2007 Service Manual



200, 225, 250 HP

Evinrude® E-TEC®

EVINRUDE®

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

† AMP, Superseal 1.5, Super Seal, Power Timer, and Pro-Crimper II are registered trademarks of Tyco International, Ltd.
† Amphenol is a registered trademark of The Amphenol Corporation.
† Champion is a registered trademark of Federal-Mogul Corporation.
† Deutsch is a registered trademark of The Deutsch Company.
† Dexron is a registered trademark of The General Motors Corporation.
† Fluke is a registered trademark of The Fluke Corporation
† Frahm is a registered trademark of James G. Biddle Co.
† Gasoila is a registered trademark of The Federal Process Corporation.
† GE is a registered trademark of The General Electric Company.
† GM is a registered trademark of The General Motors Corporation.
† Locquic and Loctite are registered trademarks of The Henkel Group.
† Lubriplate is a registered trademark of Fiske Brothers Refining Company.
† NGK is a registered trademark of NGK Spark Plugs (U.S.A.) Inc.
† NMEA is a registered trademark of the National Marine Electronics Association.
† Oetiker is a registered trademark of Hans Oetiker AG Maschinen.
† Packard is a registered trademark of Delphi Automotive Systems.
† Permatex is a registered trademark of Permatex.
† Plastigage is a registered trademark of The Dana Corporation.
† STP is a registered trademark of STP Products Company.
† Snap-on is a registered trademark of Snap-on Technologies, Inc.
† ThreeBond is a registered trademark of Three Bond Co., Ltd.

Bombardier logo is a registered trademark of Bombardier, Inc., used under license.

The following trademarks are the property of BRP US Inc. or its affiliates:

Carbon Guard™
DPL™ Lubricant
Evinrude ®
Evinrude ® *E-TEC*™
Evinrude ® */ Johnson* ® *XD30*™ Outboard Oil
Evinrude ® */ Johnson* ® *XD50*™ Outboard Oil
Evinrude ® */ Johnson* ® *XD100*™ Outboard Oil
Extreme Pressure Grease™
FasTrak™
Gel-Seal II™
Hi-Vis™ Gearcase Lubricant
Johnson ®
Moly Lube™
Nut Lock™
QuikStart™
S.A.F.E.™
S.L.O.W.™
Screw Lock™
SystemCheck™
Triple-Guard ® Grease
Twist-Grip™
2+4 ® *Fuel Conditioner*
Ultra™ *4-Stroke* Outboard Oil
HPF XR™ Gearcase Lubricant
Ultra Lock™

Printed in the United States.
© 2006 BRP US Inc. All rights reserved.
TM, ® Trademarks and registered trademarks of Bombardier Recreational Products Inc. or its affiliates.

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 alert signal words 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.

TABLE OF CONTENTS

SECTION . . . . . PAGE

INTRODUCTION 5
1 SERVICE SPECIFICATIONS AND SPECIAL TOOLS . . 17
2 INSTALLATION AND PREDELIVERY 33
3 MAINTENANCE 79
4 ENGINE MANAGEMENT MODULE (EMM) 95
5 SYSTEM ANALYSIS 113
6 ELECTRICAL AND IGNITION 135
7 FUEL SYSTEM 171
8 OILING SYSTEM 197
9 COOLING SYSTEM 217
10 POWERHEAD 227
11 MIDSECTION 263
12 GEARCASE 281
13 TRIM AND TILT 325
SAFETY S–1
INDEX Index–1
TROUBLE CHECK CHART T–1
DIAGRAMS
EMM SERVICE CODE CHART

INTRODUCTION

CONTENTS

MODELS COVERED IN THIS MANUAL 6
IDENTIFYING MODEL AND SERIAL NUMBERS 6
MODEL DESIGNATION 7
TYPICAL PAGE – A 8
TYPICAL PAGE – B 9
TYPICAL PAGE – C 10
TYPICAL PAGE – D 11
ABBREVIATIONS USED IN THIS MANUAL 12
UNITS OF MEASUREMENT 12
LIST OF ABBREVIATIONS 12
ENGINE EMISSIONS INFORMATION 13
MANUFACTURER'S RESPONSIBILITY 13
DEALER'S RESPONSIBILITY 13
OWNER'S RESPONSIBILITY 13
EPA EMISSION REGULATIONS 13
PRODUCT REFERENCE AND ILLUSTRATIONS 14
SYMBOLS 14
ELECTRICAL 14
VALUES 15
NOTES 16

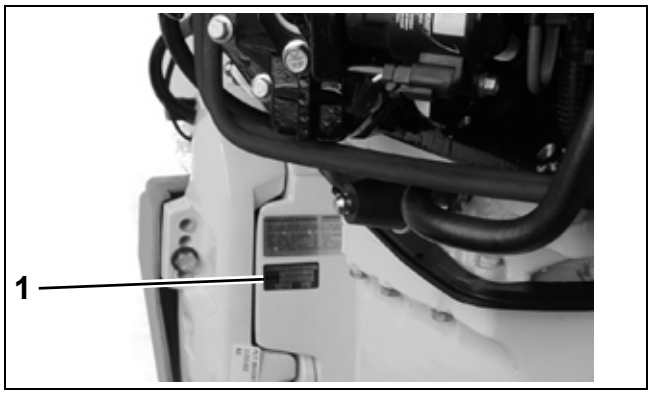
MODELS COVERED IN THIS MANUAL

This manual covers service information on all 90° V6 *Evinrude E-TEC*™ models.

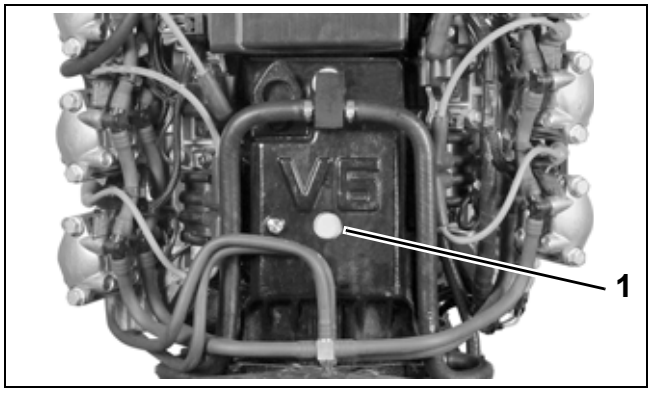
Model Number	Shaft	Paint	HP
E200HSLSUC	20”	WH	200
E200DHLSUG	20”	BL	200
E200DHLSUA	20”	BL	200
E200DHXSUC	25”	WH	200
E200HCXSUC	25”	WH	200
E225DPLSUG	20”	BL	225
E225DPLSUA	20”	BL	225
E225DPXSUG	25”	WH	225
E225DPXSUA	25”	WH	225
E225DPZSUA	30”	WH	225
E225DCXSUA	25”	WH	225
E225DCZSUG	30”	WH	225
E225DCZSUG	30”	WH	225
E225DHLSUG	20”	BL	225
E225DHLSUA	20”	BL	225
E225DHXSUG	25”	BL	225
E225DHXSUR	25”	BL	225
E250DPLSUA	20”	BL	250
E250DPXSUG	25”	WH	250
E250DPXSUA	25”	WH	250
E250DPZSUG	30”	WH	250
E250DPZSUA	30”	WH	250
E250DCXSUG	25”	WH	250
E250DCXSUA	25”	WH	250
E250DCZSUA	30”	WH	250

Identifying Model and Serial Numbers

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

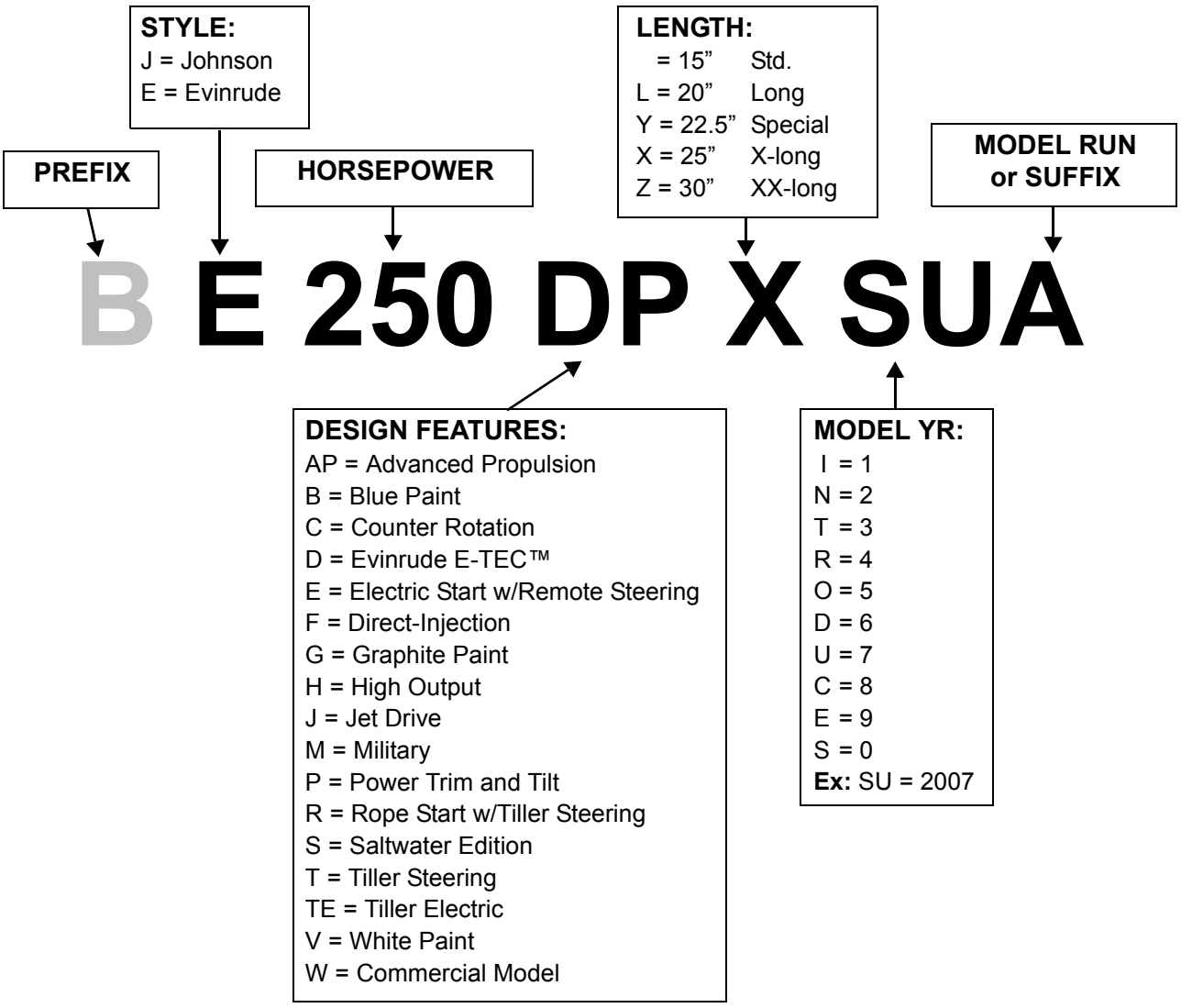


Swivel Bracket 000449
1. Model and serial number

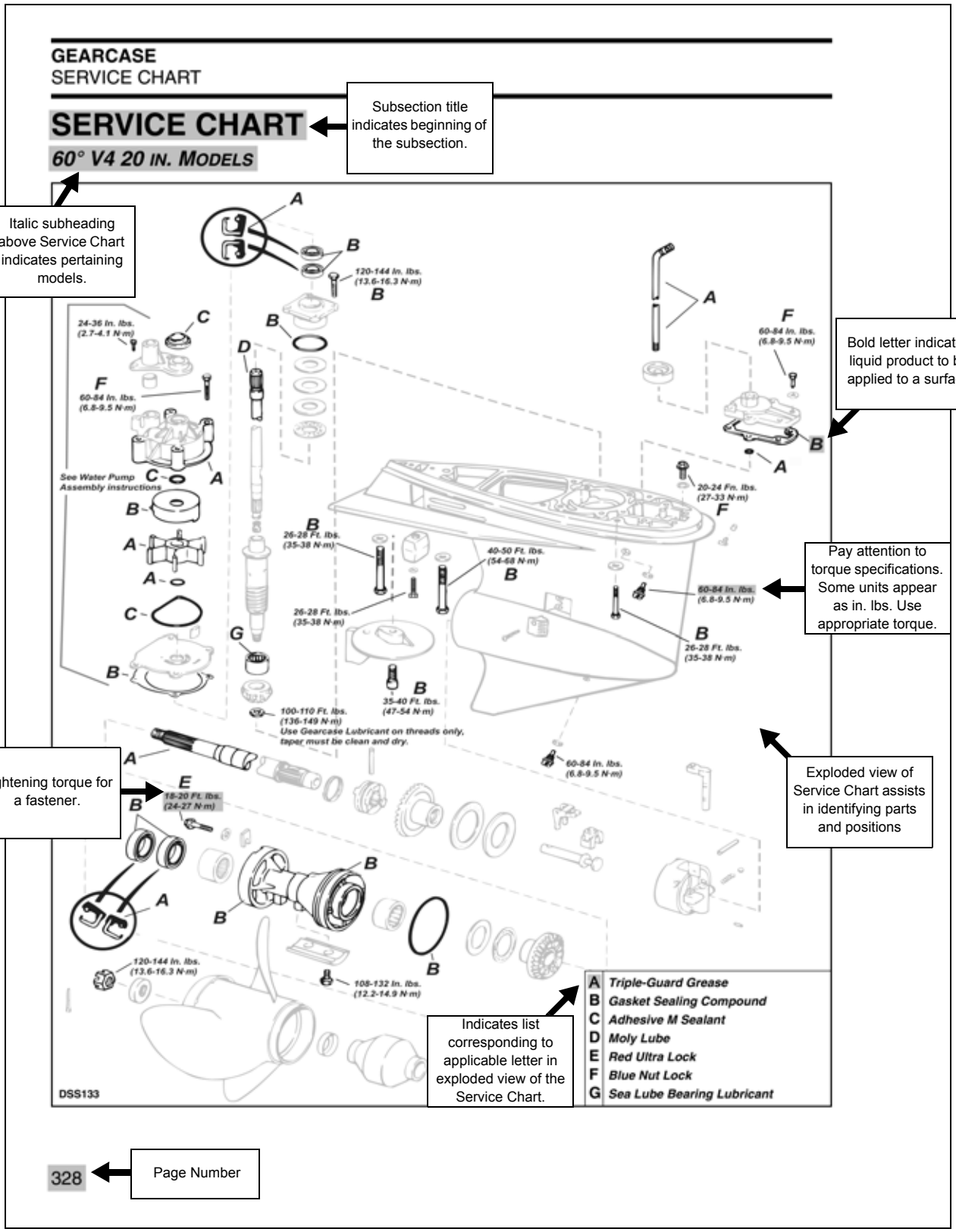


1. Serial number 003901

MODEL DESIGNATION



TYPICAL PAGE – A



TYPICAL PAGE – B

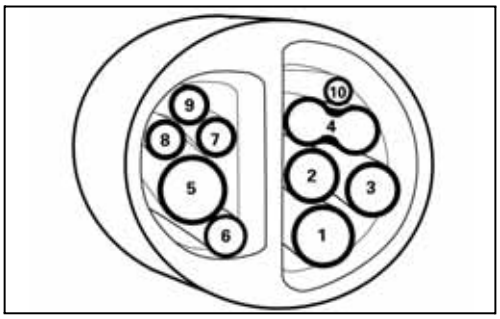
Section Title

Subsection Title

Cable, Hose, and Wire Routing

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

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



000084

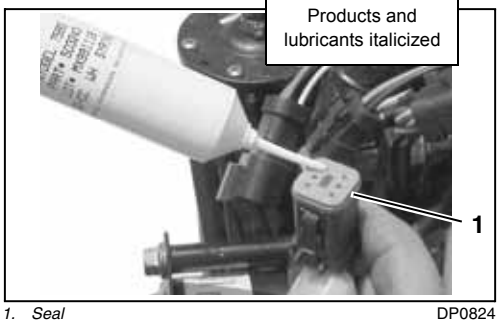
1. *Fuel supply hose*
2. *Oil return hose*
3. *Oil supply hose*
4. *Battery cables*
5. *Main wire harness (MWS)*
6. *Throttle cable*
7. *Shift cable*
8. *Oil tank sending unit harness*
9. *Water pressure hose*
10. *Accessory charge wire*

Model specific illustrations designated with image captions

Connect outboard main wire harness to boat main wire harness.

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. Push connectors together until latched.

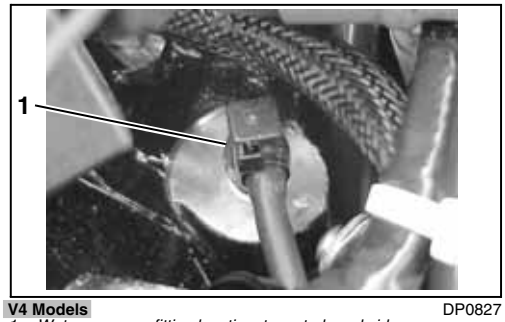
Products and lubricants italicized



1. *Seal* DP0824

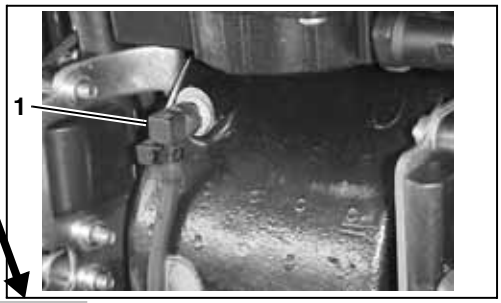
If a water pressure gauge is to be used, install the water pressure hose fitting in the cylinder block. Use *Pipe Sealant with Teflon* (P/N 910048) on the threads of the hose fitting. Refer to installation instructions supplied with gauge.

Route the water pressure hose through cover grommet with oil tank sending unit harness. Route hose along battery cables toward the back of the powerhead. Use tie straps to fasten in place.



V4 Models DP0827

1. *Water pressure fitting location: top, starboard side of cylinder/crankcase assembly, below throttle position sensor.*



V6 Models DP0828

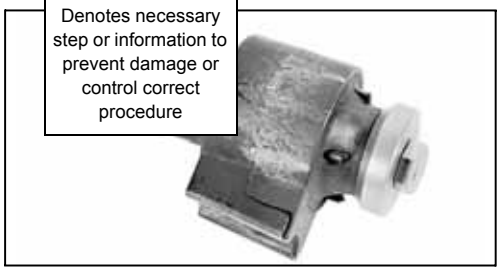
1. *Water pressure fitting location: rear of cylinder/crankcase assembly*

If temperature gauge is to be used, route sending unit wire through grommet with hose for water pressure gauge. Follow the path of battery cables. Provide adequate length to reach cylinder head. Refer to installation instructions supplied with gauge.

TYPICAL PAGE – C

IMPORTANT: The motor mount, washer, and screw are serviced as an assembly. Do not disassemble.

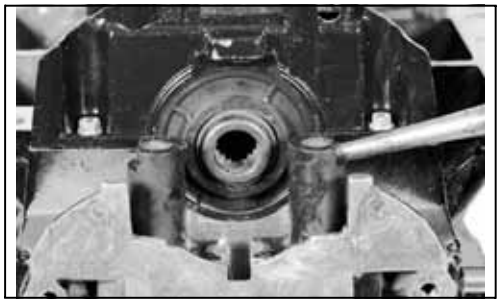
Denotes necessary step or information to prevent damage or control correct procedure



39820

Installation

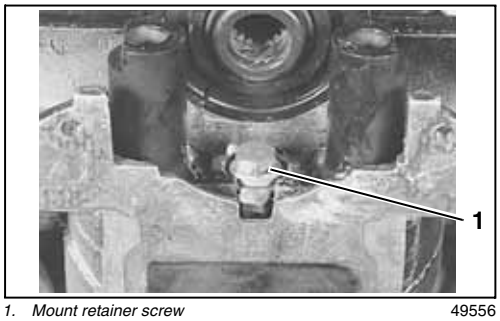
Place mount assemblies in position, with flats facing away from each other.



49557

Apply *Extreme Pressure Grease* to all sides of retainer and install between mounts.

Apply *Nut Lock* to retainer screw, install the screw, and torque to 15 to 20 ft. lbs. (20 to 27 N·m).



1. Mount retainer screw 49556

INSTALLATION

Title in italics indicates a procedure concerning a particular model

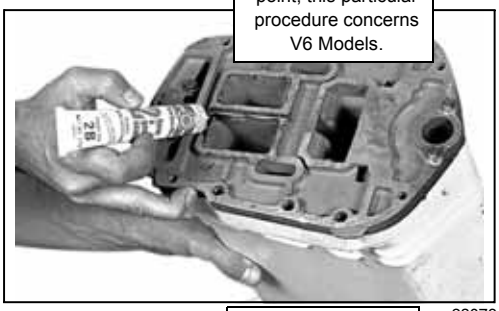
V4 MODELS

Install base gasket d ***rmatex No. 2* or *Gasket Sealin***

Title indicates the procedure specific to V4 Models is finished. From this point, this particular procedure concerns V6 Models.

V6 MODELS

Apply *Permatex No.* inner exhaust housing flange a new base gasket with *Gask* *d.*



23079

Title indicates from this point, All Models are concerned

ALL MODELS

Install a **new** base ga ensure proper sealing, mating surfaces must be clean and free of oil, grease, and foreign matter.



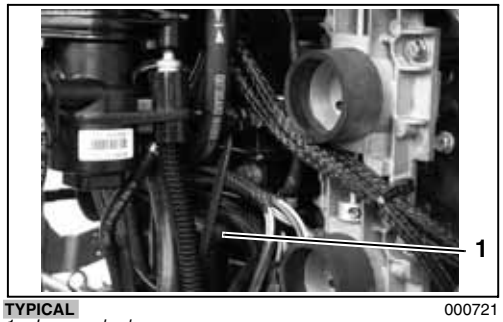
23497

Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

TYPICAL PAGE – D

Two pulse hoses connect the pump to pulse fittings on the front of the cylinder/crankcase.

- **V4 Models –** cylinders 1 and 3
- **V6 Models –** cylinders 1 and 4



TYPICAL 000721
1. Lower pulse hose

Typical illustration for lower pulse hose of V4 or V6 Models

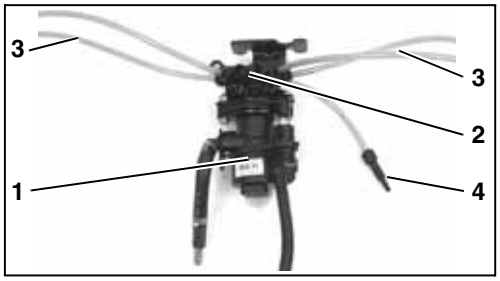
ctor-Manifold

ctor-manifold distributes the oil supe oil lift pump. A pressure-sensing switch monitors oil injection pressure.

Oil Injector-Manifold Components

- 40 V oil injector
- Oil distribution manifold
- Oil pressure switch
- Pressure regulator (oil return hose)
- Oil distribution hoses
- Oil to fuel check valve

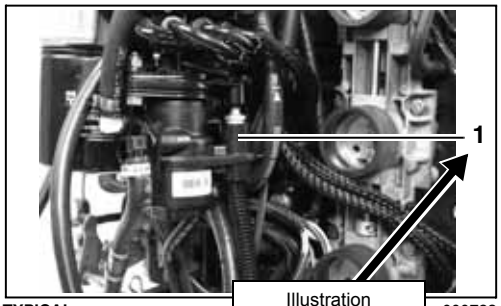
Cross references direct readers to related topics



TYPICAL 000722
1. Oil injector
2. Oil distribution manifold
3. Oil distribution hoses
4. Oil to fuel check valve

Oil Pressure Switch

The oil pressure switch is located in the oil injector-manifold and reacts to changes in oil manifold pressure. The *EMM* supplies and monitors electrical current to the switch.



TYPICAL 000723
1. Oil pressure switch

Illustration components numbered to correspond to image

The switch opens or clo llowing oil manifold pressures:

53 psi (365 kPa) (nominal) to close
43 psi (296 kPa) (nominal) to reopen

Refer to **Oil Pressure Switch Test** on p. 224.

Service Code 38

A faulty electrical circuit or an inoperative pressure switch activates service code 38 (no oil sensor feedback or lack of oil pressure) and the *EMM*:

Activates the *System Check* "NO OIL" light
Stores a service code
Initiates *S.L.O.W.*

Service Code 39

If no oil pressure is detected during startup, the *EMM* initiates an oil injector “recovery mode” to pressurize the system. If inadequate oil pressure is still detected after the recovery mode is completed, the *EMM*:

Activates the *System Check* "NO OIL" light
Stores a service code
Initiates *S.L.O.W.*

Section tabs allow for quicker reference when thumbing through manual

ABBREVIATIONS USED IN THIS MANUAL

Units of Measurement

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

List of Abbreviations

ABYC	American Boat & Yacht Council
ATDC	after top dead center
AT	air temperature sensor
BPS	barometric pressure sensor
BTDC	before top dead center
CCA	cold cranking amps
CPS	crankshaft position sensor
DI	Direct-Injection
ECU	electronic control unit
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
PDP	power distribution panel
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
S.L.O.W.™	speed limiting operational warning
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

PRODUCT REFERENCE AND ILLUSTRATIONS

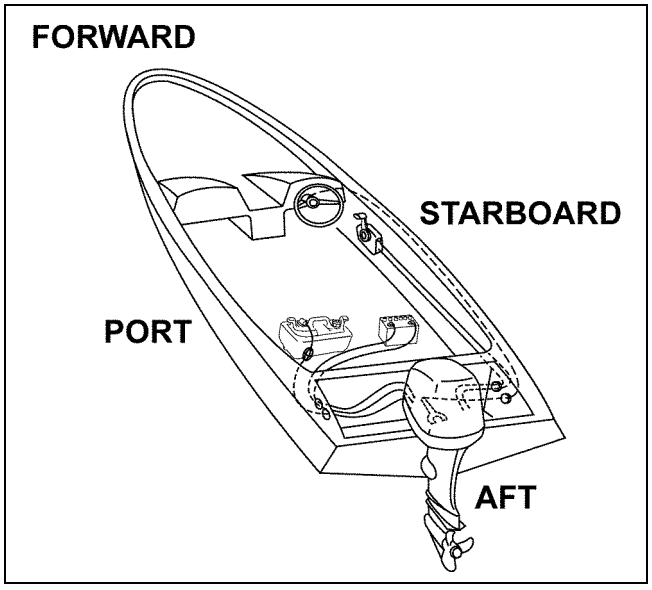
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of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



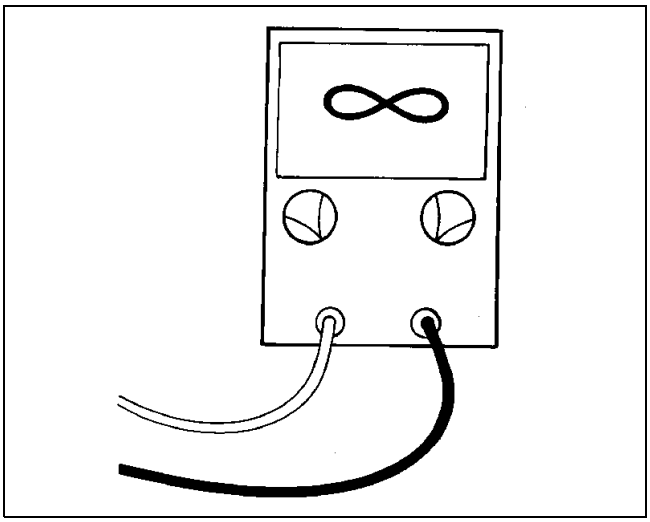
Nautical Orientation

SYMBOLS

Throughout this service manual, symbols are used to interpret electrical troubleshooting results or to assign values in drawings.

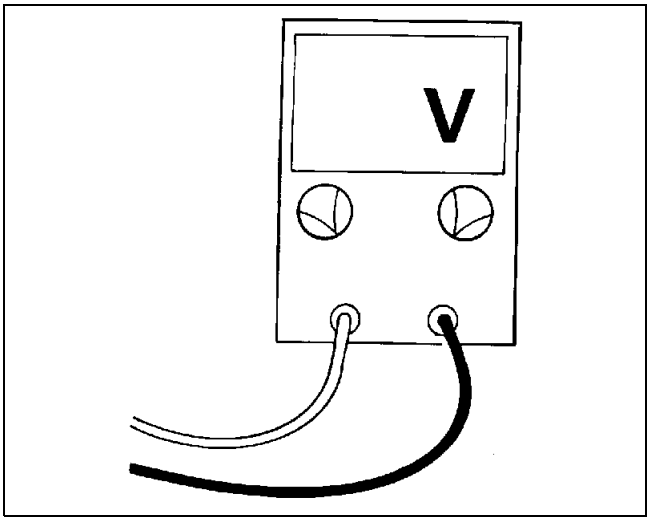
Electrical

When "∞" shows on the meter face, no continuity, or very high resistance, is indicated. The symbol is referred to as infinity.



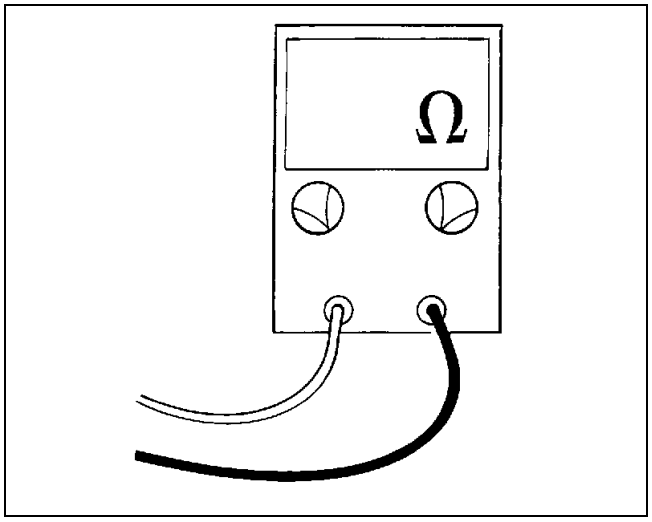
DR4203

When "V" follows a value on the meter face, the procedure is measuring voltage.



DR4204

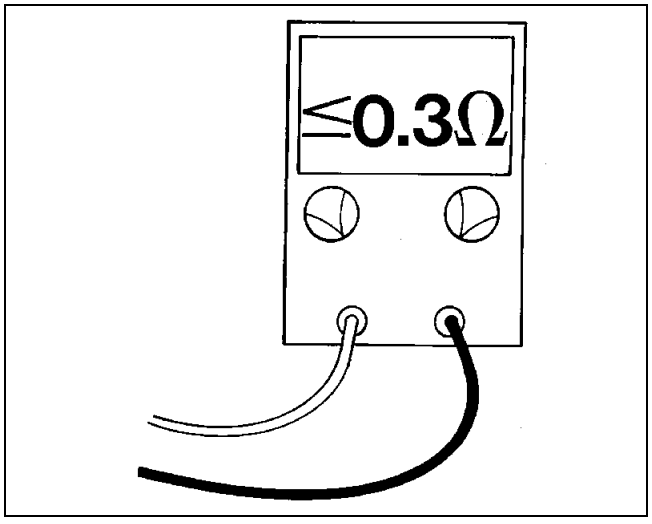
When "Ω" follows a value on the meter face, the procedure is measuring resistance. Ω is the symbol for ohm, the unit of measurement for resistance.



DR4205

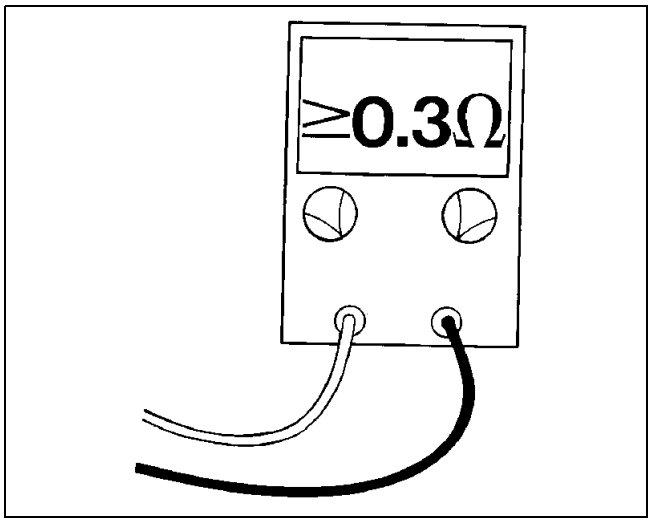
Values

When "≤" precedes a value on the meter face, the reading should be less than, or equal to, the value shown.



DR4206

When "≥" precedes a value on the meter face, the reading should be greater than, or equal to, the value shown.



DR4207

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

TABLE OF CONTENTS

TECHNICAL DATA 18
STANDARD TORQUE SPECIFICATIONS 20
SPECIAL TOOLS 21
DIAGNOSTICS 21
UNIVERSAL 21
ELECTRICAL / IGNITION 22
FUEL/OIL SYSTEMS 23
POWERHEAD 23
GEARCASE 24
TRIM AND TILT 26
SHOP AIDS 28
NOTES 32

TECHNICAL DATA

	HP	200	225	250	200 H	225 H
ENGINE	Full Throttle Operating Range	4500–5800 RPM				
	Power	200 HP (149 kw) @ 5150 RPM	225 HP (168 kw) @ 5150 RPM	250 HP (187 kw) @ 5150 RPM	Factory Tuned for High Performance	
	Idle RPM in Gear	500 ± 50				
	Test Propeller	**Standard Rotation Models:** P/N 436080 or P/N 396277 **Counter Rotation Models:** P/N 436081 or P/N 398674				
	Weight (may vary depending on model)	**20 in. (L) Models:** 516 lbs. (234 kg) **25 in. (X) Models:** 524 lbs. (238 kg) **30 in. (Z) Models:** 530 lbs. (240 kg)				
	Lubrication	*Evinrude/Johnson XD100* Oil Refer to **Oil Requirements** on p. 65				
	Engine Type	90° V 6-Cylinder Loop-Charged				
	Displacement	200.1 cu. in. (3279 cm^3)				
	Bore	3.854 in (97.89 mm)				
	Stroke	2.858 in. (72.60 mm)				
	Standard Bore	3.8535 to 3.8545 in. (97.87 to 97.90 mm) To bore oversize, add piston oversize dimension to standard bore				
	Top Crankshaft Journal	1.6199 to 1.6204 in. (41.15 to 41.16 mm)				
	Center Crankshaft Journals	2.1870 to 2.1875 in. (55.55 to 55.56 mm)				
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)				
	Rod Crankpin	1.4995 to 1.5000 in. (38.09 to 38.106 mm)				
	Piston Ring End Gap, Both	0.022 to 0.028 in. (0.57 to 0.72 mm)				
FUEL	Fuel/Oil Ratio	*EMM* Controlled				
	Starting Enrichment	*EMM* Controlled				
	Preferred Fuel	Regular unleaded gasoline				
	Acceptable Fuel	See **Fuel Requirements** on p. 64 for additional information.				
	Minimum (High) Fuel Pressure @ IDLE RPM – 500 ± 50	22 to 28 psi (152 to 193 kPa)				
	Minimum Fuel Lift Pump Pressure @ IDLE RPM – 500 ± 50	3 psi (21 kPa)				
	Maximum Fuel Inlet Vacuum	4 in. Hg. (13.5 kPa)				
	Minimum Octane	87 AKI (R+M)/2 or 90 RON				
	Additives	*2+4 ® Fuel Conditioner*, *Fuel System Cleaner* Use of other additives may result in engine damage. See **Fuel Requirements** on p. 64 for additional information.				

	HP	200	225	250	200 H	225 H
ELECTRICAL	Minimum Battery Requirements	675 CCA (845 MCA); or 750 CCA (940 MCA) below 32°F (0°C) (Use a 107 amp-hr battery for extreme applications.)				
	Alternator	Dual Voltage 50 Amp with Voltage Regulator and Battery Isolation				
	Tachometer Setting	6 pulse (12 pole)				
	Charging Isolator	Integral, Terminal on Engine Harness				
	Engine Fuses	P/N 967545 – 10 A				
COOLING	Thermostat	143°F (62°C)				
	Maximum Temperature	190°F (88°C)				
	Water pressure	11 psi minimum @ 5000 RPM				
IGNITION	Type	Capacitor Discharge				
	Firing Order	1-2-3-4-5-6				
	Ignition Features	*EMM* Controlled				
	RPM Limit	6050				
	Crankshaft Position Sensor Air Gap	Fixed				
	Spark Plug	Refer to Emission Control Information Label				
		Champion† QC10WEP @ 0.028 ± 0.003 in. (0.71 mm)				
GEARCASE	Gear Ratio	**"M" Type Gearcase**: 13:24 (.542) (1.85:1) **"L" Type Gearcase**: 14:26 (.538) (1.86:1) Refer to **GEARCASE TYPES** on p. 283				
	Lubricant	*HPF XR* Gearcase Lubricant				
	Capacity	**"M" Type Gearcase**: 44.0 fl. oz. (1300 ml) **"M" Type – Counter Rotation**: 41 fl. oz. (1220 ml) **"L" Type Gearcase:** 33.1 fl. oz. (980 ml) Refer to **GEARCASE TYPES** on p. 283				
	Shift Rod Height	**20 in. (L) Models:** 21 29/32 (556.25 mm) ± one-half turn **25 in. (X) Models:** 26 29/32 (683.25 mm) ± one-half turn **30 in. (Z) Models:** 31 29/32 (810.25 mm) ± one-half turn				
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD				
POWER TRIM/TILT	Lubrication	*Power Trim/Tilt & Power Steering Fluid* or GM Dexron† II Automatic Transmission Fluid				
	Fluid Capacity	21 fl. oz. (622 ml)				
	Trim Range	0° to 21°				
	Tilt Range	22° to 75°				
	Tilt UP Stall Pressure	1500 psi (10342 kPa)				
	Tilt IN Stall Pressure	800 psi (5516 kPa)				

STANDARD TORQUE SPECIFICATIONS

Standard Torque Chart

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	6.7-9.4
5/16 in.	120–144	10–12	13.5–16.2
3/8 in.	216–240	18–20	24.4–27.1
7/16 in.	336–384	28–32	37.9–43.4

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.

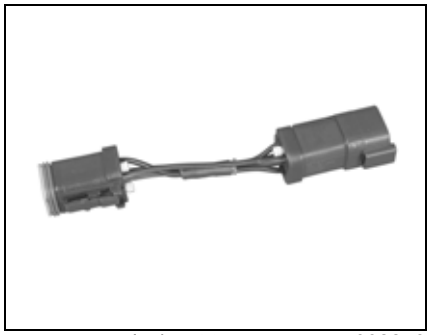
If replacement is specified or required because the locking fastener has become weak, use only authorized *Evinrude/Johnson Genuine Parts*.

SPECIAL TOOLS

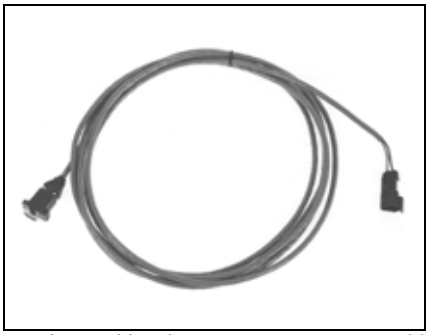
Diagnostics



Diagnostic Software for Windows based PC P/N 763724 005444



Bootstrap tool P/N 586551 002276

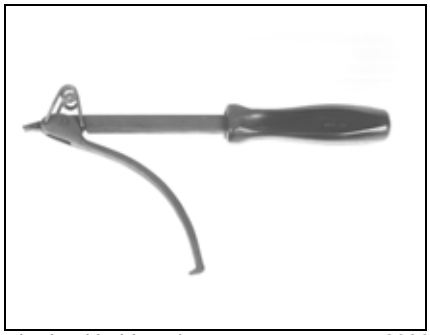


Interface cable P/N 437955 45583

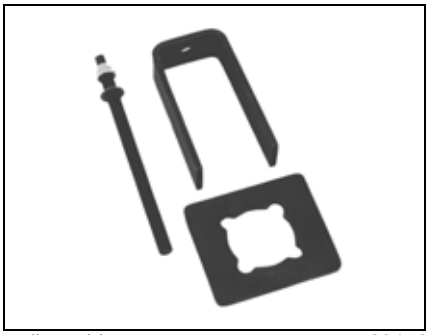
Universal



Lifting ring assembly P/N 396748 000669



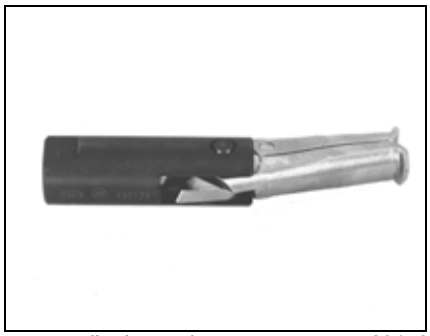
Flywheel holder P/N 771311 42938



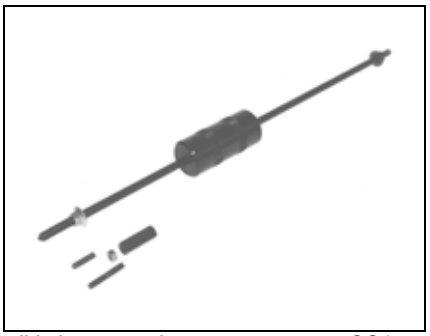
Puller Bridge – 432127 23146



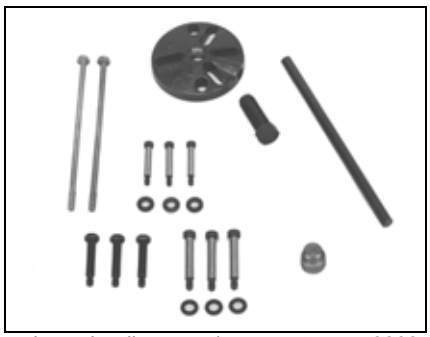
Lifting eye P/N 321537 23701



Large puller jaws P/N 432129 23148



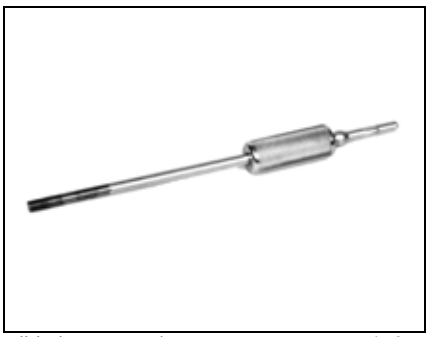
Slide hammer P/N 391008 CO1577



Universal Puller Set P/N 378103 32885



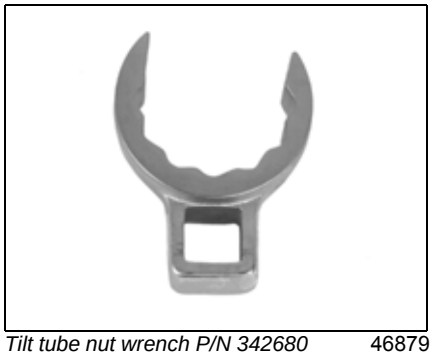
Small puller jaws P/N 432131 23150



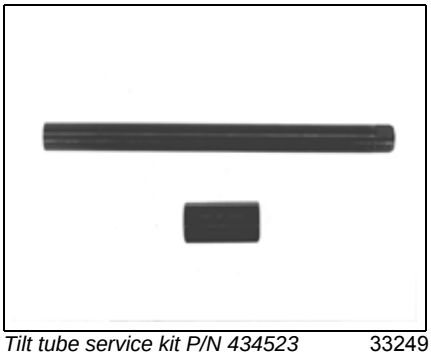
Slide hammer P/N 432128 15345



Temperature gun P/N 772018 45240

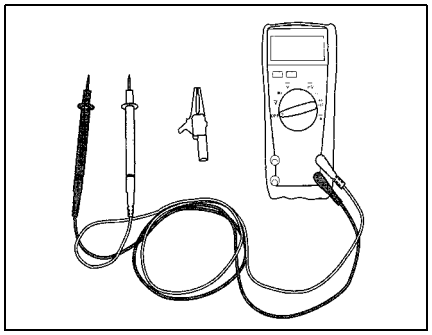


Tilt tube nut wrench P/N 342680 46879



Tilt tube service kit P/N 434523 33249

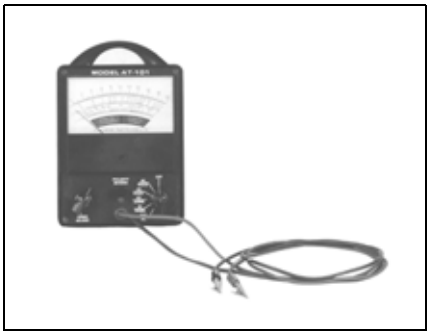
Electrical / Ignition



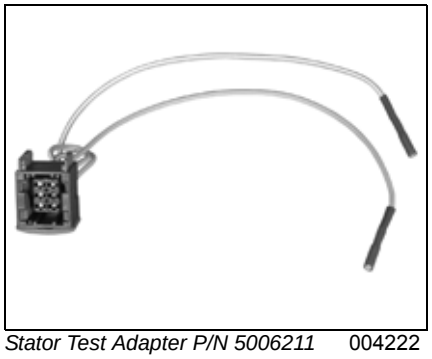
Digital multimeter DRC7265
Ohms resolution 0.01
Purchase through local supplier



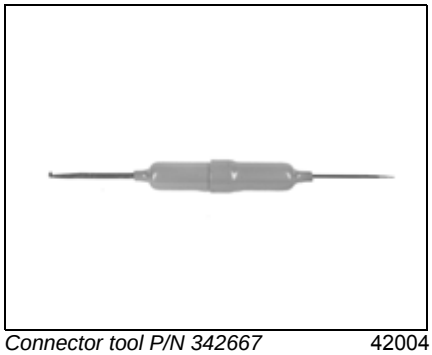
Peak reading voltmeter 49799
P/N 507972



Analog multimeter P/N 501873 49793



Stator Test Adapter P/N 5006211 004222



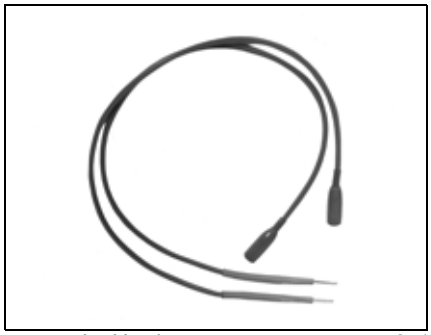
Connector tool P/N 342667 42004



Tachometer/timing light P/N 507980 49789



Crimping pliers P/N 322696 30387



Test probe kit P/N 342677 45241

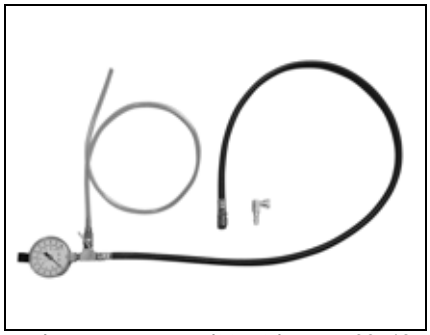


AMP† *connector tools* 002277
Primary Lock Tool P/N 777077
Secondary Lock Tool P/N 777078
Release Tool P/N 351413
Lock Installer P/N 777079

Fuel/Oil Systems



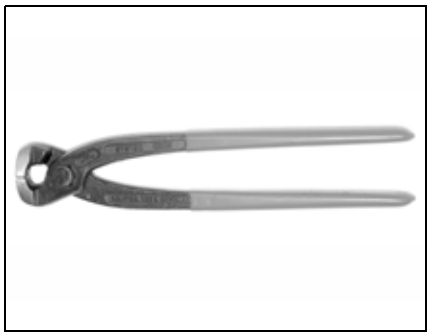
Fuel pressure gauge (100 PSI) 002275
P/N 5000902



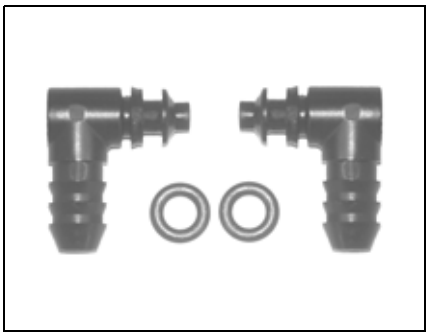
Fuel pressure gauge (60 PSI) 005135
P/N 5007100
90° fitting, P/N 353322



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



Oetiker† *pincers P/N 787145* 001081

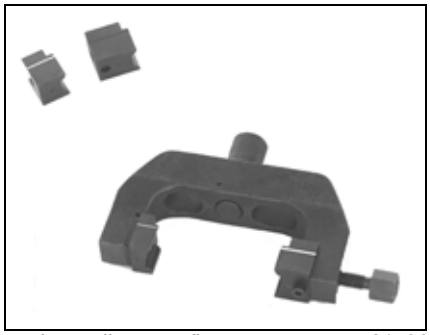


Injector test fitting kit, P/N 5005844 002465

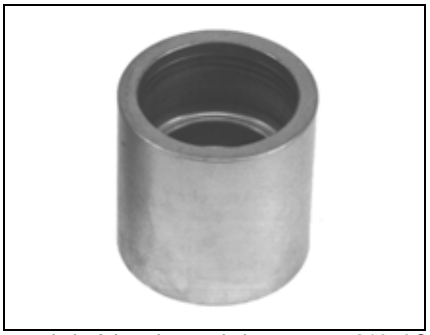
Powerhead



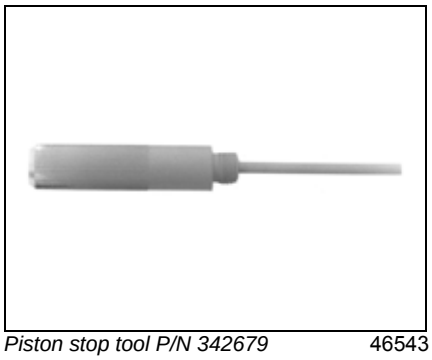
Cylinder bore gauge P/N 771310 45303



Rod cap alignment fixture 21596
P/N 396749



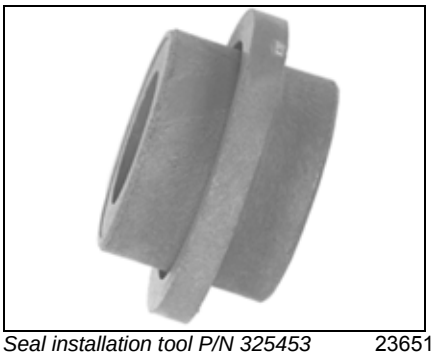
Crankshaft bearing and sleeve 21953C
installer P/N 338649



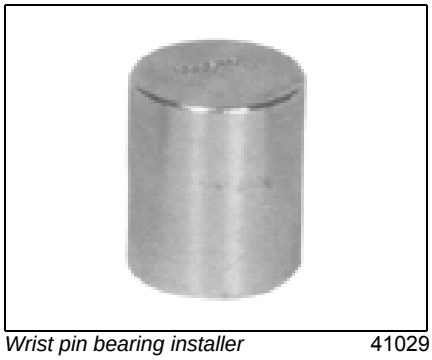
Piston stop tool P/N 342679 46543
Replacement tip P/N 5006098



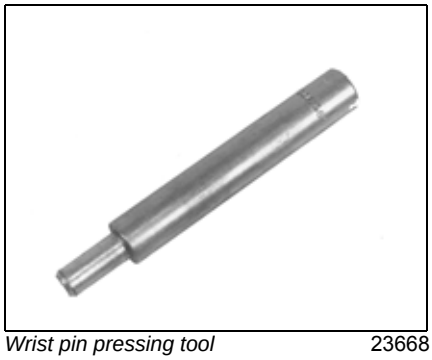
Torquing socket P/N 346187 50242



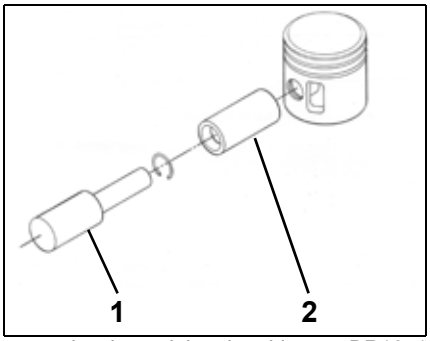
Seal installation tool P/N 325453 23651



Wrist pin bearing installer 41029
P/N 338646



Wrist pin pressing tool 23668
P/N 396747

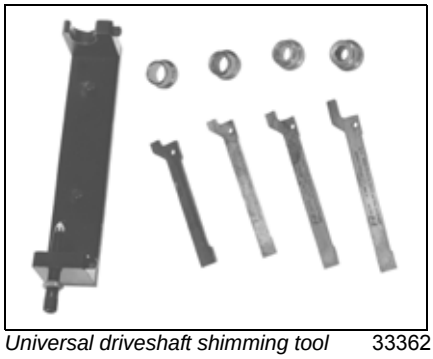


1. *Wrist pin retaining ring driver* DR1641
   P/N 396747
2. *Wrist pin cone P/N 331913*

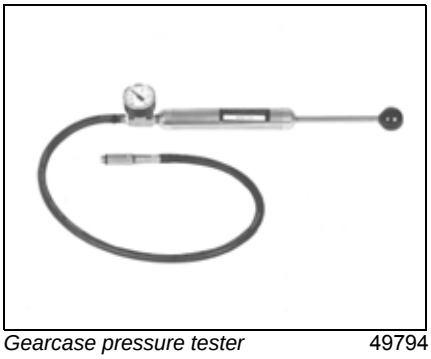
Gearcase



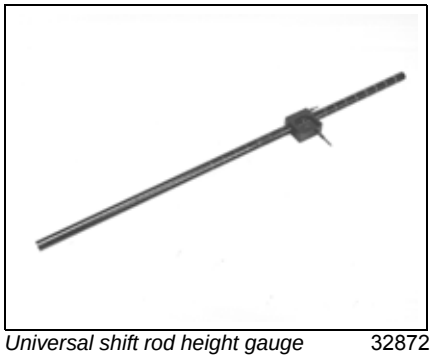
Gearcase filler 49790
P/N 501882



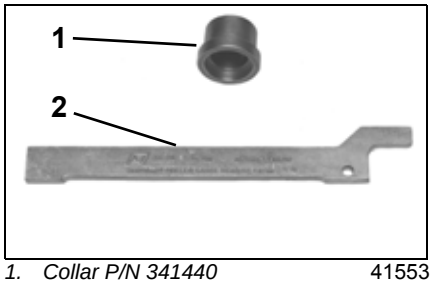
Universal driveshaft shimming tool 33362
P/N 393185



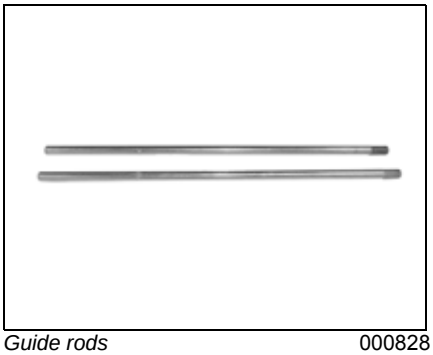
Gearcase pressure tester 49794
P/N 507977 (Stevens P/N S-34)
Gearcase vacuum tester
P/N 507982 (Stevens P/N V-34)



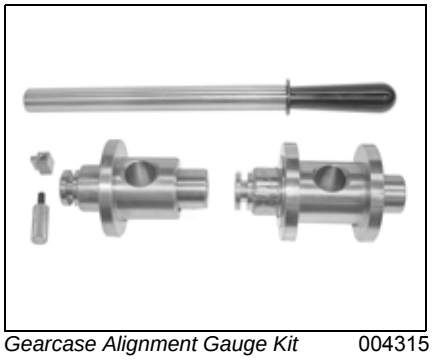
Universal shift rod height gauge 32872
P/N 389997



1. *Collar P/N 341440* 41553
2. *Gauge bar*
   -M-type gearcases –
   P/N 349957



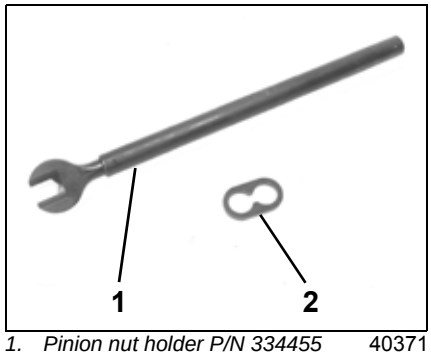
Guide rods 000828
P/N 383175



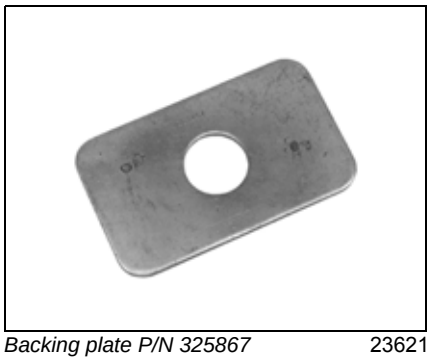
Gearcase Alignment Gauge Kit P/N 5006349 004315



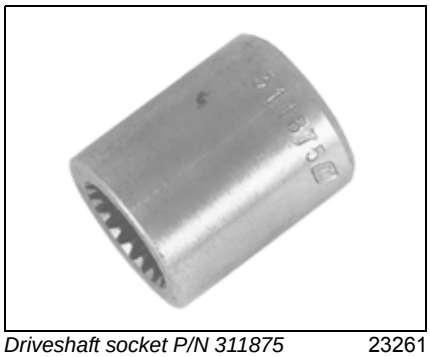
Driveshaft seal protector P/N 31867 23692



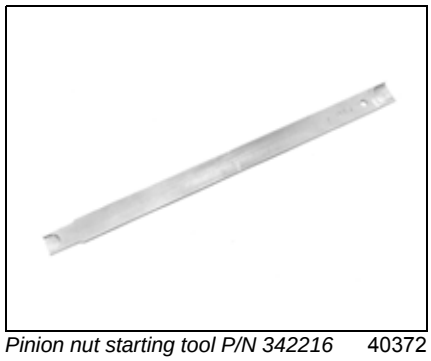
1. Pinion nut holder P/N 334455 40371
2. Wrench retainer P/N 341438



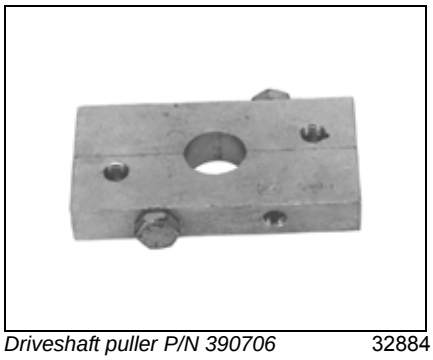
Backing plate P/N 325867 23621



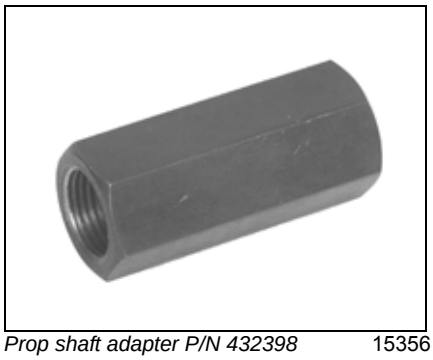
Driveshaft socket P/N 311875 23261



Pinion nut starting tool P/N 342216 40372



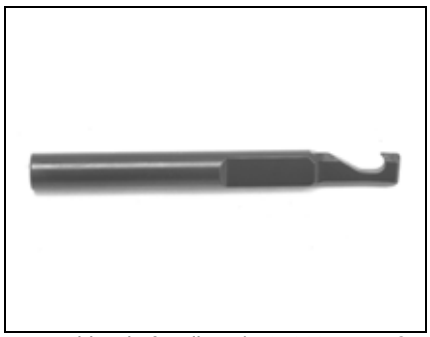
Driveshaft puller P/N 390706 32884



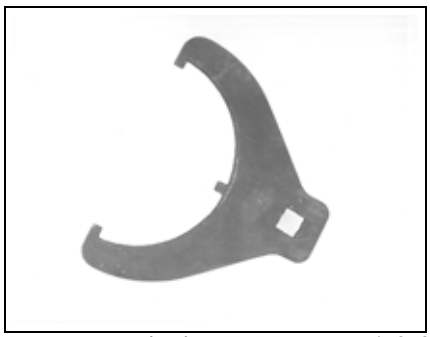
Prop shaft adapter P/N 432398 15356



Universal pinion bearing remover and installer kit P/N 391257 33974



Lower driveshaft puller P/N 342681 47257



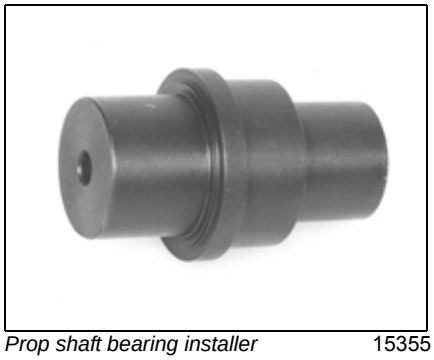
Spanner wrench P/N 432400 15358



Pinion bearing installer P/N 350958 000818



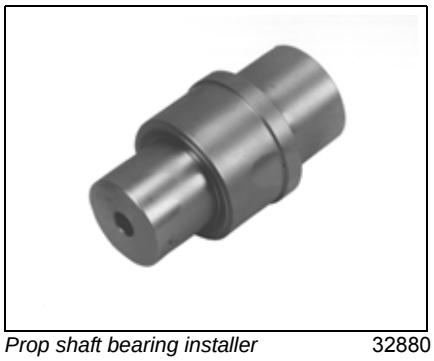
Bearing Installation Tool 32519
P/N 339778



Prop shaft bearing installer 15355
P/N 432401



Seal installation tool P/N 330268 32924



Prop shaft bearing installer 32880
P/N 339750



Prop shaft housing seal installer 32973
P/N 336311

Trim and Tilt



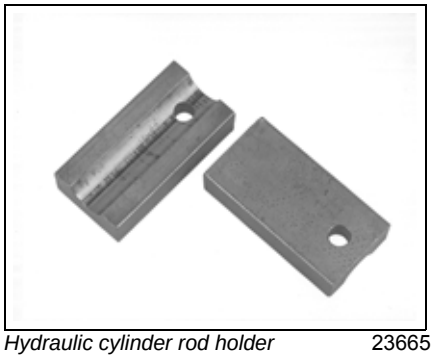
Gauge and collar assembly 33023
P/N 983975



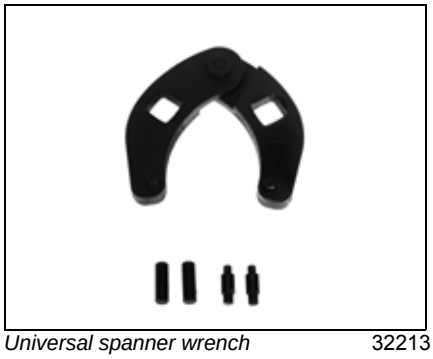
Tilt cylinder end cap remover 33741
P/N 326485



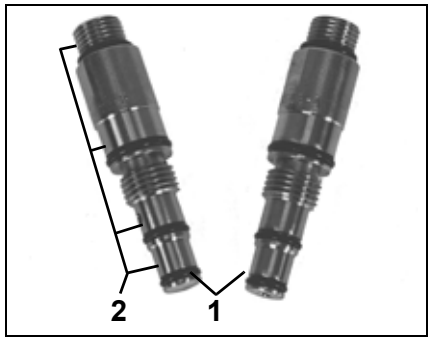
Trim/tilt service kit P/N 390010 33013



Hydraulic cylinder rod holder 23665
P/N 983213



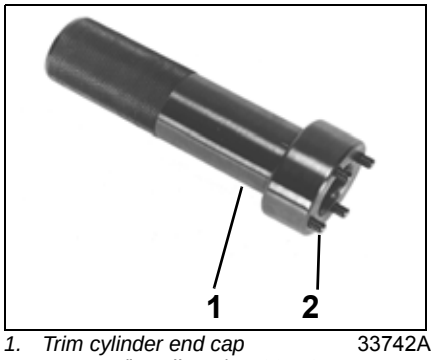
Universal spanner wrench 32213
P/N 912084



1. *Trim/tilt service kit P/N 434524* 27340
2. *Replacement o-ring kit for adapter tips P/N 434729*



Tilt cylinder seal protector 23694
P/N 326005



1. *Trim cylinder end cap remover/installer P/N 436710* 33742A
2. *Replacement tip for 436710*

SHOP AIDS



Cleaning Solvent P/N 771087



Engine Tuner P/N 777185



Anti-Corrosion Spray P/N 777193



“6 in 1” Multi-Purpose Lubricant P/N 777192



D.P.L. Spray P/N 777183



Silicone spray P/N 775630



Oil - XD100™ P/N 777118



Oil - XD50™ P/N 777225



Oil - XD30™ P/N 777219



Ultra 4-Stroke Outboard Oil, P/N 775594



4-Stroke Outboard Oil, P/N 775597



HPF XR™ Gear Lube P/N 778747



HI-VIS™ Gearcase Lube P/N 775605



Triple-Guard® Grease P/N 508298



Extreme Pressure Grease™ P/N 508303



Moly Lube P/N 175356



Needle Bearing Grease, P/N 378642



Starter Bendix Lube P/N 337016



Storage Fogging Oil P/N 777186



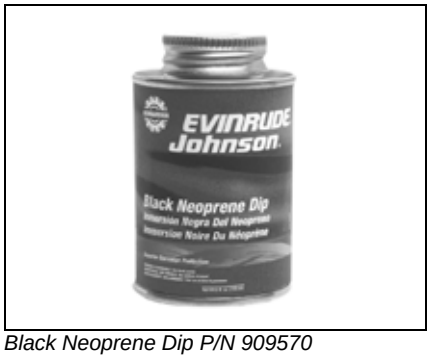
Power Trim/Tilt and Power Steering Fluid P/N 775612



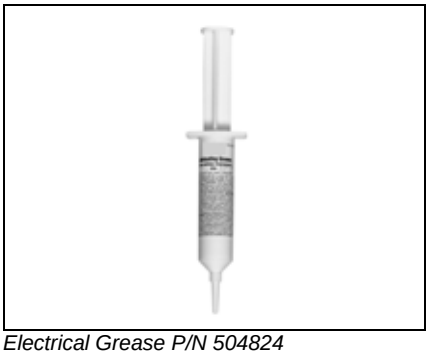
Biodegradeable TNT Fluid P/N 763439



Lubriplate† 777 P/N 317619



Black Neoprene Dip P/N 909570



Electrical Grease P/N 504824



2 + 4™ Fuel conditioner P/N 775613



Fuel System Cleaner P/N 777184



Carbon Guard™ P/N 775629



Gel-Seal and Gasket Remover P/N 771050



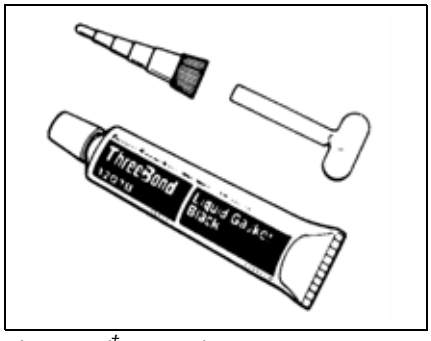
Gel·Seal II P/N 327361



Gasket Sealing Compound P/N 317201



Permatex† No. 2, P/N 910032



ThreeBond† 1104, P/N 351052
ThreeBond 1207B, P/N 351053



Pipe Sealant with Teflon P/N 910048



GE† RTV Silicone Sealant P/N 263753



Gasoila† Thread Sealant P/N 200763



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)



Locquic Primer P/N 772032



Adhesive 847 P/N 776964



Instant Bonding Adhesive P/N 509955



GM† Gear Mark Compound P/N 772666



Thermal Joint Compound P/N 322170

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

INSTALLATION AND PREDELIVERY

TABLE OF CONTENTS

BOAT RIGGING 34
- REMOTE CONTROLS 34
- BATTERY INSTALLATION 36
- BATTERY SWITCHES AND MULTIPLE BATTERIES 37
- AUXILIARY BATTERY CHARGE ISOLATOR 38
- FUEL SYSTEM REQUIREMENTS 41
- OILING SYSTEM SET-UP 43
- CABLE AND HOSE INSTALLATION 46

OUTBOARD INSTALLATION 51
- HULL PREPARATION 51
- TRANSOM MEASURING AND DRILLING 52
- LIFTING THE OUTBOARD 56
- STEERING SYSTEMS 56
- OUTBOARD MOUNTING 58

OUTBOARD RIGGING 59
- CABLE, HOSE, AND WIRE ROUTING 59
- CONTROL CABLE INSTALLATION 60
- ELECTRICAL HARNESS CONNECTIONS 62
- WATER PRESSURE GAUGE 62
- CANBUS CONNECTIONS 63

FUEL AND OIL PRIMING 64
- FUEL REQUIREMENTS 64
- FUEL SYSTEM PRIMING 65
- OIL REQUIREMENTS 65
- OIL INJECTION RATE 66
- BREAK-IN OILING 66
- *SYSTEMCHECK* LOW OIL WARNING 67
- OIL SUPPLY PRIMING 67

BEFORE START-UP 69

RUNNING CHECKS 70
- *SYSTEMCHECK* OPERATION 70
- FUEL SYSTEM 70
- EMERGENCY STOP / KEY SWITCH 70
- START-IN-GEAR PREVENTION 70
- TACHOMETER PULSE SETTING 71
- WATER PUMP OVERBOARD INDICATOR 71
- BREAK-IN 71

PROPELLERS 72
- PROPELLER SELECTION 72
- PROPELLER HARDWARE INSTALLATION 73

FINAL ADJUSTMENTS 74
- TILT LIMIT SWITCH ADJUSTMENT 74
- TRIM SENDING UNIT ADJUSTMENT 75
- TRIM TAB ADJUSTMENT 76
- DUAL-OUTBOARD ALIGNMENT 77

NOTES 78

BOAT RIGGING

Remote Controls

Control Selection

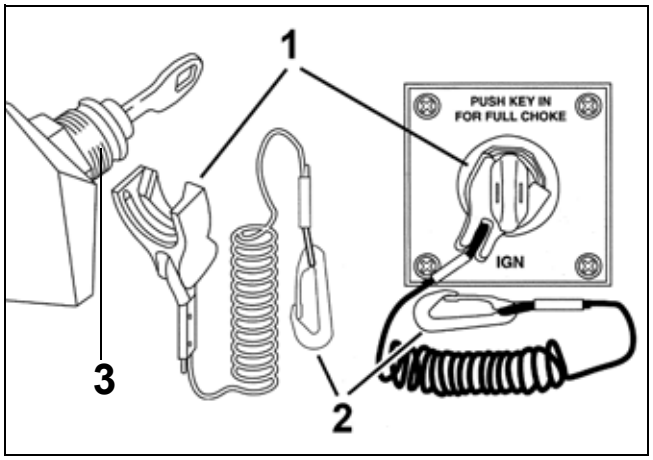
⚠ WARNING ⚠

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 styles and applications are described in the *Evinrude/Johnson Genuine Parts and Accessories Catalog.* Plan the installation of all remote controls carefully. Read the outboard's Operator's Guide and the remote control's installation instructions prior to installation.

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

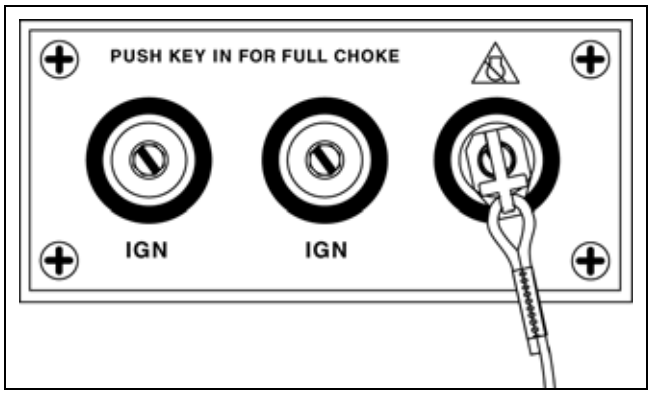
- Start-in-gear prevention
- Emergency stop / key switch
- Shift stroke must measure 1.125 to 1.330 in. (28.6 to 33.8 mm) between NEUTRAL and FORWARD
- Throttle stroke must PUSH for open
- All wiring must be compatible with Modular Wiring System (MWS) components



1. Emergency stop clip 002817
2. Safety lanyard
3. Key switch with emergency stop feature

Additional remote control information:

- Power trim/tilt switch(s) can be integral to the remote control for outboards with power tilt and trim.
- Side-mount controls require a neutral lock feature.
- Single-outboard binnacle remote controls are offered with or without an integrated key switch.
- Dual-outboard binnacle remote controls require separate key switches and 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.

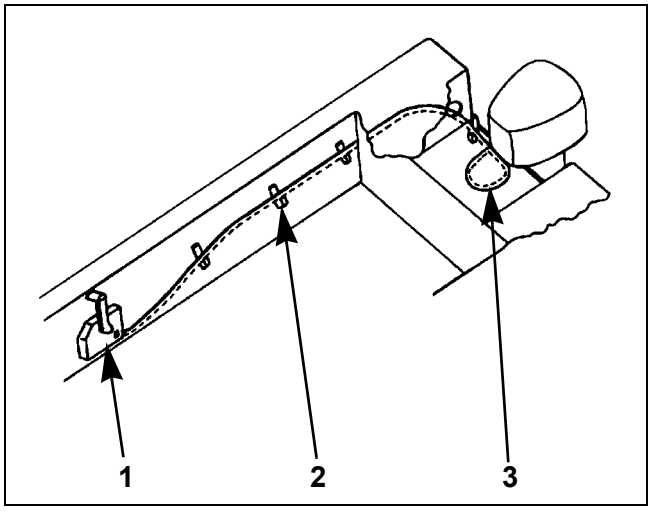
Installation Guidelines

Install the appropriate remote control following all instructions provided with the remote control.

Make sure the following items are checked:

- Correct length control cables and wiring harnesses
- Proper type and quality of cables and wiring harnesses
- Correct routing of cables and harnesses
- Appropriate slack in front of the outboard for remote control cables
- Proper routing of cables to prevent kinking
- 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.



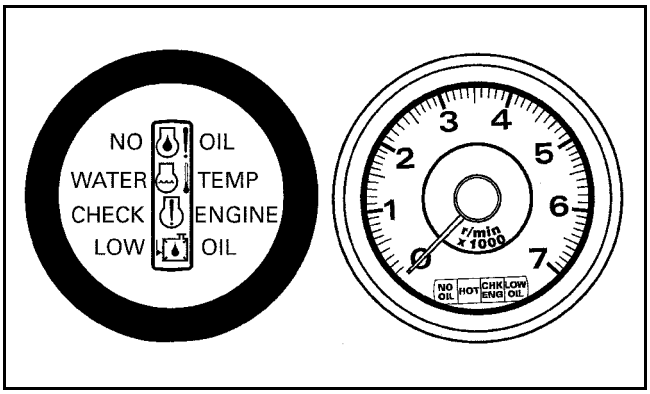
1. Surface side-mount remote control DR4277
2. Cable support
3. 12 in. (30 cm) cable loop at front of outboard

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

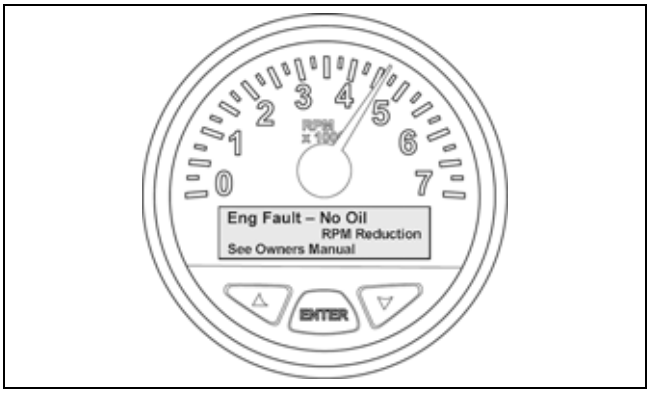
SystemCheck™ Monitor

The *SystemCheck* engine monitor alerts the operator of certain engine problems. Refer to the Operator's Guide for detailed information related to the various warning signals.

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



Typical MWS *SystemCheck* gauges 005329



Typical *I-Command* gauge 005330

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
Evinrude E-TEC 90° V	675 CCA (845 MCA), **or** 750 CCA (940 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.
- Position 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.

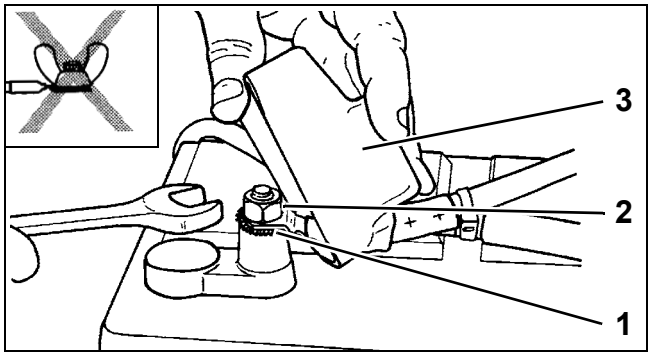
⚠ WARNING ⚠

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/Johnson 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.

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.

Models	1 to 10 Ft. (.3 to 3 m)	11 to 15 Ft. (3.4 to 4.6 m)	16 to 20 Ft. (4.9 to 6.1 m)
Evinrude E-TEC 90° V	4 Gauge	2 Gauge	1 Gauge

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. 39 for various 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

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.

The secondary battery is often charged by a battery charge isolator. Refer to **Auxiliary Battery Charge Isolator** on p. 38.

Accessory

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

The accessory battery is often charged by a battery charge isolator. Refer to **Auxiliary Battery Charge Isolator** on p. 38.

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(s) as close to the battery(s) 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.

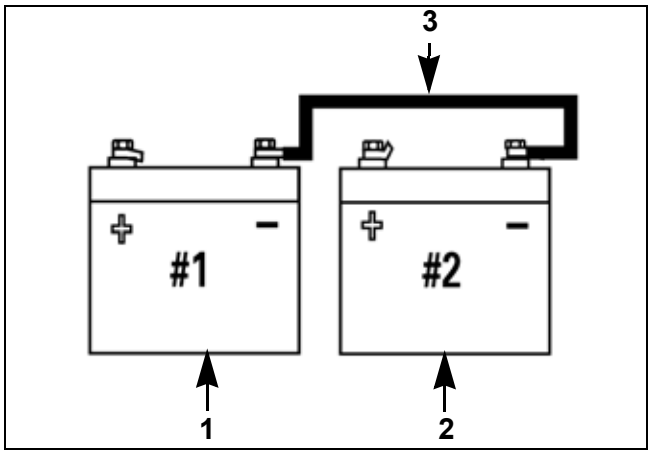
IMPORTANT: Insulate all battery positive (+) terminals to prevent shorting.

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.



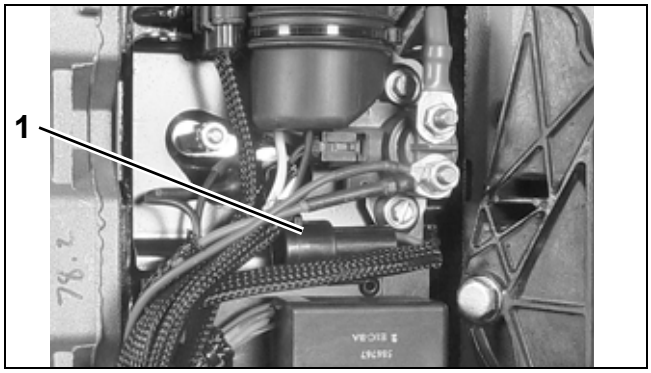
1. *Starting battery (primary)* DRC7284
2. *Accessory battery (secondary)*
3. *Cable connecting negative (–) battery terminals*

Auxiliary Battery Charge Isolator

Evinrude E-TEC 90° V outboards are equipped with isolated battery charging capability. The isolated charge connection must only be used to charge a single 12-volt battery or two 12-volt batteries wired in parallel.

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

Accessory Charge Lead Kit, P/N 5006253, is routed from a connector on the outboard's electrical panel to the accessory battery.

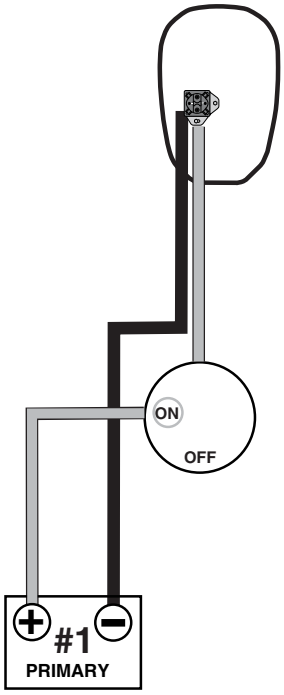


1. *Accessory battery charge connector* 003912

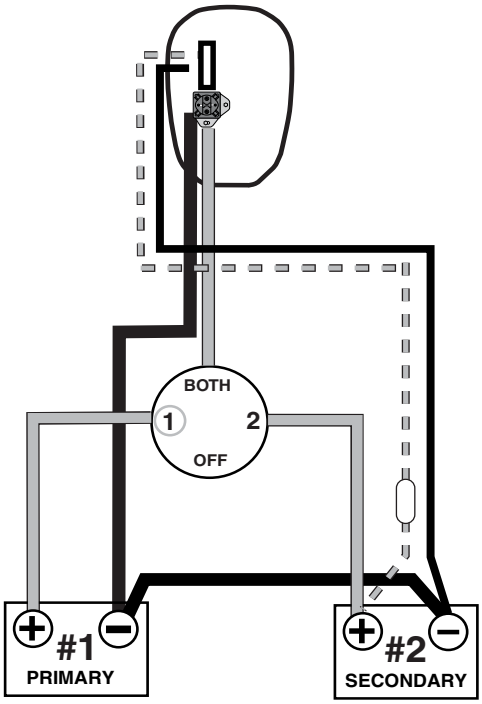
IMPORTANT: The accessory charging kit must never be connected to any battery of a 24-volt electrical system.

Battery and Switch Wiring Diagrams

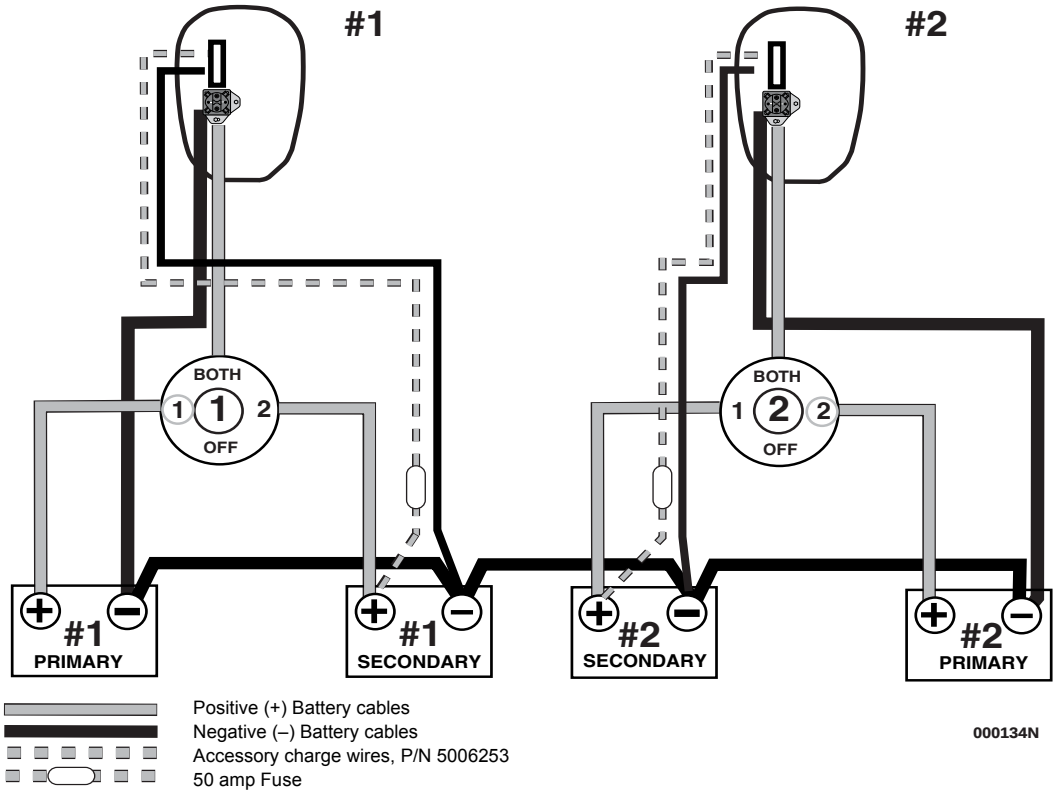
One outboard: Battery disconnect



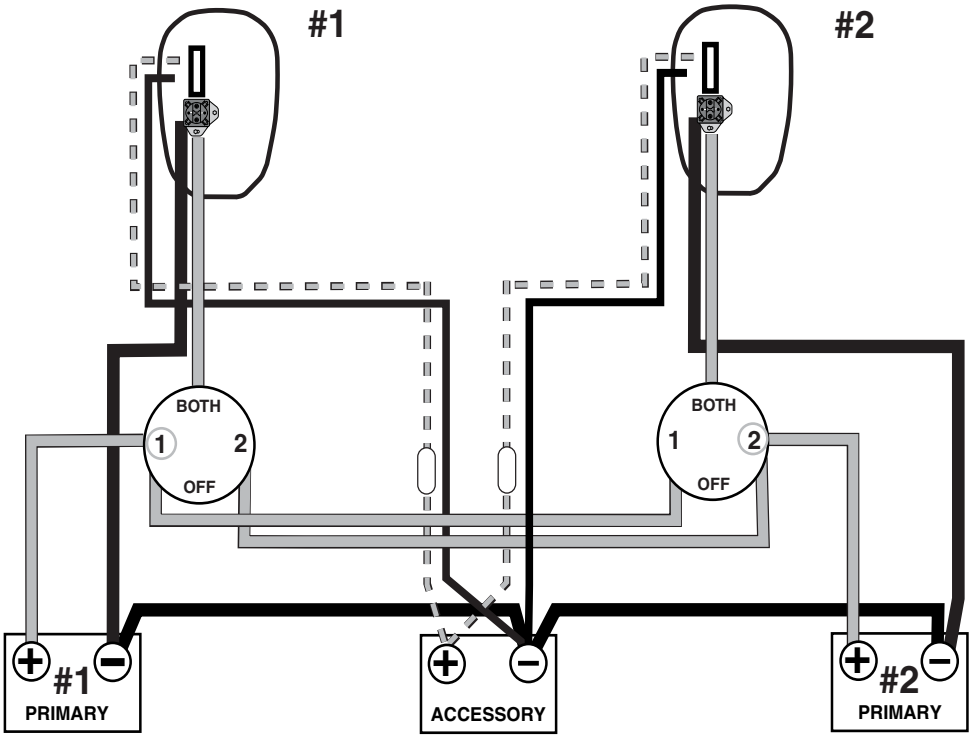
One outboard: One primary starting battery; one secondary battery



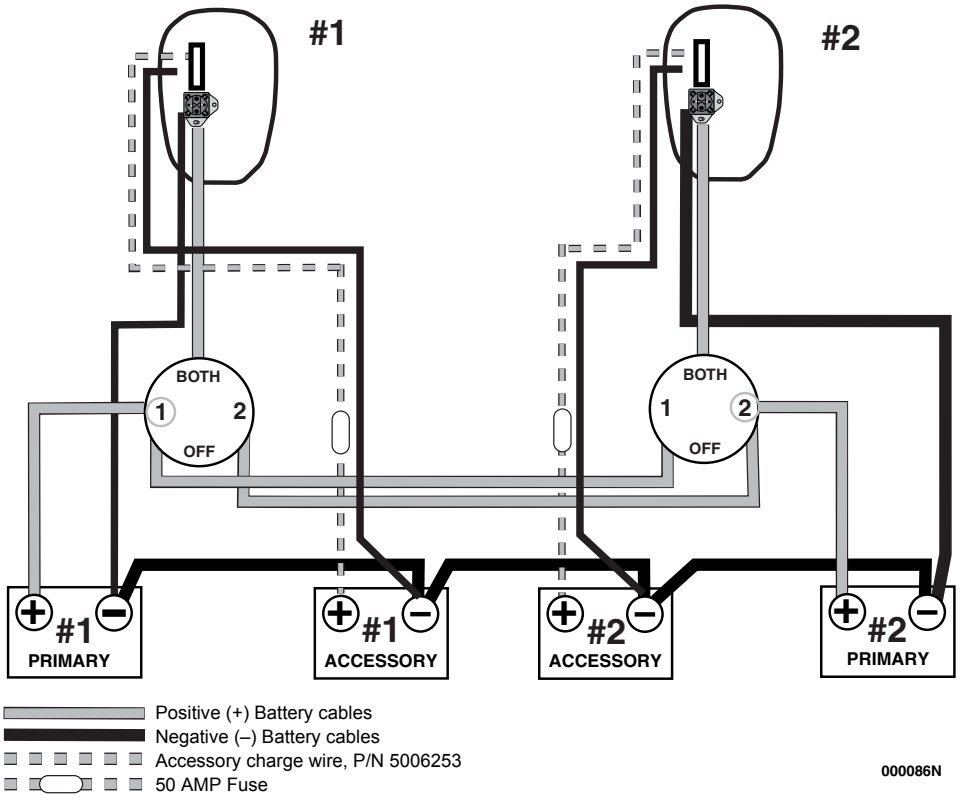
Two outboards: Two starting batteries for each outboard



Two outboards: One primary starting battery for each outboard; one isolated accessory battery



Two outboards: One primary starting battery for each outboard; two isolated accessory batteries



Fuel System Requirements

Overview

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

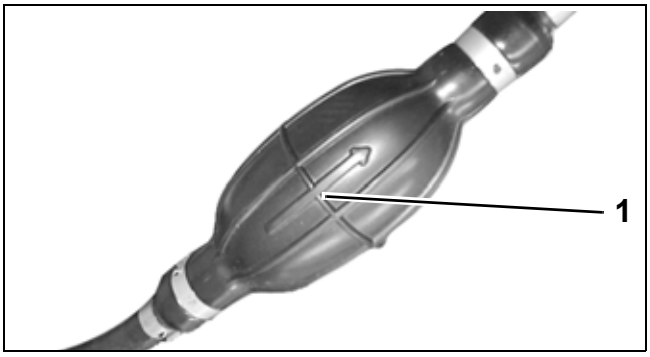
Outboards require a priming system capable of refilling the fuel system after periods of non-use.

Primer Bulbs

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

Marine Primer Pump

The 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.

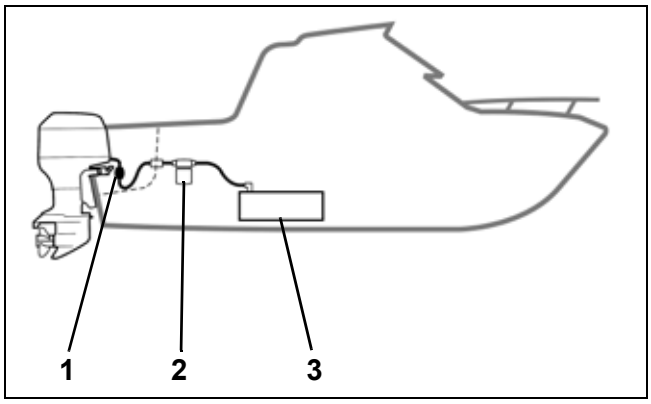
Fuel Filters

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	

Oiling System Set-Up

Location

IMPORTANT: Consider the installation location of the oil tank carefully. The oil tank is vented to the atmosphere. To avoid serious powerhead damage, be sure the oil tank is installed in a location that does not allow constant exposure to sunlight, rain, bilge water or spray.

Select a mounting location that provides:

- A solid place to mount the tank;
- A dry location that prevents exposure to rain or spraying water;
- Access for adding oil;
- Access to oil-primer bulb; and
- Interference-free hose and wire routing to outboard.

Each oil tank is originally fitted with a single oil pickup assembly with 15 ft. (4.5 m) of oil supply hose and 17 ft. (5.2 m) of sending unit wiring harness.

If necessary, the oil tank can be mounted further from the outboard than the supplied hoses and harness allow. The maximum length of oil supply hose that can be fitted to the oil tank is 25 ft. (7.6 m).

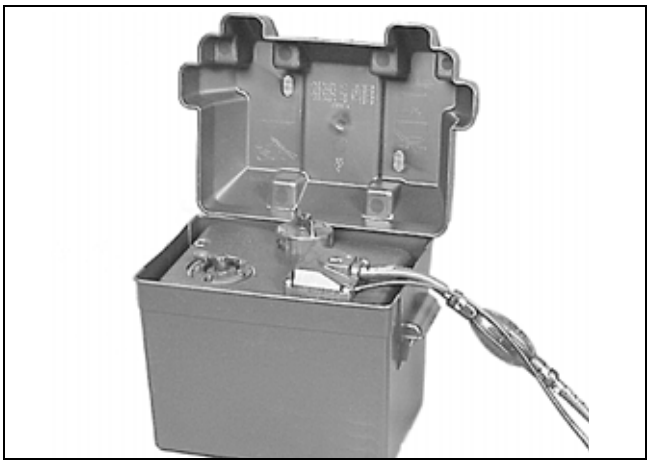
IMPORTANT: Do not add hose to an existing oil supply hose.

If the oil tank requires more than 15 ft. (4.5 m) of oil supply hose:

- Oil supply hose between the primer bulb and outboard must be replaced with one continuous length of 1/4 in. (6.4 mm) hose.
- Maximum length of hose is 25 ft. (7.6 m).
- Replacement hose must be designated for fuel or oil use and approved for marine use.
- Extend wiring harness with 16 gauge AWG wire.
- Protect connections with heat shrink tube.
- Maintain wire color and polarity when extending harness.

An appropriately sized battery box may be used to conceal and protect the oil tank, if desired.

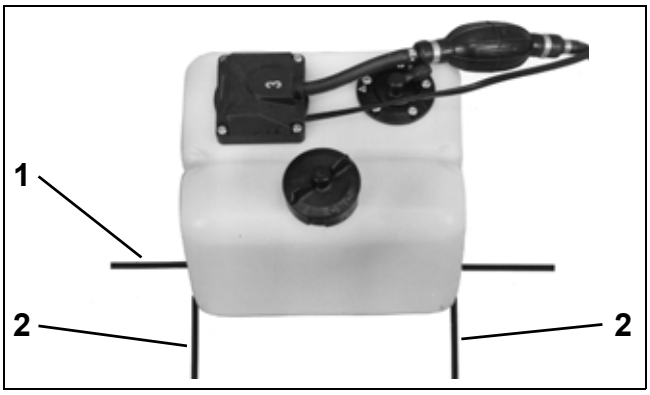
IMPORTANT: Be sure box includes drain holes so it does not fill with water and contaminate oil.



000074

Mounting

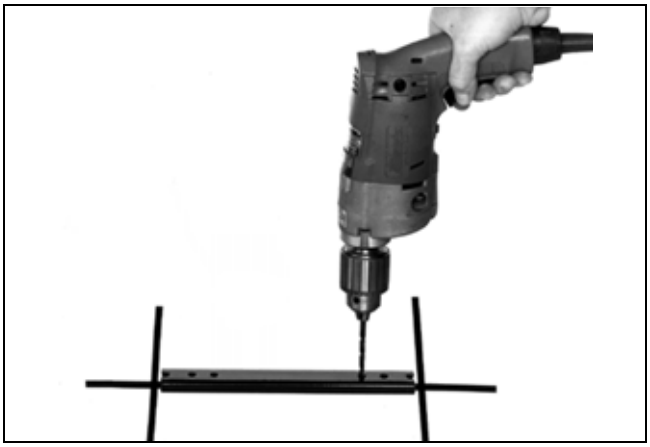
Place tank in selected position. Mark one line under groove in tank bottom and lines at each end of tank.



1. Center line of oil tank 44737
2. Ends of tank

Make sure hole locations provide enough clearance for fastening screws. Screws should not contact or penetrate hull.

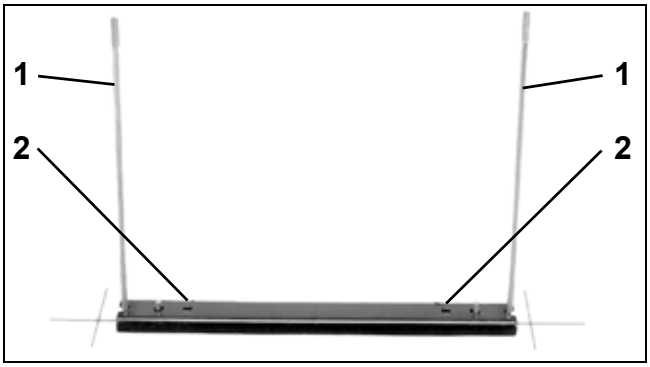
Place floor bracket on center line between end lines. Use the inner bracket holes as guides to drill two 5/32 in. (4 mm) pilot holes.



COB5381

3 GALLON (11.4 L) TANK

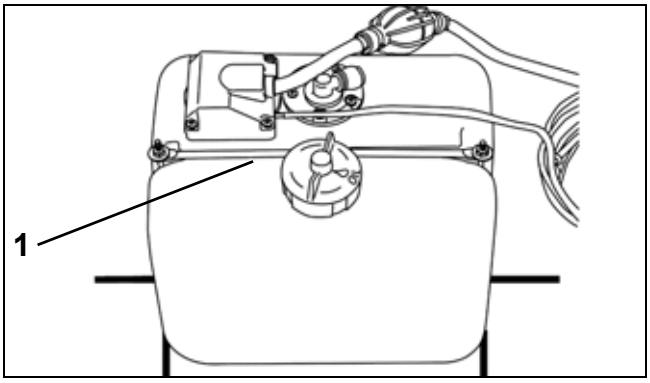
Place rods into floor bracket and secure floor bracket with lag bolts.



1. Rods
2. Lag bolts

22241B

Place oil tank onto floor bracket. Assemble crossbar onto hook rods, install flat washers and locknuts. Tighten locknuts to securely hold tank.

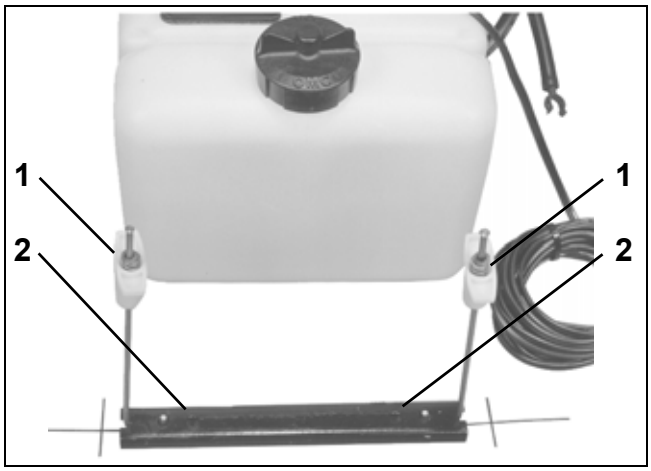


1. Crossbar

DRC7418

1.8 GALLON TANK

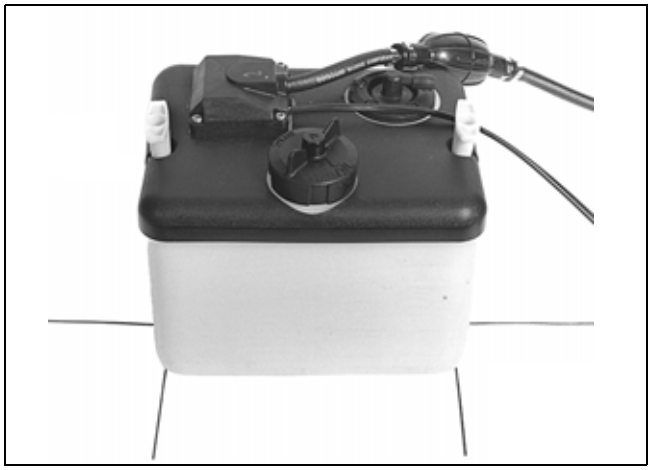
Place rods into floor bracket and secure floor bracket with lag bolts.



1. Rods
2. Lag bolts

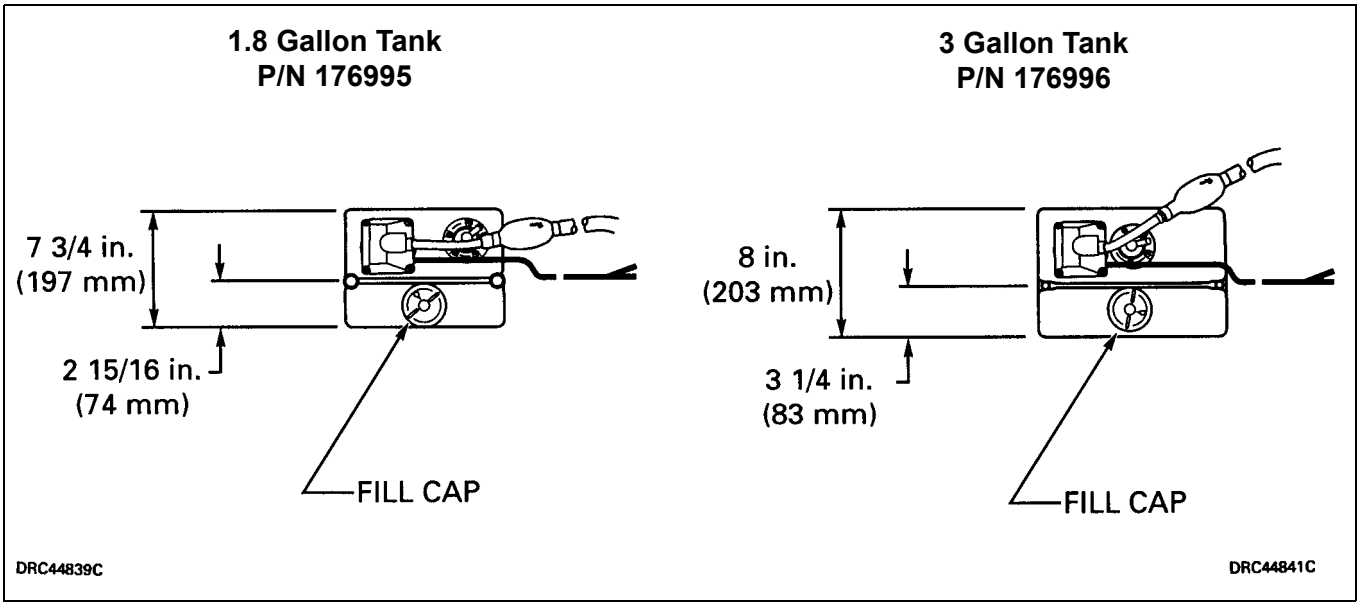
22149A

Place oil tank onto floor bracket. If cover is not pre-assembled, route oil supply hose and harness through the cover and position cover on the oil tank. Attach spring-loaded rods to cover.



48704

Oil Tank Profiles



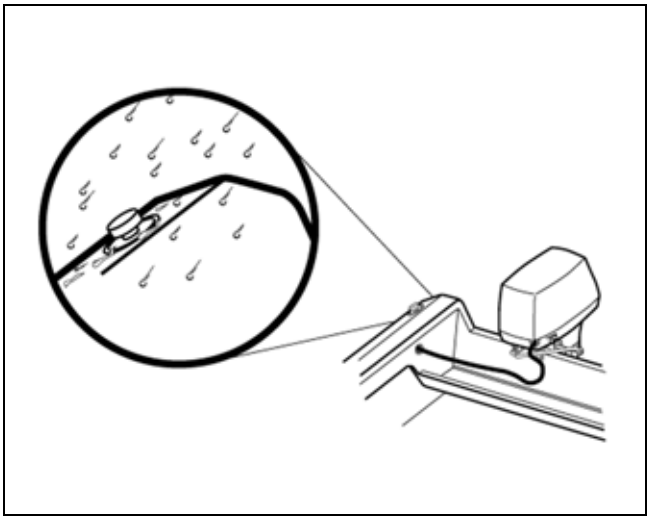
Remote Oil Fill Kit (Optional)

The remote oil fill kit (P/N 176461) provides a deck-mounted fill tube, cap, a tank-mounted tube, and nut that replace the original oil tank cap assembly.

Installation Recommendations

- Select a location on the deck of the boat that is above the oil tank fill cap.
- Select a deck location which allows the required length of 1½ in. I.D. fill hose to route as directly and as vertically as possible.
- Avoid inappropriate hose routings that could distort the fill tube or tank tube.
- Refer to installation instructions provided with remote oil fill kit.

A slanted area of the deck will allow water to drain away from the fill and is best suited for the installation.



DRC8123

Additional Items Required

- 1½ in. I.D. fill hose cut to required length. Fill hose (P/N 123956) is available in 25 ft. (7.6 m) lengths.
- Two corrosion resistant 2 in. (50 mm) hose clamps.

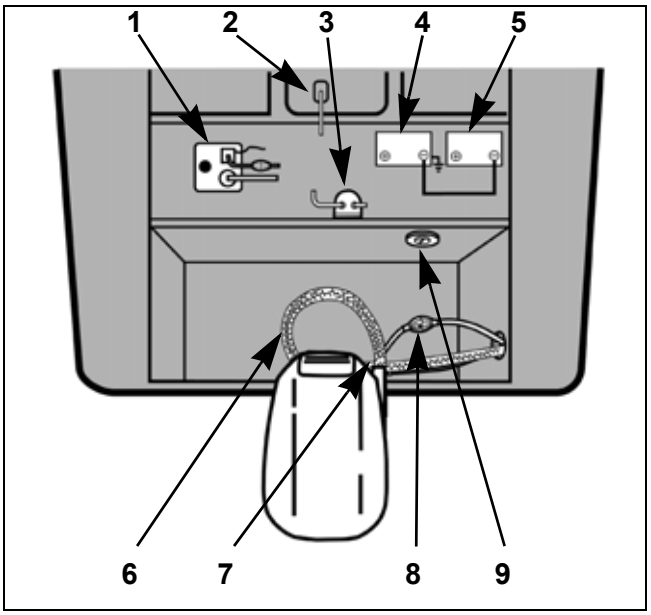
Cable and Hose Installation

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

- Throttle and shift cables
- Modular Wiring System (MWS) harness
- Battery cables and switches
- Fuel supply hose
- Primer bulb or primer pump
- Oil supply hose
- Oil tank sender harness

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

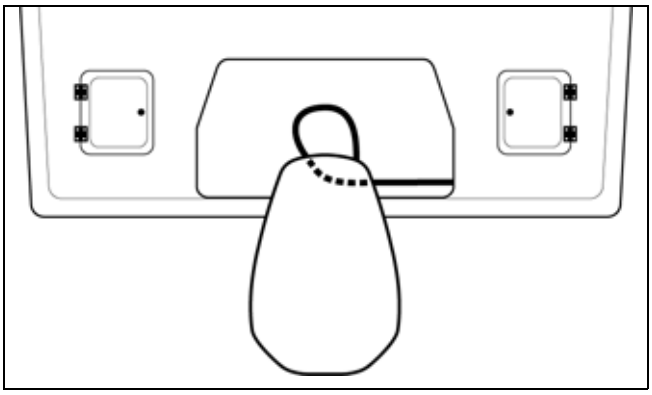
1. *Oil tank*
2. *Anti-siphon valve*
3. *Water separating fuel filter*
4. *Starting battery*
5. *Accessory battery*
6. *Flexweave protective sleeve*
7. *Access cover*
8. *Primer bulb*
9. *Battery switch*

Cable and Wire Harness Routing

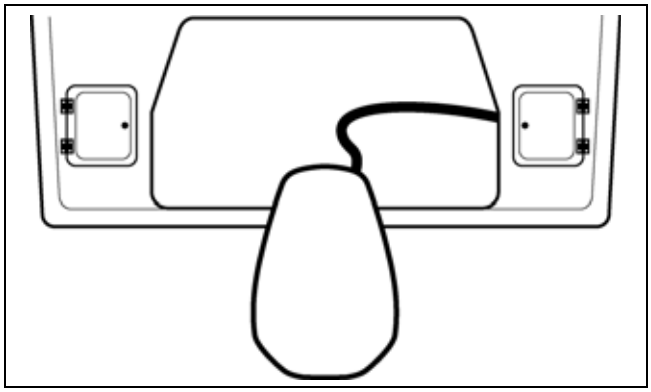
⚠ WARNING ⚠

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

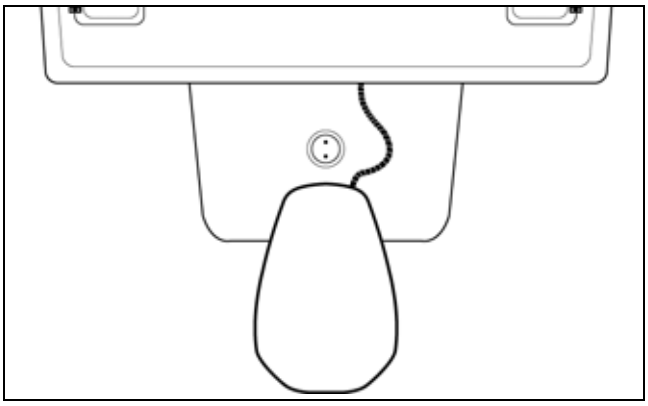
Remote control cables, wiring, and hoses must follow a similar path into the lower motor covers. Select the best routing possible for the specific application. Proper remote control cable lengths are essential. Installations must provide adequate slack for all cables, wiring, and hoses. Check clearances of routings at all trim angles, at all steering positions, and at all possible combinations of outboard positioning.



Typical Small Splash Well DRC7799



Typical Large Splash Well DRC7797

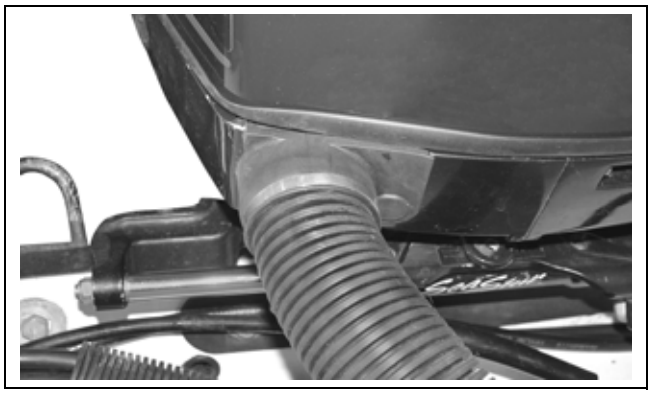


Typical Engine Bracket DRC7798A

Protective Sleeve/Conduit

Make sure all cables, wiring, and hoses have been identified and fitted to the appropriate lengths.

Next, locate appropriate shielding to protect the components that route to the outbound. An expandable “flexweave” sleeve or a flexible conduit may be used to bundle the cables together as they enter the lower motor cover.



Flexible conduit installation 005138

Battery Cables

Evinrude/Johnson 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 and to the appropriate location; and
- Use the most direct path to route the battery cables to the battery or battery switch.

Fuel Hose

Route the fuel supply hose with adequate slack to allow for the primer bulb to be held with the arrow pointing “up” during use.

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

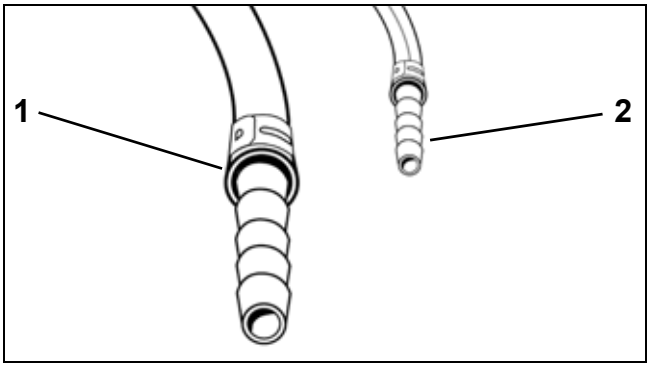
- Route fuel hoses from boat fuel system to outboard with adequate slack.
- Install the primer bulb with the arrow pointing in the direction of fuel flow to the outboard.
- Connect the fuel supply hose from the fuel tank to the fuel supply line at the outboard.

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

Oil Supply Hose

Evinrude E-TEC 90° V outboards use a single oil supply hose connected to the outboard and to the boat-mounted oil tank.

- Route the hose from the oil tank to the ¼ in. (6.4 mm) fitting of the oil supply line at the lower motor cover grommet.
- Install the hose on the fitting using the proper size *Oetiker*† clamp.



1. Fuel supply hose and fuel fitting - 3/8 in. (9 mm) 003963
2. Oil supply hose and fitting - 1/4 in. (6 mm)

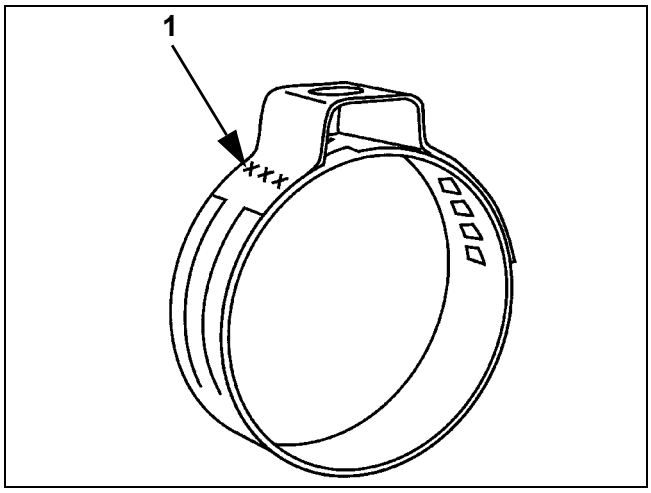
Oetiker† Clamp Servicing

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.

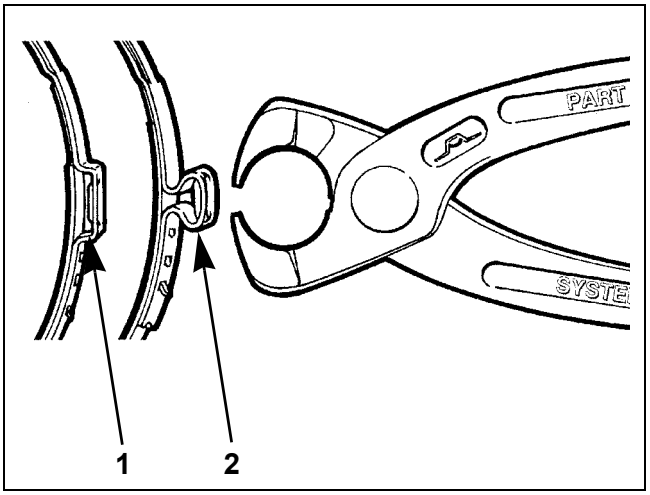
IMPORTANT: Use only *Oetiker* recommended tools to close *Oetiker* stepless clamps.

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).

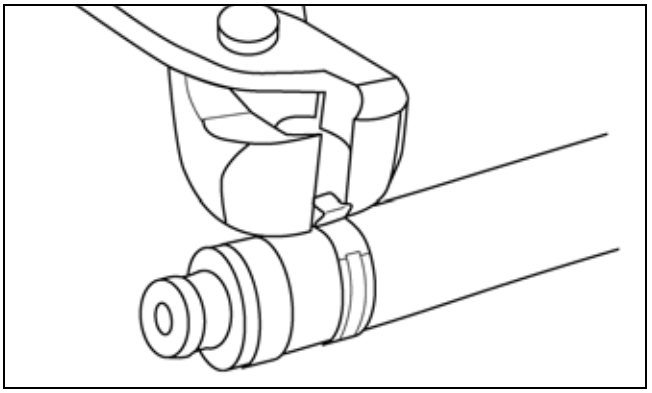


1. Open clamp
2. Closed clamp

000092

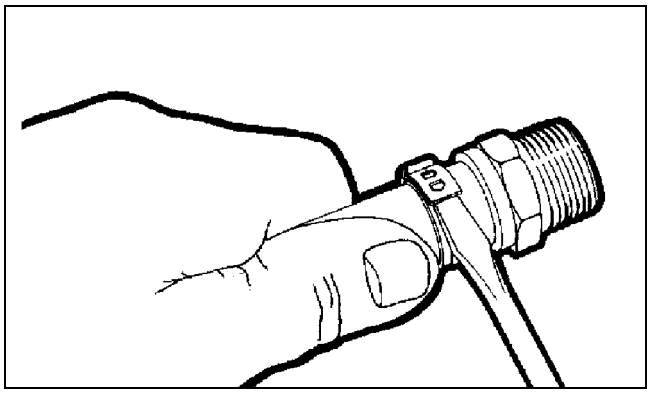
Clamp Removal

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



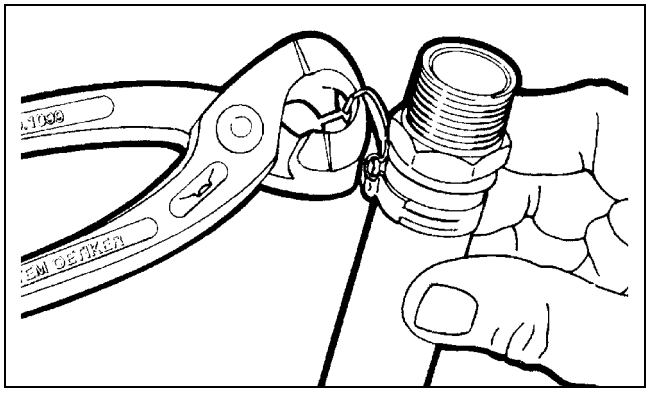
000108

Method 2: Lift end of stepless clamp with screwdriver.



000090

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



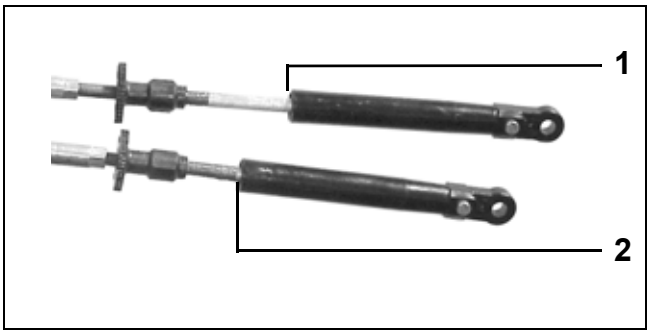
000091

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 and cannot have any protrusions.
- The transom angle should be approximately 14 degrees.
- Check transom strength and height.

⚠ WARNING ⚠

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

Top Edge of Transom or Bracket

Transom thickness or off-sets must also be considered. The top edge of the transom or bracket must provide a proper surface for stern brackets. The stern brackets must contact the flat surface of the transom or bracket. Modify moldings or components that prevent the stern brackets from resting against the transom surface. Do not modify transom brackets.

Transom Clearances

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

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

Water Flow

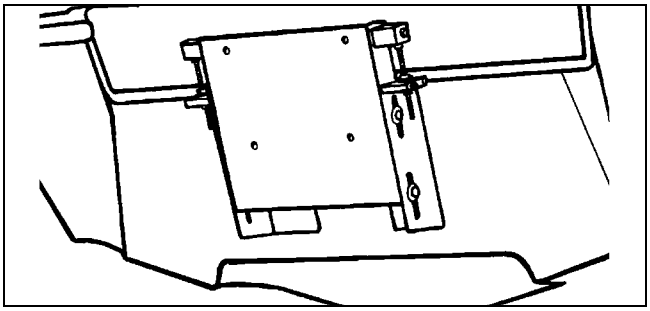
Inspect the hull area directly in front of the mounting location.

- Boat-mounted equipment should not create turbulence in the water flow directly in front of the outboard's gearcase. Turbulence or disruptions in the water flow directly in front of the gearcase will affect engine cooling and propeller 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, hydraulic unit, and steering system.



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, aluminum backing plates, washers, and nuts are used to attach the outboard to the frame of the shipping palette.

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

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

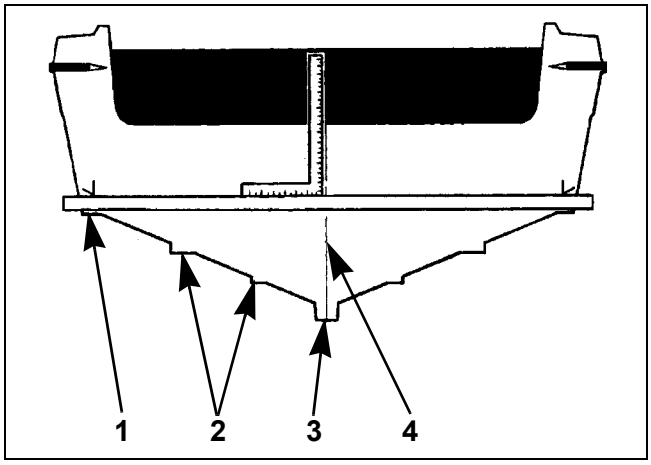
Transom Measuring and Drilling

Hull Centerline

Locate the centerline of the boat transom as it relates to the hull (bottom) of the boat.

Use a straightedge to draw a line connecting the port and starboard chines. The chines should be used as reference points for determining the centerline of the hull.

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

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.

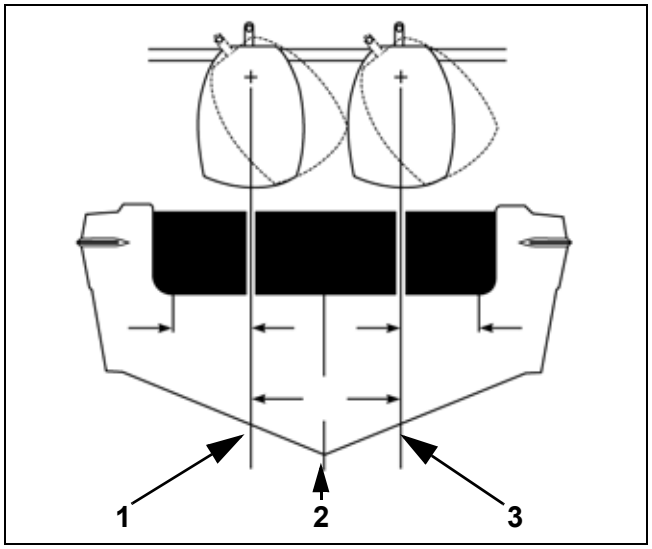
IMPORTANT: Some steering systems may require additional spacing. Refer to steering system manufacturer for recommendations.

The width of the top edge of the transom should be more than twice 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 Heights

Make sure the transom height is consistent with the height of the outboard to be installed.

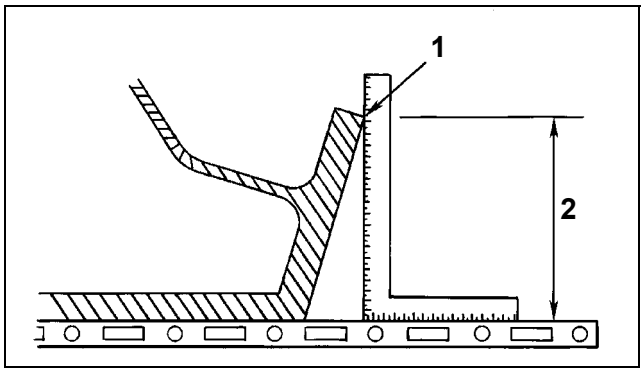
- A 19 to 21 in. (48.3 to 53.3 cm) transom height uses a 20 in. (50.8 cm) shaft outboard.
- The shaft length of the outboard being installed should come close to matching the transom height of the boat.

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*
2. *Actual transom height*

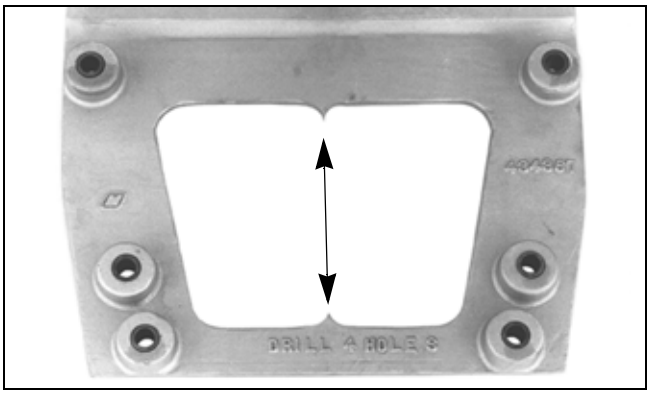
DR5541

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. 55 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.

Make sure that the proposed mounting hole locations will provide adequate clearance for mounting bolts and washers.

Check the inside area of the transom for obstructions prior to drilling mounting holes.

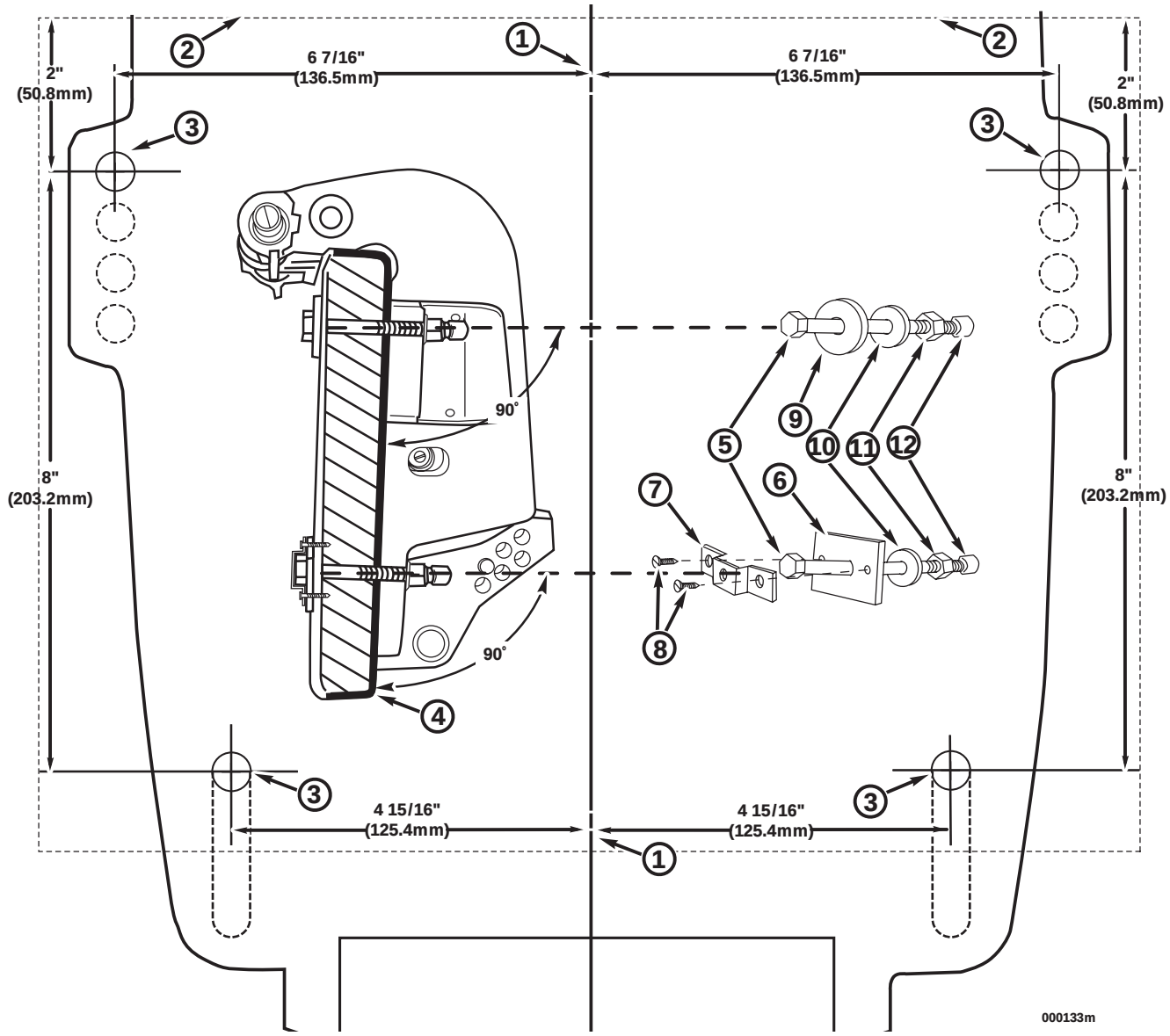
Check transom height(s) at centerlines prior to drilling any mounting holes.

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.

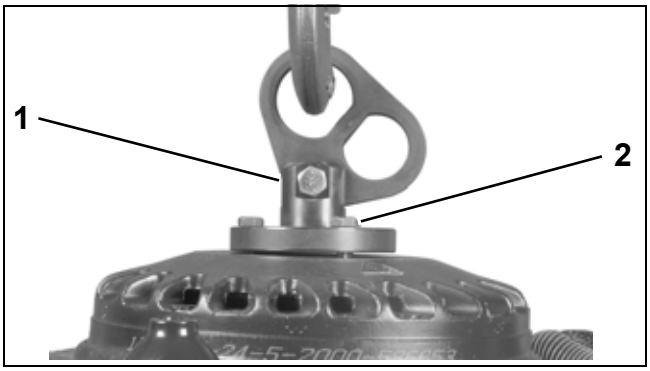
Remove shipping carton.

Remove any banding material used to secure outboard to shipping palette. The mounting hardware used to attach the outboard to the shipping frame is reused to fasten outboard to boat transom.

Use correct Lifting Fixture to lift outboard:

Model	Lifting Fixture
Evinrude E-TEC 90° V	P/N 396748

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



1. Lifting fixture 002419
2. 1 3/4 in.screws

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

Before Mounting Outboard to Transom

Some rigging components that attach directly to the outboard should be assembled before the outboard is mounted to the boat's transom. Steering system components and gearcase speedometer pickup hoses are the most common. Determine what equipment will be installed prior to mounting the outboard to the transom or bracket.

Steering Systems

Mechanical Cables

All *Evinrude/Johnson* 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 output end of the steering cable and lubricate the inner core of cable prior to installation.



ABYC-approved mechanical steering cable. 5873

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

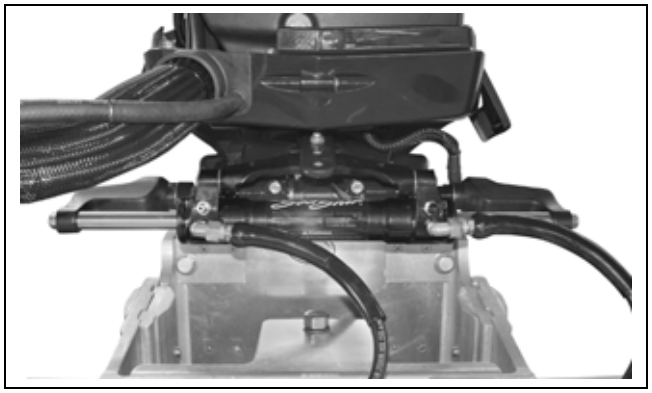
⚠ WARNING ⚠

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. Hydraulic steering systems offer certain design advantages that can be beneficial in some applications.

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

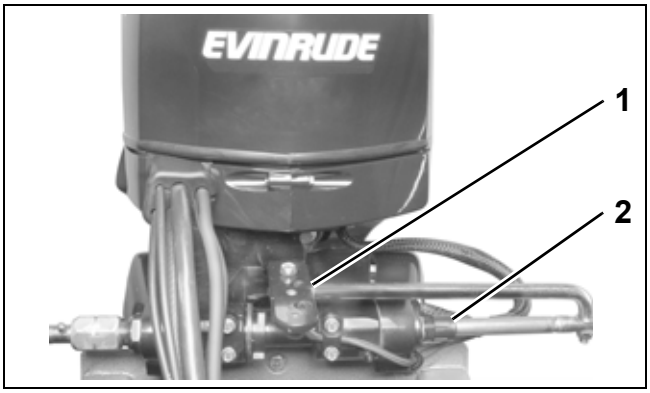


Typical manual hydraulic steering 004948

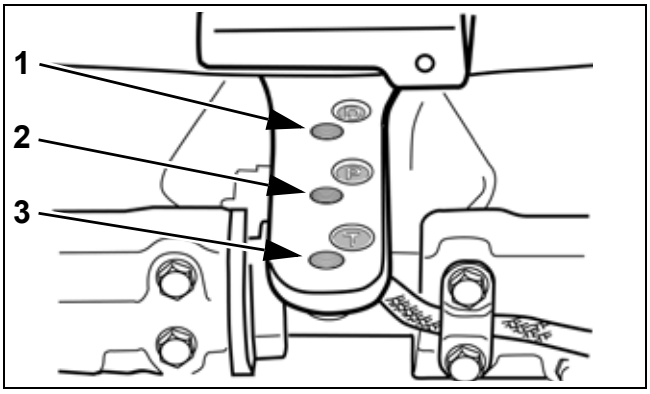
IMPORTANT: Some hydraulic steering systems require additional centerline spacing in dual-outboard installations. Refer to steering system manufacturer's recommendations and to **Dual-Outboard Centerlines** on p. 52.

Drag Links

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)*

Use the correct drag link to allow full steering travel:

Model	Drag Link
Evinrude E-TEC 90° V	P/N 175125

Outboard Mounting

Mounting Height

Boat performance depends on outboard mounting height.

Generally, the anti-ventilation plate of the gear-case should be in alignment 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.

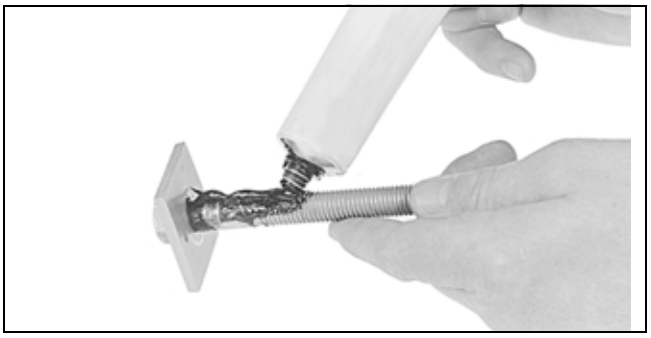
Boats that exceed 50 MPH may benefit from higher outboard heights. Consult the boat manufacturer for specific outboard mounting height information for a particular hull.

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.

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 when removed.

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

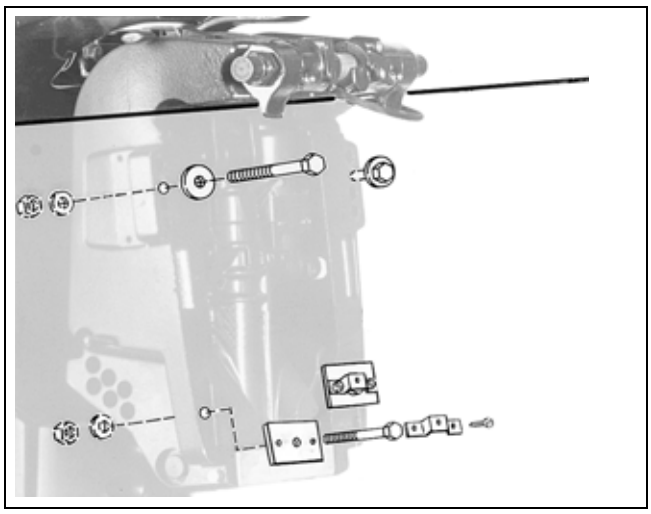


0078A

Assemble transom mounting plates on mounting bolts.

Apply sealant around the mounting bolt holes on the outer surface of the transom.

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. Torque nuts and bolts to 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.

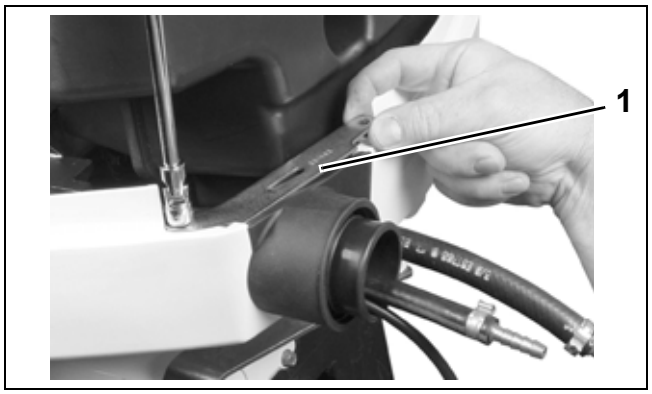
OUTBOARD RIGGING

⚠ 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

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

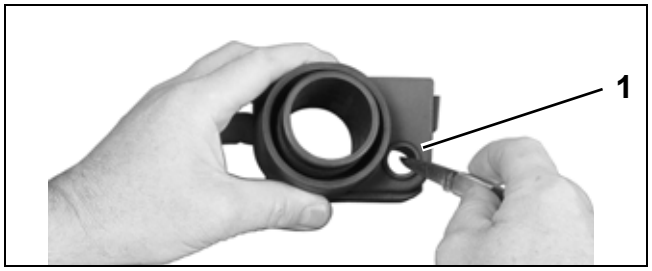


1. Grommet retaining bracket 003964

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

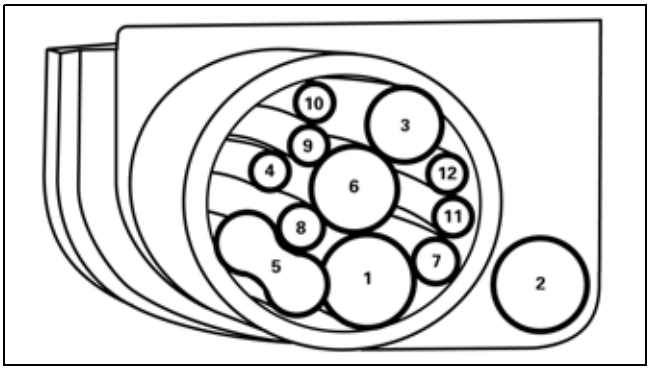
The fuel hose may be routed through the protective sleeve or through an alternate hole in the lower motor cover grommet.

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

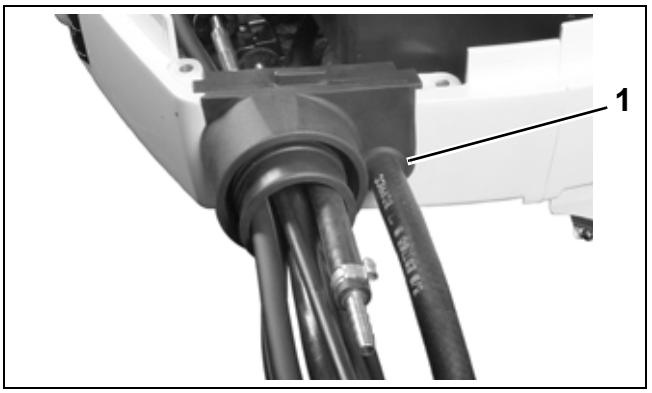


1. Alternate fuel hose location 003970

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



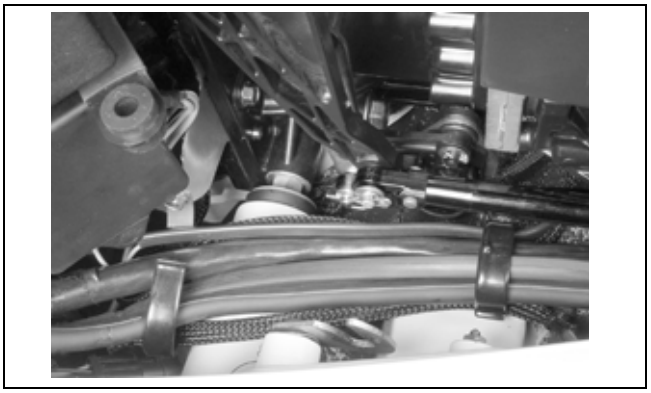
1. Fuel supply hose 000095
2. Fuel supply hose--alternate location
3. Oil supply hose
4. Oil tank sending unit harness
5. Battery cables
6. Main wire harness (MWS)
7. Shift cable
8. Throttle cable
9. Accessory charge wires
10. CANbus harness
11. Water pressure hose
12. Speedometer hose



1. Alternate fuel hose location 003971

The main wiring harness, battery cables, oil tank sending unit harness, and any CANbus cables should be routed along the same path to the star-

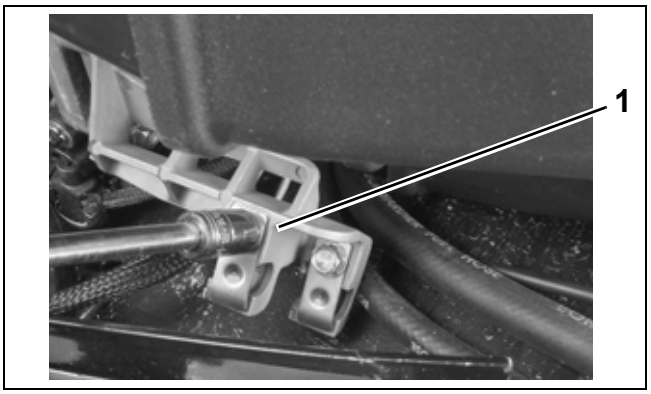
board side of the powerhead. Secure all cables with clamps.



003974

Control Cable Installation

Remove remote control cable trunnion covers and cable attachment hardware.



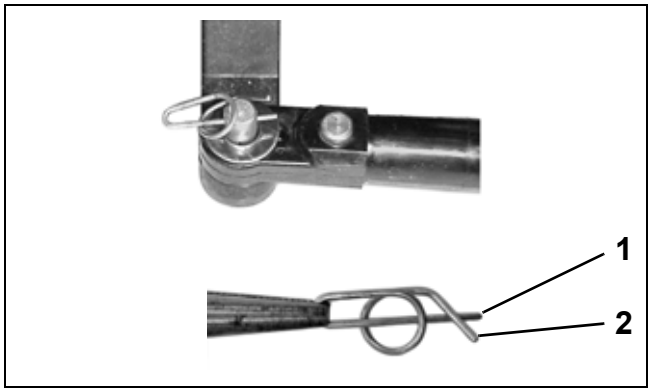
1. Trunnion covers 005037

Cable Retainer Clip Installation

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

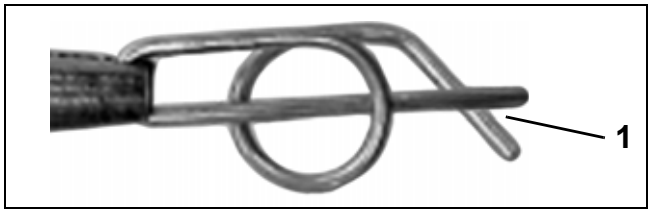
For proper installation, review the following steps:

- Place washer on pin.
- Position retainer clip with straight section on the bottom and angled section on the top.
- Use long noses 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

Shift Cable Installation and Adjustment

Position the shift cable on the shift lever pin and install the washer and retainer clip.

IMPORTANT: Do not bend or deform clip.

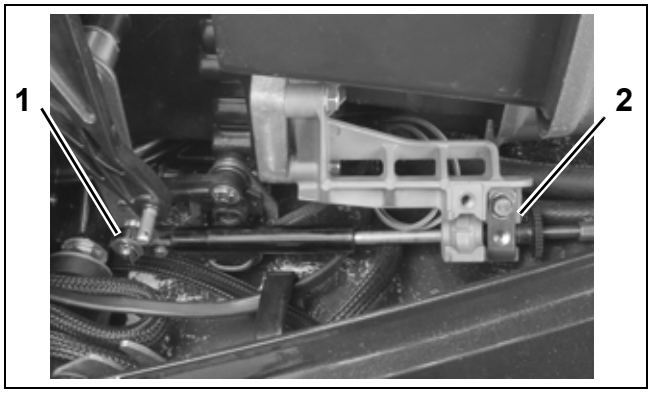
Confirm that the remote control, gearcase, shift linkage, and shift cable are in NEUTRAL.

Hold the shift linkage in NEUTRAL and grab the shift cable firmly.

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

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

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

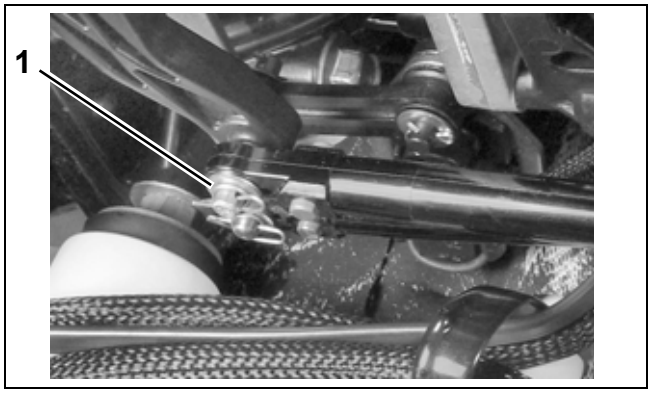


1. Shift cable retainer clip and washer 005038
2. Shift cable trunnion

Throttle Cable Installation and Adjustment

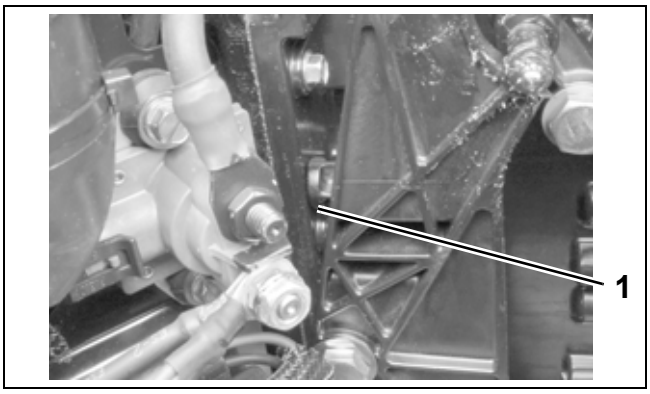
Rotate the propeller shaft and shift control lever to FORWARD, then pull control lever half-way back to NEUTRAL.

Position throttle cable on throttle lever pin and install washer and retainer clip.



1. Throttle cable retainer clip and washer 003967

With throttle cable attached to the throttle linkage, pull cable to remove slack and ensure that idle stop of the throttle linkage is against the crankcase.

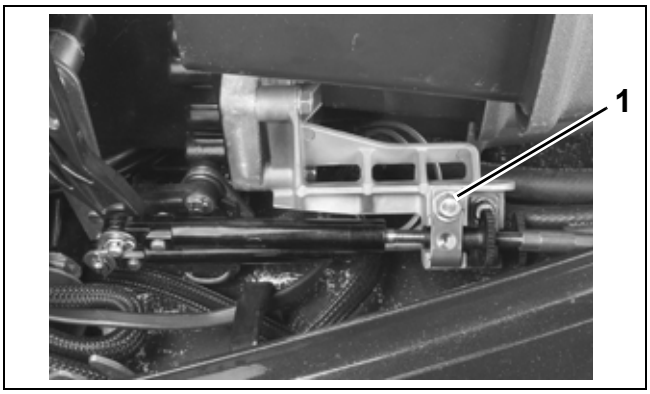


1. Throttle linkage, idle stop against crankcase 003968

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

IMPORTANT: DO NOT pre-load throttle cable. Make sure that the idle stop on the throttle linkage lightly contacts the crankcase when the remote control is in the IDLE position.

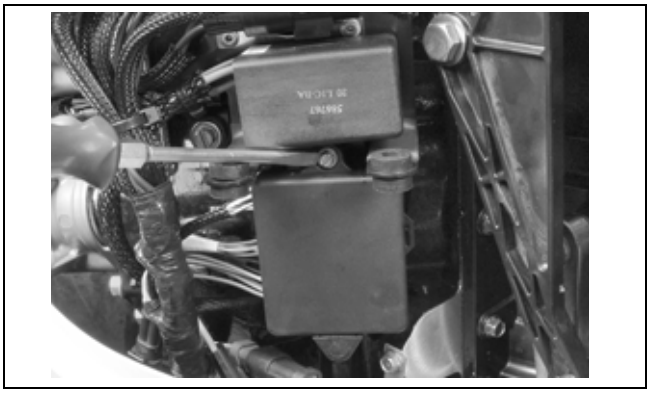
Reinstall the trunnion cover and screw. Tighten the retaining screw to a torque of 60 to 80 in. lbs. (7 to 9 N·m).



1. Trunnion cover and screw, throttle cable 005039

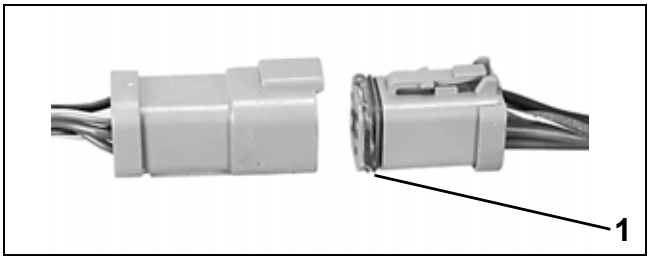
Electrical Harness Connections

Remove harness connector cover.



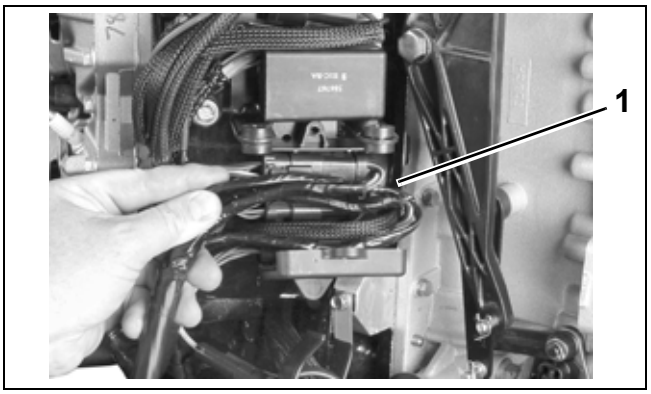
003972

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



1. Seal 42079A

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



1. Harness connections 003973

Replace harness connector cover.

Install battery cables on starter solenoid and main ground stud.

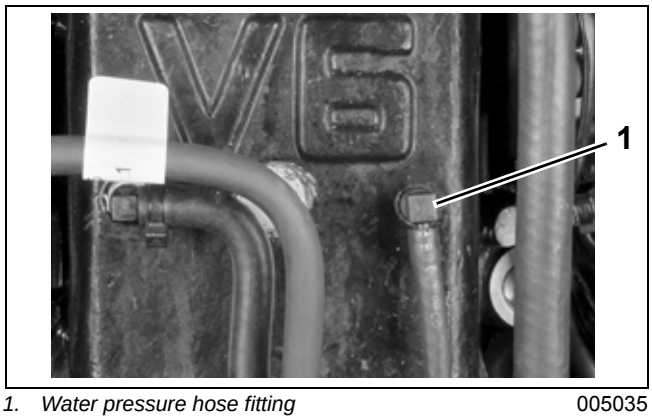


1. Positive (+) battery connection 003975
2. Ground (–) connection

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.

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



1. Water pressure hose fitting 005035

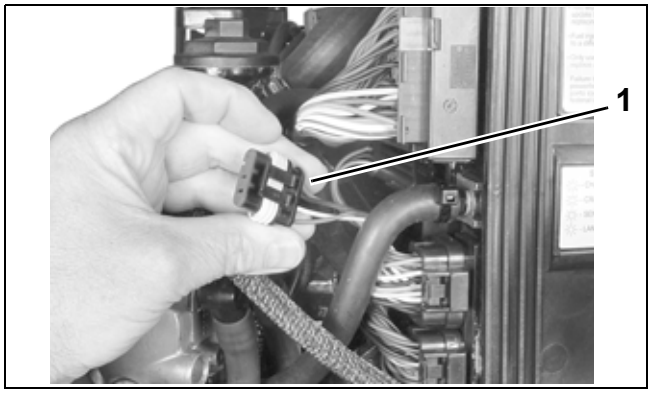
IMPORTANT: After installation, make sure there is enough clearance for all cables to avoid binding or chafing through all engine steering and tilting angles.

CANbus Connections

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

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.

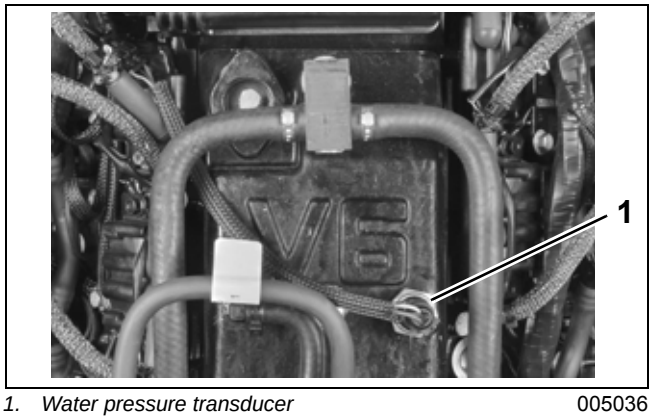
Connect the *EMM* CANbus connector to the boat CANbus network. Connect the purple wire from the CANbus Ignition Harness to the CANbus Network Harness. This connection supplies power to the network when the keyswitch is on.



1. EMM *CANbus connector* 004265

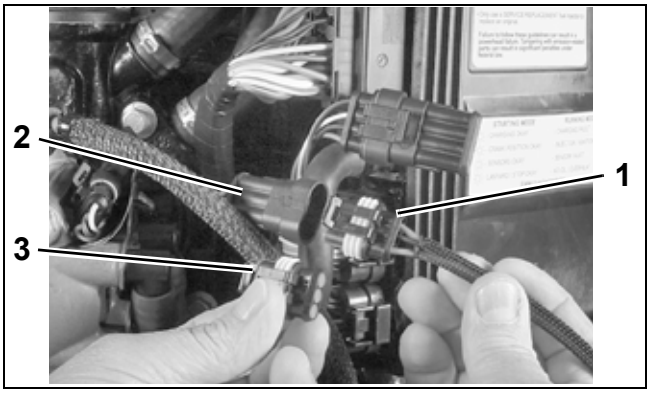
Route the harness around the starboard side of the powerhead along the same path as the battery cables.

If a CANbus water pressure gauge is used, install Water Pressure Transducer Kit, P/N 5006214, in the cylinder block.



1. *Water pressure transducer* 005036

install the transducer lead in the engine wiring harness connector.



1. *Water pressure transducer lead* 004120
2. *Engine harness connector*
3. *Cap*

If a CANbus oil level gauge is used, an optional CANbus oil level sender must be installed in the oil tank. Connect the oil level sensor harness to the boat CANbus network.

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



Engine options screen 005136
1. *Trim gauge calibration*
2. *Multi-engine setup*
3. *Water pressure gauge setup*

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.**

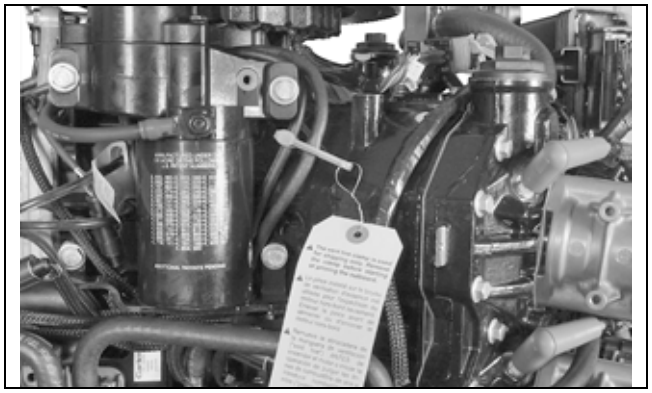
Evinrude/Johnson 2+4 **Fuel Conditioner** will help prevent gum and varnish deposits from forming in fuel system components and will remove moisture from the fuel system. It can be used continuously and should be used during any period when the outboard is not being operated on a regular basis. Its use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

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

Fuel System Priming

Vent Line Clamp

In compliance with Code of Federal Regulations, 49 CFR §173.220, all outboards utilizing a fuel vapor separator must be shipped with a vent line clamp installed. This clamp must be removed prior to attempting to prime the fuel system or start the outboard for the first time.



004223

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

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

Evinrude/Johnson XD100, XD50, or XD30 outboard oil is recommended for use in *Evinrude E-TEC* outboards.

Evinrude/Johnson XD100 outboard oil is preferred for use in *Evinrude E-TEC* models.

If these oils are not available, you must use an oil that meets NMMA TC-W3 certification.

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*.

Oil Injection Rate

If the owner desires, the Engine Management Module (*EMM*) on *Evinrude E-TEC* models can be programmed for the exclusive use of *XD100*, which will significantly reduce oil consumption.

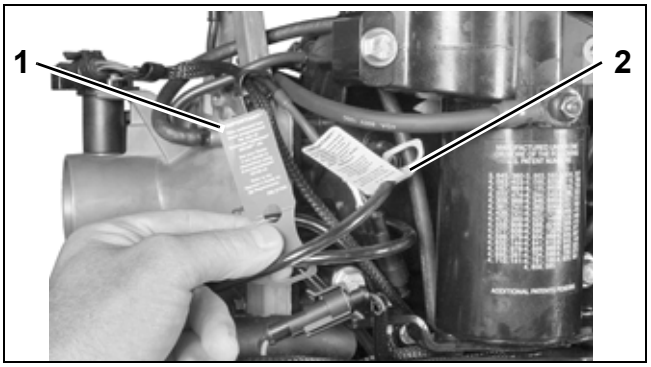
⚠ CAUTION ⚠

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.

The TC-W3 OIL control setting allows the outboard to be run on TC-W3 outboard lubricant. Changing to the optional *XD100* OIL CONTROL setting requires the use of *Evinrude XD100* outboard lubricant. Running the outboard in *XD100* OIL mode can reduce oil consumption by approximately one third. Refer to **Oil Control** on p. 109.

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

IMPORTANT: Make sure the *Evinrude E-TEC* engine label and boat decal match *EMM* programming.



1. Evinrude /Johnson XD100 *outboard lubricant (Premium)* 004119
   BLUE label
2. Evinrude /Johnson XD30 *outboard lubricant (TC-W3)*
   YELLOW label (Installed)

XD100 Outboard Oil Decal

An *Evinrude/Johnson XD100* oil decal is available to label boats equipped with *Evinrude E-TEC* outboards that have been programmed for the *XD100* oil injection ratio.

Use the **XD100 Outboard Oil Decal, P/N 352369**, to accurately inform the boat operator of the *XD100* outboard oil requirement.



***XD100* Outboard Oil Decal** 004522

Install this decal in one or more of the highly visible recommended locations to alert the outboard operator(s).

Recommended Locations:
- Dashboard/deck of boat, adjacent to key switch
- Deck of boat, adjacent to the remote oil fill
- Deck of boat, adjacent to oil tank assembly
- Oil tank cover
- Cover of oil tank compartment
- Attach to oil tank or oil fill cap

Break-In Oiling

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

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

Follow these steps for initial outboard set-up:
- Use the *Evinrude* Diagnostics Software program to confirm that the break-in program has been initiated. Refer to **Oil Control** on p. 109.
- The oil tank should be filled and the oil level accurately marked for reference.
- Fill the fuel tank with the recommended fuel.

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

SystemCheck Low Oil Warning

IMPORTANT: Leave oil tank empty until low oil warning has been tested.

Turn key switch to ON.

The *SystemCheck* gauge should initiate a test mode, momentarily sound the warning horn, and illuminate all four indicator lights. The “LOW OIL” light should remain illuminated.

Fill the oil tank with the recommended oil.

The “LOW OIL” light should turn off.

Turn key switch to OFF and install oil fill cap.

Oil Supply Priming

Oil Hose Connections

⚠ 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.

Insert the end of the oil supply hose (from the oil tank) into a suitable container.

Squeeze the oil primer bulb to flow oil from the oil tank.

Once oil flow is observed, connect the oil tank hose to the outboard’s oil supply hose and secure with 14.5 mm *Oetiker* clamp.

Oil Distribution Manifold Priming

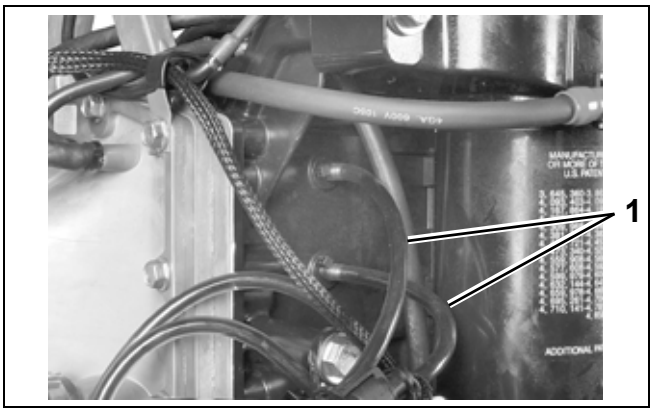
Follow these steps for initial outboard set-up:

- Squeeze the oil primer bulb to flow oil from the hose connection, through the filter, to the oil pump.
- Visually inspect filter to ensure that all air has been purged.
- Continue squeezing the primer until oil flows through the distribution manifold into the oil distribution hoses and to the crankcase fittings. All air must be eliminated from oil lines.
- Use the *Evinrude* Diagnostics Software program to confirm that 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.



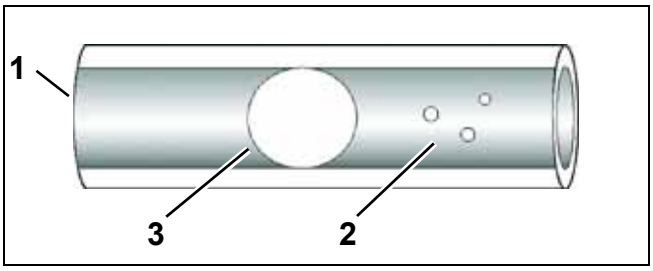
Dynamic Tests Screen 005137
1. Prime Oil button

Observe oil flow through the oil distribution hoses.



1. Oil distribution hoses (7) 004224

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



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.

Reconnect the fuel supply hose.

Repair any fuel or oil leaks.

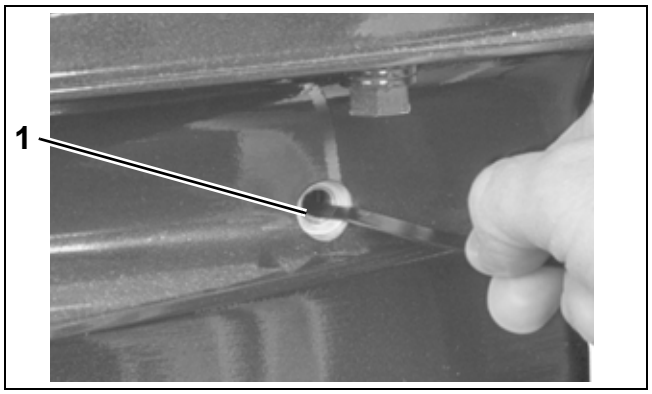
The oiling system can also be primed using the Self-Winterizing feature if diagnostic software is not available. Refer to **STORAGE** on p. 91.

BEFORE START-UP

Gearcase Lubricant

With outboard in vertical position, 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

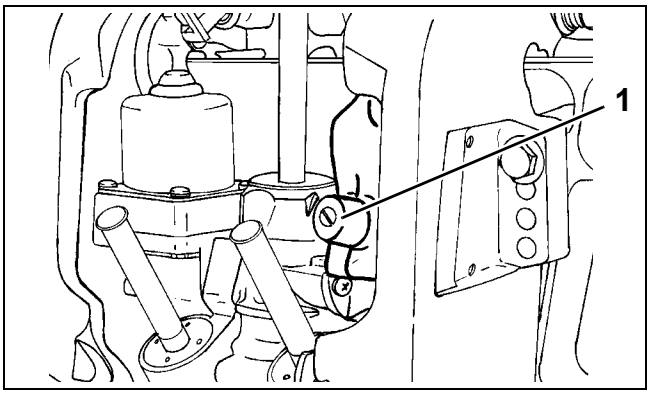
Make sure oil tank contains an adequate supply of the correct lubricant for the outboard and that the **SystemCheck Low Oil Warning** test has been performed.

When starting the outboard for the first time, refer to **Oil Supply Priming** on p. 67.

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.
- If necessary, add enough *Evinrude/Johnson Power Trim/Tilt and Power Steering Fluid* to bring fluid level even with bottom of fill cap hole when unit is at full tilt.



1. Filler cap DR22834

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.

SystemCheck Operation

Attach emergency stop lanyard.

Turn key switch to ON.

Observe the *SystemCheck* self-test function. Warning horn should sound for 1/2 second and all warning indicator 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 starter will not operate when the outboard is in gear. The start-in-gear prevention feature is required by the United States Coast Guard to help prevent personal injuries.

Start outboard and shift remote control lever to FORWARD.

Turn outboard OFF while remote control is in FORWARD.

Attempt restarting the outboard. Outboard should not start.

Pull remote control lever back to NEUTRAL and restart outboard.

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

Attempt restarting the outboard. Outboard should not start.

Tachometer Pulse Setting

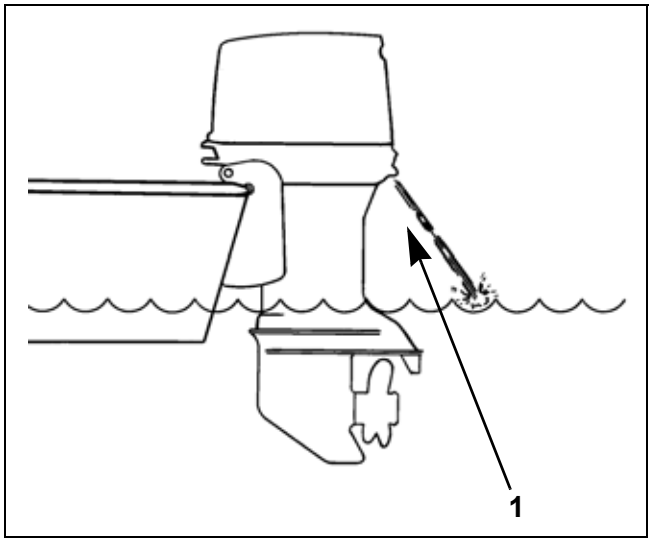
Confirm accuracy of tachometer reading.

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

Outboard Model	Tachometer Setting
Evinrude E-TEC 90° V	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 specific **TECHNICAL DATA** on p. 18.

Idle Speed

Outboard idle speed is essential for proper outboard control and shift function. Make certain 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, the customer should be referred to the correct break-in procedure in the **Operator's Guide**.

The Engine Management Module (*EMM*) on new *Evinrude E-TEC* models is programmed to automatically supply extra oil to the engine during the first few hours of operation above 2000 RPM.

The dealer may use the Diagnostic Software program to confirm that the break-in program has been initiated. Refer to **Oil Control** on p. 109.

PROPELLERS

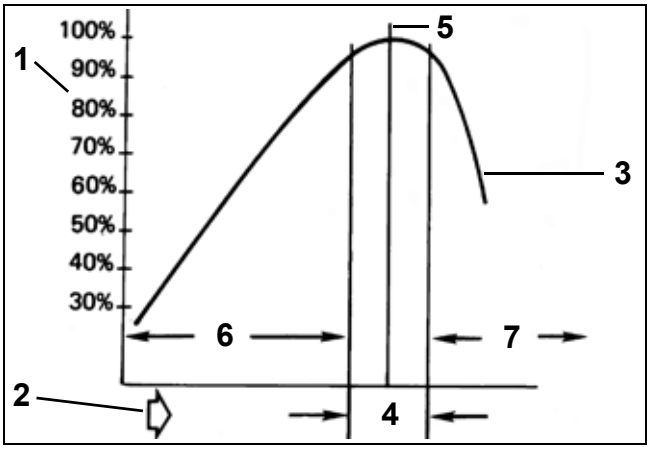
Propeller Selection

⚠ 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 **TECHNICAL DATA** on p. 18.

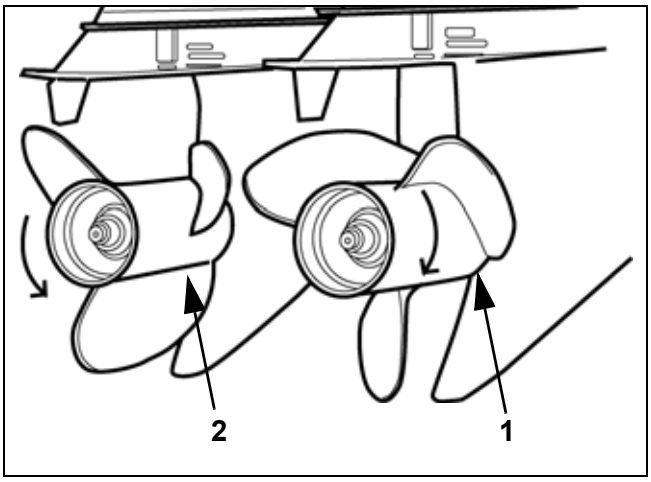


1. *Percentage of horsepower (kw)* DR1261
2. *Engine RPM*
3. *Horsepower curve*
4. *Full throttle operating range*
5. *Midpoint of full throttle operating range, horsepower rating in kilowatts (kw)*
6. *Engine is overloaded at full throttle*
7. *Engine is overspeeding at full throttle*

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.
- Right-hand propellers are considered standard rotation propellers. When propelling a boat forward, the propeller rotates in a right-hand (clockwise) direction as viewed from the rear.
- Left-hand propellers are considered counter-rotation propellers. When propelling a boat forward, the propeller rotates in a left-hand (counterclockwise) direction as viewed from the rear.



1. *Right-hand rotation (clockwise)* 000033
2. *Left-hand rotation (counterclockwise)*

⚠ WARNING ⚠

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

Propeller Hardware Installation

⚠ WARNING ⚠

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

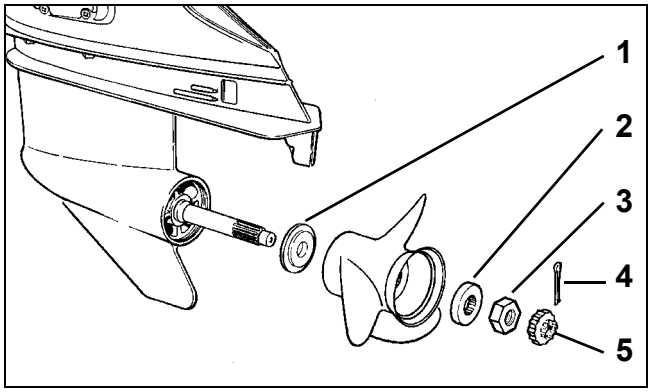
Apply *Triple-Guard* grease to the entire propeller shaft before installing the propeller.

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

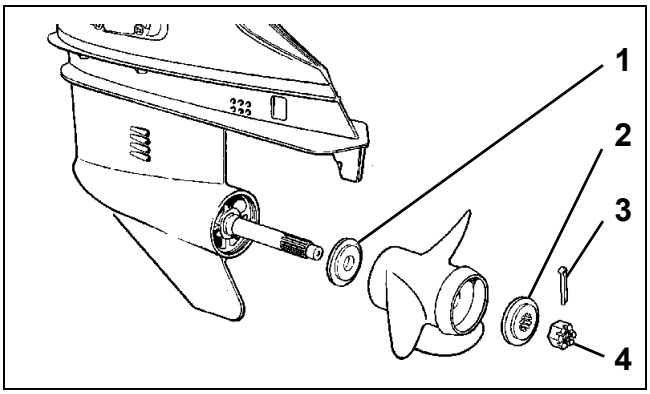
Install propeller on propeller shaft by aligning splines and pushing until seated on the thrust bushing.

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.

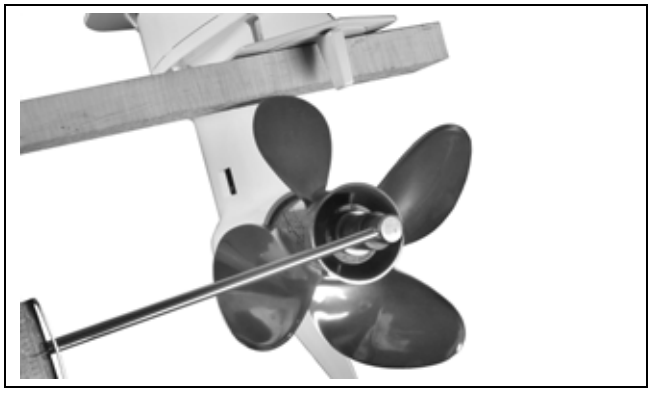


Models with cotter pin "keeper" DR4028
1. *Thrust Bushing*
2. *Spacer*
3. *Propeller Nut*
4. *Cotter Pin*
5. *Keeper*



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 torque to:
- 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

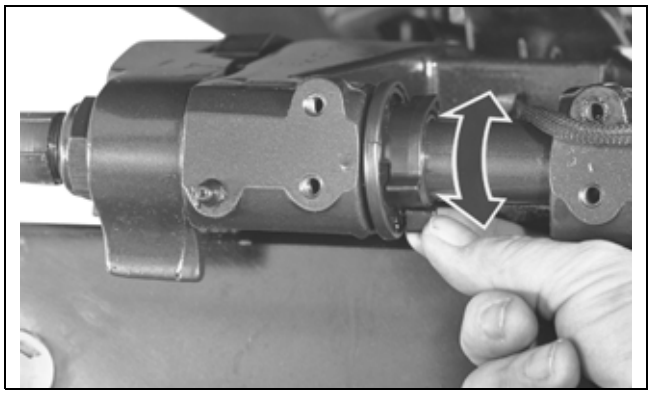
If the outboard does not clear all boat parts when tilted fully or turned side to side, safety related parts could be damaged in the course of such outboard movement. Injuries could result from loss of boat control.

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.

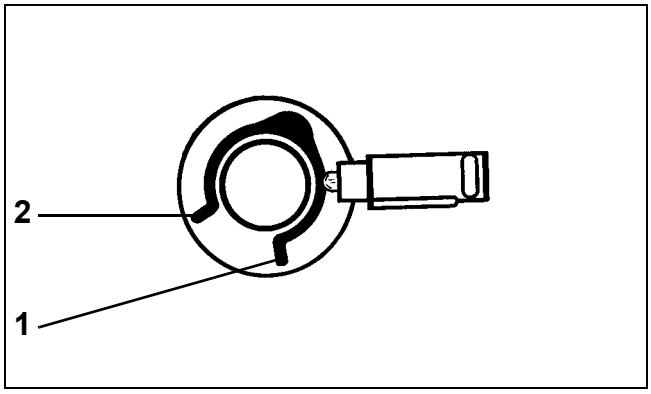
IMPORTANT: The tilt limit cam will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.



DR3916

Use the trim/tilt switch and trim the outboard IN all the way.

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

Confirm the adjustment by tilting the outboard fully, using the trim/tilt switch.

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 it is needed. Consider either changing the outboard mounting position or modifying the boat if the possibility for interference and damage exists.

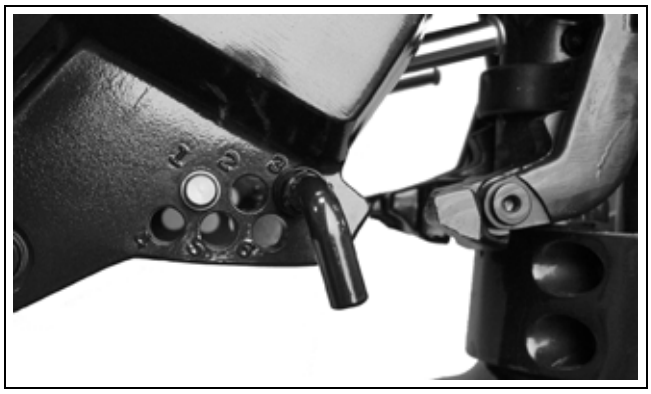
WARNING

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

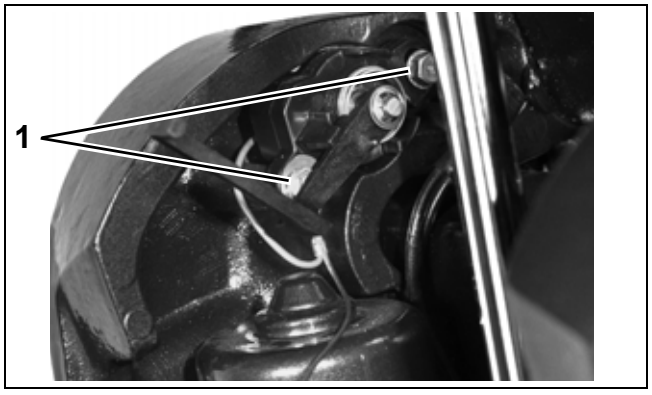
Tilt the outboard and engage the tilt support.

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.

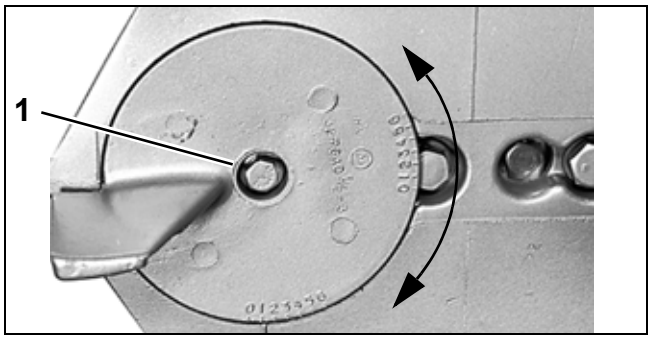
IMPORTANT: A single trim tab adjustment will relieve steering effort under only one set of speed, outboard angle and load conditions. No single adjustment can relieve steering effort under all conditions.

⚠ WARNING ⚠

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

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

- With the remote control in NEUTRAL and the engine OFF, loosen the trim tab screw. If the boat pulled to the right, move rear of the trim tab slightly to the right. If the boat pulled to the left, move rear of the trim tab slightly to the left.
- Tighten the trim tab screw 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:

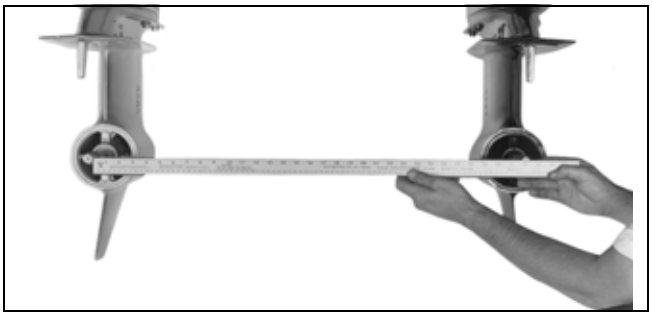
- Propeller ventilation
- Reduction of top speed
- Improper boat tracking
- Engine overheat and powerhead damage

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

Measure Alignment

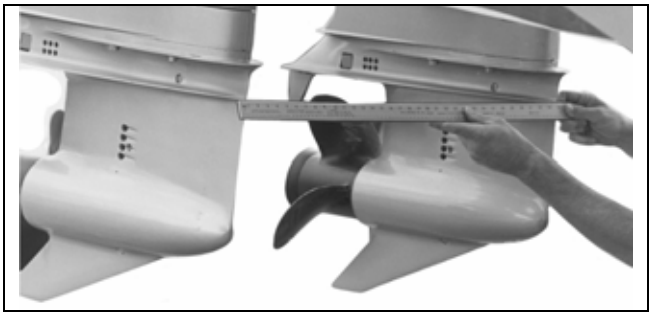
The “toe-in” (gearcase leading edges closer together than propeller shaft centers) or “toe-out” (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:

- 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 80
ANTI-CORROSION PROTECTION 81
- SACRIFICIAL ANODES 81
- TESTING PROCEDURE – CONTINUITY 81
- METALLIC COMPONENT PROTECTION 81
- EXTERIOR FINISHES 81

COOLING SYSTEM 82
- FLUSHING 82
- WATER INTAKE SCREENS 83
- ADDITIONAL MAINTENANCE 83

LUBRICATION 84
- STEERING SYSTEM 84
- SWIVEL BRACKET AND TRAILERING BRACKET 84
- TILT TUBE 84
- THROTTLE AND SHIFT LINKAGE 85
- PROPELLER SHAFT 85
- GEARCASE LUBRICANT 85
- TRIM AND TILT 86

BATTERY AND BATTERY CONNECTIONS 87
FUEL AND OIL SYSTEMS 88
- FUEL FILTER 88
- OIL FILTERS AND OIL RESERVOIR 88
- AIR SILENCER 88
- HOSES AND CONNECTIONS 88

SPARK PLUGS 89
- INDEXING 89

EXHAUST PRESSURE FITTING 90
- OPERATION TEST 90
- CLEANING 90

STORAGE 91
- FUEL SYSTEM TREATMENT 91
- INTERNAL ENGINE TREATMENT 91
- ADDITIONAL RECOMMENDATIONS 92

PRE-SEASON SERVICE 92
- OUTBOARD MOUNTING BOLTS 92
- GEARCASE LUBRICANT 92
- BATTERY(S) 92
- POWER TRIM AND TILT 92
- OPERATIONAL CHECKS 92

SUBMERGED ENGINES 93
- ENGINE DROPPED OVERBOARD (NOT RUNNING) 93
- ENGINE DROPPED OVERBOARD (RUNNING) 93
- ENGINE DROPPED OVERBOARD (IN SALT WATER) 93
- PROLONGED SUBMERSION (FRESH OR SALT WATER) 93

NOTES 94

INSPECTION AND MAINTENANCE SCHEDULE

Routine inspection and maintenance is necessary for all mechanized products. Periodic maintenance contributes to the product's life span. The following chart provides guidelines for outboard inspection and maintenance to be performed by an authorized Dealer.

IMPORTANT: Outboards used for rental operations, commercial applications, or other high hour use applications require more frequent inspections and maintenance. Inspection and maintenance should be adjusted according to operating conditions and use; and environmental conditions.

Description	Engine Care Product	Routine Inspection	Every 300 hours or every three years (1)
SystemCheck self-test and warning horn, check		✓	
Emergency stop circuit and lanyard, check operation		✓	
Controls, steering and tilting; check operation, lubricate		✓	
Engine to transom mounting hardware, re-torque (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 system components, 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			✓
Water pump, inspect / replace (more often if water pressure loss or overheating occurs)			✓

(1) Frequency for average recreational use. Commercial use, heavy use or use in salt, brackish or polluted water requires more frequent inspection and maintenance.

(2) Emission-related component

(3) Annually in salt water applications

A *HPF XR* Gearcase Lubricant

B Power Trim/Tilt Fluid

C *Triple-Guard* Grease

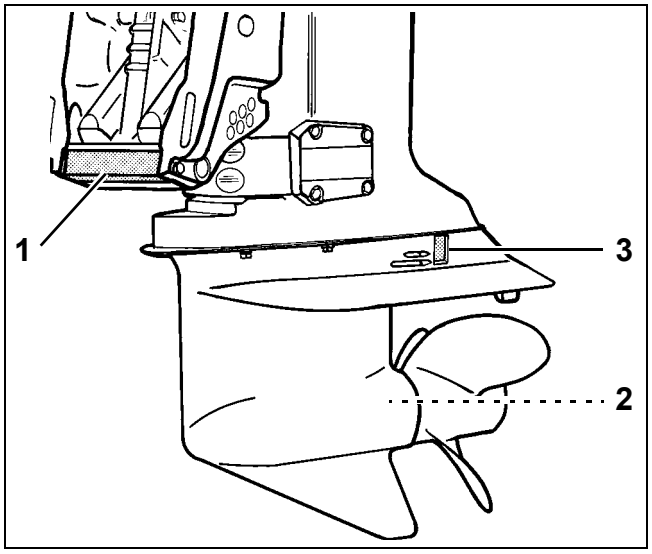
D Starter Lube Only P/N 337016

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.

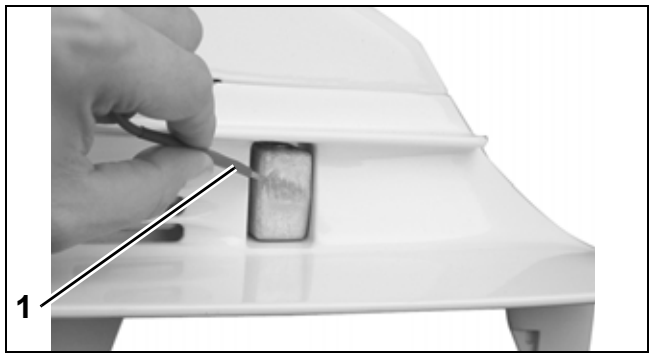
IMPORTANT: Anodes that are not eroding may indicate that the anodes are not properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

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 meter leads between engine ground and anode surface.



1. *Meter lead to anode* 000677

The multimeter should indicate 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 do the test again.

Metallic Component Protection

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

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

Exterior Finishes

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

- Use automotive wax to protect the outboard’s exterior finish from oxidation.
- Clean regularly using clean water and mild detergent soap.
- Touch-up damage to painted surfaces promptly.
- Protect moving components with appropriate lubricants.

COOLING SYSTEM

Check the condition of cooling system components regularly. The outboard cooling system consists of:

- 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. 73.

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

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



004263

Thread garden hose into flushing port.



004264

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.

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

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

Reinstall propeller.

Flushing — Outboard Not Running

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

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

Thread garden hose into flushing port.

Turn water supply ON.

Flush outboard for at least five minutes.

Turn off water supply and remove garden hose.

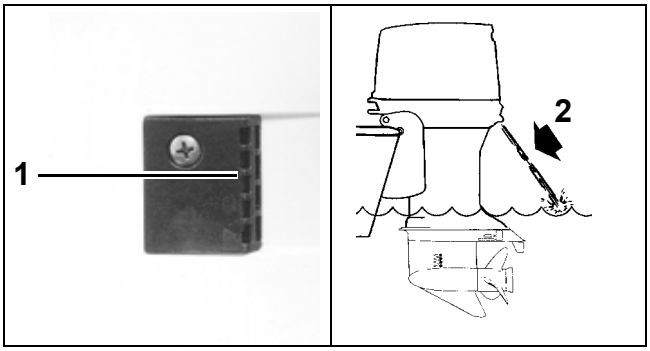
Reinstall plug and nozzle. Position the plug and nozzle to allow the water stream to be seen from the helm.

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. Clean or replace plug and nozzle as needed.



TYPICAL drc4952arev
1. *Water intake screen*
2. *Overboard water pressure*

Additional Maintenance

- Confirm function of *SystemCheck* engine monitor.
- 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

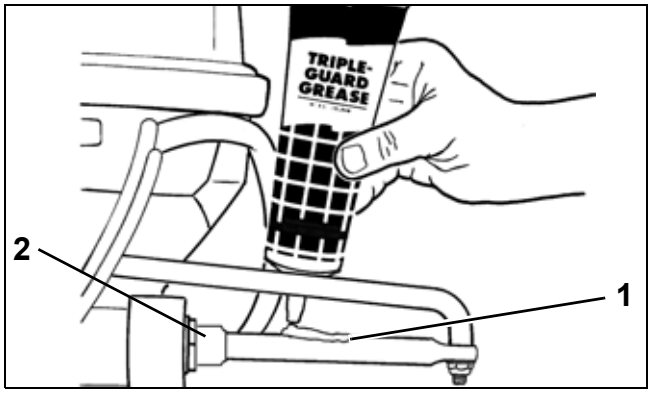
Steering System

⚠ 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*

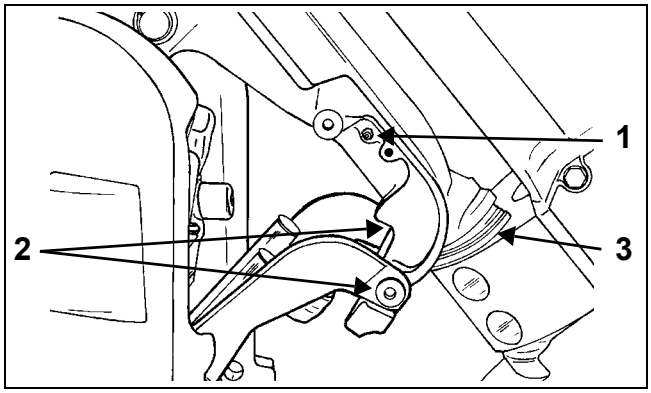
DR29546

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.

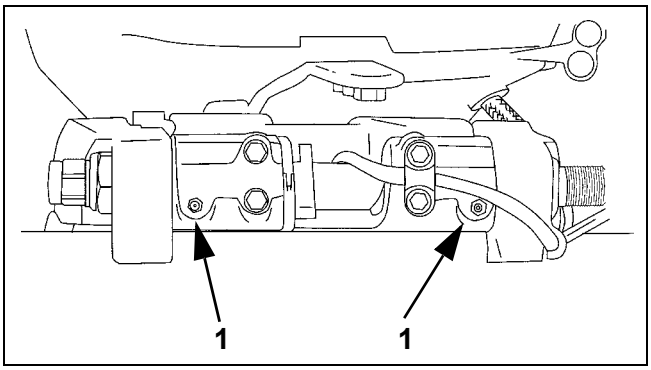


1. *Grease fitting*
2. *Pivot points*
3. *Lower swivel bracket area*

DR5073

Tilt Tube

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



1. *Tilt tube fittings*

DR38798

Throttle and Shift Linkage

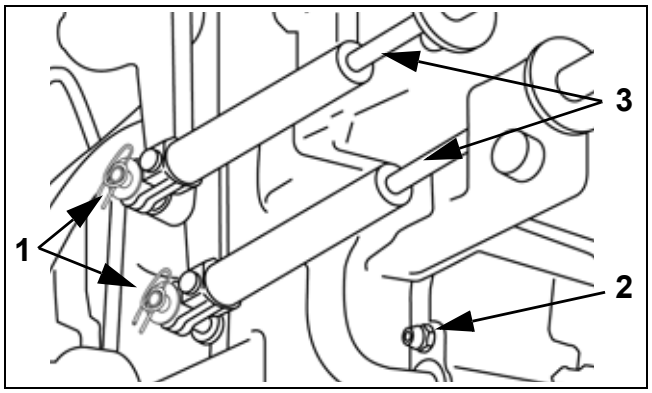
Disconnect the battery cables at the battery.

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

IMPORTANT: DO NOT disturb cable trunnion adjustments.

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

Apply *Triple-Guard* grease to:
- Pivot and slide area of the shift interrupt switch bracket
- Cable attachment pins of both the throttle and shift levers
- Brass inner casings of both the throttle and shift cables



1. Attachment pins, throttle and shift cables DRC6500R
2. Shift shaft grease fitting
3. Brass inner casings, throttle and shift cables

Shift the remote control to the NEUTRAL/IDLE position.

Install control cables in trunnion block(s) and install trunnion cover(s) and screw(s) securely.

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. 73.

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

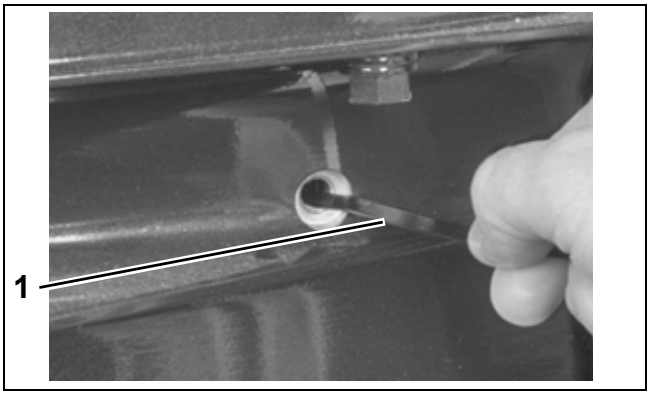
Clean propeller shaft. Inspect propeller shaft seals. Replace damaged or worn seals.

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

Reinstall propeller hardware and propeller.

Gearcase Lubricant

IMPORTANT: Always check the fill level of the gearcase lubricant prior to removing drain/fill plug. A tie strap can be used to check lubricant level.

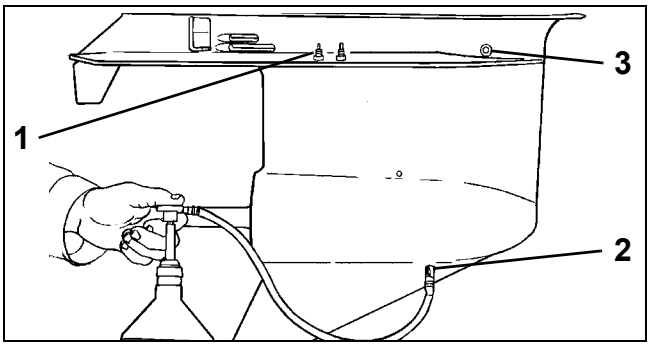


1. Tie strap 000072

Examine drained lubricant for excessive metal fragments and for any indication of water in oil (cloudy or milky appearance). Lubricant that is black in color with a burnt odor indicates worn, overheated oil. Pressure and vacuum check gearcases with apparent leaks. Repair all leaks.

Refer to the **INSPECTION AND MAINTENANCE SCHEDULE** on p. 80 for service frequency and recommended lubricants.

Refer to **LUBRICANT** on p. 284 for complete gearcase lubricant filling procedures.



1. Magnetic level and drain/fill plugs DR33681
2. Drain/fill hole
3. Lubricant level hole

Refill the gearcase with *HPF XR* Gearcase Lubricant.

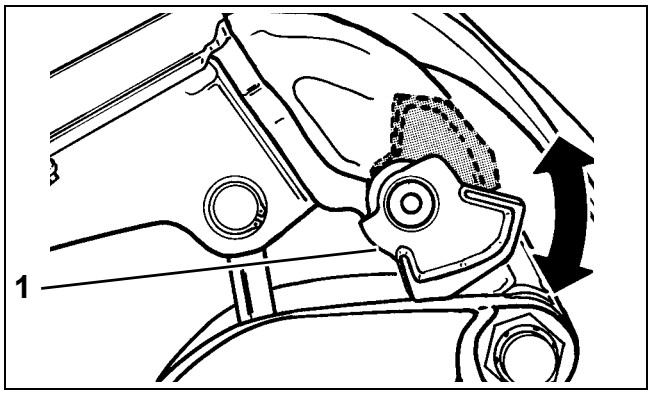
If *HPF XR* Gearcase Lubricant is not available, *Hi-Vis* gearcase lubricant can be used as an alternative; however, long term durability may be affected with continued use.

IMPORTANT: The recommended gear lubricants include special additives for marine applications. Do not use any automotive gear lubricants, 2-stroke or 4-stroke engine oil, or any other oil or grease for gearcase applications.

Trim and Tilt

Position outboard in FULL TILT (UP) position.

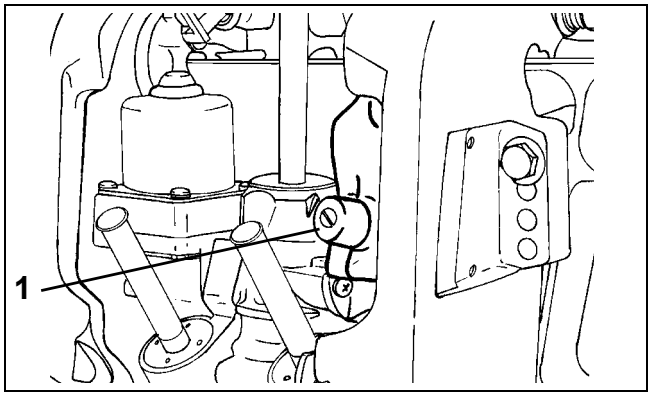
Engage the tilt support bracket.



1. Tilt support bracket DR5071

Inspect for fluid leaks. Repair all leaks.

Remove the fill cap and check fluid level. The fluid level must be even with bottom of the reservoir fill cap hole.



1. Fill cap DR22834

Add *Power Trim/Tilt and Power Steering Fluid* as needed.

Install the reservoir fill cap.

⚠ WARNING ⚠

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

BATTERY AND BATTERY CONNECTIONS

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

⚠ 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.

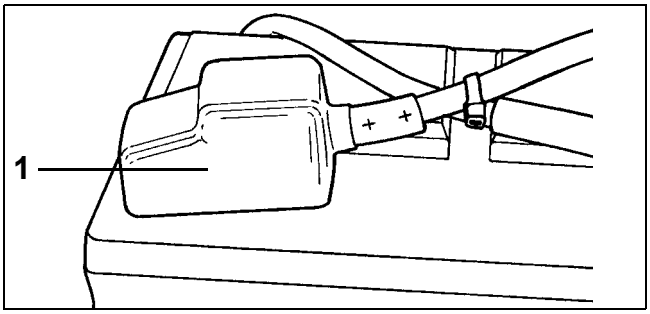
Disconnect battery negative (–) cable **first** and the battery positive (+) cable last.

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. 36.

IMPORTANT: DO NOT secure battery cables with wing nuts.

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



1. Insulator DR5104

⚠ 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 90° V outboards are equipped with a water-sensing, water-separating fuel filter. Refer to **Fuel Filter** on p. 185.

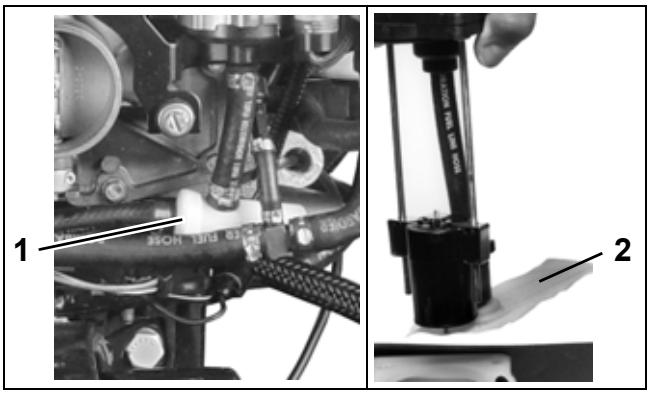


1. Water-separating fuel filter 005022

Oil Filters and Oil Reservoir

Evinrude E-TEC 90° V outboards are equipped with two serviceable oil filters: one is located in the oil injection tank, and one is located in the oil supply line just before the oil lift pump.

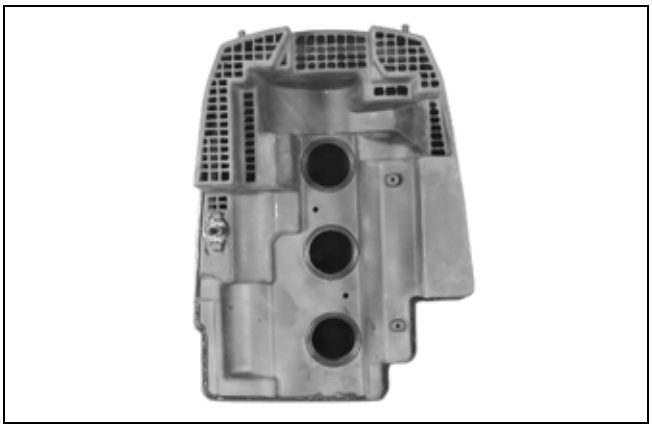
Sample oil from bottom of oil injection tank. Confirm that oil is free of water or other contaminants.



1. Filter, oil supply line 004250
2. Filter, oil injection tank 42785

Air Silencer

The air silencer on *Evinrude* outboards minimizes audible noise related to air flow into the engine.



004218

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

Hoses and Connections

Check condition of all hoses and connections related to both the fuel and oil systems.

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

⚠ WARNING ⚠

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

SPARK PLUGS

Spark plugs should be removed and examined periodically. Replace worn, fouled or damaged spark plugs.

Use only recommended spark plugs with the correct gap setting.

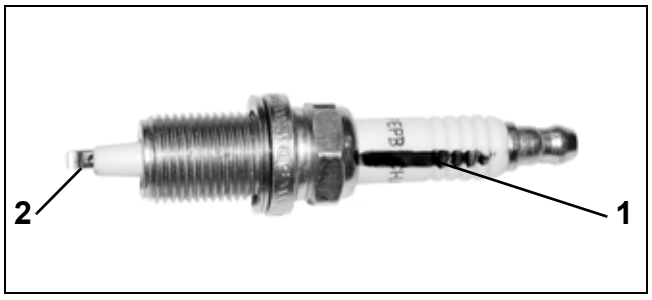
Spark Plug, *Champion*
QC10WEP @ 0.028 ± 0.003 in. (0.76 mm)

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

Indexing

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

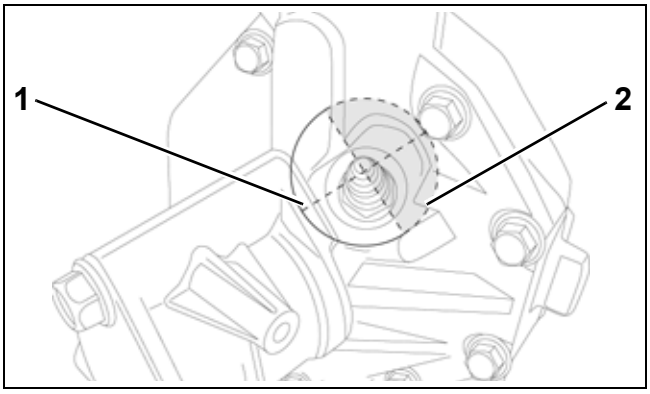
Put an ink mark on the ceramic of the spark plug that is in line with the OPEN side of the ground electrode. This mark will be used to orient the spark plug with the OPEN side of the ground electrode facing the fuel injector.



1. Ink mark 000758
2. Open side

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

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



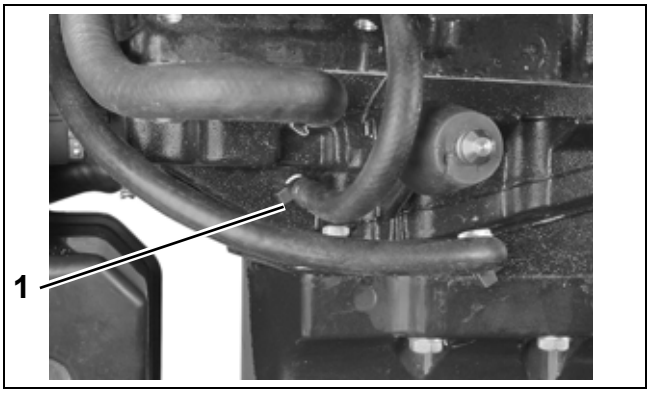
Spark Plug Indexing Diagram 004294
1. Unshaded area
2. Shaded area

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.

EXHAUST PRESSURE FITTING

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



1. Exhaust pressure fitting 005026

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

Operation Test

Use the engine *Monitor* screen of the *Evinrude* Diagnostics Software program to confirm:

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

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

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

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

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



Engine Monitor Screen 005141
1. Barometric pressure reading
2. Exhaust pressure reading

Cleaning

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

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

⚠ WARNING ⚠

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

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

IMPORTANT: Fitting does restrict air movement.

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

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:

⚠ WARNING ⚠

Outboard MUST be in NEUTRAL throughout these procedures.

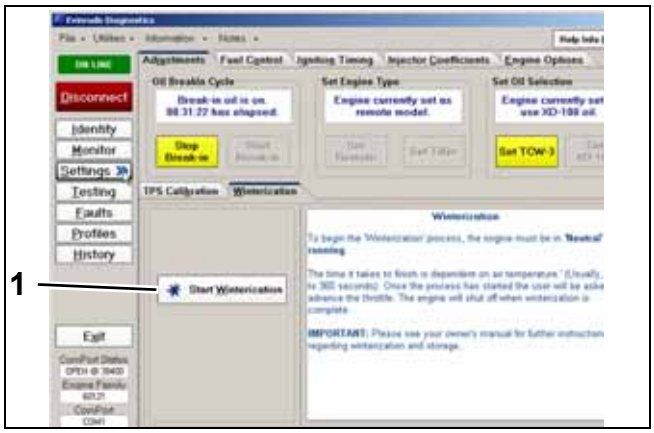
IMPORTANT: If outboard runs above FAST IDLE speed, turn outboard OFF immediately and perform the procedure again.

Throttle Control Method

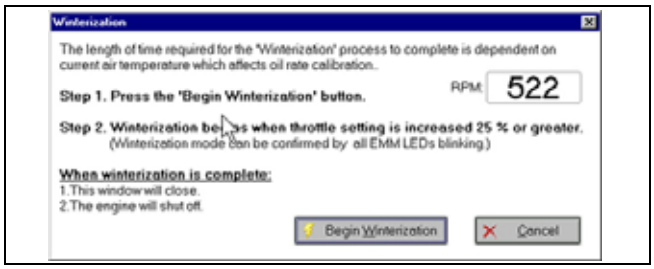
- Shift outboard into NEUTRAL position. Advance throttle control to 1/2 throttle (50%) position and start the outboard. The outboard will run at IDLE speed (*SystemCheck* lights will illuminate).
- After approximately 15 seconds *(SystemCheck* lights will go off) move throttle control to IDLE position (*SystemCheck* lights will illuminate again). Run the outboard with throttle control in IDLE position for another 15 seconds (*SystemCheck* lights will go off).
- Next, with outboard still in NEUTRAL, advance throttle control to FULL (100%) throttle position (*SystemCheck* lights will flash). The outboard will automatically go to FAST IDLE speed and begin internal fogging/lubrication.
- Allow outboard to run until it automatically shuts off (approximately 60 seconds). Turn key switch to OFF position.

Software Control Method

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



1. Winterization start button 005140



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 that it has been reinstalled with factory specified hardware. Refer to the **INSTALLATION AND PREDELIVERY** section for proper set-up procedures.

Outboard Mounting Bolts

- Check and re-torque outboard mounting bolts to 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 prior to starting outboard.
- Repair all leaks.

Water Pump

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

⚠ WARNING ⚠

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

SUBMERGED ENGINES

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. 64. 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. 155.

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 MANAGEMENT MODULE (*EMM*)

TABLE OF CONTENTS

DESCRIPTION 96
- ***EMM* FUNCTIONS** 96
- ***EMM* CONNECTIONS** 96

SENSORS AND FUNCTIONS 97
- **INTERNAL SENSORS** 97
- **EXTERNAL SENSORS** 98
- **INTERNAL FUNCTIONS** 101

***EMM* INPUTS AND OUTPUTS DIAGRAM** 102

***S.A.F.E.* WARNING SYSTEM** 103
- **ACTIVATION** 103
- **RECOVERY** 103

SHUTDOWN MODE 103

***EMM* DIAGNOSTICS** 104
- **LED INDICATORS** 104
- **DIAGNOSTIC SOFTWARE PROGRAMS** 105
- **COMMUNICATION** 105
- **PROGRAM INFORMATION** 106
- **SERVICE CODES (FAULTS)** 106
- **STATIC TESTS** 107
- **DYNAMIC TESTS** 108
- **OIL CONTROL** 109
- **TIMING VERIFICATION** 109
- **FUEL INJECTOR SERVICING** 110
- **FUEL CONTROL ADJUSTMENT** 110
- **REPORTS** 110
- **SOFTWARE REPLACEMENT** 111
- ***EMM* TRANSFER** 111

***SYSTEMCHECK* ENGINE MONITOR** 111
- **SYSTEM SELF-TEST** 112
- **SERVICE MODE** 112
- **ENGINE RUNNING** 112

DESCRIPTION

The Engine Management Module (*EMM)* is a water-cooled engine controller. It controls numerous outboard systems including alternator output for the 12 V and 55 V circuits. The stator provides the *EMM* with voltage inputs that are essential to alternator output.

This section discusses the functions of the *EMM* and the various internal and external sensors. The process for retrieving service codes stored in the *EMM* during engine operation is also presented. The *EMM* Service Code Chart located at the back of this manual can be used to reference service code information.

EMM Functions

The EMM controls the following processes and functions:

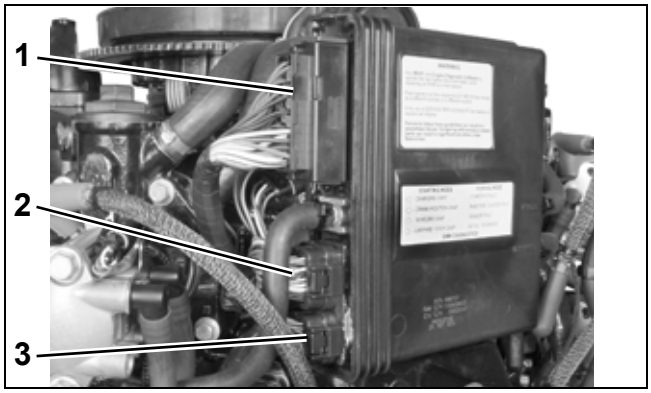
- Fuel and ignition timing and duration
- Ignition system primary voltage output
- Fuel injector activation
- Oil injector pump activation
- Electric fuel pump control
- Alternator output; 55 V and 12 V
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Service codes and warning system activation
- ROM verification, self-test
- Choke-less cold starting
- Output of “real-time” diagnostic data
- Tachometer signal
- RPM profile and engine hours
- Oiling ratios
- Shift interrupt function

EMM Connections

IMPORTANT: *EMM* connections and wiring must be clean and tight. Improper electrical connections can damage the *EMM*. DO NOT attempt to 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.



004197

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

SENSORS AND FUNCTIONS

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

Internal Sensors

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

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

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

Activates *S.A.F.E.*
Stores a service code 25
Initiates *EMM* NO OIL/OVERHEAT LED
Initiates the *SystemCheck* TEMP/HOT light

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

Activates SHUTDOWN
Stores a service code 29
Flashes *EMM* NO OIL/OVERHEAT LED
Flashes *SystemCheck* TEMP/HOT light

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. 103.

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

Stores a service code 24
Initiates *EMM* NO OIL/OVERHEAT LED

Sensor indicates less than -71°F (-57.4°C) or greater than 314°F (156.9°C) a sensor circuit fault is detected and the *EMM*:

Stores a service code 23
Initiates *EMM* NO OIL/OVERHEAT LED

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 a service code 18
Initiates *EMM* CHARGING FAULT LED
Initiates the *SystemCheck* CHECK ENGINE light

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 a service code 17
Initiates *EMM* CHARGING FAULT LED
Initiates the *SystemCheck* CHECK ENGINE light

12 V Circuit Sensor

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

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

Stores a service code 27
Initiates *EMM* CHARGING FAULT LED

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 a service code 26
Initiates *EMM* CHARGING FAULT LED

Barometric Pressure Sensor

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

If the BP sensor is out of the expected range (below 13.3 KPa or above 119.0 KPa), or the sensor or circuit fails, the *EMM:*

Stores a service code 44
Initiates *EMM* SENSOR FAULT (LED 3)

If the BP sensor is below expected range (below 70 KPa), the *EMM:*

Stores a service code 45
Initiates *EMM* SENSOR FAULT (LED 3)

If the BP sensor is above expected range (above 105 KPa), the *EMM:*

Stores a service code 46
Initiates *EMM* SENSOR FAULT (LED 3)

Exhaust Pressure Sensor

Monitors exhaust pressure during all running conditions to compensate for engine loads.

If the exhaust pressure sensor is not in the expected range (**<** 0.12 V or **>** 4.88 V), or the sensor or circuit fails, the *EMM:*

Stores a service code 87
Initiates *EMM* SENSOR FAULT (LED 3)

If the exhaust pressure is below expected range (below 40 in. water), the *EMM:*

Stores a service code 88
Initiates *EMM* SENSOR FAULT (LED 3)

If the exhaust pressure is above expected range (above 80 in. water), the *EMM:*

Stores a service code 89
Initiates *EMM* SENSOR FAULT (LED 3)

External Sensors

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 initiate 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 a service code 47
Initiates *EMM* SENSOR FAULT (LED 3)

Engine Temperature Sensor(s)

Monitor the temperature for each cylinder head. The sensor is a negative temperature coefficient thermistor (NTC). It provides engine temperature information to the *EMM.* The *EMM* uses this information to control engine operation and to activate the overheat warning system.

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

Activates *S.A.F.E.*
Stores a service code 43 (engine temperature above expected range PORT cylinder head)
Initiates *EMM* NO OIL / OVERHEAT (LED 4)
Initiates *SystemCheck* TEMP/HOT light

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

Activates *S.A.F.E.*
Stores a service code 69 (engine temperature above expected range STARBOARD cylinder head)
Initiates *EMM* NO OIL / OVERHEAT (LED 4)
Initiates *SystemCheck* TEMP/HOT light

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

Activates SHUTDOWN
Stores a service code 31
Flashes *EMM* NO OIL / OVERHEAT (LED 4)
Flashes *SystemCheck* TEMP/HOT light

The outboard will not restart, after a temperature related SHUTDOWN, until the engine temperature is BELOW 120°C (returns to normal. Refer to **SHUTDOWN MODE** on p. 103.

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

Stores a service code 41
Initiates *EMM* SENSOR FAULT (LED 3)

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

Stores a service code 42 (engine temperature below expected range)
Initiates *EMM* SENSOR FAULT (LED 3)

If engine does not reach operating temperature on PORT cylinder head (122°F / 50°C below 2300 RPM) in 10 minutes, the *EMM*:

Stores a service code 58 (engine not reaching operating temperature)
Initiates *EMM* SENSOR FAULT (LED 3)

If engine does not reach operating temperature on STARBOARD cylinder head (122°F / 50°C below 2300 RPM) in 10 minutes, the *EMM*:

Stores a service code 59 (engine not reaching operating temperature)
Initiates *EMM* SENSOR FAULT (LED 3)

Oil Pressure Sensor

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

If the sensor fails to indicate pressure in the oil distribution manifold, the *EMM*:

Activates *S.A.F.E.*
Stores a service code 38
Initiates *EMM* NO OIL / OVERHEAT (LED 4)
Initiates the *SystemCheck* NO OIL light

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

Activates SHUTDOWN
Stores a service code 33
Flashes *EMM* NO OIL / OVERHEAT (LED 4)
Flashes *SystemCheck* NO OIL light

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

If the sensor circuit fails to indicate within a specific range or fails, the *EMM*:

Stores a service code 71
Initiates *EMM* SENSOR FAULT (LED 3)

If the sensor circuit indicates below expected range (<.5 V), the *EMM*:

Stores a service code 72
Initiates *EMM* SENSOR FAULT (LED 3)

If the sensor circuit indicates above expected range (> 4.5 V), the *EMM*:

Stores a service code73
Initiates *EMM* SENSOR FAULT (LED 3)

Throttle Position Sensor

The throttle position sensor is a rotary potentiometer 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*.

If the TPS sensor or circuit fails (below 0.15 volts or above 4.95 volts), the *EMM*:

Stores a service code 12
Limits engine RPM to IDLE
Initiates *EMM* SENSOR FAULT (LED 3)
Initiates the *SystemCheck* CHECK ENGINE light

IMPORTANT: Once 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 sensor circuit indicates below 0.2 volts, the *EMM*:

Stores a service code 13
Initiates *EMM* SENSOR FAULT (LED 3)
Initiates the *SystemCheck* CHECK ENGINE light

If the TPS sensor circuit indicates above 4.85 volts, the *EMM*:

Stores a service code 14
Initiates *EMM* SENSOR FAULT (LED 3)
Initiates the *SystemCheck* CHECK ENGINE light

If the TPS sensor circuit indicates above 0.65 volts when the key is turned to the ON position, the *EMM*:

Initiates a service code 11

If the outboard is started, the code is stored.

If code 11 is present as both a Hard Fault and a Stored Fault, refer to **Control Cable Installation** on p. 60.

Crankshaft Position Sensor

The CPS is a magnetic device. It is mounted on the reed plate, adjacent to the flywheel.

Encoder rib spacing on the flywheel coincides with crankshaft position. As the encoder ribs of the flywheel 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 a service code 16
Initiates *EMM* SENSOR FAULT (LED 3)

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

Use the engine *Monitor* screen of the *Evinrude* Diagnostics Software program to check CPS operation. The outboard should indicate an RPM reading while cranking. If the CPS or its circuit fails, no RPM reading will be generated and the outboard cannot run.

Internal Functions

ROM Verification

The *EMM* runs through 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 resolve.

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 engine operation resumes when engine RPM returns to the specified range.

Shift Interrupt

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

The EMM provides voltage to the shift interrupt switch circuit. If the switch or circuit fails, the EMM stores a service code.

Shutdown, Code 57

This feature of *EMM* programming monitors engine operation for abnormally high RPM with a low TPS position. If this condition is detected, the *EMM*:

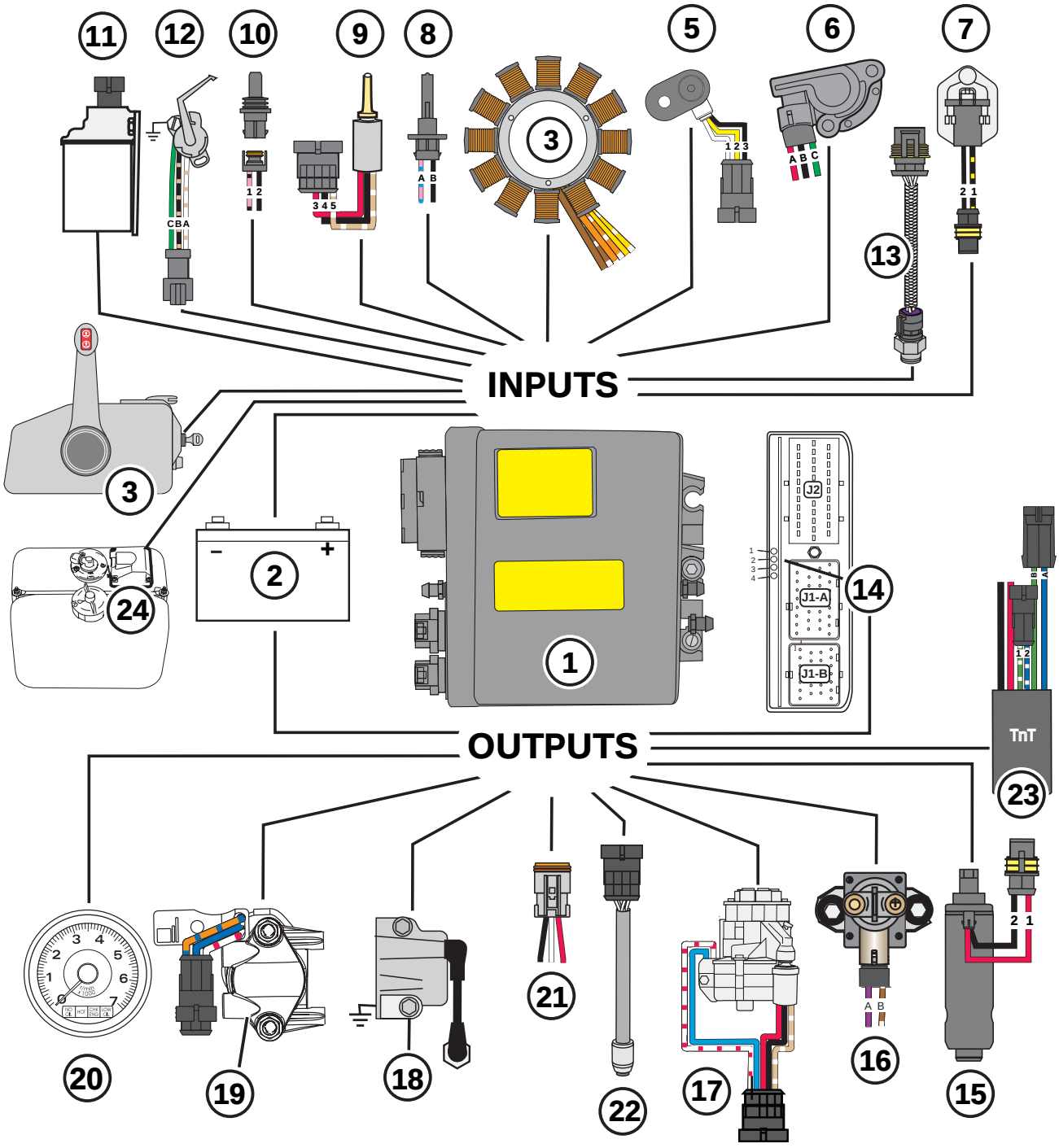
Activates SHUTDOWN
Stores a service code 57
Flashes *EMM* SENSOR FAULT (LED 3)
Flashes *SystemCheck* CHECK ENGINE light

IMPORTANT: The outboard will not restart until the service code is cleared; and the EMM is turned OFF and then ON again. Refer to **SHUTDOWN MODE** on p. 103.

Fault Codes

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

EMM INPUTS AND OUTPUTS DIAGRAM



1. Engine Management Module (*EMM*)
2. Battery (12 volt)
3. Key switch (switched B+, start signal)
4. Stator
5. Crankshaft Position Sensor (CPS)
6. Throttle Position Sensor (TPS)
7. Shift Interrupt Switch
8. Air Temperature Sensor (AT)
9. Oil Pressure Sensor (component of 16)
10. Engine Temperature Sensor(s)
11. Water in Fuel Sensor / Fuel Filter
12. Trim / Tilt Sending Unit
13. Water Pressure Sensor w/adaptor harness
14. LED indicators
15. Fuel Pump (high pressure)
16. Starter Solenoid
17. Oil Injection Pump and Manifold
18. Ignition Coil
19. Fuel Injector
20. Tachometer/*SystemCheck* Gauge
21. Diagnostic Connector
22. CANbus adaptor harness (NMEA 2000®)
23. Trim and Tilt Relay Module
24. Oil Level Switch

S.A.F.E. WARNING SYSTEM

The *EMM* activates *S.A.F.E.* (*Speed Adjusting Failsafe Electronics*) and the dash-mounted *SystemCheck* gauge and horn to alert the operator of abnormal operating conditions and to prevent engine damage that could result from:

- Loss of oil flow
- Engine overheat
- Excessive *EMM* temperature
- Excessive or reduced alternator output
- LOW Oil, sender/switch

Activation

When a sensor or switch provides the *EMM* with a specific fault signal, it responds by interrupting fuel injector and ignition operation. This results in a gradual reduction in engine RPM until the engine speed reaches 1200 RPM. The dash-mounted warning horn sounds and the appropriate *SystemCheck* light turns on. As long as *S.A.F.E.* is activated, the engine will run normally below 1200 RPM. Above 1200 RPM, the engine will vibrate excessively.

Conditions that initiate *S.A.F.E.*

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 38	No oil pressure feedback
Code 43	PORT cylinder head temperature sensor above expected range
Code 69	STARBOARD cylinder head temperature sensor above expected range

Recovery

The engine will operate in *S.A.F.E.* as long as the fault condition exists. To recover from *S.A.F.E.*, two conditions must be satisfied: sensor or switch parameters must be back within limits; and engine RPM must be reduced to idle. The system will immediately recover and engine operation will return to normal.

SHUTDOWN MODE

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

Conditions that initiate shutdown

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

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

⚠ WARNING ⚠

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

IMPORTANT: Shutdown related to code 57 or 33 requires the removal of the stored service code. Use the diagnostic software program to erase a code 57 or 33.

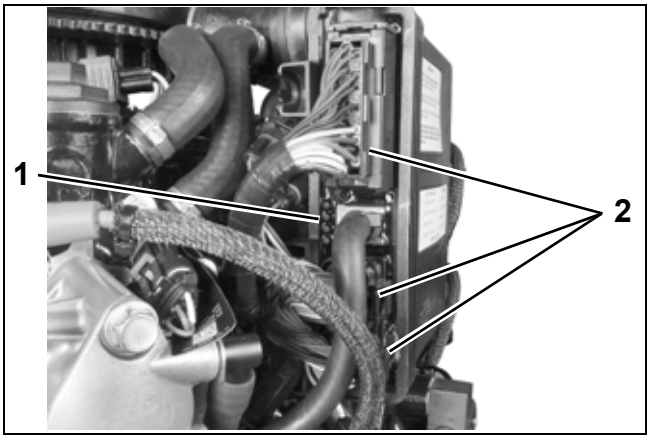
Code 57 occurs when the *EMM* detects abnormally high RPM relative to the TPS position. This condition could be caused by uncontrolled fuel entering the combustion cycle. Before removing the code and STARTING the outboard, seek out and repair the cause.

- Perform **Fuel System Pressure Test** on p. 180. Seek out possible external fuel leakage that could allow fuel and/or vapor to enter the combustion cycle through the air intake (air silencer).
- Seek out possible internal fuel leakage from a leaking injector and/or vapor separator vent hose.

EMM DIAGNOSTICS

LED Indicators

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



1. LED indicators 004198
2. Electrical connectors

Starting Mode

"Starting mode" occurs from *EMM* power ON until outboard is running for 2 seconds.

LED 1 – Stator signal 30 V or higher, "CHARGING OKAY." For NO LIGHT, investigate S.A.C. circuit operation.

LED 2 – Crankshaft position sensor output, *EMM* powered (ON), "CRANK POSITION OKAY." For NO LIGHT, investigate possible fault code 16.

LED 3 – Sensor circuits (5 V), "SENSORS OKAY." For NO LIGHT, investigate possible fault codes: 12, 13, 24, 16, 41, 42, 44, 45, 46, 47, 48, 49, 67, 68, 69.

For FLASHING LIGHT ON, investigate code 57 (High RPM with low TPS setting)

LED 4 – Lanyard/Stop circuit not grounded, "LANYARD/STOP OKAY."

For NO LIGHT, repair grounded stop circuit.

For FLASHING LIGHT ON, investigate possible fault code 29 (engine shutdown, *EMM* overheat), code 31 (engine shutdown, engine overheat) or code 33 (engine shutdown, excessive no oil condition).

Running Mode

LED 1 – Low charging output, "CHARGING FAULT." For LIGHT ON, investigate possible fault codes:

- Code 17 – system voltage (55 V) below range
- Code 18 – system voltage (55 V) above range
- Code 26 – low battery (12 V) voltage
- Code 27 – high battery (12 V) voltage
- Code 77 – S.A.C. overcurrent fault

LED 2 – Damaged injector circuit, ignition primary circuit, or fuel pump circuit, "INJECTOR/IGNITION FAULT." For LIGHT ON, investigate possible fault codes:

- Code 51 – cylinder no. 1 injector circuit open
- Code 52 – cylinder no. 2 injector circuit open
- Code 53 – cylinder no. 3 injector circuit open
- Code 54 – cylinder no. 4 injector circuit open
- Code 55 – cylinder no. 5 injector circuit open
- Code 56 – cylinder no. 6 injector circuit open
- Code 61 – cylinder no. 1 injector circuit short
- Code 62 – cylinder no. 2 injector circuit short
- Code 63 – cylinder no. 3 injector circuit short
- Code 64 – cylinder no. 4 injector circuit short
- Code 65 – cylinder no. 5 injector circuit short
- Code 66 – cylinder no. 6 injector circuit short
- Code 81 – no. 1 ignition primary circuit open
- Code 82 – no. 2 ignition primary circuit open
- Code 83 – no. 3 ignition primary circuit open
- Code 84 – no. 4 ignition primary circuit open
- Code 85 – no. 5 ignition primary circuit open
- Code 86 – no. 6 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, investigate 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 28 – shift switch malfunction
- Code 41 – PORT temp. sensor circuit fault
- Code 42 – PORT temp. below expected range
- Code 44 – BP sensor circuit fault

- Code 45 – BP below expected range
- Code 46 – BP above expected range
- Code 47 – AT sensor circuit fault
- Code 48 – AT sensor below expected range
- Code 49 – AT sensor above expected range
- Code 57 – High RPM with low TPS setting
- Code 58 – PORT operating temp. not reached
- Code 59 – STBD operating temp. not reached
- Code 67 – STBD temp. sensor circuit fault
- Code 68 – STBD temp. below expected range
- Code 71 – oil pressure circuit fault detected
- Code 72 – oil pressure below expected range
- Code 73 – oil pressure above expected range
- Code 74 – water pressure circuit fault detected
- Code 75 – water pressure below range
- Code 76 – water pressure above range
- Code 78 – analog 5V circuit overload detected
- Code 79 – starter solenoid circuit open
- Code 87 – exhaust pressure circuit fault
- Code 88 – exhaust pressure below range
- Code 89 – exhaust pressure above range

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

- Code 23 – *EMM* temperature sensor circuit fault
- Code 24 – *EMM* temp. below expected range
- Code 25 – *EMM* temp. above expected range
- Code 29 – EMM temp. OVER range (flashing)
- Code 31 – engine temp. OVER range (flashing)
- Code 34 – oil injection pump circuit open
- Code 38 – oil pressure feedback not detected
- Code 43 – PORT temp. above expected range
- Code 69 – STBD temp. above expected range

Diagnostic Software Programs

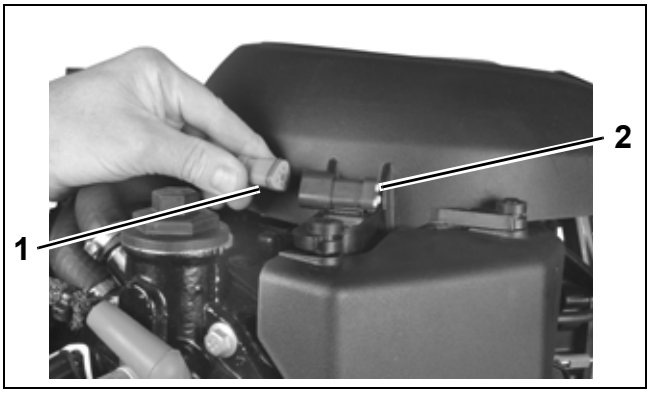
The *EMM* stores valuable information about the outboard and its running history. This information can be used for troubleshooting and for checking outboard parts information. Program information is accessed through Diagnostic Software running on a laptop computer connected to the outboard.

Personal Computer (PC) based software (*Windows*)	*Evinrude Diagnostics Software*, P/N 763724

IMPORTANT: For software help, refer to “Help Info” in the Evinrude Diagnostics software.

Communication

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



1. Diagnostic connector 005021
2. Cover

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

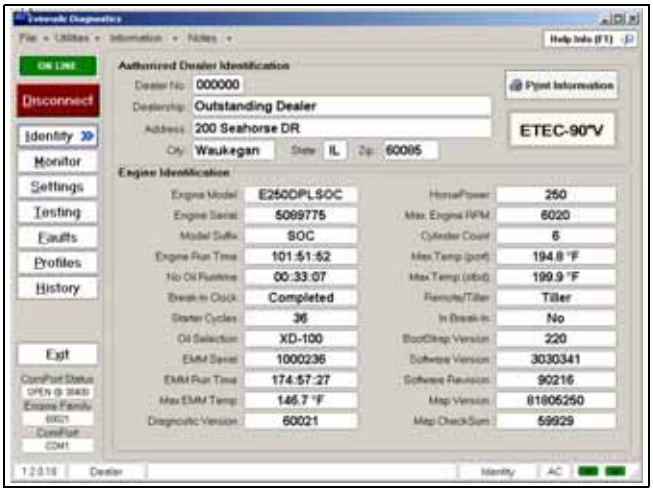
The *EMM* must turn ON before it will communicate with any outside device. Power is normally supplied to the *EMM* when the key switch is ON. Switched B+ (12 V) is supplied to the engine wire harness. Current enters the *EMM* at pin 21 (purple) of the *EMM* J1-B connector. Pin 9 (black) of the *EMM* J1-B connector provides ground to the *EMM*.

Program Information

Static Information

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

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



Identity Screen 005144

The serial number and cylinder location displayed on the *Injector Coefficients* screen must indicate the correct cylinder placement for all injectors.



Injector Coefficients Screen 005142

Dynamic Information

Refers to specific information viewed while the outboard is running. Dynamic information updates quickly and allows the viewer to monitor voltage changes. The displayed information can be used for troubleshooting and checking outboard information.



Engine Monitor Screen 005141

Service Codes (Faults)

Service codes are fault conditions the *EMM* has identified. A service code may be stored as a result of some unidentified problem or condition. If no codes are displayed, the engine has no stored service codes.

Stored Faults

A stored service code represents a previous event or condition. Service codes are stored if they occur while the outboard is running.

The *Stored Faults* screen of the diagnostic program shows the code number, the number of

times the event occurred, operating hours of first and last occurrence.



Stored Faults Review Screen 005143

Hard Faults

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



Hard Faults Review Screen 005145

Persistent Faults

The *Persistent Faults* screen provides 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 perform diagnostic testing of specified components.



Static Tests Screen 005146

Ignition Test

Use the diagnostic software to test each ignition circuit. Refer to **Static Spark Test** on p. 128.

Check each ignition circuit for continuity between the *EMM* and individual coil. Check the resistance of the ignition coil windings. Refer to **IGNITION COIL TESTS** on p. 140.

Fuel Test

Use the diagnostic software to test each fuel injector. The injector should make an audible click. Make sure the injector being monitored is wired correctly. If the injector activates, the *EMM* and injector circuits are not at fault. If the fuel injector(s) will not fire during the diagnostic tests, check the continuity of the injector circuit. Refer to Fuel Injector **Resistance Test** on p. 180.

Oil Injector

Use the diagnostic software to test the oil injection pump. Make sure the pump is wired correctly. If the pump activates, the *EMM* and oil injection circuit are not at fault. If the oil injection pump does not run during the static test, check voltage and continuity of pump circuit. Refer to **Oil Injection Pump Circuit Resistance Test** on p. 209. The resistance of the oil injection pump winding is approximately 22 Ω.

Fuel Pump

Use the diagnostic software to test the fuel pump. Make sure the pump is wired correctly. If the pump activates, the *EMM* and fuel pump circuit are not at fault. If the pump does not run during the static test, check voltage and continuity of pump circuit. Refer to **Circulation Pump Resistance Test** on p. 182. Fuel pump resistance is approximately 2 to 3 Ω.

Overheat

This test is used to simulate an overheat situation and is used to check the “ENG TEMP” or “HOT” circuit of the *SystemCheck* gauge.

Check Engine

This test is used to check the “CHECK ENGINE” circuit of the *SystemCheck* gauge.

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 005147

Fuel Test

The Fuel Test is performed with the outboard running (600 RPM minimum). This test momentarily disables one fuel injector circuit. By dropping one cylinder, RPM and running quality changes can be observed. Refer to the diagnostic software **User’s Guide** and **Dynamic Tests** on p. 120.

Ignition Test

The Ignition Test is performed with the outboard running (600 RPM minimum). This test momentarily disables the ignition circuit and fuel injection circuit to one cylinder. By dropping one cylinder, RPM and running quality changes can be observed. Refer to the diagnostic software **User’s Guide** and **Dynamic Tests** on p. 120.

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

Oil Injection Ratio (Used with *XD100* oil only)

Evinrude E-TEC outboards can be programmed to run a reduced oiling rate. This feature should **only** be used with *Evinrude/Johnson XD100* oil.



1. Oil control setting 005140

⚠ 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 diagnostic software to initiate break-in oiling. Break-in is a predetermined oiling program that runs for two hours of outboard operation, above 2000 RPM.



1. Break-in oil setting 005140

IMPORTANT: Initiate *Break-in* programming for rebuilt powerheads.

Timing Verification

Use the *Ignition Timing* screen of the diagnostic software to check and adjust *EMM* timing. *EMM* timing must be synchronized to crankshaft position. Refer to **TIMING ADJUSTMENTS** on p. 154.



005148

Perform timing verification after any of the following procedures:

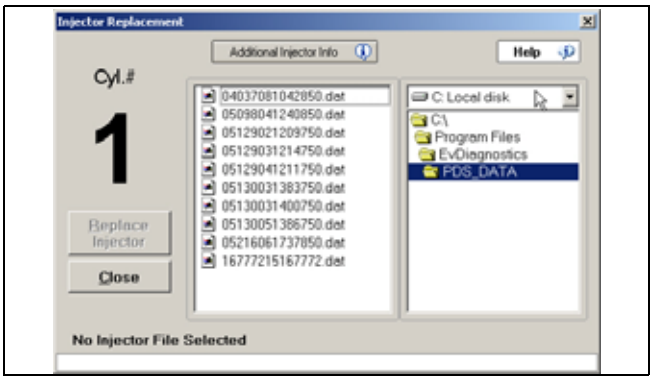
- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- *EMM* replacement
- *EMM* software replacement

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

Fuel Injector Servicing

All fuel injectors are “compensated” and require software programming. 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 **Installation** on p. 189.



005157

Fuel Control Adjustment

The purpose of this feature is to help troubleshoot cylinder combustion. The *Evinrude* Diagnostics Software program allows temporary adjustments to the fuel flow characteristics of the injectors. This feature should not be used by itself to identify a faulty injector. Adjustment can be made before the outboard is started or while it is running. Factory fuel flow settings are restored when the key switch is returned to the OFF position.



005150

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.

Clicking the print button in several windows of the diagnostic software allows the user to print engine data, or to export the information to a variety of computer file types.



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

005158



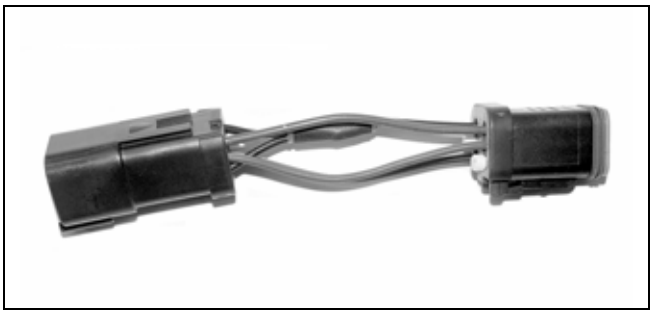
Engine Report data files

005159

Software Replacement

Software programs or “maps” are downloaded into the *EMM* prior to factory testing of the outboard. Periodically, a new map may be available to enhance the operation of an outboard. Refer to the installation instructions provided with the program.

IMPORTANT: Software replacement requires the use of “Bootstrap” Tool, P/N 586551.



002383

EMM Transfer

EMM Transfer is a feature that allows *EMM* replacement. Use the diagnostic software program and follow the “help info” instructions provided in the program.

IMPORTANT: Whenever the *EMM* is replaced, timing verification must be performed. Refer to **Timing Verification** on p. 155.



006310

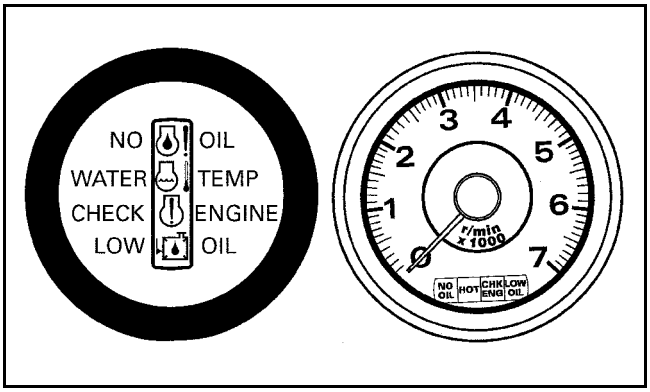
SystemCheck ENGINE MONITOR

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

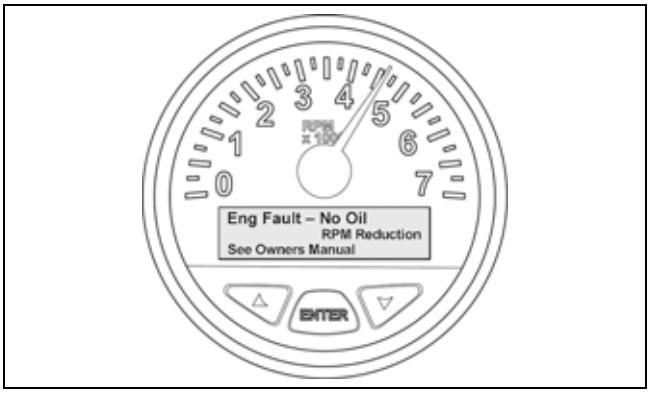
The system is compatible with the *Evinrude* Modular Wiring System (MWS), *I-Command* system, or other *NMEA 2000* compliant CANbus instruments.

Gauges

Gauges are available in several styles, from a basic gauge with four LEDs to a CANbus gauge with LCD readout.



Typical MWS *SystemCheck* gauges 005329



Typical *I-Command* gauge 005330

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

- NO OIL indicates an oil delivery problem such as an empty oil tank or damaged oil system components.
- WATER TEMP or HOT indicates an engine or *EMM* overheat condition.
- CHECK ENGINE is used to indicate numerous fault conditions identified by *EMM*.

Refer to the ***EMM* Service Code Chart** located at the back of this manual for a detailed list of service codes related to *SystemCheck* activation.

The oil tank sending unit activates the warning horn and the LOW OIL light of the gauge.

- LOW OIL indicates the oil level in the oil tank is down to the reserve level (about 1/4 full).

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. MWS 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.

Engine Running

All warning light circuits are active when the engine is running. A microprocessor in the gauge monitors the tach circuit and activates the horn circuit when engine speed exceeds 500 RPM. The gauge will continue monitoring until the engine stops.

SystemCheck warnings activate the horn for 10 seconds and the appropriate gauge light for a minimum of 30 seconds. If the failure is momentary (*e.g.*, 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.

SYSTEM ANALYSIS

TABLE OF CONTENTS

ELECTRICAL CONNECTIONS 114
GROUND CIRCUITS 116
FUSE 116
EMM DIAGNOSTICS 117
- LED INDICATORS 117
- SOFTWARE PROGRAMS 117

DIAGNOSTIC PROCEDURES 118
- SYMPTOMS 119

SPECIALIZED TEST PROCEDURES 120
- DYNAMIC TESTS 120
- TESTING WITH TIMING LIGHT 120
- INDUCTIVE AMP METER TEST 121
- ENGINE MONITORING INFORMATION 121
- VOLTAGE TESTING 122

START CIRCUIT 122
- ELECTRIC STARTER OPERATION 122
- STARTER SOLENOID ACTIVATION 123
- START CIRCUIT DIAGRAM 125

IGNITION AND ELECTRICAL CIRCUITS 126
- STOP CIRCUIT 126
- BATTERY 126
- STATOR OUTPUT VOLTAGE 126
- *EMM* 126
- CRANKSHAFT POSITION SENSOR 126
- ALTERNATOR OUTPUT/SYSTEM VOLTAGE 126
- CAPACITOR 126
- IGNITION PRIMARY VOLTAGE 126
- IGNITION COIL 126

IGNITION OUTPUT 127
- WIRING INSPECTION 127
- IGNITION VOLTAGE 127
- SYSTEM VOLTAGE 128
- STATIC SPARK TEST 128
- RUNNING IGNITION TESTS 129
- IGNITION PRIMARY CIRCUIT RESISTANCE TEST 130
- CRANKSHAFT POSITION SENSOR (CPS) TEST 130

FUEL DELIVERY 131
- MANIFOLD PRESSURE TEST 131
- VAPOR SEPARATOR CHECKS 132
- FUEL DELIVERY TO LIFT PUMP 132

FUEL INJECTOR OPERATION 132
- STATIC TESTS 132
- DYNAMIC TESTS 133

NOTES 134

ELECTRICAL 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 to identify specific wiring details.

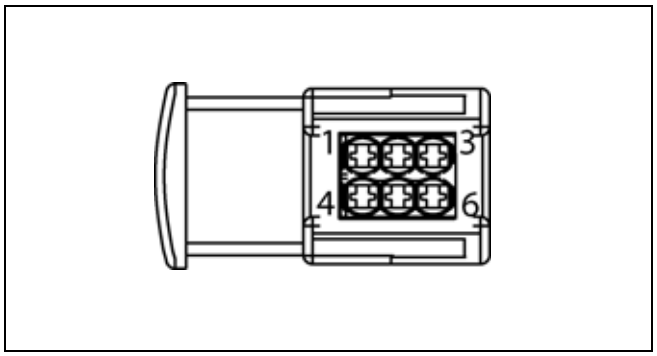
IMPORTANT: The key to effective troubleshooting is confirming the proper operation of each engine system. Causes of electrical failures may be difficult to isolate. Check the integrity of all connections, grounds, and wiring prior to replacing a suspect component.

Inspect the condition and positioning of the following components:

- Engine Management Module (*EMM*): wiring to *EMM* connectors and pins
- Stator: connections to *EMM*, wiring to connectors, and connector pins
- Engine wiring harness and connectors

Refer to **AMP Connectors** on p. 165 for *AMP* connector servicing procedures.

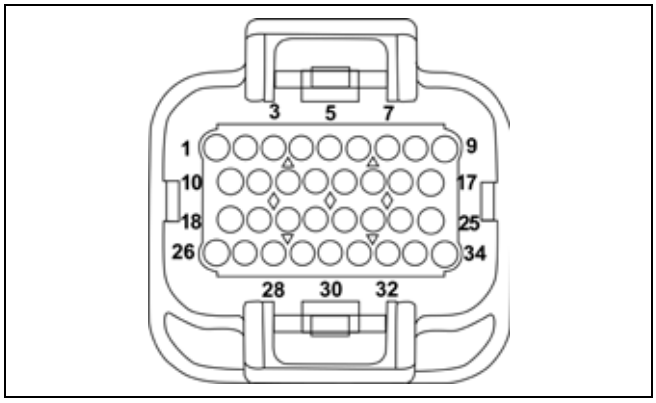
Engine Harness to Stator Connector



004050

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

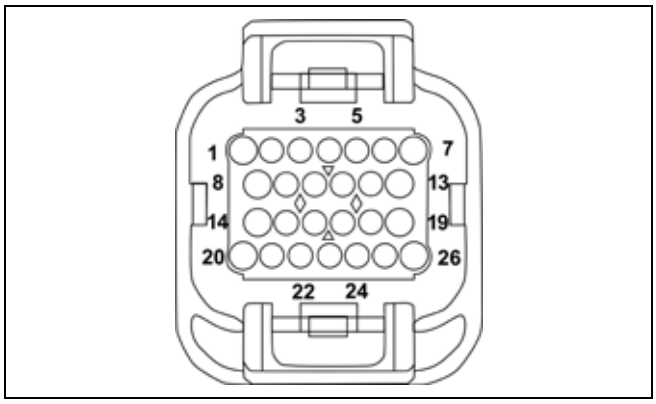
EMM J1-A Connector



001875

Pin No.	Description of Circuit	Wire Color
1	Oil Pressure switch	Tan/White
2	Diagnostic connector	Red
3	Diagnostic connector	White
4	Ground, water in fuel (digital)	Black
5	Oil level, switch	Tan/Black
6	Crankshaft position sensor (CPS)	Yellow
7	Ground, CPS (digital)	White
8	Bootstrap connector (programming)	Blk/Orange
9	Stop circuit	Blk/Yellow
10	Throttle position sensor (TPS) 5 V	Red
11	Ground (analog)	Black
12	Engine temperature sensor, port	Pink/Black
13	CANbus, NET-L	Blue
14	CANbus, NET-H	White
15	Water pressure	Pink
16	Tachometer	Gray
17	CHECK ENGINE signal, *SystemCheck*	Tan/Orange
18	TPS	Green
19	Engine temperature sensor, starboard	Pink/Black
20	Air temperature sensor	Pink/Blue
21	CANbus, NET-S	Red
22	CANbus, NET-C	Black
23	Water in fuel	Pink/Green
24	NO OIL signal, *SystemCheck*	Tan/Yellow
25	WATER TEMP signal, *SystemCheck*	Tan
26	Start signal	Yellow/Red
27	none	N/A
28	none	N/A
29	Shift switch (shift linkage)	Black/Yellow
30	Trim relay, UP	Blue/White
31	Trim relay, DOWN	Green/White
32	Trim sender, IN	White/Tan
33	Trim sender, OUT	White/Tan
34	LOW OIL signal, *SystemCheck*	Tan/Black

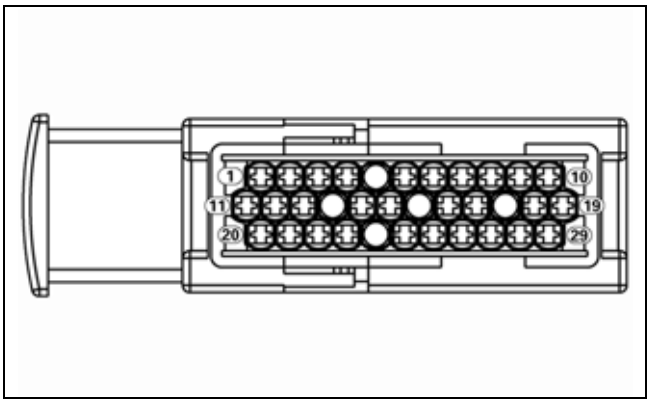
EMM J1-B Connector



001876

Pin No.	Description of Circuit	Wire Color
1	Injector, cylinder 1	Blue
2	Injector, cylinder 2	Blue
3	Injector, cylinder 3	Purple
4	+55 V, in, ignition power	White/Red
5	Fuel pump	Purple/black
6	Ignition, cylinder 4	Orange/Purple
7	Ignition, cylinder 3	Orange/Purple
8	Injector, cylinder 6	Green
9	Injector ground	Black
10	Injector ground	Black
11	Starter solenoid OUT	Brown/White
12	none	N/A
13	Ignition, cylinder 5	Orange/Green
14	Injector, cylinder 5	Green
15	Injector ground	Black
16	Injector ground	Black
17	Ignition ground	Black
18	Ignition ground	Black
19	Ignition, cylinder 2	Orange/Blue
20	Injector, cylinder 4	Purple
21	Switched B+ (12V)	Purple
22	Injector ground	Black
23	Oil solenoid	Blue
24	Ignition ground	Black
25	Ignition, cylinder 6	Orange/Green
26	Ignition, cylinder 1	Orange/Blue

EMM J2 Connector



004046

Pin No.	Description of Circuit	Wire Color
1	B+	Red
2	none	N/A
3	Isolated B+	Red/Black
4	Battery ground	Black
5	Battery ground	Black
6	none	N/A
7	Winding 1S	Yellow
8	Winding 2S	Brown
9	Injector, generator ground	Black
10	Winding 3S	Orange
11	B+	Red
12	B+	Red
13	Isolated B+	Red/Black
14	Battery ground	Black
15	Battery ground	Black
16	Battery ground	Black
17	Winding 1F	Yellow/White
18	Winding 3F	Orange/White
19	+55V	White/Red
20	B+	Red
21	Isolated B+	Red/Black
22	Isolated B+	Red/Black
23	Battery ground	Black
24	Battery ground	Black
25	Battery ground	Black
26	none	N/A
27	Injector, generator ground	Black
28	Winding 2F	Brown/White
29	+55V	White/Red

GROUND CIRCUITS

All ground circuits are essential to optimum outboard performance. Make certain all ground connections are clean and tight. Refer to wiring diagrams to identify specific wiring details.

Test Procedure

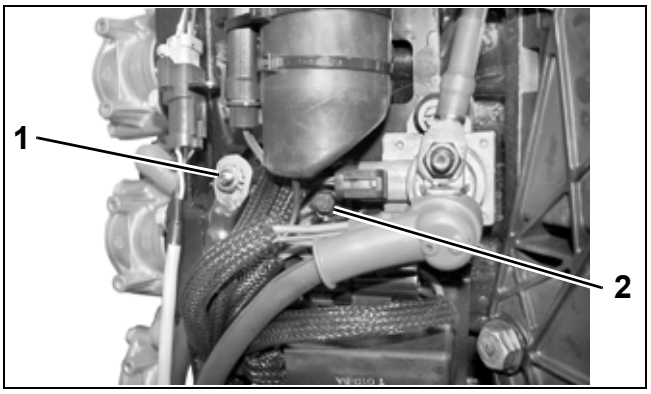
Disconnect the battery cables at the battery.

Use an ohmmeter to check grounds at the appropriate pin locations of the *EMM*. Calibrate the ohmmeter on the “high” ohms scale.

Connect the ohmmeter red lead to the ground wire and the black meter lead main harness ground. Resistance readings for all ground circuits should be 0 Ω.

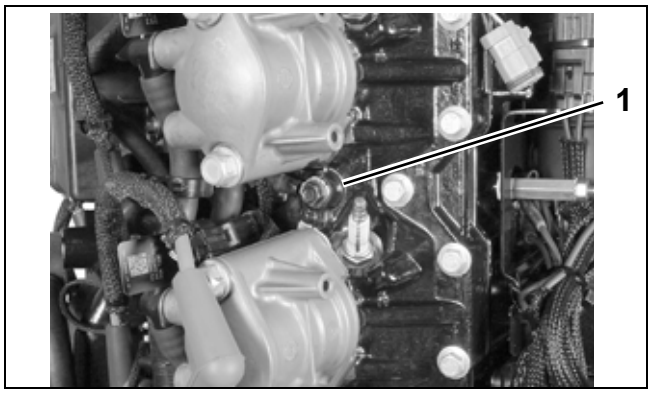
Main engine harness grounds to:

- Injector circuits: check continuity to terminal pins 9 and 27 of the *EMM* J2 connector and to terminal pins 9, 10, 15, 16 and 22 of the *EMM* J1-B connector.
- Ignition circuit: check continuity to terminal pin 17, 18, 24 of the *EMM* J1-B connector.
- Power supply / battery: check continuity to terminal pins 4, 5, 14, 15, 16, 23, 24 and 25 of *EMM* J2 connector.
- Trim and Tilt module: check connection at main ground terminal.



1. Ground stud (battery) 004183
2. Main engine harness ground

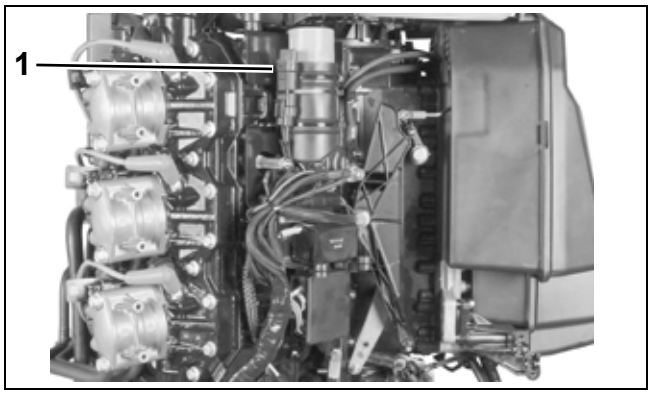
- Ignition (pins 17, 18 and 24 of the EMM J1-B connector), injector and *EMM* battery grounds on port and starboard cylinder head ground screws.



1. Ground, starboard cylinder head 004204

FUSE

The engine harness 12 V (B+) circuit is protected by one automotive style 10 amp minifuse. The fuse is positioned on the starboard side of powerhead, and fastened to the capacitor.



1. Fuse 004080

EMM DIAGNOSTICS

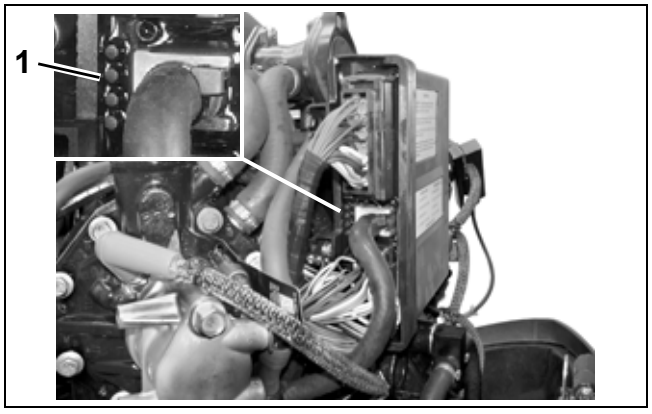
Access *EMM* information using the *EMM*'s LED indicators and the diagnostic program.

EMM turned ON is verified through LED display or communication with diagnostic software.

To access *EMM* information using the diagnostic software, connect interface cable to diagnostic plug and turn key switch ON. Battery cables and battery must be connected to supply power to *EMM*.

LED Indicators

Activation of LED indicators on the *EMM* correspond to specific *EMM* circuits.



1. LED indicators 004197
004198

IMPORTANT: LED 1 is top (HIGHEST) LED and LED 4 is bottom (LOWEST) LED.

Starting Mode

Light ON indicates system is functioning properly.

- LED 1 – Light ON, Stator signal 30 V or higher, "CHARGING OKAY"
- LED 2 – Light ON, CPS output, "CRANK POSITION OKAY"
- LED 3 – Light ON, Sensor/5 V circuits, "SENSORS OKAY"
- LED 4 – Light ON, Lanyard/Stop circuit not grounded, "LANYARD/STOP OKAY"

Refer to **EMM DIAGNOSTICS** on p. 104 for additional diagnostic information.

Running Mode

Light ON indicates system is MALFUNCTIONING.

- LED 1 – Light ON, charging output malfunction 12 V or 55 V circuit; or SAC overcurrent "CHARGING FAULT"
- LED 2 – Light ON, Injector or ignition circuit malfunction, "INJECTOR/IGNITION FAULT"
- LED 3 – Light ON, Sensor/5 V circuits, "SENSOR FAULT"
- LED 4 – Light ON, "NO OIL/OVERHEAT FAULT"

Refer to **EMM DIAGNOSTICS** on p. 104 for additional diagnostic information.

Software Programs

The *Evinrude* Diagnostics Software program can be used to communicate with the *EMM*. Communication also requires a 12 V supply to power up the *EMM*.

Refer to **EMM DIAGNOSTICS** on p. 104 for additional diagnostic information. Identify and resolve all problems related to *Stored Faults/Codes*. Note all *Stored Faults/Codes* prior to clearing the codes.



Stored Faults Review Screen 005143

DIAGNOSTIC PROCEDURES

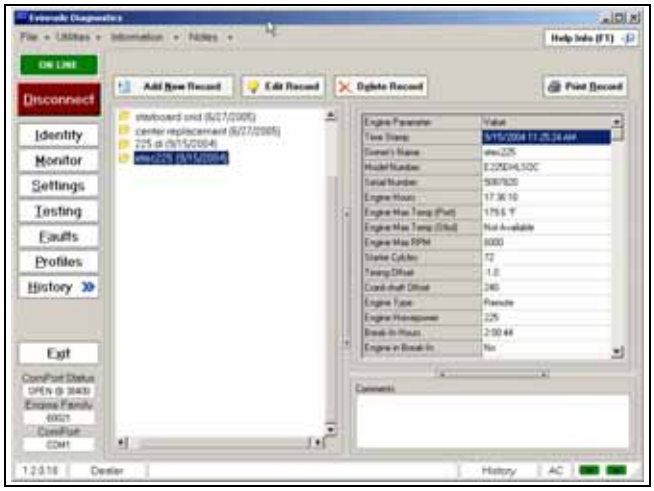
The key to effective troubleshooting is confirming the proper operation of each engine system. Causes of electrical failures may be difficult to isolate. Check the integrity of all connections, grounds, and wiring prior to replacing a suspect component. Refer to **GROUND CIRCUITS** on p. 116.

Observe and run the outboard prior to performing any unnecessary procedures. Initial inspection should include the following:

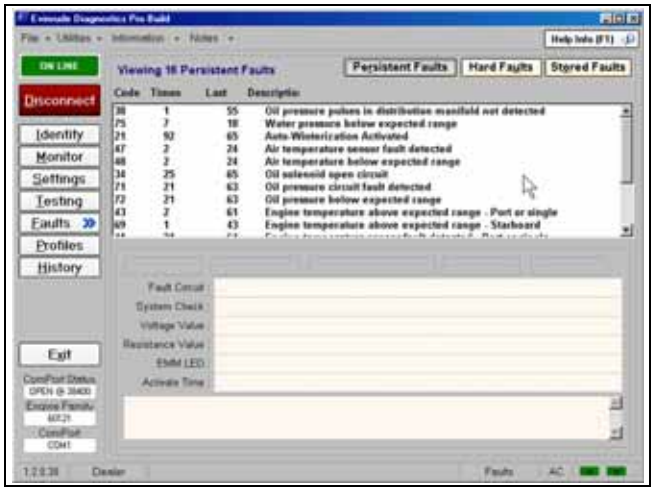
- Observe the outboard and confirm the actual symptoms. Refer to **TROUBLE CHECK CHART** at the end of this manual.
- Inspect spark plugs for indication of wear, oil fowling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.
- Make sure the outboard can be turned over easily. There should not be any mechanical binding.
- Check the *Evinrude* Diagnostics Software program *Profiles* screen, *History* screen, and *Persistent Faults* screen for evidence of prior abnormal operation. Refer to **Diagnostic Software Programs** on p. 105.



Profiles Screen 005153



History Screen 005152



Persistent Faults Screen 005400

Symptoms

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 B+ is present at “A” terminal (purple wire) of starter solenoid with key switch in the ON position.
- Proceed to **START CIRCUIT** on p. 122. Repair starter or start circuit as needed.

Outboard cranks, will not start:

- Use LED indicators of *EMM* for initial diagnostic information.
- Perform a spark test using the *Evinrude* Diagnostics Software program. Refer to **IGNITION OUTPUT** on p. 127.

Results:

Steady spark on all cylinders and proper ignition voltage:

- Check operation of all fuel injectors. Refer to **FUEL COMPONENT TESTS** on p. 179.
- Check fuel quality and that fuel is present at injectors.
- Refer to **FUEL COMPONENT TESTS** on p. 179 for fuel system pressure tests.

No spark on one or more cylinders:

- Note cylinder with no ignition output. Refer to **IGNITION OUTPUT** on p. 127.
- Monitor cranking RPM using the diagnostic program (approximately 175 RPM, minimum 75 RPM).
- Check CPS operation (verify RPM reading.)
- Perform ignition circuit resistance test(s). Refer to **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 140.

Outboard runs:

- Use *Evinrude* Diagnostics Software program to perform *Dynamic Tests*. See **Dynamic Tests** on p. 133.
- Use the *Monitor* screen of the *Evinrude* Diagnostics Software program to observe circuit voltages. Refer to **Engine Monitoring Information** on p. 121.
- Use the diagnostic software *Logging* function to record engine data as a runability problem is occurring.



Logging Screen 005154

- Use an inductive timing light to monitor the injector circuits and ignition primary circuits. Refer to **Testing with Timing Light** on p. 120, **IGNITION OUTPUT** on p. 127, **FUEL DELIVERY** on p. 131 and **FUEL COMPONENT TESTS** on p. 179.
- Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.

SPECIALIZED TEST PROCEDURES

⚠ 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.

The following tests are performed with the outboard running. Observe the operation of each electrical circuit. Look for inconsistencies between similar circuits and variations in cylinder performance.

Dynamic Tests

Use the diagnostic program to perform Dynamic Fuel and Ignition tests. These tests can be used to momentarily stop injector or ignition function for a selected cylinder while the outboard is running. This is an effective tool for checking the performance of each cylinder. Comparing one cylinder's performance to others can frequently isolate a cylinder that is not operating properly.

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

Dynamic Tests can be used in conjunction 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 005147

IMPORTANT: Test the outboard while the runability issue is present. Use the test procedures to identify inconsistencies in voltages and cylinder performance. Once a circuit has been identified as malfunctioning, a thorough inspection of all related wiring and connections must be performed. Check all voltage inputs and grounds; and perform resistance tests for all circuits prior to replacing any suspect components.

Testing with Timing Light

⚠ WARNING ⚠

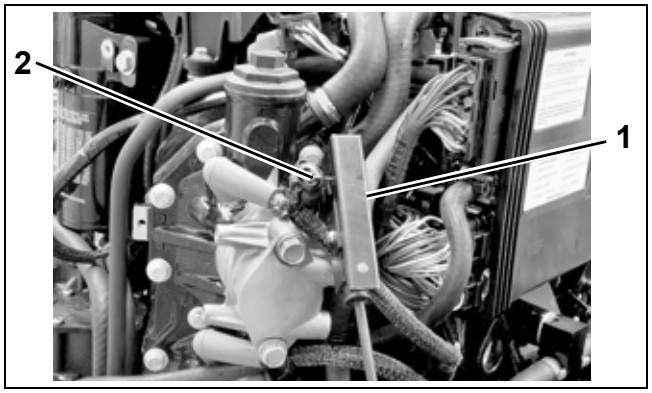
The electrical system presents a serious shock hazard. DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.

An inductive timing light can be used to monitor ignition system output and the activation of fuel injectors and the oil injection pump. DO NOT clamp timing light pick-up on more than one wire at a time. Avoid erratic timing light reading by isolating pick-up from other wires. Self powered timing lights offer the convenience of no power cables and can help eliminate false signals.

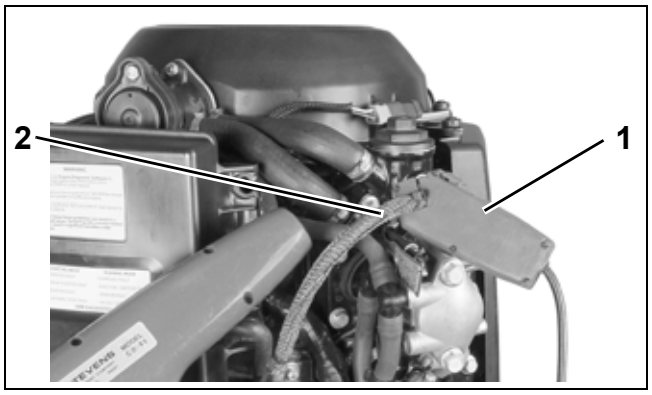
Ignition System Output

Use the timing light to monitor each ignition circuit for a consistent flash. Run outboard and observe strobe of the light. Connect the timing light pick-up to the ignition coil secondary, high tension wire and then the primary wire. The strobe should indicate one flash per revolution. Intermittent output or multiple flashes per revolution indicate improper ignition control.

Test ignition system grounds, primary circuit resistance, coil resistances and *EMM* ignition voltage prior to replacing any components.



1. *Timing light pick-up* 004327
2. *Ignition coil primary wire*



1. *Timing light pick-up* 004255
2. *Secondary, high tension wire*

Fuel Injector/Oil Injection Pump Activation

Use the timing light to monitor each fuel injector or the oil injection pump lead. The strobe of the light indicates current in the circuit.

Test all grounds, circuit resistance(s), and circuit voltages prior to replacing *EMM* for faulty injector or pump control function.

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.

Engine Monitoring Information

Use the *Evinrude* Diagnostics Software program to access the engine *Monitor* screen. This screen display provides engine information as it is occurring. Circuits are monitored for actual voltages or the condition of the circuit. Switch and sensor circuits, battery voltage (12 V), system voltage (55 V), and ignition voltage (200 V) are continuously monitored.



Engine Monitor Screen 005141

IMPORTANT: The engine *Monitor* screen of the diagnostics program does not offer voltage information for all circuits.

Voltage Testing

Use the engine *Monitor* screen of the *Evinrude* Diagnostics Software program or a digital multimeter to check voltages. Identify all wiring and circuits prior to performing any voltage tests. Refer to Wiring Diagrams and descriptions of the various systems for specific information on each circuit.

Identify erratic or lower than expected voltage readings. Determine if the voltage source or the wiring and connections of the circuit are the problem.

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

Battery Circuits (12 V)

Battery and auxiliary battery voltage is displayed on the engine *Monitor* screen of the diagnostic software. Each of these circuits are supplied approximately 25 A of battery charging current as needed and voltage is limited to approximately 14.5 V when outboard is running.

System Circuits (55 V)

55 V circuits are supplied 30 V when the key switch is ON, the *EMM* is powered up, and the outboard is not running and 55 V when outboard is running.

Stator output supplies the rectifier circuits of *EMM* with approximately 40 VAC when outboard is cranking and approximately 55 VAC when outboard is running.

Ignition System Circuits

Ignition voltage displayed on the engine *Monitor* screen of the diagnostic software will have approximately 125 ± 10 V when the key switch is ON, the *EMM* is powered up, and the outboard is not running and 200 ± 10 V when outboard is running. Cranking voltage is approximately 200 V.

START CIRCUIT

The start circuit provides the required current to the starter motor and associated electrical circuits.

Electric Starter Operation

The starter must engage and turn the flywheel. A cranking speed of approximately 100 RPM must be achieved for the outboard to start. Normal cranking speed is approximately 175 RPM.

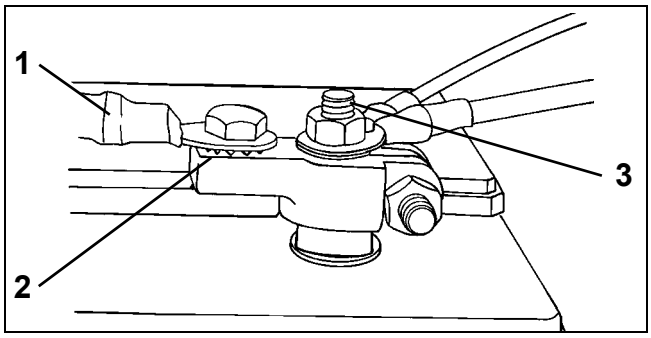
Optimum starter performance is achieved by providing:

- Proper battery capacity (675CCA). Refer **TECHNICAL DATA** on p. 18 for battery recommendations
- Cables capable of transferring the amperage
- Low resistance battery and cable connections
- A solenoid capable of switching the current

These “high amperage” start circuit components provide the battery current required to crank and start the outboard (electric start models). Check the quality and condition of the following:

12 V Marine Battery

- Battery type, capacity, and condition
- Condition of battery posts, terminals, and connections
- Battery switch type, capacity, and connections



1. *Main battery cable*
2. *Star washer*
3. *Battery post*

DR6495

Refer to **Battery Installation** on p. 36 for battery, terminal, and cable requirements.

Starter Solenoid
- Starter solenoid and connections
- Starter solenoid switched ground (NEG), terminal “B”
- Starter cable (solenoid to starter motor)
- 12 V from solenoid terminal (POS) and engine harness (red wire) to 10 A fuse

Starter Motor and Drive Gear
- Starter motor operation, refer to **ELECTRIC STARTER SERVICING** on p. 156.
- Starter bendix operation.



1. Starter solenoid 004082
2. Starter cable
3. POS battery cable

Starter Solenoid Activation

Solenoid Wiring
The positive (B+) battery cable connects to the large lower 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 at the electrical bracket.

Engine Wire Harness
Contains the following circuits:
- Red/purple output wire from fuse and provides 12 V to instrument harness
- Purple wire provides switched 12 V to solenoid (terminal “A”) and *EMM*
- Yellow/red wire provides switched 12 V to *EMM*
- Brown/white wire from terminal 11 of *EMM* J1-B connector provides switched ground (NEG) to starter solenoid (terminal “B”)

Instrument Wire Harness
Contains the following circuits:
- Red/purple wire provides 12 V to key switch terminal “B”
- Purple wire provides switched 12 V to engine wire harness
- Yellow/red wire from terminal “S” of key switch provides switched 12 V to *EMM* (key switch in START position)

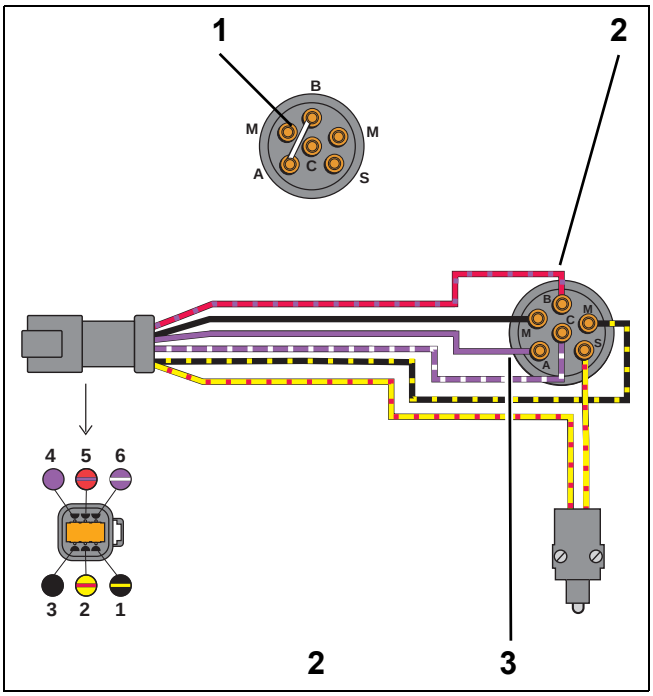
Key Switch
Terminal “B” of key switch receives 12 V input from 10 A fuse.

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 gauges.

Key Switch, ON position

12 V is applied to the “accessory” circuit. Key switch ON:

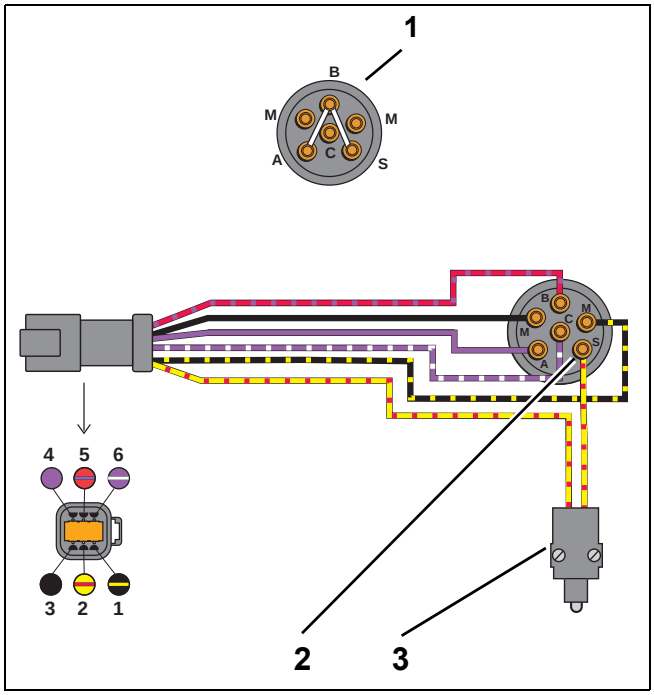
- Switches 12 V to terminal “A” of key switch and to the purple wires of the wire harnesses.
- Provides 12 V input to terminal 21 of J1-B *EMM* connector and terminal “A” of starter solenoid.



1. *Key switch, ON position – Continuity between terminals “B” and “A”* 000691
2. *Terminal “B”, 12 V (Red/purple)*
3. *Terminal “A”, 12 V (Purple)*

Key Switch, START Position

Switches 12 V to terminal “S” of key switch and 12 V is applied to neutral safety switch.



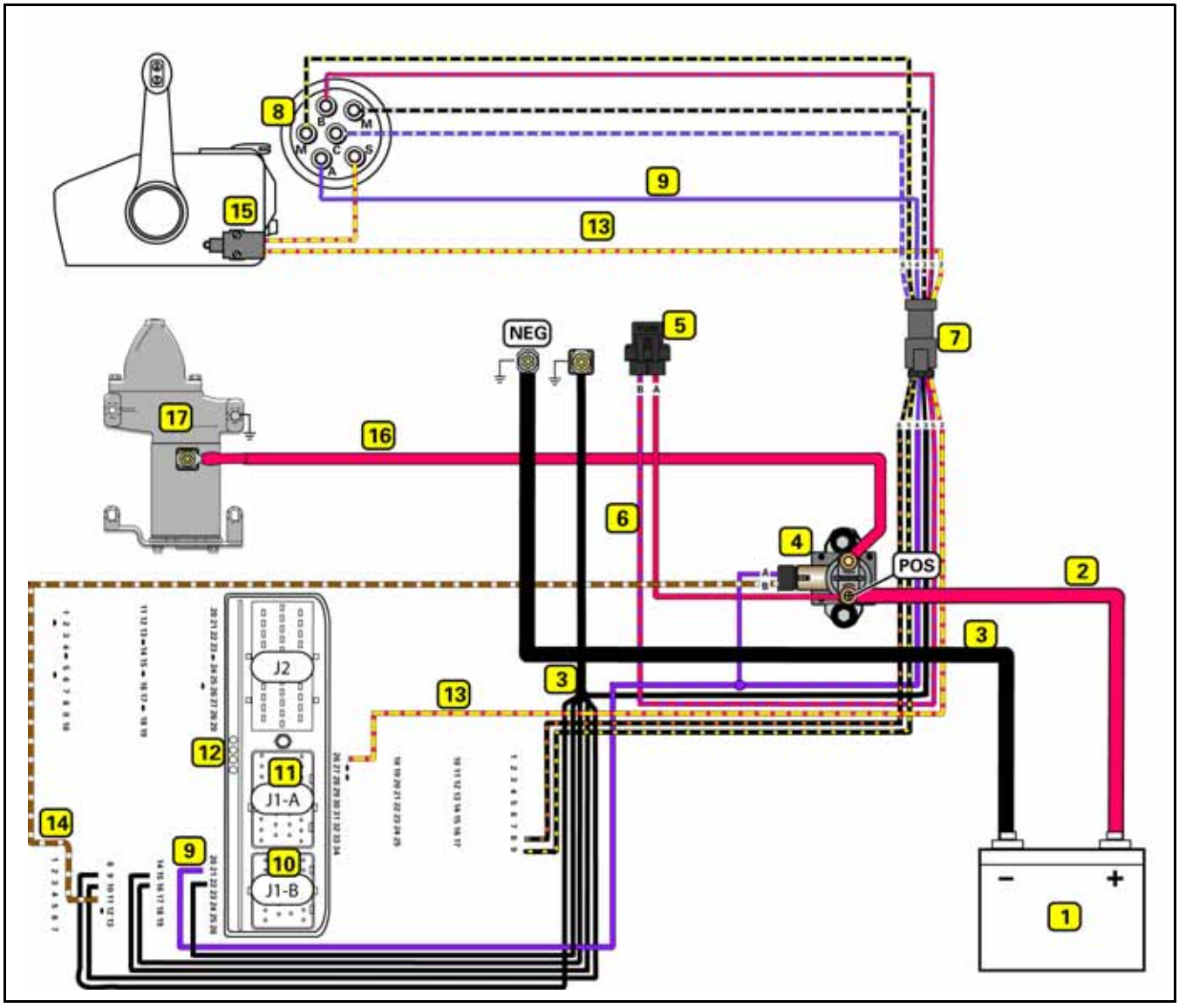
1. *Ignition switch, START position – Continuity between terminals “B” and “A”; “B” and “S”* 000691R
2. *Terminal “S”, 12 V*
3. *Neutral safety switch*

Neutral Safety Switch (Remote Control)

Terminal “S” of the key switch provides 12 V (yellow/red) to the neutral safety switch (key switch in START position).

A depressed or activated neutral safety switch (in remote control) provides 12 V to the engine wire harness yellow/red wire (key switch in START position) and terminal 26 of *EMM* J-1A connector.

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. BROWN/WHITE wire, start signal
15. Neutral Safety Switch (remote control)
16. RED starter motor cable
17. Electric starter motor

IGNITION AND ELECTRICAL CIRCUITS

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

Stop Circuit

- Outboard running: black/yellow wire NOT grounded (emergency stop switch lanyard in place).

Battery

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

Stator Output Voltage

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

EMM

- Start Assist Circuit (SAC) of *EMM* converts battery voltage (12 V) to 30 V for system circuit (55 V).
- Stator output to *EMM* provides voltage to *EMM*'s internal power supply.
- *EMM* digital ground, battery grounds, ignition grounds, and injector grounds must be functional.

Crankshaft Position Sensor

- Provides *EMM* with input.
- Outboard cranking speed exceeds 75 RPM and a steady CPS signal is generated.

Alternator Output/System Voltage

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

Capacitor

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

Ignition Primary Voltage

- Output from *EMM.*
- *EMM* provides -200 VDC ± 10 V output to orange ignition primary wires during cranking.



Engine Monitor Screen, Ignition Voltage 005141

IMPORTANT: Peak reading voltmeters must be set to "NEG" and "500" settings to measure ignition voltage.

Ignition Coil

- *EMM* provides input to primary winding of coil.
- Output from ignition coil secondary winding and high tension spark plug wire.

IGNITION OUTPUT

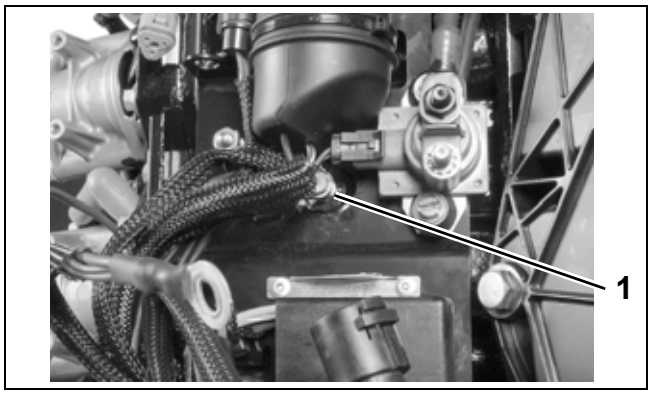
⚠ DANGER ⚠

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.

Wiring Inspection

Visually inspect all wiring, connections, and grounds. Use an ohmmeter to perform resistance tests on all ground circuits and connections. Ohmmeter readings should be approximately 0.0 Ω.

Check that main engine wire harness ground has continuity to the cylinder/crankcase.



1. Ground 004128

Make sure battery is fully charged.

Clean or repair all ground circuits, wiring, and connections as needed. Refer to **ELECTRICAL CONNECTIONS** on p. 114.

Ignition Voltage

Use the *Evinrude* Diagnostics Software program to check ignition voltage to the primary ignition circuit(s). Check the *EMM*'s ignition voltage to the primary circuits of the ignition coils on the engine *Monitor* screen.



Engine Monitor Screen, Ignition Voltage 005141

Results:

- "KEY ON" - 125 V ± 10, Ignition voltage is GOOD, check voltage with outboard "running". Refer to **Static Spark Test** on p. 128.
- "KEY ON" - less than 125 V ± 10, check system voltage to *EMM.* Refer to **System Voltage** on p. 128. Note: Key ON voltage will not be constant (fluctuates 125 - 200 V range).
- "RUNNING" - 200 V ± 10, Ignition voltage is GOOD. Refer to **Static Spark Test** on p. 128.
- "RUNNING" - less than 200 V ± 10, check stator output to *EMM*. Refer to **System Voltage** on p. 128 and **STATOR TESTS** on p. 141.

Low or no voltage on *EMM* ignition circuit:

- Check system voltage (55 V) input to ignition circuit on pin 4 of *EMM* J1-B connector.

System Voltage

The ignition module of the *EMM* is powered by the 55 V system.

Use the engine *Monitor* screen of the *Evinrude* Diagnostics Software program to check system voltage.



Engine Monitor Screen, System Voltage 005141

Results:

- "KEY ON" - 30 V ± 2, system voltage is GOOD.
- "KEY ON" - less than 30 V ± 2, check 12 V power to *EMM.* Repair connection or wiring. Possible faulty SAC circuit in *EMM*.
- "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. 141.

IMPORTANT: *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. This output supplies all 55 V circuits on the engine, including the ignition module of the *EMM*. Power is normally supplied to the *EMM* when the key switch is ON. Switched B+ (12 V) is supplied to the engine wire harness. Voltage enters the *EMM* at pin 21 (purple) of the *EMM* J1-B connector. Pin 9 (black) of the *EMM* J1-B connector provides ground to the *EMM*.

Static Spark Test

Perform the static spark test using the *Evinrude* Diagnostics Software program and a timing light.

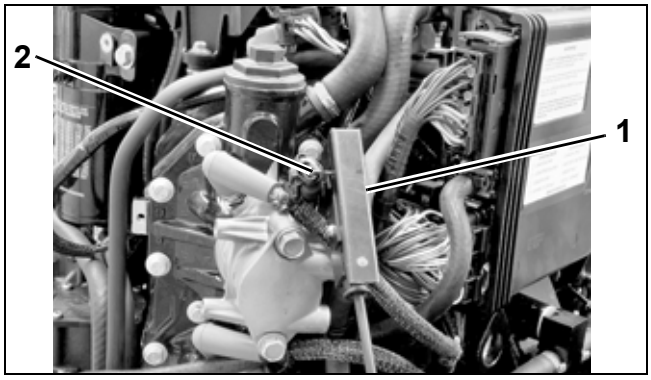
IMPORTANT: DO NOT use a spark checker tool with *E-TEC* models. Radio Frequency Interference (RFI) generated by the arcing current can cause erratic behavior in the *EMM*.

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



Testing, Static Test Screen 005146

Connect timing light pickup to primary and then secondary circuit of the ignition circuit being activated. Activate one circuit at a time and observe timing light strobe for consistent flash.



1. Timing light pick-up 004327
2. Ignition coil primary wire

Results:

- GOOD spark control on all cylinders and outboard runs, refer to **Running Ignition Tests** on p. 129 and **Dynamic Tests** on p. 120.
- NO spark control on one or more cylinders, note cylinders. Refer to **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 140.

Running Ignition Tests

The purpose of this test is to isolate ignition system malfunction. This test should be used in conjunction with other ignition system tests to identify component failures. This test provides limited information. Use the findings of this test to eliminate ignition system components. A thorough understanding of the outboard's ignition system is required.

Monitor Voltage Outputs

Use the *Evinrude* Diagnostics Software program to monitor system voltage (55 V) and ignition voltage (200 V).

- Voltage readings at a specific speed (RPM) should be steady.



Engine Monitor Screen, System and Ignition Voltage 005141

Results:

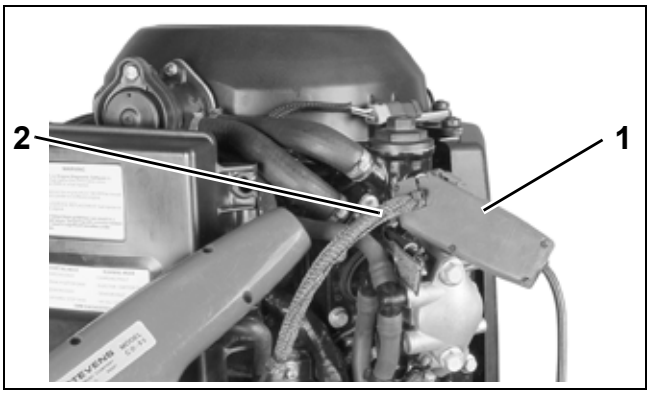
Low voltages: refer to **System Voltage** on p. 128 and **Ignition Voltage** on p. 127.

Monitor Ignition Output with Timing Light

Use a timing light to monitor the spark signal through each of the high tension spark plug wires.

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

IMPORTANT: Test on primary circuit if strobe from secondary circuit appears faulty.



1. *Timing light pick-up* 004255
2. *Spark plug lead*

Results:

Steady voltage and strobe:

- Inspect or replace spark plugs, check fuel system performance, and/or eliminate the possibility of internal engine damage.

Voltages are steady, engine misfires:

- Check CPS air gap and resistance, check ignition voltage while problem is occurring. Refer to **Ignition Primary Circuit Resistance Test** on p. 130 and **IGNITION COIL TESTS** on p. 140.

Voltages fluctuate, engine misfires:

- Inspect condition of battery and connections, test capacitor, and check all ground connections. Refer to **System Voltage** on p. 128, **Ignition Voltage** on p. 127, **Ignition Primary Circuit Resistance Test** on p. 130, and **IGNITION COIL TESTS** on p. 140.

IMPORTANT: If a running problem occurs at about 1200 RPM, the outboard may be in *S.A.F.E.* Refer to **Conditions that initiate S.A.F.E.** on p. 103.

Ignition Primary Circuit Resistance Test

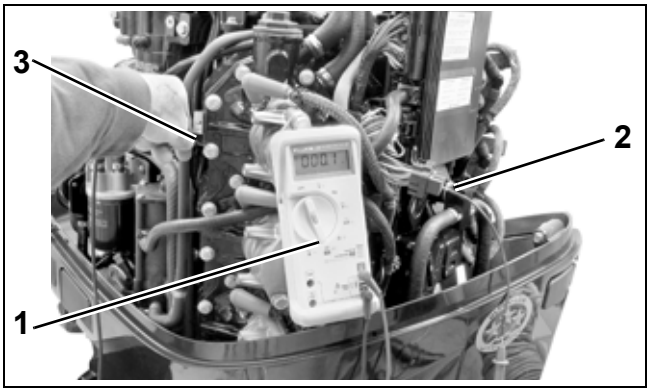
Disconnect the battery cables at the battery.

Calibrate ohmmeter to low ohms scale.

With key switch OFF, remove the *EMM* J1-B connector and measure resistance of each primary circuit. Note resistance reading between each primary wire and ground. Refer to engine wiring diagram.

Ignition Coil Primary Circuit Resistance
0.090 ± 0.005 Ω.

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



1. *Ohmmeter, low ohms scale* 004328
2. *Red meter lead, with pin adapter*
3. *Black meter lead to ground*

Results:

Primary circuit (complete circuit) resistance reading is higher than 2 Ω:

- Repair primary circuit wiring or coil grounds as needed and retest.
- Replace faulty coils or wiring.

Primary circuit resistance reading less than 2 Ω or within specification and *EMM* ignition output voltage is 130 V or higher:

- Refer to **Secondary Winding Resistance Test** on p. 140. Repair high tension spark plug lead or replace ignition coil and/or high tension spark plug lead assembly.

Crankshaft Position Sensor (CPS) Test

Use the *Evinrude* Diagnostics Software program to check RPM reading. An RPM display higher than zero indicates a CPS signal to the *EMM*. Cranking RPM is typically 175 RPM.

Observe Engine RPM and Power ON Time display fields of the engine *Monitor* screen. “ON Time” should be continuous and should not reset unless the key switch is turned OFF or power to the *EMM* is interrupted.



Engine Monitor Screen, Engine RPM display 005141

Check CPS resistance (560 Ω ± 10%). Make certain ohmmeter is calibrated properly. Refer to **Crankshaft Position Sensor (CPS) Test** on p. 139.

FUEL DELIVERY

⚠ 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. 184.

Use the *Evinrude* Diagnostics Software program to review service codes prior to troubleshooting. Correct all conditions related to service codes FIRST.

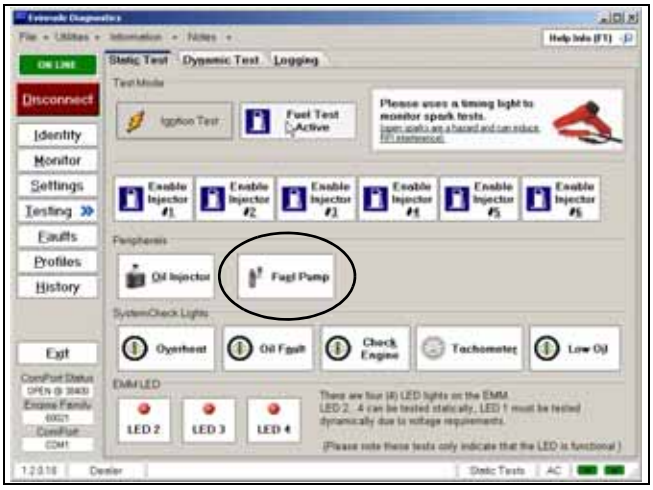
Inspect all fuel hoses, filters, and connections. Check quality of fuel supply.

Manifold Pressure Test

If the outboard runs, check pressure with the outboard running. Perform pressure tests outlined in **Fuel Supply** on p. 180.

If the outboard does not run, use the primer bulb to fill the vapor separator. Make sure circulation pump activates with key switch in ON position.

The Fuel Pump test of the diagnostic program can be used to activate electric fuel pump.



Static Tests Screen 005155

Results:

Pressure test indicates 20 to 30 psi (138 to 207 kPa):

- Circulation pump output is good. Make sure fuel system pressure does not fall below 15 psi (103 kPa) after outboard (pump) is OFF for five minutes. Leakdown indicates a fuel system leak or leaking injector.

Low or no pressure, pump runs:

- Suspect damaged fuel pressure regulator in vapor separator or faulty circulation pump. Perform **Pressure Regulator Test** on p. 181.

Pump does not run:

- Check voltage at pin 1 of fuel pump connector. Voltage should be 12 V at initial key ON, 12 V fuel pump test activated, or outboard cranking or running.
- Check voltage at pin 2 of fuel pump connector. The *EMM* controls power to the fuel pump (purple/black wire). Outboard must be cranking or running. Use the fuel pump test of the diagnostic program to activate the control function of the *EMM*. Connect voltmeter positive lead to pin 2 and negative meter lead to ground. Activate Fuel Pump test or run outboard. Voltage reading should be 12 volts.

Excessive pressure:

- Check for restricted pressure regulator in vapor separator or restricted fuel return manifold.

Vapor Separator Checks

Fuel Supply

The vapor separator must provide “solid” fuel to the fuel circulation pump. Make sure the vapor separator receives the proper fuel supply from the fuel lift pump.

Perform **Lift Pump Pressure Test** on p. 182.

- Use primer to check fuel movement through fuel lift pump.
- Outboard runs: Check pressure with outboard running.
- Outboard does not run: Check pressure with outboard cranking.

Venting

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 Delivery to Lift Pump

Perform the **Lift Pump Vacuum Test** on p. 182. Make sure no restrictions or air leaks exist in the fuel supply hose or boat fuel system.

FUEL INJECTOR OPERATION

Static Tests

Perform the *Fuel Injector Static Test* using the diagnostic program. Static tests are performed with the outboard “static” or not running. Listen for an audible “click” from each injector when it is actuated.

IMPORTANT: This test is operating injector on 12 V battery power / system voltage (55 V). Battery must be fully charged and connections must be clean and tight. The start assist circuit (SAC) of the *EMM* should convert battery voltage (12 V) to 30 V of system voltage. Injector activation should be carefully confirmed.

Results:

No injectors actuate:

- Use the diagnostic software to monitor system voltage (55 V). Check individual injector circuits from *EMM* to injectors. See **Stator Voltage Output Test** on p. 141 if system voltage is low.

Some injectors actuate; some do not:

- Make sure individual injector circuits and injectors are functional. See **Fuel Injectors** on p. 179.

All injectors actuate:

- Confirm fuel system pressure and fuel supply to injectors.

Dynamic Tests

Use the engine *Monitor* screen of the diagnostic software program to monitor outboard system voltage. Perform these tests while monitoring voltage. If voltage drops as RPM increases, check stator and system voltage operation.

Run or crank outboard. Monitor the injector control wire for each injector with an inductive timing light. Make certain the inductive 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 fuel injectors or ignition to be turned off to a particular cylinder.

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 to avoid needless part(s) replacement.

Results:

Steady light activation on all injector wires and consistent voltage readings:

- *EMM* injector control function is good.

Irregular or no light activation on some injector wires:

- Test the resistance of each injector circuit. Measure resistance between the injector connector and injector control wire at the *EMM* connector.
- Check battery cable connections.
- Make sure all grounds are clean and tight.
- Eliminate all other possibilities to isolate a faulty *EMM*.

No light activation on any injector wires (outboard cranks and starter turns flywheel):

- Confirm stator input to *EMM*, CPS operation, and all grounds and wiring connections. Possible open circuit(s), faulty CPS or *EMM*.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

ELECTRICAL AND IGNITION

TABLE OF CONTENTS

SERVICE CHART 136
DASH CONNECTIONS, INSTRUMENT HARNESS 138
SENSOR RESISTANCE TESTS 139
IGNITION COIL TESTS 140
STATOR TESTS 141
CAPACITOR TEST 142
CHARGING SYSTEM TESTS 142
SYSTEMCHECK CIRCUIT TESTS 145
REMOTE CONTROL SWITCH TESTS 147
- KEY SWITCH TEST 147
- NEUTRAL START CIRCUIT TEST 148
- NEUTRAL START SWITCH TEST 148
- EMERGENCY STOP SWITCH TEST 149

TACHOMETER CIRCUIT TESTS 149
ELECTRIC STARTER TESTS 150
- STARTER SOLENOID TEST 150
- NO LOAD CURRENT DRAW TEST 150

TILT/TRIM RELAY TEST 151
- OPERATION 151
- TEST PROCEDURE 152

FLYWHEEL SERVICING 152
- REMOVAL 152
- INSTALLATION 153

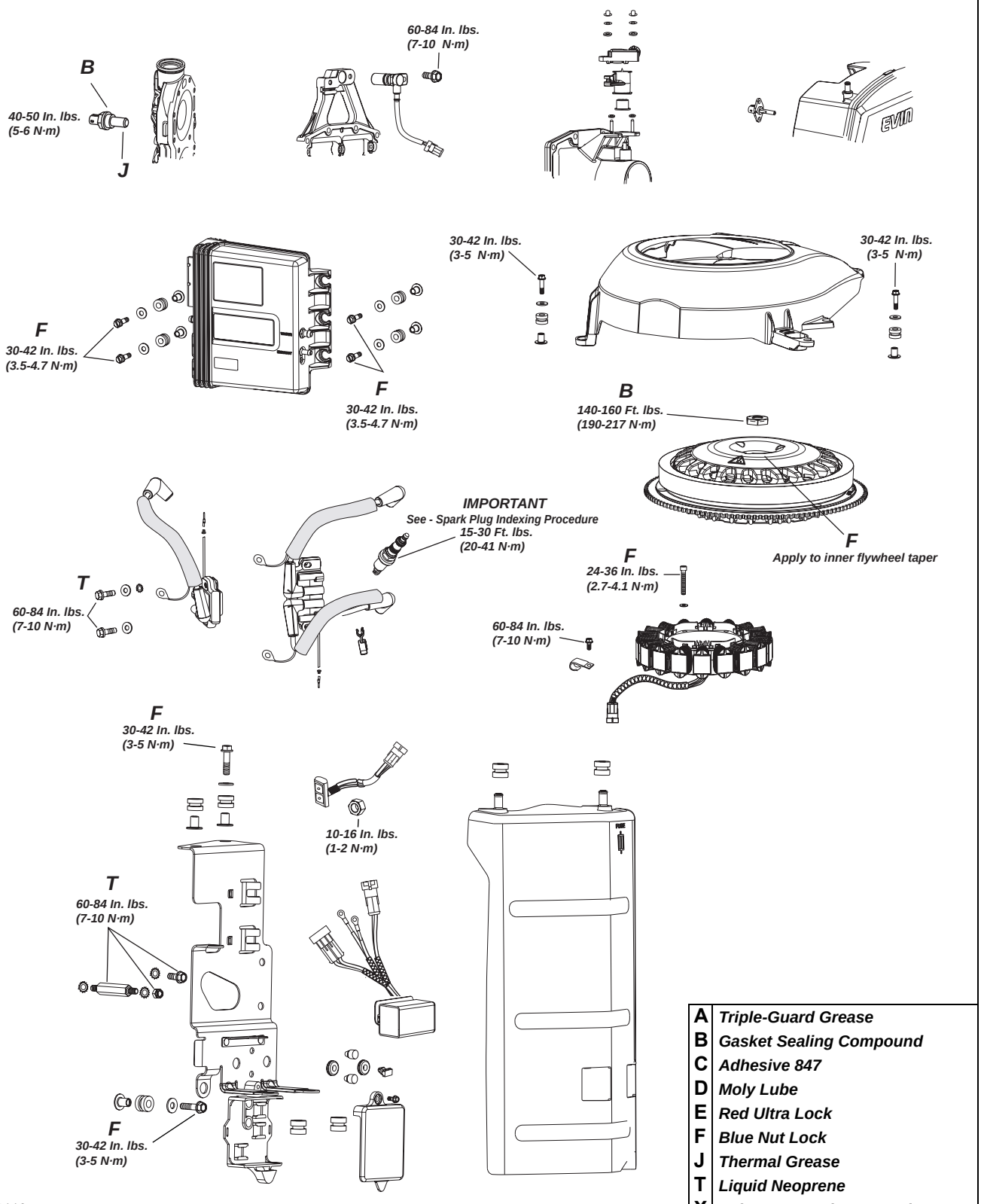
TIMING ADJUSTMENTS 154
- TIMING POINTER 154
- TIMING VERIFICATION 155

SPARK PLUGS 155
- INSPECTION 155
- INDEXING 155

ELECTRIC STARTER SERVICING 156
- REMOVAL 156
- DISASSEMBLY 157
- CLEANING AND INSPECTION 159
- ASSEMBLY 160
- INSTALLATION 163

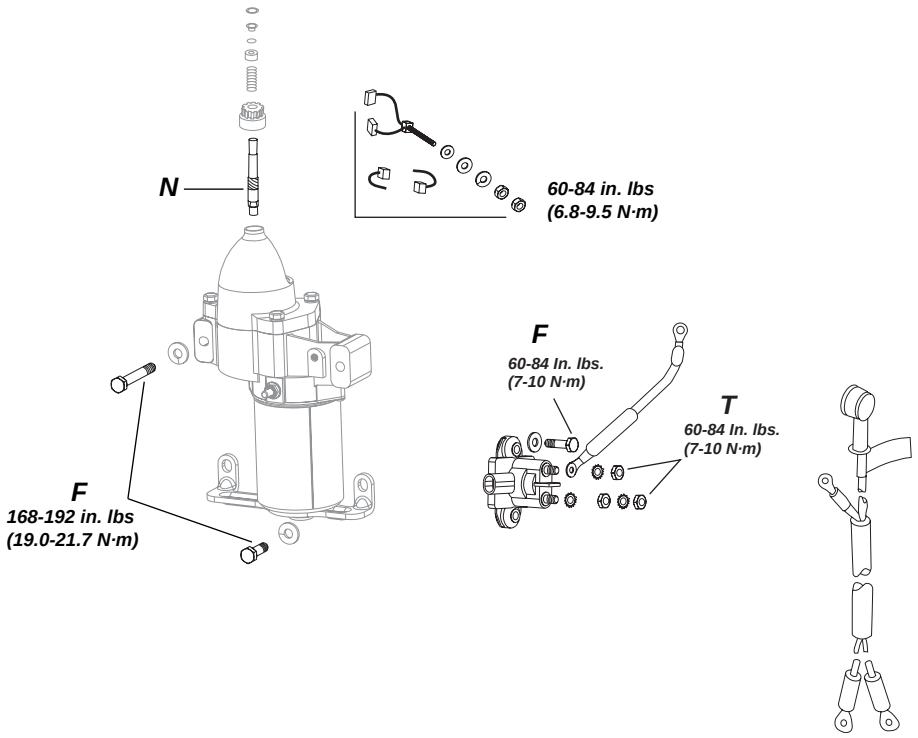
CONNECTOR SERVICING 164

SERVICE CHART



004116

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	***Index per Service Manual***



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

004100

DASH CONNECTIONS, INSTRUMENT HARNESS

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

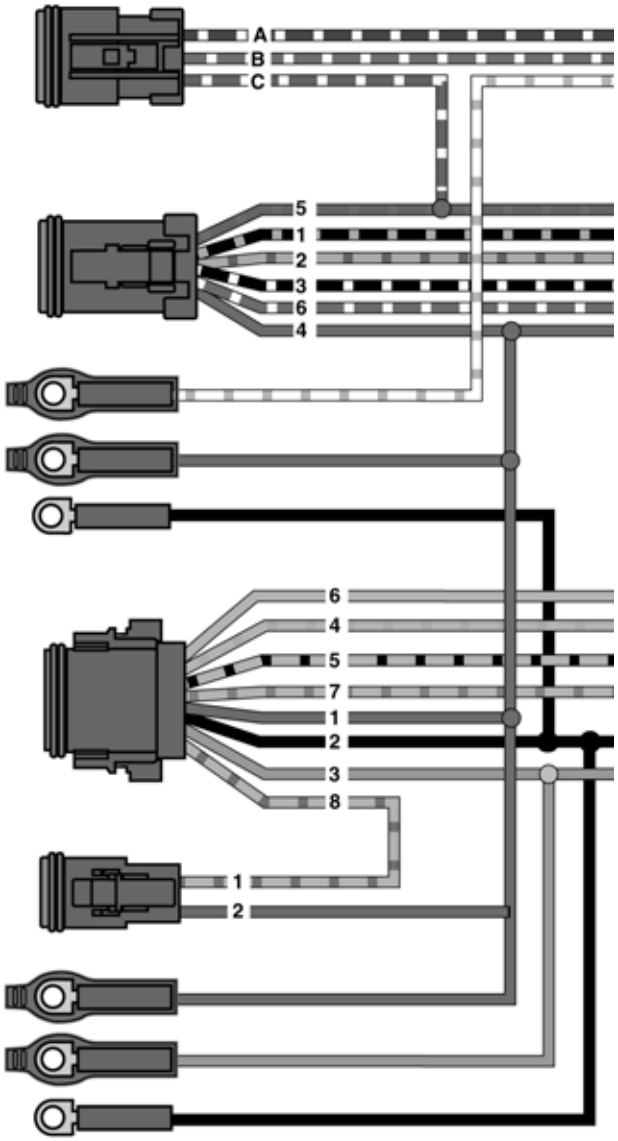
6-pin connector – Connect to a pre-wired remote control or to a dash-mounted key switch.

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

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

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

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



Instrument Harness Diagram (MWS) DRC6165R

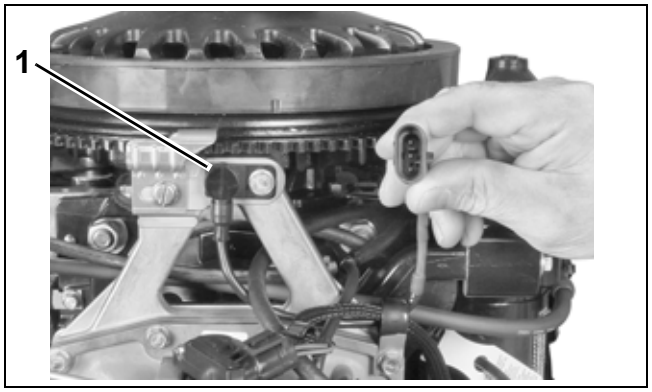
SENSOR RESISTANCE TESTS

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 appropriate circuit in the *EMM*.

IMPORTANT: Use the *Evinrude* Diagnostics Software program to monitor sensor circuit voltages or values.

Crankshaft Position Sensor (CPS) Test

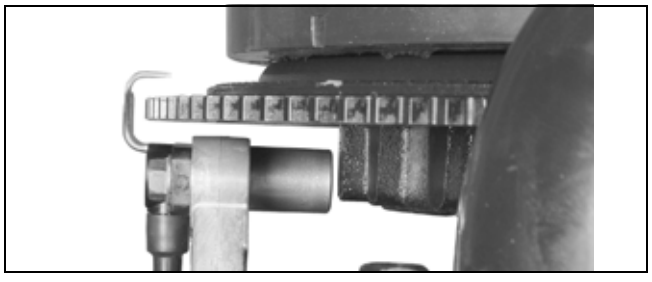
Disconnect the battery cables at the battery. Use an ohmmeter to measure sensor resistance.



1. CPS 004199

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

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



CPS 004200

Throttle Position Sensor (TPS) Test

Disconnect the battery cables at the battery. Remove the electrical connector from the TPS.

Use an ohmmeter to measure sensor resistance.

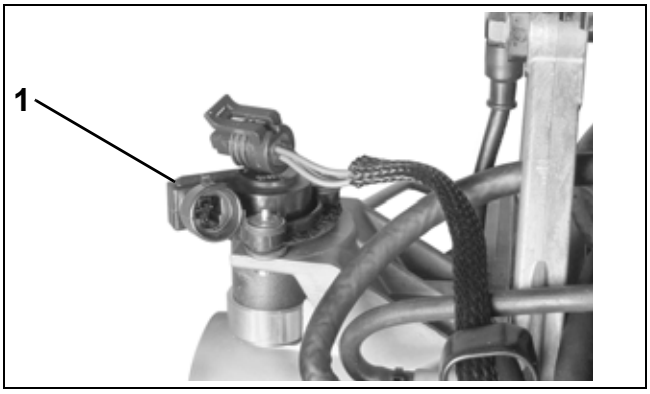
IMPORTANT: DO NOT lubricate TPS to throttle shaft surface.

STEP 1

Connect red meter lead to terminal “A” and black meter lead to terminal “B.”

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 004256

STEP 2

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.

STEP 3

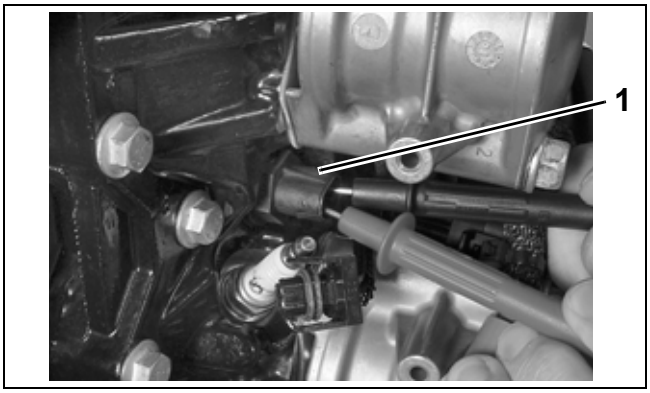
Connect red meter lead on terminal “B” and black meter lead to terminal “C.” Rotate the sensor lever. Resistance reading must change evenly as the sensor lever is moved.

TPS voltage can be monitored using the diagnostic program. Use the engine *Monitor* screen to observe voltage while outboard is running. Voltage should change evenly as sensor lever is moved.

Engine Temperature Sensor Test

Use an ohmmeter to measure resistance.

Engine Temperature Sensor Resistance
9000 to 11000 Ω @ 77°F (25°C)



1. Engine temperature sensor (2) 004196

Air Temperature Sensor (AT) Test

Use an ohmmeter to measure resistance.

AT Sensor Resistance
9000 to 11000 Ω @ 77°F (25°C)



1. AT sensor 004216

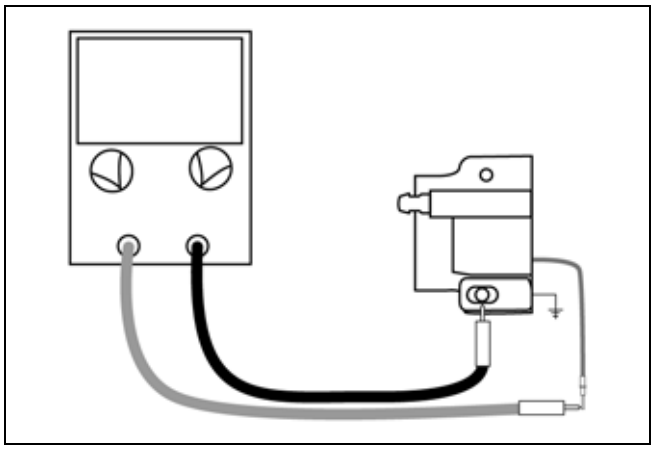
IGNITION COIL TESTS

Primary Winding Resistance Test

Connect ohmmeter between coil primary terminal and clean engine ground.

Ignition Coil Primary Resistance
0.090 ± 0.005 Ω @ 77°F (25°C)

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

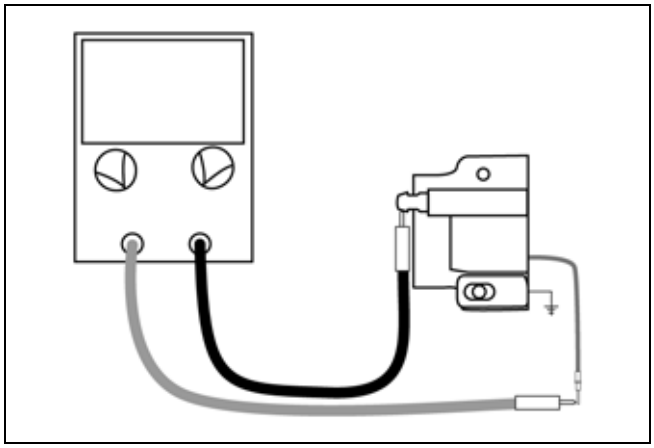


000741

Secondary Winding Resistance Test

Connect ohmmeter between coil secondary terminal and coil primary terminal.

Ignition Coil Secondary Resistance
301 ± 14 Ω @ 77°F (25°C)



000742

STATOR TESTS

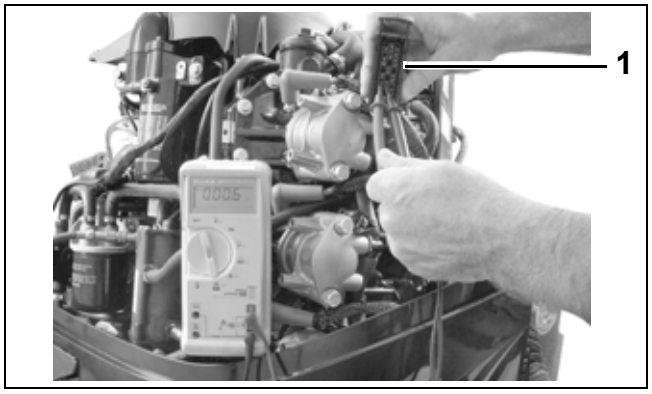
The stator consists of 3 windings (6 poles each) on a 7 inch diameter core and generates an output voltage of 55 VAC (1700 watts maximum). This voltage is converted by the *EMM* and used to provide 12 VDC for battery charging (10 A at 500 RPM and 50 A from 2000 RPM to WOT) and 55 VDC for fuel injector,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

Stator Resistance Tests

Disconnect the battery cables at the battery. Use an ohmmeter to check resistance of stator windings.

STEP 1

Disconnect *EMM* J2 connector from *EMM*.



1. EMM *J2 Connector* 004325

Calibrate ohmmeter to appropriate scale and connect meter leads to the following pins:

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

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

Stator Winding Resistance Specification
Yellow & Yellow / white 0.512 ± 0.020 Ω @ 73°F (23°C)
Brown & Brown / white 0.512 ± 0.020 Ω @ 73°F (23°C)
Orange & Orange / white 0.512 ± 0.020 Ω @ 73°F (23°C)

STEP 2

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

Stator Voltage Output Test

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

⚠ WARNING ⚠

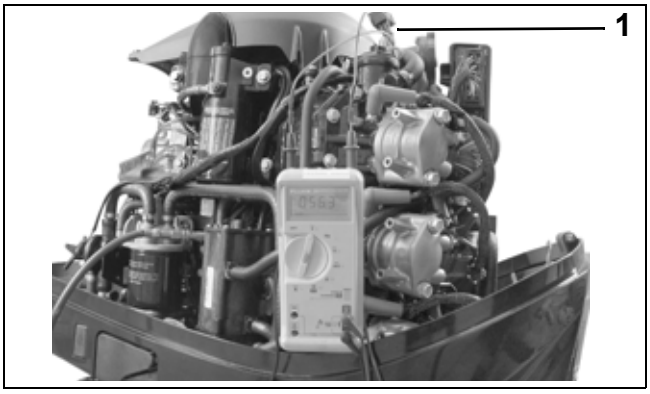
To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Disconnect CPS.

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

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

Connect meter leads to terminals of adaptor tool.



1. Stator Test Adaptor 004326

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

Stator Voltage Output (Measured between terminals 1 and 6 of tool)
20 VAC at 100 RPM 30 VAC at 150 RPM 42 VAC at 200 RPM 52 VAC at 250 RPM 62 VAC at 300 RPM

CAPACITOR TEST

The capacitor should charge when you use an ohmmeter on the high ohms scale with the proper polarity. The resistance will increase until it goes to (nearly) infinity. If the capacitor is shorted, then it will never charge. If it is open, the resistance will be infinite immediately and won't change. If the polarity of the probes is reversed, it will not charge properly either. Determine the polarity of your meter and mark it. Black is usually negative with VOMs, for example. Confirm with a marked diode. A low reading across a good diode indicates that the positive lead is on the anode (triangle) and negative lead is on the cathode (bar).

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 battery voltage is at the connector red wire when key is ON.

Test Procedure

Disconnect the battery cables at the battery.

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

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

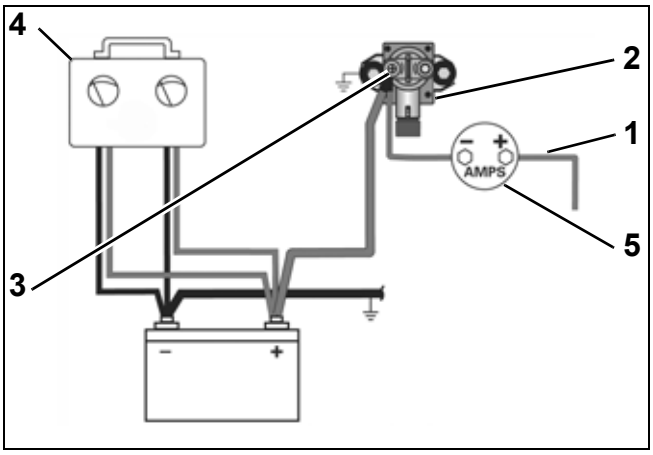
Fluke† model 334 or 336, *Snap-On*† model MT110 or EETA501, and various other amp meters should be available through local tool suppliers.

Reconnect the outboard's battery cables.

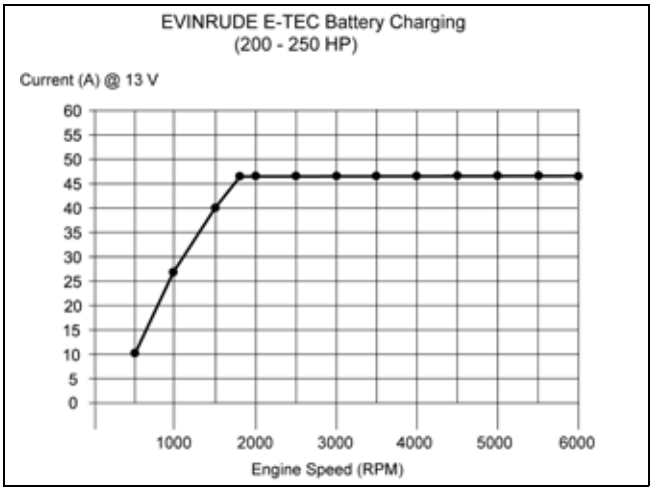
Following the manufacturer's directions, connect the variable load tester (carbon pile) across the battery terminals. *Stevens* model LB-85 and *Snap-On* model MT540D are examples of testers available.

⚠ 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 004286

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 50 A (or 25 A for each output) @ 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. 141.

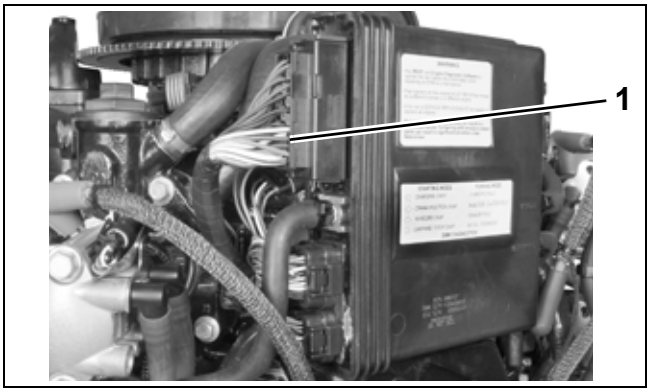
55 V Alternator Circuit

STEP 1

Check battery ground cable for continuity.

STEP 2

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 approximately 30 V.



1. *J2 connector of* EMM 004197

STEP 3

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, perform **Stator Resistance Tests** on p. 141 and **Stator Voltage Output Test** on p. 141. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or *EMM*.

Auxiliary Battery – Charge Wire

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

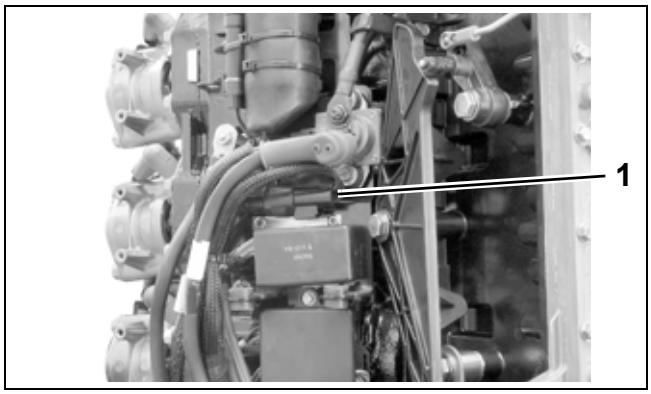
IMPORTANT: Disconnect all accessories from the auxiliary battery. Auxiliary battery must read a minimum of 8.5 V at the beginning of these tests and remain connected to the outboard during the tests.

STEP 1

Check battery ground cable for continuity.

STEP 2

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



1. Auxiliary battery charge wire connection 004329

STEP 3

With outboard running at 1000 RPM, voltage must read higher than in **STEP 2** and increase steadily to approximately 14.5 V as the outboard RPM increases.

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

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

SystemCheck CIRCUIT TESTS

Make sure the *SystemCheck* engine monitor can alert the operator during a “NO OIL,” “WATER TEMP” or “HOT,” “CHECK ENGINE,” or “LOW OIL” condition. Check the condition of the warning system and associated wiring and connections. Test the engine monitor regularly and anytime you suspect an alert situation has been missed.

The instrument harness must be connected to the outboard before performing the following tests. Refer to the **Engine Wiring** diagram and the **MWS Instrument Wiring** diagram in the back of this manual.

IMPORTANT: Use jumper wires made with the appropriate terminals to test the warning circuits.

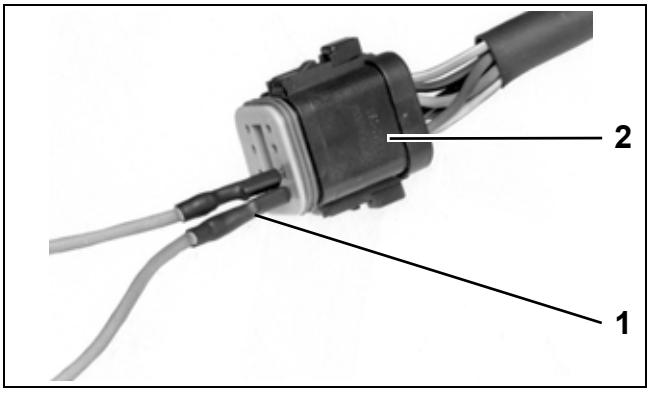


42811

Gauge Self-Test Check

Turn the key switch to ON with the outboard NOT running. The gauge warning lights for NO OIL, WATER TEMP, CHECK ENGINE, and LOW OIL must all light at once, then turn off in sequence, and the warning horn must sound for one-half second.

If the gauge lights do not turn on, turn the key switch OFF. Disconnect the gauge 8-pin connector from the back of the gauge and turn the key switch ON. Test for battery voltage between instrument harness terminal 1 (purple wire) and terminal 2 (black wire).



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

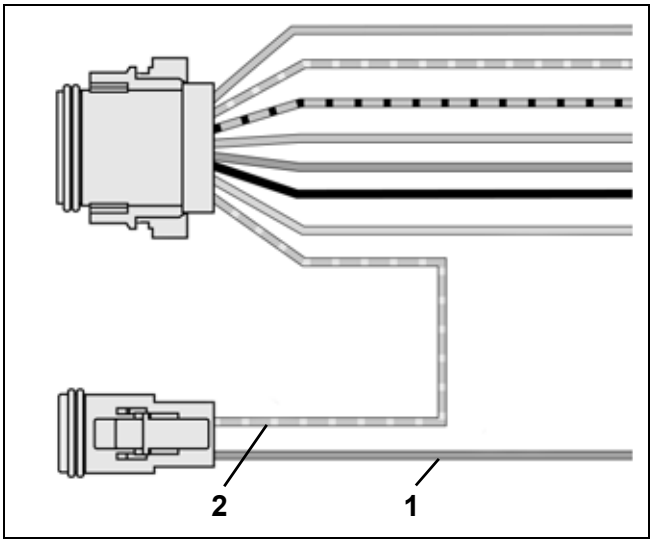
42761

- If battery voltage is present, replace the gauge.
- If there is no battery voltage, check that 12 V is present at terminal “B” of the key switch. Check condition of the instrument harness, key switch, and connections.

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

- If the substitute horn beeps, the original horn is defective and must be replaced.
- If the substitute horn does not beep, check for battery voltage between instrument harness 2-pin connector, terminal 2 (purple wire) and ground with the key switch ON. Also, check the tan/blue wire for continuity between pin 8 of the 8-pin connector and pin 1 of the 2-pin connector.
- If battery voltage is present at the purple wire and the tan/blue wire has continuity between

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.

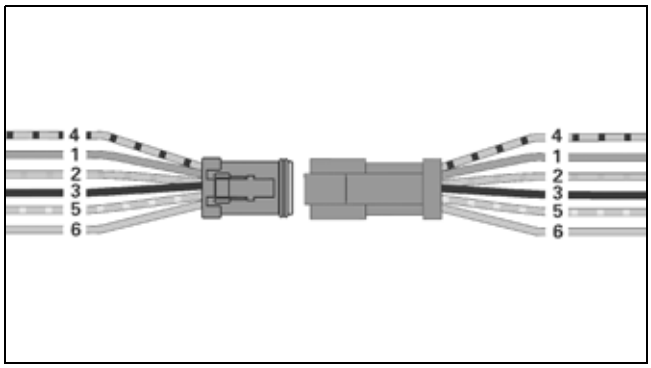
- If the CHECK ENGINE light is not on, test circuit for continuity. Check continuity of the MWS instrument harness (tan/orange wire).
- Check continuity of the engine wire harness between terminal 2 (tan/orange wire) of the *SystemCheck* connector and pin 17 of the *EMM* J1-A connector.

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.

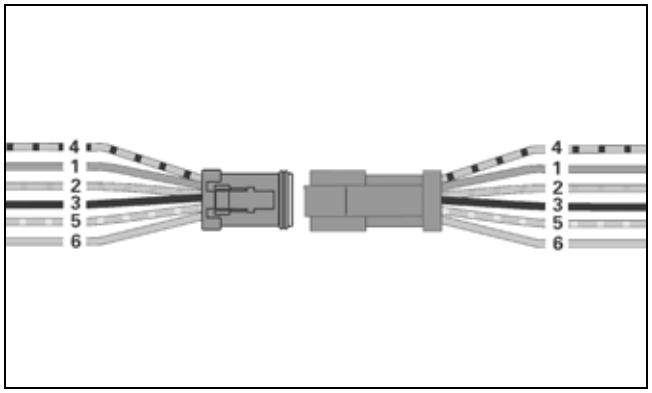
- If LED is not on, test circuit for continuity. Test for continuity of both the engine harness (tan wire) and the MWS instrument harness (tan wire).

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. 140.

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.

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.

STEP 1

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.

STEP 2

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.

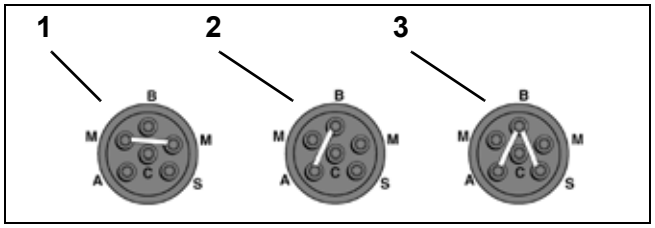
Turn switch ON. Meter must indicate continuity.

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

STEP 3

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

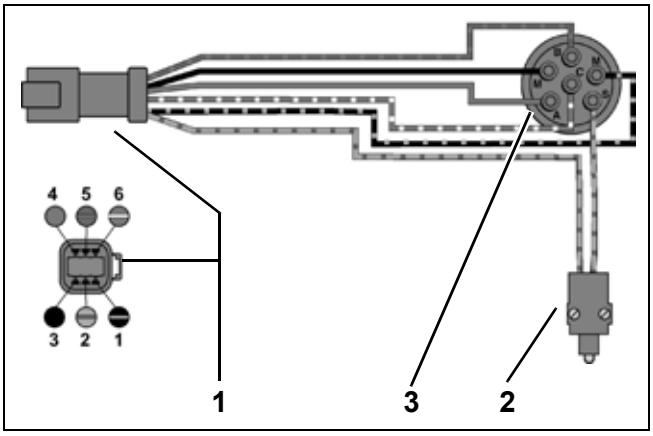
Use an ohmmeter or continuity light to test the continuity of the circuit while positioning the remote control in NEUTRAL, FORWARD, and REVERSE.

IMPORTANT: Turn propeller shaft or disconnect shift cable to allow proper remote control shift action while outboard is not running. Disconnect the MWS 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 000443
2. Neutral start switch
3. Key switch

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

Neutral Start Switch Test

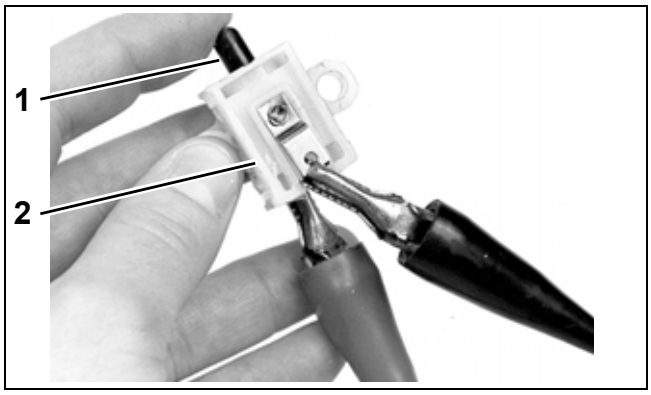
Use an ohmmeter or a continuity light to test neutral start switch operation.

IMPORTANT: All wiring must be disconnected from the switch before proceeding with this test.

Disassemble the remote control and remove the neutral start switch.

Connect one meter lead to each terminal of the switch.

- Meter must indicate continuity when the plunger is depressed
- Meter must indicate no continuity when the plunger is released.



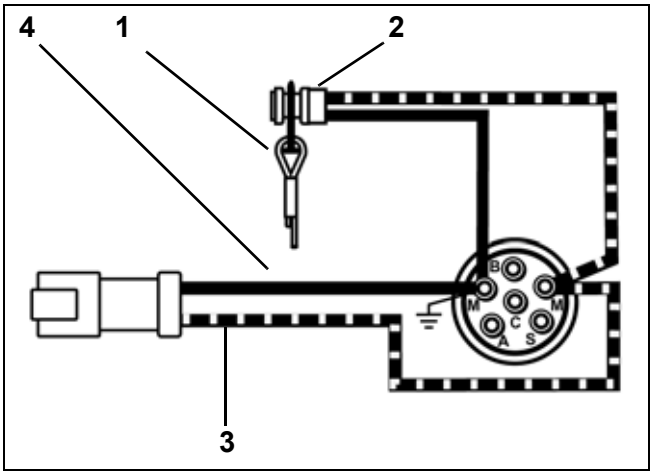
TYPICAL 3224
1. Plunger
2. Neutral start switch

Replace switch if results are incorrect.

Emergency Stop Switch Test

This switch can be incorporated into the key switch or installed as a separate switch. Either style effectively 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).

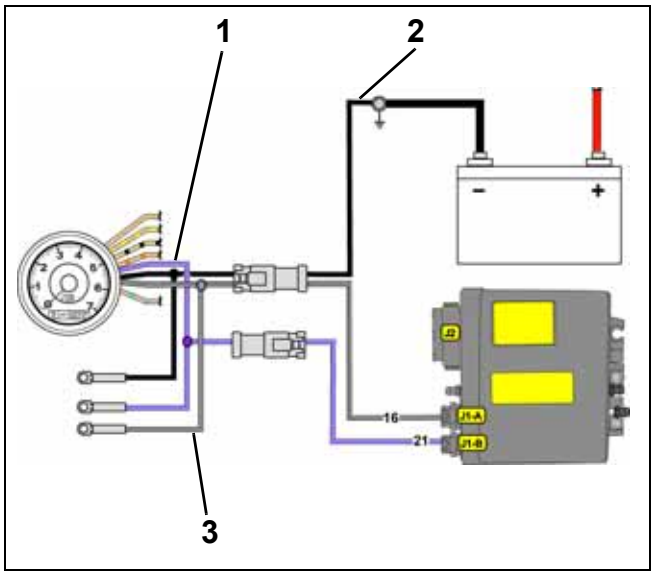


1. *Lanyard and clip assembly* 000444
2. *Emergency stop switch, separate from key switch*
3. *Stop circuit wire (black/yellow)*
4. *Ground wire (black)*

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.

TACHOMETER CIRCUIT TESTS

Check voltage at the battery. Use this reading as a reference for battery voltage.



1. *Purple lead* 004287
2. *Black lead*
3. *Gray lead*

STEP 1

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 **STEP 2**.
- If meter shows less than battery voltage, check the purple, red/purple, and black wiring circuits, fuse, key switch, and battery connections.

STEP 2

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*.

ELECTRIC STARTER TESTS

Starter Solenoid Test

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

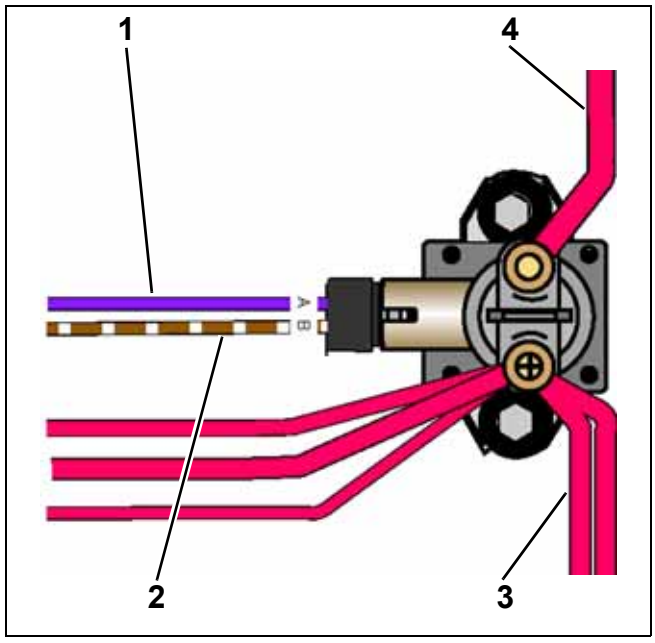
IMPORTANT: Disconnect all wiring from solenoid terminals before proceeding with this test.

Use an ohmmeter to measure resistance.

STEP 1

Put one ohmmeter lead on the starter positive (+) cable terminal and the other ohmmeter lead on the battery positive (+) cable terminal:

- Ohmmeter must not show continuity (high reading).
- If ohmmeter shows continuity (low reading), replace the solenoid.



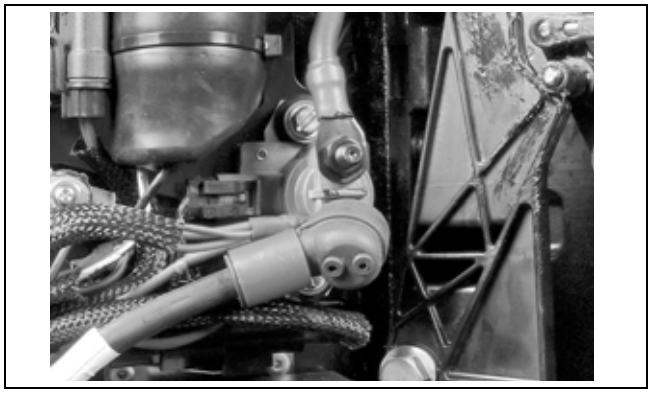
1. "A" terminal, B+ (purple) 004121
2. "B" terminal, NEG (brown/white)
3. Starter positive (+) cable terminal
4. Battery positive cable (B+) terminal

STEP 2

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.
- Ohmmeter must show continuity (low reading).
- If ohmmeter shows no continuity (high reading), replace the solenoid.

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



004182

No Load Current Draw Test

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

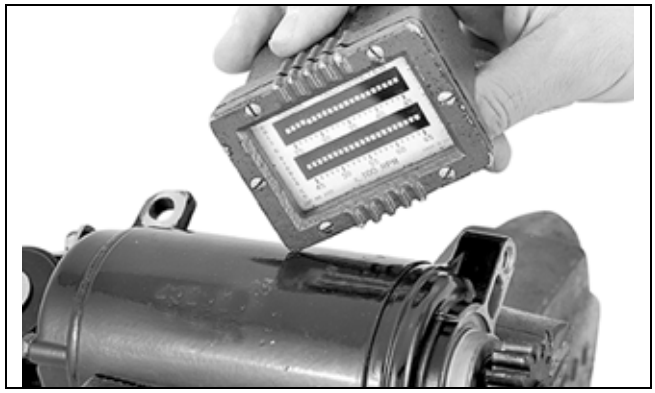
Use a battery rated at 500 CCA (60 amp-hr) or higher that is in good condition and fully charged.

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

Use an inductive ammeter or connect a 0 to 100 amp ammeter in series with a heavy jumper between the battery positive (+) terminal and the starter positive (+) terminal.

Fluke model 334 or 336, *Snap-On* model MT110 or EETA501, and various other ammeters should be available through local tool suppliers.

Attach or hold a vibration tachometer, such as a *Frahm*† *Reed* tachometer, to the starter.



TYPICAL 24083

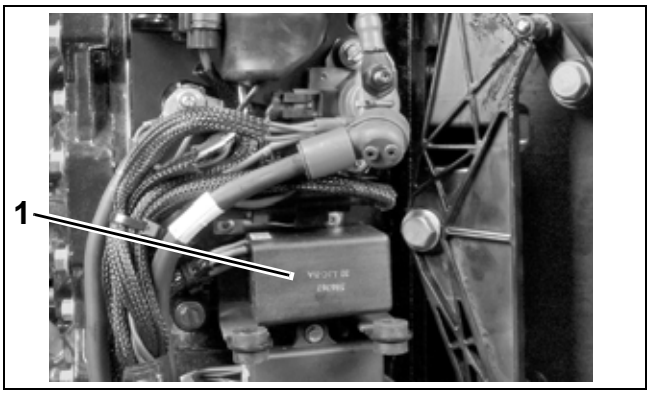
Complete the circuit with a heavy jumper between the battery negative (–) terminal and the starter frame.

Monitor the starter RPM and current draw.

- At 10,500 RPM the ammeter should show a maximum of 30 A.

TILT/TRIM RELAY TEST

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



1. Tilt and trim module 004183

The tilt and trim switch provides B+ input to green/white or blue/white wire of the TNT module.

Operation

The relay activates when B+ input from the switch is supplied to terminal 86 of the internal relays.

Terminal 87a connects to ground (B–).

Terminal 87 connects to B+.

Terminal 30 connects TNT motor.

Terminals 87a and 30 are connected when relay is not activated. This supplies ground (B–) connection to TNT motor.

Terminals 87 and 30 are considered “normally open.” B+ is applied to terminal 30 when relay is activated. This supplies ground B+ connection to TNT motor.

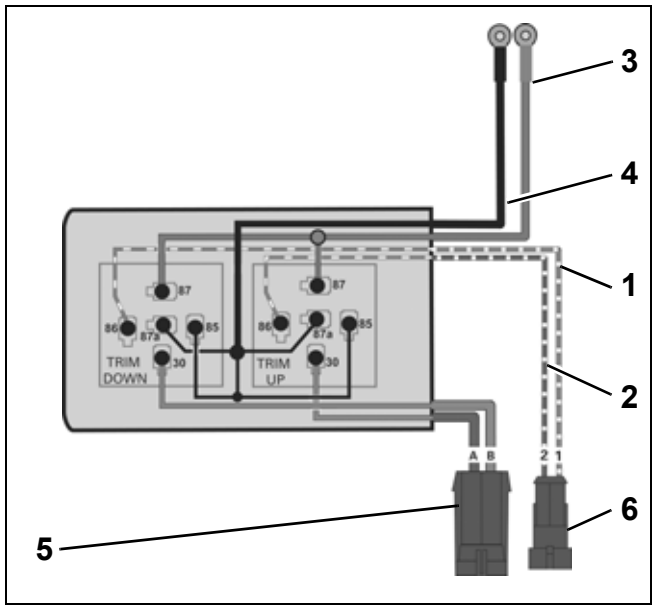
Refer to **Tilt and Trim Module Diagram**.

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*

FLYWHEEL 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 the peak-reading voltmeter, which might cause unnecessary replacement of ignition components.

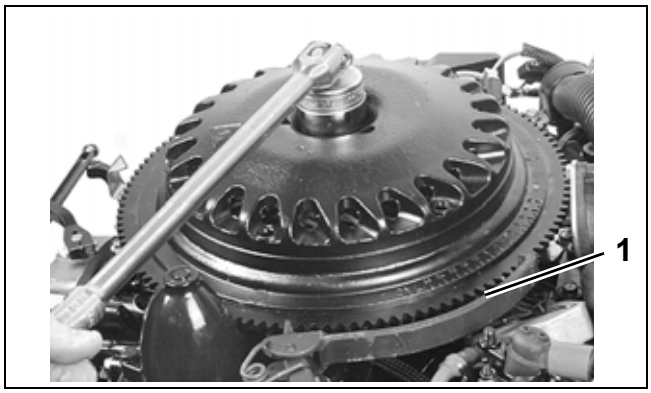
An accurate test of alternator output can help determine the flywheel’s condition. Refer to **CHARGING SYSTEM TESTS** on p. 142.

Removal

⚠ WARNING ⚠

To prevent accidental starting while servicing, remove emergency stop lanyard and disconnect the battery cables at the battery.

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



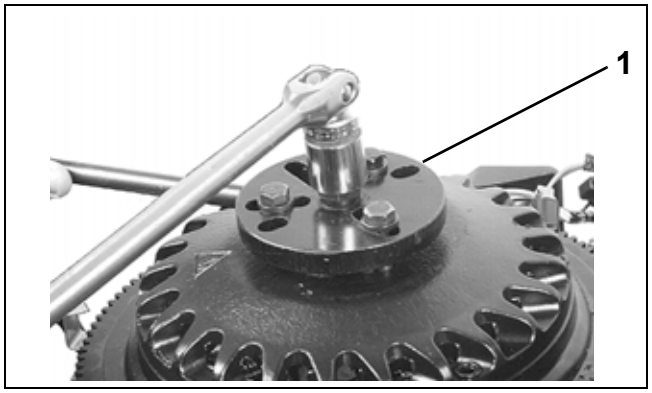
1. *Flywheel holder* DP0566

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

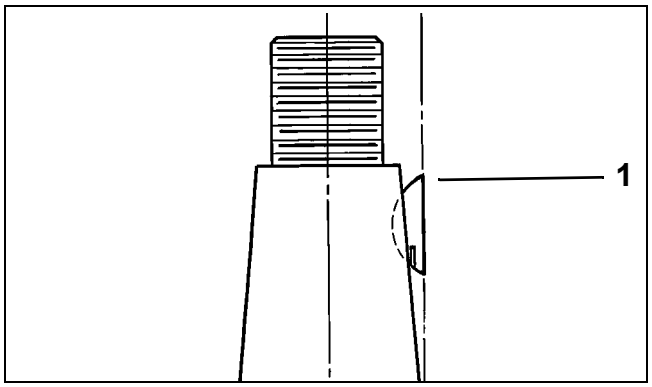
Put the puller on flywheel with body flat side up. Attach the puller body with the three shoulder screws and washers. Hold puller body with handle, and tighten pressing screw until flywheel releases. Turn the center screw and lift the flywheel off of the crankshaft.



1. Universal puller DP0568

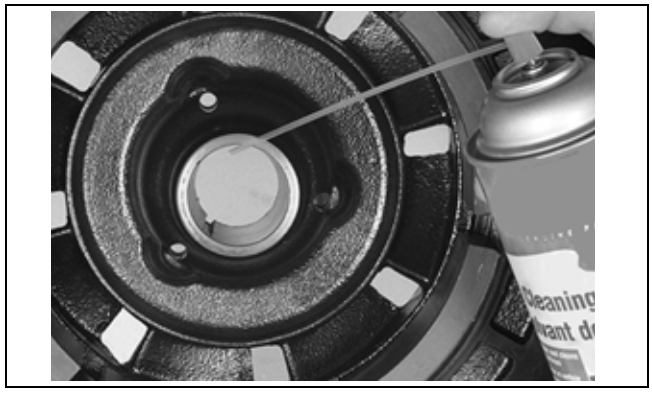
Installation

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.

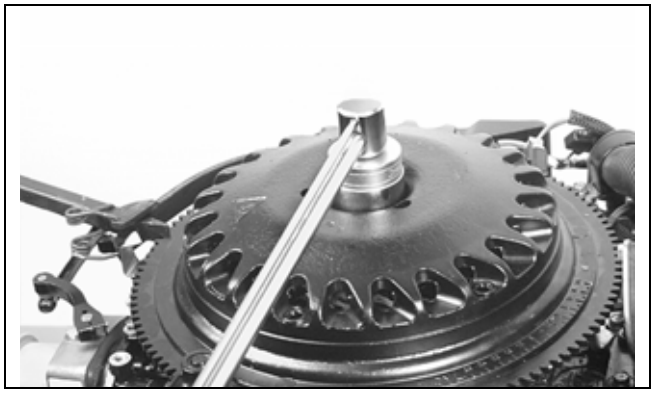


49623

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

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

Align the flywheel keyway and install the flywheel. Coat the threads of a **new** flywheel nut with *Gasket Sealing Compound*. Install the nut and torque to 140 to 160 ft. lbs. (190 to 217 N·m).



DP0567

IMPORTANT: Perform the timing verification procedure after flywheel removal or replacement. Refer to **TIMING ADJUSTMENTS** on p. 154.

TIMING ADJUSTMENTS

Timing Pointer

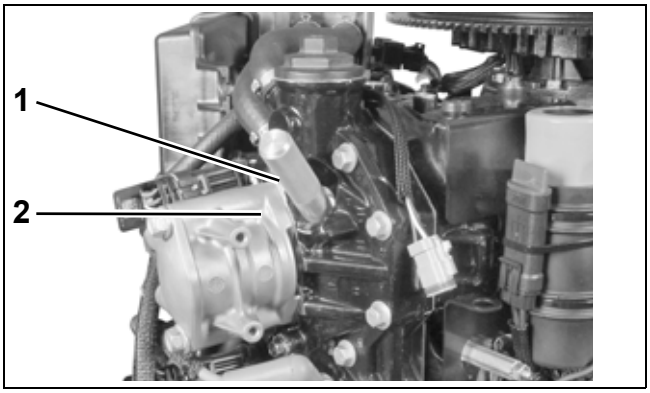
The timing pointer must be adjusted to indicate "top dead center" (TDC) of the number 1 piston. This reference to the position of the number 1 piston is used to synchronize the electronic timing controlled by the *EMM* with the mechanical position of the number 1 piston. Use the *Evinrude* Diagnostics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

⚠ WARNING ⚠

To prevent accidental starting while servicing, remove emergency stop lanyard and disconnect the battery cables at the battery.

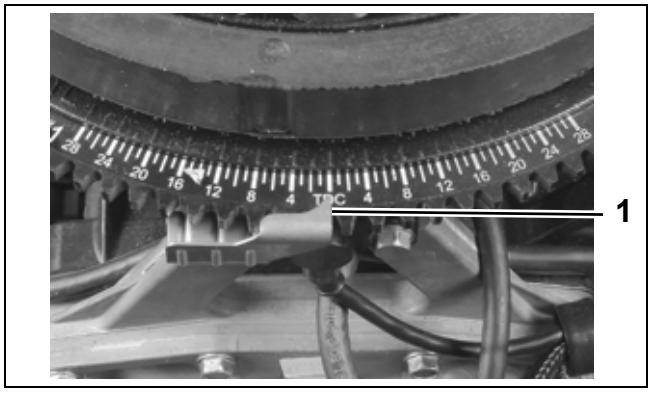
Turn the key switch OFF and disconnect the battery cables at the battery.

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, P/N 342679 004179
2. Number 1 cylinder

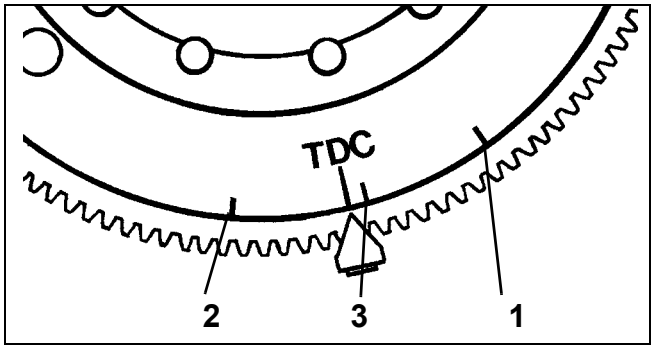
Rotate flywheel in a **counterclockwise** direction until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly against the tool. Mark the flywheel directly across from the pointer. Label this mark "A."



1. Timing pointer 005025

Rotate the flywheel in a **clockwise** direction 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 and remove it from spark plug hole.

Use a flexible measuring device to measure the distance between marks "A" and "B." Measure along the edge of the flywheel. Mark the midpoint on the flywheel. Label this mark "C." If mark "C" and the cast-in TDC boss on flywheel are in alignment, the timing pointer is in the correct location.



1. Mark "A'" DR1233
2. Mark "B"
3. Mark "C"

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.

Install spark plugs. Refer to Spark Plug **Indexing** on p. 155.

Timing Verification

Use the *Evinrude* Diagnostics Software program to synchronize the mechanical timing of the outboard with the electronic timing control function of the *EMM*.



Timing Adjustment Screen 005148

Perform timing verification 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 timing verification is performed.

SPARK PLUGS

Inspection

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.

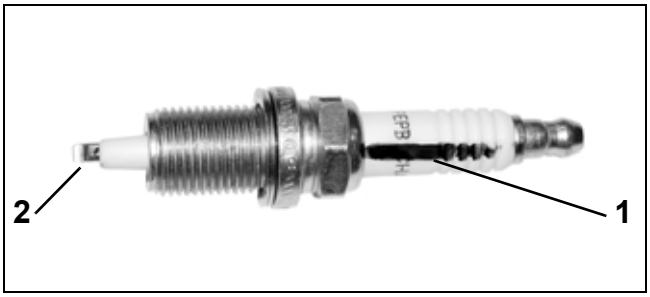
Spark Plug, *Champion*
QC10WEP @ 0.028 ± 0.003 in. (0.76 mm)

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

Indexing

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

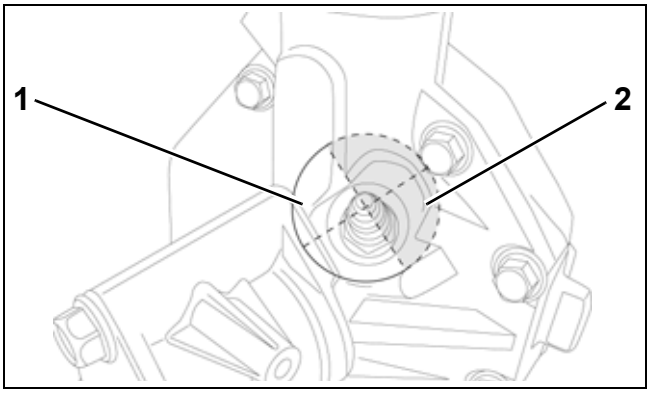
Put an ink mark on the ceramic of the spark plug that is in line with the OPEN side of the ground electrode. This mark will be used to orient the spark plug with the OPEN side of the ground electrode facing the fuel injector.



1. Ink mark 000758
2. Open side

Apply *Triple-Guard* grease to the gasket surface of the spark plugs. Install all spark plugs and tighten them 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 004294
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.

ELECTRIC STARTER SERVICING

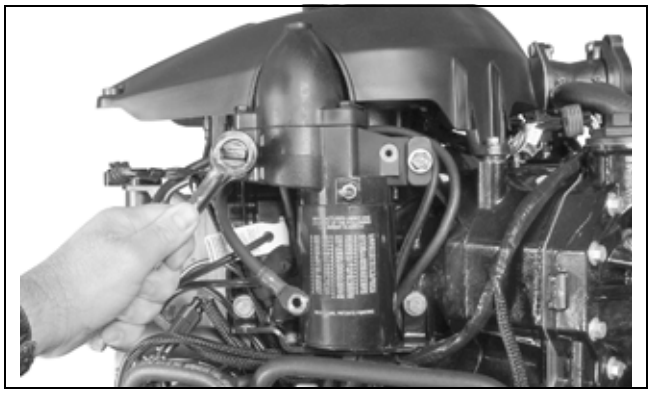
Removal

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

Disconnect the battery cables at the battery.

Remove the starter positive (+) cable.

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



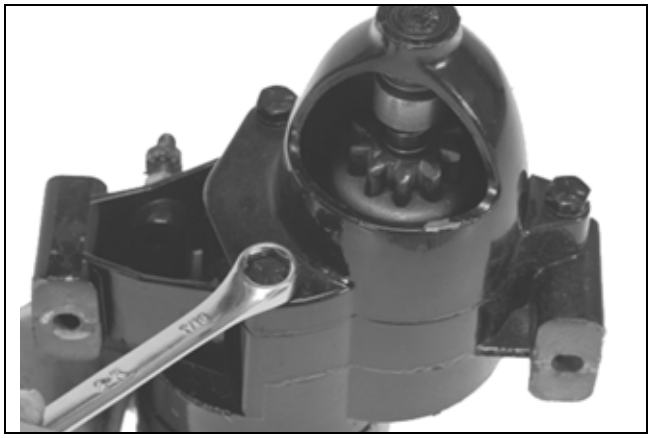
004181

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



30374

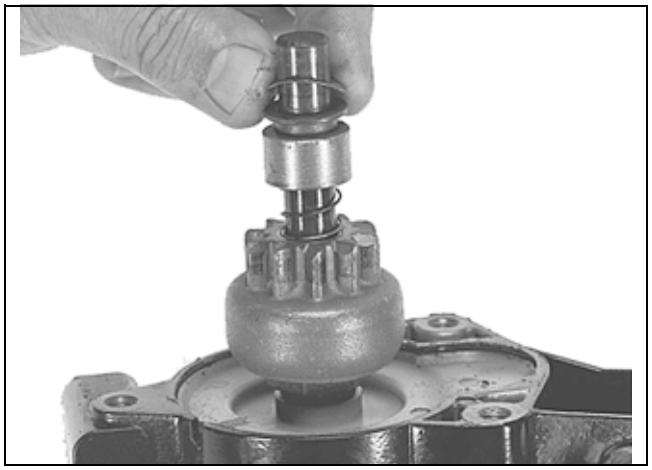
Remove the screws, lock washers, and pinion housing.



30373

Disassembly

Lift and remove the wave washer and bushing.



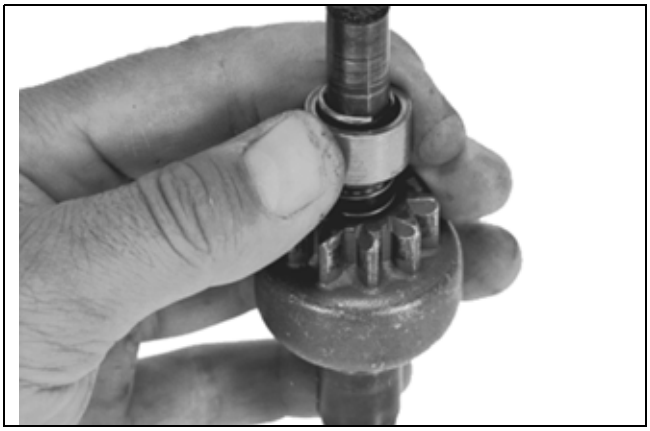
30372

Place an appropriate-sized deep socket on the spacer.

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

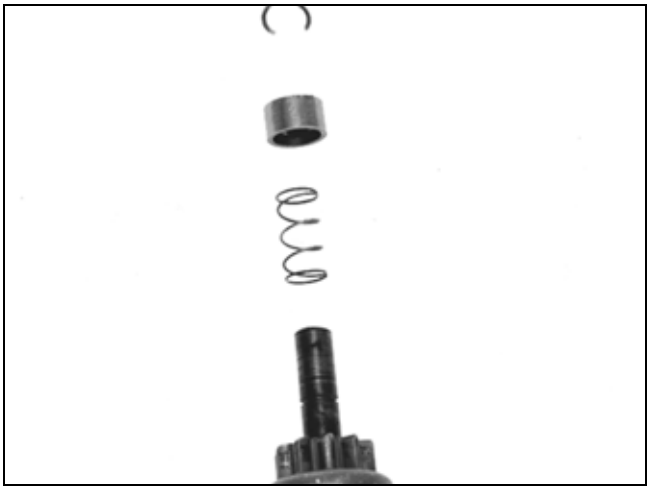


30371



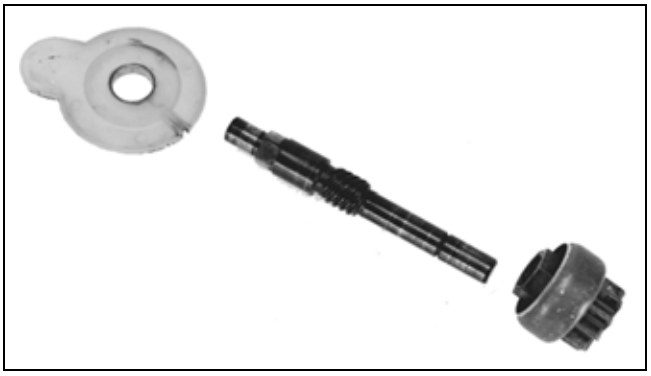
30360

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



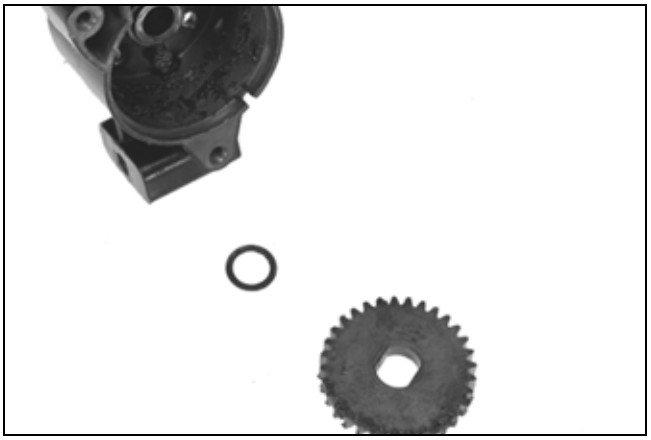
30369

Remove pinion and plastic weather cover from pinion shaft.



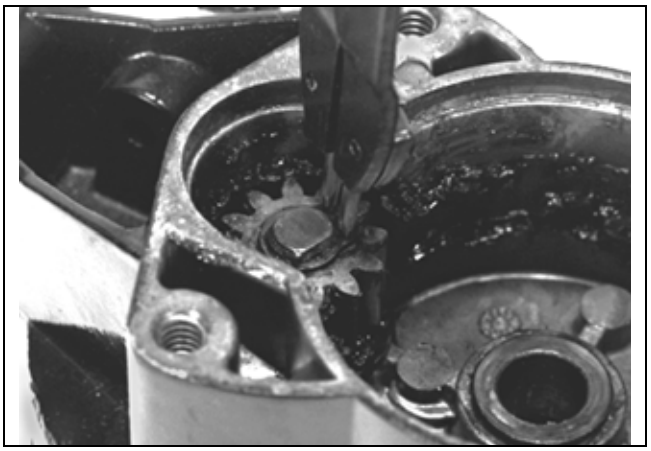
30368

Remove the driven gear and thrust washer.



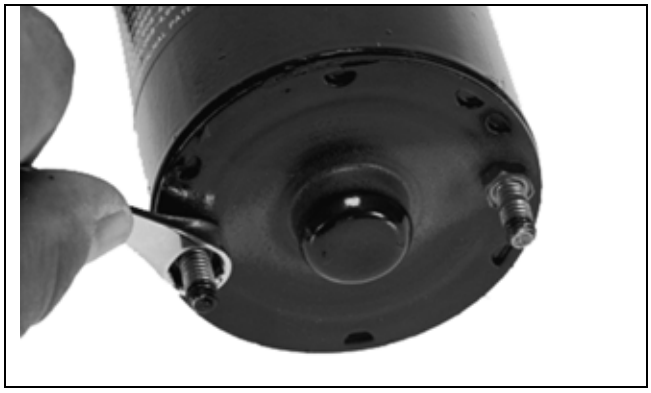
30367

Using No. 2 external retaining ring pliers, remove the retaining ring and drive gear from the armature shaft.



30366

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



30365

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

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



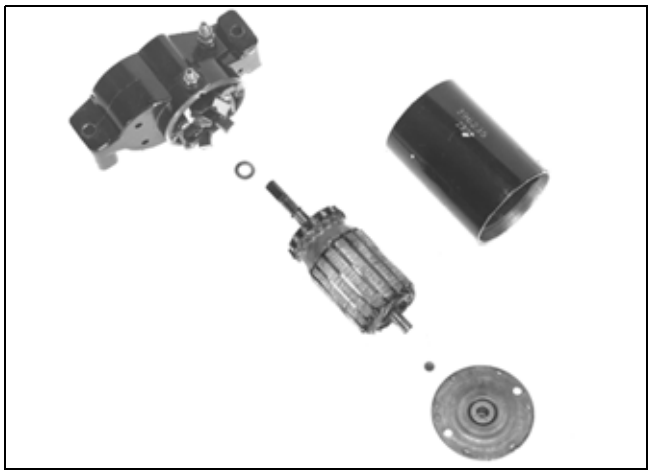
30354B

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



30352

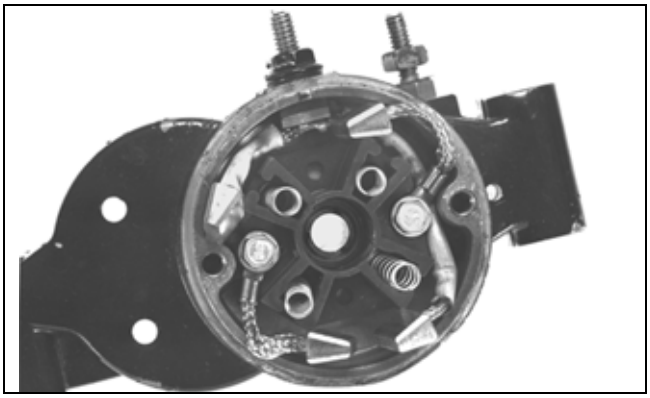
Slowly remove the armature and thrust washer. Do not lose the brush springs.



30351

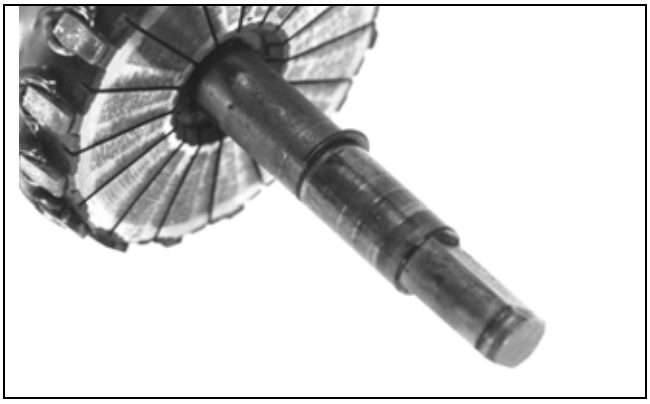
Cleaning and Inspection

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



30349

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

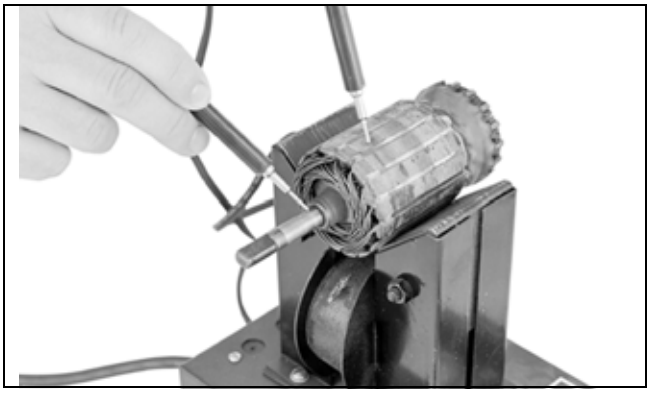


30345

Clean the commutator with 300-grade emery cloth. If commutator surface is unevenly worn or pitted, turn it on a lathe. Remove any trace of oil or metal dust from the commutator.

Check the armature on a growler for shorted turns using a test light or meter. Inspect armature insulation for indications of overheating or damaged windings. Clean off any carbon deposits or foreign

matter which could contribute to failure of windings.



TYPICAL 24058

Check permanent magnets. Make sure they strongly attract any steel or iron object held inside frame. Weak magnetism could cause excessive RPM on **No Load Current Draw Test** on p. 150.



TYPICAL 24057

After disassembling the drive, clean each part with *Cleaning Solvent* and inspect for wear and distortion.

If the pinion does not properly engage the flywheel, the pinion and screw shaft assembly could be worn, distorted, or dirty. Locate the cause of binding and correct it before completing the assembly.

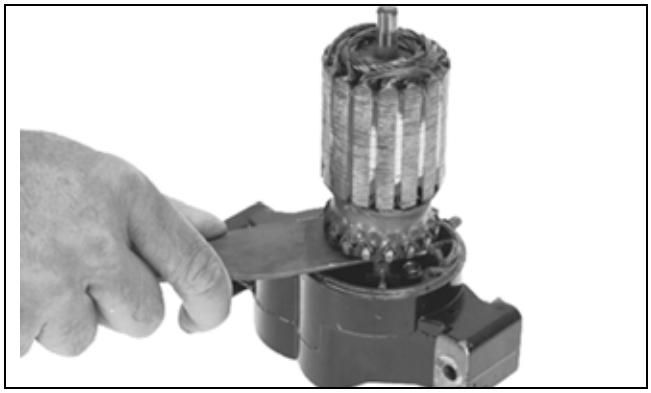
Inspect and replace end cap thrust washer if distorted or worn excessively.

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

Assembly

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

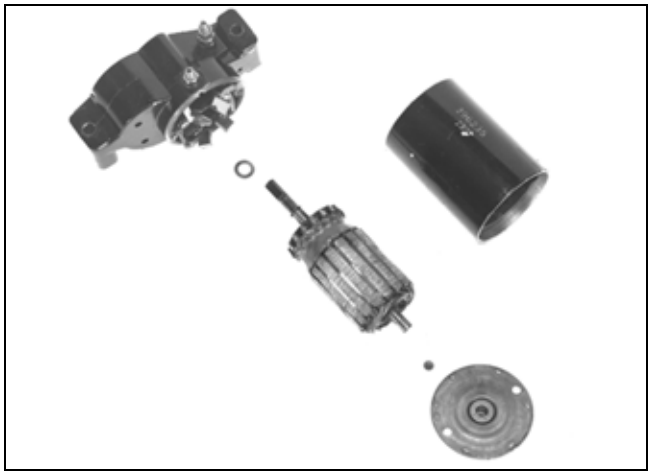
Route the brush leads and install the springs and brushes. Compress the spring with a modified putty knife.



30364

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

Apply *Extreme Pressure Grease* to the armature bushing. Install the thrust washer and armature.



30351

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

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



30352

Install insulator cap on end of shaft.



30354B

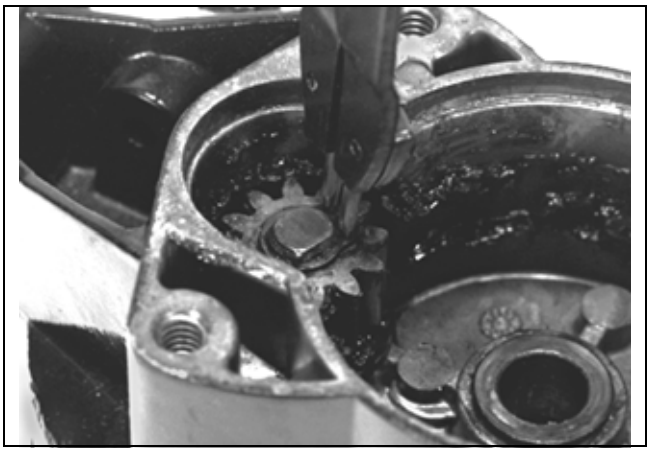
Apply a light coat of *Extreme Pressure Grease* to the end cap bearing, and install the end cap.

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



30363

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



30366

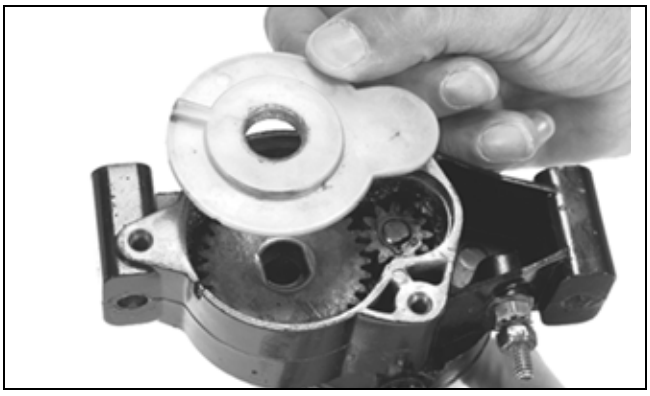
Lightly coat the gear housing bearing with *Extreme Pressure Grease*. Lightly coat the driven

gear with *Triple-Guard* grease. Install the thrust washer and driven gear.



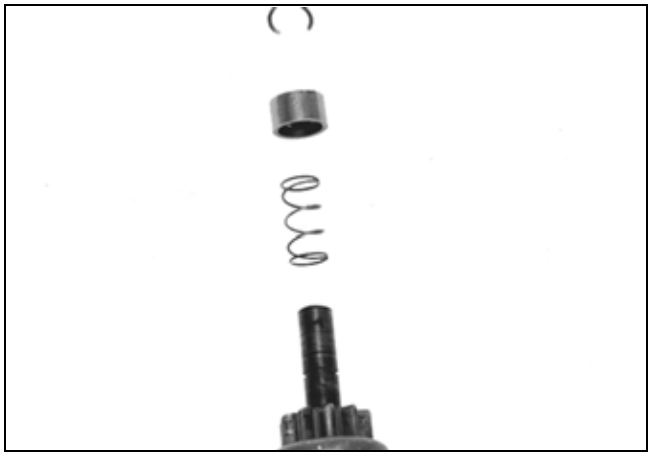
30362

Install the weather cover.



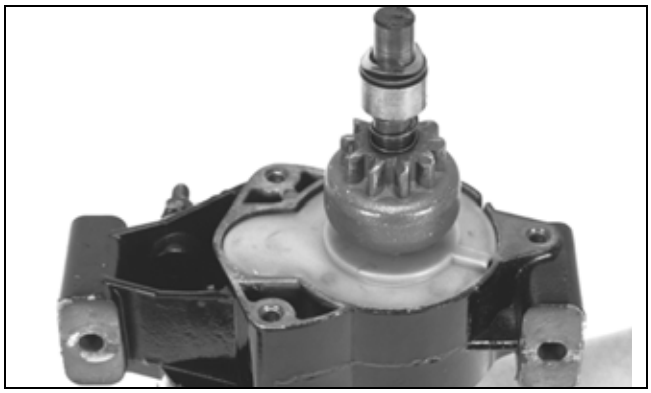
30361

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



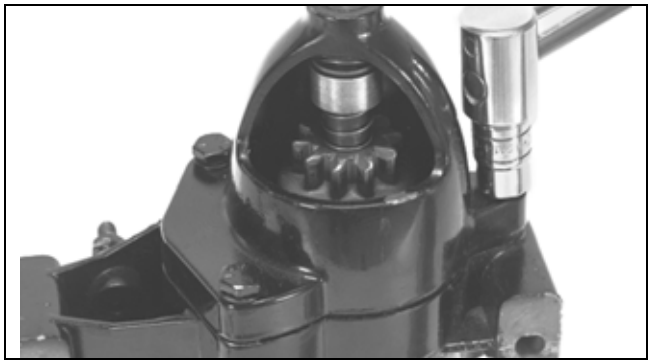
30369

Lightly coat the pinion shaft splines (helix) with *Starter Bendix Lube*. Lower the pinion into place without displacing the driven gear or thrust washer.



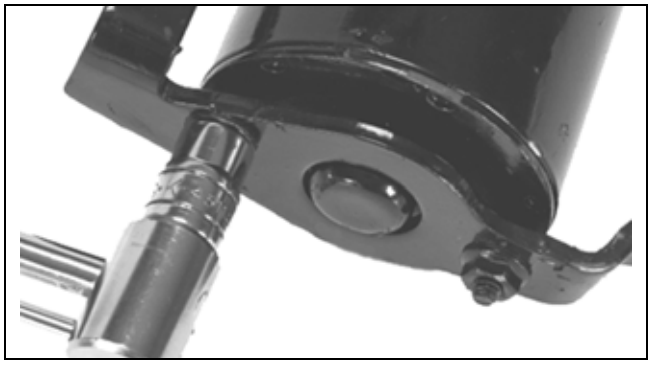
30359

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



30358

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



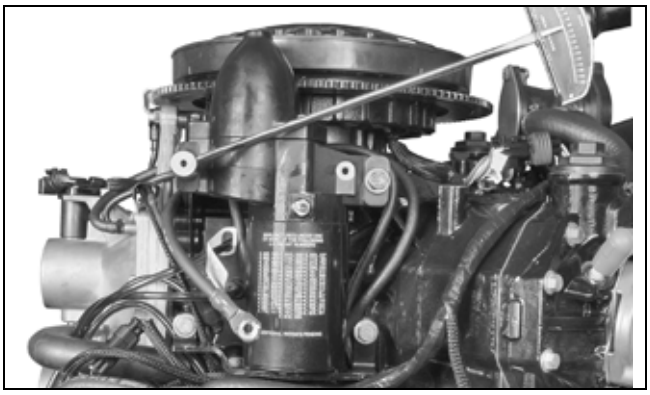
30357

To test the assembly and operation of the starter, refer to **No Load Current Draw Test** on p. 150.

Installation

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

First, tighten the top two screws, then the bottom two screws, to a torque of 168 to 192 in. lbs. (19.0 to 21.7 N·m).



004201

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

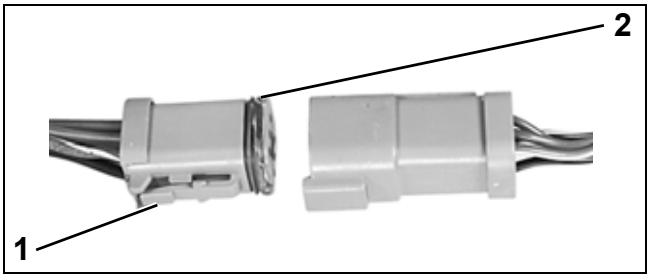
CONNECTOR SERVICING

DEUTSCH Connectors

IMPORTANT: *Electrical Grease* is recommended. Incorrect grease application can cause electrical or warning system problems.

To disconnect the connector, press the latch and pull the connectors apart.

To connect the connector, confirm that the seal is in place. Clean off any old grease and dirt from connectors. Apply a light coat of *Electrical Grease* to seal. Push connectors together until latched.

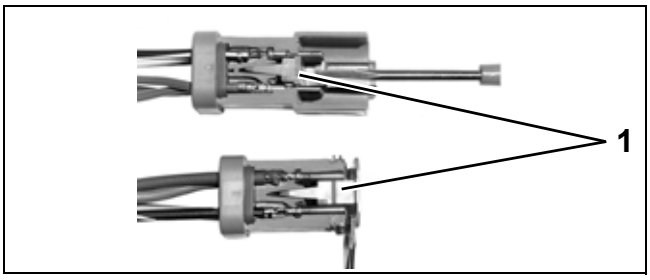


1. *Latch*
2. *Seal*

42079A

Terminal Removal

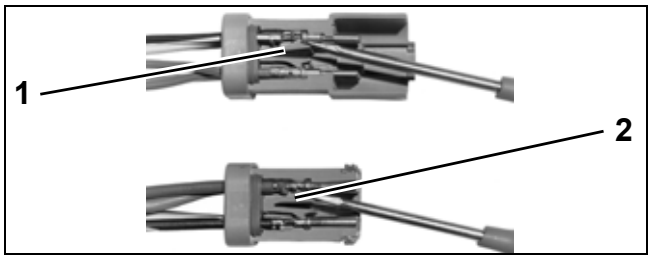
Use hook-end of Connector Service Tool, P/N 342667, to pull out wedge from receptacle, or use other end of tool to pry out wedge from plug. Use needle-nose pliers to remove wedge from 3-pin receptacle.



1. *Wedge*

42327

Release terminal latch and gently pull on wire.

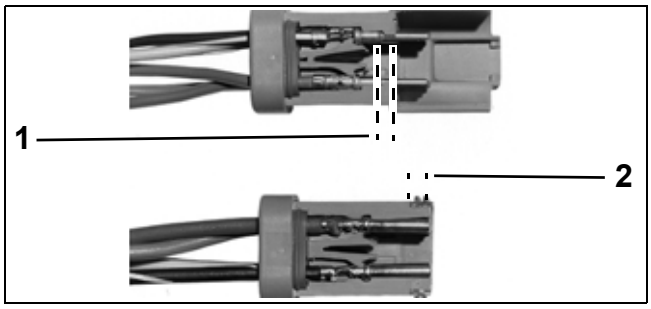


1. *Terminal latch (receptacle)*
2. *Terminal latch (plug)*

42329

Terminal Installation

Push terminal through seal until it locks into place. Fill connector with *Electrical Grease* to 1/32 in. (0.8 mm) below ledge or end of plug.



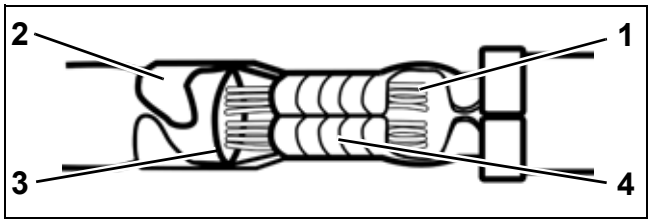
1. *Ledge of plug*
2. *End of plug*

42330

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

Crimping Terminals

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



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

DRC6205

AMP Connectors

IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals. Electrical grease is NOT used on *AMP* connectors.

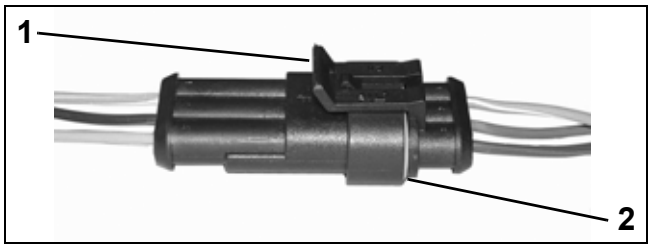
SUPERSEAL† 1.5

Disconnect

Lift latch. Pull connectors apart.

Connect

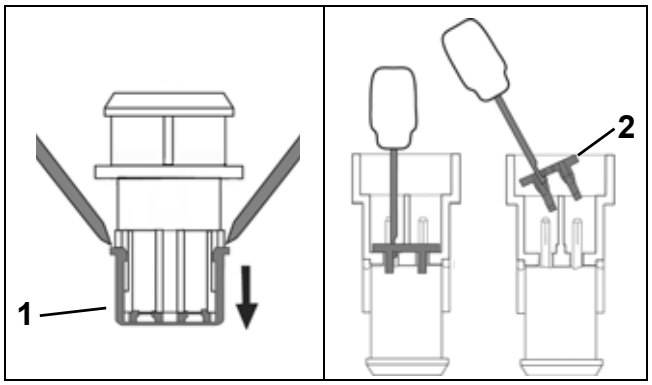
Confirm the seal is in place. Push connectors together until latched.



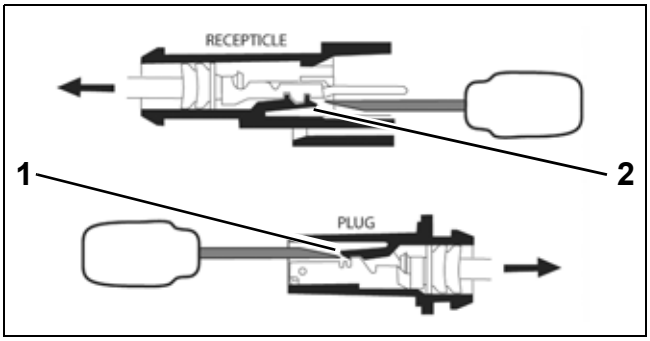
1. Latch 002448
2. Seal

Terminal Removal

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



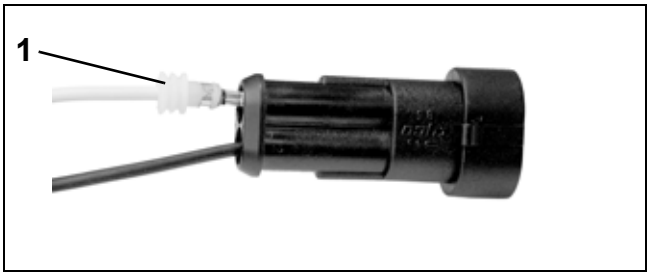
1. Anti backout device, plug 002449
2. Anti backout device, receptacle 002450



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

Terminal Installation

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



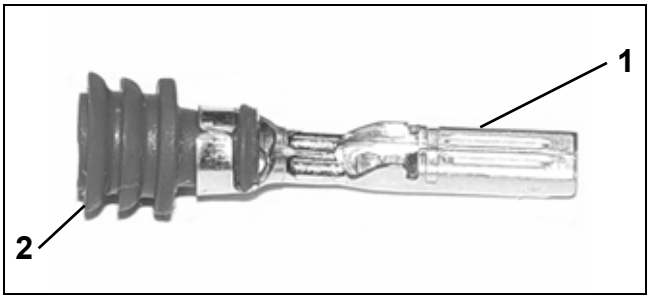
1. Terminal and seal 002451

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

Crimping Terminals

Crimping *Superseal 1.5* terminals requires 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 002452
2. Seal

SUPER SEAL†

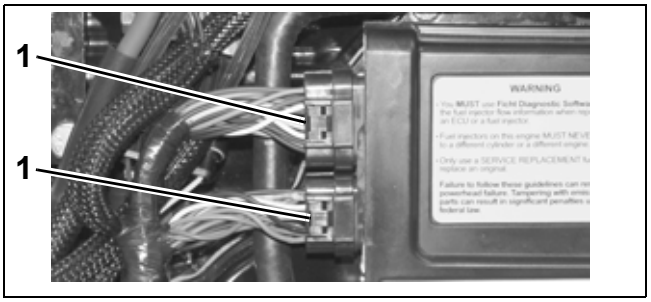
The J1-A and J1-B connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOTH latches and pull connector from plug.

Connect

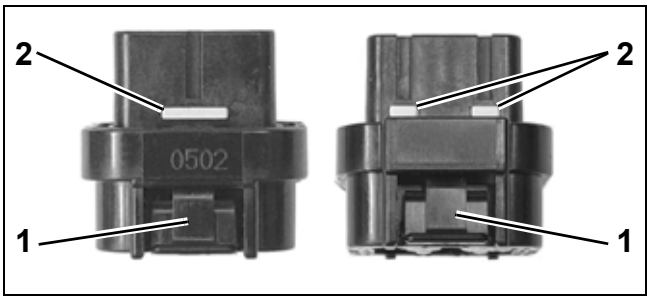
Push connector into plug until latches engage.



1. Latch 002118

Terminal Removal

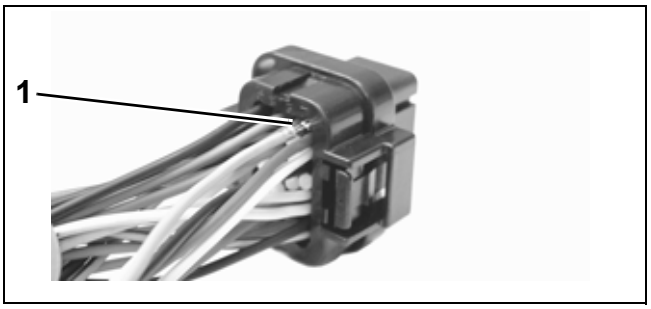
Open lock mechanism and remove terminal from connector housing.



1. Latch
2. Lock mechanism 002453

Terminal Installation

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



1. Terminal 002454

POWER TIMER† *SERIES*

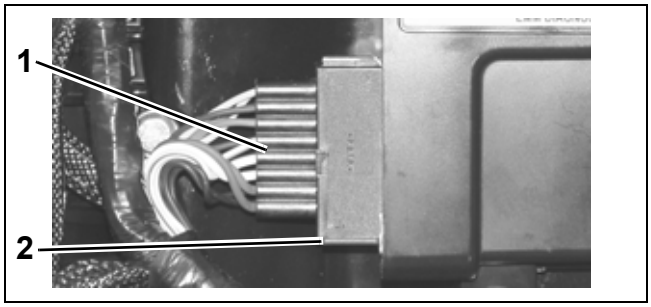
The J2 connector of the *EMM* is a *AMP Power Timer Series* connector.

Disconnect

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

Connect

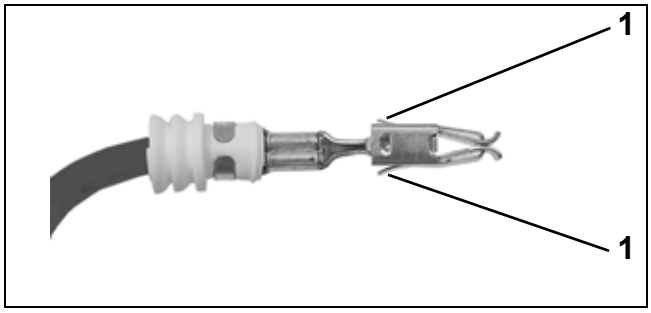
Push connector until seated in plug. Close latch completely.



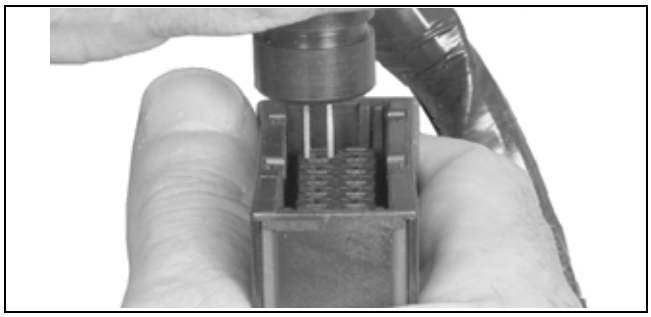
1. J2 connector 002120
2. Latch (closed)

Terminal Removal

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



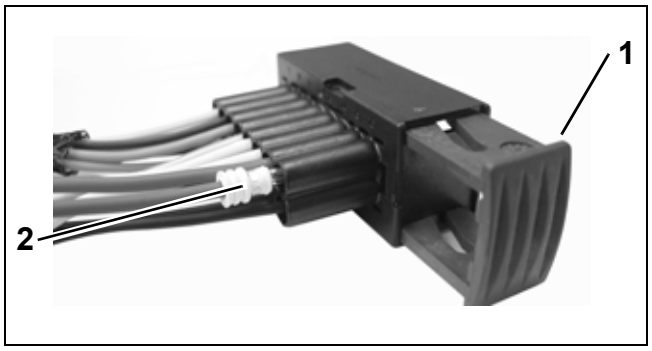
1. Locking mechanism(s) 002455



1. Terminal release tool 002313

Terminal Installation

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



1. Latch 002456
2. Terminal with seal

Packard† Connectors

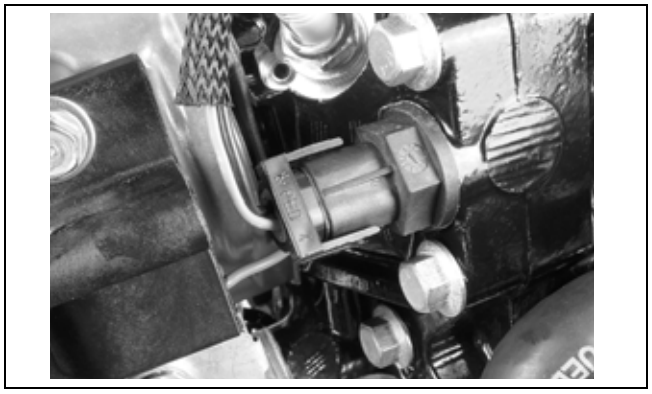
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

Disconnect

Lift latch(s). Remove connector.

Connect

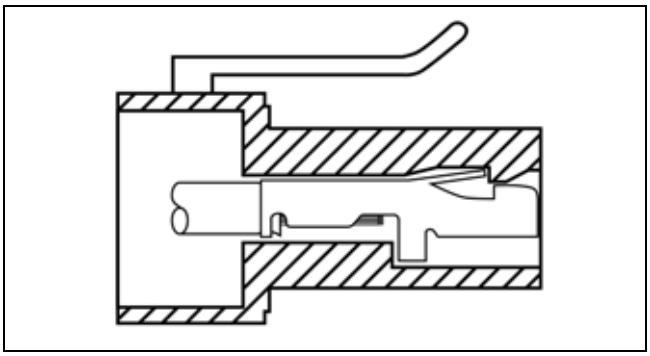
Confirm the seal is in place. Push connector onto housing until latched.



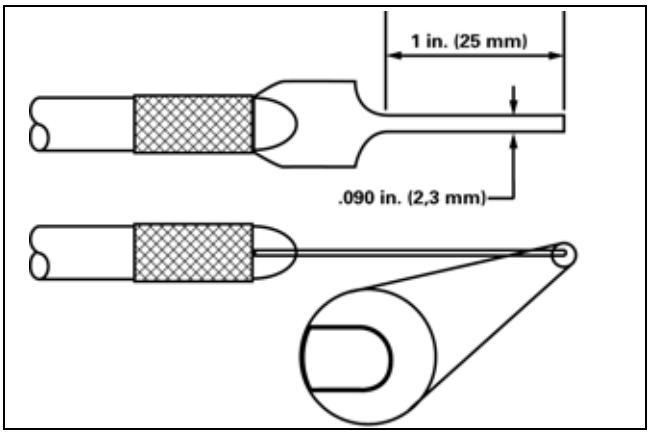
Terminal Removal

A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place. The terminal is removed by 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 170
COMPONENTS 173
- FUEL LIFT PUMP 173
- FUEL FILTER 173
- VAPOR SEPARATOR 173
- FUEL CIRCULATION PUMP 174
- FUEL MANIFOLDS 175
- FUEL INJECTORS 175

FUEL SYSTEM HOSE ROUTING 176
DIRECT INJECTION ELECTRICAL CIRCUITS 177
- INJECTOR / CIRCULATION PUMP CIRCUITS DIAGRAM 178

FUEL COMPONENT TESTS 179
- FUEL INJECTORS 179
- FUEL SUPPLY 180

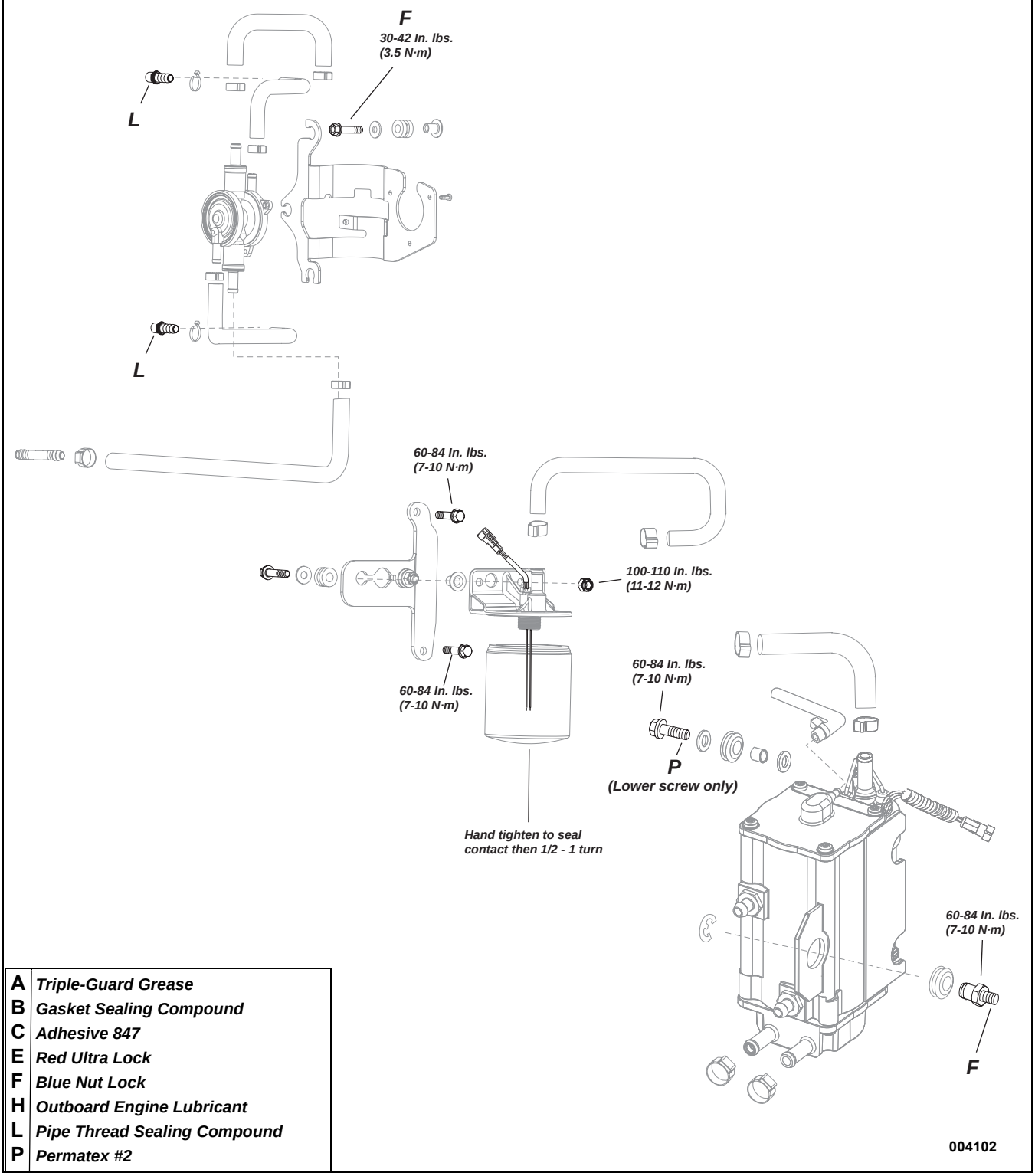
FUEL COMPONENT SERVICING 184
- RELIEVING FUEL SYSTEM PRESSURE 184
- FUEL FILTER 185
- FUEL LIFT PUMP 185
- VAPOR SEPARATOR 186
- FUEL INJECTORS 187
- FUEL MANIFOLDS 190

INTAKE MANIFOLD 191
- REMOVAL 191
- DISASSEMBLY 191
- INSPECTION 192
- ASSEMBLY 192
- INSTALLATION 193

NOTES 194

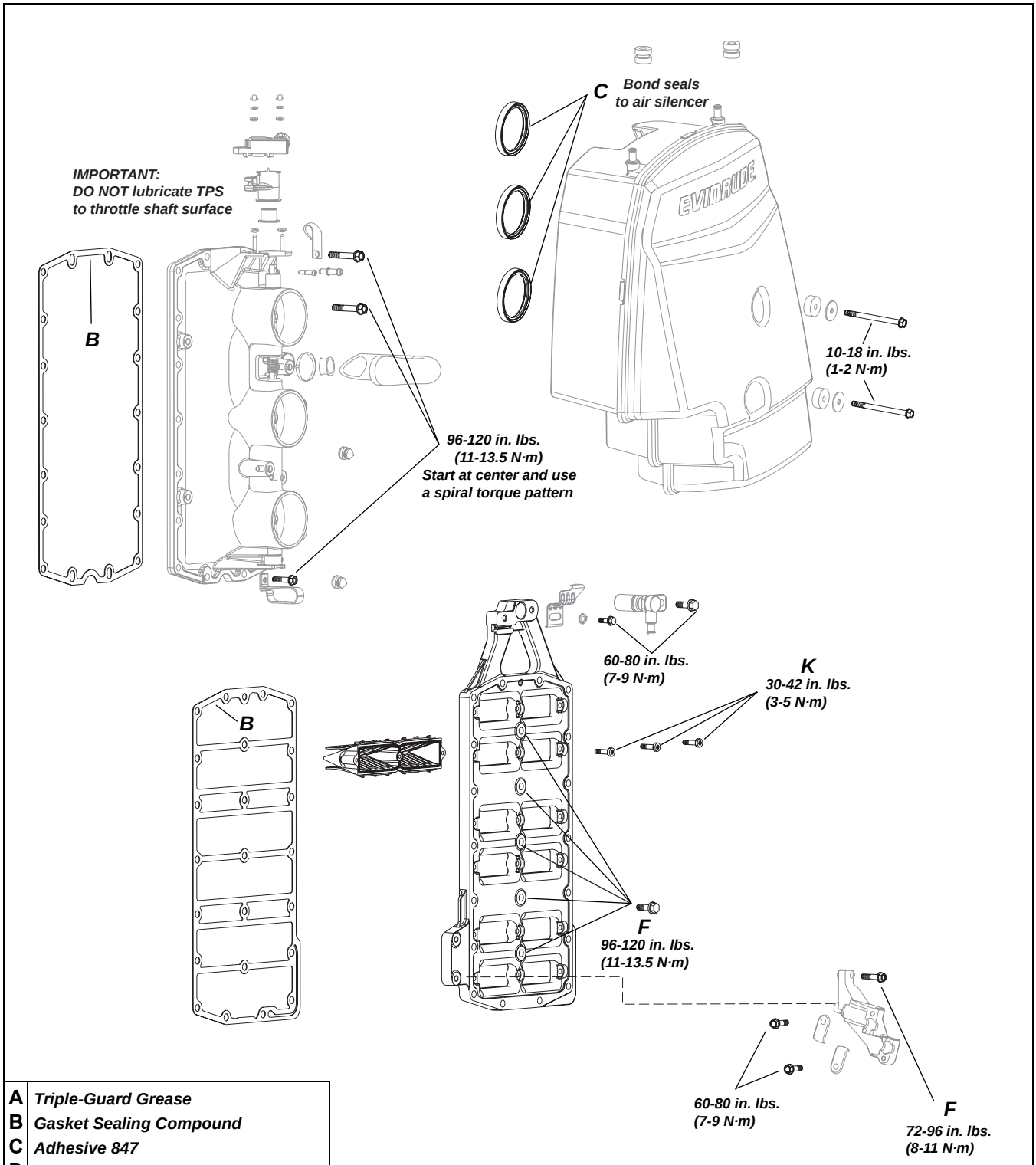
SERVICE CHART

FUEL PUMP, FUEL FILTER, VAPOR SEPARATOR



A	***Triple-Guard Grease***
B	***Gasket Sealing Compound***
C	***Adhesive 847***
E	***Red Ultra Lock***
F	***Blue Nut Lock***
H	***Outboard Engine Lubricant***
L	***Pipe Thread Sealing Compound***
P	***Permatex #2***

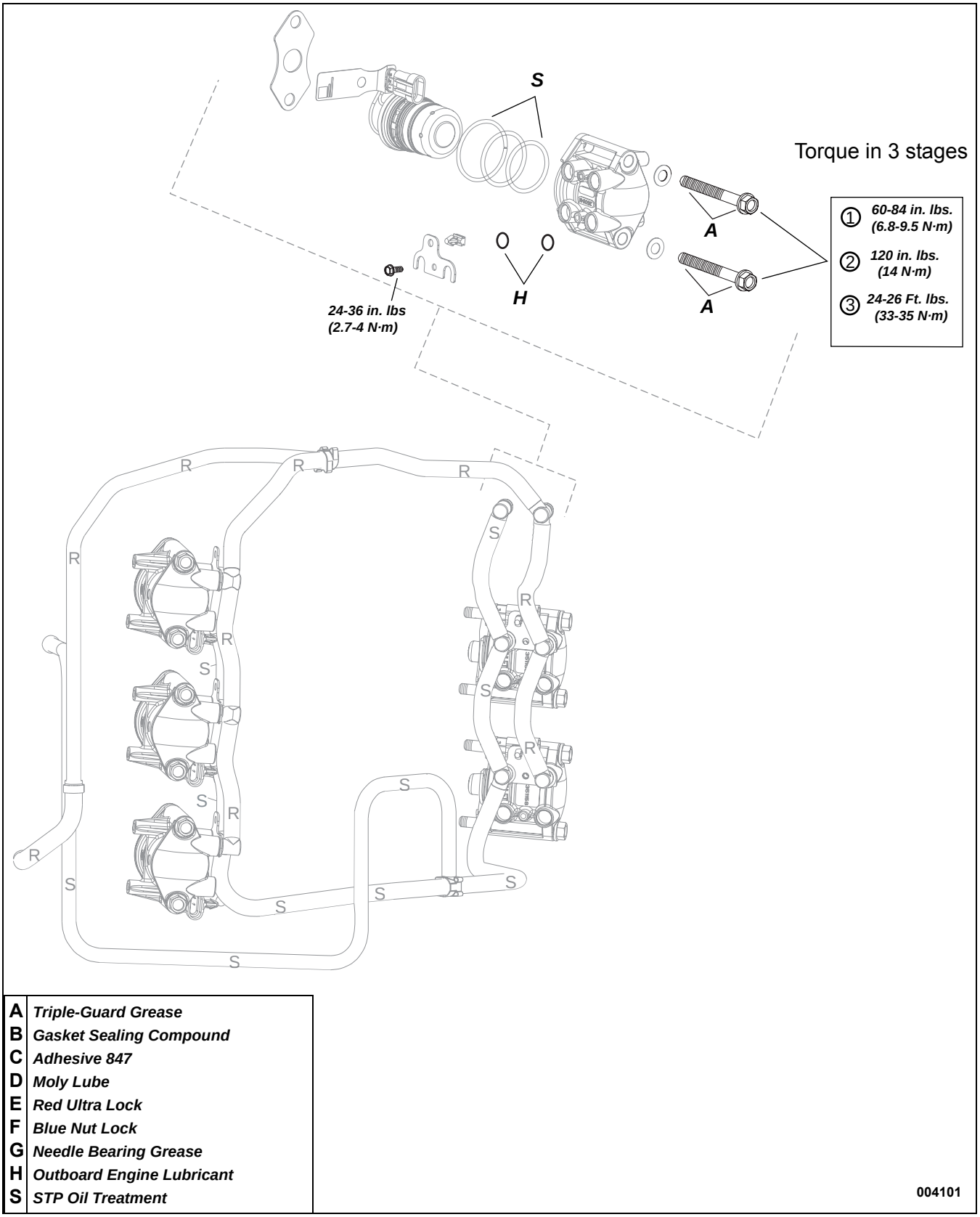
REED PLATE ASSEMBLY AND THROTTLE BODY



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*
K	*Purple, Screw Lock*

004099

FUEL MANIFOLDS AND INJECTOR



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	***Outboard Engine Lubricant***
S	***STP Oil Treatment***

004101

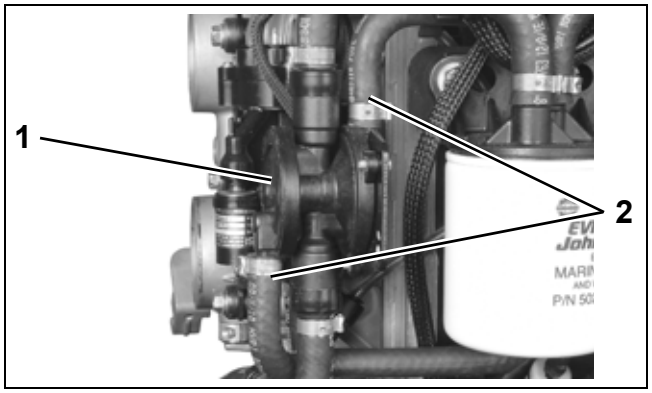
COMPONENTS

The *Evinrude E-TEC* direct injection system consists of the following components:

- Fuel Lift Pump
- Water Separating 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 hoses that connect to cylinders 3 and 6 of the cylinder/crankcase assembly.



1. Fuel lift pump 005023
2. Pulse hoses

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.

IMPORTANT: The oil injector supplies oil to the outboard's incoming fuel supply. A limited amount of oil is injected into the fuel supply to clean injectors and reduce internal fuel system deposits. Refer to **Oil Supply and Distribution Diagram** on p. 203.

Fuel Filter

The water separating fuel filter protects the vapor separator and the high-pressure components of the fuel system from water and contaminants. Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 80 for service frequency.



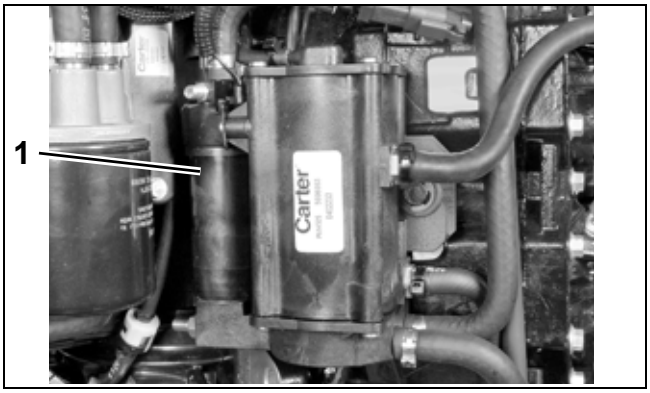
1. Filter 005022

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; and
- 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 004186
1. Circulation pump

7

Fuel Reservoir

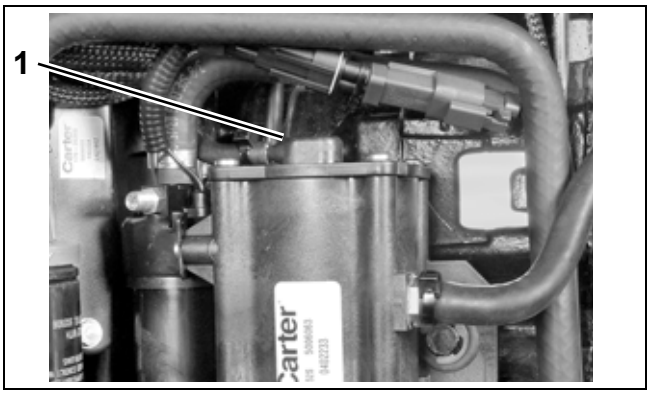
The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Cooling

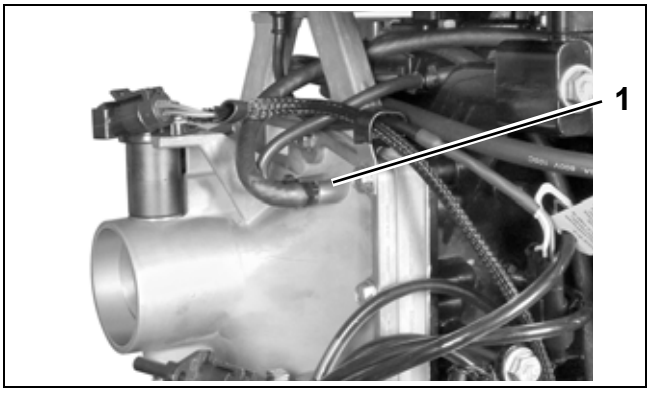
Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically. Refer to **HOSE ROUTING AND WATER FLOW DIAGRAM** on p. 216.

Venting

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



1. Vent 004187



1. Vent hose connection to intake 004188

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

As the vapor pressure in the vapor separator decreases, the fuel level begins to increase. An increase in the fuel level raises the float valve and the vent closes.

Pressure Regulator

The fuel pressure regulator helps maintain consistent fuel pressure in the fuel system.

Fuel returning from the injectors enters the fuel chamber of the vapor separator through a pressure regulator. The pressure regulator maintains approximately 20 to 30 psi (138 to 207 kPa) of fuel pressure in the high pressure side of the fuel system.

Fuel Circulation Pump

The fuel circulation pump is an electric high pressure fuel pump. The pump is controlled by the *EMM.*

Fuel Supply

The pump is mounted to the vapor separator and draws fuel from the fuel chamber. The fuel injectors receive pressurized fuel from a fuel supply manifold connected directly to the circulation pump.

Electrical Circuit

Activation of the circulation pump is controlled by the *EMM* and operates on the 12 V circuit. The circulation pump is activated momentarily when the *EMM* powers up.



005024

Fuel Manifolds

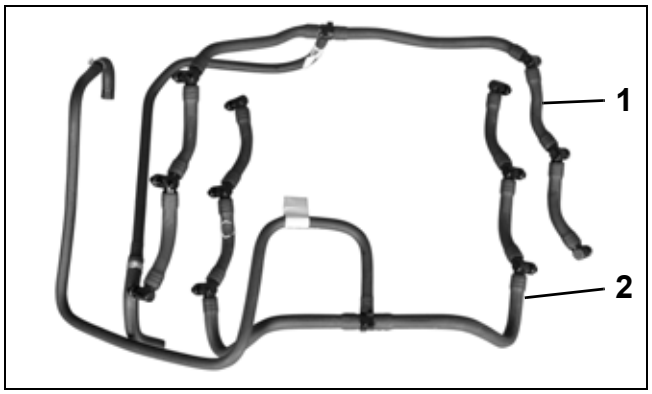
The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

Fuel Supply Manifold

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

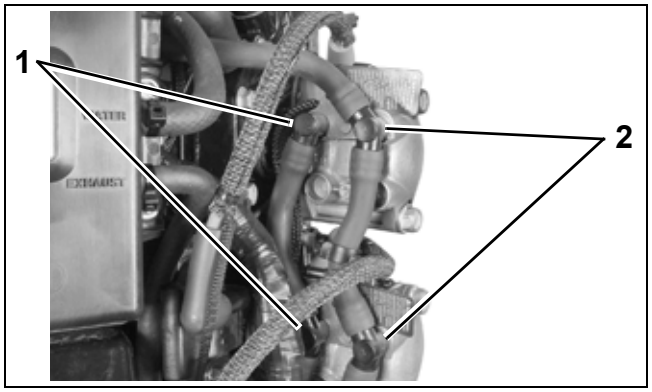
Fuel Return Manifold

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 return manifold
2. Fuel supply manifold

004242



1. Inlet ports
2. Return ports

004246

Fuel Injectors

Fuel injectors are fuel metering (55 V), electric injector pumps bolted directly to the cylinder head. The *EMM* supplies 55 V and controls the activation of each injector.

Fuel Flow Compensation

Flow tests included in the injector manufacturing process measure the flow rates of each injector. Each injector's fuel flow rate is recorded and converted to specific coefficients. These coefficients are assigned to the injector by serial number.

Each individual service injector includes these coefficients on a 3.5 in. floppy disk. This software information enables the *EMM* to control each injector based on unique fuel flow characteristics.

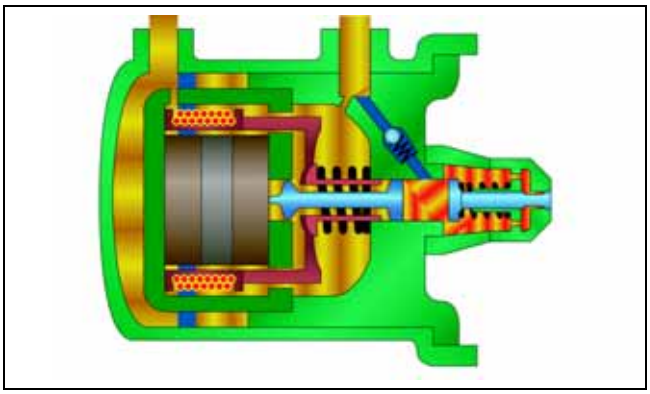
IMPORTANT: The cylinder location of each injector must always be maintained. *EMM* programming is associated with the cylinder location of each injector.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply manifold.

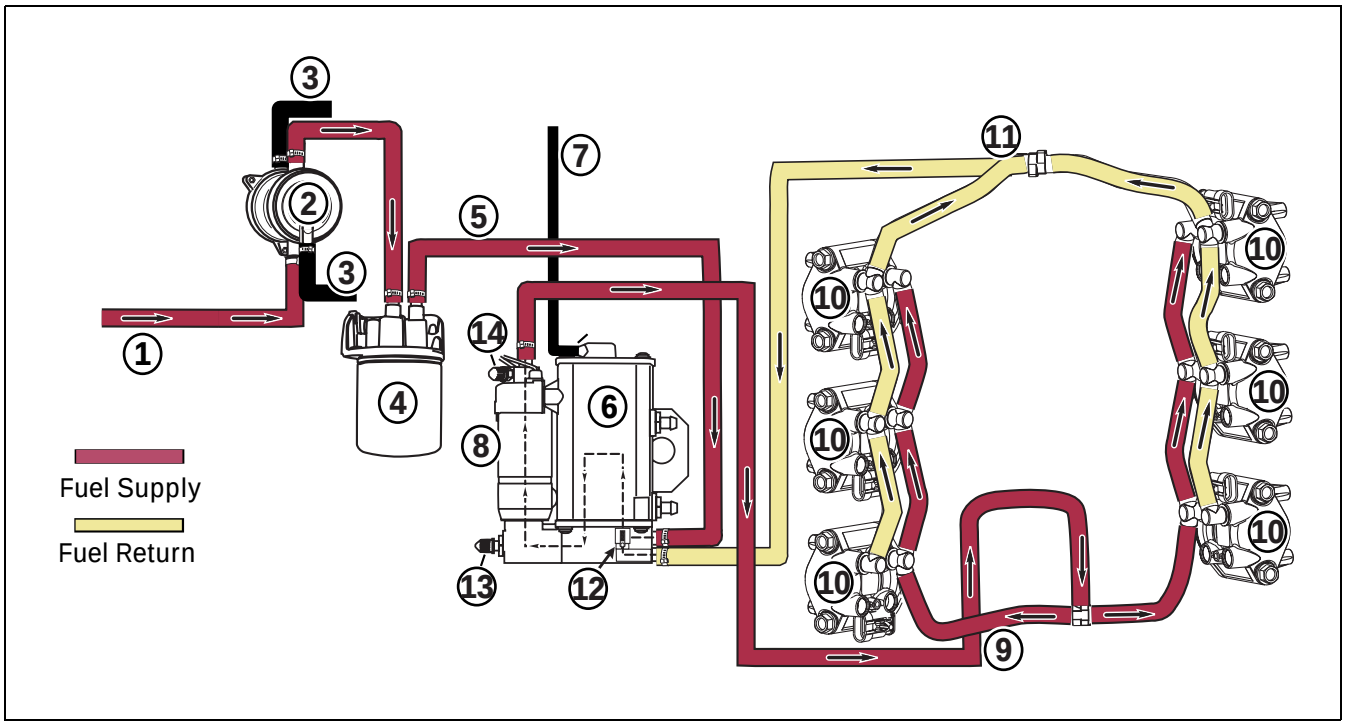
Each injector has internal fuel passages. These passages are designed to:

- Provide fuel to the injector's injection chamber
- Route fuel through the injector housing to cool the injector coil and armature.



005333

FUEL SYSTEM HOSE ROUTING



003985

1. Fuel supply from boat fuel system
2. Fuel lift pump (2 to 8 psi)
3. Pulse hose(s) from cylinder/crankcase (3 & 6)
4. Water Separator / Fuel filter
5. Fuel supply to vapor separator
6. Vapor separator
7. Vent hose to throttle body
8. Electric fuel circulation pump (20 to 35 psi)
9. Fuel supply manifold
10. Fuel injector(s)
11. Fuel return manifold
12. Pressure regulator (high pressure)
13. Test fitting (low pressure)
14. Test fitting (high pressure)

DIRECT INJECTION ELECTRICAL CIRCUITS

The outboard's 55 V alternator circuit supplies the injectors with the necessary current. Unique circuits from the *EMM* distribute this current to the specific injector.

The *EMM* controls injector operation by rapidly connecting and disconnecting one side of each component's internal coil to ground. Current must flow from the *EMM* to the injectors, through the winding of the component, back to the *EMM*, and through the *EMM* to ground. The injector's internal coil provides approximately 3 ohms of resistance in the injector circuit.

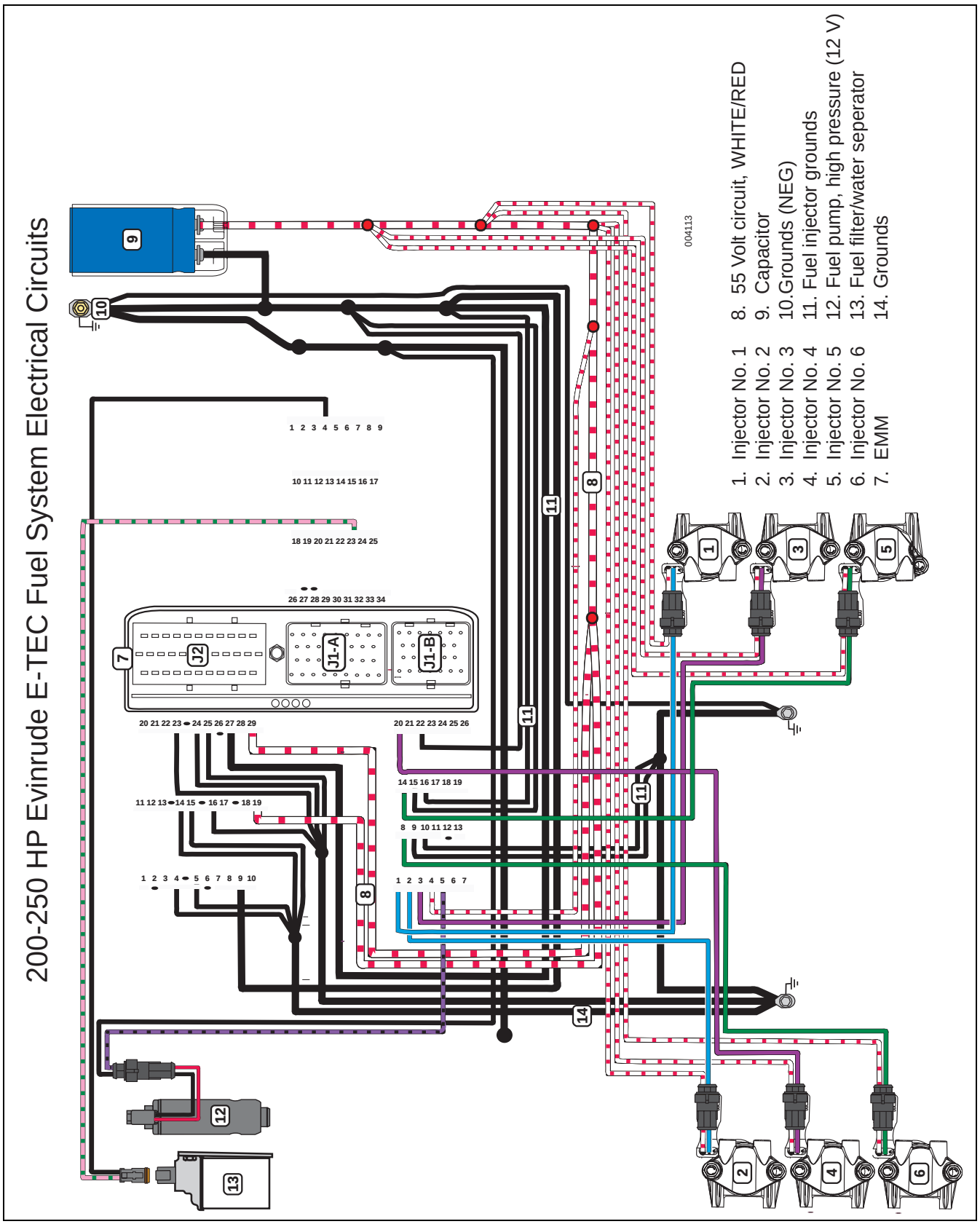
Requirements for injector activation:

- 55 V system voltage from the *EMM* and through the individual circuits; and
- Switched ground connection provided by the *EMM.*

IMPORTANT: System voltage (55 V) output is produced by stator input to *EMM* and rectifier circuits of *EMM*.

Refer to **FUEL DELIVERY** on p. 131 for additional test procedures.

Injector / Circulation Pump Circuits Diagram



FUEL COMPONENT TESTS

⚠ 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 ⚠

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 Injectors

Pressure Test

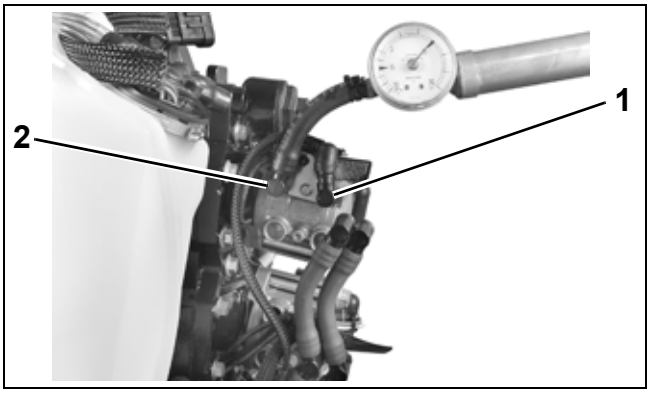
This test requires Injector Test Fitting kit, P/N 5005844.

Disconnect the battery cables at the battery.

Relieve fuel system pressure. See **Relieving Fuel System Pressure** on p. 184.

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 and 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 002379
2. Inlet fitting

Static Test

Use the *Evinrude* Diagnostics Software program to test circulation pump and fuel injectors.

Refer to **FUEL DELIVERY** on p. 131 for additional test procedures.

IMPORTANT: Static tests are performed when outboard is not running. Listen carefully for fuel pump and injector activation. These tests are operating components on battery voltage. The

fuel pump uses 12 V circuit and the injectors use 55 V circuit.



Static Tests Screen 005155

Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter to measure the injector circuit and coil resistance.

Fuel Injector Coil Resistance
2 to 3 Ω @ 72°F (22°C)

Use electrical test probe kit, P/N 342677, and a multimeter to check resistance. Wire harness adaptor leads, P/N 342228 can be used to make connection at EMM J1-B connector.

Measure resistance between pin 1 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.



004342

Fuel Supply

Fuel System Pressure Test

Relieve fuel system pressure. See **Relieving Fuel System Pressure** on p. 184.

After relieving fuel system pressure, install a 0 to 100 psi (0 to 690 kPa) Fuel Pressure Gauge, P/N 5000902 or equivalent, to the upper fuel pressure test fitting.



1. Fuel pressure gauge 004324
2. Test fitting

START outboard and check pressure. System pressure should be 20 to 35 psi (138 to 241 kPa).

Shut OFF outboard. Monitor pressure gauge. Pressure should not drop below 15 psi (103 kPa).

IMPORTANT: If outboard does not run, prime fuel system and crank outboard; check circulation pump operation; check fuel system pressure.

Results:

Normal pressure

- Observe pressure reading after outboard is shut OFF.
- Proceed to **Lift Pump Pressure Test** on p. 182.

Pressure drops after outboard shut OFF

- Leaking fuel injector
- Leaking pressure regulator
- External fuel system leak

High pressure
- Suspect 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. 182. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted fuel filter/water separator assembly.
- Lift pump not supplying adequate fuel to vapor separator. Refer to **Lift Pump Pressure Test** on p. 182.
- If the above requirements are met and vapor separator remains full of fuel, suspect damaged circulation pump. Replace vapor separator assembly.

No pressure
- Check electrical circuit and ground connections for circulation pump.
- Voltage present and pump does not run. Repair connection or replace vapor separator assembly.

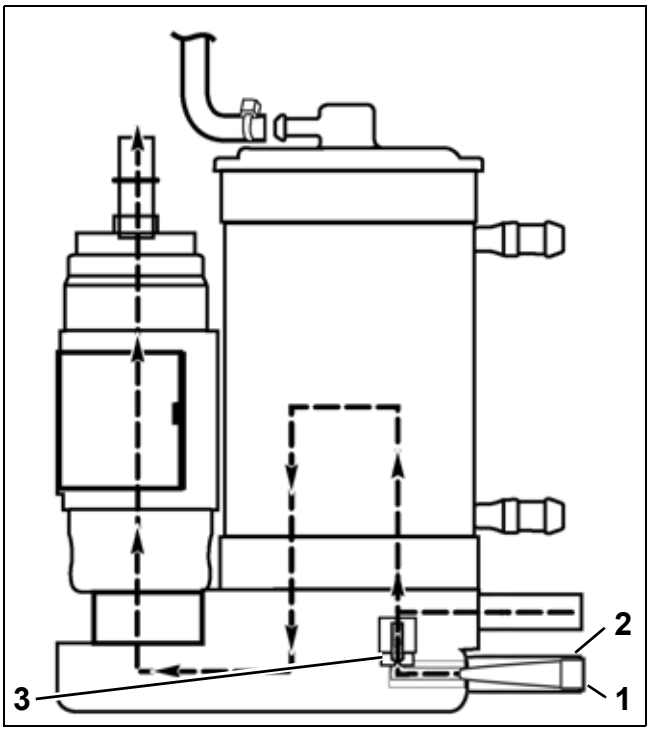
Pressure Regulator Test

Refer to **Vapor Separator** on p. 186 to remove vapor separator.

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

Apply oil to valve and connect pressure pump and hose to the fuel return fitting of vapor separator.

Apply pressure to check regulator operation. The pressure should open check valve at approximately 15 psi (103 kPa).



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

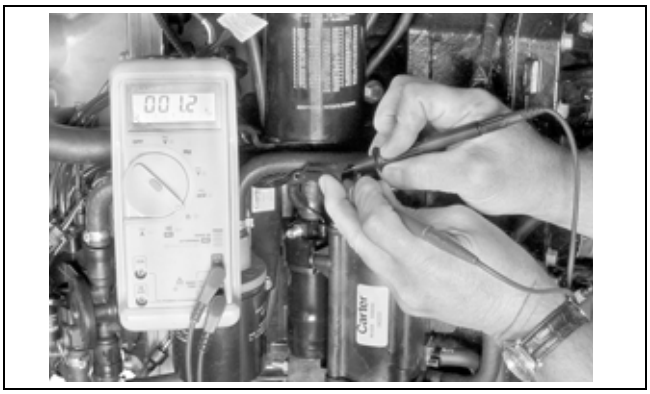
000249

Circulation Pump Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter to measure the fuel pump circuit and coil resistance.

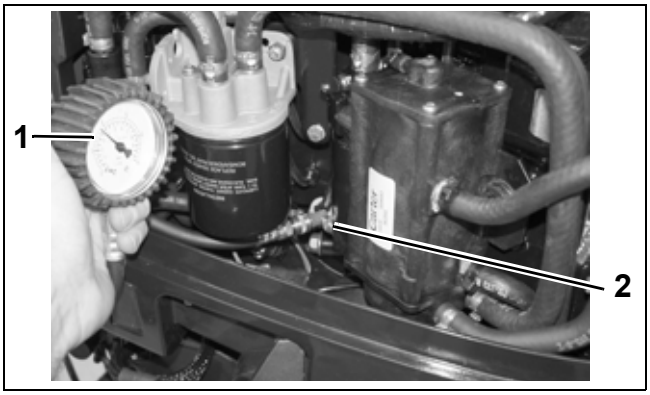
Fuel Pump Resistance
1 Ω @ 77°F (25°C)



004217

Lift Pump Pressure Test

Install a 0 to 15 psi (0 to 103 kPa) Fuel Pressure Gauge, P/N 5006397 or equivalent, to the lower fuel pressure test fitting.



1. Fuel pressure gauge
2. Test fitting

004587

Prime the fuel system and check for leaks. START outboard and run at idle speed. Hold gauge level with inlet fitting and monitor gauge for pressure reading.

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

Results:

Normal pressure

- Perform the **Lift Pump Vacuum Test** on p. 182. Make certain 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. 182. 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

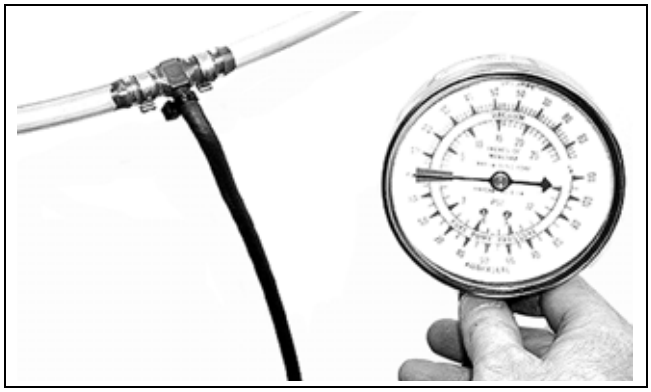
- Check pulse hoses and fittings restrictions.
- Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
- Momentarily prime or squeeze primer bulb to check gauge operation.
- Check pulse hose and fittings for restrictions.

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. 41 for fuel supply component requirements.

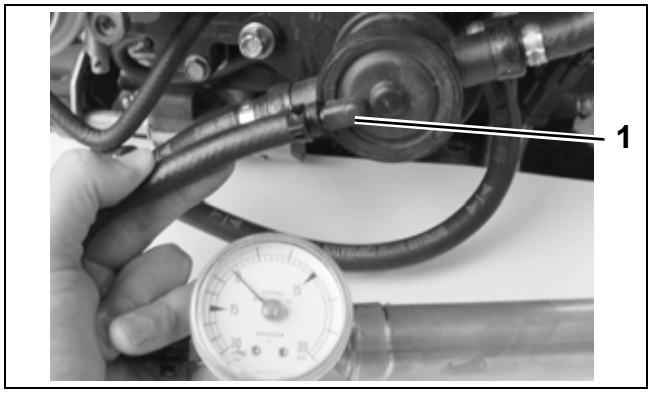
Lift Pump Diaphragm Test

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

Pump diaphragms can be pressure tested by removing both pulse hoses from the crankcase fittings.

Apply 15 psi (103 kPa) to each of the pulse hoses of the pump. Both sides of pump should hold pressure.

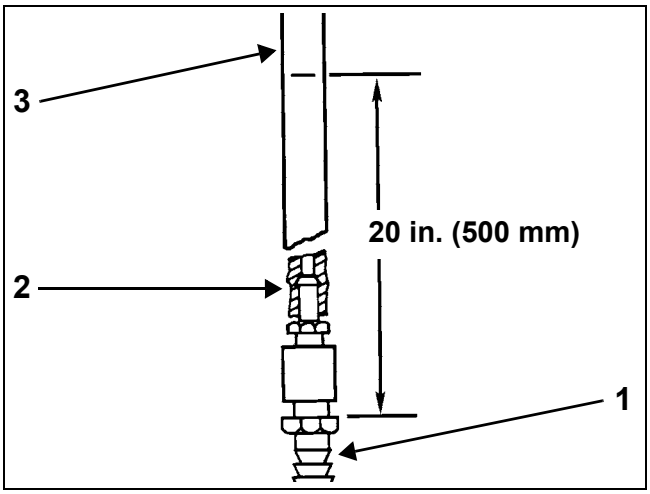
Replace lift pump if either side fails to hold pressure.



1. Pulse fitting 000670

Anti-Siphon Valve Test

Remove anti-siphon valve from fuel tank. Install adapter fittings and a 36 in. (91.4 cm) length of clear hose to the inlet side (tank end) of valve.



1. Anti-siphon valve 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 Fuel Pressure Gauge, P/N 5007100 or P/N 5000902, to top test fitting of high pressure fuel pump/vapor separator assembly.

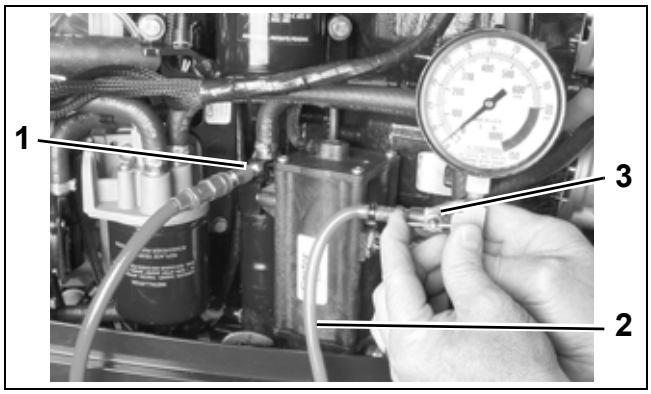


1. Shop towel 004335

Insert venting hose of gauge into a suitable container.

Slowly open gauge's venting valve.

Clean up any spilled fuel with shop towels.



1. Test fitting 004334
2. Venting hose
3. Venting valve

Fuel Filter

Removal

Disconnect the battery cables at the battery.

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

Inspect contents for any presence of water. If water is present, identify the source and correct the problem. Take additional fuel samples and drain fuel tank(s), if necessary.



1. Fuel filter 005022

Installation

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

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

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

Connect battery cables.

Run outboard and check for fuel leaks.

Fuel Lift Pump

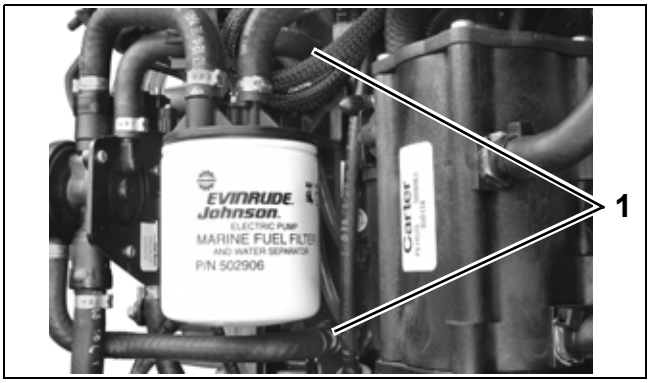
The fuel lift pump is serviceable as a complete assembly. Refer to parts catalog for service parts.

Removal

Disconnect the battery cables at the battery.

Remove air silencer.

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



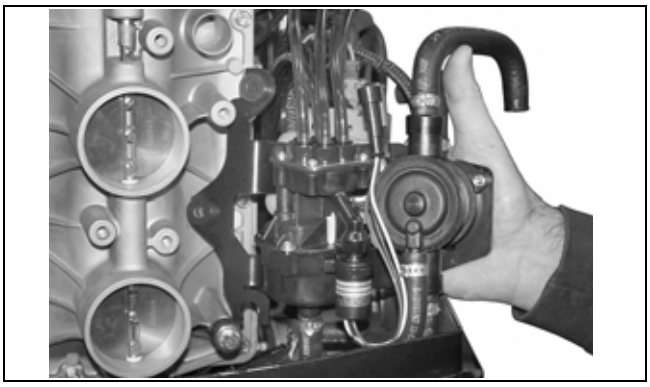
1. Pulse hose crankcase fitting 005028

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

Disconnect the fuel outlet hose from the fuel filter housing.

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

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

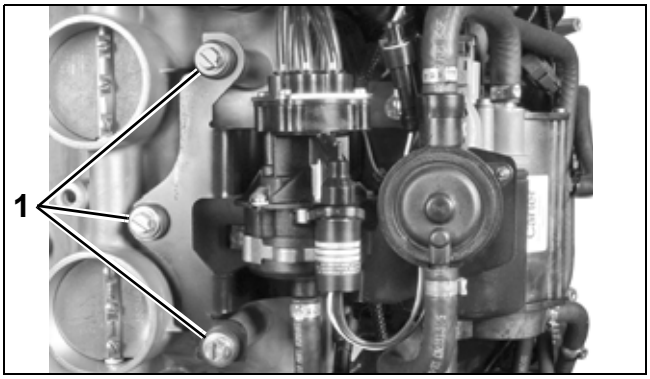


004333

Installation

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

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



1. Screws 004220

Connect the fuel outlet hose to the fuel filter. Secure with 18.5 mm *Oetiker* clamp.

Connect the fuel supply hose to the in-line fitting. Secure with 18.5 mm *Oetiker* clamp.

Route and connect the fuel lift pump pulse hoses to the crankcase. Secure with tie straps.

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

Install oil injection pump on bracket with clamp and screw.

Install air silencer and connect battery cables.

Run outboard and check for fuel leaks.

Vapor Separator

Removal

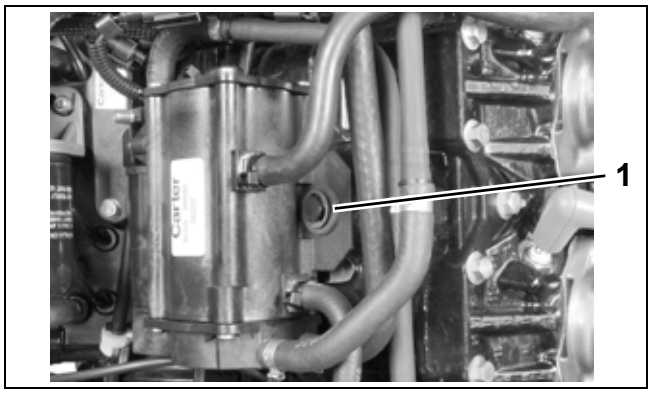
Disconnect the battery cables at the battery. Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 184.

Disconnect circulation pump electrical connector.

Position shop towel under vapor separator to absorb fuel from disassembly. 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 clamp and fuel return manifold. Remove clamp and fuel supply hose from fuel filter housing. Remove the vapor separator housing retainer clip.



1. Retainer clip 004189

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

Installation

Installation is essentially the reverse of removal. Pay close attention when performing the following **additional** tasks. Install fuel supply hose on vapor separator. Reinstall all hoses and manifolds to original locations and secure in place with appropriate clamps. Squeeze primer bulb to prime fuel system. Hold pressure on bulb and observe for fuel leaks.

Install air silencer and connect battery cables. Run outboard and check for fuel leaks.

Fuel Injectors

IMPORTANT: Note the proper locations and positioning of all spark plug leads and retainer clips prior to disassembly.

Remove high tension spark plug leads and retainers that are used to position the spark plug leads.

Mark fuel injector(s) to indicate cylinder location(s).

IMPORTANT: Fuel injector(s) must be installed in the correct cylinder location(s). Use the *Evinrude* Diagnostics Software program to confirm that the *EMM* programming matches injector positioning by cylinder location. The injector information screen of the diagnostic program displays injector serial numbers.



Injector Coefficients Screen 005142

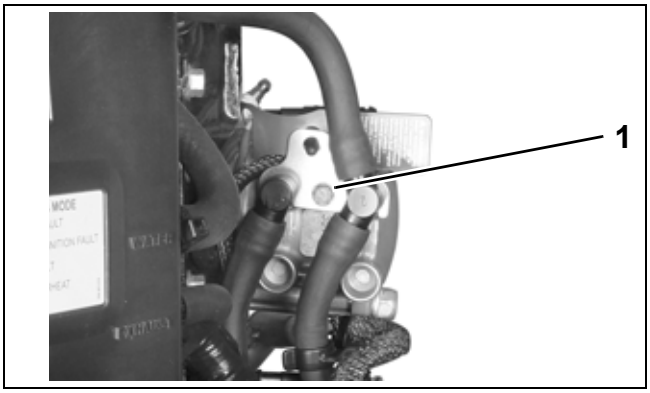
Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel tubes. Cover the injector nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal

Disconnect the battery cables at the battery.

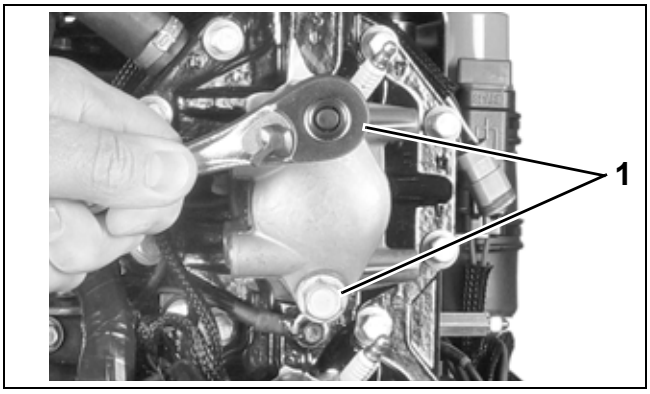
Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 184.

Remove the injector/fuel fitting retainer and disengage fuel manifold fittings.



1. Retainer screw 004266

Remove injector screws.



1. Injector screws 004267

Disconnect the fuel injector/coil electrical connector.

Disengage fuel manifold fittings from fuel injector and 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.

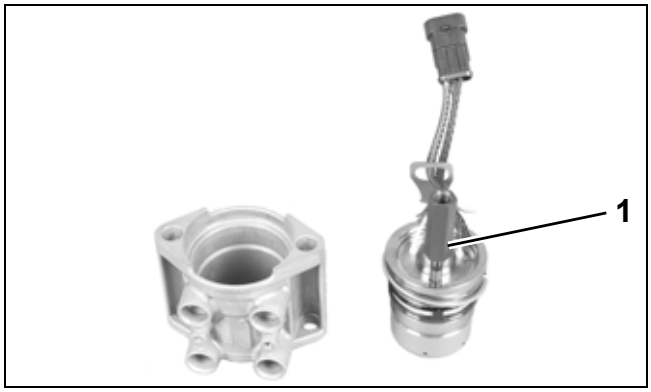
Use Slide Hammer assembly, P/N 391008, with Slide Hammer Adaptor kit, P/N 390898, components to remove injector from mounting cup.

Thread adaptor and stud into face of injector. Hold mounting cup securely. Work slide hammer to separate injector from mount housing.

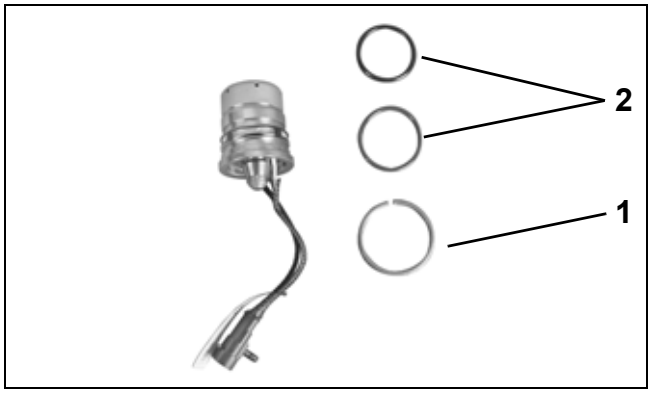


002345

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*.

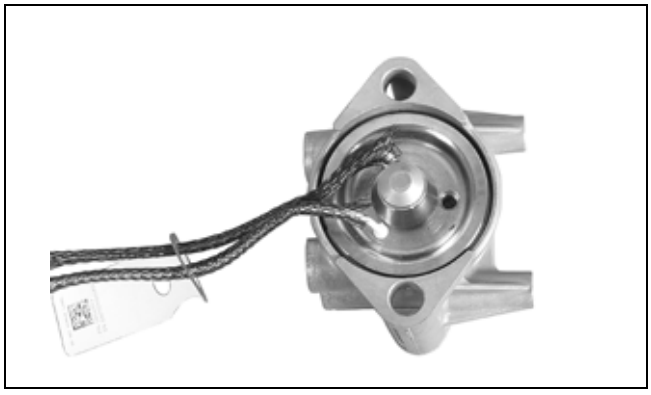


1. Adaptor 002196



1. Crush ring
2. O-rings 002317

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

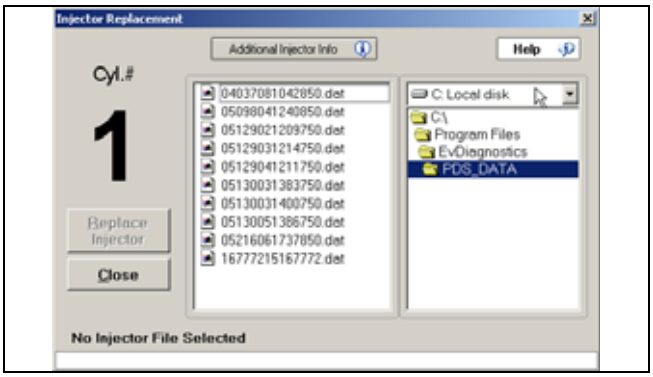


002318

Installation

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

Installation of replacement injectors requires the use of diagnostic software and coefficient 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.

Position injector and insulator in the proper cylinder location.

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

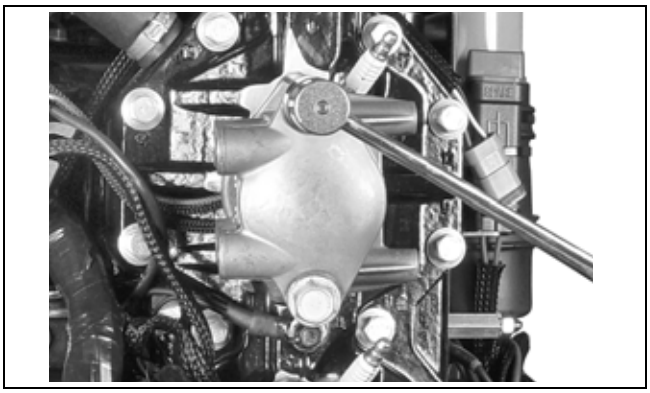
Lubricate mounting screw threads and under the head of the screw with a light coat of *Triple-Guard* grease. Install washers (one per screw) on injector retaining screws. Install screws and washers through mounting flange of injector and thread into cylinder head.



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).

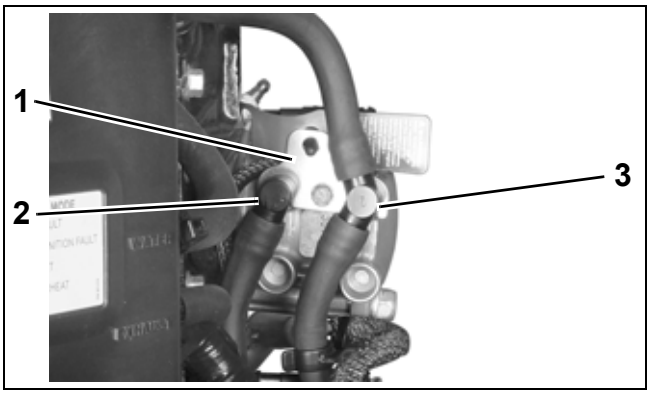


Tighten Screws in Stages 004268

7

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 004266
2. Fuel supply manifold fitting
3. Fuel return manifold fitting

Reconnect fuel injector/coil electrical connectors and high tension spark plug leads with retainers.

Reconnect battery cables. Start outboard briefly to pressurize fuel system. Turn outboard OFF and inspect all fuel system components for leaks.

Install lower engine covers and air silencer.

IMPORTANT: Install injector service software (3.5 in. floppy disk) by using the Injector Replacement Utility of the *Evinrude* Diagnostics Software program. Use the diagnostic program to confirm that all injectors are positioned properly.

Fuel Manifolds

Removal

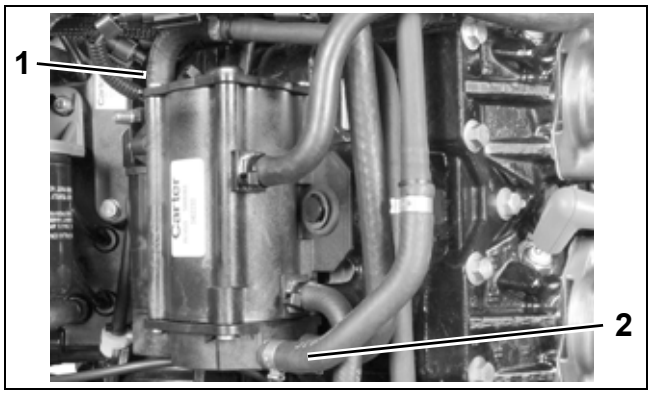
Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 184.

IMPORTANT: Note the locations and positioning of all spark plug leads and retainer clips prior to disassembly.

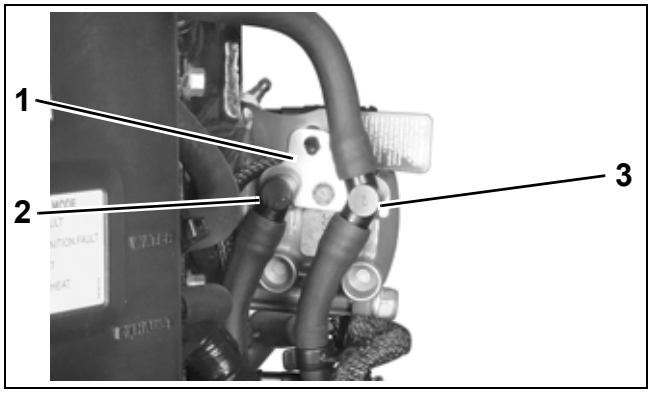
Remove clamps and disconnect the fuel manifolds as follows:

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



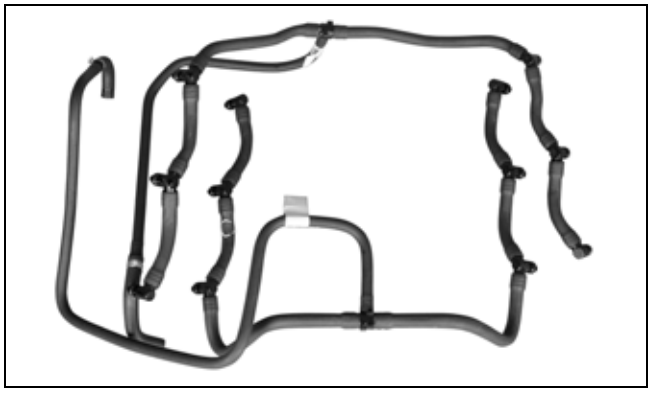
1. Fuel supply manifold 004189
2. Fuel return manifold

Remove fuel manifold retainer screws and remove retainer from fuel injector.



1. Retainer 004266
2. Fuel supply manifold fitting
3. Fuel return manifold fitting

Disconnect fuel manifold fittings from fuel injector ports.



004242

Remove any tie straps used to secure manifold(s) in place, then remove the manifold assembly(s).

Installation

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

Install air silencer and connect battery cables.

Start outboard briefly to pressurize fuel system. Turn outboard OFF and inspect all fuel system components for leaks. Repair any fuel leaks.

INTAKE MANIFOLD

Removal

Remove oil/fuel pump bracket.

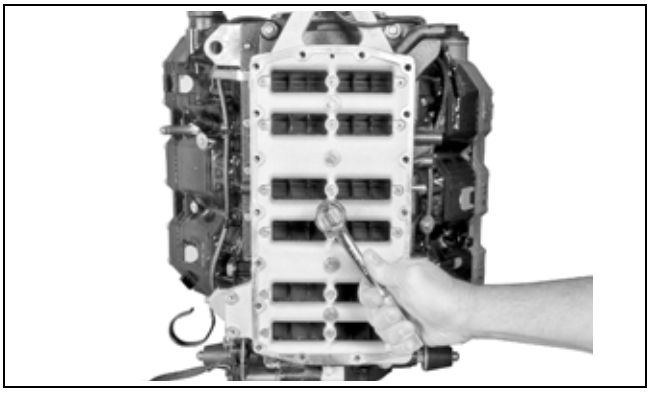
Disconnect throttle linkage. Remove throttle body screws and throttle body assembly.



004258

Remove gasket from throttle body.

Remove screws and reed plate assembly from the cylinder/crankcase assembly.



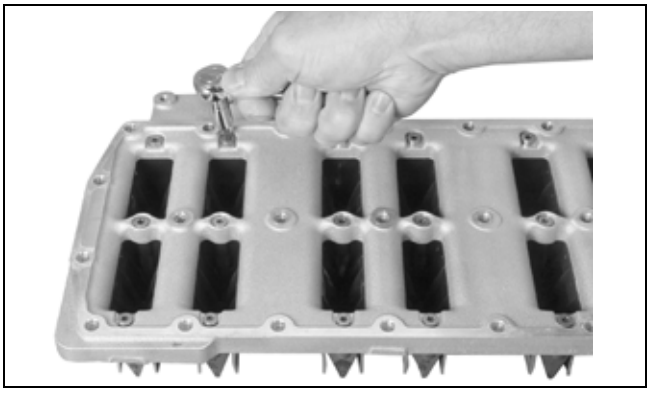
004190

Disassembly

Visually inspect reed valve assemblies. For disassembly of the reed valve assembly, see **Inspection** on p. 192**.**

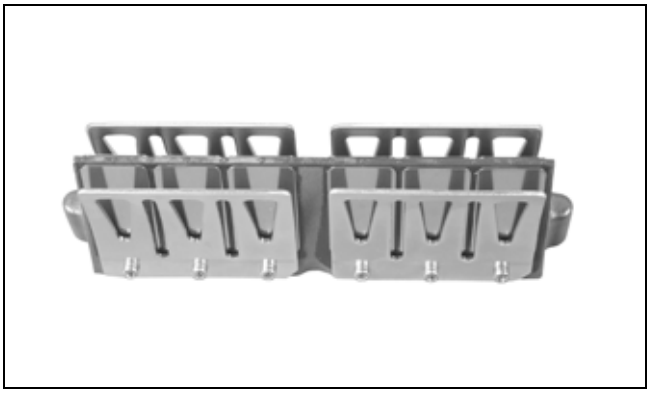
All reed plate assembly and reed valve assemblies must be cleaned prior to reassembly. DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

Remove the reed valve retainer screws and remove the assembly.



004191

Use caution to prevent damaging reed valve assemblies.

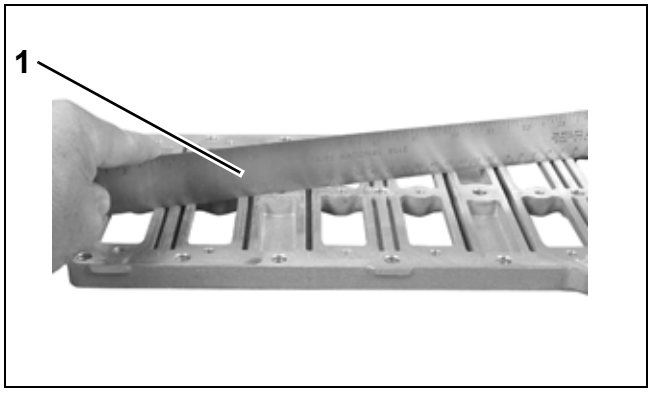


004192

Inspection

IMPORTANT: DO NOT disassemble reed valve assemblies unless reed plate seats, reed valves, or reed stops are damaged, corroded, or contaminated with debris. Damaged reed plates are not serviceable and are replaced as an assembly.

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

004193

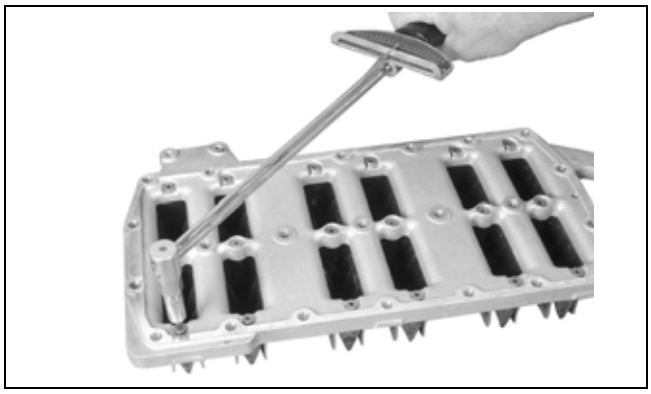
Inspect the leaf plate assemblies for damage or contamination:

- 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.

Assembly

Remove old adhesive from reed valve retaining screws.

Prime the threads with *Locquic Primer* and let dry. Apply *Nut Lock* to threads. Position reed valve on reed plate and install screws. Final torque is 30 to 42 in. lbs. (3 to 5 N·m).



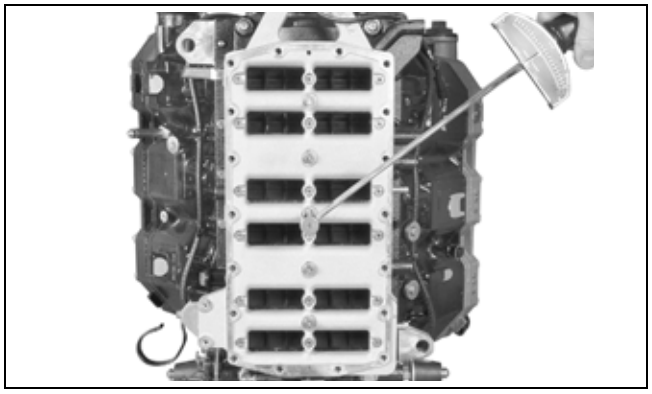
004194

Installation

Position 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. Final torque is 96 to 120 in. lbs. (11 to 13.5 N·m).



004205

Position gasket on throttle body. Install throttle body on reed plate and install screws.

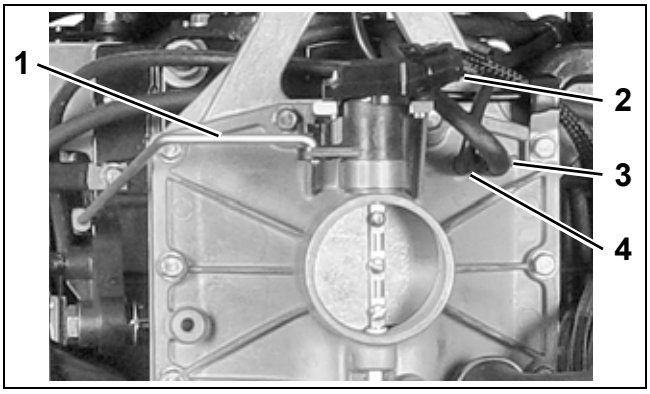
Tighten the center screws first and expand outward. Final torque is 96 to 120 in. lbs. (11 to 13.5 N·m).



004257

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

Connect throttle linkage and electrical connectors.



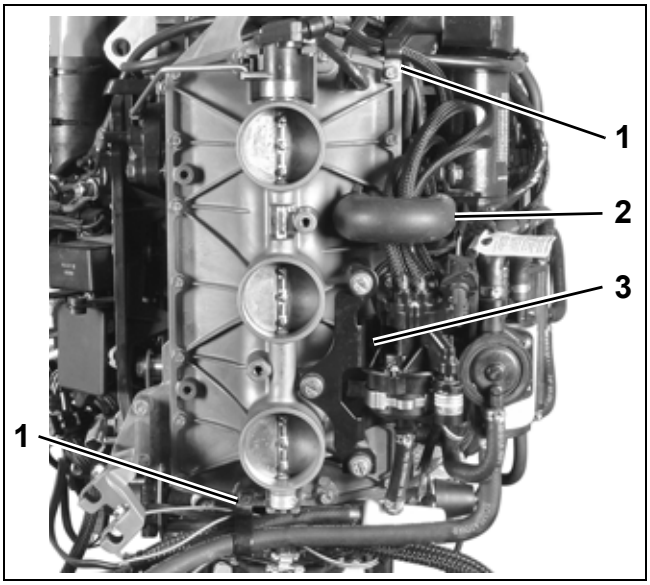
1. *Throttle linkage*
2. *TPS electrical connector*
3. *Vapor separator vent hose*
4. *Oil recirculation hose*

004248

IMPORTANT: DO NOT lubricate TPS to throttle shaft surface.

Install oil/fuel pump bracket. Tighten screws 30 to 42 in. lbs. (3.5 to 5 N·m).

Position clamps as shown.



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

004249

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

OILING SYSTEM

TABLE OF CONTENTS

SERVICE CHART 196
COMPONENTS 197
- OIL TANK 197
- OIL INJECTION PUMP 197
- OIL PRESSURE SENSOR 198
- ELECTRICAL CIRCUIT (55 V) 198
- OILING SYSTEM ELECTRICAL DIAGRAM 199
- *SYSTEMCHECK*, *I-COMMAND* AND *EMM* OILING SYSTEM WARNINGS 200
- CYLINDER AND CRANKCASE 200
- OIL RECIRCULATION SYSTEM 201
- RECIRCULATION CHECK VALVE AND HOSE ROUTINGS DIAGRAM 202
- OIL SUPPLY AND DISTRIBUTION DIAGRAM 203
- OIL INJECTION PUMP DIAGRAM 204

PRIMING 205
OILING RATES 206
- OIL INJECTION RATE 206
- *XD100* OUTBOARD OIL DECAL 206
- BREAK-IN OILING 207

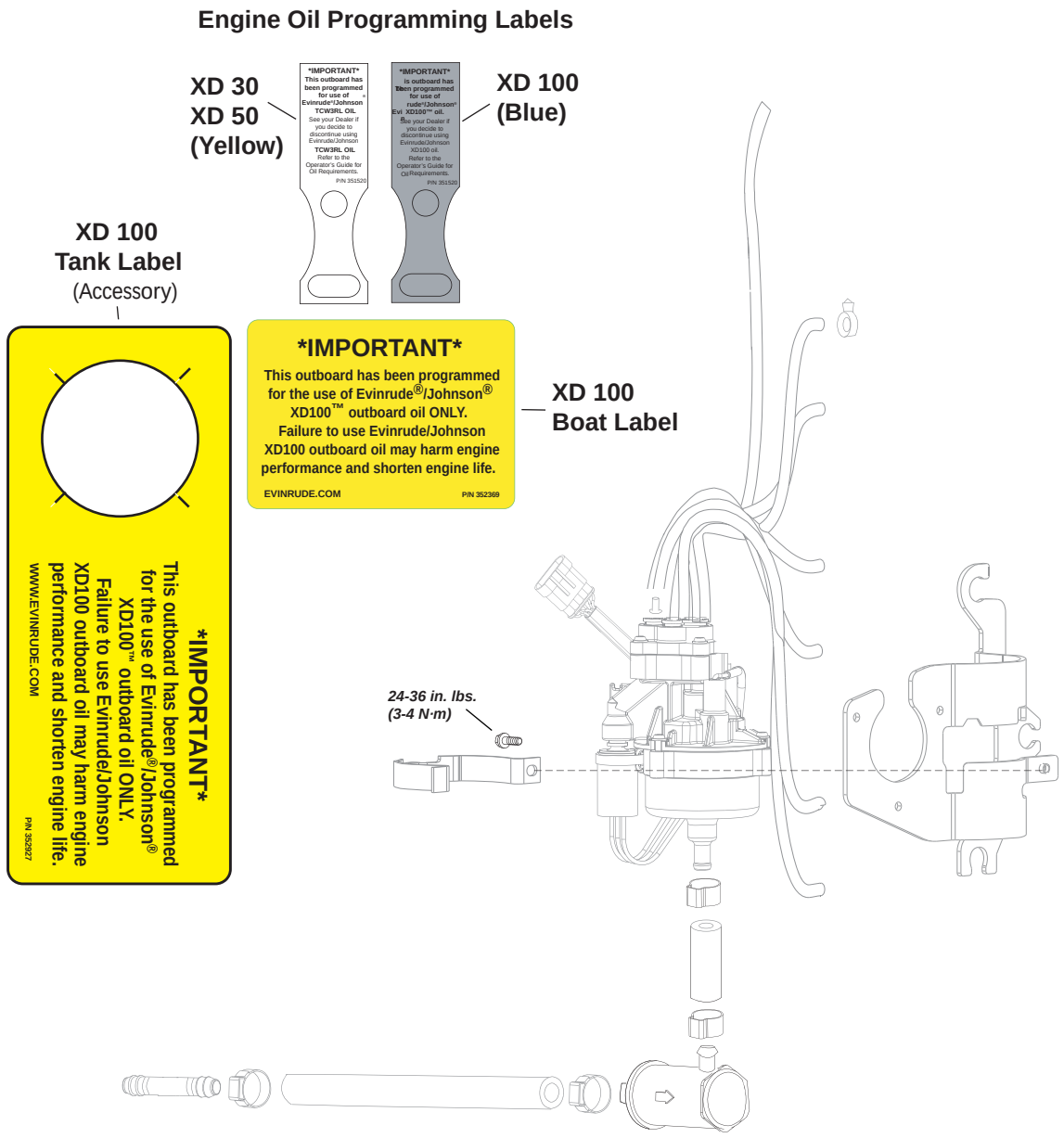
OILING SYSTEM TESTS 207
- OIL INJECTION PUMP STATIC TEST 207
- OIL INJECTION PUMP VOLTAGE TEST 208
- OIL INJECTION PUMP CIRCUIT RESISTANCE TEST 209
- OIL SUPPLY VACUUM TEST 209
- OIL INJECTION PUMP FUNCTION TEST 210
- OIL INJECTION FITTINGS FLOW TEST 211
- LOW OIL SENDING UNIT TEST 211

OIL COMPONENT SERVICING 211
- OIL DISTRIBUTION HOSES 211
- OIL INJECTION PUMP 212

NOTES 214

8

SERVICE CHART



004097a

COMPONENTS

The oiling system consists of the following components:

- Oil tank
- Oil injection pump and manifold assembly
- Oil pressure sensor
- Electrical circuit
- *SystemCheck* LOW OIL and NO OIL warning signals
- Cylinder and crankcase
- Oil recirculation system

Oil Tank

The oil tank must be properly positioned and the oil supply must be properly monitored. Refer to installation instructions provided with oil tank and **Oiling System Set-Up** on p. 43 for additional information.

Oil Tank Components

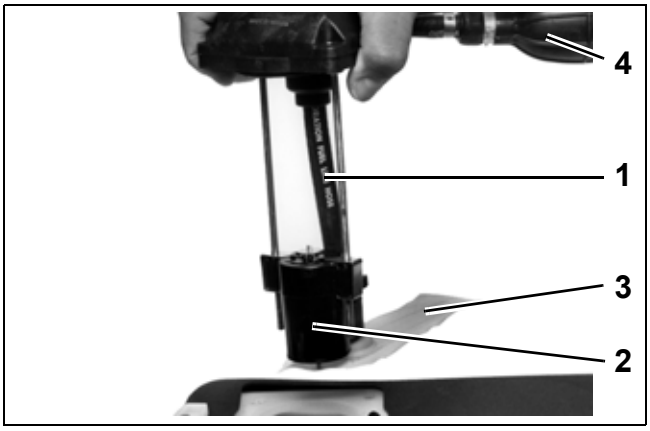
- Tank, 1.8 or 3.0 gallon capacity
- Oil pickup assembly (included with tank)
- Fill cap (included with tank)
- Mounting bracket and hardware
- Protective cover (1.8 gallon tank only)
- Hose clamp
- Hose plug



1.8 Gallon Oil Tank Kit 44839B

Oil Pick-up Components

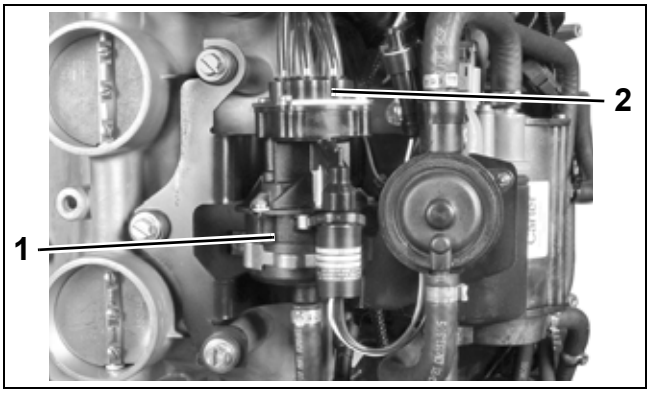
- Pickup hose
- Sending unit, LOW OIL warning, and oil pickup
- Filter
- Primer bulb and supply hose



1. *Pickup hose* 42785
2. *Sending unit*
3. *Filter*
4. *Primer bulb and oil supply hose*

Oil Injection Pump

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

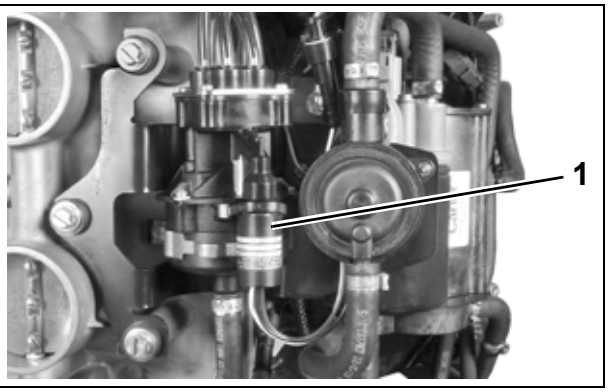


1. *Oil injection pump* 004220
2. *Oil manifold*

The oil manifold distributes the oil supplied by the oil injection pump. A pressure-sensing sensor monitors the oil injection pressure.

Oil Pressure Sensor

The oil pressure sensor reacts to changes in oil manifold pressure. The *EMM* supplies and monitors electrical current to the sensor.



1. Oil pressure sensor 04220

The sensor provides an output voltage to the *EMM* based on oil manifold pressures.

Oil Pressure Sensor Information:

5 VDC Input on RED wire
0.5 - 4.5 V Output on TAN / WHITE wire
Ground on BLACK wire

The *EMM* monitors the oil pressure sensor's electrical circuit. If circuit voltage is beyond the specified range (< 0.12 V, > 4.88 V), the *EMM*:

Stores a service code 71
Initiates *EMM* SENSOR FAULT (LED 3)

If oil pressure is below expected range (< 0.5 V), the *EMM*:

Stores a service code 72
Initiates *EMM* SENSOR FAULT (LED 3)

If oil pressure is above expected range (> 4.5 V), the *EMM*:

Stores a service code 73
Initiates *EMM* SENSOR FAULT (LED 3)

Refer to **Oil Pressure Sensor** on p. 99.

Electrical Circuit (55 V)

The oil injector is powered by the 55 V electrical circuit. The *EMM* controls injection pump operation by opening and closing the circuit's ground.

Circuit components:
- Oil injection pump winding
- Main wire harness and connections
- *EMM*, oil injection pump control function
- System voltage (55 V): stator, rectifier/regulator (*EMM*)
- Ground circuits, *EMM* and oil injection pump

Refer to **Oiling System Electrical Diagram** on p. 199 and **OILING SYSTEM TESTS** on p. 207.

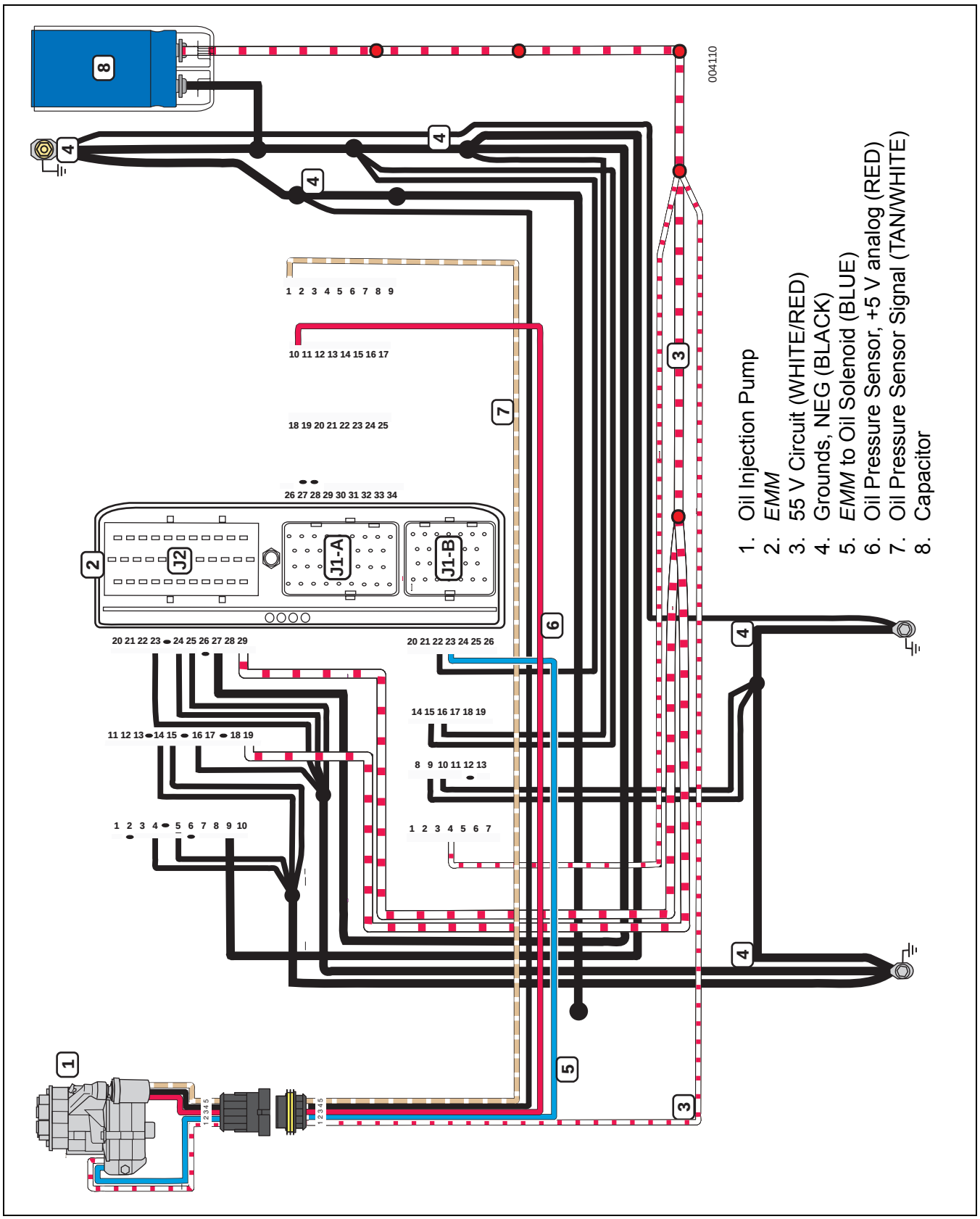
The *EMM* monitors the oil injection pump electrical circuit. If circuit voltage is beyond the specified range (open circuit), the *EMM*:

Activates *S.A.F.E.*
Stores a service code 34
Initiates *EMM* NO OIL/OVERHEAT FAULT (LED 4)
Initiates the *SystemCheck* "NO OIL" light



Stored Faults Review Screen 005145

Oiling System Electrical Diagram

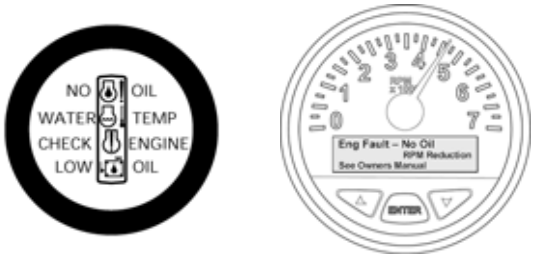


SystemCheck, *I-Command* and *EMM* Oiling System Warnings

Evinrude outboards can be monitored by *SystemCheck* or *Evinrude E-TEC* 115-250 HP outboards can be equipped with the *I-Command* Integrated Performance System (CANbus network based on NMEA 2000† standards.) Both systems warn the operator of a “NO OIL” condition.

LOW OIL Warning

A sending unit in the oil tank pick-up assembly monitors the oil level in the tank. This sending unit is designed to activate the *SystemCheck* “LOW OIL” light when the oil level falls below one-quarter capacity.



SystemCheck *I-Command*

Warning System Gauges DR5206
005330

An optional oil tank sending unit kit is available to interface with the *I-Command* System. The *I-Command* System does not provide a “LOW OIL” warning.

NO OIL Warning

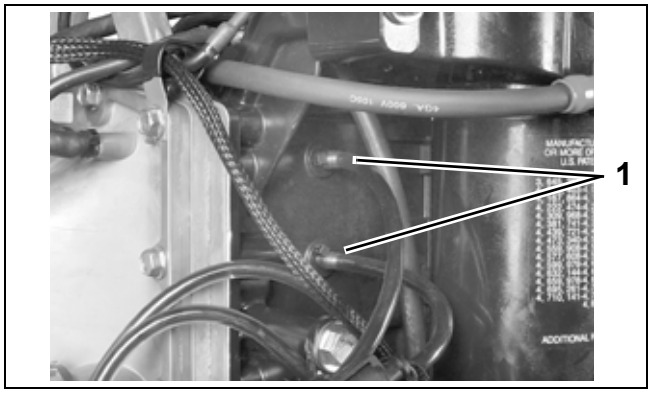
The *EMM* monitors the electrical circuit of the oil pressure sensor. If the sensor or circuit fails, or if there is a lack of oil pressure in the oil distribution manifold, the *EMM*:

Activates *S.A.F.E.*
Stores a service code 38
Initiates *EMM* NO OIL/OVERHEAT FAULT (LED 4)
Initiates the *SystemCheck* “NO OIL” light

Refer to **External Sensors** on p. 98.

Cylinder and Crankcase

Each cylinder has a pressed-in fitting at the front of the crankcase which is connected to an oil distribution hose. Lubrication for each cylinder is injected through these fittings. Additionally, one oil distribution hose is routed to a tee fitting at the top of the block, above #2 cylinder.



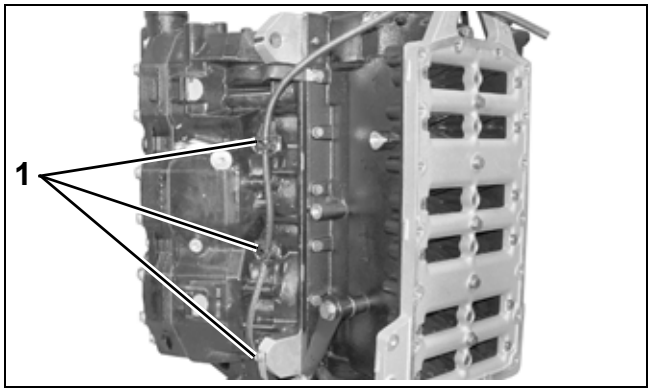
1. Pressed-in fitting 004224

Oil Recirculation System

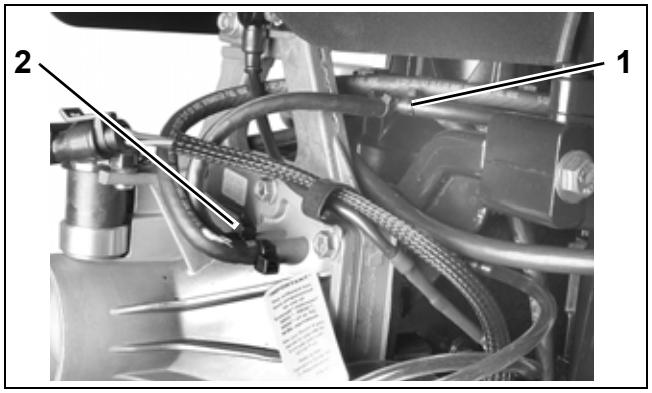
External hoses and fittings, internal cylinder/crankcase passages, and intake manifold passages are used to “recirculate” any accumulation of oil from various locations in the powerhead. The movement of oil in these “oil circuits” is controlled by check valves.

Cylinder Recirculation

Internal powerhead oil drain passages connect the lowest point of the intake port area of the cylinder block to external thread-in check valves. External hoses connect these check valves to a hose fitting pressed into the top of the intake manifold / throttle body. Intake manifold vacuum draws any accumulation of oil from the intake port area of the cylinders into the incoming air stream in front of the top reed valve.

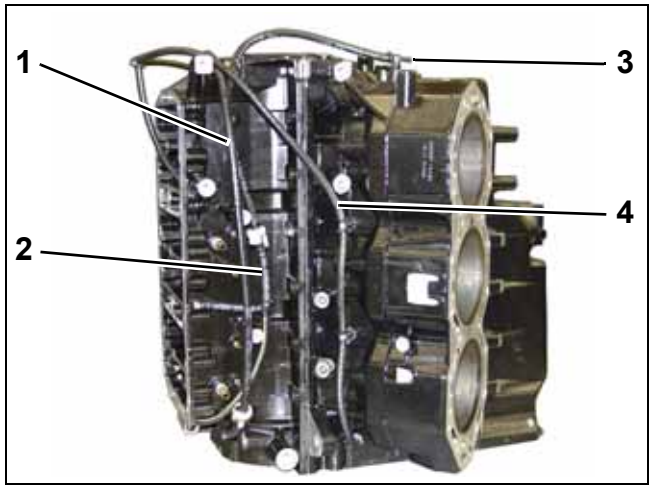


1. Check valves 004337



1. Recirculation hose 004336
2. Hose fitting

Check valves pressed into the crankcase below #4 and #6 reed valve assemblies connect to hoses which route to a tee fitting at the top of the block, above #2 cylinder.



1. Lower to upper main bearing oiling circuit 005043
2. Idle oil circuit
3. Tee fitting
4. Cylinder recirculation circuit

Crankcase / Main Bearing Recirculation

The movement of oil through the main bearings is controlled by internal passages, external fittings and hoses, and an in-line check valve.

Both center main bearings receive oil through grooved passages in the crankcase. Oil migrates to the bearings from the crankcase areas of the higher cylinders.

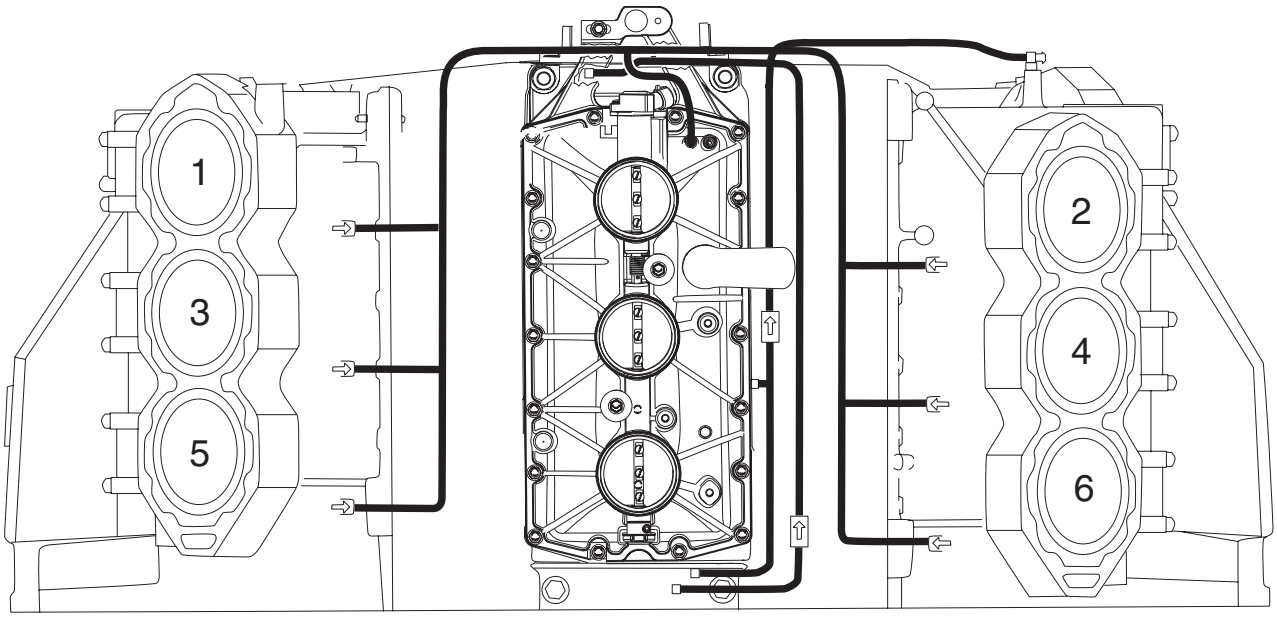
The lower main bearing receives oil through a grooved passage in the crankcase.

Lower to upper main bearing oil flow

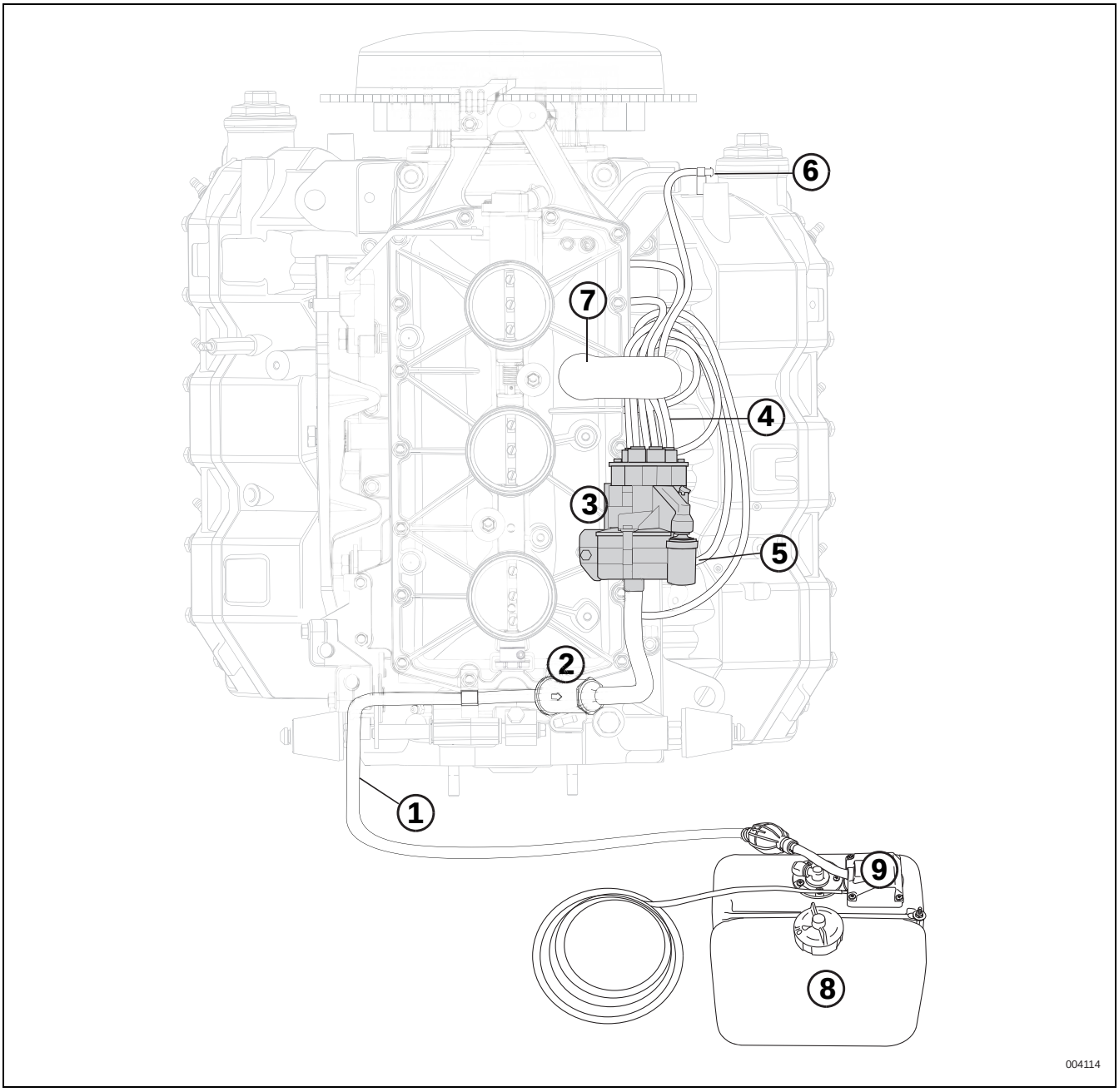
Lower main bearing cavity through internal crankcase passage to external fitting, external hoses with in-line check valve to external fitting at upper main bearing, and into upper main bearing through internal crankcase passage.

Refer to the **Recirculation Check Valve and Hose Routings Diagram** on p. 202 and the **Oil Supply and Distribution Diagram** on p. 203.

Recirculation Check Valve and Hose Routings Diagram

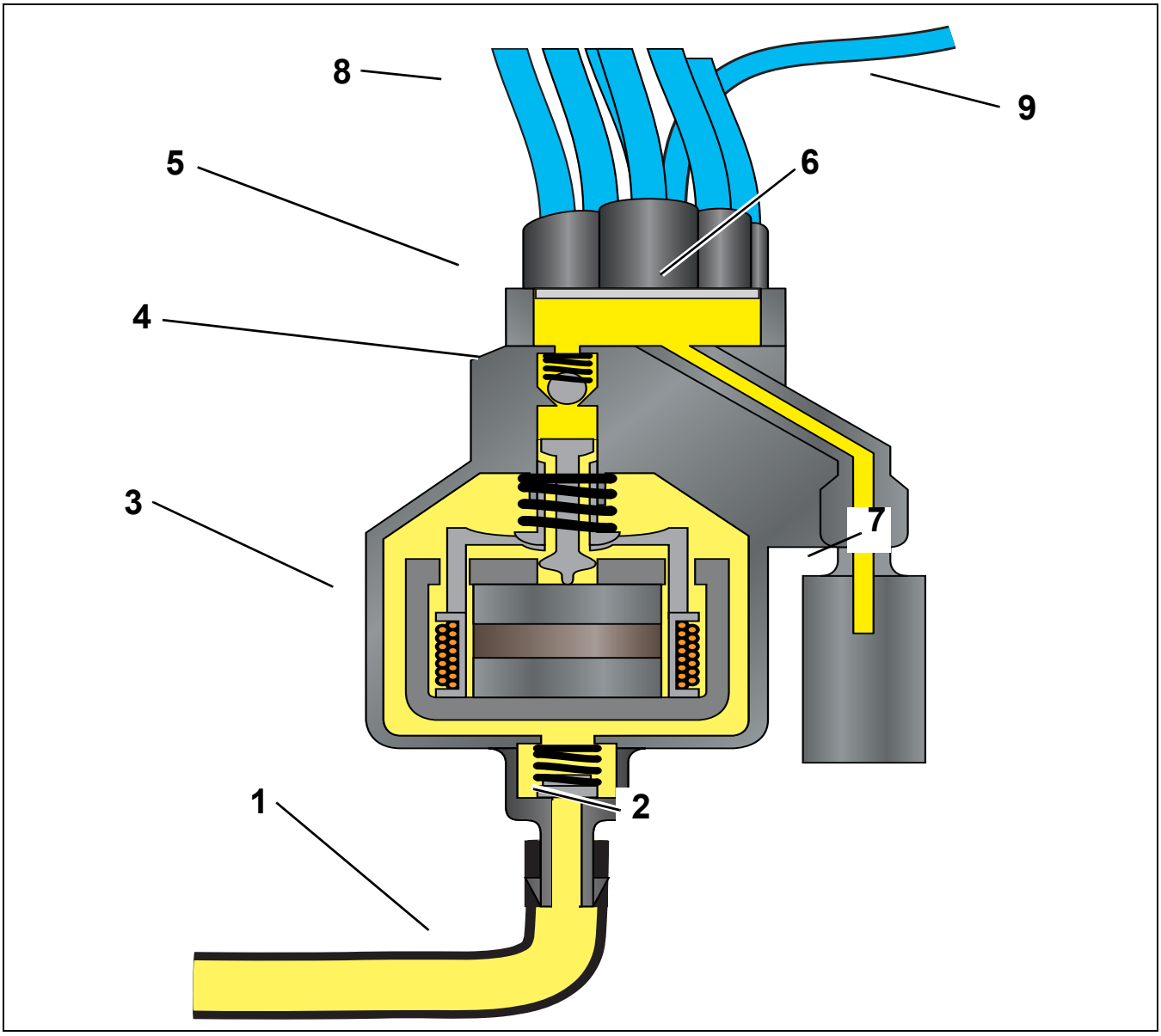


Oil Supply and Distribution Diagram



1. Oil supply hose
2. In-line oil filter
3. Oil injector assembly
4. Oil distribution hoses (7)
5. Oil pressure sensor
6. Idle oil circuit fitting
7. Idle air by-pass hose
8. Oil tank assembly
9. Oil pick-up

Oil Injection Pump Diagram



1. *Oil supply hose*
2. *Inlet check valve*
3. *Oil injection pump*
4. *Injection pump check valve*
5. *Oil distribution manifold*
6. *Filter (screen type)*
7. *Oil pressure sensor*
8. *Oil distribution hoses to individual cylinders*
9. *Oil distribution hose to idle oil circuit*

PRIMING

⚠ WARNING ⚠

To prevent injury from contact with rotating propeller, always remove the propeller before running on a flushing device.

The oiling system of the outboard must be primed:

- After the initial installation of the outboard (predelivery);
- Whenever the oil supply to the oil lift pump is disconnected or disrupted; and
- Whenever an oiling system component is removed or replaced.

Oil Hose Connections

⚠ WARNING ⚠

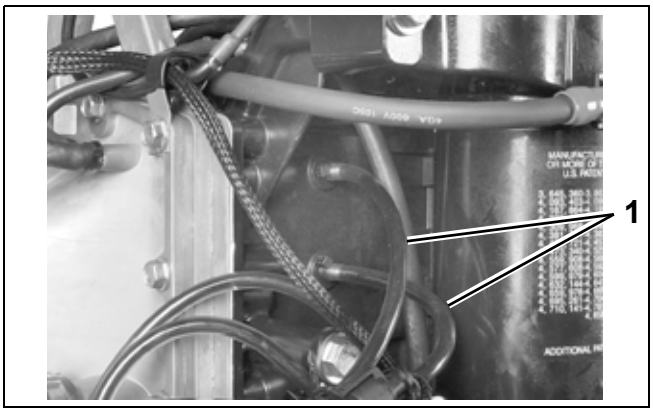
Always use caution while working around machinery with moving parts. The following set-up procedures require running tests that are performed with the outboard's motor cover removed.

Insert the end of the oil supply hose (from the oil tank) into a suitable container.

Squeeze the oil primer bulb to flow oil from the oil tank.

Once oil flow is observed, connect the oil tank hose to the outboard's oil supply hose and secure with 14.5 mm *Oetiker* clamp.

Observe oil flow through the oil distribution hoses.



1. Oil distribution hoses (7) 004224

Oil Distribution Manifold Priming

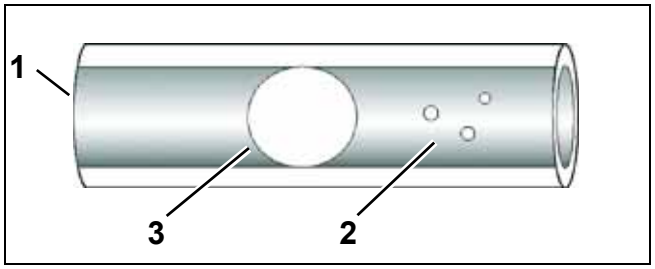
Follow these steps for initial outboard set-up:

- Squeeze the oil primer bulb to flow oil from the hose connection, through the filter, to the oil pump.
- Visually inspect filter to ensure that all air has been purged.
- Continue squeezing the primer until oil flows through the distribution manifold into the oil distribution hoses and to the crankcase fittings. All air must be eliminated from oil lines.
- Use the *Evinrude* Diagnostics Software program to confirm that 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 005137
1. Prime Oil button

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



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

8

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

Reconnect the fuel supply hose.

Repair any fuel or oil leaks.

The oiling system can also be primed using the Self-Winterizing feature if diagnostic software is not available. Refer to **STORAGE** on p. 91.

OILING RATES

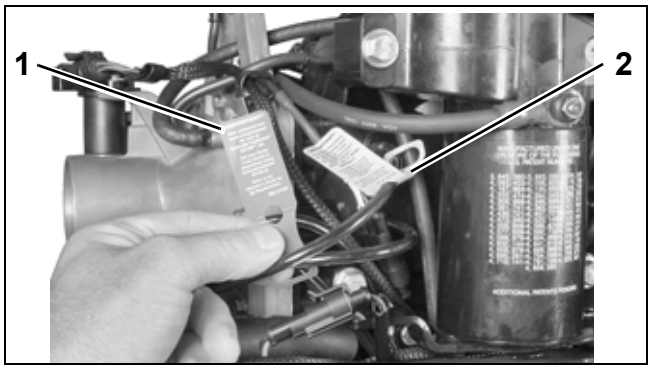
EMM programming controls the rate of oil injection. Use engine diagnostics software to access this *EMM* feature.

Oil Injection Rate

The TC-W3 OIL control setting allows the outboard to be run on TC-W3 outboard lubricant. Changing to the optional *XD100* OIL CONTROL setting requires the use of *Evinrude XD100* outboard lubricant. Running the outboard in *XD100* OIL mode can reduce oil consumption by approximately one third. See **Oil Control** on p. 109.

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

IMPORTANT: Make sure the *Evinrude E-TEC* engine label and boat decal match *EMM* programming.



1. Evinrude /Johnson XD100 *outboard lubricant (Premium)* 004119 ***BLUE label***
2. Evinrude /Johnson XD30 *outboard lubricant (TC-W3)* ***YELLOW label (Installed)***

XD100 Outboard Oil Decal

An *Evinrude/Johnson XD100* oil decal is available to label boats equipped with *Evinrude E-TEC* outboards that have been programmed for the *XD100* oil injection ratio.

Use the **XD100 Outboard Oil Decal, P/N 352369**, to accurately inform the boat operator of the *XD100* outboard oil requirement.



***XD100* Outboard Oil Decal** 004522

Install this decal in one or more of the highly visible recommended locations to alert the outboard operator(s).

Recommended Locations:
- Dashboard/deck of boat, adjacent to key switch
- Deck of boat, adjacent to the remote oil fill
- Deck of boat, adjacent to oil tank assembly
- Oil tank cover
- Cover of oil tank compartment
- Attach to oil tank or oil fill cap

IMPORTANT: Make sure the *Evinrude E-TEC* engine label and boat decal match *EMM* programming.

Break-in Oiling

The Break-in OIL setting doubles the oiling ratio for the first two hours of operation, above 2000 RPM. See **Oil Control** on p. 109.

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 the *Evinrude* Diagnostics Software program to activate *Oil Injector* test. This initiates the *EMM* control function for the oil injection pump.

Oil injection pump should activate with key switch in the ON position.



Static Tests Screen 005156
1. Oil injector test button

The *EMM* provides ground to pin 2 (blue wire) of oil injection pump electrical connector. Refer to **Oil Injection Pump Voltage Test** on p. 208.

8

Oil Injection Pump Voltage Test

Acceptable voltage readings:

- Key switch ON: approximately 30 V
- Outboard running: 55 V

STEP 1

Check voltage at pin 1 (white/red wire) of oil injection pump electrical connector with key switch ON.

Results:

- Approximately 30 V is acceptable with outboard not running. See **Oil Injection Pump Circuit Resistance Test** on p. 209.
- No voltage reading, proceed to **STEP 2**.

STEP 2

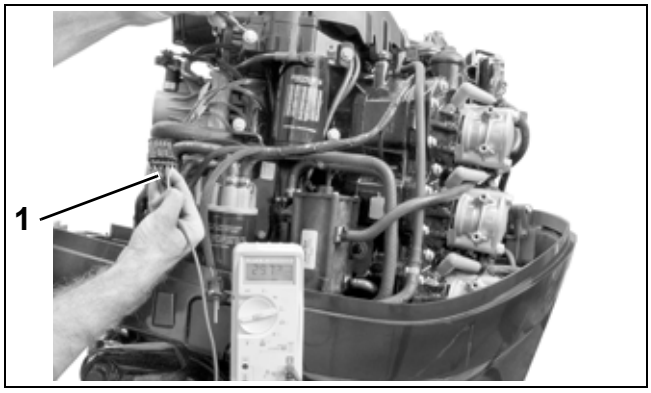
Run outboard. Check system voltage using diagnostic software program. The alternator/system output wires (white/red) are terminals 19 and 29 of the *EMM* J2 connector. If needed, use Electrical Test Probe Kit, P/N 342677, and a multimeter set to read 55 VDC to check engine harness voltage readings.

Results:

- Proper voltage reading, inspect connections and wiring. Replace faulty wire harness or connector.
- No or low voltage, check connections from *EMM* and stator to engine wire harness. Repair faulty connection or refer to **STATOR TESTS** on p. 141 for testing procedures.

STEP 3

Use Electrical Test Probe Kit, P/N 342677, and a multimeter set to read 55 VDC. Check voltage at pin 2 (blue wire) of oil injection pump connector. Key switch must be ON.



1. Oil injection pump connector (pin 2) 004344

Results:

- Approximately 30 V is acceptable, leave adapter connected, proceed to **STEP 4**.
- No voltage, refer to **Oil Injection Pump Circuit Resistance Test** on p. 209.

STEP 4

Activate oil injector using the *Evinrude* Diagnostics Software program. Monitor the voltage on oil injector pump circuit at pin 2 of oil injection pump connector.



Static Tests Screen 005156
1. Oil injector test button

Oil Injection Pump Circuit Resistance Test

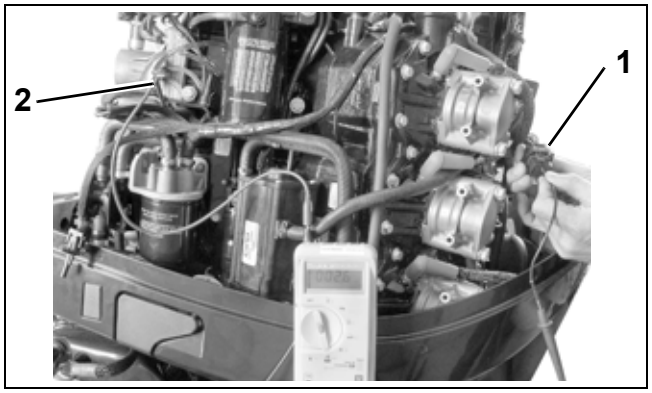
The oil injection pump circuit includes the engine wire harness, the injection pump winding and connector, and the oil injection control circuit of the *EMM*.

Disconnect the battery cables at the battery.

Use Electrical Test Probe Kit, P/N 342677, to make a connection to pin 23 of the *EMM* J1-B connector.

Calibrate ohmmeter to the LOW OHMS scale and measure the resistance between pin 23 of the *EMM* J1-B connector and pin 1 of oil injection pump connector.

Oil Injection Pump Circuit Resistance
2 to 3 Ω



1. EMM *J1-B connector (pin 23)* 004343
2. *Oil injection pump connector (pin 1)*

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 2-3 Ω, injection pump winding is good. Isolate faulty component. Repair faulty wiring or replace faulty component and retest.

Oil Supply Vacuum Test

⚠ WARNING ⚠

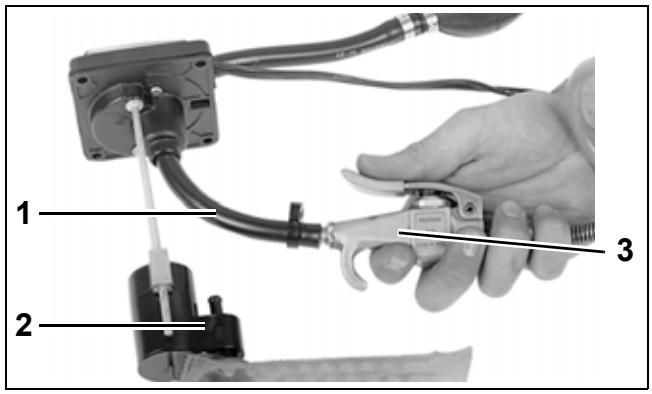
Wear safety glasses to avoid personal injury, and set compressed air pressure to less than 25 psi (172 kPa).

Remove the oil pick-up assembly from the oil tank.

Carefully remove the pickup filter and flush with a mild solvent to remove any contamination. Reinstall filter.

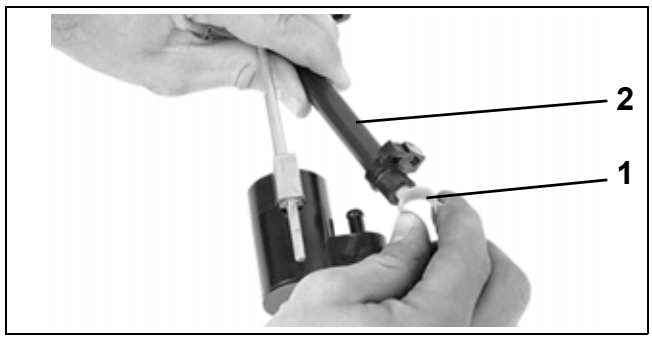
Carefully remove the oil hose from the oil pickup and remove the oil supply hose from the oil injection pump.

Use low pressure air to purge oil from hose.



1. *Oil hose* 12306
2. *Oil pickup*
3. *Low pressure air*

Use Plug/Holder, P/N 329661, and clamp to plug the pickup end of the hose.

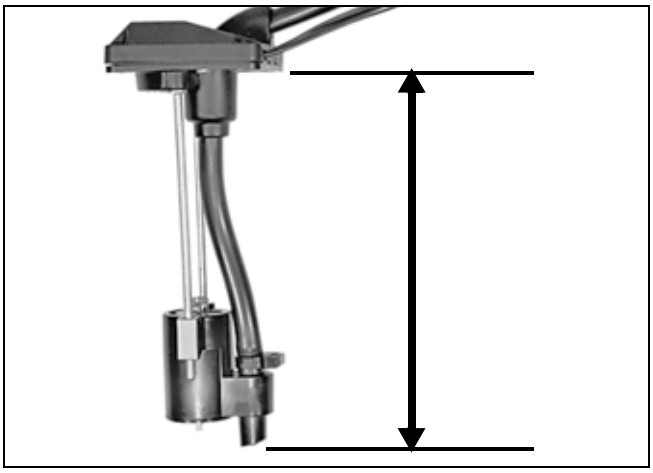


1. *Plug/holder* 12307
2. *Oil hose*

Attach a vacuum tester to the outboard side of oil supply hose and draw 7 in. Hg (24 kPa) vacuum on the hose for at least five minutes. Repair or replace any leaking components. Reinstall the oil hose.

Check height of pickup assembly.

Pickup Assembly Height	
1.8 gallon tank	6.84 to 6.96 in. (174 to 177 mm)
3.0 gallon tank	8.74 to 8.86 in. (222 to 225 mm)



Height of Oil Pickup Assembly COB5657A

Position a **new** seal on oil tank and reinstall pickup with filter into oil tank. Install and tighten screws.

Oil Injection Pump Function Test

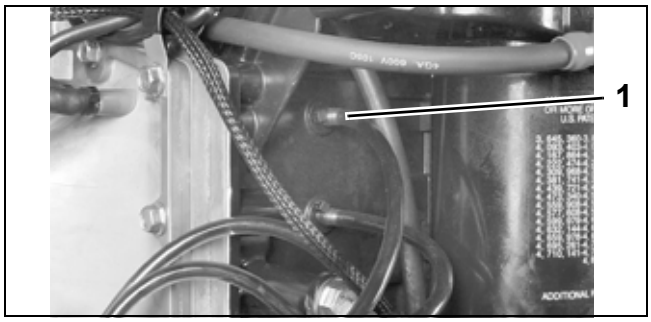
This test may be performed in two different ways:

Running Test

Remove oil distribution hose from fitting at cylinder block. Start and run the outboard at IDLE speed and observe oil flow. Confirm that a small amount of oil is discharged while injection pump is activated.

Static Test

Remove oil distribution hose from fitting at crankcase. Squeeze oil supply primer bulb to provide oil to injection pump.



TYPICAL 00
1. Fitting at cylinder block

Use the oil injector test of the *Evinrude* Diagnostics Software program to activate injector. Confirm that a small amount of oil is discharged while injection pump is activated.



Static Tests Screen 005156
1. Oil injector test button

Results:

- Oil flows from distribution hose, compare to oil flow at other distribution hoses.
- No oil discharge, compare to oil flow at other distribution hoses. If one or more hoses fail to discharge oil, check for a kinked or restricted hose before replacing the oil injection pump assembly.

Oil Injection Fittings Flow Test

WARNING

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

Confirm that the oil injection fittings of the crankcase allow fluid to move.

Remove oil distribution hose from fitting. Connect 1/8 in. I.D. (3 mm) clear vinyl tubing to the fitting. Use a syringe filled with isopropyl alcohol to force fluid through the fitting.

LOW OIL Sending Unit Test

Remove the oil from the oil tank, and turn the key switch ON. The LOW OIL light of the *System-Check* gauge should activate. Once the warning has been verified, turn the key switch ON and refill the oil tank. Confirm that the LOW OIL warning stops as the oil level exceeds one-quarter of oil tank's capacity.

OIL COMPONENT SERVICING

WARNING

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

IMPORTANT: Access to certain oil distribution hoses requires removal of various engine components. Refer to service information in the various sections of this manual for additional information related to the removal and installation of specific components. DO NOT disassemble or replace any oiling system components until you are familiar with the entire **OILING SYSTEM** section.

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	
Manifold-to-cylinder block fitting	12 in. (305 mm)
Manifold-to-idle oil circuit fitting	28 in. (711 mm)

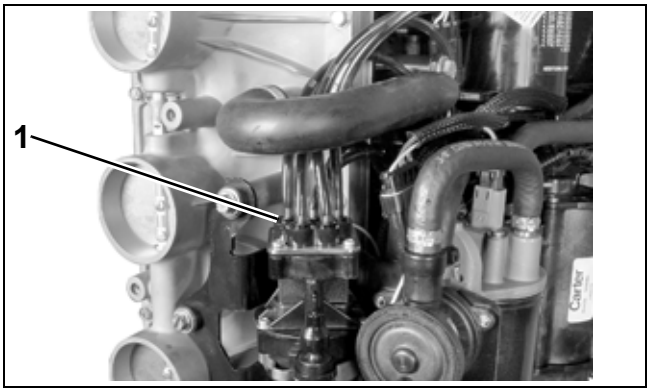
Removal

The oil distribution manifold has oil hose retainer mechanisms incorporated into the design.

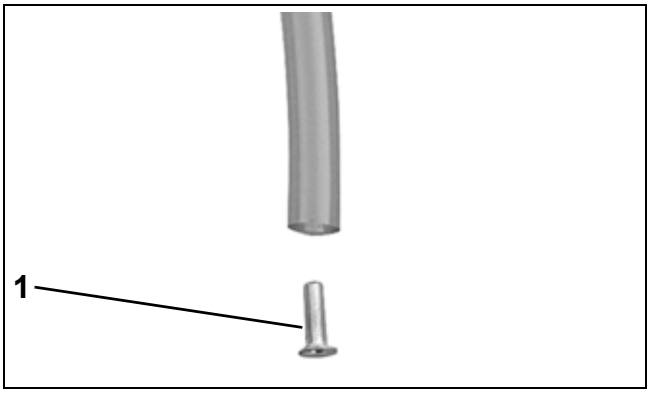
Use a pen or marker to mark the position of the oil hose relative to the retaining mechanism.

Release the hose by depressing the outer ring of the hose retaining mechanism.

Once hose is removed from the manifold, make sure hose support is in the end of the hose.



1. Retainer mechanism 004295



1. Hose support DSC0290

Installation

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

Insert hose support in manifold end of hose.

IMPORTANT: DO NOT reinsert the hose into manifold without the hose support. (Idle oil circuit hose does not require supports.)

Be sure the hose is fully inserted into manifold. The insertion depth of hose into the manifold is 5/8 in. (16 mm). Visually inspect for hose supports. Hose supports are seen through hoses.

Oil Injection Pump

Removal

Disconnect the battery cables at the battery.

Remove engine cover and air silencer.

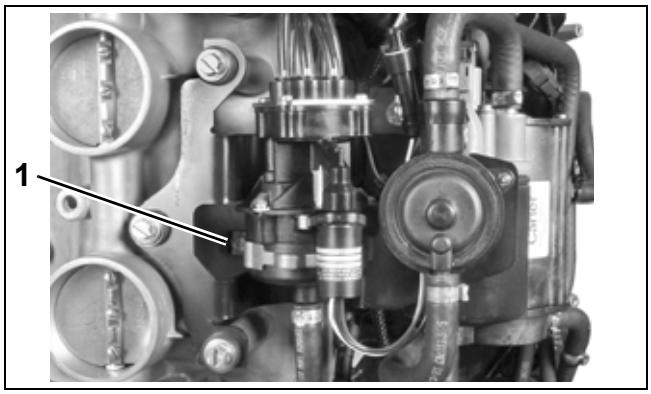
Remove the oil supply hose from the fitting (inlet) of the oil injection pump.

Disconnect the electrical connector.

IMPORTANT: Note oil distribution hose routings before proceeding with disassembly. Center hose from oil distribution manifold connects to oil to fuel check valve.

Remove oil distribution hoses from the crankcase fittings.

Remove oil injection pump clamp to bracket screw.



1. Clamp screw 004220

Remove the oil injection pump assembly.

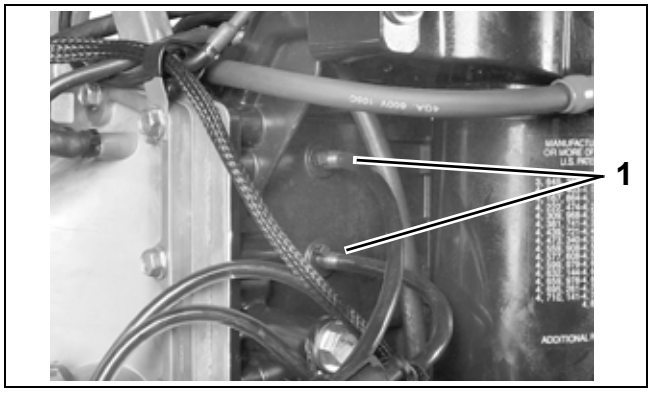
IMPORTANT: The oil injection pump and manifold is an assembly and cannot be serviced as individual components.

Installation

Route oil distribution hoses from the oil distribution manifold to the crankcase oil delivery fittings as they were prior to removal.

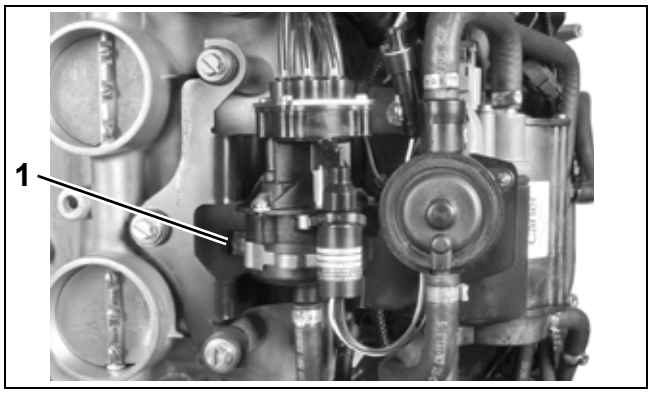
IMPORTANT: Center hose from oil distribution manifold connects to idle oil circuit fitting above #2 cylinder.

Connect oil hoses to crankcase fittings and fasten with tie straps.



1. Crankcase fitting 004224

Position the oil injection pump assembly on bracket and install clamp and retaining screw. Torque to 24 to 36 in. lbs. (3 to 4 N·m).

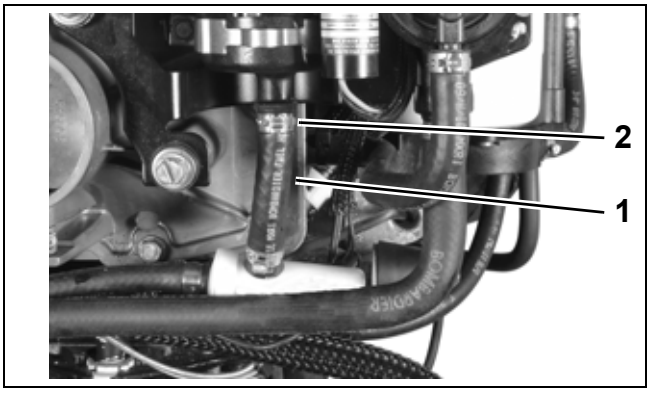


1. Clamp screw 004220

Reconnect the electrical connector.

IMPORTANT: Use oil primer bulb to purge oil supply hose before reconnecting hose to oil pump.

Reconnect oil supply hose to the inlet fitting of oil pump. Fasten with *Oetiker* clamp.



1. Oil supply hose 005519
2. Oetiker clamp

Make sure oiling system is primed. Check oil flow through oil distribution hoses. Check oil system operation and routing of oil hoses. Refer to **PRIMING** on p. 205.

Run the outboard and check for leaks.

Repair any oil leaks and any kinked or misrouted hoses.

Reinstall the air silencer and engine cover.

NOTES

Technician's Notes

Related Documents

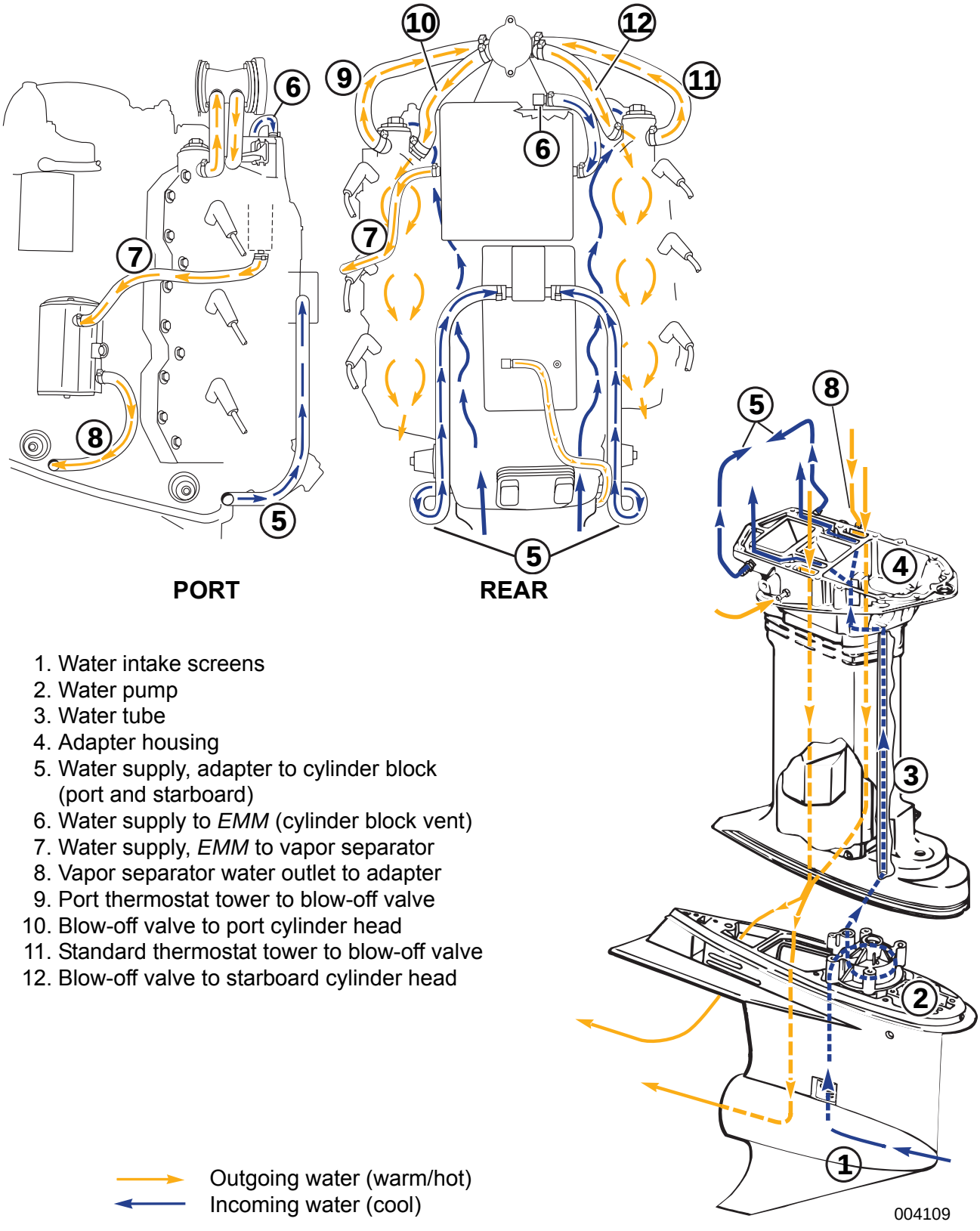
Bulletins	
Instruction Sheets	
Other	

COOLING SYSTEM

TABLE OF CONTENTS

HOSE ROUTING AND WATER FLOW DIAGRAM 216
ENGINE TEMPERATURE CHECK 217
SOFTWARE METHOD 217
PYROMETER METHOD 217
IDLE OPERATING TEMPERATURE TROUBLESHOOTING (BELOW RANGE) 218
COMPONENTS 220
GENERAL DESCRIPTION 220
WATER PUMP AND INTAKES 220
WATER SUPPLY TUBE 220
ADAPTER HOUSING 221
PRESSURE RELIEF VALVE 221
THERMOSTATS 221
BLOCK VENTING 221
OPERATION 222
CYLINDER BLOCK / CYLINDER HEAD COOLING 222
EMM AND VAPOR SEPARATOR COOLING 223
THERMOSTAT SERVICING 223
DISASSEMBLY 223
INSPECTION 223
ASSEMBLY 223
PRESSURE RELIEF VALVE SERVICING 224
DISASSEMBLY 224
INSPECTION 224
ASSEMBLY 224

HOSE ROUTING AND WATER FLOW DIAGRAM



1. Water intake screens
2. Water pump
3. Water tube
4. Adapter housing
5. Water supply, adapter to cylinder block (port and starboard)
6. Water supply to *EMM* (cylinder block vent)
7. Water supply, *EMM* to vapor separator
8. Vapor separator water outlet to adapter
9. Port thermostat tower to blow-off valve
10. Blow-off valve to port cylinder head
11. Standard thermostat tower to blow-off valve
12. Blow-off valve to starboard cylinder head

ENGINE TEMPERATURE CHECK

IMPORTANT: For correct engine operating temperatures and RPM figures, the intake water temperature must be 70° ± 10°F (21° ± 3°C).

⚠ CAUTION ⚠

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

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.

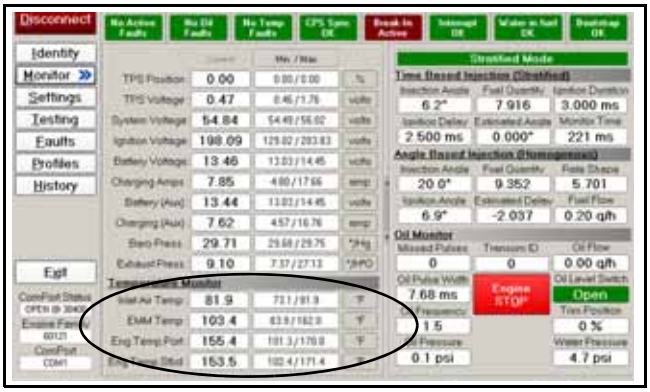
Reduce outboard speed and run engine at IDLE for five minutes. Check IDLE operating temperature.

Increase outboard speed to 5000 RPM. At 5000 RPM, operating temperature must not exceed 160°F (71°C).

Check temperature on both sides of powerhead. If engine temperature is not within this range, troubleshoot cooling system. Remember, running outboards at high speeds in test tanks may disrupt water flow to water intakes of the gearcase. Make sure the outboard has adequate water flow.

Software Method

Use the *Evinrude* Diagnostics Software program. Observe temperature displays for port and starboard temperature sensors.



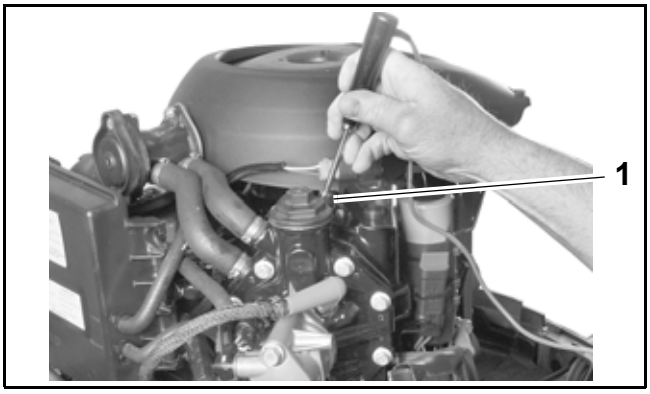
Engine Monitor Screen 005141

Typical temperature displays at IDLE speed should be 160°F ± 10°F (71°C ± 6°C)

Pyrometer Method

Use a Temperature Gun, P/N 772018, or a digital pyrometer to accurately determine the outboard's operating temperature.

Position infrared beam or pyrometer pickup at top of cylinder assembly, adjacent to the thermostat housing and cylinder head. Check temperature on both sides of powerhead.



1. Top of cylinder block (starboard side) 004339

Typical temperatures observed at IDLE speed with pyrometer should be 143°F ± 15°F (62°C ± 8°C)

IMPORTANT: If you get low or inaccurate readings during these tests, coat the probe location of

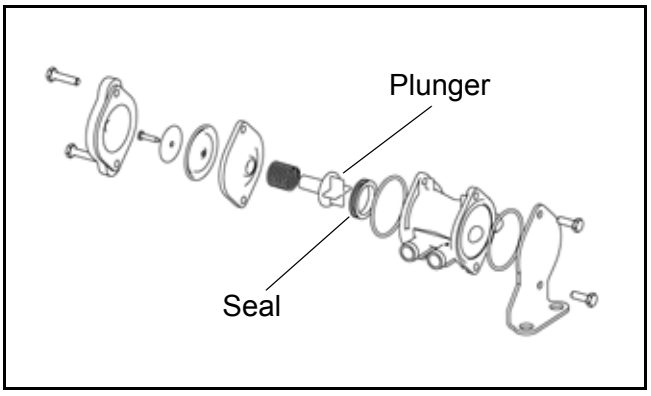
the digital pyrometer with a liberal amount of *Thermal Joint Compound*, P/N 322170.

Idle Operating Temperature Troubleshooting (Below Range)

If engine temperature is not within specified range, troubleshoot cooling system to determine problem. Check thermostats and pressure relief valve operation. Remember, cold running outboards prevent spark plugs from achieving proper operating temperatures.

Pressure Relief Valve

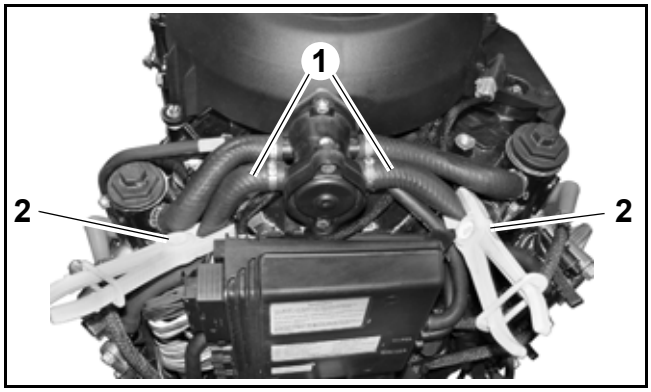
Verify engine temperature at IDLE. The pressure relief valve should be closed. Water should not flow past the plunger and seal at IDLE speed.



Pressure Relief Valve DRC8113

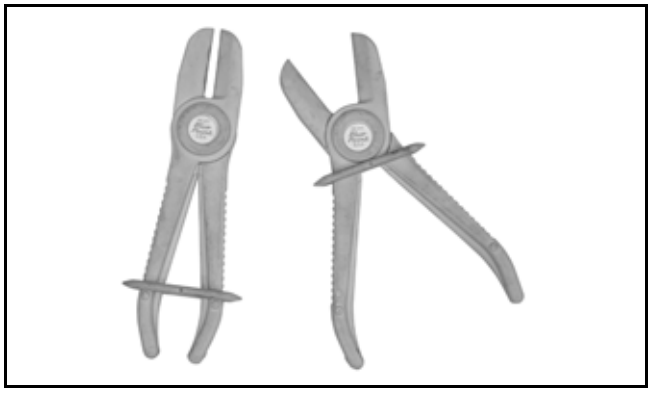
If IDLE temperature increases to specific operating range, pressure relief valve and thermostats are functioning properly.

If IDLE temperature is below specific operating range, pinch off the water outlet hoses from pressure relief valve to cylinder heads.



1. Outlet hoses
2. Pliers
DSC00827

Use hose pinching pliers (acquired through local tool source) to prevent hose damage.



Hose Pinching Pliers DSC00830

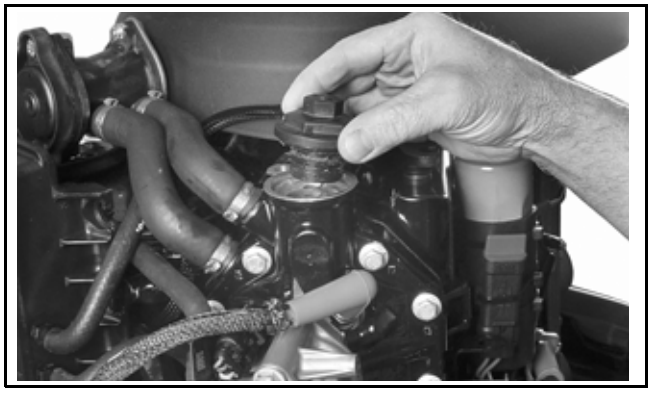
Start the outboard and check IDLE operating temperature using *Evinrude Diagnostics* software program.

If IDLE temperature increases to specific operating range, 160°F ± 10°F (71°C ± 6°C), after pinching off hoses and eliminating water flow to the cylinder heads, pressure relief valve is leaking. Replace pressure relief valve.

If IDLE temperature is still below specific operating range with hoses pinched off, inspect thermostats and thermostat seals.

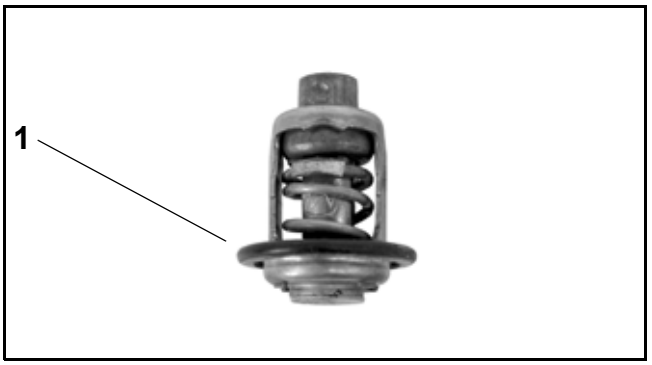
Thermostats

Remove thermostat cover(s) and inspect thermostat(s).



004338

IMPORTANT: Check position of thermostat seal and how thermostat seals against cylinder head. Seal must be properly fitted to flange of thermostat.



1. Seal, thermostat DSC02335

Inspect thermostat for cracks, heat damage, or signs of corrosion. Check thermostat for proper operation. Thermostat opens at 143°F (62°C).

COMPONENTS

General Description

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.

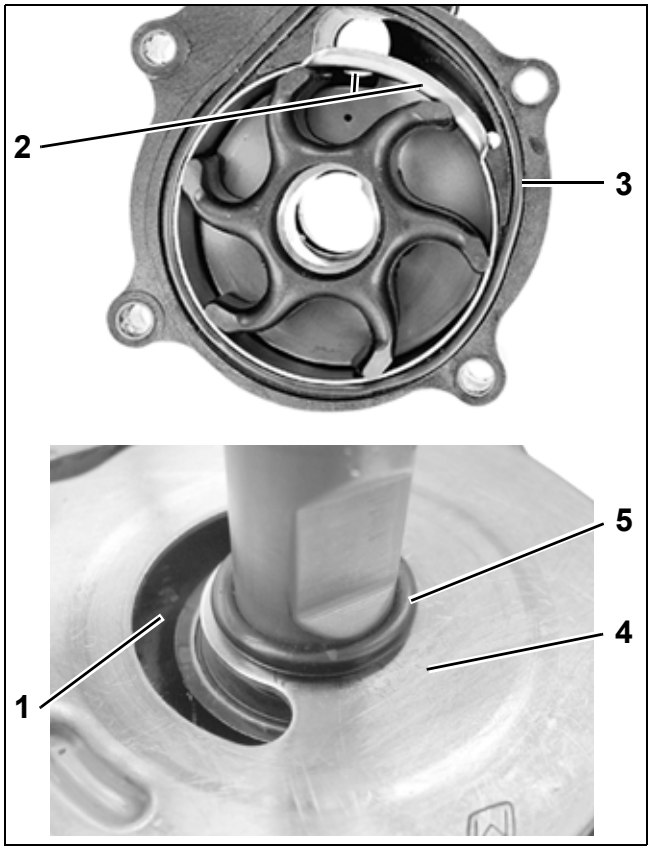
IMPORTANT: Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

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 stainless steel liner must seal against a separate stainless steel water pump plate.
- The pump operates as a positive displacement pump at LOW speeds (below 1500 RPM) and as a centrifugal pump at HIGHER speeds.
- The bottom plate MUST seal to gearcase housing.

Refer to **WATER PUMP** on p. 288 for water pump servicing.



(Impeller key removed for clarity) 000697

1. *Water inlet*
2. *Water outlet*
3. *Seal*
4. *Plate*
5. *O-ring*

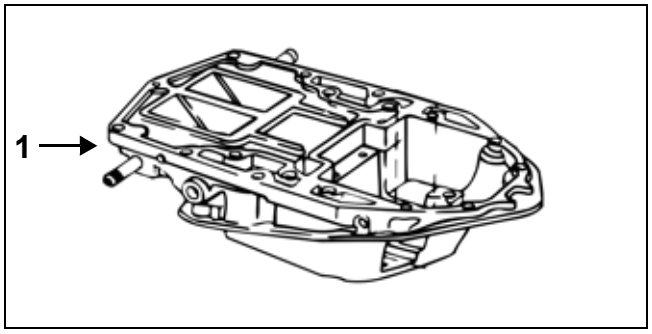
Water Supply Tube

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 inner exhaust housing with a water plate and screws.

Water supplied to the water tube provides all cooling water to the adapter housing and cylinder block.

Adapter Housing

- Adapts the cylinder/crankcase assembly (powerhead) to the exhaust housing and the water tube.
- Provides water passages which route incoming and outgoing cooling water.
- Provides exhaust passages which connect to the inner exhaust of the outboard's midsection.



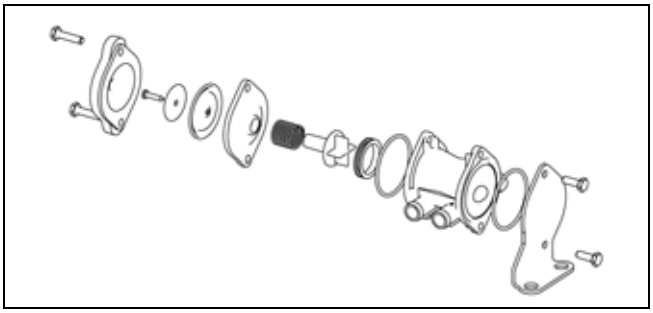
1. Adapter housing 000695

Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 1800 RPM). Pressure relief valve activates or "blows-off the seat" as water pressure increases. Spring tension is used to set the "blow off" 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 DRC8113

Thermostats

Thermostats are used to control water flow and operating temperature at lower speeds (below 1800 RPM).

Overheating: Restricted or faulty thermostats typically result in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.



Thermostat DSC02335

Refer to **THERMOSTAT SERVICING** on p. 223.

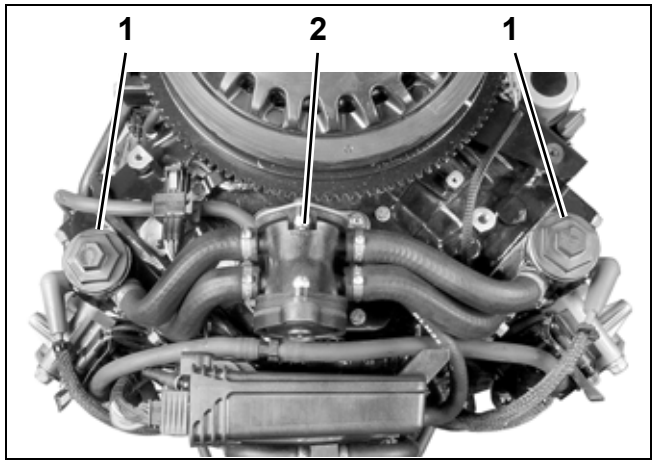
Block Venting

A fitting and hose connected to the top of the block allows the constant movement of water and/or air from the center water passage (top) of the block. Circulated water flows to an outlet fitting and exits the block through the adapter/exhaust housing.

OPERATION

Cylinder Block / Cylinder Head Cooling

The flow of water through the cylinder block and cylinder heads is controlled by two thermostats and one external pressure valve. The pressure valve is connected by hoses to the top of each cylinder head.



1. Thermostats 004269
2. Pressure valve assembly

The thermostats and pressure valve control the flow of water entering the vertical water passages of the cylinder heads.

Water outlet passage at the bottom of each cylinder head aligns with a water outlet passage in the cylinder block. Water flows through the block to the adapter housing and then out of the outboard.

At low speed, the pressure valve is against the seat and the thermostats are closed. Warm water from the top of the cylinder block gradually migrates to the thermostat pocket at the top of each cylinder head. Water movement is the result of water “bleeding” past the pressure valve and thermostats.

The thermostat eventually opens as the water temperature in the system reaches 135°F (57°C).

When thermostat opens, increased water flow is directed down the cylinder head water passage to the water outlet passage of the block. Water then exits through the adapter/exhaust housing.

At higher speeds, water pressure increases. The pressure valve opens, or lifts off the seat, at approximately 1800 RPM. Water flows through the pressure valve and bypasses the thermostats. Hoses route the water flow from the pressure valve to the vertical water passages below the thermostats. All water flows through the cylinder heads to the outlet passages of the block and then exits through the adapter housing.

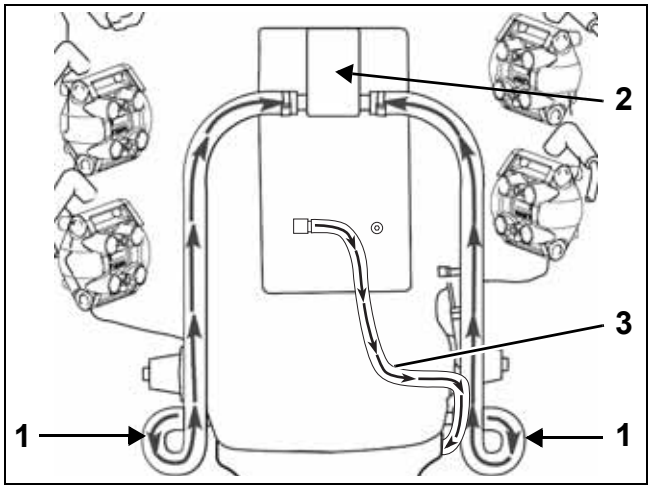
This pressure controlled water outlet circuit provides a “high flow” discharge of water during high speed operation.

This cooling system configuration provides “balanced cooling” at higher RPM by utilizing one pressure valve to control the discharge of water through both cylinder heads.

Refer to **HOSE ROUTING AND WATER FLOW DIAGRAM** on p. 216.

Additional Cooling

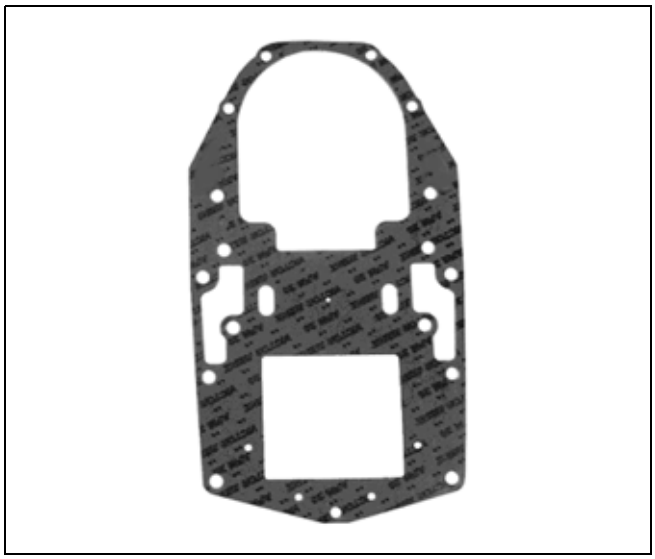
Two external water supply hoses direct water flow into the exhaust (plenum) area of the cylinder block. The water reduces exhaust runner temperatures and circulates through the cylinder block.



1. External water supply hoses 000698r
2. Exhaust (plenum)
3. Inner exhaust cooling hose

A third external water hose directs water flow from the exhaust housing of the cylinder block to an exhaust passage at the adapter. The water reduces inner exhaust temperatures and cools the propeller hub.

The base gasket limits water flow to the base of the block and diverts water flow to the rear port and rear starboard fittings of the adapter housing.



Gasket, adapter to powerhead 000661

EMM and Vapor Separator Cooling

Cooling water is routed from the top of the cylinder block to the inlet fitting of the *EMM* and through the *EMM* water cavity. Cooling of the *EMM* minimizes the temperatures of internal components.

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 block and exits through the adapter/exhaust housing.

IMPORTANT: Improper *EMM* cooling will activate service codes (code 29 and 25) and initiate *S.A.F.E.* or SHUTDOWN. Refer to **EMM DIAGNOSTICS** on p. 104 for specific service code information.

THERMOSTAT SERVICING

Disassembly

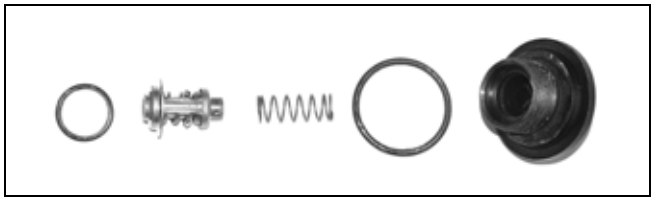
Remove the thermostat cover and O-ring from each cylinder head. Remove each thermostat.



004338

Inspection

Inspect all components for cracks, heat damage, or signs of corrosion. Replace damaged components. Clean debris from all housings and thermostat components.



000757

Assembly

Assembly is essentially the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

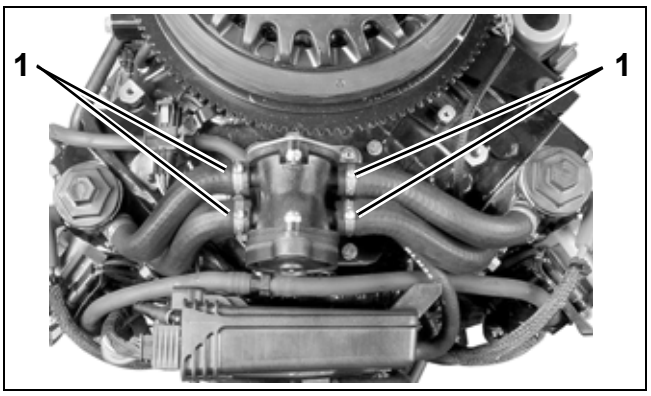
Coat threads of each cylinder head thermostat cover with *Gasket Sealing Compound*. Install and tighten the cover to a torque of 120 to 144 in. lbs. (13.6 to 16.3 N·m).

PRESSURE RELIEF VALVE SERVICING

The pressure relief valve assembly should be serviced at the same time as the thermostats.

Disassembly

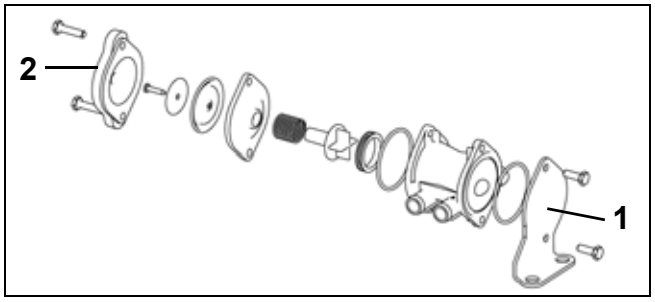
Remove hose clamps and hoses from pressure valve.



1. Hoses 004269

Remove screws securing the bracket to powerhead. Remove the pressure valve housing.

Remove the bracket and the cap from the housing. Remove the pressure valve assembly.



1. Bracket DRC8113
2. Cap

Inspection

Inspect all components for cracks, heat damage, or signs of corrosion. Replace damaged components. Clean all debris from pressure relief valve components.

Assembly

Assembly is essentially the reverse of disassembly. Pay close attention when performing the following **additional** tasks.

Torque bracket and cap screws to 60 to 84 in. lbs. (7 to 9.5 N·m).

Install valve on powerhead. Torque nuts to 60 to 84 in. lbs. (7 to 9.5 N·m).

Install hoses and secure with clamps.

POWERHEAD

TABLE OF CONTENTS

SERVICE CHART 226
GENERAL 228
- CYLINDER COMPRESSION TESTING 228
- RETAINING RING PLIERS 228
- TAPER PIN TOOL 228

REMOVAL 229
DISASSEMBLY 232
- CRANKCASE 232
- CYLINDER HEAD 233
- CONNECTING RODS AND PISTONS 233
- CRANKSHAFT 235

CLEANING 237
INSPECTION 238
- CYLINDER HEAD 238
- CRANKSHAFT 238
- CYLINDER BORE 238
- PISTONS 239
- PISTON RINGS 239
- BEARINGS 240

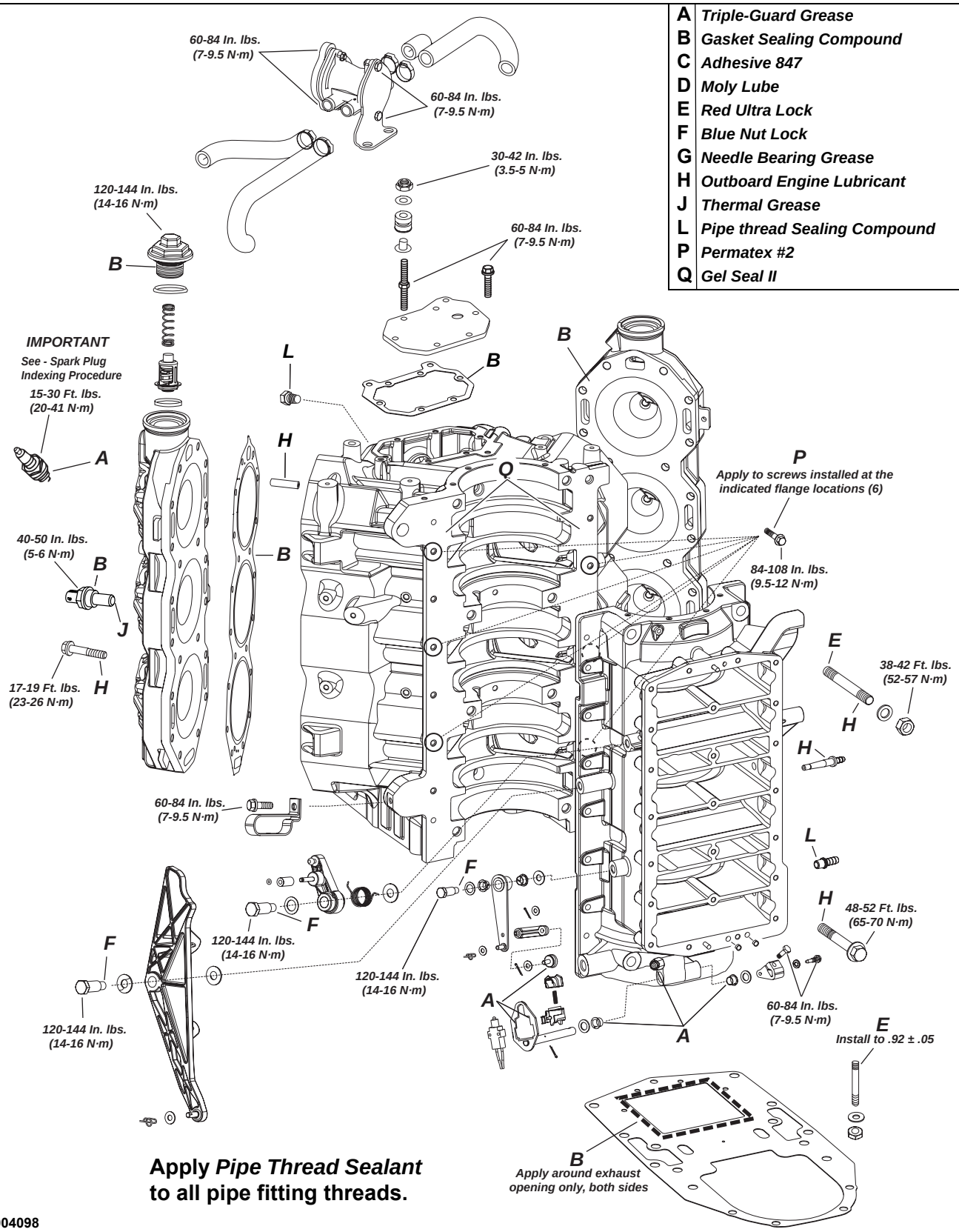
ASSEMBLY 240
- CRANKSHAFT 240
- PISTONS AND CONNECTING RODS 243
- CYLINDER HEAD 245
- CRANKSHAFT AND CONNECTING RODS 245
- CRANKCASE 248

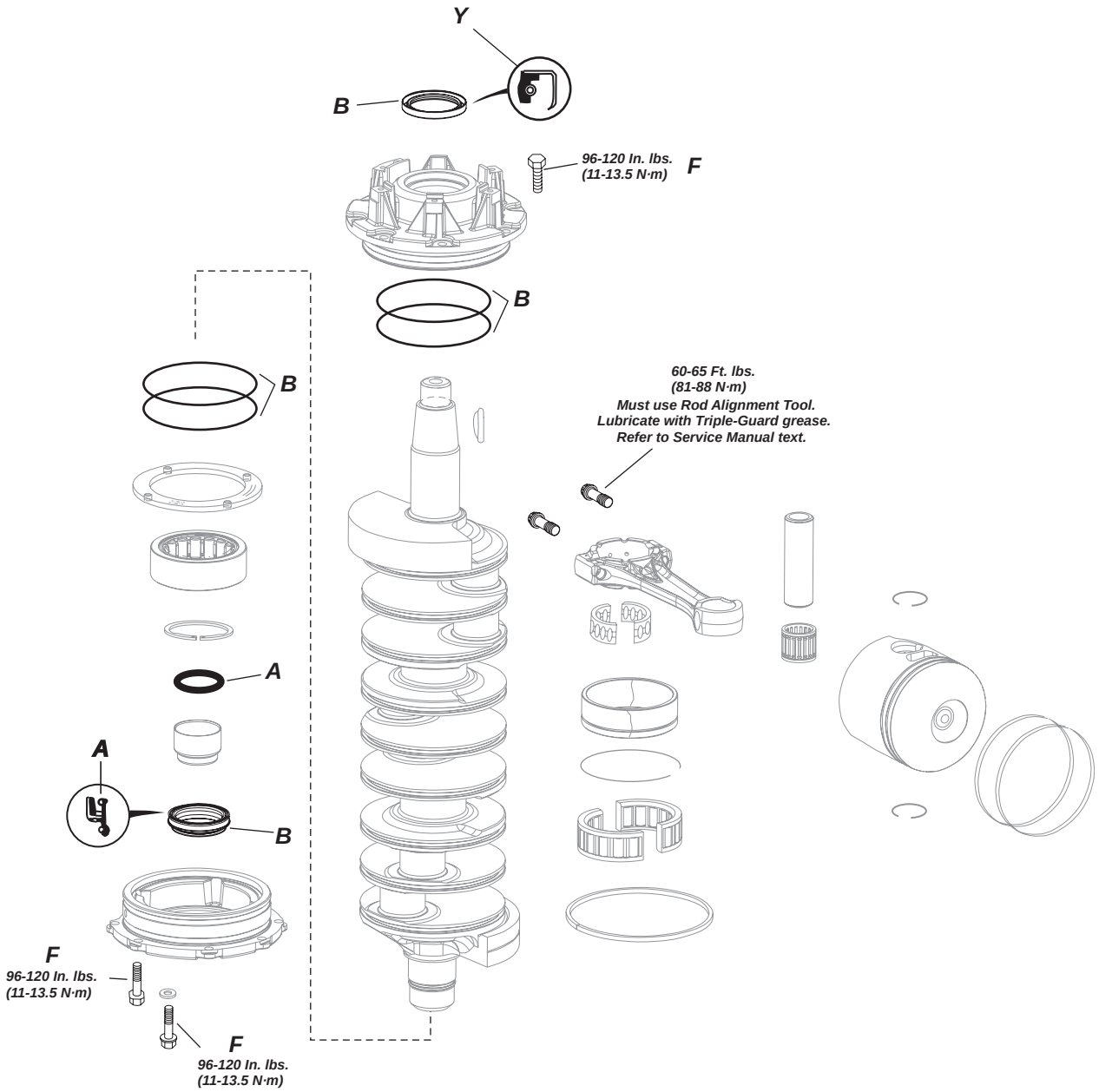
INSTALLATION 250
POWERHEAD VIEWS 253
- PORT SHORT BLOCK 253
- STARBOARD SHORT BLOCK 254
- PORT 255
- STARBOARD 256
- FRONT 257
- REAR 258
- TOP 259

NOTES 260

SERVICE CHART

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	*Outboard Engine Lubricant*
J	*Thermal Grease*
L	*Pipe thread Sealing Compound*
P	*Permatex #2*
Q	*Gel Seal II*





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*
Y	*Extreme Pressure Grease*

004108

10

GENERAL

Cylinder Compression Testing

Start and run outboard until it achieves operating temperature, then shut OFF.

Disconnect crankshaft position sensor (CPS) connector. Remove all spark plugs.

Advance throttle linkage to WOT.

Install compression tester's hose attachment into spark plug hole (14 mm threads).

While cranking outboard with starter, note maximum pressure reading on gauge. Repeat procedure for each cylinder.

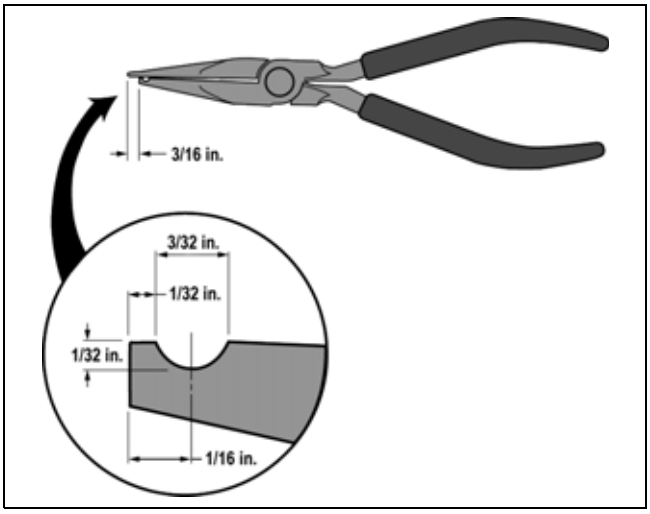
If engine shows a variation greater than 15 psi (100 kPa) between cylinders, check for:

- damaged cylinder head
- damaged pistons
- broken or stuck piston rings
- scored cylinder walls

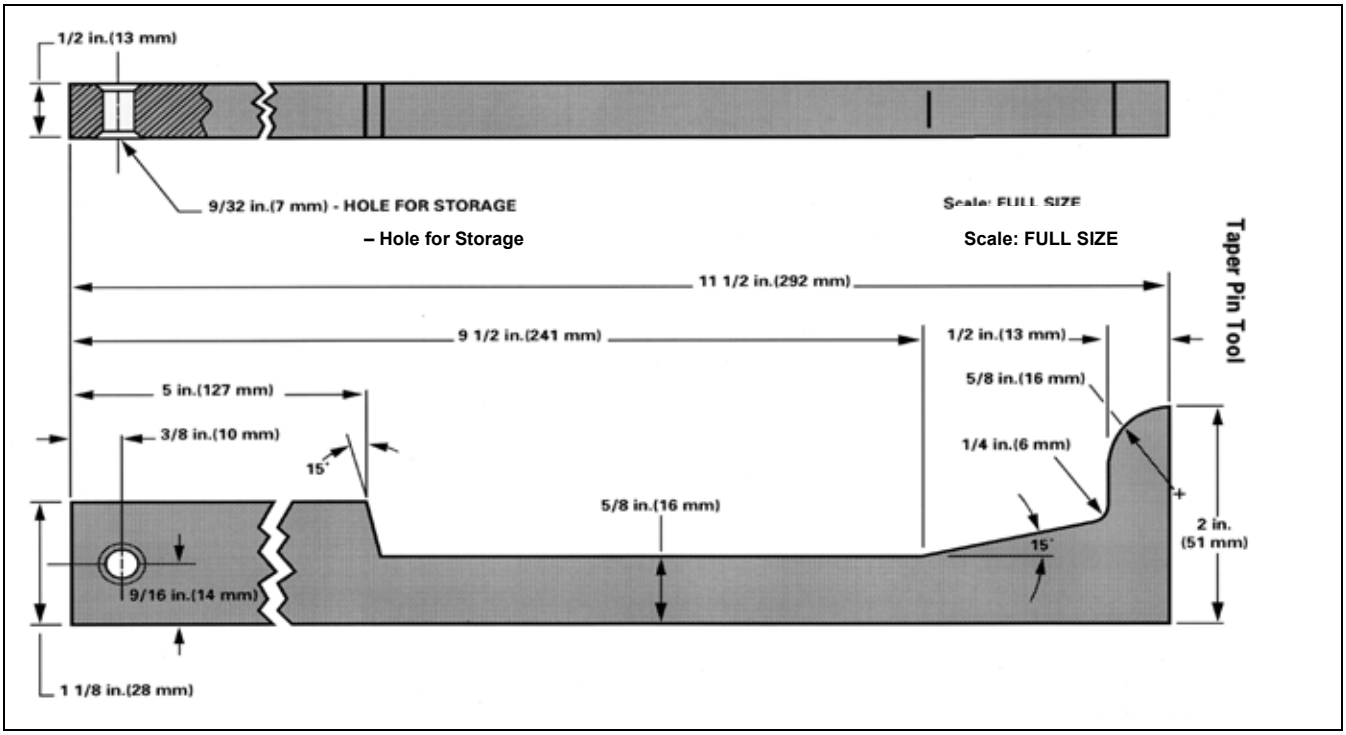
Return throttle to idle position and reconnect CPS connector. Replace spark plugs.

Refer to Spark Plug **Indexing** on p. 155.

Retaining Ring Pliers



Taper Pin Tool



REMOVAL

⚠ WARNING ⚠

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 184.

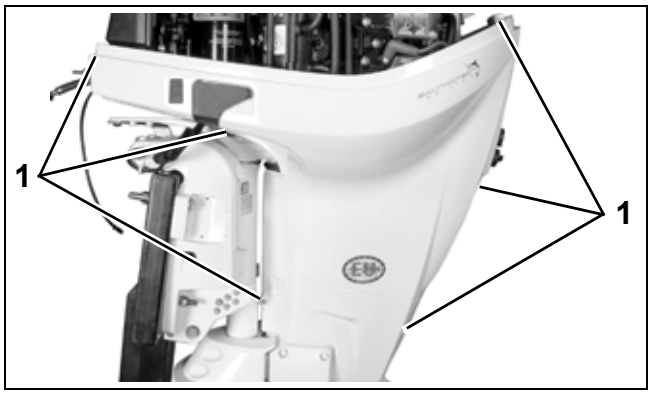
To prevent accidental starting while servicing, disconnect the battery cables at the battery.

IMPORTANT: Reinstall all fasteners, nuts, and bolts in their holes as the engine components are removed. This will simplify identification and assembly.

Remove the fuel hose and oil hose from the fittings.

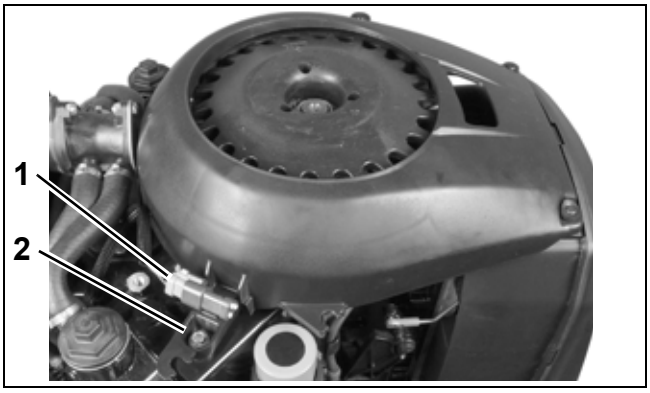
Disconnect power trim/tilt switch.

Loosen the lower engine cover retaining screws. Remove one lower cover half at a time.



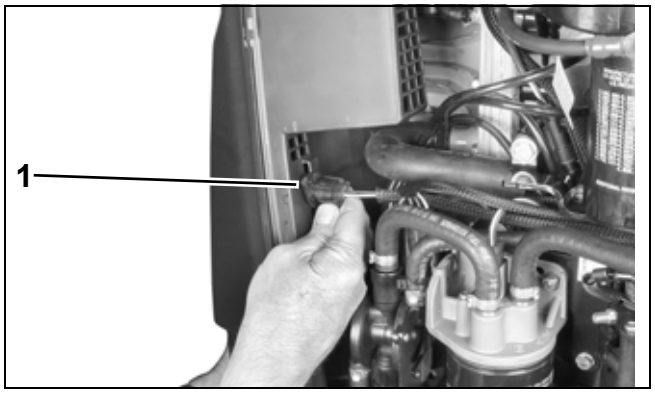
1. Lower cover screws 004122

Disconnect diagnostic connector from clip and remove flywheel cover.



1. Diagnostic connector 004237
2. Flywheel cover screw

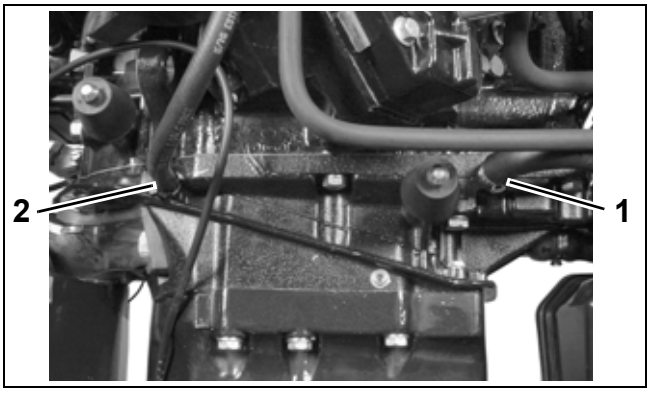
Loosen air silencer screws. Twist and remove air temperature sensor from air silencer. Remove air silencer.



1. Air temperature sensor 004219

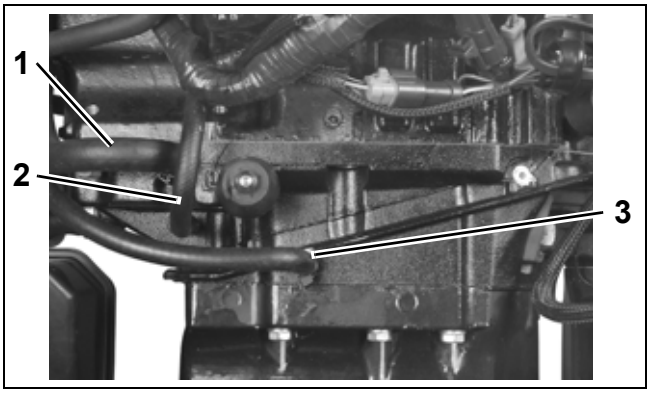
10

Remove water hoses and exhaust back pressure hose from adapter.



1. *Cooling hose (to exhaust plenum)*
2. *Cooling hose (from vapor separator)*

004239



1. *Cooling hose (to exhaust plenum)*
2. *Exhaust back pressure hose (to* EMM*)*
3. *Cooling hose (from block)*

005042

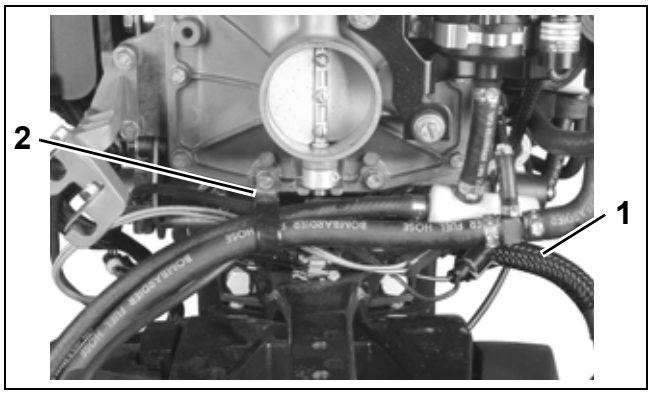
Disconnect power trim/tilt connections from engine harness.



1. *Trim/tilt connectors*

004251

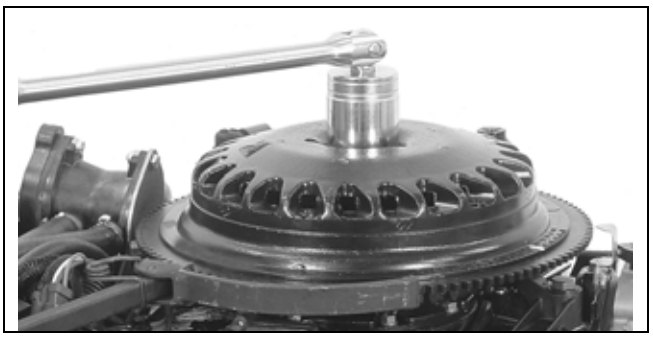
Remove trim/tilt harness from clamp.



1. *Trim harness*
2. *Clamp*

005041

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



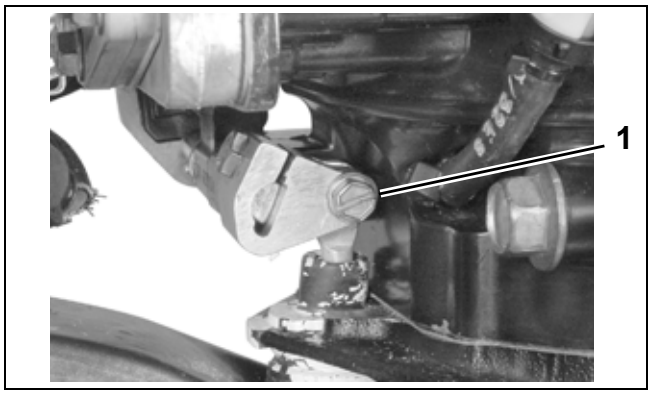
000774

Assemble pieces of Universal Puller Set, P/N 378103, and remove the flywheel. See **FLYWHEEL SERVICING** on p. 152.



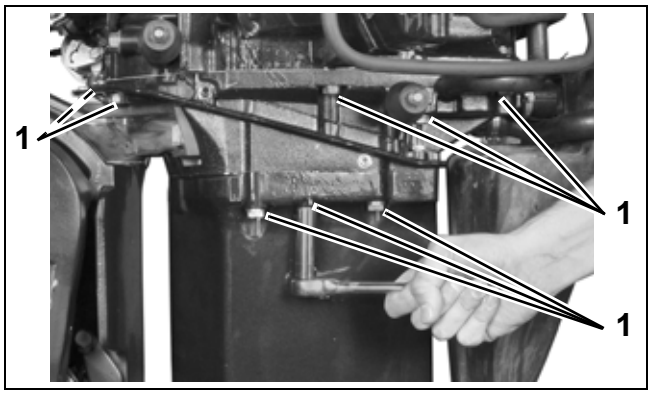
000772

Remove shift rod pin.



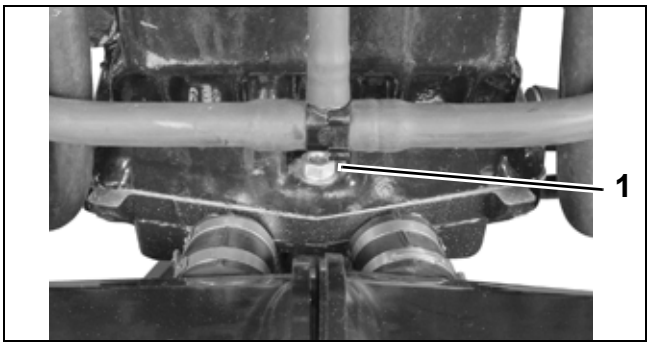
1. Shift rod pin 004241

On each side, remove the powerhead retaining screws and nuts.



1. Screws and nuts 004240

Remove the rear powerhead nut.



1. Rear powerhead nut 004252

Securely fasten Lifting Fixture, P/N 396748, to crankshaft threads and lift powerhead with a suitable hoist.



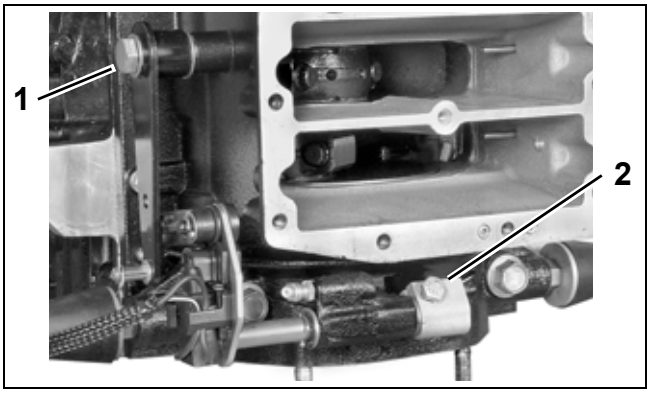
48758

Remove all fuel, ignition, and electrical components from the powerhead. To simplify reassembly and wiring installation, lay out the various screws and clamps in the order of their proper location.

DISASSEMBLY

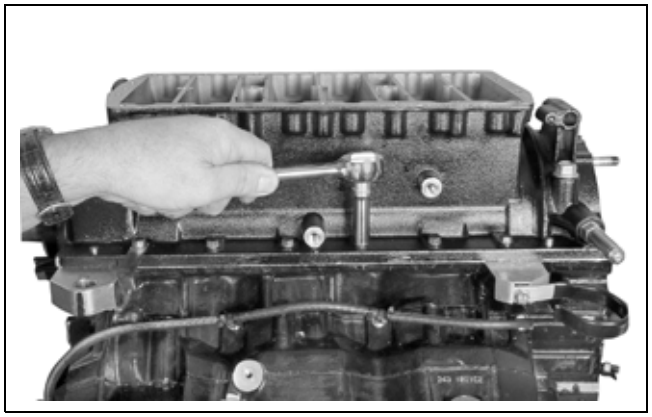
Crankcase

Remove shoulder screw from shift arm and retaining screw from shift rod lever. Slide entire shift linkage assembly from crankcase.



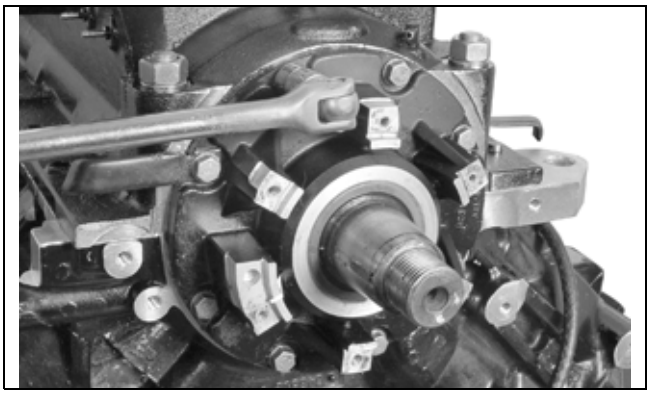
1. Shoulder screw 004145
2. Shift rod lever retaining screw

Disconnect crankcase recirculating hoses and remove crankcase flange screws.



004139

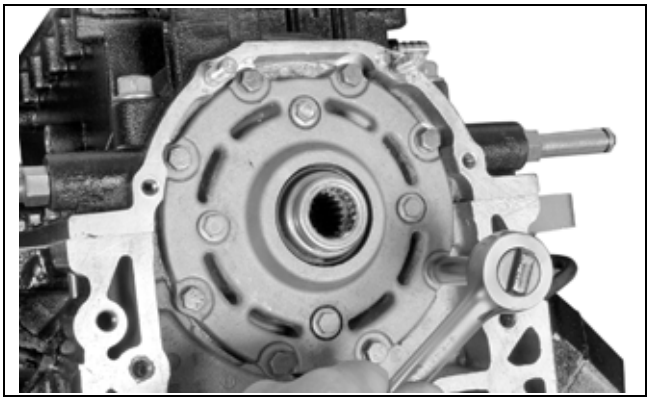
Remove the upper crankcase head screws.



004140

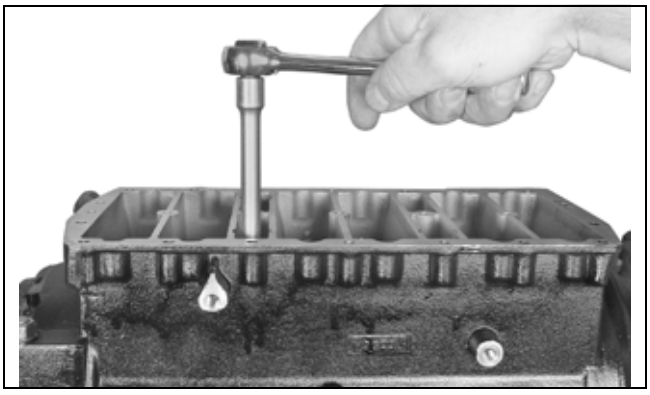
Remove the lower crankcase head screws.

IMPORTANT: DO NOT remove the four inside retaining screws on the lower crankcase head.



004146

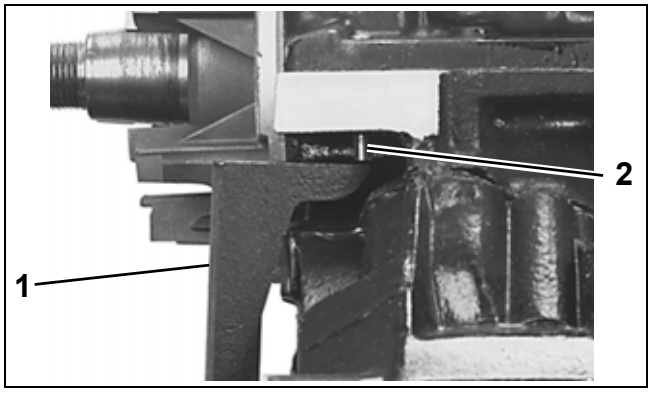
Loosen **in stages**, and remove the main bearing screws and nuts.



004136

Use the **Taper Pin Tool**, or equivalent, to push the crankcase taper pins toward intake manifold sur-

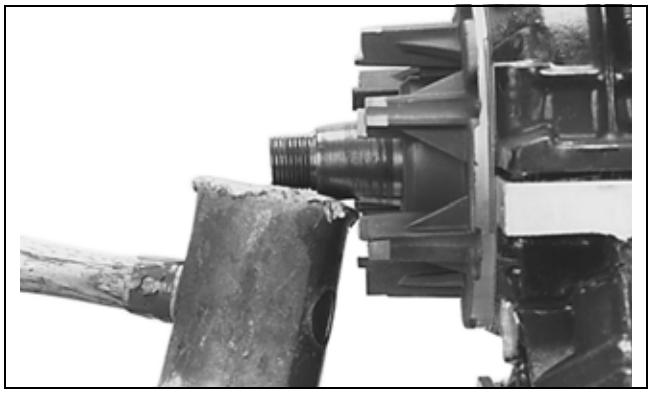
face. Do not use any tool smaller than the taper pin bore to remove the pin.



1. Tool
2. Taper pin

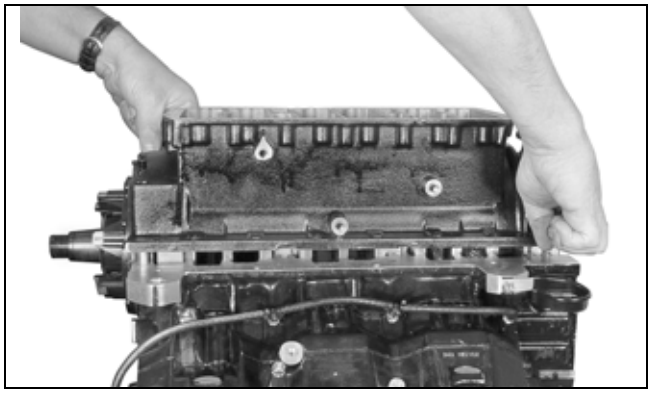
49428

Separate crankcase and cylinder block. It may be necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.



49429

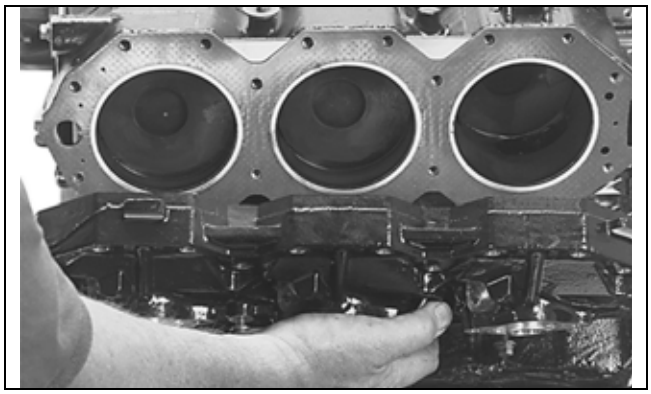
Remove the crankcase from the cylinder block carefully to avoid damaging the crankshaft seal rings.



004137

Cylinder Head

Loosen **in stages** and remove cylinder head retaining screws. Remove the cylinder heads.



49431

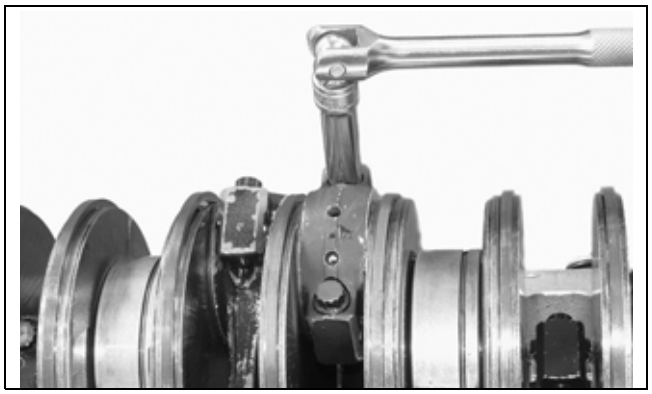
Connecting Rods and Pistons

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the flywheel.



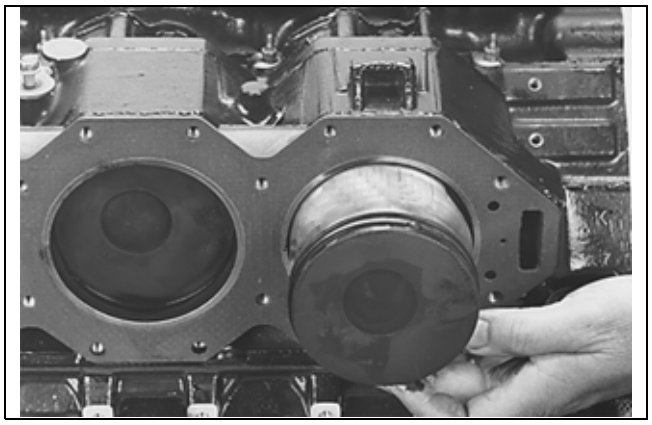
000825

Use Torquing Socket, P/N 346187, to loosen **in stages** the rod cap retaining screws. DO NOT remove the screws.



000823

Using one hand to support the piston, remove the rod cap screws with your other hand. Remove each piston and rod assembly.



49432

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.

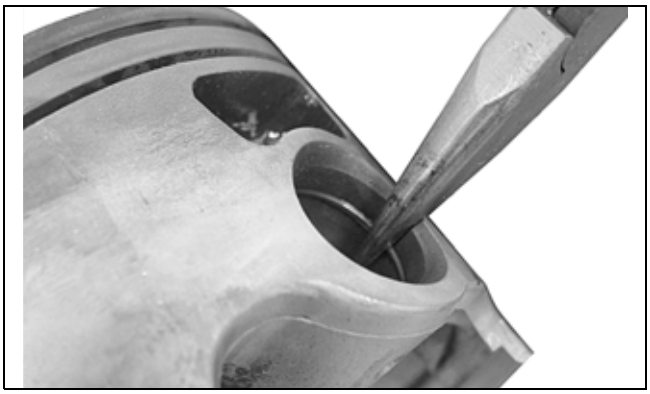


46519

⚠ WARNING ⚠

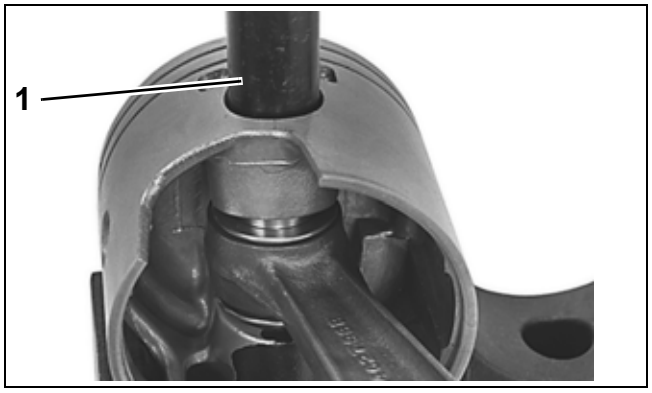
Wear safety glasses to avoid injury.

Use **Retaining Ring Pliers**, or equivalent, to remove wrist pin retaining rings. Discard retaining rings.



000689

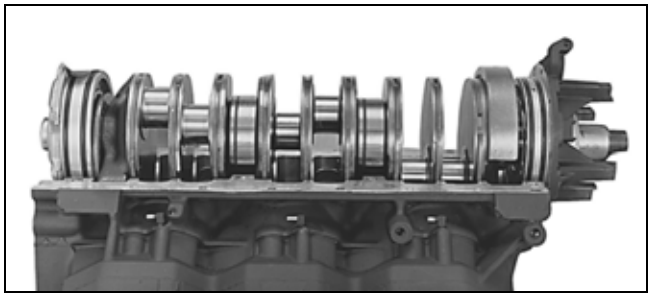
Use Wrist Pin Pressing Tool, P/N 396747, to remove wrist pin.



1. Driver, P/N 396747 31806

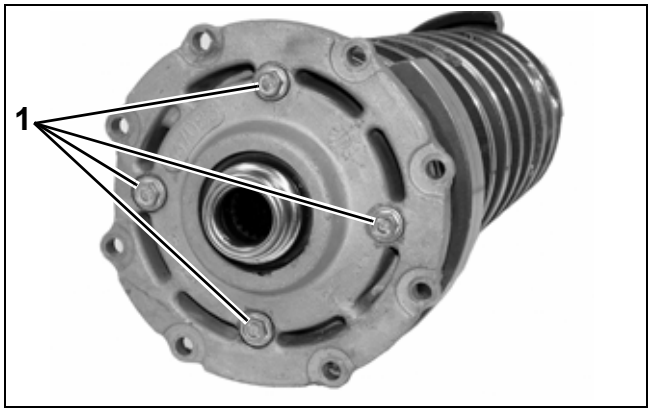
Crankshaft

Carefully lift crankshaft straight up and remove from crankcase.



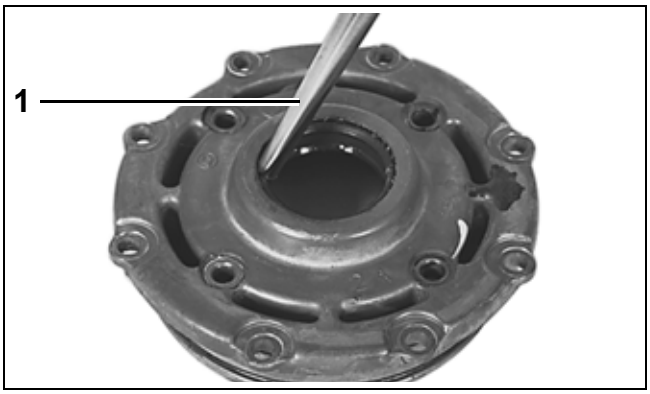
31809

If the lower crankcase head is to be resealed or the lower main bearing replaced, remove the four bearing retainer screws. While rotating the crankcase head, gently tap on the flange and remove the head.



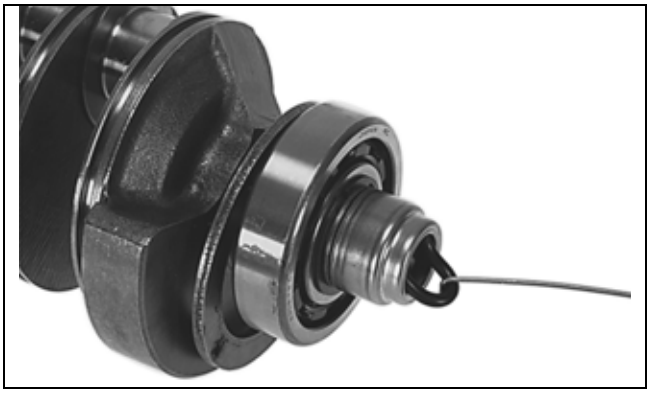
1. Bearing retaining screws 000830

To remove the lower crankshaft seal, use a drift punch. Remove and discard two crankcase head O-rings.



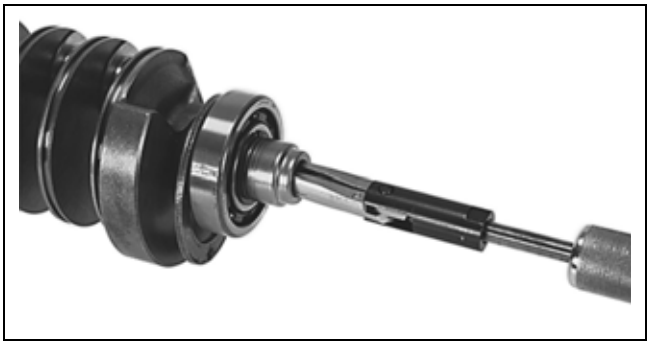
1. Drift punch 30297

Remove the O-ring from crankshaft sleeve and inspect it. Replace the O-ring if it is not in good condition.



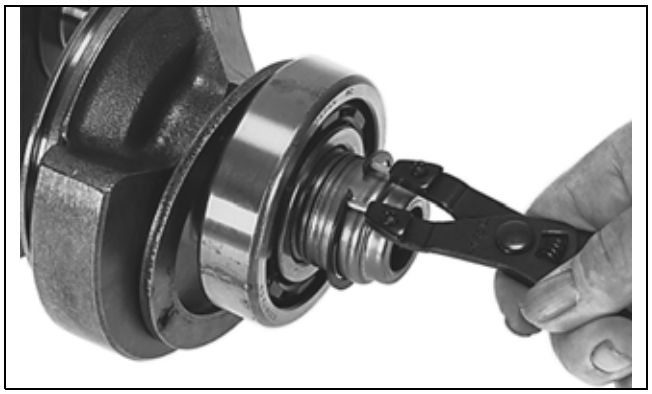
30057

Inspect the crankshaft sleeve and replace, if necessary. To remove the sleeve, use Slide Hammer, P/N 432128, and Large Puller Jaws, P/N 432129.



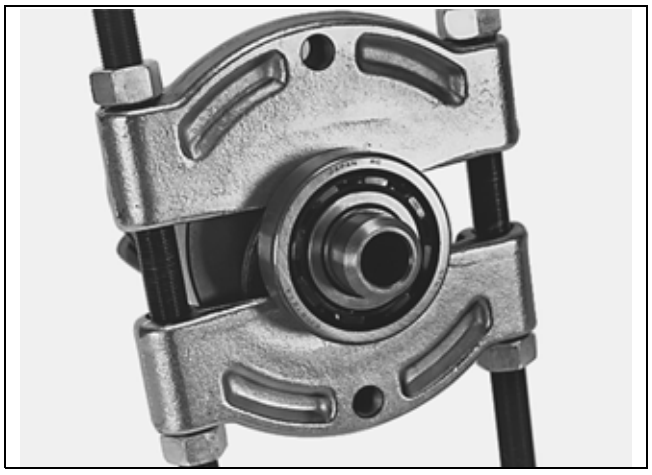
30056

Remove the lower main bearing only if it needs to be replaced. Use external retaining ring pliers to remove the lower main bearing retaining ring.



30069

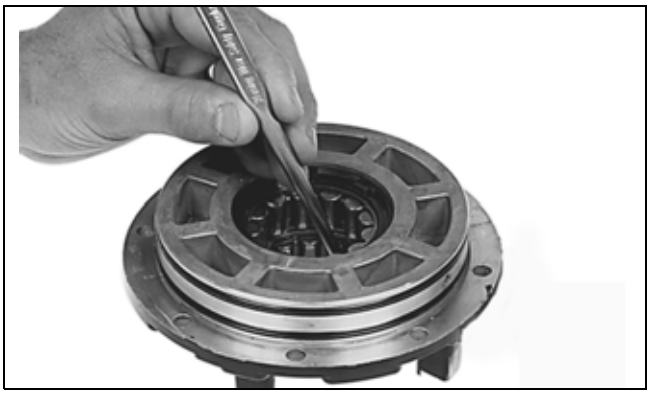
Using an appropriate bearing separator, support the bearing, place separator flats against the bearing, and press it off the crankshaft.



30291

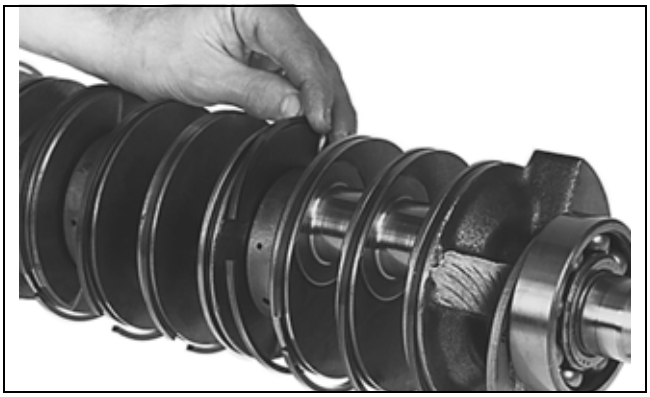
IMPORTANT: If the lower main bearing is removed from the crankshaft, it must be discarded. DO NOT reuse it.

Use a drift punch to remove the upper crankshaft seal. Remove and discard two crankcase head O-rings.



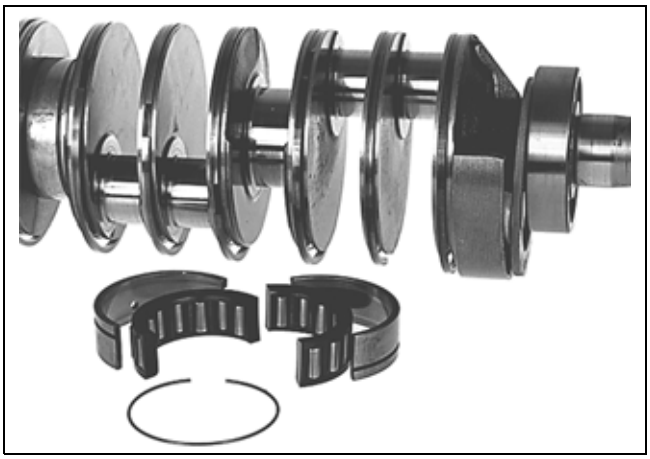
0865

Remove and inspect crankcase seal rings. Identify each ring for installation in original location.



5198

Remove center main bearings and split sleeves for inspection. DO NOT mix parts. Note location of bearings for reassembly.



5195

CLEANING

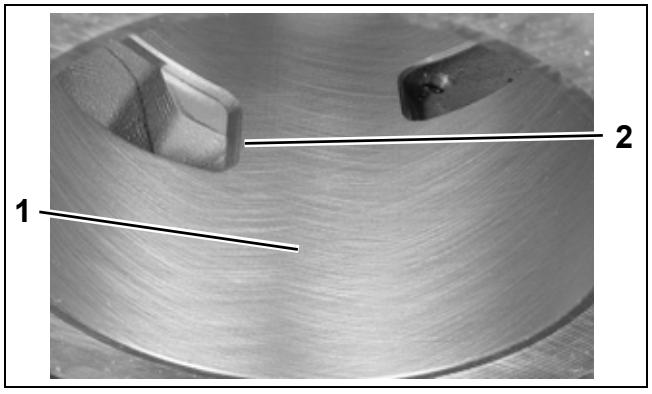
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be **completely clean and free of contaminants.**

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylinder head combustion chambers.

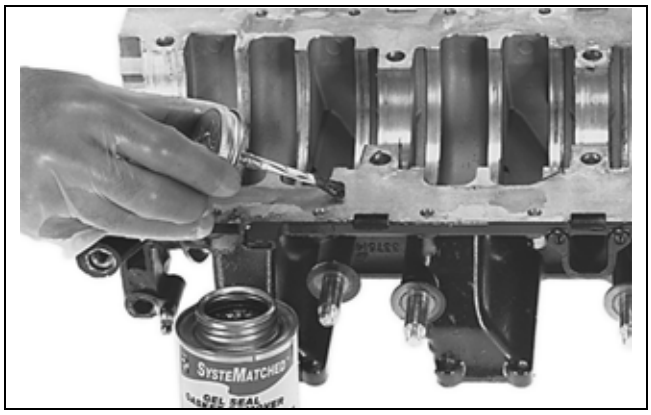
If cylinder walls are glazed from extended use, use a rigid, medium grit cylinder hone to resurface walls. Use slow RPM for best oil retention and ring sealing. When finished, a cross hatch pattern of 22 to 32° should be visible in the cylinder wall. The pattern should be uniform in both directions.

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.



TYPICAL 34861

⚠ 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.

INSPECTION

For dimensions, refer to **TECHNICAL DATA** on p. 18.

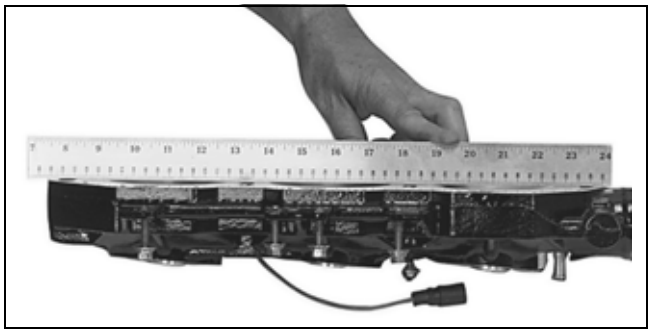
IMPORTANT: Before any inspection process can begin, all internal components must be **completely clean and free of contaminants.**

Visually inspect all parts. Check for unusual wear patterns, scuffing, or deterioration of aluminum parts, heat-related discoloration of bearings and bearing surfaces, and broken components.

Cylinder Head

Check for cylinder head warpage using a piece of bar stock or machinist's straightedge and a feeler gauge set.

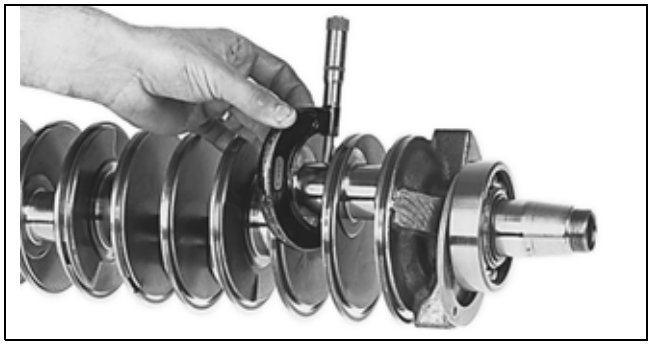
Cylinder head warpage must not exceed 0.003 in. (0.08 mm) per inch of measurement. Replace head if warpage exceeds this dimension.



49425

Crankshaft

Measure the diameter of each crankpin and main bearing journal. The lower main bearing journal would only be measured if the bearing was removed for another reason.

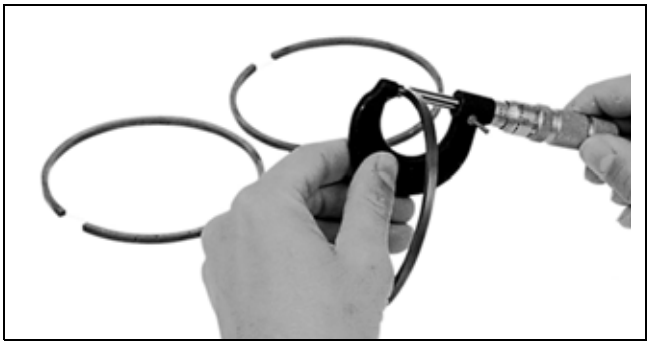


5220

Visually inspect crankcase seal rings for wear, grooves, or chipping. If rings appear worn, use a micrometer to measure ring thickness.

Replace rings that are less than 0.154 in. (3.9 mm) thick.

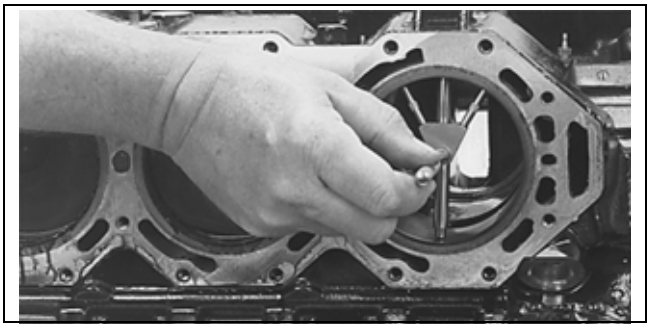
Install seal rings in their original positions on crankshaft after inspection.



1936

Cylinder Bore

Use 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.



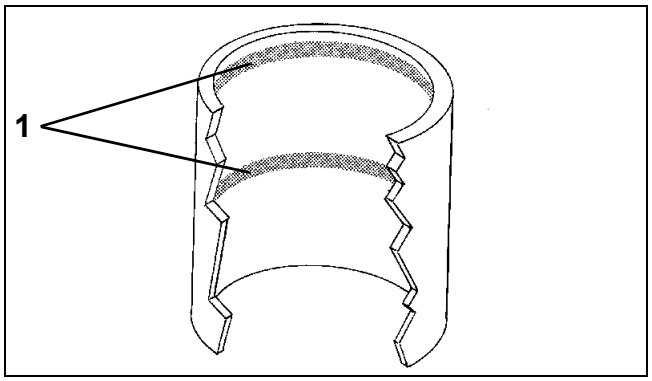
Measure as shown 49427

Measure each cylinder in at least two areas. Each area should be measured twice. The difference between the two measurements in each area is the cylinder out-of-round dimension.

- The cylinder must not be out-of-round by more than 0.004 in. (0.10 mm).

The dimensional difference between the two areas is cylinder taper.

- The cylinder taper must not exceed 0.002 in. (0.05 mm).



1. Cylinder taper DR1119

The difference between the measurements and standard bore is cylinder oversize. For dimensions, refer to **TECHNICAL DATA** on p. 18.

- The cylinder must not be oversize by more than 0.003 in. (0.08 mm).

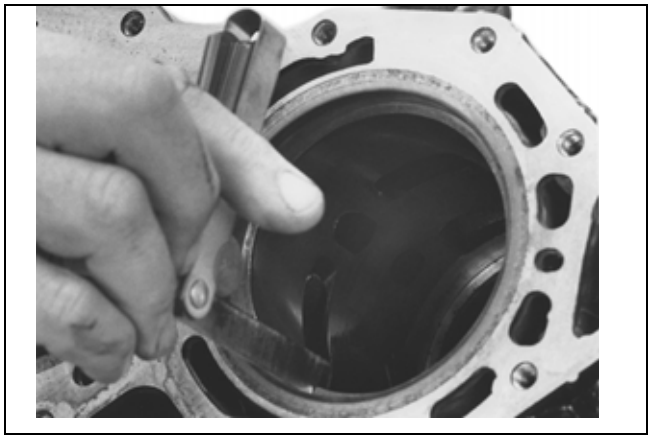
IMPORTANT: If any cylinder is outside these tolerances, it must be bored oversize. It is permissible to have one or more oversize pistons in an engine.

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.

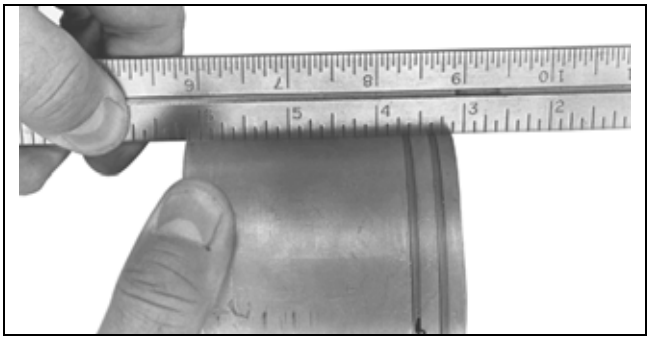


49433

Ring End Gap Specification	
Standard or Oversize rings	0.022 to 0.028 in. (0.56 to 0.71 mm)

IMPORTANT: Ring end gap increases approximately 0.003 in. (0.076 mm) for each 0.001 in. (0.025 mm) increase in cylinder bore diameter. DO NOT exceed cylinder oversize dimension.

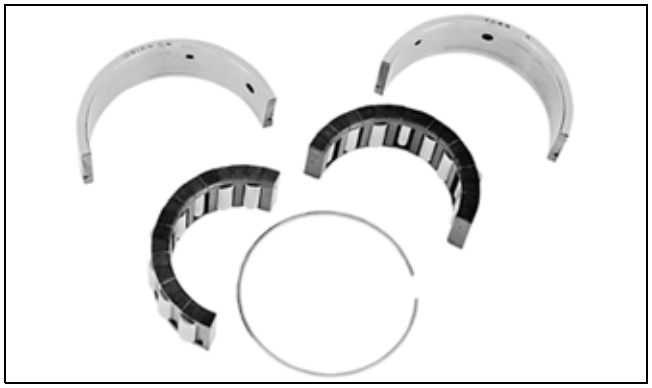
Use a machinist's straightedge to check for proper ring clearance. Position piston rings on piston. Push rings into groove and hold straightedge against the side of the piston. Rings must be even or just below the surface of piston. Rings must move freely in piston ring groove.



31796

Bearings

Inspect center main bearing and split sleeves for excess wear, nicks, or scratches. Replace if necessary.



24381

Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace if necessary.



24377

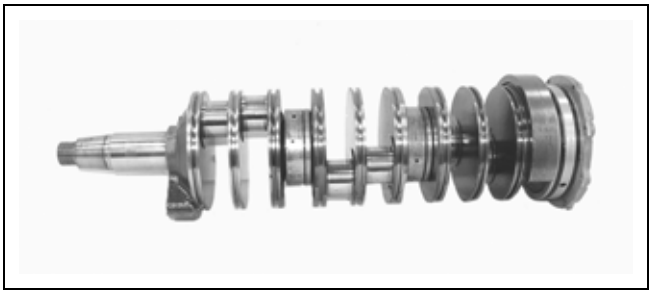
ASSEMBLY

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.

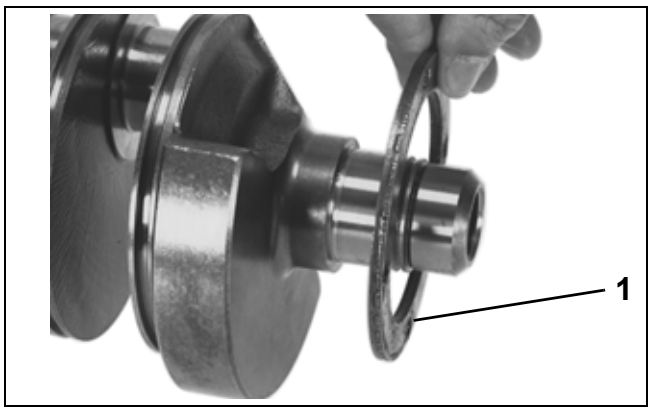
Crankshaft

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.



000829

Place bearing retainer plate, flat side down, on lower end of crankshaft.



1. Bearing retainer plate 30077

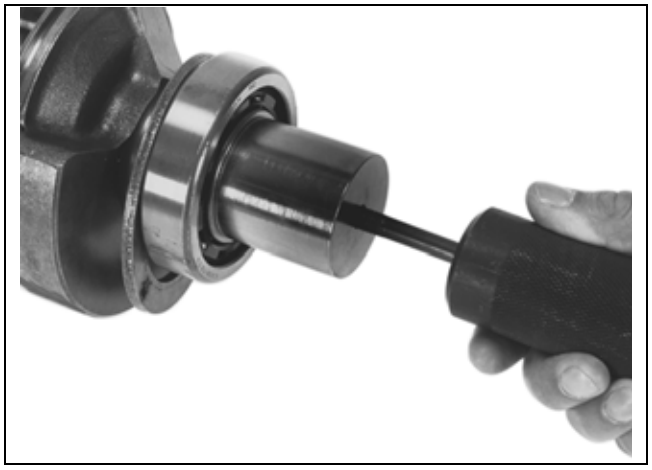
To install a new lower main bearing: Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338649, and place bearing onto crankshaft with lettered side facing the tool. Install bearing until it seats on the crankshaft.

To install a new crankshaft sleeve: Oil the end of the crankshaft. Place the sleeve in Crankshaft Bearing/Sleeve Installer, P/N 338649, and drive the sleeve onto the crankshaft until the installer contacts the lower main bearing.



30074

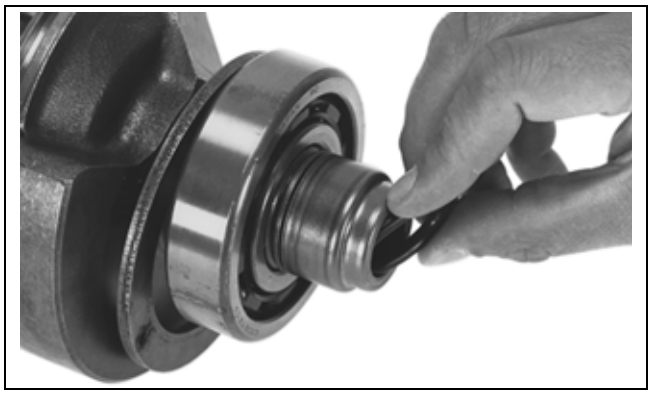
If the installer sticks on the sleeve after installation, thread Slide Hammer, P/N 391008, into installer and pull it off.



30072

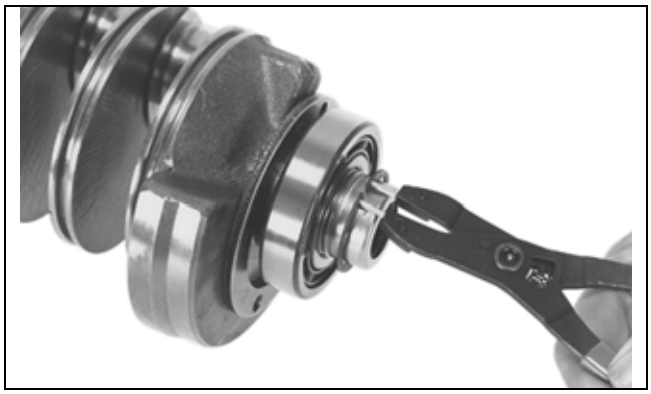
IMPORTANT: Inspect sleeve after installation. Sleeve must not be used if surface is damaged.

Lubricate a **new** driveshaft O-ring and lightly lubricate the crankshaft splines with *Moly Lube*. Install the O-ring in the sleeve.



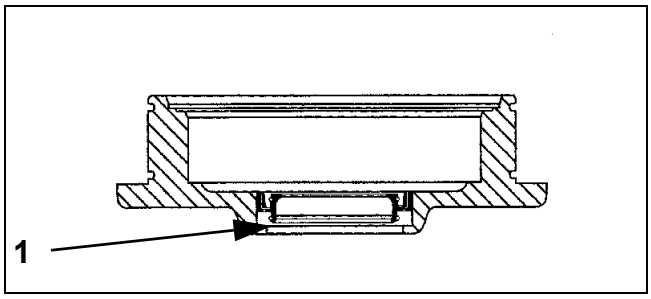
30071

Using retaining ring pliers, install lower main bearing retaining ring with sharp edge of ring facing away from bearing.



30061

Lightly coat the outside diameter of a **new** crankshaft seal with *Gasket Sealing Compound*. Use Seal Installation Tool, P/N 325453, to install seal in lower crankcase head with extended lip of seal facing down. Coat seal lips with *Triple-Guard* grease.



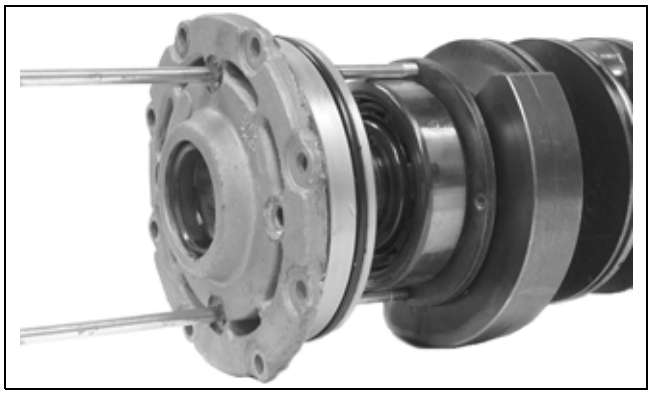
1. Seal, extended lip DRC5798

Lightly coat two **new** O-rings with *Gasket Sealing Compound* and install on lower crankcase head. Keep sealer away from oil passage.



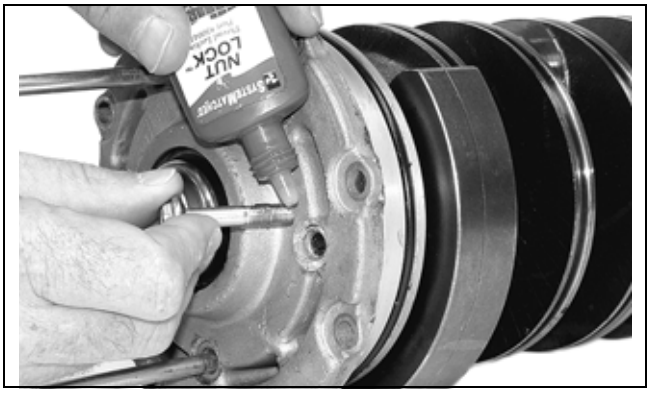
1. Oil passage 004132

Use threaded rods or Guide Rods, P/N 383175, to align retainer plate with crankcase head. Slide crankcase head onto crankshaft until seated around lower main bearing.



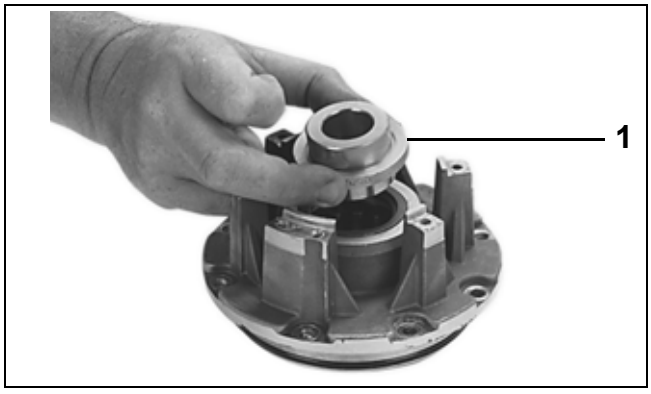
000826

Install **new** seals on the four bearing retainer screws. Apply *Nut Lock* to the threads of the screws and torque to 96 to 120 in. lbs. (11 to 13.5 N·m).



000827

Lightly coat the outside diameter of a **new** upper seal with *Gasket Sealing Compound*. Use the flat end of Seal Installation Tool, P/N 325453, to install seal flush in upper crankcase head with the lip facing down. Coat the seal lip with *Triple-Guard* grease.



1. Seal installer, P/N 325453 49597

Lightly coat two **new** O-rings with *Gasket Sealing Compound*, and install on upper crankcase head. Keep sealer away from oil passage.

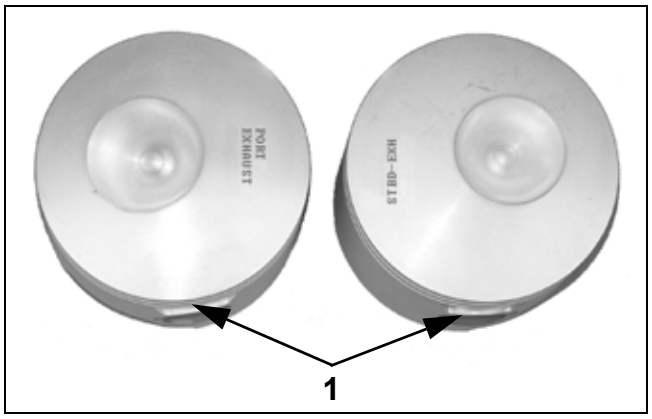


1. Oil passage 004131

Pistons and Connecting Rods

IMPORTANT: It is very important to notice port and starboard pistons in this engine. All pistons are also marked “exhaust side.”

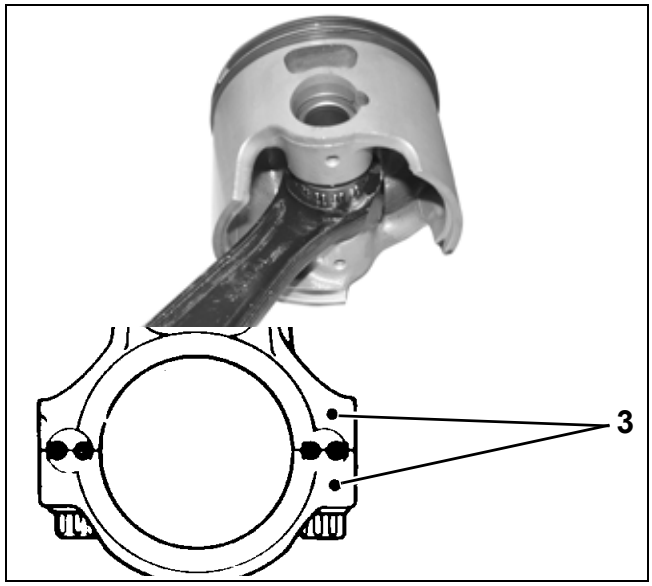
Using these marks, orient the pistons with the correct cylinders and mark the bottom wrist pin hole with a permanent marker.



1. Bottom wrist pin holes 004305

IMPORTANT: It is also very important that the connecting rods are installed with the alignment dots facing up, toward the flywheel.

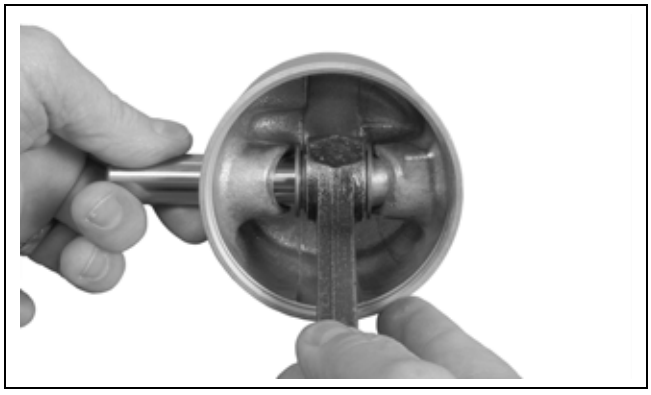
Apply outboard lubricant to the wrist pin bearings. Install the bearings in the wrist pin bore. Place connecting rod with bearing into the piston with the alignment dots facing the top of the piston.



1. Alignment dots 004306
53628

Oil the wrist pin bore and wrist pin.

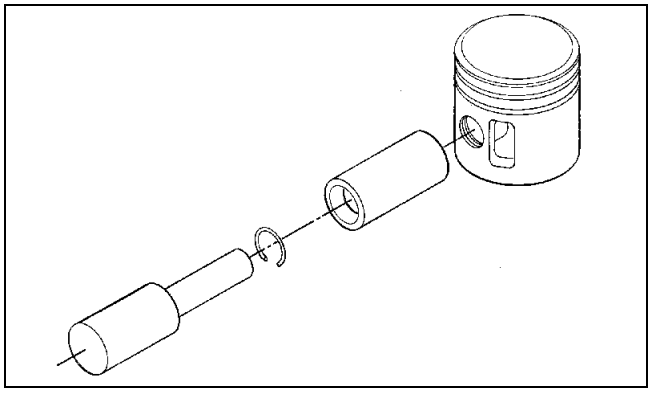
Install wrist pin through piston and connecting rod.



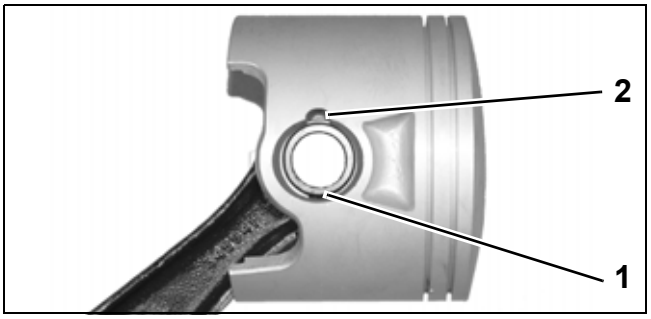
002057

Use Wrist Pin Cone, P/N 331913, and Driver, P/N 396747, to install **new** wrist pin retaining rings

in each wrist pin hole. Gap of retaining ring faces away from notch in piston.



DR1641



1. Gap in retaining ring
2. Notch in piston

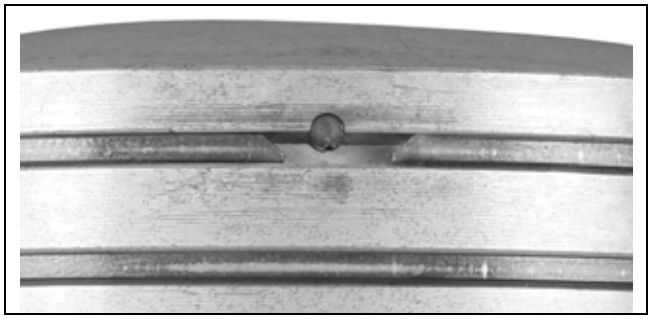
000756

Repeat steps for each piston.

Installing Pistons

When all pistons and connecting rods are assembled, install piston ring sets. Be sure rings are installed in the cylinder used to test ring end gap.

IMPORTANT: Be sure gap of ring fits squarely around dowel pin.



002048

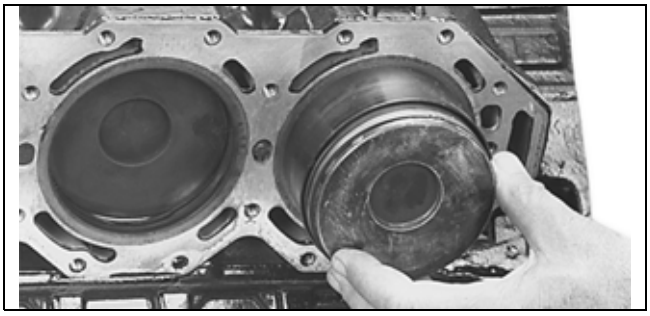
IMPORTANT: Before continuing, make sure that all *Gel-Seal II* has been removed from the cylinder block and crankcase mating flanges. If traces of hardened *Gel-Seal II* are left, main bearings could be misaligned.

Rotate cylinder block so cylinder head surface is parallel with floor.

Coat pistons, rings, cylinder walls, and ring compressor with outboard lubricant.

Center connecting rod in piston and locate piston rings on dowel pins. Place appropriate ring compressor on piston.

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.



49435

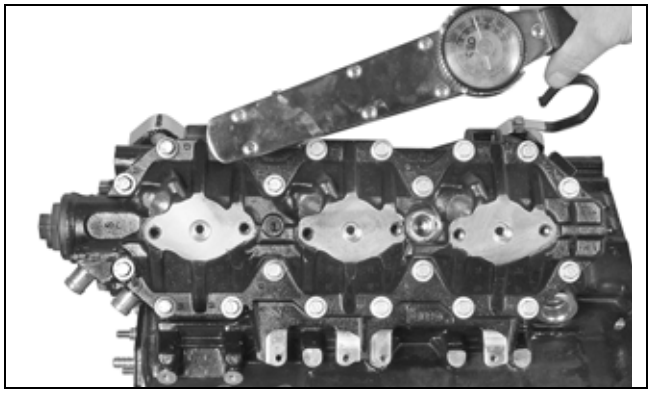
Repeat steps for each piston.

Cylinder Head

Lightly coat both sides of a new cylinder head gasket with *Gasket Sealing Compound*. Position gasket on cylinder block following instructions printed on gasket.

Install cylinder head with the thermostat facing flywheel. Apply outboard lubricant to screw threads and install the retaining screws. DO NOT use sealant on threads.

Following sequence on cylinder head, torque all screws in stages to 17 to 19 ft. lbs. (23 to 26 N·m).

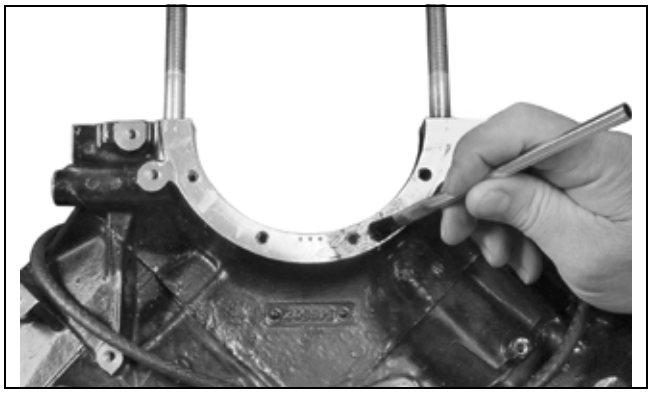


004133

Repeat steps for opposite cylinder head.

Crankshaft and Connecting Rods

Before installing crankshaft, lightly coat the cylinder block upper and lower crankcase head flange surfaces with a thin layer of *Gel-Seal II*.



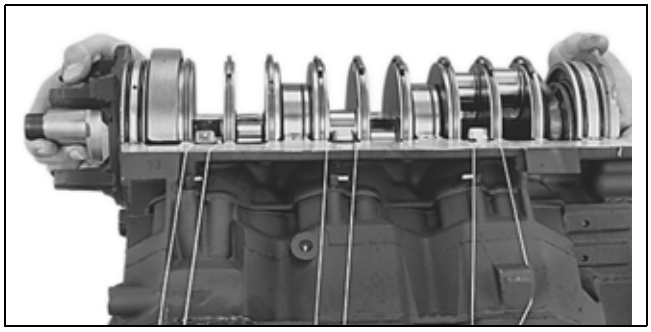
004130

Rotate the cylinder block so the crankcase mating flange is facing upward.

Push all pistons to the top of cylinders. Remove the numbered connecting rod caps and hold the connecting rods to the outside with rubber bands.

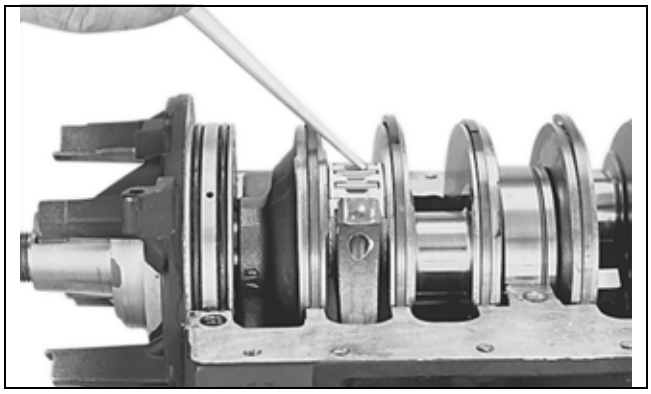
Gently lower the crankshaft into place.

- Orient all crankcase seal ring gaps facing up.
- Tap the crankshaft upward with a rawhide mallet to seat crankshaft and lower crankcase head.
- 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.
- Loosely secure upper and lower crankcase heads with two screws.



31828

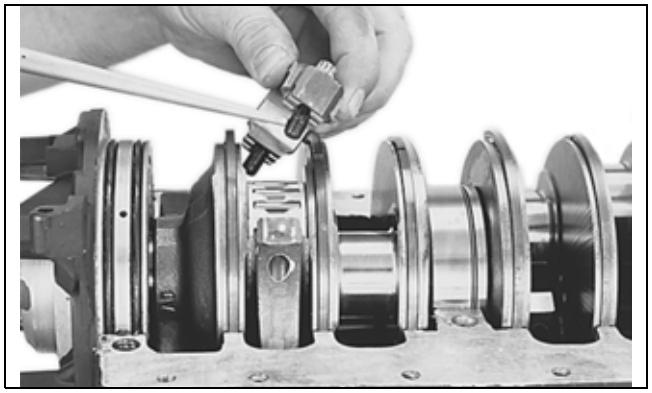
Lubricate each crankpin and bearing assembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.



31827

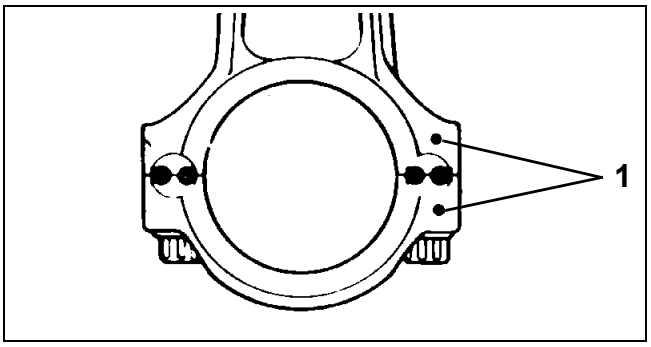
Lubricate rod cap screw threads and under screw head mating surface with a light coat of *Triple-Guard* grease. Apply outboard lubricant to screw hole threads in rod, and to screw head mating surface on cap.

Align dot on rod cap with dot on the connecting rod. Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).



31826

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dots face flywheel.



1. Alignment dots 53628

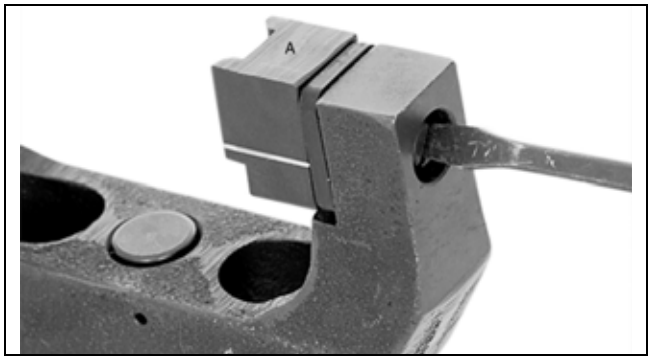
IMPORTANT: Torquing the screws without Alignment Fixture, P/N 396749, or using an incorrect procedure could cause permanent damage to the connecting rod and crankshaft. To maintain accurate torque values, keep torque wrench extension length to a minimum.

Install Rod Cap Alignment Fixture, P/N 396749, **before** tightening rod cap screws. Align the flat (marked “SET”) on the rod adjustment stop with the arrow on the frame. Position the stop at the highest setting (two lines showing). Rotate the adjustment knob 180° to lock the stop in position.

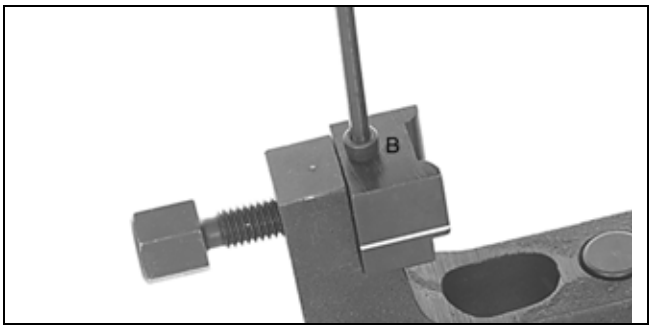


1. Adjustment stop, highest setting 2287

Secure restraining jaw “A” and forcing jaw “B” to frame.



Restraining Jaw “A” 21591

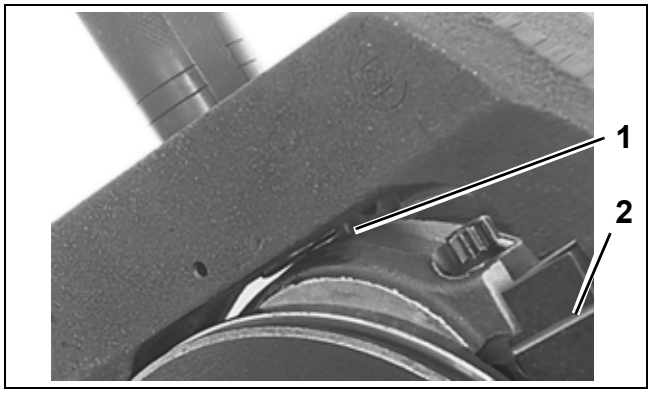


Forcing Jaw “B” 21594

Apply a light coat of outboard lubricant to the corners of the connecting rod and rod cap. Place frame on connecting rod using the following procedure:

- Position frame onto the connecting rod so the contact area of the jaw is centered on the side of the rod.

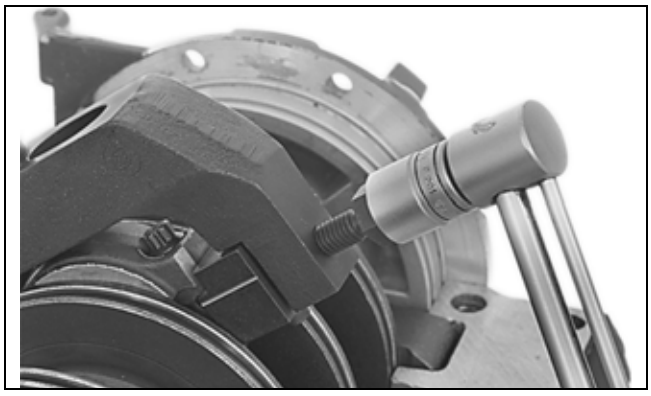
- Tighten forcing screw until jaws contact connecting rod.
- Slide frame down until adjustment stop contacts the rod cap. The groove lines on the jaws must be centered on the rod/crankpin diameter.



1. Adjustment stop
2. Groove line

21589

- Tighten the forcing screw to a torque of 23 in. lbs. (2.5 N·m).



21587

IMPORTANT: Make sure that frame is squarely in position and that rod and cap are aligned.

Loosen both rod cap screws one-quarter turn.

Use Torquing Socket, P/N 346187, to tighten rod cap screws in three stages:

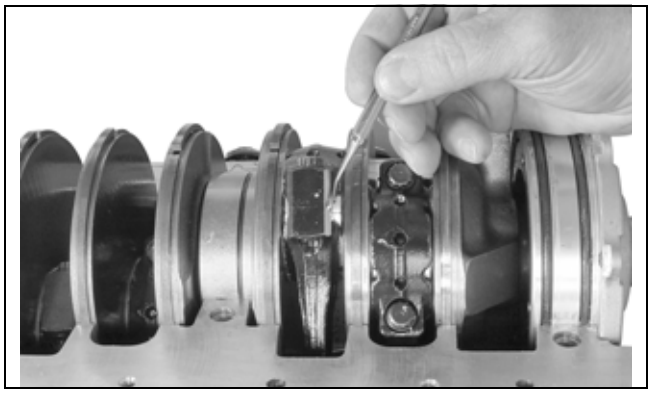
- Apply an initial torque of 40 to 60 in. lbs. (5 to 7 N·m) to both rod cap screws.
- Torque screws to 20 to 22 ft. lbs. (27 to 30 N·m).
- Apply a final torque of 60 to 65 ft. lbs. (81 to 88 N·m).



21605

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.



004129

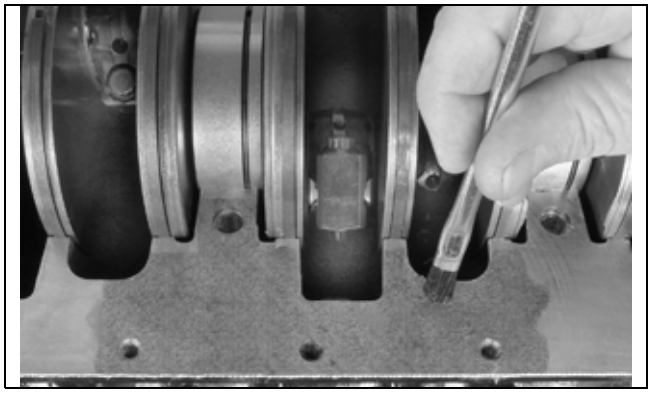
Repeat steps for remaining connecting rods.

Crankcase

Thoroughly clean and degrease the mating flanges of the crankcase and cylinder block with a non-petroleum based solvent, such as isopropyl alcohol or acetone, and let air dry.

IMPORTANT: DO NOT allow solvent to get on internal components. Clean only the mating flanges.

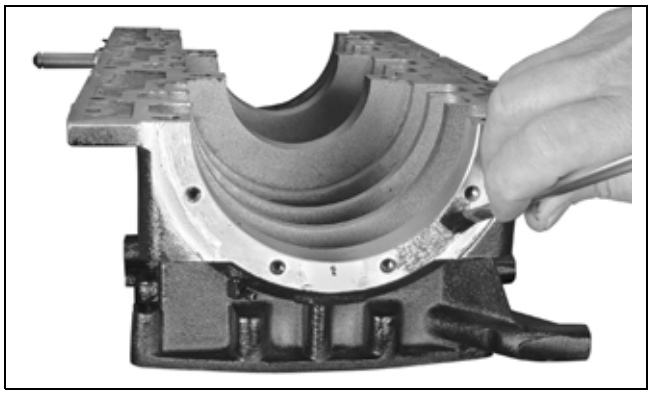
Use a small brush to dab a thin, even coat of *Gel-Seal II* sealant to the cylinder block mating flange. The application must not come within 1/4 in. (6.4 mm) of seal rings or bearings.



004127

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.

Lightly coat the upper and lower crankcase head flange surfaces with a thin layer of *Gel-Seal II*.

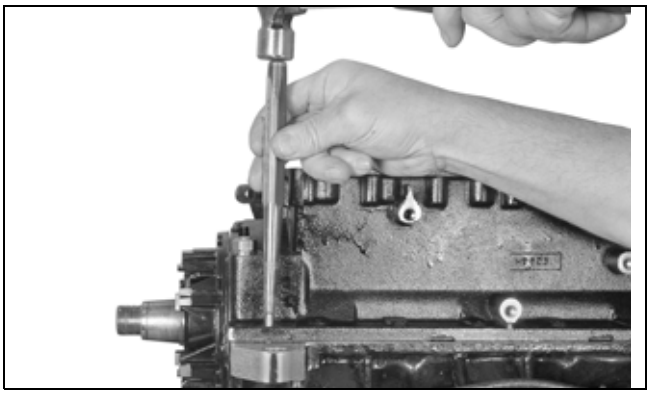


004134

IMPORTANT: If *Locquic Primer* is used, crankcase halves must be assembled and tightened within ten minutes after the *Gel-Seal II* has been applied.

Lower the crankcase into place. Install main bearing screws and nuts finger tight.

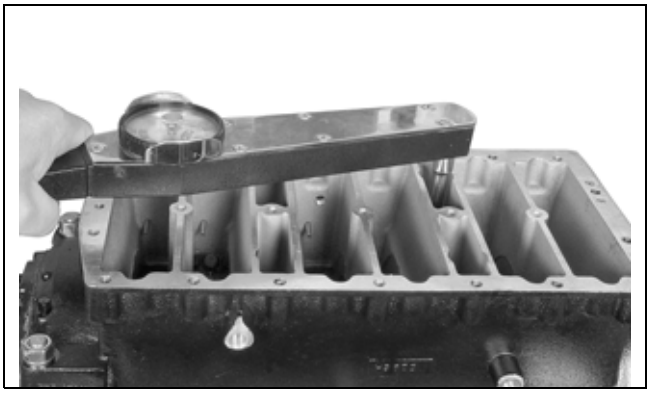
When the crankcase is seated, install and firmly seat both crankcase taper pins.



004135

Torque main bearing screws and nuts **in stages**. Begin with the center screws and work outward in a spiral pattern to final torque:

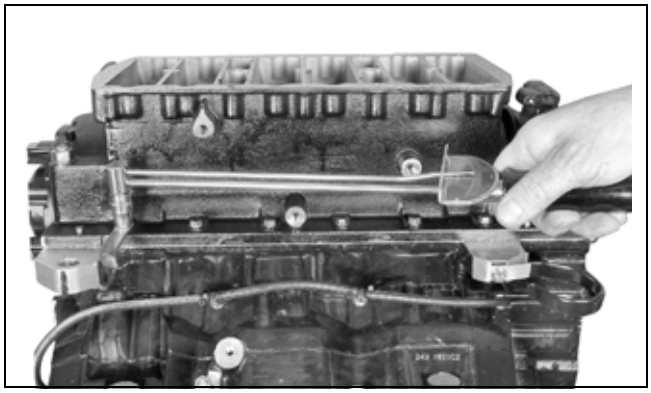
Upper Two Main Bearing Nuts	38 to 42 ft. lbs. (52 to 57 N·m)
Main Bearing Screws	48 to 52 ft. lbs. (65 to 70 N·m)



004141

Install the crankcase flange screws and torque to 84 to 108 in. lbs. (9.5 to 12 N·m). Apply *Permatex*

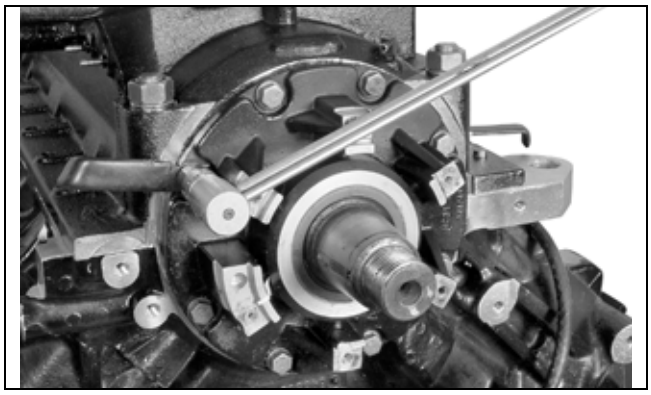
No. 2 to screws where threaded hole is open to crankcase.



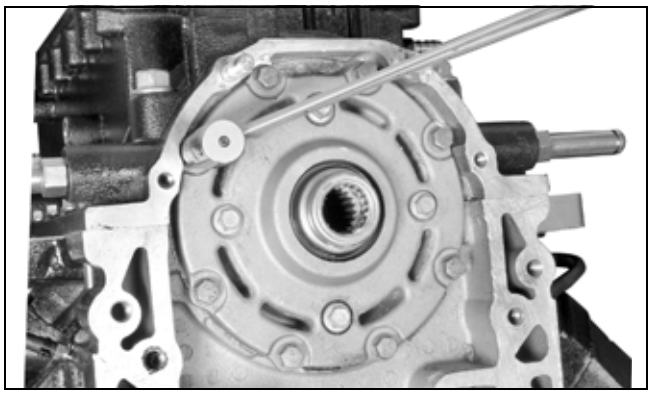
004138

Test that the crankshaft spins freely without binding.

Apply *Nut Lock* to the upper and lower crankcase head screws. Install and torque screws to 96 to 120 in. lbs. (11 to 13.5 N·m).



004142

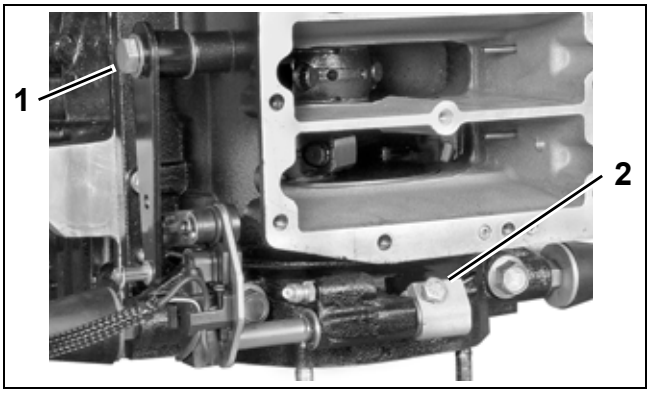


004143

IMPORTANT: After powerhead has been assembled, allow at least two hours for *Gel-Seal II* to cure before running outboard.

Install shift linkage assembly in boss at bottom of crankcase. Install shift rod lever and tighten retaining screw 60 to 84 in. lbs. (7 to 9.5 N·m).

Apply *Nut Lock* to threads of shift arm shoulder screw. Install and tighten to 120 to 144 in. lbs. (14 to 16 N·m).



1. *Shoulder screw*
2. *Shift rod lever retaining screw*

004145

Connect all crankcase recirculating hoses. Refer to **Recirculation Check Valve and Hose Routings Diagram** on p. 202.

Install the throttle body and reed plate assemblies. Refer to Intake Manifold **INTAKE MANIFOLD** on p. 191.

Install the complete ignition, electrical, and fuel systems.

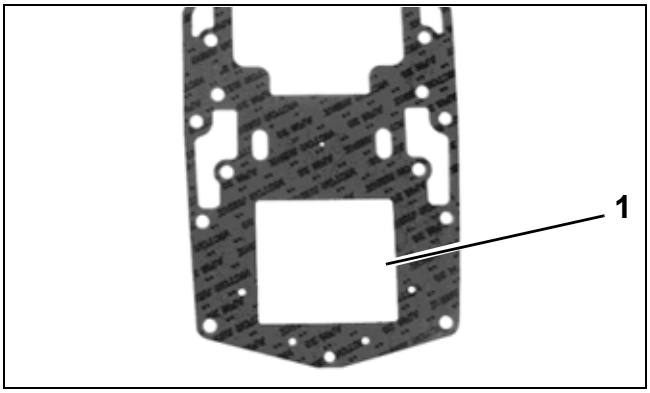
⚠ DANGER ⚠

To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

INSTALLATION

Apply *Permatex No. 2* to edge of the inner exhaust area of both sides of a **new** base gasket. Leave the other areas of gasket dry.

To ensure proper sealing, the mating surfaces must be clean and free of oil, grease, and foreign matter.



1. Inner exhaust area 000661

Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

Use Lifting Fixture, P/N 396748, to slowly lower powerhead onto exhaust housing.

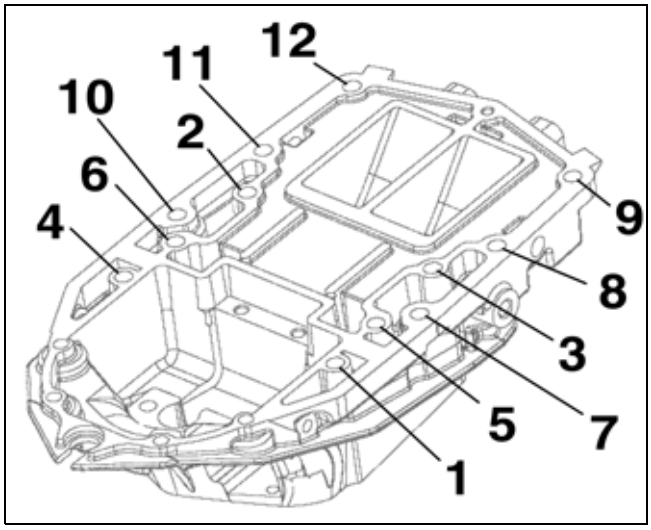


48758

Apply *Gasket Sealing Compound* to the threaded portion of the 3/8 in. diameter powerhead screws. Install all fasteners loosely before torquing any.

Torque the 3/8 in. diameter powerhead screws to 18 to 20 ft. lbs. (25 to 27 N·m) in the sequence shown.

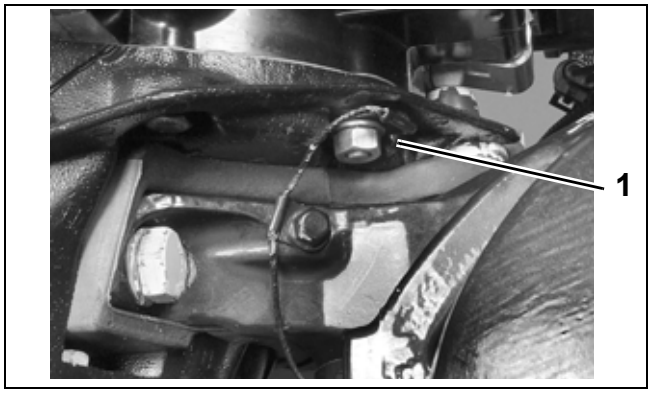
Apply *Gasket Sealing Compound* to the 5/16 in. diameter powerhead screws and torque the screws to 144 to 168 in. lbs. (16 to 19 N·m) in the sequence shown.



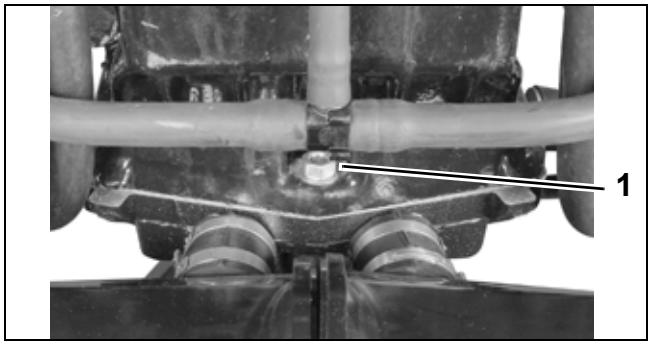
004261

IMPORTANT: In order to achieve proper sealing and prevent gasket damage, the powerhead mounting screws must be retorqued after engine has reached operating temperature and has been allowed to cool.

Install two front and one rear powerhead nuts. Tighten nuts 144 to 168 in. lbs. (16 to 19 N·m).

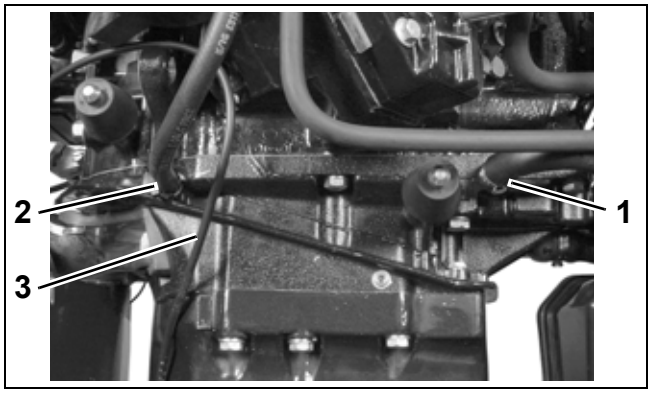


1. Front powerhead nut (2) 004262

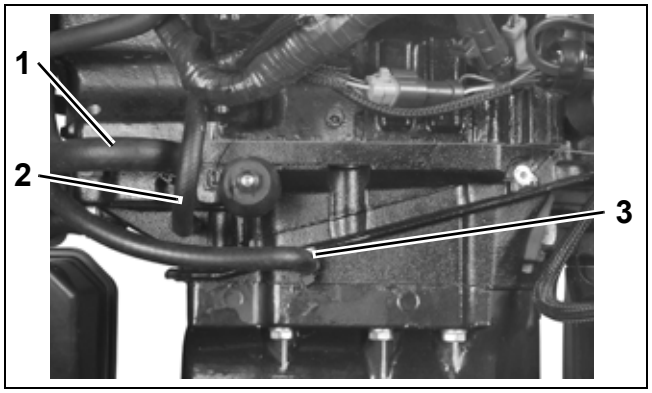


1. Rear powerhead nut 004252

Install water hoses and exhaust back pressure hose.

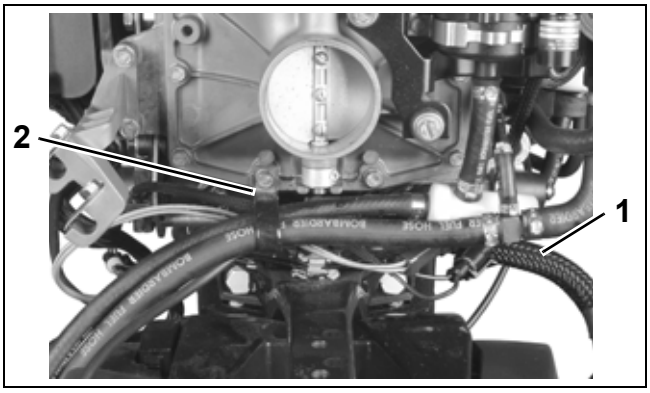


1. Cooling hose (from exhaust plenum) 004239
2. Cooling hose (from vapor separator)
3. Speedometer hose

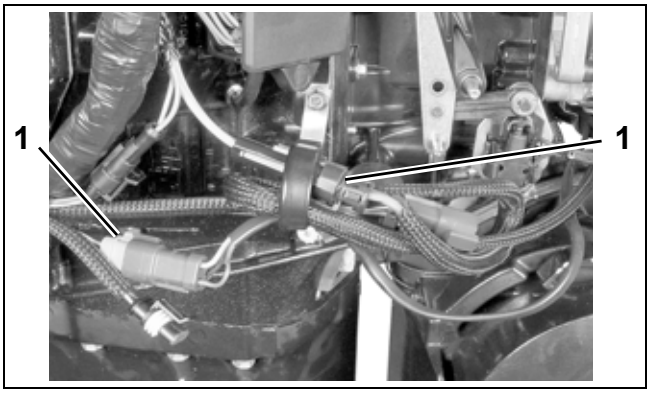


1. Cooling hose (to exhaust plenum) 005042
2. Exhaust back pressure hose (to EMM*)*
3. Cooling hose (from block)

Route power trim harness through clamp and connect to engine harness.

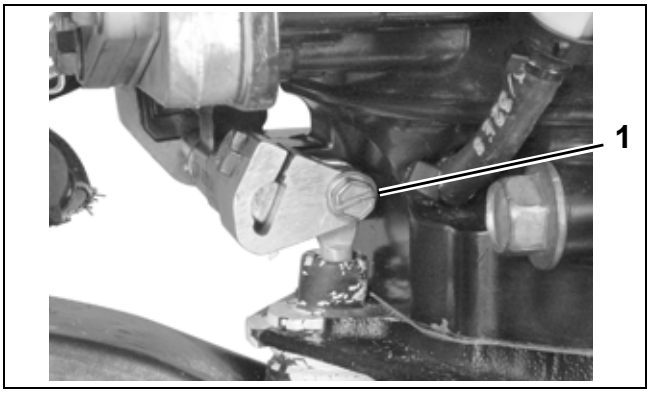


1. Trim harness 005041
2. Clamp



1. Trim/tilt connectors 004251

Align gearcase shift rod and linkage, and install the shift rod pin. Tighten 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Shift rod pin 004241

10

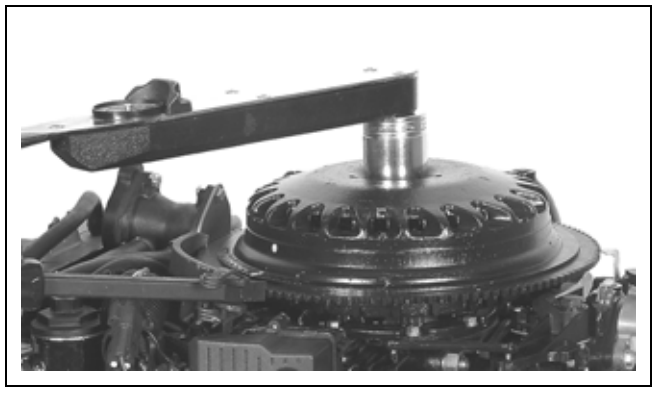
Thoroughly clean the crankshaft and flywheel tapers with *Cleaning Solvent* and let air dry.

Install flywheel key in crankshaft with flat side parallel to crankshaft centerline.

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

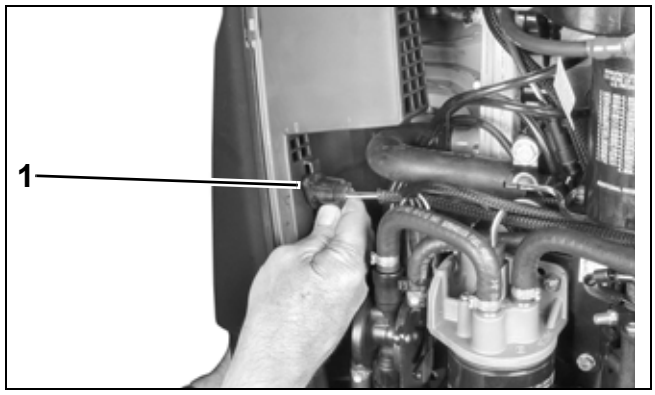
IMPORTANT: DO NOT apply too much *Nut Lock* on flywheel taper to prevents *Nut Lock* from migrating into the upper seal of the crankshaft.

Align the crankshaft key and flywheel keyway, and install flywheel. Coat the threads of a **new** flywheel nut with *Gasket Sealing Compound,* and torque the nut to 140 to 145 ft. lbs. (190 to 197 N·m).



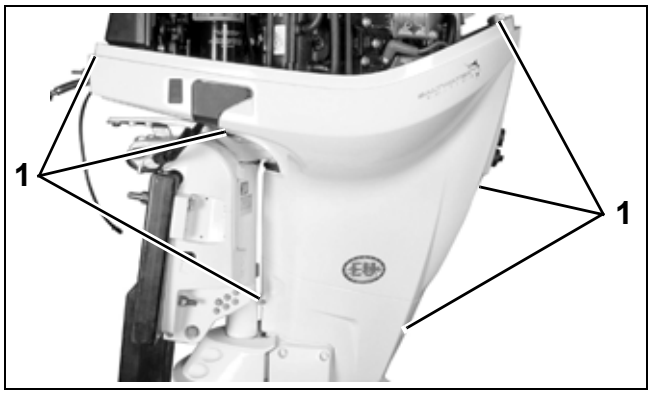
000773

Install air temperature sensor, air silencer, and flywheel cover. Tighten flywheel cover screws 30 to 42 in. lbs. (3.5 to 5 N·m).



1. Air temperature sensor 004219

Install lower engine covers and tighten screws.



1. Lower cover screws 004122

Connect fuel and oil hoses to connectors. Install battery cables, control cables, and electrical cables.

IMPORTANT: Perform the following procedures before returning outboard to service:

- Index all spark plugs. Refer to Spark Plug **Indexing** on p. 155.
- Prime oiling system. Refer to **PRIMING** on p. 205.
- Prime fuel system. Refer to **Fuel System Priming** on p. 65.
- Use the *Evinrude* Diagnostics Software program to initiate powerhead break-in. Refer to **Powerhead Break-In** on p. 109.
- Check all linkage adjustments, adjust timing pointer, and perform timing verification. Refer to **TIMING ADJUSTMENTS** on p. 154.
- Run outboard and check for water, fuel, or oil leaks.
- Confirm that engine reaches correct operating temperature and does not overheat.

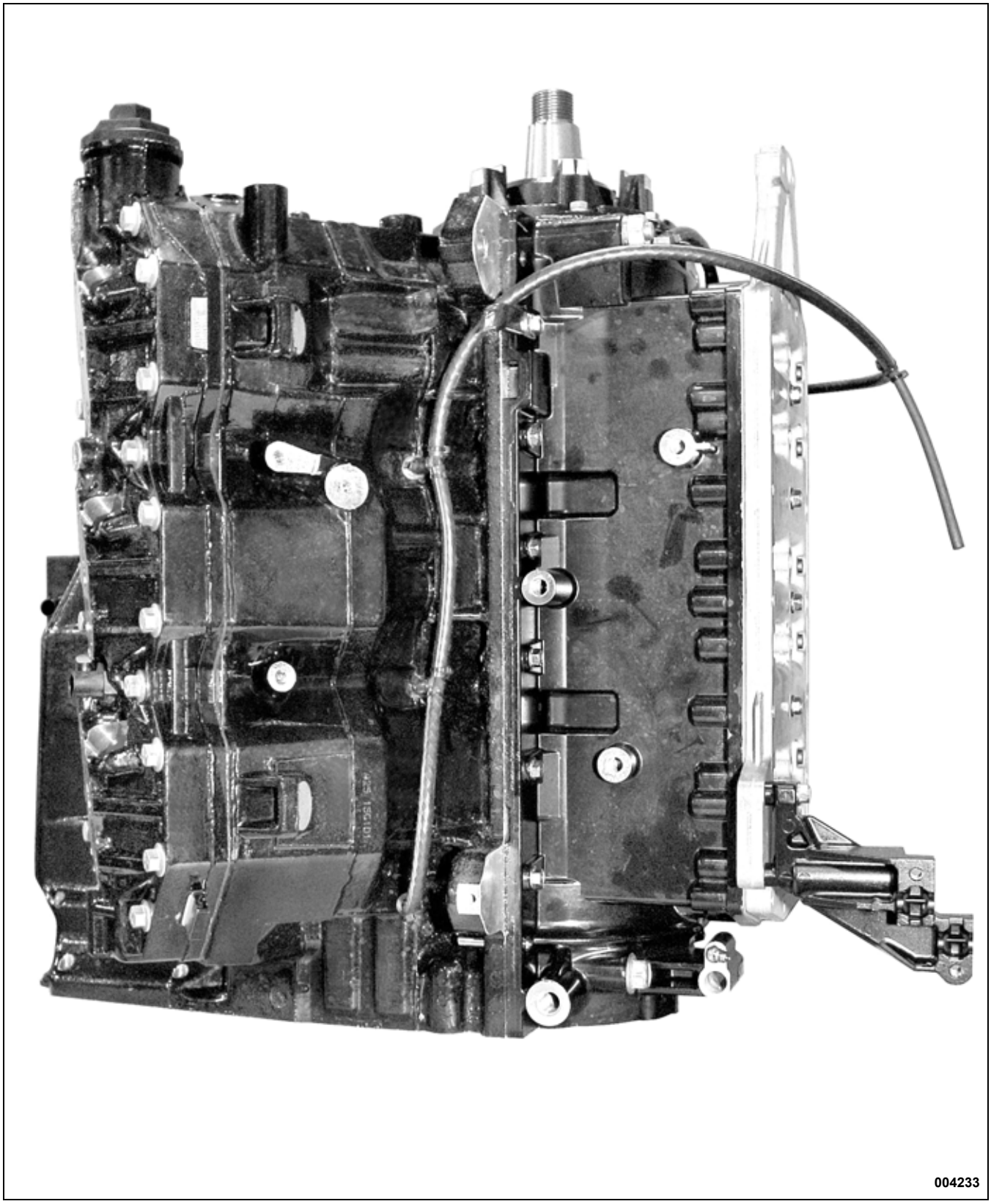
POWERHEAD VIEWS

Port Short Block



005034

Starboard Short Block



Port



Starboard



005031

Front



Rear



Top



005033

NOTES

Technician's Notes

Related Documents

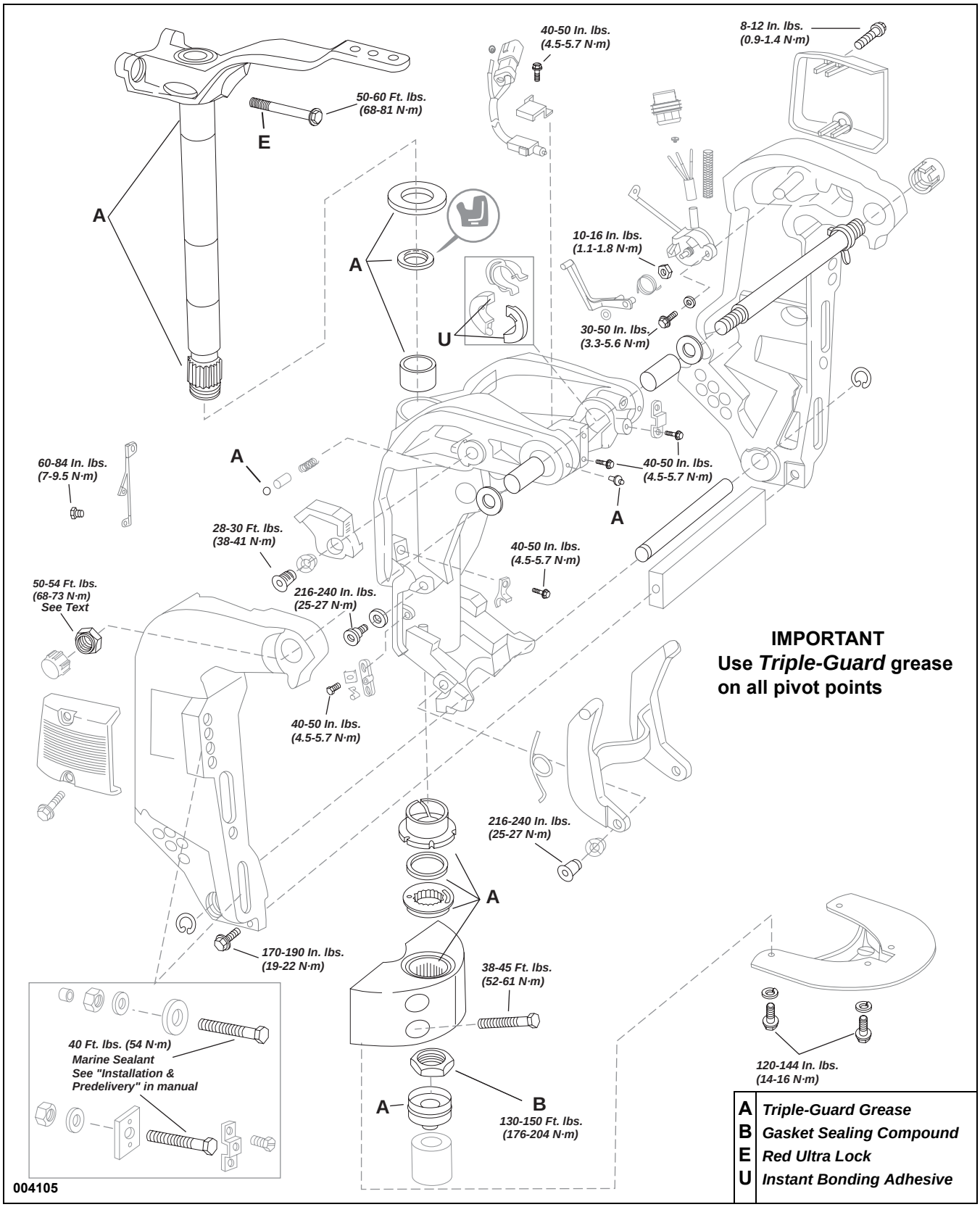
Bulletins	
Instruction Sheets	
Other	

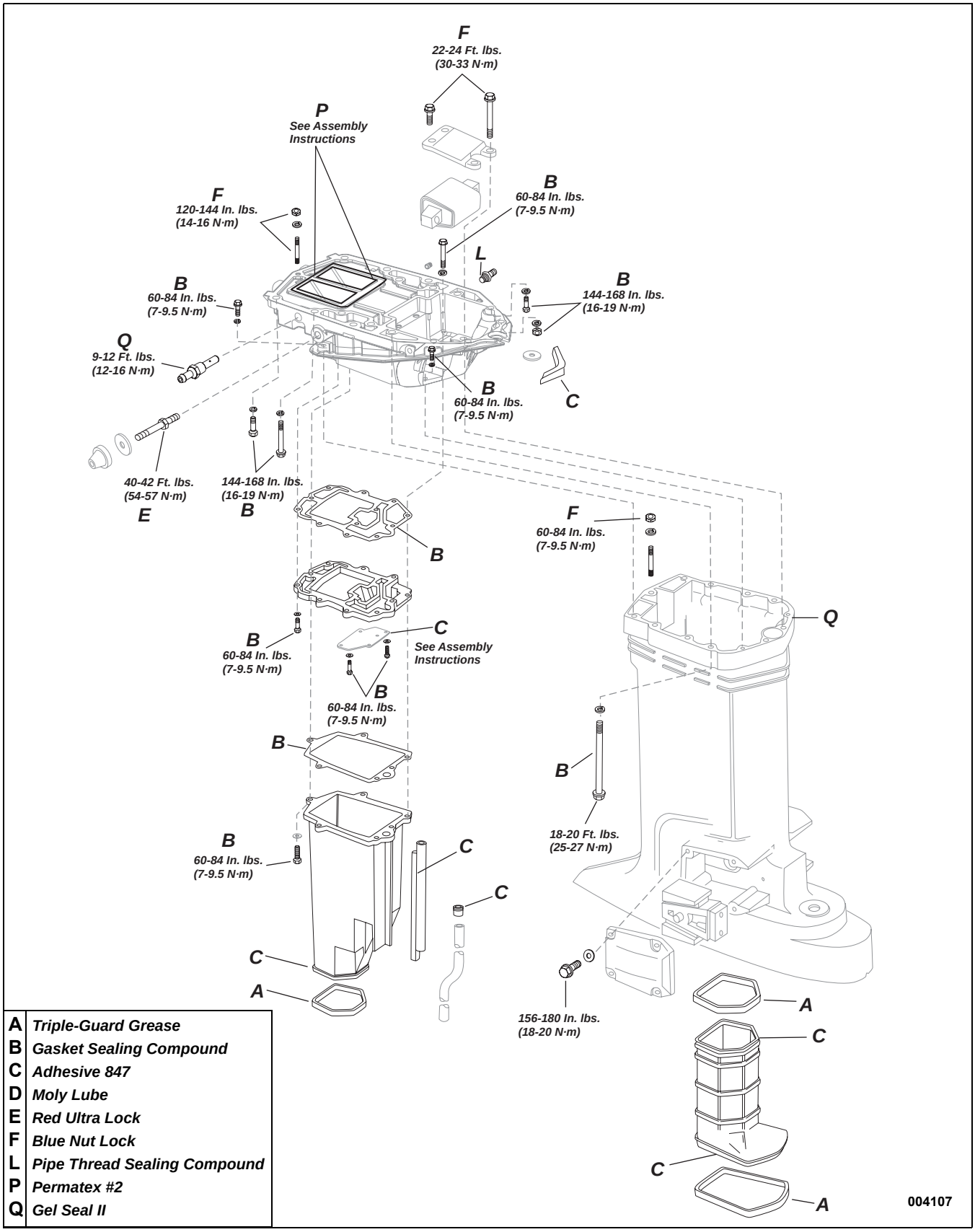
MIDSECTION

TABLE OF CONTENTS

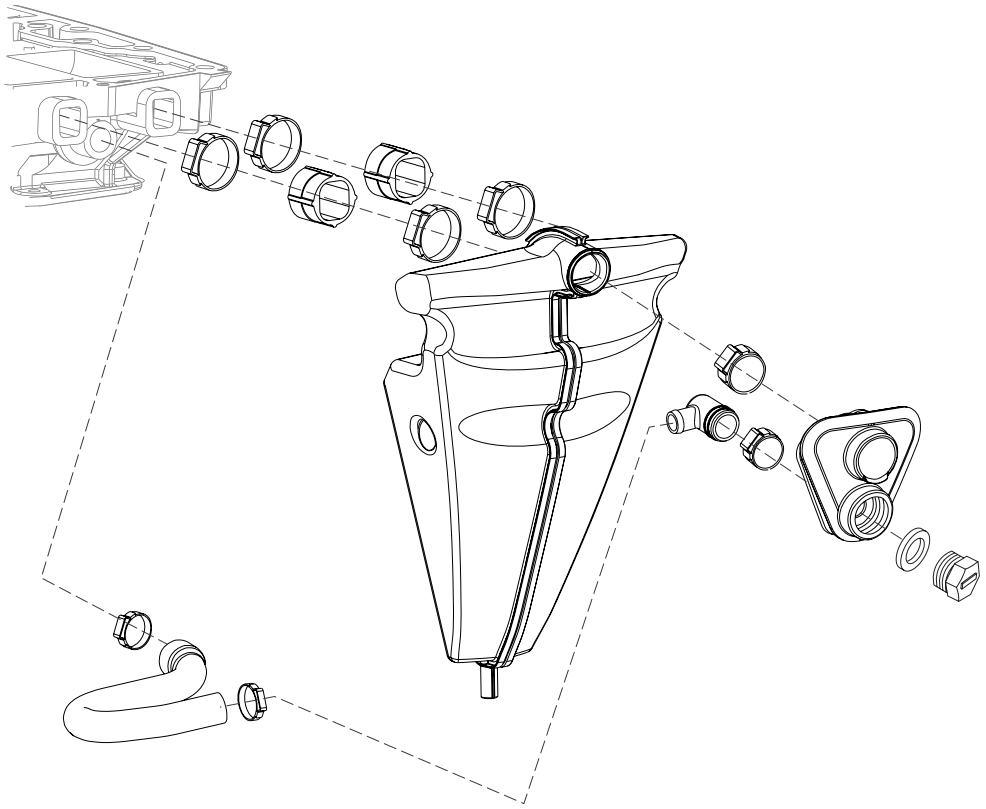
SERVICE CHART 262
TILT TUBE 265
REMOVAL 265
INSTALLATION 266
EXHAUST HOUSING 267
REMOVAL 267
DISASSEMBLY 267
CLEANING AND INSPECTION 268
ASSEMBLY 269
INSTALLATION 272
STERN BRACKET 273
REMOVAL 273
DISASSEMBLY 273
ASSEMBLY 275
EXHAUST RELIEF MUFFLER ASSEMBLY 278

SERVICE CHART





A	***Triple-Guard Grease***
B	***Gasket Sealing Compound***
C	***Adhesive 847***
D	***Moly Lube***
E	***Red Ultra Lock***
F	***Blue Nut Lock***
L	***Pipe Thread Sealing Compound***
P	***Permatex #2***
Q	***Gel Seal II***



004117

TILT TUBE

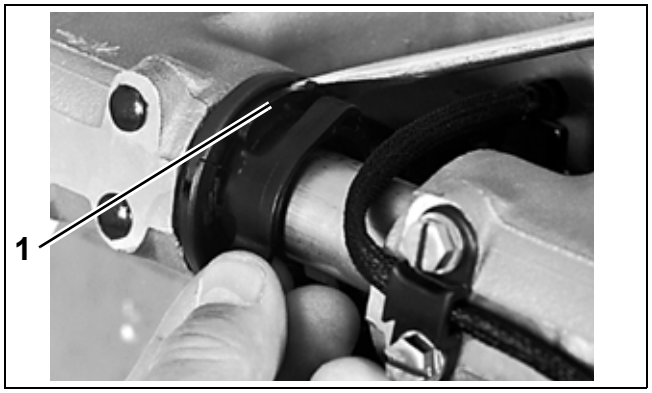
The tilt tube may be serviced without major disassembly of the outboard using Tilt Tube Service Kit, P/N 434523.

Removal

⚠ WARNING ⚠

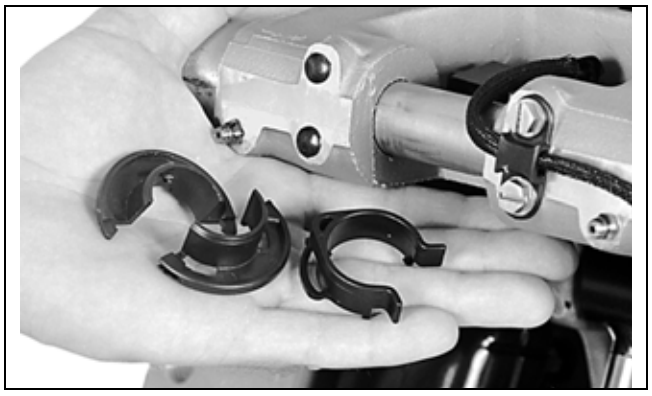
Support the outboard with a suitable hoist.

Pull locking tabs on tilt limit cam loose from collar.



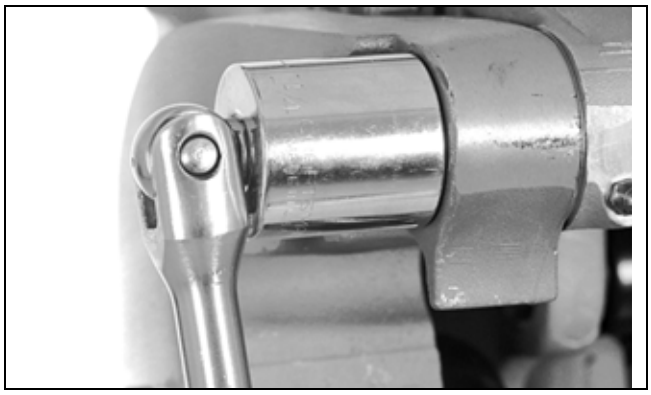
1. Locking tabs 30749

Remove the cam and collar from the tilt tube.



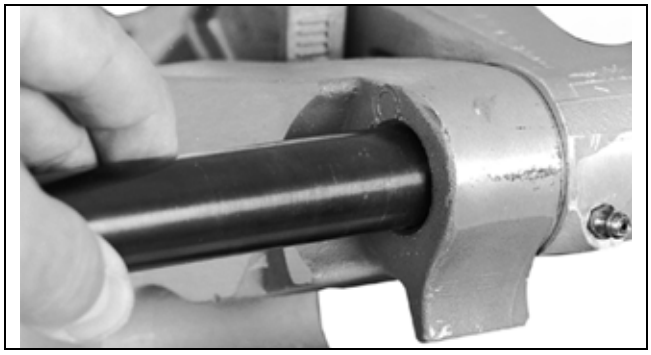
30748

Remove the nut from the starboard side.



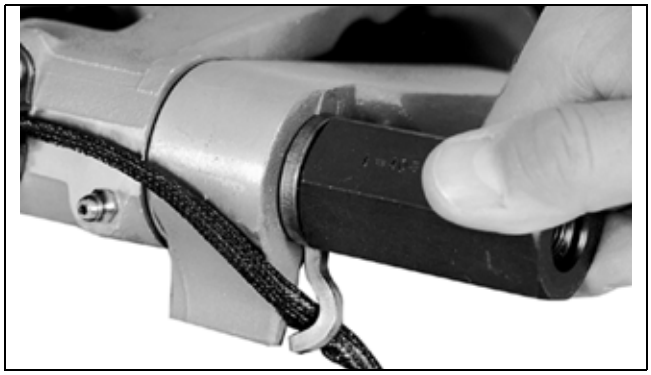
30747

Thread the spacer from Tilt Tube Service Kit, P/N 434523, onto the starboard end of the tilt tube.



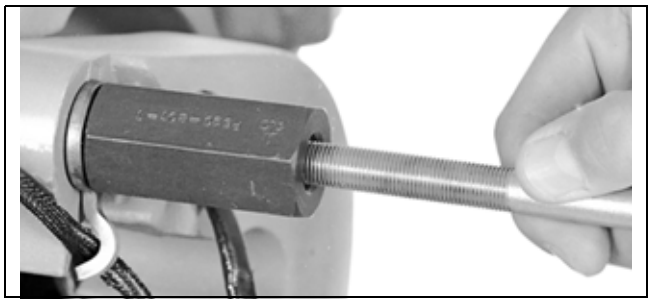
30746

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

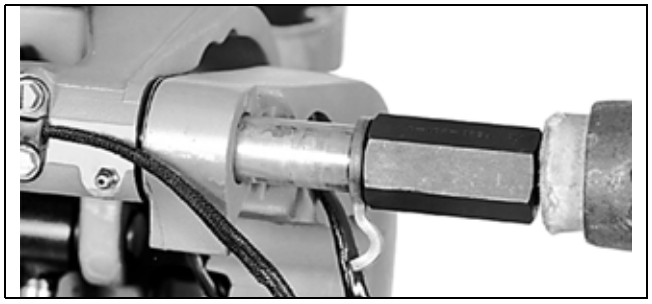
Pull tilt tube from stern bracket with the slide hammer. When tilt tube clears the port stern bracket, remove tilt tube from the spacer.

Installation

Thread starboard end of tilt tube into the spacer.

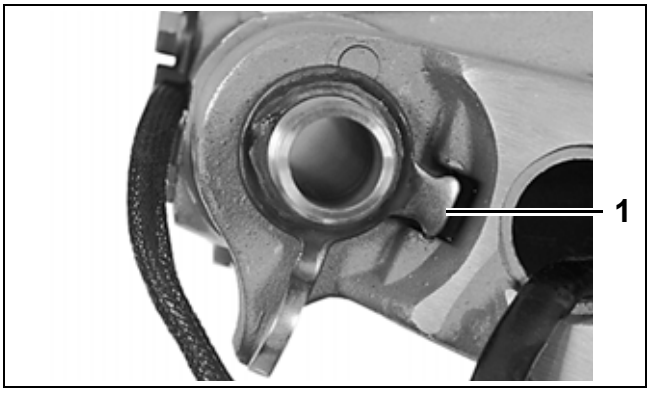
Thread the adapter onto port end of tilt tube.

Use a wood or leather mallet to tap the tilt tube into position.



30743

Make sure the lock tab is in correct position.



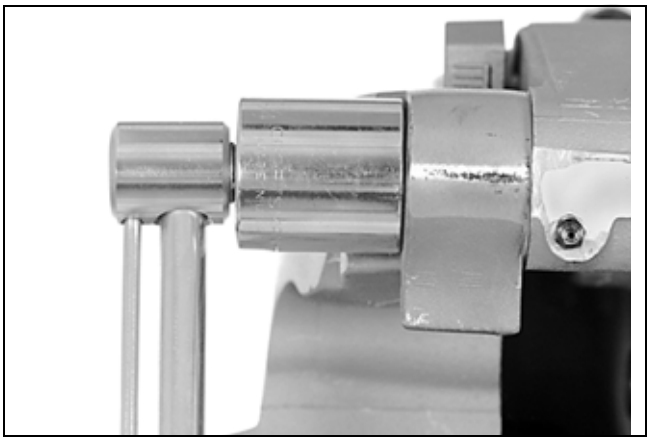
1. Lock tab 30742

Install the starboard locknut.

⚠ WARNING ⚠

Replace locknut if definite resistance is not felt.

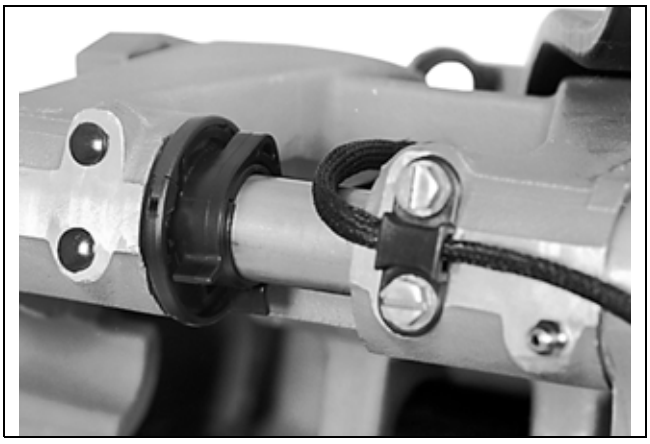
Torque starboard tilt tube nut to 50 to 54 ft. lbs. (68 to 73 N·m), then loosen nut 1/8 to 1/4 turn.



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

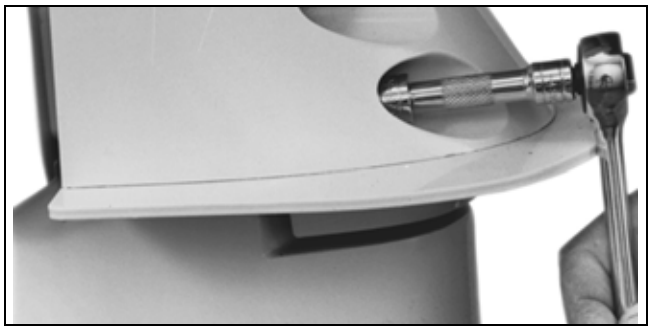
EXHAUST HOUSING

Removal

Before removing the midsection:

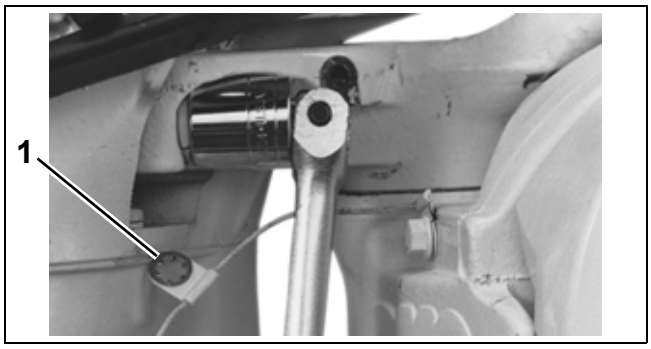
- The gearcase must be removed. Refer to Gearcase **REMOVAL AND INSTALLATION** on p. 285.
- The powerhead must be removed. Refer to Powerhead **REMOVAL** on p. 229.

Remove and discard four lower mount screws.



32590

Remove the steering arm ground lead and screw. Remove two upper mount screws.



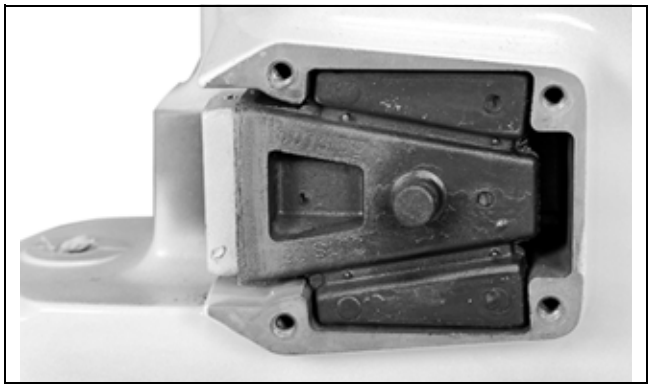
1. Ground lead (removed) 32589

Remove the exhaust housing.



TYPICAL 23034

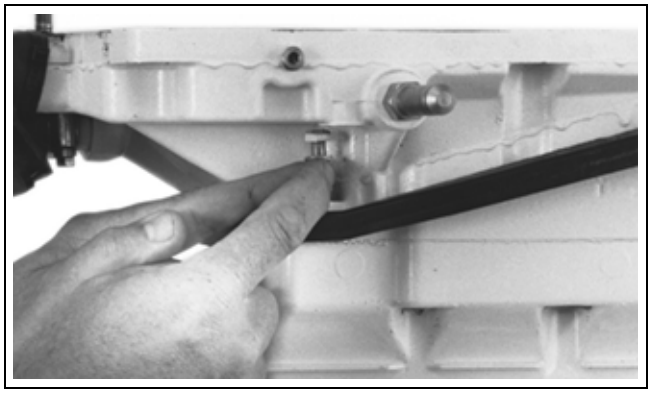
Remove lower mount covers and inspect the lower mounts.



TYPICAL 23033

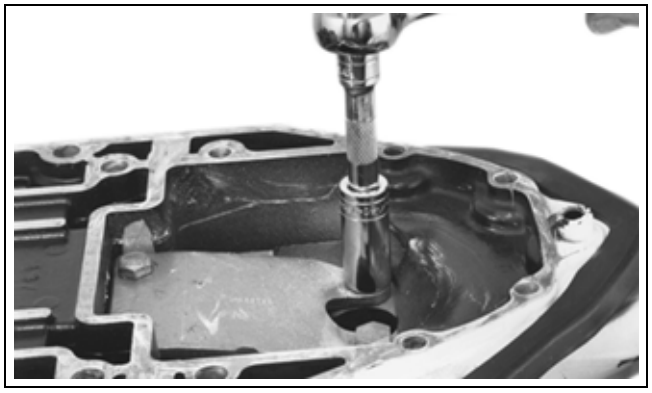
Disassembly

Remove two front and two rear adapter to outer exhaust housing screws. Remove one nut at rear of the adapter.



32580

Loosen and remove the upper mount plate screws and remove the mount plate.



32588

Lubricate the upper mount with soapy water and pry up to remove it from the adapter housing.

Separate the adapter from the outer exhaust housing.

Mark the water tube for correct reassembly location. Remove six inner exhaust housing screws. Remove the inner exhaust housing.

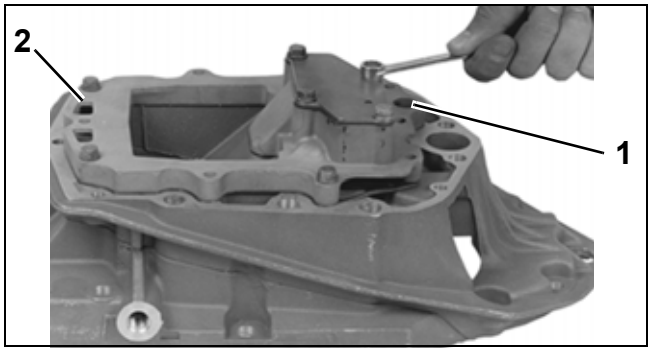


13638

Remove the water tube and grommet from the inner exhaust housing. Discard the grommet.

Loosen retaining screws and remove the cover from water plate.

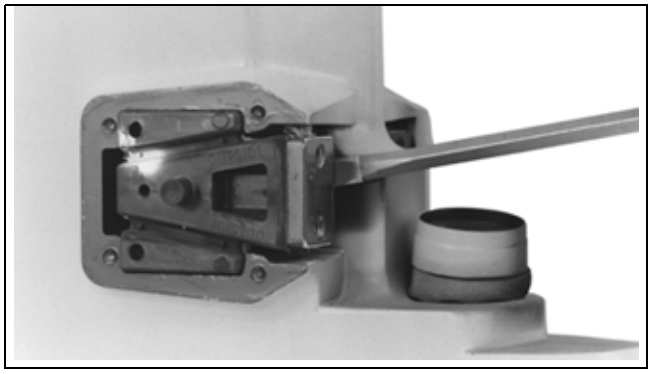
Loosen retaining screws and remove water plate from the adapter.



1. *Cover*
2. *Water plate*

13641

Remove the lower mount assemblies as necessary. Lubricate with soapy water and carefully pry at both ends.



32578

Cleaning and Inspection

⚠ WARNING ⚠

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

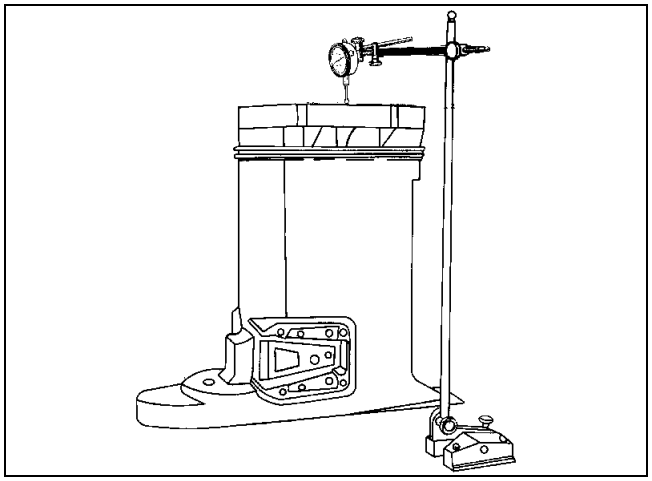
Clean all parts with parts cleaning solvent and dry with compressed air. All nut and screw threads coated with thread locking material must be thoroughly cleaned before assembly. When using a thread locking product, be sure to prime the threads with *Locquic Primer*.

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. Using a dial indicator, check flatness by measuring the run-out on the top edge of housing. The maximum allowable run-out is 0.009 in. (0.228 mm). If you do not have access to a dial indicator and surface plate, seek the services of a machine shop. DO NOT attempt to straighten a distorted housing. Replace it.

IMPORTANT: A distorted exhaust housing will cause the upper driveshaft splines to wear excessively and will damage the crankshaft splines.



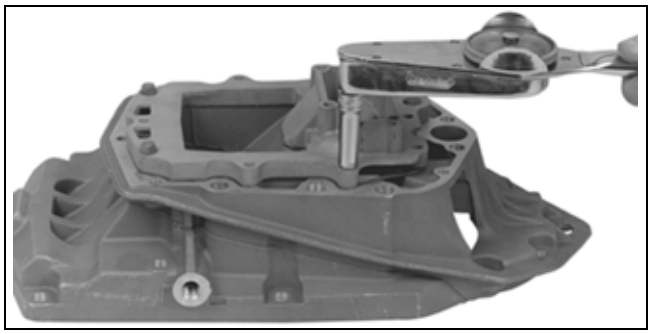
DR2223

Inspect the water tube for obstructions or kinks, which may restrict water flow.

Assembly

Lightly coat both sides of a new gasket with *Gasket Sealing Compound* and position the gasket and water plate.

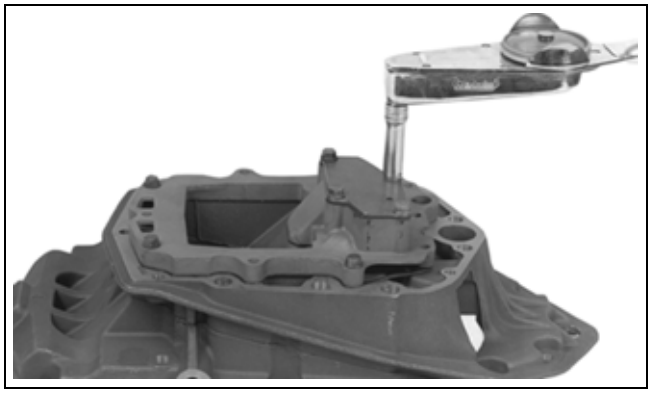
Apply *Gasket Sealing Compound* to threads of the water plate retaining screws. Install with washers and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).



13644

Apply *Adhesive 847* to the water plate surface, then place the cover on the water plate.

Apply *Gasket Sealing Compound* to threads of cover retaining screws. Install with washers and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).



13642

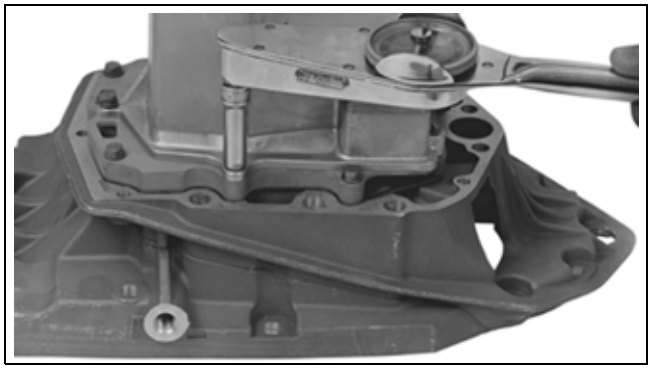
Coat the outside diameter of a new water tube grommet with *Adhesive 847*. Install grommet in the inner exhaust housing. Install the water tube.



7715

Lightly coat both sides of a new inner exhaust housing gasket with *Gasket Sealing Compound* and install it.

Install the inner exhaust housing. Coat inner exhaust housing screws with *Gasket Sealing Compound* and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).



13639

Apply *Adhesive 847* to the bottom flange of the adapter/inner exhaust housing. Install a new seal.

Apply *Triple-Guard* grease to outer surface of seal.



7713

Install a new inner exhaust housing seal. Apply *Adhesive 847* to the seal groove.



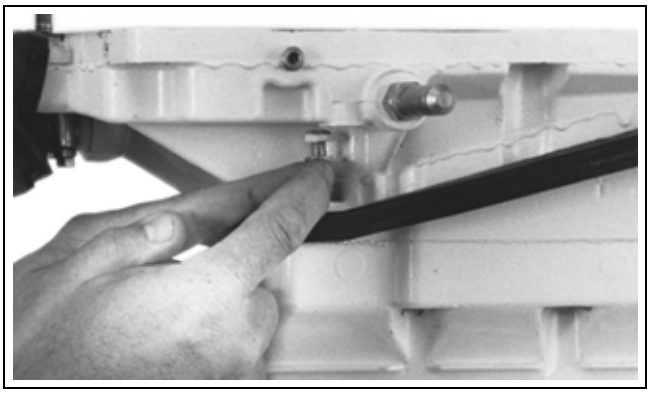
13640

Clean and degrease the adapter housing and outer exhaust housing mating surfaces with *Cleaning Solvent*. Apply *Gel-Seal II* sealant to the adapter flange of the exhaust housing.



13692

Place the adapter/inner exhaust housing into the exhaust housing. Align the water tube. Loosely install the small retaining screws and washers.

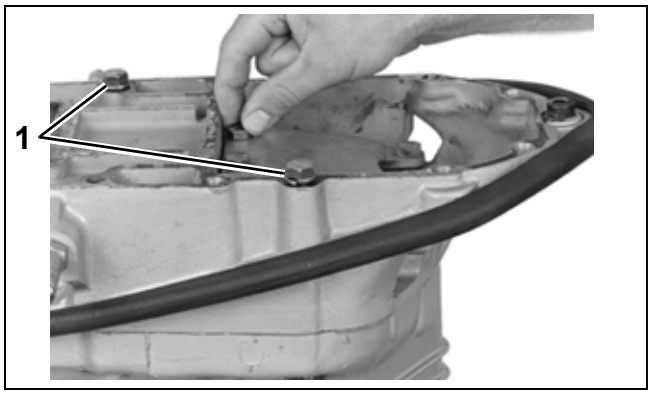


32580

Lubricate the upper mount with soapy water and push into place in the adapter housing. The mount radius must face aft with the “TOP” mark facing up.

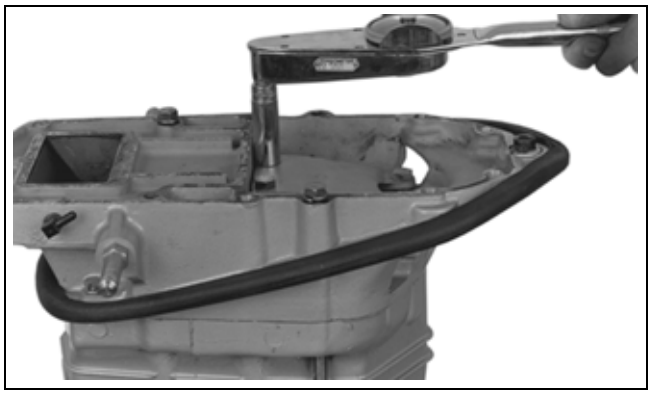
Apply *Locquic Primer* and *Nut Lock* to the upper mount plate screws and install the plate and screws loosely. Install the ground lead and star washer under the forward starboard screw.

Align the outer exhaust housing and adapter by placing two powerhead mounting screws through their holes.



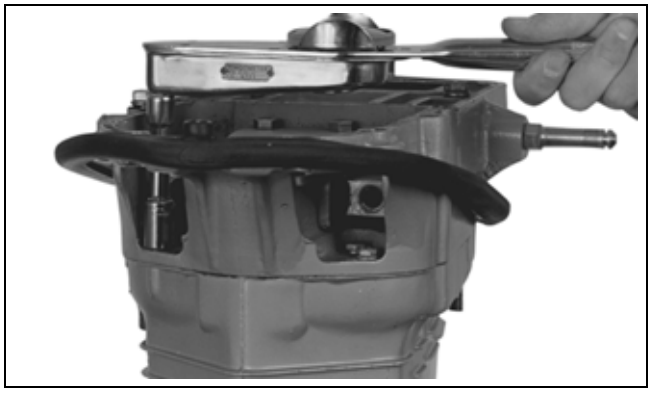
1. Powerhead mounting screws 13689

Install four mount plate screws and washers and torque to 22 to 24 ft. lbs. (30 to 33 N·m).



13690

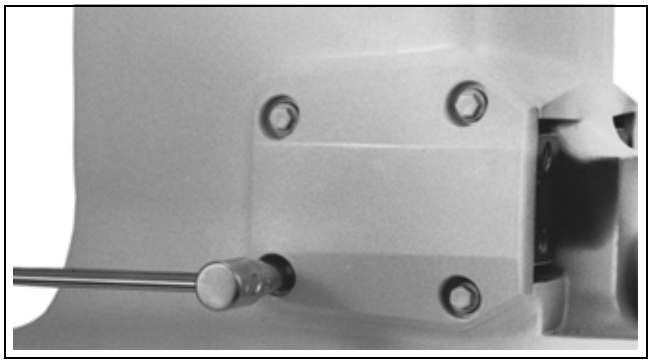
Torque the small adapter to exhaust housing screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



13691

If removed, coat the lower mounts with soapy water and press into the exhaust housing with the “OUT” mark facing outward.

Position the mount covers. Install washers and screws, and torque to 156 to 180 in. lbs. (18 to 20 N·m).



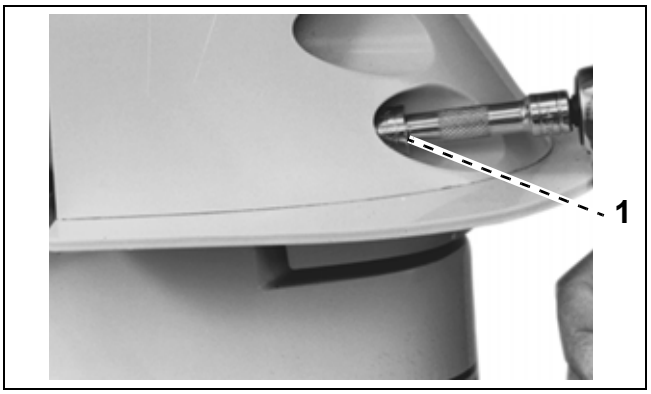
32579

IMPORTANT: Replace any lock-patch screw if its locking feature becomes weak. Definite resistance to tightening must be felt when reusing any fastener. If replacement is necessary, use only an authorized replacement or equivalent.

Installation

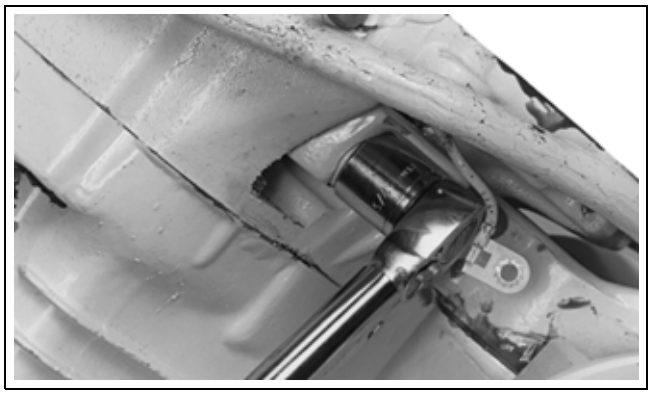
Bring the exhaust housing into position with the stern bracket.

Install four **new** lower mount screws. These screws have lock-patch pre-applied, assisting in a secure mount. Torque screws to 38 to 45 ft. lbs. (52 to 61 N·m).



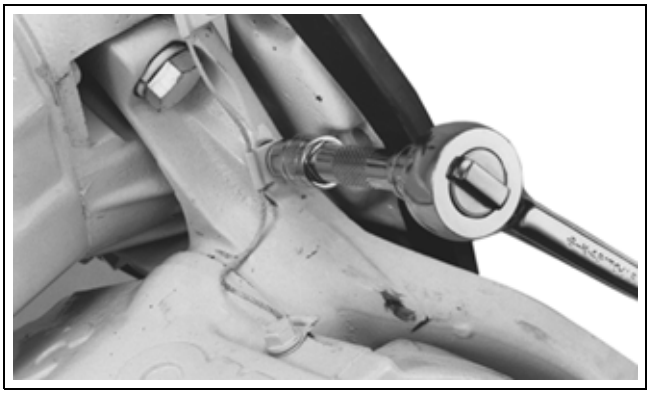
1. Lower mount screws 32590

Apply *Ultra Lock* to upper mount screws and torque to 50 to 60 ft. lbs. (68 to 81 N·m).



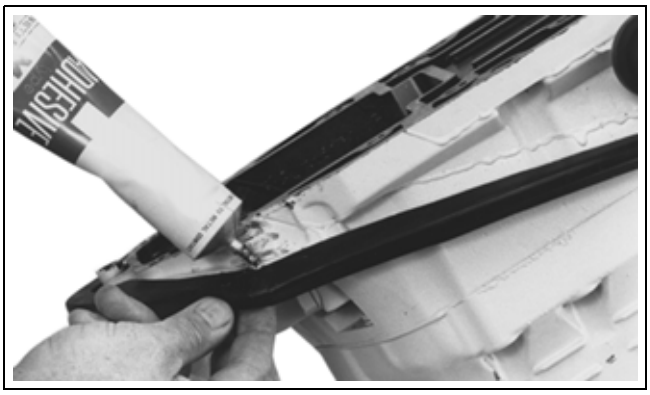
7716

Attach the ground lead and star washer to the steering arm's starboard side.



32586

If necessary, replace the exhaust adapter to lower engine cover seal. Attach with *Adhesive 847*.



32585

Install gearcase. Refer to Gearcase **REMOVAL AND INSTALLATION** on p. 285.

Install powerhead. Refer to Powerhead **INSTALLATION** on p. 250.

STERN BRACKET

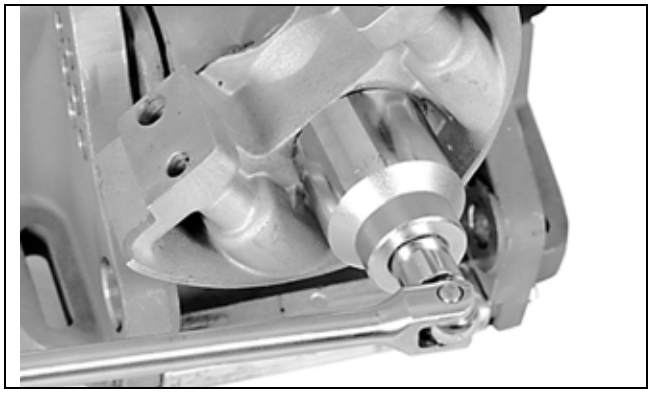
Removal

Before servicing the stern bracket:

- The gearcase must be removed. Refer to Gearcase **REMOVAL AND INSTALLATION** on p. 285.
- The powerhead must be removed. Refer to Powerhead **REMOVAL** on p. 229.
- The exhaust housing must be removed. Refer to Exhaust Housing **Removal** on p. 267.
- The power trim/tilt unit must be removed. Refer to **TRIM AND TILT** section.

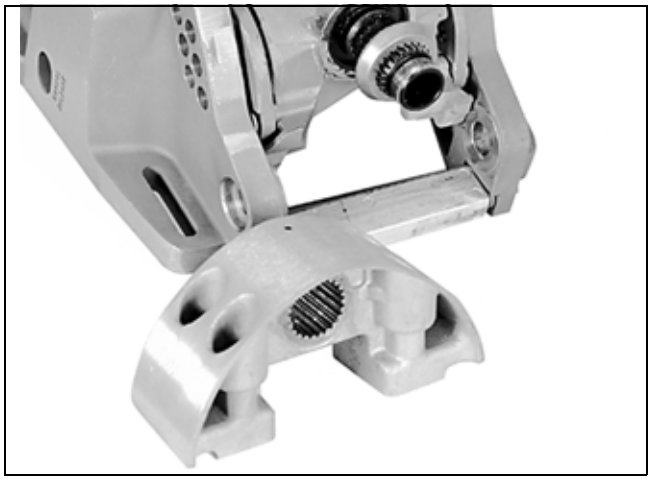
Disassembly

Remove and discard steering shaft locknut.



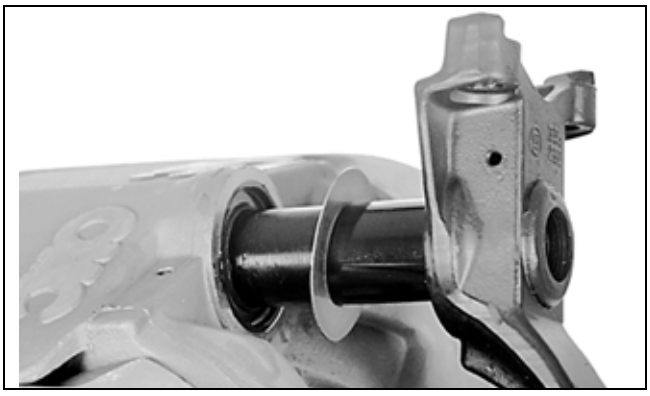
30738

Remove the lower mount bracket and keeper.



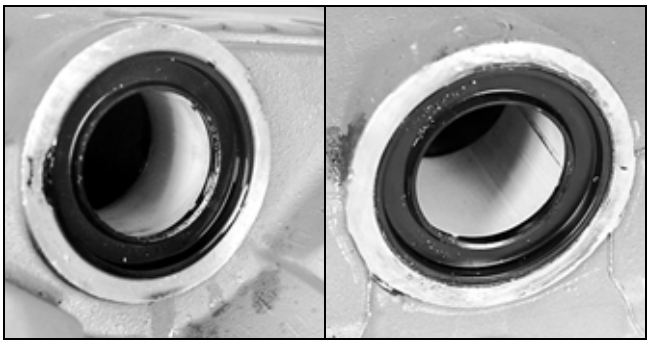
30736

Remove the steering shaft and thrust washer. It may be necessary to tap the steering shaft out using a wood dowel and mallet.



30735

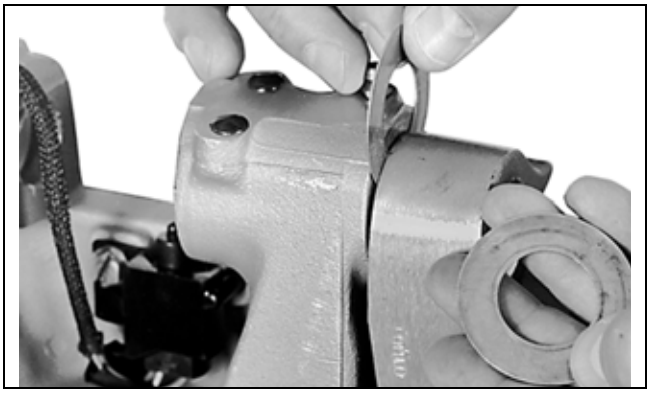
Pry out upper and lower steering shaft seals and discard. Remove the upper and lower steering shaft bushings.



30765 / 30764

Remove the tilt tube. Refer to **TILT TUBE** on p. 265.

Remove the two tilt tube washers.



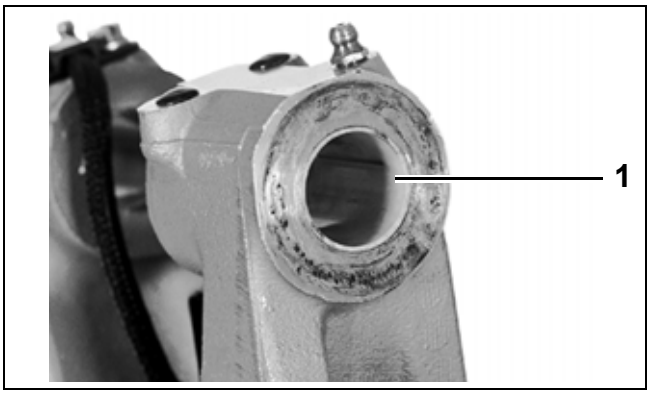
30763

Remove the anode.



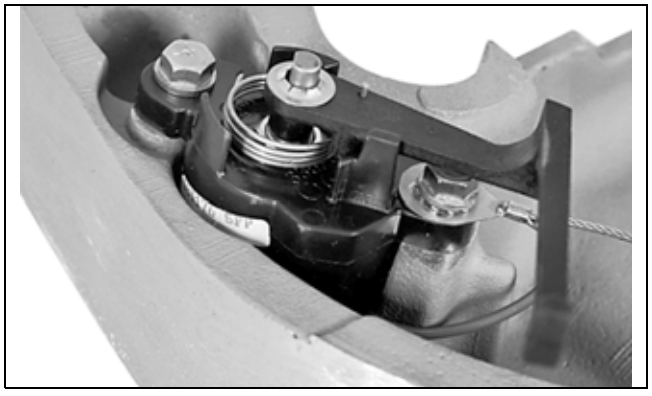
1. Anode 30762

Remove the swivel bracket. Inspect and, if necessary, replace the tilt tube bushings.



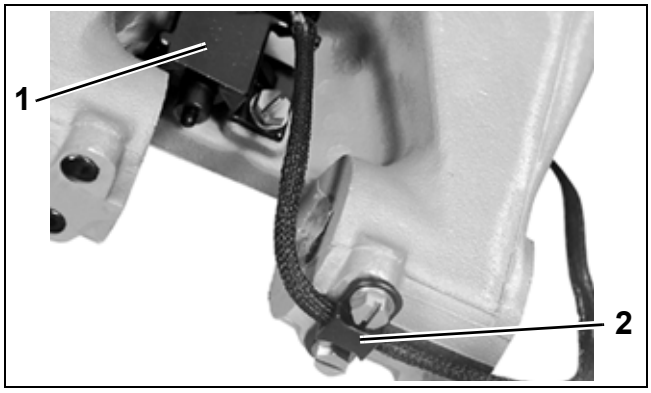
1. Tilt tube bushing 30761

Remove the trim sender unit from the port stern bracket and pull its wires through the braided tube.



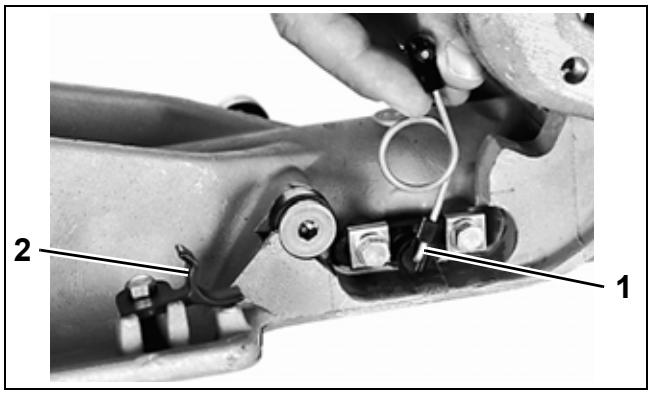
30760

Remove the tilt limit switch and retainer from the swivel bracket.



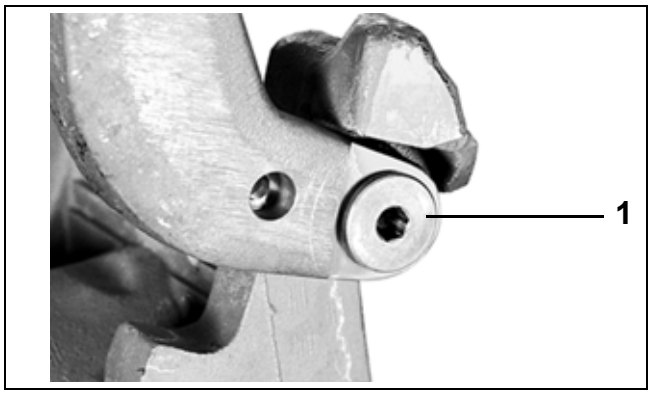
1. Tilt limit switch 30758
2. Retainer

Disconnect the trail lock spring and remove it from the swivel bracket. Remove trail arm retainer.



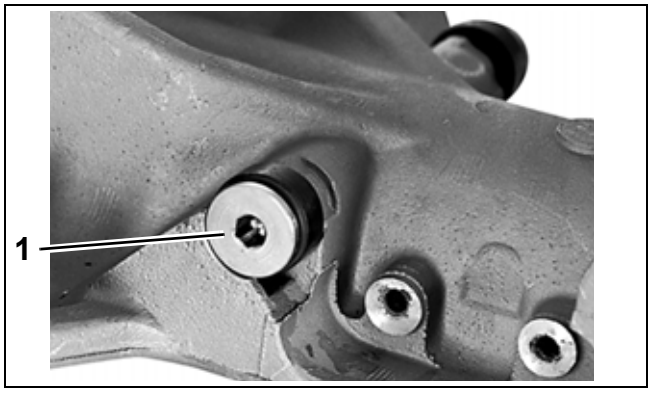
1. Trail lock spring 30756
2. Trail arm retainer

Remove the trail lock arm and bushings from the swivel bracket.



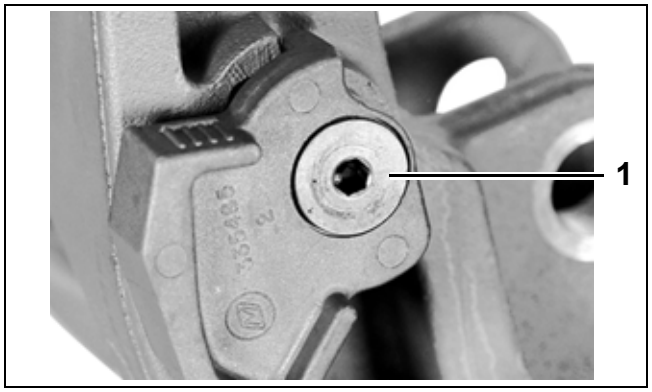
1. Trail lock bushing 30755

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

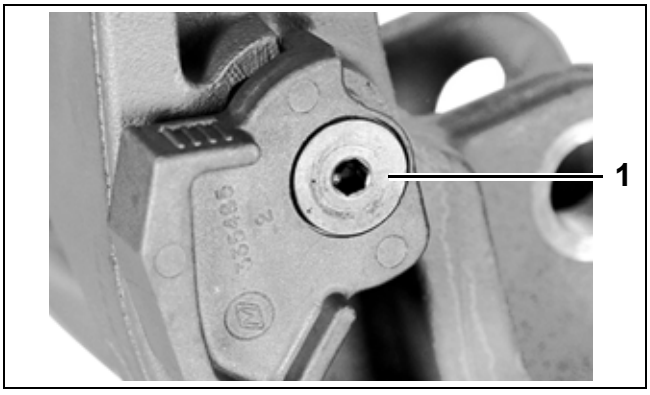
Assembly

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. Torque bushing to 28 to 30 ft. lbs. (37.9 to 40.7 N·m).

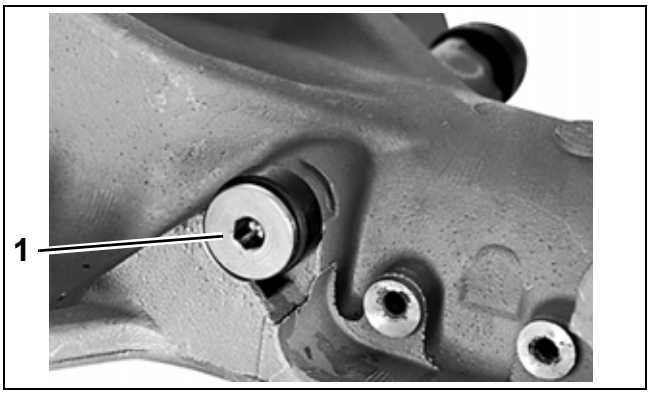


30752



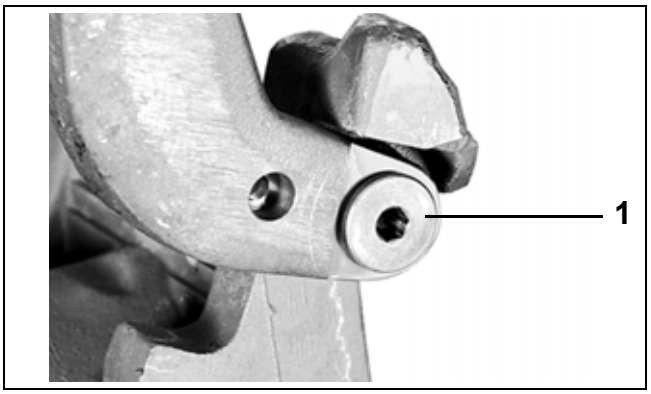
1. Tilt support bushing 30753

Install the two trim rod rollers on the swivel bracket. Torque to 216 to 240 in. lbs. (25 to 27 N·m).



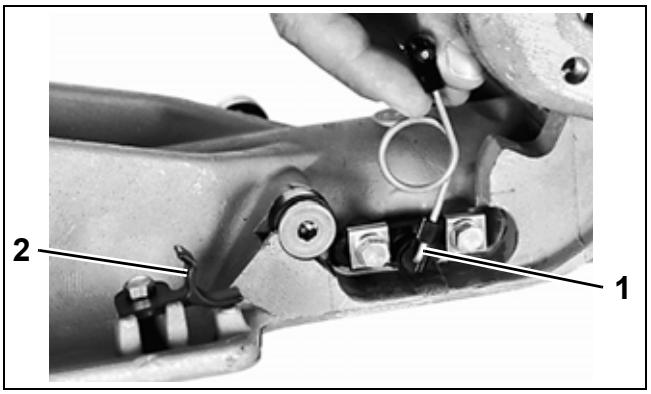
1. Trim rod roller 30754

Install the trail lock and bushings in the swivel bracket. Torque to 216 to 240 in. lbs. (25 to 27 N·m).



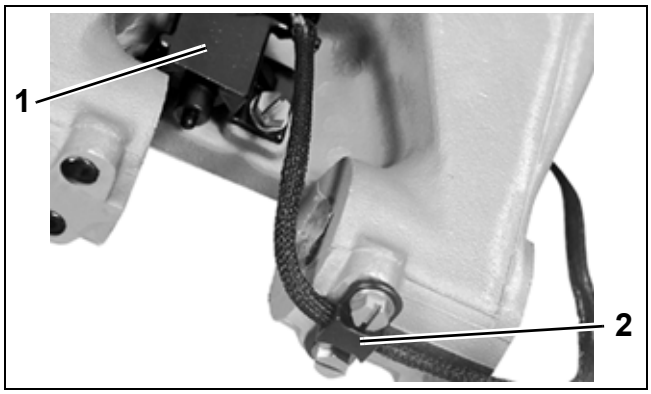
1. Trail lock bushing 30755

Install the trail lock spring in the swivel bracket and connect the spring to the trail lock.



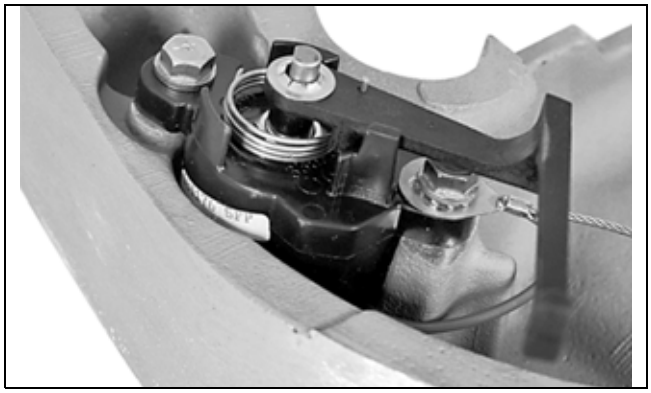
1. Trail lock spring 30756
2. Trail arm retainer

Install the tilt limit switch and retainer on the swivel bracket. Torque screws to 40 to 50 in. lbs. (4.5 to 5.7 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.

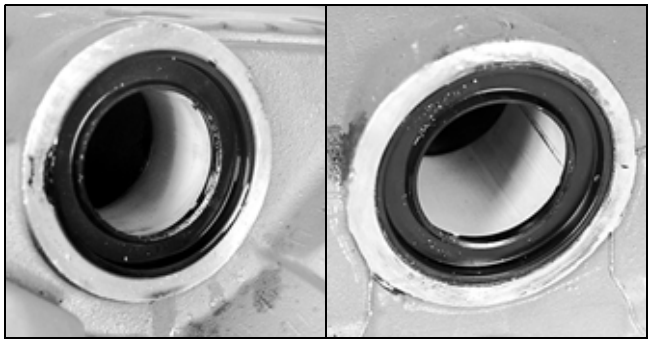


30760

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*.

- 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.

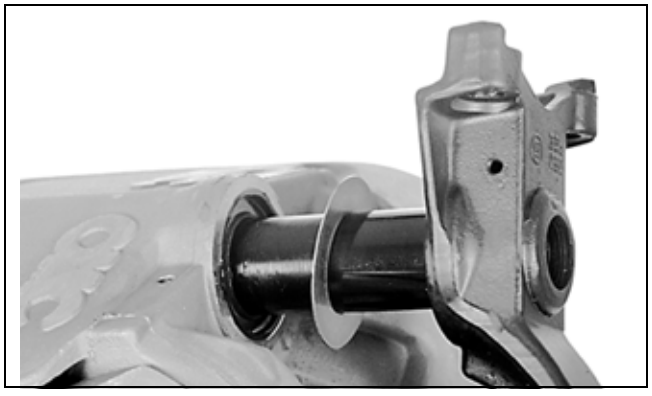


30761

Place the swivel bracket between the stern brackets and install the anode.

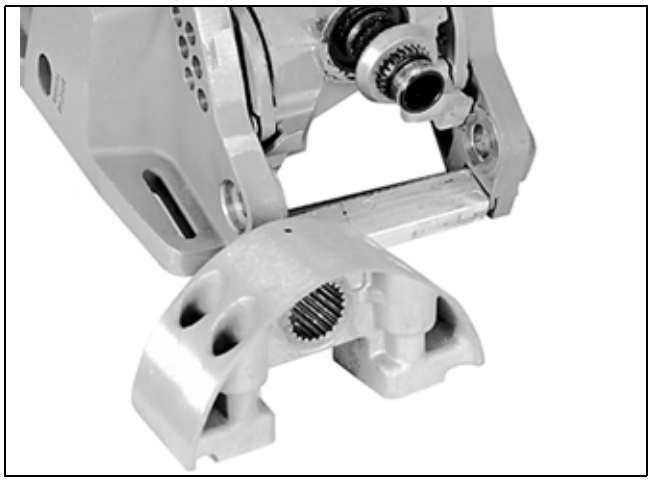
Install the tilt tube and tilt limit cam. Refer to **TILT TUBE** on p. 265.

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 torque the nut to 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 **TILT TUBE** on p. 265.

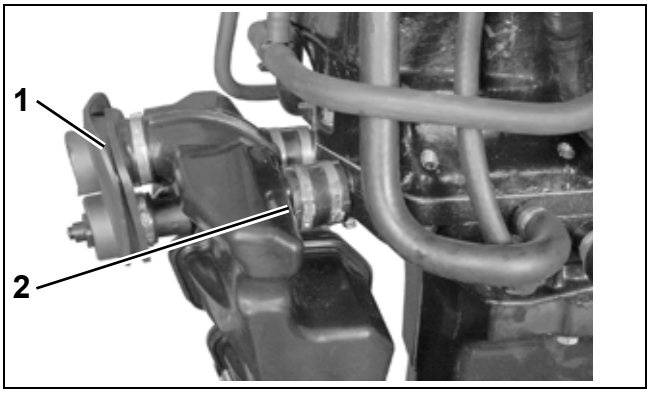
EXHAUST RELIEF MUFFLER ASSEMBLY

The exhaust relief muffler is located at the rear of the adaptor housing and concealed by the lower motor covers. The exhaust relief grommet connects directly to the muffler assembly.



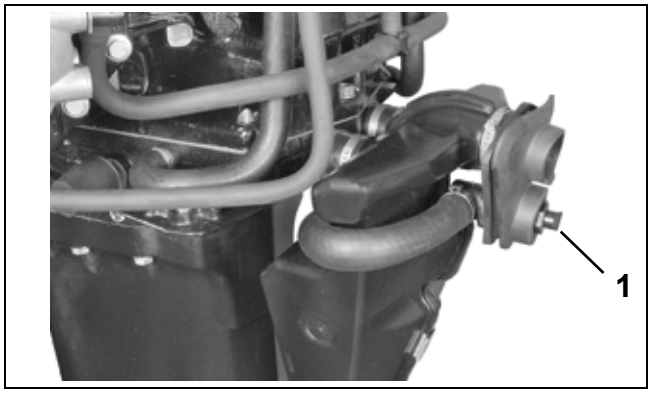
1. Exhaust relief grommet 004122

The muffler assembly connects to the exhaust relief hoses from the adaptor housing assembly.



1. Exhaust relief grommet 004226
2. Exhaust relief hoses

The overboard indicator and flush port in the exhaust relief grommet connect to the adaptor housing assembly with a hose. This hose is not connected to the muffler assembly.



1. Overboard indicator and flush port 004225

Periodically inspect hoses and connections for condition. Replace muffler or hoses as needed.

GEARCASE

TABLE OF CONTENTS

SERVICE CHART 280
GEARCASE TYPES 283
PROPELLER 283
LUBRICANT 284
LEAK TEST 285
REMOVAL AND INSTALLATION 285
WATER PUMP 288
SHIFT ROD ADJUSTMENT 290
SHIFT INTERRUPT SWITCH 291
DISASSEMBLY 291
- PRE-DISASSEMBLY INSPECTION 291
- PROPELLER SHAFT BEARING HOUSING REMOVAL 292
- PINION GEAR AND DRIVESHAFT REMOVAL 293
- DRIVESHAFT SERVICE 294
- SHIFT HOUSING, GEAR, AND PROPELLER SHAFT REMOVAL 295

GEARCASE HOUSING INSPECTION 296
BEARING AND SEAL REMOVAL 296
- SHIFT HOUSING 296
- PINION GEAR BEARING 297
- DRIVESHAFT BEARING HOUSING 298
- PROPELLER SHAFT BEARING HOUSING 298

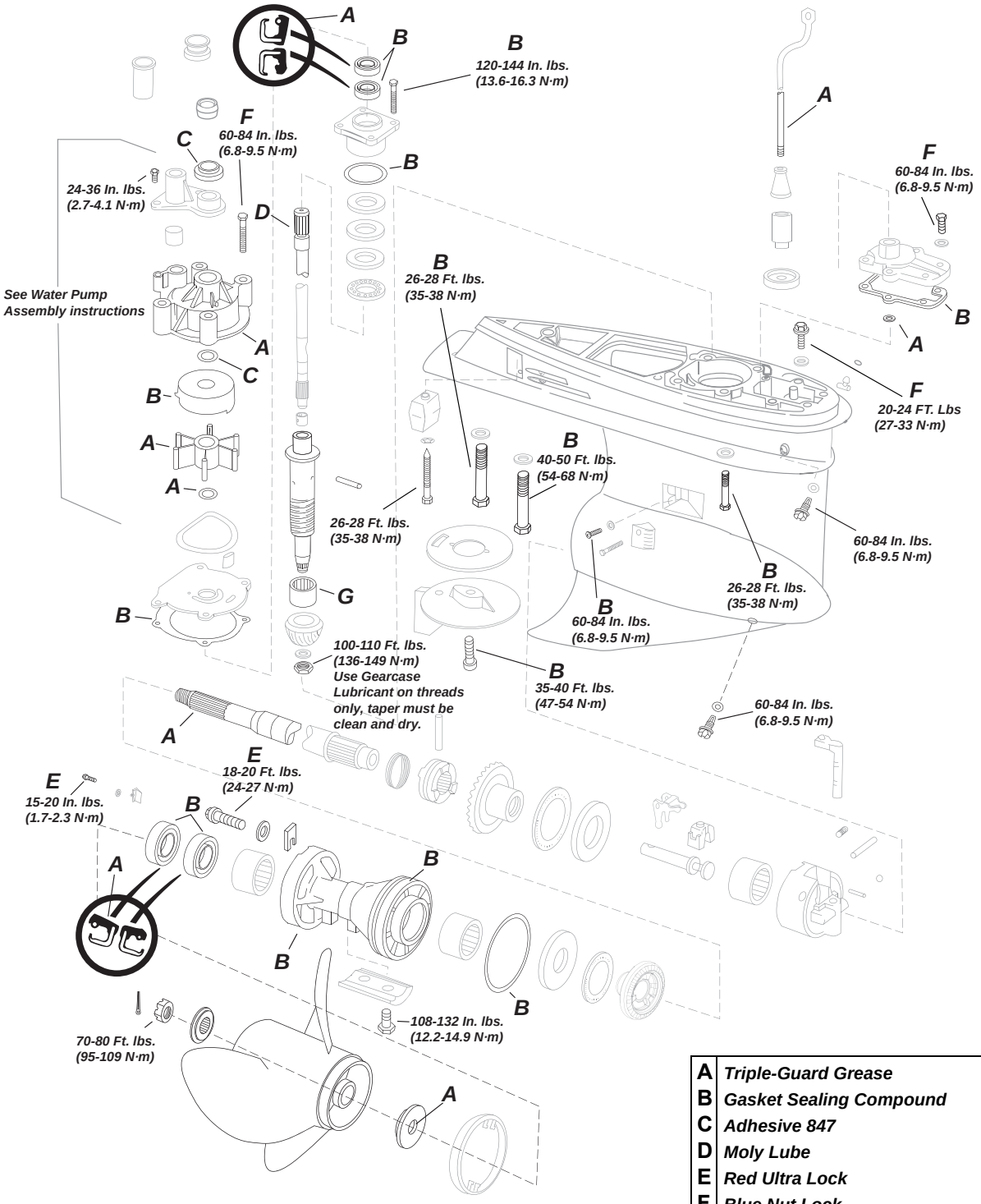
BEARING AND SEAL INSTALLATION 299
- SHIFT HOUSING 299
- PINION GEAR BEARING 301
- DRIVESHAFT BEARING HOUSING 302
- PROPELLER SHAFT BEARING HOUSING 303

DRIVESHAFT SHIMMING 304
ASSEMBLY 305
- SHIFT HOUSING, GEAR, AND PROPELLER SHAFT INSTALLATION 305
- SHIFT ROD HOUSING INSTALLATION 306
- PINION GEAR AND DRIVESHAFT INSTALLATION 307
- PROPELLER SHAFT BEARING HOUSING AND GEAR INSTALLATION 308

COUNTER ROTATION 310
- PROPELLER SHAFT BEARING HOUSING REMOVAL 310
- SHIFT HOUSING, GEAR AND PROPELLER SHAFT REMOVAL 310
- SHIFT HOUSING DISASSEMBLY 311
- SHIFT HOUSING ASSEMBLY 312
- PROPELLER SHAFT BEARING HOUSING AND FORWARD GEAR 315
- PROPELLER SHAFT BEARING HOUSING SEALS AND BEARINGS 319
- PROPELLER SHAFT BEARING HOUSING AND GEAR INSTALLATION 321

SERVICE CHART

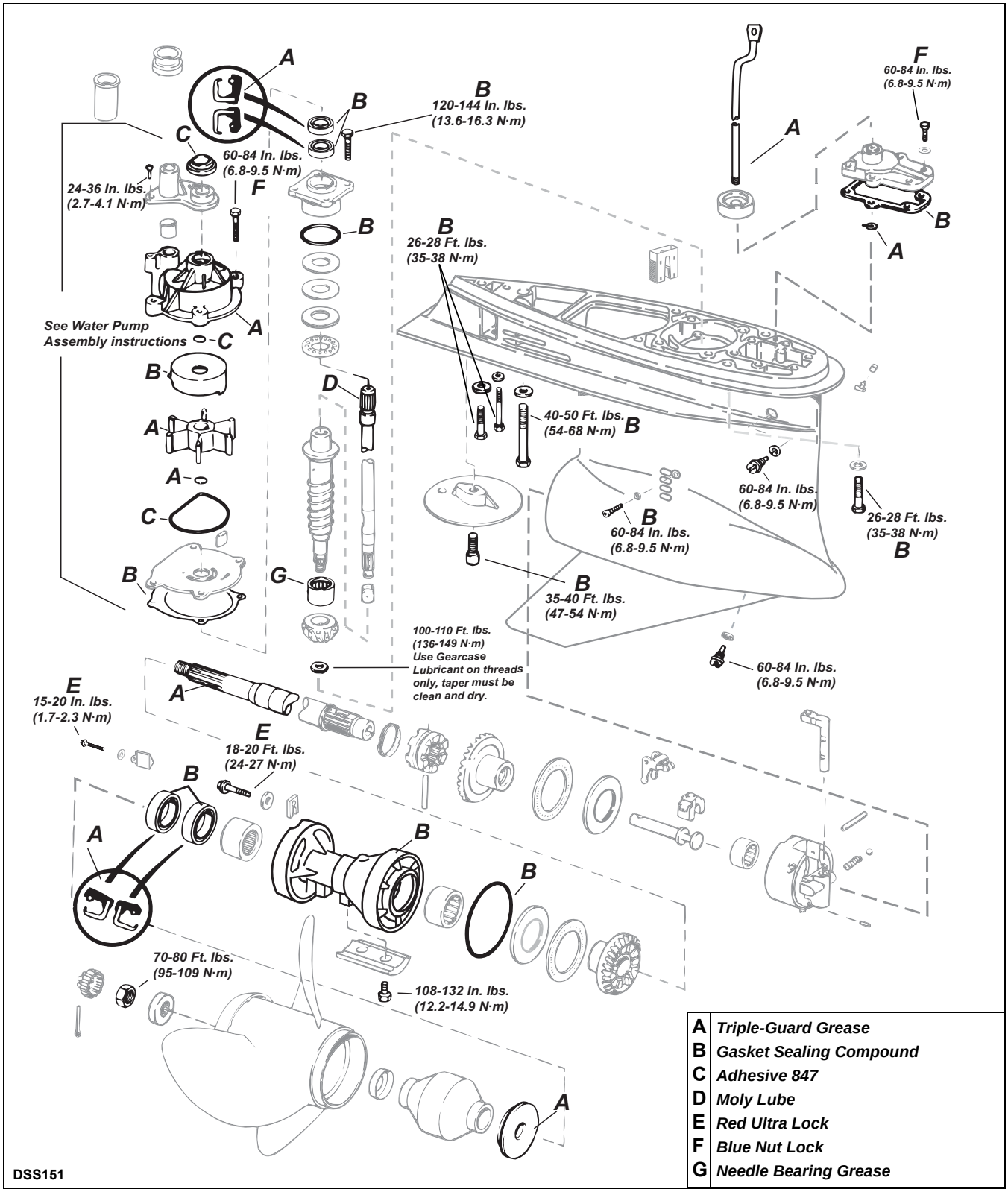
STANDARD ROTATION ***"M"–TYPE GEARCASE***



004104

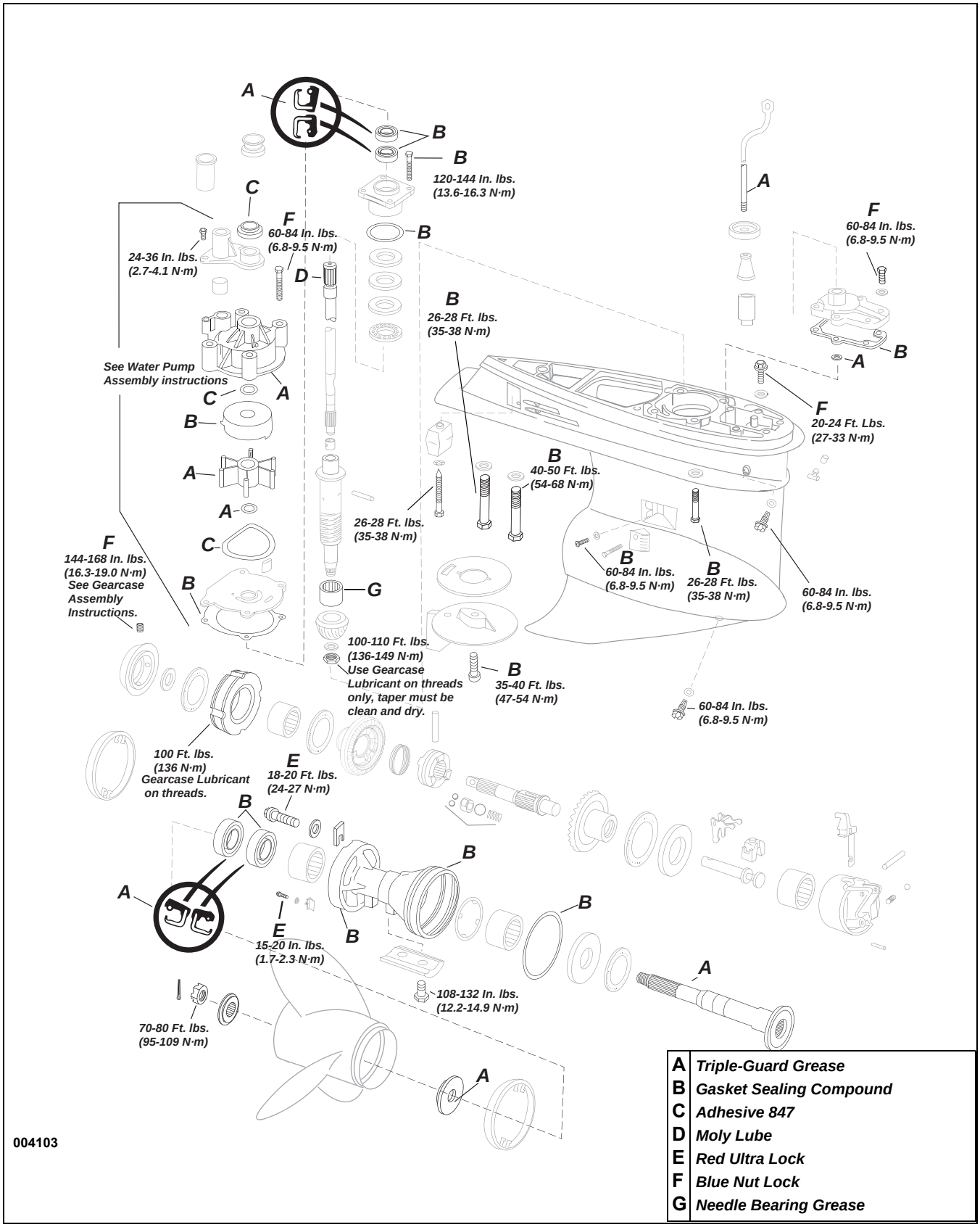
A	***Triple-Guard Grease***
B	***Gasket Sealing Compound***
C	***Adhesive 847***
D	***Moly Lube***
E	***Red Ultra Lock***
F	***Blue Nut Lock***
G	***Needle Bearing Grease***

PERFORMANCE MODELS ***"L"-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*

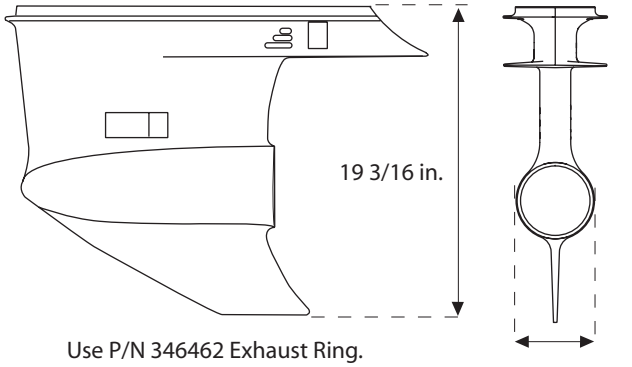
COUNTER ROTATION — *"M"-TYPE GEARCASE*



GEARCASE TYPES

Outboard Model	Housing Type	Comparative Information	Gear Ratio
20 in., 25 in., 30 in.	"M"	Large diameter gearset	13:24 (.542)
25 in. and 30 in. Counter Rotation		"CR" shafts, bearings and large diameter gearset	
Performance Models	"L"	High speed profile, standard gearset	14:26 (.538)

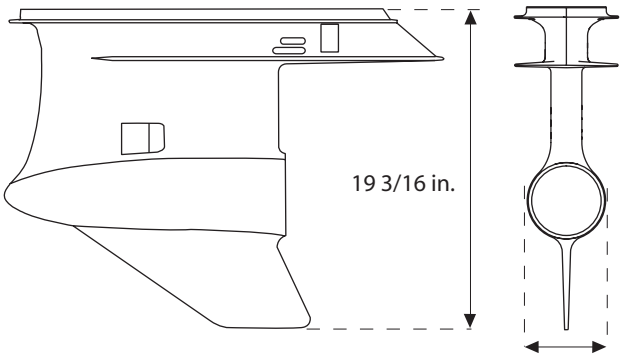
V6 "M" TYPE



Use P/N 346462 Exhaust Ring.

*Use P/N 350626 Ventilation (Weed) Ring for Bass Renegade® propellers.

V6 "L" TYPE



*Use P/N 126669 Ventilation (Weed) Ring for Bass Renegade® propellers.

PROPELLER

Inspection

⚠ 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.

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. 73.

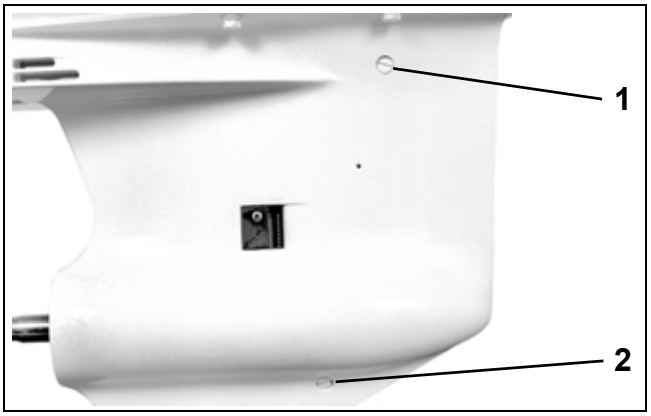
LUBRICANT

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.

Remove the lubricant level plug, then the lubricant drain/fill plug, and drain the lube from the gearcase into a container. Inspect the lube and the magnets on the plugs for metal chips.



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

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.

Inspection

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, drain lubricant into a suitable glass container. Allow the drained 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 **LEAK TEST**.

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

Secure the gearcase in a vertical position.

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

Slowly fill the gearcase with *HPF XR* 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

LEAK TEST

Drain lubricant before testing.

STEP 1

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.

STEP 2

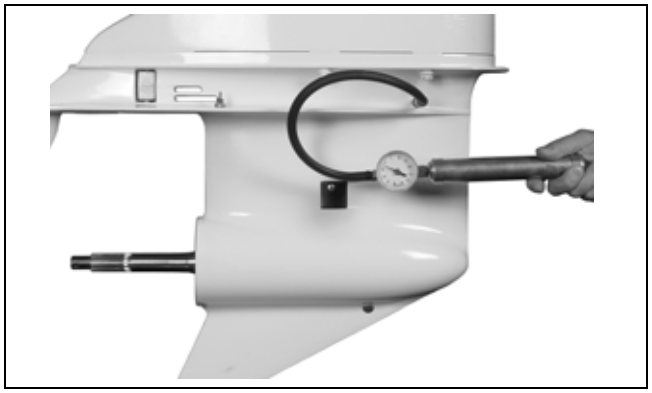
Complete successful **STEP 1** before proceeding.

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

REMOVAL AND INSTALLATION

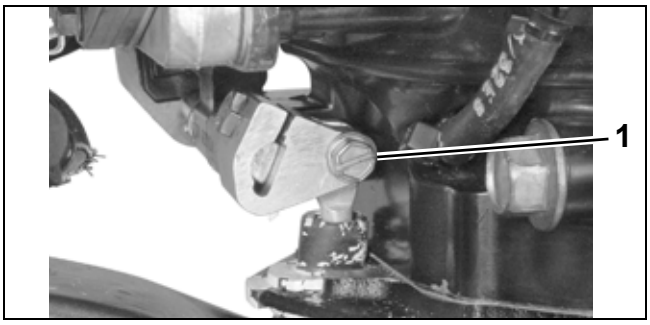
Removal

⚠ WARNING ⚠

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

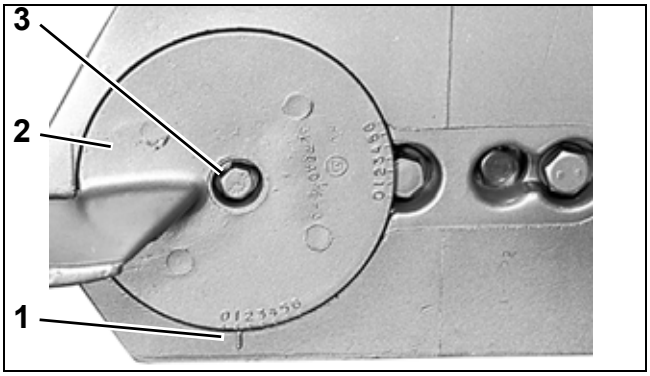
During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboard's weight with a suitable hoist or the tilt support bracket during service.

Remove screw from shift lever to release the lower shift rod.



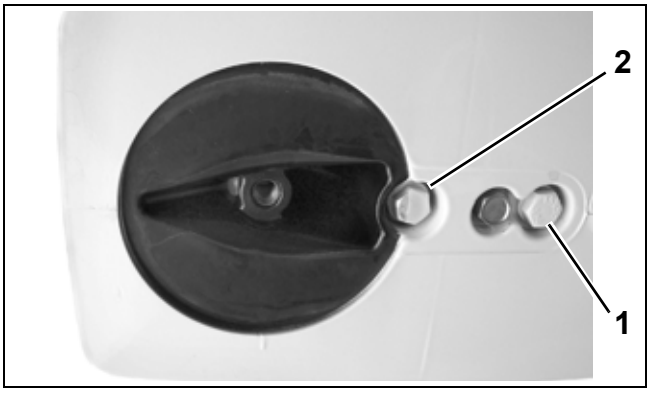
1. Shift rod screw 004241

Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw, gasket and trim tab from the gearcase.



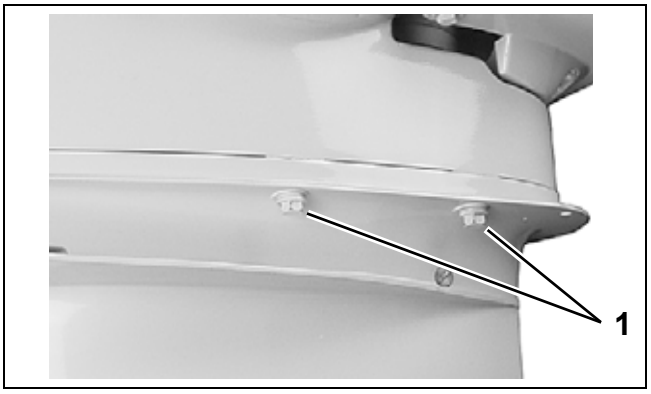
1. Index mark COA3663
2. Trim tab
3. Trim tab retaining screw

Remove the forward screw with the washer, and remove middle screw.



1. Forward screw
2. Middle screw
DSC02083

Remove the four gearcase retaining screws.



1. Gearcase retaining screws (4) 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.

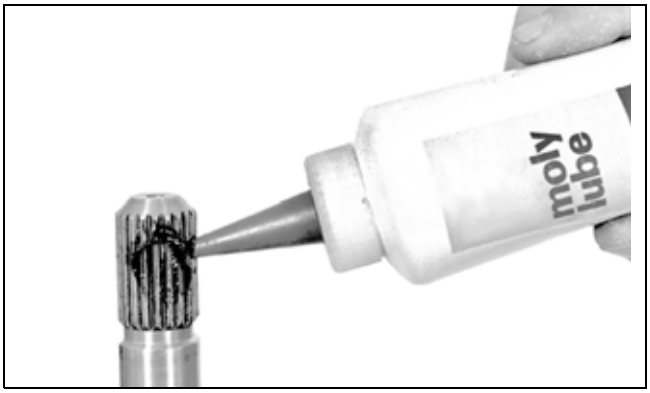
Installation

⚠ 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.

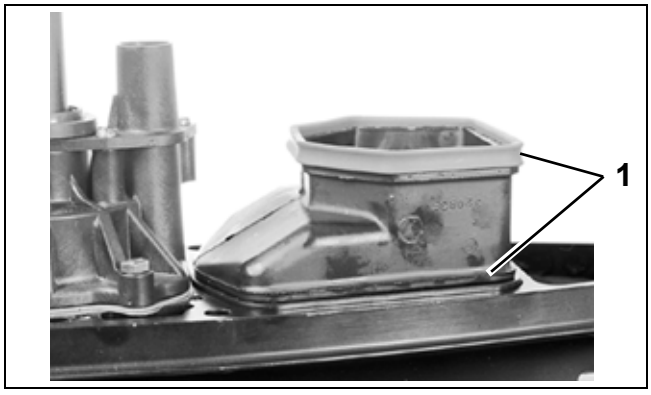
IMPORTANT: Before installation of gearcase on motor, shift rod adjustment MUST be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 290.

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. Position two new seals on the housing. Apply *Triple-Guard* grease to the seals' outer surfaces and position the housing on the gearcase.



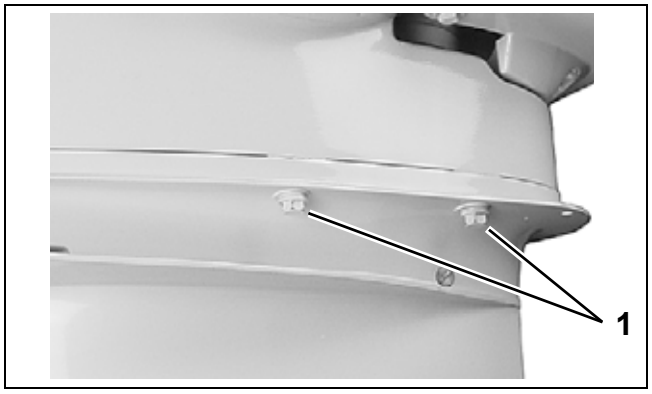
1. Lower exhaust seals 32002

Apply *Gel-Seal II* to gearcase mating surface pads on exhaust housing. Slide the gearcase into place, making sure that:

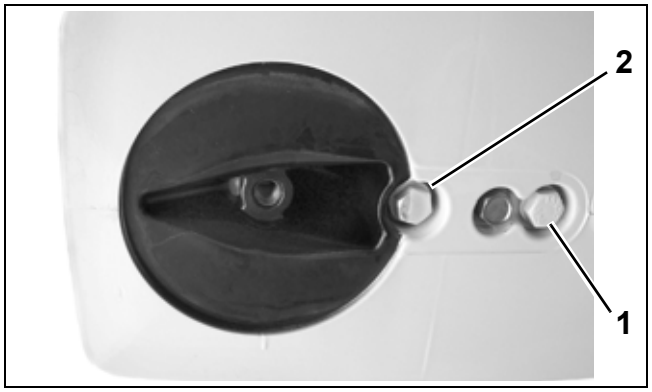
- Driveshaft engages the crankshaft.
- Water tube enters the water pump.
- Lower inner exhaust housing installs correctly.
- Shift rod does not turn and is positioned properly in shift shaft connection area.

Apply *Gasket Sealing Compound* to threads of the gearcase retaining screws. Torque the screws:

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

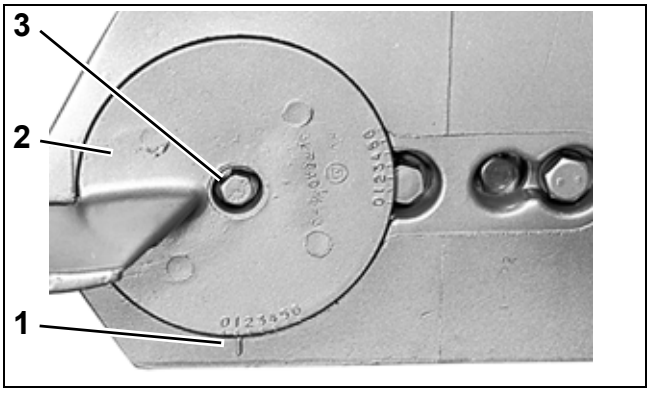


1. Gearcase retaining screws – 3/8 in. 001990



1. Forward screw - 7/16 in. DSC02083
2. Middle screw - 3/8 in.

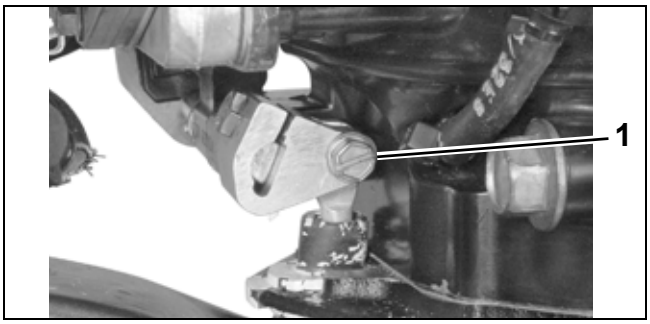
Apply *Gasket Sealing Compound* to threads of the trim tab screw. Install gasket on trim tab. Install and align the trim tab with the index marks noted prior to disassembly. Torque the trim tab screw to 35 to 40 ft. lbs. (47 to 54 N·m). For adjustment, refer to **Trim Tab Adjustment** on p. 76.



1. Index mark COA3663
2. Trim tab
3. Trim tab retaining screw

IMPORTANT: Standard rotation and counter rotation trim tabs must not be interchanged. This would result in inadequate cooling water supply to the propeller hub.

Position the shift rod in the connector. Install and torque shift rod screw to 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Shift rod screw 004241

⚠ WARNING ⚠

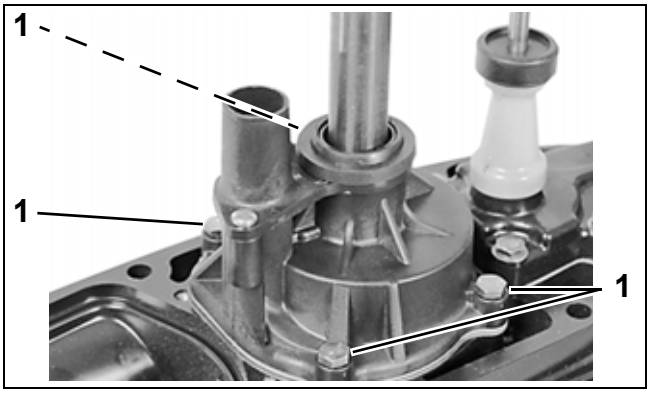
To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

IMPORTANT: During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

WATER PUMP

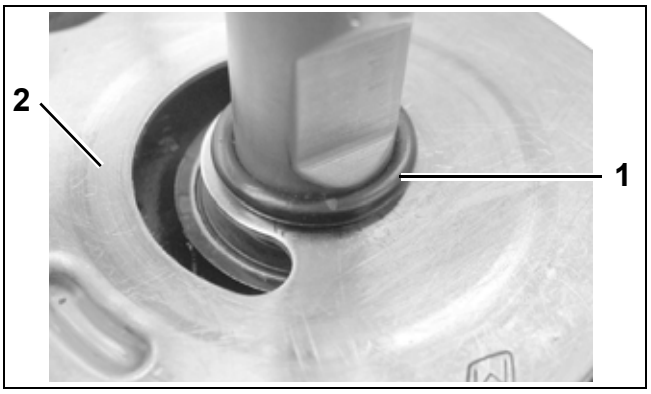
Disassembly

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 DSC02328
2. Impeller plate

Remove all the parts from the housing.

Inspection

Check impeller for overheating, hub separation, and other wear or damage.

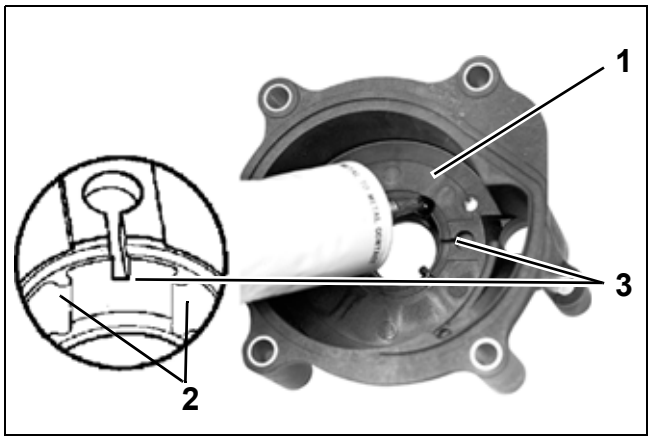
Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.

Assembly

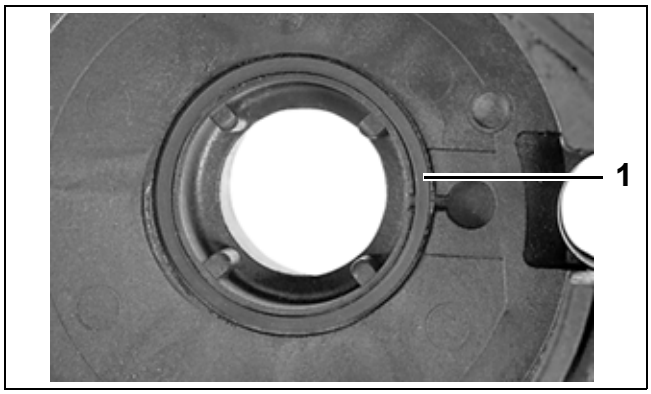
Apply a drop of *Adhesive 847* in the seal ring groove at each of the four ribs.

IMPORTANT: Do not allow any adhesive 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 2311
2. Ribs DR1185
3. Air bleed groove

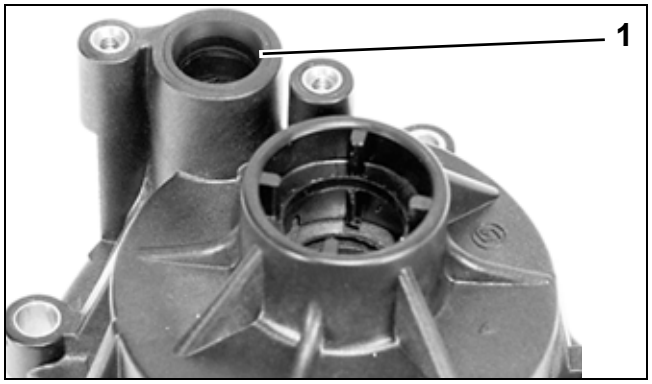
Install the O-ring in groove in the impeller housing.



1. O-ring 34814

Lightly coat the exterior of the impeller cup with *Gasket Sealing Compound*. Install the cup in the impeller housing.

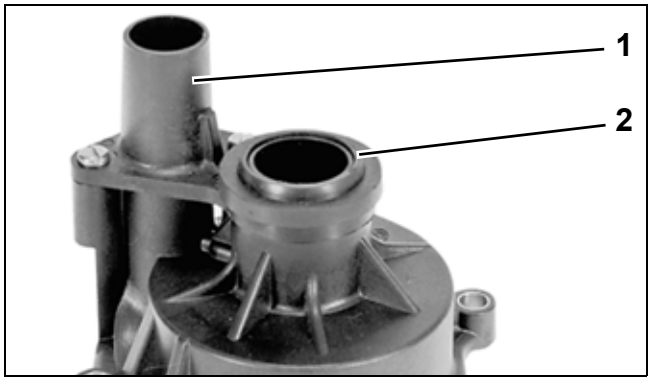
Install the water tube grommet with the inside taper facing up.



1. Water tube grommet 32000

Install the impeller housing cover and torque two screws to 24 to 36 in. lbs. (2.7 to 4.1 N·m).

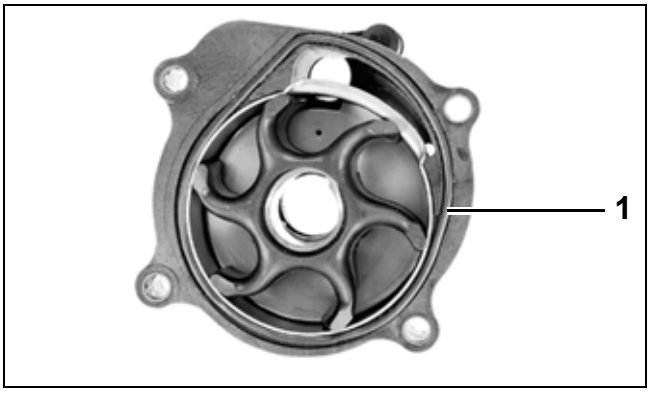
Apply *Adhesive 847* to flat side of the impeller housing grommet. Install the grommet, flat side down.



1. Impeller housing cover 32001
2. Impeller housing grommet

Lightly coat the liner with *Triple-Guard* grease. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller cam facing out.

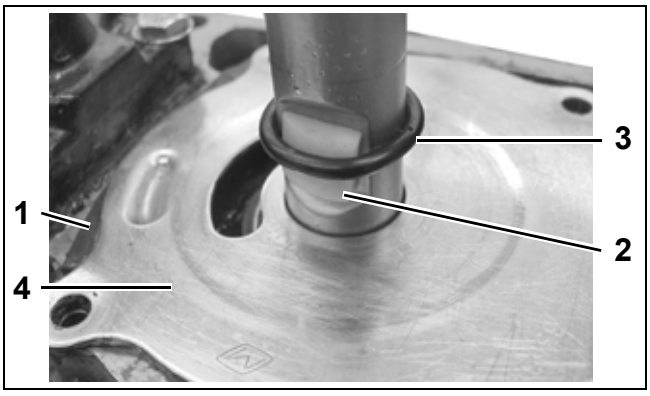
Run a thin bead of *Adhesive 847* in the seal groove, and install the special shaped O-ring seal.



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.

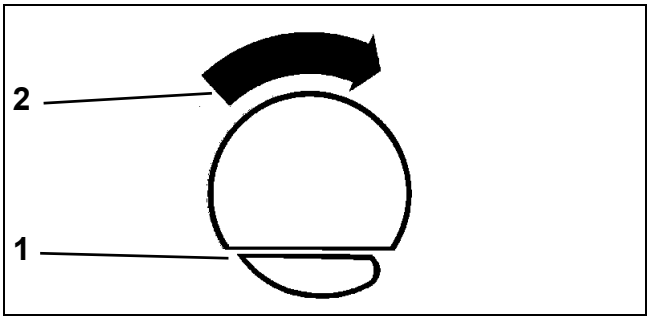


1. Impeller plate gasket DSC02326
2. Impeller plate
3. O-ring
4. Drive cam

The sharp edge of the cam is the leading edge in clockwise rotation. *Triple-Guard* grease or *Adhesive 847* can be used to retain the drive cam during water pump installation.

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.



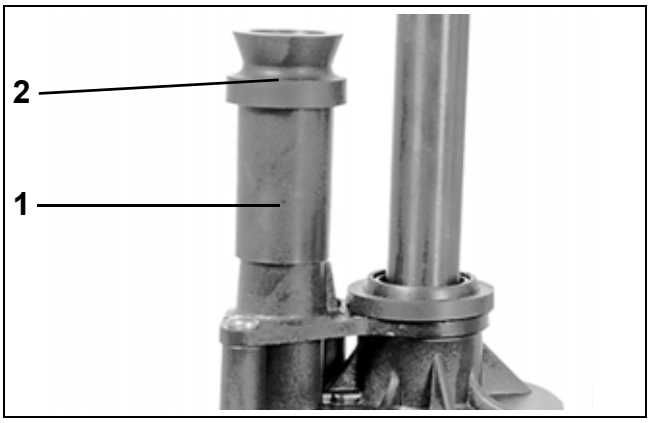
1. *Sharp edge of drive cam* CO2995
2. *Direction of driveshaft rotation*

IMPORTANT: Make sure the impeller engages the impeller cam properly. Serious powerhead damage will result if impeller cam is displaced.

Align the impeller housing with the gearcase. Apply *Gasket Sealing Compound* to threads of the four impeller housing screws. Install the screws and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).

25 IN. AND 30 IN. MODELS

Place water tube spacer with grommet on the impeller housing cover.

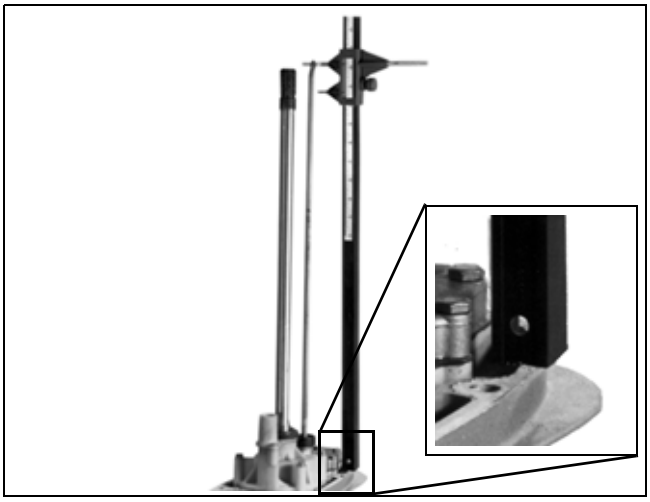


TYPICAL 32728
1. *Spacer*
2. *Grommet*

Before installation of gearcase on motor, shift rod adjustment MUST be checked. Refer to **SHIFT ROD ADJUSTMENT** on p. 290.

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 shift rod and detent lever 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 face 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)	“L, M”	21 29/32 in. ± 1/2 Turn
25 in. (X)	“M”	26 29/32 in. ± 1/2 Turn
30 in. (Z)	“M”	31 29/32 in. ± 1/2 Turn

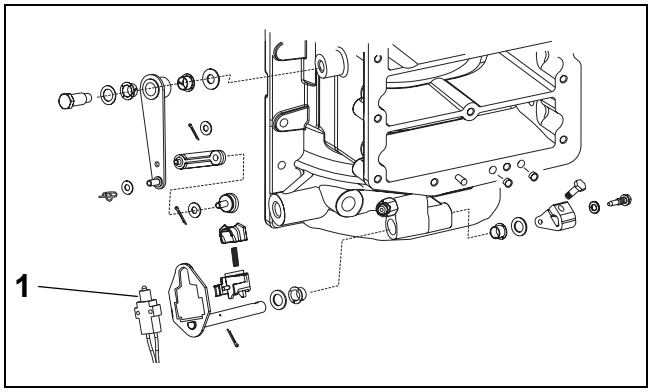
SHIFT INTERRUPT SWITCH

The shift interrupt switch is in contact with the shift lever (positioned at the base of the powerhead). The switch is normally open and activates momentarily as the shift linkage moves.

Excessive shift loads activate the switch. Typically the switch is depressed when the linkage moves from the FORWARD or REVERSE position into the NEUTRAL position.

A depressed switch completes a ground circuit connected to the EMM. The EMM then shuts off fuel and spark to three cylinders for approximately one second to reduce drivetrain loads and ease shifting, then immediately restores normal engine operation.

The shift interrupt switch must be released to its normal open position before the interrupt function can be activated again. This circuit is not functional above 2500 RPM.



1. Switch, shift interrupt 005160

DISASSEMBLY

⚠ 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 components during disassembly. Replace any damaged components, seals, O-rings, and gaskets upon assembly.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in **LUBRICANT** on p. 284.

Remove gearcase as described in **REMOVAL AND INSTALLATION** on p. 285.

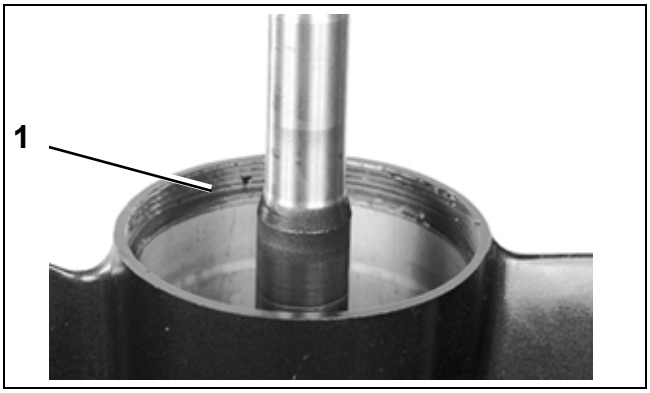
Remove water pump as described in **WATER PUMP** on p. 288.

Pre-Disassembly Inspection

Before disassembling the gearcase, examine the following:

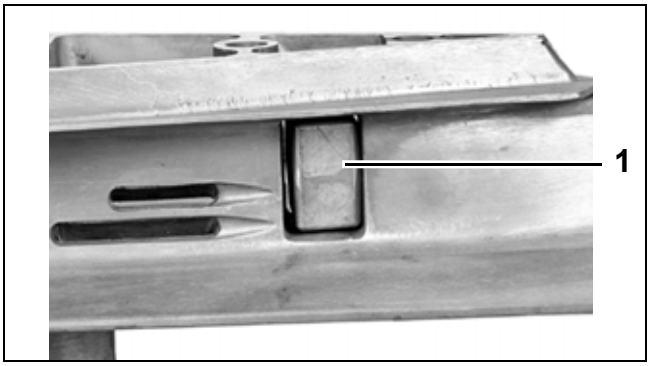
- **Gearcase Housing —** Check for visible damage to skeg, strut, anti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- **Propeller Shaft —** Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- **Shift Rod —** Check 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.



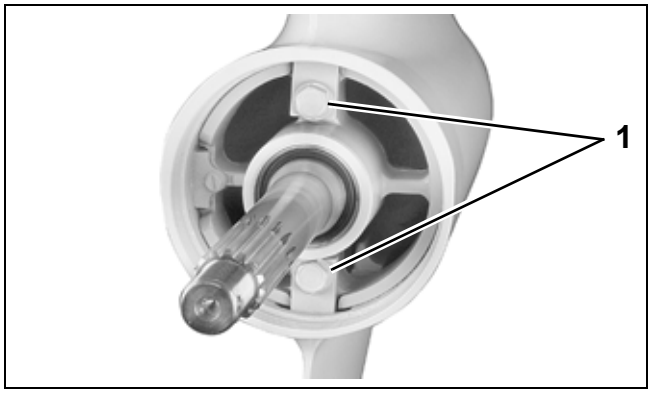
1. Gearcase anode 14161

- **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

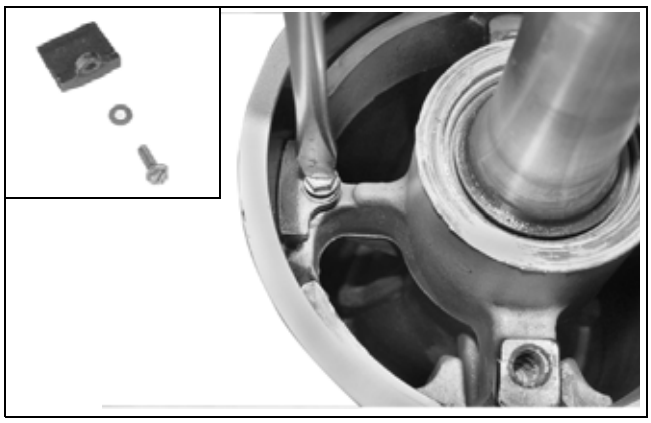
IMPORTANT: This procedure is for standard rotation gearcases only. For counter rotation gearcases, refer to **COUNTER ROTATION** on p. 310.

Remove the two screws, washers, and retainers holding the propeller shaft bearing housing.



1. Retainer tab screws 001989

Remove wedge, screw, and washer.

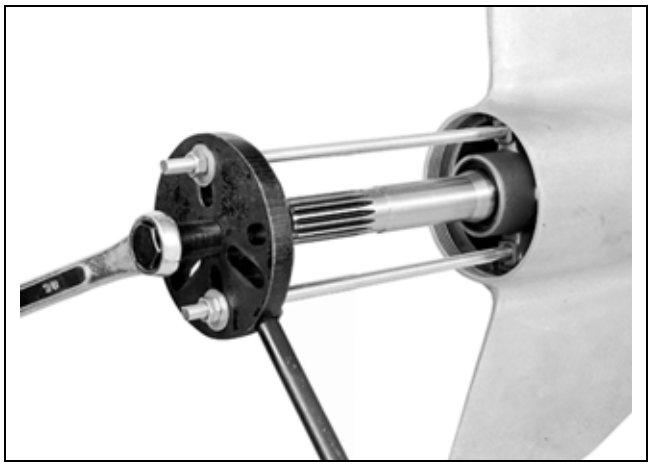


DSM02291
DSC02361

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.

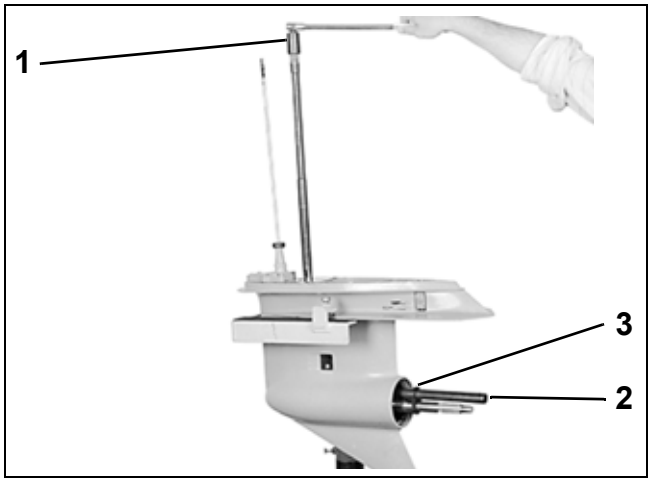


22775

Pinion Gear and Driveshaft Removal

Position the shift rod to move the clutch dog as far forward as possible. This will assist in the removal of the pinion nut.

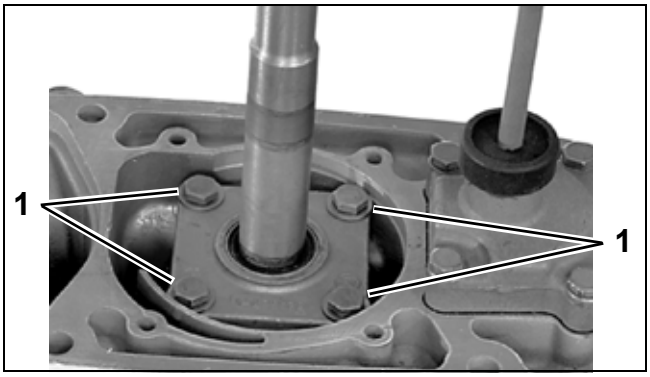
Loosen the pinion nut from the bottom of the driveshaft using Driveshaft Holding Socket, P/N 311875, Pinion Nut Holder, P/N 334455, and Wrench Retainer, P/N 341438. Pad the handle of holder to prevent damage to gearcase.



1. *Holding socket*
2. *Pinion holder*
3. *Retainer*

42229

Remove the four driveshaft bearing housing screws with washers.

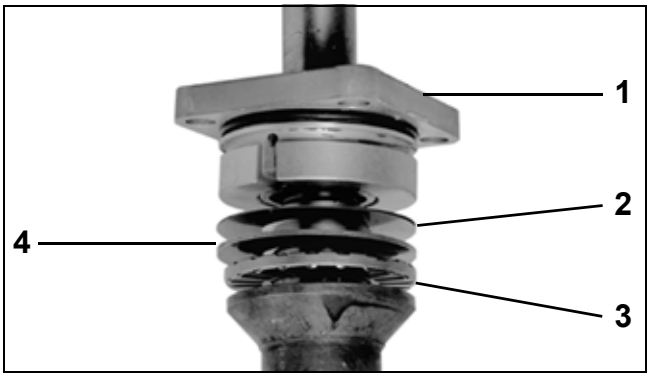


1. *Driveshaft bearing housing screws*

COA3153

Remove pinion nut and driveshaft from the gearcase. If driveshaft cannot be removed, refer to **(Special) Driveshaft Removal Procedures** on p. 294.

The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



1. *Bearing housing*
2. *Shims*
3. *Thrust bearing*
4. *Thrust washer*

COA3558

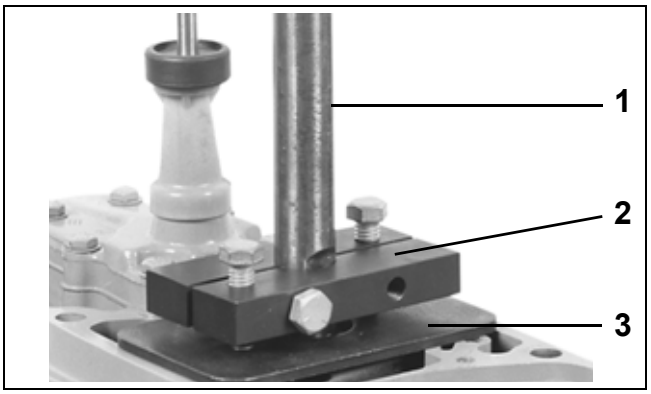
Reach inside the gearcase and remove the pinion gear and pinion nut.



COA3159

(Special) Driveshaft Removal Procedures

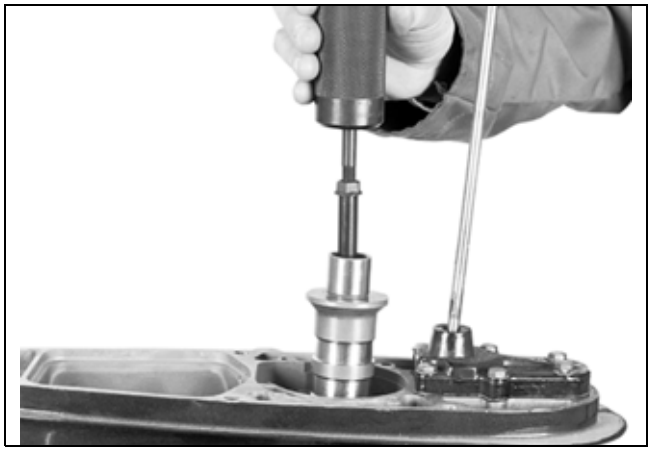
The driveshaft to pinion taper is a locking taper. If necessary, use Driveshaft Puller, P/N 390706, and Backing Plate, P/N 325867, to break the lock. Install the tools as shown by clamping them around the driveshaft. Alternately tighten the two vertical screws against the backing plate inserted between the puller and the gearcase until the driveshaft pops loose from the pinion.



1. Drive shaft
2. Puller
3. Backing plate

41177

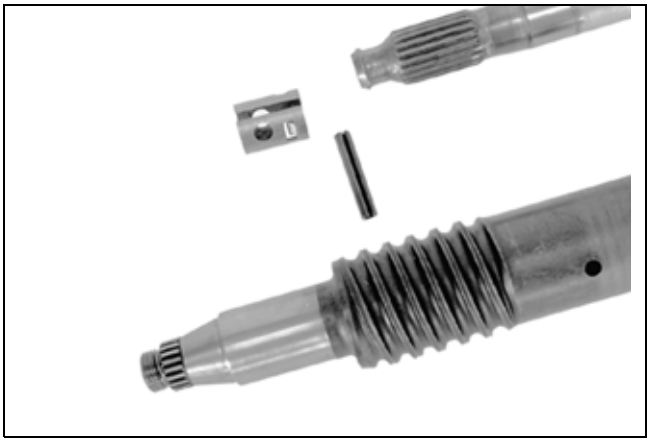
If upper driveshaft becomes separated from lower driveshaft, use Lower Driveshaft Puller, P/N 342681, to remove. Install puller into lower driveshaft and turn 90° to position hook under pin in driveshaft. Thread Slide Hammer, P/N 391008, into puller and remove driveshaft.



46905

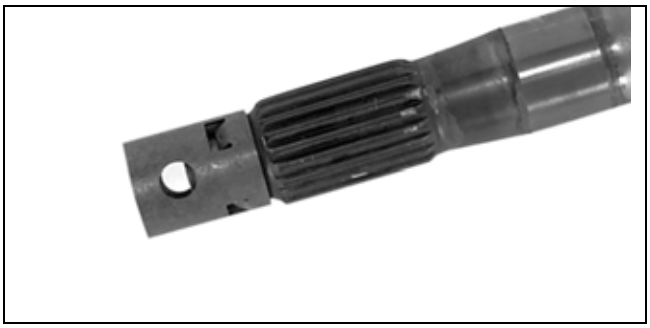
Driveshaft Service

To separate the upper driveshaft (if needed) from the lower driveshaft, remove the roll pin. Replace the damaged component.



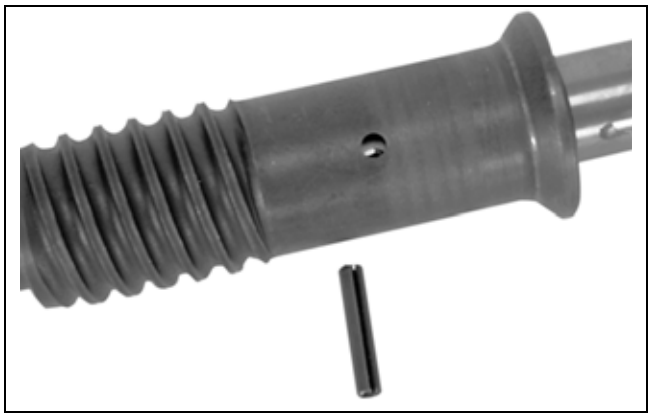
29337

To assemble the driveshaft, install **new** driveshaft retainer into the groove of the upper driveshaft.



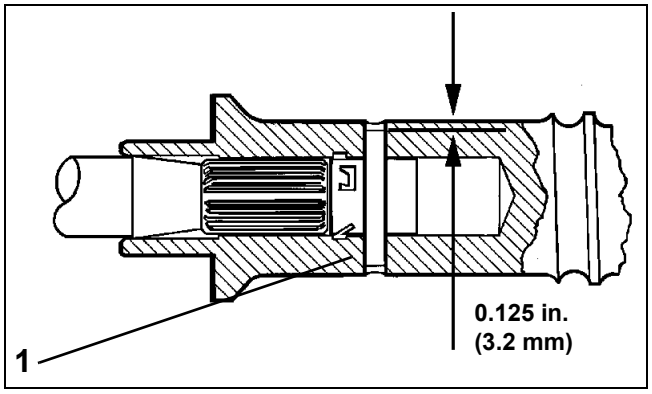
29338

Install the upper driveshaft into the lower driveshaft, aligning the holes in the driveshaft retainer and the lower driveshaft.



29330

Install the roll pin to the specified dimension.

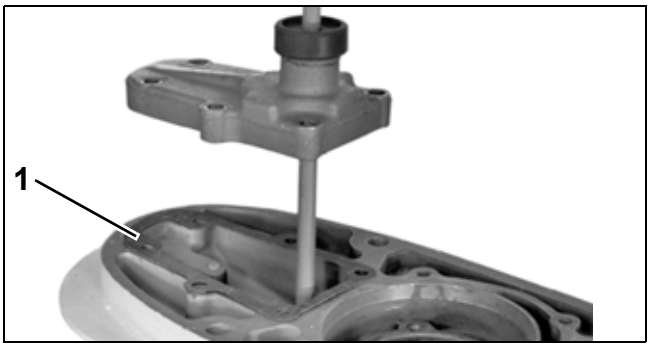


1. Roll pin DR4610

Shift Housing, Gear, and Propeller Shaft Removal

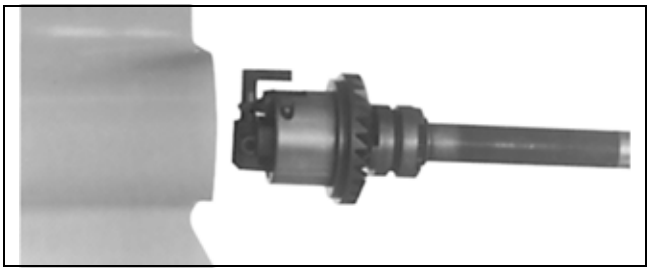
Push down on the shift rod. This will move the detent lever downward to clear the inside of the gearcase when the shaft assembly is pulled out. Unthread the shift rod from the detent lever. Remove the six screws, shift rod, and cover from the gearcase.

Discard the cover gasket. Remove and discard the shift rod O-ring from inside of cover.



1. Cover gasket COA3141

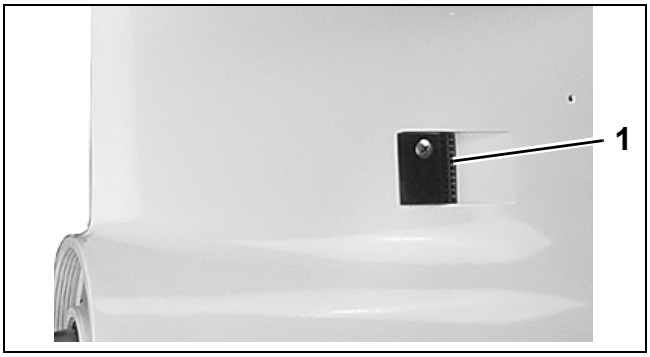
Remove propeller shaft assembly from gearcase.



COA3149

Water Intake Screens

Remove and clean water intake screens. Replace if damaged.

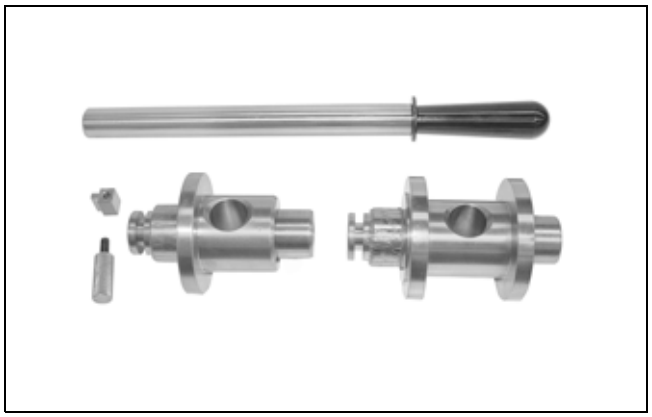


1. Water intake screen 001991

GEARCASE HOUSING INSPECTION

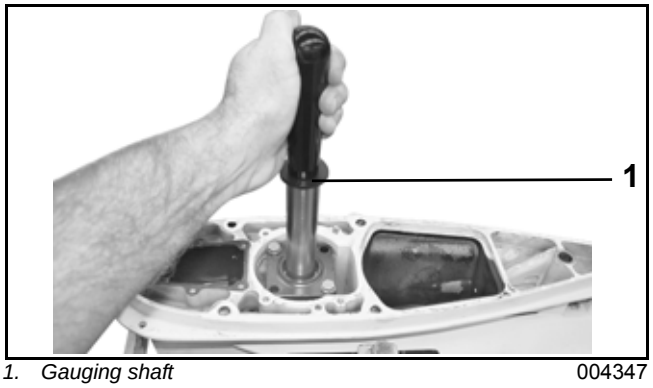
Thoroughly clean gearcase housing to remove all dirt and debris prior to inspection. Inspect pinion bearing and forward thrust surface of gearcase housing.

Use Gearcase Alignment Gauge Kit, P/N 5006349 to check the condition of gearcase housing prior to reassembly. Refer to instructions provided with kit.



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

BEARING AND SEAL REMOVAL

Shift Housing

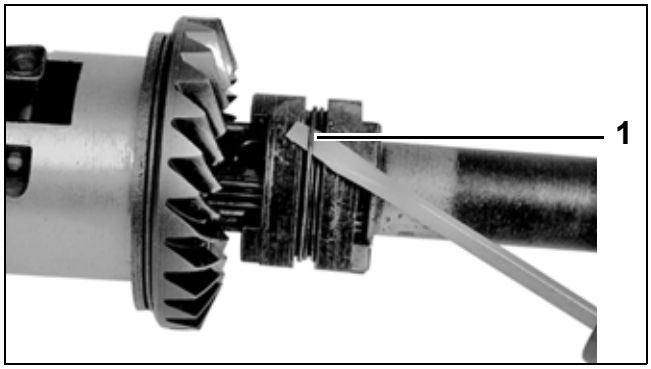
⚠ WARNING ⚠

Wear safety glasses to avoid injury.

IMPORTANT: The shift housing and forward gear bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

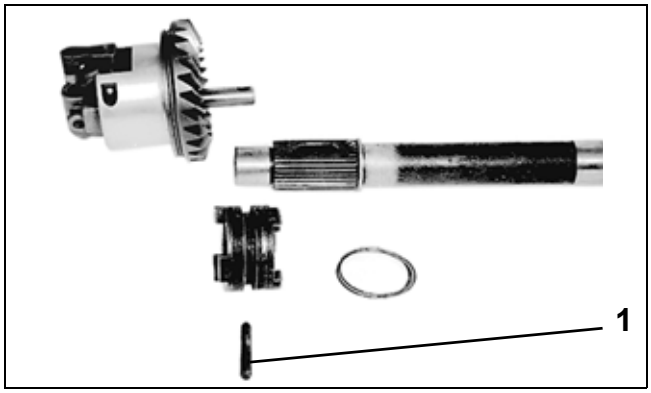
Disassembly

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring**.



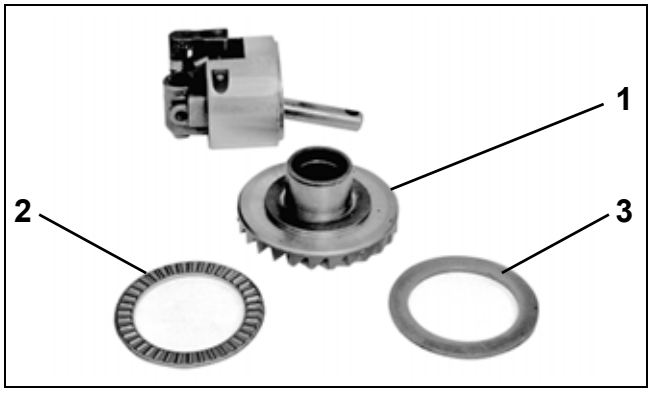
1. Clutch dog spring COA3560

Push the pin out of the clutch dog. Remove all components.



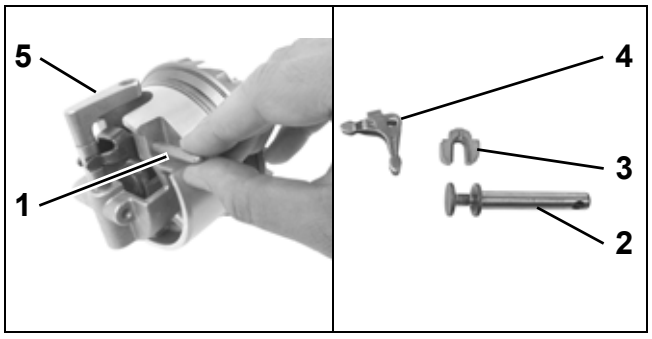
1. Pin COA3561

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 accordingly to assist in removal of components.

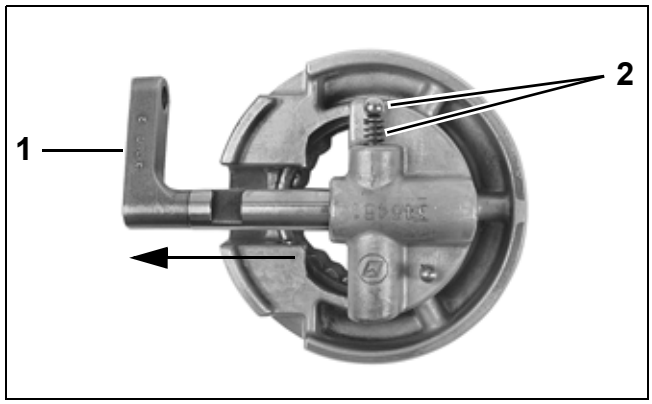


1. *Shift lever pin* DSC02449
2. *Shift shaft* DSC02489
3. *Cradle*
4. *Shift lever*
5. *Shifter detent*

⚠ 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.



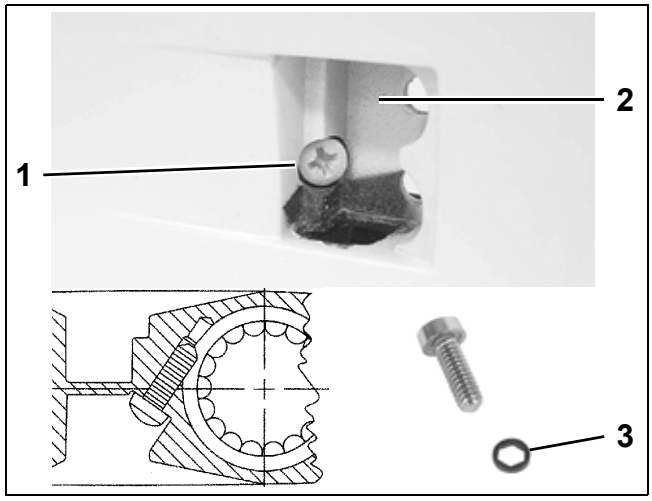
1. *Shifter detent* DSC02518
2. *Ball and spring*

Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection.

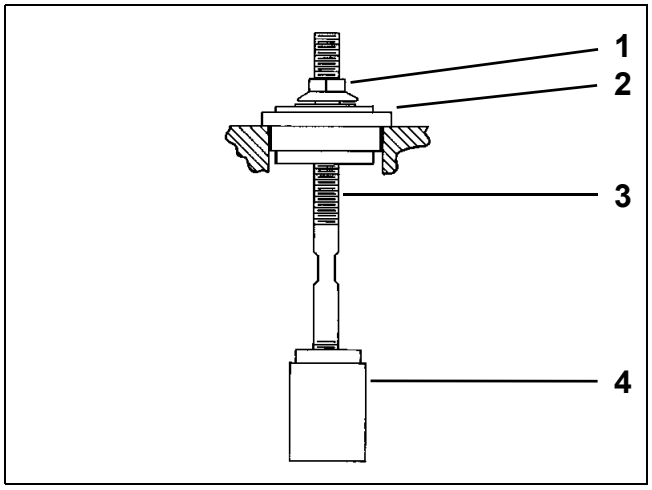
Pinion Gear Bearing

Remove pinion bearing retaining screw.



1. *Pinion bearing retaining screw* DSC02370
2. *Water screen pocket* DRC7416
3. *Seal* DSC02313

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
2. Plate, P/N 391260
3. Rod, P/N 326582
4. Remover, P/N 326579

DR3419

Driveshaft Bearing Housing

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

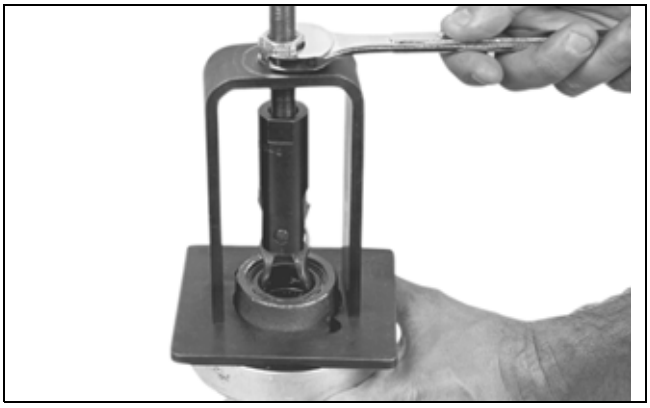
Remove and discard the O-ring from the bearing housing.

Clean the bearing housing in solvent to remove sealer from the seal bore and the O-ring groove.

Propeller Shaft Bearing Housing

Rear Seal Removal

Remove seals using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131. Position the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.



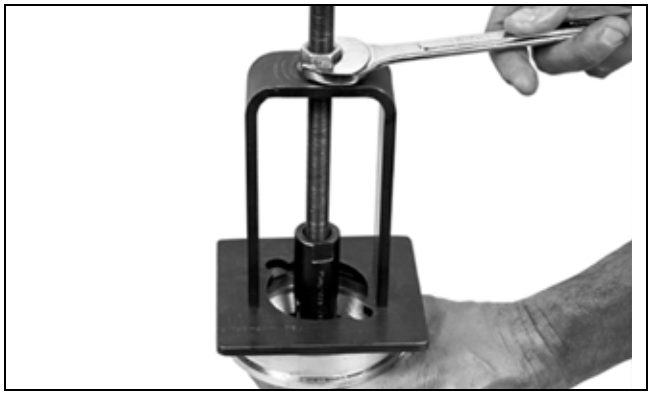
13520

Bearing Removal

Rear seals must be removed if bearing replacement is needed. See **Rear Seal Removal**.

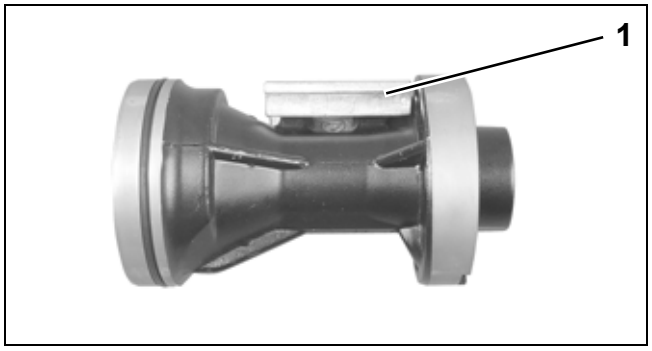
IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

Remove either bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Rest the puller plate on top of the housing to support the bridge, and tighten the jaws securely behind the bearing.



13522

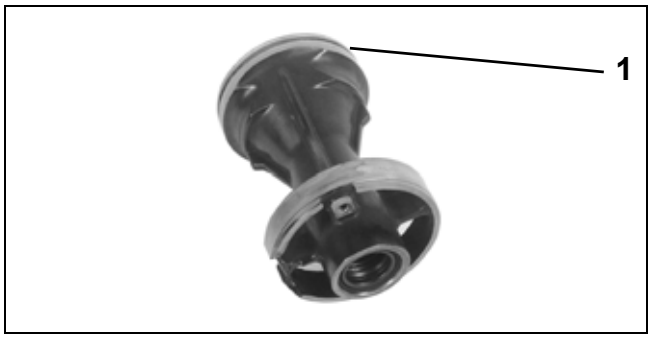
Inspect the bearing housing anode. Replace the anode if it is reduced to two-thirds of original size.



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, and sand off any sharp edges that would cut O-ring and prevent its sealing. Check for and remove any nicks or burrs on front of bearing housing.



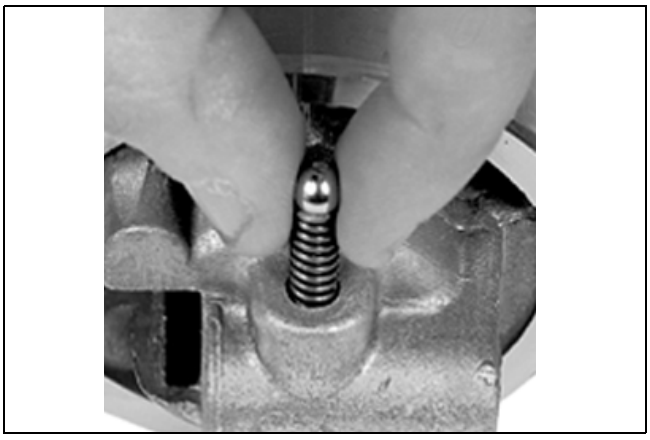
1. O-ring groove DSC02291

BEARING AND SEAL INSTALLATION

Shift Housing

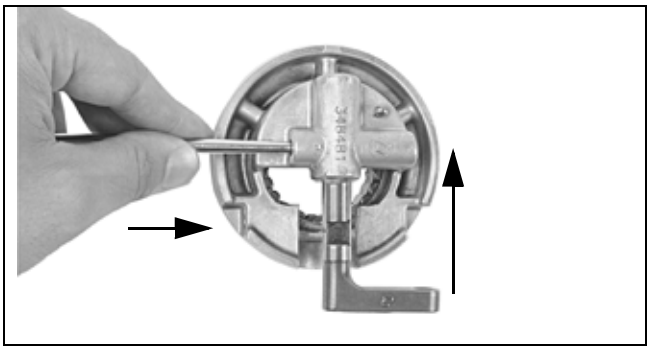
IMPORTANT: Clean and inspect all components before beginning assembly procedures. Replace any damaged components.

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.



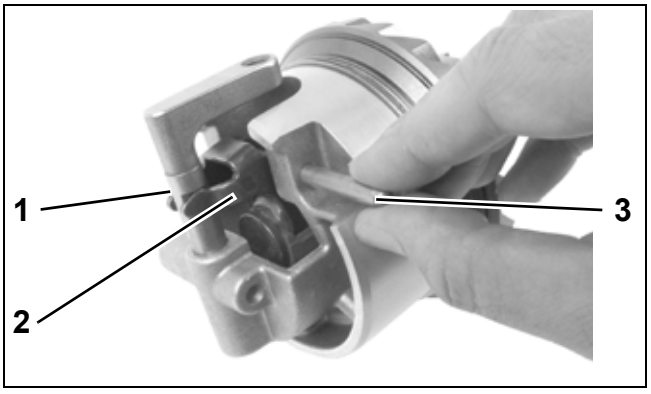
DSC02506

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case.



4520

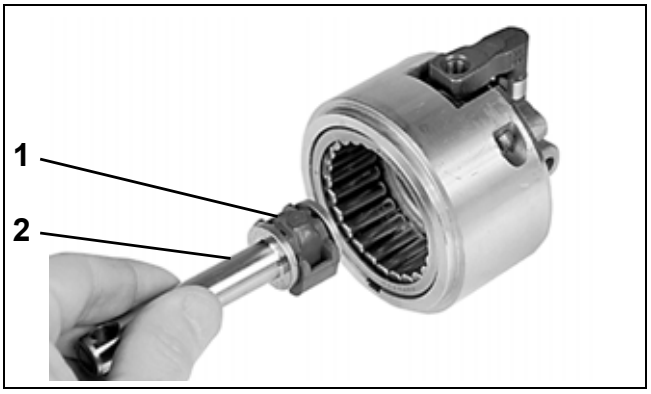
With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



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

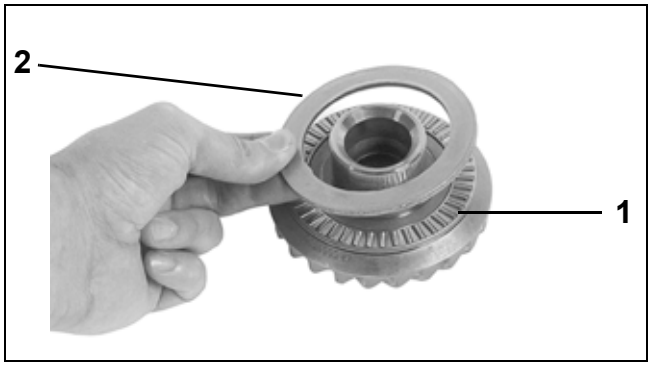
Position the shift lever arms into the recesses of the shift cradle. Pull the shifter detent back up to NEUTRAL position to hold the cradle and shaft in place.



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.

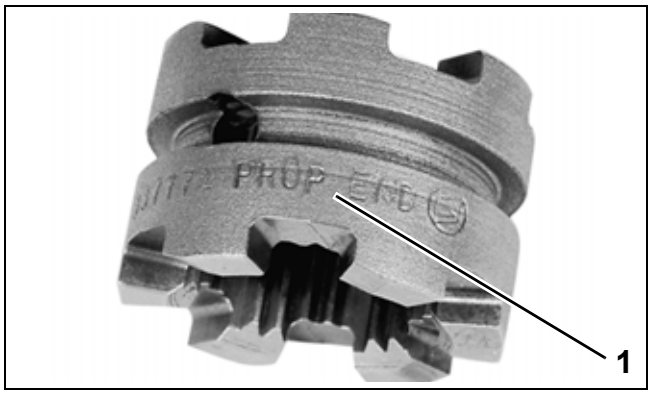


1. *Thrust bearing*
2. *Thrust washer*

DSC02297

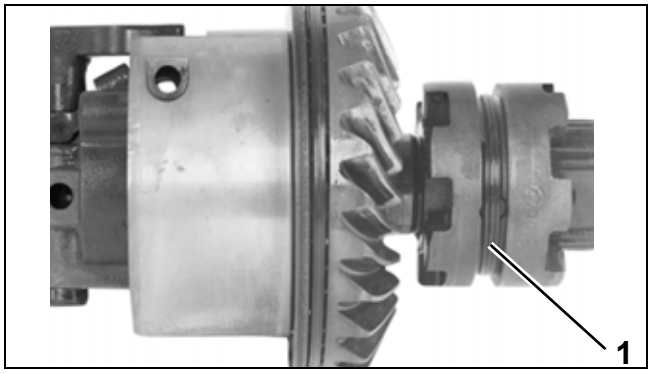
Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog on the shaft with "PROP END" facing rear of the shaft.

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" stamp COB7581

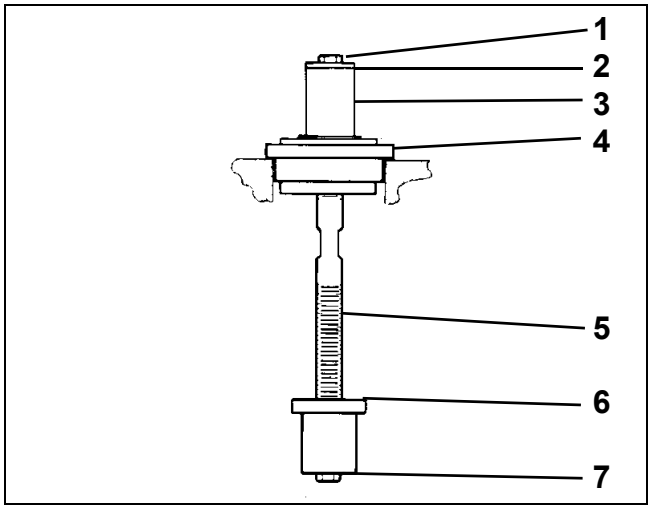
Slide the propeller shaft onto the shift shaft, align the hole in the shaft with the hole in the clutch dog, install the pin and then, a **new** clutch dog retaining spring. Position three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring COB3101

Pinion Gear Bearing

Assemble the following components of Pinion Bearing Remover and Installer, P/N 391257, as shown:



1. 1/4-20 X 1/2 in. Hex head screw 824182
2. 1 in. O.D. Flat washer
3. Spacer; P/N 350932 "M" and "XP", P/N 326584 "L"
4. Plate and Bearing P/N 391260
5. Rod P/N 326582
6. Installer/Remover, P/N 350958
7. 1/4-20 X 1 1/4 in. Hex head screw

IMPORTANT: Spacers are different sizes and cannot be interchanged.

Apply *Needle Bearing* grease to the needle bearings and insert them into the bearing case.

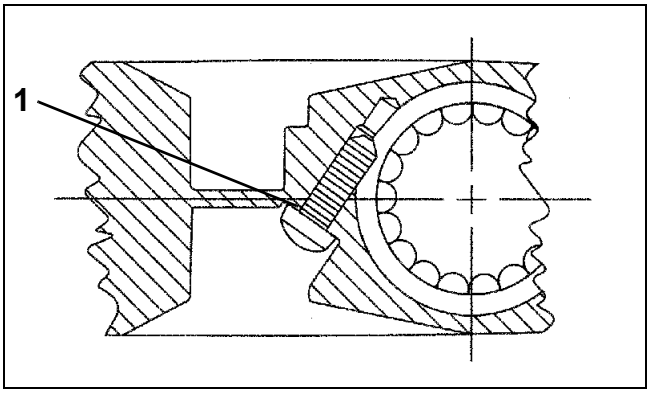
Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

IMPORTANT: The pinion bearing is tapered so that, when installed correctly, its shape compensates for stresses in the gearcase and allows full bearing contact. Whenever a gearcase is disassembled, the pinion bearing should be checked to ensure that it has been installed with the lettering facing up.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Remove the tool.

Position new O-ring on the pinion bearing retaining screw. Apply *Nut Lock* to screw threads. Install the screw and torque to 60 to 84 in. lbs. (7 to 9.5 N·m).



1. O-ring DRC7416

Driveshaft Bearing Housing

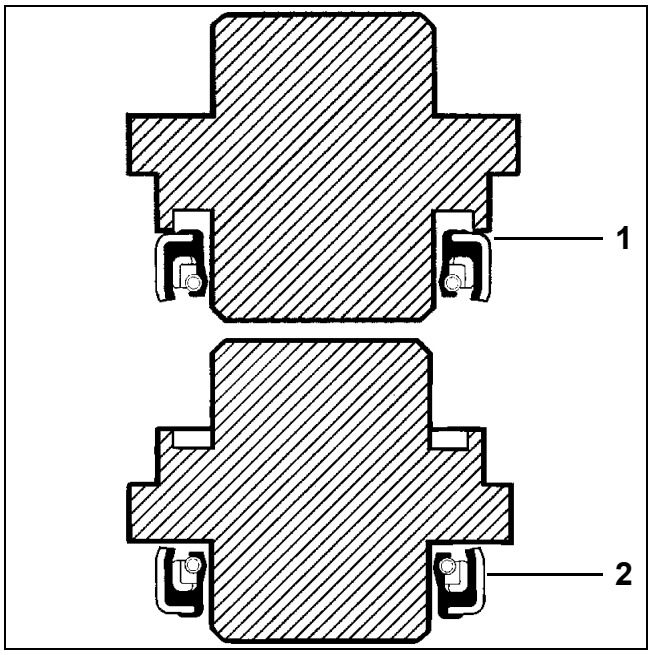
Lightly apply *Gasket Sealing Compound* to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

IMPORTANT: DO NOT install the O-ring in the bottom groove of the bearing housing. The bottom groove is an oil passage. Gearcase damage could result.



1. O-ring (top groove) 14156
2. Oil passage

Install new seals back to back in bearing housing using Seal Installation Tool, P/N 330268. Apply *Gasket Sealing Compound* to metal casings of the seals before installing. 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 DR2061
2. Outer seal DR2062

Propeller Shaft Bearing Housing

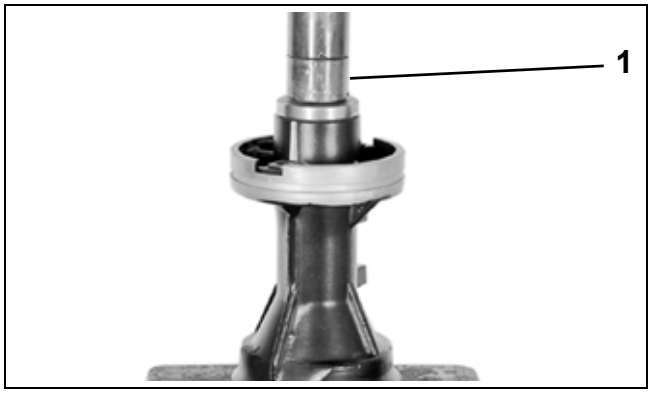
Bearing Installation

Oil, then install new bearings in bearing housing.

Place the **lettered end** of the bearing case on Bearing Installation Tool, P/N 339750, then press the bearing into the housing until the tool seats. When installed, the lettered end of the bearing should be visible.



Forward Bearing 29967
1. Bearing installation tool

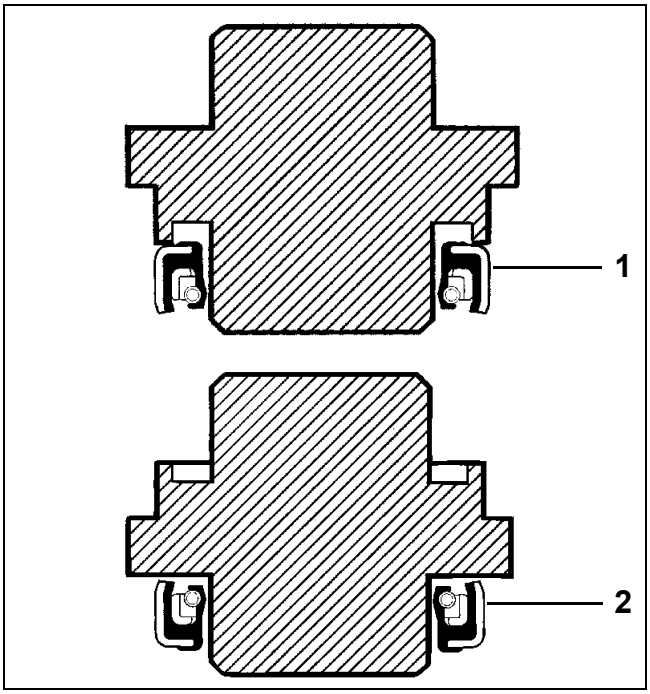


Rear Bearing 44237
1. Bearing installation tool

Rear Seal Installation

Install new seals back to back in the bearing housing using Seal Installation Tool, P/N 336311. Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

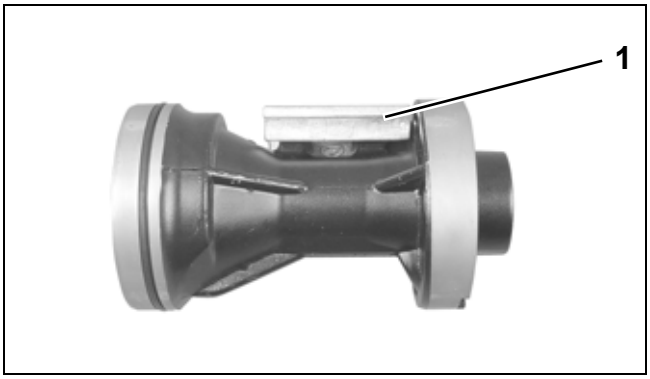
Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



1. Inner seal DR2061
2. Outer seal DR2062

Apply *Triple-Guard* grease to seal lips.

Install bearing housing anode. Torque screws to 108 to 132 in. lbs. (12.2 to 14.9 N·m).



1. Anode 001220

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.

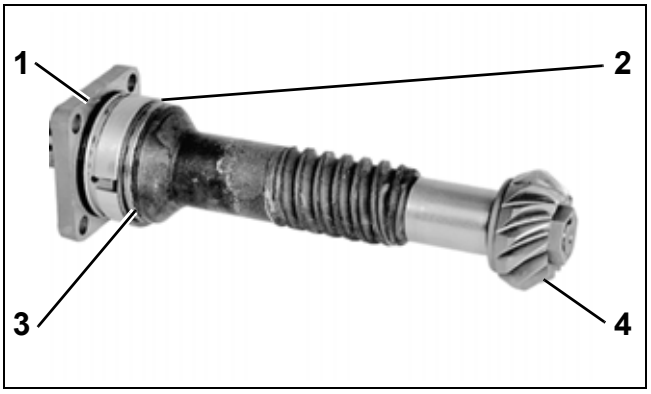
Use Driveshaft Shimming Tool, P/N 393185.

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: Degrease pinion and driveshaft tapers prior to assembly. Check tapers for any damage or material transfer. Replace any damaged components before proceeding.

Assemble the driveshaft bearing housing, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 318674, whenever installing or removing the bearing housing. Lightly coat the threads of the pinion nut with outboard lubricant and torque to 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.



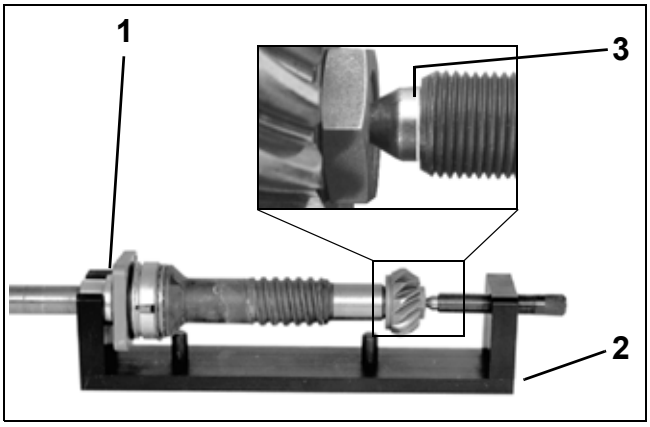
1. *Driveshaft bearing housing* COA3565
2. *Thrust washer*
3. *Thrust bearing*
4. *Pinion gear*

Select collar, P/N 341440, and the correct shim gauge bar:

- **"M"-type:** Shim gauge bar, P/N 349957
- **"L"-type:** Shim gauge bar, P/N 328367

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

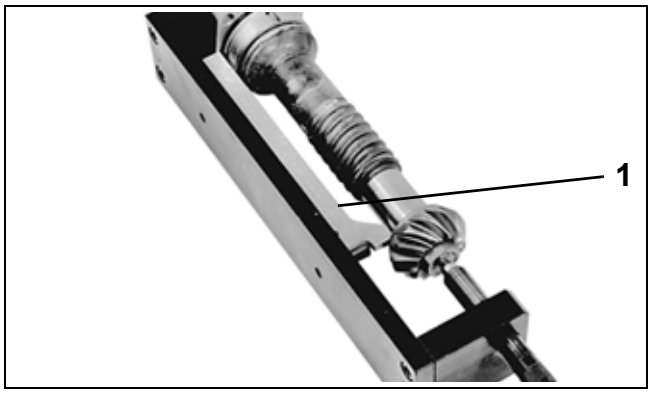
Insert the assembled driveshaft into the tool base and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.



1. *Collar* COA3566
2. *Tool base* DSC00326
3. *Groove*

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 the squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating **just the bearing**

housing and measuring the clearance between the gauge bar and the bearing housing with feeler gauges. Measure between each pair of screw holes. Replace the bearing housing and repeat check if variance exceeds 0.004 in. (0.010 mm).

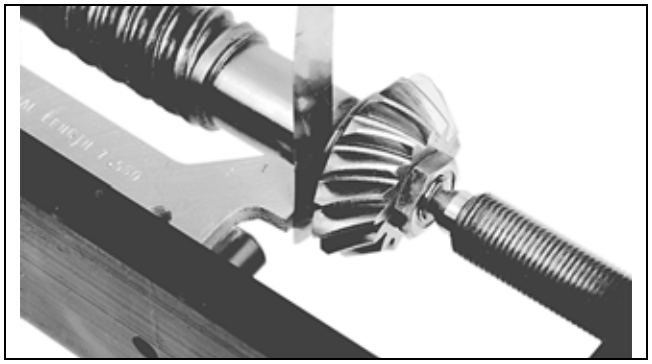
Check the squareness of the pinion to the driveshaft by holding the shim gauge bar against the bearing housing (between the screw holes) while rotating **just the driveshaft and pinion assembly** and measuring the clearance between the shim gauge bar and the pinion. Replace the pinion or the driveshaft, as necessary, and repeat the check if variance exceeds 0.002 in. (0.050 mm).

Subtract the average clearance measurement obtained 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 base. Remove the collar and bearing housing from the driveshaft, and add the required amount of shims.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 318674.

Check shimming by reassembling the driveshaft with shims and placing it back into the tool base. The measurement between the gauge bar and the pinion should be 0.020 in. (0.508 mm).



COA3543

Remove the nut and pinion from the driveshaft.

Discard the nut.

ASSEMBLY

Water Intake Screens

Install water intake screens. Torque screws to 60 to 84 in. lbs. (7 to 9.5 N·m).

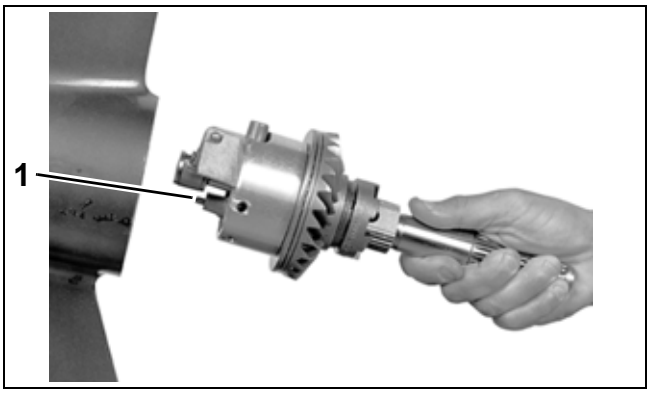


1. Water intake screen 001991

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 properly positioned. Insert the shaft assembly fully into the gearcase while **aligning shift housing pin** with hole in forward end of gearcase housing.

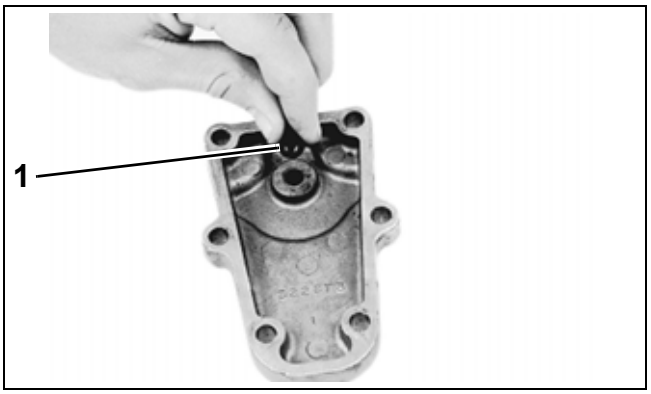


1. Pin 13594

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.

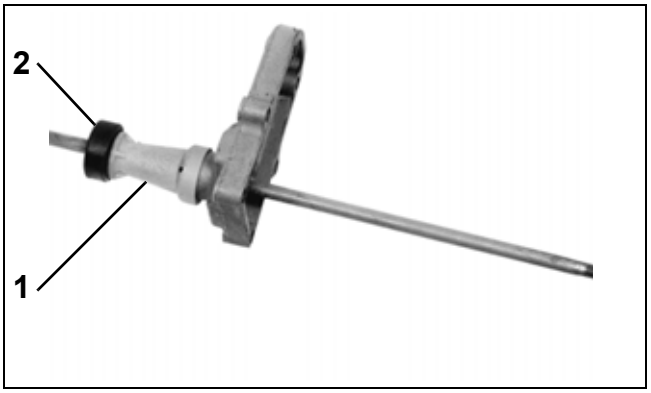
IMPORTANT: Make sure O-ring is fully seated in groove around shift rod cover's full circumference.



1. O-ring 12308

Install the shift rod spacer on the shift rod. On 30 in. models, first install the extension (not shown).

Place the shift rod grommet on the shift rod.

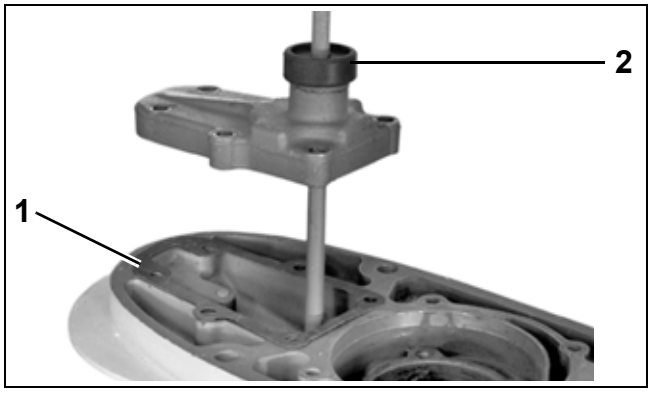


1. Grommet COA3568
2. Shift rod spacer

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.

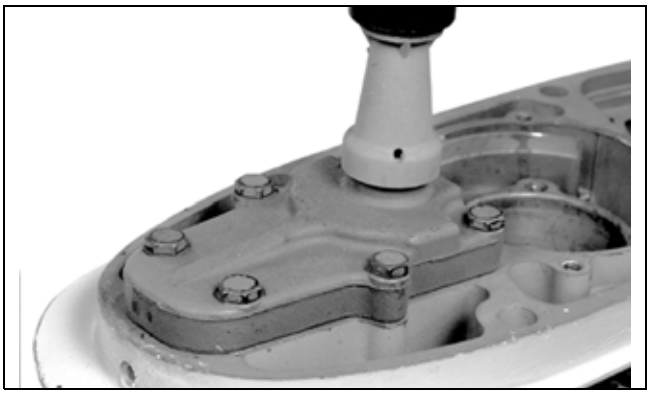
Position the gasket on the gearcase. Thread the shift rod into the shifter detent about four turns.



1. Cover gasket COA3141
2. Grommet

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 locator pin hole in the gearcase.

Apply *Ultra Lock* to the threads of the shift rod cover screws. Install the screws. Torque the screws to 60 to 84 in. lbs. (7 to 9.5 N·m).

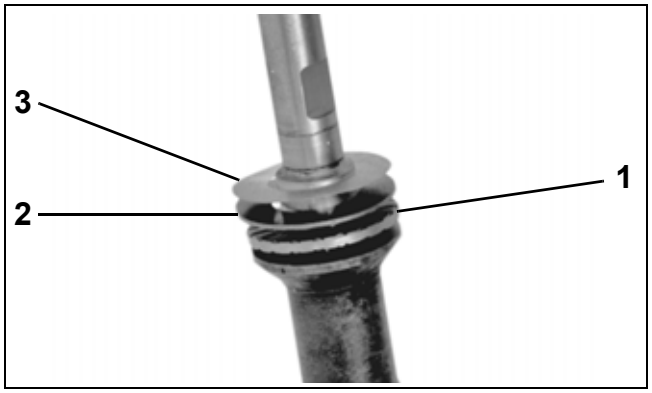


COA3569

Pinion Gear and Driveshaft Installation

Refer to **DRIVESHAFT SHIMMING** on p. 304 before proceeding.

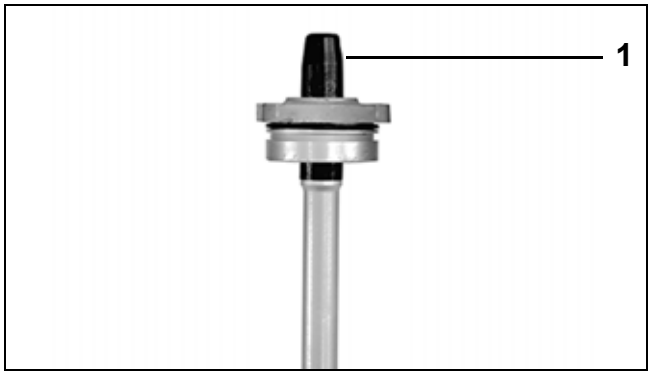
Position the driveshaft thrust bearing, thrust washer, and shim(s) (selected earlier) on the driveshaft, exactly in order shown.



1. *Thrust bearing*
2. *Thrust washer*
3. *Shim(s)*

COA3168

Using Driveshaft Seal Protector, P/N 318674, slide the driveshaft bearing housing onto the driveshaft.

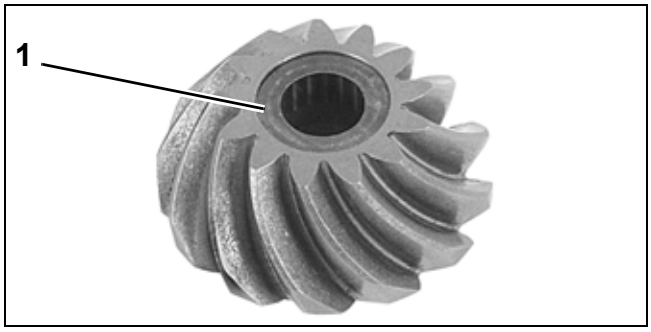


1. *Seal protector*

COA3130

Move shift rod to position clutch dog as far forward as possible. Be sure excess grease is removed from the pinion bearing.

Washer must be snapped into recess of pinion gear.

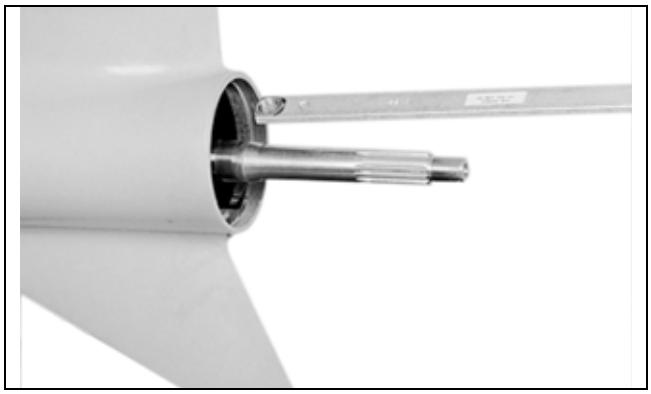


1. *Washer*

DSC02293

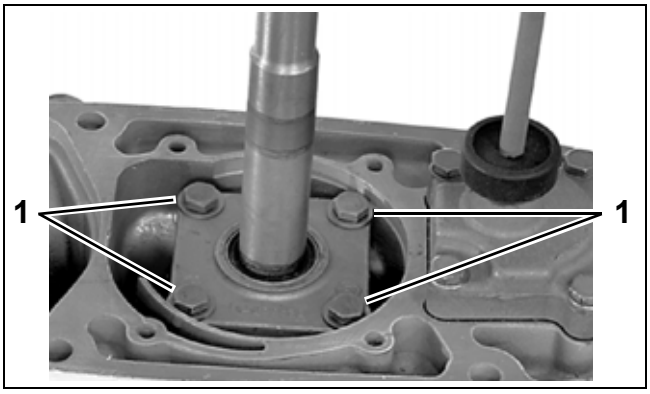
IMPORTANT: The inside taper of the pinion gear and the driveshaft taper MUST be completely free of grease. Clean the tapers with *Cleaning Solvent*. Use a shop towel free of grease and lint.

Lightly coat the threads of a **new** pinion nut with outboard lubricant and install on the driveshaft using Pinion Nut Starting Tool, P/N 342216. Turn the driveshaft by hand to engage the nut. Hand tighten pinion nut and remove the pinion nut starting tool. Proceed to next step and then torque procedure.



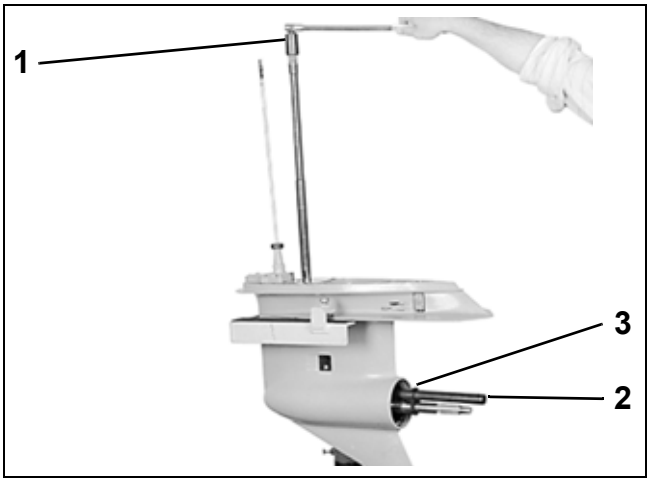
42230

Install washers on the driveshaft bearing housing screws. Apply *Gasket Sealing Compound* to the threads of the screws. Install screws and torque to 120 to 144 in. lbs. (13.6 to 16.3 N·m).



1. Driveshaft bearing housing screws COA3153

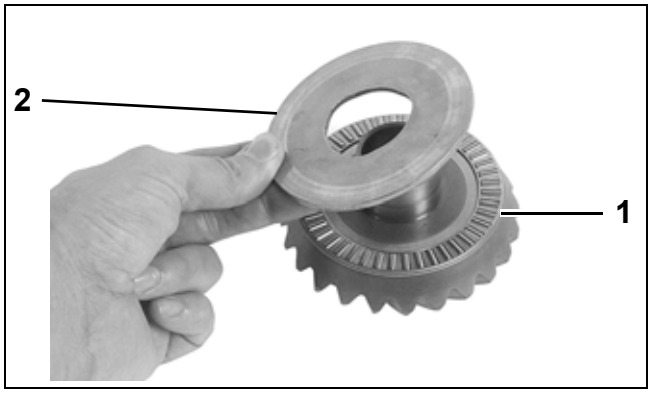
Use Driveshaft Holding Socket, P/N 311875, Pinion Nut Holder, P/N 334455, and Wrench Retainer, P/N 341438, to torque the pinion nut to 100 to 110 ft. lbs. (136 to 149 N·m).



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.

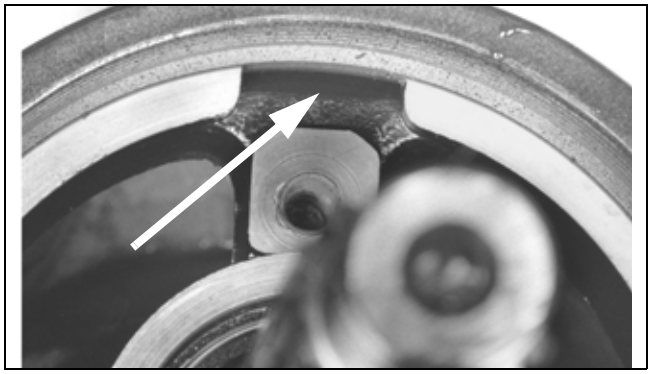


1. Thrust bearing DSC02295
2. Thrust washer

Lightly apply *Gasket Sealing Compound* to a new bearing housing O-ring. Install O-ring in groove in the housing.

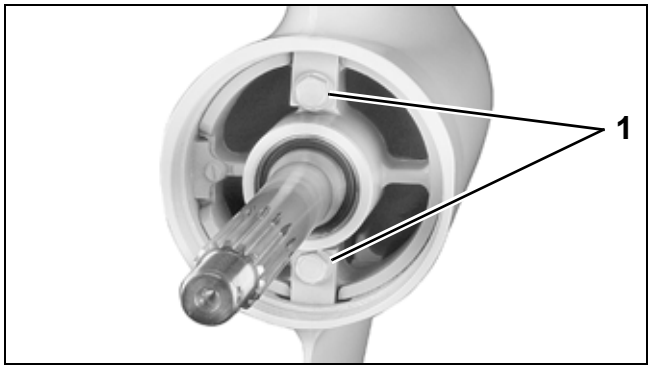
Install housing into gearcase, aligning screw holes with retainer slots in gearcase.

Housing must be completely seated to install retainer tabs.



Retainer Tab Notch 50106a

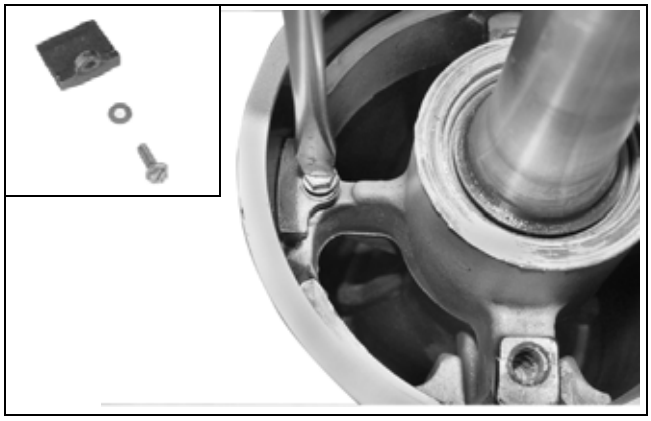
Install two retainers, washers and screws. Apply *Ultra Lock* to threads and torque screws 18 to 20 ft. lbs. (24 to 27 N·m).



1. Retainer tab screws 001989

Loosen retainer screws 1/4 turn.

Install wedge, screw, and washer. Apply *Ultra Lock* to threads and torque screw 15 to 20 in. lbs. (1.7 to 2.3 N·m).



DSM02291
DSC02361

Re-torque 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:

- **LEAK TEST** on p. 285
- **WATER PUMP** on p. 288
- **SHIFT ROD ADJUSTMENT** on p. 290
- **REMOVAL AND INSTALLATION** on p. 285
- **LUBRICANT** on p. 284
- **Propeller Hardware Installation** on p. 73
- **Trim Tab Adjustment** on p. 76

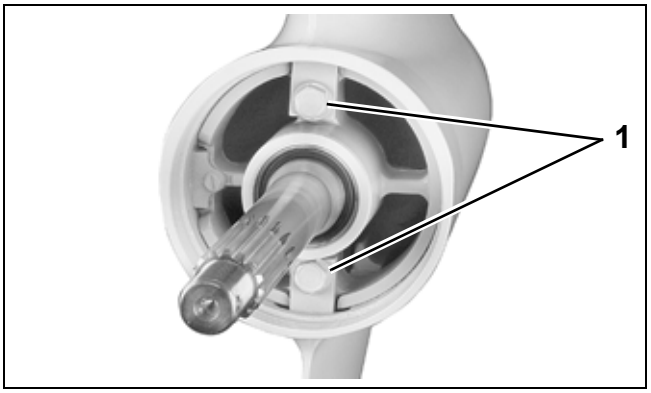
During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

COUNTER ROTATION

IMPORTANT: Counter rotation model gearcases use unique components and require some different service procedures. Use care when working on counter rotation gearcases. DO NOT interchange parts between standard and counter rotation models. Pay particular attention to these procedures when working on counter rotation gearcases.

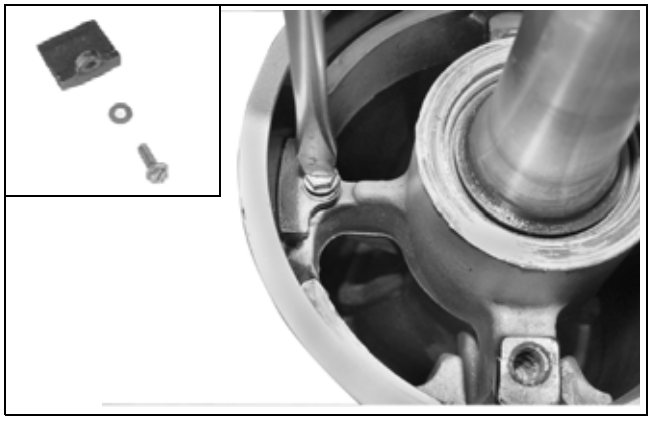
Propeller Shaft Bearing Housing Removal

Remove the two screws, washers, and retainers holding the propeller shaft bearing housing.



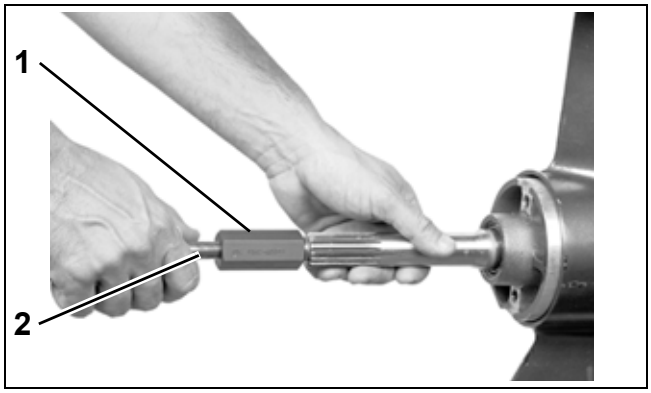
1. Retainer tab screws 001989

Remove wedge, screw, and washer.



DSM02291
DSC02361

To remove the propeller shaft, bearing housing and forward gear from a counter rotation gearcase, thread Propeller Shaft Adapter, P/N 432398, onto Slide Hammer, P/N 432128, until it seats. Thread adapter completely onto propeller shaft and pull propeller shaft, bearing housing, and forward gear assembly out of gearcase.

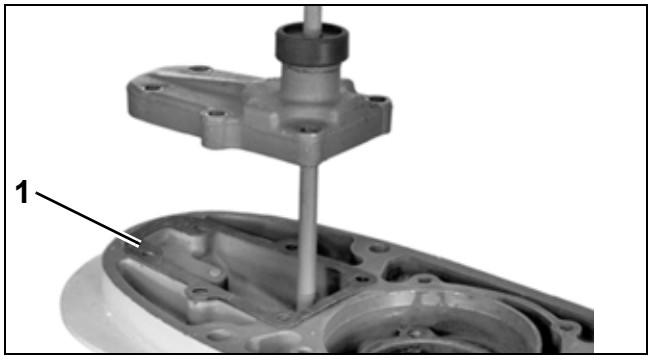


1. Adapter, P/N 432398 13501
2. Hammer, P/N 432128

Shift Housing, Gear and Propeller Shaft Removal

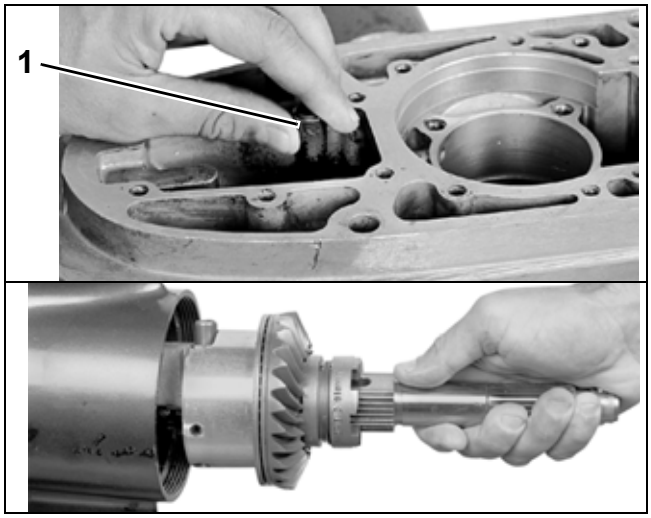
Push down on the shift rod. This will move the detent lever downward to clear the inside of the gearcase when the shaft assembly is pulled out. Unthread the shift rod from the detent lever. Remove the six screws, shift rod, and cover from the gearcase.

Discard the cover gasket. Remove the shift rod O-ring from inside of cover and discard.



1. Cover gasket COA3141

Use an appropriate tool to apply downward pressure on the detent while pulling on the propeller shaft assembly. Remove propeller shaft assembly from the gearcase.



Counter Rotation Models 14038
13489
1. Tool

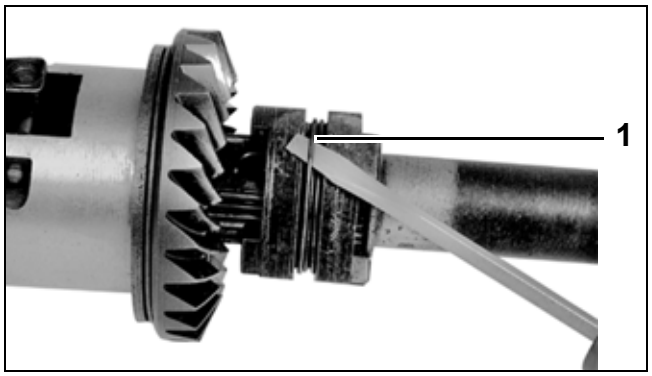
Shift Housing Disassembly

⚠ WARNING ⚠

Wear safety glasses to avoid injury.

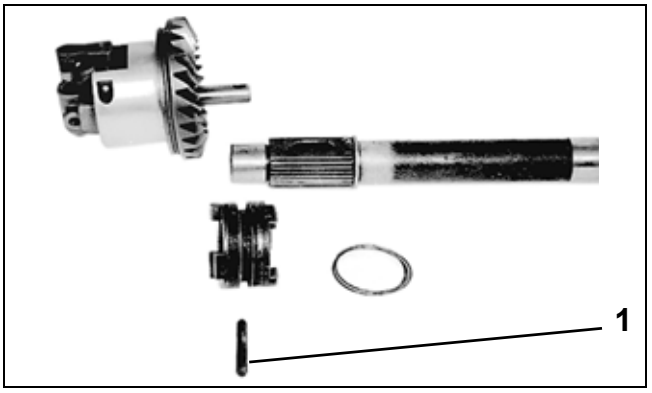
IMPORTANT: The shift housing and reverse gear bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring**.



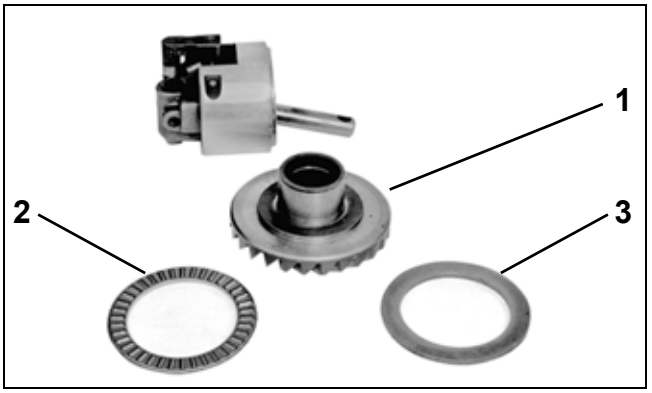
1. Clutch dog spring COA3560

Push the pin out of the clutch dog. Remove all components from the shaft.



1. Pin COA3561

Remove the gear, thrust bearing, and thrust washer from the shift housing.

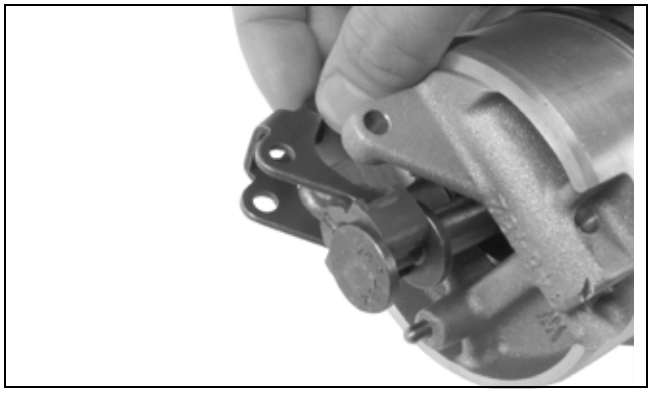


1. Gear COA3562
2. Thrust bearing
3. Thrust washer

IMPORTANT: The shift housing supports the reverse gear on counter rotation gearcases.

Remove the shift lever pin from the housing. Remove shift shaft, cradle, and shift lever. Move

shifter detent accordingly to assist in removal of components.

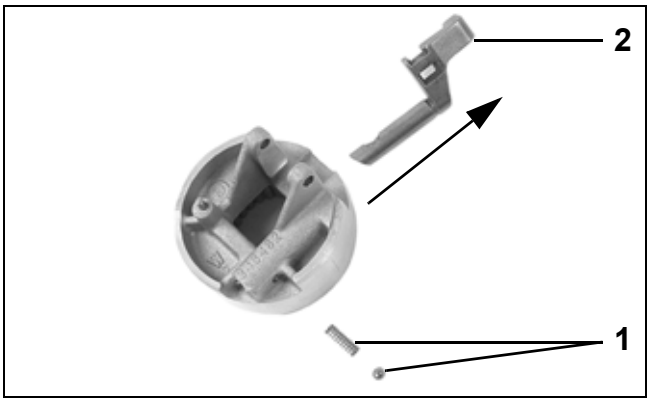


DSC02421

⚠ 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. Pull the shifter detent straight out of the housing.



1. Ball and spring
2. Shifter detent

DSC02436

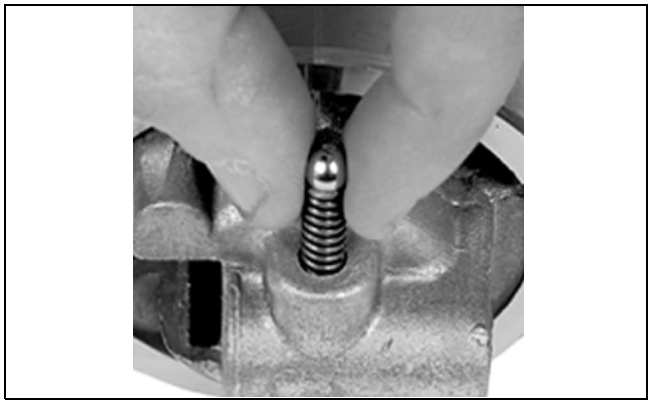
Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection.

Shift Housing Assembly

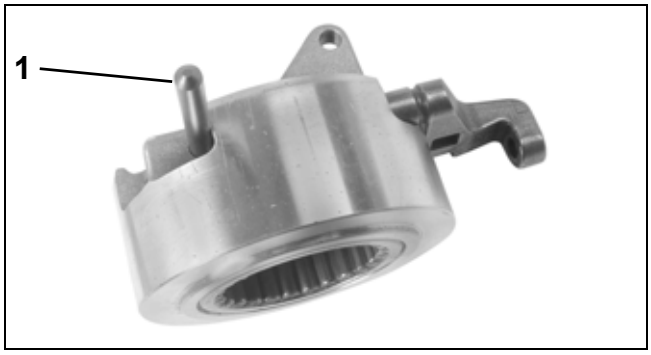
IMPORTANT: Clean and inspect all components before beginning assembly procedures. Replace any damaged components.

Lightly coat the detent ball and spring with *Needle Bearing* grease. Insert the spring in the housing, then the ball.



4518

Insert shifter detent into the housing as shown, while depressing the ball and spring with a suitable tool. Once the detent is past the ball, remove the tool and position detent to engage NEUTRAL.



1. Pin, shift lever (used as tool)

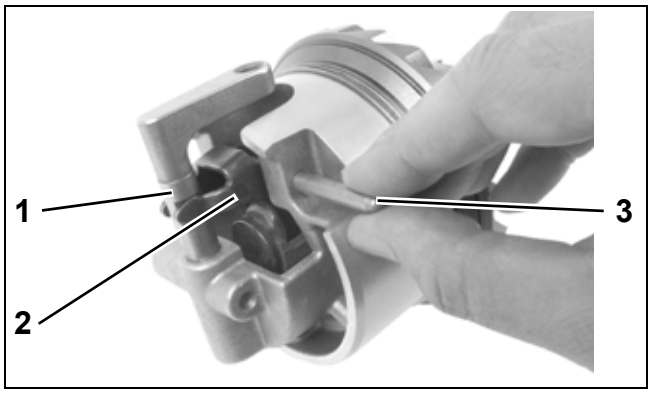
DSC02442

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case.



4520

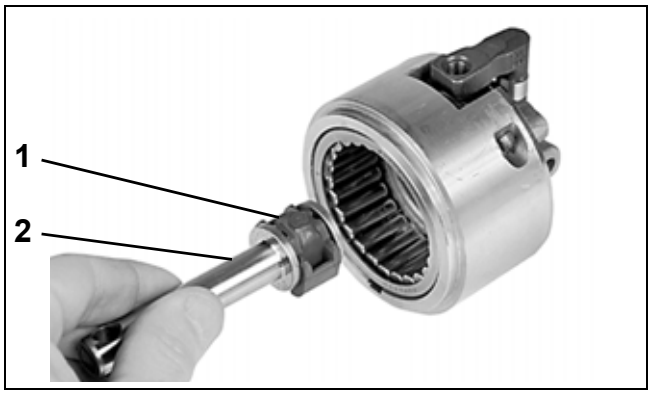
With shifter detent in NEUTRAL, install arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.



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

Position the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEUTRAL to hold the cradle and shaft in place.



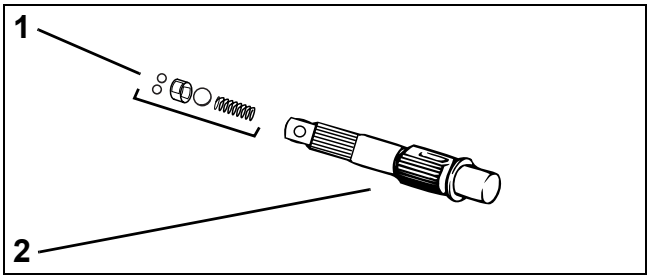
001219

Inspect clutch shaft detent balls, retainer, and spring. These parts should not require removal under normal servicing.

⚠ WARNING ⚠

Wear safety glasses to avoid injury.

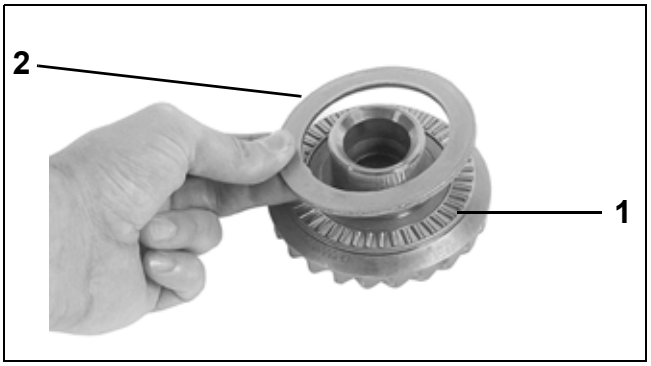
If these parts are damaged or removed, a new service kit should be installed. Refer to correct model parts catalog for kit part number.



TYPICAL
1. *Clutch Shaft Retainer Kit*
2. *Clutch Shaft*

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.

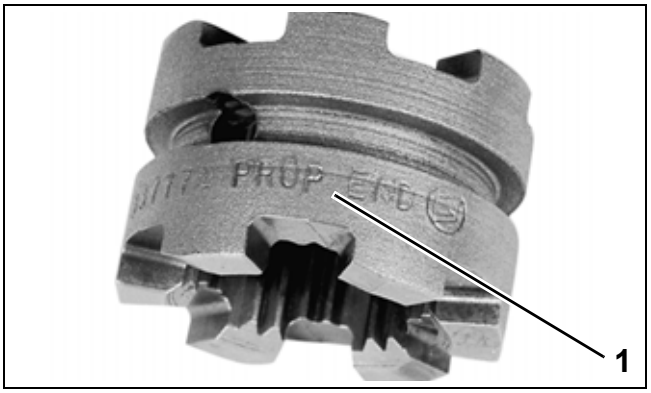
IMPORTANT: Bearing and washer must be installed in the correct order.



1. Thrust bearing
2. Thrust washer
DSC02297

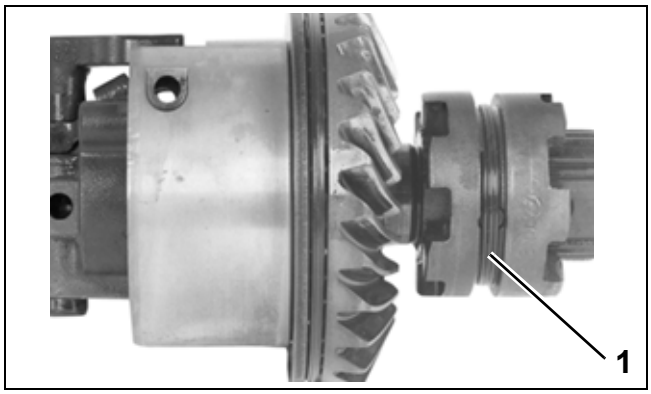
Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog on the shaft with "PROP END" facing rear of the shaft.

IMPORTANT: The clutch dog is not symmetrical. If installed backwards, it will not fully engage and will immediately damage itself and the gears.



1. "PROP END" stamp
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. Position three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring
COB3101

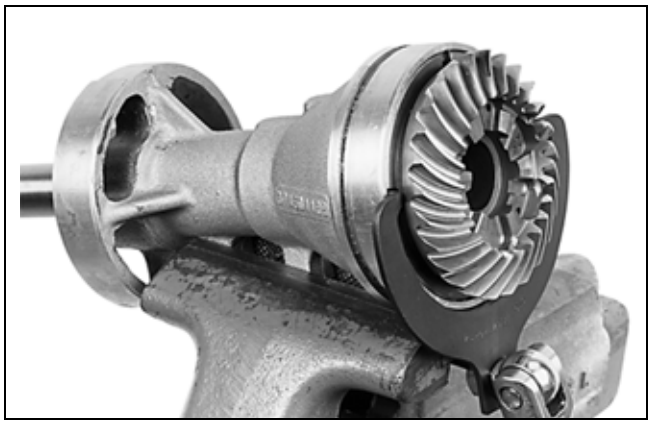
Propeller Shaft Bearing Housing and Forward Gear

Disassembly

Remove and discard the bearing housing O-ring.

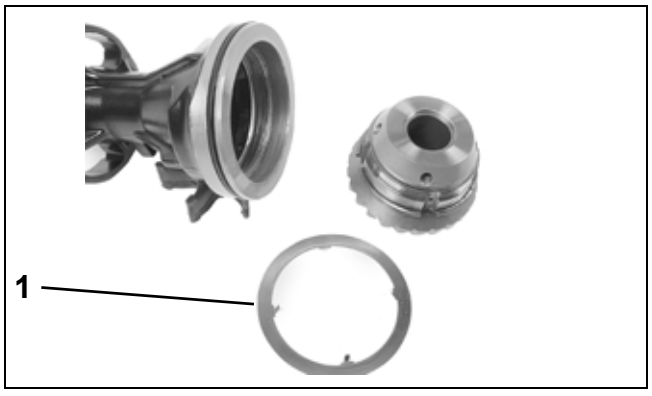
Remove the anode and discard if more than two-thirds deteriorated.

Clamp the bearing housing by the anode bosses in a vise, as shown. Remove the forward gear assembly by unscrewing it with Spanner Wrench, P/N 432400.



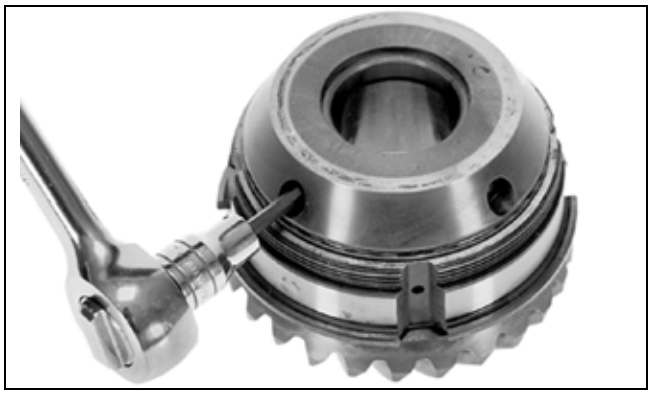
13491

Remove gear housing retaining ring.



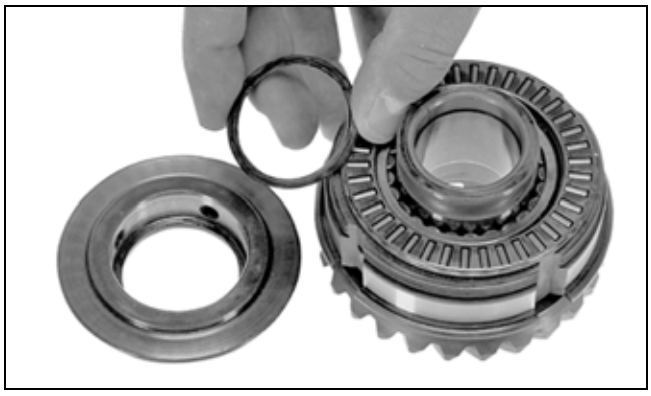
1. Retaining ring DSC02486

Remove the set screws and remove the flange.



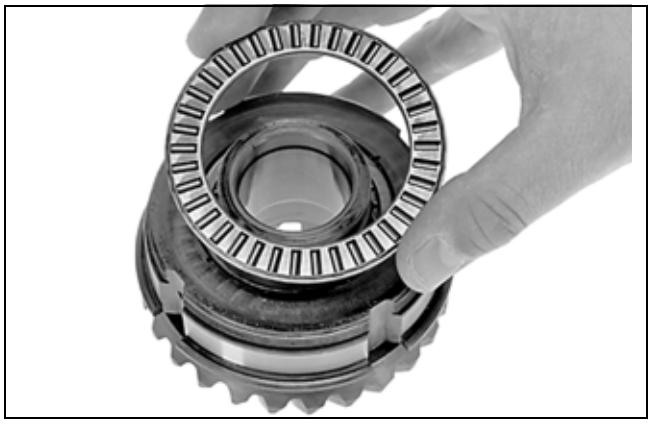
31965

Remove the shim from either the flange or forward gear.



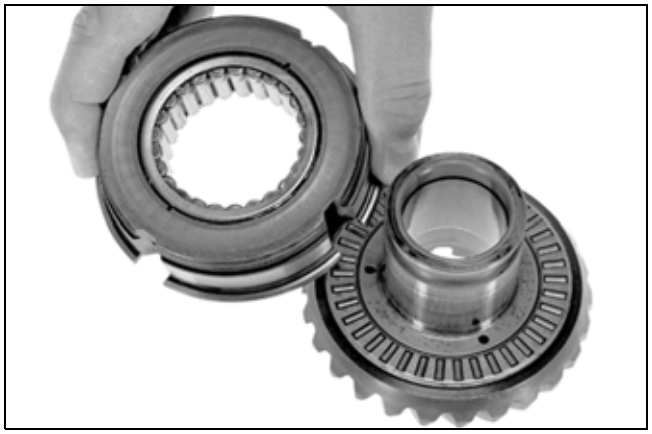
31964

Remove the thrust bearing.



31963

Remove the bearing housing from the forward gear.



31961

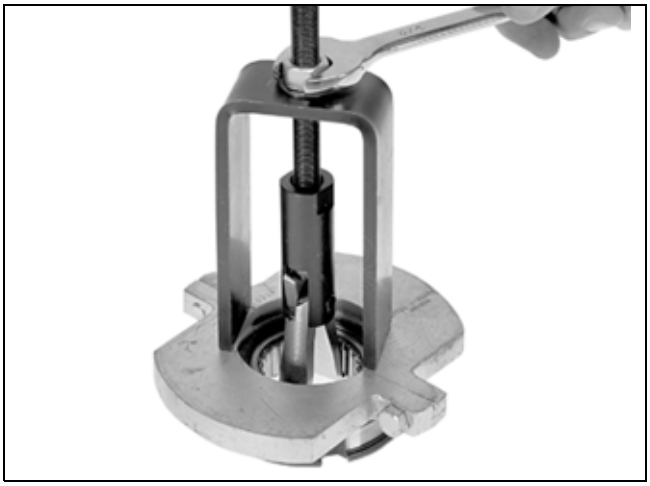
Remove the thrust bearing from the forward gear.

Inspect the forward gear for excessive wear or damage.



31960

Remove the forward gear bearing only if it needs to be replaced. If removal of the bearing is necessary, use Large Puller Jaws, P/N 432129, and Puller Bridge, P/N 432127, with an appropriate base. Leave the rollers in to allow for good contact with the puller jaws.



31958

If removed, install a new forward gear bearing. Apply *Needle Bearing* grease to 25 new rollers. Install the rollers in the bearing.

Using Bearing Installation Tool, P/N 339778, install the bearing, lettered side facing tool.



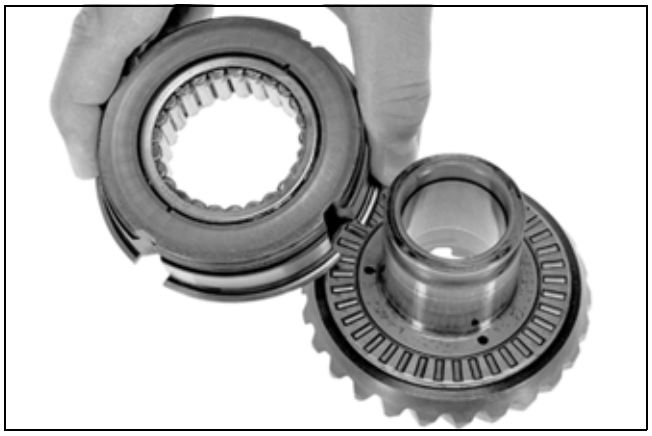
31956

Install the thrust bearing on the forward gear.



31960

Place the bearing housing on the forward gear.



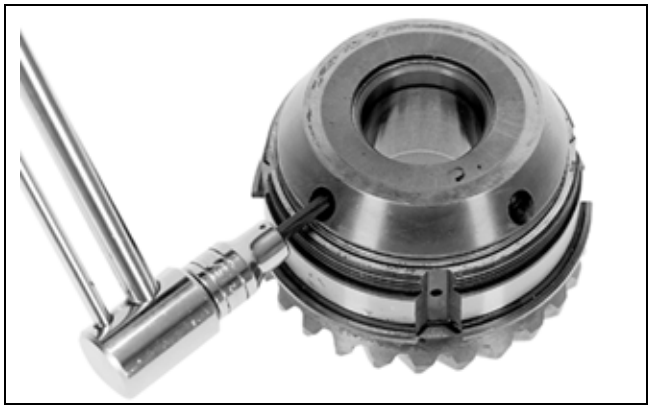
31961

Install 0.030 in. (0.7 mm) of shims and the thrust bearing in the flange. Install the thrust bearing on the forward gear.



31955

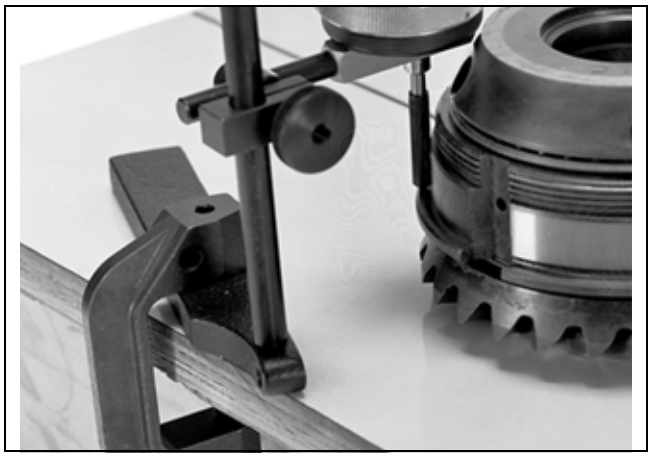
Install set screws and torque to 144 to 168 in. lbs. (16.3 to 19 N·m). Use no thread sealant.



31967

Anchor a dial indicator gauge to a flat, level surface.

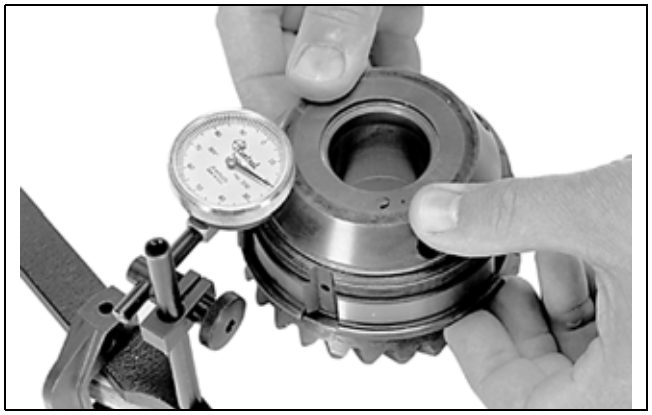
Position the gear assembly so the indicator needle makes contact with the flange on the housing. The indicator needle must be parallel with the side of the gear housing and perpendicular to the table surface. Zero the dial indicator.



31953

Grip the bearing housing 180° apart and pull up to get a reading on the indicator. To determine thickness of shims; use the following example:

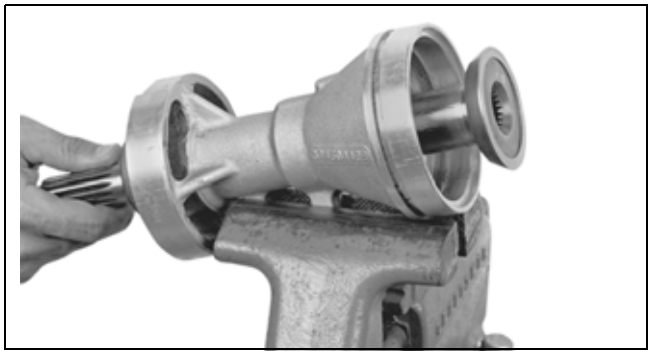
0.030 in. of shims in the assembly
– 0.020 in. reading on the dial indicator
= 010 in. difference
+ 0.001 in. necessary end play
= 0.011 in. required shims



31968

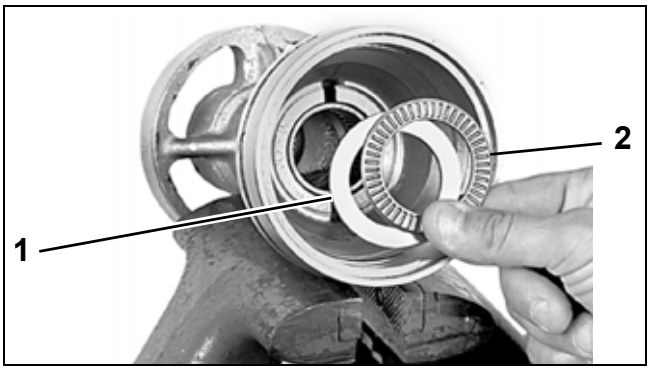
Remove the 0.030 in. (0.7 mm) of shims from the assembly. Reassemble the gear assembly using a combination of shims to achieve the required thickness. Apply *Nut Lock* to the threads of the set screws and torque to 144 to 168 in. lbs. (16.3 to 19 N·m).

Push propeller shaft out of the bearing housing.



13479

Remove the thrust washer and thrust bearing.



1. Thrust washer
2. Thrust bearing

13593

For seal and bearing service, refer to **Propeller Shaft Bearing Housing Seals and Bearings** on p. 319.

Assembly

Apply *Needle Bearing* grease to the thrust bearing. Position bearing around shoulder on the propeller shaft.

Apply *Needle Bearing* grease to the thrust washer. Place washer in recess of bearing housing.



1. Thrust bearing
2. Thrust washer

14214

Coat bearing surfaces of propeller shaft with gearcase lubricant. Slide the propeller housing onto the propeller shaft.



14159

IMPORTANT: Use caution when assembling the propeller shaft in the bearing housing. Thrust bearing must remain around shoulder on the propeller shaft.

Install gear housing retaining ring as shown.

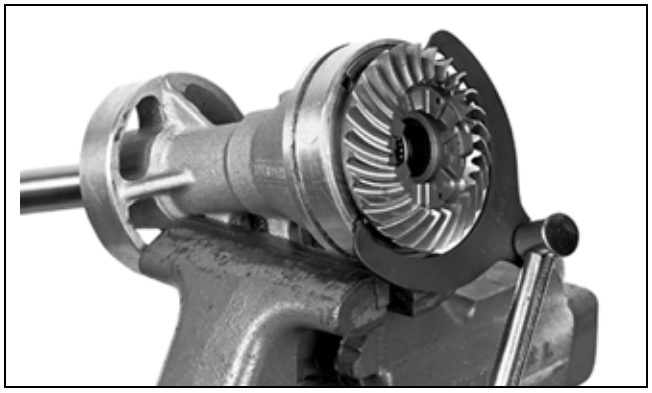


1. Retaining ring DSC02485
DSC02479

Apply gearcase lubricant to the threads of the forward gear.

IMPORTANT: To prevent damage to threads, install forward gear by hand until fully seated against propeller shaft bearing housing.

Use Spanner Wrench, P/N 432400, to tighten the gear assembly to a torque of 100 ft. lbs. (136 N·m).



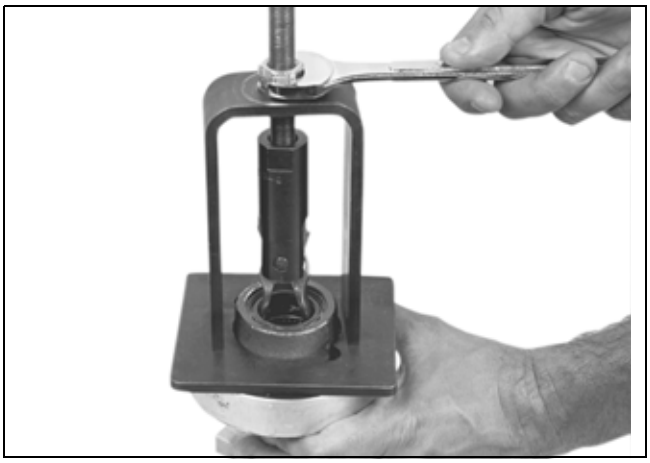
13529

Inspect the anode. Replace if necessary. Torque screws to 108 to 132 in. lbs. (12.2 to 14.9 N·m).

Propeller Shaft Bearing Housing Seals and Bearings

Rear Seal Removal

Remove seals using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131. Position the plate on top of the housing to support the bridge, and tighten jaws securely behind the inner seal.



13520

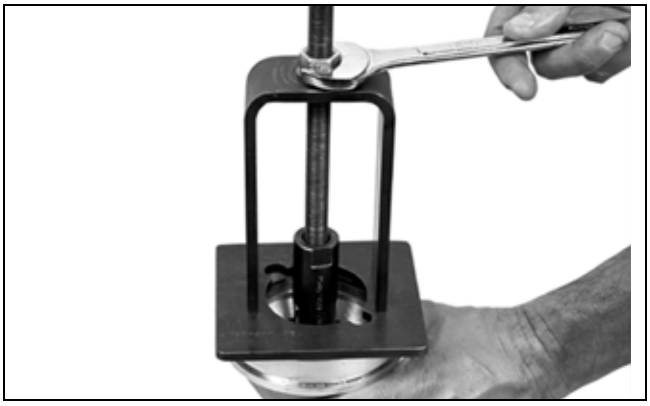
Bearing Removal

Rear seals must be removed if bearing replacement is needed. See **Rear Seal Removal** on p. 298.

IMPORTANT: Inspect bearings in place. If a bearing is removed for any reason, it must be discarded.

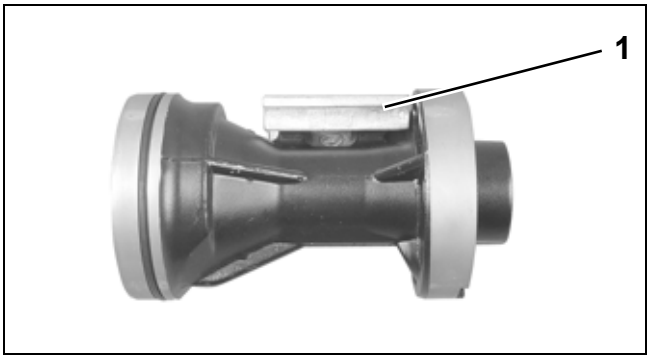
Remove either bearing using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Rest the puller plate on top of the housing to sup-

port the bridge, and tighten the jaws securely behind the bearing.



13522

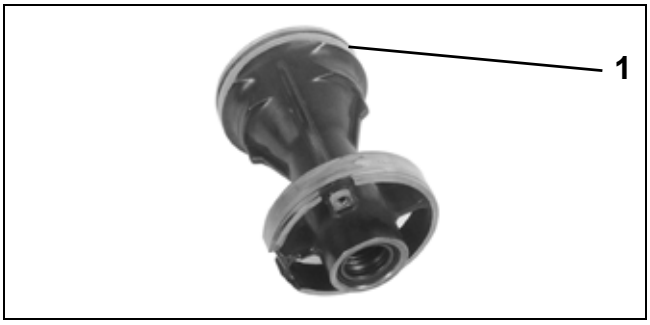
Inspect the bearing housing anode. Replace anode if it is reduced to two-thirds of original size.



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, and sand off any sharp edges that would cut O-ring and prevent its sealing. Check for and remove any nicks or burrs on front of bearing housing.



1. O-ring groove DSC02291

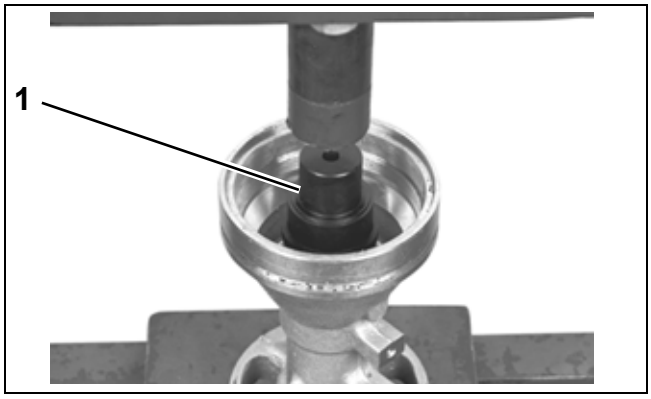
Bearing Installation

Oil, then install new bearings in bearing housing.

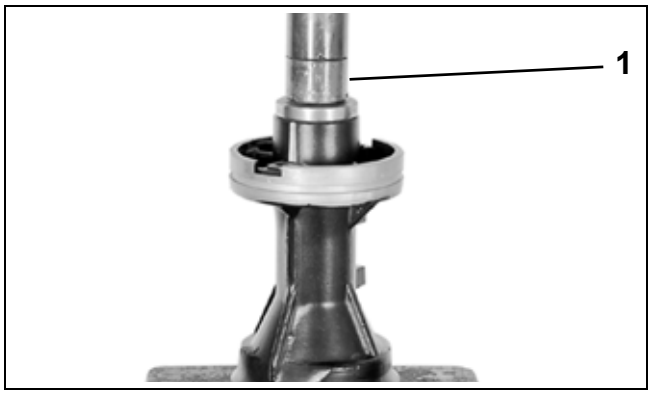
Place the **lettered end** of the bearing case on the bearing installer, then press the bearing into the housing until the tool seats. When installed, the lettered end of the bearing should be visible.

Bearing installation tool:

- P/N 339750 – rear (counter rotation only)
- P/N 432401 – forward (counter rotation only)



Forward Bearing – Counter Rotation 13519
1. Forward bearing installation tool

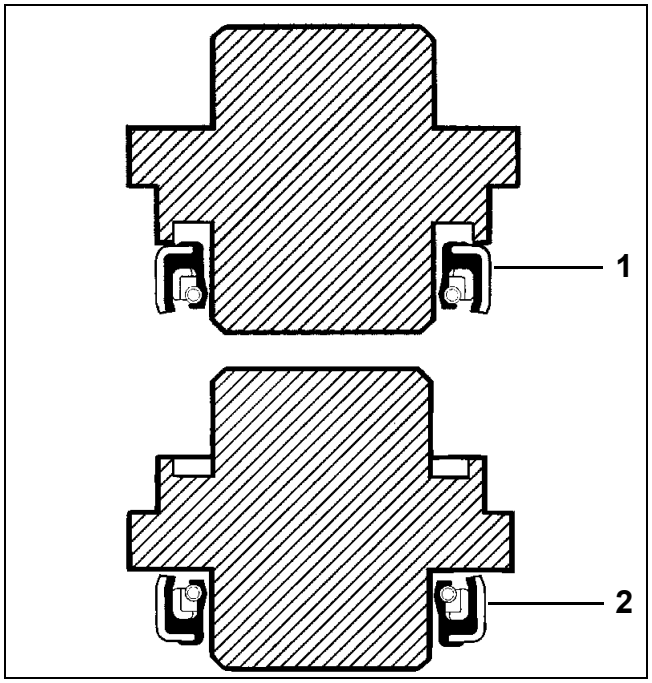


Rear Bearing 44237
1. Bearing installation tool

Rear Seal Installation

Install new seals back to back in bearing housing using Seal Installation Tool, P/N 336311. Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

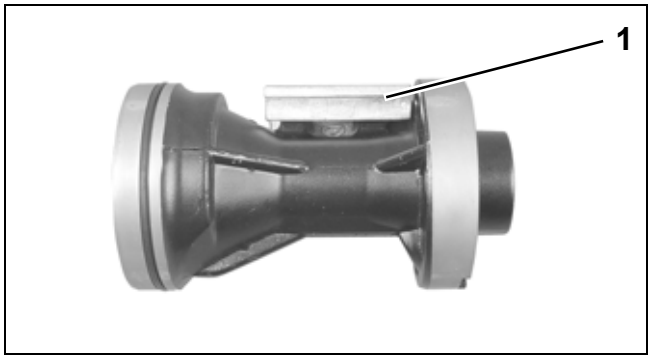
Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



1. *Inner seal* DR2061
2. *Outer seal* DR2062

Apply *Triple-Guard* grease to seal lips.

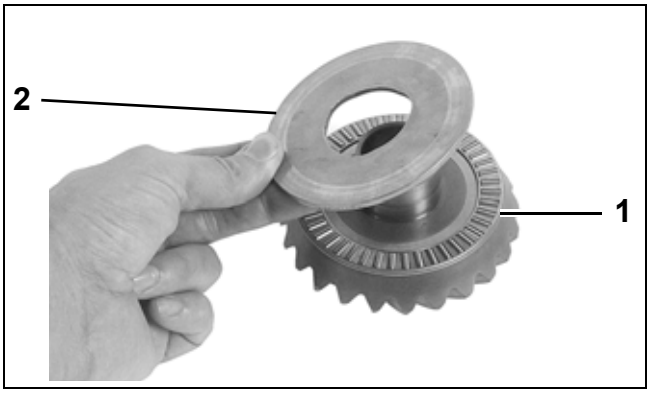
Install bearing housing anode. Torque screws to 108 to 132 in. lbs. (12.2 to 14.9 N·m).



1. *Anode* 001220

Propeller Shaft Bearing Housing and Gear Installation

Oil and install thrust bearing and thrust washer on the hub of reverse gear. Slide the gear assembly onto the propeller shaft until it engages the pinion gear.

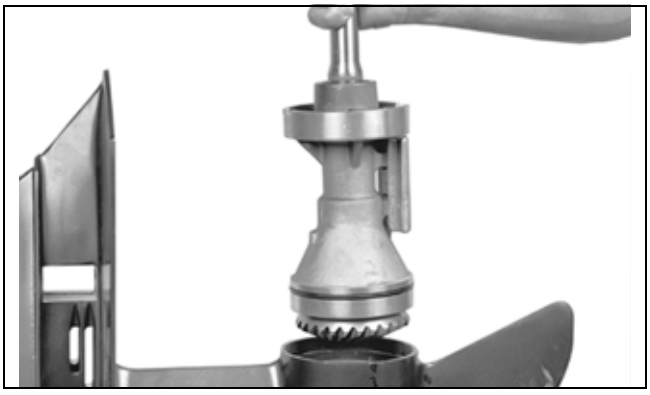


1. *Thrust bearing* DSC02295
2. *Thrust washer*

Lightly apply *Gasket Sealing Compound* to a new bearing housing O-ring. Install O-ring in groove in the housing.

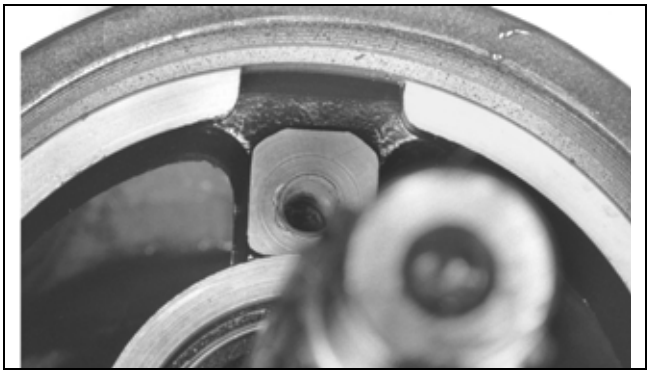
Install housing into gearcase, aligning screw holes with retainer slots in gearcase.

IMPORTANT: The propeller shaft must engage the clutch shaft and the forward gear must fully engage the pinion gear.



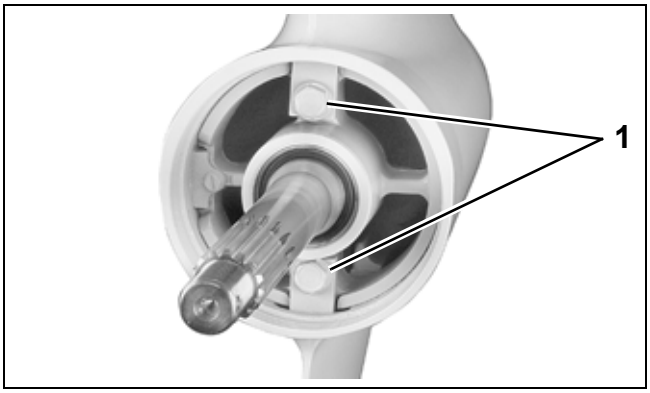
13586

Housing must be completely seated to install the retainer tabs.



Retainer Tab Notch 50106a

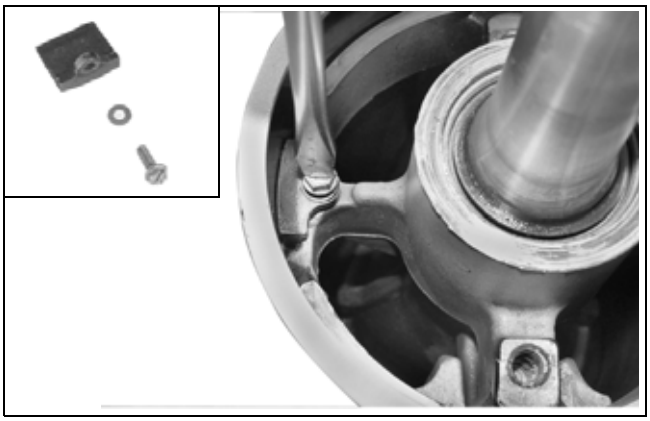
Install two retainers, washers and screws. Apply *Ultra Lock* to threads and torque screws to 18 to 20 ft. lbs. (24 to 27 N·m).



1. Retainer tab screws 001989

Loosen retainer screws 1/4 turn.

Install wedge, screw, and washer. Apply *Ultra Lock* to threads and torque screw 15 to 20 in. lbs. (1.7 to 2.3 N·m).



DSM02291
DSC02361

Re-torque 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:

- **LEAK TEST** on p. 285
- **WATER PUMP** on p. 288
- **SHIFT ROD ADJUSTMENT** on p. 290
- **REMOVAL AND INSTALLATION** on p. 285
- **LUBRICANT** on p. 284
- **Propeller Hardware Installation** on p. 73
- **Trim Tab Adjustment** on p. 76

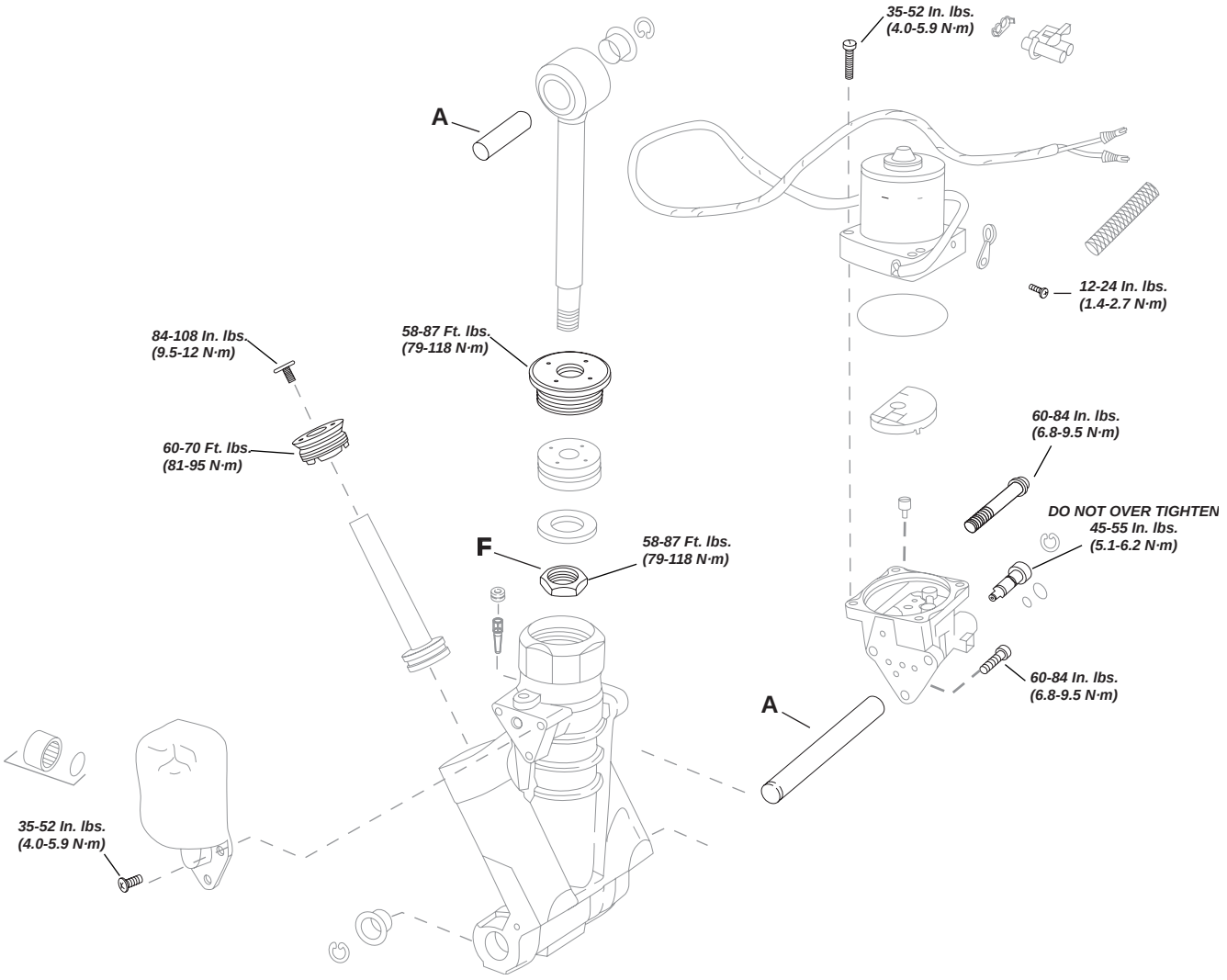
During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

TRIM AND TILT

TABLE OF CONTENTS

SERVICE CHART 324
SYSTEM DESCRIPTION 325
MANUAL ADJUSTMENT 325
TRAILERING BRACKET AND TILT SUPPORT 325
MODES OF OPERATION 326
TRIM-OUT / TILT-UP MODE 326
TILT-DOWN / TRIM-IN MODE 327
IMPACT RELIEF 328
SHALLOW WATER DRIVE TILT RELIEF 329
THERMAL EXPANSION RELIEF 329
MANUAL RELEASE – UP 330
MANUAL RELEASE – DOWN 331
ROUTINE INSPECTIONS 332
GENERAL 332
RESERVOIR FLUID 332
MANUAL RELEASE VALVE 332
STERN BRACKETS 332
TROUBLESHOOTING 333
SYMPTOMS CHART 333
SERVICE PROCEDURES 333
PRESSURE LEAKDOWN TEST 334
ELECTRICAL CIRCUIT TESTS 336
RELAY TESTING 336
TRIM AND TILT MOTOR CURRENT DRAW TESTS 336
TRIM AND TILT MOTOR NO LOAD TEST 337
TRIM GAUGE TEST 338
TRIM SENDER TEST 338
REMOVAL AND INSTALLATION 339
SERVICING 342
DISASSEMBLY 342
TILT PISTON REMOVAL 344
TILT PISTON IDENTIFICATION 345
TILT PISTON ASSEMBLY 346
TILT ROD ASSEMBLY 346
TRIM ROD REMOVAL 348
TRIM ROD ASSEMBLY 349
MANIFOLD AND RESERVOIR INSTALLATION 350
TRIM ROD INSTALLATION 351
TILT ROD INSTALLATION 351
MOTOR INSTALLATION 352
ADJUSTMENTS 353
NOTES 354

SERVICE CHART



004106

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***

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 direction of outboard propeller thrust. The trim range (first 21°) is primarily made by the trim cylinders.

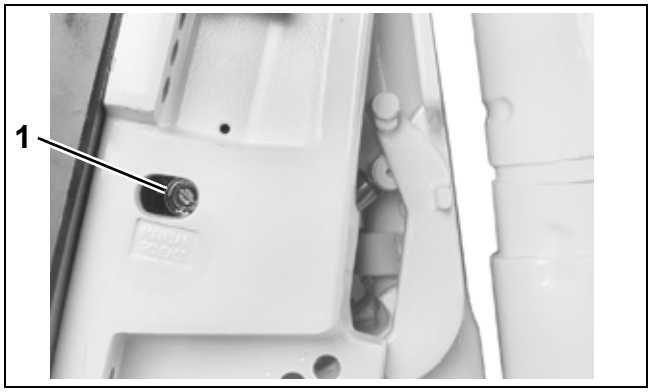
Outboard movement beyond the trim range is considered tilting. Tilting of the outboard may be desired in shallow water drive applications and trailering/storage. The tilt cylinder moves the outboard through the tilt range (final 54°).

A tilt relief valve limits the propeller thrust load that will be supported by the unit in tilt range. As pressure increases, the outboard will tilt down to the top of the trim range.

IMPORTANT: When in tilt range, make sure water is available to gearcase water pickups.

Manual Adjustment

The outboard can be manually raised or lowered through the entire trim and tilt range by opening the manual release valve a minimum of three turns. The manual release valve must be closed and torqued 45 to 55 in. lbs. (5 to 6 N·m) to hold the outboard in position and before normal operation can be resumed.

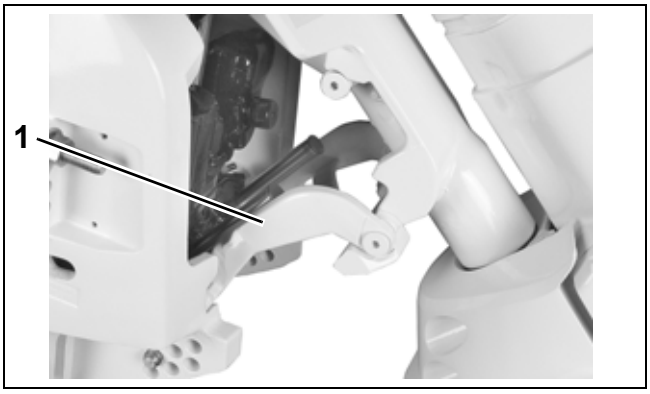


1. Manual release valve 001988

Trailering Bracket and Tilt Support

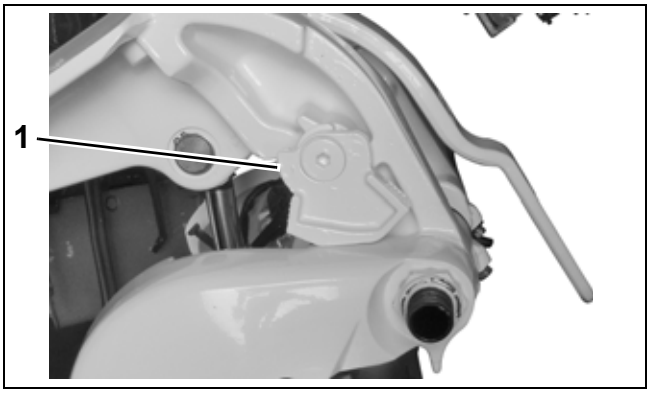
Use the trailering bracket to support the outboard when trailering in the tilted position. This bracket protects the hydraulic system from damage.

Tilt the outboard up fully, engage the bracket, then tilt the outboard down until the bracket is firmly in position.



1. Trailering Bracket 001987

For mooring or storing the boat with the outboard tilted, a tilt support is provided to support the outboard.



1. Tilt support 002279

IMPORTANT: The tilt support **must not be used to support the outboard while trailering.**

MODES OF OPERATION

The trim/tilt hydraulic assembly achieves trim and tilt movement through the following modes of operation.

Trim-OUT / Tilt-UP Mode

When the UP switch is pressed, the trim/tilt motor rotates clockwise (as viewed from pump end) and turns the pump gears.

Fluid pressure passes through the **UP shuttle valve** to the **DOWN shuttle valve**, mechanically opening the **DOWN check valve**.

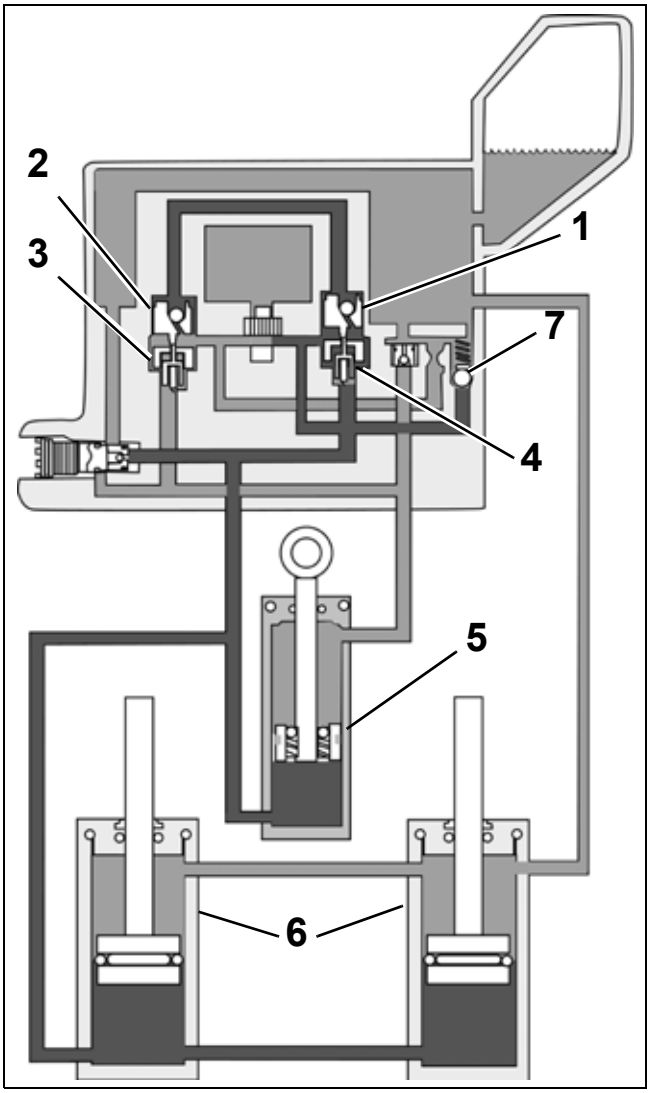
Fluid pressure pushes the **UP check valve** off its seat, and fluid passes through the valve to the bottom of all cylinders, pushing the pistons UP.

Fluid is pushed from the top of the **tilt cylinder** by the piston and returns to the pump through the open **DOWN check valve**.

In the trim range, fluid is pushed from the top of the **trim cylinders** by the pistons and returns to the reservoir.

Only fluid from the top of the tilt cylinder is returned to the pump. Because the cylinder rod displaces some fluid, that volume is less than the volume of the bottom of the tilt cylinder. So, additional fluid is drawn into the pump from the reservoir.

When all the cylinders are completely extended, the pressure increases until the **UP relief valve** opens at the tilt-up stall pressure, approximately 1500 psi (10342 kPa).



DRC3462

1. *Up shuttle valve*
2. *Down shuttle valve*
3. *Down check valve*
4. *Up check valve*
5. *Tilt cylinder*
6. *Trim cylinders*
7. *Up relief valve*

Tilt-DOWN / Trim-IN Mode

When the DOWN switch is pressed, the trim/tilt motor rotates counterclockwise (as viewed from pump end) and turns the pump gears.

Fluid pressure passes through the **DOWN shuttle valve** to the **UP shuttle valve**, which mechanically opens the **UP check valve**.

Fluid pressure pushes the **DOWN check valve** off its seat and fluid passes through the valve to the top of the tilt cylinder, moving the tilt piston DOWN.

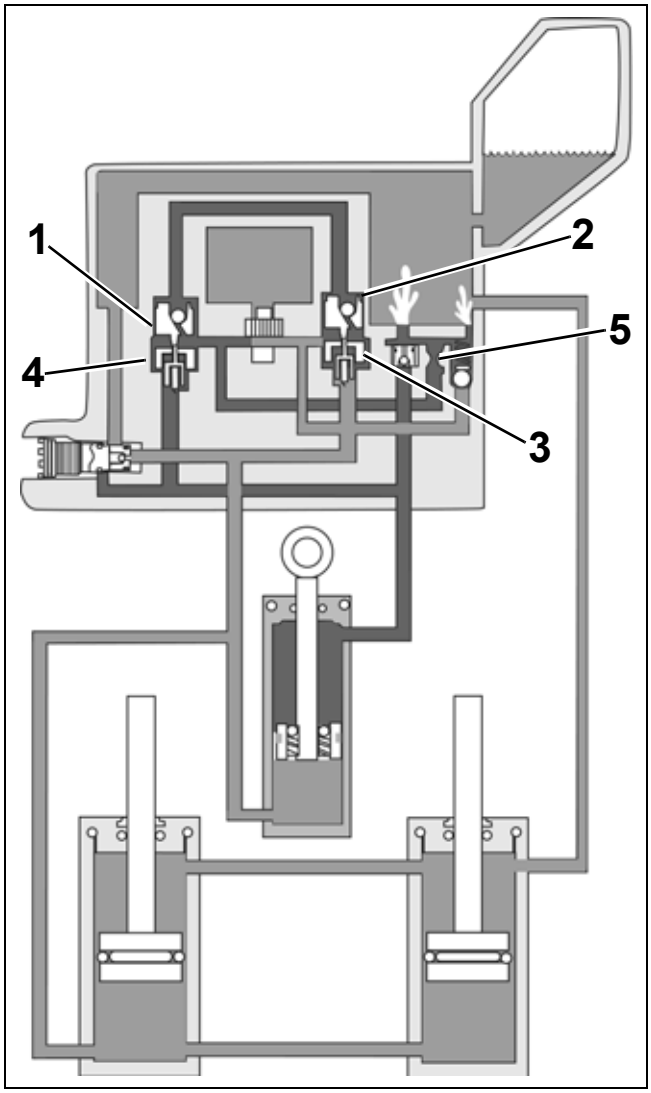
When the swivel bracket contacts the top of the trim rods, the mechanical force of the tilt cylinder pulling the outboard down also pushes the trim pistons down. Fluid is pulled from the reservoir to the top of the trim cylinders.

Fluid from the bottom of the cylinders returns through the open **UP check valve** to the pump.

In the tilt range, all of the fluid from the bottom of the tilt cylinder returns through the **UP check valve** to the pump. Since more fluid is returning to the pump than is required to fill the top of the cylinder, the excess fluid is vented through the **DOWN relief orifice** to the reservoir.

In the trim range, fluid from the bottom of all the cylinders is routed to the pump, which feeds only the top of the tilt cylinder. All of the excess fluid vents through the **DOWN relief orifice** to the reservoir.

When all cylinders are completely retracted, all of the pump output vents through the **DOWN relief orifice** to the reservoir at stall pressure (approximately 800 psi (5516 kPa)).



DRC3463

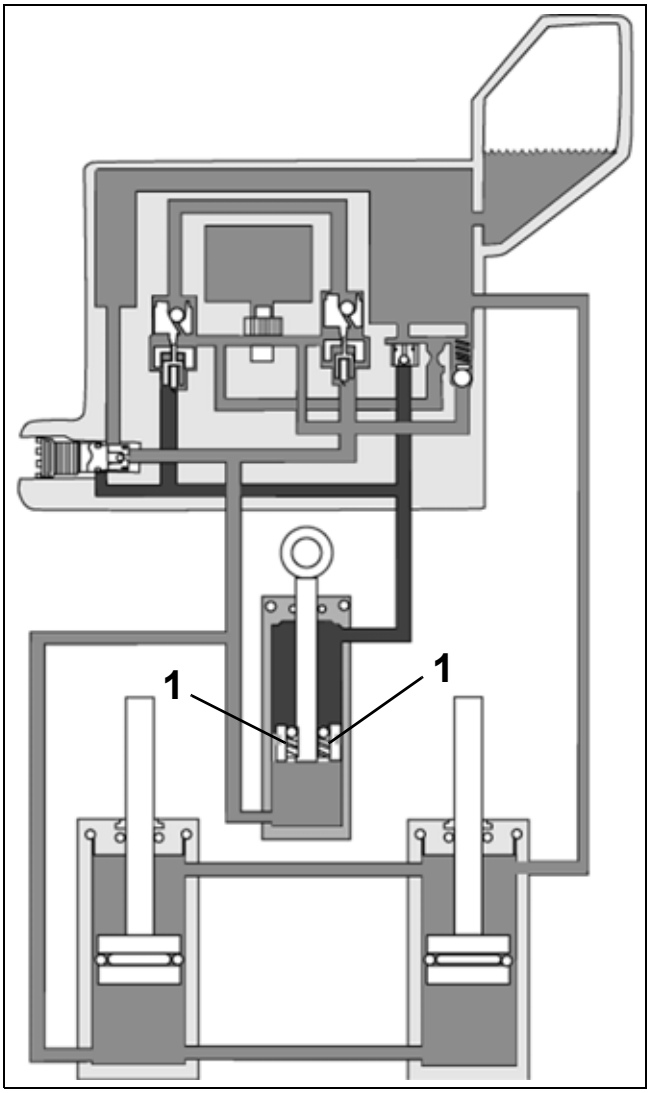
1. *Down shuttle valve*
2. *Up shuttle valve*
3. *Up check valve*
4. *Down check valve*
5. *Down relief orifice*

Impact Relief

Should the gearcase hit an underwater object and the outboard suddenly tilts up, the tilt cylinder extends. The fluid above the piston is compressed, producing high pressure.

This high pressure fluid passes through the **impact relief valves** in the tilt piston, dissipating much of the energy of the impact.

To return the outboard to its original position, the hydraulic unit must be operated in the DOWN direction.



1. Impact relief valves DRC3467

Shallow Water Drive Tilt Relief

If the outboard exceeds idle RPM while operating in shallow water drive mode (tilted up beyond the trim range), increased pressure beneath the tilt piston forces fluid through the **tilt relief valve** built into the **manual release valve**.

Fluid flows from below the tilt piston, through the **tilt relief valve**, and to the reservoir.

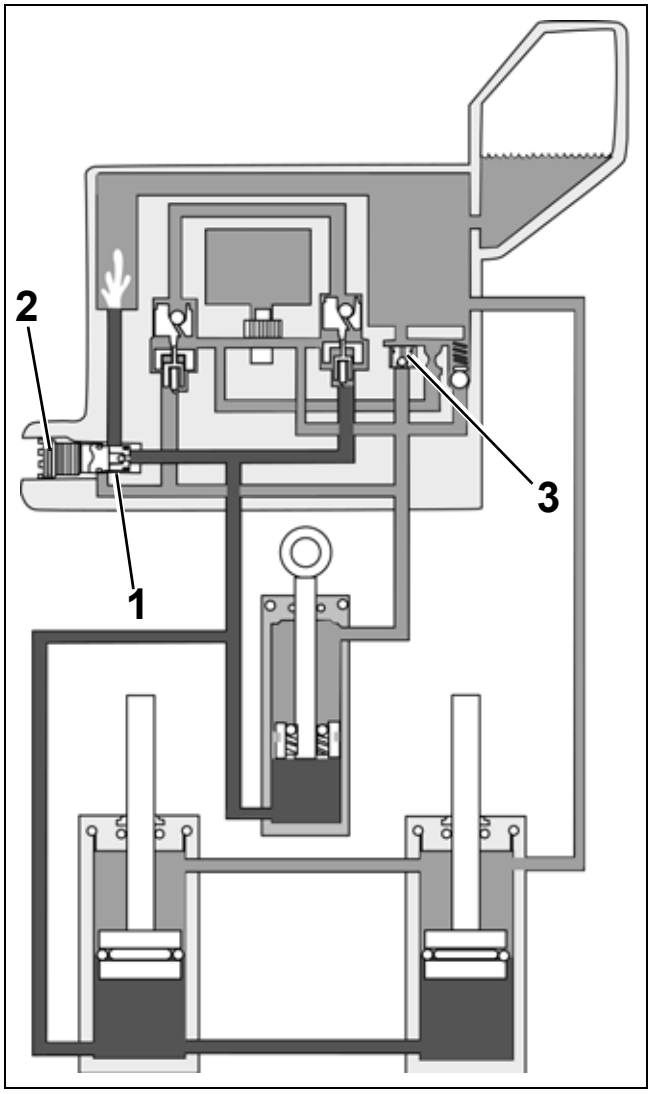
As the tilt piston moves down, the **filter valve** opens and allows fluid to flow from the reservoir to the top of the tilt cylinder.

The outboard will tilt down to the top of the trim range.

Thermal Expansion Relief

Ambient air temperature increase can cause fluid expansion within the hydraulic assembly. If the fluid expands when stored in the tilt range, the fluid under all of the pistons (and above the tilt piston) cannot expand, so its pressure increases.

If the pressure gets high enough to push the ball of the **tilt relief valve** off its seat, the excess pressure is vented to the reservoir.



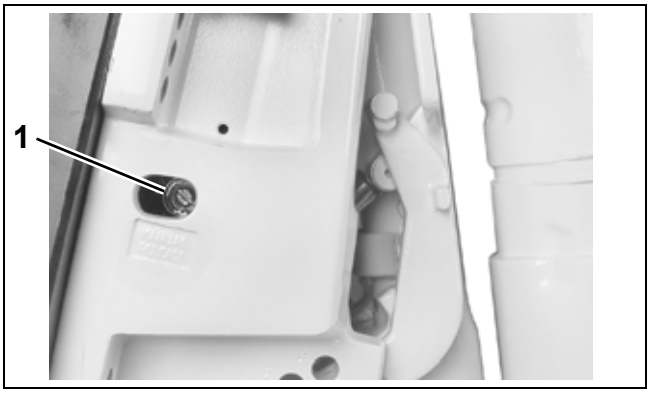
1. *Tilt relief valve*
2. *Manual release valve*
3. *Filter valve*

DRC3465

Manual Release – UP

The outboard can be positioned manually by first opening (loosening) the manual release valve.

Open the manual release valve (turn it slowly counterclockwise) with a screwdriver, about 3 1/2 turns, until it **lightly** contacts its retaining ring.



1. Manual release valve 001988

When the **manual release valve** is opened and the outboard is manually raised, fluid flows from the top of the tilt cylinder to the manual release valve. The fluid may pass through the manual release valve to the bottom of the tilt cylinder, or return to the **reservoir**. Additional fluid may be drawn from the bottom of the trim cylinders, which retract and draw additional fluid from the **reservoir** to the tops of the cylinders.

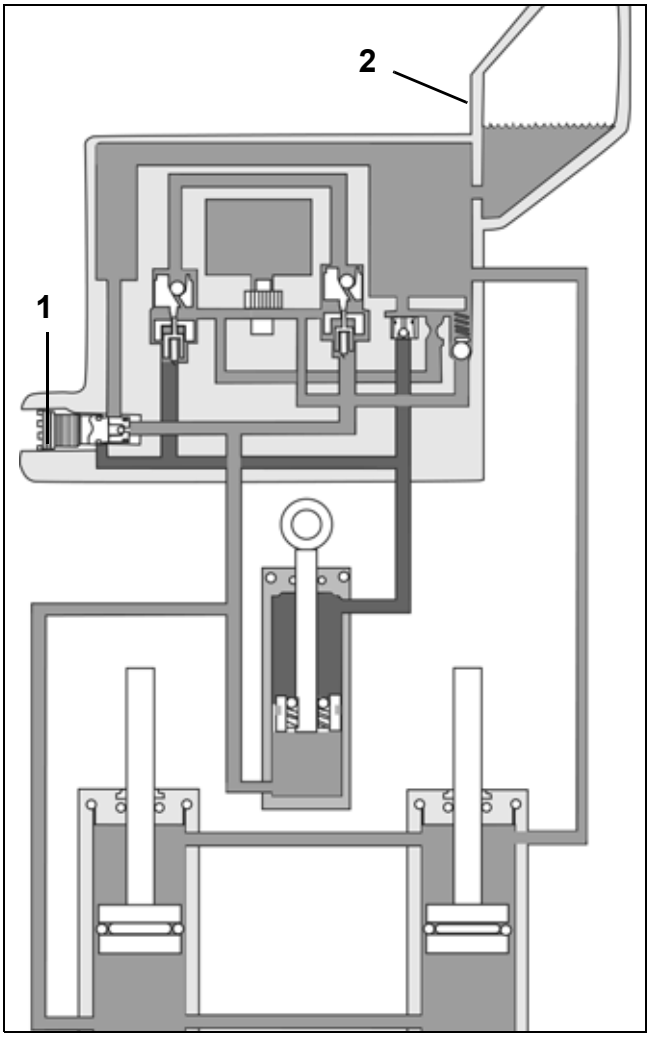
Trimming Outboard OUT

Pull gearcase out farther than the desired final position (up into the tilt range, if necessary).

Close the manual release valve.

Manually, push the gearcase in (or down) until it is supported by the trim system.

Open the manual release valve only enough to let the outboard trim in to desired position.



1. Manual release valve DRC3464
2. Reservoir

Tilting Outboard UP

Tilt outboard up and hold it with a suitable hoist or engage either its tilt support or trailering bracket.

⚠ WARNING ⚠

Do not attempt to hold the outboard up by closing the manual release valve. The outboard must be held manually, and lowered to the trim range manually, after it has been tilted up manually. The outboard can drop to the trim range if the support is removed.

Close the manual release valve firmly. The manual release valve must be closed to enable the trim/tilt unit to function.

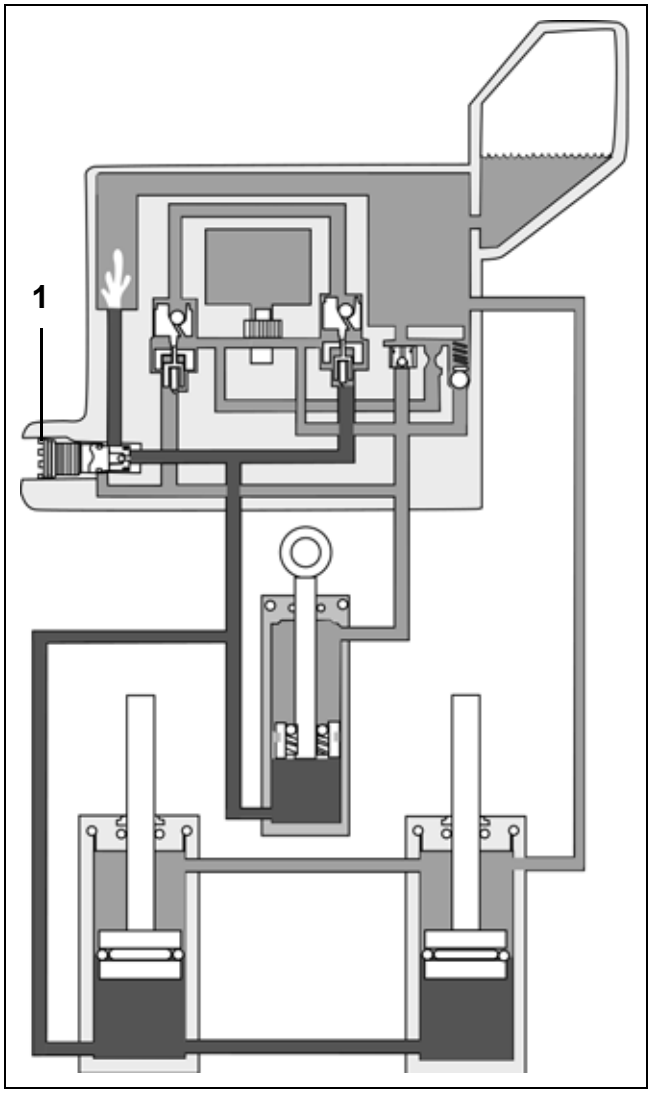
Manual Release – DOWN

When the **manual release valve** is opened and the outboard is manually tilted down or trimmed in, fluid flows from the bottom of the tilt cylinder (in the tilt range), or from the bottom of all of the cylinders (in the trim range), and past the manual release valve.

Fluid flows from the bottom of the tilt cylinder (in the tilt range) to the top of the tilt cylinder. The excess fluid, equal to the volume of the piston rod, is vented to the reservoir.

In the trim range, the fluid from the bottom of all three cylinders is vented to the reservoir, except for the amount required to fill the top of the tilt cylinder.

After opening the manual release valve, close it firmly. The manual release valve must be closed to enable the trim/tilt unit to function.



1. Manual release valve DRC3465

ROUTINE INSPECTIONS

General

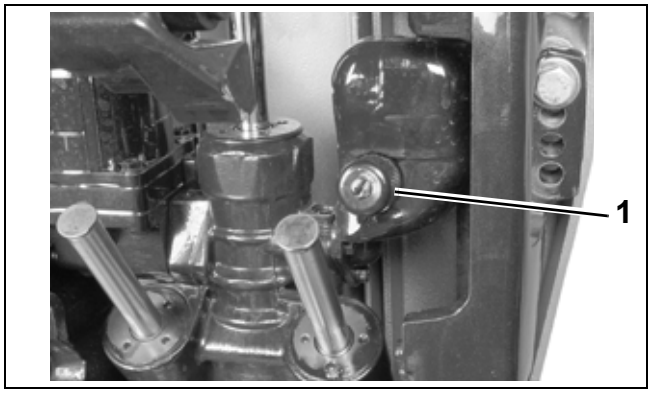
Check for external signs of fluid leakage. Correct causes as necessary.

Check the battery 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 20 fl. oz. (620 ml).

- Tilt the outboard and engage the tilt support.
- Remove the fill plug.
- Add *Power Trim/Tilt Fluid* or *GM Dexron II*, as needed, to bring level to the bottom of the fill plug threads.
- Install the fill plug and torque 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.



1. Reservoir cap 004277

Manual Release Valve

Check the manual release valve with a torque wrench.

IMPORTANT: The valve must be torqued 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. Retorque the tilt tube nuts as follows:

- Tighten the tilt tube nuts to a torque of 40 to 45 ft. lbs. (54 to 60 N·m).
- Loosen one nut 1/8 to 1/4 turn after torquing.

TROUBLESHOOTING

If the power trim/tilt system has malfunctioned and the cause has not been determined, the **Symptoms Chart** should help locate the problem.

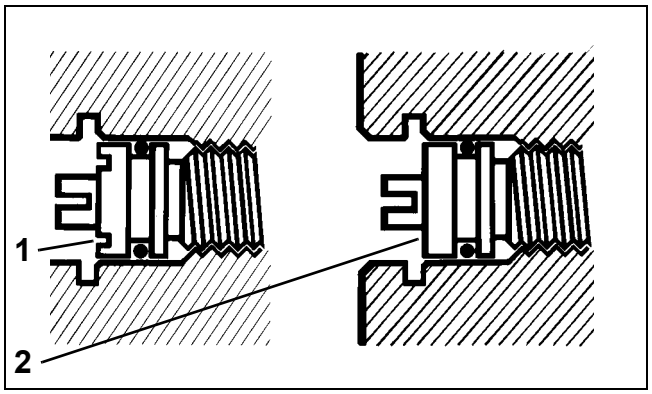
Keep a manual release valve and a valve body in stock for troubleshooting. Use these parts when the **Service Procedures** call for the substitution of known good parts.

If the trim/tilt does not work, and its motor neither runs nor hums, troubleshoot the problem by referring to **TILT/TRIM RELAY TEST** on p. 151.

If the outboard tilts part way up but not smoothly, or with a constant sound, there is probably air in the system due to low fluid. Fill reservoir and bleed (purge air from) the system.

To test for mechanical binding, open the manual release valve and manually tilt the motor up and down. If parts are binding, refer to **MIDSECTION** section.

If the outboard will not stay in shallow water drive and drops down at fast idle, the wrong manual release valve may be installed. Check for the **identification groove** in the face of the valve.



1. Grooves (incorrect valve) 30959
2. No grooves (correct valve)

If the outboard does not tilt as high as it should, and the tilt motor TURNS OFF at maximum tilt (does not sound like it is stalled at the maximum tilt position), adjust the tilt limit switch higher and retest. Refer to **Tilt Limit Switch Adjustment** on p. 74.

If any of the symptoms in the **Symptoms Chart** describe the unit, follow the indicated **Service Procedures**, in the order listed, to locate and correct the problem.

Symptoms Chart

Symptom	Service Procedures
Unit will not move in either direction.	1, 2, 3, 4, 6
Unit runs slowly in one direction, normal speed in other direction.	1, 2, 6
Unit runs slowly. (if low hours) (if high hours)	1, 2, 7 1, 2, 5, 7
Unit leaks DOWN and/or will not hold trim position against thrust in forward.	1, 2, 6
Unit leaks both UP and DOWN – Leaks down in tilt range and/or will not hold trim position against thrust in forward or reverse.	1, 2, 7
Unit will not trim/tilt one way, but works the other way. Unit will not run DOWN, but runs UP; or it runs DOWN, but will not run UP.	2, 3, 6

Service Procedures

STEP 1

Be sure the manual release valve is closed. If NOT, torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

STEP 2

Temporarily install a known good manual release valve and retest. If symptoms remain, original valve is not the problem. Reinstall original valve.

If symptoms disappear, the original valve was faulty. Remove temporary valve and replace with correct new valve.

STEP 3

Go to **TILT/TRIM RELAY TEST** on p. 151 to determine if problem is power supply.

STEP 4

Remove trim motor and check condition of drive coupling. If coupling is damaged, replace it.

STEP 5

Temporarily install a known good pump manifold assembly and retest. If symptoms remain, original assembly is not the problem. Reinstall original assembly.

If symptoms disappear, the original pump manifold assembly was faulty. Remove temporary assembly and replace it with correct one.

STEP 6

Install replacement pump manifold assembly and retest. If all symptoms are not corrected, reconsider the problem using the new symptoms.

STEP 7

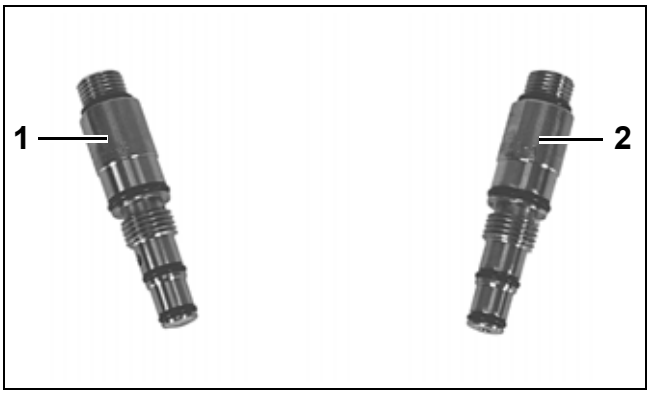
Install O-ring kit. Look for any cylinder damage. Look for chips in fluid or impact valves. Look for other abnormal conditions. If all symptoms are not corrected, reconsider the problem using the new symptoms.

Pressure Leakdown Test

Before servicing a hydraulic unit, it should be pressure tested to determine the unit's malfunction. This test must be performed with the hydraulic unit removed from the outboard and mounted in a vise or holding fixture.

Power Trim/Tilt Service Kit, P/N 434524, allows testing of trim/tilt operation and component condition.

- The “A” adapter, P/N 336658, checks operation of the UP circuit.
- The “B” adapter, P/N 336659, checks operation of the DOWN circuit.



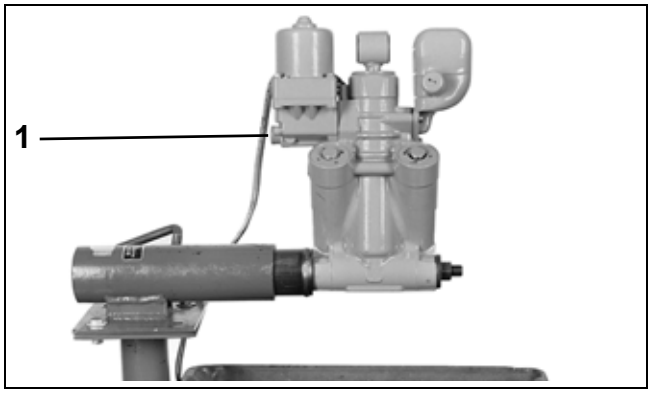
1. A Adapter 27340
2. B Adapter

This kit does not include a gauge and collar assembly. Gauge and collar assembly shipped with Power Trim/Tilt Service Kit, P/N 390010, will work. Gauge and Collar Assembly, P/N 983975, is also available.

Be sure to use a fully charged battery.

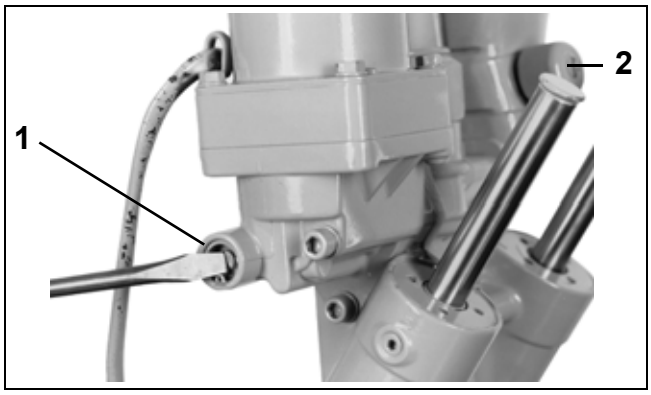
STEP 1

Screw the manual release valve in the hydraulic unit until it is seated. Place a large drain pan under the unit to catch hydraulic fluid.



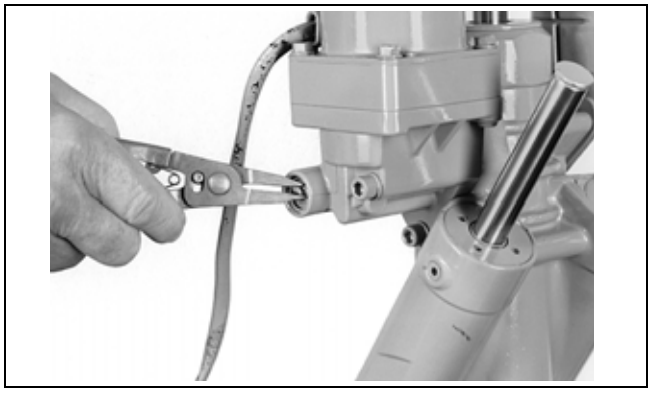
1. Manual release valve 41736

Operate the unit to the full UP position, **then run the unit down momentarily to reduce pressure.** Loosen the reservoir cap one full turn. Loosen the manual release valve three turns. Some fluid will bypass the reservoir cap. These steps will relieve the pressure in the unit.



1. Manual release valve 41739
2. Reservoir cap

Remove the manual release valve retaining ring using retaining ring pliers.

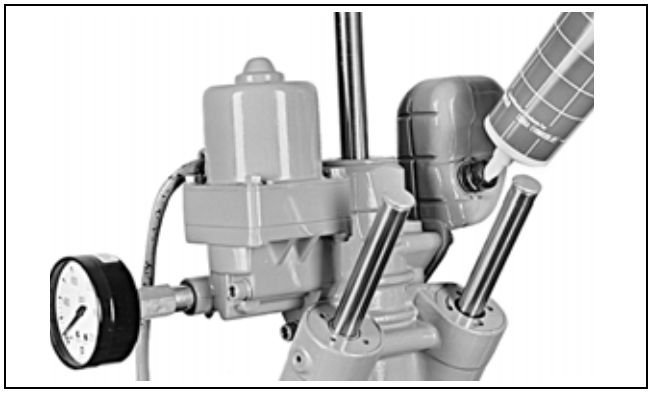


41754

Remove the manual release valve. Install pressure gauge and adapter “A” to check problems in the UP circuit.

IMPORTANT: Torque gauge and adapter lightly to 5 to 10 in. lbs. (0.6 to 1.2 N·m). Excessive torque might damage adapter or O-rings.

Cycle the unit down and up several times to purge air. With all rods fully extended, **run the unit down momentarily to reduce pressure.** Check fluid level again, and add fluid if necessary. Remember that all rods must be completely extended to check fluid level.



41757

Starting with the tilt cylinder fully retracted, run the unit UP.

- The gauge should show 0 to 200 psi (0 to 1379 kPa) as the tilt cylinder is extending.
- The gauge should show 1400 to 1600 psi (9653 to 11032 kPa) as the unit stalls.
- Release the switch and watch for a pressure drop. The stall pressure reading must not drop more than 200 psi (1379 kPa) after motor stops.

If results vary from the above limits, there is a problem in the UP circuit. Refer to **MODES OF OPERATION** on p. 326 for circuit description.

STEP 2

Install pressure gauge and adapter “B” to check problems in the DOWN circuit. Cycle the unit down and up several times to purge air. With all rods fully extended, **run the unit down momentarily to reduce pressure.** Check fluid level again, and add fluid if necessary. Remember that all rods must be completely extended to check fluid level.

Starting with the tilt cylinder fully extended, run the unit DOWN.

- The gauge should show 0 to 200 psi (0 to 1379 kPa) as the tilt cylinder is retracting.
- The gauge should show approximately 800 psi (5516 kPa) as the unit stalls.
- Release the switch and watch for a pressure drop. The stall pressure reading must not drop more than 200 psi (1379 kPa) after motor stops.

If results vary from the above limits, there is a problem in the DOWN circuit. Refer to **MODES OF OPERATION** on p. 326 for circuit description.

⚠ CAUTION ⚠

After tests are complete, run the unit up, then down momentarily. Cycle the unit down and up several times to purge air. With all rods fully extended, run the unit down momentarily to reduce pressure.

Check fluid level again and add fluid, if necessary.

ELECTRICAL CIRCUIT TESTS

Relay Testing

When the trim-UP button is pressed, the UP relay is energized and connects the blue trim motor wire to the battery positive (+) terminal. The green trim motor wire remains grounded. When the button is released, the blue trim motor wire returns to a grounded position.

When the trim-DOWN button is pressed, the DOWN relay is energized and connects the green trim motor wire to the battery positive (+) terminal. The blue motor wire remains grounded. When the button is released, the green trim motor wire returns to a grounded position.

Refer to **TILT/TRIM RELAY TEST** on p. 151 for relay testing procedure.

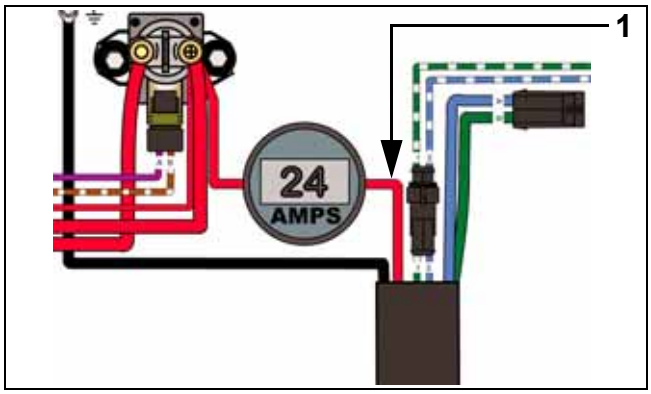
Trim and Tilt Motor Current Draw Tests

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: The specifications contained in the **Performance Chart** 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.

Performance Chart

Mode	Normal Current Draw	Time in Seconds
Trim-OUT (Trim range)	22 A	9
Tilt-UP Stall	60 to 75 A	N/A
Trim-IN (Trim range)	16 A	9
Trim-IN Stall	35 to 45 A	N/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
- Valves sticking
- Relief valve springs damaged (stall up only)

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.

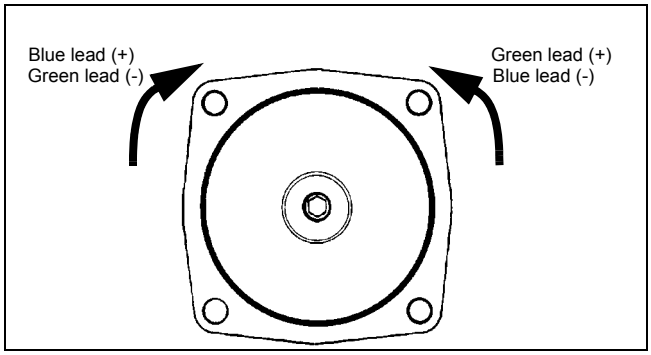
Monitor motor RPM and current draw.



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

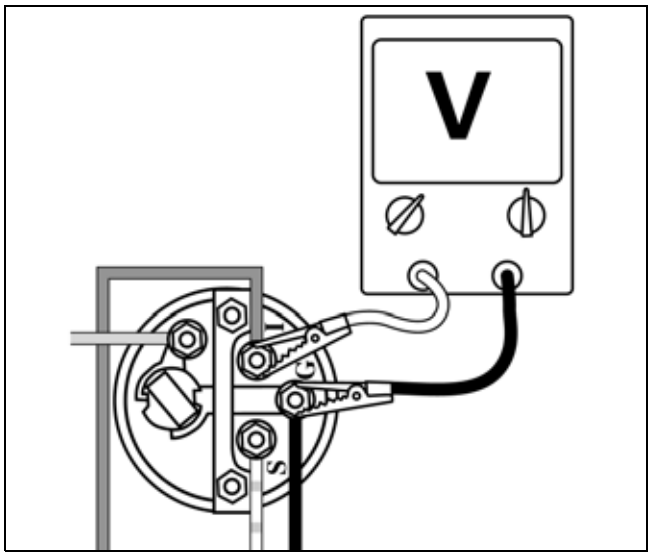
If test results vary, replace the motor.

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 10 A fuse.
- If voltage, go to **STEP 2**.

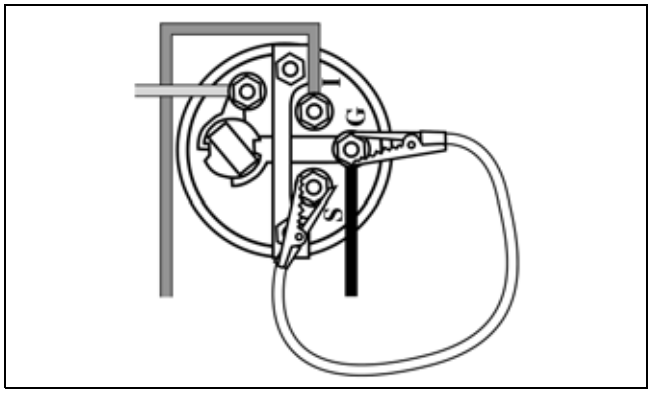


DRC6245

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**.



DRC6246A

Trim Sender Test

IMPORTANT: To avoid immediate meter damage, never apply a multimeter to an electrical circuit where voltage is present.

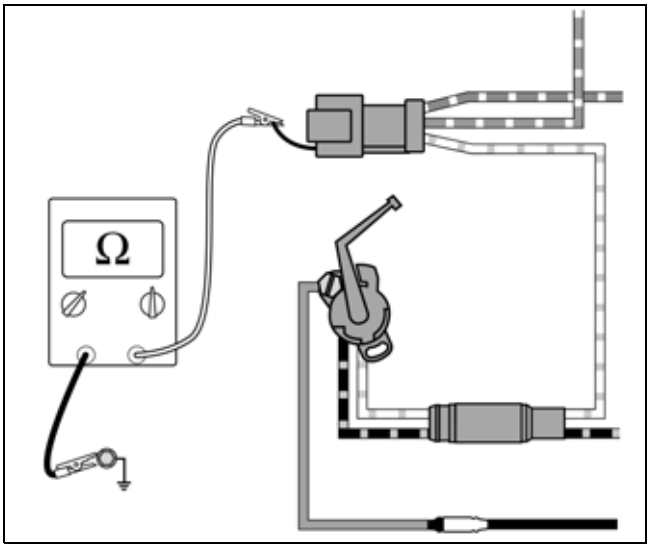
Disconnect the 3-pin *Deutsch* connector between the instrument harness and engine trim harness.

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. 338.
- If results are different, replace trim sender.



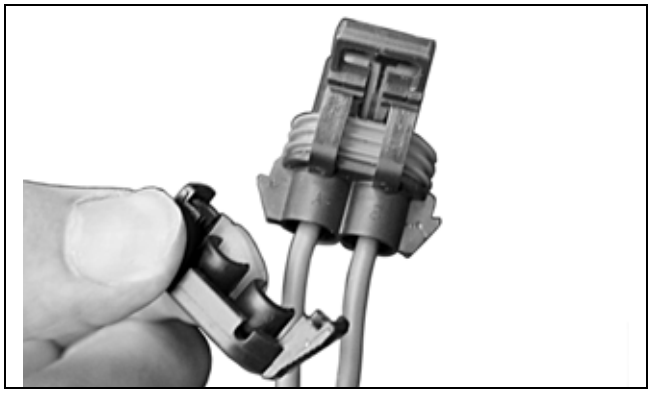
DRC6247

REMOVAL AND INSTALLATION

Removal

Remove port lower engine cover and disconnect the trim/tilt connectors.

Remove the rubber grommet from the blue/green trim/tilt cable connector.



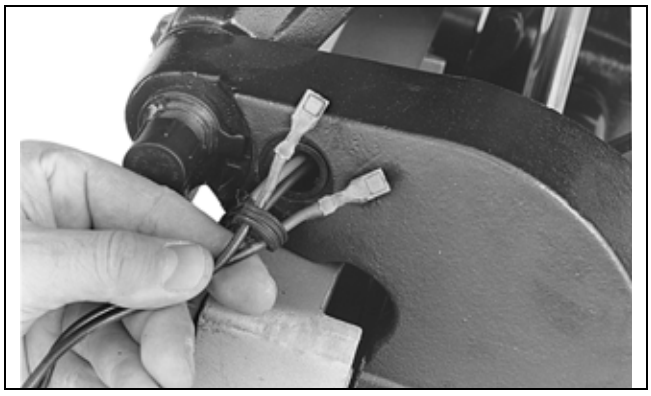
000686

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.



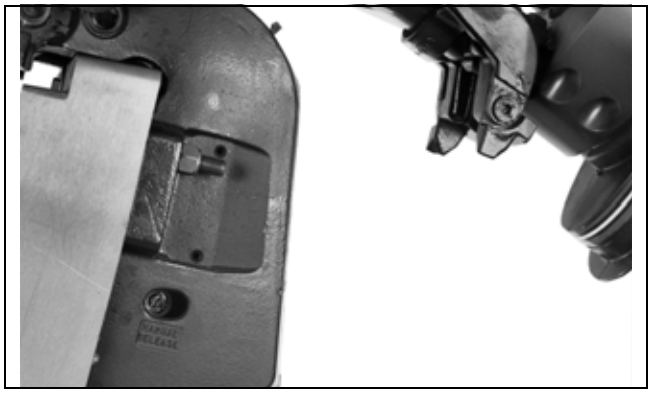
000687

Separate the trim/tilt unit wires in the braided tube to permit removal through the hole in the stern bracket.



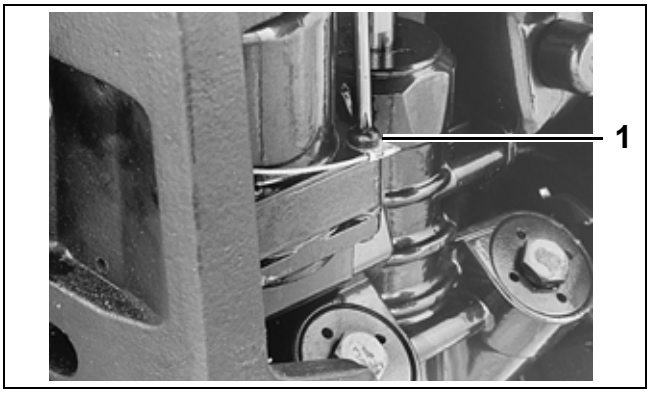
25078

Unscrew the manual release valve, raise the unit, and lock it in place with the tilt support.



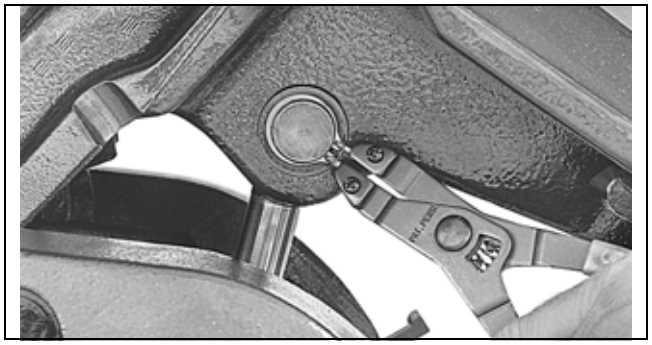
27381

Remove the ground wire from the trim/tilt unit.



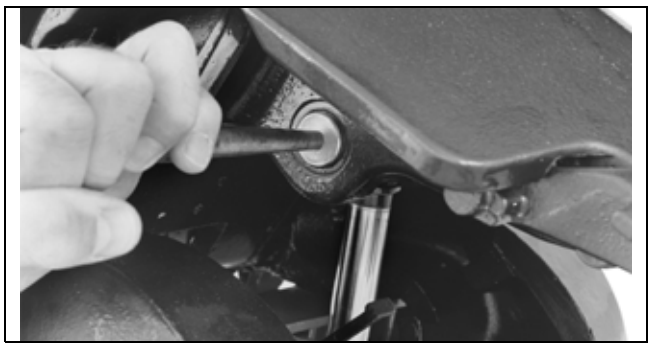
1. Ground wire 25057

Remove the external snap rings from the upper pin.



25064

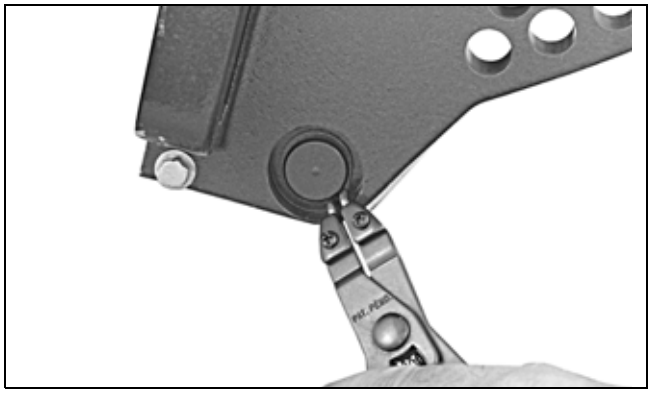
Use a punch to remove the upper pin.



25065

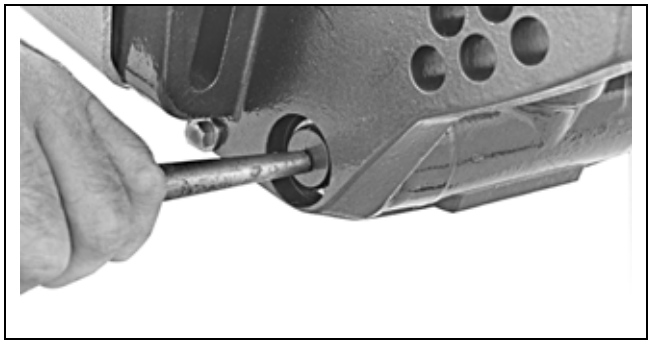
Retract the tilt cylinder rod.

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.



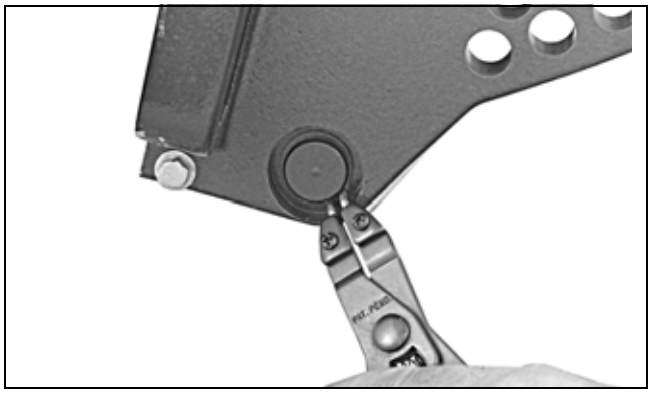
25076

Installation

Place trim/tilt unit into position. Apply *Triple-Guard* grease to the lower pin and install the pin.

If loosened, torque the tilt tube nut to 50 to 54 ft. lbs. (68 to 73 N·m), then loosen the nut by 1/8 to 1/4 turn.

Install external snap rings on lower pin with sharp edge of ring facing out.

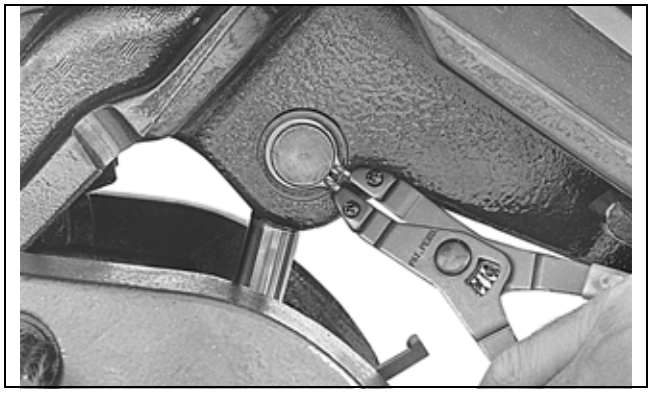


25077

Extend tilt cylinder rod to match with holes in swivel bracket.

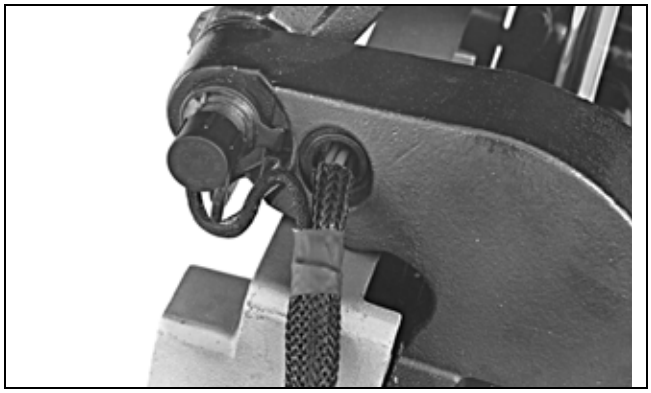
Apply *Triple-Guard* grease to upper pin and install the pin.

Install external snap rings onto upper pin with sharp edge facing out.



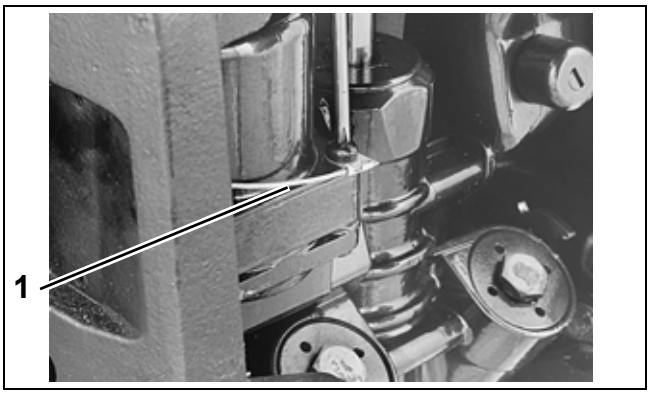
25064

Place trim/tilt wires in braided tube and install through hole in the stern bracket.



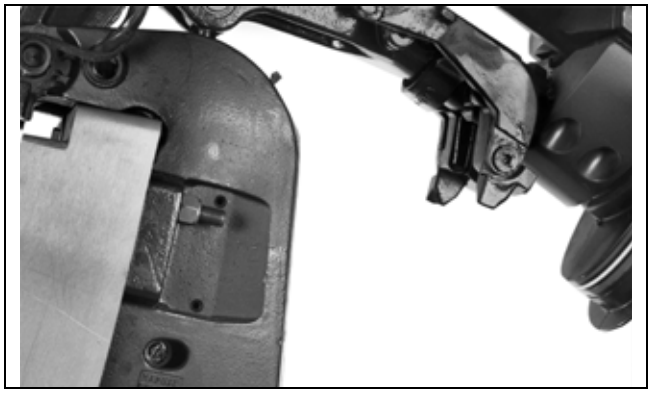
25079

Attach the ground wire to the trim/tilt unit.



1. Ground wire 25057

Release the tilt support and lower the outboard. Tighten the manual release valve to 45 to 55 in. lbs. (5.1 to 6.2 N·m).



27381

Install connector on trim/tilt cable and reconnect trim connectors to engine wire harness.

SERVICING

Disassembly

⚠ WARNING ⚠

Before removing the manual release valve, operate the unit to the full UP position, then run the unit down momentarily and loosen the reservoir cap one full turn.

To avoid personal injury, always wear eye protection when servicing the hydraulic unit. Since there might be significant residual pressure behind some components, cover each component with a shop cloth as you remove it.

Thoroughly clean the unit before disassembling it. Scrub all outside surfaces with a stiff brush and hot, soapy water to prevent surface dirt from contaminating internal parts.

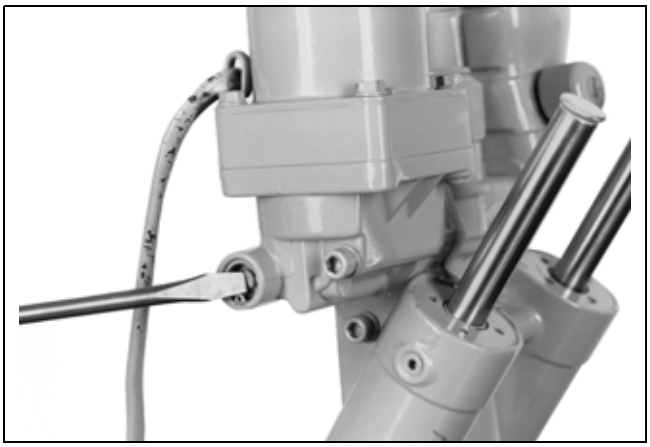
⚠ CAUTION ⚠

Do not apply heat to the cylinder body or cylinders. Excessive heat can cause high pressure leaks or failure of parts.

Always use a “lint free” shop cloth when handling power trim/tilt components.

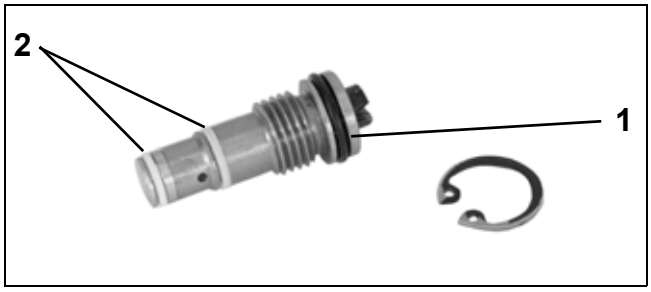
If painting the unit is required, paint it after it is completely assembled. Painting of individual components may cause flakes of paint to enter the hydraulic passages during assembly. Tape the trim/tilt piston rods before painting.

Screw the manual release valve in. Remove the retaining ring using retaining ring pliers. Remove the manual release valve.



41739

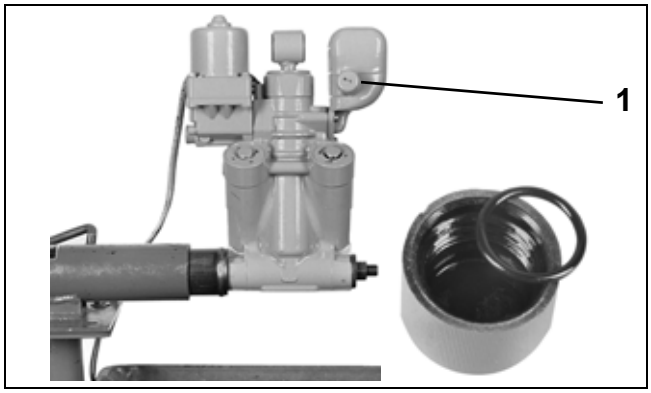
Inspect O-ring and two plastic split rings on the manual release valve for nicks and cuts. Inspect tip of valve for damage. The two plastic split rings are not available separately. If rings are damaged, replace the manual release valve.



1. O-ring
2. Plastic split rings

22863

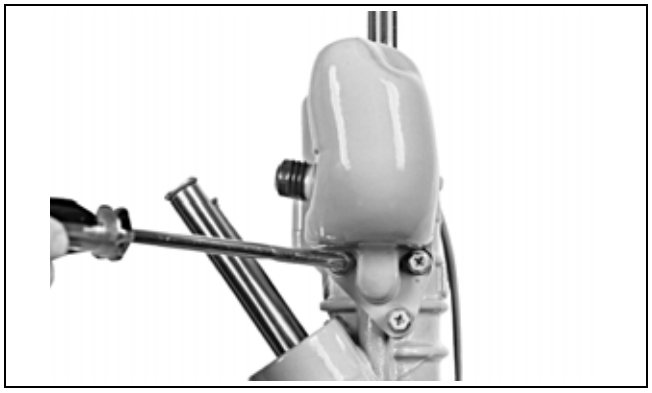
Remove reservoir cap and drain the fluid into a container. Inspect the O-ring in the cap.



1. Reservoir cap

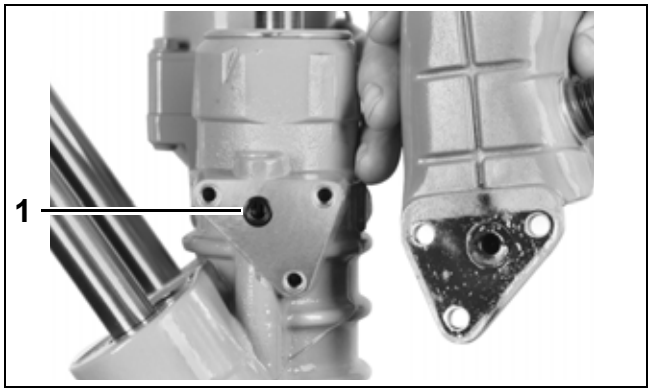
41736
41751

Remove the three *Pozidriv* screws securing the reservoir to cylinder body. Remove reservoir.



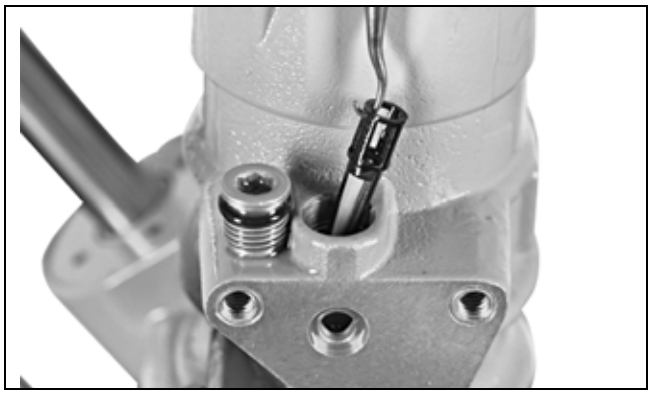
41753

Remove the reservoir O-ring from the cylinder body. Check the machined surfaces for nicks and scratches.



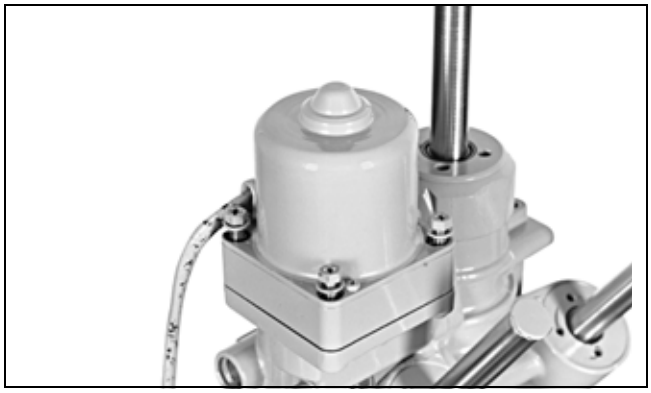
1. O-ring 41759

Use a 6 mm hex wrench to remove the plug from the cylinder body. Inspect the O-ring and the filter. Replace, if necessary.



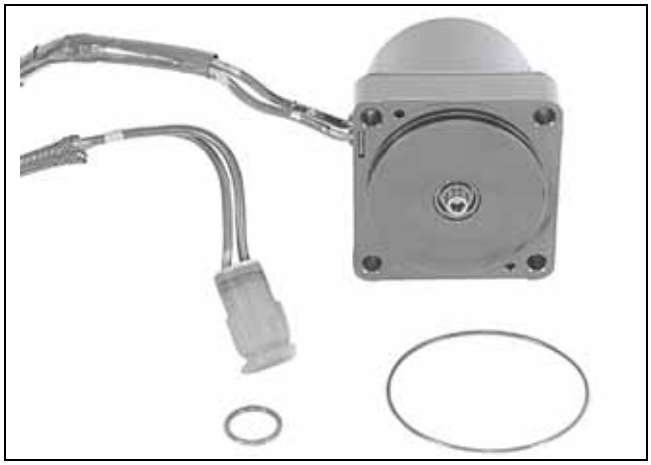
41787

Remove the four screws securing motor to pump manifold assembly.



41760

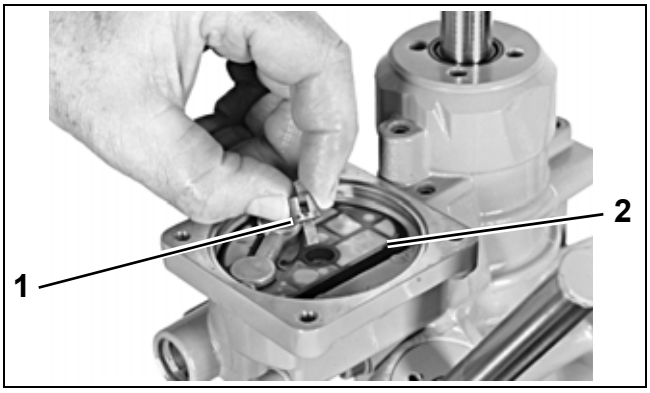
Remove the wire shield from the pump manifold. Remove the motor and inspect the motor O-ring and the O-ring on the cable connector.



22878

Remove and inspect the coupler. Remove the filter screen from the pump manifold. Check the machined surfaces on the manifold for nicks and scratches. The pump manifold is not serviceable. Do not remove the pump or any control valves from the manifold. Clean the screen with a mild

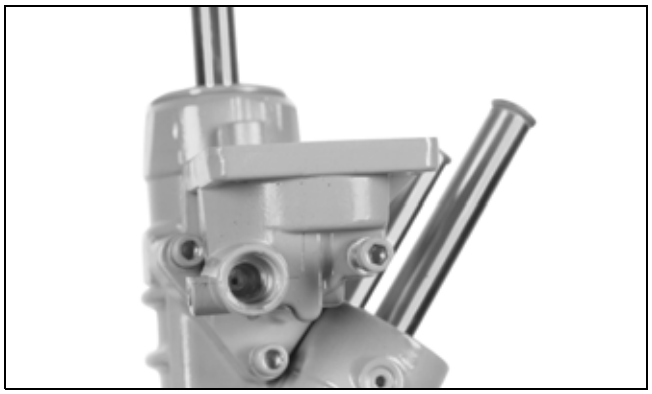
solvent and inspect it for tears, clogging, or other damage.



1. Coupler
2. Filter screen

41763

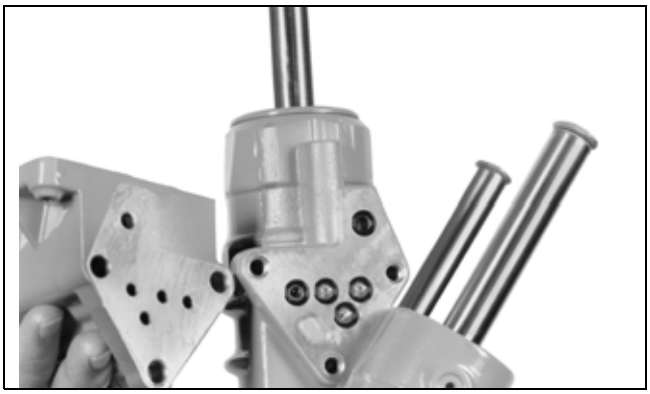
Remove the three Allen head screws securing the pump manifold assembly to cylinder body.



41798

IMPORTANT: Individual parts in the pump manifold assembly are not available separately. Do not remove pump or any control valves from the body.

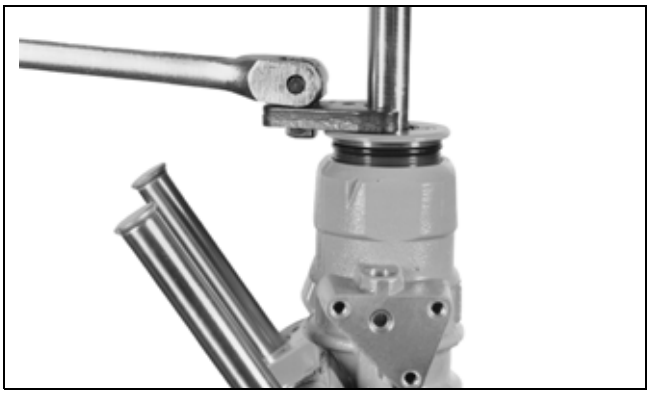
Remove the manifold. Remove five O-rings from cylinder body. Check machined surfaces for nicks and scratches.



41799

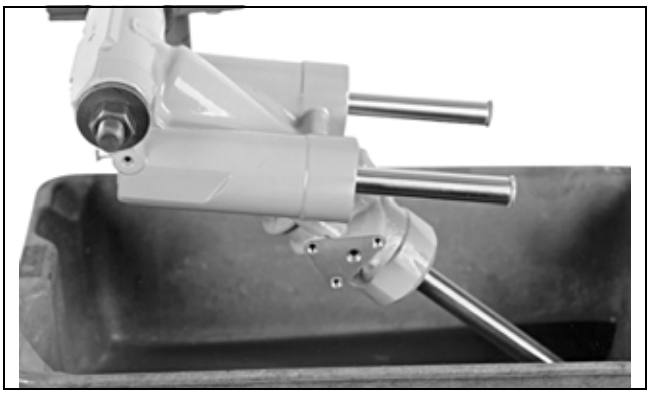
Tilt Piston Removal

Use Tilt Cylinder End Cap Remover/Installer, P/N 326485, or Universal Spanner Wrench, P/N 912084, and a breaker bar to unscrew the tilt rod end cap.



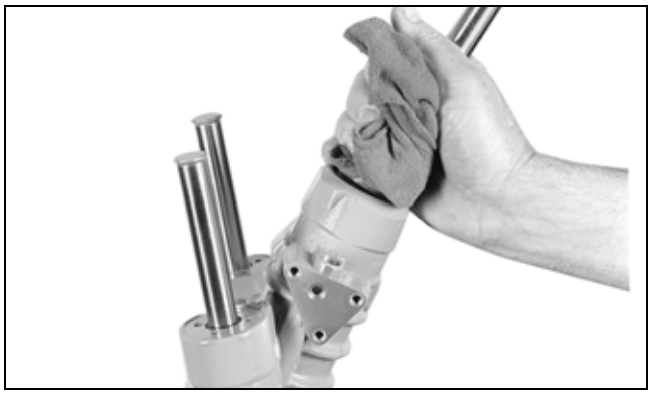
41788

Drain the fluid from above the piston.



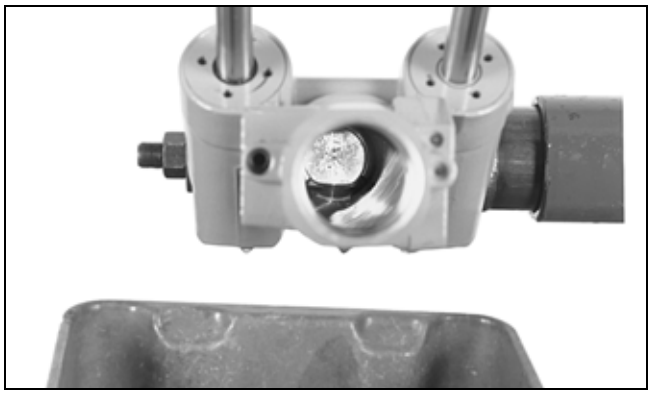
41789

Slowly pull the piston out with a rag wrapped around the rod and the top of the cylinder. Drain the remaining fluid from the cylinder.



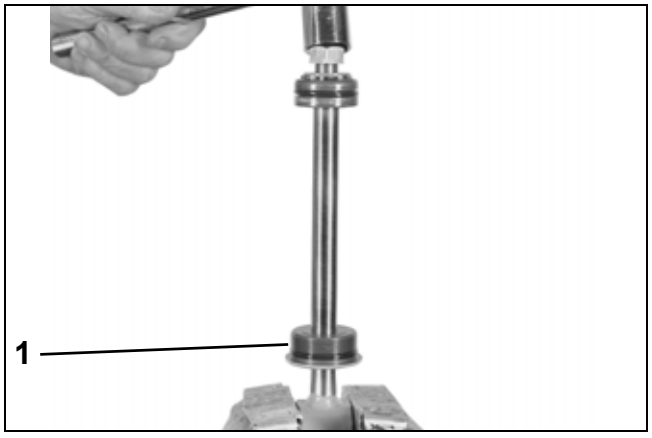
41765

Inspect the bore of the tilt cylinder for excessive scoring. If the bore of the tilt cylinder is scored or damaged, the hydraulic assembly must be replaced.



41767

Clamp the rod eye tightly in a soft jaw vise. Remove the nut from the piston end of the rod.



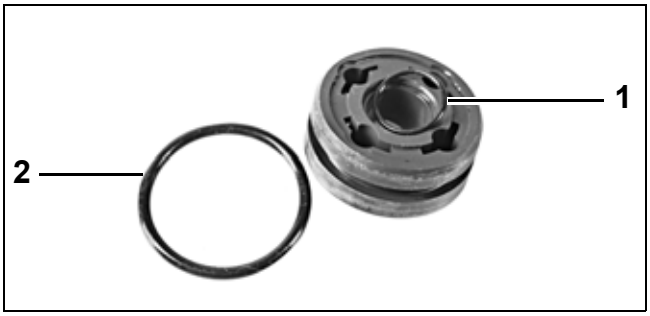
1. End cap 41781

Remove the washer. Slide the tilt piston off the rod. Be careful not to lose the springs, plungers, or small check valves in the piston assembly.



41784

Remove and discard the small inner O-ring and large outer O-ring.



1. Small inner O-ring 41819
2. Large outer O-ring

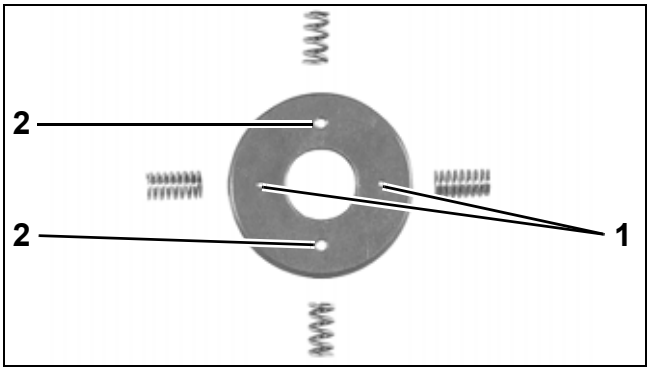
Tilt Piston Identification

⚠ WARNING ⚠

Different tilt pistons are used on hydraulic units for various outboard models. All plungers and check balls are identical. The tilt piston assemblies contain valving specific to certain models. To provide impact protection, it is important the correct piston assembly be installed.

Two of the piston relief holes are small, the other two holes are larger. Two of the springs have five coils and the other two have nine coils. On assembly, the two five-coil springs go in the large relief

holes, and the two nine-coil springs go in the small relief holes.

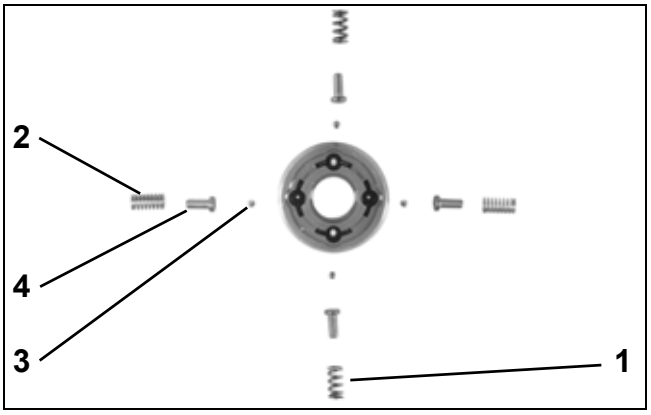


1. *Small piston relief holes* 41879
2. *Large piston relief holes*

Tilt Piston Assembly

Piston check balls and plungers are identical. Lubricate and install a new outer O-ring on the tilt piston. Place one ball, one plunger, and one spring in each hole in the piston as indicated.

The two five-coil springs go in the large relief holes and the two nine-coil springs go in the small relief holes. Set the piston aside.



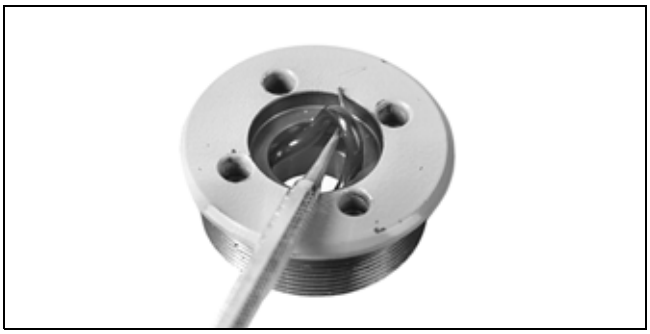
1. *Five-coil spring* 41817
2. *Nine-coil spring*
3. *Piston check ball*
4. *Plunger*

Use a screwdriver to carefully pry the scraper out of the end cap. Discard the scraper. Remove and discard the large outer O-ring.



41791

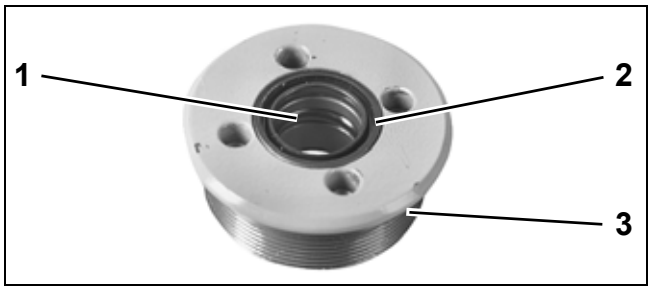
Remove and discard inner O-ring of the end cap.



41792

Tilt Rod Assembly

Clean the end cap thoroughly, then lubricate and install a new O-ring in the end cap. Lubricate and install a new scraper. The scraper is installed with the lip facing out. Lubricate and install a new O-ring on the outside of the end cap.



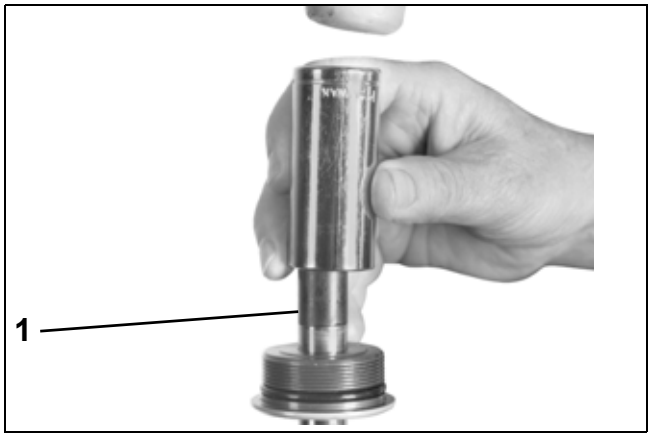
1. *Inner O-ring* 41795
2. *Lip*
3. *Outer O-ring*

Use a wire brush to clean all thread-locking material from the threads on the tilt rod.



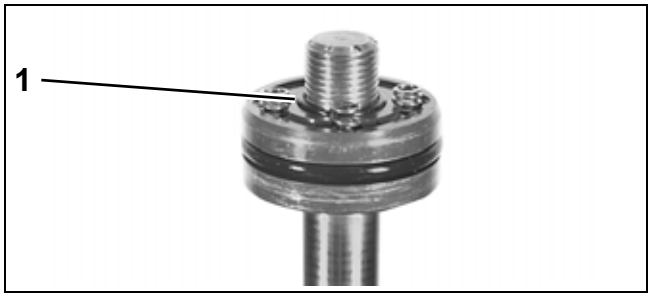
41821

Lubricate the inside surface of the end cap. Lubricate and install Tilt Cylinder Seal Protector, P/N 326005. Use a deep-well socket and a plastic mallet to drive the end cap onto the rod, then remove the seal protector. Slide the end cap down the tilt rod.



1. Tilt Cylinder Seal Protector P/N 326005 41824

Remove any lubricant from the threads on the tilt rod, prime with *Locquic Primer*, and let dry. Slide the piston assembly onto the tilt rod. Place a **new** rod O-ring over the threads.



1. O-ring 41816

Clean any thread-locking material from the threads on the inside of the nut. Spray threads of with *Locquic Primer* and let dry. Apply a small amount of *Nut Lock* to the threads. Slide the washer over the threads and install the nut. Torque to 58 to 87 ft. lbs. (79 to 118 N·m).



41783

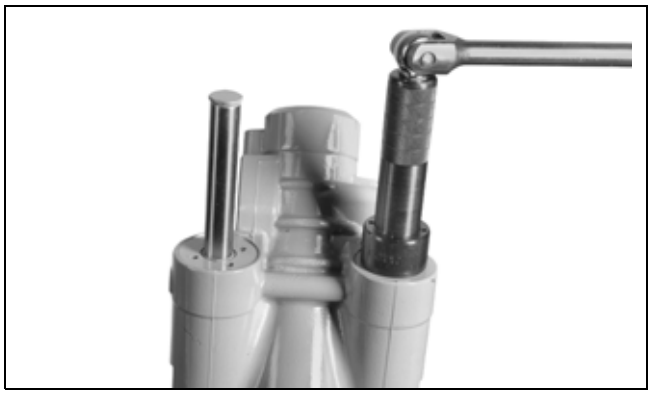
To ensure that the tilt piston has been properly assembled and the impact relief balls are properly seated, apply *Power Trim/Tilt & Steering Fluid* on top of the tilt piston. Fluid should not leak past the impact relief balls while seated. If fluid does leak, disassemble the piston assembly and inspect the relief ball seats. Set the tilt rod assembly aside.



41828

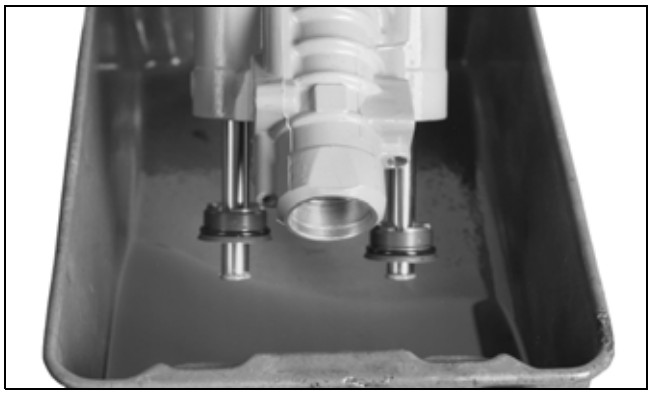
Trim Rod Removal

Unscrew trim cylinder end caps using Trim Cylinder End Cap Remover/Installer, P/N 436710, or Universal Spanner Wrench, P/N 912084, and a breaker bar. Small pins must be used in the spanner wrench.



41829

Slide the caps to the end of the rods. Drain the fluid from the top of the pistons.



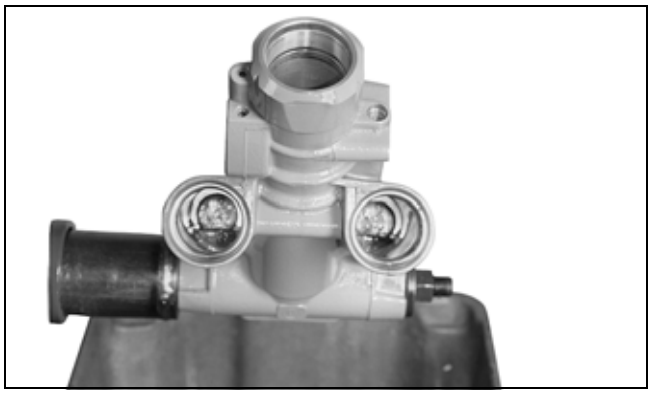
41837

Slowly pull each piston out with a rag wrapped around the rod and the top of the cylinder.



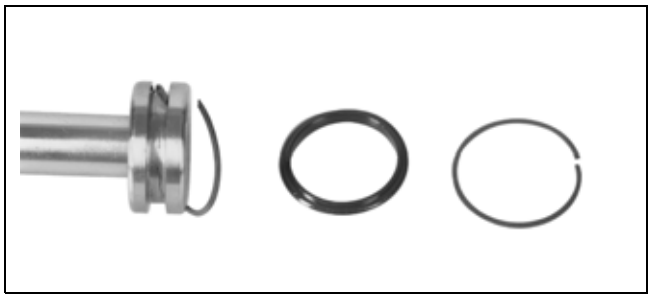
41838

Drain the remaining fluid from the cylinders. Inspect both bores of the trim cylinders for excessive scoring. If one or both trim bores are scored or damaged, the hydraulic assembly must be replaced.



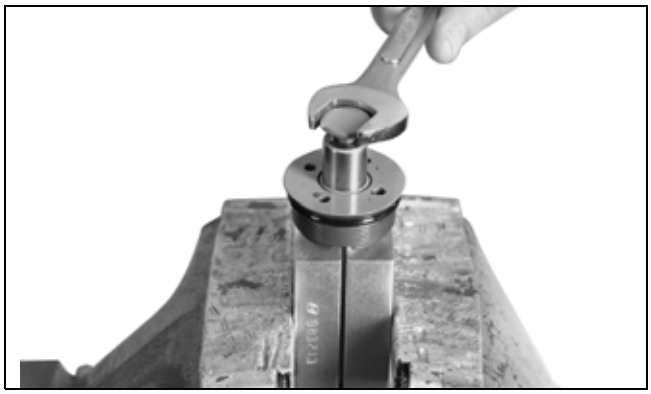
41840

Remove and discard both back-up rings and the O-ring from each trim rod piston.



41841

Using Hydraulic Cylinder Rod Holder, P/N 983213, clamp the rod tightly in a vise. Remove the thrust pad from the trim rod, then remove the end cap.



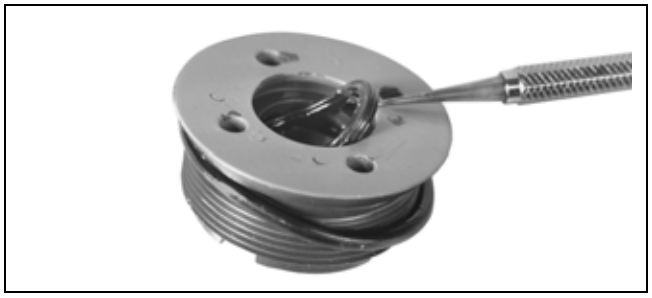
41842

Remove the rod from the vise. Use a small screwdriver to carefully pry the scraper out of the end cap. Discard the scraper.



41843

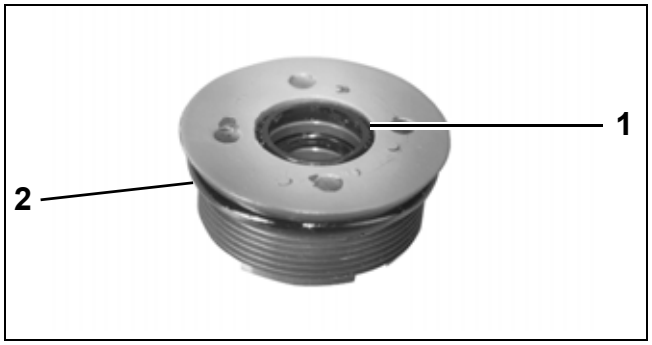
Use a suitable tool to remove the inner quad-ring and the outer O-ring. Discard the quad-ring and O-ring.



41844

Trim Rod Assembly

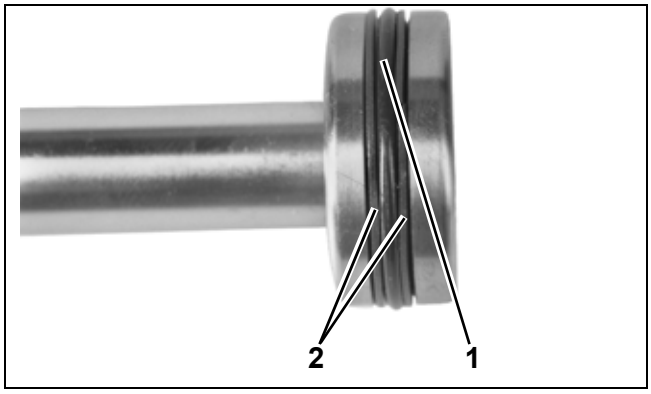
Lubricate and install a new quad-ring and scraper in the end cap. Install a new scraper with the bevel facing out. Lubricate and install a new O-ring on the outside of the end cap.



1. Bevel
2. O-ring

41845

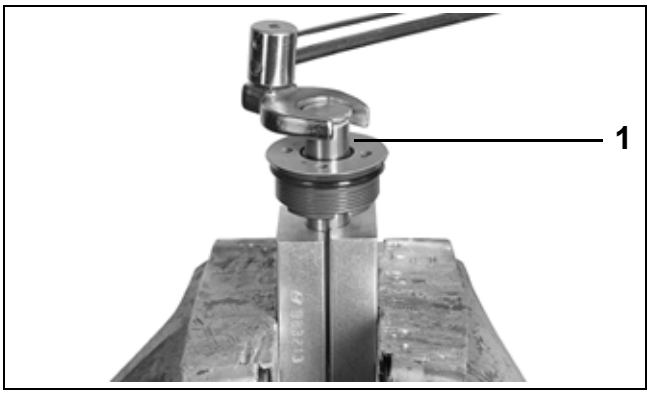
Lubricate and install a new O-ring and two new back-up rings on the trim rod piston. Place one back-up ring on each side of the O-ring. Position the open end of the back-up rings 180° apart.



1. O-ring
2. Back-up rings

41847

Using Hydraulic Cylinder Rod Holder, P/N 983213, clamp the rod tightly in a vise and lubricate the cap and rod. Slide the end cap onto the rod and install thrust pad. Torque thrust pad 84 to 108 in. lbs. (9.5 to 12 N·m).

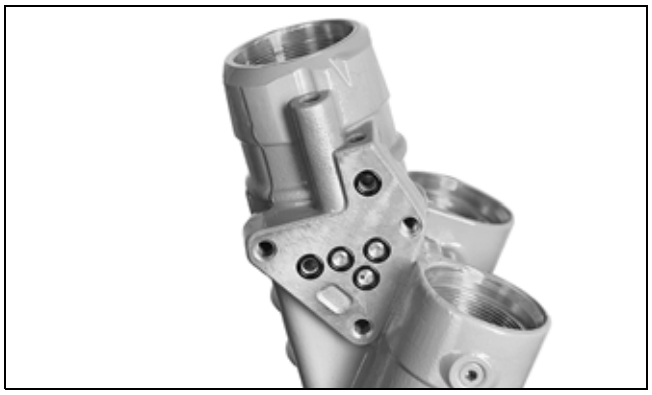


1. Thrust pad

41848

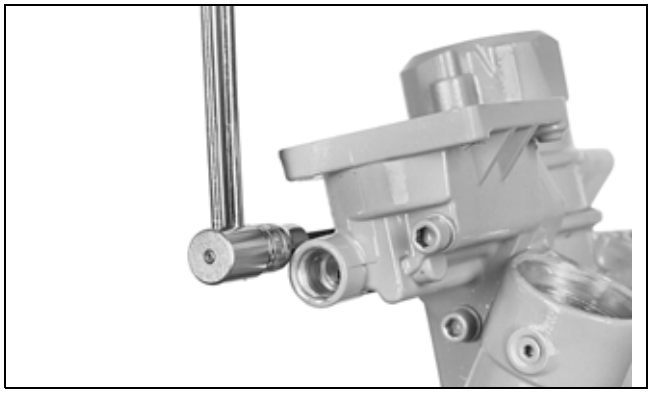
Manifold and Reservoir Installation

Lubricate five new manifold body O-rings. Place them in the cylinder body.



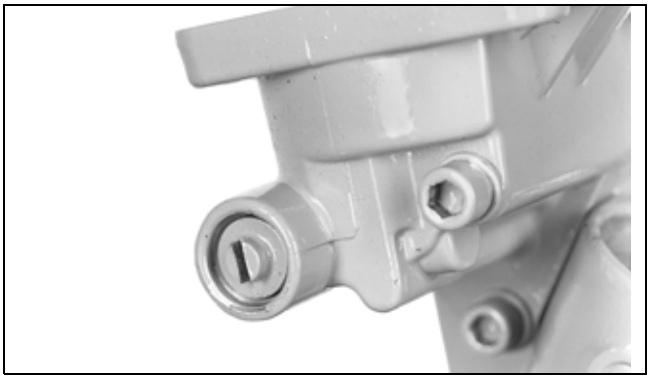
41849

Attach the valve pump assembly to the cylinder body with three *Pozidriv* screws. Torque screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



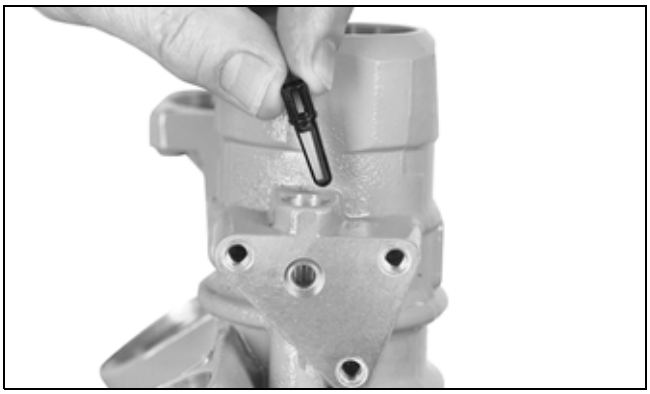
41850

Oil and install the manual release valve. Thread the valve just past the snap ring groove. Do not install the snap ring at this time. The valve will be removed later for the **Pressure Leakdown Test** on p. 334.



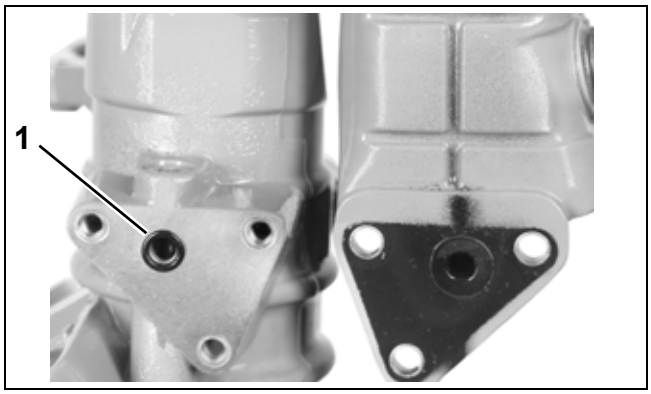
41851

Install the reservoir filter screen in the cylinder body. Make sure that the screen is seated. Use a 6 mm Allen wrench to install the plug. Tighten the plug securely.



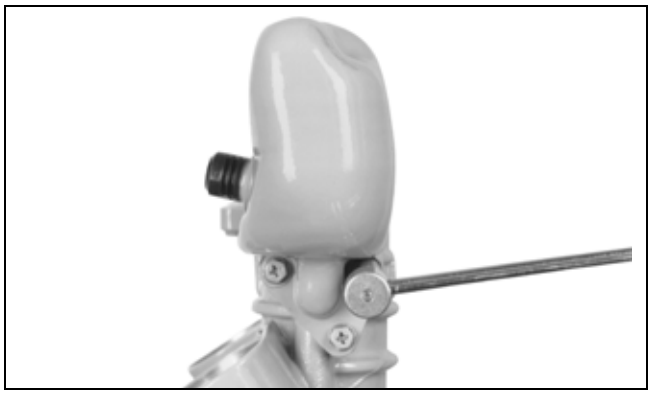
41863

Lubricate and place a new reservoir O-ring in the cylinder body.



1. O-ring 41865

Attach the reservoir to the cylinder body with three *Pozidriv* screws. Torque the screws to 35 to 52 in. lbs. (4.0 to 5.9 N·m).



41866

Trim Rod Installation

Lubricate the trim rod pistons. Place the rod assemblies into the body. Push them in until the end caps just clear the tops of the cylinders. Fill the cylinders with *Power Trim/Tilt & Steering Fluid*. Failure to fill the cylinders could cause difficulty in purging air from the unit.



41867

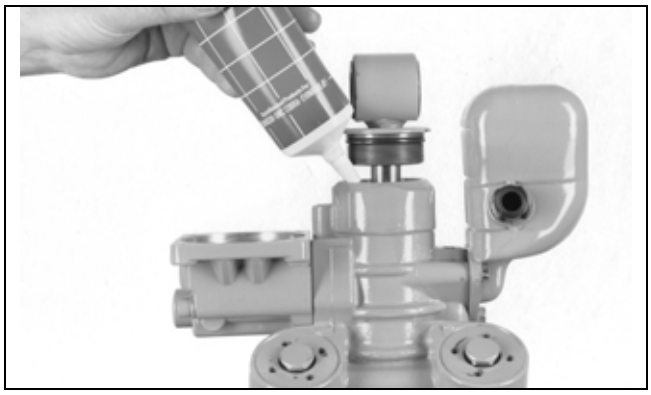
Screw the trim rod end caps into the cylinder body. Use Trim Cylinder End Cap Remover/Installer, P/N 436710, or Universal Spanner Wrench, P/N 912084. Torque caps to 60 to 70 ft. lbs. (81 to 95 N·m).



41868

Tilt Rod Installation

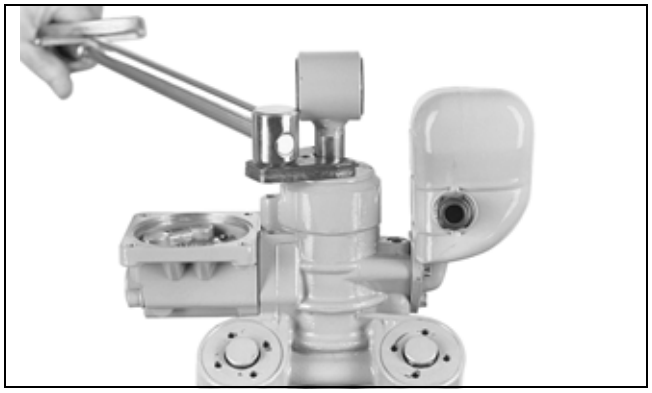
Lubricate the tilt rod piston. Slide the end cap all the way up on the rod assembly. Place the piston end of the rod assembly into the cylinder body. Push it in until the end cap just clears the cylinder top. Leave enough room to pour fluid into the cylinder. Fill the cylinder with *Power Trim/Tilt & Steering Fluid*. Failure to fill the cylinder could cause difficulty purging air from the unit.



41869

Screw tilt cylinder end cap into cylinder body. Use Tilt Cylinder End Cap Remover/Installer, P/N 326485, or Universal Spanner Wrench,

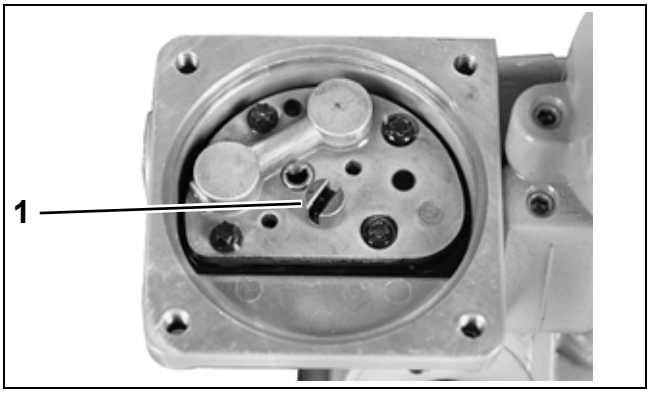
P/N 912084. Torque cap to 58 to 87 ft. lbs. (79 to 118 N·m).



41870

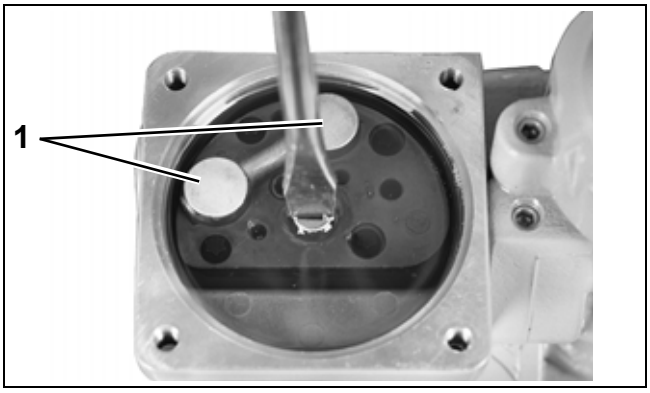
Motor Installation

Position the pump manifold so the pump mounting surface is level. Install the coupler into the pump.



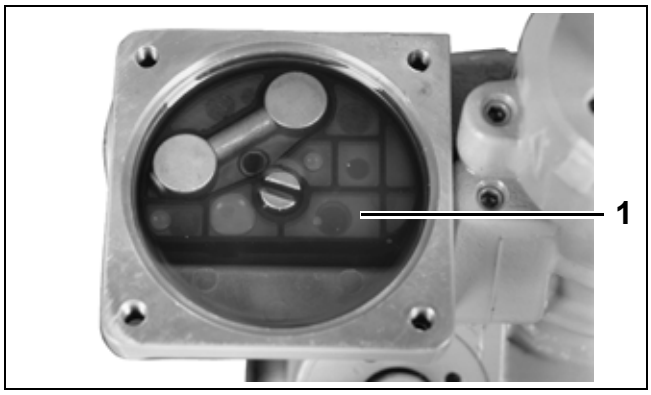
1. Coupler 41852

Fill the pump cavity with *Power Trim/Tilt & Steering Fluid* up to the top of the two bosses. Rotate the coupler clockwise and then counterclockwise until no more air bubbles come out of the pump.



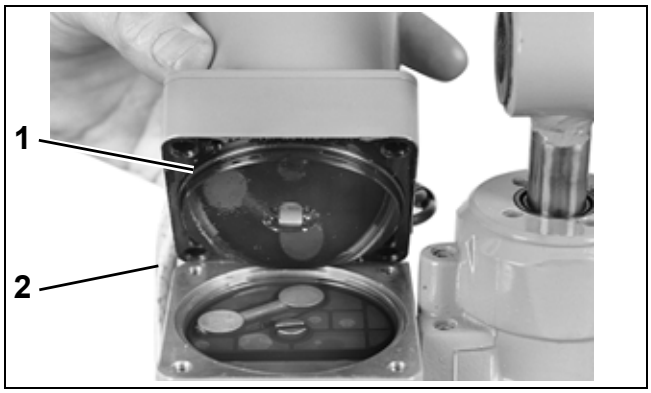
1. Bosses 41854

Install the filter screen.



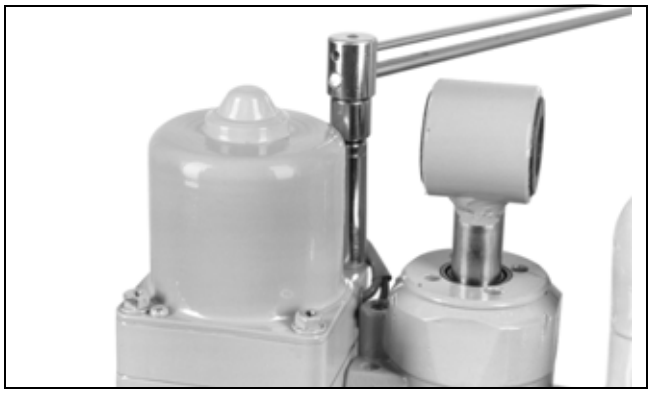
1. Filter screen 41856

Lubricate and place a new O-ring on the motor. Make sure the cable is on the transom side of the unit; align the coupler slot with the motor shaft. Place the motor on the pump manifold assembly.



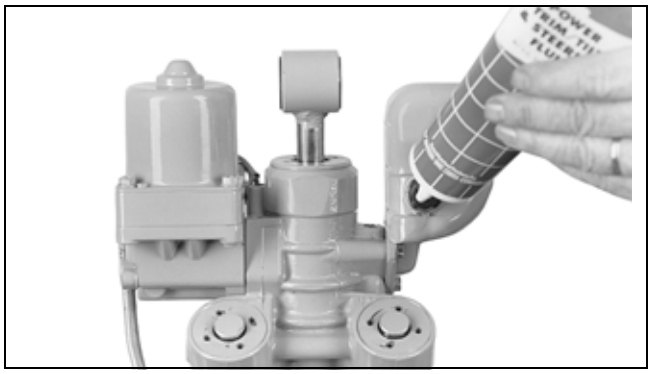
1. O-ring
2. Cable 41857

Install the four motor screws. Torque the screws to 35 to 52 in. lbs. (4.0 to 5.9 N·m).



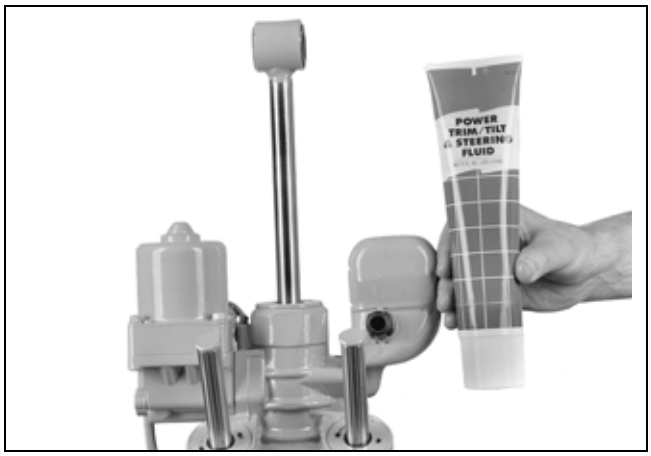
41858

Fill the reservoir to the bottom of the fill hole with *Power Trim/Tilt & Steering Fluid*. Install and tighten the reservoir cap. Turn the manual release valve in until it seats. Cycle the unit up and down several times to purge air.



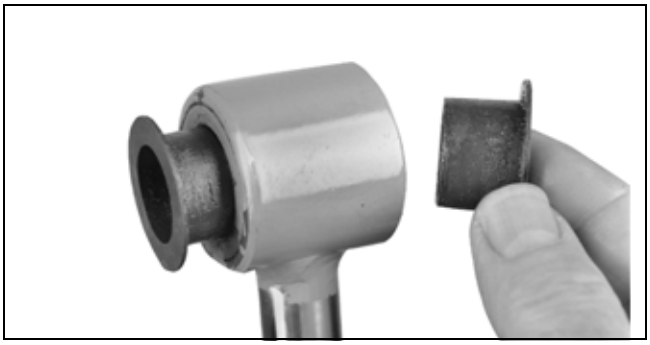
41859

Operate the unit to the full UP position, then run down momentarily to release pressure. Check the fluid level again and add fluid, if necessary. Remember that all rods must be completely up to check the fluid level. Test the unit by performing the **Pressure Leakdown Test** on p. 334.



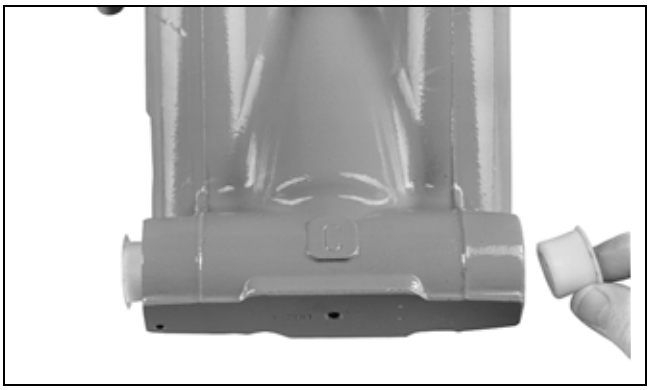
41885

Check the tilt rod bushings. Replace them if they are worn excessively.



41888

Check the bushings on the bottom of the manifold body. Replace them if they are worn excessively.



41878

Check system operation in both trim and tilt range.

ADJUSTMENTS

Refer to **Trim Sending Unit Adjustment** on p. 75.

Refer to **Tilt Limit Switch Adjustment** on p. 74.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

SAFETY

TABLE OF CONTENTS

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM S–3
OUTBOARD SHIFT SYSTEMS AND SAFETY S–4
OUTBOARD SPEED CONTROL SYSTEM AND SAFETY S–5
OUTBOARD STEERING CONTROL SYSTEM AND SAFETY S–6
OUTBOARD FUEL, ELECTRICAL SYSTEM, AND SAFETY S–8
OUTBOARD MOUNTING SYSTEM AND SAFETY S–11
OUTBOARD HYDRAULIC TILT/TRIM SHOCK ABSORPTION SYSTEM AND SAFETY S–13
OUTBOARD EMERGENCY STOP SYSTEM AND SAFETY S–14
SUMMING UP S–16
MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO FIX THEM S–17
HANDLING OUTBOARDS S–17
HANDLING LEAD/ACID BATTERIES S–21
GASOLINE – HANDLE WITH CARE S–22
HAZARDOUS PRODUCTS S–23
SAFETY AWARENESS TEST S–24

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

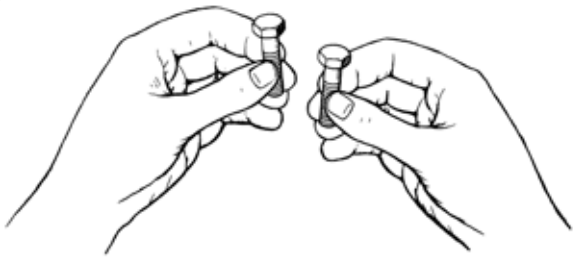
...to keep the products safe **and** reliable.

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?”

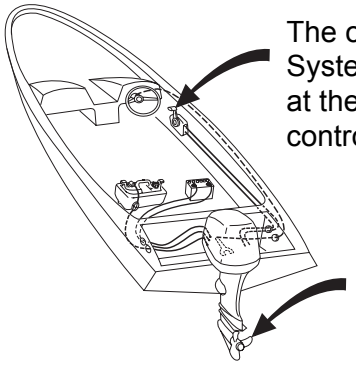
- Same size?
- Same strength?
- Same material?
- Same type?

Don’t substitute unless **you know** they are the **same** in **all** characteristics.

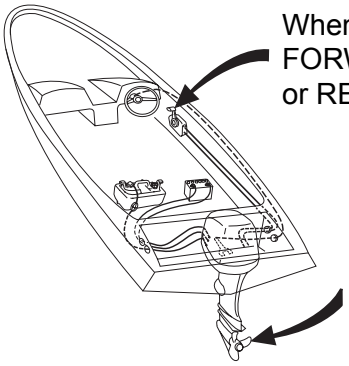
Second!

- 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

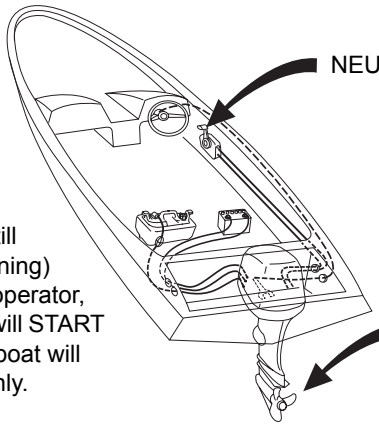


What is most important?

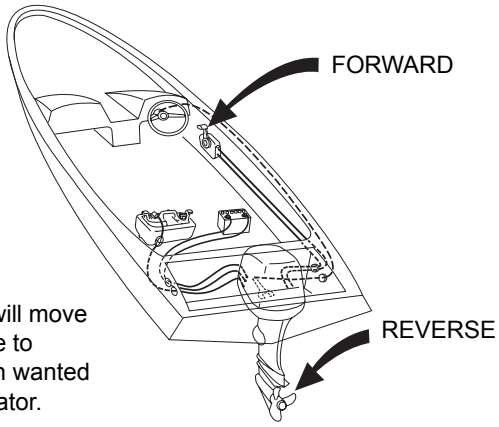


What could happen?

IF...



IF...



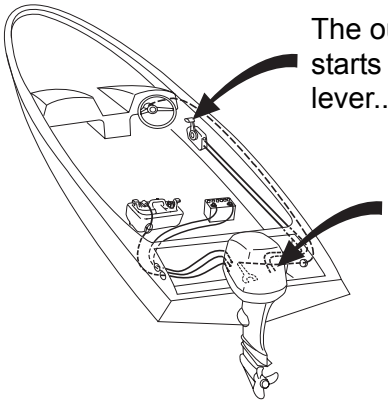
How can loss of shift control be minimized?

When rigging or after servicing

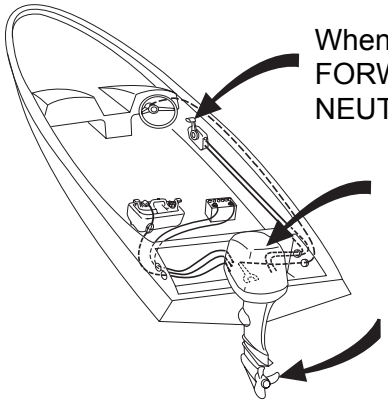
Read, **understand**, and **follow** manufacturer's **instructions**

- 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.

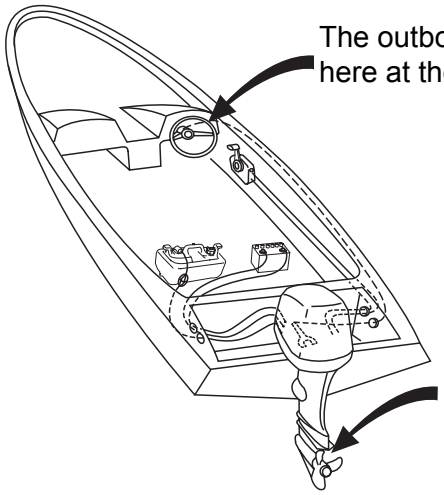
How can loss of speed control be minimized?

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

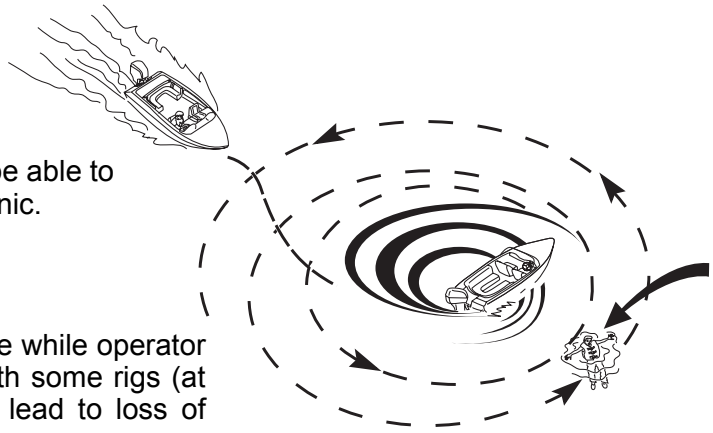


What is most important?

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.



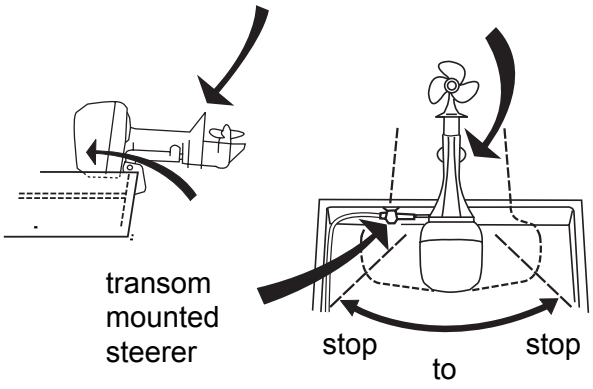
How can loss of steering control be minimized?

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!

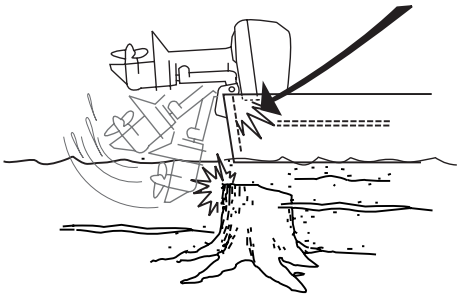
Tilt outboard into boat, then turn it.



During this procedure, steering parts:

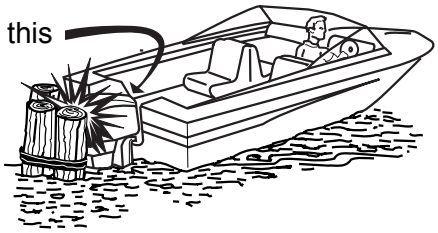
- Must not bind; and
- Must not touch other boat, outboard, or accessory parts in transom area.

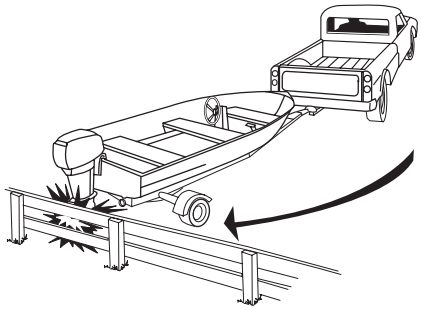
Why? A hard blow to the outboard's gearcase can result in damage to steering parts.



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



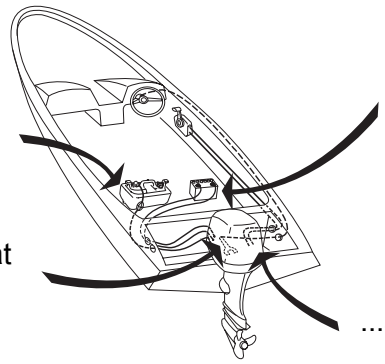


or this can put heavy loads on steering parts. Look for:

- 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



The fuel system starts here at the fuel tank...

...and ends here at the fuel injector.

The electrical system begins here at the battery...

...and ends here on the powerhead.

What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

What could happen?

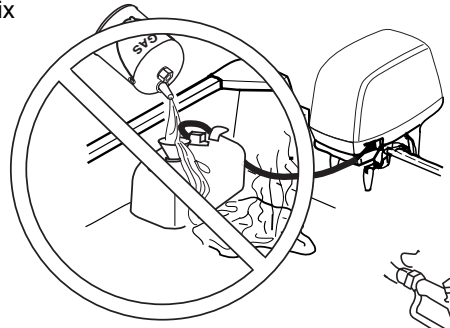
- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical 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...

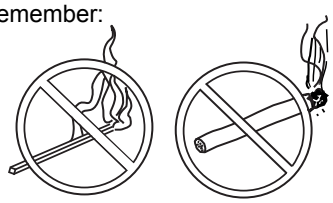




Always fill the tank outside the boat

Fumes are hard to control. They collect and hide in the bottom of the boat.

Remember:

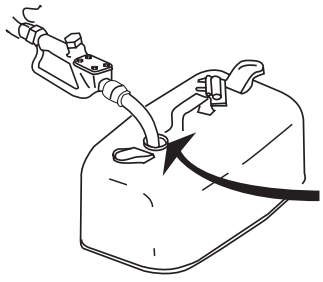




Do not use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.



If you use a funnel, it has to be metal to ground the spout to the tank.

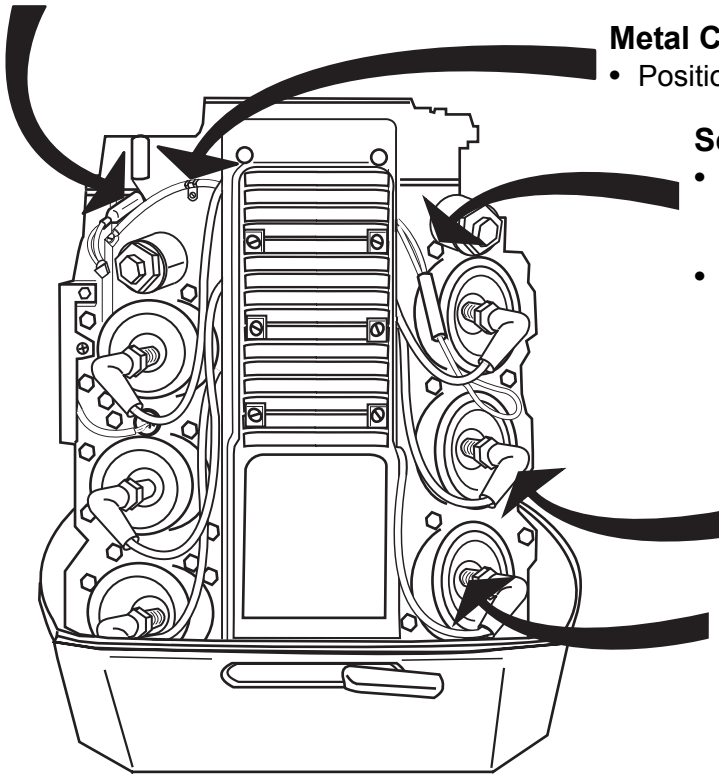


To avoid those static electric sparks, ground (touch) the spout against the tank.

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

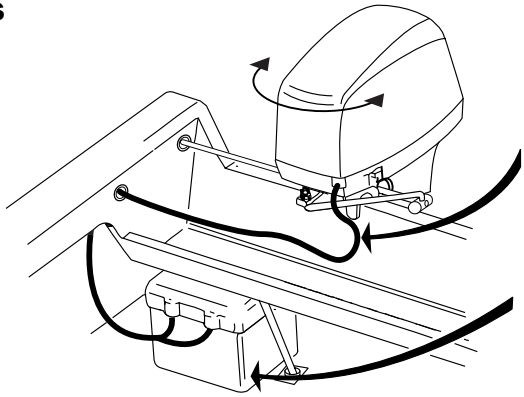
Spark Plug Boots
- Not torn or cracked
- Fully pushed onto spark plug

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)

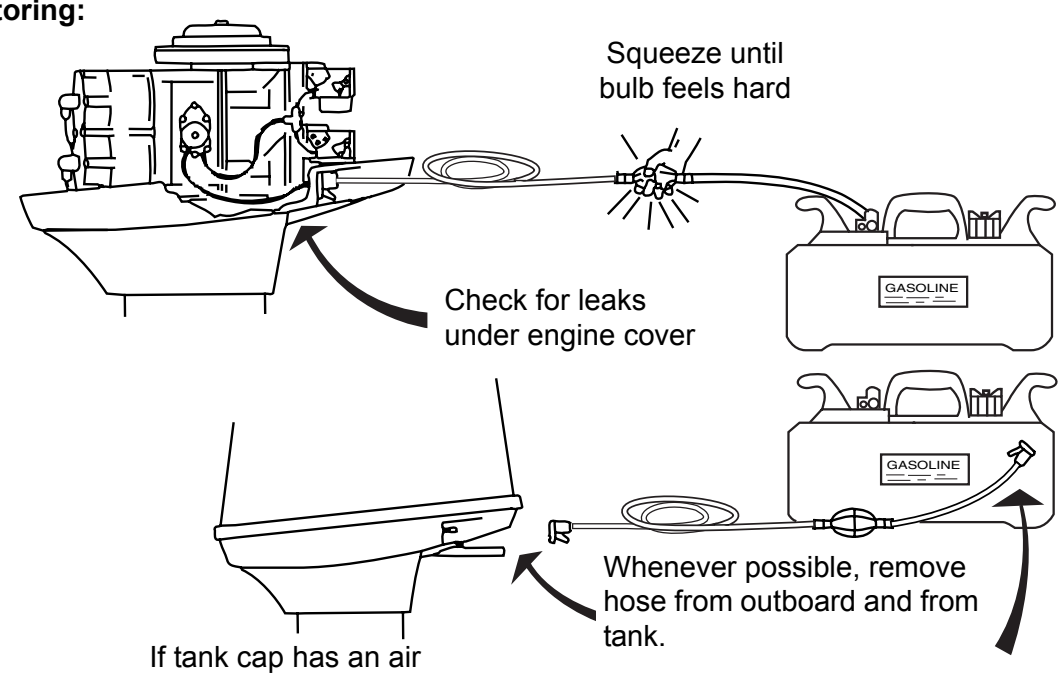


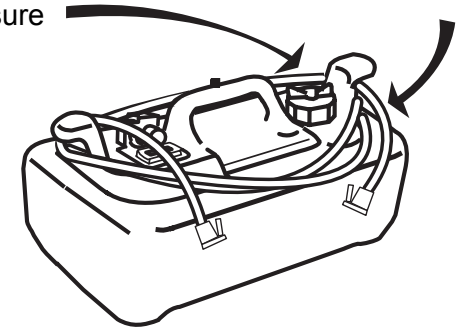
Electric Cable
- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

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:

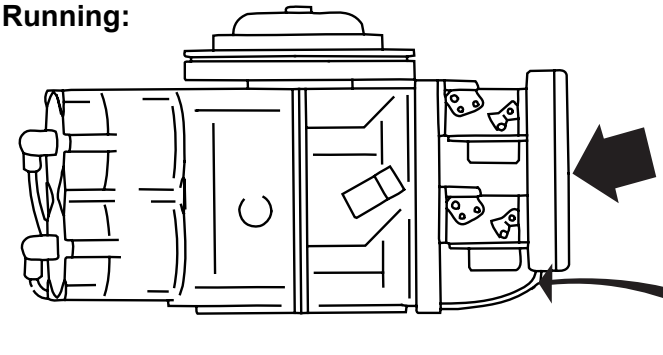




Store hose around ears of tank. This way, gasoline is trapped in tank and not in the hose, where it might leak onto the floor if the hose deteriorates.

If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used.

When Running:

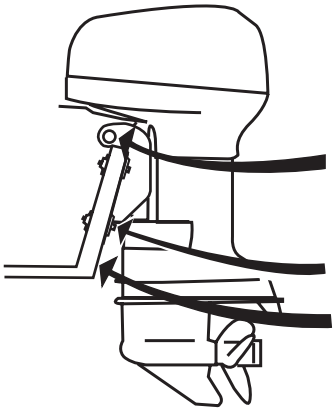


Carburetor air intake silencer will catch and hold fuel which may flood into engine if carburetor float sticks.

- **Make sure silencer and its gaskets are on engine and drain hose is in place.**
- **Air silencer mounting screws are special lock screws. Use only the special screws.**

Outboard Mounting System and Safety

The mounting system includes:



- outboard parts
- bolts, nuts, and washers
- boat's transom

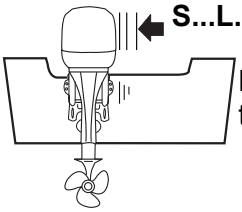
What is most important?

- Outboard must **stay** in position on boat's transom.

What could happen?

Outboard may

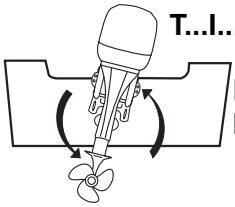
S...L...I...D...E on transom



Boat may turn and be hard to steer.

Outboard may

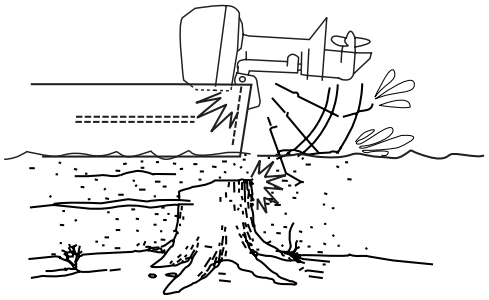
T...I...L...T on transom



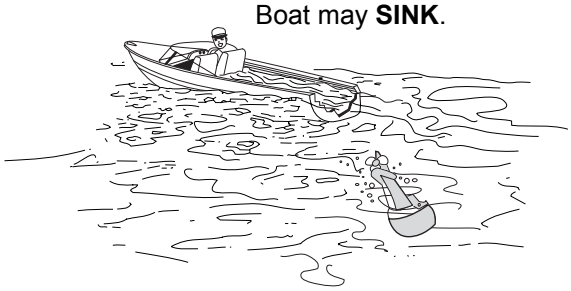
Boat may turn and be hard to steer.

- 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.



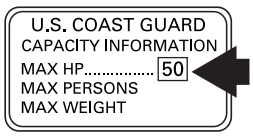
Outboard may be lost overboard.
Boat may **SINK**.



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

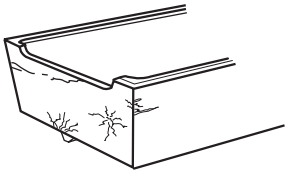


If boat plate shows...

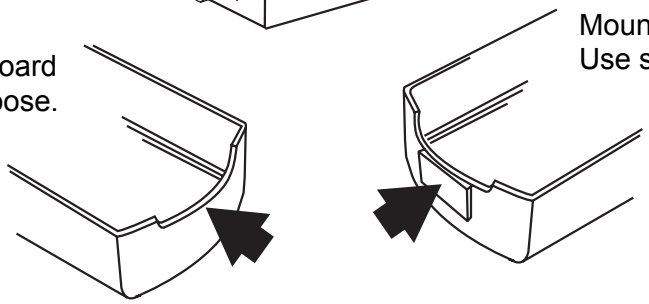
Use only or smaller



When rigging or fixing any boat, if transom looks weak, tell the owner.



If transom is curved, outboard may come loose.

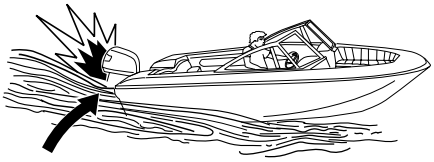


Mount on flat surface only. Use shims to make surface flat.

Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

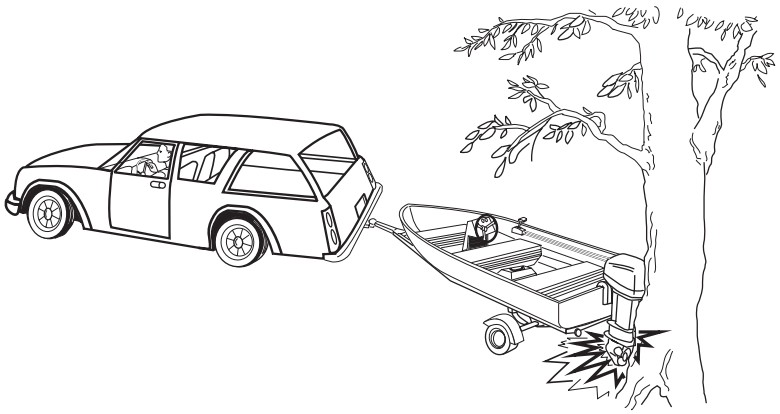


If owner tells you “I hit something really hard...”



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.”

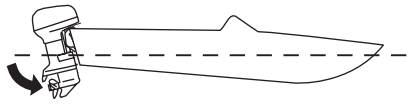
Check for a slow, heavy squash to the outboard.

- 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

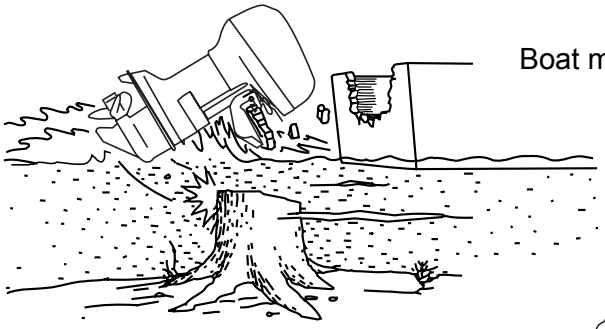
What is most important?

- 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.

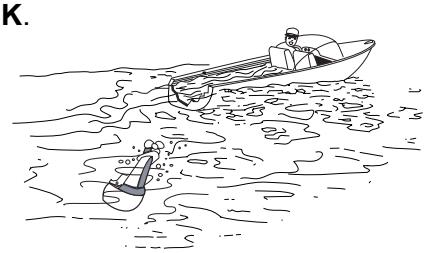


What can happen?

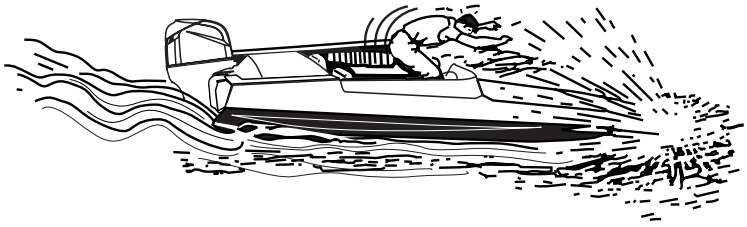
Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.



Boat may **SINK**.

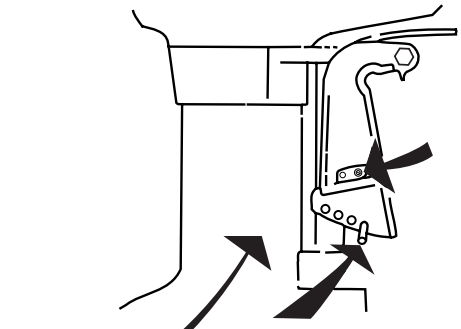


At high speeds, sudden trimming in too far may dive boat under water or spin it around.



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.

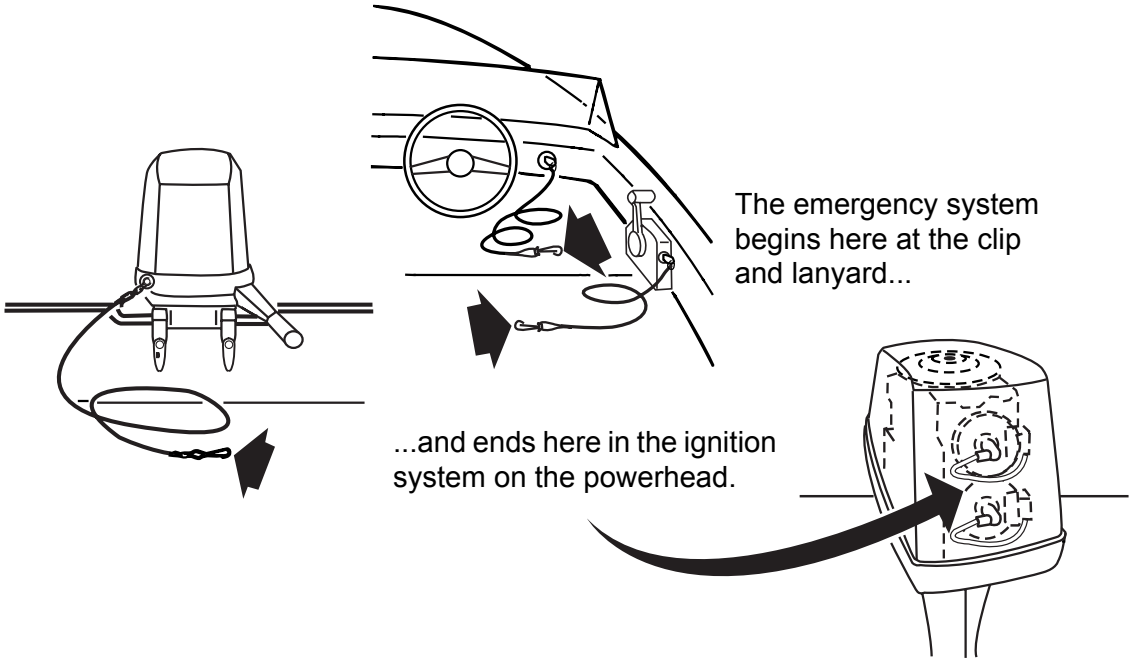


Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

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).

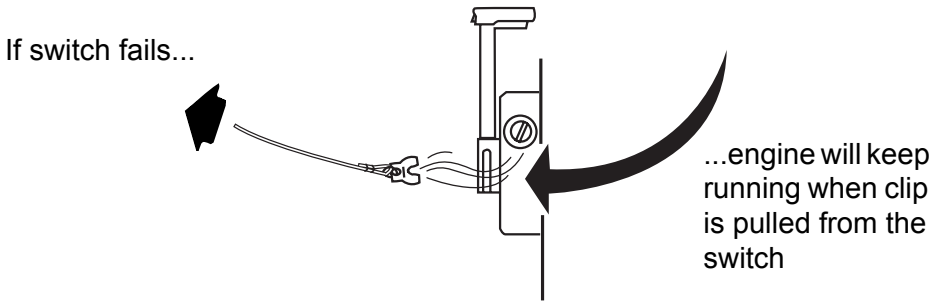
Outboard Emergency Stop System and Safety

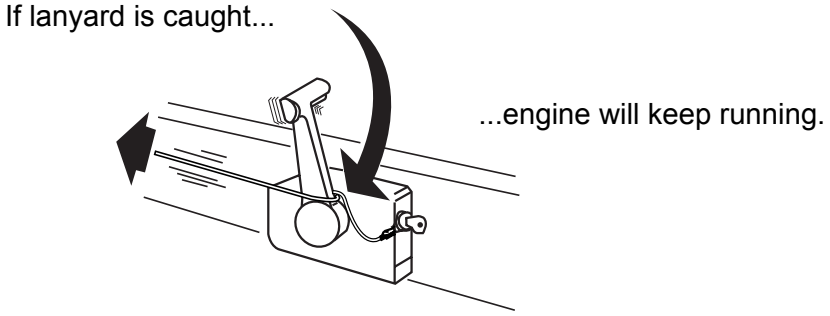


What is most important?

- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

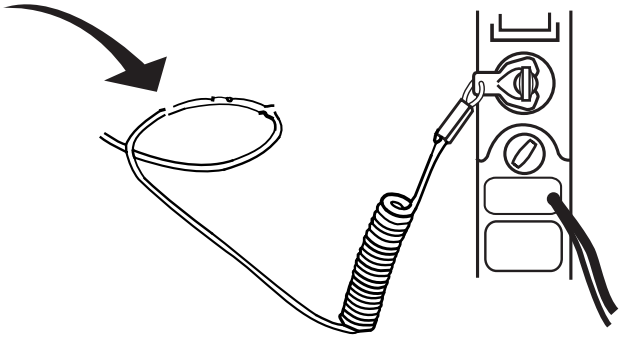
What could happen?



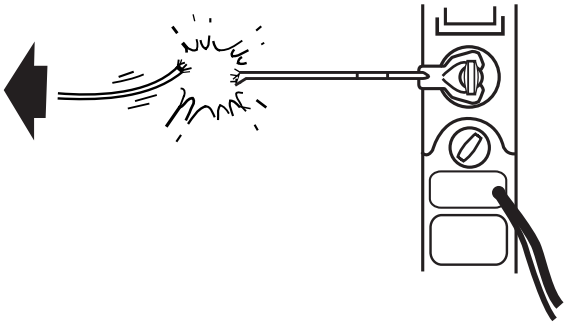


What could happen?

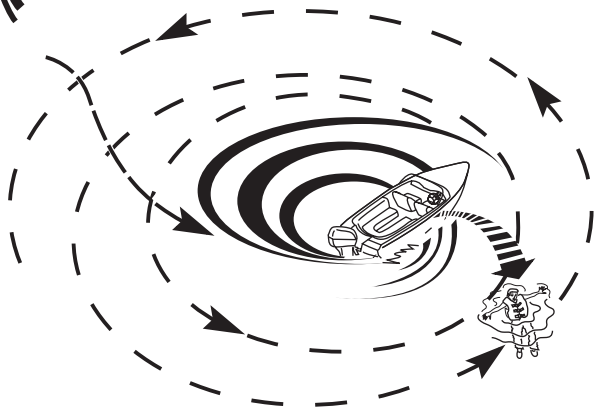
If lanyard is cut or frayed...



...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

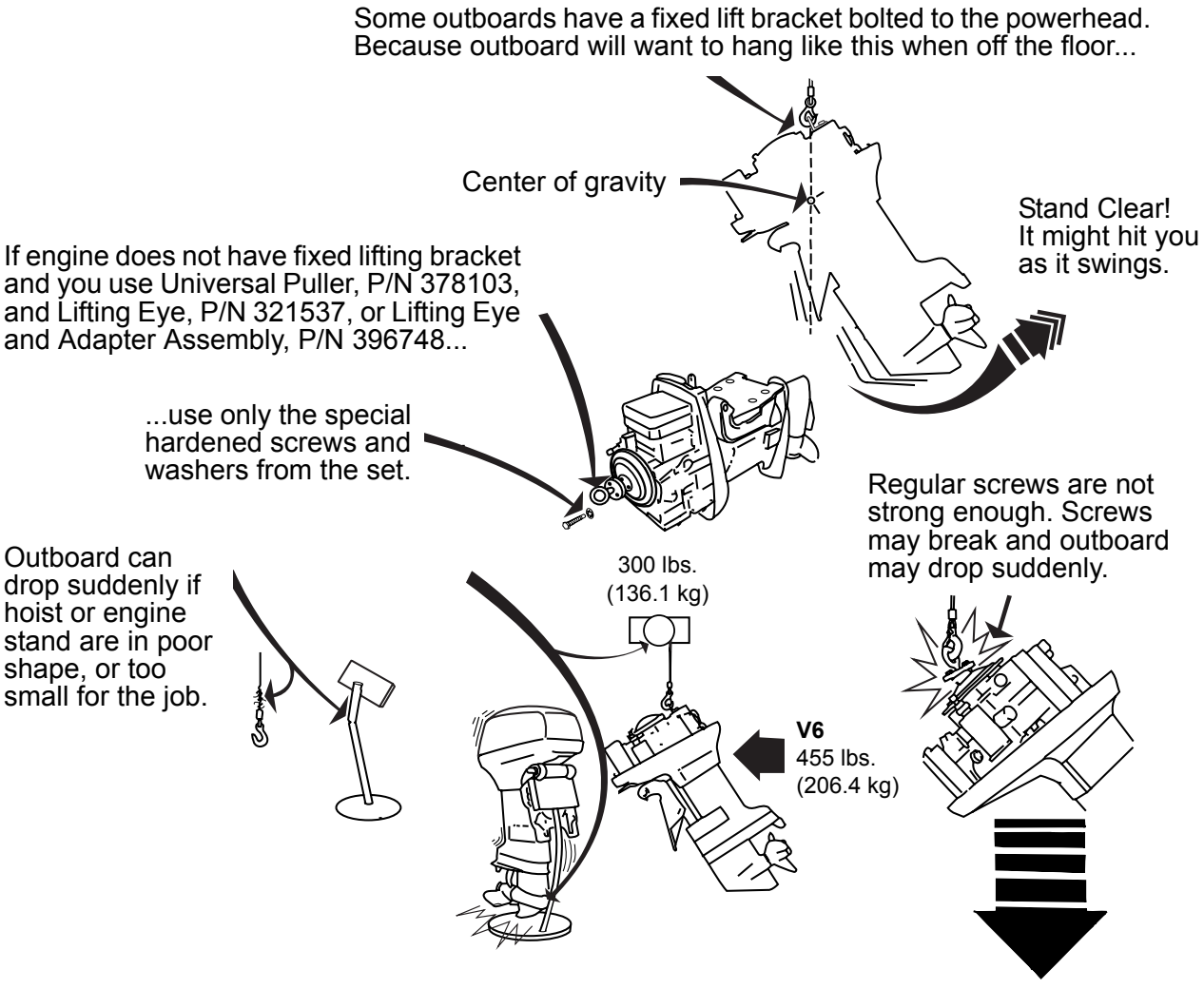
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

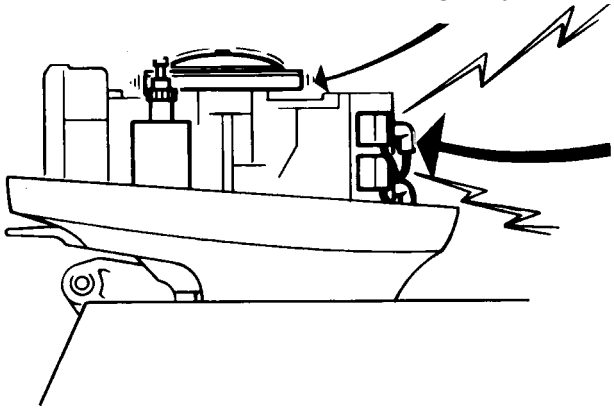
When lifting outboards



- 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.



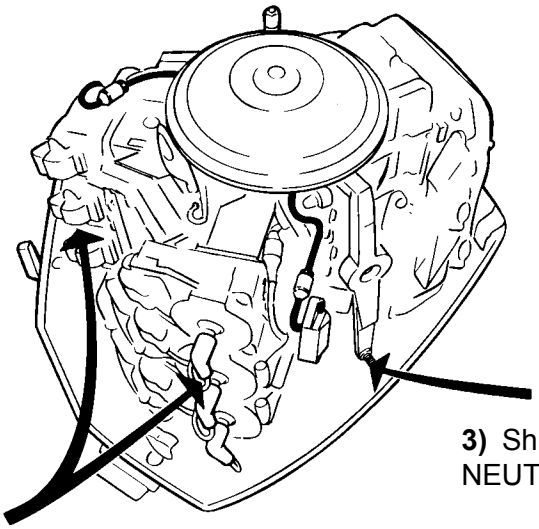
Handling high voltage parts like spark plugs and coils can shock you and may cause you to recoil into the rotating flywheel.

- 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**

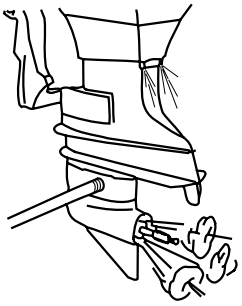
Running outboard too fast (Overspeeding)

- "Too fast" means running faster than outboard normally runs on boat.

Running too fast can happen when:

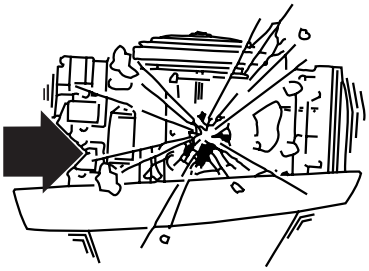
1) Using a flushing device...

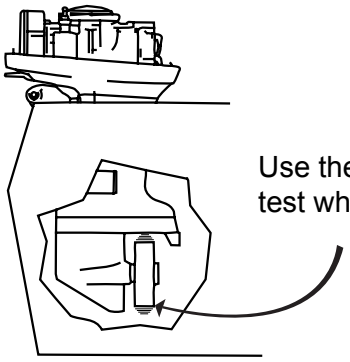
Turn on water before starting outboard. Keep engine speed below 2000 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.



2) Running with the wrong test wheel...

This may happen if outboard runs too fast.





Use the right test wheel.

Running outboards: Exhaust fumes

⚠ DANGER ⚠

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

- Whenever running the engine, assure there is proper ventilation to avoid the accumulation of carbon monoxide (CO), which is odorless, colorless, and tasteless, and can lead to unconsciousness, brain damage, or death if inhaled in sufficient concentrations. CO accumulation can occur while docked, anchored, or underway, and in many confined areas such as the boat cabin, cockpit, swim platform, and heads. It can be worsened or caused by weather, mooring and operating conditions, and other boats. Avoid exhaust fumes from the engine or other boats, provide proper ventilation, shut off the engine when not needed, and be aware of the risk of backdrafting and conditions that create CO accumulation. In high concentrations, CO can be fatal within minutes. Lower concentrations are just as lethal over long periods of time.

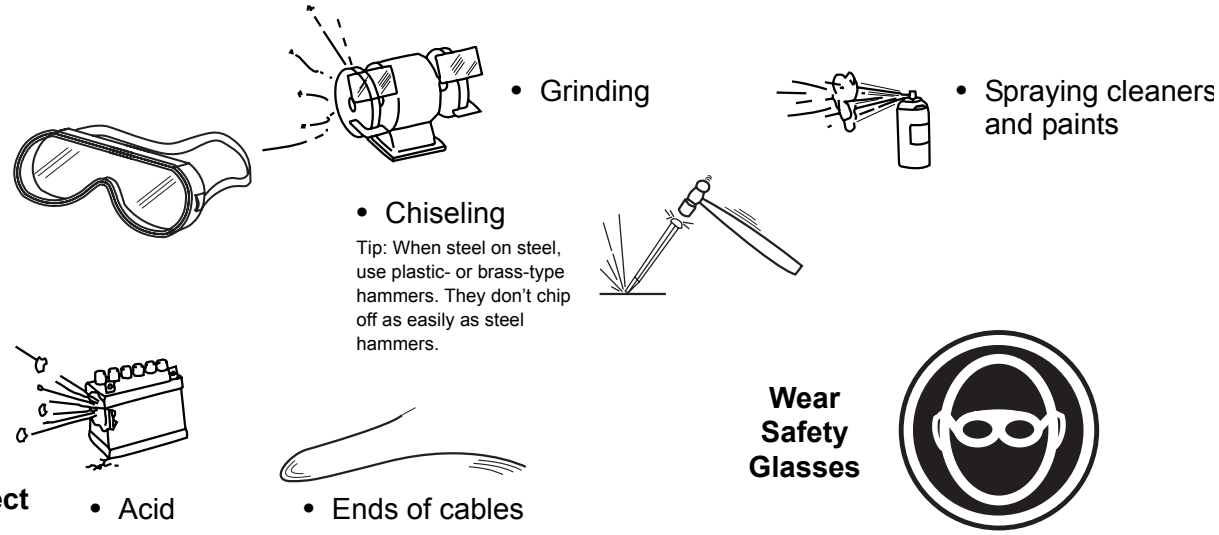
Running outboards: Propellers

DANGER

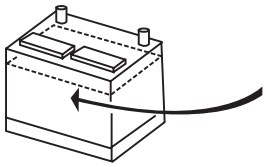
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

Eye protection

Eyes need protection when:



Handling Lead/Acid Batteries



Strong acid solution
(sulfuric acid)



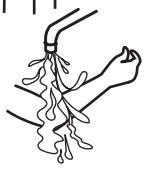
If solution gets into eyes, wash and contact a doctor immediately.



If spilled or splashed on any part of body...



Wash with
lots of water.

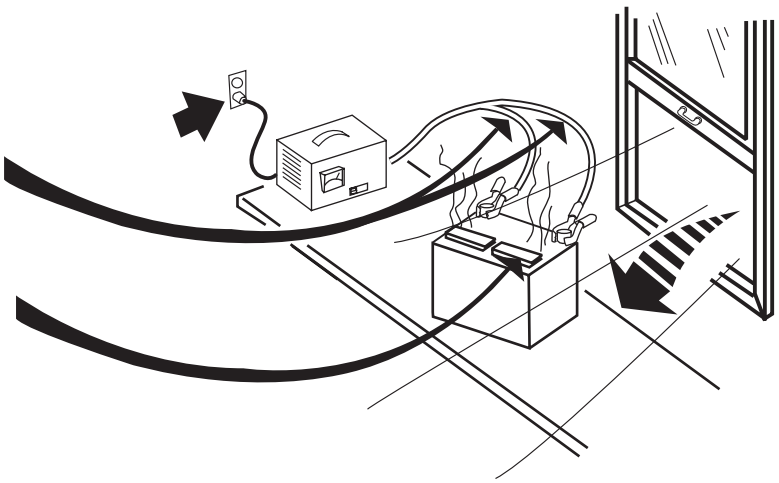


Charging lead acid batteries

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.

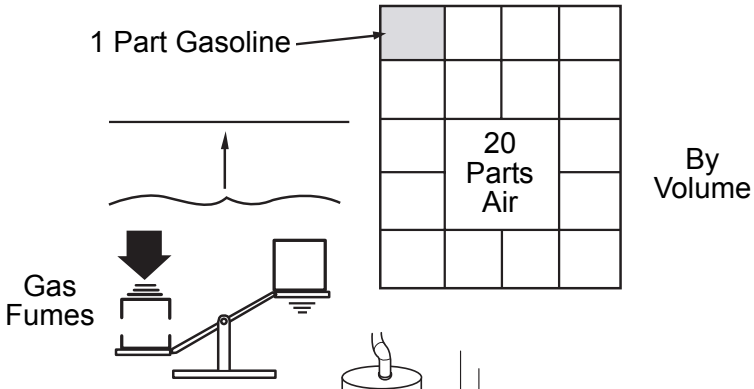


After charging:

- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

Gasoline – Handle With Care!

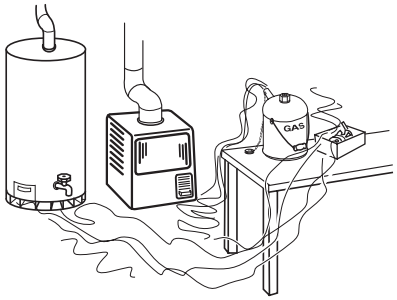
Gasoline vapor and air mixtures explode easily and violently when mixed as shown...



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.

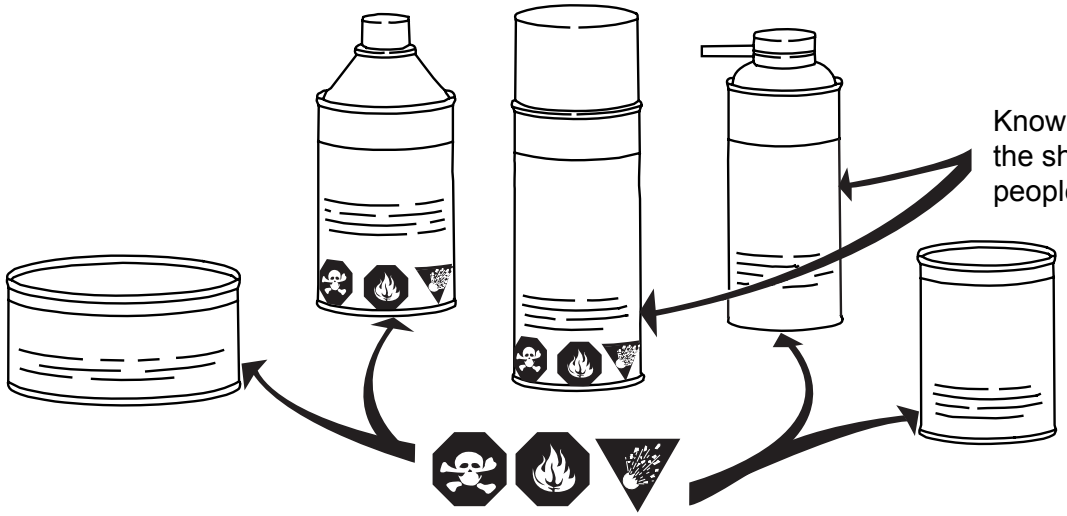
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **immediately**:
  - 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

A

Abbreviations 12
Accessories
Accessory Charge Kit, P/N 5006253 38
CANbus Water Pressure Transducer Kit, P/N 5006214 63
Drag Link, P/N 175125 57
Fuel Filter Assembly, P/N 174176 42
Remote Oil Fill Kit, P/N 176461 45
Rigging 46
XD100 Outboard Oil Decal, P/N 352369 66, 207
Adapter Housing 221
Service 267
Adjustments
Control Cable 60, 61
Shift Rod 290
Tilt Limit Switch 74
Timing 109, 154
Timing Pointer 154
Trim Sending Unit 75
Trim Tab 76
Air Silencer
Description 88
Air Temperature Sensor
Connections 114
Description 98
Resistance Test 140
Alternator Circuit Test 143
***AMP* Connector Servicing** 165
Anodes
Anti-Corrosion 81
Continuity Check 81
Propeller Shaft Bearing Housing 299
Stern Bracket 274, 277

B

Barometric Pressure Sensor 98
Batteries
Battery Charge Isolator 38
Battery Switches 37
Cable Routing 47
Cables 37
Charging System Tests 142
Connections 36, 87
Installation 36
Multiple Batteries 37
Requirements 19, 36
Storage 92
Wiring Diagrams 39
Bearing
Crankshaft 240
Break-In
EMM Programming 66, 71, 109
Gearcase 287, 309, 322
Oiling 66
Procedure 71

C

Cable, Hose, and Wire Routing 35, 46, 59
CANbus
Connections 63
Harness Routing 59
Ignition Harness 63
Oil Level Gauge 63
Software Activation 63
SystemCheck Functions 111
Water Pressure Gauge 63
Capacitor 126
Resistance Test 142
Connecting Rods
Installation on Crankshaft 245
Installation on Piston 243
Orientation 246
Removal from Crankshaft 233
Removal from Piston 234
Torquing 246
Control Cable
Adjustments 60, 61
Identification 50
Installation 60
Routing 35, 46

Cooling System
Components 220
Cylinder Block Venting 221
EMM and Vapor Separator Cooling 223
Engine Temperature Check 217
Flushing 82
Hose Routing and Water Flow 216
Operating Temperatures 71
Operation 222
Pressure Relief Valve 221, 224
Thermostats 221, 223
Turbulence 51
Vapor Separator 174
Water Intake Screens 80, 82, 83, 305
Corrosion Protection 81
Anodes 277
Counter Rotation Gearcase Service 310
Crankcase
Installation 248
Removal 232
Crankshaft
Assembly 240
Bearings 240
Disassembly 235
Inspection 238
Installation 245
Crankshaft Position Sensor
Description 100
Operation Test 130
Resistance Test 139
Cylinder Bore
Honing 237
Inspection 238
Cylinder Head
Inspection 238
Installation 245
Removal 233

D

Dash Connections 138
***Deutsch* Connector Servicing** 164
Diagnostic Procedures Overview 118
Diagnostic Software
Break-In Programming 66, 71, 109
CANbus Activation 63
Communication with Outboard 105
Crankshaft Position Sensor 100, 130
Cylinder Drop Test 120
Description 105, 117
Diagnostic Procedures Overview 118
Engine Monitoring Screen 121
Fuel Injector Programming 110, 175, 187, 190
Fuel Injector Tests 132, 133, 179
Fuel Pump Test 131, 179
Oil Injector Test 207
Oil Priming 67, 108, 205
Oiling Rate 67, 109, 205
Reports 110
Sensor Monitoring 139
Service Codes 106
Shutdown Mode 103
Static Spark Test 128
Timing Verification 109, 155
Driveshaft
Installation 307
Removal 293
Service 294
Shimming 304
Special Removal Procedures 294
Driveshaft Bearing Housing 298
Installation 302
Seal Removal 298
Dual-Outboard
Alignment 77
CANbus Setup 63
Centerlines 52

E

Electrical Circuits
Ground Circuits 116
Ignition System 126
Key Switch 124
Start Circuit 122
SystemCheck 151
Tests 116

Electrical Connectors 164
AMP Connectors 165
Deutsch Connectors 164
Packard Connectors 167
Electrical Harness Connections 62
Emergency Stop Switch
Installation 34
Operation Check 70
Test 149
Emissions Information 13
EMM
12 V Circuit Sensor 97
Connections 96, 102
Diagnostic Software 105
Diagnostics 104, 117, 118
Fuel Injector Servicing 110
Functions 96
LED Indicators 117
Map Replacement 111
Reports 110
Sensors 97, 98
Service Codes 106
Timing Verification 109, 155
Transfer 111
Engine Temperature Check 217
Engine Temperature Sensor 140
Exhaust Housing
Assembly 269
Cleaning and Inspection 268
Disassembly 267
Installation 272
Removal 267
Exhaust Pressure Fitting 90
Exterior Finish Protection 81

F

Flushing, Cooling System 82
Flywheel
Installation 153
Removal 152
Forward Gear, Counter Rotation
Assembly 316
Disassembly 315
Fuel Filter
Installation 185
Removal 185
Requirements 42
Fuel Injectors
Crush Ring Replacement 188
Electrical Circuits 177
EMM Programming 110, 175, 187, 189, 190
Installation 189
Removal 187
Tests 132, 133, 179, 180, 182
Fuel System
Additives 64
Components 173
Filter 42, 173, 185
Fuel Circulation Pump 131, 174
Fuel Filter 88, 185
Fuel Lift Pump 173, 183, 185
Fuel Manifolds 190
Fuel Requirements 64
Hose Routing 176
Intake Manifold 191
Minimum Octane 64
Pressure Tests 180
Priming 65
Relieving Pressure 184
Requirements 41
Troubleshooting 131, 179
Vapor Separator 173, 186
Fuse 116

G

Gauges
CANbus 63, 111
SystemCheck 35, 111
Tachometer 71
Gearcase
Assembly 305
Counter Rotation Service Procedures 310
Disassembly 291
Installation 286
Leak Test 285
Lubricant 85, 284
Removal 285
Grommet 59

H

Honing 237
Hoses
Fuel System 41, 47
Inspection 88
Oil Distribution 211
Oil Recirculation System 201
Oiling System 47
Routing, Fuel System 176

I

I-Command
see CANbus
Idle Controller 101
Ignition
Circuits 126
Primary Circuit Resistance Test 130
Running Tests 129
Static Spark Test 128
Ignition Coil Resistance Tests 140
Impact Relief Valves 328
Instrument Harness 138
Intake Manifold
Assembly 192
Disassembly 191
Inspection 192
Installation 193
Removal 191

K

Key Switch
Circuit Tests 147
Operation Check 70
Start Circuit 124

L

Lubrication
Engine Oil 65
Gearcase 85, 284
Propeller Shaft 85
Swivel Bracket 84
Throttle and Shift Linkage 85
Tilt Tube 84
Trailering Bracket 84
Trim and Tilt 86

M

Maintenance and Inspection Schedule 80
Manual Release Valve, Trim and Tilt
Operation 330, 331
Midsection
Exhaust Housing Servicing 267
Stern Bracket Servicing 273
Tilt Tube Servicing 265
Models/Model Designation 7
Mounting the Engine
Hull Preparation 51
Mounting Height 58

N

Neutral Start Switch
Tests 148
New Engines
Fuel and Oil Priming 64
Outboard Rigging Procedure 59

O

***Oetiker* Clamp Servicing** 48
Oil Injector
Description 197
Electrical Circuit (40 V) 198
Electrical Tests 207
Functional Test 210
Installation 212
Removal 212
Oil Pressure Sensor
Description 198
Oil Tank 43, 197
Oiling Rate 66, 109, 206
Oiling System
Components 197
Engine Lubricant 65
New Engine Set-Up 43, 65
Oil Distribution Hose Replacement 211
Oil Filters 88
Oil Injector Electrical Circuits 199
Oil Pressure Sensor 99
Oil Recirculation 201, 202
Oil Supply and Distribution 203, 204
Oil Tank 43
Oiling Rate 206

Priming 67, 205
Servicing 211
SystemCheck Warning Signals 200
Outboard Excessive Smoking T–5
Outboard Hard to Start T–3
Outboard Starts and Stalls T–4
Outboard Starts, Low Maximum RPM T–5
Outboard Surges, Runs Rough T–6
Outboard Will Not Start T–1
Outboard Won't Shut Off T–4

P

***Packard* Connector Servicing** 167
Pinion Gear
Installation 307
Removal 293
Pinion Gear Bearing
Installation 301
Removal 297
Piston Rings
End Gap 244
Inspection 239
Installation 244
Removal 234
Pistons
Assembly 243
Inspection 239
Installation 244
Powerhead
Assembly 240
Cleaning 237
Cylinder Compression Testing 228
Disassembly 232
Inspection 238
Installation 250
Removal 229
Views 253
Predelivery Checks 69
Pre-Season Service 92
Pressure Relief Valve, Cooling System 224
Priming
Fuel System 65
Oiling System 108, 205
Propeller
Inspection 283
Installation 73
Selection 72
Propeller Shaft
Installation 305
Lubrication 85
Removal 295
Propeller Shaft Bearing Housing
Bearing Installation 303
Bearing Removal 298
Installation 308
Rear Seal Installation 303
Rear Seal Removal 298
Propeller Shaft Bearing Housing, Counter Rotation
Assembly 318
Bearing Installation 320
Bearing Removal 319
Disassembly 315
Installation 321
Rear Seal Installation 321
Rear Seal Removal 319
Removal 310
Propeller Shaft, Counter Rotation
Removal 310

R

Relays
Trim and Tilt 151
Remote Controls
Cable Adjustment 60, 61
Cable Installation 60
Installation 35
Selection 34
Rigging
Boat 34
Electrical Harness 62
Outboard 59
RPM Limit 96, 100, 101, 103

S

S.A.F.E.
Activating Conditions 103
Description 103
Oil Pressure 99
Temperature 97, 98
Voltage 97
Safety S–1
Sensors 139
Air Temperature Sensor 98, 140
Barometric Pressure Sensor 98
Crankshaft Position Sensor 100, 130, 139
EMM 97, 98
Engine Temperature Sensor 98, 140
Exhaust Pressure Sensor 90, 98
Oil Pressure 99, 198
Throttle Position Sensor 100, 139
Serial Number Location 6
Service Charts
Electrical and Ignition 136
Fuel System 170
Gearcase 280
Midsection 262
Oiling System 196
Powerhead 226
Trim and Tilt 324
Shift Housing
Assembly 299
Disassembly 296
Installation 305
Removal 295
Shift Housing, Counter Rotation
Assembly 312
Removal 310
Shift Linkage, Lubrication 85
Shift Rod
Adjustment 290
Housing Installation 306
Shimming, Driveshaft 304
Shop Aids 28
Spark Plugs
Indexing 155
Inspection 118, 155
Maintenance Schedule 80
Recommendation 89, 155
Replacement 89
Special Tools 21
Specifications 18
Starter
Assembly 160
Circuit Description 122
Cleaning and Inspection 159
Current Draw Test 150
Disassembly 157
Installation 163
Removal 156
Solenoid Test 150
Start-In-Gear Protection 70, 148
Stator
Resistance Test 141
Voltage Output Test 141
Steering System
Lubrication 84
Requirements 56
Steering Arm and Shaft 273, 276
Steering Torque 76
Stern Bracket, *FasTrak*
Assembly and Installation 275
Disassembly 273
Removal 273
Stop Circuit 149
Storage 91
Submerged Engines 93
Switches
Key Switch 147
Swivel Bracket
Installation 277
Lubrication 84
Removal 274
Symbols 14
SystemCheck
CANbus Gauges 111
CHECK ENGINE Warning Signal 97, 100, 101
Circuits 151
Dash Connections 138
Description 111
Gauges 35, 111
LOW OIL Warning Signal 211
NO OIL Warning Signal 99, 198, 200
Operation Check 70
Requirement 35

S.A.F.E. 103
Self Test 112
Service Mode 112
TEMP Warning Signal 97, 98, 99
Tests 67, 108, 145, 146, 147
Warning Horn 112
Winterization Procedure 91

T

Tachometer
Pulse Setting 71
Test 149
Technical Data 18
Temperature
Operating 71, 217
Operation below freezing 65
Temperature Sensor
Description 97
Resistance Test 140
Thermostat
Assembly 223
Description 221
Disassembly 223
Inspection 223
Throttle Linkage
Lubrication 85
Throttle Position Sensor
Description 100
Tests 139
Tilt Limit Switch
Adjustment 74
Cam Installation 266
Tilt Piston
Assembly 346
Identification 345
Removal 344
Tilt Relief Valve 329
Tilt Rod
Assembly 346
Installation 351
Tilt Support 325
Tilt Tube
Installation 266
Lubrication 84
Removal 265
Timing Pointer Adjustment 154
Timing Verification 109, 155
Tools
Backing Plate, P/N 325867 294
Bearing Installation Tool, P/N 339750 303, 320
Bearing Installation Tool, P/N 339778 316
Bearing Installation Tool, P/N 432401 320
Bootstrap Tool, P/N 586551 111
Collar, P/N 341440 304
Connector Service Tool, P/N 342667 164
Crankshaft Bearing/Sleeve Installer, P/N 338649 241
Crimping Pliers, P/N 322696 164
Cylinder Bore Gauge, P/N 771310 238
Diagnostic Interface Cable, P/N 437955 105
Diagnostics Software, Windows, P/N 763724 105
Driveshaft Holding Socket, P/N 311875 293, 308
Driveshaft Puller, P/N 390706 294
Driveshaft Seal Protector, P/N 318674 304, 305, 307
Driveshaft Shimming Tool, P/N 393185 304
Electrical Test Probe Kit, P/N 342677 143, 208, 209
Flywheel Holder, P/N 771311 152, 230
Fuel Pressure Gauge, P/N 5000902 180
Fuel Pressure Gauge, P/N 5005697 182
Gauge and Collar Assembly, P/N 983975 334
Guide Rods, P/N 383175 242
Hydraulic Cylinder Rod Holder, P/N 983213 348, 349
Injector Test Fitting Kit, P/N 5005844 179
Large Puller Jaws, P/N 432129 235, 298, 316, 319
Lifting Eye, P/N 321537 S–17
Lifting Fixture, P/N 396748 231, 250
Lower Driveshaft Puller, P/N 342681 294
Oetiker Pincers, P/N 787145 49
Pinion Bearing Remover and Installer, P/N 391257 301
Pinion Nut Holder, P/N 334455 293, 308
Pinion Nut Starting Tool, P/N 342216 307

Piston Stop Tool, P/N 342679 154
Plug/Holder, P/N 329661 209
Primary Lock Tool, P/N 777077 165
Propeller Shaft Adapter, P/N 432398 310
Puller Bridge, P/N 432127 298, 316, 319
Retaining Ring Pliers 228
Rod Cap Alignment Fixture, P/N 396749 246
Seal Installation Tool, P/N 325453 241, 242
Seal Installation Tool, P/N 330268 302
Seal Installation Tool, P/N 336311 303, 321
Secondary Lock Installer, P/N 777079 165
Secondary Lock Tool, P/N 777078 165
Shim Gauge Bar, P/N 349957 304
Slide Hammer Adaptor Kit, P/N 390898 188
Slide Hammer, P/N 391008 188, 241, 294
Slide Hammer, P/N 432128 235, 266, 310
Small Puller Jaws, P/N 432131 298, 319
Spanner Wrench, P/N 432400 315, 319
Stator Test Adaptor, P/N 5006211 141
Taper Pin Tool 228
Temperature Gun, P/N 772018 217
Terminal Release Tool, P/N 351413 166
Test Propeller 18
Thermal Joint Compound, P/N 322170 218
Tilt Cylinder End Cap Remover/Installer, P/N 326485 344, 351
Tilt Cylinder Seal Protector, P/N 326005 347
Tilt Tube Service Kit, P/N 434523 265
Timing Light 120
Torquing Socket, P/N 346187 234, 247
Transom Drill Fixture, P/N 434367 54
Trim Cylinder End Cap Remover/Installer, P/N 436710 348, 351
Trim/Tilt Service Kit, P/N 390010 334
Trim/Tilt Service Kit, P/N 434524 334
Universal Puller Set, P/N 378103 153, 230, 292, S–17
Universal Shift Rod Height Gauge, P/N 389997 290
Universal Spanner Wrench, P/N 912084 344, 348, 351
Wrench Retainer, P/N 341438 293, 308
Wrist Pin Cone, P/N 331913 243
Wrist Pin Pressing Tool, P/N 396747 235
Wrist Pin Retaining Ring Driver, P/N 396747 243

Torque Charts
see Service Charts
Standard 20

Trailering Bracket
Lubrication 84
Operation 325

Trim and Tilt
Circuits 151
Disassembly 342
Electrical Circuit Tests 152
Inspection 332
Installation 340
Lubrication 86
Manifold and Reservoir Installation 350
Manual Release 330
Pressure Leakdown Test 334
Removal 339
Reservoir Fluid 332
Troubleshooting 333

Trim and Tilt Motor
Current Draw Tests 336
Installation 352
No Load Test 337

Trim Gauge Test 338

Trim Rods
Assembly 349
Installation 351
Removal 348

Trim Sender
Adjustment 75
Test 338

Trim Tab
Adjustment 76
Installation 287
Removal 285

Troubleshooting
Air Temperature Sensor 140
Charging System Tests 142
Cylinder Drop Test 120
Diagnostic Procedures 118
Engine Temperature Sensor 140
Fuel Injectors 132
Fuel System 131, 179, 180
Ignition 126, 127, 129
Inductive Amp Meter Test 121
Oiling System 207
Specialized Test Procedures 120
Timing Light Test 120
Trim and Tilt 333
Trim Sender 338
Trouble Check Chart 1
Voltage Testing 122

V

Vapor Separator
Description 173
Installation 186
Removal 186

W

Water Intake Screens 80, 82
Inspection 83
Installation 305
Removal 295
Water Pressure Gauge 62, 63
Water Pump
Assembly 288
Description 220
Disassembly 288
Inspection 288
Water Supply Tube 220
Water Temperature Sensor 98
Winterizing 91
Wiring Harness Connections 62

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.
	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** on p. 169 (vapor separator venting and fuel supply)
	Low or no fuel pressure to injectors	Check fuel manifold pressure, refer to **FUEL SYSTEM** on p. 169
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Fuel injectors not working	Check voltage at injectors
	Excessive fuel or oil, engine flooded	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent, refer to **SYSTEM ANALYSIS** on p. 113
	Low or no 55 V alternator output	Check voltage on 55 V circuit, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuits, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Ignition	Check ignition, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	CPS input to *EMM,* no sync	Check RPM reading while cranking
	No ignition system primary voltage output from *EMM* to ignition coils	Check cranking RPM (300 minimum), refer to **SYSTEM ANALYSIS** on p. 113
	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)

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** on p. 169 (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to **FUEL SYSTEM** on p. 169
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Restricted or leaking fuel injector(s)	Check injectors, refer to **FUEL SYSTEM** on p. 169
	Weak or erratic ignition operation	Check ignition, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	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** on p. 113.
	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
	Low compression	Check compression
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

OUTBOARD WILL NOT SHUT OFF

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard starts and runs, normal performance while running	Key switch or wire harness ground	Check key switch and ground to key switch, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to **FUEL SYSTEM** on p. 169
	Air in fuel system	Check for air in fuel supply manifold, refer to **FUEL SYSTEM** on p. 169 (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** on p. 113
	Restricted or leaking fuel injector(s)	Check injectors, refer to **FUEL SYSTEM** on p. 169
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Weak or erratic ignition operation	Check ignition, refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Fuel injector electrical circuit or control function	Check voltage at injectors, refer to **SYSTEM ANALYSIS** on p. 113
	Restricted or leaking fuel injectors	Check injectors, refer to **FUEL SYSTEM** on p. 169
	Low fuel pressure	Check circulation pump operation, refer to **FUEL SYSTEM** on p. 169
	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

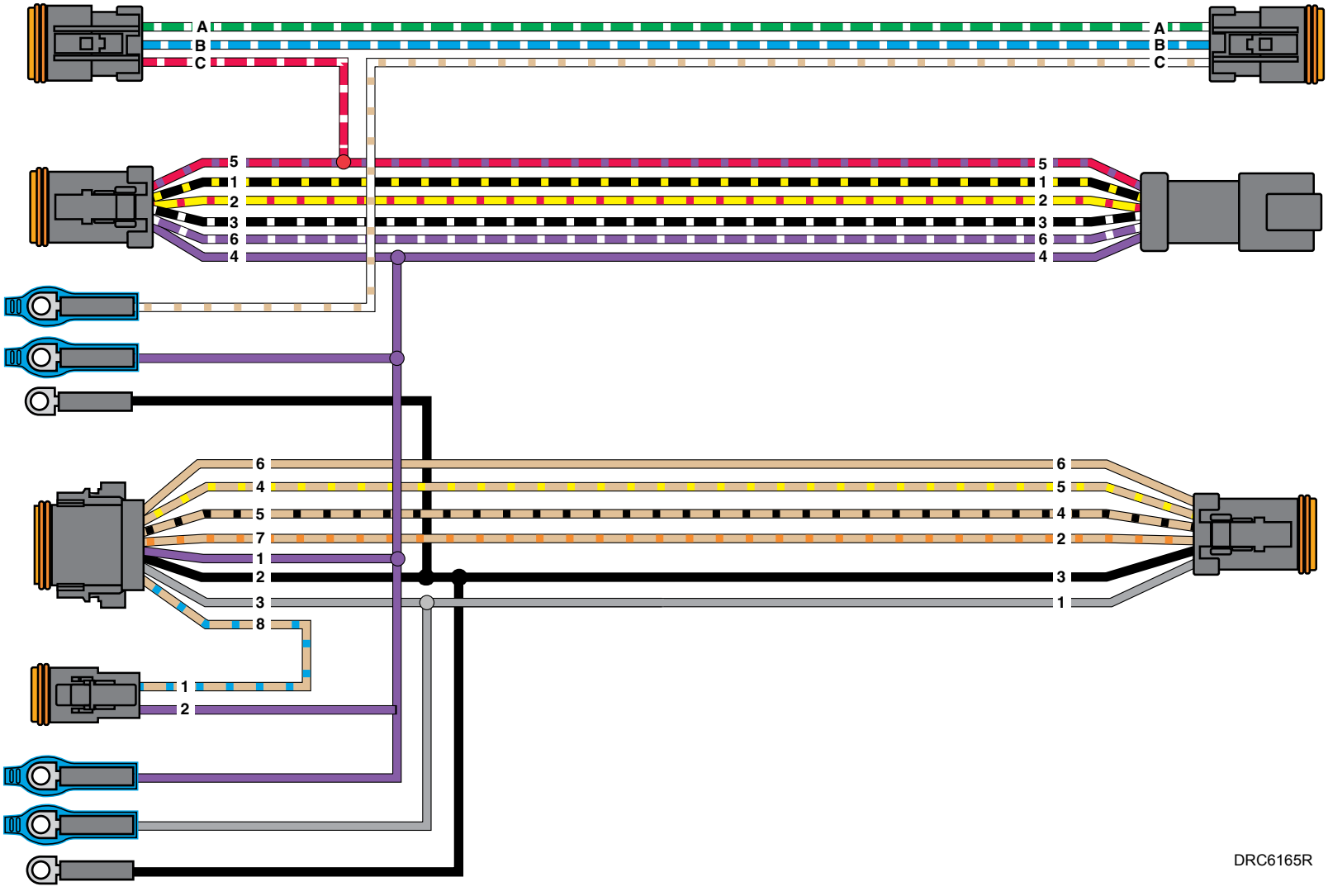
EXCESSIVE SMOKING

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** on p. 169
	Damaged fuel lift pump	Check for internal leaks

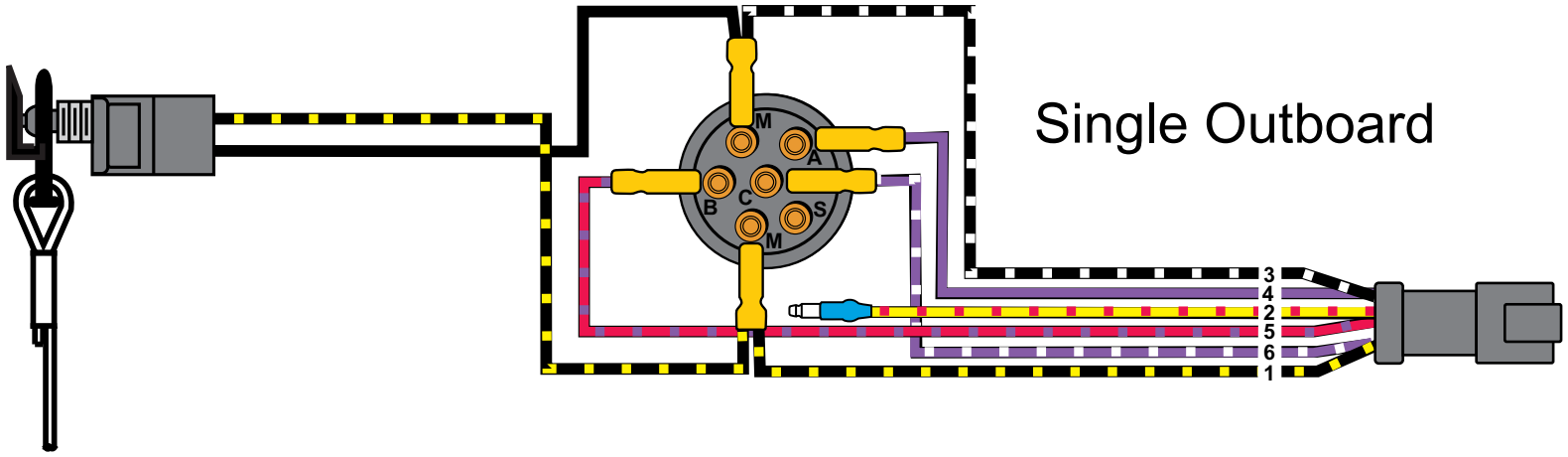
OUTBOARD SURGES, RUNS ROUGH

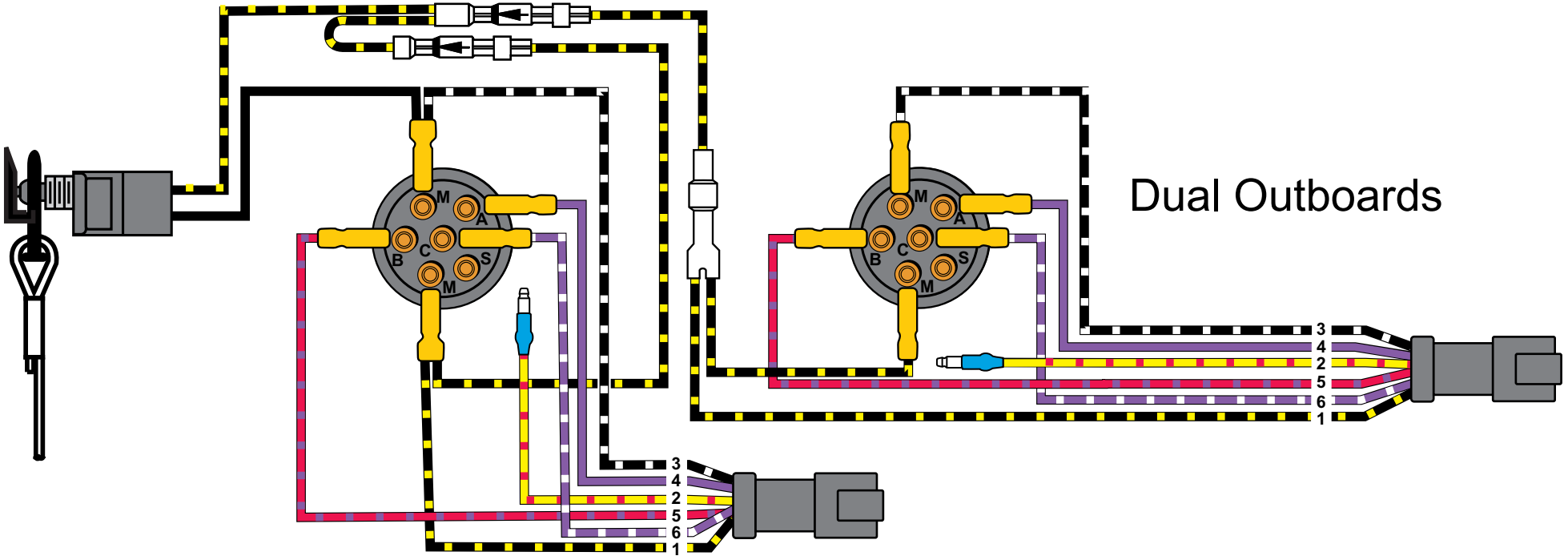
OBSERVATION	POSSIBLE CAUSE	PROCEDURE
1200 RPM and above	*S.A.F.E.*	Access *EMM* fault codes
May be erratic or inconsistent	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check and replace fuel supply
	Low or erratic fuel pressure	Check pressure, refer to **FUEL SYSTEM** on p. 169
	Air in fuel system	Check for air in fuel supply manifold, refer to **FUEL SYSTEM** on p. 169 (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** on p. 169
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	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** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to **SYSTEM ANALYSIS** on p. 113 and **ELECTRICAL AND IGNITION** on p. 135
	Restricted engine exhaust	Check and repair as needed
	Propping	Change propeller type or size as needed
Audible noise	Internal powerhead damage	Check and repair as needed
	Damaged gearcase	Inspect gearcase and lubricate

MWS Instrument Wiring Harness



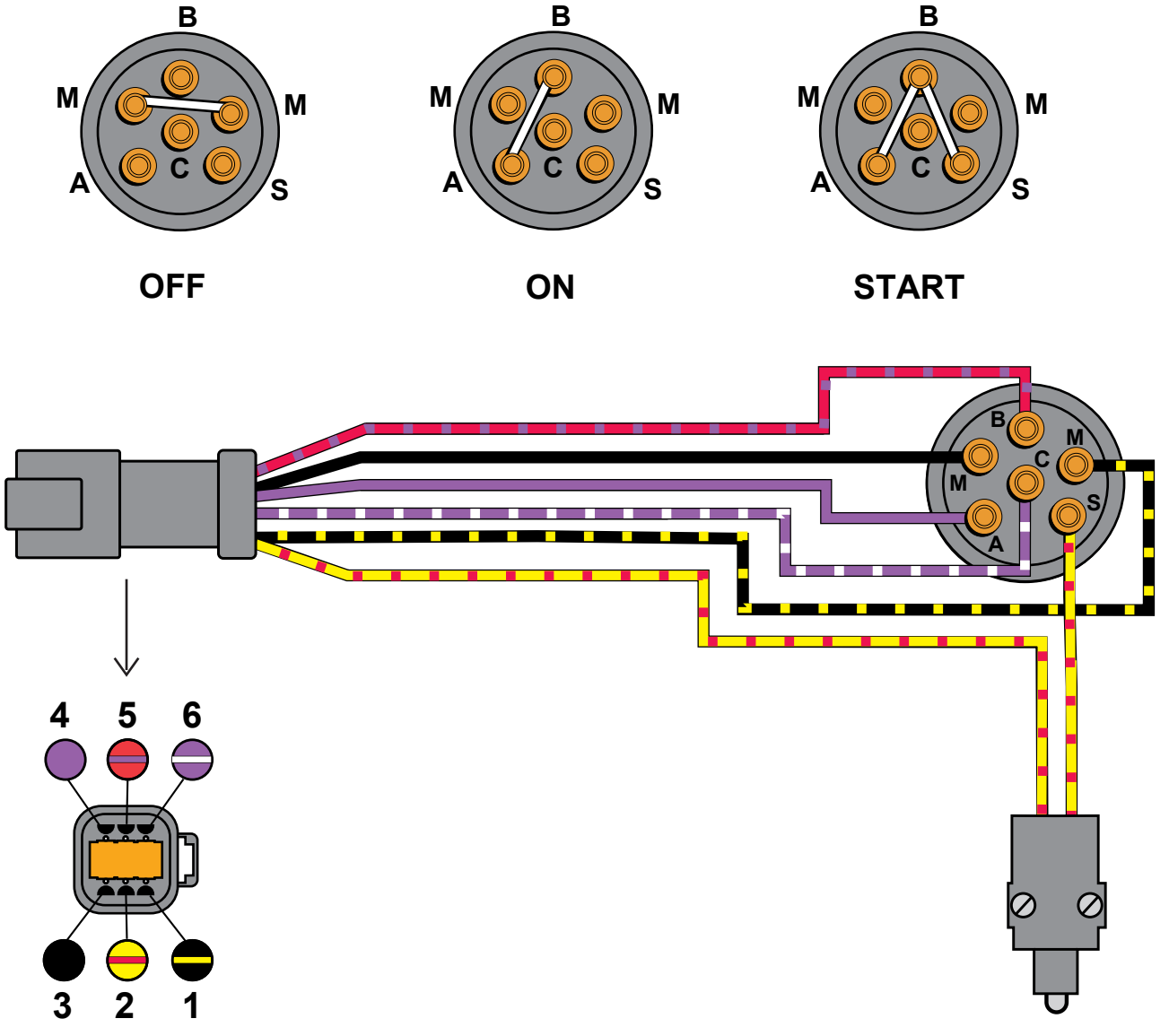
Lanyard Switch / Emergency Stop Circuits



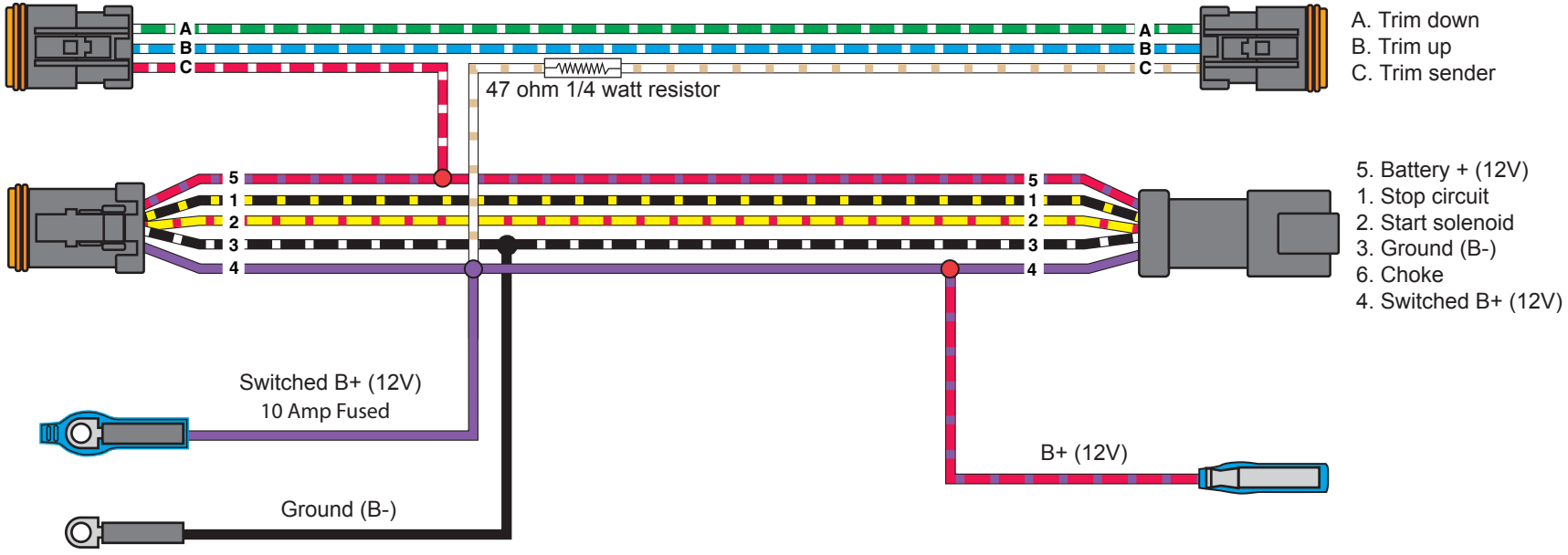


000705

MWS Key Switch and Neutral Safety Switch

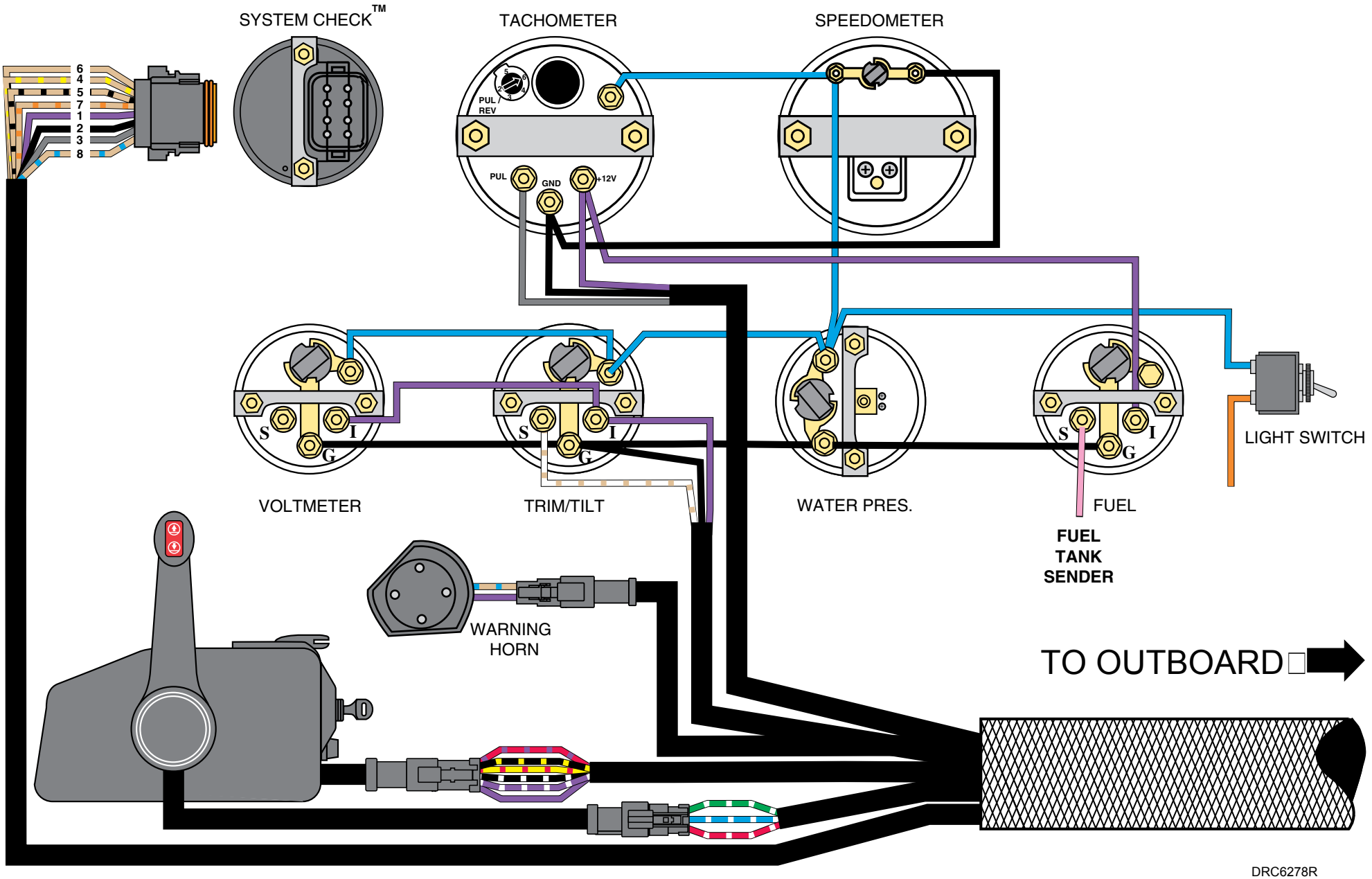


CANbus Keyswitch/TNT Wiring Harness



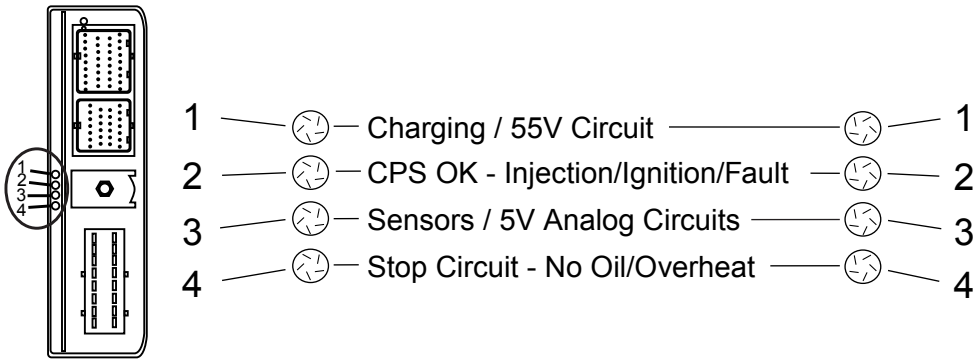
004839

MWS DASHBOARD

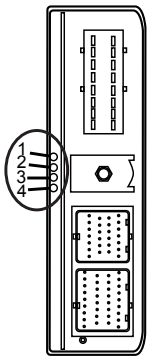


Evinrude E-TEC
EMM LED Diagnostic Indicators

In-line Models

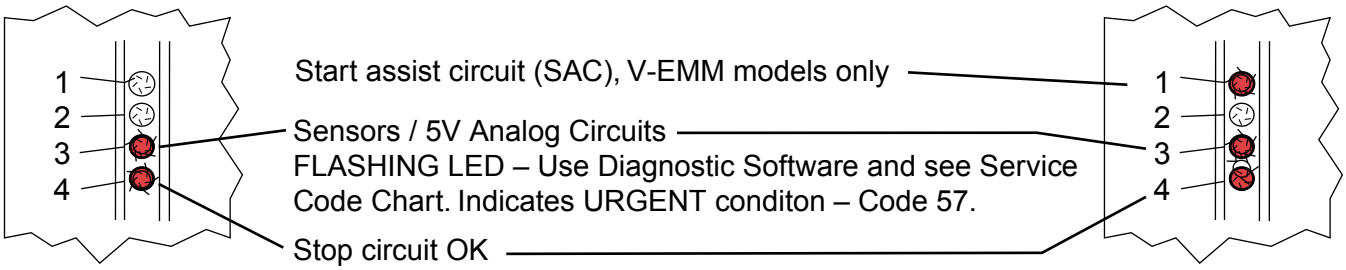


V Models



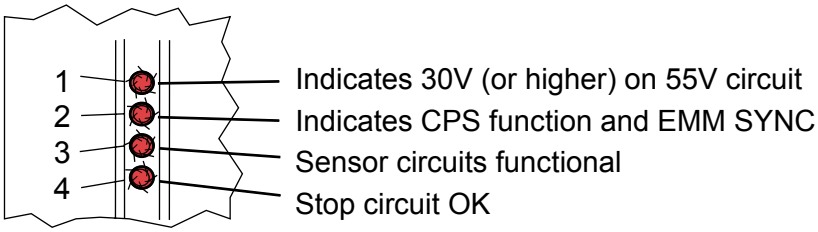
For additional information read the EMM DIAGNOSTICS chapter of **SYSTEM ANALYSIS** section in the Service Manual.

Key ON: LED's illuminate to indicate circuit function

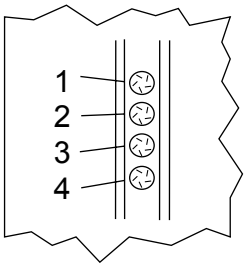


Note: No LED's ON indicates EMM not receiving battery voltage or Recoil Start model.

Starting Mode : LED's illuminate to indicate circuit function

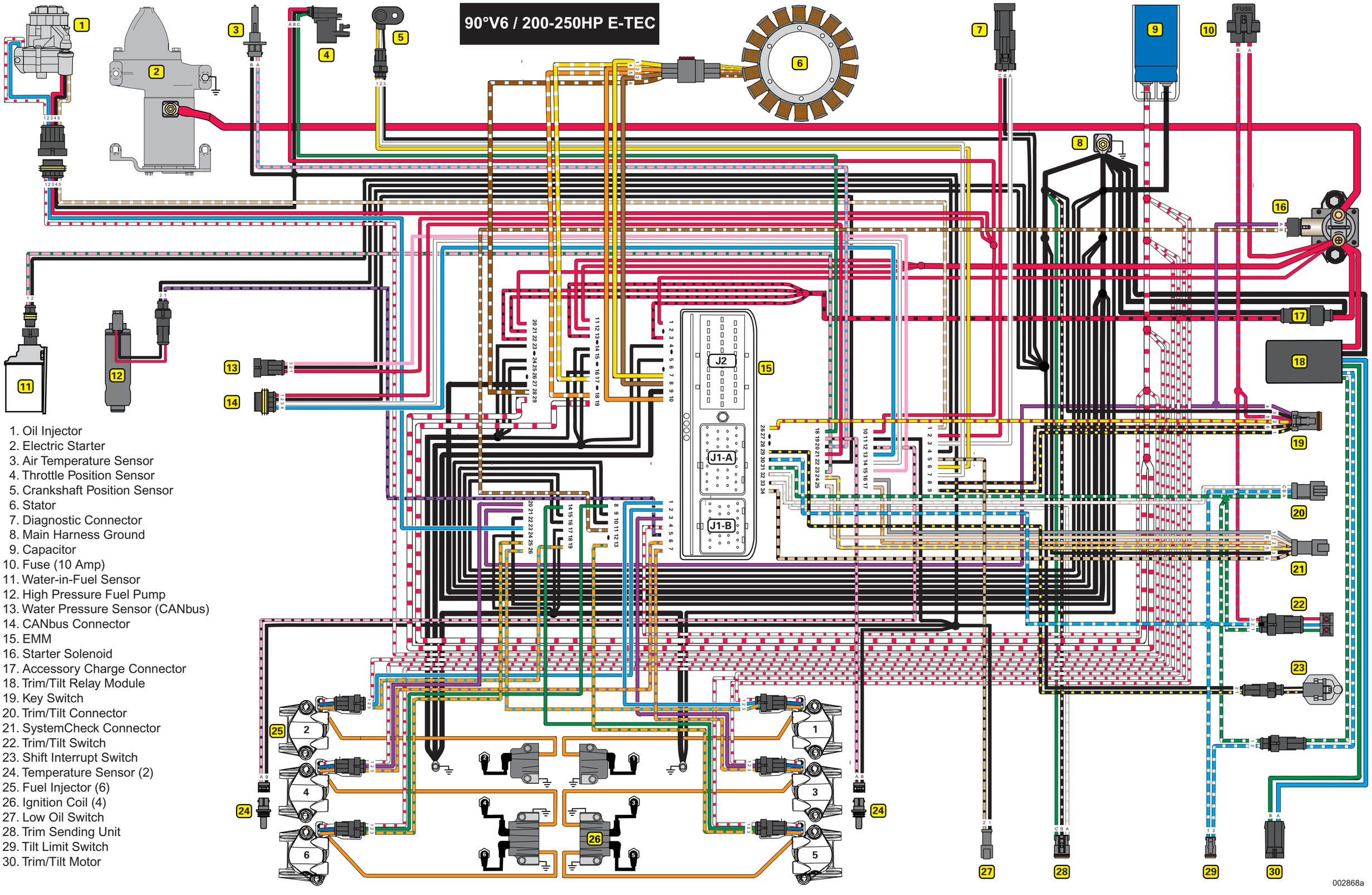


Running Mode : LED's illuminate to indicate circuit fault



Exception: ALL LED's ON / FLASHING indicates Winterization Mode

90°V6 / 200-250HP E-TEC



1. Oil Injector
2. Electric Starter
3. Air Temperature Sensor
4. Throttle Position Sensor
5. Crankshaft Position Sensor
6. Stator
7. Diagnostic Connector
8. Main Harness Ground
9. Capacitor
10. Fuse (10 Amp)
11. Water-in-Fuel Sensor
12. High Pressure Fuel Pump
13. Water Pressure Sensor (CANbus)
14. CANbus Connector
15. EMM
16. Starter Solenoid
17. Accessory Charge Connector
18. Trim/Tilt Relay Module
19. Key Switch
20. Trim/Tilt Connector
21. SystemCheck Connector
22. Trim/Tilt Switch
23. Shift Interrupt Switch
24. Temperature Sensor (2)
25. Fuel Injector (6)
26. Ignition Coil (4)
27. Low Oil Switch
28. Trim Sending Unit
29. Tilt Limit Switch
30. Trim/Tilt Motor

002868a

EVINRUDE EMM SERVICE CODE CHART

CODE	*EMM* CIRCUIT/SENSOR	*Evinrude E-TEC V-EMM*	*Evinrude E-TEC 40-90HP*	INTERNAL SENSOR	SHUT DOWN	*S.A.F.E.*	*SYSTEM CHECK* WARNING LIGHT ACTIVATION	*EMM* LED ACTIVATION	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION	
11	Throttle Position Sensor (TPS) out of idle range	✓	✓							TPS Voltage > 0.65 with key ON. Becomes stored fault when outboard starts. When both hard and stored faults present, check for improperly adjusted throttle cable.	
12	Throttle Position Sensor (TPS) circuit fault	✓	✓				CHECK ENGINE (IDLE ONLY)	SENSOR FAULT (LED 3) (IDLE ONLY)	0.8 seconds/ 1.6 seconds for 90°V6	5 V* circuit Voltage range: < 0.15 V , > 4.925 V*	3000 to 7000 Ω (between pins A and B) 4000 to 8000 Ω (between pins A and C)
										Circuit failure range voltage: 0.15 to 4.925 V*	
13	TPS below range	✓	✓				CHECK ENGINE	SENSOR FAULT (LED 3)	8 seconds	Voltage below 0.2 V. Confirm linkage and IDLE stop.	
14	TPS above range	✓	✓				CHECK ENGINE	SENSOR FAULT (LED 3)	8 seconds	Voltage above 4.85 V. Confirm linkage and WOT stop.	
15	ROM (*EMM* program)	✓	✓	✓						(ROM “CHECKSUM” verification) Verify software program number in *EMM*. Reload or replace with proper program.	
16	Crankshaft Position Sensor (CPS) Intermittent loss of SYNC	✓	✓					SENSOR FAULT (LED 3)	10 instances	Generates current, separate Ground (NEG)	560 ± 10% @ 77°F (25°C)
										Verify tachometer reading. Check CPS mounting and resistance. Inspect flywheel encoder ribs. Air gap range: 00.036 to 0.110 in. (1 to 2.8 mm), nominal 0.073 in. (1.85 mm)	
17	55 V circuit BELOW range	✓	✓	✓		✓	CHECK ENGINE	CHARGING FAULT (LED 1)	1 minute	55 V alternator output less than 45 V at 500 to 1000 RPM, or less than 52 V above 1000 RPM. Perform stator/charging tests.	
18	55 V circuit ABOVE range	✓		✓		✓	CHECK ENGINE	CHARGING FAULT (LED 1)	1 minute	55 V alternator output above 57 V. Perform stator/charging tests. Eliminate loose connections in 55 V circuit. Check capacitor.	
19	Start-in-gear		✓						0.5 seconds	Tiller models only	
21	Winterization activated	✓	✓				ALL LIGHTS ON	ALL LED’s ON		The outboard stops automatically after successful completion of winterization. Refer to Maintenance or Operator’s Guide.	
22	Engine temperature switch closed					✓	WATER TEMP/HOT			Test engine temperature and switch operation	
23	*EMM* Temperature Sensor	✓	✓	✓				NO OIL/OVERHEAT (LED 4)	8 seconds	Refer to associated codes 24 or 25.	
24	*EMM* Temperature BELOW range	✓	✓	✓				NO OIL/OVERHEAT (LED 4)	8 seconds	*EMM* temperature less than -22°F (-30°C).	
25	*EMM* Temperature ABOVE range	✓	✓	✓		✓	WATER TEMP/HOT	NO OIL/OVERHEAT (LED 4)	8 seconds	*EMM* temperature greater than 176°F (80°C). Code 25 activates *S.A.F.E.* See Code 29.	
26	12 V circuit BELOW range	✓	✓	✓				CHARGING FAULT (LED 1)	5 minutes	Battery voltage less than 12 V @ 500 to 2000 RPM or less than 12.5 V @ 2000 RPM or higher. Perform stator/charging tests.	
27	12 V circuit ABOVE range	✓	✓	✓				CHARGING FAULT (LED 1)	5 minutes	Battery voltage exceeded 15.5 V. Check battery connections and wiring.	
28	Shift switch malfunction	✓						SENSOR FAULT (LED 3)		Check shift switch linkage and switch activation. Check continuity of switch: normally open / continuity depressed. Not utilized on 60°V4 (remote models) or 60°V6 models.	
29	*EMM* temperature OVER range	✓	✓	✓	✓		WATER TEMP/HOT (FLASHING)	Flash NO OIL/OVERHEAT (LED4)	4 seconds	Outboard will crank but will NOT RESTART until *EMM* temperature falls below 212°F (100°C). Verify *EMM* cooling and outboard cooling system operation.	
31	Engine temperature OVER range	✓	✓		✓		WATER TEMP/HOT (FLASHING)	Flash NO OIL/OVERHEAT (LED 4)	4 seconds	Check engine temperature and cooling system operation. Check temperature sensor resistance. Code 31 activates SHUTDOWN at 248°F (120°C) and Code 43 or 69 activates *S.A.F.E.* at 212°F (100°C) or 194°F (90°C) on 200-250 HP, (90°V), models.	
32	Oil pressure switch, CONSTANT							SENSOR FAULT (LED 3)	255 oiler cycles	Oil pressure switch not “switching” between oil pulses, *EMM* not detecting change in manifold pressure.	
33	Excessive no oil faults	✓	✓	✓	✓		NO OIL – FLASHING	Flash NO OIL/OVERHEAT (LED4)	5 hours	Outboard has run 5 hours with code 34 or 38. SHUTDOWN mode initiated. Outboard restarts and runs for 1 minute intervals.	
34	Oil injection pump circuit OPEN (E-TEC / DI)	✓	✓			✓	NO OIL	NO OIL/OVERHEAT (LED 4)	4 seconds	Check oil injection pump circuit resistance	
35	No oil pressure (1997-2000 DI)					✓	NO OIL			Test for oil movement in system	
37	Water in fuel	✓					CHECK ENGINE			5 V* circuit and Ground (NEG)	Resistance infinite, no continuity between probes
38	Oil pressure feedback NOT detected	✓	✓			✓	NO OIL	NO OIL/OVERHEAT (LED 4)	255 oiler cycles (150 for 60°V6 and 90°V6)	Loss of oil manifold pressure. Check oil supply. Perform injection pump tests. Monitor oil flow to distribution hoses.	
39	Oil pressure prime failure					✓	NO OIL			Lack of pressure after rapid cycling injector. Check oil supply to injector. Perform injector static test. Monitor oil flow to distribution hoses.	
41	Engine Temperature Sensor (port/inline)	✓	✓					SENSOR FAULT (LED 3)	8 seconds	5 V* circuit and Ground (NEG)	9000 to 11000 Ω @ 77°F (25°C)
42	Engine Temperature BELOW range (port/ inline)	✓	✓					SENSOR FAULT (LED 3)	8 seconds	Engine temperature below -4°F (-20°C). Check engine temperature and sensor resistance.	
43	Engine Temperature ABOVE range (port/ inline)	✓	✓			✓	WATER TEMP/HOT	NO OIL/OVERHEAT (LED 4)	8 seconds	Engine temperature: 40 - 90 HP models ≥ 212°F (100°C); 115-250 HP 60°V & 90°V models ≥ 212°F (100°C) below 3000 RPM or ≥ 194°F (90°C) above 3000 RPM. Check engine temperature and cooling system operation. Check tempera;ture sensor resistance. Code 31 activates SHUTDOWN at 248°F (120°C) and Code 43 or 69 activates *S.A.F.E.* at 212°F (100°C) on 40 - 90 HP models or 194°F (90°C) on 115-250 HP 60°V & 90°V models.	
44	Barometric (Atmospheric) Pressure Sensor circuit fault (BP Sensor)	✓	✓	✓				SENSOR FAULT (LED 3)	8 seconds	Make sure *EMM*’s BP sensor tube is NOT plugged (possible “rich” running condition). Check atmospheric condition for comparison. Clear code and retest. Circuit failure range: less than 3.9 in. Hg (13.3 kPa) or greater than 35.1 in. Hg (119.0 kPa)	
45	BP Sensor BELOW range	✓	✓	✓				SENSOR FAULT (LED 3)	8 seconds	Below 20.7 in. Hg (70 kPa)	
46	BP Sensor ABOVE range	✓	✓	✓				SENSOR FAULT (LED 3)	8 seconds	Above 31 in. Hg (105 kPa)	
47	Air Temperature (AT) circuit	✓	✓					SENSOR FAULT (LED 3)	8 seconds	5 V* circuit and Ground (NEG)	9000 to 11000 Ω @ 77°F (25°C)
										Circuit failure range: less than -14.98°F (-26.1°C) or greater than 331.7°F (166.5°C)	
48	AT circuit BELOW range	✓	✓					SENSOR FAULT (LED 3)	8 seconds	Air temperature below 14°F (-10°C)	
49	AT circuit ABOVE range	✓	✓					SENSOR FAULT (LED 3)	8 seconds	Air temperature above 149°F (65°C)	

CODE	*EMM* CIRCUIT/SENSOR	*Evinrude E-TEC V-EMM*	*Evinrude E-TEC 40-90HP*	INTERNAL SENSOR	SHUT DOWN	*S.A.F.E.*	*SYSTEM CHECK* WARNING LIGHT ACTIVATION	*EMM* LED ACTIVATION	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION	
51	Fuel injector circuit #1 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds	Check circuit resistance	
52	Fuel injector circuit #2 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
53	Fuel injector circuit #3 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
54	Fuel injector circuit #4 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
55	Fuel injector circuit #5 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
56	Fuel injector circuit #6 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
57	High RPM with low TPS setting	✓	✓	✓	✓		CHECK ENGINE (FLASHING)	Flash SENSOR FAULT (LED 3)	5 seconds	*EMM* has detected abnormally high RPM relative to TPS position. This could be caused by uncontrolled fuel entering the combustion cycle. DO NOT attempt to clear code and START the outboard until the problem has been evaluated and repaired.	
58	Operating temperature not reached (port/ inline)	✓	✓					SENSOR FAULT (LED 3)	9 minutes/ 10 minutes for 90°V	Engine operating temperature less than 104° F (40° C) with engine speed less than 2300 RPM or 122°F (50°C) on 115-250 HP 60°V & 90°V models.	
59	Operating temperature not reached (stbd)	✓						SENSOR FAULT (LED 3)	9 minutes/ 10 minutes for 90°V6	Engine operating temperature less than 104° F (40° C) with engine speed less than 2300 RPM or 122°F (50°C) on 115-250 HP 60°V & 90°V models.	
61	Fuel injector circuit #1 SHORTED	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds	Test for shorts to ground. Check wiring and perform resistance test on injector circuits. Check for pinched or chafed wiring.	
62	Fuel injector circuit #2 SHORTED	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
63	Fuel injector circuit #3 SHORTED	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
64	Fuel injector circuit #4 SHORTED	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
65	Fuel injector circuit #5 SHORTED	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
66	Fuel injector circuit #6 SHORTED	✓						INJECTOR/IGNITION FAULT (LED 2)	8 seconds		
67	Engine Temperature Sensor (starboard)	✓						SENSOR FAULT (LED 3)	8 seconds	5 V* circuit and Ground (NEG)	9000 to 11000 Ω @ 77°F (25°C)
68	Engine Temperature BELOW range (stbd)	✓						SENSOR FAULT (LED 3)	8 seconds	Engine temperature below -4°F (-20°C). Check engine temperature and sensor resistance.	
69	Engine Temperature ABOVE range (stbd)	✓				✓	WATER TEMP/HOT	NO OIL/OVERHEAT (LED 4)	8 seconds	Engine temperature: 40 - 90 HP models ≥ 212°F (100°C); 115-250 HP 60°V & 90°V models ≥ 212°F (100°C) below 3000 RPM or ≥ 194°F (90°C) above 3000 RPM. Check engine temperature and cooling system operation. Check tempera;ture sensor resistance. Code 31 activates SHUTDOWN at 248°F (120°C) and Code 43 or 69 activates *S.A.F.E.* at 212°F (100°C) on 40 - 90 HP models or 194°F (90°C) on 115-250 HP 60°V & 90°V models.	
71	Oil pressure circuit sensor fault detected	✓						SENSOR FAULT (LED 3)	4 seconds	< 0.12 V , > 4.88 V	
72	Oil pressure BELOW expected range	✓						SENSOR FAULT (LED 3)	8 seconds	< 0.5 V	
73	Oil pressure ABOVE expected range	✓						SENSOR FAULT (LED 3)	8 seconds	> 4.5 V	
74	Water pressure sensor circuit fault detected	✓					CANBus Option	SENSOR FAULT (LED 3)	8 seconds	Use Evinrude Diagnostic Software to activate option < 0.12 V , > 4.88 V	
75	Water pressure BELOW expected range	✓						SENSOR FAULT (LED 3)	8 seconds	< 0.5 V	
76	Water pressure ABOVE expected range	✓						SENSOR FAULT (LED 3)	8 seconds	> 4.5 V	
77	S.A.C. overcurrent fault	✓		✓				CHARGING FAULT (LED 1)	8 seconds	Check for shorted 55 V wiring (injector circuits). Check for pinched or chaffed wiring.	
78	Analog 5V circuit overload detected	✓		✓			CHECK ENGINE	SENSOR FAULT (LED 3)	8 seconds	Sensor voltage reference fault. Check sensors and related wiring. Check for pinched or chaffed wiring.	
79	Starter solenoid circuit OPEN	✓					CHECK ENGINE	SENSOR FAULT (LED 3)	8 seconds	Check starter solenoid circuit for continuity (key switch OFF) and for 12 V with key switch ON.	
81	Ignition primary circuit #1 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	100 instances	Check circuit resistance	
82	Ignition primary circuit #2 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	100 instances		
83	Ignition primary circuit #3 OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	100 instances		
84	Ignition primary circuit #4 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	100 instances		
85	Ignition primary circuit #5 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	100 instances		
86	Ignition primary circuit #6 OPEN	✓						INJECTOR/IGNITION FAULT (LED 2)	100 instances		
87	Exhaust pressure circuit fault	✓		✓				SENSOR FAULT (LED 3)	8 seconds	< 0.12 V , > 4.88 V	Check for plugged or pinched hose or exhaust fitting.
88	Exhaust pressure BELOW expected range	✓		✓				SENSOR FAULT (LED 3)	8 seconds	< 40 in. water	
89	Exhaust pressure ABOVE expected range	✓		✓				SENSOR FAULT (LED 3)	8 seconds	> 80 in. water	
91	Fuel pump circuit OPEN	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	2 seconds	55 V engine running (40-90HP Inline) 12 V key ON / engine running (200-250HP “90°V”)	approximately 1Ω @ 77°F (25°C)
92	Exhaust valve solenoid OPEN (115HP)	✓								Check exhaust valve control module circuit for continuity. (EMM J1-B connector between pins 5 &12, electric fuel pump wiring connector disconnected.) Refer exhaust valve relay test. Use Evinrude Diagnostic Software for “static” test of actuator motor.	
93	Water injection solenoid OPEN (60HP)		✓								
94	Fuel pump circuit SHORTED	✓	✓					INJECTOR/IGNITION FAULT (LED 2)	8 seconds	Test for shorts to ground. Check wiring and perform resistance test on pump circuit.	
97	Intermittent switched B+ detected	✓								Check connections and wiring	

* Sensor voltages are listed for description purposes only. Sensor voltage readings should be viewed using Diagnostic Program.

NOTE: Always note service codes before clearing codes. Clear stored codes using diagnostic software. Some hard codes, such as code 57, are cleared by turning EMM “OFF” and then “ON” again.

EVINRUDE® Johnson®

BRP

GENUINE PARTS

