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Evinrude ® / Johnson ® XD50™ Outboard Oil HPF XR™ Gearcase Lubricant

Evinrude [®] / Johnson [®] XD100[™] Outboard Oil HPF PRO[™] Gearcase Lubricant Gel-Seal II[™]

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

All special tools referenced in this manual can be found in the **Special Tools Guide**, P/N 5008526.

REFERENCE INFORMATION

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SAFETY NOTICE

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

This pu blication is written fo r qualified, facto rytrained technicians who are already familiar with the use of *Evinrude/Johnson* Special Tools. The included in formation is not a substitute for work experience. It is an organized guide for reference, repair, and/or maintenance.

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

A DANGER

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

A WARNING

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

A CAUTION

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

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

These safety alert signal words mean:

ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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

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

Torque wre nch tig htening specifications must strictly be adhered to.

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

When repla cement p arts are required, use *Evinrude/Johnson Genuine Parts* or parts with equivalent characteristics, including type, strength and mate rial. Use of subst andard p arts could result in injury or product malfunction.

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

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

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

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

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

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

A DANGER

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

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

WARNING

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

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

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

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

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

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

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

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

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

Always work in a well ventilated area.

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

ABBREVIATIONS USED IN THIS MANUAL

Units of Measurement

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

List of Abbreviations

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

EMISSION-RELATED INSTALLATION INSTRUCTIONS

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

Maintenance, replacement, or repair of the emission control de vices 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 ma rine outboards must de termine the exha ust emission levels for each outboard horsepower family and certify the se outboards with the United States of America Environmental Protection Agency (EPA). An emissions control information labe I, 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 1 999 and more recent *Evinrude/Johnson* outboards that carry an emissions control information label, adjustments must be kept with in 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 mo dify the outbo ard in an y manner that would alter the horsepower or allow emission levels to excee d their predete rmined factory specifications.

Exceptions include manu facturer's prescrib ed changes, such as altitude ad justments, for example.

Owner's Responsibility

The owner/operator is required to have outboa rd 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 wo uld a lter the horsepower or a llow e missions levels to exceed their predetermined factory specifications.

Tampering with the fuel system to change horsepower or mo dify emission levels beyond fa ctory 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 pollutio n from new watercraf t 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, whe never practical, returned to the original intent of the design. The responsibilities liste d above are general and in no way a comple te listing of the r ules and regulations pertaining to the EPA re guirements on e xhaust emissions marine products. For more detailed information on this subject, you may contact the following locations:

VIA U.S. POSTAL SERVICE:

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

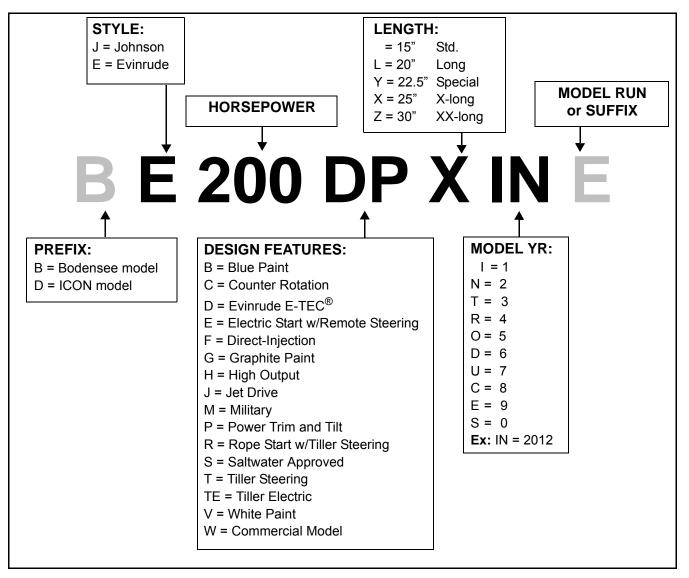
VIA EXPRESS or COURIER MAIL:

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

EPA INTERNET WEB SITE:

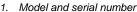
www.epa.gov

MODEL DESIGNATION



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







Serial number

002225

MODELS COVERED IN THIS MANUAL

This manual covers service information on all 52.7 cubic inch (.86 L), 2-Cylinder; and 79 cubic inch (1.29 L), 3-Cylinder *Evinrude E-TEC* models.

Model	Displacement	Gearcase	Height	Color	Description
E40DRLINC	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Manual Tilt, Tiller Steering, Rope Start
E40DTLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Tiller Steering, Electric Start
E40DPLINC	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Remote Steering, Electric Start
E40DSLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	White	Power Tilt, Remote Steering, Electric Start
E40DHLINS	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Remote Steering, Electric Start, H.O. Stylin
E40DHSLINS	.86 L, 52.7 ci	12:32 / 0.375 F	20"	White	Power Tilt, Remote Steering, Electric Start, H.O. Stylin
E50DTLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Tiller Steering, Electric Start
E50DPLINC	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Remote Steering, Electric Start
E50DSLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	White	Power Tilt, Remote Steering, Electric Start
E60DTLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Tiller Steering, Electric Start
E60DPLINC	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Power Tilt, Remote Steering, Electric Start
E60DSLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	White	Power Tilt, Remote Steering, Electric Start
E65WDRLINM	.86 L, 52.7 ci	12:32 / 0.375 F	20"	Blue	Manual Tilt, Tiller Steering, Rope Start
E65WDRYINM	.86 L, 52.7 ci	12:32 / 0.375 F	22.5"	Blue	Manual Tilt, Tiller Steering, Rope Start
E75DPLINC	1.29 L, 79.0 ci	13:26 / 0.50 S	20"	Blue	Power Tilt, Steel Steering Arm
E75DSLINM	1.29 L, 79.0 ci	13:26 / 0.50 S	20"	White	Power Tilt, Stainless Steering Arm
E90DPLINC	1.29 L, 79.0 ci	13:26 / 0.50 S	20"	Blue	Power Tilt, Steel Steering Arm
E90DSLINS	1.29 L, 79.0 ci	13:26 / 0.50 S	20"	White	Power Tilt, Stainless Steering Arm
E90DPXINC	1.29 L, 79.0 ci	12:27 / 0.444 O	25"	White	Power Tilt, Stainless Steering Arm
E90WDELINM	1.29 L, 79.0 ci	13:26 / 0.50 S	20"	Blue	Manual Tilt, Steel Steering Arm, Commercial Model
E90WDEXINM	1.29 L,79.0 ci	12:27 / 0.444 O	25"	White	Manual Tilt, Steel Steering Arm, Commercial Model

SERVICE SPECIFICATIONS

		40 - 65 HP E-TEC Models		
	Full Throttle Operating Range RPM	40 HP – 5000 to 6000 RPM 50 HP – 5500 to 6000 RPM 60 HP – 5500 to 6000 RPM 65 HP – 5500 to 6000 RPM		
	Power	40 HP (29.4 kw) @ 5500 RPM 50 HP (36.8 kw) @ 5750 RPM 60 HP (44.1 kw) @ 5750 RPM 65 HP (47.8 kw) @ 5750 RPM		
	Idle RPM in Gear	800 ± 50 EMM Controlled		
	Idle RPM in Neutral	750 ± 50 EMM Controlled		
	Test Propeller	P/N 382861		
ENGINE	Weight (may vary depending on model)	(RL) Models: 232 lbs. (105 kg) (HL, PL, SL, TL) Models: 240 lbs. (109 kg)		
	Lubrication	Evinrude/Johnson XD100, XD50, XD30; or NMMA TC-W3 certified		
1	Engine Type	In-line, 2 Cylinder, Two-Cycle		
	Displacement	52.7 cu. in. (864 cc)		
	Bore	3.601 in (91.47 mm)		
	Stroke	2.588 in. (65.74 mm)		
	Standard Bore	3.6005 to 3.6015 in. (91.45 to 91.48 mm) To bore oversize, add piston oversize dimension to standard bore		
	Top Crankshaft Journal	2.1870 to 2.1875 in. (55.55 to 55.56 mm)		
	Center Crankshaft Journal	2.1870 to 2.1875 in. (55.55 to 55.56 mm)		
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)		
	Rod Crankpin	1.3757 to 1.3762 in. (34.94 to 34.96 mm)		
	Piston Ring End Gap, Both	0.011 to 0.023 in. (0.28 to 0.58 mm)		
	Fuel/Oil Control	EMM Controlled		
	Starting Enrichment	EMM Controlled		
	Minimum (High) Fuel Pressure	24 to 28 psi (165 to 193 kPa)		
EL	Minimum Fuel Lift Pump Pressure	3 psi (21 kPa)		
FUE	Maximum Fuel Inlet Vacuum	4 in. Hg.		
	Minimum Octane	87 AKI (R+M)/2 or 90 RON		
	Additives	2+4 [®] Fuel Conditioner, Fuel System Cleaner Use of other additives may result in engine damage.		
		See Fuel Requirements on p. 131 for additional information		

		40 – 65 HP E-TEC Models
SAL	Minimum Battery Requirements	640 CCA (800 MCA) or 800 CCA (1000 MCA) below 32° F (0° C)
ELECTRICAL	Alternator	25-Amp fully regulated. Refer to Predelivery and Installation Guide for multiple battery applications.
Ę(Tachometer Setting	6 pulse (12 pole)
E	Engine Fuse	P/N 967545 – 10 A
Ŋ	Thermostat 14	3°F (62°C)
COOLING	Maximum Temperature	212°F (100°C)
ၓ	Water pressure	12 to 14 psi @ 5000 RPM
	Туре	Capacitor Discharge
	Firing Order	1-2
_	Ignition Timing	EMM Controlled
Ó	RPM Limit in Gear	6250
GNITION	RPM Limit in Neutral	1800
19/	Crankshaft Position Sensor Air Gap	Fixed
	Charle Divis	Refer to Emission Control Information Label
	Spark Plug	Champion [†] QC10WEP @ 0.028 ± 0.003 in. (0.71 mm)
1	Gear Ratio	12:32 (.375)
GEARCASE	Lubricant HPF XR Gearcase Lube HPF Pro in high performance or commercial applications	
1R	Capacity	22 fl. oz. (650 ml)
)E/	Shift Rod Height	20 in. (L) Models: 21.38 (543 mm) ± one-half turn
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARD
TILT	Lubrication	Evinrude/Johnson Biodegradable TNT Fluid
TRIM/	Fluid Capacity	15.2 fl. oz. (450 ml)
POWER TRIM/TILT	Trim Range	0° to 15°
POV	Tilt Range	16° to 65°

		75 – 90 HP E-TEC Models	
	Full Throttle Operating Range RPM	4500 to 5500 RPM	
	Power	75 HP (56 kw) @ 5000 RPM 90 HP (67.1 kw) @ 5000 RPM	
	Idle RPM in Gear	700 ± 50 EMM Controlled	
	Idle RPM in Neutral	600 ± 50 <i>EMM</i> Controlled	
	Test Propeller	(L) Models: P/N 386246 (X) Models: P/N 387388	
	Weight (may vary depending on model)	(L) Models: 320 lbs. (145 kg) (X) Models: 335 lbs. (152 kg)	
ENGINE	Lubrication	Evinrude/Johnson XD100, XD50, XD30; or NMMA TC-W3 certified	
Ž	Engine Type	In-line, 3 Cylinder, Two-Cycle	
7	Displacement	79.1 cu. in. (1296 cc)	
	Bore	3.601 in (91.47 mm)	
	Stroke	2.588 in. (65.74 mm)	
	Standard Bore	3.6005 to 3.6015 in. (91.45 to 91.48 mm) To bore oversize, add piston oversize dimension to standard bore	
	Top Crankshaft Journal	2.1870 to 2.1875 in. (55.55 to 55.56 mm)	
	Center Crankshaft Journals	2.1870 to 2.1875 in. (55.55 to 55.56 mm)	
	Bottom Crankshaft Journal	1.5747 to 1.5752 in. (40.0 to 40.01 mm)	
	Rod Crankpin	1.3757 to 1.3762 in. (34.94 to 34.96 mm)	
	Piston Ring End Gap, Both	0.011 to 0.023 in. (0.28 to 0.58 mm)	
	Fuel/Oil Control	EMM Controlled	
	Starting Enrichment	EMM Controlled	
	Minimum (High) Fuel Pressure	24 to 28 psi (165 to 193 kPa)	
FUEL	Minimum Fuel Lift Pump Pressure	3 psi (21 kPa)	
FU	Maximum Fuel Inlet Vacuum	4 in. Hg.	
	Minimum Octane	87 AKI (R+M)/2 or 90 RON	
		2+4® Fuel Conditioner, Fuel System Cleaner	
	Additives	Use of other additives may result in engine damage.	
		See Fuel Requirements on p. 131 for additional information	

		75 – 90 HP E-TEC Models		
SAL	Minimum Battery Requirements	640 CCA (800 MCA) or 800 CCA (1000 MCA) below 32° F (0° C)		
ELECTRICAL	Alternator	25-Amp fully regulated. Refer to Predelivery and Installation Guide for multiple battery applications.		
Ē	Tachometer Setting	6 pulse (12 pole)		
E	Engine Fuse	P/N 967545 – 10 A		
Ŋ	Maximum Temperature	212°F (100°C)		
COOLING	Thermostat	143°F (62°C)		
ၓ	Water pressure	19 to 21 psi @ 5000 RPM		
	Туре	Capacitor Discharge		
	Firing Order	1-2-3		
	Ignition Timing	EMM Controlled		
Q	RPM Limit in Gear	6250		
GNITION	RPM Limit in Neutral	1800		
16/	Crankshaft Position Sensor Air Gap	Fixed		
	Spark Plug	Refer to Emission Control Information Label		
	Spark riug	Champion [†] QC10WEP @ 0.028 ±.003 in. (0.71 mm)		
1	Gear Ratio	20 in. (L) Models: 13:26 (.500) 2:1 25 in. (X) Models: 12:27 (.444) 2.25:1		
SE	Lubricant	HPF XR Gearcase Lube		
GEARCASE	Capacity	20 in. (L) Models: 31.6 fl. oz. (935 ml) 25 in. (X) Models: 32.8 fl. oz. (970 ml)		
GE/	Shift Rod Height	20 in. (L) Models: 21.25 (539.75 mm) ± one-half turn 25 in. (X) Models: 26.25 (666.75 mm) ± one-half turn		
	Shift Cable Stroke	1.125 to 1.330 in. (28.6 to 33.8 mm) measured between NEUTRAL and FORWARI		
TILT	Lubrication	Single Piston System–Evinrude/Johnson Biodegradable TNT Fluid		
	Fluid Capacity	21 fl. oz. (620 ml)		
TRII	Trim Range	0° to 15°		
POWER TRIM	Tilt Range	16° to 65°		

STANDARD TORQUE SPECIFICATIONS

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

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

WARNING

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

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

PRODUCT REFERENCE AND ILLUSTRATIONS

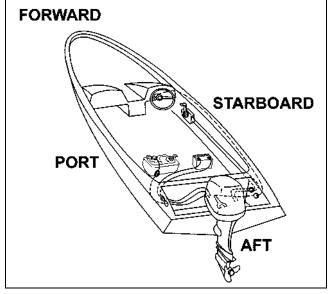
BRP US Inc. reserves the right to make changes at any time, wit hout notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on mode Is manufactured prior to date of such change. Specifications used are based on the late st 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 no t depict a ctual 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 of ten identifies p arts and procedures using these terms.



Nautical Orientation

006411

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THROTTLE AND SHIFT LINKAGE	
PROPELLER SHAFT	
GEARCASE LUBRICANT	
TRIM AND TILT	
SPARK PLUGS	
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INSPECTION AND MAINTENANCE SCHEDULE

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

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

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

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

- A HPF Pro Gearcase Lubricant
- B Power Trim/Tilt Fluid (Three ram hydraulic systems)
 Biodegradeable TNT Fluid (Single ram hydraulic systems)
- C Triple-Guard Grease
- D Starter Bendix Lube Only

⁽²⁾ Emission-related component

⁽³⁾ Annually in salt water applications

LIFTING THE OUTBOARD

WARNING

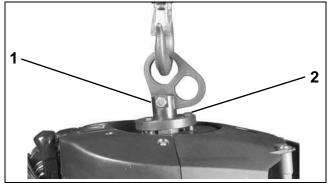
To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.

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

Use correct Lifting Fixture to lift outboard:

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

With re coil starter re moved, Place lifting tool on flywheel and se at the three screws completely. Refer to **RECOIL STARTER REMOVAL** on p. 363.



- Lifting fixture
- 1 1/8 in. screws

002098

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

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

OUTBOARD RIGGING CONNECTIONS

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

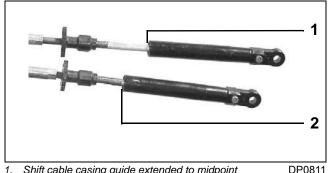
Common Practices – All Models

Control Cable Identification

IMPORTANT: Identify con trol ca ble fun ction 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.



- Shift cable casing guide extended to midpoint
- Throttle cable casing guide retracted

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



30501

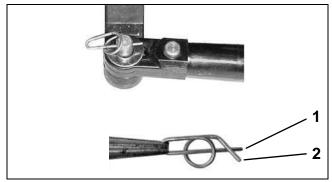
OUTBOARD RIGGING CONNECTIONS

Cable Retainer Clip Installation

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

For proper installation, review the following steps:

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



Straight section Angled section

DP0818 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 Angled section behind straight section DP0817a

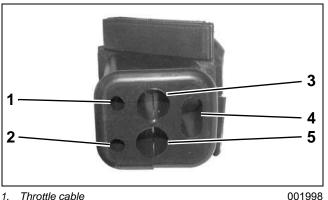
Cable, Hose, and Wire Routing

A CAUTION

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

Refer to **Control Cable Identification** on p. 17.

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



Throttle cable

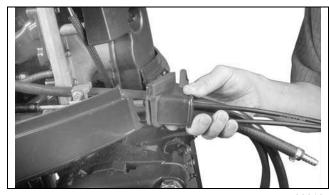
Shift cable

Main wiring harness

Battery cable

Fuel line

Place the g rommet int o position in the lower engine cover.



002104

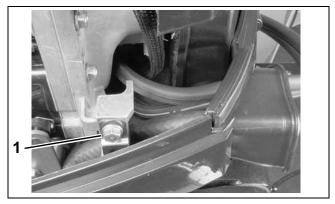
When grommet is in p lace and all cables have been installed, tighten a tie strap around the outside of the gromme t to form a watertight sea I around the cables.

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

Control Cable Installation

Refer to Control Cable Identification on p. 17.

Remove cable ret ainer from an chor block. Apply *Triple-Guard* grease to both anchor block pockets.



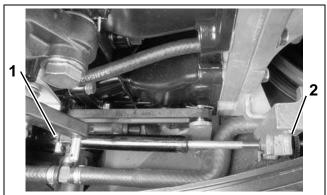
Cable retainer

002099

IMPORTANT: DO NOT secure cables to throttle and shift leve r pins until a II cables, wires, a nd hoses have been routed and grommet has be en installed in the lower engine cover.

Make sure the remote control is in NEUTRAL, and throttle is in the IDLE position.

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



1. Shift lever pin

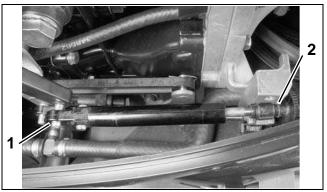
2. Trunnion nut

002100

If there are not enough threads on the shift cable for the adjustment, or if the gea rease does not shift fully into FORWARD or REVERSE, refer to **SHIFT ROD ADJUSTMENT** on p. 300, or **SHIFT ROD ADJUSTMENT** on p. 323.

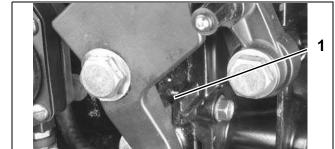
With remote control lever in NEUTRAL, pull firmly on throttle cable casing to remove slack.

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



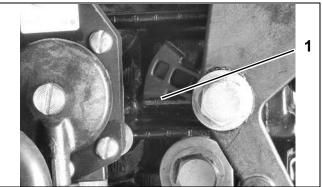
Throttle lever pin
 Trunnion nut

002101



1. Throttle lever stop – 3 Cylinder models

005111



1. Throttle lever stop – 2 Cylinder models

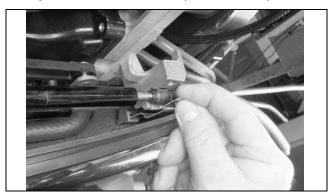
005114

OUTBOARD RIGGING CONNECTIONS

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

After grommet has been installed in lower engine cover, install the washers and retainer clips on the throttle and shift leve rpins. Refer to Cable Retainer Clip Installation on p. 18.

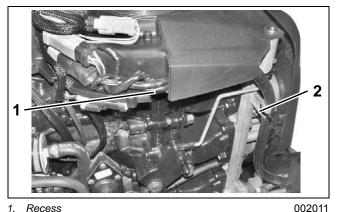
Install cable retainer and screw. Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



002103

SystemCheck Harness Connections

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

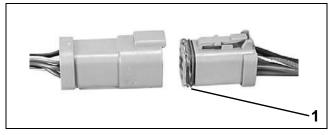


Recess

2. Tie strap

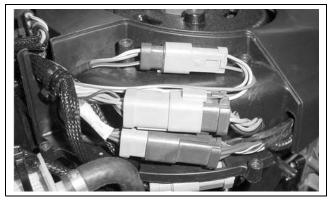
Before installing electrical connectors, check that the seal is in place. CI ean off any dirt from connectors. Apply a light coat of Electrical Grease to

the seal only. DO NOT fill connectors with Electrical Grease.



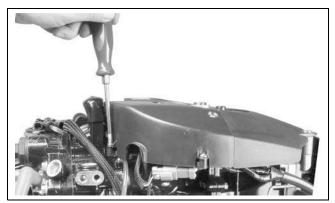
Seal 42079A

Arrange connectors in flywheel cover.



001999

Install electrical cover and secure with screws.



002102

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

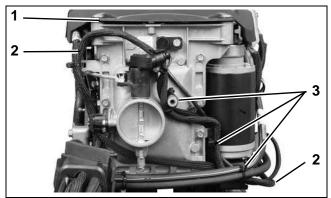
I-Command Network Connections

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

Remove lower motor covers. Remove air silencer.

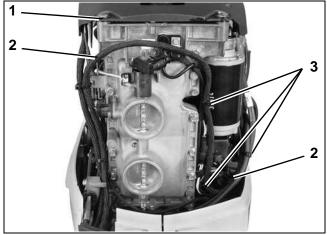
Route *I-Command* Engine Interface Cable around the front of the throttle body, following the path of the TPS wiring, and behind the batte ry cable. Loosely install tie straps as shown.

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



2 Cylinder Models

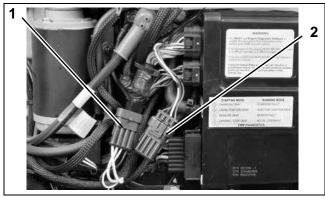
- 1. Flywheel cover
- Harness routing
- 3. Tie straps



3 Cylinder Models

- 1. Flywheel cover
- Harness routing
- 3. Tie straps

Connect the *I-Command* Engine Interface Cable to the *EMM* CANbus connector.



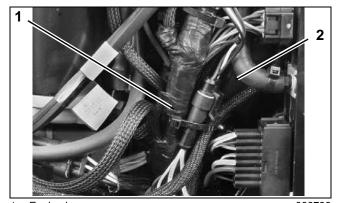
1. I-Command network connector

2. EMM CANbus connector

006735

2 CYLINDER MODELS

To prevent interference with engine cover latch, bundle excess wiring b ehind *EMM* cooling water hose. Secure *I-Command* connectors to back side of engine harness with tie strap.



Engine harness
 EMM cooling water hose

006736

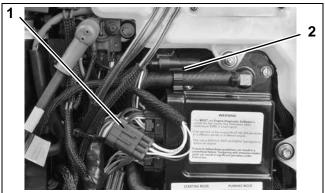
006742

006738

OUTBOARD RIGGING CONNECTIONS

3 CYLINDER MODELS

EMM CANbus connector cap is clipped to EMM cooling water hose. Remove clip from cap install on I-Command harness connector.



- Canbus harness connector
- EMM CANbus connector cap and clip

006743

Install clip and connector to hose.



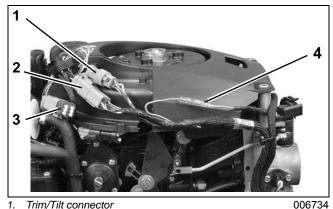
- CANbus connectors
- EMM cooling water hose

ALL MODELS

Adjust harness routing as needed and secure with tie straps.

Use an I-Command Ignition and Trim Harness to connect the outboard to the key switch and trim/tilt control. Sea I unused SystemCheck co nnector with 6-Pin Connector Seal, P/N 586076.

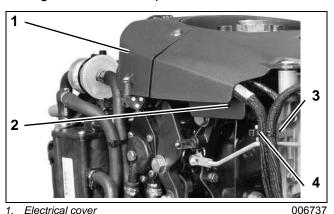
If connecting to an existing I-Command Classic network, connect the purple wires bet ween the I-Command Ig nition and Trim Harn ess and the I-Command Engine Interface Cable. This connection supplies power to the network when the key switch is on. I-Command Digital networks do not use this connection.



- Trim/Tilt connector
- CANbus Ignition connector
- SystemCheck connector (with seal)
- Deutsch-style harness power connector

22

Route I-Command Ignition Harness through wire channel in flywheel cover. Install electrical cover. Make sure both harnesses are in front of the tab and tighten with tie strap.



- Electrical cover 1.
- 2. Wire channel
- 3. Tab
- Tie strap

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



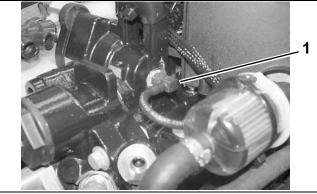
Engine Options Screen

008563A

Water Pressure Gauge

To display engine water pre ssure, install a water pressure hose fitting in the e cylind er block as shown.

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



Water pressure hose fitting

002461

For an I-Command water pressure display, several water p ressure senso r kit s are a vailable. Refer to the Evinrude/Johnson Genuine Parts and Accessories catalog.

BATTERY AND BATTERY CONNECTIONS

A WARNING

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

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

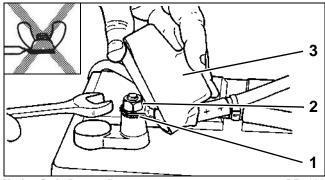
- Confirm that battery meets the minimum engine requirements.
- · Connections must be clean and tight.
- Observe a II wiring connections prior to d isassembly.

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.

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

- Starwasher
 Hex nut
- 3. Terminal Insulator

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

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

WARNING

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

OETIKER CLAMP SERVICING

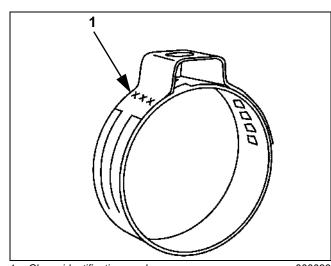
Clamp Identification

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

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

WARNING

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



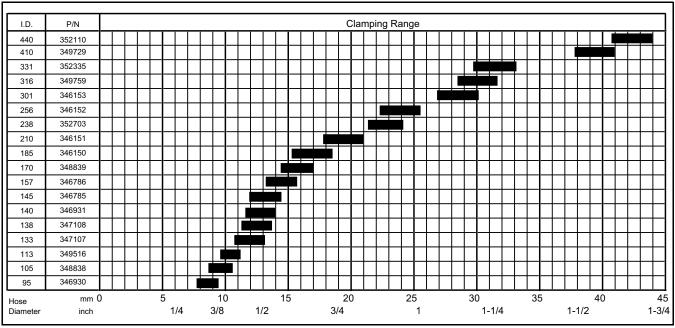
1. Clamp identification numbers

000093

Clamp Selection

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

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



008458

OETIKER CLAMP SERVICING

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.

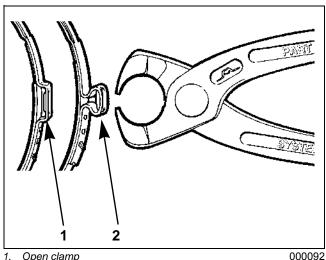
IMPORTANT: Use only *Oetiker* re commended tools to close Oetiker stepless clamps.

Oetiker p incers a re available in the Evinrude/ Johnson Genuine Parts and Accessories Catalog.



DP0886

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

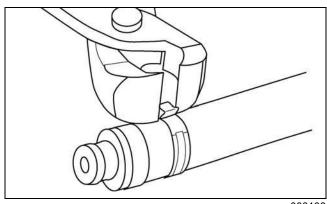


Open clamp

Closed clamp

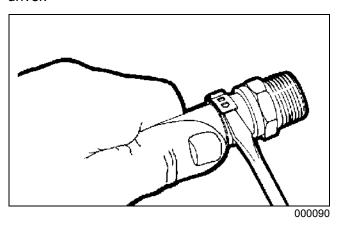
Clamp Removal

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

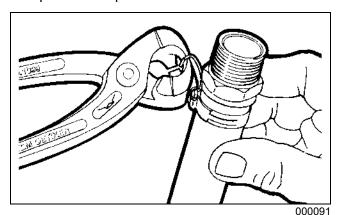


000108

Method 2: Lift end of stepless clamp with screwdriver.



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



ADJUSTMENTS

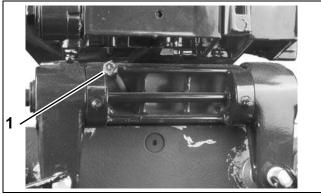
Steering Friction Adjustment

Tiller models are equipped with a steering friction adjustment. Steering friction is not required when remote steering is used.

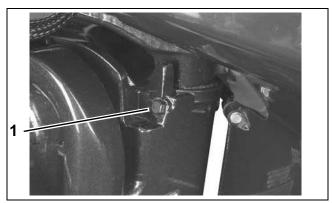
Adjust steering friction with outboard mounted to boat by loose ning or t ightening the adjustment screw. Steering friction should be adjusted so a slight drag is felt when turning.

WARNING

Do not overtighten. The steering friction screw is not intended to allow "hands off" steering.



1. Steering friction adjustment—Manual tilt models



1. Steering friction adjustment—Power tilt models

005116

001256

Throttle Friction Adjustment

Tiller models are equ ipped with a thro ttle friction adjustment knob lo cated on the st eering handle. Tighten the knob to reduce the effort required to hold a throttle setting.

Turn the knob:

- clockwise to increase friction
- counterclockwise to decrease friction

WARNING

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



002191

Tilt Limit Switch Adjustment (75 – 90 HP)

A WARNING

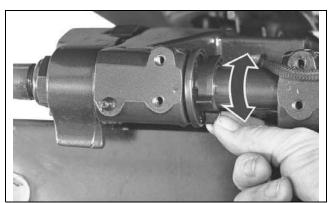
If the outboard does not clear all boat parts when tilted fully or turned side to side, safety related parts could be damaged in the course of such outboard movement. Injuries could result from loss of boat control.

Adjust the tilt limit switch on all new outboard installations.

Check the clearance between outboard(s) and the boat's motor we II and transo m area. T ilt outboard(s) to highest point of clearance and turn the steering system lock to lock.

If the outb oard cont acts the boat's mo tor well when fully tilted, adjust the tilt limit cam to reduce full-tilt position.

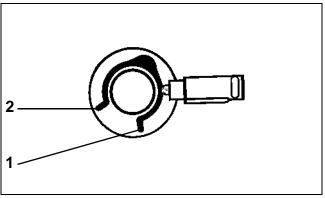
NOTICE The tilt limit cam will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.



DR3916

Place the outboard in normal operating position.

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



Lower adjustment tab
 Upper adjustment tab

DR4268

Check the adjustment by tilting the outboard fully.

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

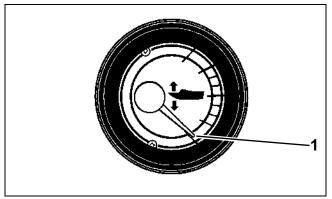
To pre vent da mage to equipment, provide additional motor well clearance when needed. Consider eith er changing the outboard mounting position or modifying the boat if the possibility for interference and damage exists.

A 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 (40 – 60 HP)

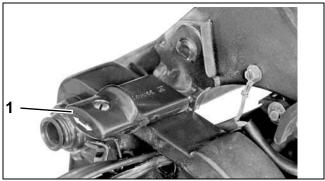
The sending unit eccentric cam must be ad justed so that the gauge needle is aligned with the lowest gauge mark with the outboard trimmed all the way DOWN.



1. Lowest gauge mark

DR2827

Check if the gauge needle is a bove or below the lowest gauge mark. Tilt engine UP and engage trailering lock.



1. Trailering lock

18954

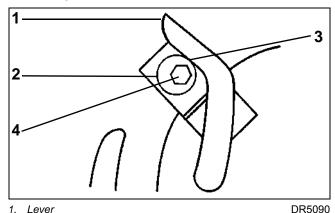
WARNING

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

When the outboard is trimmed all the way DOWN, the sending unit lever to uches the eccentric cam just forward of the top of the cam at the contact point.

Loosen cam scre w and rotate eccentric cam to adjust full down gauge position:

- If the needle was above the lowest mark, move the thick part of the cam T OWARD the contact point. Tighten the screw, and recheck the gauge reading.
- If the needle was below the lowest mark, move the thick part of the cam AWAY from the contact point. Tighten the screw, and recheck the gauge reading.



Lever
 Eccentric cam

3. Contact point

4. Cam screw

Tighten eccentric cam retaining screw and check needle position at full trim DOWN.

ADJUSTMENTS

Trim Sending Unit Adjustment (75 – 90 HP)

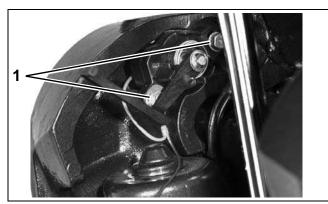
Tilt the outboard and engage the tilt support.

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



29072

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



1. Screws

27339

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

Observe the trim gau ge. If the needle does not show cen ter position, tilt the outboard up a nd 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 a djustment is correct, till the outboard up, tighten the two sending unit screws, and remove the thrust rod.

Trim Limiter Rod

The trim limiter rod prevents excessive trim down.

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

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

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

A 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

A 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.

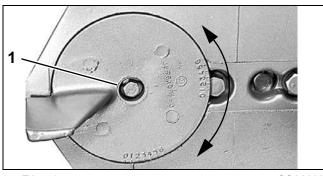
IMPORTANT: A single trim t ab adjustment will relieve steering effort under only one set of speed, outboard angle and load conditions. No sing le adjustment can relieve steering effort under all conditions.

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

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

Tighten the trim tab screw as follows:

• 40 - 90 HP: 35 to 40 ft. lbs. (47 to 54 N·m).



1. Trim tab screw

COA3663

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

Outboards with High Transom Heights

The trim tab may be ab ove 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 t abs equally and in the same direction.

Dual Outboards, One Counter and One Standard Rotation

Set both trim tabs to the center position.

ADJUSTMENTS

Dual-Outboard Alignment

Dual outboards must be connected with a tie bar and adjuste d to a lign the o utboards for corre ct water flow to the gearcases and propellers.

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

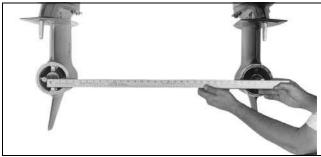
- Propeller ventilation
- Reduction of top speed
- Improper boat tracking
- Engine overheat and powerhead damage

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

Measure Alignment

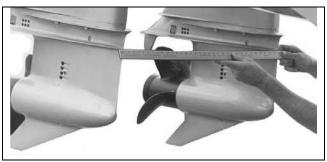
The "toe-in" (gearcase lea ding edge s closer together than propeller shaft centers) or "toe-out" (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:

- 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 bo at/motor comb inations respond differently to dual-outboard alignments. Each application must be thoroughly tested until the idea I combination of performance, steering, and cooling is found.

A common practice is to set-up the outboards parallel, or with a small a mount of "toe-out," and adjust inward until best results are achieved.

- A typical set-up, with out boards mounted directly on the transom, often runs best with a slight amount of "toe-in."
- Outboards mount ed be hind the transom on motor brackets usua lly require p arallel alig nment or "toe-out."

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

Check steerin g opera tion. Make sure that the steering system operates properly at various trimangles.

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 gea reases. Reset the outboard alignment and retest.

OPERATIONAL CHECKS

A DANGER

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

WARNING

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

A CAUTION

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

Engine Monitoring System

Attach emergency stop lanyard.

SystemCheck

Turn key switch to ON. Warning ho rn shou ld sound for 1/2 second.

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

I-Command

Turn key switch to ON.

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

Fuel System

Perform running checks of the fuel system by fo llowing these steps:

- Squeeze fuel primer bulb until hard or activa te electric primer. Observe all fuel hoses and connections. Repair any leaks.
- Start outb oard. Inspect all hoses and connections. Repair a ny I eaks o r mi srouted h oses immediately.

Emergency Stop / Key Switch

Check e mergency 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 startin-gear prevention feature is required by the United States Coast Guard to help prevent personal injuries.

Start outboard and shift to FORWARD.

Turn outboard OFF while control is in FORWARD.

Try to restart the o utboard. Outboard should not start.

Shift back to NEUTRAL and restart outboard.

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

Try to restart the o utboard. Ou tboard should not start.

COOLING SYSTEM

Tachometer Pulse Setting (SystemCheck)

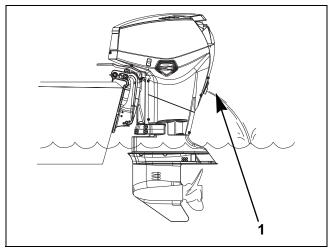
Confirm accuracy of tachometer reading.

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

Outboard Model	Tachometer Setting
40–90 HP	6 Pulse or 12 Pole

Water Pump Overboard Indicator

A steady stre am of water should flow from the overboard indicator.



1. Water pump overboard indicator

008469

Operating Temperature

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

Idle Speed

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

COOLING SYSTEM

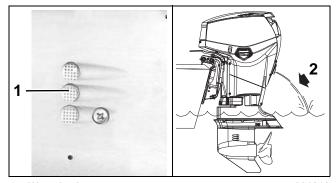
Regularly inspect cooling system components for corrosion, damage, leaks, or restrictions:

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

Water Intake Screens

Inspect condition of water int ake screens. Clean or replace as needed.

Confirm function of overboard water pressure indicator.



Water intake screen
 Overboard indicator

001212 008470

Engine Flushing

Flush the outboard with fresh water following each use in brackish, salt, or polluted water to minimize the accumulation of scale and silt deposits in cooling system passages.

The outboard can be flushed on the trailer or at dockside; running or not running.

IMPORTANT: The outboard must be lo cated in a well ven tilated area with appropriate ground drainage during the flushing procedure.

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

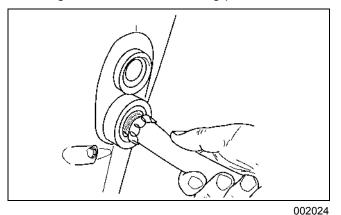
Flushing — Outboard Running

WARNING

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

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

Thread garden hose into flushing port.



Turn water supply on.

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

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

Reinstall propeller.

Flushing — Outboard Not Running

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

Thread garden hose into flushing port.

Turn water supply ON.

Flush outboard for at least five minutes.

Turn off water supply and remove garden hose.

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

ROUTINE SERVICE COOLING SYSTEM

Running the Outboard Using a Hose and Flushing Adapter

WARNING

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

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

- · Flush the engine
- Run for a n extende d pe riod of time, such a s when performing diagnostic work
- Run the engine on a dynamometer
- Prepare the outboard for storage.

IMPORTANT: The outboard must be lo cated in a well ven tilated area with appropriate grou nd drainage.

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

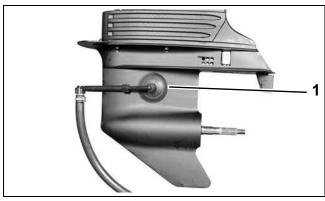
Be sure water supply is sufficient to run the engine above idle speed.

Water Supply Requirements

Model	Water Flow @ WOT
40–65 HP	4 to 6.5 GPM ¹ (15 to 24 LPM ²)
75–90 HP	7.5 to 9 GPM (28 to 34 LPM)

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

Install flushing adapter onto gearcase water inlet screens.



1. Flushing adapter

008342

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

Monitor engine water pressure gauge when:

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

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

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

LUBRICATION

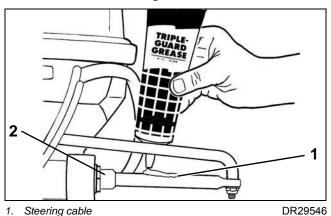
Steering System

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 ap propriate cleaning solvent to remove corrosion and dirt from output end of cable before coating it wit h gre ase. Make sure wip er nu t is installed and not damaged.



- Steering cable
- Wiper nut

Tiller Handle

Lubricate the tiller handle grease fitting s with Triple-Guard grease.



1. Tiller handle fittings – Standard handle

008196



1. Tiller handle fittings - Long handle

ROUTINE SERVICE

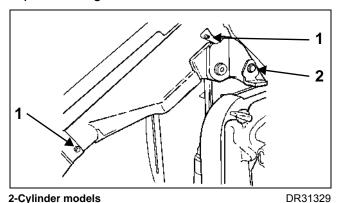
LUBRICATION

Swivel Bracket and Trailering Bracket

Lubricate th e 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.



2-Cylinder models Grease fitting

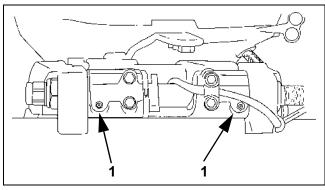
Tilt support

3-Cylinder models

- Grease fitting
- Pivot points
- Lower swivel bracket area

Tilt Tube

Lubricate the tilt tube grease fittin gs with Triple-Guard grease.



Tilt tube fittings

DR38798

Throttle and Shift Linkage

Disconnect the battery cables at the battery.

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

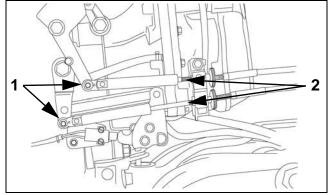
IMPORTANT: DO NOT disturb cab le trunnion adjustments.

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

Apply *Triple-Guard* grease to:

DR5073

- Cable attachment pins of both the throttle and shift levers
- Inner casings of both the throt tle and shif t cables.



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

Shift the re mote control to the NEUTRAL/IDLE position.

Install control cables.

Check proper throttle and shift function.

Propeller Shaft

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

A 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. 294.

Inspect bushing a nd blad e surfa ces. Re place damaged or worn propellers.

Clean p ropeller shaft. Inspect pro peller shaf t seals. Replace damaged or worn seals.

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

Reinstall propeller hardware and propeller.

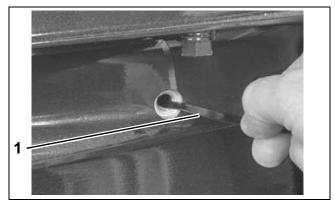
Gearcase Lubricant

Draining

A WARNING

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

IMPORTANT: Always check the fill le vel of the gearcase lub ricant at the u pper plug befo re removing the lower, drain/fill plug. A tie st rap can be used to check lubricant level.

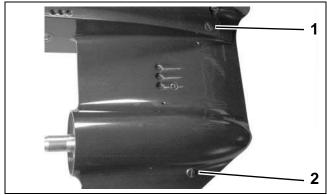


1. Tie strap

000072

If lubricant level is low, refer to **GEARCASE LEAK TEST** on p. 295.

Remove the lubricant level plug, then the lubricant drain/fill plug, an d dr ain the lube from the gearcase into a container.



Lubricant level plug

2. Lubricant drain/fill plug

ROUTINE SERVICE

LUBRICATION

Inspection

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

Inspect the lub ricant for water cont amination. Water can make the lubrican t milky in app earance. Ho wever, n ormal ae ration can also cause the same appearance.

To che ck f or wa ter co ntamination, put lu bricant into a glass con tainer. Allow the oil to settle for a minimum of one hour to determine if there is an abnormal amount of water in the oil.

If water is present, refer to **GEARCASE LEAK TEST** on p. 295.

Overheated lubricant will have a bla ck color and burned odor.

Internal gearcase inspect ion is re commended when lubricant is contaminated or shows signs of failure.

Filling

Refer to the **INSPECTION AND MAINTENANCE SCHEDULE** on p. 16 for service frequency and recommended lubricants.

Secure the gearcase in a vertical position.

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

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

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

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



Lubricant level plug
 Lubricant drain/fill plug

27023

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

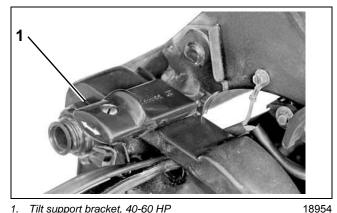
Trim and Tilt

A CAUTION

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

Check reservoir fluid level at least e very th ree years or 300 operating hours.

- 40-60 HP: System cap acity is appro ximately 15.2 fl. oz. (450 ml).
- 75-90 HP: System capacity is approximately 21 fl. oz. (620 ml).
- Tilt the outboard and engage the tilt support.



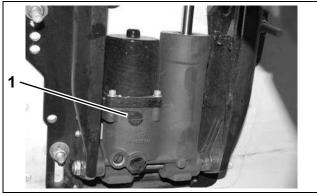
1. Tilt support bracket, 40-60 HP

Tilt support bracket, 75-90 HP

002279

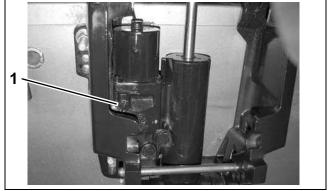
Remove filler cap and check fluid level.

• Single Ram System-Add Evinrude/Johnson Biodegradable TNT Fluid, as n eeded, to bring level to the bottom of the fill plug threads.



Single Ram System, 40 - 60 HP Filler cap

008018



Single Ram System, 79 - 90 HP 1. Filler cap

008017

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

- Disengage tilt support.
- Cycle the un it at lea st five complet e cycles to purge all air from the system. When cycling the unit, hold the trim switch ON a n additional 5 to 10 seconds after the unit reaches the end of its travel before activating the switch in the opposite direction.

ROUTINE SERVICE

SPARK PLUGS

SPARK PLUGS

Spark plu gs shou ld be removed and exa mined periodically. Replace worn , fou led or d amaged spark plugs.

Use only recommended spark plugs with the correct gap setting.

Spark Plug, Champion

QC10WEP @ 0.028 ± 0.003 in. (0.71 mm)

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

Removal

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



006521

Indexing

Spark p lug indexing position s the groun d ele ctrode of the sp ark plug opposite the fuel injector nozzle.

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



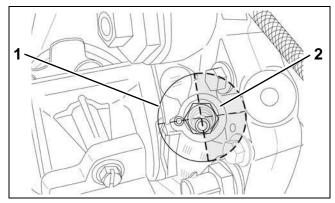
1. Ink mark

2. Open side

000758

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

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



Spark Plug Indexing Diagram

Unshaded area

2. Shaded area

002106

If the ma rk is in the shaded area, reset torque wrench to 30 ft. lbs. $(41 \text{ N} \cdot \text{m})$ and continue to turn until the mark is in the unshaded area.

If the mark does not rea $\,$ ch the unsh aded ar ea before the torque of 30 ft. lbs. (41 N·m) is reached, the spark plug cannot be indexed for that cylinder. Try another sp ark plug an $\,$ d repe at th $\,$ e ste ps above.

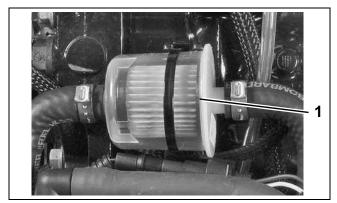
FUEL AND OIL SYSTEMS

Routine replacement of filters reduces the possibility of f oreign mate rial restricting the incoming fuel or oil supplies.

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

Fuel Filter

Evinrude E-TEC 40–9 0 HP ou thourds are equipped with an in-line fuel filter. Refer to **FUEL COMPONENT SERVICING** on p. 142.



1. In-line fuel filter

002145

Oil Filters and Oil Reservoir

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

Air Silencer

The air silencer maximizes air flow while minimizing noise.



40 - 65 HP 002227



75 - 90 HP 002158

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

Hoses and Connections

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

- Visually inspect all components.
- Observe all clamp s, hoses, a nd co nnections while outboard is running.
- Replace all damaged components.
- Repair all leaks.

WARNING

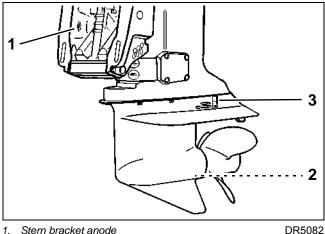
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

ANTI-CORROSION **PROTECTION**

Sacrificial Anodes

Galvanic corrosion occurs in fre sh 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 equ ipped with three sacrificial anodes.



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

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

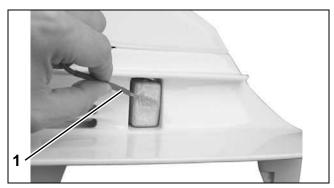
IMPORTANT: Anodes that are not eroding may not be properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

For best anode performance:

- · Replace all anodes that have eroded or disintegrated to two-thirds of their original size.
- Do not p aint or app ly pro tective co atings to anodes or anode fasteners.
- · Avoid using metal-based antifouling paint on the boat or outboard.

Testing Procedure – Continuity

Connect ohmmeter leads between engine ground and anode surface.



Meter lead to anode

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

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

Metallic Component Protection

Protect metal components on outboards from corrosion. Use the following product s 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 preve nt corrosion and reduce oxidation:

- Use a utomotive wax to prot ect the outboard's exterior finish from oxidation
- Clean regularly using clean wa ter and mild detergent soap
- Touch-up damage to painted surfaces promptly.

STORAGE

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

Fuel System Treatment

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

Internal Engine Treatment

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

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

IMPORTANT: Engine MUST be in NEUTRAL throughout these procedures.

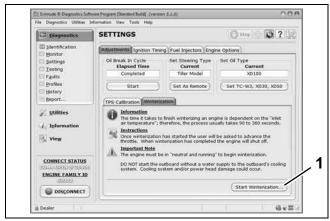
Throttle Control Method

- Advance thrott le control to 1 /2 thro ttle (5 0%) position and t hen st art the outb oard. All four SystemCheck lights will turn on an d the outboard will run at idle speed.
- After ap proximately 15 seconds, the System-Check lights will go off. Move thro ttle to IDLE position. SystemCheck lights will light again.
- Wait another 15 seconds. SystemCheck lights will go of f. At this poin t, advance thrott le to FULL (in neutral). SystemCheck lights will flash, indicating that outboard is in winterize mode.
- Outboard will automatically go to fast idle and fog it self. Allow outbo ard to run un til it shut s itself off (about one minute).

IMPORTANT: If *SystemCheck* lights do not flash, or outboard runs above fast id le, immediately turn of f outboard and start the procedure again.

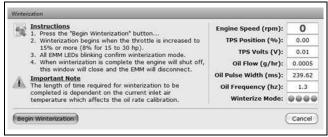
Software Control Method

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



1. Winterization start button

008564



008565

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

IMPORTANT: When f inished, I eave t he outboard in vertical position long enough to completely drain the powerhead.

ROUTINE SERVICE

PRE-SEASON SERVICE

Additional Recommendations

- Fill oil reservoir.
- Inspect the fuel filter. If there is debris in the fuel filter, it must be replaced.
- Replace gearcase lubricant.
- Remove and inspect propeller.
- Clean and grease propeller shaft.
- Blow water from gearcase speedometer pickup system (gearcase speedometer models only).
- Lubricate all grease fittings and linkages.
- Inspect o utboard, steering system, an d controls. Replace all damaged and worn components. Refer to ma nufacturer's and lubrication recommendations.
- Touch up painted su rfaces as ne eded. Coat outer painted surfaces with automotive wax.
- Remove b attery(s) from boat. S tore in a coo I, dry location. Periodically charge battery(s) while stored. Re fer to manu facturer's maintenance recommendations when servicing batteries.
- Store outboard in upright (vertical) position.
- Check for fuel leakage.

A WARNING

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

PRE-SEASON SERVICE

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

Outboard Mounting Bolts

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

Gearcase Lubricant

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

Battery(s)

• Replace batteries that cannot be charged.

Power Trim and Tilt

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

Operational Checks

- Refer to OPERATIONAL CHECKS on p. 33
- Steering system
- Remote controls
- All other accessories and instrumentation

Check Oil Injection Tank

• Inspect the oil tank for leaks.

Check Fuel System

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

Water Pump

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

WARNING

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

SUBMERGED ENGINES

Once an outb oard has been submerged in fresh or salt wate r, 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 outbo ard cannot b e 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 ho rizontal p osition (cylinder heads d own). Slowly rot ate 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 st art 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 reasse mbly. Coat all exposed solenoid terminals and engine grounds with *Black Neoprene Dip.*

Clean and insp ect a II electrical compone nts. Replace damaged or corroded components prior to returning the outboard to service. Electric starters sh ould be disassembled, cleaned, flush ed 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 supp ly hose and oil ret urn hose from out board. Drain and clean a ll oil hoses, filters, and oil tank assemblies.

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

Prime oil system and fuel system. Refer to **FUEL SYSTEM PRIMING** on p. 136 and **Oil Supply Priming** on p. 165. Make su re all oil injection hoses are clean and filled with oil.

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

Inject a small amount of out board lubricant in to spark p lug holes and install n ew sp ark p lugs. Refer to Spark Plug **Indexing** on p. 42.

Reinstall all removed or disconnected parts.

Use Evinrude Diagnostics software to:

- Initiate Break-in
- Check fuel pump operation
- Check injector operation (fuel and oil)
- Check timing (once outb oard is run ning 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 procedure s u sed for Engine Dropped Overboard (Not Running) and Engine Dropped Overboard (Running). Disa ssemble and clean outboards that have been submerged in salt water for prolonged pe riods of time. Clean or replace electrical components as necessary.

Prolonged Submersion (Fresh or Salt Water)

Outboards that have been dropped overboard and not recovered immediat ely, must be service d within three hou rs of recovery . Follow the same procedures used for Engine Dropped Overboard (Not Running) and Engine Dropped Overboard (Running).

NOTES

Technician's Notes Related Documents Bulletins **Instruction Sheets** Other

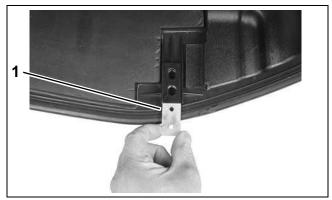
ENGINE COVER SERVICE

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Latch Hook Installation

Insert threaded bracket into pocket.



1. Bracket 006468

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

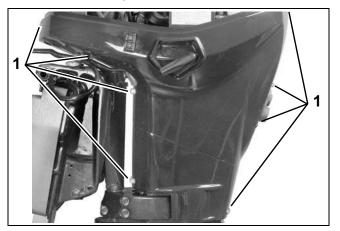


006469

UPPER COVER SERVICE LOWER COVER SERVICE

Lower Cover Removal

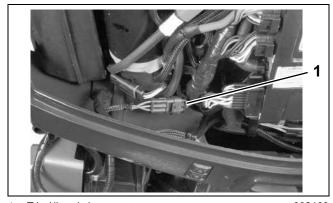
Remove lower engine cover screws.



1. Lower cover screws

002168

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



Trim/tilt switch connector

Lower Cover Installation

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

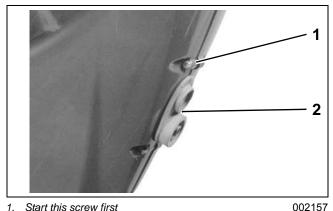
- Install air silencer on throttle body.
- Place st arboard cover o n out board and ro ute fuel hose and battery cable through grommet notch.
- Insert trim cable grommet into port side cover.
- Connect trim/tilt switch connector.
- Place port side cover into position on outboard.



- Trim cable grommet
- Trim/tilt switch connector

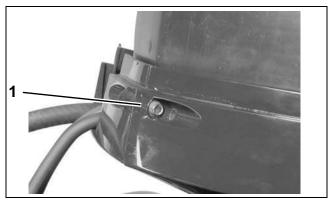
002216

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



- Start this screw first
- 2. Exhaust relief grommet

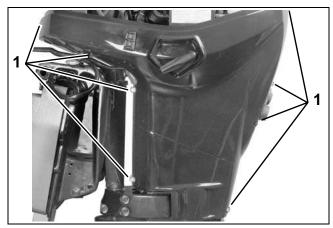
Start the top fron t scr ew n ext and draw cover halves together.



Start this screw second

002165

Install remain ing cover screws and tigh ten all screws to 24 to 36 in. lbs. (3 to 4 N·m).



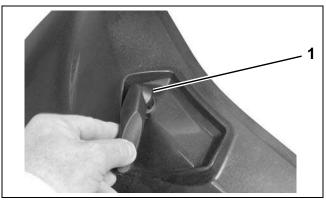
1. Lower cover screws

ENGINE COVER SERVICE

LOWER COVER SERVICE

Latch Handle Installation

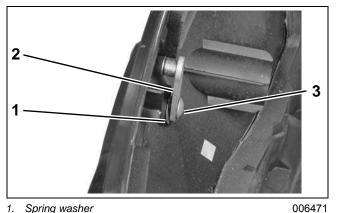
Apply a light coat of Triple-Guard grease to latch handle shaft. Insert handle into lower cover.



1. Triple-Guard grease

006470

Apply Ultra-Lock to screw threads. Place spring washer and ho ok into position and tig hten screw to a torque of 180 in. lbs. (20 N·m).



- Spring washer
- Hook
- Screw

Trim Switch Installation

Place switch into position through cover.

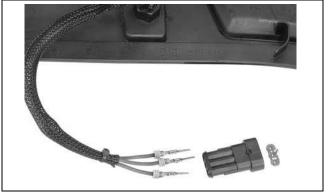


Install nut on switch. Tighten nut to a torque of 10 to 16 in. lbs. (1 to 2 N·m).



006747

Install electrical connector. Refer to CONNECTOR SERVICING on p. 116.



006748

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DESCRIPTION

DESCRIPTION

The Engine Manage ment Mo dule (*EMM*) is a water-cooled e ngine controller. It controls many outboard systems in cluding alternator ou tput for the 12 V and 55 V circuits. Operating vo Itage is supplied to the *EMM* by the stator.

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

EMM Functions

The *EMM* controls the following processes and functions:

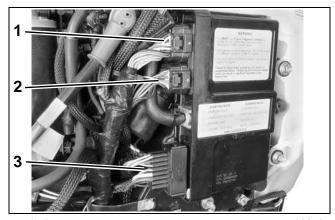
- Alternator output; 55 V and 12 V
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil injector pump activation
- · Electric fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Service code creation and storage
- Warning system activation
- ROM verification, self-test
- Choke-less cold starting
- · Output of diagnostic data
- Tachometer signal
- RPM profile and engine hours
- Oiling ratios
- Exhaust water valve activation (60 65 HP)

EMM Connections

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

Make sure EMM connections are clean and tight.

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



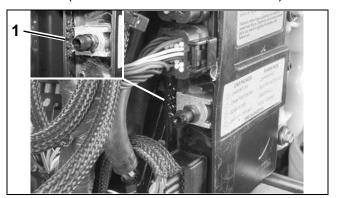
- J1-A connector
- 2. J1-B connector
- 3. J2 connector

006487

LED Indicators

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

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



LED indicators
 (Cooling hose removed for clarity)

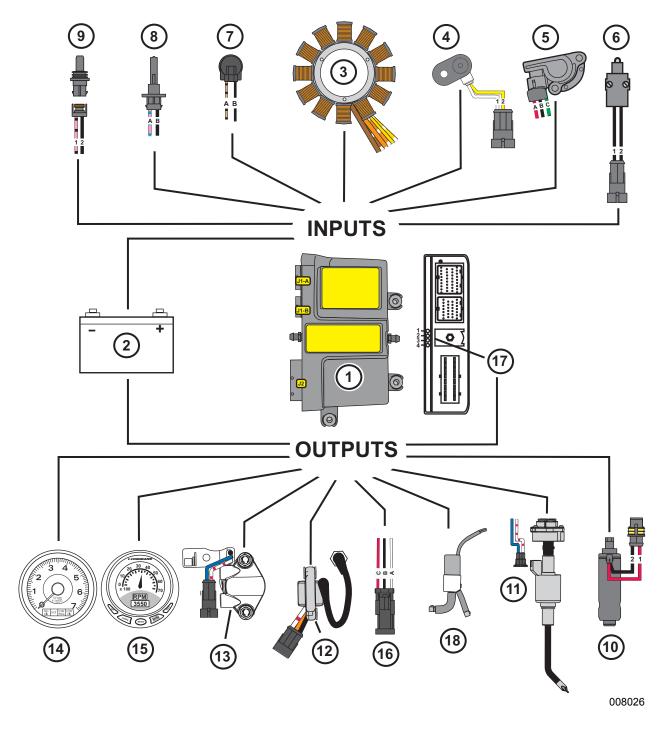
002429 006467

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

As the outbo ard is being started, all four LEDs should light and then go off in sequence. If any of the LEDs does NOT light during starting, refer to **EMM LED INDICATORS** on p. 77.

When the outboard is running, all LEDs should be off. If any LED is lighted while the outboard is running, refer to **EMM LED INDICATORS** on p. 77.

EMM INPUTS AND OUTPUTS DIAGRAM



- 1. Engine Management Module (EMM)
- 2. Battery (12 volt)
- 3. Stator
- 4. Crankshaft Position Sensor (CPS)
- 5. Throttle Position Sensor (TPS)
- 6. Neutral Switch

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

- 13. Fuel Injector
- 14. Tachometer/SystemCheck Gauge
- 15. I-Command (CANbus) Display
- 16. Diagnostic Connector
- 17. LED Indicators
- 18. Exhaust Water Valve (60–65 HP)

INTERNAL SENSORS

INTERNAL SENSORS

Sensor inp uts and inte rnal *EMM* contro llers are used to control outboard operation. Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the *EMM* Service Code Chart at the back of this manual for a complete list of all engine fault codes.

Internal sensors are NOT serviceable. Re programming or replacement ma y be required to resolve internal *EMM* issues.

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

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

Activates S.A.F.E.

Stores service code 25

EMM LED 4: ON (Running)

Engine Monitor TEMP display: ON

If *EMM* temp erature excee ds 212°F (100 °C) or the circuit fails, the *EMM*:

Activates SHUTDOWN

Stores service code 29

EMM LED 4: FLASHING

Engine Monitor TEMP display: FLASHING

IMPORTANT: The outboard will not restart until the en gine co ols be low 2 12°F (1 00°C)and the *EMM* temperatu re returns to normal. Re fer to **SHUTDOWN MODE** on p. 62.

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

Stores service code 24

EMM LED 3: OFF (Cranking)

EMM LED 3: ON (Running)

If sensor read s less than $-71^{\circ}F$ (-57 .4°C) or greater than 313°F (156°C), a sensor circuit fault is detected and the *EMM*:

Stores service code 23

EMM LED 3: OFF (Cranking)

EMM LED 3: ON (Running)

55 V Circuit Sensor

Monitors the EMM's 55 V alternator circuit.

If system voltage exceeds 57 volts, the EMM:

Activates S.A.F.E.

Stores service code 18

EMM LED 1: ON (Running)

Engine Monitor CHECK ENGINE display: ON

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

Activates S.A.F.E.

Stores service code 17

EMM LED 1: ON (Running)

Engine Monitor CHECK ENGINE display: ON

12 V Circuit Sensor

Monitors the EMM's 12 V alternator circuit.

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

Stores service code 27

EMM LED 1: ON (Running)

Engine Monitor LOW BATTERY display: ON

If battery voltage is less than 12.5 V, the *EMM*:

Stores service code 26

EMM LED 1: ON (Running)

Engine Monitor LOW BATTERY display: ON

EXTERNAL SENSORS

5 V Circuit Sensor

Monitors the EMM's 5 V sensor circuit.

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

Stores service code 78	
EMM LED 3: OFF (Cranking)	
EMM LED 3: ON (Running)	

Barometric Pressure Sensor

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

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

Stores service code 44

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

Stores a service code 45

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

Stores service code 46

EXTERNAL SENSORS

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

The *EMM* provides a 5 V DC signal for sensor circuits. It monitors all sen sor volt age inputs and compares them to prede termined accept able ranges. In puts that fall outside of the acceptable range create service codes.

Air Temperature Sensor

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

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

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

Engine Temperature Sensor

Monitors cylinder head temperature.

75 - 90 HP Models

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

Activates S.A.F.E.
Stores service code 40
EMM LED 4: ON (Running)
Engine Monitor TEMP display: ON

If cylinder he ad temperature exceeds 194° F (90° C) above 3500 RPM, the *EMM*:

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

EXTERNAL SENSORS

If cylinder h ead temperature exceeds 212° F (100° C) above 35 00 RPM, or 23 0° F (1 10° C) below 3500 RPM, the *EMM:*

Activates SHUTDOWN

Stores service code 31

EMM LED 4: FLASHING

Engine Monitor TEMP display: FLASHING

40 - 65 HP MODELS

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

Activates S.A.F.E.

Stores service code 43

EMM LED 4: ON (Running)

Engine Monitor TEMP display: ON

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

Activates SHUTDOWN

Stores service code 31

EMM LED 4: FLASHING

Engine Monitor TEMP display: FLASHING

ALL MODELS

The outboard will not restart after a temperature related SHUTDOWN until the engine temperature returns to normal. Refer to **SHUTDOWN MODE** on p. 62.

If sensor values are less than -15°F (-26.1°C) or greater than 332°F (166.5°C), the *EMM*:

Stores service code 41

EMM LED 3: OFF (Cranking)

EMM LED 3: ON (Running)

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

Stores service code 42

EMM LED 3: OFF (Cranking)

EMM LED 3: ON (Running)

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

Stores service code 58

EMM LED 3: OFF (Cranking)

EMM LED 3: ON (Running)

Low Oil Switch

The low oil switch monit ors the oil level in the oil tank.

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

Engine Monitor LOW OIL display: ON

When the oil le vel falls b elow o ne-quarter, t he *EMM* b egins counting oil pump pulse cycles. When it reaches:

• 40 - 65 HP: 4800 pulses

• **75 – 90 HP**: 6000 pulses

the EMM:

Activates S.A.F.E.

Stores service code 117

EMM LED 4: ON (Running)

Engine Monitor NO OIL display: ON

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

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

Activates SHUTDOWN

Stores service code 33

EMM LED 4: FLASHING

Engine Monitor NO OIL display: FLASHING

EXTERNAL SENSORS

Throttle Position Sensor

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

If TPS voltage is greater than 0.78 volts when the key is turned to ON, or the recoil starter is pulled, the *EMM*:

Creates service code 11

If the outboard starts, the code is saved.

If code 11 is present as both a Active Fault and a Occurred Fault, refer to **Control Cable Installation** on p. 19. For tiller models, re fer to **Throttle Cable Adjustment** on p. 276, or **Throttle Cable Adjustment** on p. 287.

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

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

IMPORTANT: When a TPS circu it fault has been detected, the outboard will not accele rate above idle speed. To reset, stop the outboard and correct the fault.

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

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

If the TPS circuit read s above 4.85 volt s, the *EMM*:

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

Crankshaft Position Sensor

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

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

Stores service code 16
EMM LED 2: OFF (Cranking)
EMM LED 3: ON (Running)

Approximate air g ap b etween CPS and flywheel encoder ribs is 0.073 inch (1.85 mm).

Use the *Evinrude Diagnostics* so ftware *Monitor* screen to check CPS opera tion. The software should show an RPM reading while the outboard is cranking. If the CPS or its circuit fails, no RPM reading will appear and the outboard cannot run.

Neutral Switch

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

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

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

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

INTERNAL EMM FUNCTIONS

INTERNAL EMM FUNCTIONS

ROM Verification

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

Idle Controller

The idle controller reacts to engine operating conditions. Fu el an d ign ition timings are a ltered to maintain a specific RPM when e ngine is cold or warm. The contro ller is inactive when TPS is advanced from idle position.

RPM Limiter

This fea ture of *EMM* p rogramming prevents engine damage due to excessive RPM. At 62 50 RPM, fuel and ignition to the cylinders is shut off. Normal op eration resumes when engine RPM returns to the specified range.

Neutral RPM Limiter

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

Exhaust Water Valve Activation (60 - 65 HP)

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

Two conditions must be met to activate the valve:

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

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

Engine Monitor and Warning Systems

Refer to **ENGINE MONITOR SYSTEM** on p. 61.

Refer to **S.A.F.E. WARNING SYSTEM** on p. 62.

Refer to **SHUTDOWN MODE** on p. 62.

Fault Code Creation and Storage

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

ENGINE MONITOR SYSTEM

ENGINE MONITOR SYSTEM

All remote controlled outboards must be equipped with an engine monitoring syste m to warn the operator of conditions that could damage the outboard.

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

The outb oard's *EMM* sen ds information about monitored functions to:

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

IMPORTANT: Operating the outboard without an engine monito r will void the warranty for failures related to monitored functions. For information about bo at mount ed Information Displa v System options, refer to the current **Predelivery** and Installation Guide included with the service manual set.



Typical I-Command and SystemCheck gauges

007988

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

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

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

System Self-Test

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

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

Service Mode

SystemCheck goes into a service mode if the key is left ON after self-test (engine NOT running). All light circuits and sensors are active, but the horn is not. Grounding the appropriate light circuit wire will turn the light on, but the horn will not sound. SystemCheck CIRCUIT TESTS on Refer to p. 107.

Engine Running

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

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

S.A.F.E. WARNING SYSTEM

S.A.F.E. WARNING SYSTEM

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

Code 17	Alternator 55 V below expected range
Code 18	Alternator 55 V above expected range
Code 25	EMM temperature above expected
	range
Code 34	Oil injector open circuit
Code 40	Cylinder head temperature above
	expected range-low speed
Code 43	Cylinder head temperature above
	expected range-high speed
Code 117	NO OIL detected

Activation

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

Recovery

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

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

SHUTDOWN MODE

Outboard "sh utdown" will occur if specific fault s are detected by the *EMM*:

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

Code 57 occurs when the *EMM* d etects abn ormally high RPM relative to the TPS position. This condition could be cause d by uncontrolled fuel entering the combustion cycle. Before removing the code and ST ARTING the outboard, find and repair the cause.

- Perform Fuel System Pressure Test on p. 137.
 Check for external fuel leakage that could allow fuel and/or vapor to enter the engine through the air intake.
- Check for internal fuel leakage from a le aking injector or vapor separator vent hose.

A WARNING

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

Recovery

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

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

DIAGNOSTIC **SOFTWARE FUNCTIONS**

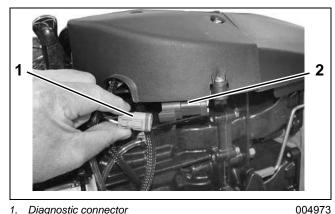
The EMM stores valuable information about the outboard and its running history. This information can be used for trou bleshooting, for checking parts information, and for ma king adjustments to the system.

Use Evinrude Diagnostics software, version 5.1 or higher, and a laptop computer to access program information.

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

Communication

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



- Diagnostic connector

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

The EMM must turn ON before it will communicate with the computer.

ELECTRIC START MODELS

Power is normally supplied to the *EMM* when the key switch is ON. Switched B+ (12 V) enters the EMM at pin 28 (purple) of the EMM J1-B connector.

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

ROPE START MODELS

Diagnostic communications on non-ru nning rope start models requires a power supply to the *EMM*.

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

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



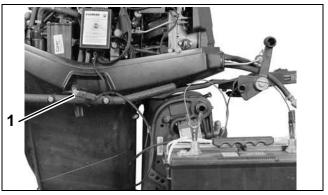
- Power supply tool
- Engine harness connectors

007279

IMPORTANT: Static test s require more p ower than the internal batteries of the tool can provide. Static te sts perf ormed using only the interna power supply batteries will produce false results.

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

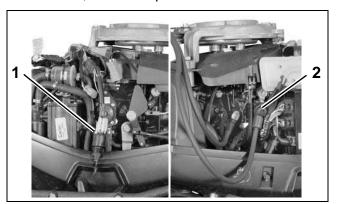
- Fuel pump
- Fuel injector
- · Ignition coil
- Oil injector



1. External power connector

DIAGNOSTIC SOFTWARE FUNCTIONS

If Diagnostic Power Supply Tool, P/N 587005, is not available, a Bat tery Cable, P/N 584348, can be connected to the engine mounted so lenoid. Use accessory Key Switch As sembly, P/N 176408, to control power to the *EMM*.



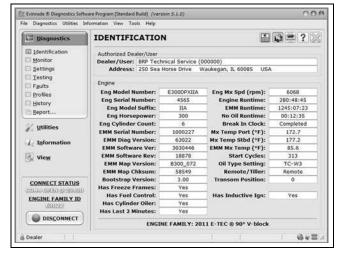
- Accessory key switch
- 2. Battery cable

007281 007282

Static Information

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

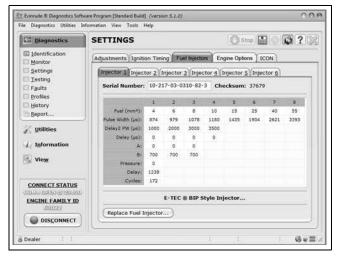
The outboard model and serial numbers displayed on the *Identity* screen must ma tch the identification label on the outboard swivel bracket.



Identity Screen

008567

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

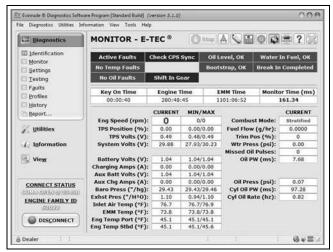


Injector Coefficients Screen

008568

Dynamic Information

Dynamic information is viewed while the outboard is running. Ch anges in dat a, such as voltages or temperatures, are shown as they happen.

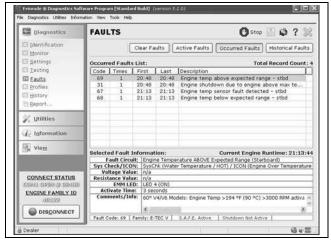


Monitor Screen

Occurred Service Codes (Faults)

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

The Occurred Faults scree n of the diagnostics software shows the code number, the number of times the event occurred, and operating hours of first and last occurrences.

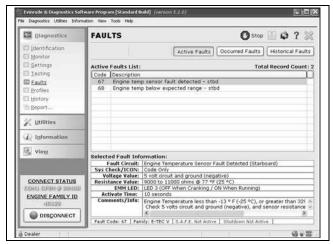


Occurred Faults Review Screen

008584

Active Faults

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



Active Faults Review Screen

00858

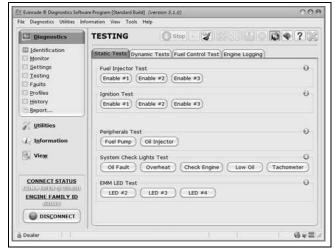
Historical Faults

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

Historical faults cannot be erased.

Static Tests

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



Static Tests Screen

008569A

Ignition Test

Use the diagnostics software to test each ig nition circuit. Refer to **Static Ignition Test** on p. 81.

Fuel Test

Use the diagnostics sof tware to te st each fue I injector circuit. Refer to **Fuel Injector Static Test** on p. 84.

Oil Injector

Use the diagnostics software to test the oil injection pump circuit. Refer to **OILING SYSTEM TESTS** on p. 166.

Fuel Pump

Use the diagnostics software to test the fuel pump circuit. Refer to **Fuel Pump Static Test** on p. 84.

Water Injector

This test activat es the exhaust water valve solenoid (60 - 65 HP). Refer to **Exhaust Water Valve Static Test** on p. 86.

DIAGNOSTIC SOFTWARE FUNCTIONS

Overheat

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

Oil Fault

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

Check Engine

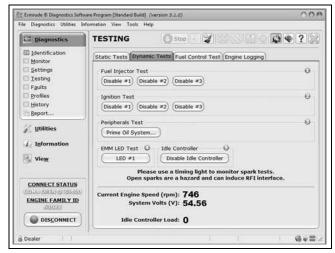
This test is used to check the "CHECK ENGINE" circuit of the Engine Monitoring system.

Tachometer

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

Dynamic Tests

Dynamic test's are performed with the outboard running.



Dynamic Tests Screen

008570

Ignition Test

This test momen tarily disab les the ig nition a nd fuel injection circuits to one cylinder. By dropping one cylinder, RPM and ru nning quality change s can be observed. Refer to **DYNAMIC TESTS** on p. 76.

Fuel Test

This te st momen tarily disables one f uel injector circuit. By dropp ing one cylinder, RPM and running quality changes can be observed. Refer to **DYNAMIC TESTS** on p. 76.

Prime Oil

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

Oil Control Settings

Set Oil Type

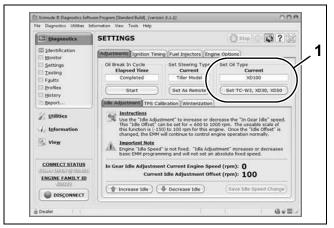
The TC-W3 oil type setting is the standard setting for all outboards. Set TC-W3 for:

- Operation with a II TC-W3 outboard oils including XD30, XD50, or XD100
- Applications requiring maximum lubrication
- Extreme applications (ra cing or harsh cond itions).

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

Use the XD100 setting for:

- Conventional use (runabouts, cruisers)
- Moderate applications.



1. Oil control setting

008580

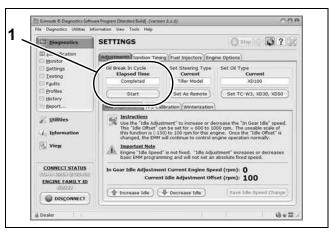
A CAUTION

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.

Δ

Powerhead Break-In

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

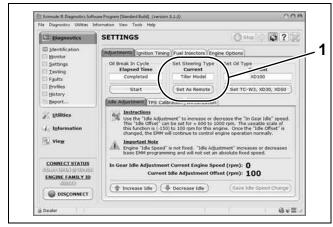


1. Break-in oil setting

008580

Tiller/Remote Programming

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



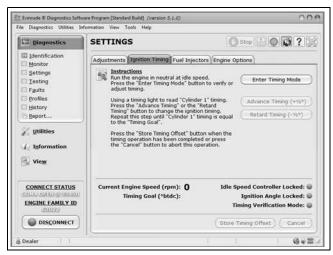
1. Starter mode setting

008580

Ignition Timing

Use the *Ignition Timing* scre en to check an d adjust *EMM* timing. *EMM* timing must be synchronized to crankshaft position.

Refer to **TIMING ADJUSTMENTS** on p. 113.



008572

Check timing af ter any of the following procedures:

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

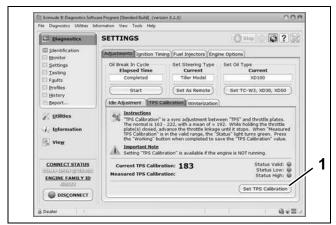
IMPORTANT: Make sure the timing poin ter is set and the outboard reaches operating temperature before making adjustments.

DIAGNOSTIC SOFTWARE FUNCTIONS

TPS Calibration

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

Refer to TPS Calibration on p. 114.



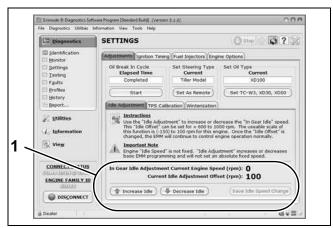
1. TPS Calibration button

008581

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

Idle Speed Control

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



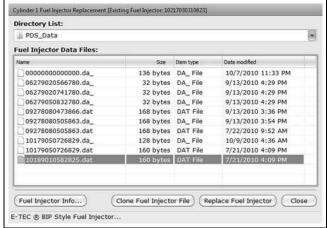
1. Idle adjustment

008580

Fuel Injector Servicing

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

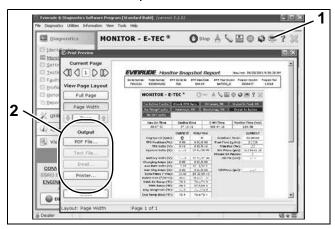
To inst all a service injector, click the "Replace" button on the *Injector Coefficients* screen and select the file for the replacement injector. Refer to **Fuel Injector Service** on p. 146.



Reports

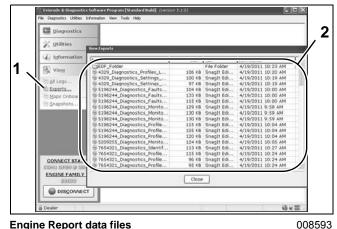
Engine reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

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



- Print button
- 2. Print/Export options

008592



Engine Report data files

- Exports button
- 2. Data files

Software Replacement

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



Software Update button

008594

IMPORTANT: If using Diagnostic Power Supply Tool, P/N 587005, to supply po wer to the *EMM*, use Accessory Power Cable Kit, P/N 5008092, to connect an external 12 volt battery to the Power Supply Tool.

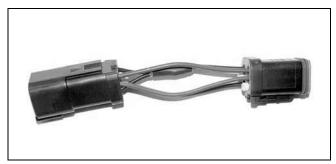
If the internal batteries of the Power Supply Tool have a low volt age condition the EMM could turn OFF durin g the so ftware up load, resulting in a failed software update.



Power supply tool

EMM SERVICING

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



002383

008495

EMM Transfer

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

Select *EMM Data Transfer* from the *Utilities* menu. Select *Perform Transfer From Memory* and follow the instructions provided with the program.



- 1. Select EMM Data Transfer
- 2. Select Perform Transfer From Memory

IMPORTANT: Whenever the *EMM* is rep laced, *EMM* timing must be synchronized to crankshaft position. Refer to **TIMING ADJUSTMENTS** on p. 113.

EMM SERVICING

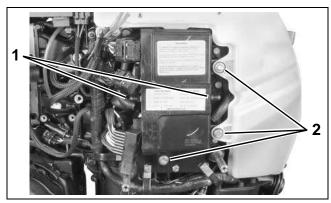
IMPORTANT: If a n ew *EMM* is being installed, refer to **EMM Transfer** on p. 70.

Removal

Disconnect cooling hoses from EMM.

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

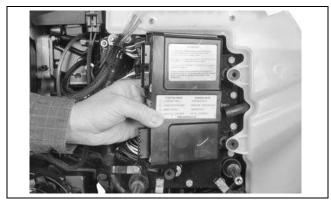
Remove three *EMM* retaining screws a nd washers. Remove *EMM*.



- 1. Cooling hose connections
- 2. EMM mounting screws

006476

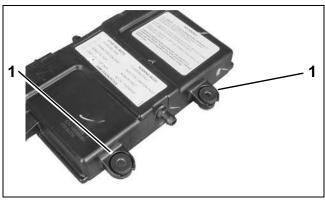
Remove *EMM* from behind oil tank bosses.



Installation

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

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



1. Isolator mounts

006478

Apply $Nut\ Lock\ t$ ot hreads of EMM ret aining screws. Tighten to a torque of 30 to 42 in. lbs. (4 to 5 N·m).

Install harn ess connectors and cooling h oses. Secure hoses with tie straps.

NOTES

Related Documents	
Bulletins	
Instruction Sheets	
Other	
Cinci	
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SYSTEM ANALYSIS

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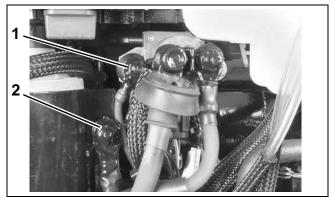
DIAGNOSTIC PROCEDURES

Visual Inspections

Inspect wiring and electric al connections. Disassemble a nd clean all corrode d connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits.

- Refer to ELECTRICAL HARNESS CONNEC-TIONS on p. 92.
- Refer to WIRING DIAGRAM at the back of this manual.
- Refer to CONNECTOR SERVICING on p. 116.

Make sure all g round connections are clean and tight. Refer to **GROUND CIRCUITS** on p. 94.



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

002292

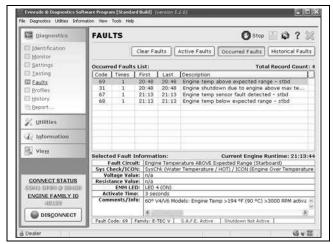
Inspect spark plugs for wear, oil fowling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.

Check the fuse and the emergency st op switch lanyard.

Operational Inspections

Run the ou thought to confirm actual symp toms before performing any unne cessary procedures. Inspection should include the following:

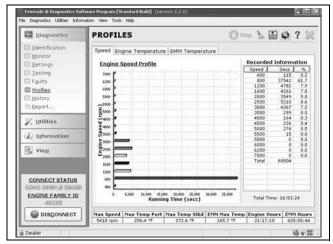
- Make sure the outboard can be cranked easily, with no mechanical binding.
- Check the EMM LED Indicators for system status information. Re fer to EMM LED INDICATORS on p. 77.
- Check the Evinrude Diagnostics software Active Faults and Occurred Faults screens for current service codes. Correct a ny problems and clear the codes before further troubleshooting. Refer to Occurred Service Codes (Faults) on p. 65.



Occurred Faults Review Screen

008584

Check the diag nostics software *Profiles*, *Occurred*, and *Historical Faults* screens for evidence of abnormal operation.



Profiles Screen

008587

Troubleshooting

Outboard will not crank, starter does not operate:

- Check co ndition of batt ery and cables (ma in battery switch and cables). Make sure battery cables are not reversed.
- Confirm that switched B+ is present at "A" terminal (yellow/red wire) of starter solenoid with key switch in the START position.
- Check ground at "B" te rminal harness connection.
- Refer to ELECTRIC START TESTS on p. 102.
 Repair starter or start circuit as needed.

Outboard cranks, will not start:

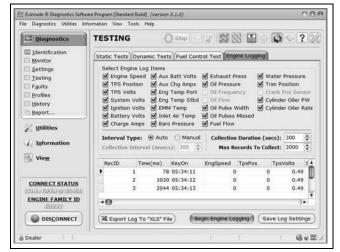
- Check emergency stop switch and lanyard
- Check powerhead mounted neutral switch
- Check the EMM LED Indicators for system status information. Refer to EMM LED INDICATORS on p. 77.
- Use the Evinrude Diagnostics sof tware Occurred Faults screen to check for current service codes. If there are multiple occurred sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
- Perform a Static Ign ition test using Evinrude Diagnostics so ftware and a n ind uctive t iming light. Refer to Static Ignition Test on p. 81.
- If ignition test indicates steady sp ark, refer to **FUEL DELIVERY TESTS** on p. 84.

Outboard runs, low on power, misfires:

- Check the EMM LED Indicators for system status information. Refer to EMM LED INDICATORS on p. 77.
- Use the Evinrude Diagnostics software Monitor screen to check syste m (55 V) and TPS voltages. System voltage should be steady, and TPS voltage should be between 0.2 and 4.85 V.

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

- Use the diagnostics software *Dynamic Tests* to isolate a faulty cylinder. See **DYNAMIC TESTS** on p. 76.
- Use an inductive timing light to check ig nition and fuel injector circuits. Refer to Running Ignition Tests on p. 82 and Running Fuel System Tests on p. 85.
- Use the diagn ostics software Fuel Control Adjustment test to help identify a cylind er that may be too rich or too lean. Refer to Fuel Control Adjustment on p. 76.
- Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.
- Check fuel quality and that fuel is present at injectors.
- Use the diagnostics software *Logging* function to record engine data as a problem is occurring.



Logging Screen

008574

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

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

DYNAMIC TESTS

Cylinder Drop Tests

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

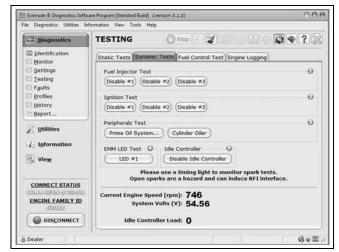
- The Dynamic Ig nition test disables the ignition and fuel injection circuits to a cylinder.
- The Dynamic Fuel te st mome ntarily disable s one fuel injector circuit.

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

IMPORTANT: Test the out board at the RPM where the problem is occurring. Use the test procedures to identify inconsistencies in voltages and cylinder performance. On ce a circuit has been identified a smalfu nctioning, inspect all related wiring and connections. Check all voltage in puts and grounds; and perform resistance tests for all circuits before replacing any suspect components.

Dynamic Tests can be used with:

- A timing light to determine how other cylinders are affected by one cylinder being "dropped"; or
- A digital mult imeter to check volt age changes on electrical circuits.



Dynamic Test Screen

008570A

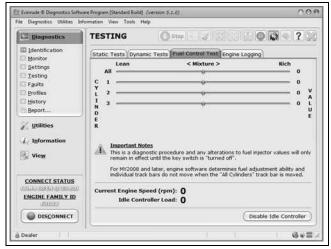
IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed. The *Dynamic Tests* screen includes a function to temporarily disable the idle controller.

Fuel Control Adjustment

Use this test is to help identify a cylinder that may be too rich or too lean. This feature should not be used by itself to identify a faulty injector.

Evinrude Diagnostics software allo ws temporary adjustments to the fuel flow characteristics of the injectors. Factory fuel flow settings are restored when power to the *EMM* is returned to OFF.

Test the outboard at the RPM where the problem is occurring.



008575A

If the outbo ard run q uality improves with a fue I control adjustment, eliminate ot her possibilities before replacing an injector:

- Refer to Fuel System Pressure Test on p. 137.
- Refer to Running Fuel System Tests on p. 85.

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

Inductive Amp Meter Test

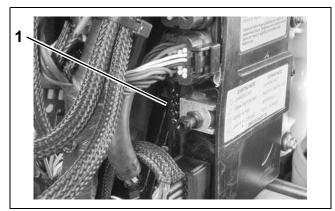
Use a n ind uctive amp me ter to monito r battery charging and current flow . Ident ifying erratic amperage in a circuit c an b e used to isolate a problem component.

EMM LED INDICATORS

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

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

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



1. LED indicators

006467

Key ON

IMPORTANT: Diagnostic communication s on non-running rope start models requires that power is supplied to the *EMM*. Refer to **Communication** on p. 63.

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

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

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

Starting

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

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

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

Code 16 – CPS, intermittent loss of sync

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

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

For FLASHING LIGHT, check for Code 57.

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

· Grounded stop circuit.

For FLASHING LIGHT, check for:

- Code 29 EMM temp. OVER range (flashing)
- Code 31 Engine temp. OVER range (flashing)
- Code 33 Engine shut down, excessive no oil condition

SYSTEM ANALYSIS

EMM LED INDICATORS

Running

When the outbo ard is runn ing, all of the LEDs should be off. If a light is on, check for:

LED 1 – CHARGING FAULT:

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

LED 2 - INJECTOR/IGNITION FAULT:

- Code 51 cylinder no. 1 injector circuit open
- Code 52 cylinder no. 2 injector circuit open
- Code 53 cylinder no. 3 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 81 no. 1 ignition coil circuit open
- Code 82 no. 2 ignition coil circuit open
- Code 83 no. 3 ignition coil circuit open
- Code 90 Water injection solenoid short
- Code 91 fuel pump circuit open
- Code 93 Water injection solenoid open
- Code 94 fuel pump circuit short
- Code 101 No. 1 ignition timing circuit shorted
- Code 102 No. 2 ignition timing circuit shorted
- Code 103 No. 3 ignition timing circuit shorted

LED 3 – Sensor circuits (5 V), SENSOR FAULT. For LIGHT ON, check for possible fault codes:

- Code 12 TPS circuit fault
- Code 13 TPS below expected range
- Code 14 TPS above expected range
- Code 16 CPS, intermittent loss of sync
- Code 23 EMM temp. sensor circuit fault
- Code 24 *EMM* temp. below expected range
- Code 41 temp. sensor circuit fault
- Code 42 temp. below expected range
- Code 47 AT sensor circuit fault
- Code 48 AT sensor below expected range
- Code 49 AT sensor above expected range
- Code 57 high RPM with low TPS setting
- Code 58 operating temp. not reached
- Code 78 Sensor supply voltage fault

LED 4 – Engine overh eat, *EMM* te mperature or sensor, oil injection pump o r sensor, NO OIL / OVERHEAT. For LIGHT ON, che ck for possible fault codes:

- Code 25 EMM overheat
- Code 29 EMM overheat, critical (flashing)
- Code 31 engine overheat, critical (flashing)
- Code 33 excessive NO OIL faults
- Code 34 oil injection pump circuit open
- Code 40 engine overheat, low rpm
- Code 43 engine overheat
- Code 117 Critical NO OIL detected

IGNITION OUTPUT TESTS

A DANGER

The electrical system presents a serious shock hazard. Allow outboard to sit for two minutes after running before handling capacitor or 55 V electrical components. Failure to handle capacitor properly can result in uncontrolled electrical discharge and possible electrical shock to humans.

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

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

Required Ignition Systems

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

Stop Circuit

 Black/yellow wire NOT grounded (eme rgency stop switch lanyard in place).

Neutral Switch

 Powerhead mounted neutral switch provides a switched ground circuit to EMM. The circu it enables spe cialized control functions such as neutral st art prot ection and RPM limiting in NEUTRAL.

Stator Output Voltage

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

EMM

 Controls ignition grounds, injector grounds, and engine timing.

Crankshaft Position Sensor

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

Alternator Output/System Voltage

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

Capacitor

- Connected to 55 V circuit (white/red) to stabilize current on 55 V circuit
- Negative terminal of cap acitor mu st be grounded.

Ignition Coil

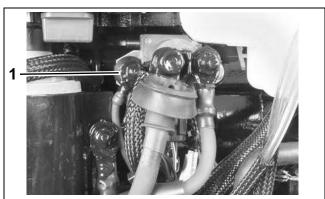
- Primary circuits are powered by system (55 V) voltage
- EMM provides control signal to ignition coil
- Output from ignition coil secondary winding and high tension spark plug wire.

Wiring Inspection

Visually inspect all wi ring, con nections, and grounds.

Use a digit al ohmmeter to test resist ance on all ground circuits and connections. Ohmmeter readings should be approximately 0.0 W.

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



1. Main engine harness ground

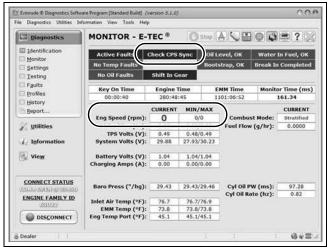
002292

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

Crankshaft Position Sensor (CPS) Test

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

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



Engine RPM and CPS Sync displays

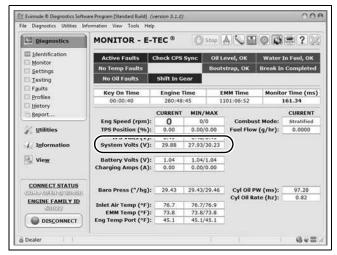
008566A

If the *Monitor* screen says "Check CPS Sync," refer to **Crankshaft Position Sensor (CPS) Test** on p. 95.

System Voltage Test

The ignition system is p owered by the 55 V system.

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



Monitor Screen, System voltage

008566A

Results:

- EMM ON (not running) approximately 1 V less than battery voltage, system voltage is GOOD.
- EMM ON (not running) no voltage, check 12 V power to EMM. Repair connection or wiring.
- RUNNING 55 V ± 2, system voltage is GOOD.
- RUNNING less tha n 55 V ± 2, check st ator output to EMM. Rep air connection o r wirin g. Possible faulty stator or EMM. Refer to STATOR TESTS on p. 97.

IMPORTANT: The *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. Power is normally supplied to the *EMM* when the key switch is turned ON. The *EMM* is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked. On a non-running rope st art engine, power is supplied to the *EMM* by Diag nostic Power Supply T ool, P/N 587005.

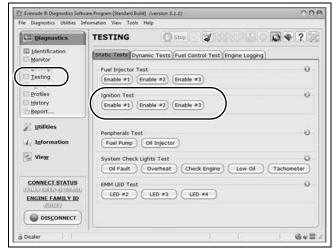
Static Ignition Test

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

IMPORTANT: DO NOT perform st atic te sts using Diagnostic Power Supply Tool, P/N 587005, with internal 9 volt batteries only. This will produce false results. Refer to **Communication** on p. 63.

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

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

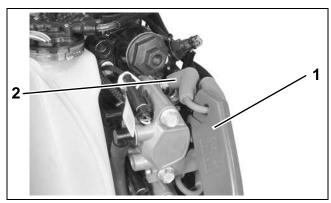


Static Tests Screen

008569A

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

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



1. Timing light pick-up

Spark plug lead

006492

Results:

No spark on one or more cylinders:

- Inspect or replace spark plugs
- Refer to Ignition Control Circuit Tests on p. 83
- Refer to Ignition Coil Tests on p. 83

Steady spark on all cylinders:

 Refer to Running Ignition Tests on p. 82 and DYNAMIC TESTS on p. 76.

SYSTEM ANALYSIS

IGNITION OUTPUT TESTS

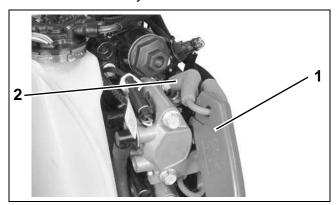
Running Ignition Tests

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

- Voltage readings at a specific spe ed (RPM) should be steady
- Refer to **System Voltage Test** on p. 80.

Use an inductive timing light to monitor the spark signal through each of the secon dary circu it (spark plug lead) wires.

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



1. Timing light pick-up

Spark plug lead

Results:

006492

Steady voltage and strobe, engine misfires:

- Inspect or replace spark plugs
- Refer to **FUEL DELIVERY TESTS** on p. 84
- Check for internal engine damage.

Steady voltage, erratic strobe, engine misfires:

- Inspect or replace spark plugs
- Check CPS air gap and resistance.
- Refer to Ignition Control Circuit Tests on p. 83
- Refer to Ignition Coil Tests on p. 83.

Voltages fluctuate, engine misfires:

- Inspect battery and connections
- Test capacitor and all ground connections.
- Refer to System Voltage Test on p. 80
- Refer to Ignition Control Circuit Tests on p. 83
- Refer to Ignition Coil Tests on p. 83.

IMPORTANT: If a running problem occurs at about 1200 RPM, the outboard may be in *S.A.F.E.* Refer to **S.A.F.E. WARNING SYSTEM** on p. 62.

Ignition Control Circuit Tests

Use a digital multimeter to test the following:

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

Disconnect ignition coil connector.

Supply voltage test:

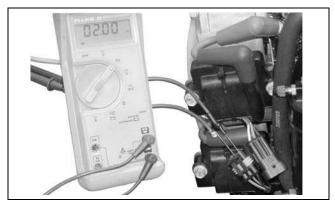
Use an appropriate adapter to connect the red meter lead to pin 3 (white/red) of the engine harness connector and the black lead to ground. With *EMM* ON, voltage should be approximately 1 V less than battery voltage.

Control signal test:

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

Use an appropriate adapter to connect the red meter lead to pin 2 (orange) of the engine harness connector and the black lead to ground. Activate diagnostics sof tware *Static Ignition* test and observe me ter for consist ent read ing (a pproximately 2 Hz).

If control signal is pre sent, connect black meter lead to p in 1 (black) and re peat te st to confirm harness ground.



006609

Harness resistance test:

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

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

If circuits test good, replace EMM.

Ignition Coil Tests

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

- 55 V is supplied to the white/red wire of the ignition coil connector
- A control signal is present on the orange wire of the ignition coil conn ector. Re fer to **Ignition** Control Circuit Tests on p. 83.
- The black wire of the ignition coil connector provides continuity to ground.
- The secondary spark plug lead provides continuity.

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

Capacitor Test

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

Remove capacitor from electrical harness.

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

- If the capacitor is working co rrectly, it will sto re energy from the meter. The resist ance reading will increase until it goes to (nearly) infinity.
- If the ca pacitor is shorted, the reading will immediately show full continuity.
- If there is an open circuit in the ca pacitor, the meter will show no continuity.

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

FUEL DELIVERY TESTS

A 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. 142.

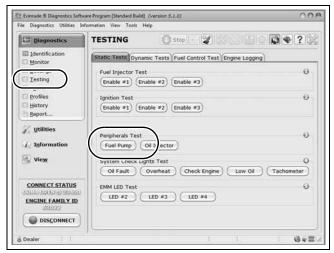
Check the *Evinrude Diagnostics* sof tware *Occurred Faults* screen for current service codes before troubleshooting. Correct any problems and clear the codes FIRST.

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

Fuel Pump Static Test

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

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply T ool, P/N 587005, with internal 9 volt batt eries only. This will produce false results. Refer to **Communication** on p. 63.



Static Tests Screen

008569A

If the pump does not run:

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

- Voltage should be 55 V when the outboard is cranking or running.
- The EMM controls the fuel pump ground (brown wire). Use a n ohmmet er to check continuity between pin 2 of f uel pump connector and ground. Use the fuel pump static test to activate the control function of the EMM. Resistance should drop as EMM connects the control circuit to ground.
- Refer to Circulation Pump Resistance Test on p. 139.

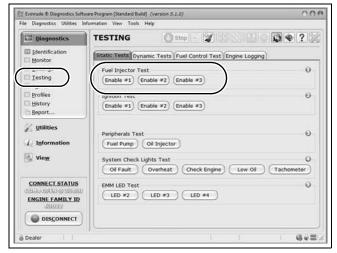
If the pump runs:

- Refer to Fuel System Pressure Test on p. 137.
- Refer to Running Fuel System Tests on p. 85.

Fuel Injector Static Test

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

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply T ool, P/N 587005, with internal 9 volt batteries only. This will p roduce false results. Refer to **Communication** on p. 63.



Static Tests Screen

008569A

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

Results:

No injectors actuate:

- Use the Monitor screen of the diagnostics software to make su re volt age is present on the system voltage circuit.
- Refer to Running Fuel System Tests on p. 85.

Some injectors actuate; some do not:

- For non-working injectors, test the resistance of injector circuit between the injector connector and injector control wire at the EMM.
- See Fuel Injector Resistance Test on p. 139.

All injectors actuate:

• Refer to Running Fuel System Tests on p. 85.

Running Fuel System Tests

Run or crank the outboard.

Use the *Evinrude Diagnostics* sof tware *Monitor* screen to check system voltage. If voltage is low, or drops as RPM increases, refer to **Stator Voltage Output Test** on p. 97.

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

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

Results:

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

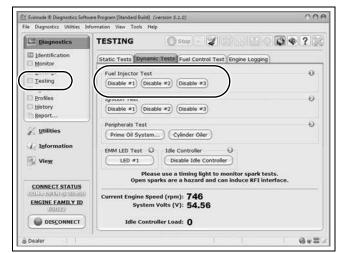
- Check stator input to *EMM*, CPS operation, and all grounds and wiring connections.
- Eliminate all other possibilities to isolate a faulty EMM.

Irregular or n o lig ht activation on some in jector wires:

- Test the resistance of individual injector circuits between the injector connector and injector control wire at the EMM.
- Check battery cable connections.
- Make sure all grounds are clean and tight.
- See Fuel Injector Resistance Test on p. 139.

Steady light activation on all in jector wire s and consistent voltage readings, *EMM* injector control function is good:

 Use the diagnostics software Dynamic Fuel Test to isolate a faulty cylinde r. See DYNAMIC TESTS on p. 76.



Dynamic Tests Screen

008570A

- Refer to Fuel Injector Pressure Test on p. 138.
- Refer to Fuel System Pressure Test on p. 137.

EXHAUST WATER VALVE (60–65HP)

During rapid acceleration, the *EMM* opens a valve that injects wat er into the exh aust. This water changes exhaust tuning, b oosting midran ge horsepower as the boat comes on plane.

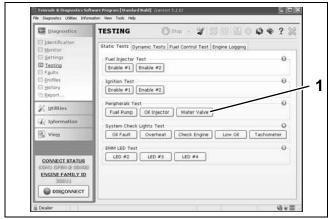
If the valve is plugged or not working, the operator may not notice a problem during slo wacceleration. During rap id acceleration, the outboard will be low on power around 3200 rpm, depending on boat and load.

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

Exhaust Water Valve Static Test

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

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



Static Tests Screen

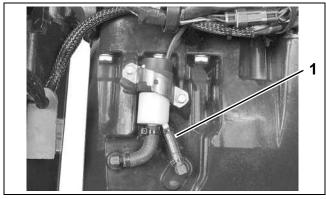
1. Water valve test button

008596

Exhaust Water Valve Dynamic Test

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

Disconnect the water valve outlet hose.



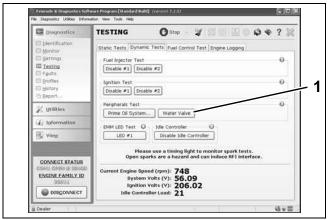
1. Water valve outlet hose

004293

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

With the outboard id ling, activate the dyna mic water valve test and check for water flow. A steady stream of water should flow from the hose while the test is running.

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



Dynamic Tests Screen

1. Water valve test button

008597

Results:

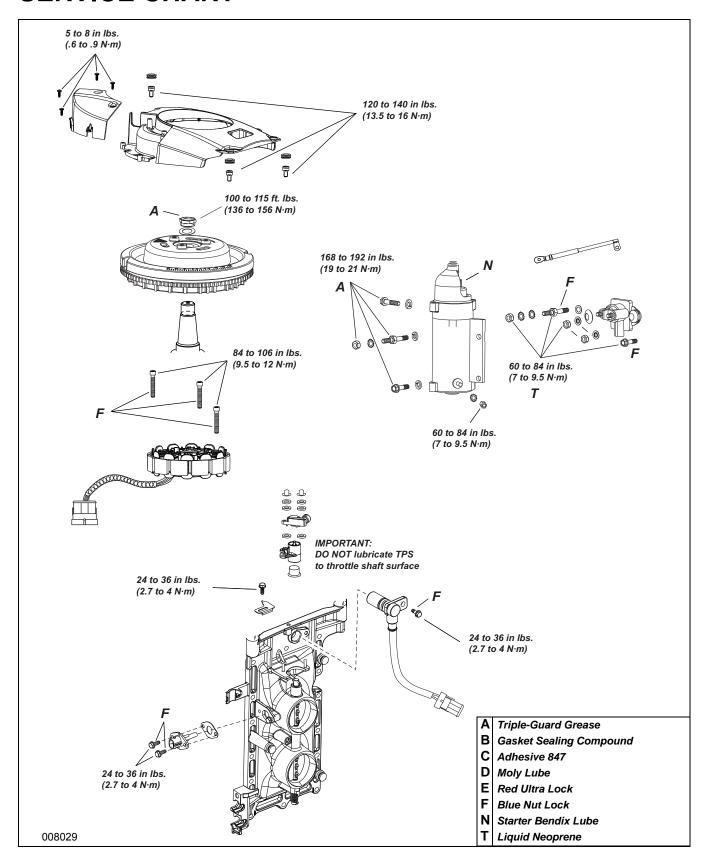
- No water flo w—check for debris in valve assembly and wa ter supply line. Re fer to EXHAUST WATER VALVE TEST on p. 106.
- Water appears—make sure fitting into exhaust housing is clear.

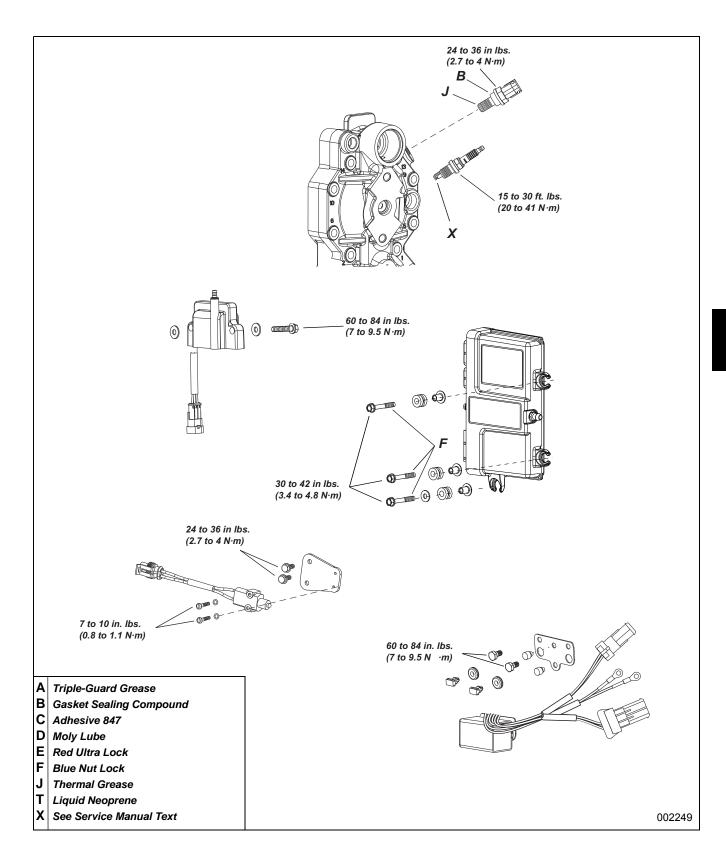
ELECTRICAL AND IGNITION

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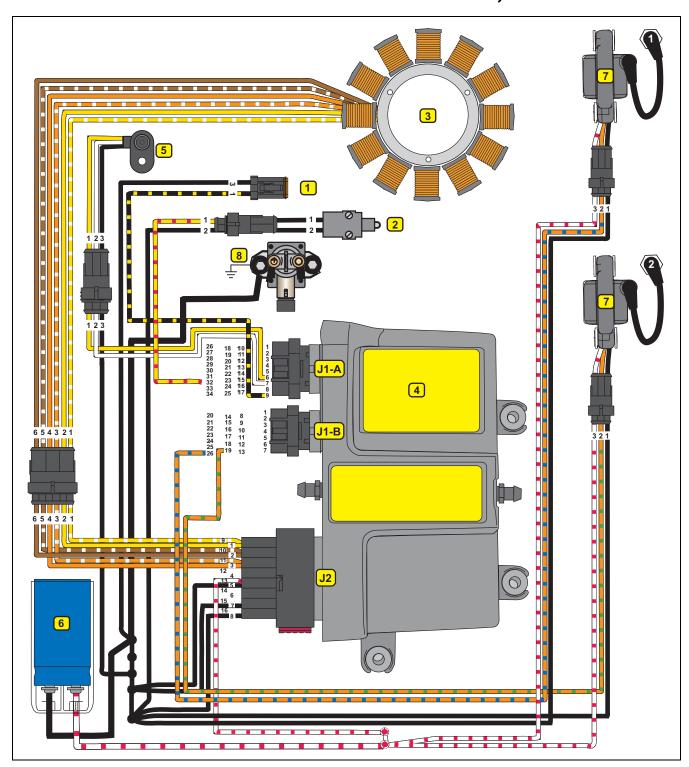
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SERVICE CHART





IGNITION SYSTEM CIRCUIT DIAGRAM, 40 – 65 HP

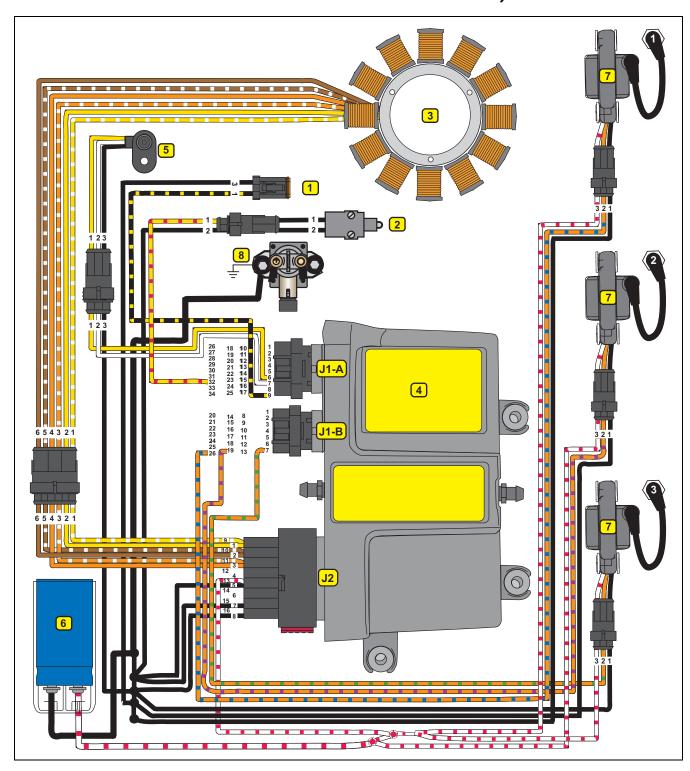


- 1. Key switch (stop circuit)
- 2. Neutral switch
- 3. Stator

- 4. *EMM*
- 5. Crankshaft position sensor
- 6. Capacitor

- 7. Ignition coil
- 8. Main harness ground

IGNITION SYSTEM CIRCUIT DIAGRAM, 75 – 90 HP



- 1. Key switch (stop circuit)
- 2. Neutral switch
- 3. Stator

- 4. *EMM*
- 5. Crankshaft position sensor
- 6. Capacitor

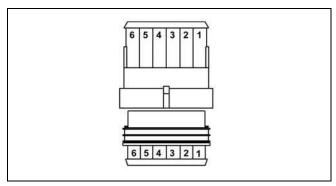
- 7. Ignition coil
- 8. Main harness ground

ELECTRICAL HARNESS CONNECTIONS

Inspect wiring and electric al connections. Disassemble a nd clean all corrode d connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits. Refer to wiring diagrams and reference charts for specific wiring details.

Refer to **CONNECTOR SERVICING** on p. 116.

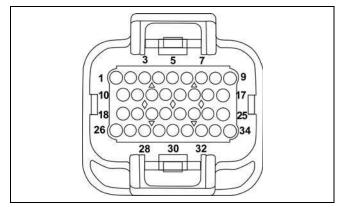
Engine Harness to Stator Connector



002025

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

EMM J1-A Connector

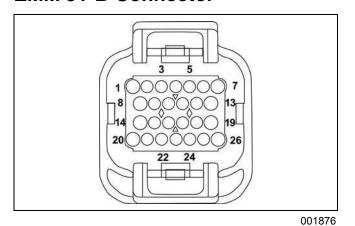


001875

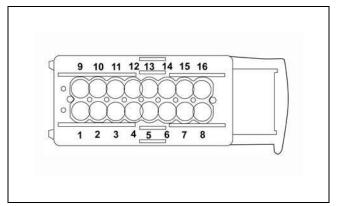
Pin No.	Description of Circuit	Wire Color
1	vacant	
2	Diagnostic connector	Red
3	Diagnostic connector	White
4	vacant	
5	vacant	
6	Crankshaft position sensor (CPS)	Yellow
7	Ground, CPS (digital)	White
8	Bootstrap connector (programming)	Blk/Orange
9	Stop circuit	Blk/Yellow
10	Throttle position sensor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

6

EMM J1-B Connector



EMM J2 Connector



001877

Pin No.	Description of Circuit	Wire Color
1	Injector, cylinder 2, 75–90 HP	Purple
1	Injector, cylinder 2, 40–65 HP	Green
2	Injector, cylinder 3, 75–90 HP	Green
2	Exhaust water valve, 60–65 HP	Blue/Red
3	vacant	
4	vacant	
5	vacant	
6	NO OIL signal, SystemCheck	Tan/Yellow
7	Ignition, cylinder 3, 75–90 HP	Orange/Green
7	vacant, 40-65 HP	
8	Injector, cylinder 1	Blue
9	vacant	
10	vacant	
11	vacant	
12	vacant	
13	vacant	
14	Injector ground	Black
15	vacant	
16	vacant	
17	vacant	
18	vacant	
19	Ignition, cylinder 2, 75–90 HP	Orange/Purple
19	Ignition, cylinder 2, 40–65 HP	Orange/Green
20	Injector ground	Black
21	Injector ground	Black
22	vacant	
23	Oil solenoid	Blue
24	vacant	
25	vacant	
26	Ignition, cylinder 1	Orange/Blue

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

GROUND CIRCUITS

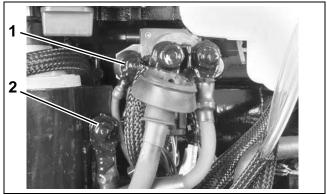
All ground circuits are essential to reliable outboard performance. Make sure all ground connections are clean and tight. Refer to wiring diagrams for specific wiring details.

EMM Ground Tests

Disconnect the battery cables at the battery.

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

- System/power supply grounds: Check continuity between terminal pins 5, 7, and 8 of EMM J2 connector and the main harness ground.
- Injector circu it g rounds: Check continuity between te rminal p ins 14, 20, a nd 2 1 of the EMM J1 -B conne ctor a nd the main h arness ground.
- Sensor circuit g rounds: Check continuity between terminal pin s 26 and 27 of the EMM J1-A co nnector and the appropriate sensor ground connections. Refer to wiring diagrams.



Main harness ground
 Ground stud (battery)

002292

Additional Ground Tests

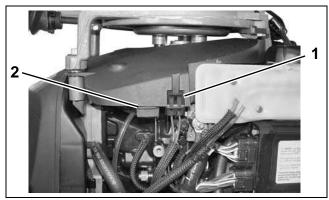
Check connections and continuity at the following locations:

- Starter solenoid terminal B and main harness ground.
- Trim and Tilt module ground at main harness ground.

FUSE

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

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



Fuse
 Spare fuse

005004

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

6

SENSOR TESTS

All senso r circu its a re de pendent o n wiring a nd connections, *EMM* supplied current (5 V), a nd sensor resist ance. The supplied current flows through the wiring circuit and sensor be fore returning to the *EMM*.

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

Crankshaft Position Sensor (CPS) Test

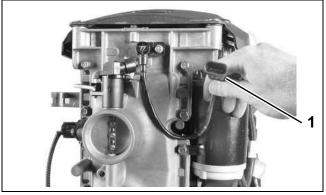
Use the *Evinrude Diagnostics* software CPS Sync and engine RPM displays to confirm a valid CPS signal while the outboard is cranking or running. An RPM display higher than zero indicates a CPS signal to the *EMM*.

Disconnect the crankshaft position sensor.

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

Sensor Resistance

 $560 \Omega \pm 10\%$ @ 77°F (25°C)

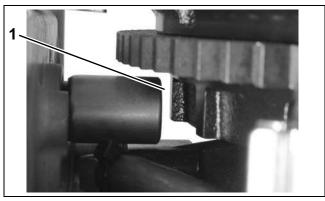


CPS Connector

002286

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

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



1. CPS gap

006527

Throttle Position Sensor (TPS) Test

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

Remove the electrical connector from the throttle position sensor.

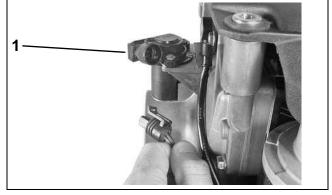
Use a digital multimeter to measure sensor resistance.

Sensor Resistance between "A" and "B"

3000 to 7000 Ω @ 77°F (25°C)

Sensor Resistance between "A" and "C"

4000 to 8000 Ω @ 77°F (25°C)



1. TPS 002289

ELECTRICAL AND IGNITION

SENSOR TESTS

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

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

Engine Temperature Sensor Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter to measure sensor resistance.

Engine Temperature Sensor Resistance
680 Ω ± 5% @ 212°F (100°C)
10000 Ω ± 1% @ 77°F (25°C)
32654 Ω ± 2.5% @ 32°F (0°C)



1. Engine temperature sensor

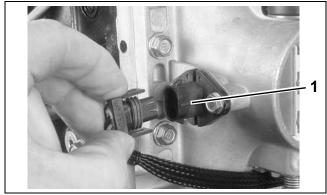
006612

Air Temperature Sensor (AT) Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter to measure sensor resistance.

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



1. AT sensor 006613

STATOR TESTS

The stator consists of 3 windings (4 poles each) on a 5 inch diameter core and gene rates an output vo Itage of 55 VAC (1 100 watt s maximum). This voltage is converted by the *EMM* to provide 12 VDC for battery charging (3 to 5 A at 500 RPM and 25 A from 3000 RPM to WOT) and 55 VDC for fuel injector, and fuel and oil pump operation.

Stator Resistance Tests

Use a digital multimeter to check resistance of stator windings.

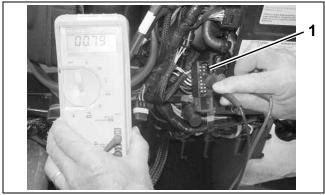
Disconnect EMM J2 connector from EMM.

Stator Winding Resistance Specification

Yellow & Yellow / white .670 \pm 0.020 Ω @ 73°F (23°C)

Brown & Brown / white .670 \pm 0.020 Ω @ 73°F (23°C)

Orange & Orange / white .670 \pm 0.020 Ω @ 73°F (23°C)



1. EMM J2 Connector

002462

Connect meter leads to the following pins:

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

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

To che ck for a g rounded winding, conne ct on e meter lead to ground and alternately connect the other meter lead to each stator wire. Meter should read no continuity. If meter rea ds continuity, replace stator.

Stator Voltage Output Test

ELECTRIC START MODELS

Use a digit al multimeter to che ck st ator output voltage. Set meter to read 110 VAC output.

A WARNING

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

Disconnect CPS.

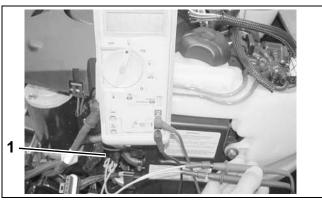
Disconnect st ator (6-pin) con nector from th e engine harness (6-pin) connector.

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

Connect meter leads to terminals of adaptor tool.

With a fully charged battery, crank outboard (300 RPM minimum) and observe meter reading:

- 30 VAC at 300 RPM
- 40 VAC at 400 RPM
- 55 VAC above 500 RPM



Stator Test Adaptor

002396

ELECTRICAL AND IGNITION

CHARGING SYSTEM TESTS

ROPE START MODELS

Use a Pea k Reading Voltmeter, P/N 507972, to check st ator output volt age. Set meter to the 50 VAC scale.

A WARNING

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

Disconnect CPS. Remove spark plugs. Make sure outboard is in NEUTRAL. Refer to **SPARK PLUGS** on p. 42.

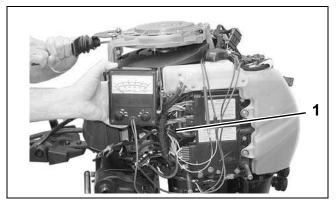
Disconnect stator (6-pin) connector from the engine harness (6-pin) connector.

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

Connect meter leads to terminals of adaptor tool.

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

Stator o utput voltage should be approximately 30 VAC.



1. Stator Test Adaptor

006750

IMPORTANT: Index all sp ark plu gs. Refer to Spark Plug **Indexing** on p. 42.

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 consist s of mo nitoring the system's response to a partially discharged battery. Use a variable load tester to discharge the battery.

IMPORTANT: The regulator requ ires voltage to operate. Before proceeding, make sure there is at least 7 V on the positive te rminal of the st arter solenoid.

Disconnect the battery cables at the battery.

Use an in ductive amp meter or con nect a 0 to 50 A ammeter in series between the red wire of engine wire harness (alternator output from *EMM*) and the po sitive (B+) battery cable ter minal of starter solenoid.

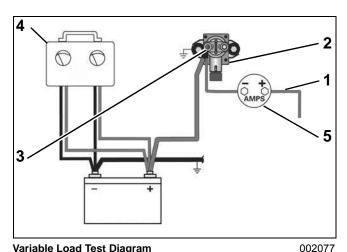
Fluke[†] model 334 or 336, Snap-On[†] model MT110 or EETA501, and va rious oth er amp meters should be available through local tool suppliers.

Reconnect the battery cables.

Following the manufa cturer's directions, connect the variable load tester (carbon pile) across the battery terminals. Stevens mo del LB-85 a nd Snap-On model MT540D are examples of testers available.

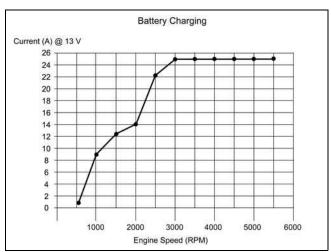
WARNING

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

- Red wire (alternator output from EMM)
- Starter solenoid
- Battery cable terminal (B+)
- Variable load tester
- Ammeter



Battery Charging Graph

002076

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

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

Decrease the battery load toward 0 A.

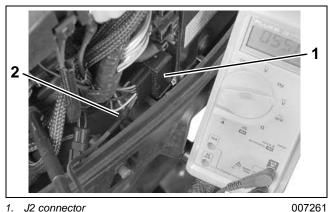
- Ammeter should show a reduced output. As the current draw decreases, the e battery volt age should stabilize at approximately 14.5 V.
- If results vary, check stator BEFORE replacing the *EMM*. Refer to **STATOR TESTS** on p. 97.

55 V Alternator Circuit

Check battery ground cable for continuity.

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

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



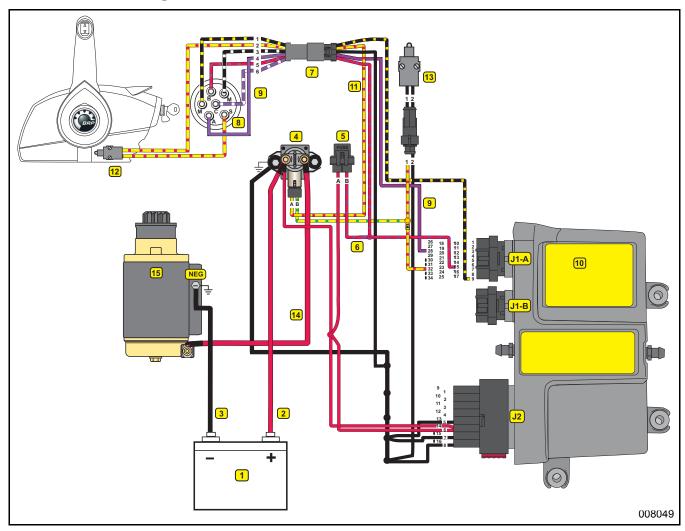
- Test probe

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

If there is any other reading, refer to **STATOR TESTS** on p. 97. Inspect the st ator wiring an d connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or EMM.

ELECTRIC START CIRCUIT

Start Circuit Diagram



- 1. Marine battery
- 2. RED wire (POS)
- 3. BLACK wire (NEG)
- 4. Starter solenoid
- 5. Fuse (10 amp)
- 6. RED/PURPLE wire
- 7. Key switch connectors
- 8. Ignition switch

- 9. PURPLE wire (switched B+)
- 10. Engine Management Module (EMM)
- 11. YELLOW/RED wire, start
- 12. Neutral Safety Switch (remote control)
- 13. Neutral Safety Switch (engine)
- 14. RED starter motor cable
- 15. Electric starter motor

Start Circuit Operation

The starter must engage and turn the flywhee I. The outboard must crank a minimum of 300 RPM to start.

Starter performance depends on the following:

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

Refer to Predelivery and Installation Guide for battery, terminal, and cable requirements.

Solenoid Wiring

The positive (B+) battery cable connects to a large terminal of the starter solenoid. This terminal also provides the 12 V power supply to the engine harness (red wire) and the 10 A fuse. The red/purple wire from the fuse holder (10 A) provides 12 V to terminal "B" of key switch.

The negative (B₋) batte ry cable connects to the main ground stud on the starter housing.

Engine Wire Harness

Contains the following circuits:

- Red/purple output wire from fuse provides 12 V to instrument harness.
- Purple wire provides switched 12 V to EMM.
- Yellow/red wire provides switched 12 V to solenoid (terminal "A").
- Yellow/green wire pro vides g round (NEG) to starter solenoid (terminal "B").

Instrument Wire Harness

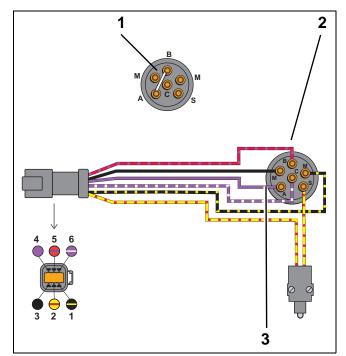
Contains the following circuits:

- Red/purple wire provides 12 V to key switch terminal "B".
- Purple wire pro vides switch ed 12 V to engin e wire harness.
- Yellow/red wire from terminal "S" of key switch provides switched 12 V to solenoid (termina I "A") (key switch in START position).

Key Switch, ON position

12 V is ap plied to the accessory circuit. Key switch ON:

- Switches 12 V to terminal "A" of key switch and to the purple wires of the wire harnesses.
- Provides 12 V input to terminal 28 of EMM J1-B connector. EMM turns ON.



- Key switch, ON position Continuity between terminals "B" and "A"
- 000691

- Terminal "B", 12 V (Red/purple)
 Terminal "A", 12 V (Purple)

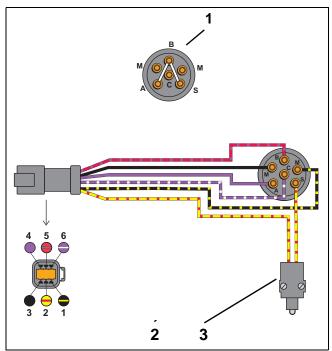
ELECTRICAL AND IGNITION

ELECTRIC START TESTS

Key Switch, START Position

Key switch START:

- Switches 12 V to terminal "S" of key switch and to the neutral safety switch (in remote control).
- A closed neutral safety switch provides 12 V to the en gine wire ha rness yellow/red wire an d solenoid (terminal "A").



- Ignition switch, START position Continuity between terminals "B" and "A"; "B" and "S'
- Terminal "S", 12 V
- Neutral safety switch

ELECTRIC START TESTS

Starter Solenoid Test

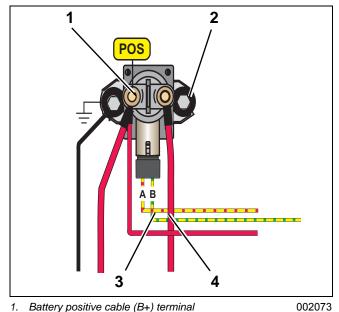
Disconnect the B+ (POS) battery cable at the battery.

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

Use a digital multimeter to measure resistance.

Put on e me ter lea d on the starter positive (+) cable terminal and the other lead on the battery positive (+) cable terminal:

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



- Battery positive cable (B+) terminal
- Starter positive (+) cable terminal
- "A" terminal (yellow/red)

000691R

"B" terminal (yellow/green)

Apply B+ to terminal "A" of solenoid and ground (NEG) to terminal "B" of solenoid. Measure resistance between the starter positive (+) cable terminal and the positive battery (+) cable terminal.

- The solenoid must close with an audible click.
- Meter must show continuity (low reading).
- If met er shows no continuity (high reading), replace the solenoid.

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

102

Starter Voltage Drop Test

WARNING

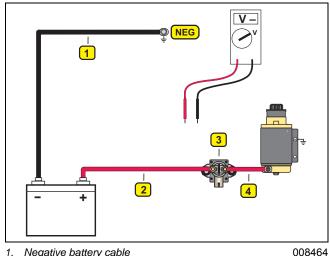
To prevent accidental starting of outboard, disconnect crankshaft position sensor (CPS).

Use a digit al voltme ter to me asure the volt age drop on each section of the start circuit.

If an y vo Itage read ing is greate r than 0.5 VDC check that connections are clean, tight and free of corrosion. Clean or replace any corroded or damaged cables or connections.

STEP 1: Con nect voltmet er positive (+) lead to the terminal for the ne gative (-) batter y cable at powerhead. Connect vo Itmeter negative (-) le ad to negative (–) battery post.

 Activate st arter motor and ob serve volt age reading.



- Negative battery cable 1.
- Positive battery cable
- Solenoid
- Starter cable

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

 Activate st arter motor and ob serve volt age reading.

STEP 3: First, activate st arter motor. Conne ct positive (+) lead to starter solenoid terminal. Connect negative (-) lead to opposite starter solenoid terminal.

Observe voltage reading.

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

 Activate st arter motor a nd observe volt age reading.

No Load Current Draw Test

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

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

Use an inductive ammeter or connect a 0 to 10.0 amp amme ter in series with a heavy jump er between the battery positive (+) terminal and the starter positive (+) terminal.

Fluke model 33 4 or 336, Snap-On model MT110 or EETA501, and various other ammeters should be available through local tool suppliers.

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



24083

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

Monitor the starter RPM and current draw.

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

REMOTE CONTROL SWITCH TESTS

Key Switch Test

Refer to Wiring Diagrams at back of manual.

Use an ohmmeter or a continuity light to test key switch operation. Replace switch if re sults are incorrect with any of the following tests.

IMPORTANT: Disconnect battery and ke y switch wiring before proceeding with the following tests.

Stop/Ground Terminals (M) – Conn ect meter between the two "M" terminals. Me ter must indicate NO continuity at START or ON.

Turn key switch OFF. Meter must indicate continuity.

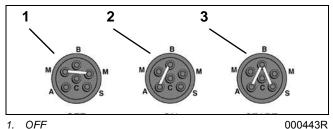
Accessory Terminal (A) – Mak e sure the ke y switch is OFF. Connect the ohmmeter or continuity light between terminals "B" (battery) and "A" (accessory) of key switch. Meter must indicate NO continuity.

Turn switch ON. Meter must indicate continuity.

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

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

IMPORTANT: The cho ke function or terminal "C" of the key switch is NOT used.



OFF
 ON

3. START

Neutral Start Circuit Test

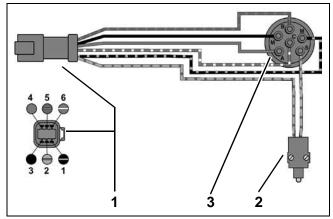
Use an ohmmeter or con tinuity light to test the continuity of the e circu it while period ositioning the remote control in NEUTRAL, FOR WARD, and REVERSE.

IMPORTANT: Turn propeller shaft or disconnect shift cab le to allo w proper re mote cont rol shift action while o utboard is not run ning. Disconnect the instrument h arness connector from the key switch harness connector.

Make sure the remote control handle is in NEU-TRAL. Connect mete r between termina 15 (red/purple wire) and terminal 2 (yellow/red wire). Turn the key switch to START. Meter must indicate continuity.

Move the remote con trol han dle to FOR WARD and turn the key swit ch to START. Meter must NOT indicate continuity.

Move the remote control handle to REVERSE and turn the key switch to START. Meter must NOT indicate continuity.



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

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

000443

000444

Neutral Start Switch Test

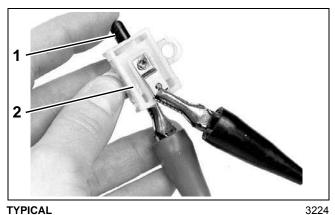
Use an ohmmeter or a continuity light to test neutral start switch operation.

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

Disassemble the remote control and remove the neutral start switch.

Connect on e meter lead to each terminal of the switch.

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



TYPICAL

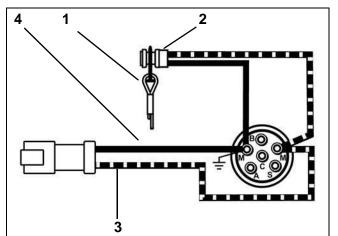
- 1. Plunger
- 2. Neutral start switch

Replace switch if results are incorrect.

Emergency Stop Switch Test

This switc h can be part of the ke y switc h or installed as a separate switch. Either st yle 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 groun d wire (black) and one "M" terminal is the stop circuit wire (black/yellow).



- Lanyard and clip assembly
- Emergency stop switch, separate from key switch
- Stop circuit wire (black/yellow)
- Ground wire (black)

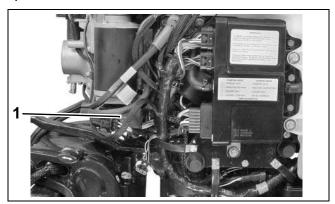
Install the clip on the emergency stop switch or key switch. S tart the outb oard. Pull the clip from the switch. The outboard must stop running.

ELECTRICAL AND IGNITION

TILT/TRIM RELAY TEST

TILT/TRIM RELAY TEST

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



1. Tilt and trim module

006754

The tilt an d trim switch provides B+ inp ut 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 no rmally ope n. B+ is applied to terminal 30 when relay is act ivated. This supplies ground B+ connection to TNT motor.

Refer to Tilt and Trim Module Diagram.

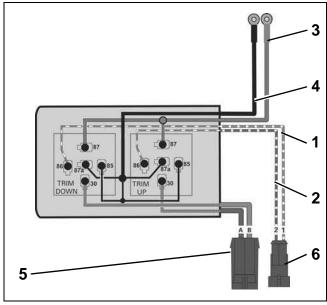
Test Procedure

Make sure r ed and black wire s 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 met er mu st indicate battery volt age (12 V) with B+ connected to either terminal.



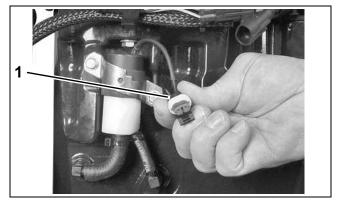
Tilt and Trim Module Diagram

002063

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

EXHAUST WATER VALVE TEST

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



1. Water valve electrical connector

004297

Water Valve Solenoid Resistance

 $295 \Omega \pm 20 @ 77^{\circ}F (25^{\circ}C)$

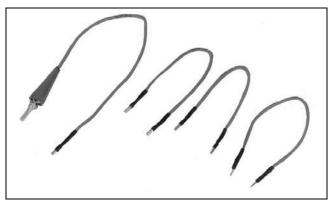
6

SystemCheck CIRCUIT TESTS

Make sure the *SystemCheck* engine monitor can warn the opera tor during a "NO OIL," "W ATER 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 be fore performing the following test s. Refer to the **Engine Wiring** diagram and the **MWS Instrument Wiring** diagram in the back of this manual.

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



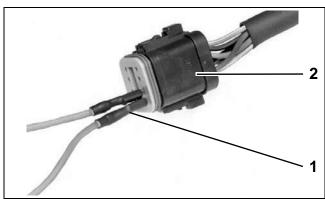
42811

Gauge Self-Test Check

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

If the gauge lig hts 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. T est for b attery volt age be tween

instrument harne ss termi nal 1 (purple wire) an d terminal 2 (black wire).



- 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.

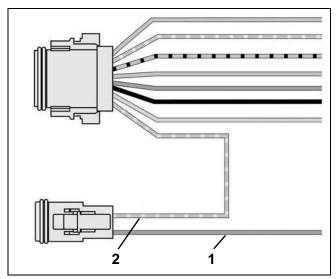
If the lights worked, but the warn ing horn did n ot sound fo r one-h alf seco nd, turn the key switch OFF. Disconnect the warning horn 2-pin connector. Substitute a known good warning h orn. Turn the key switch ON.

- If the substitute horn beeps, the original horn is defective and must be replaced.
- If the subst itute horn does not beep, check for battery voltage between instrument harness 2pin con nector, terminal 2 (purple wire) an d 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 cont inuity bet ween

ELECTRICAL AND IGNITION

SystemCheck CIRCUIT TESTS

the two conn ectors, replace SystemCheck gauge.



Purple wire
 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.

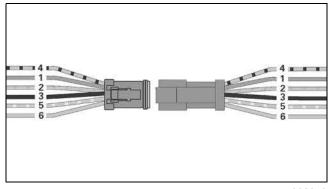
- If the CHECK ENGINE light is not on, test circuit for continuity. Check continuity of the MWS instrument harness (tan/orange wire).
- Check cont inuity of the engine wire harness between terminal 2 (tan/orange wire) of the SystemCheck connector and pin 17 of the EMM J1-A connector.

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 f rom the *EMM*. The *EMM* receives information from the temperature sensor on the cylinder head.

Using a ju mper wire, con nect tan wire (pin 6) of the engine harness connector to a cle an engine ground.



002079

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

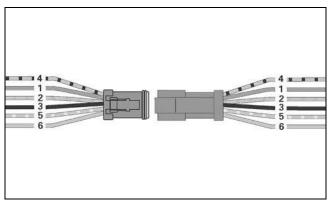
 If LED is n ot on, test circuit for continuity. Test for continuity of both the engine harness (t an wire) and the MWS instrument harn ess (t an wire).

Turn the key switch OFF and reconnect all disconnected circuits.

IMPORTANT: To test the temp erature sensor itself, refer to **Engine Temperature Sensor Test** on p. 96.

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 en gine ground. The LOW OIL light should turn on after 40 seconds.



002079

If the LOW OIL light does not turn on af ter 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 Black wire (pin 3) must be grounded.

Using a jumper wire, connect tan/yellow wire (pin 5) to a clean engine ground.

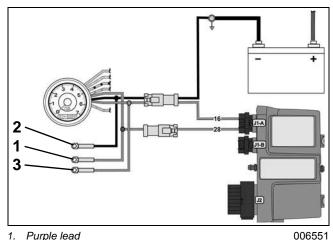
Turn the key switch ON. After the normal self-test sequence, the NO OIL light should stay on.

- 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 eng ine wire harness between terminal 5 (tan/yellow wire) of the SystemCheck connector and pin 24 of the EMM J1-A connector.

Turn the key switch OFF and reconnect all disconnected circuits.

TACHOMETER CIRCUIT TESTS

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



- Purple lead
- Black lead
- Gray lead

Connect the red meter lead to the tachometer purple wire and the black meter lead to the tachometer black wire (key ON, outboard NOT running).

- If meter shows battery voltage, go to next step.
- If meter shows less than battery voltage, check the purple, red/purple, and black wiring circuits; fuse, key switch, and battery connections.

Disconnect gray and black wires at t achometer. Set Fluke 29 Series II meter, or equivalent, to Hz scale. Co nnect mete r between gra y wire an d black wire. With outboard running at 100 0 RPM. meter should indicate 90 to 105 Hz.

- If meter read s 90 to 1 05 Hz, replace tachome-
- 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 comection at EMM; replace faulty EMM.

ELECTRICAL AND IGNITION

FLYWHEEL AND STATOR SERVICING

FLYWHEEL AND STATOR SERVICING

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

An accurate test of alternation of utput can help determine the flywheel's condition. Refer to **CHARGING SYSTEM TESTS** on p. 98.

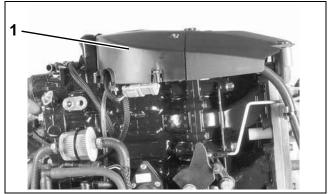
Flywheel Removal

A WARNING

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

Remove the recoil st arter assembly (rope start models). Refer to **RECOIL STARTER REMOVAL** on p. 363.

Remove the electrical cover from flywheel cover.



1. Electrical cover

002084

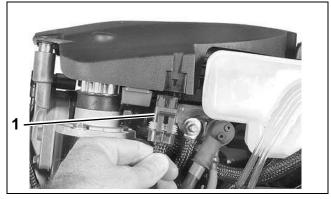
Disconnect wiring harne ss and remo ve wiring from cover.



MWS harness

002086

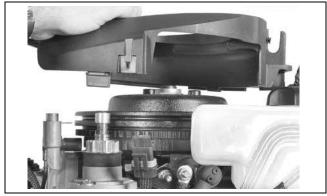
Remove fuse holder from flywheel cover.



Fuse holder

002094

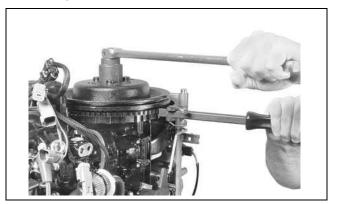
Lift flywheel cover to remove.



002087

6

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



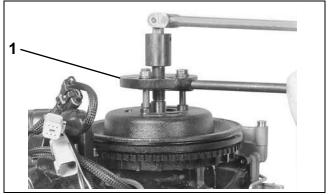
002088

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

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

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

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

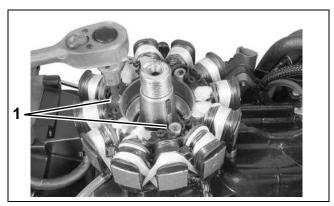


1. Universal puller 002089

Stator Service

Disconnect stator harness connector.

Remove three allen head screws to remove stator.



Stator screws

006486

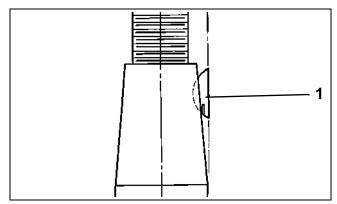
To install stator, position stator on cylinder block. Apply *Nut Lock* to screw threads. Install screws and tighten in crossing pattern to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).

Flywheel Installation

WARNING

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

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



1. Flywheel key

DRC2116

ELECTRICAL AND IGNITION

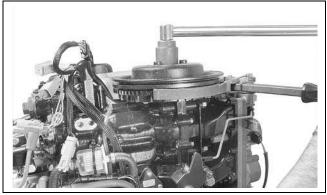
IGNITION COIL SERVICING

Thoroughly clean t he crankshaf t and f lywheel tapers with *Cleaning Solvent* and let dry.



002093

Align the f lywheel keywa y a nd inst all flywhee I. Coat the threads of flywheel nut with *Triple-Guard* grease. Install the washer and nut and tighten to a torque of 100 to 115 ft. lbs. (136 to 156 N·m).



002090

Replace flywheel co ver and recoil st arter (rope start models).

IMPORTANT: Check ignition timing af ter flywheel removal or replacement. Refer to **TIMING ADJUSTMENTS** on p. 113.

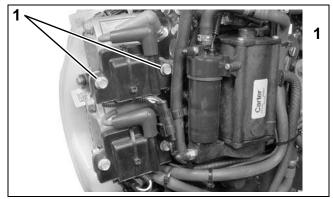
IGNITION COIL SERVICING

Ignition Coil Removal

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

Remove two ignition coil retaining screws.

Do not lose the rubber washers between coil and bracket.



1. Screws 008187

Ignition Coil Installation

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

Install remaining rubbe r washers on scre ws between coil and bracket.



1. Rubber washers

008188

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

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

TIMING ADJUSTMENTS

Timing Pointer

A WARNING

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

The timing pointer must be ad justed to in dicate top dead cente r (TDC) of the number 1 pist on. This reference to the position of the number 1 piston is used to synch ronize the electronic timing controlled by the *EMM* with the mechanical position of the number 1 piston.

Always check timing po inter adjustment be fore using the *Evinrude Diagnostics* sof tware Timing Verification procedure.

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

Install Piston S top T ool, P/N 342679, into the spark plug hole of the number 1 cylinder.

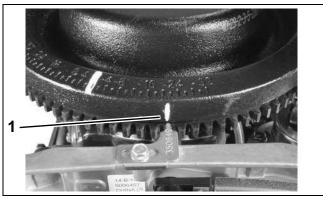


1. Piston stop tool

006493

Rotate flywheel **counterclockwise** until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly a gainst

the tool. Mark the flywheel directly across from the pointer. Label this mark "A."



1. Timing pointer

006552

Rotate the flywheel **clockwise** until the p iston contacts the tool. Mark the flywheel directly across from the pointer. Label this mark "B." Rot ate flywheel **counterclockwise** slightly to release too I then remove it from spark plug hole.

Use a flexible measuring device, such as a piece of string, to find the exact center b etween marks "A" and "B." Measure along the edge of the flywheel. Mark and label the center point "C."

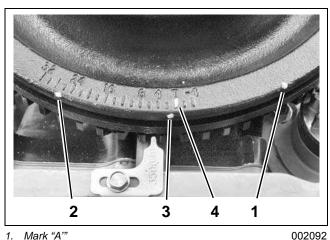
If mark "C" and the cast-in TDC boss on flywhee I are in alignment, the timing pointer is in the correct location.

If the pointer alignment is NOT correct, rotate the flywheel **clockwise** to align the mark "C" with the pointer. Hold the flywheel in this position. Loosen the pointer retaining screw and adjust the pointer

ELECTRICAL AND IGNITION

TIMING ADJUSTMENTS

location to align with the cast-in TDC boss on the flywheel. Tighten retaining screw.



- Mark "A" 1.
- 2. Mark "B"
- Mark "C"
- TDC boss

Repeat the entire ad justment process to sure pointer is aligned correctly.

Install spark plugs. Refer to Spark Plug Indexing on p. 42.

Timing Verification

Use Evinrude Diagnostics software to synchronize the mechanical timing of the outbo ard with the electronic timing of the EMM.

Start the outboard.

Use the Settings/Ignition Timing screen of the diagnostics sof tware and follow the on-screen instructions.



Ignition Timing Screen

008572

Check ignit ion timing a fter any of the following procedures:

- Powerhead replacement
- Crankshaft replacement
- Flywheel removal or replacement
- CPS replacement
- EMM replacement
- EMM software replacement (reprogramming)

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

TPS Calibration

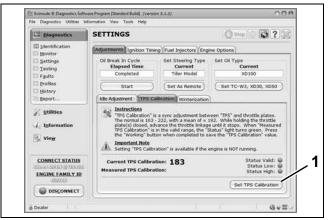
Use Evinrude Diagnostics sof tware to te II t he EMM what throttle position sensor voltage is when the throttle plates begin to open.

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

Remove the lower engine covers and air silencer.

Do NOT start the outboard.

On the Settings/Adjustments screen of the dia gnostics software, click the "Set TPS Calibration" button.



TPS Calibration button

008581

While holding the throt tle plates closed, advance the throttle lin kage until it stop s. The *Measured* TPS Calibration field on the screen will increase.

Click the Working button in the sof tware to calibrate the TPS.

Install the air silencer and lower engine covers.

6

ELECTRIC STARTER SERVICING

Starter Removal

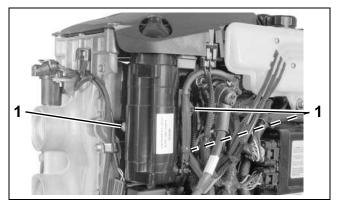
IMPORTANT: Do not clean the st arter drive while the starter motor and drive are in stalled on the powerhe ad. The cleaning a gent could drain into the starter motor, washing dirt from the drive into the starter bearings and commutator.

Disconnect the battery cables at the battery.

Remove lower motor cove rs and air silencer. Refer to **Lower Cover Removal** on p. 50.

Remove the starter positive (+) cable from post on starter. Remove the bat tery neg ative cable (-) from the double-ended stud.

Remove two starter mounting screws and doubleended stud. Remove the starter.



1. Screws 008189

Starter Installation

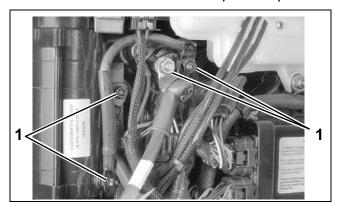
Apply *Triple-Guard* grease to the th reads of the two st arter screws, the double-ended stud, and also to the washers.

Position the st arter and inst all the screws an d washers. Tighten screws to a torque of 168 to 192 in. lbs. (19 to 21 N·m).

Attach starter positive (+) cable to post with lock washer and nut; tighten securely.

Install the battery negative cable (–) to the double-ended stud.

Coat connections with Black Neoprene Dip.



1. Black Neoprene Dip

ELECTRICAL AND IGNITION

CONNECTOR SERVICING

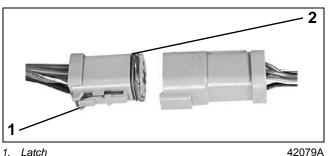
CONNECTOR SERVICING

DEUTSCH Connectors

IMPORTANT: Electrical Grease is reco mended. Incorrect grease applica tion can cause electrical or warning system problems.

To disconnect the connector, press the latch and pull the connectors apart.

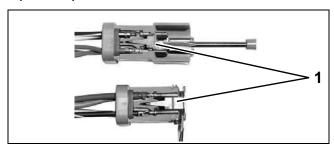
To connect the connector, confirm that the seal is in place. Clean off any old gre ase and dirt fro m connectors. Apply a light coat of Electrical Grease to sea I o nly. Push connectors to gether until latched.



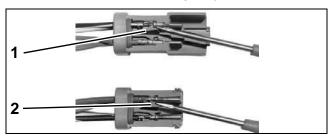
I atch Seal

Terminal Removal

Use hook-end of Co nnector Se rvice T ool, P/N 342667, to pull out wedge from receptacle, or use other end of tool to pry out wedge from plug. Use need le-nose p liers to remo ve wed ge fro m 3-pin receptacle.



Wedge 42327 Release terminal latch and gently pull on wire.



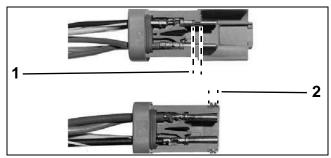
Terminal latch (plug)

Terminal latch (receptacle)

42329

Terminal Installation

Push terminal through seal until it locks into place. Fill connector with Electrical Grease to 1/32 in. (0.8 mm) below ledge or end of plug.



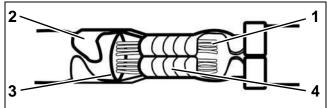
Ledge of plug 2. End of plug

42330

Push we dge in until latched. W edge 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-g auge 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 stran ds. Crimp wire securely. Do not solder. Crimp insulation in 14/16-gauge notch of crimping pliers.



DRC6205 End of wire strands

- Insulation crimp area
- End of insulation
- Wire crimp area

AMP Connectors

IMPORTANT: Always use the appropriate meter test probe s and ada pters when testing components fitted with these terminals. Electrical grease is NOT used on AMP connectors.

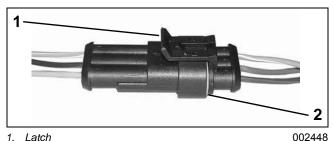
SUPERSEAL 1.5

Disconnect

Lift latch. Pull connectors apart.

Connect

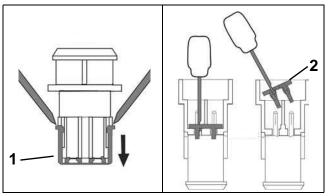
Confirm the seal is in place. Push conn ectors together until latched.



- 1. Latch
- 2. Seal

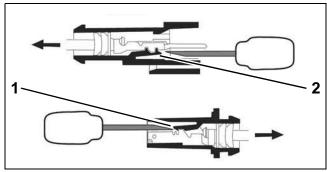
Terminal Removal

Use Secondary Lock Tool, P/N 777078, to release anti-backout device of conn ector hou sing. Next, use Primary Lo ck Tool, P/N 77 7077, to release locking tab of connector housing. Release locking tab and pull on wire to remove from connector housing.



- 1. Anti backout device, plug
- 2. Anti backout device, receptacle

002449 002450

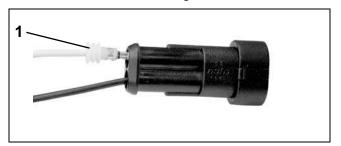


- Locking tab, plug
- Locking tab, receptacle

002447

Terminal Installation

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



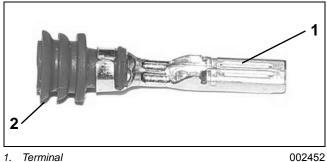
Terminal and seal

002451

Align anti-backout d evice with connector housing and terminals. Use Seco ndary Lock In staller, P/N 777079, to seat device in connector.

Crimping Terminals

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



Terminal

2. Seal

ELECTRICAL AND IGNITION

CONNECTOR SERVICING

SUPER SEAL

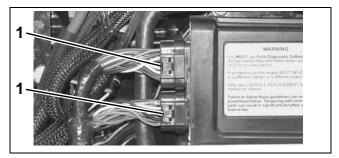
The J1-A and J1-B connectors of the *EMM* are *AMP Super Seal* connectors.

Disconnect

Depress BOT H latches and pull con nector from plug.

Connect

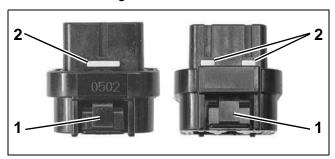
Push connector into plug until latches engage.



1. Latch 002118

Terminal Removal

Open lock me chanism and remove terminal from connector housing.



Latch

2. Lock mechanism

002453

Terminal Installation

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



1. Terminal 002454

POWER TIMER SERIES

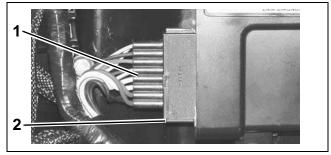
The J2 connector of the *EMM* is an *AMP Power Timer Series* connector.

Disconnect

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

Connect

Push connector until seate d in plug. Close latch completely.



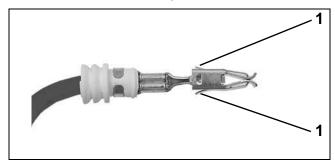
1. J2 connector

2. Latch (closed)

002120

Terminal Removal

Use Terminal Rele ase T ool, P/N 351413, to release BOTH locking mechanisms of con nector. Pull terminal from housing.



Locking mechanism(s)

002455

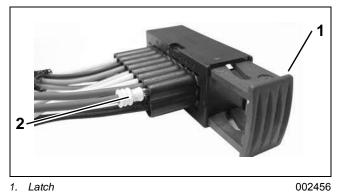


1. Terminal release tool

002313

Terminal Installation

Align terminal with connector housing and push terminal with se al in to connector housing until seated.



- Terminal with seal

PackardConnectors

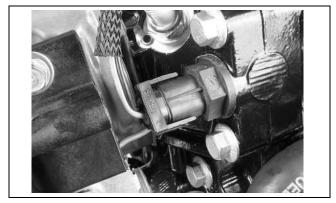
IMPORTANT: Always use the appropriate meter test probe s and ada pters when testing components fitted with these terminals.

Disconnect

Lift latch(s). Remove connector.

Connect

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

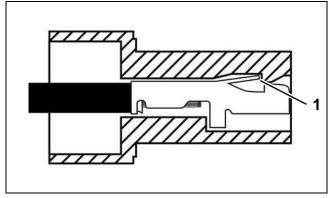


DSC02124

Terminal Removal

A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place. The terminal is removed by releasing the tab and then pushing the terminal and wire through connector housing.

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



1. Tab DRC5940a

Terminal Installation

Install wire gasket o n wires and fe through the corr ect terminal position of the co nnector 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 st rands in crimp; leave no loose strands. Crimp wire and insulation securely using crimping pliers.

NOTES

Technician's Notes Related Documents Bulletins **Instruction Sheets** Other

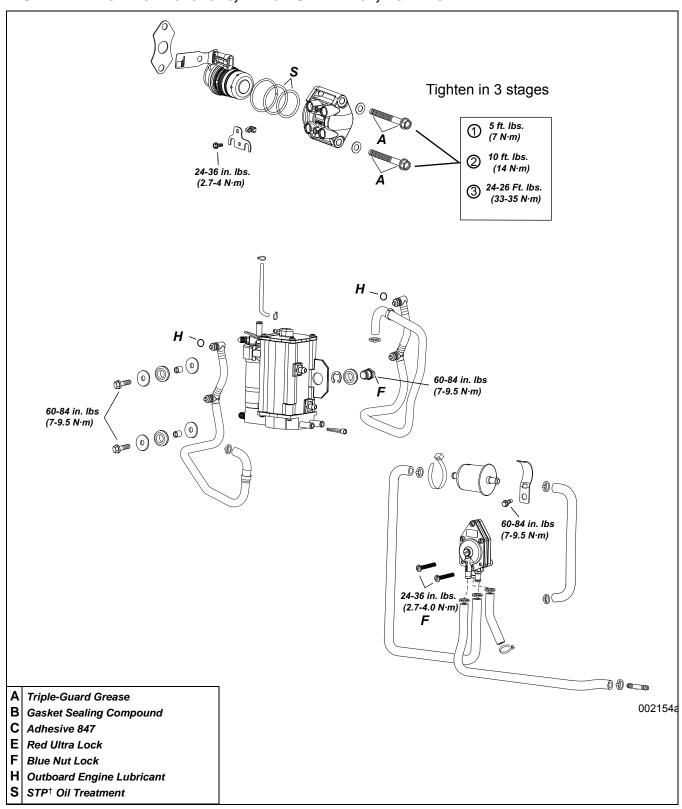
FUEL SYSTEM

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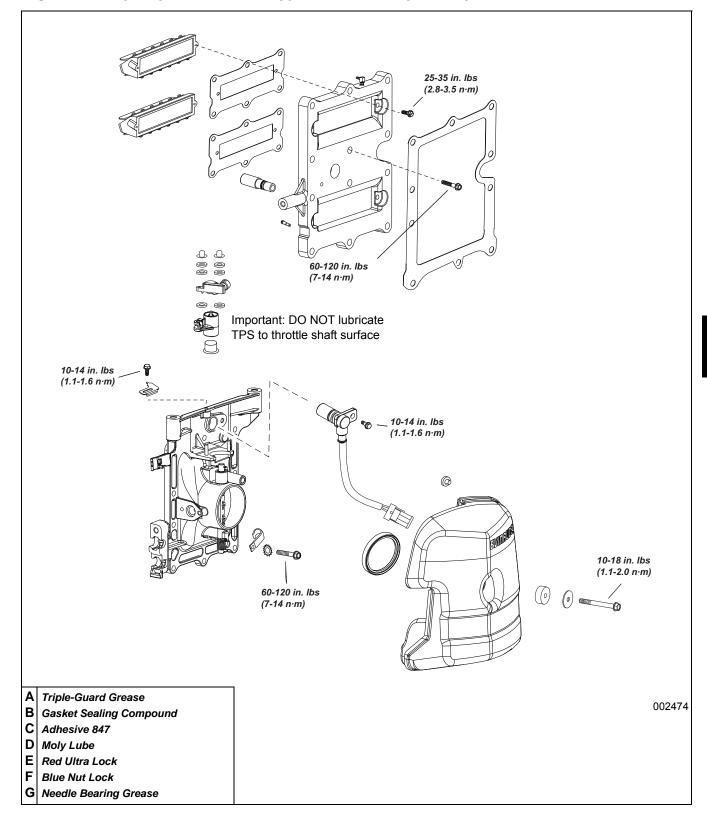
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FUEL LIFT PUMP SERVICE	
VAPOR SEPARATOR SERVICE	
FUEL MANIFOLD SERVICE	
FUEL INJECTOR SERVICE	
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SERVICE CHART

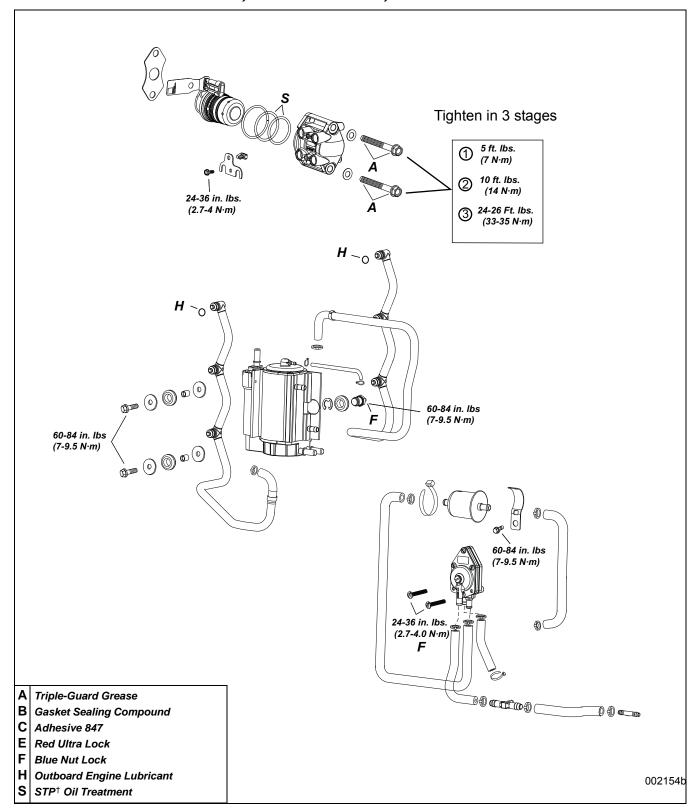
2-CYLINDER MODELS: INJECTORS, VAPOR SEPARATOR, FUEL PUMP



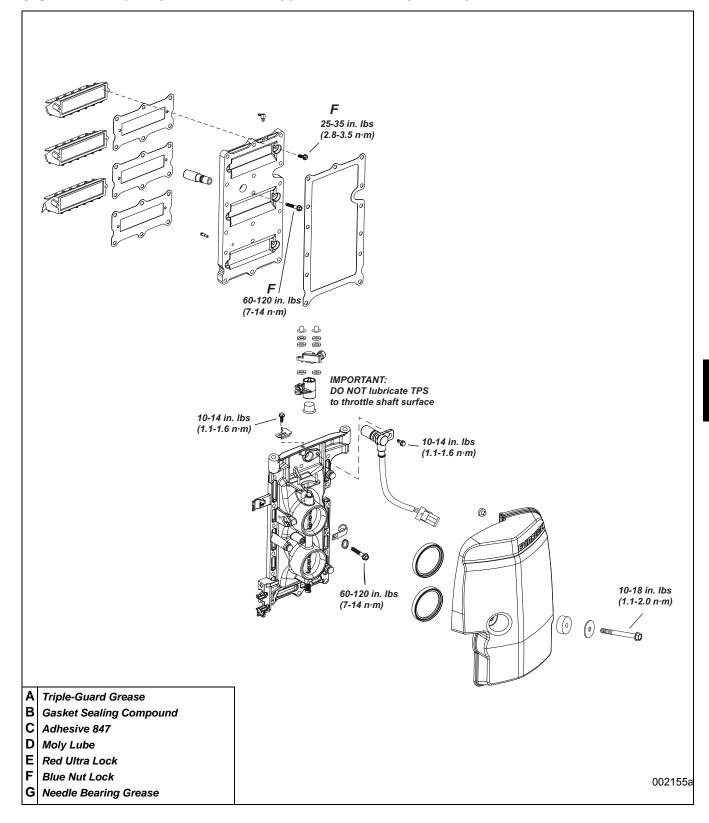
2-CYLINDER MODELS: REED PLATE ASSEMBLY AND THROTTLE BODY



3-CYLINDER MODELS: INJECTORS, VAPOR SEPARATOR, FUEL PUMP

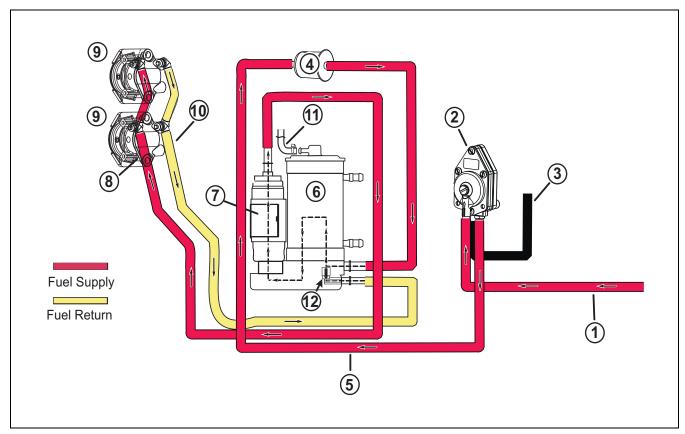


3-CYLINDER MODELS: REED PLATE ASSEMBLY AND THROTTLE BODY



FUEL SYSTEM HOSE ROUTING

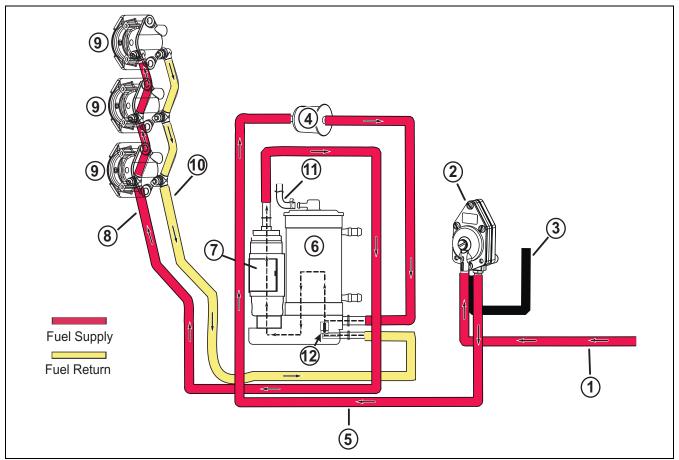
2-CYLINDER MODELS



002148

- 1. Fuel supply from boat fuel system
- 2. Fuel lift pump (2 to 8 psi)
- 3. Pulse hose from cylinder/crankcase
- 4. Fuel filter
- 5. Fuel supply to vapor separator
- 6. Vapor separator
- 7. Electric fuel circulation pump (20 to 30 psi)
- 8. Fuel supply manifold
- 9. Fuel injector(s)
- 10. Fuel return manifold
- 11. Vent hose to intake manifold
- 12. Pressure regulator (high pressure)

3-CYLINDER MODELS

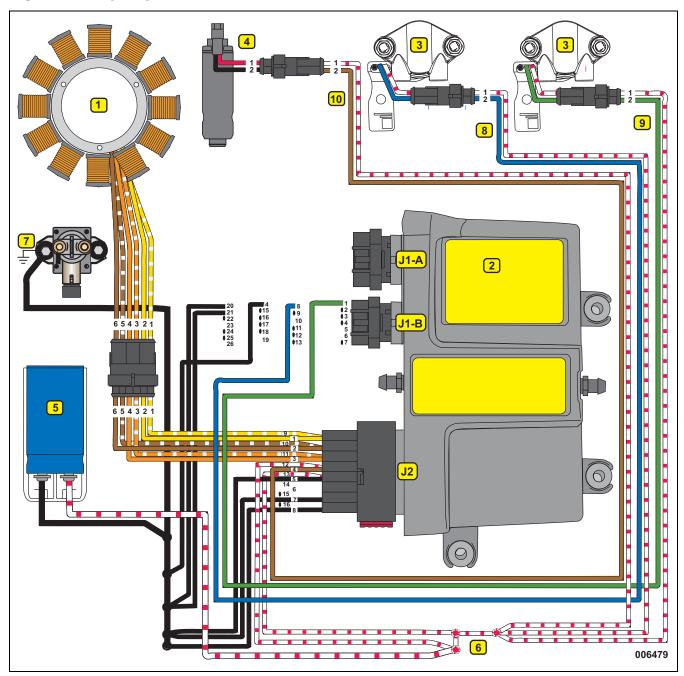


002148a

- 1. Fuel supply from boat fuel system
- 2. Fuel lift pump (2 to 8 psi)
- 3. Pulse hose from cylinder/crankcase
- 4. Fuel filter
- 5. Fuel supply to vapor separator
- 6. Vapor separator
- 7. Electric fuel circulation pump (20 to 30 psi)
- 8. Fuel supply manifold
- 9. Fuel injector(s)
- 10. Fuel return manifold
- 11. Vent hose to intake manifold
- 12. Pressure regulator (high pressure)

FUEL SYSTEM CIRCUIT DIAGRAMS

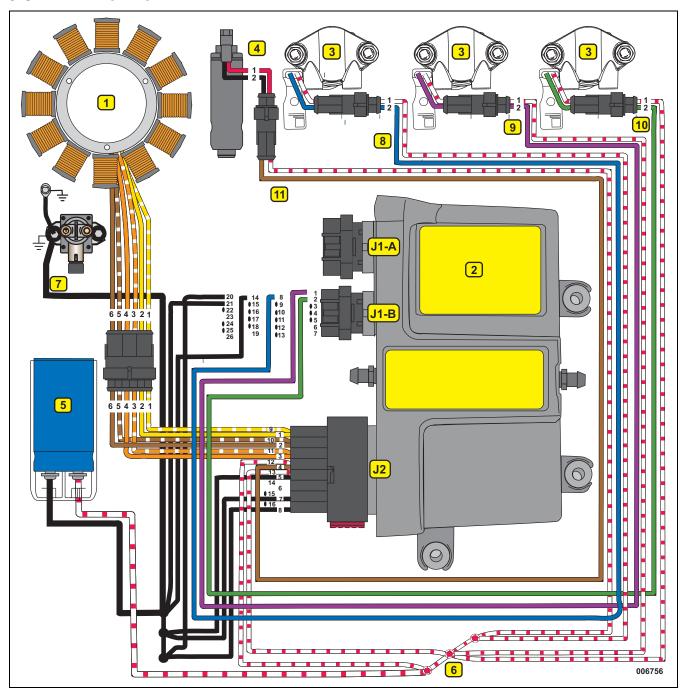
2-CYLINDER MODELS



- 1. Stator
- 2. *EMM*
- 3. Fuel injector
- 4. Fuel circulation pump
- 5. Capacitor
- 6. WHITE/RED (55 V)
- 7. BLACK ground wires
- 8. BLUE

- 9. GREEN
- 10. BROWN

3-CYLINDER MODELS



- 1. Stator
- 2. *EMM*
- 3. Fuel injector
- 4. Fuel circulation pump
- 5. Capacitor
- 6. WHITE/RED (55 V)
- 7. BLACK ground wires
- 8. BLUE

- 9. PURPLE
- 10. GREEN (2)
- 11. BROWN

FUEL SYSTEM REQUIREMENTS

Regulations and Guidelines

Vessel man ufacturer, and /or installer of an EP A certified outboard, must meet minimum specifications for boat fuel systems established by:

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

Portable Fuel Tanks

WARNING

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

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

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

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

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

Fuel Flow Requirements

	15 – 30 HP	40 – 90 HP	115 – 300 HP
Fuel tank pickup tube	1/4 in. (6.4 mm) min. ID	5/16 in. (7.9 mm) min. ID	3/8 in. (9.5 mm) min. ID
Fuel fittings	5/32 in. (4.1 mm) min. ID	1/4 in. (6.4 mm) min. ID	9/32 in. (7.1 mm) min. ID
Fuel supply hoses	1/4 in. (6.4 mm) min. ID	3/8 in. (9.5 mm) min. ID	3/8 in. (9.5 mm) min. ID
	ALL MODELS		
Fuel tank pickup screen	100 mesh, 304 grade stainless steel wire, 0.0045 in. wire diameter, 1 in. (25 mm) long		
Antisiphon valve	2.5 in. (63.5 mm) Hg maximum pressure drop at 20 gph (76 l/hr) flow		
Remote fuel filter	0.4 in. Hg maximum pressure drop at 20 gph (76 l/hr) flow, 150 in.² (1290 cm²) of filter area		
Maximum fuel pump lift height	Fuel pump should not be located more than 30 in. (76.2 cm) above bottom of fuel tank		

Fuel Requirements

A 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 unleade d automotive ga soline 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 fue is **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 b oat's fuel system may h ave different requirements regarding the use of alcohol fuels. Refer to the boat's owner guide.
- Alcohol at tracts and ho lds moisture that can cause corrosion of metallic parts in the fuel system.
- Alcohol blend ed fuel ca n cause engine pe rformance problems.
- All parts of the fuel system should be inspected frequently and replaced if signs of deterioratio n 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 ap proved for use in *Evinrude* outboards are $2+4^{\circ}$ fuel conditioner a nd *Evinrude/Johnson* Fue I 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 fue I 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. It suse will reduce sp ark plug fouling, fuel system icing, and fuel system compone int deterioration.

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

COMPONENTS

The fuel syste m includes the following components:

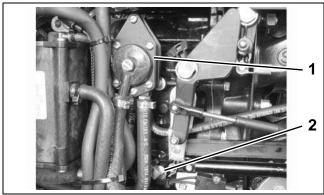
- Fuel Lift Pump
- Fuel Filter
- Vapor Separator
- Fuel Circulation Pump
- Fuel Supply Manifolds
- Fuel Injectors
- · Fuel Return Manifolds

Fuel Lift Pump

The fuel lift pump is a mechanical, pressure-pulse pump. The diaphragm of the pump is driven by a pulse hose that connect s to the cylinder/crank-case assembly.

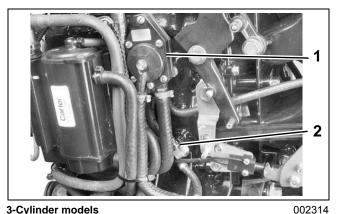
Fuel lift pump pulse hose location:

2-Cylinder Models: Number 2 cylinder
 3-Cylinder Models: Number 3 cylinder



2-Cylinder models1. Fuel lift pump2. Pulse hose fitting

006558



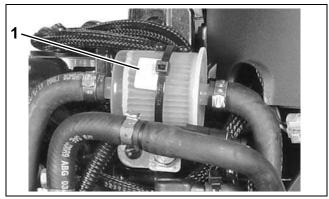
3-Cylinder models
1. Fuel lift pump

2. Pulse hose fitting

Vacuum from the fuel lift pump pulls fuel from the fuel t ank. Once fu el reaches the pump, interna l pump pressure force s the fuel from the pump through the fuel filter and into the vapor separator.

Fuel Filter

The fuel filter protects the vapor separator and the high-pressure components of the fuel system from contaminants. Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 16 for service frequency.



1. Filter 002145

Vapor Separator

The vapor separator:

- Serves as a water-cooled fuel reservoir to accumulate incoming fuel from the fuel lift pump and from the fuel return manifold.
- Contains a flo at controlling the venting of fue I vapors.
- Contains a fu el pressure regulator for t he high pressure fuel system.

The vapor separator is serviced as an assembly and includes the fuel circulation pump.



Vapor Separator Assembly
1. Circulation pump

006555

Fuel Reservoir

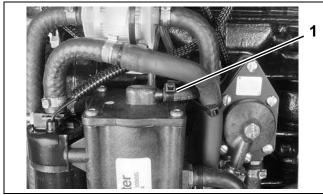
The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation p ump. It is water-cooled to enhance vapor separating capabilities.

Cooling

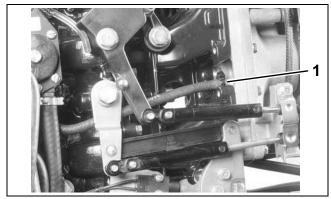
Water is used to cool the f uel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically. Refer to **HOSE ROUTING AND WATER FLOW DIAGRAMS** on p. 174.

Venting

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



1. Vent 005007



1. Vent hose connection to intake

002180

The vapor separator vent is opened and closed by a float valve. The float valve moves with the fuel level in the fu el chamb er. 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 int ake manifold through the vent hose.

As the vapor pressure in the va por sep arator decreases, the fuel level begins to in crease. 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 SYSTEM COMPONENTS

Fuel Circulation Pump

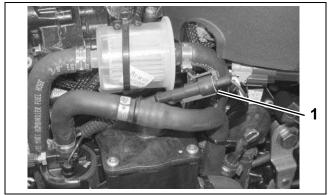
The fuel circulation pump is an electric high pressure fuel pump.

Fuel Supply

The pump is mounted to the vapor separator and draws fuel from the fuel chamber. It pumps pressurized fuel through a fuel supply manifold connected to the fuel injectors.

Electrical Circuit

The circula tion p ump is controlled by the *EMM* and opera tes on the 55 V circuit. The outboard must be cranking or running (CPS input to *EMM*) for the circulation pump to be activated. The *EMM* controls pump o peration by rapidly connecting and disconnecting the pump's internal coil to ground.



1. Fuel pump electrical connector

006557

Fuel Manifolds

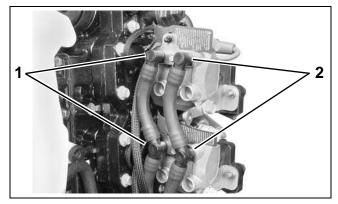
The fuel supply and return manifolds route fuel through the high pressure side of the fuel system.

Fuel Supply Manifold

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

Fuel Return Manifold

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



Fuel supply
 Fuel return

006560

Fuel Injectors

Fuel injectors are fuel metering, electric solenoids (55 V) bolted directly to the cylinder head. The *EMM* controls the activation of each injector by rapidly connecting and disconnecting the injector's internal coil to ground.

Fuel Flow Compensation

The flow rate of each injector is measured as part of the manufacturing process. This information is recorded and assigned to the injector by serial number.

The *EMM* is programmed to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the *EMM*. DO NOT install an injector without updating the compensation software.

Each service injector includes it s fuel flow information on a 3.5 in. flo ppy disk. Th is sof tware allows the *EMM* to be reprogrammed for this injector's unique fuel flow characteristics.

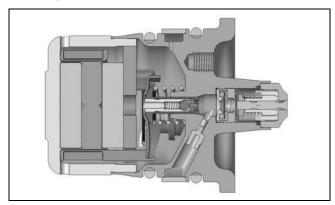
NOTICE Fuel injectors MUST NOT be moved from one cylinder to another. EMM programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply manifold.

Each injector has internal fuel passages. These passages are designed to:

- Provide fuel to the injector's injection chamber
- Route fuel through the injector hou sing to cool the injector coil and armature

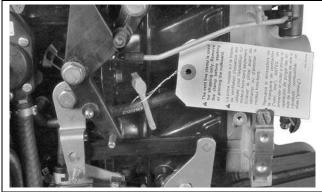


006619

FUEL SYSTEM PRIMING

Vent Line Clamp

Federal Reg ulations require that a II o utboards with a fuel vapor separator must be shipped with a vent line clamp inst alled. This clamp must be removed before priming the fuel system or starting the outboard for the first time.



002552

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

Priming the Fuel System

A 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.

REMOTE MODELS

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 fue I flow is observed, connect fuel supply hose from fuel tank to hose fitting on outboa rd. Secure hose with *Oetiker* clamp.

TILLER MODELS

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

ALL MODELS

Use the primer to fill the vapor separator.

The high-pressure fuel circu its and in jectors will prime as the outboard is cranked with the starter.

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

WARNING

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

FUEL SYSTEM TESTS

WARNING

Use caution when working on any pressurized fuel system. Wear safety glasses and work in a well ventilated area. Extinguish all smoking materials and make certain no open flames or ignition sources exist. Before starting any fuel system service, carefully relieve fuel system pressure. Failure to properly relieve fuel system pressure can result in spraying fuel and/or excessive fuel spillage during servicing. Fuel is flammable and can be explosive under certain conditions.

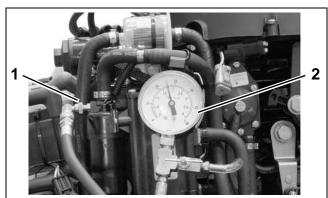
Fuel System Pressure Test

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 142.

WARNING

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

After relieving fuel system pressure, install a 0 to 60 p si (0 to 415 kPa) Fuel Pressur e Gau ge, P/N 5007100 or equivalent, to the upper fuel pressure test fitting.



- 1. Test fitting
- 2. Fuel pressure gauge

006655

START outboard and che ck pressu re. Syste m pressure should be 20 to 35 psi (138 to 241 kPa).

Shut OFF outbo ard. Mo nitor pr essure gaug e. Pressure should not drop below 15 psi (103 kPa).

IMPORTANT: If outb oard does not run, prime fuel system and crank outboard; check circulation pump operation; check fuel system pressure.

Results:

Normal pressure:

- Observe pressure reading after outboard is shut OFF
- Refer to **Lift Pump Pressure Test** on p. 139

Pressure drops after outboard is shut OFF:

- Check for leaking fuel injector.
- Check for leaking pressure regulator.
- Check for external fuel system leak.

High pressure:

 Check for restricted filter or fuel return fitting of vapor separator, damaged pressure regulator in vapor separator, or restricted fuel return manifold.

Low pressure:

- Check fuel supply to fuel lift pump. Refer to Lift Pump Vacuum Test on p. 140. Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
- Restricted fuel filter/water separator assembly.
- Lift pump not supp lying enough fuel to vap or separator. Refer to Lift Pump Pressure Test on p. 139.
- If the above tests are good and vapor separator remains full of fuel, check for da maged circulation pump. Replace vapor separator assembly.

No pressure:

- Check electrical circuit and ground connections for circulation pump.
- If volt age is present and pump does not run, repair connection or replace vapor separator assembly.

Relieve fuel system pressure before removing fuel pressure gauge. Refer to **Relieving Fuel System Pressure** on p. 142.

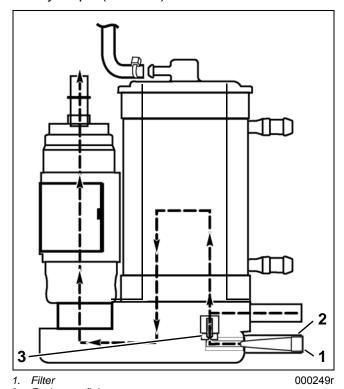
Pressure Regulator Test

Refer to **Vapor Separator Service** on p. 144 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 a pproximately 15 psi (103 kPa).



Fuel return fitting
 Pressure regulator

Vapor Separator Vent Check

Monitor the vapor separator vent hose. No fuel or a trace of fuel is accep table. Excessive fuel discharge indicates a vapor separator vent malfunction. Monitor vent f or presence of fuel during testing. Temporarily install clear tubing for mon itoring. Replace vapor sep arator if the venting of fuel is continuous.

Fuel Injector Pressure Test

This te st re quires Inj ector T est Fi tting ki t, P/N 5005844.

Disconnect the battery cables at the battery.

Loosen oil tank assembly to provide access to fuel manifolds. Refer to **Oil Tank Assembly** on p. 169.

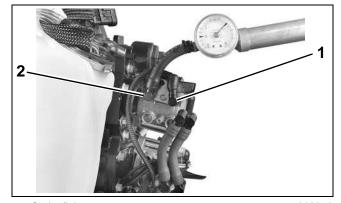
Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 142.

WARNING

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

IMPORTANT: Perform test with in jector mounted to cylinde r h ead and fittin gs installed with manifold retainer.

Use cap and tie strap to seal off outlet fitting. Connect a 0 to 30 psi (0 to 207 kPa) pressure tester to the inlet fitting. Pressurize the injector to 30 psi (207 kPa). Pressure must hold for at least five minutes.



Outlet fitting
 Inlet fitting

002379

Refer to **FUEL DELIVERY TESTS** on p. 84 for additional test procedures.

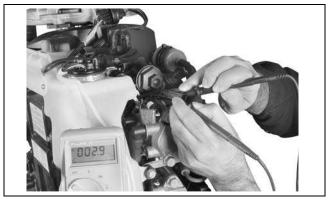
Fuel Injector Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter to measure the injector coil resistance.

Fuel Injector Coil Resistance

2 to 3 Ω @ 72°F (22°C)



006620

Use a dig ital multimeter with ap propriate adapter leads to measure resistance of the complete injector circuit, including injector and associated wiring.

Measure resistance between pin 1 (white/red) of injector connector (connected) and the appropriate pin lo cation of EMM J1-B co nnector (disconnected). Refer to engin e wiring diag ram for specific EMM J1-B connector pin location for the injector circuit being tested (blue, purple or green).



006621

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

Circulation Pump Resistance Test

Disconnect the battery cables at the battery.

Use a digital multimeter with app ropriate adapter leads to measure the fue I pump circuit and coil resistance.

Fuel Pump Resistance

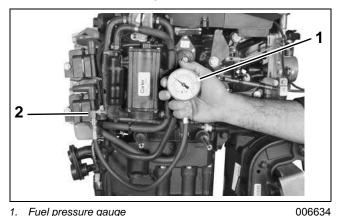
3 Ω @ 77°F (25°C)



006633

Lift Pump Pressure Test

Install a 0 to 15 p si (0 to 103 kPa) Fue I Pressure Gauge, P/N 5006397 or equ ivalent, to the lower fuel pressure test fitting.



Fuel pressure gauge Test fitting

Prime the fuel system and check for leaks. START outboard and run at idle speed. Hold gauge level with inlet fitting and monitor gauge for pressure reading.

Pressure should stabilize at a read ing grea ter than 3 psi (27 kPa).

FUEL SYSTEM

FUEL SYSTEM TESTS

Results:

Normal pressure:

 Perform the Lift Pump Vacuum Test on p. 140.
 Make sure no a ir 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. 140.
 Make sure no a ir 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:

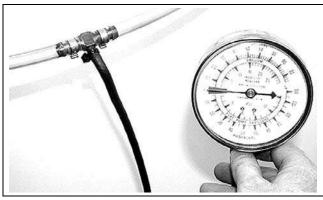
- Check pulse hoses and fittings restrictions.
- Check fuel flow through fuel lift pump. Use fuel primer or primer bulb to force fuel through pump.
- Momentarily prime or squee ze p rimer bulb to check gauge operation.
- Check pulse hose and fittings for restrictions.

Lift Pump Vacuum Test

Confirm fuel supply to the fuel lift pump.

Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet). Secure connections with tie straps to prevent fuel or air leaks.

NOTICE Do not use fuel primer bulb, manual fuel primer, or electric fuel pump primer to restart outboard. A positive pressure in the fuel supply could damage some vacuum gauges.



000243

START outboard and run at FULL THROTTLE for at least two minutes. Monitor clear vinyl ho se 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 va cuum should not exceed 4 in. Hg. (13.5 kPa) at the inlet to the fuel lift pump under any o perating conditions (IDLE to WOT).

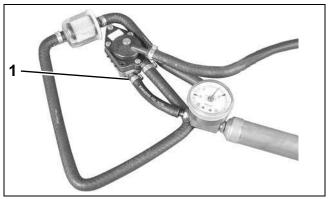
A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to **FUEL SYSTEM REQUIREMENTS** on p. 130 for fuel supply component requirements.

Lift Pump Diaphragm Test

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

Remove the pulse hose from the crankcase fitting.

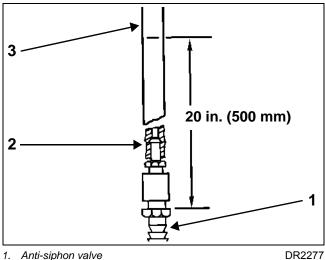
Apply 15 p si (103 kPa) to the pulse hose of the pump. Replace lift pump if pump fails to hold pressure.



002334a Pulse fitting

Anti-Siphon Valve Test

Remove anti-siphon valve fro m fuel tank. Install adapter fittings and a 36 in . (91.4 cm) leng th of clear hose to the inlet side (tank end) of valve.



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

Fill clear hose with water to a height of 20 in. (500 mm). W ater mu st NOT flo w through va lve. An occasional drip is accept able. 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

A 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 fu el system p ressure before disassembly. Temporarily restrict the fu el supply hose from fuel t ank with hose pincer. Remove propeller and disconnect circula tion fuel pump electrical connector. If out board runs, st art and run at IDLE for 5 seconds and ST OP outboard. If outboard do es NOT run, crank for 10 seconds.

Disconnect the battery cables at the battery.

Wrap a shop t owel completely around the pressure test valve while connecting fitting from Fue I Pressure Gauge, P/N 5007 100, to top test fitting of fuel pump/vapor separator assembly.



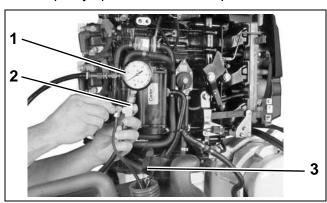
1. Shop towel

005011

Insert venting hose of gauge into a suitable container

Slowly open gauge's venting valve.

Clean up any spilled fuel with shop towels.



. Test fittina

Venting valve

3. Venting hose

005012

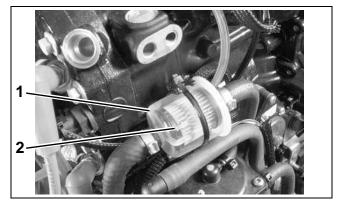
Fuel Filter Service

Removal

Disconnect the battery cables at the battery.

Remove filter carefully to prevent spilling contents.

Inspect conte nts for any pre sence of wa ter. If water is present, identify the source and correct the problem. T ake a dditional fuel samp les and drain fuel tank(s) if necessary.



Fuel filter
 Arrow

002192

Installation

Install filter in fuel supply hoses. Note arrow indicating direction of fuel flo w on filter. Secure filter with appropriate clamps.

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

Connect battery cables.

Run outboard and check for fuel leaks.

Fuel Lift Pump Service

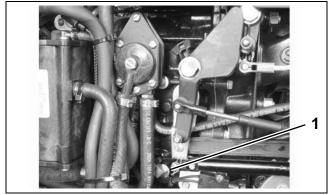
The fuel lift pump is serviceable as a comple te assembly or can be repaired with a fuel pump repair kit. Refer to parts catalog for service parts.

Removal

Disconnect the battery cables at the battery.

Disconnect the fuel hoses from the fuel pump housing.

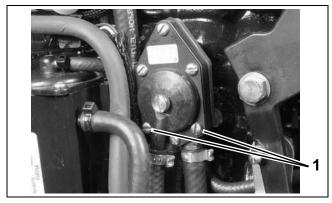
Disconnect the fuel lift pump pulse hose at the crankcase fitting.



1. Crankcase fitting

006558

Loosen t he fuel lif t p ump mounting scre ws. Remove the fuel lift pump as an assembly.



1. Screws

002194

Fuel pump repair kit, P/N 438616, is available for internal service of fuel pump. Refer to instructions included with kit.

FUEL SYSTEM

FUEL COMPONENT SERVICING

Installation

Place fuel pump in po sition on crankcase. Apply *Nut Lock* to mounting screws. Tighten screws to a torque of 24 to 36 in. lbs. (2.8 to 4.0 N·m).

Connect the fuel lift pump pulse hose to the crankcase. Secure with tie strap.

Connect the fuel hoses to the fuel filter. Secure with *Oetiker* clamps.

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

Connect battery cables.

Run outboard and check for fuel leaks.

Vapor Separator Service

Removal

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 142.

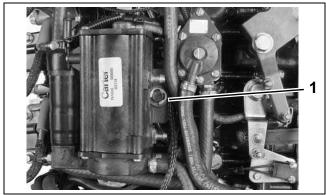
Disconnect circulation pump electrical connector.

Remove clamp and fuel supply manifold from top of circulation pump. Remo ve clamp and va por vent hose from separator cover.

Remove clamp s and vap or separator cooling water hoses.

Remove clamps and fuel return manifold and fuel supply hose from bottom of vapor separator.

Remove the vapor separator housing retainer clip.

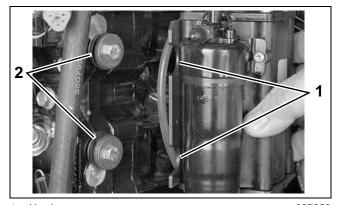


Retainer clip 005013

Remove vapor sep arator/fuel pump from t he mounting stud and slide va por separator housing from the grooves of the isolator mounts.

Installation

Slide the vap or sep arator b racket no tches in to grooves of the isolator mounts. Install forward isolator of va por sep arator on mounting st ud a nd secure with retainer clip.



Notches
 Isolator mounts

007859

Install all hoses and manifolds in original locations and secure with appropriate clamps. Route hoses and secure with tie straps as shown.



007860

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

Connect battery cables.

Run outboard and check for fuel leaks.

Fuel Manifold Service

Removal

Disconnect the battery cables at the battery.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 142.

Remove oil t ank assembly. Refer to **Oil Tank Assembly** on p. 169.

Remove clamps and disconnect the fuel manifolds as follows:

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



- 1. Fuel supply manifold
- 2. Fuel return manifold

006555

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



1. Screw

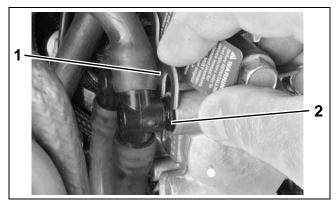
006559

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

Installation

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

Install retainer in the outer groove of the manifold fittings. Install and tighten screw to a torque of 24 to 36 in. lbs. $(2.7 \text{ to } 4 \text{ N} \cdot \text{m})$.



Retainer
 Manifold fitting groove

005342

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

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

Install oil tank asse mbly. Refer to **Oil Tank Assembly** on p. 169.

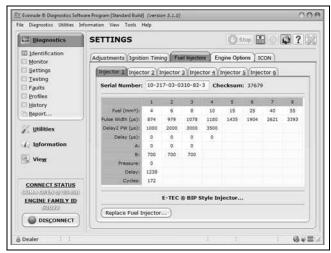
FUEL SYSTEM

FUEL COMPONENT SERVICING

Fuel Injector Service

Mark fuel injectors to show cylinder locations.

NOTICE Fuel injectors must be installed in the correct cylinder locations. Use *Evinrude Diagnostics* Software to make sure that *EMM* programming matches injector positioning. The *Injector Coefficients* screen displays injector serial numbers for each cylinder.



Injector Coefficients Screen

008568

Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fue I manifo lds. Cover the injector no zzle port in cylinder head to prevent contamination of combustion chamber.

Removal

Disconnect the battery cables at the battery.

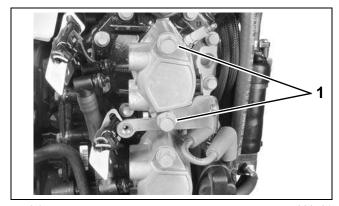
Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure** on p. 142.

Remove fuel manifold s. Refer to **Fuel Manifold Service** on p. 145.

Remove the ignition coil assemblies.

Disconnect the fuel injector electrical connector.

Remove injector screws.



Injector screws

006561

Remove fuel injector and insulator.

Crush Ring Replacement

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

Use Slide Ha mmer assembly, P/N 391008, with Slide Hammer Adaptor kit, P/N 390898, to remove injector from mounting cup.

Thread adaptor and stud into face of injector. Hold mounting cup securely. Use slide hammer to separate injector from mount housing.



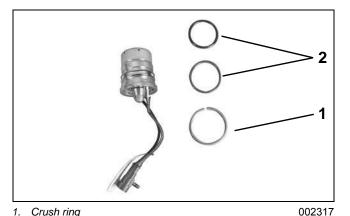
002345

Remove adaptor from injector. Remove crush ring and O-rings from injector. Inspect and clean injec-

tor filter. Install new crush ring and O-rings. Lubricate O-rings with STP[†] Oil Treatment.



002196 1. Adaptor



Crush ring

O-rings

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



002318

Installation

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

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

Coefficient data for some replacement injectors is supplied on a computer disk shipped with the injector. If a disk is not included with the injector, coefficient dat a ca n be downloade d from the Evinrude/Johnson dealer website. Ref er to the instructions provided with the injector kit.

Upload Coefficient Files to EMM

IMPORTANT: If using Diagnostic Power Supply Tool, P/N 587005, to supply po wer to the EMM, use Accessory Power Cable Kit, P/N 5008092, to connect an external 12 volt battery to the Power Supply Tool.

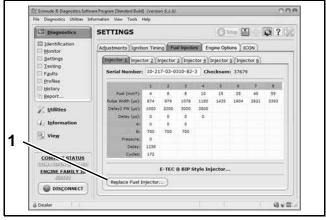
If the internal batteries of the Power Supply Tool have a low volt age condition the EMM could turn OFF during the coefficient upload, resulting in a failed update.

Use the Evinrude Diagnostics so ftware Settings screen to upload the coefficient file to the EMM.

Select the *Injectors* tab.

Select the cylinder tab for injector being replaced.

Select the Replace Injector button.



"Replace Injector" button

008568A

FUEL SYSTEM

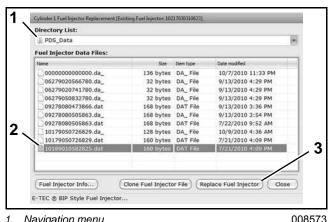
FUEL COMPONENT SERVICING

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

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

Select the correct file for the injector.

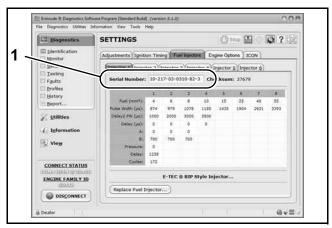
Select the Replace Injector button.



- Navigation menu
- 2. Injector coefficient file
- "Replace Injector" button

After the upload is complete, the p rogram will return to the Cylinder tab.

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



Serial number

008568A

Install Injector

The following ite ms and their ma ting surfaces must be cleaned prior to reassembly:

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

A CAUTION

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

Place injector and insulator in the proper cylinder location.

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

Lubricate mounting screw threads and under the head of the screw with a light coat of Triple-Guard grease. Install washers (on e per screw) on injector retaining screws. In stall screws and washers through mounting flange of injector and into cylinder head.



002316

Tighten screws in stages, starting with the lower screw.

- First torque is 5 ft. lbs. (7 N·m).
- Second torque is 10 ft. lbs. (14 N·m).
- Final torque is 24 to 26 ft. lbs. (33 to 35 N·m).



Tighten Screws in Stages

006562

Reconnect fuel injector electrical connectors.

Install the ignition co il assemblies. T ighten coil screws to a torqu e of 60 to 8 4 in. lbs (7 to $9.5 \text{ N} \cdot \text{m}$).

Install fuel manifolds. Refer to **Fuel Manifold Service** on p. 145.

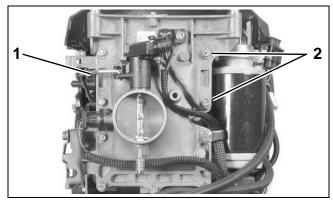
Intake Manifold Service

Removal

Disconnect vapor separator vent hose, main bearing vent hose, air temperature sensor, crankshaft position sensor, and throttle position sensor.

Use Ball So cket Remover To ol, P/N 342226, to remove throttle link arm.

Remove throttle body screws and throttle body assembly.

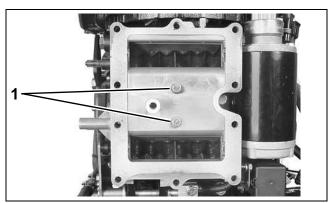


- Link arm
- 2. Throttle body screws

002499

Remove gasket from throttle body.

Remove screws and reed plate assembly from the crankcase.



1. Screws 002503

FUEL SYSTEM

FUEL COMPONENT SERVICING

Disassembly

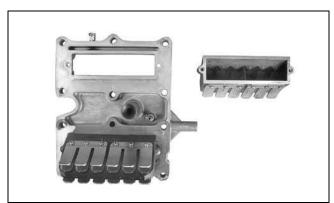
All reed pla te assembly and reed valve assemblies must be cleaned prior to reassembly. DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

Remove the re ed valve ret ainer screws a nd remove the assembly.



002496

Use cau tion to prevent damaging reed valve assemblies.



002504

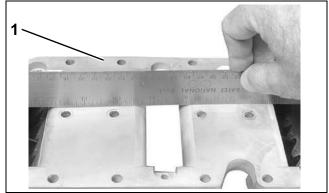
NOTICE DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

Inspection

Inspect the leaf plate a ssemblies for da mage or contamination:

- Leaf plates must not be distorted.
- Leaf valve must not be cracked or chipped.
- Leaf plate stops must not be distorted or loose.
- Leaf plate assemblies must be clean.

Inspect the intake manifold. All gasket surfaces must be cleaned, smooth, and free of nicks. Use a machinist's stra ight-edge and a feeler gauge to check flatness in all directions. Surface must be flat, \pm 0.004 in. (0.10 mm).



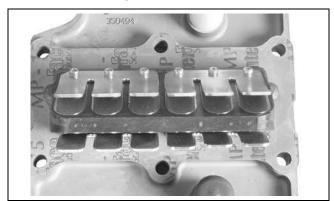
1. Straight-edge

002324

Assembly

Remove old adhe sive from reed valve ret aining screws.

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



002333

Prime screw th reads with *Locquic Primer* and let dry. Apply *Nut Lock* to threads. Position reed valve on reed plate an d install screws. T ighten screws to a torque of 25 to 35 in. lbs. (2.8 to 4.0 N·m).

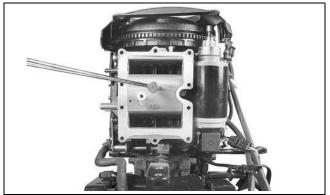


002326

Installation

Place reed plate assembly on cylinder/crankcase.

Apply *Nut Lock* to two re ed plate screws. Inst all and tighten screws to a torque of 60 to 120 in. lbs. (7 to 13.5 N·m).

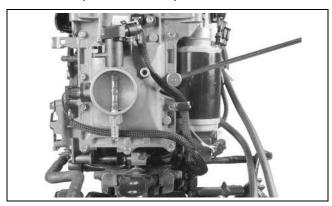


002505

Place gasket on throttle body. Install throttle body on reed plate and install **new** screws.

IMPORTANT: If old screws mu st be re-used, make sure all previous thread locking mate rial is removed and apply *Nut Lock* to threads.

Tighten the center screws first and exp and outward. Tighten in stages to a final to rque of 60 to 120 in. lbs. (7 to 13.5 N·m).



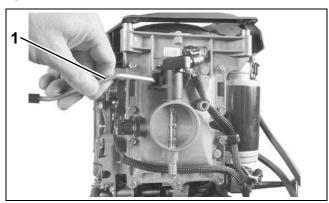
002501

Install vapor separator vent hose and main bearing vent hose. Secure with tie straps.

Install air temperature sensor, crankshaft position sensor, and throttle position sensor electrical connectors.

Connect throttle linkage.

IMPORTANT: DO NOT lubricate the rottle linkages.



1. Throttle linkage

002500

Refer to TPS Calibration on p. 114.

NOTES

Technician's Notes Related Documents Bulletins **Instruction Sheets** Other

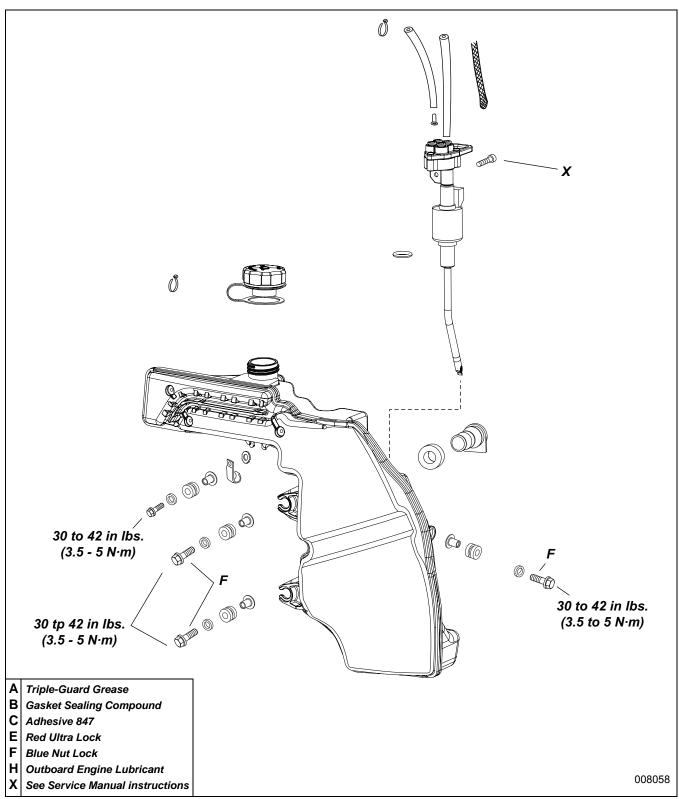
OILING SYSTEM

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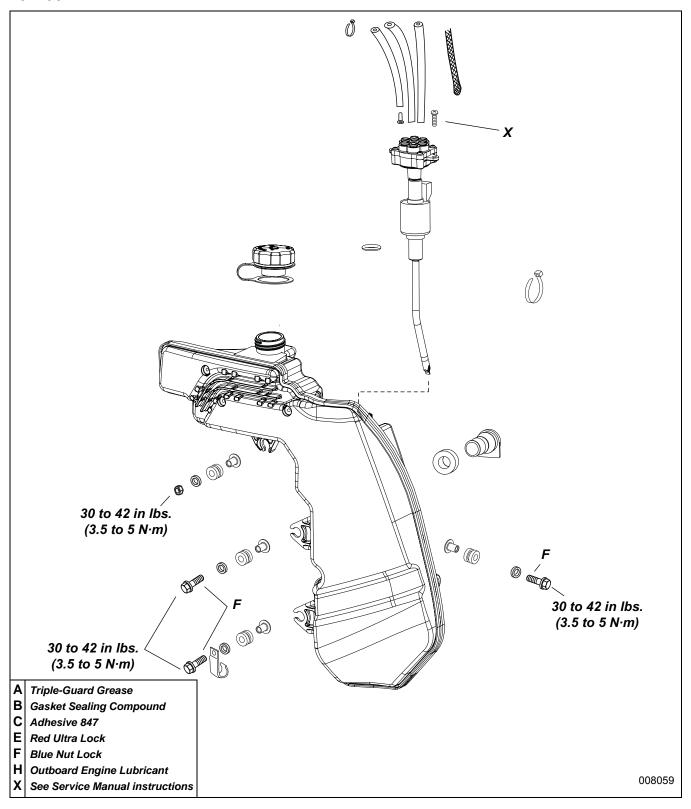
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OIL INJECTION PUMP	1/1

SERVICE CHART

40 - 65 HP

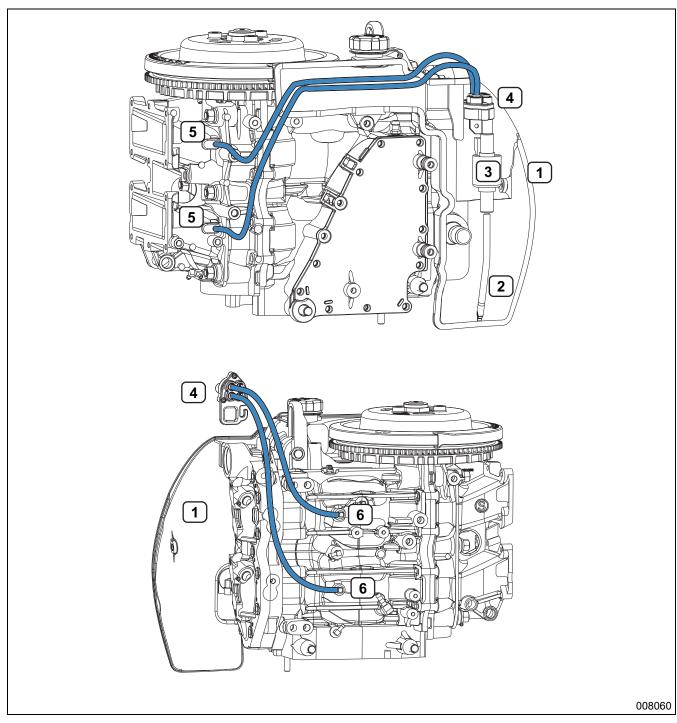


75 - 90 HP



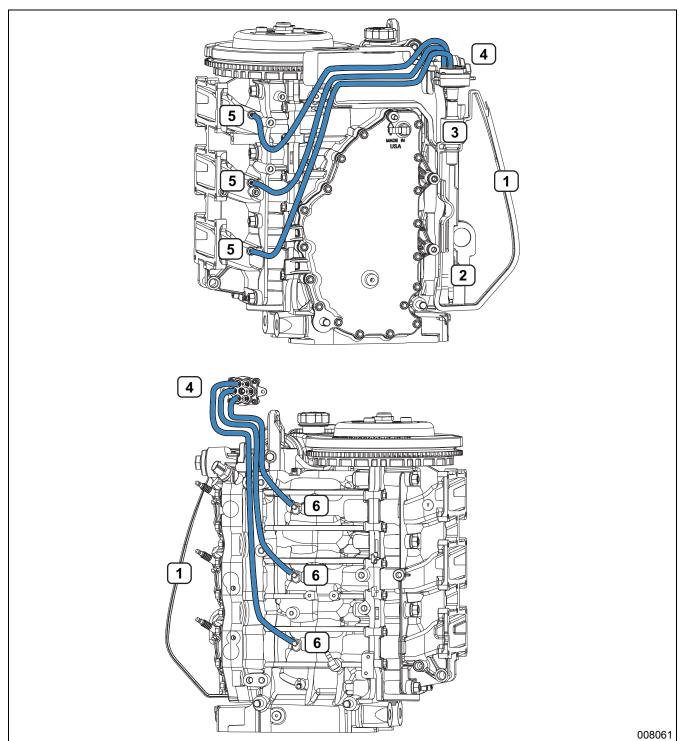
OIL SUPPLY DIAGRAMS

40 - 65 HP



- 1. Oil tank
- 2. Oil pick-up/filter
- 3. Oil injection pump
- 4. Oil distribution manifold
- 5. Crankcase oil inlet (port)
- 6. Cylinder oil inlet (starboard)

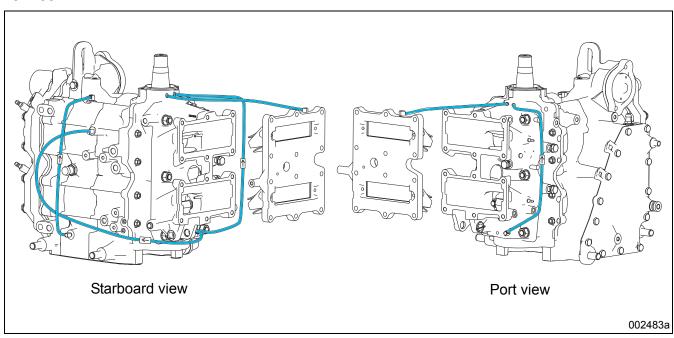
75 – 90 HP



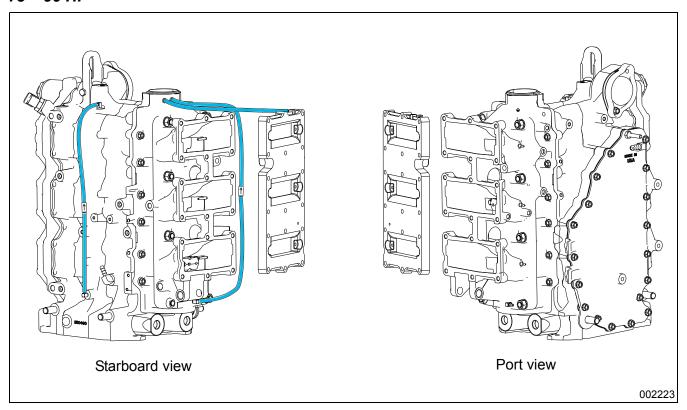
- 1. Oil tank
- 2. Oil pick-up/filter
- 3. Oil injection pump
- 4. Oil distribution manifold
- 5. Crankcase oil inlet (port)
- 6. Cylinder oil inlet (starboard)

OIL RECIRCULATION DIAGRAMS

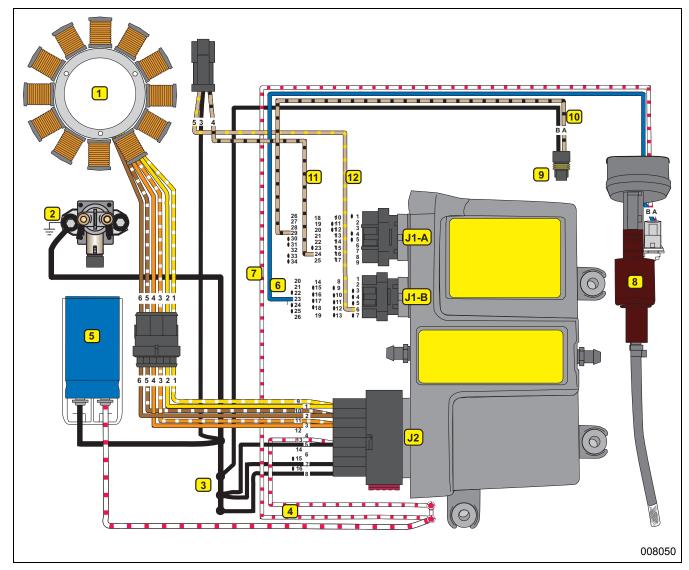
40 - 65 HP



75 – 90 HP



OILING SYSTEM CIRCUIT DIAGRAM



- 1. Stator
- 2. Main harness ground (BLACK)
- 3. Alternator grounds (BLACK)
- 4. Alternator output, WHITE / RED wires (55 V)
- 5. Capacitor (55 V)
- 6. EMM injector control (BLUE)
- 7. 55 V to injection pump (WHITE / RED)
- 8. Oil injection pump
- 9. Low oil switch
- 10. Low oil switch to *EMM* (TAN/BLACK)
- 11. Low oil signal to *SystemCheck* gauge (TAN/BLACK)
- 12 No oil signal to *SystemCheck* gauge (TAN/YELLOW)

OIL SYSTEM REQUIREMENTS

Recommended Lubricants

Evinrude/Johnson XD100, XD50, or XD30 outboard oils are recommended for use in Evinrude E-TEC outboards. If these oils are no tavailable, you must use a TC-W3 certified oil.

Evinrude/Johnson XD100 o utboard oil is h ighly recommended for all conditions and applications.

Engine Lubricant Below 32°F (0°C)

If the outboard will be operat ed in temperature s below freezing (32°F, 0°C), use *Evinrude/Johnson XD100*.

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

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

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

The "LOW OIL" warning should not display.

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

COMPONENTS

The oiling system in cludes the following components:

- Oil tank
- Oil injection pump and manifold assembly
- Oil level switch
- Electrical circuit
- LOW OIL and NO OIL warning systems
- Cylinder and crankcase
- Oil recirculation system.

Oil Tank Assembly

The oil tank is mounted on the powerhead under the engine cover. Oil level must be monitored.

3-CYLINDER MODELS

Oil Tank Components:

- Tank, 2.4 quart. (2.3 liter) capacity
- Oil pickup and filter assembly
- Oil injection pump and manifold assembly
- LOW OIL switch
- Oil distribution hoses



008062

2-CYLINDER MODELS

Oil Tank Components:

- Tank, 2 quart. (1.87 liter) capacity
- Oil pickup and filter assembly
- · Oil injection pump and manifold assembly
- LOW OIL switch
- Oil distribution hoses

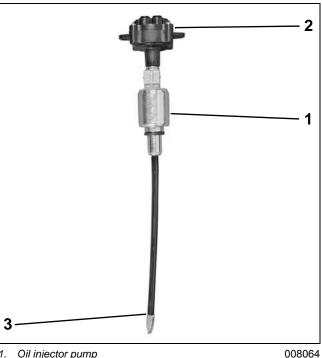


008063

Oil Injection Pump

The oil injection pump is an electric (55 V) actuator style pump. It draws oil from the oil tank and supplies pressurized oil to the oil manifo ld. The EMM supplies 55 V and controls activation of the pump.

The oil manifold distributes the oil supplied by the pump.



- Oil injector pump
- Oil distribution manifold
- 3. Pickup tube and filter

Electrical Circuit (55 V)

The oil injector is powered by the 55 V electrical circuit. The EMM controls pump operation by rapidly connecting a nd disconnectin g the pump's internal coil to ground.

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

Activates S.A.F.E.
Stores a service code 34
EMALED 4 ON (D)
EMM LED 4: ON (Running)
Engine Monitor NO OIL display: ON

OILING SYSTEM

COMPONENTS

LOW OIL Warning

A switch in the oil tank assembly monitors the oil level in the oil tank.

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

Engine Monitor LOW OIL display: ON

Approximate oil reserve at Low Oil activation:

• 0.45 qt. (0.43 l).

NO OIL Warning

When the oil le vel falls below one-quarter, the *EMM* begin s coun ting oil pump pulse cycle s. When it reaches:

40 – 65 HP: 4800 pulses
75 – 90 HP: 6000 pulses

the EMM:

Activates S.A.F.E.

Stores service code 117

EMM LED 4: ON (Running)

Engine Monitor NO OIL display: ON

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

- Oil level must be above one-quarter
- The warning re sets after three oil p ump pulse cycles when the out board has been stopped and restarted.

If outboard has be en run fo r more th an 3 hou rs with NO OIL faults (codes 34 & 117), the *EMM*

Stores service code 33

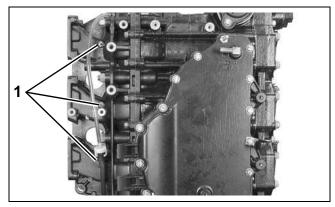
EMM LED 4: FLASHING

Engine Monitor NO OIL display: FLASHING

Cylinder and Crankcase

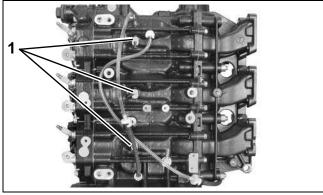
The oil d istribution mani fold provides crankcase lubrication thro ugh oil distribution n hoses and pressed-in fittings on the crankcase and cylinder block.

3-CYLINDER MODELS



1. Crankcase oil fittings

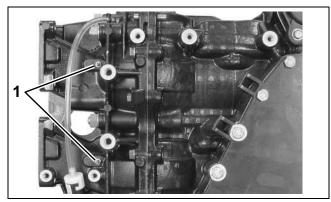
006758



1. Cylinder block oil fittings

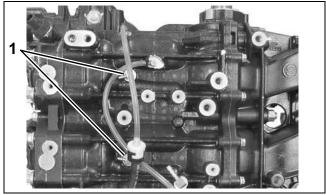
006759

2-CYLINDER MODELS



1. Crankcase oil fittings

006614



1. Cylinder block oil fittings

006615

Oil Recirculation System

External ho ses an d f ittings, internal cylinder/crankcase passages, and intake manifold passages are used to recirculate any accumulation of oil from various loca tions in the powerhead. The movement of oil is controlled by check valves.

Cylinder Recirculation

Internal p owerhead oil drain p assages connect the intake port areas of the cylin ders to circulate residual oil in the block.

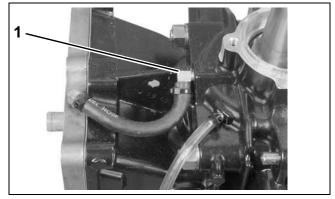
External fittings and in-line check valves on each side of the cylinder block control the movement of oil from the lower cylinder port to the upper cylinder port.

Crankcase / Main Bearing Recirculation

The movement of oil through the main bearings is controlled by int ernal p assages, e xternal fittings and hoses, and check valves.

Lower to upper main bearing oil flow:

- Lower main bearing cavity to internal crankcase passage to external fitting, external h oses with in-line check valve to external fitting at upper main bearing, and into upper main bearing through internal crankcase passage.
- Internal crankcase passage to external fitting in crankcase cover at upper main bearing, hose routed to reed plate fitting. This circuit vents the upper main bearing cavity to promote oil flow.



1. Upper main bearing vent

002399

Refer to the **OIL RECIRCULATION DIAGRAMS** on p. 158.

OIL CONTROL SETTINGS

Oil Injection Rate

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

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

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

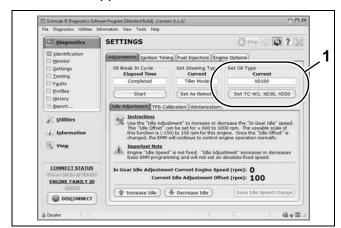
- Operation with all TC-W 3 outboard oils including XD30, XD50, or XD100.
- Applications requiring maximum lubrication.
- Extreme applications (commercial or harsh conditions, racing or other high performance operation).
- Use this se tting with XD100 out board oil in extreme applications

The *XD100* setting provide s an option to run the outboard at a reduced oil injection rate. This setting REQUIRES the use of *Evinrude XD100* outboard lub ricant and is not re commended for all applications.

IMPORTANT: The *XD100* setting is not available on all models.

Use the *XD100* setting for:

- Conventional use (runabouts, cruisers)
- Moderate applications



Oil control setting

008580

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

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



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

An *XD100* Outbo ard Oil Decal, P/N 35 2369, is available to label bo ats equipped with ou tboards that have been programmed for the reduced oil injection ratio.

NOTICE

This outboard has been programmed for the use of Evinrude [®]/Johnson[®] XD100[™] outboard oil ONLY.

Failure to use Evinrude ®/Johnson® XD100™ outboard oil may harm engine performance and shorten engine life.

355627

XD100 Outboard Oil Decal

355627

002507

Install decals in a highly visib le location, such a s one of the following:

- Dashboard/deck of boat, next to key switch
- Deck of boat, next to the remote oil fill
- Deck of boat, next to oil tank assembly
- · Oil tank cover
- Cover of oil tank compartment
- Attach to oil tank or oil fill cap.

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

Break-In Oiling

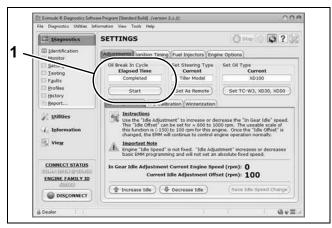
IMPORTANT: DO NOT add oil in the fuel t ank on *Evinrude E-TEC* models.

The *EMM* automatically sup plies extra oil to the engine as follows:

40 – 90 HP: First two hours above 2000 RPM

Follow these steps for outboard set-up:

- Use Evinrude Diagnostics sof tware to m ake sure the break-in program has been started on a new outboard.
- Use the diag nostics software to st art break-in oiling after a powerhead rebuild.



1. Break-in oil setting

008580

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

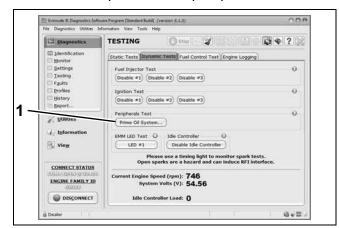
Oil Supply Priming

A 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.

Start the outboard. Use the oil priming function in the software to m ake sure t he sy stem is completely primed.

Use the *Prime Oil System* button of the *Dynamic Test* screen to prime the oil pump.



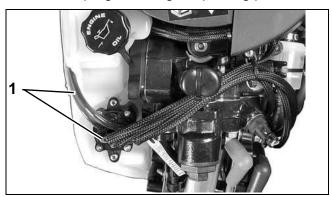
Dynamic Test Screen
1. Prime Oil System button

008570A

OILING SYSTEM

OILING SYSTEM TESTS

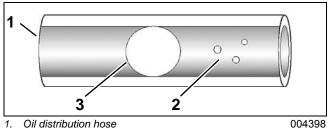
Observe oil flow through all oil distribution hoses. Air must be purged during the priming procedure.



Oil distribution hoses

007997

Small bubbles are acceptable. La rge b ubbles must be eliminated through continued priming.



- Oil distribution hose
- Small bubbles

Large bubbles

Repair any fuel or oil leaks.

The oiling system on these models can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to STOR-**AGE** on p. 45.

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 Voltage Tests

IMPORTANT: Do NOT perform static tests using Diagnostic Power Supply T ool, P/N 587005, with internal 9 volt batteries only. This will p roduce false results. Refer to **Communication** on p. 63.

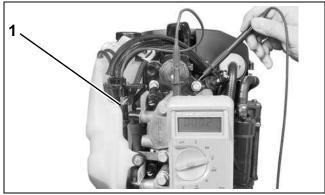
The *EMM* controls the pump by providing ground through pin 23 (blue wire) of the J1-B connector and pin B (blue wire) of the oil pump connector.

Acceptable Oil Injection Pump		
Test Readings		
Key switch ON	approximately 12 VDC	
Control signal	approximately 5 Hz	
Engine running	approximately 55 VDC	

Use a digital multimeter calibrated to a scale that reads 12 V (DC) to mea sure voltage between the oil pump electrical connector and engine ground.

Connect negative meter lead to ground.

Use an appropriate test probe to connect positive meter le ad to pin B (b lue wire) of oil injection pump electrical connector.



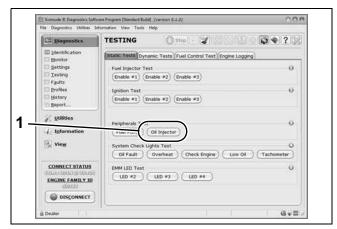
1. Oil injection pump electrical connector

008065

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

Voltage at pin B should be approximately 12 V.

Use the *Oil Injector* te st of *Evinrude Diagnostic* software *Static Test* screen to activate the oil pump.



Static Tests Screen
1. Oil injector test button

008082A

IMPORTANT: This test is op erating the pump with 12 V b attery power on the system volt age (55 V) circuit. The oil injection pump will not pump oil when operating on 12 V.

Observe voltage at pin B.

 Voltage at pin B should drop as the oil pump cycles.

Check the control signal while the *Oil Injector* test is running. Set the digit al multimeter to the Hertz (Hz) scale.

Meter should read approximately 5 Hz.

Results:

- If voltage and control signal readings at pin B are within range, the EMM and wiring are not at fault.
- If voltage at pin B is not within range, check voltage at pin A (white/red wire) of oil pump electrical connector.

Connect positive meter lead to pin A (white /red wire) of oil injection pu mp electrical connector. Observe voltage at pin A.

Voltage at pin A should be approximately 12 V.

Set digital multimeter to a scale that re ads 55 V (DC).

Start the engine. Observe voltage at pin A.

- Voltage at pin A should be approximately 55 V.
- If voltage at p in A is within range, refer to Oil Injection Pump Resistance Test on p. 167.
- No volt age re ading at pin A, refer to System Voltage Test on p. 80.

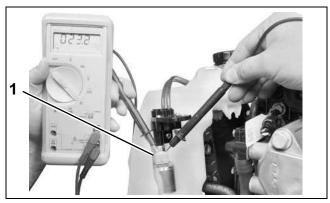
Oil Injection Pump Resistance Test

Disconnect the battery cables at the battery.

Disconnect the electrical connector from the oil injection pump.

Use a digital multimeter to measure the resistance between the pins of the oil injection pump connector. Calibrate the meter to the LOW OHMS scale.

Oil Injection Pump Circuit Resistance 22Ω



1. Oil injection pump connector

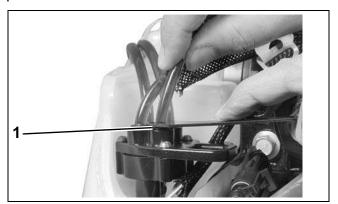
008420

Results:

 An infinite reading (∞) indicates an open circuit of the injection pump winding. Replace faulty pump.

Oil Injection Pump Function Test

Remove oil distribution hose from fitting at oil distribution manifold. Do not lose the brass hose support.



1. Retainer mechanism

008067

Temporarily install a length of oil hose.



008068

Start the outboard and observe oil flow:

- Oil flows from hose, compare to oil flow at other distribution fittings
- If one or more fittings fail to flow oil, replace the oil injection pump assembly.

Reinstall hose into manifold.

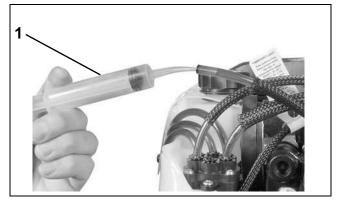
IMPORTANT: Make sure ho se su pport is in hose a nd ho se is f ully in serted int o ma nifold. Refer to **Oil Distribution Hoses** on p. 169.

Oil Injection Fittings Flow Test

Make sure the oil injection fittings of the cylinder and crankcase assembly allow fluid to move.

Remove oil distribution nose from o il distribution manifold.

Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.



Svrinae

008069

LOW OIL Sending Unit Test

Remove oil from the oil tank.

Turn the ke y switch ON. The dash mount ed Engine Monitor system should show a LOW OIL warning.

Once the warning has been confirmed, refill the oil tank and start the outboard. The LOW OIL warning should stop after the oil pump cycles 3 times.

OIL COMPONENT SERVICING

WARNING

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

Oil Distribution Hoses

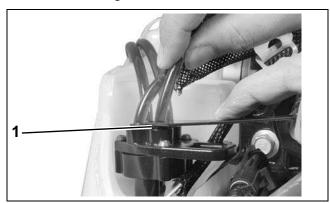
The oil distribution hoses to each cylinder MUST be the same length. DO NOT alter the length of any hoses.

Oil Distribution Hose Length:

• 20 in. (508 mm)

Removal

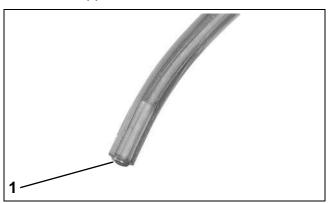
Release the hose by depressing the outer ring of the hose retaining mechanism.



1. Retainer mechanism

008067

Once hose is removed from the manifold, make sure hose support is in the end of the hose.



1. Hose support 008070

Installation

Cut Repla cement Oil Hose , P/N 778708, to the correct length. Insert hose support in manifold end of hose.

IMPORTANT: DO NOT insert distribution hoses into manifold without a hose support.

Be sure the hose is full y in serted into man ifold. Insertion depth is 5/8 in. (16 mm). Visually inspect for hose supports.

Oil Tank Assembly

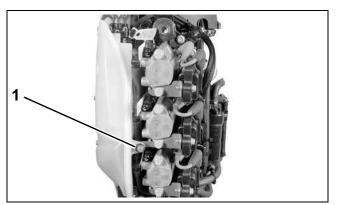
Removal

Disconnect the battery cables at the battery.

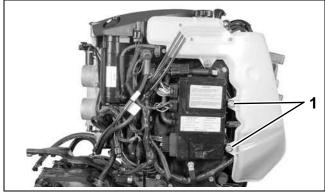
Remove engine covers and air silencer.

Remove oil tank retaining screws.

3-CYLINDER MODELS



1. Screw 008071

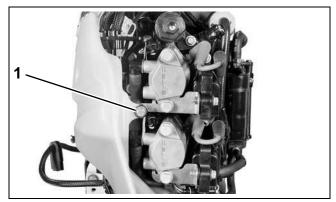


1. Screws 008072

OILING SYSTEM

OIL COMPONENT SERVICING

2-CYLINDER MODELS



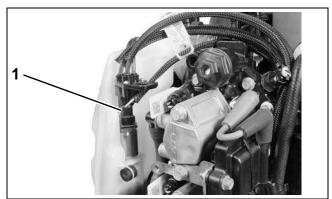
1. Screw 008073



1. Screws 008074

ALL MODELS

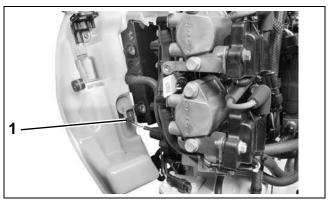
Disconnect the electrical connector to the oil injection pump and manifold assembly.



1. Oil pump connector

008075

Disconnect the electrical connector to the low oil switch.



1. Low oil switch connector

008076

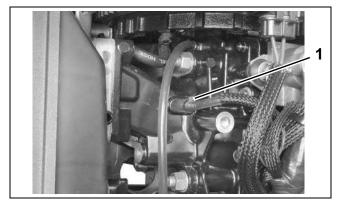
IMPORTANT: Note oil distribut ion ho se ro utings before proceeding with disassembly.

Remove oil distribution hoses from the manifold.

Installation

Position oil t ank assembly on powerhead. Cle an mounting screws and ap ply $Nut\ Lock$ to threads. Install screws and tighten to a torque of 30 to 42 in. lbs. (3.5 to 5 N·m).

Install protective sleeves and route oil distribution hoses from the oil distribution ma nifold to the crankcase oil delivery fittings. Refer to **OIL SUP-PLY DIAGRAMS** on p. 156. Secure oil ho ses to crankcase fittings with tie straps.



1. Tie strap

006573

Run outboard and check for leaks. Use *Evinrude Diagnostics* sof tware to activate "Oil Prime." Check oil flow through oil distrib ution hoses. Check oil system operation and routing of oil system hoses.

Repair an y oil leaks and kinked or misroute d hoses. Install air silencer and engine covers.

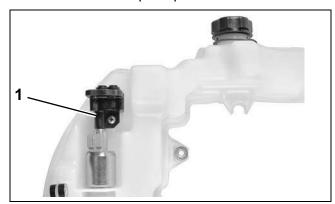
Oil Injection Pump

Removal

Remove oil distribution h oses from oil manifold. Refer to Oil Distribution Hoses on p. 169.

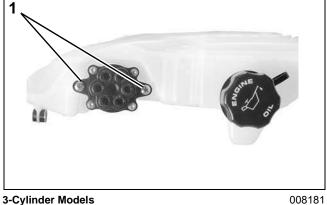
Remove oil from oil tank.

Remove oil tank. Refer to Oil Tank Assembly on p. 169. Remove retaining screw(s) from oil pump assembly. Twist and pull up on oil pump to remove from tank. DO NOT pull up on oil manifold.



2-Cylinder Models
1. Screw

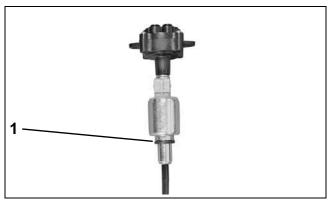
008180



3-Cylinder Models
1. Screws

Installation

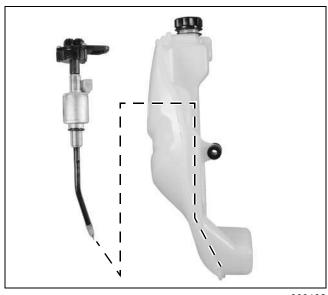
Apply a dro p of out board lubricant to a new oil pump o-ring. Install o-ring on oil pump flange.



1. O-ring 008064

2-CYLINDER MODELS

Install oil pump and manifold so that be nd of oil pick up assembly is positioned to follow the contour of the oil tank as shown.



008182

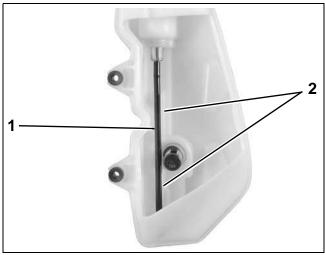
OILING SYSTEM

OIL COMPONENT SERVICING

3-CYLINDER MODELS

Install oil pump and manifold straight into oil tank.

IMPORTANT: Be sure oil pick u p assembly is positioned in front of oil t ank baffle to prevent interference with the LOW OIL switch.



- Oil pick up assembly
 Oil tank baffle

008183

ALL MODELS

Install oil pump ret ainer screw(s). T ighten securely.

IMPORTANT: Turn self-tapping screws cou nter clock-wise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the oil tank.

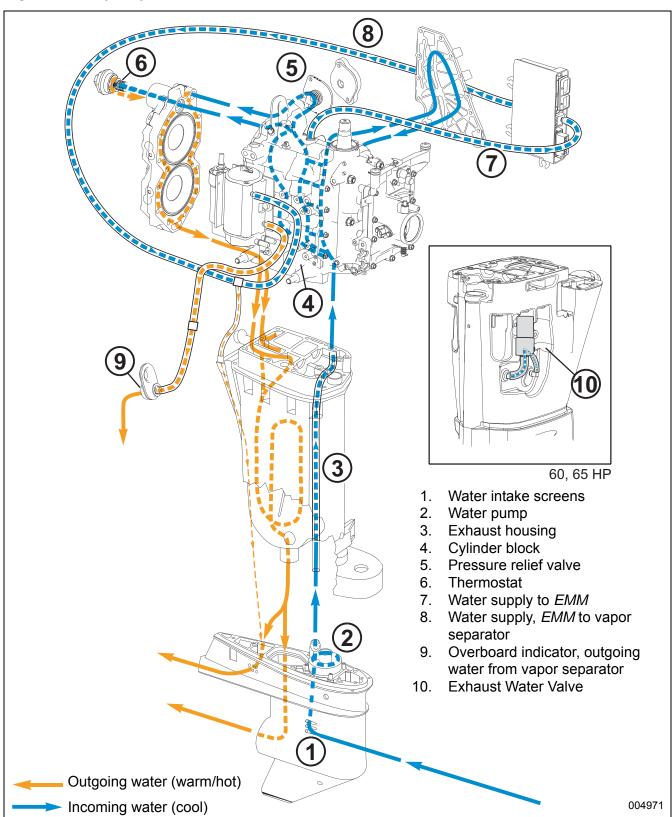
COOLING SYSTEM

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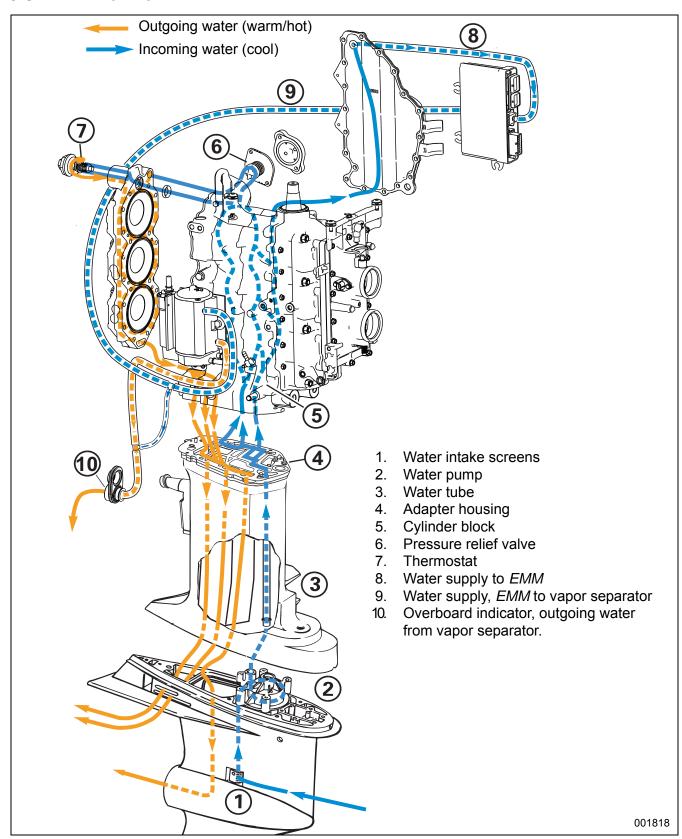
HOSE ROUTING AND WATER FLOW DIAGRAMS	174
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HOSE ROUTING AND WATER FLOW DIAGRAMS

2-CYLINDER MODELS



3-CYLINDER MODELS



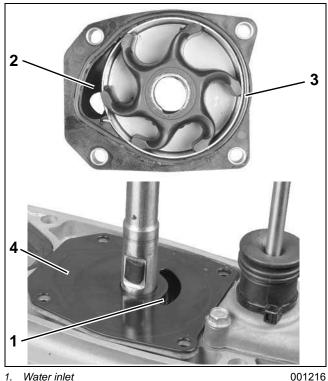
COMPONENTS

Water Pump and Intakes

External water int akes mounted in the gearcase housing collect water and must supply the inlet side of the water pump with an unrestricted and unaerated water supply. Water is drawn into the water pump through a hole in the lower plate of the water pump assembly. All cooling water to the powerhead is provided by the water pump.

- A nylon wedge (impeller key) is used to engage the impeller bushing and driveshaft.
- The nylon impeller housing with liner must seal against a separate water pump plate.
- The bottom plate MUST seal to gearcase.
- The pump operates as a positive displacement pump at LOW speeds (below 1500 RPM) and as a centrifugal pump at HIGHER speeds.

Refer to WATER PUMP SERVICE on p. 298, or WATER PUMP SERVICE on p. 320 for servicing.



- Water inlet
- Water outlet
- Seal
- Plate

IMPORTANT: The water pump hou sing on 2cylinder models includes a small hole to the rear of the wa ter outlet. This hole provides cooling water for the tip of the exhaust passage. Be sure to use the correct parts when replacing the water gump.



1. Hole 004970

Exhaust Housing

2-CYLINDER MODELS

The water p ump outlet connect s wit h p assages located in the outboard's midsection. A grommet seals the water pump housing to the exhaust housing.

Water supplied to the exhaust housing provides all cooling water to the cylinder block.

Water Supply Tube

3-CYLINDER MODELS

001217

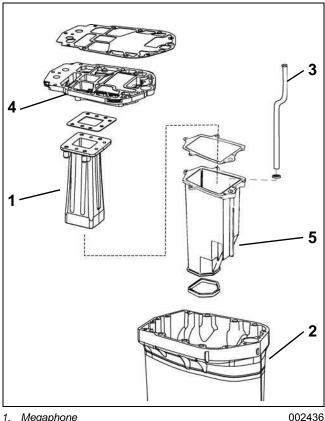
The water pump outlet connects with the water supply tube located in the outboard's midsection. Grommets seal the water tube to the water pump housing and the adaptor housing. The water tube fastens to the base of the adapter housing with a retainer plate and screws.

Water supplied to the water tube provides all cooling water to the adaptter housing and cylind er block.

Adapter/Inner Exhaust Housing

3-CYLINDER MODELS

- Adapts the cylin der/crankcase assembly (powerhead) to the exh aust housing and the water tube.
- Provides water passages which route incoming and outgoing cooling water.
- Provides exhaust p assages which connect to the gearcase.



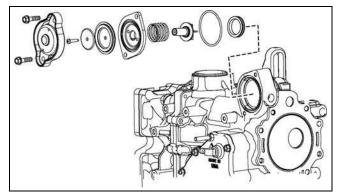
- Megaphone
- 2. Exhaust housing
- Water tube
- Adapter housing
- Inner exhaust housing

Pressure Relief Valve

A pressure relief valve is used to control wa flow and operating temperature at higher speeds (above approximately 1800 RPM). The pressure relief valve ope ns a s water pressure incre ases. Spring tension sets the opening pressure.

Overheating: A restricted or faulty valve typically results in HIGH SPEED overheating.

Overcooling: Debris may prevent the valve from closing completely.



Pressure relief valve components

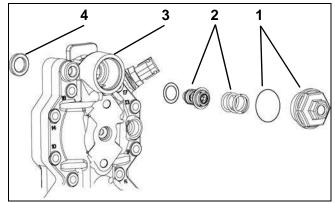
002437

Thermostat

The thermostat controls water flow and operating temperature at lower speeds (below 1800 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.



- Cover and O-ring
- Spring and thermostat
- Cylinder head
- Cylinder head seal

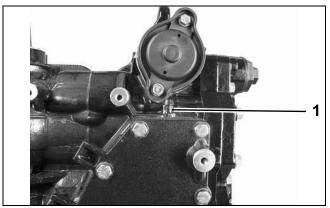
002439

COOLING SYSTEM

COMPONENTS

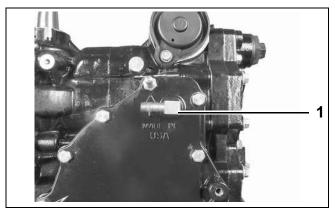
Block Venting

A fit ting an d hose connected to the top of the exhaust cover allows the constant movement of water and/or air from the block. Circulated water flows t hrough the *EMM* and vapo r separator before exiting through the overboard indicator.



2-Cylinder models
1. Fitting

002478

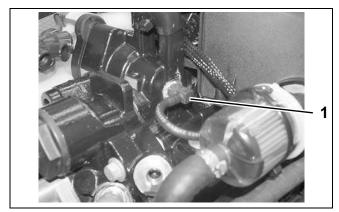


3-Cylinder models
1. Fitting

002440

Water Pressure Connection

A fitting and hose for an accessory water pressure gauge can be connected at the top of the cylinder block next to the pressure valve housing.



. Fitting 002461

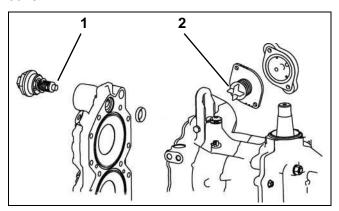
OPERATION

All models use a two-stage cooling system design. The cooling system is dependent on water pump pressure and controlled by thermost at and pressure valve operation.

NOTICE Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

Cylinder Block / Cylinder Head Cooling

The flow of water throu gh the cylinder block and cylinder head is controlled by a the rmostat and a pressure relief valve. The pressure valve is located in the top of the block next to the exhaust cover.



- 1. Thermostat
- 2. Pressure valve assembly

002441

The thermost at and pr essure valve co ntrol the flow of water entering the vertical water passages of the cylinder head.

At low speed, the pressure valve is aga inst the seat and the thermost at is closed. Warm water from the cylinder block gradua lly migrates to the thermostat pocket at the top of the cylinder head.

The thermostat opens when the water temp erature reaches approximately 143°F (62°C).

When t he t hermostat opens, wat er flows down through the cylinder head to a passage in the cylinder block. Water flows through the block to the exhaust housing and then out of the outboard.

At higher speeds, wate r pressure op ens th e pressure relief valve at approximately 1800 RPM. Water flows through the valve to the cylinder head and byp asses the theoremstat. All was ter flows through the cylinder head to the outlet passage of the block and the nexits through the exhaust housing.

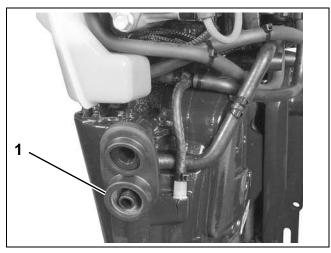
EMM and Vapor Separator Cooling

Cooling water is routed from the top of the cylinder block to the inlet fitting of the *EMM* water cavity. Cooling of the *EMM* helps to stabilize the temperatures of internal components.

IMPORTANT: Improper *EMM* cooling will activate service cod es 25 and 29 and the Engin e Monitor warning system. Refer to the *EMM* Service Code Chart at the back of this manual for specific service code information.

Cooling water from the *EMM* is routed to the water inlet fit ting of the vapor separator water cavity. Cooling the vapor separator fuel chamb er minimizes fuel vaporization.

Cooling water from the vapor sep arator is routed to the overboard indicator.



1. Overboard indicator

004969

ENGINE TEMPERATURE CHECK

IMPORTANT: The engine tempe ratures listed below are based on an intake water temperature of 70° ± 10°F (21° ± 3°C).

Install correct test propeller and place outboard in a test tank or in the water. Start outboard and run at 3000 RPM in FOR WARD gear for at least five minutes. Remember, running o utboards at high speeds in test t anks may disrupt wat er flow to gearcase water int akes. Make sure the outbo ard has adequate water flow.

A CAUTION

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

Reduce speed to IDLE for five minutes. Check IDLE operating temperature.

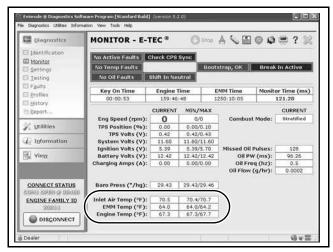
Increase speed to 5000 RPM and check temperature.

If engine temperatures are not within range, troubleshoot cooling system.

If engine temperature tests within rang e, but the engine mon itor d isplay ind icates a "W ATER TEMP" warning, refer to **WATER TEMP/ HOT Circuit Test** on p. 108.

Software Method

Use *Evinrude Diagnostics* software to read temperature displays.



Monitor Screen

008598

Typical temperatur e sensor readin gs at IDLE speed should be $155^{\circ}F \pm 5^{\circ}F$ (68.3°C ± 3°C).

Typical temperature sensor readings at WOT speed should be 160°F ± 40°F (71°C ± 22°C).

Operating temp erature must not excee d 212°F (100°C).

Pyrometer Method

Use a Temperature Gun, P/N 772018, or a digital pyrometer to measure the ou thooard's operating temperatures.

Measure temperature of the thermostat housing at the top of cylinder head.

Typical pyrometer readings at IDLE speed should be $145^{\circ}F \pm 10^{\circ}F$ ($63^{\circ}C \pm 6^{\circ}C$).

Typical pyrometer readings at WOT speed should be 150°F ± 40°F (66°C ± 22°C).

9

IMPORTANT: If you get low or in accurate readings with a digital pyrometer, coat the probe location with *Thermal Joint Compound*, P/N 322170.



Thermostat housing

008345

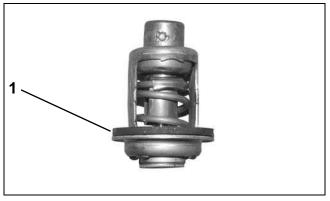
IMPORTANT: Digital pyrometer or tempera ture gun measu rements may be slightly lower th an software temperature readings.

Idle Operating Temperature Troubleshooting (Below Range)

If en gine IDL E te mperature is below operating range, 155°F ± 5°F (68.3°C ± 3°C), check thermostat and pressure relief valve operation.

Thermostat Inspection

Check position of thermostat seal and ho w thermostat seals against cylinder head. Seal must be properly fitted to flange of thermostat.



1. Thermostat seal

006401

Check thermost at for cracks, hea t damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

Refer to **THERMOSTAT SERVICING** on p. 182.

Pressure Relief Valve Inspection

The pressure re lief valve should be closed at IDLE speed. Water should not flow past the plunger and seal.

Start the outboard and check IDLE operating temperature.

If IDLE temperature is too low , ch eck pressure relief valve plunger and seal for damage or debris that could prevent t he valve from closing completely.

If IDLE temperature is still below operating range, replace pressure relief valve a ssembly and plunger seal.

To test p ressure relief valve opera tion, monitor temperature at the thermostat housing with Temperature Gun, P/N 772018, or digital pyrometer.

Confirm normal IDLE operating temperature.

Slowly increase engine sp eed from IDLE, up through 2500 RPM.

Engine temperature should decrease from normal IDLE temperatures as pressure relief valve opens. Valve should open between 1800-2200 RPM.

If temperature decreases at a lower RPM, replace pressure relief valve assembly.

Refer to **PRESSURE RELIEF VALVE SERVIC-ING** on p. 183.

TEMPERATURE SENDER SERVICING

Removal

Loosen sensor and remove by hand. Use care to avoid breaking threads.



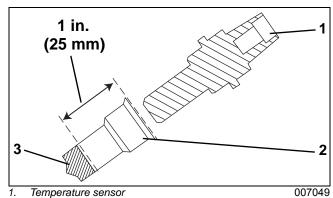
008346

Clean sensor threads, sensor, and sensor cavity.

Installation

Fill bottom of sensor cavity with 0.7 cc of *Thermal Joint Compound*, P/N 322170. Sensor cavity should be filled to 1 in ch (25 mm) below the top edge of the cavity.

Install sensor. DO NOT use gasket sealing compound. SLOWLY tighten temperature sensor to a torque of 50 to 70 in. lbs. (5.6 to 8.0 N·m).



2. Sensor cavity

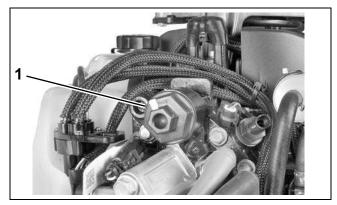
3. Thermal joint compound

Wait 10 minutes for trapped air to bleed from cavity. Th ermal compo und may seep past threads. Retighten sensor.

THERMOSTAT SERVICING

Disassembly

Remove the thermostat cover and O-ring from cylinder head.



008347

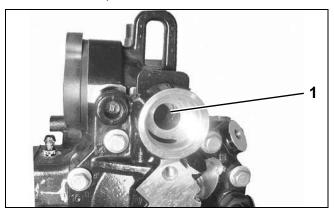
Remove spring, thermostat, and gasket.



002444

Remove the cylinder head if cylinder head thermostat seal requires replacement. Place new seal in the cylinder head with side marked "TO CYL

HEAD" facing thermostat. Refer to **Cylinder Head Installation** on p. 207.

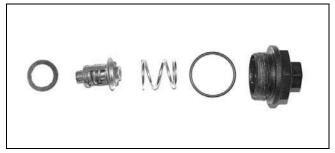


1. Cylinder head seal

002445

Inspection

Inspect all parts for cracks, heat damage, or signs of co rrosion. Re place dama ged p arts. Clean debris from housing and parts.



000756

Assembly

Assembly is the rever se of disassemb ly. Pa y close attent ion when pe rforming the following additional tasks.

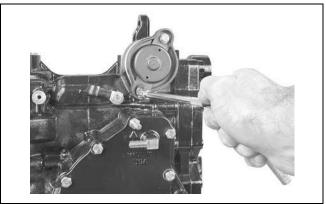
Coat t hreads of thermost at cover with *Gasket Sealing Compound* and install new O-ring. Install and tighten cover to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).

PRESSURE RELIEF VALVE SERVICING

The pressure relief valve assembly should be serviced at the same time as the thermostat.

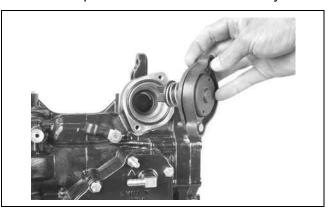
Disassembly

Remove screws and cove r from pressure valve assembly.



002443

Remove the pressure relief valve assembly.



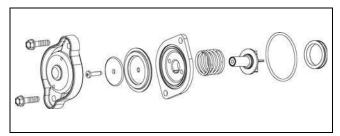
002459

COOLING SYSTEM

PRESSURE RELIEF VALVE SERVICING

Inspection

Inspect all parts for cracks, heat damage, or signs of corrosion. Re place dama ged p arts. Clean debris from housing and parts.



Pressure Relief Valve Assembly Components

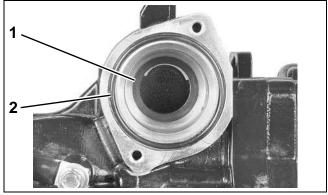
002442

Assembly

Assembly is the rever se of disassemb ly. Pa y close attent ion when pe rforming the following additional tasks.

Install a **new** plunger seal squarely over ridge in housing.

Apply a light coat of *Triple-Guard* grease to a **new** cover o-ring and place in groove in housing.



Plunger seal
 Cover o-ring

002458

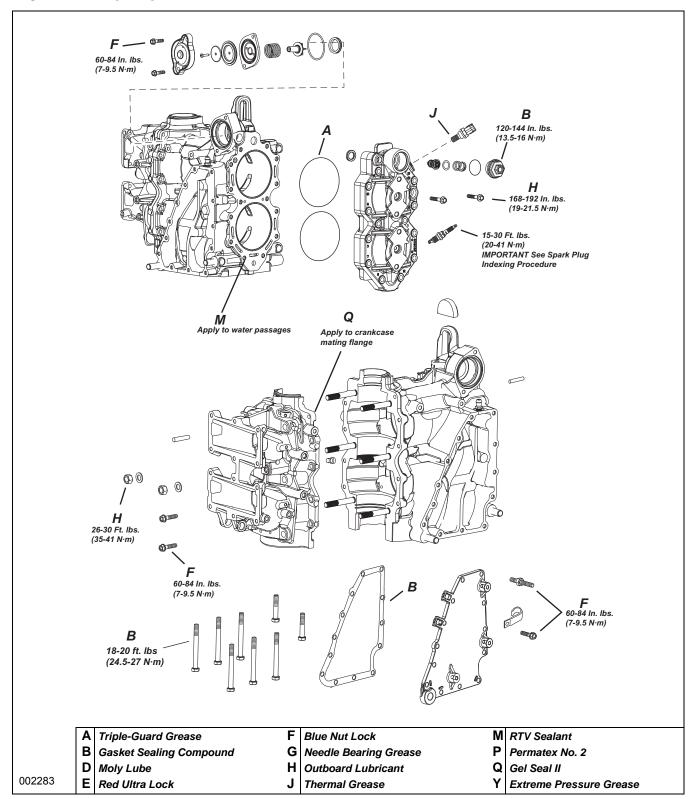
Install valve assembly into housing.

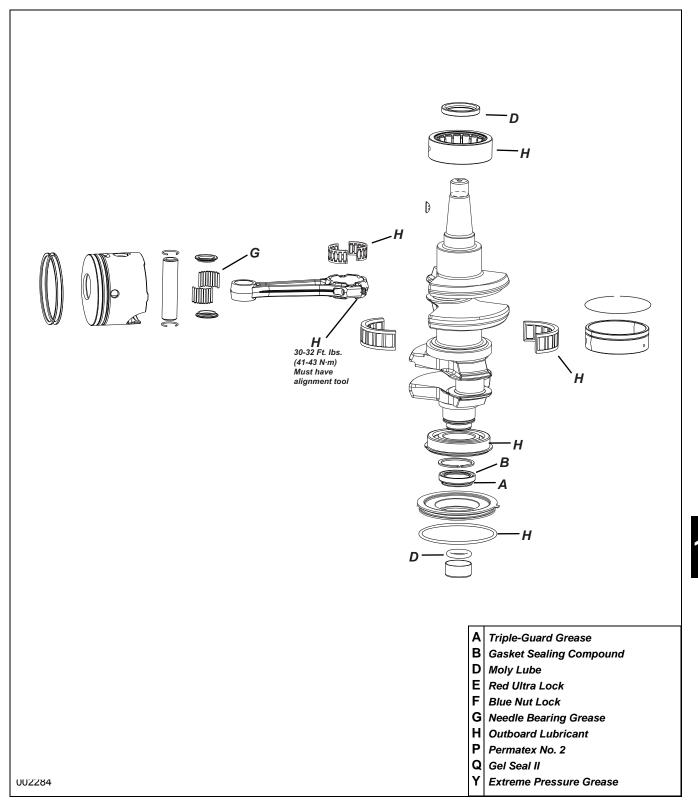
Tighten cover screws to a torque of 60 to 84 in. lbs. (7 to $9.5 \text{ N} \cdot \text{m}$).

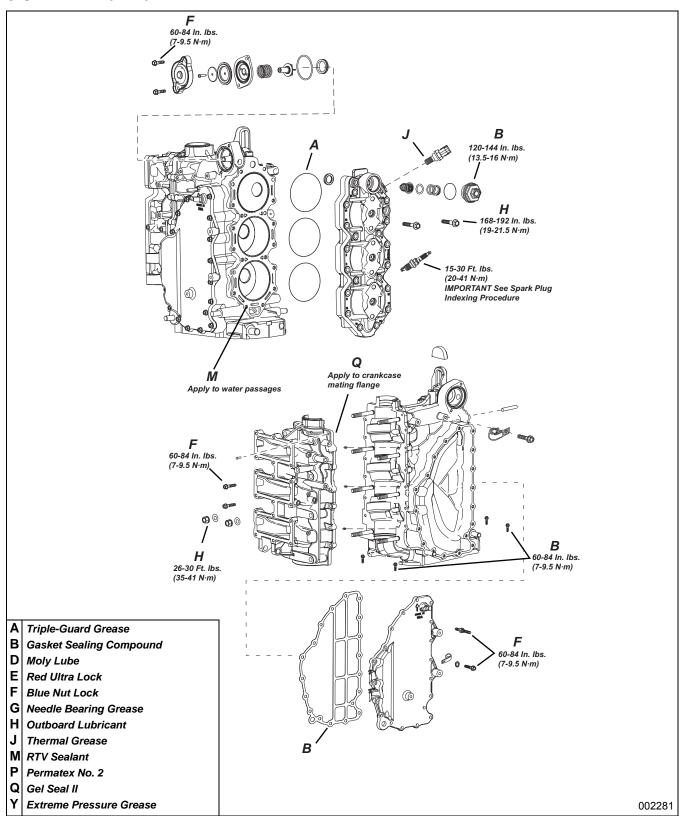
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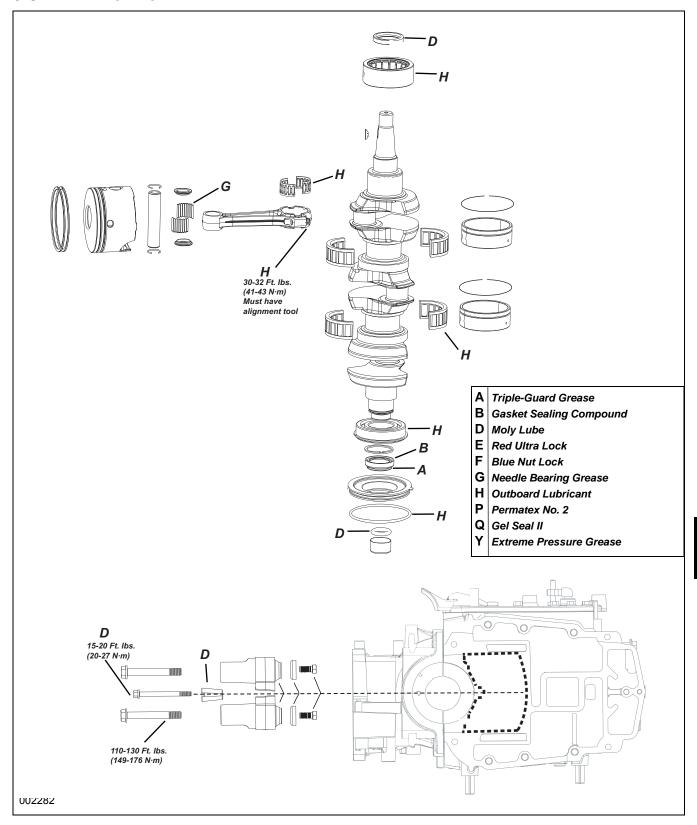
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SERVICE CHART









COMPRESSION TESTING

Start and run outboard until it achieves o perating 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 eng ine shows a variatio n greater than 15 p si (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 sp ark plugs. Refer to S park Plug **Indexing** on p. 42.

POWERHEAD REMOVAL

2-Cylinder Models

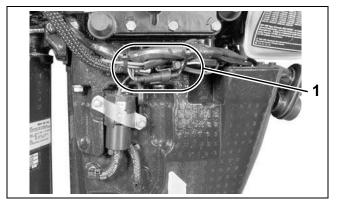
A WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure on p. 142.

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

Remove lower motor covers. Refer to **Lower Cover Removal** on p. 50.

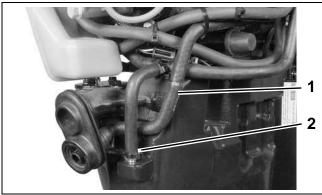
Disconnect power trim connectors and exhaust water valve electrical connector (60, 65).



Connectors

008429

Disconnect cooling water ho ses from exhaust housing.

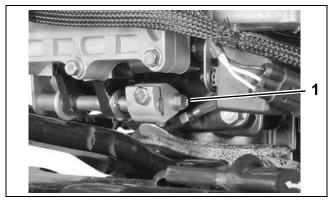


1. Overboard indicator hose

Drain hose

004298

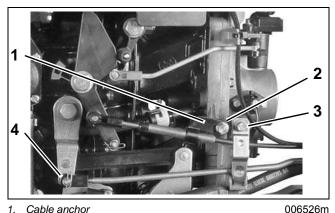
Remove pin and wa sher from shift rod lever to release the lower shift rod.



002171 Shift rod screw

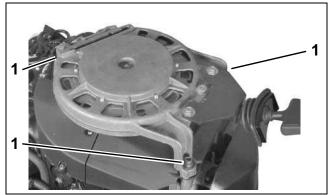
ROPE START MODELS

Remove throttle cable and tiller shift rod.



- 1. Cable anchor
- Anchor screw
- Cable retainer
- Shift rod retainer

Remove thee recoil starter housing and starter ratchet. Refer to RECOIL STARTER REMOVAL on p. 363.



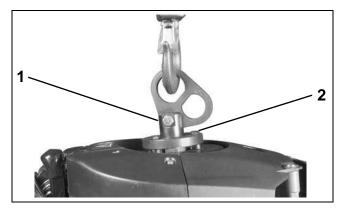
1. Starter housing screws (3)

002515

ALL MODELS

Install Lifting Fixture, P/N 396748, on flywheel and seat the three screws completely.

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



Lifting fixture

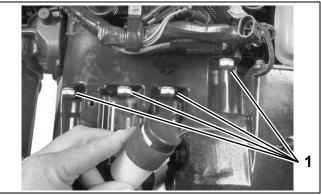
1 1/8 in. screws

002098

Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.

Loosen the screws holding the exhaust wa valve to the exhaust housing.

Move water valve aside and remove the eig ht exhaust housing to powerhead screws.



Powerhead screws

004292

Use a suitable tool to carefully separate the powerhead from exhaust housing.

IMPORTANT: Do not damage the powerhead or exhaust housing mating surfaces.

POWERHEAD REMOVAL

3-Cylinder Models

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. 142.

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

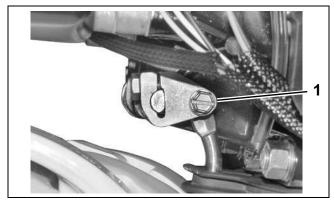
Remove lower motor covers. Refer to **Lower Cover Removal** on p. 50.

Disconnect power trim connectors.



002152

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



1. Shift rod pin

002013

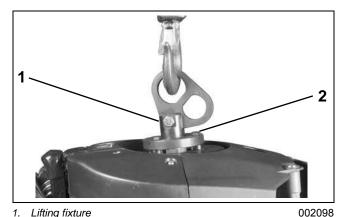
Remove six retaining screws and exha ust relief muffler.



002159

Install Lifting Fixture, P/N 396748, on flywheel and seat the three screws completely.

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



Lifting fixture
 1 1/8 in. screws

00209

Fasten appropriate chain hook to eye of tool and support weight of powerhead with hoist.

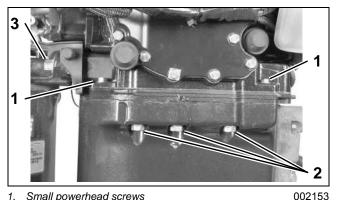
Remove the small powerhead screw at rear.



Rear small powerhead screw

002160

Remove remaining four small powerhead screws, six large powerhead screws, and the upper mount screws.



- Small powerhead screws
- Large powerhead screws
- Upper mount screws

Use a suitable tool to carefully separate the powerhead from exhaust housing.



002161

IMPORTANT: Do not damage the powerhead or exhaust housing mating surfaces.

POWERHEAD DISASSEMBLY

Systems Removal

To simplify reassembly and wirin g installation, lay out the various screws and clamps in the order of their proper location.

Remove the electric st arter. Refer to Starter Removal on p. 115.

Remove the oil tank. Refer to Oil Tank Assembly on p. 169.

Remove f uel pump assemb lies, fu el manifolds, and filter. Refer to FUEL COMPONENT SERVIC-**ING** on p. 142.

Remove *EMM*, then electrical harness assembly. Label connectors for reassembly locations. Refer to EMM SERVICING on p. 70.

Remove flywheel and stator. Refer to **FLYWHEEL** AND STATOR SERVICING on p. 110.

Remove ignition coils and fuel injectors. Refer to IGNITION COIL SERVICING on p. 112 and Fuel Injector Service on p. 146.

IMPORTANT: Mark injectors for cylinder location before removal. All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Remove all oil distribution and recirculation hoses.

Remove throttle linkage. Refer to Throttle Linkage Removal on p. 194.

Remove sh ift linkage. Refer to Shift Linkage Removal on p. 194.

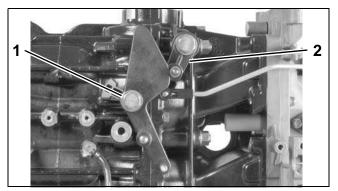
Remove the throttle body and reed plate assemblies. Refer to Intake Manifold Service on p. 149.

Remove pres sure vallve assembly. Refer to PRESSURE RELIEF VALVE SERVICING on p. 183.

POWERHEAD DISASSEMBLY

Throttle Linkage Removal

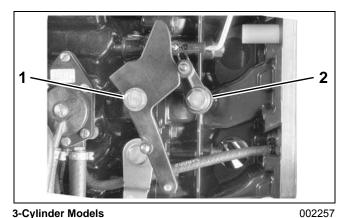
Remove throttle cam and throttle lever.



2-Cylinder Models

- Throttle lever screw
- 2. Throttle return lever

002245



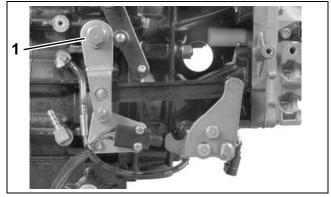
3-Cylinder Models

- Throttle cam screw
 Throttle lever screw

Shift Linkage Removal

Remove shoulder screw from shift arm and retaining screw from shift rod lever.

Remove the cotter pin and washer holding the shift shaft (2-cylinder models).



Shift lever screw

002250

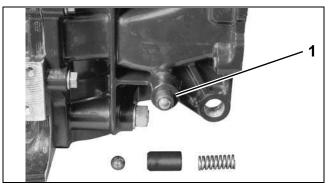


- Shift rod lever screw
- Cotter pin

002246

Slide ent ire shift linkag e assembly from case.

Remove the ball, g uide, and spring of the shift detent assembly from the crankcase.

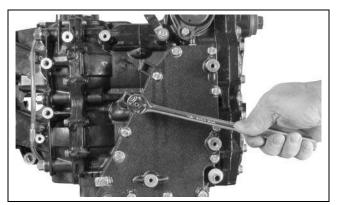


Shift detent assembly

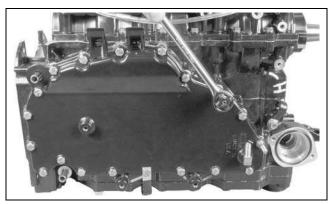
002135

Crankcase Disassembly

Remove screws and carefully pry off exhaust side water cover.



002234

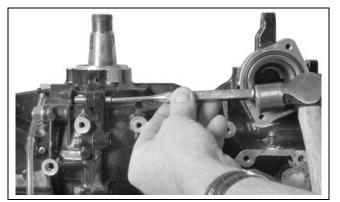


002124

A WARNING

Wear safety glasses to avoid injury.

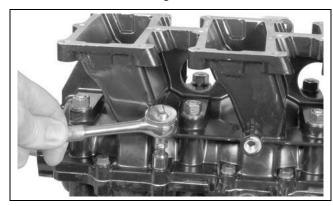
Use a 1/8 in. diameter pin punch to push crankcase taper pin toward the front side of the engine.



002232

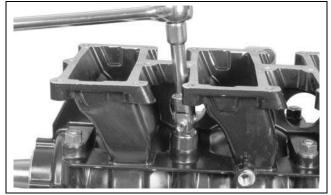
IMPORTANT: Do not use a tapered pun ch or any other tool that could jam in or damage the taper bore when removing the pin.

Remove crankcase flange screws.



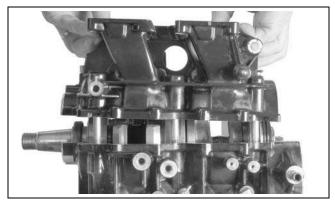
002137

Loosen in stages and remove the main bearin g nuts and washers.



002138

Separate crankcase and cylinder block. It may be 10 necessary to tap on crankshaft with a rawhide or rubber mallet to loosen.



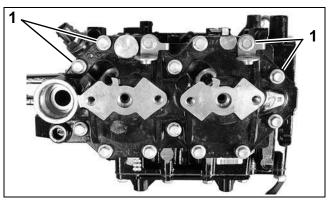
002252

POWERHEAD DISASSEMBLY

Cylinder Head Removal

Remove thermostat cover and thermostat assembly. Re fer to **THERMOSTAT SERVICING** on p. 182.

Loosen **in stages** and remove cylinde r he ad screws. Remove the cylinder head. Discard thermostat seal and O-rings.

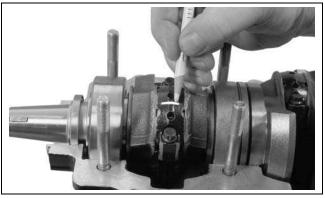


1. Cylinder head screws

007850

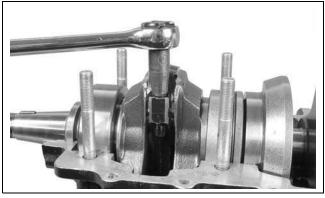
Connecting Rods and Pistons

Use a permanent marker to identify each connecting rod cap, connecting rod, and piston by cylinder number. Number 1 is closest to the top.



002140

Use Torquing Socket, P/N 331638, to loo sen in stages the ro d cap ret aining screws. DO NOT remove the screws.



002123

Use one hand to support the piston, and remove the rod cap screws with your other hand. Remove each piston and rod assembly.



002141

NOTICE Reattach each rod cap to its rod as soon as the piston is removed. Each cap is unique and can only be installed on its mated rod. Do not allow rod to contact inside surface of cylinder or crankshaft.

IMPORTANT: Identify all internal compone nts so that if reu sed, they can be reinstalled in the ir original positions.

Repeat steps for each remaining piston and connecting rod.

Use an appropriate ring exp ander to remove all piston rings from pistons. Discard the rings.

WARNING

Wear safety glasses to avoid injury.



002054

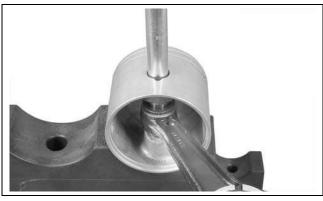
Remove wrist pin retaining rings. Discard retaining rings.



002046

The wrist pin fit is loose on both sides. Push the wrist pin through to free the p iston from the con-

necting rod. If nece ssary, use Wrist Pin Pressin g Tool, P/N 326356, to remove the wrist pin bearing.

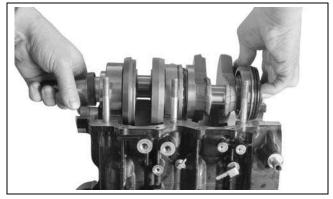


002047

Be careful not to lose any of the 28 needle bearings or the two wrist pin washers. Do not mix bearings with those from another cylinder. If any of the bearings are worn or lost, replace all 28 bearings during reassembly.

Crankshaft Removal

Carefully lift crankshaft straight u p and re move from crankcase.

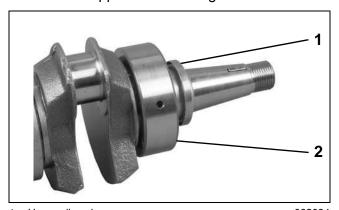


002263

Remove upper sea I from crankshaft. Discard the seal. A new up per se al must be inst alled on assembly.

POWERHEAD DISASSEMBLY

Remove the upper main bearing.



Upper oil seal
 Upper main bearing

002034

Remove the lower bearing seal housing.



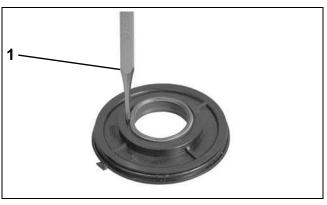
002042

Remove the housing O-ring. Discard O-ring.



002044

Use a punch to remove the housing seal. Discard seal.



1. Punch 002053

Inspect housing and replace if necessary.

Remove the O-ring from cr ankshaft sleeve a nd inspect it. Repla ce the O-ring if it is not in go od condition.



002040

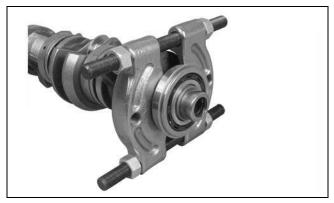
10

Inspect the crankshaft sleeve and replace if ne cessary. To remove the sleeve, use Slide Hammer, P/N 432128, and Large Puller Jaws, P/N 432129.



002041

Use a be aring separator to support the bearing, and press off the crankshaft.



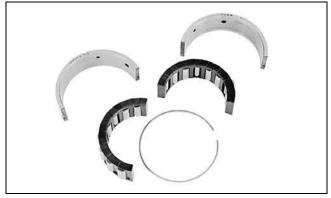
002052

Remove the lower main bearing only if it needs to be replaced. Use external retaining ring pliers to remove the lower bearing retaining ring.



002039

Remove center main be arings and split sleeves for inspection. DO not mix p arts. Note location of bearings for reassembly.



24381

IMPORTANT: If the lower main bearing is removed fro m the cranksha ft, it must be discarded. DO NOT reuse it.

CYLINDER BLOCK CLEANING

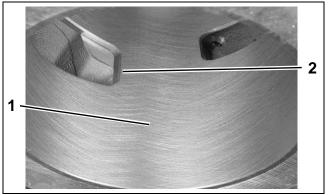
IMPORTANT: Before inspecting or assembling powerhead, all internal components must be completely clean and free of contaminants. Be careful to avoid damaging any machined surfaces.

Remove any carbon accumulation from exhaust port areas.

Remove any carbon accumulation from cylin der head combustion chambers.

If cylinder walls are glazed from extende d 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 p attern of 22 to 32° should be visible in the cylinder wall. The pattern should be uniform in both directions.

IMPORTANT: To avoid piston or cylind er block damage, restore the chamfer to all port edge s using a ball hone or other suitable tool.



1. Crosshatch pattern in cylinder wall

Chamfered port edge

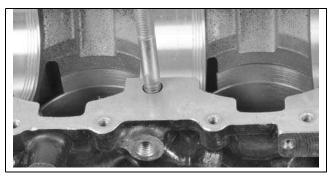
002067

Use *Gel Seal and Gasket Remover* to remove all traces of g askets, adhesives, and *Gel-Seal II™*

sealant from the cylinder block, crankcase, cylinder head, and water cover.

A WARNING

To avoid personal injury, wear eye protection and rubber gloves when using *Gel Seal and Gasket Remover*.



002068

Carefully remove any carbon ac cumulation from the tops and ring groo ves of the piston using *Engine Tuner*. A ring groove cleaning tool can be made by brea king an old ring and grinding an angle on it send. 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 cylind er block and crankcase. Blow all holes and passageways with compressed air.

A 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 libera I amount of outboard lubricant to prevent corrosion.

POWERHEAD INSPECTION

For d imensions, refer to **SERVICE SPECIFICA-TIONS** on p. 10.

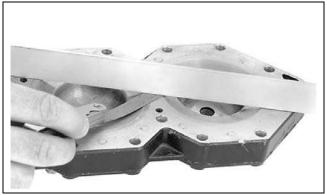
IMPORTANT: Before any inspect ion process can begin, all internal components must be completely clean and free of contaminants.

Visually inspect all parts. Check for unusual wear patterns, scuf fing, or dete rioration of aluminu m parts, heat-related discoloration of be arings and bearing surfaces, and broken components.

Cylinder Head

Check for cylinder head warpage using a piece of bar stock or machinist's straightedge and a feeler gauge set.

Cylinder head warpage must not exceed 0.006 in. (0.15 mm) per inch of me asurement. Re place head if warpage exceeds this dimension.

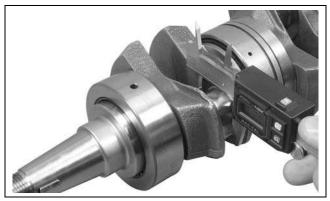


24423

Check fuel deflector pins for damage.

Crankshaft

Measure the diameter of each crankpin and main bearing journal. The lower main be aring journal would only be measu red if the bearing was removed for another reason.



002142

Cylinder Bore

Use a Cylinder Bore Gauge to inspect each cylinder bore for an out-of-round, oversize, or tapered condition. Be sure the gauge is perfectly square in the bore when measuring.



007283

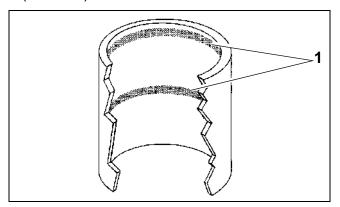
Measure each cylinder in at least two areas. Each area should be measured twice. The difference between the two measurements in each are a is the cylinder out-of-round dimension.

• The cylinder must not be out-of-round by more than 0.004 in. (0.10 mm).

POWERHEAD INSPECTION

The dimensional dif ference between the two areas is cylinder taper.

 The cylin der taper must n ot exceed 0.002 in. (0.05 mm).



1. Measurement areas

DR3482

The difference between the measurement s and standard bore is cylin der oversize. For dimensions, refer to **SERVICE SPECIFICATIONS** on p. 10.

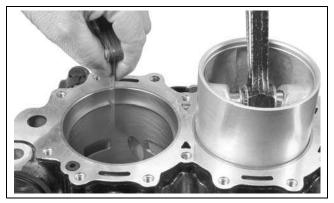
 The cylinder must not be oversized by more than 0.003 in. (0.08 mm).

Pistons

Visually inspect pistons for sign s 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 feele r gauge to measu re the ring end gap.



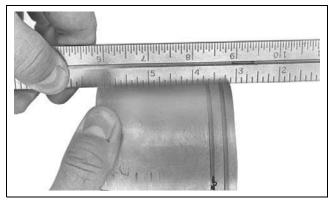
002143

• 0.011 to 0.023 in. (0.28 to 0.58 mm)

Ring end gap should be:

IMPORTANT: Ring end g ap increases ap proximately 0.003 in. (0. 076 mm) for e ach 0.001 in. (0.025 mm) incre ase in cylinder bo re diamet er. DO NOT exceed cylinder oversize dimension.

Use a machinist's straightedge to check for proper ring clea rance. Position piston rings on p iston. Push rings into groove and hold straighted ge against the side of the piston. Rings must be even or just be low the surface of piston. Rings must move freely in piston ring groove.



31796

Bearings

Inspect center main bearings and split sleeves for excess wear, nicks, or scratches. Replace if necessary.

Inspect crankshaft rod bearings for excess wear, nicks, or scratches. Replace if necessary.



24381

POWERHEAD ASSEMBLY

IMPORTANT: Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All interna I components must be perfectly clean and lightly coated with outboard lubricant.

IMPORTANT: Use new wrist pin retaining rings, gaskets, seals, and O-rings during assembly.

Crankshaft Assembly

Oil the end of the cra nkshaft. Use Crankshaf t Bearing/Sleeve Installer, P/N 338647, and place a new lower main bearing onto crankshaft with lettered side facing the tool. Inst all bearing until it seats on the crankshaft.



002029

Oil the end of the crankshaft. Use Crankshaft Bearing/Sleeve Installer, P/N 338647, to drive a new sleeve onto the crankshaft until the installer contacts the lower main bearing.



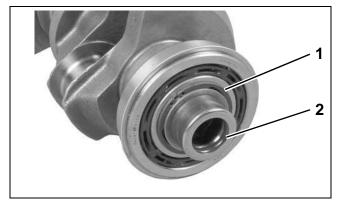
002030

If the inst aller sticks on the sleeve after installation, thread Slide Hamme r, P/N 391008, in to installer and pull it off.

IMPORTANT: Inspect sleeve af ter inst allation. Sleeve must not be used if surface is damaged.

Use retaining ring pliers to install bearing retaining ring with sharp edge facing away from bearing.

Lubricate a new driveshaft O-ring and lightly lubricate crankshaft splines with *Moly Lube*. Inst all O-ring in sleeve.



1. Bearing retaining ring

. O-ring

002031

Lubricate the center main bea rings and split sleeves with outboard lubricant and install them in their original positions. The split sleeve ring grooves must face toward driveshaft (lower) end of crankshaft when installed.



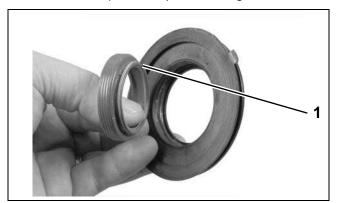
1. Groove toward driveshaft end

002032

Lightly coat the outside edge of a new lower housing se al with *Gasket Sealing Compound*. Press against outer case of the seal to install seal in the

POWERHEAD ASSEMBLY

lower housing with exte nded lip facing down. Lubricate seal lip with *Triple-Guard* grease.



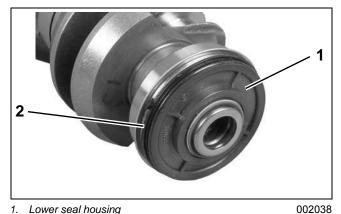
1. Seal lip 002036



002037

Install a new O-ring on the lower housing. Before installing cr ankshaft into cylin der block, apply a thin coat of Gasket Sealing Compound to outer edge of O-ring.

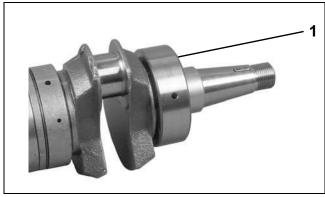
Place lower seal housing on crankshaft.



Lower seal housing

2. O-ring

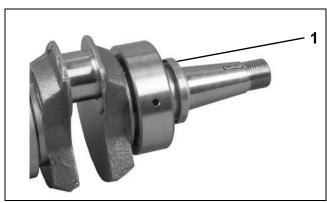
Lubricate upper main bearing with outboard lubricant and install on crankshaft.



Upper main bearing

002033

Pack lip of upper oil seal with Moly Lube. Place seal on crankshaft with lip do wn and enclosed face up. Do not apply sealer to outside edge of the seal.



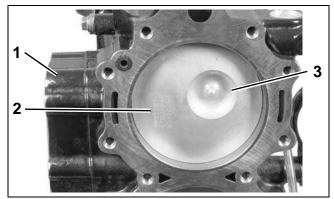
Upper oil seal

002034

Pistons and Connecting Rods

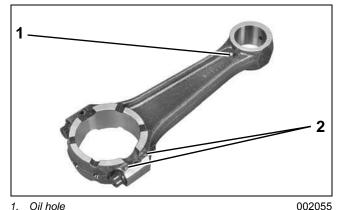
NOTICE It is very important that the pistons in this engine are installed in the correct location and direction. Engine damage will occur if installed incorrectly.

New piston s are st amped "EXH." This marking should be turned toward the exhaust side of the block. The splash bowl on the dome of the piston will be located toward the top and starboard side of the block.



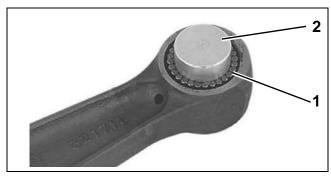
- Exhaust side of block 1.
- Stamped markings
- Splash bowl

NOTICE It is also very important that the connecting rods are installed with the alignment dots and the diagonal oil hole facing up, toward the flywheel.



- Oil hole
- Raised dots

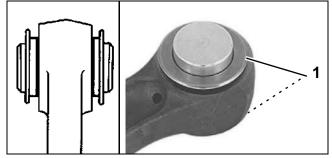
Apply Needle Bearing Grease to the wrist pin bearings. Install the bearings in the small end of the connecting rod. Align be arings with Wrist Pin Bearing Tool, P/N 336660.



- 28 needle bearings
- Wrist pin bearing tool

24903

Place the two wrist pin thrust washers on the tool with flat side of the washers facing out.



Wrist pin thrust washers

002049

DR3480 24902

Oil the wrist pin bore and wrist pin. Place connecting rod, with bearings, washers, and tool, into the piston with the alignment dots facing the top of the piston.

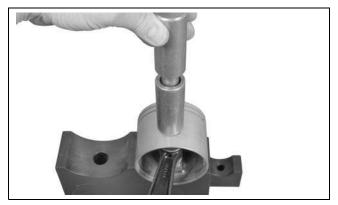
Install wrist pin through piston and connecting rod, pushing bearing tool out through the piston.



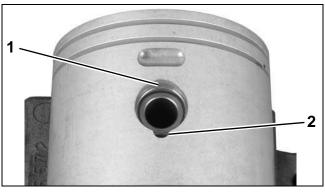
002057

POWERHEAD ASSEMBLY

Use W rist Pin Cone , P/N 3 18600, and Driver , P/N 318599, to install new wrist pin retaining rings in each wrist pin hole. Gap of retaining ring faces up, away from notch in piston.



002058



1. Gap of retaining ring

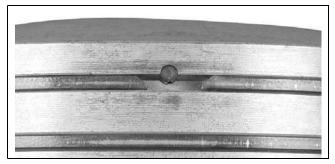
2. Notch in piston

002050

Installing Pistons

When all pistons and connecting rods are assembled, inst all piston rin g set s. Be sure rings are installed in the cylinder used to test ring end gap. Refer to **POWERHEAD INSPECTION** on p. 201.

IMPORTANT: Be sure gap of ring fit's squarely around dowel pin.



002048

NOTICE Before continuing, make sure that all *Gel-Seal II* has been removed from the cylinder block and crankcase mating flanges. If traces of hardened *Gel-Seal II* are left, main bearings could be misaligned. Refer to CYLINDER BLOCK CLEANING on p. 200.

Coat pistons, rings, cylinder walls, and an appropriate ring compressor with outboard lubricant.

Center connecting rod in piston and locate piston rings on dowel pins. Place appropriate ring compressor on piston.

Slide piston and rod assembly into the correct cylinder, as marked during disassembly. Guide connecting rod through cylinder block to avoid scratching cylinder wall.



1. Ring compressor

002059

Repeat steps for each piston.

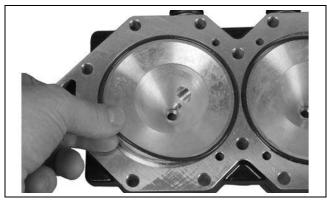
0

Cylinder Head Installation

Install a new thermostat seal in cylinder head with side marked "TO CYL HEAD" facing toward thermostat.

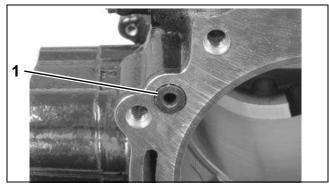
Refer to **THERMOSTAT SERVICING** on p. 182 before installing cylinder head.

Lightly lub ricate new cylinder head O-rings with *Triple-Guard* grease and install in cylinder head.



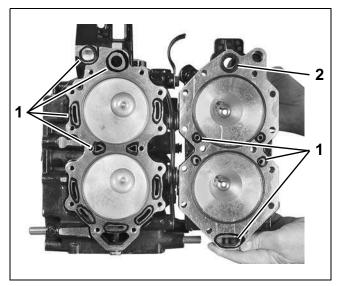
002061

Apply soa py water to water dam and insert into block.



1. Water dam 002062

Apply a 1/16 in. (2 mm) be ad of *RTV Adhesive* around each water passage on the block and cylinder head as shown.



RTV sealant
 Thermostat seal

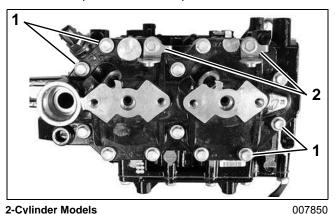
002272

Install cylinder head with the thermostat to ward the top. Place ig nition coil bracket s as shown below.

Apply outb oard lu bricant to screw thre ads an d install the cylinder head screws. DO NOT use any sealant or locking compound on threads.

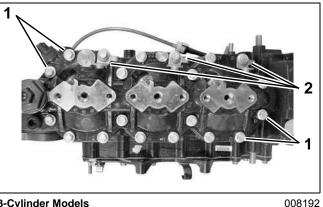
POWERHEAD ASSEMBLY

Following seg uence st amped on cylinder he ad, tighten all screws in stages to a torque of 168 to 192 in. lbs. (19 to 21.7 N·m).



2-Cylinder Models

- Cylinder head screws
- Ignition coil bracket



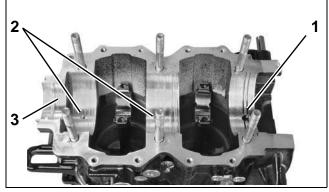
3-Cylinder Models

- Cylinder head screws
- Ignition coil bracket

Crankshaft and Connecting Rod Installation

Apply Gasket Sealing Compound to lower oil seal groove in cylinder block. DO NOT put any sealer in upper seal groove.

Check that main bearing alignment dowel pins are seated in the block.



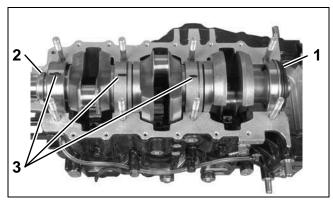
- Gasket Sealing Compound
- Dowel pins
- No sealer here

002262

Push all pistons t o the top of cylin ders. Remove numbered connecting rod caps.

Gently lower crankshaft into place.

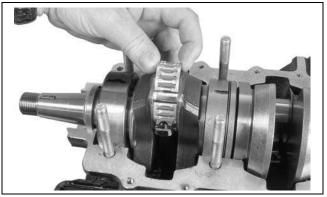
- Align t ab o n lower bearing seal housing with hole in crankcase.
- Align upper oil seal in groove.
- Locate each main bearing on it s dowel pin. A mark placed on the bearing race opposite the dowel pin ho le will help in the alignment process.



- 1. Lower seal housing
- 2. Upper oil seal
- 3. Alignment marks

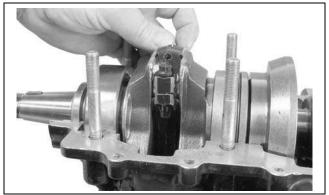
002070

Lubricate e ach crankpin and bearing a ssembly with outboard lubricant. Slowly pull connecting rod up to crankshaft and install bearing halves.



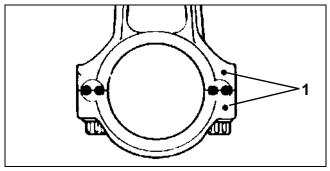
002115

Lubricate rod cap screw threads and under screw head mating surface with outboard lubricant. Align dot on rod cap with do t on the connecting rod. Install rod cap screws finger tight (NO MORE than 6 in. lbs. (1 N·m) maximum).



002116

IMPORTANT: Be sure alignment dot on rod cap matches dot on rod and that both dot s face flywheel.

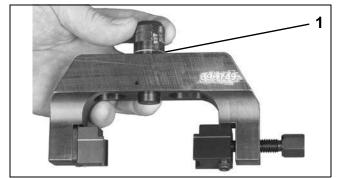


1. Alignment dots

53628

NOTICE Tightening rod cap screws without Alignment Fixture, P/N 396749, or using an incorrect procedure could cause permanent damage to the connecting rod and crankshaft. To maintain accurate torque values, keep torque wrench extension length to a minimum.

Install Rod Cap Alignme nt Fixture, P/N 39674 9, **before** tighten ing rod cap screws. Align the flat marked "SET" on the rod e ngagement stop with the arrow on the frame. Position stop at the center setting (one line showing). Rot ate a djustment knob 180° to lock in position.

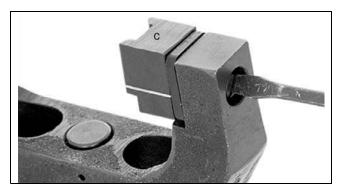


1. Center position, one line showing

002484

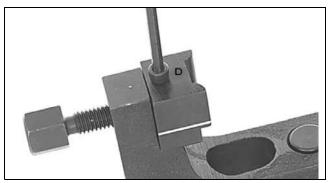
POWERHEAD ASSEMBLY

Secure restraining jaw "C" and forcing jaw "D" to frame.



Restraining Jaw "C"

21591



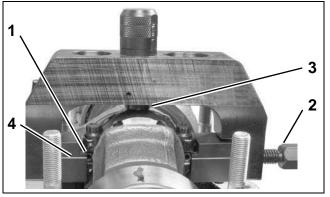
Forcing Jaw "D"

21594

Apply a light coat of outboard lubricant to the corners of the connecting rod and rod cap. Place frame on connecting rod using the followin g procedure.

- Place frame onto the connecting rod so the contact area of the jaw is center ed on the side of the rod.
- Tighten forcing screw u ntil jaws con tact connecting rod.
- Slide frame down until adjustment stop contacts the rod cap. The groove lines on the jaws mu st be centered on the rod/crankpin diameter.

 Tighten the forcing screw to a torque of 14 to 16 in. lbs. (1.6 to 1.8 N·m).



- 1. Contact area of jaw
- 2. Forcing screw
- Adjustment stop
- 4. Groove line

002071

IMPORTANT: Make sure that frame is squ arely in position and that rod and cap are aligned.

Loosen both rod cap screws one-quarter turn.

Use Torquing Socket, P/N 331638, to tighten rod cap screws in three stages:

- Apply first torque of 40 to 60 in. lbs. (5 to 7 N·m) to both rod cap screws.
- Tighten screws to a torque of 14 to 16 ft. lbs. (19 to 21.7 N·m).
- Apply final torque of 30 to 32 ft. lbs. (41 to 43 N·m).

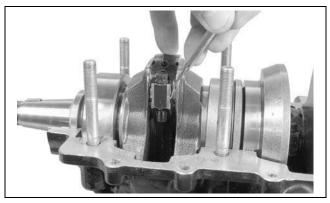


002072

IMPORTANT: If a new screw is used, it must be installed as above. Then, it must be removed, relubricated, and installed again.

Loosen forcing screw and remove the frame.

Test at least three corners of the rod and cap joint with a pick. Joint must be smooth with no step.



002117

Crankcase Assembly

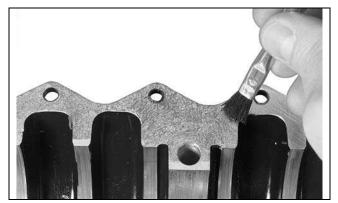
Make sure crankshaft is still seated on dowel pins before assembling crankcase.

Thoroughly clean an d deg rease the mating flanges of the crankcase and cylinder block with a non-petroleum based so lvent, such as iso propyl alcohol or acetone, and let air dry.

IMPORTANT: DO NOT allow solvent to get on internal componen ts. Clean on ly the mating flanges.

Apply *Gasket Sealing Compound* to lower oil seal groove in crankcase. DO NOT put any sealer in upper seal groove.

Use a small brush with a tapping motion to apply a thin, even coat of *Gel-Seal II* sealant to the crankcase mating fla nge. The sea ler must no t come within 1/4 in. (6.4 mm) of bearings.



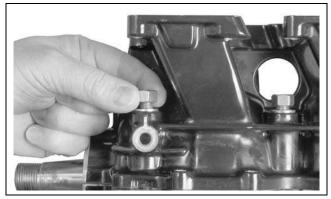
TYPICAL 003874

IMPORTANT: Gel-Seal II has a shelf life of at least one year when stored at room temperature. Test the Gel-Seal II or replace it if the age of the tube cannot be determined. Using old Gel-Seal II could cause crankcase air leaks.

IMPORTANT: The use of *Locquic Primer* is NOT recommended. If p rimer is used, crankcase halves must be assemble d and tightened within ten minutes after the *Gel-Seal II* has been applied.

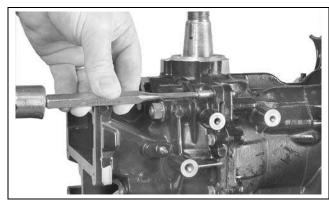
Lower the crankcase into place. Make sure that upper oil seal and lo wer seal housing are seated in grooves.

Apply outb oard lu bricant to the main bearin g studs. Inst all nut s and washe rs finger tight, no more than 60 in. lbs. $(7 \text{ N} \cdot \text{m})$.



00227

When the crankcase is se ated, install and firmly seat the crankcase taper pin.



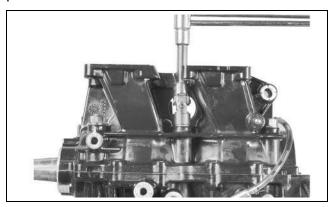
002260

Tighten main bearing nut s **in stages** to a final torque of:

• 26 to 30 ft. lbs. (35 to 41 N·m).

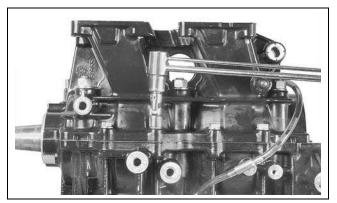
POWERHEAD ASSEMBLY

Start in the center and work out ward in a spiral pattern.



002254

Apply *Nut Lock* to crankcase flange screws. Install screws and tighten to a torque of 60 to 84 in. lb s. $(7 \text{ to } 9.5 \text{ N} \cdot \text{m})$.



002259

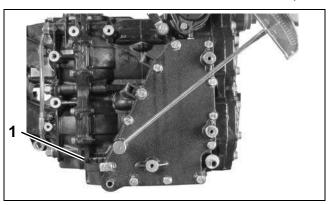
Test that the crankshaft spins freely without binding.

IMPORTANT: After powerhead ha s be en assembled, allow at least two hours for *Gel-Seal II* to cure before running outboard.

Apply Gasket Sealing Compound to both sides of a new water cover gasket. Place gasket and cover on cylinder block.

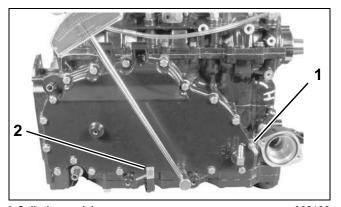
Apply *Nut Lock* to cover screws. Position J-clamps as shown. Tighten all screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Note: 3-Cylinder models include a double-ended stud and use a lock washer under the J-clamp.



2-Cylinder models
1. J-clamp

002242r



3-Cylinder models1. Double-ended stud

002122

2. J-clamp

Shift Linkage Installation

Place the spring, guide, and ball of the shift detent assembly in to the crankcase. Lubricate with *Triple-Guard* grease.



1. Shift detent assembly

002135

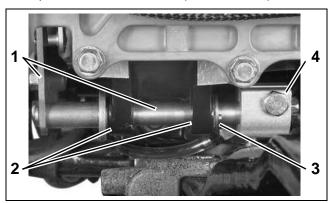
10

Lubricate shift linkage bosses at the base of the crankcase with Triple-Guard grease. Insert bushings into bosses.

Apply Triple-Guard grease to the shaft and detent of the sh ift lever assembly. Guide sh aft through bushings in crankcase.

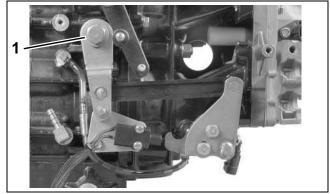
Install cotter pin and washer on the shaft (2-cylinder models).

Install shift rod lever and tighten retaining screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



- Shift lever and shaft
- Bushing
- Cotter pin and washer
- Shift rod lever screw

Apply *Triple-Guard* grease to shoulder of shift arm screw and Nut Lock to threads. Install arm, screw, and washer and tight en screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



1. Shift lever screw

002250

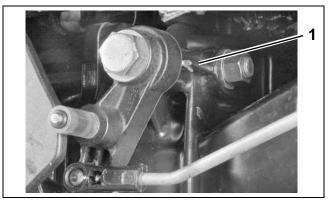
002246

Throttle Linkage Installation

Apply *Nut Lock* to threads of throttle lever screw.

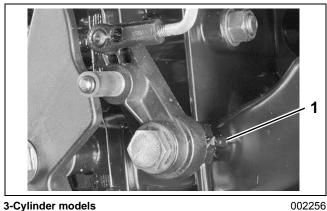
Insert spring into cavity of throttle return lever.

Install lever, screw, and washer on crankcase and hook spring on rib as sho wn. Tighten screw to a torque of 120 to 144 in. lbs. (13.5 to 16 N·m).



2-Cylinder models Throttle lever spring

002255

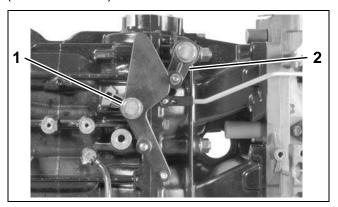


3-Cylinder models Throttle lever spring

Apply Nut Lock to thread s of throttle cam screw. Install cam, screw, and wa sher on cylinder block

POWERHEAD ASSEMBLY

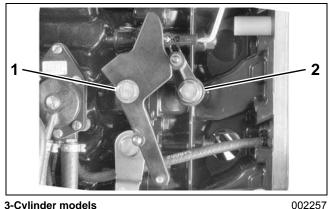
and tighten screw to a torque of 120 to 144 in. lbs. $(13.5 \text{ to } 16 \text{ N} \cdot \text{m})$.



2-Cylinder models

- Throttle lever screw
- 2. Throttle return lever

002245



3-Cylinder models1. Throttle lever screw

2. Throttle return lever

IMPORTANT: Do not lubricate throttle levers or shoulder screws.

Final Powerhead Assembly

Install the reed plate and throttle body assemblies. Refer to **Intake Manifold Service** on p. 149.

Install oil recirculatin g hoses and che ck valves. Refer to **OIL RECIRCULATION DIAGRAMS** on p. 158, or **POWERHEAD VIEWS** on p. 221.

Install thermostat assembly. Refer to **THERMO-STAT SERVICING** on p. 182.

Install pressure valve assembly. Refer to **PRES-SURE RELIEF VALVE SERVICING** on p. 183.

Install shift linkage. Refer to **Shift Linkage Installation** on p. 212.

Install throttle linkage. Refer to **Throttle Linkage Installation** on p. 213.

Install fue I injecto rs and ignition coils. Ref er to Fuel Injector **Installation** on p. 147 and **IGNITION COIL SERVICING** on p. 112.

IMPORTANT: All injectors must be installed in their original location. Improper injector installation can result in powerhead failure.

Install stator and flywheel. Refer to **FLYWHEEL AND STATOR SERVICING** on p. 110.

Install electrical harness, then install *EMM*. Refer to **EMM SERVICING** on p. 70.

Install fuel pump assemblies, fuel man ifolds, and filter. Refer to **FUEL COMPONENT SERVICING** on p. 142.

Install the oil tank and oil injection hoses. Refer to **Oil Tank Assembly** on p. 169.

Install the electric starter. Refer to Starter **Starter Installation** on p. 115.

A WARNING

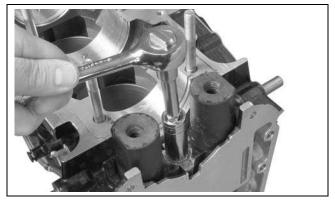
To prevent fire and explosion hazard, make sure all electrical and ignition wiring is routed and clamped in original positions.

10

UPPER MOUNT SERVICING (3-Cylinder)

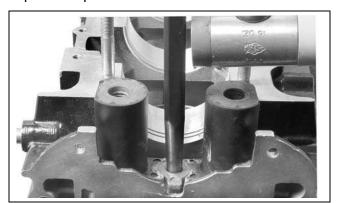
Removal

Remove mount retainer screw.



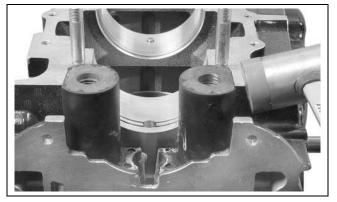
002069

Insert suit able pun ch in t aper of mount retainer. Tap side of punch to loosen mount retainer.



002130

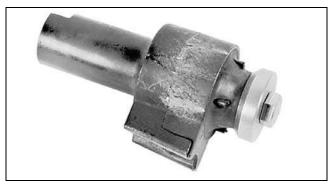
Dislodge mount assemblies and remove.



002132

Inspect mounts and replace if necessary.

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

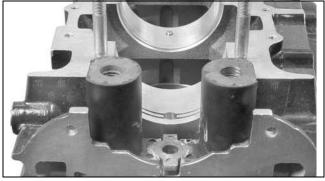


39820

Installation

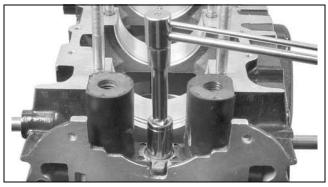
Place mount assemblies in position, with flats facing away from each other.

Apply *Moly Lube* to all sides of retainer and install between mounts.



002133

Install the retainer screw and tighten to a torque of 15 to 20 ft. lbs. (20 to 27 N·m).

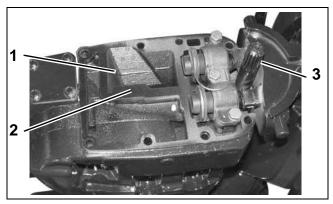


002134

POWERHEAD INSTALLATION

Powerhead Mounting – 2-Cylinder Models

Apply *Permatex No. 2* to both sides of a new base gasket around the exhaust port only. Install gasket on exhaust housing. To ensure proper sealing, mating surfaces must be clean and dry.

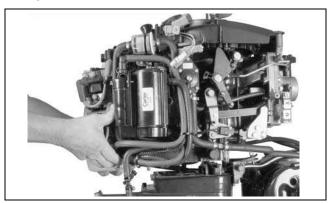


- Exhaust port
- 2. Clean surface
- 3. Moly Lube

004972

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

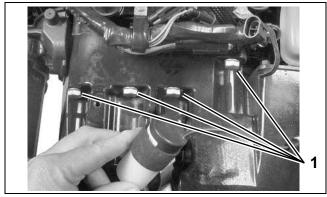
Use Lif ting Fixture, P/N 396748, and hoist to slowly lower p owerhead onto exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.



002269

Apply *Triple-Guard* g rease to the t hreads, and *Gasket Sealing Compound* to the shan k of the powerhead screws.

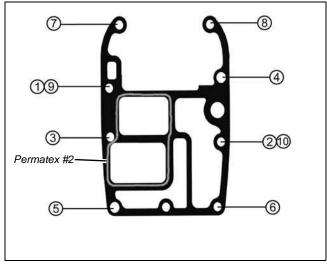
Loosely install all powerhead screws before tightening:



1. Powerhead screws

004292

Tighten the eight powerhead screws to a torque of 18 to 20 f t. lbs. (24 to 27 $N \cdot m$) in the sequence shown.



Large screw torque sequence, 1 - 10

002175

IMPORTANT: Retighten powerhea d mo unting screws after outboard has been run at full ope rating temperature and allowed to cool.

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

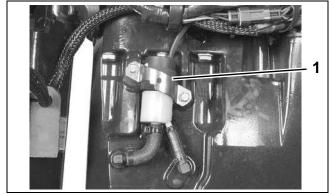


Shift rod screw 002171

Check shift linkage a djustment. Refe r to Shift Linkage Adjustment on p. 220.

IMPORTANT: Make sure the gear rease shifts completely into both forward and reverse and that propeller shaft spins freely in neutral.

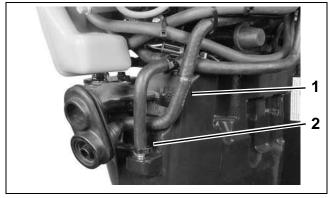
Apply Nut Lock to threads of exhaust water valve screws and tighten to a torque of 60 to 84 in. lb s. (7 to 9.5 N.m).



Exhaust water valve

004293

Connect cooling water hoses to exhaust housing.



Overboard indicator hose

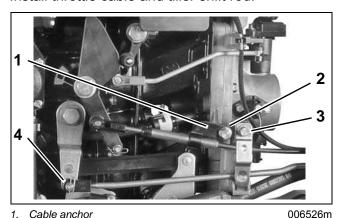
Drain hose

004298

Connect the power trim connectors and exhaust water valve connector (60, 65). Secure cable s in clamps.

ROPE START MODELS

Install throttle cable and tiller shift rod.



Cable anchor 1.

Anchor screw Cable retainer

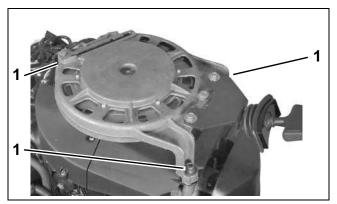
Shift rod retainer

Refer to Throttle Cable Adjustment on p. 276, or Throttle Cable Adjustment on p. 287.

POWERHEAD

POWERHEAD INSTALLATION

Install recoil starter ratchet and housing on outboard. Refer to **RECOIL STARTER INSTALLATION** on p. 369.



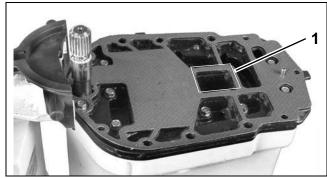
1. Starter housing screws (3)

002515

Install the lower engine covers. Refer to **LOWER COVER SERVICE** on p. 50.

Powerhead Mounting – 3-Cylinder Models

Apply *Permatex No. 2* to both sides of a new base gasket around the exhaust port only. Install gasket on adapter. To ensure proper sealing, mating surfaces must be clean and dry.



1. Apply Permatex No. 2 here

002164

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

Use Lif ting Fixture, P/N 396748, and hoist to slowly lower powerhead ont o exhaust hou sing. Guide into positio n over alignment pin at rear of exhaust housing. If necessary, rotate flywheel in a clockwise direction to align crankshaft and driveshaft splines.



1. Alignment pin

002162

Apply *Triple-Guard* gr ease to the th reads, and *Gasket Sealing Compound* to the shank of the powerhead screws.

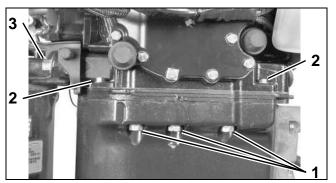
Apply *Triple-Guard* grease to upper mount screw threads.

Loosely in stall all powerhe ad screws a nd upp er mount screws before tightening.

- Tighten the six larg e powerhe ad screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m) in the sequence shown.
- Tighten the five small powerhead screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

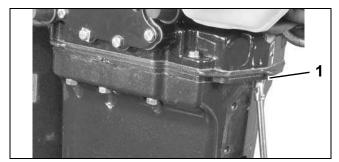
10

 Tighten the upper mount screws to a torque of 110 to 130 ft. lbs. (149 to 176 N·m). Make sure that screw heads are tight against steering arm.



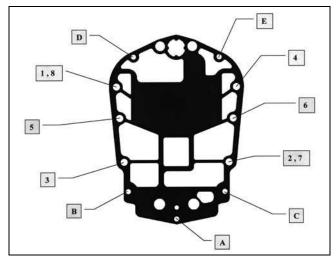
- 1. Large powerhead screws
- 2. Small powerhead screws
- 3. Upper mount screws

002153



1. Rear small powerhead screw

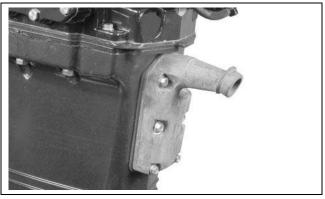
002160



Large screw torque sequence, 1–8 Small screw torque sequence, A–E 002167

IMPORTANT: Retighten powerhe ad mounting screws after outboard has been run at full operating temperature and allowed to cool.

Apply Gasket Sealing Compound to exhaust relief muffler gasket and retaining screws. Install muffler and tighten screws to a to rque of 60 to 84 in. lbs. (7 to 9.5 N·m).



002163

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



Shift rod screw

002013

Check shift lin kage adjustment. Refer to **Shift Linkage Installation** on p. 212.

IMPORTANT: Make su re the gear case shif ts solidly into both forward and reverse and that propeller shaft spins freely in neutral.

POWERHEAD

POWERHEAD INSTALLATION

Connect the power trim connectors.



002152

Install the lower engine covers. Refer to **LOWER COVER SERVICE** on p. 50.

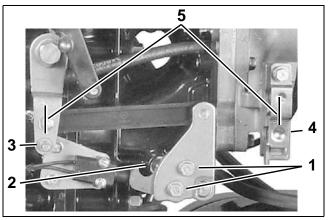
Shift Linkage Adjustment

Adjust shift linkage as follows:

- · Loosen adjustment screws on shift lever.
- Be sure that ball is centered in detent assembly.
- Adjust shift lever so that the screw hole in shift rod lever lines up with the hole in the gearcase shift rod when gearcase is in neutral.
- When correctly adjust ed, the shift lever will be parallel with the vertical line of the outboard, and the distance between the shift lever pin and the center of the shift cable trun nion pocket should be approximately 7 in. (17.8 cm).

IMPORTANT: The shift rod height is the most critical of these ad justments and should not be moved durin g this procedure. Refer to **SHIFT ROD ADJUSTMENT** on p. 300, or **SHIFT ROD ADJUSTMENT** on p. 323.

 Tighten adjustment screws to 60 to 84 in. lbs. (7 to 9.5 N·m).



002125

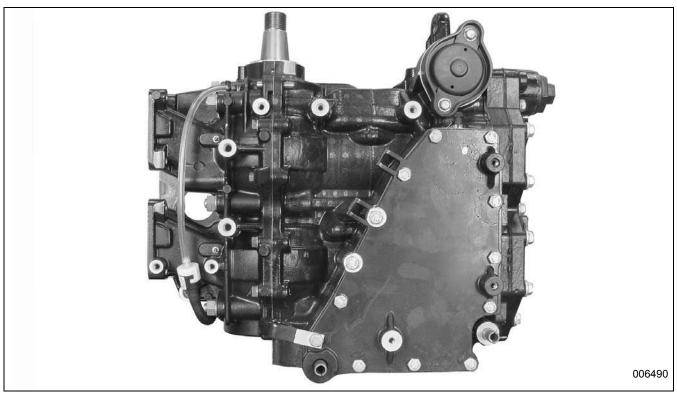
- Adjustment screws
 Shift detent assembly
- 3. Shift lever pin
- 4. Trunnion pocket
- 5. 7 inch dimension

Final Adjustments

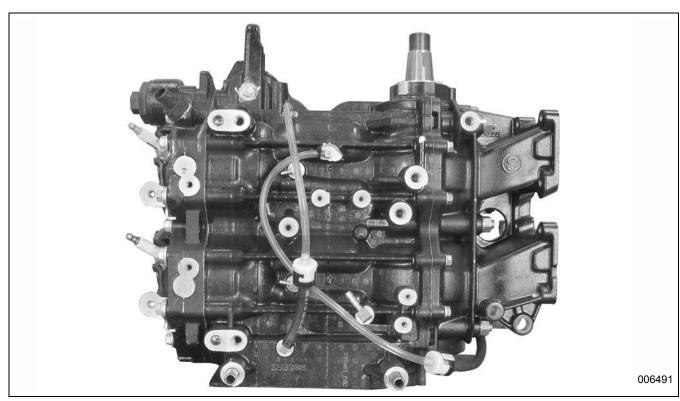
NOTICE After installing a new or rebuilt powerhead, perform the following procedures before returning outboard to service:

- Adjust timing pointer.
- Index all sp ark plugs. Refer to Spark Plu g Indexing on p. 42.
- Use Evinrude Diagnostics software to start powerhead b reak-in o iling. Ref er to Powerhead Break-In on p. 67.
- Use *Evinrude Diagnostics* software to set TPS calibration. Refer to **TPS Calibration** on p. 114.
- Use *Evinrude Diagnostics* sof tware to make sure engine management software version and revision are current. Update as required.
- Prime fuel system.
- Prime oiling system. Refer to Oil Supply Priming on p. 165.
- Use Evinrude Diagnostics software to check engine timing. Ref er t o TIMING ADJUST-MENTS on p. 113.
- Run outboard and check for water, fuel, or oil leaks.
- Make sure en gine rea ches correct op erating temperature and does not overheat.

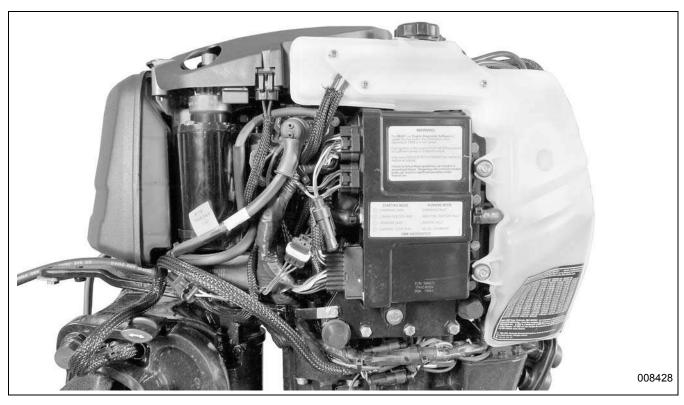
2-Cylinder Port – Hose Routings



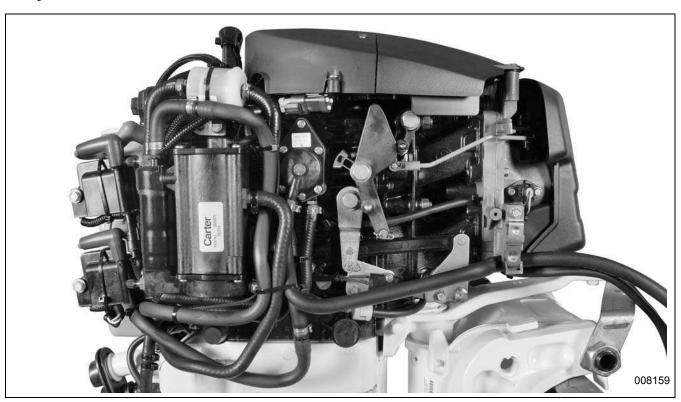
2-Cylinder Starboard – Hose Routings



2-Cylinder Port Dressed Powerhead



2-Cylinder Starboard Dressed Powerhead



2-Cylinder Port Rope Start Models



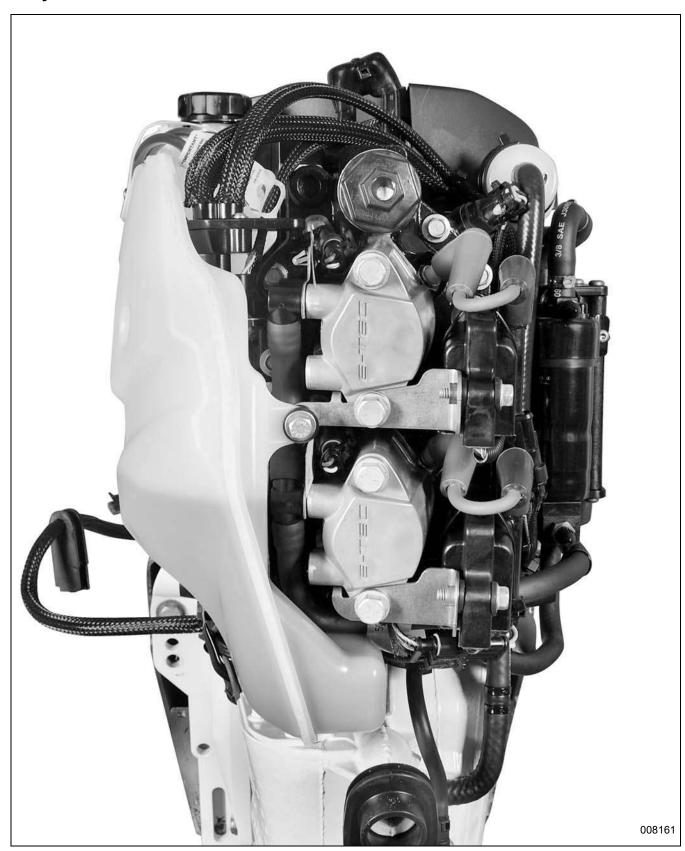
2-Cylinder Starboard Rope Start Models



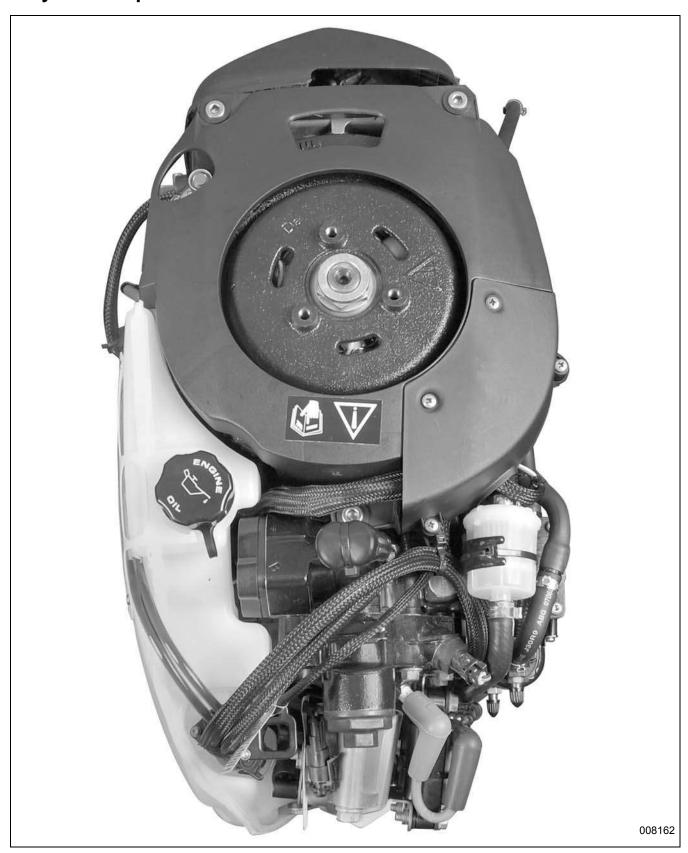
2-Cylinder Front



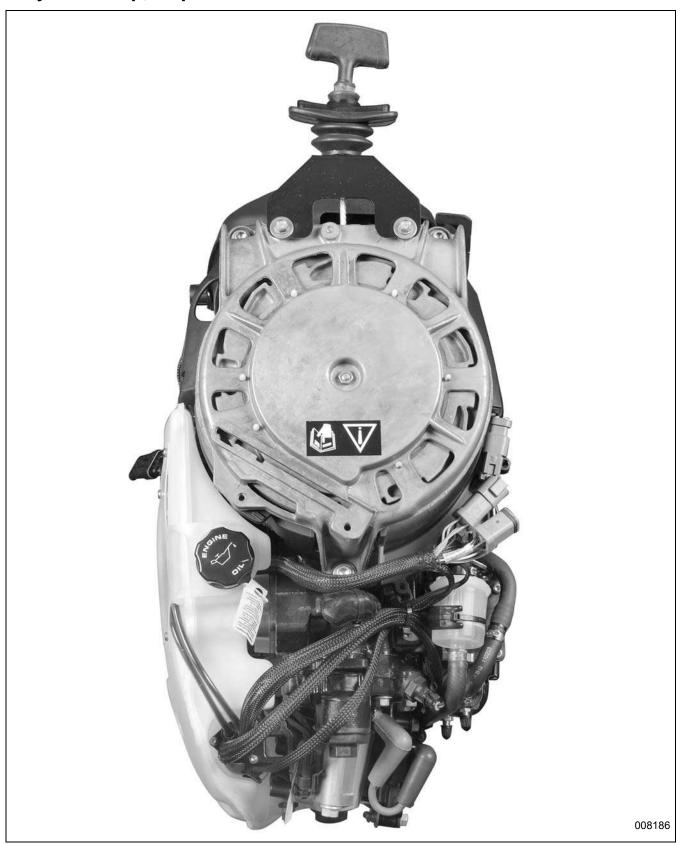
2-Cylinder Rear



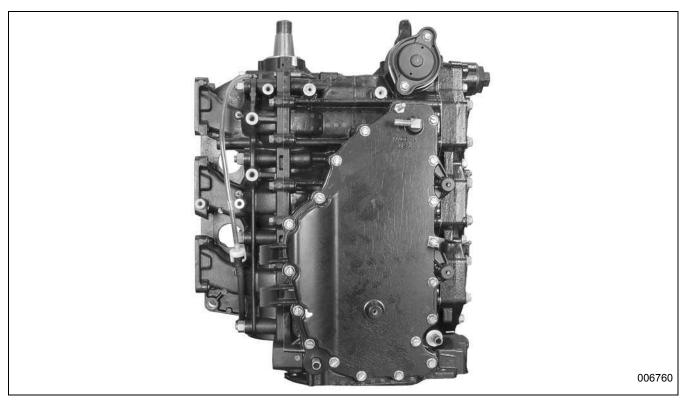
2-Cylinder Top



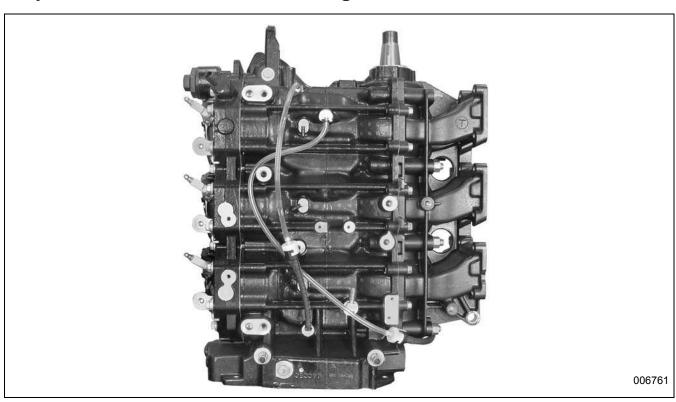
2-Cylinder Top, Rope Start Models



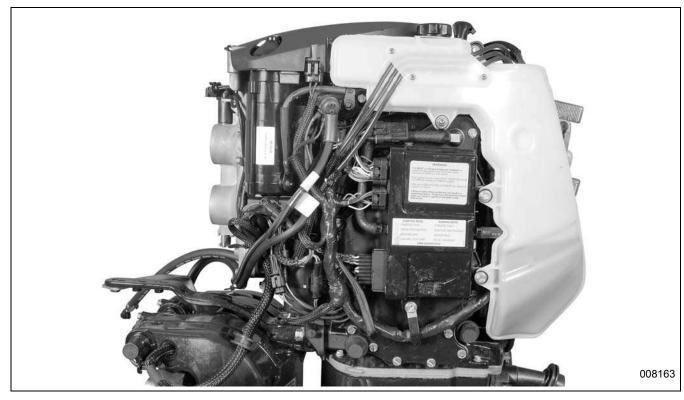
3-Cylinder Port – Hose Routings



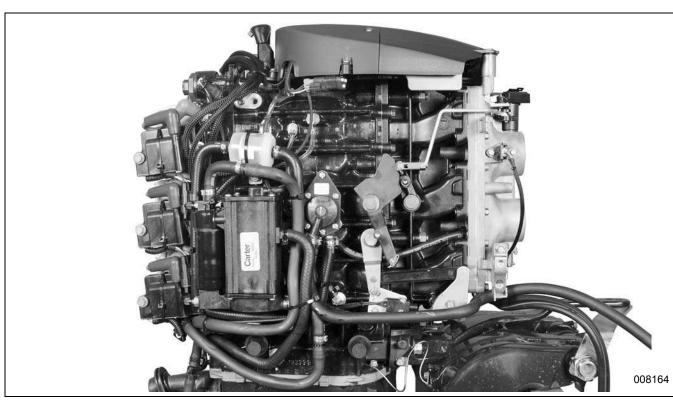
3-Cylinder Starboard – Hose Routings



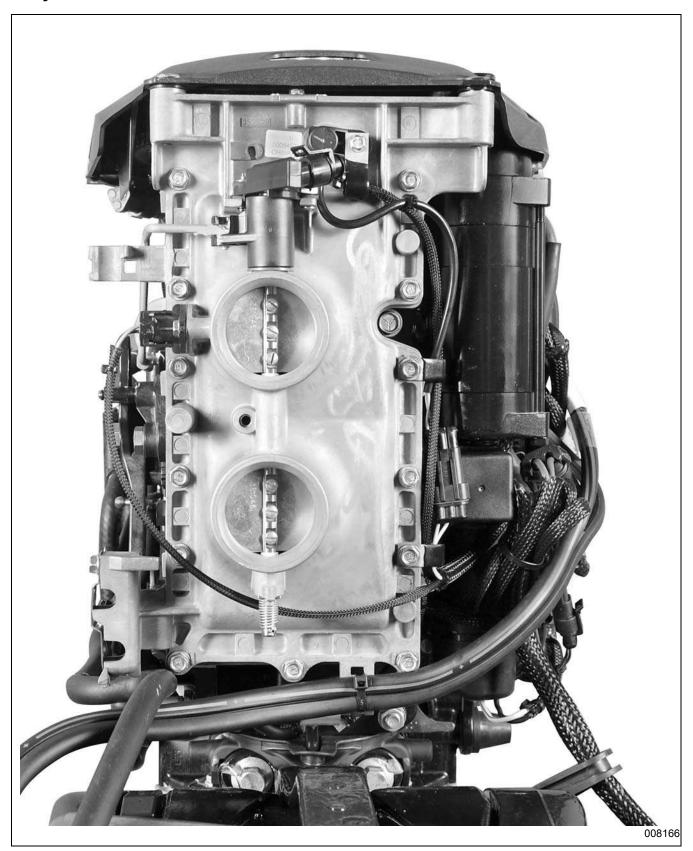
3-Cylinder Port Dressed Powerhead



3-Cylinder Starboard Dressed Powerhead



3-Cylinder Front



3-Cylinder Rear



3-Cylinder Top



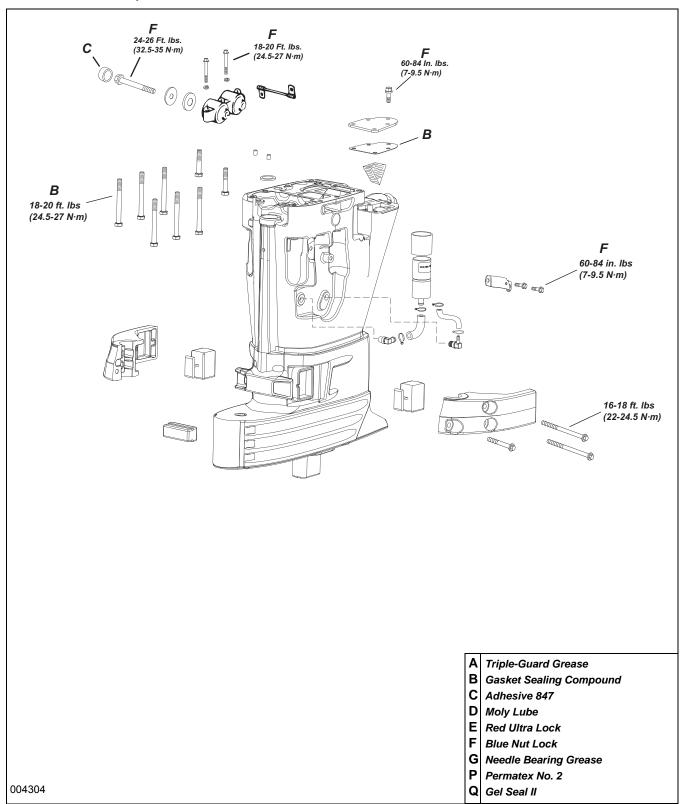
MIDSECTION

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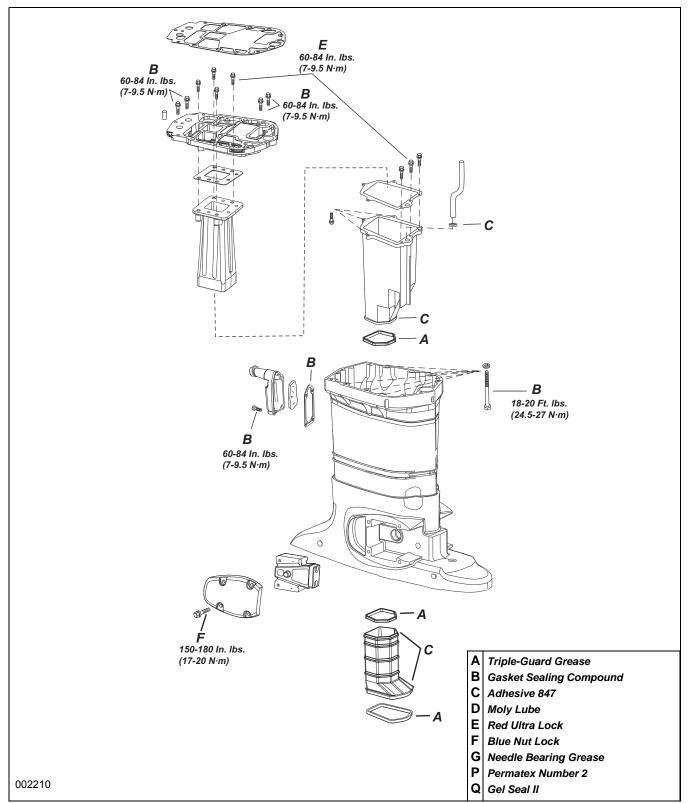
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SERVICE CHARTS

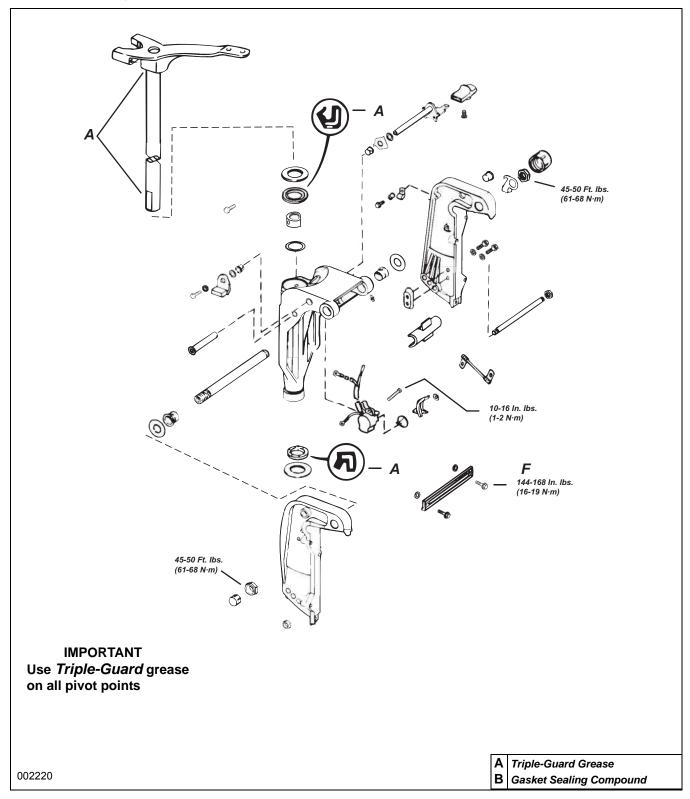
EXHAUST HOUSING, 40 - 65 HP



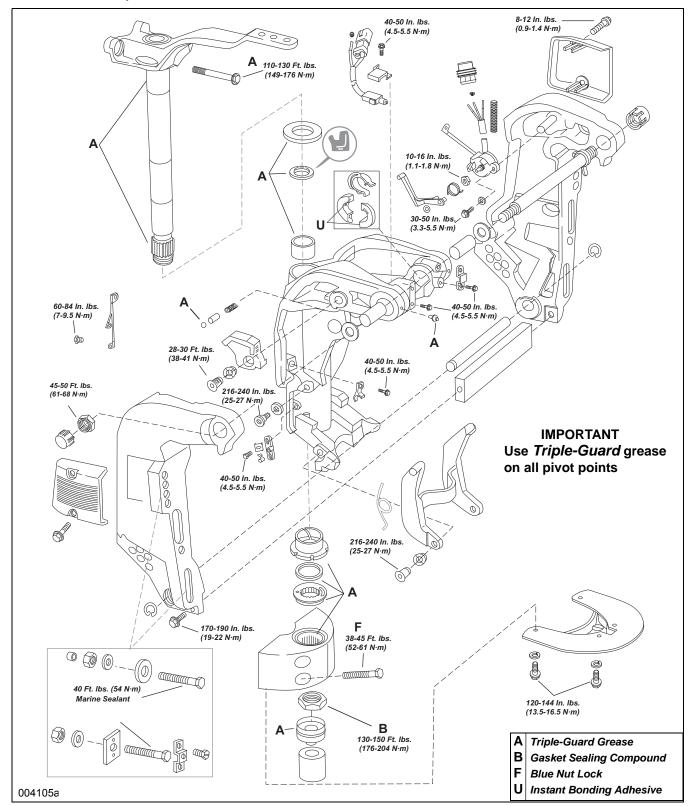
EXHAUST HOUSING, 75 - 90 HP



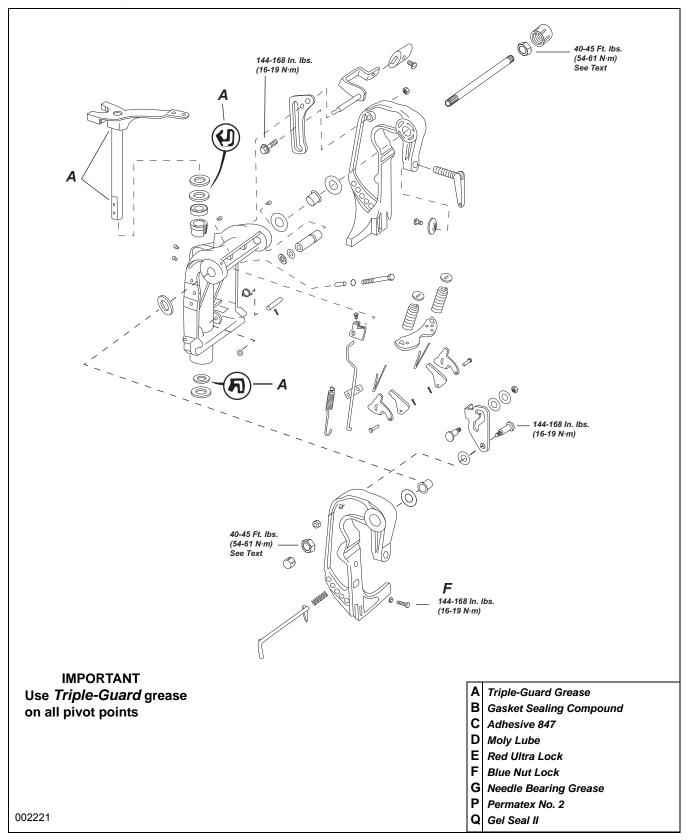
STERN BRACKET, 40 - 60 HP POWER TILT



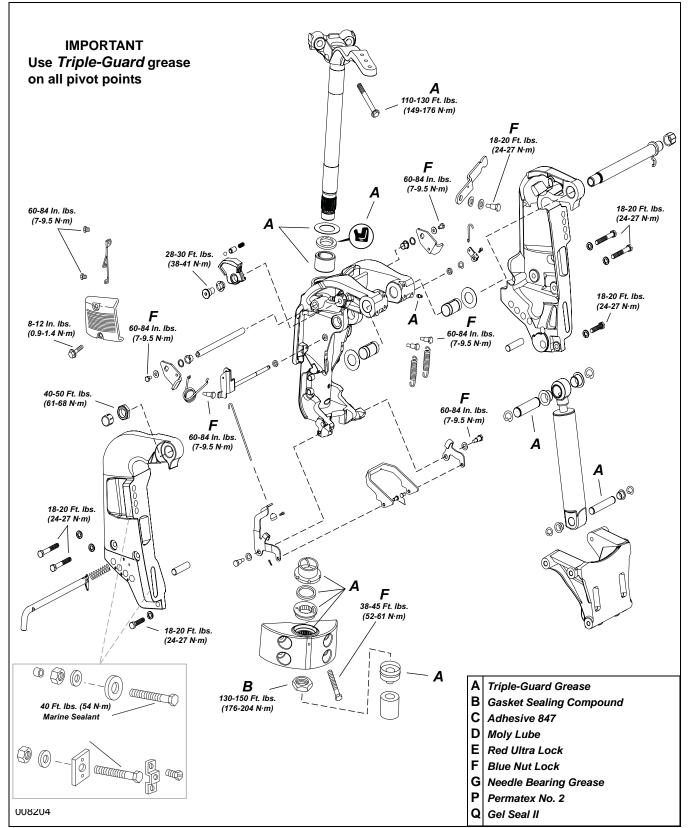
STERN BRACKET, 75 - 90 HP POWER TILT



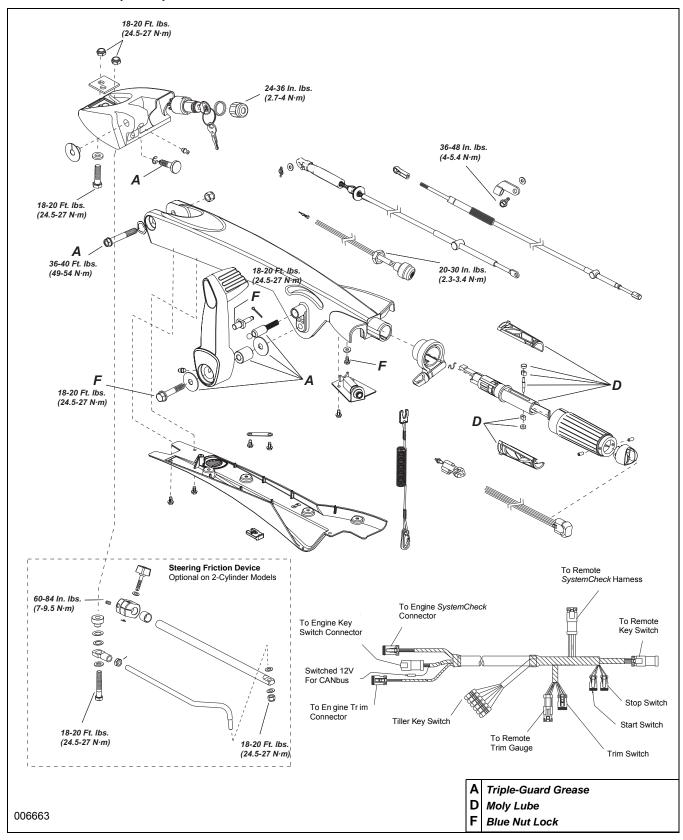
STERN BRACKET, 40 - 65 HP MANUAL TILT



STERN BRACKET, 90 HP MANUAL TILT



TILLER HANDLE (LONG)



TILT TUBE, 75 – 90 HP

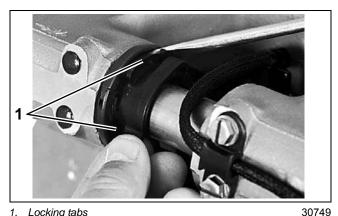
The tilt tube may be serviced without major disassembly of the outboard using Tilt Tube Service Kit, P/N 434523.

Removal

WARNING

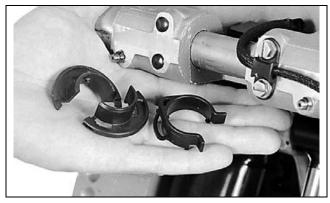
Support the outboard with a suitable hoist.

Pull the locking tabs on the tilt limit cam loose from the collar.



1. Locking tabs

Remove the cam and collar from the tilt tube.

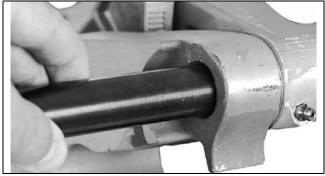


Remove the nut from the starboard side.



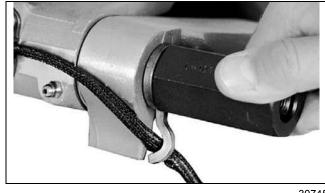
30747

Thread the spacer from Tilt T ube Service Kit, P/N 434523, on to the st arboard end of the tilt tube.



30746

Remove steering cable wiper nut from tilt tube. Thread the adap ter from T ilt T ube Service Kit, P/N 434523, onto the port end of the tilt tube.

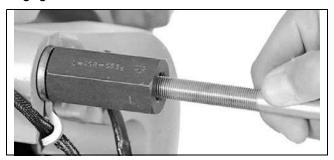


30745

MIDSECTION

TILT TUBE, 75 - 90 HP

Thread Slide Hammer, P/N 432128, into the adapter until at least 2 in. (51 mm) of threa d are engaged.



30744

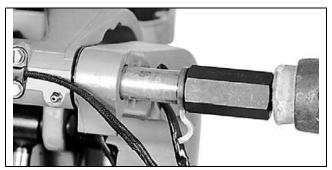
Pull tilt tube from stern bracket with the slide hammer. When tilt tube clears the port stern b racket, remove tilt tube from the spacer.

Installation

Thread starboard end of tilt tube into the spacer.

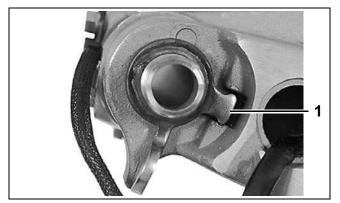
Thread the adapter onto port end of tilt tube.

Use a wood or leather mallet to tap the tilt tube into position.



30743

Make sure the lock tab is in correct position.



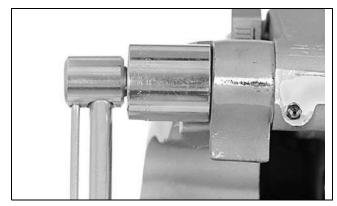
1. Lock tab 30742

Install the starboard locknut.

A WARNING

Replace locknut if definite resistance is not felt.

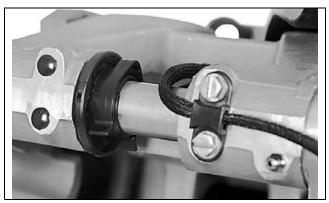
Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).



30741

Replace steering cable wiper nut on port end of tilt tube.

Apply one drop of instant bond ing adhesive in receiving chann els of tilt limit switch collar a nd install collar and tilt cam on tilt tube. Be sure locating tab on collar fits in hole on tilt tube.



30750

11

EXHAUST HOUSING, 40 – 65 HP

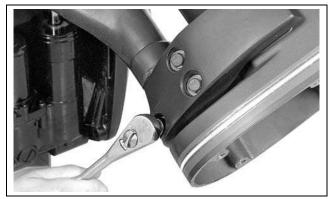
The exhaust ho using cont ains no se rviceable internal p arts. The exhaust wate r valve a nd the exhaust relief muffler can both be serviced without removing the exhaust housing.

Exhaust Housing Removal

Before removing the exhaust housing:

- Remove the gearcase. Refer to Gearcase GEARCASE REMOVAL AND INSTALLATION on p. 296.
- Remove the powerhead. Refer to Powerhe ad POWERHEAD REMOVAL on p. 190.

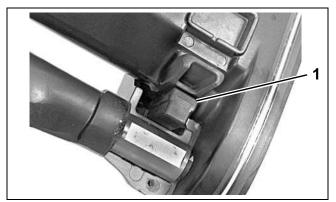
Remove the three lower mount cover screws.



17527

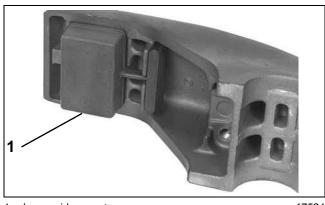
Separate lower mount covers from swivel bracket.

Check condition of the lower front mount a nd two lower side mounts.



1. Lower front mount

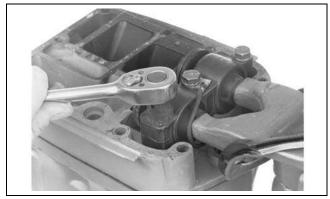
17526



1. Lower side mount

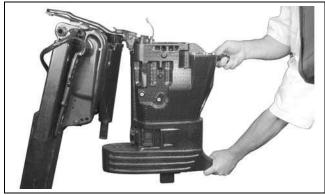
17524

Remove the three upper mount to exhaust housing screws. Be sure to support exhaust ho using so it does not fall.



COA2943

Remove the exhaust housing.



Exhaust Housing

005069

MIDSECTION

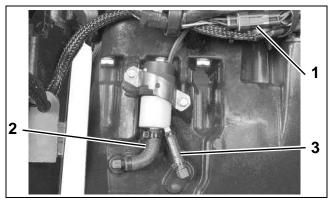
EXHAUST HOUSING, 40 - 65 HP

Exhaust Water Valve (60–65 HP)

Disconnect water valve electrical connector.

Remove screws and bracket holding valve to exhaust housing.

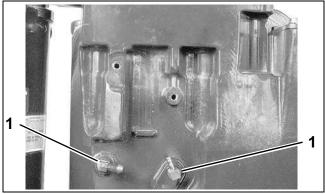
Remove tie strap s a nd disconnect water valve hoses (3) from exhaust housing.



- 1. Electrical connector
- 2. Inlet hose
- 3. Outlet hose

004293

Check that all water passages are clear.



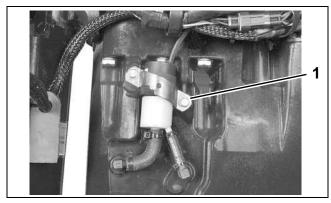
1. Fitting, water passage

004300

Install hoses to fittings on exhaust housing.

Place water valve and bracket in position.

Apply *Nut Lock* to screws, install and tighten 60 to 84 in. lbs. (7 to 9.5 N.m).

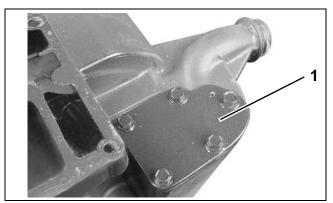


1. Exhaust water valve screws

004293

Exhaust Relief Muffler

Remove exhaust relief muffler cover to inspect filter element. Clean or replace as needed.



1. Exhaust relief muffler cover

004301

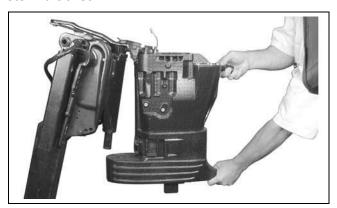
Apply Gasket Sealing Compound to cover gasket and install cover.

Apply *Nut Lock* to co ver screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N.m).

11

Exhaust Housing Installation

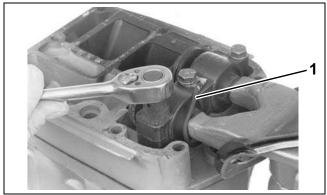
Bring the exhaust housing into positio n with the stern bracket.



Exhaust Housing

005069

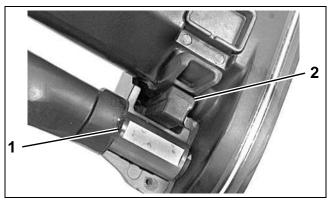
Apply *Nut Lock* to threads of the upper mount screws. Install the screws and place ground lead under t he cente r screw. Tighten screws to a torque of 18 to 20 ft. lbs. (24 to 27 N·m).



1. Ground lead

COA2943

Place lo wer thrust washer on the steering shaft and place the lower front mount into position.

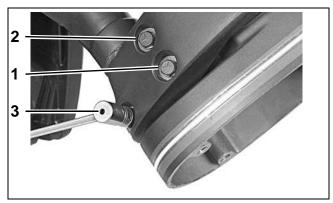


1. Thrust washer

17526

2. Lower front mount

Install lower side mount covers. Install and tighten the screws in stages to a torque of 16 to 18 ft. lbs. (22 to 24 $N \cdot m$) following sequence shown.



Torque sequence

17528

Install gearcase. Refer to Gearcase **GEARCASE REMOVAL AND INSTALLATION** on p. 296.

Install powerhead. Refer to Powerhead **POWER-HEAD INSTALLATION** on p. 216.

MIDSECTION

EXHAUST HOUSING, 75 - 90 HP

EXHAUST HOUSING, 75 – 90 HP

Exhaust Housing Removal

Before removing the exhaust housing:

- Remove the gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 296.
- Remove the p owerhead. Refer to **POWER-HEAD REMOVAL** on p. 190.

Remove and discard four lower mount screws.



20" Models 23036



25" Models 32590

Remove the exhaust housing.



001986

Lower Mount Service

Remove lower mount covers and inspect the lower mounts.

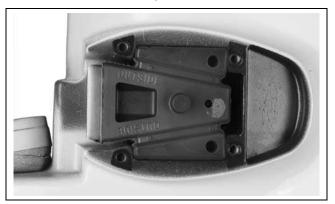
If replacement is necessary, lubricate mount with soapy water and carefully pry at both ends to remove.



001971

11

If re moved, coat the lower mount s with soap y water and press into the exhaust housing with the "OUTSIDE" mark facing outward.



001970

Install t he mount covers. Apply *Nut Lock* to screws, install washers and screws, and tighten to a torque of 150 to 180 in. lbs. (17 to 20 N·m).



001972

Exhaust Housing Installation

Bring the exhaust housing into position with the stern bracket.

Install four **new** lower mount screws with lock-patch. Tighten screws to a torque of 38 to 45 ft. lbs. (51 to 61 $N \cdot m$).



20" Models 23036



25" Models 32590

Install gearcase. Refer to **GEARCASE REMOVAL AND INSTALLATION** on p. 296.

Install powerhea d. Refer to **POWERHEAD INSTALLATION** on p. 216.

MIDSECTION

EXHAUST HOUSING, 75 - 90 HP

Exhaust Housing Disassembly

Remove the front and rear screws retaining the adapter/inner exhaust hou sing to the e xhaust housing.



1. Adapter retaining screws

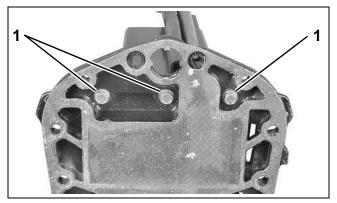
001981

Lift the a dapter/inner exhaust housing out of the exhaust housing.



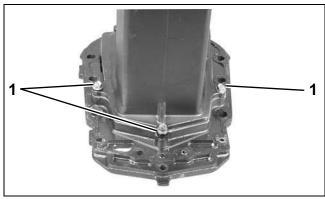
001980

Remove the three upper screws and three lower screws securing the inner exhaust housing to the adapter housing.



1. Upper inner exhaust housing screws

001975



1. Lower inner exhaust housing screws

001974

Remove the wa ter tube from the inne r exhaust housing. Discard water tube grommet.

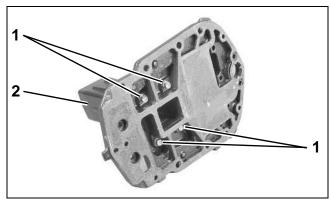


1. Water tube grommet

001984

Remove the se al from the bott om flan ge of the inner exhaust housing.

Remove t he four screws securing the exhaust megaphone to the adapter housing.



. Adapter to megaphone screws

001976

Exhaust megaphone

11

Cleaning and Inspection

WARNING

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

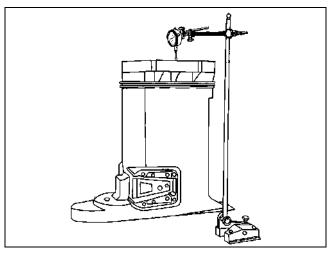
Clean all parts with parts cleaning solvent and dry with compressed air . All nu t and screw thread s coated with thread locking material must be thoroughly cleaned before a ssembly. When u sing a thread lo cking pr oduct, be sure to p rime the threads with *Locquic Primer*.

Examine the upper and lower thrust mounts, and replace if deteriorated or damaged.

Before checking the exhau st housing for distortion, thoroughly clean the top and bottom mating surfaces and remove all sealer and corrosion.

Check the exha ust hou sing for distortion. Place the housing on a surface plate. Use a dial indicator to check flatness by measuring the run-out on the top edge of housing. The maximum allowable run-out is 0.009 in. (0.228 mm). If you do not have access to a dial indicator and surface plate, seek the services of a machine shop. DO NOT attempt to straighten a distorted housing; replace it.

IMPORTANT: A d istorted e xhaust h ousing will cause the upper driveshaft splines to wear excessively and will damage the crankshaft splines.

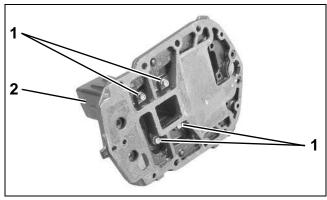


DR2223

Inspect the water tube for obst ructions or kinks, which may restrict water flow.

Exhaust Housing Assembly

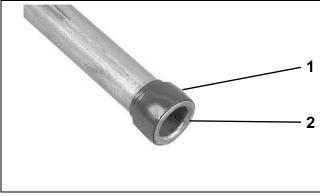
Place a new gasket between the exha ust megaphone and adapter housing. Apply *Ultra Lock* to the threads of the screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



- 1. Adapter to megaphone screws
- 2. Exhaust megaphone

001976

Place a new grommet on the water tube and coat the outside edge with *Adhesive 847*.



- . Water tube grommet
- 2. Flared end of water tube

001977

MIDSECTION

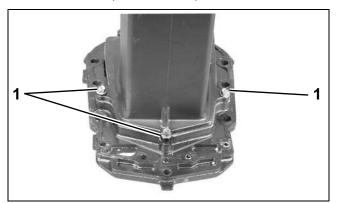
EXHAUST HOUSING, 75 - 90 HP

Install the water tube through the top of the inner exhaust housing and align as shown:

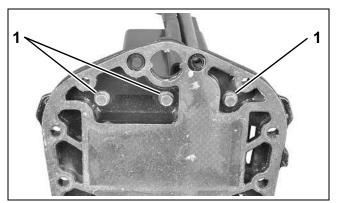


001982

Place a new gasket between the in ner exhaust housing and the adapter ho using. Apply *Ultra Lock* to the screws. Install the three lower screws and three upper screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Lower inner exhaust housing screws

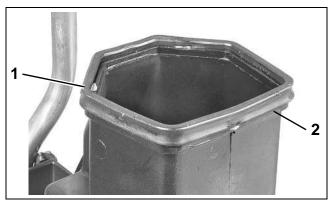


1. Upper inner exhaust housing screws

001975

001974

Apply *Adhesive 847* to the bottom flange of the inner exhaust hou sing. Install a new seal. Apply *Triple-Guard* grease to outer seal surface.



Seal
 Bottom flange

001973

Clean an d d egrease t he a dapter hou sing a nd outer exhaust ho using matin g surface s with *Cleaning Solvent*. Apply *Gel-Seal II* sealant to the adapter flange of the exhaust housing.

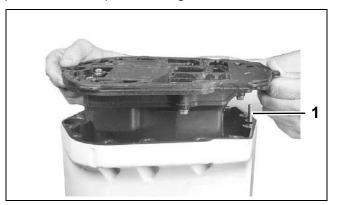


001983

Place the a dapter/inner exhaust housing into the exhaust housing. Guide the water tube throug h

11

the hole in the outer housing and the alignment pin into the adapter housing.



1. Alignment pin

001980

Apply *Gasket Sealing Compound* to threads of the four retaining screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



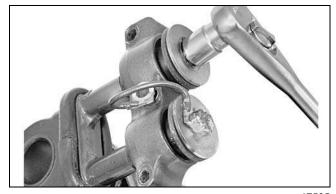
1. Adapter retaining screws

001981

STERN BRACKET, 40 – 60 HP Power Tilt

Stern Bracket Disassembly

Remove the bumpers from the upper mount retaining screws. Remove the screws, upper mount, and ground lead from the bracket.

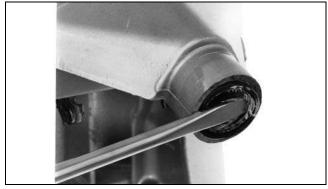


17505

Pull the steerin g arm out of the swivel bra cket. Use an appropriate tool to pry the upper and lower seals from the swivel bracket.



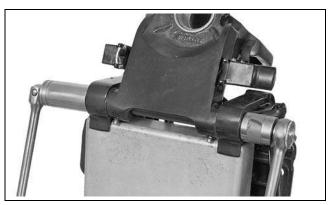
COA2957



COA2958

STERN BRACKET, 40 - 60 HP POWER TILT

To sep arate the swivel b racket from the stern bracket, remove one tilt tube nut.



17544

Remove the tie bar to se parate the two stern brackets.



17541

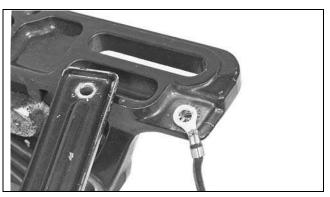
Check the condition of the anode. Replace the anode if it has been reduced to two-thirds its original size.



17551

Stern Bracket Assembly

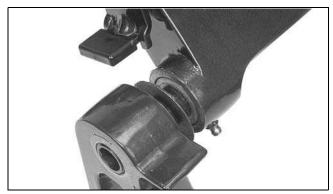
Assemble the tie bar to the stern brackets. Place the ground lead and starwasher between the port stern bracket and tie bar.



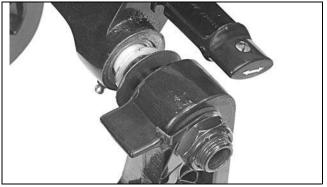
17540

Lubricate the swivel bracket bu shings with *Triple-Guard* grease. Place the bushing s in the swivel bracket.

Position the swivel bracket be tween the stern brackets. Place a thrust washer be tween each of the stern brackets and the swivel bracket.



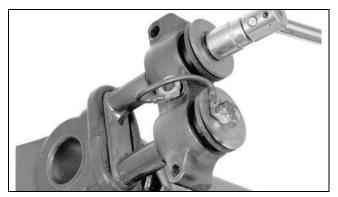
17553



17552

Install the tilt tube. Tighten the tilt tube nu ts 40 to 45 ft. lbs. (54 to 61 N·m), then back off 1/8 to 1/4 turn.

Apply *Nut Lock* to th reads of the upper mount to steering arm screws. Install the mount and tighten the screws 24 to 26 ft. lbs. (32.5 to 35 N·m). Make sure to place the ground lead under the starboard screw.



17506

Apply a liberal amount of *Adhesive 847* to head s of the upper mount screws.



17507

Place the bumpers on the upper mount screws.



17509

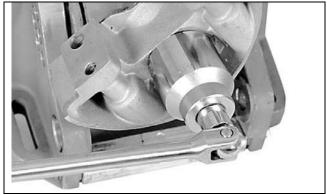
STERN BRACKET, 75 – 90 HP Power Tilt

Stern Bracket Disassembly

Before servicing the stern bracket:

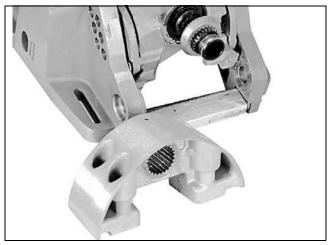
- Remove gearcase . Refer to GEARCASE REMOVAL AND INSTALLATION on p. 296.
- Remove po werhead. Refer to **POWERHEAD REMOVAL** on p. 190.
- Remove exh aust housing. Ref er to **Exhaust Housing Removal** on p. 246.
- Remove power trim/tilt unit. Refer to TRIM AND TILT REPLACEMENT on p. 352.

Remove and discard steering shaft locknut.



30738

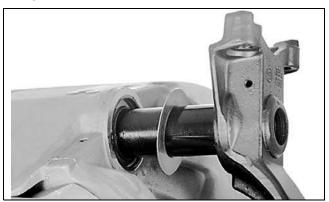
Remove the lower mount bracket and keeper.



Lower mount bracket - 20" Models

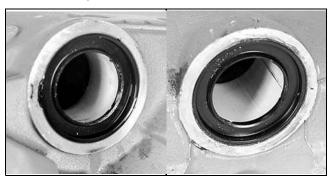
STERN BRACKET, 75 - 90 HP POWER TILT

Remove the steering shaft and thrust washer. It may be necessary to tap the st eering shaft out using a wood dowel and mallet.



30735

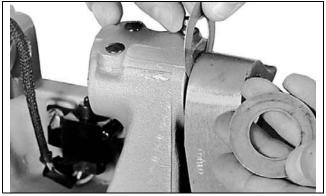
Pry out upper and lower steering shaft seals and discard. Remove the upper and lower steering shaft bushings.



30765 / 30764

Remove the tilt tube. Refer to **TILT TUBE**, **75 – 90 HP** on p. 241.

Remove the two tilt tube washers.



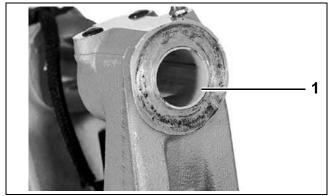
30763

Remove the anode.



1. Anode 30762

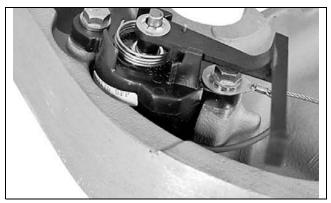
Remove the swivel bracket. Inspect and, if necessary, replace the tilt tube bushings.



1. Tilt tube bushing

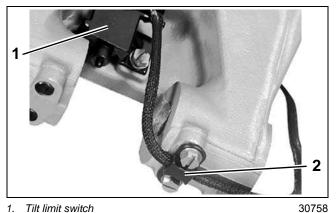
30761

Remove the trim sen der unit from the port ste rn bracket an d p ull it s wire s through t he braided tube.



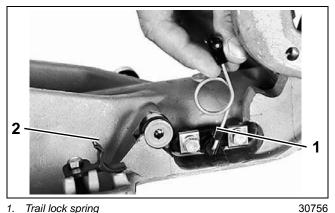
30760

Remove the tilt limit switch and retainer from the swivel bracket.



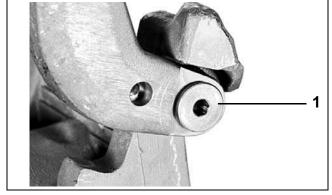
- 1. Tilt limit switch
- 2. Retainer

Disconnect the trail lock spring and remove it from the swivel bracket. Remove trail arm retainer.



- Trail lock spring
- Trail arm retainer

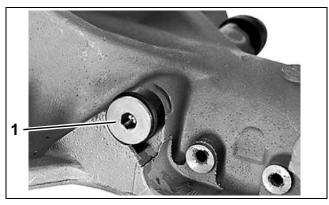
Remove the trail lock arm and b ushings from the swivel bracket.



Trail lock bushing

30755

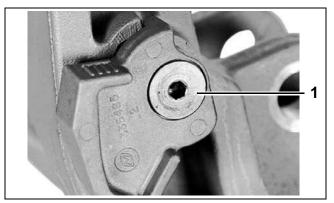
Remove the two trim rod rollers from the swivel bracket.



Trim rod roller

30754

Remove the tilt support and bushing from the swivel bracket and inspect the deten t roller and spring.



1. Tilt support bushing

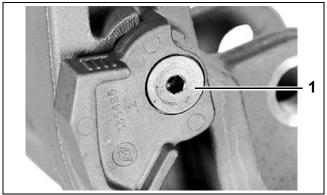
Stern Bracket Assembly

IMPORTANT: Before proceeding, make sure all components h ave b een tho roughly clean ed. Replace any seals t hat have been removed. Inspect all thru st washers and bu shings for evidence of deterioration.

Install the detent roller and spring and the tilt support with bushing in the swivel bracket. Tighten bushing to a torque of 28 to 30 f t. lbs. (38 to 41 $N \cdot m$).



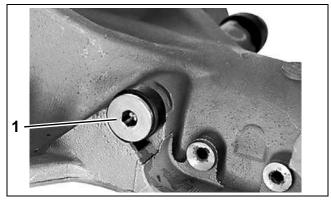
30752



. Tilt support bushing

30753

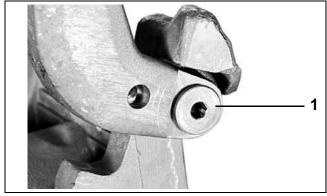
Install the two trim rod rollers on the swivel bracket. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



1. Trim rod roller

30754

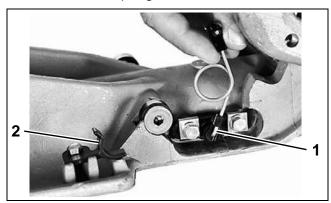
Install the trail lock and bushings in the swivel bracket. Tighten to a torque of 216 to 240 in. lbs. (25 to 27 N·m).



1. Trail lock bushing

30755

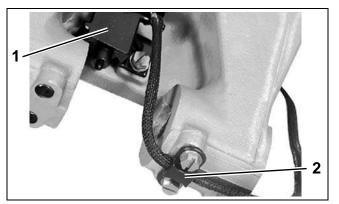
Install the trail lock spring in the swivel br acket and connect the spring to the trail lock.



Trail lock spring
 Trail arm retainer

11

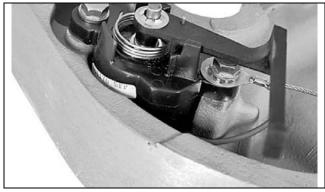
Install the tilt limit switch and retainer on the swivel bracket. Tighten screws to a torque of 40 to 50 in. lbs. (4.5 to 5.5 N·m).



- 1. Tilt limit switch
- 2. Retainer

30758

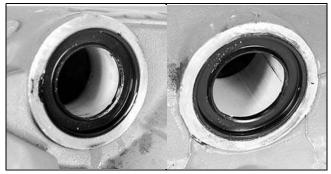
Route the trim sende r wires th rough the braided tube, and inst all the sen der unit in the port stern bracket.



30760

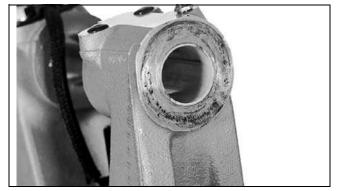
Install the upper and lower steering shaft bushings and new seals in the swivel bracket. Both seal lips face out.

 Coat the outside surfaces of seals with Gasket Sealing Compound. Coat the bushing s and sea I lip s with Triple-Guard grease.



30765 / 30764

Coat tilt tu be bushin gs with *Triple-Guard* grease and, if removed, install them in the swivel bracket.

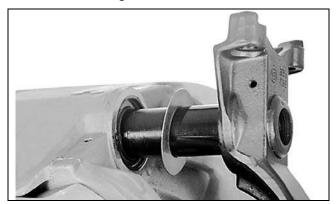


30761

Place the swivel bracket between the stern brackets and install the anode.

Install the tilt tube and tilt limit cam. Refer to **TILT TUBE**, **75 – 90 HP** on p. 241.

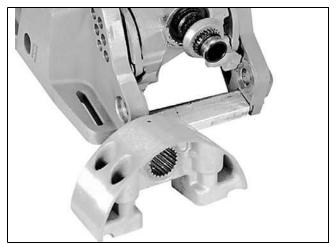
Install the steering shaft and thrust washer.



30735

STERN BRACKET, 40 - 60 HP MANUAL TILT

Install the steering shaft keep er. Ap ply 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 unst aked side facing the mo bracket. Align the bracket with the st eering arm and tighten the nut to a torque of 130 to 150 ft. lbs. (176 to 204 N·m).



Fill the swivel bracket wit h Triple-Guard grease through the gre ase fit ting on the bracket's port side. Lubricate the tilt tube, swivel bracket, and stern brackets through the two forward grease fittings.

Install the e xhaust housing. Refer to **Exhaust** Housing Installation on p. 247.

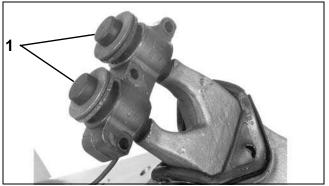
STERN BRACKET, 40 – 60 HP Manual Tilt

Clamp Screw Service

Inspect clamp screw assemblies). Replace swivel plate and retainer if bent or loose. To install a new swivel plate, remove screw and old plate. Apply Locquic Primer to t he thre ads of the screw a nd allow it to dry four to five minut es. Then apply Ultra Lock to threads. Install a new swivel plate with screw and tighten securely.

Stern Bracket Disassembly

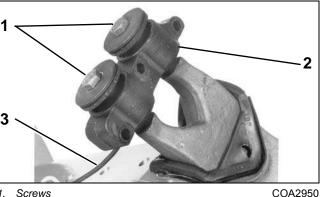
Remove bumpers from the upper mount retaining screws.



1. Bumpers

COA2949

Remove screws, upper mount, and grou nd lead from the bracket.

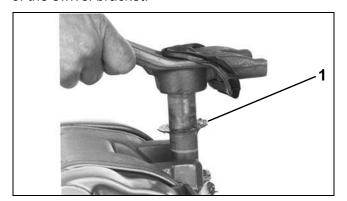


Screws

Upper mount

Ground lead

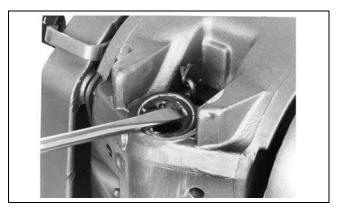
Slide the pivot sha ft and upper thrust washer out of the swivel bracket.



1. Upper thrust washer

COA2956

Use an appropriate tool to pry the upper and lower seals from the swivel bracket.

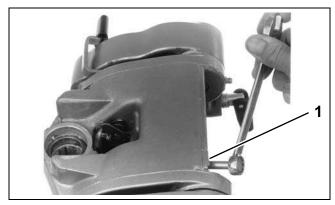


COA2957



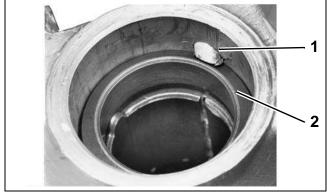
COA2958

Loosen the steering friction screw while pu shing outward on the steering friction pin. When the pin is flush with the inside surface of the ca sting, remove the steering friction thrust ring.



1. Steering friction screw

COA2959

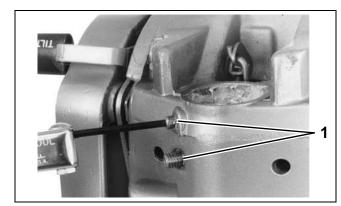


Steering friction pin
 Steering friction thrust ring

COA2988

Tighten the ste ering friction screw until the ste ering friction pin can be removed. Then, remove the steering friction screw.

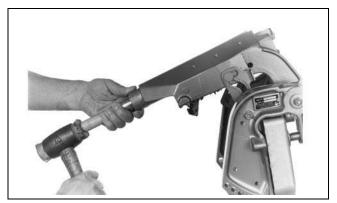
Remove the two set screws from the swivel bracket.



1. Setscrews COA2961

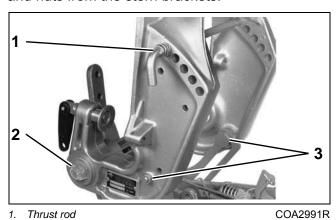
STERN BRACKET, 40 - 60 HP MANUAL TILT

Drive the steering friction bushing up and out of the swivel bracket.



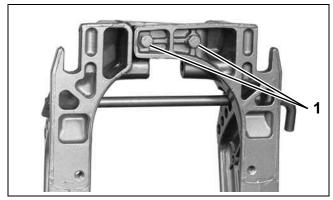
COA2974

Remove the thrust rod fro m the stern b rackets. Remove on e tilt tube nut, and remo ve tilt tube from the ste rn bracket s and swivel bracket. Remove the port and st arboard stop link screws and nuts from the stern brackets.



- Thrust rod
- Tilt tube nut
- Stop link screw and nut

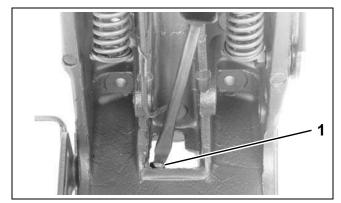
Remove the two stern bracket flange screws and separate the stern bracket s from the swive bracket.



1. Flange screws

COA2992

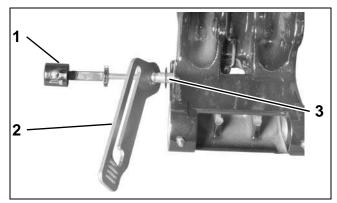
Place the tilt/ru n lever in the RUN positio n. Loosen the bellcrank setscrew.



1. Bellcrank setscrew

COA2976

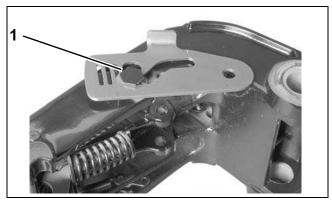
Remove the tilt/run lever, port stop link, and bushing from the swivel bracket.



- Tilt/run lever
- Port stop link
- Bushing .

11

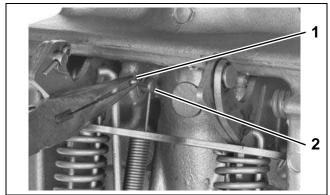
Remove the st arboard sto p link retaining screw and nut from the swivel bracket.



1. Starboard stop link screw

002205

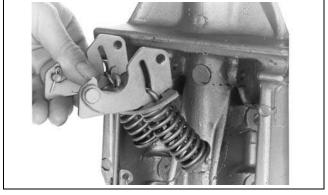
Remove the co tter pins from both reverse lock pins. Remove the reverse lock pins and springs.



- Cotter pin
- 2. Reverse lock pin

COA2979

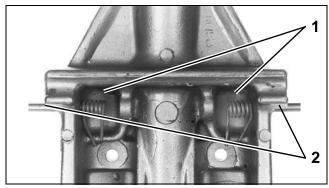
Remove the reve rse loc k assembly from the swivel bracket.



COA2980

Stern Bracket Assembly

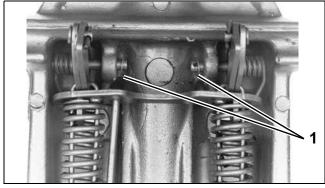
Place the reverse lock springs in the swive I bracket. Insert the reverse lock pins in the swive I bracket and part way through the reverse lock springs. Place the reverse lock assembly between the springs. Push the pins through the springs and the reverse lock assembly.



- 1. Reverse lock springs
- 2. Reverse lock pins

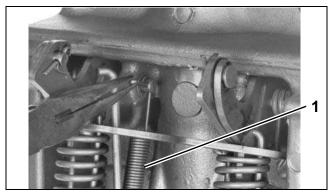
COA2981

Install the washers on the reverse lock pins. Install the link spring on the port pin. Install the two cotter pins in the reverse lock pins.



Washers

COA2982

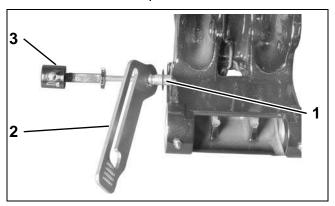


1. Link spring

COA2979

STERN BRACKET, 40 - 60 HP MANUAL TILT

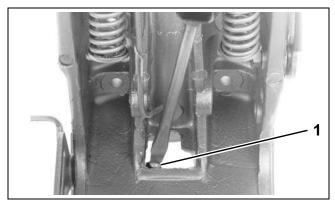
Install the bushing, the port stop link, and the tilt/run lever in the swivel bracket. The tilt/run lever should be in the RUN position.



- 1. Tilt/run lever
- 2. Port stop link
- 3. Bushing

002204

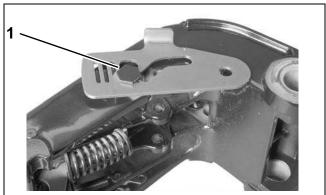
Install the wave washer and the bellcrank on the tilt/run shaft. Tighten the setscrew.



1. Bellcrank setscrew

COA2976

Install the st arboard stop lin k on the swivel bracket. Install and tighten the screw and th e nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).



1. Starboard stop link screw

002205

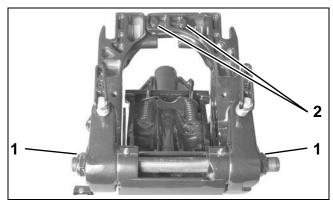
Place the swivel bracket between the stern brackets

Install the tilt tube through the following parts and install the tilt tube nuts loosely:

- Starboard stern bracket
- Thrust washer
- Bushing
- Swivel bracket
- Bushing
- Thrust washer
- Port stern bracket

Apply *Nut Lock* to threads of the two flange screws. Install the two screws through the st arboard st ern bra cket fla nge into the port stern bracket flange. Tighten the screws to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

Tighten the tilt tube nuts to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).



Tilt tube nuts
 Flange screws

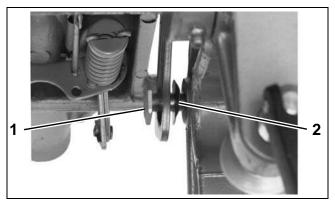
002206

Install the thrust rod in the stern brackets.

Install the larger shoulder screw through the port stop link, wave washer, and port stern bracket.

11

Install and tighten the nut to a torque of 144 to 168 in. lbs. (16 to 19 N·m).

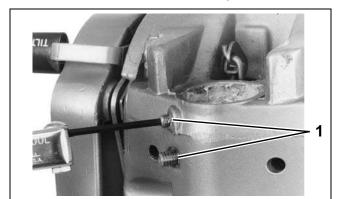


- 1. Port stop link screw
- 2. Wave washer

COA2984

Install the smaller sh oulder screw throu gh the starboard stop link and stern bracket. Install and tighten the nut to a torque of 144 to 168 in. lbs. (16 to 19 $N \cdot m$).

Apply *Ultra Lock* to th reads of large set screws. Install the screws in the swivel bracket so that one thread remains outside the casting.



1. Setscrews COA2961

Place the steerin g friction bu shing in the swivel bracket with groove in line with the setscrews.



COA2986

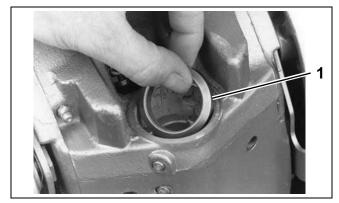
Apply *Triple-Guard* grease to the steering friction pin. Install the pin in the swivel bracket flush with inside surface. The pin should point up.



1. Steering friction pin

COA2988

Install the st eering friction thrust ring, bevel sid e up, in the swivel bracket. Thread the steering friction screw in the swivel bracket . Turn the screw until the steering friction pin makes contact with top of the thrust ring. Do not tighten the screw.



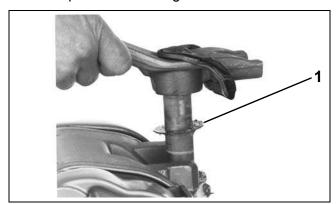
1. Steering friction thrust ring

COA2987

STERN BRACKET, 40 - 60 HP MANUAL TILT

Install new upper and lower seals in the swivel bracket with lip s of sea ls facing away from the bracket.

Slide the upper thrust washer on the pivot shaft. Slide the pivot shaft through the swivel bracket.



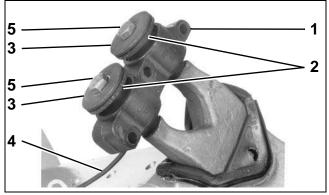
Upper thrust washer

COA2956

COA2950

Lubricate the swivel bracket through the four lubrication fittings with Triple-Guard grease.

Apply Nut Lock to threads of the upper mount to steering arm screws. Positio n the uppe r rubber mount, the upper mount washers, and the retaining wa shers on the ste ering arm with the word "UP" on the mount facing up. Be sure to place the ground lead be tween the mount (starboard side) and the steering arm. Install and tighten the mount retaining screws to a torque of 24 to 26 f t. lb s. (32.5 to 35 N·m).



- Upper mount
- Upper mount washers
- Retaining washers
- Ground lead
- Retaining screws

Place the mount screw bumpers on the up per mount screws.

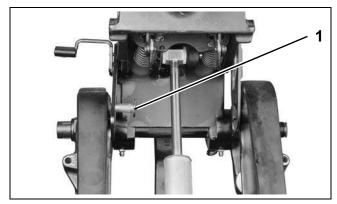
Tilt Assist Cylinder

The tilt assist cylinder can be replaced without disassembly of the stern brackets.

A WARNING

Support the outboard with a suitable hoist.

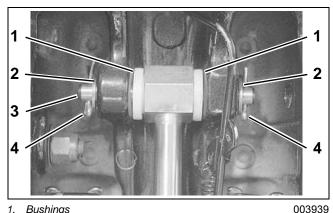
Remove port stop link screw. Push port stop link down to clear upper pivot pin access hole.



1. Stop link screw

006651

Remove both cotter pins and washers. Use appropriate tool to remove upper pivot pin.

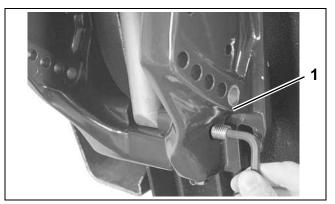


- **Bushings**
- Washers 2.
- Pivot pin
- Cotter pins

The starboard stern bracket includes an access hole for the lower tilt pin.

11

Remove set screw fro m starboard stern b racket lower pivot pin access hole and use an appropriate tool to remove lower pivot pin.



1. Lower pivot pin access hole

004260

If lower pivot cannot be removed because of corrosion or damage, stern brackets may need to be disassembled.



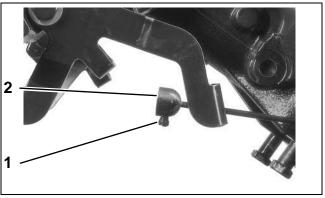
003940

Assembly is the reverse of disassembly. Install **new** cotter p ins in upper pivot pin. Install a **new** set screw in starboard stern bracket lower pivot pin access hole and tighten securely.

STERN BRACKET, 90 HP Manual Tilt

Stern Bracket Disassembly

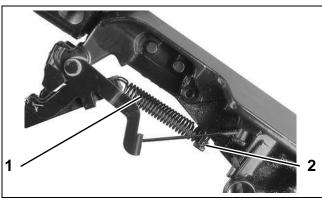
Loosen set scre w a nd remove reve rse lock release collar.



- Set screw
- 2. Reverse lock release collar

006697

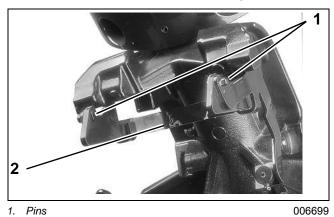
Remove re verse lock springs from locking lever and reverse lock spring screws.



- . Reverse lock springs
- Reverse lock spring screws

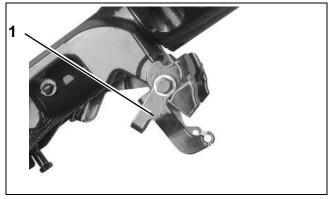
STERN BRACKET, 90 HP MANUAL TILT

Remove cotter pins, pins and locking lever.



- Pins Locking lever 1. 2.

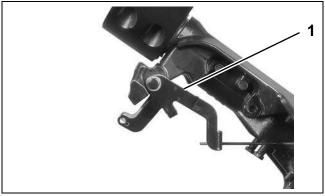
Remove port reverse lock link.



Port reverse lock link

006695

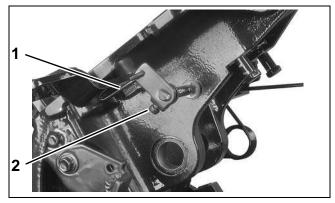
Remove starboard reverse lock link.



1. Starboard reverse lock link

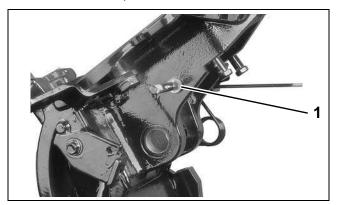
006696

Loosen bellcrank set screw, remove bellcrank and handle link rod.



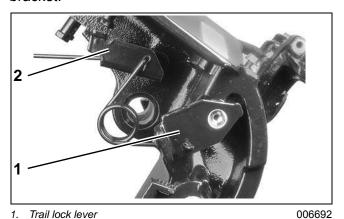
- Bellcrank set screw Handle link rod

Remove retaining ring and bellcrank shaft spacer from reverse lock pivot shaft.



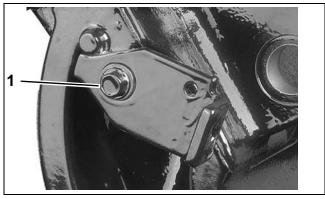
1. Retaining ring 006693

Remove screw from trail lock lever. Remove trail lock lever and reverse lock pivot shaft from swivel bracket.



- Trail lock lever
- Reverse lock pivot shaft

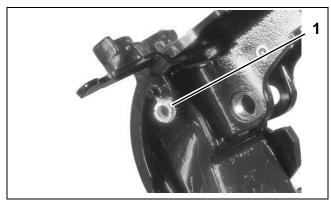
Remove port trail lock lever and trail lock shaft as an assembly.



Port trail lock lever and shaft

006704

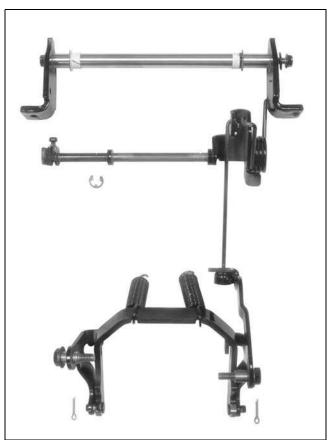
Remove port and starboard trail lock shaft bushings from swivel bracket.



Trail lock shaft bushings

Stern Bracket Assembly

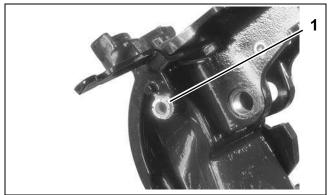
Reverse Lock and Trail Lock Reference



1. Component reference view 2

006686

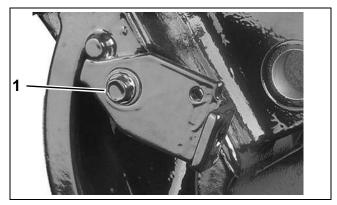
Place port and starboard trail lock shaft bushings in the swivel bracket.



1. Trail lock shaft bushings (port side shown)

006687

Apply blue *Nut Lock* to screw and assemble port trail lock le ver on tra il lo ck shaf t wi th screw, washer and nylon washer. Install in swivel bracket from port side. DO NOT tighten screw at this time.

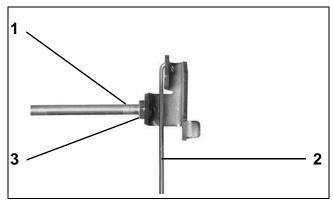


1. Port trail lock lever and shaft

006704

Refer to Reverse Lock and Trail Lock Reference on p . 268 for correct orientation of re verse lock and trail lock components.

Assemble reverse lock pivot shaft, reverse lock lever rod and bellcrank shaft spacer as shown.

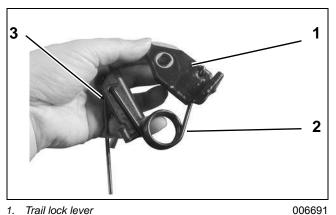


1. Reverse lock pivot shaft

Reverse lock lever rod

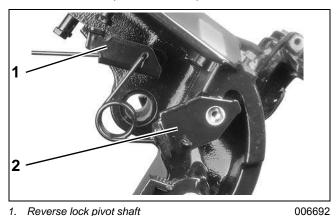
3. Bellcrank shaft spacer

Assemble starboard trail lock lever and trail lock spring to reverse lock pivot shaft.



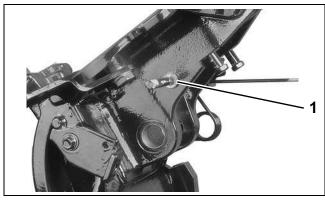
- Trail lock lever 1.
- Trail lock spring 2.
- Reverse lock pivot shaft and rod

Install nylon wa sher on trail lock shaft and install above components into swivel bracket. Install trail lock wash er, ap ply blue Nut Lock to screw a nd install screw. Tighten both screws to a torq ue of 60 to 84 in. lbs. (7 to 9.5 N·m).



- Reverse lock pivot shaft
- Trail lock lever

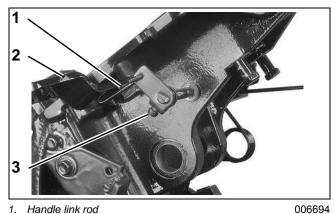
Install remaining bellcrank shaft spacer on reverse lock pivot shaft, then install retaining ring.



Retaining ring

006693

Install the handle link rod to reverse lock lever and bellcrank. Install b ellcrank on reverse lock pivot shaft. Tighten the setscrew.

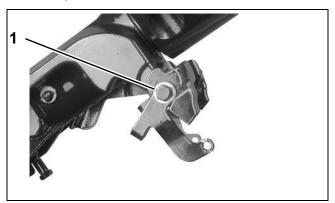


- Handle link rod
- Reverse lock lever 2.
- Bellcrank setscrew

Install the port re verse lock link on the swive I bracket. Install washer screw. Apply blue Nut Lock to screw thre ads and in stall washer and screw.

STERN BRACKET, 90 HP MANUAL TILT

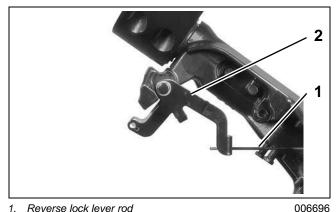
Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.54 N·m).



Port reverse lock link

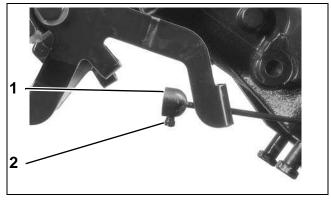
006695

Place reverse lock lever rod through hole at top of starboard reverse lock lever. Install the starboard reverse lock link on the swivel bracket. Apply blue Nut Lock to screw threads and install washer and screw. Tighten screw to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



- Reverse lock lever rod
- Starboard reverse lock link

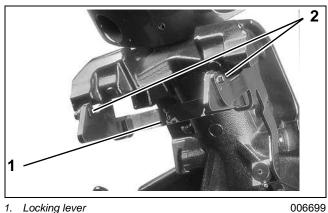
Install reverse lock release collar and tighten set



- Reverse lock release collar
- 2. Set screw

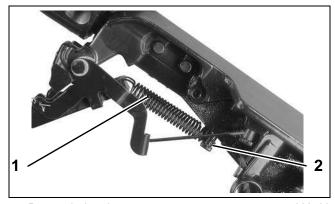
006697

Install locking lever, pins and new cotter pins.



- Locking lever
- Pins

Install reverse lock springs on locking lever a nd reverse lock spring screws.



- Reverse lock springs
- 2. Reverse lock spring screws

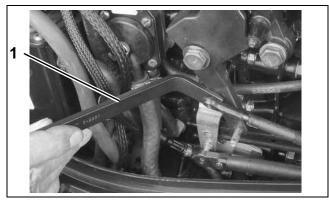
TILLER HANDLE SERVICE - Standard

Removal

WARNING

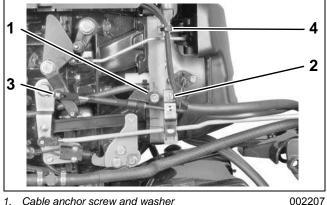
To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

Use Ball Socket Remover tool, P/N 342226, to unsnap the throt tle cable clip from t he thrott le lever.



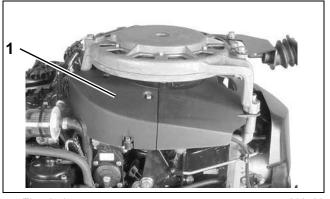
Remover tool 005121

Remove the th rottle cable anchor scre wand washer. Loosen throttle cable retainer screw. And, remove the tie strap holding the tiller handle electrical harness.



- Cable anchor screw and washer
- Cable retainer screw
- Clip
- 4. Tie strap

Remove the electrical cover.



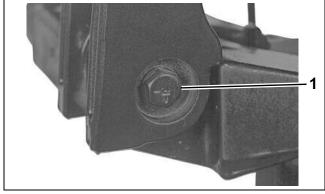
Disconnect the electrical harness coming from the tiller handle.



Electrical harness connector

Remove throttle cable and wires from grommet in lower engine cover.

Remove the scre w attaching steering h andle. Remove handle.



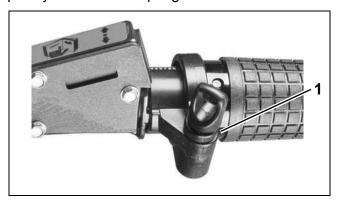
1. Screw 31194

TILLER HANDLE SERVICE - STANDARD

Disassembly

Loosen throttle friction control so th ere is no restriction on grip.

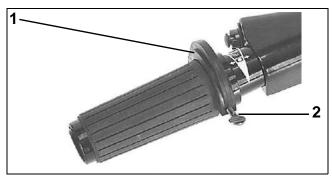
IMPORTANT: Do not back screw out co mpletely. Nut is under spring tension.



Throttle friction control

001259

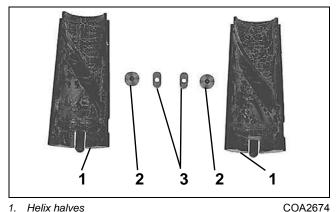
Use Twist-Grip Remover, P/N 390767, to depress the grip de tents. Tighten screw and remove the grip by pulling grip.



Twist-Grip Remover

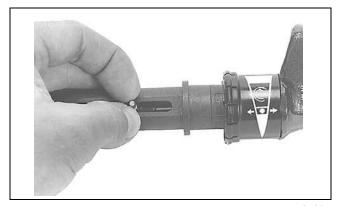
002189

Remove the helix halves, rollers, and guides.



- Helix halves
- Rollers
- Guides

Pull the throttle pin out of the cable.



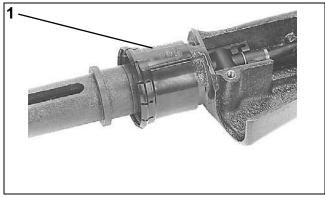
24294

Remove stop switch cover screws and cover/stop switch assembly.



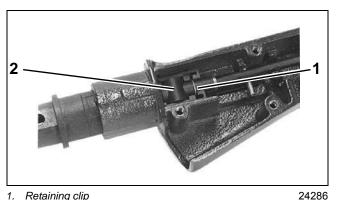
24288

Remove the throttle control plate.



1. Throttle control plate

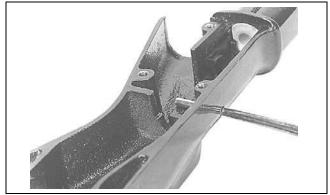
Remove the throttle cable retaining clip. Pry the cable trunnion o ut of t he steerin g han dle a nd remove cable.



- Retaining clip
- Cable trunnion

IMPORTANT: DO NOT remove the inner handle except to replace it.

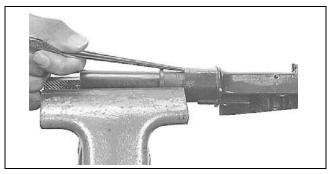
Use a punch and mallet to drive ou t the steel p in holding the inner handle into the steering handle.



24285

Remove the plastic inner handle from the metal outer handle by driving the outer handle off with a mallet and a punch. Inner handle is bonded to the

outer handle. After removing, chip away remnants of inner handle.



24284

Remove throttle cable seal from the inner handle.

Inspection

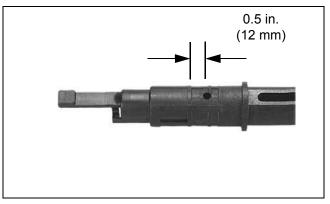
Inspect the thrott le ca ble for kinks and wea r. Replace if necessary.

Inspect the steering handle components for wear, cracks, or damage. Replace parts if necessary.

Assembly

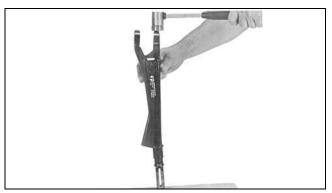
Install the throttle cable seal in inner handle.

If removed, apply Loctite Depend 300 adhesive to inner handle at areas shown.



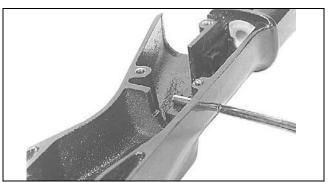
TILLER HANDLE SERVICE - STANDARD

Install the metal outer handle over the plastic inner handle and drive the outer handle into place.



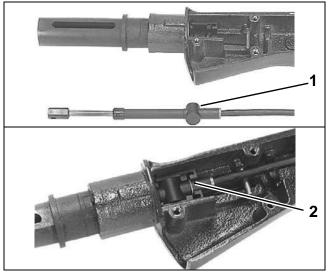
31202

Secure tab of the inner handle into recess of the outer handle with the steel pin.



24285

Install the handle end of the throttle cable. Snap the throttle cable trunnion into the recess in the handle. Install the retainer clip.

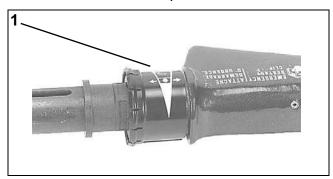


1. Throttle cable trunnion

2. Retainer clip

24282 24286

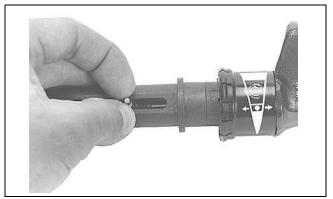
Install the throttle control plate on outer handle.



1. Throttle control plate

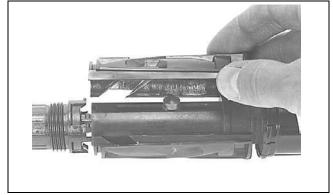
24295

Push the throttle cable pin through the end of the throttle cable.



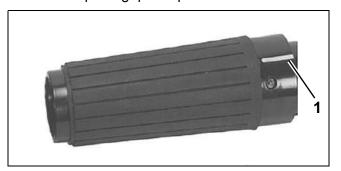
24294

Lubricate e nd of t he pin, guides, rollers, h elix grooves, and inner handle guide slot with *Moly Lube*. Place the guides over the roller pin and into the slots of the inner handle. Place the rollers on the ends of the eroller p in. Assemble the h elix halves on the handle and slide the grip over the helix.



24293

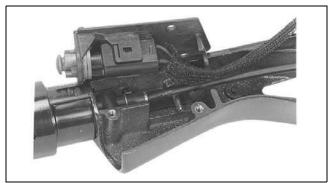
Be sure the twist -grip's spe ed in dicator line is positioned with the speed range symbol on the handle. Snap the grip into place.



1. Indicator line

002190

Slide the protective sle eve over the stop switch leads and throttle cable and inst all stop switch cover.



24291



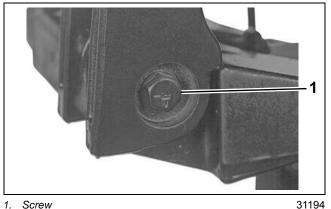
24288

Installation

Apply Triple-Guard grease to the two steering handle bushin gs. Place the bushin gs into the steering bracket. Attach the steering handle to the bracket. Tighten screw to a torqu e of 36 t o 40 ft. lbs. (49 to 54 N·m).

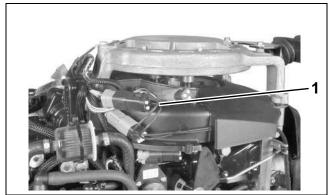
A CAUTION

The steering handle nut must have a nylon patch for locking. Replace the nut if it has lost its locking feature. Tighten the nut so the steering handle can be pivoted and maintained in any position.



1. Screw

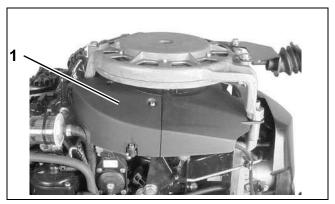
Route t hrottle cab le and electrical ha through grommet in lo wer motor cover. Connect harness to engine wiring harness.



Electrical harness connector

TILLER HANDLE SERVICE - STANDARD

Install electrical cover.



002509

Throttle Cable Adjustment

Place throttle cable in position. Use Ball Socket Installer too I, P/N 342225, to snap t hrottle cable connector onto throttle lever.



Installer tool

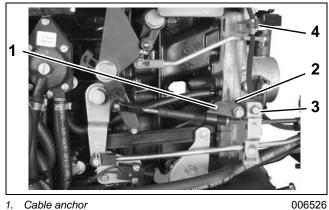
Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle bod y boss. Then, rotate anchor four turns to ward the end of the cable.

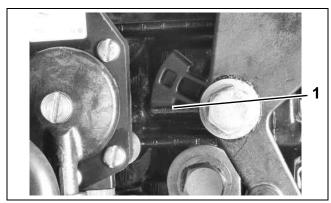
Install washer, cable a nchor, and cable anchor screw on t hrottle bod y boss. T ighten screw securely.

Secure electrical harness with tie strap.



Cable anchor

- 2. Boss
- Cable retainer
- Tie strap



Throttle lever stop

005114



Turn anchor four turns toward cable end.

006564

IMPORTANT: Rotate twist grip. Make sure throttle cam goes to full throttle without bending cable, and still returns to IDLE stop.

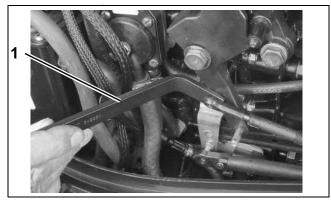
TILLER HANDLE **SERVICE – Long Handle**

Removal

WARNING

To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

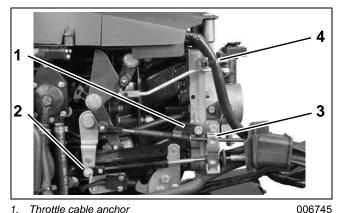
Use Ball Socket Remover tool, P/N 342226, to unsnap the throt tle cable clip from t he thrott le lever.



Remover tool

Remove the th rottle cable anchor scre wand washer. Loosen throttle cable retainer screw. And, remove the tie strap holding the tiller handle electrical harness.

Remove retainer clip from shift cable.

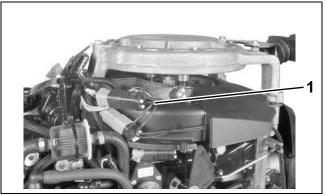


- Throttle cable anchor
- Shift cable retainer clip
- Cable retainer
- Tie strap

Remove the electrical cover.

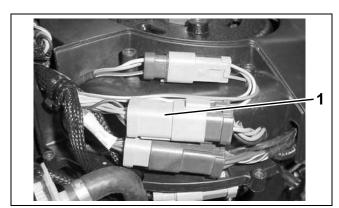


Disconnect the electrical harness coming from the tiller handle.



Rope Start models Electrical harness connector

002511



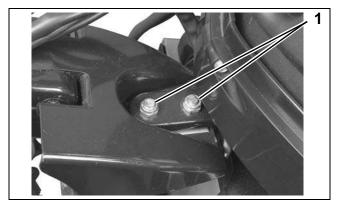
Tiller Electric models Electrical harness connectors

001999

Remove shift and throttle cables and wire harness from grommet in lower engine cover.

TILLER HANDLE SERVICE - LONG HANDLE

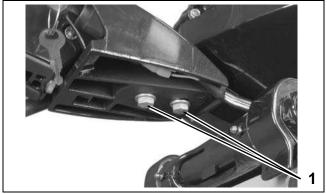
Remove locknuts from screws on top of steering arm.



1. Screw

006362

Remove the screws attaching tiller bracket to steering arm. Remove tiller bracket and handle.



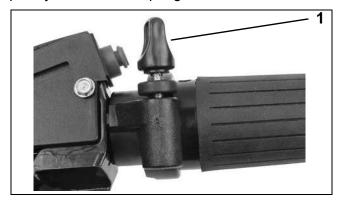
1. Screw

006361

Disassembly

Loosen th rottle frict ion control so the re is no restriction on grip.

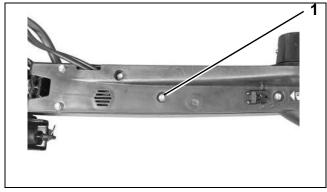
IMPORTANT: Do not back screw out completely. Nut is under spring tension.



1. Throttle friction control

006711

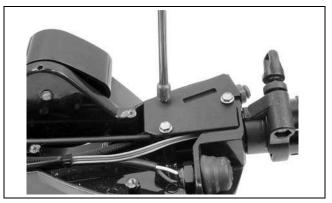
Remove seven screws and bottom cover of tiller handle.



1. Cover screw

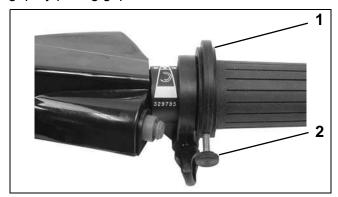
006566

Remove stop switch cover s crews, un plug st op switch electrical connector and remove st op switch assembly.



Disconnect trim switch connector. Remove connector from trim switch wires. Refer to CONNEC-TOR SERVICING on p. 116.

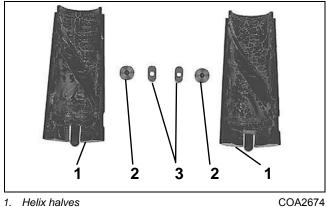
Use Twist-Grip Remover, P/N 390767, to depress the grip de tents. Tighten screw and remove the grip by pulling grip.



- Twist-Grip Remover
- Screw

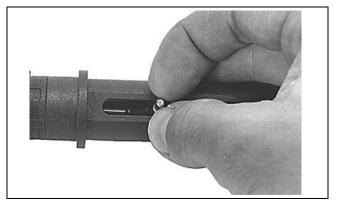
006710

Remove the helix halves, rollers, and guides.



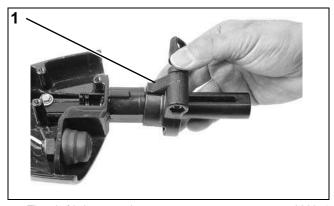
- Helix halves 1.
- 2. Rollers
- Guides

Pull the throttle pin out of the cable.



006712

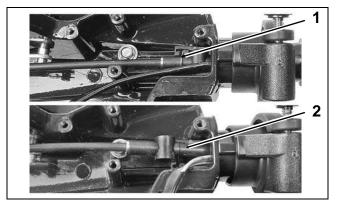
Remove the throttle friction control.



Throttle friction control

006671

Remove the thro ttle cable ret aining clip. Pry the cable trunnion ou t of the st eering hand le and remove cable.



Throttle cable trunnion

006674

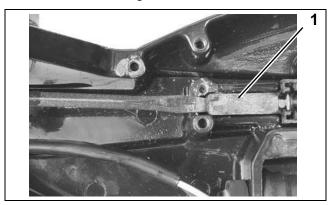
The trim switch wiring can now be removed from the inner handle.

Remove the screw and washer retaining the inner handle tab.



TILLER HANDLE SERVICE - LONG HANDLE

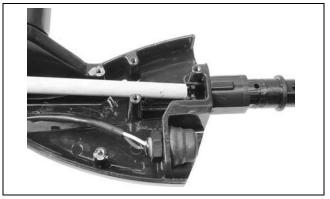
Use an appropriate tool to carefully pry up on the inner handle retaining tab.



Inner handle retainer tab

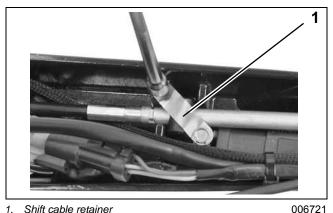
006679

Use a wooden dowel and a soft mallet to remove the inner handle.



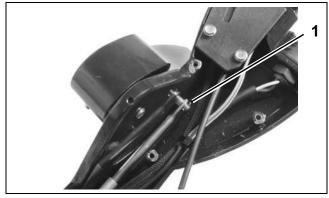
006678

Remove shift cable retainer from shift cable trunnion.



1. Shift cable retainer

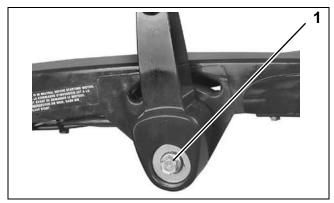
Remove cotter pin from shift handle pin. Remove shift cable.



1. Cotter pin

006708

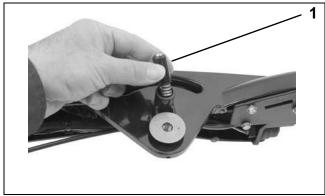
Remove shift handle screw and washer. Remove shift handle, bushing and washer.



1. Shift handle screw

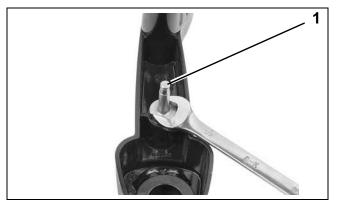
006714

Remove shift handle detent ball, spring and guide.



Detent ball, spring and guide

Remove the shift pin if necessary.



1. Shift pin

Inspection

Inspect the thro ttle cable fo r kin ks an d we ar. Replace if necessary.

Inspect the shift cable for kinks and wear. Replace if necessary.

Inspect the steering handle components for wear, cracks, or damage. Replace parts if necessary.

Assembly

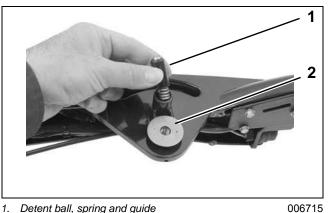
Apply Nut Lock to th reads of shift pin and install shift pin into shift handle. Tighten to a torque of 18 to 22 ft. lbs. (24.5 to 29 N·m).



1. Detent ball, spring and guide

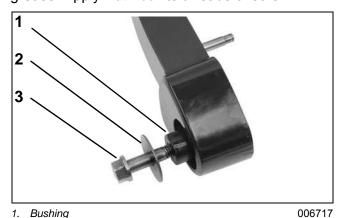
006716

Coat de tent ball, spring a nd guide with Guard grease and install into shift handle. Place one washer on shift handle mounting boss.



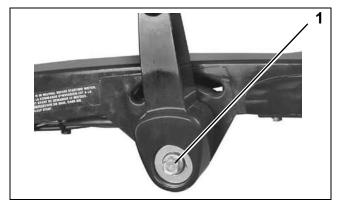
- Detent ball, spring and guide
- Washer

Coat bushing an d washer with Triple-Guard grease. Apply Nut Lock to threads of screw.



- Bushing
- Washer
- Screw

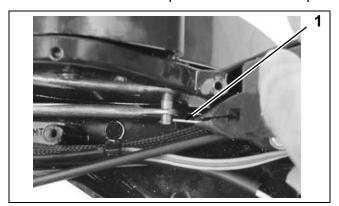
Install shift handle on tiller handle and tighte n screw to a torq ue of 18 to 20 ft. lbs. (24.5 to 27 N·m).



1. Shift handle screw

TILLER HANDLE SERVICE - LONG HANDLE

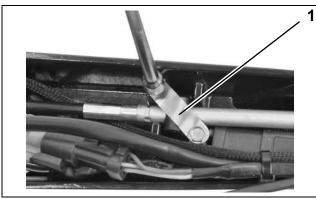
Install shift cable on shift pin with a new cotter pin.



1. Cotter pin

006720

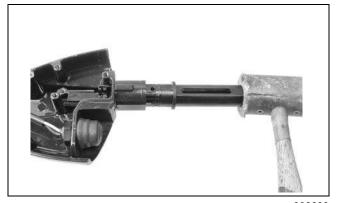
Install shift cable retainer on shift cable trunnion.



1. Shift cable retainer

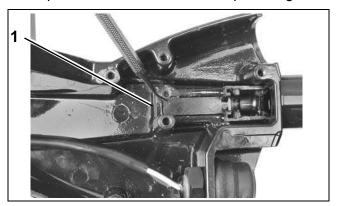
006721

Use a soft-faced mallet to install the inner handle.



006680

Secure tab of the inner handle into the outer handle. Tab must be flush with the back of the flange and top of tab must be flush with top of flange.

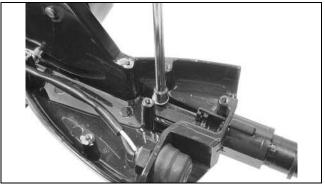


1. Back of flange

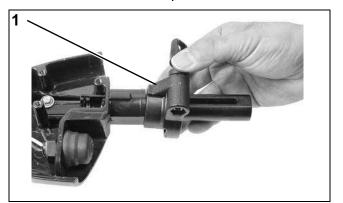
006682

Apply *Nut Lock* on the screw threads, install the washer and screw.

IMPORTANT: Turn se If-tapping screw counterclock-wise until th reads of screw en gage threads of screw boss. Failure to follow this procedure will damage the screw boss th reads. Once threads are engaged, tighten screw so that there is no space between tab, washer and screw. Top of tab MUST be flush with top of flange.



Install the throttle control plate on outer handle.



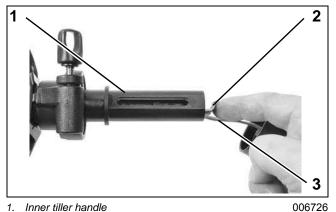
Throttle friction control

006671

Install trim switch wiring t hrough in ner steering handle.

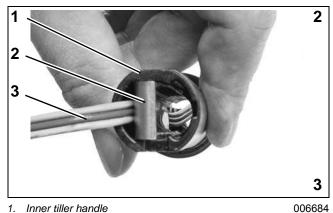
IMPORTANT: Trim switch wiring m ust NO T be twisted through the throttle twist grip or inner tiller handle / wire guide.

Insert wire guide into inner steering handle.



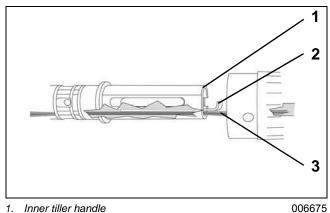
- Inner tiller handle
- Wire guide 2.
- Trim switch wires

Wire guide should slide easily into place. If any binding is felt, inspect trim switch wirin g for twisting. If wire guide is forced into place, it WILL damage trim switch wiring.



- 1. Inner tiller handle
- Wire guide
- Trim switch wires

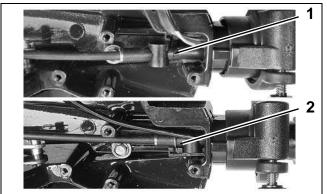
switch wi ring is NOT twiste d Make sure trim before proceeding.



- Inner tiller handle
- 2. Wire guide
- Trim switch wires

TILLER HANDLE SERVICE - LONG HANDLE

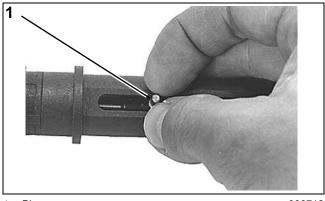
Install the handle end of the throttle cable. Snap the throttle cable trunnion into the recess in the handle. Install the retainer clip.



- Throttle cable trunnion
- Retainer

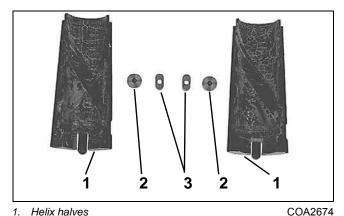
006683

Push the throttle cable pin through the end of the throttle cable.



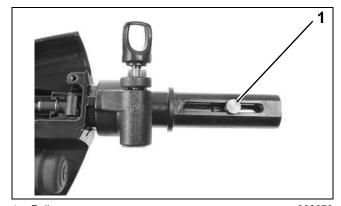
1. Pin 006712

Lubricate end of the pin, guides, rollers, helix halves, an d inne r handle guide slot with Moly Lube.



- Helix halves
- 2. Rollers
- Guides

Place the guides over the roller p in and into the slots of the inner handle. Place the rollers on the ends of the roller pin.



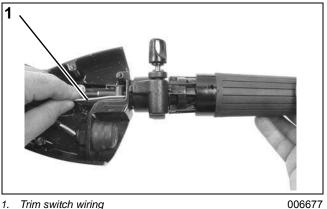
Roller 006670

Assemble the helix halves on the handle and slide the grip over the helix.



006718

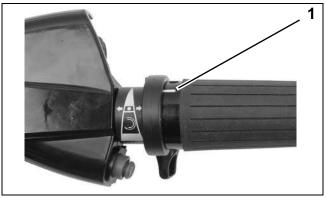
Carefully pull trim switch wires through inner tiller handle as twist grip assembly is installed.



Trim switch wiring

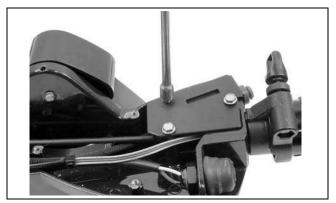
Install trim switch connector. Refer to CONNEC-TOR SERVICING on p. 116.

Be sure the twist -grip's spe ed in dicator line is positioned with the speed range symbol on the handle. Snap the grip into place.



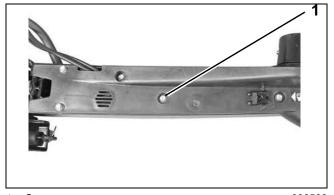
1. Indicator line 006719

Install stop switch assembly and connect to harness.



006713

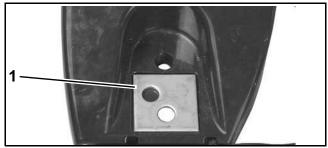
Install b ottom cover of tiller han dle wit h seven screws.



1. Cover screw 006566

Installation

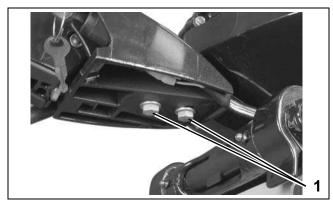
The ste ering arm can be positioned straight, or angled 15° port or starboard by moving the adjustment plate.



1. Plate adjustment for tiller in CENTER position.

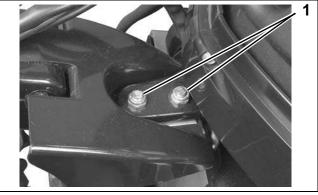
005083

Place tiller bracket on steering arm from the bottom. Thread steering arm screws, with washers, into steering arm and tighten to a tor que of 18 to 20 ft.lbs. $(24.5 \text{ to } 27 \text{ N} \cdot \text{m})$.



1. Screw 006361

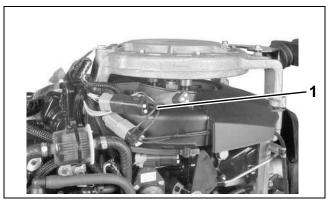
Install locknuts on screws on top of steering arm. Hold screws with wrench and tighten locknuts to a torque of 18 to 20 ft.lbs. (24.5 to 27 N·m).



1. Screw 006362

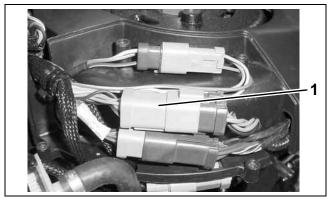
TILLER HANDLE SERVICE - LONG HANDLE

Route shift and throttle cables and electrical harness through grommet in lower motor cover. Connect harness to engine wiring harness.



Rope Start models
1. Electrical harness connector

002511

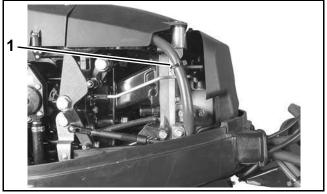


Tiller Electric models

1. Electrical harness connectors

001999

Use tie strap to se cure harness to throttle body bracket.



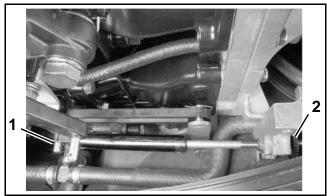
1. Bracket 006314

Control Cable Installation

IMPORTANT: DO NOT complete fina I att achment of cables to shift and throttle levers until all cables, wires, and hoses have been routed and grommet has been placed into the lower engine cover.

Shift Cable Adjustment

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



Shift lever pin
 Trunnion nut

002100

Secure shift cable to the shift lever pin. For proper installation, review the following steps:

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

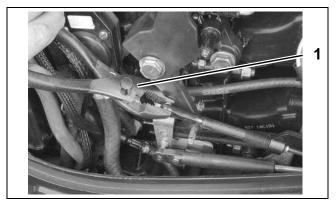


Locked Retainer Clip
1. Angled section behind straight section

DP0817a

Throttle Cable Adjustment

Place throttle cable in position. Use Ball Socket Installer too I, P/N 342225, to snap t hrottle cable connector onto throttle lever.



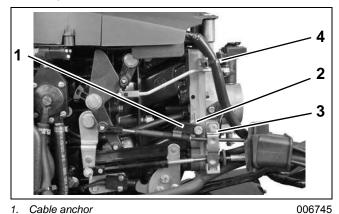
Installer tool

Place throttle cable in upper anchor pocket. Install cable retainer on anchor block.

Hold twist grip in full SLOW position. Pull firmly on cable to remove backlash.

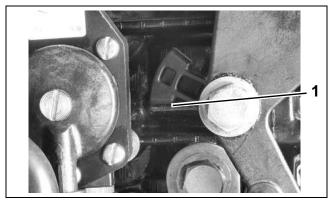
Adjust cable anchor so throttle cam is against idle stop when anchor screw aligns with throttle bod y boss. Then, rotate anchor four turns to ward the end of the cable.

Install washer, cable an chor, and cable anchor screw o n th rottle body b oss. Tighten screw securely.



Cable anchor

- 2. Boss
- 3. Cable retainer
- Tie strap



1. Throttle lever stop

005114



Turn anchor four turns toward cable end.

006564

IMPORTANT: Rotate twist grip. Make sure throttle cam goes to full throttle without bending cable, and still returns to IDLE stop.

NOTES

Technician's Notes Related Documents Bulletins **Instruction Sheets** Other

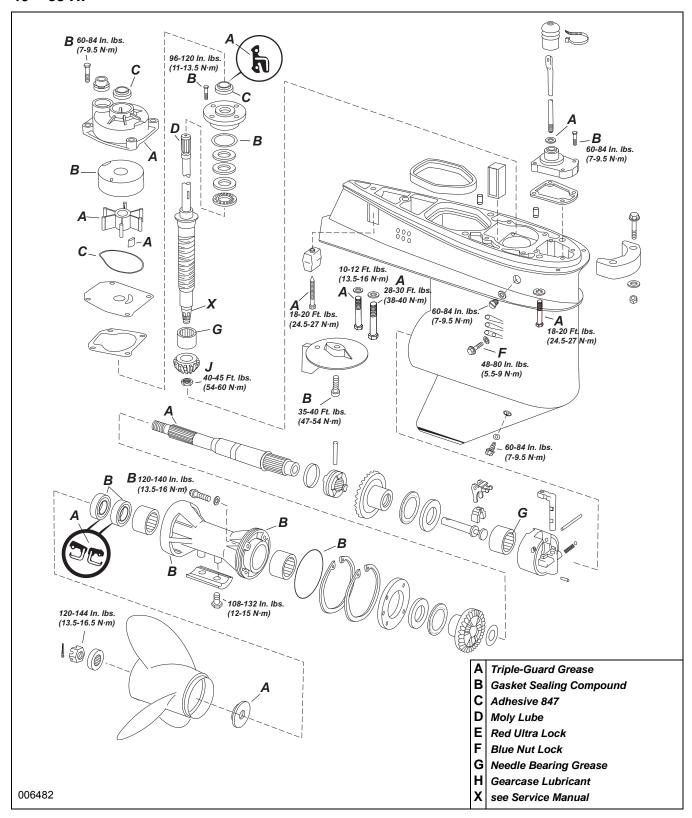
GEARCASE

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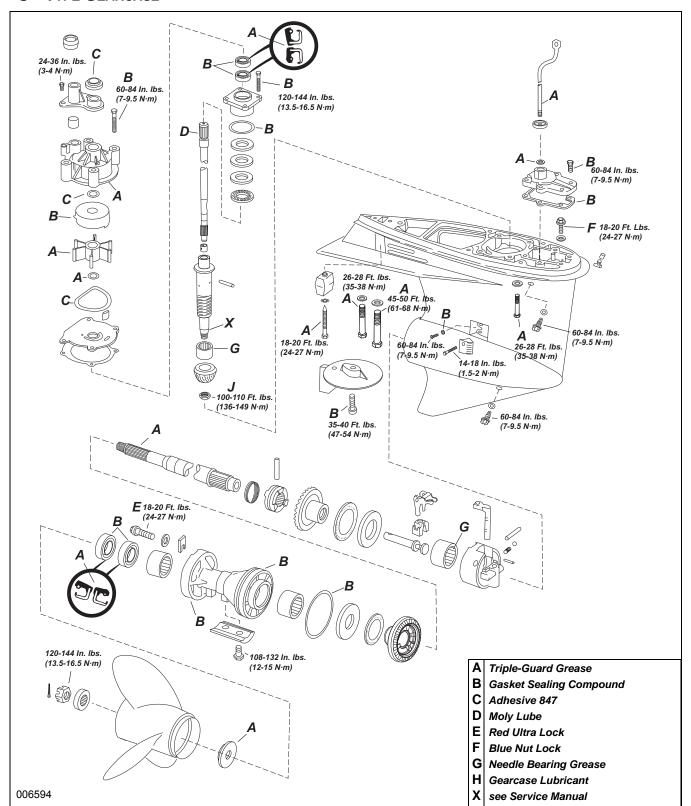
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SERVICE CHARTS

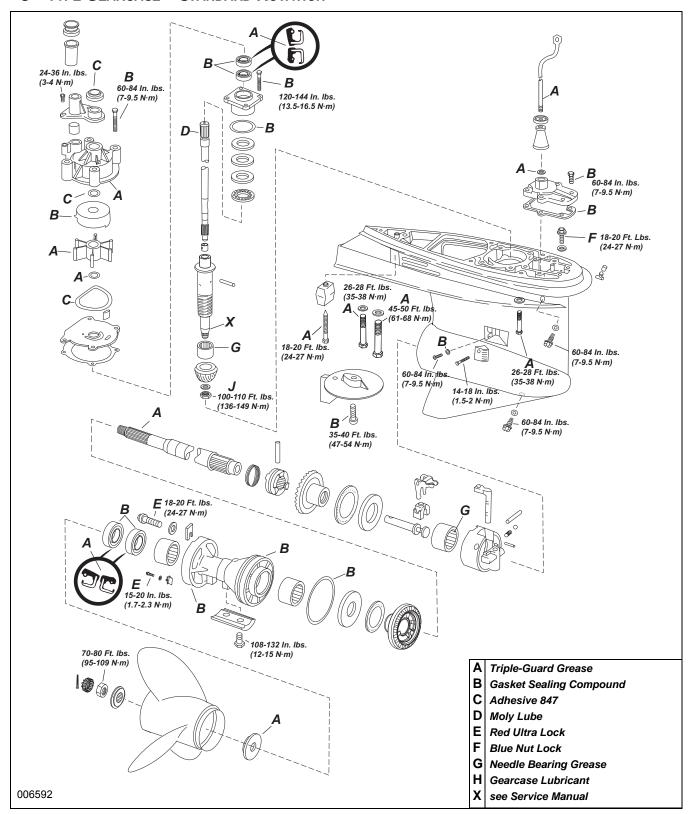
40 – 65 HP



"S"-TYPE GEARCASE



"O"-TYPE GEARCASE - STANDARD ROTATION



GEARCASE TYPES, 75 – 90 HP

Outboard Model	Gearcase Type	General Comparison	Service Procedure Comparison
(L) Models with 20 in. shaft	"S"	Unique housing, shafts, gears, and bearings	Similar
(X) Models with 25 in. shaft	"O"	Unique housing, shafts, gears, and bearings	

PROPELLER SERVICE

Inspection

Carefully examine propeller and outboard for the following:

- Damaged blades and signs of propeller cavitation (burned paint, etc.)
- Spun or overheated inner hub
- Worn or twisted splines and inadequate lub ricant
- 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. 294.

WARNING

When servicing the propeller, always shift the outboard to NEUTRAL, turn the key switch OFF, and disconnect the battery positive (+) cable so the outboard cannot be started accidentally.

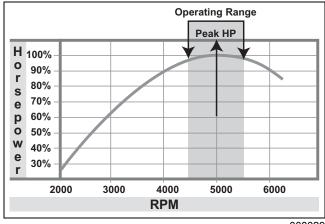
Propeller Selection

A 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 p ropeller designs and sizes is the best method of propeller selection.

The co rrect propeller, und er no rmal lo ad conditions, will allow the engine to run near the midpoint of the RPM oper ating range at full throttle. Refer to **SERVICE SPECIFICATIONS** on p. 10.



008329

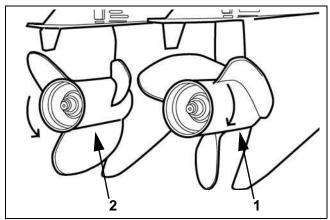
NOTICE If the propeller blades have too much pitch, the engine will operate below its normal range at full throttle. Power will be lost, and powerhead damage could occur. If the propeller blades have too little pitch, the engine will operate above its normal range and damage from overspeeding could occur.

GEARCASE

PROPELLER SERVICE

When selecting a propeller, consider the following:

- Use an accurat e tachometer to determine the engine's full-throttle RPM.
- The outboard should be trimmed for top speed.
- Select a prop eller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle opera ting range when the boat has a normal load.
- Occasionally, one propeller will not cover a wide range of boat application s — 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 style s and sizes.
- Right-hand propellers are considered standard rotation propellers. When propelling a bo at forward, the p ropeller rotates in a right-ha nd (clockwise) direction as viewed from the rear.
- Left-hand pr opellers are considered counterrotation 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

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

IMPORTANT: Depending on propeller style, different thrust bushings, sp acers, and cotter pin keepers are used. See the *Evinrude/Johnson Genuine Parts and Accessories Catalog* for correct propeller hardware.

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

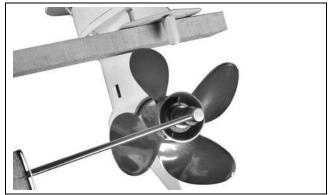
Install thrust bushing onto prop eller shaft with taper of bushing matching taper of shaft.

If inst alling a p ropeller with an interchangeable hub, assemble the propeller following instructions provided with the propeller.

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

Install the spacer over the propeller shaft splines.

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



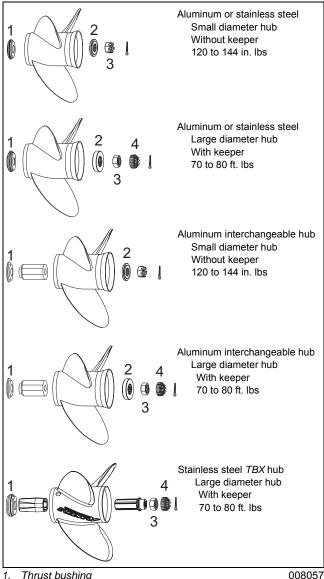
001992

Install the propeller nut and tighten to a torque of:

- With Keeper 70 to 80 ft. lbs. (95 to 109 N·m)
- Without Ke eper 120 to 144 in. lbs. (13.6 to 16.3 N·m)

If cotter pin holes in the nut (without keeper) and shaft do not align, tighten further. Do not loosen.

Install keeper (if applicable). Install new cotter pin.



- Thrust bushing 1.
- 2. Spacer
- Propeller nut
- Keeper

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

GEARCASE LEAK TEST

Drain lubricant before testing.

Use Gearcase Pressure Tester, P/N 507977. Install lubricant drain/fill p lug and seal, threa d pressure test g auge fitting and seal in lubricant level hole.

Pressurize 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates lea kage, submerge the gearcase in water to determine source of leak.

If the gauge does not in dicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leaks.

Make necessary repairs and repeat test.

Install Gearca se V acuum T ester, P/N 507982. Apply 3 to 5 in. of vacuum (76 to 127 mm) Hg. with pump.

If vacuu m gaug e indicat es le akage, apply oil around suspect ed seal. If lea k stop s or oil drawn in, seal is defective.

Repeat test, g earcase must hold minimum of 15 in. vacuum (381 mm) Hg.



002388

GEARCASE REMOVAL AND INSTALLATION

Gearcase Removal

A WARNING

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

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

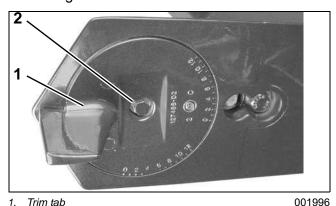
Remove pin and wa sher from shift rod lever to release the lower shift rod.



Shift rod screw

002171

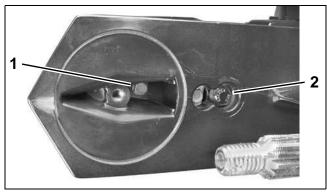
Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw and trim tab from the gearcase.



Trim tab

Trim tab retaining screw

Remove the 5/16-18 x 1.25 in. screw and washer. and remove 7/16-14 x 3.5 in, screw and washer.

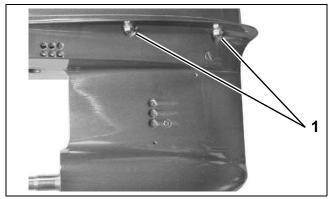


5/16-18 x 1.25 in. screw

001995

7/16-14 x 3.5 in. screw

Remove the four 3/8-16 x 1.5 in. gearcase retaining screws and washers.



Gearcase retaining screws

001994

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

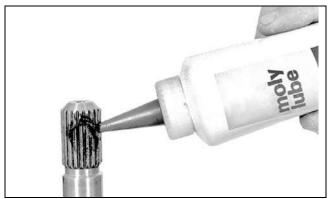
Gearcase Installation

WARNING

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

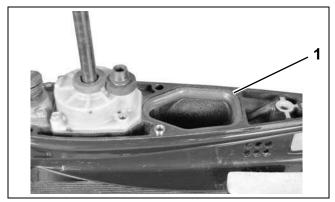
NOTICE Before installing gearcase, shift rod adjustment MUST be checked. Refer to SHIFT ROD ADJUSTMENT on p. 300.

Coat the drivesh aft splines with *Moly Lube*. DO NOT co at top surface of the driveshaft be cause lubricant may prevent seating of the driveshaft in the crankshaft.



30385

Apply *Adhesive 847* to the exhaust housing seal's outer su rface. Place the seal in the ge arcase exhaust cavity. Apply *Triple-Guard* grease to the seal's inner surfaces.



1. Exhaust housing seal

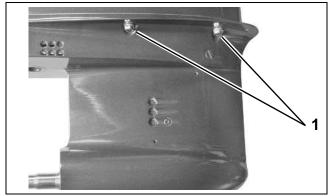
008354

Slide the gearcase into place, making sure:

- Driveshaft engages the crankshaft.
- · Inner exhaust housing installs correctly.
- Shift rod does not turn and is positio ned properly in the shift rod lever below the crankcase.

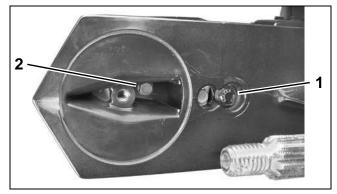
Apply *Triple-Guard* g rease to th reads of the gearcase retaining screws. Tighten the screws to a torque of:

- 3/8 in. screws 18 to 20 ft. lbs. (24 to 27 N·m)
- **7/16 in.** screw 28 to 30 ft. lbs. (38 to 40 N·m)
- **5/16 in.** screw 10 to 12 ft. lbs. (13.5 to 16 N·m)



1. 3/8 in. screws

001994



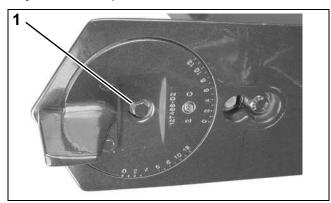
7/16 in. screw
 5/16 in screw

001995

Apply *Triple-Guard* grease to threads of the trim tab screw. Install and align the trim tab with the index marks noted prior to disassembly. Tighten the trim tab screw to a to rque of 35 to 4 0 ft. lbs.

WATER PUMP SERVICE

(47 to 54 N·m). For adjustment, refer to **Trim Tab Adjustment** on p. 31.



1. Trim tab screw

001996

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



Shift rod screw

002171

A WARNING

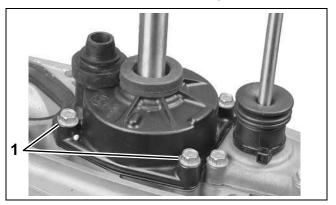
To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

IMPORTANT: During break-in period of a rea ssembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

WATER PUMP SERVICE

Disassembly

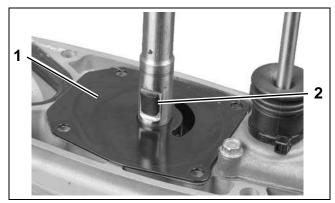
Remove the four impeller housing screws.



1. Impeller housing screws

001203

Slide the water pump of f the driveshaft. Remove the impeller key, impeller plate, and gasket. Discard the gasket.



1. Impeller plate

001214

2. Drive key

Remove all the parts from the housing.

Inspection

Check impeller for o verheating, hub sep aration, and other wear or damage.

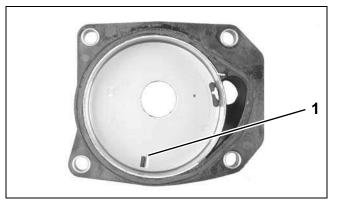
Check liner and wear plate for scoring, distortion, and impeller material transfer.

Inspect the housing for cracks or melting.

Make sure gasket surface is clean and smooth.

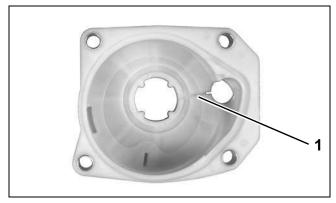
Assembly

Lightly co at the exterior rim of the impeller cup with Gasket Sealing Compound. Install the cup in the impeller housing. The cup locks in place in the housing with a square index tab.



1. Index tab 001215

IMPORTANT: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.

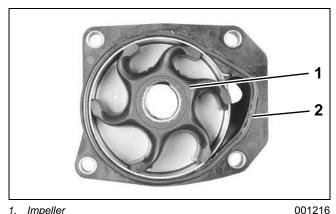


1. Air bleed groove

006415

Lightly coat the inside of the liner with *Triple-*Guard grease. With a co unterclockwise rotation, install the impeller into the liner with the slot for the impeller key facing out.

Apply a thin bead of *Adhesive 847* in the seal groove, and install the special shaped O-ring seal.

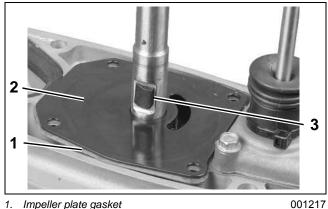


1. Impeller

O-ring seal

Apply Gasket Sealing Compound to both sides of a new impeller plate gasket. Install the gasket and impeller plate.

Apply *Triple-Guard* g rease to te mporarily hold drive key in place.



Impeller plate gasket

Impeller plate

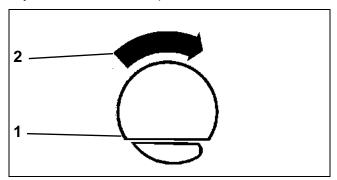
Drive key

The sharp edge of the key is the le ading edge in clockwise rotation.

Slide the water pump down the driveshaft. Align impeller slot with the impeller key . Rot ate th e driveshaft to engage the key with the impeller, and

SHIFT ROD ADJUSTMENT

slide water pump down over key. Be sure impeller key does not fall out of position.



- 1. Sharp edge of drive key
- 2. Direction of driveshaft rotation

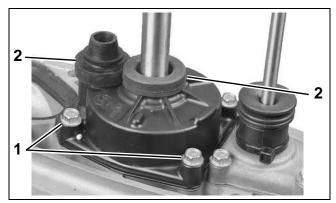
CO2995

NOTICE Make sure the impeller engages the impeller key. Serious powerhead damage will result if impeller key is not in place.

Align the impeller housing with the gea rcase. Apply *Gasket Sealing Compound* to threads of the four impeller h ousing screws. In stall the screws and tighten to a torque of 60 to 84 in. lbs. $(7 \text{ to } 9.5 \text{ N} \cdot \text{m})$.

Install the wa ter tube gromme ton the impeller housing.

Apply a th in bead of *Adhesive 847* to groove of the impeller housing grommet. Install the grommet on the impeller housing.



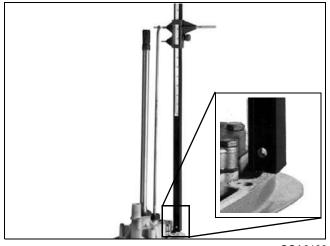
- 1. Housing screws
- 2. Water tube grommet
- 3. Impeller housing grommet

001203

NOTICE Before installing gearcase, shift rod adjustment MUST be checked. Refer to SHIFT ROD ADJUSTMENT on p. 300.

SHIFT ROD ADJUSTMENT

Check the shift rod height from the shift rod hole to the surface of the gea rease using Universal Shift Rod Height Gauge, P/N 389997.



COA6166

With the gea rease in NEUTRAL, rotate the shift rod up or down as necessary for correct adjustment. Once correct height is achieved, rotate rod one half turn or less to direct offset to the rear.

Shift Rod Height:

• 21.38 in. (543 mm) ± One-Half Turn

12

GEARCASE DISASSEMBLY

Pre-Disassembly Inspection

WARNING

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

IMPORTANT: Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant** on p. 39.

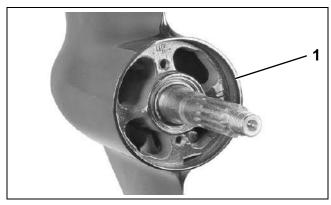
Remove gearcase. Refe r to **GEARCASE REMOVAL AND INSTALLATION** on p. 296.

Remove wa ter pump. Re fer to **WATER PUMP SERVICE** on p. 298.

Before disassembling the gearcase, examine the following:

- Gearcase Housing Check for visible da mage to skeg, strut, an ti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- Propeller Shaft Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- Shift Rod Check for misadjusted, bent, or binding rod. A misadjusted shift rod height can cause shift difficulty, loss of boat and outboard control, and gearcase damage.

 Hydrostatic Seal Grooves — Must be in good condition to help prevent propeller ventilation.



1. Hydrostatic seal grooves

002217

 Gearcase Anodes — If anodes have eroded to two-thirds their origina I size, t hey must b e replaced.



1. Gearcase anode

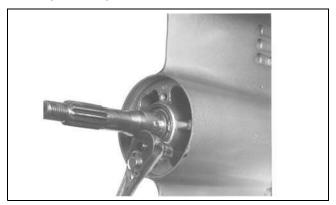
002014

- **Drive Shaft** Check splines for visible damage, twisting and wear. Severe spline wear indicates the exhaust housing or gearcase has been distorted, possibly by impact damage.
- Water Intake Screens Ch eck for damage and blo ckage. If screens ca nnot b e cleane d, they mu st be re placed. Different screens a re available and should not be mixed. Refer to correct model parts manual for listing and description.

GEARCASE DISASSEMBLY

Propeller Shaft Bearing Housing Removal

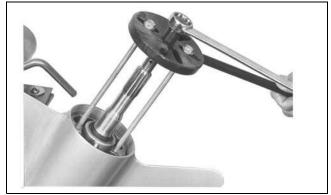
Use a 5/16 in. thin wall socket to remove the four screws with O-rings ho lding the pr opeller shaft bearing housing.



COA3571

Remove the propeller shaft bearing housing from the gearcase using the following:

- Puller body, screw, and hand le from Universal Puller Set, P/N 378103.
- Two 5/16-18 x 8 in. screws, P/N 316982, from Universal Puller Set, P/N 378103.

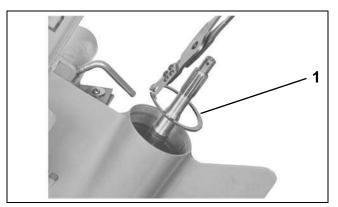


9437

Remove the two ret aining ring s using Ret aining Ring Pliers, P/N 331045.

A CAUTION

Retaining rings are under extreme pressure during removal and installation. To prevent personal injury, wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers. After the retaining rings are removed far enough from the gearcase to clear the housing, release the tension on the pliers while retaining ring is still around the propeller shaft.



1. Retaining ring

9438

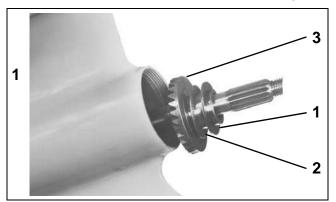
Remove the retainer plate from the gearcase.



1. Retainer plate

GEARCASE DISASSEMBLY

Remove the larger th rust washer, thrust bearing, and reverse gear from the gearcase. Remove the smaller thrust washer located in front of the gear.



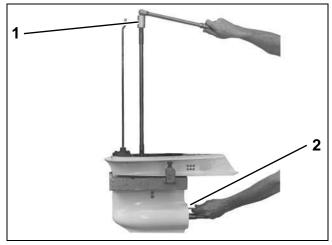
- Larger thrust washer
- Thrust bearing
- Reverse gear

COA3514

Pinion Gear and Driveshaft Removal

Adjust the shift rod to move the clutch do g as far forward as possible. This will help ease removal of the pinion nut.

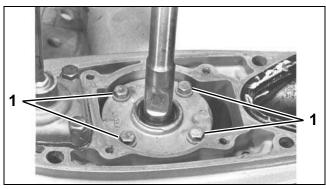
Use Driveshaft Holding Socket, P/N 334995, and an 1 1/16 in. open-e nd wrench to loo sen and remove the pinion nu t from the bottom of the driveshaft. Pad han dle of the wrench to prevent damage to gearcase.



- Holding socket
- 11/16 Wrench

COA3573T

Remove the four driveshaf t bearing ho using screws.

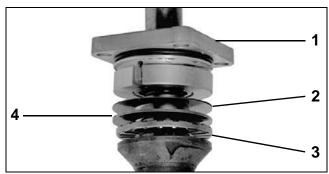


Driveshaft bearing housing screws

COA3671

COA3558

Remove the driveshaft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



- Bearing housing
- Shims
- Thrust bearing
- Thrust washer

If driveshaft cannot be removed, refer to **Locked** Driveshaft Removal on p. 304.

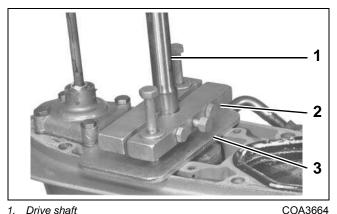
Remove the pinion gear from the gearcase.



GEARCASE DISASSEMBLY

Locked Driveshaft Removal

The driveshaft to pinion taper is a locking taper. If necessary, use Puller, P/N 387206, and Backing Plate, P/N 325867, to break the lock. Install the tools as shown by clamp ing t hem around the driveshaft with the tool's setscrew aligned with the impeller drive key slot. Tighten the set screw into the slot. Alternately tighten the two vertical screws against the backing plate inserted be tween the puller and the gearcase until the driveshaft pops loose from the pinion.

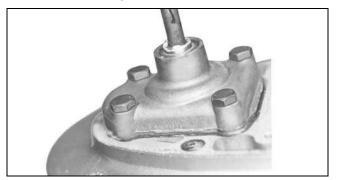


- Drive shaft
- Puller
- Backing plate

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 ou t. Unscrew the sh ift rod from the deten t lever. Remove screws, cover, and shift rod from the gearcase.

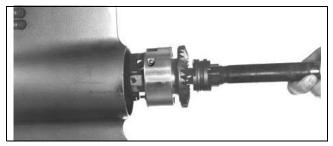
Discard the cover gasket. Remove and disca rd the shift rod O-ring from inside of cover.



COA3666

IMPORTANT: Make sure oil fill/drain plug is removed from gearcase.

Remove propeller shaft assembly from gearcase.



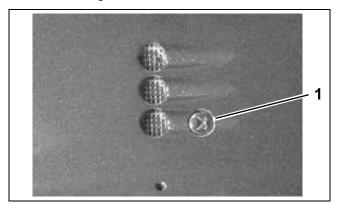
SHIFTER, BEARING AND SEAL SERVICE

SHIFTER, BEARING AND **SEAL SERVICE**

Pinion Bearing Removal

Inspect t he p inion b earing fo r da mage with out removing it. If the bearing is removed for any reason, it must be replaced.

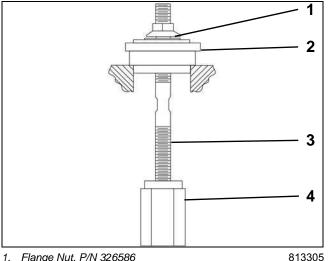
If the pinion bearing must be replaced, remove the bearing retaining screw from the gearcase. Discard the O-ring from the screw.



1. Bearing retaining screw

001997

Assemble Pinion Bearing Remover and Installer, P/N 5005927, in the gearcase as follows:

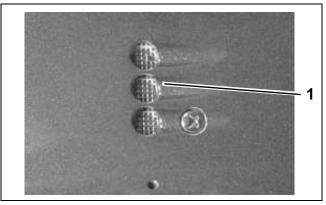


- 1. Flange Nut, P/N 326586
- Plate, P/N 391260
- 3. Rod. P/N 326582
- Remover, P/N 326580

Use a 1 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise and draw the bearing up from the housing.

Water Intake Screen

Inspect the water intake screen for blockage an d remove it by depressing the tabs on either side of the screen and pushing upward.



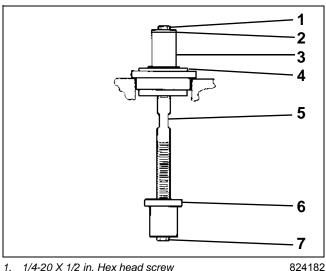
Water intake screen

001997

Pinion Bearing Installation

Install the water intake scree n. Drop it in to the water intake cavity and use a suitable tool to push it down as far as it will go.

Assemble Pinion Bearing Remover and Installer, P/N 5005927, as shown:



- 1/4-20 X 1/2 in. Hex head screw
- 1 in. O.D. Flat washer
- Spacer, P/N 326584 Plate, P/N 391260
- Rod, P/N 326582
- Installer, P/N 326575
- 1/4-20 X 1 1/4 in. Hex head screw

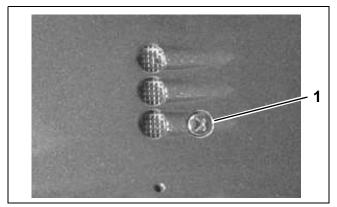
IMPORTANT: Spacers a re dif ferent size s an d cannot be interchanged.

SHIFTER, BEARING AND SEAL SERVICE

Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Place a new O-ring on the pinion bearing retaining screw. Apply Gasket Sealing Compound to O-ring and Nut Lock to screw threads. Install the screw and tighten to a torque of 48 to 80 in. lbs. (5.5 to 9.0 N·m).



1. Bearing retaining screw

001997

Shift Housing Disassembly

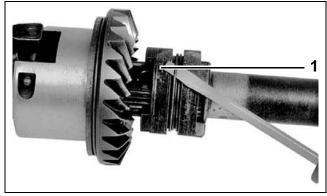
A WARNING

Wear safety glasses to avoid injury.

IMPORTANT: The shift housing and forward gear bearing are serviced as an assembly. If either are worn or damaged, replace the complete assembly.

Insert a suitable tool under one end of the clutch dog spring and remo ve it from its groove by

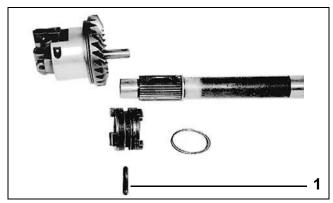
unwrapping it from aro und the clut ch dog. **Discard the spring**.



1. Clutch dog spring

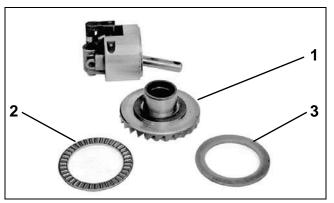
COA3560

Push the p in out of the clutch dog. Remove all parts.



Pin COA3561

Remove the ge ar, thrust bearing, and thrust washer from the shift housing.



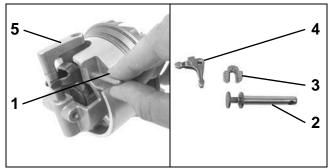
1. Gear

2. Thrust bearing

Thrust washer

SHIFTER, BEARING AND SEAL SERVICE

Remove the shift lever pin from the ho Remove shift shaft, cradle and shift lever. Move shifter detent as need ed to help ease removal of parts.



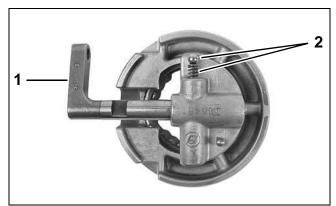
- Shift lever pin
- 2. Shift shaft
- Cradle
- Shift lever
- Shifter detent

DSC02449 DSC02489

A WARNING

Wear safety glasses to avoid personal injury. The detent ball and spring and come out with great force.

Wrap the housing with a sho p cloth to catch ball and spring. Rotate the shifter detent 90° in either direction, then pull the detent out of the housing.



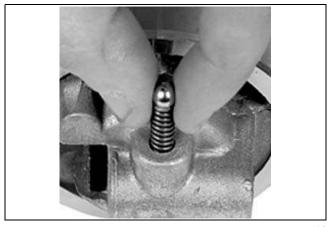
- Shifter detent
- 2. Ball and spring

DSC02518

Shift Housing Assembly

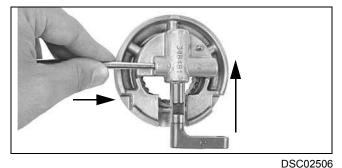
IMPORTANT: Clean and inspect all parts before beginning assemb ly pro cedures. Replace any damaged parts.

Lightly coat the detent ball and spring with Needle Bearing grease. Insert the spring in the housing, then the ball.



4518

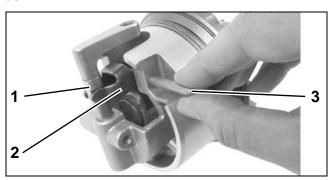
Insert shifter detent at 90° angle into the housing as shown, while depressing the ball and spring with a suitable tool. Once the shifter detent is past the ball, re move the tool and position d etent to engage NEUTRAL position.



Remove the detent ball and spring.

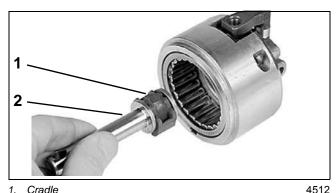
SHIFTER, BEARING AND SEAL SERVICE

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.



- Shifter detent
- Shift lever
- Pin, shift lever

Rest the cradle on the shift shaft.



- Cradle
- Shift shaft

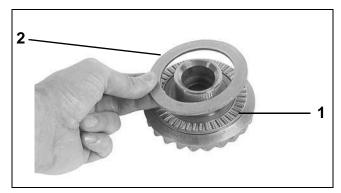
Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEU-TRAL position to hold the cradle and shaft in position.



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 ge ar, bearing, and washer into the bearing housing.

NOTICE Bearing and washer must installed in the correct order.



Thrust bearing

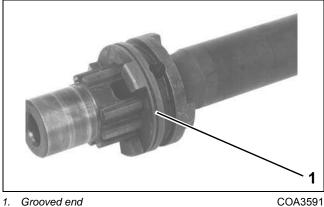
DSC02449

Thrust washer

DSC02297

Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog with grooved end toward the forward end of the shaft.

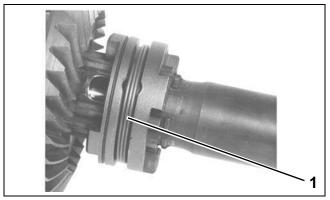
NOTICE The clutch dog is not symmetrical. If installed backward, it will not fully engage and will immediately damage itself and the gears.



Grooved end

SHIFTER, BEARING AND SEAL SERVICE

Slide the propeller shaft onto the shift shaft, align the hole in the sh aft with the hole in the clutch dog, inst all the pin and then, a **new** clutch dog retaining spring. Place three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



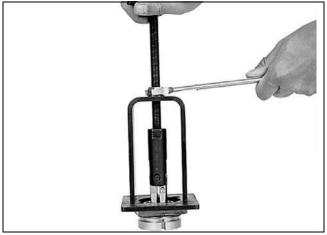
1. Retaining spring

COA3592

Driveshaft Bearing Housing Service

The driveshaft bearing is not serviceable. Replace the b earing ho using assembly if the bearing is worn or da maged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Remove the driveshaft bearing housing seal using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seal.



14155

Remove and discard the O-ring from the bearing housing.

Clean the bearing ho using in solvent to re move sealer from the seal bore and the O-ring groove.

Lightly apply *Gasket Sealing Compound* to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

NOTICE Do not install the O-ring in the bearing housing's bottom groove. The bottom groove is an oil passage. Gearcase damage could result.



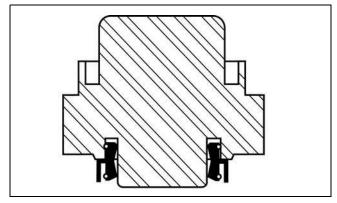
1. O-ring (top groove)

2. Oil passage

14156

Apply *Adhesive 847* to casing of new seal before installing.

Use Seal In staller, P/N 342665 to inst all seal in bearing housing with the exposed lip facing away from housing. Apply *Triple-Guard* grease to seal lips.



DRC5720

12

SHIFTER, BEARING AND SEAL SERVICE

Propeller Shaft Bearing Housing Service

Rear Seal Removal

Remove se als using Puller Bridge, P/N 432127, and Lar ge Puller Jaws, P/N 432129. Pla ce the plate on top of the housing to support the bridge. and tighten jaws securely behind the inner seal.



21047

Bearing Removal

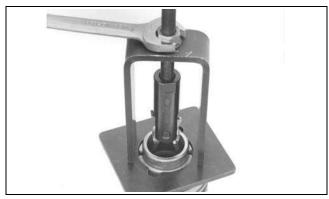
IMPORTANT: Inspect bea rings in place . If a bearing is removed for any reason, it must be discarded.

Remove rear b earing u sing Pu ller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.



21045

Remove fro nt bearing using Puller Brid ge, P/N 432127, and Bearing Puller, P/N 432130. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.



21067

Inspect the b earing housing anode. Replace anode if it is reduced to two-thirds of original size. Tighten screws to a torque of 108 to 132 in. lbs. (12 to 15 N·m).



1. Anode

Discard the bearing housing O-rin g. Clean the housing and be arings in solvent an d dry th oroughly. If bearings were no t replaced, rotate the needles to check for freedom of movement.

Inspect O-ring groove. Sand off any sharp edges that might cut O-r ing. Remove any nicks or burrs on front of bearing housing.



1. O-ring groove

DSC02291

SHIFTER, BEARING AND SEAL SERVICE

Thoroughly clean the four bearing housing retaining screws in solvent. Discard the O-rings.

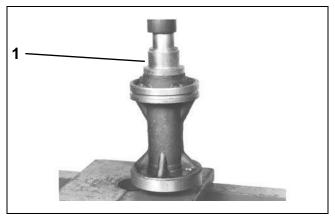
Bearing Installation

Oil, then install new bearings in bearing housing.

Place the **lettered end** of the bearing case on the bearing installer, then press the bearing into the housing until the tool seats. When in stalled, the lettered end of the bearing should be visible.

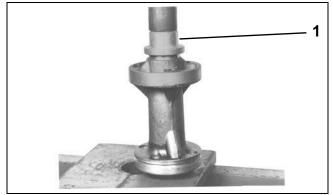
Bearing Installation Tool:

• P/N 326562



Forward Bearing
1. Bearing installation tool

COA3579



Rear Bearing

1. Bearing installation tool

COA3580

Rear Seal Installation

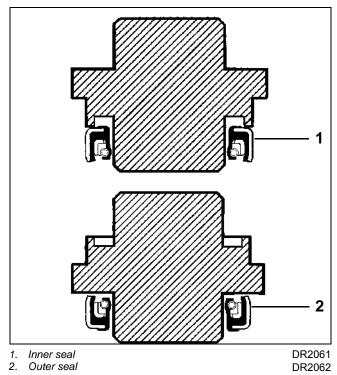
Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

Seal Installation Tool:

• P/N 326551

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



Apply *Triple-Guard* grease to seal lips.

12

DRIVESHAFT SHIMMING

NOTICE If a new pinion gear is needed, replace gear set before shimming.

Pinion ge ar backlash is adju sted by using shims between the drivesh aft bearing housing and the thrust washer. When in stalling a new thrust bearing or washer, bearing housing, pinion, or driveecessary to p roperly sh im the shaft, it is n assembly to restore the correct clearance.

Use Driveshaft Shimming Tool, P/N 5005925.

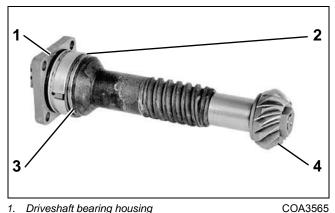
Shim gauge bars are precision made and should be handled carefully. The len gth of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaf before assembly. Replace any damaged parts.

Assemble the driveshaft bearing ho using, thru st washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector. P/N 312403. when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with outboard lubricant and tighten to a torque of 40 to 45 ft. lbs. (54 to 60 N·m).

IMPORTANT: The origina I pinion nut may be used for shimming, but must NOT be used in final assembly.



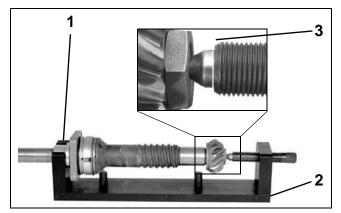
- Driveshaft bearing housing
- Thrust washer
- Thrust bearing
- Pinion

Select correct collar and shim gauge bar:

- Collar: P/N 328363
- Shim gauge bar: P/N 328366

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten pre load screw against the driveshaft until groove on the spr ing-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.



1. Collar 2.

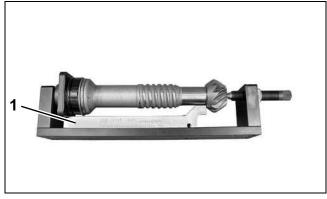
t

Tool base

COA3566 DSC00326

Rotate the driveshaf t several revolutions to se at bearings.

Lay the tool b ase on it s side. Place the shim gauge bar against guide pins of the tool base.



1. Shim gauge bar

005416

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating just the bearing housing. Use a fe eler gauge to me asure cle arance

between the gauge b ar and the bearing housing between each pair of screw holes. Replace the bearing housing and repeat check if va riance is greater than 0.004 in. (0.101 mm).

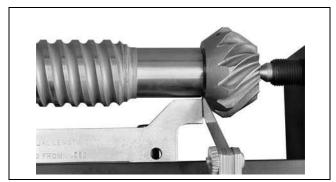
Check squareness of the pinion to the driveshaft. Hold the shim g auge bar ag ainst the bearing housing (between the scre w holes) while rotating just the driveshaft and pinion assembly. Measure clea rance be tween the gauge bar and the pinion at se veral locations. If variance is greater than 0.002 in . (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the averag e clearan ce measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness req uired. Sele ct t he fe west number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 312403.

Check clear ance again. The measurement between the gau ge bar and pinion should be 0.020 in. (0.508 mm).



005417

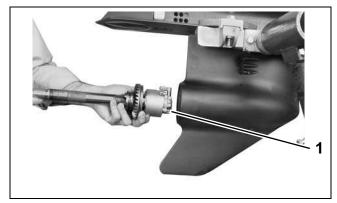
Remove the nut an d pinion from the driveshaf t. Discard the nut.

GEARCASE ASSEMBLY

Shift Housing, Gear, and **Propeller Shaft Installation**

Push shifter detent into fa rthest downward position. Tip the rea r of the gearcase slightly downward to assist in the installation of the shaft assembly.

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully in to the gea rcase while aligning shift housing pin with hole in forward end of gearcase housing.

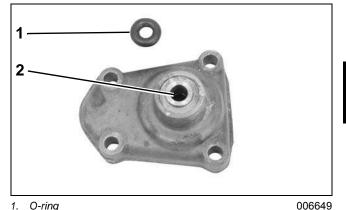


1. Pin 006648

Shift Rod Housing Installation

Lubricate a new shift rod cover O-ring with Triple-Guard grease. Install the O-ring into the shift rod cover.

IMPORTANT: Make sure O-ring is fully seated in groove.

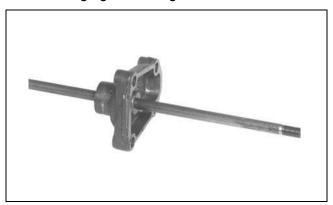


O-ring

Groove

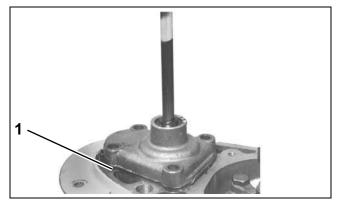
GEARCASE ASSEMBLY

Apply *Triple-Guard* grease to the threaded end of the shift rod and insert it through the cover. Turn the shift rod while pushing it through the cover to avoid damaging the O-ring.



COA3544

Apply Gasket Sealing Compound to both sides of a new shift rod cover gasket. Place the gasket on the gearcase. Thread the shift rod into the shifter detent about four turns.



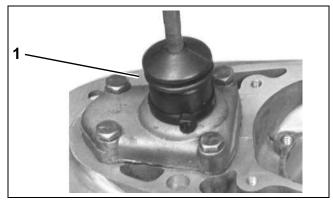
1. Cover gasket

COA3545

Move shift rod from side to side while pushing on the propeller shaft to ensure proper alignment of the bearing housing locator pin into the pin hole in the gearcase.

Apply *Gasket Sealing Compound* to the threads of the shift rod cover screws. Tighten the screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Place the cover seal on the shift rod cover.



1. Cover seal

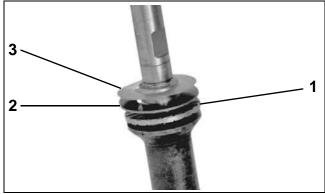
002514

Pinion Gear and Driveshaft Installation

Refer to **DRIVESHAFT SHIMMING** on p. 312 before proceeding.

Install new seals in driveshaft bearing housing. Refer to **Driveshaft Bearing Housing Service** on p. 309.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.



1. Thrust bearing

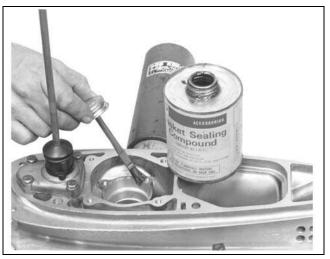
COA3168

- 2. Thrust washer
- 3. Shim(s)

Lightly apply Gasket Sealing Compound to the gearcase are a that contacts mounting flange of

12

the driveshaft bearing housing. Do not coat inside bearing housing bore surface of the gearcase.



6207

Adjust shift rod to move clutch dog as far forward as possible. Be sure excess grea se is re moved from the pinion bearing.

IMPORTANT: The inside t aper of the pinion gear and the driveshaft taper MUST be completely free of grease. Clean the tapers with *Cleaning Solvent*. Use a shop towel free of grease and lint.

Place the pinion gear into the gearcase. Insert the driveshaft into the gearcase and thro ugh the pinion gear.

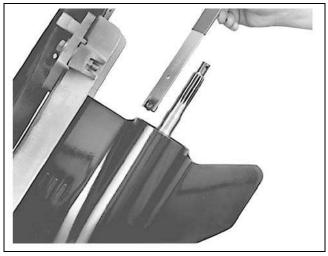
Using Drivesha ft Sea I Protector, P/N 312403, slide the driveshaft t b earing ho using o nto the driveshaft and into position in the gearcase. Align the embossed word "FRONT" toward the shift rod. Do not install screws at this time.



1. Seal protector

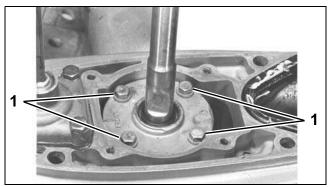
COA3130

Lightly coat the thre ads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 320675, to install nut on the driveshaft. Turn the driveshaft by han d to thread the nut on to shaft.



33220

Apply *Gasket Sealing Compound* to the threads of the driveshaft bearing housing screws. Tighten screws **in stages** to a torque of 96 to 120 in. lbs. (11 to 14 N·m).

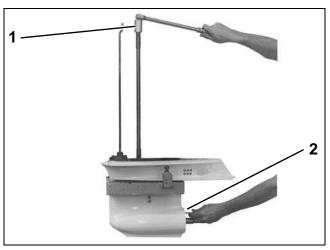


1. Driveshaft bearing housing screws

COA3671

GEARCASE ASSEMBLY

Use Driveshaft Holding Socket, P/N 334995, and an 11/16 in. open-end wrench, to tighten the pinion nut to a torque of 40 to 45 ft. lbs. (54 to 60s N·m). Pad handle of the wrench to prevent damage to gearcase.

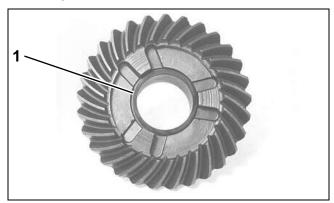


- 1. Holding socket
- 2. 11/16 Wrench

COA3573T

Propeller Shaft Bearing Housing and Gear Installation

Place the small thrust washe r in recess of the reverse gear.

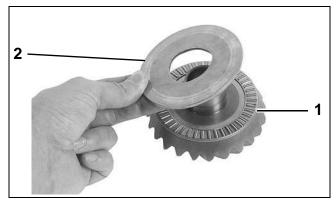


1. Small thrust washer

COA3597

Oil and inst all thrust bear ing a nd la rger thru st washer on hu b of reverse gear. Slide the gear

assembly onto the propeller shaft until it engages the pinion gear.

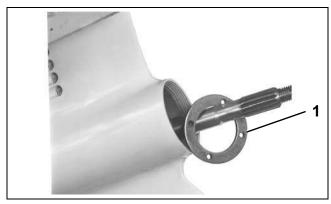


Thrust bearing
 Thrust washer

DSC02295

Slide the bearing housing retainer plate into posi-

tion over the propeller shaft.



1. Retaining ring

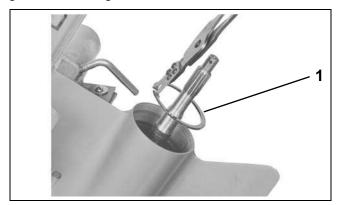
COA3513

Using Ret aining Ring Pliers, P/N 331045, inst all the two retaining rings.

A CAUTION

Retaining rings are under extreme pressure during installation. Wear safety glasses and proceed with care to avoid unsnapping the ring from the pliers.

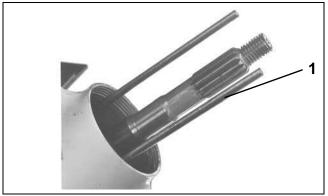
Make sure the retaining rings are sea ted in the grooves in the gearcase.



1. Retaining ring

9438

Thread two Guide Pins, P/N 383175, in to the retainer plate to align holes in the plate with holes in the p ropeller shaft bea ring h ousing. Do not thread guide pins more than two turns into the retainer plate.



1. Guide pin

COA3550

Install O-rin g in groove in the bearing hou sing. Lightly apply *Gasket Sealing Compound* to the O-ring flange and aft support flange of the bearing housing. Do not allow se aler to contact either forward thrust surface or bearings in the housing.

Align the be aring housing on the guide pins with the word "UP" toward the top. Place the housing into gearcase and tap the housing with a soft face mallet to seat the O-ring.

Apply Gasket Sealing Compound to the threads and seals of the four prope ller housing retaining screws. Install two of the screws into the bearing housing finger tight. Remove the guide pins and install the remaining two screws. Tighten all fo ur screws to a torque of 120 to 140 in. lbs. (14 to 16 $N \cdot m$).

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- GEARCASE LEAK TEST on p. 295
- WATER PUMP SERVICE on p. 298
- SHIFT ROD ADJUSTMENT on p. 300
- GEARCASE REMOVAL AND INSTALLATION on p. 296
- Gearcase Lubricant on p. 39
- Propeller Hardware Installation on p. 294
- Trim Tab Adjustment on p. 31.

During bre ak-in pe riod of a reassemble d gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

GEARCASE REMOVAL AND INSTALLATION

Gearcase Removal

A WARNING

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

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

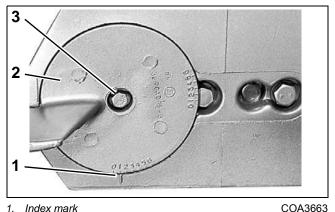
Remove pin and wa sher from shift rod lever to release the lower shift rod.



Shift rod screw

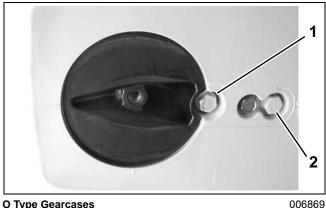
002013

Note where the index mark on the gearcase aligns with the index number of the adjustable trim tab so the trim tab can be installed in the same position. Remove the trim tab retaining screw and trim tab from the gearcase.



- Index mark
- Trim tab
- Trim tab retaining screw

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



O Type Gearcases

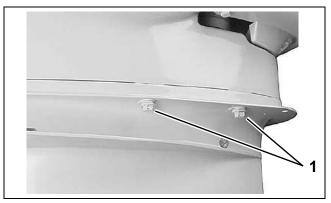
- 3/8-16 x 3.5 in. screw
- 7/16-14 x 3.5 in. screw



S Type Gearcases

- 3/8-16 x 1.75 in. screw
- 7/16-14 x 3.5 in. screw

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



Gearcase retaining screws

001990

COA3139

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

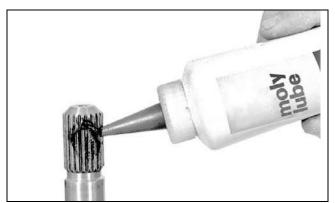
Gearcase Installation

WARNING

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

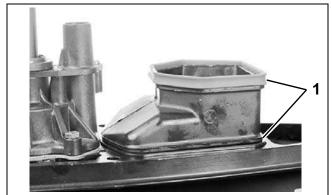
NOTICE Before installing gearcase, shift rod adjustment MUST be checked. Refer to SHIFT ROD ADJUSTMENT on p. 323.

Coat the drivesh aft splines with *Moly Lube*. DO NOT co at top surface of the driveshaft be cause lubricant may prevent seating of the driveshaft in the crankshaft.



30385

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



1. Lower exhaust seals

32002

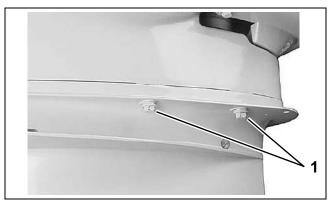
Slide the gearcase into place, making sure:

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

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

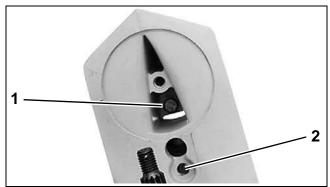
Install screws and washers and tighten to a torque of:

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



1. 3/8 in. screws

001990



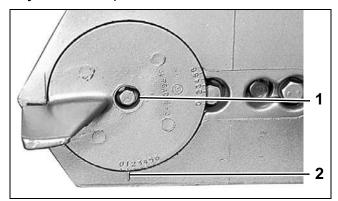
. 3/8 in screw

2. 7/16 in. screw

GEARCASE SERVICE, 75 – 90 HP MODELS

WATER PUMP SERVICE

Apply *Triple-Guard* grease to threads of the trim tab screw. In stall and align the trim t ab with the index marks n oted prior to disassembly. Tighten the trim tab screw to a torque of 35 to 40 ft. lbs. (47 to 54 N·m). For adjustment, refer to **Trim Tab** Adjustment on p. 31.



Trim tab screw Index mark

COA3663

Place the shift rod in the shift rod lever. Install the retaining pin and washer. Tighten pin to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



Shift rod screw

002013

WARNING

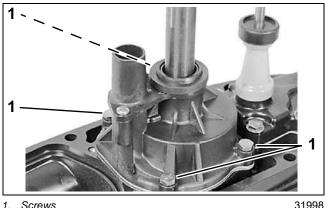
To prevent loss of operator control, check for proper shifting operation and adjust, if necessary.

IMPORTANT: During break-in period of a rea ssembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

WATER PUMP SERVICE

Disassembly

Rotate the driveshaf t counterclockwise to unlock the impeller key. Remove the four impeller housing screws.



Screws

Slide the wate r pump of f the driveshaft. Remove the impeller key, O-ring, impeller plate, and gasket. Discard the gasket.



O-ring

Impeller plate

DSC02328

Remove all the parts from the housing.

Inspection

Check impeller for o verheating, hub sep aration, and other wear or damage.

Check liner and wear plate for scoring, distortion, and impeller material transfer.

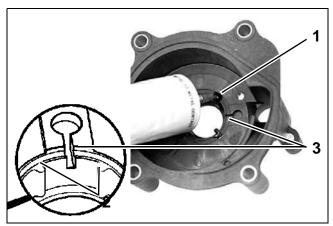
Inspect the housing for cracks or melting.

Make sure gasket surface is clean and smooth.

Assembly

Apply a drop of Adhesive 847 in the seal ring groove at each of the four ribs.

IMPORTANT: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.

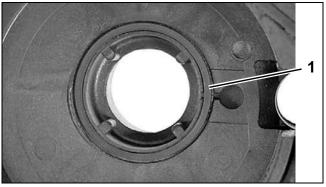


- Seal ring groove
- Air bleed groove

2311

DR1185

Install the O-ring in groove in the impeller housing.



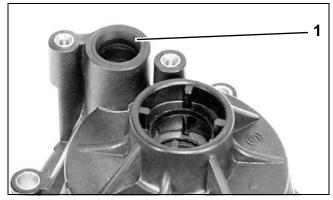
1. O-ring

34814

Lightly co at the exterior rim of the impeller cup with Gasket Sealing Compound. Install the cup in the impeller housing. The cup locks in place in the housing with a square index tab.

Make sure vent hole in impeller cup is open.

Install the water tube grommet wit in the inside taper facing up.

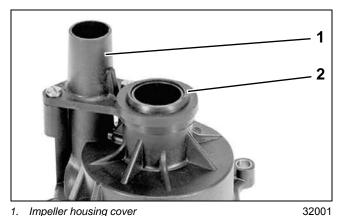


Water tube grommet

32000

Apply Triple-Guard grease to screw threads and install the imp eller housing cover an d tighte n screws to a torque of 24 to 36 in. lbs. (3 to 4 N·m).

Apply *Adhesive 847* to flat side of the impeller housing grommet. I nstall the gro mmet, flat side down.



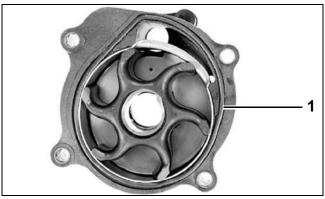
- Impeller housing grommet

Lightly coat the inside of the liner with Triple-Guard grease. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller key facing out.

GEARCASE SERVICE, 75 – 90 HP MODELS

WATER PUMP SERVICE

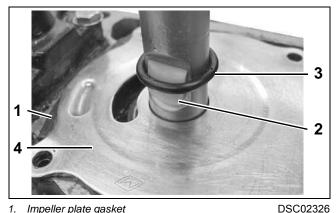
Apply a thin bea d of Adhesive 847 in the s eal groove, and install the special shaped O-ring seal.



O-ring 34815

Apply Gasket Sealing Compound to both sides of a new impeller plate gasket. Install the gasket and impeller plate.

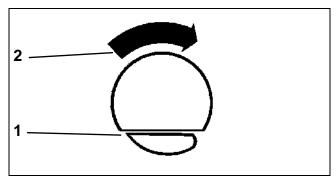
Apply Triple-Guard grease to a new impeller Oring. Slide the O-ring down the driveshaft and half way over installed impeller key to temporarily hold key in place.



- Impeller plate gasket 1.
- Impeller plate 2.
- O-ring
- Drive key

The sharp edge of the key is the leading edge in clockwise rotation.

Slide the water pump down the drivesha ft. Align impeller slot with the impeller key. Rot ate the driveshaft to engage the key with the impeller, and slide water pump down over key. Be sure impeller key does not fall out of position.



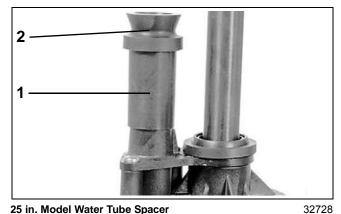
- Sharp edge of drive key
- Direction of driveshaft rotation

CO2995

NOTICE Make sure the impeller engages the impeller key. Serious powerhead damage will result if impeller key is not in place.

Align the impeller housing with the gear Apply Gasket Sealing Compound to threads of the four impeller ho using screws. Inst all the screws and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

On 25 in. models, pla ce water tub e spacer and grommet on the impeller housing cover.

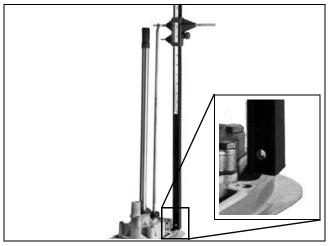


- 25 in. Model Water Tube Spacer
- Spacer
- Grommet

NOTICE Before installing gearcase, shift rod adjustment MUST be checked. Refer to SHIFT **ROD ADJUSTMENT on p. 323.**

SHIFT ROD ADJUSTMENT

Check the shift rod height from the shift rod hole to the surface of the ge arcase using Universal Shift Rod Height Gauge, P/N 389997.



COA6166

With the gea rease in NEUTRAL, rotate the shift rod up or down as necessary for correct adjustment. Once correct height is achieved, rotate rod one half turn or less to direct offset forward.

IMPORTANT: The NEUTRAL detent is a twostep design. Make sure the NEUTRAL detent ball is in the center step before checking shift rod height.

Shift Rod Heights

Model	Туре	Height	
20 in. (L)	"S"	21.25 in. ± One-Half Turn	
25 in. (X)	"O"	26.25 in. ± One-Half Turn	

GEARCASE DISASSEMBLY

Pre-Disassembly Inspection

WARNING

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

IMPORTANT: Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant** on p. 39.

Remove gearcase. Refe r to **GEARCASE REMOVAL AND INSTALLATION** on p. 318.

Remove wa ter pump. Re fer to **WATER PUMP SERVICE** on p. 320.

Before disassembling the gearcase, exa mine the following:

- Gearcase Housing Check for visible da mage to skeg, strut, an ti-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 misad justed, bent, or binding rod. A misadju sted shift rod height can cause shift difficulty, loss of boat and outboard control, and gearcase damage.

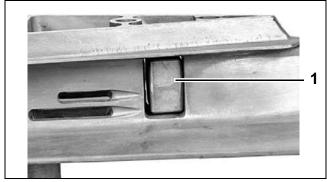
 Hydrostatic Seal Grooves — Must be in good condition to help prevent propeller ventilation.



1. Hydrostatic seal grooves

4557

 Gearcase Anodes — If anodes have eroded to two-thirds their origina I size, t hey must be replaced.



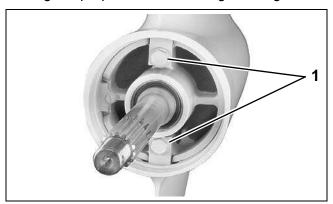
1. Gearcase anode

14161

- Drive Shaft Check splines for visible damage, twisting and wear. Severe spline wear indicates the exh aust housing or gearcase has been distorted, possibly by impact damage.
- Water Intake Screens Check for damage and blo ckage. If screens ca nnot be cleaned, they must be replaced. Different screens are available and should not be mixed. Refer to correct model parts manual for listing and description.

Propeller Shaft Bearing Housing Removal

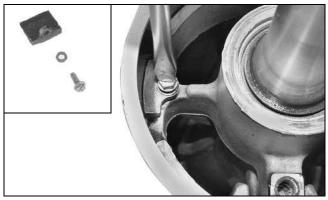
Remove the two screws, washers, and retainers holding the propeller shaft bearing housing.



Retainer tab screws

001989

Remove wedge, screw, and washer ("O" Type).

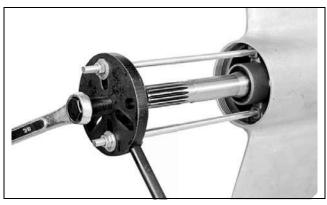


DSM02291 DSC02361

Remove the propeller shaft bearing housing from the gearcase using the following:

- Puller body, screw, and hand le from Universal Puller Set, P/N 378103.
- Two 5/16-18 x 11 in. (2 79 mm) threa ded rods, two large 5/1 6 in. I. D. f lat washers, a nd two 5/16-18 nuts (obtain locally).

Assemble components and pull the bearing housing from the gearcase.



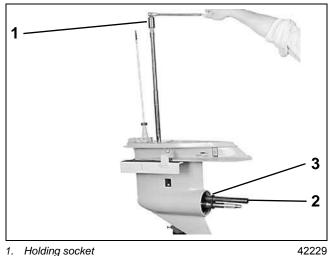
22775

Remove the thrust washer, thrust bearing, and reverse gear from gearcase.

Pinion Gear and Driveshaft Removal

Adjust the shift rod to move the clutch dog as far forward as possible. This will help ease removal of the pinion nut.

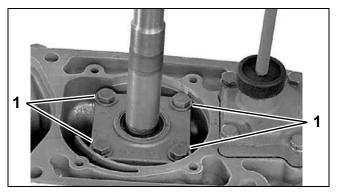
Use Driveshaft Holding Socket, P/N 311875, Pinr. P/N 334455, and W ion Nut Holde Retainer, P/N 341438 to loo sen and remove the pinion nut from the b ottom of the driveshaft. Pad handle of holder to prevent damage to gearcase.



- Holding socket
- Pinion holder
- Retainer

GEARCASE DISASSEMBLY

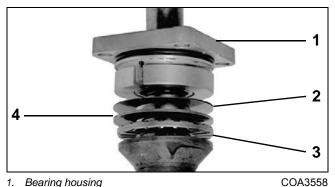
Remove t he four d riveshaft bea ring h ousing screws.



Driveshaft bearing housing screws

COA3153

Remove t he drivesh aft from the gearcase. The bearing housing, shims, thrust bearing, and thrust washer will come out with the driveshaft.



- Bearing housing
- Shims
- Thrust bearing
- Thrust washer

If driveshaft cannot be removed, refer to Locked Driveshaft Removal on p. 326.

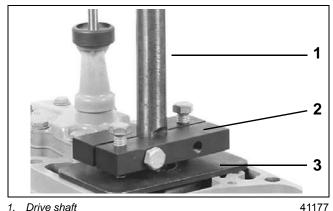
Remove the pinion gear from the gearcase.



COA3159

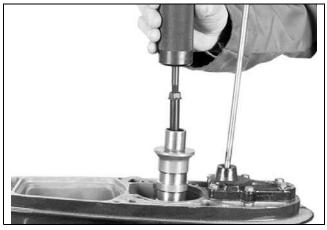
Locked Driveshaft Removal

The driveshaft to pinion taper is a locking taper. If necessary, use Driveshaft Puller, P/N 390706, and Backing Plate, P/N 325867, to break the lock. Install the too Is as shown by clamp ing 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.



- Drive shaft
- Puller
- Backing plate

If upper driveshaft becomes separated from lower driveshaft, use Lower Driveshaf t Puller P/N 342681, to remove . Inst all 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

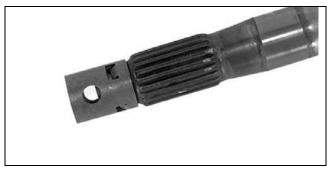
Driveshaft Service

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

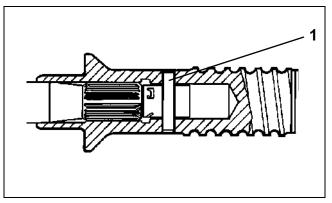
Install the upp er driveshaft into the lower driveshaft, aligning the holes in the driveshaft retainer and the lower driveshaft.



29330

"S" Type Gearcases

Install the roll pin flush.

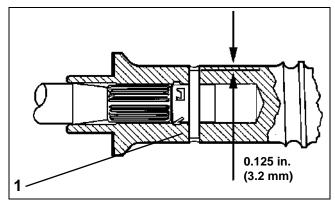


1. Roll pin

DR4596

"O" Type Gearcases

Install the roll pin to the specified dimension.



1. Roll pin

DR4610

Shift Housing, Gear and Propeller Shaft Removal

Push down on the shif t rod. This will move the detent lever downward to clear the inside of the gearcase when t he shaft assembly is pulled o ut. Unscrew the shif t rod from the dete nt lever. Remove scre ws, cover, and shift rod from the gearcase.

Discard the cover gasket. Remo ve and discard the shift rod O-ring from inside of cover.



Cover gasket

COA3141

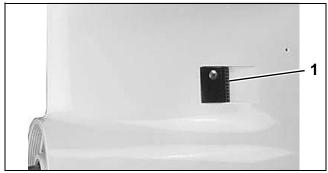
Remove propeller shaft assembly from gearcase.



COA3149

Water Intake Screens

Remove and clean water intake screens. Replace if damaged.



1. Water intake screen

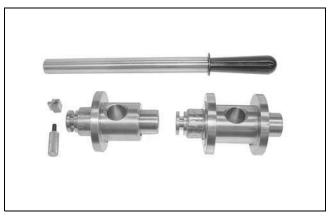
001991

GEARCASE HOUSING INSPECTION

Thoroughly clean gearcase housing to remove all dirt and deb ris prior to inspection. Inspect pinion bearing an d forward thrust surface of gearcase housing.

Use Gearcase Alignment Gauge Kit, P/N 5006349 to check the condition of gearcase housing prior to reassembly. Refer to instructions provided with kit. Use additional Gauging Head as follows:

P/N 352879, for "S" Type gearcases.



004315

IMPORTANT: DO NOT force gauging shaft into alignment hole. Shaft MUST slide easily into hole of gauging head. If shaft does not slide into hole, gearcase ho using is damaged and **must** be replaced.



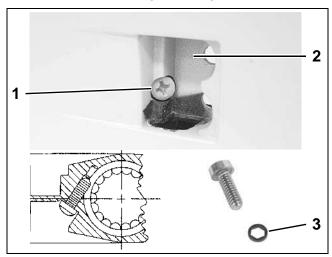
1. Gauging shaft

00434

SHIFTER, BEARING AND **SEAL SERVICE**

Pinion Bearing Removal

Remove pinion bearing retaining screw.



- Pinion bearing retaining screw
- Water screen pocket

Seal

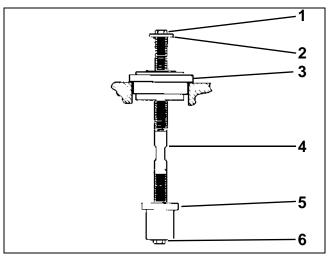
DSC02370 DRC7416 DSC02313

824163

Assemble Pin ion Bearing Remo ver/Installer, P/N 5005927, in the gearcase as follows:

"S" Type Gearcases

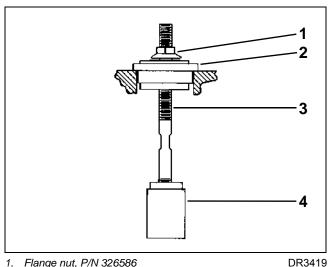
Use a mallet to drive the bea ring from the hou sing.



- 1. 1/4-20 x 1/2 in. Hex Head Screw
- 1 in. O.D. Flat Washer
- Plate, P/N 391260
- 4. Rod, P/N 326582
- 5. Installer/Remover, P/N 326574
- 6. 1/4-20 x 1 1/4 in. Hex Head Screw

"O" Type Gearcases

Use a 7/8 in. wrench to hold the remover in place. Use a 3/4 in. wrench to turn flange nut clockwise. Draw the bearing up from the housing.

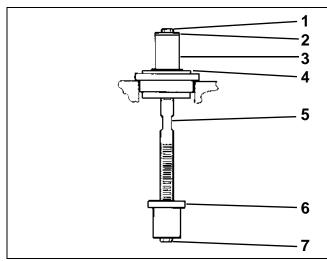


- Flange nut, P/N 326586
- Plate, P/N 391260 Rod, P/N 326582
- Remover, P/N 326579

Pinion Bearing Installation

Assemble the following componen ts of Pinio n Bearing Remover and Installer, P/N 5005927, as

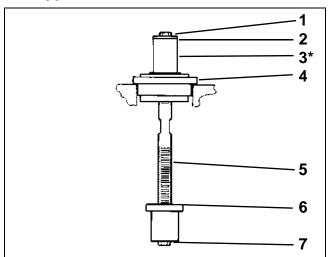
"S" Type Gearcases



- 1/4-20 X 1/2 in. Hex head screw
- 1 in. O.D. Flat washer
- Spacer, P/N 341437
- Plate, P/N 391260
- Rod, P/N 326582
- Installer/Remover, P/N 326574
- 1/4-20 X 1 1/4 in. Hex head screw

SHIFTER, BEARING AND SEAL SERVICE

"O" Type Gearcases



- 1. 1/4-20 X 1/2 in. Hex head screw
- 2. 1 in. O.D. Flat washer
- 3. Spacer, P/N 326584
- 4. Plate 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.

824182

Apply *Needle Bearing* grease to the needle bearings and insert them into the be aring case ("O" Type gearcases).

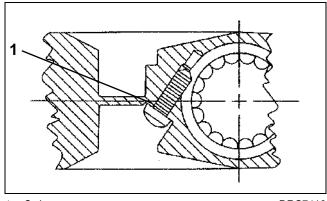
Place the bearing on the installer tool with the **lettered side of the bearing facing the top** of the gearcase. Use *Needle Bearing* grease to hold the bearing on the tool.

IMPORTANT: The pinion bearing is tapered so that, when installed correctly, its shape compensates for stresses in the gearcase and allows full bearing contact. Whenever a gearcase is disassembled, the pinion bearing should be checked to ensure that it has been installed with the lettering facing up.

Insert the tool with the bearing into the gearcase. Drive the bearing into the gearcase until the washer on the tool contacts the spacer.

Remove the tool.

Place a new O-ring on the pinion bearing retaining screw. Apply G asket Sealing Compound to O-ring. Apply Nut Lock to screw thre ads. Install the screw and tighten to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



O-ring DRC7416

Shift Housing Disassembly

WARNING

Wear safety glasses to avoid injury.

IMPORTANT: The shift housing and bearing are serviced as an assembly . If e ither are wo rn or damaged, replace the complete assembly.

Insert a suitable tool under one end of the clutch dog spring a nd remove it from it s g roove by unwrapping it from aro und the clut ch dog. **Discard the spring**.

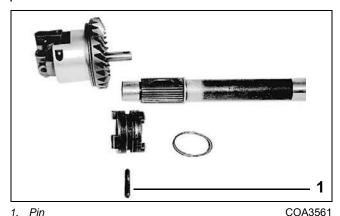


1. Clutch dog spring

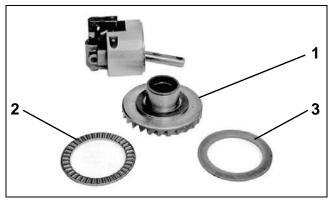
COA3560

SHIFTER, BEARING AND SEAL SERVICE

Push the pin o ut of the clutch dog . Remove all parts.



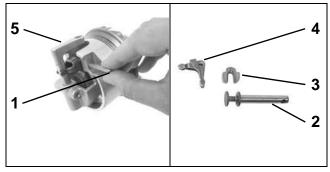
Remove the gear, thrust bearing, and thru washer from the shift housing.



1. Thrust bearing

Thrust washer

Remove the shift lever pin from the ho Remove shift shaft, cradle and shift lever. Move shifter detent as needed to help ease re moval of parts.



Shift lever pin

DSC02449 Shift shaft DSC02489

3. Cradle

2.

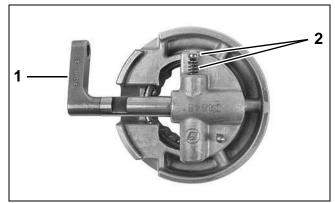
COA3562

- Shift lever
- 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 cat ch ball and spring. Rotate the shifter detent 90° in either direction, then pull the detent out of the housing.



Shifter detent Ball and spring DSC02518

Remove the detent ball and spring.

Remove needle bearings from bearing housing for cleaning and inspection ("O" Type).

SHIFTER, BEARING AND SEAL SERVICE

Shift Housing Assembly

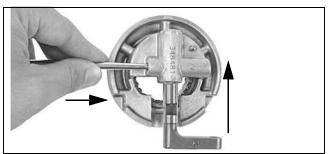
IMPORTANT: Clean and inspect all parts before beginning assembly p rocedures. Replace an y damaged parts.

Lightly coat the detent ball and spring with *Needle Bearing* grease. Insert the spring in the housing, then the ball.



4518

Insert shifter detent at 90° angle into the housing as shown, while depressing the ball and spring with a suitable tool. Once the shifter detent is past the ball, remove the tool and position detent to engage NEUTRAL position.



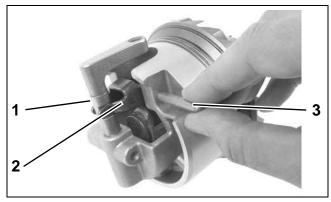
DSC02506

Thoroughly grease 25 needle bearings with *Needle Bearing* grease and place in the bearing case ("O" Type gearcases).



4520

With shifter detent in NEUTRAL, in stall arms of shift lever into detent slots. Align the pivot holes and insert the retaining pin. Push shifter detent down.

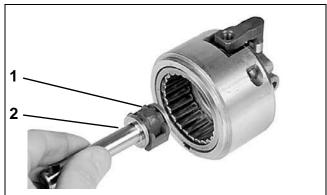


. Shifter detent

Shift lever
 Pin. shift lever

DSC02449

Rest the cradle on the shift shaft.



TYPICAL

Cradle
 Shift shaft

SHIFTER, BEARING AND SEAL SERVICE

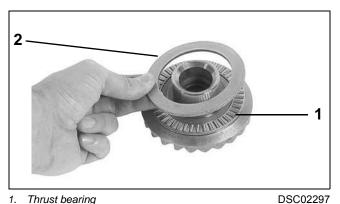
Place the shift lever arms into the recesses of the shift cradle. Pull shifter detent back up to NEU-TRAL position to ho ld the cradle and sh aft in place.



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.

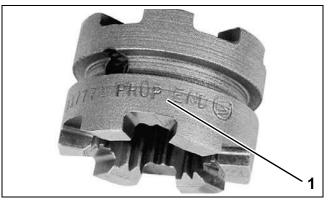
NOTICE Bearing and washer must be installed in the correct order.



- Thrust bearing
- Thrust washer

Align holes in the clutch dog with slot in the propeller shaft. Install the clutch dog on the shaft with "PROP END" facing rear of the shaft.

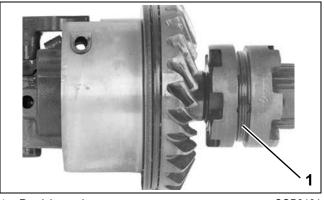
NOTICE The clutch dog is not symmetrical. If installed backward, it will not fully engage and will immediately damage itself and the gears.



1. "PROP END"

COB7581

Slide the propeller shaft onto the shift shaft, align the hole in the shaft with the hole in the clutch dog, inst all the pin and then, a new clutch dog retaining spring. Place three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Retaining spring

COB3101

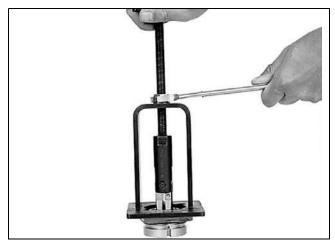
SHIFTER, BEARING AND SEAL SERVICE

Driveshaft Bearing Housing Service

The driveshaft bearing is not serviceable. Replace the b earing h ousing assembly if the be aring is worn or da maged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Seal Removal

Remove the drivesha ft 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 ho using in so Ivent to remove sealer from the seal bore and the O-ring groove.

Seal Installation

Lightly apply Gasket Sealing Compound to a new O-ring. Install the O-ring in top groove of the bearing housing. Do not allow sealant in oil passage.

NOTICE Do not install the O-ring in the bearing housing's bottom groove. The bottom groove is an oil passage. Gearcase damage could result.

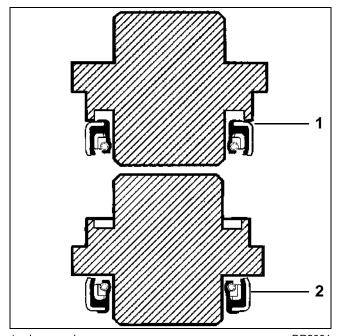


- 1. O-ring (top groove)
- Oil passage

14156

Apply Gasket Sealing Compound to ca sings of new seals before installing.

Use Seal Inst allation Tool, P/N 330268 to install new seals back to back in bearing housing. Install inner seal with lip facing toward bearing housing, then the outer seal with lip facing away from bearing housing . Apply *Triple-Guard* grea se to seal lips.



- Inner seal
- Outer seal

DR2061 DR2062

Propeller Shaft Bearing Housing Service

Rear Seal Removal

Remove se als using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131. Place the plate on top of the housing to support the bridge. and tighten jaws securely behind the inner seal.

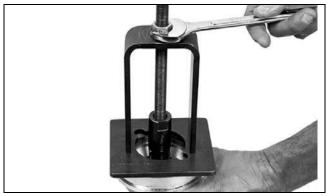


13520

Bearing Removal

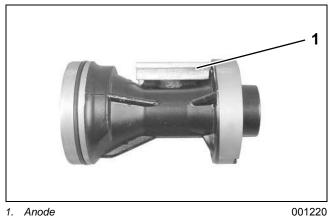
IMPORTANT: Inspect bea rings in place . If a bearing is removed for any reason, it must be discarded.

Remove either bear ing u sing Puller Brid P/N 432127, and Large Puller Jaws, P/N 432129. Place the puller plate on top of the housing to support the bridge, and tighten jaws securely behind the bearing.



13522

Inspect the b earing housing anode. Replace anode if it is reduced to two-thirds of original size. Tighten screws to a torque of 108 to 132 in. lbs. (12 to 15 N·m).



1. Anode

Discard the bearing housing O-rin g. Clean the housing and be arings in solvent an d dry th oroughly. If bearings were no t replaced, rotate the needles to check for freedom of movement.

Inspect O-ring groove. Sand off any sharp edges that might cut O-r ing. Remove any nicks or burrs on front of bearing housing.



1. O-ring groove

DSC02291

SHIFTER, BEARING AND SEAL SERVICE

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 in stalled, the lettered end of the bearing should be visible.

Bearing installation tool:

- P/N 326562 "S" Type gearcases
- P/N 339750 "O" Type gearcases



Forward Bearing

1. Bearing installation tool

29967



Rear Bearing

1. Bearing installation tool

44237

Rear Seal Installation

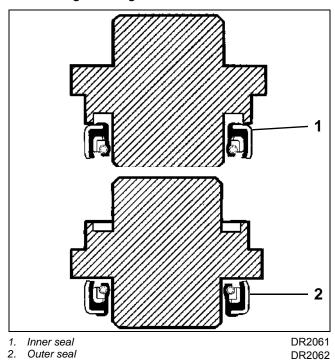
Apply *Gasket Sealing Compound* to metal casings of the seals before installing.

Use Seal Installation Tool to install new seals back to back in bearing housing.

Seal installation tool:

- P/N 326551 "S" Type gearcases
- P/N 336311 "O" Type gearcases

Install inner seal with lip facing toward the bearing housing, then outer seal with lip facing away from the bearing housing.



Apply *Triple-Guard* grease to seal lips.

DRIVESHAFT SHIMMING

NOTICE If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is achieved by using shims between the drivesh aft bearing housing and the thrust washer. When in stalling a new thrust bearing or washer, bearing housing, pinion, or driveshaft, it is n ecessary to p roperly sh im the assembly to restore factory clearance.

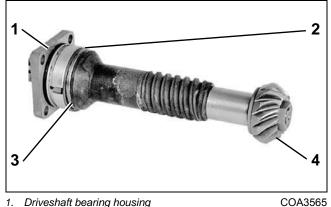
Use Drive shaft Shimming T ool, P/N 50059 25 (replaces P/N 393185).

Shim gauge bars are precision made and should be handled carefully. The len gth of each bar is stamped near the part number. This dimension is 0.020 in. (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaf before assembly. Replace any damaged parts.

Assemble the driveshaft bearing ho using, thrust washer, thrust bearing, and pinion onto the driveshaft. Use Driveshaft Seal Protector, P/N 318674, when installing or removing the bearing housing.

Lightly coat the threads of the pinion nut with outboard lubricant and tighten to a torque of 100 to 110 ft. lbs. (136 to 149 N·m).



- Driveshaft bearing housing
- Thrust washer
- Thrust bearing
- Pinion

IMPORTANT: The original pinion nut may be used for shimming, but must NOT be used in final assembly.

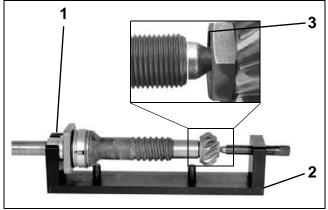
Select correct collar and shim gauge bar:

Collar: P/N 341440

Shim gauge bar: P/N 328367

Slide the collar onto the driveshaft with large end in contact with the bearing housing.

Insert the assembled driveshaft into the tool base and tighten pre load screw against the driveshaft until groove on the spr ing-loaded plunger is flush with end of threads. Tighten locking ring on preload screw.



Collar Tool base

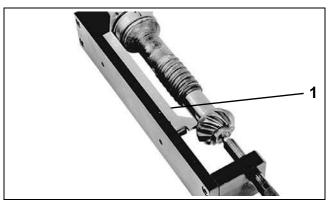
Groove

t

COA3566 DSC00326

Rotate the driveshaf t several revolutions to se at bearings.

Lay the tool base on its side. Position the shim gauge bar against guide pins of the tool base.



Shim gauge bar

COA3567

Check squareness of the bearing housing mounting surface by holding the shim gauge bar against the pinion while rotating just the bearing housing. Use a fe eler gauge to me asure cle arance

GEARCASE ASSEMBLY

between the gauge bar and the bearing housing between each pair of scre w holes. Replace the bearing housing and re peat check if va riance is greater than 0.004 in. (0.101 mm).

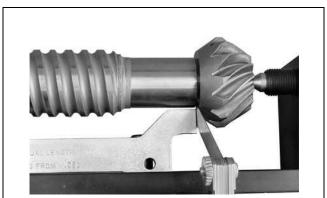
Check squareness of the pinion to the driveshaft. Hold the shim g auge bar ag ainst the bearing housing (between the screw holes) while rotating just the driveshaft and pinion assembly. Measure clea rance between the gauge bar and the pinion at se veral locations. If variance is greater than 0.002 in . (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.

Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.

Remove the driveshaft from the tool and add the required shims between the bearing housing and the thrust washer.

IMPORTANT: Use extreme care when removing bearing housing to avoid damaging the seals. Use Driveshaft Seal Protector, P/N 318674.

Check clea rance again. The measurement between the gau ge bar and pinion should be 0.020 in. (0.508 mm).



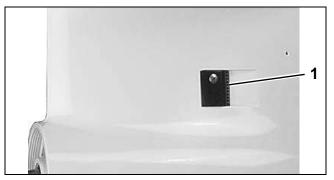
005417

Remove the nut an d pinion from the driveshaf t. Discard the nut.

GEARCASE ASSEMBLY

Water Intake Screens

Install water int ake screens. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



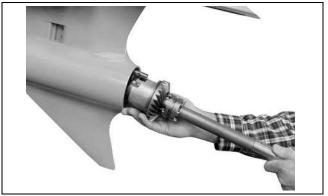
1. Water intake screen

001991

Shift Housing, Gear, and Propeller Shaft Installation

Push shifter detent into fa rthest downward position. Tip the rear of the gearcase slightly downward to assist in the installation of the shaft assembly.

Be sure the thrust bearing and the thrust washer are in the proper position. Insert the shaft assembly fully in to the gea rease while aligning shift housing pin with hole in forward end of gearcase housing.

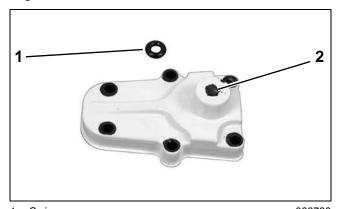


005427

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.

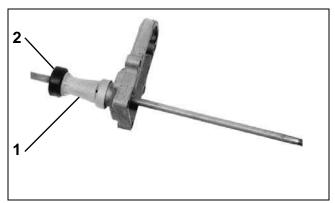


O-ring
 Groove

006780

Place the shift rod grommet on the shift rod.

Install shift rod spacer under grommet on 25 in. models.



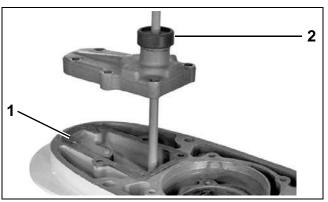
Grommet
 Shift rod spacer

COA3568

Apply *Triple-Guard* grease to the threaded end of the shift rod and insert it through the cover. Turn the shift rod while pushing it through the cover to avoid damaging the O-ring.

Apply *Gasket Sealing Compound* to both sides of a new shift rod cover gasket. Place the gasket on the gearcase.

Thread the shift rod into the shifter detent about four turns.



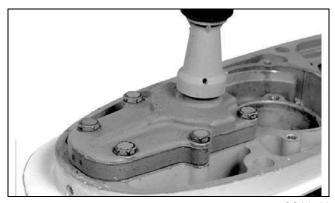
Cover gasket
 Grommet

the gearcase.

COA3141

Move shift rod from side to side while pushing on the propeller shaft to ensure proper alignment of the bearing housing locator pin into the pin hole in

Apply *Gasket Sealing Compound* to the threads of the shift rod cover screws. Tighten the screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



COA3569

Refer to SHIFT ROD ADJUSTMENT on p. 323.

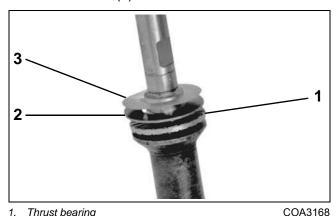
GEARCASE ASSEMBLY

Pinion Gear and Driveshaft Installation

Refer to **DRIVESHAFT SHIMMING** on p. 337 before proceeding.

Install new seals in drivesh aft bearing housing. Refer to Driveshaft Bearing Housing Service on p. 334.

Place the driveshaft thrust bearing, thrust washer, and correct shim(s) on the driveshaft as shown.



- Thrust bearing
- Thrust washer
- Shim(s)

Using Drivesh aft Sea I Protector, P/N 318674, slide the driveshaft bearing housing onto the

driveshaft and into position in the gearcase.



1. Seal protector

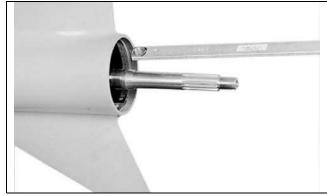
COA3130

Adjust shift rod to move clutch dog as far forward as possible. Be sure excess grea se is re moved from the pinion bearing.

IMPORTANT: The inside taper of the pinion gear and the driveshaft taper MUST be pletely free of grease. Clean the t apers with Cleaning Solvent. Use a shop towel free of grease and lint.

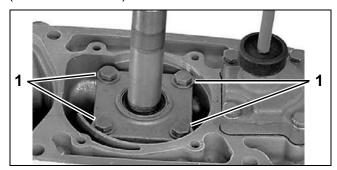
Place the pinion gear into the gearcase. Insert the driveshaft into the gearcase and through the pinion gear.

Lightly coat the thre ads of a **new** pinion nut with outboard lubricant. Use Pinion Nut Starting Tool, P/N 342216, to install nut on the driveshaft. Turn the driveshaft by han d to thread the shaft.



42230

Apply Gasket Sealing Compound to the threads of the driveshaf t bea ring housing screws. Tighten screws in stages to a torque of 120 to 144 in. lbs. (13.5 to 16.5 N·m).

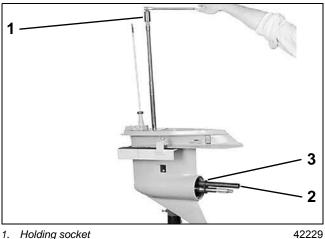


Driveshaft bearing housing screws

COA3153

GEARCASE ASSEMBLY

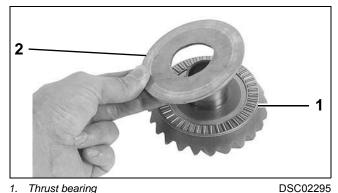
Use Driveshaft Holding Socket, P/N 311875, Piner, P/N 334455, and W rench ion Nut Hold Retainer, P/N 341438, to tighten the pinion nut to a torque of 100 to 110 ft. lbs. (136 to 149 N·m). Pad handle of holder to prevent damage to gearcase.



- Holding socket
- Pinion holder
- 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.

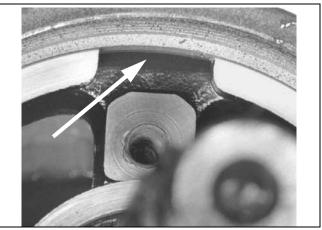


- Thrust bearing
- Thrust washer

Lightly apply Gasket Sealing Compound to a new bearing housing O-ring. Install O-ring in groove in the housing.

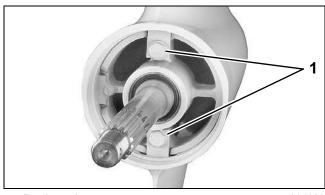
Install hou sing into ge arcase. Align screw holes with retainer slots in gearcase.

Housing mu st be completely sea ted to install retainer tabs.



Retainer Tab Notch

Install two ret ainers, washers andd screws. Apply Ultra Lock to the reads and tighte n scr ews to a torque of 18 to 20 ft. lbs. (24 to 27 N·m).



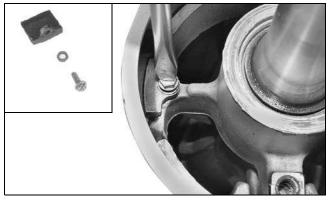
Retainer tab screws

GEARCASE ASSEMBLY

"O" Type Gearcases

Loosen retainer screws 1/4 turn.

Install wed ge, screw, and wa sher. Ap ply *Ultra Lock* to threads and tig hten screw to a torq ue of 15 to 20 in. lbs. (1.7 to 2.3 N·m).



DSM02291 DSC02361

Re-tighten two retainer screws to 18 to 20 ft. lbs. $(24 \text{ to } 27 \text{ N} \cdot \text{m}).$

Confirm that torque on the wedge screw is 15 to 20 in. lbs. $(1.7 \text{ to } 2.3 \text{ N} \cdot \text{m})$.

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- GEARCASE LEAK TEST on p. 295
- WATER PUMP SERVICE on p. 320
- SHIFT ROD ADJUSTMENT on p. 323
- GEARCASE REMOVAL AND INSTALLATION on p. 318
- Gearcase Lubricant on p. 39
- Propeller Hardware Installation on p. 294
- Trim Tab Adjustment on p. 31.

During bre ak-in pe riod of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

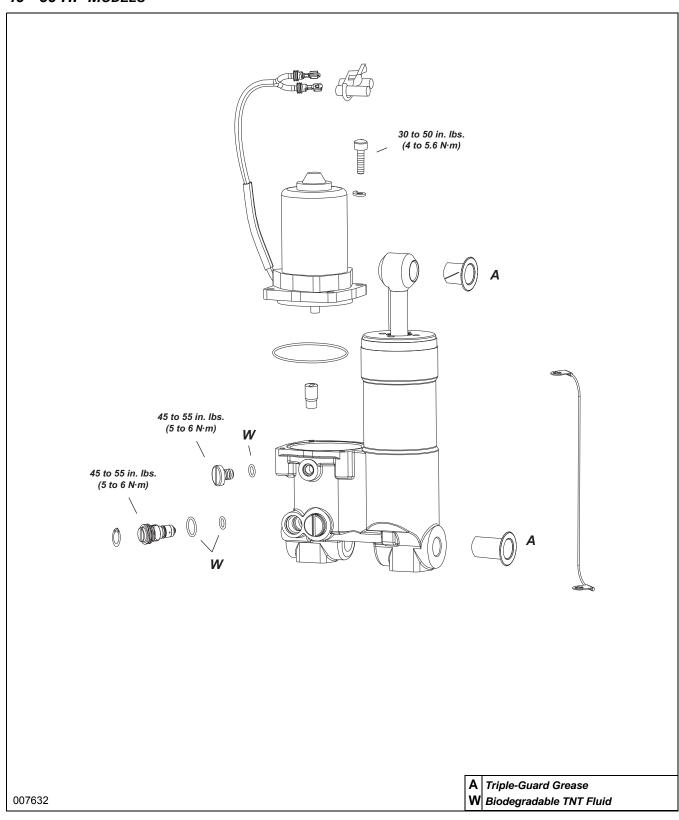
TRIM AND TILT

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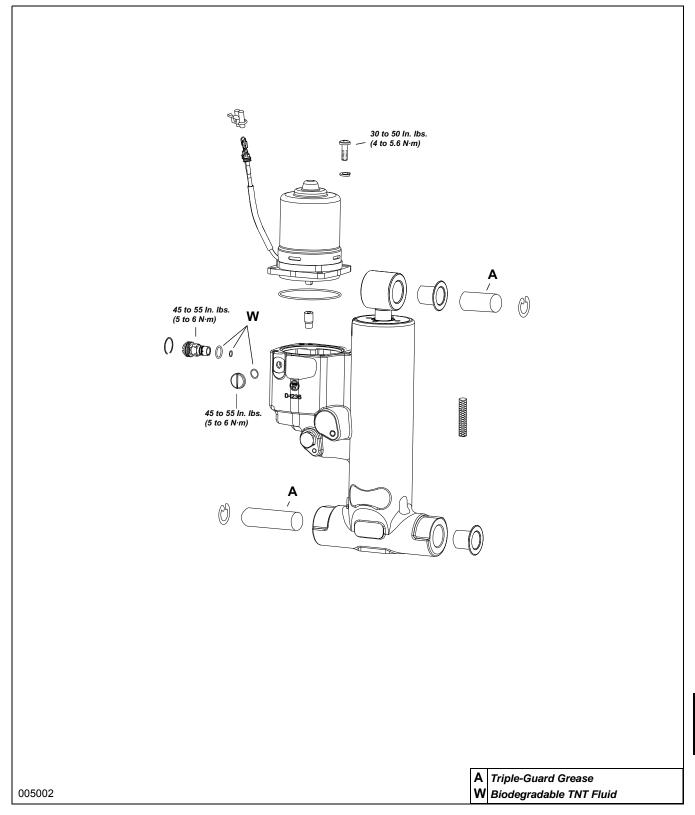
SERVICE CHART

40 - 60 HP MODELS



15

75 - 90 HP MODELS



SYSTEM DESCRIPTION

The power trim/tilt hydraulic system is completely contained between the outboard's stern brackets.

The system consists of:

- Electric motor
- Oil reservoir
- Pump manifold assembly
- Cylinder body assembly

Optimal boat and outboard performance can be achieved by adjusting (trimming) the angle of outboard propeller thrust. The first 15° of outboard movement is considered trim range.

Outboard mo vement be yond the trim ra nge is considered tilting. Tilting of the outboard may be desired for shallow water d rive and f or trailering/storage. The tilt cylinder moves the outboard through the tilt range.

IMPORTANT: When in tilt range , ma ke sure water is available to gearcase water pickups.

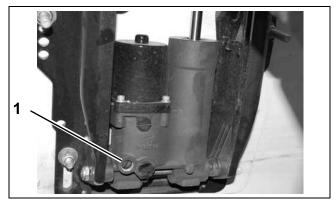
Manual Adjustment

The outboard can be manually raised or lo wered through its entire trim and tilt range by opening the manual release valve a minimum of three turns. When this cycle is complete, the manual release valve must be closed and tightened to a torque of 45 to 55 in. lbs. (5 to 6 N·m) before normal operation can be resumed.



1. Manual release valve, 75-90 HP

001988



Manual release valve, 40-60 HP

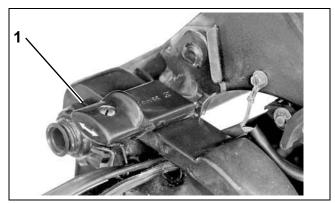
008018

Trailering Bracket And Tilt Support

40 - 60 HP MODELS

These outboards are equipped with combination tilt support/trailering brackets.

Tilt the outboard up fully, engage the bracket, then tilt the outboard down until the b racket is firmly in position.



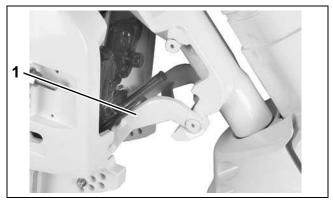
1. Tilt support bracket, 40-60 HP

18954

75 - 90 HP MODELS

Use the trailering bracket to support the outboard when trailering in the tilted position. This bracket protects the hydraulic system from damage.

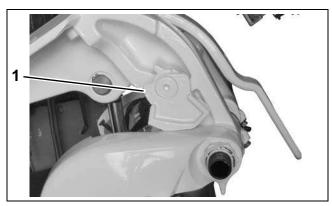
Tilt the outboard up fully, engage the bracket, then tilt the outboard down until the bracket is firmly in position.



Trailering Bracket

001987

For mooring or storing the boat with the outboard tilted, a tilt support is provided to support the outboard.



Tilt Support

002279

IMPORTANT: The tilt support must not be used to support the outboard while trailering.

ROUTINE INSPECTIONS

General

Check for external signs of fluid leakage. Correct causes as necessary.

Check the battery to be sure it is in good operating condition.

Reservoir Fluid

Check reservoir fluid leve I at least e very th ree years or 300 operating hours. System capacity is approximately:

40 - 60 HP: 15.2 fl. oz. (450 ml)
75 - 90 HP: 21 fl. oz. (620 ml)

IMPORTANT: Use only *Evinrude/Johnson* Bi odegradable TNT Fluid to fill the hydraulic system.

Refer to **Trim and Tilt** on p. 41 for filling procedure.

Manual Release Valve

Check the manual release valve with a torq ue wrench.

IMPORTANT: Tighten valve to a torque of 45 to 55 in. lbs. (5 to 6 N·m).

Stern Brackets

Inspect the stern brackets for binding.

Tighten starboard tilt tube nut to a torque of 45 to 50 ft. lbs. (61 to 68 N·m).

TROUBLESHOOTING

Use the following guidelines to check a single piston trim/tilt unit that is not working correctly.

Cylinder Leakdown:

- Manual release valve seals
- External leaks

No reverse lock:

External leaks

No operation, motor runs:

- Manual release valve open
- Fluid level low
- Pump coupler
- Hydraulic pump

No tilt down:

- Manual release valve
- Fluid level

Slow performance:

- · Manual release valve
- Fluid level low
- Mechanical binding
- Electric motor
- Hydraulic pump

Unit locked in tilt up:

- Mechanical binding
- Hydraulic pump

ELECTRICAL CIRCUIT TESTS

Relay Testing

When the trim-UP button is pressed, the UP relay is energized and connects the blue trim motor wire to the battery positive (+) terminal. The green trim motor wire remains grounded. When the button is released, the blue trim moto r wire returns to a grounded position.

When the trim-DOWN butto n 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 re leased, the gre en trim motor returns to a grounded position.

Refer to TILT/TRIM RELAY TEST on p. 106 for relay testing procedure.

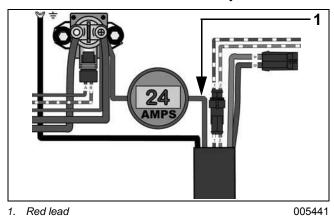
Trim and Tilt Motor **Current Draw Tests**

Careful an alysis of the electric motor's current draw and trim/tilt unit operating speed aids evaluation of the electric motor and certain mechanical components.

Use a battery rated at 360 CCA (50 Ah) or higher that is in good condition and fully charged to perform this test.

IMPORTANT: Specifications are for st atic hydraulic tests. DO NOT att empt to perform the following tests while the boat is moving.

Connect a 0 to 100 A DC ammete r in series between the battery side of the starter solenoid and the red lead to the trim/tilt relay module.



1. Red lead

Observe ammeter and a stopwatch while running hydraulic unit through several complete cycles.

Compare test results to the values listed:

75 - 90 HP MODELS

Mode	Normal Current Draw	Time in Seconds
Full Range UP	<30 A	12-18
Full Range DOWN	<30 A	<18
Stall	<40 A	_

40 - 60 HP MODELS

Mode	Normal Current Draw	Time in Seconds
Stall UP	11 to 16 Amps	_
Stall DOWN	16 to 22 Amps	_
Full Range UP	_	13 to 19
Full Range DOWN	_	10 to 16

TRIM AND TILT

ELECTRICAL CIRCUIT TESTS

Test results include three basic possibilities:

A. Low current draw - Check for:

- Valves leaking
- Pump damaged
- O-rings leaking
- Manual release valve damaged

B. High current draw - Check for:

- Valves sticking
- Pump binding
- Motor binding
- Cylinder binding

C. Normal current draw, slow operating speed – Check for:

Manual release valve damaged

Trim and Tilt Motor No Load Test

IMPORTANT: Securely fasten m otor 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 25 A ammeter in series with the battery positive (+) terminal, ammete r red le ad toward terminal.

Attach or hold a vibration or mechanical tachometer to the motor while performing this test.

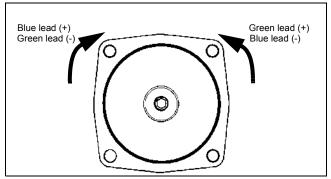
Monitor motor RPM and current draw.



30957

The motor shaft must rotate clockwise, as viewed from the pump end, when positive (+) is applied to the blu e le ad, a nd n egative (-) is connected to green lead.

The motor shaft must rotate counterclockwise, as viewed from the pump end, when po sitive (+) is applied to the green lead, and negative (–) is applied to the blue lead.



DR4238r

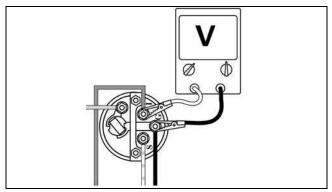
If test results vary, replace the motor.

Trim Gauge Test

STEP 1

Turn key switch ON. Using a voltmeter, check for voltage between the trim gauge "I" and "G" terminals.

- If no voltage, check condition of instrument harness, key switch, and engine 20 A fuse.
- If voltage is shown, go to STEP 2.

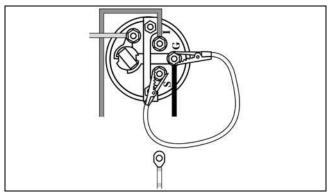


DRC6245

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

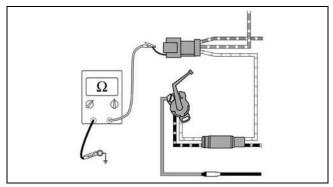
IMPORTANT: To avoid immedia te me ter damage, never apply an ohmmeter to an electrical circuit where voltage is present.

Disconnect the 3-pin connector betwee n the instrument harness and engine trim harness. Connect an ohmmeter between the white/tan wire, terminal "C," of the en gine harness and a clean engine ground.

With the outboard fully DOW N, meter must show a reading above 80 ohms.

With the outb oard fully UP, meter must show a reading below 10 ohms.

- If results agree, refer to Trim Gauge Test on p. 351.
- If results are different, replace trim sender.



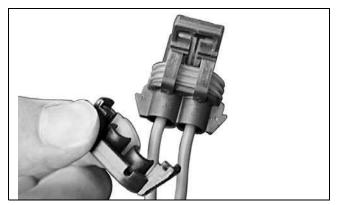
DRC6247

TRIM AND TILT REPLACEMENT

Removal

Raise the outboard and engage the tilt support.

Remove the rubber grommet from the blue/green trim/tilt cable connector.



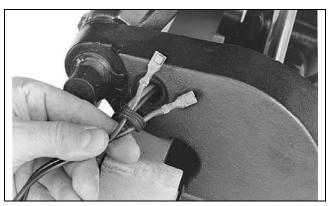
000686

Remove the terminals from the connector by using a suitable tool to depress the tab. While the tab is depressed, pull on the wire from the rear of the connector to release it from the connector.



000687

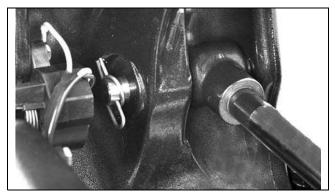
Separate the trim/tilt unit wires in the braided tube to p ermit remo val t hrough the hole in the stern bracket.



25078

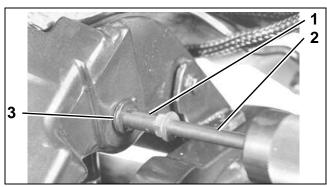
40 - 60 HP MODELS

Remove the spring clip from the cylinder pin.



15493

Thread Adapter, P/N 340624, onto Slide Hammer, P/N 391008. Screw the adapter into the cylinder pin and remove the pin.



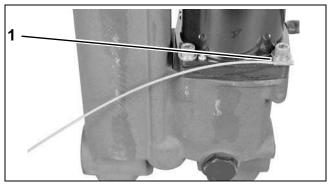
- Thread adapter
- 2. Slide hammer
- 3. Cylinder pin

Remove one of the locknuts from the angle adjustment rod. Remove the rod from the stern brackets.



18941

Remove the un it from the stern bracket s far enough to remove the ground lead from the pump motor mounting screw.

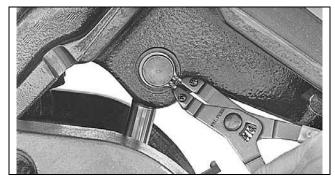


Ground lead

007640

75 – 90 HP MODELS

Remove the external snap rings from the up per pin.



25064

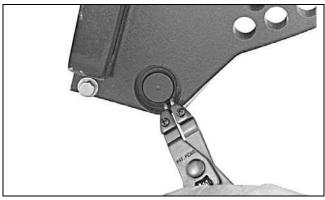
Use a punch to remove the upper pin.



25065

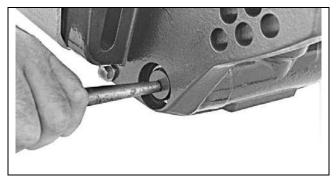
Retract the tilt cylinder rod.

Remove the external s nap rings from the lower pin.



25077

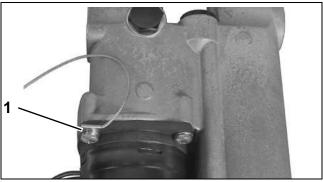
Use a punch to remove the lower pin and remove the trim/tilt unit from the stern brackets.



TRIM AND TILT

TRIM AND TILT REPLACEMENT

Remove the un it from the stern bracket s far enough to remove the ground lead from the pump motor mounting screw.



1. Ground lead 002527

Lubricate the an gle adjustment rod with *Triple-Guard* grease. Install the rod. Tighten the locknuts to a torque of 20 to 25 ft. lbs. (27 to 34 N·m).



18941

Installation

40 - 60 HP MODELS

Lubricate the cylinder and thrust rod bushings with *Triple-Guard* grease. Install the bushings.



15591

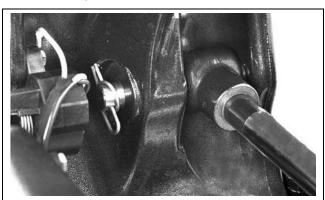
Install the ground lead.

Place trim/tilt unit into position.

Loosen the manual release valve if necessary and extend tilt cylinder rod to match with holes in swivel bracket.

Apply *Triple-Guard* grease to upper pin and install the pin.

Secure the cylinder pin with cotter clip.

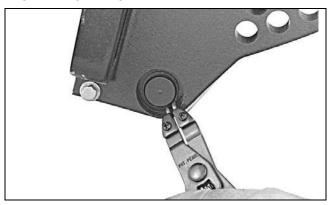


75 - 90 HP MODELS

Install the ground lead.

Place trim/tilt unit into position. Apply *Triple-Guard* grease to the lower pin and install the pin.

Install external snap rings on lower pin with sharp edge of ring facing out.

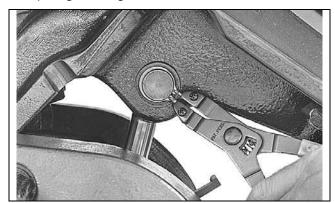


25077

Loosen the manual release valve if necessary and extend tilt cylinder rod to match with ho les in swivel bracket.

Apply *Triple-Guard* grease to upper pin and install the pin.

Install e xternal snap rings o nto upp er pin with sharp edge facing out.



25064

ALL MODELS

Place trim/tilt wires in br aided tub e an d inst all through hole in the stern bracket.



25079

Install connector on trim/tilt cable and reconnect trim connectors to engine wire harness.

Release the tilt support and lower the outboard. Tighten the manual release valve to a torque of 45 to 55 in. lbs. (5 to 6 $N \cdot m$).

TRIM AND TILT SERVICE

Disassembly

Thoroughly clean the unit before disassembling. Scrub all outside surfaces with a stiff brush and hot, soapy water to prevent surface dirt from contaminating internal parts.

Always use a lint free shop cloth when handling power trim/tilt components.

If painting the unit is required, paint it after it is completely assembled. Painting of individual components may cause flakes of paint to enter the hydraulic passages during a ssembly. Tape the trim/tilt piston rods before painting.

A WARNING

There may be high pressure behind some power trim valves. To avoid injury when removing manual release valve, be sure to cover valve with a shop cloth until the pressure is released. Wear safety glasses.

IMPORTANT: Before removing manual release valve, relieve pressure by fully extending cylinder.

Screw the man ual release valve in. Remove the retaining ring using a small pick or screwdriver. Discard the retaining ring.



40 - 60 HP Models

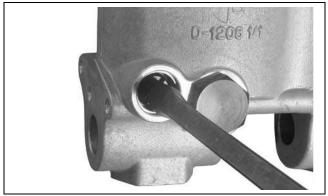
002528



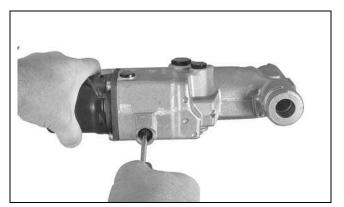
75 - 90 HP Models

004279

Slowly remove the manual release valve. There may be pressure behind the valve—wear safety glasses.



40 - 60 HP Models 002529



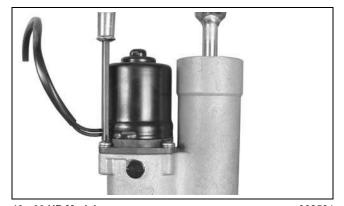
75 - 90 HP Models 004285

Inspect the manual release valve. Discard the Orings on the housing.



007108

Remove t he four large mo tor flange retaining screws. Remove the motor and discard O-ring, screws, and washers.



40 - 60 HP Models 002531



75 - 90 HP Models 004282

Remove drive coupler from either the motor or the pump assembly.



002532

TRIM AND TILT

TRIM AND TILT SERVICE

Assembly

IMPORTANT: Use only *Evinrude/Johnson* Bi odegradable TNT Fluid to fill the hydraulic system.

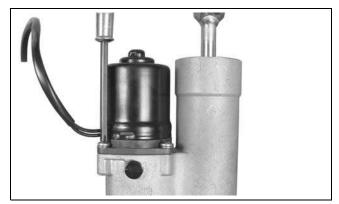
Install drive coupler in pump assembly.

Install a new motor O-ring.



002533

Position the motor on the manifold and install four **new** screws and lock washers. Tighten the screws 35 to 50 in. lbs. (4 to 5.6 N·m).



40 - 60 HP Models

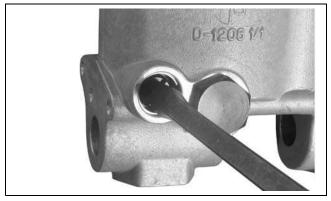
002531



75 - 90 HP Models

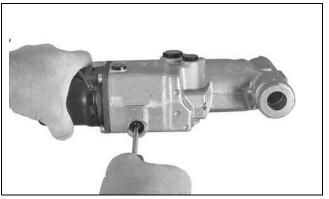
004282

Oil O-rings and install them on the manual release valve. Oil and install the manual release valve. Tighten the valve to a torque of 45 to 55 in. lbs. (5 to 6 $N \cdot m$).



40 - 60 HP Models

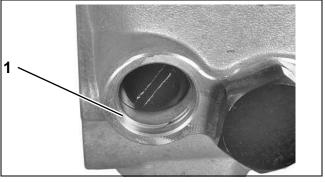
002529



75 - 90 HP Models

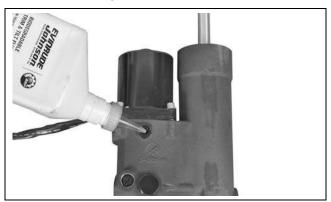
004285

Install **new** retaining ring in groove.



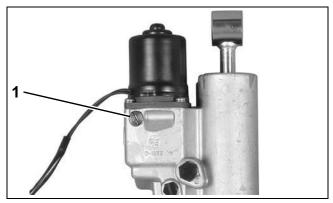
1. Retaining ring

Fill the oil reservoir up to the fill plug with *Evinrude/Johnson* Biodegr adable TNT Fluid. Install the fill plug.



40 - 60 HP Models

007646



75 - 90 HP Models

004278

Run the motor, then recheck oil level. Cycle the unit several times and check the oil level when the cylinder is fully extended. Oil should be level with bottom of fill port. Install and tighten the fill plug to a torque of 45 to 55 in. lbs. (5 to 6 $N \cdot m$).

NOTES

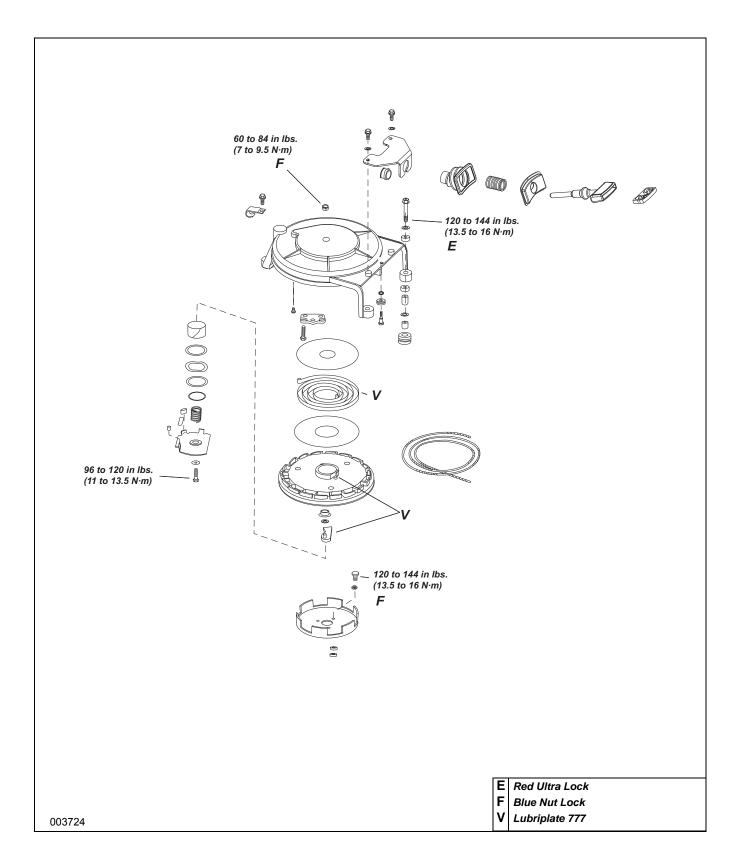
Technician's Notes Related Documents Bulletins **Instruction Sheets** Other

MANUAL STARTER

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SERVICE CHART



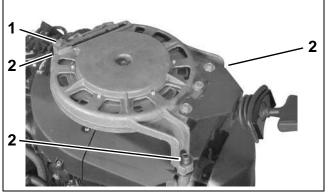
RECOIL STARTER **REMOVAL**

A WARNING

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

Remove the clamp holding the oiling system wiring harness.

Remove the three st arter housing screws and washers.



Clamp Starter housing screws (3) 002515

Lift starter housing from outboard.

Remove three screws and remove starter ratchet from flywheel.



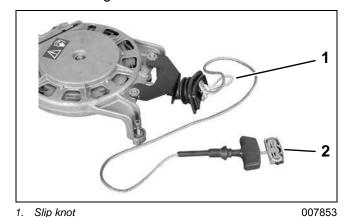
1. Ratchet 006483

RECOIL STARTER **DISASSEMBLY**

A WARNING

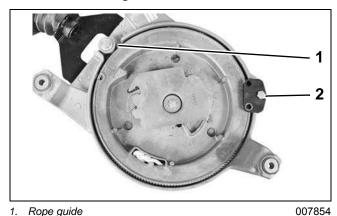
Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

Pull the starter rope out far enough to tie a slip knot in the rope. Remove the end of the starter rope from the handle anchor and remove the handle. Release the slip knot and ease the rope back in until the rewind spring is fully unwound. If necessary, remove the starter handle bracket from the starter housing.



Slip knot 2. Rope anchor

Remove the rope g uide and pulley sup port from the starter housing.



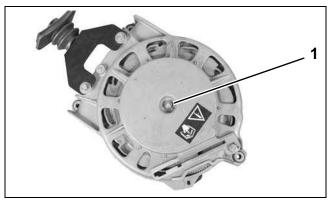
Rope guide

Pulley support

MANUAL STARTER

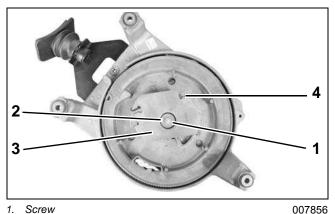
RECOIL STARTER DISASSEMBLY

Remove the nut from the starter pawl retaining screw.



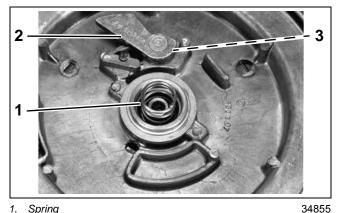
1. Nut 007855

Remove the starter pawl retaining screw, washer, and starter pawl plate with plate return spring from the starter assembly.



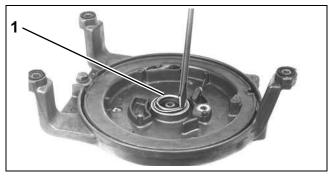
- Screw
- 2. Washer
- 3. Plate
- Spring

Remove starter housing spring and starter pawl with spring washer from the starter assembly.



- Spring
- Spring washer (under starter pawl)

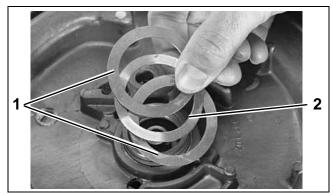
Use a screwdriver to pry open the pulley lock ring, and remove ring from the starter.



1. Lock ring

COA1368

Remove the friction plates and friction plate spring washer.



- Friction plates
- Friction plate spring washer

34854

Hold the pulley in the starter housing while turning the starter over, legs do wn. Hold fingers clear of the pulley and jar the starter housing against a bench to dislodge the rewind spring and pulley. Remove the pulley bushing from the pulley.



007857

RECOIL STARTER CLEANING AND INSPECTION

Wash metal components in solvent and dry with compressed air.

Inspect the rewind sp ring for broken end lo ops and weak tension.

Examine the starter pawl for wear.

Inspect the starter components for wear. Replace as necessary.

Inspect starter rope. Replace rope if frayed. Cut new rope 96.5 in. (245 cm) in length. Fuse ends of rope to a length of 1/2 in. (12 mm).

Examine the pulley and the starter housing. Look for shar p edge s and rough surfaces that could fray the starter rope. File and polish to remove.

Examine the st arter and starter lockout p arts. Replace any worn or damaged parts.

RECOIL STARTER ASSEMBLY

WARNING

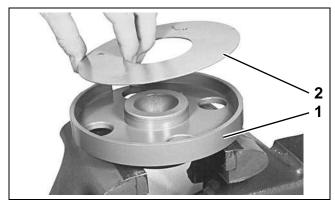
Wear safety glasses while disassembling and assembling manual starters because of rewind spring tension.

Place starter spring shield and pulley bushing into the starter housing.



1. Shield COA1360

Clamp base of Starter Spring Winder and Installer, P/N 392093, in a vise. Inse rt release plate in to spring winder base.



1. Base

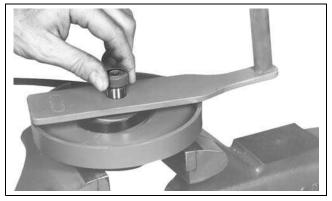
2. Plate

CO3593

MANUAL STARTER

RECOIL STARTER ASSEMBLY

Apply *Triple-Guard* grease or *Lubriplate 777* to the rewind spring. Install the re wind spring into the spring winder base with open loop of spring facing inward. Insert the pin of the crank and pin assembly into the loop of the rewind spring. Secure the crank and pin assembly to the starter winder base with the crank retainer screw.



CO3591

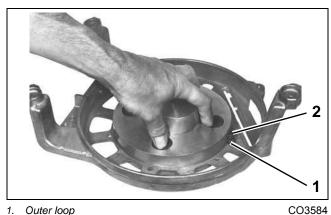
Rotate the crank and pin assembly in the direction shown on the tool. Wind the spring into the starter winder base until end of spring contacts the starter winder base.

Remove the crank retainer screw and the cran k and pin asse mbly from the starter win der base. Remove the starter winder base from the vise.



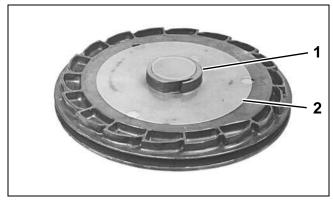
CO3589

Install the rewind spring into the starter housing. Locate the outer loop of the rewind spring on the pin in the starter housing. Press down through the holes in the spring winder base to tra nsfer the rewind spring into the starter housing.



Outer loop

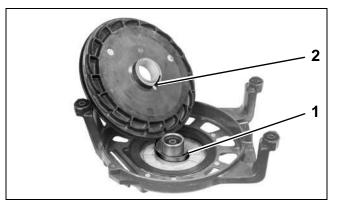
Apply *Triple-Guard* grease or *Lubriplate 777* to the pulley bushing. Install the pulley bushin g in the pulley. Place the pulley shim on the pulley.



Bushing Shim

COA1364

Bend the inside lo op of the rewind sprin g in toward the center of the starter housing. Place the inner loop of the spring in the slot of the pulley, and install the pulley in the starter housing.

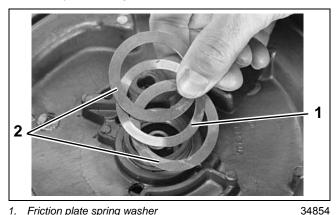


1. Inside loop

2. Slot

COA1365

Place the friction plate spring washer between the two friction plates on the pulley hub. Secu re the friction plate and friction plate spring washer with the pulley lock ring.

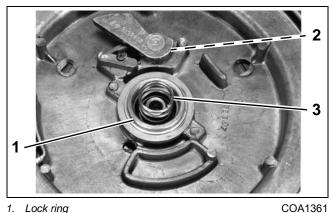


Friction plate spring washer 1.

Friction plates

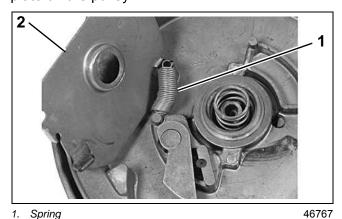
Make sure the starter pawl bushing is installed in the pulley. Apply Triple-Guard grease or Lubriplate 777 to boss of the starter pawl. Place spring washer on the boss of the starter pawl. Place the starter pawl in the pulley.

Place the st arter hou sing spring in the st arter housing.



Spring washer (under starter pawl) 2.

Install the starter pawl plate return spring on the starter pawl plate. Press the other end of spring on the boss of the pulley. Position the starter pawl plate on the pulley.



Spring

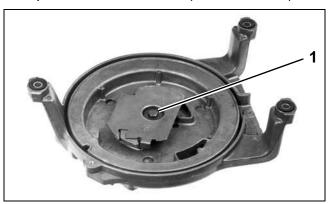
Clean threads of the starter pawl plate retaining

screw and nut to remove adhesive.

MANUAL STARTER

RECOIL STARTER ASSEMBLY

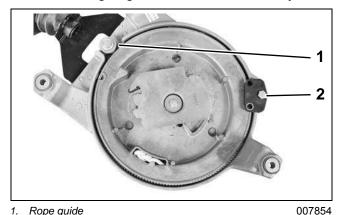
Install the starter pawl plate retaining screw and washer into the starter housing. Tighten screw to a torque of 96 to 120 in. lbs. (11 to 13.5 N·m).



1. Screw COA1375

Spray threads of starter pawl plate retaining screw and nut with Locquic Primer. Apply Nut Lock to the threads of the nut. I nstall and tighten the nut securely.

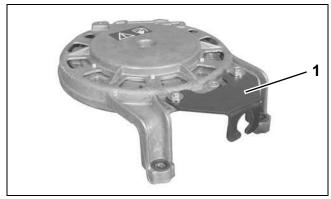
Install the rope guide and pulley support to the starter housing. Tighten the screws securely.



Rope guide

2. Pulley support

If removed, install the starter handle bracket to the starter housing. Tighten screws securely.



Starter handle bracket

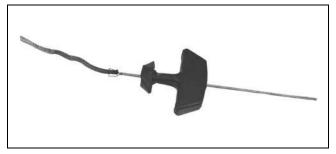
002517

Tie a knot in one end of the starter rope. With the starter housing upside down on a bench, wind the pulley counterclockwise until the rewind spring is tight.

Back off the rewind spring until the rope cavity of the pulley is aligned with the rope guide. Thre ad the starter rope through the pulley, rope guide, and outlet in the starter handle bracket.

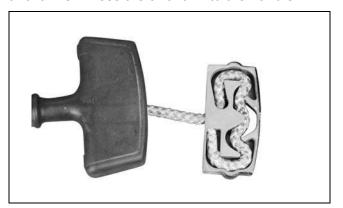
Seat the knotted end of the starter rope in the pulley. Tie a slip knot in the starter rope to hold rope in position.

Apply Triple-Guard grease or Lubriplate 777 to the handle end of the starter rope. Using Starter Rope Threading Tool, P/N 378774, th read the starter rope through the handle.



COA1373

Press the starter rope into the channel of the rope anchor, with end of starter rope firmly against end of channel. Press the anchor into the handle.



007858

Check ope ration of the st arter pawl when the starter rope is pulled out. The starter pawl should extend when the starter rope is pulled and retract when the starter rope recoils.

RECOIL STARTER INSTALLATION

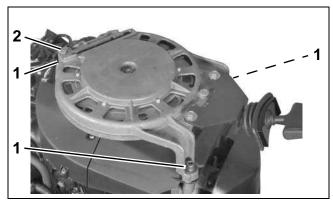
Apply *Nut Lock* to the thre ads of st arter ratch et screws. Install washers and ratchet on flywheel. Tighten screws to a torque of 120 to 14 4 in. lbs. $(13.5 \text{ to } 16 \text{ N} \cdot \text{m})$.



006654

Place t he st arter a ssembly onto the outboard. Install the starter housing retaining screws, washers, and lock washers. Be sure to place washers between the starter housing and the flywheel cover. Apply *Ultra Lock* to threads and tighten the three starter housing screws to a torque of 120 to 144 in. lbs. (14 to 16 N·m).

Install clamp for oiling system wiring harness.



1. Starter housing screws (3)

2. Clamp

002515

NOTES

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	Bulletins
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	Othor
	Other

SAFETY

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MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM

WARNING

This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

- Product user is informed; and
- Products are safe and reliable.

It is up to you, the people who...

- Rig boats;
- Fix machinery; and
- Maintain equipment

...to keep the products safe **and** reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

First!

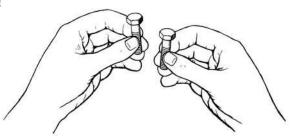
A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS

"They look the same, but are they the same?"

- Same size?
- Same strength?
- Same material?
- Same type?

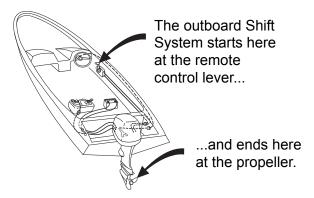
Don't substitute unless **you know** they are the **same** in **all** characteristics.



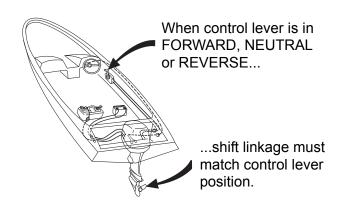
Second!

- Special locking bolts and nuts are of ten used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.
- When the outboard is returned to the boat, use only the special nuts and bolts to hold remote steering, shift, and throttle cables to the outboard.

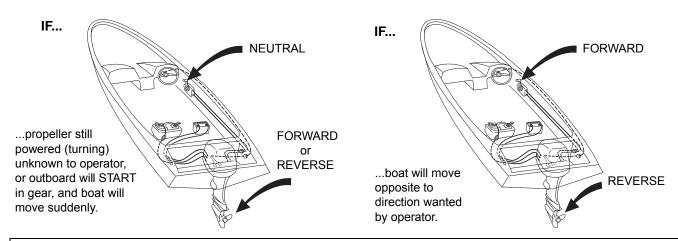
Outboard Shift Systems and Safety



What is most important?



What could happen?



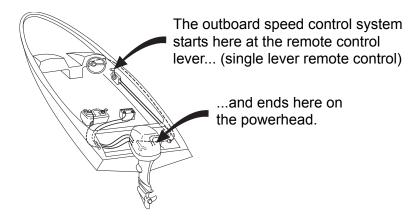
How can loss of shift control be minimized?

Read, understand, and follow manufacturer's instructions

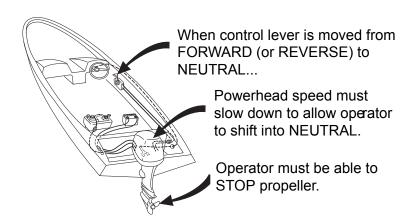
When rigging or after servicing

- Follow warnings marked "\(\underbrack{\Lambda}\)" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure prop eller 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 do wn 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?

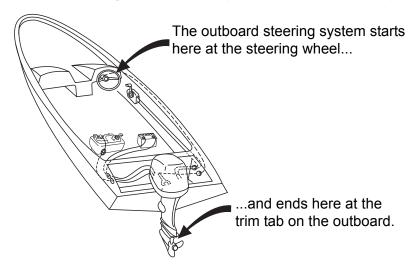
Read, understand, and follow manufacturer's instructions

When rigging or after servicing

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:

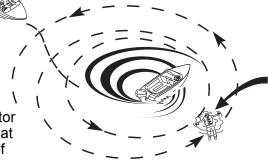
- Must not come apart;
- Must not jam; and
- Must not be sloppy or loose.

What could happen?

• If steering system comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.



 If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high spe ed), lo ose steering co uld lead to loss of boat control.





How can loss of steering control be minimized?

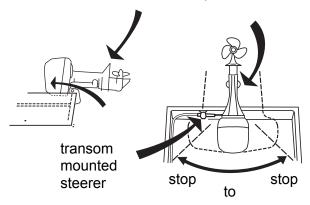
• Use a steer ing syst em recommende d by the outbo ard ma nufacturer which meets Marine Industry Safety Standards (ABYC).

When rigging or after

- Read, understand, and follow manufacturer's instructions
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Keep parts moving freely. Lubricate parts as shown in manual.
 - Use the bolts, nuts and washers supplied with steering attachment kits—they are a special locking type that will not loosen, rust, or weaken.

Transom Mounted Steering Systems – Check to Uncover Possible Trouble!

Tilt outboard into boat, then turn it.

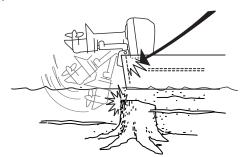


Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

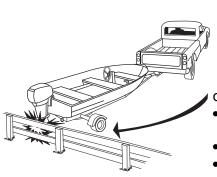
During this procedure, steering parts:

- Must not bind; and
- Must not tou ch ot her boat, outboard, or accessory parts in transom area.

Why? A hard blow to the outboa rd's gearcase can result in damage to st eering parts.



Check for damaged parts. Blows to the outboard like this

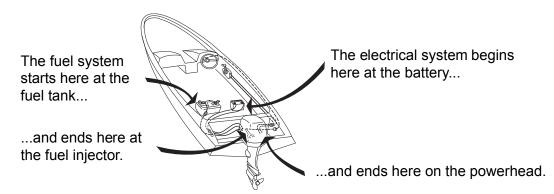


or this can put heavy loads on steering parts. Look for:

- Cracked parts, including steering parts, swive I b rackets, and transom brackets:
- Bent parts; and
- Loose nuts and bolts.

Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Outboard Fuel, Electrical System, and Safety



What is most important?

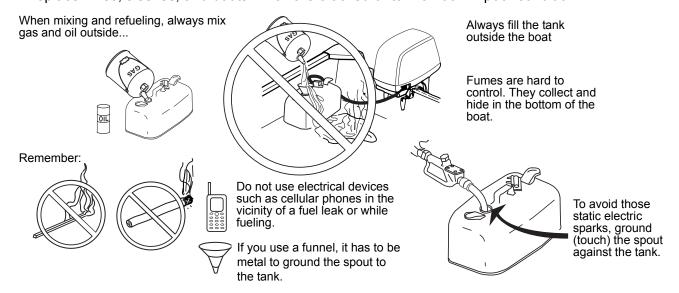
- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

What could happen?

- When not boating, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- When boating, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

- Read, understand, and follow manufacturer's instructions
- Follow warnings marked "
 [™] closely.
- **Do not** substitute fuel or electrical systems p arts 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.



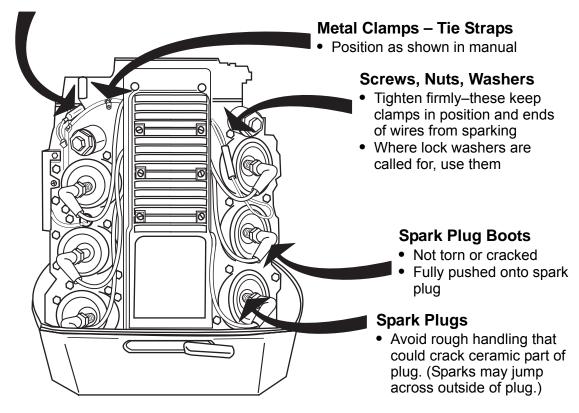
If electrical parts are replaced or even removed from the outboard, check the following:

Wire and high voltage lead routing

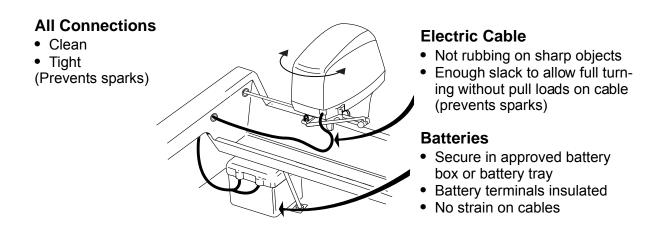
- As shown in service manual
- Away from moving parts which could cut wires or wire insulation
- Away from engine cover latches which can catch and cut insulation from high voltage spark plug leads

Sleeves, boots, shields

- In position (to avoid shock hazard)
- Not torn or cracked

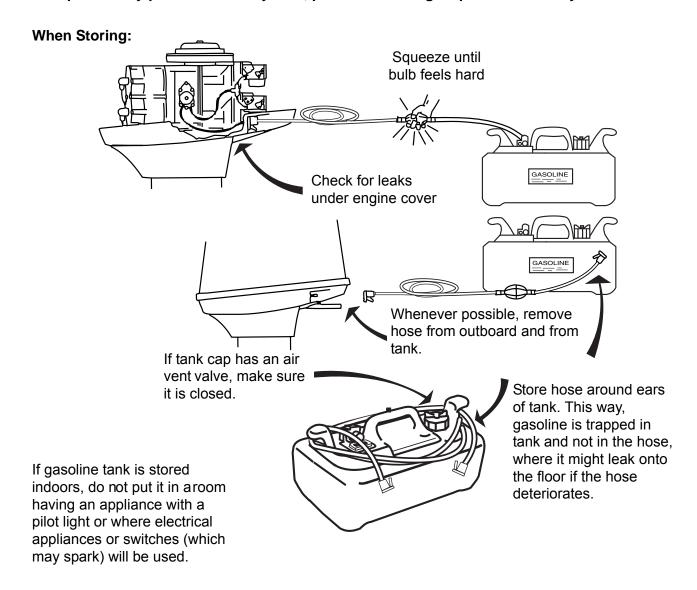


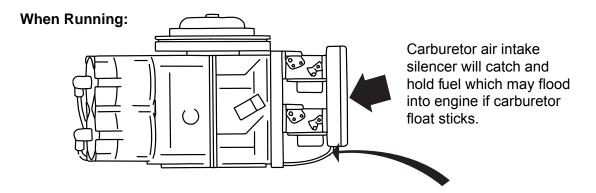
In transom area:



SAFETY

After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

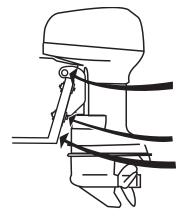




- Make sure silencer and its gaskets are on engine and drain hose is in place.
- Air silencer mounting screws are special lock screws. Use only the special screws.

Outboard Mounting System and Safety

The mounting system includes:



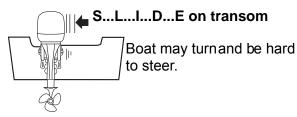
- outboard parts
- bolts, nuts, and washers
- boat's transom

What is most important?

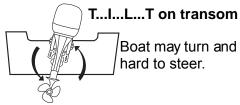
• Outboard must stay in position on boat's transom.

What could happen?

Outboard may



Outboard may

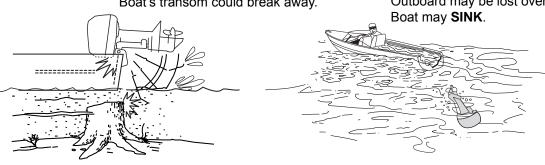


Boat may turn and be hard to steer.

• 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.

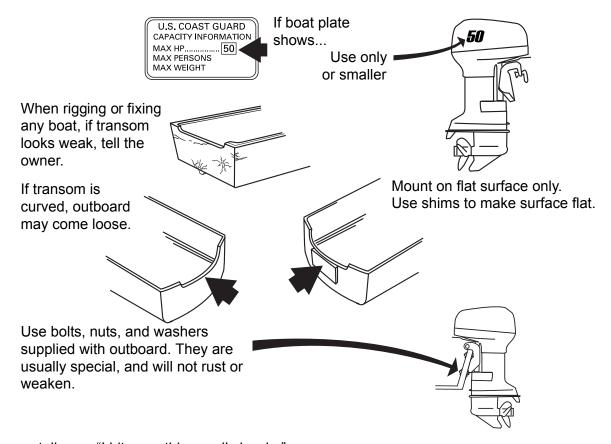
Outboard may be lost overboard. Boat may SINK.



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

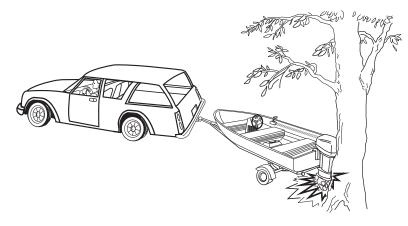


If owner tells you "I hit something really hard..."



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."

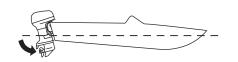
Check for a slow, heavy squash to the outboard.

 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

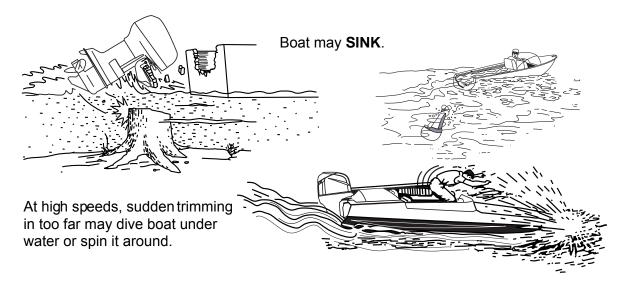
What is most important?

- 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.



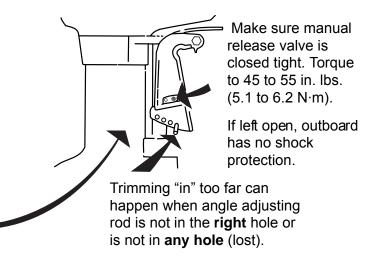
What can happen?

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.

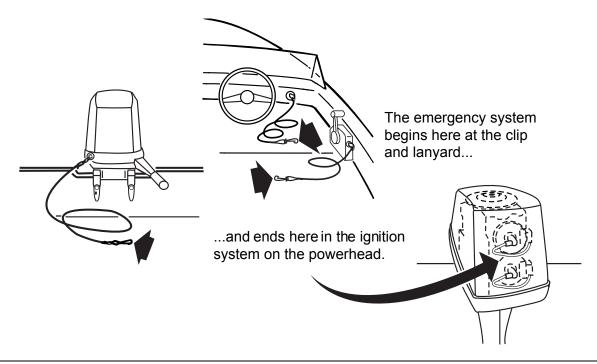


How can possible conditions be minimized?

- Read, understand, and follow manufacturer's instructions.
- Follow warnings marked "\(\underbrack{\Lambda}\)" 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.



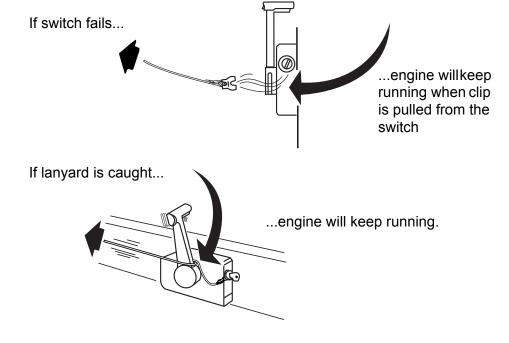
Outboard Emergency Stop System and Safety



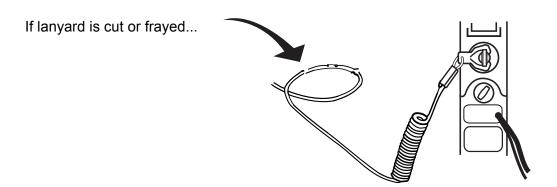
What is most important?

• The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

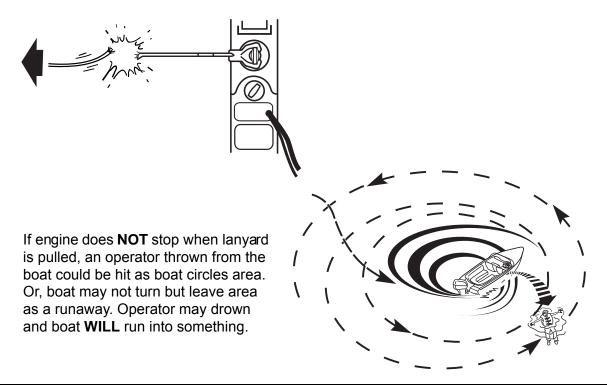
What could happen?



What could happen?



...lanyard or clip may break when pulled...



How can failure of the emergency stop system be minimized?

- Read, understand, and follow manufacturer's instructions
- Follow warnings marked "\(\Lambda\)" closely.

When or after

- Assemble parts carefully.
- rigging Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.

- **servicing** Locate control box and other items in area to keep lanyard from being caught.
 - ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.

SAFETY

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:

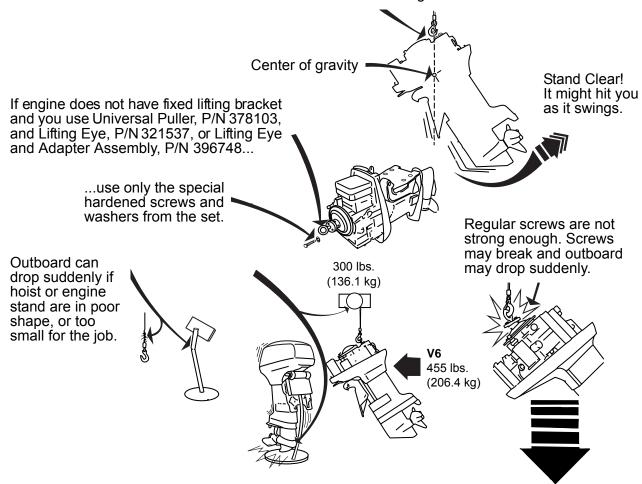
- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

When lifting outboards

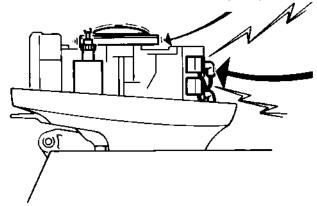
Some outboards have a fixed lift bracket bolted to the powerhead. Because outboard will want to hang like this when off the floor...



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.

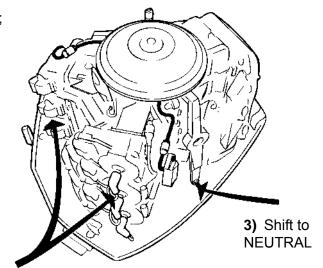
Outboard starting at the wrong time

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...



2) Twist and remove ALL spark plug leads



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:

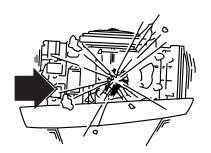
1) Using a flushing device...

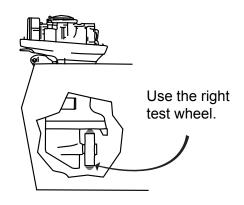
Turn on water before starting outboard. Keep engine speed below 200 0 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.



2) Running with the wrong test wheel...

This may happen if outboard runs too fast.





Running outboards: Exhaust fumes

A 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 carbo n monoxide (CO), which is odo rless, colorless, and tasteless, and can lead to unconsciousness, brain damage, or de ath if inh aled in sufficient concentrations. CO accumulation can occur while do cked, anchored, or underway, and in many confined areas such as the boat cab in, cockpit, swim platform, and heads. It can be worsened or caused by weat her, 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 fat all within minutes. Lower concentrations are just as lethal over long periods of time.

SAFETY

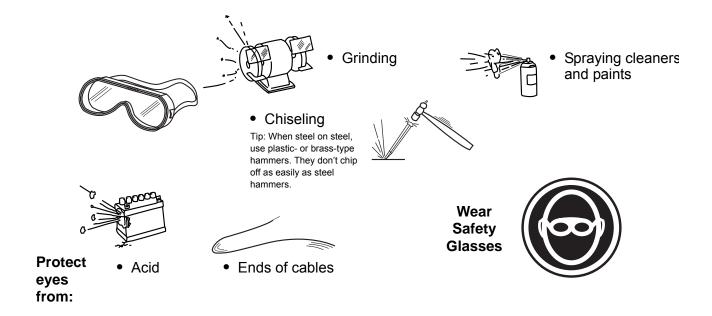
Running outboards: Propellers

A DANGER

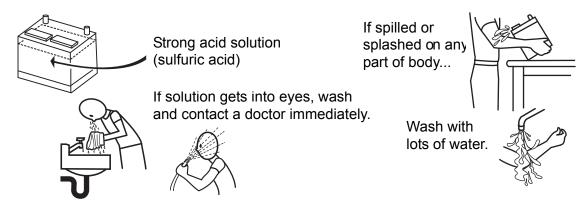
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

Eye protection

Eyes need protection when:

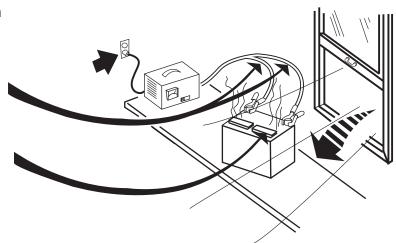


Handling Lead/Acid Batteries



Charging lead acid batteries

- 1) Attach and remove these cables with charger UNPLUGGED from 110 V wall socket. (This prevents shocks if charger is defective.)
- **2)** Observe correct polarity when connecting these larger leads.
- **3)** Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. **Make sure vents are open.** If clogged, pressure inside may build. Battery may EXPLODE.



Battery gas is explosive!

While charging or discharging, remember:

- No smoking
- No flames
- No sparks

DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.



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.

After charging:

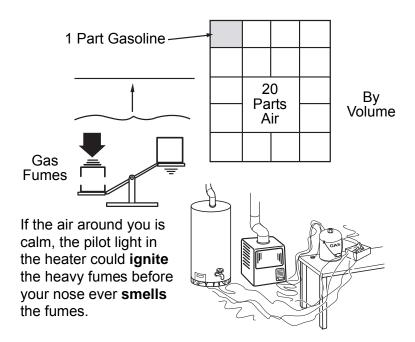
- Shut off charger
- Pull charger plug out of 1 10 V outlet
- Take charger cables off battery posts

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...



What can you do?



Store gasoline in sturdy, approved, sealed gas can and keep outside.

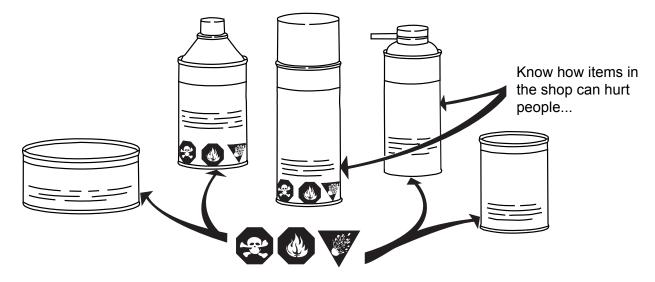
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, not for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, immediately:
 - 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

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 t ake responsibility for the safe mainten ance 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, precau tions, 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 p arts 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 underst and that safety -related a ccidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?

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TROUBLE CHECK CHART

OUTBOARD WILL NOT START

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard does not	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
turn over	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
	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
		Check wiring and emergency stop switch. Check the safety lanyard is installed and stop circuit is not grounded.
	In gear–Tiller models	Make sure outboard is in neutral
	No Fuel	Check for fuel in fuel tank
	Water in fuel	Check fuel filter, sample fuel from fuel return manifold.
	Contaminated or poor fuel quality	Check or replace fuel supply
	Fuel supply restricted	Check primer, anti-siphon valve, and fuel pick-up. Use primer to fill vapor separator with fuel.
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	,	Check fuel manifold pressure, refer to FUEL SYSTEM
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Fuel injectors not working	Check voltage at injectors
Outboard turns over	Excessive fuel or oil, engine flooded	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent, refer to FUEL SYSTEM
	Low or no 55 V alternator output	Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Ignition	Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	CPS input to <i>EMM</i> , no sync	Check RPM reading while cranking
	No ignition system control signal from <i>EMM</i> to ignition coils	Check cranking RPM (300 minimum), refer to SYSTEM ANALYSIS
	Low or no compression	Check compression
	Water in engine	Check condition of spark plugs and cylinders
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed
	EMM program, timing, or operation	Check <i>EMM</i> program and timing; check injector information (by location and serial number)
	Neutral switch, tiller models	Check neutral switch operation

OUTBOARD HARD TO START

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
	Weak battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections, check voltage drop on high amperage circuit
	Starter or bendix/drive gears	Check starter, inspect bendix/drive gears
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check or replace fuel supply
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to FUEL SYSTEM
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
Outboard eventually starts, may or may not	Low or no alternator output (55 V)	Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
run properly once started	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM
	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Crankshaft Position Sensor (CPS)	Check CPS air gap and <i>EMM</i> LED indicators
	Excessive fuel or oil, engine flooding	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent. Refer to SYSTEM ANALYSIS.
	EMM program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

OUTBOARD WILL NOT SHUT OFF

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
	Key switch or wire harness ground	Check key switch and ground to key switch, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
Outboard starts and runs, normal performance while	Stop circuit wiring	Check <i>EMM</i> LED indicators. Check wire harness (black/yellow) and key/stop switch(s).
running EMM failure	Check <i>EMM</i> LED indicators and eliminate stop circuit as possible cause. Stop wire (black/yellow) has 4.0 VDC from <i>EMM</i> with key on or outboard running.	

OUTBOARD STARTS AND STALLS

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
	Faulty wiring, connections, or grounds	Check all grounds, connections, and wiring
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low or no alternator output (55 V)	Check voltage on 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to FUEL SYSTEM
Outboard may not run for more than a few seconds	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Injector electrical circuit or control function	Check voltage at injectors, refer to SYSTEM ANALYSIS
	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM
	EMM program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs
	Weak or erratic ignition output	Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION
	Internal powerhead damage	Check and repair as needed

OUTBOARD STARTS, LOW MAXIMUM RPM

OBSERVATION	POSSIBLE CAUSE	PROCEDURE		
SystemCheck light	Outboard is in S.A.F.E.	Check Service Codes and SystemCheck warning		
Setup or rigging	Incorrect propeller	Refer to specifications, check recommended WOT RPM; water test and install correct pitch propeller		
change	Incorrect outboard mounting height	Refer to installation guidelines		
	Incorrect, fouled, or worn spark plugs	Replace spark plugs		
	Contaminated or poor quality fuel	Check or replace fuel supply		
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks		
	Low alternator output (55 V)	Check voltage on 55 V circuits, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION		
Performance of outboard at lower	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION		
speeds appears normal	Fuel injector electrical circuit or control function	Check voltage at injectors, refer to SYSTEM ANALYSIS		
	Restricted or leaking fuel injectors	Check injectors, refer to FUEL SYSTEM		
	Low fuel pressure	Check circulation pump operation, refer to FUEL SYSTEM		
	EMM programming, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs		
	Restricted engine exhaust	Check and repair as needed		

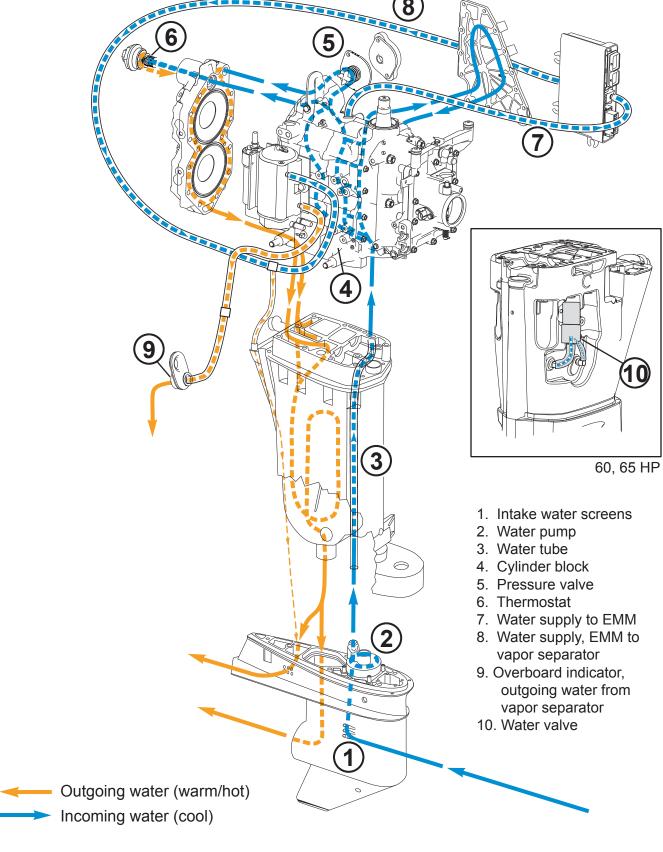
EXCESSIVE SMOKING

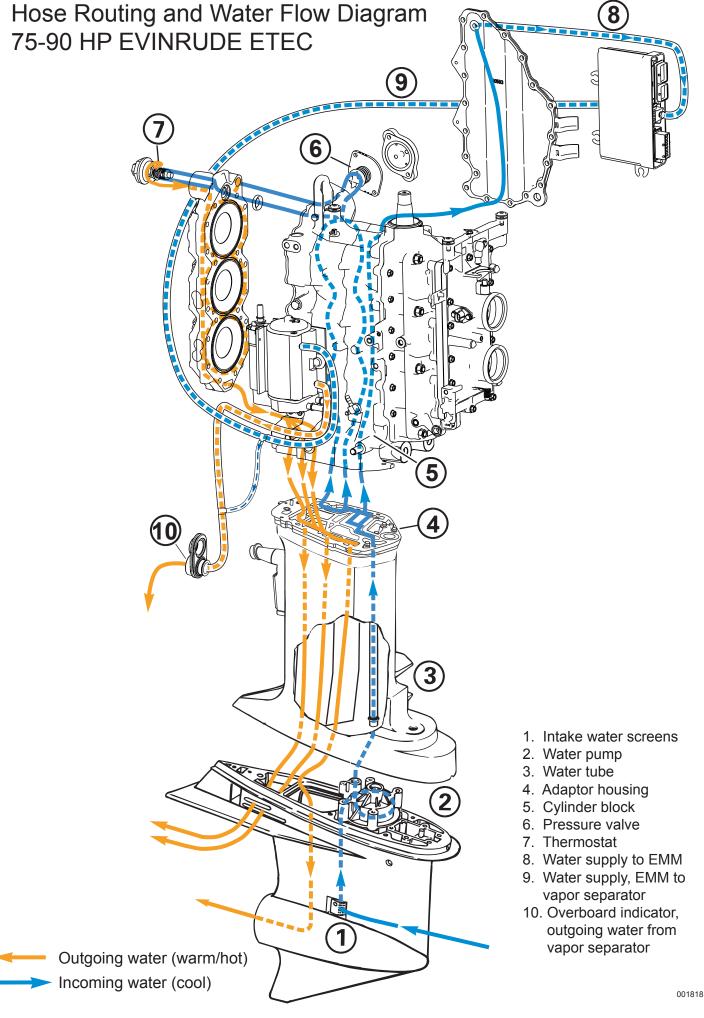
OBSERVATION	POSSIBLE CAUSE	PROCEDURE		
	Contaminated or poor fuel quality	Check or replace fuel supply		
	Excessive fuel or oil	Check fuel system for fuel supply air leaks or		
May coincide with	consumption	leaking fuel injectors		
increased oil	Outboard in break-in mode	Use diagnostics program to check		
consumption (normal if occurs after	Outboard mounted too low	Check installation height of outboard		
winterization)	Vapor separator vent	Check vapor separator assembly for proper venting/float valve operation		
	Faulty/leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM		
	Damaged fuel lift pump	Check for internal leaks		

OUTBOARD SURGES, RUNS ROUGH

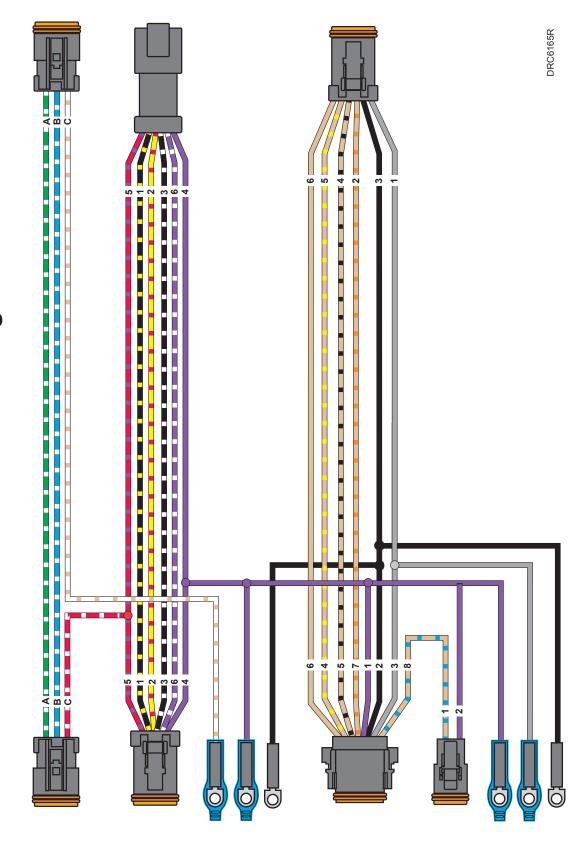
OBSERVATION	POSSIBLE CAUSE	PROCEDURE		
1200 RPM and above	S.A.F.E.	Access <i>EMM</i> fault codes		
	Incorrect, fouled, or worn spark plugs	Replace spark plugs		
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port		
	Contaminated or poor fuel quality	Check and replace fuel supply		
	Low or erratic fuel pressure	Check pressure, refer to FUEL SYSTEM		
	Air in fuel system	Check for air in fuel supply manifold, refer to FUEL SYSTEM (vapor separator venting and fuel supply)		
	Fuel supply restricted	Check primer bulb, anti-siphon valve, and fuel pick-up, check for fuel system air leaks		
May be erratic or inconsistent	Restricted or leaking fuel injector(s)	Check injectors, refer to FUEL SYSTEM		
	Faulty wiring, connections, grounds, or CPS air gap	Check all grounds, connections, and wiring. Check CPS air gap.		
	Low alternator output (55 V)	Check voltage on 55 V circuit, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION		
	EMM program, timing, or operation	Check <i>EMM</i> program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs		
	Weak or erratic ignition operation	Check ignition, refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION		
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to SYSTEM ANALYSIS and ELECTRICAL AND IGNITION		
	Restricted engine exhaust	Check and repair as needed		
Audible noise	Internal powerhead damage	Check and repair as needed		
, tadibie fielde	Damaged gearcase	Inspect gearcase and lubricate		

Hose Routing and Water Flow Diagram 40 – 65 E-TEC Inline 2 Cylinder

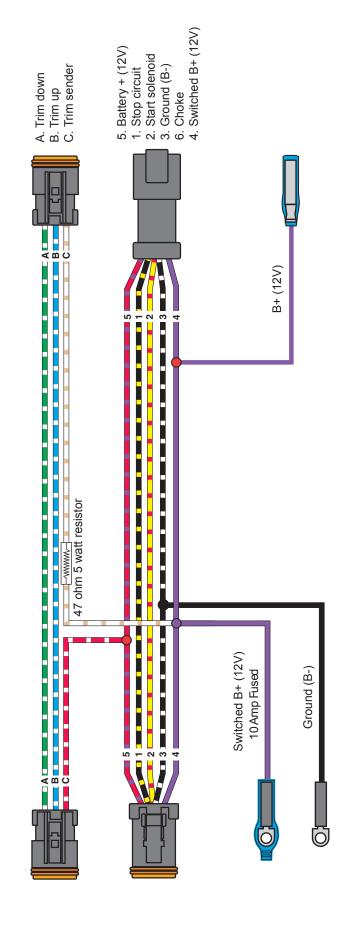


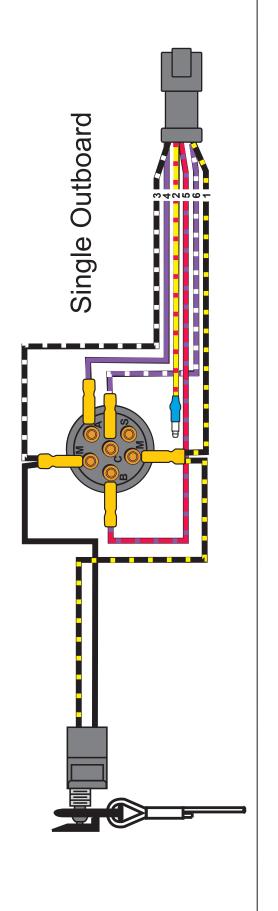


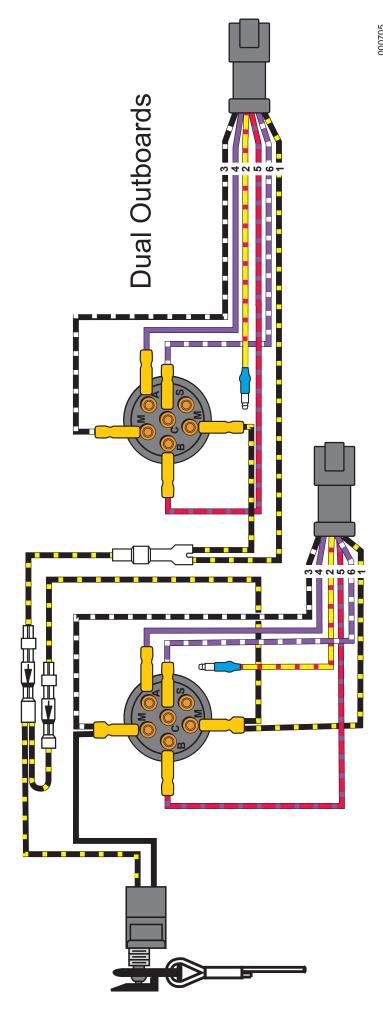
MWS Instrument Wiring Harness

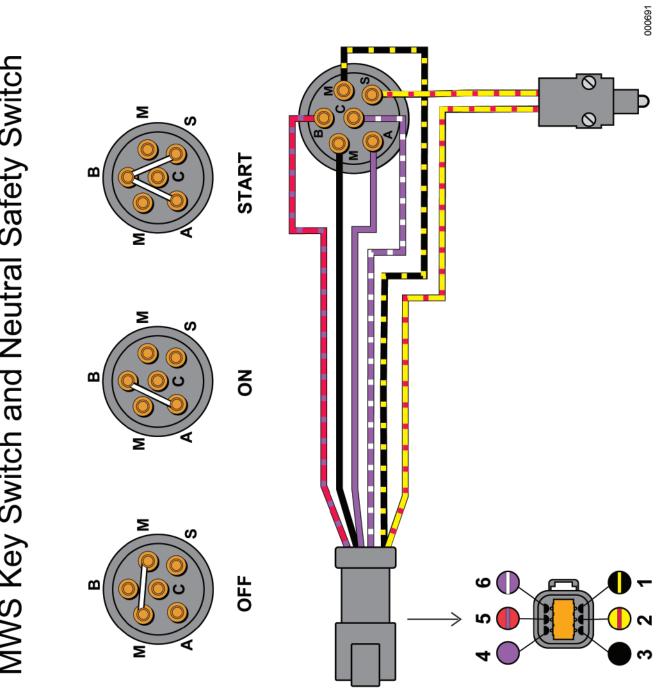


I-Command Keyswitch/TNT Wiring Harness

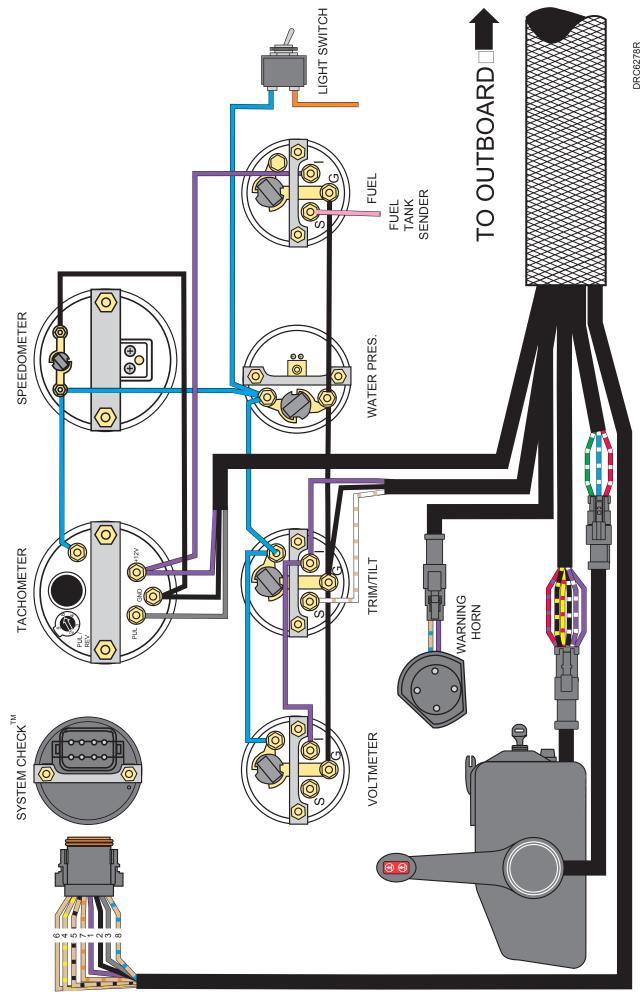




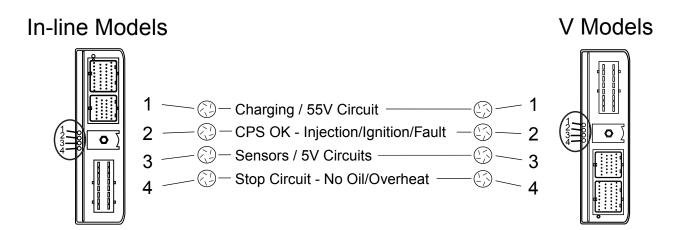




MWS DASHBOARD

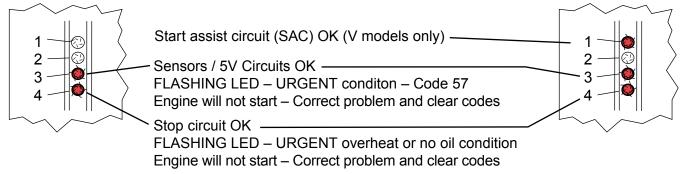


Evinrude E-TEC EMM LED Diagnostic Indicators



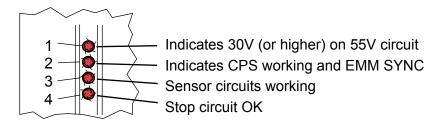
For more information, refer to SYSTEM ANALYSIS in the Service Manual.

KEY ON: LED's illuminate to indicate circuit function



Note: No LED's ON indicates EMM not receiving battery voltage or Recoil Start model.

STARTING: LED's illuminate to indicate circuit function

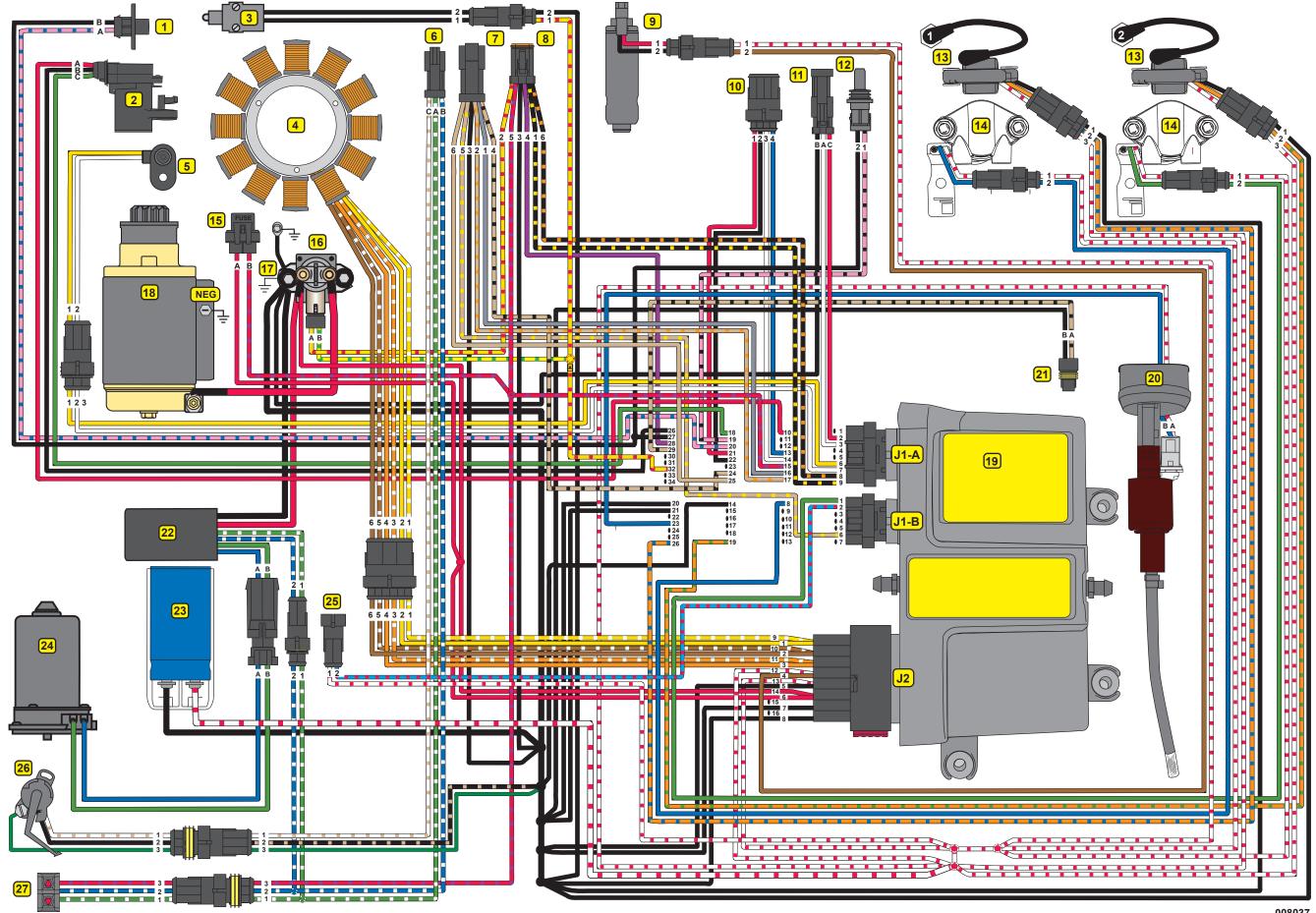


RUNNING: LED's illuminate to indicate circuit fault



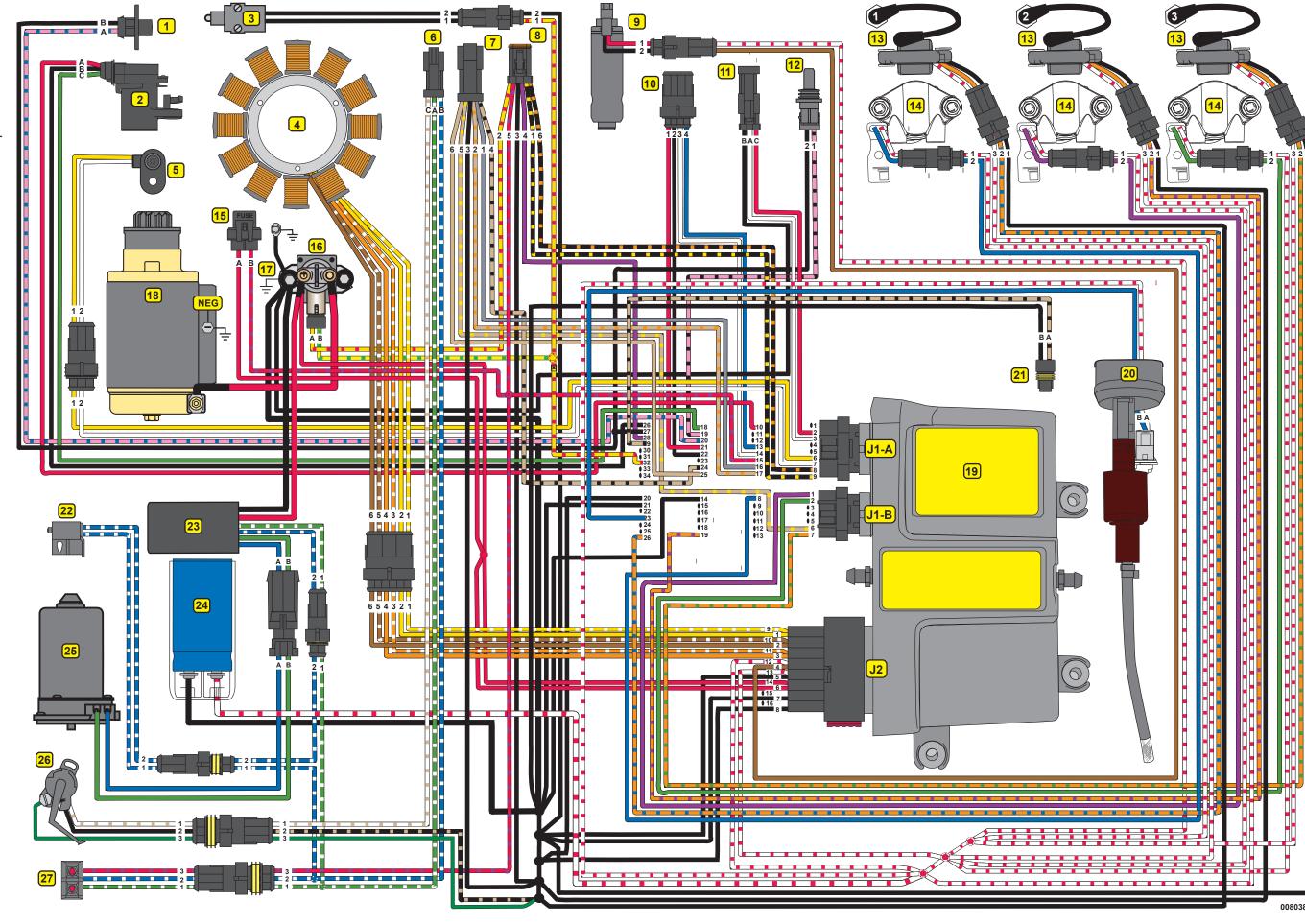
40 - 65 HP E-TEC

- 1. Air Temperature Sensor
- 2. Throttle Position Sensor
- 3. Neutral Switch
- 4. Stator
- 5. Crankshaft Position Sensor
- 6. Trim/Tilt Connector
- 7. SystemCheck Connector
- 8. Key Switch Connector
- 9. High Pressure Fuel Pump
- 10. CANbus Connector
- 11. Diagnostic Connector
- 12. Temperature Sensor
- 13. Ignition Coil
- 14. Fuel Injector
- 15. Fuse (10 Amp)
- 16. Starter Solenoid
- 17. Main Harness Ground
- 18. Electric Starter
- 19. EMM
- 20. Oil Injector
- 21. Low Oil Switch
- 22. Trim/Tilt Relay Module
- 23. Capacitor
- 24. Trim/Tilt Motor
- 25. Water Valve Connector
- 26. Trim Sending Unit
- 27. Trim/Tilt Switch



75 – 90 HP E-TEC

- 1. Air Temperature Sensor
- 2. Throttle Position Sensor
- 3. Neutral Switch
- 4. Stator
- 5. Crankshaft Position Sensor
- 6. Trim/Tilt Connector
- 7. SystemCheck Connector
- 8. Key Switch Connector9. High Pressure Fuel Pump
- 10. CANbus Connector
- 11. Diagnostic Connector
- 12. Temperature Sensor
- 13. Ignition Coil
- 14. Fuel Injector
- 15. Fuse (10 Amp)
- 16. Starter Solenoid
- 17. Main Harness Ground
- 18. Electric Starter
- 19. EMM
- 20. Oil Injector
- 21. Low Oil Switch
- 22. Tilt Limit Switch
- 23. Trim/Tilt Relay Module
- 24. Capacitor
- 25. Trim/Tilt Motor
- 26. Trim Sending Unit
- 27. Trim/Tilt Switch



EVINRUDE 40 – 90 HP EMM SERVICE CODE CHART

CODE	EMM CIRCUIT/SENSOR	INTERNAL	S.A.F.E	SHUT	EMM LED DISPLAY	DASHBOARD GAUGE WARNING DISPLAY	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION
11	Throttle Position Sensor (TPS) out of idle range				-	-	2 seconds	TPS Voltage > 0.78 V with key ON (or cranking). Becomes stored fault when outboard starts. When both hard and stored faults are present, check for improperly adjusted throttle cable.
12	Throttle Position Sensor (TPS) circuit fault				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	0.8 seconds	TPS Voltage: < 0.14 V, or > 4.92 V. Engine limited to idle speed. Check sensor resistance—3000 to 7000 Ω (between pins A and B) & 4000 to 8000 Ω (between pins A and C)
13	TPS below range				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	TPS Voltage < 0.2 V. Check linkage and IDLE stop.
14	TPS above range				LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	TPS Voltage > 4.85 V. Check linkage and WOT stop.
15	ROM (<i>EMM</i> program)	\checkmark			-	-	-	ROM "CHECKSUM" failure. Check software program number in <i>EMM</i> . Reload or replace with proper program.
16	Crankshaft Position Sensor (CPS) Intermittent loss of SYNC				LED 2: OFF (Cranking) LED 3: ON (Running)	-	10 instances	EMM counts losses of synchronization with crankshaft sensor. Check CPS mounting and resistance. Air gap range: 00.036 to 0.110 in. (1 to 2.8 mm), nominal 0.073 in. (1.85 mm) Resistance: 560 Ω ± 10% @ 77°F (25°C)
17	55 V circuit BELOW range	\checkmark	\checkmark		LED 1: ON (Running)	CHECK ENGINE	1 minute	System Voltage < 45 V. Engine limited to 1200 RPM. Perform stator/charging tests.
18	55 V circuit ABOVE range	\checkmark	✓		LED 1: ON (Running)	CHECK ENGINE	1 minute	System Voltage > 57 V. Engine limited to 1200 RPM. Perform stator/charging tests. Check for loose connections in 55 V circuit. Check capacitor.
19	Start-in-gear				LED 3: OFF (Cranking)	CHECK ENGINE	=	Attempted engine start while in gear. Engine will not start.
	Winterization activated				All LEDs FLASHING	All Lights FLASHING	-	Engine is speed limited, and stops after 360 oil pulses. Refer to Maintenance or Operator's Guide.
	EMM Temperature Sensor circuit fault	\checkmark			LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	<i>EMM</i> Temperature < -71° F (-57.4° C), or > 313° F (156° C).
	EMM Temperature BELOW range	\checkmark			LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	EMM Temperature < -22 ° F (-30° C).
	EMM Temperature ABOVE range	\checkmark	\checkmark		LED 4: ON (Running)	WATER TEMP/HOT	8 seconds	EMM Temperature > 176°F (80°C). Engine limited to 1200 RPM. See Code 29.
	12 V circuit BELOW range	\checkmark			LED 1: ON (Running)	LOW BATTERY	5 minutes	Battery voltage < 12.5 V. Perform stator/charging tests.
27	12 V circuit ABOVE range	\checkmark			LED 1: ON (Running)	LOW BATTERY	5 minutes	Battery voltage > 15.5 V. Check battery connections and wiring.
29	EMM Temperature OVER range	\checkmark		✓	LED 4: FLASHING	WATER TEMP/HOT (FLASHING)	4 seconds	EMM Temperature > 212° F (100° C). Engine SHUTDOWN. Will NOT restart until EMM temperature returns to operating range. Check outboard and EMM cooling systems.
31	Engine temperature OVER range			√	LED 4: FLASHING	WATER TEMP/HOT (FLASHING)	8 seconds	2-Cylinder models: Engine Temperature > 248° F (120° C) 3-Cylinder models: Engine Temperature > 212° F (100° C) above 3500 RPM, or 3-Cylinder models: Engine Temperature > 230° F (110° C) below 3500 RPM Engine SHUTDOWN. Check cooling system. Check temperature sensor resistance—9000 to 11000 Ω @ 77°F (25°C).
	Critical NO OIL detected	\checkmark		√	LED 4: FLASHING	NO OIL (FLASHING)	3 hours	Outboard has run three hours with code 34 or 117. Engine SHUTDOWN. Will restart and run for 1 minute intervals.
	Oil injection pump circuit OPEN		√		LED 4: ON (Running)	NO OIL	4 seconds	Engine limited to 1200 RPM. Check oil injection pump circuit resistance—22 Ω .
40	Engine Temperature ABOVE range–Low speed		\checkmark		LED 4: ON (Running)	WATER TEMP/HOT	8 seconds	3-Cylinder models only. Engine Temperature > 212° F (100° C) below 3500 RPM.
41	Engine Temperature Sensor circuit fault				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Engine Temperature < -15° F (-26.2° C), or > 332° F (166.5° C). Check 5 V circuit and ground (NEG), and sensor resistance—9000 to 11000 Ω @ 77°F (25°C).
42	Engine Temperature BELOW range				LED 3: OFF (Cranking) / ON (Running)	-	8 seconds	Engine Temperature < -4° F (-20° C). Check engine temperature and sensor resistance.
43	Engine Temperature ABOVE range		✓		LED 4: ON (Running)	WATER TEMP/HOT	8 seconds	2-Cylinder models: Engine Temperature > 212° F (100° C). 3-Cylinder models: Engine Temperature > 194° F (90° C) above 3500 RPM Engine limited to 1200 RPM. Check cooling system.
44	Barometric Pressure (BP) Sensor circuit fault	√			-	-	8 seconds	Pressure < 3.9 in. Hg (13.3 kPa), or > 35.1 in. Hg (119.0 kPa). Make sure <i>EMM</i> BP sensor tube is NOT plugged. Check atmospheric condition for comparison. Clear code and retest.
	BP Sensor BELOW range	\checkmark			-	-	8 seconds	Pressure < 20.7 in. Hg (70 kPa).
46	BP Sensor ABOVE range	\checkmark			-	-	8 seconds	Pressure > 31 in. Hg (105 kPa).

Rev 01/10

CODE	EMM CIRCUIT/SENSOR	INTERNAL	S.A.F.E	EMM LED DISPLAY	DASHBOARD GAUGE WARNING DISPLAY	TIME TO ACTIVATE	SENSOR: CIRCUIT VOLTAGE / RESISTANCE (Ω) / INFORMATION	
47	Air Temperature (AT) circuit fault			LED 3: OFF (Cranking) / ON (Running)	CHECK ENGINE	8 seconds	Air temperature < -58° F (-49.9° C), or > 218° F (103.2° C). Check 5 V circuit and ground (NEG), and sensor resistance—9000 to 11000 Ω @ 77°F (25°C).	
48	Air Temperature BELOW range			LED 3: OFF (Cranking) / ON (Running)	=	8 seconds	Air temperature < -22° F (-30° C).	
49	Air Temperature ABOVE range			LED 3: OFF (Cranking) / ON (Running)	=	8 seconds	Air temperature > 158° F (70° C).	
51	Fuel injector circuit #1 OPEN			LED 2: ON (Running)	-	2 seconds		
52	Fuel injector circuit #2 OPEN			LED 2: ON (Running)	=	2 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).	
53	Fuel injector circuit #3 OPEN			LED 2: ON (Running)	-	2 seconds		
57	High RPM with low TPS setting	✓		✓ LED 3: FLASHING	CHECK ENGINE (FLASHING)	10 seconds	TPS < 5% and RPM > 3000. Engine SHUTDOWN. Will NOT restart until code has been cleared. The problem could be caused by uncontrolled fuel entering the engine. DO NOT attempt to start the outboard until the problem has been found and repaired.	
58	Operating temperature not reached			LED 3: OFF (Cranking) / ON (Running)	-	10 minutes	Engine temperature < 104° F (40° C) with engine speed < 2300 RPM. Check thermostat and pressure relief valve.	
61	Fuel injector circuit #1 SHORTED			LED 2: ON (Running)	-	8 seconds		
62	Fuel injector circuit #2 SHORTED			LED 2: ON (Running)	=	8 seconds	Check injector/circuit resistance—2 to 3 Ω @ 72°F (22°C).	
63	Fuel injector circuit #3 SHORTED			LED 2: ON (Running)	-	8 seconds		
78	Sensor supply voltage fault	√		LED 3: OFF (Cranking) / ON (Running)	=	10 seconds	Sensor voltage < 4.75 V. Check sensors and related wiring. Check for pinched or chafed wiring.	
81	Ignition timing circuit #1 OPEN			LED 2: ON (Running)	-	10 instances		
82	Ignition timing circuit #2 OPEN			LED 2: ON (Running)	-	10 instances	EMM counts failed ignition events. Check wiring. Test with known good ignition coil.	
83	Ignition timing circuit #3 OPEN			LED 2: ON (Running)	-	10 instances		
90	Water injection solenoid SHORTED			LED 2: ON (Running)	-	8 seconds	Check circuit resistance—295 Ω ± 20 @ 77°F (25°C).	
91	Fuel pump circuit OPEN			LED 2: ON (Running)	-	8 seconds	Check pump/circuit resistance—2 to 3 Ω @ 77°F (25°C).	
93	Water injection solenoid OPEN			LED 2: ON (Running)	-	8 seconds	Check circuit resistance—295 Ω ± 20 @ 77°F (25°C).	
94	Fuel pump circuit SHORTED			LED 2: ON (Running)	-	2 seconds	Check pump/circuit resistance—2 to 3 Ω @ 77°F (25°C).	
101	Ignition timing circuit #1 SHORTED			LED 2: ON (Running)	-	20 instances		
102	Ignition timing circuit #2 SHORTED			LED 2: ON (Running)	-	20 instances	EMM counts failed ignition events. Check wiring. Test with known good ignition coil.	
103	Ignition timing circuit #3 SHORTED			LED 2: ON (Running)	-	20 instances		
117	Critical LOW OIL detected	✓	✓	LED 4: ON (Running)	NO OIL	4800 Pulses (2-Cyl) 6000 Pulses (3-Cyl)	EMM counts oil pump pulses after LOW OIL switch closes. Engine limited to 1200 RPM. Stop outboard and add oil to tank. Warning resets after three oil pump pulses.	
NOTE	NOTE: Always note service codes before clearing codes. Clear stored codes using diagnostic software. Clearing some codes requires turning EMM "OFF" and then "ON" again.							

