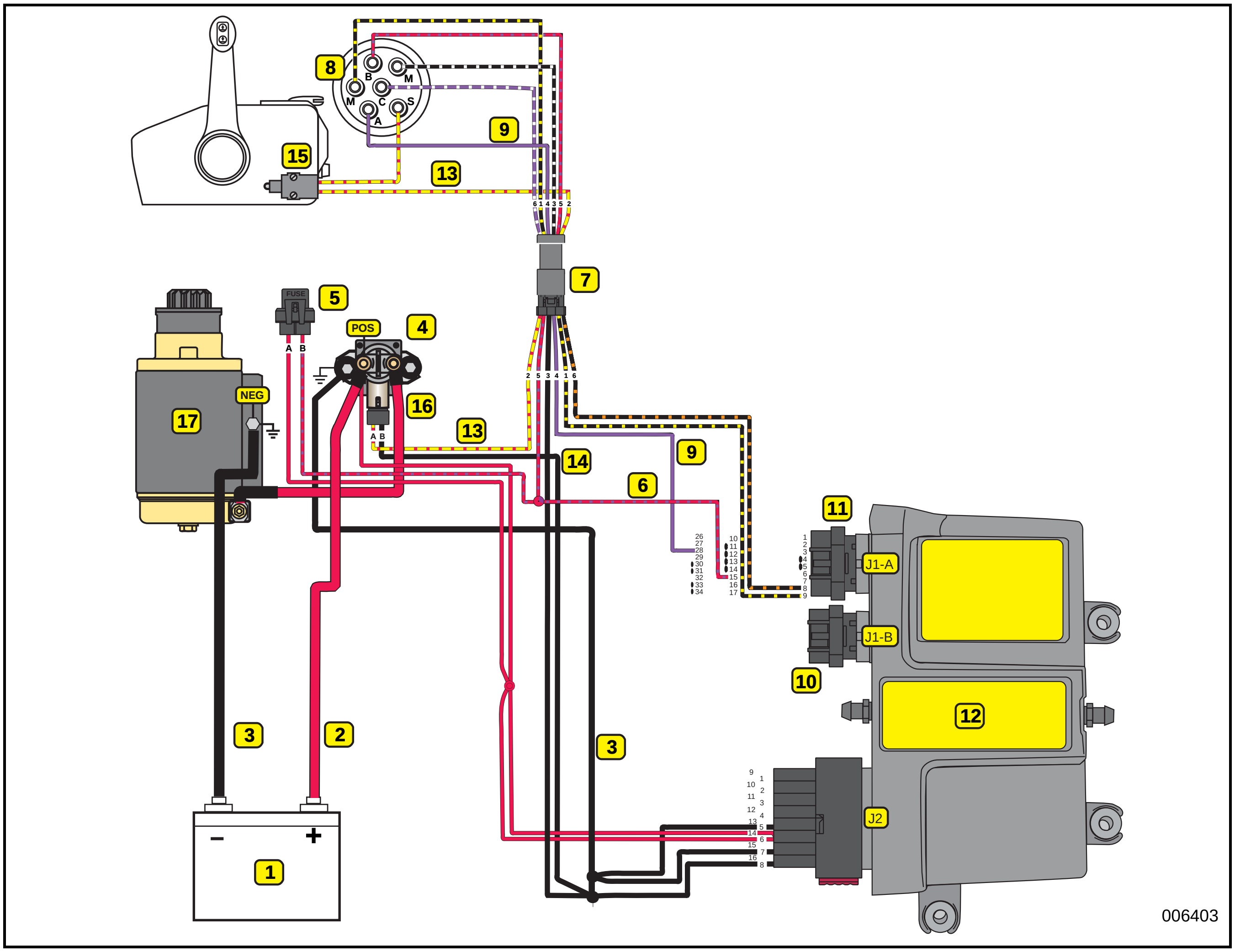
With outboard running at 1000 RPM, voltage on white/red wires should increase to 55 V.

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

If there is any other reading, refer to **STATOR TESTS** on p. 126. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or *EMM*.

ELECTRIC START CIRCUIT

Start Circuit Diagram



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

7

Start Circuit Operation

The starter must engage and turn the flywheel. The outboard must crank a minimum of 300 RPM to start.

Starter performance depends on the following:

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

Refer to **Battery Installation** on p. 27 for battery, terminal, and cable requirements.

Solenoid Wiring

The positive (B+) battery cable connects to a large terminal of the starter solenoid. This terminal also provides the 12 V power supply to the engine harness (red wire) and the 10 A fuse. The red/purple wire from the fuse holder (10 A) provides 12 V to terminal “B” of key switch.

The negative (B–) battery cable connects to the main ground stud on the starter housing.

Engine Wire Harness

Contains the following circuits:

- Red/purple output wire from fuse provides 12 V to instrument harness.
- Purple wire provides switched 12 V to *EMM.*
- Yellow/red wire provides switched 12 V to solenoid (terminal “A”).
- Black wire provides ground (NEG) to starter solenoid (terminal “B”).

Instrument Wire Harness

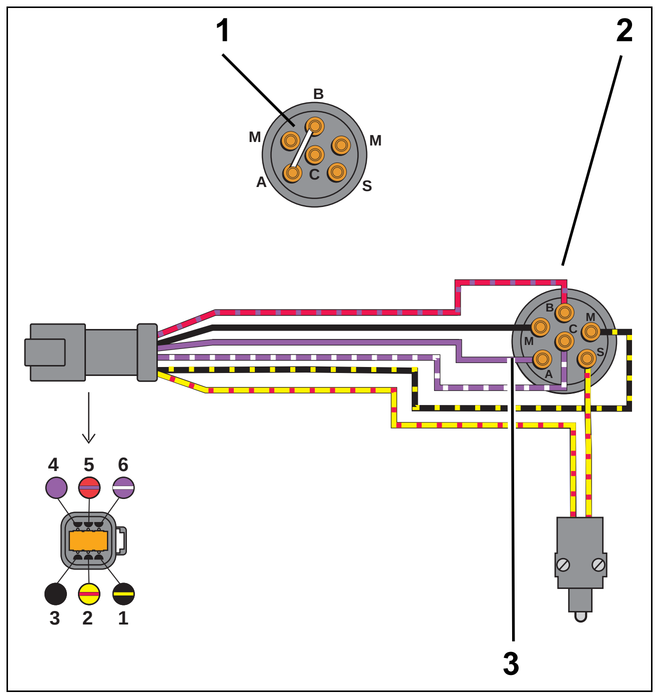
Contains the following circuits:

- Red/purple wire provides 12 V to key switch terminal “B”.
- Purple wire provides switched 12 V to engine wire harness.
- Yellow/red wire from terminal “S” of key switch provides switched 12 V to solenoid (terminal “A”) (key switch in START position).

Key Switch, ON position

12 V is applied to the accessory circuit. Key switch ON:

- Switches 12 V to terminal “A” of key switch and to the purple wires of the wire harnesses.
- Provides 12 V input to terminal 28 of *EMM* J1-B connector. *EMM* turns ON.

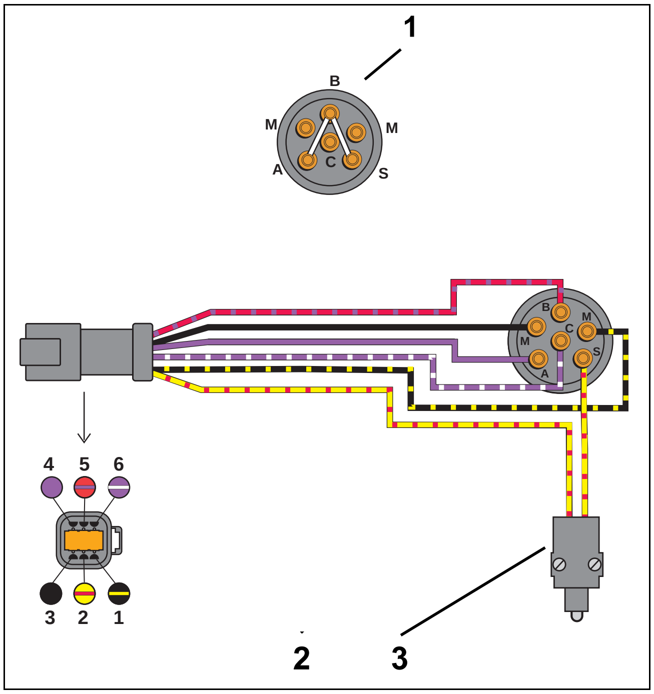


000691

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

Key Switch, START Position

Key switch START:
- Switches 12 V to terminal “S” of key switch and to the neutral safety switch (in remote control).
- A closed neutral safety switch provides 12 V to the engine wire harness yellow/red wire and solenoid (terminal “A”).



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

000691R

ELECTRIC START TESTS

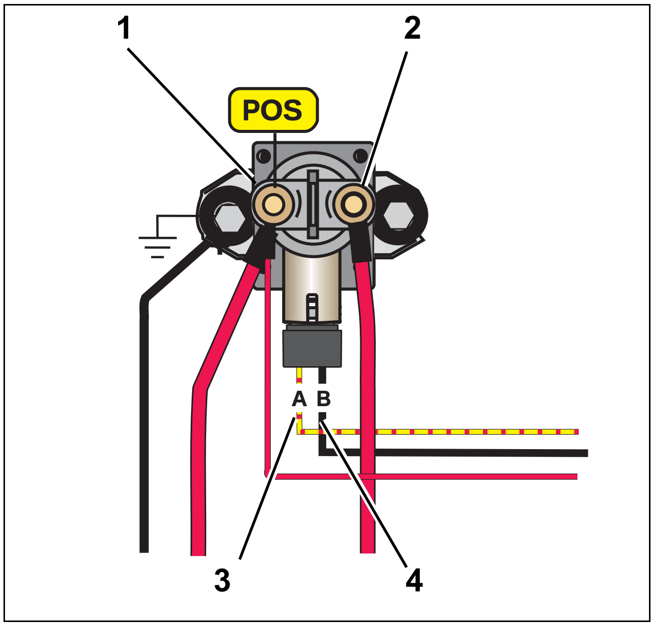
Starter Solenoid Test

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

IMPORTANT: Disconnect all wiring from solenoid terminals before proceeding with this test.

Use a digital multimeter to measure resistance.

Put one meter lead on the starter positive (+) cable terminal and the other lead on the battery positive (+) cable terminal:
- Meter must not show continuity (high reading).
- If meter shows continuity (low reading), replace the solenoid.



1. *Battery positive cable (B+) terminal*
2. *Starter positive (+) cable terminal*
3. *“A” terminal (yellow/red)*
4. *“B” terminal (black)*

002073

Apply B+ to terminal “A” of solenoid and ground (NEG) to terminal “B” of solenoid. Measure resistance between the starter positive (+) cable terminal and the positive battery (+) cable terminal.
- The solenoid must close with an audible click.
- Meter must show continuity (low reading).
- If meter shows no continuity (high reading), replace the solenoid.

7

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

002292

No Load Current Draw Test

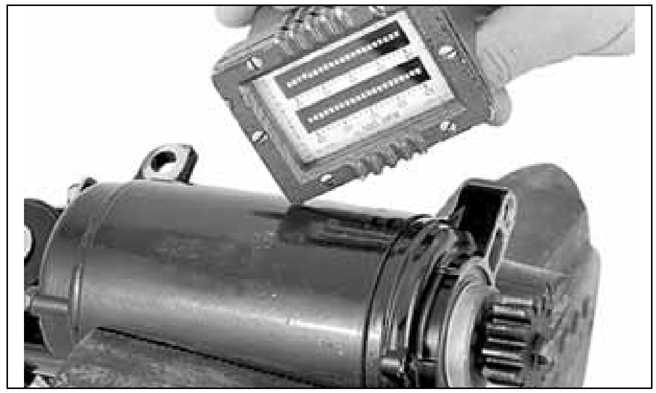
Securely fasten starter in a vise or suitable fixture before proceeding with this check.

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

Use an inductive ammeter or connect a 0 to 100 amp ammeter in series with a heavy jumper between the battery positive (+) terminal and the starter positive (+) terminal.

Fluke model 334 or 336, *Snap-On* model MT110 or EETA501, and various other ammeters should be available through local tool suppliers.

Attach or hold a vibration tachometer, such as a *Frahm*† *Reed* tachometer, to the starter.



24083

Complete the circuit with a heavy jumper between the battery negative (–) terminal and the starter frame.

Monitor the starter RPM and current draw.

- At 10,500 RPM the ammeter should show a maximum of 30 A.

REMOTE CONTROL SWITCH TESTS

Key Switch Test

Refer to **Wiring Diagrams** at back of manual.

Use an ohmmeter or a continuity light to test key switch operation. Replace switch if results are incorrect with any of the following tests.

IMPORTANT: Disconnect battery and key switch wiring before proceeding with the following tests.

Stop/Ground Terminals (M) – Connect meter between the two "M" terminals. Meter must indicate NO continuity at START or ON.

Turn key switch OFF. Meter must indicate continuity.

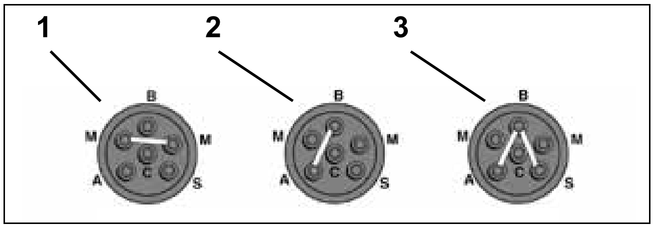
Accessory Terminal (A) – Make sure the key switch is OFF. Connect the ohmmeter or continuity light between terminals "B" (battery) and "A" (accessory) of key switch. Meter must indicate NO continuity.

Turn switch ON. Meter must indicate continuity.

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

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

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



1. *OFF*
2. *ON*
3. *START*

000443

Neutral Start Circuit Test

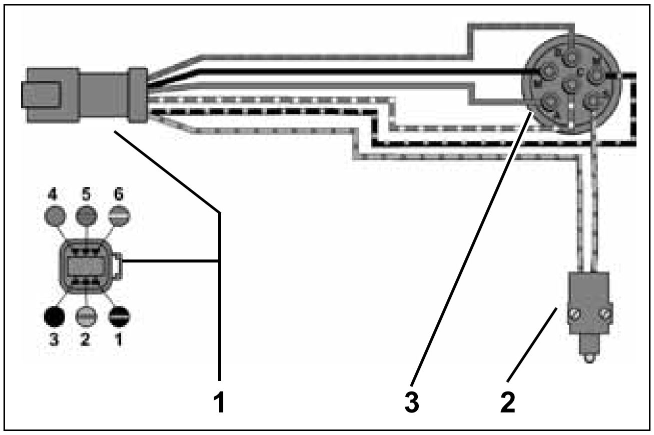
Use an ohmmeter or continuity light to test the continuity of the circuit while positioning the remote control in NEUTRAL, FORWARD, and REVERSE.

IMPORTANT: Turn propeller shaft or disconnect shift cable to allow proper remote control shift action while outboard is not running. Disconnect the instrument harness connector from the key switch harness connector.

Make sure the remote control handle is in NEUTRAL. Connect meter between terminal 5 (red/purple wire) and terminal 2 (yellow/red wire). Turn the key switch to START. Meter must indicate continuity.

Move the remote control handle to FORWARD and turn the key switch to START. Meter must NOT indicate continuity.

Move the remote control handle to REVERSE and turn the key switch to START. Meter must NOT indicate continuity.



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

000443

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

Neutral Start Switch Test

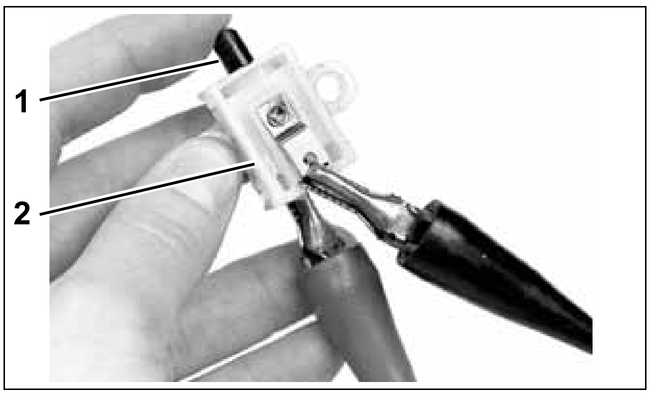
Use an ohmmeter or a continuity light to test neutral start switch operation.

IMPORTANT: All wiring must be disconnected from the switch before proceeding with this test.

Disassemble the remote control and remove the neutral start switch.

Connect one meter lead to each terminal of the switch.

- Meter must indicate continuity when the plunger is depressed
- Meter must indicate no continuity when the plunger is released.



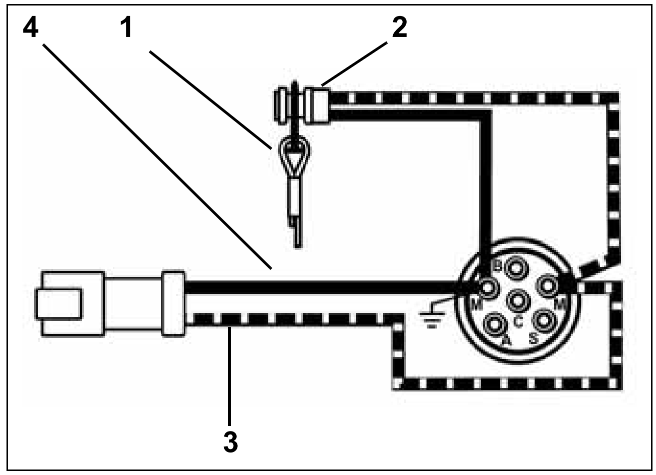
TYPICAL 3224
1. *Plunger*
2. *Neutral start switch*

Replace switch if results are incorrect.

Emergency Stop Switch Test

This switch can be part of the key switch or installed as a separate switch. Either style connects the "M" terminals of the key switch.

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



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

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

TILT/TRIM RELAY TEST

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

1. *Tilt and trim module* 002064

The tilt and trim switch provides B+ input to green/white or blue/white wire of the TNT module.

Operation

The relay activates when B+ input from the switch is supplied to terminal 86 of the internal relays.

Terminal 87a connects to ground (B–).

Terminal 87 connects to B+.

Terminal 30 connects TNT motor.

Terminals 87a and 30 are connected when relay is not activated. This supplies ground (B–) connection to TNT motor.

Terminals 87 and 30 are considered "normally open." B+ is applied to terminal 30 when relay is activated. This supplies ground B+ connection to TNT motor.

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

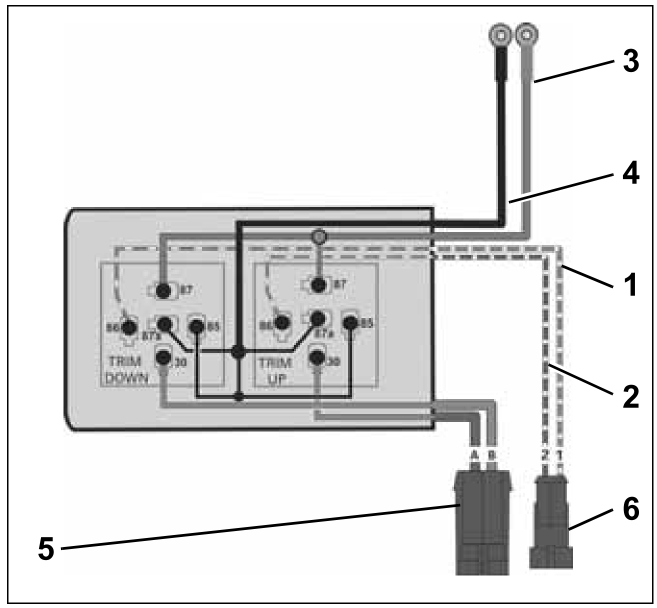
Test Procedure

Make sure red and black wires are connected to 12 V battery power supply.

Set voltmeter to 12 VDC scale. Connect test leads to terminals "A" and "B" of TNT motor connector.

Use a wire jumper to alternately connect B+ to terminals "1" and "2" of tilt and trim switch connector.

The meter must indicate battery voltage (12 V) with B+ connected to either terminal.



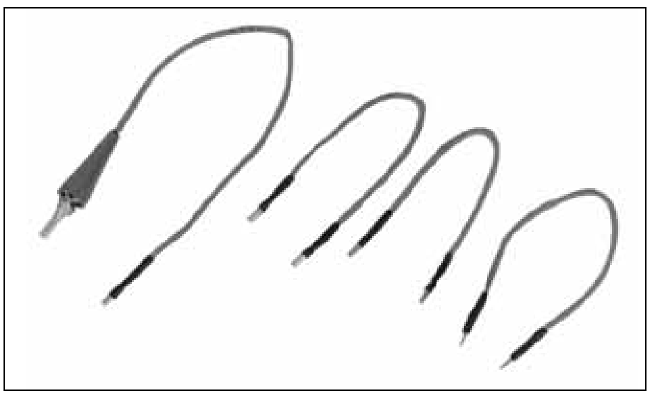
Tilt and Trim Module Diagram 002063
1. *Green/white wire*
2. *Blue/white wire*
3. *B+, red wire*
4. *B–, black wire*
5. *TNT motor connector*
6. *TNT switch connector*

SystemCheck CIRCUIT TESTS

Make sure the *SystemCheck* engine monitor can alert the operator during a “NO OIL,” “WATER TEMP” or “HOT,” “CHECK ENGINE,” or “LOW OIL” condition. Check the condition of the warning system and associated wiring and connections. Test the engine monitor regularly and anytime you suspect an alert situation has been missed.

The instrument harness must be connected to the outboard before performing the following tests. Refer to the **Engine Wiring** diagram and the **MWS Instrument Wiring** diagram in the back of this manual.

IMPORTANT: Use jumper wires made with the appropriate terminals to test the warning circuits.

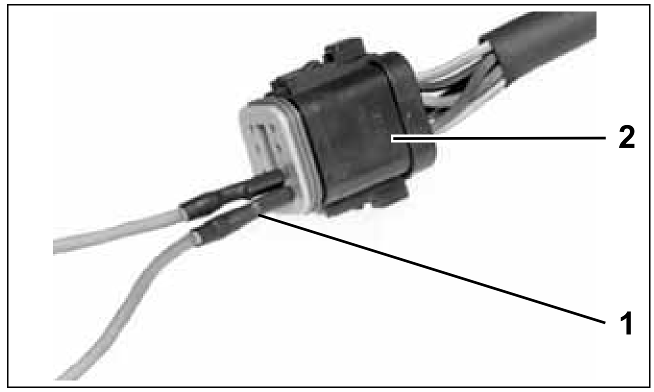


42811

Gauge Self-Test Check

Turn the key switch to ON with the outboard NOT running. The gauge warning lights for NO OIL, WATER TEMP, CHECK ENGINE, and LOW OIL must all light at once, then turn off in sequence, and the warning horn must sound for one-half second.

If the gauge lights do not turn on, turn the key switch OFF. Disconnect the gauge 8-pin connector from the back of the gauge and turn the key switch ON. Test for battery voltage between instrument harness terminal 1 (purple wire) and terminal 2 (black wire).



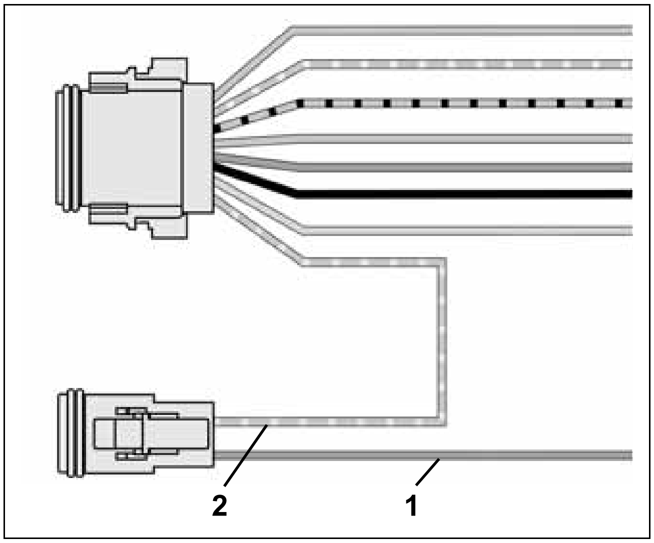
1. *Test adapter(s)* 42761
2. *Connector,* SystemCheck *gauge*

- If battery voltage is present, replace the gauge.
- If there is no battery voltage, check that 12 V is present at terminal “B” of the key switch. Check condition of the instrument harness, key switch, and connections.

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

- If the substitute horn beeps, the original horn is defective and must be replaced.
- If the substitute horn does not beep, check for battery voltage between instrument harness 2-pin connector, terminal 2 (purple wire) and ground with the key switch ON. Also, check the tan/blue wire for continuity between pin 8 of the 8-pin connector and pin 1 of the 2-pin connector.
- If battery voltage is present at the purple wire and the tan/blue wire has continuity between

the two connectors, replace *SystemCheck* gauge.



1. *Purple wire*
2. *Tan/blue wire*

DRC6280

Turn the key switch OFF and reconnect all disconnected circuits.

CHECK ENGINE Circuit Test

Separate the 6-pin *SystemCheck* connector of MWS instrument harness from engine harness. Black wire (pin 3) must be grounded.

Using a jumper wire, connect tan/orange wire (pin 2) to a clean engine ground.

Turn the key switch ON. After the normal self-test sequence, the CHECK ENGINE light should stay on.

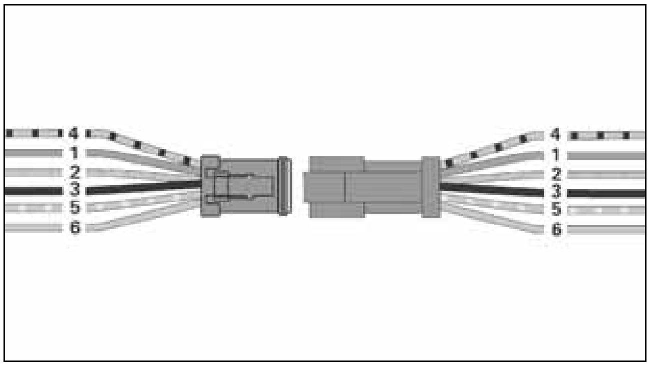
- If the CHECK ENGINE light is not on, test circuit for continuity. Check continuity of the MWS instrument harness (tan/orange wire).
- Check continuity of the engine wire harness between terminal 2 (tan/orange wire) of the *SystemCheck* connector and pin 17 of the *EMM* J1-A connector.

Turn the key switch OFF and reconnect all disconnected circuits.

WATER TEMP/ HOT Circuit Test

The tan wire of engine harness and the MWS harness receives a signal from the *EMM.* The *EMM* receives information from the temperature sensor on the cylinder head.

Using a jumper wire, connect tan wire (pin 6) of the engine harness connector to a clean engine ground.



002079

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

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

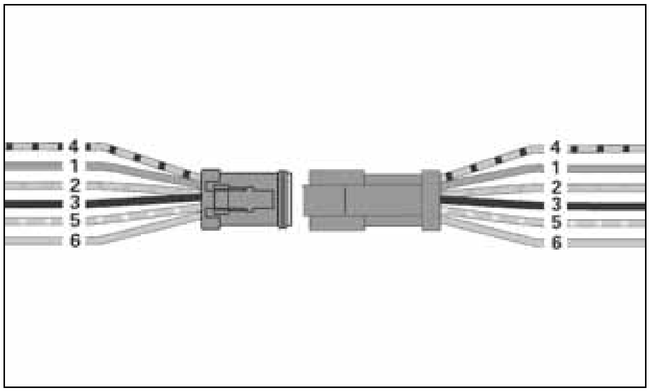
Turn the key switch OFF and reconnect all disconnected circuits.

IMPORTANT: To test the temperature sensor itself, refer to **Engine Temperature Sensor Test** on p. 125.

7

LOW OIL Circuit Test

Turn the key switch ON. Using a jumper wire, connect tan/black wire (pin 4) of the engine harness connector to a clean engine ground. The LOW OIL light should turn on after 40 seconds.



002079

If the LOW OIL light does not turn on after connecting the terminal to ground, test circuit for continuity.

Turn the key switch OFF and reconnect all disconnected circuits.

NO OIL Circuit

Separate the 6-pin *SystemCheck* connector of MWS instrument harness from engine harness. Black wire (pin 3) must be grounded.

Using a jumper wire, connect tan/yellow wire (pin 5) to a clean engine ground.

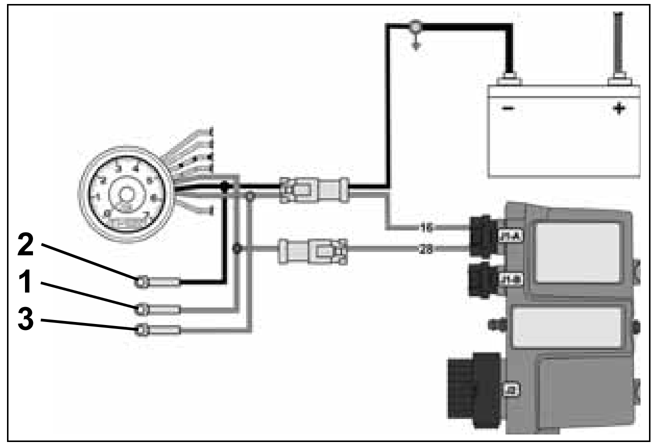
Turn the key switch ON. After the normal self-test sequence, the NO OIL light should stay on.

- If the NO OIL light is not on, test circuit for continuity. Test for continuity of the MWS instrument harness (tan/yellow wire).
- Test for continuity of the engine wire harness between terminal 5 (tan/yellow wire) of the *SystemCheck* connector and pin 24 of the *EMM* J1-A connector.

Turn the key switch OFF and reconnect all disconnected circuits.

TACHOMETER CIRCUIT TESTS

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



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

006551

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

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

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

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

FLYWHEEL AND STATOR SERVICING

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

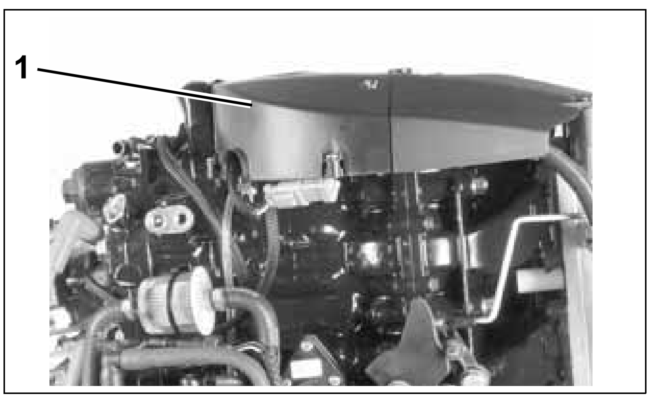
An accurate test of alternator output can help determine the flywheel's condition. Refer to **CHARGING SYSTEM TESTS** on p. 127.

Flywheel Removal

⚠ WARNING ⚠

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

Remove the electrical cover from flywheel cover.

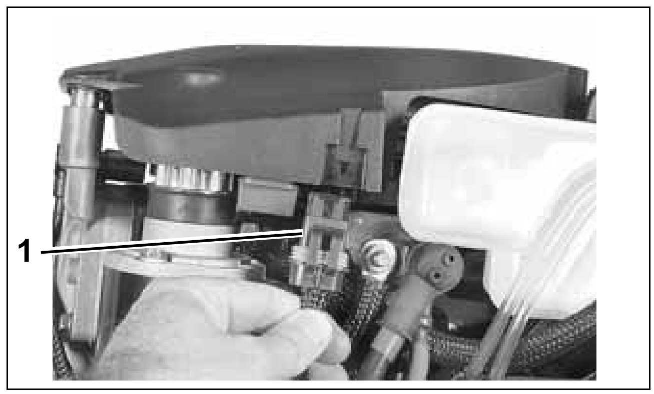


1. *Electrical cover* 002084

Disconnect wiring harness and remove wiring from cover.

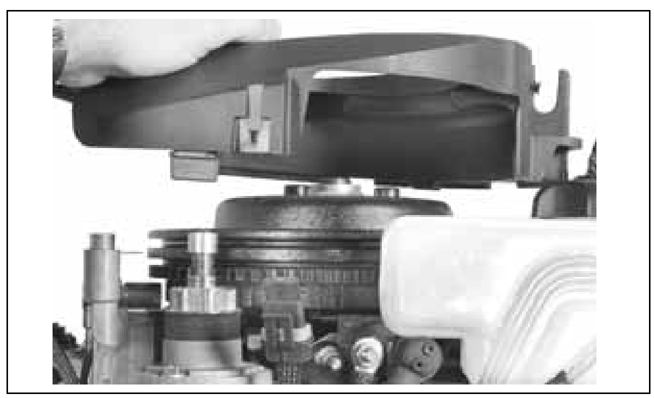
1. *MWS harness* 002086

Remove fuse holder from flywheel cover.



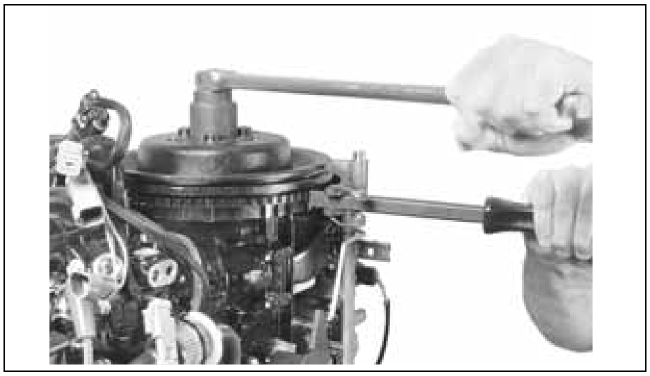
1. *Fuse holder* 002094

Lift flywheel cover to remove.



002087

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

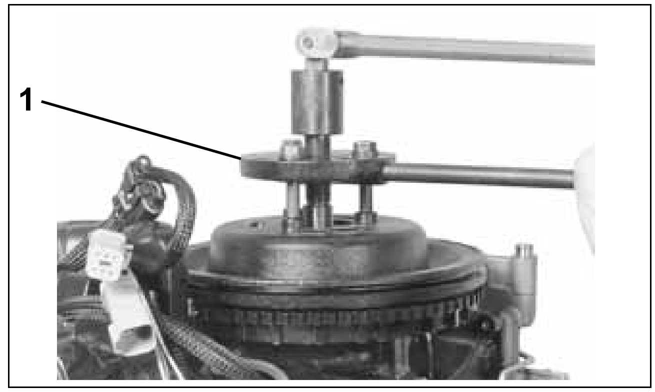


002088

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.

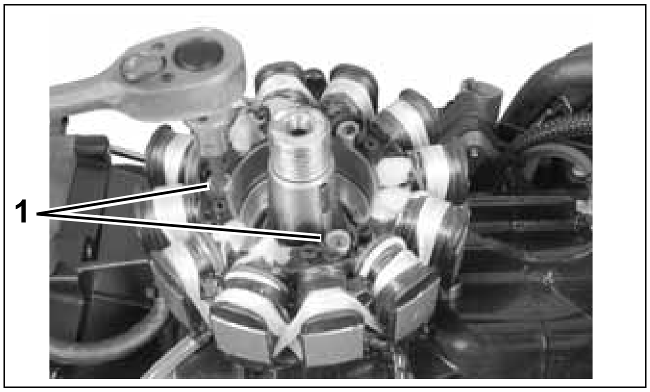


1. *Universal puller* 002089

Stator Service

Disconnect stator harness connector.

Remove three allen head screws to remove stator.

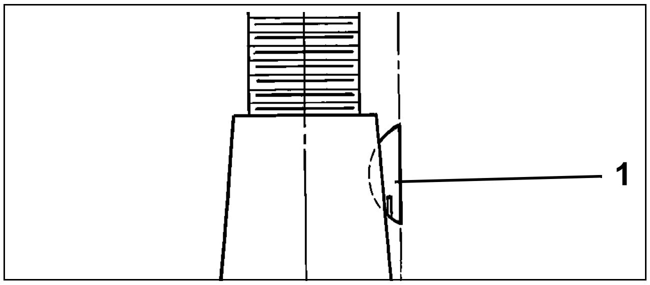


1. *Stator screws* 006486

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

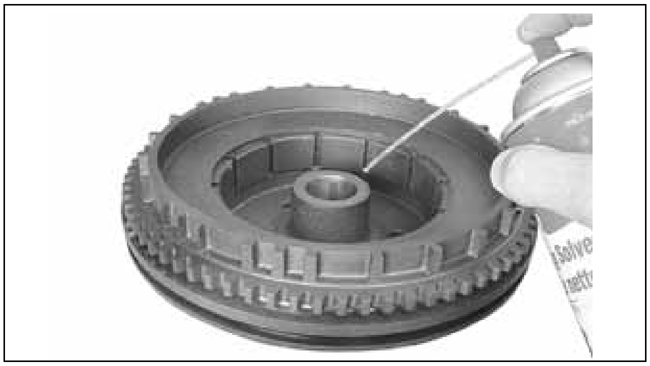
Flywheel Installation

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



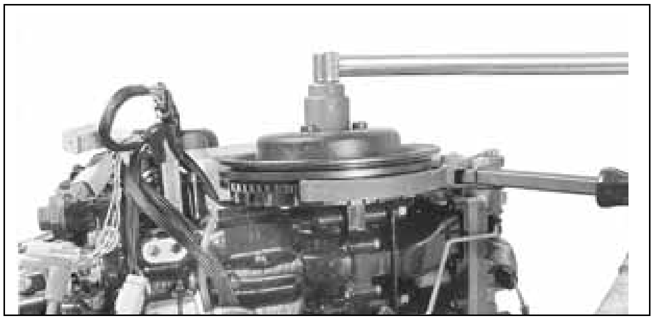
1. *Flywheel key* DRC2116

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



002090

Replace flywheel cover and recoil starter (rope start models).

IMPORTANT: Check ignition timing after flywheel removal or replacement. Refer to **TIMING ADJUSTMENTS** on p. 142.

7

TIMING ADJUSTMENTS

Timing Pointer

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

Use *Evinrude Diagnostics* software to verify and adjust timing. Refer to the software’s help system for outboard timing verification procedures.

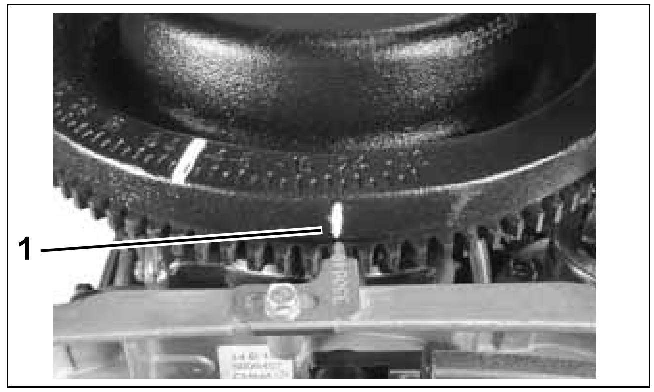
> **⚠ WARNING ⚠**
>
> **To prevent accidental starting while servicing, remove emergency stop lanyard and disconnect the battery cables at the battery.**

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

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

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.”

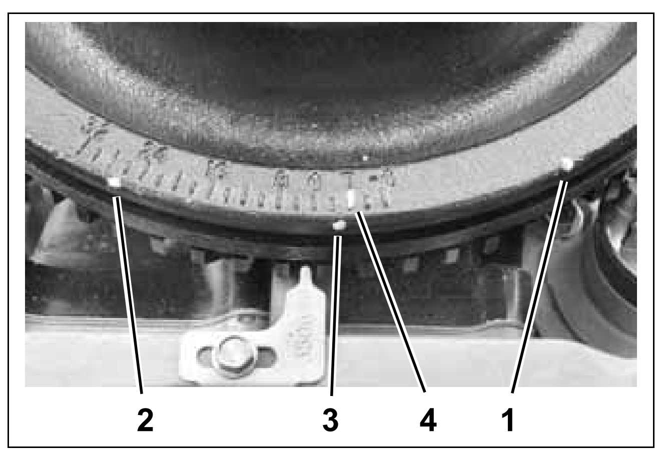


1. *Timing pointer* 006552

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 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.



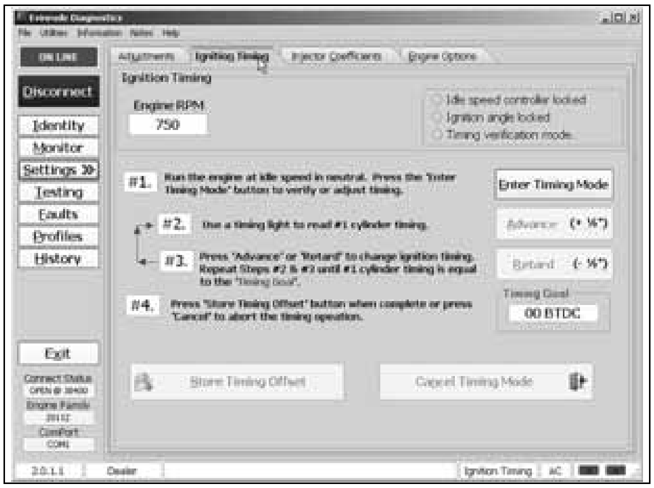
1. *Mark “A’”* 002092
2. *Mark “B”*
3. *Mark “C”*
4. *TDC boss*

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

Install spark plugs. Refer to Spark Plug **Indexing** on p. 76.

Timing Verification

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



Timing Adjustment Screen 006547

Check ignition timing after any of the following procedures:
- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- *EMM* replacement
- *EMM* software replacement (reprogramming)

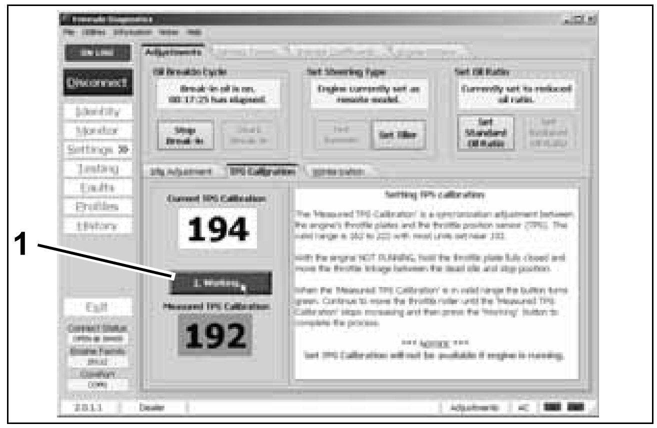
IMPORTANT: Make sure the timing pointer is set and the outboard reaches operating temperature before making any timing adjustments.

TPS Calibration

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

Remove the air silencer.

On the *Settings* screen of the diagnostics software, click the "Set TPS Calibration" button.



1. *TPS Calibration button* 006548

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

Click the "Working" button in the software to calibrate the TPS.

Install the air silencer.

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

ELECTRIC STARTER SERVICING

Starter Removal

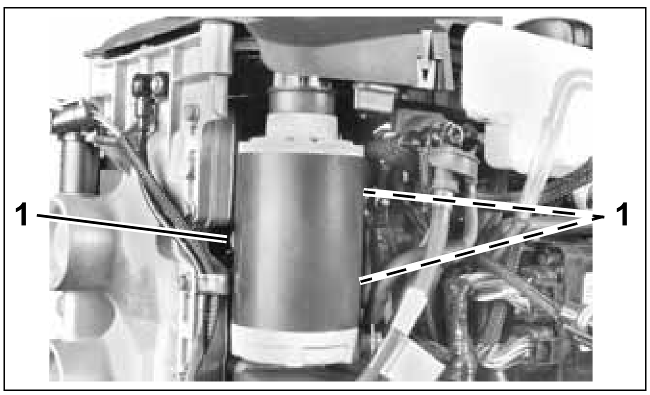
IMPORTANT: Do not clean the starter drive while the starter motor and drive are installed on the powerhead. The cleaning agent could drain into the starter motor, washing dirt from the drive into the starter bearings and commutator.

Disconnect the battery cables at the battery.

Remove lower motor covers and air silencer. Refer to **Lower Cover Removal** on p. 82.

Remove the starter positive (+) cable from post on starter. Remove the battery negative cable (–) from the double-ended stud.

Remove two starter mounting screws and double-ended stud. Remove the starter.



1. Screws 002293

Starter Disassembly

Remove the retaining ring, spacers, spring and starter pinion from pinion shaft.

002294
002295

Mark the end cap and brush holder cap orientation. Remove the two thru-bolts.

002296

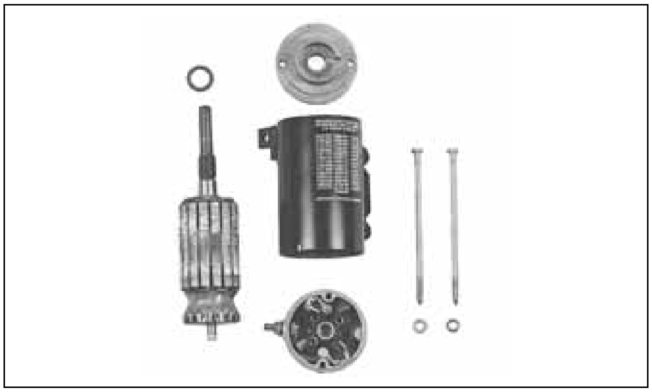
Remove the end cap and thrust washer.

002298

Remove brush holder cap from armature and frame assembly. Do not lose the brush springs.

002299

Slowly, remove the armature from frame.



38288

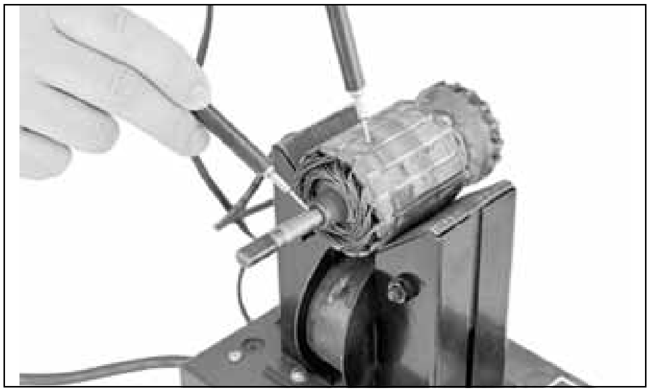
Starter Cleaning and Inspection

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

002300

Clean the commutator with 300-grade emery cloth. If commutator surface is unevenly worn or pitted, turn it on a lathe. Remove any trace of oil or metal dust from commutator.

Check the armature on a growler for shorted turns using a test light or meter. Inspect armature insulation for indications of overheating or damaged windings. Clean off any carbon deposits or foreign matter which could contribute to failure of windings.



TYPICAL 24058

Check permanent magnets and make sure they strongly attract any steel or iron object held inside frame. Weak magnetism could cause excessive RPM on **No Load Current Draw Test** on p. 132.

TYPICAL 24057

After disassembling the drive, clean each part with *Cleaning Solvent* and inspect for wear and distortion.

If the pinion does not properly engage the flywheel, the pinion and screw shaft assembly could be worn, distorted, or dirty. Locate the cause of binding and correct it before completing the assembly.

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

Starter Assembly

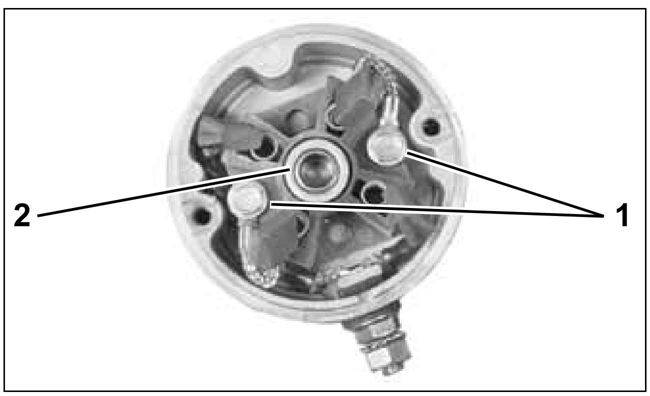
IMPORTANT: If removed, apply *Locquic Primer* and *Screw Lock* to the brush card screws before installing.

Place armature in frame.

Apply *Moly Lube* to the armature bushing.

Route the brush leads and install the springs and brushes.

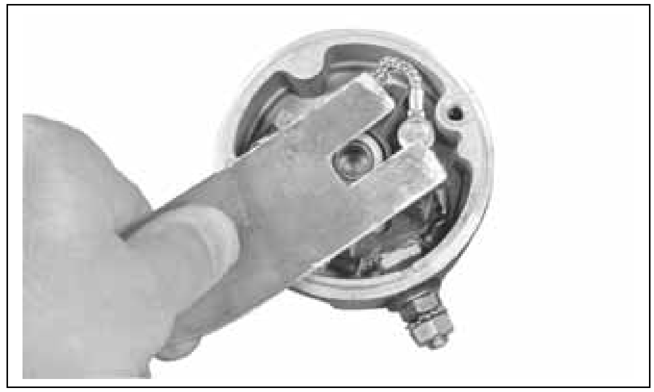
IMPORTANT: Incorrect orientation of the brushes could damage the starter or cause reverse rotation.



1. *Brush card screws*
2. *Armature bushing*

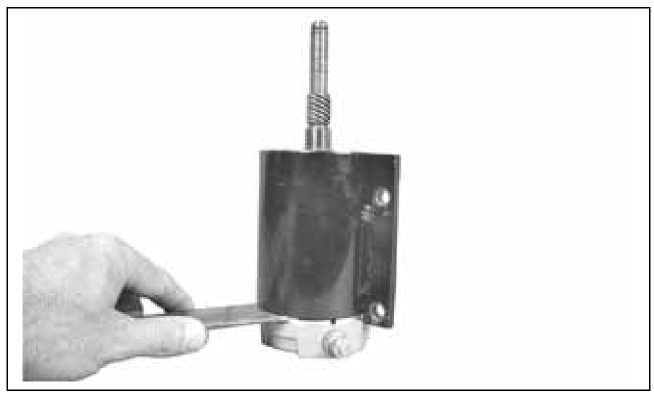
002300

Compress the brushes and springs with a modified putty knife.



002309

Align and place brush holder cap firmly on armature and slide putty knife out, making sure the brushes are retained properly.



002310

Install thrust washer. Align and place end cap onto armature shaft.

002308

Apply *Locquic Primer* and *Screw Lock* to the threaded portion, and install the two thru-bolts. Tighten bolts to a torque of 100 to 110 in. lbs. (11 to 12.5 N·m).

002306

Lubricate the splines (helix) of starter pinion shaft with *Starter Bendix Lube*. DO NOT use liquid or aerosol spray lubricants.

002307

Install pinion, spacer and spring.

002305

Install spacer and retaining clip. Spacer must be raised to cover clip completely.

002311
002297

To test the assembly and operation of the starter, refer to **No Load Current Draw Test** on p. 132.

Starter Installation

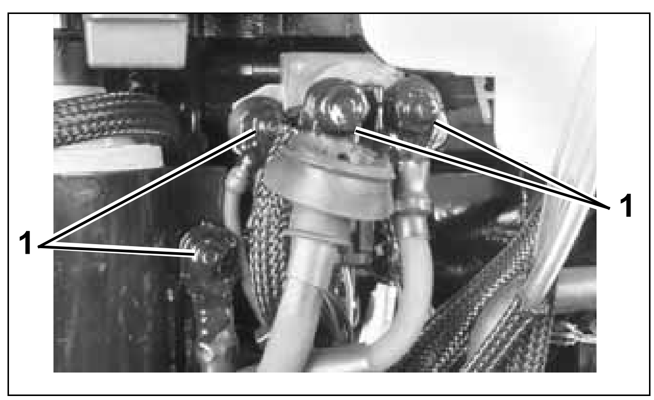
Apply *Triple-Guard* grease to the threads of the two starter screws, the double-ended stud, and also to the washers.

Position the starter and install the screws and washers. Tighten screws to a torque of 168 to 192 in. lbs. (19 to 21 N·m).

Attach starter positive (+) cable to post with lock washer and nut; tighten securely.

Install the battery negative cable (–) to the double-ended stud.

Coat connections with *Black Neoprene Dip*.



1. *Black Neoprene Dip* 002292

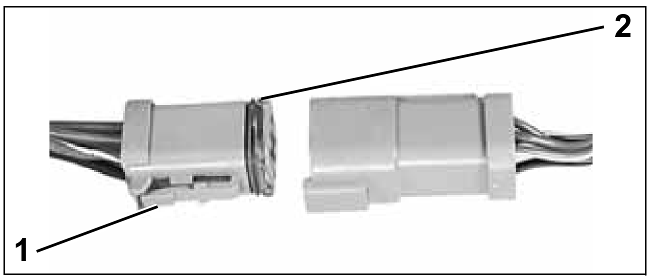
CONNECTOR SERVICING

DEUTSCH Connectors

IMPORTANT: *Electrical Grease* is recommended. Incorrect grease application can cause electrical or warning system problems.

To disconnect the connector, press the latch and pull the connectors apart.

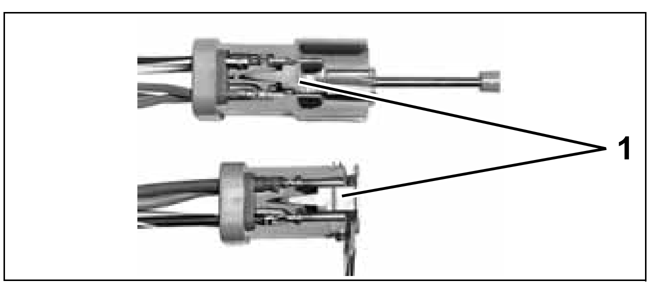
To connect the connector, confirm that the seal is in place. Clean off any old grease and dirt from connectors. Apply a light coat of *Electrical Grease* to seal. Push connectors together until latched.



1. *Latch* 42079A
2. *Seal*

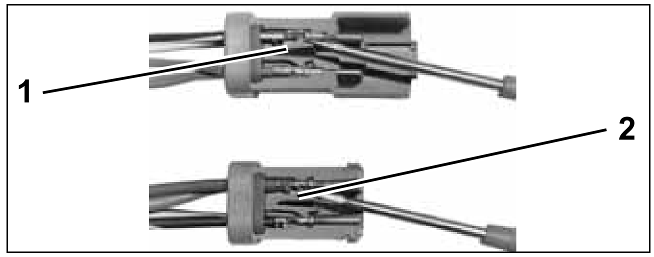
Terminal Removal

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



1. *Wedge* 42327

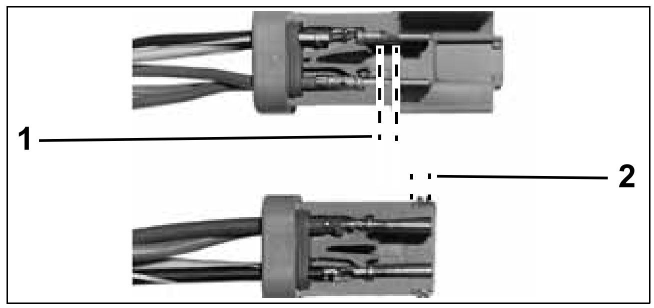
Release terminal latch and gently pull on wire.



1. *Terminal latch (receptacle)* 42329
2. *Terminal latch (plug)*

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.

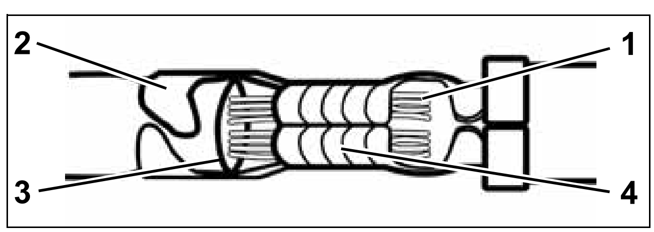


1. *Ledge of plug* 42330
2. *End of plug*

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

Crimping Terminals

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* DRC6205
2. *Insulation crimp area*
3. *End of insulation*
4. *Wire crimp area*

AMP Connectors

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

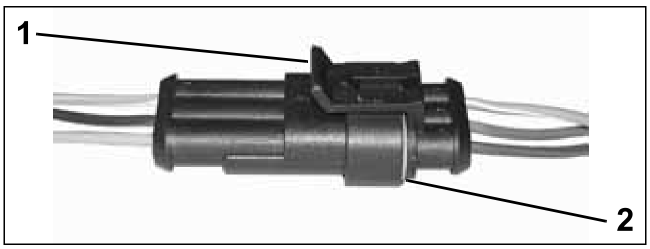
SUPERSEAL† 1.5

Disconnect

Lift latch. Pull connectors apart.

Connect

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

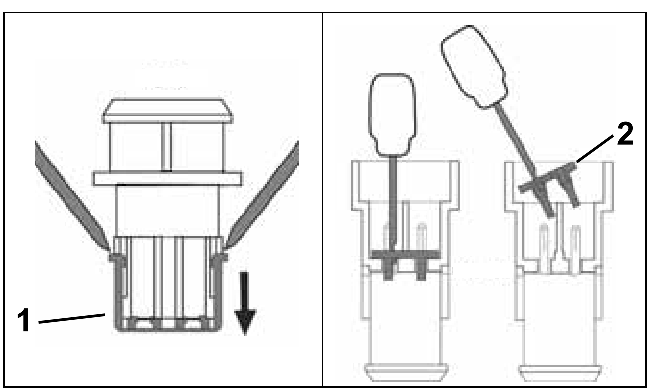


1. *Latch*
2. *Seal*

002448

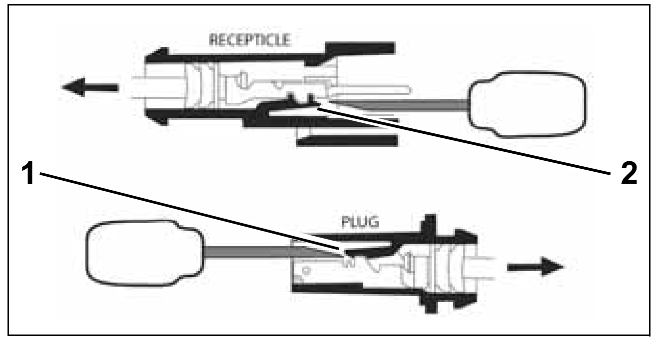
Terminal Removal

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



1. *Anti backout device, plug*
2. *Anti backout device, receptacle*

002449
002450

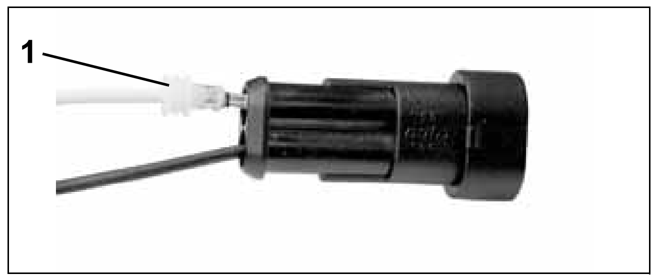


1. *Locking tab, plug*
2. *Locking tab, receptacle*

002447

Terminal Installation

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



1. *Terminal and seal*

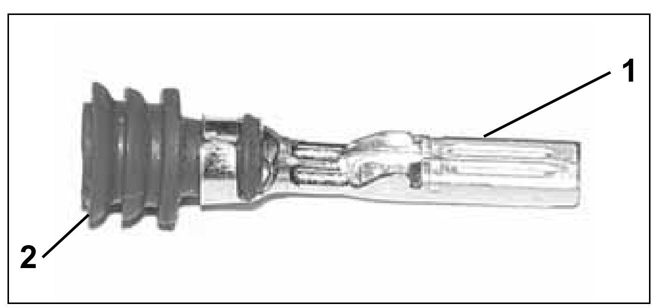
002451

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

Crimping Terminals

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

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



1. *Terminal*
2. *Seal*

002452

SUPER SEAL†

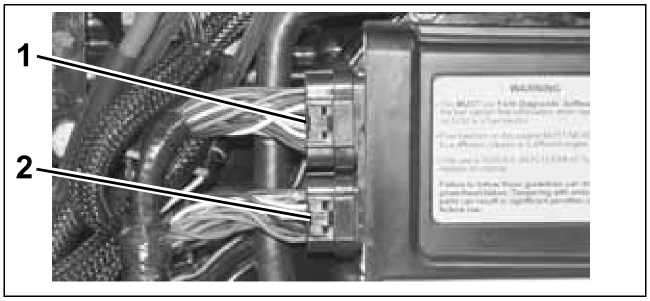
The J1-A and J1-B connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOTH latches and pull connector from plug.

Connect

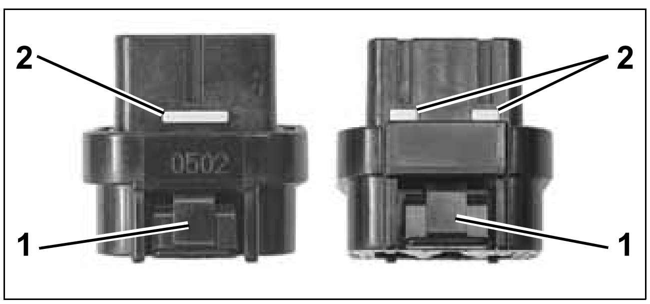
Push connector into plug until latches engage.



1. *J1-A connector* 002118
2. *J1-B connector*

Terminal Removal

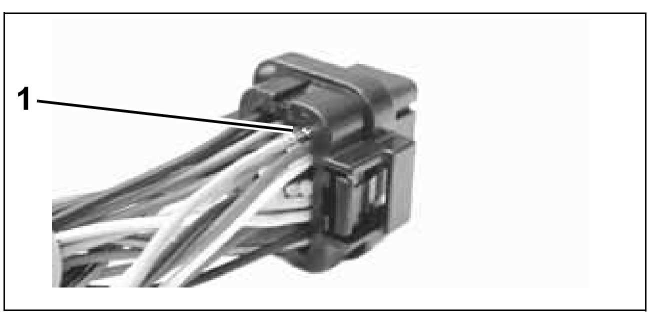
Open lock mechanism and remove terminal from connector housing.



1. *Latch* 002453
2. *Lock mechanism*

Terminal Installation

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



1. *Terminal* 002454

POWER TIMER† *SERIES*

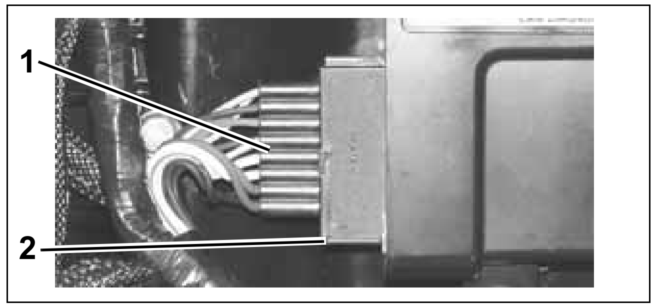
The J2 connector of the *EMM* is a *AMP Power Timer Series* connector.

Disconnect

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

Connect

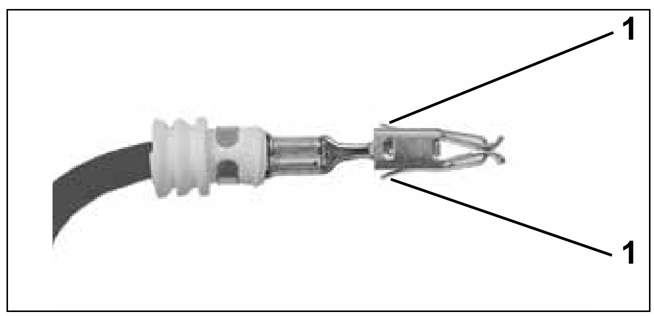
Push connector until seated in plug. Close latch completely.



1. *J2 connector* 002120
2. *Latch (closed)*

Terminal Removal

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

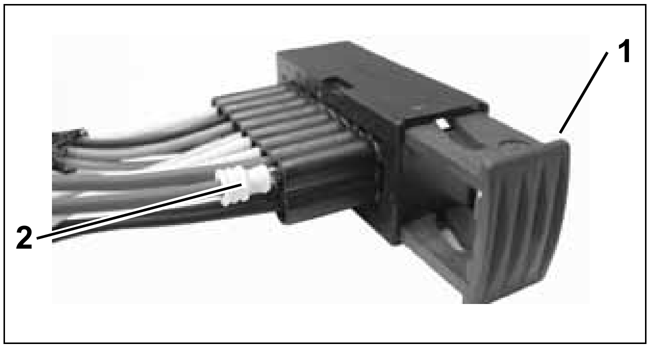


1. *Locking mechanism(s)* 002455

1. *Terminal release tool* 002313

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

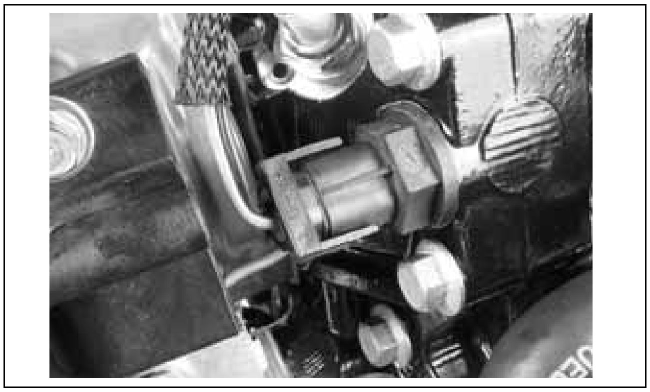
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

Disconnect

Lift latch(s). Remove connector.

Connect

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

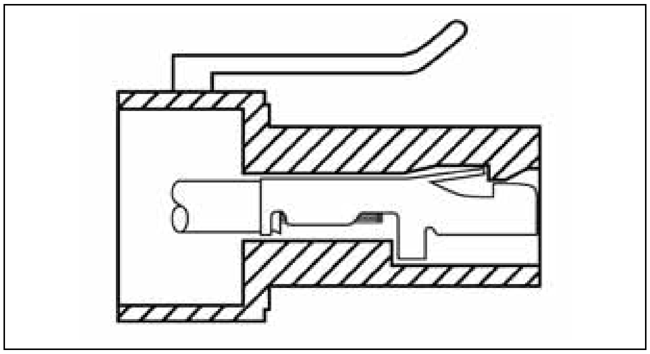


7

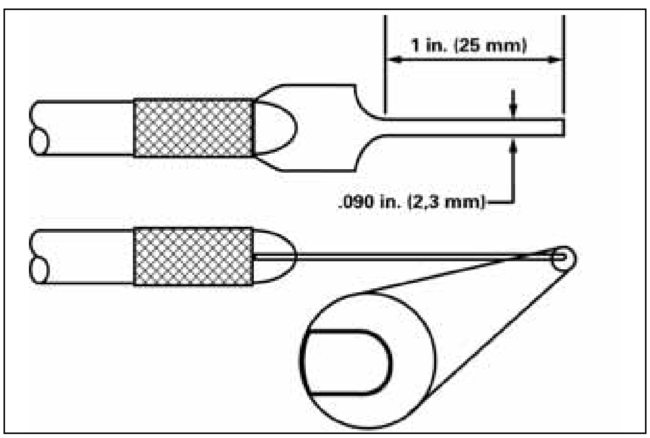
Terminal Removal

A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place. The terminal is removed by pushing wire and terminal through connector housing.

Insert a thin wire, such as a paper clip, into the connector above the terminal to release tab.



TYPICAL DRC5940



Terminal Tool DRC5941

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.

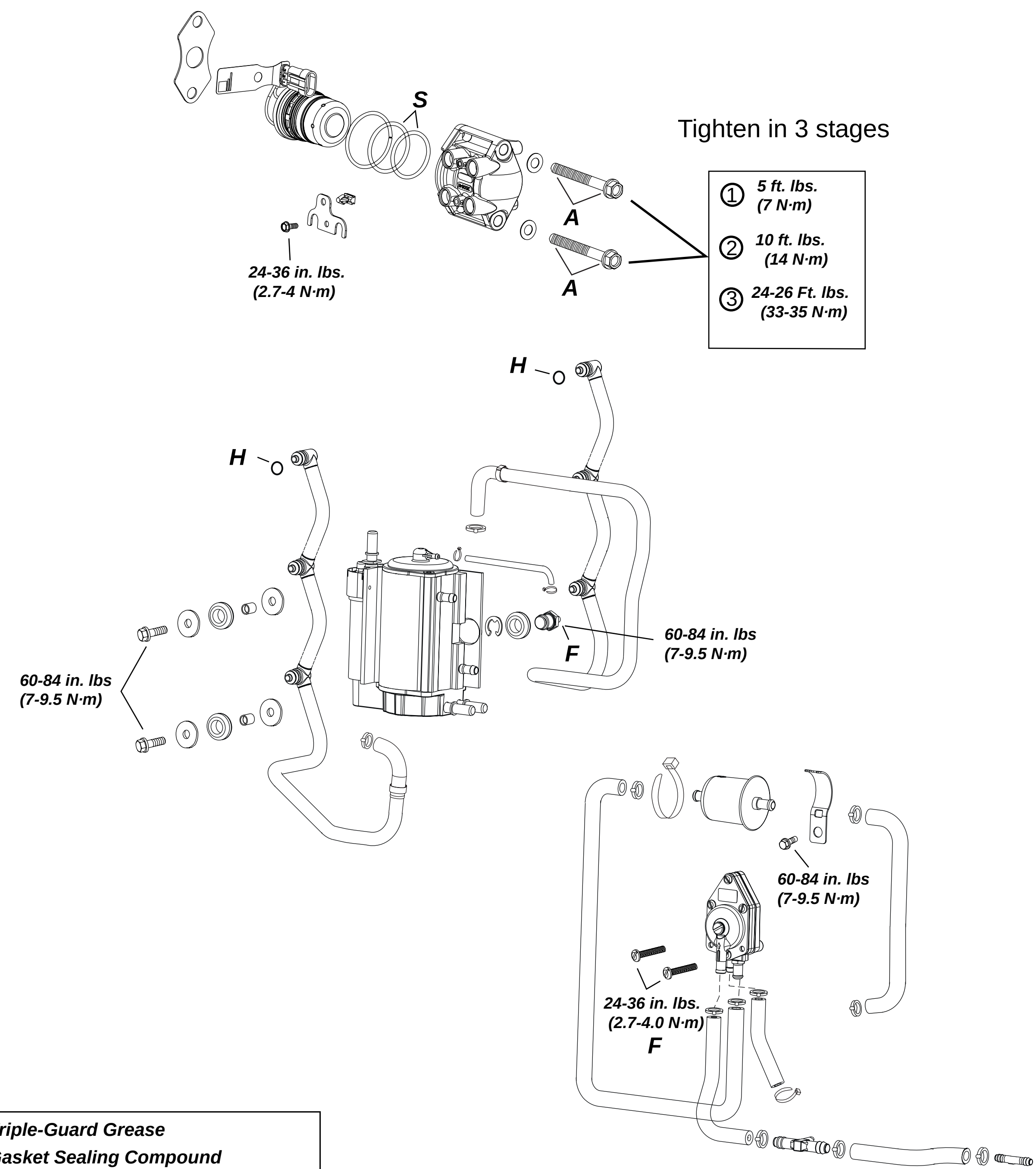
Capture all wire strands in crimp; leave no loose strands. Crimp wire and insulation securely using crimping pliers.

FUEL SYSTEM

TABLE OF CONTENTS

SERVICE CHART

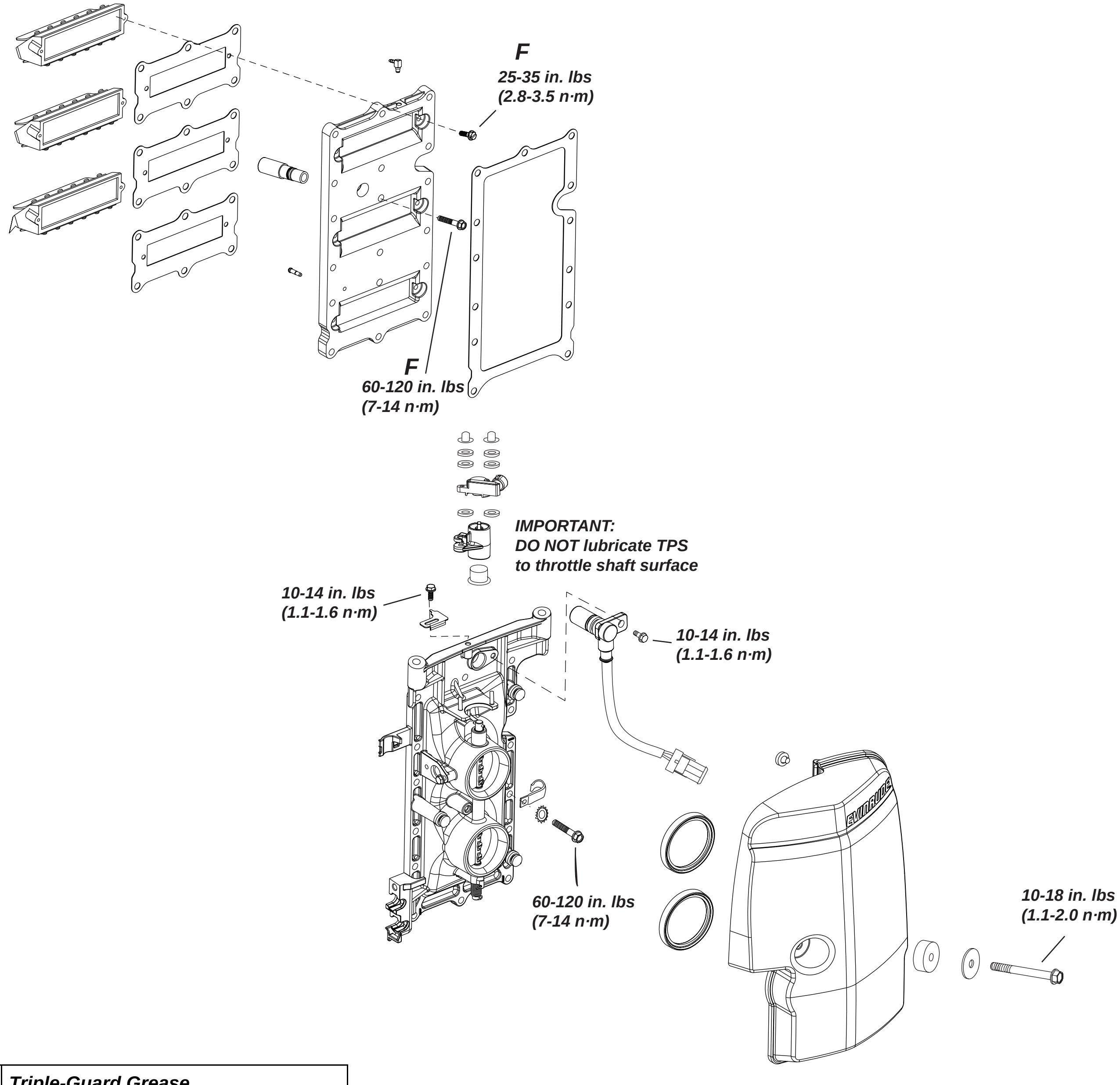
INJECTORS, VAPOR SEPARATOR, FUEL PUMP



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*

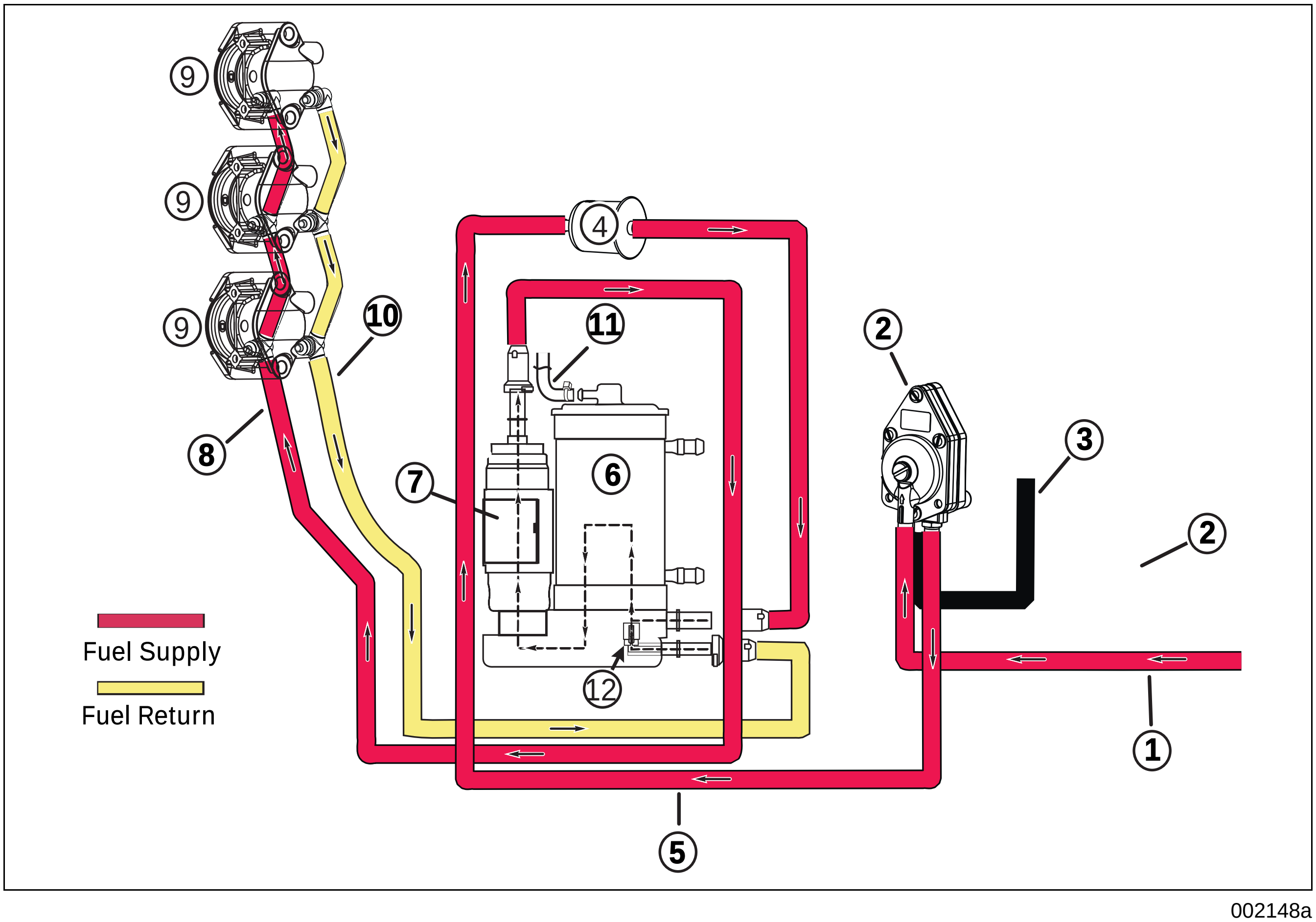
002154b

REED PLATE ASSEMBLY AND THROTTLE BODY



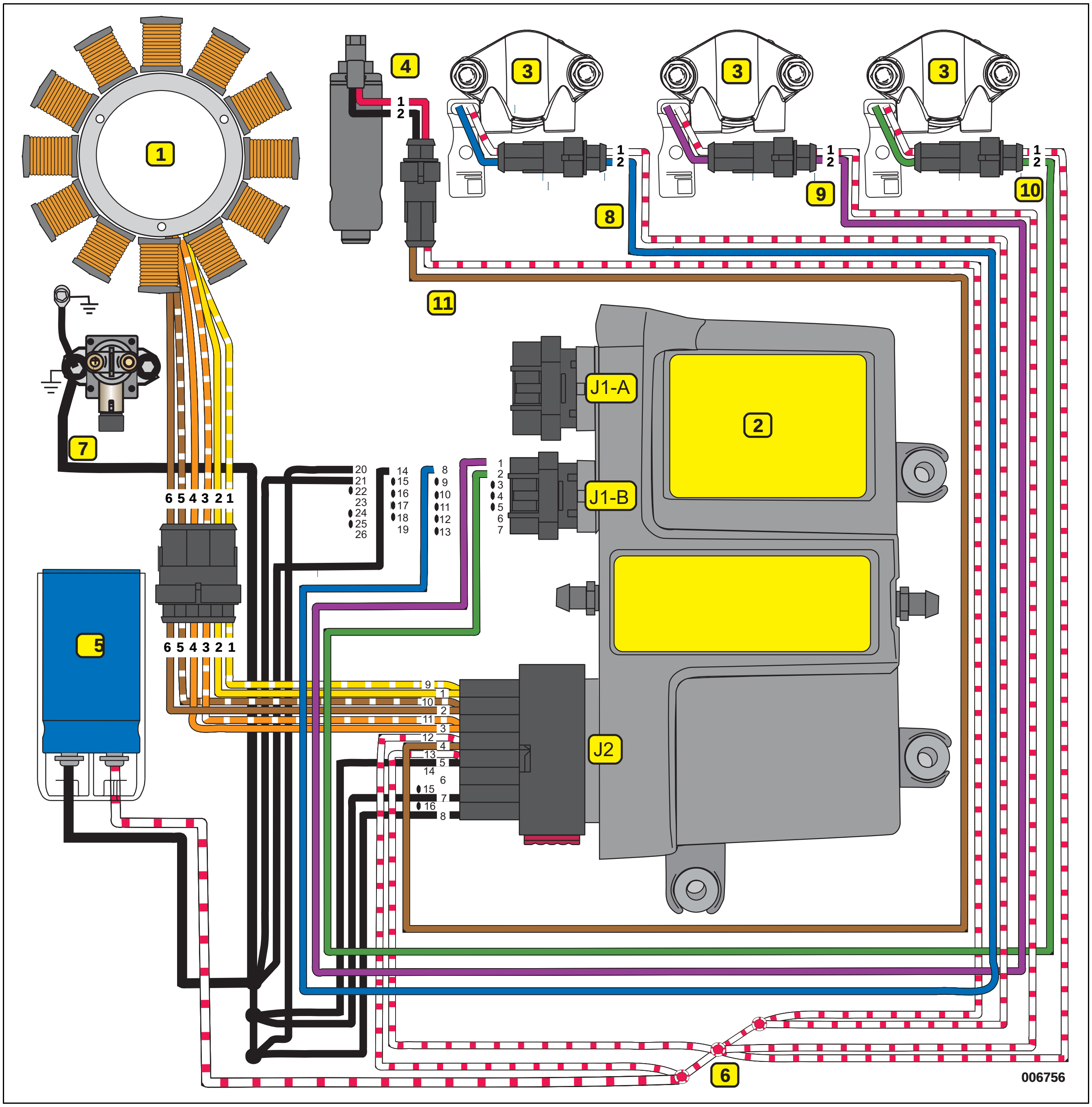
A	*Triple-Guard Grease*
B	*Gasket Sealing Compound*
C	*Adhesive 847*
D	*Moly Lube*
E	*Red Ultra Lock*
F	*Blue Nut Lock*
G	*Needle Bearing Grease*

FUEL SYSTEM HOSE ROUTING



1. Fuel supply from boat fuel system
2. Fuel lift pump (2 to 8 psi)
3. Pulse hose from cylinder/crankcase
4. Fuel filter
5. Fuel supply to vapor separator
6. Vapor separator
7. Electric fuel circulation pump (20 to 30 psi)
8. Fuel supply manifold
9. Fuel injector(s)
10. Fuel return manifold
11. Vent hose to intake manifold
12. Pressure regulator (high pressure)

FUEL SYSTEM CIRCUIT DIAGRAM



1. Stator
2. *EMM*
3. Fuel injector
4. Fuel circulation pump
5. Capacitor
6. WHITE/RED (55 V)
7. BLACK ground wires
8. BLUE
9. PURPLE
10. GREEN (2)
11. BROWN

COMPONENTS

The fuel system includes the following components:

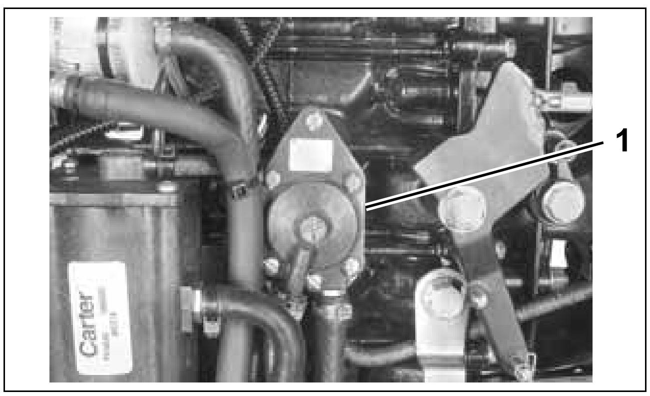
- Fuel Lift Pump
- Fuel Filter
- Vapor Separator
- Fuel Circulation Pump
- Fuel Supply Manifolds
- Fuel Injectors
- Fuel Return Manifolds

Fuel Lift Pump

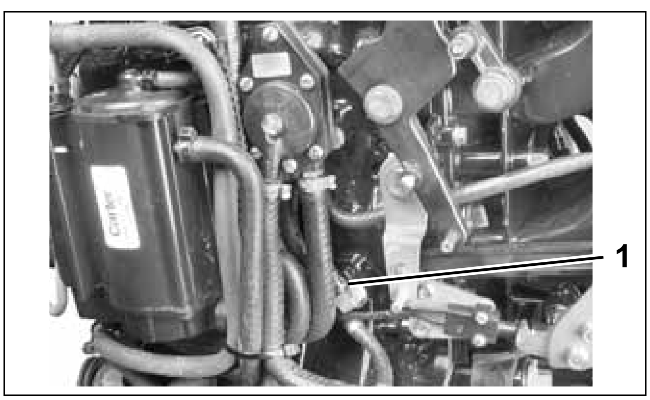
The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by a pulse hose that connects to the cylinder/crankcase assembly.

Fuel lift pump pulse hose location:

- Number 3 cylinder



1. *Fuel lift pump* 005005

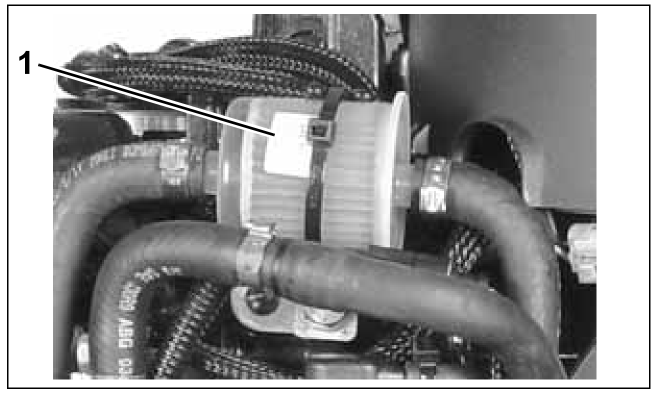


1. *Pulse hose* 002314

Vacuum from the fuel lift pump pulls fuel from the fuel tank. Once fuel reaches the pump, internal pump pressure forces the fuel from the pump through the fuel filter and into the vapor separator.

Fuel Filter

The fuel filter protects the vapor separator and the high-pressure components of the fuel system from contaminants. Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 66 for service frequency.



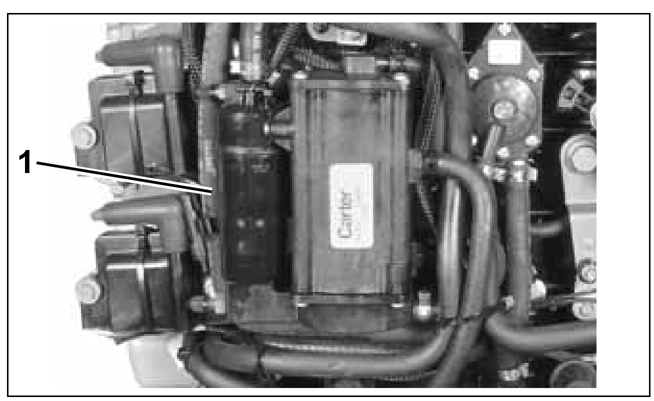
1. *Filter* 002145

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 006555
1. *Circulation pump*

Fuel Reservoir

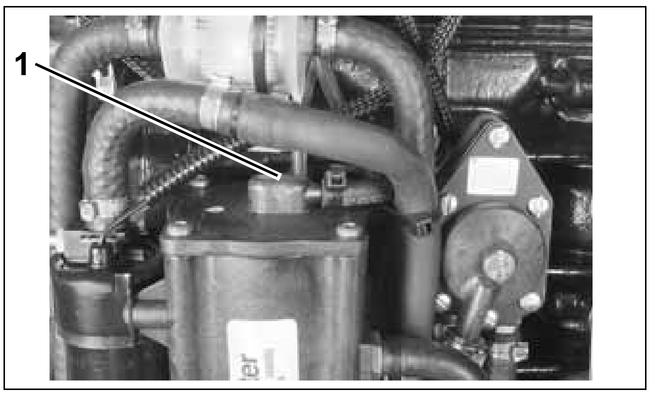
The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Cooling

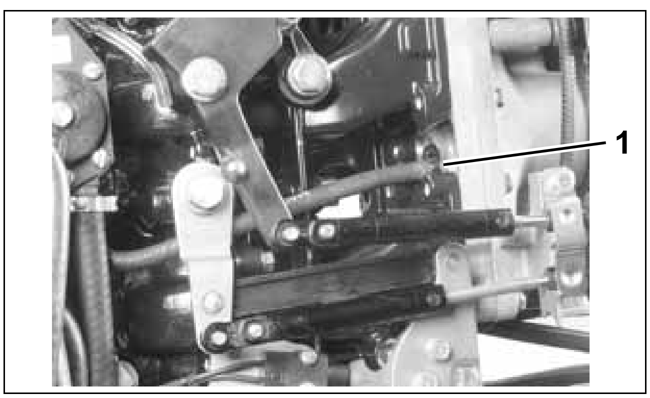
Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically. Refer to **HOSE ROUTING AND WATER FLOW DIAGRAM** on p. 190.

Venting

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



1. *Vent* 005007



1. *Vent hose connection to intake* 002180

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

As the vapor pressure in the vapor separator decreases, the fuel level begins to increase. An increase in the fuel level raises the float valve and the vent closes.

Pressure Regulator

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

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

Fuel Circulation Pump

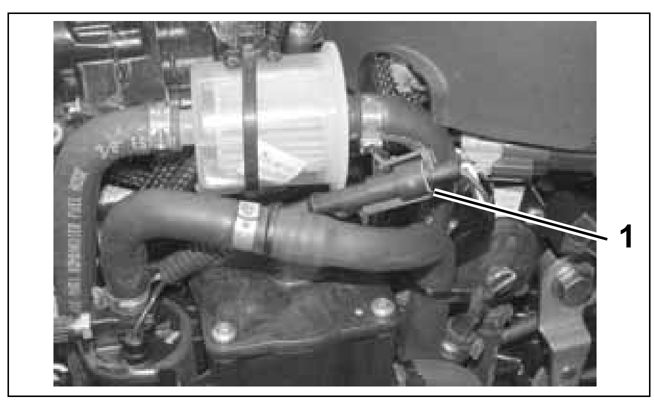
The fuel circulation pump is an electric high pressure fuel pump.

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 Manifolds

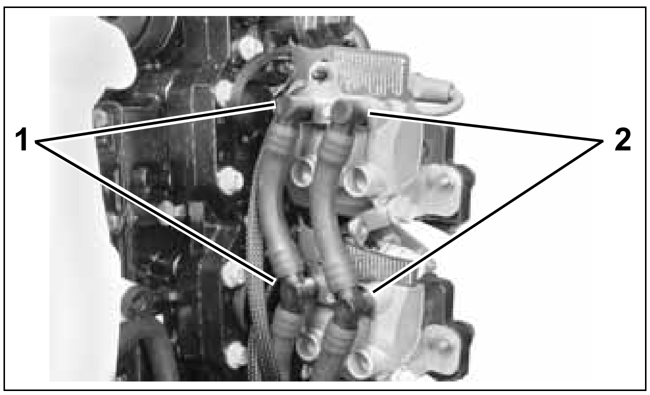
The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

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.

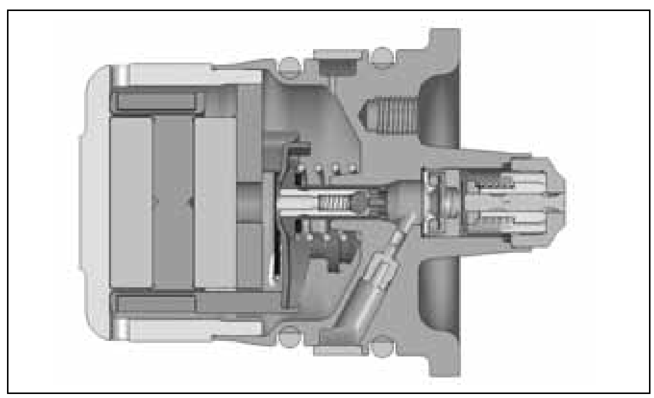
IMPORTANT: Fuel injectors MUST NOT be moved from one cylinder to another. *EMM* programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply manifold.

Each injector has internal fuel passages. These passages are designed to:

- Provide fuel to the injector's injection chamber
- Route fuel through the injector housing to cool the injector coil and armature



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.

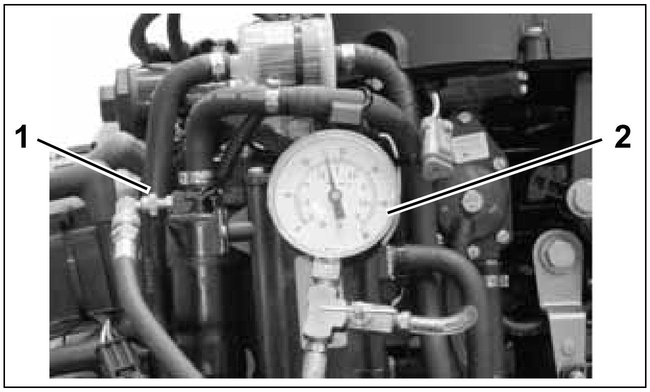
Fuel System Pressure Test

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 166.

⚠ WARNING ⚠

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

After relieving fuel system pressure, install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, to the upper fuel pressure test fitting.



1. *Test fitting*
2. *Fuel pressure gauge*

006655

START outboard and check pressure. System pressure should be 20 to 30 psi (138 to 207 kPa).

Shut OFF outboard. Monitor pressure gauge. Pressure should not drop below 15 psi (103 kPa).

IMPORTANT: If outboard does not run, prime fuel system and crank outboard; check circulation pump operation; check fuel system pressure.

Results:

Normal pressure:
- Observe pressure reading after outboard is shut OFF
- Refer to **Lift Pump Pressure Test** on p. 163.

Pressure drops after outboard is shut OFF:
- Check for leaking fuel injector.
- Check for leaking pressure regulator.
- Check for external fuel system leak.

High pressure:
- Check for restricted filter or fuel return fitting of vapor separator, damaged pressure regulator in vapor separator, or restricted fuel return manifold.

Low pressure:
- Check fuel supply to fuel lift pump. Refer to **Lift Pump Vacuum Test** on p. 164. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted fuel filter/water separator assembly.
- Lift pump not supplying enough fuel to vapor separator. Refer to **Lift Pump Pressure Test** on p. 163.
- If the above tests are good and vapor separator remains full of fuel, check for damaged circulation pump. Replace vapor separator assembly.

No pressure:
- Check electrical circuit and ground connections for circulation pump.
- If voltage is present and pump does not run, repair connection or replace vapor separator assembly.

Relieve fuel system pressure before removing fuel pressure gauge. Refer to **Relieving Fuel System Pressure** on p. 166.

8

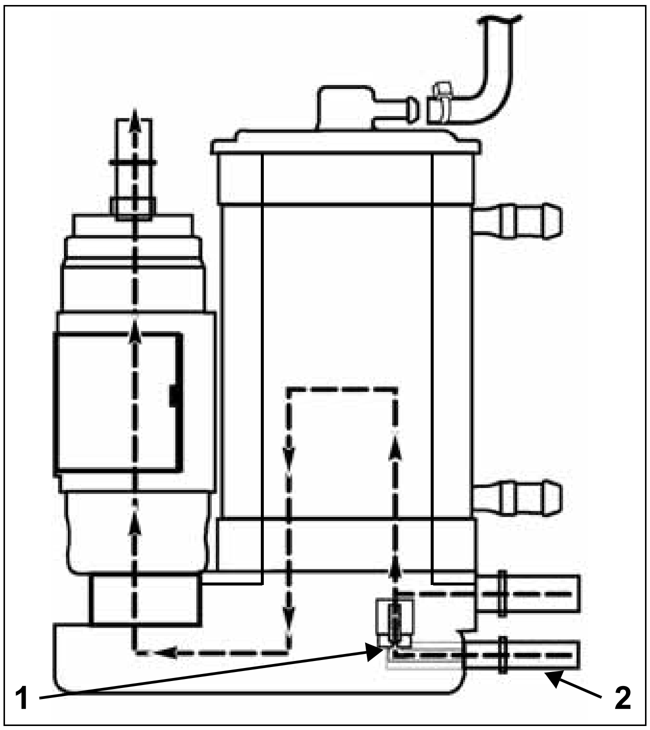
Pressure Regulator Test

Refer to **Vapor Separator Service** on p. 168 to remove vapor separator.

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

Apply oil to valve and connect pressure pump and hose to the fuel return fitting of vapor separator.

Apply pressure to check regulator operation. The pressure should open check valve at approximately 15 psi (103 kPa).



1. *Pressure regulator*
2. *Fuel return fitting*

000249

Vapor Separator Vent Check

Monitor the vapor separator vent hose. No fuel or a trace of fuel is acceptable. Excessive fuel discharge indicates a vapor separator vent malfunction. Monitor vent for presence of fuel during testing. Temporarily install clear tubing for monitoring. Replace vapor separator if the venting of fuel is continuous.

Fuel Injector Pressure Test

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

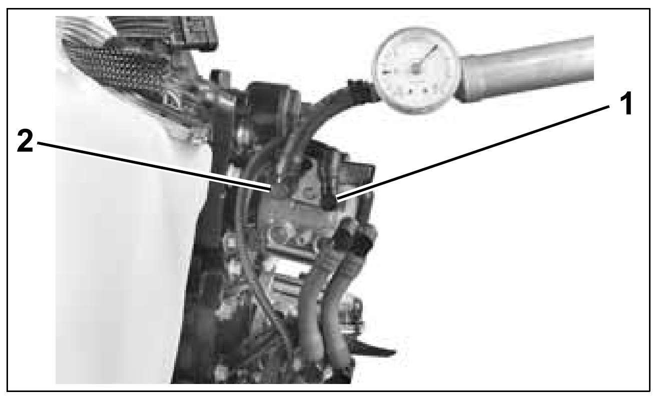
Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 166.

⚠ 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. 114 for additional test procedures.

Fuel Injector Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter to measure the injector coil resistance.

Fuel Injector Coil Resistance
2 to 3 Ω @ 72°F (22°C)

006620

Use a digital multimeter with appropriate adapter leads to measure the injector circuit resistance.

Measure resistance between pin 2 of injector connector and the appropriate pin location of *EMM* J1-B connector. Refer to engine wiring diagram for specific *EMM* J1-B connector pin location for the injector circuit being tested.

006621

Circulation Pump Resistance Test

Disconnect the battery cables at the battery.

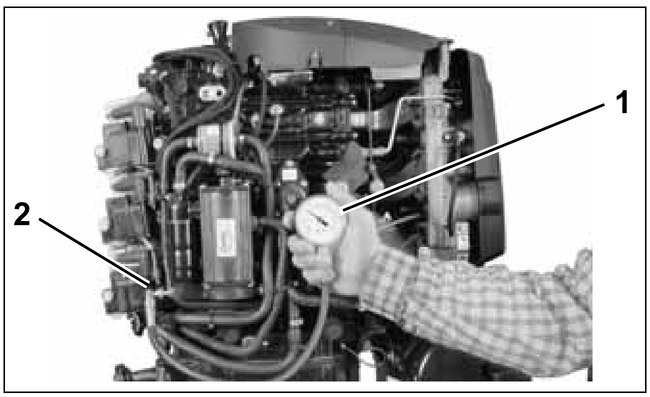
Use a digital multimeter to measure the fuel pump circuit and coil resistance.

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

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*

006781

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).

8

Results:

Normal pressure:
- Perform the **Lift Pump Vacuum Test** on p. 164. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Low pressure:
- Check pulse hoses and fittings for restrictions.
- Perform the **Lift Pump Vacuum Test** on p. 164. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.
- Check fuel flow through fuel lift pump. Use fuel primer bulb to force fuel through pump.

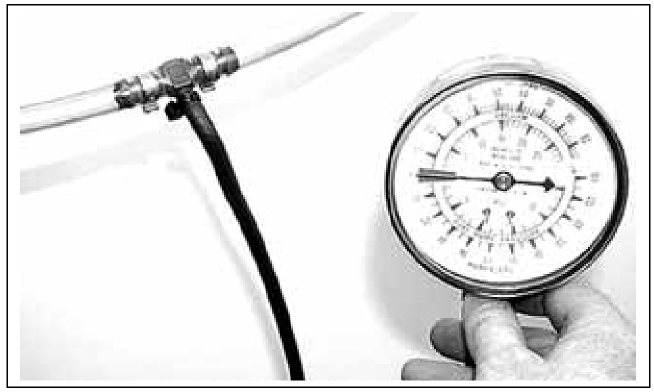
No pressure:
- Check pulse hoses and fittings restrictions.
- Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
- Momentarily prime or squeeze primer bulb to check gauge operation.
- Check pulse hose and fittings for restrictions.

Lift Pump Vacuum Test

Confirm fuel supply to the fuel lift pump.

Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet). Secure connections with tie straps to prevent fuel or air leaks.

IMPORTANT: Do not use fuel primer bulb, manual fuel primer, or electric fuel pump primer to restart outboard. A positive pressure in the fuel supply could damage some vacuum gauges.



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).

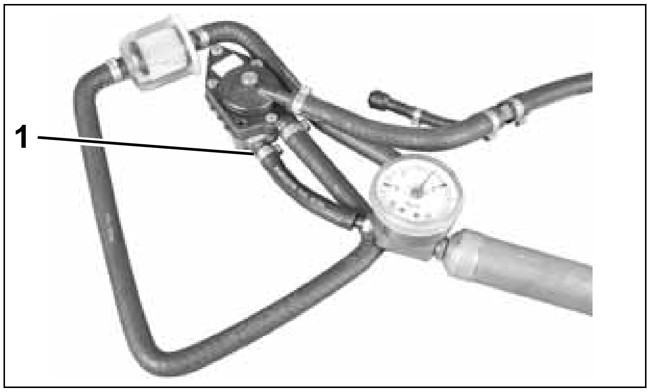
A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to **Fuel System Requirements** on p. 32 for fuel supply component requirements.

Lift Pump Diaphragm Test

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

Remove the pulse hose from the crankcase fitting.

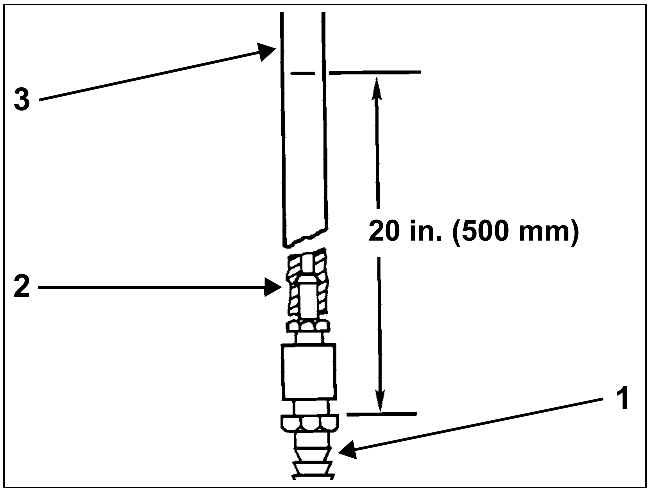
Apply 15 psi (103 kPa) to the pulse hose of the pump. Replace lift pump if pump fails to hold pressure.



1. *Pulse fitting* 002334

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* DR2277
2. *Adapter fitting*
3. *Clear hose*

Fill clear hose with water to a height of 20 in. (500 mm). Water must NOT flow through valve. An occasional drip is acceptable. Replace valve if water drips continuously.

Increase height of water to 25 in. (630 mm). Water should flow through valve as water level reaches 25 in. (630 mm). Replace the anti-siphon valve if test results are different.

FUEL COMPONENT SERVICING

⚠ WARNING ⚠

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

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

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

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

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

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

Relieving Fuel System Pressure

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

Disconnect the battery cables at the battery.

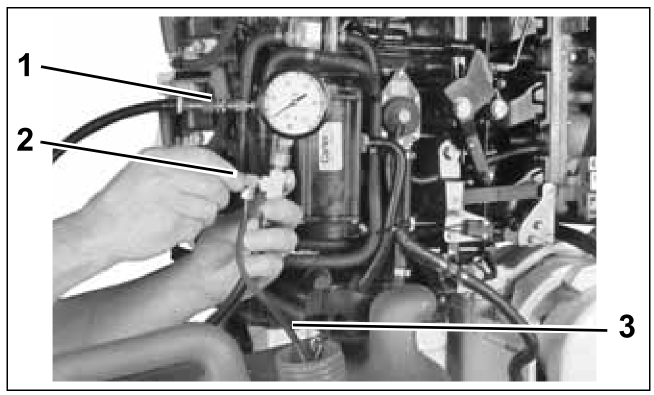
Wrap a shop towel completely around the pressure test valve while connecting fitting from Fuel Pressure Gauge, P/N 5007100, to top test fitting of fuel pump/vapor separator assembly.

1. *Shop towel* 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* 005012
2. *Venting valve*
3. *Venting hose*

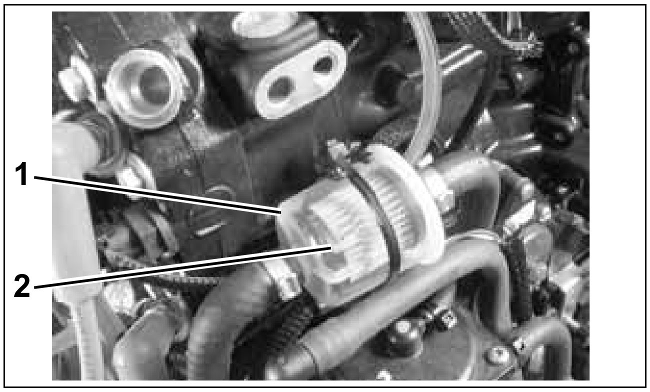
Fuel Filter Service

Removal

Disconnect the battery cables at the battery.

Remove filter carefully to prevent spilling contents.

Inspect contents for any presence of water. If water is present, identify the source and correct the problem. Take additional fuel samples and drain fuel tank(s) if necessary.



1. *Fuel filter* 002192
2. *Arrow*

Installation

Install filter in fuel supply hoses. Note arrow indicating direction of fuel flow on filter. Secure fiter with appropriate clamps. Refer to **Oetiker Clamp Servicing** on p. 40.

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

Connect battery cables.

Run outboard and check for fuel leaks.

Fuel Lift Pump Service

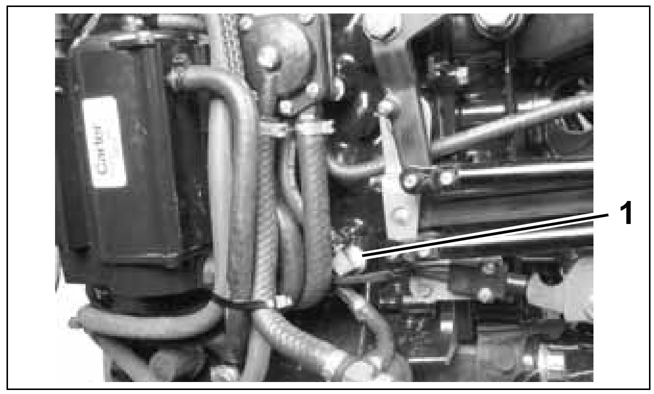
The fuel lift pump is serviceable as a complete assembly or can be repaired with a fuel pump repair kit. Refer to parts catalog for service parts.

Removal

Disconnect the battery cables at the battery.

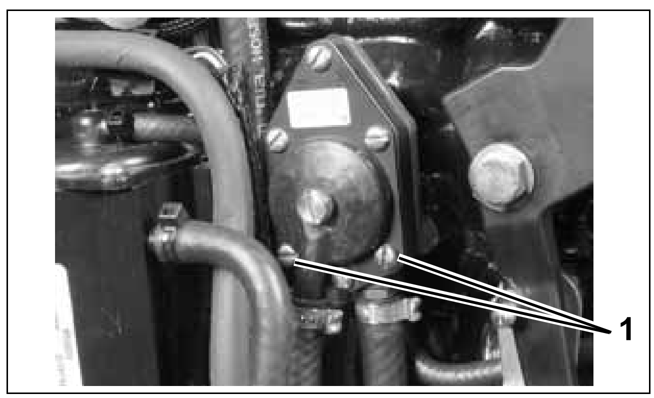
Disconnect the fuel hoses from the fuel pump housing.

Disconnect the fuel lift pump pulse hose at the crankcase fitting.



1. *Crankcase fitting* 002193

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



1. *Screws* 002194

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.

Connect battery cables.

Run outboard and check for fuel leaks.

Vapor Separator Service

Removal

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 166.

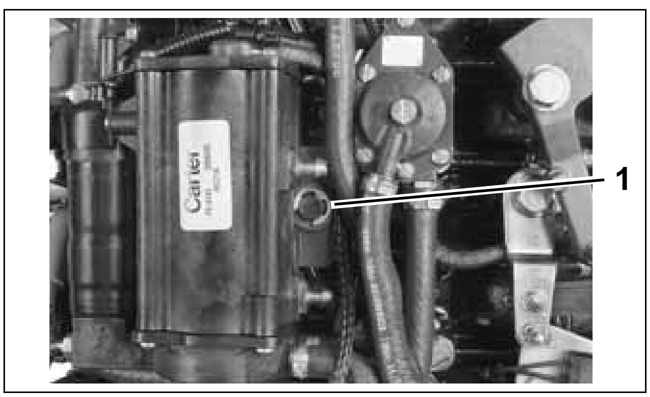
Disconnect circulation pump electrical connector.

Remove clamp and fuel supply manifold from top of circulation pump. Remove clamp and vapor vent hose from separator cover.

Remove clamps and vapor separator cooling water hoses.

Remove clamps and fuel return manifold and fuel supply hose from bottom of vapor separator.

Remove the vapor separator housing retainer clip.



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

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

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

Run outboard and check for fuel leaks.

Fuel Manifold Service

Removal

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 166.

Remove oil tank assembly. Refer to **Oil Tank Assembly** on p. 187.

Remove clamps and disconnect the fuel manifolds as follows:
- Fuel supply manifold to circulation pump.
- Fuel return manifold to vapor separator.

1. *Fuel supply manifold* 006555
2. *Fuel return manifold*

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

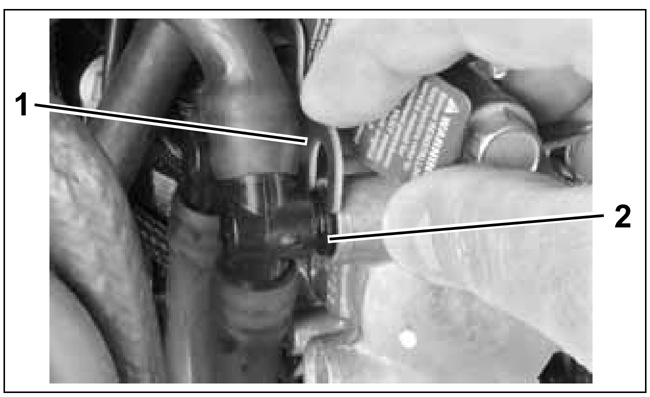
1. *Screw* 006559

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 and screw. Retainer must engage the outer groove of the manifold fittings.



1. *Retainer* 005342
2. *Manifold fitting groove*

Install the fuel manifolds to the fuel pump assembly and secure with clamps:
- Fuel supply manifold to circulation pump.
- Fuel return manifold to vapor separator.

Install oil tank assembly. Refer to **Oil Tank Assembly** on p. 187.

Fuel Injector Service

Mark fuel injectors to show cylinder locations.

IMPORTANT: Fuel injectors must be installed in the correct cylinder locations. Use *Evinrude Diagnostics* Software to make sure that *EMM* programming matches injector positioning. The *Injector Coefficients* screen displays injector serial numbers.

Injector Coefficients Screen 006771

Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel manifolds. Cover the injector nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 166.

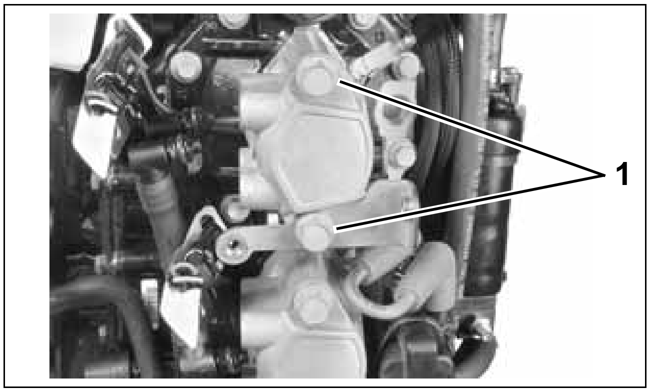
Remove fuel manifolds. Refer to **Fuel Manifold Service** on p. 168.

Remove the ignition coil assemblies.

Disconnect the fuel injector electrical connector.

8

Remove injector screws.



1. *Injector screws* 006561

Remove fuel injector and insulator.

Crush Ring Replacement

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

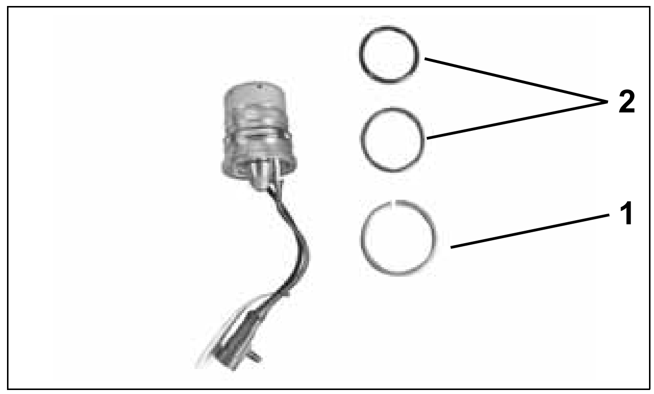
Use Slide Hammer assembly, P/N 391008, with Slide Hammer Adaptor kit, P/N 390898, to remove injector from mounting cup.

Thread adaptor and stud into face of injector. Hold mounting cup securely. Use slide hammer to separate injector from mount housing.

002345

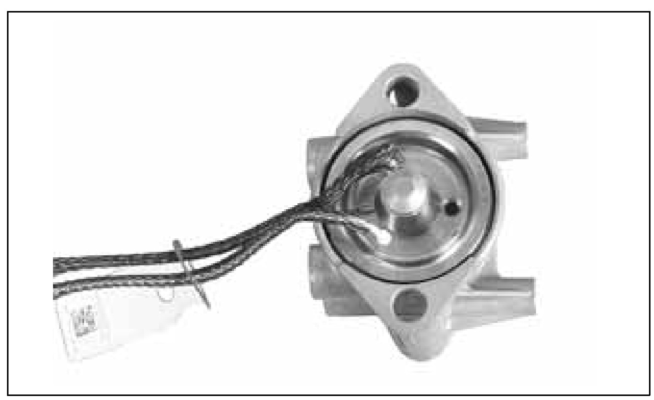
Remove adaptor from injector. Remove crush ring and O-rings from injector. Inspect and clean injector filter. Install new crush ring and O-rings. Lubricate O-rings with *STP*† *Oil Treatment*.

1. *Adaptor* 002196



1. *Crush ring* 002317
2. *O-rings*

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



002318

Installation

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

Installation of replacement injectors requires the use of diagnostics software and fuel flow data supplied with all replacement injectors on 3.5 in. floppy disk.

005157

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.

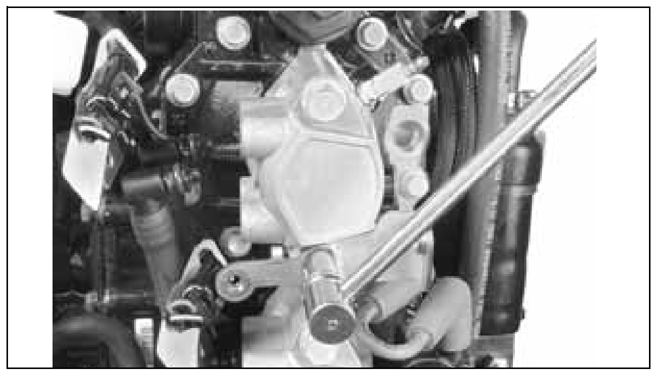
IMPORTANT: Be careful not to pinch any wiring or hoses during assembly.

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.

Install fuel manifolds. Refer to **Fuel Manifold Service** on p. 168.

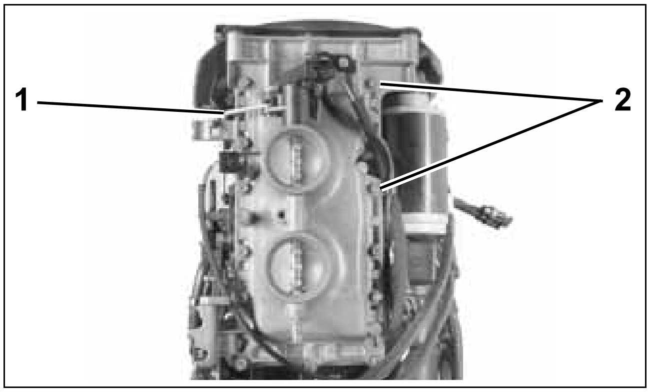
IMPORTANT: Install injector service data (3.5 in. floppy disk) by using the Injector Replacement Utility of *Evinrude Diagnostics* software. Check the *Injector Coefficients* screen to make sure that all injectors are positioned properly.

Intake Manifold Service

Removal

Disconnect throttle link arm.

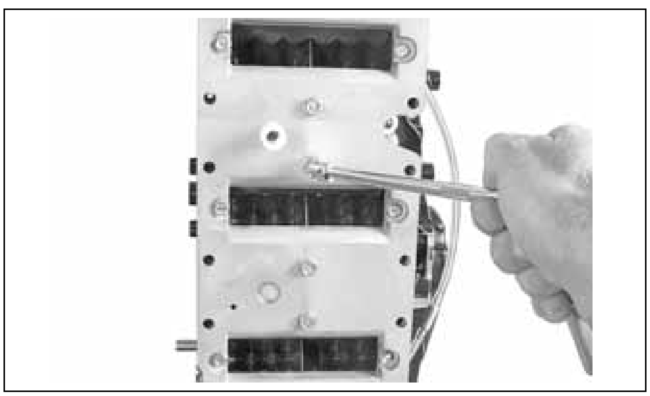
Remove throttle body screws and throttle body assembly.



1. *Link arm* 002321
1. *Throttle body screws*

Remove gasket from throttle body.

Remove screws and reed plate assembly from the crankcase.

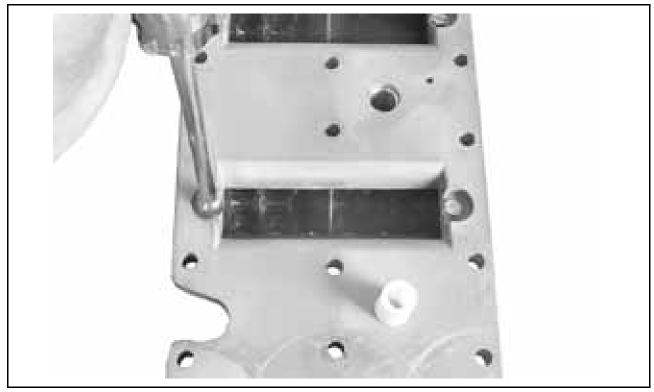


002322

Disassembly

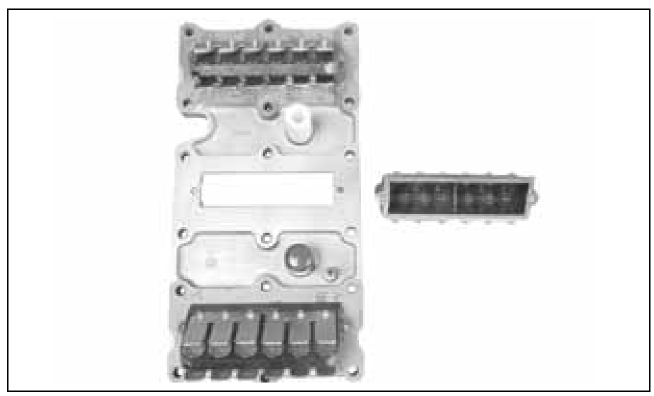
All reed plate assembly and reed valve assemblies must be cleaned prior to reassembly. DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

Remove the reed valve retainer screws and remove the assembly.



002323

Use caution to prevent damaging reed valve assemblies.



002325

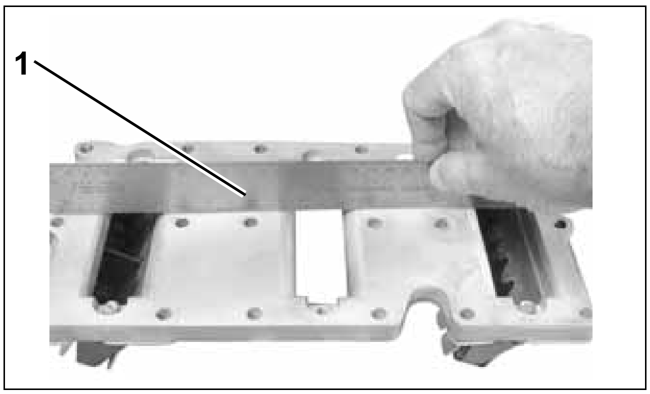
IMPORTANT: DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

Inspection

Inspect the leaf plate assemblies for damage or contamination:

- Leaf plates must not be distorted.
- Leaf valve must not be cracked or chipped.
- Leaf plate stops must not be distorted or loose.
- Leaf plate assemblies must be clean.

Inspect the intake manifold. All gasket surfaces must be cleaned, smooth, and free of nicks. Use a machinist's straight-edge to check flatness in all directions. Surface must be flat, ±0.004 in. (0.10 mm).

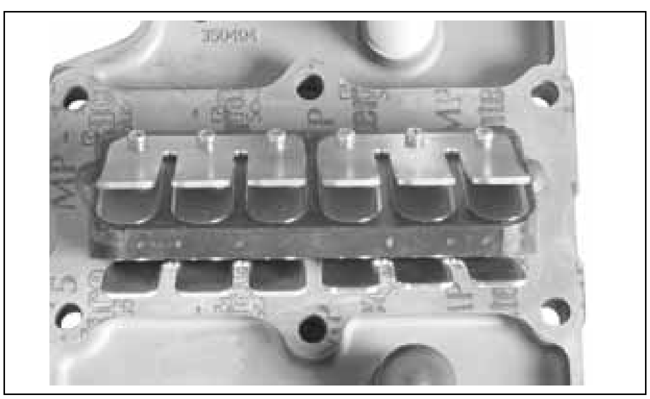


1. *Straight-edge* 002324

Assembly

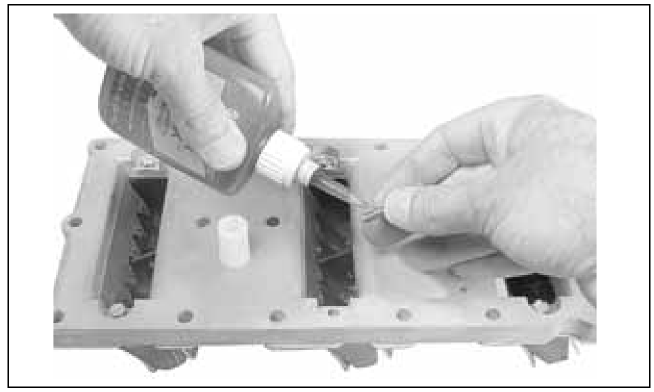
Remove old adhesive from reed valve retaining screws.

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).



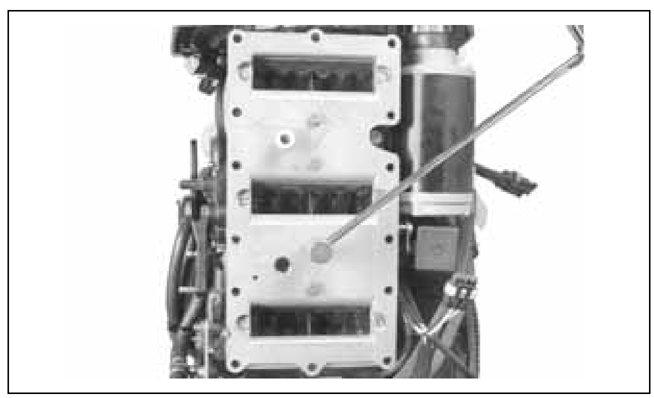
002326

Installation

Place reed plate assembly on cylinder/crankcase.

Apply *Nut Lock* to screws. Install all screws.

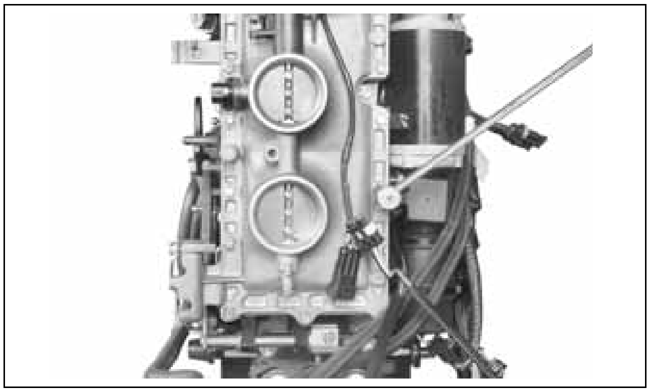
Tighten the center screws first and expand outward. Tighten in stages to a final torque of 60 to 120 in. lbs. (7 to 13.5 N·m).



002328

Place gasket on throttle body. Install throttle body on reed plate and install screws.

Tighten the center screws first and expand outward. Final torque is 60 to 120 in. lbs. (7 to 13.5 N·m).



002329

Install upper main bearing vent hose and secure with tie strap.

Connect throttle linkage and electrical connectors.

IMPORTANT: Refer to **TPS Calibration** on p. 143.DO NOT lubricate throttle linkages.

OILING SYSTEM

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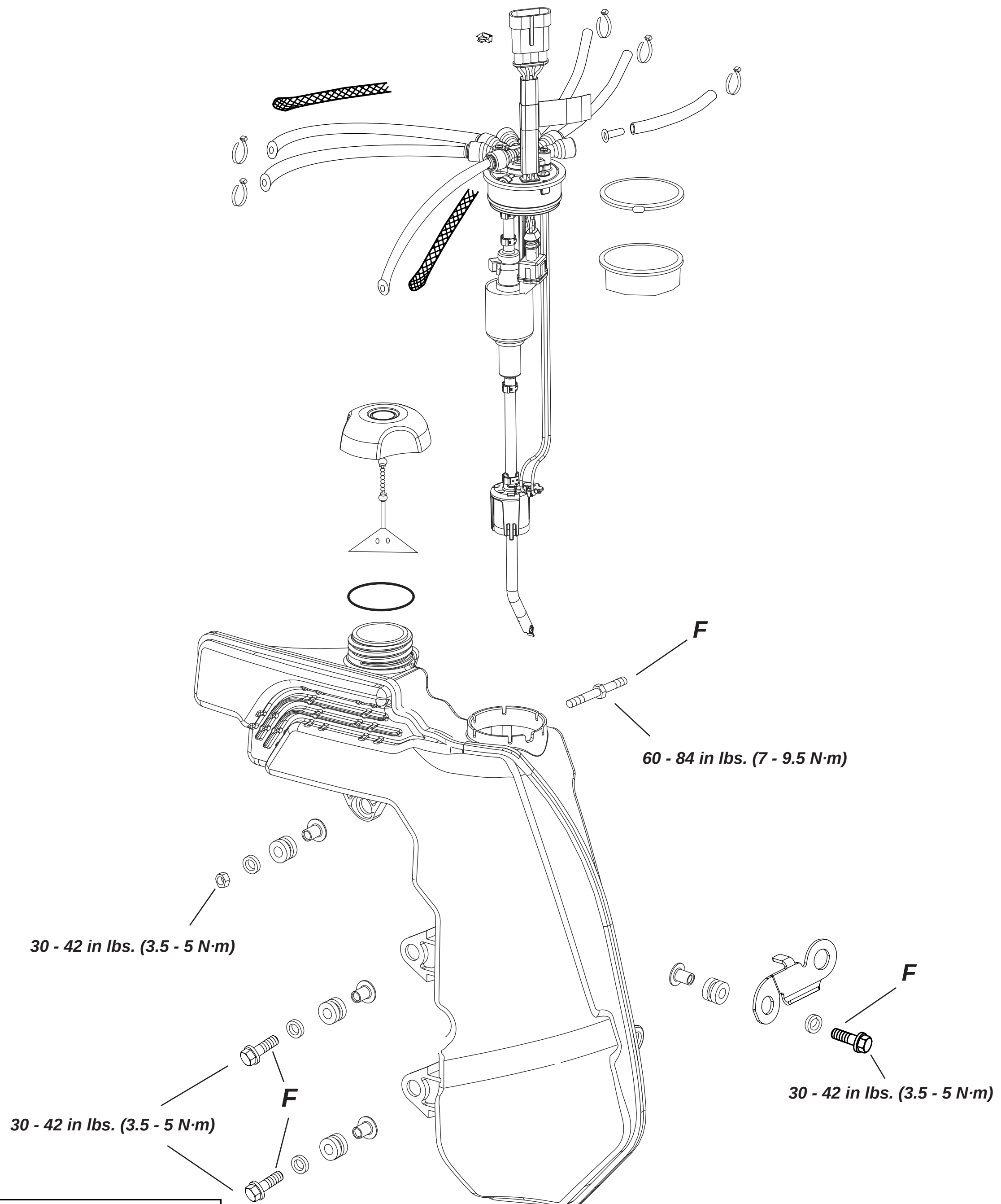
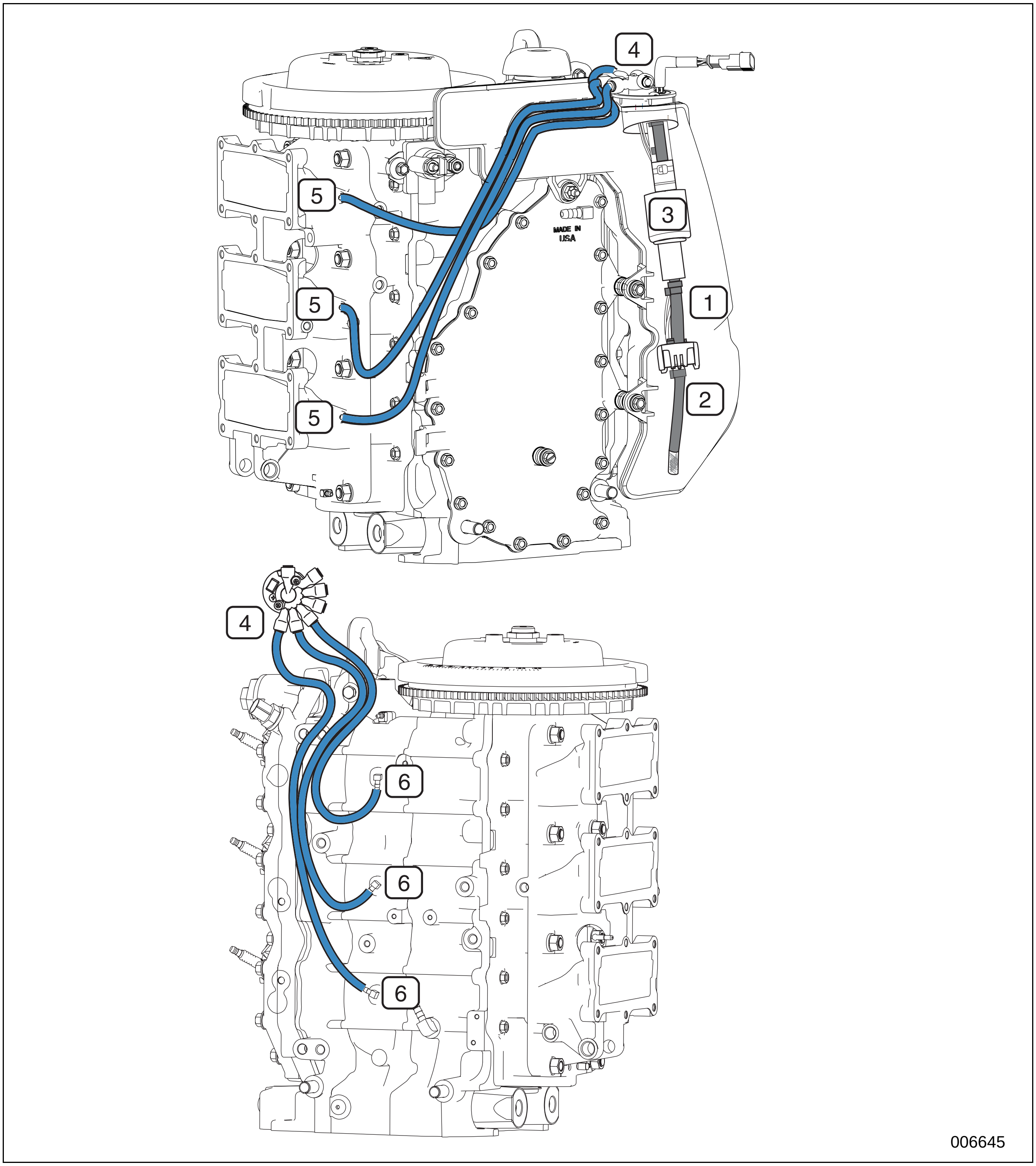
SERVICE CHART



A	*Triple-Guard Grease*
B	*Gasket Sealing Compound*
C	*Adhesive 847*
E	*Red Ultra Lock*
F	*Blue Nut Lock*
H	*Outboard Engine Lubricant*
S	*STP Oil Treatment*

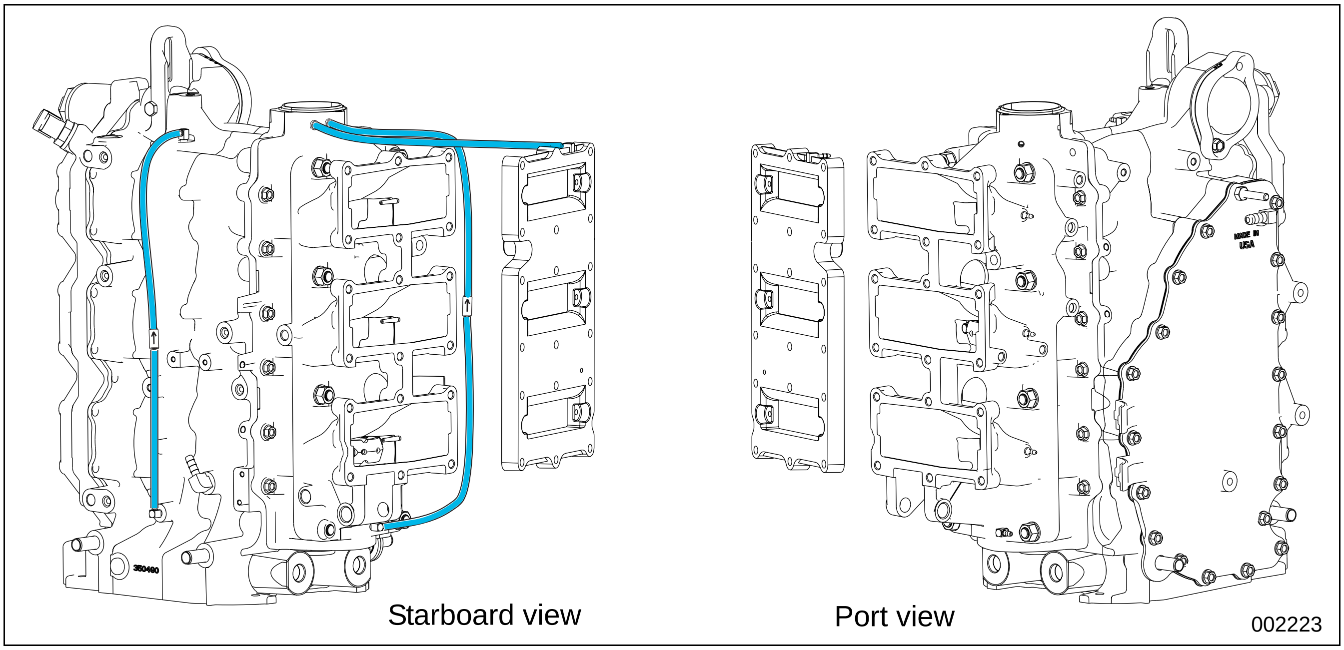
002213a

OIL SUPPLY DIAGRAMS

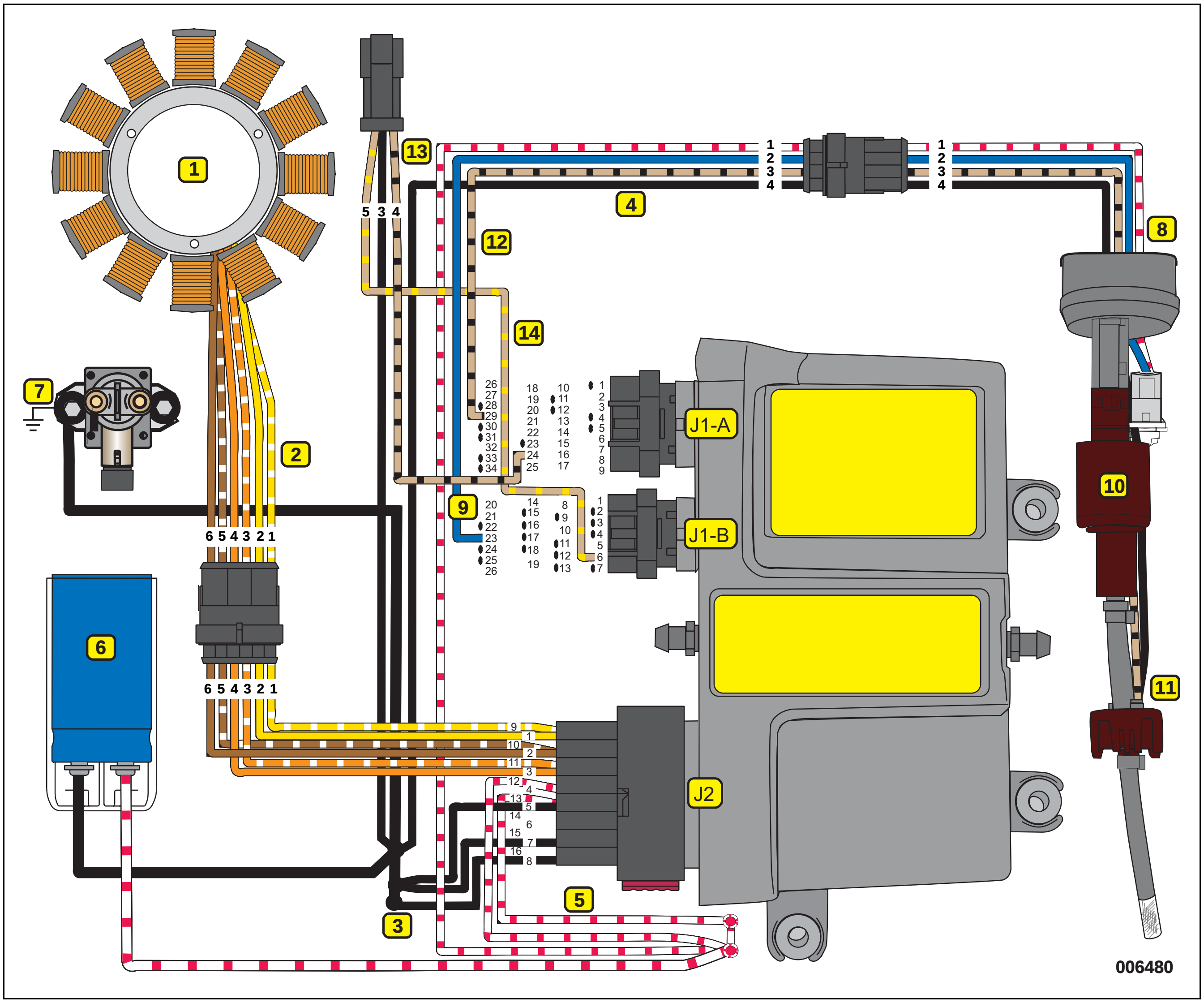


1. Oil tank
2. Oil pick-up/filter
3. Oil injection pump
4. Oil distribution manifold
5. Crankcase oil inlet (port)
6. Cylinder oil inlet (starboard)

OIL RECIRCULATION DIAGRAM



OILING SYSTEM CIRCUIT DIAGRAM



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:

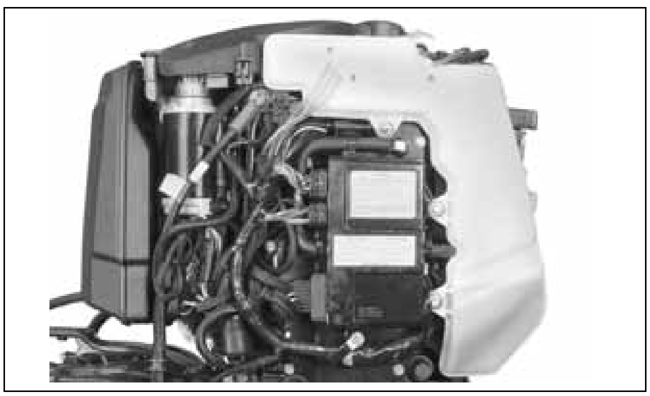
- Oil tank
- Oil injection pump and manifold assembly
- Electrical circuit
- LOW OIL and NO OIL warning systems
- Cylinder and crankcase
- Oil recirculation system.

Oil Tank Assembly

The oil tank is mounted on the powerhead under the engine cover. Oil level must be monitored.

Oil Tank Components:

- Tank, 3 quart. (2.8 liter) capacity
- Oil pickup and filter assembly
- Oil injection pump and manifold assembly
- LOW OIL sending unit
- Oil distribution hoses

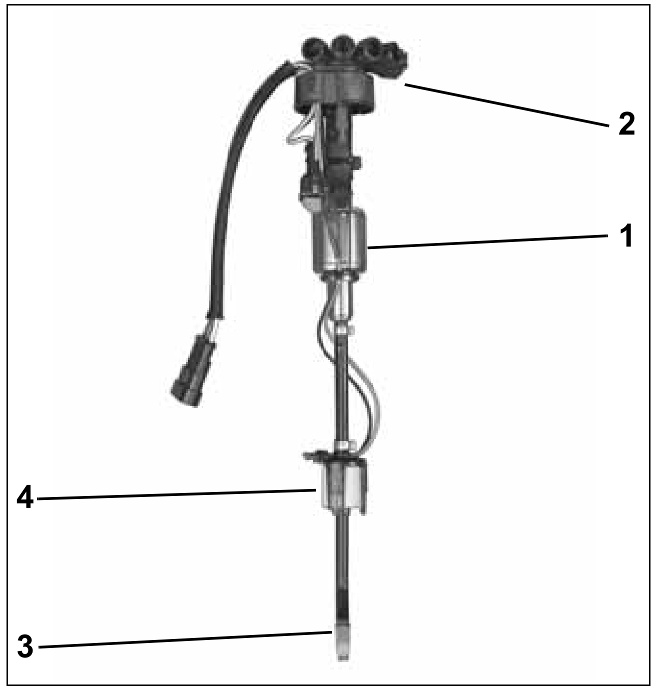


006757

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* 006481
2. *Oil distribution manifold*
3. *Pickup tube and filter*
4. *Low oil sending unit*

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 service code 34
EMM LED 4: ON (Running)
Engine Monitor NO OIL display: ON

LOW OIL Warning

A sending unit in the oil tank pick-up assembly monitors the oil level in the oil tank.

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

Engine Monitor LOW OIL display: ON

Approximate oil reserve at Low Oil activation:
- 0.61 qt. (0.57 l).

NO OIL Warning

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

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

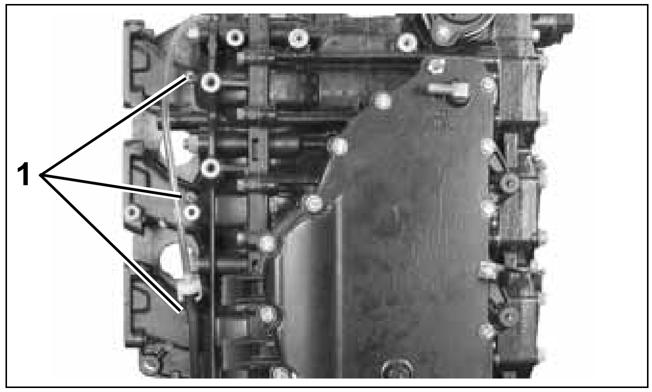
To recover from *S.A.F.E.* mode, the oil pump must cycle for a minimum of three pulses with the oil level above one-quarter.

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

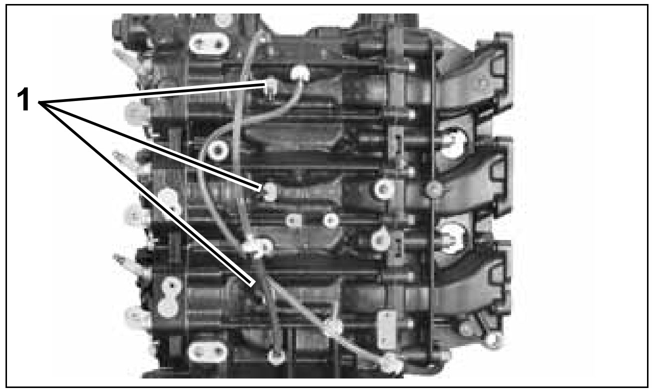
Activates SHUTDOWN
Stores service code 33
EMM LED 4: FLASHING
Engine Monitor NO OIL display: FLASHING

Cylinder and Crankcase

The oil distribution manifold provides crankcase lubrication through oil distribution hoses and pressed-in fittings on the crankcase and cylinder block.



1. *Crankcase oil fittings* 006758



1. *Cylinder block oil fittings* 006615

9

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.

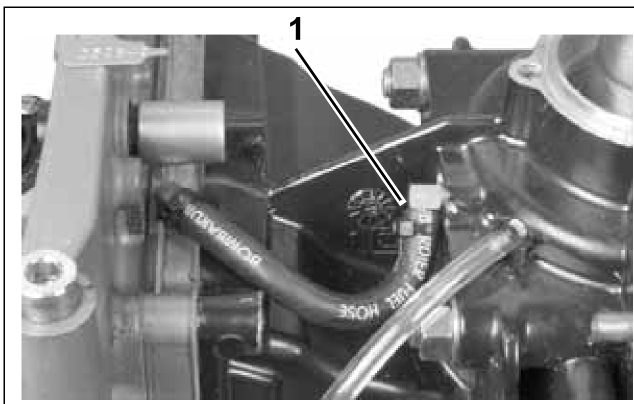
External fittings and in-line check valves on each side of the cylinder block control the movement of oil from the lower cylinder port to the upper cylinder port.

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* 002872

Refer to the **OIL RECIRCULATION DIAGRAM** on p. 178.

OIL CONTROL SETTINGS

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. 54.

Oiling Rates

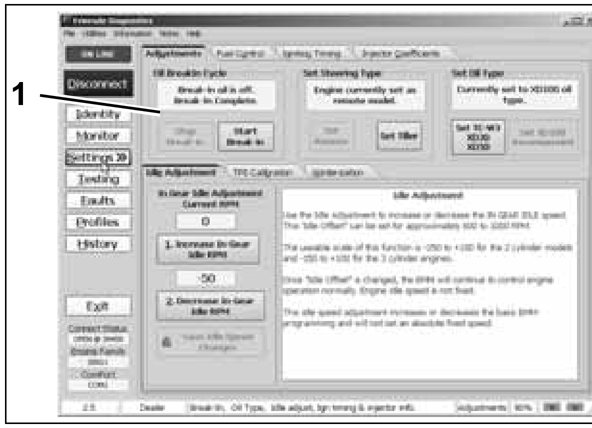
EMM programming controls the rate of oil injection based on engine RPM. This rate can be adjusted for the grade of oil being used, and also for powerhead break-in. Use *Evinrude Diagnostics* software to access these features.

Refer to **Oil Injection Rate** on p. 53.

Break-in Oiling

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

- Use *Evinrude Diagnostics* software to make sure the break-in program has been started on a new outboard.
- Use the diagnostics software to start break-in oiling after a powerhead rebuild.



1. *Break-in oil setting* 006540

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

OILING SYSTEM TESTS

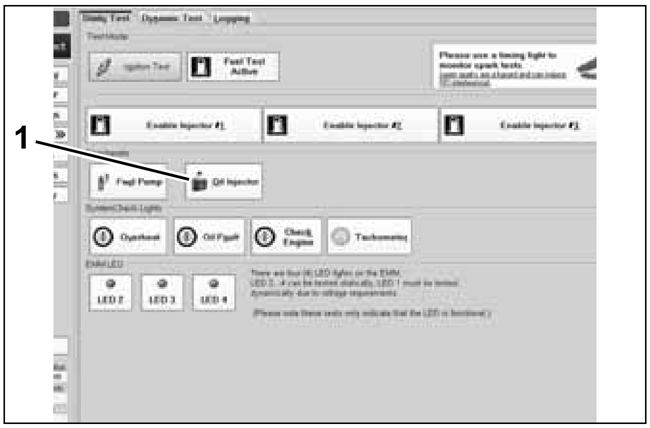
IMPORTANT: Always perform visual inspections to identify oiling system leaks. Make sure the oil tank is filled and oil supply is not contaminated.

Oil Injection Pump Static Test

IMPORTANT: Static tests are performed with the outboard not running.

Use *Evinrude Diagnostics* software to activate the *Oil Injector* test. This test starts the *EMM* control function for the oil injection pump.

The *EMM* controls the pump by providing ground through pin 23 (blue wire) of the J1-B connector and pin 2 (blue wire) of the oil tank connector.



Static Tests Screen 006775
1. Oil injector test button

IMPORTANT: This test is operating the pump with 12 V battery power on the system voltage (55 V) circuit. The oil injection pump will not activate on 12 V.

Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil tank connector (pin 2).

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

Refer to **Oil Injection Pump Voltage Test** on p. 183.

Oil Injection Pump Voltage Test

Check voltage at pin 1 (white/red wire) of oil tank electrical connector.

Acceptable voltage readings:
- Key switch ON: slightly less than 12 V
- Outboard running: 55 V

Results:
- If voltage is not within range, refer to **Oil Injection Pump Circuit Resistance Test** on p. 184.
- No voltage reading, refer to **System Voltage Test** on p. 110.

Monitor the voltage on the oil injector circuit at pin 2 (blue wire) of oil tank connector with outboard running at 1500 RPM.

Use an appropriate test probe and a digital multimeter calibrated to a scale that reads 55 V (DC). Connect positive meter lead to pin 2 and negative meter lead to ground.

002385

Voltage reading should be approximately 55 V, and drop approximately 5 V as *EMM* actuates oil injection pump.

Oil Injection Pump Circuit Resistance Test

IMPORTANT: The complete oil injection pump electrical circuit includes *EMM* alternator output, the engine wire harness, the injection pump winding and connectors, and the oil injector control circuit of the *EMM*. Check continuity of all wiring and connections.

Disconnect the battery cables at the battery.

Use an appropriate test probe to make a connection to pin 1 of the oil injection pump connector.

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

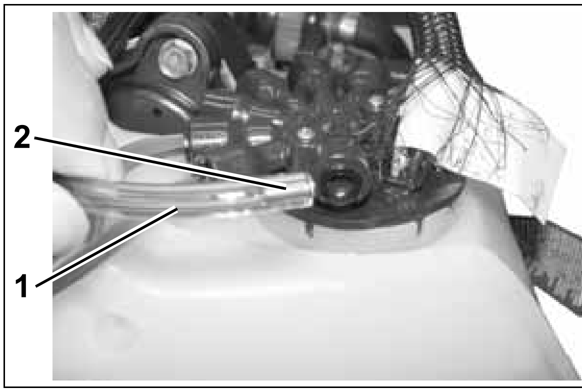
Oil Injection Pump Resistance
22 Ω

1. *Oil injection pump connector (pin 1)* 006572

Results:
- An infinite reading (∞) indicates an open circuit. Isolate the faulty wiring, connection, or injection pump winding. Repair faulty wiring or replace faulty component and retest.
- For a higher than expected reading, test resistance of the injection pump. If injection pump resistance reading is approximately 22 Ω, injection pump winding is good. Isolate faulty component. Repair faulty wiring or replace faulty component and retest.

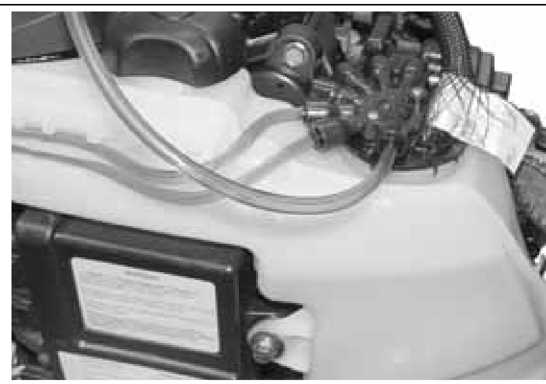
Oil Injection Pump Function Test

Remove oil distribution hose from fitting at oil distribution manifold. Do not lose the brass hose support.



1. *Oil distribution hose* 002362
2. *Hose support*

Temporarily install a length of oil hose.



002377

Start the outboard and observe oil flow:
- Oil flows from hose, compare to oil flow at other distribution fittings
- If one or more fittings fail to flow oil, replace the oil injection pump assembly.

Reinstall hose into manifold.

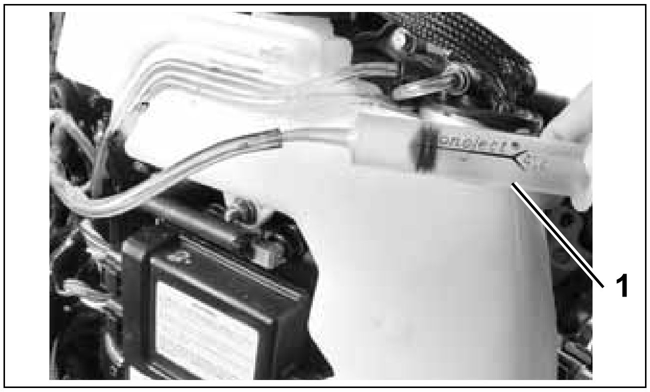
IMPORTANT: Make sure hose support is in hose and hose is fully inserted into manifold. Refer to **Oil Distribution Hoses** on p. 186.

Oil Injection Fittings Flow Test

Make sure the oil injection fittings of the cylinder and crankcase assembly allow fluid to move.

Remove oil distribution hose from oil distribution manifold.

Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.



1. Syringe 002376

LOW OIL Sending Unit Test

Remove the oil from the oil tank.

Turn the key switch ON. The dash mounted Engine Monitor system should show a LOW OIL warning.

Once the warning has been confirmed, refill the oil tank and start the outboard. The LOW OIL warning should stop after the oil pump cycles 3 times.

OIL COMPONENT SERVICING

⚠ WARNING ⚠

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

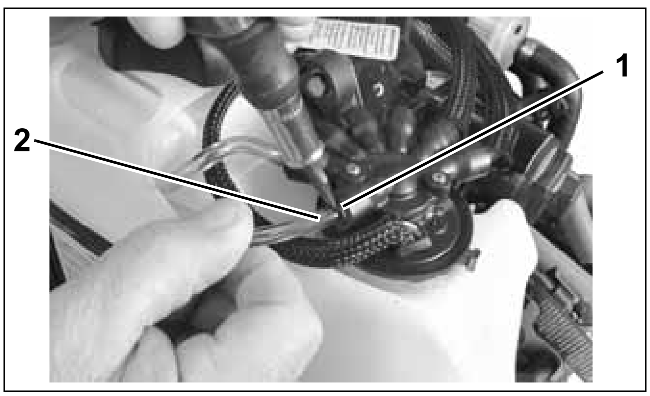
Oil Distribution Hoses

The oil distribution hoses to each cylinder MUST be the same length. DO NOT alter the length of any hoses.

Oil Distribution Hose Length:
- 23 in. (584 mm)

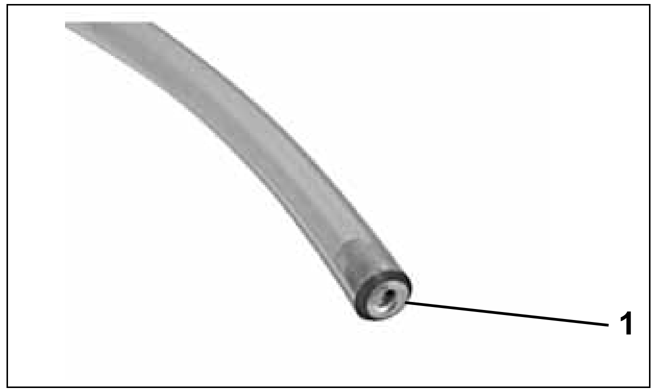
Removal

Release the hose by depressing the outer ring of the hose retaining mechanism.



1. Retainer mechanism 006577
2. Hose support

Once hose is removed from the manifold, make sure hose support is in end of the hose.



1. Hose support DSC00291

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.

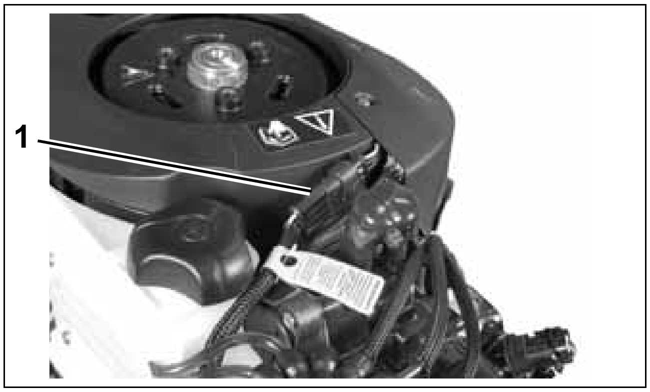
Oil Tank Assembly

Removal

Disconnect the battery cables at the battery.

Remove engine covers and air silencer.

Disconnect the electrical connector to the oil injection pump and manifold assembly.

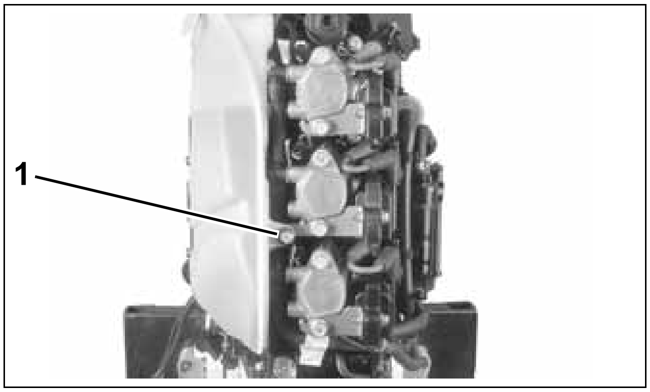


1. *Oil pump connector* 006776

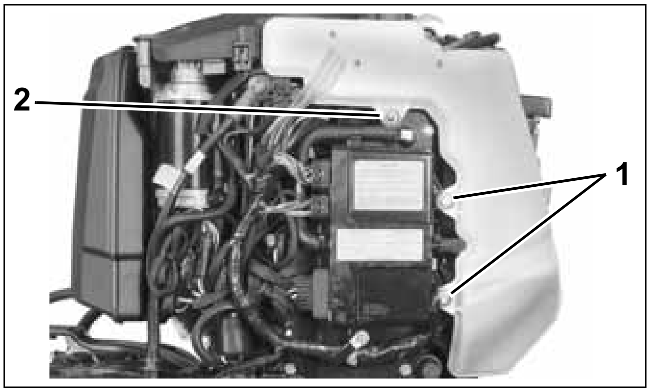
IMPORTANT: Note oil distribution hose routings before proceeding with disassembly.

Remove oil distribution hoses from the crankcase fittings.

Remove oil tank retaining screws and nut.



1. *Screw* 006777

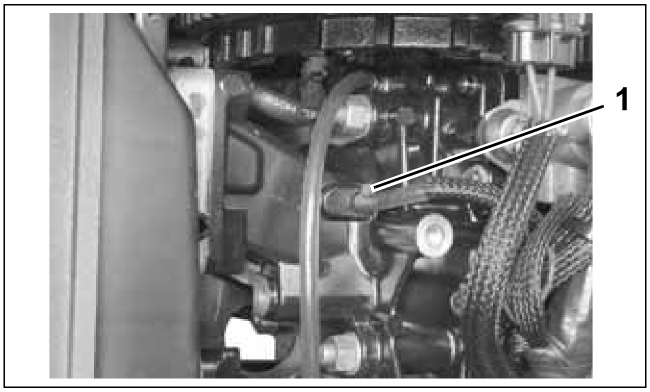


1. *Screws* 006778
2. *Nut*

Installation

Position oil tank assembly on powerhead. Clean mounting screws and apply *Nut Lock* to threads. Install screws and tighten to a torque of 30 to 42 in. lbs. (3.5 to 5 N·m). Install nut and tighten to a torque of 30 to 42 in. lbs. (3.5 to 5 N·m).

Install protective sleeves and route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings. Refer to **OIL SUPPLY DIAGRAMS** on p. 177. Secure oil hoses to crankcase fittings with tie straps.



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.

NOTES

Technician's Notes

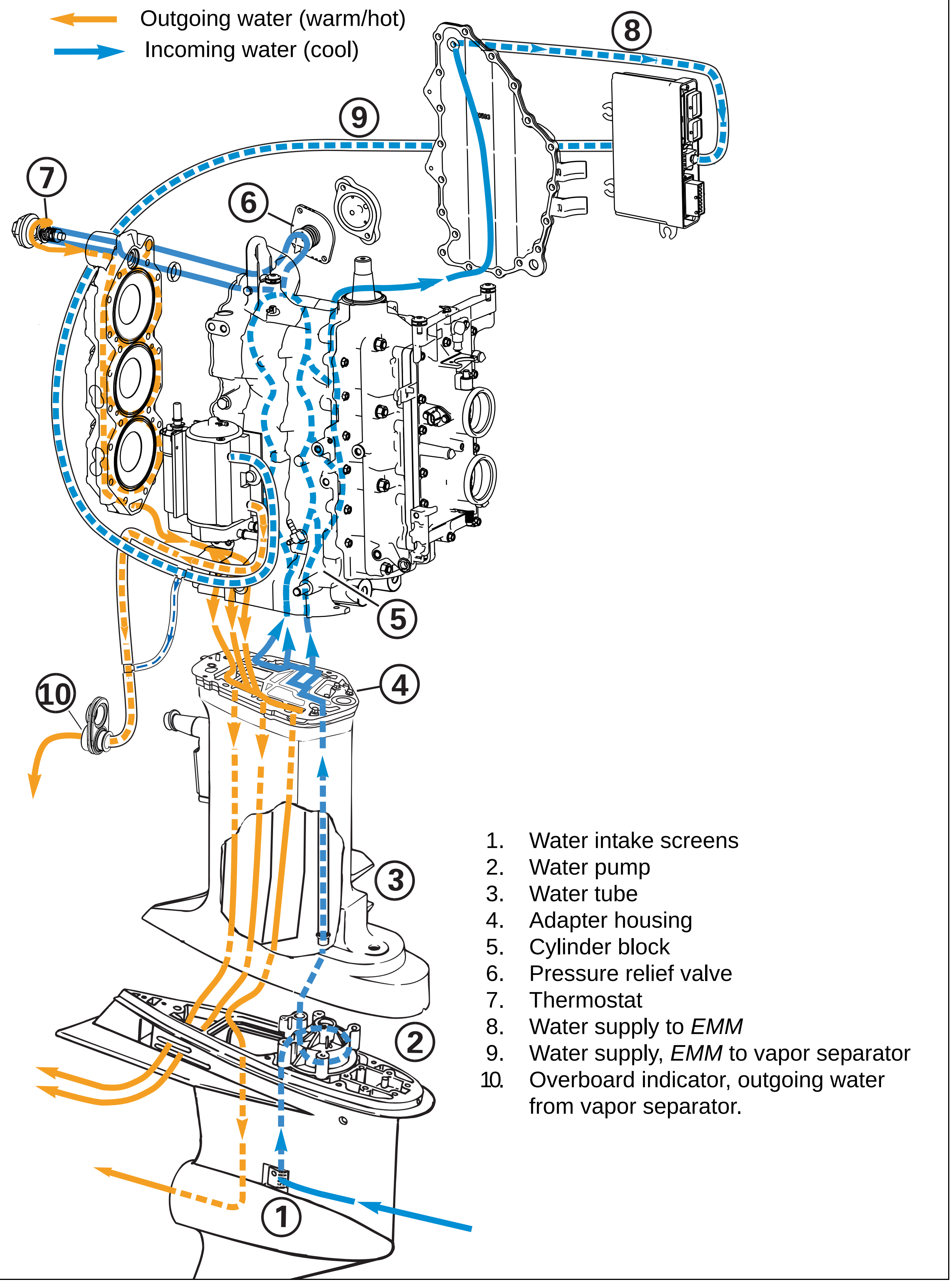
Related Documents

Bulletins	
Instruction Sheets	
Other	

COOLING SYSTEM

TABLE OF CONTENTS

HOSE ROUTING AND WATER FLOW DIAGRAM



1. Water intake screens
2. Water pump
3. Water tube
4. Adapter housing
5. Cylinder block
6. Pressure relief valve
7. Thermostat
8. Water supply to *EMM*
9. Water supply, *EMM* to vapor separator
10. Overboard indicator, outgoing water from vapor separator.

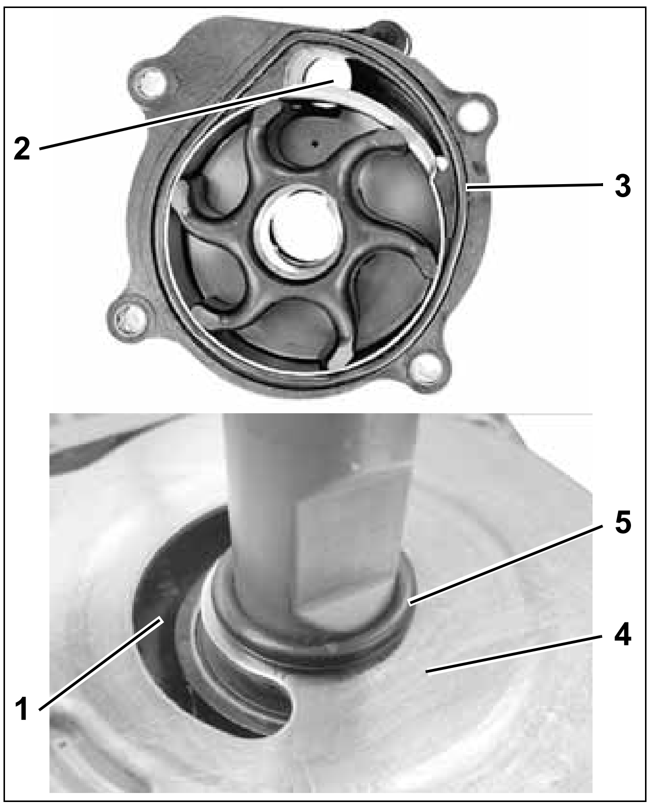
COMPONENTS

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. 263 for servicing.



1. *Water inlet* 000697
2. *Water outlet* DSC02328
3. *Seal*
4. *Plate*
5. *O-ring*

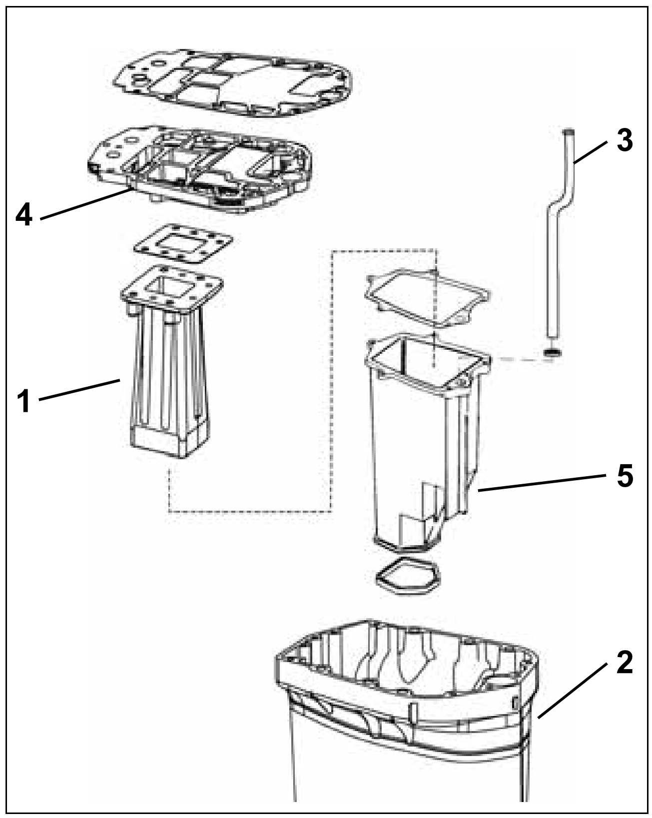
Water Supply Tube

The water pump outlet connects with the water supply tube located in the outboard's midsection. Grommets seal the water tube to the water pump housing and the adaptor housing. The water tube fastens to the base of the adapter housing with a retainer plate and screws.

Water supplied to the water tube provides all cooling water to the adapter housing and cylinder block.

Adapter/Inner Exhaust Housing

- Adapts the cylinder/crankcase assembly (powerhead) to the exhaust housing and the water tube.
- Provides water passages which route incoming and outgoing cooling water.
- Provides exhaust passages which connect to the gearcase.



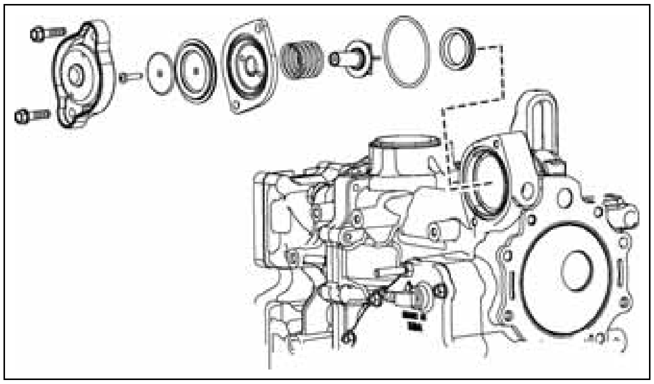
1. *Megaphone* 002436
2. *Exhaust housing*
3. *Water tube*
4. *Adapter housing*
5. *Inner exhaust housing*

Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 2000 RPM). The pressure relief valve opens as water pressure increases. Spring tension sets the opening pressure.

Overheating: A restricted or faulty valve typically results in HIGH SPEED overheating.

Overcooling: Debris may prevent the valve from closing completely.



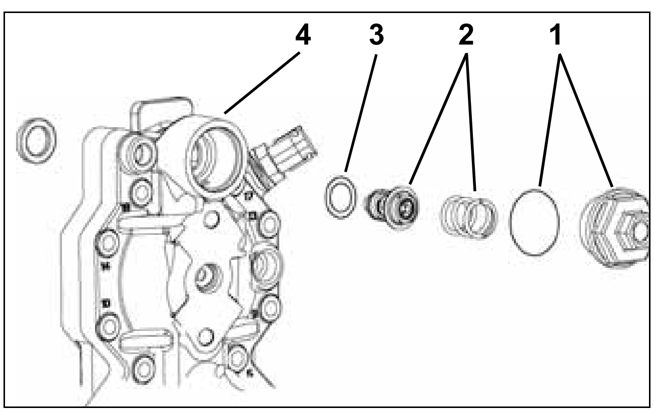
Pressure relief valve components 002437

Thermostat

The thermostat controls water flow and operating temperature at lower speeds (below 2000 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

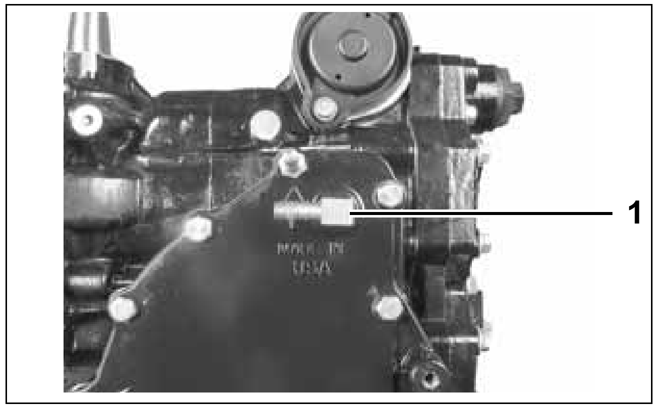
Overcooling: Debris may prevent the thermostat from closing completely.



1. *Cover and O-ring* 002439
2. *Spring and thermostat*
3. *Seal*
4. *Cylinder head*

Block Venting

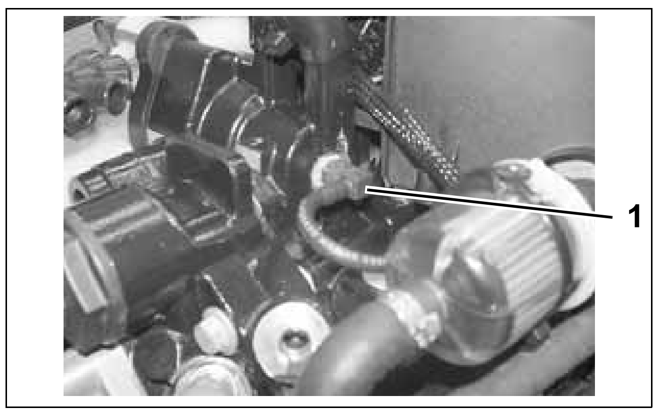
A fitting and hose connected to the top of the exhaust cover allows the constant movement of water and/or air from the block. Circulated water flows through the *EMM* and vapor separator before exiting through the overboard indicator.



1. *Fitting* 002440

Water Pressure Connection

A fitting and hose for an accessory water pressure gauge can be connected at the top of the cylinder block next to the pressure valve housing.



1. *Fitting* 002461

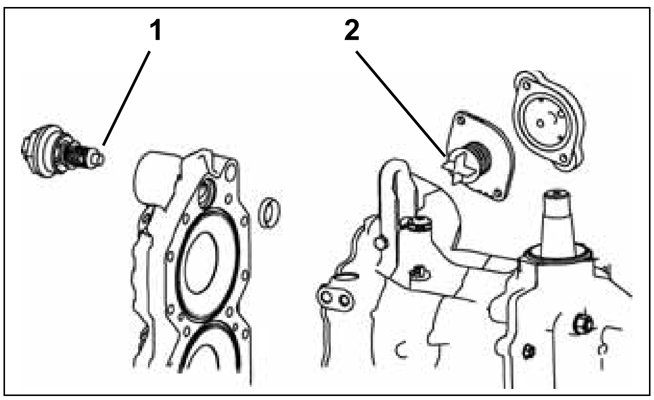
OPERATION

All models use a two-stage cooling system design. The cooling system is dependent on water pump pressure and controlled by thermostat and pressure valve operation.

IMPORTANT: Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cylinder block and cylinder heads is controlled by a thermostat and a pressure relief valve. The pressure valve is located in the top of the block next to the exhaust cover.



1. *Thermostat* 002441
2. *Pressure valve assembly*

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.

This pressure controlled water outlet circuit provides a “high flow” discharge of water during high speed operation.

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* 002457

10

ENGINE TEMPERATURE CHECK

IMPORTANT: The engine temperatures listed below are based on an intake water temperature of 70° ± 10°F (21° ± 3°C).

Install correct test propeller and place outboard in a test tank or in the water. Start outboard and run at 3000 RPM in FORWARD gear for at least five minutes. Remember, running outboards at high speeds in test tanks may disrupt water flow to gearcase water intakes. Make sure the outboard has adequate water flow.

⚠ 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.

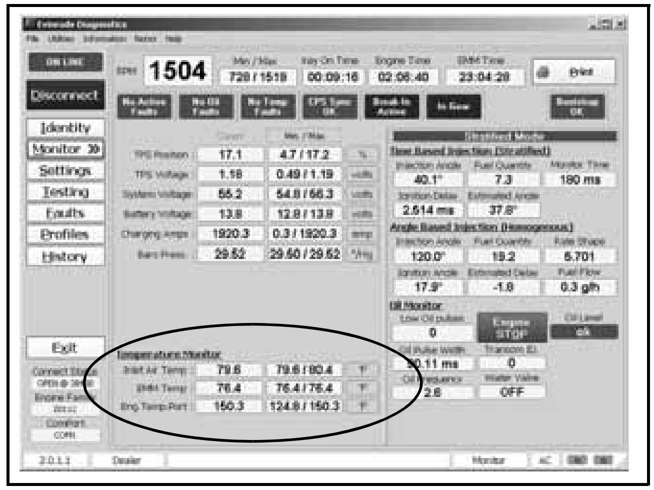
Increase speed to 5000 RPM and check temperature.

If engine temperature is not within range, troubleshoot cooling system.

If engine temperature tests within range, but the *SystemCheck* gauge indicates a “WATER TEMP” warning, refer to **WATER TEMP/ HOT Circuit Test** on p. 137.

Software Method

Use *Evinrude Diagnostics* software to read temperature displays.



Monitor Screen 006539

Typical temperature displays at IDLE speed should be 155°F ± 5°F (68.3°C ± 3°C).

Typical temperature displays at WOT speed should be 160°F ± 40°F (71°C ± 22°C).

Operating temperature must not exceed 212°F (100°C).

Pyrometer Method

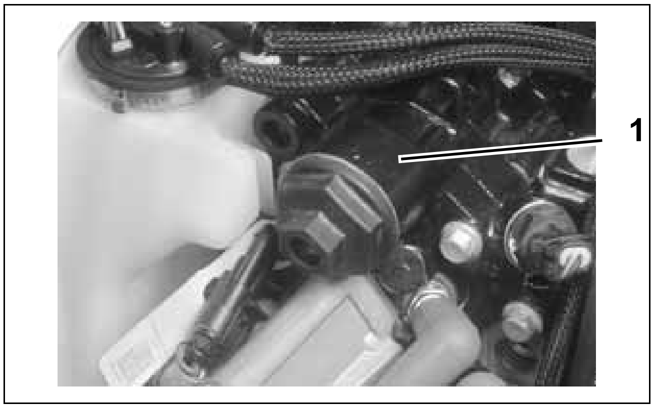
Use a Temperature Gun, P/N 772018, or a digital pyrometer to measure the outboard’s operating temperatures.

Measure temperature of the thermostat housing at the top of cylinder head.

Typical pyrometer readings at IDLE speed should be 145°F ± 10°F (63°C ± 6°C).

Typical pyrometer readings at WOT speed should be 150°F ± 40°F (66°C ± 22°C).

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 002438

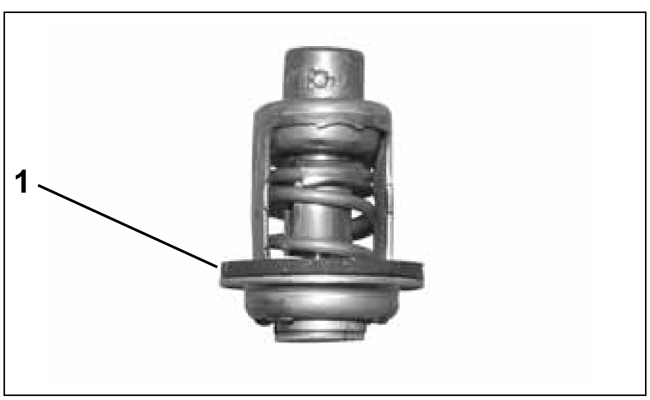
IMPORTANT: Digital pyrometer or temperature gun measurements may be slightly lower than software temperature readings.

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. 196.

Pressure Relief Valve Inspection

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

Start the outboard and check IDLE operating temperature.

If IDLE temperature is too low, check pressure relief valve plunger and seal for damage or debris that could prevent the valve from closing completely.

If IDLE temperature is still below operating range, replace pressure relief valve assembly and plunger seal.

To test pressure relief valve operation, monitor temperature at the thermostat housing with Temperature Gun, P/N 772018, or digital pyrometer.

Confirm normal IDLE operating temperature.

Slowly increase engine speed from IDLE, up through 2500 RPM.

Engine temperature should decrease from normal IDLE temperatures as pressure relief valve opens. Valve should open between 1800-2200 RPM.

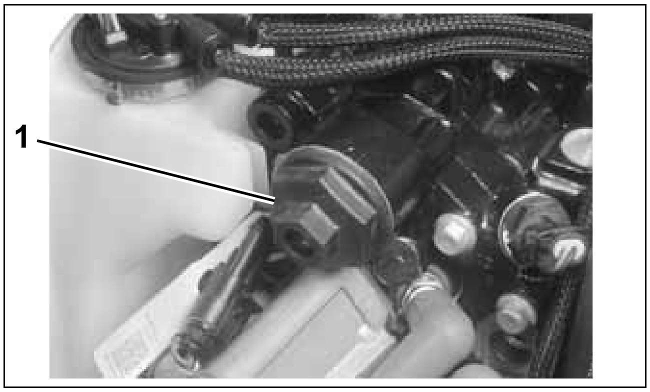
If temperature decreases at a lower RPM, replace pressure relief valve assembly.

Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 197.

THERMOSTAT SERVICING

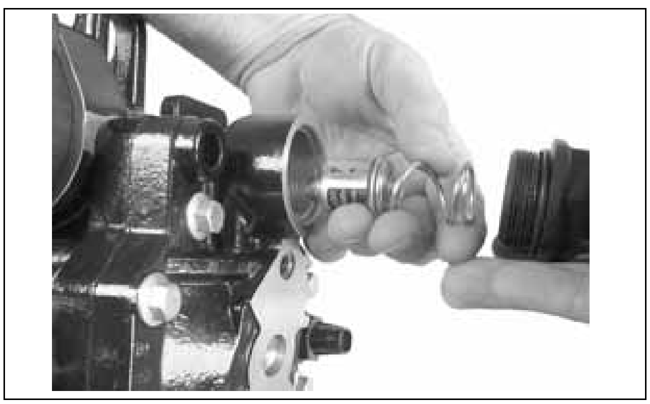
Disassembly

Remove the thermostat cover and O-ring from cylinder head.



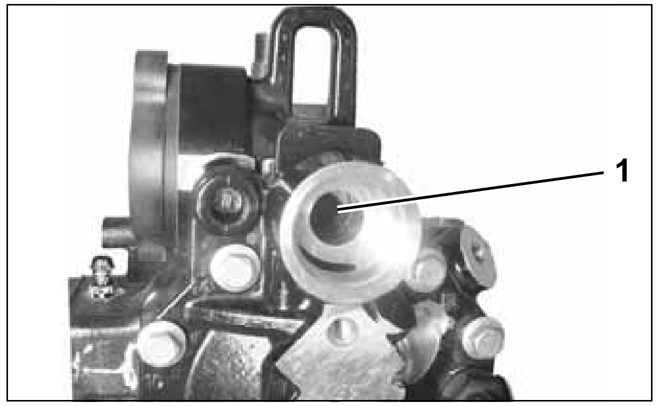
006616

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. 217.

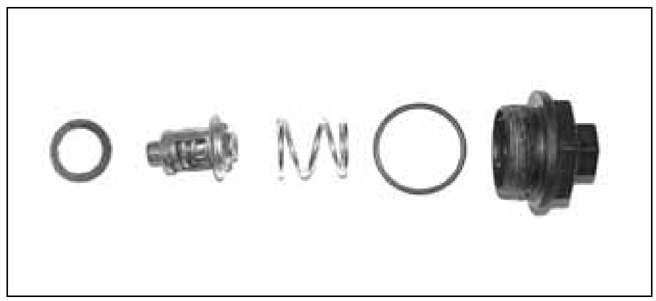


1. *Cylinder head seal*

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.

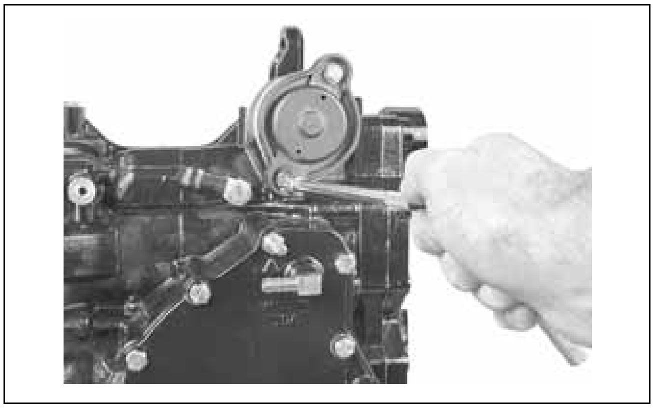
Coat threads of thermostat cover with *Gasket Sealing Compound* and install new O-ring. Install and tighten cover to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).

PRESSURE RELIEF VALVE SERVICING

The pressure relief valve assembly should be serviced at the same time as the thermostat.

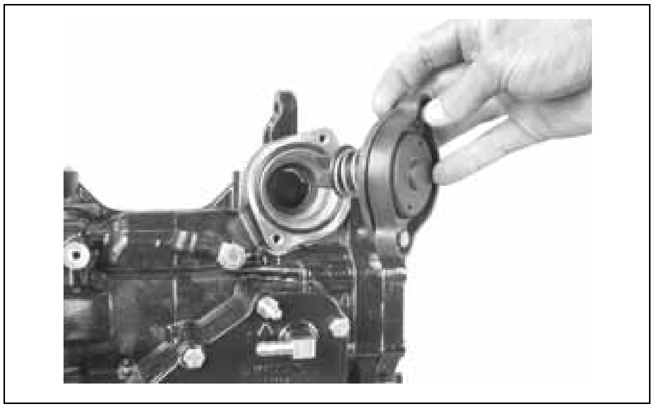
Disassembly

Remove screws and cover from pressure valve assembly.



002443

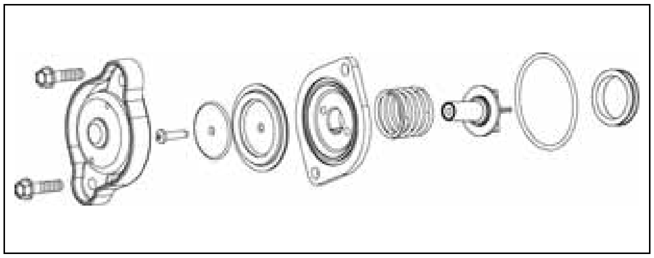
Remove the pressure relief valve assembly.



002459

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Replace damaged parts. Clean debris from housing and parts.



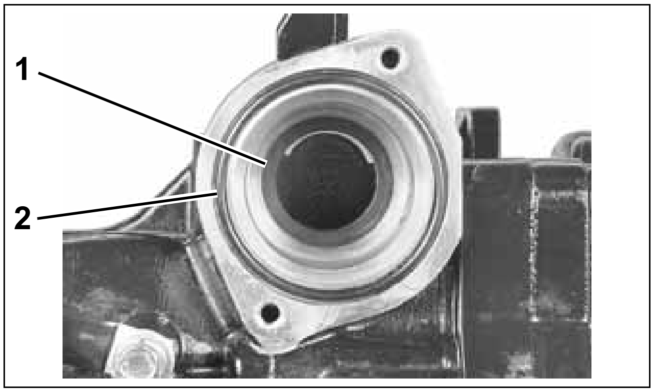
Pressure relief valve assembly components 002442

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).

NOTES

Technician's Notes

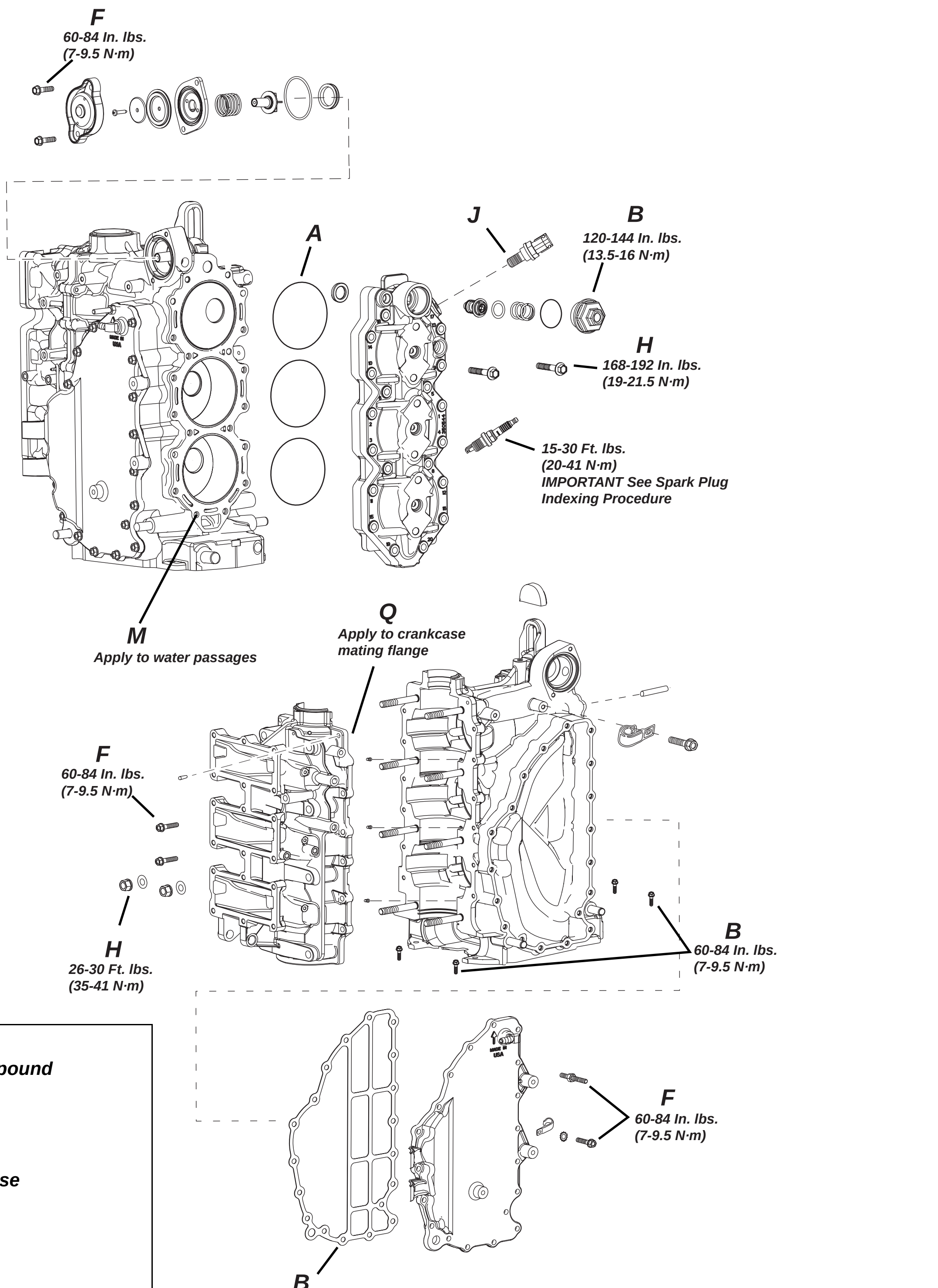
Related Documents

Bulletins	
Instruction Sheets	
Other	

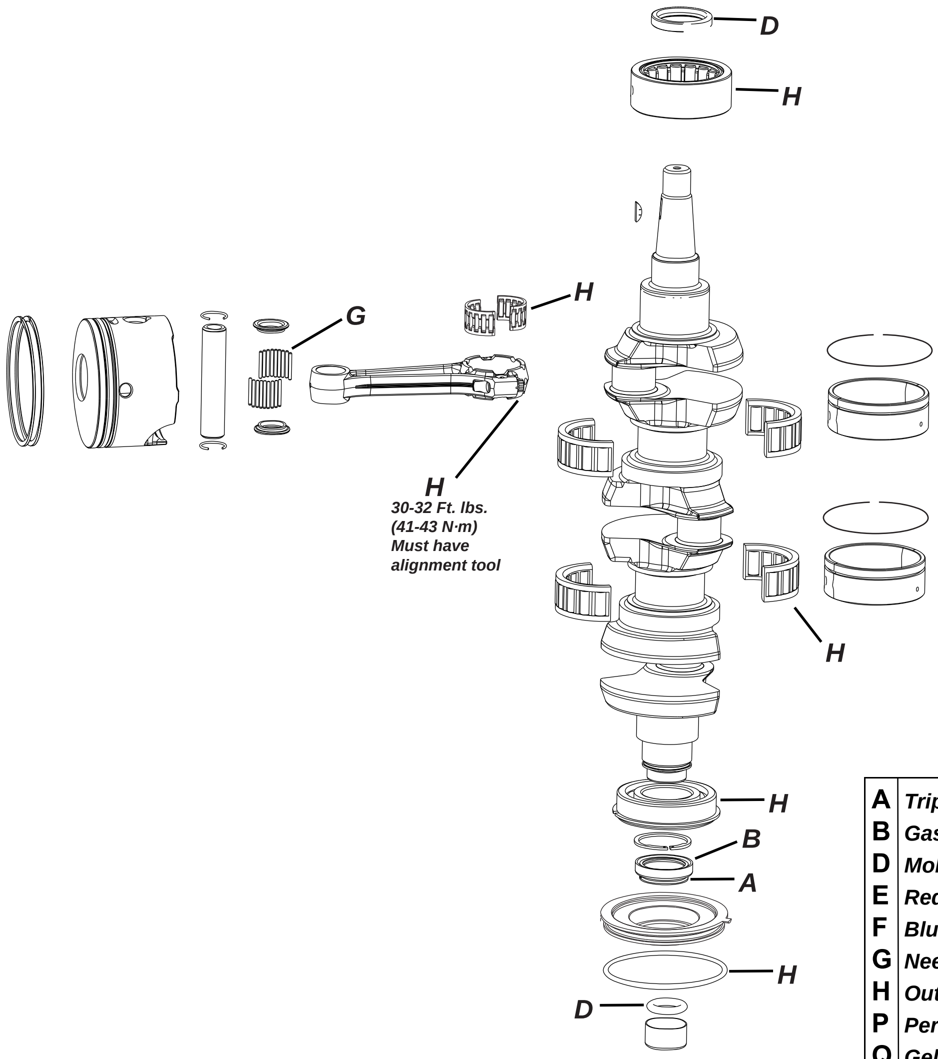
POWERHEAD

TABLE OF CONTENTS

SERVICE CHART



A	*Triple-Guard Grease*
B	*Gasket Sealing Compound*
D	*Moly Lube*
E	*Red Ultra Lock*
F	*Blue Nut Lock*
G	*Needle Bearing Grease*
H	*Outboard Lubricant*
J	*Thermal Grease*
M	*RTV Sealant*
P	*Permatex No. 2*
Q	*Gel Seal II*
Y	*Extreme Pressure Grease*



A	*Triple-Guard Grease*
B	*Gasket Sealing Compound*
D	*Moly Lube*
E	*Red Ultra Lock*
F	*Blue Nut Lock*
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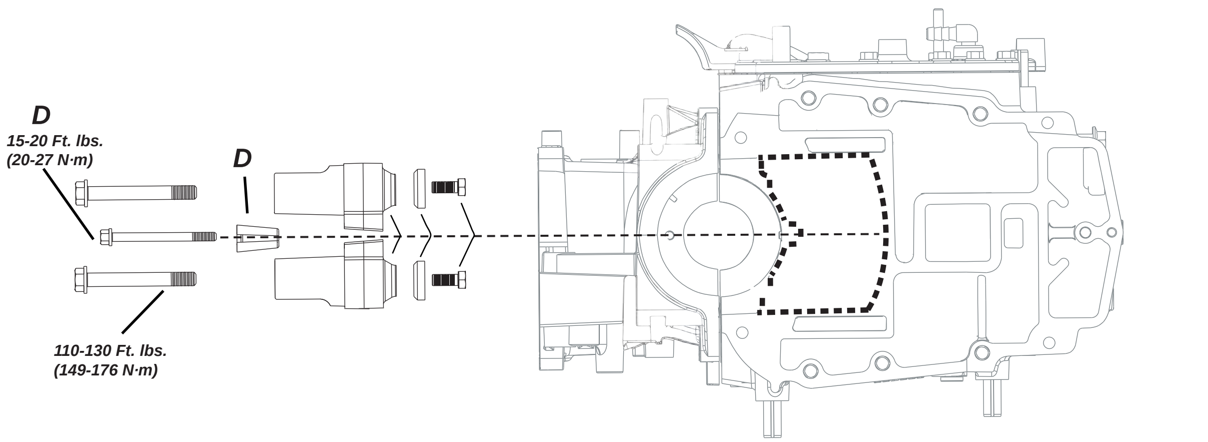


002282

POWERHEAD REMOVAL

⚠ WARNING ⚠

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

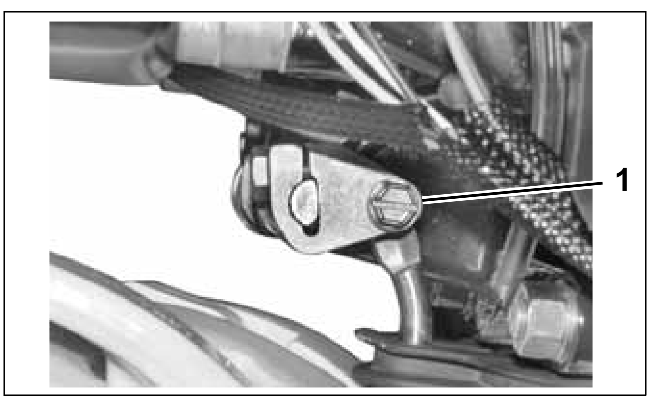
To prevent accidental starting while servicing, disconnect the battery cables at the battery.

Remove lower motor covers. **Lower Cover Removal** on p. 82.

Disconnect power trim connectors.

002152

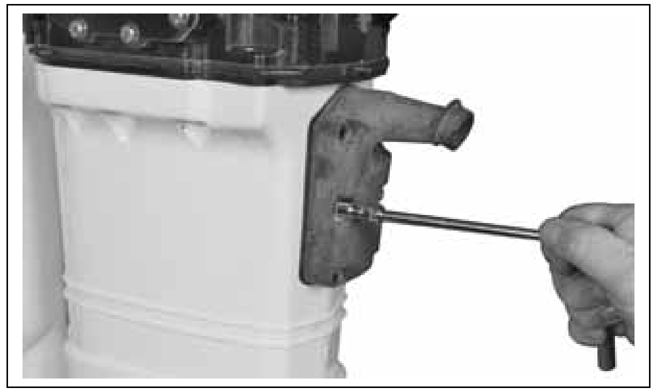
Remove pin and washer from shift rod lever to release the lower shift rod.



1. *Shift rod screw*

002013

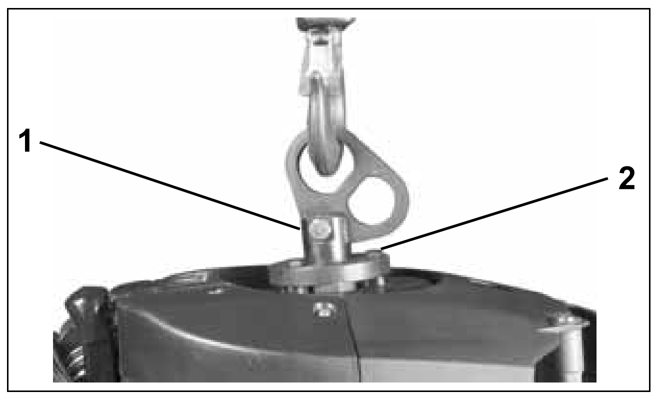
Remove six retaining screws and exhaust relief muffler.



002159

Install Lifting Fixture, P/N 396748, on flywheel and seat the three screws completely.

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

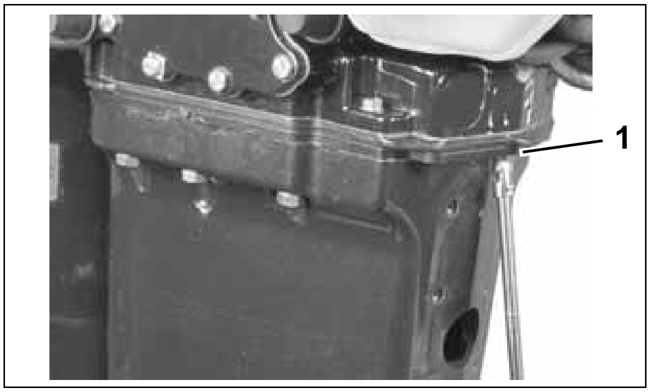


1. *Lifting fixture*
2. *1 1/8 in. screws*

002098

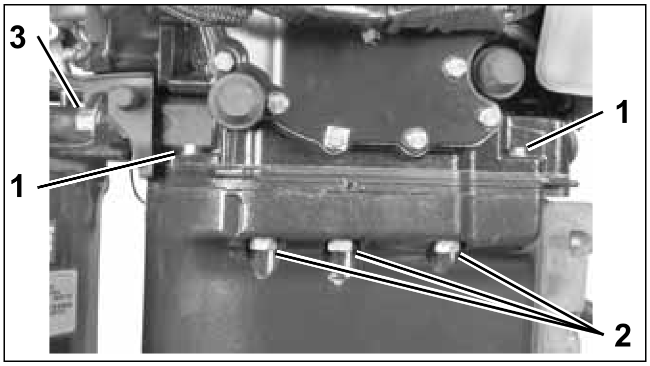
Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.

Remove the small powerhead screw at rear.



1. *Rear small powerhead screw* 002160

Remove remaining four small powerhead screws, six large powerhead screws, and the upper mount screws.



1. *Small powerhead screws* 002153
2. *Large powerhead screws*
3. *Upper mount screws*

Use a suitable tool to carefully separate the powerhead from exhaust housing.

002161

IMPORTANT: Do not damage the powerhead or exhaust housing mating surfaces.

POWERHEAD DISASSEMBLY

General

To simplify reassembly and wiring installation, lay out the various screws and clamps in the order of their proper location.

Remove the electric starter. Refer to **Starter Removal** on p. 144.

Remove the oil tank. Refer to **Oil Tank Assembly** on p. 187.

Remove fuel pump assemblies, fuel manifolds, and filter. Refer to **FUEL COMPONENT SERVICING** on p. 166.

Remove *EMM* and electrical harness assembly. Refer to **EMM SERVICING** on p. 102.

Remove flywheel and stator. Refer to **FLYWHEEL AND STATOR SERVICING** on p. 139.

Remove ignition coils and fuel injectors. Refer to **Fuel Injector Service** on p. 169.

IMPORTANT: Mark injectors for cylinder location before removal. All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Remove throttle linkage. Refer to **Throttle Linkage Removal** on p. 204.

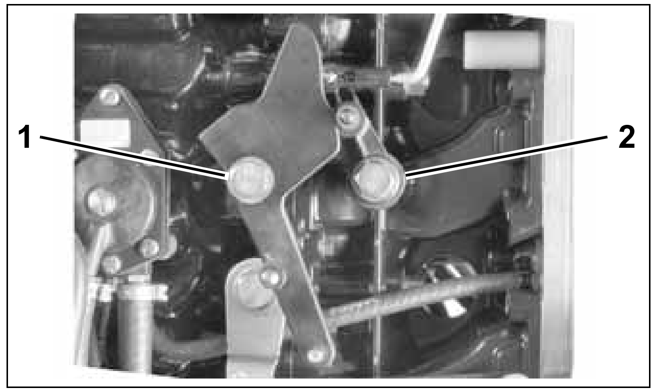
Remove shift linkage. Refer to **Shift Linkage Removal** on p. 204.

Remove the throttle body and reed plate assemblies. Refer to **Intake Manifold Service** on p. 172.

Remove pressure valve assembly. Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 197.

Throttle Linkage Removal

Remove throttle cam and throttle lever.

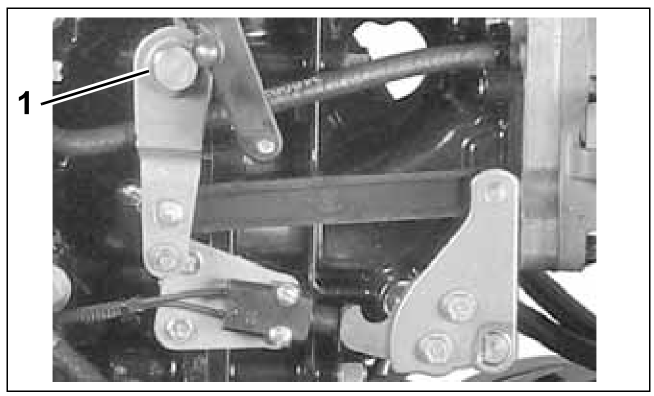


1. *Throttle cam screw*
2. *Throttle lever screw*

002257

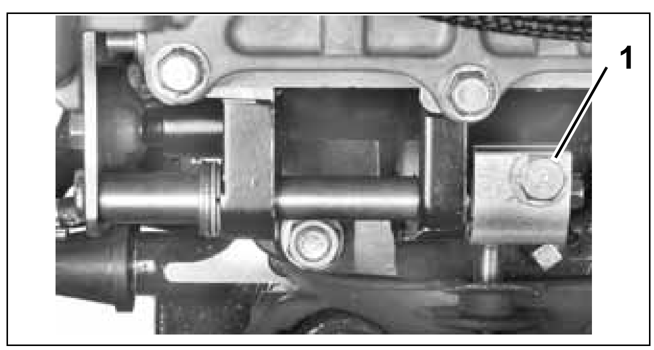
Shift Linkage Removal

Remove shoulder screw from shift arm and retaining screw from shift rod lever.



1. *Shift lever screw*

002126

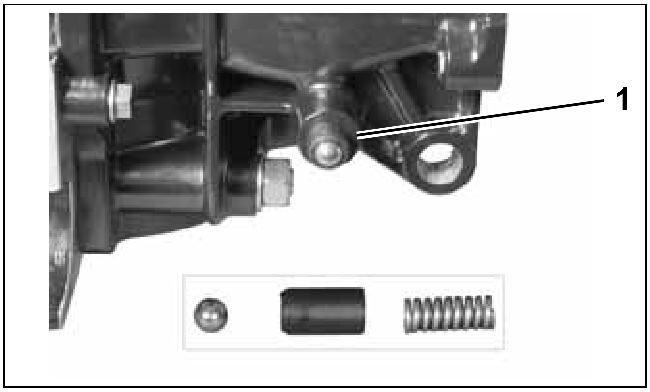


1. *Shift rod lever screw*

002127

Slide entire shift linkage assembly from crankcase.

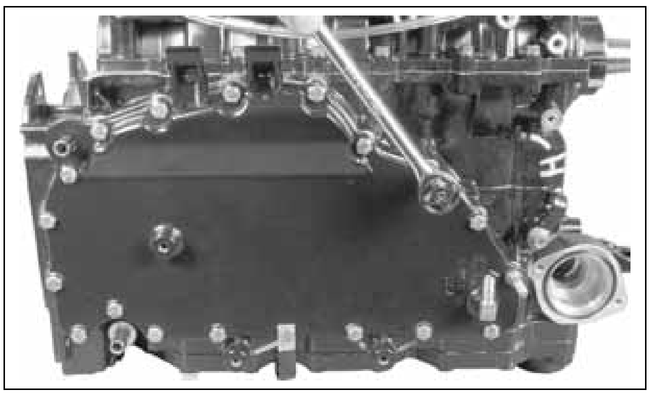
Remove the ball, guide, and spring of the shift detent assembly from the crankcase.



1. *Shift detent assembly* 002135

Crankcase Disassembly

Remove screws, double-ended stud, and exhaust side water cover.

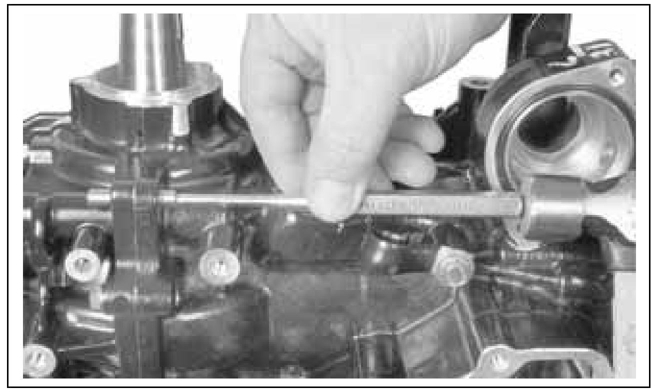


002124

⚠ WARNING ⚠
Wear safety glasses to avoid injury.

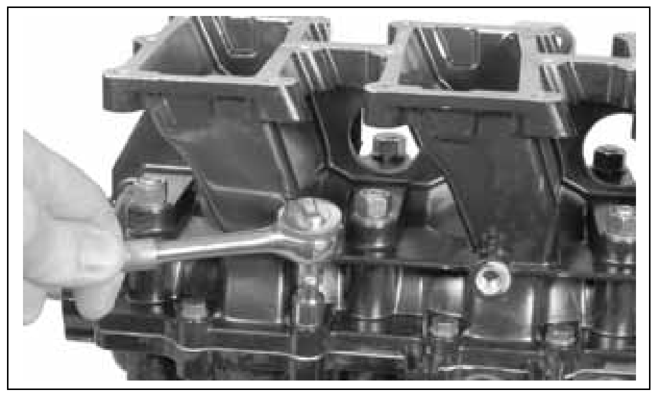
Use a 1/8 in. diameter pin punch to push crankcase taper pin toward the front side of the engine.

IMPORTANT: Do not use a tapered punch or any other tool that could jam in or damage the taper bore when removing the pin.



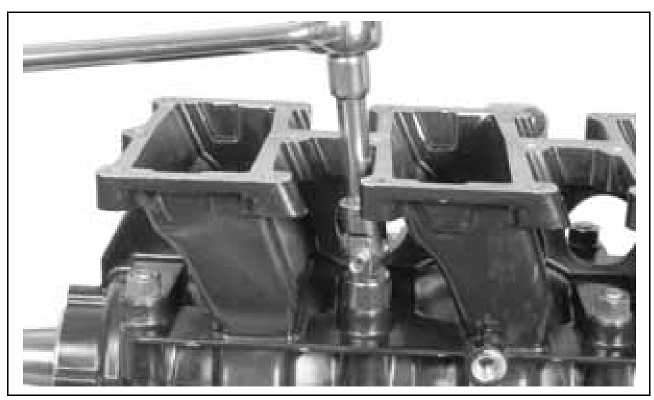
002136

Remove crankcase flange screws.



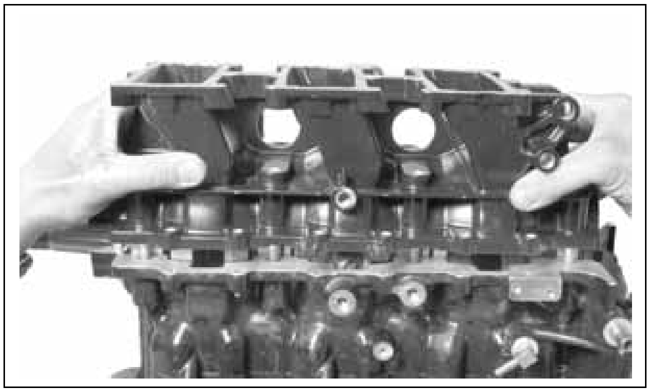
002137

Loosen **in stages** and remove the main bearing nuts and washers.



002138

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.

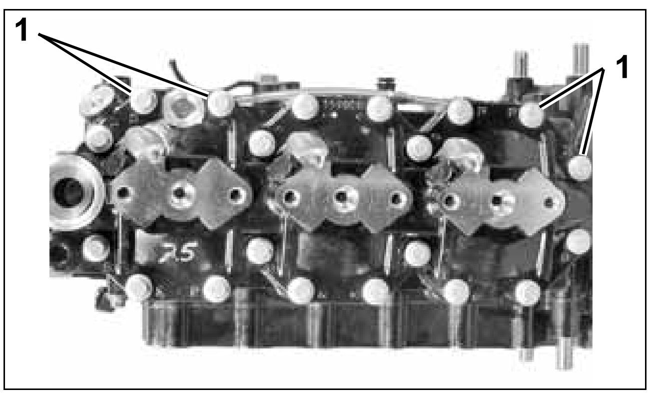


002139

Cylinder Head Removal

Remove thermostat cover and thermostat assembly. Refer to **THERMOSTAT SERVICING** on p. 196.

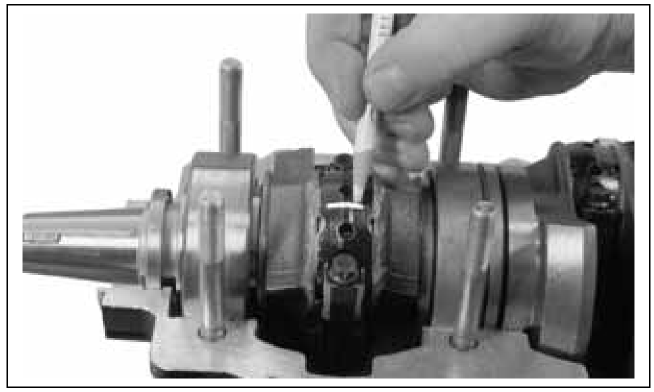
Loosen **in stages** and remove cylinder head retaining screws. Remove the cylinder head. Discard thermostat seal and O-rings.



1. Cylinder head screws (20 total) 002066

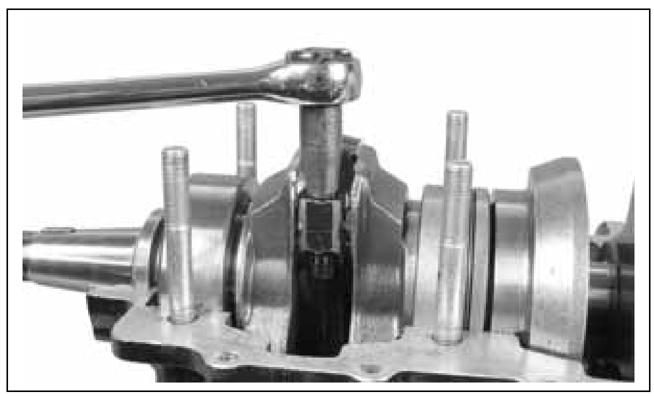
Connecting Rods and Pistons

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the flywheel.



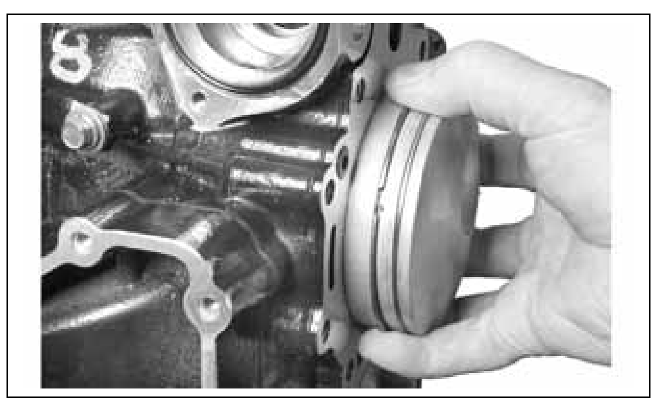
002140

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

IMPORTANT: Reattach each rod cap to its rod as soon as the piston is removed. Each cap is unique and can only be installed on its mated rod. Do not allow rod to contact inside surface of cylinder or crankshaft.

IMPORTANT: Identify all internal components so that if reused, they can be reinstalled in their original positions.

Repeat steps for each remaining piston and connecting rod.

Use an appropriate ring expander to remove all piston rings from pistons. Discard the rings.

WARNING

Wear safety glasses to avoid injury.

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 bearing.

002047

Be careful not to lose any of the 28 needle bearings or the two wrist pin washers. If any of the bearings are worn or lost, replace all 28 bearings during reassembly.

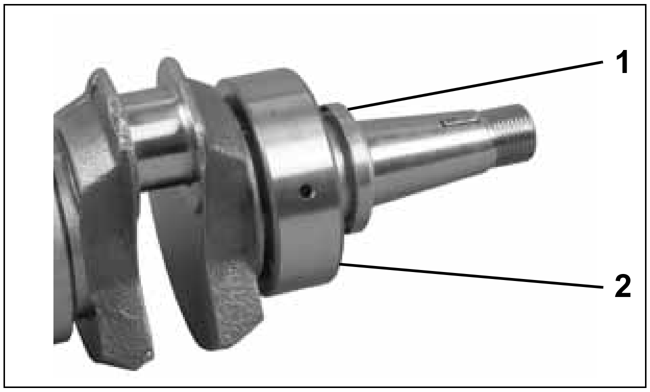
Crankshaft Removal

Carefully lift crankshaft straight up and remove from crankcase.

002045

Remove upper seal from crankshaft. Discard the seal. A new upper seal must be installed on assembly.

Remove the upper main bearing.



1. *Upper oil seal*
2. *Upper main bearing*

002034

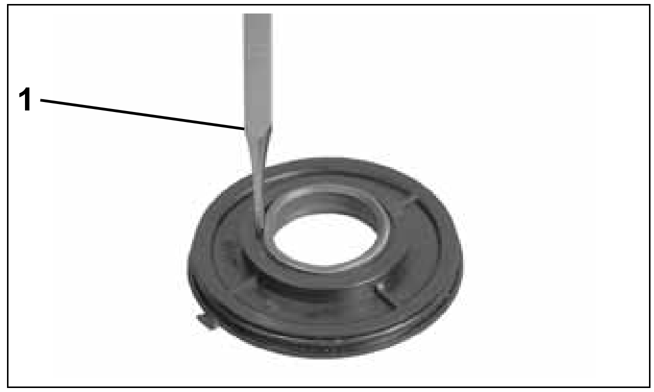
Remove the lower bearing seal housing.

002042

Remove the housing O-ring. Discard O-ring.

002044

Use a punch to remove the housing seal. Discard seal.



1. *Punch*

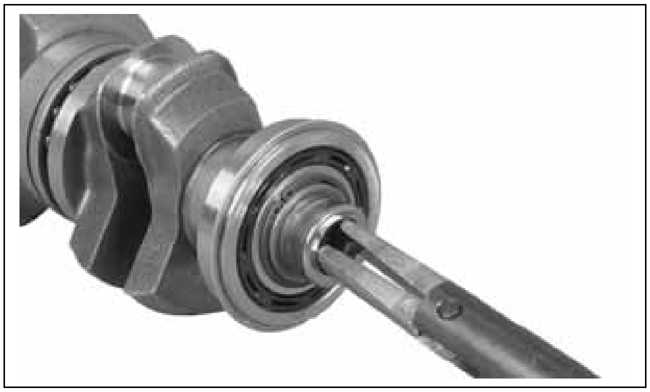
002053

Inspect housing and replace if necessary.

Remove O-ring from crankshaft sleeve and inspect it. Replace the O-ring if it is not in good condition.

002040

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.



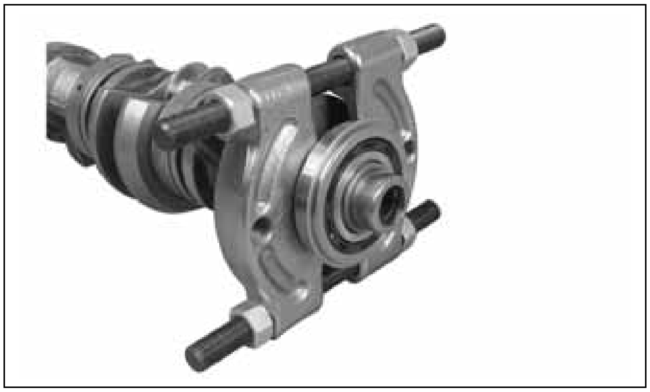
002041

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

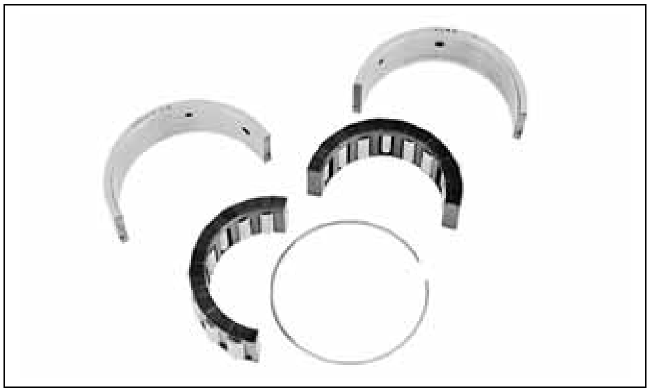
IMPORTANT: If the lower main bearing is removed from the crankshaft, it must be discarded. DO NOT reuse it.

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

11

CYLINDER BLOCK CLEANING

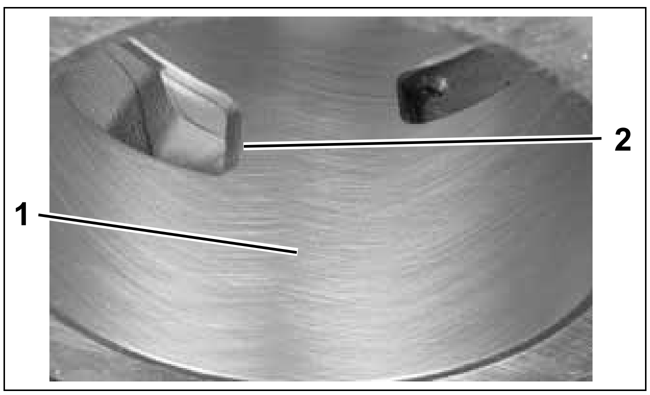
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants.

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylinder head combustion chambers.

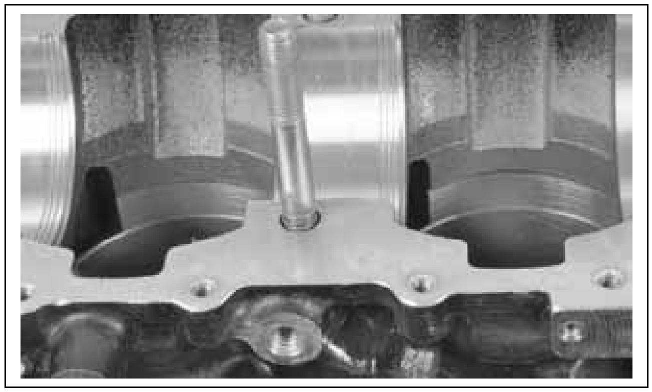
If cylinder walls are glazed from extended use, use a rigid, medium grit cylinder hone to resurface walls. Use slow RPM for best oil retention and ring sealing. When finished, a cross hatch pattern of 22 to 32° should be visible in the cylinder wall. The pattern should be uniform in both directions.

IMPORTANT: To avoid piston or cylinder block damage, restore the chamfer to all port edges using a ball hone or other suitable tool.



1. *Crosshatch pattern in cylinder wall* 002067
2. *Chamfered port edge*

Use *Gel Seal and Gasket Remover* to remove all traces of gaskets, adhesives, and *Gel-Seal II*™ sealant from the cylinder block and crankcase.



002068

WARNING

To avoid personal injury, wear eye protection and rubber gloves when using *Gel Seal and Gasket Remover*.

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.

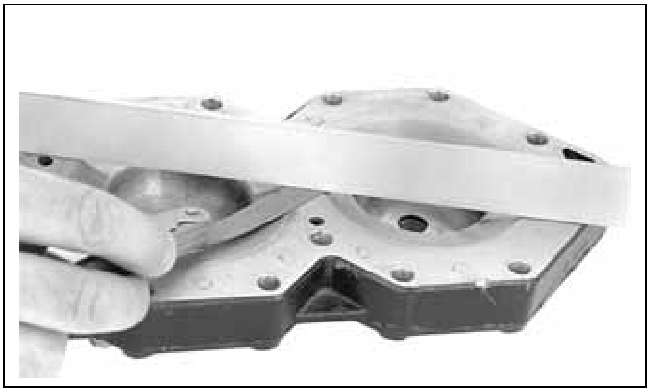
IMPORTANT: Before any inspection process can begin, all internal components must be completely clean and free of contaminants.

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.

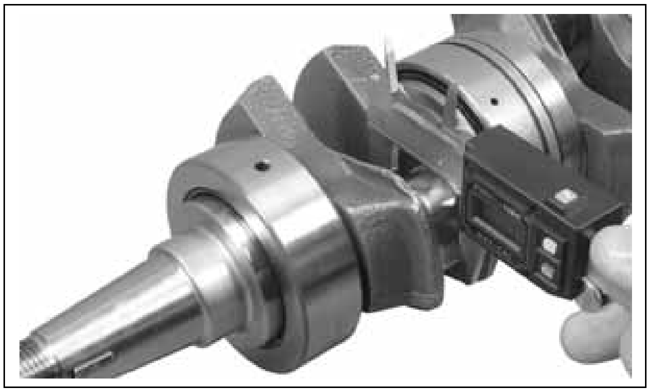
Cylinder head warpage must not exceed 0.006 in. (0.15 mm) per inch of measurement. Replace head if warpage exceeds this dimension.



24423

Crankshaft

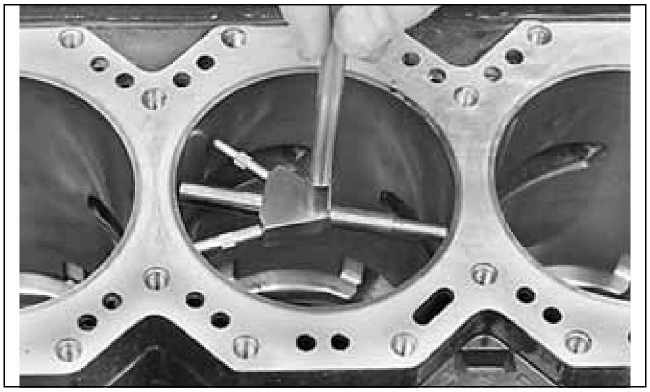
Measure the diameter of each crankpin and main bearing journal. The lower main bearing journal would only be measured if the bearing was removed for another reason.



002142

Cylinder Bore

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



Measure as shown 46528

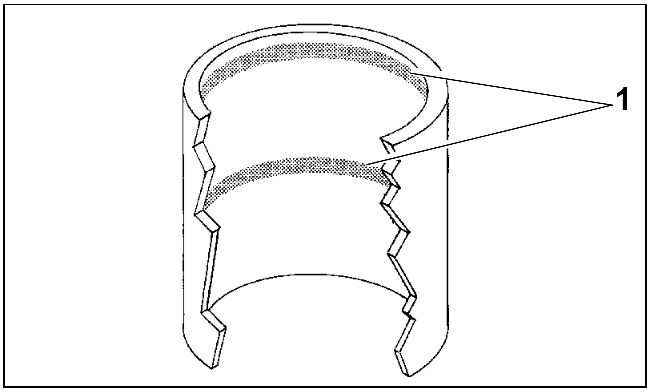
Measure each cylinder in at least two areas. Each area should be measured twice. The difference between the two measurements in each area is the cylinder out-of-round dimension.

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

11

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.

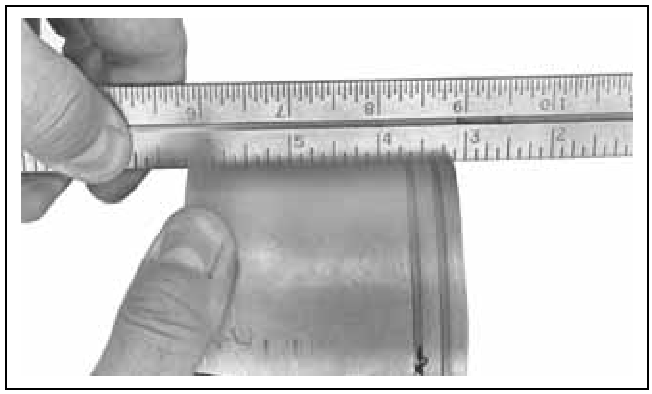
002143

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.

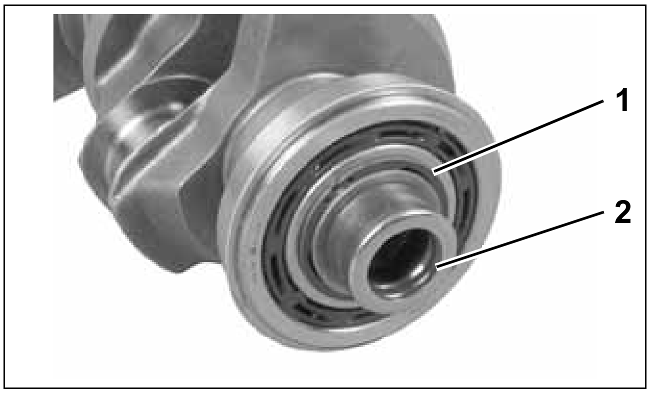
002030

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.

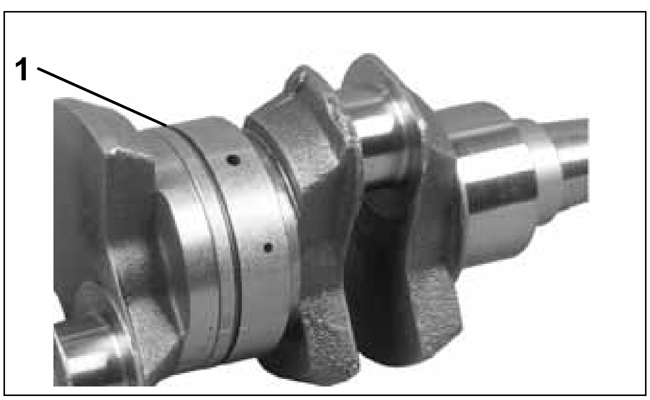
Use retaining ring pliers to install bearing retaining ring with sharp edge facing away from bearing.

Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with *Moly Lube*. Install O-ring in sleeve.



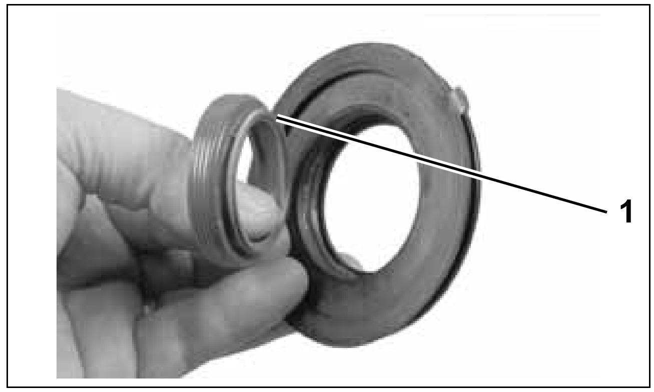
1. *Bearing retaining ring* 002031
2. *O-ring*

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.

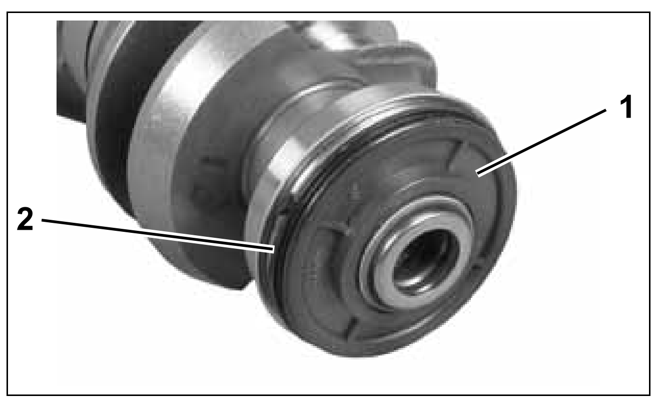


1. *Seal lip* 002036

002037

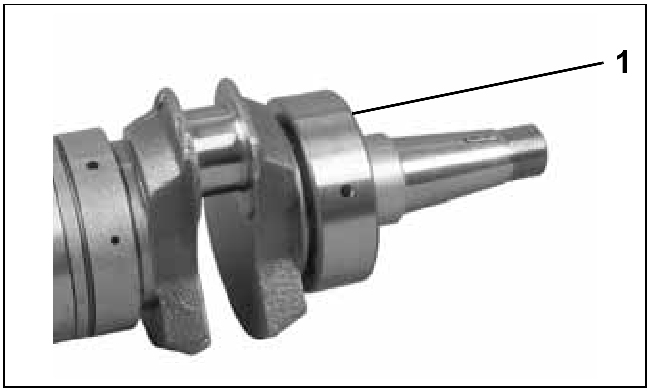
Install a new O-ring on the lower housing. Before installing crankshaft into cylinder block, apply a thin coat of *Gasket Sealing Compound* to outer edge of O-ring.

Place lower seal housing on crankshaft.



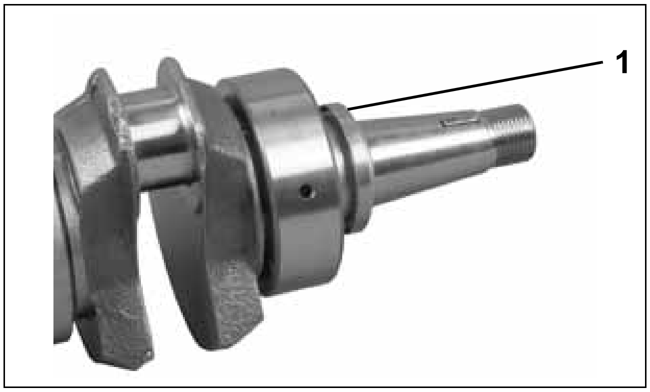
1. *Lower seal housing* 002038
2. *O-ring*

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 toward driveshaft and enclosed face toward flywheel. Do not apply sealer to outside edge of the seal.

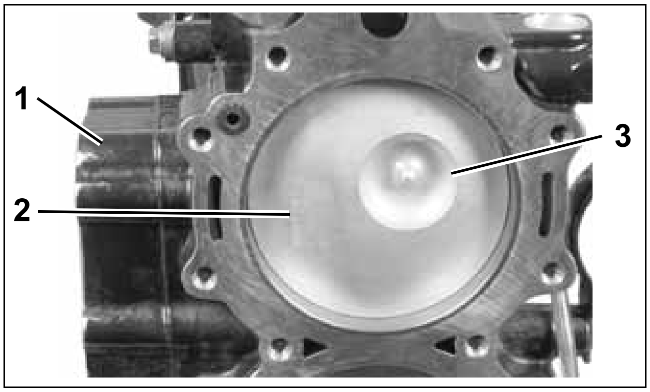


1. *Upper oil seal* 002034

Pistons and Connecting Rods

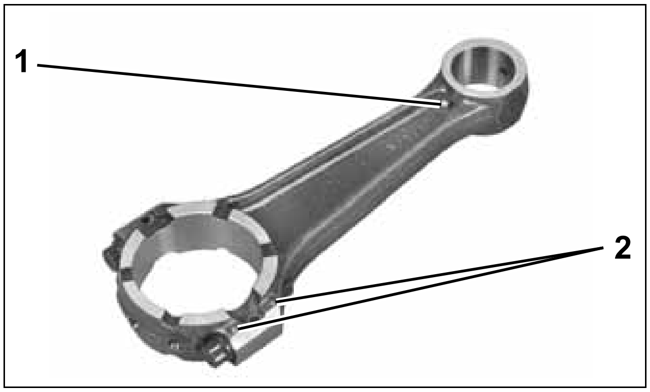
IMPORTANT: It is very important that the pistons in this engine are installed in the correct location and direction.

New pistons are stamped "EXH." This marking should be turned toward the exhaust side of the block. The splash bowl on the dome of the piston will be located toward the flywheel and opposite the exhaust port.



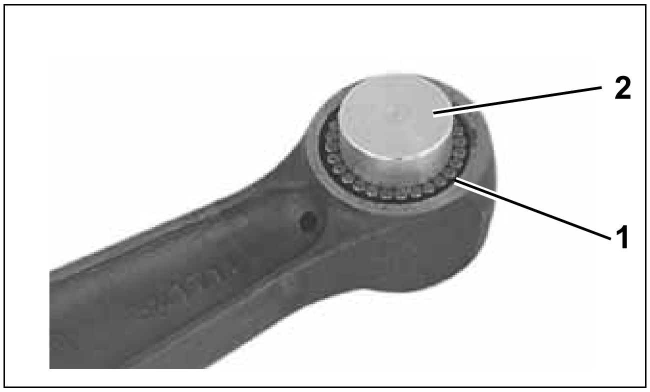
1. *Exhaust side of block* 002049
2. *Stamped markings*
3. *Splash bowl*

IMPORTANT: It is also very important that the connecting rods are installed with the alignment dots and the diagonal oil hole facing up, toward the flywheel.



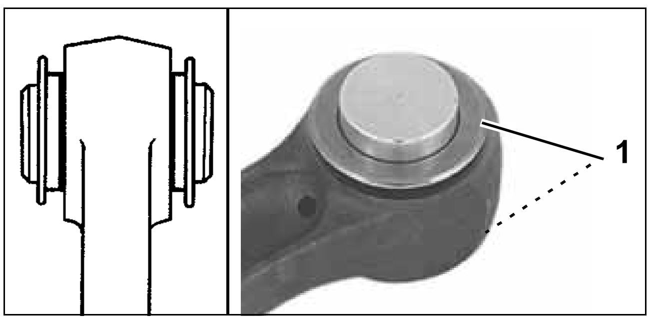
1. *Oil hole* 002055
2. *Raised dots*

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

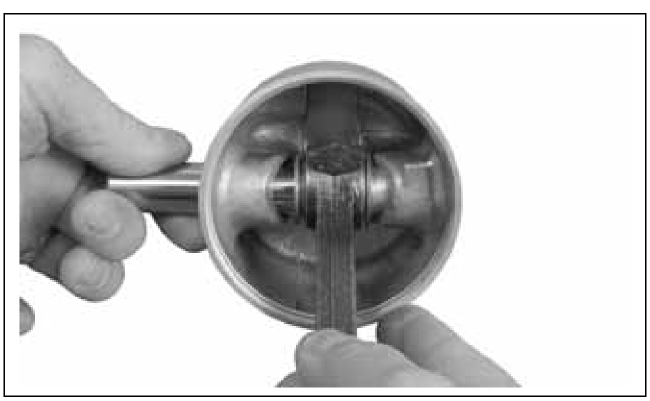
Place the two wrist pin thrust washers on the tool with flat side of the washers facing out.



1. Wrist pin thrust washers
DR3480
24902

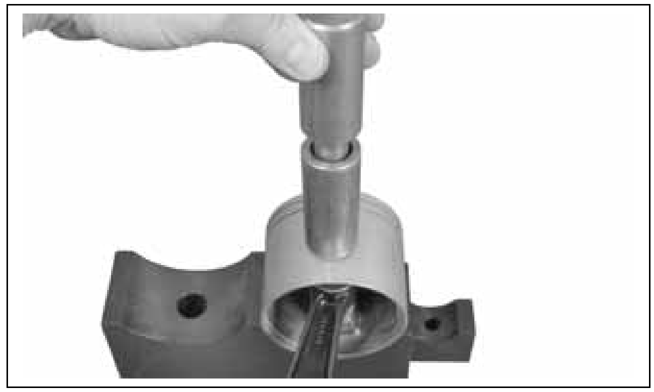
Oil the wrist pin bore and wrist pin. Place connecting rod, with bearings, washers, and tool, into the piston with the alignment dots facing the top of the piston.

Install wrist pin through piston and connecting rod, pushing bearing tool out through the piston.

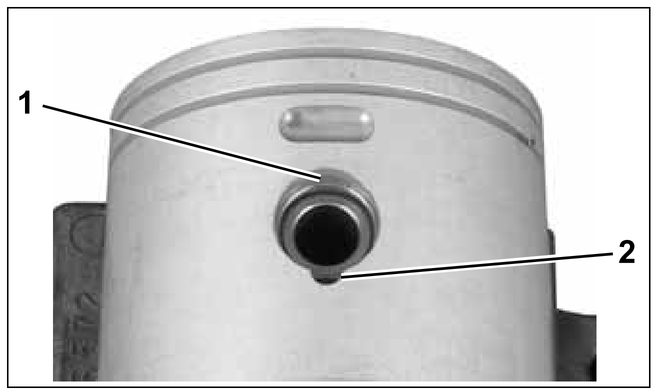


002057

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

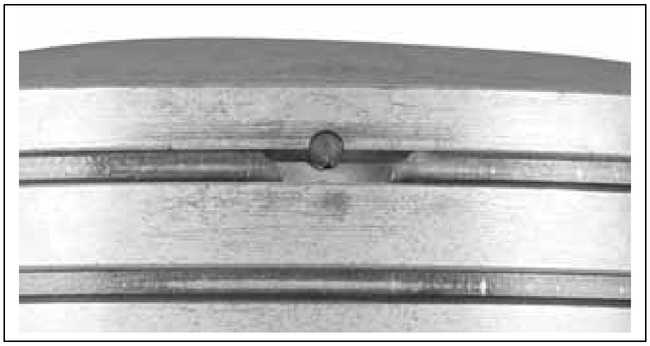


1. Gap of retaining ring
2. Notch in piston
002050

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. 211.

IMPORTANT: Be sure gap of ring fits squarely around dowel pin.



002048

IMPORTANT: Before continuing, make sure that all *Gel-Seal II* has been removed from the cylinder block and crankcase mating flanges. If traces of hardened *Gel-Seal II* are left, main bearings could be misaligned. Refer to **CYLINDER BLOCK CLEANING** on p. 210*.*

Coat pistons, rings, cylinder walls, and Ring Compressor, P/N 336314, with outboard lubricant.

Center connecting rod in piston and locate piston rings on dowel pins. Place appropriate ring compressor on piston.

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.

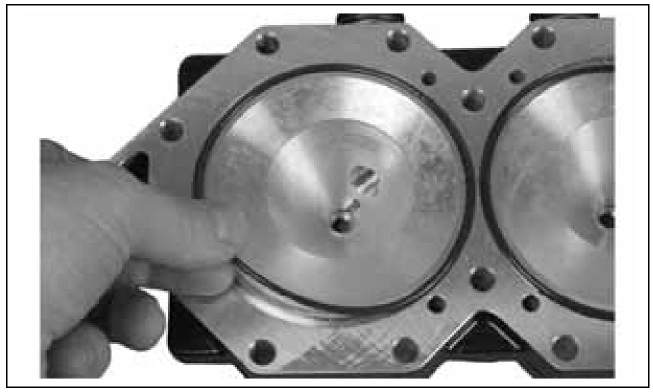
1. *Ring compressor* 002059

Cylinder Head Installation

Install a new thermostat seal in cylinder head with side marked “TO CYL HEAD” facing toward thermostat.

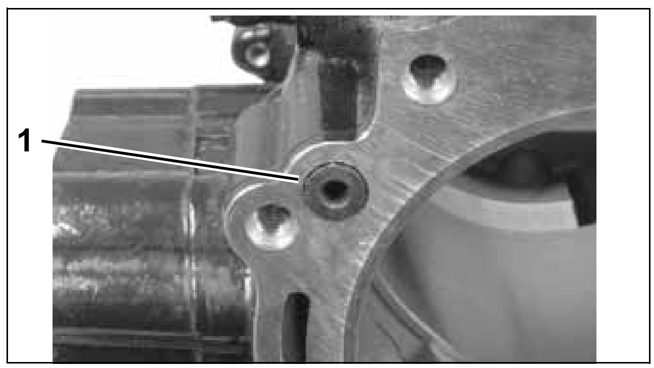
Refer to **THERMOSTAT SERVICING** on p. 196 before installing cylinder head.

Lightly lubricate new cylinder head O-rings with *Triple-Guard* grease and install in cylinder head.



002061

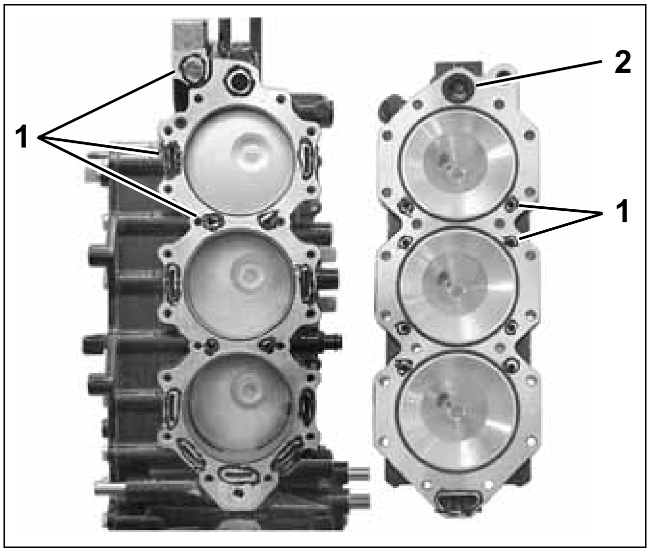
Apply soapy water to water dam and insert into block.



1. *Water dam* 002062

11

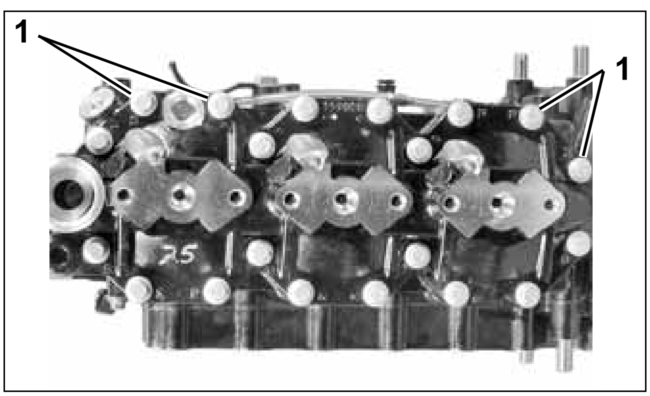
Apply a 1/16 in. (2 mm) bead of *RTV Adhesive* around each water passage on the block and cylinder head as shown. Apply adhesive with a brush around thermostat seat area on block.



1. *RTV adhesive* 002065
2. *Thermostat seal*

Install cylinder head with the thermostat toward the top. Apply outboard lubricant to threads and install the cylinder head screws. DO NOT use any sealant on threads

Following sequence on cylinder head, tighten all screws in stages to a torque of 168 to 192 in. lbs. (19 to 21.5 N·m).



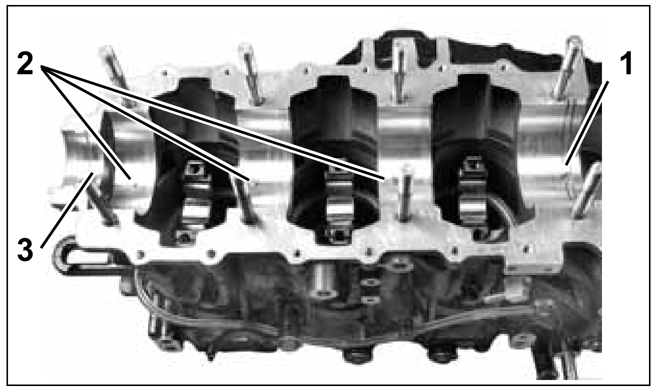
1. *Cylinder head screws (20 total)* 002066

Crankshaft and Connecting Rod Installation

Rotate cylinder block so crankcase mating flange is facing up.

Apply *Gasket Sealing Compound* to lower oil seal groove in cylinder block. DO NOT put any sealer in upper seal groove.

Check that main bearing alignment dowel pins are seated in the block.

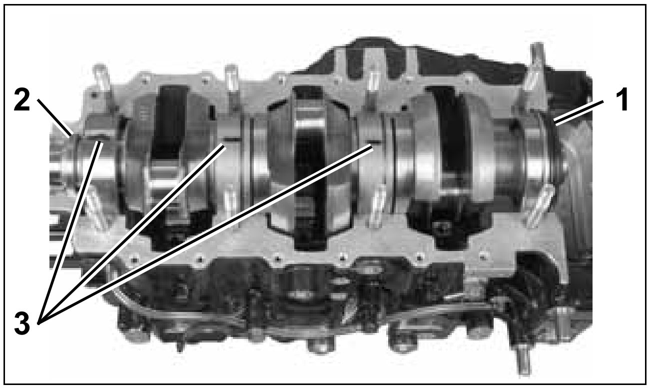


1. *Gasket Sealing Compound* 002114
2. *Dowel pins*
3. *No sealer here*

Push all pistons to the top of cylinders. Remove numbered connecting rod caps.

Gently lower crankshaft into place.
- Align tab on lower bearing seal housing with hole in crankcase.
- Align upper oil seal in groove.
- Locate each main bearing on its dowel pin. A mark placed on the bearing race opposite the

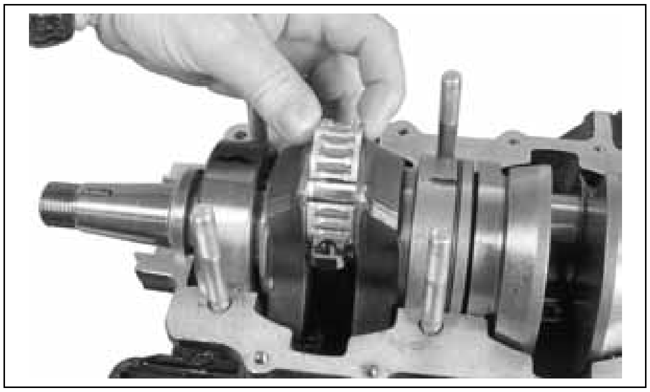
dowel pin hole will help in the alignment process.



1. *Lower seal housing*
2. *Upper oil seal*
3. *Alignment marks*

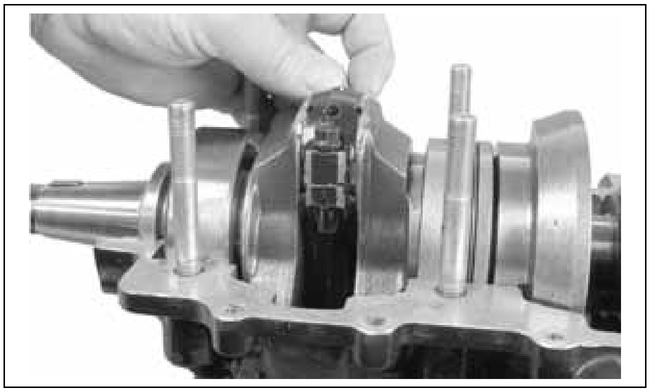
002070

Lubricate each crankpin and bearing assembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.



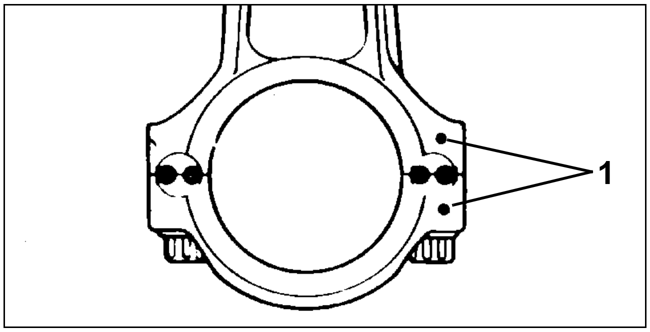
002115

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 flywheel.

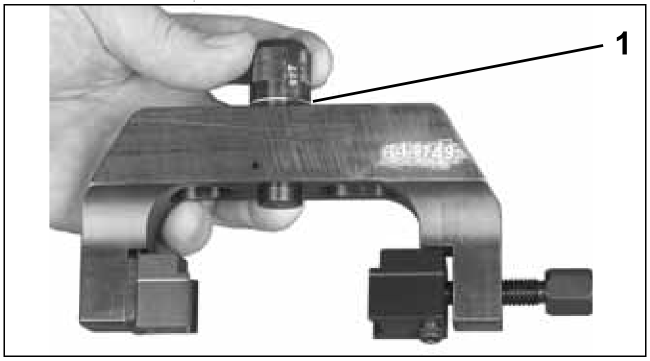


1. *Alignment dots*

53628

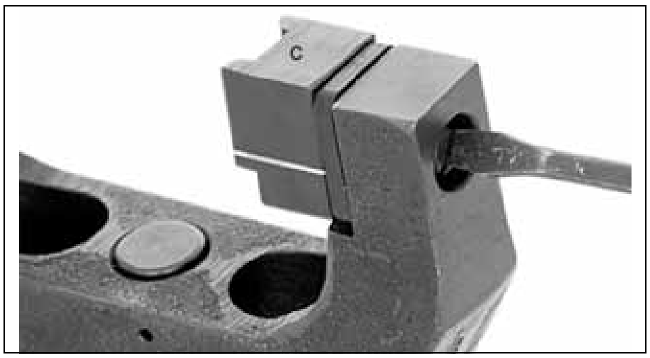
IMPORTANT: Tightening rod cap screws without Alignment Fixture, P/N 396749, or using an incorrect procedure could cause permanent damage to the connecting rod and crankshaft. To maintain accurate torque values, keep torque wrench extension length to a minimum.

Install Rod Cap Alignment Fixture, P/N 396749, **before** tightening rod cap screws. Align the flat marked “SET” on the rod engagement stop with the arrow on the frame. Position stop at the center setting (one line showing). Rotate adjustment knob 180° to lock in position.

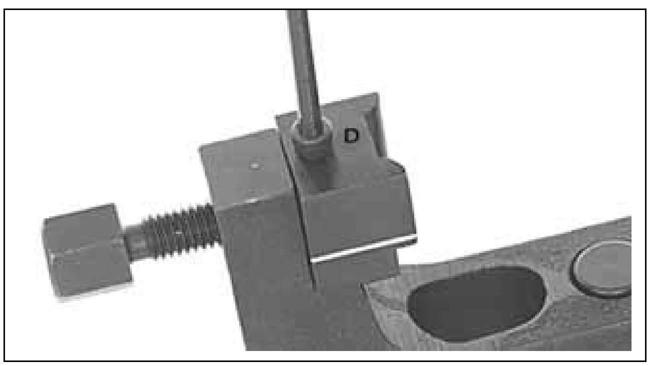


1. *Center position, one line showing* 002484

Secure restraining jaw “C” and forcing jaw “D” to frame.



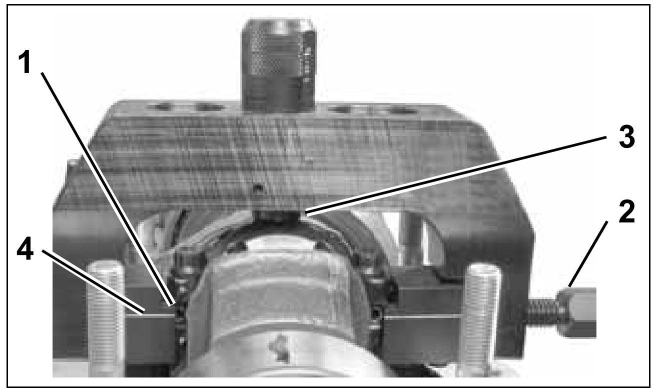
Restraining Jaw “C” 21591



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.

- Position frame onto the connecting rod so the contact area of the jaw is centered on the side of the rod.
- Tighten forcing screw until jaws contact connecting rod.
- Slide frame down until adjustment stop contacts the rod cap. The groove lines on the jaws must be centered on the rod/crankpin diameter.
- Tighten the forcing screw to a torque of 14 to 16 in. lbs. (1.6 to 1.8 N·m).



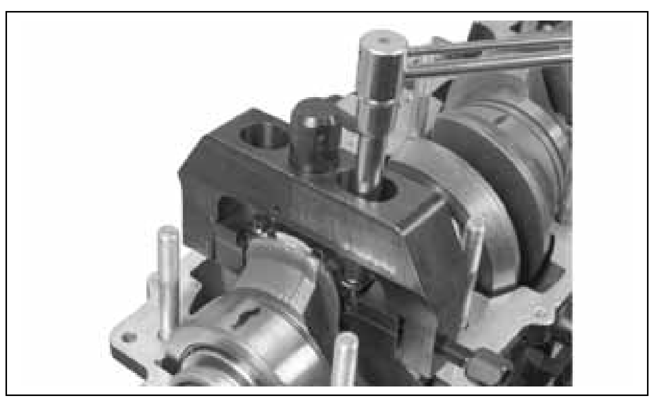
1. *Contact area of jaw* 002071
2. *Forcing screw*
3. *Adjustment stop*
4. *Groove line*

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).

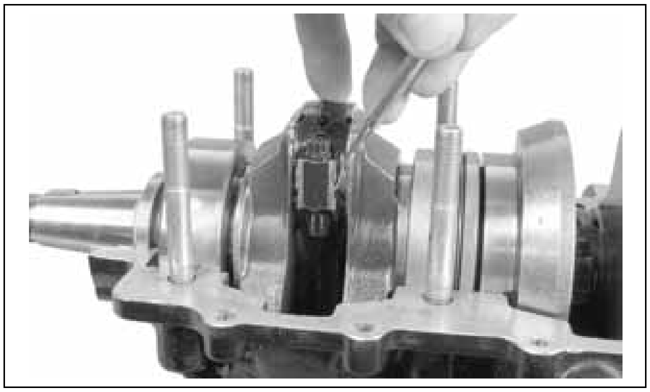


002072

IMPORTANT: If a new screw is used, it must be installed as above. Then, it must be removed, relubricated, 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

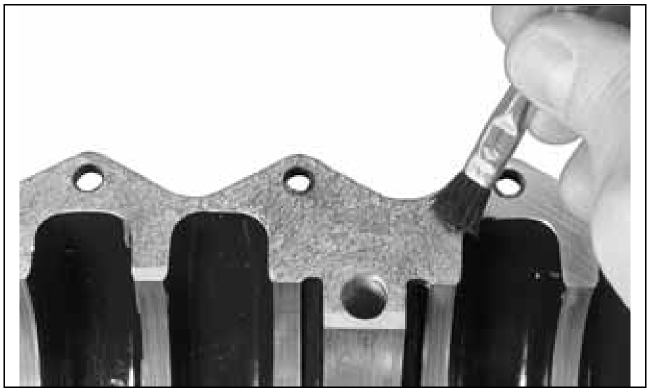
Crankcase Assembly

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.



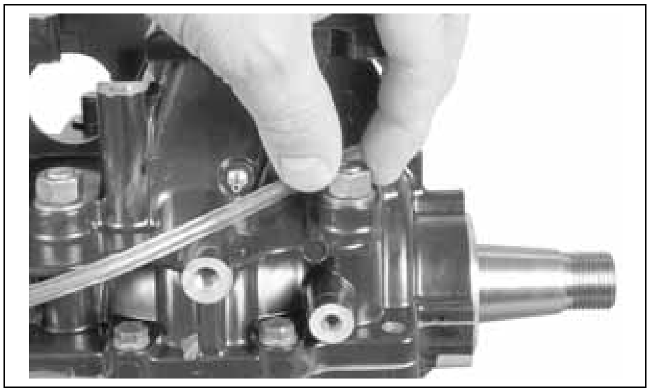
Typical 003874

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.

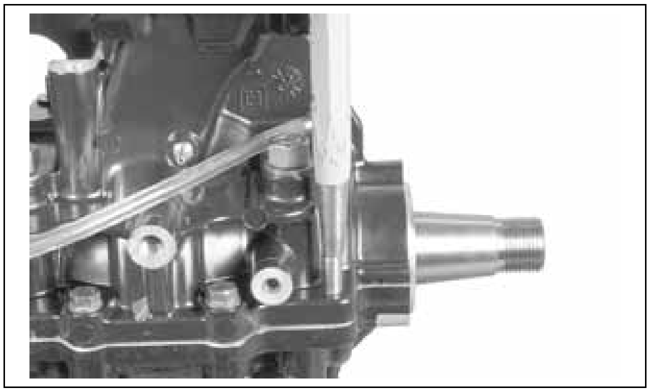
Apply outboard lubricant to the main bearing studs. Install nuts and washers finger tight, no more than 60 in. lbs. (7 N·m).



002119

11

When the crankcase is seated, install and firmly seat the crankcase taper pin.

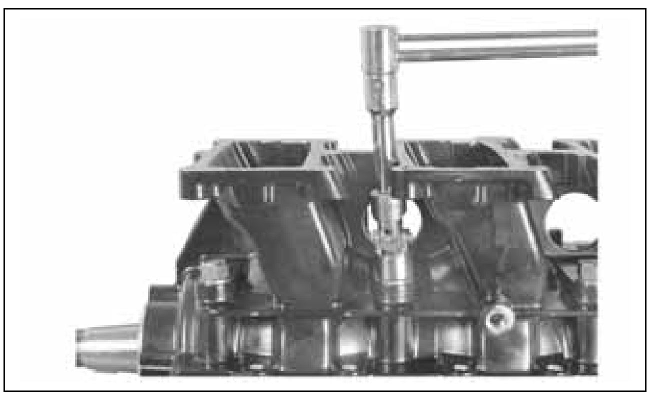


002121

Tighten main bearing nuts **in stages** to a final torque of:

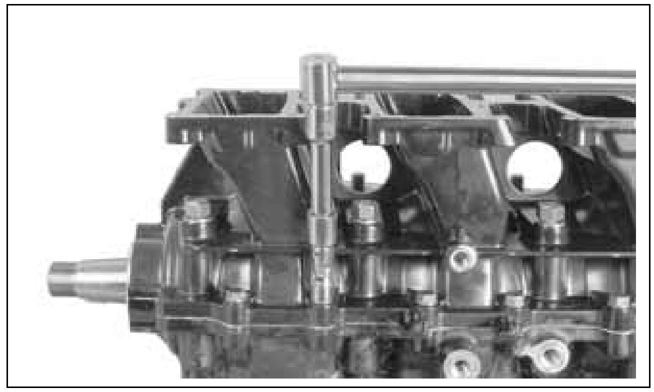
- 26 to 30 ft. lbs. (35 to 41 N·m).

Start in the center and work outward in a spiral pattern.



002096

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).



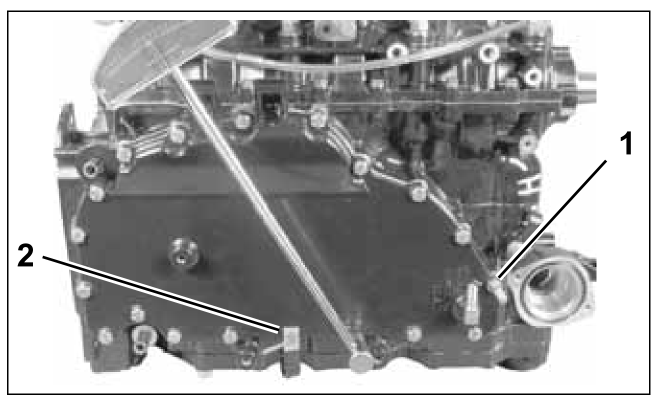
002105

Test that the crankshaft spins freely without binding.

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

Apply *Gasket Sealing Compound* to both sides of a new water cover gasket. Position gasket and cover on cylinder block.

Apply *Nut Lock* to cover screws and double ended stud. Place star washer under J-clamp and position as shown. Tighten all screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

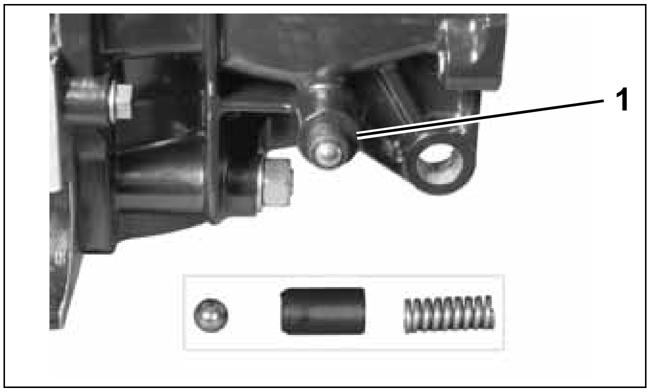


1. *Double ended stud*
2. *J-clamp*

002122

Shift Linkage Installation

Place the spring, guide, and ball of the shift detent assembly into the crankcase. Lubricate with *Triple-Guard* grease.

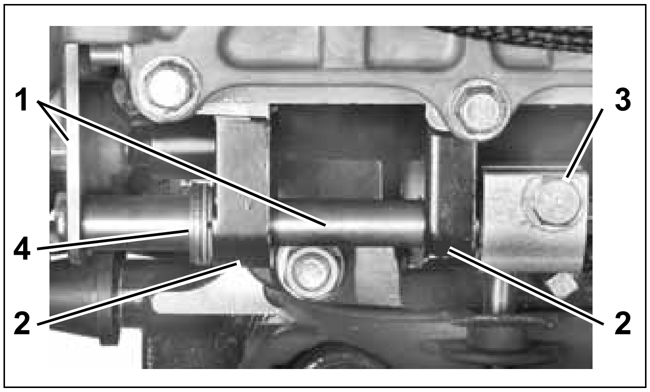


1. *Shift detent assembly* 002135

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

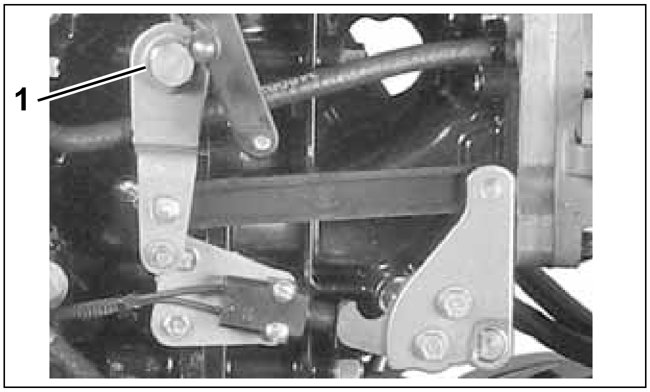
Apply *Triple-Guard* grease to the shaft and detent of the shift lever assembly. Guide shaft through bushings in crankcase.

Install 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* 002127
2. *Bushing*
3. *Shift rod lever screw*
4. *Washers (3)*

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).



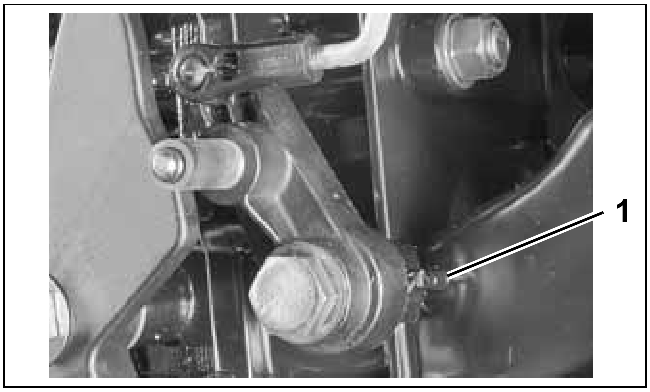
1. *Shift lever screw* 002126

Throttle Linkage Installation

Apply *Nut Lock* to threads of throttle lever screw.

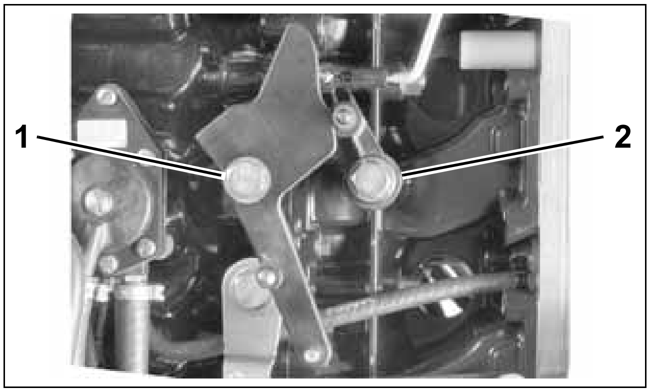
Insert spring into cavity of throttle return lever.

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. *Throttle lever spring* 002256

Apply *Nut Lock* to threads of throttle cam screw. Install cam, screw, and washer on cylinder block and tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



1. *Throttle lever screw* 002257
2. *Throttle return lever*

IMPORTANT: Do not lubricate throttle levers or shoulder screws.

Final Powerhead Assembly

Install the reed plate and throttle body assemblies. Refer to **Intake Manifold Service** on p. 172.

Install oil recirculating hoses and check valves. Refer to **OIL RECIRCULATION DIAGRAM** on p. 178, or **POWERHEAD VIEWS** on p. 229.

Install pressure valve assembly. Refer to **PRESSURE RELIEF VALVE SERVICING** on p. 197.

Install shift linkage. Refer to **Shift Linkage Installation** on p. 223.

Install throttle linkage. Refer to **Throttle Linkage Installation** on p. 223.

Install fuel injectors and ignition coils. Refer to Fuel Injector **Installation** on p. 171.

IMPORTANT: All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Install stator and flywheel. Refer to **FLYWHEEL AND STATOR SERVICING** on p. 139.

Install electrical harness, then install *EMM*. Refer to **EMM SERVICING** on p. 102.

Install fuel pump assemblies, fuel manifolds, and filter. Refer to **FUEL COMPONENT SERVICING** on p. 166.

Install the oil tank and oil injection hoses. Refer to **Oil Tank Assembly** on p. 187.

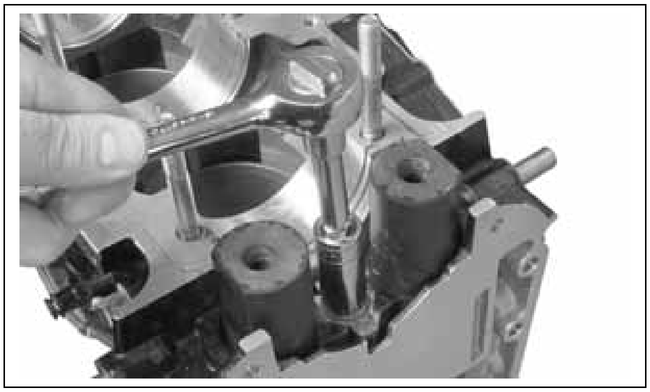
Install the electric starter. Refer to **Starter Installation** on p. 147.

⚠ WARNING ⚠
To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

UPPER MOUNT SERVICING

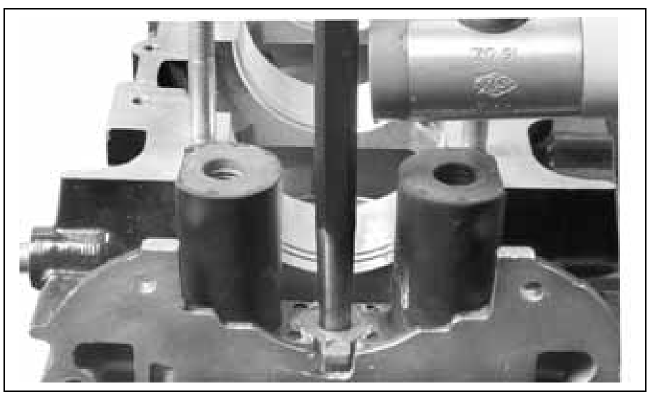
Removal

Remove mount retainer screw.



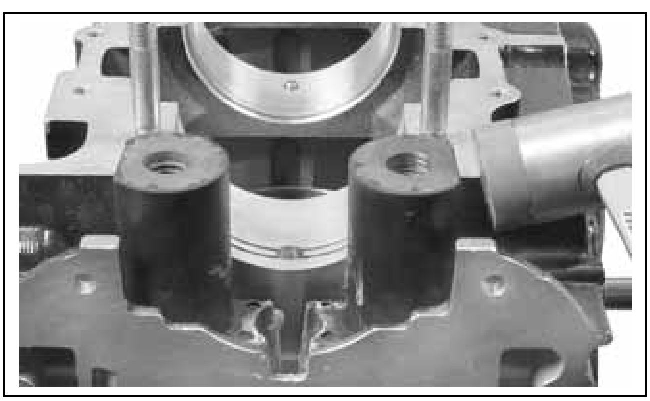
002069

Insert suitable punch in taper of mount retainer. Tap side of punch to loosen mount retainer.



002130

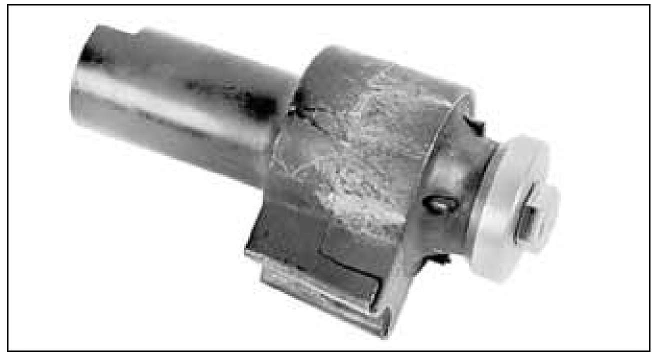
Dislodge mount assemblies and remove.



002132

Inspect mounts and replace if necessary.

IMPORTANT: The motor mount, washer, and screw are serviced as an assembly. Do not disassemble.

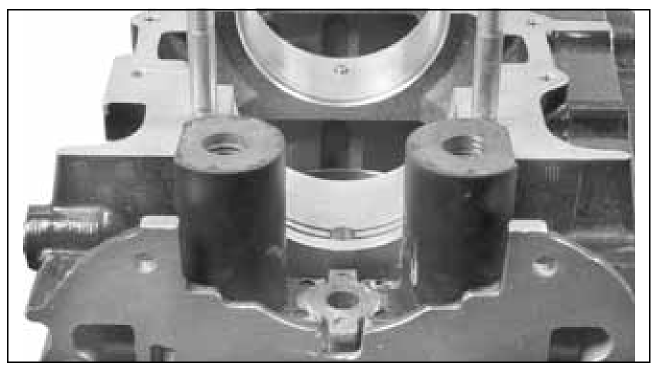


39820

Installation

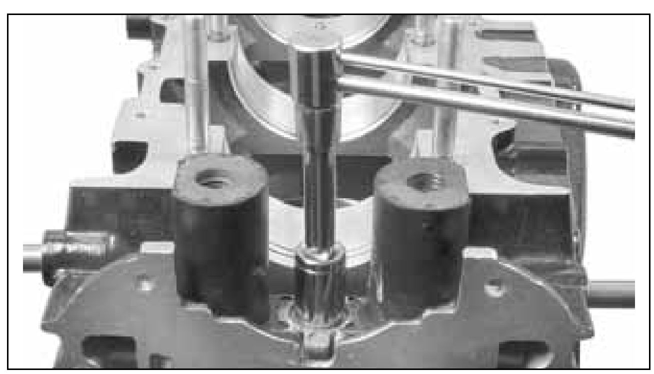
Place mount assemblies in position, with flats facing away from each other.

Apply *Moly Lube* to all sides of retainer and install between mounts.



002133

Install the retainer screw and tighten to a torque of 15 to 20 ft. lbs. (20 to 27 N·m).

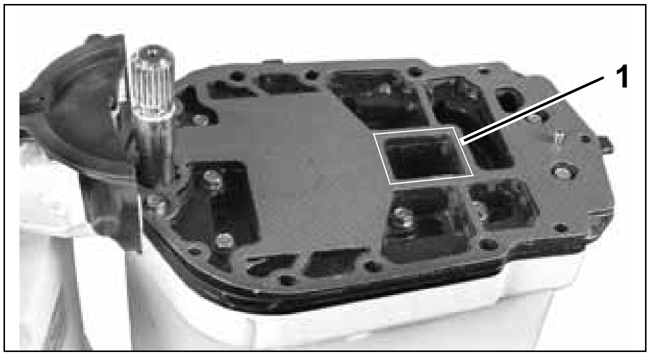


002134

POWERHEAD INSTALLATION

Powerhead Mounting

Apply *Permatex No. 2* to both sides of a new base gasket around the exhaust port only. Install gasket on adapter. To ensure proper sealing, mating surfaces must be clean and dry.



1. *Apply* Permatex No. 2 *here* 002164

Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

Slowly lower powerhead onto exhaust housing. Guide into position over alignment pin at rear of exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.

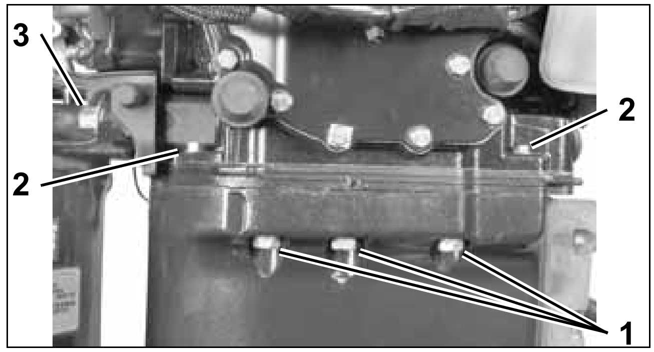
1. *Alignment pin* 002162

Apply *Triple-Guard* grease to the threads, and *Gasket Sealing Compound* to the shank of the powerhead screws.

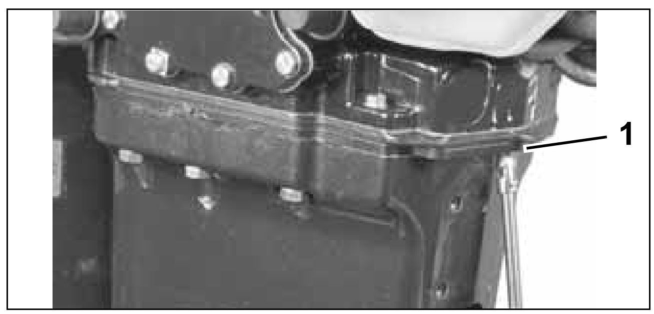
Apply *Triple-Guard* grease to upper mount screw threads.

Loosely install all powerhead screws and upper mount screws before tightening.

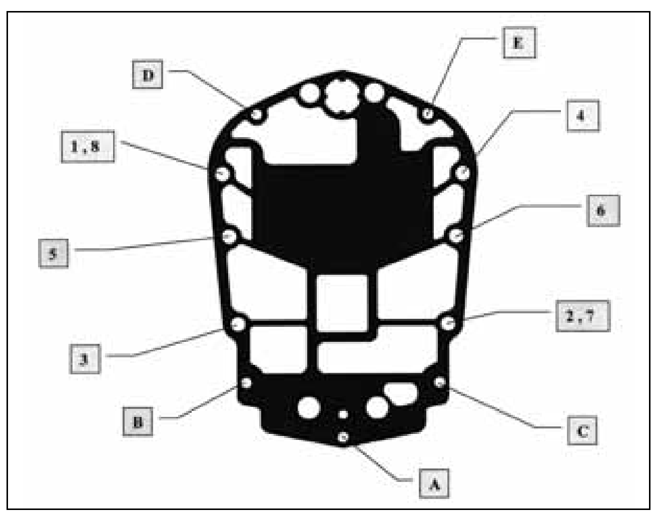
- Tighten the six large powerhead screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m) in the sequence shown.
- Tighten the five small powerhead screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).
- Tighten the upper mount screws to a torque of 110 to 130 ft. lbs. (149 to 176 N·m). Make sure that screw heads are tight against steering arm.



1. *Large powerhead screws* 002153
2. *Small powerhead screws*
3. *Upper mount screws*



1. *Rear small powerhead screw* 002160



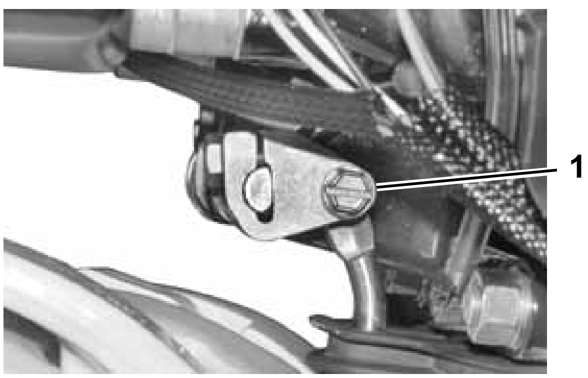
Large screw torque sequence, 1–8
Small screw torque sequence, A–E 002167

IMPORTANT: Retighten powerhead mounting screws after outboard has been run at full operating temperature and allowed to cool.

Apply *Gasket Sealing Compound* to exhaust relief muffler gasket and retaining screws. Install muffler and tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

002163

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* 002013

Check shift linkage adjustment. Refer to **Shift Linkage Adjustment** on p. 228.

IMPORTANT: Make sure the gearcase shifts solidly into both forward and reverse and that propeller shaft spins freely in neutral.

Connect the power trim connectors.

002152

Install the lower engine covers. Refer to **LOWER COVER SERVICE** on p. 82.

IMPORTANT: Perform the following procedures before returning outboard to service:

- Index all spark plugs. Refer to Spark Plug **Indexing** on p. 76.
- Adjust timing pointer and check engine timing. Refer to **TIMING ADJUSTMENTS** on p. 142.
- Use *Evinrude Diagnostics* software to start powerhead break-in oiling. Refer to **Powerhead Break-In** on p. 98.
- Prime oiling system. Refer to Oiling System **Oil Supply Priming** on p. 54.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

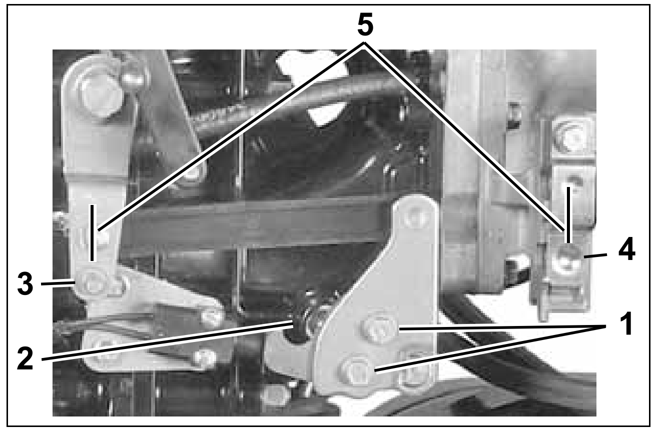
Shift Linkage Adjustment

Adjust shift linkage as follows:

- Loosen adjustment screws on shift lever.
- Be sure that ball is centered in detent assembly.
- Adjust shift lever so that the screw hole in shift rod lever lines up with the hole in the gearcase shift rod when gearcase is in neutral.
- When correctly adjusted, the shift lever will be parallel with the vertical line of the outboard, and the distance between the shift lever pin and the center of the shift cable trunnion pocket should be approximately 7 in. (17.8 cm).

IMPORTANT: The shift rod height is the most critical of these adjustments and should not be moved during this procedure. Refer to **SHIFT ROD ADJUSTMENT** on p. 266.

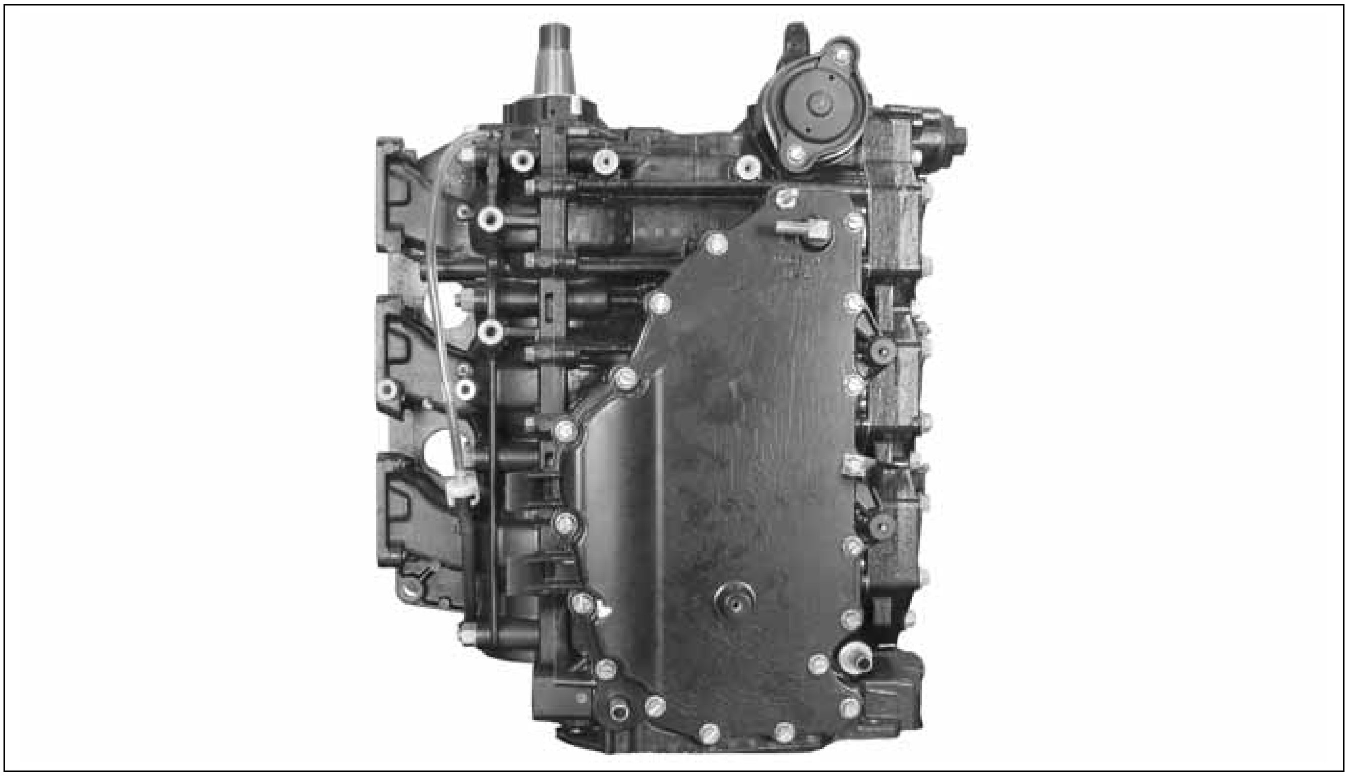
- Tighten adjustment screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



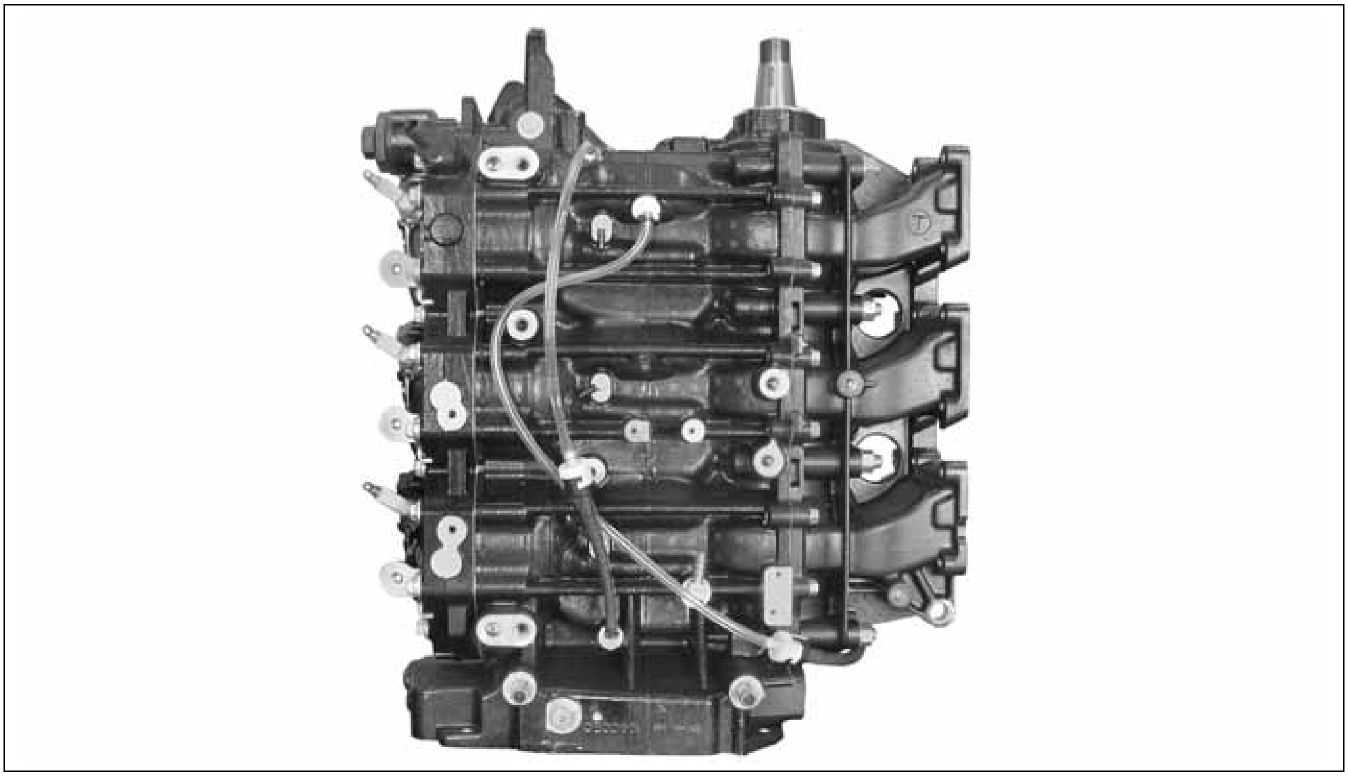
1. *Adjustment screws*
2. *Shift detent assembly*
3. *Shift lever pin*
4. *Trunnion pocket*
5. *7 inch dimension*

002125

Port Short Block

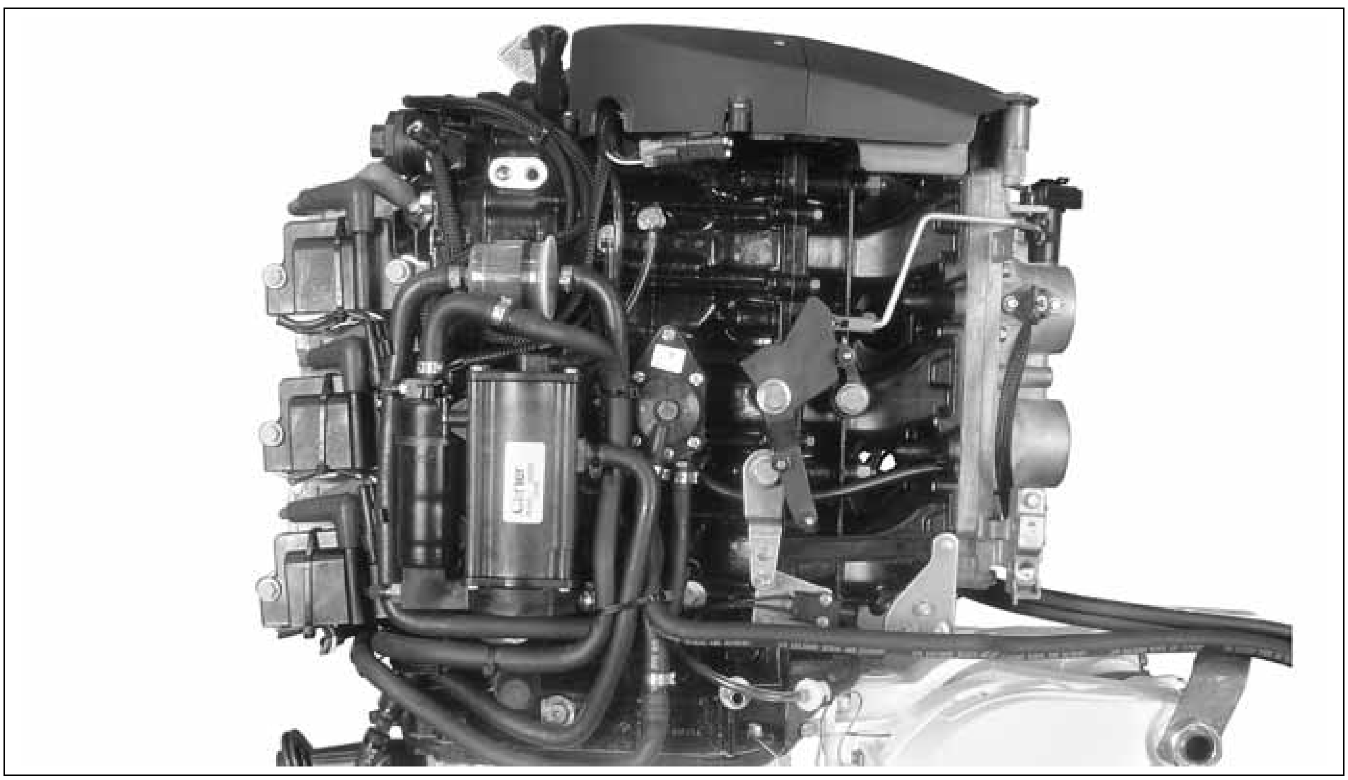


Starboard Short Block

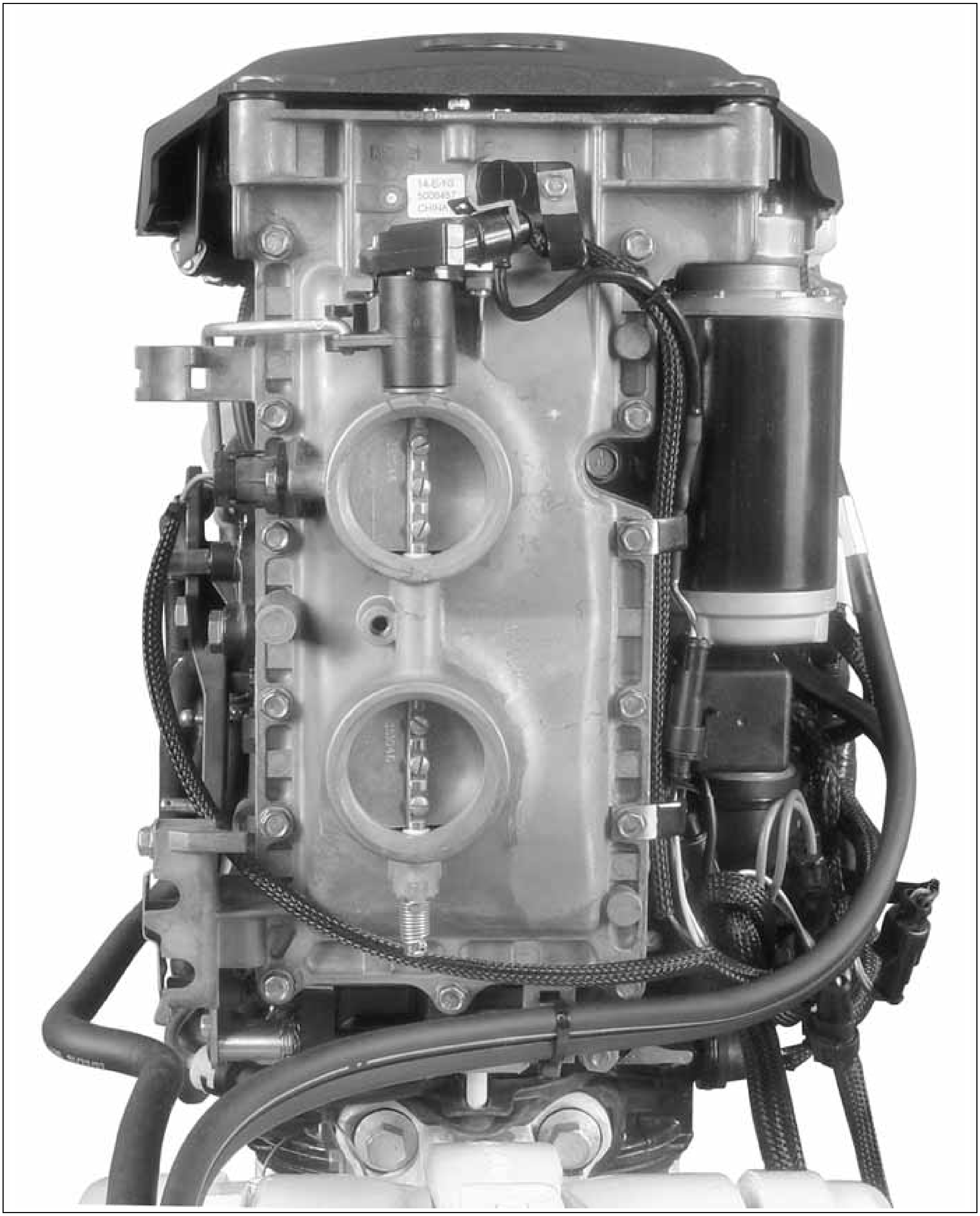


Port Dressed Powerhead

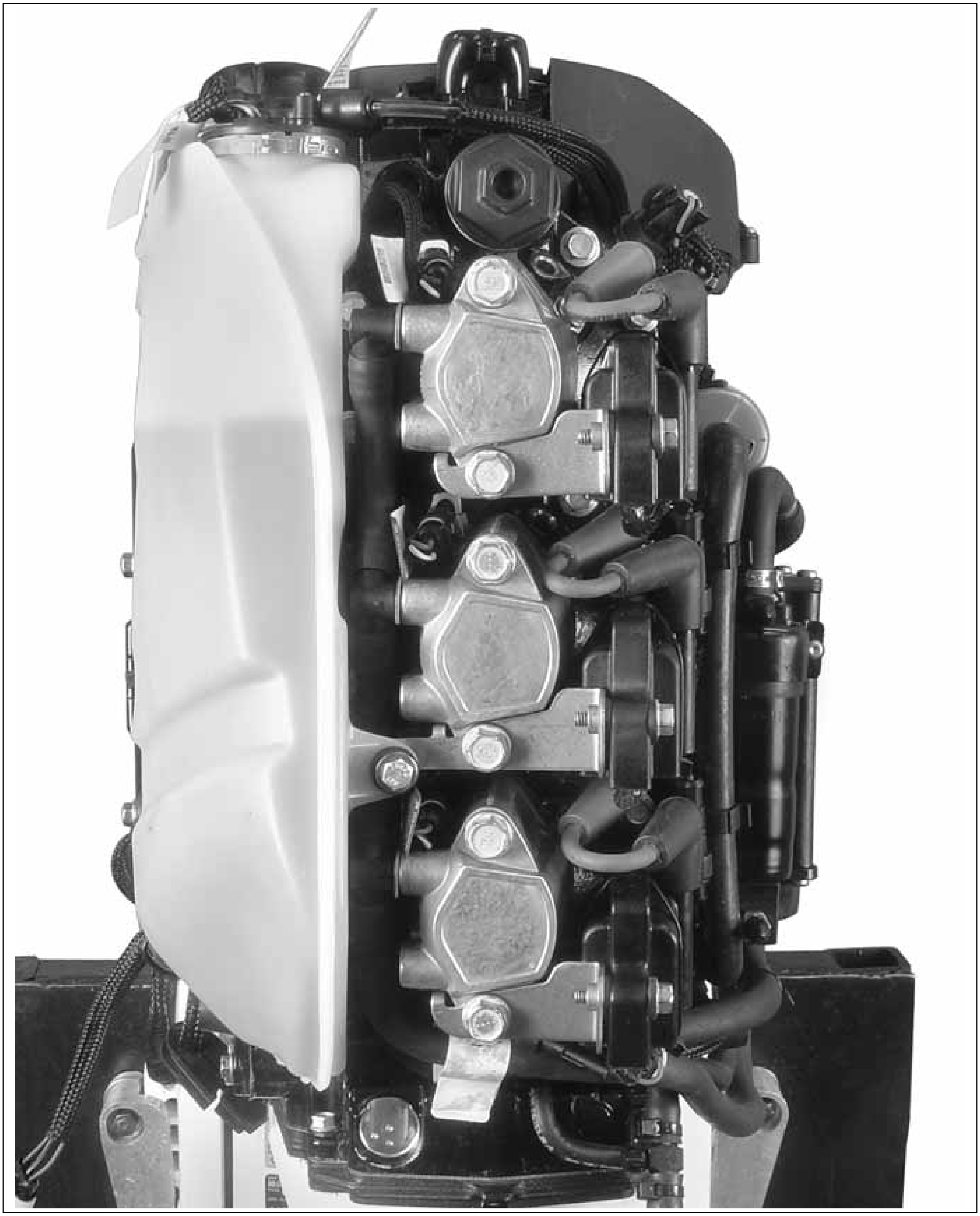
Starboard Dressed Powerhead



Front



Rear



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NOTES

Technician's Notes

Related Documents

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MIDSECTION

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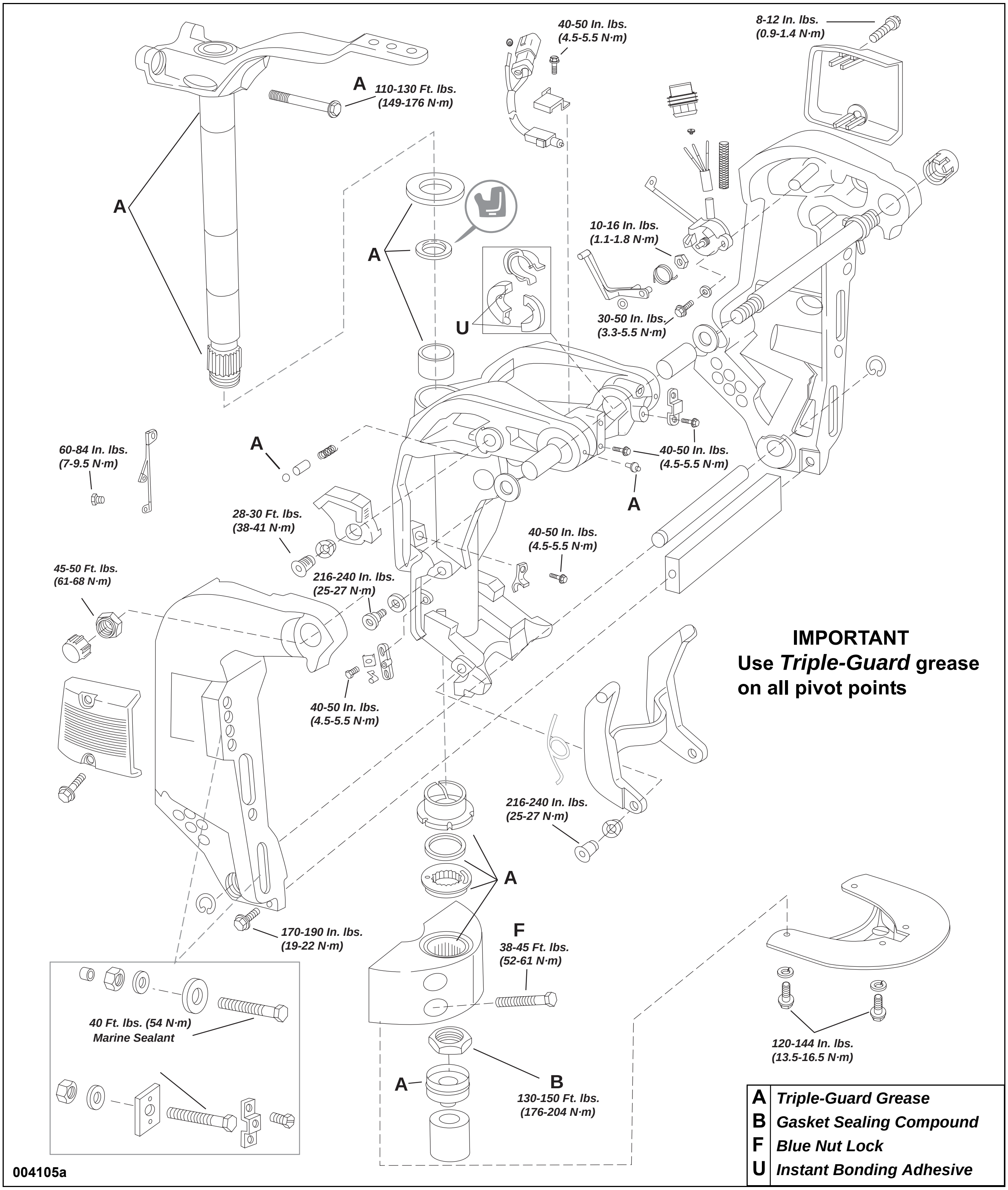
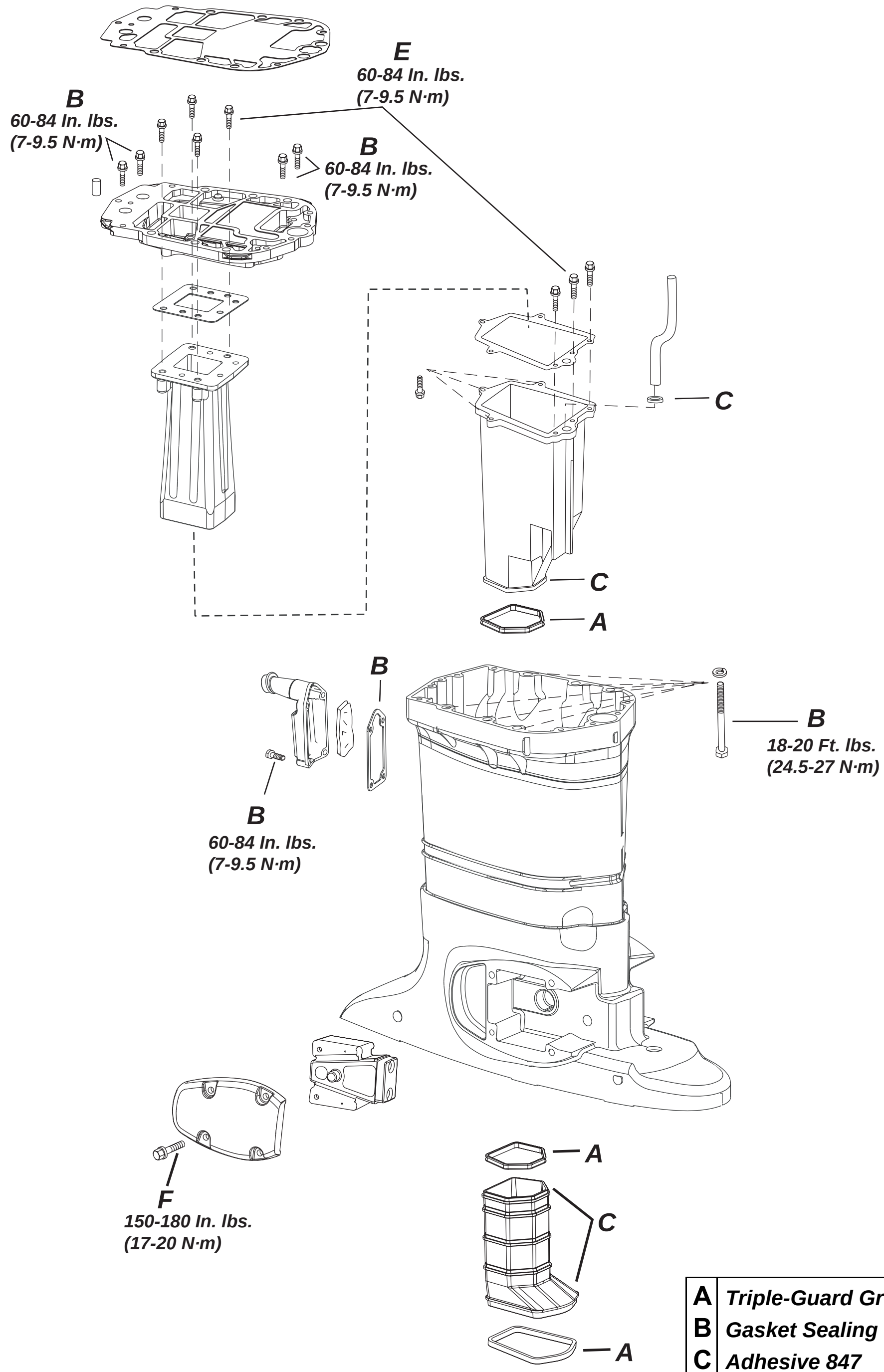
SERVICE CHART

STERN BRACKET



EXHAUST HOUSING



A	*Triple-Guard Grease*
B	*Gasket Sealing Compound*
C	*Adhesive 847*
D	*Moly Lube*
E	*Red Ultra Lock*
F	*Blue Nut Lock*
G	*Needle Bearing Grease*
P	*Permatex Number 2*
Q	*Gel Seal II*

002210

TILT TUBE

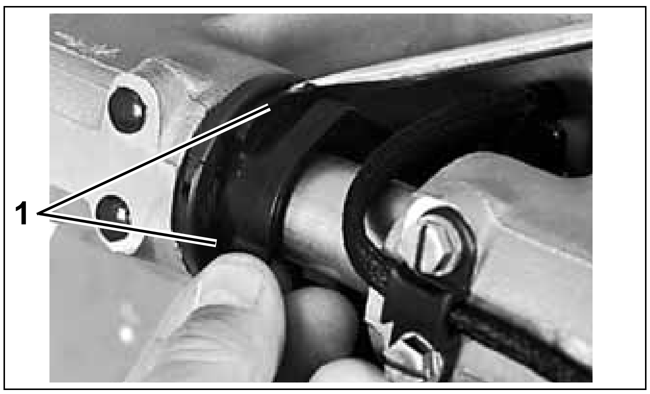
The tilt tube may be serviced without major disassembly of the outboard using Tilt Tube Service Kit, P/N 434523.

Removal

⚠ WARNING ⚠

Support the outboard with a suitable hoist.

Pull the locking tabs on the tilt limit cam loose from the collar.



1. *Locking tabs*

30749

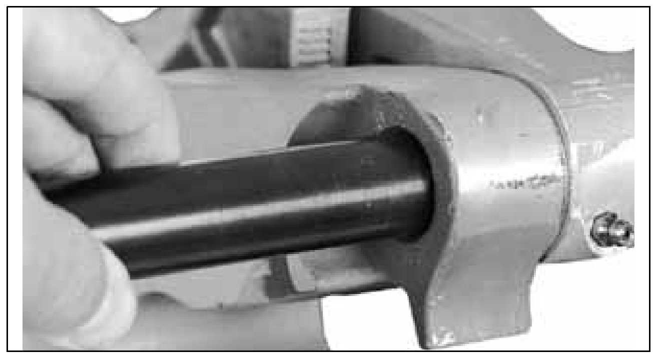
Remove the cam and collar from the tilt tube.

30748

Remove the nut from the starboard side.

30747

Thread the spacer from Tilt Tube Service Kit, P/N 434523, onto the starboard end of the tilt tube.

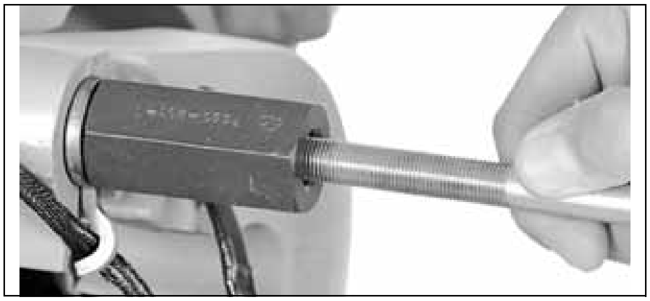


30746

Remove steering cable wiper nut from tilt tube. Thread the adapter from Tilt Tube Service Kit, P/N 434523, onto the port end of the tilt tube.

30745

Thread Slide Hammer, P/N 432128, into the adapter until at least 2 in. (51 mm) of thread are engaged.



30744

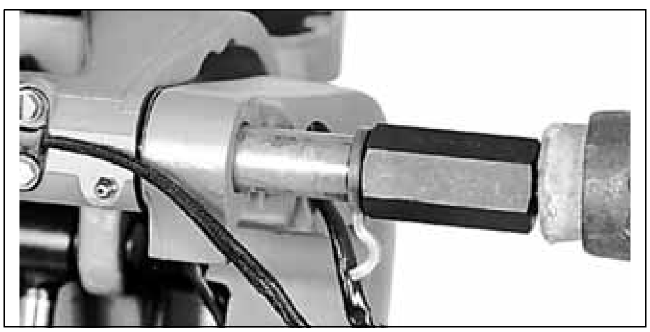
Pull tilt tube from stern bracket with the slide hammer. When tilt tube clears the port stern bracket, remove tilt tube from the spacer.

Installation

Thread starboard end of tilt tube into the spacer.

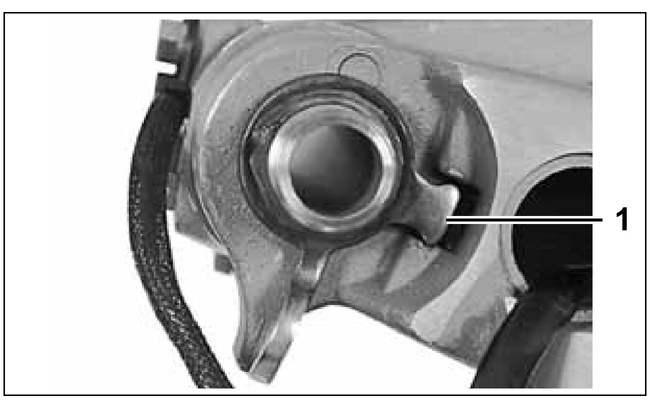
Thread the adapter onto port end of tilt tube.

Use a wood or leather mallet to tap the tilt tube into position.



30743

Make sure the lock tab is in correct position.

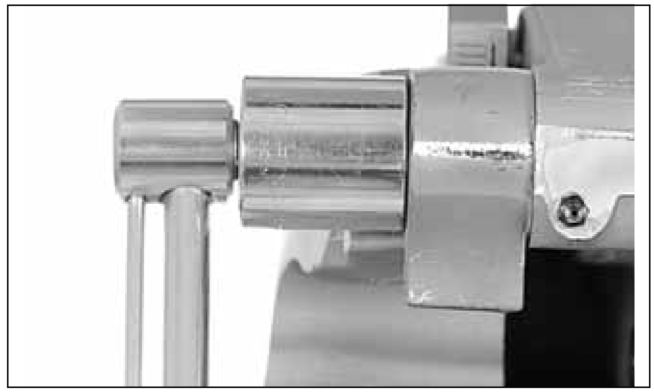


1. Lock tab 30742

Install the starboard locknut.

> **⚠ WARNING ⚠**
>
> **Replace locknut if definite resistance is not felt.**

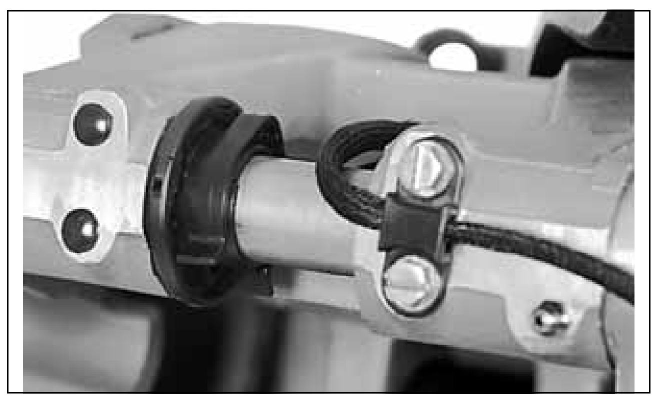
Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).



30741

Replace steering cable wiper nut on port end of tilt tube.

Apply one drop of instant bonding adhesive in receiving channels of tilt limit switch collar and install collar and tilt cam on tilt tube. Be sure locating tab on collar fits in hole on tilt tube.



30750

EXHAUST HOUSING

Exhaust Housing Removal

Before removing the midsection:

- The gearcase must be removed. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 261.
- The powerhead must be removed. Refer to **POWERHEAD REMOVAL** on p. 202.

Remove and discard four lower mount screws.

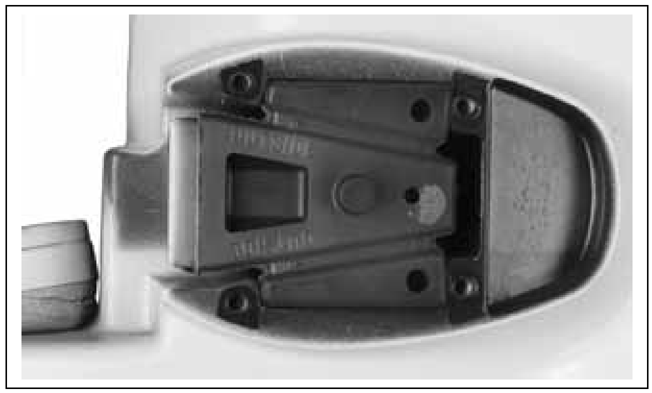
20" Models 23036

25" Models 32590

Remove the exhaust housing.

001986

Remove lower mount covers and inspect the lower mounts.



001970

If replacement is necessary, lubricate mount with soapy water and carefully pry at both ends to remove.

001971

Exhaust Housing Disassembly

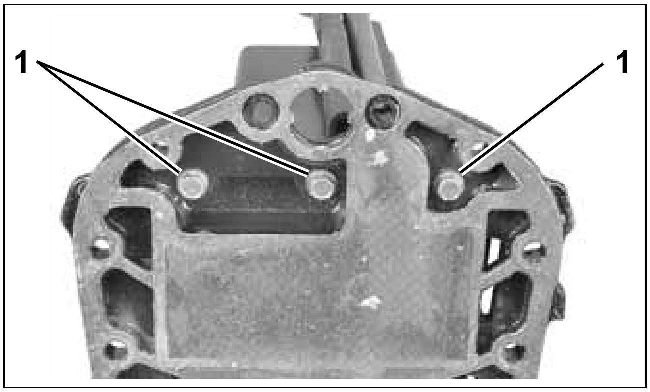
Remove the front and rear screws retaining the adapter/inner exhaust housing to the exhaust housing.

1. *Adapter retaining screws* 001981

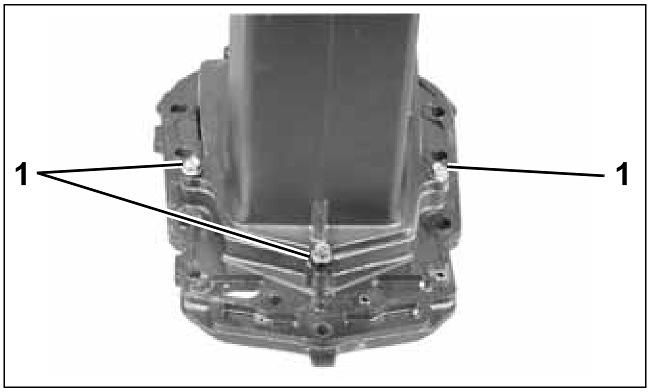
Lift the adapter/inner exhaust housing out of the exhaust housing.

001980

Remove the three upper screws and three lower screws securing the inner exhaust housing to the adapter housing.



1. *Upper inner exhaust housing screws* 001975



1. *Lower inner exhaust housing screws* 001974

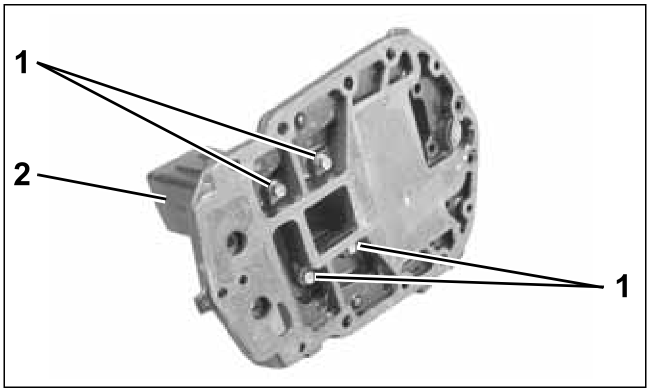
Remove the water tube from the inner exhaust housing. Discard water tube grommet.

1. *Water tube grommet* 001984

Remove the seal from the bottom flange of the inner exhaust housing.

12

Remove the four screws securing the exhaust megaphone to the adapter housing.



1. *Adapter to megaphone screws* 001976
2. *Exhaust megaphone*

Remove the lower mount assemblies as necessary. Lubricate with soapy water and carefully pry at both ends.

Cleaning and Inspection

⚠ WARNING ⚠

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

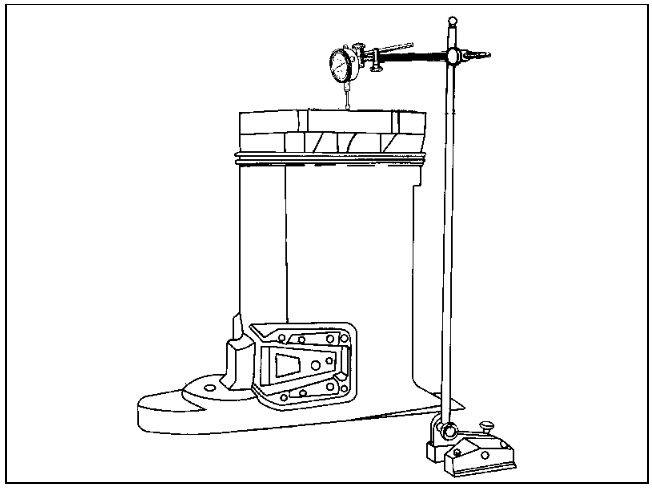
Clean all parts with parts cleaning solvent and dry with compressed air. All nut and screw threads coated with thread locking material must be thoroughly cleaned before assembly. When using a thread locking product, be sure to prime the threads with *Locquic Primer*.

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

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

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

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

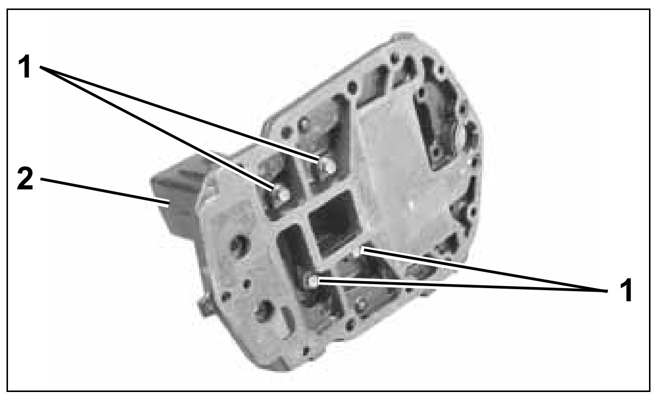


DR2223

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

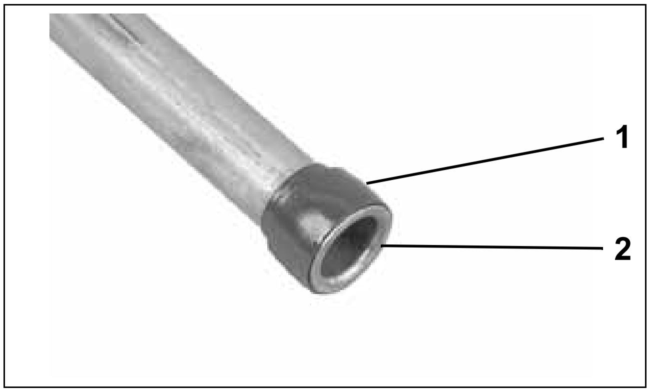
Exhaust Housing Assembly

Place a new gasket between the exhaust megaphone and adapter housing. Apply *Ultra Lock* to the threads of the screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. *Adapter to megaphone screws* 001976
2. *Exhaust megaphone*

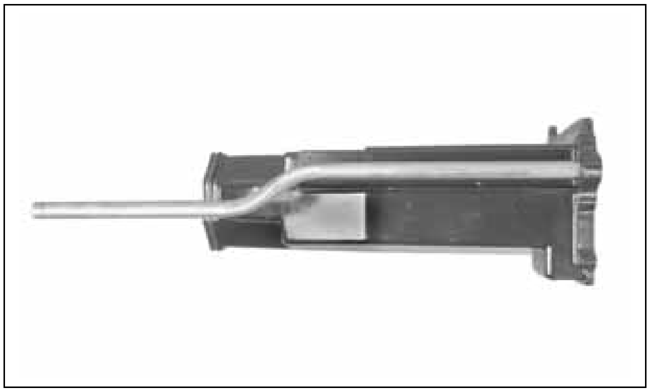
Place a new grommet on the water tube and coat the outside edge with *Adhesive 847*.



1. *Water tube grommet*
2. *Flared end of water tube*

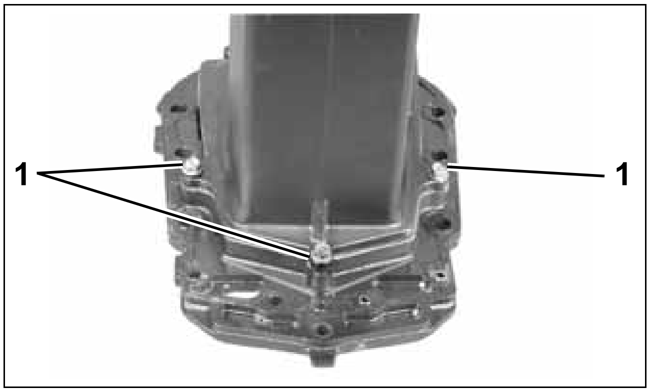
001977

Install the water tube through the top of the inner exhaust housing and align as shown:



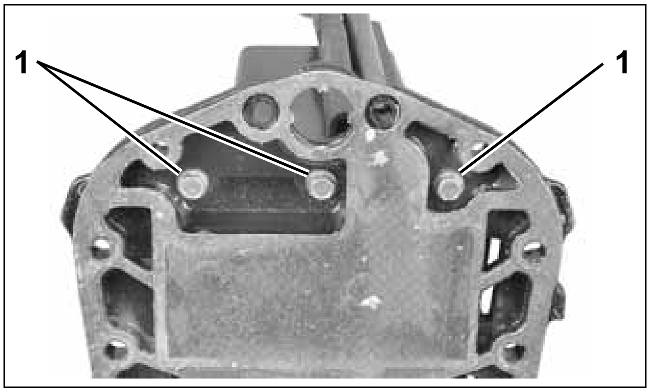
001982

Place a new gasket between the inner exhaust housing and the adapter housing. Apply *Ultra Lock* to the screws. Install the three lower screws and three upper screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. *Lower inner exhaust housing screws*

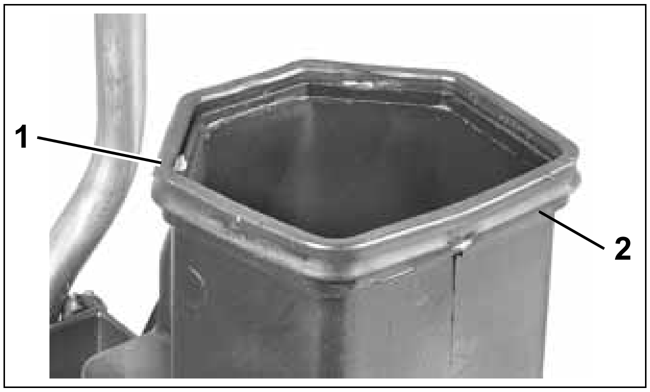
001974



1. *Upper inner exhaust housing screws*

001975

Apply *Adhesive 847* to the bottom flange of the inner exhaust housing. Install a new seal. Apply *Triple-Guard* grease to outer seal surface.



1. *Seal*
2. *Bottom flange*

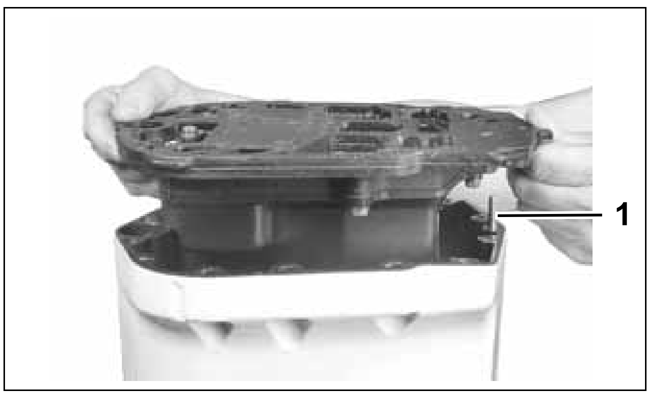
001973

12

Clean and degrease the adapter housing and outer exhaust housing mating surfaces with *Cleaning Solvent*. Apply *Gel-Seal II* sealant to the adapter flange of the exhaust housing.

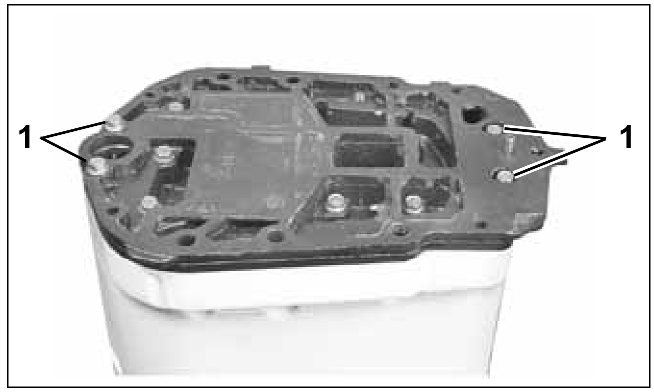
001983

Place the adapter/inner exhaust housing into the exhaust housing. Guide the water tube through the hole in the outer housing and the alignment pin into the adapter housing.



1. *Alignment pin* 001980

Apply *Gasket Sealing Compound* to threads of the four retaining screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. *Adapter retaining screws* 001981

If removed, coat the lower mounts with soapy water and press into the exhaust housing with the "OUTSIDE" mark facing outward.

Install the mount covers. Apply *Nut Lock* to screws, install washers and screws, and tighten to a torque of 150 to 180 in. lbs. (17 to 20 N·m).

001972

Exhaust Housing Installation

Bring the exhaust housing into position with the stern bracket.

Install four **new** lower mount screws with lock-patch. Tighten screws to a torque of 38 to 45 ft. lbs. (51 to 61 N·m).

20” Models 23036

25” Models 32590

Install gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 261.

Install powerhead. Refer to **POWERHEAD REMOVAL** on p. 202.

STERN BRACKET

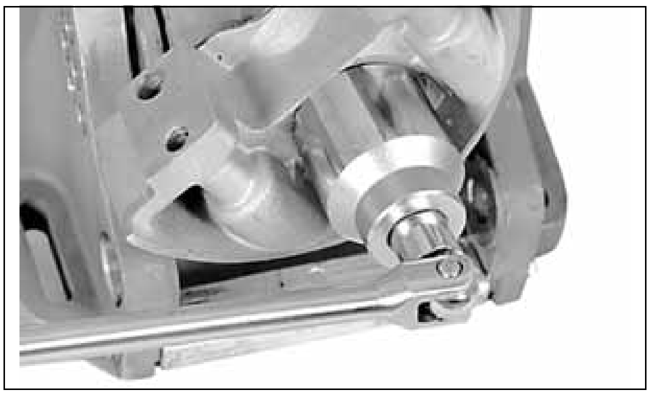
Stern Bracket Removal

Before servicing the stern bracket:

- Remove gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 261.
- Remove powerhead. Refer to **POWERHEAD REMOVAL** on p. 202.
- Remove exhaust housing. Refer to **Exhaust Housing Removal** on p. 240.
- Remove power trim/tilt unit. Refer to **TRIM AND TILT** on p. 287.

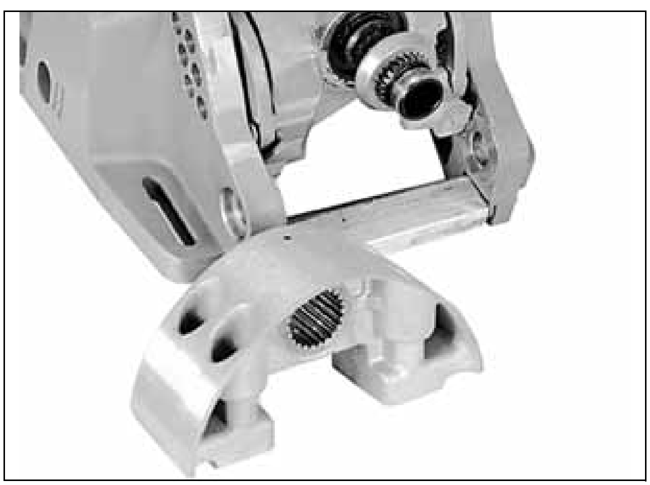
Stern Bracket Disassembly

Remove and discard steering shaft locknut.



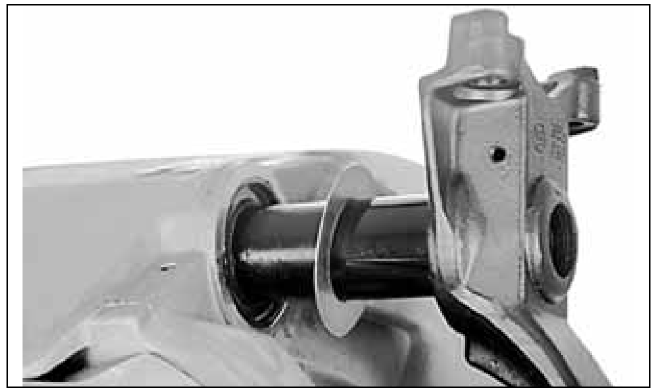
30738

Remove the lower mount bracket and keeper.



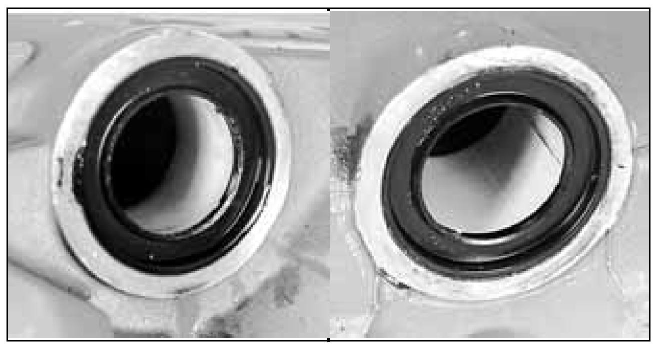
Lower mount bracket – 20" Models 30736

Remove the steering shaft and thrust washer. It may be necessary to tap the steering shaft out using a wood dowel and mallet.



30735

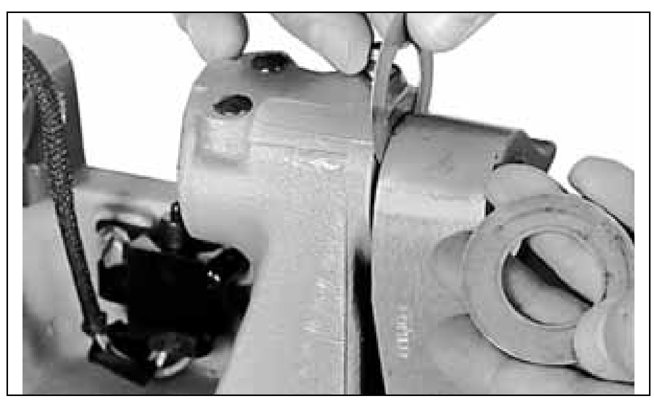
Pry out upper and lower steering shaft seals and discard. Remove the upper and lower steering shaft bushings.



30765 / 30764

Remove the tilt tube. Refer to **TILT TUBE** on p. 238.

Remove the two tilt tube washers.

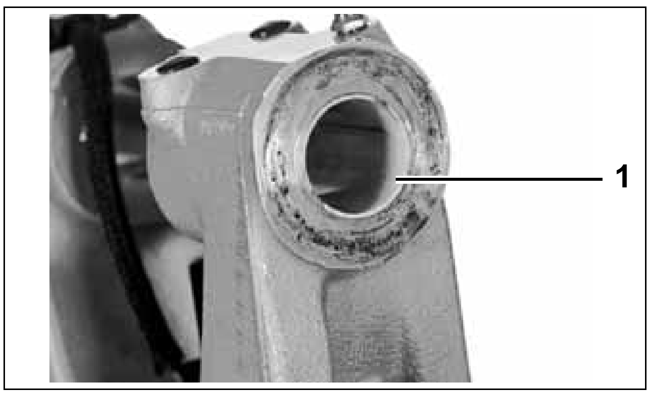


30763

Remove the anode.

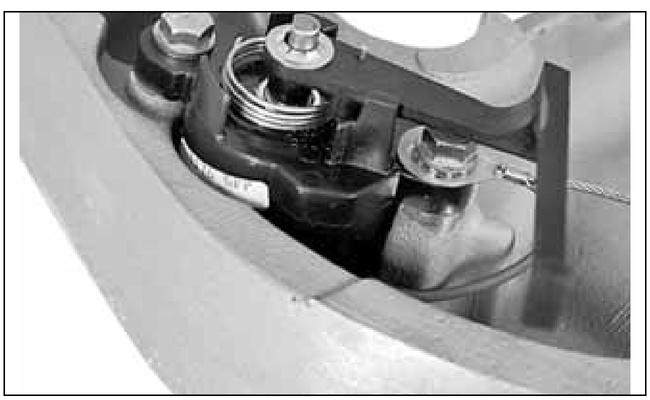
1. *Anode* 30762

Remove the swivel bracket. Inspect and, if necessary, replace the tilt tube bushings.



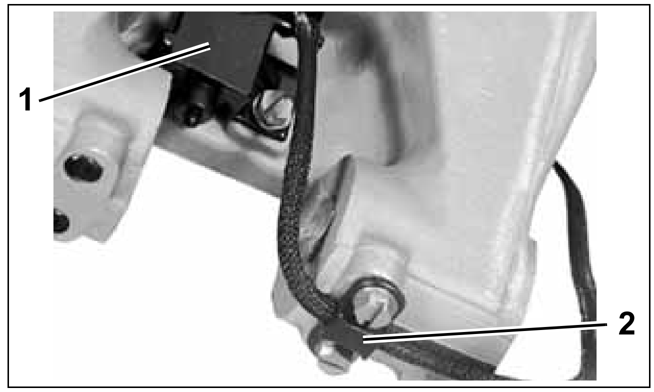
1. *Tilt tube bushing* 30761

Remove the trim sender unit from the port stern bracket and pull its wires through the braided tube.



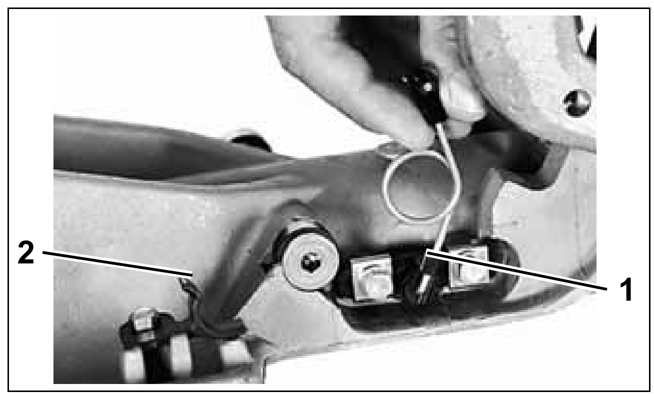
30760

Remove the tilt limit switch and retainer from the swivel bracket.



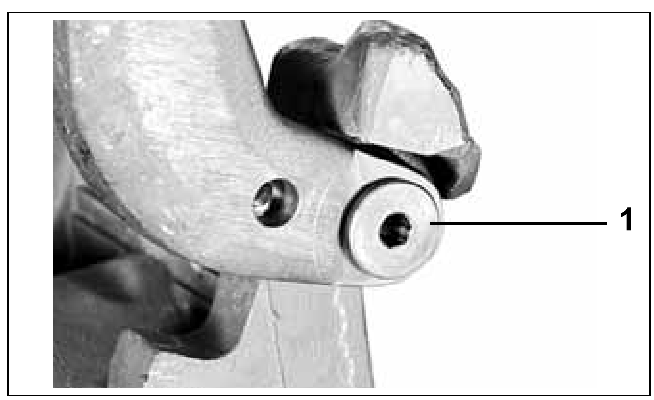
1. *Tilt limit switch* 30758
2. *Retainer*

Disconnect the trail lock spring and remove it from the swivel bracket. Remove trail arm retainer.



1. *Trail lock spring* 30756
2. *Trail arm retainer*

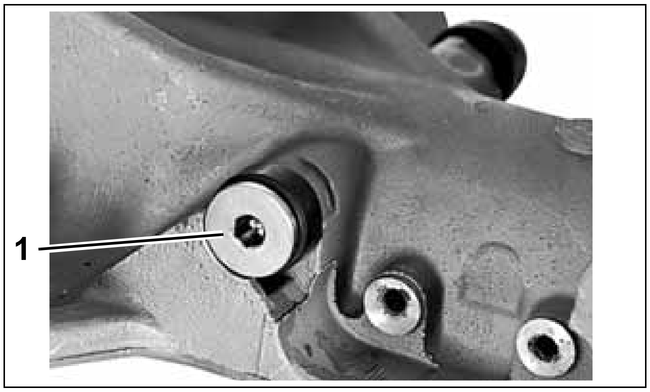
Remove the trail lock arm and bushings from the swivel bracket.



1. *Trail lock bushing* 30755

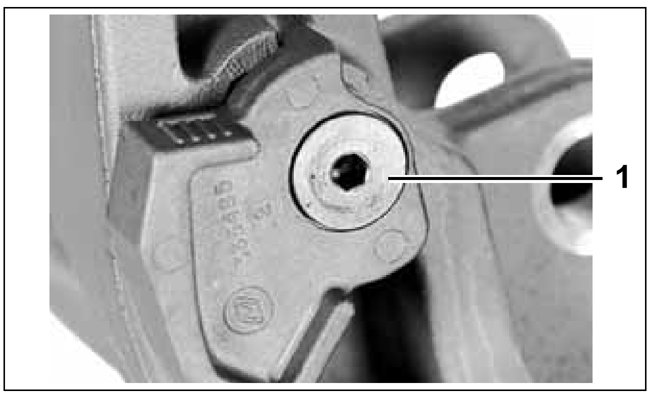
12

Remove the two trim rod rollers from the swivel bracket.



1. *Trim rod roller* 30754

Remove the tilt support and bushing from the swivel bracket and inspect the detent roller and spring.



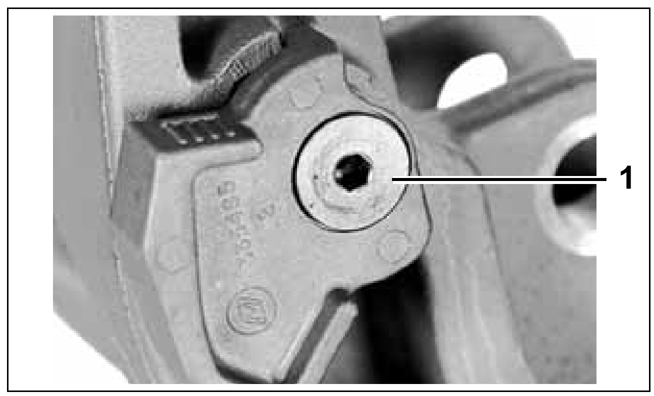
1. *Tilt support bushing* 30753

Stern Bracket Assembly

IMPORTANT: Before proceeding, make sure all components have been thoroughly cleaned. Replace any seals that have been removed. Inspect all thrust washers and bushings for evidence of deterioration.

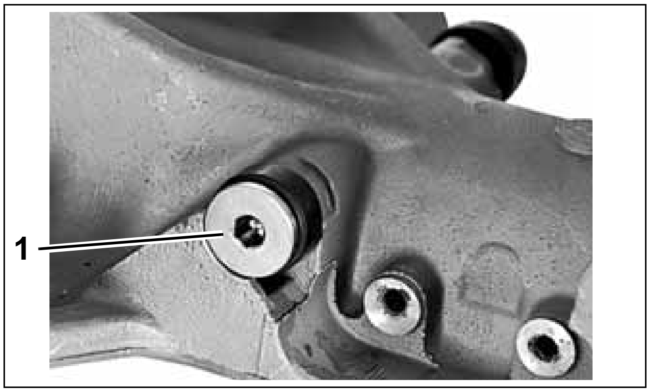
Install the detent roller and spring and the tilt support with bushing in the swivel bracket. Tighten bushing to a torque of 28 to 30 ft. lbs. (38 to 41 N·m).

30752



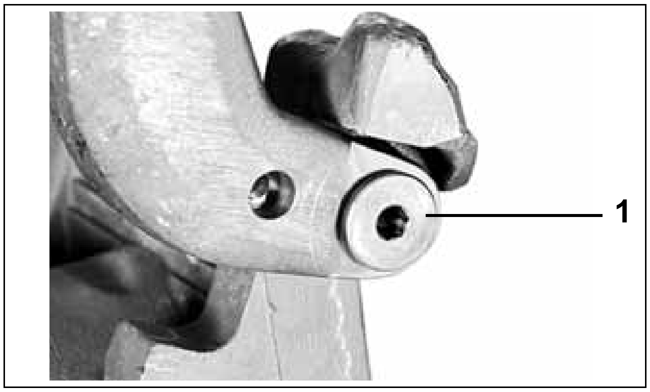
1. *Tilt support bushing* 30753

Install the two trim rod rollers on the swivel bracket. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



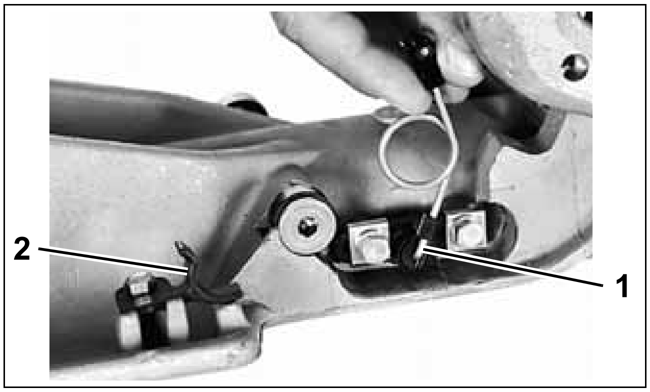
1. *Trim rod roller* 30754

Install the trail lock and bushings in the swivel bracket. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



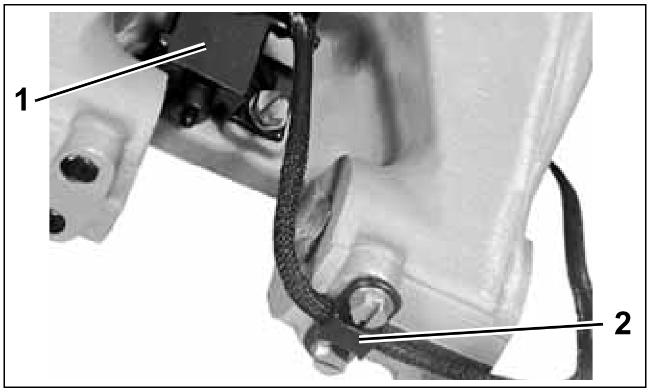
1. *Trail lock bushing* 30755

Install the trail lock spring in the swivel bracket and connect the spring to the trail lock.



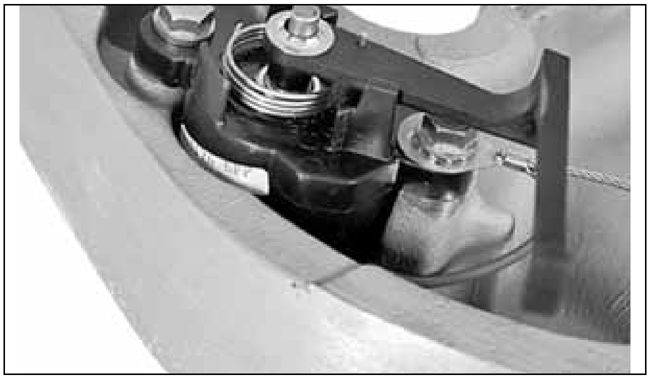
1. *Trail lock spring* 30756
2. *Trail arm retainer*

Install the tilt limit switch and retainer on the swivel bracket. Tighten screws to a torque of 40 to 50 in. lbs. (4.5 to 5.5 N·m).



1. *Tilt limit switch* 30758
2. *Retainer*

Route the trim sender wires through the braided tube, and install the sender unit in the port stern bracket.



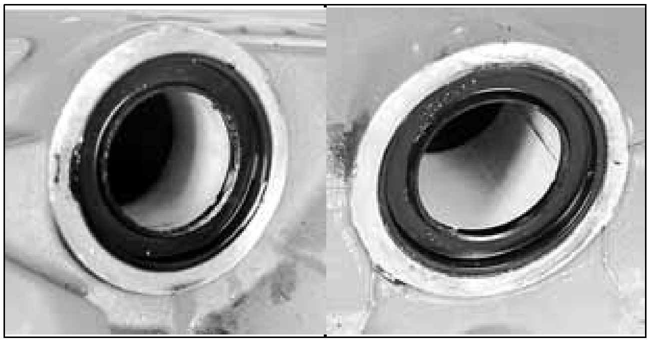
30760

Install the upper and lower steering shaft bushings and new seals in the swivel bracket. Both seal lips face out.

- Coat the outside surfaces of seals with *Gasket Sealing Compound*.

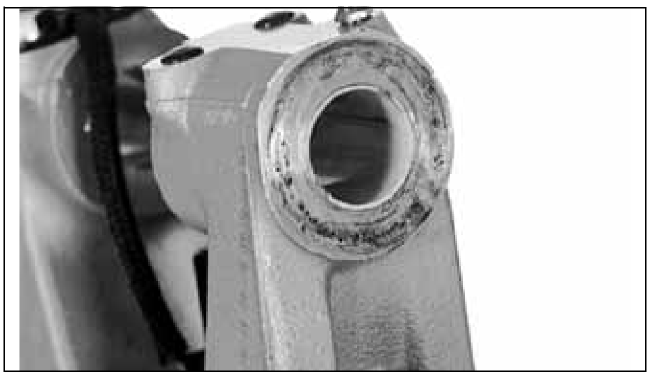
12

- Coat the bushings and seal lips with *Triple-Guard* grease.



30765 / 30764

Coat tilt tube bushings with *Triple-Guard* grease and, if removed, install them in the swivel bracket.

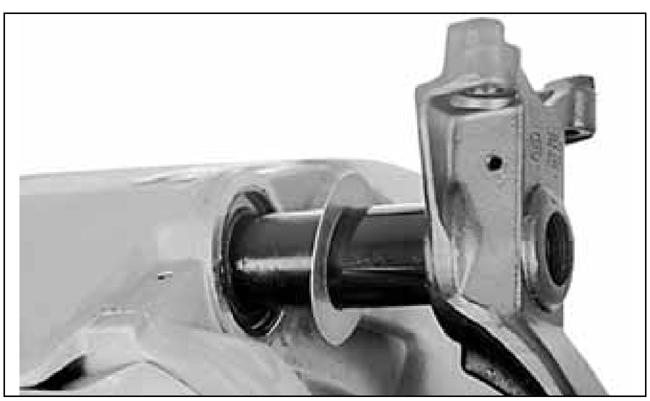


30761

Place the swivel bracket between the stern brackets and install the anode.

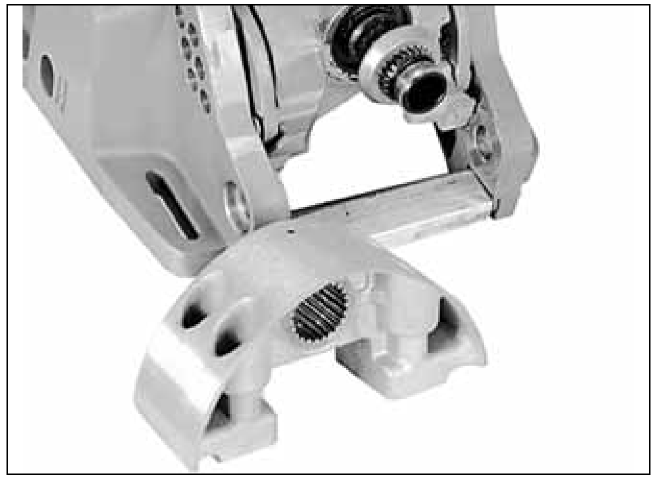
Install the tilt tube and tilt limit cam. Refer to **TILT TUBE** on p. 238.

Install the steering shaft and thrust washer.



30735

Install the steering shaft keeper. Apply *Locquic Primer* and *Nut Lock* to the splines of the steering shaft and lower mount bracket.



30736

Install the lower mount bracket and a new locking nut with its unstaked side facing the mount bracket. Align the bracket with the steering arm and tighten the nut to a torque of 130 to 150 ft. lbs. (176 to 204 N·m).

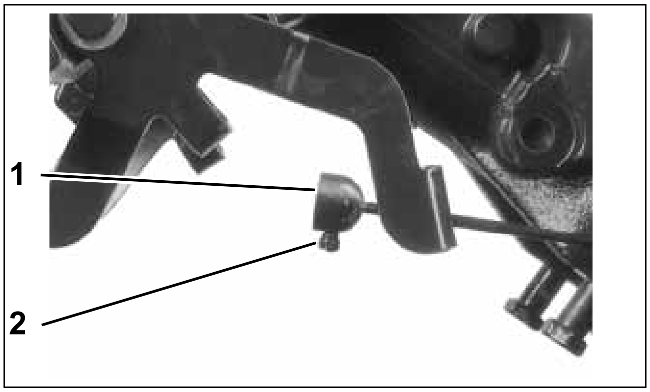
30767

Fill the swivel bracket with *Triple-Guard* grease through the grease fitting on the bracket's port side. Lubricate the tilt tube, swivel bracket, and stern brackets through the two forward grease fittings.

Install the exhaust housing. Refer to **Exhaust Housing Installation** on p. 245.

Swivel Bracket Disassembly (Manual Tilt)

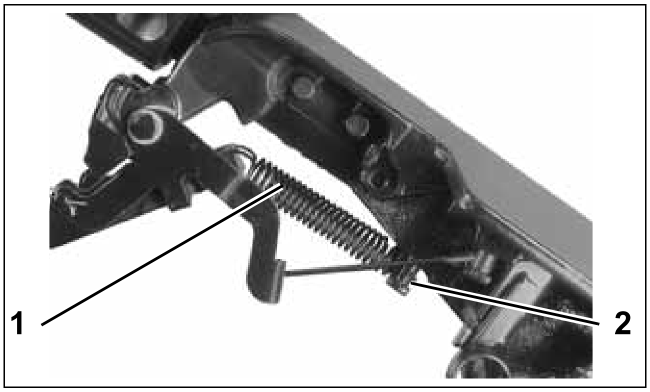
Loosen set screw and remove reverse lock release collar.



1. *Reverse lock release collar*
2. *Set screw*

006697

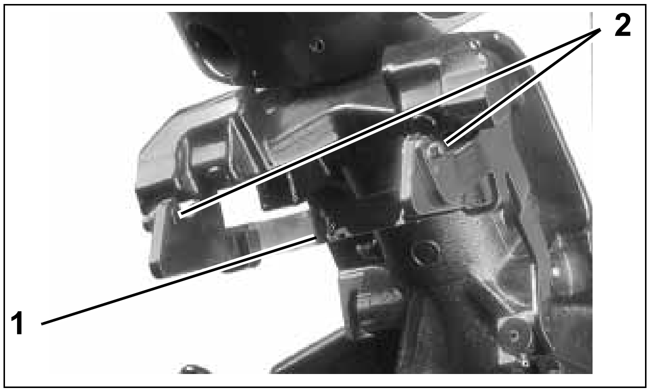
Remove reverse lock springs from locking lever and reverse lock spring screws.



1. *Reverse lock springs*
2. *Reverse lock spring screws*

006700

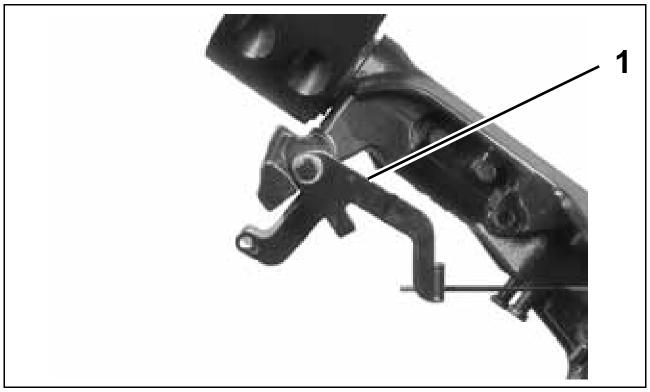
Remove cotter pins, pins and locking lever.



1. *Locking lever*
2. *Pins*

006699

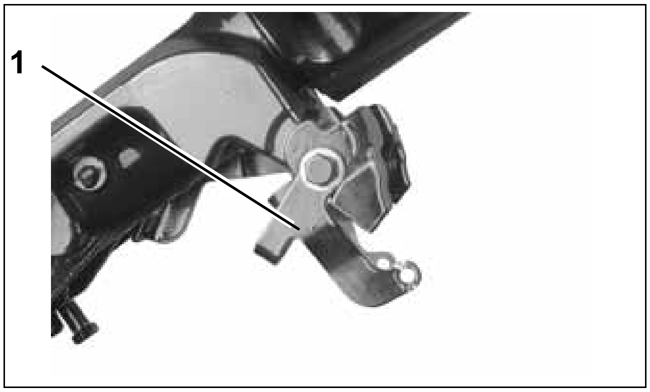
Remove starboard reverse lock link.



1. *Starboard reverse lock link*

006696

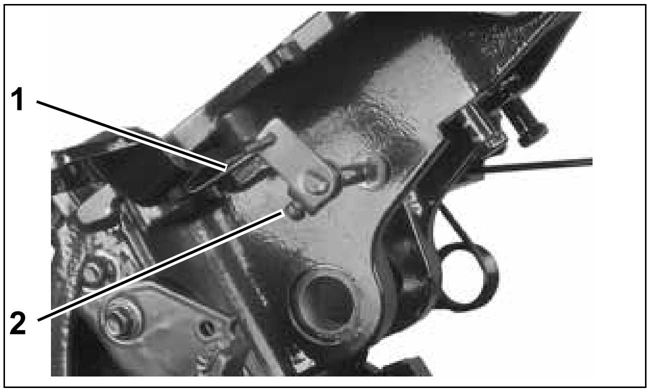
Remove port reverse lock link.



1. *Port reverse lock link*

006695

Loosen bellcrank set screw, remove bellcrank and handle link rod.

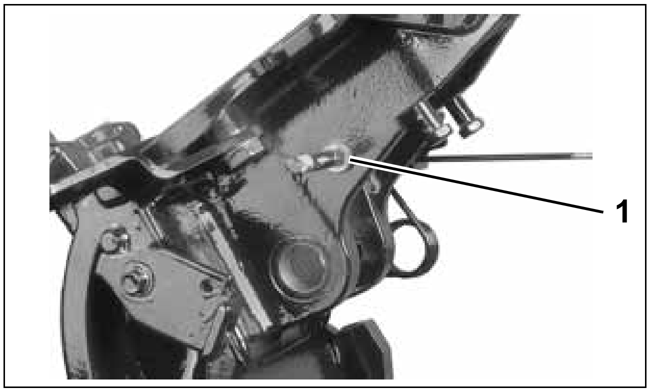


1. *Handle link rod*
2. *Bellcrank setscrew*

006694

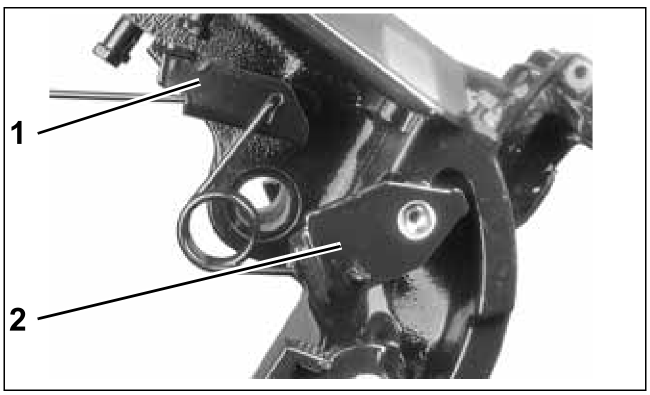
12

Remove retaining ring and bellcrank shaft spacer from reverse lock pivot shaft.



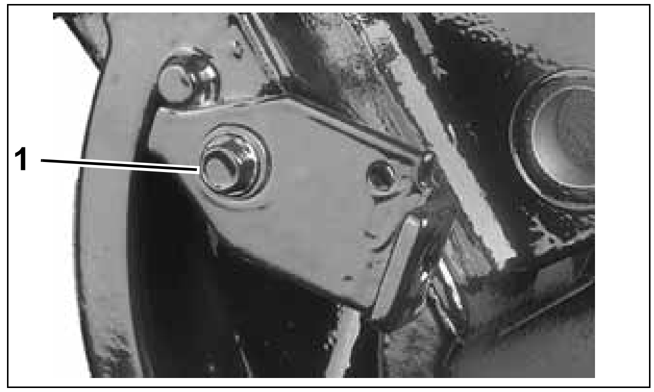
1. *Retaining ring* 006693

Remove screw from trail lock lever. Remove trail lock lever and reverse lock pivot shaft from swivel bracket.



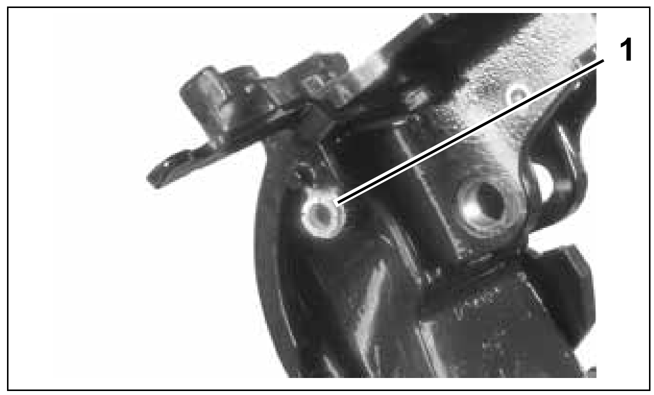
1. *Reverse lock pivot shaft* 006692
2. *Trail lock lever*

Remove port trail lock lever and trail lock shaft as an assembly.



1. *Port trail lock lever and shaft* 006704

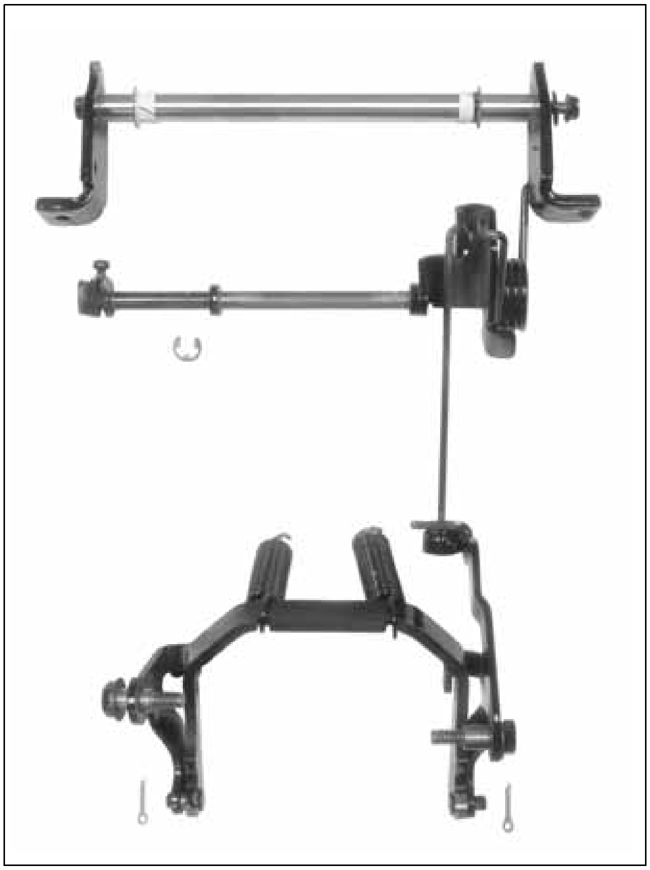
Remove port and starboard trail lock shaft bushings from swivel bracket.



1. *Trail lock shaft bushings* 006687

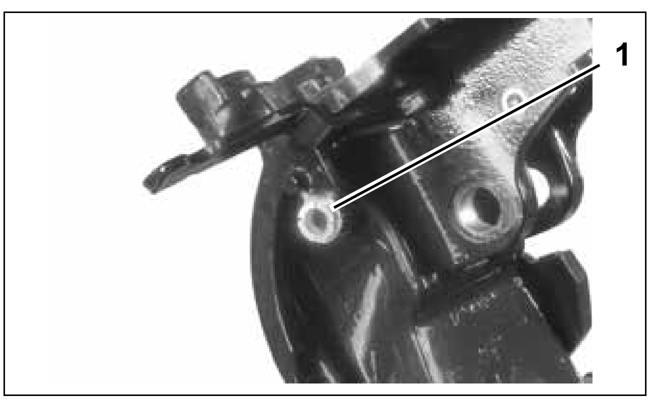
Swivel Bracket Assembly (Manual Tilt)

Reverse Lock and Trail Lock Reference



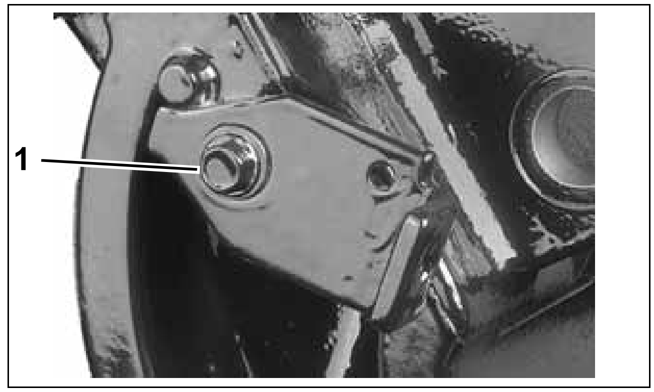
1. Component reference view 2 006686

Place port and starboard trail lock shaft bushings in the swivel bracket.



1. Trail lock shaft bushings (port side shown) 006687

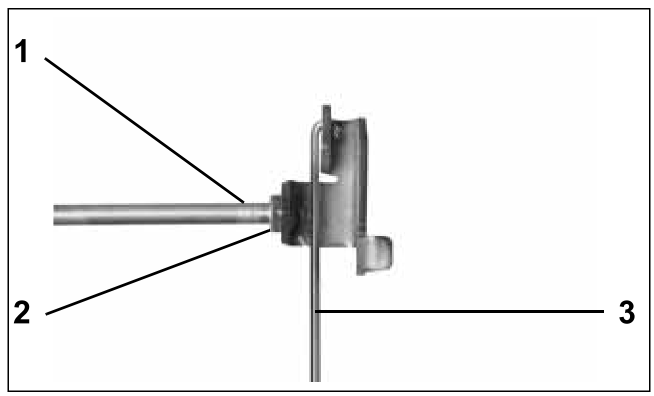
Apply blue *Nut Lock* to screw and assemble port trail lock lever on trail lock shaft with screw, washer and nylon washer. Install in swivel bracket from port side. DO NOT tighten screw at this time.



1. Port trail lock lever and shaft 006704

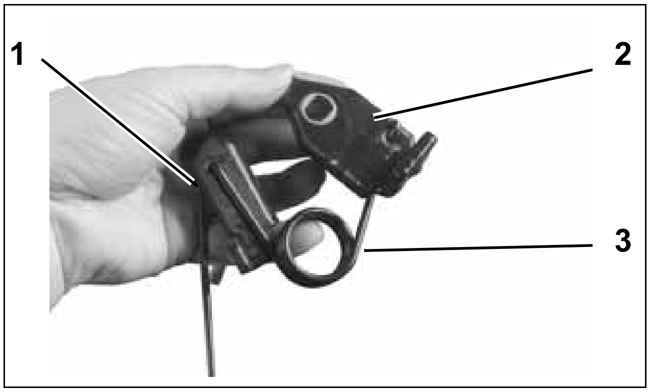
Refer to **Reverse Lock and Trail Lock Reference** on p. 253 for correct orientation of reverse lock and trail lock components.

Assemble reverse lock pivot shaft, reverse lock lever rod and bellcrank shaft spacer as shown.



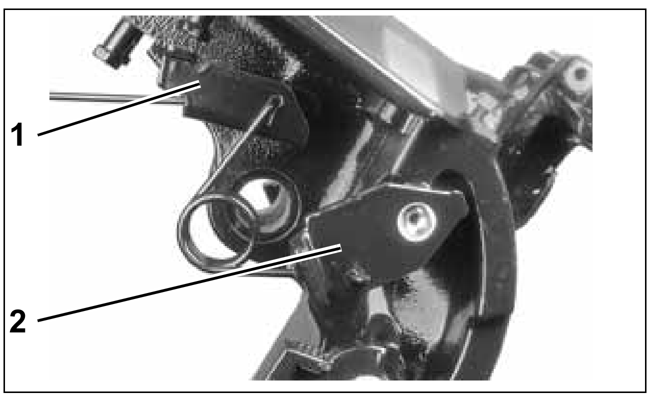
1. Reverse lock pivot shaft 006690
2. Bellcrank shaft spacer
3. Reverse lock lever rod

Assemble starboard trail lock lever and trail lock spring to reverse lock pivot shaft.



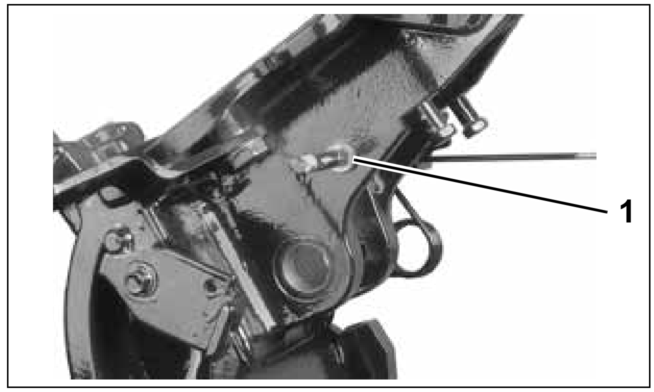
1. *Reverse lock pivot shaft and rod* 006691
2. *Trail lock lever*
3. *Trail lock spring*

Install nylon washer to trail lock shaft and install above components to swivel bracket. Install trail lock washer, apply blue *Nut Lock* to screw and install screw. Tighten both screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



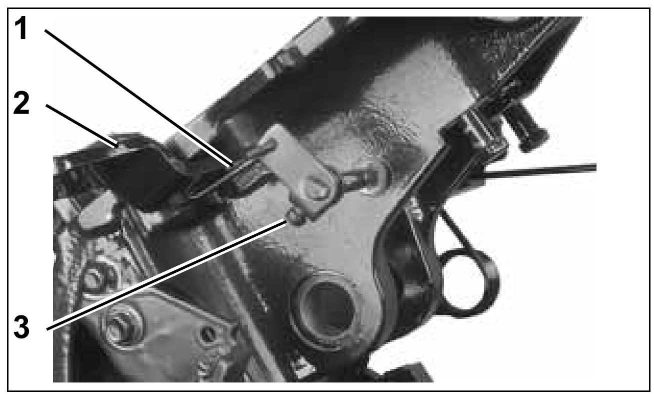
1. *Reverse lock pivot shaft* 006692
2. *Trail lock lever*

Install remaining bellcrank shaft spacer on reverse lock pivot shaft, then install retaining ring.



1. *Retaining ring* 006693

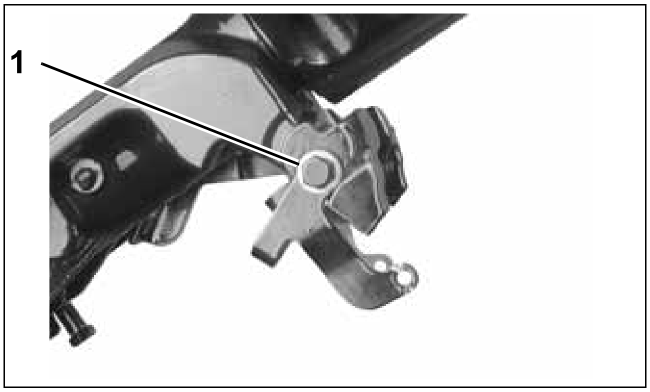
Install the rod handle link to reverse lock lever and bellcrank. Install bellcrank on reverse lock pivot shaft. Tighten the setscrew.



1. *Handle link rod* 006694
2. *Reverse lock lever*
3. *Bellcrank setscrew*

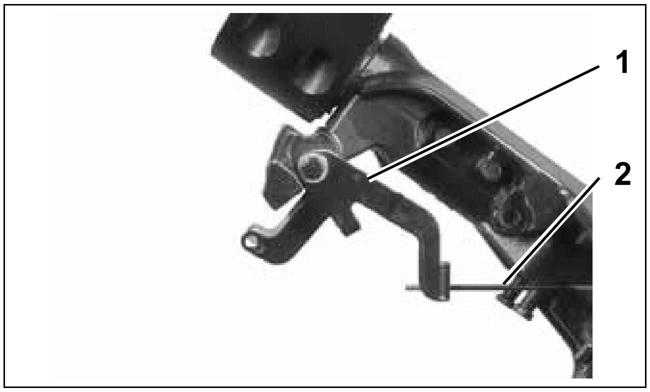
Install the port reverse lock link on the swivel bracket. Install washer screw. Apply blue *Nut Lock* to screw threads and install washer and screw.

Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.54 N·m).



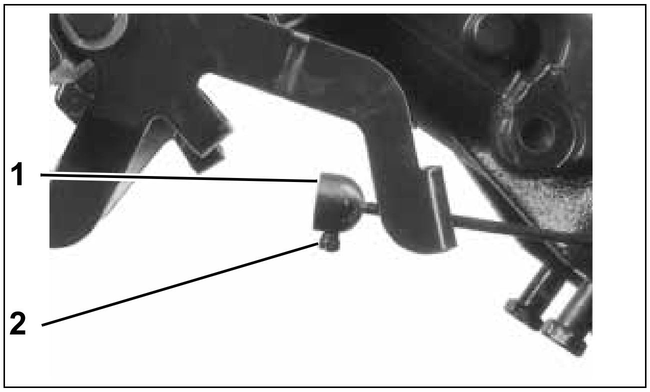
1. *Port reverse lock link* 006695

Place reverse lock lever rod through hole at top of starboard reverse lock lever. Install the starboard reverse lock link on the swivel bracket. Apply blue Nut Lock to screw threads and install washer and screw. Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



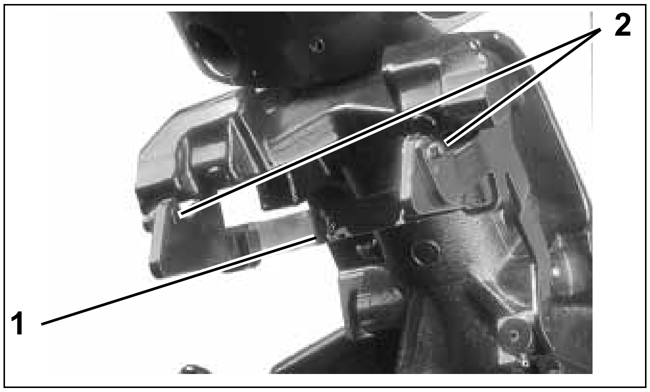
1. *Starboard reverse lock link* 006696
2. *Reverse lock lever rod*

Install reverse lock release collar and tighten set screw.



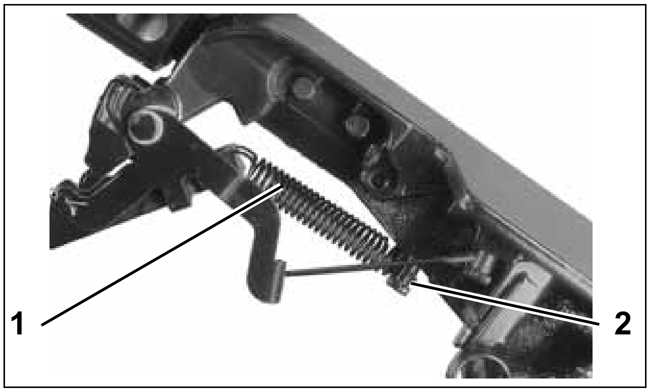
1. *Reverse lock release collar* 006697
2. *Set screw*

Install locking lever, pins and new cotter pins.



1. *Locking lever* 006699
2. *Pins*

Install reverse lock springs on locking lever and reverse lock spring screws.



1. *Reverse lock springs* 006700
2. *Reverse lock spring screws*

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NOTES

Technician's Notes

Related Documents

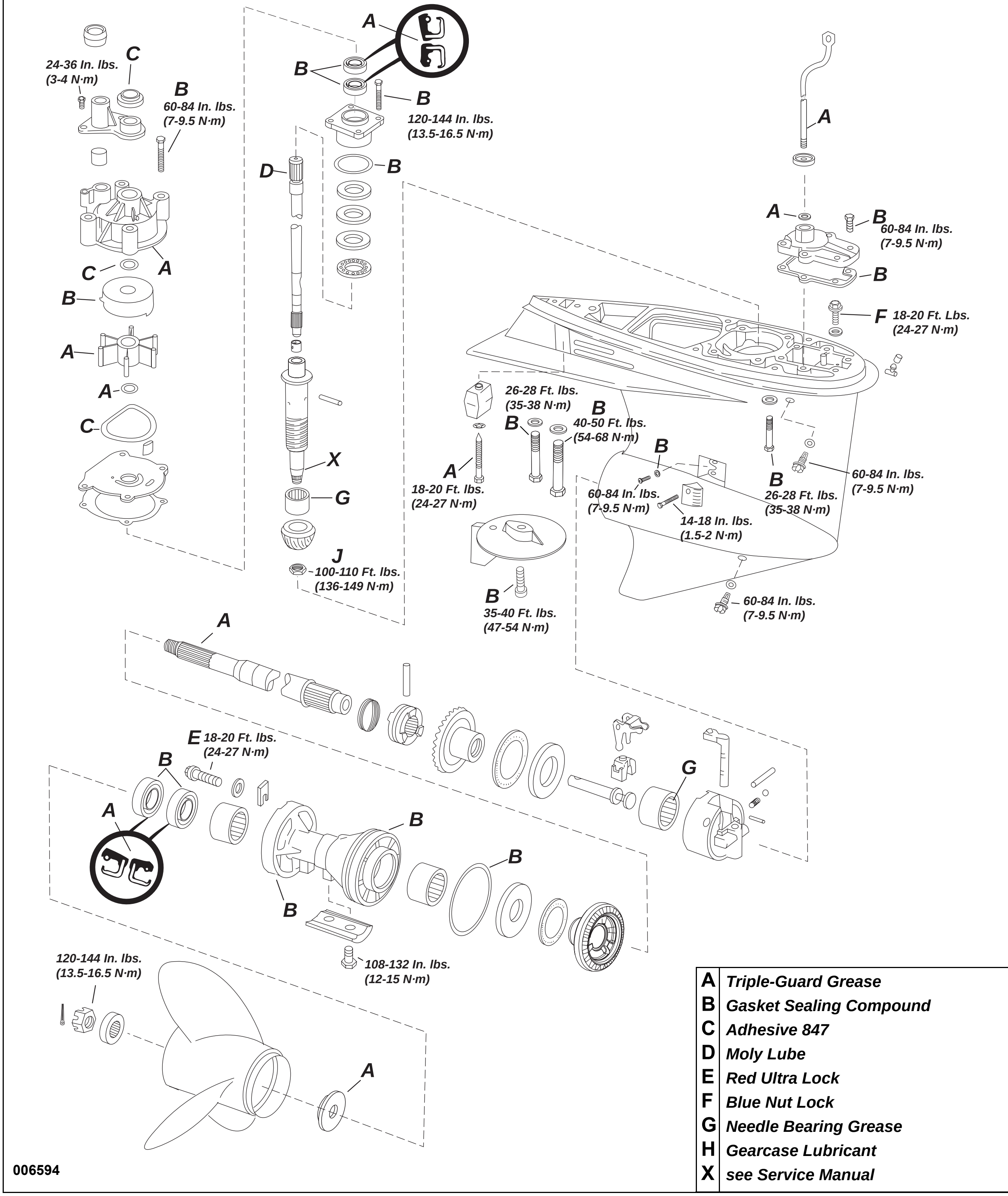
Bulletins	
Instruction Sheets	
Other	

GEARCASE

TABLE OF CONTENTS

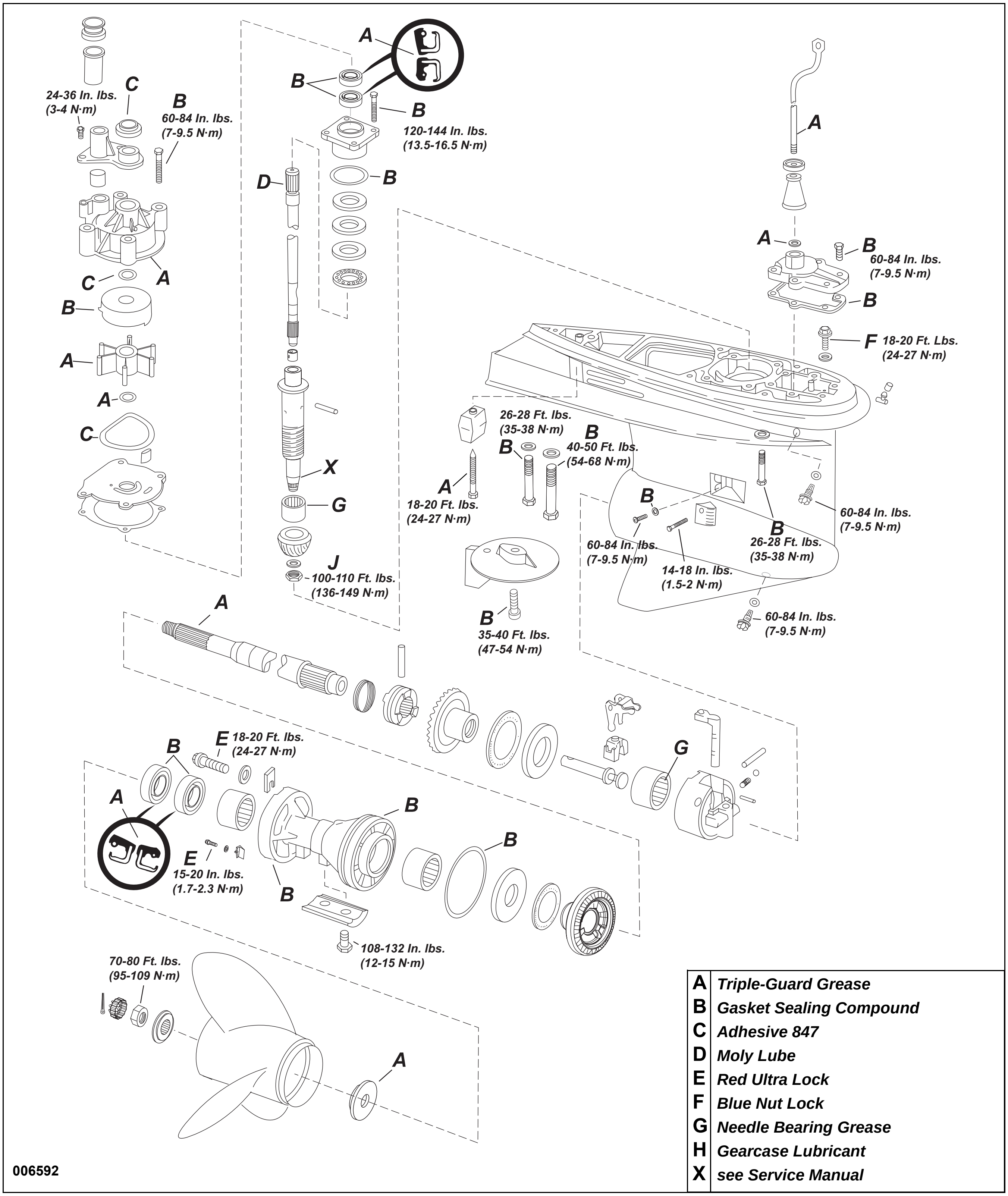
SERVICE CHART

"S"–TYPE GEARCASE



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*
H	*Gearcase Lubricant*
X	*see Service Manual*

"O"–TYPE GEARCASE – STANDARD ROTATION



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*
H	*Gearcase Lubricant*
X	*see Service Manual*

GEARCASE TYPES

Outboard Model	Gearcase Type	General Comparison	Service Procedure Comparison
(L) Models with 20 in. shaft	“S”	Unique housing, shafts, gears, and bearings	Similar
(X) Models with 25 in. shaft	“O”	Unique housing, shafts, gears, and bearings	

PROPELLER SERVICE

Inspection

Carefully examine propeller and outboard for the following:

- Damaged blades and signs of propeller cavitation (burned paint, etc.)
- Spun or overheated inner hub
- Worn or twisted splines and inadequate lubricant
- Damaged or missing converging ring (if applicable)
- Damage to outer hub area
- Worn, missing, or incorrect thrust washer and spacer
- Correct size and style
- Check for bent or damaged propeller shaft and twisted splines.

Refer to **Propeller Hardware Installation** on p. 59.

⚠ WARNING ⚠

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and disconnect the battery positive (+) cable so the outboard cannot be started accidentally.

GEARCASE LEAK TEST

Drain lubricant before testing.

Install lubricant drain/fill plug and seal, thread pressure test gauge fitting and seal in lubricant level hole.

Pressurize 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leak.

If the gearcase pressure gauge does not indicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leakage.

Make necessary repairs and repeat test.

Install vacuum test gauge. Apply 3 to 5 in. of vacuum (76 to 127 mm) Hg. with pump.

Check for leakage.

If leakage occurs, apply oil around suspected seal. If leak then stops or oil is drawn in, that seal is defective.

Repeat test, gearcase must hold minimum of 15 in. (381 mm) Hg.

002388

GEARCASE REMOVAL AND INSTALLATION

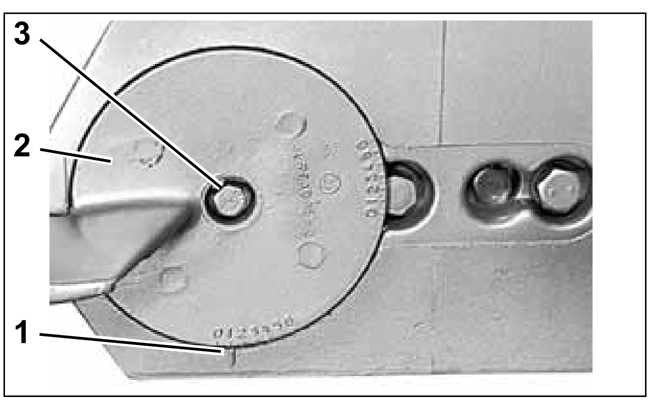
Gearcase Removal

> ⚠ **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.

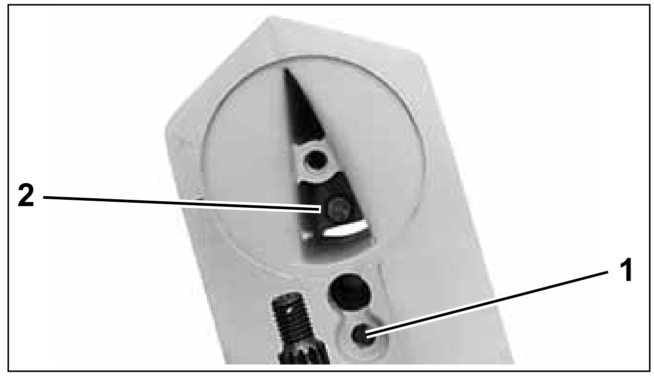
1. *Shift rod screw* — 002013

Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw and trim tab from the gearcase.



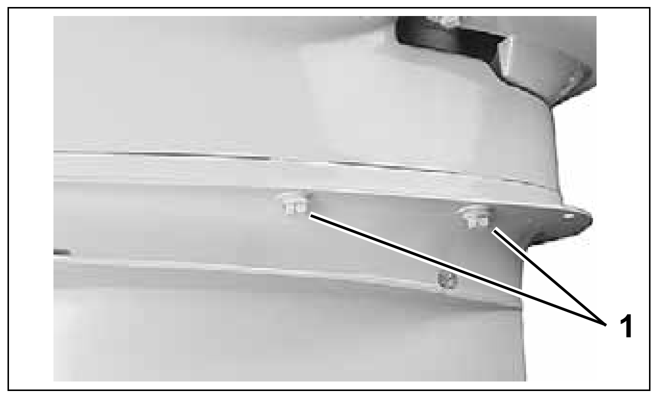
1. *Index mark* — COA3663
2. *Trim tab*
3. *Trim tab retaining screw*

Remove the forward screw with washer and recessed retaining screw.



1. *Forward screw* — COA3139
2. *Recessed screw*

Remove the four gearcase retaining screws.



1. *Gearcase retaining screws* — 001990

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

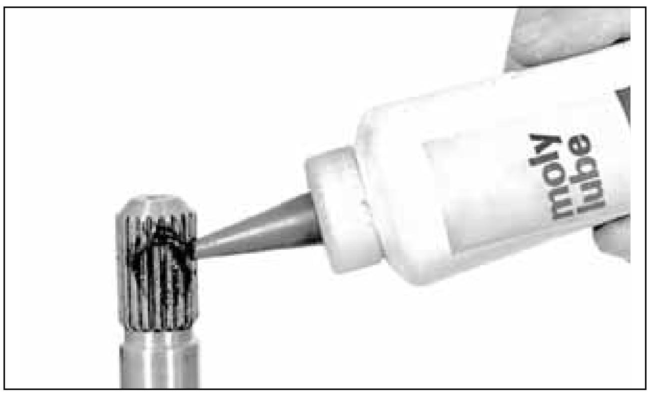
Gearcase Installation

⚠ WARNING ⚠

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

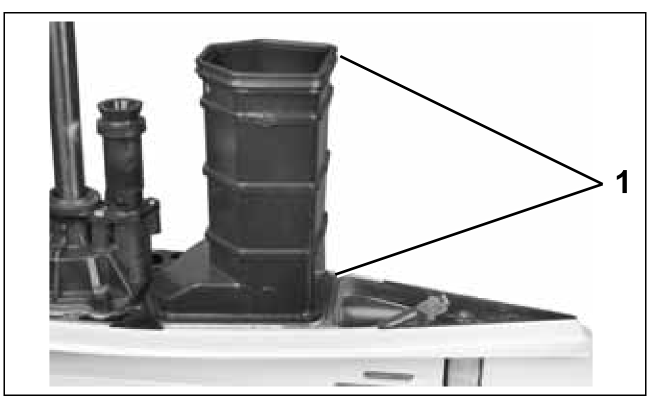
IMPORTANT: Before installing gearcase, shift rod adjustment MUST be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 266.

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



30385

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



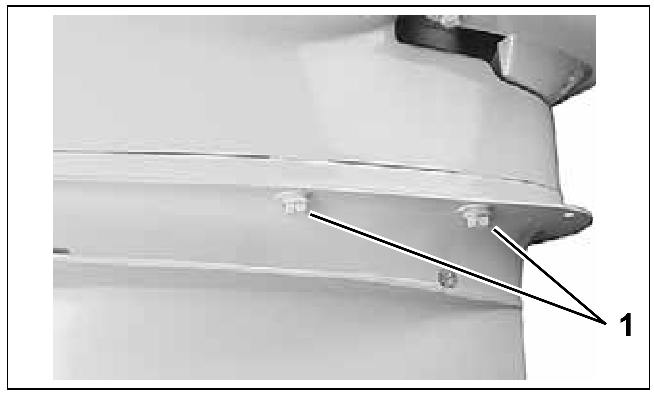
TYPICAL 001985
1. *Lower exhaust seals*

Apply *Gel-Seal II* to gearcase mating surface pads on exhaust housing. Slide the gearcase into place, making sure:

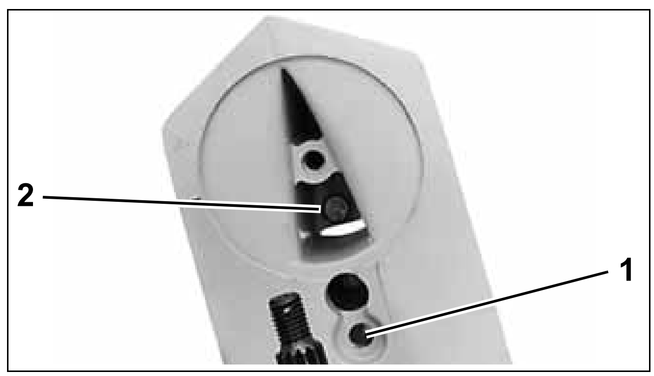
- Driveshaft engages the crankshaft.
- Water tube enters the water pump.
- Lower inner exhaust housing installs correctly.
- Shift rod does not turn and is positioned properly in shift shaft connection area.

Apply *Gasket Sealing Compound* to threads of the gearcase retaining screws. Tighten the screws to a torque of:

- **3/8 in.** screws – 26 to 28 ft. lbs. (35 to 38 N·m)
- **7/16 in.** screws – 40 to 50 ft. lbs. (54 to 68 N·m)

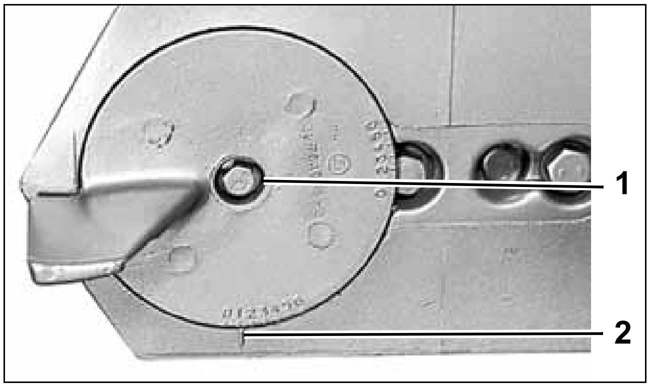


1. *3/8 in. screws* 001990



1. *7/16 in. screw* COA3139
2. *3/8 in screw*

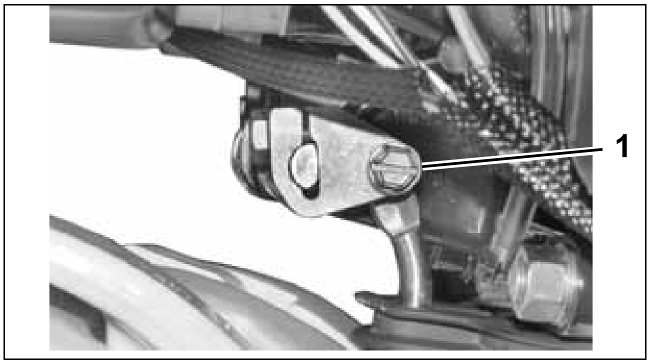
Apply *Gasket Sealing Compound* to threads of the trim tab screw. Install and align the trim tab with the index marks noted prior to disassembly. Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m). For adjustment, refer to **Trim Tab Adjustment** on p. 62.



1. *Trim tab screw*
2. *Index mark*

COA3663

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. *Shift rod screw*

002013

⚠ WARNING ⚠

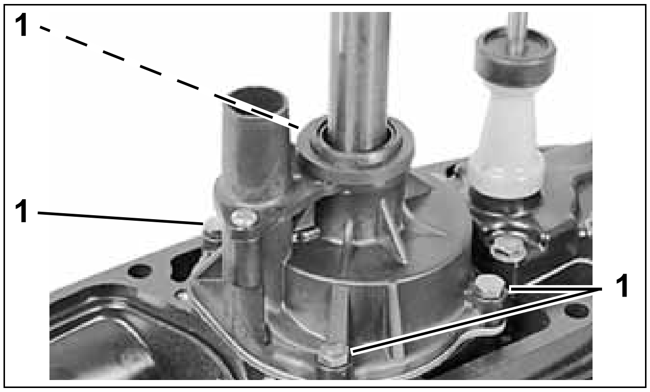
To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

IMPORTANT: During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

WATER PUMP SERVICE

Disassembly

Rotate the driveshaft counterclockwise to unlock the impeller cam. Remove the four impeller housing screws.



1. *Screws*

31998

Slide the water pump off the driveshaft. Remove the impeller drive cam, O-ring, impeller plate, and gasket. Discard the gasket.

1. *O-ring*
2. *Impeller plate*

DSC02328

Remove all the parts from the housing.

Inspection

Check impeller for overheating, hub separation, and other wear or damage.

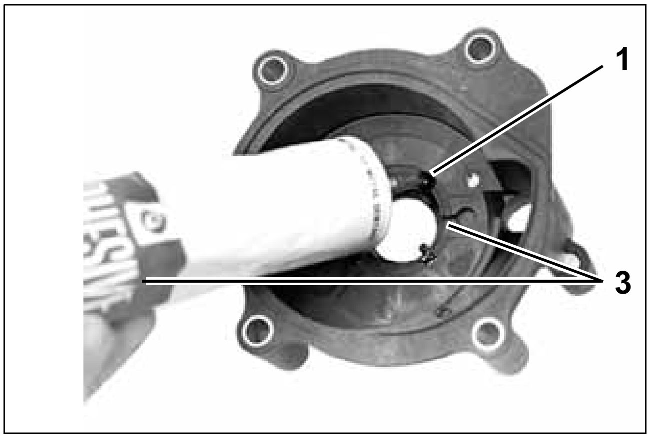
Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.

Assembly

Apply a drop of *Adhesive 847* in the seal ring groove at each of the four ribs.

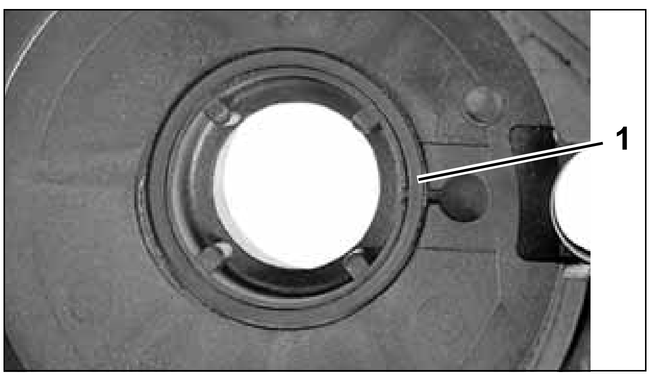
IMPORTANT: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.



1. *Seal ring groove*
2. *Ribs*
3. *Air bleed groove*

2311
DR1185

Install the O-ring in groove in the impeller housing.

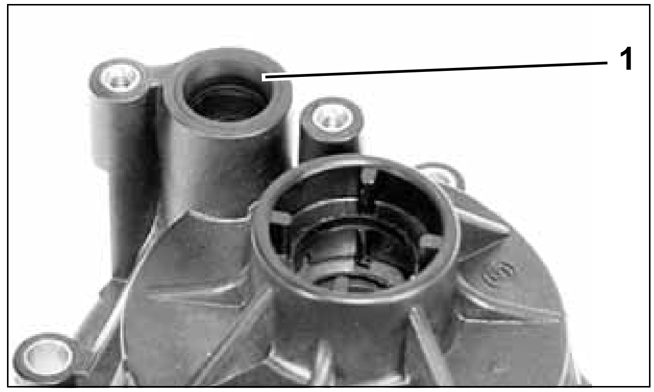


1. *O-ring*

34814

Lightly coat the exterior of the impeller cup with *Gasket Sealing Compound*. Install the cup in the impeller housing.

Install the water tube grommet with the inside taper facing up.

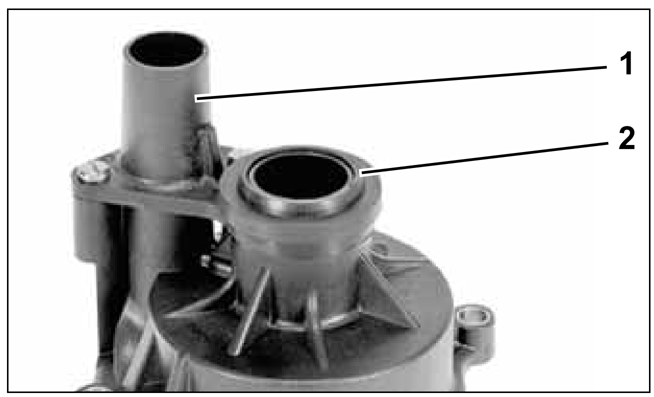


1. *Water tube grommet*

32000

Install the impeller housing cover and tighten screws to a torque of 24 to 36 in. lbs. (3 to 4 N·m).

Apply *Adhesive 847* to flat side of the impeller housing grommet. Install the grommet, flat side down.

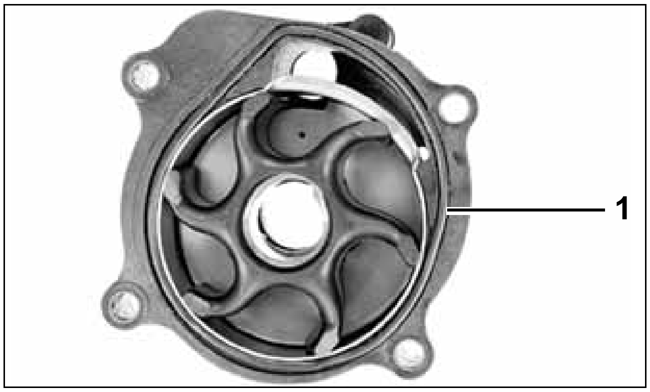


1. *Impeller housing cover*
2. *Impeller housing grommet*

32001

Lightly coat the liner with *Triple-Guard* grease. With a counterclockwise rotation, install the impeller into the liner with slot for impeller cam facing out.

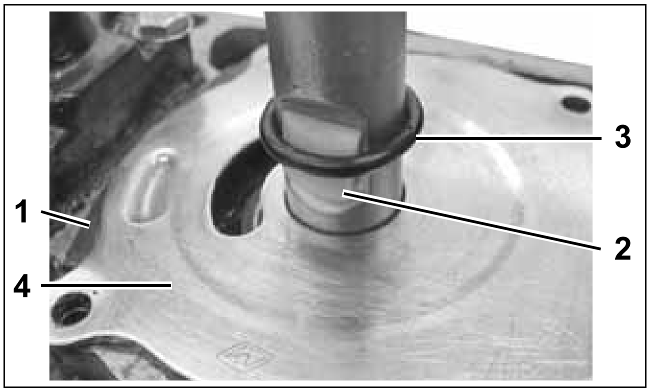
Run a thin bead of *Adhesive 847* in the seal groove, and install the special shaped O-ring seal.



1. *O-ring* 34815

Apply *Gasket Sealing Compound* to both sides of a new impeller plate gasket. Install the gasket and impeller plate.

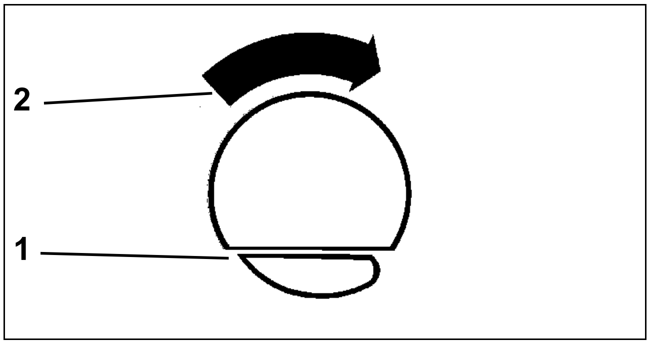
Apply *Triple-Guard* grease to a new impeller O-ring. Slide the O-ring down the driveshaft and slide half way over installed drive cam to temporarily hold cam in place.



1. *Impeller plate gasket* DSC02326
2. *Impeller plate*
3. *O-ring*
4. *Drive cam*

The sharp edge of the cam is the leading edge in clockwise rotation.

Slide the water pump down the driveshaft. Align impeller slot with the impeller cam. Rotate the driveshaft to engage the impeller cam with the impeller, and slide water pump down over cam. Be sure impeller cam does not fall out of position.



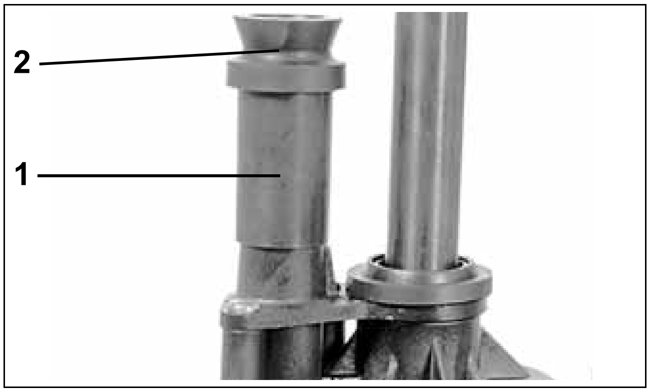
1. *Sharp edge of drive cam* CO2995
2. *Direction of driveshaft rotation*

IMPORTANT: Make sure the impeller engages the impeller cam. Serious powerhead damage will result if impeller cam 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).

25 IN. MODELS

Place water tube spacer with grommet on the impeller housing cover.



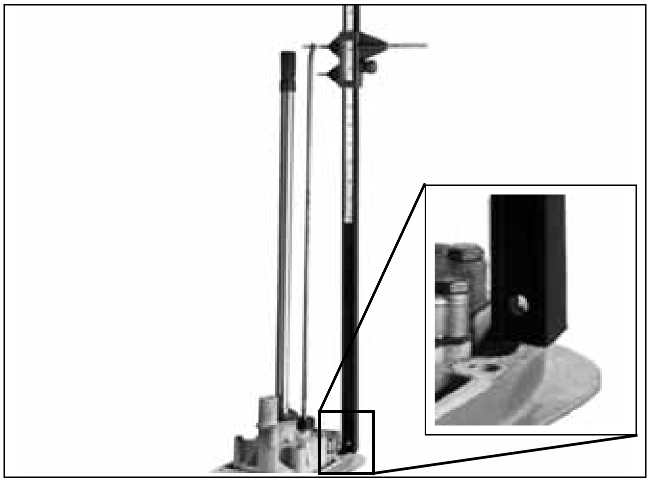
25 in. Model Water Tube Spacer 32728
1. *Spacer*
2. *Grommet*

IMPORTANT: Before installing gearcase, shift rod adjustment MUST be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 266.

13

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 forward.

IMPORTANT: The NEUTRAL detent is a two-step design. Make sure the NEUTRAL detent ball is in the center step before checking shift rod height.

Shift Rod Heights

Model	Type	Height
20 in. (L)	“S”	21.25 in. ± One-Half Turn
25 in. (X)	“O”	26.25 in. ± 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 and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant** on p. 71.

Remove gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 261.

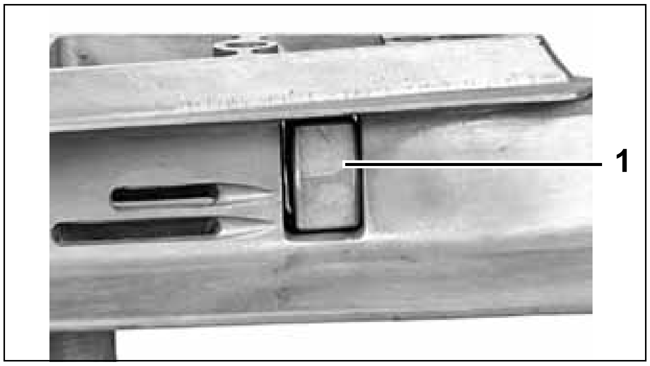
Remove water pump. Refer to **WATER PUMP SERVICE** on p. 263.

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 4557

- **Gearcase Anodes —** If anodes have eroded to two-thirds their original size, they must be replaced.

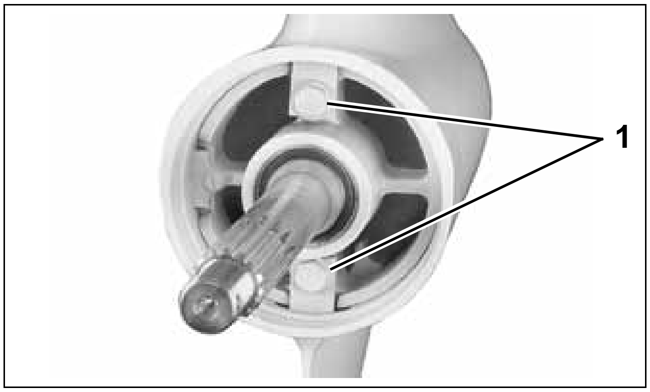


1. Gearcase anode 14161

- **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.

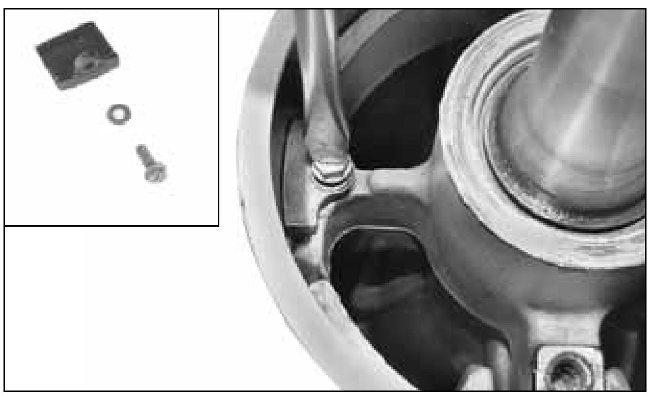
Propeller Shaft Bearing Housing Removal

Remove the two screws, washers, and retainers holding the propeller shaft bearing housing.



1. *Retainer tab screws* 001989

Remove wedge, screw, and washer (“O” Type).

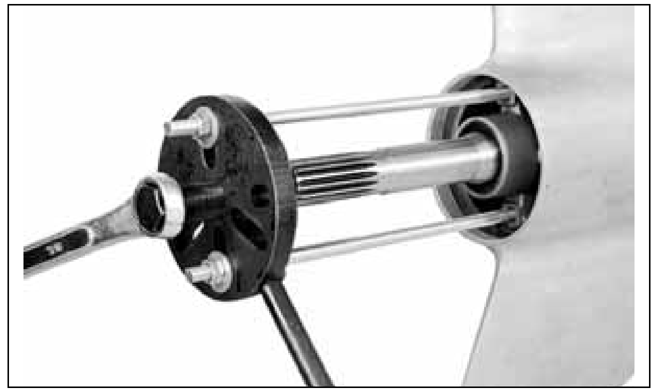


DSM02291
DSC02361

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 11 in. (279 mm) threaded rods, two large 5/16 in. I.D. flat washers, and two 5/16-18 nuts (obtain locally).

Assemble components and pull the bearing housing from the gearcase. Remove the thrust washer, thrust bearing, and reverse gear from gearcase.

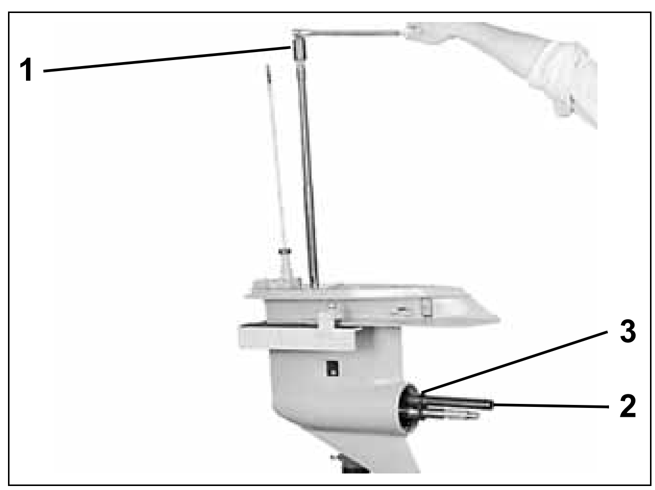


22775

Pinion Gear and Driveshaft Removal

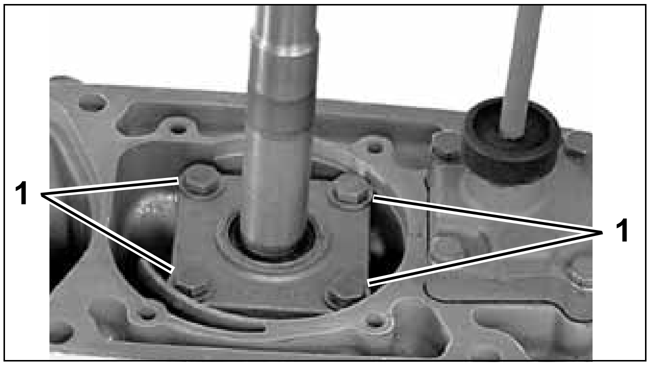
Adjust the shift rod to move the clutch dog as far forward as possible. This will help ease removal of the pinion nut.

Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Holder, P/N 334455, and Wrench Retainer, P/N 341438 to loosen the pinion nut from the bottom of the driveshaft. Pad handle of holder to prevent damage to gearcase.



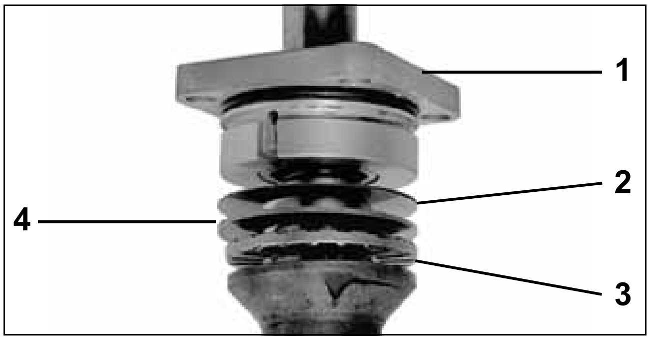
1. *Holding socket* 42229
2. *Pinion holder*
3. *Retainer*

Remove the four driveshaft bearing housing screws.



1. *Driveshaft bearing housing screws* COA3153

Remove pinion nut and driveshaft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



1. *Bearing housing* COA3558
2. *Shims*
3. *Thrust bearing*
4. *Thrust washer*

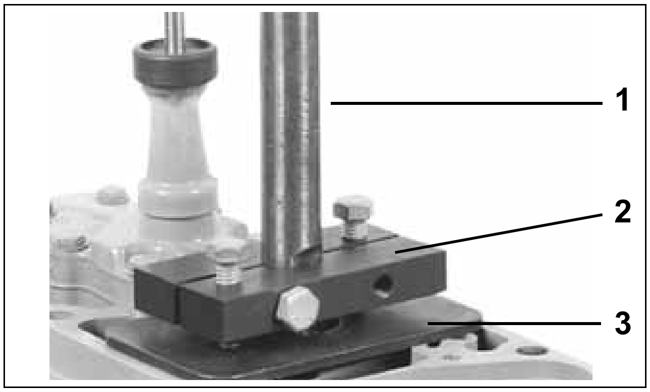
If driveshaft cannot be removed, refer to **Locked Driveshaft Removal** on p. 269.

Remove the pinion gear and pinion nut from the gearcase.

COA3159

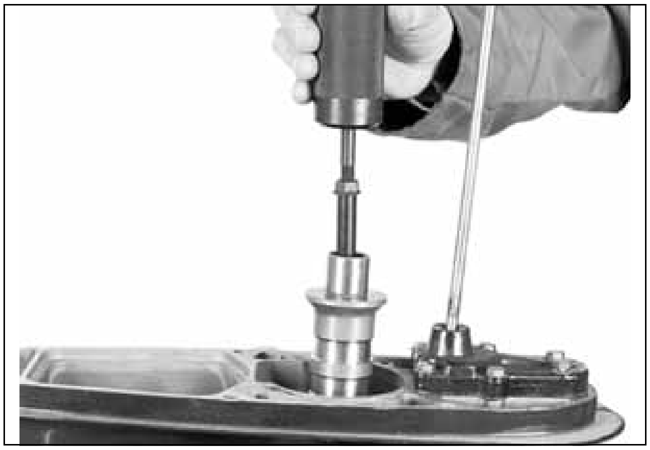
Locked Driveshaft Removal

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



1. *Drive shaft* 41177
2. *Puller*
3. *Backing plate*

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

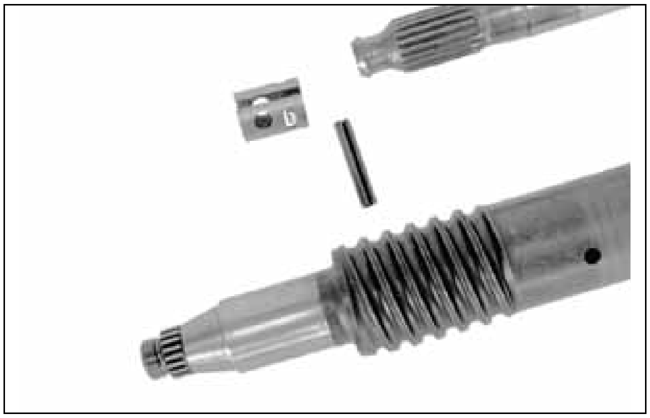


46905

13

Driveshaft Service

To separate the upper driveshaft (if needed) from the lower driveshaft, remove the roll pin. Replace the damaged component.



29337

To assemble the driveshaft, install **new** driveshaft retainer into the groove of the upper driveshaft.

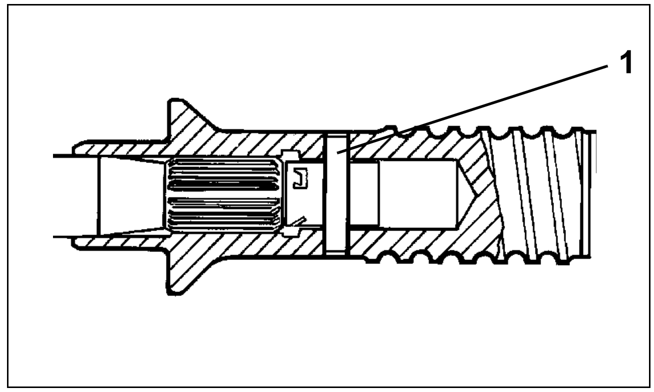
29338

Install the upper driveshaft into the lower driveshaft, aligning the holes in the driveshaft retainer and the lower driveshaft.

29330

"S" Type Gearcases

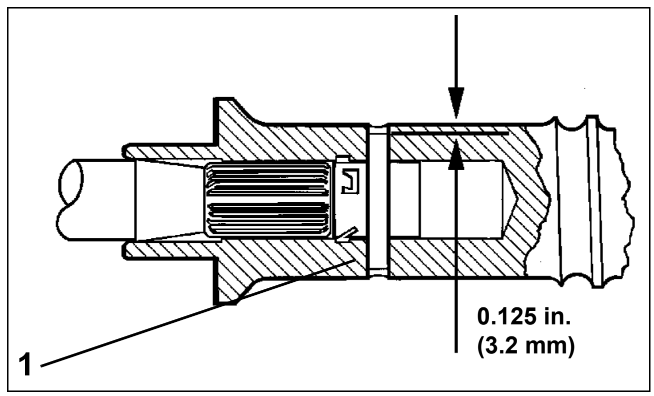
Install the roll pin flush.



1. *Roll pin* DR4596

"O" Type Gearcases

Install the roll pin to the specified dimension.



1. *Roll pin* DR4610

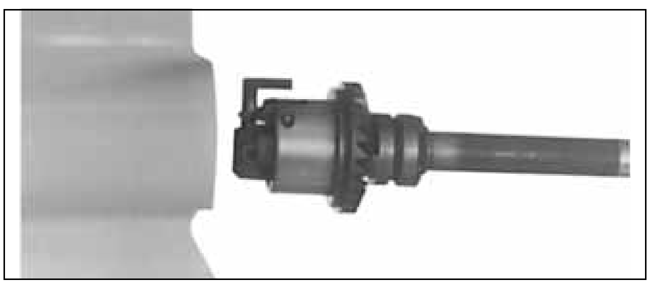
Shift Housing, Gear and Propeller Shaft Removal

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.

1. *Cover gasket* COA3141

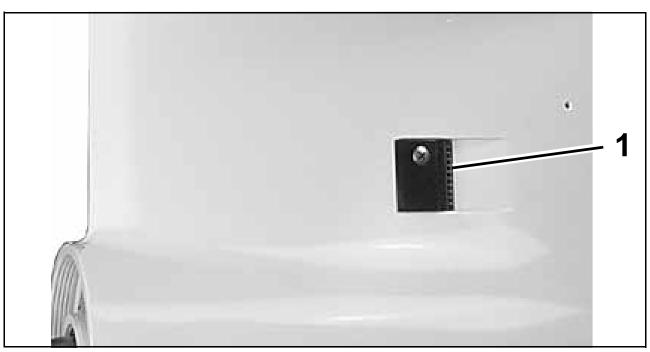
Remove propeller shaft assembly from gearcase.



COA3149

Water Intake Screens

Remove and clean water intake screens. Replace if damaged.



1. *Water intake screen* 001991

GEARCASE HOUSING INSPECTION

Thoroughly clean gearcase housing to remove all dirt and debris prior to inspection. Inspect pinion bearing and forward thrust surface of gearcase housing.

Use Gearcase Alignment Gauge Kit, P/N 5006349 to check the condition of gearcase housing prior to reassembly. Refer to instructions provided with kit. Use additional Gauging Head as follows:

- P/N 352879, for “S” Type gearcases.

004315

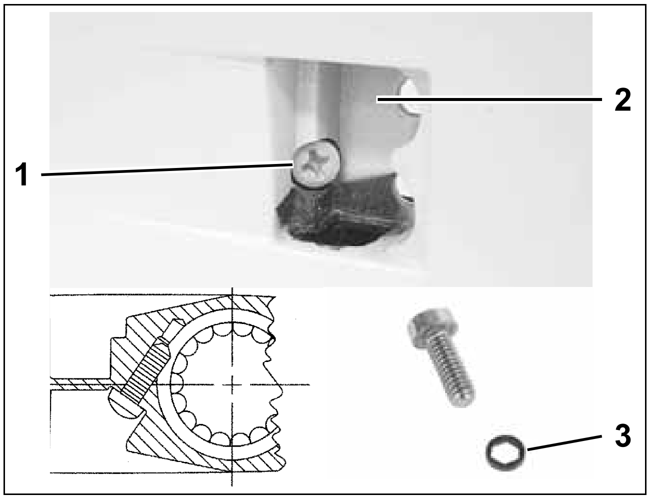
IMPORTANT: DO NOT force gauging shaft into alignment hole. Shaft MUST slide easily into hole of gauging head. If shaft does not slide into hole, gearcase housing is damaged and **must** be replaced.

1. *Gauging shaft* 004347

SHIFTER, BEARING AND SEAL SERVICE

Pinion Bearing Removal

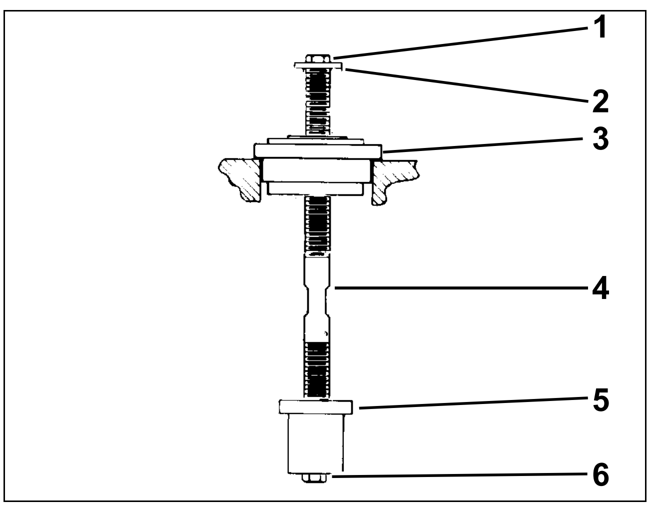
Remove pinion bearing retaining screw.



1. *Pinion bearing retaining screw* DSC02370
2. *Water screen pocket* DRC7416
3. *Seal* DSC02313

"S" Type Gearcases

Assemble Pinion Bearing Remover/Installer, P/N 391257, in the gearcase as follows:

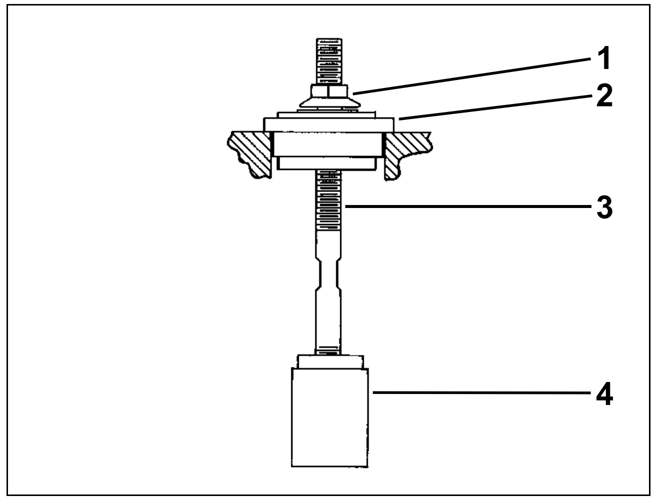


1. *1/4-20 x 1/2 in. Hex Head Screw* 824163
2. *1 in. O.D. Flat Washer*
3. *Plate, P/N 391260*
4. *Rod, P/N 326582*
5. *Installer/Remover, P/N 326574*
6. *1/4-20 x 1 1/4 in. Hex Head Screw*

Use a mallet to drive the bearing from the housing.

"O" Type Gearcases

Use a 7/8 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise. Draw the bearing up from the housing.

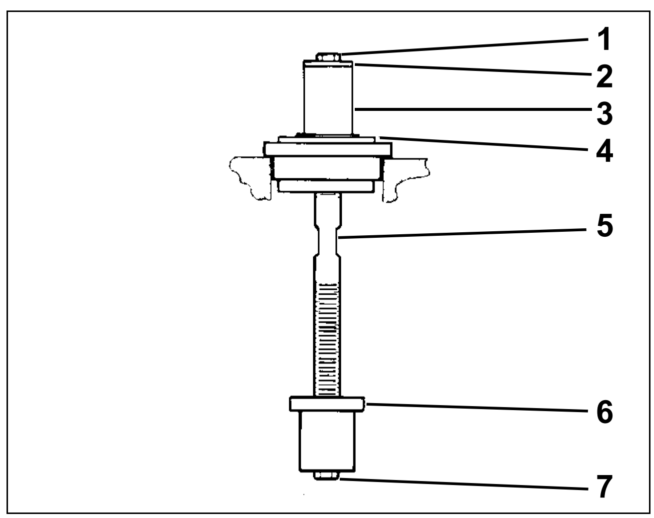


1. *Flange nut, P/N 326586* DR3419
2. *Plate, P/N 391260*
3. *Rod, P/N 326582*
4. *Remover, P/N 326579*

Pinion Bearing Installation

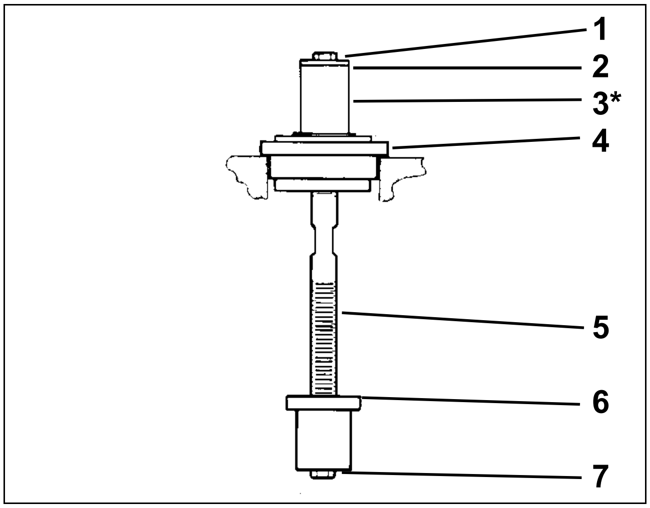
Assemble the following components of Pinion Bearing Remover and Installer, P/N 391257, as shown:

"S" Type Gearcases



1. *1/4-20 X 1/2 in. Hex head screw* 824182
2. *1 in. O.D. Flat washer*
3. *Spacer, P/N 341437*
4. *Plate, P/N 391260*
5. *Rod, P/N 326582*
6. *Installer/Remover, P/N 326574*
7. *1/4-20 X 1 1/4 in. Hex head screw*

"O" Type Gearcases



1. *1/4-20 X 1/2 in. Hex head screw* 824182
2. *1 in. O.D. Flat washer*
3. *Spacer, P/N 326584*
4. *Plate and Bearing P/N 391260*
5. *Rod P/N 326582*
6. *Installer/Remover, P/N 350958*
7. *1/4-20 X 1 1/4 in. Hex head screw*

IMPORTANT: Spacers are different sizes and cannot be interchanged.

Apply *Needle Bearing* grease to the needle bearings and insert them into the bearing case ("O" Type gearcases).

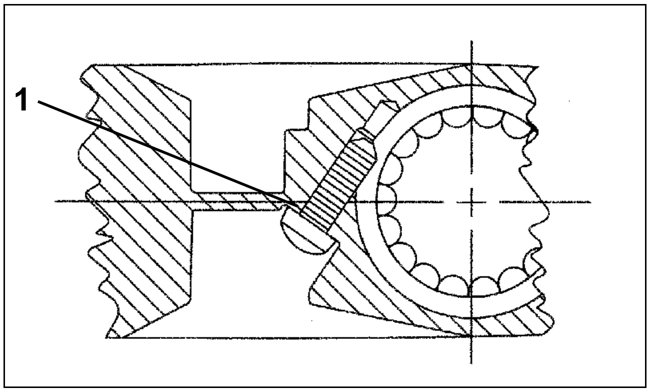
Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

IMPORTANT: The pinion bearing is tapered so that, when installed correctly, its shape compensates for stresses in the gearcase and allows full bearing contact. Whenever a gearcase is disassembled, the pinion bearing should be checked to ensure that it has been installed with the lettering facing up.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Remove the tool.

Position new O-ring on the pinion bearing retaining screw. Apply G*asket Sealing Compound* to O-ring. Apply *Nut Lock* to screw threads. Install the screw and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. *O-ring* DRC7416

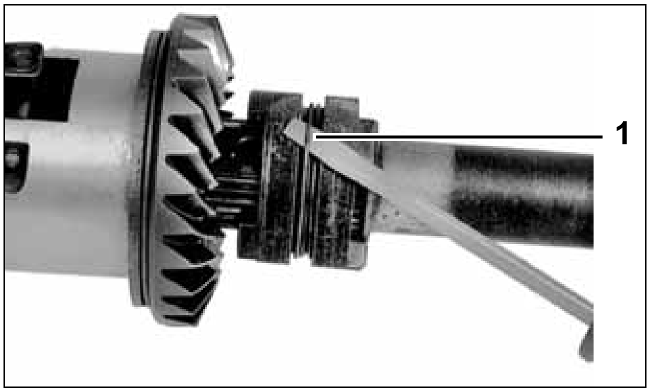
Shift Housing Disassembly

⚠ WARNING ⚠

Wear safety glasses to avoid injury.

IMPORTANT: The shift housing and bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

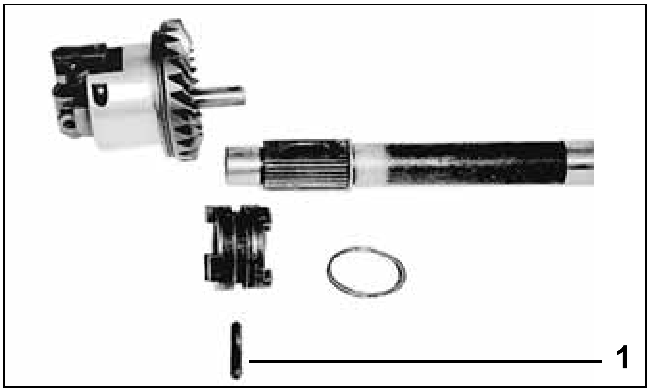
Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring**.



1. *Clutch dog spring* COA3560

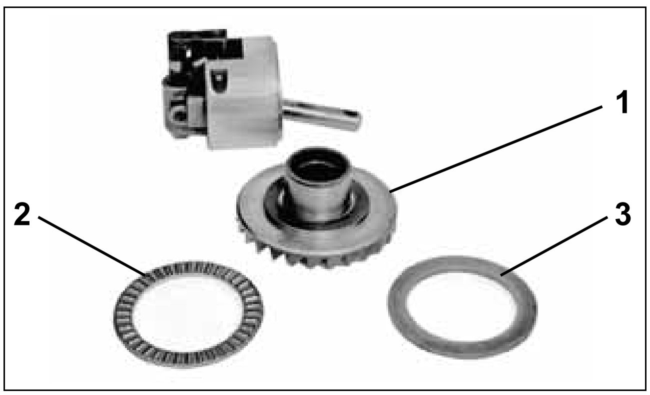
13

Push the pin out of the clutch dog. Remove all parts.



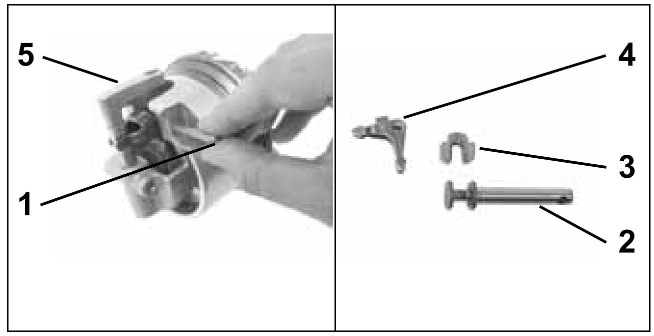
1. *Pin* COA3561

Remove the gear, thrust bearing, and thrust washer from the shift housing.



1. *Gear* COA3562
2. *Thrust bearing*
3. *Thrust washer*

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.

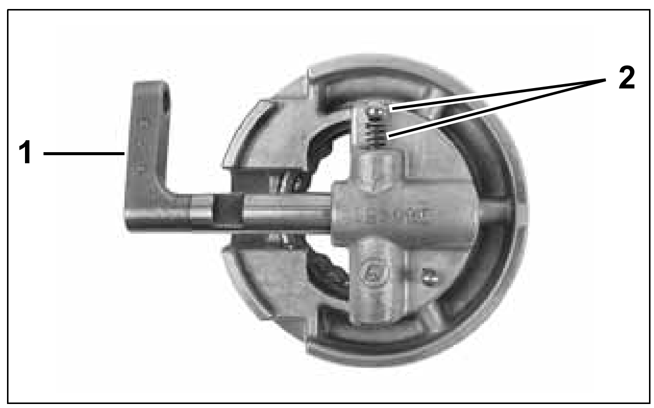


1. *Shift lever pin* DSC02449
2. *Shift shaft* DSC02489
3. *Cradle*
4. *Shift lever*
5. *Shifter detent*

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* DSC02518
2. *Ball and spring*

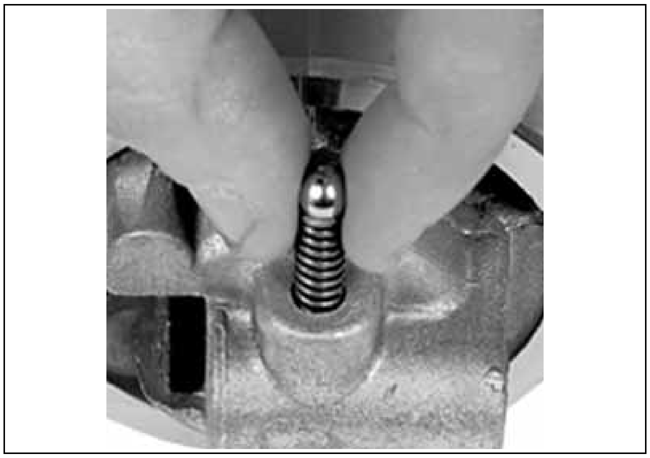
Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection (“O” Type).

Shift Housing Assembly

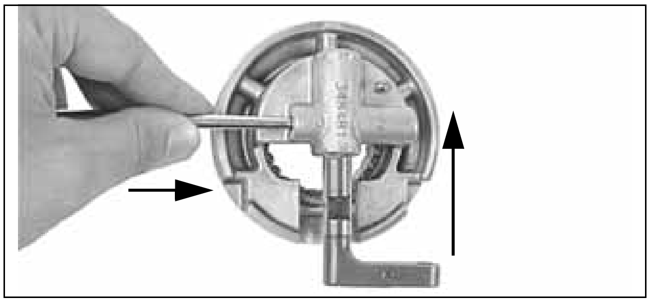
IMPORTANT: Clean and inspect all parts before beginning assembly procedures. Replace any damaged parts.

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.

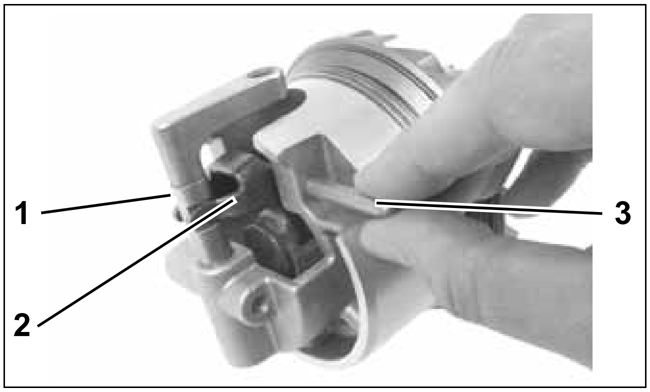


DSC02506

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case (“O” Type gearcases).

4520

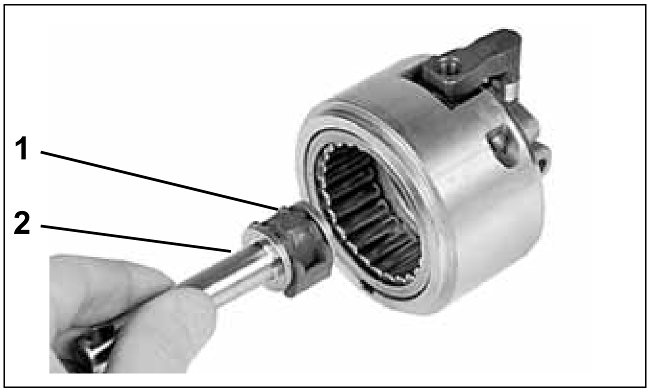
With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



1. *Shifter detent*
2. *Shift lever*
3. *Pin, shift lever*

DSC02449

Rest the cradle on the shift shaft.



TYPICAL
1. *Cradle*
2. *Shift shaft*

4512

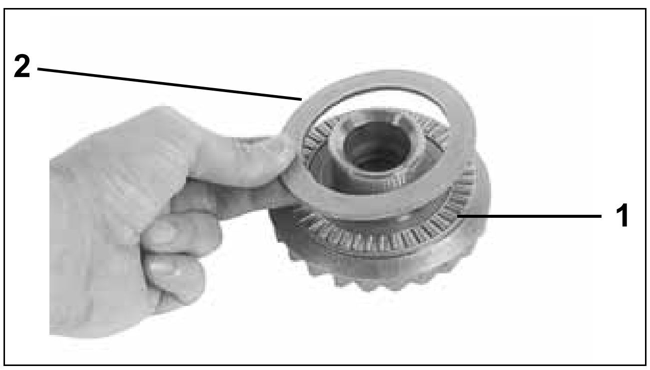
13

Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEUTRAL position to hold the cradle and shaft in place.

001219

Coat thrust bearing and thrust washer with *Needle Bearing* grease. Place the bearing on the back of the gear. Set the washer on top of the thrust bearing. Insert the gear, bearing, and washer into the bearing housing.

IMPORTANT: Bearing and washer must be installed in the correct order.

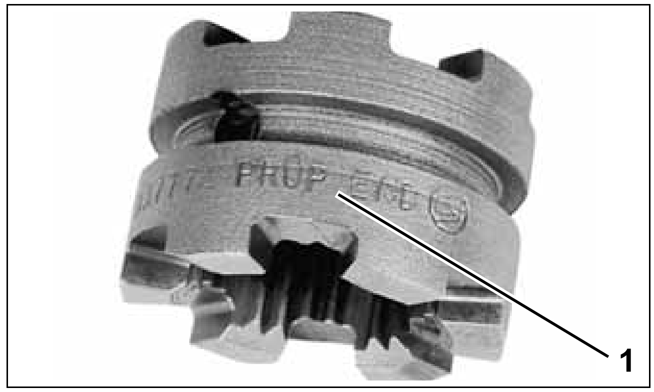


1. *Thrust bearing*
2. *Thrust washer*

DSC02297

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

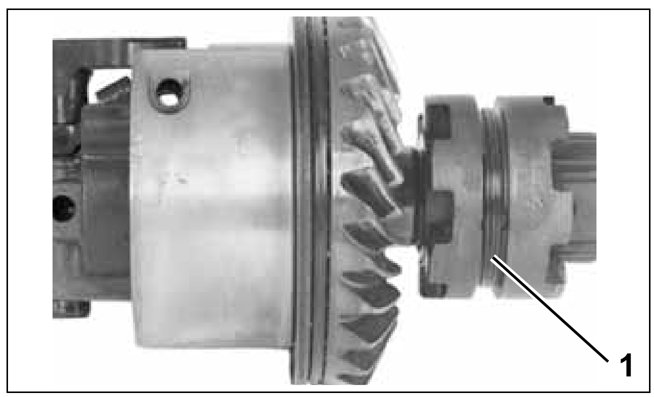
IMPORTANT: The clutch dog is not symmetrical. If installed backward, it will not fully engage and will immediately damage itself and the gears.



1. *"PROP END"*

COB7581

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



1. *Retaining spring*

COB3101

Driveshaft Bearing Housing Service

The driveshaft bearing is not serviceable. Replace the bearing housing assembly if the bearing is worn or damaged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Seal Removal

Remove the driveshaft bearing housing seals using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seals.

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.

Seal Installation

Lightly apply *Gasket Sealing Compound* to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

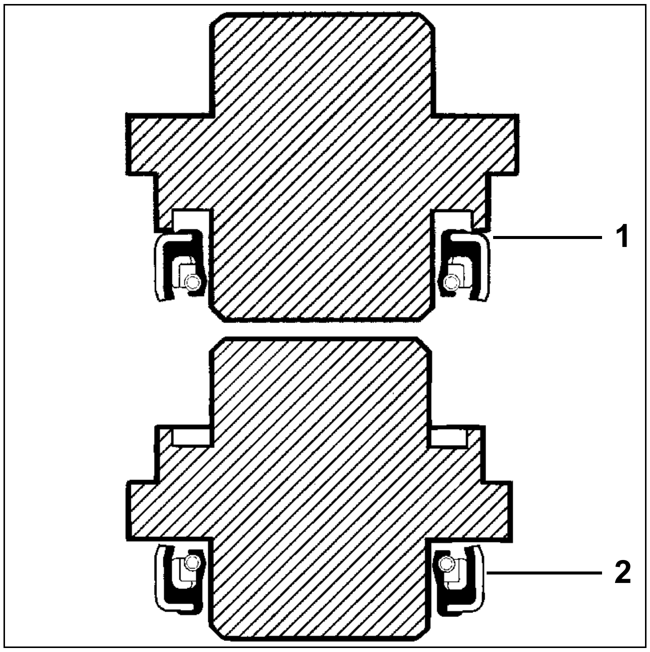
IMPORTANT: Do not install the O-ring in the bearing housing's bottom groove. The bottom groove is an oil passage. Gearcase damage could result.

1. *O-ring (top groove)*
2. *Oil passage*

14156

Apply *Gasket Sealing Compound* to metal casings of new seals before installing.

Use Seal Installation Tool, P/N 330268 to install new seals back to back in bearing housing. Install inner seal with lip facing toward bearing housing, then the outer seal with lip facing away from bearing housing. Apply *Triple-Guard* grease to seal lips.



1. *Inner seal*
2. *Outer seal*

DR2061
DR2062

13

Propeller Shaft Bearing Housing Service

Rear Seal Removal

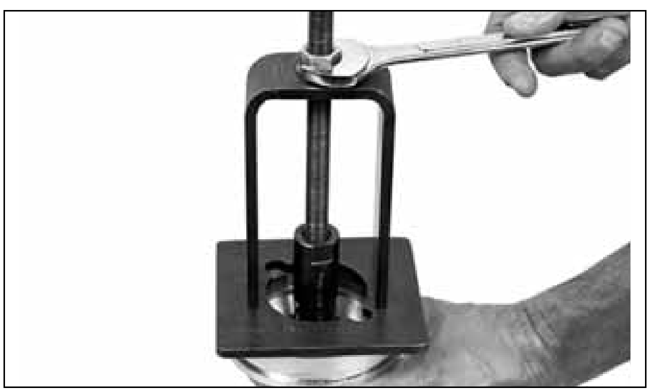
Remove seals using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131. Place the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.

13520

Bearing Removal

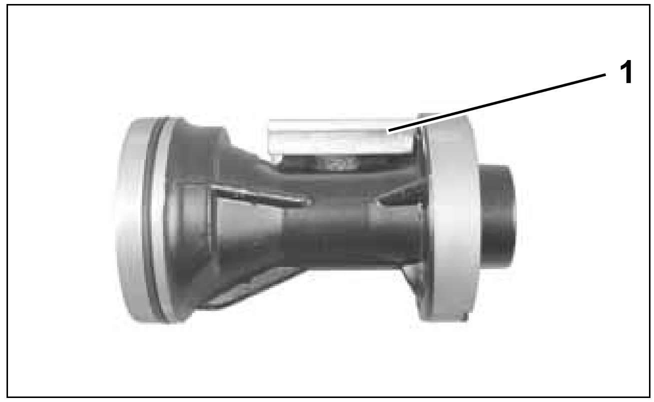
IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

Remove either bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.



13522

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

Bearing Installation

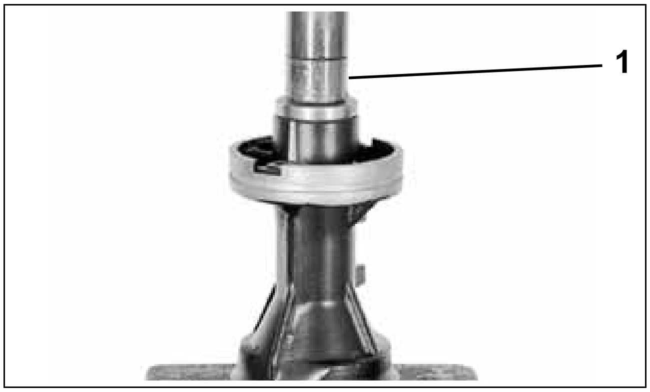
Oil, then install new bearings in bearing housing.

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 – “S” Type gearcases
- P/N 339750 – “O” Type gearcases

Forward Bearing 29967
1. *Bearing installation tool*



Rear Bearing 44237
1. *Bearing installation tool*

Rear Seal Installation

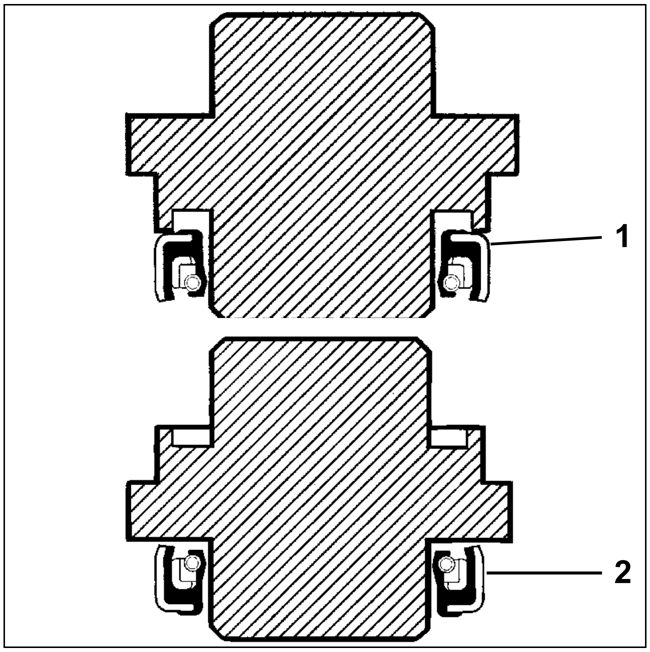
Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

Seal installation tool:

- P/N 326551 – “S” Type gearcases
- P/N 336311 – “O” Type gearcases

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



1. *Inner seal* DR2061
2. *Outer seal* DR2062

Apply *Triple-Guard* grease to seal lips.

13

DRIVESHAFT SHIMMING

IMPORTANT: If new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is achieved by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion, or driveshaft, it is necessary to properly shim the assembly to restore factory clearance.

Use Driveshaft Shimming Tool, P/N 5005925 (replaces P/N 393185).

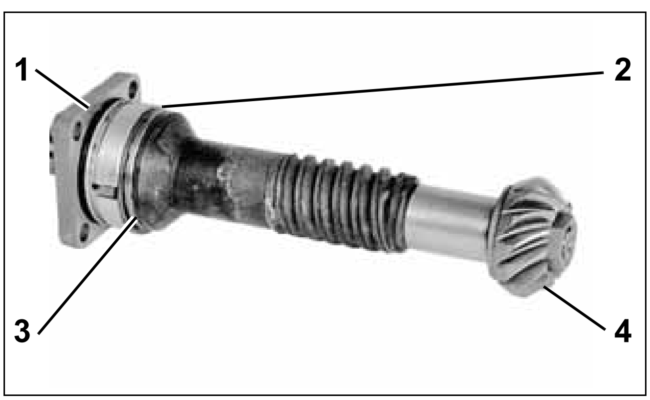
Shim gauge bars are precision made and should be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 318674, when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with outboard lubricant and tighten to a torque of 100 to 110 ft. lbs. (136 to 149 N·m).

IMPORTANT: The original pinion nut may be used for shimming, but must **NOT** be used in final assembly.



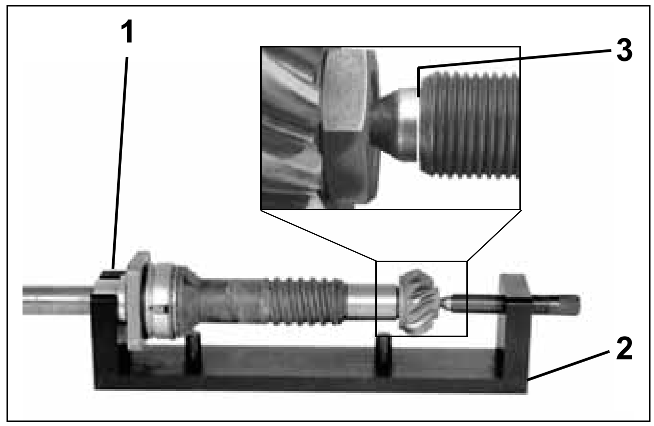
1. *Driveshaft bearing housing*
2. *Thrust washer*
3. *Thrust bearing*
4. *Pinion*

COA3565

Select correct collar and shim gauge bar:
- Collar: P/N 341440
- Shim gauge bar: P/N 328367

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.

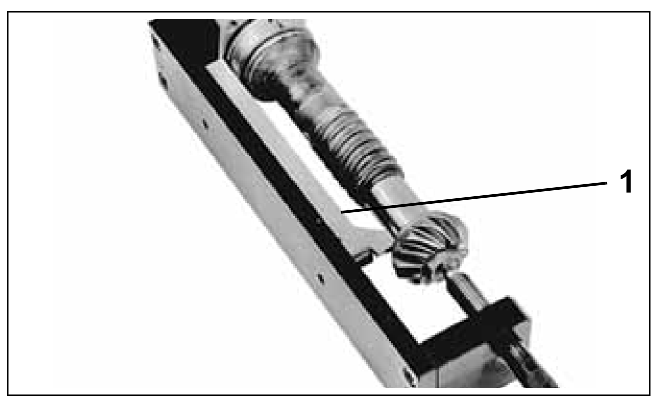


1. *Collar*
2. *Tool base*
3. *Groove*

COA3566
DSC00326

Rotate the driveshaft several revolutions to seat bearings.

Lay the tool base on its side. Position the shim gauge bar against guide pins of the tool base.



1. *Shim gauge bar*

COA3567

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).

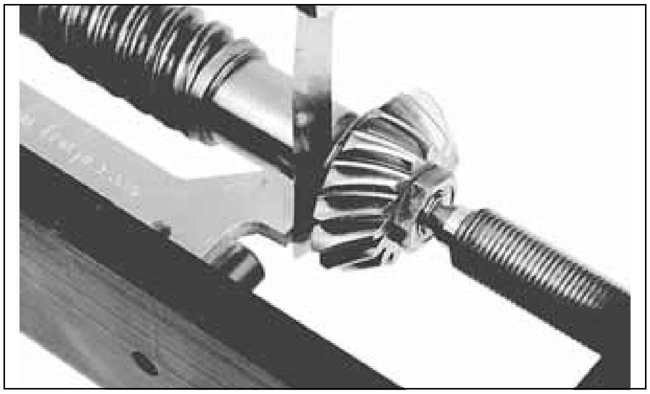
Check squareness of the pinion to the driveshaft. Hold the shim gauge bar against the bearing housing (between the screw holes) while rotating **just the driveshaft and pinion assembly**. Measure clearance between the gauge bar and the pinion at several locations. If variance is greater than 0.002 in. (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 318674.

Check clearance again. The measurement between the gauge bar and pinion should be 0.020 in. (0.508 mm).



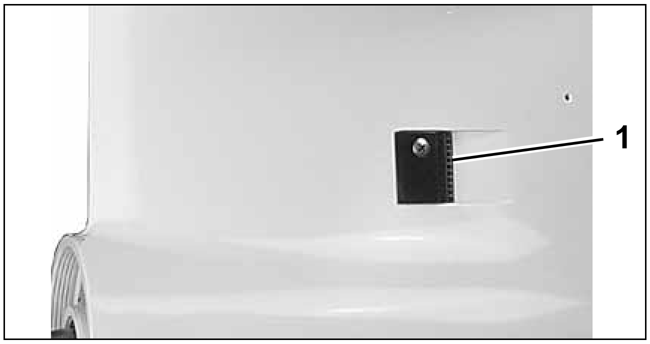
COA3543

Remove the nut and pinion from the driveshaft. Discard the nut.

GEARCASE ASSEMBLY

Water Intake Screens

Install water intake screens. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

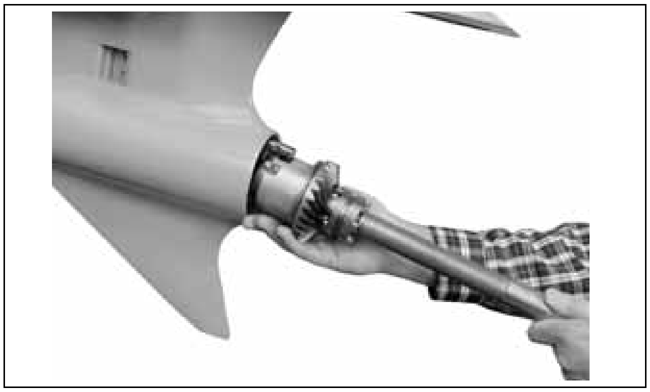


1. *Water intake screen* 001991

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.



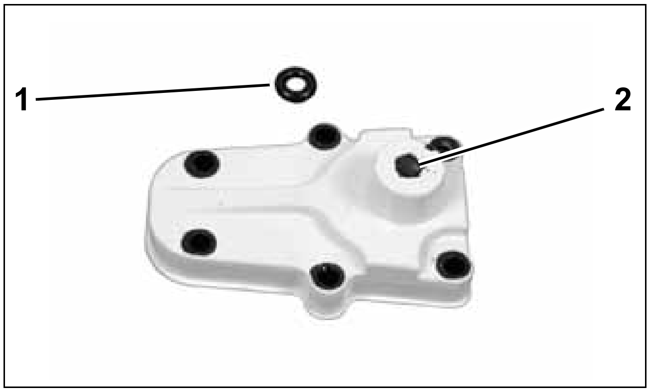
005427

13

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.

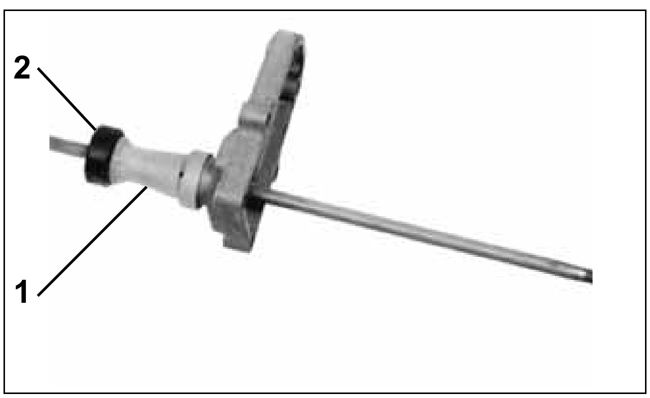


1. *O-ring*
2. *Groove*

006780

Place the shift rod grommet on the shift rod.

Install shift rod spacer under grommet on 25 in. models.



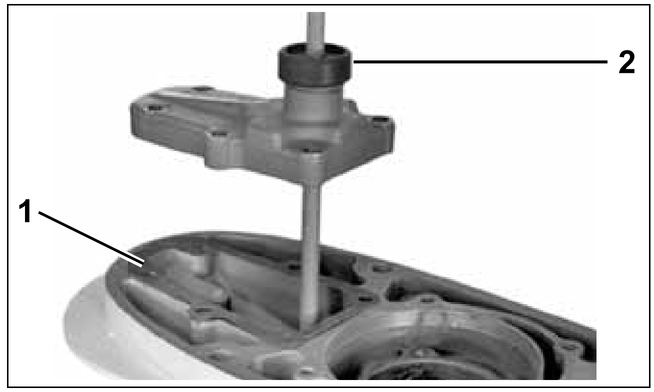
1. *Grommet*
2. *Shift rod spacer*

COA3568

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.

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.

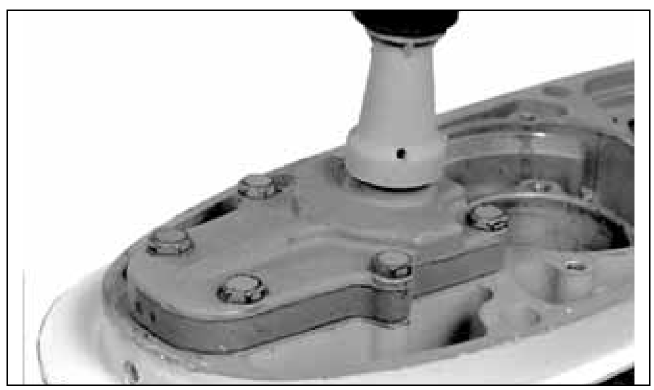


1. *Cover gasket*
2. *Grommet*

COA3141

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).



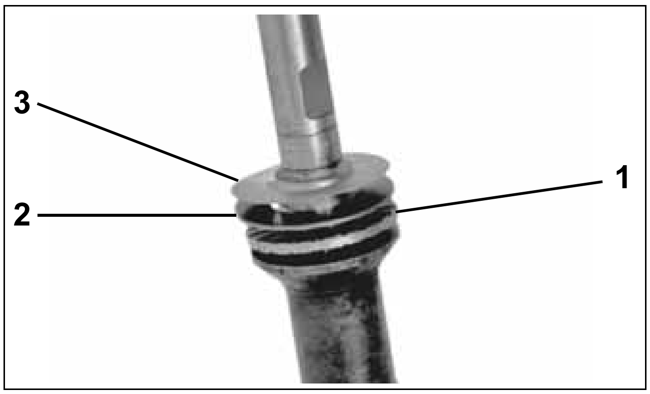
COA3569

Pinion Gear and Driveshaft Installation

Refer to **DRIVESHAFT SHIMMING** on p. 280 before proceeding.

Install new seals in driveshaft bearing housing. Refer to **Driveshaft Bearing Housing Service** on p. 277.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.



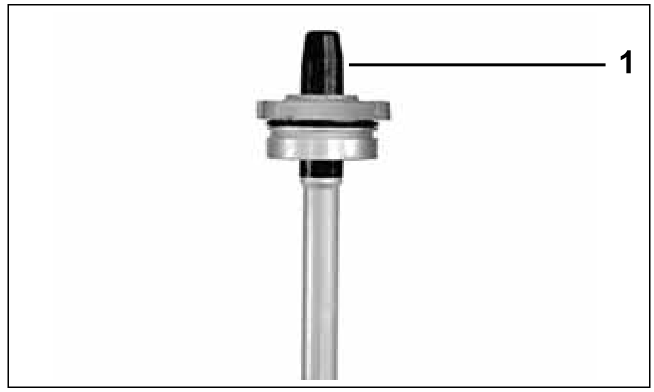
1. *Thrust bearing* COA3168
2. *Thrust washer*
3. *Shim(s)*

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.

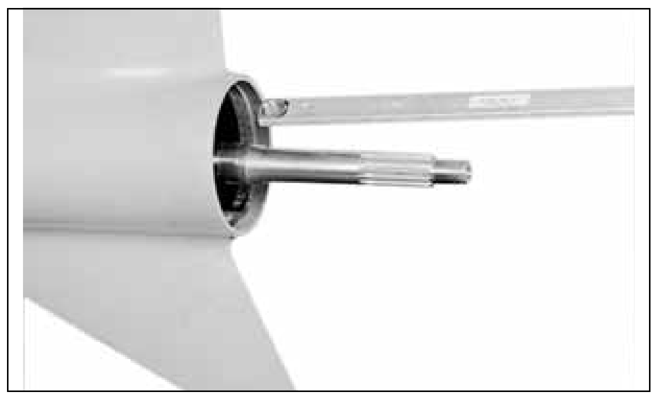
Place the pinion gear into the gearcase. Insert the driveshaft into the gearcase and through the pinion gear.

Using Driveshaft Seal Protector, P/N 318674, slide the driveshaft bearing housing onto the driveshaft and into position in the gearcase.



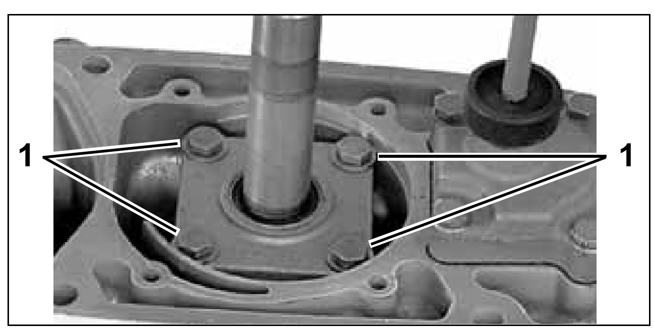
1. *Seal protector* COA3130

Lightly coat the threads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 342216, to install nut on the driveshaft. Turn the driveshaft by hand to thread the nut on to shaft.



42230

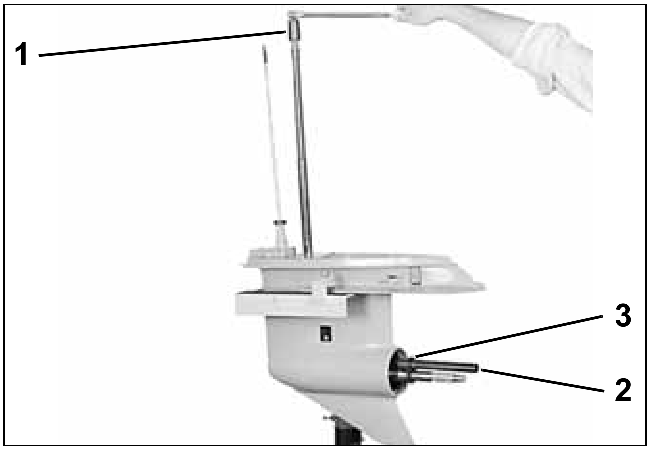
Apply *Gasket Sealing Compound* to the threads of the driveshaft bearing housing screws. Tighten screws **in stages** to a torque of 120 to 144 in. lbs. (13.5 to 16.5 N·m).



1. *Driveshaft bearing housing screws* COA3153

13

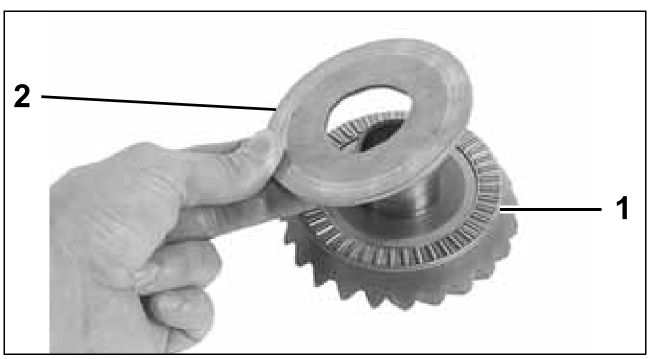
Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Holder, P/N 334455, and Wrench Retainer, P/N 341438, to tighten the pinion nut to a torque of 100 to 110 ft. lbs. (136 to 149 N·m). Pad handle of holder to prevent damage to gearcase.



1. *Holding socket* 42229
2. *Pinion holder*
3. *Retainer*

Propeller Shaft Bearing Housing and Gear Installation

Oil and install thrust bearing and thrust washer on hub of reverse gear. Slide the gear assembly onto the propeller shaft until it engages the pinion gear.

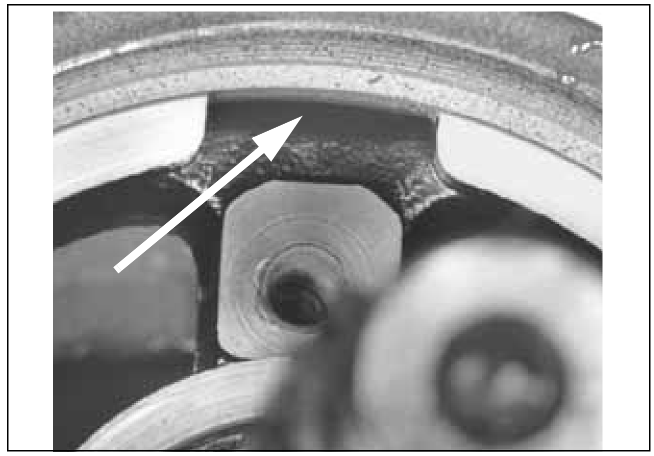


1. *Thrust bearing* DSC02295
2. *Thrust washer*

Lightly apply *Gasket Sealing Compound* to a new bearing housing O-ring. Install O-ring in groove in the housing.

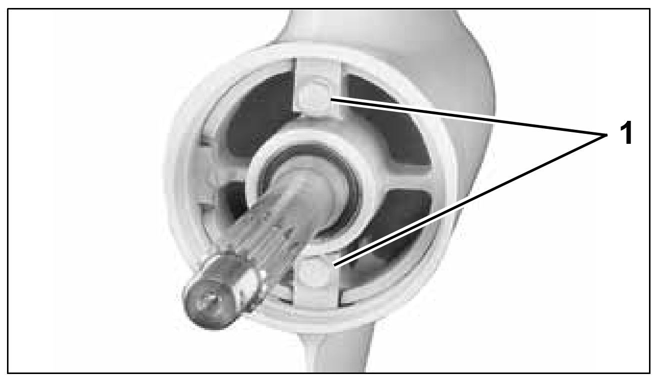
Install housing into gearcase. Align screw holes with retainer slots in gearcase.

Housing must be completely seated to install retainer tabs.



Retainer Tab Notch 50106a

Install two retainers, washers and screws. Apply *Ultra Lock* to threads and tighten screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m).

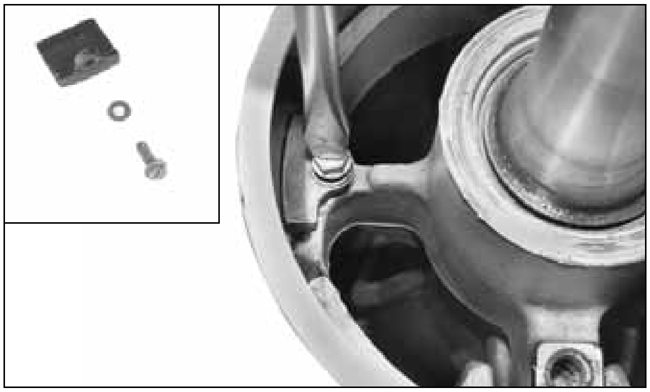


1. *Retainer tab screws* 001989

"O" Type Gearcases

Loosen retainer screws 1/4 turn.

Install wedge, screw, and washer. Apply *Ultra Lock* to threads and tighten screw to a torque of 15 to 20 in. lbs. (1.7 to 2.3 N·m).



DSM02291
DSC02361

Re-tighten two retainer screws to 18 to 20 ft. lbs. (24 to 27 N·m).

Confirm that torque on the wedge screw is 15 to 20 in. lbs. (1.7 to 2.3 N·m).

To complete gearcase assembly, refer to:

- **GEARCASE LEAK TEST** on p. 260
- **WATER PUMP SERVICE** on p. 263
- **SHIFT ROD ADJUSTMENT** on p. 266
- **GEARCASE REMOVAL AND INSTALLATION** on p. 261
- **Gearcase Lubricant** on p. 71
- **Propeller Hardware Installation** on p. 59
- **Trim Tab Adjustment** on p. 62.

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

TRIM AND TILT

TABLE OF CONTENTS

SYSTEM DESCRIPTION

The power trim/tilt hydraulic system is completely contained between the outboard's stern brackets.

The system consists of:
- Electric motor
- Oil reservoir
- Pump manifold assembly
- Cylinder body assembly

Optimal boat and outboard performance can be achieved by adjusting (trimming) the angle of outboard propeller thrust. The first 15° of outboard movement is considered trim range.

Outboard movement beyond the trim range is considered tilting. Tilting of the outboard may be desired for shallow water drive and for trailering/storage. The tilt cylinder moves the outboard through the tilt range (final 50°).

A tilt relief valve limits the propeller thrust load that will be supported by the unit in tilt range. As pressure increases, the outboard will tilt down to the top of the trim range.

IMPORTANT: When in tilt range, make sure water is available to gearcase water pickups.

Manual Adjustment

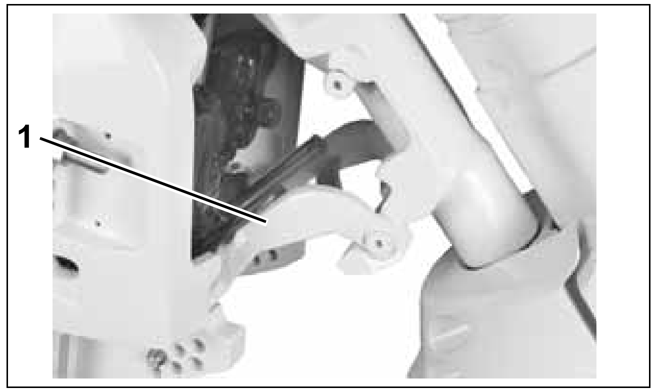
The outboard can be manually raised or lowered through the entire trim and tilt range by opening the manual release valve a minimum of three turns. The manual release valve must be closed and torqued 45 to 55 in. lbs. (5 to 6 N·m) to hold the outboard in position and before normal operation can be resumed.

1. Manual release valve 001988

Trailering Bracket And Tilt Support

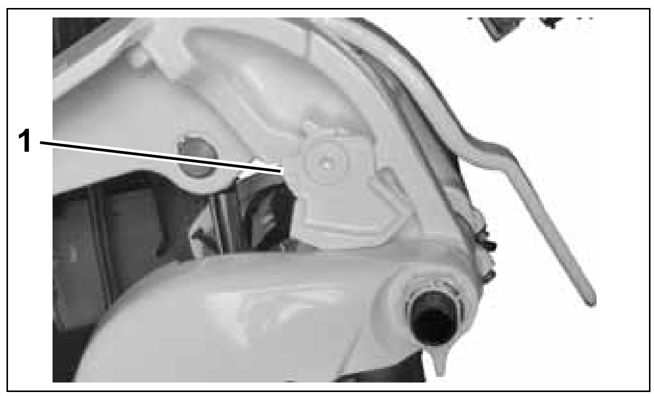
Use the trailering bracket to support the outboard when trailering in the tilted position. This bracket protects the hydraulic system from damage.

Tilt the outboard up fully, engage the bracket, then tilt the outboard down until the bracket is firmly in position.



Trailering Bracket 001987

For mooring or storing the boat with the outboard tilted, a tilt support is provided to support the outboard.



002279

IMPORTANT: The tilt support must not be used to support the outboard while trailering.

ROUTINE INSPECTIONS

General

Check for external signs of fluid leakage. Correct causes as necessary.

Check the battery and make sure it is in good operating condition.

Reservoir Fluid

Check reservoir fluid level every three years or every 300 operating hours. System capacity is approximately 21 fl. oz. (620 ml).

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

Refer to **Trim and Tilt** on p. 73 for filling procedure.

Manual Release Valve

Check the manual release valve with a torque wrench.

IMPORTANT: The valve must be tightened to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

Stern Brackets

Inspect the stern brackets for binding with the swivel bracket in the thrust rod area. Retighten the tilt tube nuts as follows:
- Tighten the tilt tube nuts to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

TROUBLESHOOTING

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

Cylinder Leakdown:
- Manual release valve seals
- External leaks

No reverse lock:
- External leaks

No operation, motor runs:
- Manual release valve open
- Fluid level low
- Pump coupler
- Hydraulic pump

No tilt down:
- Manual release valve
- Fluid level

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

Unit locked in tilt up:
- Mechanical binding
- Hydraulic pump

ELECTRICAL CIRCUIT TESTS

Relay Testing

When the trim-UP button is pressed, the UP relay is energized and connects the blue trim motor wire to the battery positive (+) terminal. The green trim motor wire remains grounded. When the button is released, the blue trim motor wire returns to a grounded position.

When the trim-DOWN button is pressed, the DOWN relay is energized and connects the green trim motor wire to the battery positive (+) terminal. The blue motor wire remains grounded. When the button is released, the green trim motor wire returns to a grounded position.

Refer to **TILT/TRIM RELAY TEST** on p. 135 for relay testing procedure.

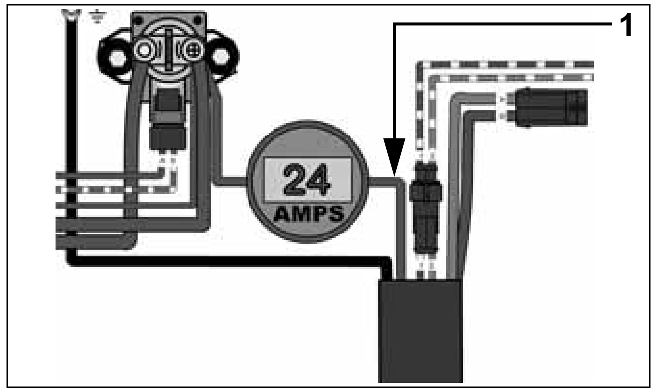
Trim and Tilt Motor Current Draw Tests

Careful analysis of the electric motor's current draw and trim/tilt unit operating speed aids evaluation of the electric motor and certain mechanical components.

Use a battery rated at 360 CCA (50 Ah) or higher that is in good condition and fully charged to perform this test.

IMPORTANT: Specifications are for static hydraulic tests. DO NOT attempt to perform the following tests while the boat is moving.

Connect a 0 to 100 A DC ammeter in series between the battery side of the starter solenoid and the red lead to the trim/tilt relay module.



1. *Red lead* 005441

Observe ammeter and a stopwatch while running hydraulic unit through several complete cycles.

Compare test results to the values listed:

Mode	Normal Current Draw	Time in Seconds
Full Range UP	<30 A	12-18
Full Range DOWN	<30 A	<18
Stall	<40 A	–

Test results include three basic possibilities:

A. Low current draw – Check for:
- Valves leaking
- Relief valve springs weak
- Pump damaged
- O-rings leaking
- Check valves fouled or damaged
- Manual release valve damaged

B. High current draw – Check for:
- Pump binding
- Motor binding
- Cylinder binding
- Valves sticking

C. Normal current draw, slow operating speed – Check for:
- Impact valves damaged
- Check valve or shuttle valve malfunctioning
- Manual release valve damaged

Trim and Tilt Motor No Load Test

IMPORTANT: Securely fasten motor in a suitable fixture before proceeding with this test.

Use a battery rated at 360 CCA (50 Ah) or higher that is in good condition and fully charged to perform this test.

Connect a 0 to 50 A ammeter in series with the battery positive (+) terminal, ammeter red lead toward battery.

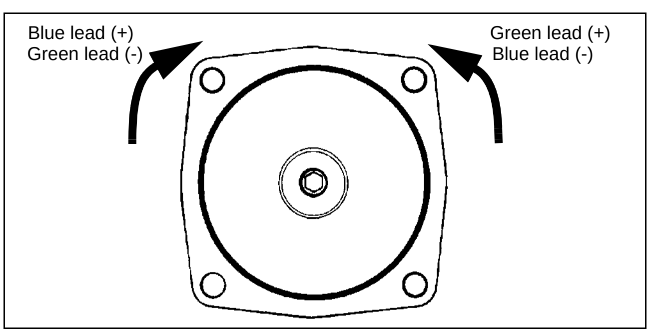
Attach or hold a vibration or mechanical tachometer to the motor while performing this test.

Monitor motor RPM and current draw.

30957

The motor shaft must rotate clockwise, as viewed from the pump end, when positive (+) is applied to the blue lead, and negative (–) is connected to green lead.

The motor shaft must rotate counterclockwise, as viewed from the pump end, when positive (+) is applied to the green lead, and negative (–) is applied to the blue lead.



DR4238r

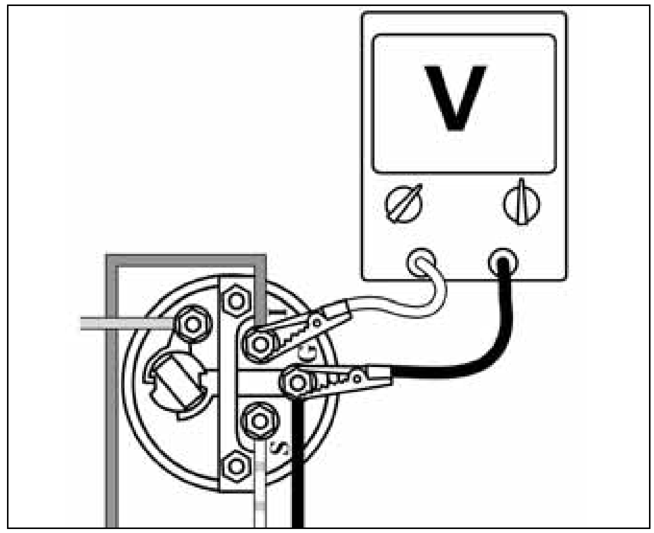
If test results vary, replace the motor.

Trim Gauge Test

STEP 1

Turn key switch ON. Using a voltmeter, check for voltage between the trim gauge “I” and “G” terminals.

- If no voltage, check condition of instrument harness, key switch, and engine 20 A fuse.
- If voltage, go to **STEP 2**.

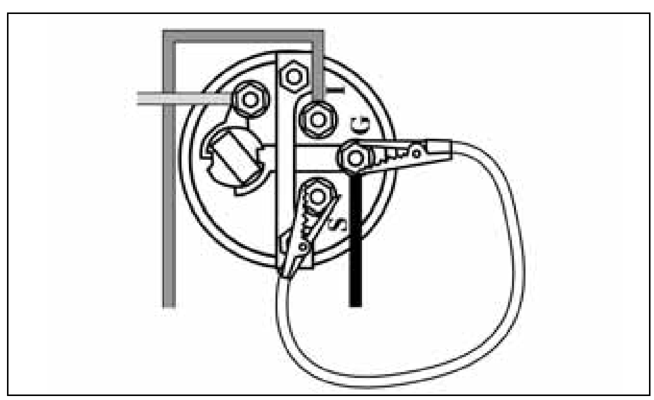


DRC6245

STEP 2

Remove the white/tan lead from the trim gauge “S” terminal. With key switch ON, gauge should indicate full-trim DOWN position. Now connect a jumper wire between terminals “S” and “G.” Gauge should indicate full-trim UP position.

- If results are different, replace the trim gauge.
- If results agree, refer to **Trim Sender Test** on p. 292.



DRC6246A

Trim Sender Test

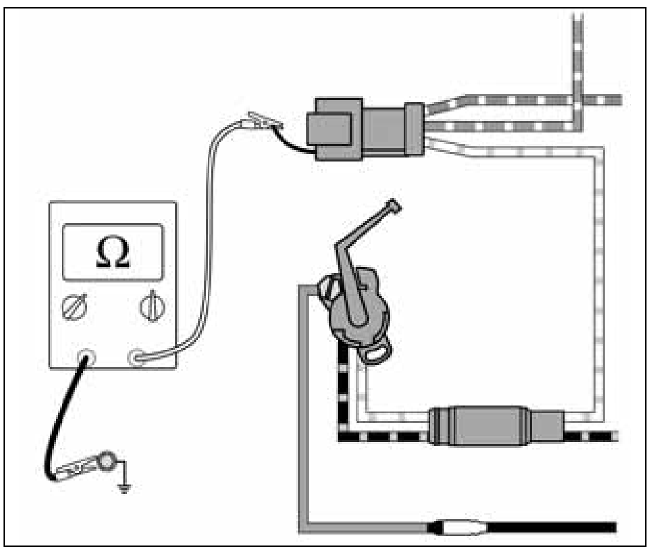
IMPORTANT: To avoid immediate meter damage, never apply a multimeter to an electrical circuit where voltage is present.

Disconnect the 3-pin *Deutsch* connector between the instrument harness and engine trim harness.

Connect an ohmmeter between the white/tan wire, terminal “C,” of the engine harness and a clean engine ground.

With the outboard fully DOWN, meter must show a reading above 80 Ω.

With the outboard fully UP, meter must show a reading below 10 Ω.
- If results agree, refer to **Trim Gauge Test** on p. 291.
- If results are different, replace trim sender.



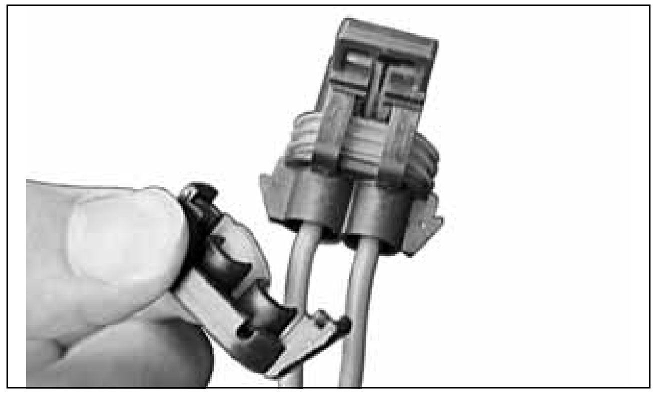
DRC6247

TRIM AND TILT SERVICE

Removal

Remove lower engine cover and disconnect the trim/tilt connectors. Refer to **LOWER COVER SERVICE** on p. 82.

Remove the rubber grommet from the blue/green trim/tilt cable connector.



000686

Remove the terminals from the connector by using a suitable tool to depress the tab. While the tab is depressed, pull on the wire from the rear of the connector to release it from the connector.

000687

Separate the trim/tilt unit wires in the braided tube to permit removal through the hole in the stern bracket.

25078

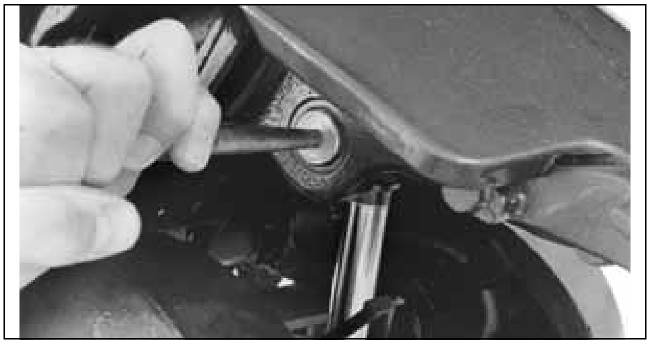
Unscrew the manual release valve, raise the unit, and lock it in place with the tilt support.

27381

Remove the external snap rings from the upper pin.

25064

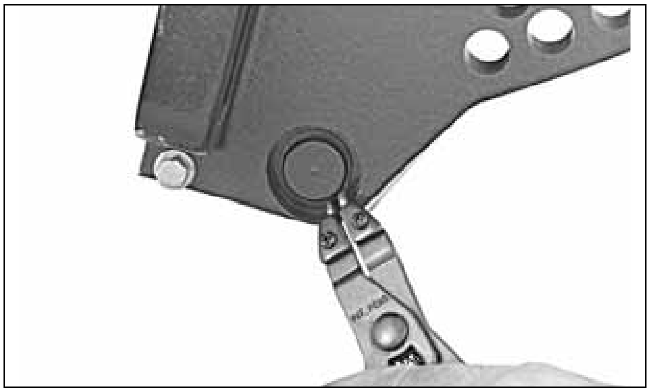
Use a punch to remove the upper pin.



25065

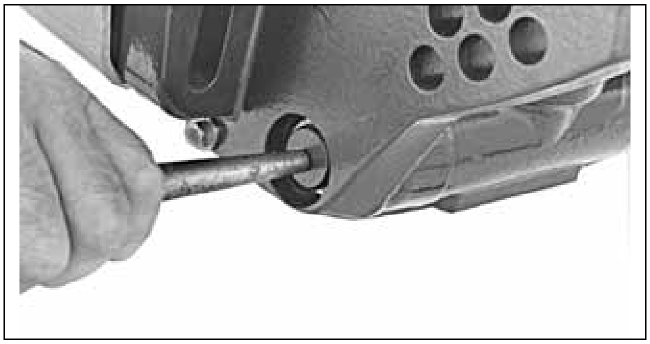
Retract the tilt cylinder rod.

Remove the external snap rings from the lower pin.



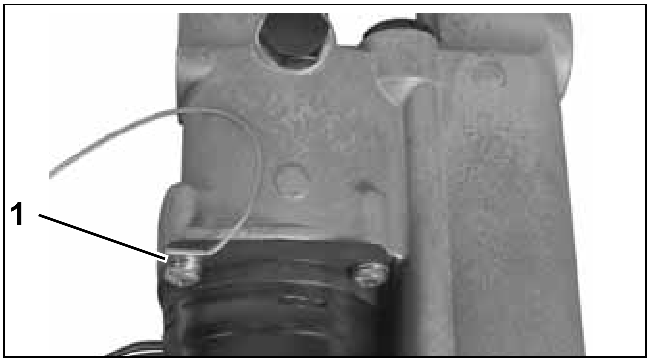
25077

Use a punch to remove the lower pin and remove the trim/tilt unit from the stern brackets.



25076

Remove the unit from the stern brackets far enough to remove the ground lead from the pump motor mounting screw.



1. *Ground lead* 002527

Disassembly

Thoroughly clean the unit before disassembling. Scrub all outside surfaces with a stiff brush and hot, soapy water to prevent surface dirt from contaminating internal parts.

Always use a lint free shop cloth when handling power trim/tilt components.

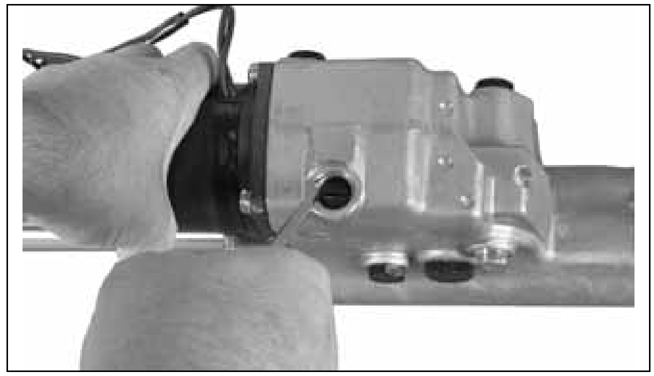
If painting the unit is required, paint it after it is completely assembled. Painting of individual components may cause flakes of paint to enter the hydraulic passages during assembly. Tape the trim/tilt piston rods before painting.

⚠ WARNING ⚠

There may be high pressure behind some power trim valves. To avoid injury when removing manual release valve, be sure to cover valve with a shop cloth until the pressure is released. Wear safety glasses.

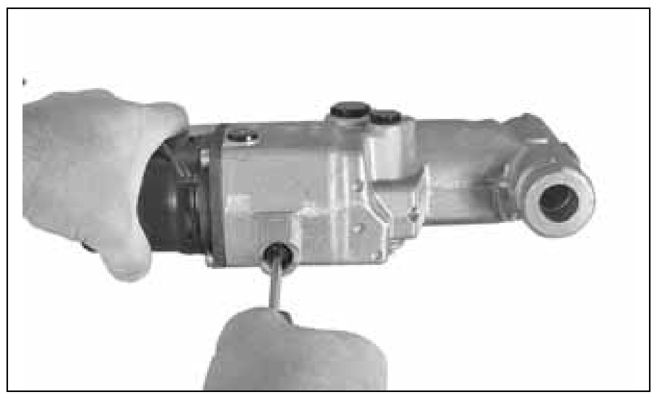
IMPORTANT: Before removing manual release valve, relieve pressure by fully extending cylinder.

Screw the manual release valve in. Remove the retaining ring using a small pick or screwdriver. Discard the retaining ring.



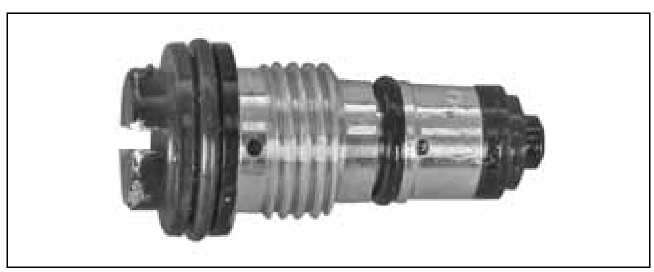
004279

Slowly remove the manual release valve. There may be pressure behind the valve—wear safety glasses.



004285

Inspect the manual release valve. Discard the O-rings on the housing.



004284

Remove the four large motor flange retaining screws. Remove the motor and discard O-ring, screws, and washers.

004282

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

004281

Assembly

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

Install drive coupler in pump assembly.

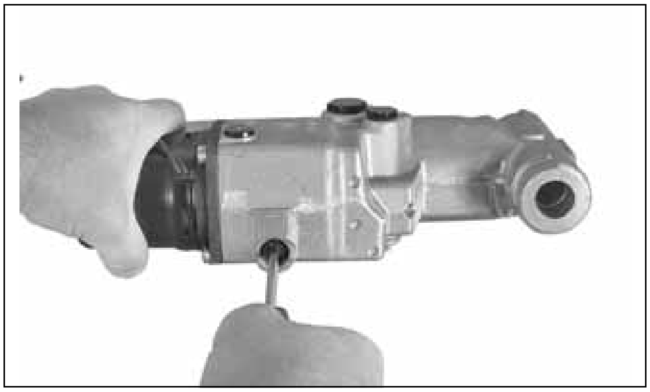
Install a new motor O-ring.

004280

Position the motor on the manifold and install four **new** screws and lock washers. Tighten the screws 35 to 50 in. lbs. (4 to 5.6 N·m).

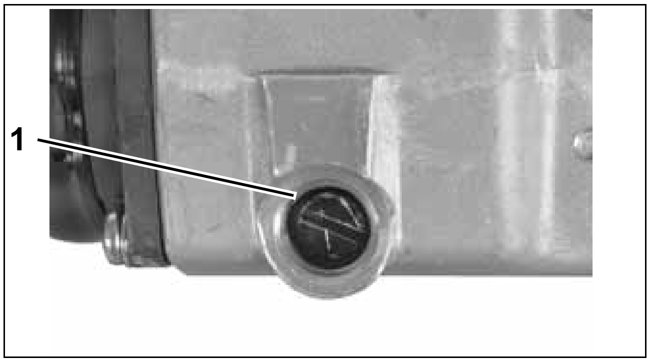
004282

Oil O-rings and install them on the manual release valve. Oil and install the manual release valve. Tighten the valve to a torque of 45 to 55 in. lbs. (5.1 to 6.2 N·m).



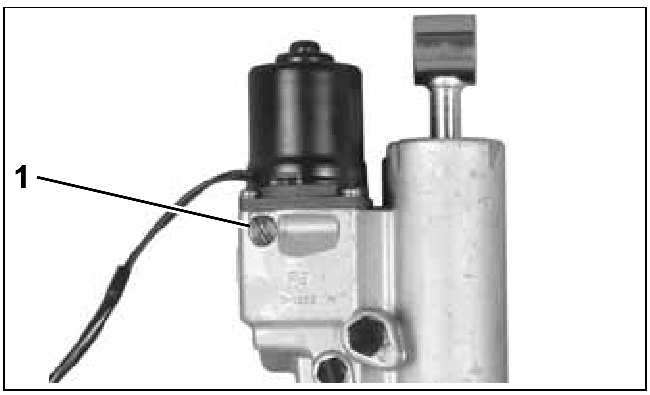
004285

Install **new** retaining ring in groove.



1. *Retaining ring* 004283

Fill the oil reservoir up to the fill plug with *Evinrude/Johnson* Biodegradable TNT Fluid. Install and tighten the fill plug. Do not torque the plug at this time.



1. *Reservoir cap* 004278

Run the motor, then recheck oil level. Cycle the unit several times and check the oil level when the cylinder is fully extended. Oil should be level with bottom of fill port. Install and tighten the fill plug to a torque of 45 to 55 in. lbs. (5.1 to 6.2 N·m).

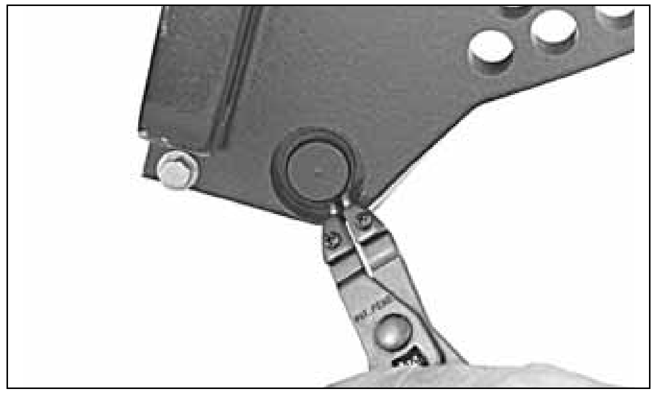
Installation

Install the ground lead.

Place trim/tilt unit into position. Apply *Triple-Guard* grease to the lower pin and install the pin.

If loosened, tighten the tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

Install external snap rings on lower pin with sharp edge of ring facing out.



25077

Extend tilt cylinder rod to match with holes in swivel bracket.

Apply *Triple-Guard* grease to upper pin and install the pin.

Install external snap rings onto upper pin with sharp edge facing out.

25064

Place trim/tilt wires in braided tube and install through hole in the stern bracket.

25079

Release the tilt support and lower the outboard. Tighten the manual release valve to a torque of 45 to 55 in. lbs. (5.1 to 6.2 N·m).

Install connector on trim/tilt cable and reconnect trim connectors to engine wire harness.

Install lower engine cover. Refer to **LOWER COVER SERVICE** on p. 82.

ADJUSTMENTS

Refer to **Trim Sending Unit Adjustment** on p. 61.

Refer to **Tilt Limit Switch Adjustment** on p. 60.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

SAFETY

TABLE OF CONTENTS

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM

WARNING

This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

- Product user is informed; and
- Products are safe and reliable.

It is up to you, the people who...

- Rig boats;
- Fix machinery; and
- Maintain equipment

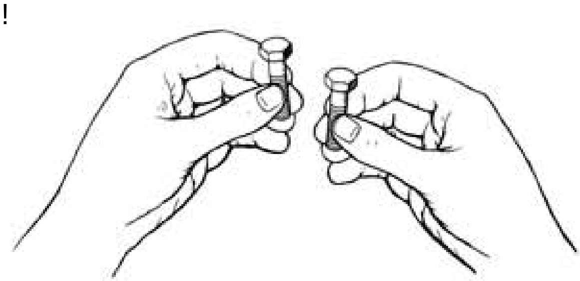
...to keep the products safe **and** reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

First!

A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS



“They look the same, but are they the same?”

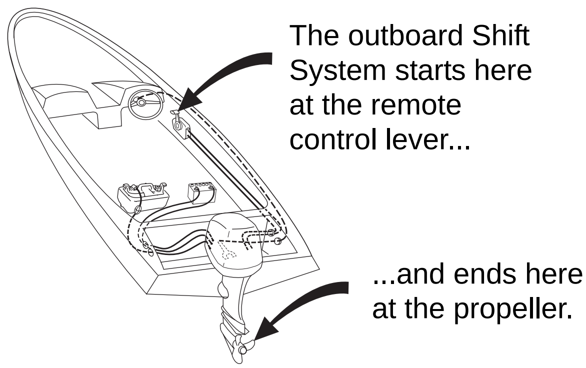
- Same size?
- Same strength?
- Same material?
- Same type?

Don’t substitute unless **you know** they are the **same** in **all** characteristics.

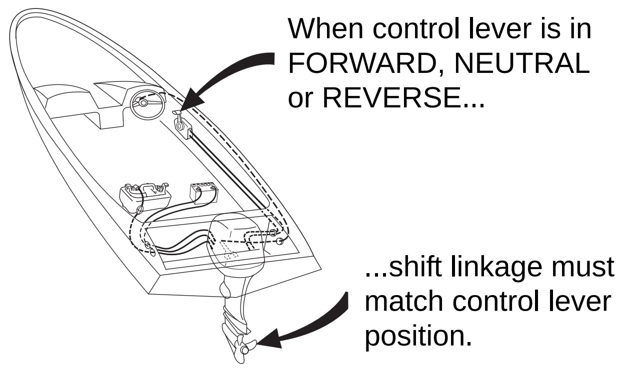
Second!

- Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.
- When the outboard is returned to the boat, use only the special nuts and bolts to hold remote steering, shift, and throttle cables to the outboard.

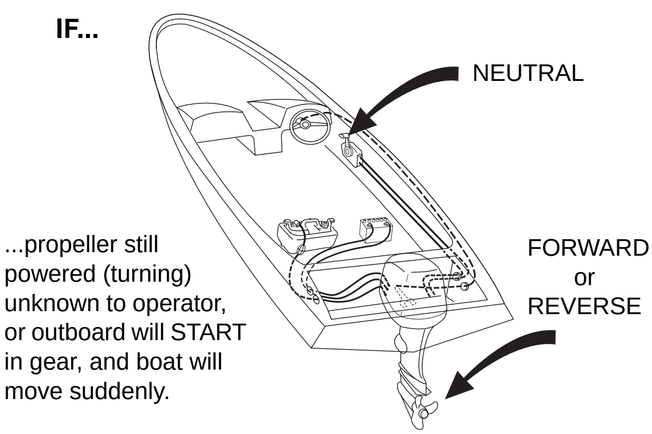
Outboard Shift Systems and Safety

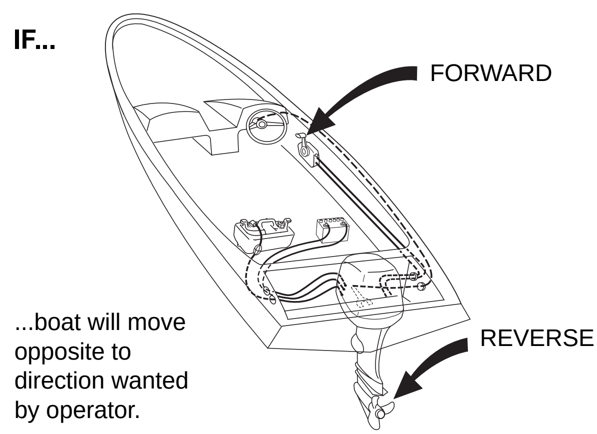


What is most important?



What could happen?

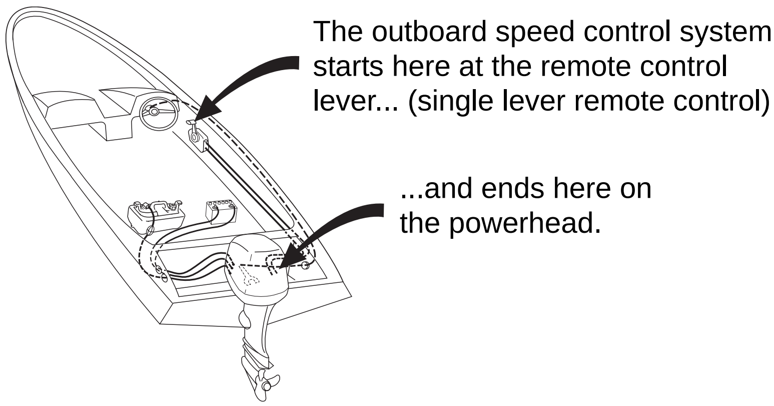




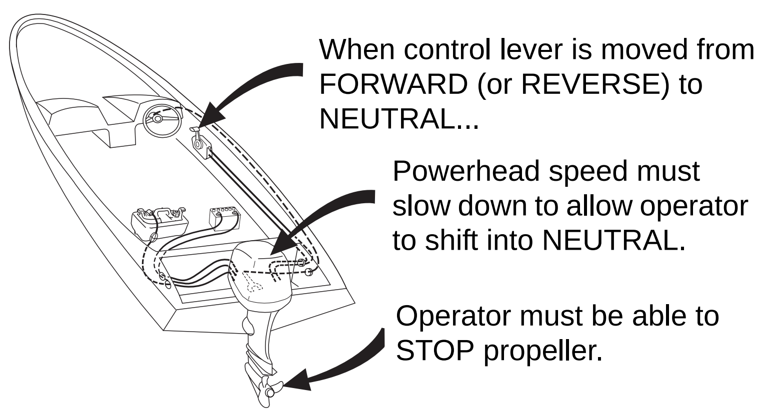
How can loss of shift control be minimized?

When rigging or after servicing	**Read**, **understand**, and **follow** manufacturer’s **instructions** • Follow warnings marked “⚠” closely. • Assemble parts carefully. • Make adjustments carefully. • Test your work. Do not guess. Make sure propeller does just what the operator wants and nothing else. • Do not shift gears on a stopped outboard. Adjustments can be lost and parts weakened.

Outboard Speed Control System and Safety



What is most important?



What could happen?

If Operator cannot slow down the outboard or shift into NEUTRAL gear (stop propeller), Operator could panic and lose control of boat.

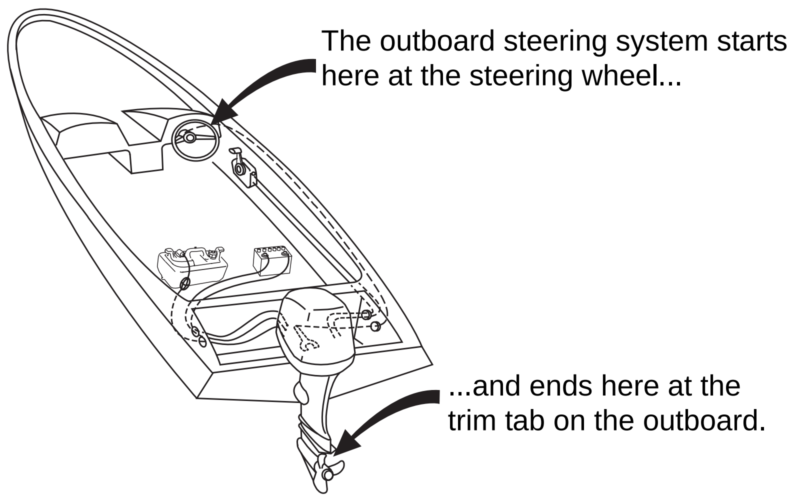
How can loss of speed control be minimized?

When rigging or after servicing

Read, **understand**, and **follow** manufacturer's **instructions**

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else.
- Make sure full throttle can be obtained so Operator will not overload parts.

Outboard Steering Control System and Safety

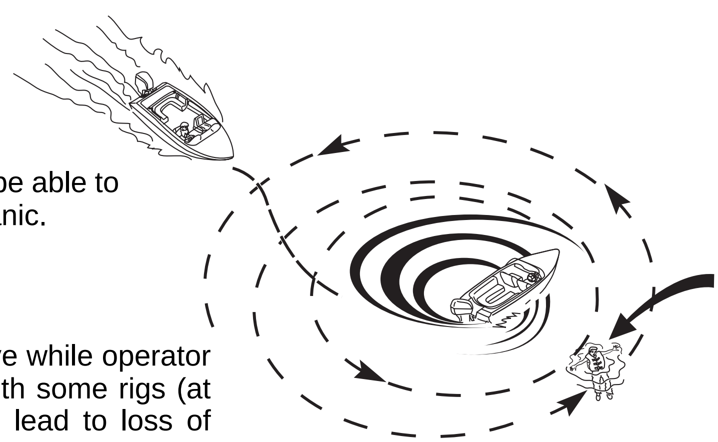


What is most important?

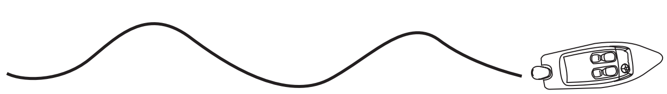
The steering system:
- Must not come apart;
- Must not jam; and
- Must not be sloppy or loose.

What could happen?

- If steering system comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.



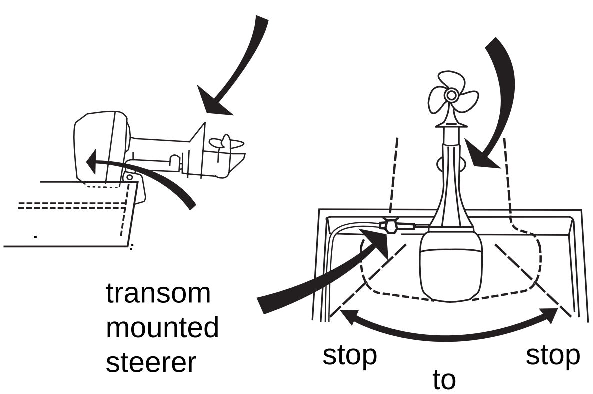
- If steering jams, operator may not be able to avoid obstacles. Operator could panic.
- If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high speed), loose steering could lead to loss of boat control.



How can loss of steering control be minimized?	
When rigging or after servicing	• Use a steering system recommended by the outboard manufacturer which meets Marine Industry Safety Standards (ABYC). • **Read**, **understand**, and **follow** manufacturer’s **instructions** • Follow warnings marked “⚠” closely. • Assemble parts carefully. • Make adjustments carefully. • Keep parts moving freely. Lubricate parts as shown in manual. • Use the bolts, nuts and washers supplied with steering attachment kits—they are a special locking type that will not loosen, rust, or weaken.

Transom Mounted Steering Systems – Check to Uncover Possible Trouble!

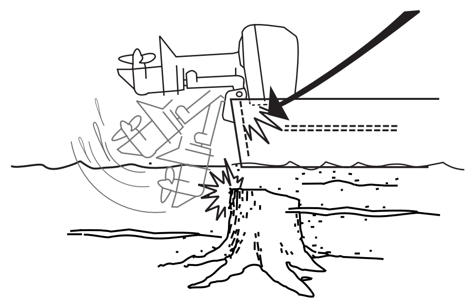
Tilt outboard into boat, then turn it.



During this procedure, steering parts:

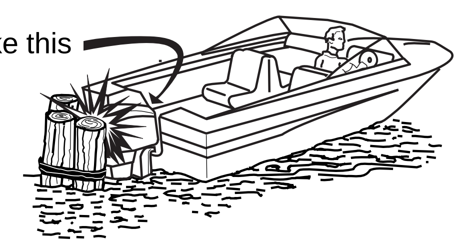
- Must not bind; and
- Must not touch other boat, outboard, or accessory parts in transom area.

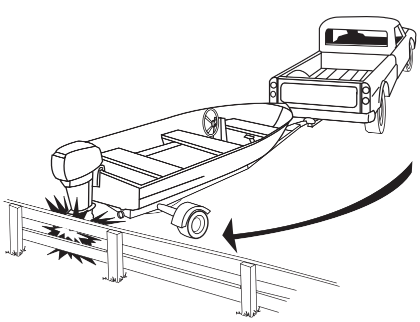
Why? A hard blow to the outboard’s gearcase can result in damage to steering parts.



Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

Check for damaged parts. Blows to the outboard like this



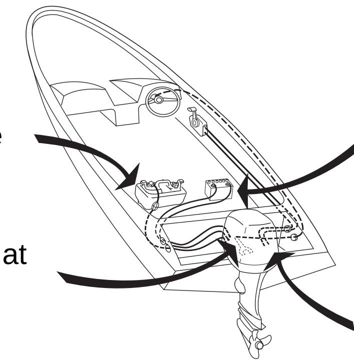


or this can put heavy loads on steering parts. Look for:

- Cracked parts, including steering parts, swivel brackets, and transom brackets;
- Bent parts; and
- Loose nuts and bolts.

Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Outboard Fuel, Electrical System, and Safety



What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

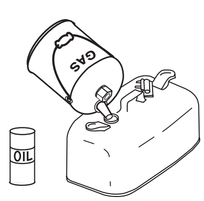
What could happen?

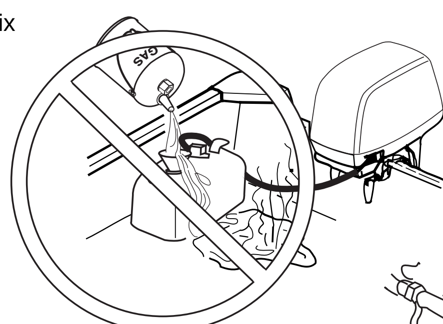
- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

- **Read**, **understand**, and **follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- **Do not** substitute fuel or electrical systems parts with other parts which may look the same. Some electrical parts, like starter motors, are of special design to prevent stray sparks outside their cases.
- Replace wires, sleeves, and boots which are cracked or torn or look in poor condition.

When mixing and refueling, always mix gas and oil outside...

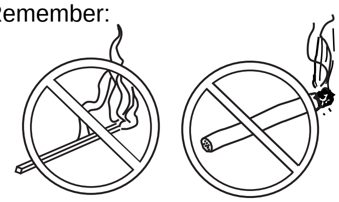




Always fill the tank outside the boat

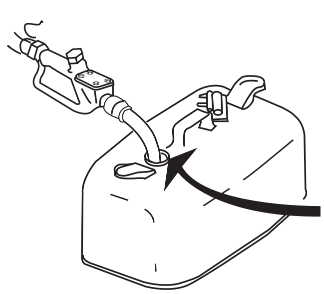
Fumes are hard to control. They collect and hide in the bottom of the boat.

Remember:



Do not use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.

If you use a funnel, it has to be metal to ground the spout to the tank.



To avoid those static electric sparks, ground (touch) the spout against the tank.

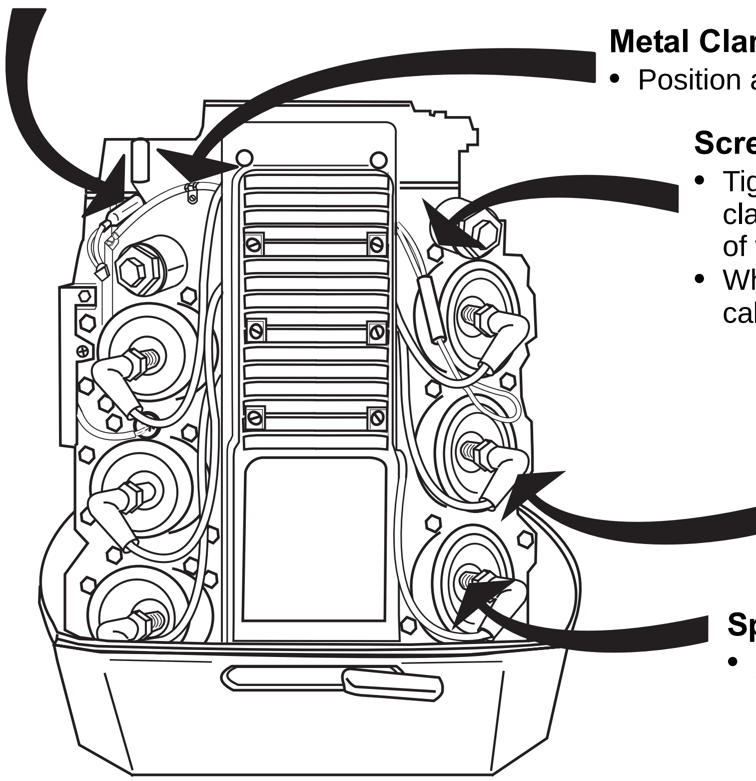
If electrical parts are replaced or even removed from the outboard, check the following:

Wire and high voltage lead routing

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

Sleeves, boots, shields

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



Metal Clamps – Tie Straps

- Position as shown in manual

Screws, Nuts, Washers

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

Spark Plug Boots

- Not torn or cracked
- Fully pushed onto spark plug

Spark Plugs

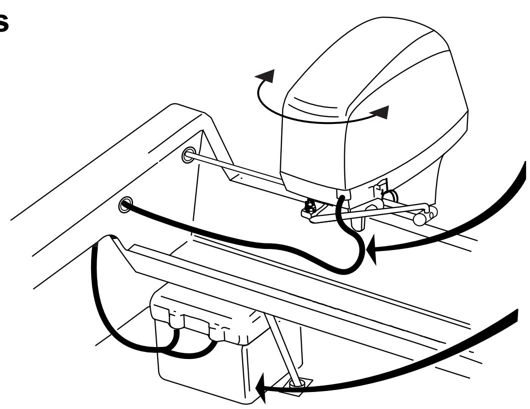
- Avoid rough handling that could crack ceramic part of plug. (Sparks may jump across outside of plug.)

In transom area:

All Connections

- Clean
- Tight

(Prevents sparks)



Electric Cable

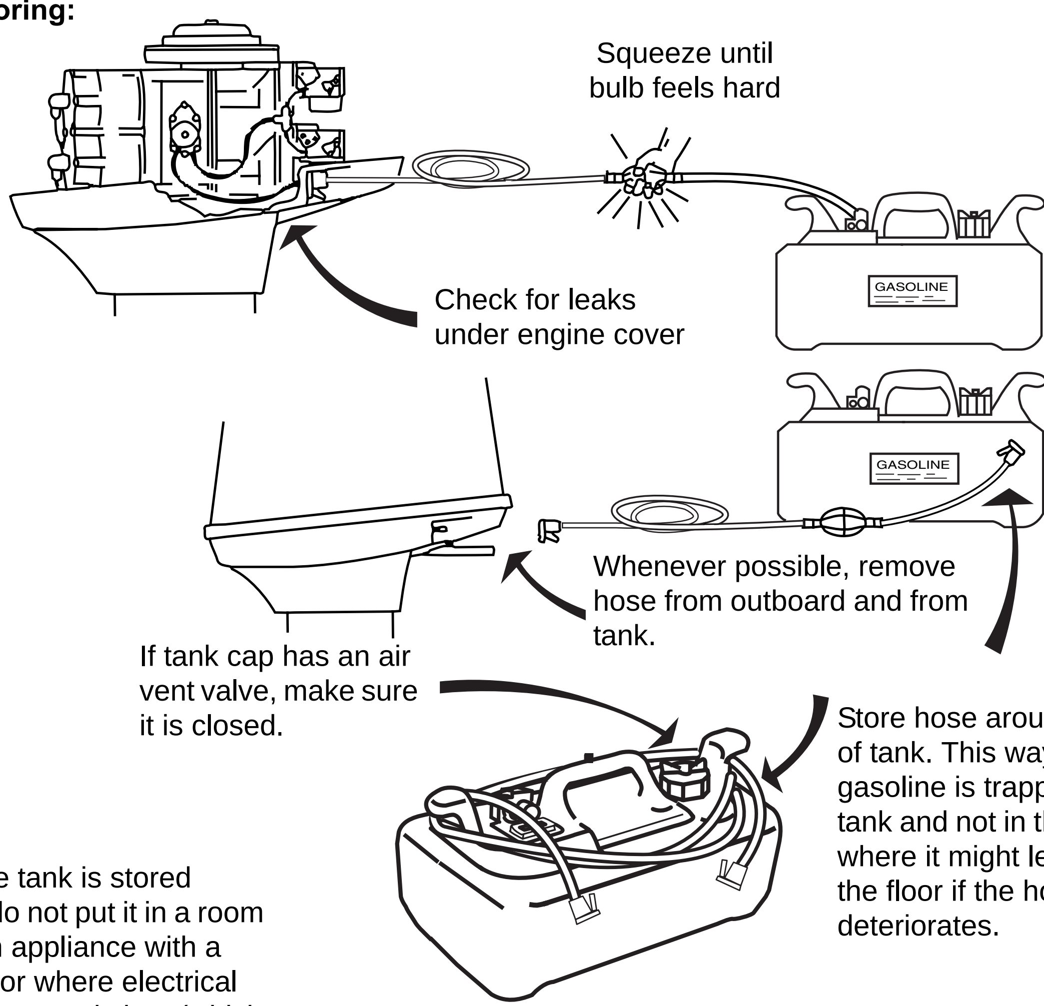
- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

Batteries

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

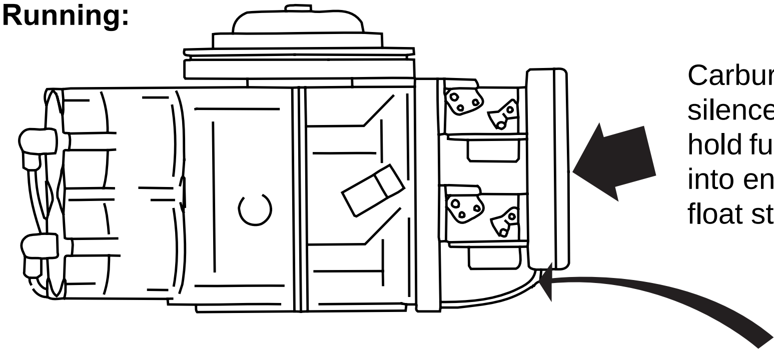
After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When Storing:



If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used.

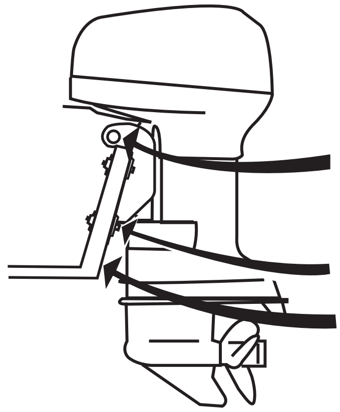
When Running:



- **Make sure silencer and its gaskets are on engine and drain hose is in place.**
- **Air silencer mounting screws are special lock screws. Use only the special screws.**

Outboard Mounting System and Safety

The mounting system includes:



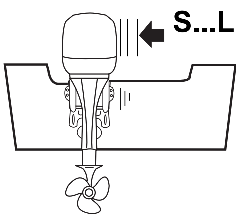
- outboard parts
- bolts, nuts, and washers
- boat’s transom

What is most important?
• Outboard must **stay** in position on boat’s transom.

What could happen?

Outboard may

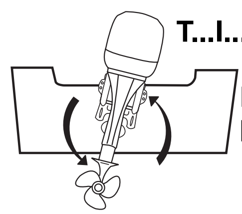
S...L...I...D...E on transom



Boat may turn and be hard to steer.

Outboard may

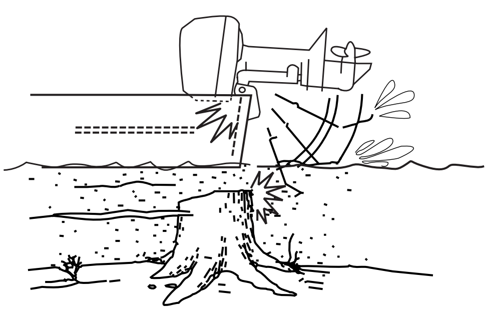
T...I...L...T on transom



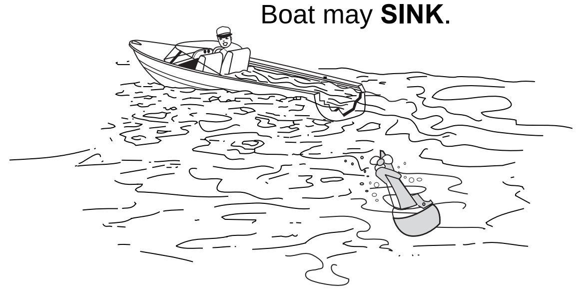
Boat may turn and be hard to steer.

- If outboard hits something solid and does not stay on the transom, boat occupants may be injured from the outboard or its parts entering the boat.

Boat’s transom could break away.



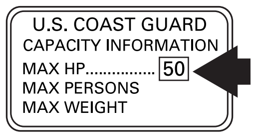
Outboard may be lost overboard.
Boat may **SINK**.



How Can Loss of Mounting Be Minimized?

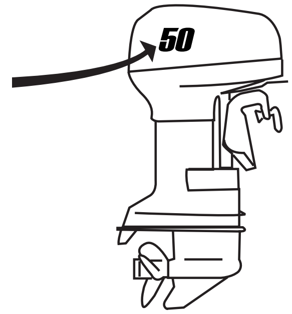
- **Read**, **understand**, and **follow** manufacturer’s **instructions.**
- Follow warnings marked “⚠” closely.

If weakened, parts could fail later on the water, when not expected

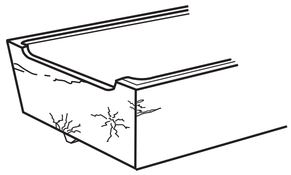


If boat plate shows...

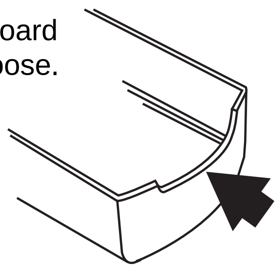
Use only or smaller

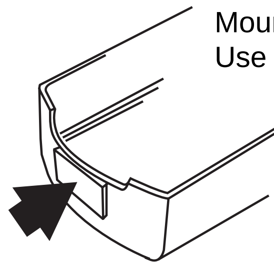


When rigging or fixing any boat, if transom looks weak, tell the owner.



If transom is curved, outboard may come loose.

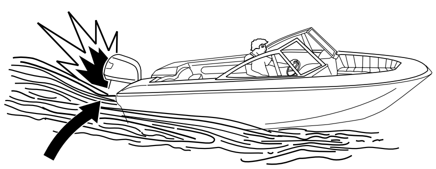




Mount on flat surface only. Use shims to make surface flat.

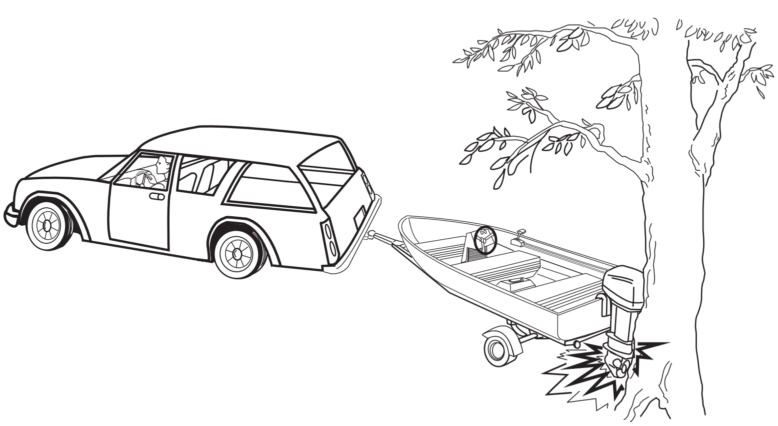
Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

If owner tells you “I hit something really hard...”



Check for a high speed blow to the lower unit.

OR...



“I was backing up and I think the outboard may have hit a tree or something.”

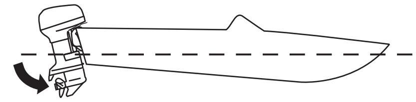
Check for a slow, heavy squash to the outboard.

- Look for damaged parts and loosened nuts and bolts in both the steering and mounting systems. Replace damaged parts.

Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety

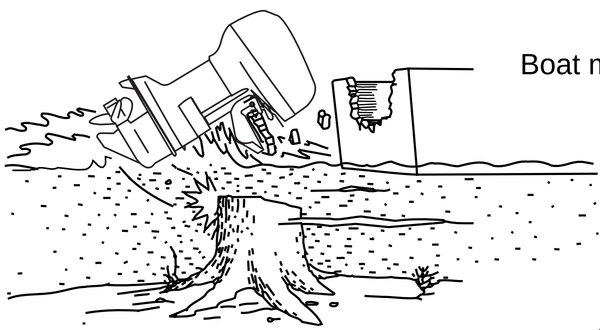
What is most important?

- Shock absorption system must always be ready to absorb some blows to the lower parts of the outboard.
- Outboard must not trim in too far suddenly.



What can happen?

Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.

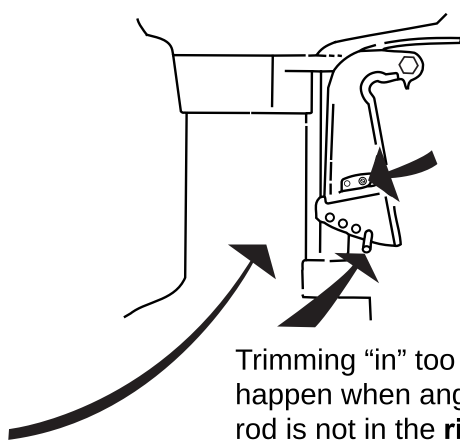


Boat may **SINK**.

At high speeds, sudden trimming in too far may dive boat under water or spin it around.

How can possible conditions be minimized?

- **Read**, **understand**, and **follow** manufacturer’s **instructions.**
- Follow warnings marked “⚠” closely.
- Test your work whenever possible.
- If oil leaks are seen in service areas, determine source. Keep reservoir filled.
- If outboard is hydraulic tilt/trim model, always return rod to hole position determined by boat operator and make sure angle adjusting rod retain is in locked position.

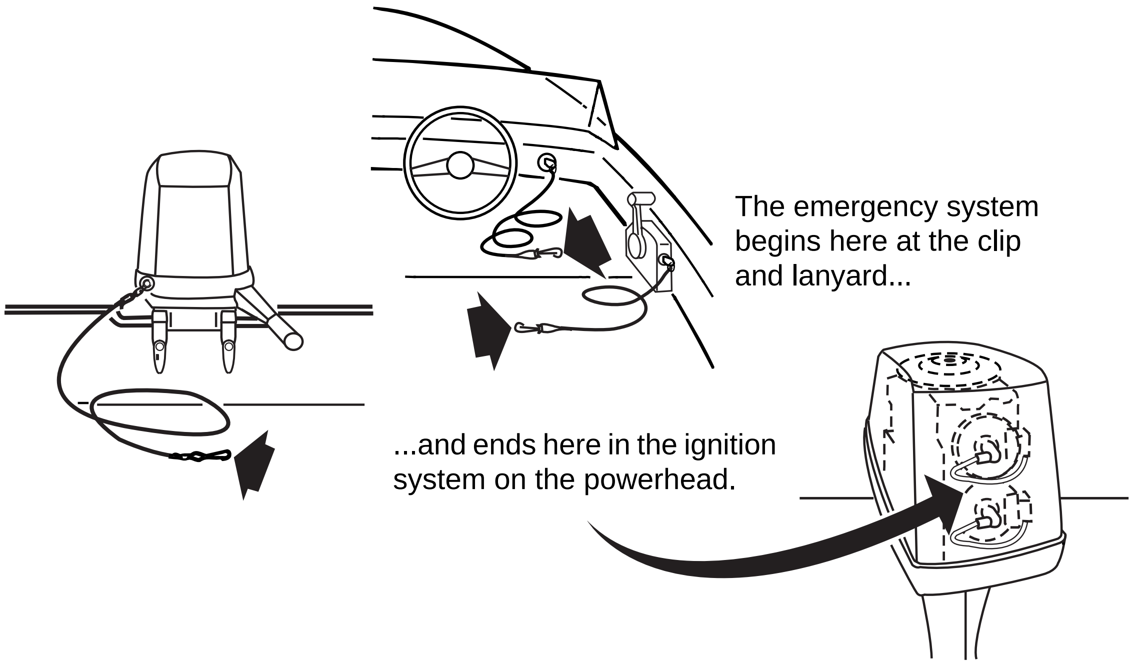


Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

If left open, outboard has no shock protection.

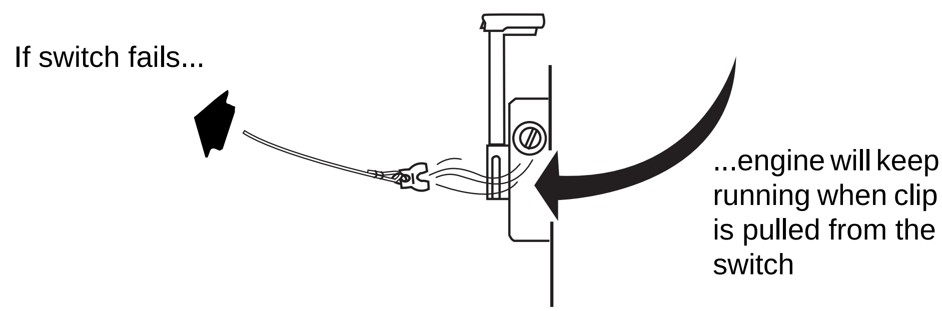
Trimming “in” too far can happen when angle adjusting rod is not in the **right** hole or is not in **any hole** (lost).

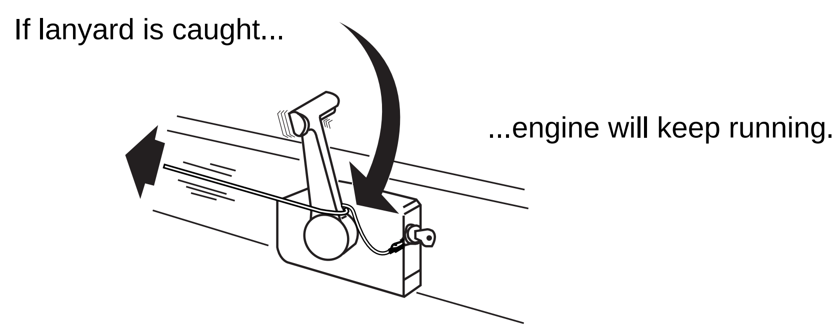
Outboard Emergency Stop System and Safety



What is most important?
• The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

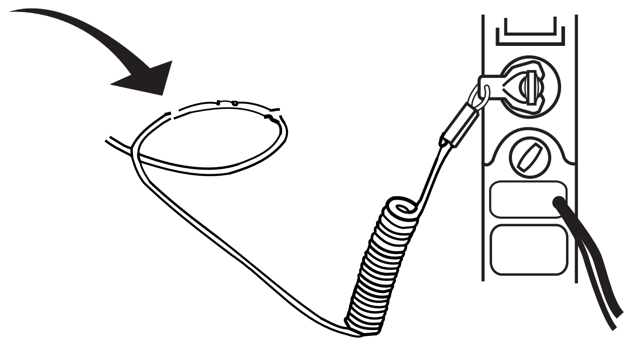
What could happen?



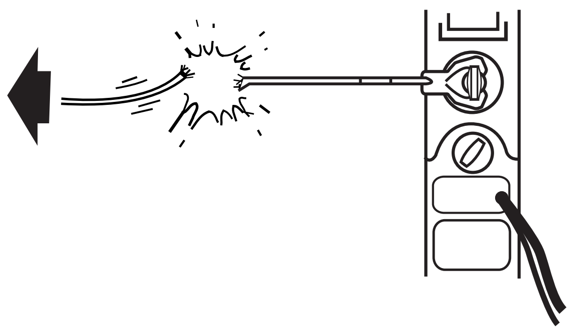


What could happen?

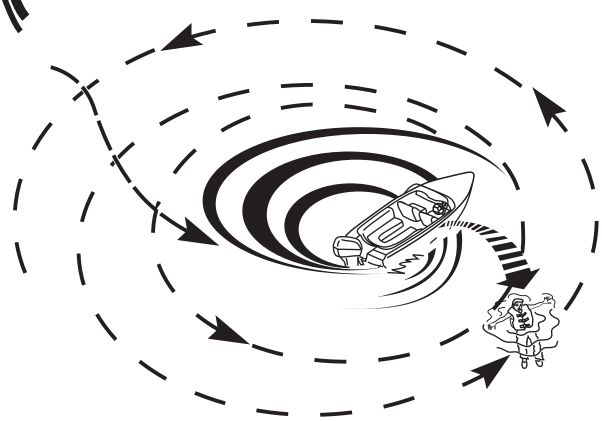
If lanyard is cut or frayed...



...lanyard or clip may break when pulled...



If engine does **NOT** stop when lanyard is pulled, an operator thrown from the boat could be hit as boat circles area. Or, boat may not turn but leave area as a runaway. Operator may drown and boat **WILL** run into something.



How can failure of the emergency stop system be minimized?

When rigging or after servicing

- **Read**, **understand**, and **follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.
- Locate control box and other items in area to keep lanyard from being caught.
- **ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.**

Summing up

Now you know some things that can take the joy out of boating.

No doubt about it—proper safety takes time!

- Reading and understanding instructions
- Re-reading warnings marked "⚠"
- Putting parts together correctly
- Making correct adjustments
- Testing your work

And making sure

- Worn or damaged parts are replaced
- Replaced parts are like originals in every way
- Customer is told of things which need attention

But, do you really want the alternative?

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO FIX THEM

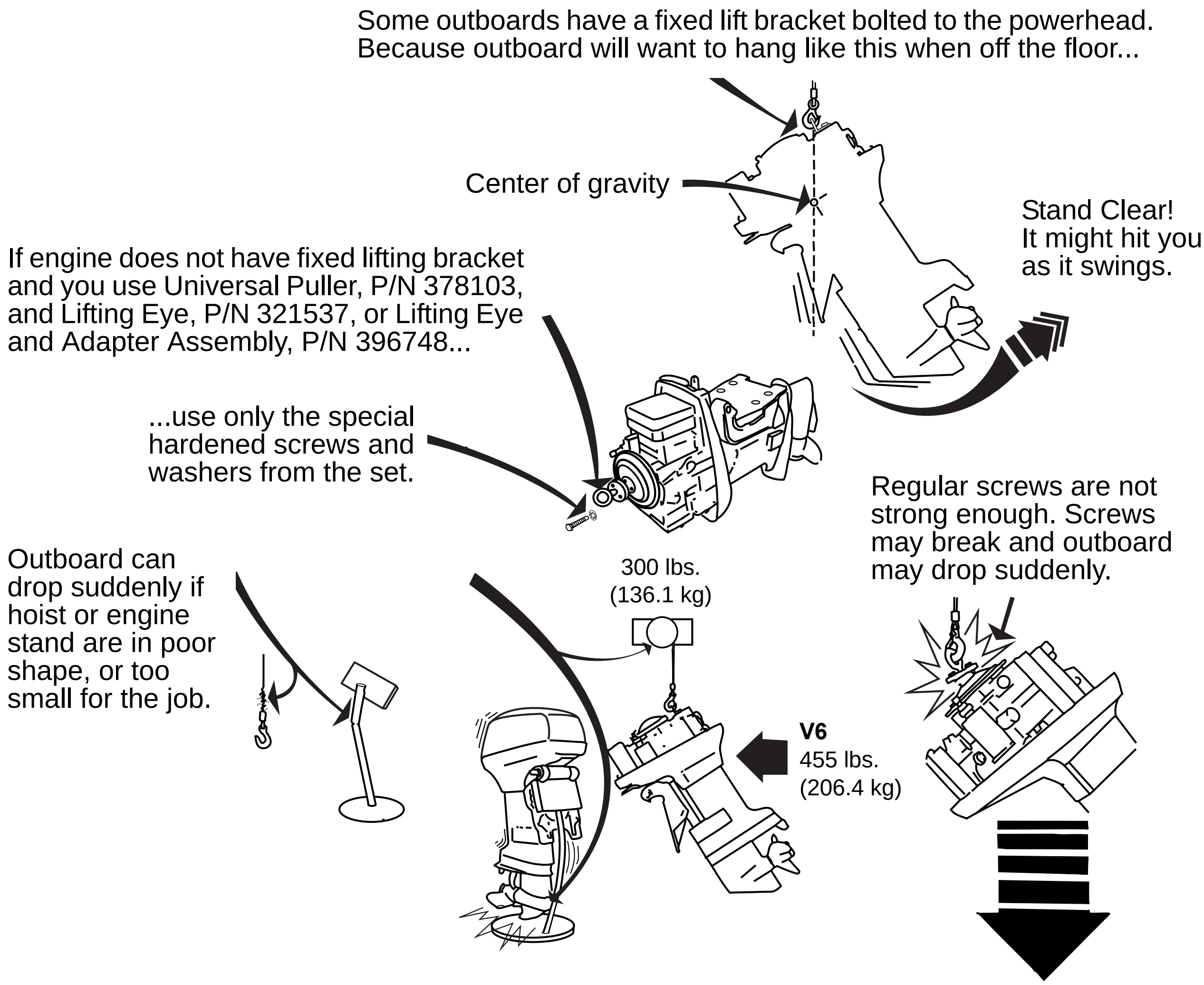
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

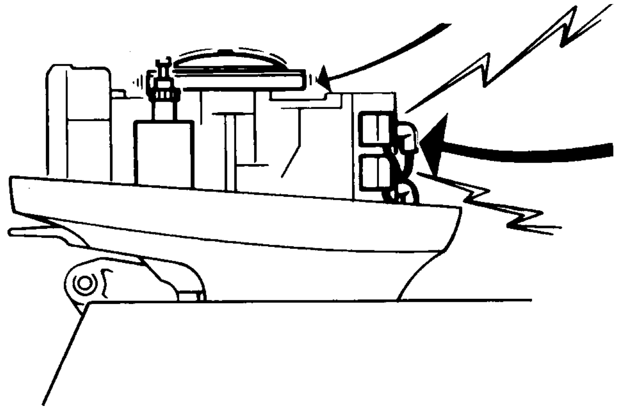
When lifting outboards



- Make sure shop aids have extra capacity, and keep them in good repair.

Running outboard with engine cover removed

Engine cover is a guard. When you remove cover/guard to work on the outboard, remember: loose clothing (open shirt sleeves, neckties), hair, jewelry (rings, watches, bracelets), hands and arms can be caught by the spinning flywheel.



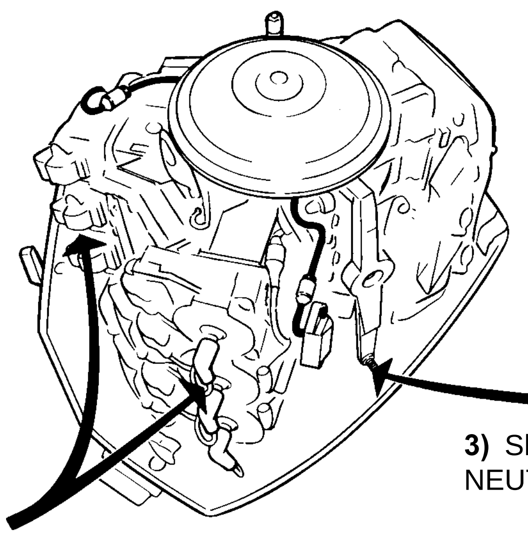
Handling high voltage parts like spark plugs and coils can shock you and may cause you to recoil into the rotating flywheel.

- Two people working together on a live outboard must look out for each other. Never, ever, use the key to start the outboard before signaling your partner. He may be leaning over the outboard with hands on the flywheel, handling a “hot” electrical part, or near the propeller.

Outboard starting at the wrong time

When you do things that turn the flywheel like:

- Off-season storage fogging (oiling) of outboard;
- Removing propeller with a powered tool;
- Electrical system checks;
- Servicing the flywheel; or
- Any other actions **ALWAYS...**



1) Turn key switch OFF

2) Twist and remove ALL spark plug leads

3) Shift to NEUTRAL

Check prop shaft. Is outboard really in NEUTRAL?

NO SPARK ➡ **NO START** ➡ **NO SURPRISES**

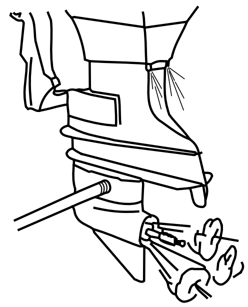
Running outboard too fast (Overspeeding)

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

Running too fast can happen when:

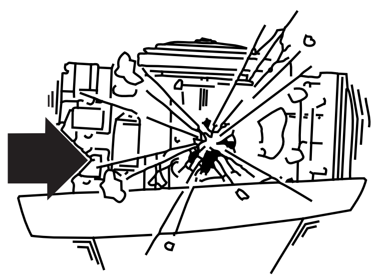
1) Using a flushing device...

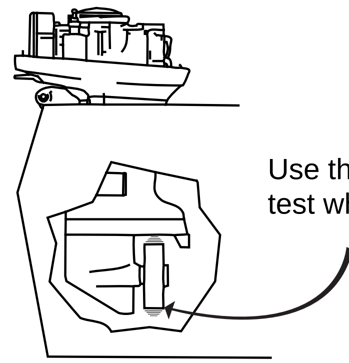
Turn on water before starting outboard. Keep engine speed below 2000 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.



2) Running with the wrong test wheel...

This may happen if outboard runs too fast.





Running outboards: Exhaust fumes

⚠ **DANGER** ⚠

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

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

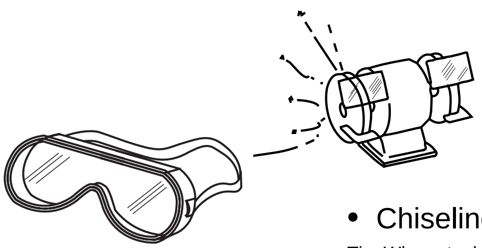
Running outboards: Propellers

DANGER

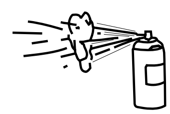
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

Eye protection

Eyes need protection when:



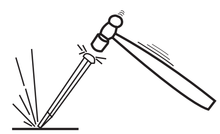
- Grinding

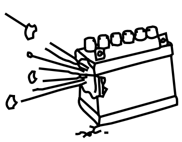


- Spraying cleaners and paints

- Chiseling

Tip: When steel on steel, use plastic- or brass-type hammers. They don't chip off as easily as steel hammers.



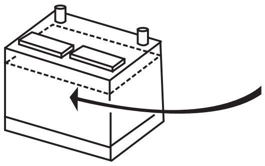


Wear Safety Glasses

Protect eyes from:

- Acid
- Ends of cables

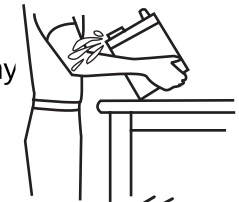
Handling Lead/Acid Batteries



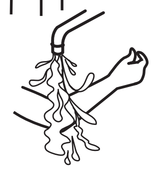
Strong acid solution
(sulfuric acid)

If solution gets into eyes, wash
and contact a doctor immediately.

If spilled or
splashed on any
part of body...



Wash with
lots of water.

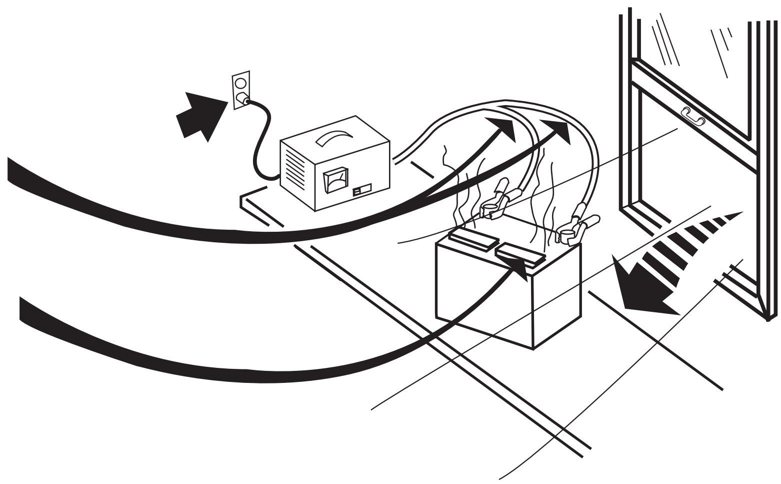


Charging lead acid batteries

1) Attach and remove these cables with charger UNPLUGGED from 110 V wall socket. (This prevents shocks if charger is defective.)

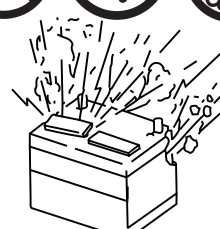
2) Observe correct polarity when connecting these larger leads.

3) Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. **Make sure vents are open.** If clogged, pressure inside may build. Battery may EXPLODE.



Battery gas is explosive!

While charging or discharging, remember:
- No smoking
- No flames
- No sparks



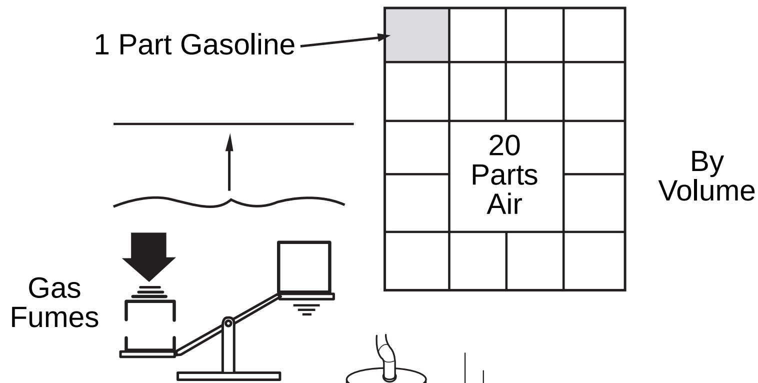
Never remove charger cables from battery posts. It is a sure way to make a lot of sparks in an area surrounded by battery gas.

DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.

After charging:
- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

Gasoline – Handle With Care!

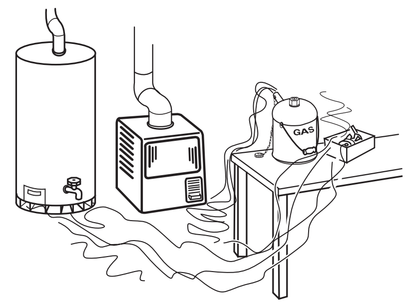
Gasoline vapor and air mixtures explode easily and violently when mixed as shown...



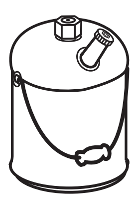
When you smell ANY odor of gasoline, explosion is possible.

Gasoline fumes are heavy and will sink to the lowest point in the boat or room and will STAY there, WAITING...

If the air around you is calm, the pilot light in the heater could **ignite** the heavy fumes before your nose ever **smells** the fumes.



What can you do?



Store gasoline in sturdy, approved, sealed gas can and keep outside.

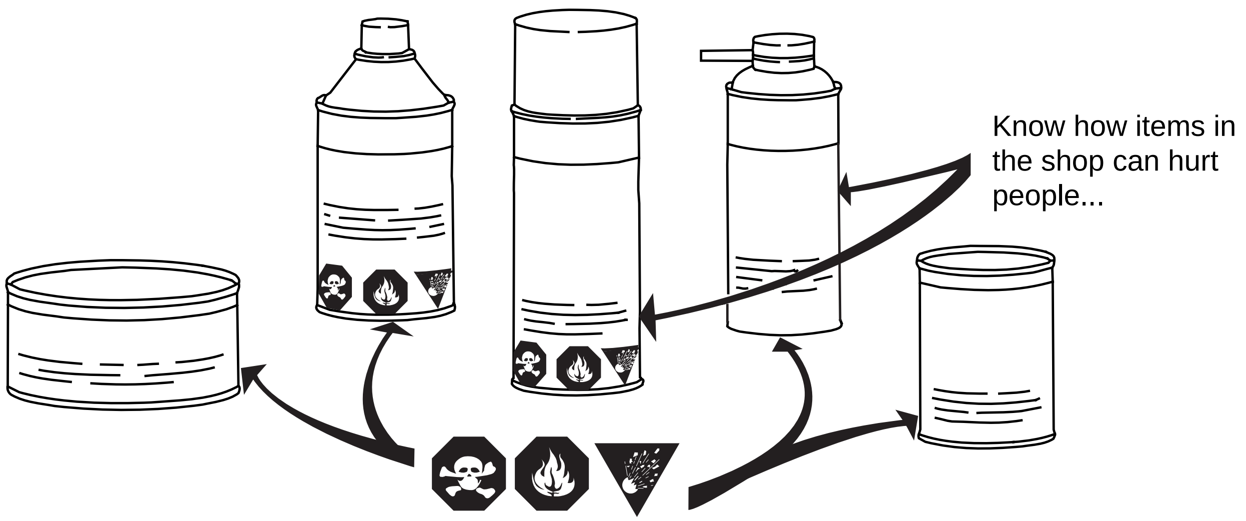
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **immediately**:
  - Put out open flames, cigarettes, sparking devices;
  - Wipe up spill or leak;
  - Get towels and rags outside fast;
  - Open doors and windows; and
  - Check **lowest** area for fumes.

Be aware of items in and around repair area which can ignite fumes. Control them if fumes are smelled.

- Matches, cigarettes, blow torches, welders
- Electric motors (with unsealed cases)
- Electric generators (with unsealed cases)
- Light switches
- Appliance pilot lights or electric ignitors (furnace, dryer, water heaters)
- Loose wires on running outboards
- Other variables which may ignite fumes

How many of these are in your repair area?

Hazardous Products



READ
- "How and where to use"
- "How to give First Aid." Have recommended First Aid materials on hand should an emergency arise
- "How to dispose of can"

It's all on the **back of the can or bottle label.**

And remember: Little children are very curious and will try to taste everything so **keep containers away from children!**

Safety Awareness Test

The Technician's Safety Awareness Test....

1) Did you read this Safety section from page S–1 to page S–24?

2) Are you ready to take responsibility for the safe maintenance practices and procedures of your repair shop, co-workers, and technicians?

3) Do you understand all the safety precautions and instructions contained in this entire service manual?

4) Will you follow all safety warnings, precautions, instructions and recommendations outlined in this service manual?

5) Do you understand that the service manual as a whole and this Safety section, in particular, contain essential information to help prevent personal injury and damage to equipment and your customers?

6) Have you received training related to common shop safety practices to protect yourself and others around you?

7) When replacement parts are required, will you use *Evinrude®/Johnson® Genuine Parts* or parts with equivalent characteristics, including type, strength and material?

8) Are you ready to follow the recommendations in this service manual before you service any boat or outboard?

9) Do you understand that safety-related accidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?

INDEX

T

TROUBLE CHECK CHART

OUTBOARD WILL NOT START

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard does not turn over	Battery switch not ON	Check battery switch operation
	Discharged battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections. Check for voltage drop in starter circuit.
	Faulty connection or ground, damaged electrical harness	Check all grounds, connections and wiring
	Fuse (10 A)	Check wiring, then replace faulty fuse
	Wiring harness	Check for 12 V at terminal “B” of key switch
	Key switch	Check key switch operation
	Starter solenoid	Check wiring and test solenoid
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears
	Seized powerhead or gearcase	Check and repair as needed
Outboard turns slowly	Discharged battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections. Check voltage drop in starter circuit.
	Powerhead hydro-locked	Check cylinders for water
	Partially seized powerhead or gearcase	Check and repair as needed
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears

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–Tiller models	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** and **ELECTRICAL AND IGNITION**
	Ignition	Check ignition, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	CPS input to *EMM,* no sync	Check RPM reading while cranking
	No ignition system control signal from *EMM* to ignition coils	Check cranking RPM (300 minimum), refer to **SYSTEM ANALYSIS**
	Low or no compression	Check compression
	Water in engine	Check condition of spark plugs and cylinders
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed
	EMM program, timing, or operation	Check *EMM* 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	Weak battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections, check voltage drop on high amperage circuit
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check or replace fuel supply
	Air in fuel system	Check for air in fuel supply manifold, refer to **FUEL SYSTEM** (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to **FUEL SYSTEM**
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low or no alternator output (55 V)	Check voltage on 55 V circuit, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Restricted or leaking fuel injector(s)	Check injectors, refer to **FUEL SYSTEM**
	Weak or erratic ignition operation	Check ignition, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Crankshaft Position Sensor (CPS)	Check CPS air gap and *EMM* LED indicators
	Excessive fuel or oil, engine flooding	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent. Refer to **SYSTEM ANALYSIS**.
	EMM program, timing, or operation	Check *EMM* program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

OUTBOARD WILL NOT SHUT OFF

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard starts and runs, normal performance while running	Key switch or wire harness ground	Check key switch and ground to key switch, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Stop circuit wiring	Check *EMM* LED indicators. Check wire harness (black/yellow) and key/stop switch(s).
	EMM failure	Check *EMM* LED indicators and eliminate stop circuit as possible cause. Stop wire (black/yellow) has 4.0 VDC from *EMM* with key on or outboard running.

OUTBOARD STARTS AND STALLS

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard may not run for more than a few seconds	Faulty wiring, connections, or grounds	Check all grounds, connections, and wiring
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low or no alternator output (55 V)	Check voltage on 55 V circuits, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to **FUEL SYSTEM**
	Air in fuel system	Check for air in fuel supply manifold, refer to **FUEL SYSTEM** (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Injector electrical circuit or control function	Check voltage at injectors, refer to **SYSTEM ANALYSIS**
	Restricted or leaking fuel injector(s)	Check injectors, refer to **FUEL SYSTEM**
	EMM program, timing, or operation	Check *EMM* program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs
	Weak or erratic ignition output	Check ignition, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Internal powerhead damage	Check and repair as needed

OUTBOARD STARTS, LOW MAXIMUM RPM

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

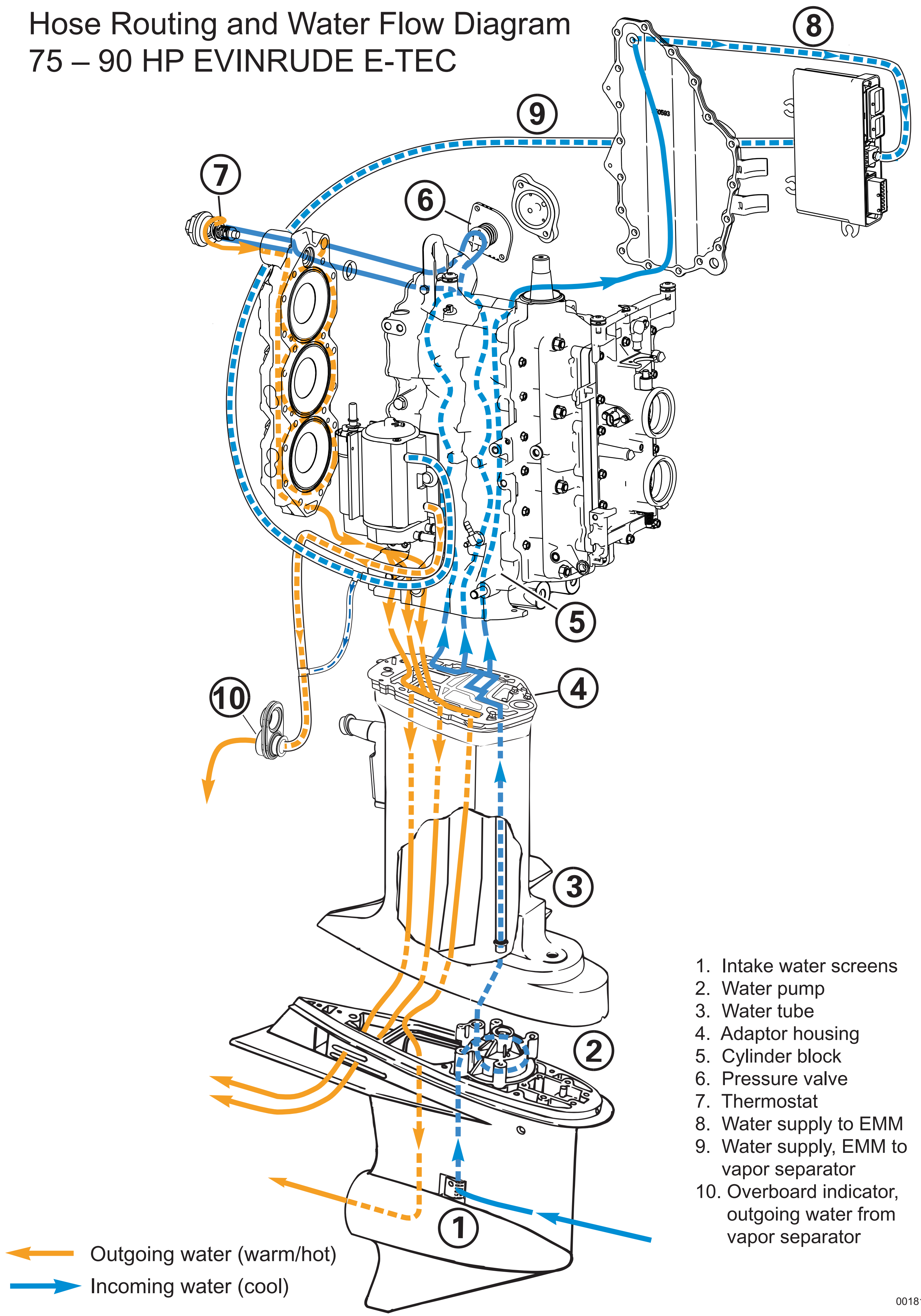
EXCESSIVE SMOKING

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

OUTBOARD SURGES, RUNS ROUGH

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
1200 RPM and above	*S.A.F.E.*	Access *EMM* fault codes
May be erratic or inconsistent	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check and replace fuel supply
	Low or erratic fuel pressure	Check pressure, refer to **FUEL SYSTEM**
	Air in fuel system	Check for air in fuel supply manifold, refer to **FUEL SYSTEM** (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Restricted or leaking fuel injector(s)	Check injectors, refer to **FUEL SYSTEM**
	Faulty wiring, connections, grounds, or CPS air gap	Check all grounds, connections, and wiring. Check CPS air gap.
	Low alternator output (55 V)	Check voltage on 55 V circuit, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	EMM program, timing, or operation	Check *EMM* program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Weak or erratic ignition operation	Check ignition, refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to **SYSTEM ANALYSIS** and **ELECTRICAL AND IGNITION**
	Restricted engine exhaust	Check and repair as needed
Audible noise	Internal powerhead damage	Check and repair as needed
	Damaged gearcase	Inspect gearcase and lubricate

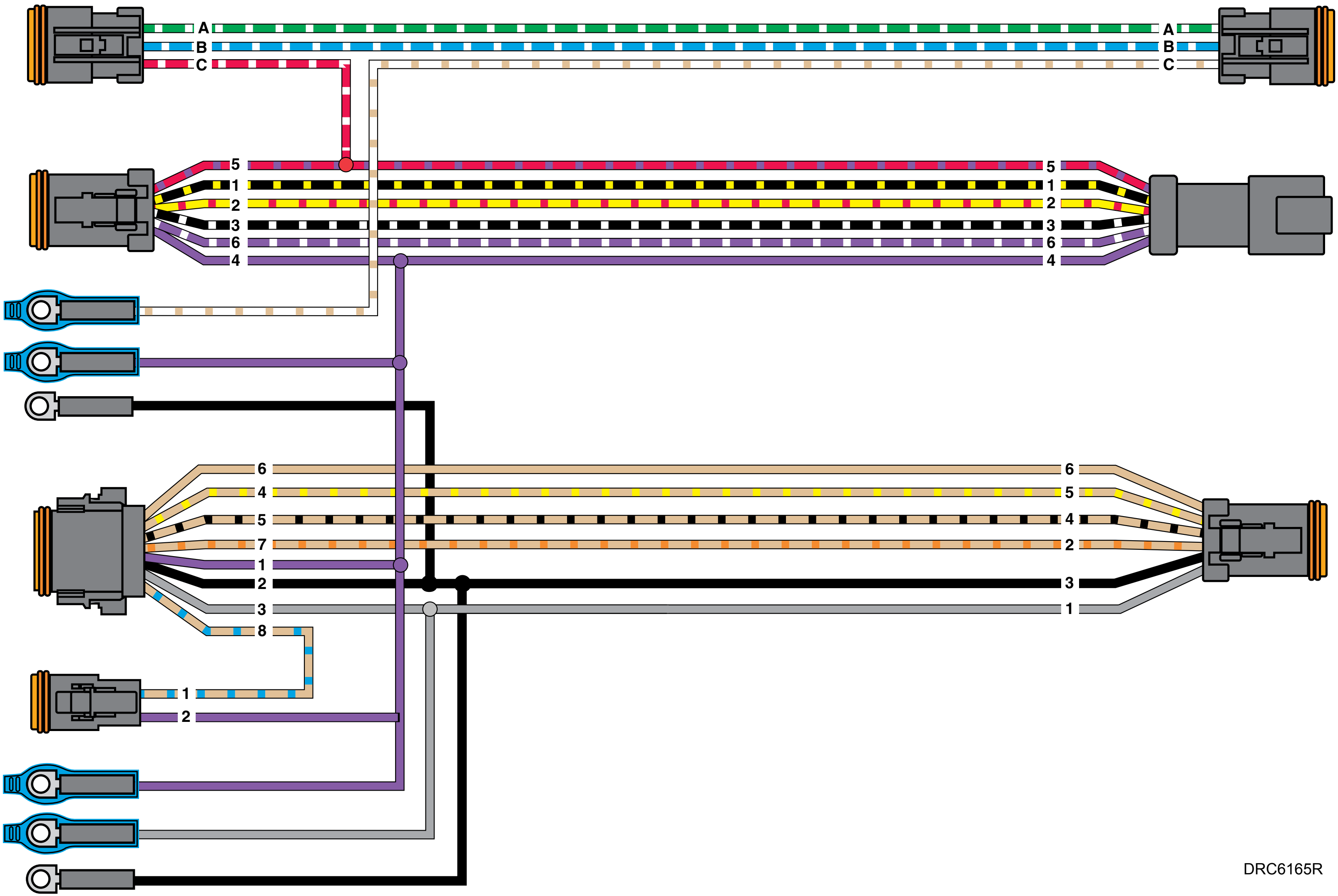
Hose Routing and Water Flow Diagram
75 – 90 HP EVINRUDE E-TEC



1. Intake water screens
2. Water pump
3. Water tube
4. Adaptor housing
5. Cylinder block
6. Pressure valve
7. Thermostat
8. Water supply to EMM
9. Water supply, EMM to vapor separator
10. Overboard indicator, outgoing water from vapor separator

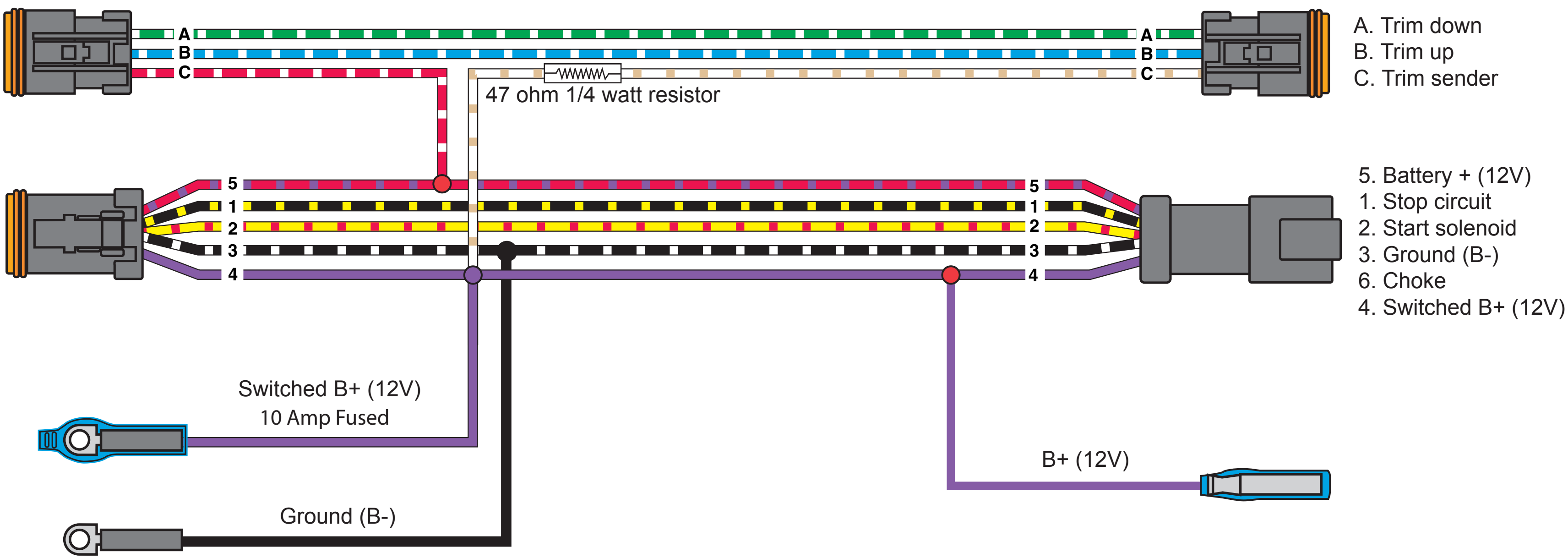
001818

MWS Instrument Wiring Harness



DRC6165R

CANbus Keyswitch/TNT Wiring Harness



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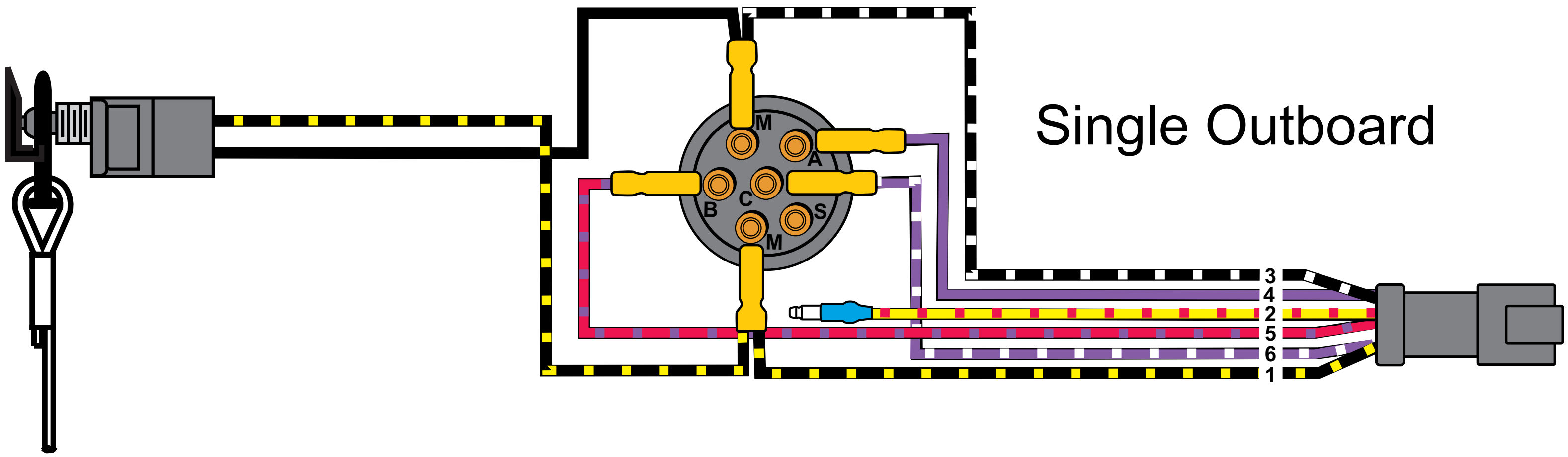
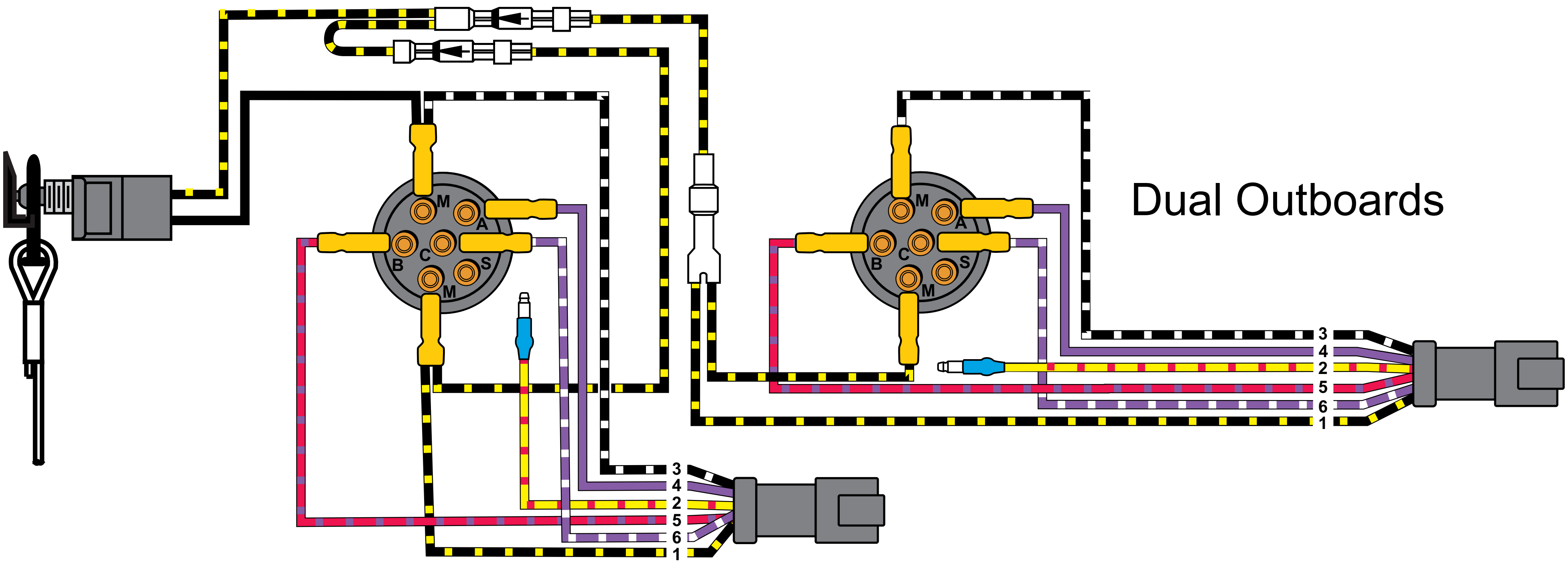
Lanyard Switch / Emergency Stop Circuits





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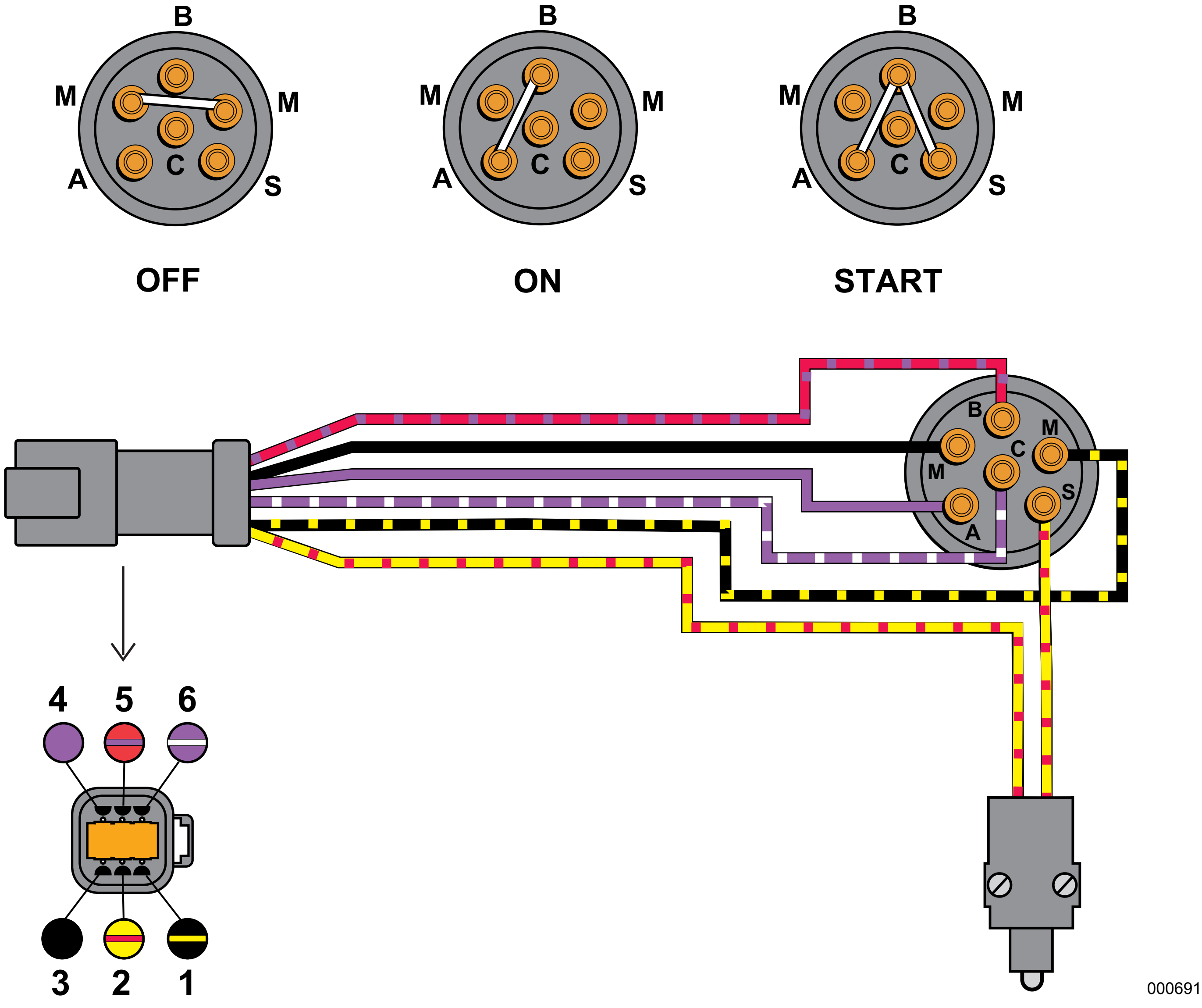
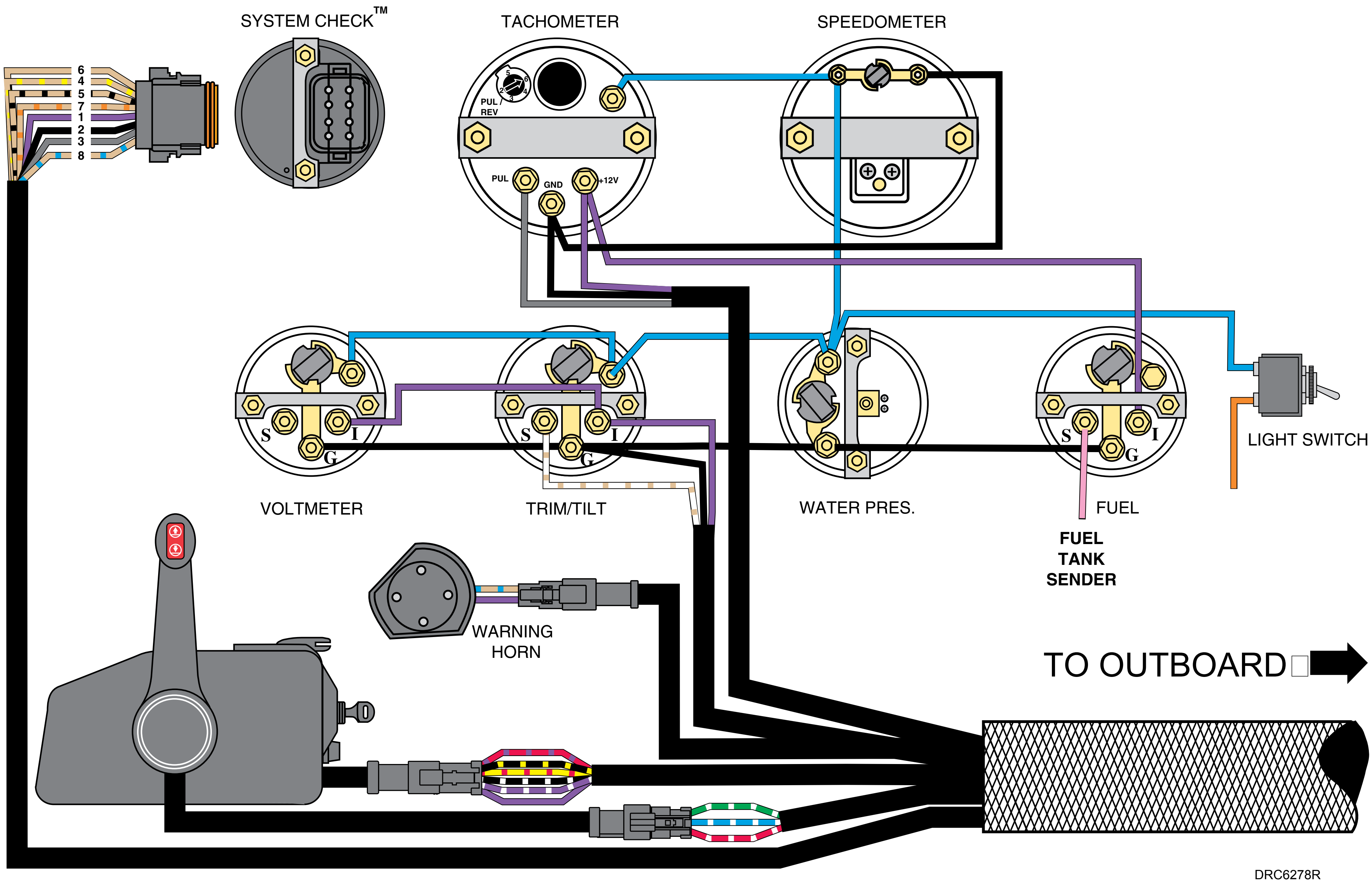
MWS Key Switch and Neutral Safety Switch

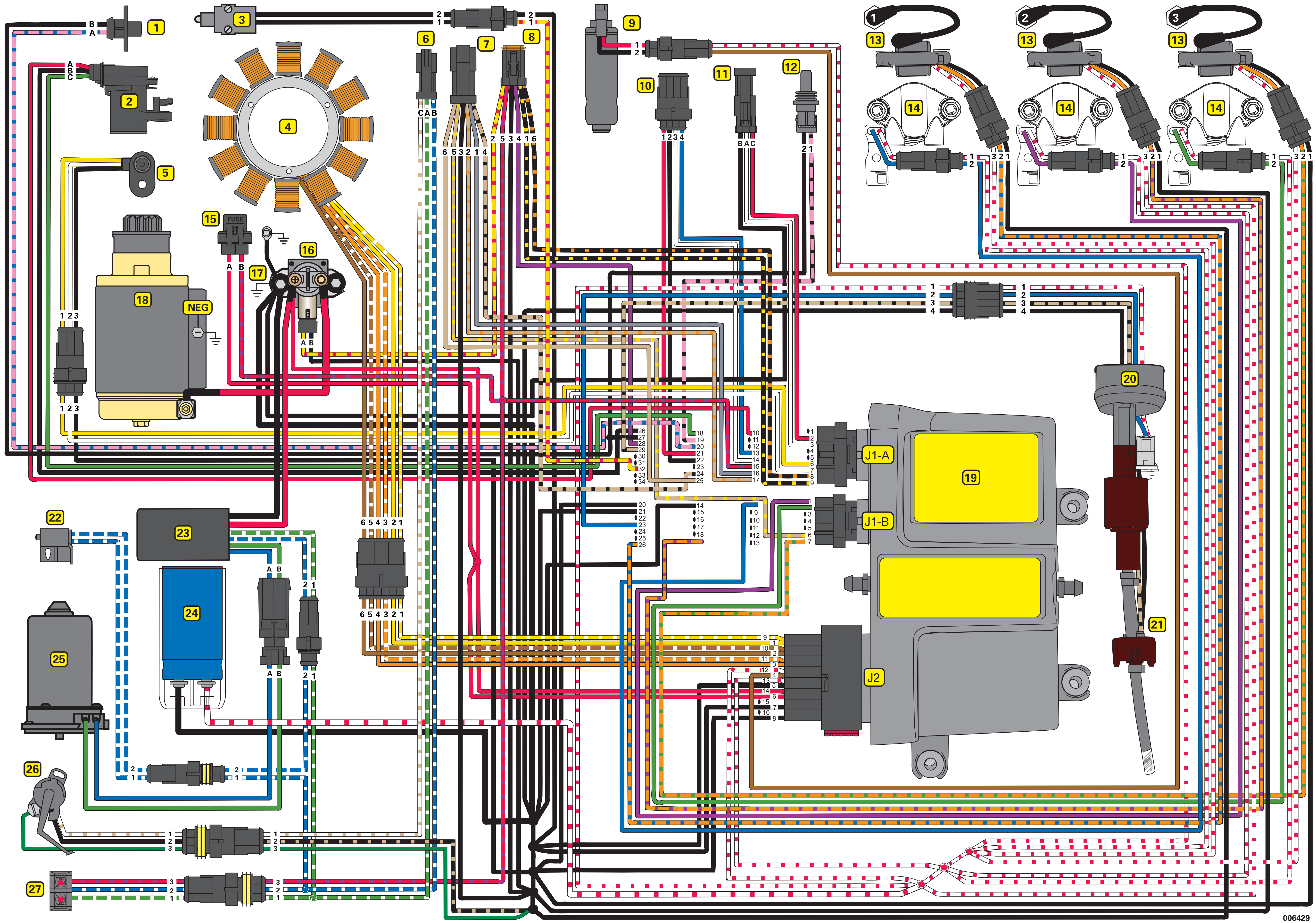


MWS DASHBOARD



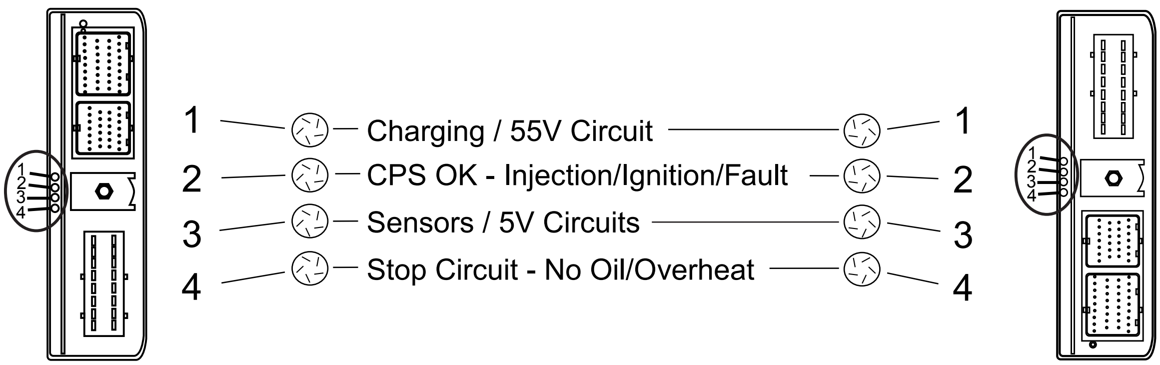
75 – 90 HP E-TEC

1. Air Temperature Sensor
2. Throttle Position Sensor
3. Neutral Switch
4. Stator
5. Crankshaft Position Sensor
6. Trim/Tilt Connector
7. SystemCheck Connector
8. Key Switch Connector
9. High Pressure Fuel Pump
10. CANbus Connector
11. Diagnostic Connector
12. Temperature Sensor
13. Ignition Coil
14. Fuel Injector
15. Fuse (10 Amp)
16. Starter Solenoid
17. Main Harness Ground
18. Electric Starter
19. EMM
20. Oil Injector
21. Low Oil Switch
22. Tilt Limit Switch
23. Trim/Tilt Relay Module
24. Capacitor
25. Trim/Tilt Motor
26. Trim Sending Unit
27. Trim/Tilt Switch



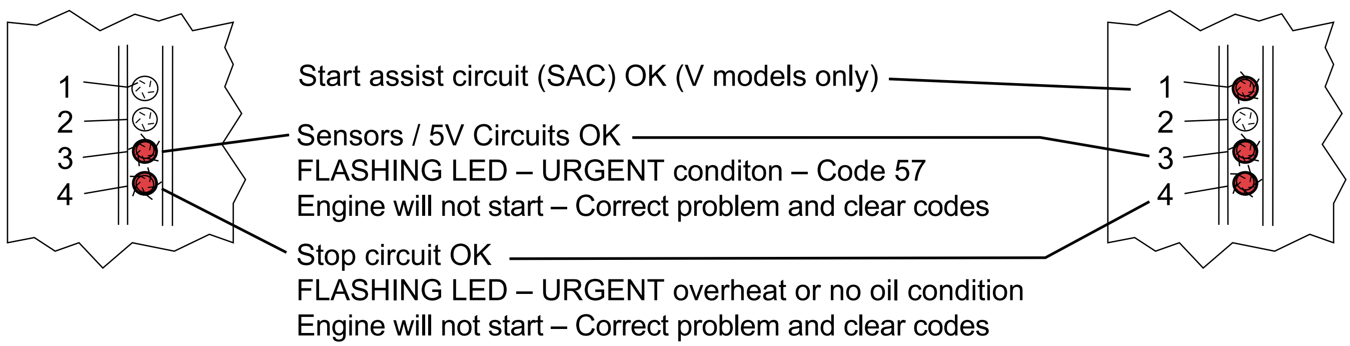
Evinrude E-TEC
EMM LED Diagnostic Indicators

In-line Models / V Models



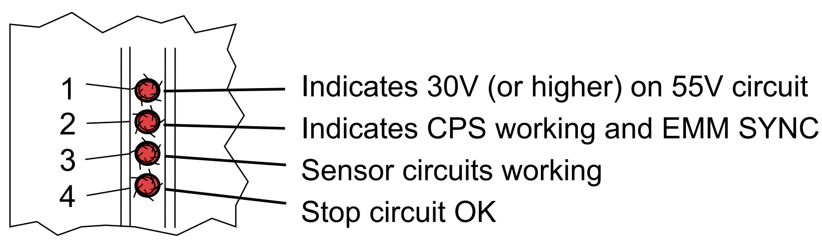
For more information, refer to **SYSTEM ANALYSIS** in the Service Manual.

KEY ON: LED's illuminate to indicate circuit function

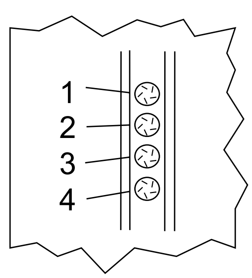


Note: No LED's ON indicates EMM not receiving battery voltage or Recoil Start model.

STARTING: LED's illuminate to indicate circuit function



RUNNING : LED's illuminate to indicate circuit fault



Exception: ALL LED's ON / FLASHING indicates Winterization Mode

EVINRUDE 40 – 90 HP *EMM* SERVICE CODE CHART

CODE	*EMM* CIRCUIT/SENSOR	INTERNAL SENSOR	*S.A.F.E*	SHUT DOWN	*EMM* LED DISPLAY	DASHBOARD GAUGE WARNING DISPLAY	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) / 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. Engine limited to 1200 RPM. Perform stator/charging tests.
18	55 V circuit ABOVE range	✓	✓		LED 1: ON (Running)	CHECK ENGINE	1 minute	System Voltage > 57 V. Engine limited to 1200 RPM. 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 limited to 1200 RPM. 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 SHUTDOWN. Will NOT restart until *EMM* temperature returns to operating range. Check outboard and *EMM* cooling systems.
31	Engine temperature OVER range			✓	LED 4: FLASHING	WATER TEMP/HOT (FLASHING)	8 seconds	Engine Temperature > 248° F (120° C). Engine SHUTDOWN. 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 SHUTDOWN. Will restart and run for 1 minute intervals.
34	Oil injection pump circuit OPEN		✓		LED 4: ON (Running)	NO OIL	4 seconds	Engine limited to 1200 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 > 212° F (100° C). Engine limited to 1200 RPM. 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).

CODE	*EMM* CIRCUIT/SENSOR	INTERNAL SENSOR	*S.A.F.E*	SHUT DOWN	*EMM* LED DISPLAY	DASHBOARD GAUGE WARNING DISPLAY	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION
51	Fuel injector circuit #1 OPEN				LED 2: ON (Running)	-	2 seconds	
52	Fuel injector circuit #2 OPEN				LED 2: ON (Running)	-	2 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).
53	Fuel injector circuit #3 OPEN				LED 2: ON (Running)	-	2 seconds	
57	High RPM with low TPS setting	✓		✓	LED 3: FLASHING	CHECK ENGINE (FLASHING)	10 seconds	TPS < 5% and RPM > 3000. Engine SHUTDOWN. Will NOT restart until code has been cleared. The problem could be caused by uncontrolled fuel entering the engine. DO NOT attempt to start the outboard until the problem has been found and repaired.
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	
62	Fuel injector circuit #2 SHORTED				LED 2: ON (Running)	-	8 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).
63	Fuel injector circuit #3 SHORTED				LED 2: ON (Running)	-	8 seconds	
81	Ignition timing circuit #1 OPEN				LED 2: ON (Running)	-	10 instances	
82	Ignition timing circuit #2 OPEN				LED 2: ON (Running)	-	10 instances	*EMM* counts failed ignition events. Check wiring. Test with known good ignition coil.
83	Ignition timing circuit #3 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	
102	Ignition timing circuit #2 SHORTED				LED 2: ON (Running)	-	20 instances	*EMM* counts failed ignition events. Check wiring. Test with known good ignition coil.
103	Ignition timing circuit #3 SHORTED				LED 2: ON (Running)	-	20 instances	
117	Critical LOW OIL detected	✓	✓		LED 4: ON (Running)	NO OIL	4800 Pulses (2 Cyl) 6000 Pulses (3 Cyl)	*EMM* counts oil pump pulses after LOW OIL switch closes. Engine limited to 1200 RPM. Stop outboard and add oil to tank. Warning resets after three oil pump pulses.
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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