

2007

Service Manual



9.9, 15 HP

Johnson® 4 Stroke

Johnson®



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

EVINRUDE
Johnson



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2+4® Fuel Conditioner

Ultra™ 4-Stroke Outboard Oil

HPF XR™ Gearcase Lubricant

Ultra Lock™

SAFETY INFORMATION

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

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

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

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

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

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

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

These safety alert signal words mean:

ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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

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

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

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

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

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

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

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



DANGER



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

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



WARNING



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

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

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

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

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

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

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

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

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

Always work in a well ventilated area.

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

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INTRODUCTION

MODELS COVERED IN THIS MANUAL

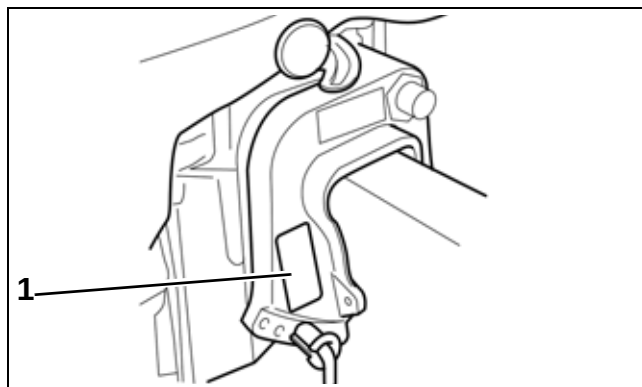
MODELS COVERED IN THIS MANUAL

This manual covers service information on *Johnson* 9.9 and 15 HP 4-Stroke models. Use this manual together with the proper Parts Catalog for part numbers and for exploded views of the outboard, which are a valuable aid to disassembly and reassembly.

Model Number	Start	Shaft	Steer
J10R4SUB	Rope	15 in.	Tiller
J10RL4SUB	Rope	20 in.	Tiller
J10TE4SUB	Electric	15 in.	Tiller
J10TEL4SUB	Electric	20 in.	Tiller
J10TBL4SUD	Electric	20 in.	Tiller
J10EL4SUM	Electric	20 in.	Remote
J10BL4SUM	Electric	20 in.	Remote
J15R4SUB	Rope	15 in.	Tiller
J15RL4SUB	Rope	20 in.	Tiller
J15TE4SUB	Electric	15 in.	Tiller
J15TEL4SUB	Electric	20 in.	Tiller
J15EL4SUR (Europe only)	Electric	20 in.	Remote

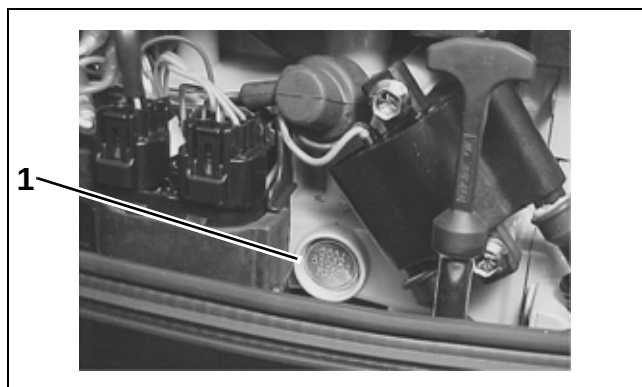
Identifying Model and Serial Numbers

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



Starboard Stern Bracket
1. Model and serial number

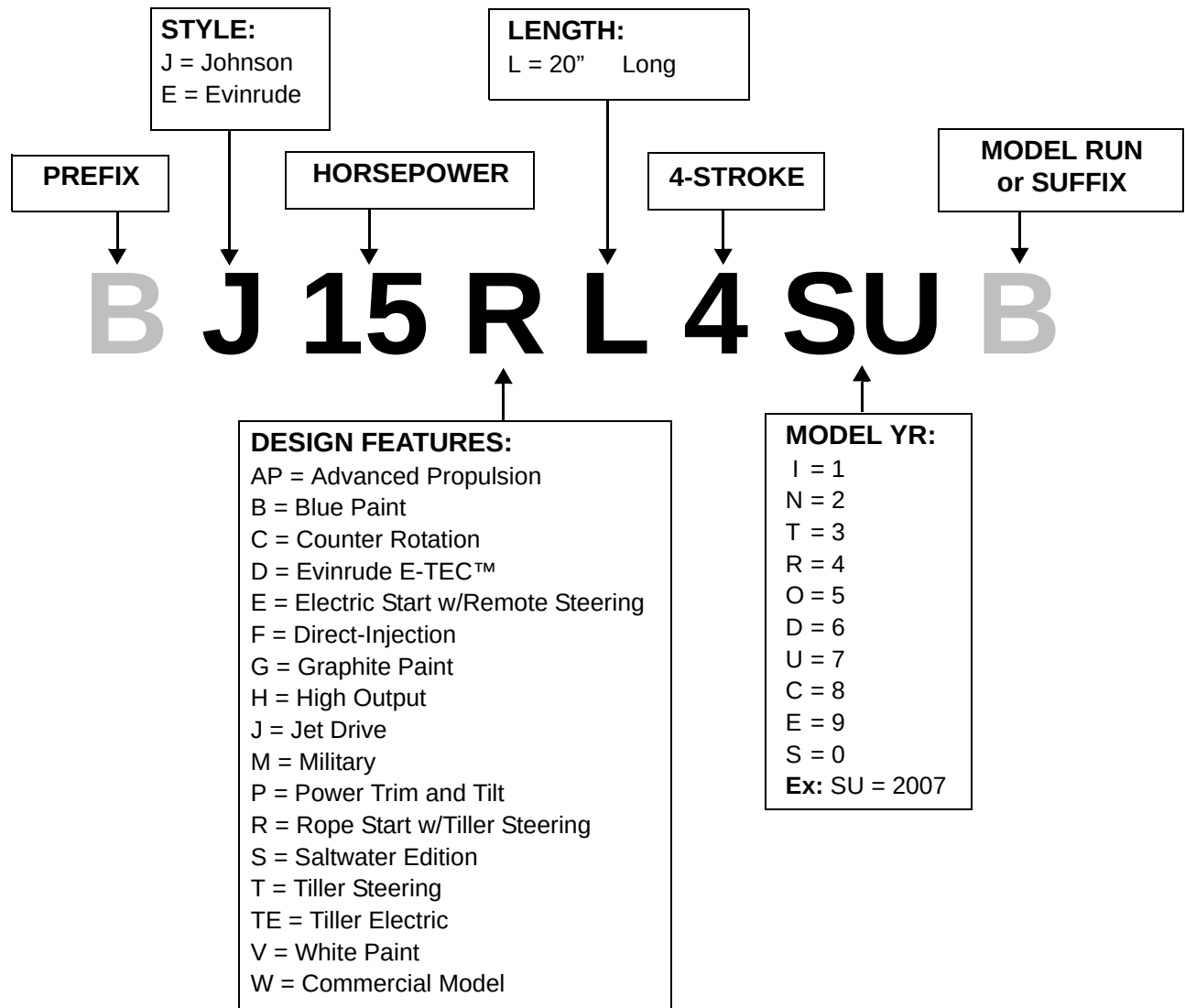
004351



Powerhead
1. Serial number

004352

MODEL DESIGNATION

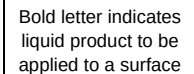


TYPICAL PAGE – A

SERVICE CHART

Subsection title indicates beginning of the subsection.

Italic subheading
above Service Chart
indicates pertaining
models.



Pay attention to torque specifications. Some units appear as in. lbs. Use appropriate torque.

Tightening torque for
a fastener.

Exploded view of Service Chart assists in identifying parts and positions

Indicates list corresponding to applicable letter in exploded view of the Service Chart.

- | | |
|----------|-----------------------------------|
| A | Triple-Guard Grease |
| B | Gasket Sealing Compound |
| C | Adhesive M Sealant |
| D | Moly Lube |
| E | Red Ultra Lock |
| F | Blue Nut Lock |
| G | Sea Lube Bearing Lubricant |

328

Page Number

TYPICAL PAGE – B

Section Title

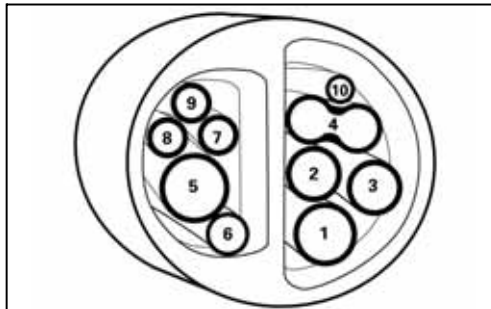
**INSTALLATION AND PREDELIVERY
OUTBOARD RIGGING PROCEDURE**

Subsection Title

Cable, Hose, and Wire Routing

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

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



000084

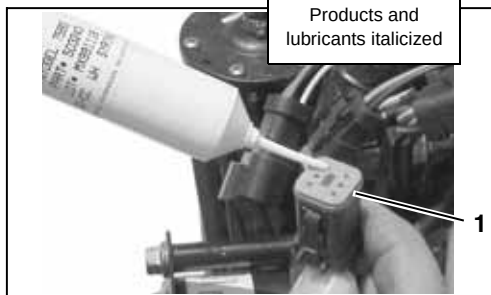
1. Fuel supply hose
2. Oil return hose
3. Oil supply hose
4. Battery cables
5. Main wire harness (MWS)
6. Throttle cable
7. Shift cable
8. Oil tank sending unit harness
9. Water pressure hose
10. Accessory charge wire

Model specific
illustrations
designated with
image captions

Connect outboard main wire harness to boat main wire harness.

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

Products and
lubricants italicized



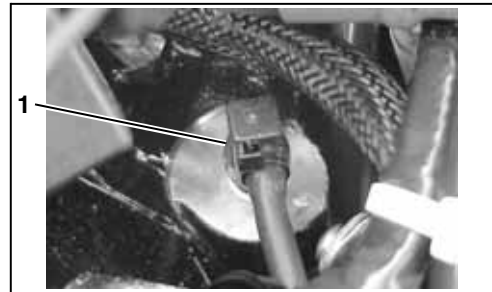
1. Seal

DP0824

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

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

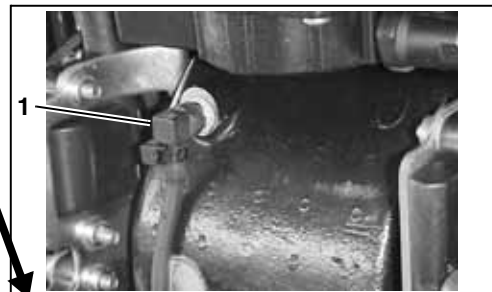
2



DP0827

V4 Models

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



DP0828

V6 Models

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

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

TYPICAL PAGE – C

POWERHEAD INSTALLATION

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

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



39820

Installation

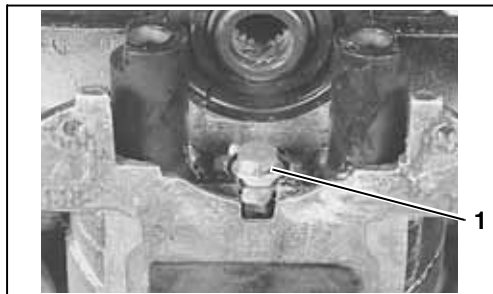
Place mount assemblies in position, with flats facing away from each other.



49557

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

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



1. Mount retainer screw

49556

272

INSTALLATION

V4 MODELS

Install base gasket d
No. 2 or Gasket Sealin

Title in italics indicates a procedure concerning a particular model

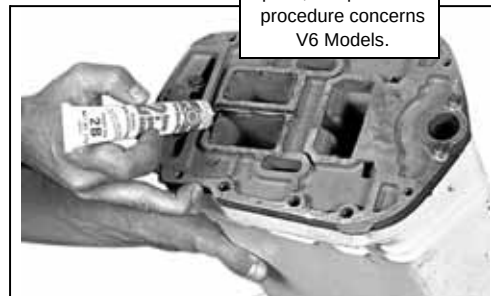
Permatex

V6 MODELS

Apply *Permatex No. 2* to exhaust housing flange
base gasket with Gasket

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

inner a new d.



23079

ALL MODELS

Install a new base ga

Title indicates from this point, All Models are concerned

ensure proper sealing, mating surfaces must be clean and free of oil, grease, and foreign matter.



23497

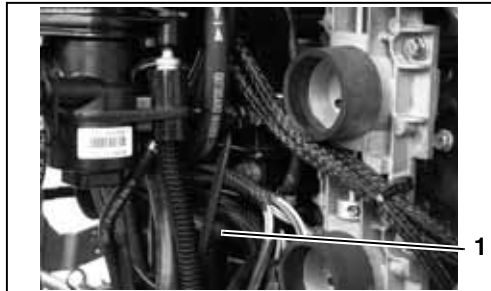
Coat the driveshaft splines with *Moly Lube*. Do not apply lubricant to end of driveshaft.

TYPICAL PAGE – D

OILING SYSTEM COMPONENTS

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

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



TYPICAL
1. Lower pulse hose

000721

Typical illustration for lower pulse hose of V4 or V6 Models

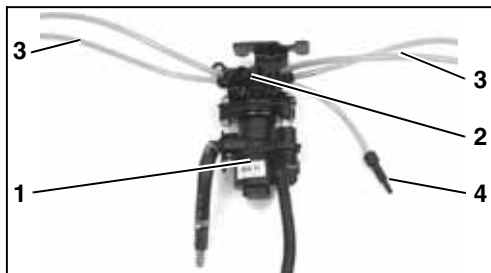
Oil Injector-Manifold

The oil injector-manifold distributes the oil supplied by the oil lift pump. A pressure-sensing switch monitors oil injection pressure.

Oil Injector-Manifold Components

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

Cross references direct readers to related topics

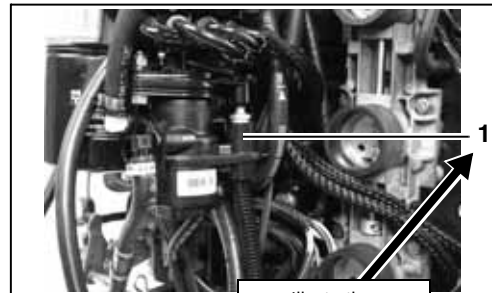


TYPICAL
1. Oil injector
2. Oil distribution manifold
3. Oil distribution hoses
4. Oil to fuel check valve

000722

Oil Pressure Switch

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



TYPICAL
1. Oil pressure switch

000723

Illustration components numbered to correspond to image

The switch opens or closes in response to the following oil manifold pressures:

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

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

Service Code 38

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

- | |
|--|
| Activates the <i>System Check</i> "NO OIL" light |
| Stores a service code |
| Initiates <i>S.L.O.W.</i> |

Service Code 39

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

- | |
|--|
| Activates the <i>System Check</i> "NO OIL" light |
| Stores a service code |
| Initiates <i>S.L.O.W.</i> |

8

Section tabs allow for quicker reference when thumbing through manual

INTRODUCTION

ABBREVIATIONS USED IN THIS MANUAL

ABBREVIATIONS USED IN THIS MANUAL

Units of Measurement

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

List of Abbreviations

ABYC	American Boat & Yacht Council
ATDC	after top dead center
AT	air temperature sensor
BPS	barometric pressure sensor
BTDC	before top dead center
CCA	cold cranking amps
CPS	crankshaft position sensor
DI	Direct-Injection
ECU	electronic control unit
EMM	engine management module
ICOMIA	International Council of Marine Industry Associations
MCA	marine cranking amps
MWS	modular wiring system
NMEA	National Marine Electronics Assoc.
NTC	negative temperature coefficient
PDP	power distribution panel
PTC	positive temperature coefficient
ROM	read only memory
S.A.F.E.™	speed adjusting failsafe electronics
SAC	start assist circuit
SAE	Society of Automotive Engineers
S.L.O.W.™	speed limiting operational warning
SYNC	synchronization
TDC	top dead center
TPS	throttle position sensor
WOT	wide open throttle
WTS	water temperature sensor

PRODUCT REFERENCE AND ILLUSTRATIONS

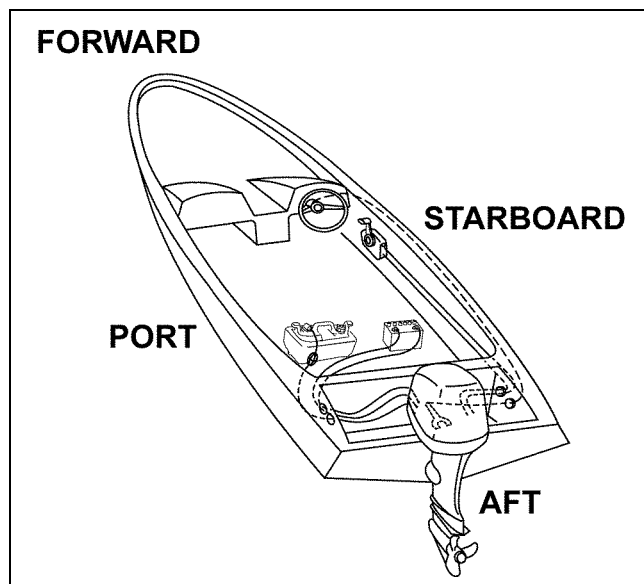
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of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

The continuing accuracy of this manual cannot be guaranteed.

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

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

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



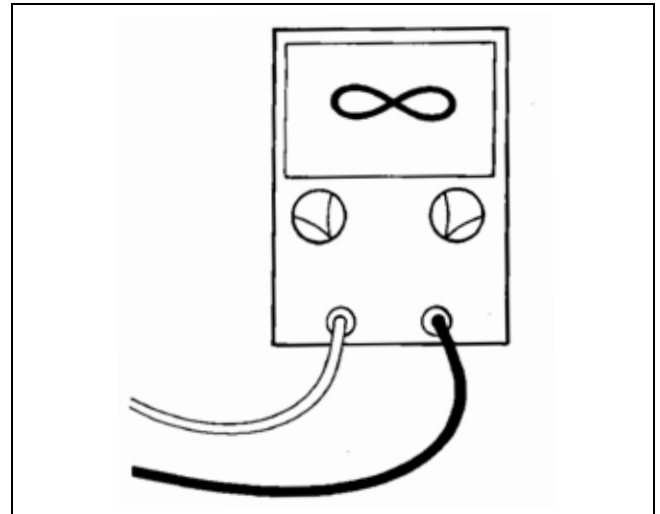
Nautical Orientation

SYMBOLS

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

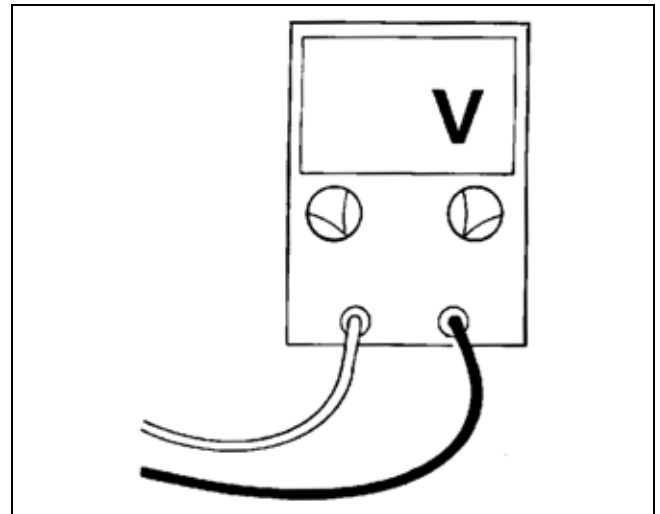
Electrical

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



DR4203

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

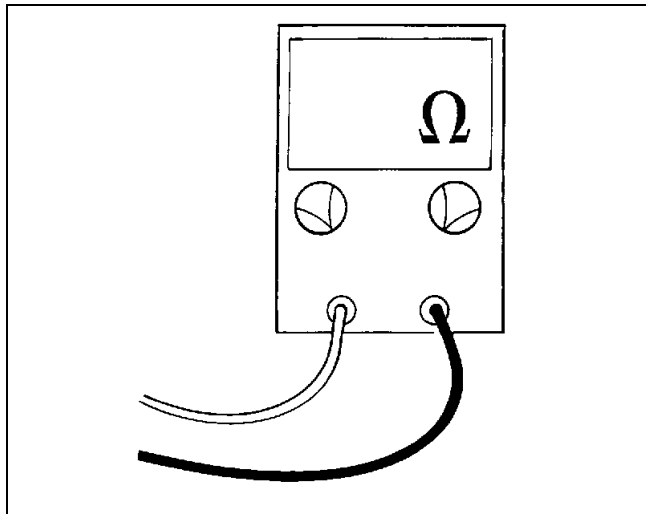


DR4204

INTRODUCTION

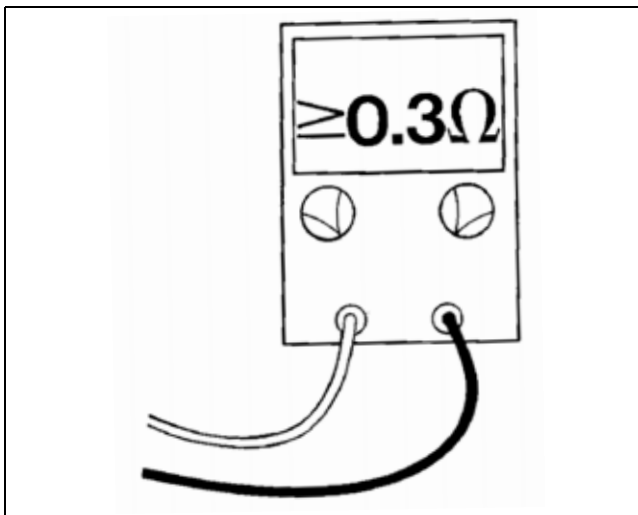
SYMBOLS

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



DR4205

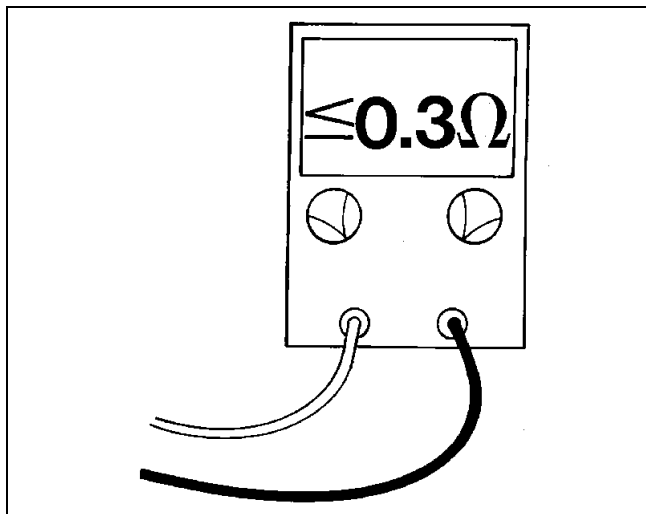
When “ $\geq$ ” precedes a value on the meter face, the reading should be greater than, or equal to, the value shown.



DR4207

Values

When “ $\leq$ ” precedes a value on the meter face, the reading should be less than, or equal to, the value shown.



DR4206

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

1

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SERVICE SPECIFICATIONS AND SPECIAL TOOLS

TECHNICAL DATA

TECHNICAL DATA

ENGINE	HP	9.9	15
	Full Throttle Operating Range RPM	4900-5500	5400-6000
	Power	9.9 HP (7.3 kw) @ 5000 RPM	15 HP (11 kw) @ 5700
	Idle RPM in Gear	820 to 920	
	Weight	(R) Models: 97 lbs. (44 kg) (RL) Models: 99 lbs. (45 kg) (TE) Models: 106 lbs. (48 kg) (TEL) Models: 108 lbs. (49 kg) (EL) Models: 106 lbs. (48 kg)	
	Lubrication	<i>Evinrude/Johnson Ultra 4-Stroke</i> outboard oil Refer to Oil Requirements on p. 40.	
	Engine Type	4-Stroke SOHC 2-cylinder	
	Displacement	18.4 cu. in. (302 cm ³)	
	Bore	2.28in. (58 mm)	
	Stroke	2.24 in. (57 mm)	
	Compression ratio	9.0:1	
FUEL SYSTEM	Carburetion	One single-throat carburetor, float feed	
	Main Jet	#70	#115
	Pilot Jet	#38	#40
	Low-Speed Setting	PRE-SET (1-7/8 ± 1/2 turns)	PRE-SET (2-7/8 ± 1/2 turns)
	Starting Enrichment	(R) Models: Manual (E) Models: Automatic	
	Float Level Setting	13.5 ± 2 mm	
	Preferred Fuel	Regular unleaded, plus grade unleaded, premium unleaded gasolines	
	Acceptable Fuel	Any of the above gasolines with 10% Ethanol or 5% Methanol with 5% co-solvents	
	Minimum Octane	87 AKI (R+M)/2 or 90 RON	
	Additives	2+4 [®] Fuel Conditioner, Fuel System Cleaner, Carbon Guard Use only <i>Evinrude/Johnson</i> recommended fuel additives. The use of other additives may result in engine damage. See Fuel Requirements on p. 39 for additional information.	

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

TECHNICAL DATA

	HP	9.9	15
ELECTRICAL	Alternator	7 Amp, Regulated	
	Battery Minimum Recommendation	12 Volt, 360 CCA (465 MCA) with 90 Minutes Reserve Capacity or 50 Ampere-Hour	
	Tachometer Setting (Requires Battery Charging)	6 Pulse/12 Pole	
	Fuse	20 A (Electric start models)	
COOLING	Thermostat opens	136 to 144°F (58 to 62°C)	
IGNITION	Type	Digital Capacitor Discharge	
	RPM Limit	6500 RPM	
	Spark Plugs	NGK [†] BKR6E @ 0.030 in. (0.76 mm)	
	Ignition Timing	5° ATDC @ 1000 RPM	
GEARCASE	Gear Ratio	12:25 (2.08:1)	
	Lubricant	HPF XR Gearcase Lube	
	Capacity	5.7 fl. oz. (170 ml)	

1

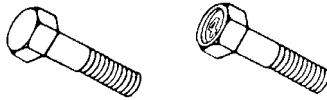
STANDARD TORQUE SPECIFICATIONS

Tightening Torque – Important Fasteners

ITEM	THREAD DIAM.	TIGHTENING TORQUE		
		N·m	kg·ft	lb·ft
Cylinder head cover bolt	6 mm	10	1.0	7.0
Cylinder head bolt	8 mm	27	2.7	20.0
Crankcase bolt	6 mm	14	1.4	10.0
	8 mm	25	2.5	18.0
Conrod cap bolt	7 mm	12	1.2	8.5
Oil pump bolt	6 mm	14	1.4	10.0
Oil pump gallery bolt	6 mm	14	1.4	10.0
Intake manifold bolt	8 mm	23	2.3	16.5
Carburetor mounting bolt	6 mm	10	1.0	7.0
Fuel pump bolt	6 mm	10	1.0	7.0
Thermostat cover bolt	6 mm	10	1.0	7.0
Valve adjusting lock nut	5 mm	11	1.1	7.9
Timing pulley nut	26 mm	50	5.0	36.0
Flywheel nut	14 mm	78.4	8.0	57.9
Spark plug	—	27	2.7	19.5
Power unit mounting bolt and nut	8 mm	23	2.3	16.5
Driveshaft housing bolt	8 mm	23	2.3	16.5
Oil pressure switch	—	13	1.3	9.5
Oil regulator	14 mm	27	2.7	19.5
Camshaft pulley bolt	6 mm	10	1.0	7.0
Engine oil drain plug	12 mm	13	1.3	9.5
Upper mount bolt	8 mm	23	2.3	16.5
Upper mount bracket bolt	8 mm	23	2.3	16.5
Lower mount cover bolt	8 mm	23	2.3	16.5
Lower mount bolt	8 mm	23	2.3	16.5
Clamp bracket shaft nut	7/8-14 UNF	43	4.3	31.0
Shallow drive arm bolt	10 mm	25	2.5	18.0
Tiller handle cover bolt	8 mm	17	1.7	12.3
Water pump case bolt	8 mm	18	1.8	13.0
Gearcase bolt	8 mm	23	2.3	16.5
Propeller nut	12 mm	18	1.8	13.0
Propeller shaft bearing housing bolt	6 mm	8	0.8	6.0

Tightening Torque – General Bolt

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

ITEM	THREAD DIAM.	TIGHTENING TORQUE		
		N·m	kg-ft	lb-ft
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
(Conventional or “4” marked bolt)	10 mm	22 – 35	2.2 – 3.5	16.0 – 25.5
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 10	0.6 – 1.0	4.5 – 7.0
	8 mm	15 – 20	1.5 – 2.0	11.0 – 14.5
(Stainless steel bolt)	10 mm	34 – 41	3.4 – 4.1	24.5 – 29.5
	5 mm	3 – 6	0.3 – 0.6	2.0 – 4.5
	6 mm	8 – 12	0.8 – 1.2	6.0 – 8.5
	8 mm	18 – 28	1.8 – 2.8	13.0 – 20.0
(7 marked or “A” marked bolt)	10 mm	40 – 60	4.0 – 6.0	29.0 – 43.5



WARNING

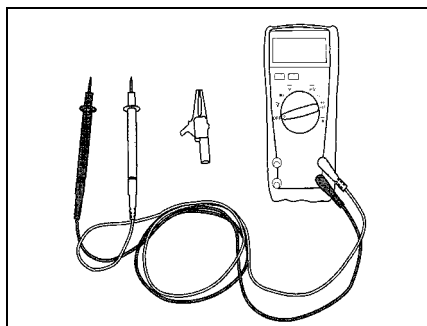


Torque wrench tightening specifications must be strictly adhered to. Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to turning must be felt when reusing a locking fastener.

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

SPECIAL TOOLS

Electrical / Ignition



Digital multimeter DRC7265
Ohms resolution 0.01
Purchase through local supplier



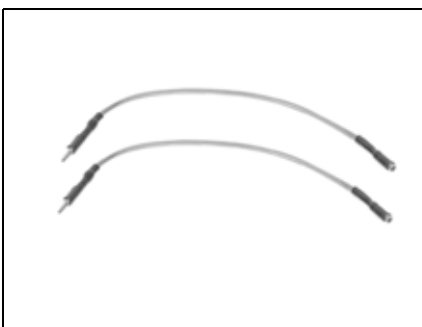
CD Peak reading voltmeter 49799
P/N 507972



Multimeter, analog 49793
P/N 501873



Flywheel removal screws 002570
P/N 5034235



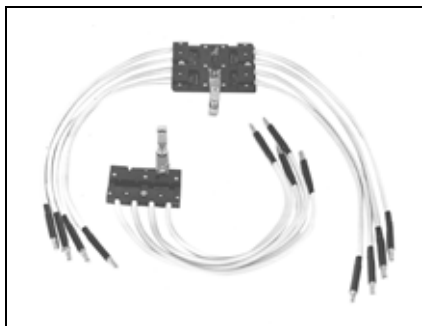
Wire harness adapter leads 40269
P/N 342228



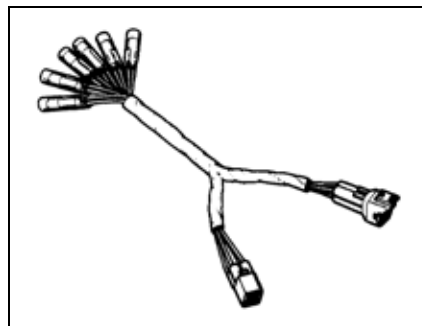
Tachometer/timing light 49789
P/N 507980



Flywheel holder P/N 5034227 002605



Spark checker 49798
P/N 508118



6-Pin connector test cord 002550
P/N 5034231



Ignition analyzer 49791
P/N 501890

Fuel and Oil



Fuel/Oil pressure gauge 002275
P/N 5000902



Fuel vacuum tester 23286
P/N 390954

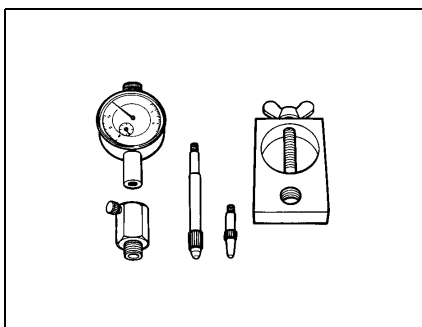


Oil pressure test adapter 002623
P/N 350930

Gearcase



Gearcase filler 49790
P/N 501882



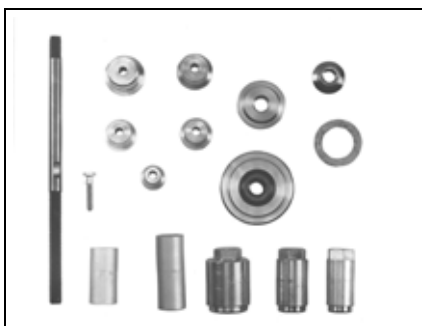
Dial indicator set



Gearcase fill/drain adaptor 48642
P/N 772269



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



Universal pinion bearing remover
and installer kits P/N 5005927
and P/N 5005928 33974



Installer handle 002575
P/N 345822



Prop shaft remover 002630
P/N 5034237

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

SPECIAL TOOLS

Powerhead



Crankshaft holder
P/N 5034236

002587



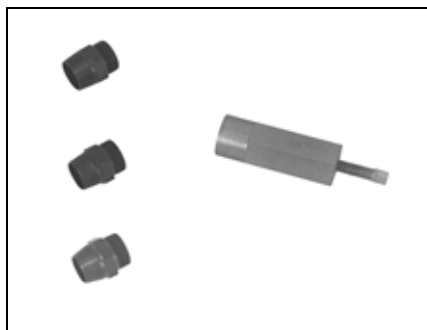
Cylinder bore gauge
P/N 771310

45303



Valve lifter adapter kit
P/N 5000899

002625



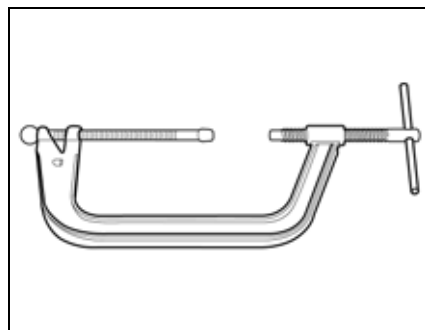
Crankshaft upper seal remover/
installer kit P/N 391060 (9.9-15 HP)

23102



Tappet adjusting tool
P/N 341444

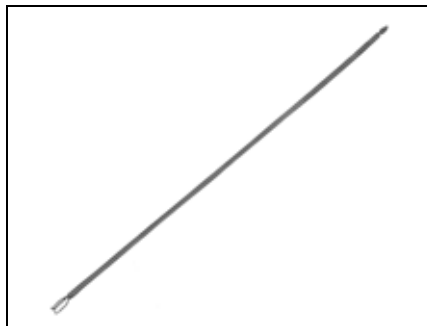
38202



Valve spring compressor
P/N 346186

DRC50025

Starter



Starter rope threading tool
P/N 387784

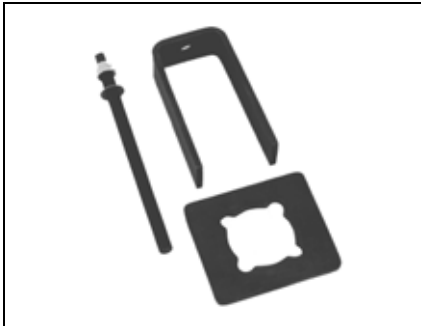
23682



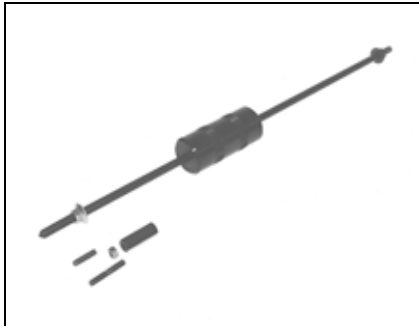
Starter spring winder/installer
P/N 392093

CO3583

Universal



Puller Bridge P/N 432127 23146



Slide hammer P/N 391008 CO1577



Universal Puller Set P/N 378103 32885



Puller jaws (small) P/N 432131 23150
(replacement jaws P/N 437952)



Slide hammer P/N 432128 15345



Puller jaws (large) P/N 432129 23148
(replacement jaws P/N 437954)



Tie strap installation tool P/N 323716 18105



Puller jaws (bearing) P/N 432130 23149
(replacement jaws P/N 437953)



Temperature gun P/N 772018 45240

SHOP AIDS



Cleaning Solvent P/N 771087



Engine Tuner P/N 777185



Anti-Corrosion Spray P/N 777193



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



D.P.L. Spray P/N 777183



Silicone spray P/N 775630



Ultra 4-Stroke Outboard Oil, P/N 775594



4-Stroke Outboard Oil, P/N 775597



HPF XR™ Gear Lube P/N 778747



HI-VIS™ Gearcase Lube P/N 775605



Triple-Guard® Grease P/N 508298



*Extreme Pressure Grease™
P/N 508303*

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

SHOP AIDS

1



Moly Lube P/N 175356



Needle Bearing Grease, P/N 378642



Starter Bendix Lube P/N 337016



Storage Fogging Oil
P/N 777186



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



Adhesive 847 P/N 776964



Lubriplate† 777 P/N 317619



Black Neoprene Dip P/N 909570



Electrical Grease P/N 504824



2 + 4™ Fuel conditioner P/N 775613



Fuel System Cleaner P/N 777184



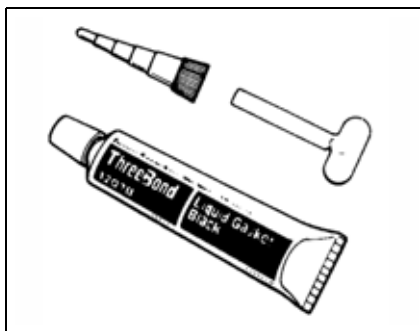
Carbon Guard™ P/N 775629

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

SHOP AIDS



Gasket Sealing Compound P/N 317201



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



Permatex[†] No. 2, P/N 910032



GE[†] RTV Silicone Sealant P/N 263753



Pipe Sealant with Teflon P/N 910048



Thermal Joint Compound P/N 322170



GM[†] Gear Mark Compound P/N 772666



Locquic Primer P/N 772032



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

INSTALLATION AND PREDELIVERY

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BOAT RIGGING

Remote Controls

Control Selection

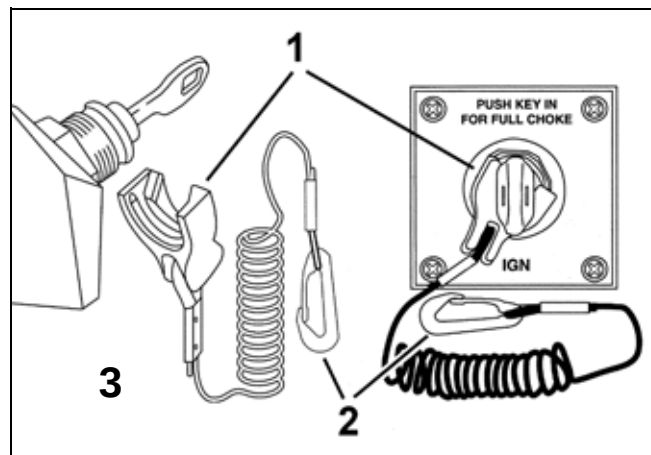
⚠**WARNING**⚠

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

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

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

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



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

002817

Additional remote control information:

- Side-mount controls require a neutral lock feature.
- Single-outboard binnacle remote controls are offered with or without an integrated key switch.

⚠**WARNING**⚠

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

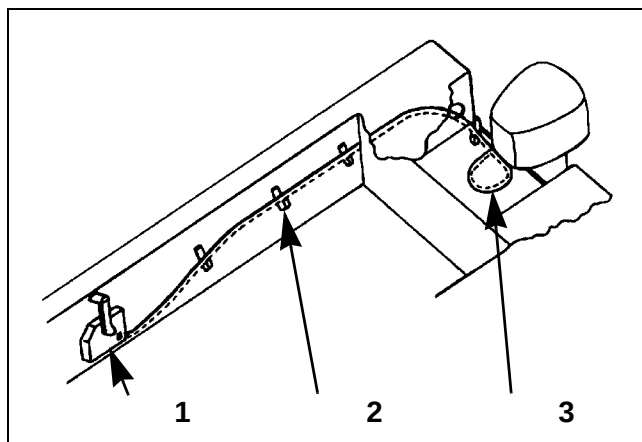
Installation Guidelines

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

Make sure the following items are checked:

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

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



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

DR4277

Battery Installation

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

Minimum 12 Volt Battery Recommendations

- 360 CCA (465 MCA), 50 amp-hr minimum

Location and Preparation

Proper installation will prevent battery movement while underway.

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



WARNING

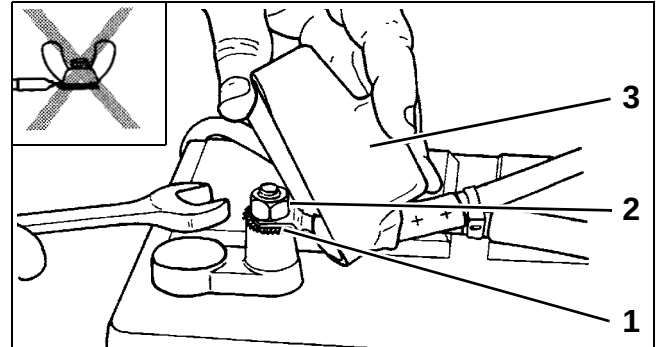


Keep the battery connections clean, tight, and insulated to prevent their shorting or arcing and causing an explosion. If the battery mounting system does not cover the connections, install protective covers. Check often to see that connections stay clean and tight.

Connections

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

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



Marine Style Battery Post

1. Starwasher
2. Hex nut
3. Terminal Insulator

DR5103

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

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

Battery Cable Requirements

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

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

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

Models	1 to 10 Ft. (.3 to 3 m)	11 to 15 Ft. (3.4 to 4.6 m)	16 to 20 Ft. (4.9 to 6.1 m)
9.9/15 HP	10 Gauge	8 Gauge	6 Gauge

INSTALLATION AND PREDELIVERY BOAT RIGGING

Fuel System Requirements

Overview

Fuel systems must meet the minimum specifications. These requirements must be met to insure the proper delivery of fuel to the outboard. The guidelines established by the ABYC and U.S. Coast Guard should always be followed.

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

Fuel Hose

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

- Use only fuel lines (or copper tubing) that meet the outboard minimum I.D. requirement.
- "USCG Type A1" fuel hose must be used between permanent fuel tanks and motor well fittings on inaccessible routings.
- Use "USCG Type B1" for fuel hose routings in motor well areas.
- Use corrosion-resistant metal clamps on permanently installed fuel hoses routed below decks.
- Multi-outboard applications require separate fuel tank pickups. Install separate fuel hoses from the fuel tank to the outboards in multi-outboard applications.

Fuel System Primer

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

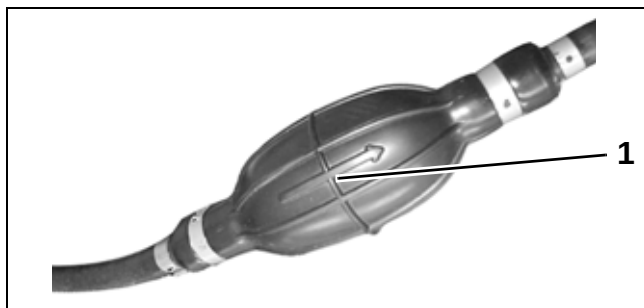
Primer Bulbs

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

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

- The primer bulb should be installed in an accessible location.
- The arrow on the primer bulb must point in the direction of fuel flow.

- The fuel primer bulb must be positioned in the fuel supply hose so the primer bulb can be held with the arrow pointing "up" during priming.



1. Arrow indicates direction of fuel flow

000124

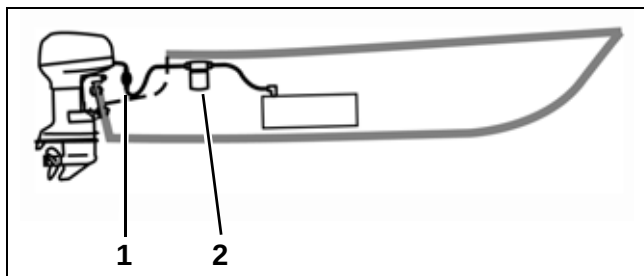
Fuel Filters

Boat-mounted fuel filters and water-separating fuel filter assemblies must meet the required fuel flow and filter specification. The filter must be mounted to a rigid surface above the "full" level of the fuel tank and accessible for servicing.

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



0070



Typical Fuel Supply Configuration

1. Primer bulb
2. Fuel filter (optional)

001151

OUTBOARD INSTALLATION

Hull Preparation

Maximum Capacity



WARNING



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

Before installing outboard:

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



1029A

Mounting Surface

Inspect transom surface prior to drilling mounting holes.

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



WARNING



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

Top Edge of Transom or Bracket

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

Transom Clearances

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

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

Water Flow

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

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

Mounting Hardware



WARNING



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

INSTALLATION AND PREDELIVERY

OUTBOARD INSTALLATION

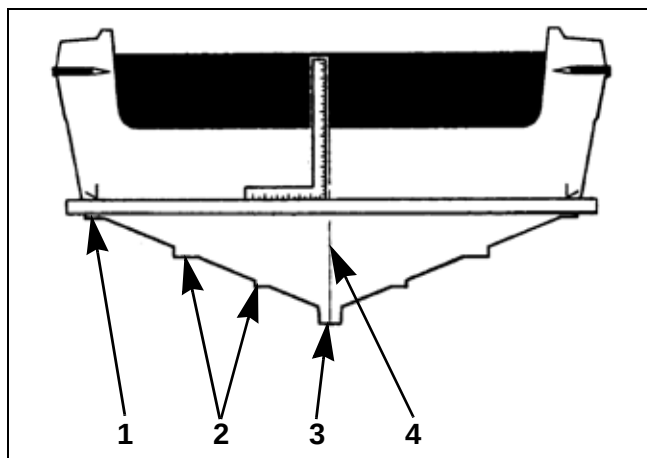
Transom Measuring and Drilling

Hull Centerline

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

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

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



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

DR5568

Transom Heights

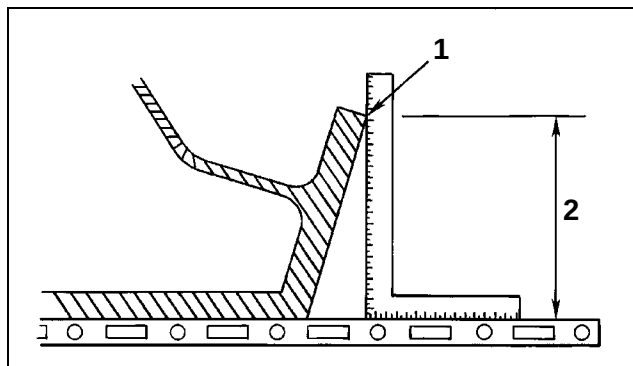
Make sure the transom height is consistent with the height of the outboard to be installed.

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

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

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

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



1. Top edge of transom
2. Actual transom height

DR5541

Transom Drilling Locations

Use the outboard stern brackets as a template for location and size of holes to drill in the transom.

Center the outboard on the transom (or mounting bracket) and tighten clamp screws by hand. An accessory transom plate is recommended to protect the transom.

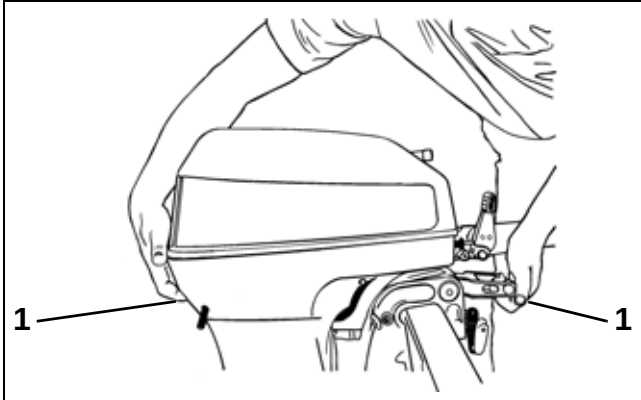
Using each stern bracket's mounting holes as a guide, drill holes through the transom.

Drill one 11/32 in. (8.7 mm) hole for each side.

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

Lifting the Outboard

Lift the outboard using the lift grips (NOT the tilt grip or steering handle) and place it in the center of the boat's transom.



TYPICAL
1. Lift grips

DR4661

Before Mounting Outboard to Transom

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

Steering Systems

Mechanical Cables

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

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

Extend the output end of the steering cable and lubricate the inner core of cable prior to installation.

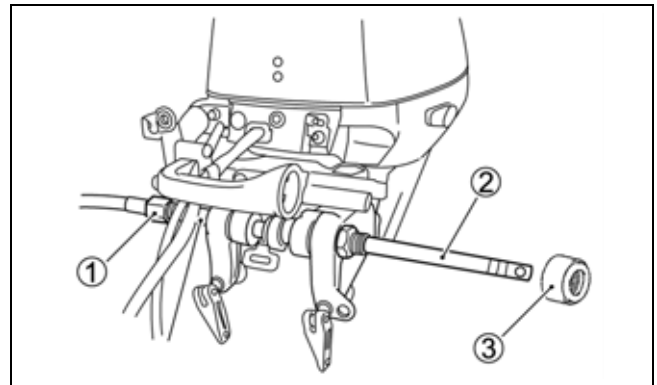


ABYC-approved mechanical steering cable.

5873

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

Apply *Triple-Guard* grease to cable and install cable wiper nut on tilt tube.



1. Cable nut
2. Grease
3. Wiper nut

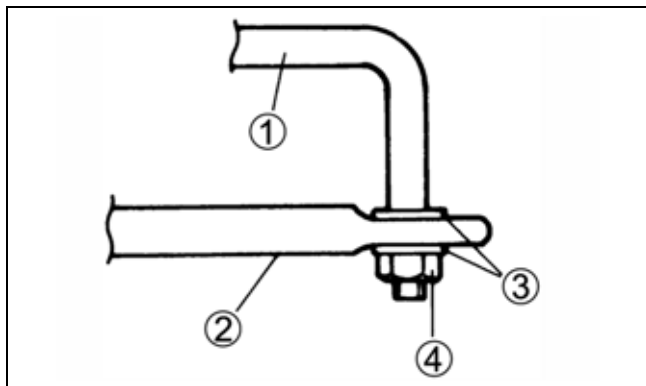
004823

INSTALLATION AND PREDELIVERY

OUTBOARD INSTALLATION

Drag Link

Connect drag link to the steering cable with washers and safety nut. Tighten the nut to 84 in. lbs. (10 N·m), then back the nut off 1/8 turn.



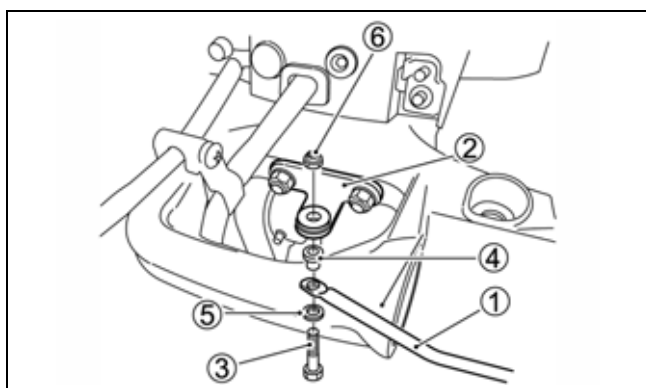
1. Drag link
2. Steering cable
3. Washers
4. Safety nut

004824

Move the steering cable until hole of drag link aligns with the thread hole on the attachment.

Connect the drag link to the attachment by tightening the screw with spacer and washer. Tighten screw to 24.5 ft. lbs. (34 N·m).

Install safety nut and tighten to 24.5 ft. lbs. (34 N·m).



1. Drag link
2. Attachment
3. Screw
4. Spacer
5. Washer
6. Safety nut

004825

IMPORTANT: After assembly, check for smooth and free steering operation.

Outboard Mounting

Fastening the Outboard to the Transom



WARNING



The outboard must be correctly installed. Failure to correctly install the outboard could result in serious injury, death, or property damage.

IMPORTANT: Follow all directions carefully. The outboard's warranty will not cover product damage or failure resulting from incorrect outboard installation.



WARNING



Even if equipped with clamp screws, the outboard must be bolted to the boat to prevent it from "working off the transom" during operation.

Center the outboard on the boat's transom (or mounting bracket) and tighten the clamp screws by hand, NOT with tools. An accessory transom plate is recommended to protect the boat's transom (or mounting bracket).



WARNING

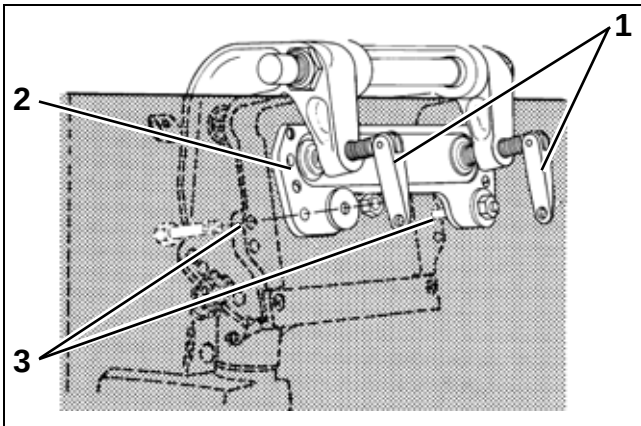


If either side of the transom deforms or cracks when the bolts are tightened to their recommended torque, the transom construction may not be adequate or may be deteriorated. Structural failure of the transom could result in loss of boat control and injury to the occupants.

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

Apply marine sealer (rated for above and below waterline use) under hex heads of bolts, on the mounting plates, and to the bolt shanks.

Tighten bolts to 14.5 ft. lbs. (20 N·m).



TYPICAL

1. Clamp screws
2. Transom plate
3. Stern bracket holes

DR5815

IMPORTANT: After 30 minutes of operation, retighten clamp screws by hand. DO NOT use tools to tighten clamp screws. Check clamp screws regularly.

OUTBOARD RIGGING



WARNING



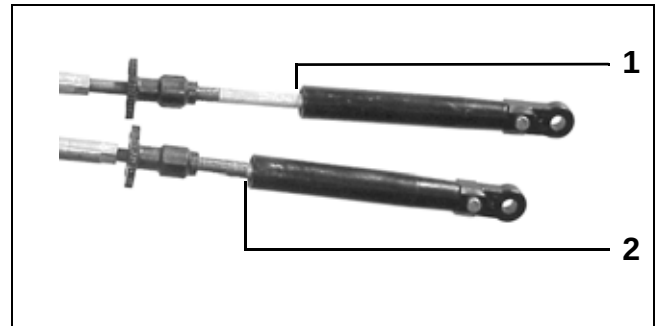
To prevent accidental starting of engine, confirm the battery cables are disconnected at battery and spark plug leads are disconnected from spark plugs.

Control Cable Identification

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

Identify each control cable:

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



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

DP0811

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



30501

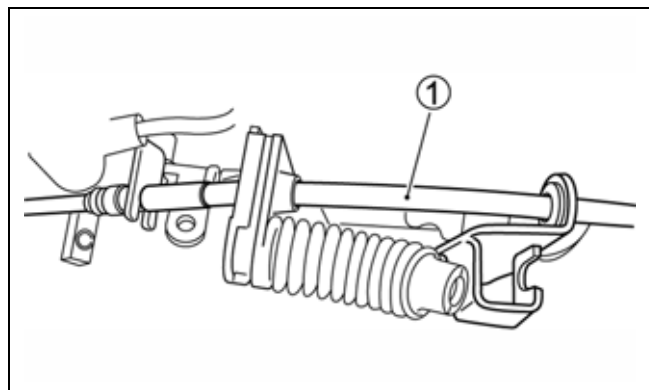
INSTALLATION AND PREDELIVERY OUTBOARD RIGGING

Cable, Hose, and Wire Routing

IMPORTANT: Provide sufficient slack at outboard end to permit unrestricted steering and tilting of outboard. Do not allow cables to bind.

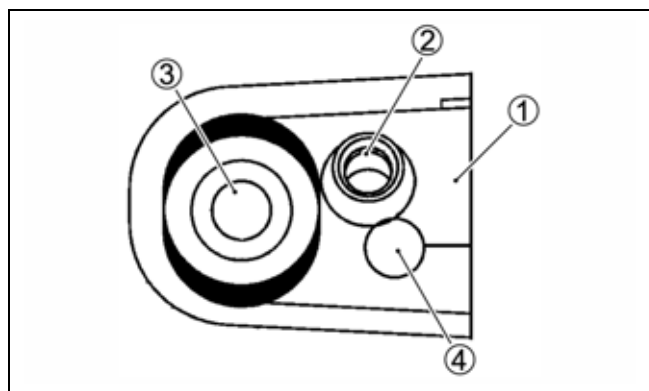
Route the following items through grommet as shown:

- Throttle cable
- Shift cable
- Wiring harness



1. Throttle cable

004814

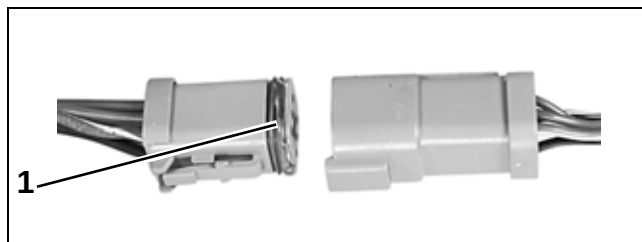


1. Grommet
2. Throttle cable
3. Shift cable
4. Wiring harness

004815

Before installing wiring harness, check that seal is in place. Clean connectors and apply a light coat

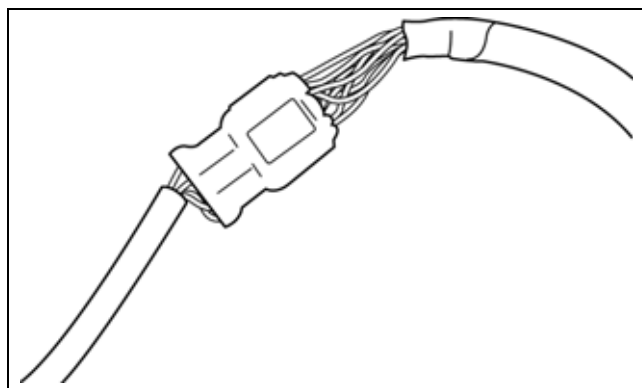
of *Electrical Grease* to the seal. Push connector together until latched.



1. Seal

42079A

Secure connector of remote harness to engine wiring harness connector.



004816

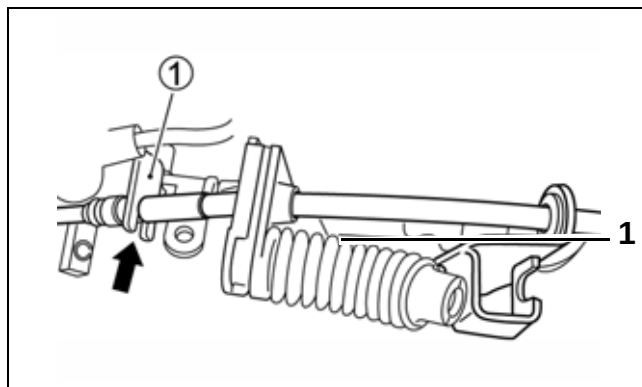
Control Cable Installation

Remove side covers. Refer to side cover **Removal and Installation** on p. 180.

Throttle Cable Installation

Position the remote control handle in NEUTRAL. Be sure the throttle cable is retracted (IDLE).

Secure the cable in the throttle cable holder by fitting groove on the cable into slot on the holder.



1. Cable holder

004817

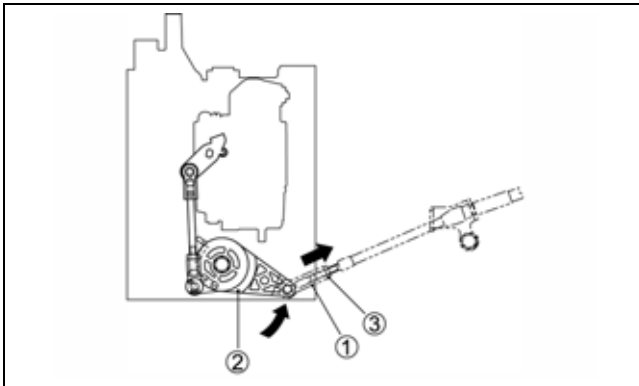
Thread the throttle cable connector onto the cable end.

Turn throttle drum fully counter clockwise.

While pushing cable end in, adjust the connector until the center of connector hole aligns with the center of outer ball pivot on the drum.

When aligned, press fit the connector onto the outer ball pivot and tighten the lock nut.

IMPORTANT: Install the connector of throttle control cable onto the **OUTER** ball pivot on the drum.

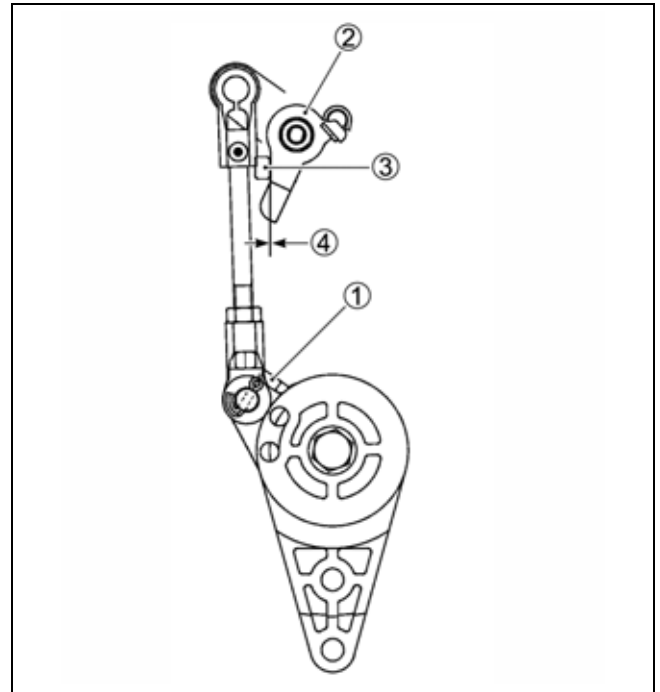


1. Throttle cable connector
2. Throttle drum
3. Lock nut

004818

Make sure throttle drum contacts stop with throttle control fully opened. Also, make sure 0 to 2 mm clearance exists between the carburetor throttle

lever and stop with throttle control fully opened. If not, adjust connector.

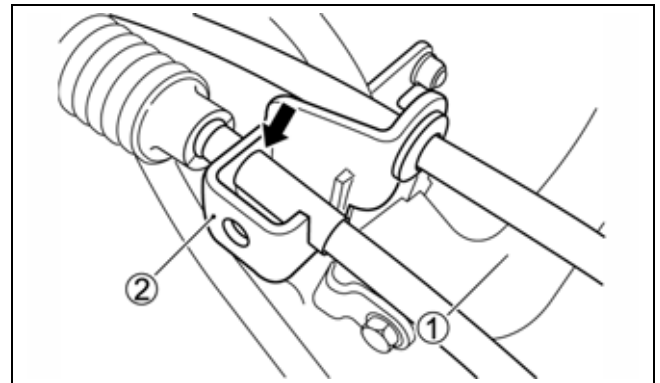


1. Throttle stop
2. Carburetor throttle lever
3. Carburetor throttle stop
4. Clearance

32276

Shift Cable Installation

Secure shift cable in cable holder by fitting groove on the cable into slot on the holder.



1. Shift cable
2. Cable holder

004820

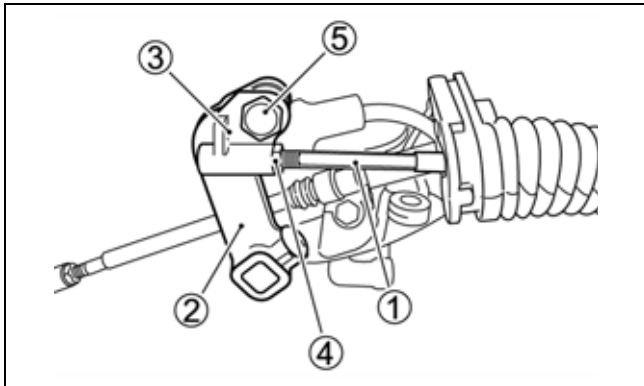
Make sure that the clutch control arm is in the **NEUTRAL** position.

Thread the clutch cable connector onto the cable end until the connector aligns with thread hole of

INSTALLATION AND PREDELIVERY OUTBOARD RIGGING

the clutch control arm. Then, tighten the cable lock nut.

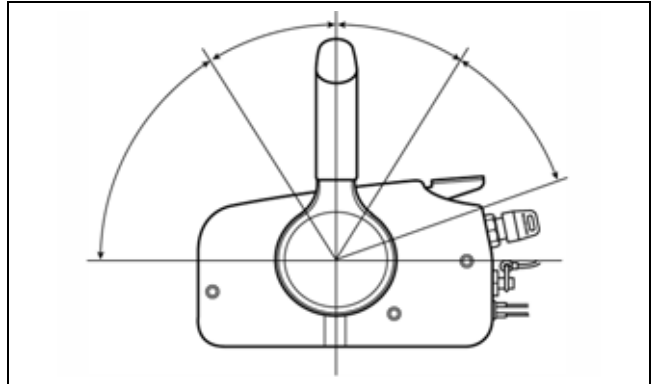
Install connector on the clutch control arm with screw. Tighten to 22 in. lbs. (2.5 N·m).



1. Shift cable
2. Clutch control arm
3. Cable connector
4. Lock nut
5. Screw

004821

Make sure that both forward and reverse gears can be engaged with the same angle of remote control handle travel from NEUTRAL position.



004822

FUEL AND OIL

Fuel Requirements



WARNING



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

Always turn off the outboard before fueling.

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

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

Remove portable fuel tanks from the boat before fueling.

Always wipe off any fuel spillage.

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

Minimum Octane

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

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

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

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

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

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

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

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

Additives

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

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

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

Evinrude/Johnson Carbon Guard will minimize carbon deposit build-up when used as directed.

INSTALLATION AND PREDELIVERY RUNNING CHECKS

Oil Requirements

IMPORTANT: 4-Stroke outboards are shipped without oil in the crankcase. Oil must be added before starting the engine for the first time.

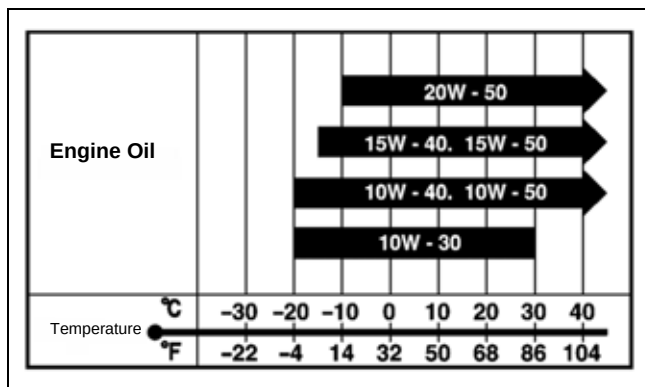
IMPORTANT: During the initial 10-hour break-in period, use *Evinrude/Johnson* 4-Stroke Outboard Oil or SAE 10W-40, API SE, SF, SG, SH, or SJ rated. DO NOT use synthetic or synthetic blend oils during break-in period.

Evinrude/Johnson Ultra™ 4-Stroke synthetic outboard oil is recommended for normal use in these outboards after break-in.

If *Ultra* 4-Stroke oil is not available, you must use SAE 10W-40, API SE, SF, SG, SH, or SJ rated.

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

If SAE 10W-40 motor oil is not available, select an alternative according to the following chart:



004813

RUNNING CHECKS



WARNING



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



DANGER



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



DANGER



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

Break-In (10 Hours)

Follow this procedure to protect the outboard during its initial hours of operation. Careful break-in allows internal engine components to seat properly, resulting in maximum engine life and performance.

Failure to carefully follow the break-in procedures can result in engine damage.

Perform the 10-Hour break-in procedure with the boat and engine in the water, using an appropriate propeller.

IMPORTANT: DO NOT perform break-in using a flushing device. DO NOT start-up or run the engine out of water. DO NOT leave a running engine unattended.

During the break-in, check water pump operation often. Look for a steady stream of water from the water pump indicator. If the stream of water stops, shut off the engine to prevent damage. Find and correct the cause before continuing.

Change the RPM often. Avoid holding a throttle setting longer than 15 minutes.

Check the crankcase oil level often. Add oil if needed.

First 10 minutes of operation — Operate engine in gear at idle only.

Balance of First 2 hours of operation — Operate in gear below 3500 RPM or 1/2 throttle only.

With easy planing boats, use full throttle to quickly accelerate boat onto plane. Immediately reduce throttle to one-half as soon as the boat is on plane. BE SURE boat remains on plane at this throttle setting.

Third hour of operation — Run the engine in gear at various speeds up to 4000 RPM or 3/4 throttle only.

Balance of first 10 hours of operation — Run the engine in gear at various engine speeds including full throttle, but remain at full throttle no longer than 5 minutes.

Change the engine speed every 15 minutes.

DO NOT exceed recommended maximum engine RPM. Refer to **TECHNICAL DATA** on p. 16.

Fuel System

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

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

Emergency Stop Switch

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

Outboard Controls

Confirm that controls can be easily moved into all gear and throttle settings. Do not shift outboard when propeller shaft is not turning.

Start-In-Gear Prevention



WARNING



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

Start outboard and shift outboard into FORWARD.

Turn outboard OFF while lever is in FORWARD.

Attempt to restart the outboard. Outboard should not start.

Pull shift lever back to NEUTRAL and restart outboard.

Shift remote control lever to REVERSE.

Turn outboard OFF while lever control is in REVERSE.

Attempt to restart the outboard. Outboard should not start.

INSTALLATION AND PREDELIVERY RUNNING CHECKS

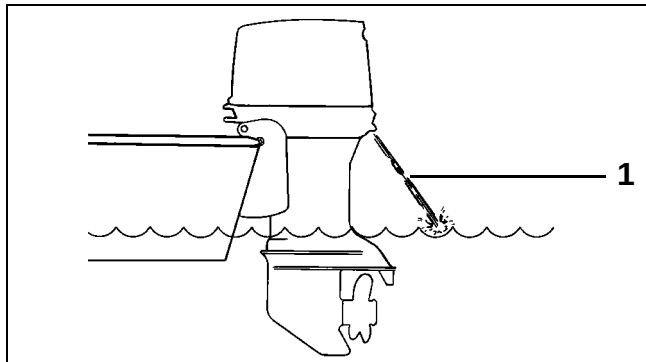
Tachometer Pulse Setting

Confirm accuracy of tachometer reading.

- Adjust dial on back of tachometer to 6 pulse/12 pole setting.

Water Pump Overboard Indicator

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



1. Water pump overboard indicator

DRC4952

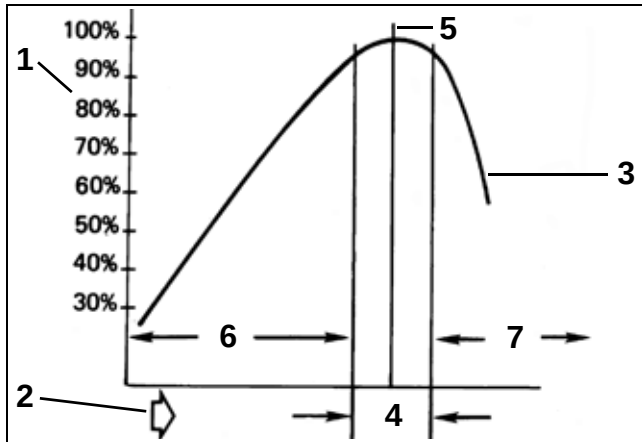
Operating Temperature

An outboard running at idle speed should achieve a temperature based on the engine's thermostatic control. In general, the powerhead temperature should reach at least 100°F (38°C) after five minutes of idling. Confirm that the powerhead reaches idle temperature.

PROPELLER SELECTION

Refer to **Propeller Hardware Installation** on p. 44 before installing propeller.

The correct propeller, under normal load conditions, will allow the engine to run near the midpoint of the RPM operating range at full throttle. Refer to **TECHNICAL DATA** on p. 16.



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

DR1261

Procedure

The propeller selection process is very important to the engine's service life and to boat performance. Proceed carefully and thoroughly while considering the following points:

- During the engine break-in period, run the outboard at wide-open throttle for only brief periods of time to check full-throttle RPM.
- Use an accurate tachometer to determine the engine's full-throttle RPM while testing various propellers.
- Select a propeller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load in it. Refer to **TECHNICAL DATA** on p. 16.
- To compensate for changes in boat loading, the engine's full-throttle RPM must be verified periodically.

IMPORTANT: If the propeller blades have too much pitch, the engine is operating below its normal range at full throttle, power is being lost, and powerhead damage could occur. If the propeller blades have too little pitch, the engine is operating above its normal range at full throttle and damage from overspeeding could occur.



CAUTION



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



WARNING



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

INSTALLATION AND PREDELIVERY

PROPELLER SELECTION

Propeller Hardware Installation



WARNING



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

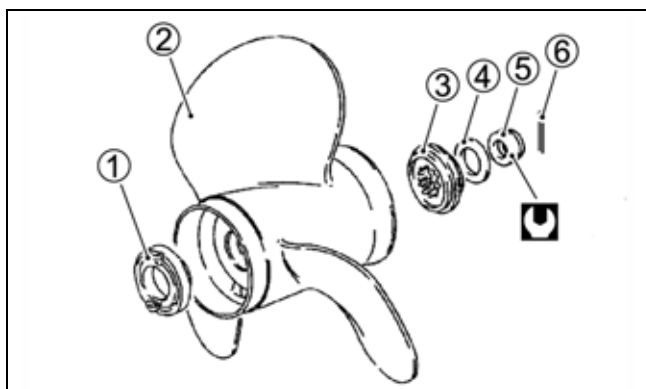
Apply *Triple-Guard* grease to the entire propeller shaft before installing the propeller.

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

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

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

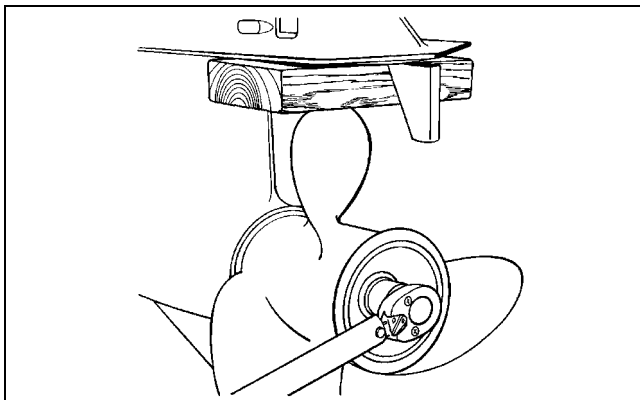
Install the spacer, engaging the propeller shaft splines.



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

004361

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



DRC3984

Install the propeller nut and torque to:

- 156 in. lbs. (18 N·m)

If cotter pin holes in the propeller nut and propeller shaft are not aligned, tighten the nut until they are in line. Do not loosen.

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

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

MAINTENANCE

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MAINTENANCE

INSPECTION AND MAINTENANCE SCHEDULE

INSPECTION AND MAINTENANCE SCHEDULE

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

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

Engine Maintenance and Inspection Schedule						
Description	Engine Care Product	Frequency				
		Each Use	10-Hour Inspection	Every 50 Hours or 6 months	Every 100 Hours or Annually	Every 200 Hours or Biannually
Swivel bracket, inspect and lubricate ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Clamp screws, inspect and lubricate ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Tilt lock pin, inspect and lubricate ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Throttle linkage, inspect and lubricate ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Steering bracket, lubricate ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Exhaust housing bushing ⁽¹⁾	D	Every 60 days / Every 30 in Saltwater				
Lubrication and corrosion protection for metallic components	A	Every 60 days / Every 30 in Saltwater				
Battery connections and condition, check	D	✓	✓			
Anticorrosion anodes, check operation		✓	✓			
Water intake screens, check condition		✓	✓			
Overboard water pump indicator, check operation		✓	✓			
Steering friction, check/adjust		✓	✓			
Throttle and shift operation, check function		✓	✓			
Emergency stop circuit and lanyard, check function		✓	✓			
Starter, inspect cord		✓	✓			
Crankcase oil level, check	H	✓	✓			
Crankcase oil, replace ⁽²⁾	H		✓			✓
Oil filter, replace			✓			✓
Fuel filter inspection, eliminate contamination			✓		✓	
Fuel filter, replace						✓
Flush cooling system		✓				
Thermostat, inspect and check operation			✓		✓	
Operator's Guide, onboard		✓				
Engine upper and lower motor covers, clean and wax				✓		

MAINTENANCE

INSPECTION AND MAINTENANCE SCHEDULE

3

Engine Maintenance and Inspection Schedule						
Description	Engine Care Product	Frequency				
		Each Use	10-Hour Inspection	Every 50 Hours or 6 months	Every 100 Hours or Annually	Every 200 Hours or Biannually
Operator's Guide, review					✓	
Timing belt		Replace every four years				
Valve tappet clearance, inspect ⁽³⁾			✓			✓
Driveshaft splines, inspect and lubricate	E					✓
Fuel system components, inspect and repair leaks ⁽³⁾			✓	✓		
Carburetor, inspect						✓
Breather line, replace						✓
Fastener inspection, tighten loosened components			✓	✓		
Starter pinion shaft, inspect and lubricate	F			✓		
Electrical and ignition wires and connections, inspect			✓		✓	
Gearcase lubricant replace	B		✓		✓	
Powerhead synchronization and linkage, inspect ⁽³⁾	D		✓		✓	
Gearcase lubricant, inspect fill level and condition of lube	B			✓		
Propeller shaft, inspect and lubricate	D				✓	
Spark plugs, replace ⁽³⁾					✓	
Decarbonize	G				✓	
Water pump, inspect and replace						✓

(1) Also recommended at 10-Hour Inspection

(2) Replace every 100 hours or annually if *Ultra 4-Stroke* oil is not used.

(3) Emission-related component

- A *Evinrude/Johnson* Anti-Corrosion Spray or *Evinrude/Johnson* "6 in 1" Multi-Purpose Lubricant
- B *HPF XR* Gearcase Lubricant
- C Power Trim/Tilt and Power Steering Fluid
- D *Triple-Guard* Grease
- E *Evinrude/Johnson Molyube*
- F Starter Bendix Lube Only
- G *Evinrude/Johnson* Engine Tuner
- H *Evinrude/Johnson Ultra 4-Stroke* synthetic blend oil

10-HOUR INSPECTION

IMPORTANT: All *Johnson* outboard owners are encouraged to return their new engines to an authorized dealer for a mechanical check.

This check should be performed after approximately 10 operating hours. The cost of this check should be figured at local dealer labor rates and paid for by the engine owner.

The 10 hour inspection should check:

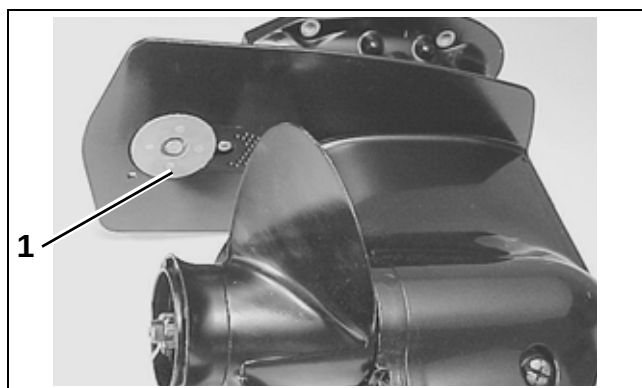
- Anticorrosion anodes functionality
- Water intake screens
- Overboard water pump indicator
- Steering operation
- Throttle and shift operation
- Emergency stop circuit and lanyard functionality
- Fuel system components, repair any leaks
- Fuel filter, eliminate any contamination
- Fasteners, tighten loose components
- Air silencer, clean and inspect
- Thermostat operation
- Engine to transom mounting hardware
- Electrical and ignition wires and connections
- Synchronization and linkage adjustments

ANTI-CORROSION PROTECTION

Sacrificial Anodes

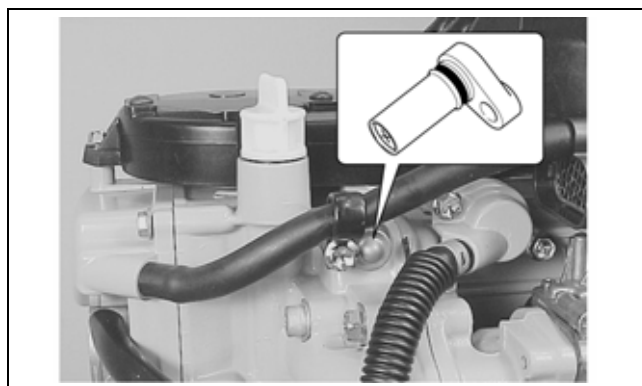
Galvanic corrosion occurs in fresh or salt water. Salt, brackish, and polluted water can accelerate corrosion. "Sacrificial" anodes are intended to protect the underwater metal components of the outboard from galvanic corrosion.

Outboards are equipped with sacrificial anodes.



1. Gearcase housing anode

004382



Powerhead waterjacket anode

004778

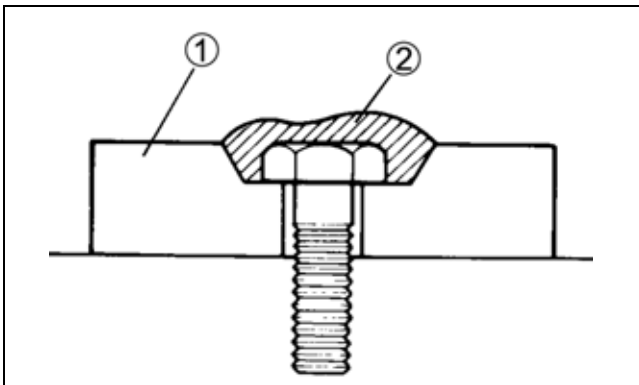
Visually inspect anodes and metal components below water level. Erosion of anodes is normal and indicates the anodes are functioning properly.

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

For best anode performance:

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

IMPORTANT: The anode securing screw should be covered with silicone sealant.



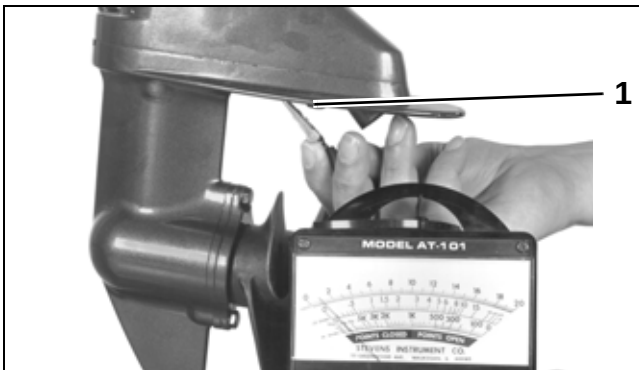
1. Anode
2. Silicone sealant

004779

Testing Procedure – Continuity

Calibrate multimeter on “HIGH” ohm scale.

Connect meter leads between engine ground and anode surface.



- TYPICAL**
1. Meter lead to anode

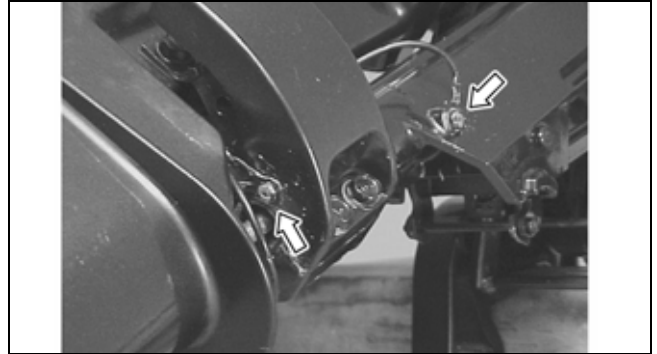
25347

The multimeter should indicate little or no resistance. If resistance is high, check the following:

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

Bonding Wires

Check bonding wires for breaks, corrosion or other damage. Clean wire terminals with solvent. Replace if necessary.



004780



004781

Metallic Component Protection

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

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

Exterior Finishes

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

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

COOLING SYSTEM

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

- water intake screens
- overboard water pressure indicator
- water pump
- all internal water passages
- thermostat

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.



WARNING



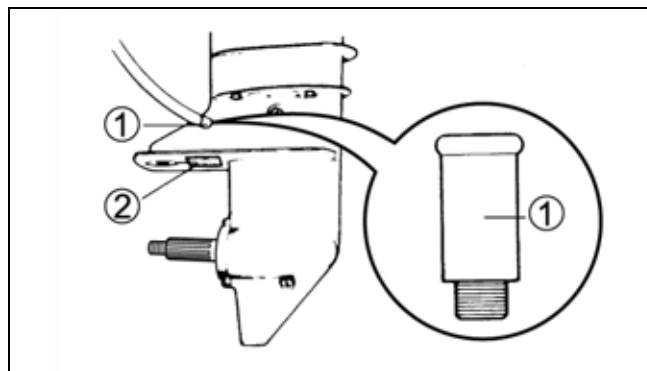
Prevent injury from contact with rotating propeller; remove the propeller before flushing.

Procedure

Remove propeller and shift the outboard to NEUTRAL.

Install flushing device and garden hose.

Cover the water intake hole with tape.



1. Flushing device
2. Tape

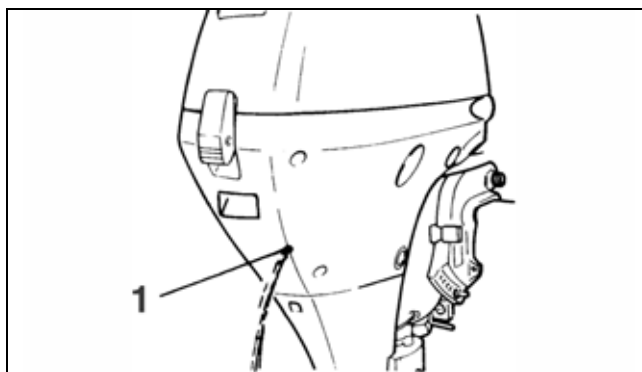
004782

START outboard. Run outboard at IDLE only for at least five minutes.

IMPORTANT: To prevent damage, do not run outboard above fast idle. Water must flow from the

water pump indicator. If it does not, shut off the outboard and repair as needed.

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



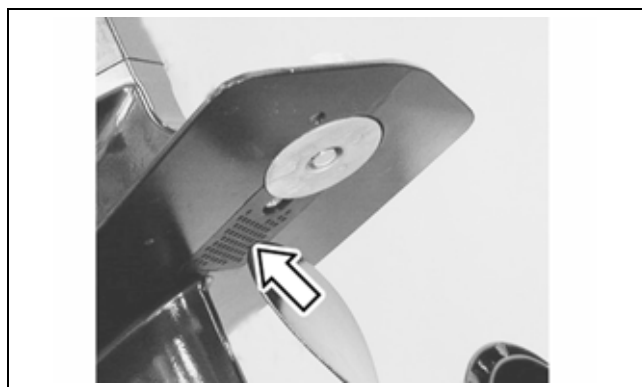
1. Water pump indicator

004783

Remove outboard from tank and install propeller.

Water Intake Screen

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



1. Water intake screen

004784

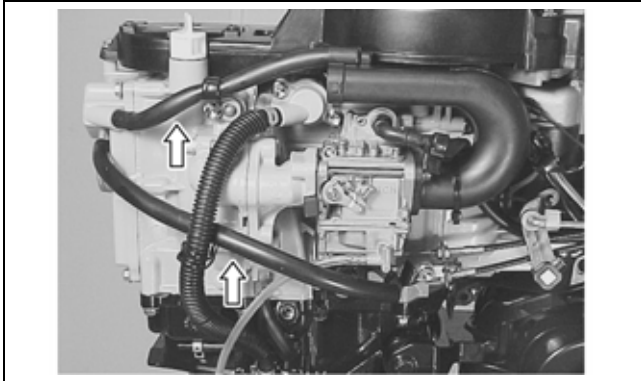
Water Pump

Inspect water pump every 200 hours of operation. Refer to **WATER PUMP** on p. 202.

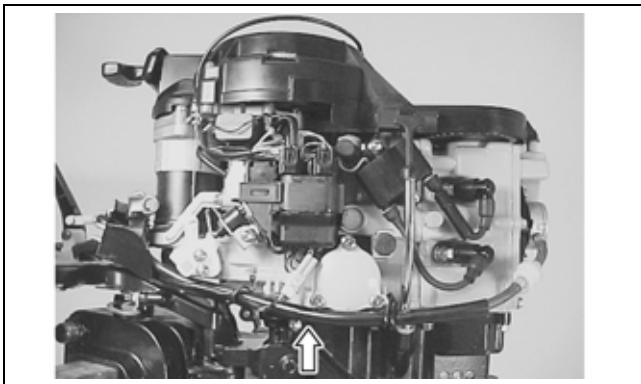
FUEL SYSTEM

Breather and Fuel Line

If leakage, cracks, swelling, or other damage is found, replace the breather line and/or the fuel line.



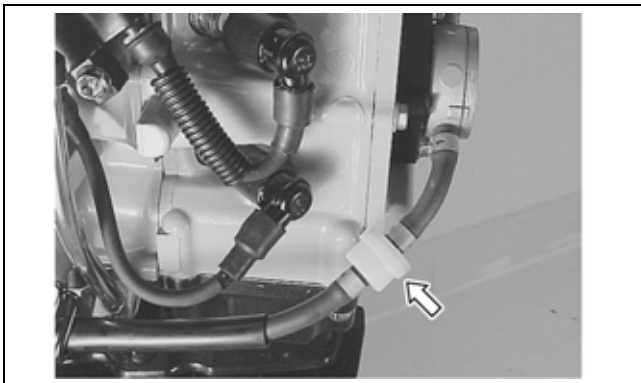
004810



004811

Fuel Filter

If water accumulation, sediment, leakage, cracks, or other damage is found, replace the fuel filter.



004812

BATTERY

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



WARNING



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

- Confirm that battery meets the minimum engine requirements.
- Connections must be clean and tight.

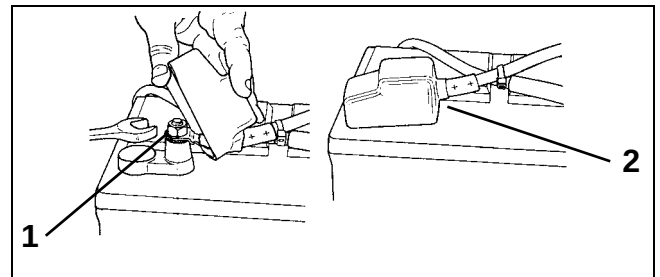
Disconnect battery negative (–) cable **first** and the battery positive (+) cable last.

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

Reinstall battery and tighten connections securely. Refer to **Battery Installation** on p. 29.

IMPORTANT: DO NOT secure battery cables with wing nuts.

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



1. Connection
2. Insulator

000866



WARNING



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

LUBRICATION

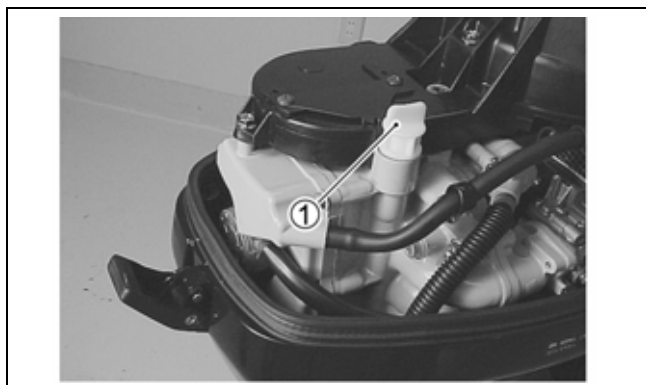
Engine Oil

Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 46 for oil change schedule.

IMPORTANT: Engine oil should be changed while engine is warm.

Place outboard upright on a level surface.

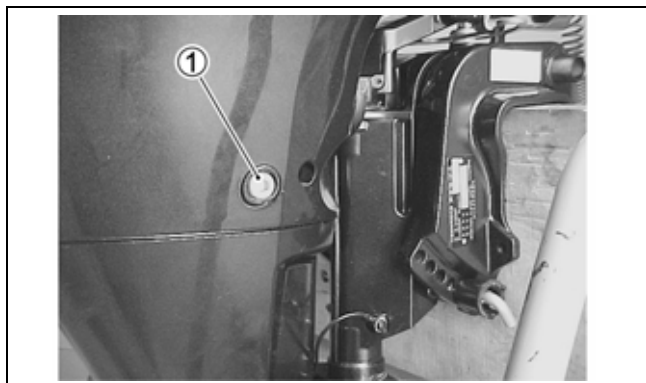
Remove the oil filler cap.



1. Oil filler cap

004785

Place a container under engine oil drain plug, then remove plug and gasket to drain engine oil.

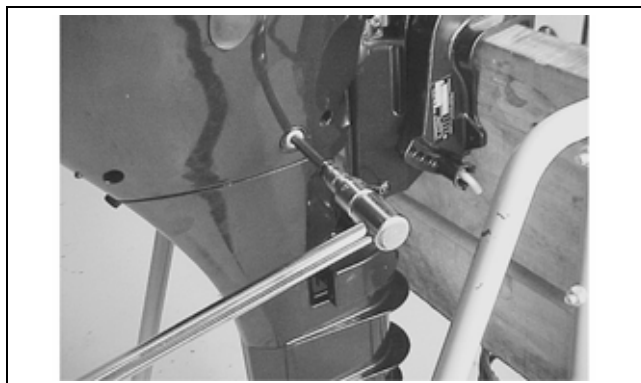


1. Oil drain plug

004786

Install new gasket and oil drain plug. Tighten plug to 114 in. lbs. (13 N·m).

IMPORTANT: Do not re-use gasket once removed. Always use a new gasket.



004787

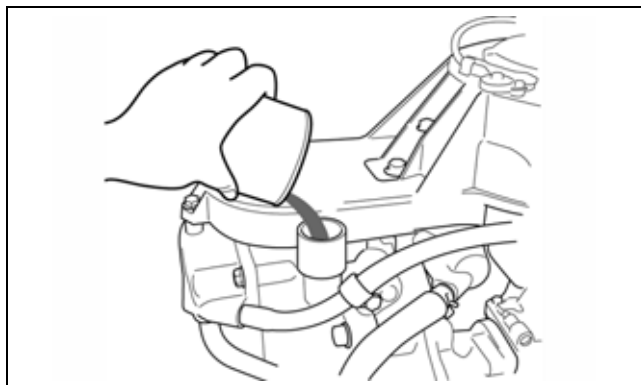
Pour recommended oil into oil filler opening, then install filler cap.

Recommended oil:

- Evinrude/Johnson Ultra 4-Stroke oil, or
- SAE 10W-40, API classification SE, SF, SG, SH, SJ.

Oil amount:

- Oil change only: 1.1 Qt. (1.0 L)
- Oil filter change: 1.2 Qt. (1.1 L).



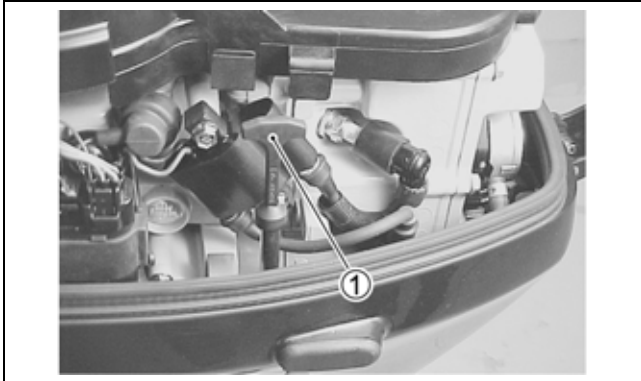
004788

Start the engine and allow it to run for several minutes at idle speed.

Turn off engine and wait for approximately two minutes.

Remove the oil dipstick and wipe it clean.

Reinsert dipstick fully into dipstick tube, then remove to check oil level.

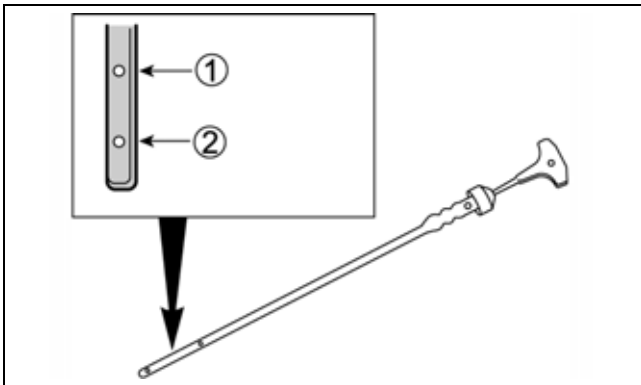


1. Dipstick

004789

Oil level should be between full level Max mark (hole) and low level Min mark (hole).

If oil is low, add recommended oil to full level hole.



1. Max
2. Min

004790

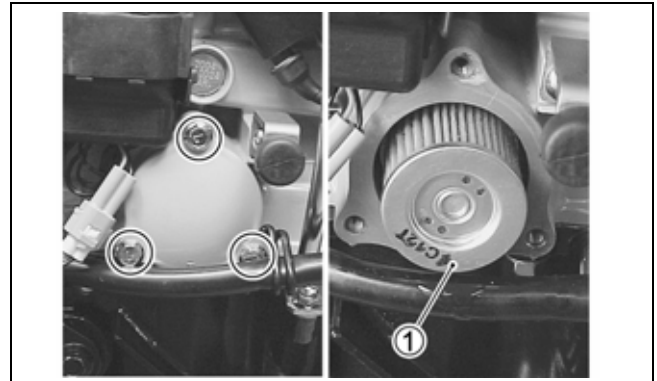
Engine Oil Filter

IMPORTANT: When replacing oil filter, change engine oil at the same time.

Remove side covers. Refer to side cover **Removal and Installation** on p. 180.

Remove three screws securing oil filter cap.

Remove the oil filter.

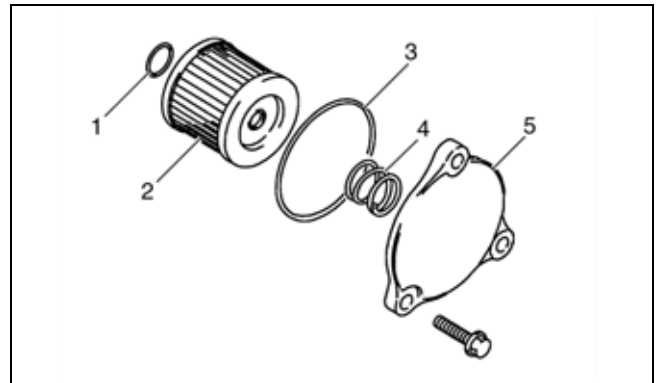


1. Oil filter

004791

Assembly is reverse order of disassembly.

IMPORTANT: Do not re-use o-rings once removed. Always use new o-rings.



1. O-ring
2. Oil filter
3. O-ring
4. Spring
5. Filter cap

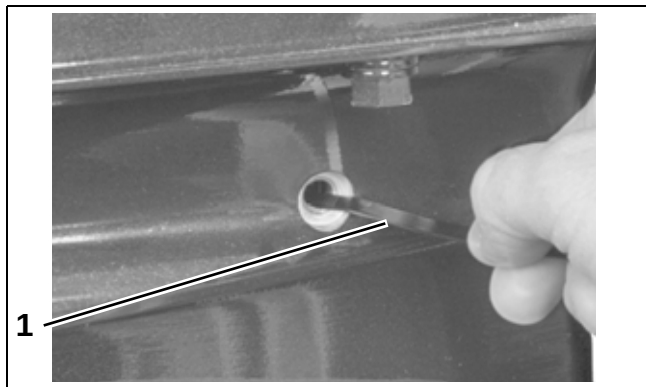
004792

MAINTENANCE

LUBRICATION

Gearcase Lubricant

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



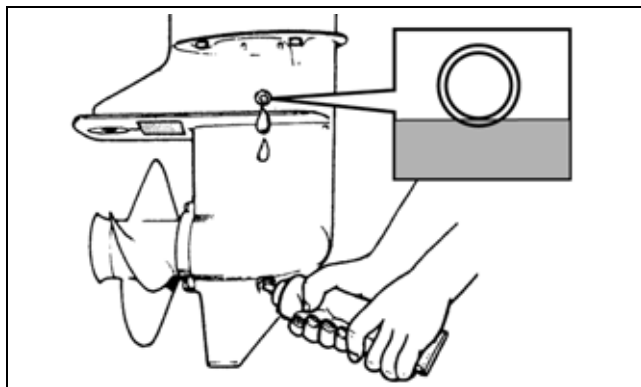
TYPICAL
1. Tie strap

000072

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

Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 46 for service frequency and recommended lubricants.

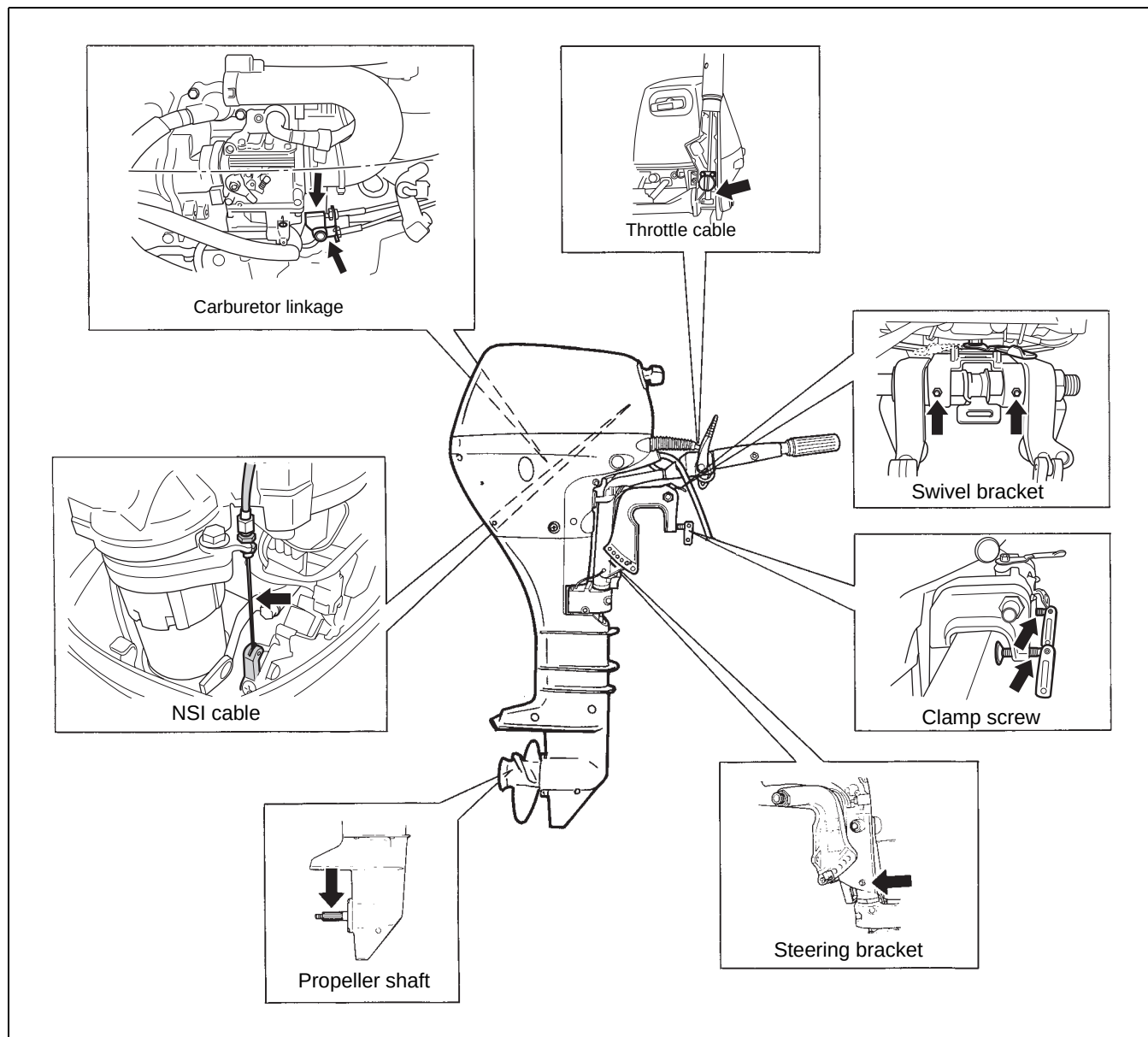
Refer to **LUBRICANT** on p. 198 for complete gearcase lubricant filling procedures.



004363

Linkages and Fittings

Apply *Triple-Guard* grease to the points shown.



WARNING



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

SPARK PLUGS

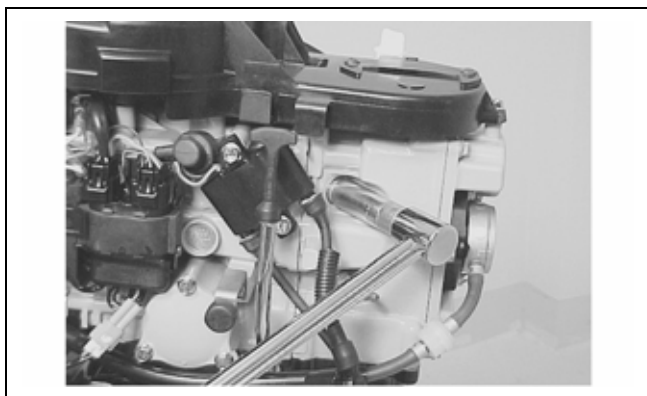
Spark plugs should be removed and examined periodically. Replace worn, fouled or damaged spark plugs.

- Remove spark plugs and inspect condition.
- Set spark plug gap on new, replacement spark plugs.
- Apply *Electrical Grease* to the ribbed portion of the spark plug ceramic and to the opening of the spark plug cover to prevent corrosion.

Recommended spark plug and gap setting:

- *NGK BKR6E @ 0.030 in. (0.8 mm).*

Tighten spark plugs 20 ft. lbs. (27 N·m).



004793

VALVE CLEARANCE

Measurement

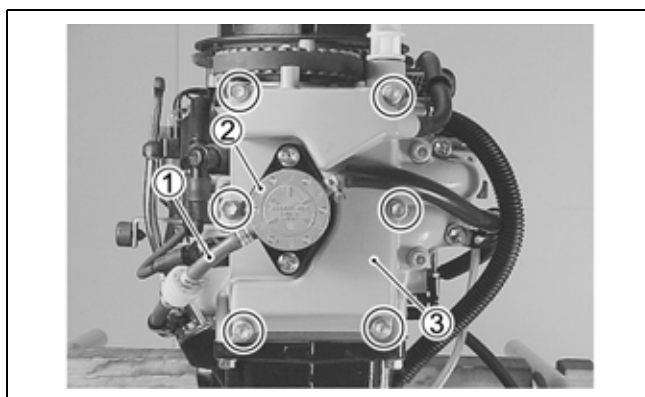
Remove side covers. Refer to side cover **Removal and Installation** on p. 180.

Remove recoil starter. Refer to starter **REMOVAL** on p. 219.

Remove spark plugs.

Disconnect the fuel hose from fuel pump.

Remove six screws and cylinder head cover.



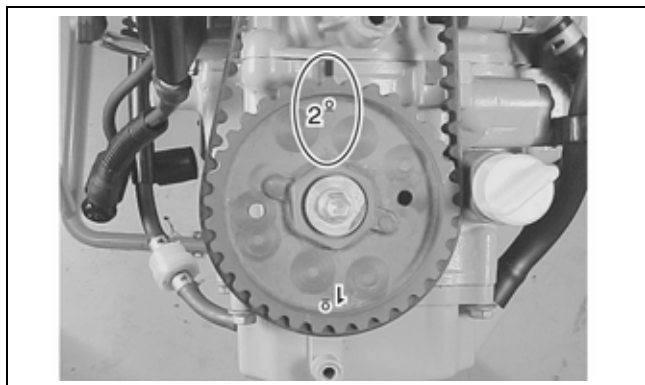
1. Fuel hose
2. Fuel pump
3. Cylinder head cover

004794

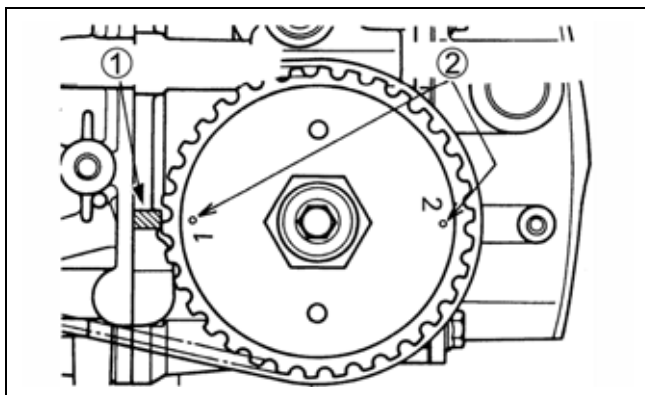
Rotate the flywheel clockwise to bring each piston to Top Dead Center (TDC) on compression stroke. Align each PUNCH mark on cam pulley with INDEX mark on cylinder head block.

IMPORTANT: Rotate the crankshaft in the normal running direction only (clockwise) to prevent water pump impeller damage.

PUNCH mark	TDC cylinder number
1	No. 1 cylinder
2	No. 2 cylinder



004795

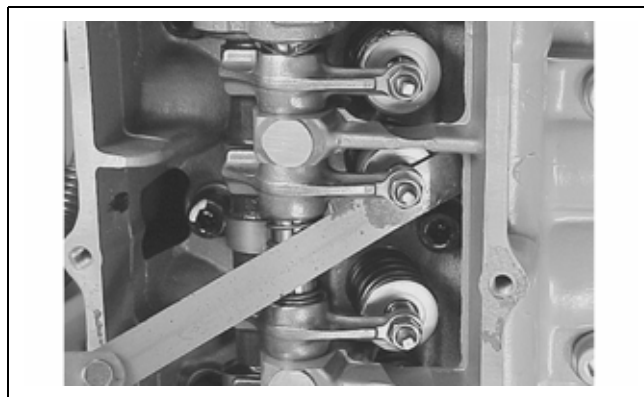


1. INDEX mark
2. PUNCH mark

004796

IMPORTANT: The piston must be at its TDC position on a compression stroke to check or adjust valve clearance.

Use a feeler gauge to measure clearance between valve stem end and valve adjusting screw on rocker arm.



004797

Valve clearance: (cold engine)

- IN: 0.007 to 0.009 in. (0.18 to 0.22 mm)
- EX: 0.007 to 0.009 in. (0.18 to 0.22 mm)

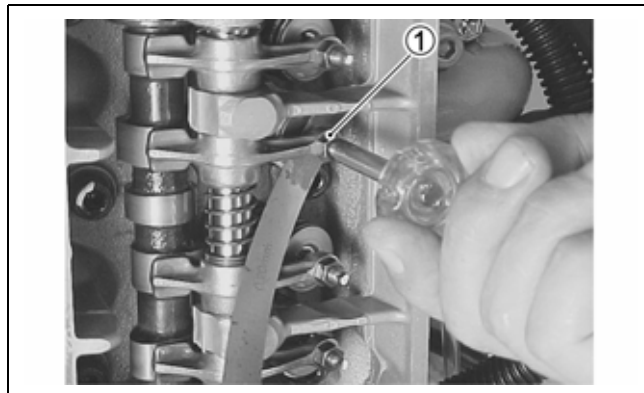
If measurement is out of specification, adjust valve clearance.

IMPORTANT: The valve clearance specification is for COLD engine condition.

Adjustment

Loosen valve adjusting lock nut.

Turn valve adjusting screw using Tappet Adjusting Tool, P/N 341444, to bring valve clearance within specification.



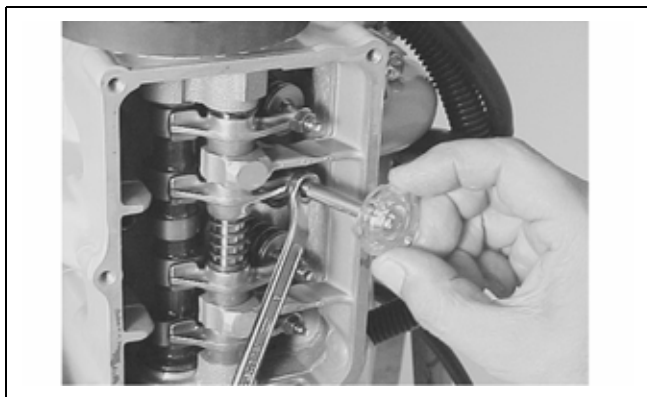
1. Lock nut

004798

MAINTENANCE

TIMING BELT

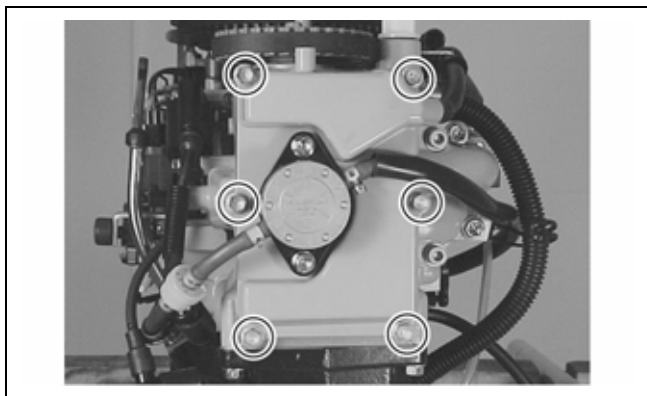
Tighten valve adjusting lock nut while holding valve adjusting screw. Tighten nut 95 in. lbs. (11 N·m).



004799

Recheck valve clearance.

Tighten the cylinder head screws to 84 in. lbs. (10 N·m).



004800

IMPORTANT: Do not re-use gasket once removed. Always use a new gasket.

TIMING BELT

Remove side covers. Refer to side cover **Removal and Installation** on p. 180.

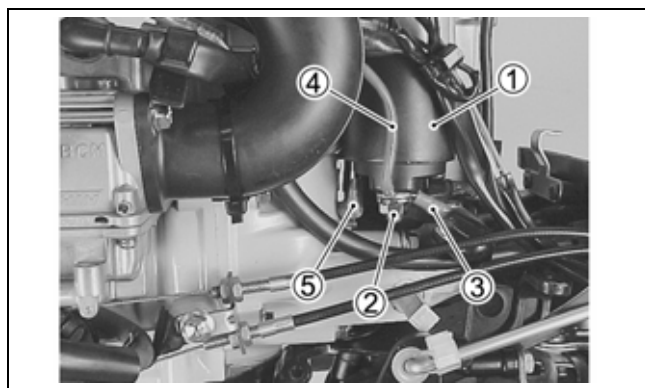
Remove recoil starter. Refer to starter **REMOVAL** on p. 219.

Remove spark plugs.

Remove flywheel. Refer to **COMPONENT SERVICING** on p. 101.

Remove nut, positive (+) battery cable, and positive (+) battery charge cable from the magnetic switch "B" terminal of starter motor.

Disconnect red lead wire from starter motor magnetic switch "S" terminal.

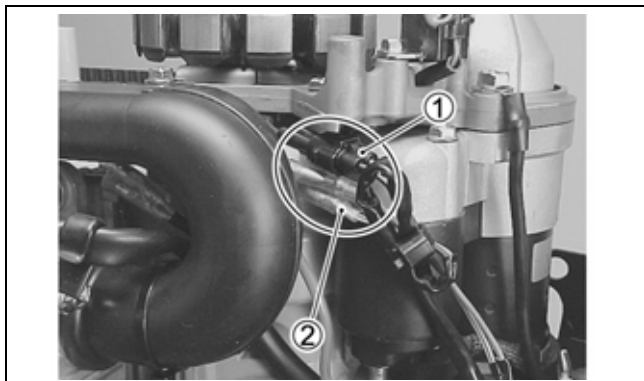


004735

1. Magnetic switch
2. Nut
3. Battery cable
4. Battery charge cable
5. "S" terminal red lead

Disconnect engine stop switch lead wire connector.

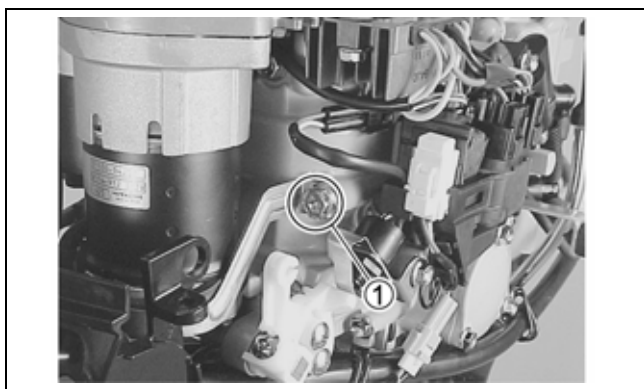
Disconnect starter switch lead wire connector (tiller models).



1. Stop switch connector
2. Starter switch connector

004736

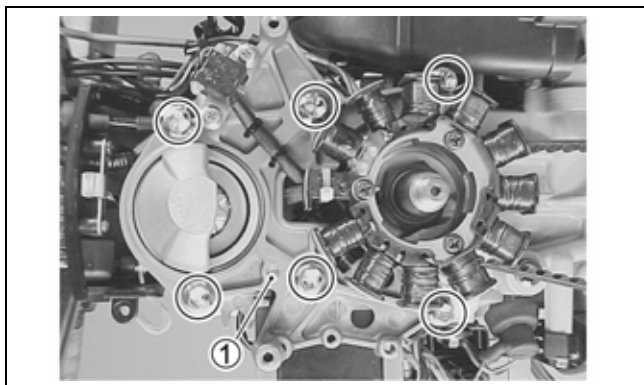
Remove the PORT side screw securing starter motor band.



1. Starter motor band screw

004737

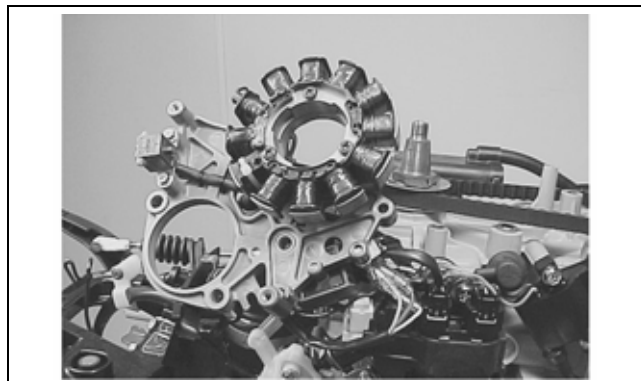
Remove the six screws securing stator base.



1. Stator base

004738

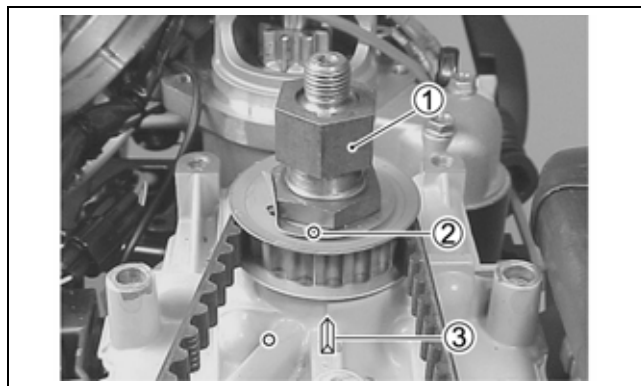
Lift stator base from cylinder block and lay it on port side as shown.



004801

Rotate the crankshaft, using Crankshaft Holder, P/N 5034236, to align the PUNCH mark on the timing pulley with the INDEX mark on the cylinder block.

IMPORTANT: Rotate the crankshaft in the normal running direction only (clockwise) to prevent water pump impeller damage.



1. Crankshaft holder
2. PUNCH mark
3. INDEX mark

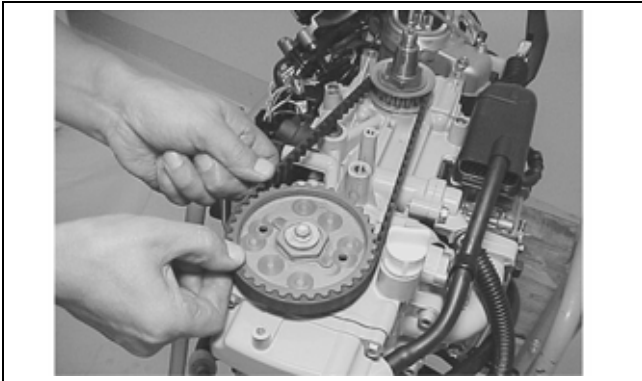
004802

IMPORTANT: Do not rotate the cam pulley with timing belt removed.

MAINTENANCE

TIMING BELT

Remove the timing belt from the cam pulley first, then from the timing pulley.



004803



CAUTION



Do not rotate the crankshaft or the cam pulley before installing the belt; the following must be checked:

The PUNCH mark on the timing pulley aligns with the INDEX mark on the cylinder block.

Either of the PUNCH marks on the cam pulley aligns with the INDEX mark on the cylinder head block.

If the timing pulley or the cam pulley is rotated with the timing belt removed or installed but misaligned, this may cause the valves to become bent.

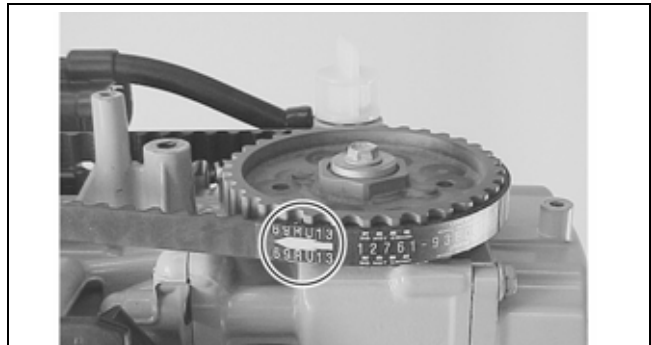
If the alignment marks are not correctly matched, loosen the valve adjusting lock nuts and the valve adjusting screws fully to prevent valve damage.

Then align the marks correctly by rotating the cam pulley clockwise.

Install the timing belt on the timing pulley first, then the cam pulley.

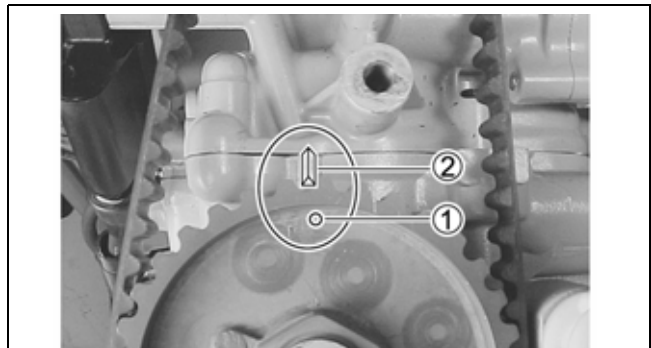
IMPORTANT: Always keep the timing belt away from any grease and oil.

IMPORTANT: The timing belt must be installed with the arrow toward the direction of rotation.



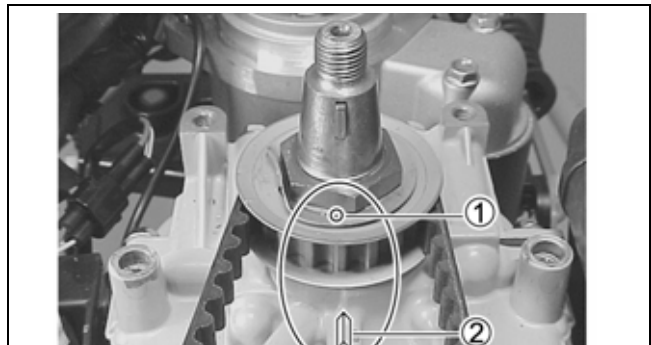
004804

Make sure that either of the PUNCH marks on the cam pulley aligns with the INDEX mark on the cylinder head block when the PUNCH mark on the timing pulley aligns with the INDEX mark on the cylinder block.



1. PUNCH mark on cam pulley
2. INDEX mark on cylinder head

004805



1. PUNCH mark on timing pulley
2. INDEX mark on cylinder block

004806

IDLE SPEED

Check throttle link mechanism and carburetor throttle valve for smooth operation.

Connect a shop tachometer to the engine.



004807

Start and warm the engine.

Check engine idle speed:

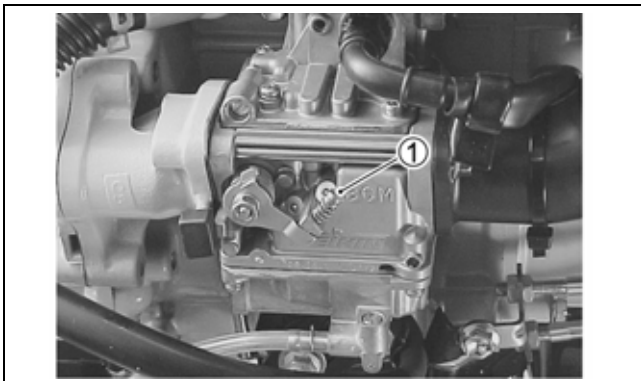
- 850 to 950 RPM

IMPORTANT: Check and/or adjust idle speed after the engine speed has stabilized.

If idle speed is out of specification, adjust as follows:

Turn the throttle stop screw:

- Clockwise: Engine speed increases
- Counterclockwise: Engine speed decreases.



1. Throttle stop screw

004808

IGNITION TIMING

IMPORTANT: Before checking ignition timing, make sure idle speed is adjusted within specification.

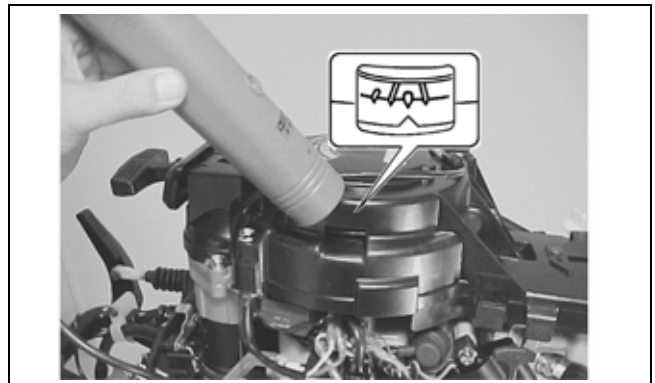
Start and warm the engine.

Connect a shop tachometer and timing light to the engine.

Check the ignition timing while operating the engine at 1000 RPM.

Ignition timing:

- 5° ATDC @ 1000 RPM



004809

STORAGE



WARNING



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

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

Fuel System Treatment

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

START outboard and RUN at IDLE speed for five minutes to ensure that the entire fuel system is filled with the storage mixture.

Proceed with **Internal Engine Treatment**.

Internal Engine Treatment

Check level and condition of crankcase oil. Change oil and filter if required. Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 46.

Use *Evinrude/Johnson Storage Fogging Oil* to prevent corrosion of internal engine components during periods of storage.

Remove spark plugs and spray a liberal amount of *Evinrude/Johnson Storage Fogging Oil* into the spark plug holes.

Turn the flywheel in a clockwise direction to distribute the fogging oil throughout the cylinders. Install and torque the spark plugs.

If outboard is equipped with a portable fuel tank, disconnect fuel hose from outboard and tank.

IMPORTANT: DO NOT restart outboard until it goes back into service.

If the outboard is removed from boat, examine all loosened and removed hardware. Replace damaged or missing parts with genuine *Evinrude/Johnson* parts or equivalent.

Additional Recommendations

- Replace gearcase lubricant.
- Remove and inspect propeller.
- Clean and grease propeller shaft.
- Lubricate all grease fittings and linkages.
- Clean or replace fuel filter element.
- Inspect outboard and controls. Replace all damaged and worn components. Refer to manufacturer's maintenance and lubrication recommendations.
- Touch up painted surfaces as needed. Coat outer painted surfaces with automotive wax.
- Store outboard in upright (vertical) position.
- Check for fuel leakage.



WARNING



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

PRE-SEASON SERVICE

If the outboard was removed from the boat for storage, make certain it has been reinstalled with factory specified hardware.

Crankcase Oil

- Check oil level
- Add oil as needed

Gearcase Lubricant

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

Operational Checks

- Steering
- Throttle and shift
- All other accessories

Fuel System

- Inspect entire fuel system for leaks prior to starting outboard. Repair all leaks.
- Start outboard and reinspect.



WARNING



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

SUBMERGED ENGINES

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

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

Engine Dropped Overboard (Not Running)

Disconnect battery cables at the battery.

Rinse powerhead with clean water.

Remove spark plug leads and spark plugs.

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

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

Place engine in upright position. Drain, disassemble, and clean carburetor.

MAINTENANCE

SUBMERGED ENGINES

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

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

Change oil and filter.

Remove carburetor for draining, disassembly and cleaning.

Disconnect fuel supply hose from outboard. Drain and clean all fuel hoses, filters, and fuel tanks. Refill fuel tank with fresh fuel.

Inject a small amount of outboard lubricant into spark plug holes and install new spark plugs.

Reinstall all removed or disconnected parts.

Run the outboard below 1500 RPM for one-half hour.

Change oil and filter again.

Engine Dropped Overboard (Running)

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

Engine Dropped Overboard (In Salt Water)

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

Prolonged Submersion (Fresh or Salt Water)

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

ELECTRICAL

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CAUTION SYSTEM

Two caution systems alert the operator when an abnormality occurs:

- Over-revolution Caution
- Low Oil Pressure Caution

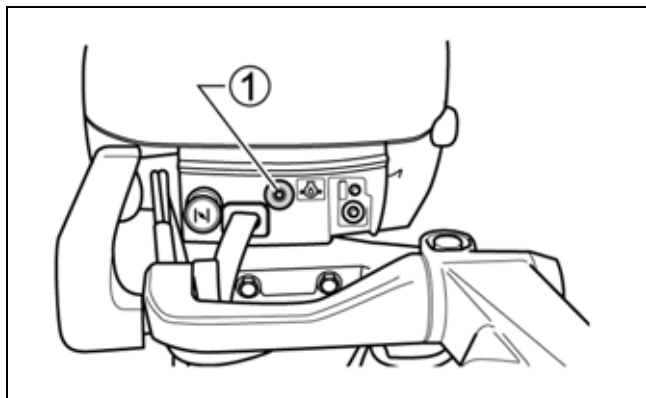
Caution Type	Lamp	Buzzer *	Rev Limiter
Over-revolution	Yes	No	Yes
Low oil pressure	Yes	Yes	Yes

* Remote models only

Self Test

The caution lamp turns ON two seconds after starting engine.

On remote control models, the caution buzzer sounds when ignition switch is turned ON. Buzzer stops when engine starts and oil pressure switch turns OFF.



1. Caution lamp

004714

Over-Revolution Caution System

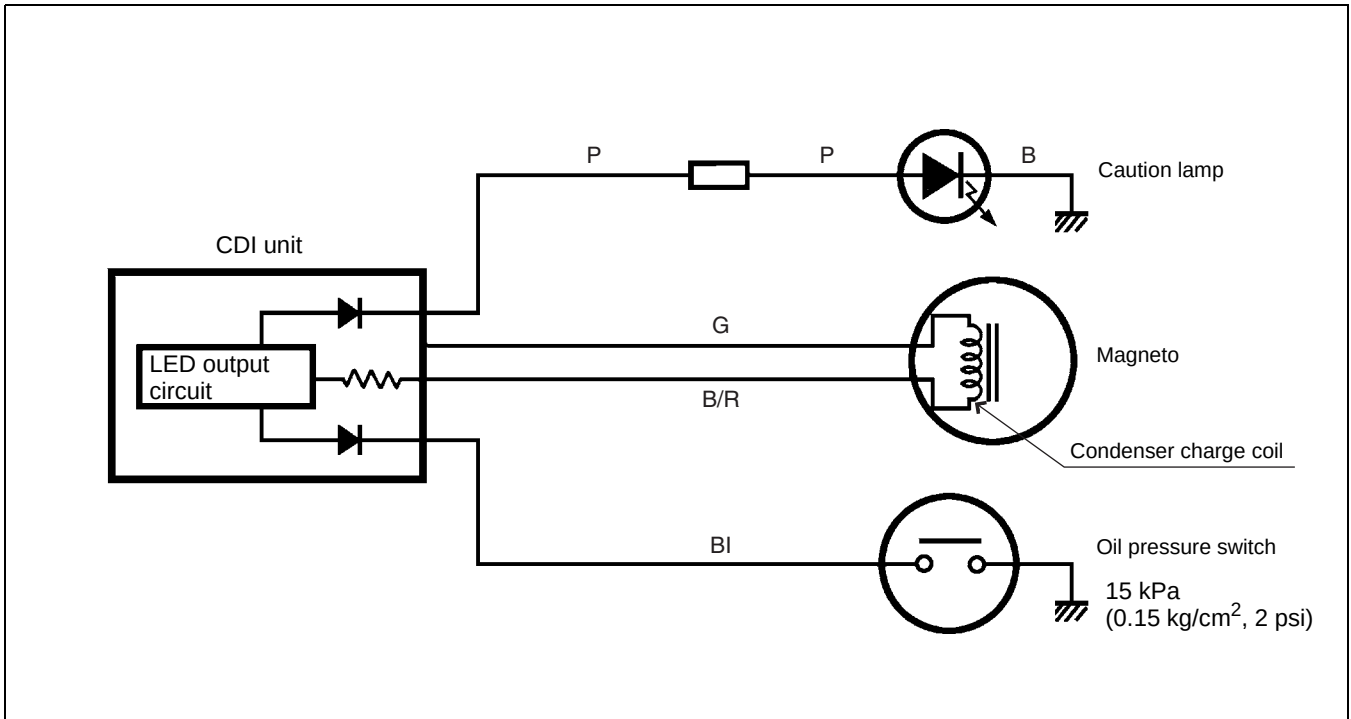
The CDI unit engages the over-revolution limiter above 6500 RPM.

- If the operator decreases engine speed to less than approximately 6200 RPM within 10 seconds, the over-revolution caution control will be cancelled.
- If the engine is operated at a speed above 6500 RPM for more than 10 seconds, the engine speed will be automatically lowered to approximately 300 RPM by intermittent ignition.
- During operation of the over-revolution caution control, the caution lamp is ON.

To cancel the over-revolution caution control, close the throttle to reduce engine speed below approximately 2500 RPM for more than one second.

IMPORTANT: In NEUTRAL, the over-revolution caution system activates at 4000 RPM and the caution lamp does not light. To cancel the neutral rev-limiter, close throttle completely for more than one second.

Low Oil Pressure Caution System



The oil pressure switch activates the low oil pressure caution system when engine oil pressure drops below 2 psi (15 kPa).

- Caution lamp turns ON
- Buzzer sounds (remote models)
- Engine speed is reduced to approximately 2000 RPM through intermittent ignition signals.

To cancel the low oil pressure caution warning:

- Stop engine and check engine oil level. Refill to correct level.
- The caution system is reset when oil pressure reaches 2 psi (15 kPa), over 1500 RPM, for 1.5 seconds.

If the engine oil level is correct, check for the following:

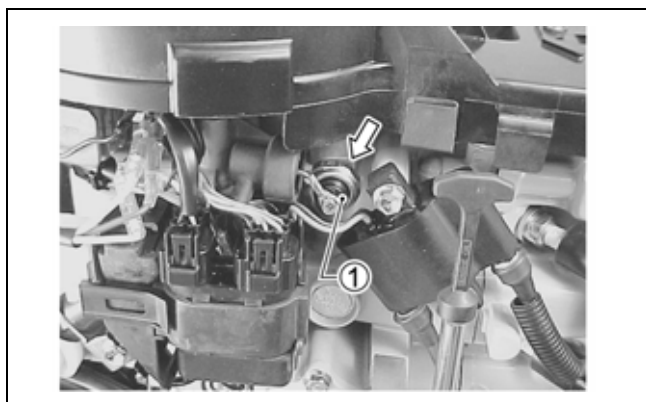
- Improper oil viscosity
- Malfunctioning oil pressure switch
- Clogged oil filter
- Worn oil pump relief valve
- Oil leakage from oil passage
- Excessive wear/damage of oil pump

Oil Pressure Caution System Tests

IMPORTANT: Before checking the oil pressure caution circuit, make sure the engine oil pressure is within specification.

Oil Pressure Switch

Remove the blue lead wire from the oil pressure switch.

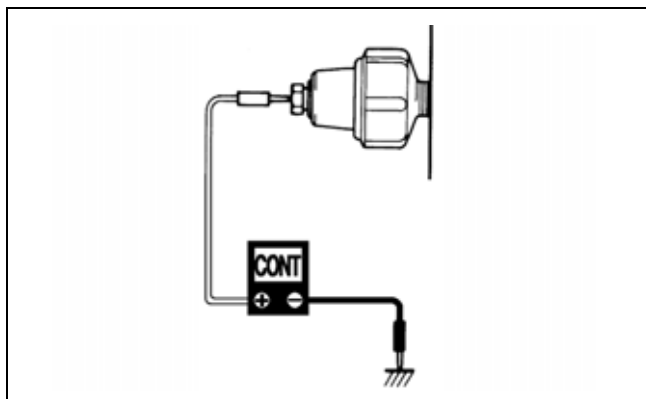


1. Oil pressure switch

004715

Check the continuity between switch terminal and engine ground.

Engine running	No Continuity
Engine stopped	Continuity



004716

Oil Pressure Caution Lamp Circuit

Remove the blue lead wire from the oil pressure switch.

Start the engine.

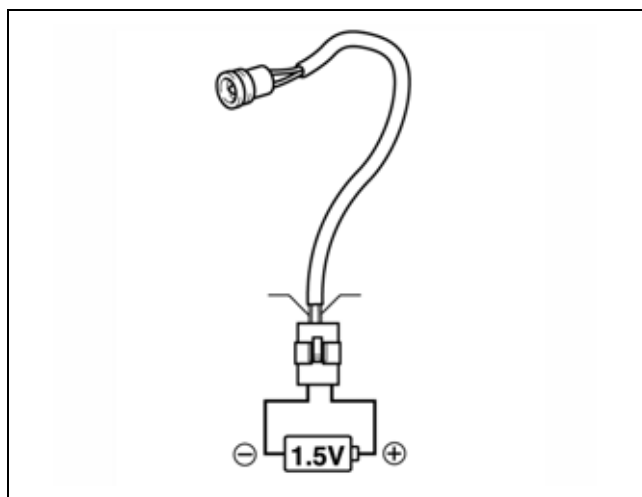
Touch the blue lead wire to engine ground. If the caution lamp comes on, the oil pressure switch circuit and lamp are normal.

Caution Lamp

Disconnect lamp lead wires from engine harness.

Connect the wires to a 1.5 V battery.

If lamp does not light, replace lamp.



004717

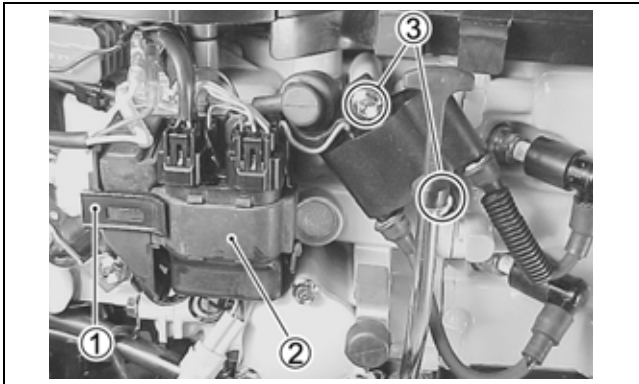
Oil Pressure Switch Service

Removal

Remove CDI stopper plate by sliding it upward.

Remove CDI unit from electrical parts holder.

Remove the two screws securing ignition coil.

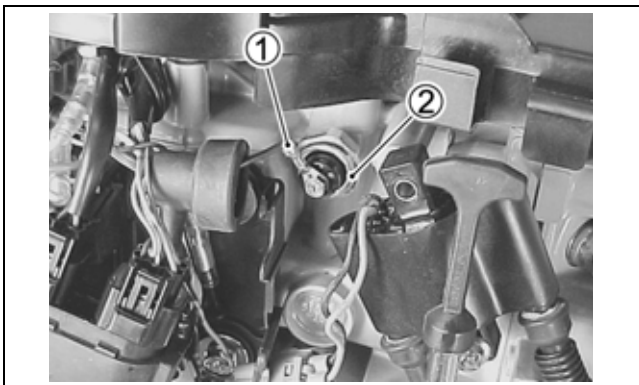


1. Stopper plate
2. CDI unit
3. Ignition coil screws

004476

Loosen screw and disconnect blue lead wire from oil pressure switch.

Remove the oil pressure switch.



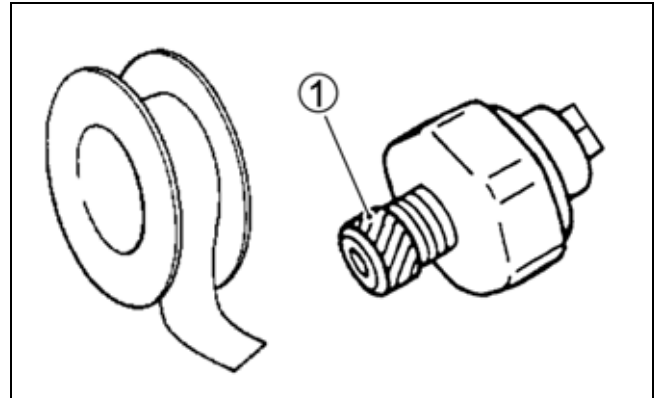
1. Blue lead wire
2. Oil pressure switch

004477

Installation

Installation is reverse order of removal with special attention to the following steps:

Before installing oil pressure switch, wrap threads with sealing tape.



DRC4155

Tighten switch to 114 in. lbs. (13 N·m).

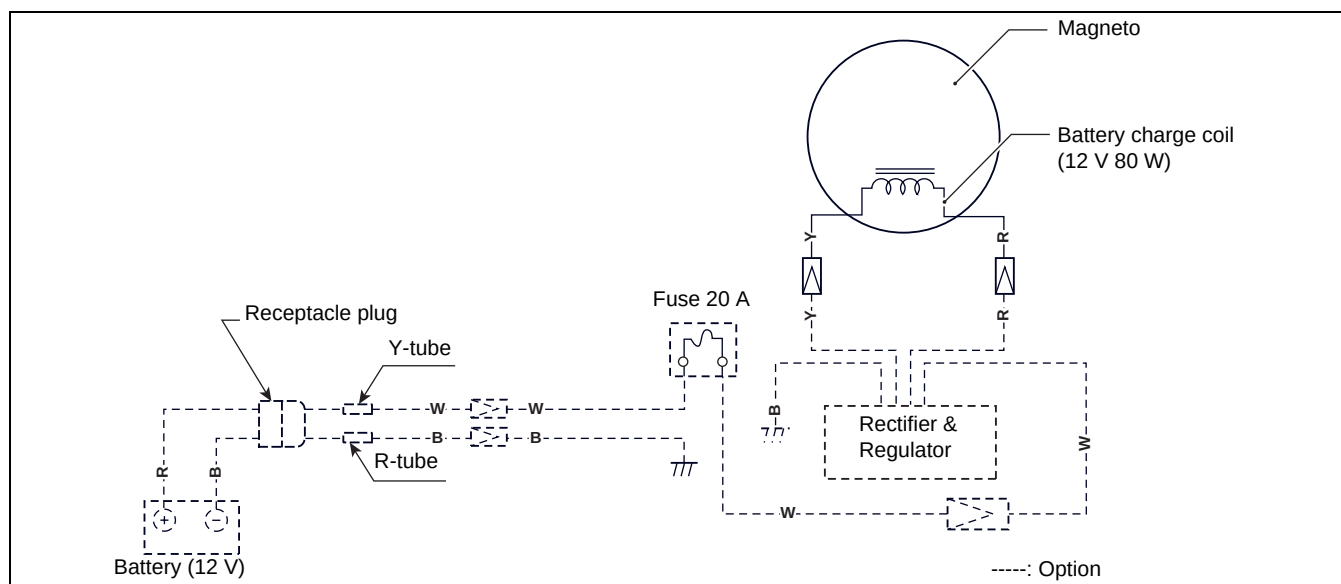
Start engine and check for oil leaks.

BATTERY CHARGING SYSTEM

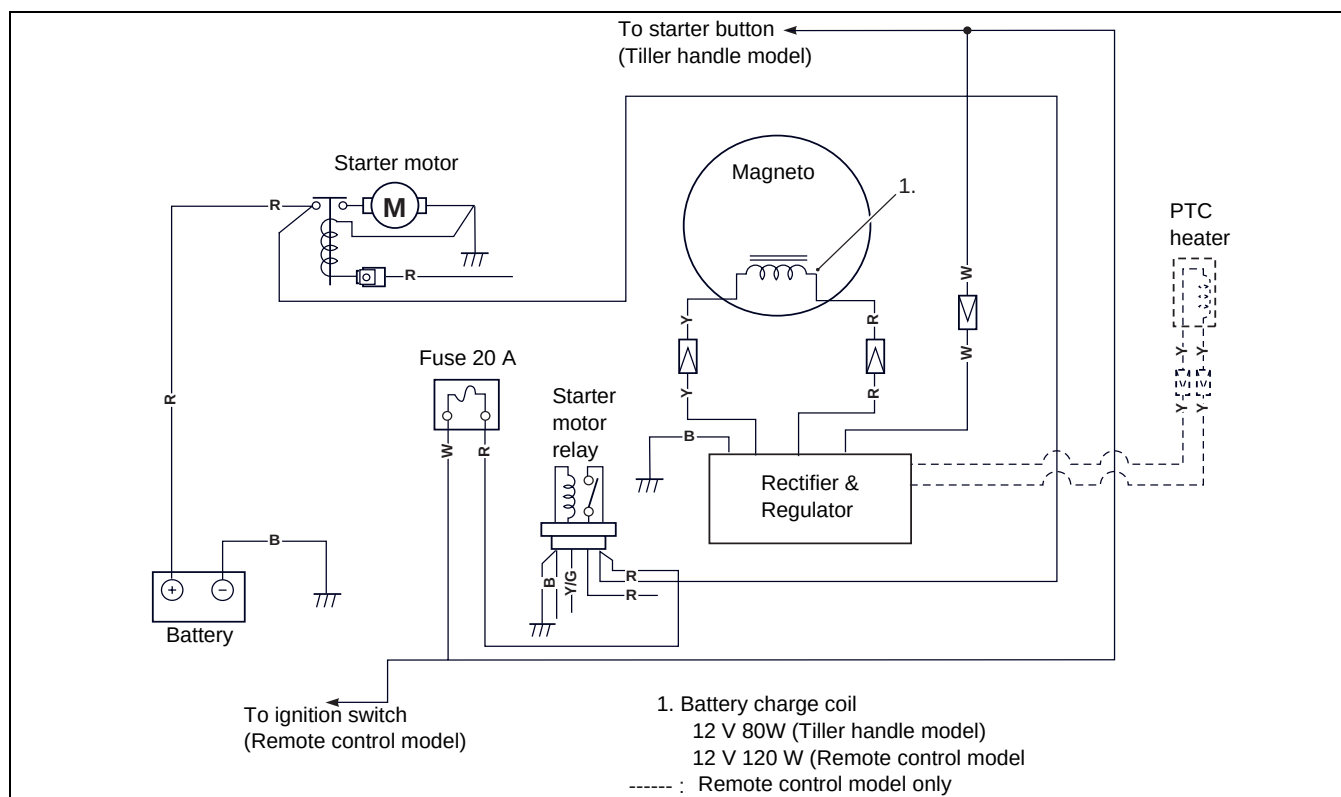
The battery charging system includes the battery charge coil, rectifier/regulator, and battery.

AC current generated by the battery charge coil is converted by the rectifier into regulated DC current which is used to charge the battery.

Manual start models



Electric start models



Inspection

Battery Charge Coil Output

Disconnect battery charge coil wires from rectifier.

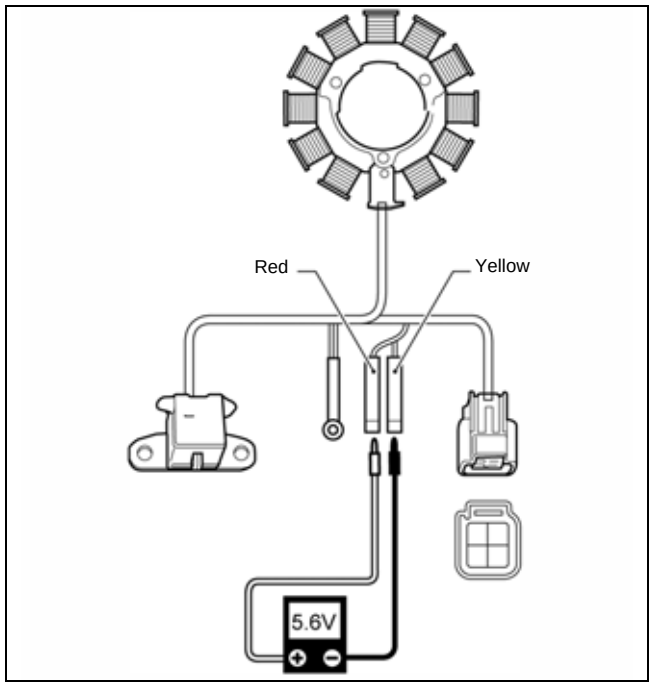
Connect Peak Reading Voltmeter to battery charge coil lead wires as shown.

Tester probe connection	
+ (Red)	- (Black)
Red	Yellow

Remove spark plugs. Crank with recoil starter.

Battery charge coil output:

- 5.6 V or over



004719

If measurement is out of specification, replace the battery charge coil.

Battery Charge Coil Resistance

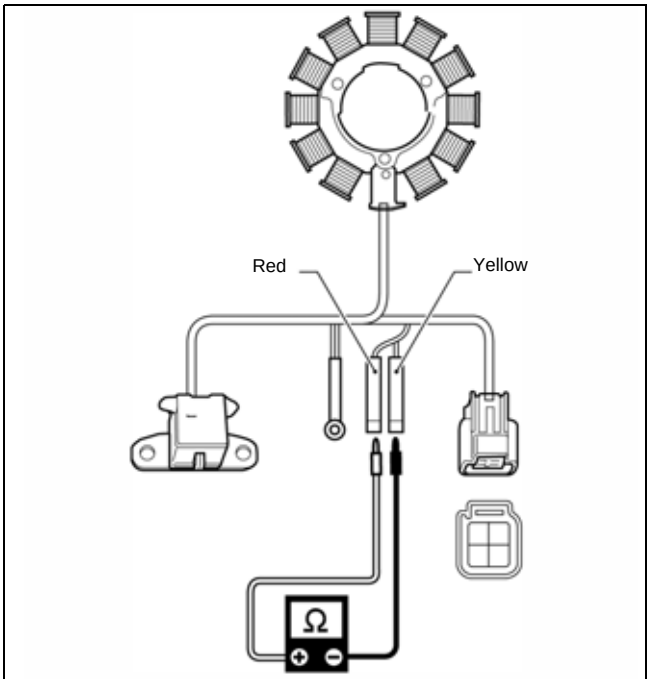
Disconnect battery charge coil wires from rectifier.

Connect Ohmmeter test probes to battery charge coil lead wires as shown.

Tester probe connection	
Probe	Other Probe
Red	Yellow

Battery charge coil resistance:

- 0.9 to 1.3 Ω (80 W coil)
- 0.3 to 0.44 Ω (120 W coil)



004720

If measurement is out of specification, replace the battery charge coil.

ELECTRICAL

BATTERY CHARGING SYSTEM

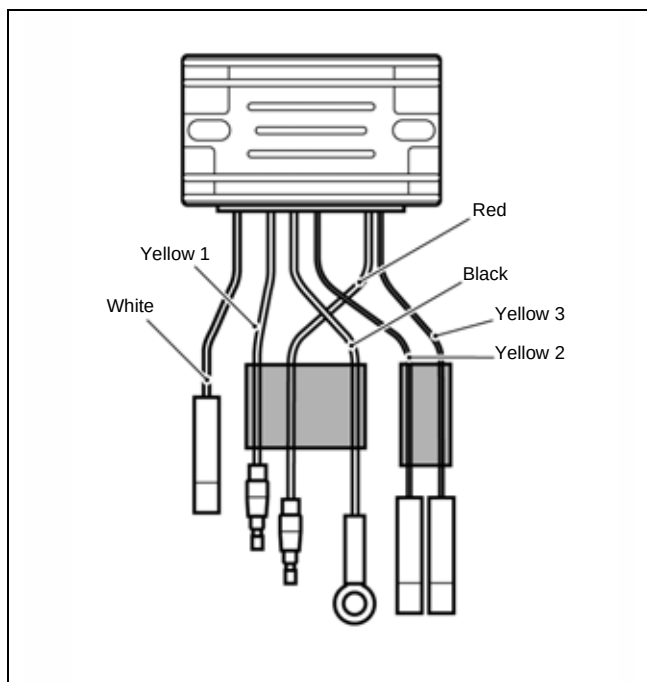
Rectifier and Regulator

Disconnect all lead wires of rectifier and regulator.

Measure the resistance between leads in the combinations shown:

Remote control models Unit: Approx. k Ω

Tester probe - (Black)	Tester probe + (Red)					
	Black	White	Yellow 1	Red	Yellow 2	Yellow 3
	Black	7 – 11	2 – 4	2 – 4	2 – 3	7 – 11
	White	∞	∞	∞	∞	0
	Yellow 1	160 – 240	2 – 4	400 – 600	400 – 600	2 – 4
	Red	160 – 240	2 – 4	400 – 600	400 – 600	2 – 4
	Yellow 2	∞	∞	∞	∞	∞
	Yellow 3	∞	0	∞	∞	∞



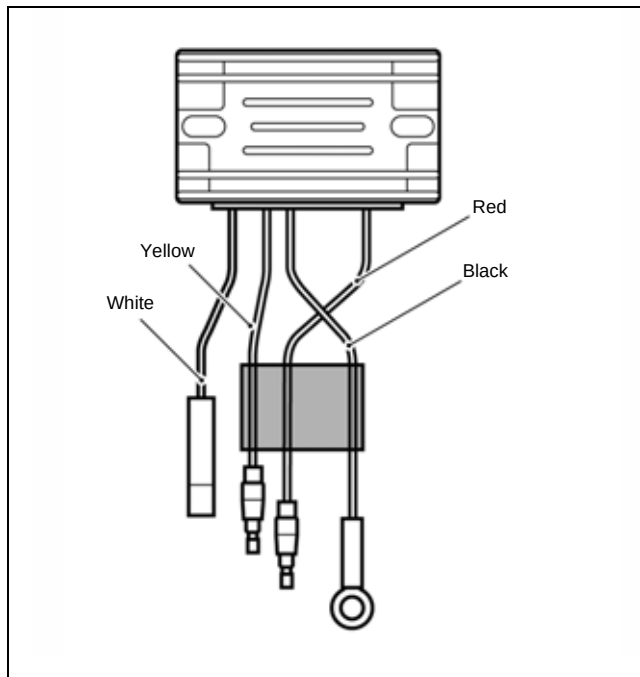
004721

If measurement is out of specification, replace the rectifier and regulator.

Tiller models

Unit: Approx. k Ω

Tester probe - (Black)	Tester probe + (Red)			
	Black	White	Yellow	Red
	Black	7 – 11	2 – 4	2 – 4
	White	∞	∞	∞
	Yellow	∞	2 – 4	∞
	Red	∞	2 – 4	∞



004722

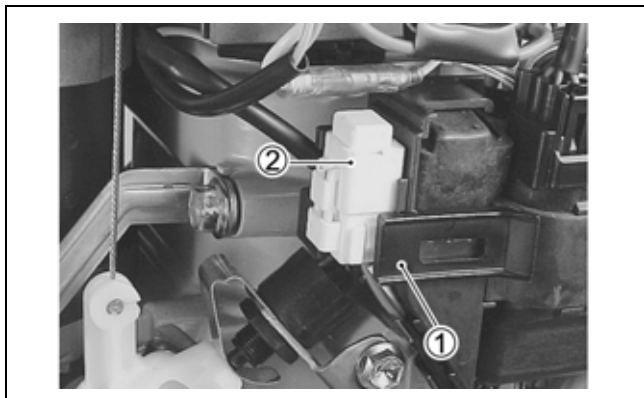
If measurement is out of specification, replace the rectifier and regulator.

Fuse

Remove plate by sliding it upward.

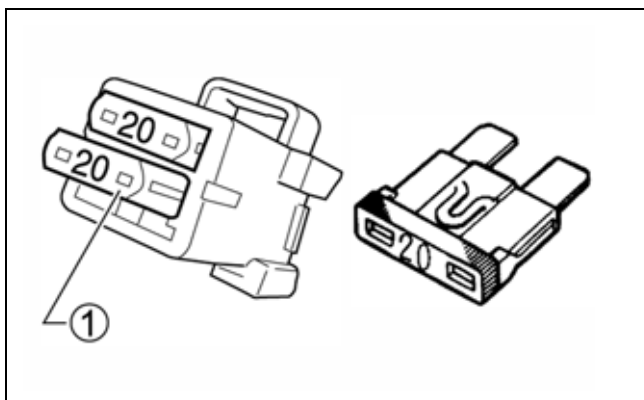
Remove the fuse from fuse case.

Inspect the fuse and replace with a new 20-amp fuse if needed.



1. Plate
2. Fuse case

004723



1. Fuse

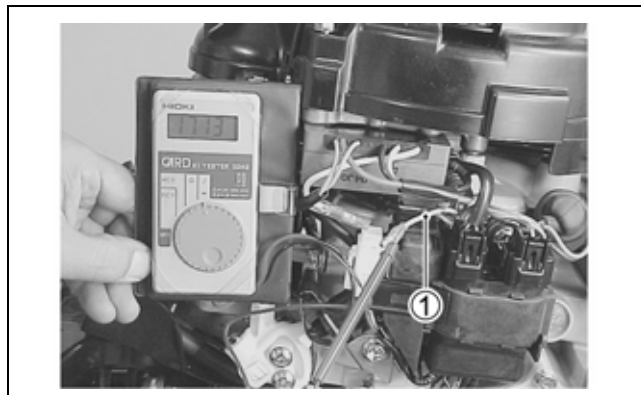
004724

Fuse Case

Disconnect battery cables at the battery.

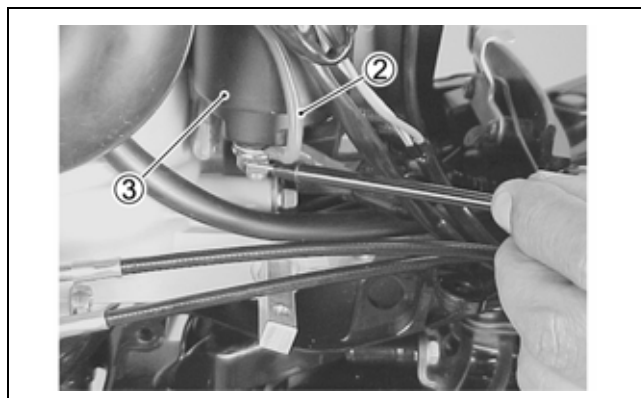
Disconnect white lead wire of rectifier from engine wire harness.

Check continuity between white lead wire of engine wire harness and red lead wire of starter motor magnetic switch "B" terminal.



1. White rectifier lead

004725



1. Red magnetic switch lead
2. Starter magnetic switch

004726

If no continuity is indicated, replace engine wire harness and/or fuse.

ELECTRICAL

BATTERY CHARGING SYSTEM

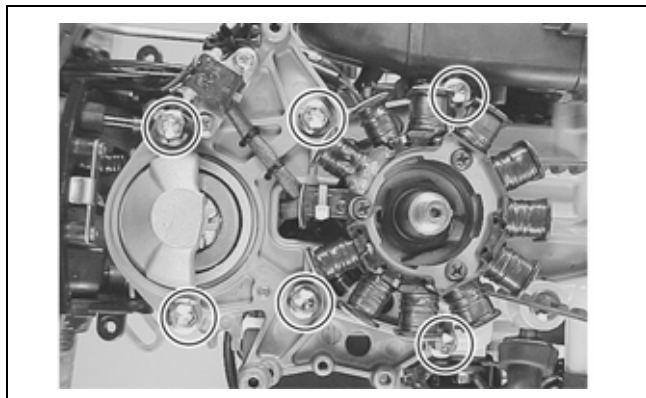
Removal and Installation

Before removing electrical parts:

- Disconnect battery cables at the battery.
- Twist and remove all spark plug leads.

Battery and Condenser Charge Coil

Remove flywheel, stator base, and battery charge coil. Refer to **COMPONENT SERVICING** on p. 101.



004728

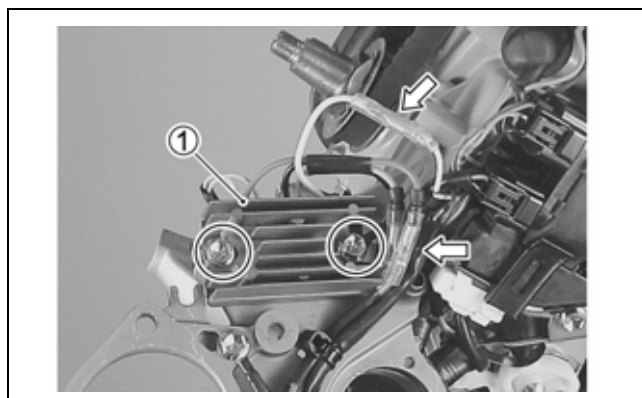
Rectifier and Regulator

Remove the screws securing stator base. Refer to **COMPONENT SERVICING** on p. 101.

Lift stator base from cylinder block and lay it on port side.

Remove the screws securing the rectifier and regulator.

Disconnect lead wire connectors.



1. Rectifier/regulator

004729

Installation

Installation is reverse order of removal with special attention to the following steps:

Check wire routing. Refer to **WIRE ROUTING** on p. 229.

ELECTRIC STARTER SYSTEM

Operation

The starting circuit includes the battery, starting motor, ignition switch (or starter button), neutral switch, and related wiring.

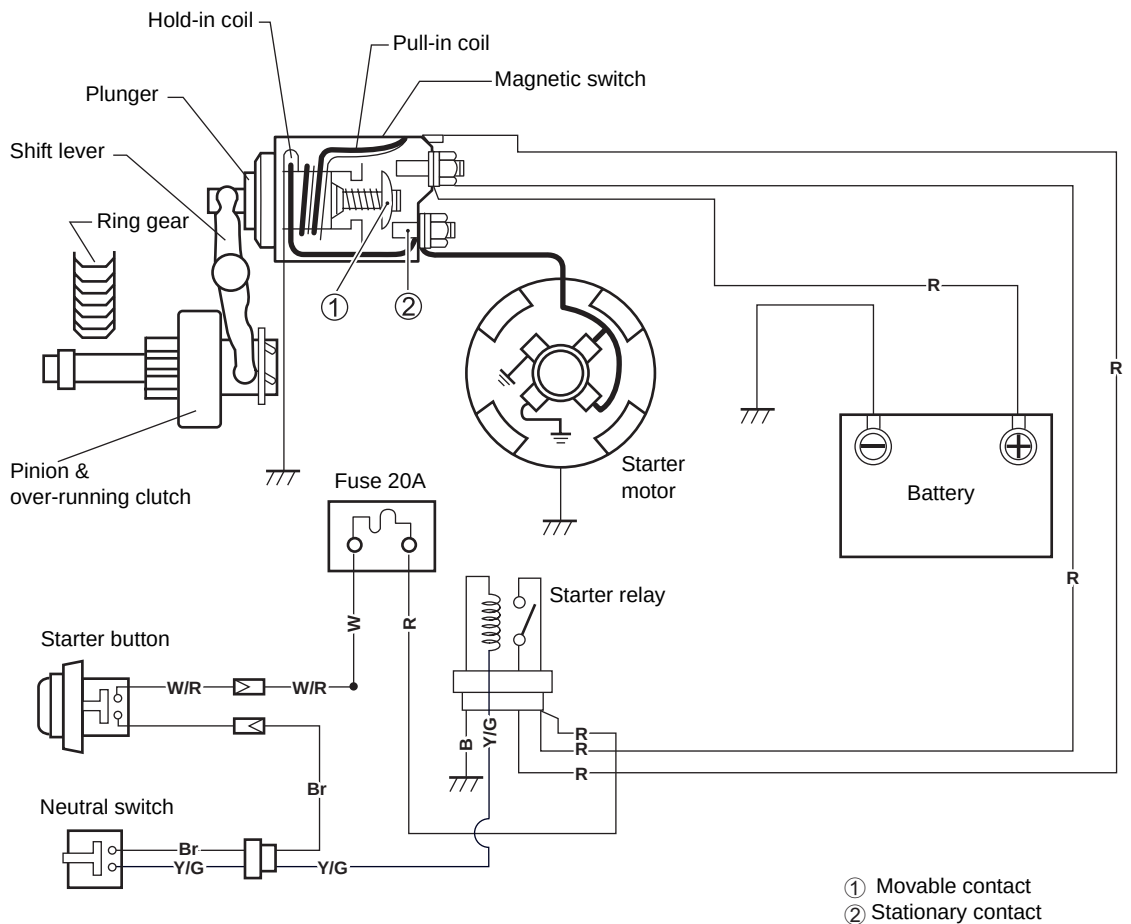
The starter motor magnetic switch coils are magnetized when the starter button is closed.

The resulting plunger and pinion shift lever movement causes the pinion to engage the engine flywheel gear, the magnetic switch main contacts to close, and engine cranking to take place.

When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the starter button is opened, at which time the torsion spring causes the pinion to disengage.

4

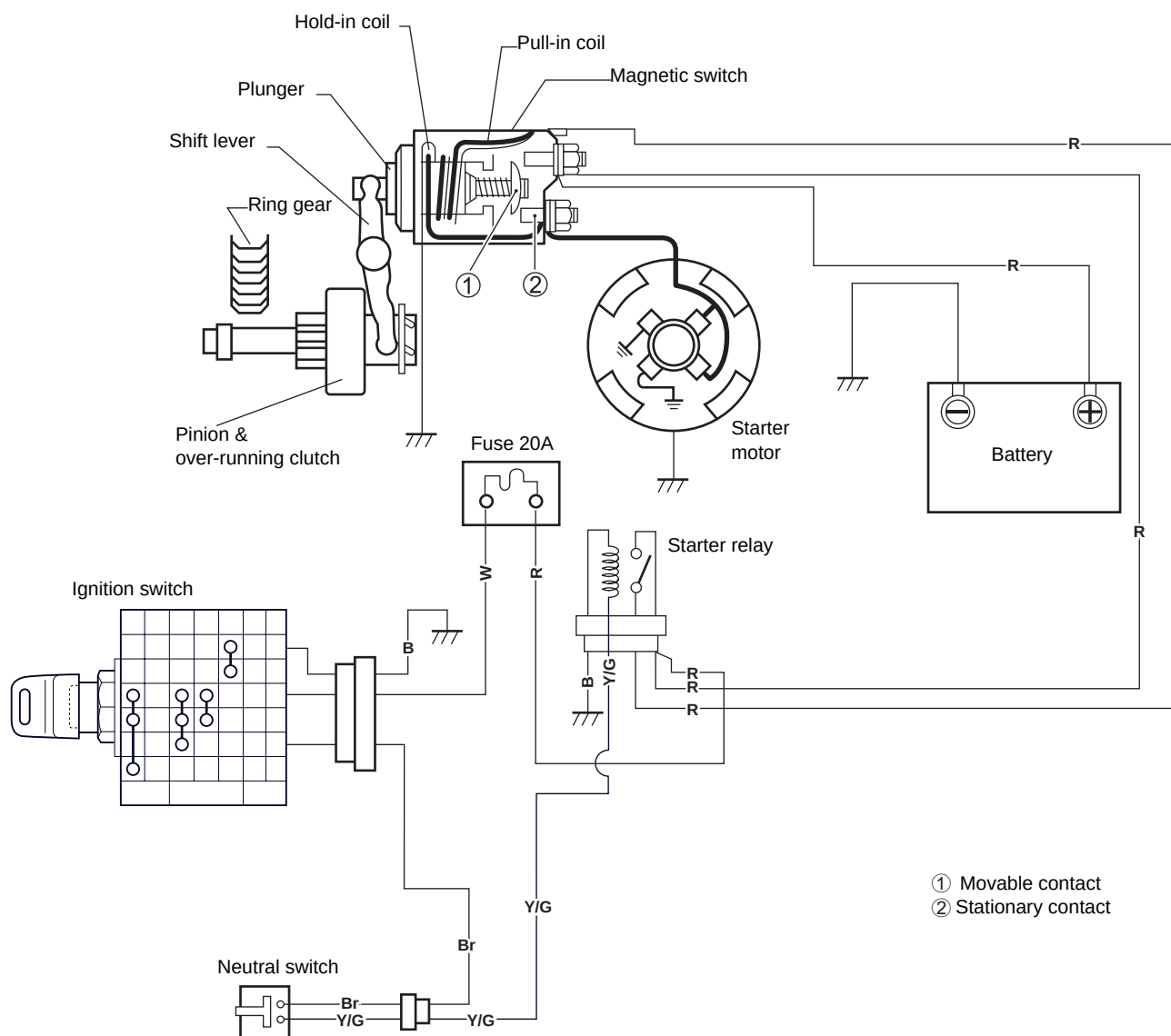
Tiller Models



ELECTRICAL

ELECTRIC STARTER SYSTEM

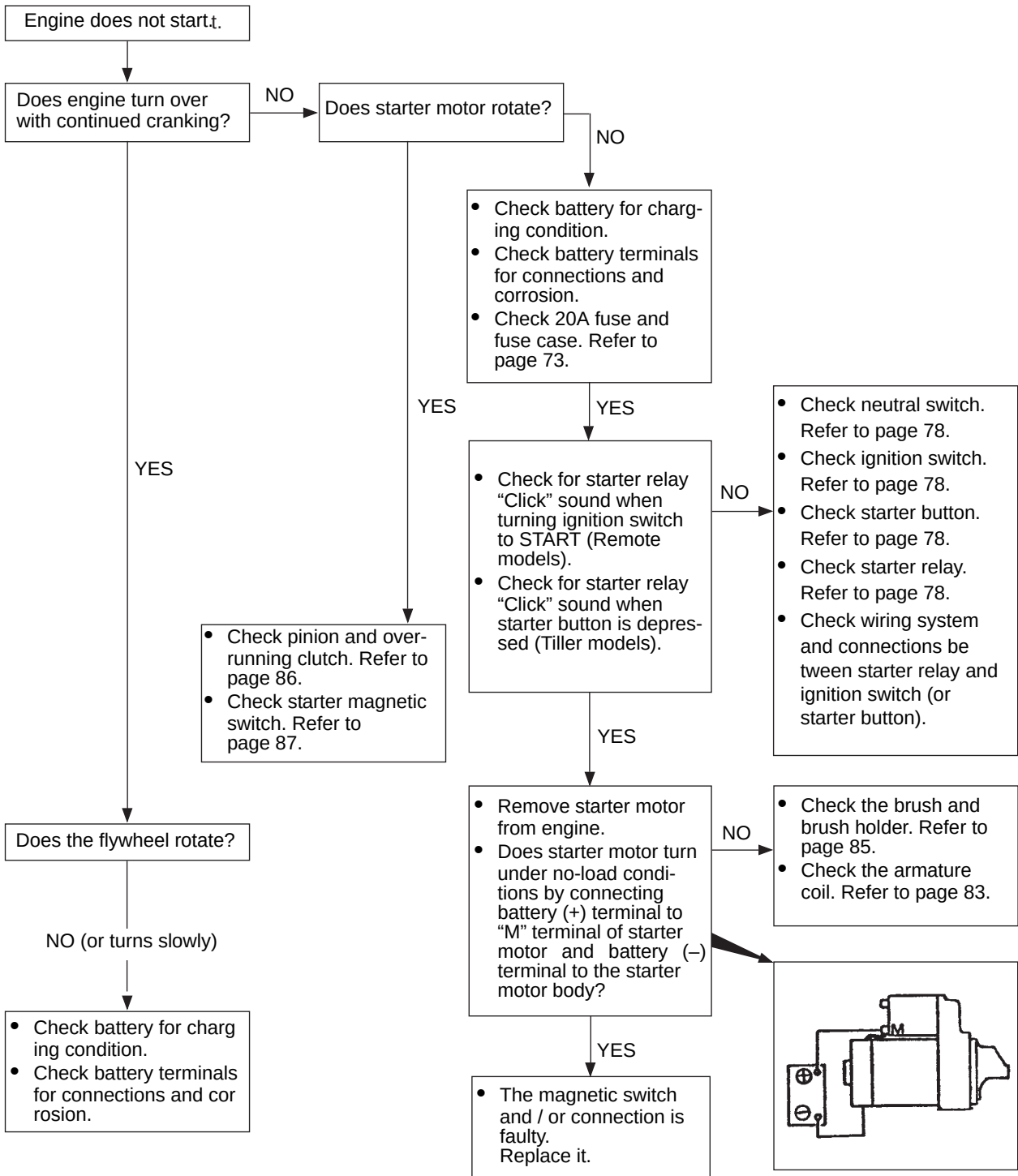
Tiller Models



Troubleshooting

Before troubleshooting the electric starter system, make sure:

- Battery is fully charged
- All cables and wires are securely connected
- Shift is in NEUTRAL position.



ELECTRICAL

ELECTRIC STARTER SYSTEM

Inspection

Ignition Switch (Remote Models)

Disconnect the ignition switch from remote control wiring harness.

Check continuity between switch terminals at the key positions shown:

Key Position	Switch Terminals					
	M	M	B	A	S	C
OFF	○	○				
ON			○	○		
START			○	○	○	
PUSH			○	○		○

○ — ○ : Continuity

If out of specification, replace the ignition switch.

Starter Button (Tiller Models)

Disconnect the starter button lead wire.

Check continuity between the wiring leads under the conditions shown:

	Tester probe connection		Continuity
	Probe	Other Probe	
Starter button not depressed	White/Red	Brown	No
Starter button depressed			Yes

If out of specification, replace the starter button.

Neutral Switch

Disconnect neutral switch lead wire.

Check continuity between lead wires while operating the shift lever of remote control.

Shift position	Continuity
Neutral	Yes
Forward	No
Reverse	No

If out of specification:

- Check switch position adjustment.
- Replace neutral switch.

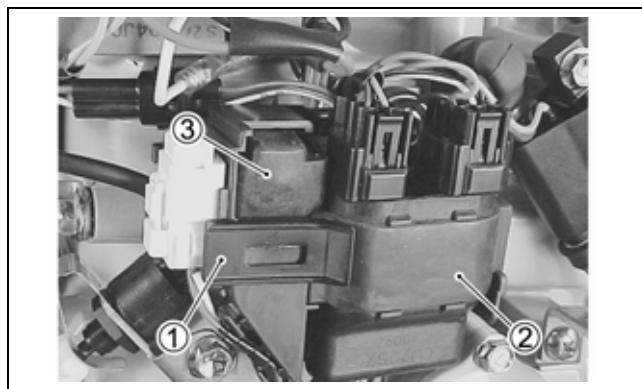
IMPORTANT: After installing neutral switch, check for proper function.

Starter Motor Relay

Remove plate by sliding it upward.

Remove CDI unit.

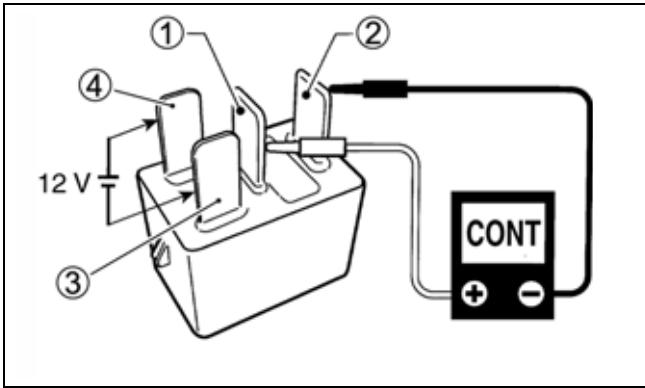
Pull out relay from electric parts holder, then disconnect starter motor relay from wire.



1. Plate
2. CDI unit
3. Starter relay

004730

Connect 12V positive (+) to terminal (4), and (–) to terminal (3). Then, check continuity between terminal (1) and (2) when 12 V is applied.

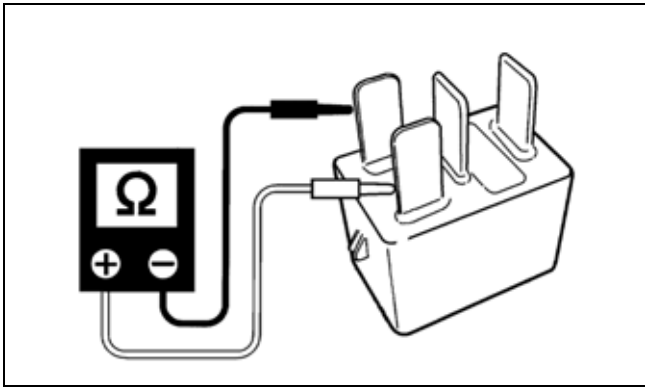


12 V Power	Continuity
Applied	Yes
Not Applied	No

Measure resistance between relay terminals (3) and (4).

Starter motor relay solenoid coil resistance:

- 145 to 190 Ω



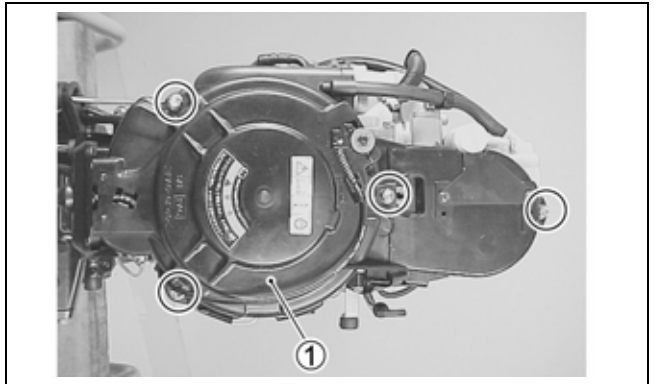
If any of the above measurements are out of specification, replace starter motor relay.

Starter Motor Service

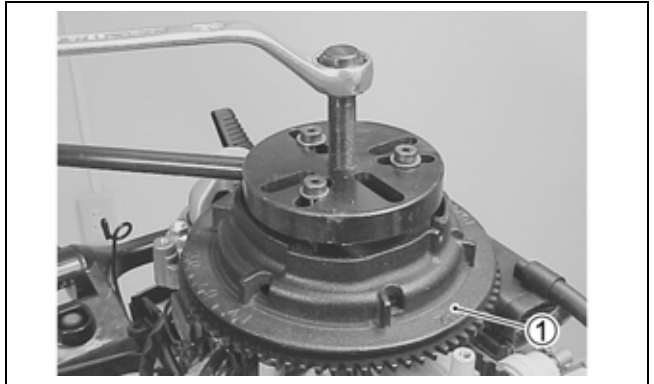
Removal

Remove engine side covers. Refer to side cover **Removal and Installation** on p. 180.

Remove recoil starter. Refer to manual starter **REMOVAL** on p. 219.



Remove flywheel. Refer to component **Removal** on p. 101.

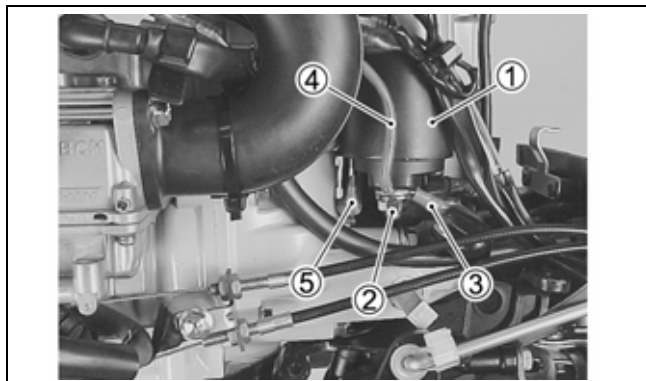


Remove nut, positive (+) battery cable, and positive (+) battery charge cable from the magnetic switch “B” terminal of starter motor.

ELECTRICAL

ELECTRIC STARTER SYSTEM

Disconnect red lead wire from starter motor magnetic switch "S" terminal.

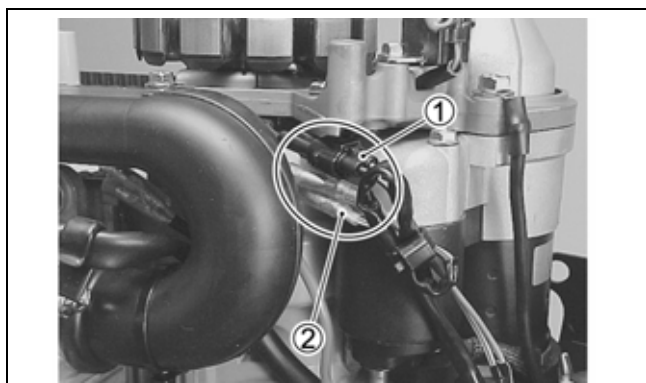


1. Magnetic switch
2. Nut
3. Battery cable
4. Battery charge cable
5. "S" terminal red lead

004735

Disconnect engine stop switch lead wire connector.

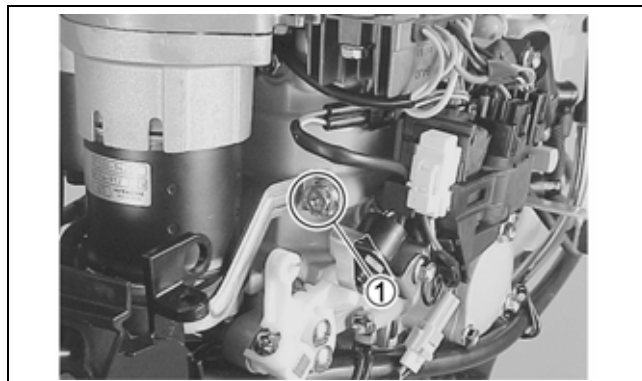
Disconnect starter switch lead wire connector (tiller models).



1. Stop switch connector
2. Starter switch connector

004736

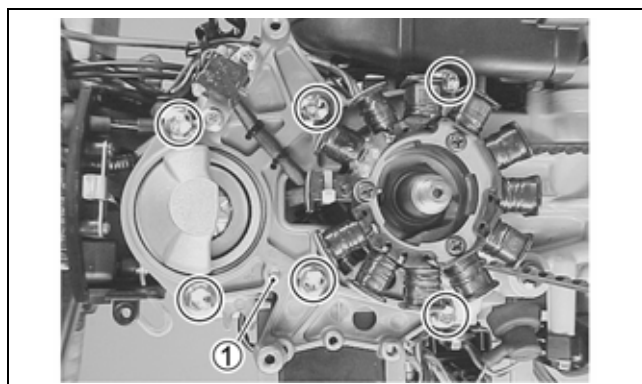
Remove the PORT side screw securing starter motor band.



1. Starter motor band screw

004737

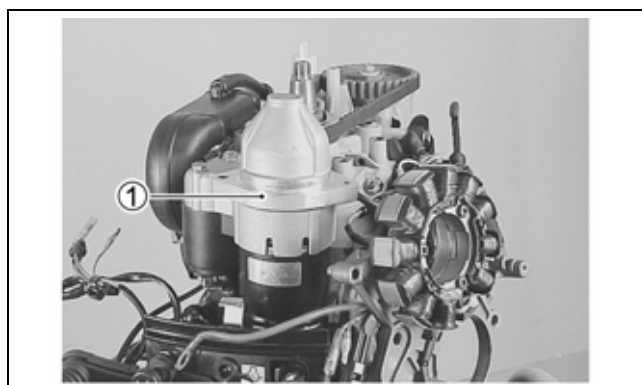
Remove the six screws securing stator base.



1. Stator base

004738

Lift up stator base, then remove starter motor.



1. Starter motor

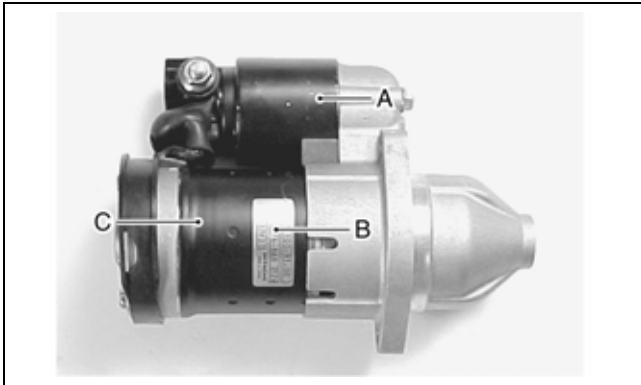
004739

Disassembly

When servicing starter motor, clean component parts thoroughly.

DO NOT use a degreasing tank or grease dissolving solvent on yoke assembly, armature coil, over-running clutch assembly, magnetic switch, or rubber or plastic parts. These parts should be cleaned with compressed air or wiped with a clean cloth.

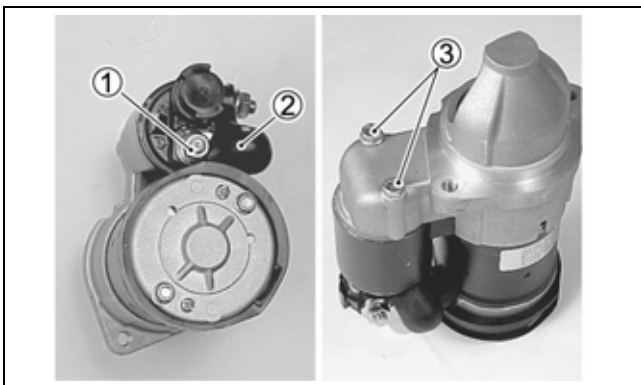
IMPORTANT: Before disassembling starter motor, put match marks at three locations (A, B, and C) to avoid any possible alignment mistakes.



004741

Remove nut from magnetic switch, then disconnect the connecting wire.

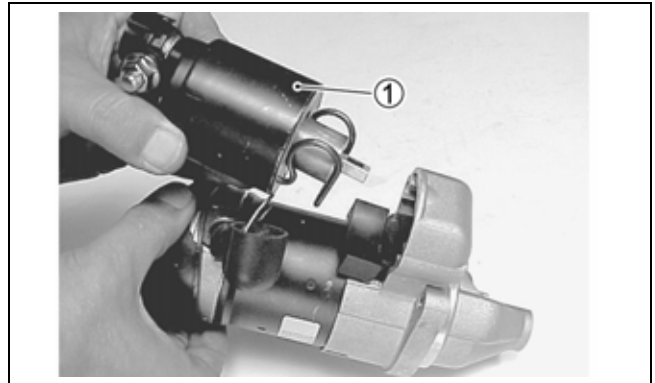
Remove two screws securing magnetic switch.



1. Nut
2. Connecting wire
3. Magnetic switch screws

004742

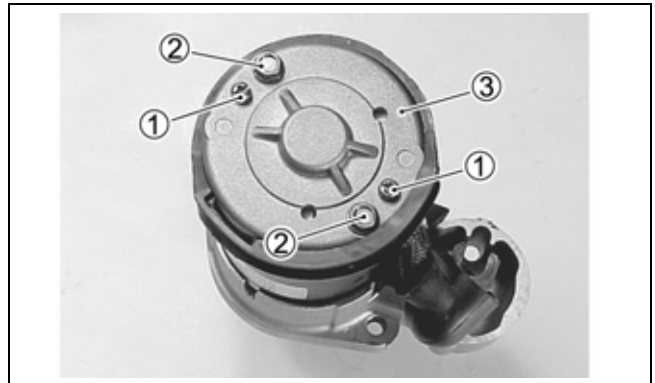
Remove the magnetic switch.



1. Magnetic switch

004743

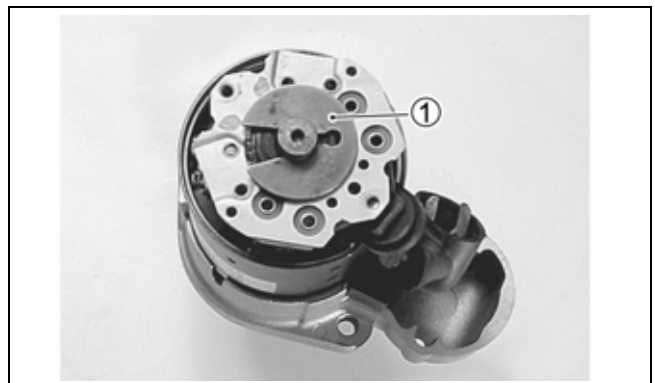
Remove screws, long through bolts, and rear cover.



1. Rear cover screws
2. Through bolts
3. Rear cover

004744

Remove thrust washer with screwdriver.



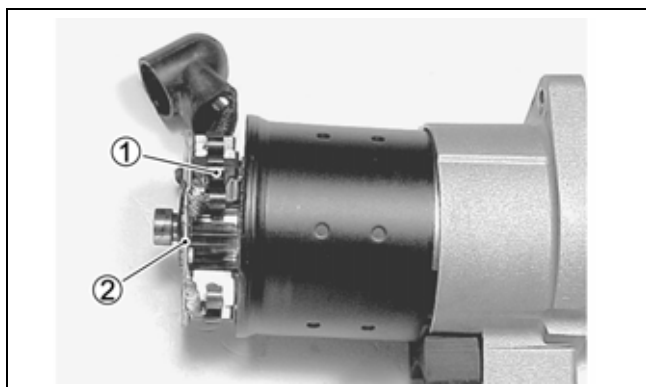
1. Thrust washer

004745

ELECTRICAL

ELECTRIC STARTER SYSTEM

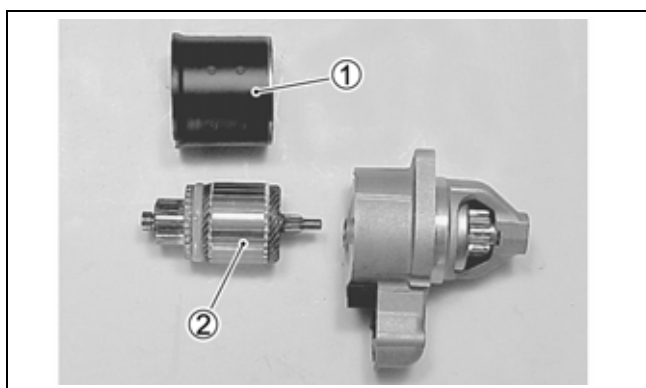
Pull the brush spring up to separate the brush from the surface of the commutator, then remove the brush holder.



1. Brush spring
2. Brush holder

004746

Remove the yoke and armature.

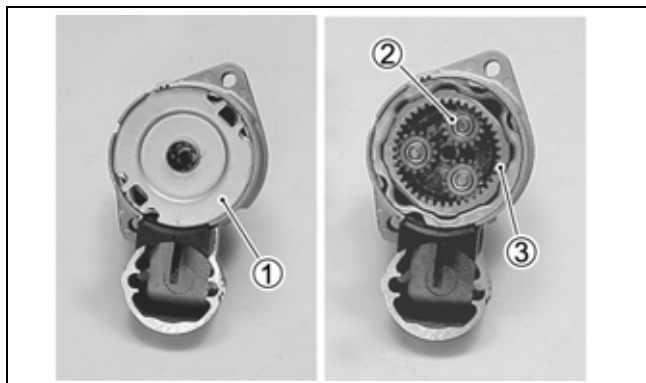


1. Yoke
2. Armature

004747

Remove the center cover plate.

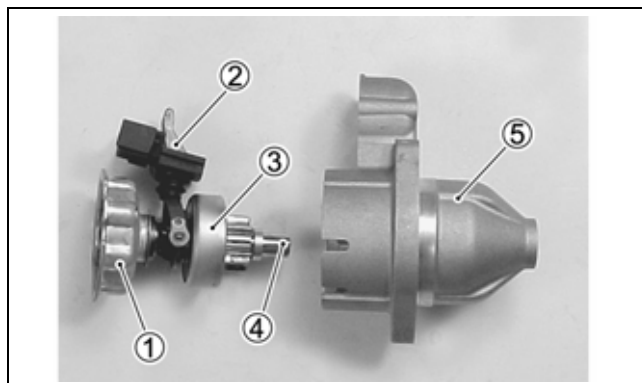
Remove the planetary gears and internal gear.



1. Center cover plate
2. Planetary gears
3. Internal gear

004748

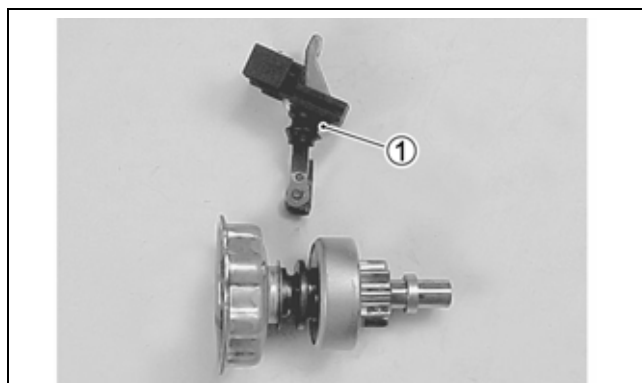
Remove the center bracket, with shift lever, pinion, and pinion shaft, from front housing.



1. Center bracket
2. Shift lever
3. Pinion
4. Pinion shaft
5. Front housing

004749

Remove the shift lever.



1. Shift lever

004750

Push the pinion stopper down, then pry off the stopper ring.

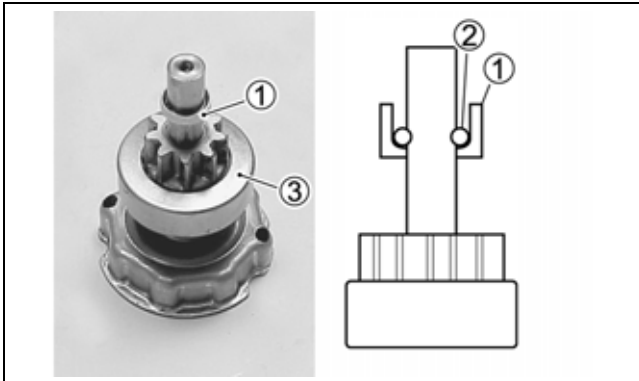
Remove the pinion stopper and pinion.



WARNING



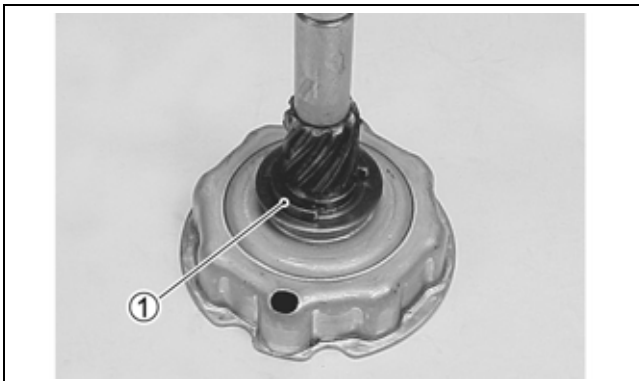
Wear safety glasses when disassembling and assembling stopper ring.



1. Pinion stopper
2. Stopper ring
3. Pinion

004751

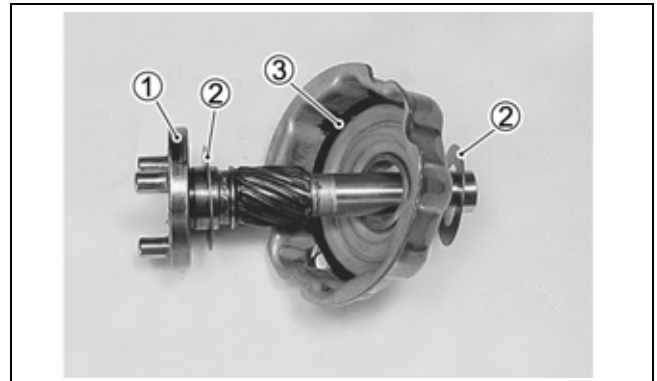
Remove the E-ring.



1. E-ring

004752

Remove the pinion shaft, washers, and rubber ring from center bracket.



1. Pinion shaft
2. Washers
3. Rubber ring

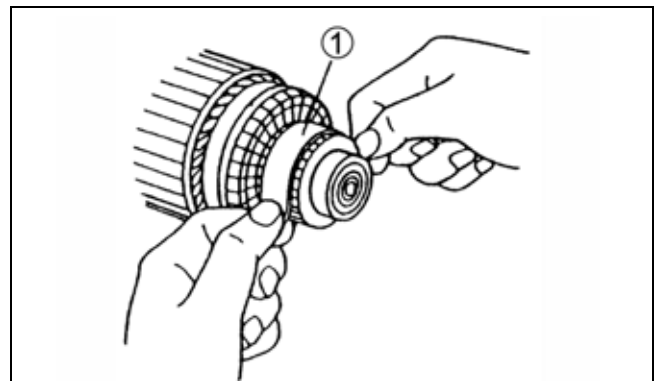
004753

4

Inspection and Servicing

Armature and Commutator

Inspect the commutator surface. If gummy or dirty, clean with #500 grit emery cloth.



1. Commutator

004754

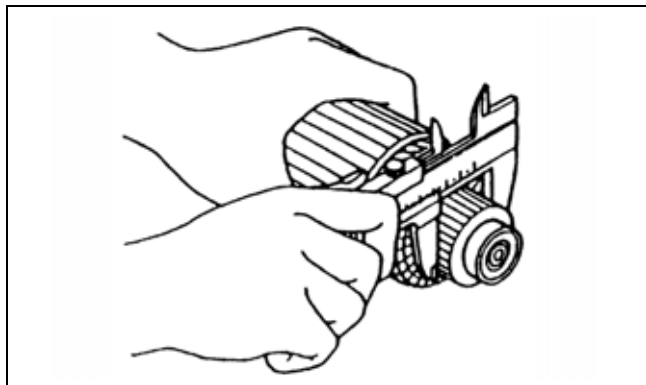
ELECTRICAL

ELECTRIC STARTER SYSTEM

Measure commutator outside diameter.

- Standard: 1.14 in. (29.0 mm)
- Service limit: 1.10 in. (28.0 mm)

If measurement exceeds service limit, replace armature.



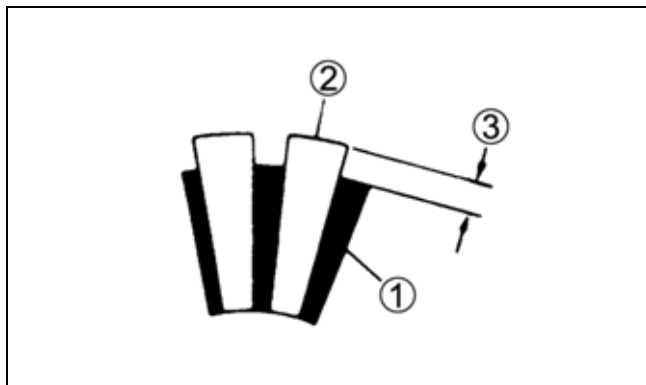
004755

Check that mica (insulator) between the segments is undercut to specified depth.

- Standard: 0.02 to 0.03 in. (0.5 to 0.8 mm)
- Service limit: 0.01 in. (0.2 mm)

If measurement exceeds service limit, cut to specified depth.

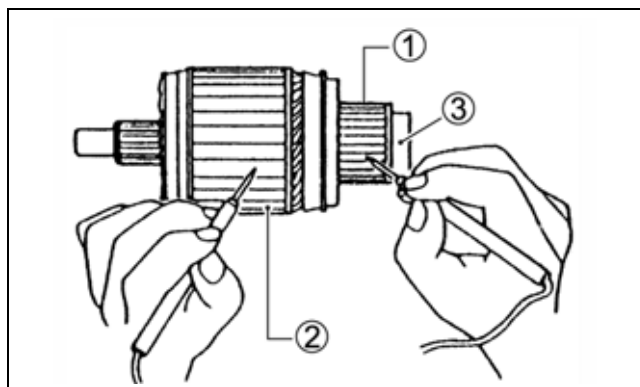
IMPORTANT: Remove all particles of mica and metal with compressed air.



1. Mica
2. Segment
3. Undercut

004756

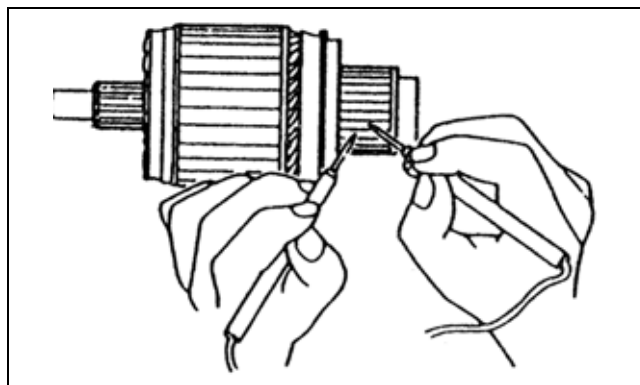
Check for continuity between the commutator and the armature core/shaft. Replace armature if continuity is indicated.



1. Commutator
2. Armature core
3. Armature shaft

004757

Check for continuity between adjacent commutator segments. Replace armature if no continuity is indicated.



004758



WARNING



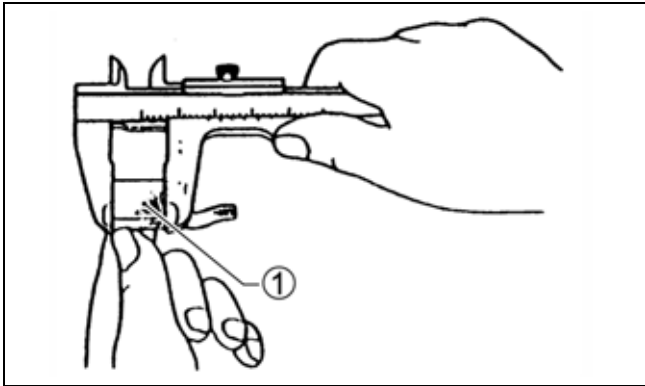
Wear safety glasses when disassembling and assembling stopper ring.

Brushes

Check the length of each brush.

- Standard: 0.61 in. (15.5 mm)
- Service limit: 0.37 in. (9.5 mm)

If brushes are worn to service limit, replace brushes.



1. Brush 004759

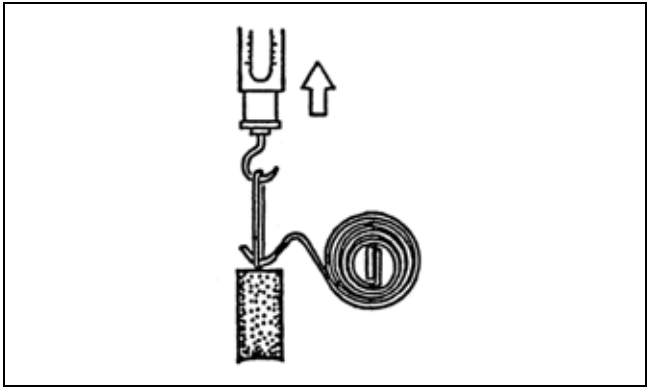
Brush Spring

Inspect brush spring for wear, damage, or other abnormal conditions.

Check the brush spring tension.

- Standard: 3.3 to 4.0 lb. (15 to 18 N)

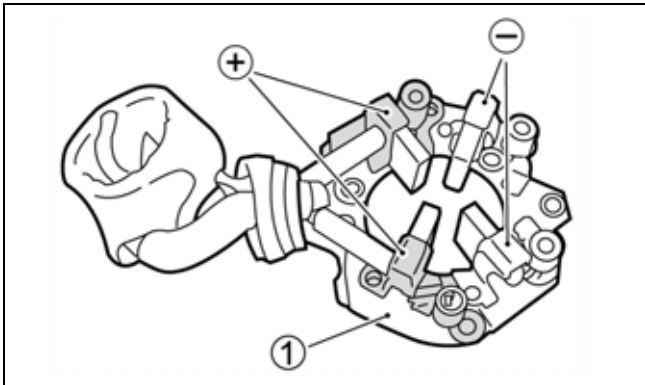
Replace if necessary.



004761

Brush Holder

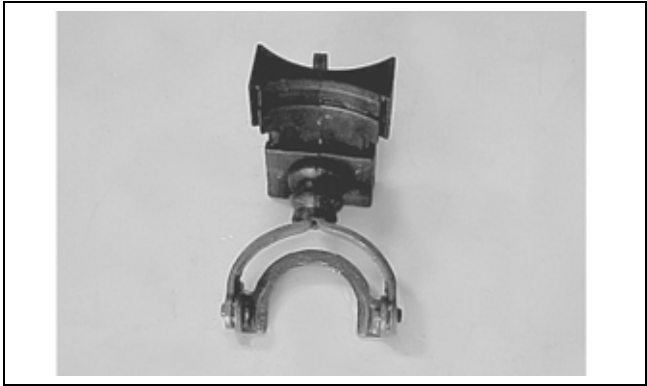
Check brush holder continuity.



1. Base plate 004760

Shift Lever

Inspect shift lever for wear. Replace if necessary



004762

Tester probe connection	Continuity
Brush holder positive (+) to brush holder negative (-)	No
Brush holder positive (+) to base plate (ground)	No

If out of specification, replace the brush holder.

ELECTRICAL

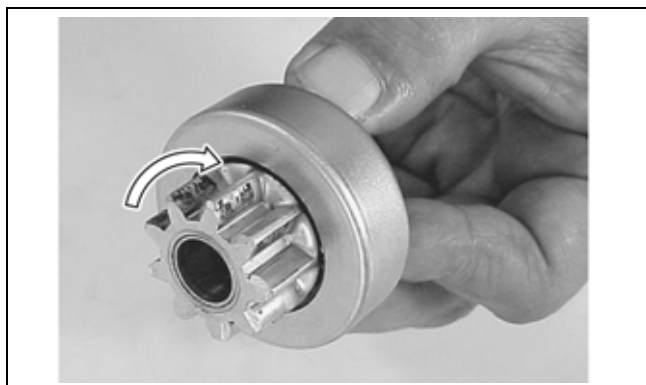
ELECTRIC STARTER SYSTEM

Pinion and Over-Running Clutch

Inspect pinion for wear, damage, or other abnormal conditions.

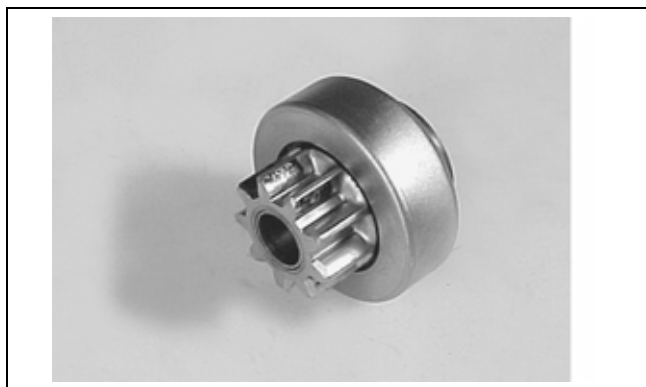
Check that clutch locks when turned in direction of drive and rotates smoothly in reverse direction.

Replace if necessary.



004763

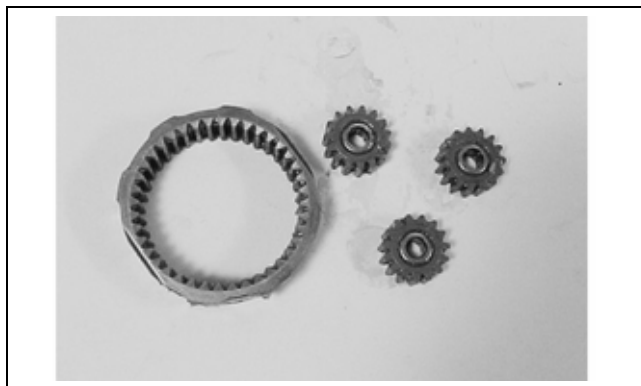
Inspect spline teeth for wear or other damage. Inspect pinion for smooth movement. Replace if necessary.



004764

Gear

Inspect planetary gears and internal gear for wear, damage, or other abnormal conditions. Replace if necessary.

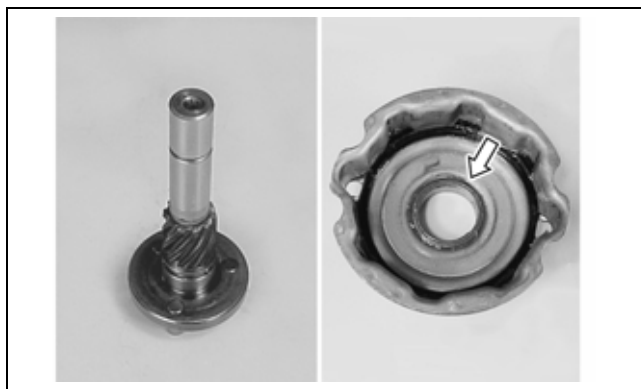


004765

Pinion Shaft/Pinion Shaft Bush

Inspect pinion shaft for wear damage, or other abnormal conditions. Replace if necessary.

Inspect pinion shaft bushing for wear or other damage. Replace if necessary.

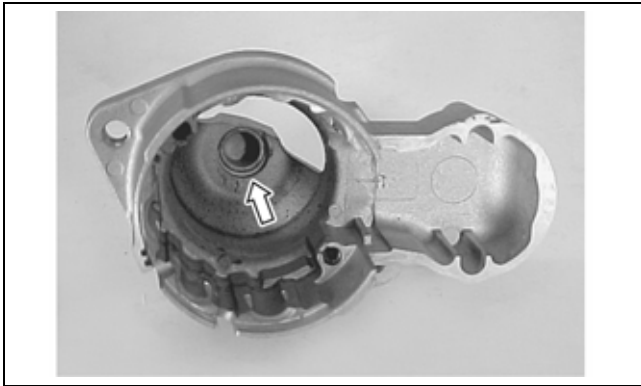


004766

Front Housing

Inspect front housing for wear, damage, or other abnormal conditions. Replace if necessary.

Inspect bushing for wear or other damage. Replace if necessary.



004767

Armature Shaft Bushing

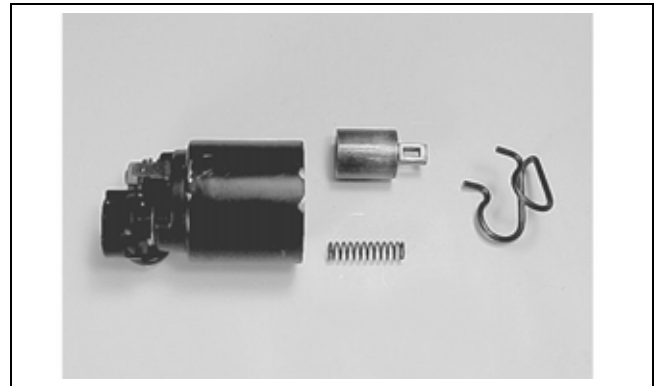
Inspect bushing for wear or other damage. Replace if necessary.



004768

Plunger

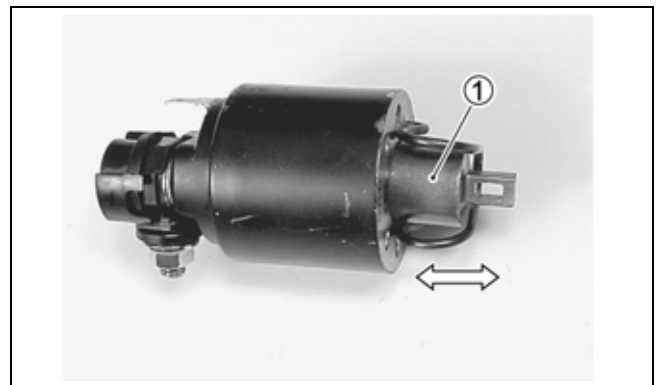
Inspect plunger for wear or other damage. Replace if necessary.



004769

Magnetic Switch

Push in plunger and release. The plunger should return quickly to its original position. Replace if necessary.



1. Plunger

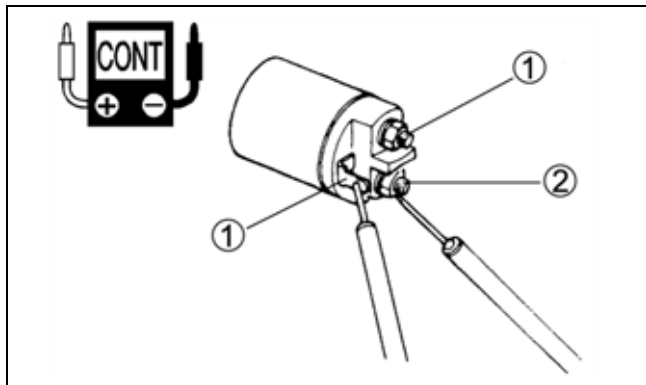
004770

ELECTRICAL

ELECTRIC STARTER SYSTEM

Check for continuity across magnetic switch "S" terminal and "M" terminal.

If no continuity, replace coil.

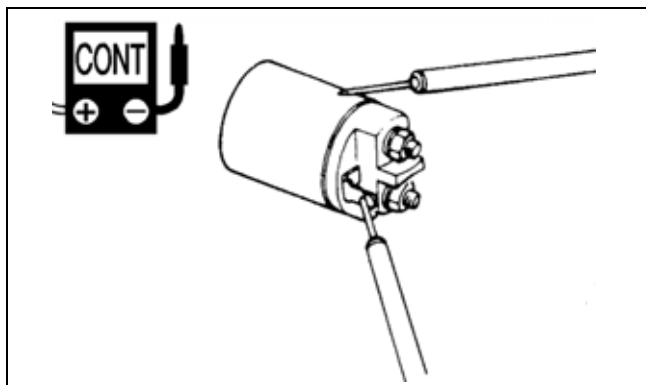


1. "S" terminal
2. "M" terminal
3. "B" terminal

004771

Check for continuity across magnetic switch "S" terminal and coil case.

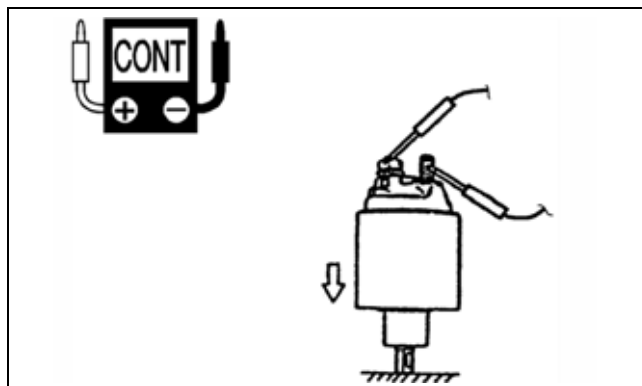
If not continuity, replace coil.



004772

Place plunger against a flat surface and push the magnetic switch down. With switch held down, check for continuity between terminal "B" and terminal "M."

If no continuity, replace the magnetic switch and/or plunger.

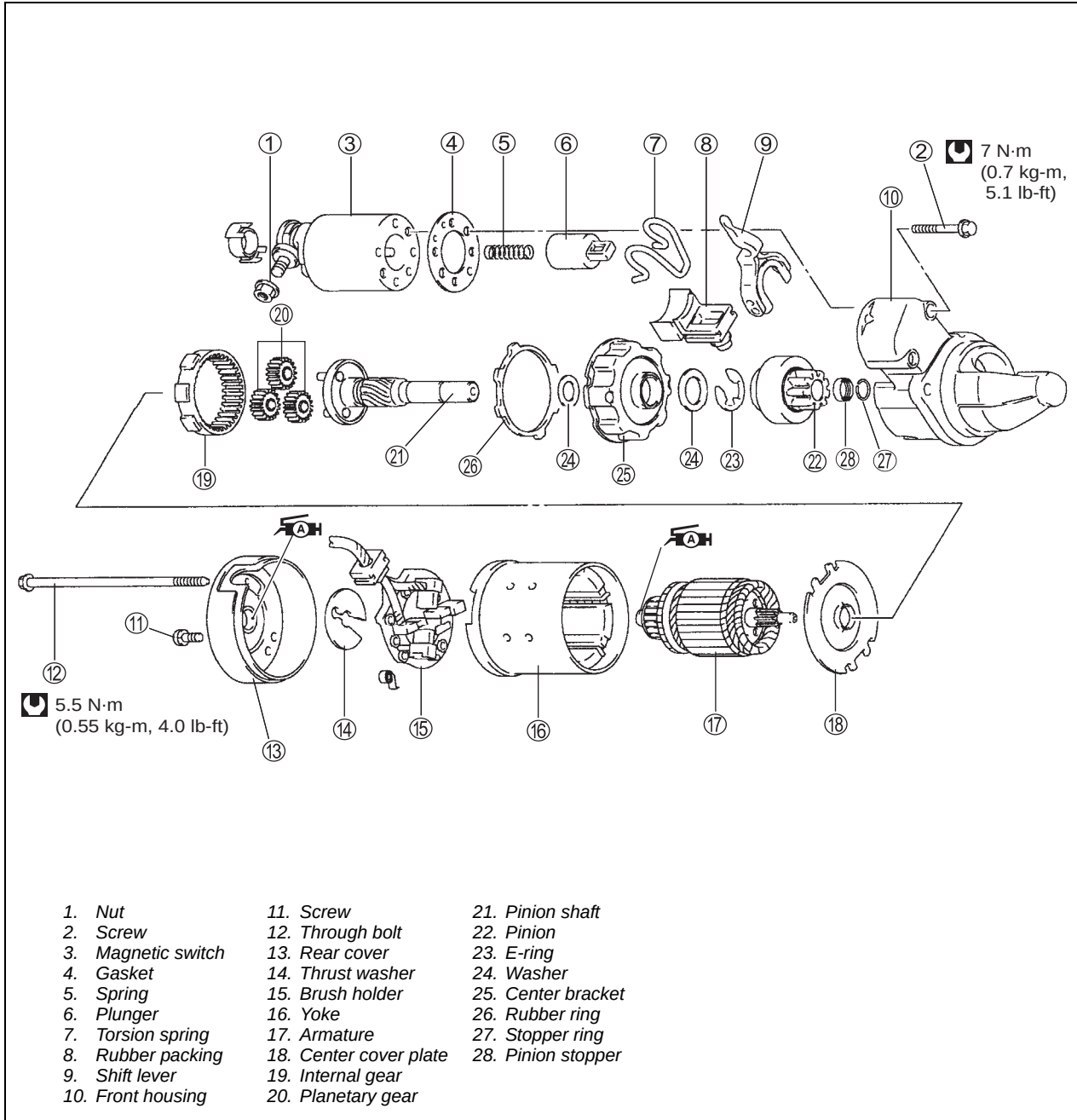


004773

Assembly

Assembly is reverse order of disassembly with special attention to the following steps.

When installing pinion shift lever, refer to diagram for installation direction.



IMPORTANT: When installing armature, use care to avoid breaking brushes.

ELECTRICAL

ELECTRIC STARTER SYSTEM

Performance Tests

IMPORTANT: Each test must be performed within 3 to 5 seconds to avoid coil damage from overheating.



WARNING



When performing the following test, be sure to connect the battery and the starting motor with a lead wire of the same size as the original equipment used there.

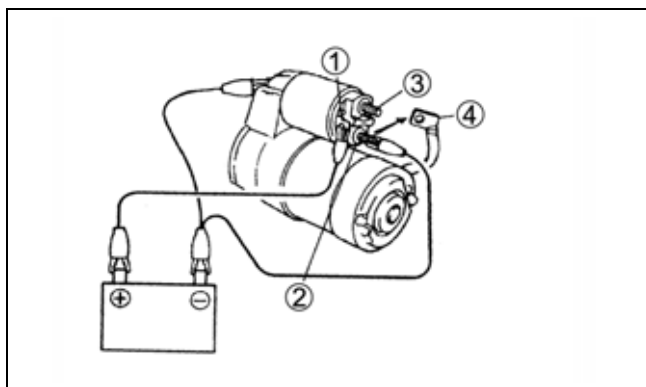
Pull-In/Hold-In Test

Connect battery to magnetic switch as shown.

Check that plunger and pinion (over-running clutch) move outward.

If plunger and pinion don't move, replace magnetic switch.

IMPORTANT: Before testing, disconnect brush lead from terminal "M."

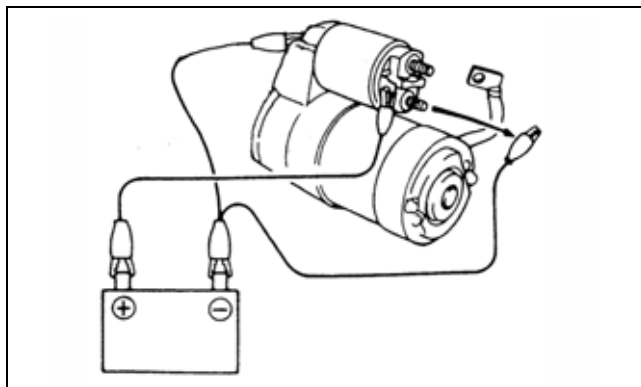


1. "S" terminal
2. "M" terminal
3. "B" terminal
4. Brush lead

004774

While connected as above with plunger out, disconnect negative lead from terminal "M."

Check that plunger and pinion remain out. If plunger and pinion return inward, replace magnetic switch.

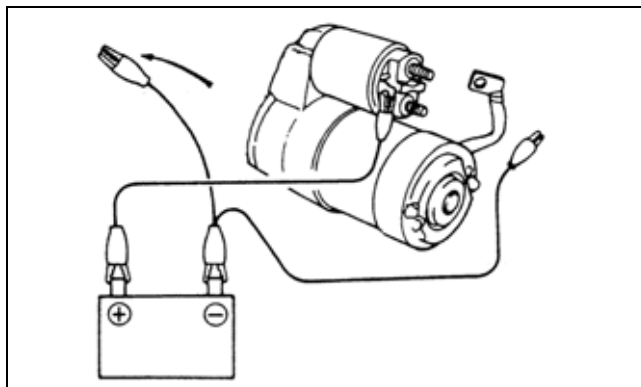


004775

Plunger and Pinion Return Test

Disconnect negative lead from switch/motor body.

Check that plunger and pinion return inward. If plunger and don't return inward, replace magnetic switch.



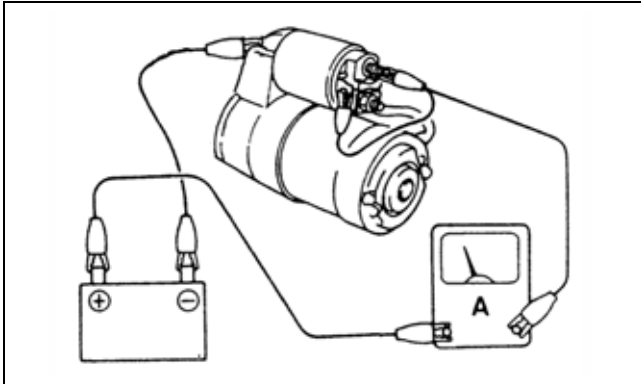
004776

No-Load Performance Test

Connect battery and ammeter to starter motor as shown:

Check that starter rotates smoothly and steadily with pinion moving out.

Check that ammeter indicates 90 A at 11 V.



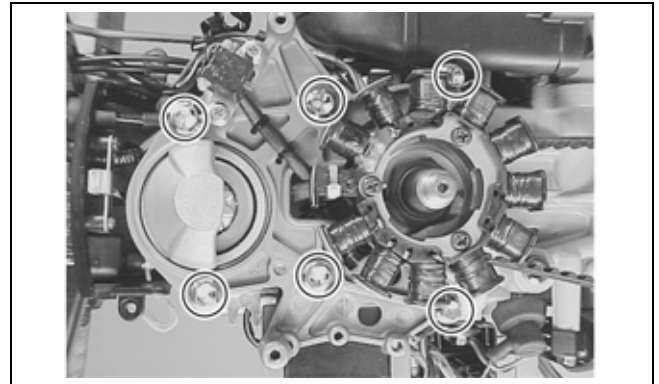
004777

Installation

Installation is reverse order of removal with special attention to the following steps:

Install starter motor and stator base. Apply *Nut Lock* to threads and tighten screws as follows:

- 8 mm: 16.5 ft. lbs. (23 N·m)
- 6 mm: 84 in. lbs. (10 N·m)



004740

Check wire routing. Refer to **WIRE ROUTING** on p. 229.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

IGNITION SYSTEM

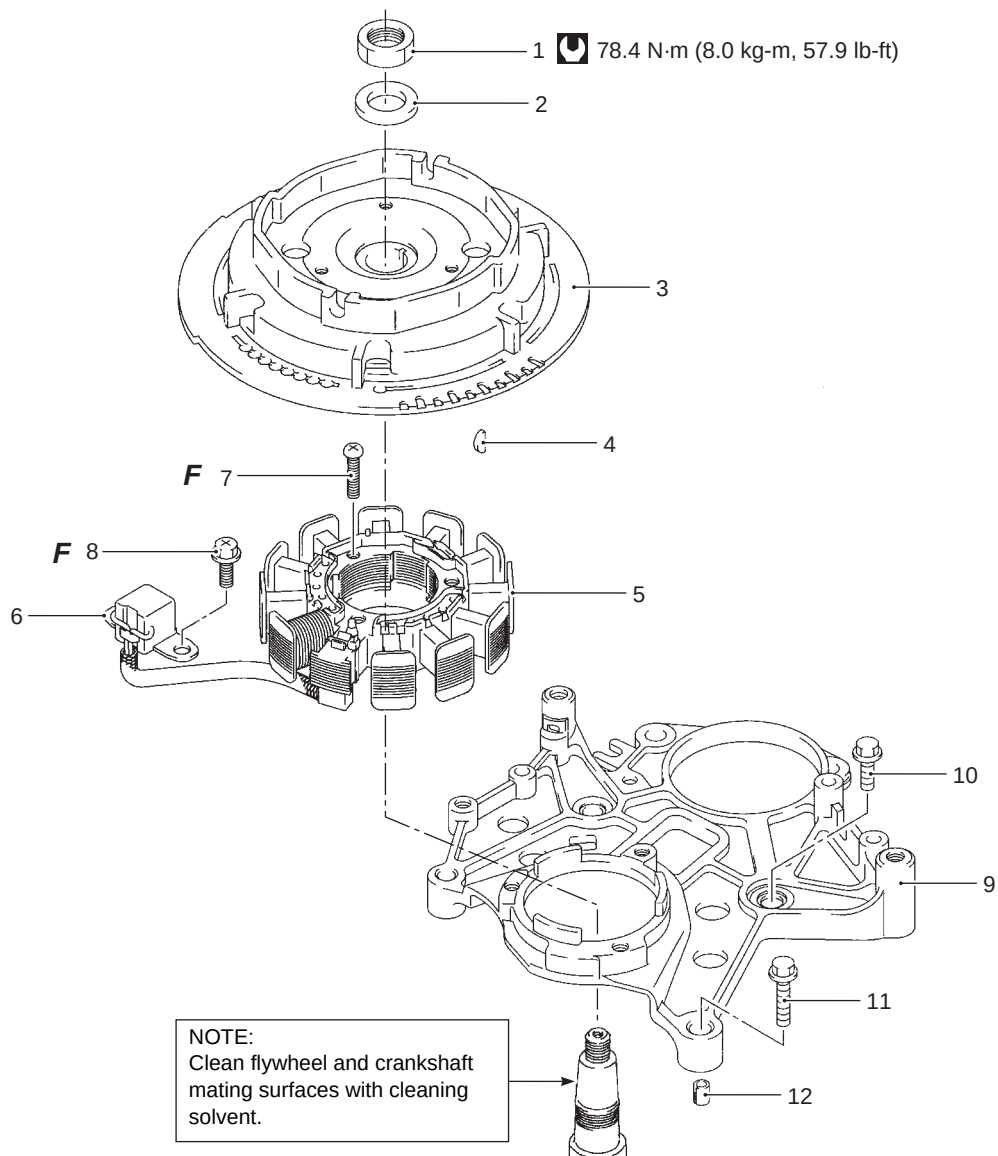
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IGNITION SYSTEM SERVICE CHART

SERVICE CHART

1. Nut
2. Washer
3. Flywheel
4. Key
5. Battery & condenser charge coil
6. Pulser coil
7. Screw
8. Screw
9. Stator base
10. Screw
11. Screw
12. Dowel pin



A Triple-Guard Grease
B Gasket Sealing Compound
C Adhesive 847
D Moly Lube

F Blue Nut Lock
R DPL Penetrating Lube
W HPF XR Gear Oil

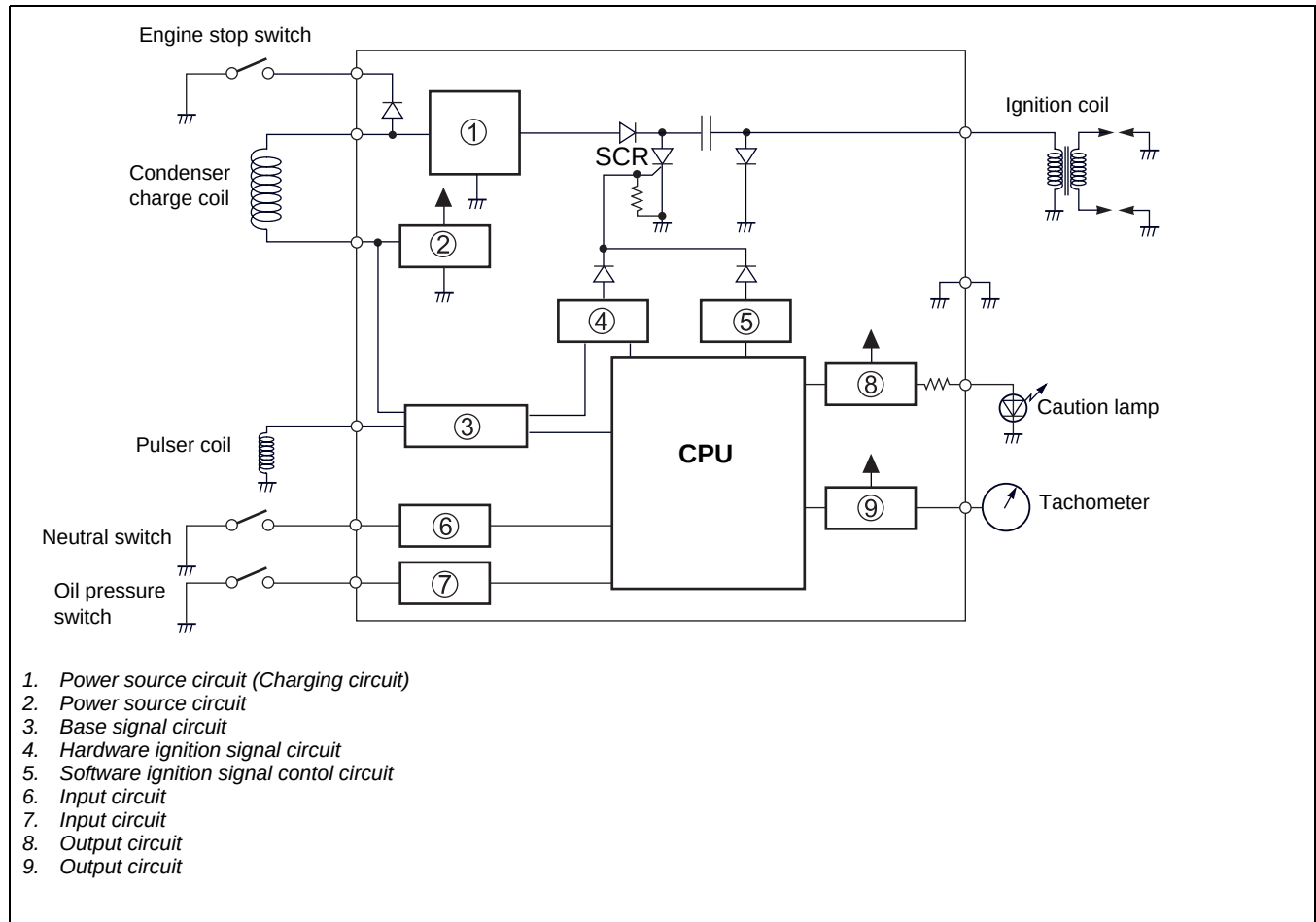
03I00110

OPERATION

The ignition system is a condenser discharge type. The condenser built in the CDI unit stores the electrical energy generated by the condenser charge coil.

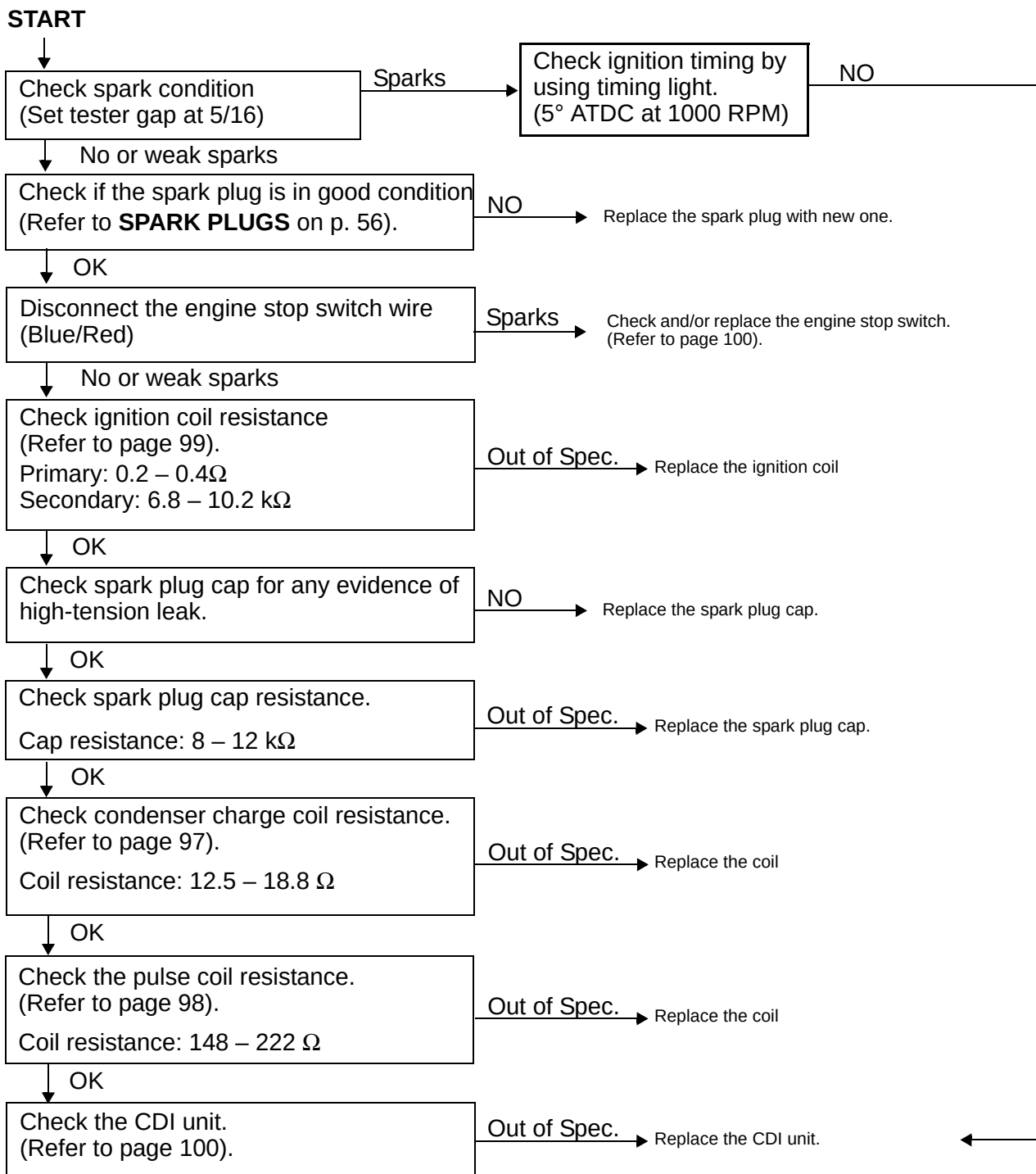
The electrical energy stored in the condenser is released to the ignition coil primary windings by the ignition timing signal calculated by the CDI unit from the pulser coil signal.

Ignition timing varies based upon engine speed. Timing is fixed at 10° ATDC until the engine starts. Timing then varies from 5° ATDC to 30° BTDC based on engine speed.



TROUBLESHOOTING

Perform the following ignition system tests when engine is hard to start to determine if the cause is in the ignition or other system.



IGNITION TESTS

⚠

WARNING

⚠

Always disconnect the battery cables at the battery before beginning resistance tests.

Condenser Charge Coil

Output Test

Disconnect condenser charge coil lead wire connector.

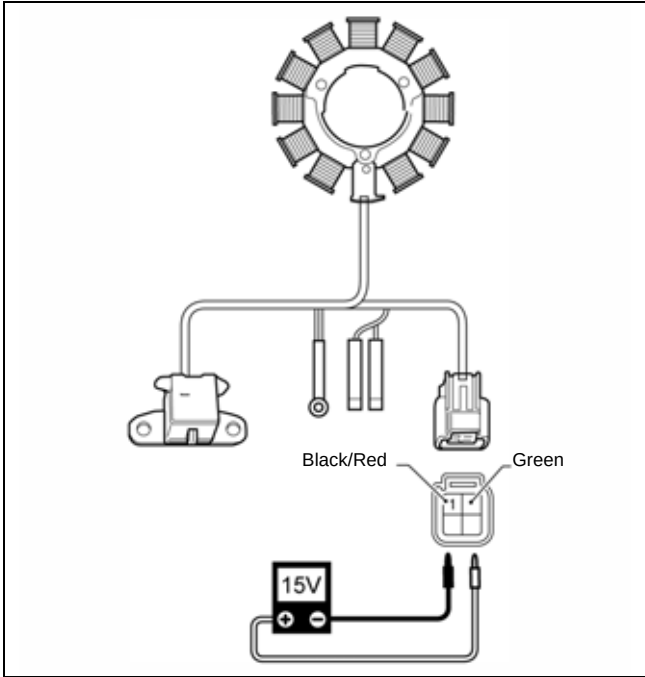
Connect Adapter Leads, P/N 342228, and Peak Reading Voltmeter to coil lead wires as shown:

Tester probe connection	
+ (Red)	- (Black)
Green	Black/Red

Remove spark plugs. Crank with recoil starter.

Condenser charge coil output:

- 15 V or over



004691

If measurement is out of specification, replace the condenser charge coil.

Resistance Test

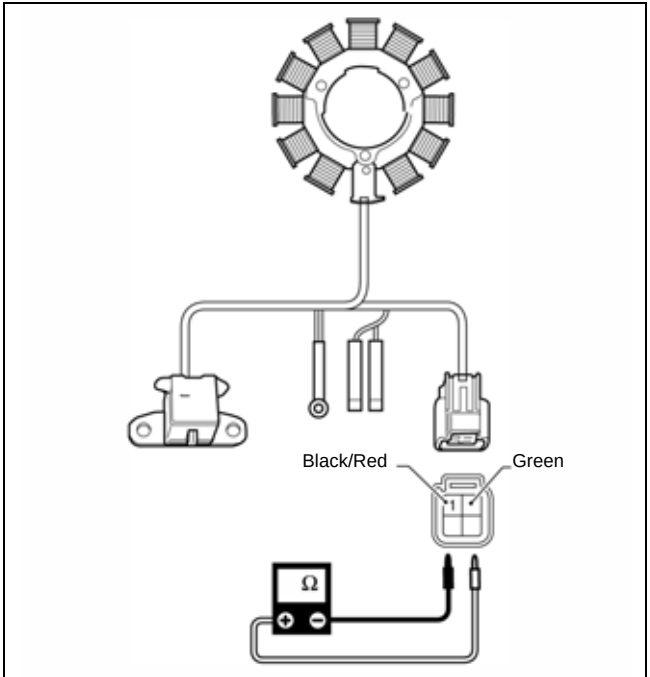
Disconnect condenser charge coil lead wire connector.

Connect Adapter Leads, P/N 342228, and Ohmmeter test probes to coil lead wires as shown:

Tester probe connection	
Probe	Other Probe
Green	Black/Red

Condenser charge coil resistance:

- 12.5 to 18.8 Ω



004692

If measurement is out of specification, replace the condenser charge coil.

IGNITION SYSTEM

IGNITION TESTS

Pulser Coil

Output Test

Disconnect the pulser coil lead wire connector.

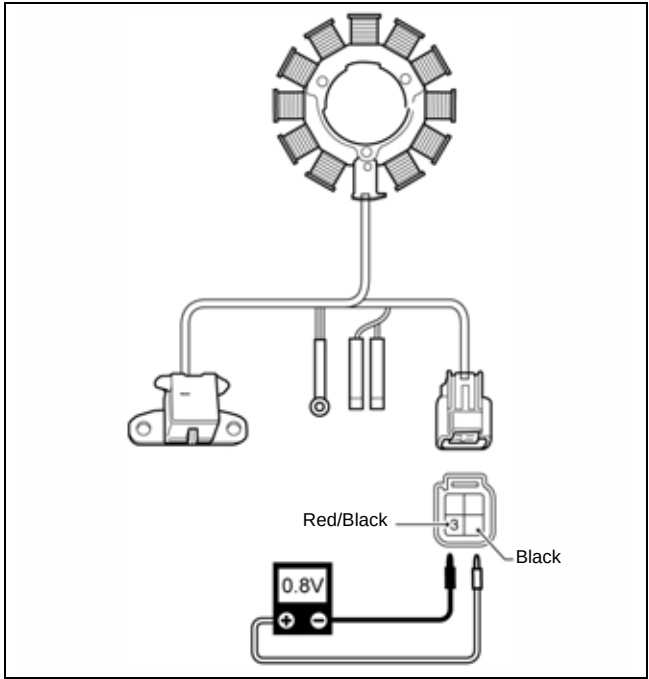
Connect Adapter Leads, P/N 342228, and Peak Reading Voltmeter to coil lead wires as shown:

Tester probe connection	
+ (Red)	- (Black)
Red/Black	Black (Ground)

Remove spark plugs. Crank with recoil starter.

Pulser coil output:

- 0.8 V or over



If measurement is out of specification, replace the pulser coil.

Resistance Test

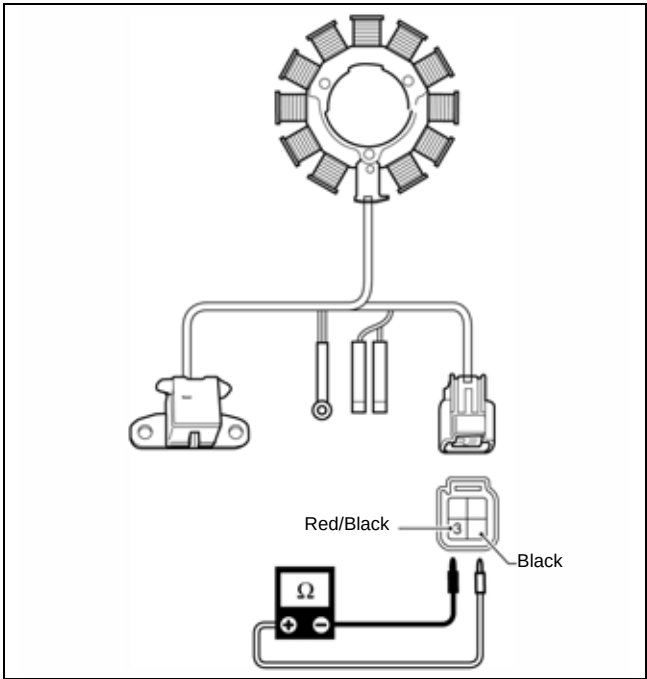
Disconnect pulser coil lead wire connector.

Connect Adapter Leads, P/N 342228, and Ohm-meter test probes to coil lead wires as shown:

Tester probe connection	
Probe	Other Probe
Red/Black	Black (Ground)

Pulser coil resistance:

- 148 to 222 Ω



If measurement is out of specification, replace the pulser coil.

Ignition Coil

Primary Resistance Test

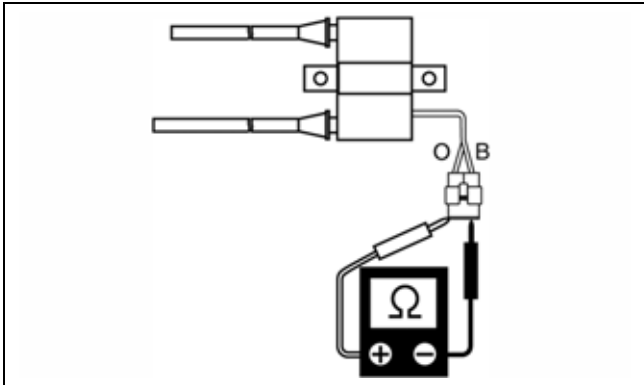
Disconnect ignition coil lead wire connector.

Connect Ohmmeter test probes to coil lead wires as shown:

Tester probe connection	
Probe	Other Probe
Orange	Black

Primary ignition coil resistance:

- 0.2 to 0.4 Ω



004695

If measurement is out of specification, replace the ignition coil.

Secondary Resistance Test

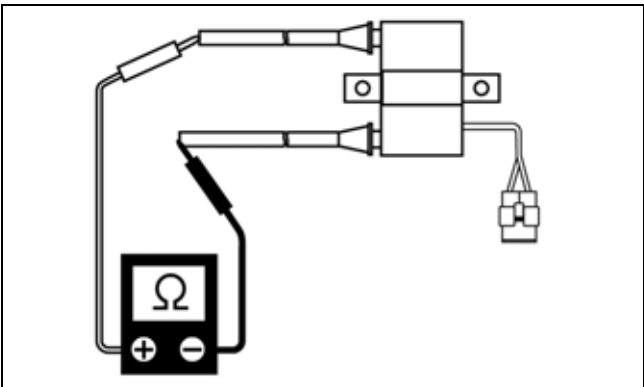
Remove the spark plug caps from the high-tension lead.

Connect Ohmmeter test probes to the high-tension leads as shown:

Tester probe connection	
Probe	Other Probe
High-tension lead	Other high-tension lead

Secondary ignition coil resistance:

- 6.8 to 10.2 k Ω



004696

If measurement is out of specification, replace the ignition coil.

IGNITION SYSTEM

IGNITION TESTS

CDI Unit

Output Test

Disconnect 6 pin wire harness connector from CDI unit.

Connect 6 pin Test Cord, P/N 5034231, between CDI unit and wire harness.

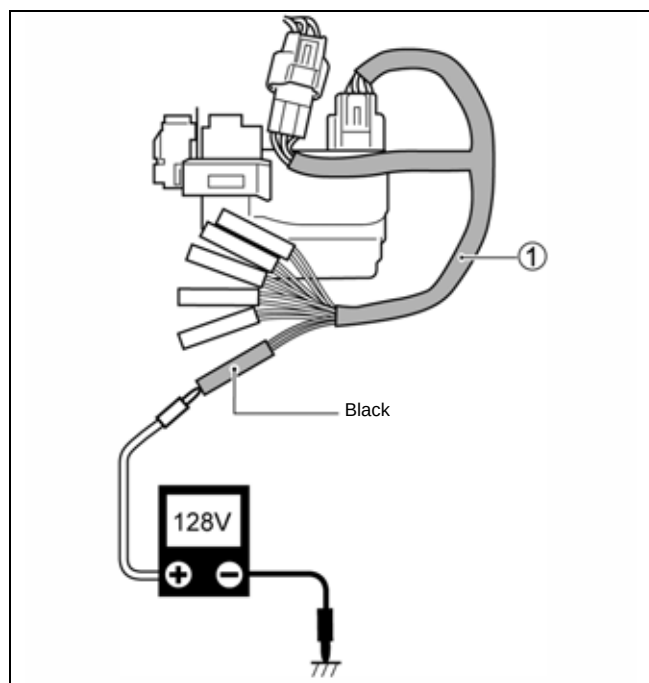
Connect Peak Reading Voltmeter to test cord lead wires as shown. Set tester range to NEG 500.

Tester probe connection	
+ (Red)	- (Black)
Orange (Test cord wire is black)	Engine Ground

Remove spark plugs. Crank with recoil starter.

CDI unit output:

- 128 V or over



1. 6 Pin test cord

004697

If measurement is out of specification, replace the CDI unit.

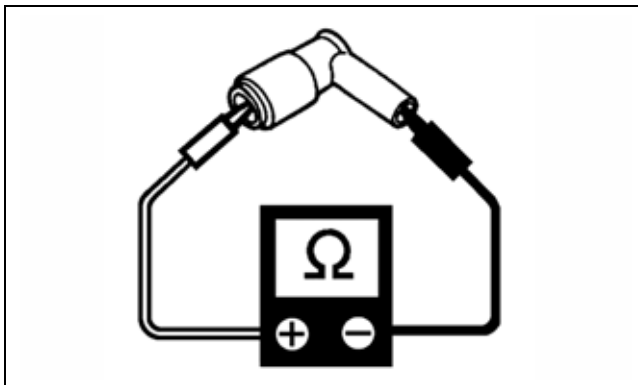
Spark Plug Cap

Resistance Test

Measure spark plug cap resistance.

Spark plug cap resistance:

- 8 to 12 k Ω



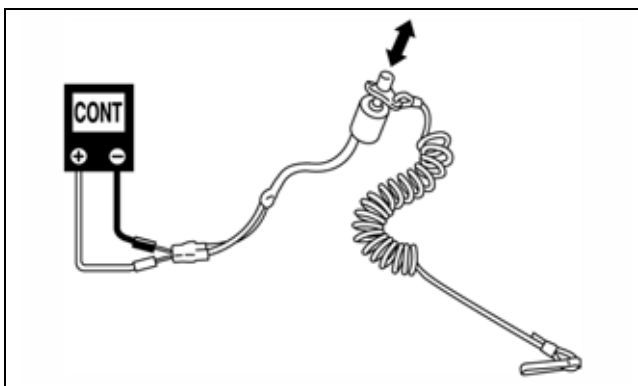
004698

If measurement is out of specification, replace the spark plug cap.

Engine Stop Switch

Check continuity between stop switch Blue/Red and Black leads as follows:

Switch condition	Continuity
Lock plate IN	No
Lock plate OUT	Yes
Lock plate IN & button depressed	Yes



004699

COMPONENT SERVICING

Removal



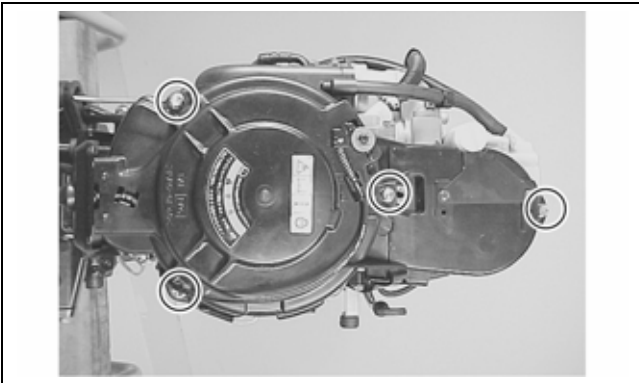
WARNING



Before removing ignition parts:
Disconnect battery cables at the battery.
Twist and remove all spark leads.

Flywheel

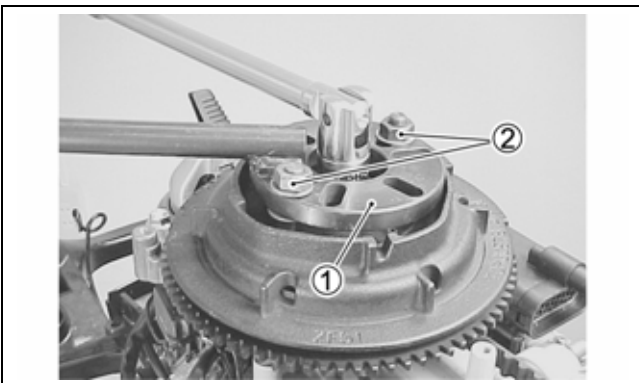
Remove manual starter. Refer to starter **REMOVAL** on p. 219.



004700

Use Flywheel Holder, P/N 5034227, and Screws, P/N 5034235 to loosen the flywheel nut.

IMPORTANT: Do not remove flywheel nut at this time to avoid damage to crankshaft when using flywheel puller.

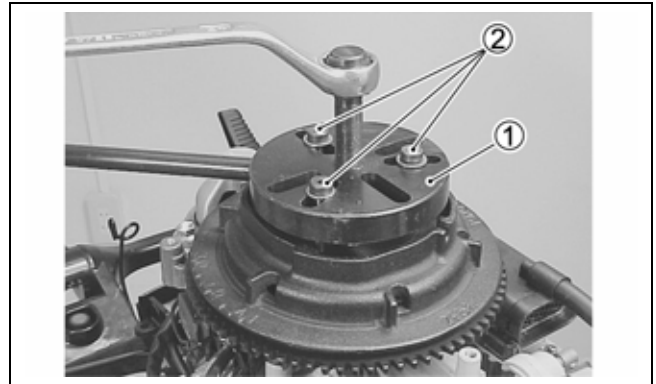


1. Flywheel holder
2. Screw and washer set

004701

Use Universal Puller Set, P/N 378103, and Screws, P/N 5034235, to loosen flywheel from crankshaft.

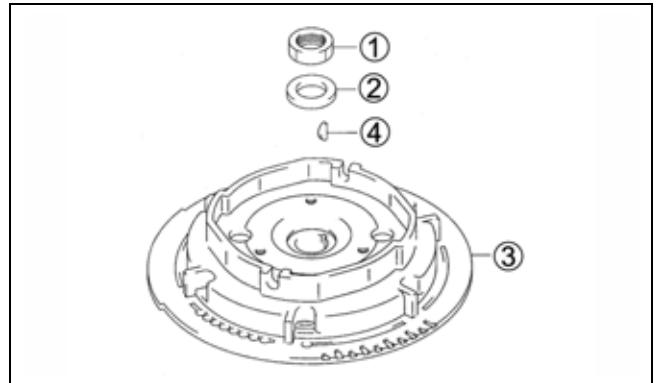
Install the puller on flywheel with body flat side up. Seat the shoulder screws completely. Hold puller by its handle, and tighten pressing screw until flywheel releases.



1. Universal puller
2. Screw and washer set

004702

Remove the flywheel nut, washer, flywheel, and key.



1. Flywheel nut
2. Washer
3. Flywheel
4. Key

004703

IGNITION SYSTEM

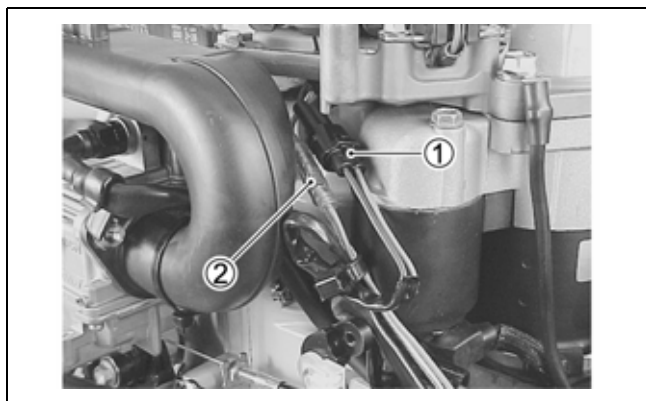
COMPONENT SERVICING

Charge Coil and Pulser Coil

Remove side covers. Refer to side cover **Removal and Installation** on p. 180.

Disconnect stop switch lead wire connector.

Disconnect starter button lead wire connector (tiller models).

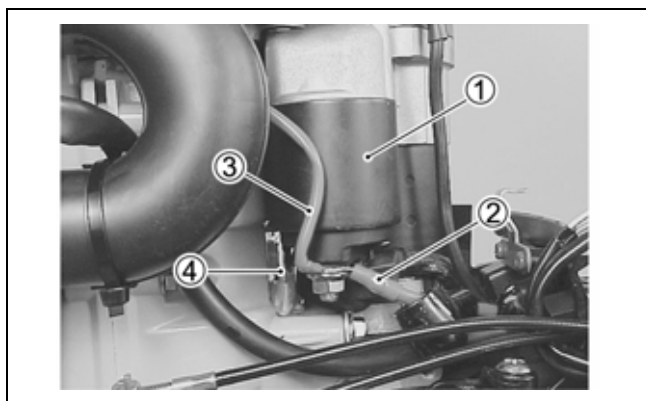


1. Stop switch connector
2. Starter button connector

004704

Remove nut, positive (+) battery cable, and positive (+) battery charge cable from the starter motor magnetic switch "B" terminal.

Disconnect the red lead wire from starter motor magnetic switch "S" terminal.



1. Starter motor magnetic switch
2. Positive battery cable
3. Battery charge cable
4. Red starter lead wire

004705

Loosen the PORT side starter motor band screw.



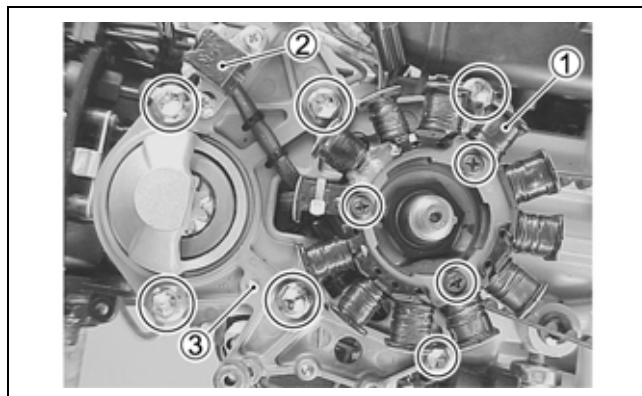
1. Starter band screw

004706

Remove three screws securing charge coil.

Remove two screws securing pulser coil.

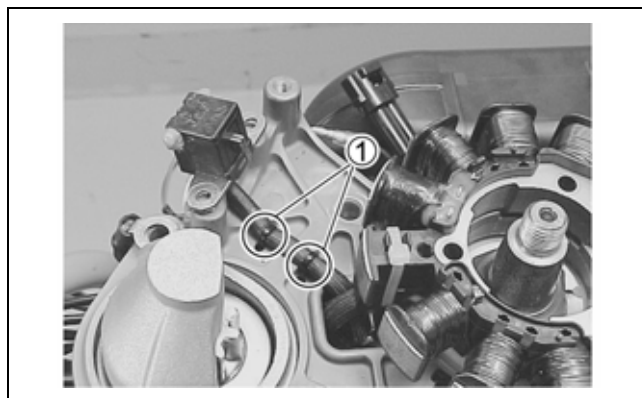
Remove six screws securing stator base.



1. Charge coil
2. Pulser coil
3. Stator base

004707

Cut cable ties securing pulser coil wiring harness to stator base.

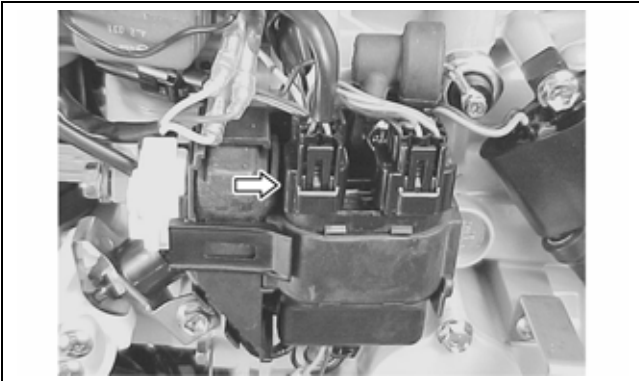


1. Cable ties

004708

IGNITION SYSTEM COMPONENT SERVICING

Disconnect the 4-pin wiring harness connector from CDI unit.



004709

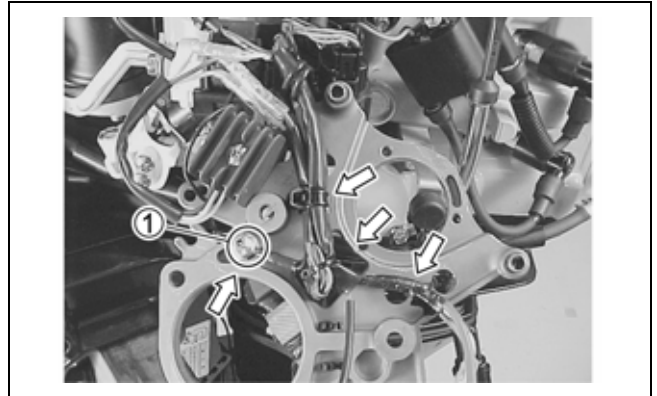
Lift stator base from cylinder block.

Cut the cable ties securing coil wiring harness to stator base.

Disconnect battery charge coil lead wire connector from rectifier.

Remove the screw securing pulser coil ground lead wire.

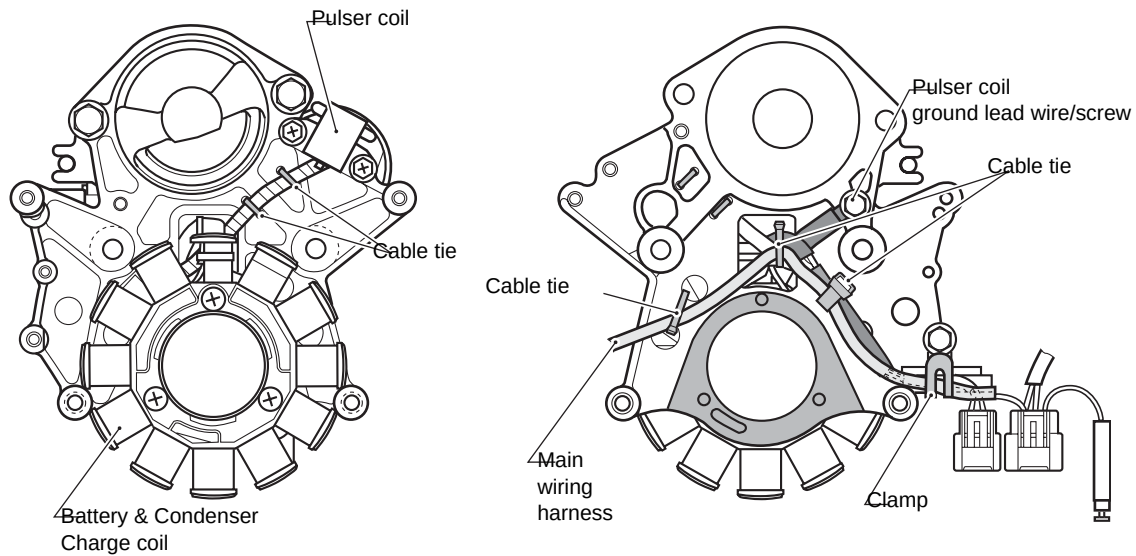
Remove the charge coil.



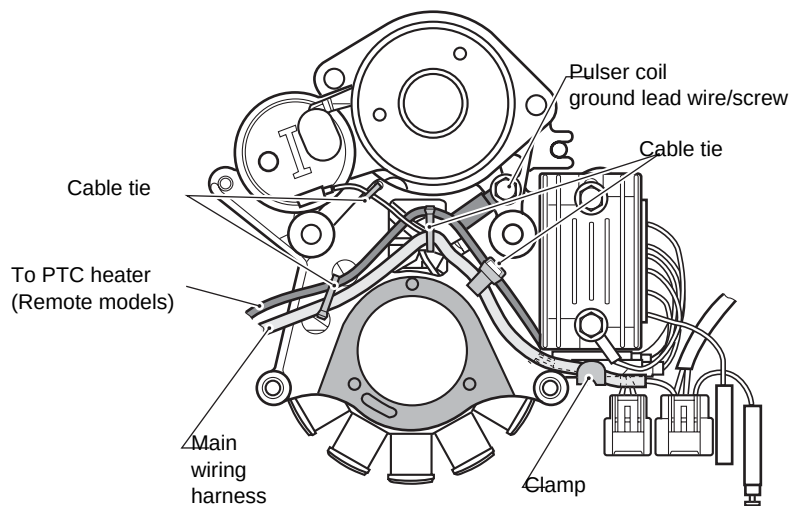
004710

5

Installation



Manual start model



Electric start model

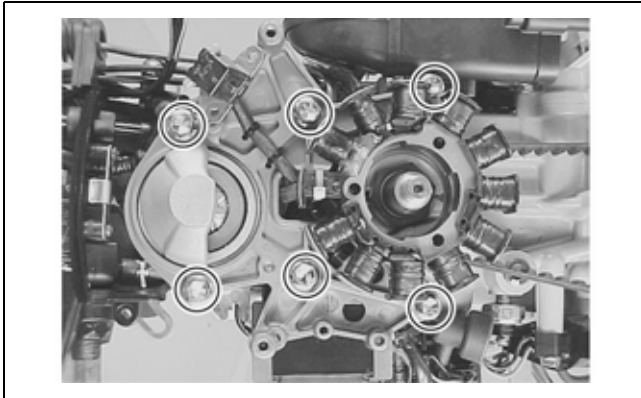
Installation is reverse order of removal with special attention to the following steps:

Charge Coil and Pulser Coil

Secure coil lead wire with cable ties, then check that wire is routed properly, away from hot or rotating parts.

Install stator base. Apply *Nut Lock* to threads and tighten screws as follows:

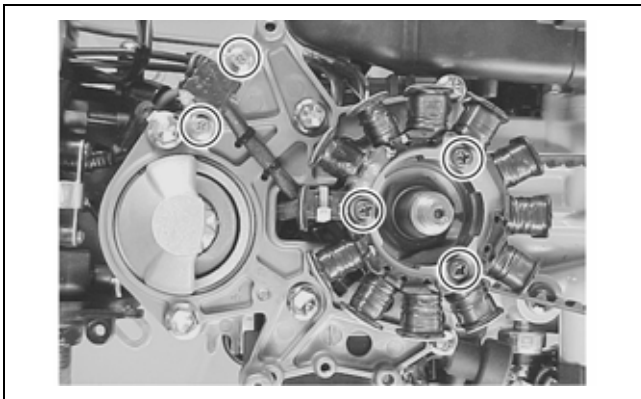
- 8 mm: 16.5 ft. lbs. (23 N·m)
- 6 mm: 84 in. lbs. (10 N·m)



1. Screws

004711

Apply *Nut Lock* to threads of coil mounting screws. Tighten screws securely.



004712

Flywheel

Clean flywheel and crankshaft mating surfaces with cleaning solvent.

Use Flywheel Holder, P/N 5034227, and Screws, P/N 5034235 to hold the flywheel. Tighten nut to 58 ft. lbs. (78.4 N·m).



004713

Final Assembly Check

Perform the following checks to ensure proper and safe operation:

All parts removed have been returned to their original positions.

Wire routings are correct. Refer to **WIRE ROUTING** on p. 229.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

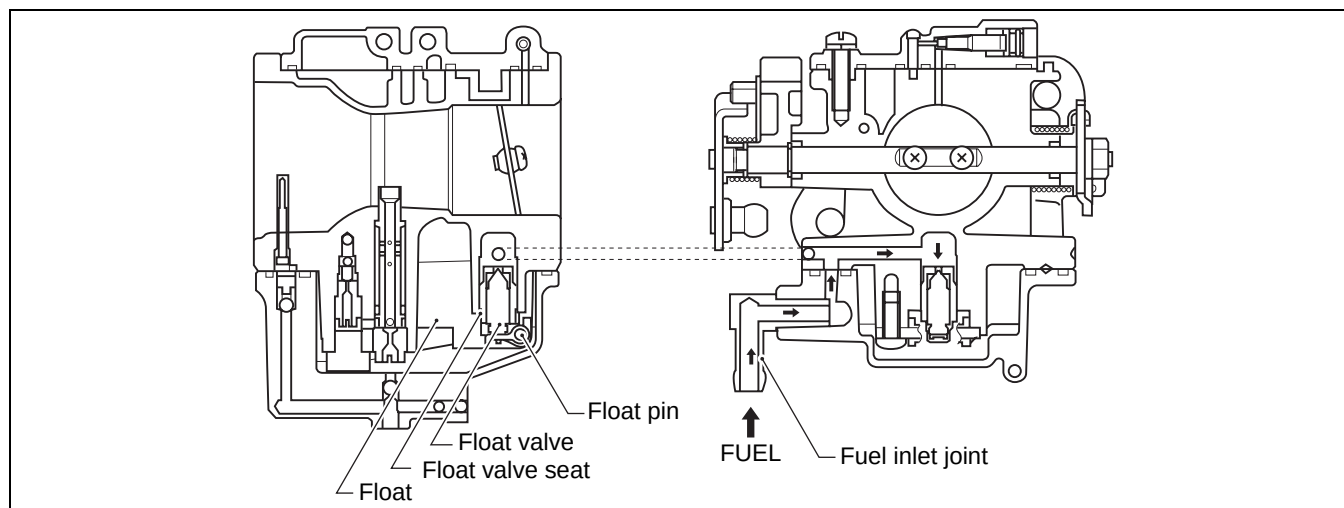
FUEL SYSTEM

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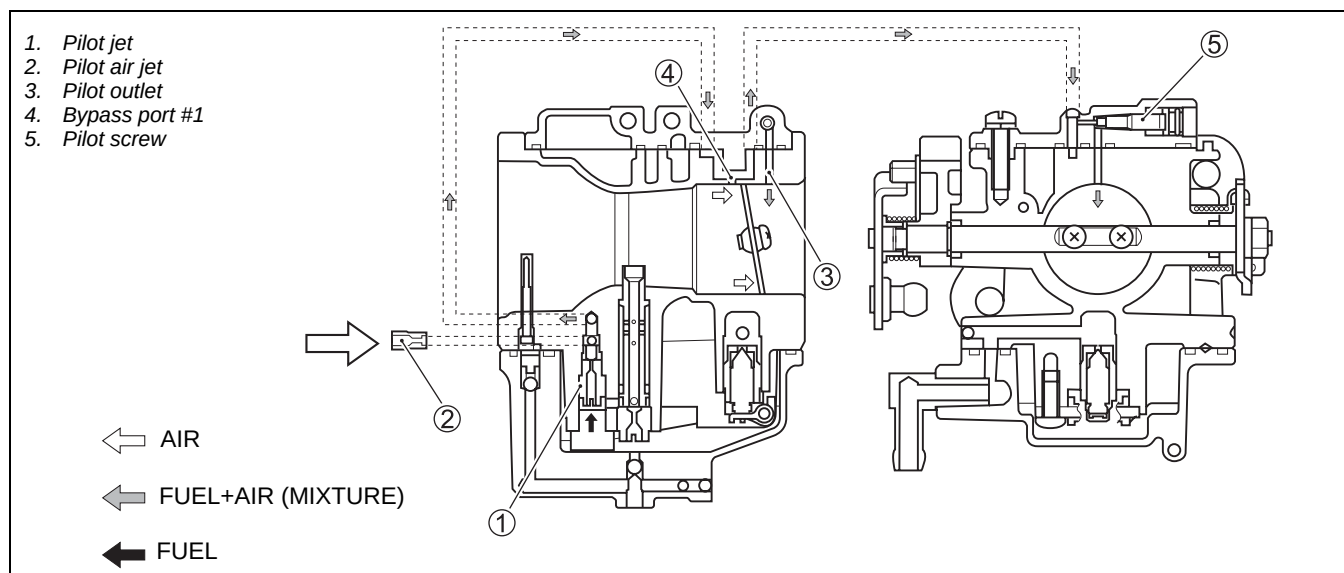
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CARBURETOR OPERATION

Float system



Idling/Trolling



After passing through the pilot jet, fuel mixes with air supplied from the pilot air jet.

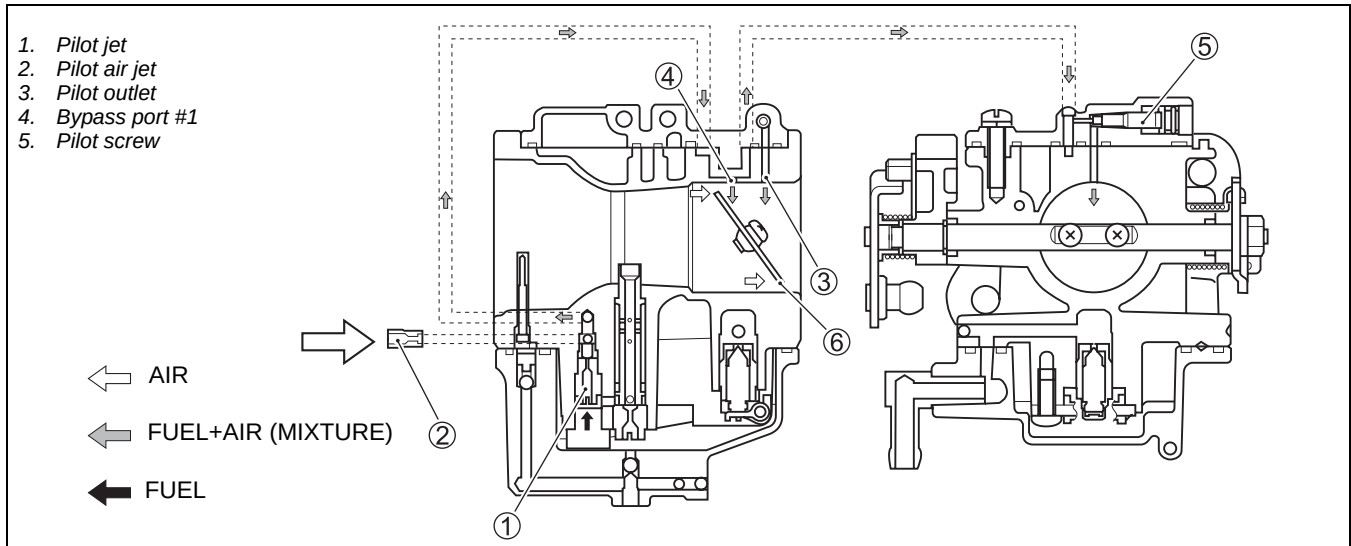
This mixture passes through the pilot screw seating area and is jetted both from the pilot outlet and bypass port #1.

No mixture is jetted either from the bypass port #2 or from those located upstream. These ports serve as air passages.

As the pilot screw is turned clockwise (screwed in), the mixture (A/F) will become leaner. As the screw is turned counterclockwise (screwed out), the mixture will become richer.

The throttle stop screw adjusts idling/trolling speed. When the stop screw is turned clockwise (screwed in), the speed raises and when turned counterclockwise (screwed out), the speed lowers.

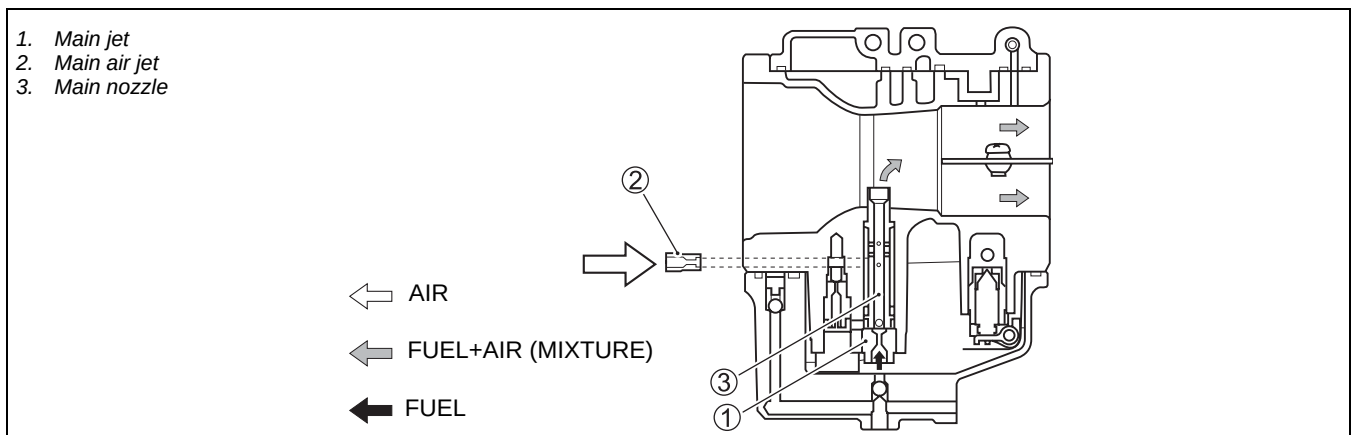
Low-Mid speed



As the throttle valve is opened gradually, air flowing through the throttle bore increases in proportion to the valve opening angle. At this time, because fuel mixture jets from the bypass port #2 and those upstream successively, the optimum mixture ratio (A/F) is maintained, raising engine speed smoothly.

6

Mid-High Speed



When the throttle valve opens further and engine speed rises, fuel passes through the main jet and enters the main nozzle, in which it is mixed with air supplied from the main air jet before sprayed into the main bore.

Accelerator pump

Only 15 HP models are equipped with an accelerator pump system.

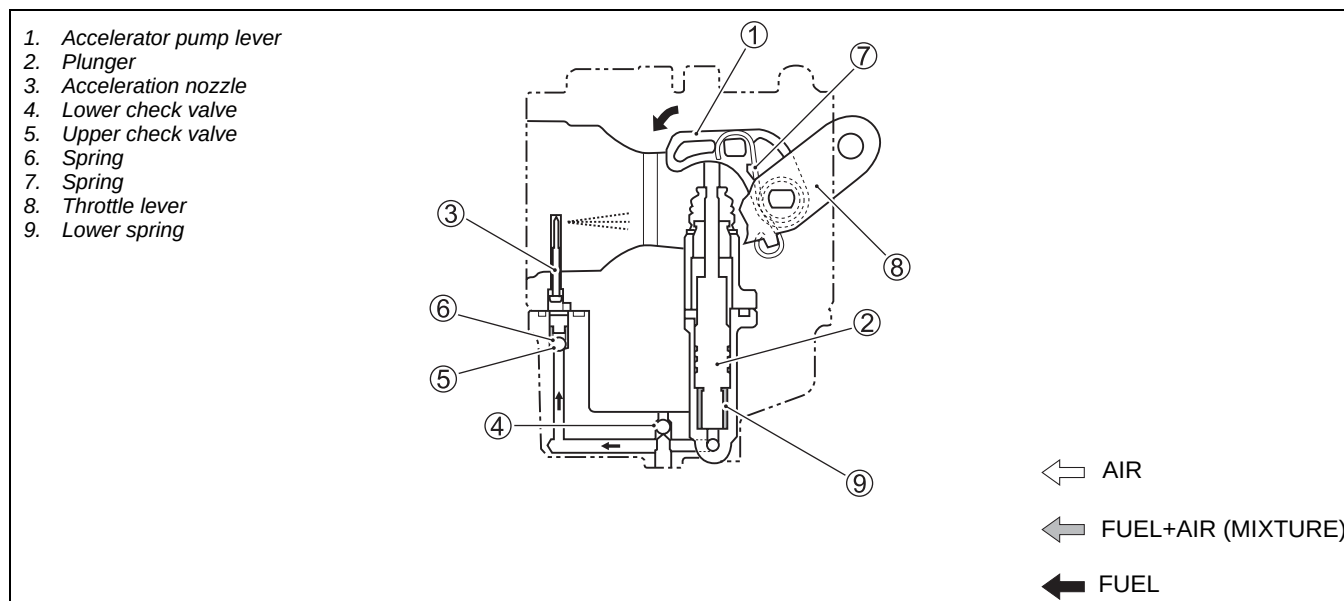
When quickly accelerated, the engine draws a large volume of air with fuel lagging behind causing the mixture to be transitionally lean.

The accelerator pump compensates for such a fuel deficiency. This is a plunger type pump that pressure feeds fuel, at the time of quick acceleration, to the acceleration pump nozzle, which sprays fuel into the main bore. With this provision, the engine can be accelerated smoothly.

Operation of acceleration pump

When the throttle lever is opened quickly, the accelerator pump lever moves in the direction indicated by the arrow with spring force causing the plunger to be depressed. Because the lower check valve closes due to pressure, fuel inside the accelerator pump chamber forces the upper check valve open, causing fuel to be sprayed to the main bore through the acceleration nozzle.

When the throttle lever returns, the accelerator pump lever moves in the opposite direction of the arrow, which causes the plunger to be returned by the force of lower spring. At this time, the upper check valve is closed by spring force and the lower check valve opens, allowing fuel to enter the accelerator pump chamber.



Auto-Enrichener System

Remote models are equipped with an auto-enrichener system.

The automatic enrichener device consists of the PTC heater, the thermo-wax, and the plunger/needle. When the thermo-wax is cold, the plunger/needle moves upward, and fuel is drawn into the enrichener circuit from the float chamber.

Enrichener jet meters this fuel, which then flows into fuel pipe and mixes with the air coming from the upper part of the float chamber. The mixture, rich in fuel content, reaches upper part of the fuel pipe and mixes again with air coming through a passage extending from main bore.

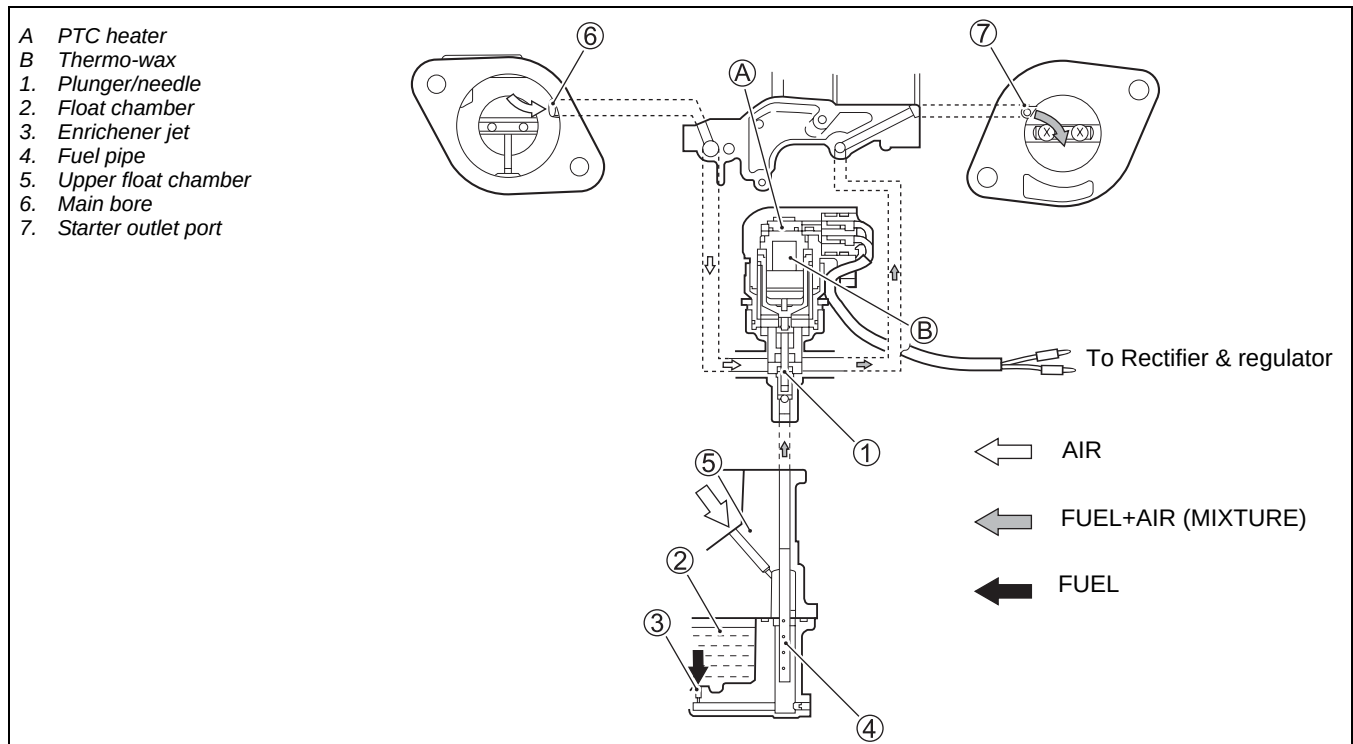
The two successive mixings of fuel with air are such that proper fuel/air mixture for starting is produced when the mixture is sprayed out through outlet port into the main bore.

When the engine is cold:

- The auto-enrichener passage is open when the thermo-wax is at atmospheric temperature.

When the engine is started:

- As PTC heater temperature increases, the thermo-wax gradually expands and closes enrichener passage with the needle of the plunger.



FUEL SYSTEM

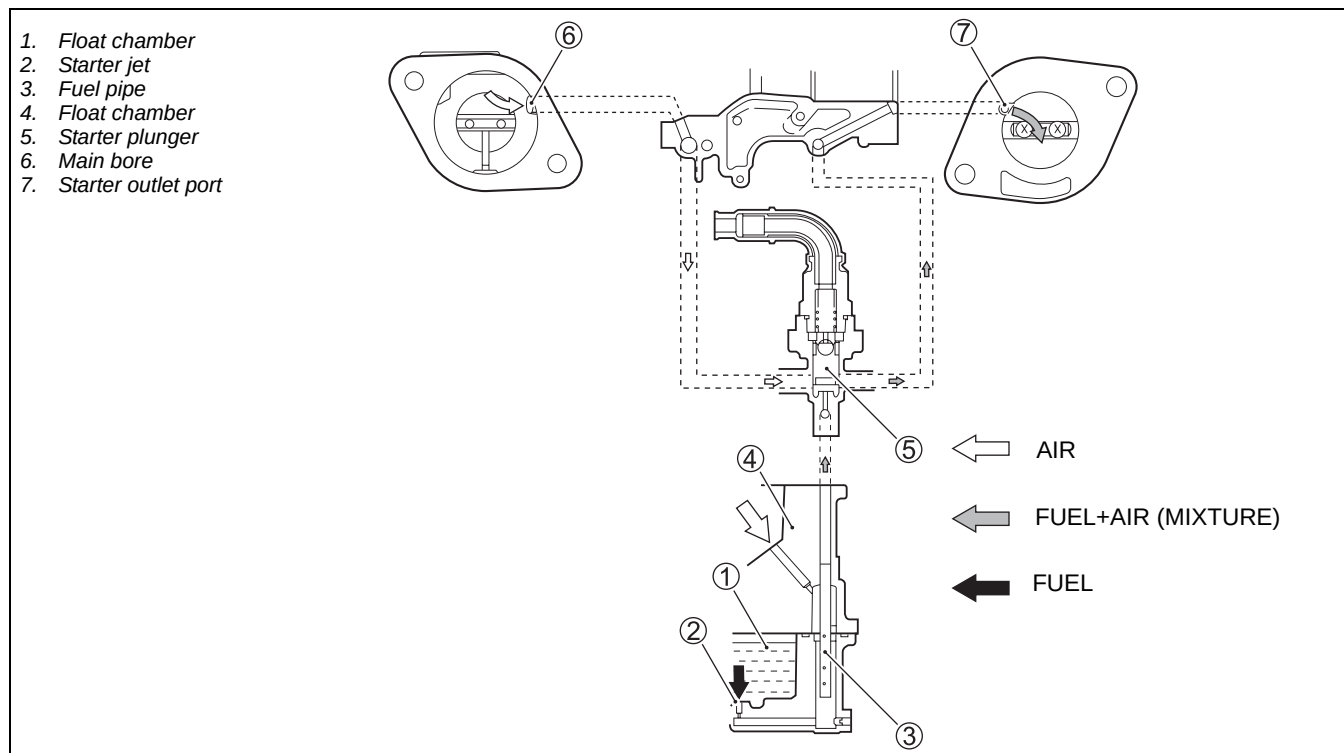
CARBURETOR OPERATION

Manual Starter System

When starter knob is pulled, fuel is drawn into the starter circuit from the float chamber.

Starter jet meters this fuel, which then flows into fuel pipe and mixes with the air coming from the upper part of float chamber. The mixture, rich in fuel content, reaches starter plunger and mixes again with the air coming through a passage extending from main bore.

The two successive mixings of fuel with air produce the proper fuel/air mixture for starting when the mixture is sprayed out through starter outlet port into the main bore.

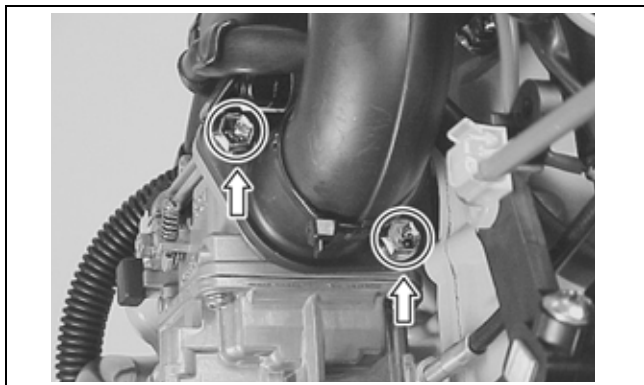


CARBURETOR SERVICE

Removal

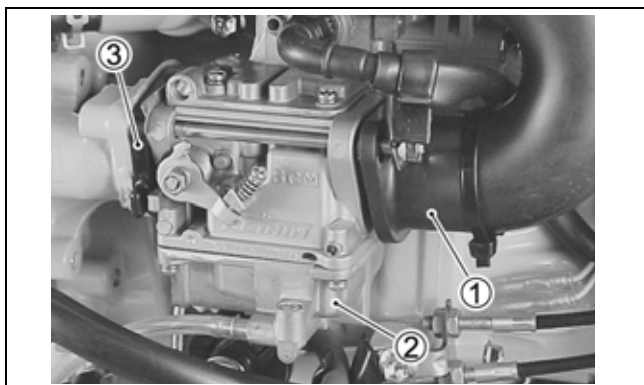
Remove the STBD side cover. Refer to side cover **Removal and Installation** on p. 180.

Remove two screws securing carburetor.



004650

Remove the silencer case, carburetor, and insulator.

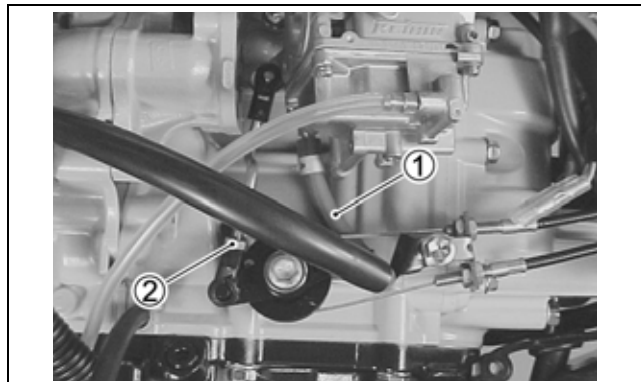


1. Silencer case
2. Carburetor
3. Insulator

004651

Remove fuel hose from carburetor inlet.

Remove throttle rod from carburetor.

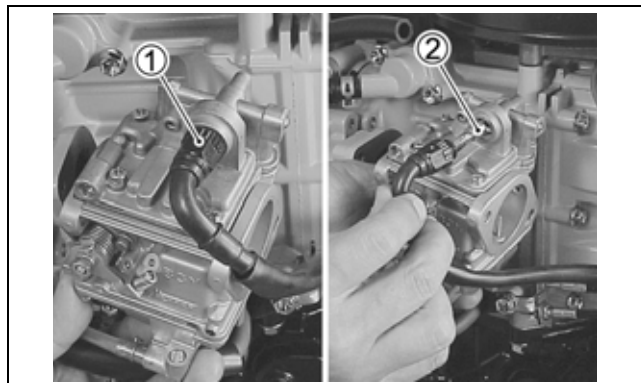


1. Fuel hose
2. Throttle rod

004652

Tiller models:

- Unscrew the starter cable lock nut, then remove starter cable with starter plunger.

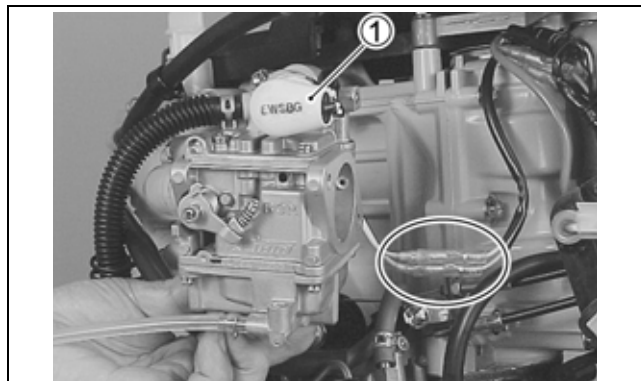


1. Starter cable lock nut
2. Starter plunger

004653

Remote models:

- Disconnect the auto-enricher lead wire connector.



1. Auto-enricher

004654

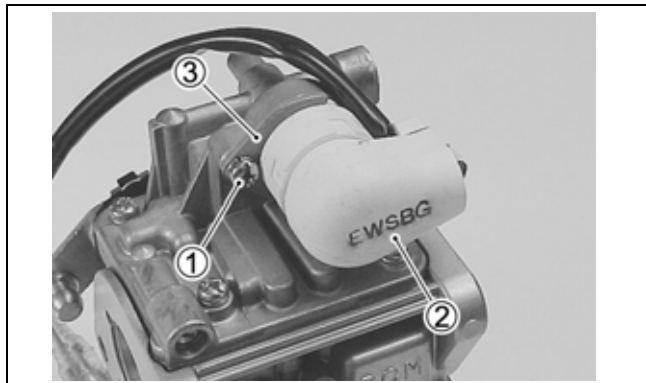
FUEL SYSTEM

CARBURETOR SERVICE

Disassembly

Remote models:

- Remove the screw and auto-enrichener with plate.

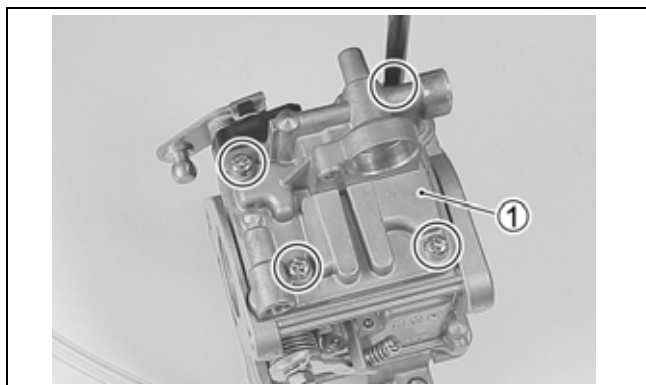


1. Screw
2. Auto-enrichener
3. Plate

004658

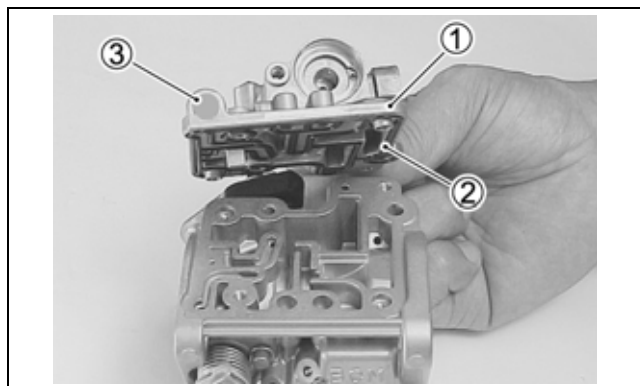
Remove the four screws securing the top cover, then remove the cover and gasket.

IMPORTANT: On carburetors with covered pilot screw, DO NOT remove the cover and adjust pilot screw.



1. Top cover

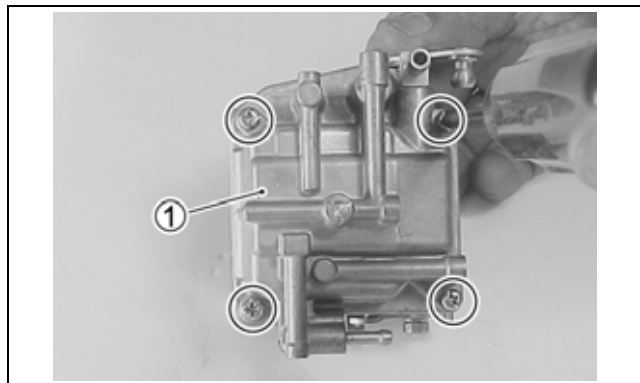
004659



1. Top cover
2. Gasket
3. Pilot screw cover

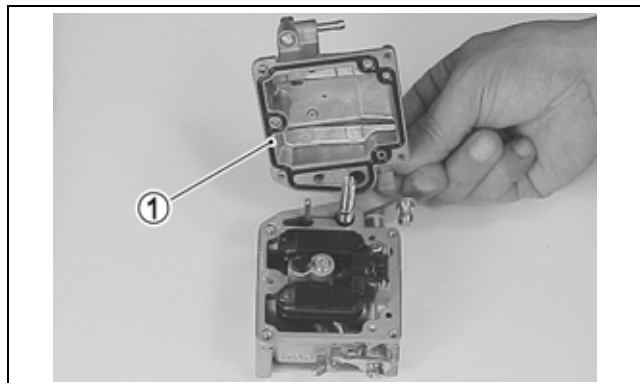
004660

Remove the four screws securing the float chamber, then remove the chamber and gasket.



1. Float chamber

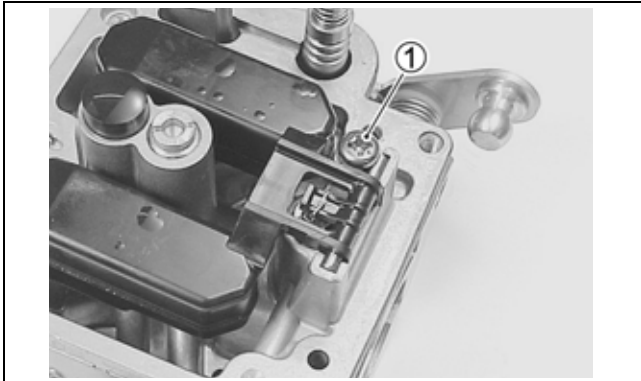
004661



1. Gasket

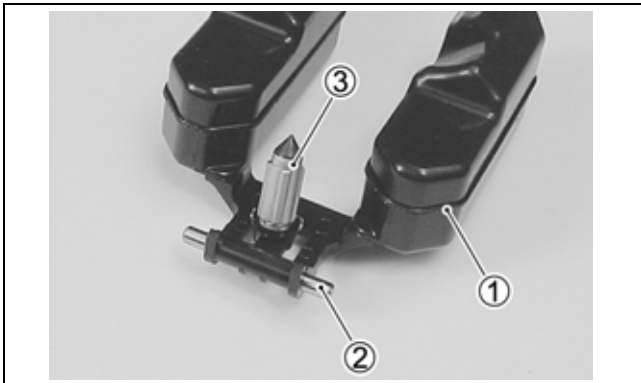
004662

Remove the float pin screw. Remove float, float pin, and needle valve.



1. Float pin screw

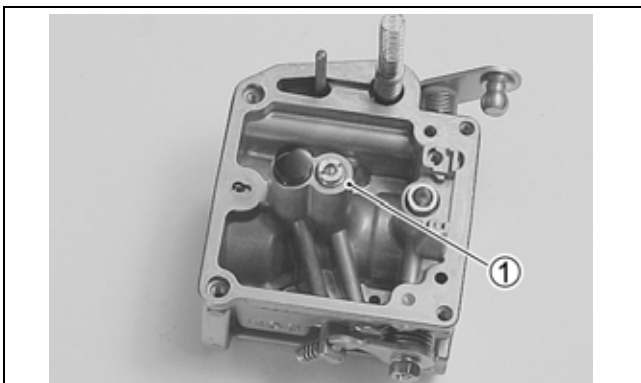
004663



1. Float
2. Float pin
3. Needle valve

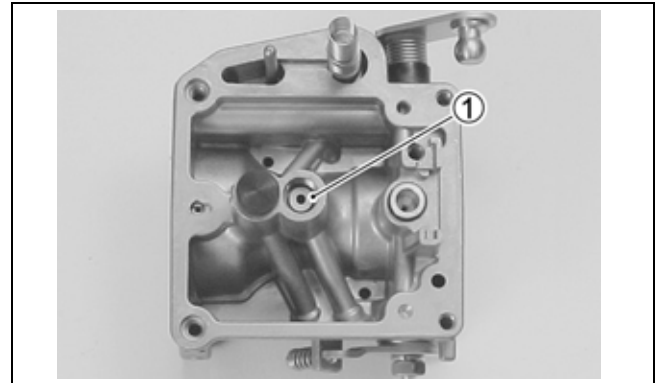
004664

Remove the main jet and main nozzle.



1. Main jet

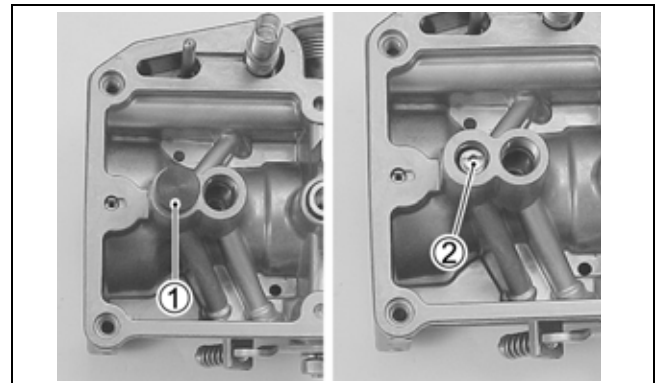
004665



1. Main nozzle

004666

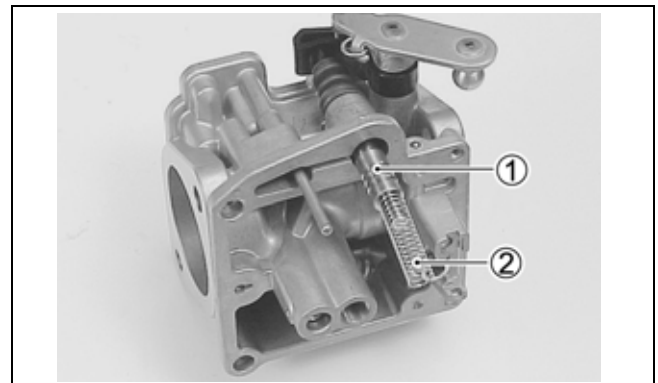
Remove the cap and pilot jet.



1. Cap
2. Pilot jet

004667

Remove the accelerator pump plunger and spring.



1. Accelerator pump plunger
2. Spring

004668

FUEL SYSTEM

CARBURETOR SERVICE

Cleaning and Inspection

Carburetor must be completely disassembled. Use a clean bristle brush to remove gum or varnish deposits. Thoroughly clean components with *Carburetor and Choke Cleaner*.

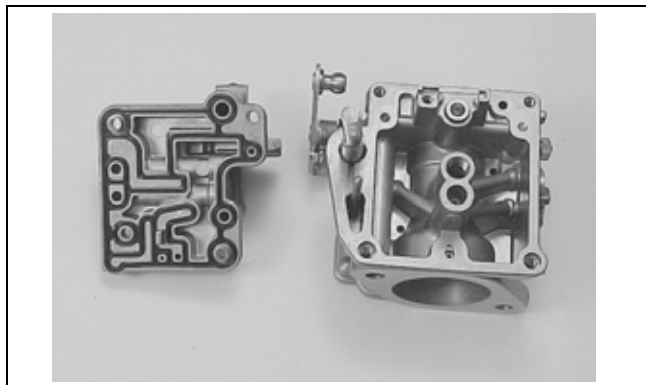
IMPORTANT: Do not clean carburetor or its components by submerging in strong carburetor cleaner or hot soaking tank. Strong cleaners might damage components or remove sealing compounds.

Flush all carburetor holes and passages with a small syringe filled with isopropyl alcohol. Blow passages and carburetor dry with compressed air of not more than 25 psi (172 kPa). When drying passages, direct the flow of shop air opposite to the direction of fuel flow.

IMPORTANT: Wire or small drill bits must not be used to clean carburetor orifices and jets.

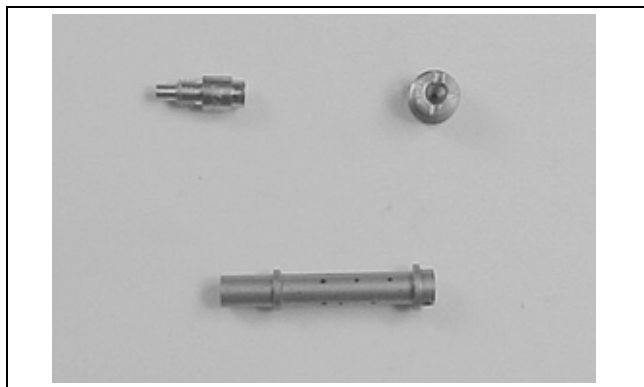
Inspect the carburetor body and top cover. If cracks or other damage are found on any component, replace it.

Inspect needle valve seat. Replace carburetor body if worn or damaged.



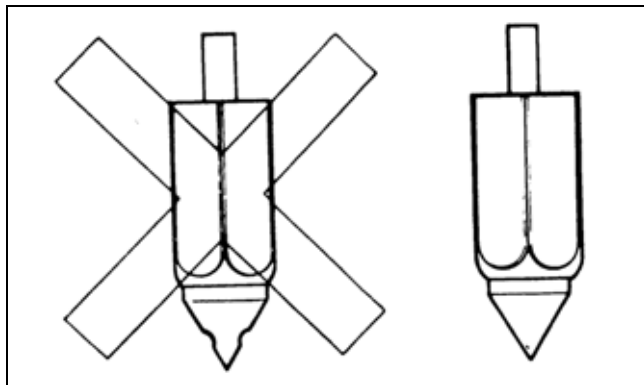
004669

Inspect jet and nozzle.



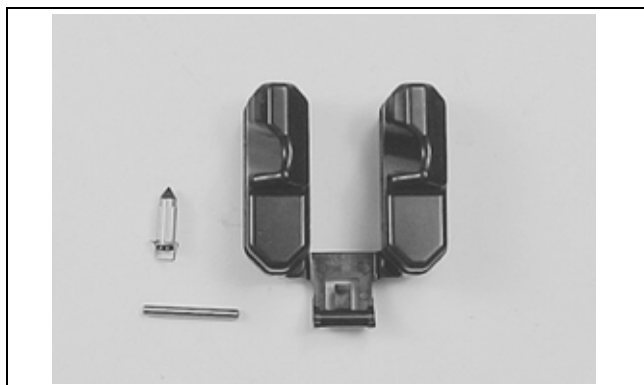
004670

Inspect needle valve assembly. If broken tips or wear are found, replace assembly.



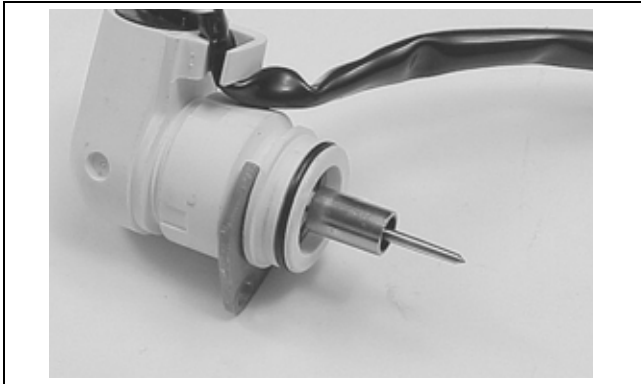
004671

Inspect the float.



004672

Inspect the auto-enrichener needle valve. If broken tip or wear is found, replace the auto-enrichener.

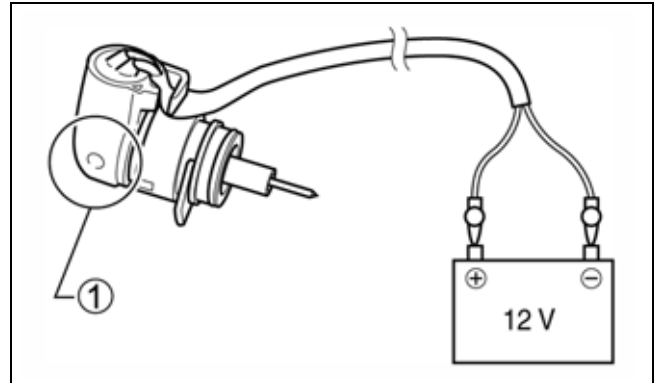


004673

Connect the auto-enrichener leads to a 12 V battery:

- Check that the PTC heater area is heated 5 minutes after battery has been connected.

IMPORTANT: Do not attempt to disassemble the auto-enrichener.

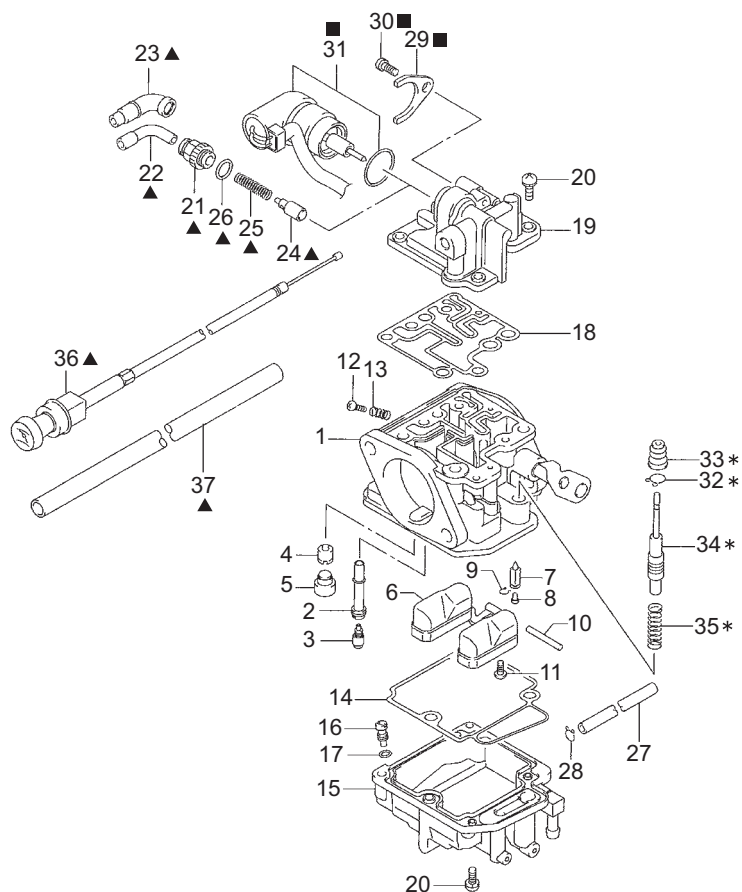


004674

Assembly

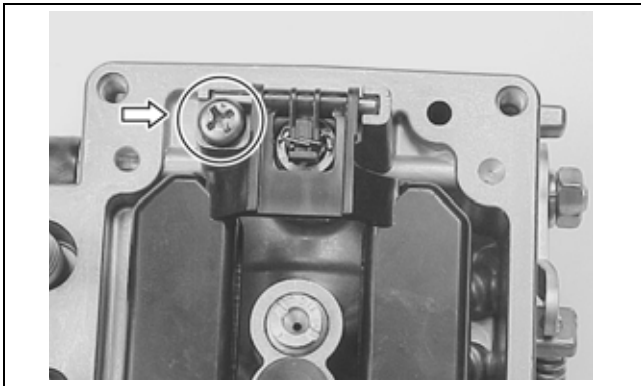
- 32. *Clip*
- 33. *Cap*
- 34. *Plunger*
- 35. *Spring*
- 36. *Starter knob assy*
- 37. *Cable protector*

▲ Tiller models



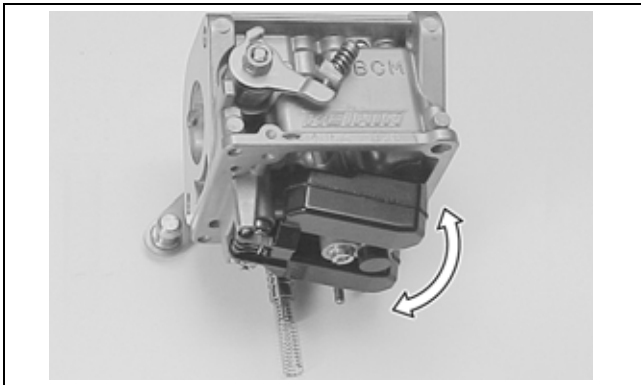
Assembly is reverse order of disassembly with special attention to the following steps:

Install the float, with float pin and needle valve. Secure float pin with screw.



004675

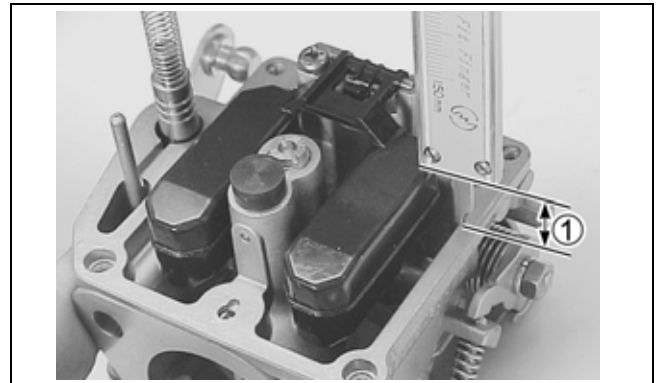
IMPORTANT: After installing float, inspect for smooth movement of float.



004676

Measure and adjust float height.

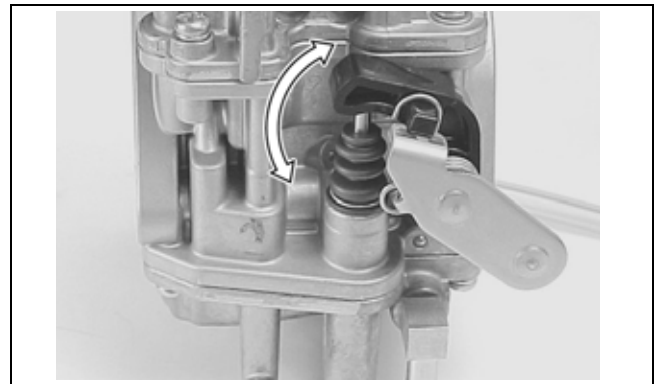
- Float height: 13.5 ± 2 mm



1. Float height

004677

Check that accelerator pump plunger operates smoothly and together with throttle lever.



004676

FUEL SYSTEM

CARBURETOR SERVICE

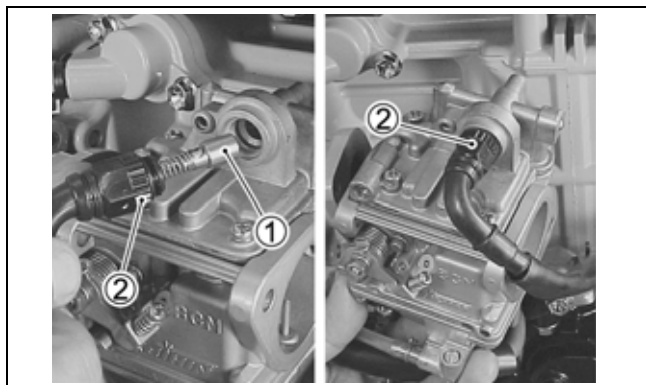
Installation

Installation is reverse order of removal with special attention to the following steps:

IMPORTANT: Do not re-use gasket. Air leakage will cause a lean air/fuel mixture which can result in severe engine damage.

Tiller models:

- Install starter cable with starter plunger, then tighten the starter cable lock nut securely.

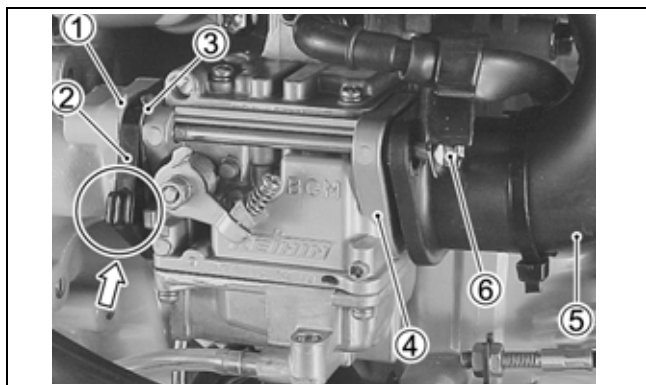


1. Starter plunger
2. Starter cable lock nut

004655

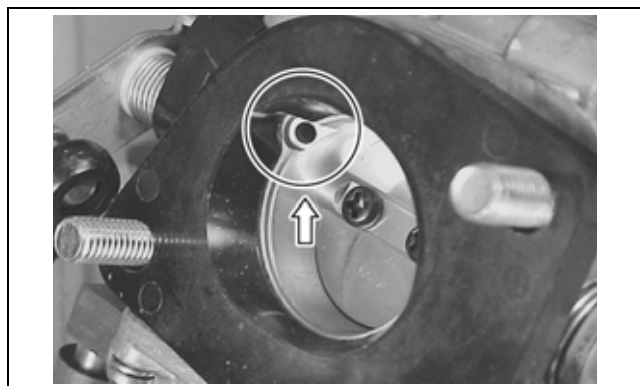
Install insulator gasket, insulator, carburetor gasket, carburetor, and silencer case. Tighten carburetor mounting screws to 84 in. lbs. (10 N·m).

IMPORTANT: When installing carburetor gasket, be sure that starter fuel passage is not obstructed. The projection of insulator must be faced to STBD and intake manifold sides.



1. Insulator gasket
2. Insulator
3. Carburetor gasket
4. Carburetor
5. Silencer case
6. Screws

004656



Starter fuel passage

004657

Perform the following checks to ensure proper and safe operation:

- All parts removed have been returned to their original positions.
- No fuel leakage is evident when fuel system is pressurized.

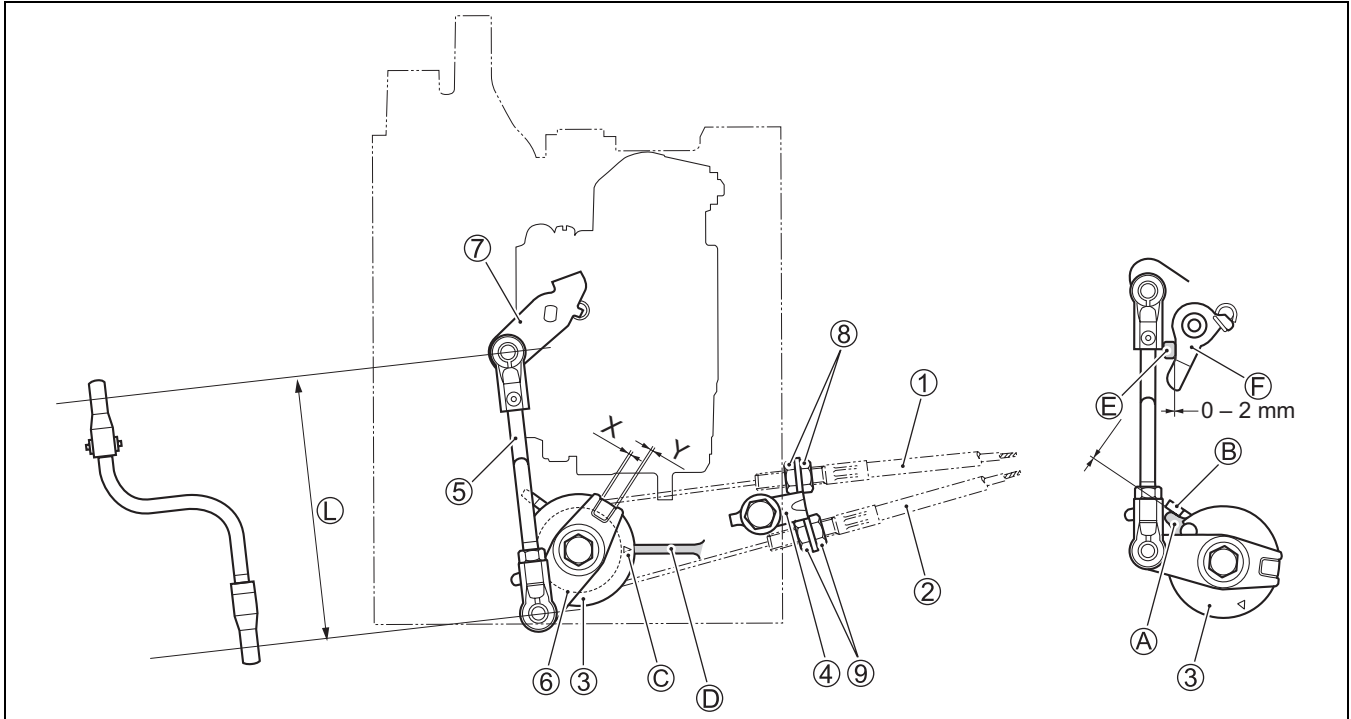
**WARNING**

After servicing the fuel system, check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

THROTTLE CONTROL

Installation/Adjustment

Tiller Models



Fit two throttle cables, (1) and (2), both to the throttle drum (3) and the cable holder (4).

Adjust the length (L) of throttle rod (5) to 96 mm (3.78 in.).

Fit one end of the throttle rod (5) to the throttle lever (6) and other end to the carburetor throttle arm (7).

Turn throttle control grip to its full open position. Adjust the throttle cable (1) by turning the lock nuts (8) so that the stopper (A) on the throttle drum (3) can contact the stopper (B) on the cylinder block.

Return throttle control grip to its completely closed position. Adjust the throttle cable (2) by turning the lock nuts (9) so that the matching mark (C) can align with the rib (D) on the cylinder block.

With the throttle control grip in completely closed position, check that there are clearances, X and Y, between the throttle drum and throttle control lever. Secure the throttle cables, (1) and (2), on the cable holder by tightening the lock nut.

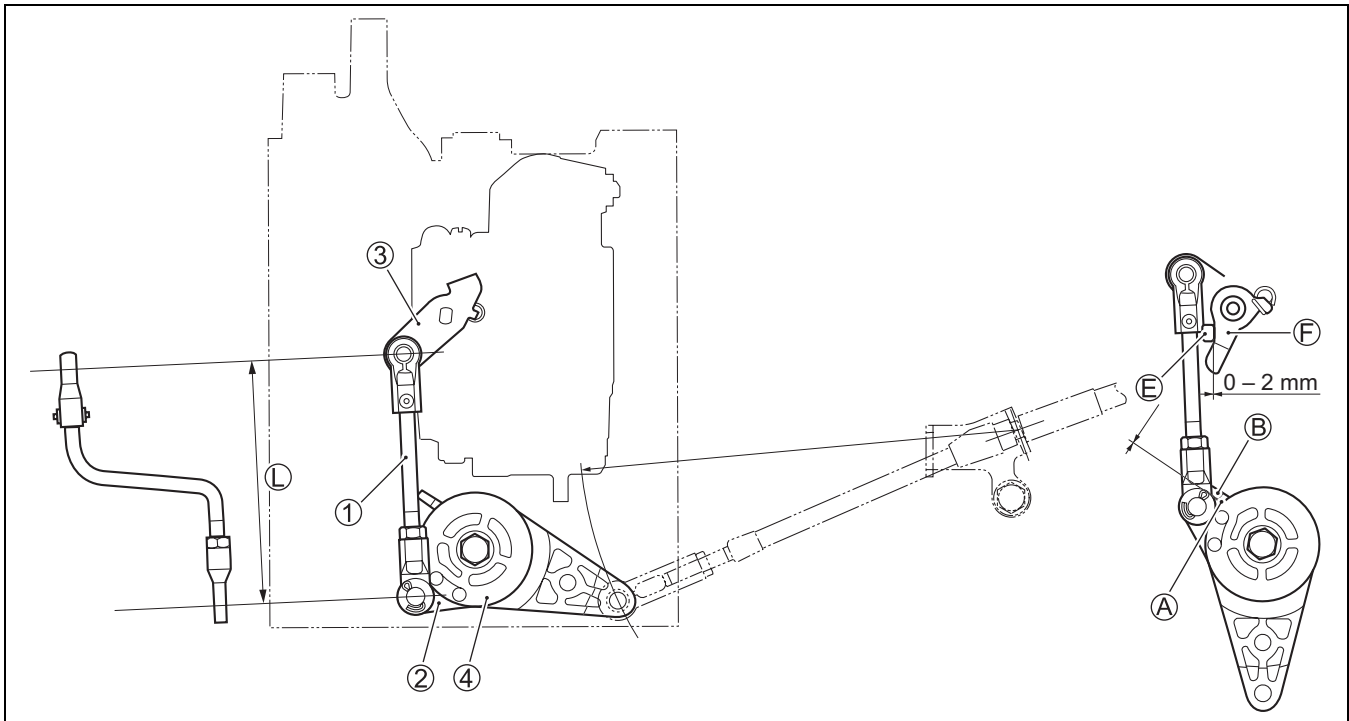
Position the throttle control grip in full open position. Check that there is 0-2 mm of clearance between the carburetor full open stopper (E) and the lever (F) when the throttle drum stopper (A) and cylinder block stopper (B) are in contact.

Loosen the throttle tension adjuster fully. Open the throttle control grip fully and then release. The throttle control grip should return to the closed direction by the return spring force on the carburetor. If the grip does not return, readjustment is necessary because the throttle cable tension is too high.

FUEL SYSTEM

THROTTLE CONTROL

Remote Models



Adjust the length (L) of throttle rod (1) to 88.5 mm (3.48 in.).

Fit one end of the throttle rod (1) to the throttle lever (2) and other end to the carburetor throttle arm (3).

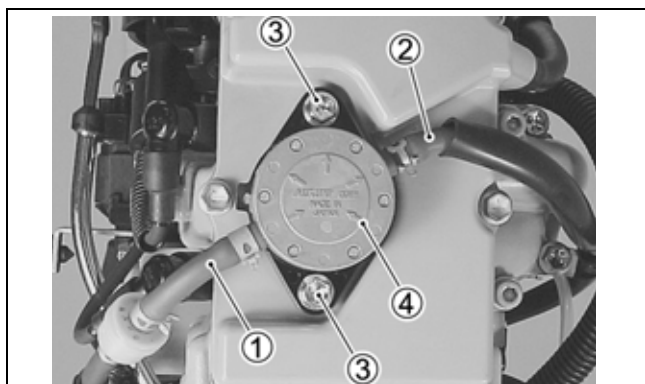
Turn throttle drum (4) clockwise to allow the throttle drum stopper (A) to contact the cylinder block stopper (B). Check that there is 0 – 2 mm of clearance between the carburetor full open stopper (E) and the lever (F). If no clearance is found, adjust the length of throttle rod.

FUEL PUMP

Removal

Disconnect the inlet hose and outlet hose from fuel pump.

Remove two screws.

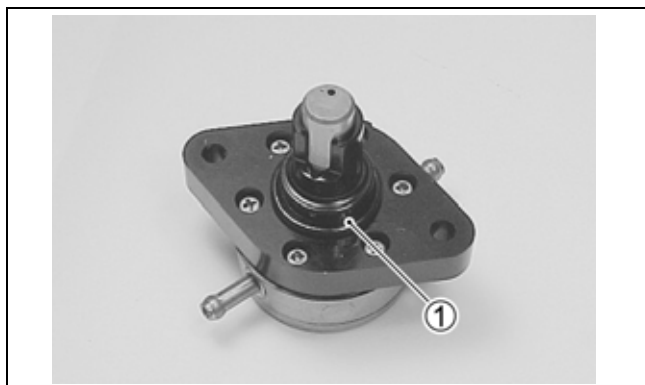


1. Inlet hose
2. Outlet hose
3. Screws
4. Fuel pump

004679

Remove the fuel pump and o-ring.

IMPORTANT: Do not re-use o-ring. Always use a new o-ring.

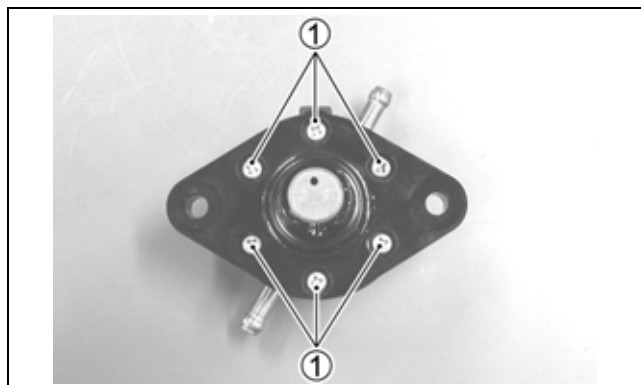


1. O-ring

004680

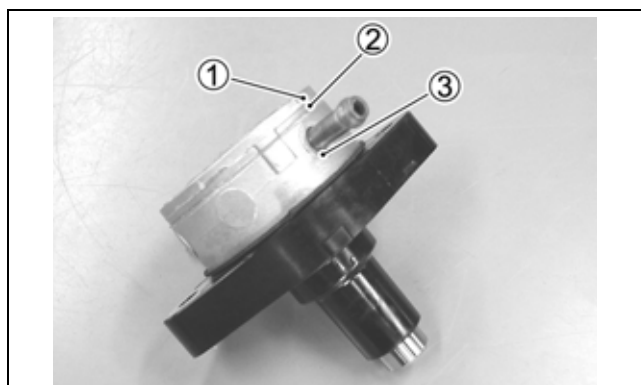
Disassembly

Remove six screws, outer plate, gasket, and valve body.



1. Screws

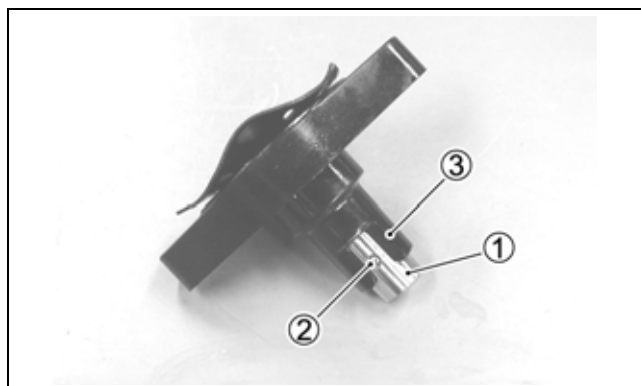
004683



1. Outer plate
2. Gasket
3. Valve body

004684

Turn piston until the pin comes out through cut-away of pump body.



1. Piston
2. Pin
3. Pump body

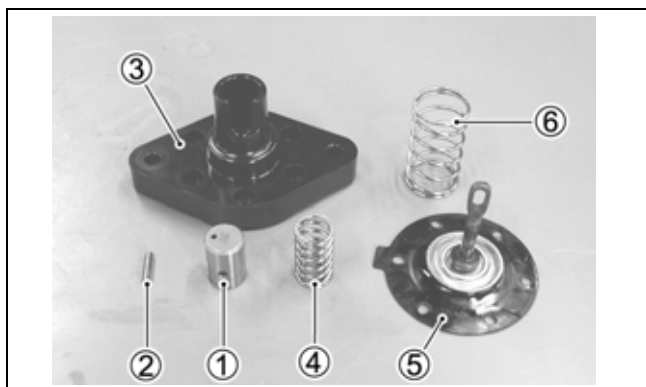
004685

FUEL SYSTEM

FUEL PUMP

Remove the following parts:

- Piston
- Pin
- Pump body
- Spring
- Diaphragm
- Spring



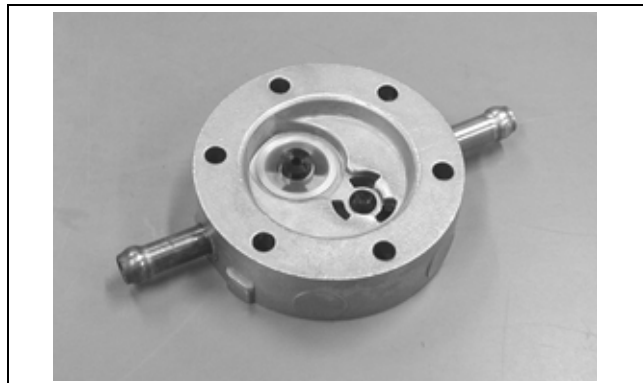
1. Piston
2. Pin
3. Pump body
4. Spring
5. Diaphragm
6. Spring

004686

IMPORTANT: Do not re-use the diaphragm set once removed. Always use a new diaphragm set.

Inspection

Inspect the fuel pump check valves. If tears, distortion, or damage is found, replace the fuel pump.



004687

Inspect the fuel pump body and outer plate. If cracks, nicks, distortion, or damage is found, replace the fuel pump.



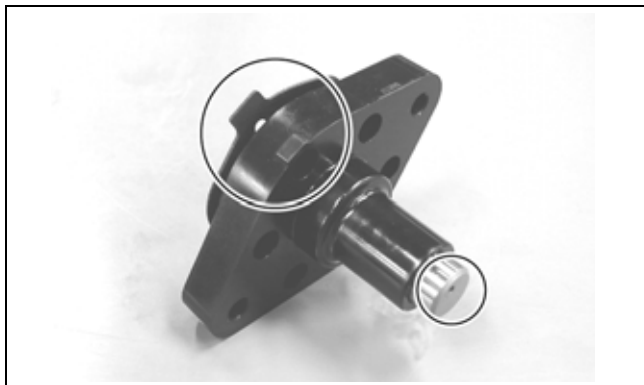
004688

Assembly

Assembly is reverse order of disassembly with special attention to the following steps:

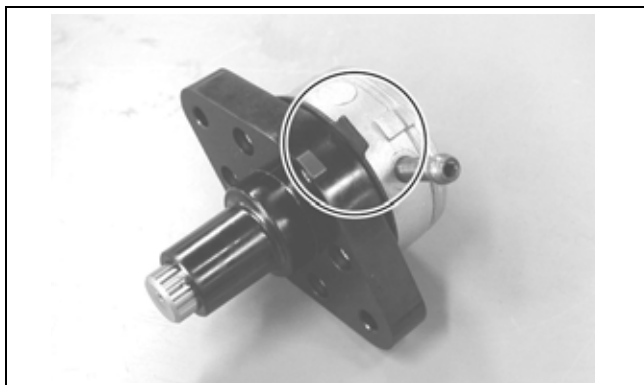
When connecting the diaphragm set to piston with pin, align punch mark on the piston and the projection of diaphragm.

IMPORTANT: Do not re-use the diaphragm set once removed. Always use a new diaphragm set.



004689

Align the projections on the pump body, the diaphragm, valve body, gasket, and outer plate when assembling.

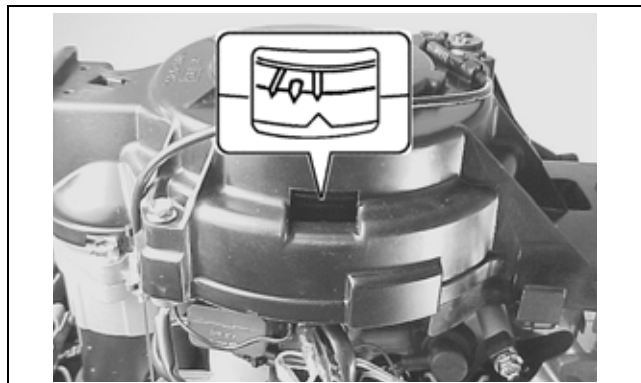


004690

Installation

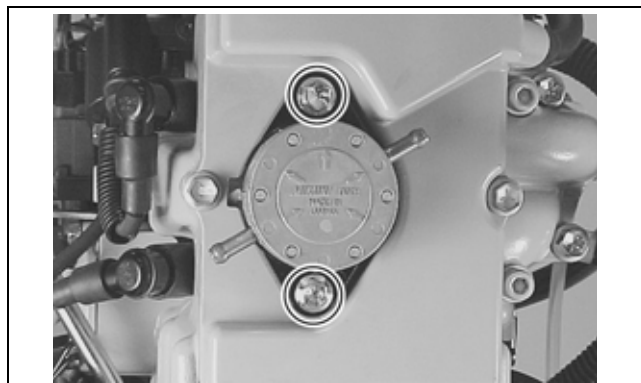
Installation is reverse order of removal with special attention to the following steps:

IMPORTANT: Before installing fuel pump, rotate the crankshaft to bring the No. 1 (top cylinder) piston to Top Dead Center on a compression stroke.



004681

Tighten fuel pump screws 84 in. lbs. (10 N·m).



004682



WARNING



After servicing the fuel system, check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

POWERHEAD

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**POWERHEAD
SPECIFICATIONS**

SPECIFICATIONS

Item	Unit	Data
		9.9/15 HP

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.05 (0.002)
Cam height	IN	STD	mm (in)	23.394 – 23.454 (0.9210 – 0.9234)
		Limit	mm (in)	23.294 (0.9171)
	EX	STD	mm (in)	23.397 – 23.457 (0.9211 – 0.9235)
		Limit	mm (in)	23.297 (0.9172)
Camshaft journal oil clearance		STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Camshaft holder inside diameter	Upper	STD	mm (in)	25.000 – 25.021 (0.9843 – 0.9851)
	Lower	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)
Camshaft journal outside diameter	Upper	STD	mm (in)	24.959 – 24.980 (0.9826 – 0.9835)
	Lower	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
Rocker arm shaft to rocker arm clearance		STD	mm (in)	0.016 – 0.045 (0.0006 – 0.0018)
		Limit	mm (in)	0.060 (0.0024)
Rocker arm inside diameter		STD	mm (in)	13.000 – 13.018 (0.5118 – 0.5125)
Rocker arm shaft outside diameter		STD	mm (in)	12.973 – 12.984 (0.5107 – 0.5112)

Item	Unit	Data	
		9.9/15 HP	

VALVE/VALVE GUIDE

Valve diameter	IN		mm (in)	26 (1.0)
	EX		mm (in)	22 (0.9)
Valve clearance (when cold)	IN	STD	mm (in)	0.18 – 0.22 (0.007 – 0.009)
	EX	STD	mm (in)	0.18 – 0.22 (0.007 – 0.009)
Valve guide to valve stem clearance	IN	STD	mm (in)	0.010 – 0.037 (0.0004 – 0.0015)
		LIMIT	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.035 – 0.062 (0.0014 – 0.0024)
		LIMIT	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve stem outside diameter	IN	STD	mm (in)	5.475 – 5.490 (0.2156 – 0.2161)
	EX	STD	mm (in)	5.450 – 5.465 (0.2146 – 0.2152)
Valve guide protrusion	IN,EX	LIMIT	mm (in)	10 (0.39)
Valve stem deflection	IN,EX	LIMIT	mm (in)	0.016 (0.006)
Valve stem runout	IN,EX	LIMIT	mm (in)	0.05 (0.002)
Valve head radial runout	IN,EX	LIMIT	mm (in)	0.03 (0.001)
Valve head thickness	IN,EX	LIMIT	mm (in)	0.5 (0.02)
Valve seat width	IN,EX	STD	mm (in)	0.9 – 1.1 (0.035 – 0.043)
Valve spring free length		STD	mm (in)	32.52 (1.280)
		LIMIT	mm (in)	32.40 (1.276)
Valve spring tension		STD	kg (lb)	9 (19.8) at length 28.5 mm (1.12 in)
		LIMIT	kg (lb)	7.6 (16.8) at length 28.5 mm (1.12 in)

POWERHEAD SPECIFICATIONS

Item	Unit	Data	
		9.9/15 HP	

CYLINDER/PISTON/PISTON RING

Cylinder distortion	Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance	STD	mm (in)	0.0276 – 0.0425 (0.0011 – 0.0017)
	Limit	mm (in)	0.100 (0.0039)
Cylinder bore	STD	mm (in)	58.000 – 58.015 (2.2835 – 2.2841)
Cylinder measuring position		mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter	STD	mm (in)	57.965 – 57.980 (2.2821 – 2.2827)
Piston measuring position		mm (in)	15 (0.6) from piston skirt end
Cylinder bore wear	Limit	mm (in)	0.055 (0.0022)
Piston ring end gap	1st	STD	0.10 – 0.25 (0.004 – 0.010)
		Limit	0.50 (0.020)
	2nd	STD	0.10 – 0.25 (0.004 – 0.010)
		Limit	0.50 (0.020)
Piston ring free end gap	1st	STD	Approx. 5.8 (0.23)
		Limit	4.6 (0.18)
	2nd	STD	Approx. 7.4 (0.29)
		Limit	5.9 (0.23)
Piston ring to groove clearance	1st	STD	0.02 – 0.06 (0.0008 – 0.0024)
		Limit	0.10 (0.004)
	2nd	STD	0.02 – 0.06 (0.0001 – 0.002)
		Limit	0.10 (0.004)
Piston ring to groove width	1st	STD	1.21 – 1.23 (0.0476 – 0.0484)
	2nd	STD	1.21 – 1.23 (0.0476 – 0.0484)
	Oil	STD	2.51 – 2.53 (0.0988 – 0.0996)
Piston ring thickness	1st	STD	1.17 – 1.19 (0.0461 – 0.0469)
	2nd	STD	1.17 – 1.19 (0.0461 – 0.0469)
Piston pin oil clearance	STD	mm (in)	0.002 – 0.013 (0.0001 – 0.0005)
	Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter	STD	mm (in)	13.995 – 14.000 (0.5510 – 0.5512)
	Limit	mm (in)	13.980 (0.5504)
Piston pin hole diameter	STD	mm (in)	14.002 – 14.008 (0.5513 – 0.5515)
	Limit	mm (in)	14.030 (0.5524)

Item	Unit	Data	
		9.9/15 HP	

CRANKSHAFT / CONNECTING ROD

Connecting rod small end inside diameter	STD	mm (in)	14.006 – 14.014 (0.5514 – 0.5517)
	Limit	mm (in)	14.040 (0.5528)
Connecting rod big end oil clearance	STD	mm (in)	0.025 – 0.045 (0.0010 – 0.0018)
	Limit	mm (in)	0.063 (0.0025)
Connecting rod big end inside diameter	STD	mm (in)	29.025 – 29.034 (1.1427 – 1.1431)
Crank pin outside diameter	STD	mm (in)	28.989 – 29.000 (1.1413 – 1.1417)
Crank pin outside diameter difference	Limit	mm (in)	0.010 (0.0004)
Connecting rod big end side clearance	STD	mm (in)	0.10 – 0.20 (0.004 – 0.008)
	Limit	mm (in)	0.60 (0.024)
Connecting rod big end width	STD	mm (in)	19.95 – 20.00 (0.785 – 0.787)
Crank pin width	STD	mm (in)	20.10 – 20.15 (0.791 – 0.793)
Crankshaft thrust clearance	Limit	mm (in)	0.60 (0.024)
Crankshaft length	STD	mm (in)	126.8 – 126.9 (4.992 – 4.996)
Crankcase length	STD	mm (in)	127.0 – 127.1 (5.000 – 5.004)
Crankshaft main bearing oil clearance	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
	Limit	mm (in)	0.060 (0.0024)
Crankcase bearing holder inside diameter	STD	mm (in)	35.000 – 35.016 (1.3780 – 1.3786)
Crankshaft bearing journal outside diameter	STD	mm (in)	31.989 – 32.000 (1.2594 – 1.2598)
Crankshaft journal outside diameter difference	Limit	mm (in)	0.010 (0.0004)
Bearing thickness	STD	mm (in)	1.486 – 1.494 (0.0585 – 0.0588)

THERMOSTAT

Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)
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TEST PROCEDURES

Compression Testing

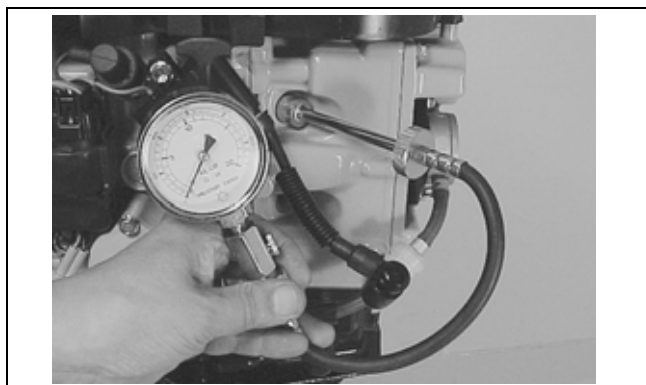
Start and run outboard until it achieves operating temperature, then shut OFF.

Remove lower side covers. Refer to **SIDE COVER** on p. 180.

Remove spark plugs

Advance throttle linkage to WOT.

Install compression tester's hose attachment into spark plug hole.



004475



WARNING



Disconnect the safety lanyard from the emergency stop switch prior to cranking the engine. This will prevent any residual fuel from the cylinders from being ignited by a spark from the spark plug cap.

While cranking outboard with starter, note maximum pressure reading on gauge. Repeat procedure for each cylinder.

IMPORTANT: The values shown are guidelines only, not absolute service limits.

Cylinder Compression Test

Standard (models with decom- pression system)	78 to 120 psi (550 to 850 kPa)
Standard (models without decom- pression system)	116 to 175 psi (820 to 1230 kPa)
Maximum difference between cylinders	14 psi (100 kPa)

If engine shows a variation greater than 14 psi (100 kPa) between cylinders, check for:

- Excessively worn cylinder wall
- Worn piston
- Worn or stuck piston rings
- Poor seating of valves
- Ruptured or damaged cylinder head gasket

Install all parts that were removed.

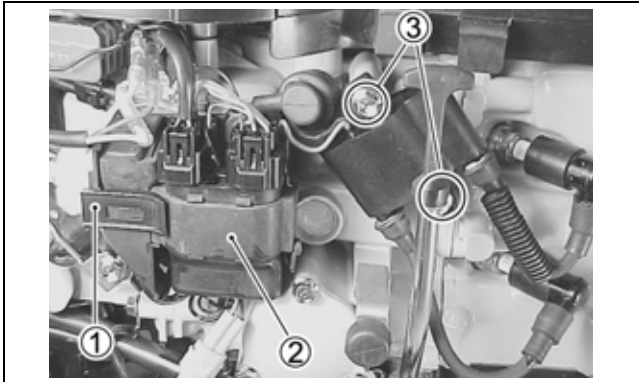
Oil Pressure Test

Check the engine oil level.

Remove CDI stopper plate by sliding it upward.

Remove CDI unit from electrical parts holder.

Remove the two screws securing ignition coil.

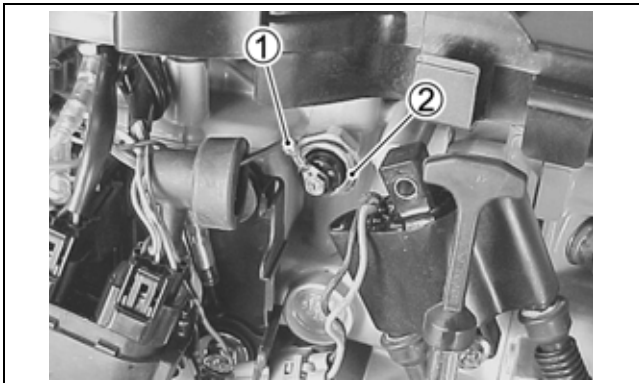


1. Stopper plate
2. CDI unit
3. Ignition coil screws

004476

Loosen screw and disconnect blue lead wire from oil pressure switch.

Remove the oil pressure switch.



1. Blue lead wire
2. Oil pressure switch

004477

Install Oil Pressure Test Adapter, P/N 350930, and Pressure Gauge, P/N 5000902, into oil pressure switch hole.



004478

Place CDI unit in position and install ignition coil.

Connect an engine tachometer.

Start and run outboard until it achieves operating temperature.

After warm up, shift into forward gear and increase speed to 3000 RPM. Pressure should read 28 to 71 psi (200 to 500 kPa) at 3000 RPM.

IMPORTANT: The values shown are guidelines only, not absolute service limits.

If oil pressure is lower or higher than specification, consider the following causes:

Low oil pressure

- Clogged oil filter
- Leakage from oil passages
- Defective oil pump
- Defective oil pressure regulator
- Damaged o-ring

High oil pressure

- Using an engine oil of too high viscosity
- Clogged oil passage
- Clogged oil pressure regulator

After testing, install the oil pressure switch.

REMOVAL AND INSTALLATION

Removal



WARNING



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

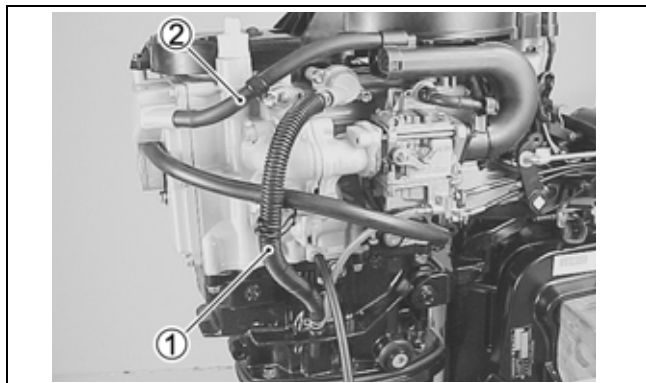
Disconnect the battery cables at the battery.

Drain engine oil. Refer to **Engine Oil** on p. 52.

Remove side covers. Refer to **SIDE COVER** on p. 180.

Remove the manual starter. Refer to **Starter REMOVAL** on p. 219.

Disconnect water hose from thermostat cover and oil pan. Disconnect breather hose from cylinder head cover and air silencer.



1. Water hose
2. Breather hose

004479

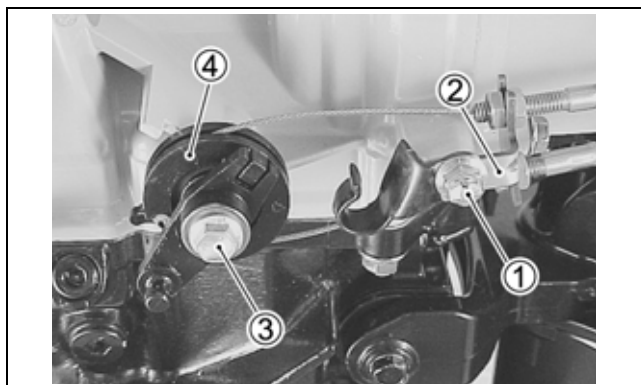
Remove air silencer and carburetor assembly. Refer to **CARBURETOR SERVICE** on p. 113.

Remove fuel pump. Refer to **FUEL PUMP** on p. 123.

On tiller handle models:

- Remove screw and throttle cable holder.

- Remove screw and throttle drum.



1. Throttle cable holder screw
2. Throttler cable holder
3. Throttle drum screw
4. Throttle drum

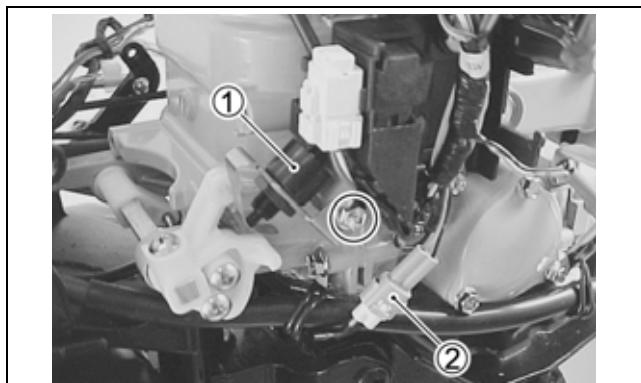
004480

Remove the flywheel and ignition components. Refer to **COMPONENT SERVICING** on p. 101.

Remove electric starter. Refer to **Starter Motor Service** on p. 79.

Remove screw and neutral switch/switch bracket. Then disconnect the switch lead connector.

Disconnect the caution lamp lead wire connector.

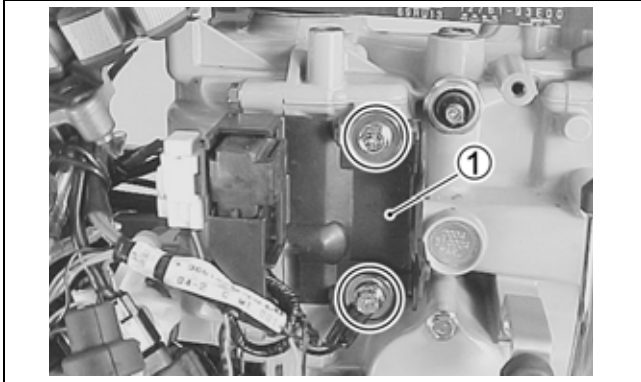


1. Neutral switch
2. Caution lamp lead connector

004481

POWERHEAD REMOVAL AND INSTALLATION

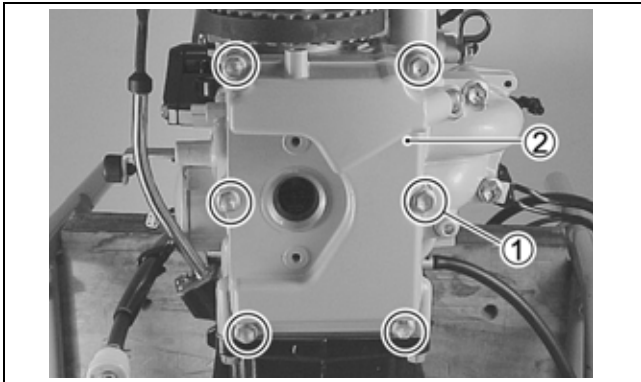
Remove the two screws securing electric parts holder, then remove stator base and engine main harness assembly.



1. Electric parts holder

004482

Remove six cylinder head cover screws, and then cylinder head cover and gasket.



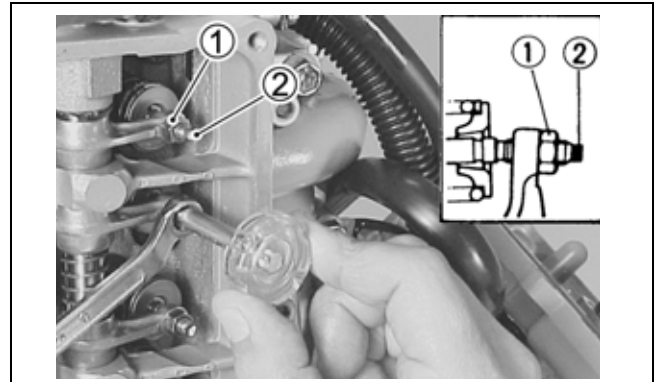
1. Cylinder head cover screws
2. Cylinder head cover

004483

Loosen all valve adjusting lock nuts.

Loosen the four valve adjusting screws fully. Leave screws in place.

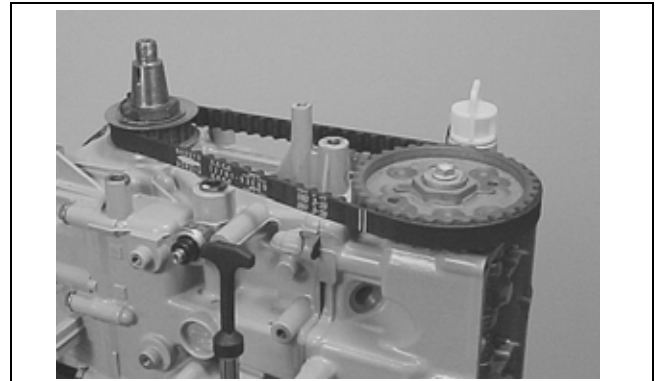
IMPORTANT: To prevent valve damage, loosen valve adjusting screws fully before removing timing belt.



1. Lock nut
2. Valve adjusting screw

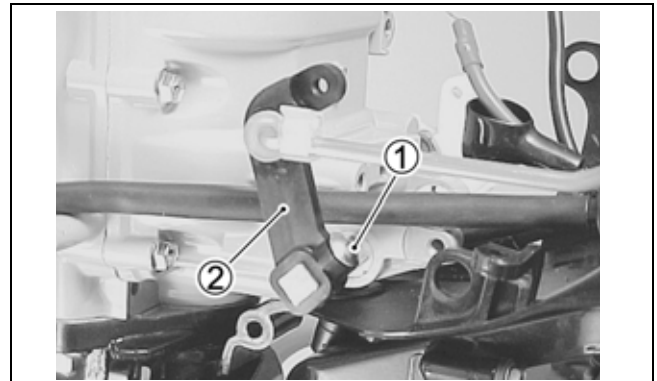
004484

Remove the timing belt. Refer to **TIMING BELT** on p. 58.



004485

Loosen screw, then remove the clutch control lever from the clutch lever shaft.

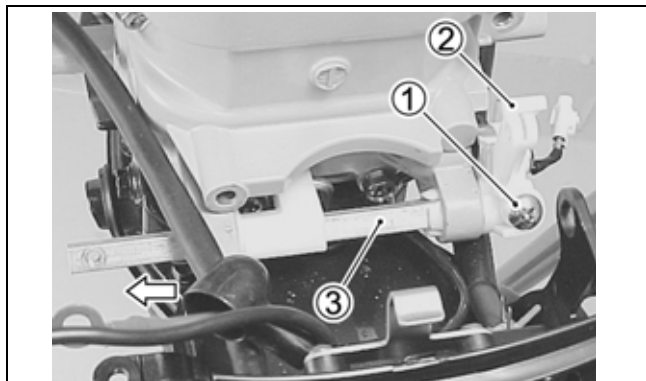


1. Screw
2. Clutch control lever

004486

POWERHEAD REMOVAL AND INSTALLATION

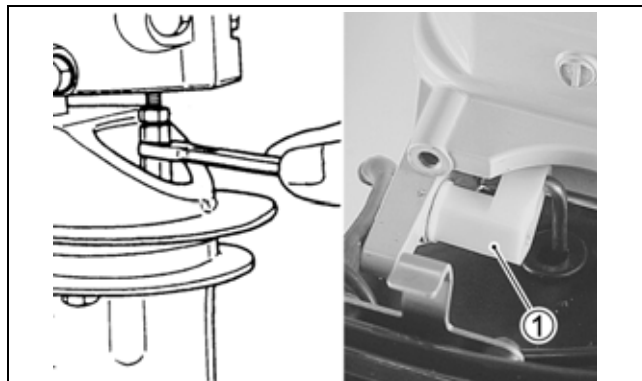
Remove the screw securing clutch notch lever.
Remove clutch lever shaft.



1. Screw
2. Clutch notch lever
3. Clutch lever shaft

004487

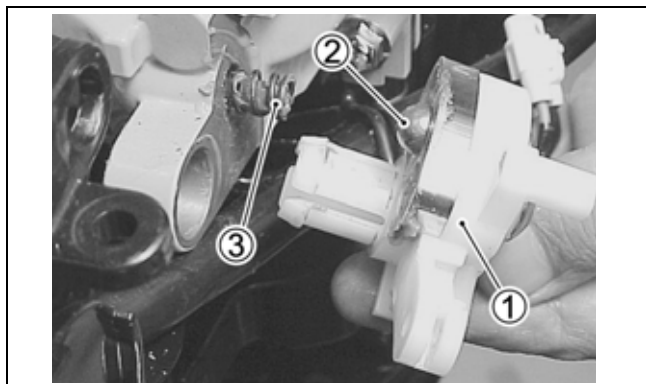
p. 200. Push the clutch rod arm out from pivot eyelet on crankcase.



1. Clutch rod arm

004489

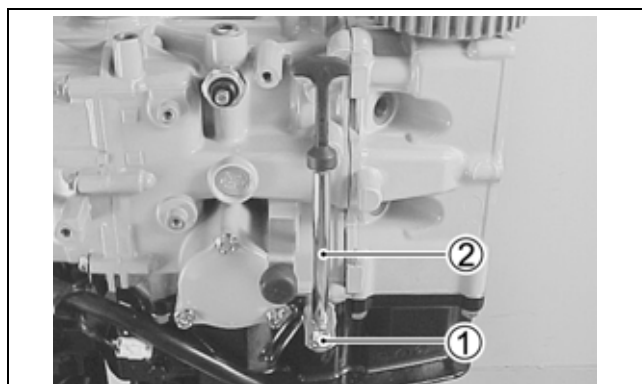
Remove clutch notch lever, clutch notch ball, and spring.



1. Clutch notch lever
2. Clutch notch ball
3. Spring

004488

Remove screw and oil dipstick tube.



1. Screw
2. Dipstick tube

004490

Remove six screws and two nuts. Lift powerhead from oil pan.



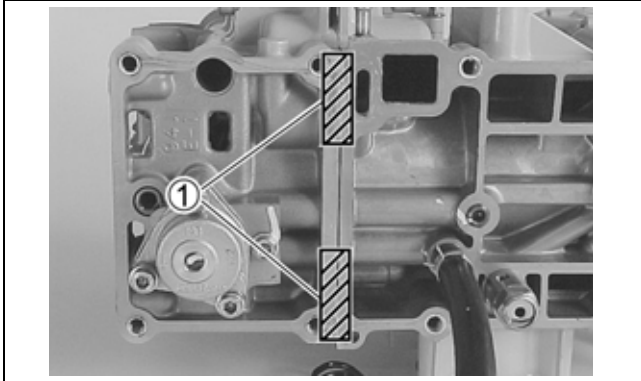
004491

Separate the clutch rod from the shift rod. Refer to Gearcase **REMOVAL AND INSTALLATION** on

Installation

Installation is reverse order of removal with special attention to the following:

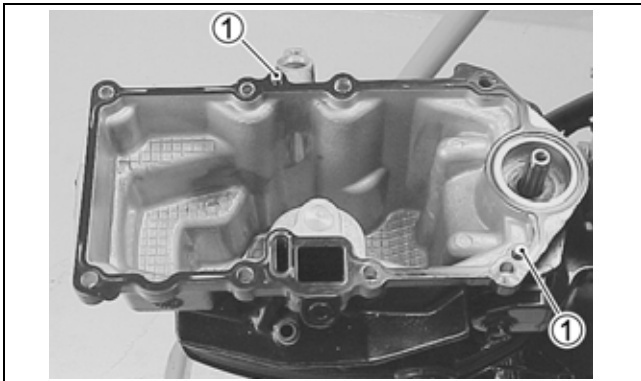
Apply *ThreeBond*[†] 1207B sealant to areas shown:



1. Apply sealant here

004492

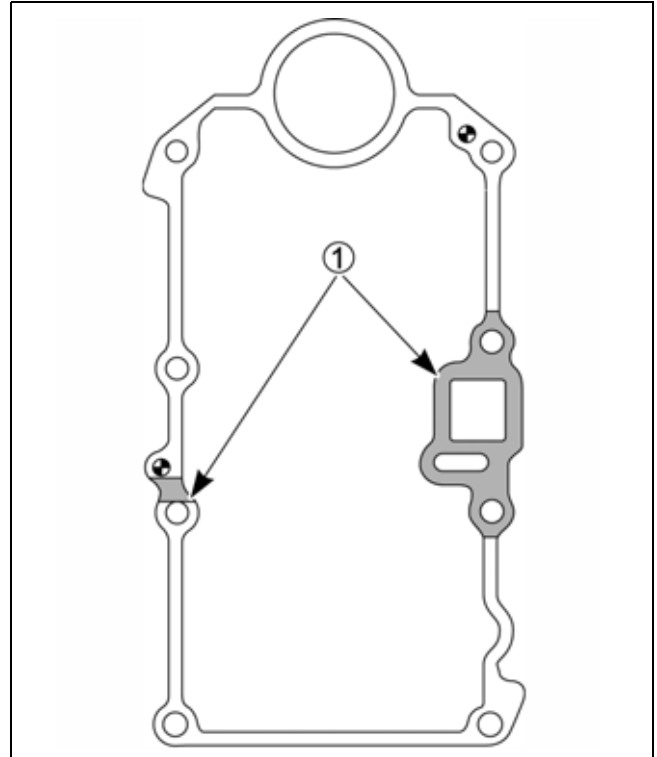
Install dowel pins in oil pan.



1. Dowel pins

004493

Apply *ThreeBond* 1207B sealant to both surfaces of **new** base gasket at positions shown and install on oil pan.



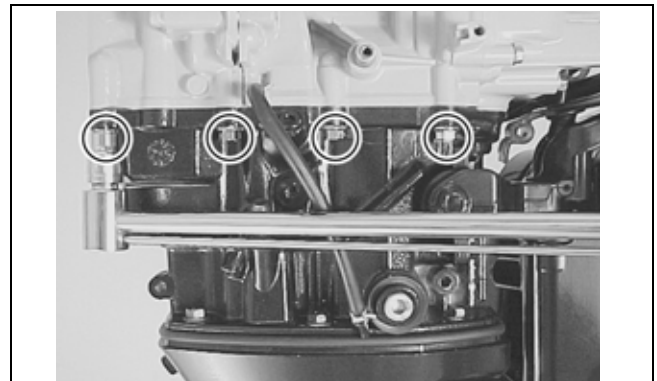
1. Apply sealant here

004494

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

Lower the powerhead on to oil pan. If necessary, rotate crankshaft to align crankshaft and drive-shaft splines.

Apply *Gasket Sealing Compound* to mounting screws. Install and tighten 6 screws and two nuts to 198 in. lbs. (23 N·m).

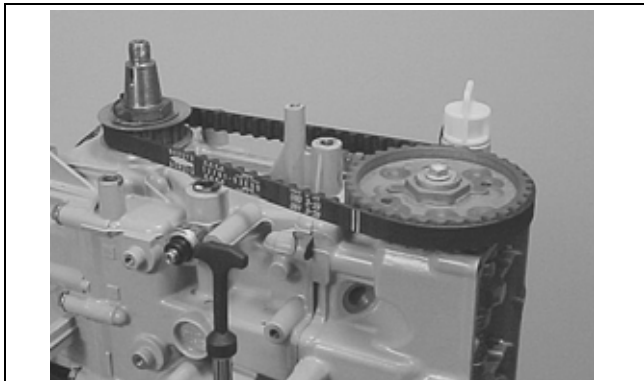


004495

POWERHEAD

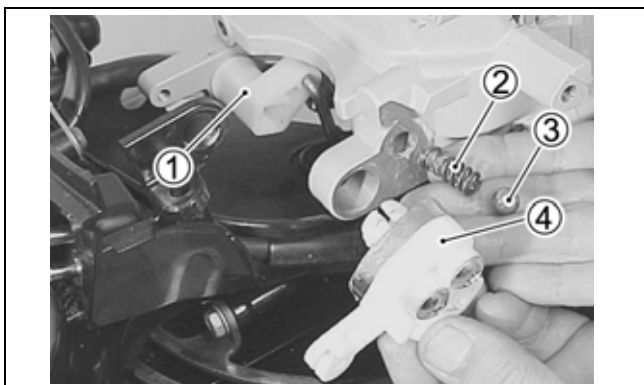
REMOVAL AND INSTALLATION

Install the timing belt. Refer to **TIMING BELT** on p. 58.



004485

Install clutch rod arm, clutch notch spring, ball, and clutch notch lever.

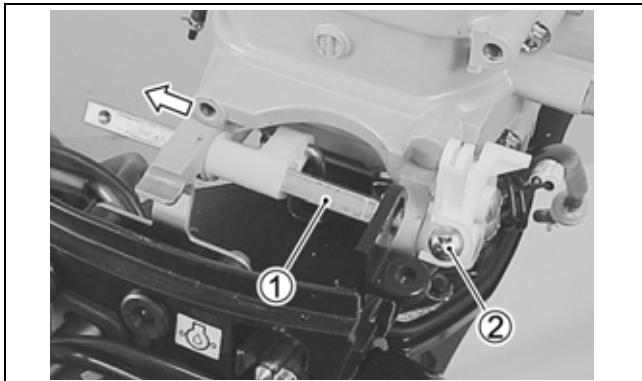


1. Clutch rod arm
2. Clutch notch spring
3. Ball
4. Clutch notch lever

004496

Install clutch lever shaft by passing it from PORT side through the clutch notch lever and then the

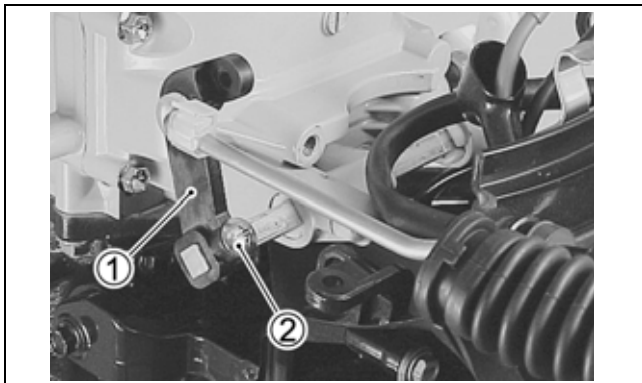
clutch rod arm. Tighten the clutch notch lever with screw.



1. Clutch lever shaft
2. Screw

004497

Install clutch control lever. Tighten screw securely.

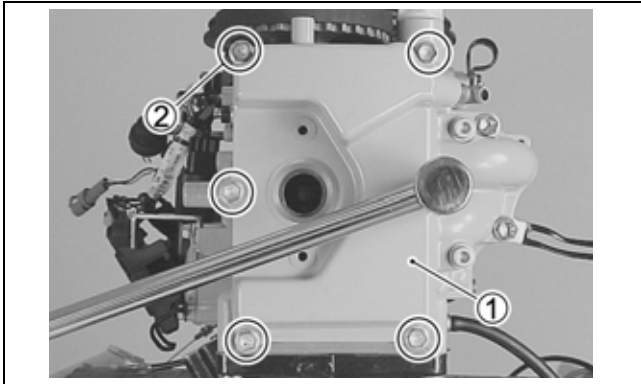


1. Clutch control lever
2. Screw

004498

IMPORTANT: Before installing cylinder head cover, check valve clearance. Refer to **VALVE CLEARANCE** on p. 56.

Install cylinder head cover gasket and cylinder head cover. Tighten cover screws 84 in. lbs. (10 N·m).



1. Cylinder head cover
2. Cover screws

004499

Final Assembly Checks

Install ignition and electrical components. Refer to **COMPONENT SERVICING** on p. 101.

Install the manual starter. Refer to Starter **INSTALLATION** on p. 223.

Install fuel system components. Refer to **FUEL SYSTEM** on p. 107.

Confirm correct wire and hose routing. Refer to **WIRE/HOSE ROUTING** on p. 225.

Fill crankcase with recommended engine oil. Refer to **Engine Oil** on p. 52.

Install side covers. Refer to side cover **Removal and Installation** on p. 180.

Check for fuel, oil, or water leaks.



WARNING



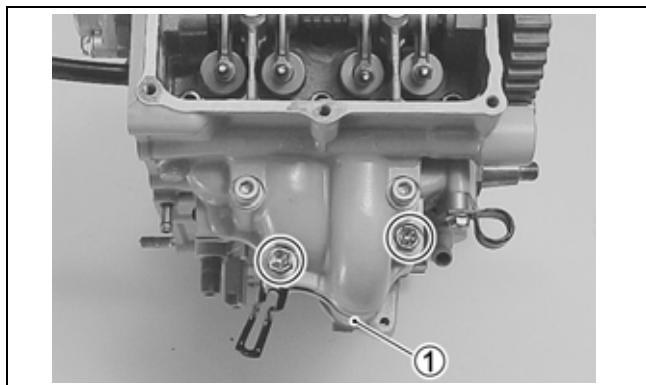
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

IMPORTANT: To avoid permanent powerhead damage, instruct operator to repeat the original outboard break-in procedure, as described in the **Operator's Guide**, before putting outboard back into normal service.

CYLINDER HEAD ASSEMBLY

Removal

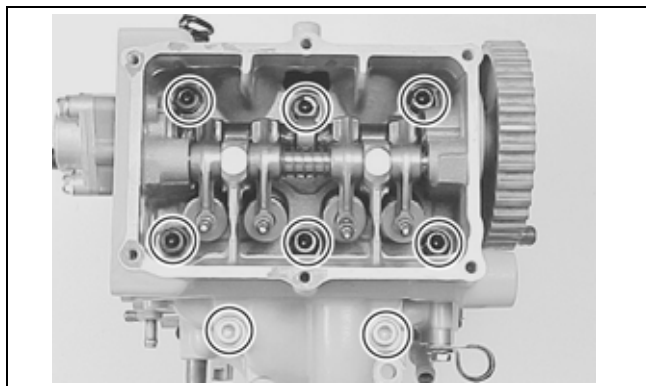
Remove two intake manifold screws and intake manifold.



1. Intake manifold

004500

Remove eight cylinder head screws and cylinder head.



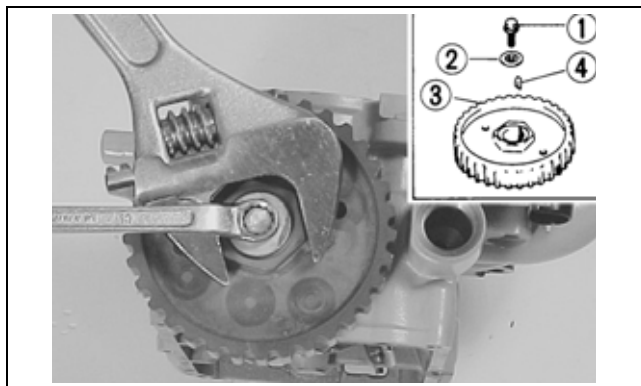
1. Cylinder head screws

004501

Disassembly

Remove the screw, washer, and cam pulley.

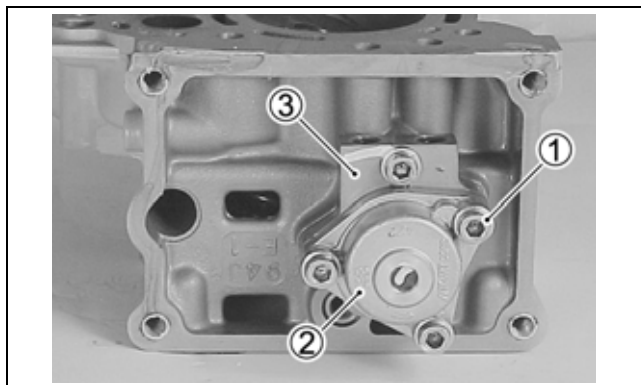
Remove key from camshaft.



1. Screw
2. Washer
3. Cam pulley
4. Key

004502

Remove four screws, oil pump assembly, and oil gallery block.

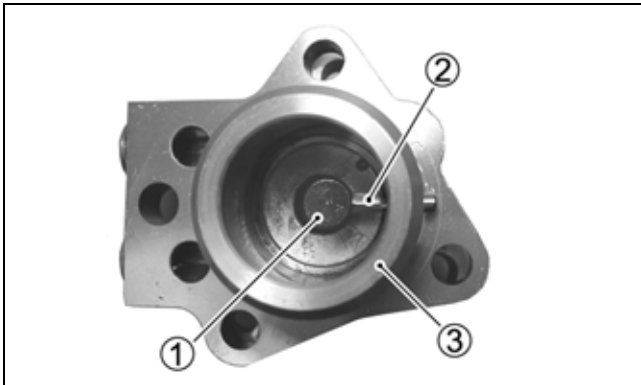


1. Screw
2. Oil pump assembly
3. Oil gallery block

004503

POWERHEAD CYLINDER HEAD ASSEMBLY

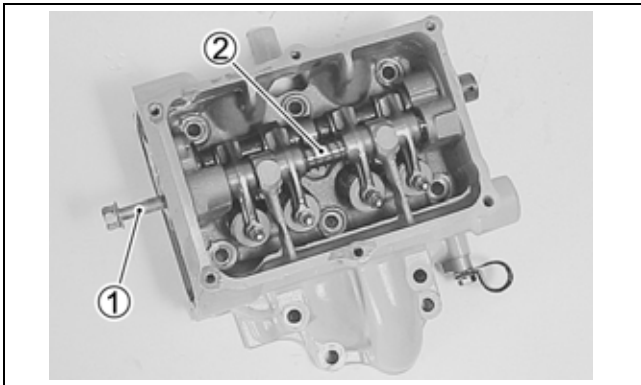
Turn the oil pump shaft until the pin aligns with hole in oil gallery block. Remove pin.



1. Oil pump shaft
2. Pin
3. Gallery block

004504

Install an 8 mm bolt into the lower end of the rocker arm shaft. Use the bolt to pull out the shaft.

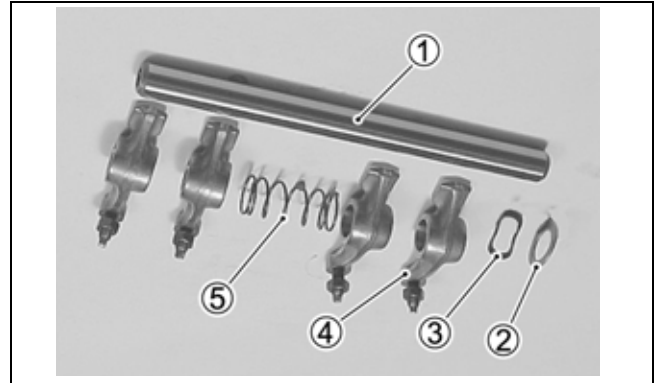


1. 8 mm bolt
2. Rocker arm shaft

004505

Remove the washer, wave washer, rocker arms, and spring.

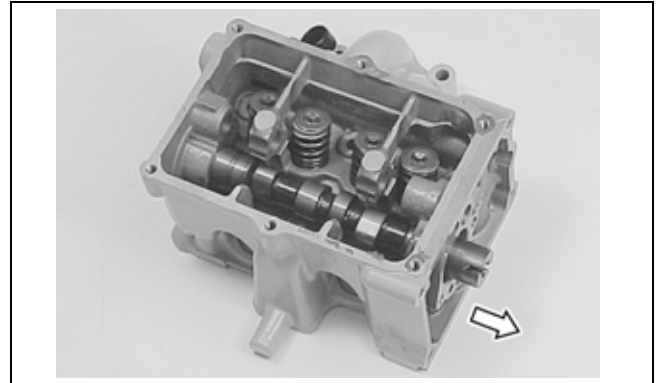
IMPORTANT: Mark each rocker arm for reassembly in its original position.



1. Rocker arm shaft
2. Washer
3. Wave washer
4. Rocker arm
5. Spring

004506

Pull the camshaft out toward oil pan side.



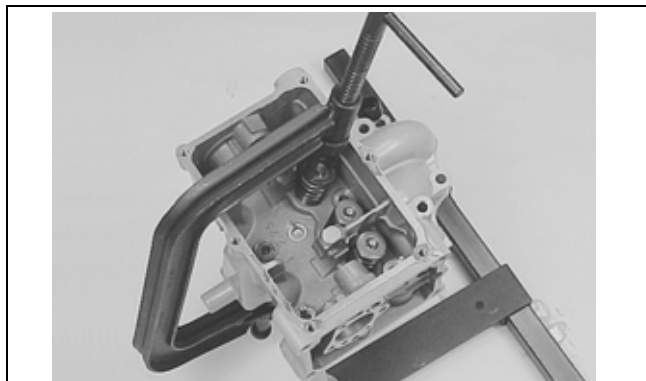
004507

Use Valve Spring Compressor, P/N 346186, and attachment "A" from Valve Lifter Adaptor Kit,

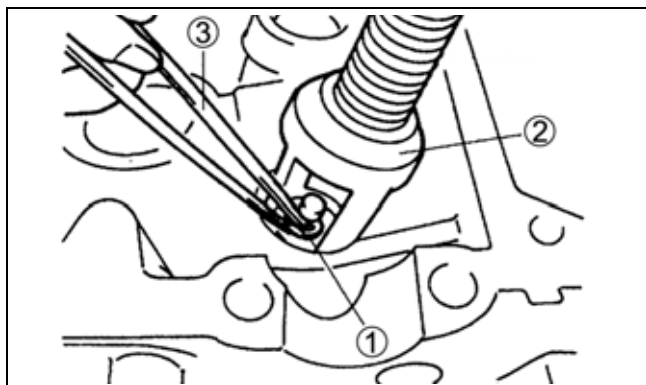
POWERHEAD

CYLINDER HEAD ASSEMBLY

P/N 5000899, and tweezers to remove valve cot-
ters while compressing valve spring.



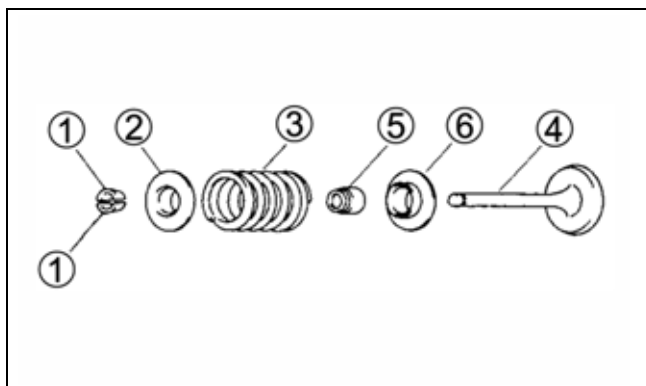
004508



1. Valve cotters
2. Attachment "A"
3. Tweezers

004509

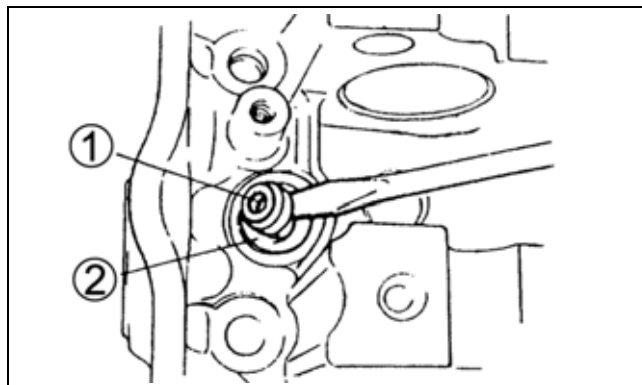
Remove valve spring retainer, valve spring, and
valve.



1. Cotters
2. Retainer
3. Spring
4. Valve
5. Valve stem seal
6. Valve spring seat

004510

Remove valve stem seal and valve spring seat.



1. Valve stem seal
2. Valve spring seat

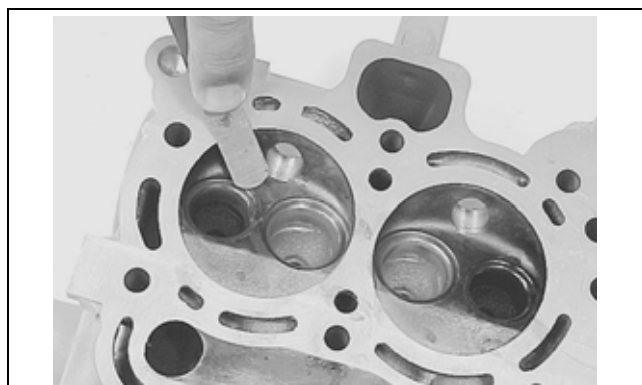
004511

Cleaning/Inspection

Cylinder Head

Remove all carbon from combustion chambers.

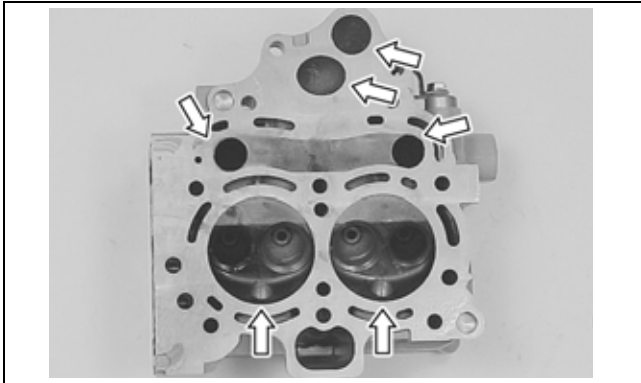
IMPORTANT: Do not use sharp edged tools to
scrape carbon off cylinder head or components.
Be careful not to scuff or nick metal surfaces.



004512

Inspect intake and exhaust ports, combustion
chambers, head surface, and valve seat.

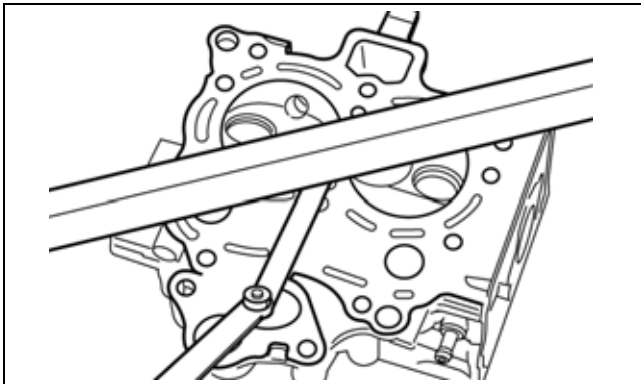
If cracks or other damage are found, replace cylinder head.



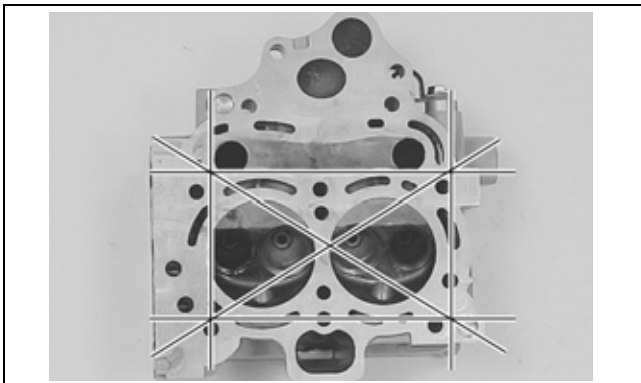
004513

Check for cylinder head warpage using a piece of bar stock or machinist's straightedge and a feeler gauge set.

Measure distortion across six locations. Cylinder head warpage must not exceed 0.002 in. (0.05 mm). If measurement exceeds this limit, resurface or replace cylinder head.



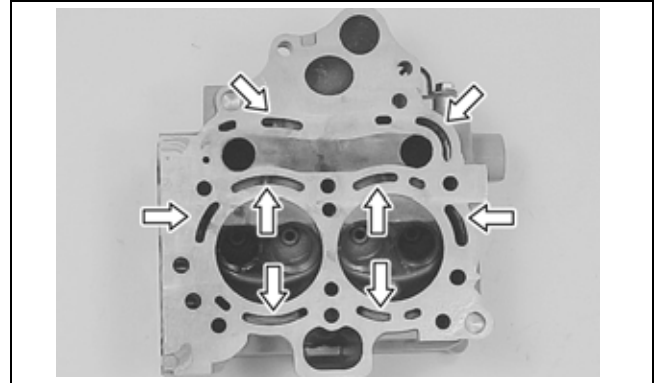
004514



004515

IMPORTANT: Cylinder head can be resurfaced, using a surface plate and #400 grit wet sandpaper. Move the cylinder head in a figure eight pattern when sanding.

Inspect and clean water jackets.

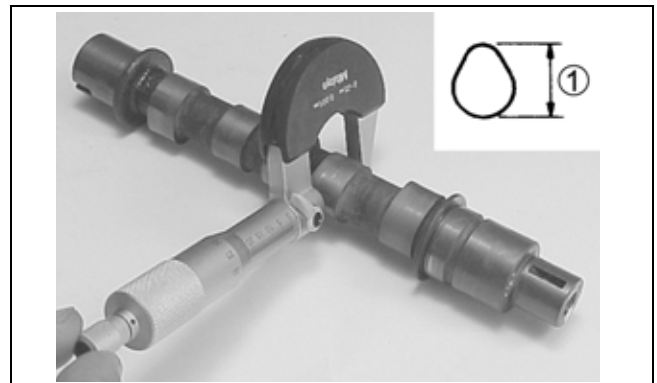


004616

Camshaft

Inspect cam face for scratches and wear.

Use a micrometer to measure the cam height. If measurement is outside service limit, replace camshaft.



1. Cam height

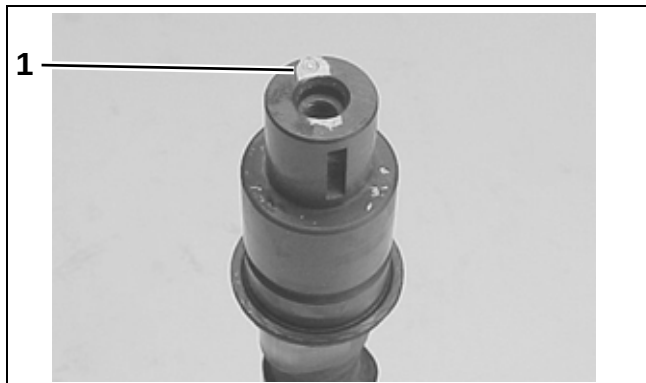
004517

Cam Height Specifications		
	Standard	Service Limit
IN	0.9210 – 0.9234 in. (23.394 – 23.454 mm)	0.9171 in. (23.294 mm)
EX	0.9210 – 0.9235 in. (23.397 – 23.457 mm)	0.9172 in. (23.297 mm)

POWERHEAD

CYLINDER HEAD ASSEMBLY

IMPORTANT: Camshafts for rope start or electric start models are identified with a mark:

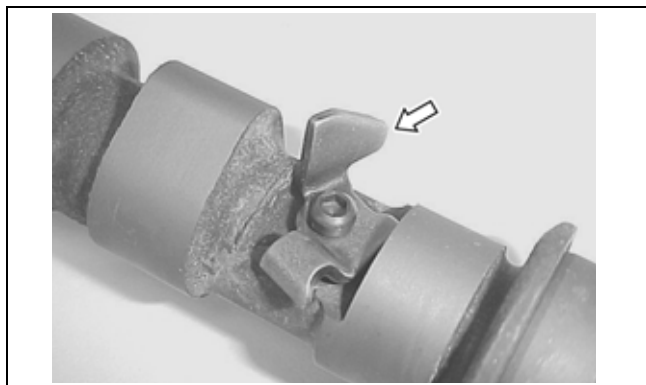


1. I.D. Mark

004518

Model	Identification Mark
Rope start models	94J0
Electric start models	94J1

Inspect decompression parts on the camshaft (rope start models). If abnormal movement is found, replace camshaft.



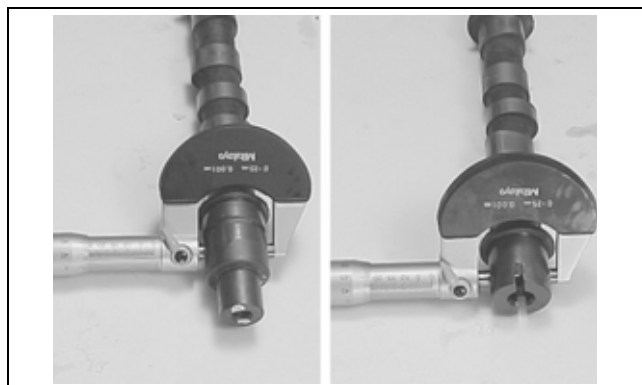
004519

Camshaft holder inside diameter:

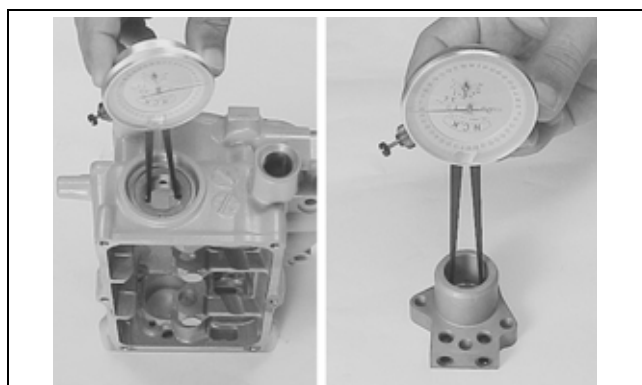
- Upper side: 0.9843 to 0.9851 in. (25.000 to 25.021 mm)
- Lower side: 0.9055 to 0.9063 in. (23.000 to 23.021 mm)

Camshaft journal oil clearance:

- Standard: 0.0008 to 0.0024 in. (0.020 to 0.062 mm)
- Service limit: 0.0039 in. (0.100 mm)



004520



004521

Camshaft Journal Oil Clearance

To check clearance, measure the following:

- Camshaft journal outside diameter (2 locations)
- Camshaft holder inside diameter (2 locations)

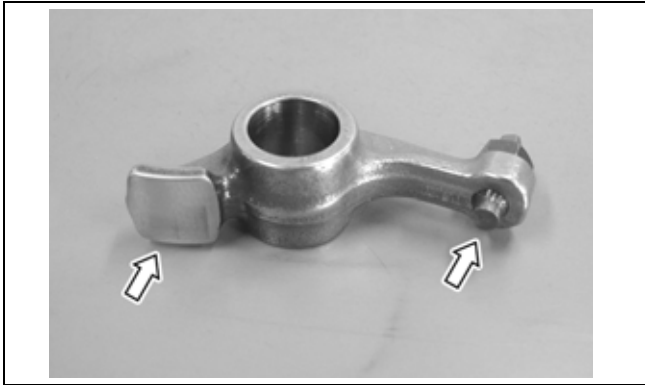
Camshaft journal outside diameter:

- Upper side: 0.9826 to 0.9835 in. (24.959 to 24.980 mm)
- Lower side: 0.9039 to 0.9047 in. (22.959 to 22.980 mm)

If clearance exceeds service limit, replace camshaft and, if necessary, cylinder head and/or oil gallery block.

Rocker Arm/Shaft

Inspect the cam-riding face and tip of the adjusting screw. If excessive wear is found, replace the rocker arm and/or adjusting screw.



004523

To check rocker arm to shaft clearance, measure the following:

- Rocker arm shaft outside diameter
- Rocker arm inside diameter

Rocker arm shaft outside diameter:

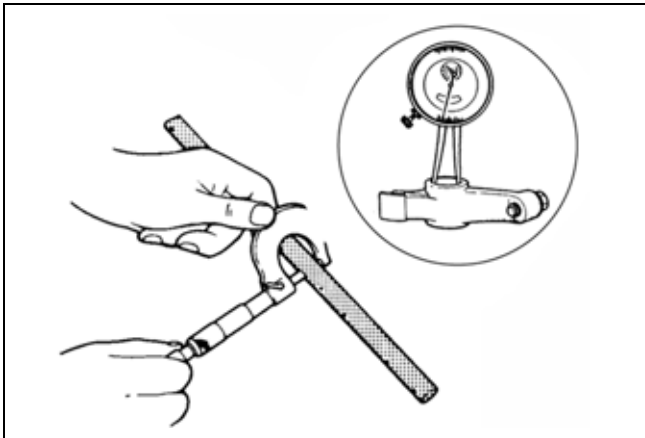
- 0.5107 to 0.5112 in. (12.973 to 12.984 mm)

Rocker arm inside diameter:

- 0.5118 to 0.5125 in. (13.000 to 13.018 mm)

Rocker arm to shaft clearance:

- Standard: 0.0006 to 0.0018 in. (0.016 to 0.045 mm)
- Service limit: 0.0024 in. (0.060 mm)



004524

If clearance exceeds service limit, replace rocker arm and/or rocker arm shaft.

Valve/Valve Guide

To check valve guide to valve stem clearance, measure the following:

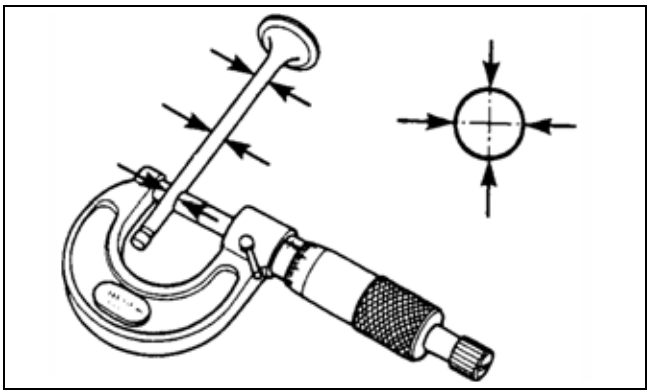
- Valve stem outside diameter
- Valve guide inside diameter

Valve stem outside diameter:

- IN 0.2156 to 0.2161 in. (5.475 to 5.490 mm)
- EX 0.2146 to 0.2152 in. (5.450 to 5.465 mm)

Valve guide inside diameter:

- IN 0.2165 to 0.2170 in. (5.500 to 5.512 mm)
- EX 0.2165 to 0.2170 in. (5.500 to 5.512 mm)



004525

Valve guide to valve stem clearance		
	Standard	Service Limit
IN	0.0004 – 0.0015 in. (0.010 – 0.037 mm)	0.0028 in. (0.070 mm)
EX	0.0014 – 0.0024 in. (0.035 – 0.062 mm)	0.0035 in. (0.090 mm)

If clearance exceeds service limit, replace valve and/or valve guide.

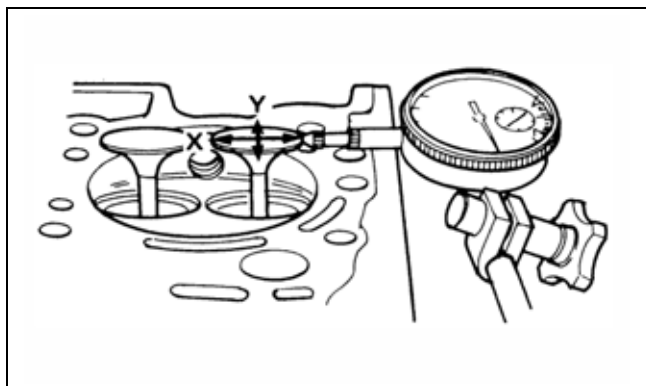
POWERHEAD CYLINDER HEAD ASSEMBLY

If unable to measure valve guide inside diameter, measure valve stem deflection as follows:

Install valve into valve guide.

Position the valve head at approximately 10 mm away from valve seat.

Move valve head in "X" and "Y" directions and measure deflection with a dial indicator.



004526

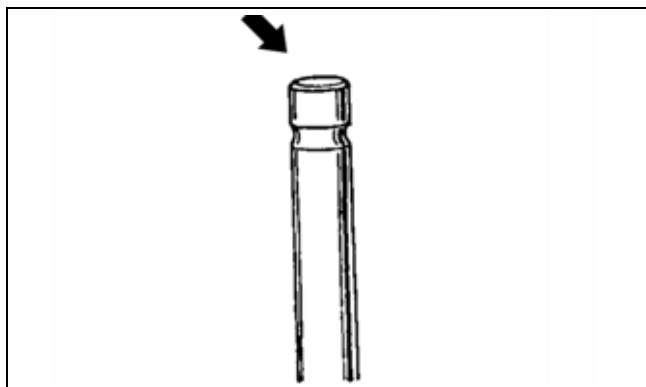
Valve stem deflection:

- Service limit: 0.006 in. (0.16 mm)

If measurement exceeds service limit, replace valve.

If measurement still exceeds service limit with new valve, replace valve guide.

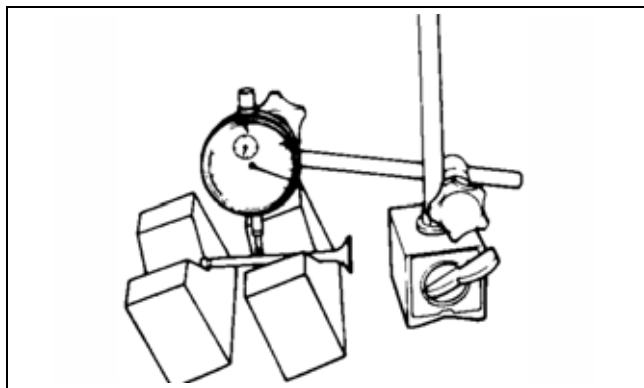
Inspect valve stem end face for pitting and wear. If necessary, valve stem end may be resurfaced. Use caution when resurfacing, do not grind away stem end chamfer. When chamfer has been worn away, replace valve.



004527

Measure valve stem runout. If measurement exceeds service limit, replace valve.

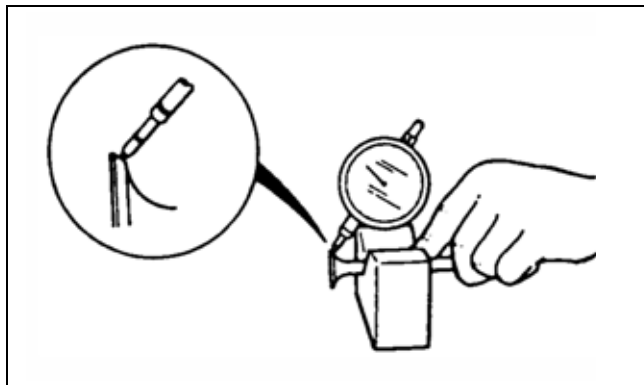
- Service limit: 0.002 in. (0.05 mm)



004528

Measure valve head radial runout. If measurement exceeds service limit, replace valve.

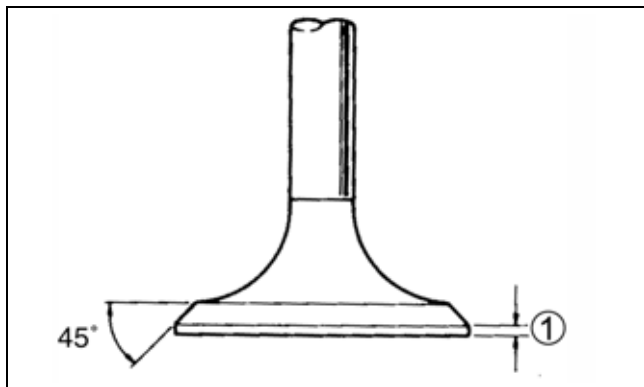
- Service limit: 0.0012 in. (0.03 mm)



004529

Measure valve head thickness. If measurement exceeds service limit, replace valve.

- Service limit: 0.02 in. (0.5 mm)



1. Valve head thickness

004530

Measure valve seat contact width as follows:

Coat valve seat evenly with Prussian Blue

Install valve into valve guide

Put valve lapper on valve

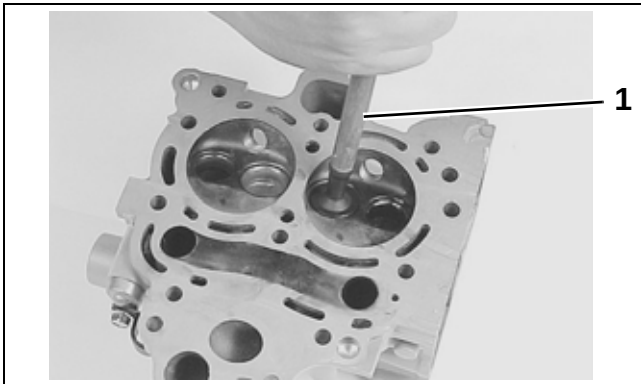
Rotate valve while gently tapping valve contact area against seat

Repeat until a continuous pattern in the Prussian Blue is seen

Measure valve seat contact width:

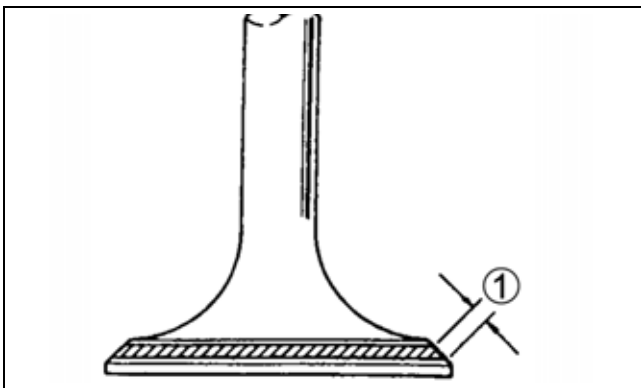
- Service limit: 0.035 to 0.043 in. (0.9 to 1.1 mm)

If measurement exceeds service limit, repair valve seat. Refer to **Valve Seat Servicing** on p. 149.



1. Valve lapper

004531



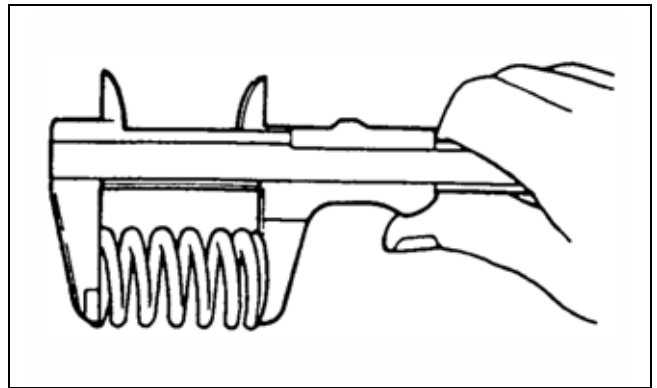
1. Valve seat contact area

004532

Valve Spring

Measure valve spring free length. If measurement is lower than service limit, replace valve spring.

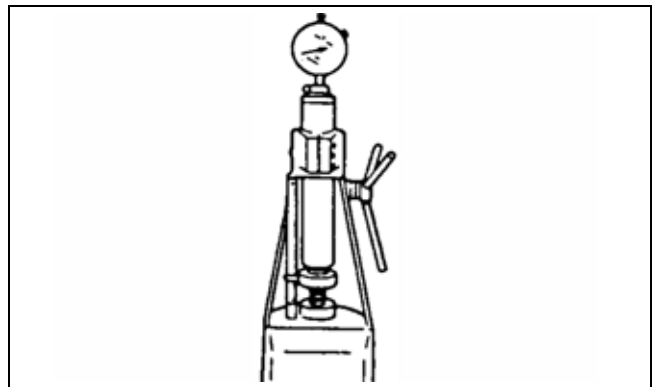
- Standard: 1.280 in. (32.52 mm)
- Service limit: 1.276 in. (32.40 mm)



004541

Measure valve spring tension. If measurement is lower than service limit, replace valve spring.

- Standard: 19.8 lbs. (90 N) for 1.12 in. (28.5 mm)
- Service limit: 16.8 lbs. (76 N) for 1.12 in. (28.5 mm)



004542

Oil Seal

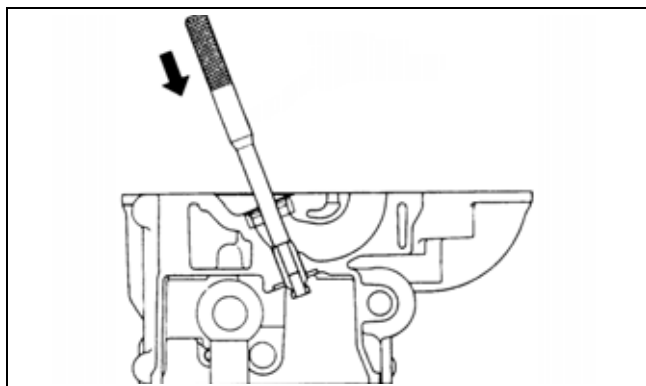
Inspect condition. If cracked, cut or damaged, replace oil seal.

Assembly

Valve Guide Replacement

IMPORTANT: Be careful not to damage cylinder head when replacing valve guide.

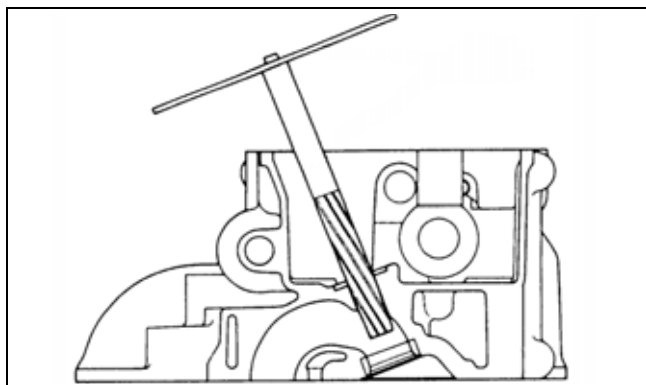
Drive valve guide out toward valve spring side.



004533

IMPORTANT: Do not reuse valve guide once it has been removed. Always use a new valve guide (oversize) when assembling.

Ream valve guide hole with 11 mm reamer to true hole and remove burrs. Turn reamer clockwise, never counterclockwise.

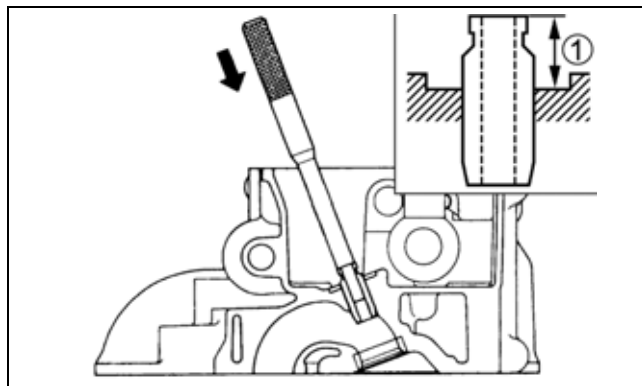


004534

Drive valve guide in from valve spring side to the specified height.

Measure valve guide protrusion:

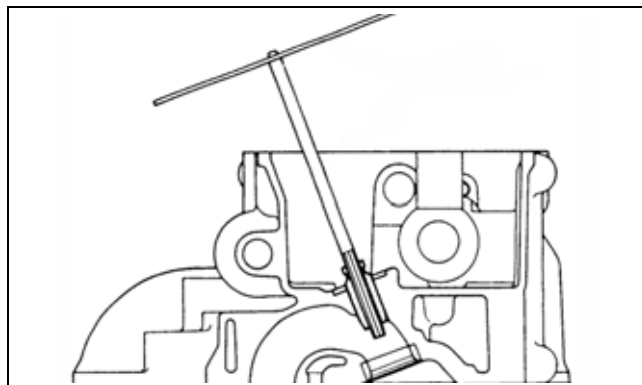
- Protrusion: 0.39 ± 0.02 in (10.0 ± 0.5 mm)



1. Valve guide protrusion

004535

Ream valve guide bore with 5.5 mm reamer.



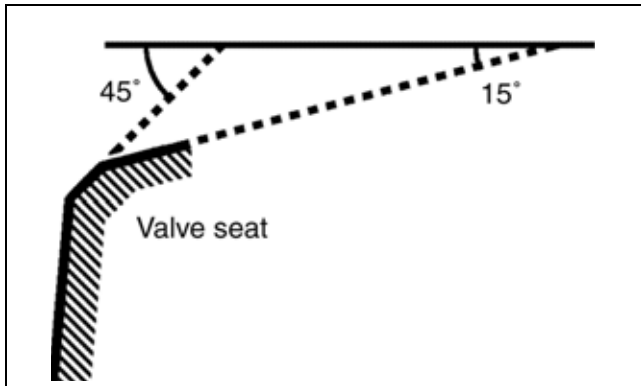
004536

Clean and oil the valve guide bore after reaming.

Valve Seat Servicing

If the contact between valve and seat is not uniform, the valve seat must be refaced.

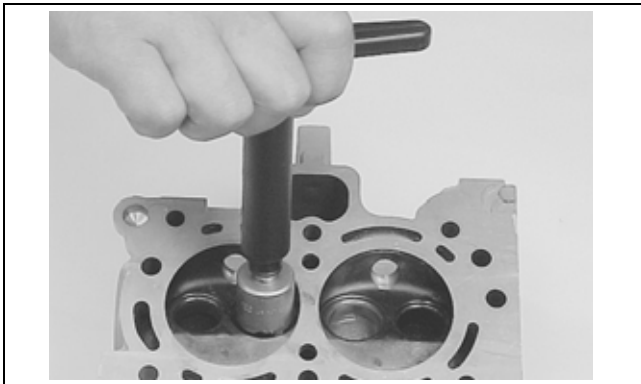
Both intake and exhaust valve seats must have two chamfer angles, 15° and 45°.



004537

Use 45° cutter to reface valve seat.

IMPORTANT: Turn cutter clockwise, never counterclockwise.

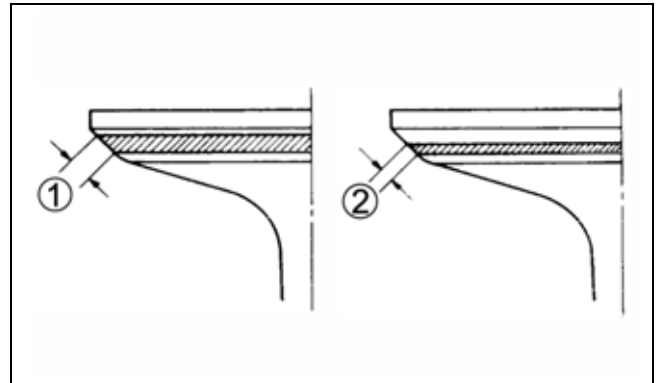


004538

Measure valve seat contact width. Refer to **Valve/Valve Guide** on p. 145.

If width is too high (wide), reface valve seat using the 15° cutter.

If width is too low (narrow), reface valve seat using the 45° cutter.



1. Too high (wide)
2. Too low (narrow)

004539

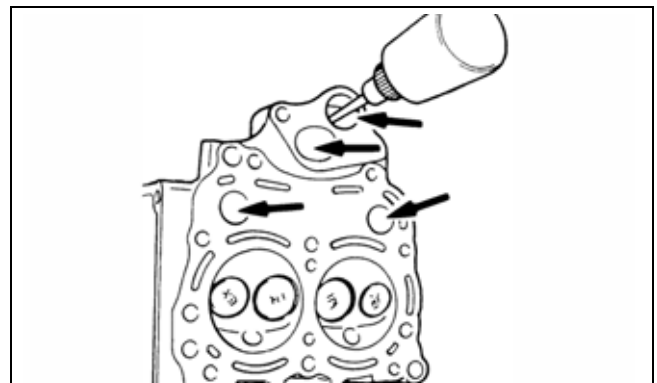
IMPORTANT: Grind seat areas minimally only. Do not grind more than necessary.

Clean up any burrs using the 45° cutter very lightly.

Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.

Recheck valve seat contact area.

Clean and assemble cylinder head and valve components. Fill intake and exhaust ports with solvent to check for leaks between seat and valve. If any leaks occur, inspect valve seat and face for burrs.



004540

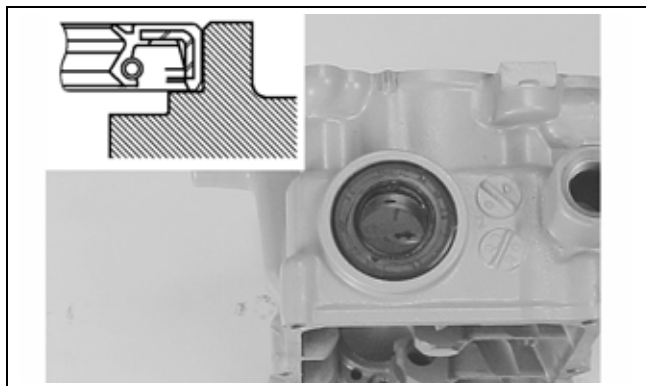
POWERHEAD

CYLINDER HEAD ASSEMBLY

Oil Seal

Install the oil seal with the spring/lipped side facing inward.

IMPORTANT: Do not re-use the seal once removed. Always install a new oil seal.



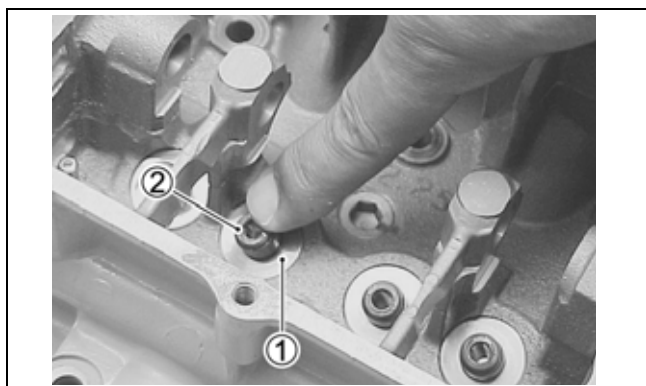
004544

Valve

Install valve spring seat.

Apply oil to valve stem seal and push seal onto valve guide.

IMPORTANT: Do not re-use valve stem seal once removed. Always install a new valve stem seal.



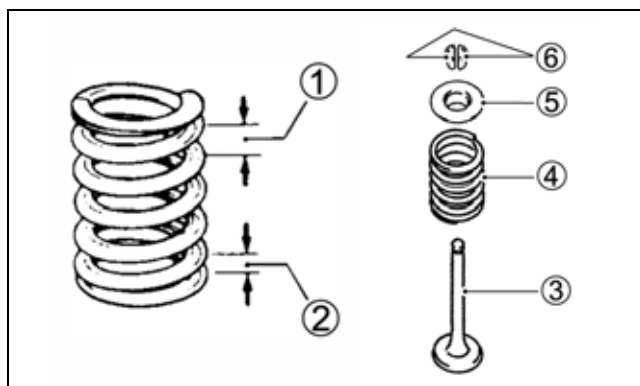
1. Valve spring seat
2. Valve stem seal

004543

Apply oil to stem seal, valve guide bore, and valve stem.

Install valve, valve spring, and valve retainer.

IMPORTANT: Install each valve and spring in its original position. Set valve spring in place with narrow spiral area facing valve spring seat.

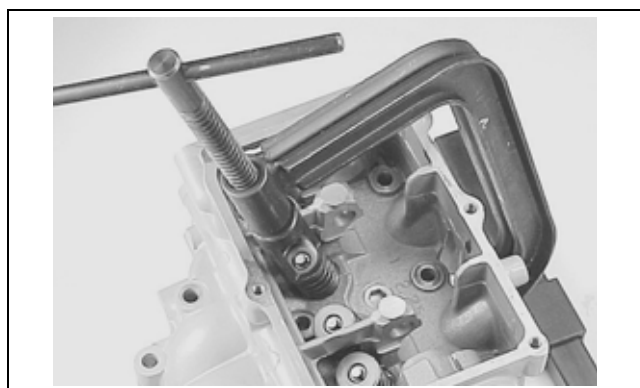


1. Wide spiral area
2. Narrow spiral area
3. Valve
4. Valve spring
5. Retainer
6. Cotter

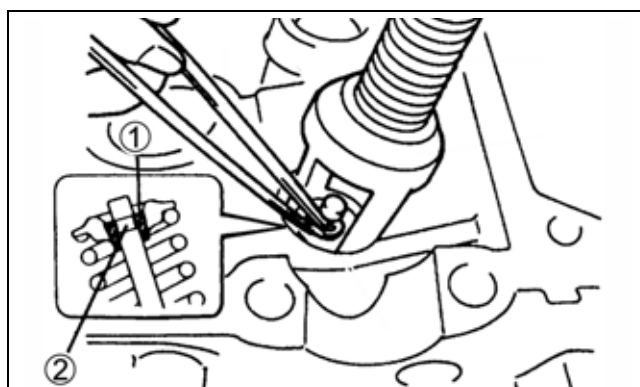
004545

Use Valve Spring Compressor, P/N 346186, and attachment "A" from Valve Lifter Adaptor Kit, P/N 5000899, and tweezers to install valve cotter.

Make sure valve cotter is properly seated in groove.



004546



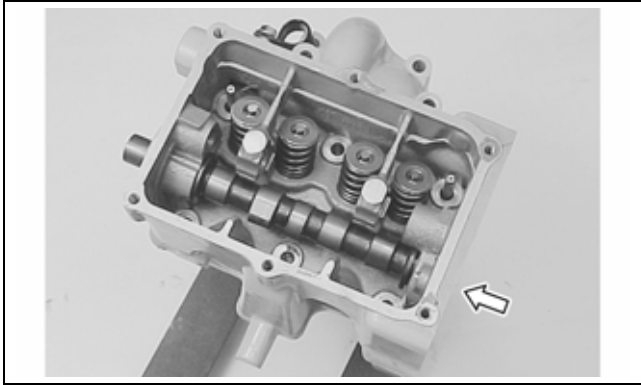
1. Valve cotter
2. Groove

004547

Camshaft

Apply engine oil to the surface of each camshaft lobe and journals.

Install the camshaft from oil pan side.



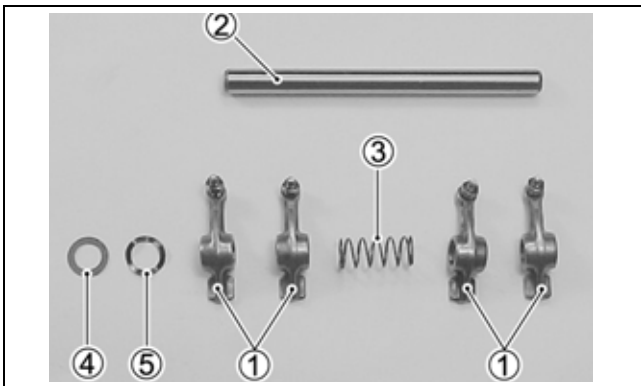
004548

Rocker Arm/Shaft

Apply engine oil to the rocker arms and rocker arm shaft.

Install the rocker arms, rocker arm spring, washer, wave washer, and rocker arm shaft.

IMPORTANT: Reassemble each rocker arm in its original position. Install the rocker arm shaft with threaded end down.

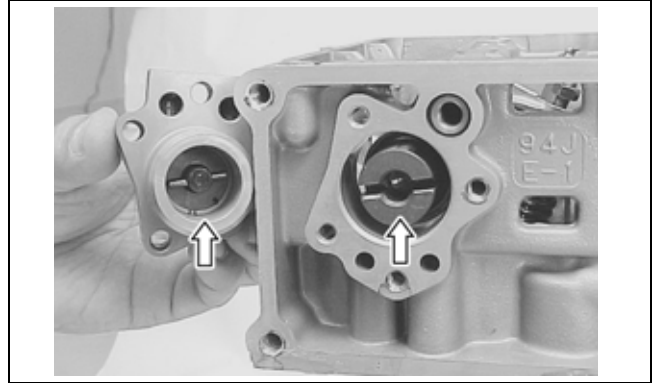


004549

1. Rocker arm
2. Rocker arm shaft
3. Spring
4. Washer
5. Wave washer

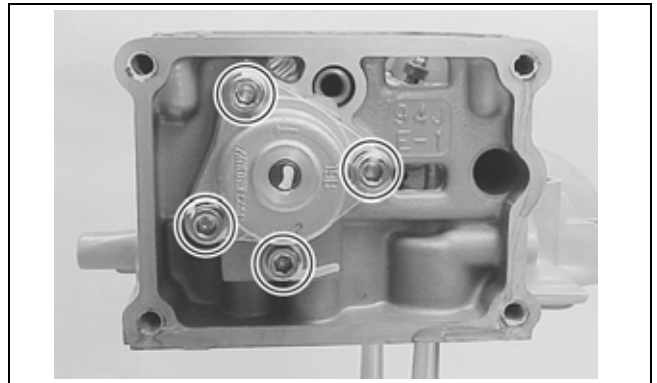
Oil Pump

Install oil gallery block and oil pump assembly by aligning the pin on the oil pump shaft with the recess on the camshaft.



004550

Tighten four oil pump bolts 120 in. lbs. (14 N·m).



004551

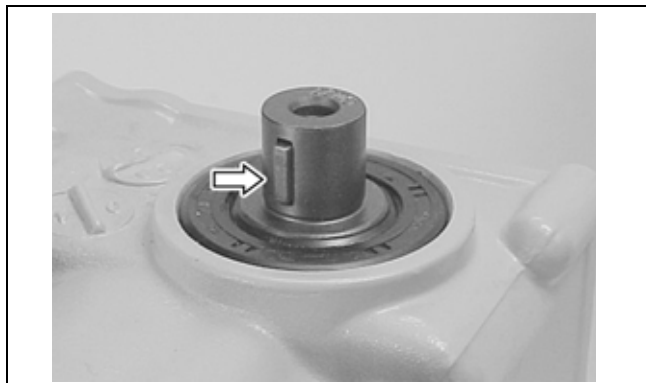
POWERHEAD

CYLINDER HEAD ASSEMBLY

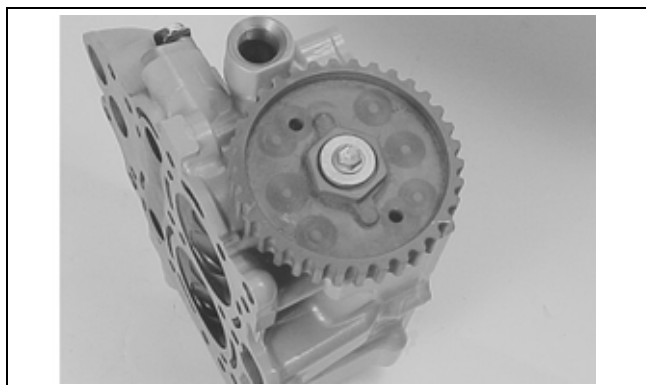
Camshaft Pulley

Install the key and camshaft pulley.

Tighten screw 84 in. lbs. (10 N·m).



004552



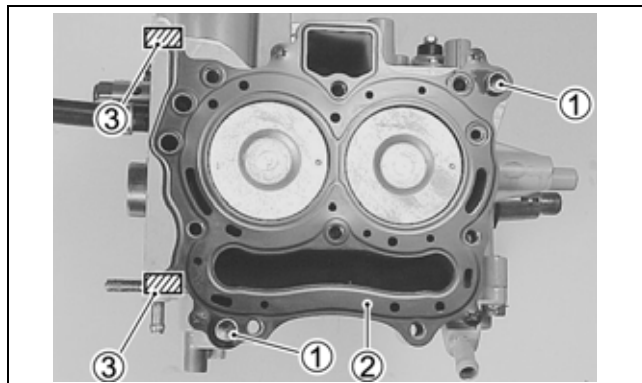
004553

Installation

IMPORTANT: Do not re-use gasket. Always use a new gasket.

Insert dowel pins and place a new cylinder head gasket into position on cylinder.

Apply *ThreeBond* 1207B sealant to both surfaces of the areas shown:



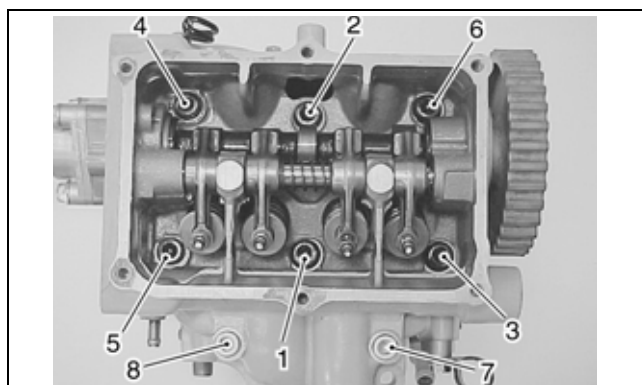
004554

1. Dowel pins
2. Gasket
3. Apply sealant here

Position cylinder head on cylinder.

Apply engine oil to cylinder head screws.

Lightly seat all cylinder head screws. Then tighten, in stages, to 20 ft. lbs. (27 N·m) following the pattern shown.



Cylinder head screw torque pattern

DR2661

CYLINDER/CRANKCASE/ PISTON ASSEMBLY

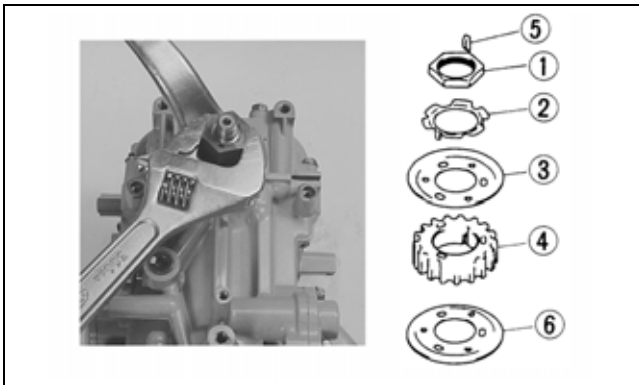
Disassembly

Before disassembly:

- Remove the powerhead. Refer to **REMOVAL AND INSTALLATION** on p. 134.
- Remove the cylinder head assembly. Refer to cylinder head **Removal** on p. 140.

Use a screwdriver to straighten locking edges of lock washer, and then remove timing pulley nut.

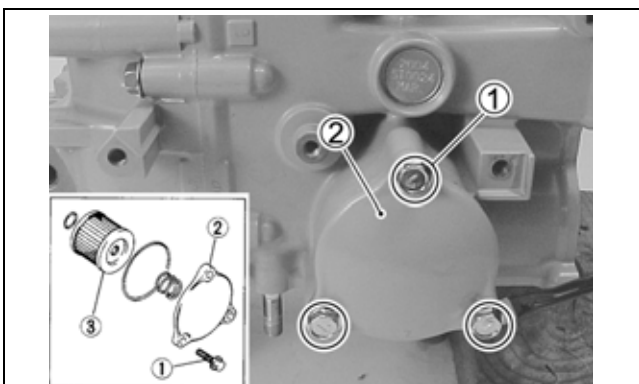
Remove the lock washer, upper guide, timing pulley, key, and lower guide.



1. Timing pulley nut
2. Lock washer
3. Upper guide
4. Timing pulley
5. Key
6. Lower guide

004556

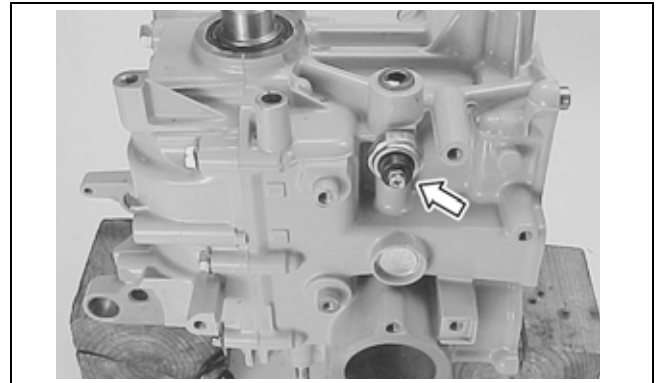
Remove screws, oil filter cap, and oil filter.



1. Oil filter screws
2. Oil filter cap
3. Oil filter

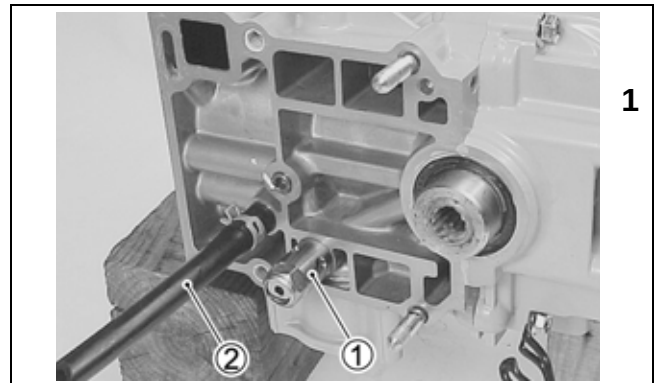
004557

Remove oil pressure switch.



004558

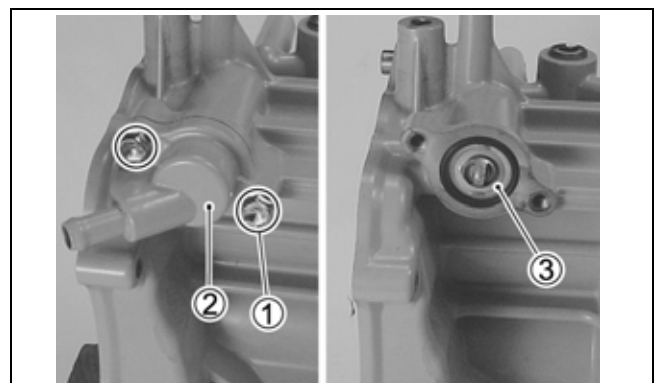
Remove oil pressure regulator and oil hose.



1. Oil pressure regulator
2. Oil hose

004559

Remove screws, thermostat cover, and thermostat.



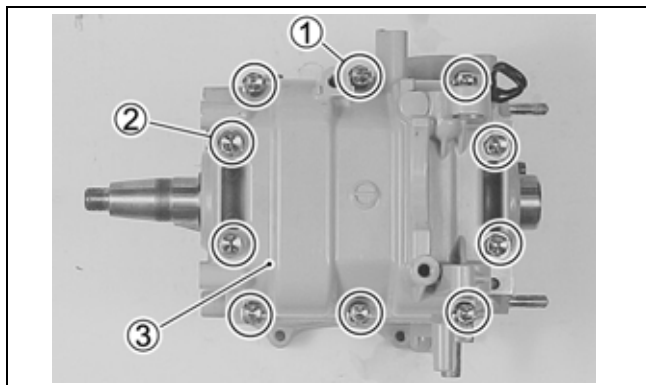
1. Thermostat cover screws
2. Thermostat cover
3. Thermostat

004561

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Remove six crankcase flange screws and four main bearing screws. Remove crankcase from cylinder block.

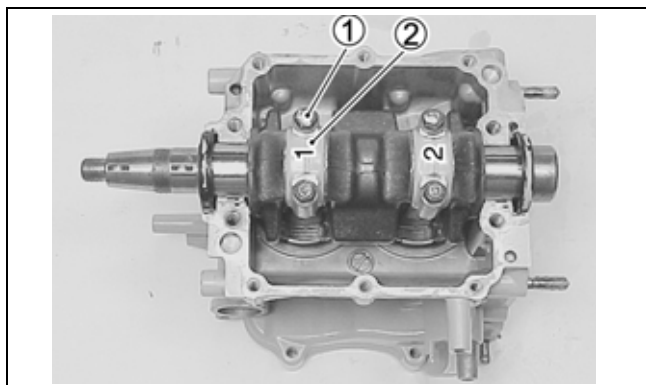


1. Flange screws
2. Main bearing screws
3. Crankcase

004562

Remove all connecting rod screws and caps.

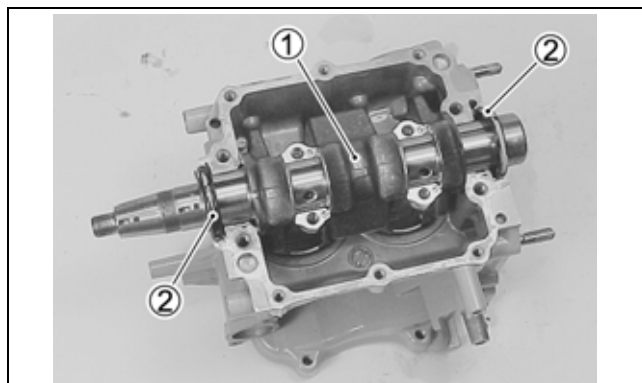
IMPORTANT: Mark cylinder number on all caps for proper reassembly.



1. Connecting rod cap screw
2. Cylinder identification

004563

Remove crankshaft. Remove oil seals from crankshaft.

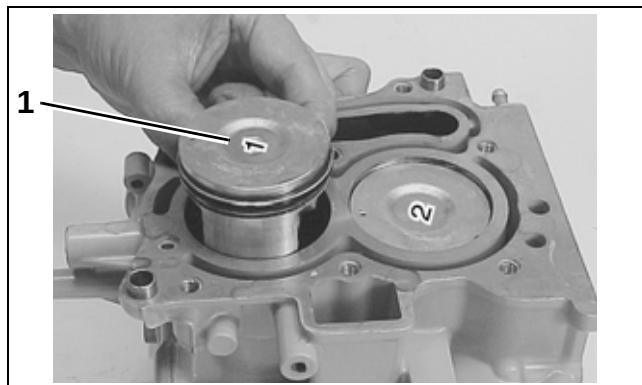


1. Crankshaft
2. Crankshaft seals

004564

Push piston and connecting rod out through the top of cylinder bore.

IMPORTANT: Mark cylinder number on all connecting rods and pistons for proper reassembly.



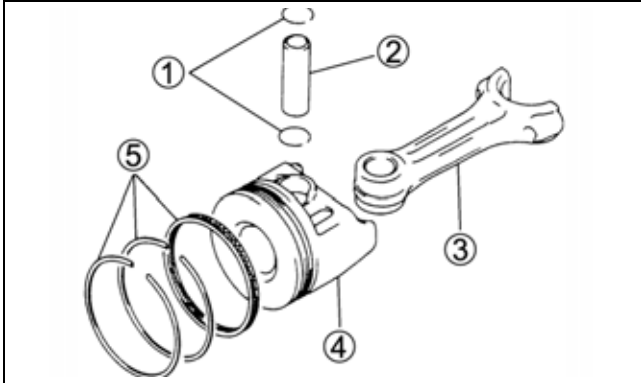
1. Cylinder Identification

004565

Remove piston pin circlips.

Remove piston pin from connecting rod.

Remove piston rings from piston.



1. Circlips
2. Piston pin
3. Connecting rod
4. Piston
5. Piston rings

004566

Cleaning/Inspection

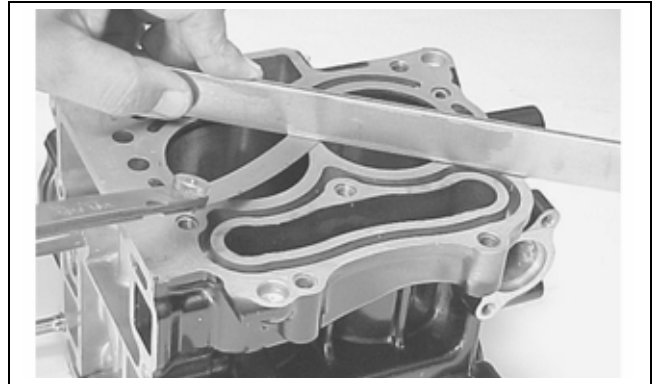
IMPORTANT: If excessive wear, cracks, defects, or damage is found on any component, replace component.

Cylinder

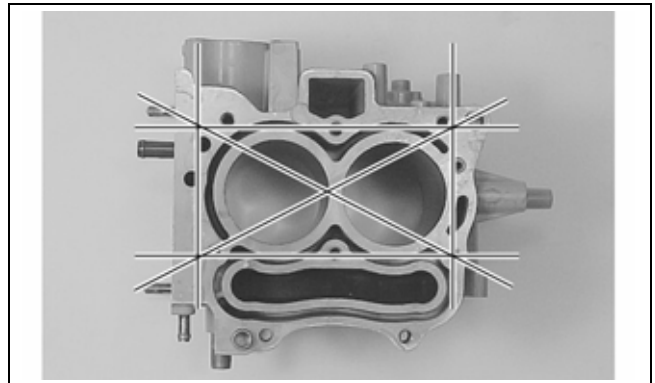
Use a straightedge and a thickness gauge to measure the cylinder distortion on the gasket surface at six locations as shown.

The service limit for distortion is 0.002 in. (0.05 mm). If measurement exceeds service limit, resurface or replace cylinder.

The cylinder can be resurfaced using a surface plate and #400 grit wet sandpaper. Move the cylinder in a figure eight pattern when sanding.

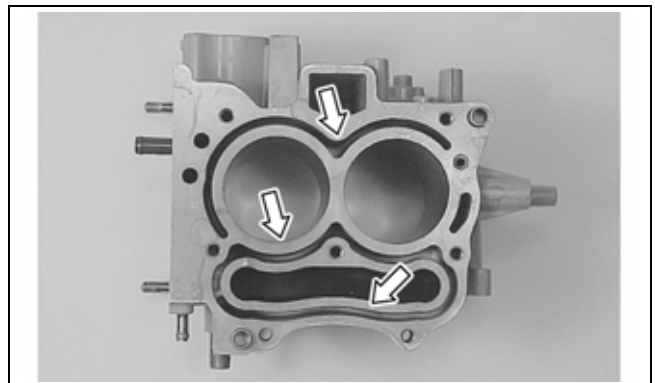


004567



004568

Check water jackets for clogs or obstructions.



004569

POWERHEAD

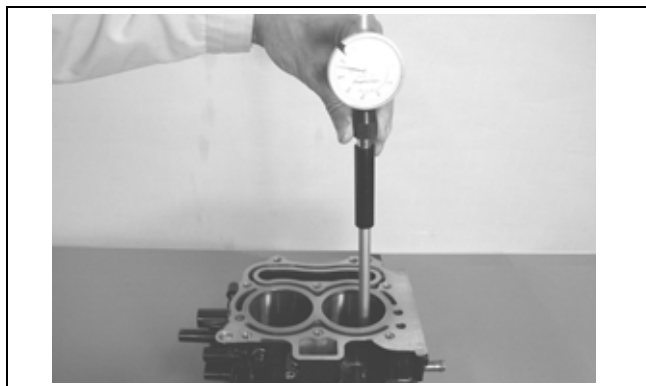
CYLINDER/CRANKCASE/PISTON ASSEMBLY

Measure the cylinder bore in the thrust and axial directions at three depth positions A, B, and C.

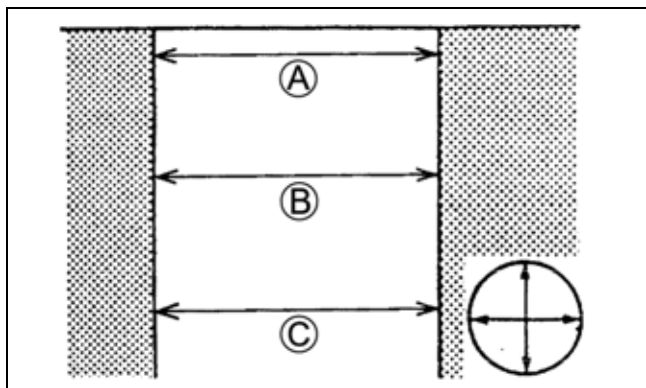
The difference between the two depth measurements is the cylinder bore taper.

The difference between the axial and transverse measurements is the cylinder bore out-of-round.

The service limit for cylinder bore wear is 0.0022 in. (0.055 mm). If either taper or out-of-round measurement exceeds service limit, rebore or replace cylinder.



004570



004571

To check the piston to cylinder bore clearance, measure:

- Cylinder bore at 50 mm below the cylinder head gasket surface.
- Piston skirt diameter at 15 mm above the skirt end.
- Take measurements at a 90° angle from the piston pin.

Subtract the piston skirt measurement from the cylinder bore measurement to determine clearance.

Cylinder bore:

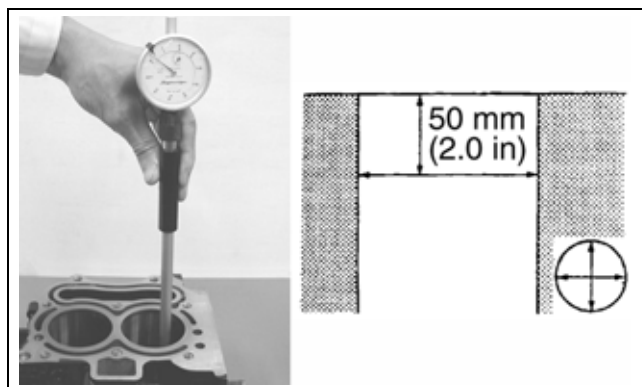
- Standard: 2.2835 to 2.2841 in. (58.000 to 58.015 mm)

Piston skirt diameter:

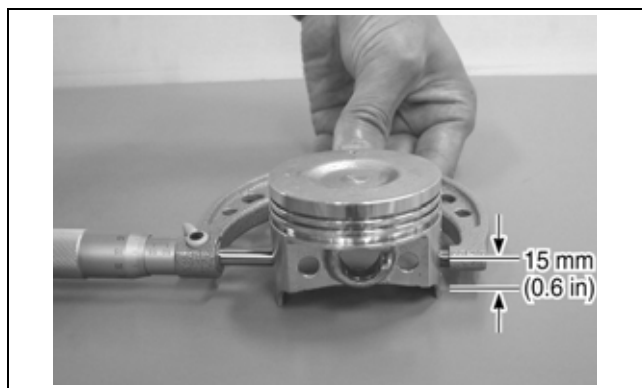
- Standard: 2.2821 to 2.2827 in. (57.965 to 57.980 mm)

Piston to cylinder clearance:

- Standard: 0.0011 to 0.0017 in. (0.0276 to 0.0425 mm)
- Service limit: 0.0039 in. (0.100 mm)



004572



004573

If measurement exceeds service limit, replace the piston and/or the cylinder, or rebore the cylinder.

An oversize piston and rings, 0.020 in. (50 mm) is available.

Pistons and Rings

Measure piston ring to groove clearance after decarbonizing.

Standard piston ring groove width:

- 1st and 2nd rings: 0.0476 to 0.0484 in. (1.21 to 1.23 mm)
- Oil ring: 0.0988 to 0.0996 in. (2.51 to 2.53 mm)

Standard piston ring thickness:

- 1st and 2nd rings: 0.0461 to 0.0469 in. (1.17 to 1.19 mm)

Piston ring to groove clearance:

- Standard: 1st and 2nd rings, 0.0008 to 0.0024 in. (0.02 to 0.06 mm)
- Service limit: 1st and 2nd rings, 0.004 in. (0.10 mm)

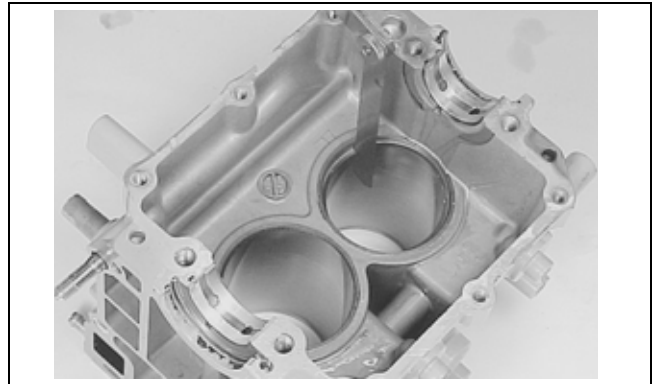
If measurement exceeds service limit, replace the piston and/or piston ring.



004574

Measure piston ring end gap with piston ring in the lowest position of cylinder bore. If measurement exceeds service limit, replace piston ring.

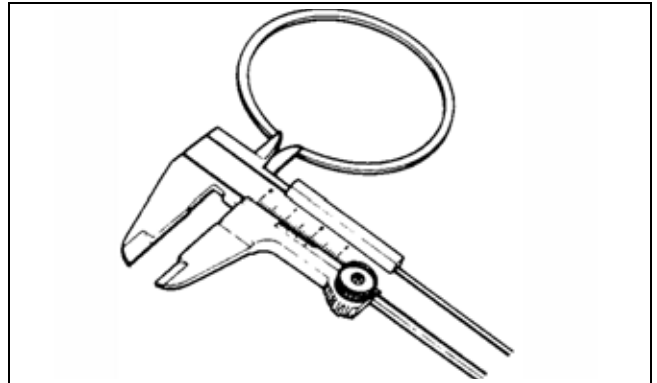
- Standard: 1st and 2nd rings, 0.004 to 0.010 in. (0.10 to 0.25 mm)
- Service limit: 1st and 2nd rings, 0.020 in. (0.50 mm)



004575

Measure piston ring free end gap. If measurement exceeds service limit, replace piston ring.

- Standard: 1st ring, approx. 0.23 in. (5.8 mm)
2nd ring, approx. 0.29 in. (7.4 mm)
- Service limit: 1st ring, approx. 0.18 in. (4.6 mm)
2nd ring, approx. 0.23 in. (5.9 mm)



004576

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Check that the piston pin and the piston pin hole are free from excessive wear and damage.

Apply engine oil on piston pin so that piston pin can move smoothly in the piston pin hole.

To check piston pin to piston pin hole clearance, measure the following:

- Piston pin outside diameter in the thrust and axial directions.
- Piston pin hole diameter in the thrust and axial directions.

Piston pin outside diameter:

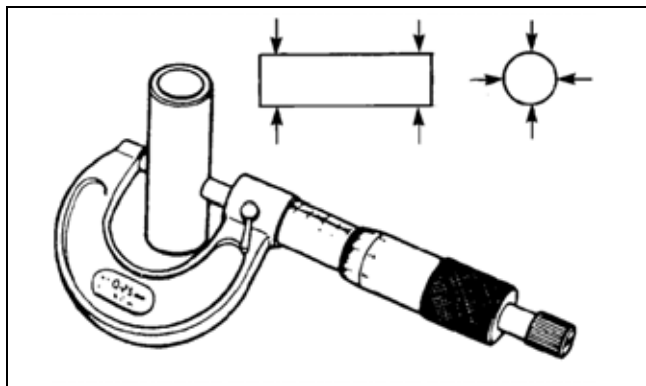
- Standard: 0.5510 to 0.5512 in. (13.995 to 14.000 mm)
- Service limit: 0.5504 in. (13.980 mm)

Piston pin hole diameter:

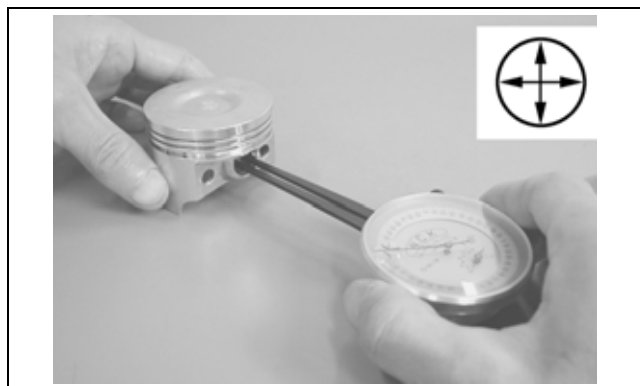
- Standard: 0.5513 to 0.5515 in. (14.002 to 14.008 mm)
- Service limit: 0.5524 in. (14.030 mm)

Piston pin to piston pin hole clearance:

- Standard: 0.0001 to 0.0005 in. (0.002 to 0.013 mm)
- Service limit: 0.0016 in. (0.040 mm)



004577



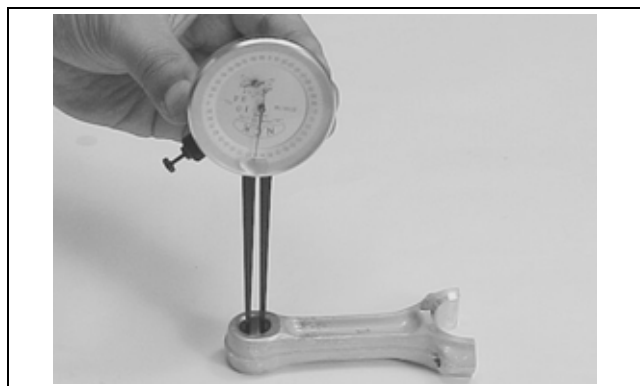
004578

If measurement exceeds service limit, replace the piston pin and/or piston.

Connecting Rods

Measure the connecting rod small end inside diameter. If measurement exceeds service limit, replace the connecting rod.

- Standard: 0.5514 to 0.5517 in. (14.006 to 14.014 mm)
- Service limit: 0.5528 in. (14.040 mm)



004579

Measure connecting rod big end side clearance with connecting rod installed on crank pin. If measurement exceeds service limit, replace the connecting rod and/or crankshaft.

Connecting rod big end width:

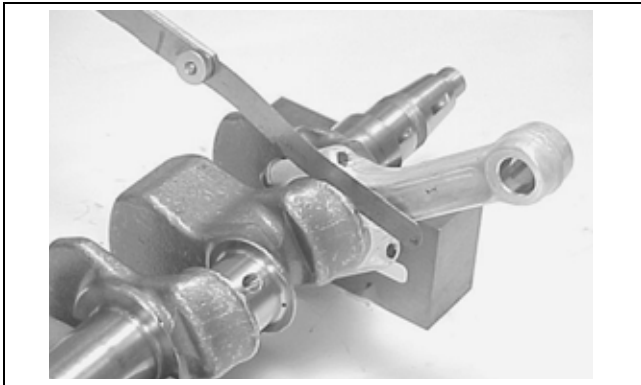
- Standard: 0.785 to 0.787 in. (19.95 to 20.00 mm)

Crank pin width:

- Standard: 0.791 to 0.793 in. (20.10 to 20.15 mm)

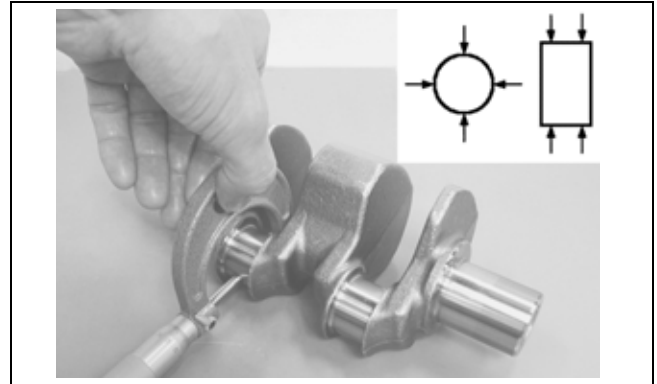
Connecting rod big end side clearance:

- Standard: 0.004 to 0.008 in. (0.10 to 0.20 mm)
- Service limit: 0.024 in. (0.60 mm)



004580

Measure the crank pin outside diameter in the thrust and axial directions at two positions as shown:



004581

Check for the following:

- Difference of the measurements at two positions (Taper).
- Difference between the thrust and axial measurements (Out-of-round).

Crank pin outside diameter:

- Standard: 1.1413 to 1.1417 in. (28.989 to 29.000 mm)

Taper and Out-of-round:

- Service limit: 0.0004 in (0.010 mm)

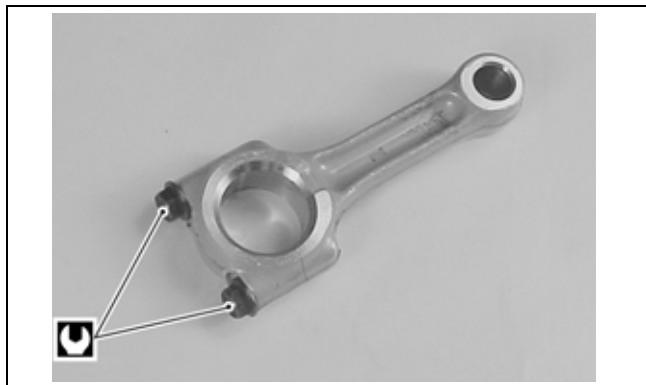
If measurement exceeds service limit, replace crankshaft.

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Measure the connecting rod big end inside diameter as follows:

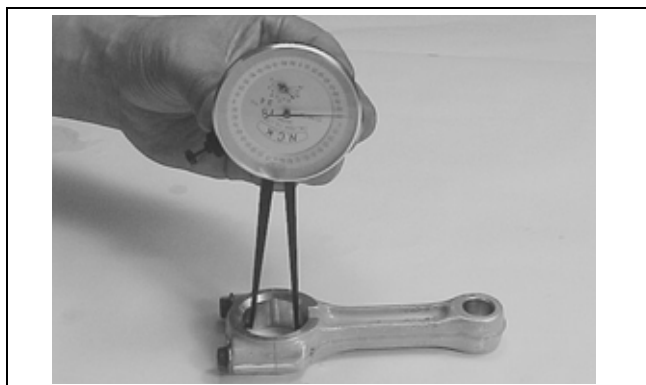
- Clean the surface of the rod and cap.
- Install the cap on the rod.
- Apply engine oil to screws and tighten to 102 in. lbs (12 N·m).



004582

Measure the connecting rod inside diameter:

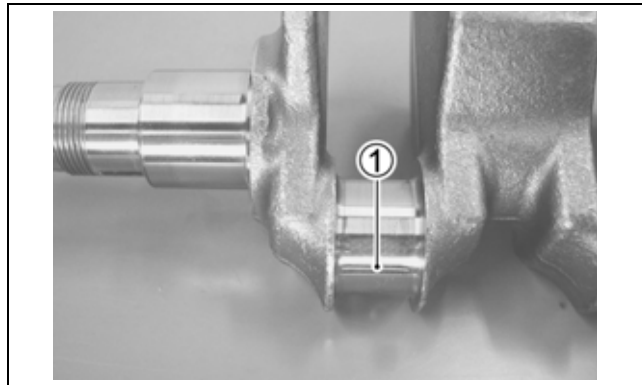
- Standard: 1.1427 to 1.1431 in. (29.025 to 29.034 mm).



004583

Measure connecting rod big end oil clearance as follows:

- Clean the surfaces of rod, cap, and crankpin.
- Place a piece of Plastigage on crank pin parallel to the crankshaft. Avoid placing Plastigage over the oil hole.

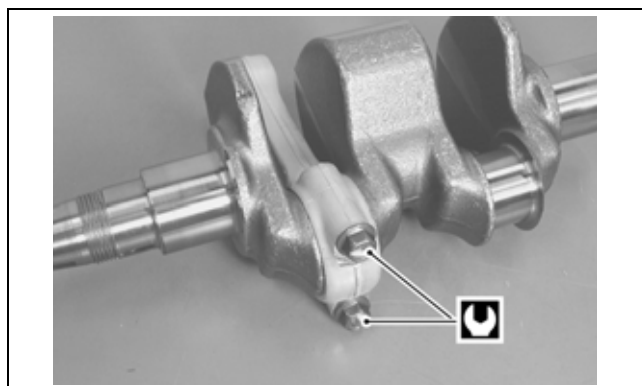


1. Plastigage

004584

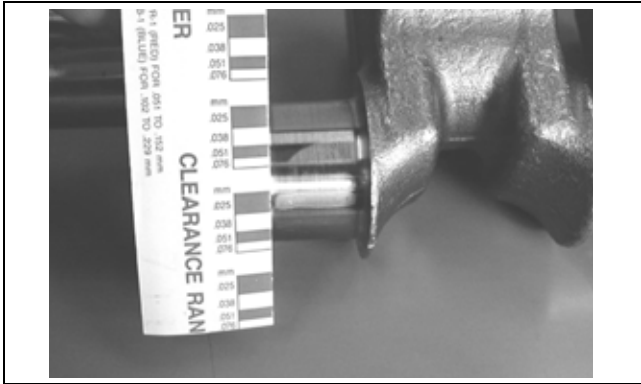
- Install connecting rod and cap to crankpin.
- Apply engine oil to screws and tighten to 102 in. lbs. (12 N·m).

IMPORTANT: Do not rotate connecting rod with Plastigage in place.



004585

- Remove rod and cap from crankpin.
- Measure the compressed Plastigage at its widest point.



004586

Connecting rod big end oil clearance:

- Standard: 0.0010 to 0.0018 in. (0.025 to 0.045 mm).
- Service limit: 0.0025 in. (0.063 mm)

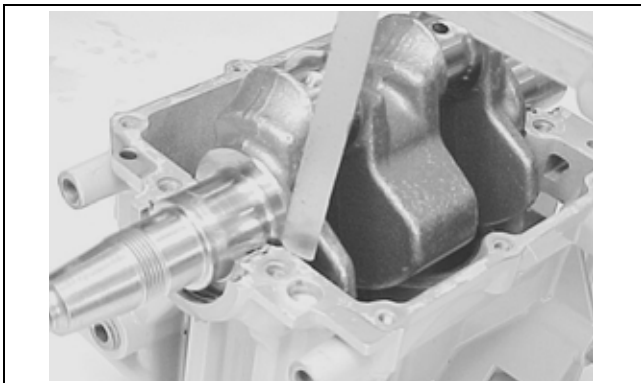
If measurement exceeds service limit, replace connecting rod and/or crankshaft.

Crankshaft

Measure crankshaft thrust clearance. If measurement exceeds service limit, replace crankshaft and/or crankcase.

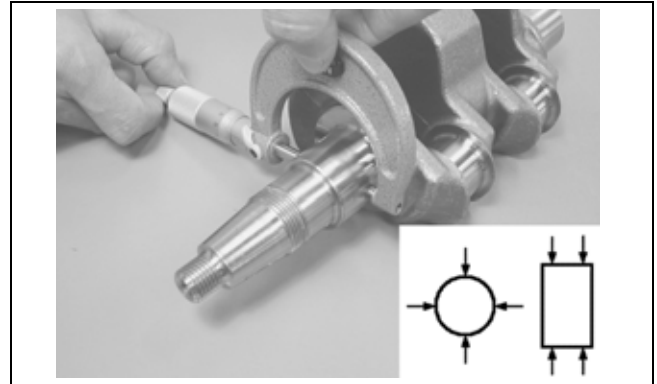
Crankshaft thrust clearance:

- Service limit: 0.024 in. (0.6 mm)



004588

Measure the crankshaft journal outside diameter in the thrust and axial directions at two positions as shown:



004589

Check for the following:

- Difference of the measurements at two positions (Taper).
- Difference between the thrust and axial measurements (Out-of-round).

Crankshaft journal outside diameter:

- Standard: 1.2594 to 1.2598 in. (31.989 to 32.000 mm)

Taper and Out-of-round:

- Service limit: 0.0004 in (0.010 mm)

If measurement exceeds service limit, replace crankshaft.

Check main bearing condition. If pitting, flaking, burning, or excessive wear is found, replace both upper and lower halves.

IMPORTANT: Always replace both bearing halves, never replace only half of a bearing set.



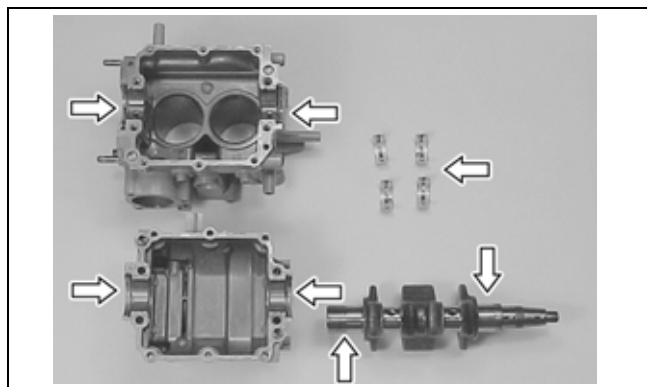
004590

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Measure the crankshaft journal oil clearance as follows:

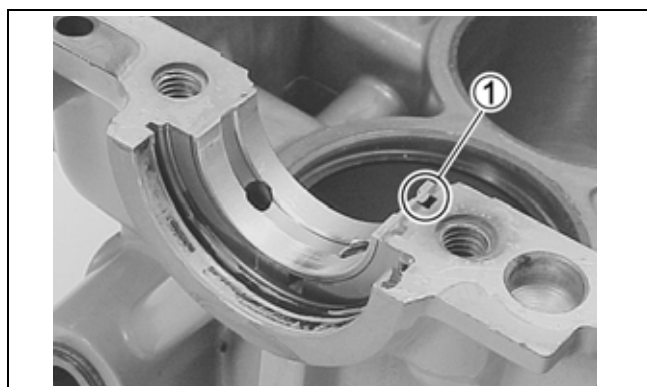
- Clean surface of the bearing holder (crankcase and cylinder), bearing, and crankshaft bearing journal.



004591

- Install crankshaft main bearing to cylinder and crankcase.

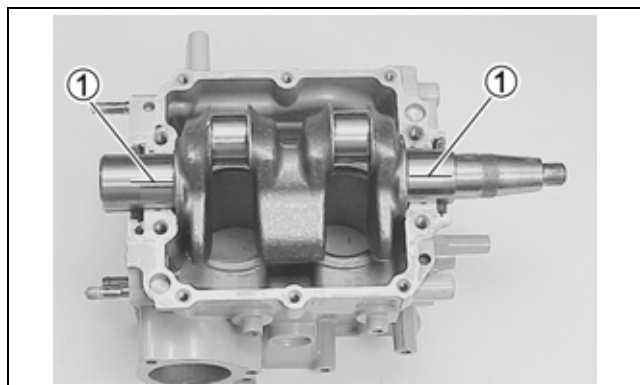
IMPORTANT: Reassemble each bearing in its original position. Align the tab of bearing with notch in cylinder and crankcase. Do not apply oil to bearing.



1. Notch

004592

- Install crankshaft to cylinder.
- Place a piece of Plastigage across full width of bearing (parallel to crankshaft) on journal. Do not place Plastigage over oil hole.



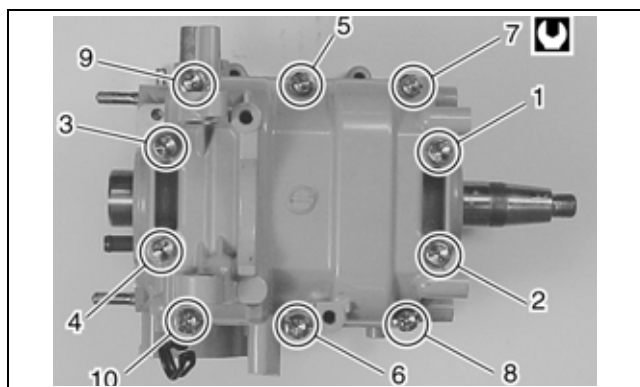
1. Plastigage

004593

- Install crankcase (with the bearing) to cylinder.
- Apply engine oil to crankcase screws and tighten to specification following the pattern shown:

Main bearing screws, 216 in. lbs. (25 N·m).
Flange screws, 120 in. lbs. (14 N·m).

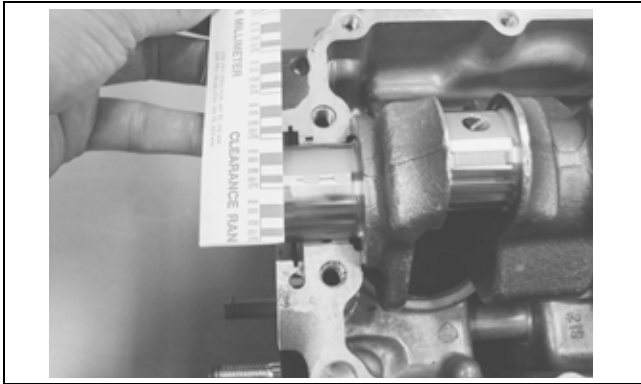
IMPORTANT: Do not rotate crankshaft while Plastigage is installed.



Crankcase screw torque pattern

004594

- Remove crankcase from cylinder.
- Measure the compressed Plastigage at its widest point.



004595

Crankshaft journal oil clearance:

- Standard: 0.0008 to 0.0019 in. (0.020 to 0.047 mm).
- Service limit: 0.0024 in. (0.060 mm).

If measurement exceeds service limit, replace crankshaft bearing.

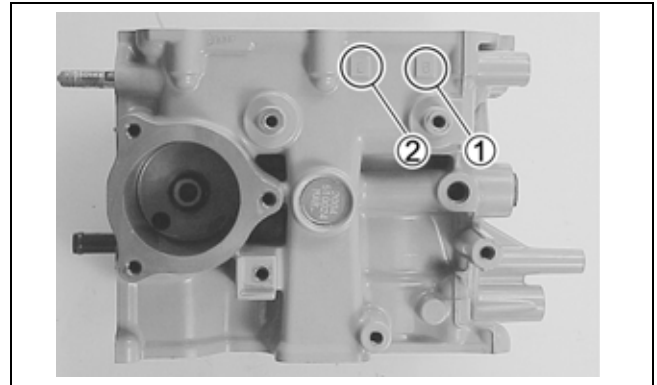
Main Bearing Selection

Whenever a bearing needs replacement, select a new bearing using the following procedure:

Check crankshaft journal outside diameter. Refer to **Crankshaft** on p. 161.

Find two stamped code letters on PORT side of cylinder. The letters (A or B) represent bearing holder inside diameter:

- A: 1.3783 to 1.3786 in. (35.008 to 35.016 mm)
- B: 1.3780 to 1.3783 in. (35.000 to 35.008 mm)

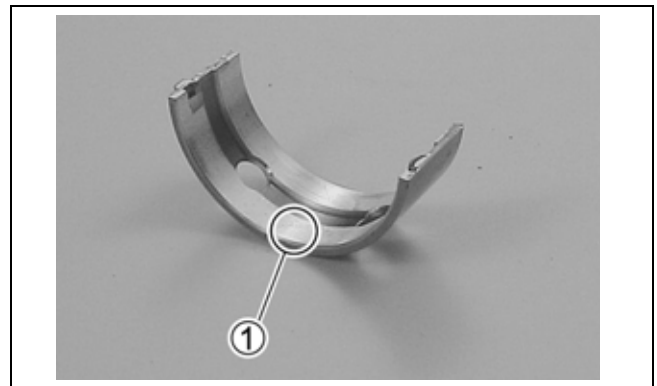


1. Upper bearing code
2. Lower bearing code

004620

Two main bearing thicknesses are available. Bearing thickness is identified by a color mark painted on the bearing:

- Green: 0.0585 to 0.0587 in. (1.486 to 1.490 mm)
- Black: 0.0587 to 0.0588 in. (1.490 to 1.494 mm)



1. Color mark

004621

Select crankshaft bearing based on stamped codes:

- A: Select bearing with BLACK marking.
- B: Select bearing with GREEN marking.

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Assembly

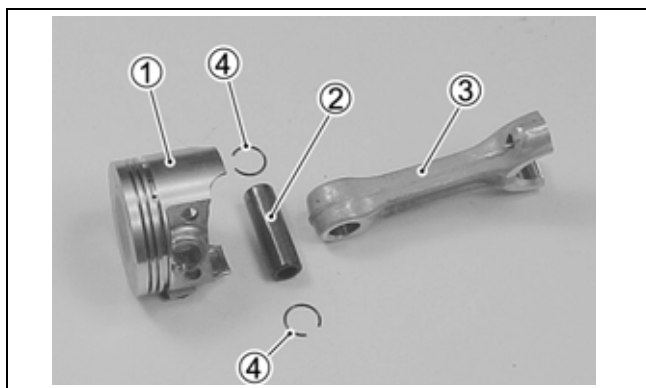
IMPORTANT: If original components are not replaced, each piston, piston pin, and connecting rod is to be assembled and installed in its original location.

IMPORTANT: Do not re-use gaskets, o-rings, seals, or circlips once removed. Always use new parts.

Piston and Connecting Rod

Apply engine oil to piston pin, piston pin bore, and connecting rod.

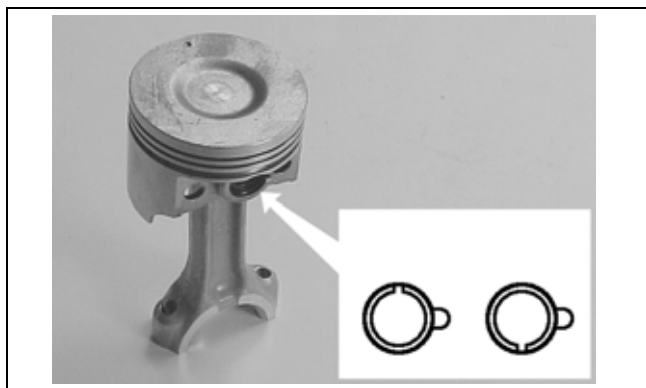
Fit connecting rod to piston and insert piston pin through piston and rod.



1. Piston
2. Piston pin
3. Connecting rod
4. Circlip

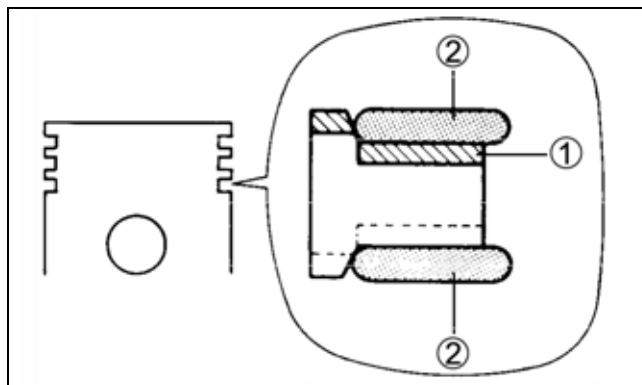
004596

Install piston pin circlips with gap facing either up or down.



004597

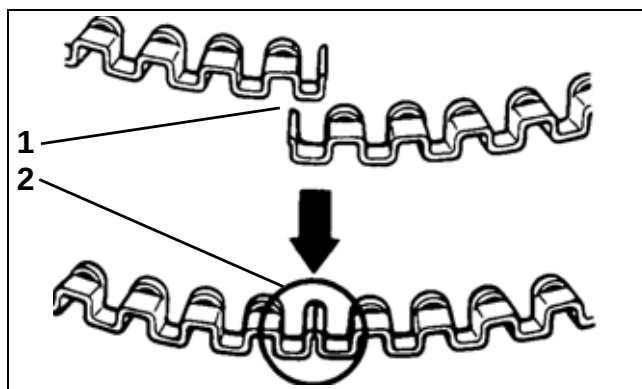
Apply engine oil to piston rings. Install oil ring spacer first, then side rails.



1. Spacer
2. Side rail

004598

IMPORTANT: When installing spacer, do not allow ends to overlap in the groove.

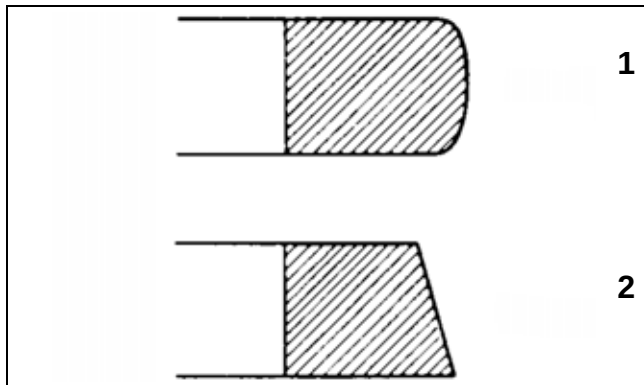


1. Incorrect
2. Correct

004599

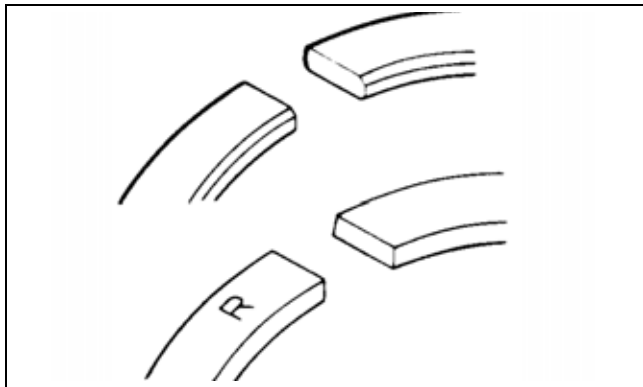
Install 2nd ring on piston with "R" mark toward the piston head.

Install 1st ring on piston. There is no I.D. mark on standard 1st ring.



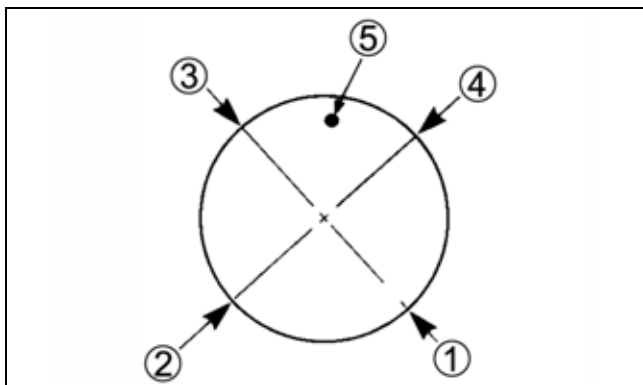
1. 1st Ring
2. 2nd Ring

004600



004601

Position rings so that gaps are staggered at approximately 90° angles.



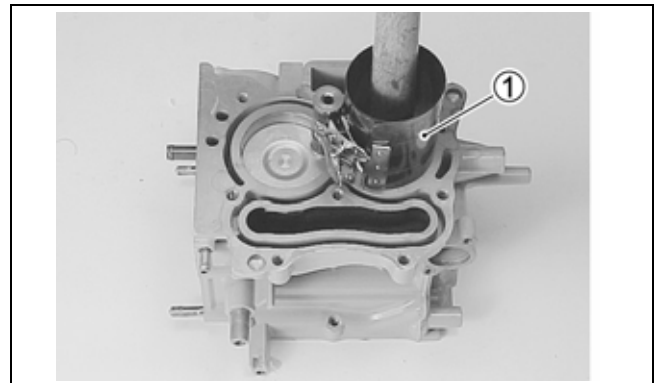
1. 1st Ring
2. Oil ring lower side rail
3. 2nd Ring
4. Oil ring upper side rail
5. Piston "O" mark

004602

Apply engine oil to piston and cylinder walls.

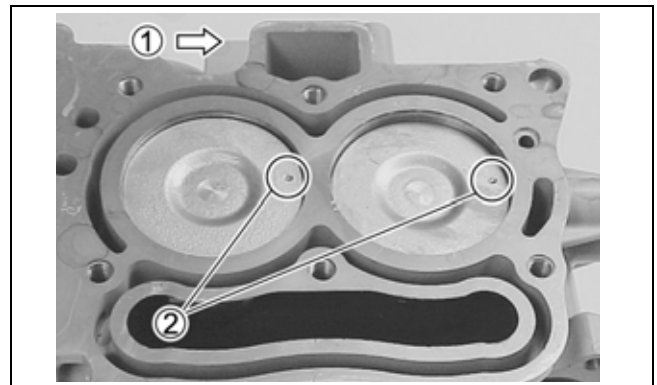
Insert piston and connecting rod assembly into cylinder bore from cylinder head side using piston ring compressor.

IMPORTANT: Position the "O" mark on piston head toward flywheel.



1. Ring compressor

004603



1. Flywheel side
2. "O" Mark

004604

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

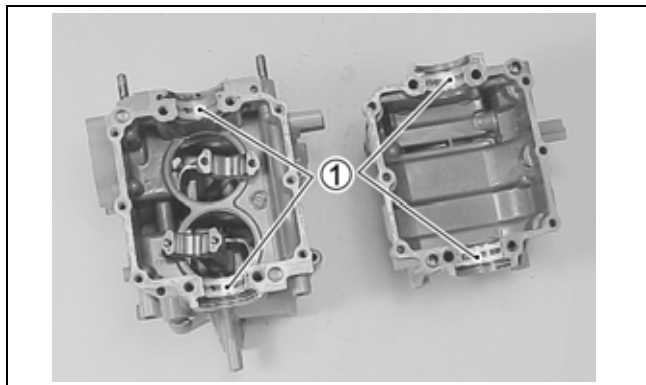
Crankshaft

Install crankshaft main bearings in cylinder and crankcase.

Align the tab of bearing with notch in cylinder and crankcase.

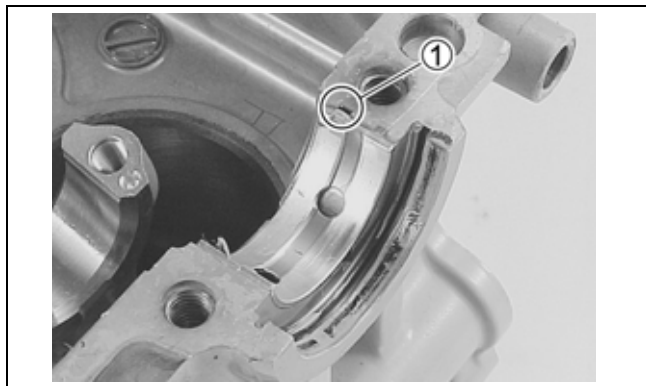
Apply engine oil to bearing inner surface.

IMPORTANT: Assemble each bearing in its original position.



1. Apply oil here

004605

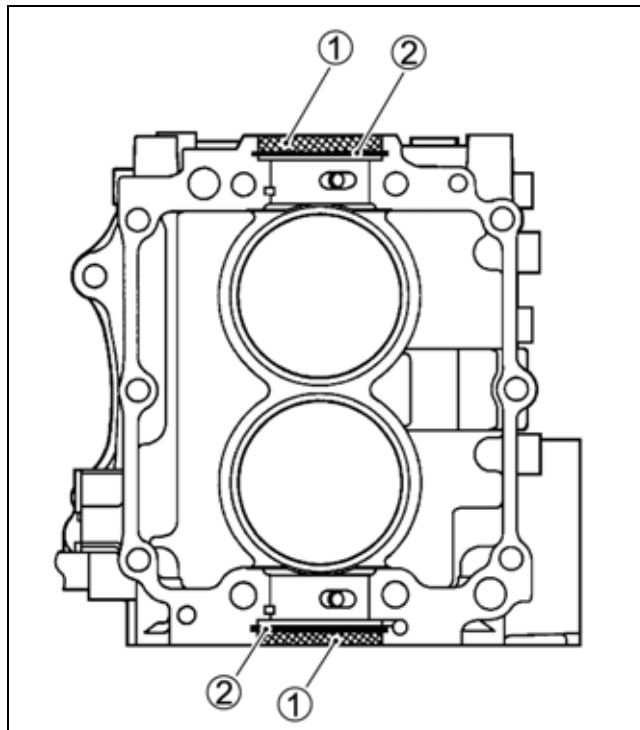


1. Notch

004606

Apply *ThreeBond* 1207B sealant to the oil seal fitting surface of the cylinder.

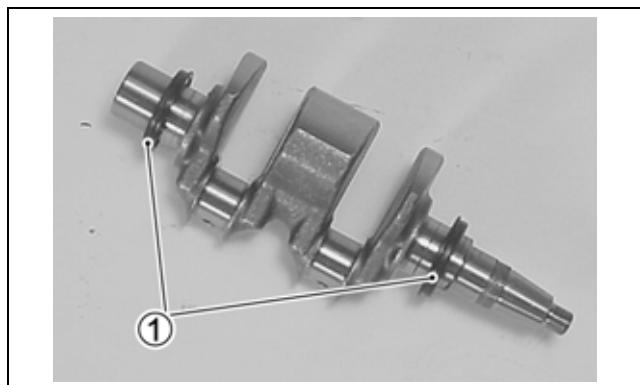
Do not allow sealant into the groove for the oil seal tab.



- 1. Seal fitting surface
- 2. Seal tab groove

004607

Apply engine oil to oil seal lips. Install seals on crankshaft with spring/lipped side facing inward.

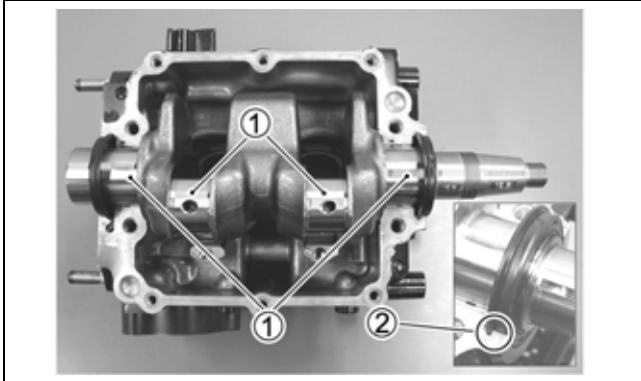


1. Crankshaft seals

004608

Apply engine oil to crank journal, crankpin, and connecting rod.

Be sure to fit oil seal tabs in grooves of cylinder.



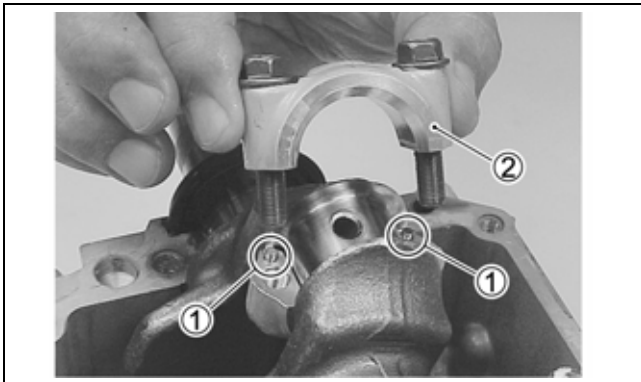
1. Apply oil here
2. Seal tab groove

004609

Apply engine oil to connecting rod cap.

Install dowel pins and cap to connecting rod.

IMPORTANT: Install each connecting rod cap in its original location.

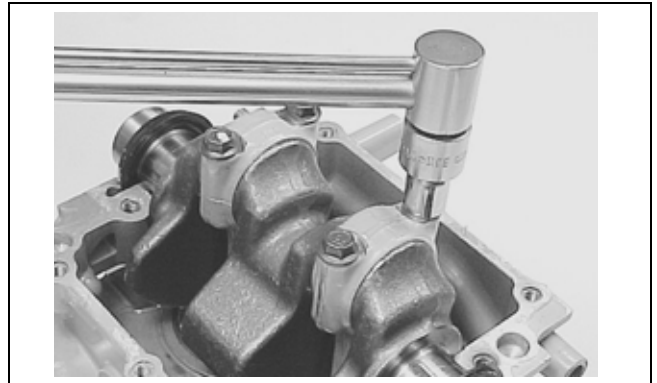


1. Dowel pin
2. Connecting rod cap

004610

Apply engine oil to connecting rod cap screws.

Tighten screws to 102 in. lbs. (12 N·m).



004611

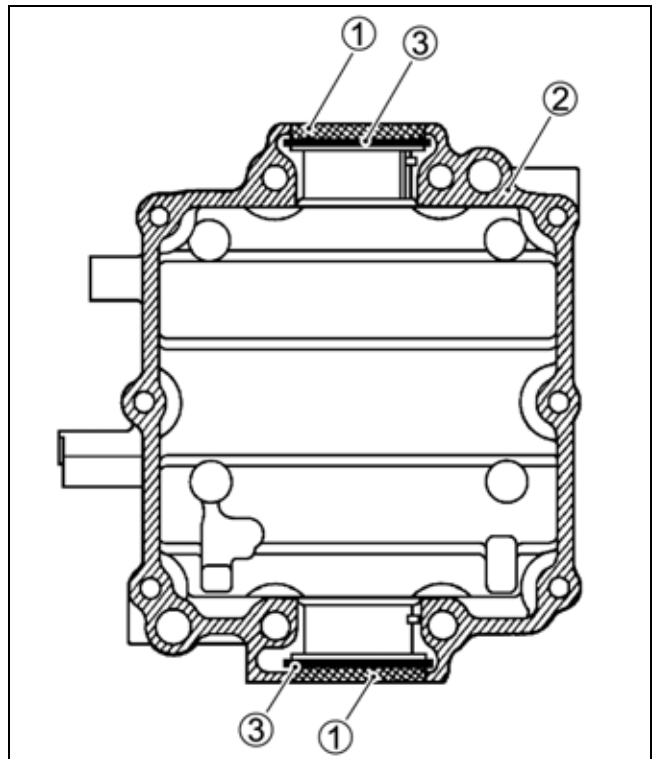
Crankcase

Clean mating surfaces of cylinder and crankcase.

Apply *ThreeBond* 1207B sealant to the oil seal fitting surface and the mating surface of the crankcase.

Do not allow sealant into the groove for the oil seal tab.

IMPORTANT: Do not allow sealant on bearing.



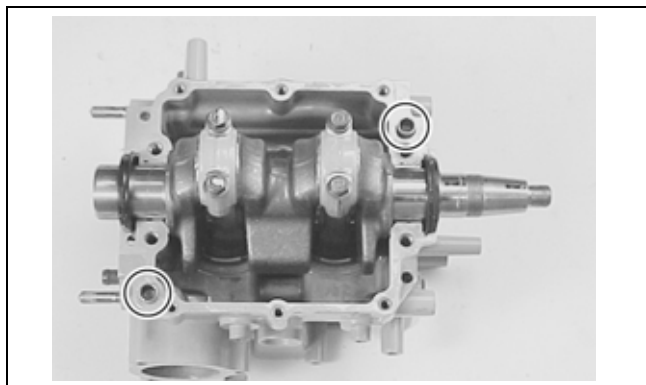
1. Seal fitting surface
2. Mating surface
3. Seal tab groove

004612

POWERHEAD

CYLINDER/CRANKCASE/PISTON ASSEMBLY

Install two dowel pins.

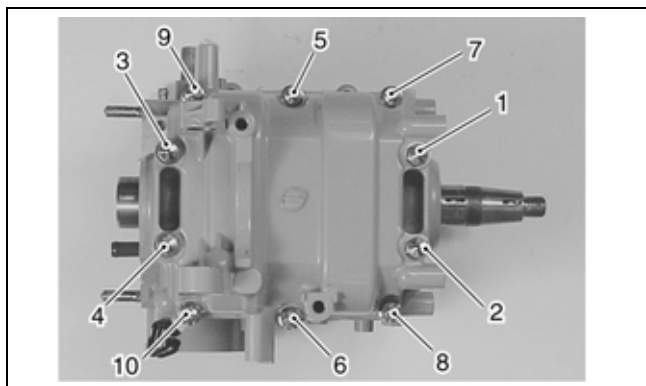


004613

Install crankcase (with bearing) on the cylinder.

Apply engine oil lightly to crankcase screws and tighten to the specified torque in the sequence shown:

- 6 mm: 120 in. lbs. (14 N·m)
- 8 mm: 216 in. lbs. (25 N·m)



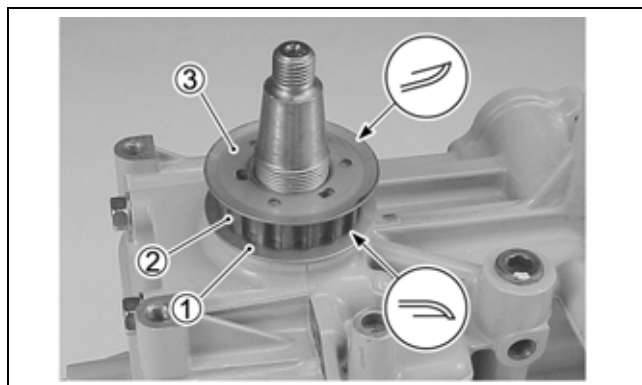
Crankcase screw torque sequence

004614

Timing Pulley

Install lower guide, key, timing pulley, and upper guide.

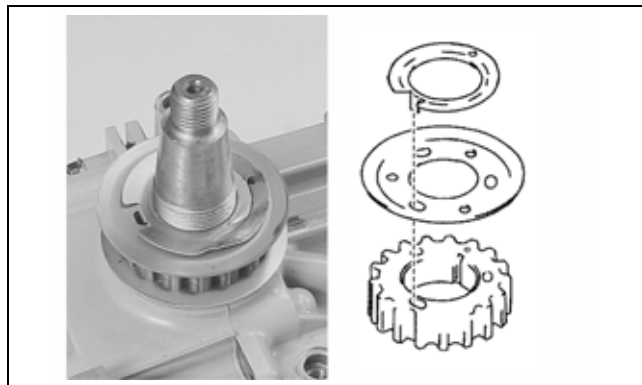
IMPORTANT: Install timing pulley with PUNCH mark upward, and belt guides with flanges toward outside.



1. Lower guide
2. Timing pulley
3. Upper guide

004615

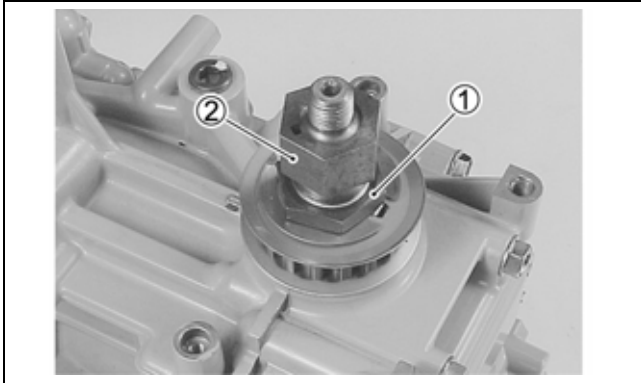
Install lock washer with tab in notch through upper guide and timing pulley.



004616

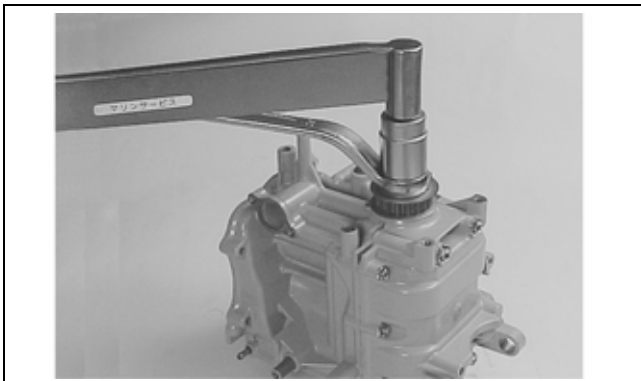
Apply *Nut Lock* to timing pulley nut and install on crankshaft.

Holding crankshaft with Crankshaft Holder, P/N 5034236, tighten pulley nut to 36 ft. lbs. (50 N·m).



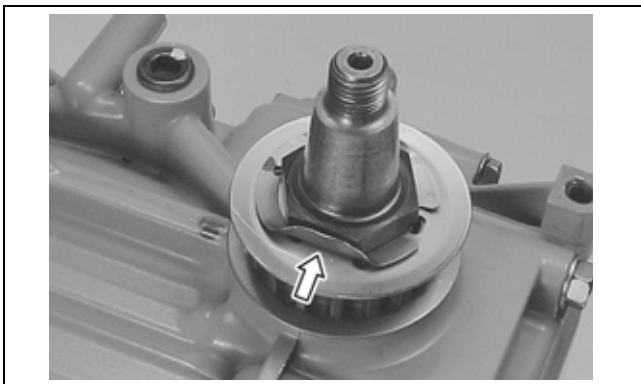
1. Timing pulley nut
2. Crankshaft holder

004617



004618

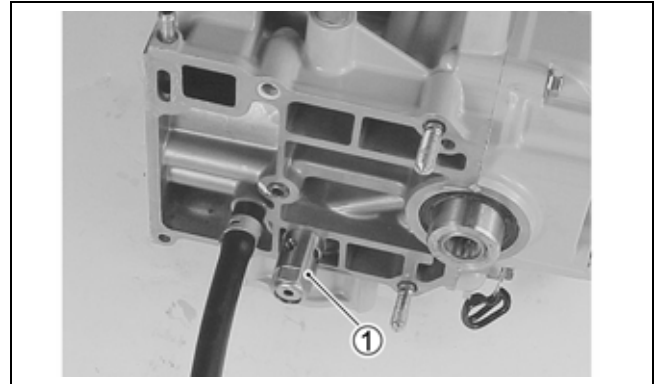
Bend lock washer edge toward nut.



004619

Oil Pressure Regulator

Install oil pressure regulator to cylinder. Tighten to 19.5 ft. lbs. (27 N·m).



004622

Thermostat

Refer to **Thermostat Service** on p. 170.

Oil Filter

Refer to **Engine Oil Filter** on p. 53.

Cylinder Head

Refer to cylinder head **Installation** on p. 152.

COOLING SYSTEM

Operation

The cooling system consists of:

- Water pump, in the lower unit
- Water tube, between lower unit and powerhead
- Thermostat, in the powerhead

If overheating occurs, check cooling system parts for blockage, corrosion buildup, or damage.

Refer to **WATER PUMP** on p. 202.

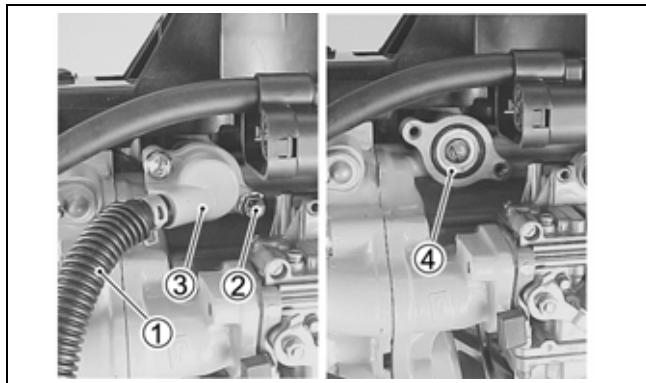
Refer to driveshaft housing **Cleaning and Inspection** on p. 183.

Thermostat Service

Removal

Disconnect water hose from thermostat cover.

Remove two screws, thermostat cover, and thermostat.



1. Water hose
2. Thermostat cover screws
3. Thermostat cover
4. Thermostat

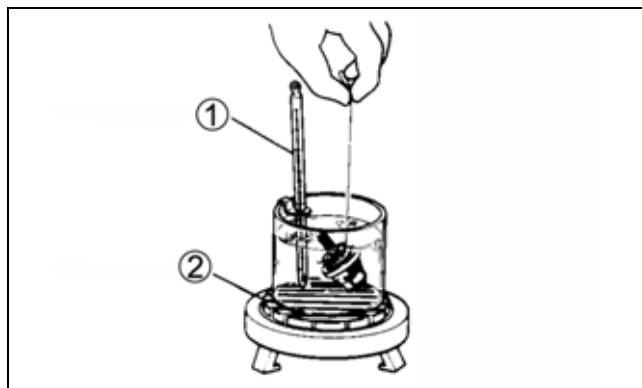
004623

Inspection

If salt deposits, corrosion, wear, or other damage are found, clean or replace.

Check thermostat opening temperature as follows:

- Insert a length of thread between thermostat valve/body, and suspend thermostat in a container of water.
- Place thermometer in container and heat water.
- Observe water temperature when thermostat valve opens and releases thread.



1. Thermometer
2. Heater

004624

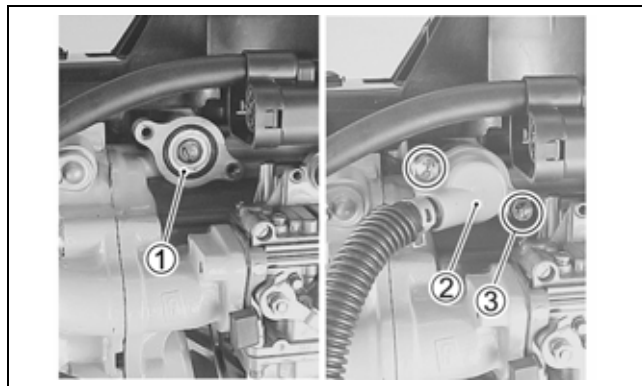
Thermostat operating temperature:

- Standard: 136 to 144° F (58 to 62° C).

Installation

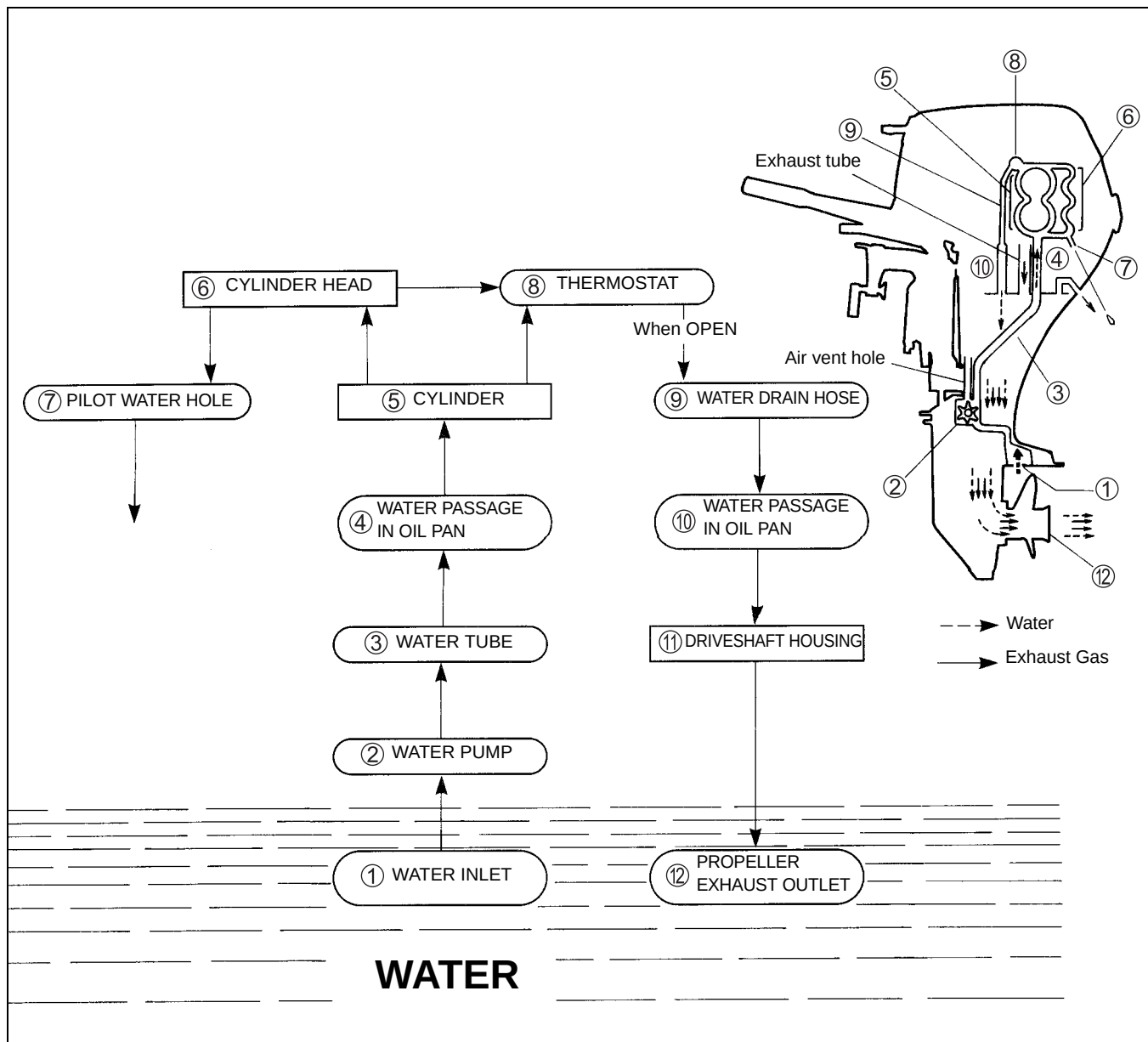
Install thermostat and thermostat cover on cylinder and secure with screws.

Tighten screws 84 in. lbs. (10 N·m).



004625

Cooling System Diagram

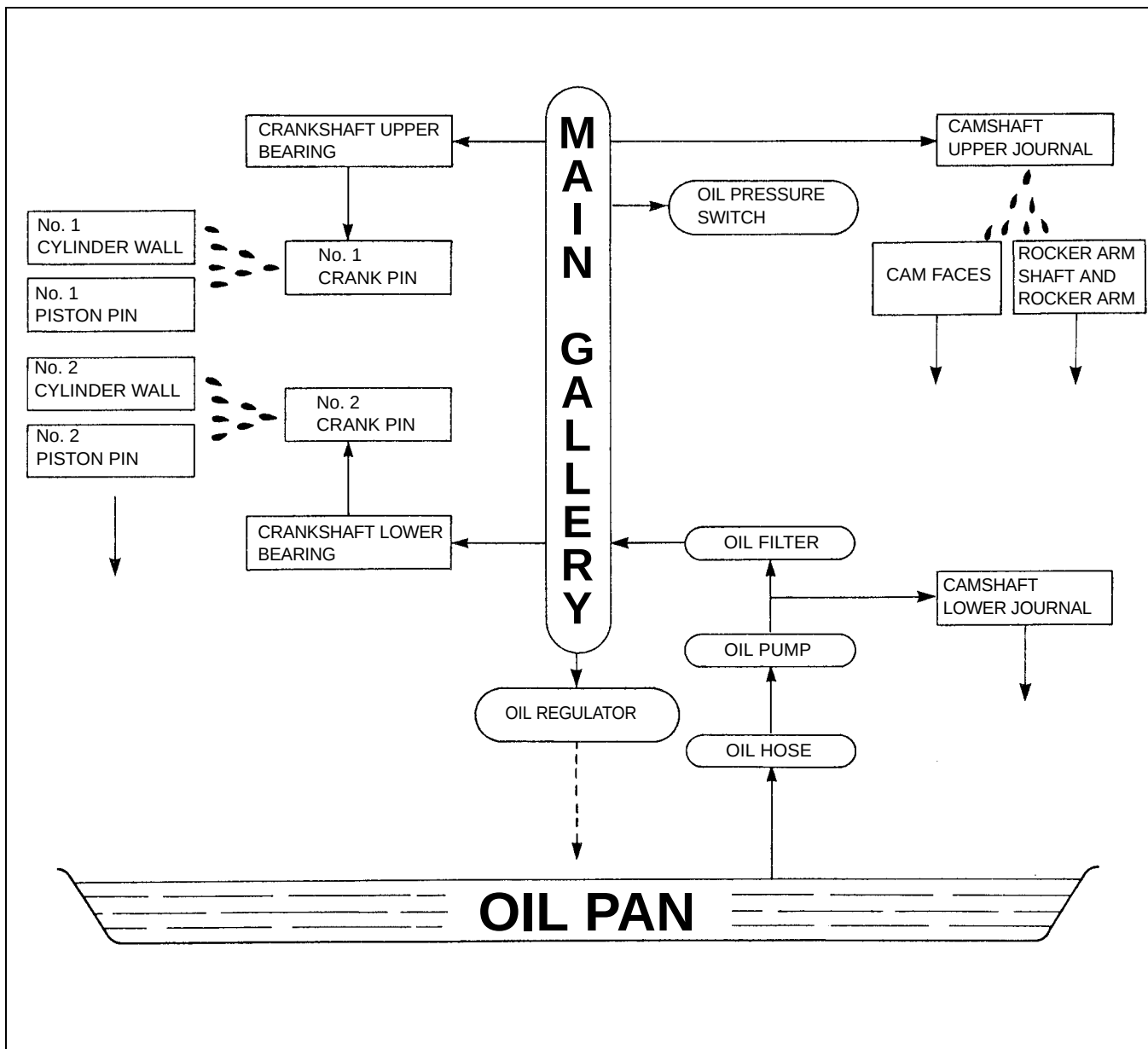


06i01730

ENGINE LUBRICATION SYSTEM

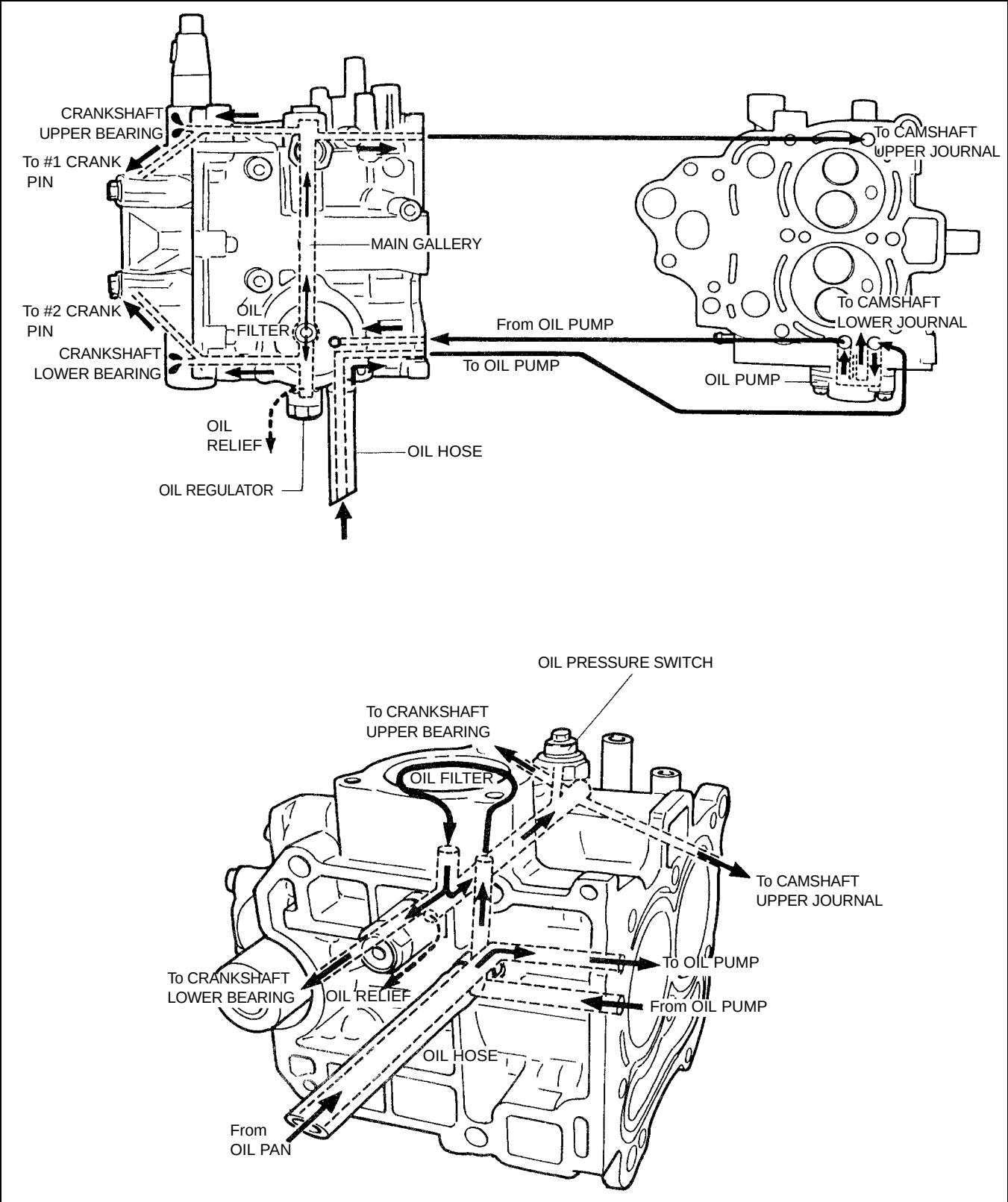
Engine oil stored in the oil pan is pumped up by the trochoid type pump.

Engine Oil Lubrication Chart



06i01740

Oil Passage Locations



NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

MIDSECTION

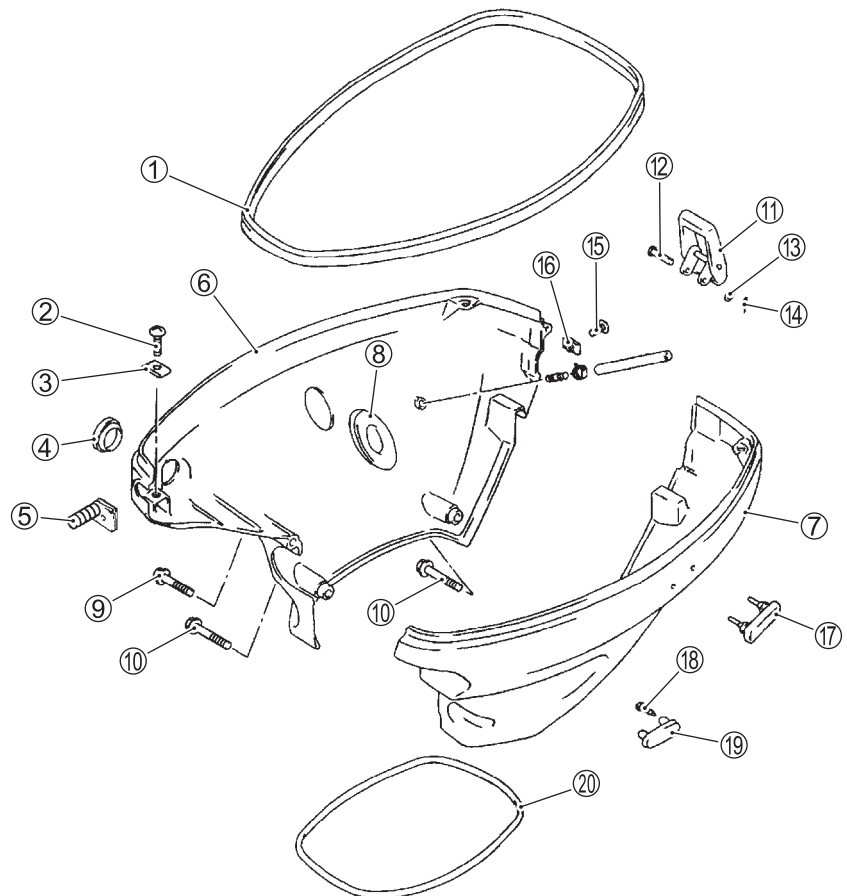
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SERVICE CHART

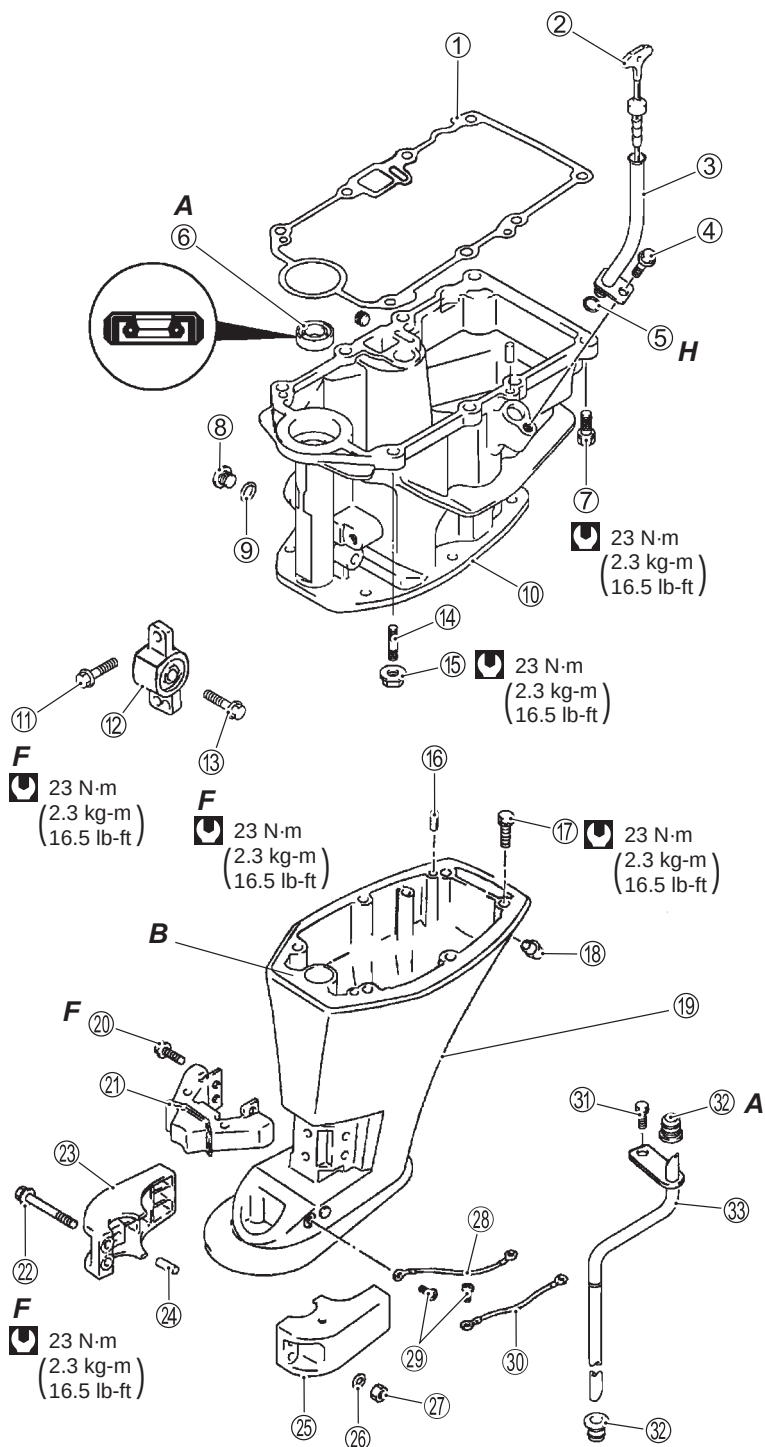
SIDE COVER

1. Side cover seal (1)
2. Screw (2)
3. Snap pin (1)
4. Washer (1)
5. Pin (1)
6. Fastener (1)
7. Screw (2)
8. Screw (1)
9. Screw (1)
10. STBD side cover (1)
11. PORT side cover (1)



DRIVESHAFT HOUSING

1. Gasket (1)
2. Oil level gauge (1)
3. Oil level gauge guide (1)
4. Screw (1)
5. O-ring (1)
6. Oil seal (1)
7. Screw (6)
8. Plug (2)
9. Gasket (2)
10. Oil pan assembly (1)
11. Screw (4)
12. Upper mount (2)
13. Screw (2)
14. Stud (2)
15. Nut (2)
16. Dowel pin (2)
17. Screw (6)
18. Pipe (1)
19. Driveshaft housing (1)
20. Screw (4)
21. Lower mount (1)
22. Screw (2)
23. Lower mount cover STBD (1)
24. Pin (2)
25. Lower mount cover PORT (1)
26. Washer (2)
27. Nut (2)
28. Bonding wire (1)
29. Screw (2)
30. Bonding wire (1)
31. Screw (1)
32. Grommet (2)
33. Water tube (1)

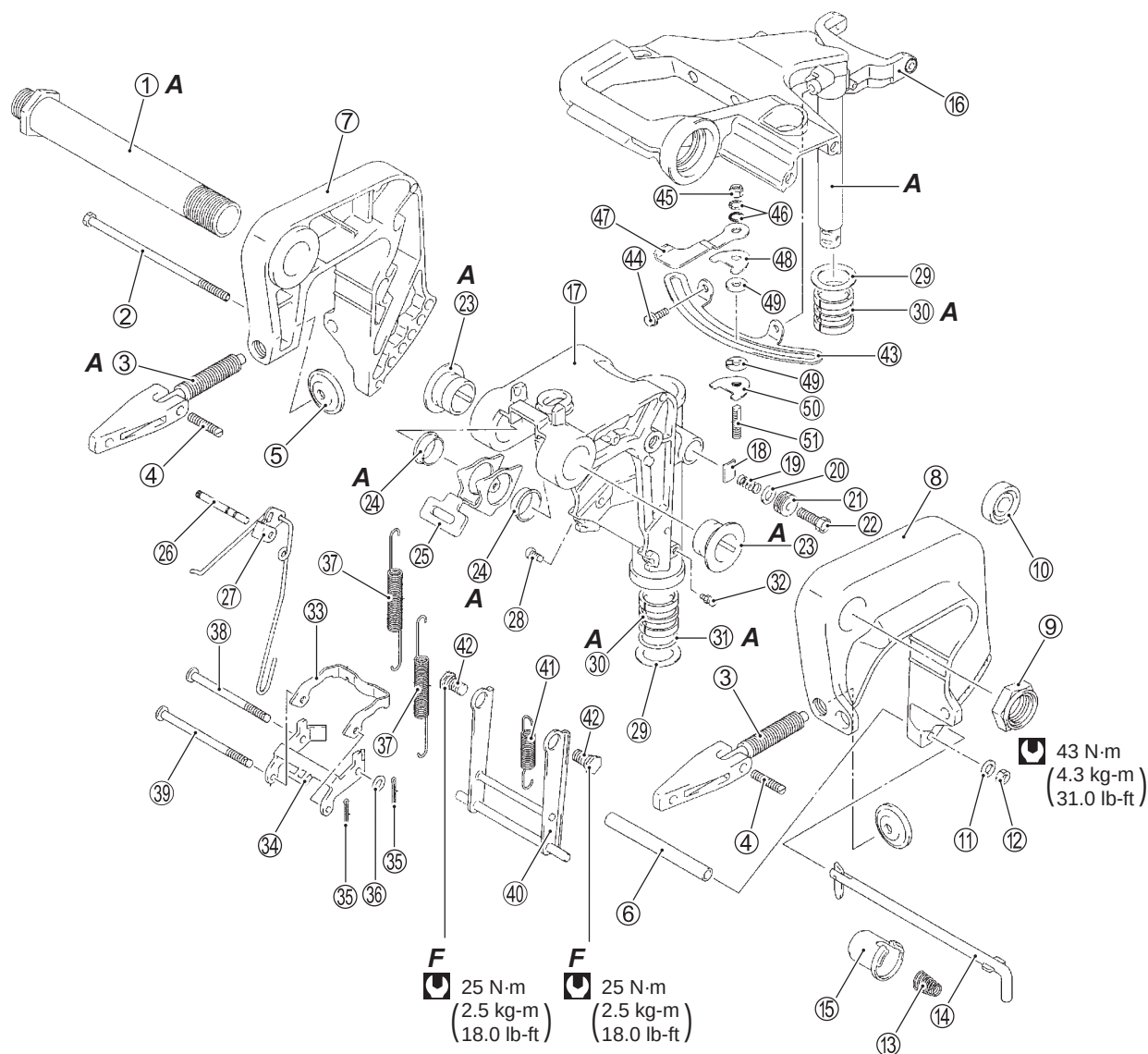


A	Triple-Guard Grease
B	Gasket Sealing Compound
C	Adhesive 847
D	Moly Lube
E	Red Ultra Lock
F	Blue Nut Lock
G	Needle Bearing Grease
H	Outboard Lubricant
Q	Gel Seal II

004414

MIDSECTION SERVICE CHART

STERN BRACKET

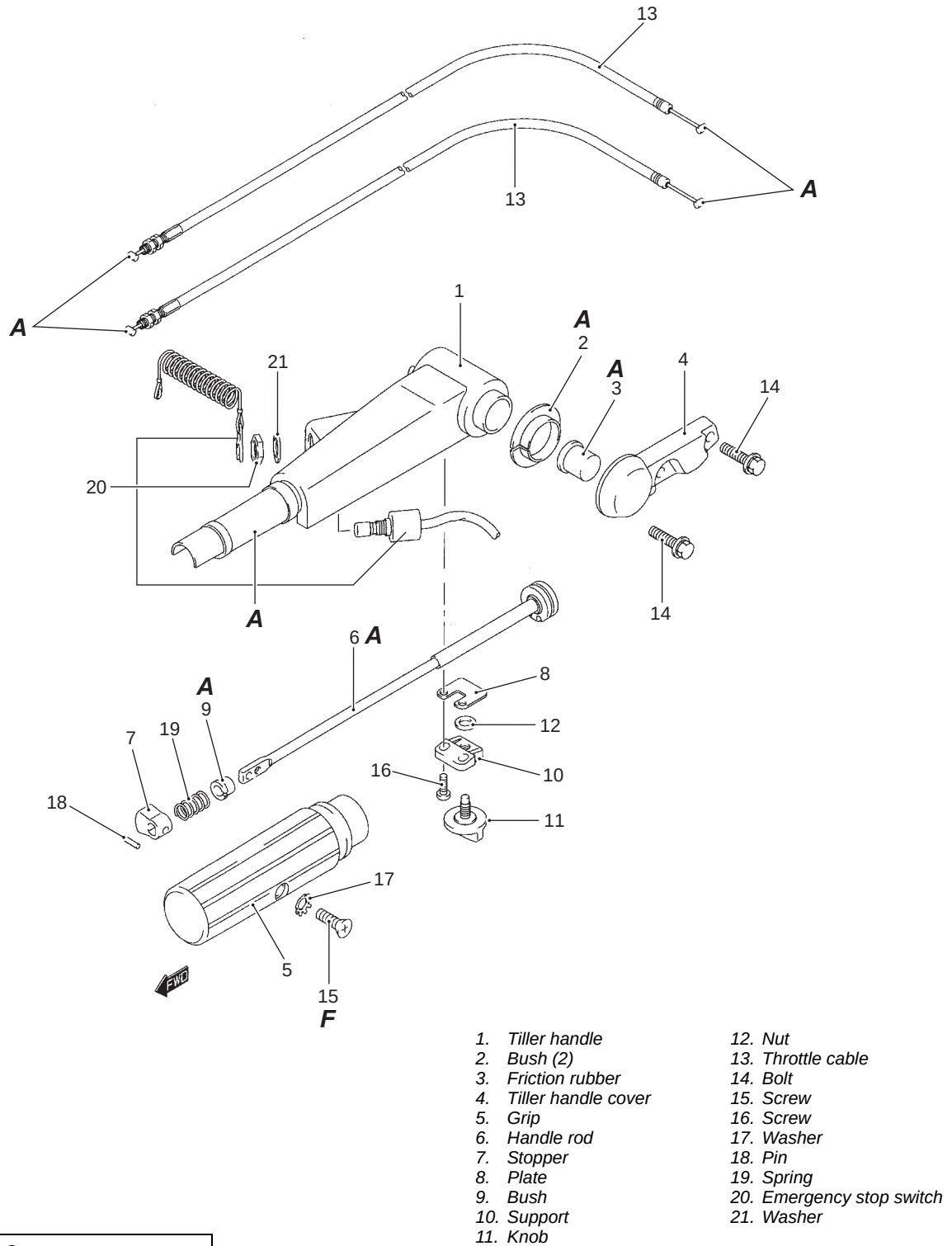


- | | | | |
|----------------------------|---------------------------|-------------------------------|---------------------------------|
| 1. Clamp bracket shaft (1) | 15. Stopper (1) | 29. Washer (2) | 43. Steering adjuster plate (1) |
| 2. Screw (1) | 16. Steering bracket (1) | 30. Bushing (2) | 44. Screw (2) |
| 3. Clamp screw (2) | 17. Swivel bracket (1) | 31. O-ring (1) | 45. Nut (1) |
| 4. Pin (2) | 18. Steering adjuster (1) | 32. Nipple (3) | 46. Washer (2) |
| 5. Clamp plate (2) | 19. Spring (1) | 33. Reverse lock arm (1) | 47. Steering adjuster (1) |
| 6. Spacer (1) | 20. Washer (1) | 34. Reverse lock arm link (1) | 48. Friction plate (1) |
| 7. Clamp bracket STBD (1) | 21. Cover (1) | 35. Cotter pin (2) | 49. Washer (1) |
| 8. Clamp bracket PORT (1) | 22. Screw (1) | 36. Washer (1) | 50. Nut (1) |
| 9. Nut (1) | 23. Bushing | 37. Spring (2) | 51. Steering adjuster shaft (1) |
| 10. Seal (1) | 24. Bushing | 38. Pin (1) | |
| 11. Washer (1) | 25. Release lever (1) | 39. Pin (1) | |
| 12. Nut (1) | 26. Release arm pin (1) | 40. Shallow drive (1) | |
| 13. Spring (1) | 27. Release link (1) | 41. Spring (1) | |
| 14. Tilt lock pin (1) | 28. Screw (1) | 42. Screw (2) | |

A Triple-Guard Grease
F Blue Nut Lock

004415

TILLER HANDLE

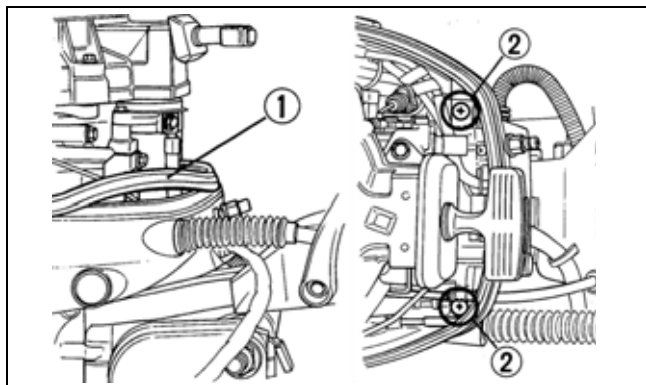


SIDE COVER

Removal and Installation

Remove the side cover seal.

Remove two cover screws.

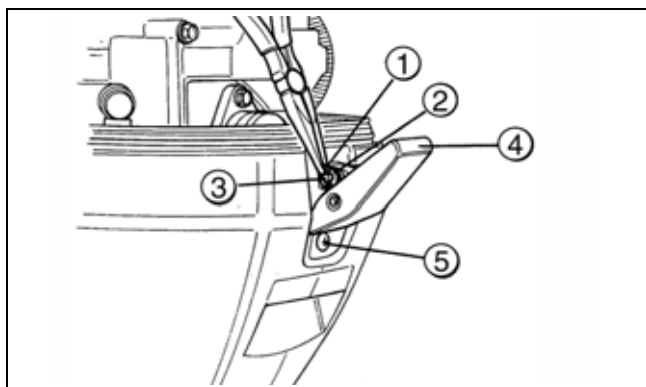


1. Side cover seal
2. Screws

004417

Remove snap pin, washer, pin, and fastener.

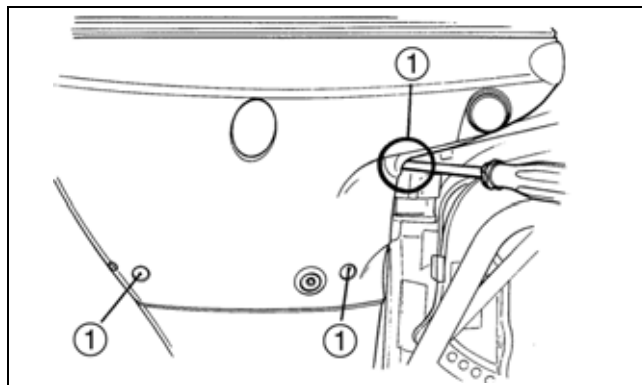
Remove screw.



1. Snap pin
2. Washer
3. Pin
4. Fastener
5. Screw

004418

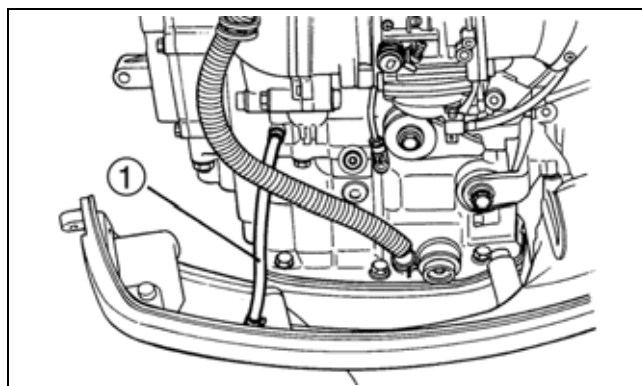
Remove three screws from STBD side.



1. Screws

004419

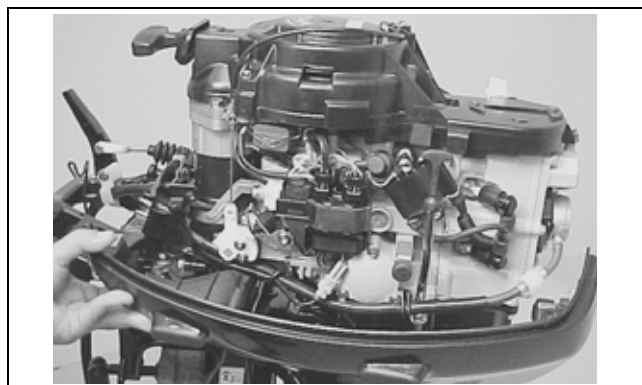
Disconnect water hose and remove STBD side cover.



1. Water hose

004420

Remove PORT side cover.



004421

Installation is reverse order of removal.

DRIVESHAFT HOUSING AND OIL PAN

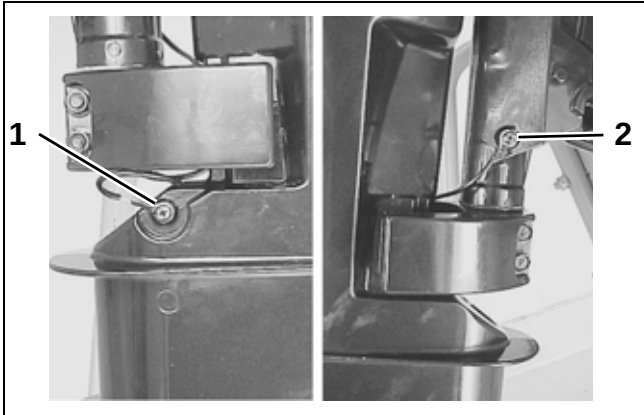
Removal

Remove the powerhead. Refer to Powerhead Removal on p. 134.

Remove the gearcase. Refer to Gearcase REMOVAL AND INSTALLATION on p. 200.

Remove screw and bonding wire from driveshaft housing.

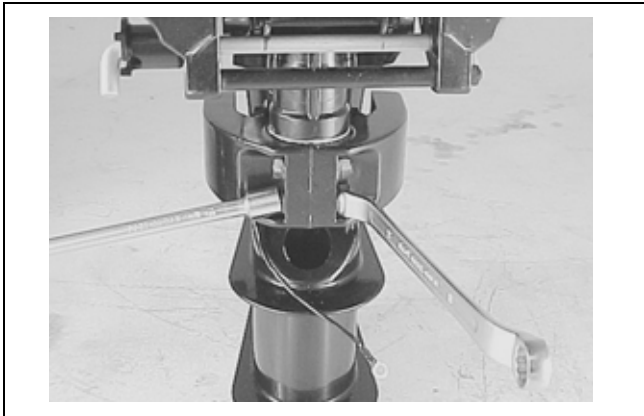
Remove screw and bonding wire from swivel bracket.



1. Driveshaft housing screw
2. Swivel bracket screw

004422

Remove the two lower mount cover bolts and remove both lower mount covers.

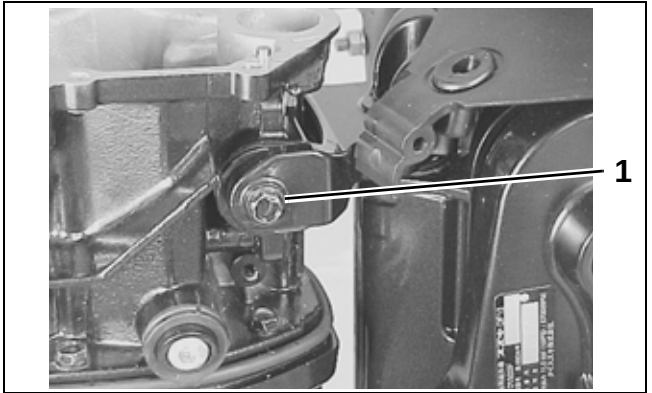


004423

Remove two upper mount screws and driveshaft housing (with oil pan).

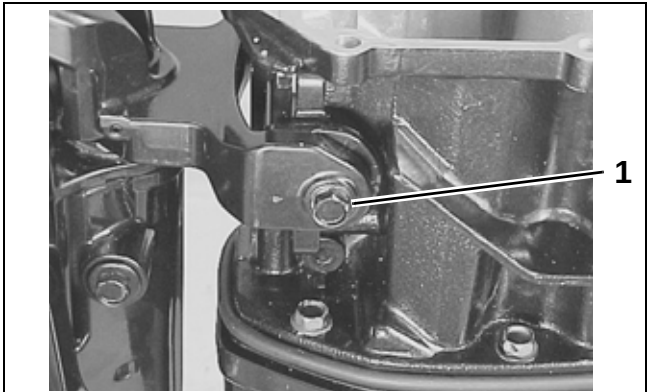
**WARNING**

When removing the upper mount screws, driveshaft housing must be firmly supported.



1. Upper mount screw

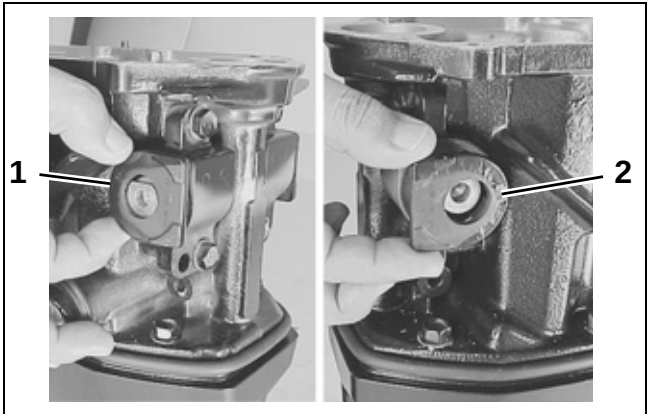
004424



1. Upper mount screw

004425

Remove upper mount stoppers.



1. Upper mount stoppers

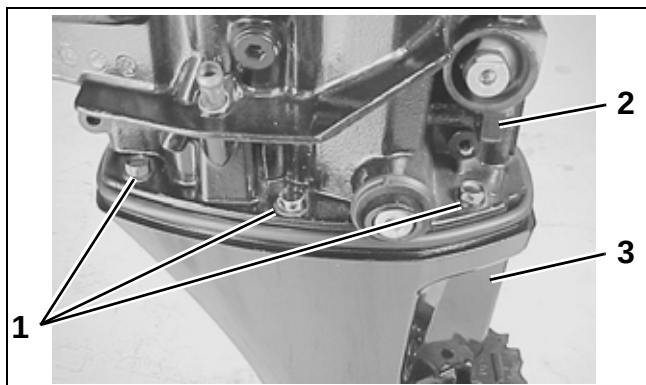
004426

MIDSECTION

DRIVESHAFT HOUSING AND OIL PAN

Disassembly

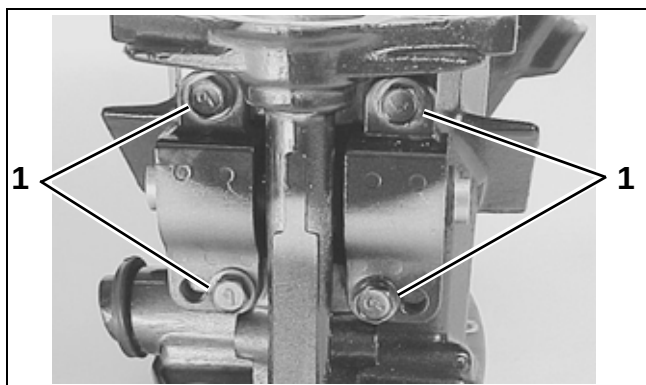
Remove six screws and oil pan from the driveshaft housing.



- 1. Screws
- 2. Oil pan
- 3. Driveshaft housing

004427

Remove four screws and upper mounts.



- 1. Upper mount screws

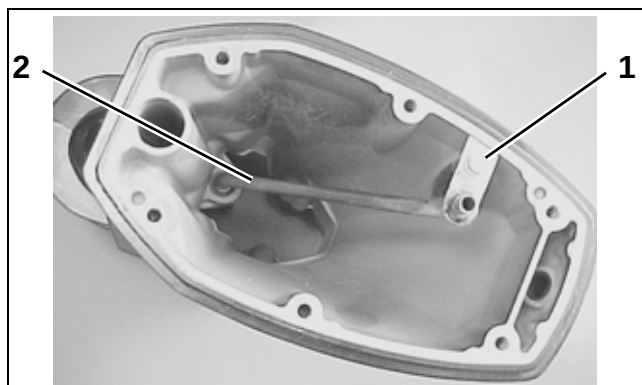
004428

Remove four screws and lower mount.



004429

Remove screw and water tube.



- 1. Screw
- 2. Water tube

004430

Cleaning and Inspection



WARNING



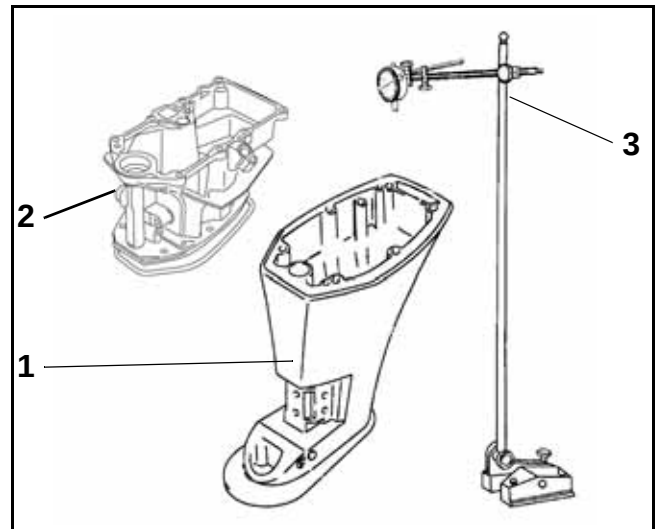
To avoid personal injury, wear eye protection and set compressed air pressure to less than 25 psi (172 kPa).

- Clean all parts with cleaning solvent and dry with compressed air.
- All nut and screw threads that are coated with *Nut Lock* or *Screw Lock* must be thoroughly cleaned before assembly. When using a thread locking product, prime the threads with Locquic Primer.
- Discard all oil seals, O-rings, and gaskets. Use new components during assembly.
- Check all bushings for wear and proper fit. Replace if necessary.
- Inspect the rubber motor mounts. Replace if deteriorated or damaged.
- Inspect the water tube for obstructions or kinks which may restrict water flow. Replace the grommet if worn or damaged.
- Inspect the stern brackets, swivel bracket, and steering arm for cracks and other damage.
- Inspect the shift components for wear. Replace if deteriorated or damaged.

Before checking the driveshaft or oil pan housings for distortion, thoroughly clean the top and bottom mating surfaces and remove all sealer and corrosion.

Check the driveshaft and oil pan housings for distortion. Place the housing on a surface plate. Use a dial indicator to check the flatness by measuring the run-out on the top edge of the housing. The maximum allowable run-out is 0.009 in. (0.228 mm).

If you do not have access to a dial indicator and a surface plate, seek the services of a machine shop. DO NOT attempt to straighten a distorted housing. Replace it.



1. Driveshaft housing
2. Oil pan housing
3. Dial indicator

004431

8

IMPORTANT: A bent driveshaft or oil pan housing will cause the upper driveshaft splines to wear excessively and will also damage the crankshaft splines. Additionally, a distorted upper oil pan housing can result in loss of oil or allow water to enter the oil.

MIDSECTION

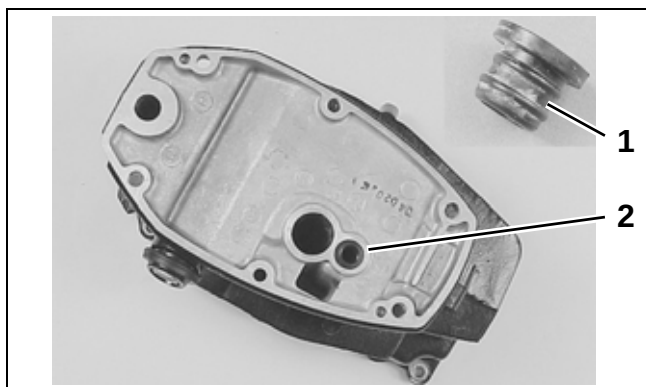
DRIVESHAFT HOUSING AND OIL PAN

Assembly

Assembly is reverse order of disassembly with special attention to the following steps:

Apply *Triple-Guard* grease to the outer surface of the water tube upper grommet.

Install grommet in oil pan.

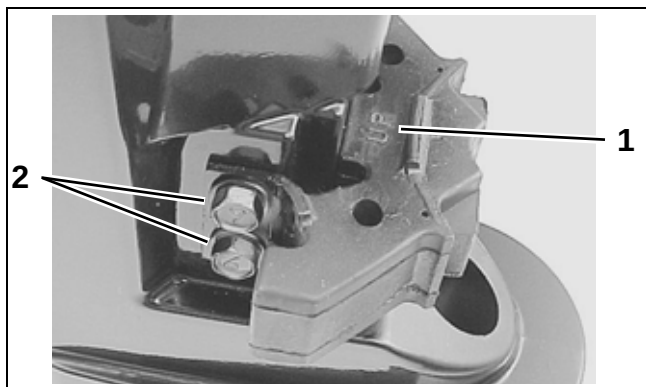


004432

Install lower mount with “UP” mark facing upward.

Apply *Nut Lock* to lower mount screw threads.

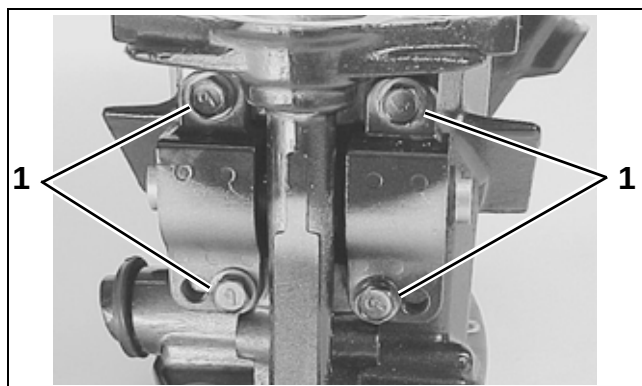
Tighten lower mount screws 198 in. lbs. (23 N·m).



004433

Apply *Nut Lock* to upper mount screw threads.

Tighten upper mount screws 198 in. lbs. (23 N·m).

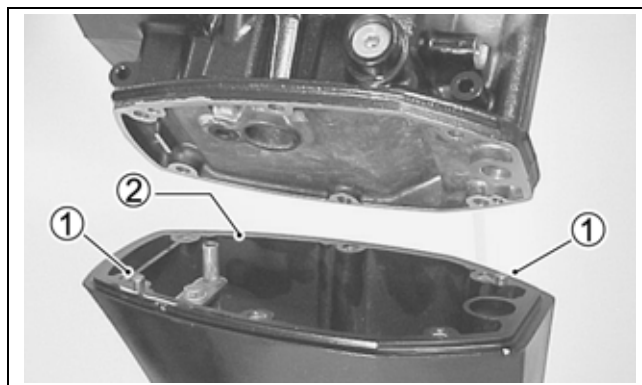


1. Upper mount screws

004428

Install two dowel pins in driveshaft housing.

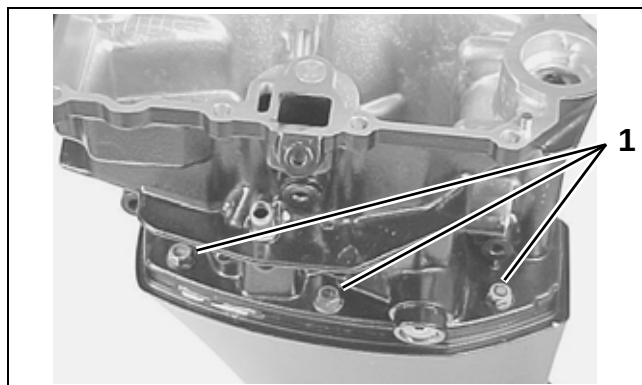
Apply *Gasket Sealing Compound* to mating surfaces of driveshaft housing and oil pan.



1. Dowel pins
2. Apply Gasket Sealing Compound

004434

Install the oil pan on the driveshaft housing and tighten six screws 198 in. lbs. (23 N·m).

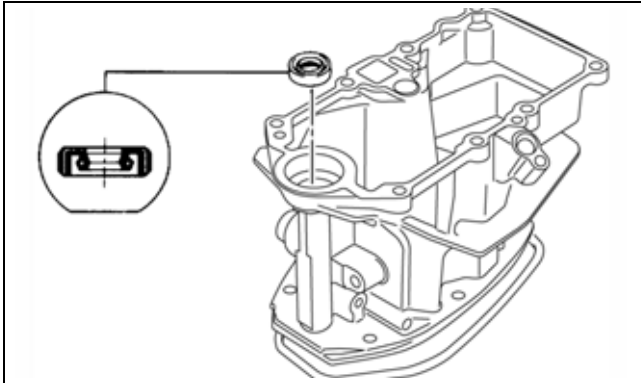


1. Oil pan to driveshaft housing screws

004435

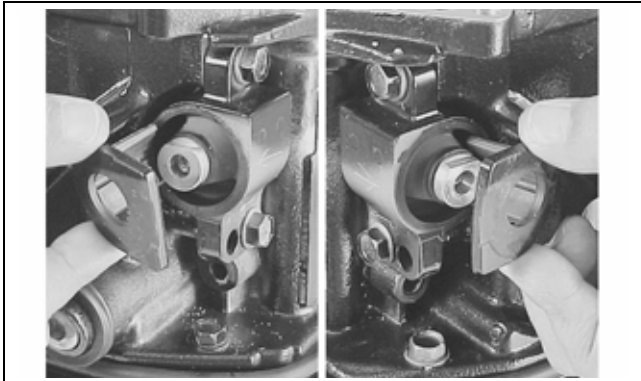
MIDSECTION DRIVESHAFT HOUSING AND OIL PAN

Install oil seal with lip (spring side) facing downward (toward driveshaft housing).



004436

Install the upper mount stoppers to upper mounts.

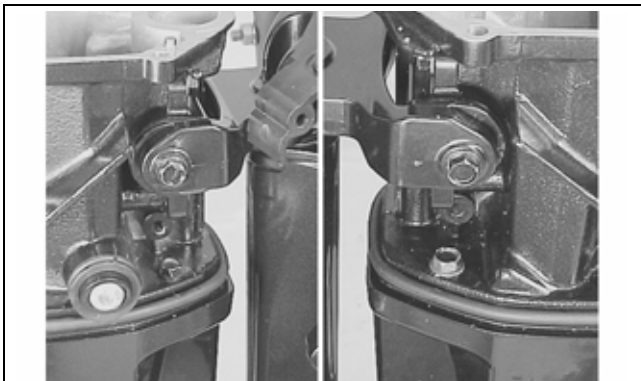


004437

Install driveshaft housing/oil pan to steering bracket.

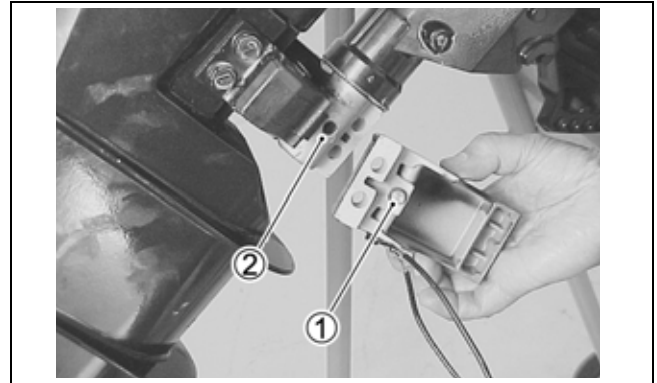
Apply *Nut Lock* to upper mount screw threads.

Tighten upper mount screws 198 in. lbs. (23 N·m).



004438

Install lower mount covers, making sure that pin in cover fits into the hole of steering shaft.

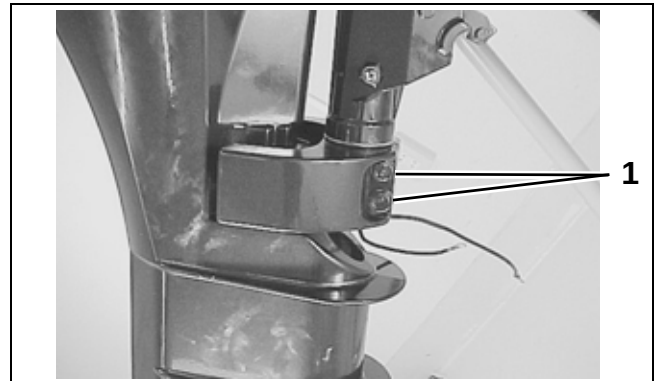


1. Pin
2. Hole

004439

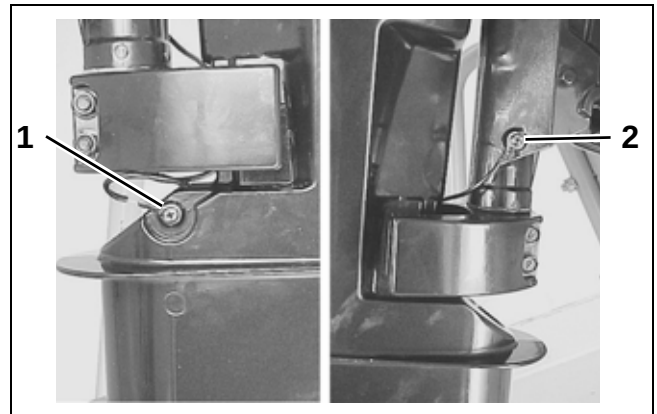
Apply *Nut Lock* to lower mount cover screw threads.

Tighten cover screws 198 in. lbs. (23 N·m).



004440

Install bonding wire to driveshaft housing and swivel bracket.



1. Driveshaft housing screw
2. Swivel bracket screw

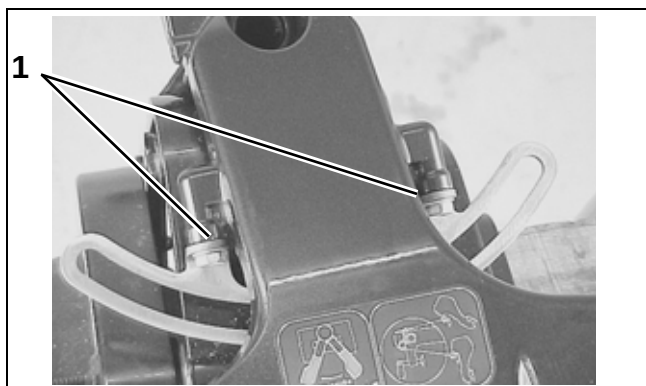
004422

STERN BRACKET

Disassembly

Remove driveshaft housing/oil pan assembly. Refer to **Removal** on p. 181.

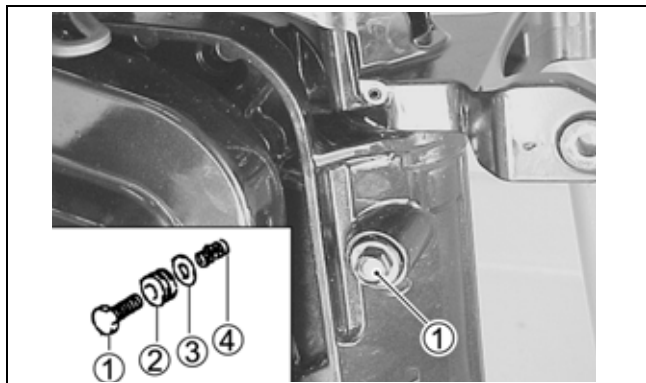
Remove the two screws securing steering friction plate to the steering bracket (tiller models).



Steering friction plate screws

004441

Remove steering adjuster screw, cover, washer, and spring.



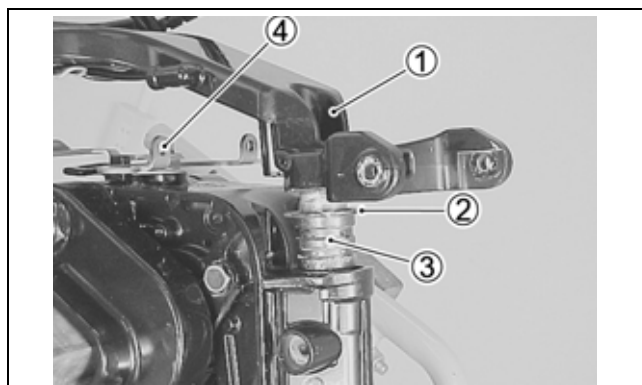
1. Steering adjuster screw
2. Cover
3. Washer
4. Spring

004442

Lift steering bracket upward to remove from swivel bracket.

Remove washer and upper bushing from swivel bracket.

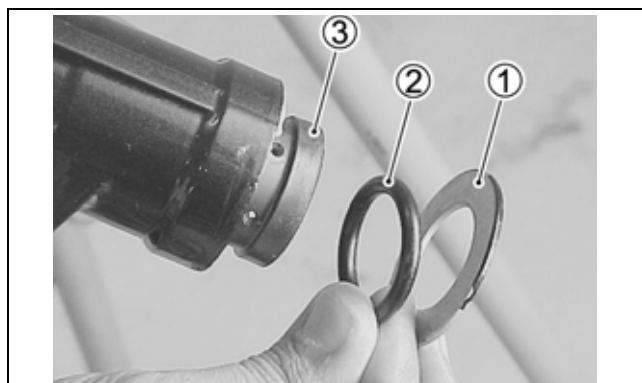
Remove steering friction adjuster (tiller models).



1. Steering bracket
2. Washer
3. Upper bushing
4. Friction adjuster

004443

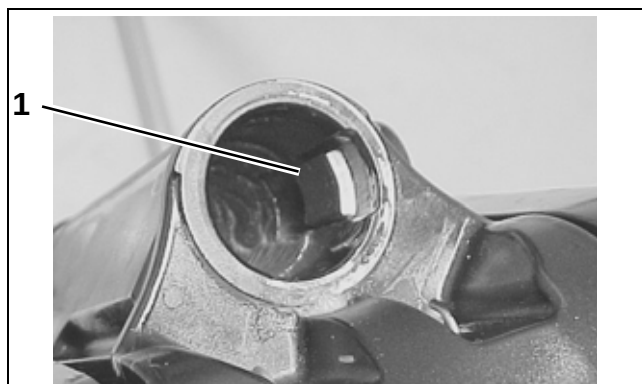
Remove washer, o-ring, and lower bushing.



1. Washer
2. O-ring
3. Bushing

004444

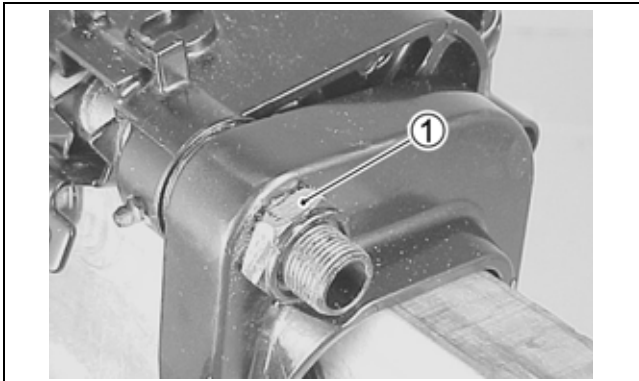
Remove steering adjuster plate.



1. Steering adjuster plate

004445

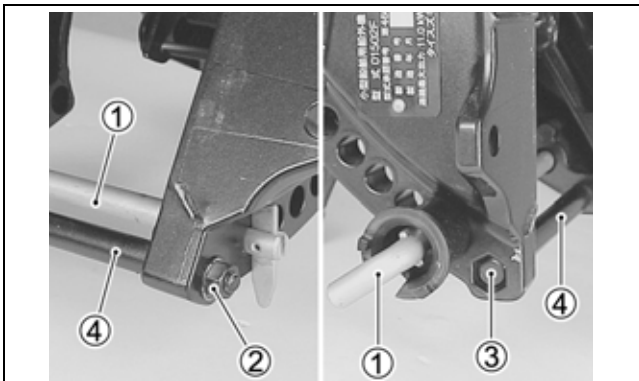
Remove nut from clamp bracket shaft.



1. Nut

004446

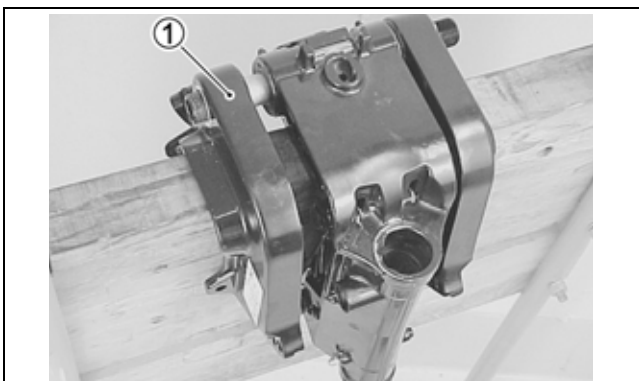
Remove tilt lock pin, nut, bolt, and spacer.



1. Tilt lock pin
2. Nut
3. Bolt
4. Spacer

004447

Slide PORT clamp bracket off clamp bracket shaft.

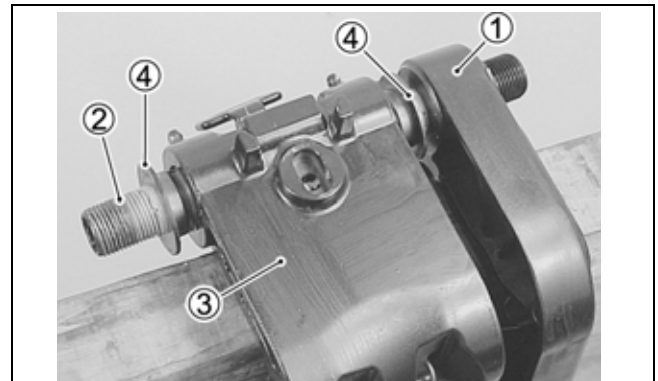


1. PORT clamp bracket

004448

Pull STBD clamp bracket outward to remove clamp bracket and bracket shaft from swivel bracket.

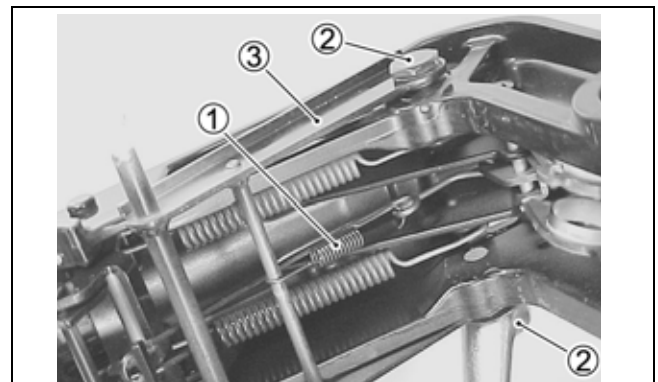
Remove bushings from each side of swivel bracket.



1. STBD clamp bracket
2. Bracket shaft
3. Swivel bracket
4. Bushing

004449

Remove small spring, two screws, and shallow drive arm.



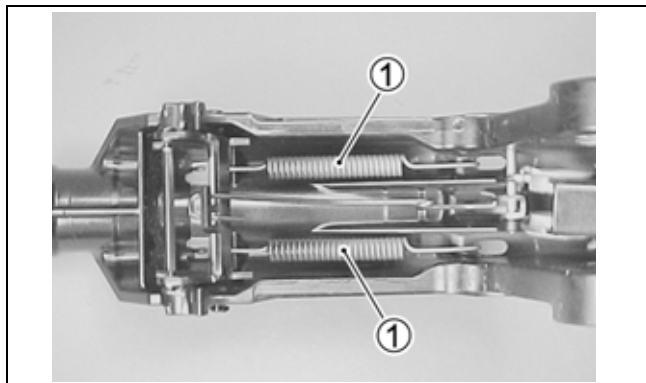
1. Spring
2. Screws
3. Shallow drive arm

004450

MIDSECTION

STERN BRACKET

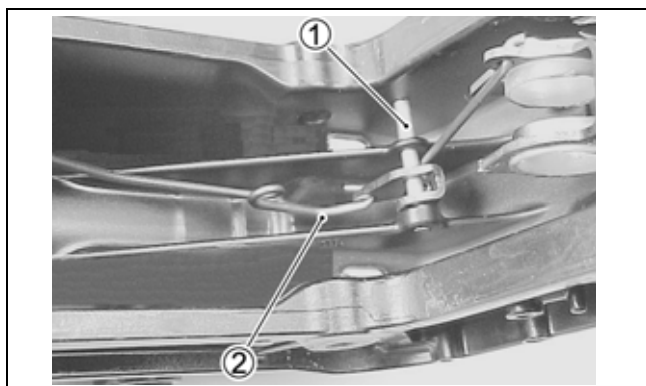
Remove two large springs from reverse lock arm and swivel bracket.



1. Reverse lock springs

004451

Remove the release arm pin and release link.

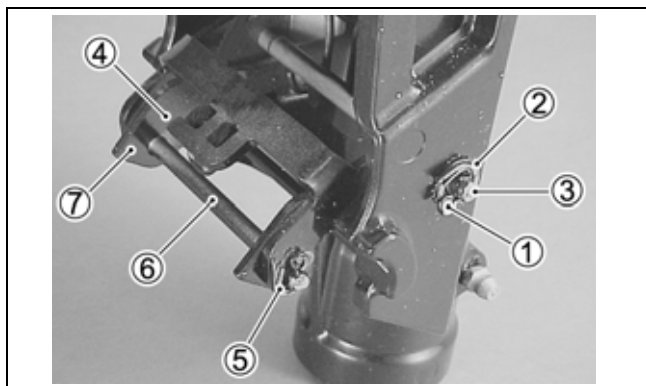


1. Release arm pin
2. Release link

004452

Remove cotter pin, washer, pin, and reverse lock.

Remove cotter pin, pin, and reverse lock arm.



1. Cotter pin
2. Washer
3. Pin
4. Reverse lock
5. Cotter pin
6. Pin
7. Reverse lock arm

004453

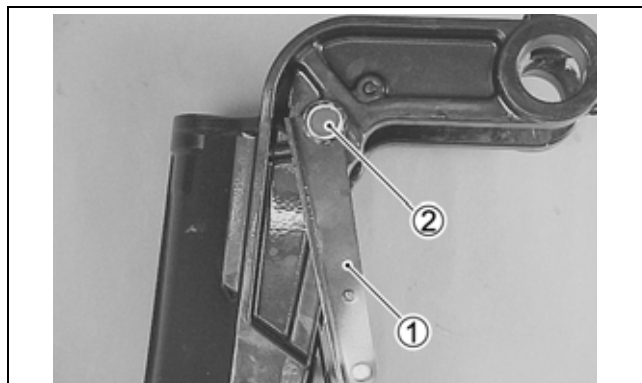
Inspection

Inspect all parts for excessive wear, cracks, defects, or damage. Replace as necessary.

Assembly

Assembly is reverse order of disassembly with special attention to the following steps:

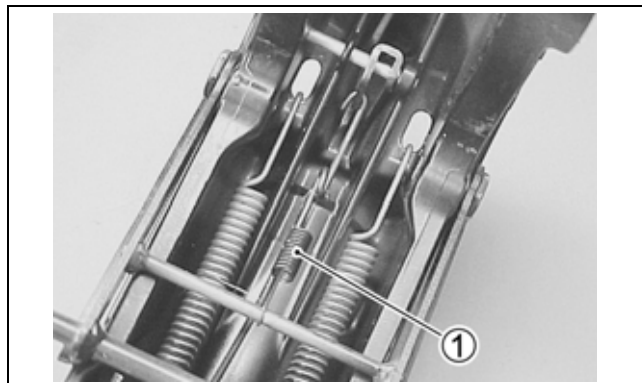
Apply *Nut Lock* to threads of shallow drive arm screws. Install arm and tighten screws 216 in. lbs. (25 N·m).



1. Shallow drive arm
2. Screw

004454

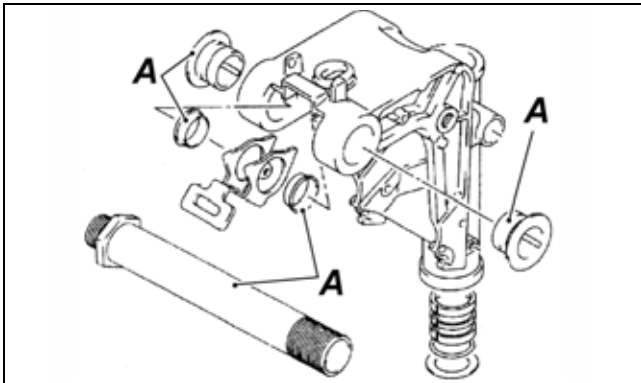
Install arm spring as shown.



1. Spring

004455

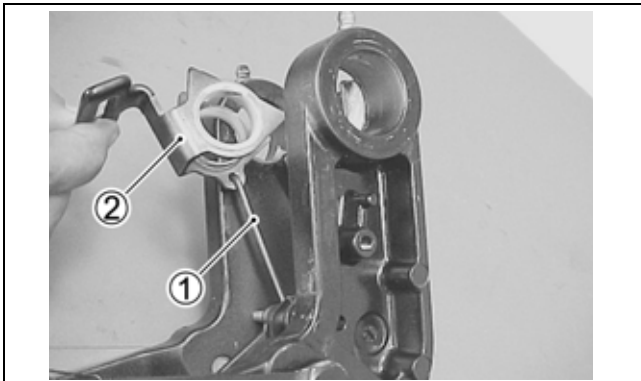
Apply *Triple-Guard* grease to clamp bracket shaft and bushings.



A. Apply grease here

004456

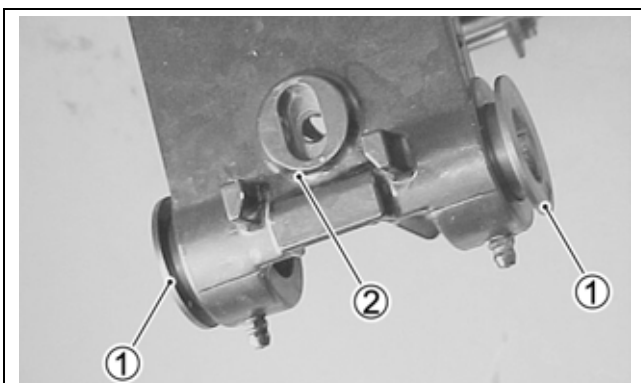
Connect the release link to release lever.



1. Release link
2. Release lever

004457

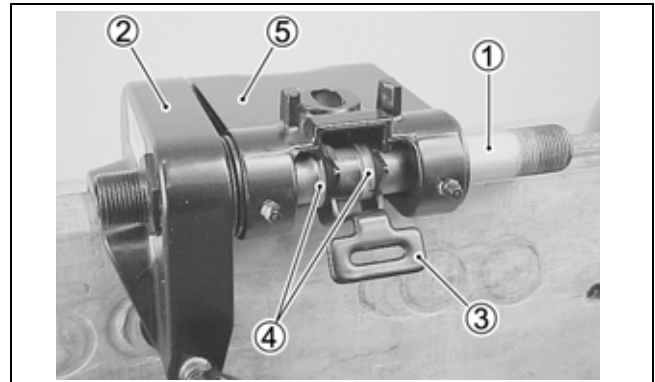
Insert PORT and STBD bushings into the swivel bracket.



1. Bushings
2. Swivel bracket

004458

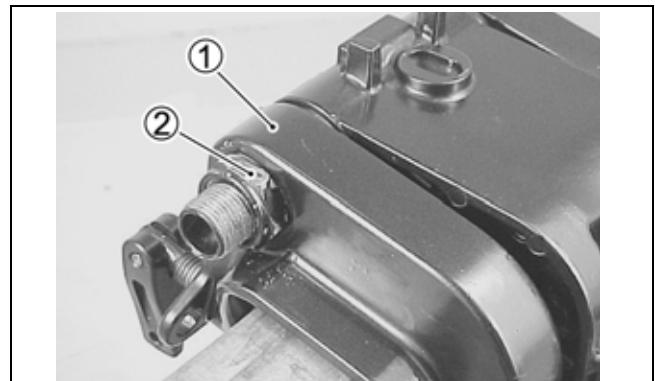
Assemble the clamp bracket shaft, STBD clamp bracket, release lever, bushings, and swivel bracket.



1. Clamp bracket shaft
2. STBD clamp bracket
3. Release lever
4. Bushings
5. Swivel bracket

004459

Install PORT clamp bracket and clamp bracket shaft nut. Tighten nut to 31 ft. lbs. (43 N·m).



1. PORT clamp bracket
2. Clamp bracket shaft nut

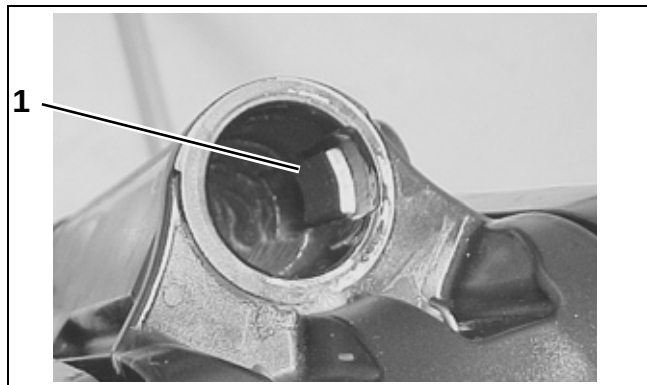
004460

MIDSECTION

STERN BRACKET

Apply *Triple-Guard* grease to bushings, o-ring, and pilot shaft portion of steering bracket.

Install the steering adjuster plate in swivel bracket.

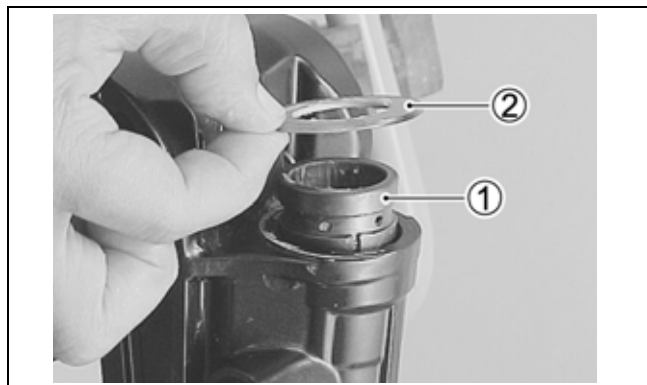


1. Steering adjuster plate

004445

Install upper bushing and washer on swivel bracket. The bushing outside face is tapered—install the smaller diameter first.

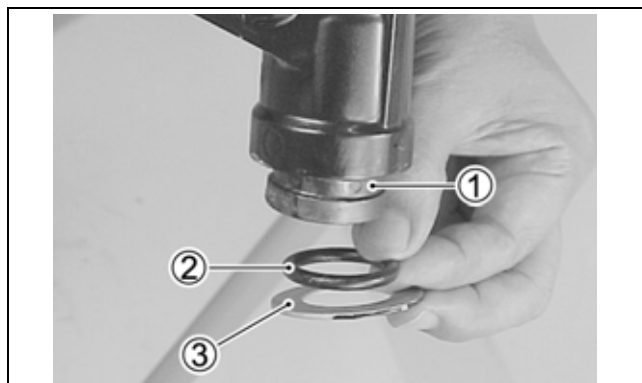
IMPORTANT: Make sure that steering adjuster is placed between upper bushing and swivel bracket housing.



1. Upper bushing
2. Washer

004461

Install lower bushing, o-ring, and washer on swivel bracket.

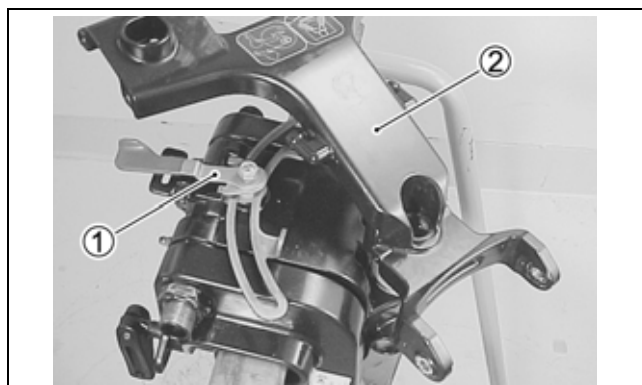


1. Lower bushing
2. O-ring
3. Washer

004462

Install steering friction adjuster assembly (tiller models).

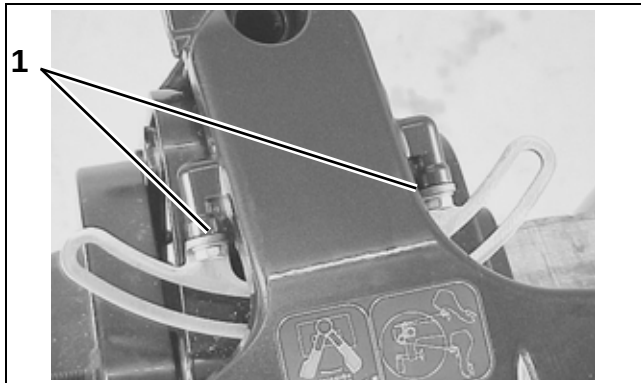
Apply *Triple-Guard* grease to steering bracket shaft and install in swivel bracket.



1. Steering friction adjuster assembly
2. Steering bracket shaft assembly

004463

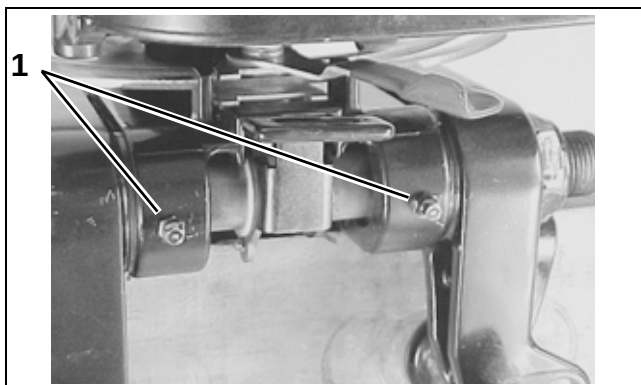
Install steering friction adjuster plate to steering bracket (tiller models).



Steering friction plate screws

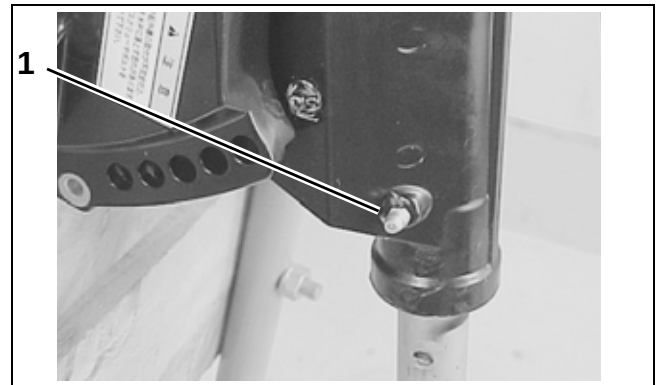
004441

After completing stern bracket assembly, apply *Triple-Guard* grease at each grease fitting.



1. Grease fittings

004464



1. Grease fittings

004465

STEERING HANDLE

Removal



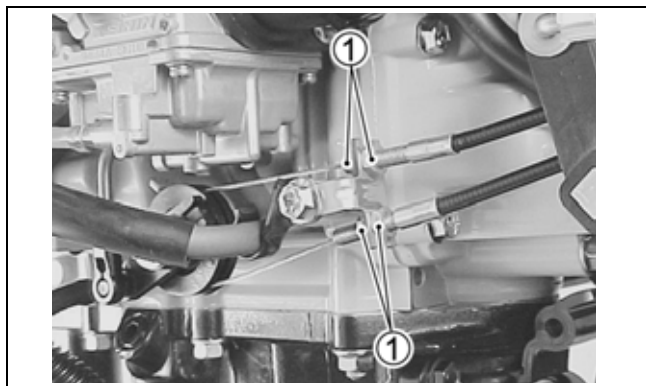
WARNING



To avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

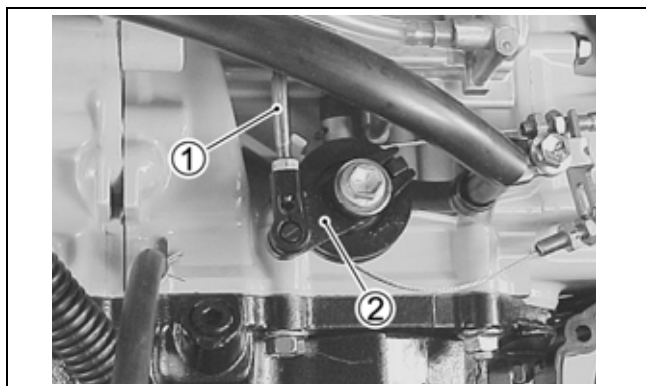
Remove the STBD side cover. Refer to Side Cover **Removal and Installation** on p. 180.

Loosen throttle cable lock nuts.



004466

Remove the throttle rod from throttle lever.

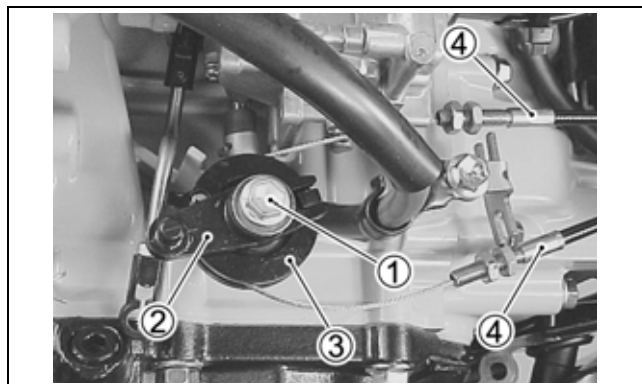


1. Throttle rod
2. Throttle lever

004467

Remove screw, throttle lever, and throttle drum.

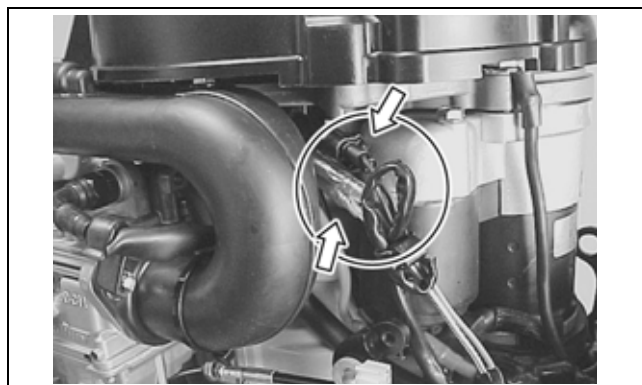
Remove throttle cables from throttle drum.



1. Screw
2. Throttle lever
3. Throttle drum
4. Throttle cables

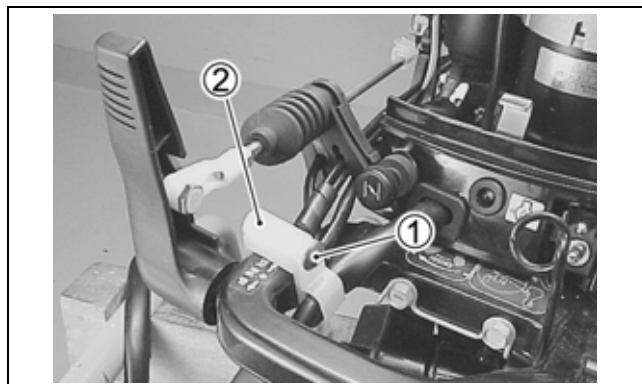
004468

Disconnect emergency stop switch lead wire. Disconnect starter switch lead wire.



004469

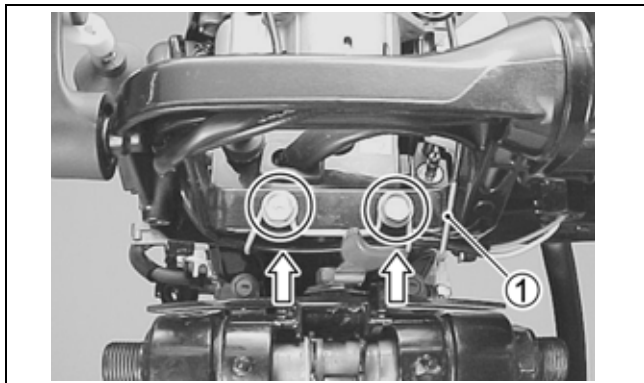
Remove screw and cable clamp.



1. Screw
2. Cable clamp

004470

Remove two screws securing fuel hose clamp.

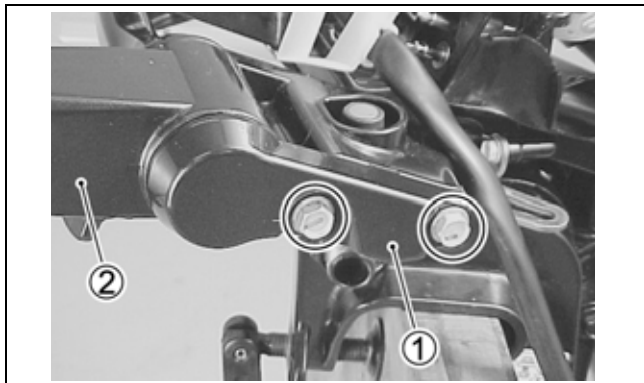


1. Fuel hose clamp

004471

Remove two screws and handle cover.

Remove tiller handle and throttle cable assembly.



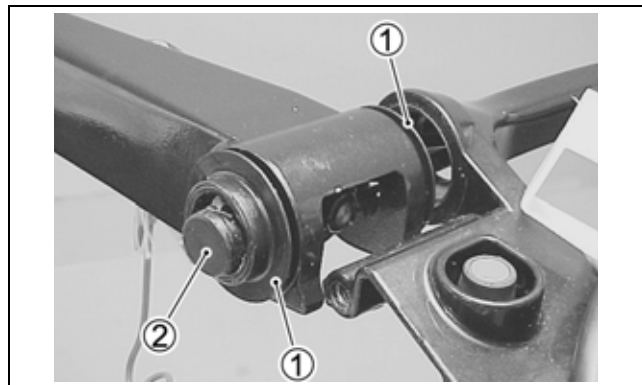
1. Handle cover
2. Tiller handle assembly

004472

Installation

Installation is reverse order of removal with special attention to the following:

Place bushings and friction rubber on tiller handle. Lubricate with *Triple-Guard* grease.



1. Bushing
2. Friction rubber

004473

Install tiller handle and handle cover. Tighten cover screws to 148 in. lbs. (17 N·m).



004474

Install and adjust throttle cables. Refer to **OUT-BOARD RIGGING** on p. 35.

Check wire and cable routing. Refer to **WIRE/HOSE ROUTING** on p. 225.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

GEARCASE

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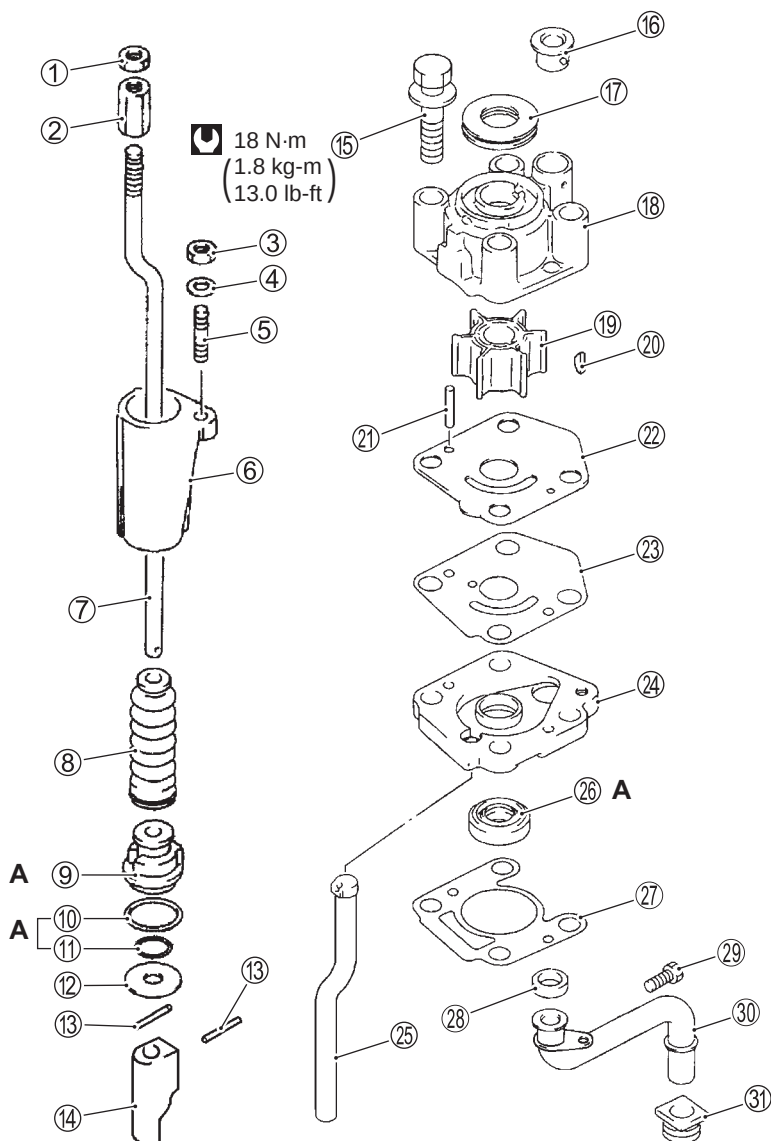
SERVICE CHART

-

F *Blue Nut Lock*
R *DPL Penetrating Lube*
W *HPF XR Gear Oil*

196

1. Nut (1)
2. Turnbuckle (1)
3. Nut (1)
4. Washer (1)
5. Stud bolt (1)
6. Collar (1)
7. Shift rod (1)
8. Boot (1)
9. Shift rod guide (1)
10. O-ring (1)
11. O-ring (1)
12. Washer (1)
13. Spring pin (2)
14. Shift cam (1)
15. Bolt (4)
16. Bush (1)
17. Grommet (1)
18. Water pump case (1)
19. Impeller (1)
20. Key (1)
21. Dowel pin (2)
22. Under panel (1)
23. Gasket (1)
24. Water inlet housing (1)
25. Water drain tube (1)
26. Oil seal (1)
27. Gasket (1)
28. Grommet (1)
29. Bolt (1)
30. Water inlet tube (1)
31. Grommet (1)



- | | |
|----------------------------------|-------------------------------|
| A Triple-Guard Grease | D Moly Lube |
| B Gasket Sealing Compound | F Blue Nut Lock |
| C Adhesive 847 | R DPL Penetrating Lube |

004359

PROPELLER

Inspection

Carefully check the propeller and outboard for the following conditions:

- Damaged blades and signs of propeller cavitation
- Spun or overheated inner hub
- Inadequate lubricant
- Damage to outer hub area
- Correct size
- Check for bent or damaged propeller shaft

Installation

Refer to **Propeller Hardware Installation** on p. 44.



WARNING



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

LUBRICANT

Draining

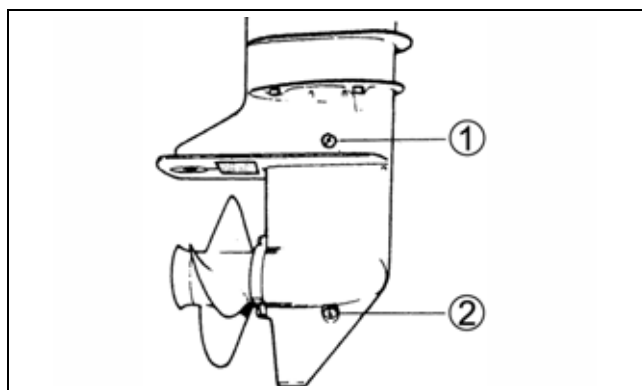


WARNING



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

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



TYPICAL

1. Lubricant level plug (upper)
2. Lubricant drain/fill plug (lower)

004362

The presence of metal **fuzz** can indicate normal wear of the gears, bearings, or shafts within the gearcase. Metal **chips** can indicate extensive internal damage.

Inspection

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

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

Refer to **LEAK TEST** on p. 199.

Overheated lubricant will give the lubricant a black color and burned odor.

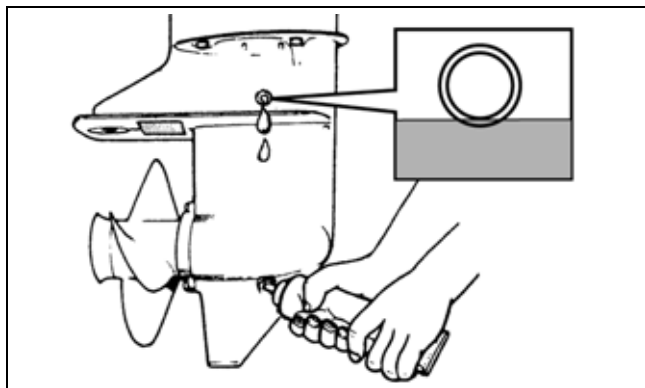
Internal gearcase inspection is recommended when lubricant is contaminated or shows signs of failure.

Filling

Secure the gearcase in a vertical position.

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

Slowly fill the gearcase with *HPF XR* gearcase lube through the drain/fill hole until it appears at the oil level hole. Filling the gearcase too quickly can cause air pockets and the gearcase may not fill completely. Clean plug seal area and install the lubricant level plug and **new** seal, then the lubricant drain/fill plug and **new** seal. Tighten them to a torque of 114 in. lbs. (13 N·m).



004363

LEAK TEST

Drain lubricant before testing.

STEP 1

Install lubricant drain/fill plug and seal, thread pressure test gauge fitting and seal in lubricant level hole.

Pressurize 3 to 6 psi (21 to 42 kPa).

If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leakage.

If the gearcase pressure gauge does not indicate leakage, increase pressure to 14 psi (100 kPa). Check for leakage.

Make necessary repairs and repeat test.

IMPORTANT: Do not exceed pressure of 15.5 psi (110 kPa) or damage to oil seals will result.



TYPICAL

34924

REMOVAL AND INSTALLATION

Removal



WARNING

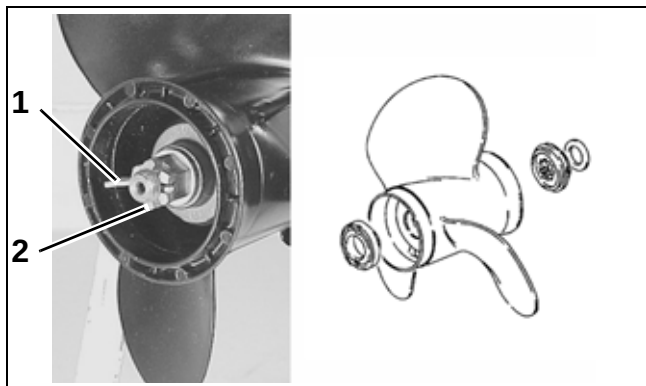


To prevent accidental starting while servicing, twist and remove all spark plug leads.

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

Remove cotter pin and nut, and all propeller hardware from the gearcase.

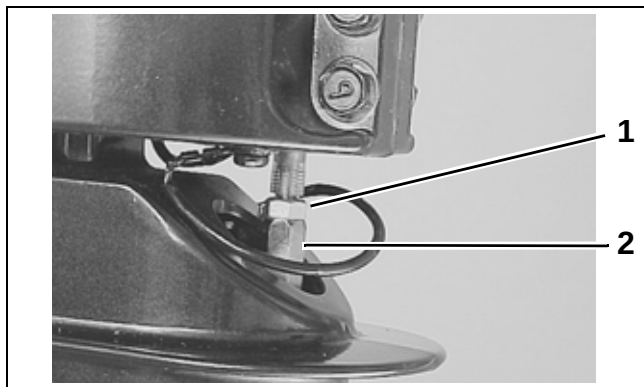
Inspect the condition of the propeller hub.



1. Cotter pin
2. Propeller nut

004364

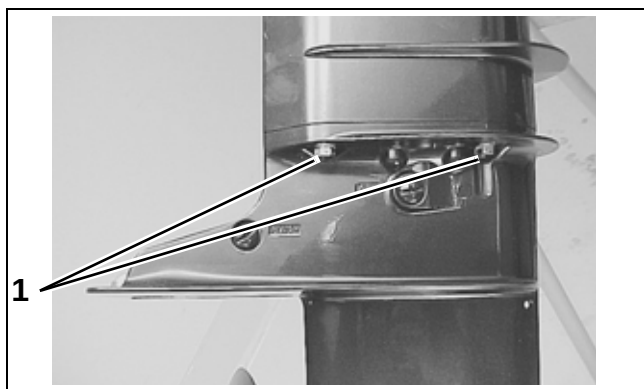
Loosen the clutch rod lock nut. Unscrew the turnbuckle to separate the clutch rod from the shift rod.



1. Clutch rod lock nut
2. Turnbuckle

004365

Remove four gearcase retaining screws.



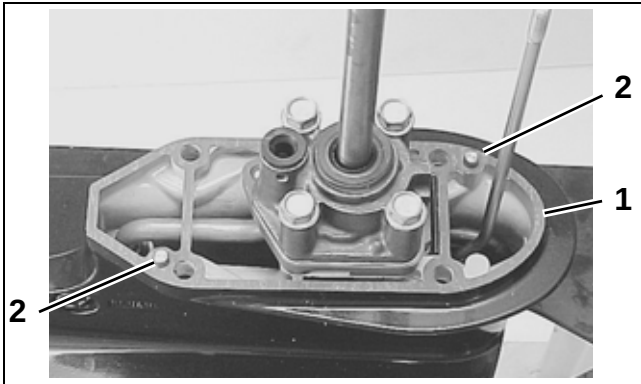
1. Screws

004366

Remove gearcase from the exhaust housing and place in a suitable holding fixture.

Installation

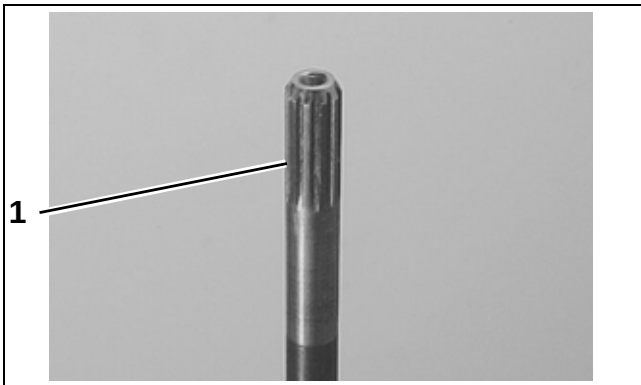
Install gasket and two dowel pins.



1. Gasket
2. Dowel pins

004367

Coat the driveshaft splines with *Moly Lube*. DO NOT coat top surface of the driveshaft as lubricant may prevent seating of the driveshaft in the crankshaft.



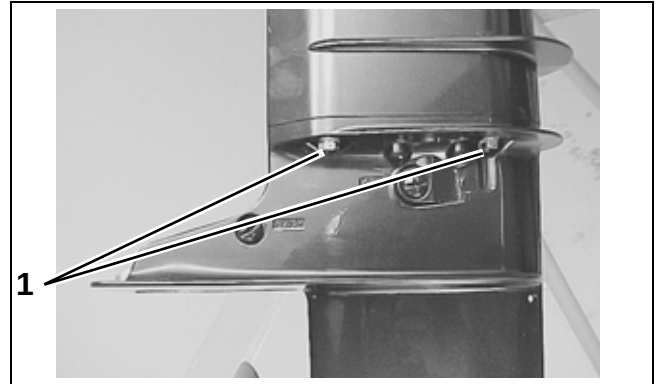
1. Driveshaft splines

004368

Lightly apply *Triple-Guard* grease to lower outside diameter of the water tube.

Install the gearcase onto the exhaust housing. Guide the water tube into the water tube grommet and see that the driveshaft engages the crankshaft. Rotate the flywheel, if necessary.

Apply *Gasket Sealing Compound* to the threads of the gearcase retaining screws. Install screws and tighten to a torque of 198 in lbs. (23 N·m).

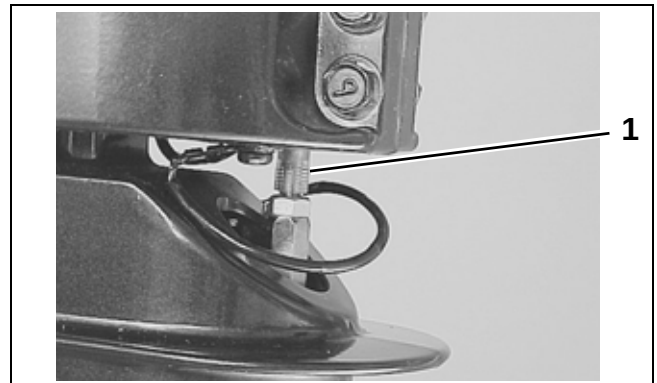


1. Screws

004366

Clutch Adjustment

Install hose on the clutch rod.

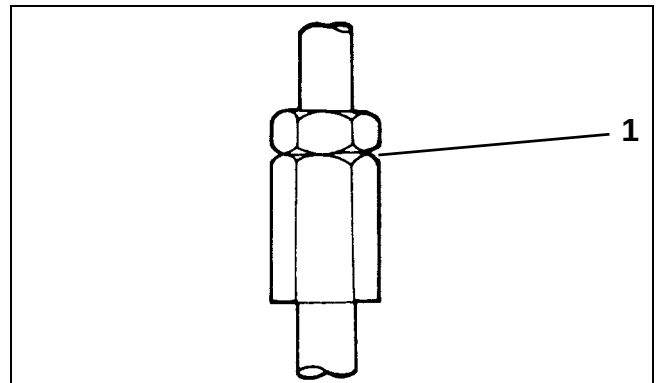


1. Hose

004365

Connect clutch rod and shift rod.

IMPORTANT: Make sure that the chamfered edge of the turnbuckle faces upward to seat against the upper nut when tightened.

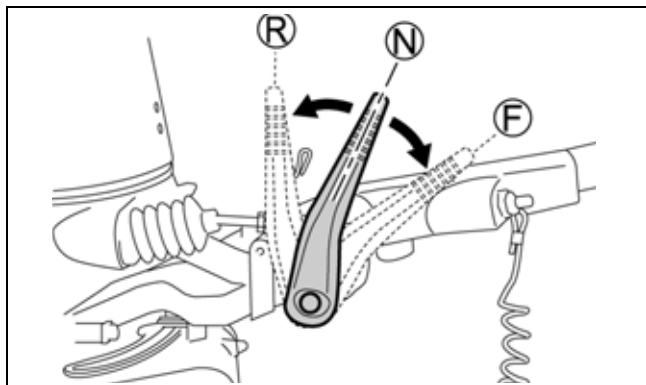


1. Chamfering

004369

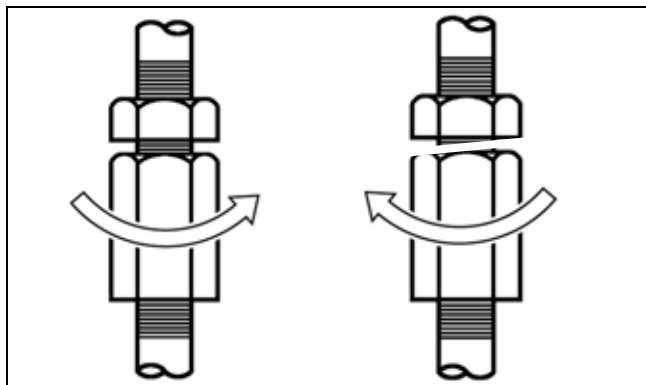
GEARCASE WATER PUMP

Move the shift lever from NEUTRAL through FORWARD and REVERSE to check that proper engagement of both gears is at an equal angle from NEUTRAL.



004370

If Forward gear engage earlier (at a smaller angle) than Reverse, the turnbuckle should be rotated until both gears engage with the same amount of shift lever travel.



004371

Lock the upper nut securely when correct adjustment has been obtained.

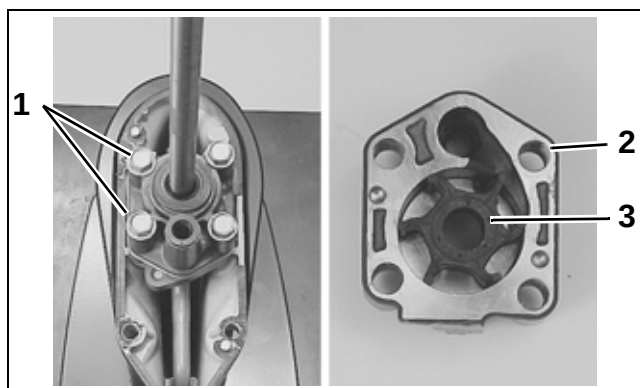
WATER PUMP

Disassembly

Remove gearcase from exhaust housing as described in **REMOVAL AND INSTALLATION** on p. 200.

Remove the four water pump housing screws.

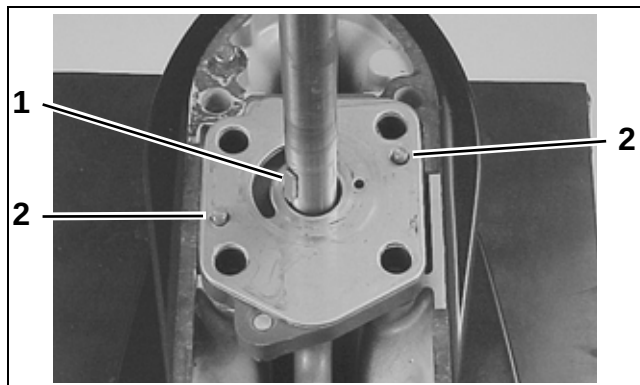
Remove the impeller housing and impeller by sliding them up and off the driveshaft.



004372

1. Screws
2. Housing
3. Impeller

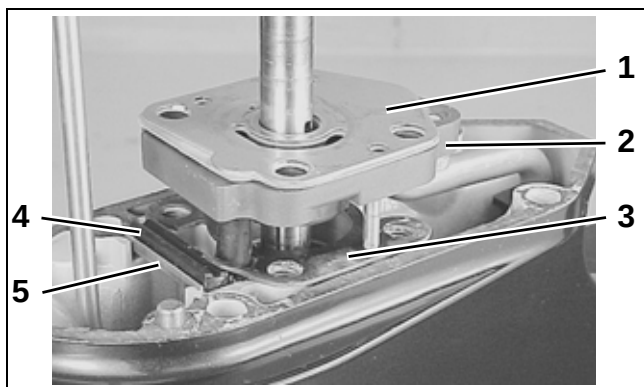
Remove the impeller key and dowel pins.



004373

1. Impeller key
2. Dowel pins

Remove the under panel, under panel gasket, water inlet housing, gasket, exhaust seal rubber, and exhaust seal core.



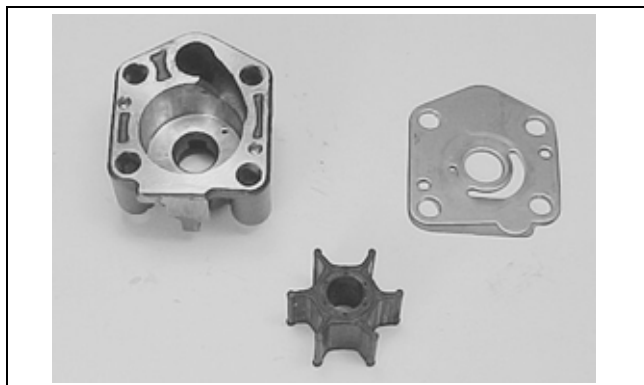
1. Under panel
2. Water inlet housing
3. Gasket
4. Exhaust seal rubber
5. Exhaust seal core

004374

Inspection

Inspect the impeller vanes for cuts, cracks, tears, or excessive wear. Replace is necessary.

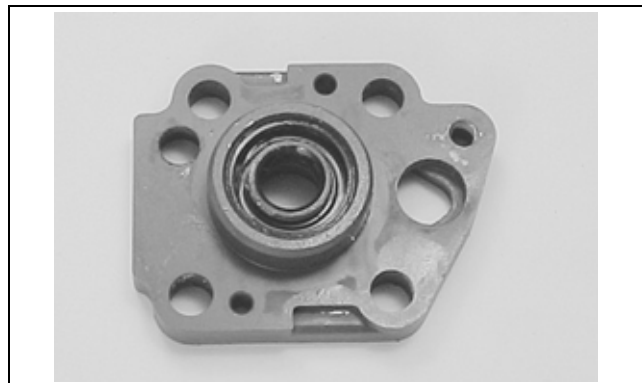
Inspect the pump case and the under panel for cracks, distortion, or corrosion. Replace if necessary.



004375

Inspect the water inlet housing for cracks or other damage. Replace if necessary.

Inspect the oil seal for wear, cuts, nicks or tears. Replace if necessary.



004376

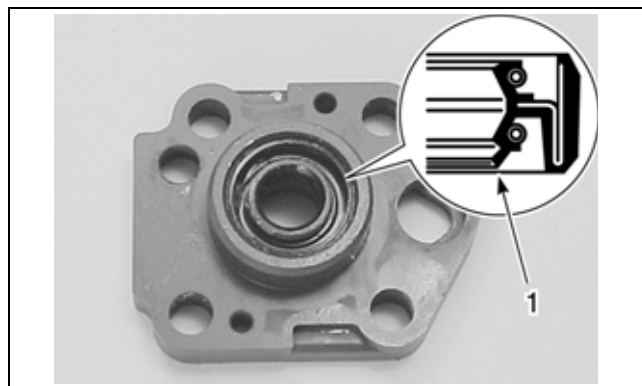
Assembly

If necessary, remove the oil seal using Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131.



8-10 p1

Using an oil seal installer, drive a new seal into the housing. The seal lips should face the water pump case. Apply *Triple-Guard* grease to the seal lips.

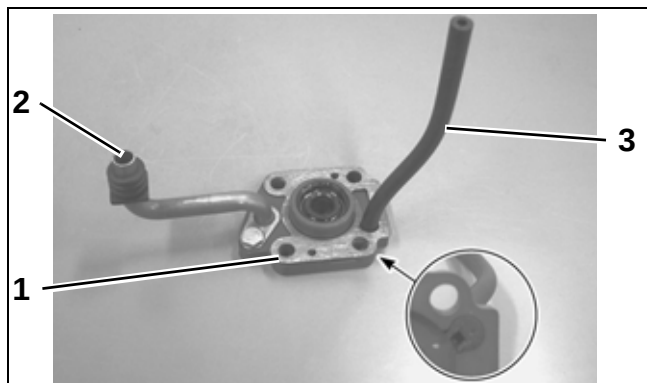


1. Seal lip

004377

GEARCASE WATER PUMP

Install gasket, water inlet tube, and water drain tube to the water inlet housing.

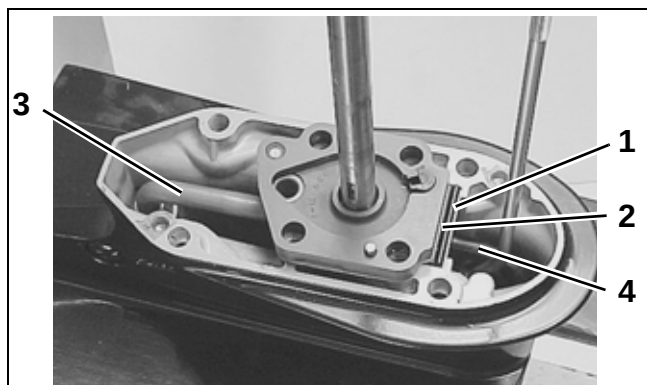


1. Gasket
2. Water inlet tube
3. Water drain tube

004378

Install the seal core and seal rubber.

Install the water inlet housing assembly to the gearcase. Place the water inlet tube and drain tube into position.

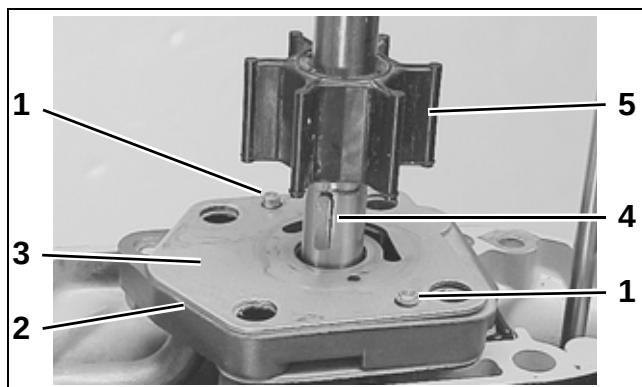


1. Exhaust seal core
2. Exhaust seal rubber
3. Water inlet tube
4. Drain tube

004379

Place the dowel pins, under panel gasket, and under panel into position.

Insert the key in the driveshaft and slide the impeller onto driveshaft, ensuring that key and keyway are aligned.

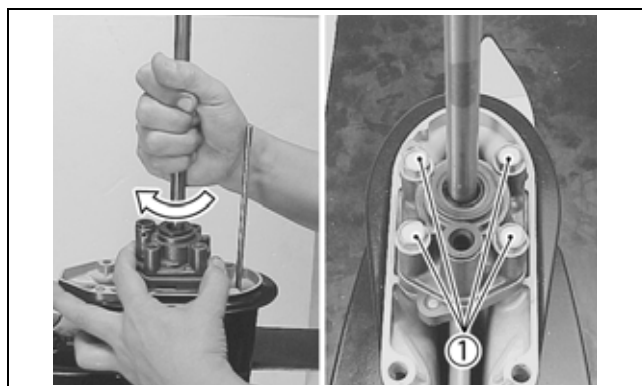


1. Dowel pins
2. Under panel gasket
3. Under panel
4. Key
5. Impeller

004380

Install the pump case while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.

Tighten the four pump housing screws to 156 in. lbs. (18 N·m).



1. Housing screws

004381

DISASSEMBLY



WARNING



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

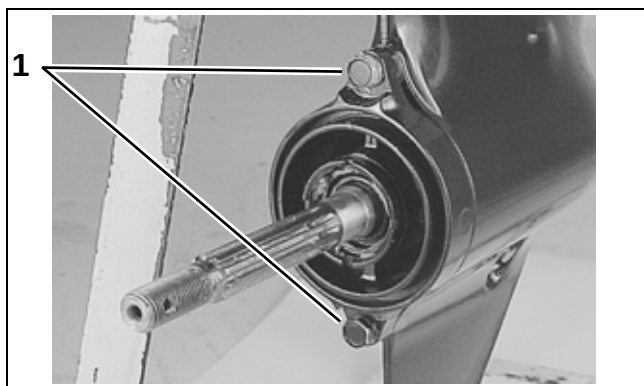
IMPORTANT: Clean and inspect all components during disassembly. Replace all damaged components, seals, O-rings, and gaskets upon assembly.

Remove propeller. Refer to **Propeller Hardware Installation** on p. 44.

Remove gearcase. Refer to **REMOVAL AND INSTALLATION** on p. 200.

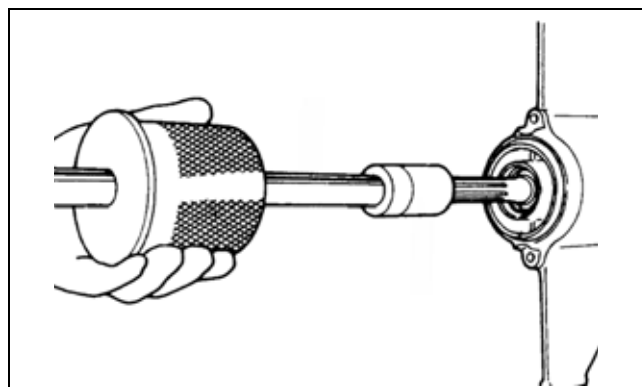
Remove water pump. Refer to **WATER PUMP** on p. 202.

Remove two propeller shaft bearing housing retaining screws.



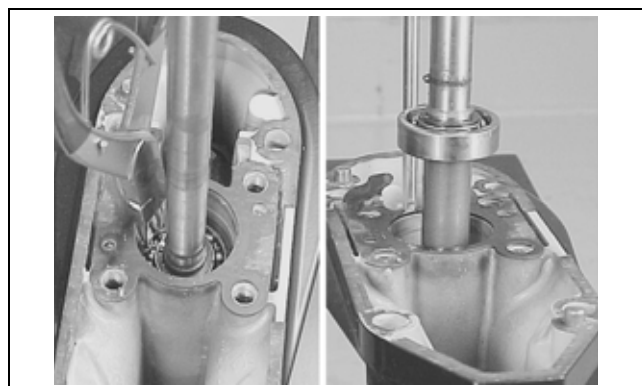
004383

Use Slide Hammer, P/N 391008, and Prop Shaft Remover, P/N 5034237, to pull out the propeller shaft bearing housing assembly.



004384

Use snap ring pliers to remove circlip retaining the upper driveshaft bearing. Lift out the driveshaft assembly with bearing.

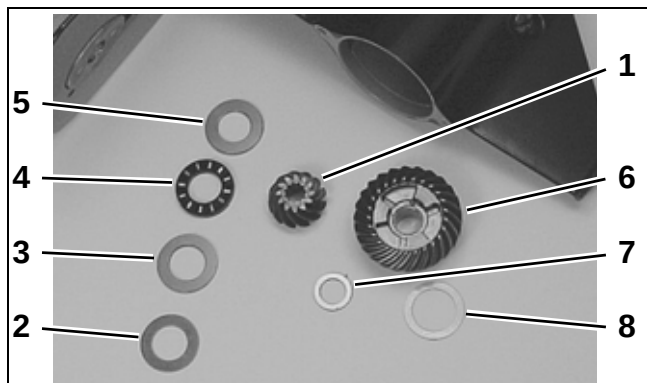


004385

Remove the pinion gear, pinion gear back up shim, thrust washer, thrust bearing, and thrust washer.

GEARCASE DISASSEMBLY

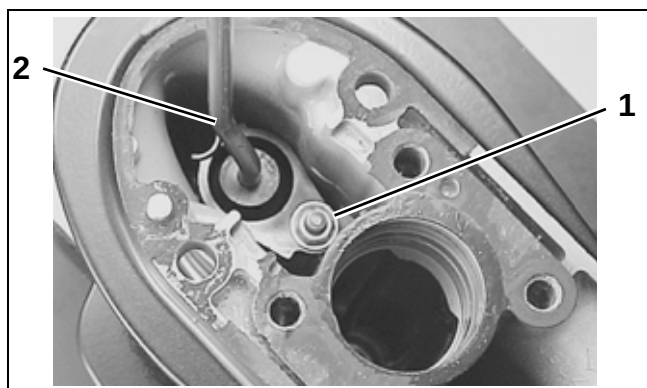
Remove the forward gear, thrust washer, and forward gear back-up shim.



1. Pinion gear
2. Pinion gear backup shim
3. Thrust washer
4. Thrust bearing
5. Thrust washer
6. Forward gear
7. Thrust washer
8. Forward gear backup shim

004386

Remove the nut and shift rod assembly.

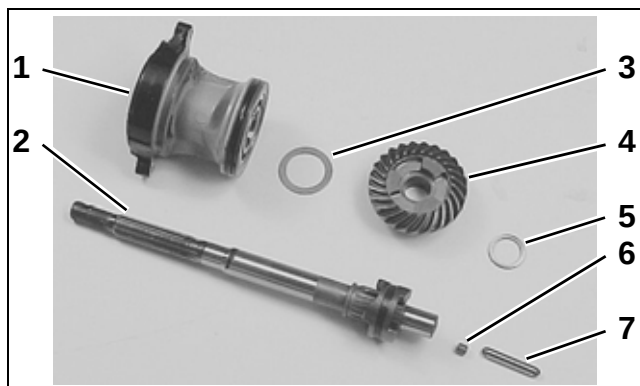


1. Nut
2. Shift rod assembly

004387

Propeller Shaft Bearing Housing Components

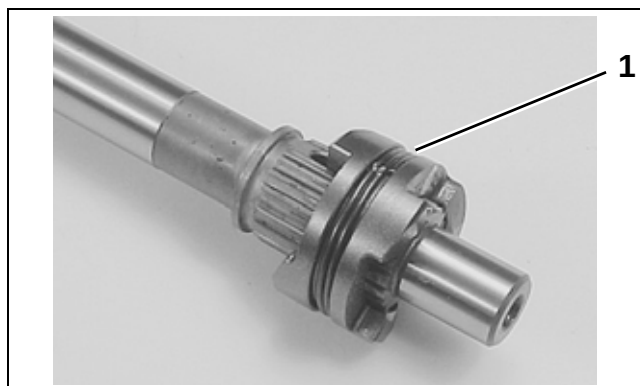
Remove propeller shaft components and reverse gear from bearing housing assembly.



1. Propeller shaft bearing housing
2. Propeller shaft
3. Reverse gear backup shim
4. Reverse gear
5. Thrust washer
6. Push pin
7. Push rod

004388

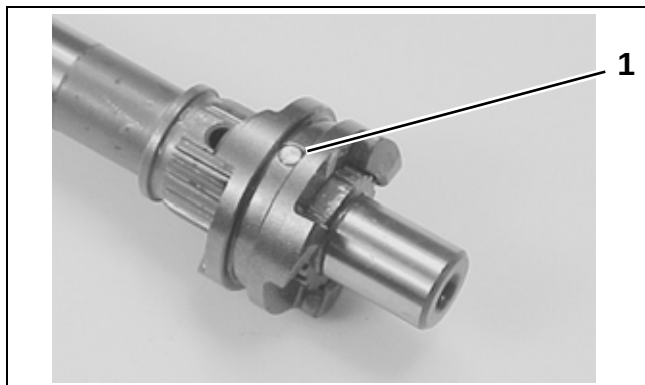
Remove the spring from the clutch dog shifter.



1. Spring

004389

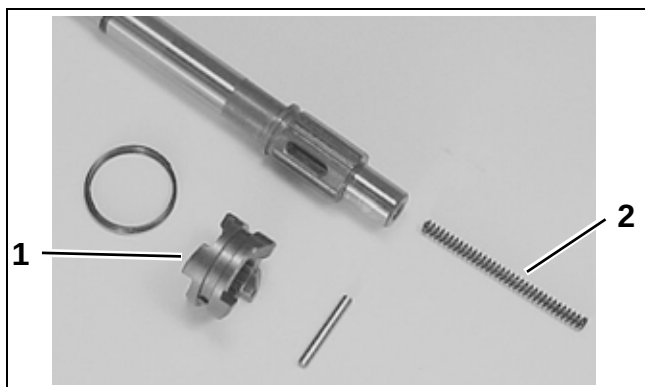
Use a punch to push the pin out of the clutch.



1. Pin

004390

Remove clutch dog shifter and spring.



1. Clutch
2. Spring

004391

Bearing Housing Seals

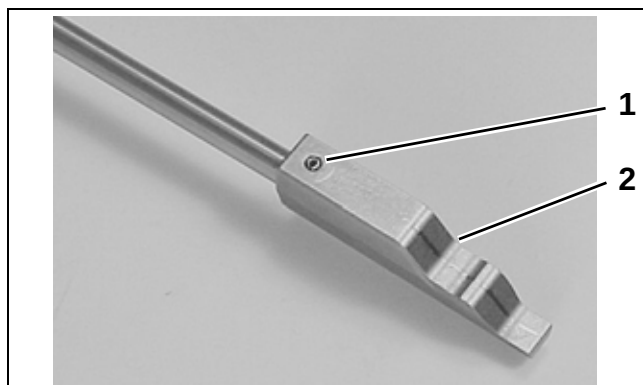
Use Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131, to remove oil seals.



8-9 p1

Shift Rod Components

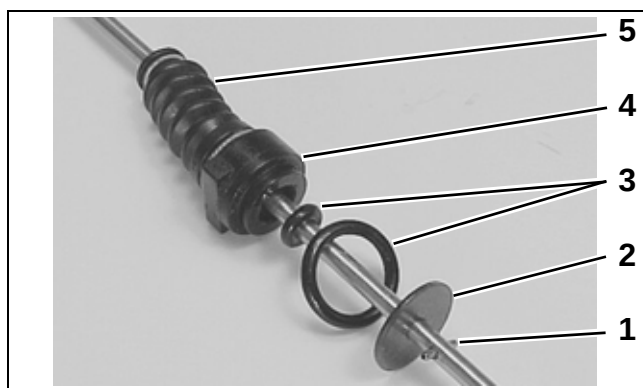
Push out pin and remove the clutch cam.



1. Pin
2. Cam

004392

Remove pin, washer, o-rings, shift rod guide, and boot.



1. Pin
2. Washer
3. O-ring
4. Shift rod guide
5. Boot

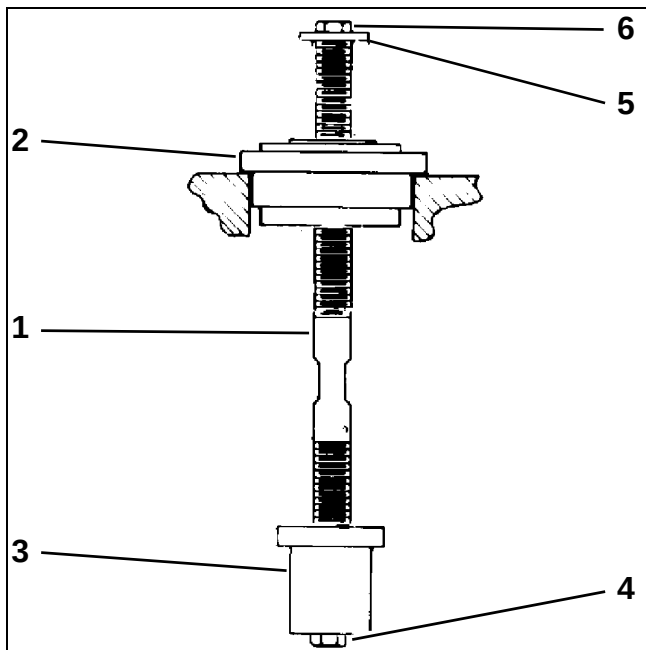
004393

GEARCASE CLEANING AND INSPECTION

Pinion Bearing

Inspect the pinion bearings in place. If necessary, remove the bearings using Universal Pinion Bearing Remover and Installer kits, P/N 5005927 and P/N 5005928.

Assemble tools as shown:



1. Rod, P/N 326582
2. Pilot plate, P/N 326583
3. Remover/Installer, P/N 351055
4. 1/4 x 20 x 1 1/4 hex-head screw
5. 1 in O.D. x 1/4 I.D. Flat washer
6. 1/4 x 20 x 1/2 hex-head screw

824163

Set rod/remover assembly in gearcase. Drive both bearings down into the gear area.



8-10 p5

CLEANING AND INSPECTION



WARNING



Replace damaged components. Shift system failure could cause loss of control over direction of engine thrust.

To avoid personal injury, wear eye protection and regulate air pressure to not more than 25 PSI (172 kPa).

Discard all seals, O-rings, gaskets, and clutch dog spring.

Clean all gearcase components in solvent and dry with compressed air. After cleaning, coat all internal components with *HPF XR* gearcase lube to prevent rusting.

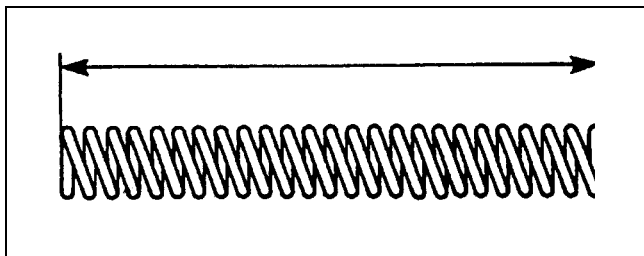
Perform the following inspections:

- **Gearcase housing** — all gasket surfaces must be free of gasket material. All threaded holes must be free of corrosion and sealer.
- **Gearcase anode** — if anode has been reduced to two-thirds of its original size, it must be replaced. Refer to **MAINTENANCE** section for testing procedure.
- **Driveshaft** — check splines for chips, wear, and cracks. Bearing and gear surfaces must not show signs of metal transfer, corrosion, or discoloration. Severe spline wear might indicate an exhaust housing or gearcase has been distorted by impact damage.
- **Water intake screen** — must be clear. If screen can't be cleaned, it must be replaced.
- **All internal components** — must be visually inspected for signs of wear, distortion, chipping, metal transfer, pitting, galling, and discoloration due to improper lubrication.
- **Water pump** — check impeller for wear, crumbling, and hub bonding. Check impeller cup and plate for scoring and distortion.
- **Shift cam** — Inspect the stepped surfaces for excessive wear, chips, or other damage.

Clutch Return Spring

Measure the clutch return spring free length.
Replace if out of specification:

- Standard: 2.75 in. (70 mm)
- Service limit: 2.6 in. (67 mm)

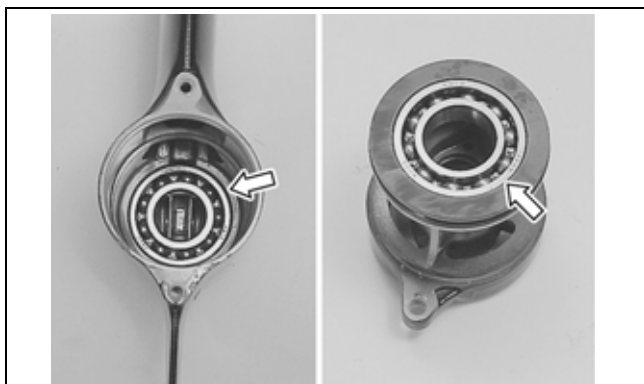


8_8_2

Forward and Reverse Bearings

Check for pitting, noise, rough operation.

If necessary remove bearings using Puller Bridge, P/N 432127. and Large Puller Jaws, P/N 432129.



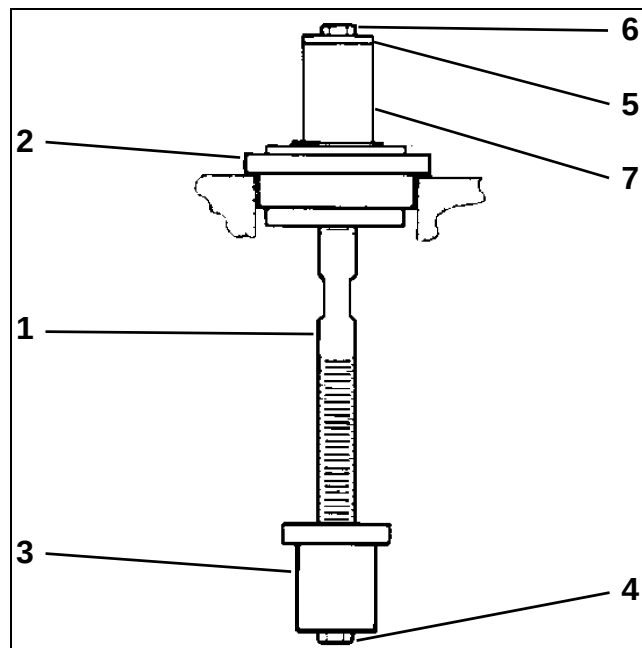
004394

ASSEMBLY

Before beginning assembly, refer to **CLEANING AND INSPECTION**.

Pinion Bearing

Assemble tools from Universal Pinion Bearing Remover and Installer kits, P/N 5005927 and P/N 5005928, as shown:



1. Rod, P/N 326582
2. Pilot plate, P/N 326583
3. Remover/Installer, P/N 351055
4. 1/4 x 20 x 1 1/14 hex-head screw
5. 1 in O.D. x 1/4 I.D. Flat washer
6. 1/4 x 20 x 1/2 hex-head screw
7. Spacer, P/N 326585

824182

GEARCASE ASSEMBLY

Place the installer rod (with the pinion bearing on the end) into the gearcase.

Drive the first bearing down into position by gently striking the installer shaft until the washer contacts the spacer on the pilot plate.

Repeat to install the second bearing.



1. Bushing installer
2. Rod
3. Bushing

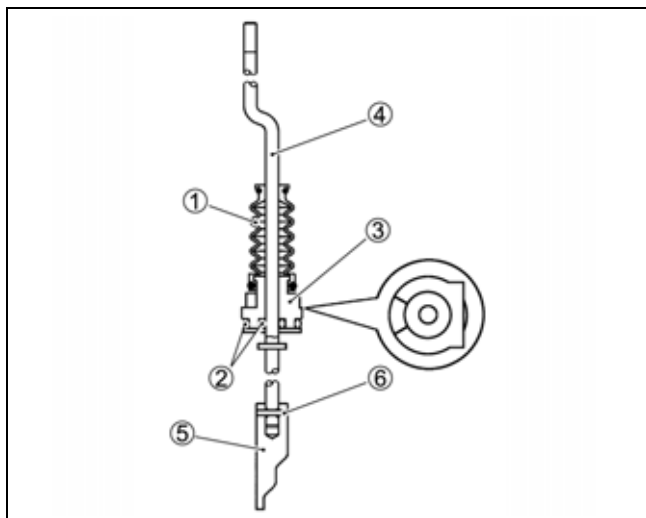
8-11 p3

Shift Rod/Shift Cam Assembly

Apply *Triple-Guard* grease to the inside of the boot and to the o-rings.

Install the shift rod guide on the shift rod.

Attach the shift cam to shift rod and insert the spring pin.

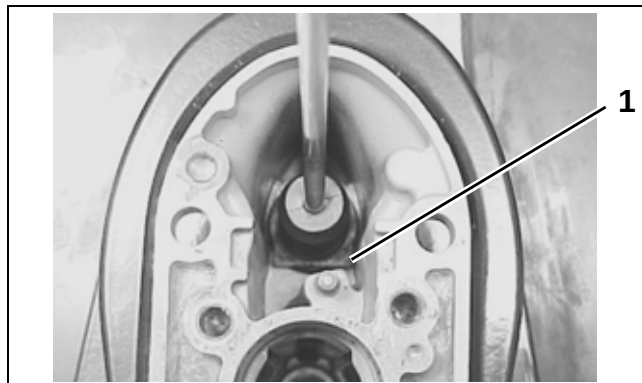


1. Boot
2. O-rings
3. Shift rod guide
4. Shift rod
5. Shift cam
6. Spring pin

004395

Install the shift rod assembly in the gearcase with the stepped face of the cam facing the propeller.

Install shift rod guide in the gearcase with the flat edge toward the propeller.

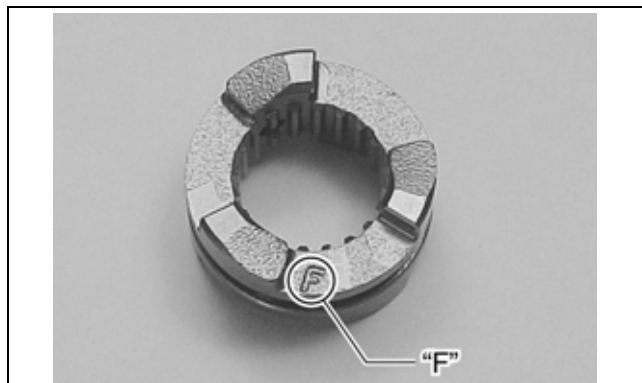


7. Flat edge of shift rod guide

004396

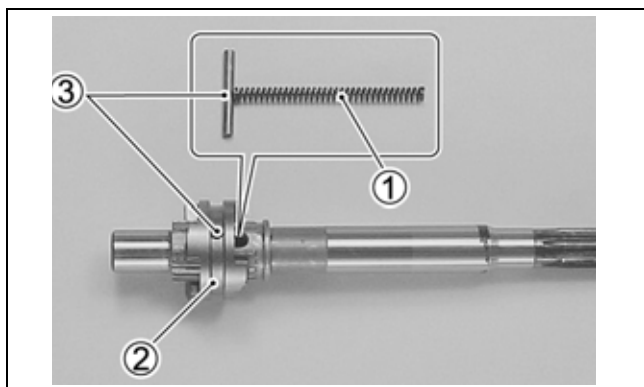
Propeller Shaft

Install the clutch dog shifter with "F" mark toward forward gear.



004397

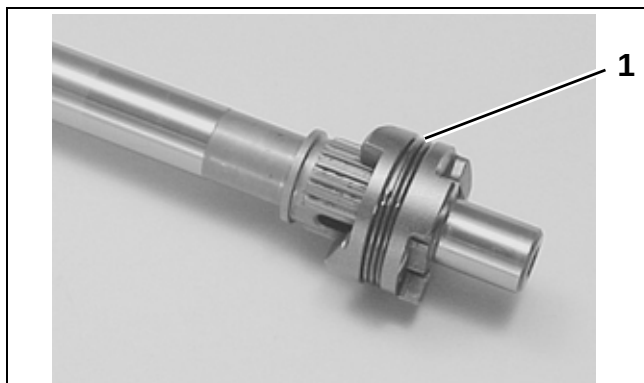
Insert the return spring into propeller shaft. Depress the return spring and slide the dog pin into both clutch dog and propeller shaft.



1. Return spring
2. Clutch dog
3. Pin

004399

Install clutch dog spring, ensuring that it fits snugly into groove on shifter.

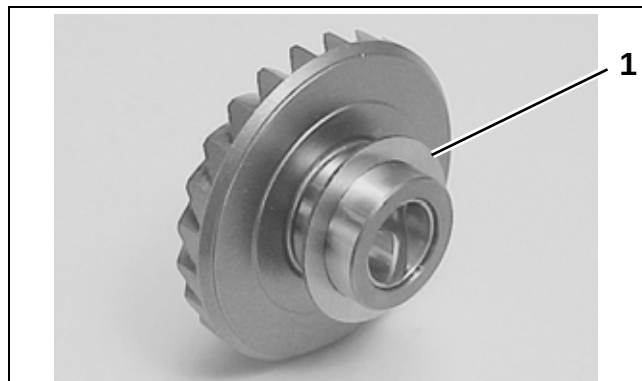


1. Spring

004400

Forward Gear

Apply gear oil to the forward gear. Place the back-up shim in position and install the gear in the gearcase.



1. Shim

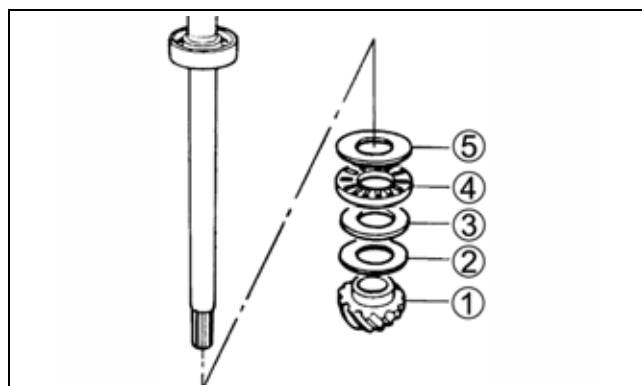
004401

Pinion Gear and Driveshaft

Apply gear oil to the thrust bearing and pinion gear.

Place the pinion gear, back-up shim, thrust washer (I.D. 20 mm), thrust bearing, and thrust washer (I.D. 21 mm) in gearcase.

Lower driveshaft assembly into the gearcase until the bottom of shaft passes to center of pinion gear.

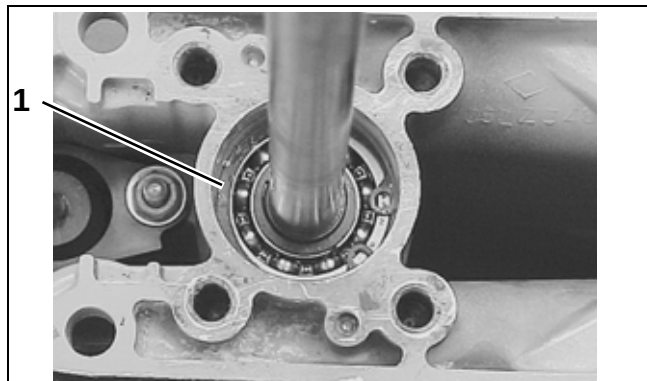


1. Pinion gear
2. Shim
3. Thrust washer (20 mm)
4. Thrust bearing
5. Thrust washer (21 mm)

004402

GEARCASE ASSEMBLY

Install the circlip above the upper driveshaft bearing.



1. Circlip

004403

Check that backlash exists between the pinion gear and forward gear. Refer to **SHIMMING ADJUSTMENTS** on p. 213.

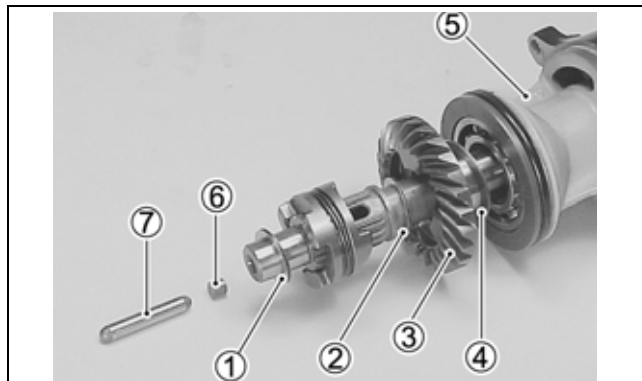
Propeller Shaft Bearing Housing

IMPORTANT: Check and adjust shimming **before** installing seals and o-rings in bearing housing. Refer to **SHIMMING ADJUSTMENTS** on p. 213.

Assemble the propeller shaft in the following sequence:

- Forward thrust washer
- Reverse thrust washer
- Reverse gear
- Reverse gear back-up shim
- Propeller shaft housing

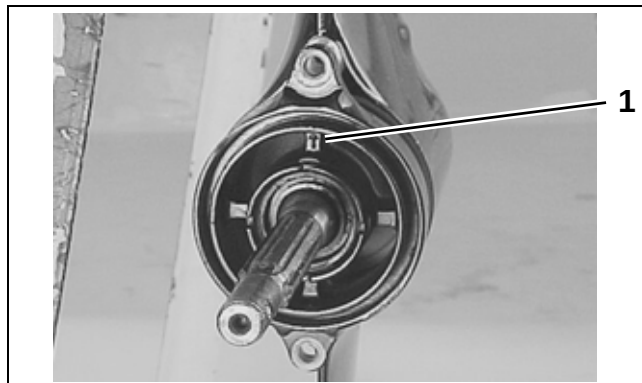
Insert the push pin and push rod into propeller shaft.



1. Forward thrust washer
2. Reverse thrust washer
3. Reverse gear
4. Reverse gear back-up shim
5. Propeller shaft housing
6. Push pin
7. Push rod

004406

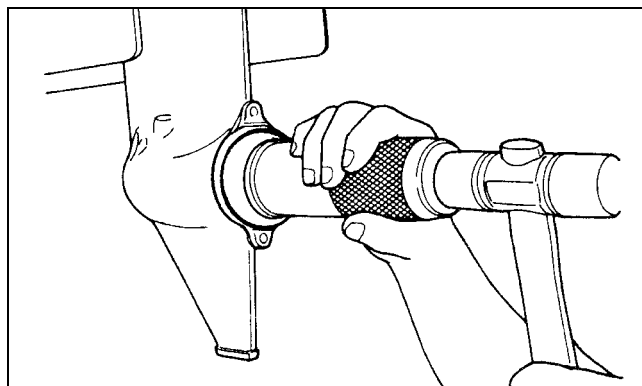
Install the propeller shaft and bearing housing assembly with the arrow mark facing up.



1. Arrow

004407

Use Installer Handle, P/N 345822, to seat bearing housing completely in gearcase.



8_16_2

When the housing is fully seated, tighten both retaining screws to 72 in. lbs. (8 N·m).

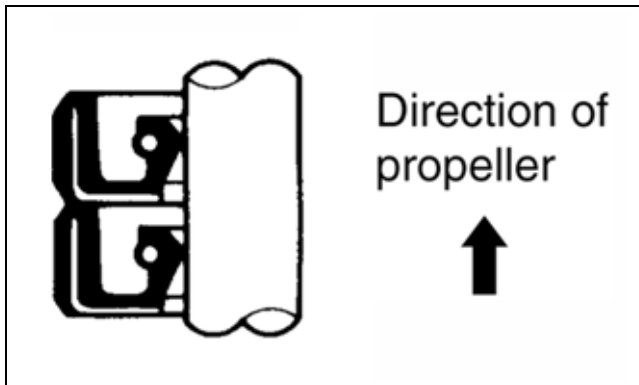
Check and adjust backlash. Refer to **SHIMMING ADJUSTMENTS** on p. 213.

When shimming is correct, remove bearing housing for final installation of seals and o-rings.

Apply *DPL* to the outer casing of two new propeller shaft bearing housing oil seals.

Use seal installer to press seals (one at a time) into the housing.

The lipped portion of the seals should face toward the propeller. Apply *Triple-Guard* grease to the seal lips.



004405

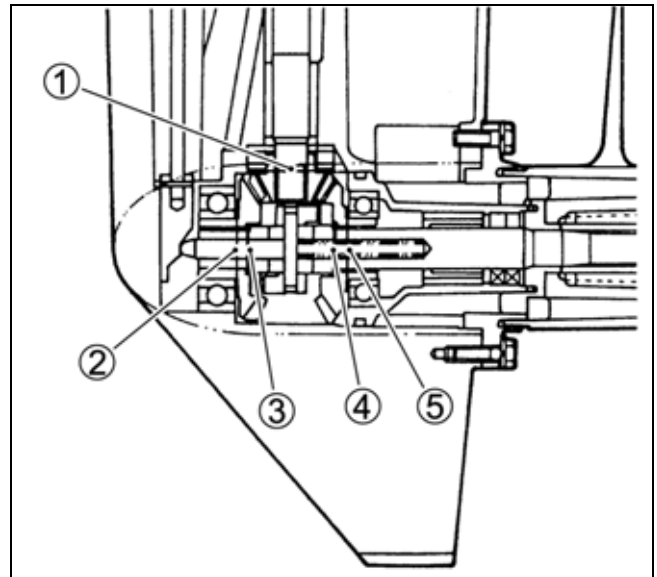
Apply *Triple-Guard* grease to a new bearing housing O-ring. Install O-ring in groove of housing.

Install bearing housing in gearcase and tighten retaining screws to 72 in. lbs. (8 N·m).

SHIMMING ADJUSTMENTS

If gearcase has been rebuilt or has had components replaced, shimming for correct gear contact and backlash will have to be adjusted to ensure smooth, reliable operation of gears.

Shim/Washer Positions



	Item	Available thickness (mm)	Design specification thickness (mm)
1	Pinion gear back up shim	0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3	1.0
2	Forward gear back up shim	0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3	1.0
3	Forward gear thrust washer	1.5	1.5
4	Reverse gear thrust washer	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9	1.5
5	Reverse gear back up shim	0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3	1.0

004408

GEARCASE

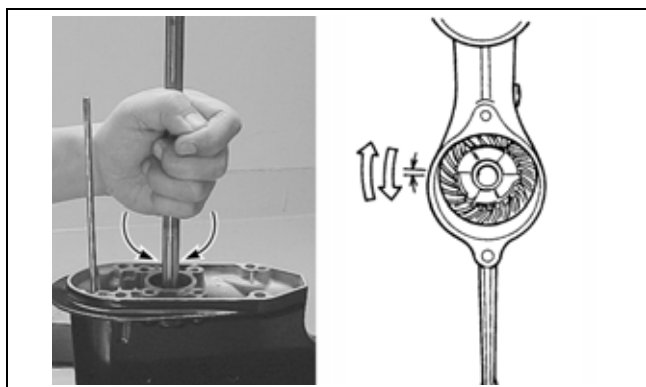
SHIMMING ADJUSTMENTS

Forward Gear/Pinion Gear

Correctly assemble forward gear, pinion gear, driveshaft, and related components. Refer to **ASSEMBLY** on p. 209.

Check that a slight amount of backlash exists between pinion gear and forward gear by slightly rotating driveshaft or forward gear by hand.

- If there is no backlash, reduce back-up shim thickness.
- If there is too much backlash, increase back-up shim thickness.



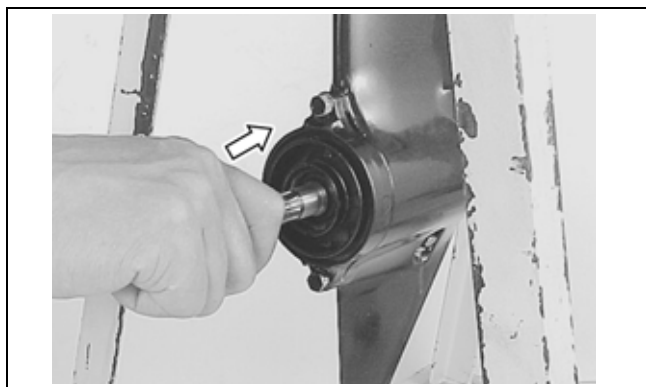
004404

Gear Tooth Contact Pattern

Apply a light coat of Prussian Blue on the convex surface of forward gear.

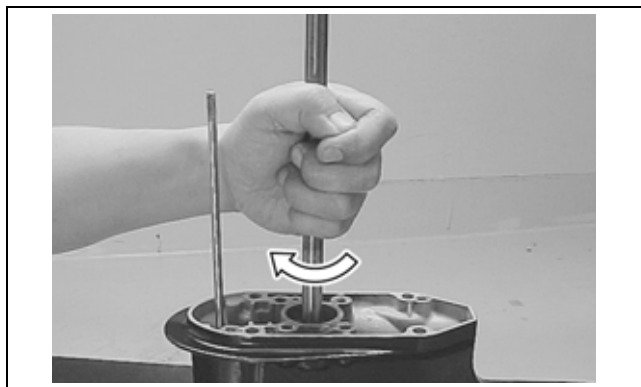
Install propeller shaft and housing assembly (minus reverse gear and internal components).

Push propeller shaft inward and hold in position.



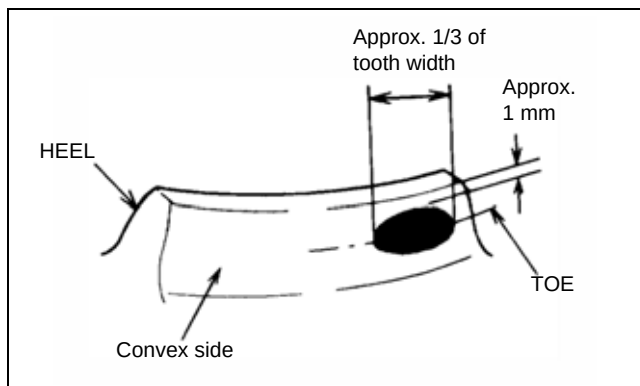
004409

Rotate the driveshaft clockwise 5-6 times by hand.



004410

Pull out propeller shaft and housing to check tooth contact pattern.



Optimum tooth contact

004411

If pattern is too high:

- Decrease forward gear shim thickness.
- Slightly increase pinion gear shim thickness.

If pattern is too low:

- Increase forward gear shim thickness.
- Slightly decrease pinion gear shim thickness.

IMPORTANT: Damage and chipping of forward and pinion gear may result if tooth pattern is not correct.

IMPORTANT: Recheck backlash if shimming has been adjusted.

Pinion Gear/Reverse Gear

Check the amount of backlash between the pinion gear and forward gear.

Install the propeller shaft, reverse gear, and bearing housing assembly. Tighten retaining screws to 72 in. lbs. (8 N·m).

Check the amount of backlash by slightly rotating the driveshaft by hand.

Backlash should not be less than between the pinion and forward gears.

If backlash is less, reduce reverse gear back-up shim thickness.

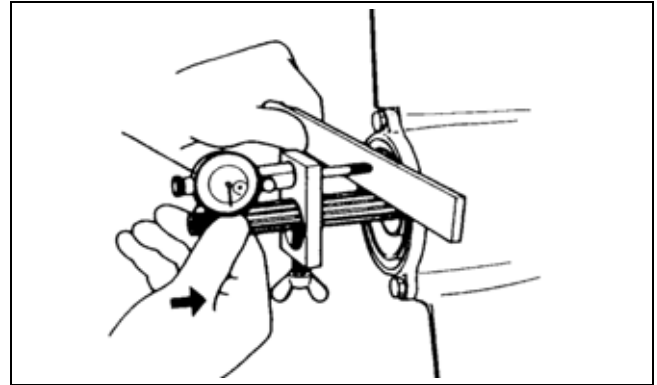
Propeller Shaft Thrust Play

After adjusting all gear positions, measure the propeller shaft play. If not within the following values, make a shim adjustment:

- **Propeller shaft thrust play:** 0.008 to 0.016 in. (0.2 to 0.4 mm)

IMPORTANT: Maintain the forward gear thrust washer at standard thickness (1.5 mm) and adjust only the reverse gear thrust washer.

Assemble a Dial Indicator to the propeller shaft.



004412

Push propeller inward.

Hold shaft in and set dial gauge pointer to zero.

Slowly pull shaft outward and read the maximum thrust play on the dial.

- If play is too large, increase reverse gear thrust washer thickness.
- If play is too small, reduce reverse gear thrust washer thickness.

NOTES

Technician's Notes

[illegible]

Related Documents

[illegible]

MANUAL STARTER

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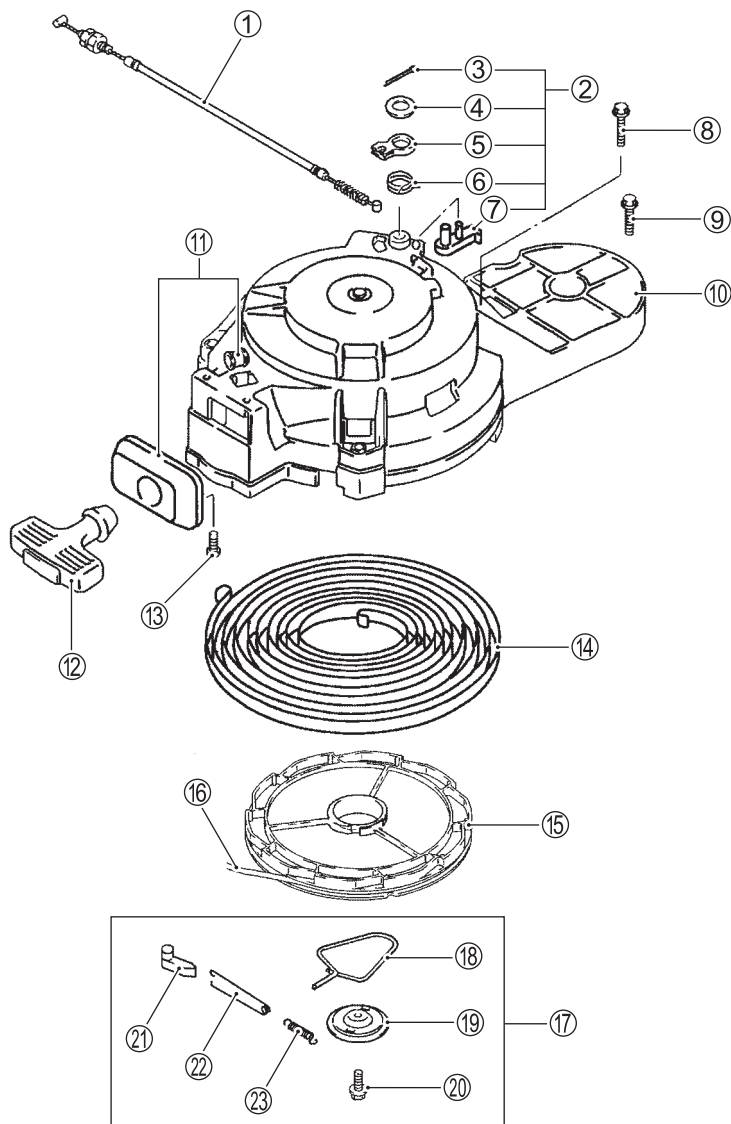
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SERVICE CHART

1. NSI cable (1)
2. NSI set
3. Cotter pin (1)
4. Washer (1)
5. Stopper arm (1)
6. Spring (1)
7. Reel stopper (1)
8. Screw (1)
9. Screw (3)
10. Recoil case (1)
11. Rope guide (1)
12. Grip (1)
13. Screw (1)
14. Recoil spring (1)
15. Reel (1)
16. Rope (1)
17. Ratchet set
18. Friction spring (1)
19. Friction plate (1)
20. Screw (1)
21. Ratchet (1)
22. Ratchet guide (1)
23. Return spring (1)



REMOVAL



WARNING

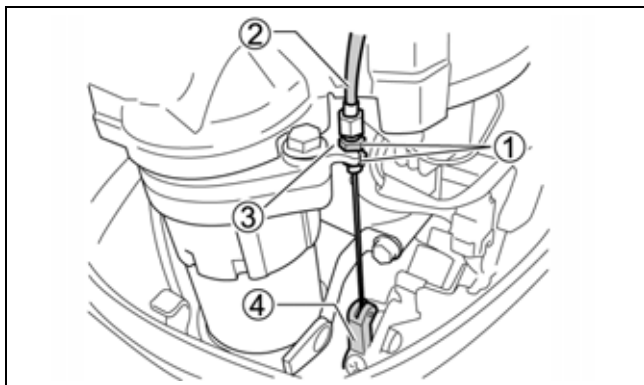


Avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

Wear safety glasses while disassembling and assembling manual starters to avoid personal injury caused by rewind spring tension.

Loosen lock nuts and remove NSI cable from cable bracket (stator base).

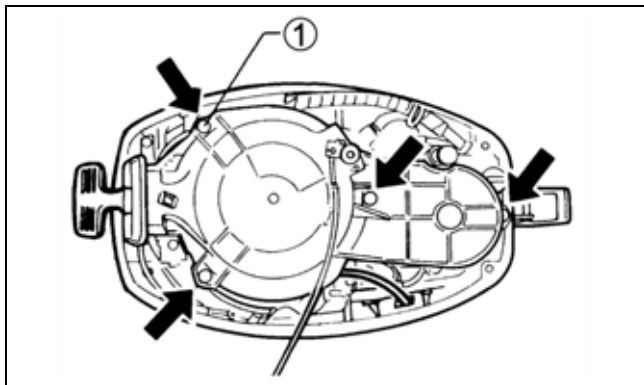
Remove NSI cable from clutch notch lever.



1. Lock nut
2. NSI cable
3. Cable bracket
4. Clutch notch lever

004626

Remove four screws securing recoil starter. Remove starter assembly.

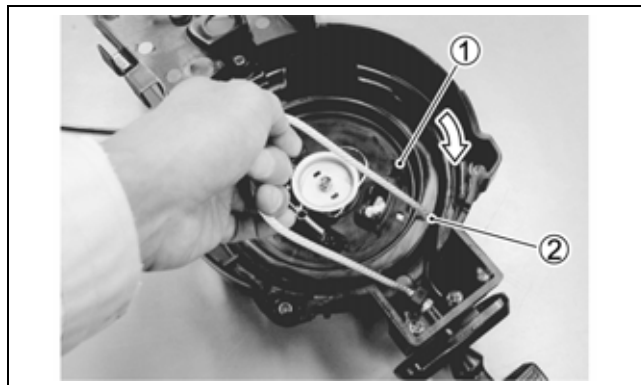


1. Starter screws

004627

DISASSEMBLY

Pull starter rope out of recoil case and guide the rope into notch in the reel. Turn reel clockwise to release the tension in the recoil spring.

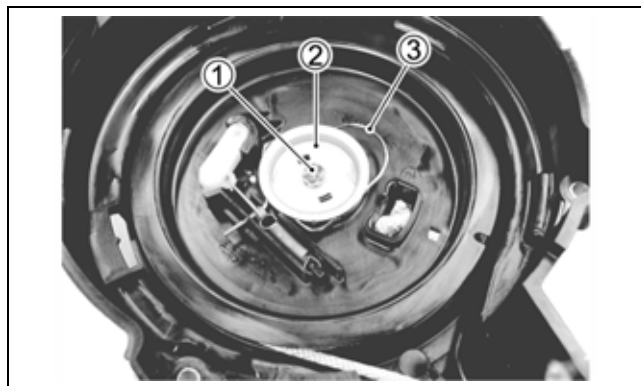


1. Reel
2. Notch

004628

Remove screw and friction plate, with friction spring.

Remove the reel.

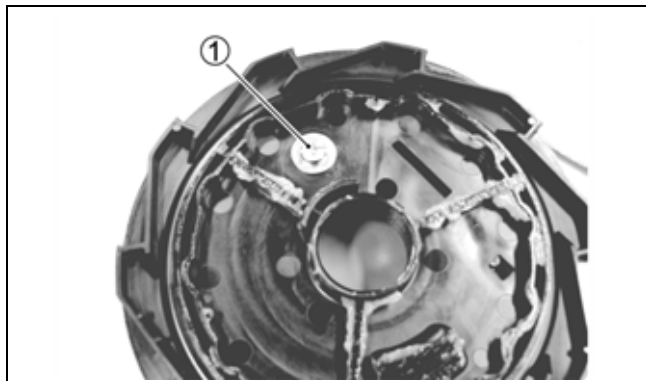


1. Screw
2. Friction plate
3. Spring

004629

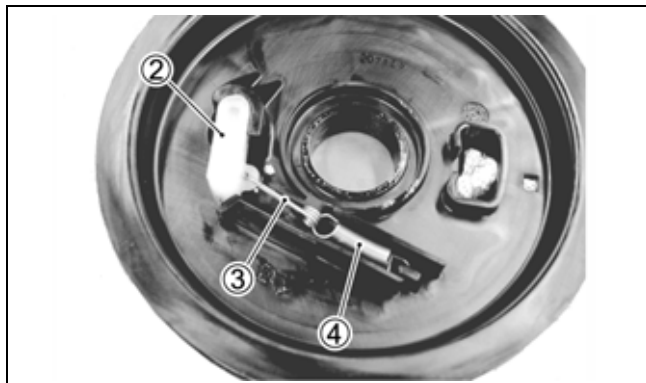
MANUAL STARTER DISASSEMBLY

Remove the screw, ratchet (pawl), ratchet guide, and return spring.



1. Screw

004630



- 2. Ratchet (pawl)
- 3. Ratchet guide
- 4. Return spring

004631

Remove starter rope.



004632

Remove the recoil spring.

IMPORTANT: Do not remove the recoil spring unless replacement is necessary. It should be visually inspected in its assembled position.

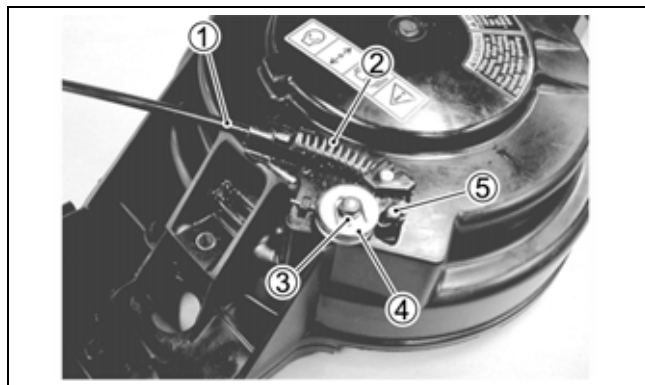


1. Recoil spring

004633

Remove NSI cable with spring.

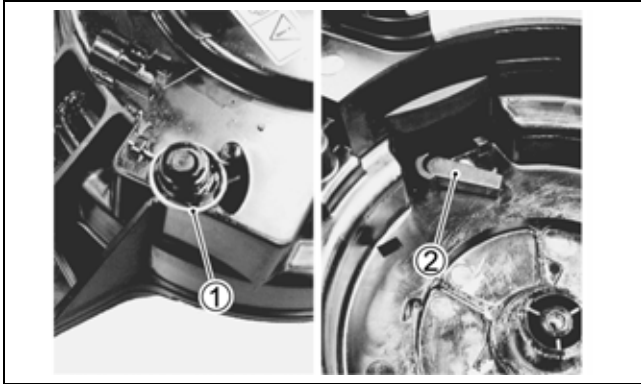
Remove cotter pin, washer, and stopper arm.



- 1. NSI cable
- 2. Spring
- 3. Cotter pin
- 4. Washer
- 5. Stopper arm

004634

Remove the reel stopper spring and reel stopper.



1. Reel stopper spring
2. Reel stopper

004635

Inspect the reel and recoil case.

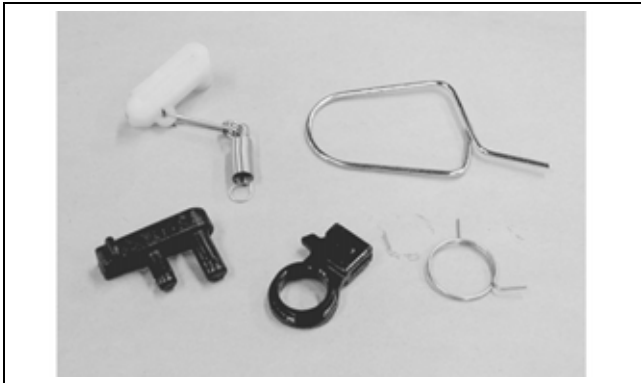


004637

INSPECTION

IMPORTANT: If any part is worn excessively, cracked, defective, or damaged, it must be replaced.

Inspect the ratchet (pawl), stopper arm, and all springs.



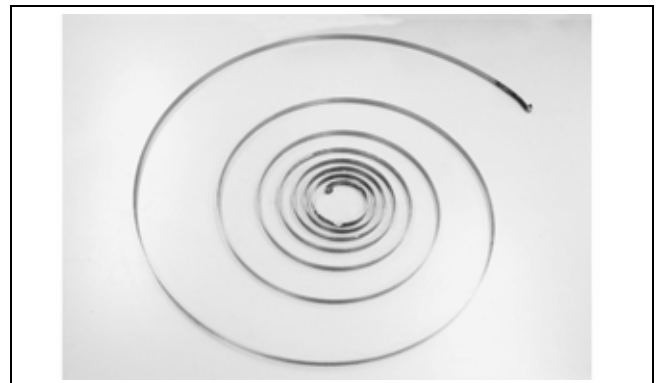
004636

Inspect the recoil rope.



004638

Inspect the recoil spring.



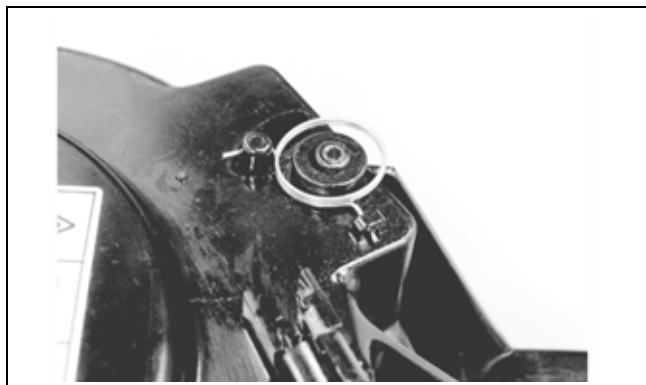
004639

MANUAL STARTER ASSEMBLY

ASSEMBLY

Assembly is reverse order of disassembly with special attention to the following steps:

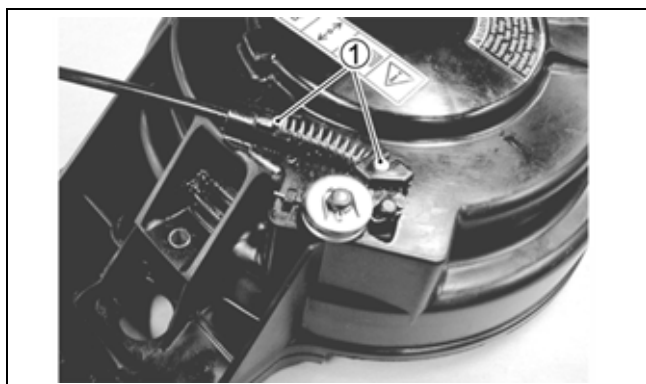
Install stopper spring.



004641

Install NSI set and NSI cable.

Apply *Triple-Guard* grease to the cable.



004642

Rewind spring using Starter Spring Winder, P/N 392093, insert (4) hose sections as shown to space coiled spring away from sides of starter winder base. Remove winder base from winder assembly. Locate winder base over the spring pocket in the recoil case. Carefully transfer the recoil spring from the base to the case.

Secure the outer end of recoil spring in groove in recoil case.



004643



004644



WARNING



Because of the coiled tension in the recoil spring, wear safety glasses and hand protection when winding or unwinding this component.

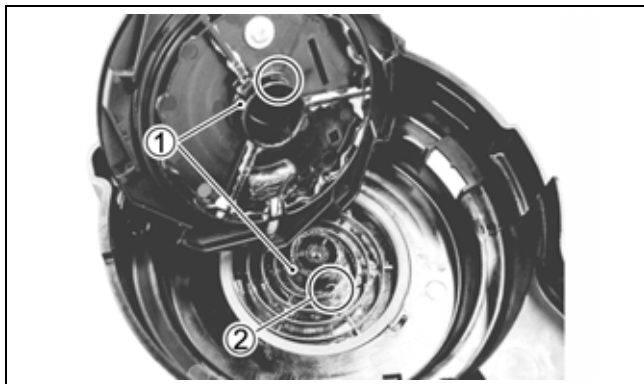
Install the ratchet set.



004645

Install the reel on the recoil case.

- Apply *Triple-Guard* grease to center hub.
- Align groove in reel with bent end of spring.



1. Apply grease here
2. Spring end

004646

After assembly, guide rope into notch in the reel and rotate the reel approximately 5 turns counter-clockwise until the spring is tensioned.

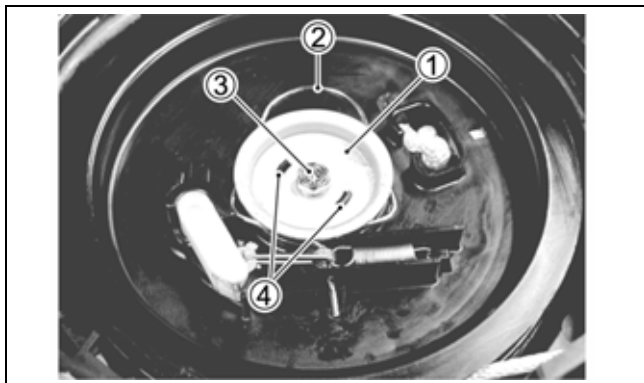


004648

Apply *Nut Lock* to threads of friction plate screw.

Install friction plate with friction spring and secure with screw.

IMPORTANT: Align holes in friction plate with square lugs on center boss.



1. Friction plate
2. Friction spring
3. Screw
4. Square lugs

004647

INSTALLATION

Installation is reverse order of removal with special attention to the following steps:

- Check that all removed parts are installed.
- Check the neutral start interlock function.

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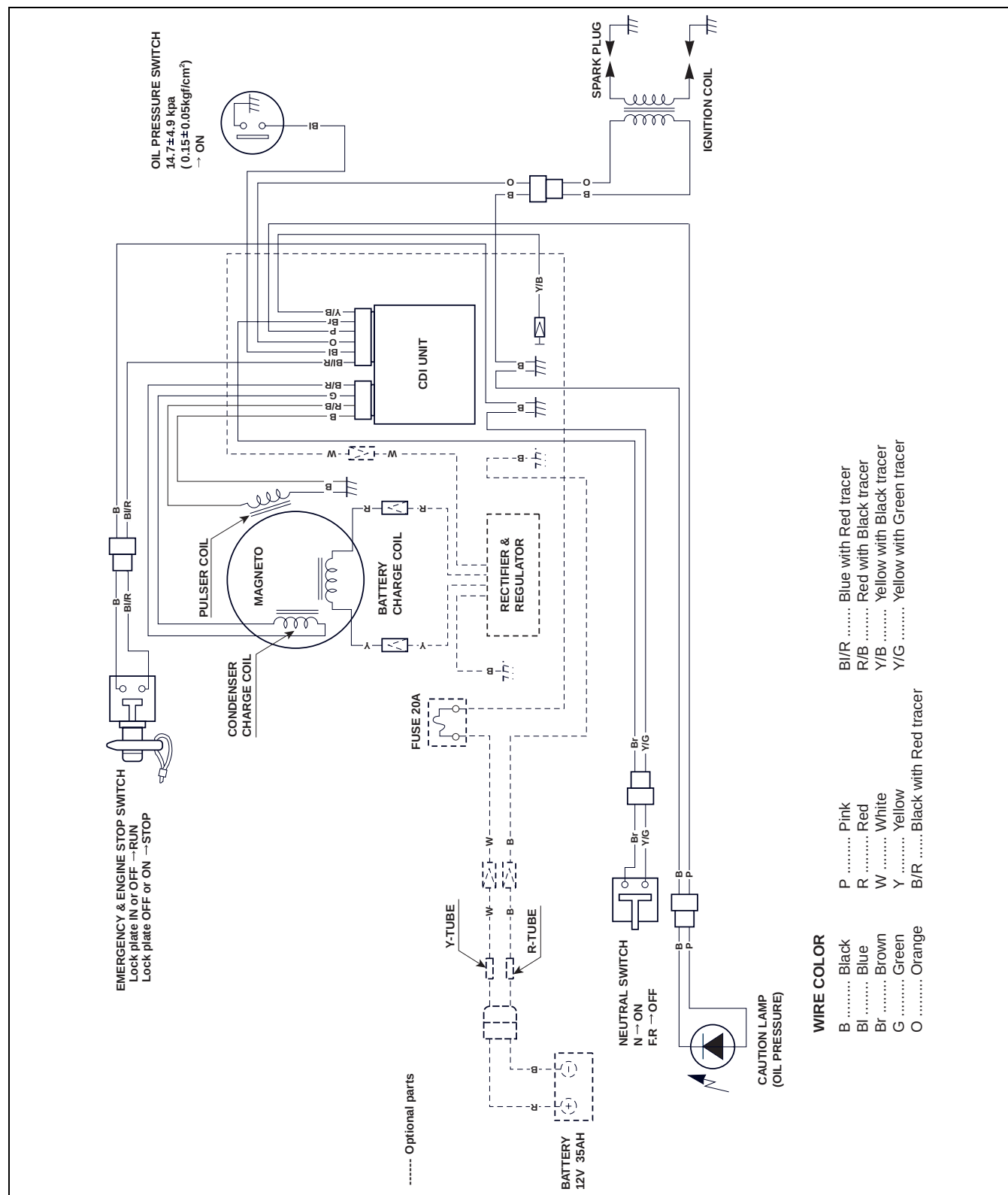
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WIRE ROUTING 229

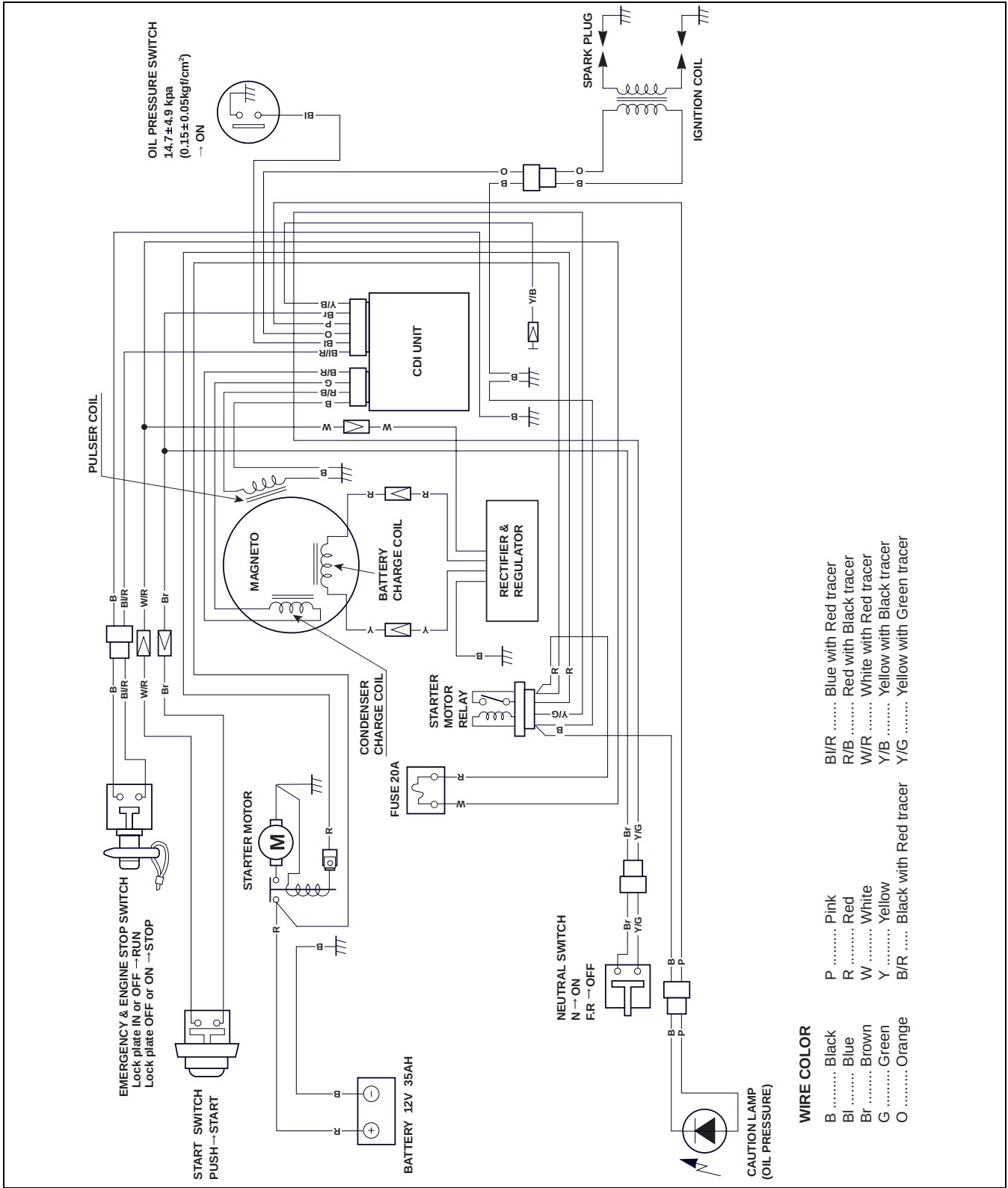
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WIRING DIAGRAMS

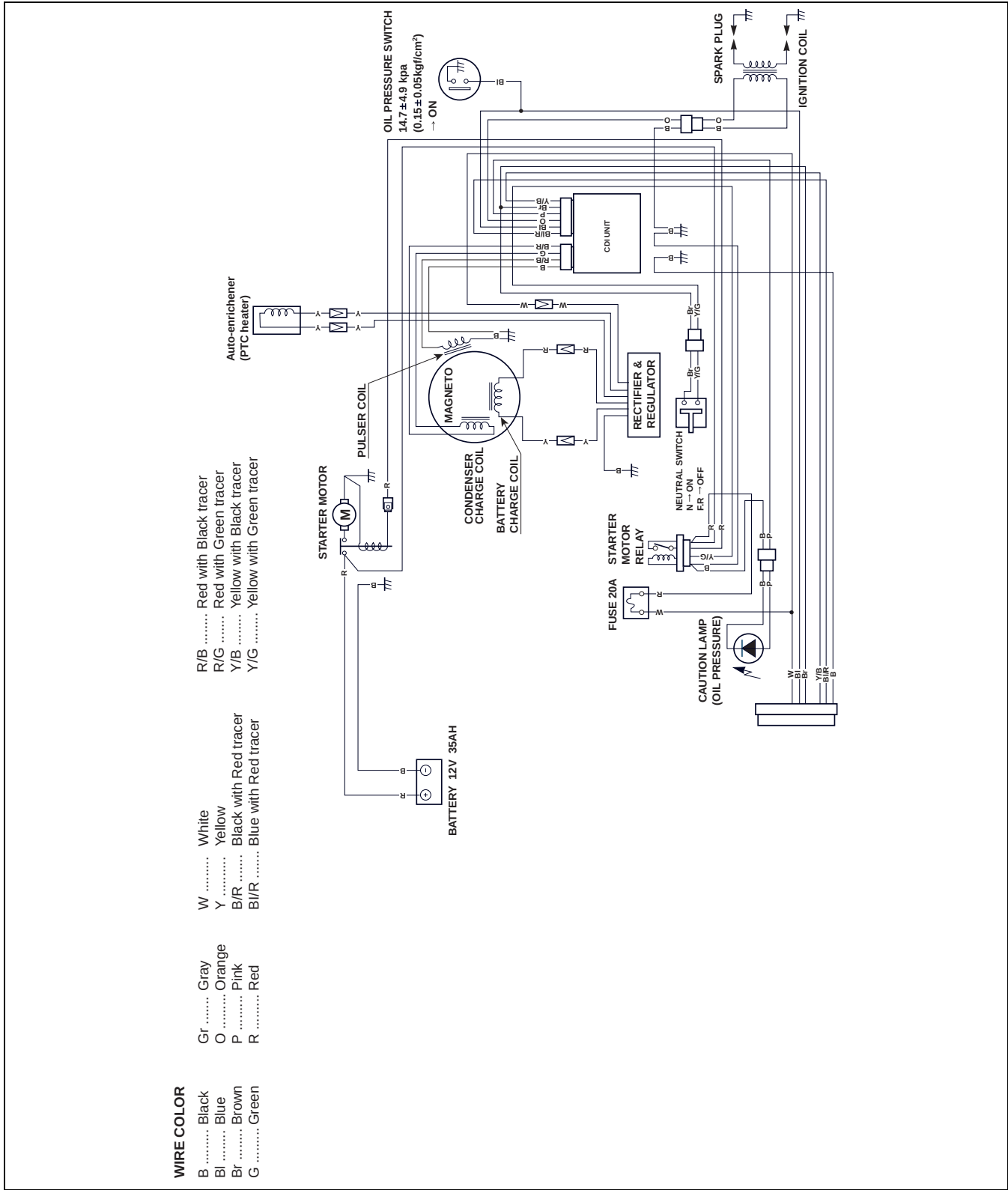
Rope Start Models



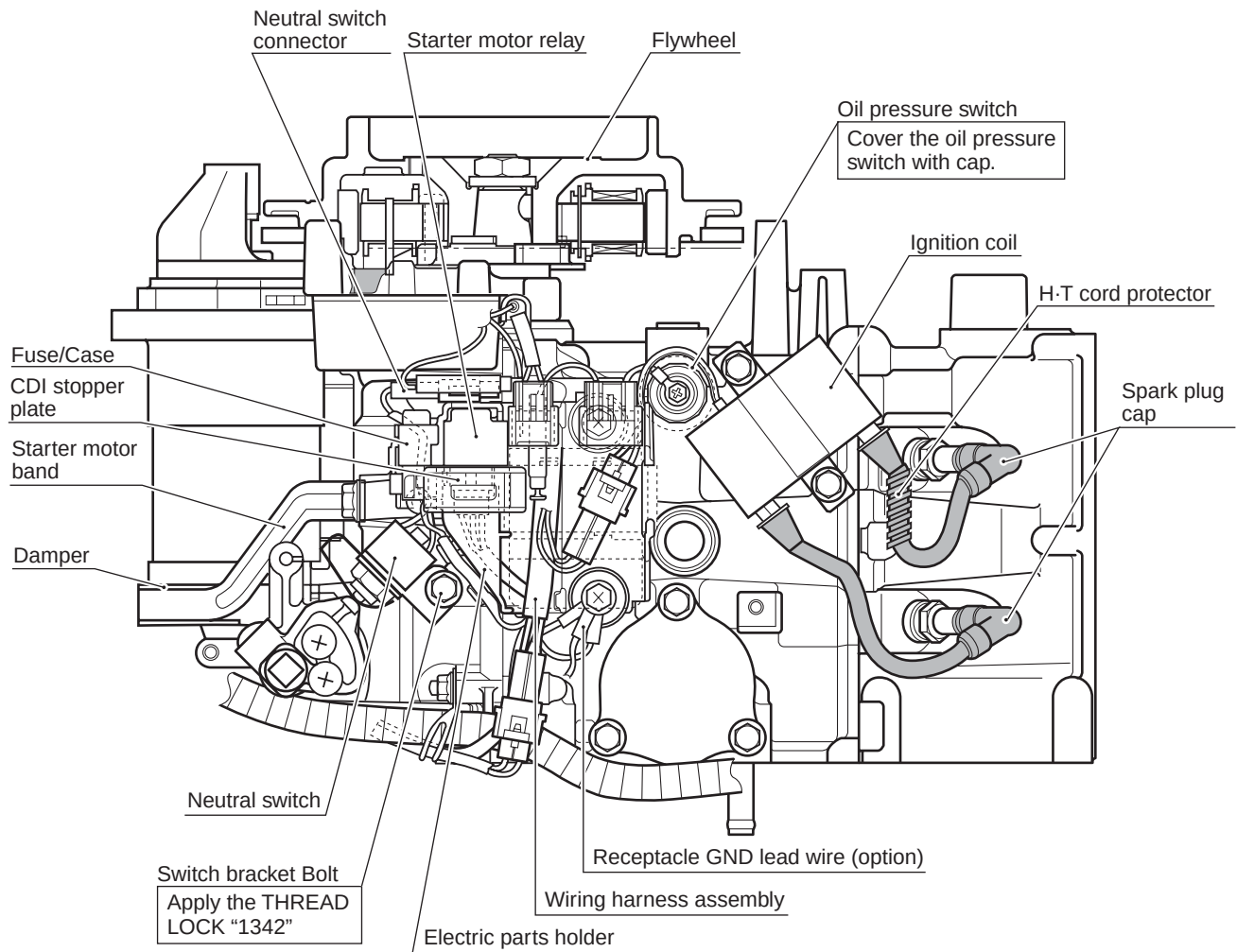
Tiller Electric Models



Remote Electric Models

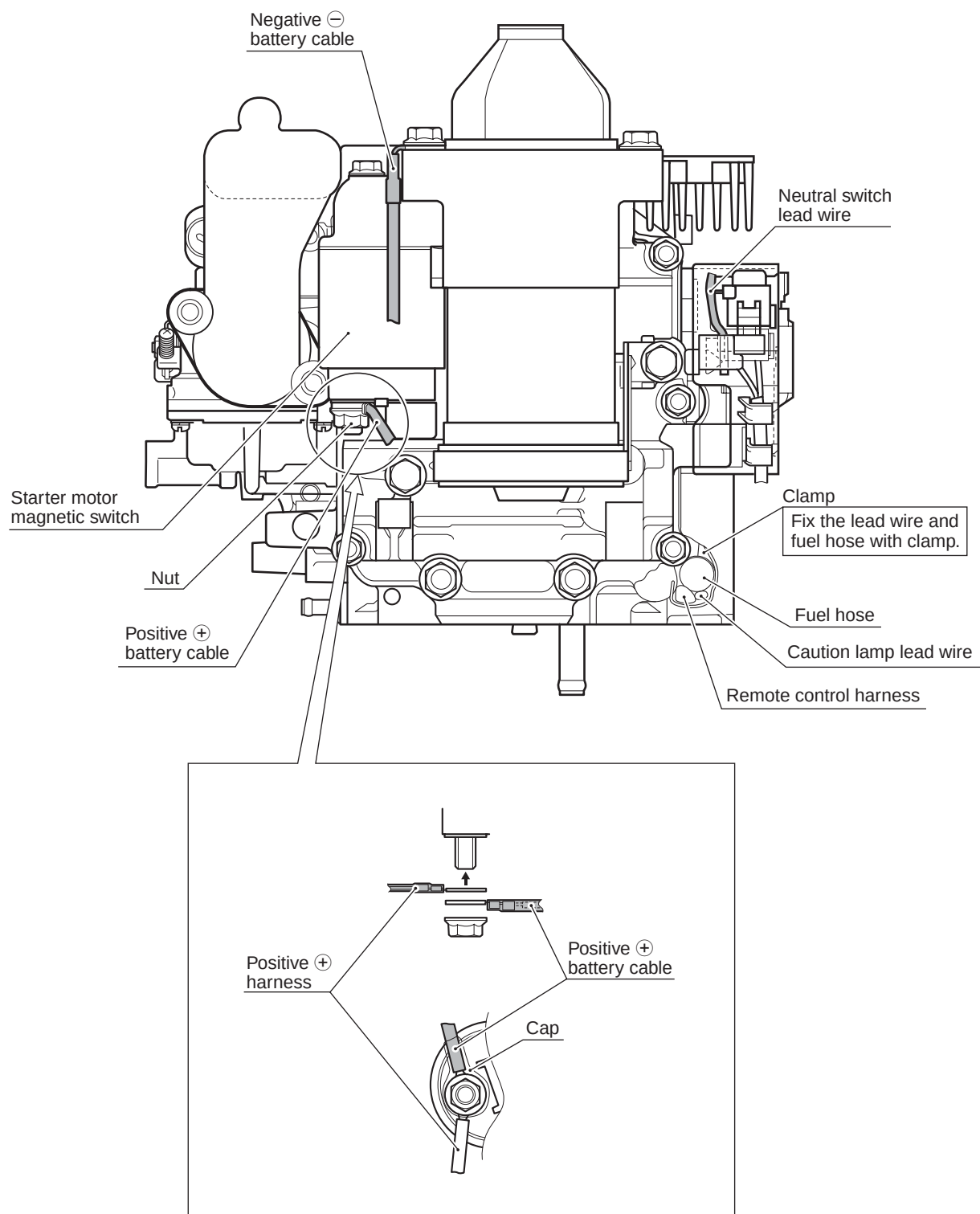


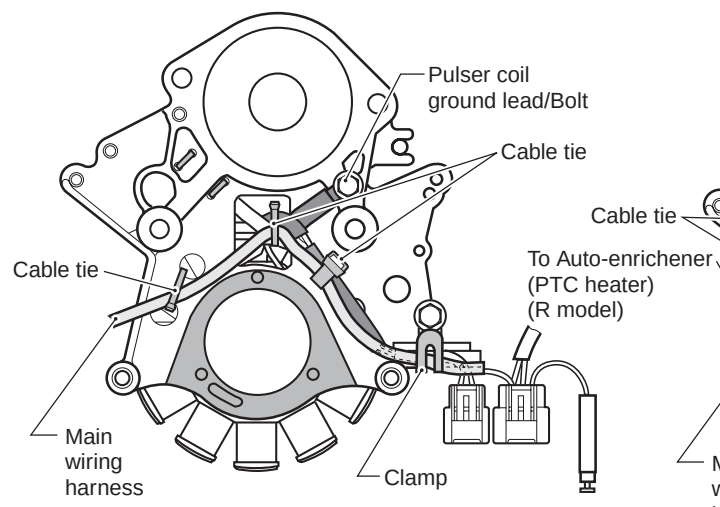
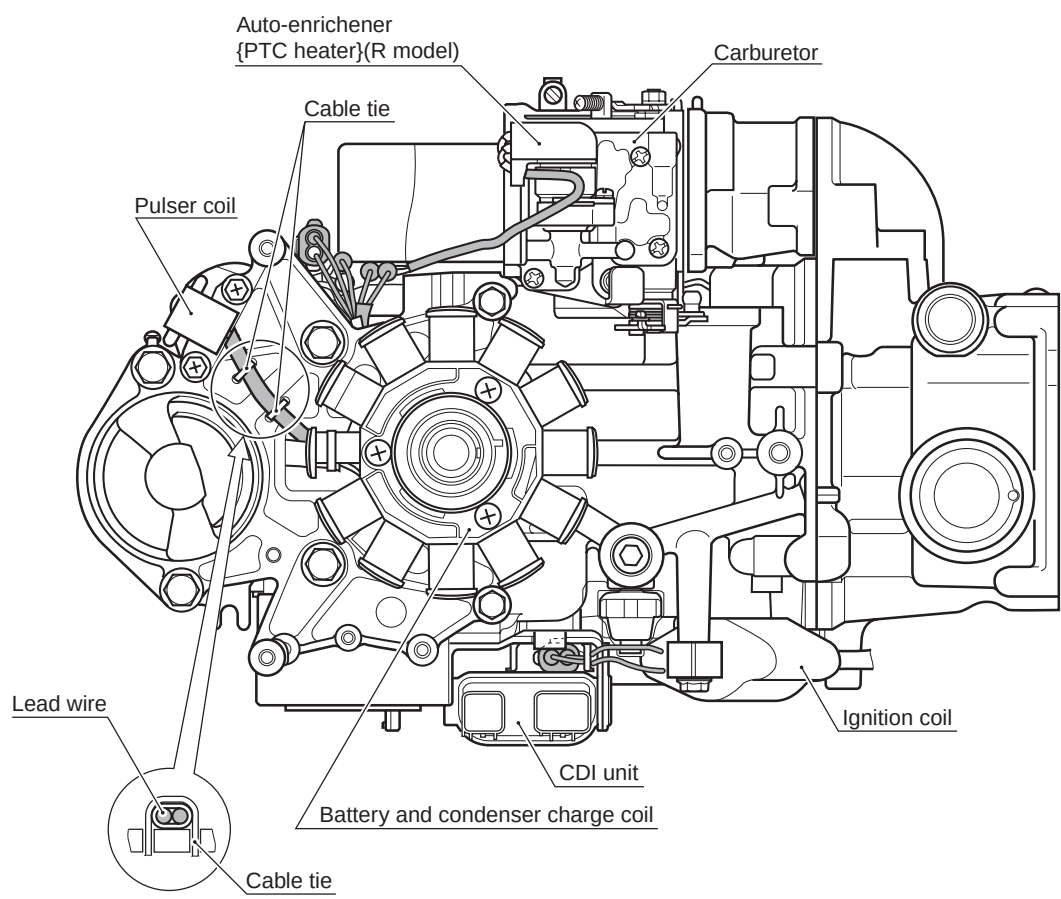
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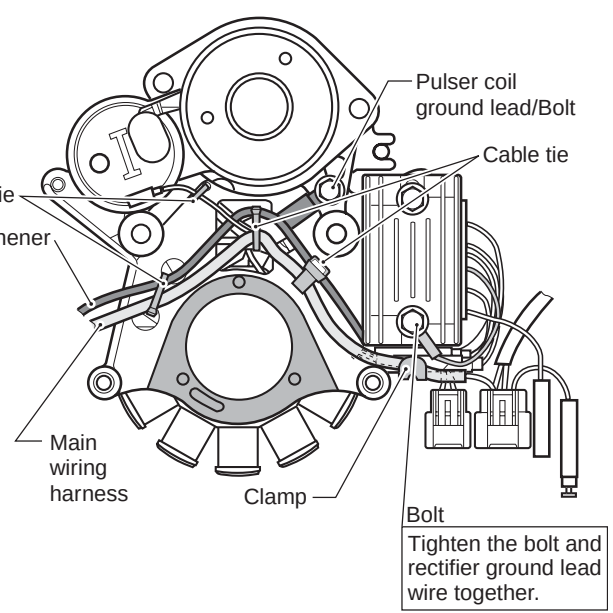
WIRE/HOSE ROUTING

WIRE ROUTING





Manual starter model

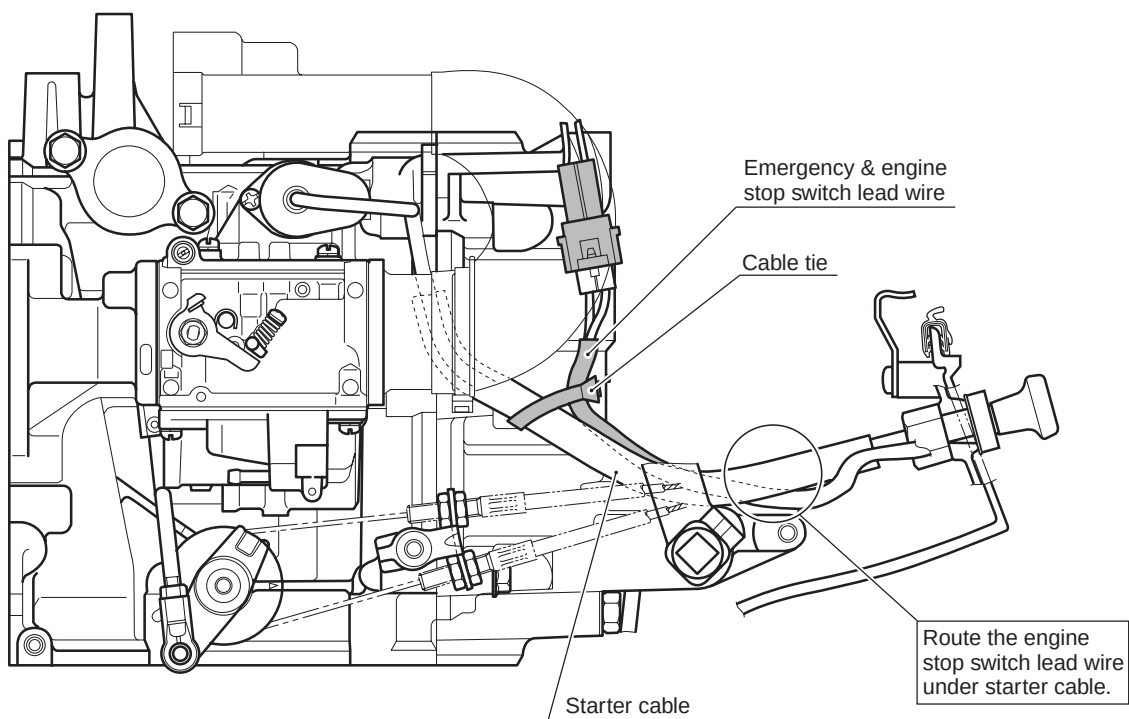


Electric starter model

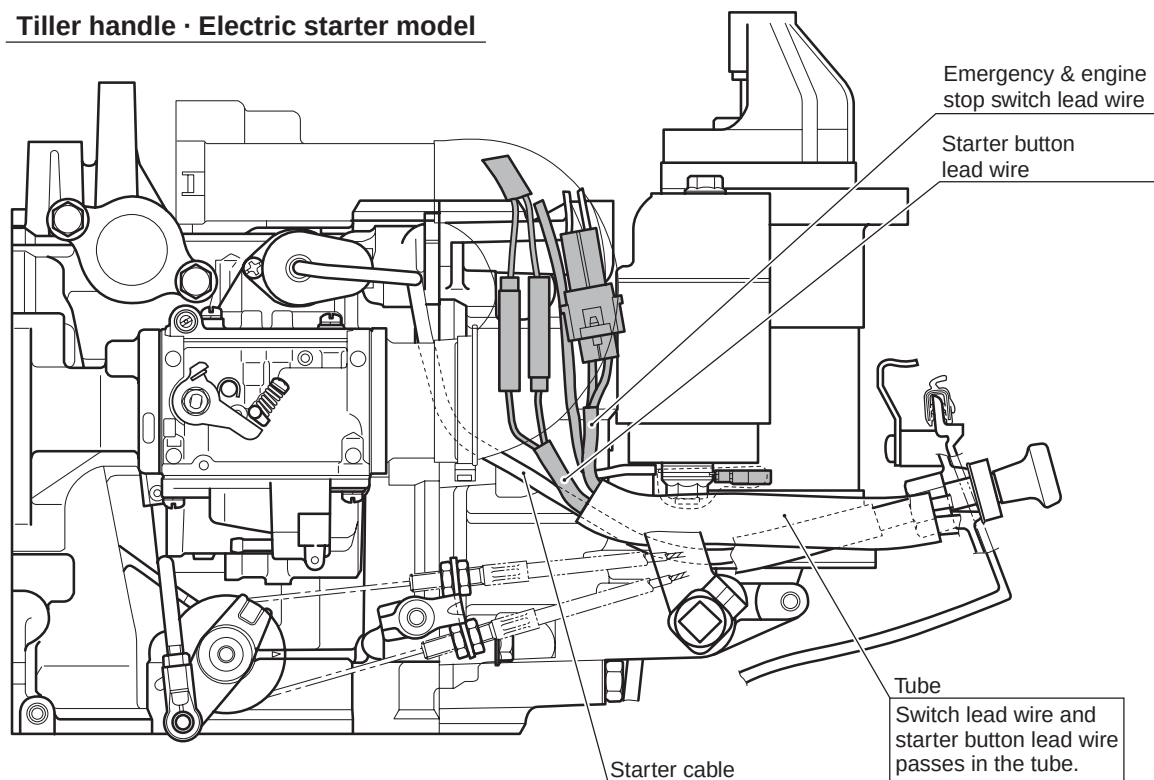
WIRE/HOSE ROUTING

WIRE ROUTING

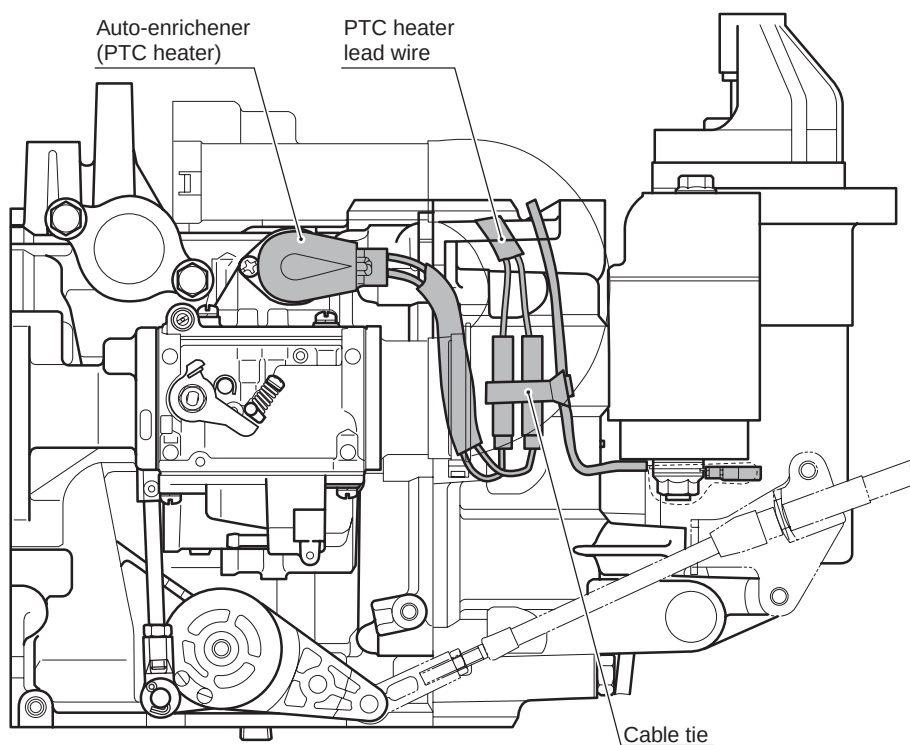
Tiller handle · Manual starter model



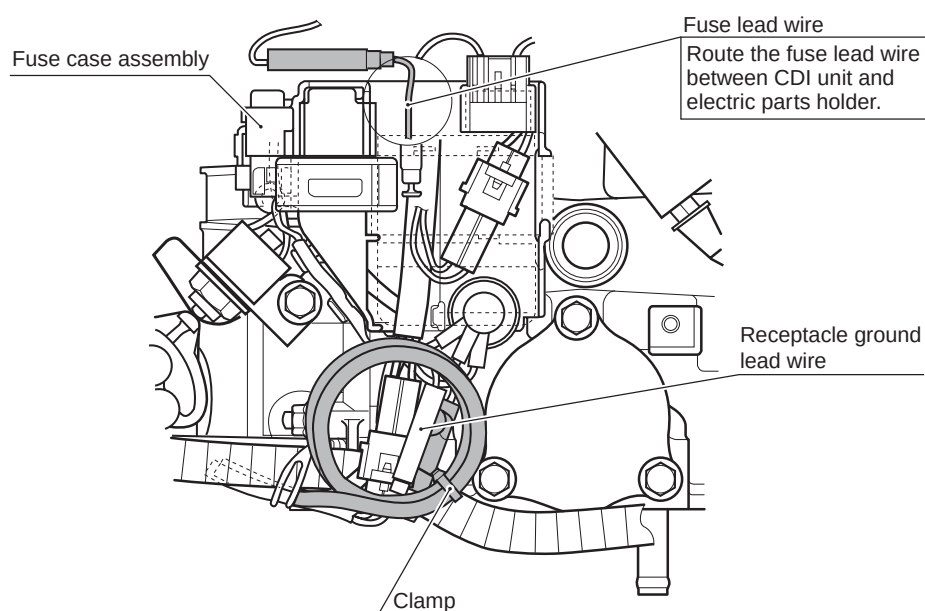
Tiller handle · Electric starter model



Remote control model



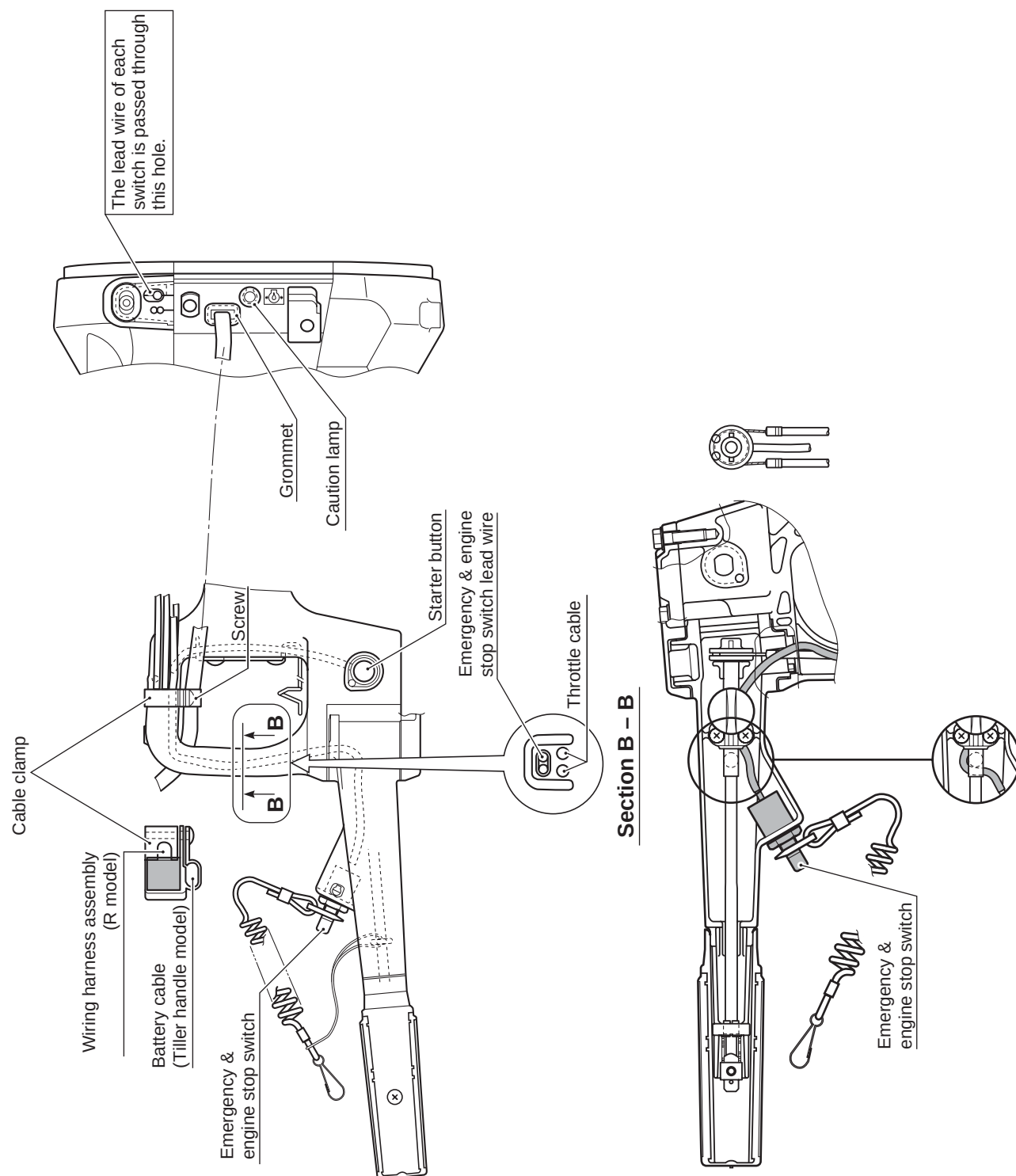
Routing of Receptacle lead wire (Optional part)



WIRE/HOSE ROUTING

WIRE ROUTING

Tiller handle



FUEL/WATER HOSE ROUTING

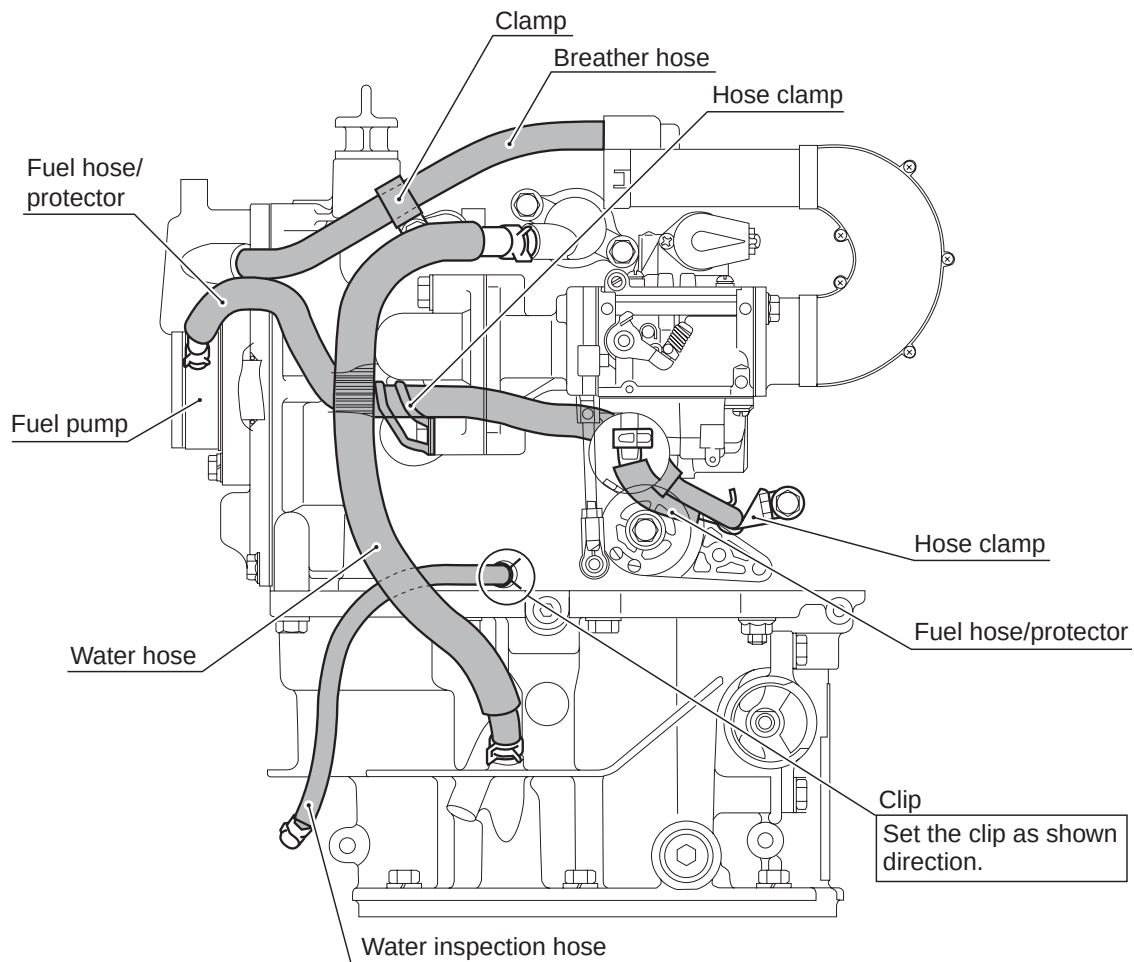
Do not over-bend (kink) or twist hoses when installing.

When installing hose clips, position tabs to avoid contact with other parts.

Check that hoses do not contact rods and levers during either engine operation or standstill.

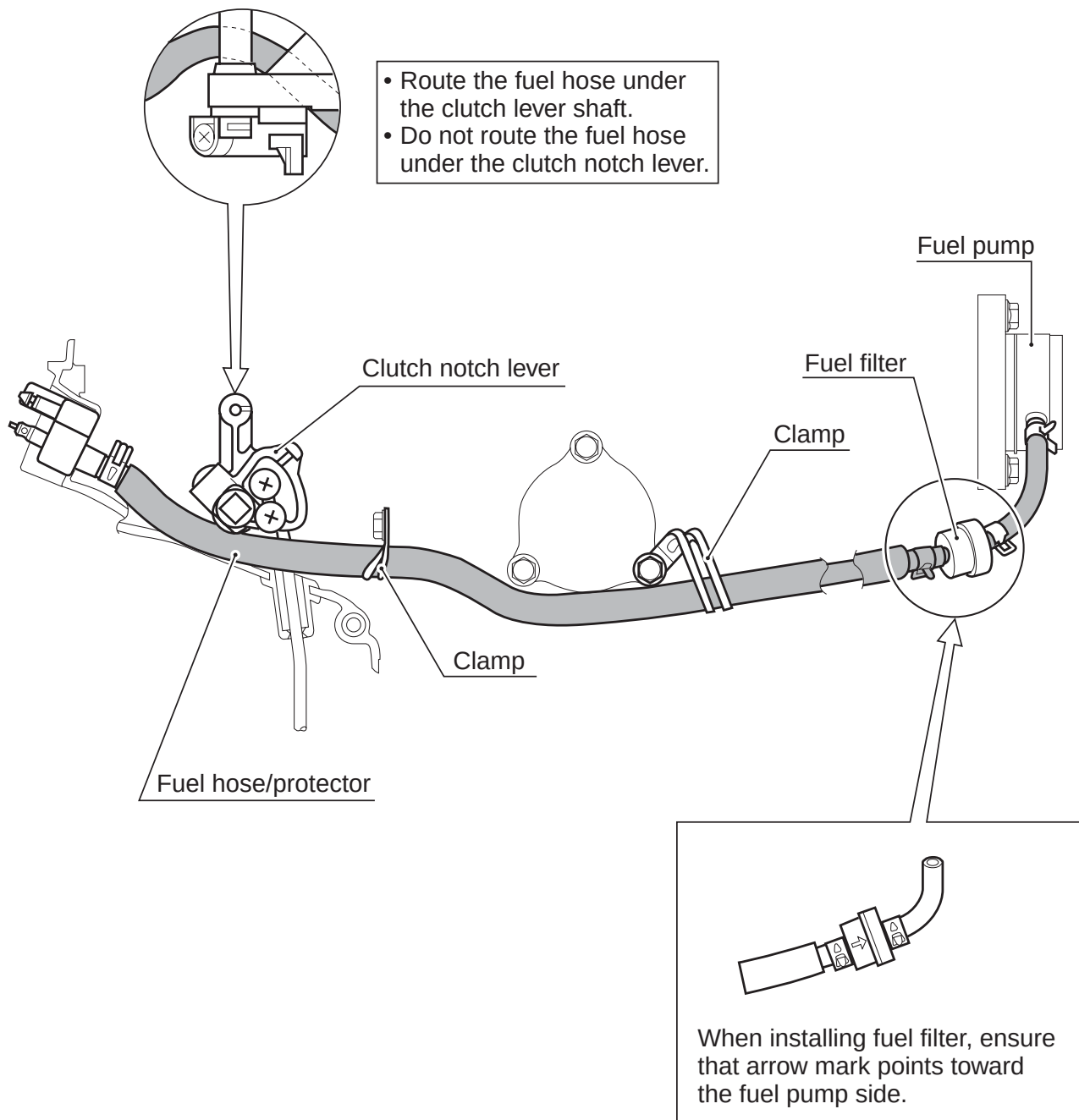
Extreme care should be taken not to cut, abrade or cause any other damage on hoses.

Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.



WIRE/HOSE ROUTING

FUEL/WATER HOSE ROUTING



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MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM



WARNING



This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

- Product user is informed; and
- Products are safe and reliable.

It is up to you, the people who...

- Rig boats;
- Fix machinery; and
- Maintain equipment

...to keep the products safe **and** reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

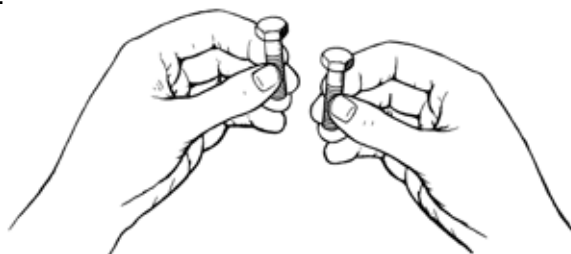
First!

A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS

"They look the same, but are they the same?"

- Same size?
- Same strength?
- Same material?
- Same type?

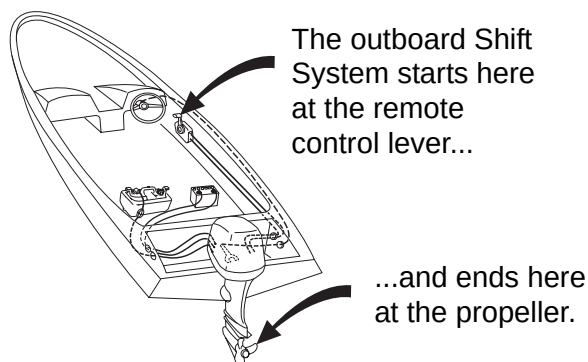


Don't substitute unless **you know** they are the **same** in **all** characteristics.

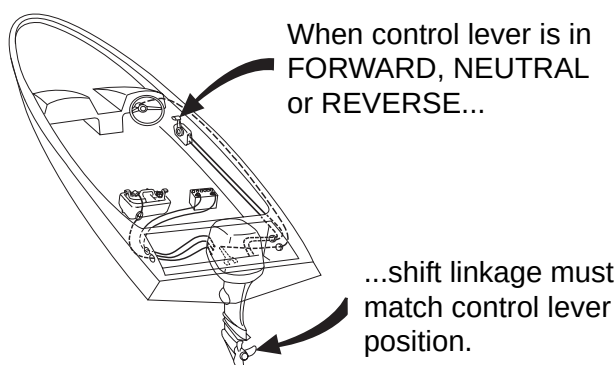
Second!

- Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.
- When the outboard is returned to the boat, use only the special nuts and bolts to hold remote steering, shift, and throttle cables to the outboard.

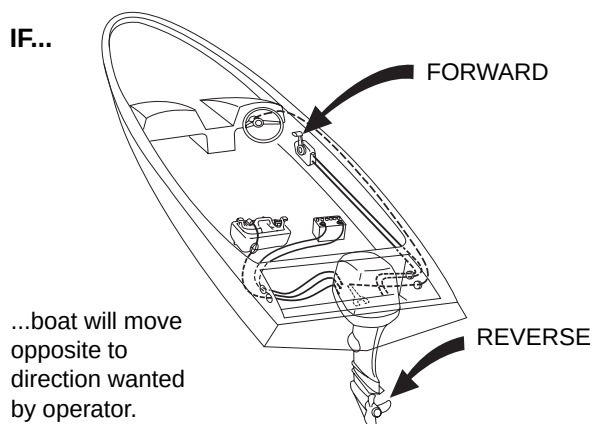
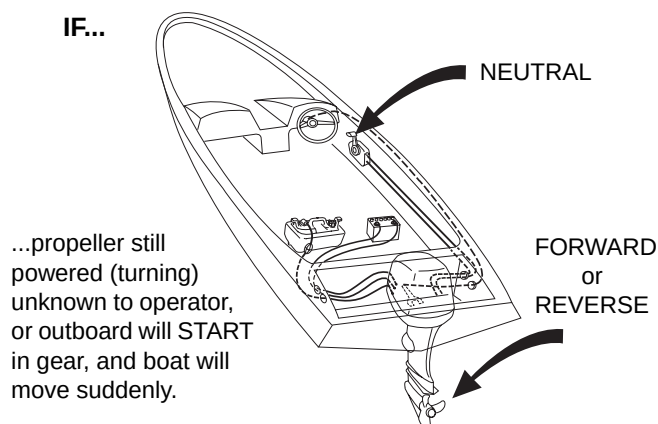
Outboard Shift Systems and Safety



What is most important?



What could happen?



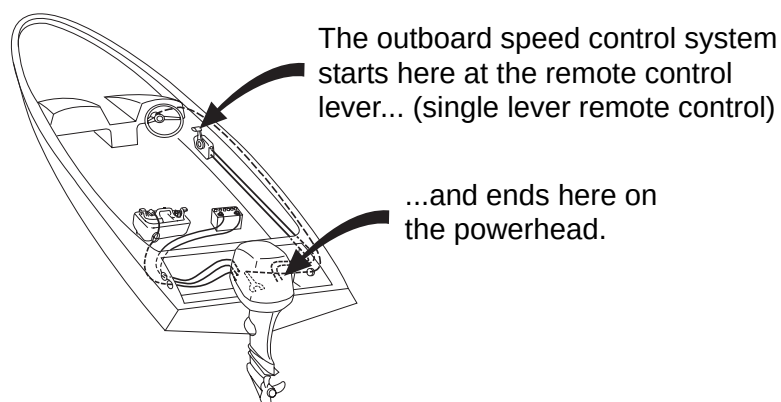
How can loss of shift control be minimized?

When rigging or after servicing

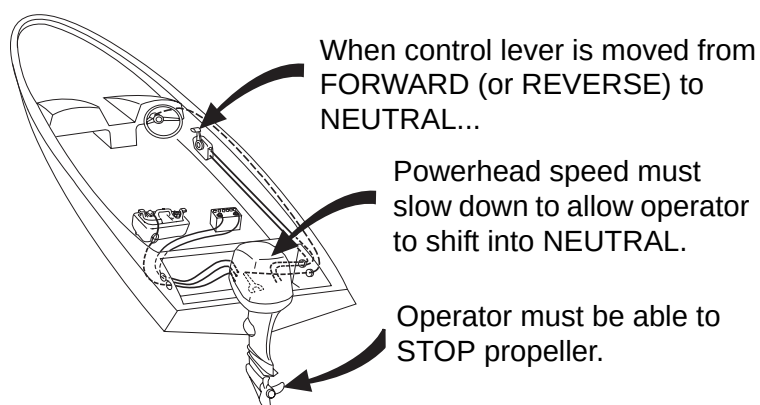
Read, understand, and follow manufacturer's instructions

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure propeller does just what the operator wants and nothing else.
- Do not shift gears on a stopped outboard. Adjustments can be lost and parts weakened.

Outboard Speed Control System and Safety



What is most important?



What could happen?

If Operator cannot slow down the outboard or shift into NEUTRAL gear (stop propeller), Operator could panic and lose control of boat.

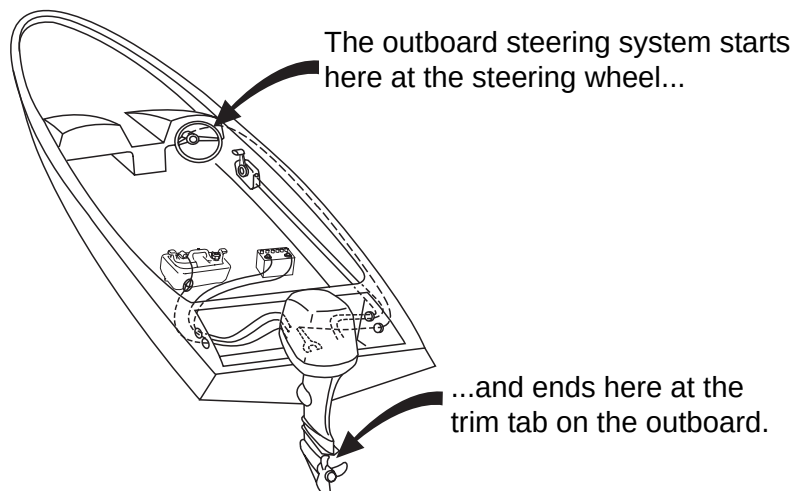
How can loss of speed control be minimized?

When rigging or after servicing

Read, understand, and follow manufacturer's instructions

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else.
- Make sure full throttle can be obtained so Operator will not overload parts.

Outboard Steering Control System and Safety



What is most important?

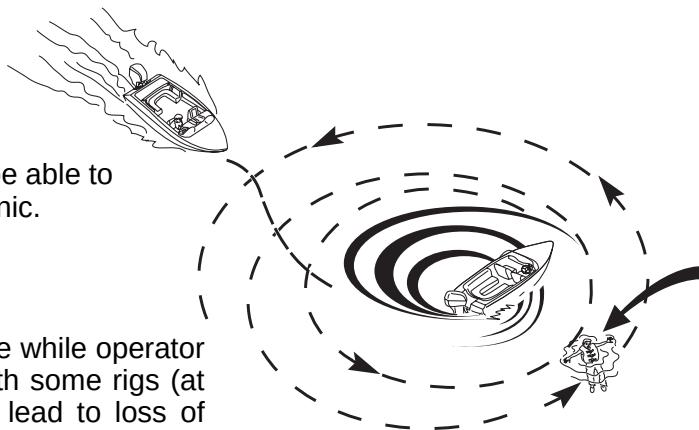
The steering system:

- Must not come apart;
- Must not jam; and
- Must not be sloppy or loose.

What could happen?

- If steering system comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.

- If steering jams, operator may not be able to avoid obstacles. Operator could panic.
- If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high speed), loose steering could lead to loss of boat control.



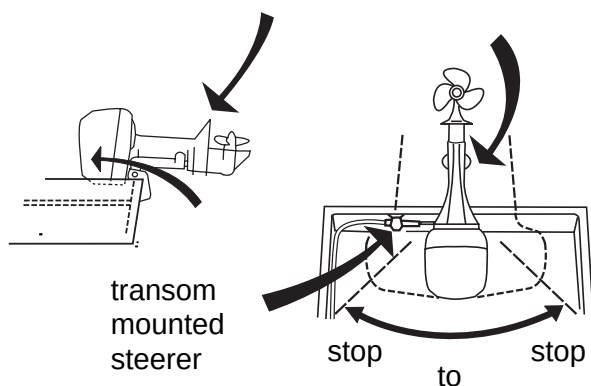
How can loss of steering control be minimized?

When rigging or after servicing

- Use a steering system recommended by the outboard manufacturer which meets Marine Industry Safety Standards (ABYC).
- **Read, understand, and follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Keep parts moving freely. Lubricate parts as shown in manual.
- Use the bolts, nuts and washers supplied with steering attachment kits—they are a special locking type that will not loosen, rust, or weaken.

Transom Mounted Steering Systems – Check to Uncover Possible Trouble!

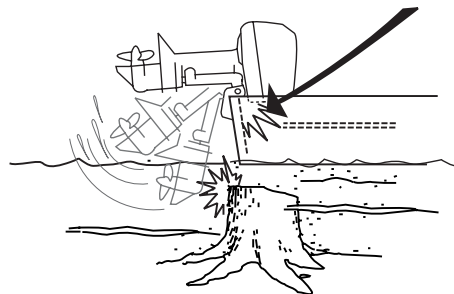
Tilt outboard into boat, then turn it.



During this procedure, steering parts:

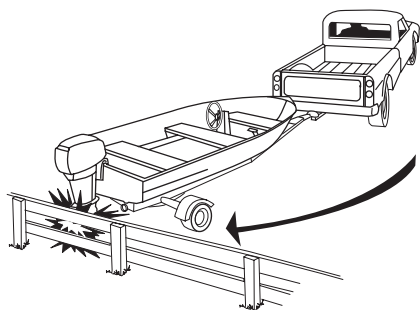
- Must not bind; and
- Must not touch other boat, outboard, or accessory parts in transom area.

Why? A hard blow to the outboard's gearcase can result in damage to steering parts.



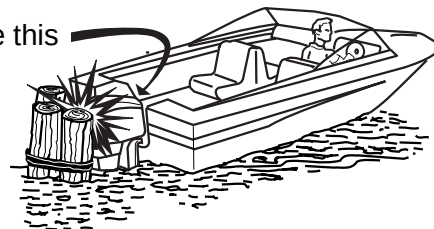
Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

Check for damaged parts. Blows to the outboard like this



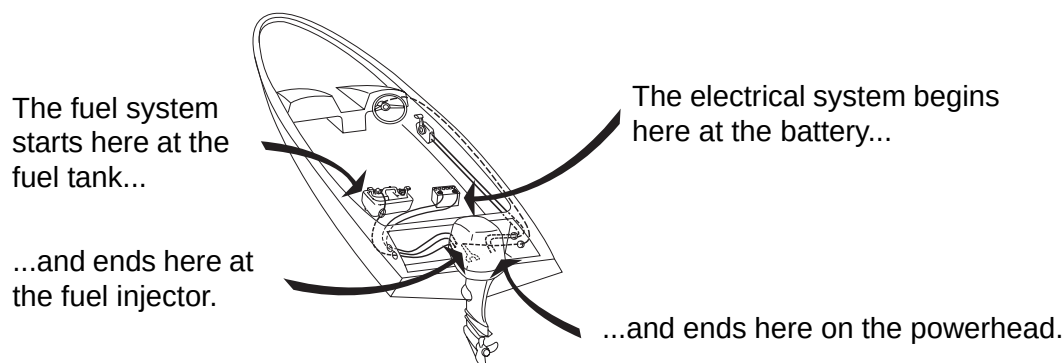
or this can put heavy loads on steering parts. Look for:

- Cracked parts, including steering parts, swivel brackets, and transom brackets;
- Bent parts; and
- Loose nuts and bolts.



Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Outboard Fuel, Electrical System, and Safety



What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

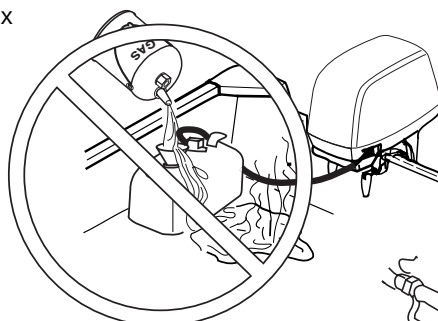
What could happen?

- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

- **Read, understand, and follow** manufacturer's instructions
- Follow warnings marked "⚠" closely.
- **Do not** substitute fuel or electrical systems parts with other parts which may look the same. Some electrical parts, like starter motors, are of special design to prevent stray sparks outside their cases.
- Replace wires, sleeves, and boots which are cracked or torn or look in poor condition.

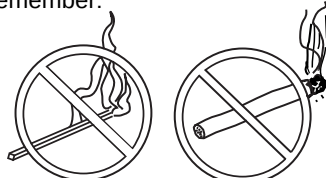
When mixing and refueling, always mix gas and oil outside...



Always fill the tank outside the boat

Fumes are hard to control. They collect and hide in the bottom of the boat.

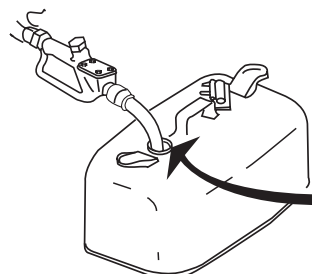
Remember:



Do not use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.



If you use a funnel, it has to be metal to ground the spout to the tank.



To avoid those static electric sparks, ground (touch) the spout against the tank.

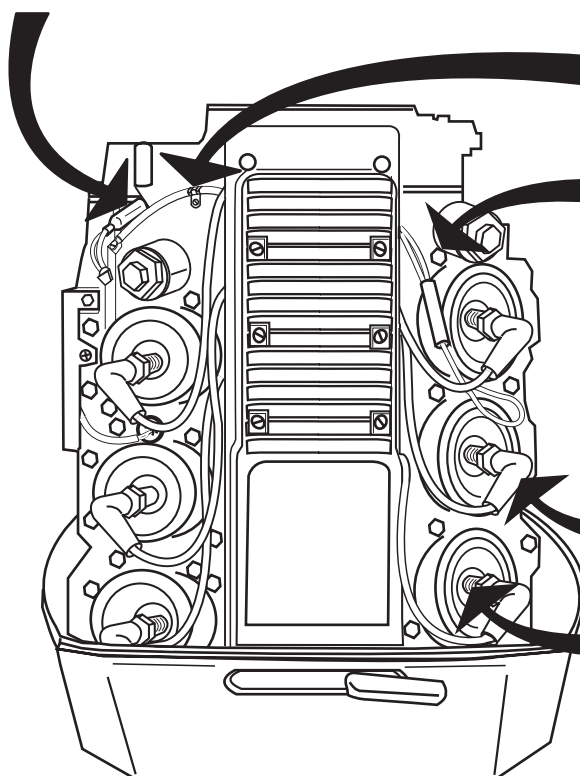
If electrical parts are replaced or even removed from the outboard, check the following:

Wire and high voltage lead routing

- As shown in service manual
- Away from moving parts which could cut wires or wire insulation
- Away from engine cover latches which can catch and cut insulation from high voltage spark plug leads

Sleeves, boots, shields

- In position (to avoid shock hazard)
- Not torn or cracked



Metal Clamps – Tie Straps

- Position as shown in manual

Screws, Nuts, Washers

- Tighten firmly—these keep clamps in position and ends of wires from sparking
- Where lock washers are called for, use them

Spark Plug Boots

- Not torn or cracked
- Fully pushed onto spark plug

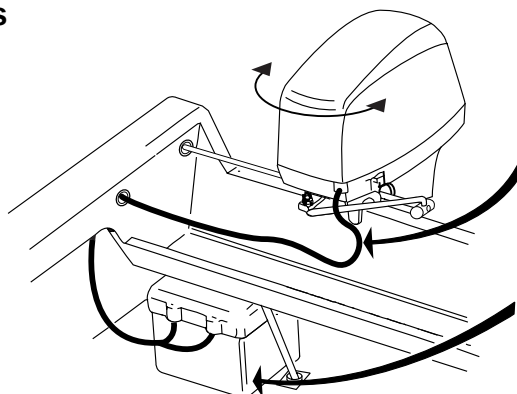
Spark Plugs

- Avoid rough handling that could crack ceramic part of plug. (Sparks may jump across outside of plug.)

In transom area:

All Connections

- Clean
 - Tight
- (Prevents sparks)



Electric Cable

- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

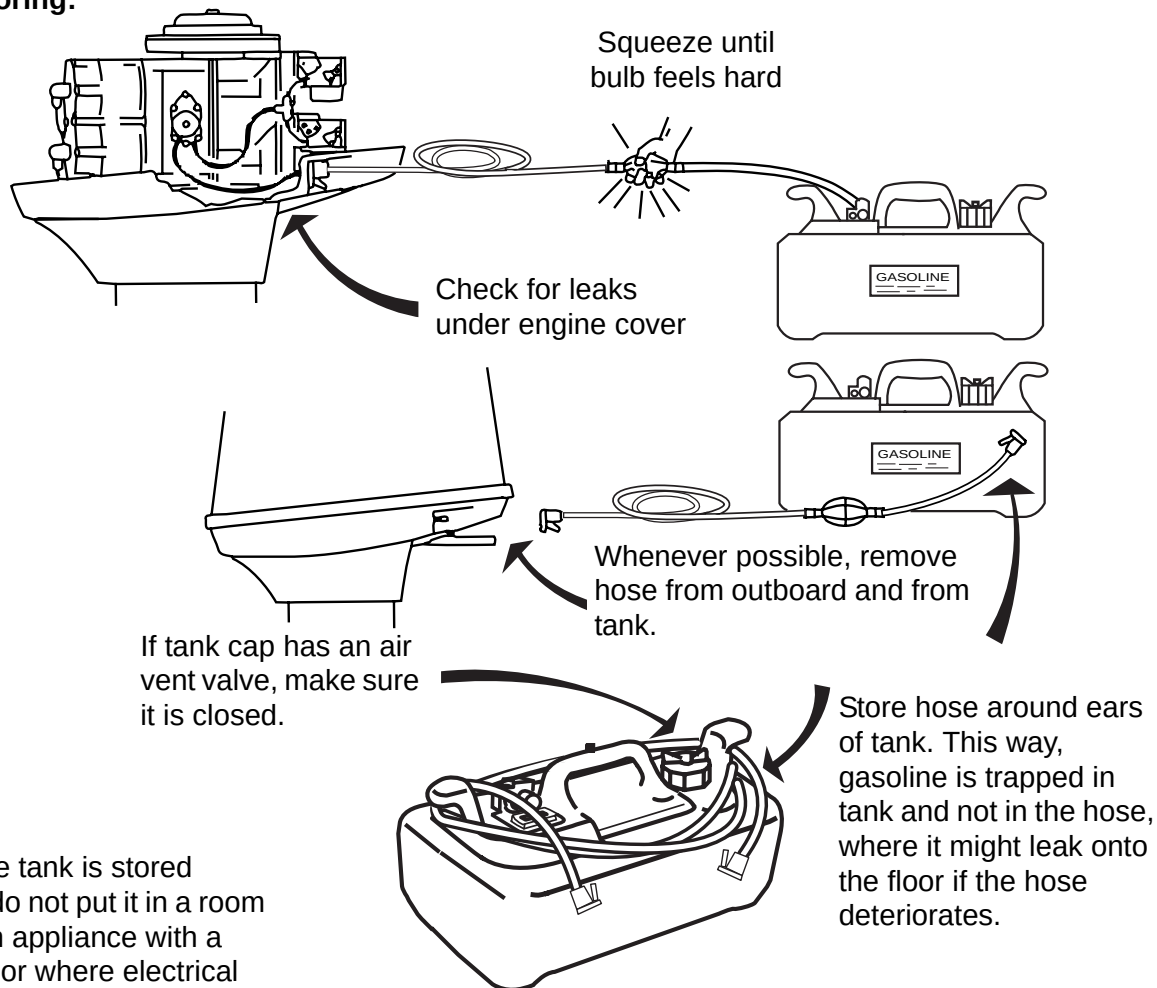
Batteries

- Secure in approved battery box or battery tray
- Battery terminals insulated
- No strain on cables

SAFETY

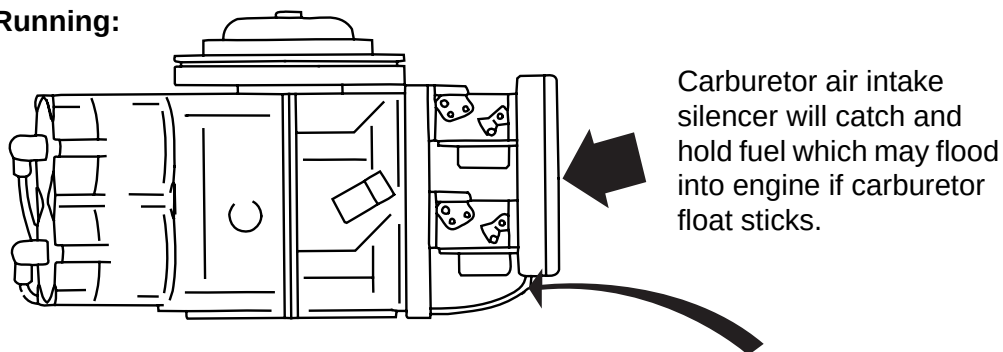
After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When Storing:



If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used.

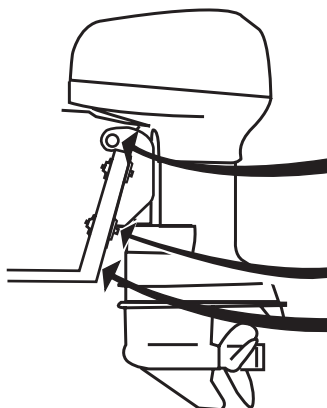
When Running:



- Make sure silencer and its gaskets are on engine and drain hose is in place.
- Air silencer mounting screws are special lock screws. Use only the special screws.

Outboard Mounting System and Safety

The mounting system includes:

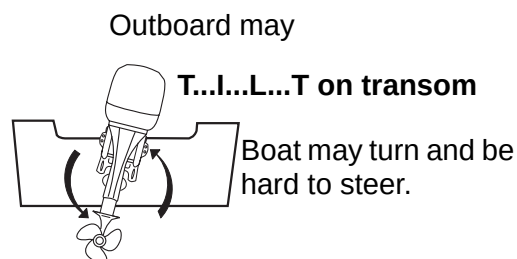
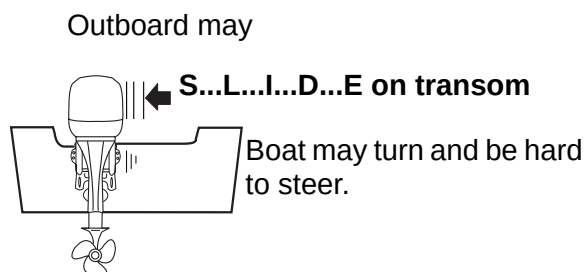


- outboard parts
- bolts, nuts, and washers
- boat's transom

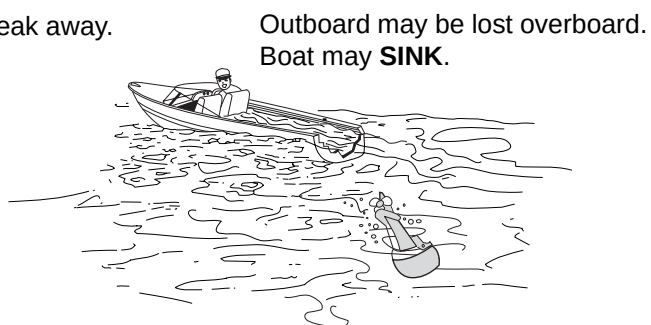
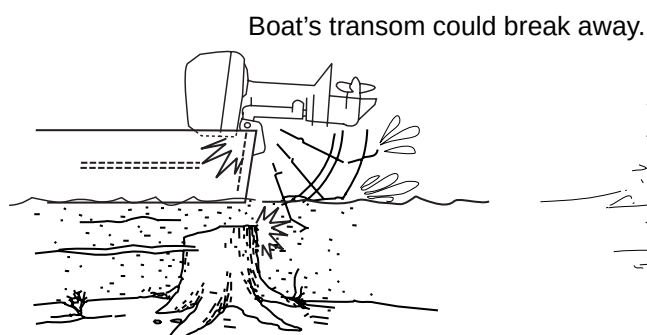
What is most important?

- Outboard must **stay** in position on boat's transom.

What could happen?



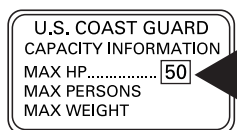
- If outboard hits something solid and does not stay on the transom, boat occupants may be injured from the outboard or its parts entering the boat.



How Can Loss of Mounting Be Minimized?

- **Read, understand, and follow** manufacturer's **instructions**.
- Follow warnings marked "⚠" closely.

If weakened, parts could fail later on the water, when not expected

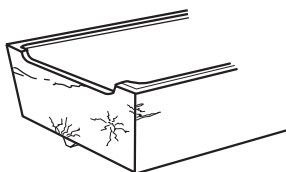


If boat plate shows...

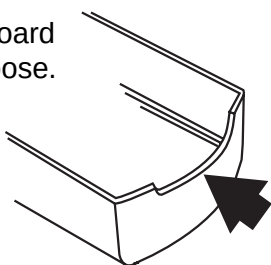
Use only
or smaller



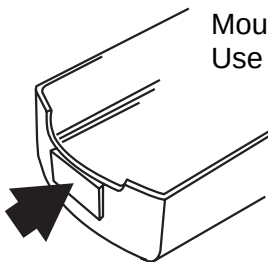
When rigging or fixing any boat, if transom looks weak, tell the owner.



If transom is curved, outboard may come loose.



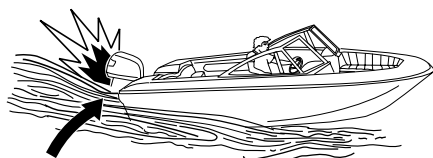
Mount on flat surface only.
Use shims to make surface flat.



Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

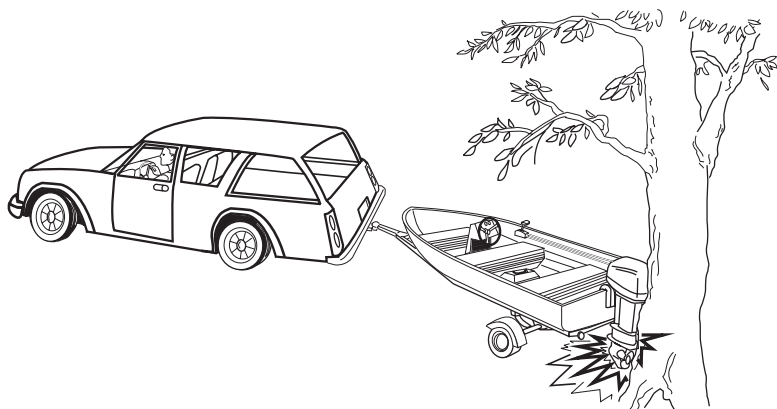


If owner tells you "I hit something really hard..."



Check for a high speed blow to the lower unit.

OR...



"I was backing up and I think the outboard may have hit a tree or something."

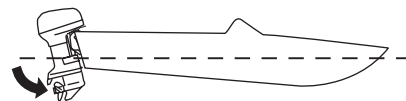
Check for a slow, heavy squash to the outboard.

- Look for damaged parts and loosened nuts and bolts in both the steering and mounting systems. Replace damaged parts.

Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety

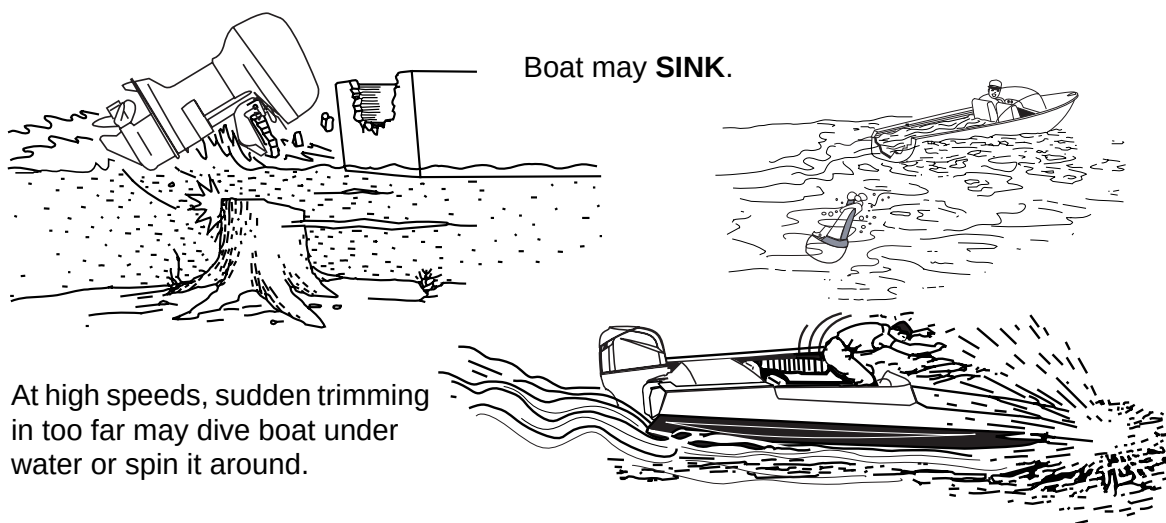
What is most important?

- Shock absorption system must always be ready to absorb some blows to the lower parts of the outboard.
- Outboard must not trim in too far suddenly.



What can happen?

Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.

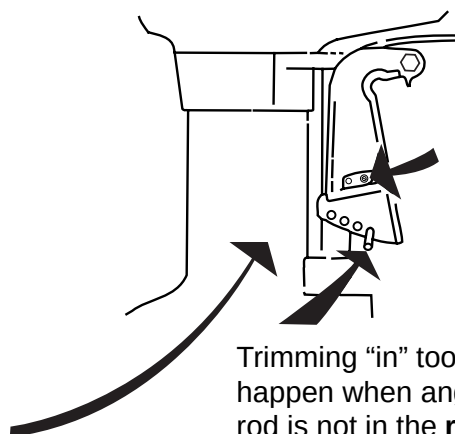


Boat may **SINK**.

At high speeds, sudden trimming in too far may dive boat under water or spin it around.

How can possible conditions be minimized?

- **Read, understand, and follow** manufacturer's **instructions**.
- Follow warnings marked "⚠" closely.
- Test your work whenever possible.
- If oil leaks are seen in service areas, determine source. Keep reservoir filled.
- If outboard is hydraulic tilt/trim model, always return rod to hole position determined by boat operator and make sure angle adjusting rod retain is in locked position.

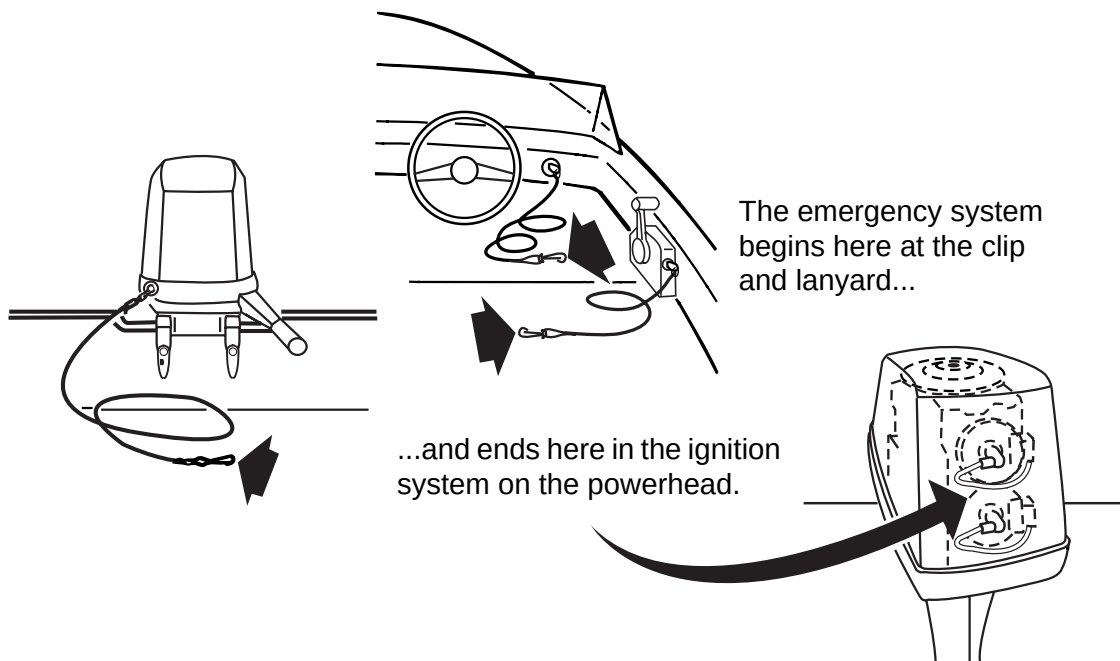


Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

If left open, outboard has no shock protection.

Trimming "in" too far can happen when angle adjusting rod is not in the **right** hole or is not in **any** hole (lost).

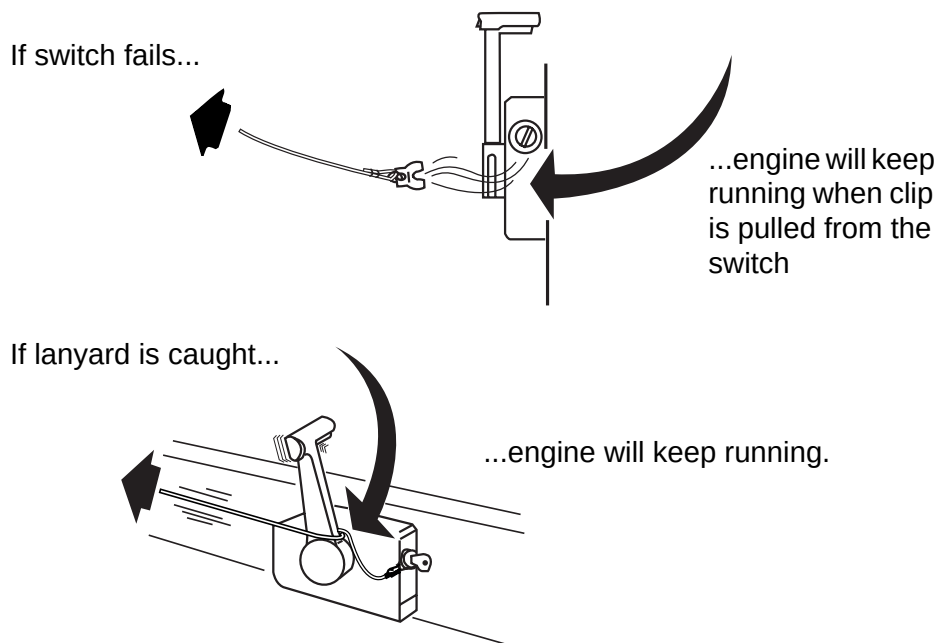
Outboard Emergency Stop System and Safety



What is most important?

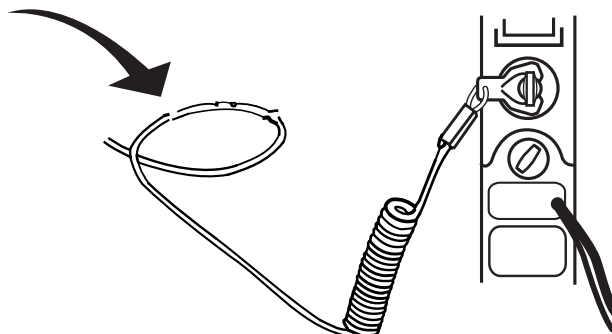
- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

What could happen?

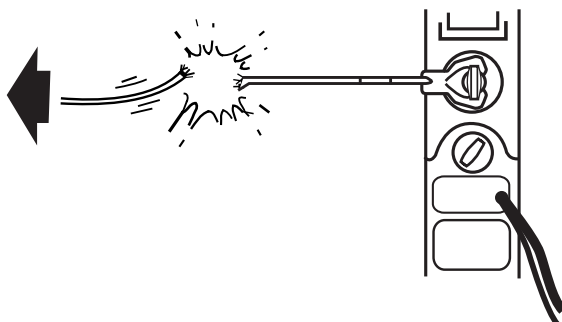


What could happen?

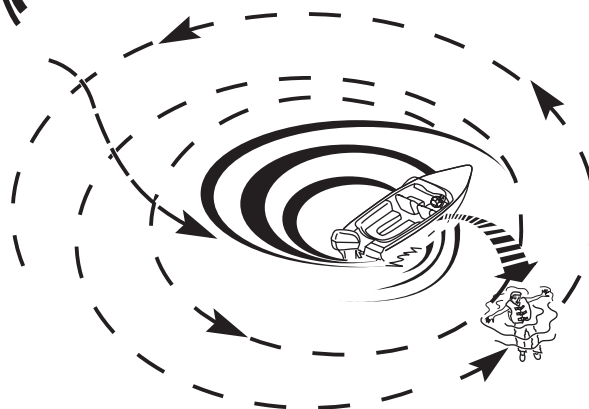
If lanyard is cut or frayed...



...lanyard or clip may break when pulled...



If engine does **NOT** stop when lanyard is pulled, an operator thrown from the boat could be hit as boat circles area. Or, boat may not turn but leave area as a runaway. Operator may drown and boat **WILL** run into something.



How can failure of the emergency stop system be minimized?

When rigging or after servicing

- Read, understand, and follow manufacturer's instructions
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.
- Locate control box and other items in area to keep lanyard from being caught.
- **ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.**

Summing up

Now you know some things that can take the joy out of boating.

No doubt about it—proper safety takes time!

- Reading and understanding instructions
- Re-reading warnings marked “⚠”
- Putting parts together correctly
- Making correct adjustments
- Testing your work

And making sure

- Worn or damaged parts are replaced
- Replaced parts are like originals in every way
- Customer is told of things which need attention

But, do you really want the alternative?

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO FIX THEM

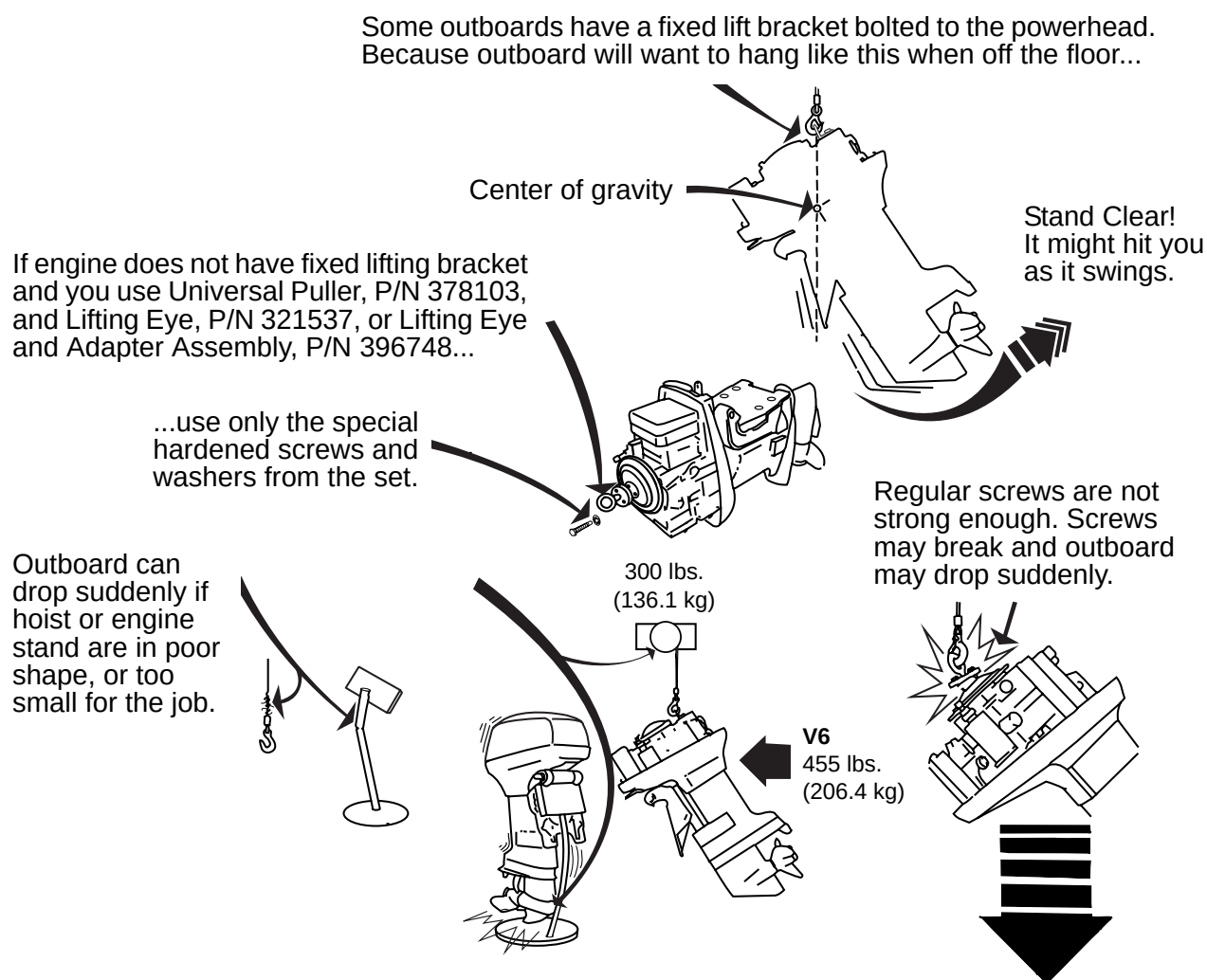
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

When lifting outboards

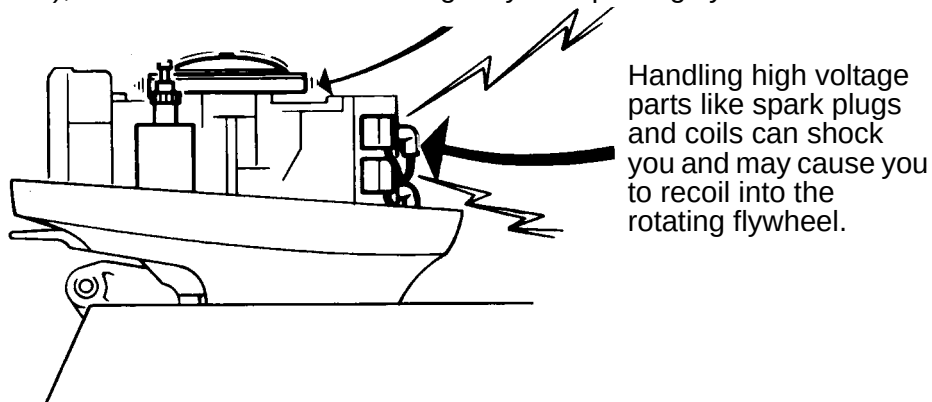


- Make sure shop aids have extra capacity, and keep them in good repair.

SAFETY

Running outboard with engine cover removed

Engine cover is a guard. When you remove cover/guard to work on the outboard, remember: loose clothing (open shirt sleeves, neckties), hair, jewelry (rings, watches, bracelets), hands and arms can be caught by the spinning flywheel.



- Two people working together on a live outboard must look out for each other. Never, ever, use the key to start the outboard before signaling your partner. He may be leaning over the outboard with hands on the flywheel, handling a “hot” electrical part, or near the propeller.

Outboard starting at the wrong time

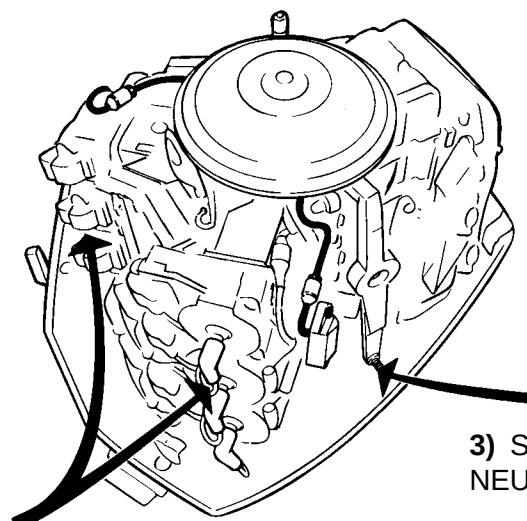
When you do things that turn the flywheel like:

- Off-season storage fogging (oiling) of outboard;
- Removing propeller with a powered tool;
- Electrical system checks;
- Servicing the flywheel; or
- Any other actions **ALWAYS...**

1) Turn key switch OFF

2) Twist and remove ALL spark plug leads

3) Shift to NEUTRAL



Check prop shaft. Is outboard really in NEUTRAL?

NO SPARK



NO START



NO SURPRISES

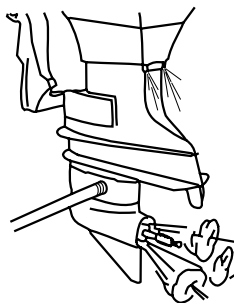
Running outboard too fast (Overspeeding)

- “Too fast” means running faster than outboard normally runs on boat.

Running too fast can happen when:

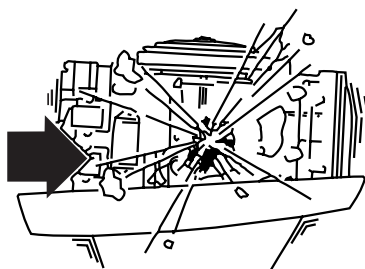
1) Using a flushing device...

Turn on water before starting outboard.
Keep engine speed below 2000 RPM.
With no load, outboard will run too fast
very easily. Wear eye protectors.



2) Running with the wrong test wheel...

This may happen if
outboard runs too fast.



Use the right
test wheel.

Running outboards: Exhaust fumes



DANGER



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

- Whenever running the engine, assure there is proper ventilation to avoid the accumulation of carbon monoxide (CO), which is odorless, colorless, and tasteless, and can lead to unconsciousness, brain damage, or death if inhaled in sufficient concentrations. CO accumulation can occur while docked, anchored, or underway, and in many confined areas such as the boat cabin, cockpit, swim platform, and heads. It can be worsened or caused by weather, mooring and operating conditions, and other boats. Avoid exhaust fumes from the engine or other boats, provide proper ventilation, shut off the engine when not needed, and be aware of the risk of backdrafting and conditions that create CO accumulation. In high concentrations, CO can be fatal within minutes. Lower concentrations are just as lethal over long periods of time.

Running outboards: Propellers



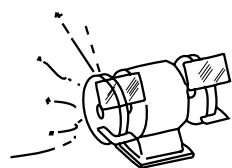
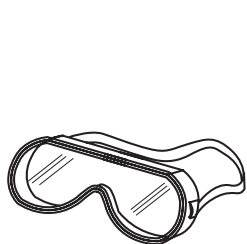
DANGER



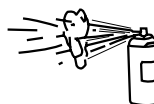
Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue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

Eye protection

Eyes need protection when:



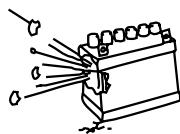
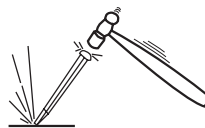
- Grinding



- Spraying cleaners and paints

- Chiseling

Tip: When steel on steel, use plastic- or brass-type hammers. They don't chip off as easily as steel hammers.



Protect eyes from:

- Acid

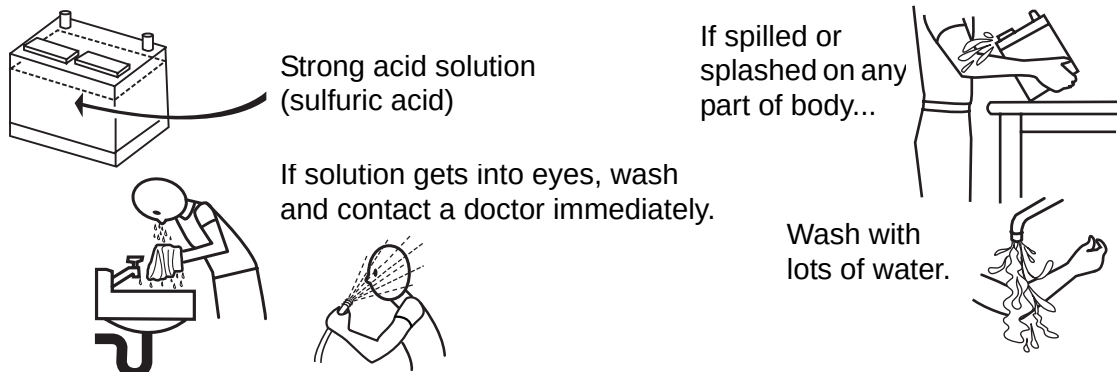


- Ends of cables

**Wear
Safety
Glasses**

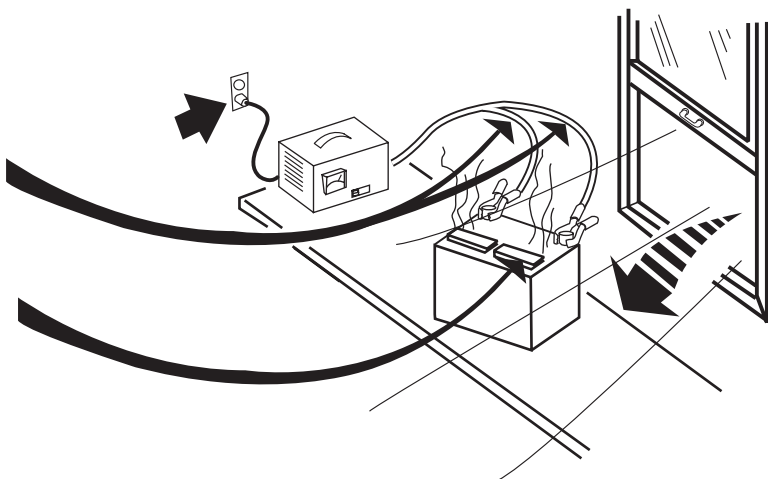


Handling Lead/Acid Batteries



Charging lead acid batteries

- 1) Attach and remove these cables with charger **UNPLUGGED** from 110 V wall socket. (This prevents shocks if charger is defective.)
- 2) Observe correct polarity when connecting these larger leads.
- 3) Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. **Make sure vents are open.** If clogged, pressure inside may build. Battery may **EXPLODE**.



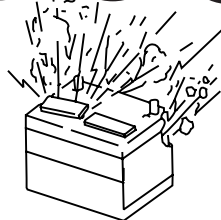
Battery gas is explosive!

While charging or discharging, remember:

- No smoking
- No flames
- No sparks



Never remove charger cables from battery posts. It is a sure way to make a lot of sparks in an area surrounded by battery gas.



DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.



After charging:

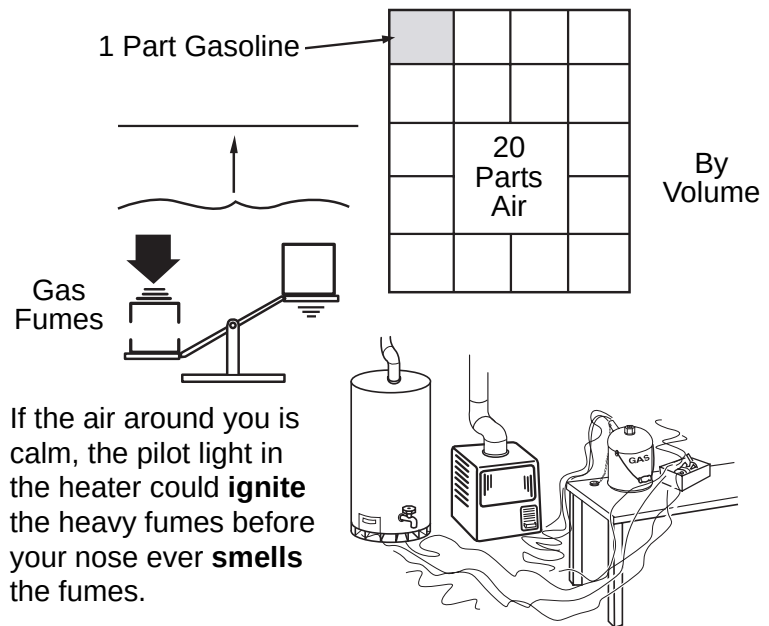
- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

Gasoline – Handle With Care!

Gasoline vapor and air mixtures explode easily and violently when mixed as shown...

When you smell ANY odor of gasoline, explosion is possible.

Gasoline fumes are heavy and will sink to the lowest point in the boat or room and will STAY there, WAITING...



What can you do?



Store gasoline in sturdy, approved, sealed gas can and keep outside.

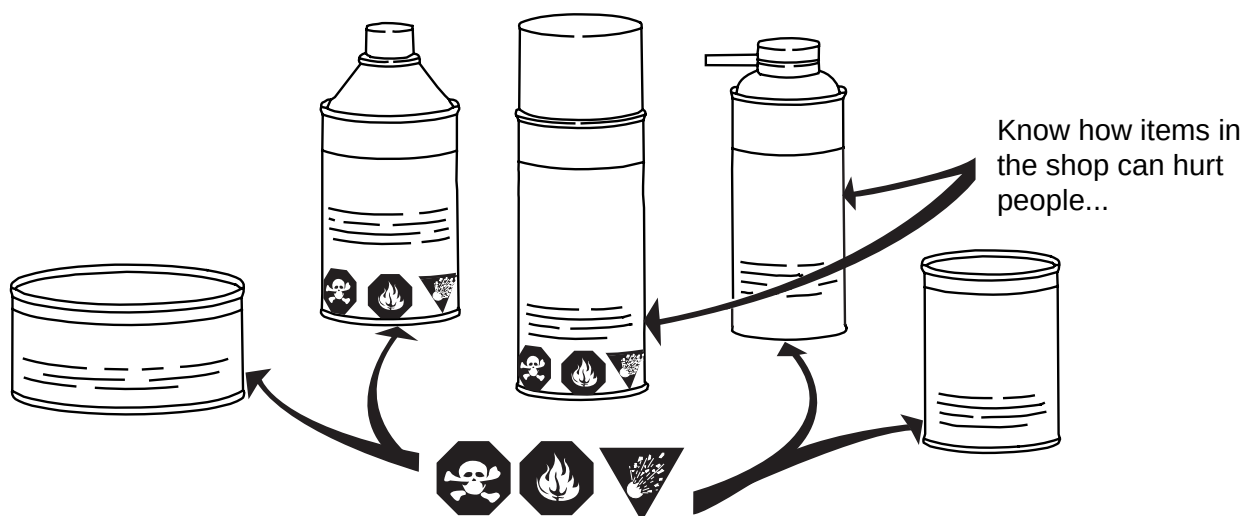
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel **ONLY**, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **immediately**:
 - Put out open flames, cigarettes, sparking devices;
 - Wipe up spill or leak;
 - Get towels and rags outside fast;
 - Open doors and windows; and
 - Check **lowest** area for fumes.

Be aware of items in and around repair area which can ignite fumes. Control them if fumes are smelled.

- Matches, cigarettes, blow torches, welders
- Electric motors (with unsealed cases)
- Electric generators (with unsealed cases)
- Light switches
- Appliance pilot lights or electric ignitors (furnace, dryer, water heaters)
- Loose wires on running outboards
- Other variables which may ignite fumes

How many of these are in your repair area?

Hazardous Products

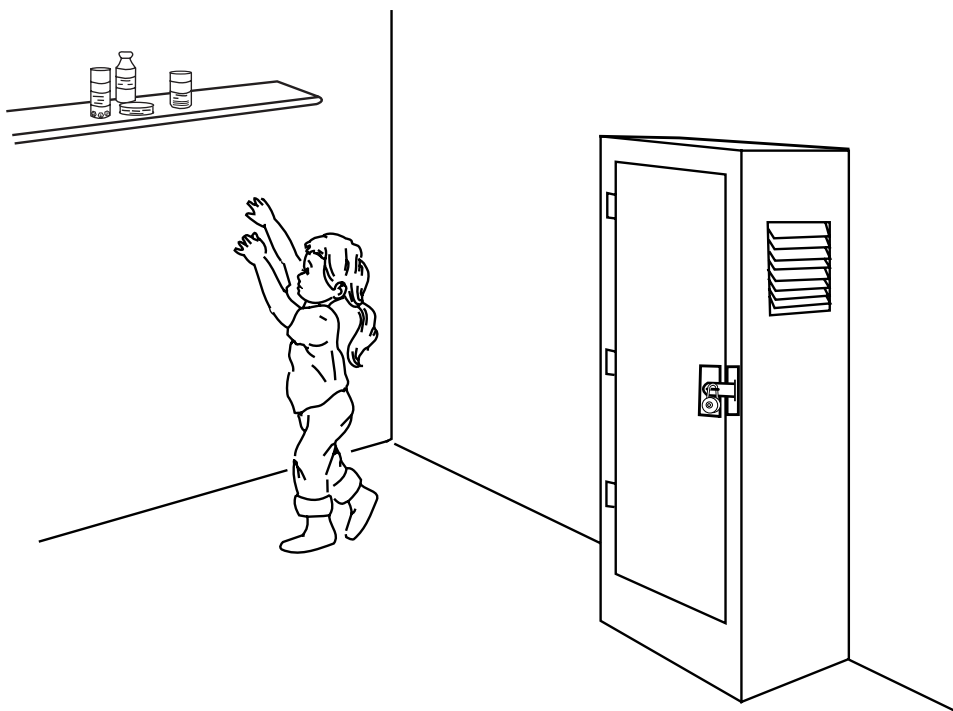


READ

- "How and where to use"
- "How to give First Aid." Have recommended First Aid materials on hand should an emergency arise
- "How to dispose of can"

It's all on the **back of the can or bottle label**.

And remember: Little children are very curious and will try to taste everything so **keep containers away from children!**



Safety Awareness Test

The Technician's Safety Awareness Test....

- 1)** Did you read this Safety section from page S–1 to page S–24?
- 2)** Are you ready to take responsibility for the safe maintenance practices and procedures of your repair shop, co-workers, and technicians?
- 3)** Do you understand all the safety precautions and instructions contained in this entire service manual?
- 4)** Will you follow all safety warnings, precautions, instructions and recommendations outlined in this service manual?
- 5)** Do you understand that the service manual as a whole and this Safety section, in particular, contain essential information to help prevent personal injury and damage to equipment and your customers?
- 6)** Have you received training related to common shop safety practices to protect yourself and others around you?
- 7)** When replacement parts are required, will you use *Evinrude®/Johnson® Genuine Parts* or parts with equivalent characteristics, including type, strength and material?
- 8)** Are you ready to follow the recommendations in this service manual before you service any boat or outboard?
- 9)** Do you understand that safety-related accidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?

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