2007 Service Manual

25 HP

Johnson® 4 Stroke

Johnson® BRP

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

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Ultra™ *4-Stroke* Outboard Oil
HPF XR™ Gearcase Lubricant
Ultra Lock™

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SAFETY INFORMATION

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

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

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

⚠ DANGER ⚠

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

⚠ WARNING ⚠

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

⚠ CAUTION ⚠

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

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

These safety 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

CONTENTS

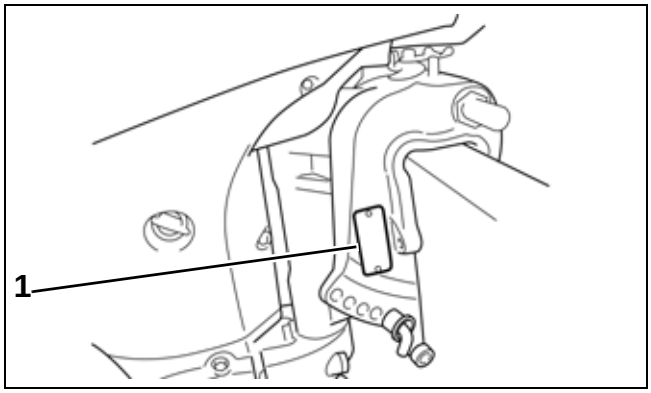
MODELS COVERED IN THIS MANUAL

This manual covers service information on *Johnson* 25 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.

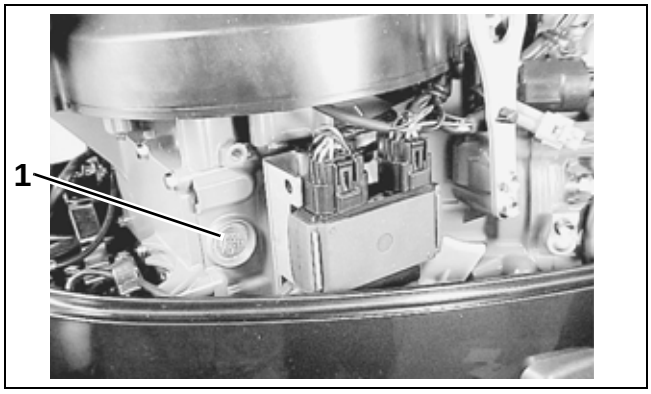
Model Number	Start	Shaft	Steer
J25R4SUR	Rope	15 in.	Tiller
BJ25R4SUC	Rope	15 in.	Tiller
J25RL4SUR	Rope	20 in.	Tiller
BJ25RL4SUC	Rope	20 in.	Tiller
J25TE4SUR	Electric	15 in.	Tiller
BJ25TE4SUC	Electric	15 in.	Tiller
J25TEL4SUR	Electric	20 in.	Tiller
BJ25TL4SUC	Electric	20 in.	Tiller
J25E4SUR	Electric	15 in.	Remote
BJ25E4SUC	Electric	15 in.	Remote
J25EL4SUR	Electric	20 in.	Remote
BJ25EL4SUC	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.

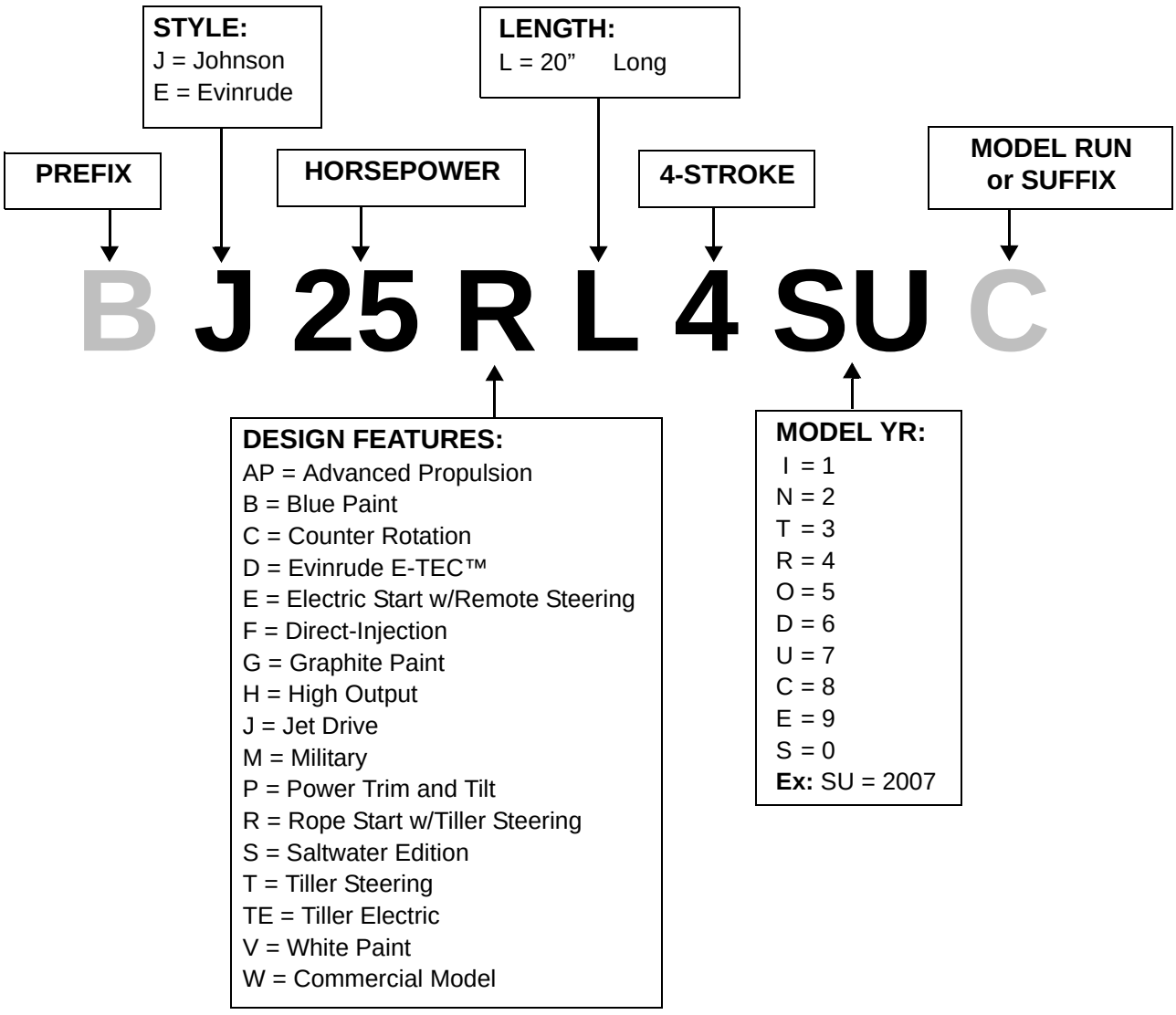


Starboard Stern Bracket 005520
1. Model and serial number

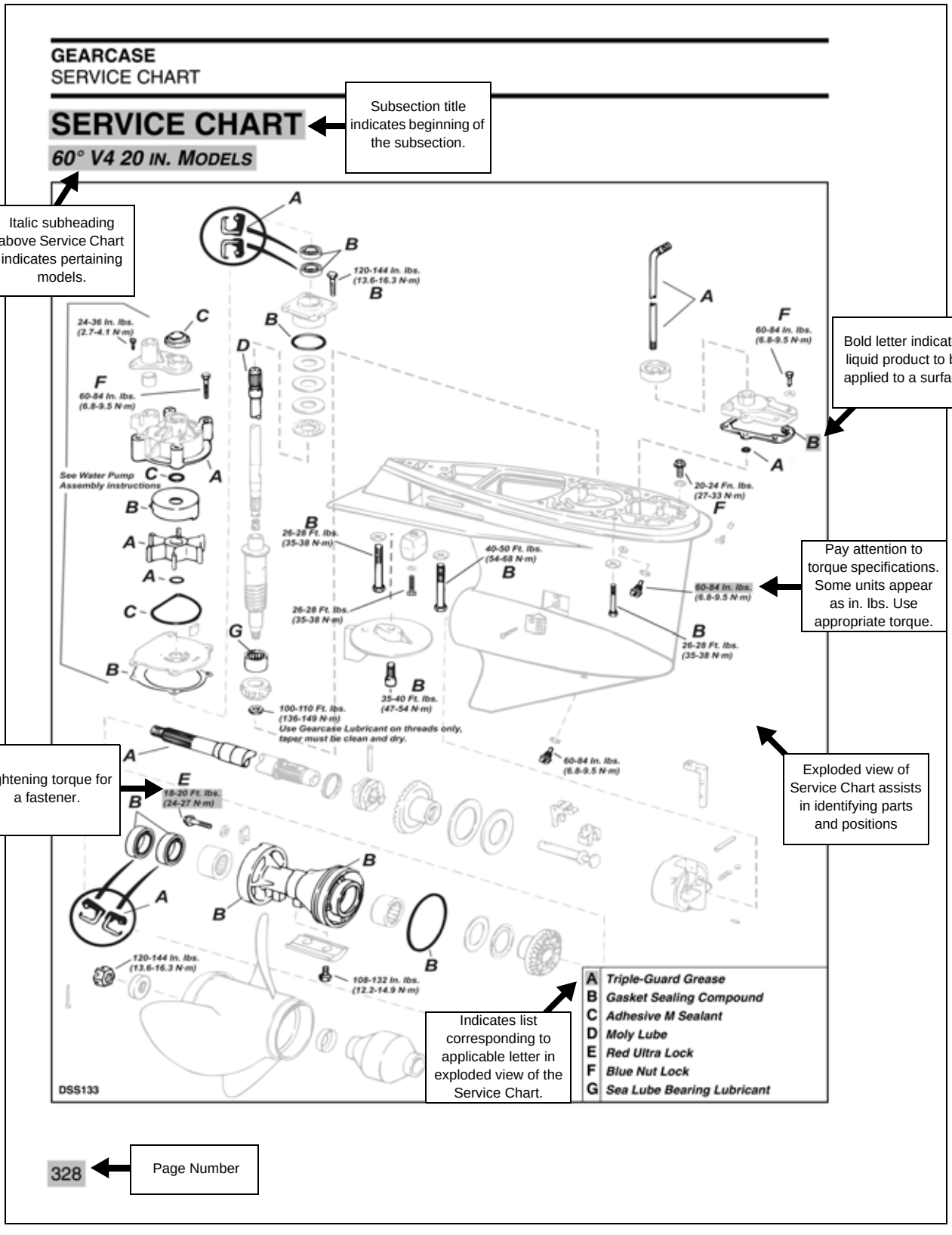


Powerhead 005521
1. Serial number

MODEL DESIGNATION



TYPICAL PAGE – A



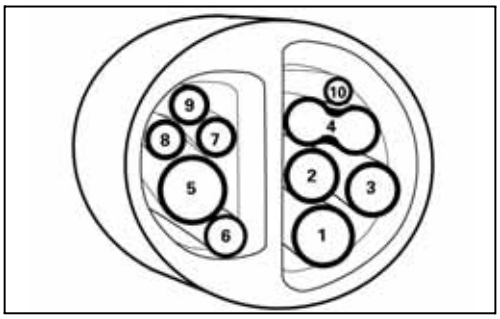
TYPICAL PAGE – B

Section Title → **INSTALLATION AND PREDELIVERY**
Subsection Title → OUTBOARD RIGGING PROCEDURE

Cable, Hose, and Wire Routing

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

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



000084

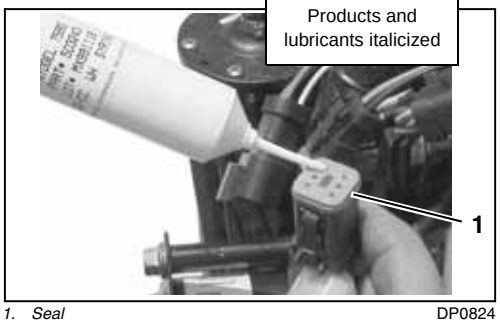
1. *Fuel supply hose*
2. *Oil return hose*
3. *Oil supply hose*
4. *Battery cables*
5. *Main wire harness (MWS)*
6. *Throttle cable*
7. *Shift cable*
8. *Oil tank sending unit harness*
9. *Water pressure hose*
10. *Accessory charge wire*

Model specific illustrations designated with image captions

Connect outboard main wire harness to boat main wire harness.

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

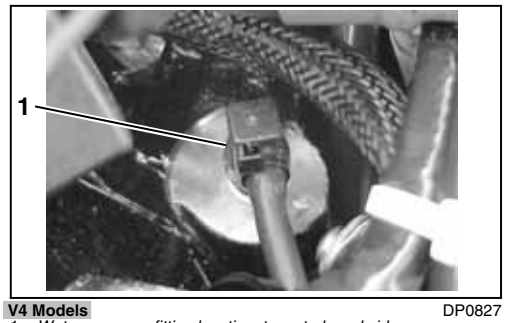
Products and lubricants italicized



1. *Seal* DP0824

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

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



V4 Models DP0827

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

V6 Models DP0828

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

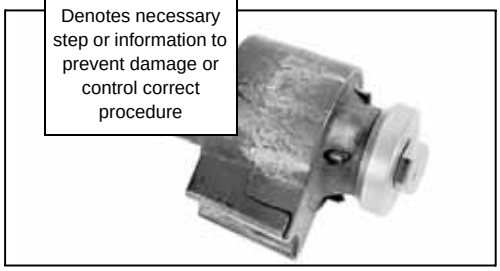
If temperature gauge is to be used, route sending unit wire through grommet with hose for water pressure gauge. Follow the path of battery cables. Provide adequate length to reach cylinder head. Refer to installation instructions supplied with gauge.

TYPICAL PAGE – C

POWERHEAD
INSTALLATION

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

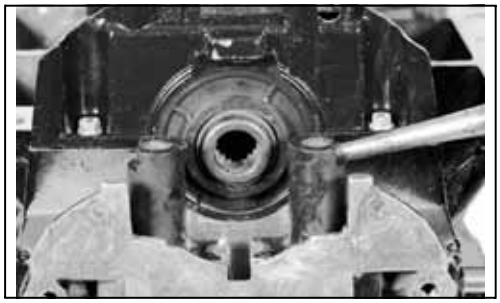
Denotes necessary step or information to prevent damage or control correct procedure



39820

Installation

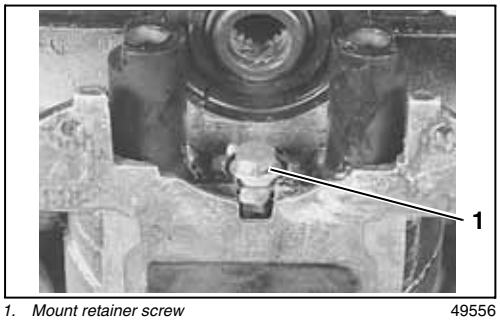
Place mount assemblies in position, with flats facing away from each other.



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

INSTALLATION

Title in italics indicates a procedure concerning a particular model

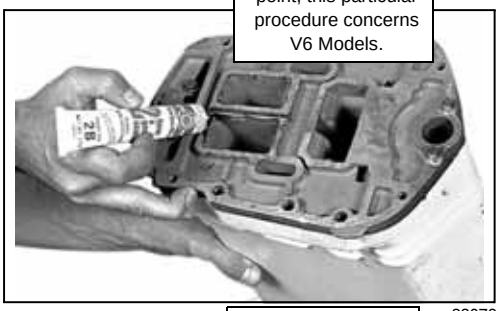
V4 MODELS

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

V6 MODELS

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

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

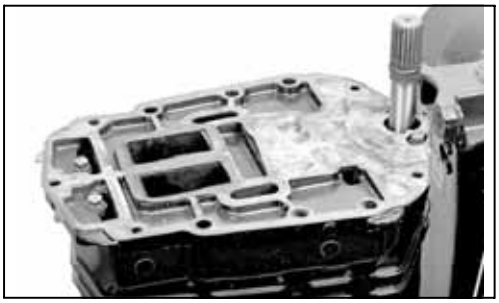


23079

Title indicates from this point, All Models are concerned

ALL MODELS

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



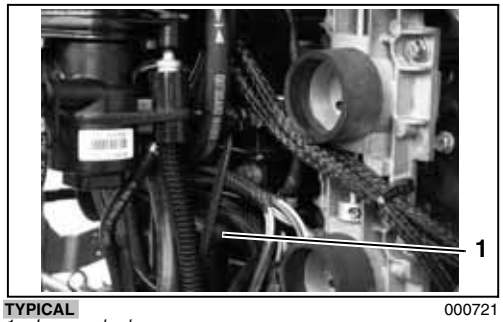
23497

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

TYPICAL PAGE – D

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

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



TYPICAL 000721
1. Lower pulse hose

Typical illustration for lower pulse hose of V4 or V6 Models

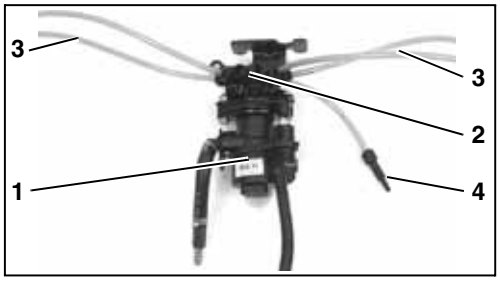
ctor-Manifold

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

Oil Injector-Manifold Components

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

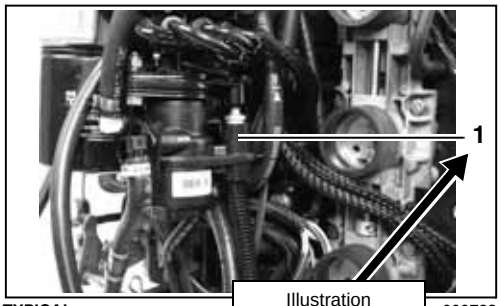
Cross references direct readers to related topics



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

Oil Pressure Switch

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



TYPICAL 000723
1. Oil pressure switch

Illustration components numbered to correspond to image

The switch opens or clo llowing oil manifold pressures:

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

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

Service Code 38

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

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

Service Code 39

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

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

Section tabs allow for quicker reference when thumbing through manual

ABBREVIATIONS USED IN THIS MANUAL

Units of Measurement

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

List of Abbreviations

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

PRODUCT REFERENCE AND ILLUSTRATIONS

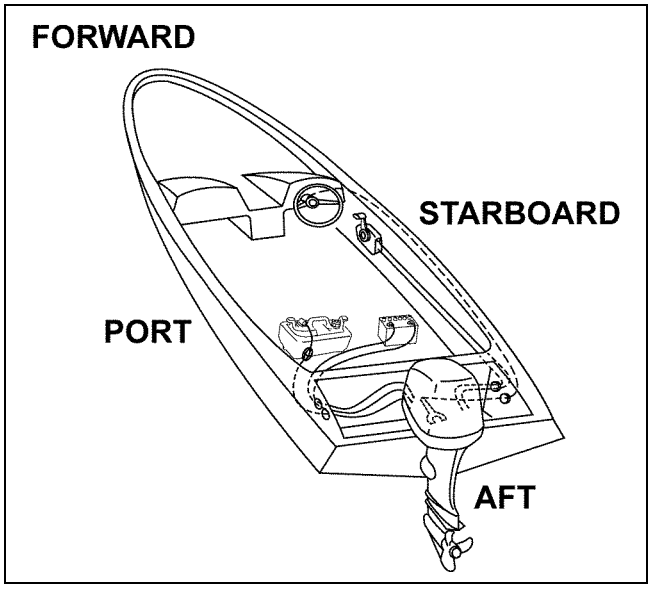
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of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

The continuing accuracy of this manual cannot be guaranteed.

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

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

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



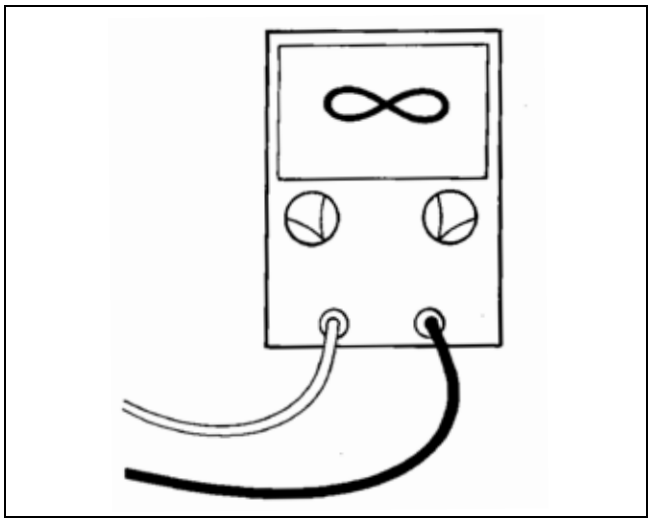
Nautical Orientation

SYMBOLS

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

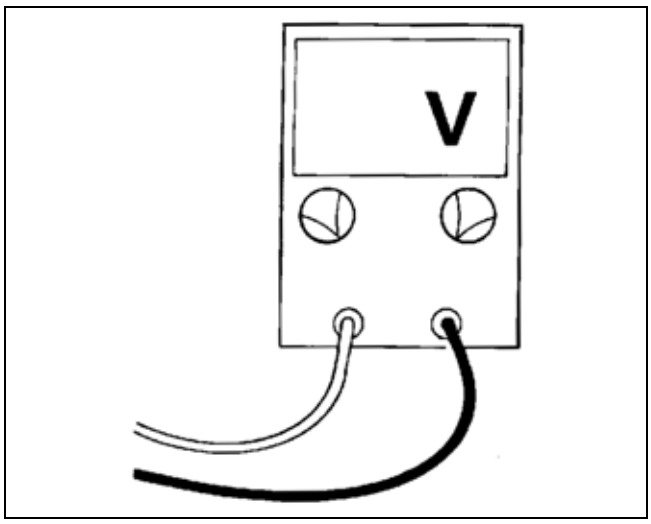
Electrical

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



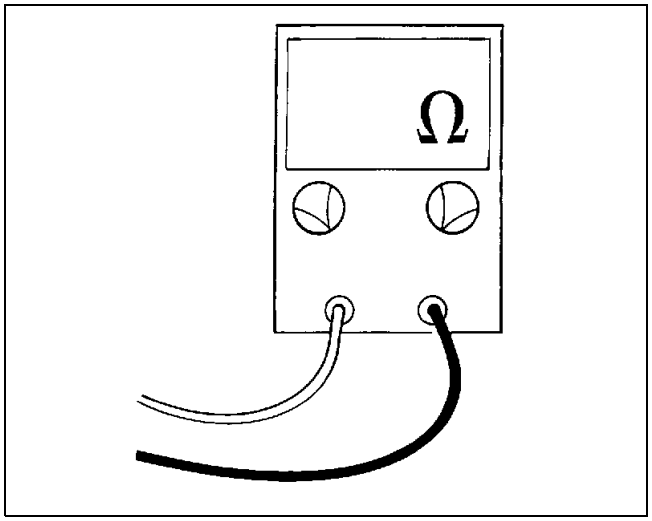
DR4203

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



DR4204

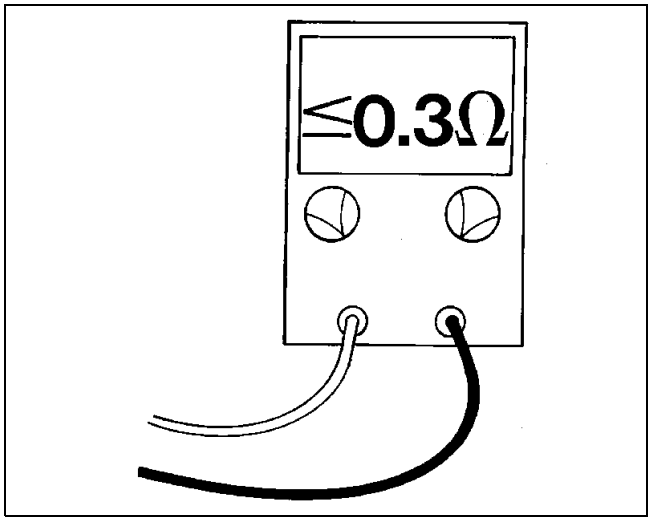
When "Ω" follows a value on the meter face, the procedure is measuring resistance. Ω is the symbol for ohm, the unit of measurement for resistance.



DR4205

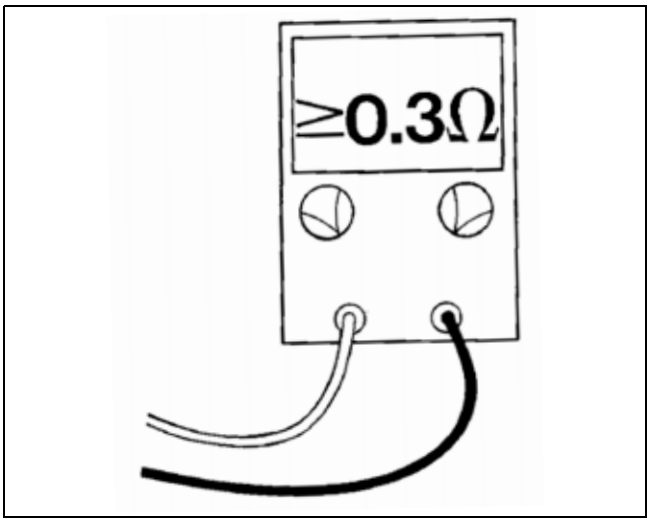
Values

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



DR4206

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



DR4207

SERVICE SPECIFICATIONS AND SPECIAL TOOLS

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TECHNICAL DATA

	HP	25
ENGINE	Full Throttle Operating Range RPM	4700-5300
	Power	25 HP (18.4 kw) @ 5000 RPM
	Idle RPM	900 to 1000 in gear 950 to 1050 in neutral
	Weight	**(R) Models:** 152 lbs. (69 kg) **(RL) Models:** 159 lbs. (72 kg) **(TE) Models:** 161 lbs. (73 kg) **(TEL) Models:** 168 lbs. (76 kg) **(E) Models:** 154 lbs. (70 kg) **(EL) Models:** 161 lbs. (73 kg)
	Lubrication	*Evinrude/Johnson Ultra 4-Stroke* outboard oil Refer to **Oil Requirements** on p. 40.
	Oil Capacity	1.6 quartt (1.5 liter) – Oil change only 1.9 quart (1.8 liter) – Oil/filter change
	Engine Type	4-Stroke OHC 2-cylinder V
	Displacement	32.8 cu. in. (538 cm^3)
	Bore	2.80in. (71 mm)
	Stroke	2.68 in. (68 mm)
	Compression ratio	9.3:1
FUEL SYSTEM	Carburetion	One single-throat carburetor, float feed
	Main Jet	#135
	Main Air Jet	#155
	Pilot Jet	#48
	Low-Speed Setting	PRE-SET (2-3/4 ± 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 *Evinrude/Johnson* recommended fuel additives. The use of other additives may result in engine damage.
		See **Fuel Requirements** on p. 39 for additional information.

	HP	25
ELECTRICAL	Alternator	6 Amp, Regulated (Rope Start) 15 Amp, Regulated (Electric Start)
	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	5500 RPM
	Spark Plugs	*NGK*† BKR6E @ 0.030 in. (0.76 mm)
	Ignition Timing	2° BTDC @ 1000 RPM
GEARCASE	Gear Ratio	11:23 (2.09:1)
	Lubricant	*HPF XR Gearcase Lube*
	Capacity	14.2 fl. oz. (420 ml)

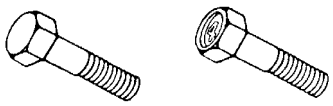
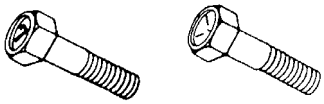
STANDARD TORQUE SPECIFICATIONS

Tightening Torque – Important Fasteners

ITEM	THREAD DIAMETER	TIGHTENING TORQUE		
		N·m	kg-m	lb-ft
Cylinder head cover bolt	6 mm	10	1.0	7.2
Cylinder head bolt	10 mm	55	5.5	39.8
Crankcase bolt	8 mm	23	2.3	16.6
	10 mm	50	5.0	36.2
Conrod cap bolt	7 mm	12	1.2	8.7
Rocker arm pivot bolt	8 mm	23	2.3	16.5
Valve adjusting lock nut	6 mm	11	1.1	8.0
Oil pressure switch	—	13	1.3	9.5
Oil relief valve spring retainer	16 mm	28.5	2.9	21.0
Intake manifold bolt	8 mm	25	2.5	18.1
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
Flywheel bolt	16 mm	196	19.6	142
Starter motor mounting bolt	8 mm	23	2.3	16.5
Engine oil filter	—	14	1.4	10.0
Engine oil drain plug	12 mm	13	1.3	9.5
Power unit mounting bolt	8 mm	23	2.3	16.5
	10 mm	50	5.0	36.0
Water pressure valve cover bolt	6 mm	10	1.0	7.0
Driveshaft housing bolt	8 mm	23	2.3	16.5
Upper mount bolt/nut	10 mm	50	5.0	36.0
Upper mount cover bolt	8 mm	23	2.3	16.5
Lower mount bolt/nut	12 mm	64	6.4	46.3
Clamp bracket shaft nut	7/8-14UNF	43	4.3	31.0
Tilt stopper arm bolt	10 mm	18	1.8	13.0
Shallow drive arm bolt	10 mm	18	1.8	13.0
Tiller handle cover bolt	8 mm	23	2.3	16.5
Water pump case nut	6 mm	11	1.1	8.0
Gearcase bolt	8 mm	23	2.3	16.6
Propeller shaft bearing housing bolt	6 mm	10	1.0	7.2
Pinion nut	8 mm	18	1.8	13.0
Propeller nut	14 mm	24.5	2.5	18.0

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 ⟡ marked bolt)	10 mm	40 – 60	4.0 – 6.0	29.0 – 43.5

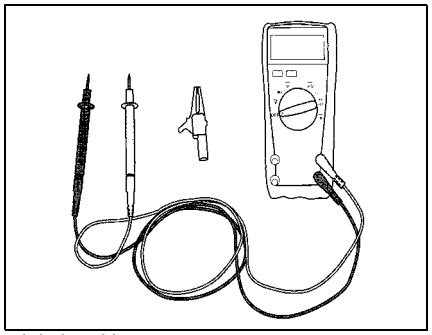
⚠ WARNING ⚠

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

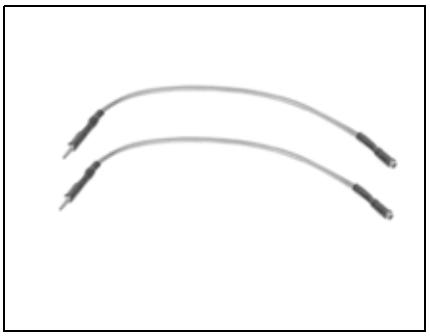


Digital multimeter DRC7265
Ohms resolution 0.01
Purchase through local supplier

CD Peak reading voltmeter 49799
P/N 507972

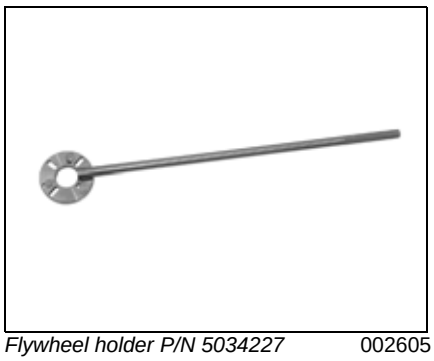
Multimeter, analog 49793
P/N 501873

Flywheel removal screws 002570
P/N 5034235

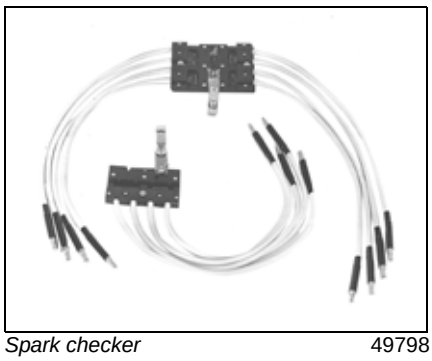


Wire harness adapter leads 40269
P/N 342228

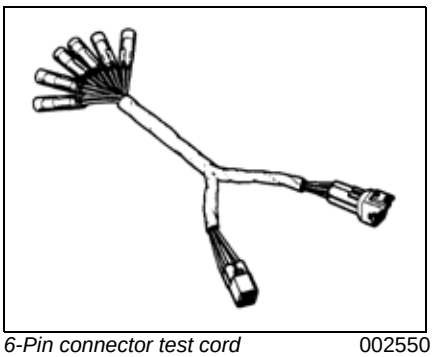
Tachometer/timing light 49789
P/N 507980



Flywheel holder P/N 5034227 002605



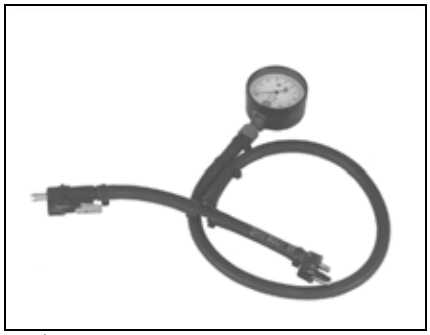
Spark checker 49798
P/N 508118



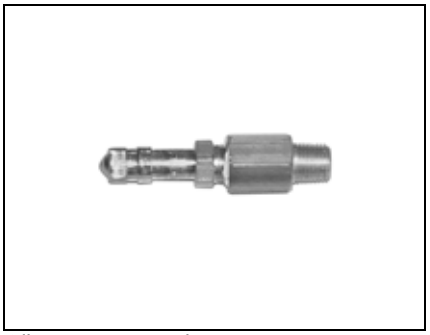
6-Pin connector test cord 002550
P/N 5034231

Fuel and Oil

Fuel/Oil pressure gauge 002275
P/N 5000902



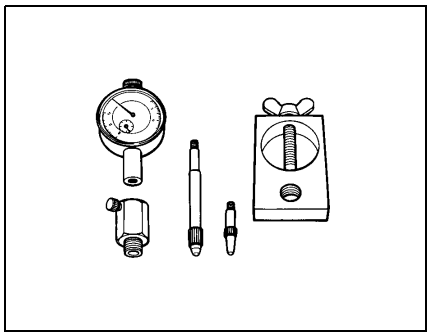
Fuel vacuum tester 23286
P/N 390954



Oil pressure test adapter 002623
P/N 350930

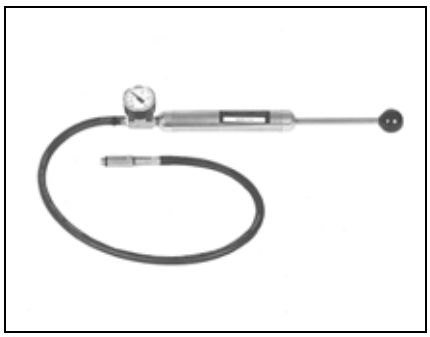
Gearcase

Gearcase filler 49790
P/N 501882



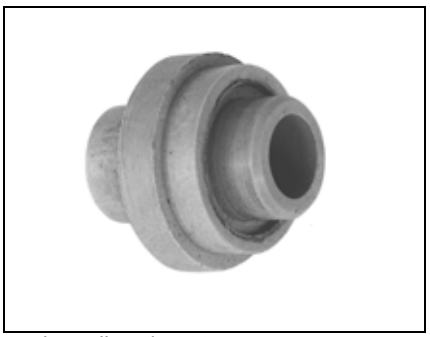
Dial indicator set

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)*

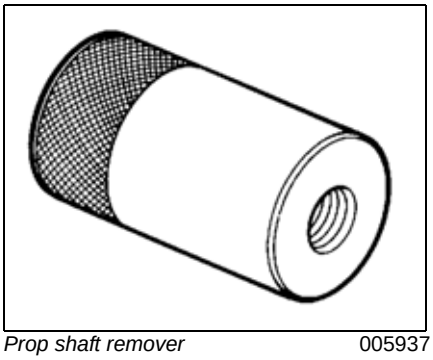
Universal pinion bearing remover 33974
and installer kits P/N 5005927
and P/N 5005928



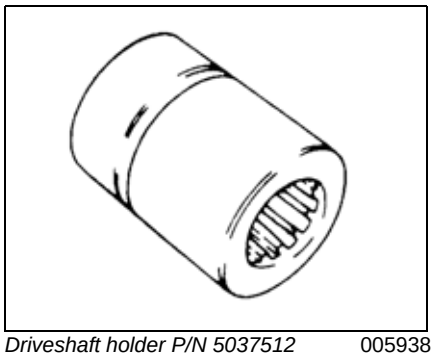
Seal Installer P/N 326545 23408

Bearing Installer P/N 5034774 002645

Bearing remover P/N 5034764 002646



Prop shaft remover 005937
P/N 5034762

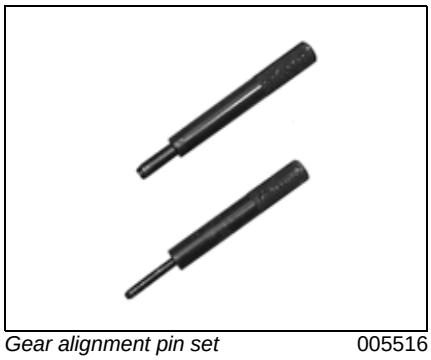


Driveshaft holder P/N 5037512 005938

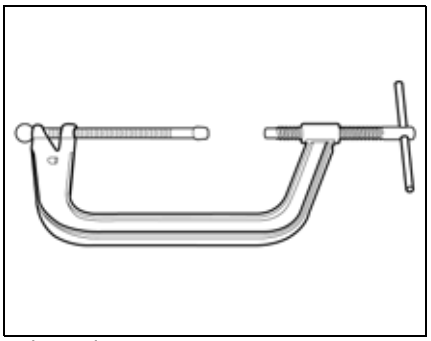
Installer handle 002575
P/N 345822

Powerhead

Cylinder bore gauge 45303
P/N 771310



Gear alignment pin set 005516
P/N 5037488

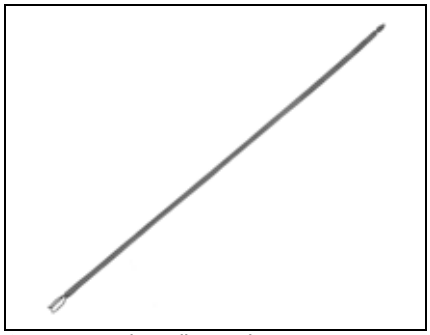


Valve spring compressor DRC50025
P/N 346186

Crankshaft remover / installer 005518
P/N 5037487

Valve lifter adapter kit 002625
P/N 5000899

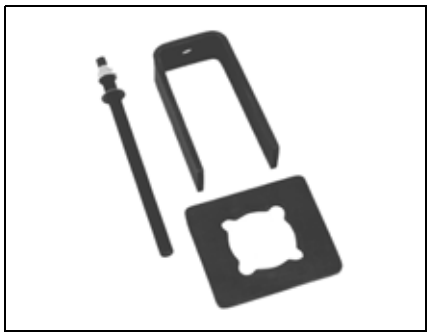
Starter



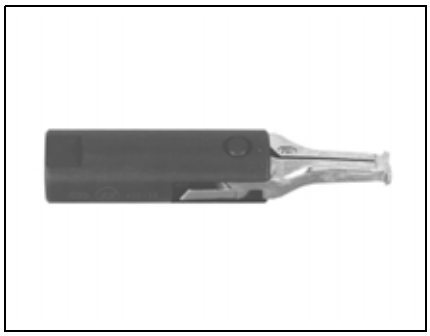
Starter rope threading tool 23682
P/N 387784

Starter spring winder/installer CO3583
P/N 392093

Universal

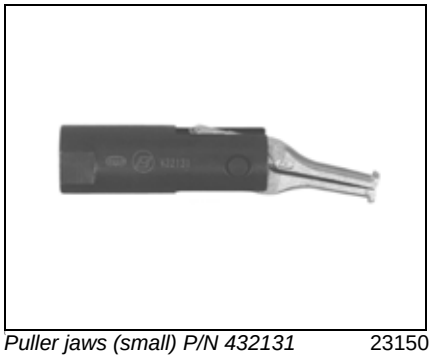


Puller Bridge P/N 432127 23146

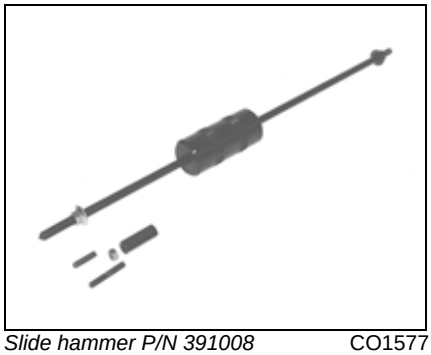


Puller jaws (bearing) P/N 432130 23149
(replacement jaws P/N 437953)

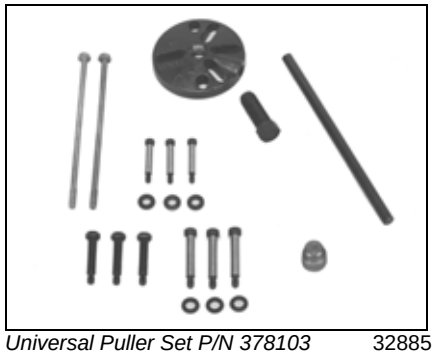
Temperature gun P/N 772018 45240



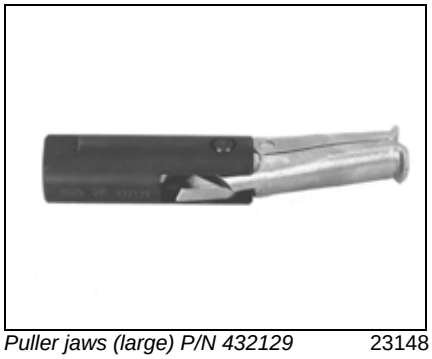
Puller jaws (small) P/N 432131 23150
(replacement jaws P/N 437952)



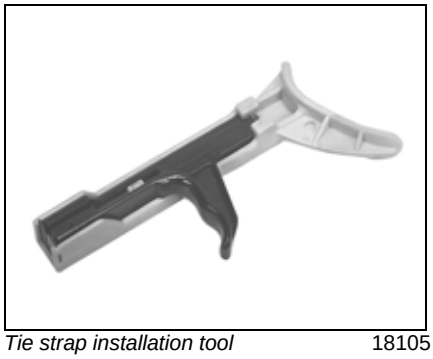
Slide hammer P/N 391008 CO1577



Universal Puller Set P/N 378103 32885



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



Tie strap installation tool 18105
P/N 323716

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

Moly Lube P/N 175356

Needle Bearing Grease, P/N 378642

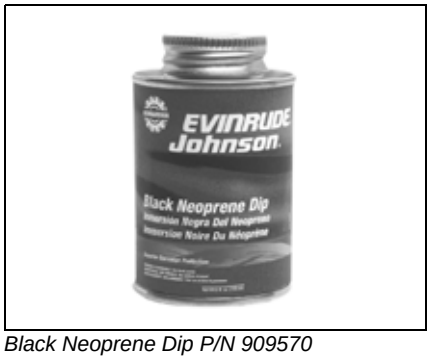
Starter Bendix Lube P/N 337016

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

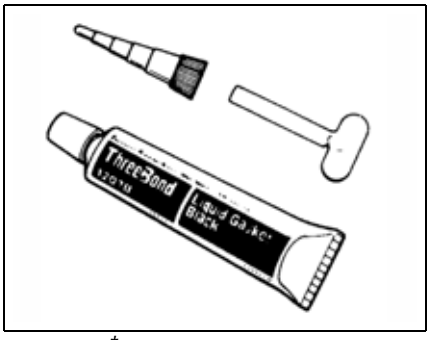
Electrical Grease P/N 504824

2 + 4™ Fuel conditioner P/N 775613

Fuel System Cleaner P/N 777184

Carbon Guard™ P/N 775629

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

TABLE OF CONTENTS

BOAT RIGGING

Remote Controls

Control Selection

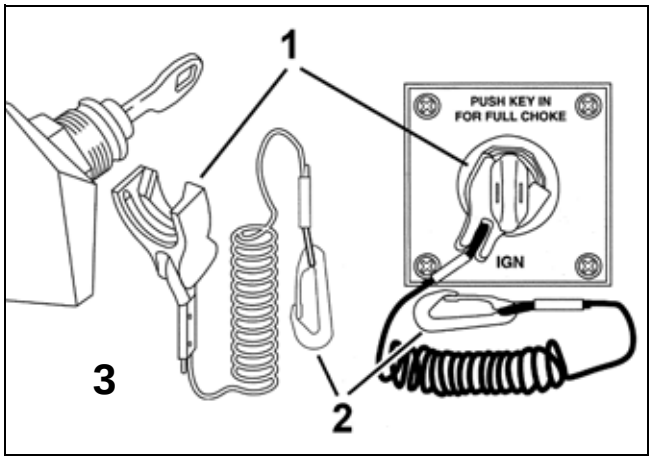
⚠ WARNING ⚠

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

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

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

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



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

Additional remote control information:

- 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.

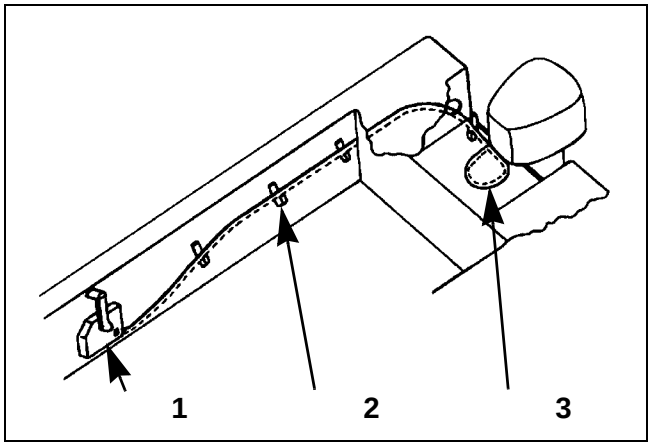
Installation Guidelines

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 DR4277
2. Cable support
3. 12 in. (30 cm) cable loop at front of outboard

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.

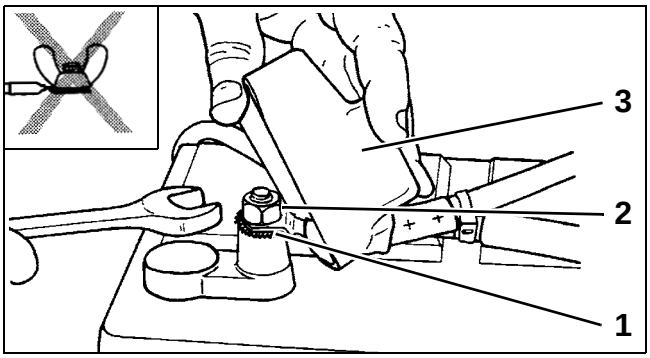
⚠ WARNING ⚠

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 DR5103
1. *Starwasher*
2. *Hex nut*
3. *Terminal Insulator*

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

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

Battery Cable Requirements

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

Specialized outboard installations with extended length battery cables require an increased wire size. Refer to the 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. (0.3 to 3 m)	11 to 15 ft. (3.4 to 4.6 m)	16 to 20 ft. (4.9 to 6.1 m)
25 HP	6 Gauge	4 Gauge	3 Gauge

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

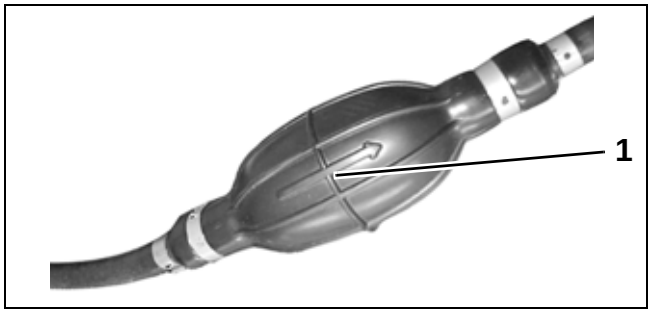
Outboards require a priming system capable of refilling the fuel system after periods of non-use.

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.



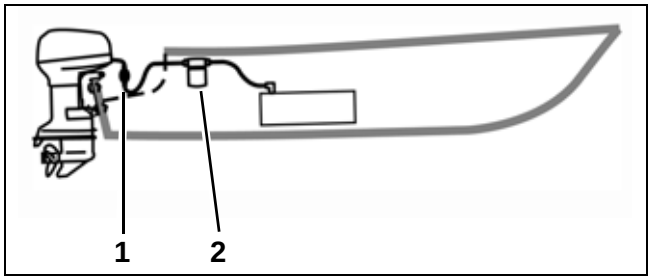
1. Arrow indicates direction of fuel flow 000124

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 001151
1. Primer bulb
2. Fuel filter (optional)

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.

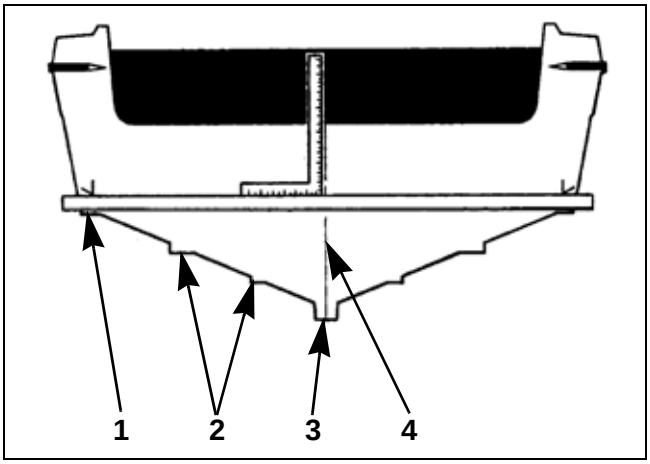
Transom Measuring and Drilling

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* DR5568
2. *Strake*
3. *Keel*
4. *Hull centerline*

Transom Heights

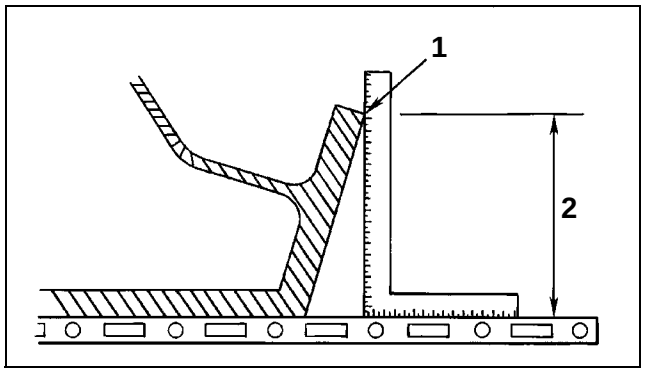
Make sure the transom height is consistent with the height of the outboard to be installed.

- 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* DR5541
2. *Actual transom height*

Transom Drilling Locations

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

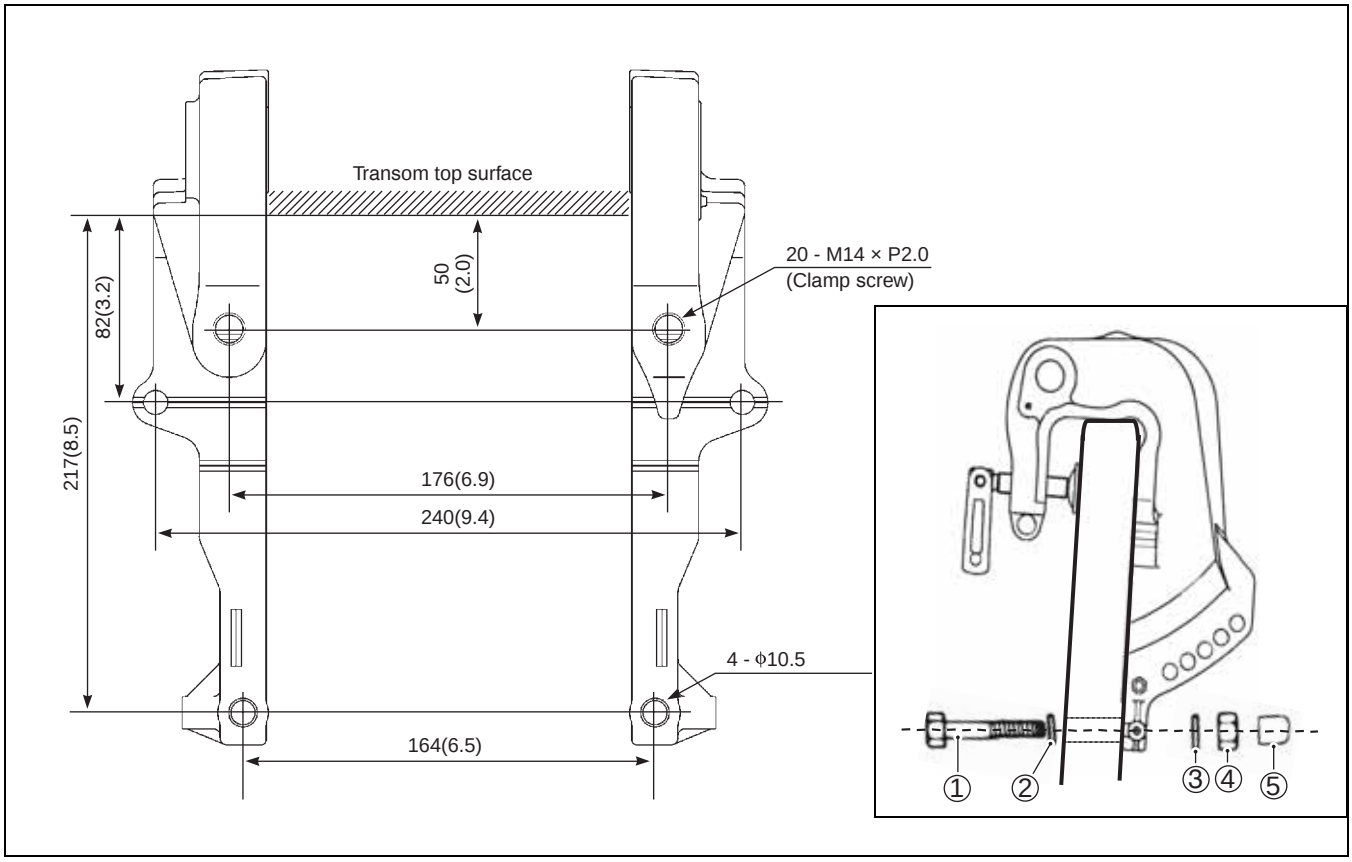
Center the outboard on the transom (or mounting bracket) and tighten clamp screws by hand. An accessory transom plate is recommended to protect the transom.

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

Drill one 7/16 in. (10 mm) hole for each side. The use of bolts in top holes is optional.

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

Drilling and Hardware Diagram

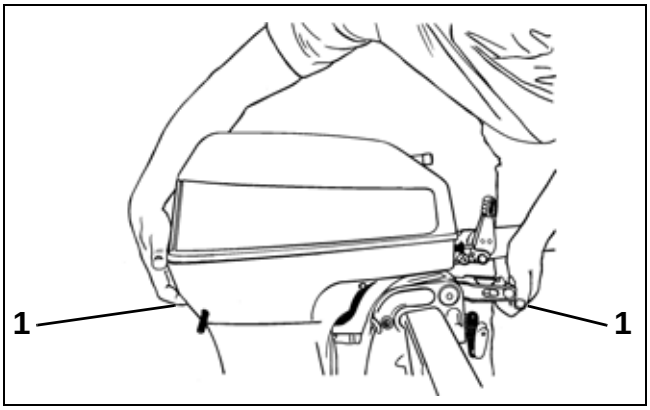


Item	Part name	Part Number	Quantity
1	Bolt - (M 10 x 110 mm)	5037005	2
2	Washer No. 1	5037006	2
3	Washer No. 2	5037164	2
4	Nut	5030054	2
5	Cap	5037004	2

- To ensure a water-tight outboard installation, silicon sealant should be applied to all bolt holes.
- If tightening torque cannot be reached to the specified torque due to weak transom material, it is necessary to reinforce the transom board with an attachment plate.

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 DR4661
1. Lift grips

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.

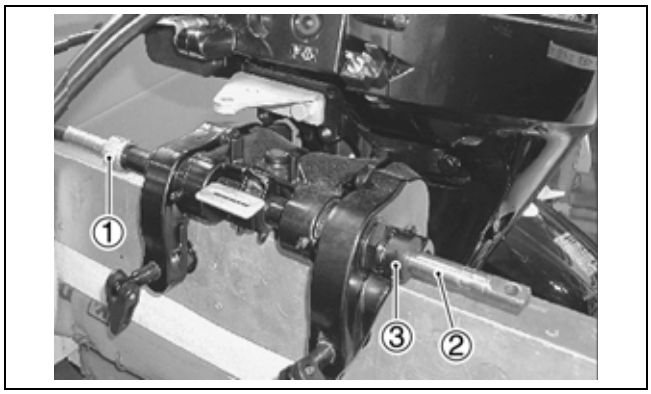
Dual-cable mechanical steering helps provide firm steering control at high speeds.

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.

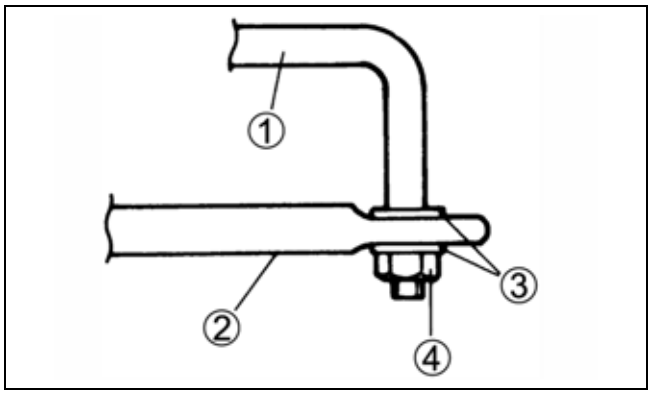
Apply *Triple-Guard* grease to cable and install cable wiper nut on tilt tube.



1. Cable nut 005894
2. Grease
3. Wiper nut

Drag Link

Connect drag link to the steering cable with washers and safety nut. Tighten the nut to 88 in. lbs. (10 N·m), then back the nut off 1/8 turn.



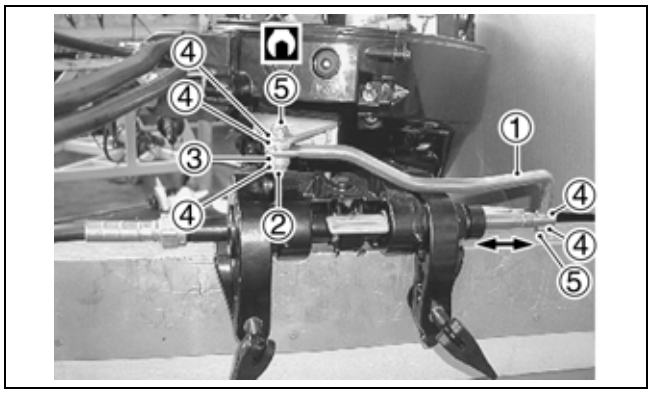
004824

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

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).



005903

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

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).

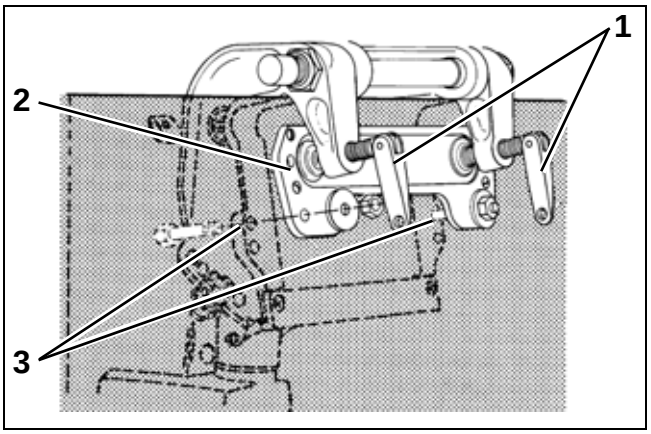
⚠ WARNING ⚠

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 29 ft. lbs. (40 N·m).



TYPICAL DR5815
1. *Clamp screws*
2. *Transom plate*
3. *Stern bracket holes*

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 ⚠

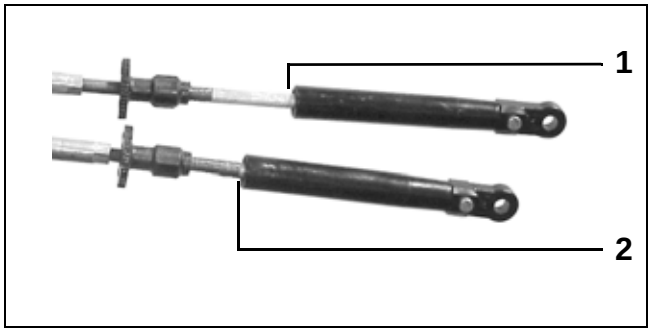
To prevent accidental starting of engine, confirm the battery cables are disconnected at battery and spark plug leads are disconnected from spark plugs.

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* DP0811
2. *Throttle cable casing guide retracted*

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

30501

Control Cable Installation

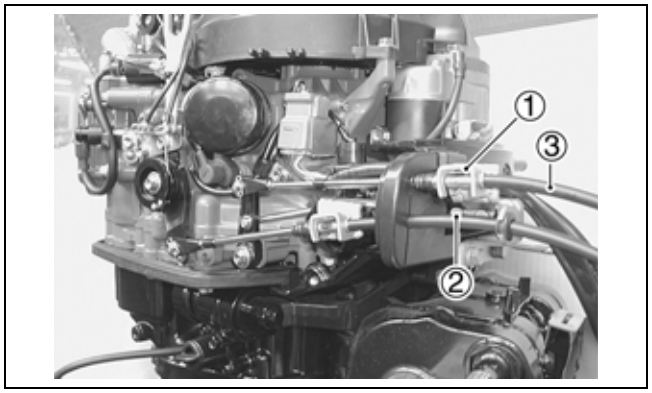
IMPORTANT: Provide sufficient slack at outboard end to permit unrestricted steering and tilting of outboard. Do not allow cables to bind.

Remove side covers. Refer to side cover **Removal and Installation** on p. 177.

Remove two screws and the shift cable holder.

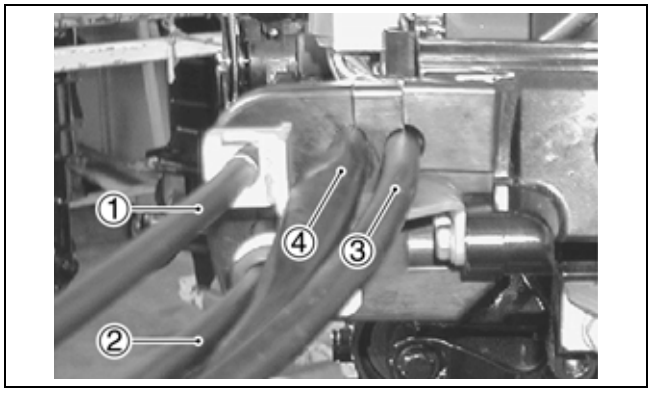
Insert the shift cable through grommet.

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



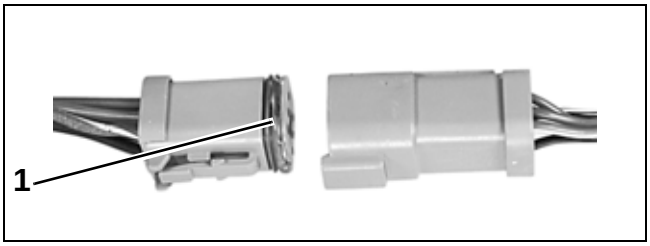
1. *Cable holder* 005904
2. *Screw*
3. *Shift cable*

Route cables through grommet as shown:



1. *Shift cable* 005905
2. *Throttle cable*
3. *Wire harness*
4. *Battery cable*

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

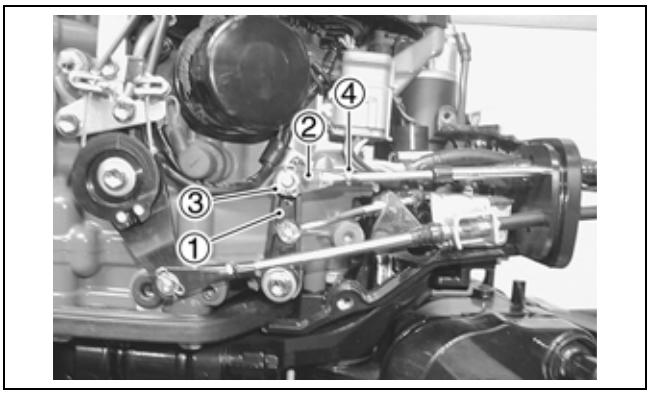
Secure connector of remote harness to engine wiring harness connector.

Shift Cable

Place remote control handle in NEUTRAL. Make sure that shift arm is in NEUTRAL.

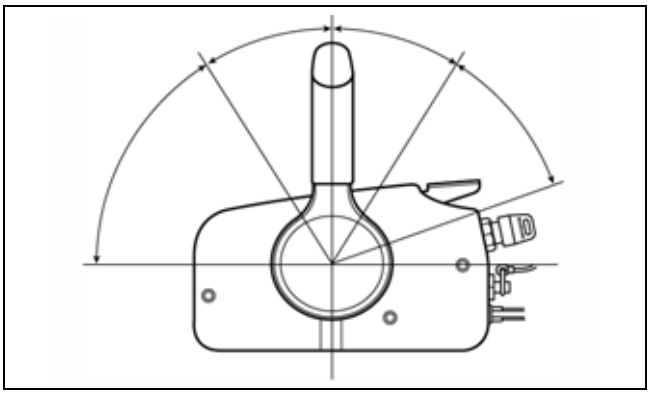
Thread connector onto the shift cable until connector hole aligns with pivot pin on the shift arm.

Install washer and clip, then tighten lock nut.



1. *Shift arm* 005906
2. *Connector*
3. *Washer and clip*
4. *Lock nut*

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



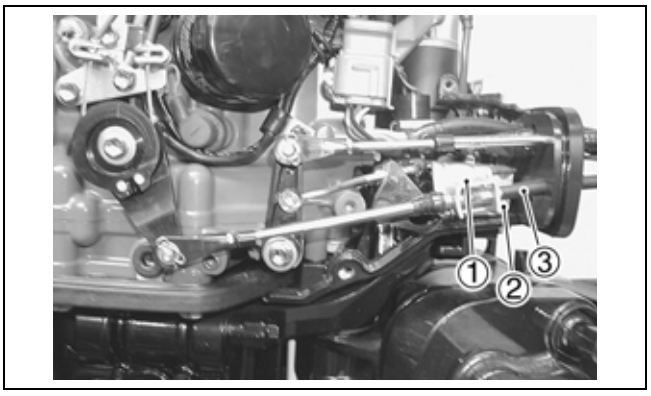
004822

Throttle Cable

Remove two screws and the throttle cable holder.

Insert the throttle cable through grommet.

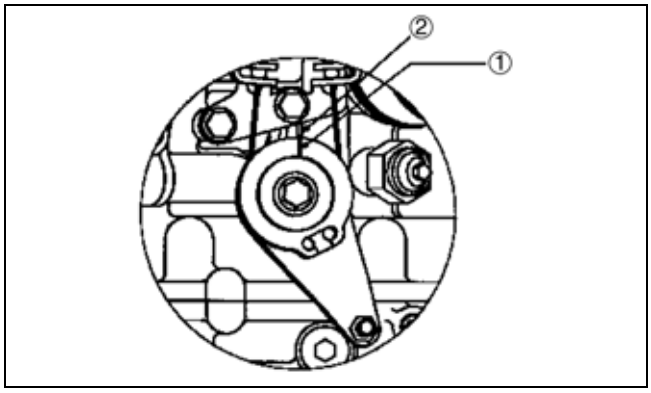
Install the throttle cable in the cable holder by fitting groove on the cable into slot on the holder. Reinstall holder.



1. *Cable holder*
2. *Screw*
3. *Throttle cable*

005907

Turn throttle drum fully counterclockwise. Match mark of throttle control lever must align with cylinder block rib. Refer to **Installation/Adjustment** on p. 120.

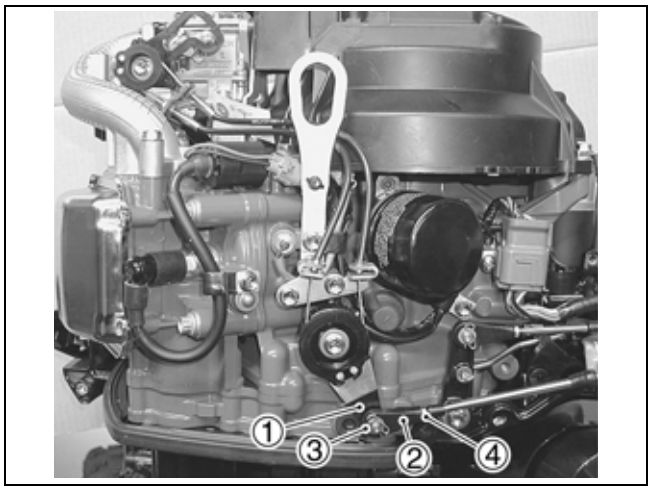


1. *Match mark*
2. *Cylinder block rib*

005908

While inner throttle cable end out, adjust the connector until the center of connector hole aligns with the pivot on the throttle control lever.

Install washer and clip, then tighten lock nut.

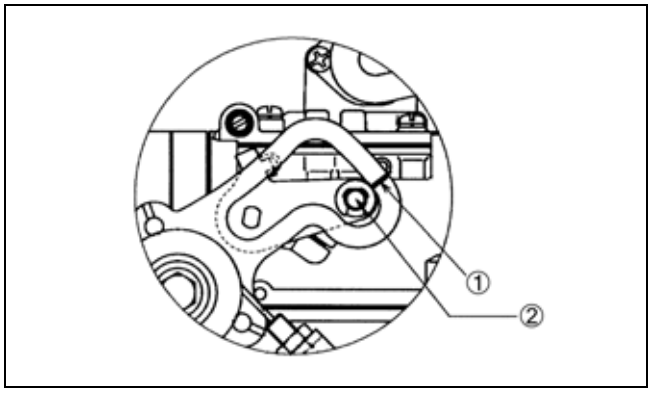


1. *Throttle control lever*
2. *Connector*
3. *Washer and clip*
4. *Lock nut*

005909

When throttle is fully closed, make sure throttle cam match mark and carburetor throttle lever

roller are aligned. Refer to **Installation/Adjustment** on p. 120.



1. Match mark 005910
2. Roller

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.

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.

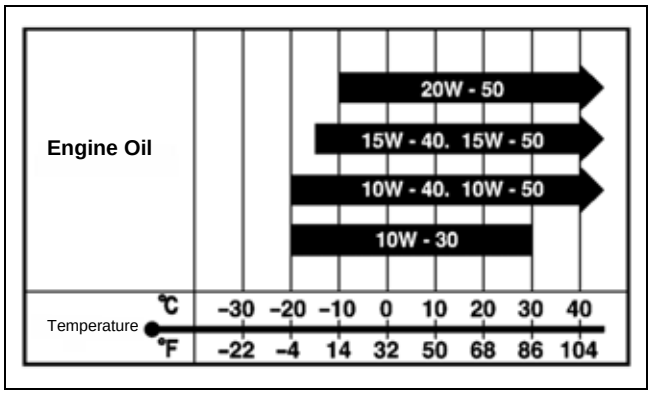
IMPORTANT: During the initial 10-hour break-in period, use *Evinrude/Johnson* 4-Stroke Outboard Oil or SAE 10W-40, API SE, SF, SG, SH, or SJ rated. DO NOT use synthetic or synthetic blend oils during break-in period.

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.

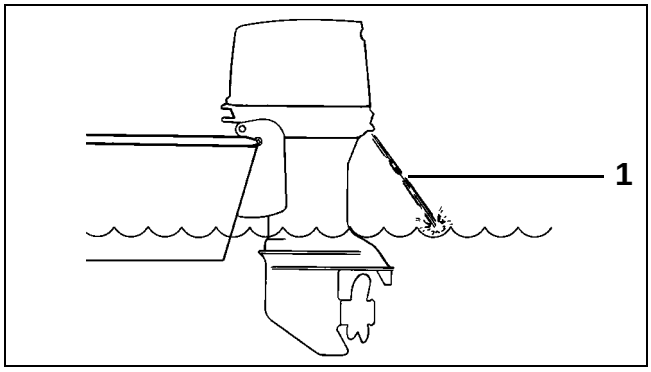
Tachometer Pulse Setting

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

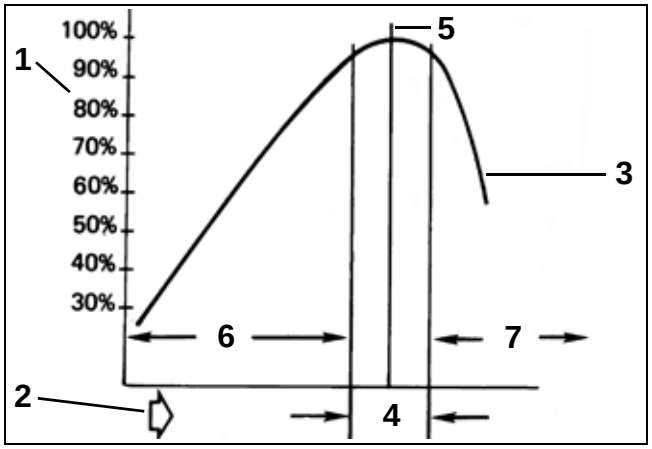
Operating Temperature

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.



DR1261

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*

⚠ CAUTION ⚠

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

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.

⚠ 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.

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.

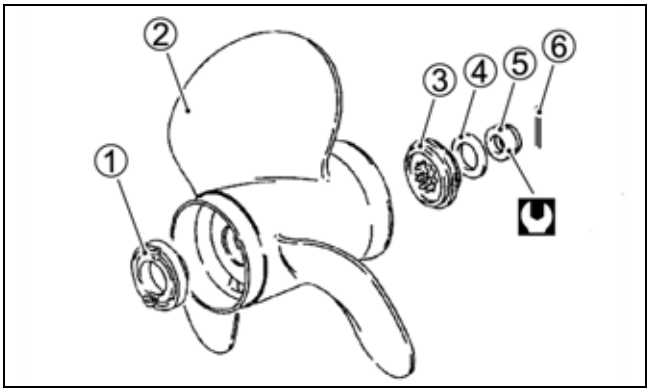
Apply *Triple-Guard* grease to the entire propeller shaft before installing the propeller.

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.

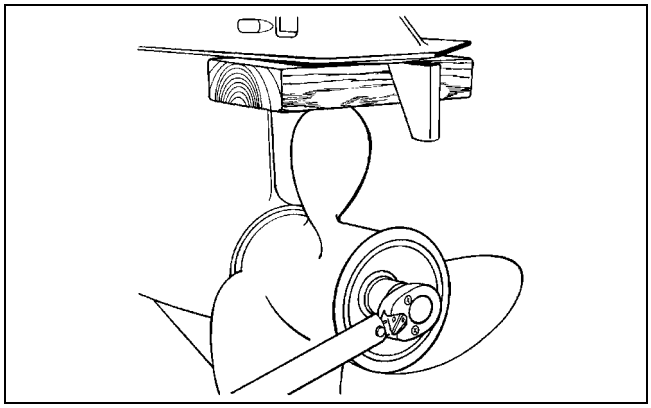
Install the spacer, engaging the propeller shaft splines.



004361

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

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



DRC3984

Install the propeller nut and torque to:

- 217 in. lbs. (24.5 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.

Trim Tab Adjustment

⚠ WARNING ⚠

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

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

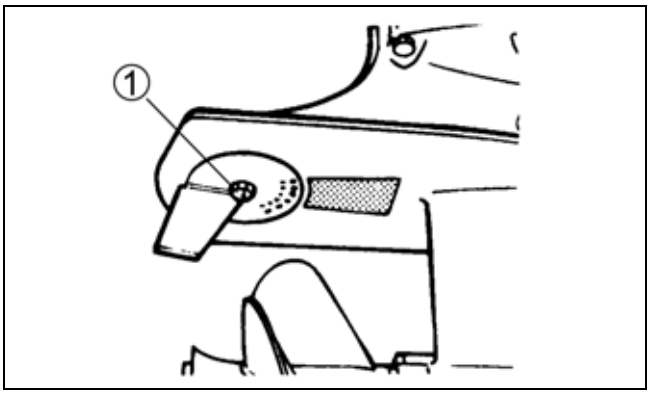
IMPORTANT: A single trim tab adjustment will relieve steering effort under only one set of speed, outboard angle and load conditions. No single adjustment can relieve steering effort under all conditions.

⚠ WARNING ⚠

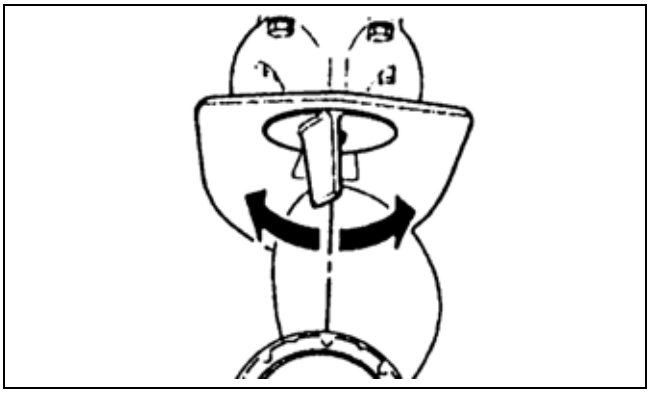
To prevent accidental starting while servicing, twist and remove all spark plug leads.

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

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



1. Trim tab screw 005931



005932

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

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

MAINTENANCE

TABLE OF CONTENTS

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						
		Frequency				
Description	**Engine Care Product**	**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 fitter, replace						✓
Flush cooling system		✓				
Thermostat, inspect and check operation			✓		✓	
Operator's Guide, onboard		✓				
Engine upper and lower motor covers, clean and wax				✓		

Engine Maintenance and Inspection Schedule						
		Frequency				
Description	**Engine Care Product**	**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 *Ultral 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 Molylube*

F Starter Bendix Lube Only

G *Evinrude/Johnson* Engine Tuner

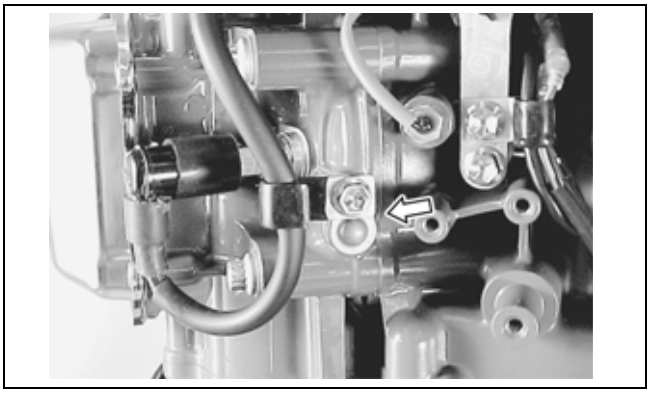
H *Evinrude/Johnson Ultra 4-Stroke* synthetic blend oil

ANTI-CORROSION PROTECTION

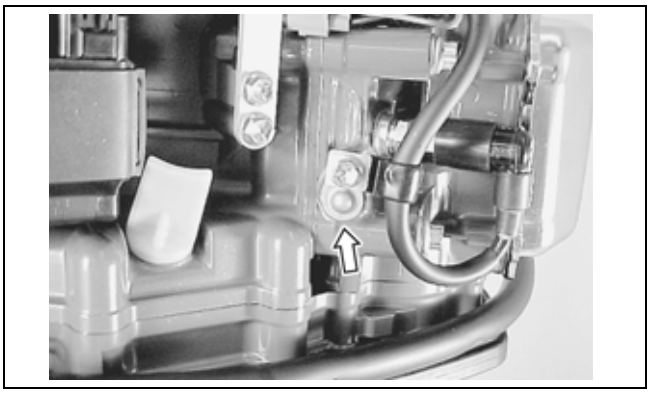
Sacrificial Anodes

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.

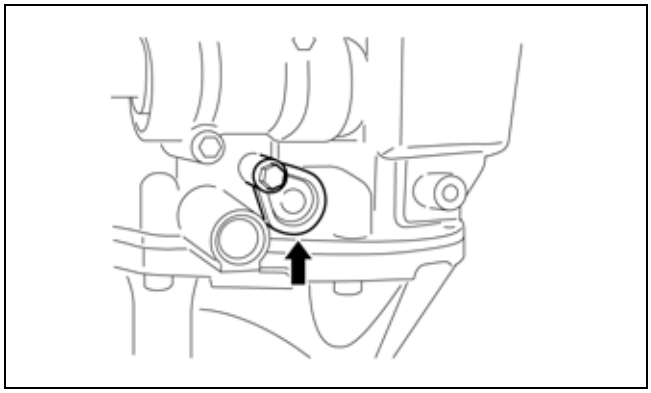
Outboards are equipped with sacrificial anodes.



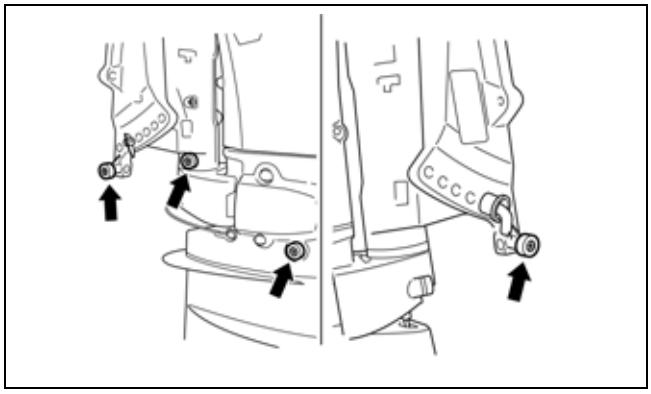
STARBOARD Cylinder Head Anode 005523



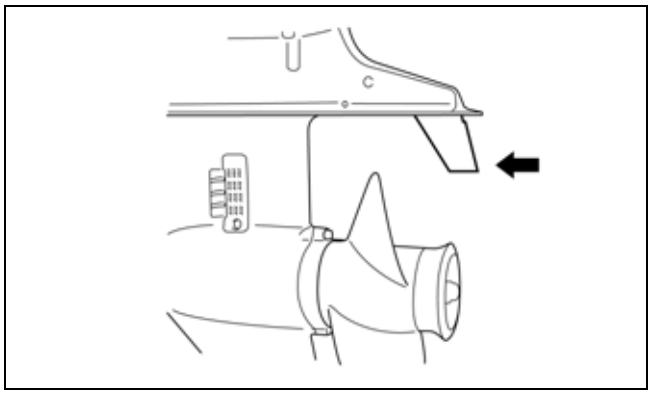
PORT Cylinder Head Anode 005524



Oil Pan Anode 005525



Midsection Anodes 005526



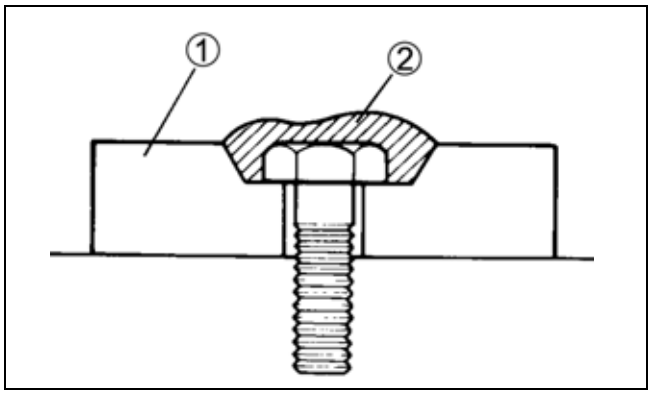
Gearcase Housing Anode (Trim Tab) 005522

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 004779
2. Silicone sealant

Testing Procedure – Continuity

Calibrate multimeter on “HIGH” ohm scale.

Connect meter leads between engine ground and anode surface.

1. Meter lead to anode 005952

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.

005527

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.

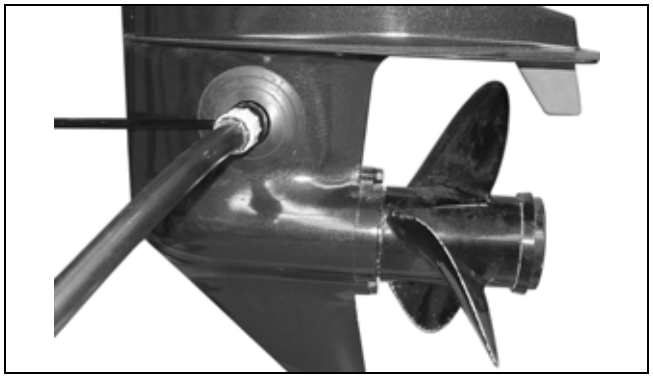
⚠ WARNING ⚠

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.

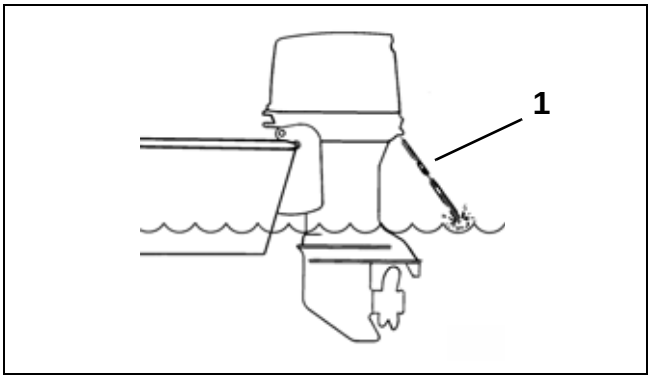


Flushing Device 005951

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.

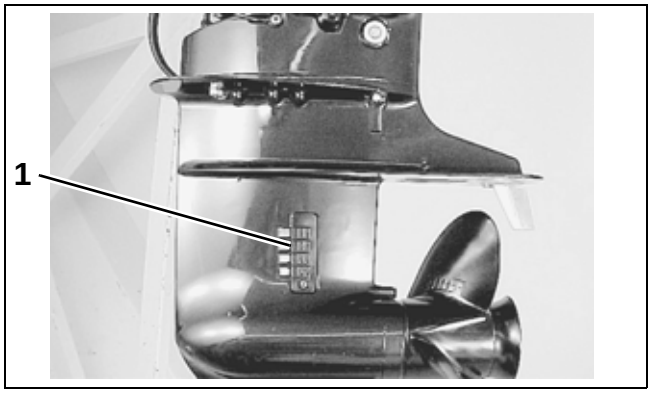


1. Water pump indicator drc4952

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 005941

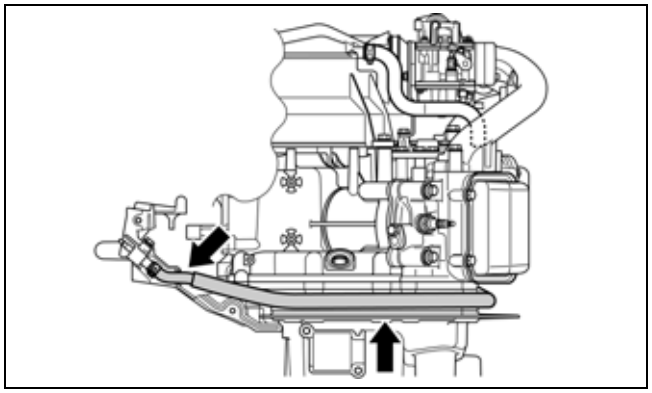
Water Pump

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

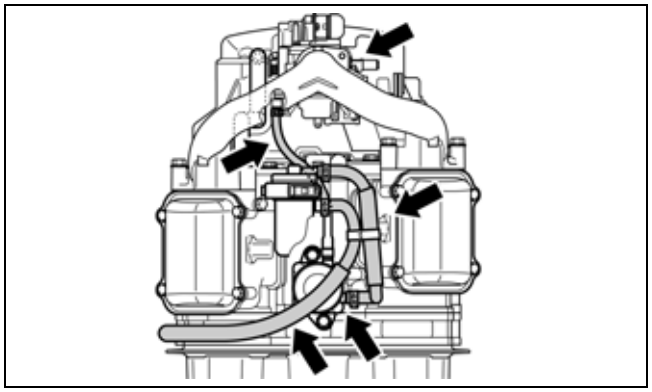
FUEL SYSTEM

Breather and Fuel Line

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



005528



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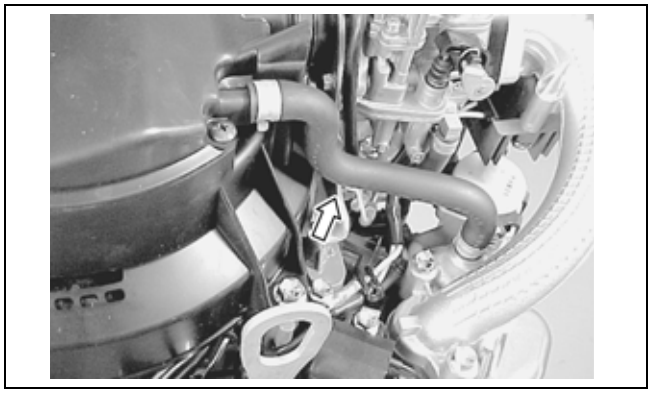


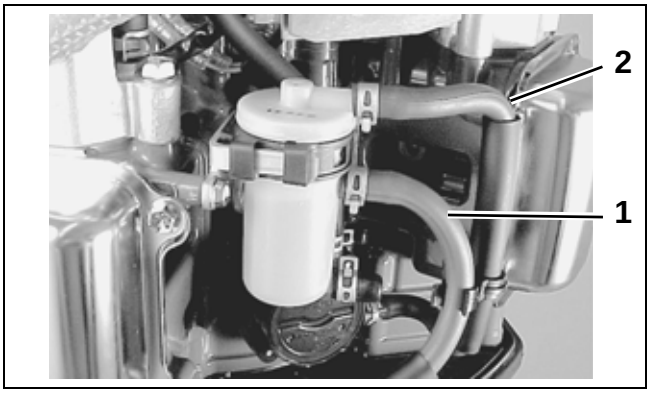
005530

Fuel Filter

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

If water or sediment is found, clean as follows:

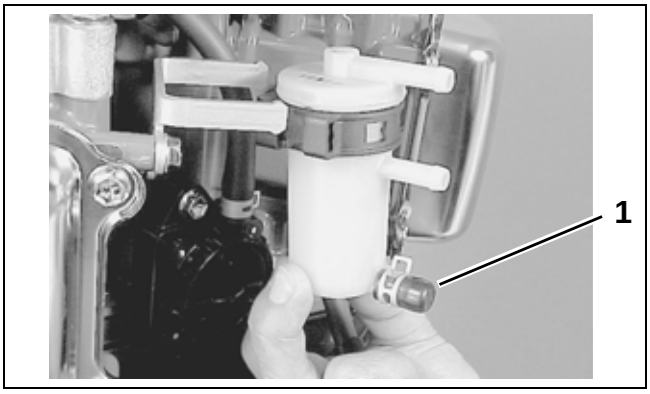
- Disconnect inlet hose and outlet hose from fuel filter.
- Remove filter from bracket,



1. Inlet hose
2. Outlet hose

005531

- Remove cap, then drain and clean filter.



1. Cap

005532

- Install cap and secure with clamp.
- Connect hoses and secure with clamps.
- Start engine and check for fuel leaks.

⚠ WARNING ⚠

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

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.

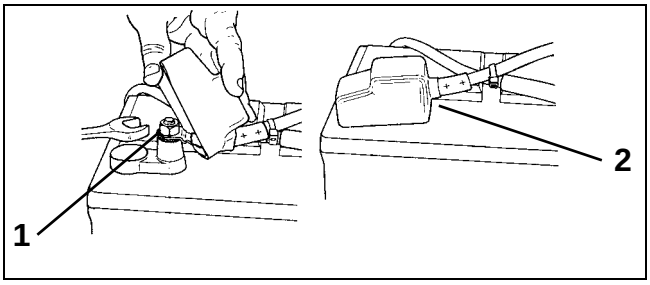
Disconnect battery negative (–) cable **first** and the battery positive (+) cable last.

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

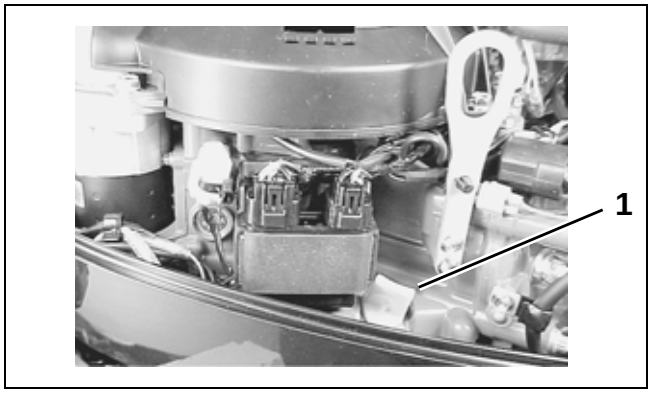
Oil Level Check

Place outboard upright on a level surface.

Remove the oil level dipstick (filler cap) and wipe clean.

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

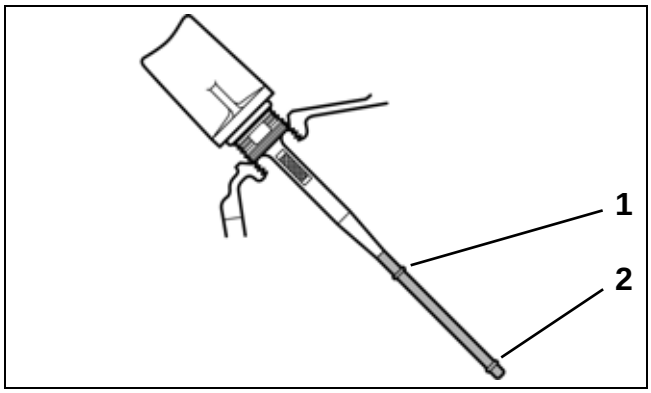
IMPORTANT: Do not screw dipstick in to check oil level.



1. Oil filler cap
005533

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

If oil is low, add recommended oil.



1. Full level line
2. Low level line
005534

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

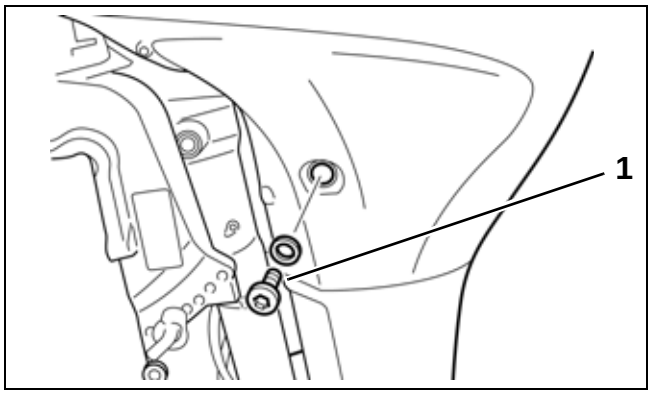
Oil amount:
- Oil change only: 1.6 Qt. (1.5 L)
- Oil filter change: 1.9 Qt. (1.8 L).

Oil Change

Refer to **INSPECTION AND MAINTENANCE SCHEDULE** on p. 48 for oil change schedule.

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

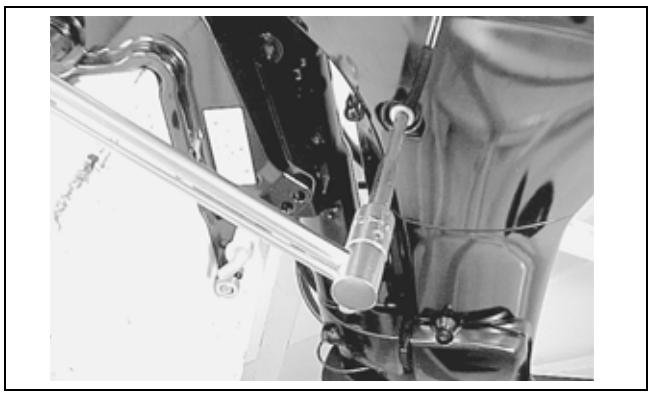
Place a container under engine oil drain plug, then remove plug and gasket to drain engine oil.



1. Oil drain plug 005535

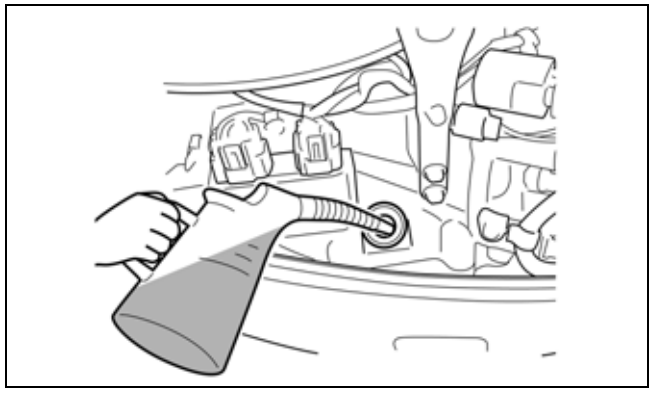
Install new gasket and oil drain plug. Tighten plug to 114 in. lbs. (13 N·m).

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



005536

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



005537

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

Engine Oil Filter

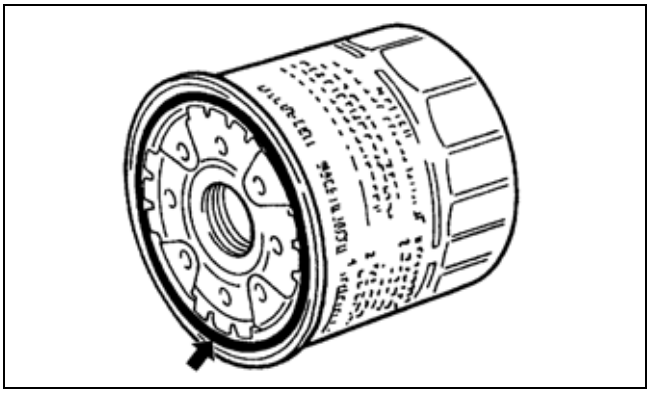
IMPORTANT: When replacing oil filter, change engine oil at the same time.

Place a shop cloth under oil filter.

Use an oil filter wrench to loosen filter, then remove filter and o-ring.

Oil Filter 005538

IMPORTANT: Before fitting new oil filter, be sure to oil o-ring.



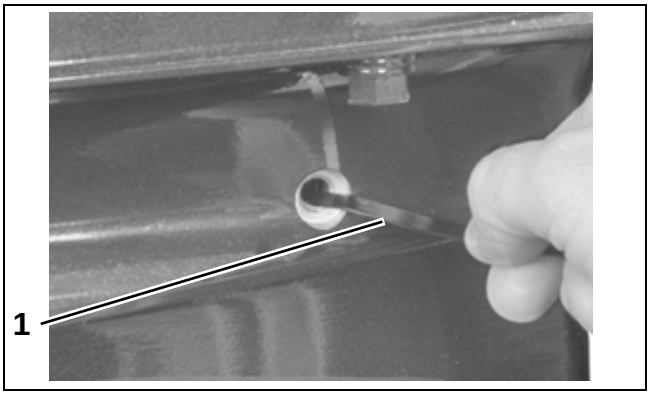
005539

Screw new filter on by hand until o-ring contacts the mounting surface.

Use wrench to tighten filter 3/4 turn from point of contact.

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.

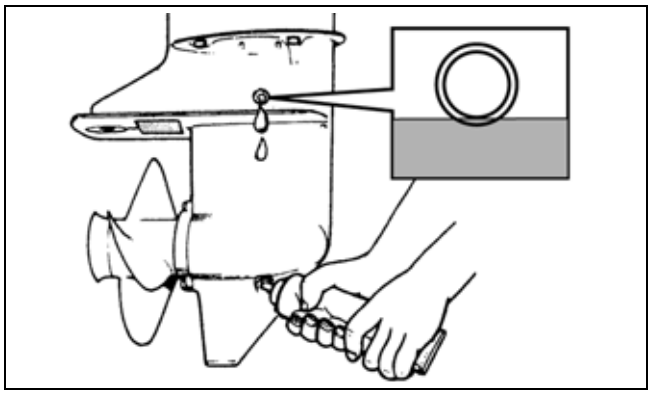


TYPICAL 000072
1. Tie strap

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. 48 for service frequency and recommended lubricants.

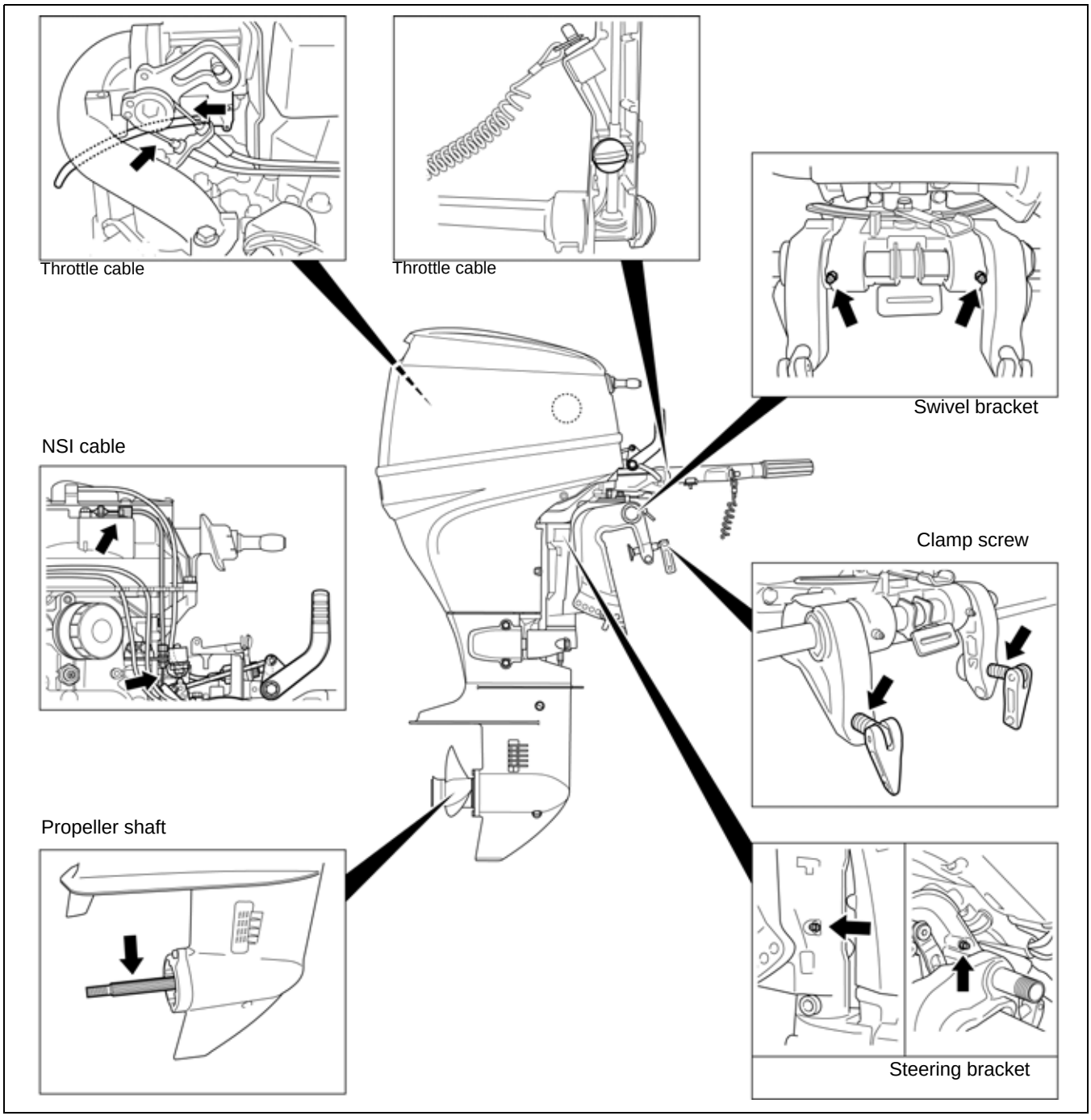
Refer to **LUBRICANT** on p. 198 for complete gearcase lubricant filling procedures.



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

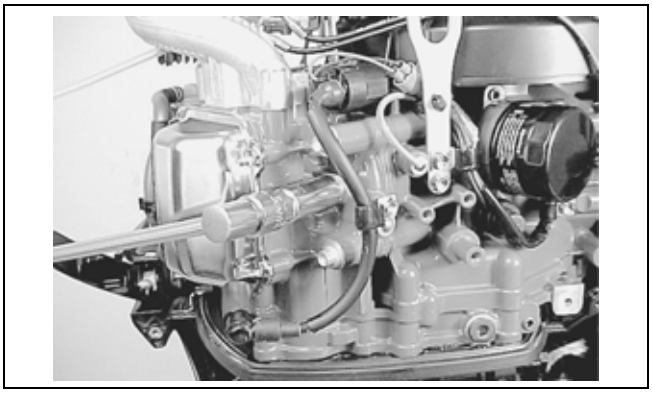
Spark plugs should be removed and examined periodically. Replace worn, fouled or damaged spark plugs.

- 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. (28 N·m).



005542

VALVE CLEARANCE

Measurement

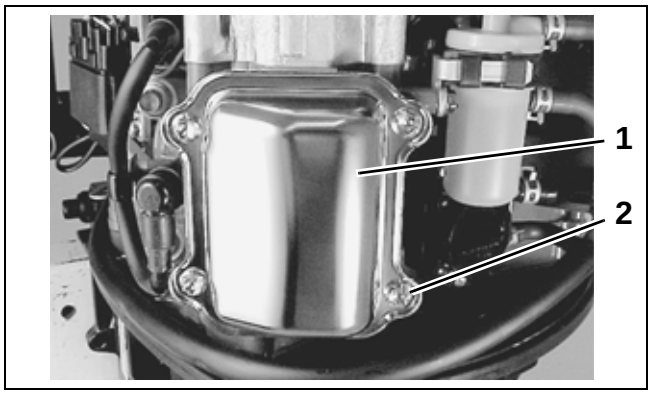
Remove side covers. Refer to side cover **Removal and Installation** on p. 177.

Remove recoil starter (rope start models). Refer to starter **REMOVAL** on p. 219.

Remove flywheel cover (electric start models).

Remove spark plugs.

Remove eight screws and port/stbd cylinder head covers.



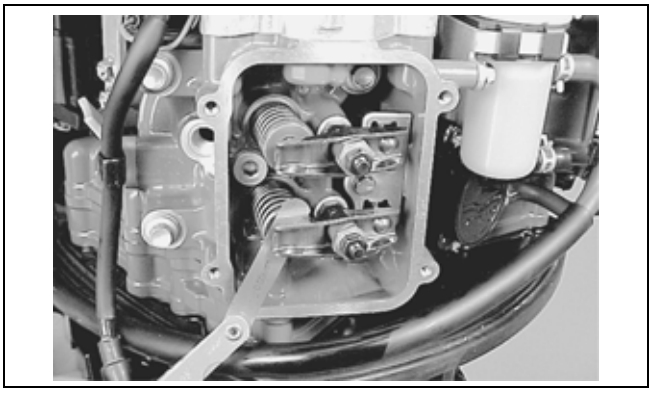
1. Cylinder head cover 005543
2. Cover screw

Rotate the flywheel clockwise to bring each piston to Top Dead Center (TDC) on compression stroke.

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

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 rocker arm.



005544

Valve clearance: (cold engine)

- IN: 0.001 to 0.003 in. (0.03 to 0.07 mm)
- EX: 0.001 to 0.003 in. (0.03 to 0.07 mm)

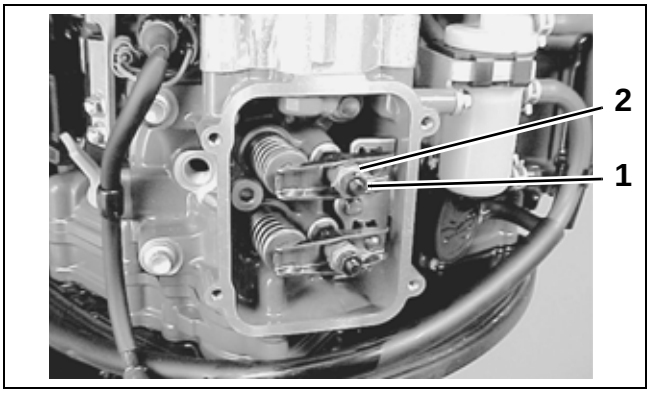
If measurement is out of specification, adjust valve clearance.

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

Adjustment

Loosen valve adjusting lock nut while holding pivot nut.

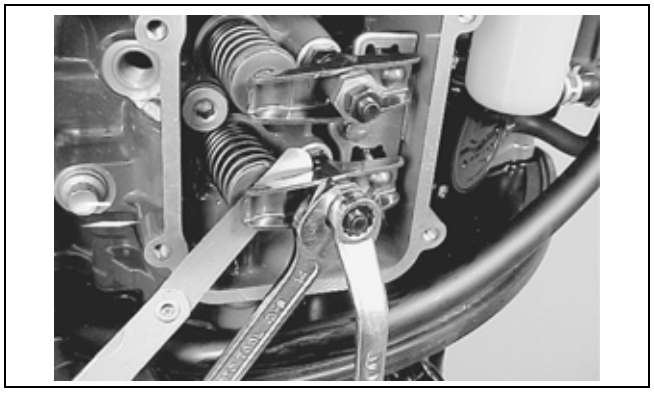
Turn pivot nut to bring valve clearance within specification.



1. Lock nut
2. Pivot nut

005545

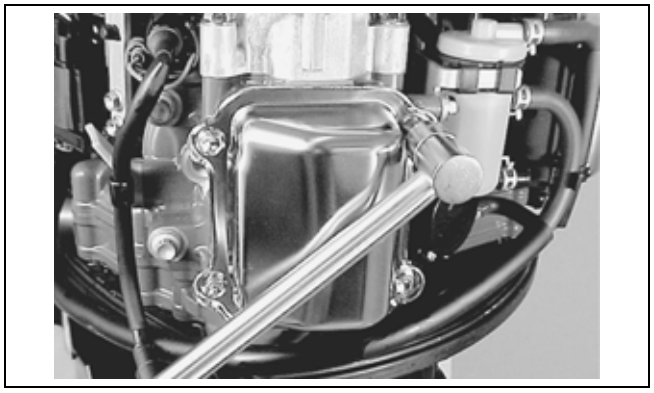
Tighten lock nut to 95 in. lbs. (11 N·m) while holding pivot nut.



005546

Recheck valve clearance.

Tighten the cylinder head cover screws to 88 in. lbs. (10 N·m).



005547

IMPORTANT: Do not re-use cylinder head cover gasket. Always use a new gasket.

IDLE SPEED

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

Connect a shop tachometer to the engine.

005548

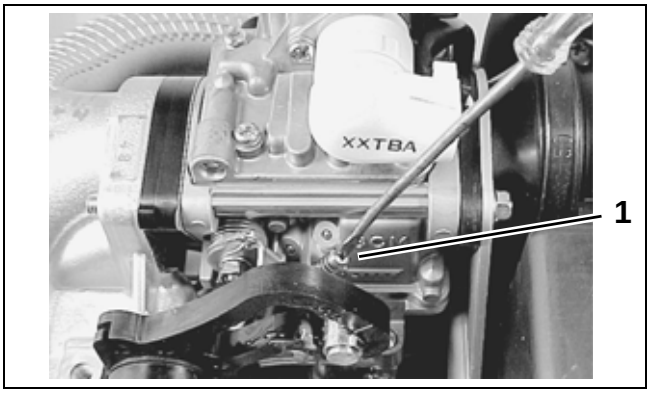
Start and warm the engine.

Check engine idle speed:
- 950 to 1050 RPM in neutral
- 900 to 1000 RPM in gear

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 005549

IGNITION TIMING

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

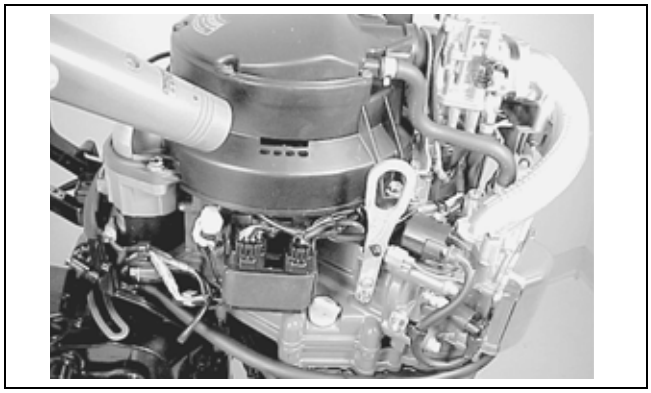
Start and warm the engine.

Connect a shop tachometer and timing light to the no. 1 cylinder.

005550

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

Ignition timing:
- 2° BTDC @ 1000 RPM



005551

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. 48.

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.

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)**.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

ELECTRICAL

TABLE OF CONTENTS

CAUTION SYSTEM

Two caution systems alert the operator when an abnormality occurs:

- Over-revolution Caution
- Low Oil Pressure Caution
- Overheat Caution

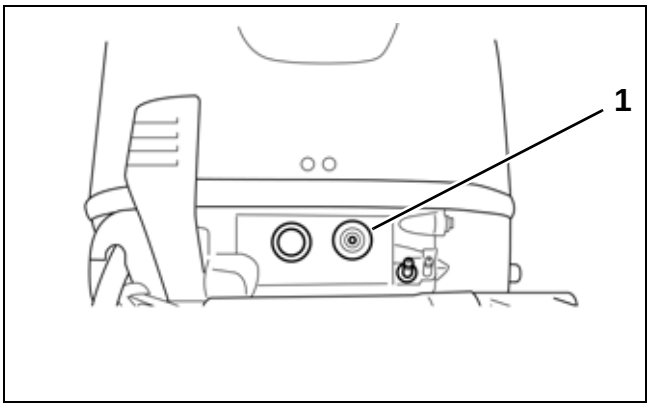
Caution Type	Lamp	Buzzer *	Rev Limiter
Over-revolution	Yes	No	Yes
Low oil pressure	Yes	Yes	Yes
Overheat	Yes	Yes	Yes

* 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 005555

Over-Revolution Caution System

The CDI unit engages the over-revolution limiter above 5500 RPM.

- If the engine is operated at a speed above 5500 RPM for more than 10 seconds, the engine speed will be automatically lowered to approximately 3000 RPM by intermittent ignition.
- If the operator decreases engine speed to less than approximately 5500 RPM within 10 seconds, the over-revolution caution control will be cancelled.
- 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 3000 RPM and the caution lamp does not light. To cancel the neutral over-revolution caution control, 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 7 psi (49 kPa).

- Caution lamp turns ON
- Buzzer sounds (remote models)
- Engine speed is reduced to approximately 1500 RPM through intermittent ignition signals.

To cancel the low oil pressure caution warning:

- Stop engine and check engine oil level. Refill to correct level.

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

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

Overheat Caution System

The overheat caution system activates when the cylinder wall temperature is higher than 230° F (110° C):\

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

To cancel the overheat caution control:

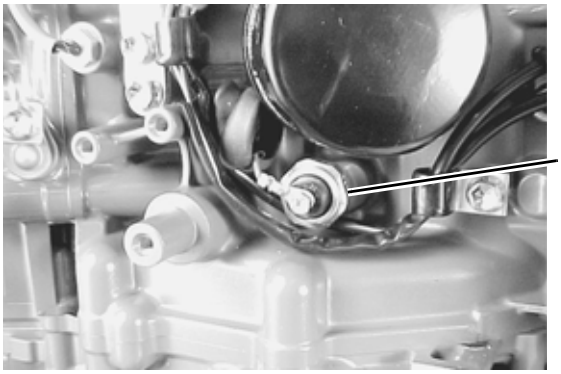
- Cylinder wall temperature must be reduced to less than 185° F (85 ° C), and
- Engine speed must be reduced to 1500 RPM or lower.

Oil Pressure Caution System Tests

IMPORTANT: Before checking the oil pressure caution circuit, make sure the engine oil pressure is within specification. Refer to **Oil Pressure Test** on p. 129.

Oil Pressure Switch

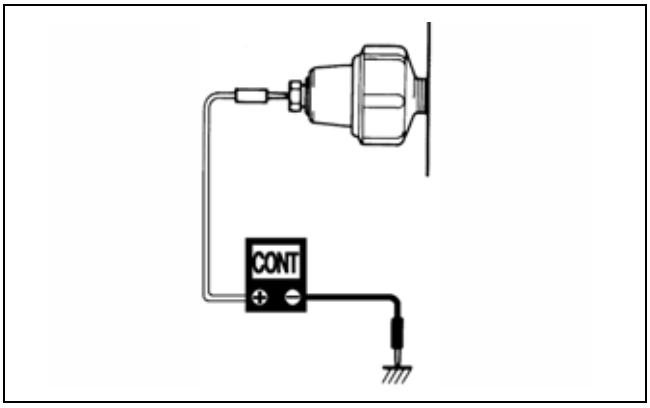
Remove the blue lead wire from the oil pressure switch.



1. Oil pressure switch 005556

Check the continuity between switch terminal and engine ground.

Engine running	No Continuity
Engine stopped	Continuity



004716

If measurement exceeds specification, replace oil pressure switch.

Oil Pressure Caution Lamp Circuit

Remove the blue lead wire from the oil pressure switch.

Start the engine.

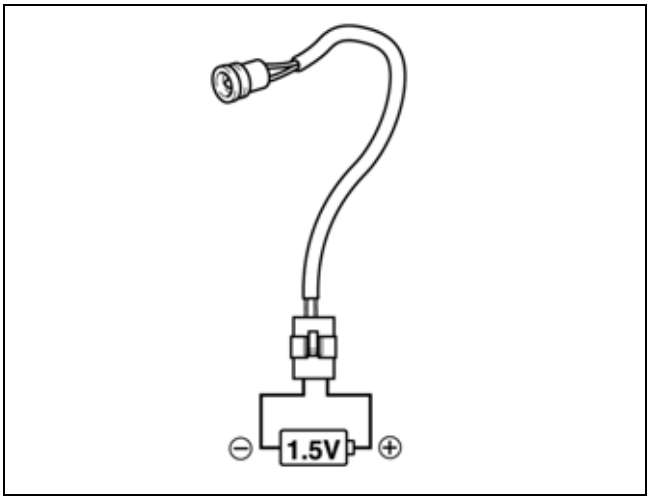
Touch the blue lead wire to engine ground. If the caution lamp comes on, the oil pressure switch circuit and lamp are normal.

Caution Lamp

Disconnect lamp lead wires from engine harness.

Connect the wires to a 1.5 V battery.
- Pink wire to battery positive
- Black wire to battery negative

If lamp does not light, replace lamp.



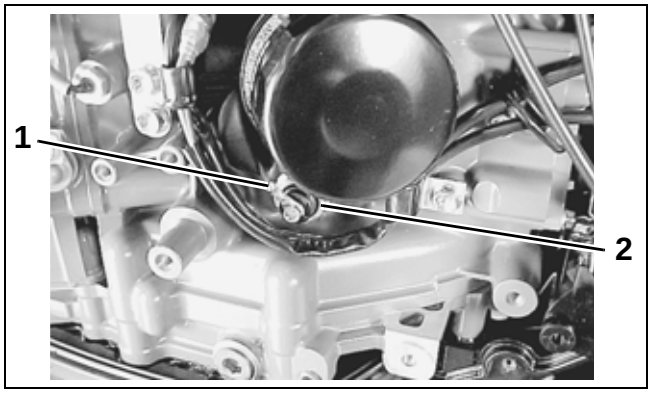
004717

Oil Pressure Switch Service

Removal

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

Remove the oil pressure switch.

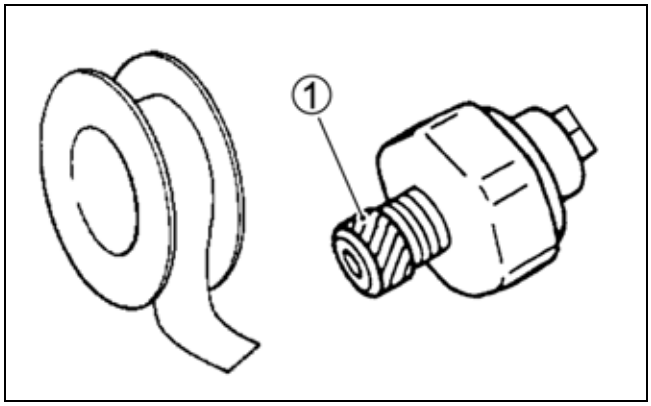


1. Blue lead wire 005552
2. Oil pressure switch

Installation

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

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



004718

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

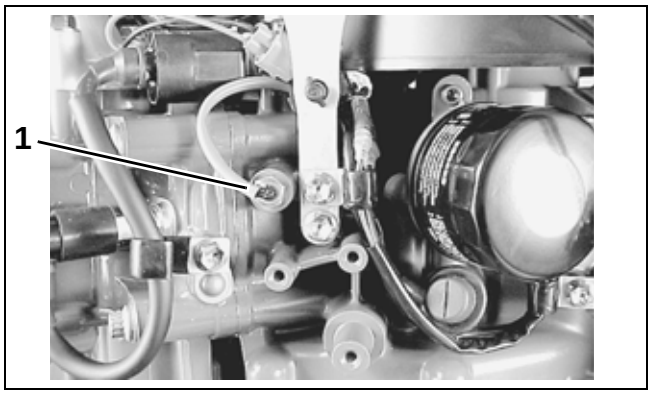
Start engine and check for oil leaks.

Temperature Sensor Tests

The temperature sensor is a thermistor type sensor which sends a voltage signal to the CDI unit.

The input signal is used to detect both temperature and temperature change over time.

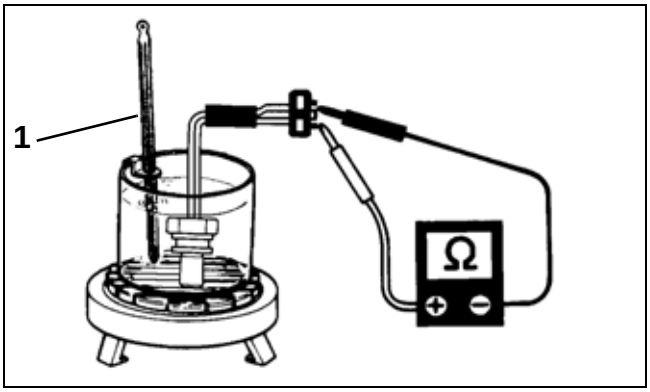
Remove the temperature sensor from the engine.



1. Temperature sensor 005557

Connect an ohmmeter to sensor lead wires

Place the sensor's tip in water and gradually heat the water while monitoring changes in resistance.



1. Thermometer 005558

Sensor resistance should be as follows:

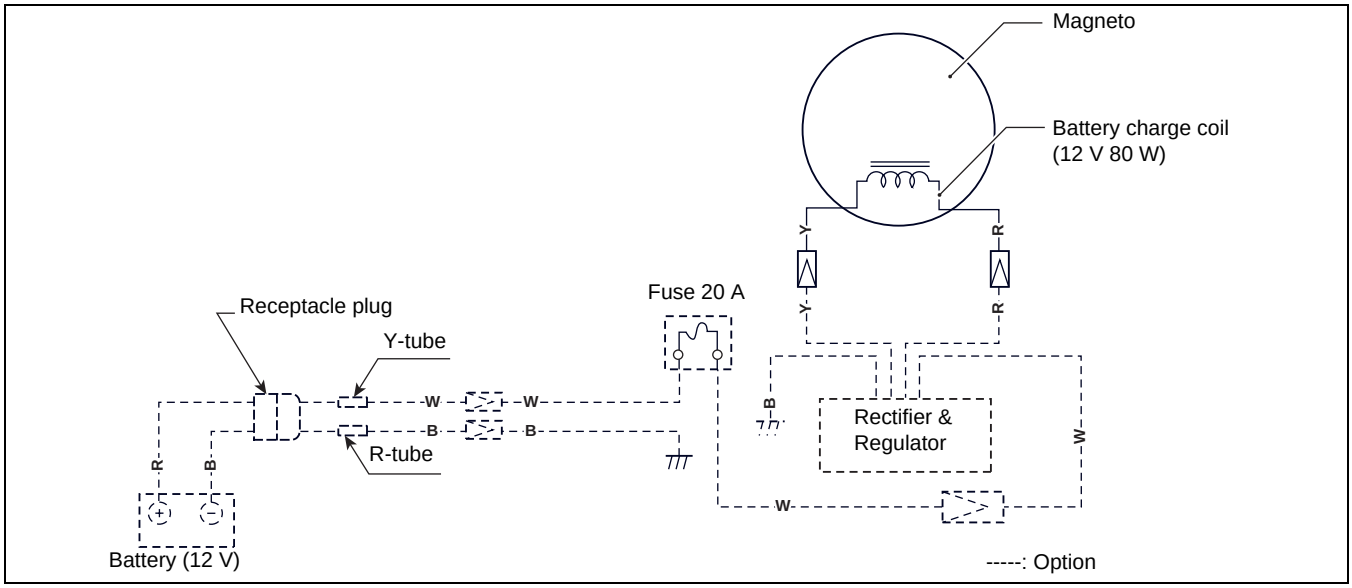
- 32° F (0° C) — 5.3 to 6.6 kΩ
- 77° F (25° C) — 1.8 to 2.3 kΩ
- 122° F (50° C) — 0.73 to 0.96 kΩ
- 167° F (75° C) — 0.33 to 0.45 kΩ

BATTERY CHARGING SYSTEM

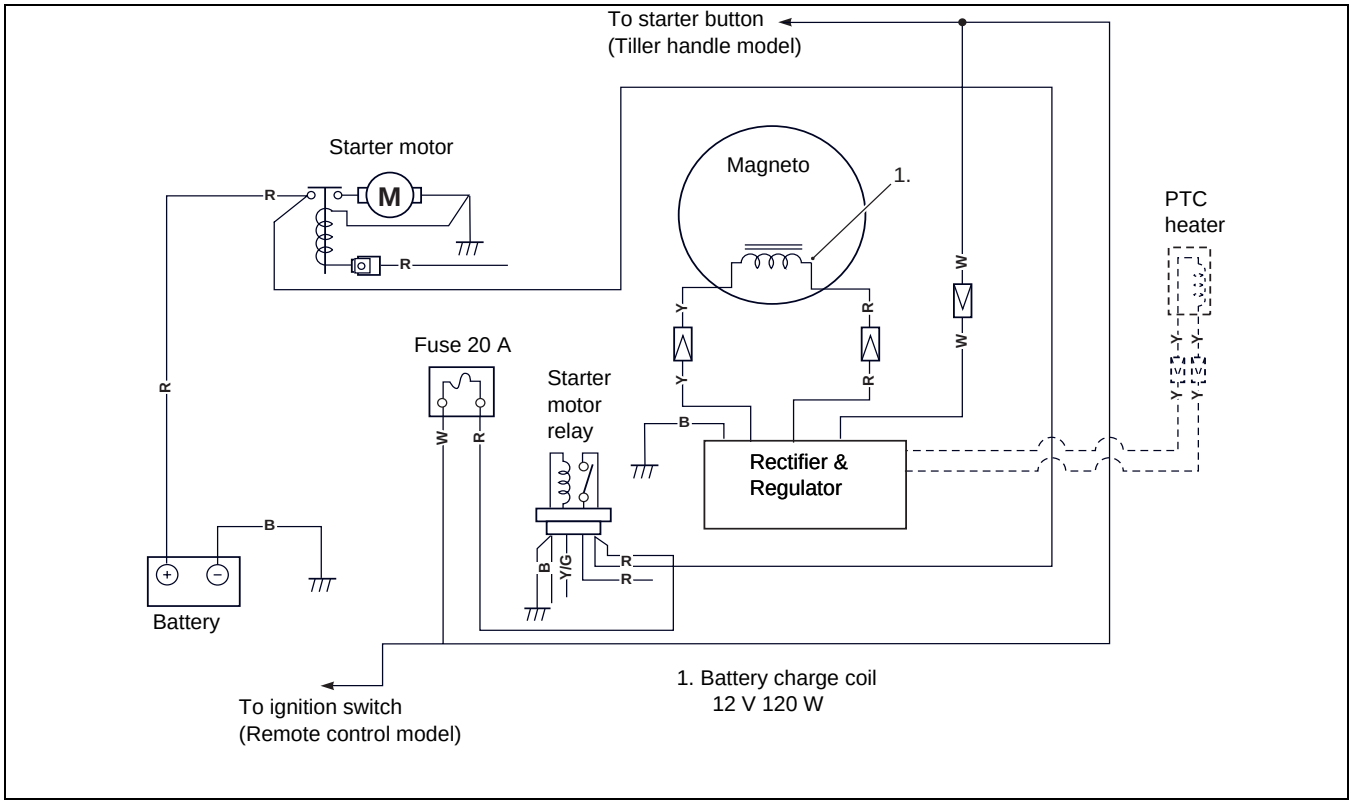
The battery charging system includes the battery charge coil, rectifier/regulator, and battery.

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

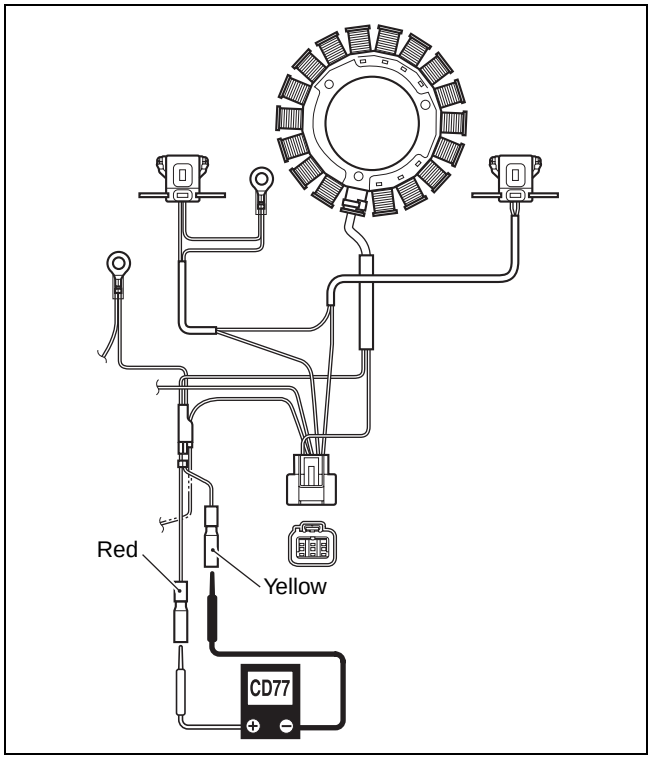
Disconnect battery charge coil wires from rectifier.

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

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

Remove spark plugs. Crank with starter.

Battery charge coil output:
- 2 V or over (rope start models)
- 4.8 V or over (electric start models)



005559

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

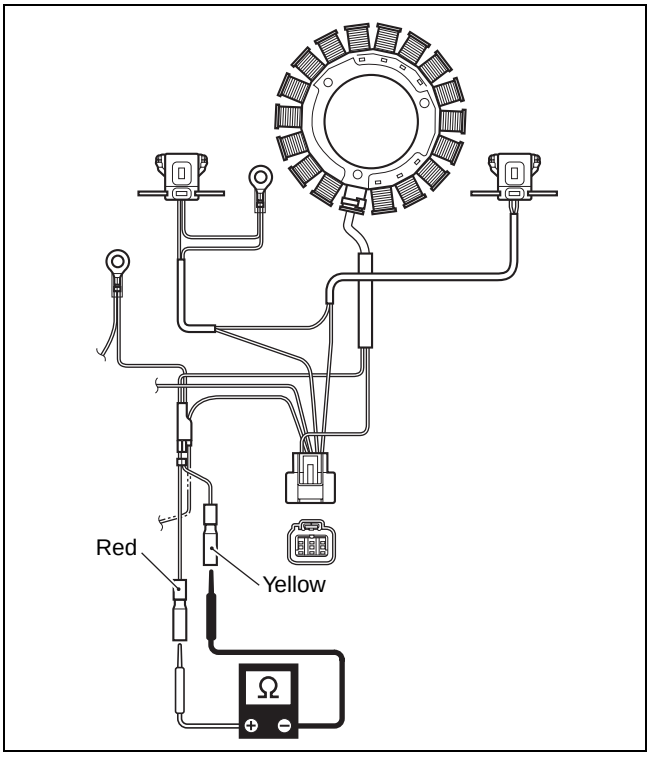
Battery Charge Coil Resistance

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:
- 0.27 to 0.41 Ω (80 W coil)
- 0.24 to 0.36 Ω (180 W coil)



005560

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

4

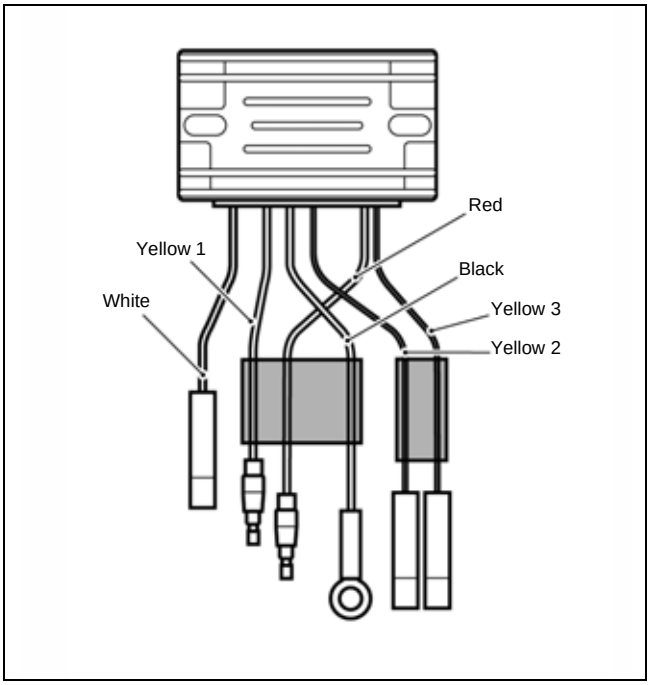
Rectifier and Regulator

Disconnect all lead wires of rectifier and regulator.

Measure the resistance between leads in the combinations shown:

Unit: Approx. kΩ

		Tester probe + (Red)					
		Black	**White**	**Yellow 1**	**Red**	**Yellow 2**	**Yellow 3**
Tester probe - (Black)	**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	∞	∞	∞	



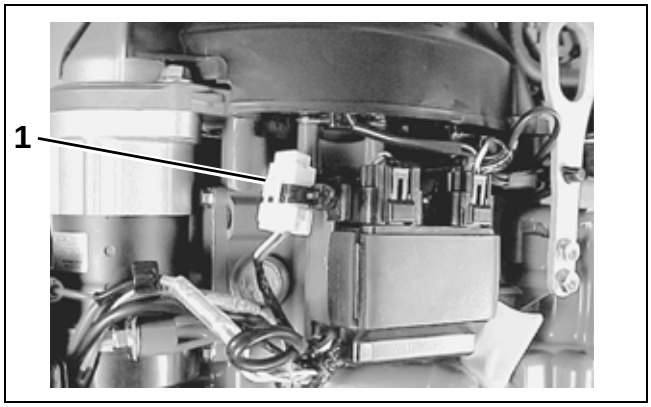
004721

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

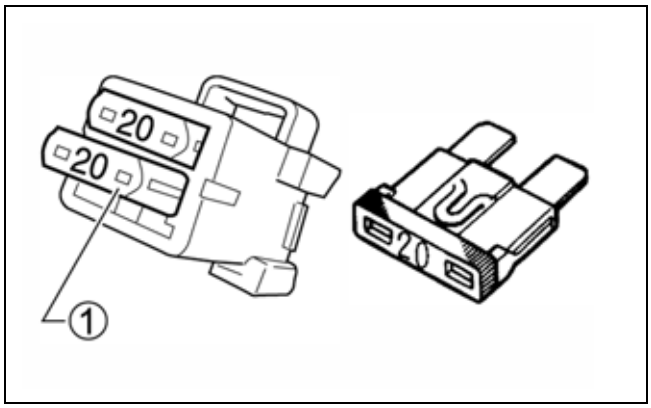
Fuse

Remove the fuse from fuse case.

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



1. Fuse case 005561



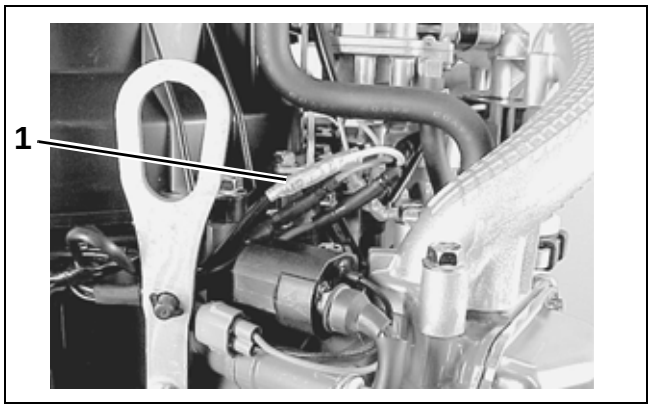
1. Fuse 004724

Fuse Case

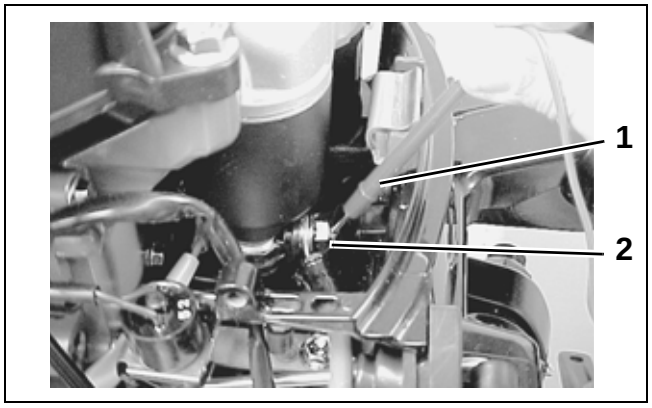
Disconnect battery cables at the battery.

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 005562



1. Red magnetic switch lead 005563
2. Starter magnetic switch

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

Removal and Installation

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

Battery Charge Coil

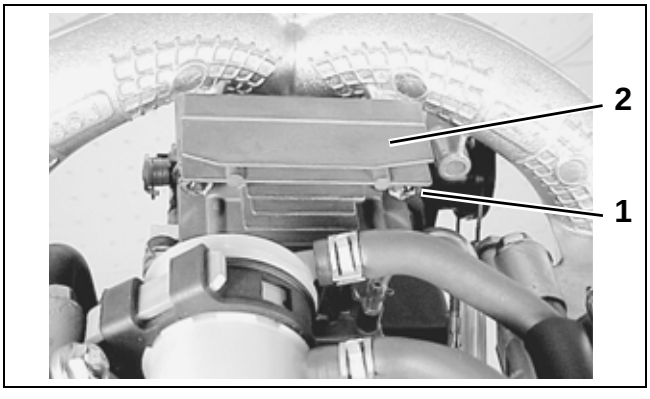
Remove flywheel, screws, and battery charge coil. Refer to **COMPONENT SERVICING** on p. 99.

005564

Rectifier and Regulator

Remove the screws securing the rectifier and regulator.

Disconnect lead wire connectors.



1. Screws 005565
2. Rectifier/regulator

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

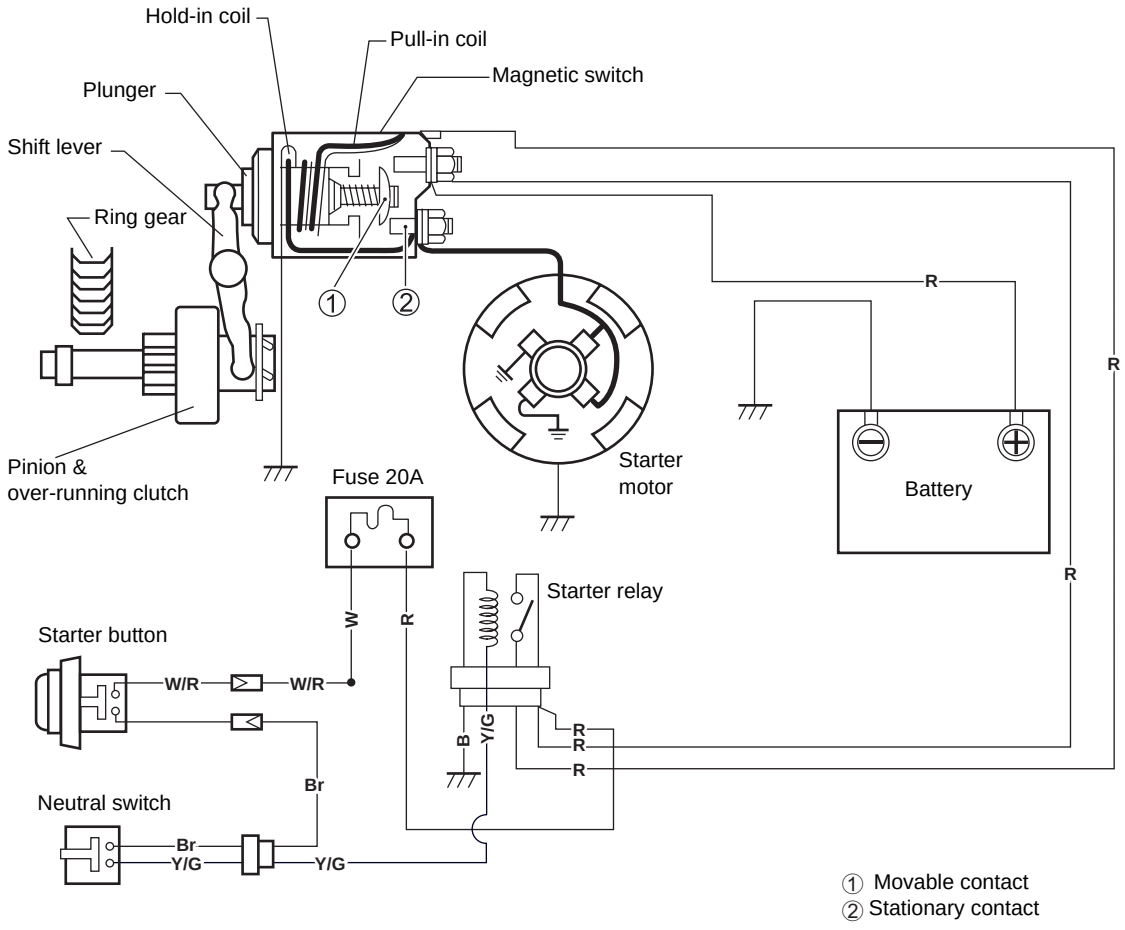
The starting circuit includes the battery, starting motor, ignition switch (or starter button), neutral switch, and related wiring.

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

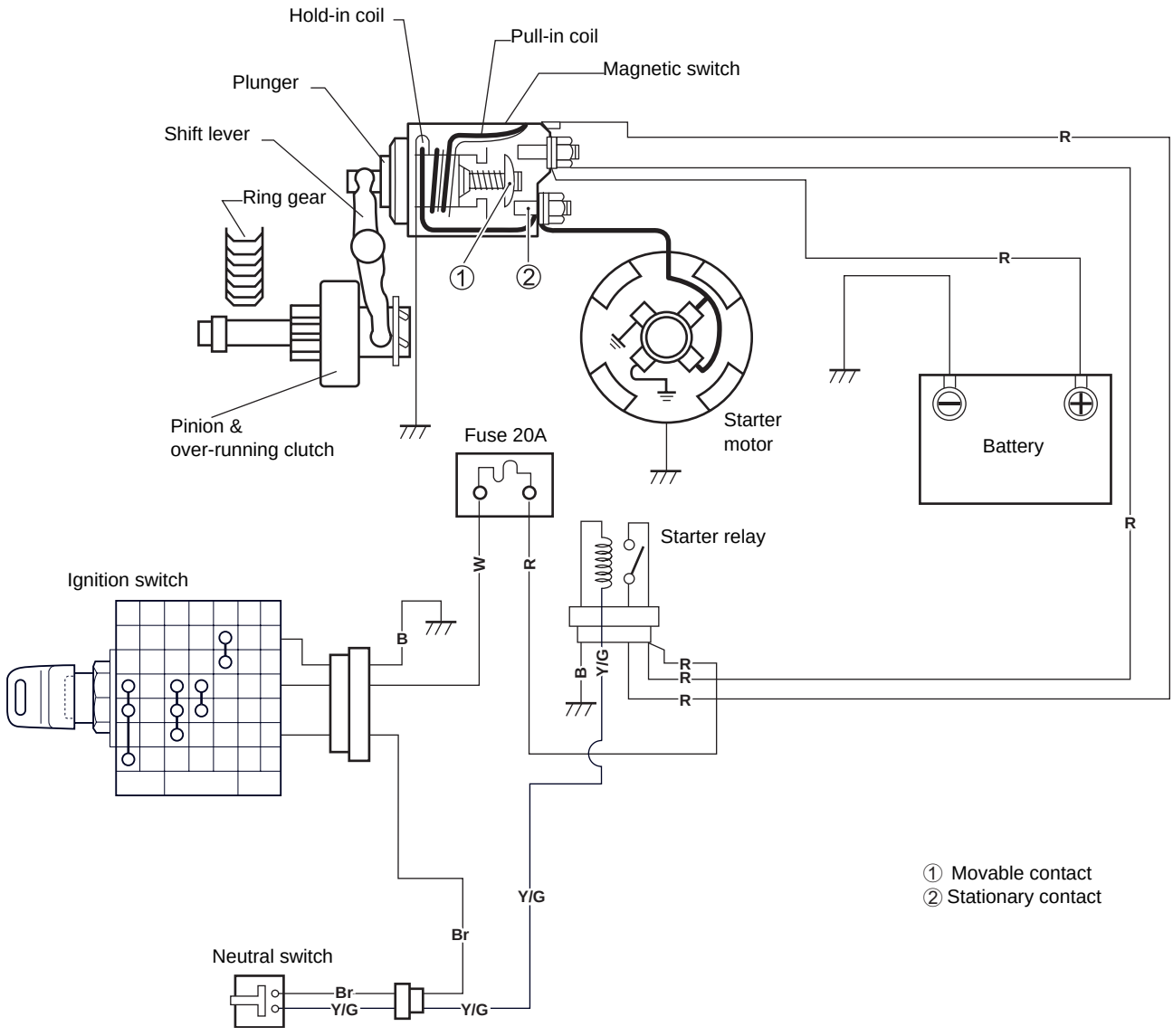
The resulting plunger and pinion shift lever movement causes the pinion to engage the engine flywheel gear, the magnetic switch main contacts to close, and engine cranking to take place.

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.

Tiller Models



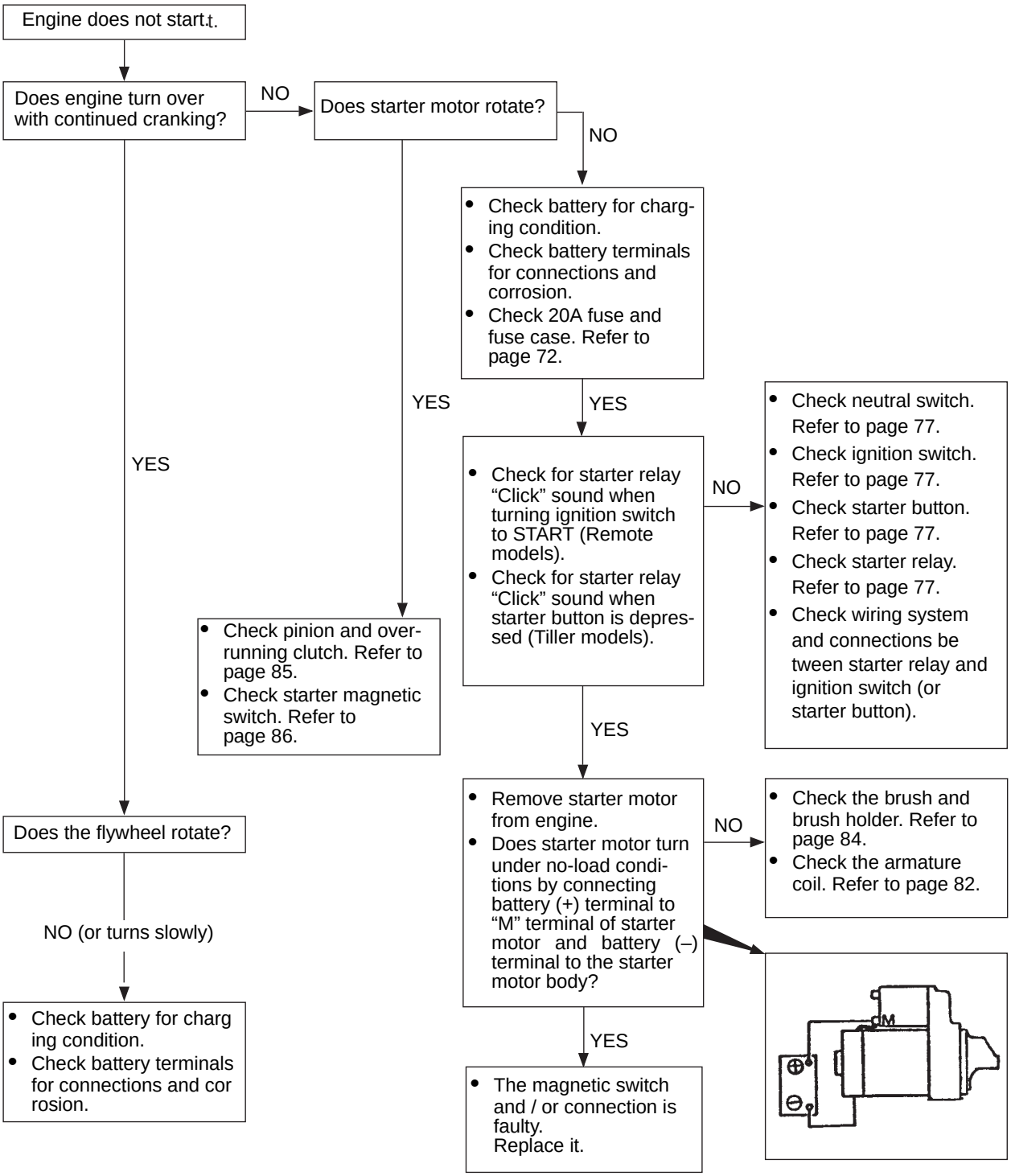
Remote Models



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.



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	O	O				
ON			O	O		
START			O	O	O	
PUSH			O	O		O

O — O : Continuity

If out of specification, replace the ignition switch.

Starter Button (Tiller Models)

Disconnect the starter button lead wire.

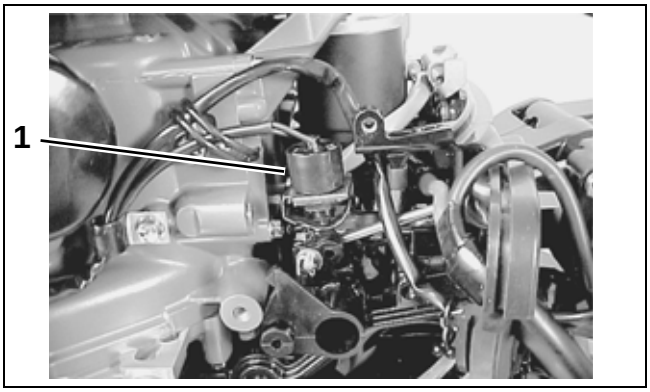
Check continuity between the wiring leads under the conditions shown:

	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.



1. Neutral switch 005566

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

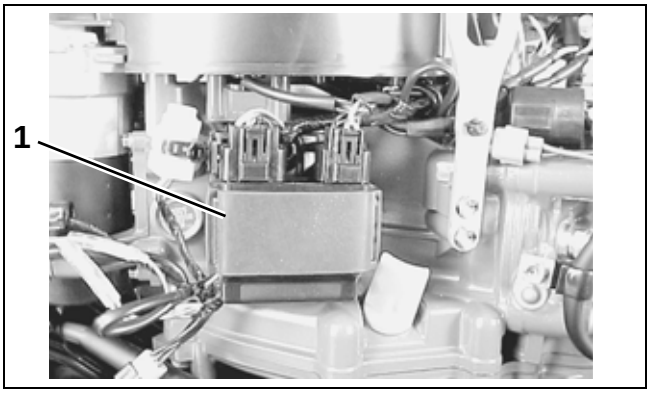
Shift position	Continuity
Neutral	Yes
Forward	No
Reverse	No

If out of specification:
- Check switch position adjustment.
- Replace neutral switch.

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

Starter Motor Relay

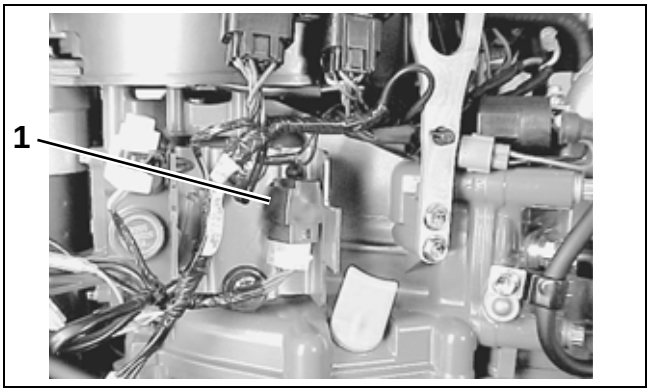
Remove CDI unit.



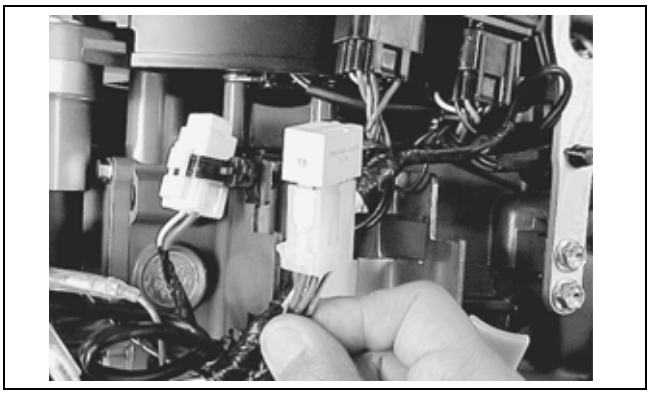
1. CDI unit 005567

Pull out relay and relay holder from electric parts holder, then remove relay holder from starter

motor relay. Disconnect starter motor relay from wire connector.

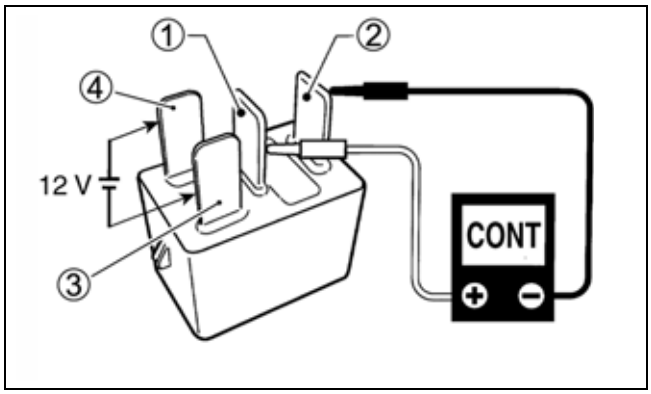


1. Starter relay 005568



005569

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



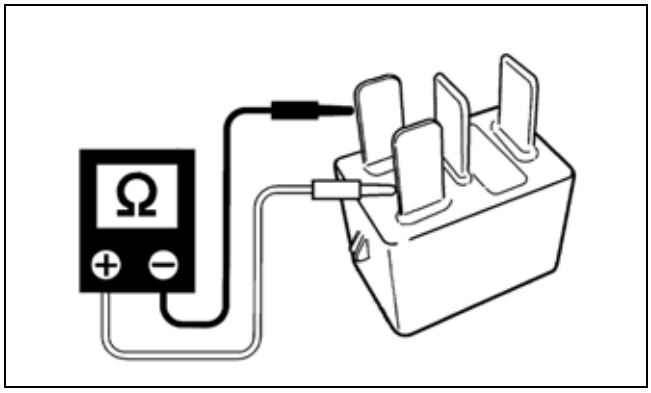
004731

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



004732

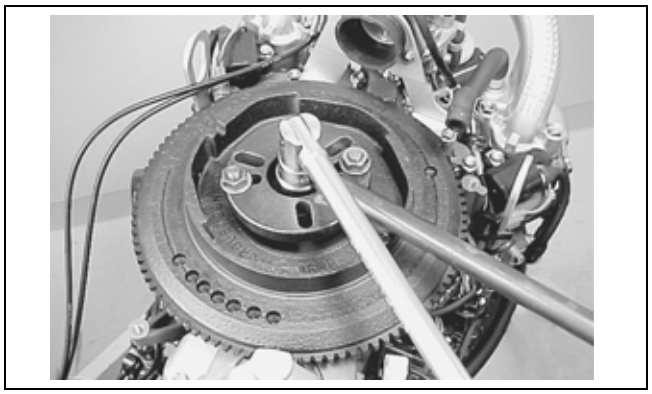
If any of the above measurements are out of specification, replace starter motor relay.

Starter Motor Service

Removal

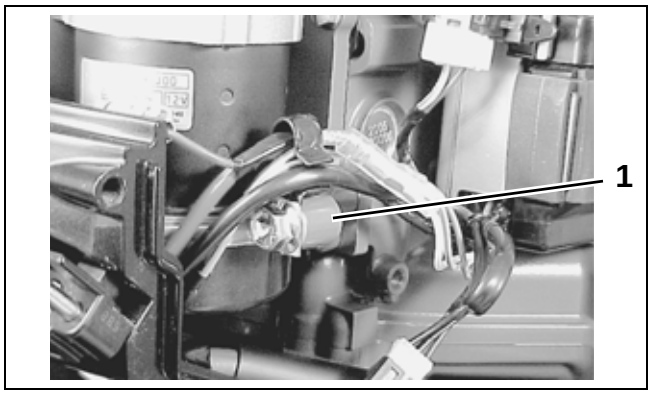
Remove engine side covers. Refer to side cover **Removal and Installation** on p. 177.

Remove flywheel cover and flywheel. Refer to component **Removal** on p. 99.



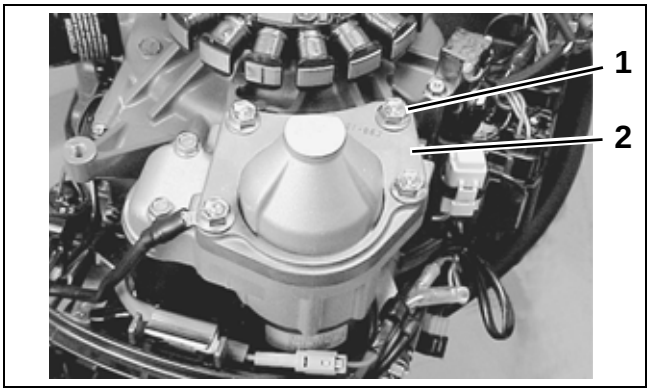
1. Flywheel 005570

Remove the PORT side screw securing starter motor band.



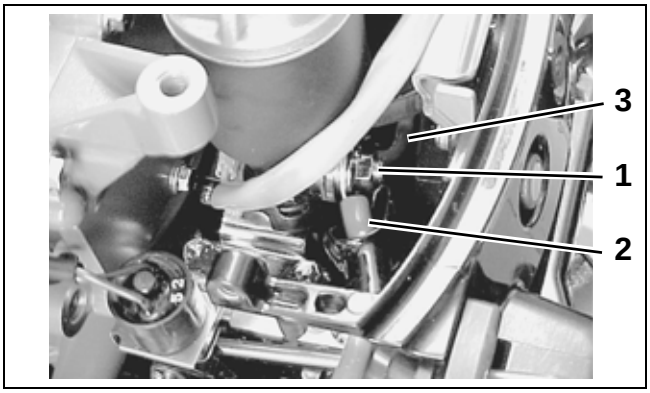
1. Starter motor band screw 005571

Remove four screws securing starter motor and bracket. Lift up and remove bracket.



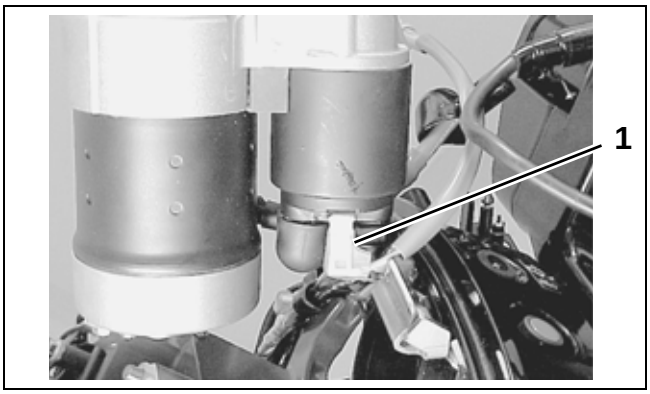
1. Starter motor bracket screws 005572
2. Bracket

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



1. Nut 005573
2. Battery cable
3. Battery charge cable

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



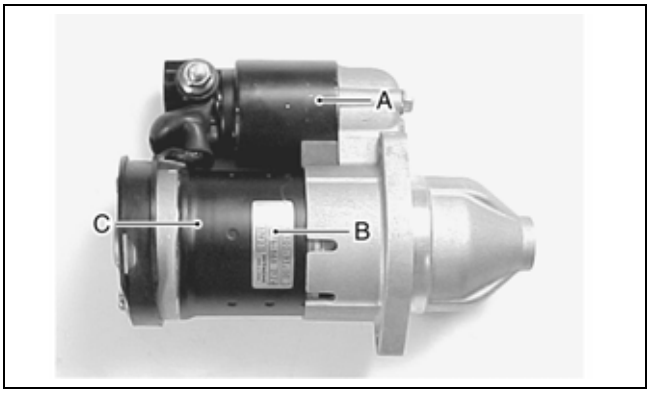
1. Magnetic switch “S” terminal 005574

Disassembly

When servicing starter motor, clean component parts thoroughly.

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

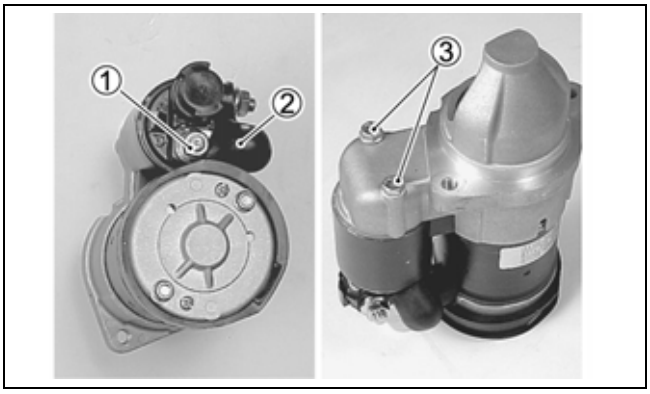
IMPORTANT: Before disassembling starter motor, put match marks at three locations (A, B, and C) to avoid any possible alignment mistakes.



004741

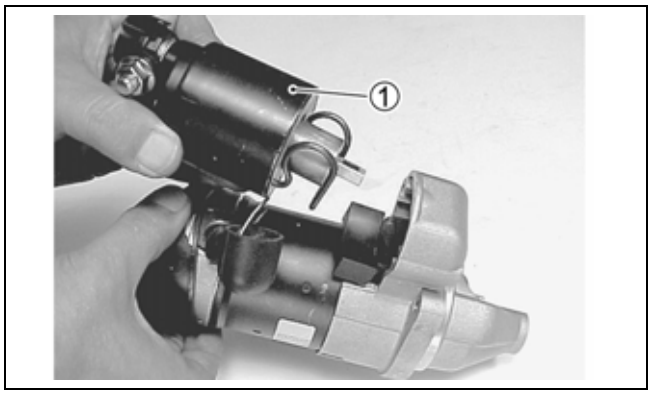
Remove nut from magnetic switch, then disconnect the connecting wire.

Remove two screws securing magnetic switch.



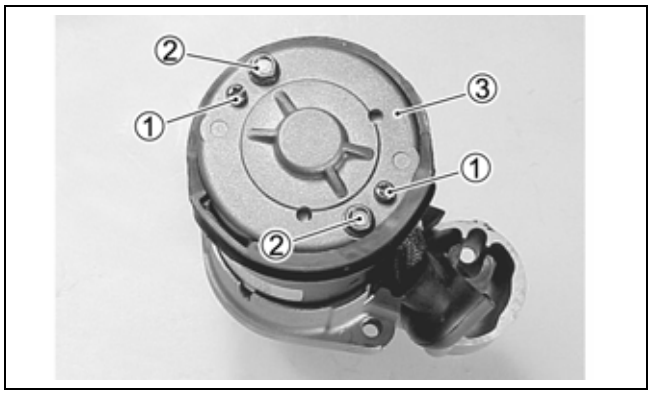
1. Nut 004742
2. Connecting wire
3. Magnetic switch screws

Remove the magnetic switch.



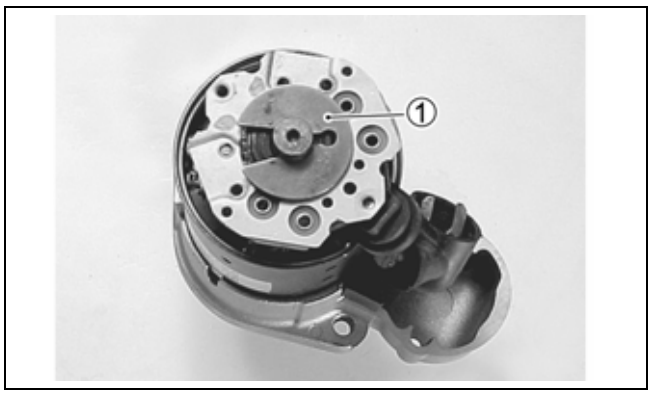
1. Magnetic switch 004743

Remove screws, long through bolts, and rear cover.



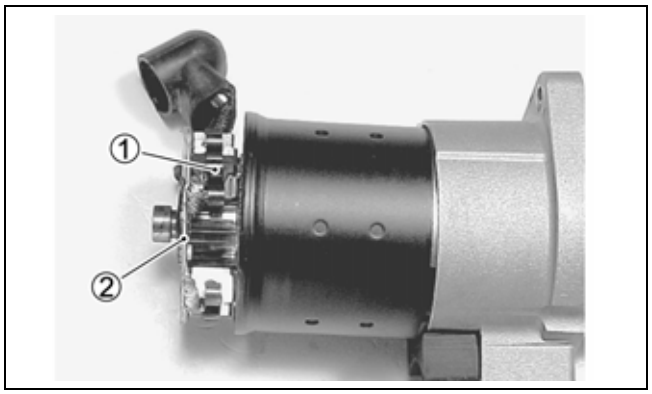
1. Rear cover screws 004744
2. Through bolts
3. Rear cover

Remove thrust washer with screwdriver.



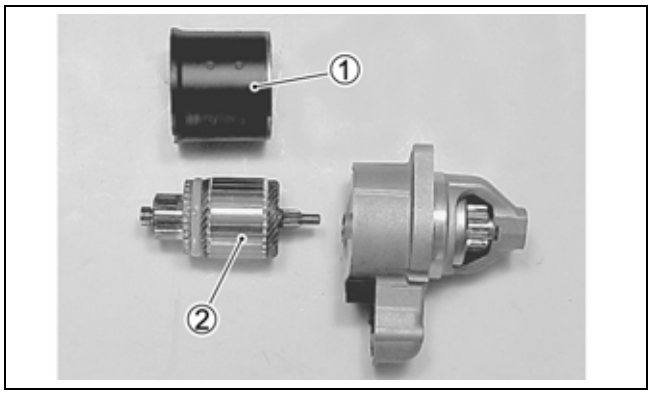
1. Thrust washer 004745

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



1. *Brush spring* 004746
2. *Brush holder*

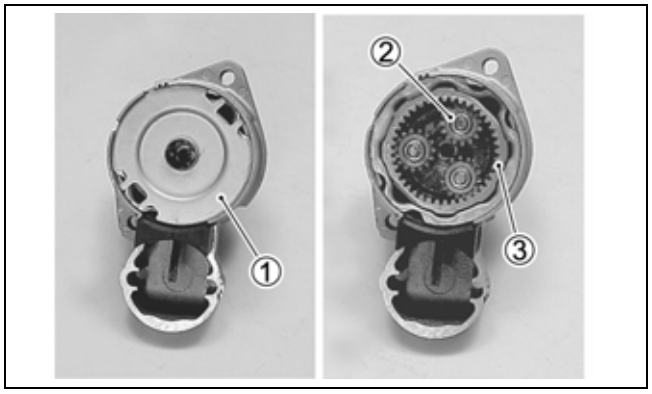
Remove the yoke and armature.



1. *Yoke* 004747
2. *Armature*

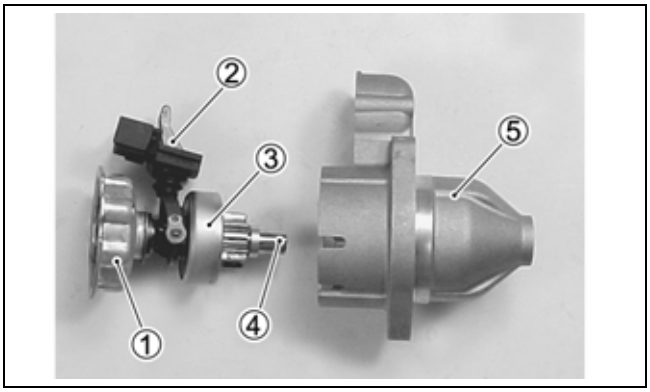
Remove the center cover plate.

Remove the planetary gears and internal gear.



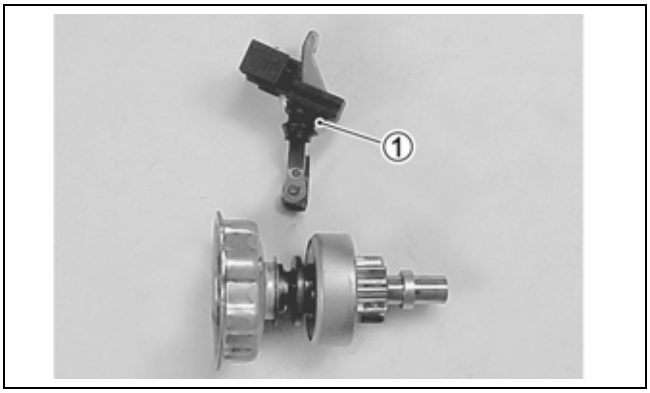
1. *Center cover plate* 004748
2. *Planetary gears*
3. *Internal gear*

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



1. *Center bracket* 004749
2. *Shift lever*
3. *Pinion*
4. *Pinion shaft*
5. *Front housing*

Remove the shift lever.



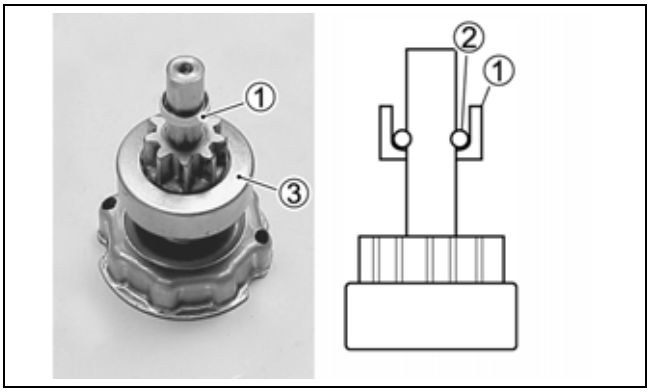
1. *Shift lever* 004750

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

Remove the pinion stopper and pinion.

⚠ WARNING ⚠

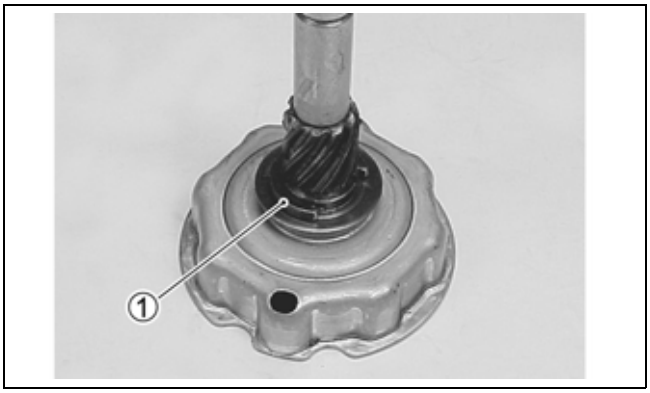
Wear safety glasses when disassembling and assembling stopper ring.



1. *Pinion stopper*
2. *Stopper ring*
3. *Pinion*

004751

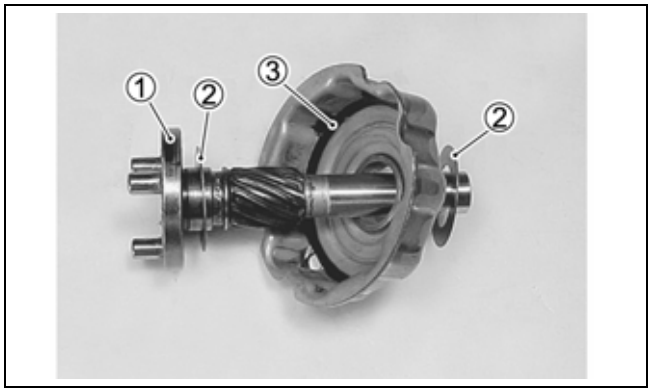
Remove the E-ring.



1. *E-ring*

004752

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



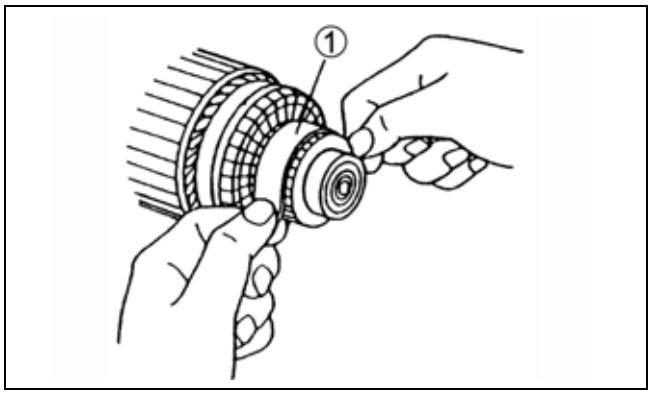
1. *Pinion shaft*
2. *Washers*
3. *Rubber ring*

004753

Inspection and Servicing

Armature and Commutator

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



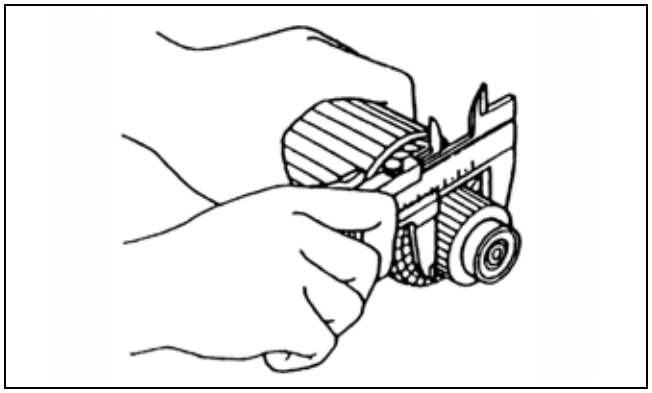
1. *Commutator*

004754

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.



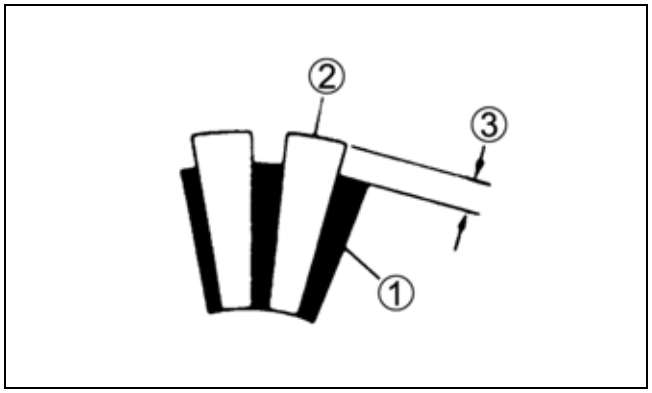
004755

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.

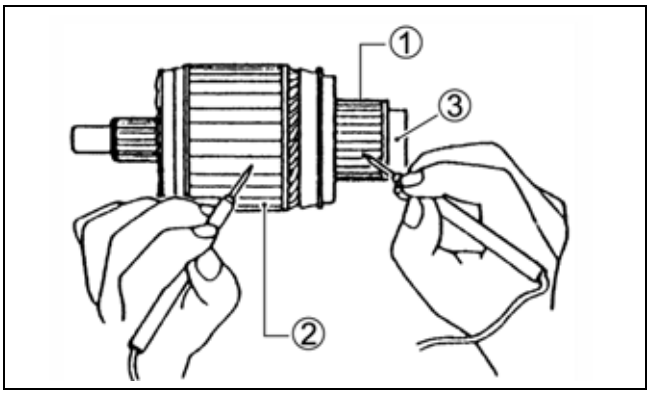
IMPORTANT: Remove all particles of mica and metal with compressed air.



1. Mica
2. Segment
3. Undercut

004756

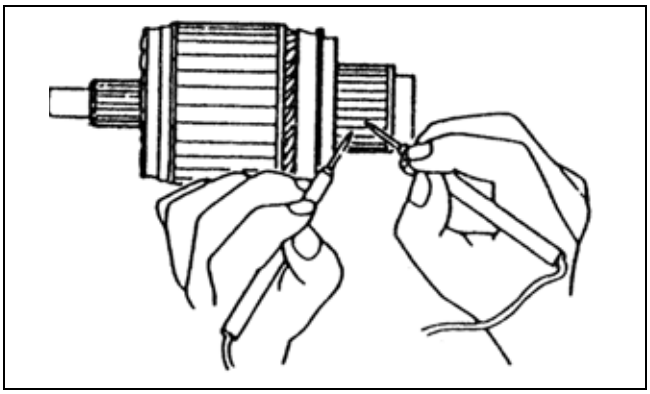
Check for continuity between the commutator and the armature core/shaft. Replace armature if continuity is indicated.



1. Commutator
2. Armature core
3. Armature shaft

004757

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



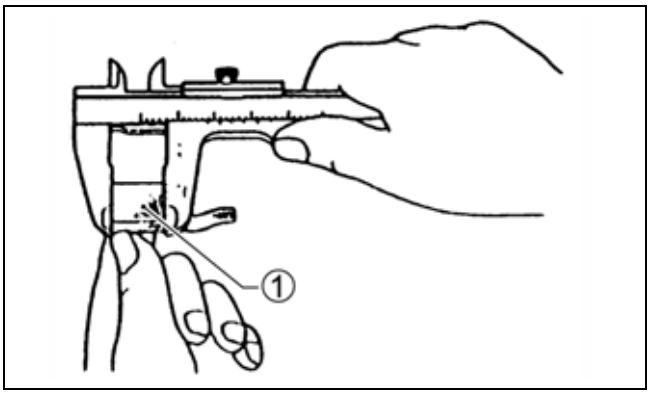
004758

Brushes

Check the length of each brush.

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

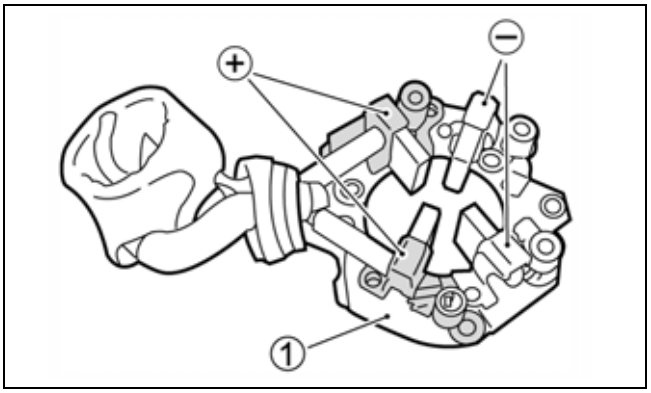
If brushes are worn to service limit, replace brushes.



1. Brush 004759

Brush Holder

Check brush holder continuity.



1. Base plate 004760

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.

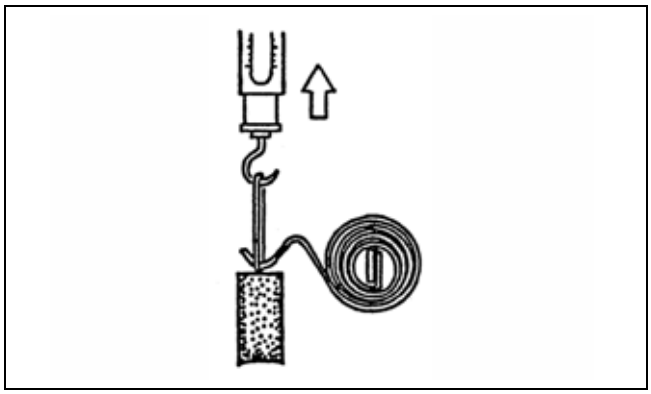
Brush Spring

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)

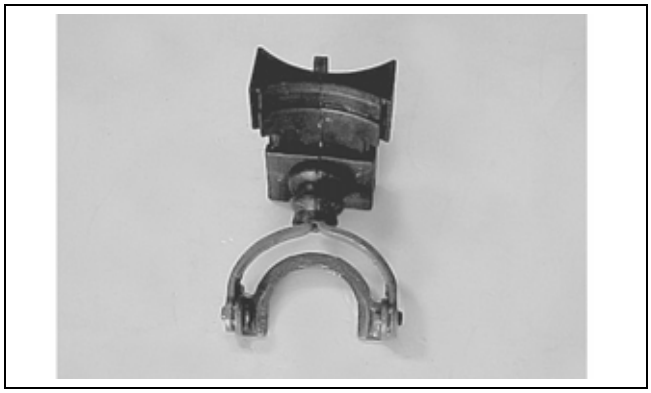
Replace if necessary.



004761

Shift Lever

Inspect shift lever for wear. Replace if necessary



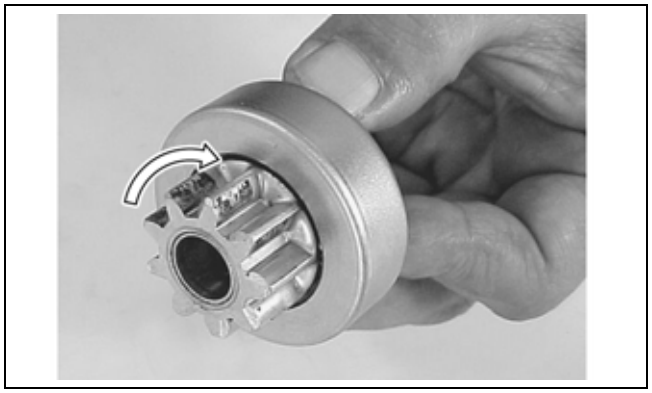
004762

Pinion and Over-Running Clutch

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

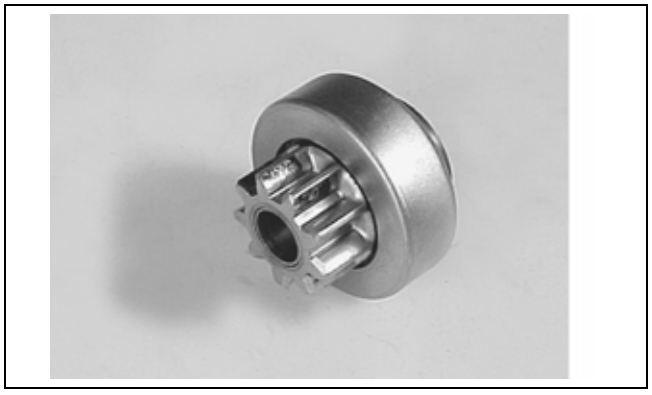
Check that clutch locks when turned in direction of drive and rotates smoothly in reverse direction.

Replace if necessary.



004763

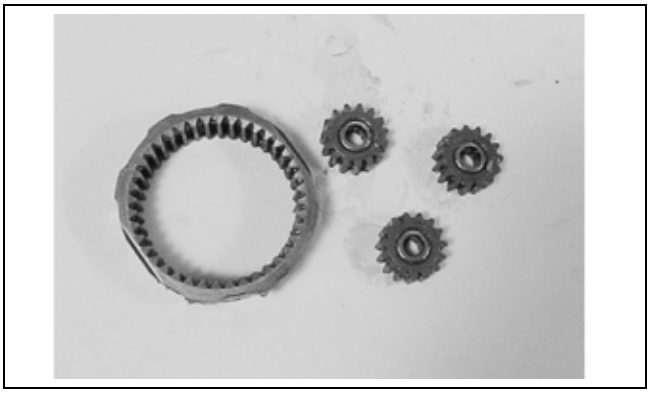
Inspect spline teeth for wear or other damage. Inspect pinion for smooth movement. Replace if necessary.



004764

Gear

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

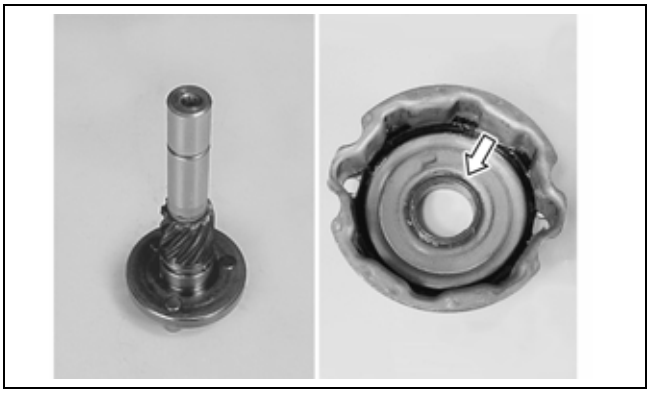


004765

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.

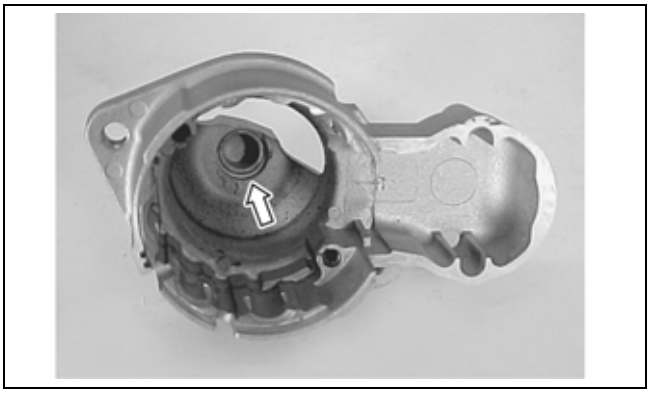


004766

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

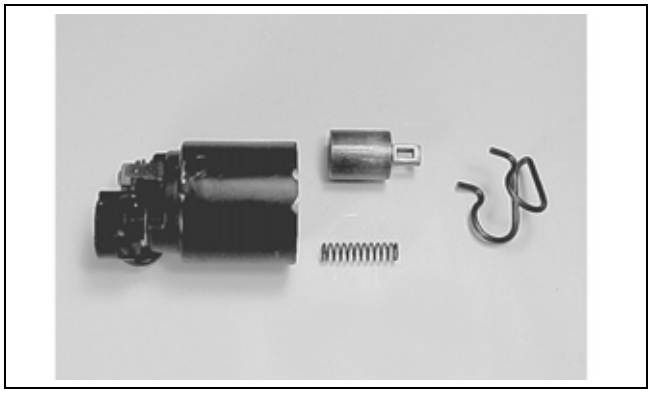
Armature Shaft Bushing

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

004768

Plunger

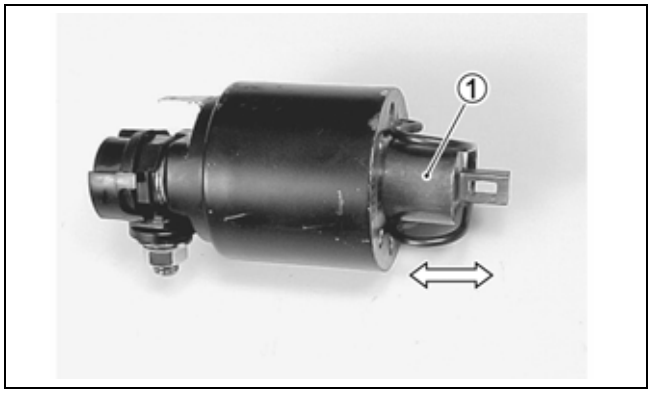
Inspect plunger for wear or other damage. Replace if necessary.



004769

Magnetic Switch

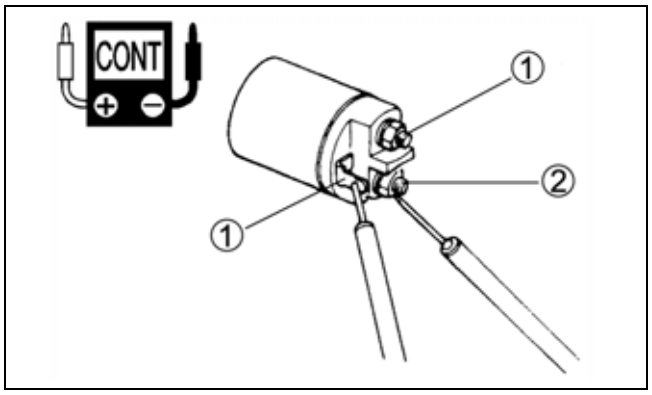
Push in plunger and release. The plunger should return quickly to its original position. Replace if necessary.



1. Plunger 004770

Check for continuity across magnetic switch “S” terminal and “M” terminal.

If no continuity, replace coil.

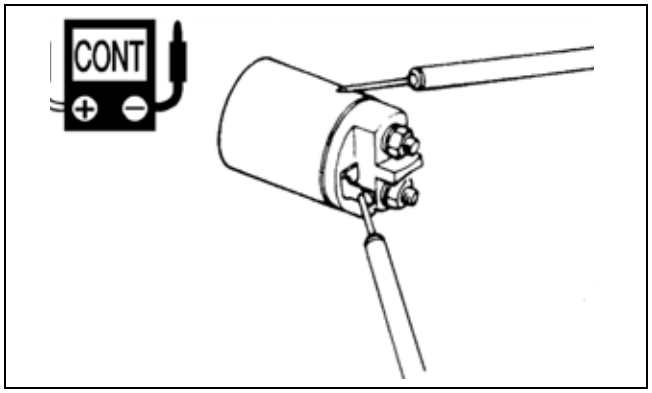


1. “S” terminal
2. “M” terminal
3. “B” terminal

004771

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

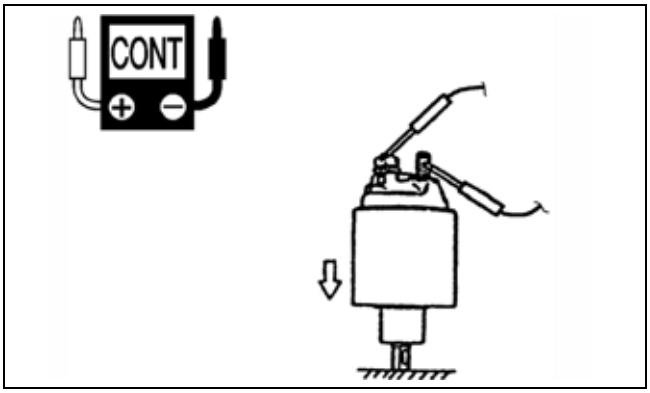
If no continuity, replace coil.



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.

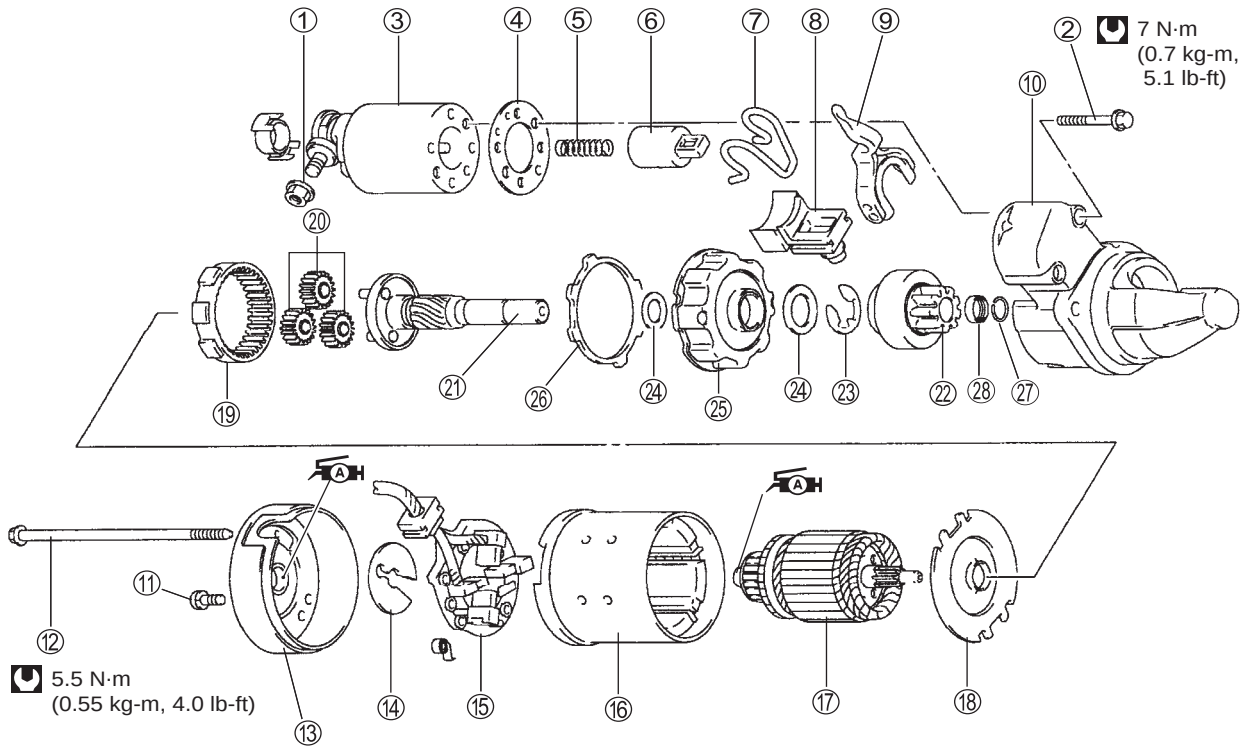


004773

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.



1. *Nut*
2. *Screw*
3. *Magnetic switch*
4. *Gasket*
5. *Spring*
6. *Plunger*
7. *Torsion spring*
8. *Rubber packing*
9. *Shift lever*
10. *Front housing*
11. *Screw*
12. *Through bolt*
13. *Rear cover*
14. *Thrust washer*
15. *Brush holder*
16. *Yoke*
17. *Armature*
18. *Center cover plate*
19. *Internal gear*
20. *Planetary gear*
21. *Pinion shaft*
22. *Pinion*
23. *E-ring*
24. *Washer*
25. *Center bracket*
26. *Rubber ring*
27. *Stopper ring*
28. *Pinion stopper*

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

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.

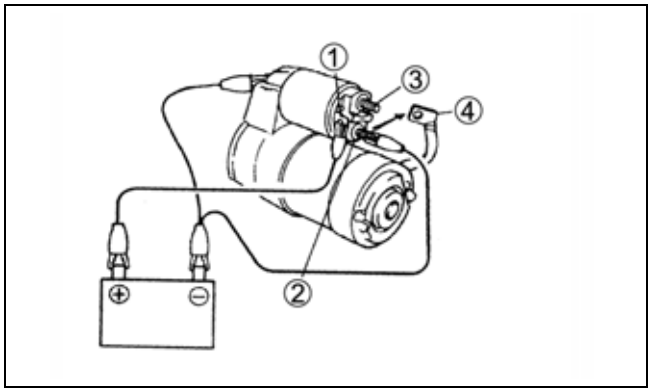
Pull-In/Hold-In Test

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."

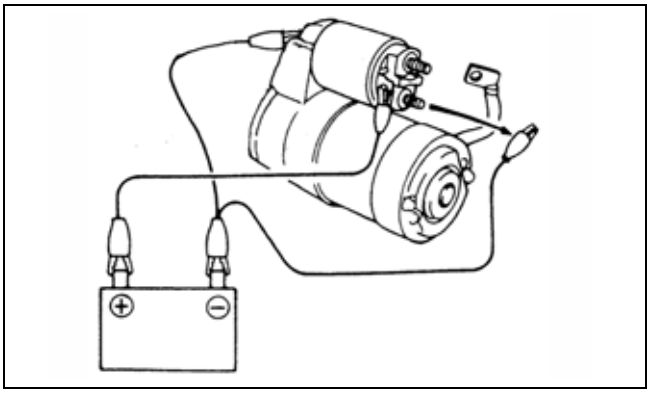


004774

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

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.

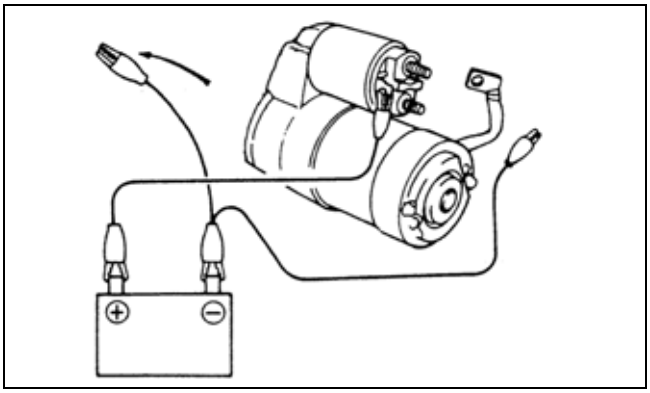


004775

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.



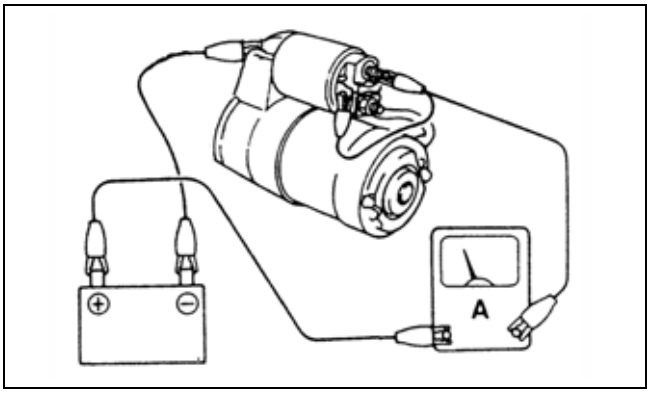
004776

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.

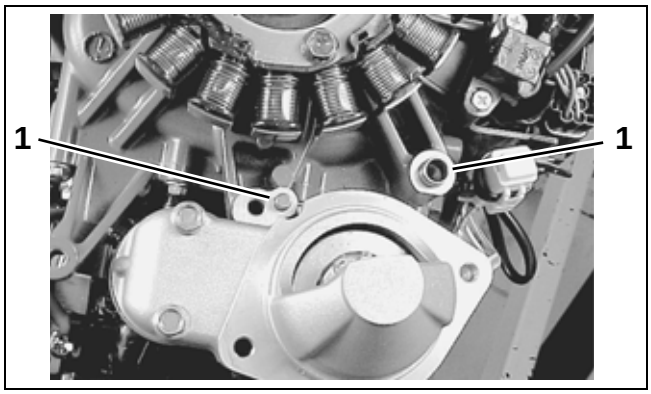


004777

Installation

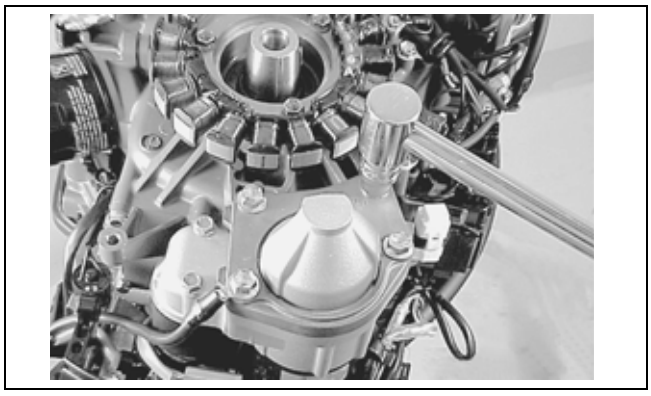
Installation is reverse order of removal with special attention to the following steps:

Place starter motor in position, then install two dowel pins and motor bracket.



1. Dowel pins 005575

Tighten starter and bracket screws to 16.5 ft. lbs. (23 N·m).



005576

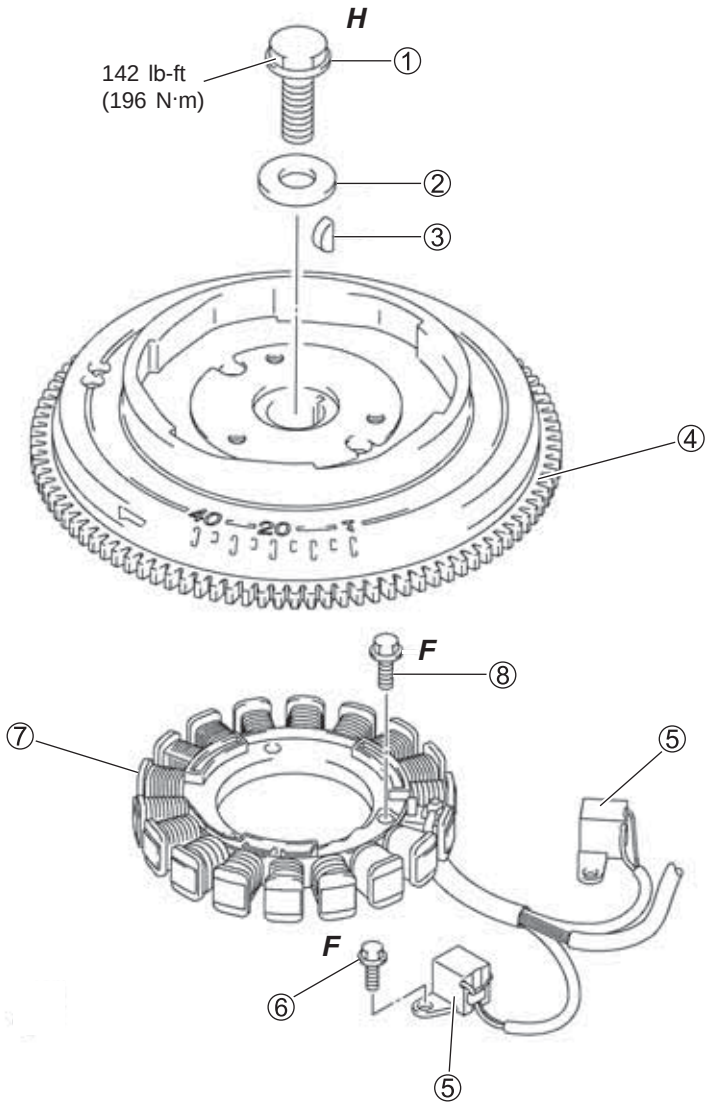
Check wire routing. Refer to **WIRE ROUTING** on p. 229.

IGNITION SYSTEM

TABLE OF CONTENTS

SERVICE CHART

① Flywheel bolt
② Washer
③ Key
④ Flywheel
⑤ Crankshaft position sensor
⑥ Screw
⑦ Charge coil (Stator)
⑧ Bolt



NOTE:
Clean flywheel and crankshaft mating surfaces with cleaning solvent.

A ***Triple-Guard Grease***	**F** ***Blue Nut Lock***
B ***Gasket Sealing Compound***	**H** ***Outboard Lubricant***
C ***Adhesive 847***	**R** ***DPL Penetrating Lube***
D ***Moly Lube***	**W** ***HPF XR Gear Oil***

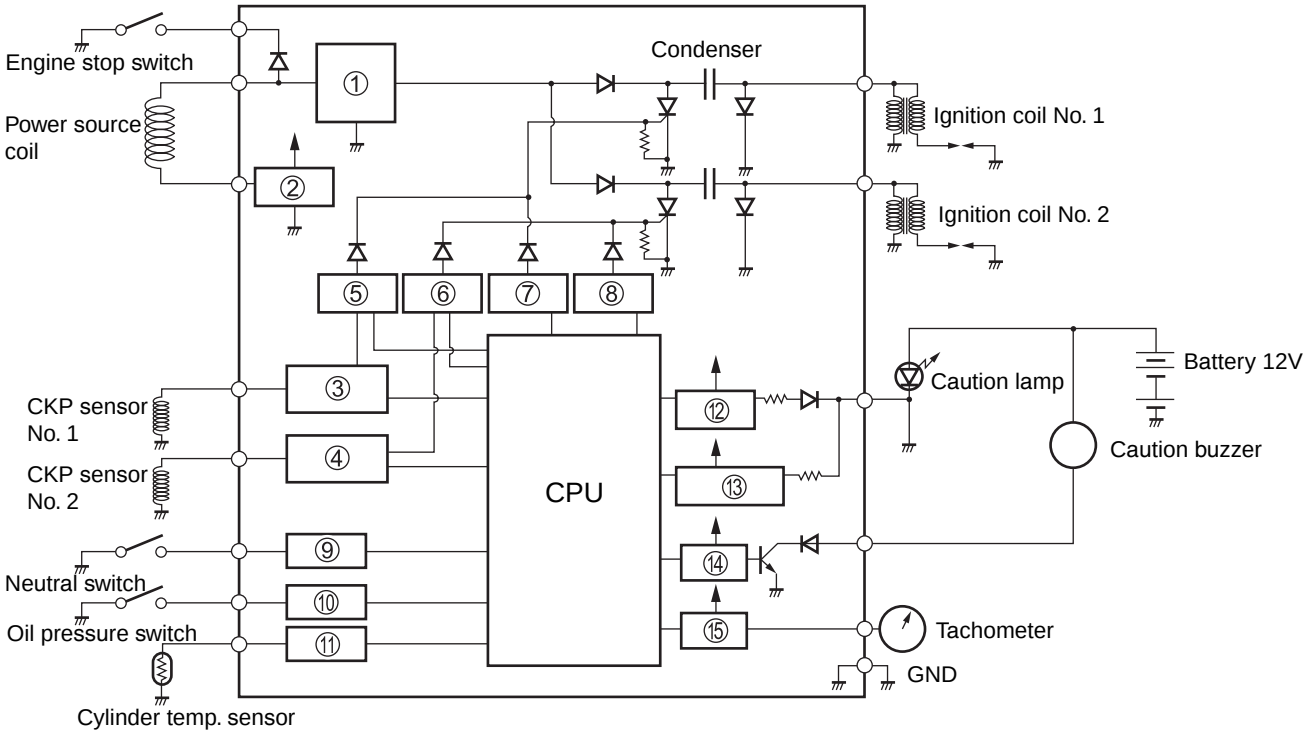
005571

OPERATION

The ignition system is a condenser discharge type. The condenser built in the CDI unit stores the electrical energy generated by the power source coil (stator).

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 crankshaft position sensor signals.

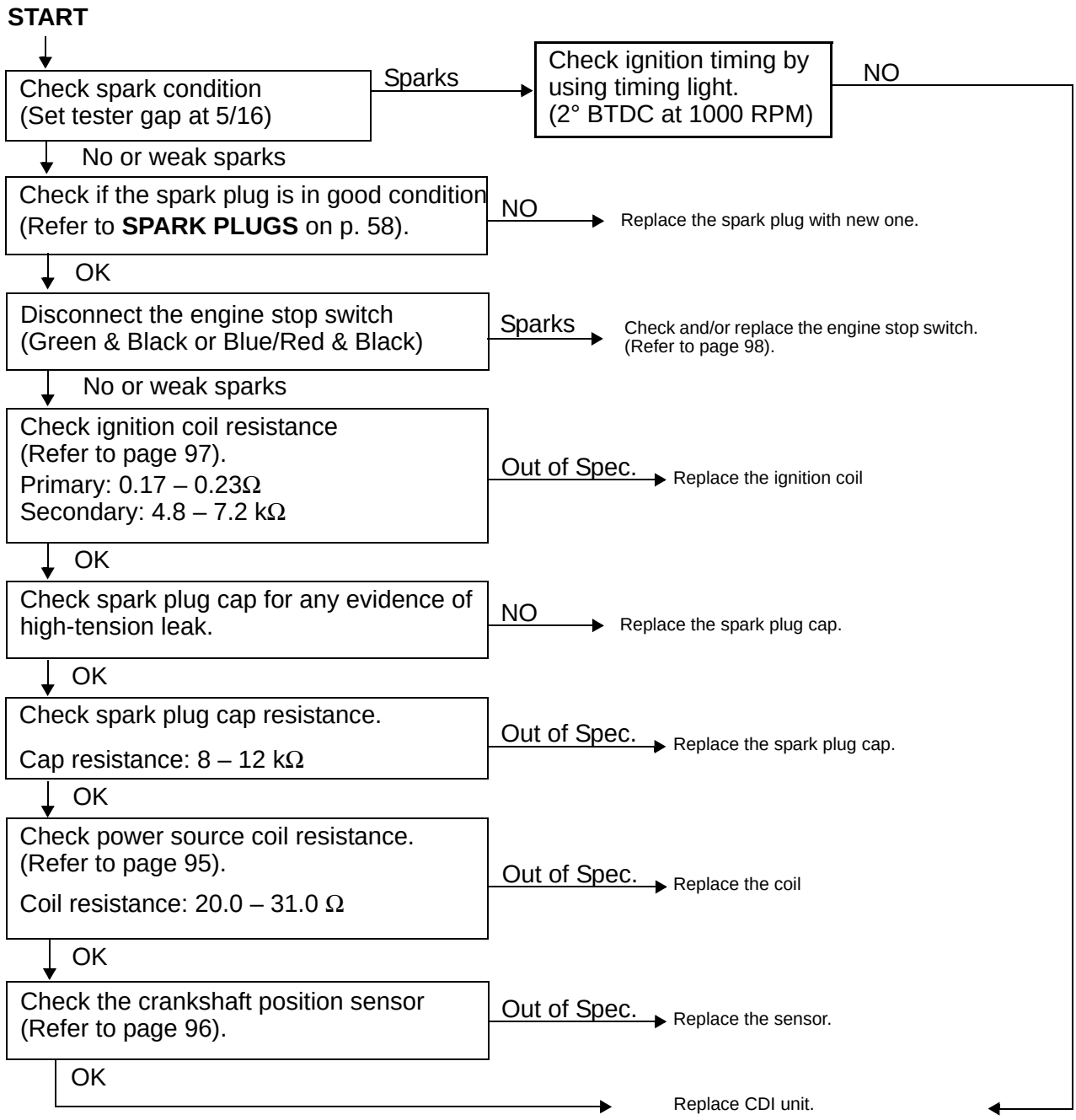
Ignition timing varies based upon engine speed. Timing is fixed at 10° BTDC until the engine starts. Timing then varies from 2° BTDC to 27° BTDC based on engine speed.



① Power source circuit (Charging circuit)
② Power source circuit
③ Noise filter circuit #1
④ Noise filter circuit #2
⑤ Hardware ignition signal circuit #1
⑥ Hardware ignition signal circuit #2
⑦ Software ignition signal control circuit #1
⑧ Software ignition signal control circuit #2
⑨ Input circuit
⑩ Input circuit
⑪ Input circuit
⑫ Caution lamp output circuit
⑬ Oil caution lamp output circuit
⑭ Output circuit
⑮ Output circuit

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.

Power Source Coil (Stator)

Output Test

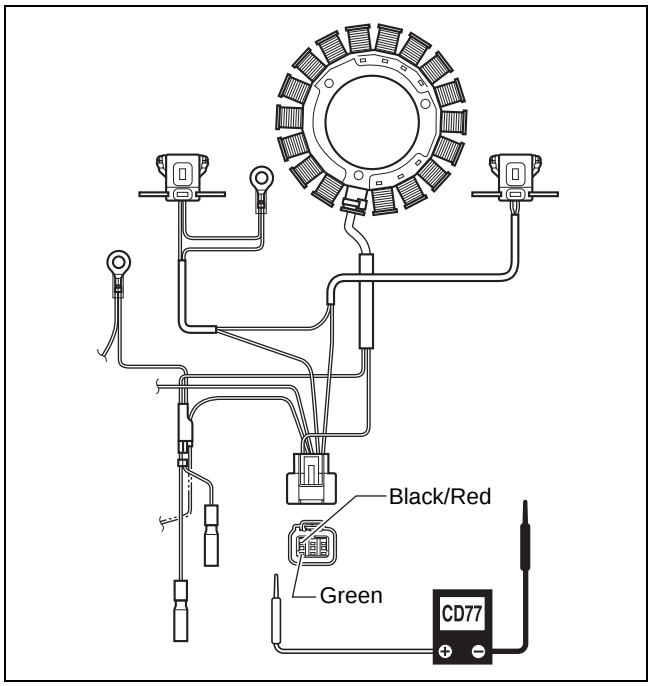
Disconnect power source coil lead wire connector from CDI unit.

Connect Peak Reading Voltmeter to coil lead wires as shown. Set tester range to POS 500.

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

Remove spark plugs. Crank with starter.

Power source coil output:
- 20 V or over



005577

If measurement is out of specification, replace power source coil.

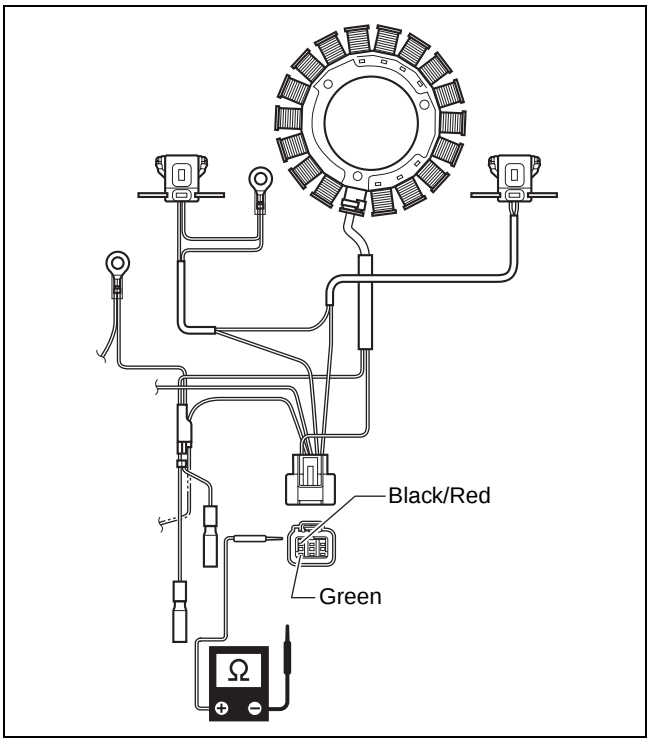
Resistance Test

Disconnect power source coil lead wire connector from CDI unit.

Connect ohmmeter to coil lead wires as shown:

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

Power source coil resistance:
- 20.0 to 31.0 Ω



005573

If measurement is out of specification, replace power source coil.

Crankshaft position Sensor

Output Test

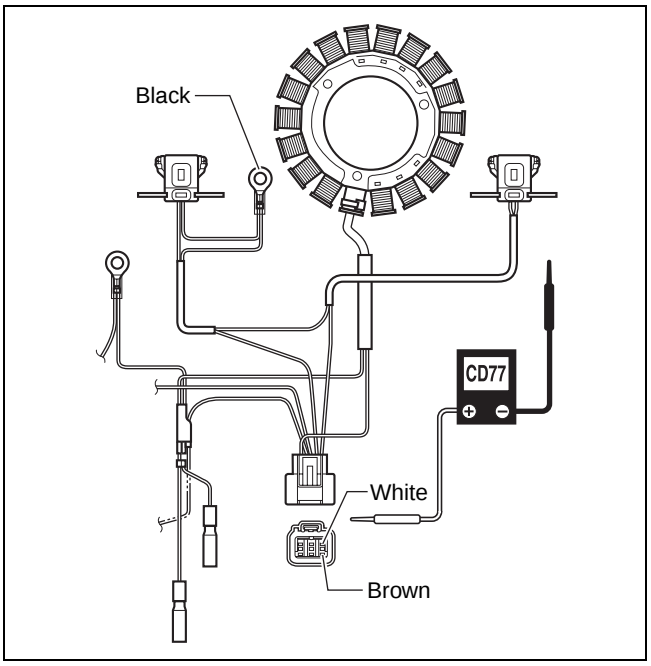
Disconnect crankshaft position sensor lead wire connector from CDI unit.

Connect Peak Reading Voltmeter to sensor lead wires as shown. Set tester range to SEN 50:

Sensor	Tester probe connection	
	+ (Red)	- (Black)
No. 1	White	Black
No. 2	Brown	

Remove spark plugs. Crank with starter.

Crankshaft position sensor output:
- White & black – 3.6 V or over
- Brown & black – 3.6 V or over



005578

If measurement is out of specification, replace power source coil.

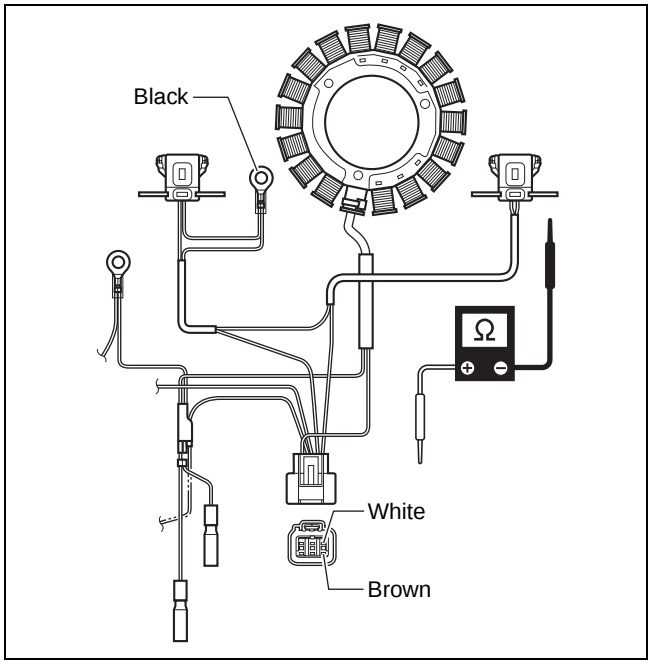
Resistance Test

Disconnect sensor lead wire connector from CDI unit.

Connect ohmmeter test probes to coil lead wires as shown:

Sensor	Tester probe connection	
	+ (Red)	- (Black)
No. 1	White	Black
No. 2	Brown	

Pulser coil resistance:
- White & black – 148 to 222 Ω
- Brown & black – 148 to 222 Ω



005574

If measurement is out of specification, replace the crankshaft position sensor.

Ignition Coil

Primary Resistance Test

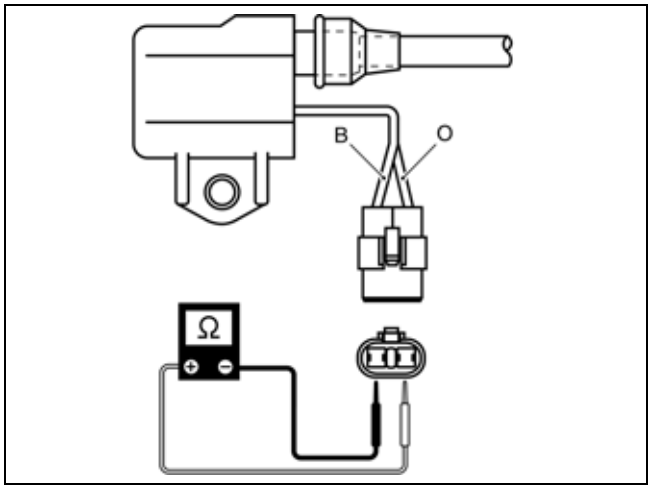
Disconnect ignition coil lead wire connector from engine harness.

Connect ohmmeter test probes to coil lead wires as shown:

Tester probe connection	
+ (Red)	**-** (Black)
Orange	Black

Primary ignition coil resistance:

- 0.17 to 0.23 Ω



005575

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

Secondary Resistance Test

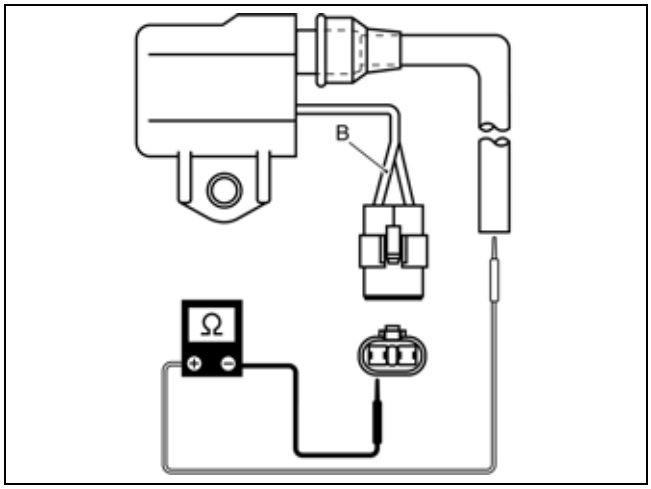
Remove the spark plug caps from the high-tension leads.

Connect ohmmeter test probes black primary lead and to the high-tension lead as shown:

Tester probe connection	
+ (Red)	**-** (Black)
High-tension lead	Black

Secondary ignition coil resistance:

- 4.8 to 7.2 kΩ



005576

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

CDI Unit

Output Test

Disconnect 6 pin wire harness connector from CDI unit.

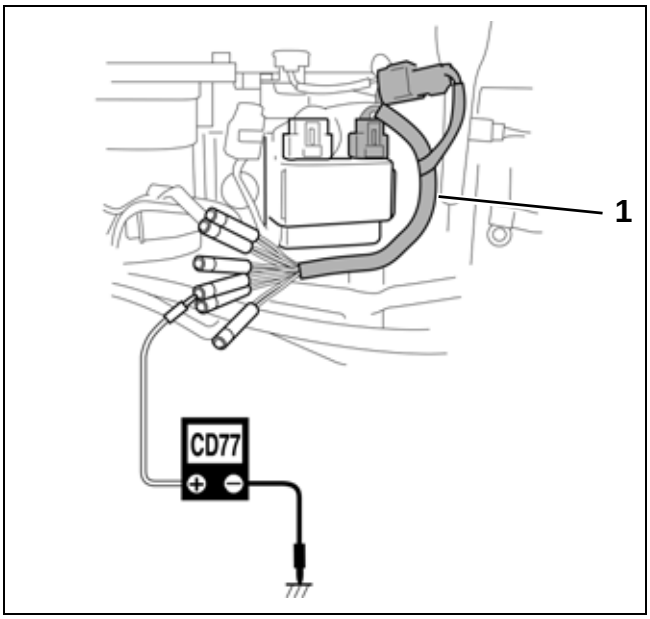
Connect 6 pin Test Cord, P/N 5034231, between CDI unit and wire harness.

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

Igniton coil	Tester probe connection	
	+ (Red)	- (Black)
No. 1	Test cord gray wire	Black (Ground)
No. 2	Test cord pink/black wire	

Remove spark plugs. Crank with starter.

CDI unit output:
- 105 V or over



1. 6 Pin test cord 005579

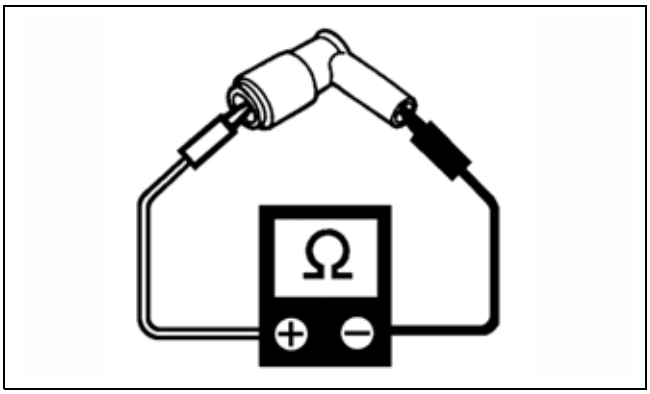
If measurement is out of specification, replace power source coil.

Spark Plug Cap

Resistance Test

Measure spark plug cap resistance.

Spark plug cap resistance:
- 8 to 12 kΩ



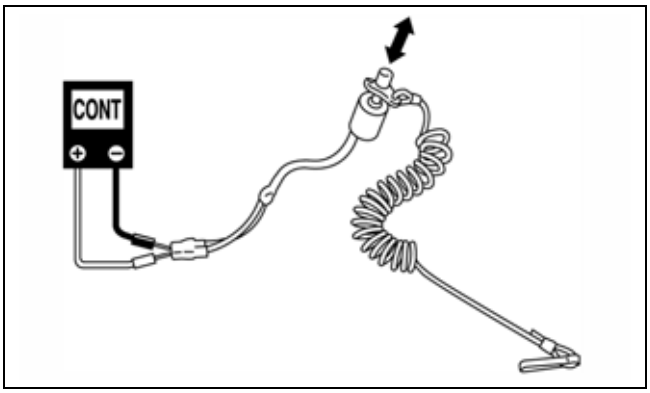
004698

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.

Disconnect the battery cables at the battery.

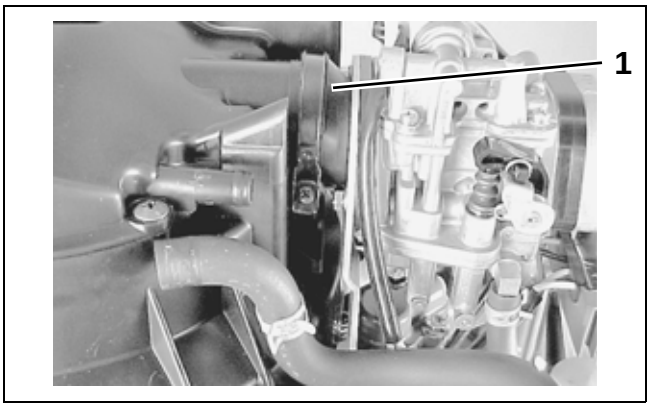
Twist and remove spark plug leads.

Remove flywheel cover as follows:

Loosen clamp securing breather hose, then remove breather hose from flywheel cover.

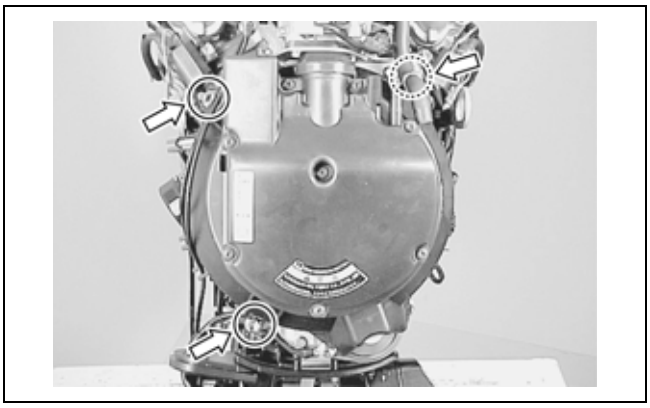
1. Breather hose 005580

Loosen the clamp securing outlet tube to flywheel cover.



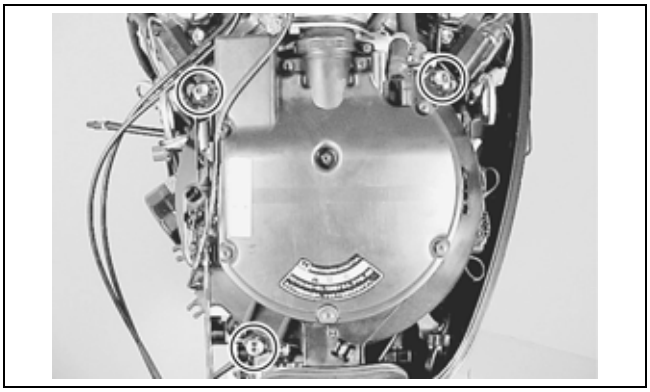
1. Outlet tube clamp 005581

Remove three bolts and flywheel cover.



005582

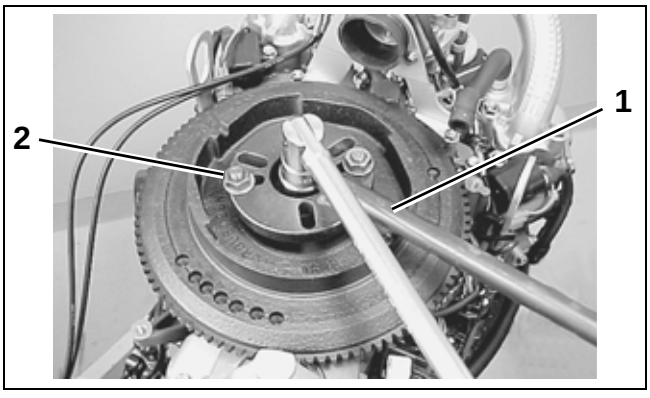
Remove manual starter if applicable. Refer to starter **REMOVAL** on p. 219.



005583

Use Flywheel Holder, P/N 5034227, and Screws, P/N 5034235 to loosen the flywheel bolt 2-3 turns.

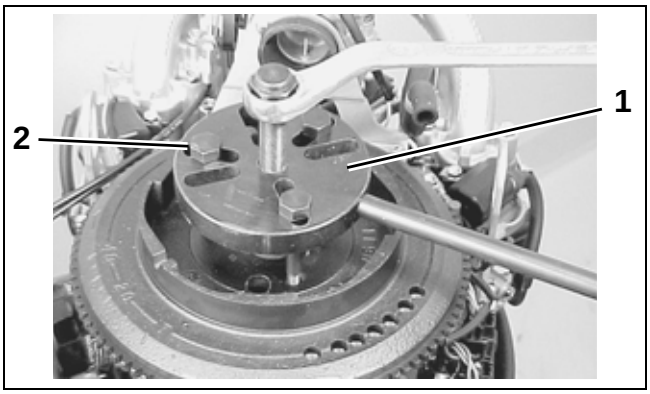
IMPORTANT: Do not remove flywheel bolt at this time to avoid damage to crankshaft when using flywheel puller.



1. Flywheel holder 005584
2. Screw and washer set

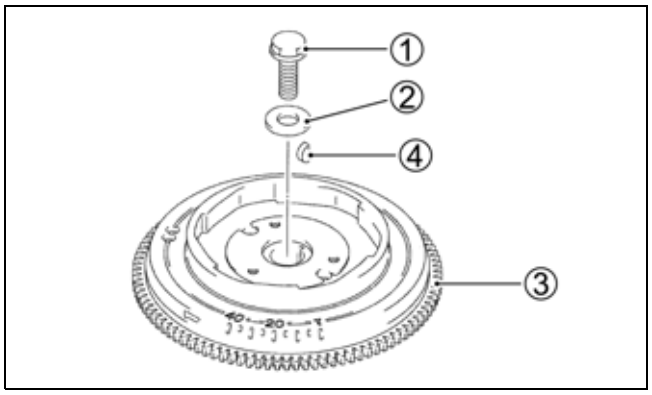
Use Universal Puller Set, P/N 378103, and Screws, P/N 5034235, to loosen flywheel from crankshaft.

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.



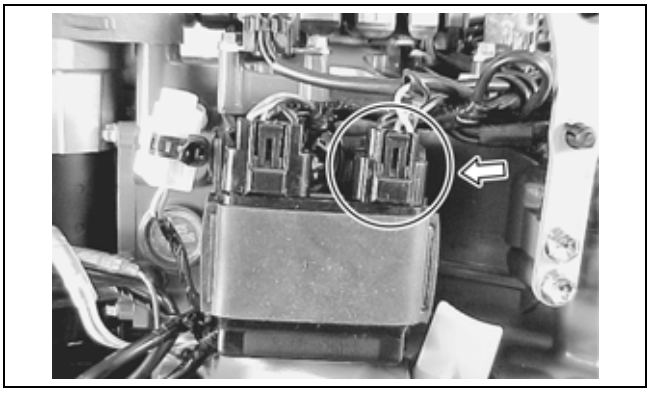
1. Universal puller 005585
2. Screw and washer set

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



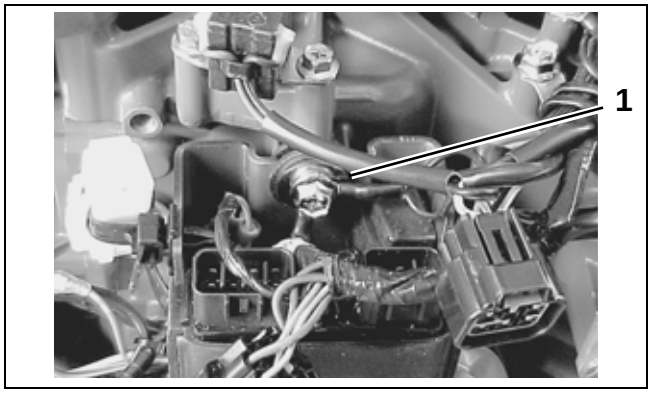
1. Flywheel bolt 005586
2. Washer
3. Flywheel
4. Key

Disconnect the 6-pin wiring harness connector from CDI unit.



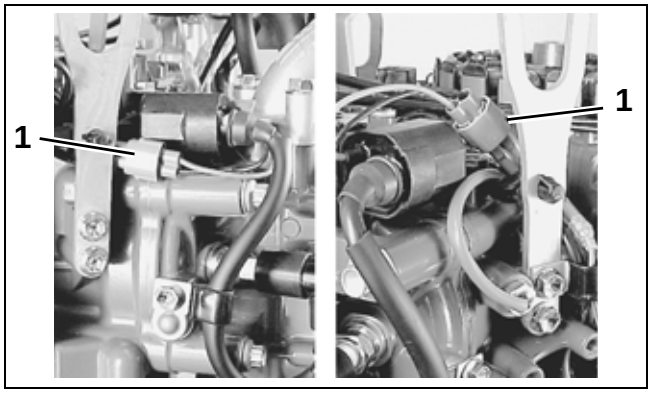
005587

Remove bolt securing the ignition coil ground wire.



1. Coil ground lead 005588

Disconnect ignition coil lead connectors.

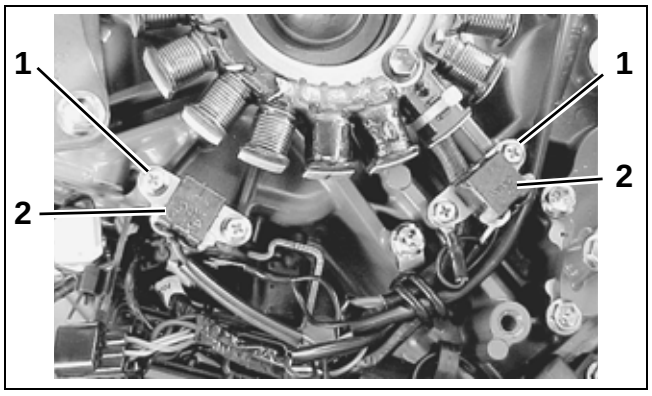


1. Ignition coil lead connectors 005589

Disconnect Red and Yellow lead wire from rectifier & regulator.

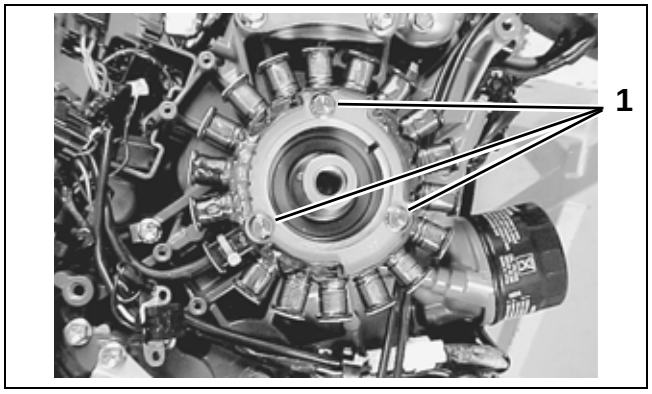
005590

Remove screws and crankshaft position sensors.



1. Sensor screws 005591
2. Crankshaft position sensors

Remove three screws, then remove charge coil and power source coil (stator).



1. Stator screws 005592

Installation

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

Apply *Nut Lock* to threads of stator screws and tighten screws securely.

Apply *Nut Lock* to threads of crankshaft position sensor screws and tighten screws securely.

Clean flywheel and crankshaft mating surfaces with cleaning solvent.

Apply outboard lubricant to flywheel bolt and washer before installing.

Use Flywheel Holder, P/N 5034227, and Screws, P/N 5034235 to hold the flywheel. Tighten bolt to 142 ft. lbs. (196 N·m).

005593

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

Related Documents

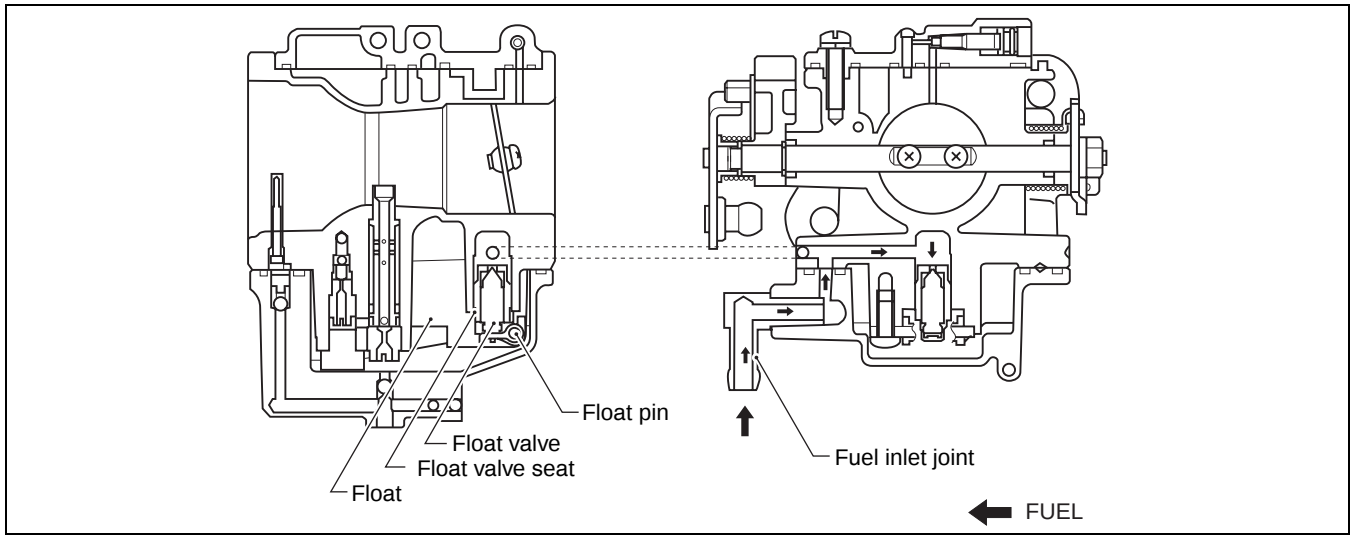
Bulletins	
Instruction Sheets	
Other	

FUEL SYSTEM

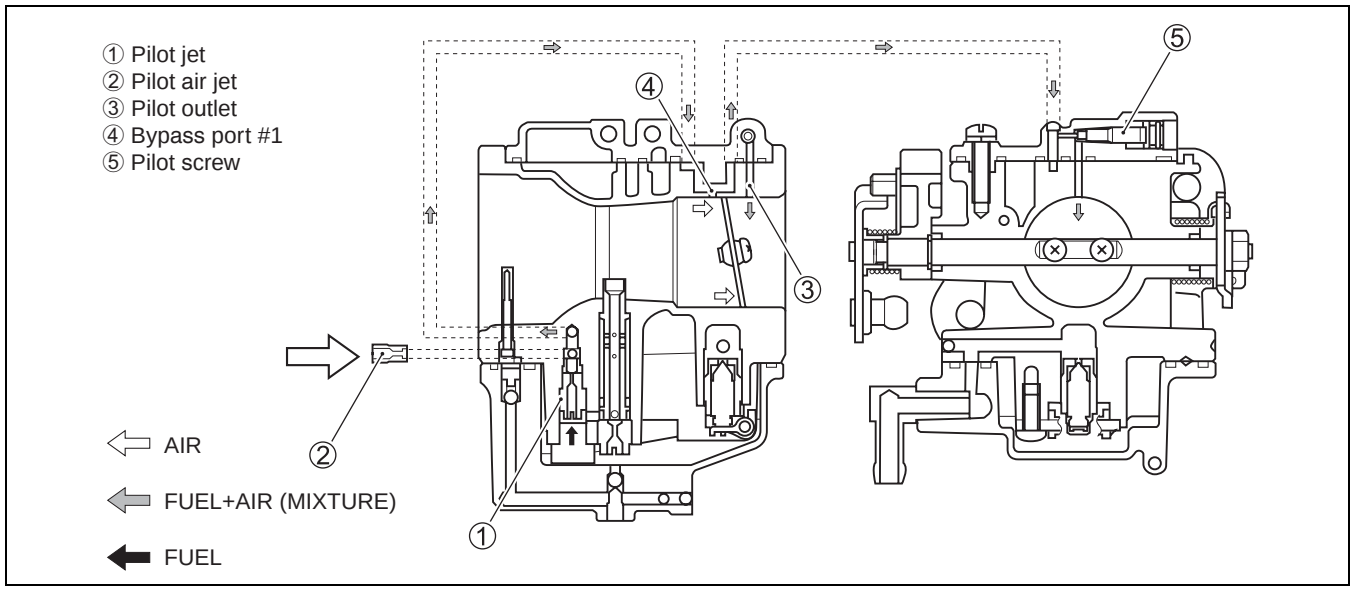
TABLE OF CONTENTS

CARBURETOR OPERATION

Float System



Idling/Trolling



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

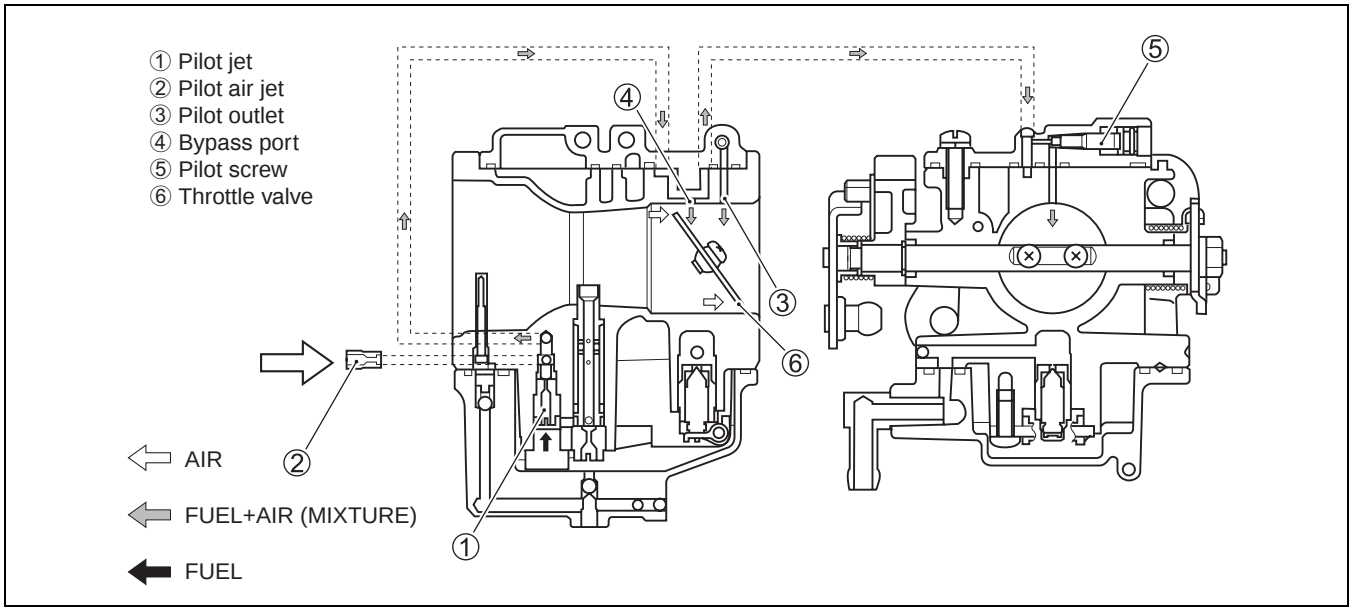
This mixture passes through the pilot screw seat and is jetted from the pilot outlet and bypass port #1.

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.

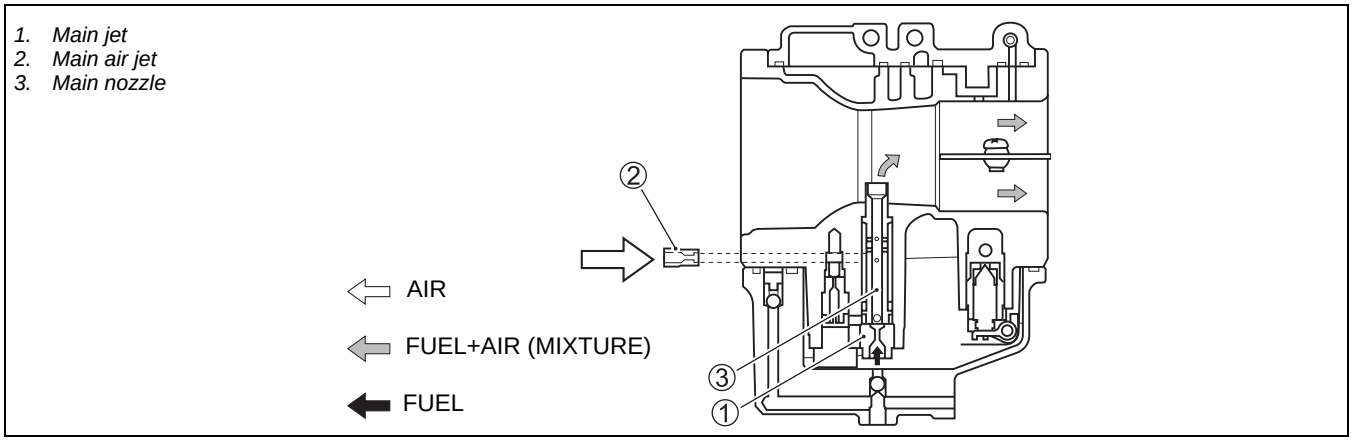
The throttle stop screw adjusts idling/trolling speed. When the stop screw is turned clockwise (screwed in), the speed raises and when turned counterclockwise (screwed out), the speed lowers.

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.

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

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

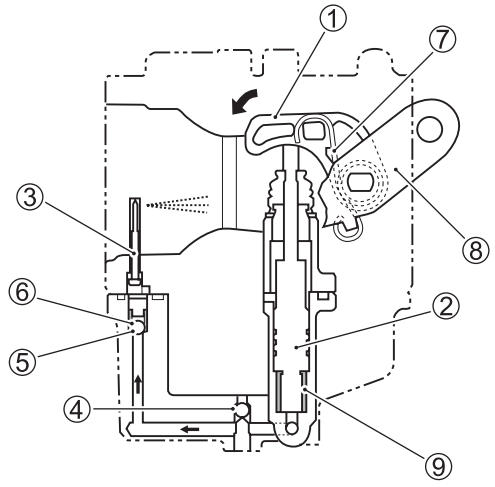
The accelerator pump compensates for such a fuel deficiency. This is a plunger type pump that pressure feeds fuel, at the time of quick acceleration, to the acceleration pump nozzle, which sprays fuel into the main bore. With this provision, the engine can be accelerated smoothly.

Operation

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.

1. *Accelerator pump lever*
2. *Plunger*
3. *Acceleration nozzle*
4. *Lower check valve*
5. *Upper check valve*
6. *Spring*
7. *Spring*
8. *Throttle lever*
9. *Lower spring*



AIR

FUEL+AIR (MIXTURE)

FUEL

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.

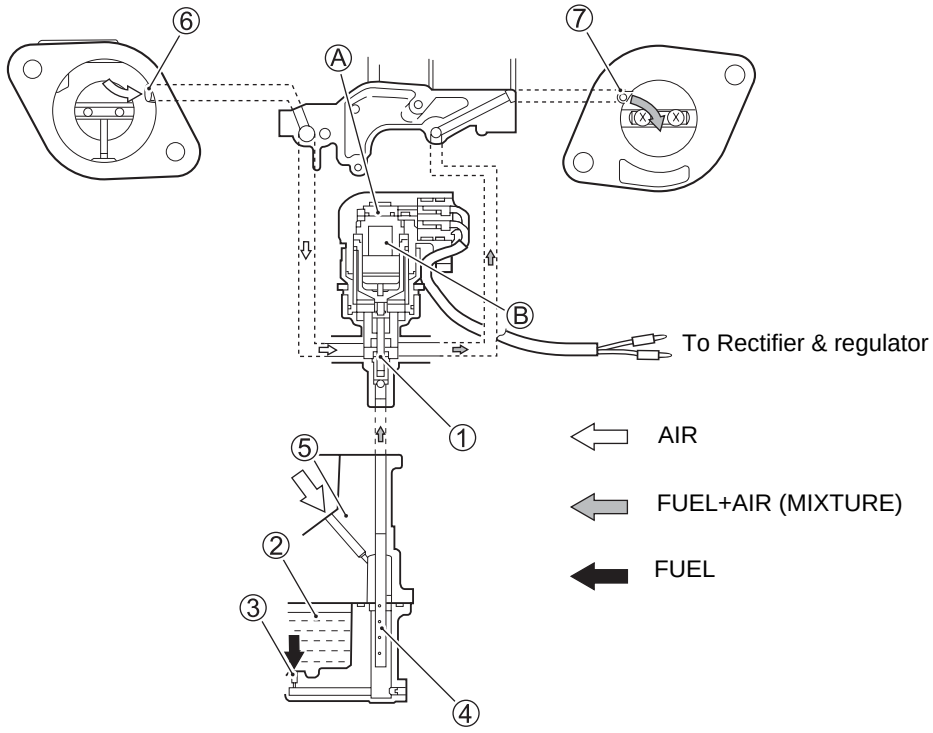
The enrichener jet meters this fuel, which then flows into fuel pipe and mixes with the air coming from the upper part of the float chamber. The mixture, rich in fuel content, reaches upper part of the fuel pipe and mixes again with air coming through a passage extending from main bore.

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.

A PTC heater
B Thermo-wax
1. Plunger/needle
2. Float chamber
3. Enrichener jet
4. Fuel pipe
5. Upper float chamber
6. Main bore
7. Starter outlet port



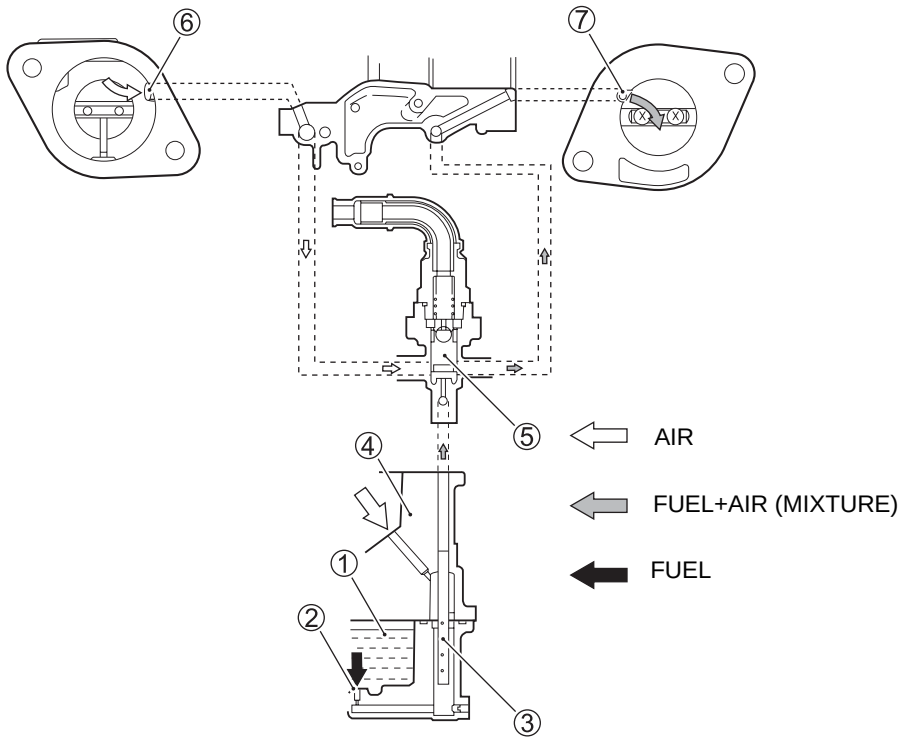
Manual Starter System

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

The 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.

1. *Float chamber*
2. *Starter jet*
3. *Fuel pipe*
4. *Float chamber*
5. *Starter plunger*
6. *Main bore*
7. *Starter outlet port*



CARBURETOR SERVICE

Removal

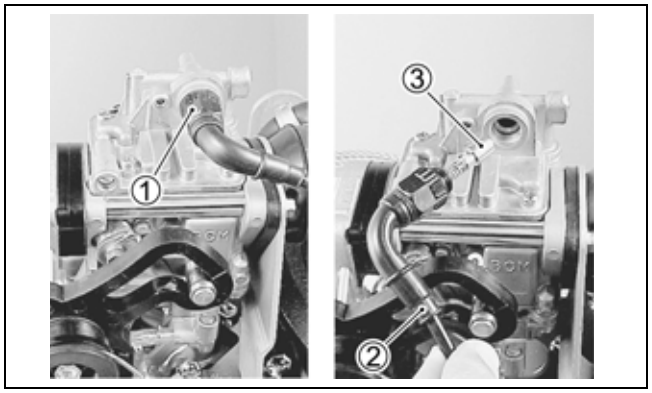
Remove the STBD side cover. Refer to side cover **Removal and Installation** on p. 177.

Remove recoil starter (rope start models). Refer to starter **REMOVAL** on p. 219.

Remove flywheel cover (electric start models). Refer to ignition **COMPONENT SERVICING** on p. 99.

Tiller models:

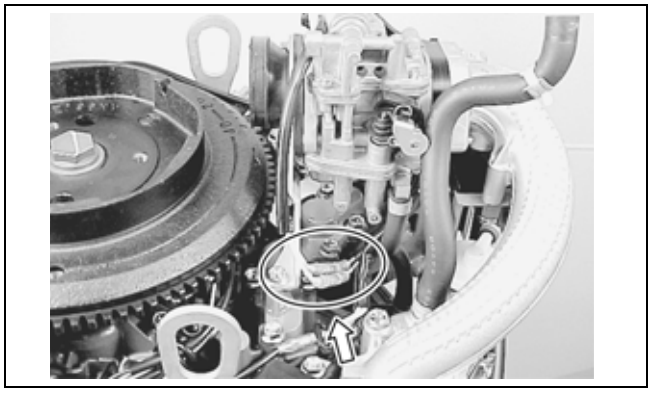
- Unscrew the starter cable lock nut, then remove starter cable with starter plunger.



1. *Starter cable lock nut* 005597
2. *Starter cable*
3. *Starter plunger*

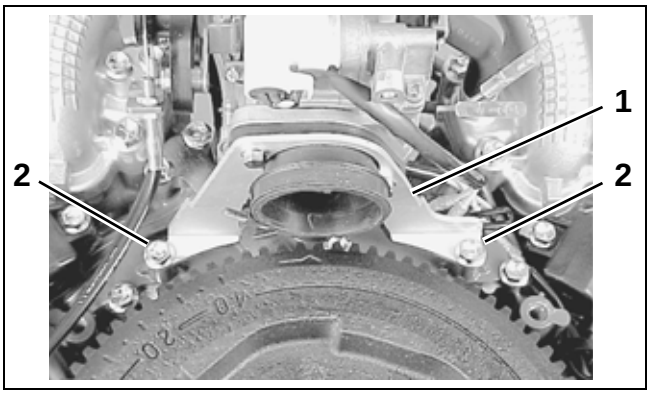
Remote models:

- Disconnect the auto-enrichener lead wire connector.



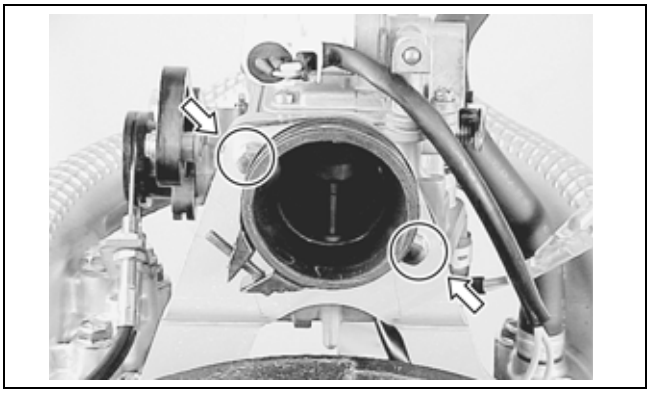
005598

Remove two screws securing plate.



1. *Plate* 005599
2. *Plate screws*

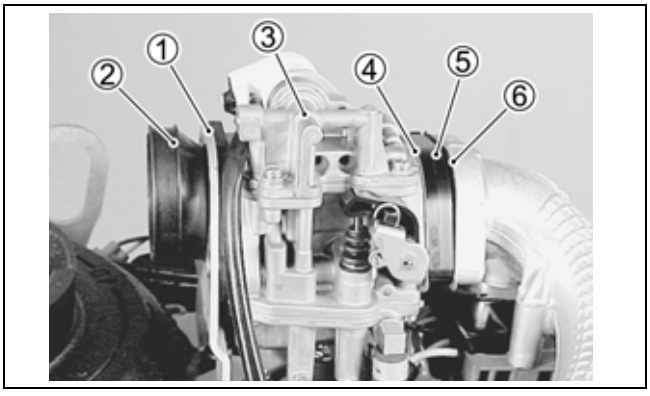
Remove two screws securing carburetor.



005600

Remove plate, outlet tube, carburetor, gasket, insulator, and gasket.

Detach fuel hose from carburetor inlet.

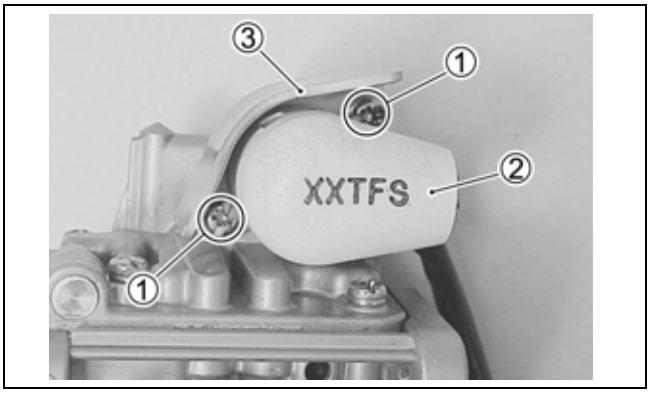


1. *Plate* 005601
2. *Outlet tube*
3. *Carburetor*
4. *Gasket*
5. *Insulator*
6. *Gasket*

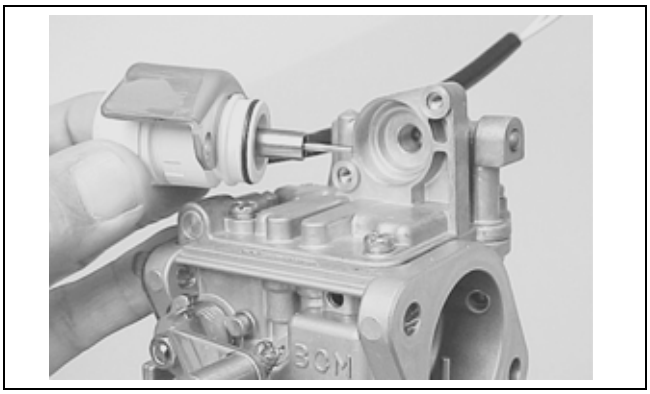
Disassembly

Remote models:

- Remove screws, auto-enrichener, and heater guard.



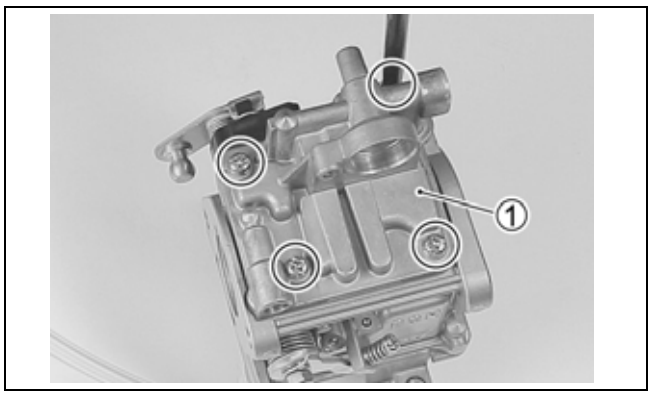
1. Screws 005606
2. Auto-enrichener
3. Heater guard



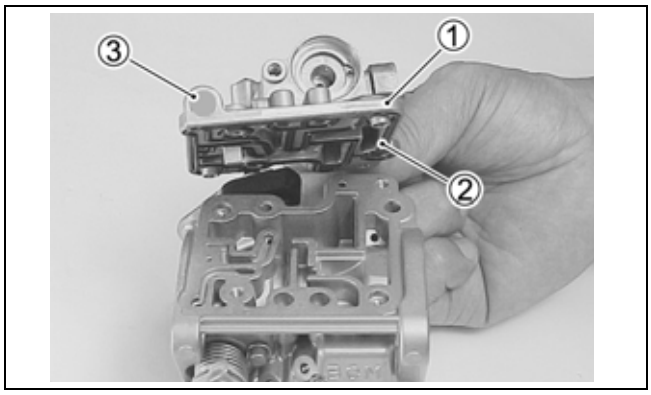
005607

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.

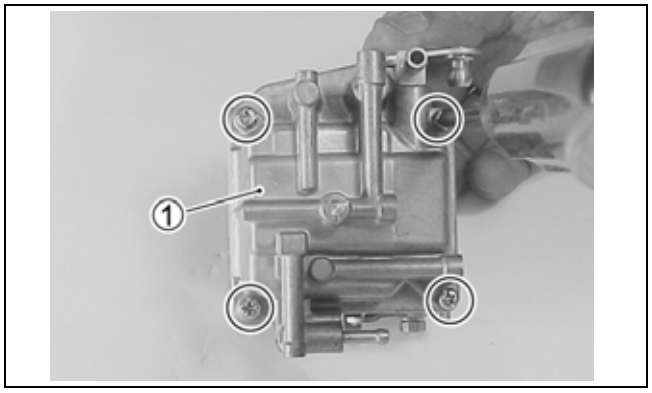


1. Top cover 004659

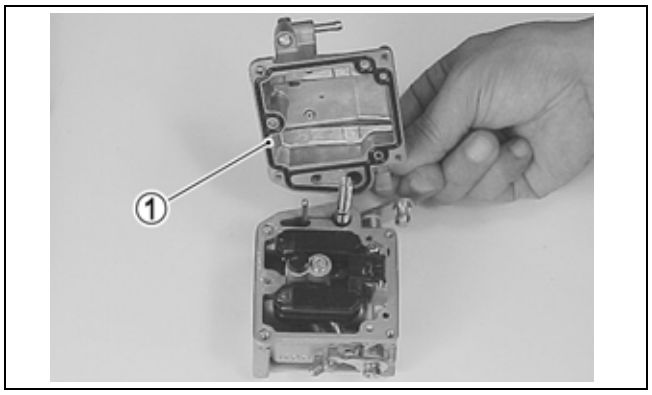


1. Top cover 004660
2. Gasket
3. Pilot screw cover

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

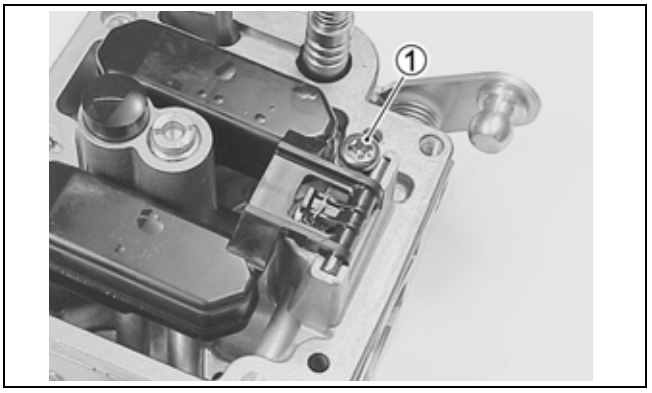


1. Float chamber 004661

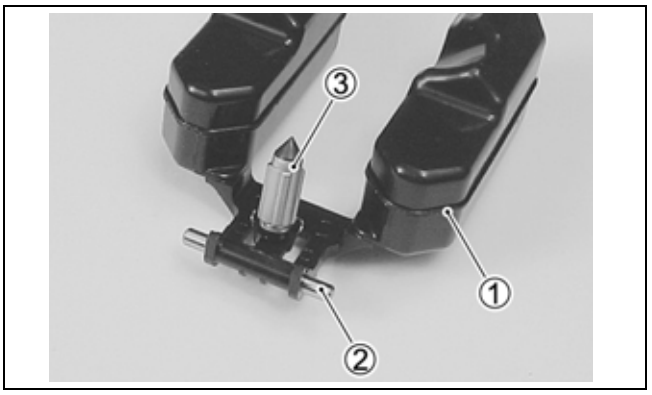


1. Gasket 004662

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

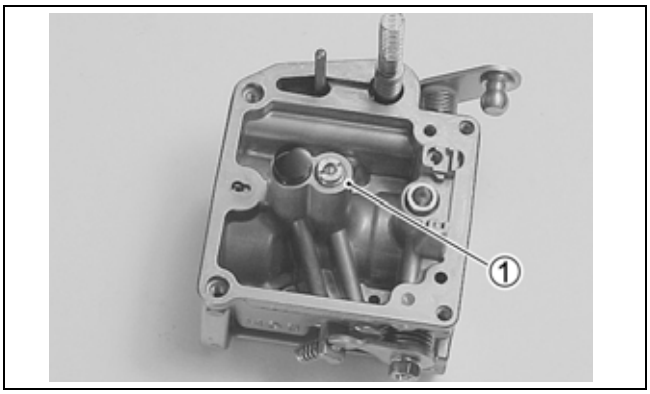


1. Float pin screw 004663

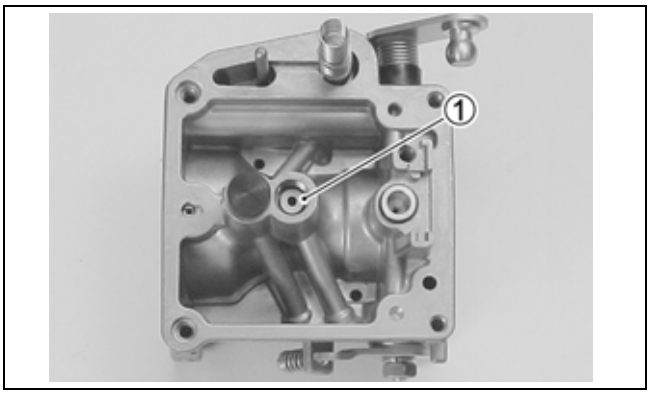


1. Float 004664
2. Float pin
3. Needle valve

Remove the main jet and main nozzle.

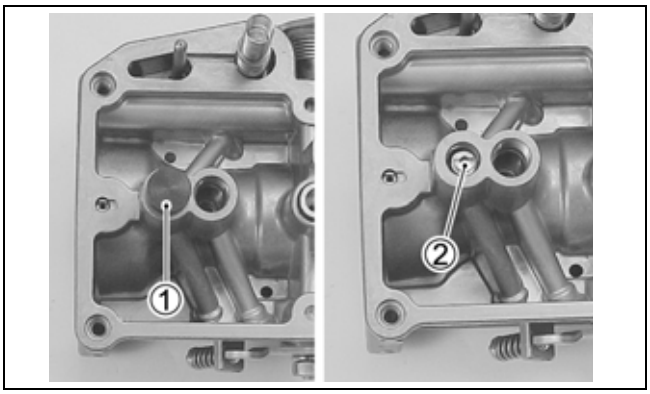


1. Main jet 004665



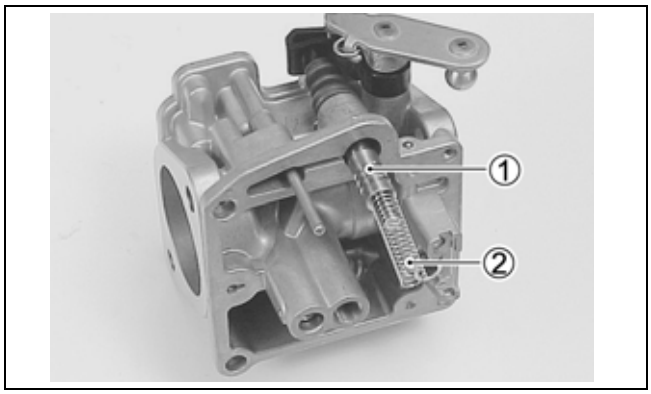
1. Main nozzle 004666

Remove the cap and pilot jet.



1. Cap 004667
2. Pilot jet

Remove the accelerator pump plunger and spring.



1. Accelerator pump plunger 004668
2. Spring

Cleaning and Inspection

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

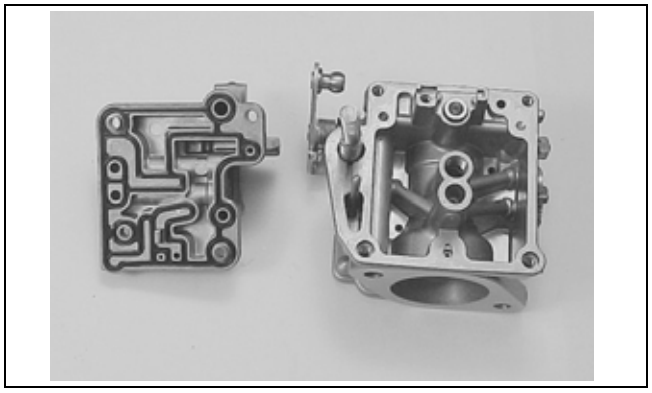
IMPORTANT: Do not clean carburetor or its components by submerging in strong carburetor cleaner or hot soaking tank. Strong cleaners might damage components or remove sealing compounds.

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.

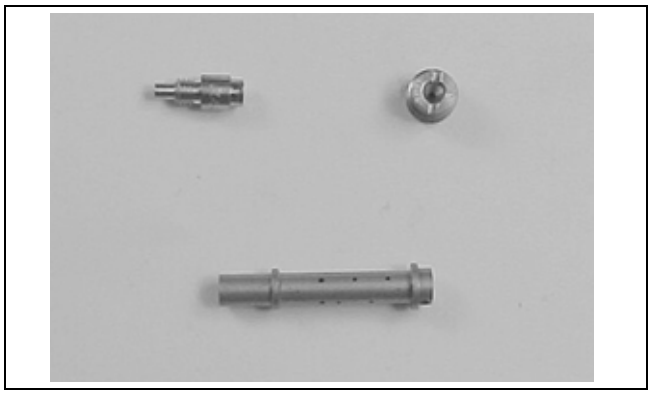
Inspect the carburetor body and top cover. If cracks or other damage are found on any component, replace it.

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



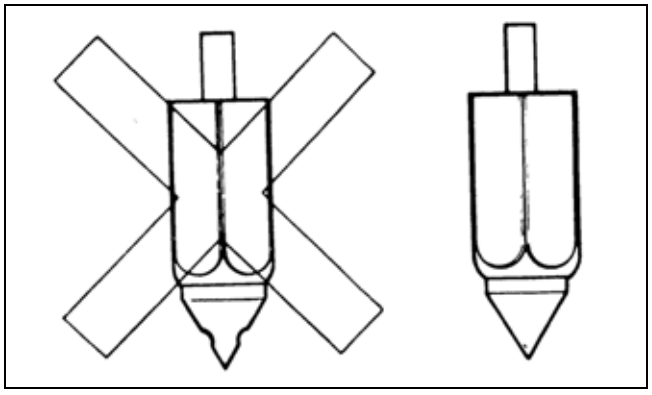
004669

Inspect jet and nozzle.



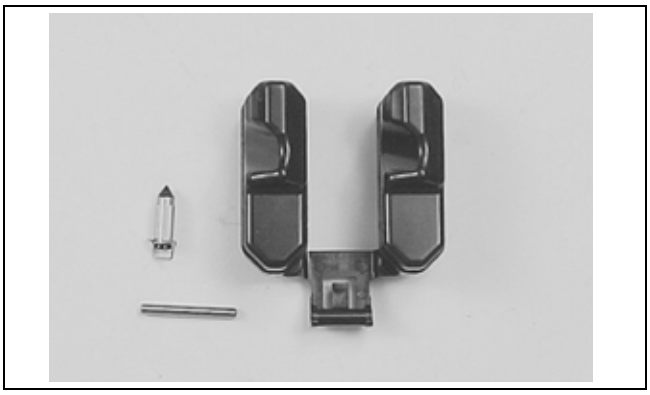
004670

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



004671

Inspect the float.



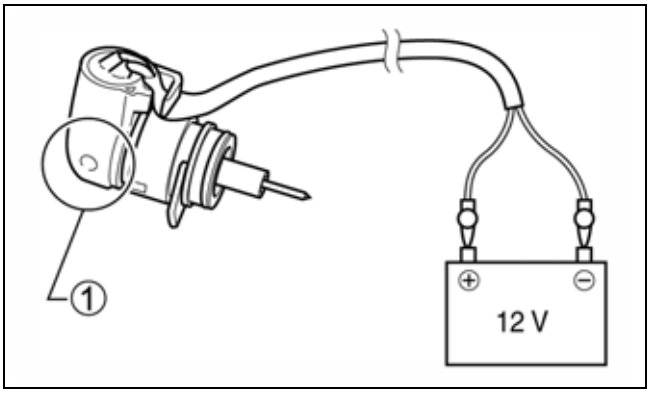
004672

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

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.

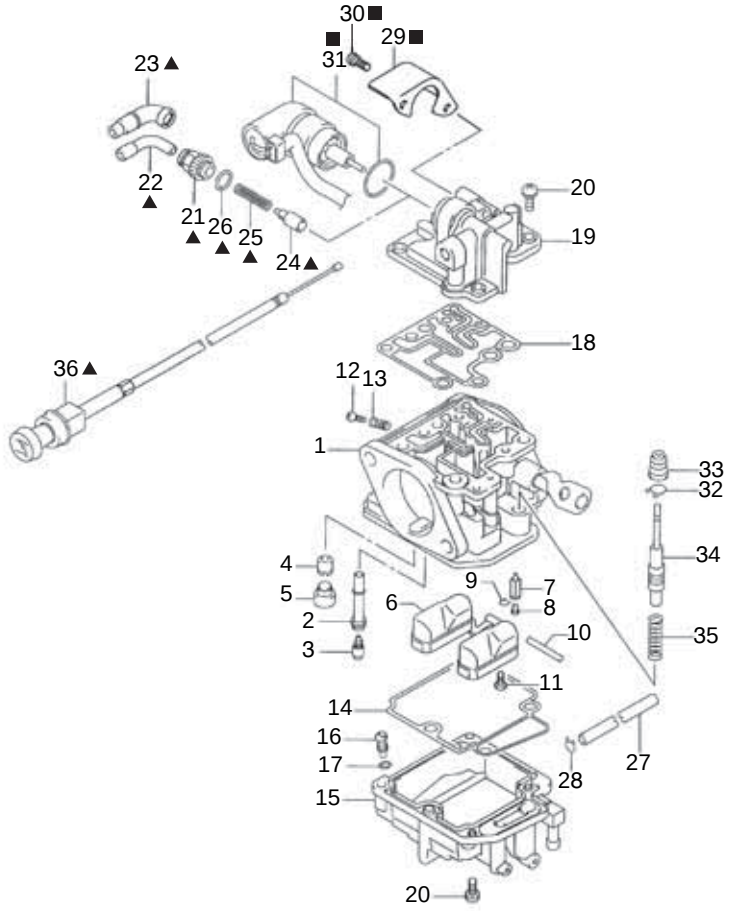


1. PTC heater 004674

Assembly

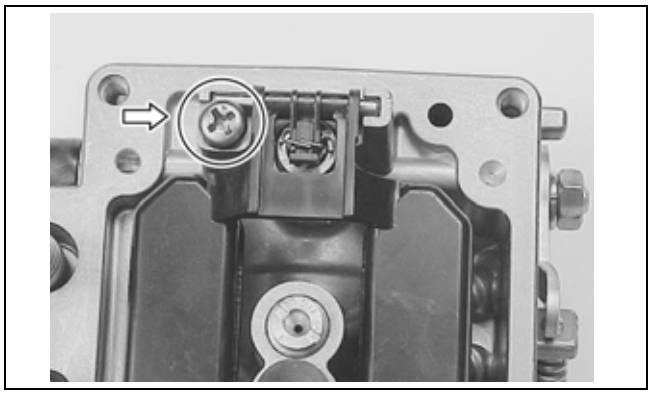
1. Carburetor body
2. Main nozzle
3. Main jet
4. Pilot jet
5. Cap
6. Float
7. Needle valve
8. Needle valve pin
9. Clip
10. Pin
11. Screw
12. Stop screw
13. Spring
14. Gasket
15. Float chamber
16. Drain screw
17. O-ring
18. U-ring
19. Top cover
20. Screw
21. Cable holder
22. Cable guide
23. Cable sealing cap
24. Starter valve
25. Spring
26. O-ring
27. Drain hose
28. Clip
29. Heater guard
30. Screw
31. Starter assy
32. Clip
33. Cap
34. Plunger
35. Spring
36. Starter knob assy

■ Electric models
▲ Rope models



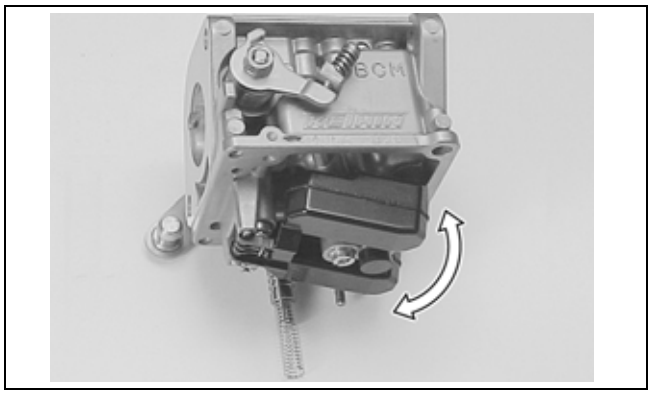
Assembly is reverse order of disassembly with special attention to the following steps:

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



004675

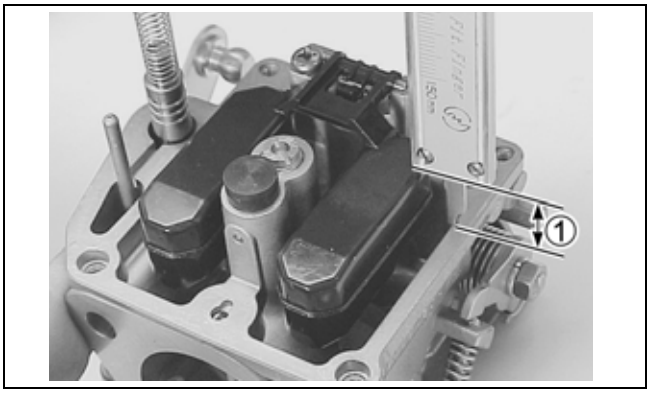
IMPORTANT: After installing float, inspect for smooth movement of float.



004676

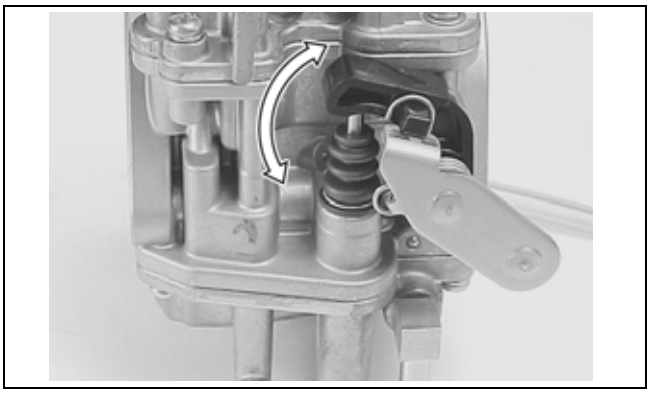
Measure and adjust float height.

- Float height: 13.5 ± 2 mm



1. Float height 004677

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



004676

6

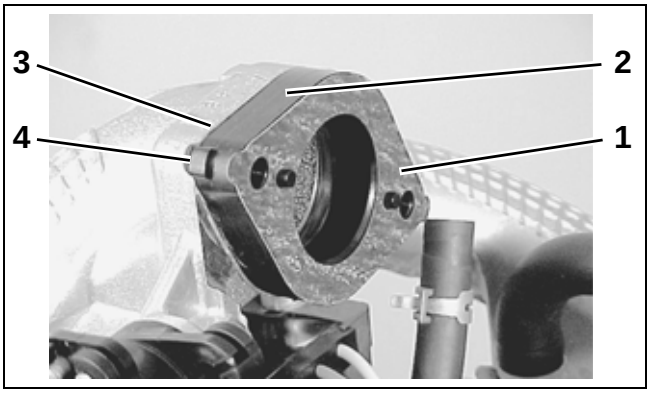
Installation

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

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

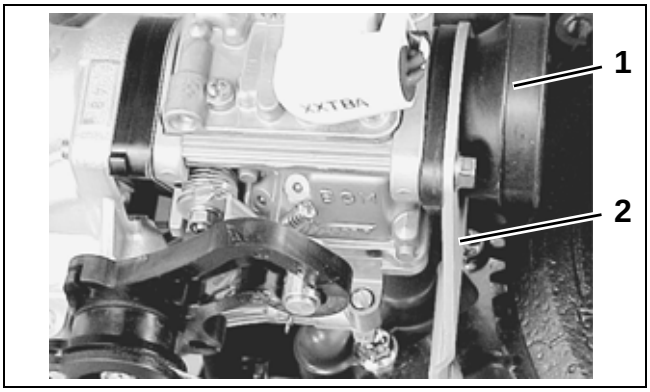
Install insulator gasket, insulator, and carburetor gasket.

IMPORTANT: The projection of insulator must be faced to STBD and intake manifold sides.



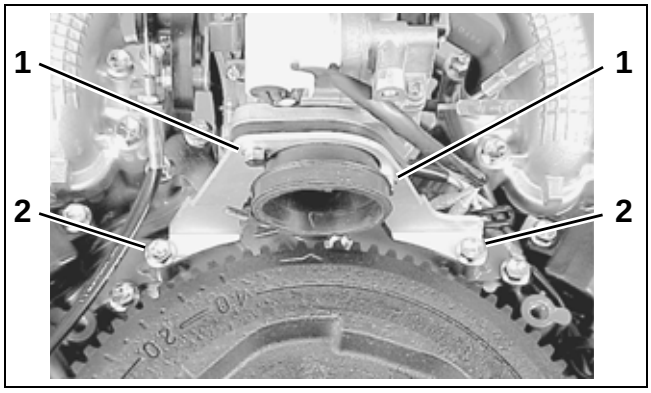
1. *Insulator gasket* 005602
2. *Insulator*
3. *Carburetor gasket*
4. *Projection*

Install carburetor, outlet tube, and plate.



1. *Outlet tube* 005603
2. *Plate*

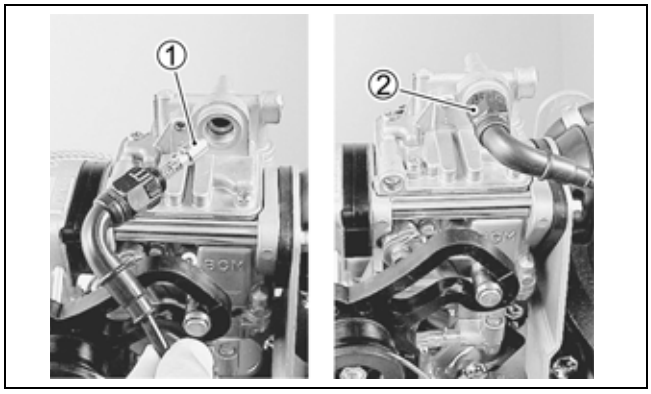
Tighten carburetor and plate mounting screws to 88 in. lbs. (10 N·m).



1. *Carburetor mounting screws* 005604
2. *Plate mounting screws*

Tiller models:

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



1. *Starter plunger* 005605
2. *Starter cable lock nut*

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.

FUEL PUMP

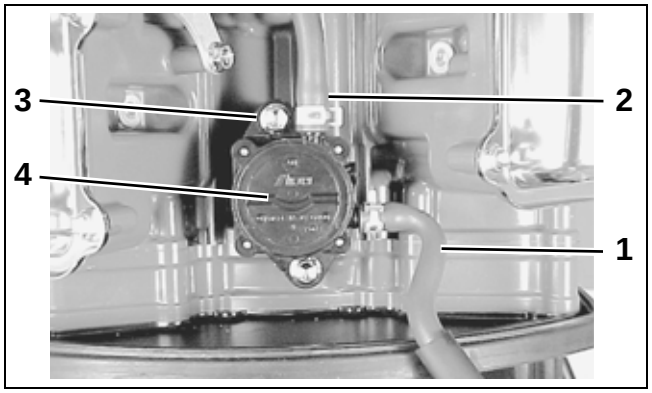
Removal

Remove the STBD side cover. Refer to side cover **Removal and Installation** on p. 177.

Remove the fuel filter from filter bracket.

1. Fuel filter 005609

Disconnect inlet hose and outlet hose from fuel pump. Remove two screws.



1. Inlet hose
2. Outlet hose
3. Screws
4. Fuel pump
005610

Remove the fuel pump and o-ring. Note position of pump rod.

IMPORTANT: Do not re-use o-ring.

1. O-ring
2. Pump rod
005611

Inspection

The fuel pump assembly is not serviceable. Do not disassemble the pump. Inspect fuel pump for leaks, cracks, or damage.

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.

Tighten fuel pump bolts 88 in. lbs. (10 N·m).

005612

⚠ 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.

INTAKE MANIFOLD SERVICE

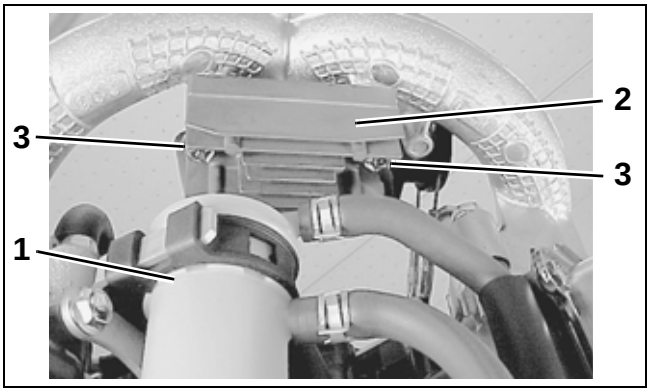
Removal

Remove recoil starter (rope start models). Refer to starter **REMOVAL** on p. 219.

Remove flywheel cover (electric start models). Refer to ignition **COMPONENT SERVICING** on p. 99.

Remove the carburetor assembly. Refer to **CARBURETOR SERVICE** on p. 109.

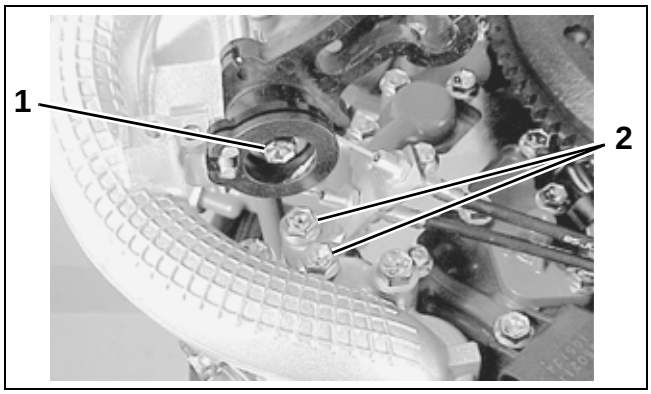
Remove the fuel filter from filter bracket. Remove two screws securing rectifier/regulator. Disconnect rectifier lead wire connectors.



1. Fuel filter
2. Rectifier
3. Rectifier screws

005364

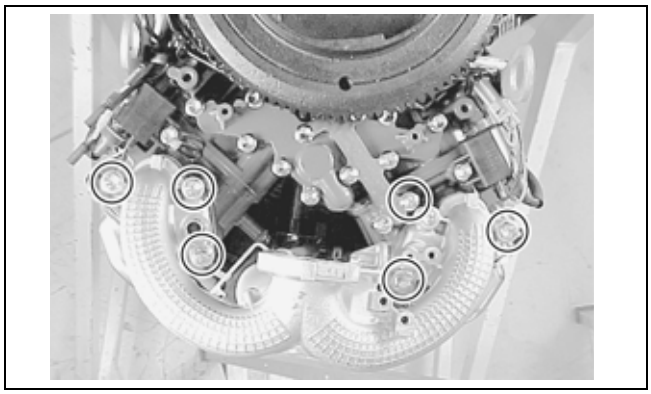
Remove screw, throttle drum (with throttle cables), and throttle cam. Remove two screws and cable bracket.



1. Throttle drum screw
2. Cable bracket screws

005635

Remove six screws and intake manifold.



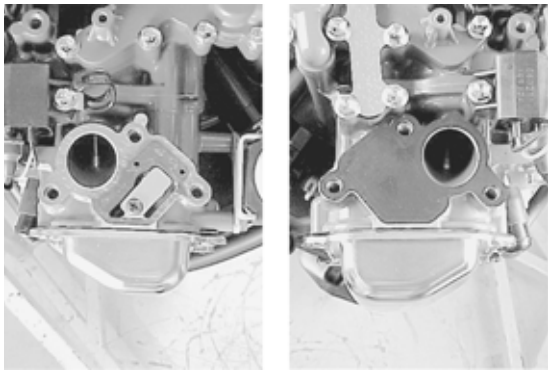
005636

Installation

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

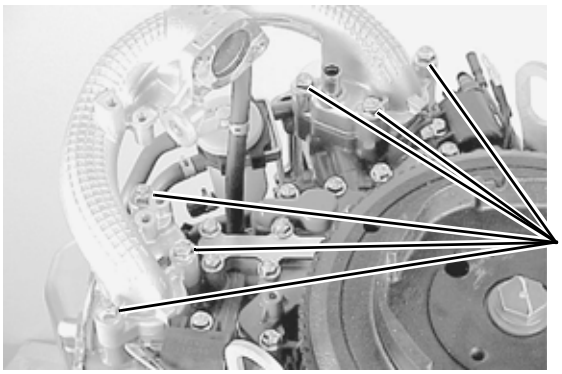
Install gaskets and intake manifold.

IMPORTANT: Port and starboard intake manifold gaskets are shaped differently.



005637

Tighten manifold screws 220 in. lbs. (25 N·m).



1. Manifold screws 005638

Install rectifier/regulator and fuel filter.

Install carburetor. Refer to **CARBURETOR SERVICE** on p. 109.

Install recoil starter or flywheel cover.

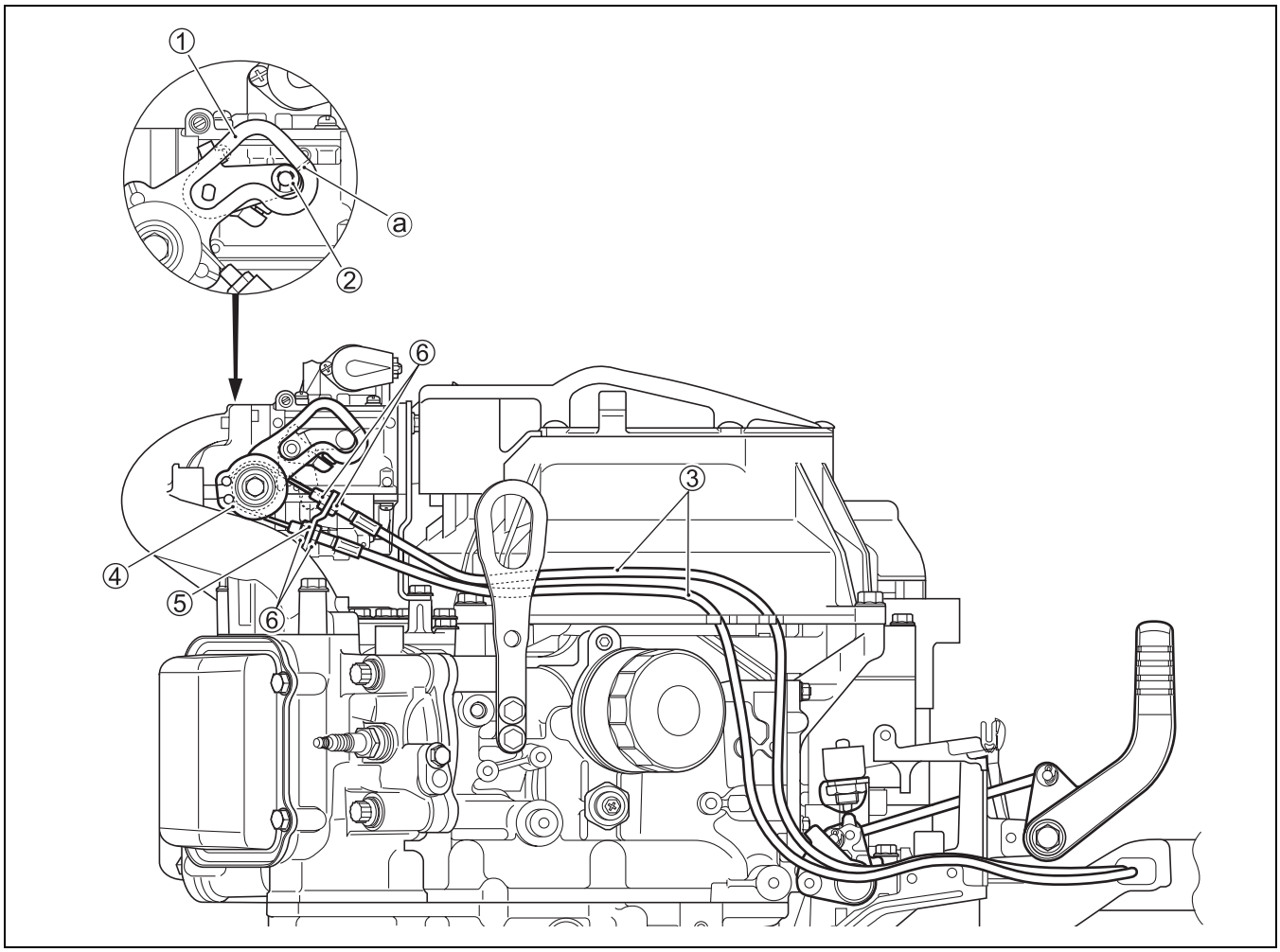
⚠ WARNING ⚠

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



Rotate throttle control grip to bring the throttle to full close.

Align the match mark a on throttle cam 1 with the center of throttle lever roller 2 and hold this position.

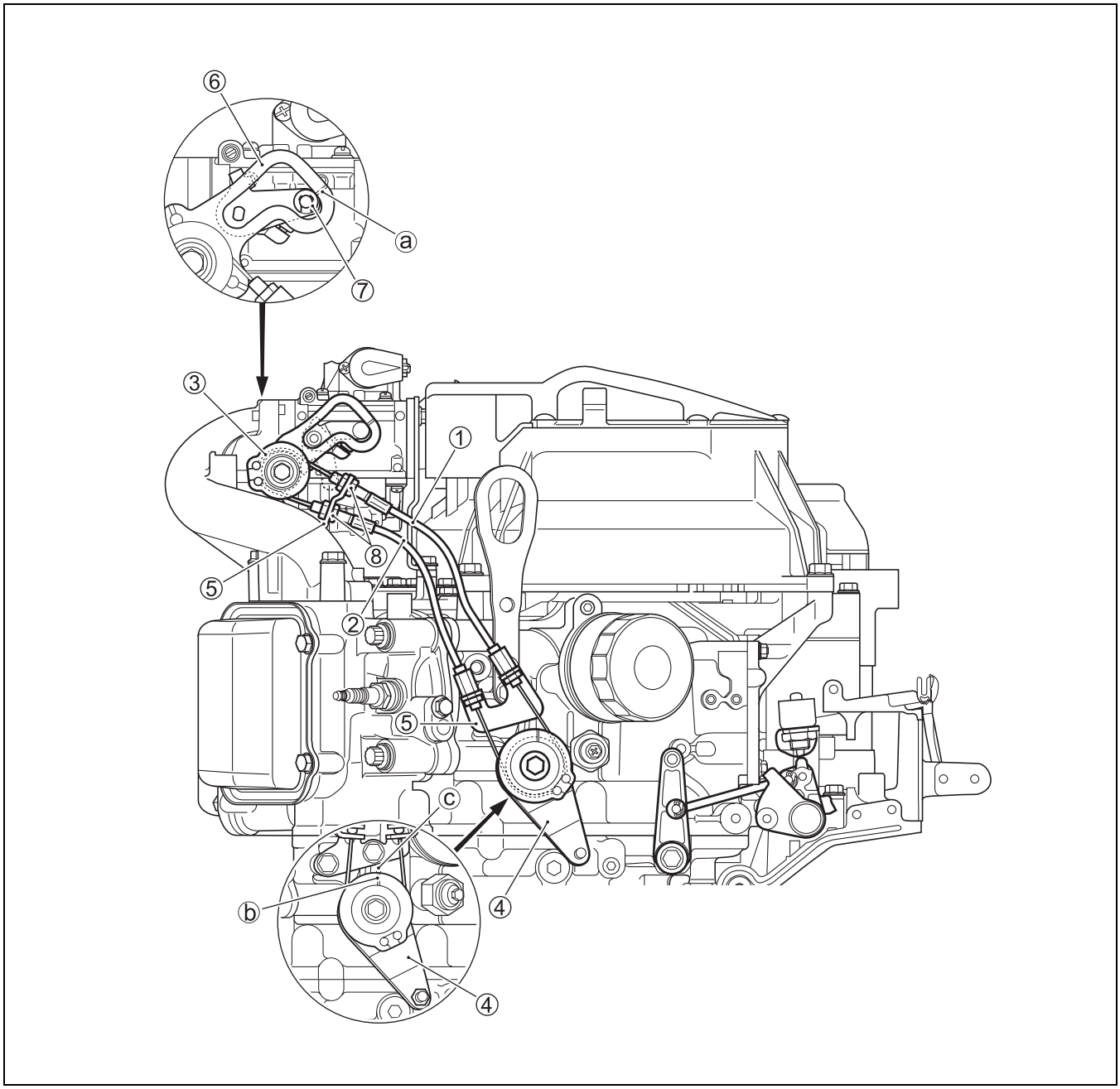
Install throttle control cables 3 to throttle drum 4 and cable holder 5 .

Turn lock nut 6 in appropriate direction to install inner cable with no sag.

Tighten the lock nut to secure throttle cable to cable bracket.

Rotate the throttle control grip from fully closed position to fully open position several times.
With the throttle control grip at full close, make sure the match mark a on throttle cam 1 aligns with the center of throttle lever roller 2 .

Remote Models



Install two throttle cable 1 · 2 to throttle drum 3 , interlink throttle lever 4 and each cable brackets 5 .

Align the match mark b (–) on interlink throttle lever 4 with the cylinder block rib C and hold this position.

Align the match mark a on the throttle cam 6 with the center of throttle lever roller 7 , then hold this condition unmoved and turn the cable lock nuts 8 so as to removed play on inner cables. Tighten the lock nuts securely.

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

POWERHEAD

TABLE OF CONTENTS

SPECIFICATIONS

Item			Unit	Data
				25 HP
CYLINDER HEAD/CAMSHAFT				
Cylinder head distortion		Limit	mm (in)	0.05 (0.002)
Cam height	IN	STD	mm (in)	32.921 – 33.081 (1.2961 – 1.3024)
		Limit	mm (in)	32.821 (1.2922)
	EX	STD	mm (in)	32.921 – 33.081 (1.2961 – 1.3024)
		Limit	mm (in)	32.821 (1.2922)

Item			Unit	Data
				25 HP
VALVE/VALVE GUIDE				
Valve diameter		IN	mm (in)	31.0 (1.22)
		EX	mm (in)	26.0 (1.02)
Valve clearance (when cold)	IN	STD	mm (in)	0.03 – 0.07 (0.001 – 0.003)
	EX	STD	mm (in)	0.03 – 0.07 (0.001 – 0.003)
Valve seat angle	IN			30°, 45°, 60°
	EX			30°, 45°, 75°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		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)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.450 – 5.465 (0.2146 – 0.2152)
Valve guide protrusion	IN	STD	mm (in)	14.2 (0.5591)
	EX	STD	mm (in)	12.5 (0.4921)
Valve stem deflection	IN	LIMIT	mm (in)	0.014 (0.006)
	EX	LIMIT	mm (in)	0.018 (0.007)
Valve stem runout	IN,EX	LIMIT	mm (in)	0.05 (0.002)
Valve head radial runout	IN,EX	LIMIT	mm (in)	0.08 (0.003)
Valve head thickness	IN	STD	mm (in)	1.0 (0.0394)
		LIMIT	mm (in)	0.5 (0.0197)
	EX	STD	mm (in)	1.0 (0.0394)
		LIMIT	mm (in)	0.5 (0.0197)
Valve seat width	IN,EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	40.84 (1.608)
		LIMIT	mm (in)	39.21 (1.5437)
Valve spring tension		STD	kg (lb)	11.1 – 12.8 (24.5 – 28.2) at length 31.5 mm (1.24 in)
		LIMIT	kg (lb)	10.2 (22.5) at length 31.5 mm (1.24 in)

Item			Unit	Data
				25 HP
CYLINDER/PISTON/PISTON RING				
Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	71.000 – 71.020 (2.7953 – 2.7961)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	70.970 – 70.990 (2.7941 – 2.7949)
Piston measuring position			mm (in)	13 (0.512) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.10 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.12 – 0.27 (0.0047 – 0.0106)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.0138 – 0.0197)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 8.0 (0.3150)
		Limit	mm (in)	6.4 (0.2520)
	2nd	STD	mm (in)	Approx. 10 (0.3937)
		Limit	mm (in)	8.0 (0.3150)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.02 – 1.04 (0.0402 – 0.0409)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	Oil	STD	mm (in)	2.01 – 2.03 (0.0791 – 0.0799)
Piston ring thickness	1st	STD	mm (in)	0.97 – 0.09 (0.0382 – 0.0390)
	2nd	STD	mm (in)	1.17 – 1.19 (0.0461 – 0.0469)
Piston pin outside diameter		STD	mm (in)	17.995 – 18.000 (0.7085 – 0.7087)
		Limit	mm (in)	17.980 (0.7079)
Piston pin hole diameter		STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)
		Limit	mm (in)	18.030 (0.7098)

Item		Unit	Data
			25 HP
CRANKSHAFT / CONNECTING ROD			
Connecting rod small end inside diameter	STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)
Connecting rod big end oil clearance	STD	mm (in)	0.020 – 0.030 (0.0008 – 0.0012)
	Limit	mm (in)	0.065 (0.0026)
Connecting rod big end inside diameter	STD	mm (in)	39.015 – 39.025 (1.5360 – 1.5364)
Crank pin outside diameter	STD	mm (in)	38.990 – 39.000 (1.5350 – 1.5354)
Crank pin out-side diameter difference	Limit	mm (in)	0.010 (0.0004)
Connecting rod big end side clearance	STD	mm (in)	0.07 – 0.30 (0.0028 – 0.0118)
	Limit	mm (in)	1.0 (0.0394)
Connecting rod big end width	STD	mm (in)	21.95 – 22.05 (0.8642 – 0.8681)
Crank pin width	STD	mm (in)	44.170 – 44.220 (1.7390 – 1.7409)
THERMOSTAT			
Thermostat operating temperature		°C (°F)	58 – 62 (136 – 144)

TEST PROCEDURES

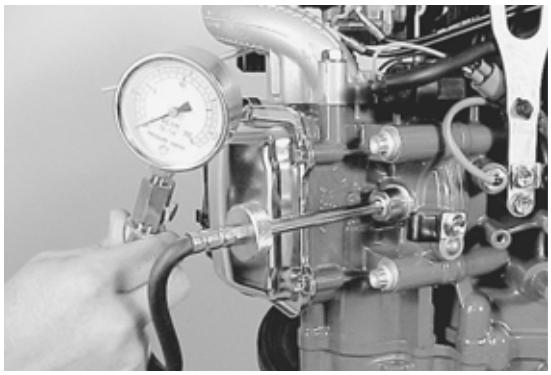
Compression Testing

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

Remove spark plugs.

Advance throttle linkage to WOT.

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



005554

⚠ 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 decompression system)	71 to 100 psi (500 to 700 kPa)
Standard (models without decompression system)	142 to 185 psi (1000 to 1300 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.

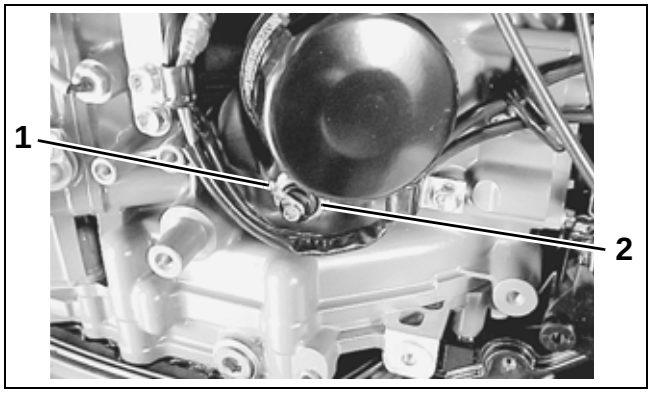
Oil Pressure Test

Check the engine oil level.

Remove side covers. Refer to side cover **Removal and Installation** on p. 177.

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

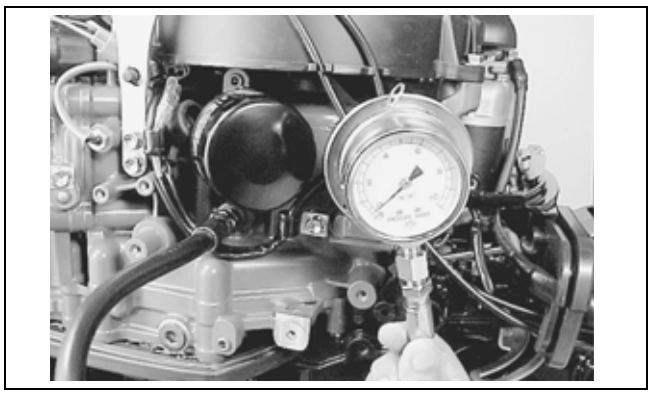
Remove the oil pressure switch.



1. Blue lead wire
2. Oil pressure switch

005552

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



005553

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 43 psi (200 to 300 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. Refer to **Oil Pressure Switch Service** on p. 68.

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.

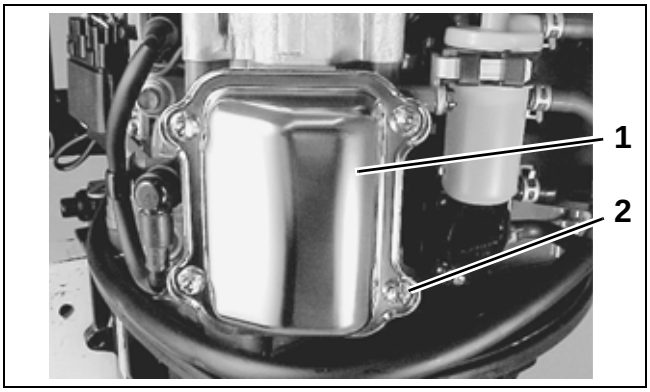
Remove all spark plugs.

Drain engine oil. Refer to **Engine Oil** on p. 54.

Remove the intake manifold assembly. Refer to **INTAKE MANIFOLD SERVICE** on p. 118.

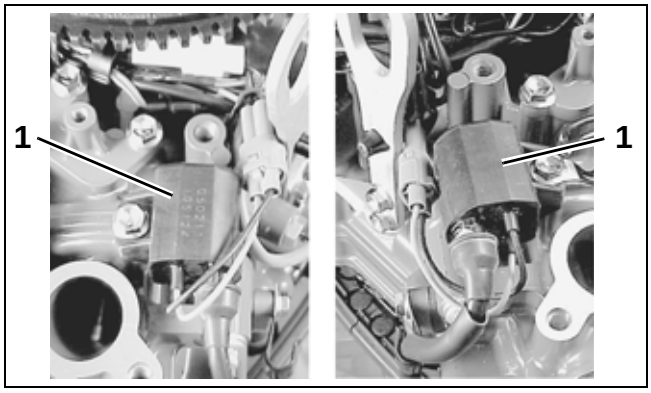
Remove fuel filter bracket and fuel pump. Refer to **FUEL PUMP** on p. 117.

Remove eight screws and port/stbd cylinder head covers.



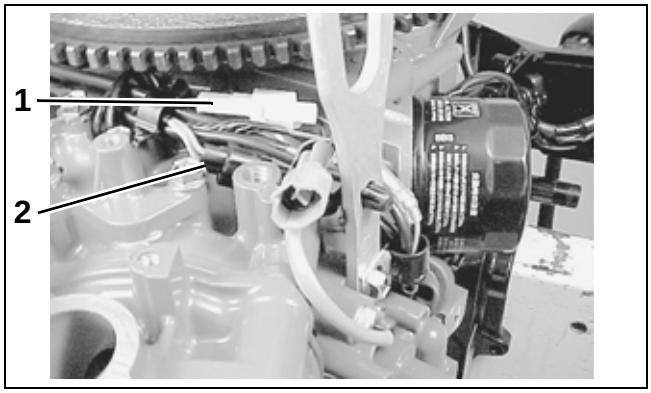
1. Cylinder head cover 005543
2. Cover screw

Remove screws and two ignition coils, then disconnect primary lead wire connectors.



1. Ignition coils 005639

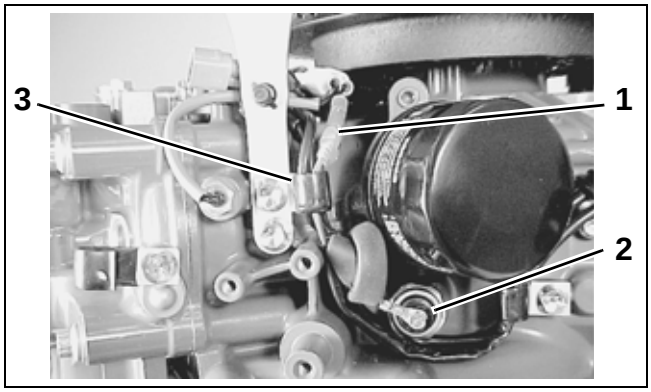
Disconnect temperature sensor wire connector and neutral switch wire connector.



1. Temperature sensor connector 005640
2. Neutral switch connector

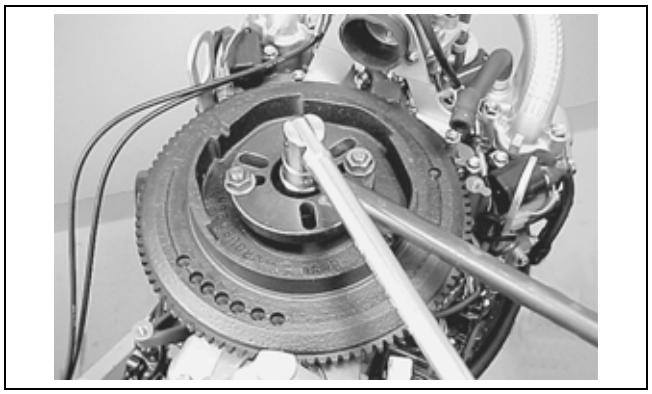
Disconnect stop switch wire connector and oil pressure switch wire.

Remove screw and wire clamp.



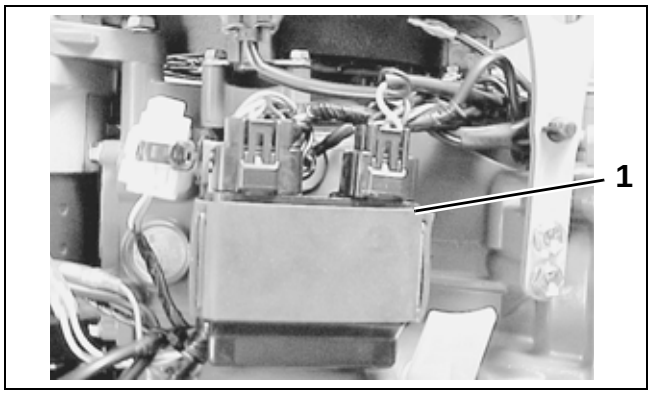
1. Stop switch connector 005641
2. Oil pressure switch
3. Clamp

Remove flywheel, stator, and crankshaft position sensors. Refer to ignition **COMPONENT SERVICING** on p. 99.



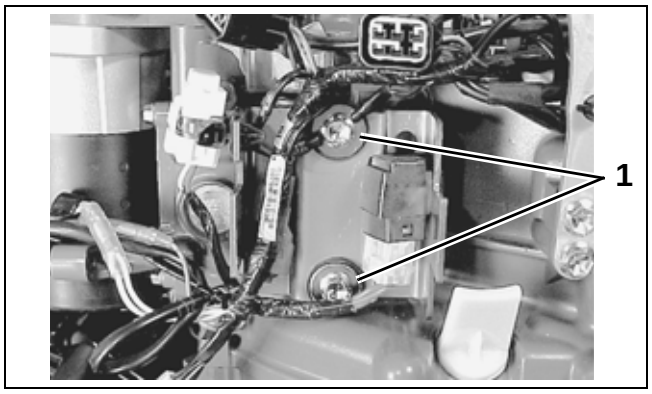
005584

Disconnect all engine wiring harness connectors from CDI unit and remove CDI unit from electric parts holder.



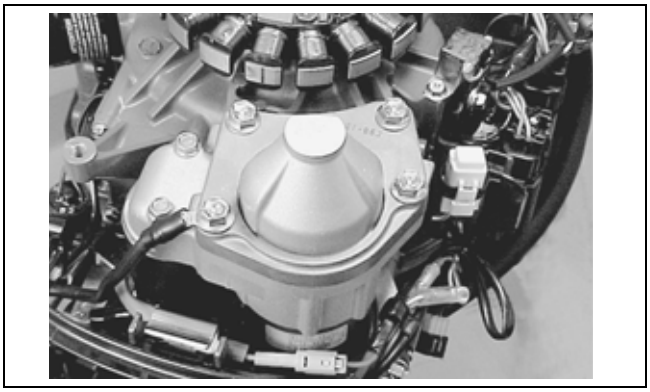
1. CDI unit 005642

Remove two screws and electric parts holder.



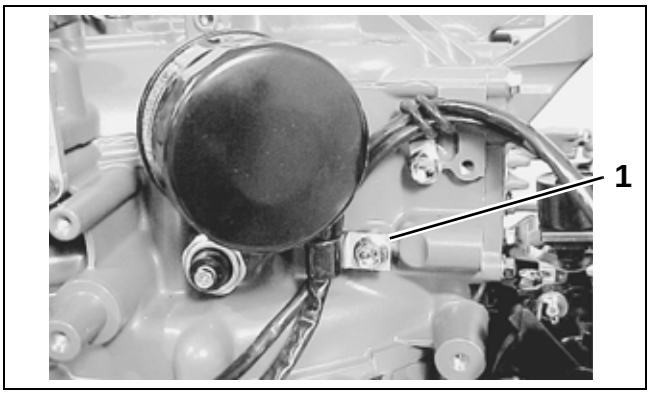
1. Holder screws 005643

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



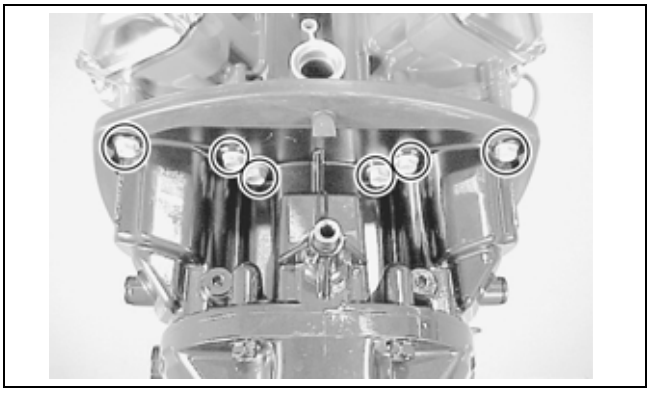
005572

Remove screws and wire clamps.

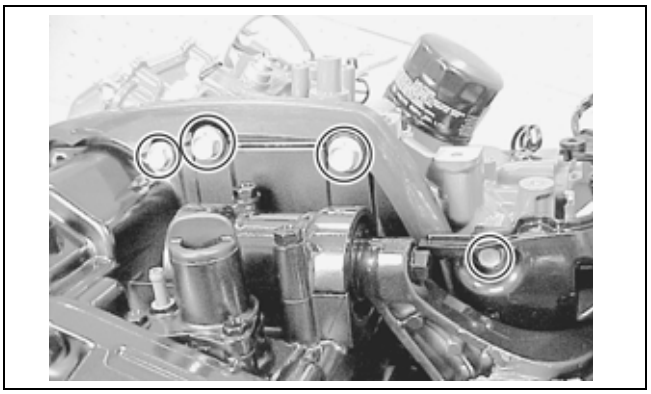


1. Clamp 005644

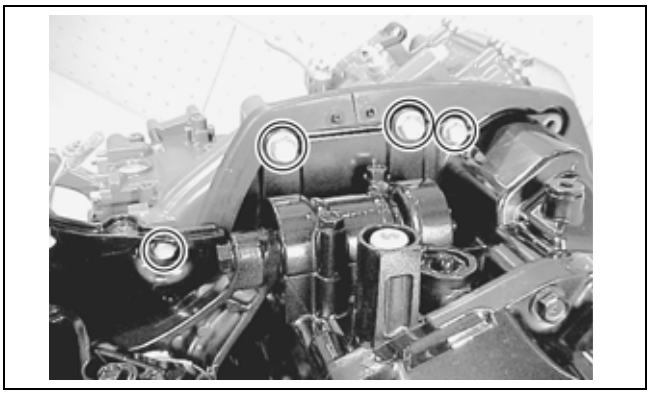
Remove twelve powerhead mounting screws and two nuts.



005645

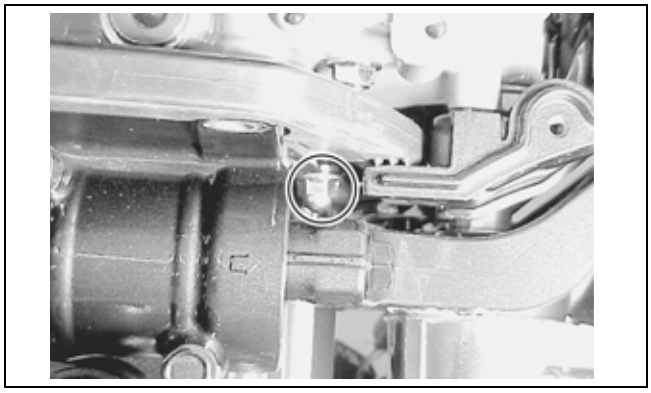


005646

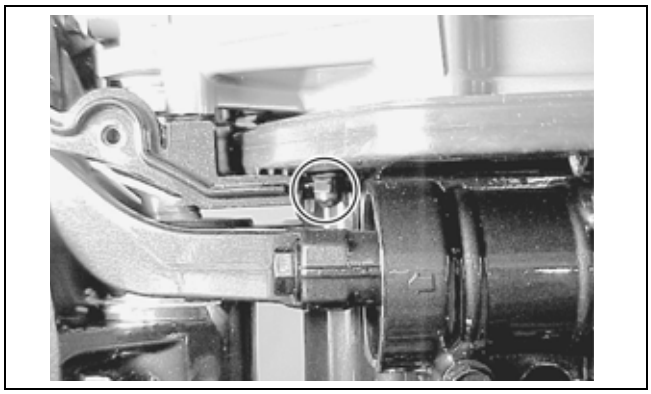


005647

Remove two screws securing front panel to crankcase. Lift powerhead from oil pan.

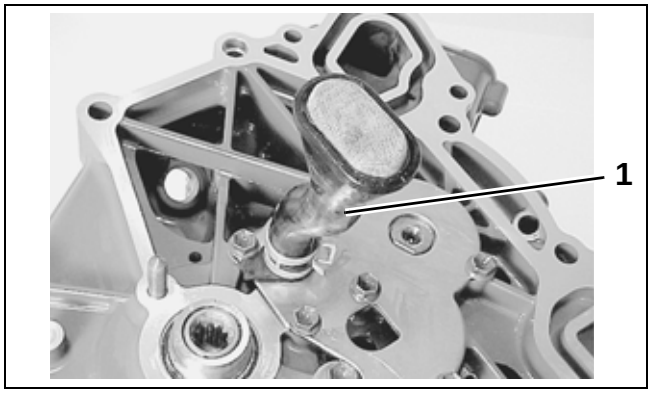


005648



005649

Loosen clamp and remove oil strainer.

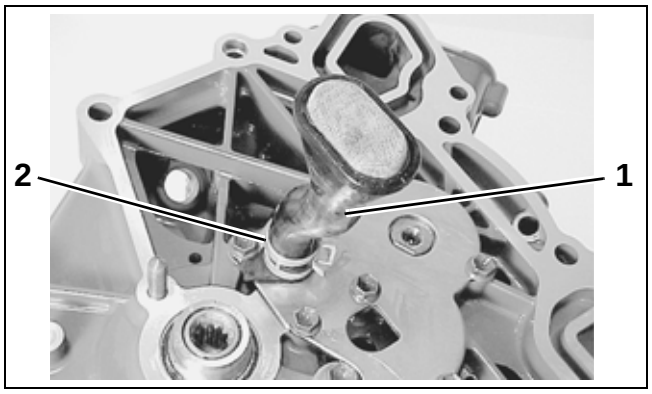


1. Oil strainer 005650

Installation

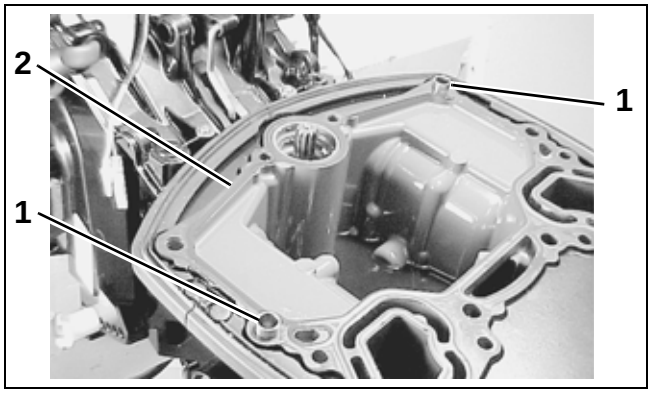
Installation is reverse order of removal with special attention to the following:

Install oil strainer and secure with clamp.



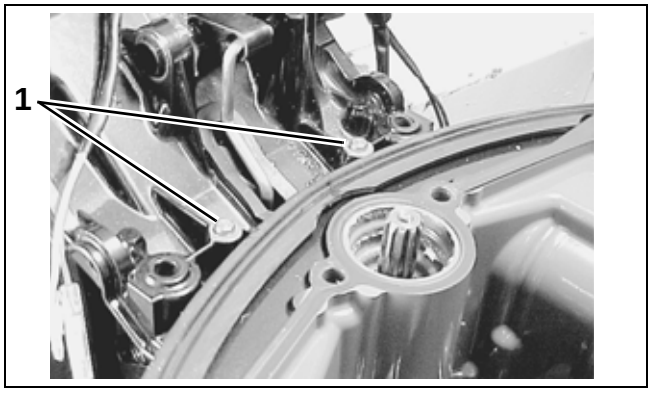
1. Oil strainer
2. Clamp
005650

Install dowel pins and gasket on oil pan.



1. Dowel pins
2. Gasket
005651

Install dowel pins in front panel.



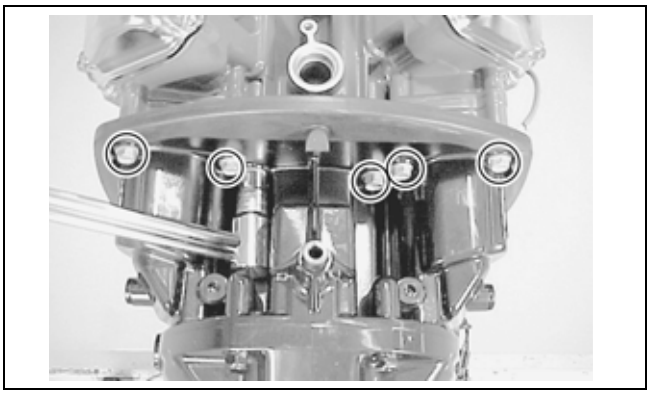
1. Dowel pins
005652

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

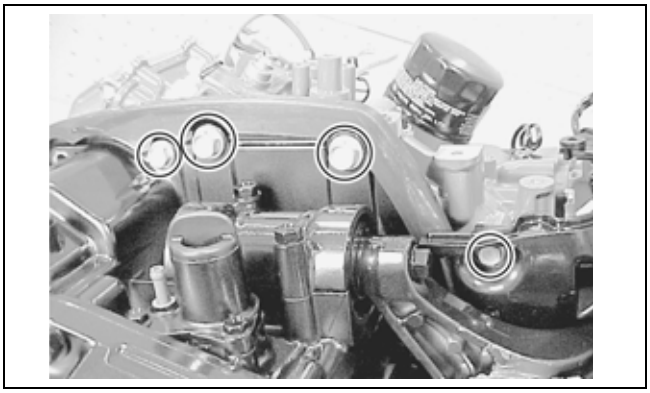
Lower the powerhead on to oil pan. If necessary, rotate crankshaft to align crankshaft and driveshaft splines.

Apply *Gasket Sealing Compound* to mounting screws. Install and tighten 12 screws and two nuts as follows:

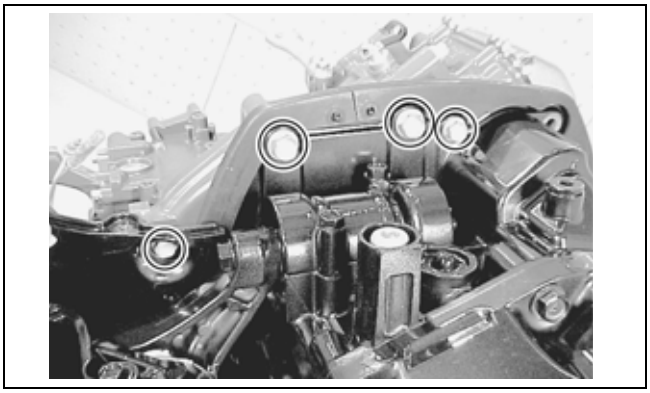
- 8 mm, 16.5 ft. lb. (23 N·m)
- 10 mm, 36 ft. lb. (50 N·m)



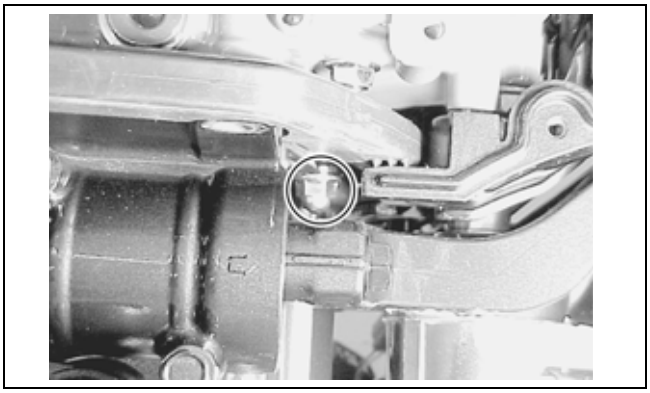
005653



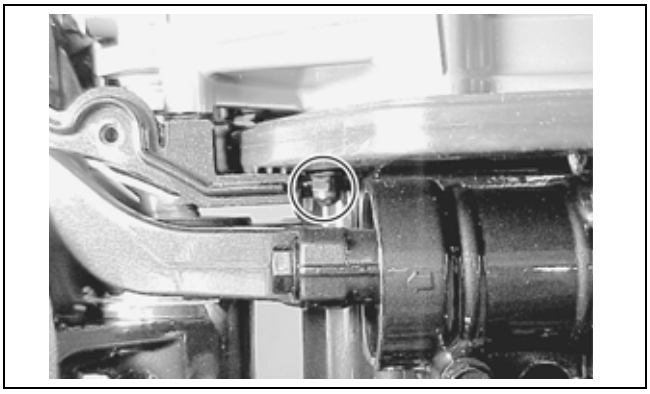
005646



005647

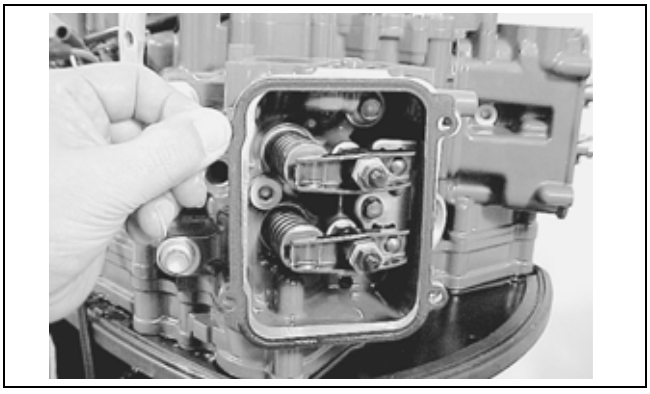


005648



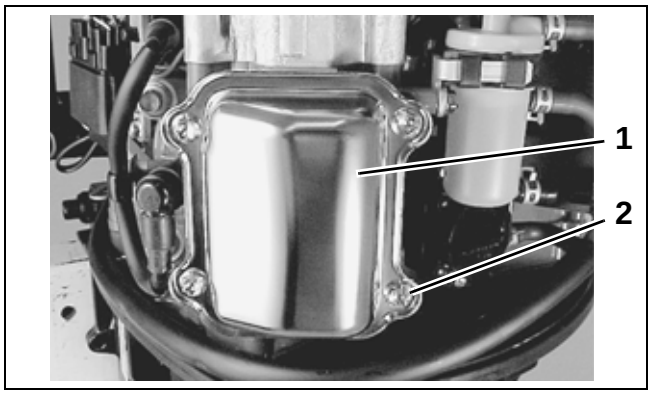
005649

IMPORTANT: Before installing cylinder head cover, check valve clearance. Refer to **VALVE CLEARANCE** on p. 58.



005654

Install cylinder head cover gasket and cylinder head cover. Tighten cover screws 88 in. lbs. (10 N·m).



1. *Cylinder head cover*
2. *Cover screw*

005543

Install electric starter. Tighten starter and bracket screws to 16.5 ft. lbs. (23 N·m). Refer to **Starter Motor Service** on p. 79.

Install ignition and electrical components. Refer to **COMPONENT SERVICING** on p. 99.

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

Install fuel system components. Refer to **FUEL SYSTEM** on p. 103.

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. 54.

Install side covers. Refer to side cover **Removal and Installation** on p. 177.

Check for fuel, oil, or water leaks.

⚠ WARNING ⚠

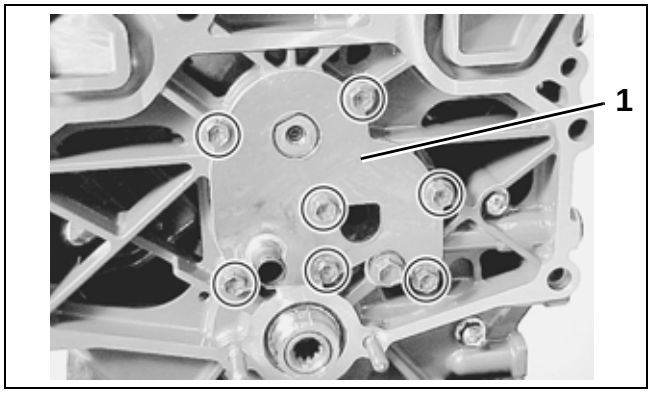
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

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.

OIL PUMP

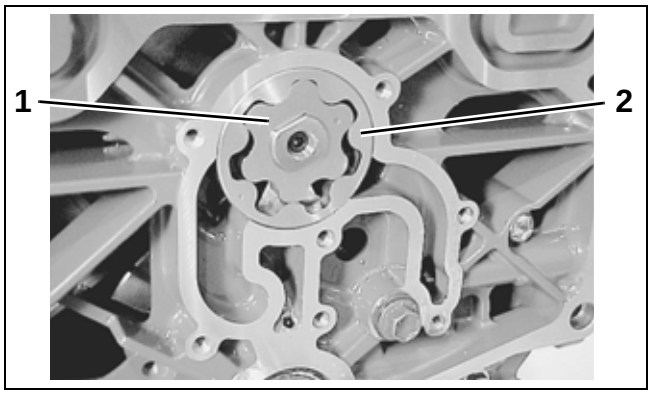
Disassembly

Remove seven screws and oil pump rotor plate.



1. Oil pump rotor plate 005655

Remove inner and outer rotors.



1. Inner rotor 005656
2. Outer rotor

Inspection

Check oil pump case for excessive wear or damage.

005657

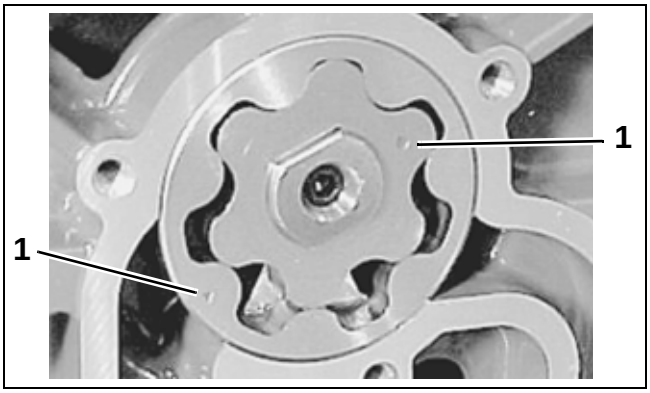
Check rotors and rotor plate for excessive wear or damage. Replace as necessary.

Assembly

Apply a thin coat of engine oil to inner and outer rotors, inside surfaces of oil pump case, and plate.

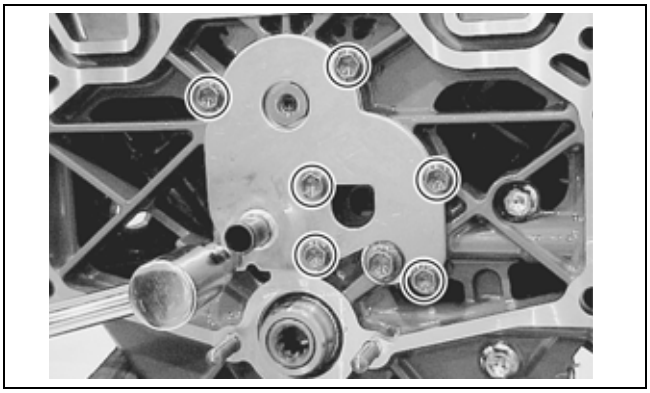
Install outer and inner rotors in pump case.

IMPORTANT: Punch marks on rotors (○, △) must face rotor plate.



1. Punch marks 005658

Install rotor plate and tighten screws 88 in. lbs. (10 N·m).



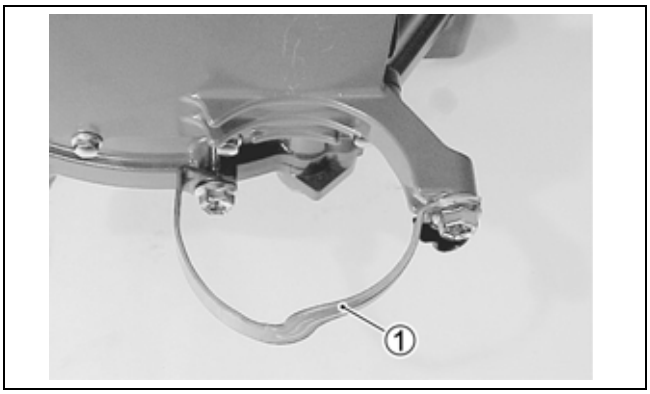
005659

CYLINDER HEAD

Removal

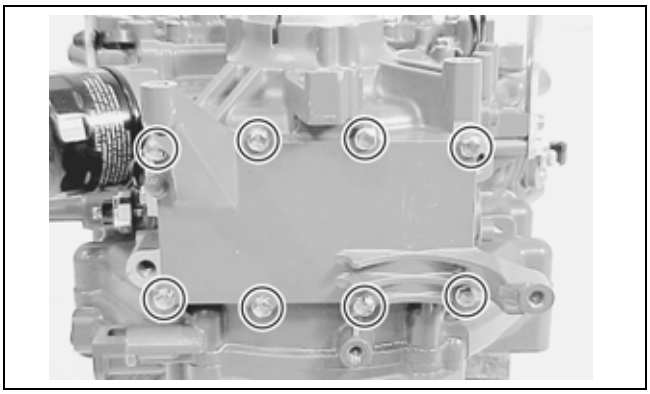
Remove powerhead. Refer to powerhead **REMOVAL AND INSTALLATION** on p. 130.

Remove screws and starter motor band.



1. Starter motor band 005660

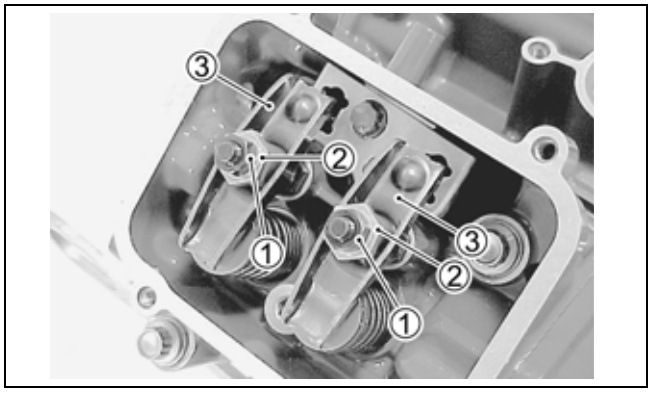
Remove eight screws and crankcase front plate.



005661

Remove oil pump. Refer to **OIL PUMP** on p. 135.

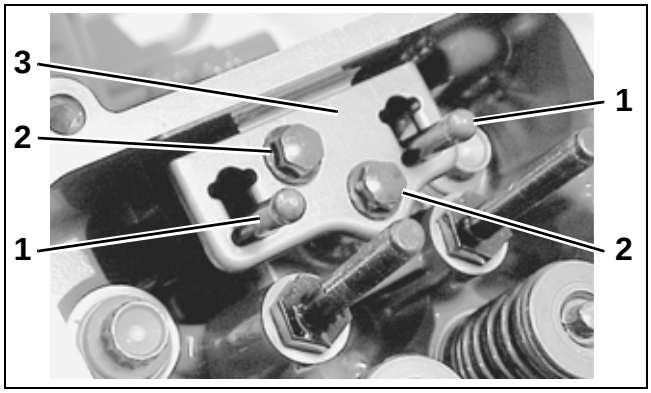
Loosen and remove valve adjusting lock nuts, then remove pivot nuts and rocker arms.



1. Lock nuts 005662
2. Pivot nuts
3. Rocker arms

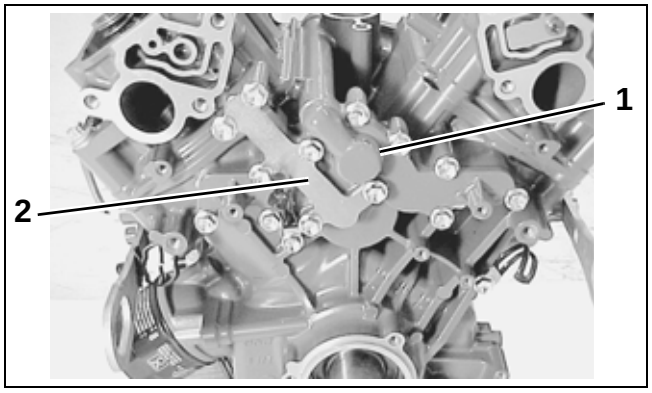
IMPORTANT: Mark each rocker arm for reassembly in its original location.

Remove push rods. Remove screws and push rod guide.



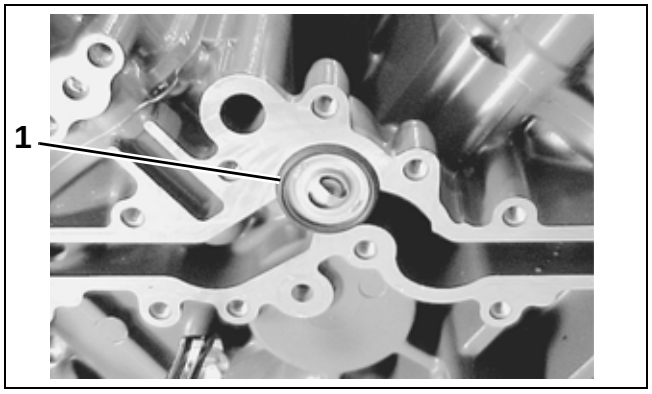
1. Push rod 005663
2. Guide screws
3. Pushrod guide

Remove 13 screws, thermostat cover, and oil gallery plate.



1. Thermostat cover 005664
2. Oil gallery plate

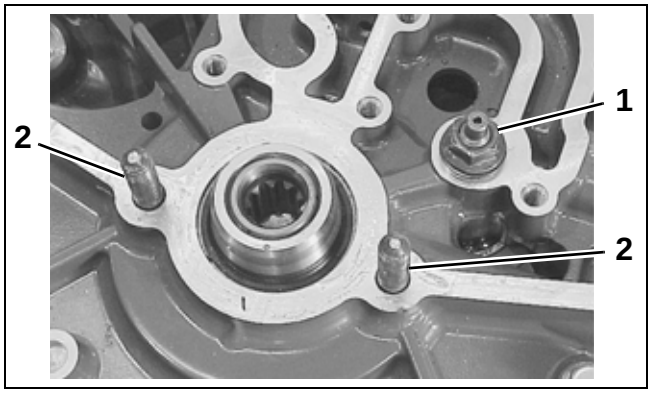
Remove thermostat.



1. Thermostat 005665

Remove idle gear shaft nut and washer.

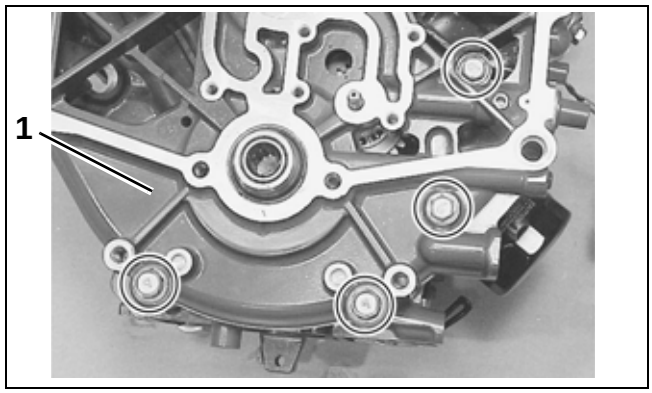
Remove two studs from bottom crankcase.



1. Idle gear shaft nut 005666
2. Stud

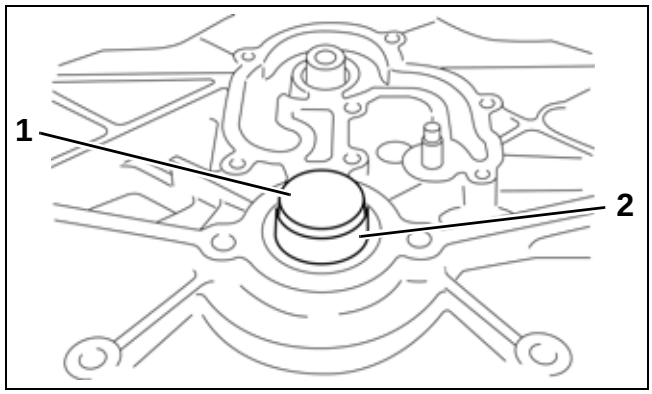
Remove four screws securing bottom crankcase.

IMPORTANT: To prevent valve damage, be sure rocker arms have been removed before removing bottom half of crankcase.



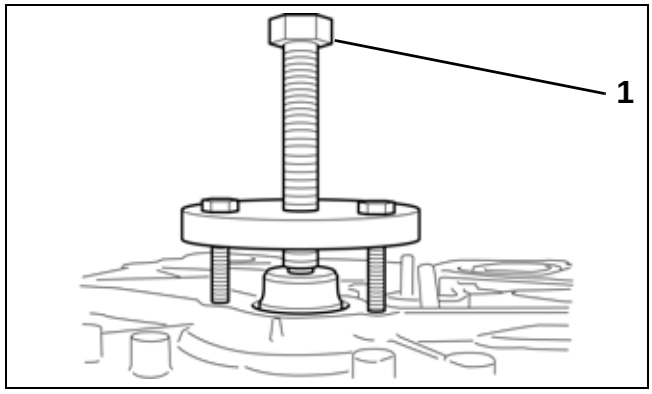
1. Bottom crankcase 005667

Place spacer from Crankshaft Remover/Installer Kit, P/N 5037487, on crankshaft as shown.



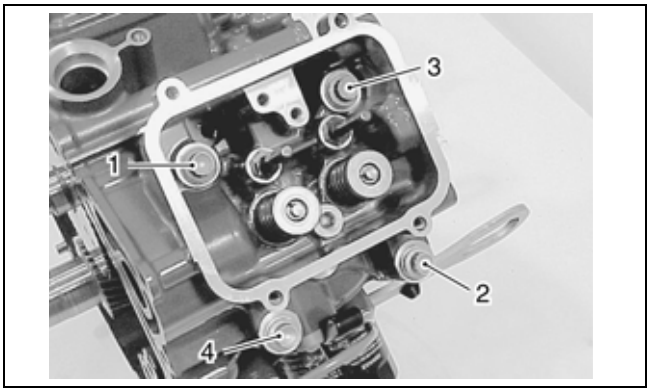
1. Spacer 005668
2. Crankshaft

Install Crankshaft Remover, then lift and remove the bottom crankcase by turning bolt.

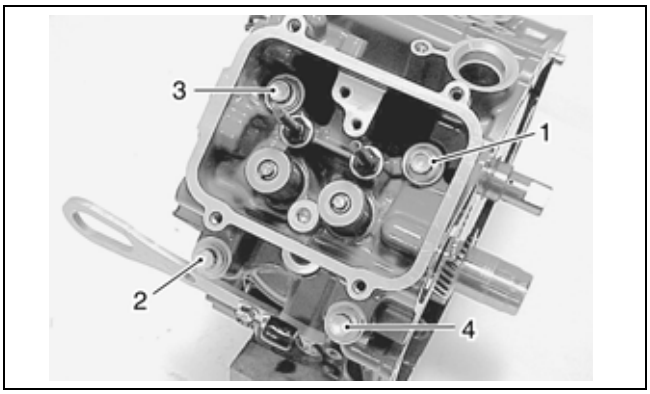


1. Crankshaft remover bolt 005669

Use a 10 mm deep socket to remove four cylinder head bolts in the order shown.



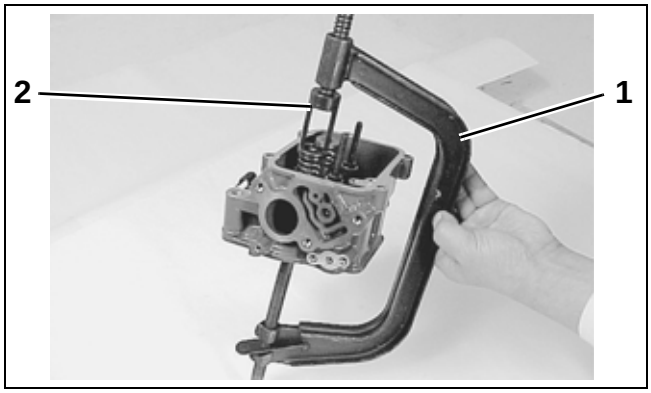
Starboard Cylinder Head 005670



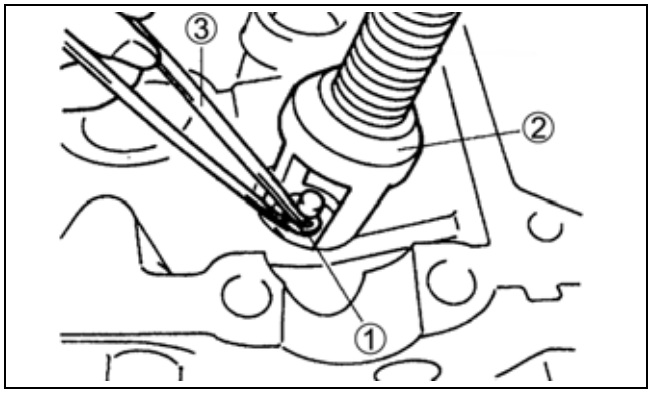
Port Cylinder Head 005671

Disassembly

Use Valve Spring Compressor, P/N 346186, and attachment from Valve Lifter Adaptor Kit, P/N 5000899, and tweezers to remove valve cotters while compressing valve spring.



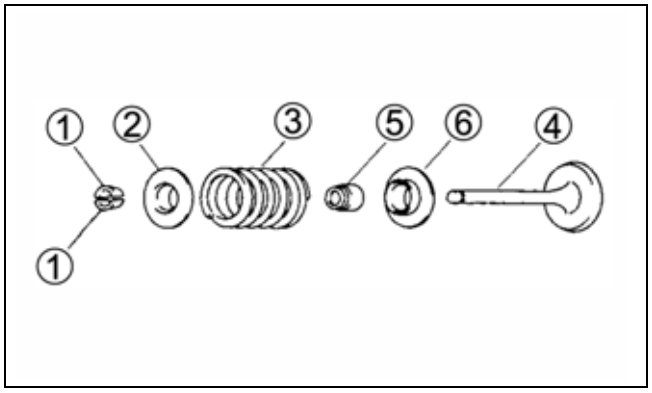
1. Valve spring compressor 005680
2. Attachment



1. Valve cotters 004509
2. Attachment "A"
3. Tweezers

IMPORTANT: Mark each valve and valve spring for reassembly in its original location.

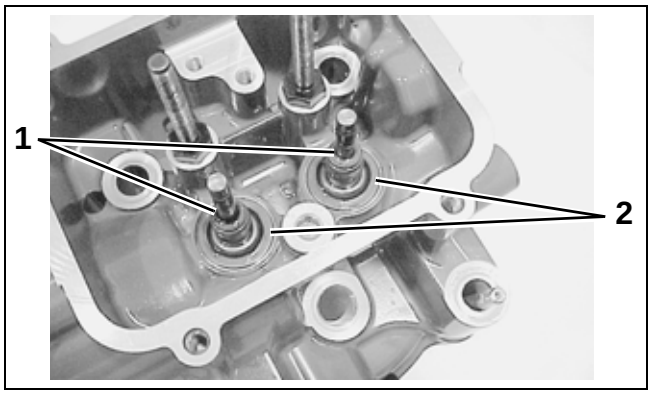
Remove valve spring retainer, valve spring, and valve.



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

004510

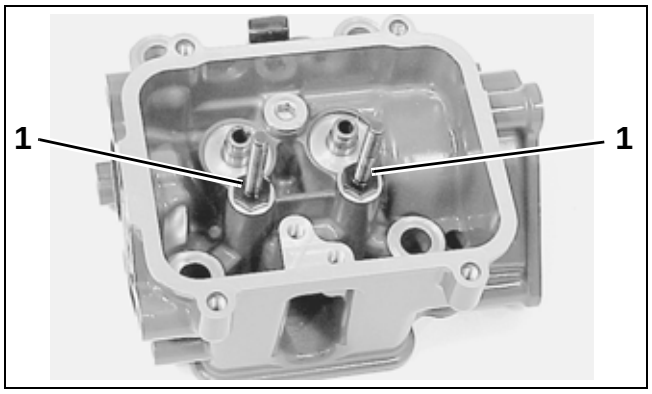
Remove valve stem seal and valve spring seat.



1. *Valve stem seal*
2. *Valve spring seat*

005681

Remove rocker arm pivot bolts.



1. *Pivot bolts*

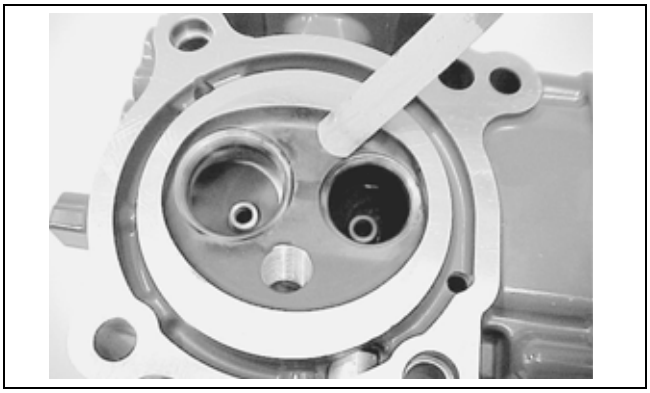
005682

Cleaning/Inspection

Cylinder Head

Remove all carbon from combustion chambers.

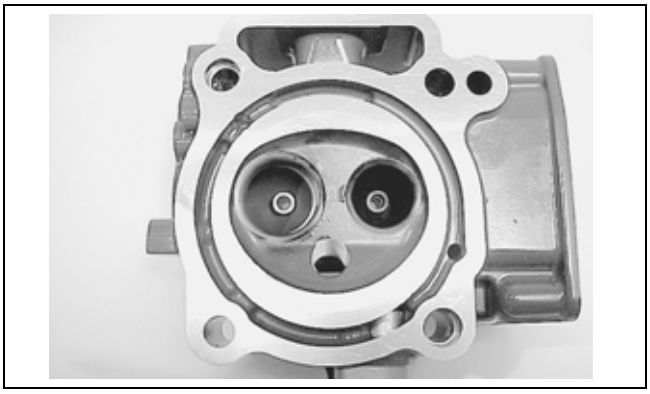
IMPORTANT: Do not use sharp edged tools to scrape carbon off cylinder head or components. Be careful not to scuff or nick metal surfaces.



005672

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

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

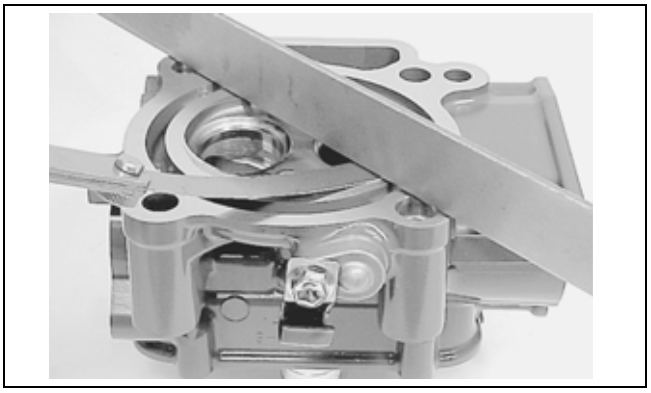


005673

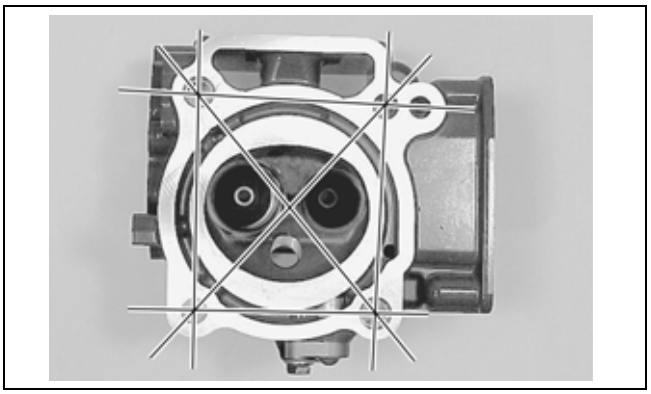
Check for cylinder head warpage using a piece of bar stock or machinist's straightedge and a feeler gauge set.

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.



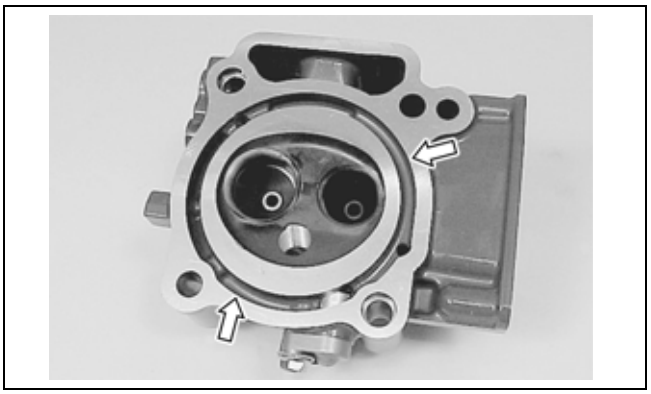
005674



005675

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.

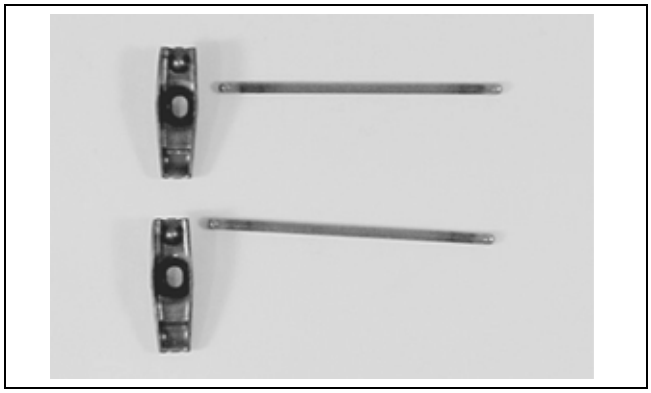


005676

Rocker Arm/Push Rod

Inspect rocker arms. Replace if cracked, distorted, or damaged.

Inspect push rods. Replace if bent or worn.



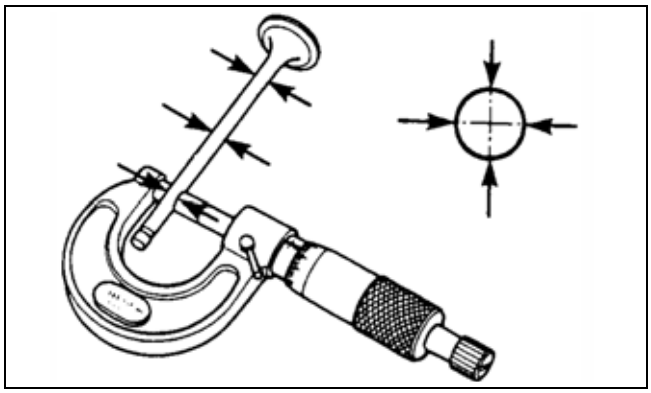
005677

Valve/Valve Guide

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

Valve stem outside diameter:
- IN 0.2152 to 0.2157 in. (5.465 to 5.480 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	0.0008 – 0.0019 in. (0.020 – 0.047 mm)	0.0028 in. (0.070 mm)
EX	0.0014 – 0.0024 in. (0.035 – 0.062 mm)	0.0035 in. (0.090 mm)

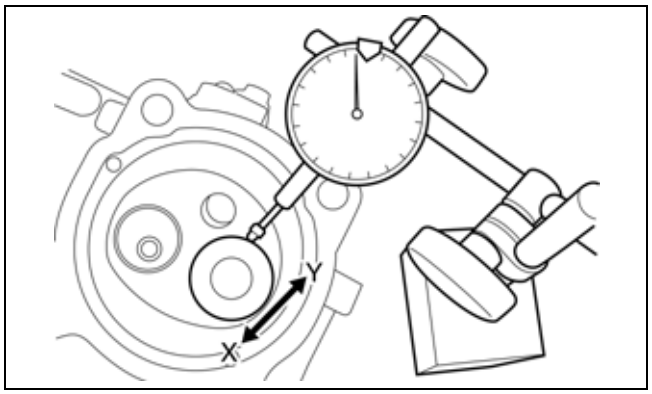
If clearance exceeds service limit, replace valve and/or valve guide.

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 5 mm away from valve seat.

Move valve head in the direction "X – Y" and measure deflection with a dial indicator.



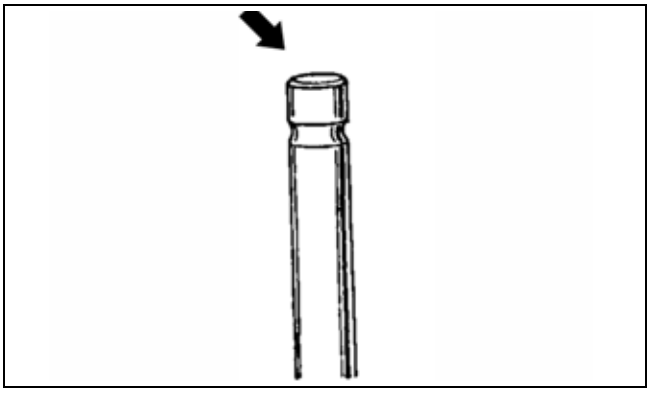
005678

Valve stem deflection service limit:
- IN 0.006 in. (0.14 mm)
- EX 0.007 in. (0.18 mm)

If measurement exceeds service limit, replace valve.

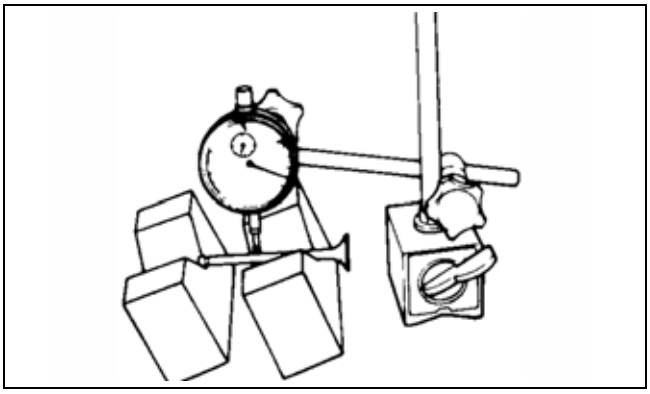
If measurement still exceeds service limit with new valve, replace valve guide.

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.



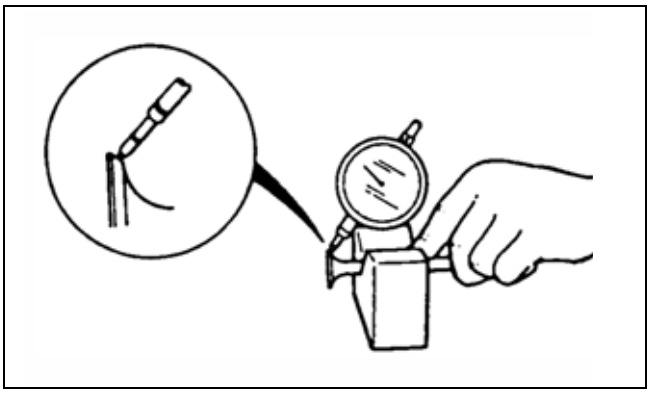
004527

Measure valve stem runout. If measurement exceeds service limit, replace valve.
- Service limit: 0.002 in. (0.05 mm)



004528

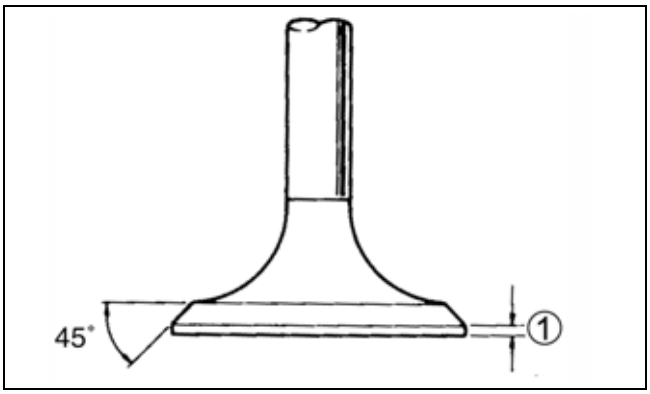
Measure valve head radial runout. If measurement exceeds service limit, replace valve.
- Service limit: 0.003 in. (0.08 mm)



004529

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

- Standard: 0.0394 in. (1.0 mm)
- Service limit: 0.0197 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

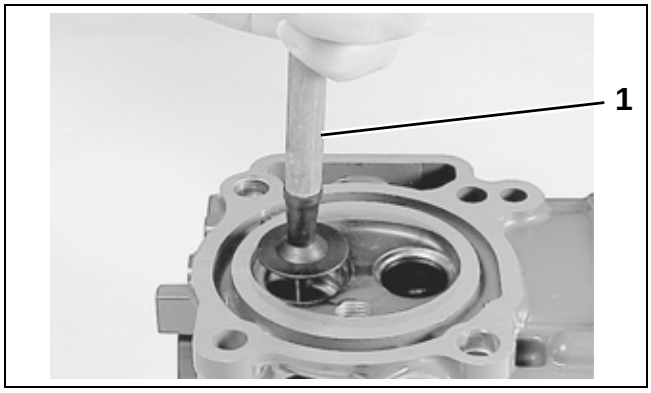
Rotate valve while gently tapping valve contact area against seat

Repeat until a continuous pattern in the Prussian Blue is seen

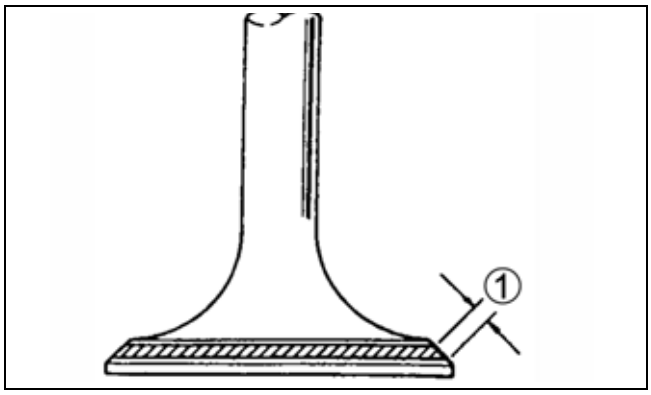
Measure valve seat contact width:

- Service limit: 0.04 to 0.05 in. (1.1 to 1.3 mm)

If measurement exceeds service limit, repair valve seat. Refer to **Valve Seat Servicing** on p. 144.



1. Valve lapper 005679

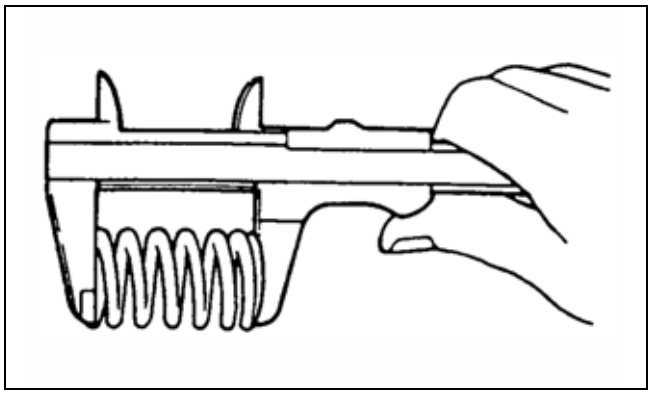


1. Valve seat contact area 004532

Valve Spring

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

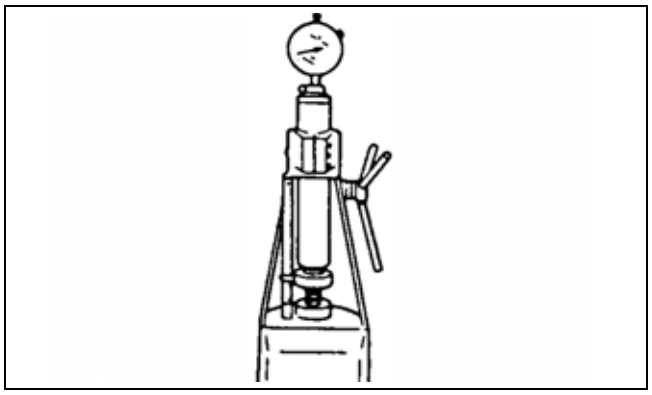
- Standard: 1.608 in. (40.84 mm)
- Service limit: 1.5487 in. (39.21 mm)



004541

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

- Standard: 24.5 to 28.2 lbs. (111 to 128 N) for 1.24 in. (31.5 mm)
- Service limit: 22.5 lbs. (102 N) for 1.24 in. (31.5 mm)



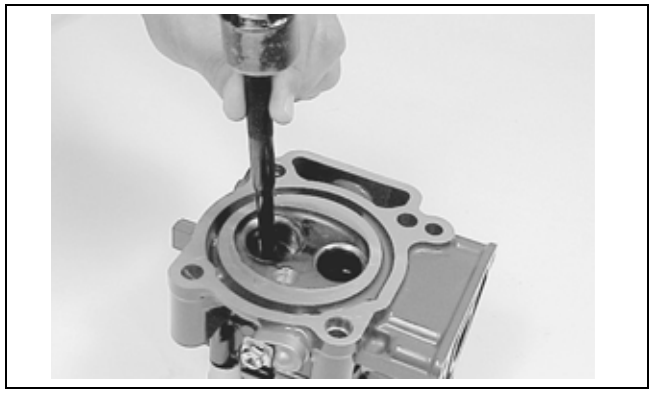
004542

Assembly

Valve Guide Replacement

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

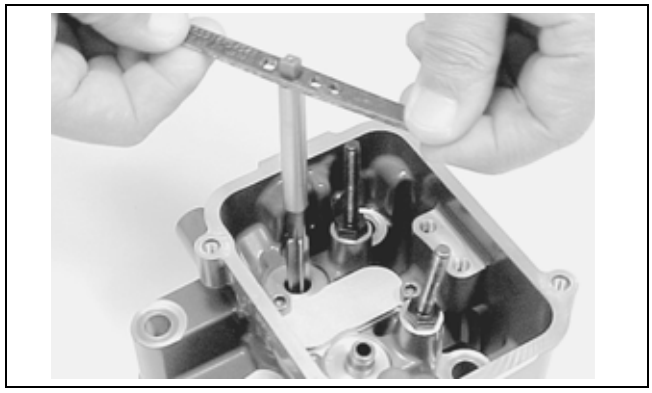
Drive valve guide out toward valve spring side.



005683

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 10.5 mm reamer to true hole and remove burrs. Turn reamer clockwise, never counterclockwise.

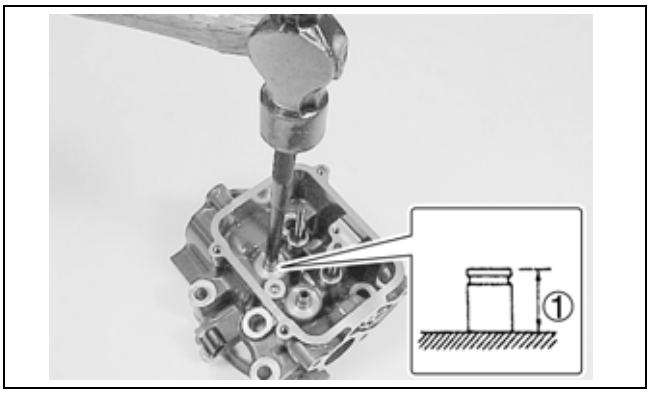


005684

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

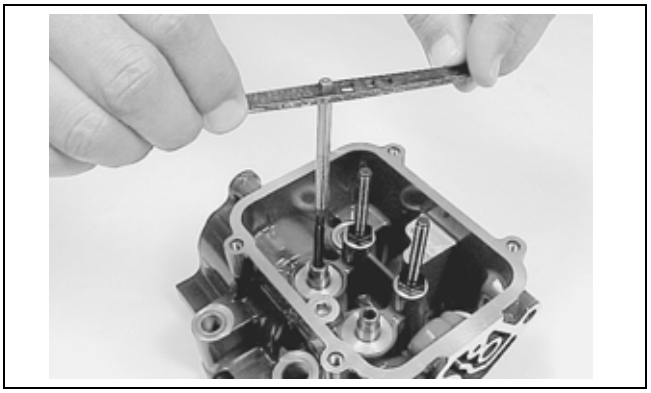
Measure valve guide protrusion:

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



1. Valve guide protrusion 005685

Ream valve guide bore with 5.5 mm reamer.



005686

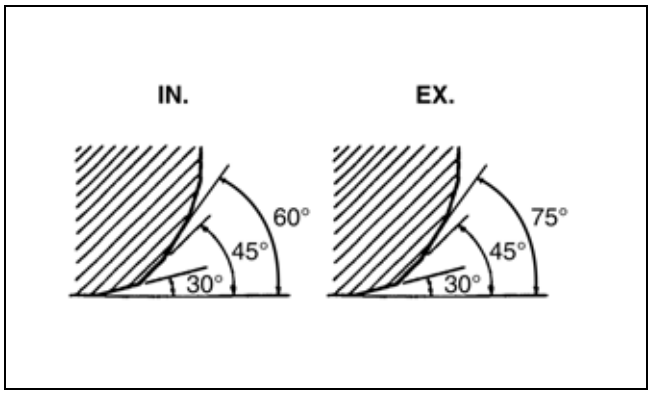
Clean and oil the valve guide bore after reaming.

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 have three chamfer angles:

- IN: 30°, 45°, 60°
- EX: 30°, 45°, 75°



005687

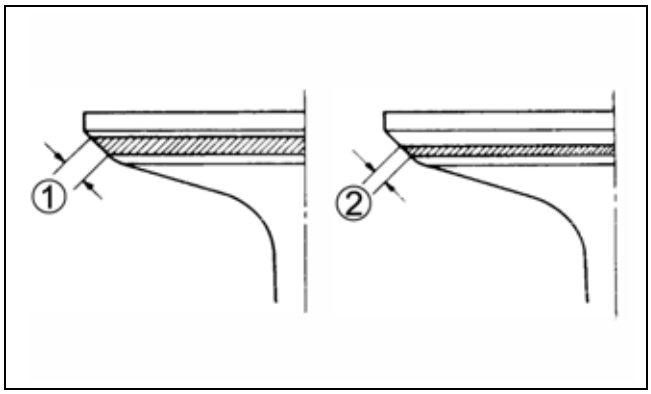
Use 45° cutter to reface valve seat.

IMPORTANT: Turn cutter clockwise, never counterclockwise.

Measure valve seat contact width. Refer to **Valve/Valve Guide** on p. 140.

If width is too high (wide), reface valve seat using 30° cutter.

If width is to low (narrow), reface valve seat using 60° cutter (intake) or 75° cutter (exhaust).

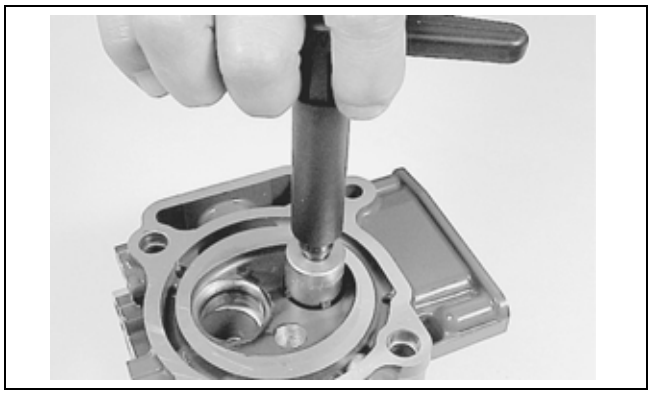


1. Too high (wide) 004539
2. Too low (narrow)

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

Clean up any burrs using 45° cutter very lightly.

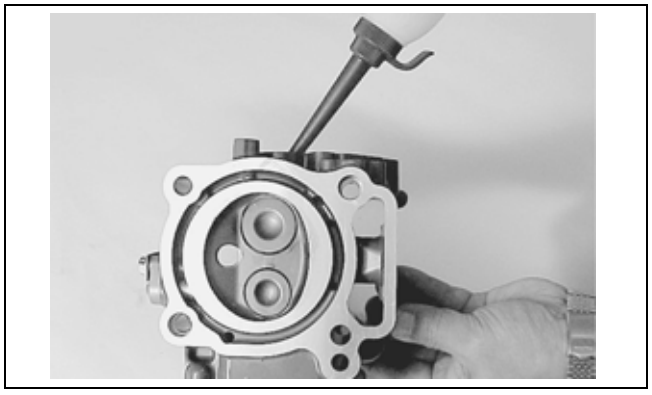
Lap valve on seat in two steps, first with coarse grit lapping compound applied to face, and second with fine grit compound.



005688

Recheck valve seat contact area.

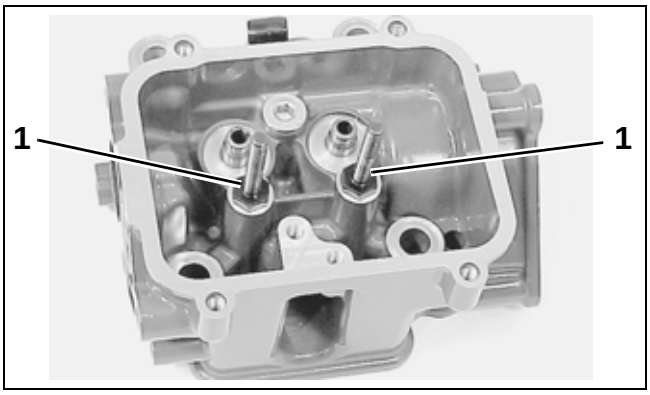
Clean and assemble cylinder head and valve components. Fill intake and exhaust ports with solvent to check for leaks between seat and valve. If any leaks occur, inspect valve seat and face for burrs.



005689

Valves

Apply *Nut Lock* to threads of rocker arm pivot bolts. Install pivot bolts and tighten 16.5 ft. lbs. (23 N·m).

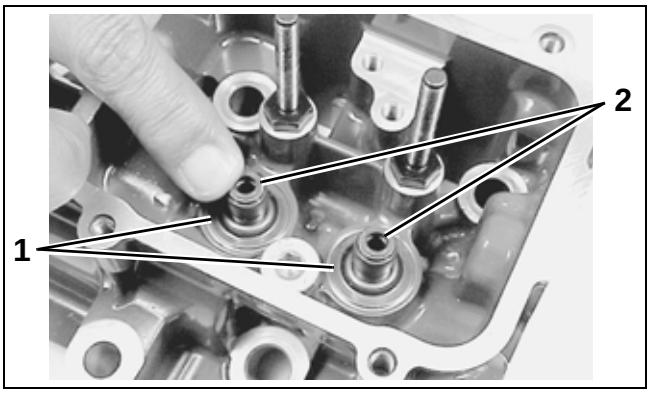


1. Pivot bolts 005682

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.

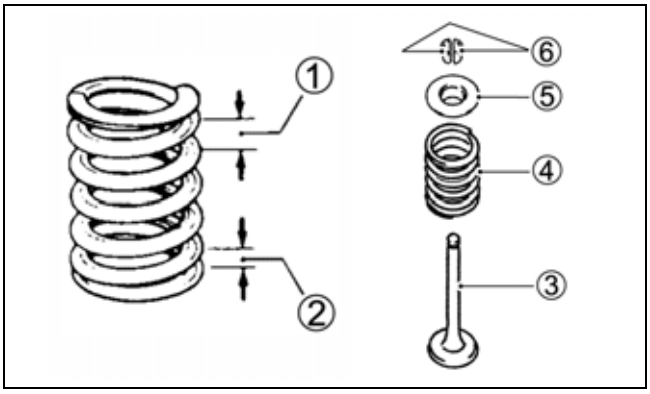


1. Valve spring seat
2. Valve stem seal 005690

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.

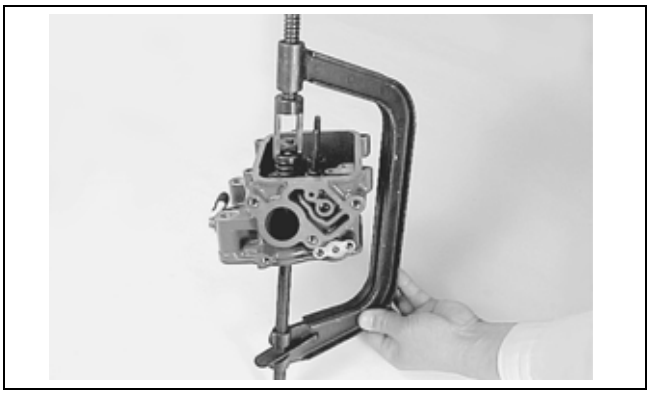


1. *Wide spiral area*
2. *Narrow spiral area*
3. *Valve*
4. *Valve spring*
5. *Retainer*
6. *Cotters*

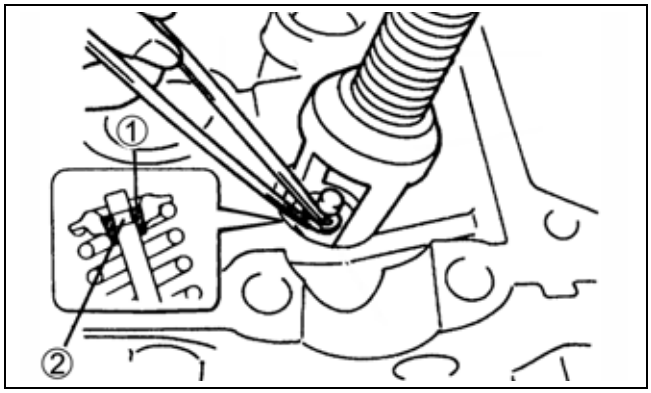
004545

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

Make sure valve cotters are properly seated in groove.



005691



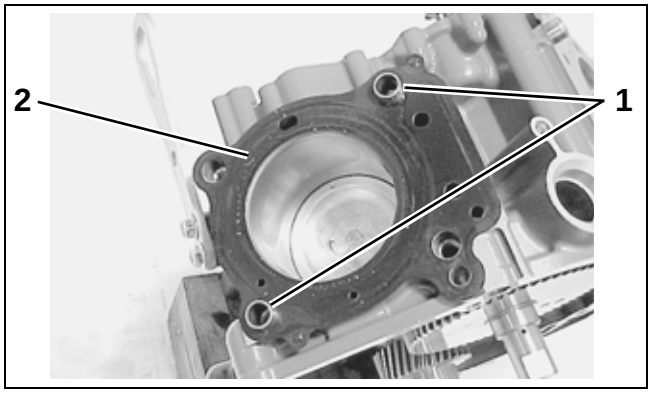
1. *Valve cotter*
2. *Groove*

004547

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 block.



1. *Dowel pins*
2. *Gasket*

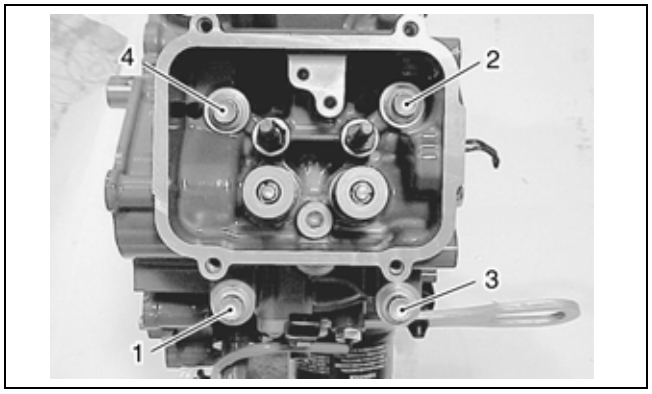
005692

Position cylinder head on cylinder block.

Apply engine oil to cylinder head screws.

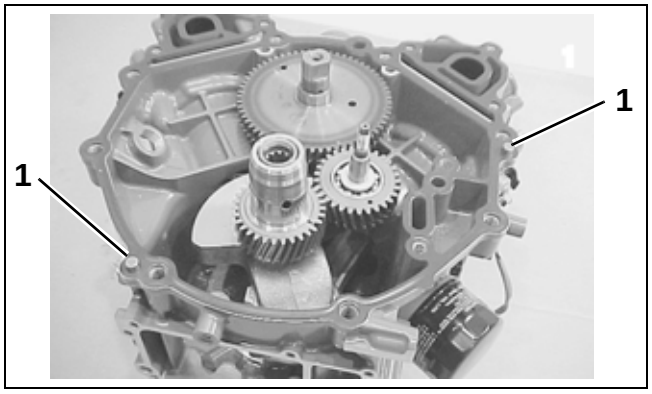
Lightly seat all cylinder head screws. Then tighten, in stages, following the pattern shown.

- Tighten to 20 ft. lbs. (28 N·m)
- Loosen all screws completely
- Tighten to 20 ft. lbs. (28 N·m)
- Tighten to 40 ft. lbs. (55 N·m)



Torque Pattern – Cylinder Head 005693

Place dowel pins and bottom crankcase gasket into position.

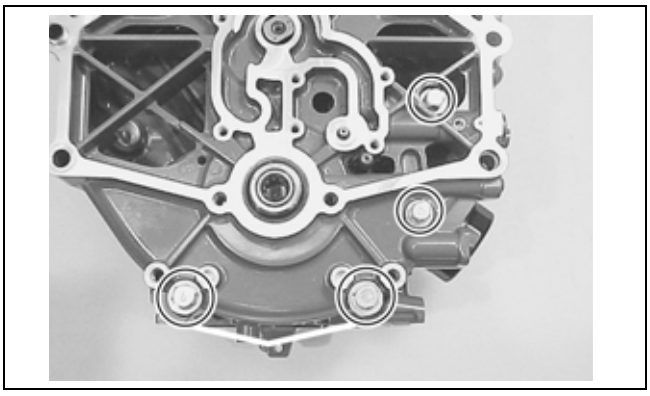


1. Dowel pins 005694

IMPORTANT: Before installing bottom crankcase, make sure idle gear is in place and all timing marks are aligned. Refer to **Idle Gear** on p. 164.

Place bottom crankcase into position.

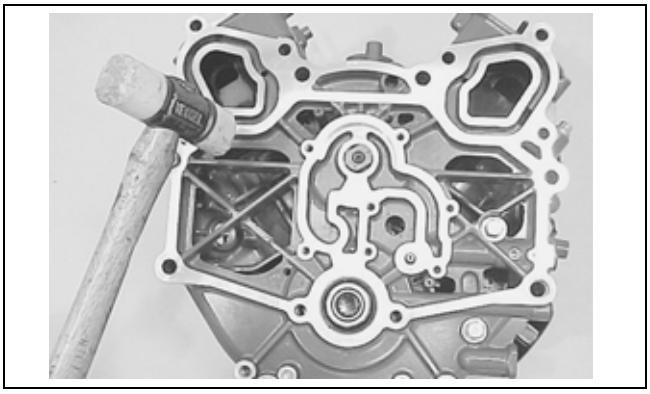
Install 8 mm and 10 mm screws from Crankshaft Remover/Installer Kit, P/N 5037487, in positions shown.



005695

Tighten each screw gradually and evenly until they bottom.

IMPORTANT: Crankcase and cylinder block surfaces should always be held parallel. Tap four corners of crankcase with a rubber hammer while gradually tightening screws.



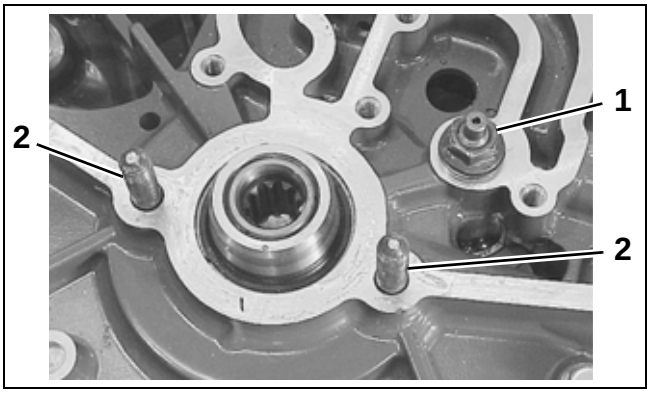
005696

When special tool screws have bottomed, replace them with crankcase screws. Tighten screws as follows:

- 8 mm: 16.5 ft. lbs. (23 N·m)
- 10 mm: 36 ft. lbs. (50 N·m)

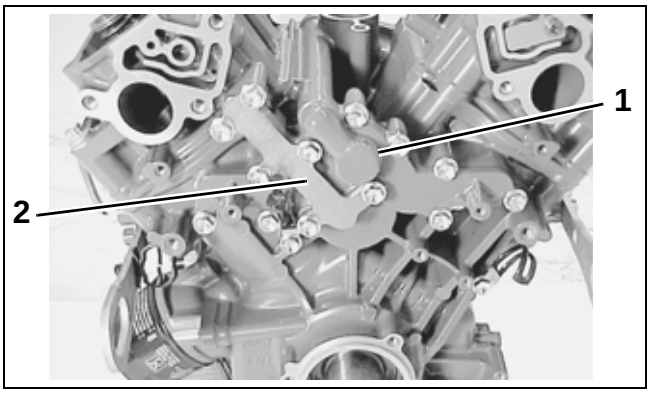
Install washer and idle gear shaft nut. Tighten nut securely.

Install two studs in crankcase.



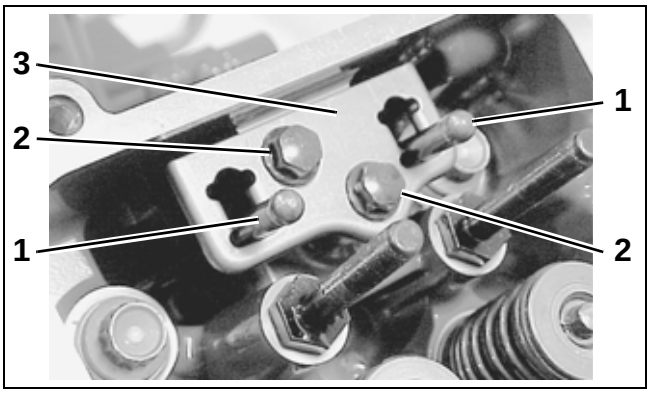
1. *Idle gear shaft nut* 005666
2. *Stud*

Install thermostat, thermostat cover, and oil gallery plate. Tighten screws 88 in. lbs. (10 N·m).



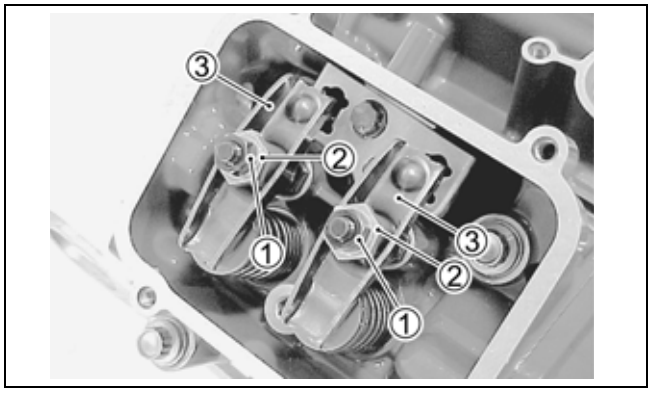
1. *Thermostat cover* 005664
2. *Oil gallery plate*

Install push rod guide and tighten screws securely. Install push rods.



1. *Push rod* 005663
2. *Guide screws*
3. *Pushrod guide*

Install rocker arms, pivot nuts, and valve adjusting lock nuts on to pivot bolts.

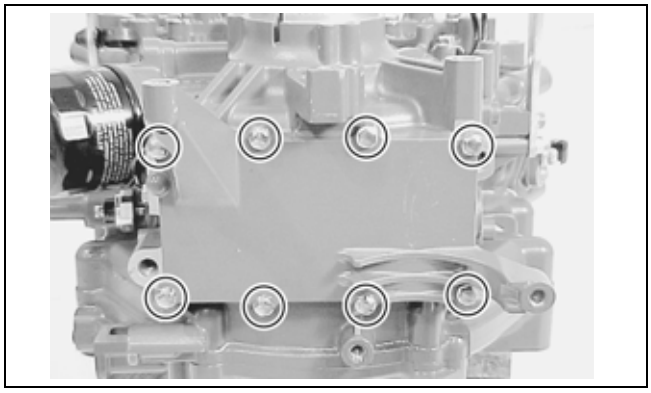


1. *Lock nuts* 005662
2. *Pivot nuts*
3. *Rocker arms*

IMPORTANT: Reassemble each rocker arm in its original location.

Adjust valve clearance. Refer to **VALVE CLEARANCE** on p. 58.

Install crankcase front plate and screws.



005661

Install oil pump components. Refer to **OIL PUMP** on p. 135.

Install powerhead. Refer to powerhead **REMOVAL AND INSTALLATION** on p. 130.

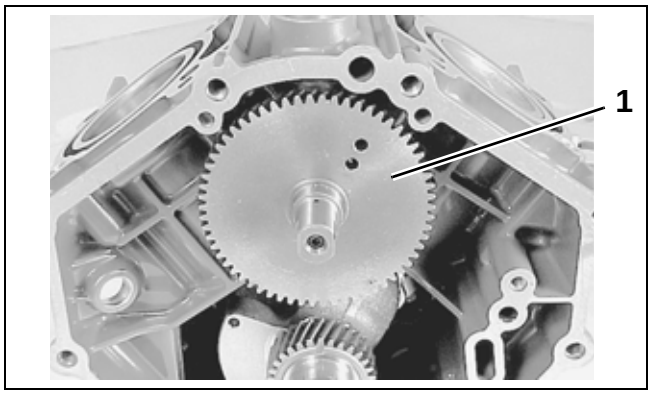
CRANKSHAFT, PISTONS AND CAMSHAFT

Disassembly

Remove the powerhead. Refer to **REMOVAL AND INSTALLATION** on p. 130.

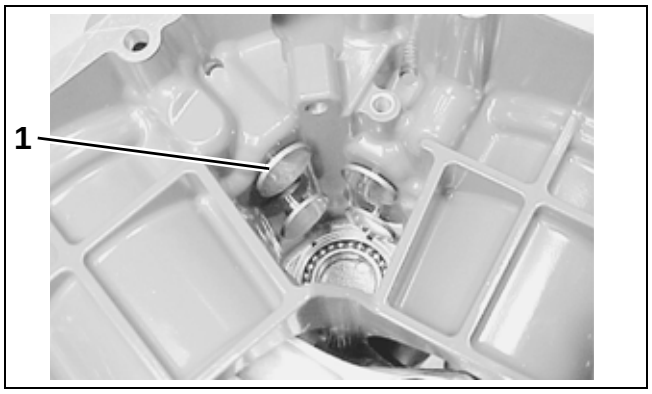
Remove the cylinder head assemblies. Refer to cylinder head **Removal** on p. 136.

Remove the idle gear and camshaft.



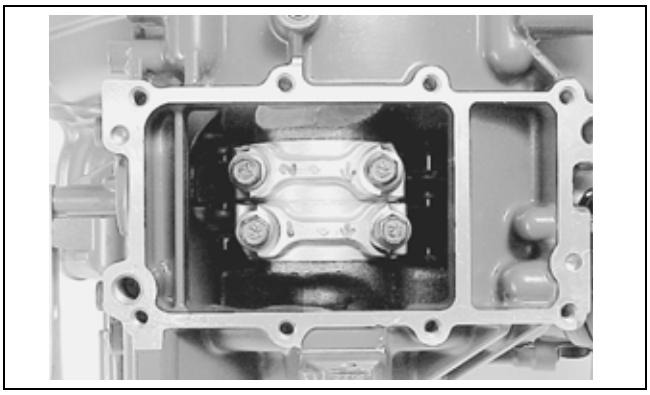
1. Camshaft 005697

Remove the four tappets.



1. Tappets 005698

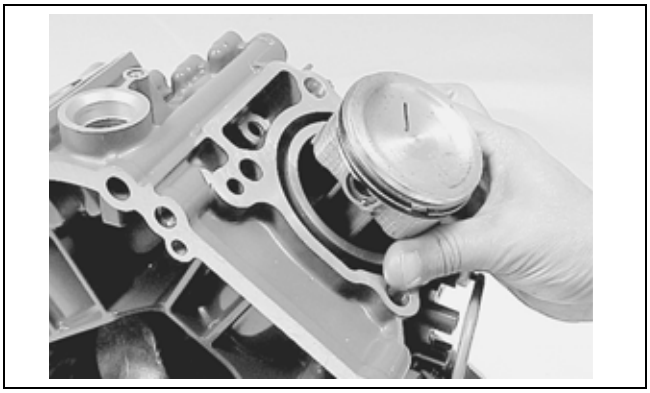
Remove connecting rod screws and caps.



005699

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.

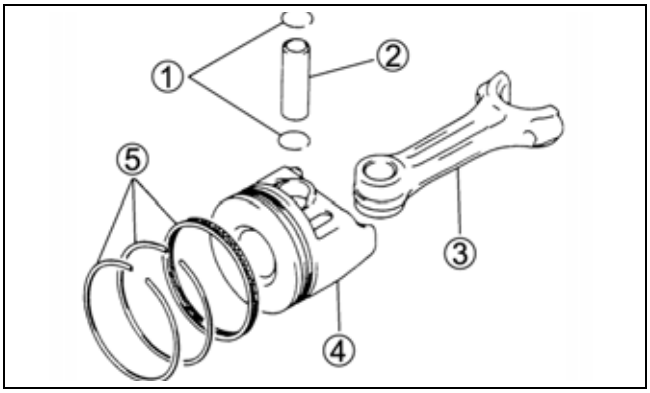


005700

Remove piston pin circlips.

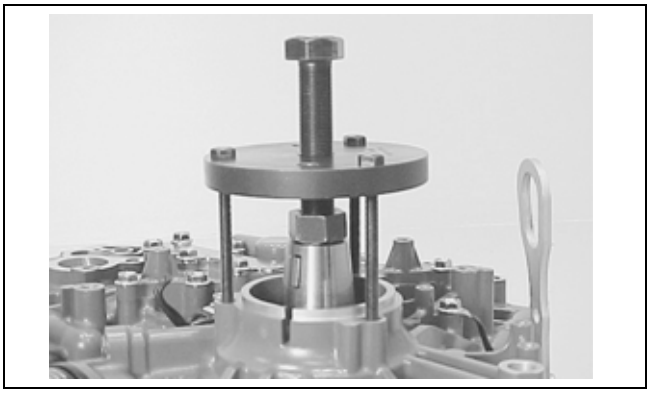
Remove piston pin from connecting rod.

Remove piston rings from piston.



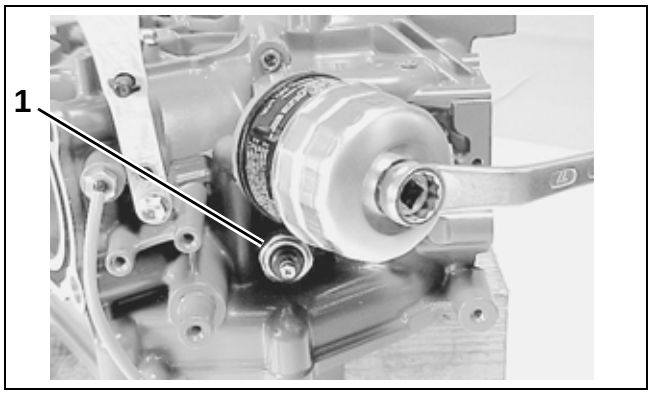
1. *Circlips* 004566
2. *Piston pin*
3. *Connecting rod*
4. *Piston*
5. *Piston rings*

Install Crankshaft Remover/Installer Kit, P/N 5037487, as shown. Push crankshaft out by turning bolt.



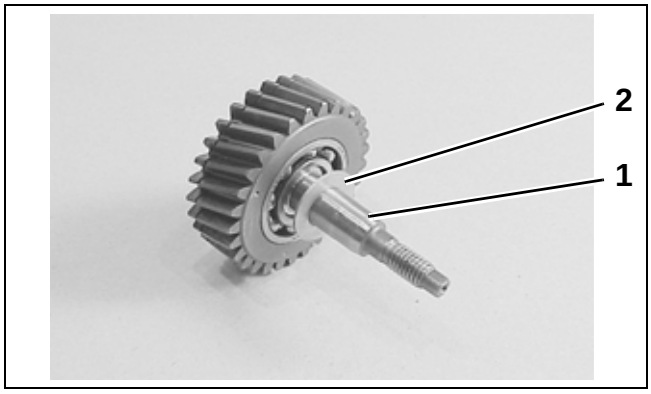
005701

Remove oil filter and oil pressure switch.



1. *Oil pressure switch* 005702

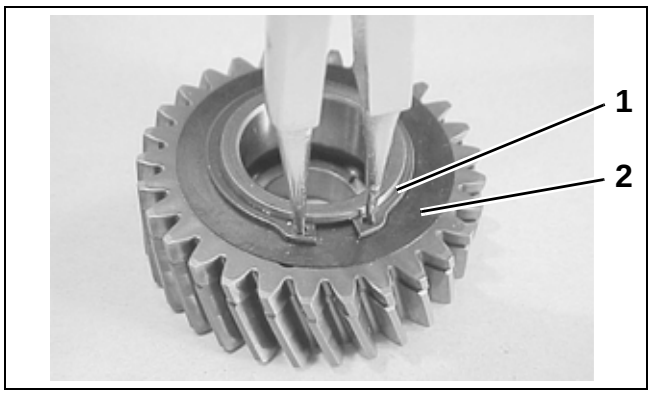
Remove shaft and washer from idle gear.



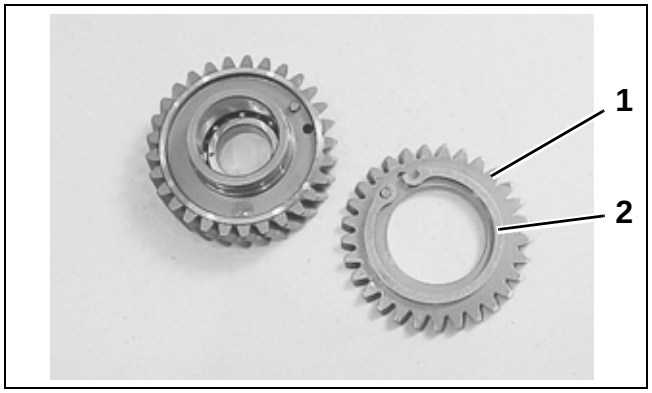
1. *Shaft* 005703
2. *Washer*

Remove circlip, washer, and no. 1 gear.

Remove the spring plate.

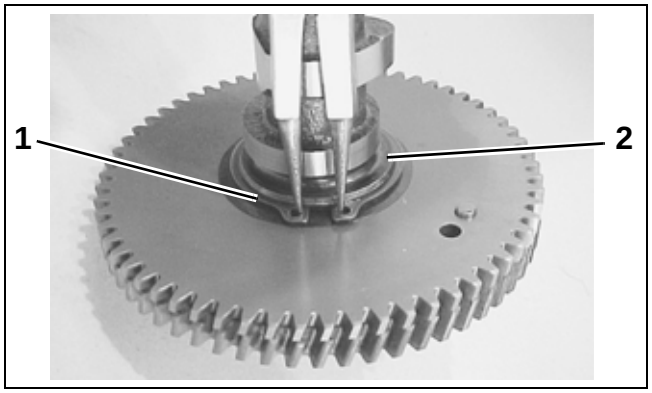


1. *Circlip* 005704
2. *Washer*



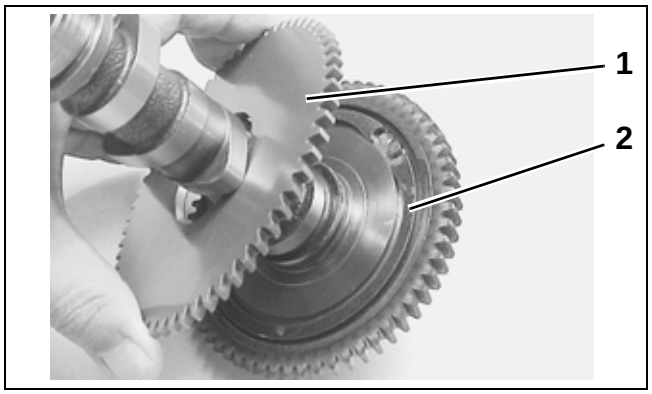
1. No. 1 gear 005705
2. Spring plate

Remove circlip and washer from camshaft timing gear.



1. Circlip 005706
2. Washer

Remove no. 1 gear and spring plate.



1. No. 1 gear 005707
2. Spring plate

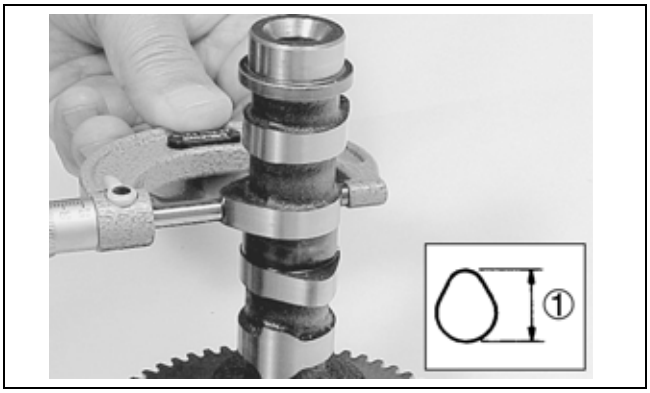
Cleaning/Inspection

IMPORTANT: If cracks, excessive wear, or other damage is found on any component, replace component.

Camshaft

Inspect cam face and journals for pitting, scratches, wear, or damage. If any of these conditions are found, replace camshaft.

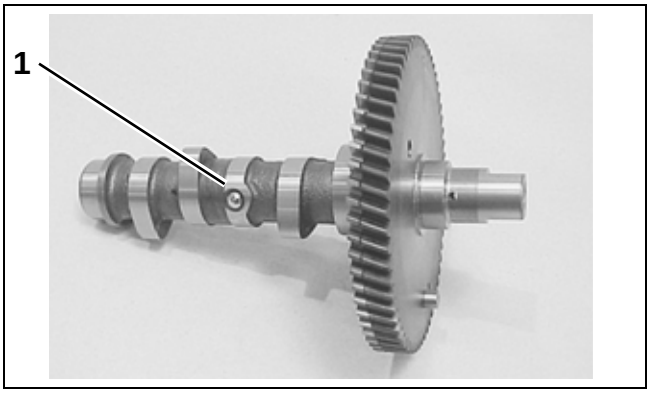
Use a micrometer to measure the cam height. If measurement is outside service limit, replace camshaft.



1. Cam height 005708

Cam Height Specifications		
	Standard	**Service Limit**
IN	1.2961 – 1.3024 in. (32.921 – 33.081 mm)	1.2922 in. (32.821 mm)
EX	1.2961 – 1.3024 in. (32.921 – 33.081 mm)	1.2922 in. (32.821 mm)

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



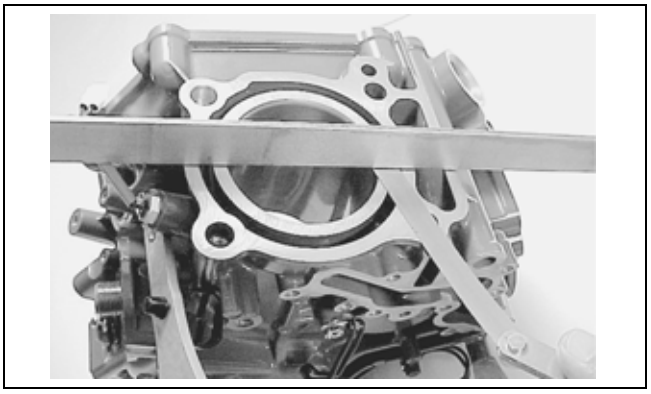
1. Decompression parts 005709

Cylinder

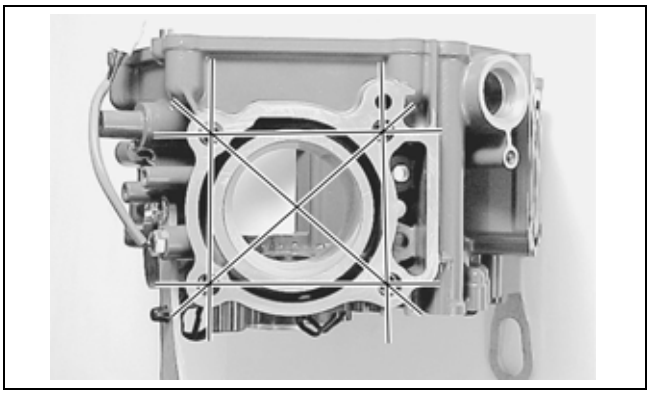
Use a straightedge and a thickness gauge to measure the cylinder distortion on the gasket surface at six locations as shown.

The service limit for distortion is 0.001 in. (0.03 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.

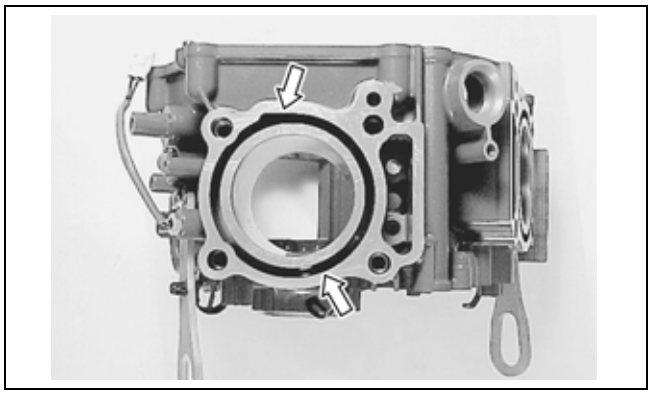


005710



005711

Check water jackets for clogs or obstructions.



005712

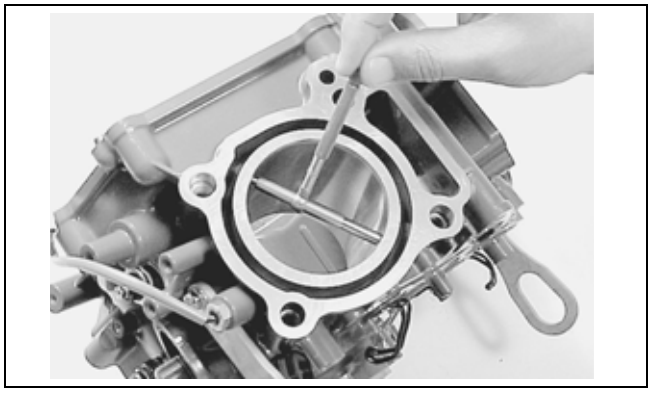
Measure the cylinder bore in the thrust and axial directions at two depth positions 1 and 2.

The difference between the two depth measurements is the cylinder bore taper.

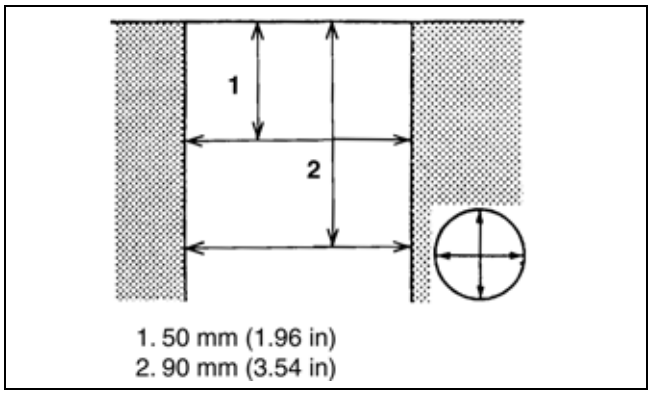
The difference between the axial and transverse measurements is the cylinder bore out-of-round.

The service limit for cylinder bore wear is 0.0039 in. (0.10 mm). If either taper or out-of-round mea-

surement exceeds service limit, rebore or replace cylinder.



005713



005714

To check the piston to cylinder bore clearance, measure:

- Cylinder bore at 50 mm below the cylinder head gasket surface.
- Piston skirt diameter at 13 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:

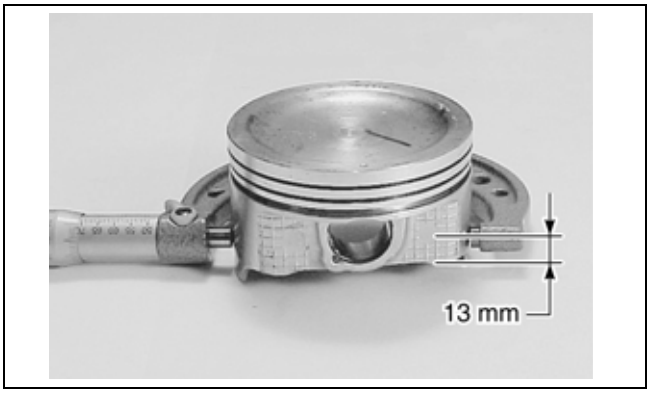
- Standard: 2.7953 to 2.7961 in. (71.000 to 71.020 mm)

Piston skirt diameter:

- Standard: 2.7941 to 2.7949 in. (70.970 to 70.990 mm)

Piston to cylinder clearance:

- Standard: 0.0008 to 0.0016 in. (0.020 to 0.040 mm)
- Service limit: 0.0039 in. (0.100 mm)



005715

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.

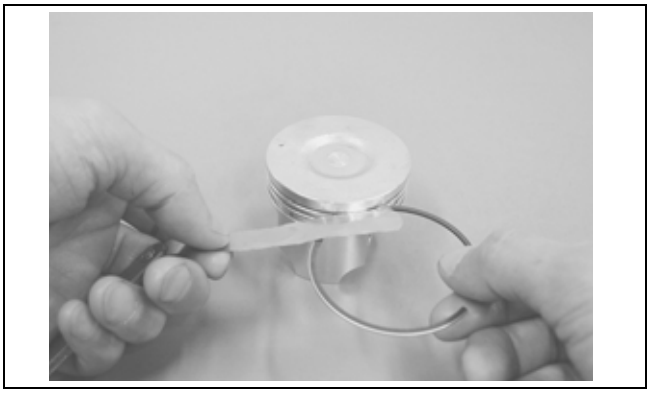
Standard piston ring groove width:
- 1st ring: 0.0402 to 0.0409 in. (1.02 to 1.04 mm)
- 2nd ring: 0.0476 to 0.0484 in. (1.21 to 1.23 mm)
- Oil ring: 0.0791 to 0.0799 in. (2.01 to 2.03 mm)

Standard piston ring thickness:
- 1st ring: 0.0382 to 0.0390 in. (0.97 to 0.99 mm)
- 2nd ring: 0.0461 to 0.0469 in. (1.17 to 1.19 mm)

Piston ring to groove clearance, standard:
- 1st ring: 0.0012 to 0.0028 in. (0.030 to 0.070 mm)
- 2nd ring: 0.0008 to 0.0024 in. (0.020 to 0.060 mm)

Service limit:
- 1st ring: 0.005 in. (0.12 mm)
- 2nd ring: 0.004 in. (0.10 mm)

If measurement exceeds service limit, replace the piston and/or piston ring.

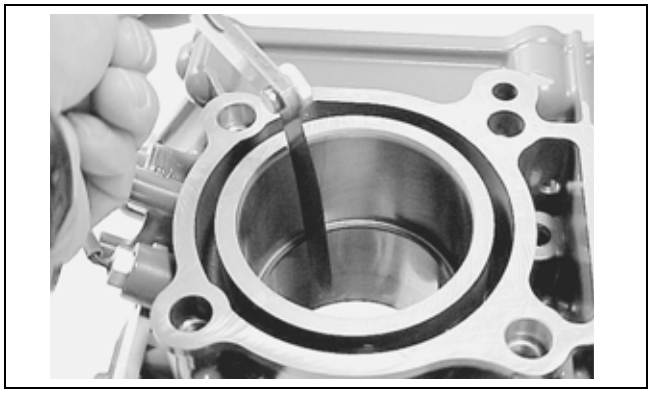


004574

Measure piston ring end gap with piston ring in the lowest position of cylinder bore. If measurement exceeds service limit, replace piston ring.

Piston ring end gap, standard:
- 1st ring: 0.0047 to 0.0106 in. (0.12 to 0.27 mm)
- 2nd ring: 0.0138 to 0.0197 in. (0.35 to 0.50 mm)

Service limit:
- 1st ring: 0.028 in. (0.70 mm)
- 2nd ring: 0.039 in. (1.00 mm)

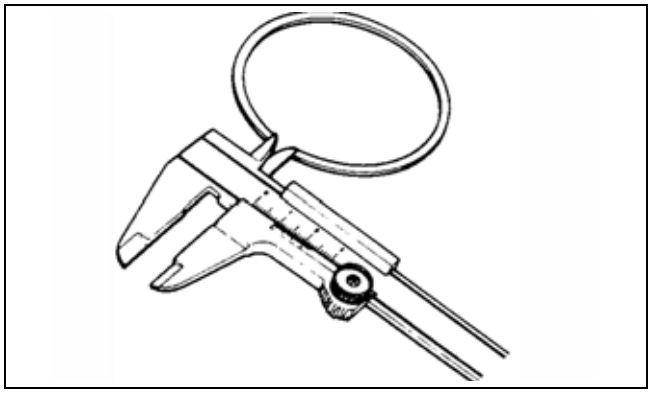


005716

Measure piston ring free end gap. If measurement exceeds service limit, replace piston ring.

Piston ring free end gap, standard:
- 1st ring: Approx. 0.3150 in. (8 mm)
- 2nd ring: Approx. 0.3937 in. (10 mm)

Service limit:
- 1st ring: 0.2520 in. (6.4 mm)
- 2nd ring: 0.3150 in. (8.0 mm)



004576

Check that the piston pin and the piston pin hole are free from excessive wear and damage.

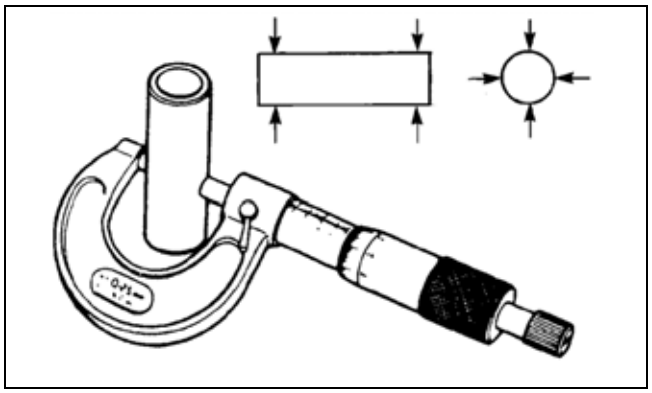
Apply engine oil on piston pin so that piston pin can move smoothly in the piston pin hole.

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.

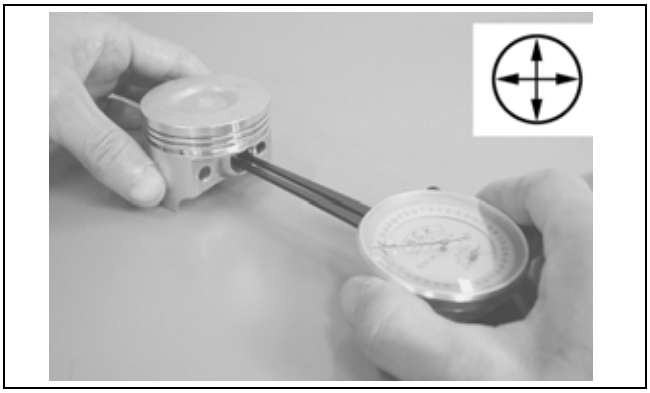
Piston pin outside diameter:
- Standard: 0.7085 to 0.7087 in. (17.995 to 18.000 mm)
- Service limit: 0.7079 in. (17.980 mm)

Piston pin hole diameter:
- Standard: 0.7089 to 0.7092 in. (18.006 to 18.014 mm)
- Service limit: 0.7098 in. (18.030 mm)

Piston pin to piston pin hole clearance:
- Standard: 0.0002 to 0.0007 in. (0.006 to 0.019 mm)
- Service limit: 0.0016 in. (0.040 mm)



004577

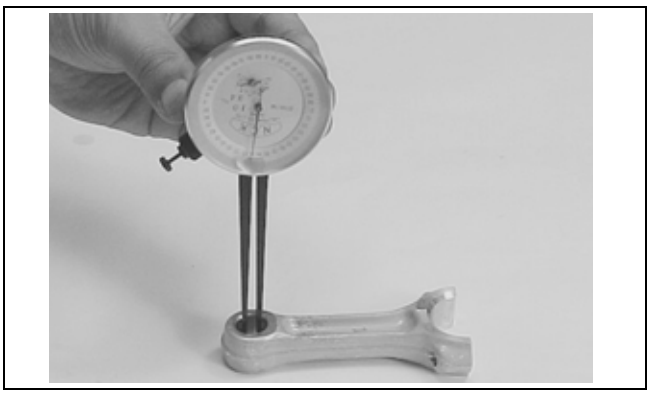


004578

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: 0.7089 to 0.7092 in. (18.006 to 18.014 mm)
- Service limit: 0.7098 in. (18.030 mm)



004579

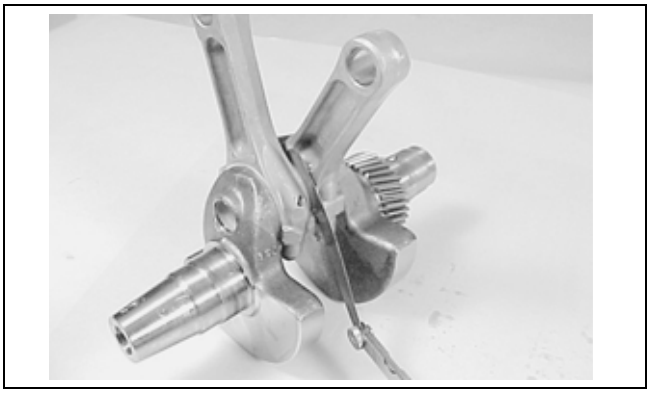
Piston pin to connecting rod hole clearance:
- Standard: 0.0002 to 0.0007 in. (0.006 to 0.019 mm)
- Service limit: 0.0028 in. (0.07 mm)

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: 0.9642 to 0.8681 in. (21.950 to 22.050 mm)

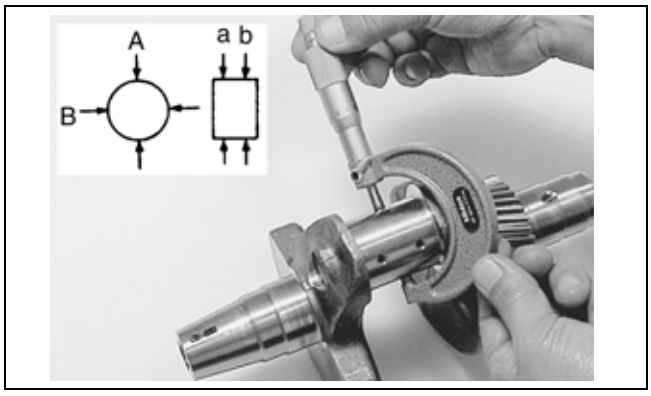
Crank pin width:
- Standard: 1.7390 to 1.7409 in. (44.170 to 44.220 mm)

Connecting rod big end side clearance:
- Standard: 0.0028 to 0.0118 in. (0.07 to 0.30 mm)
- Service limit: 0.0394 in. (1.0 mm)



005717

Measure the crank pin outside diameter in the thrust and axial directions at two positions as shown:



005718

Check for the following:
- Difference of the measurements at two positions (Taper).
- Difference between the thrust and axial measurements (Out-of-round).

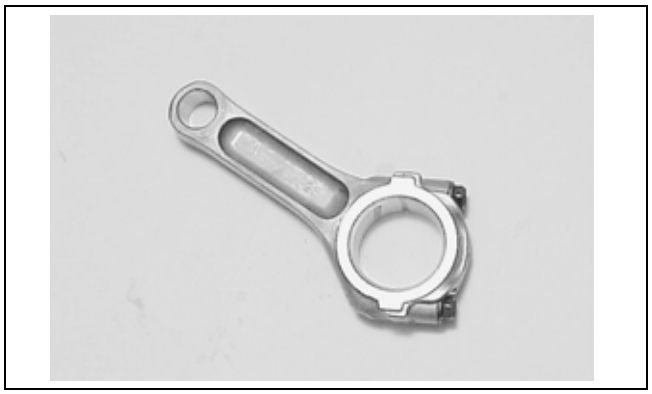
Crank pin outside diameter:
- Standard: 1.5350 to 1.5354 in. (38.990 to 39.000 mm)

Taper and Out-of-round:
- Service limit: 0.0004 in (0.010 mm)

If measurement exceeds service limit, replace crankshaft.

Measure the connecting rod big end inside diameter as follows:

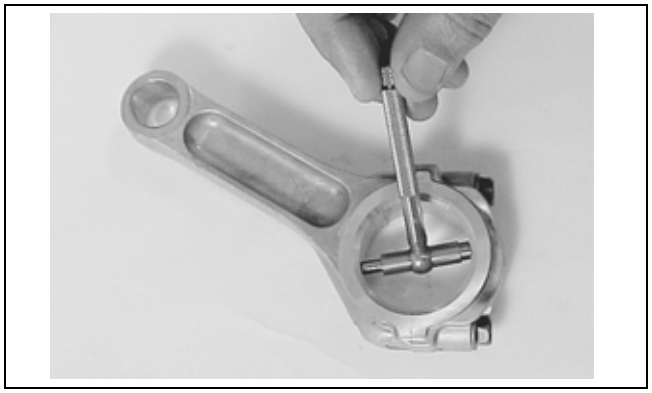
- Clean the surface of the rod and cap.
- Install the cap on the rod.
- Apply engine oil to screws and tighten to 102 in. lbs (12 N·m).



005719

Measure the connecting rod inside diameter:

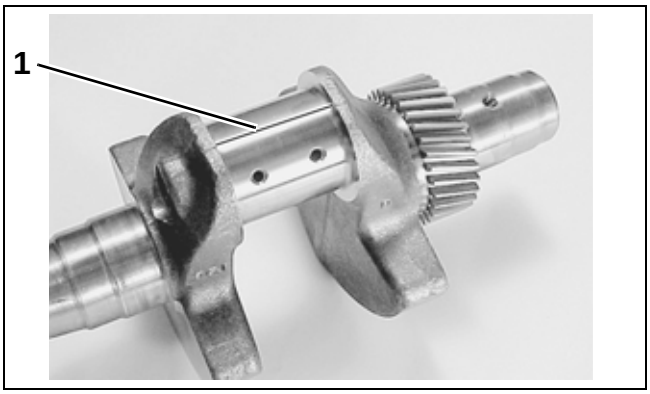
- Standard: 1.5360 to 1.5364 in. (39.015 to 39.025 mm).



005720

Measure connecting rod big end oil clearance as follows:

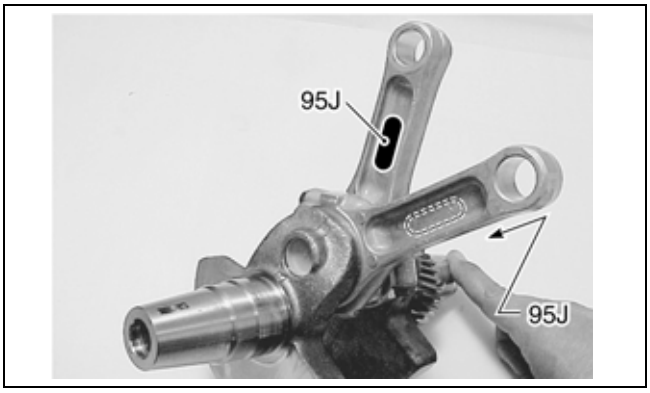
- Clean the surfaces of rod, cap, and crankpin.
- Place a piece of Plastigage on crank pin parallel to the crankshaft. Avoid placing Plastigage over the oil hole.



1. Plastigage 005721

- Install connecting rods and caps to crankpin with marks as shown.

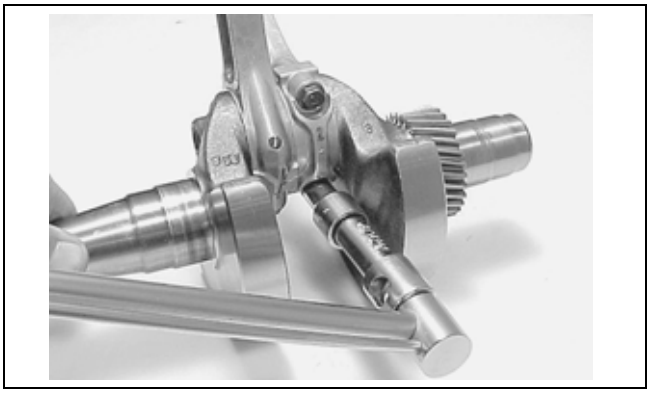
IMPORTANT: Do not rotate connecting rod with Plastigage in place.



005722

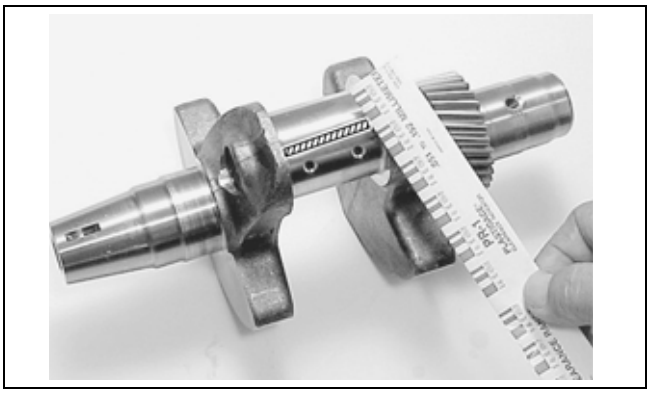
7

- Apply engine oil to screws and tighten in two steps to 102 in. lbs. (12 N·m).



005723

- Remove rods and caps from crankpin.
- Measure the compressed Plastigage at its widest point.



005724

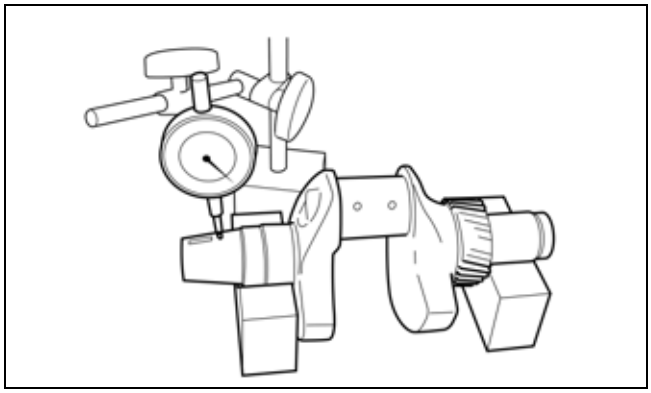
Connecting rod big end oil clearance:
- Standard: 0.0008 to 0.0012 in. (0.020 to 0.030 mm).
- Service limit: 0.0026 in. (0.065 mm)

If measurement exceeds service limit, replace connecting rod and/or crankshaft.

Crankshaft

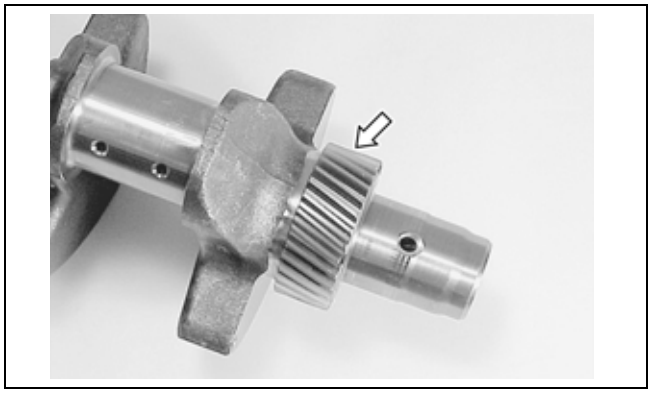
Measure crankshaft runout using “V” blocks and a dial indicator. If measurement exceeds service limit, replace crankshaft and/or crankcase.

Crankshaft runout:
- Service limit: 0.002 in. (0.05 mm)



005725

Inspect timing gear. Replace crankshaft if damaged or worn.



005726

Oil Seals and Bearings

Visually check the oil seals in the cylinder block and bottom crankcase for cuts, nicks, excessive wear or other damage.

Check main bearings for pitting and noisy or rough operation.

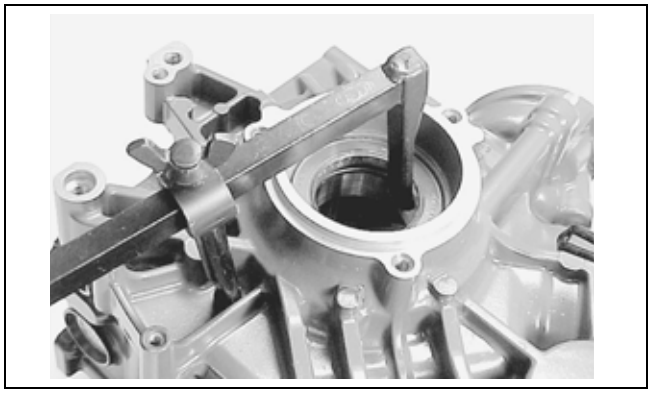
Assembly

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.

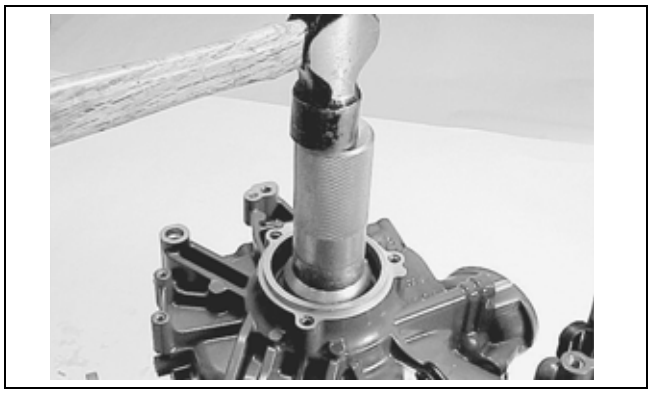
Upper Oil Seal and Bearing

Remove upper oil seal from cylinder block.



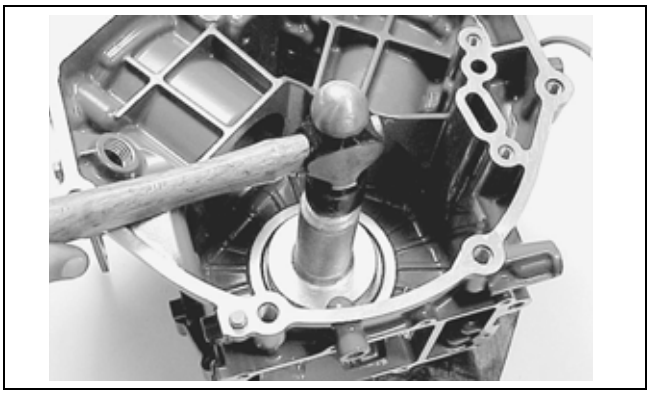
005727

Drive the bearing down and out.



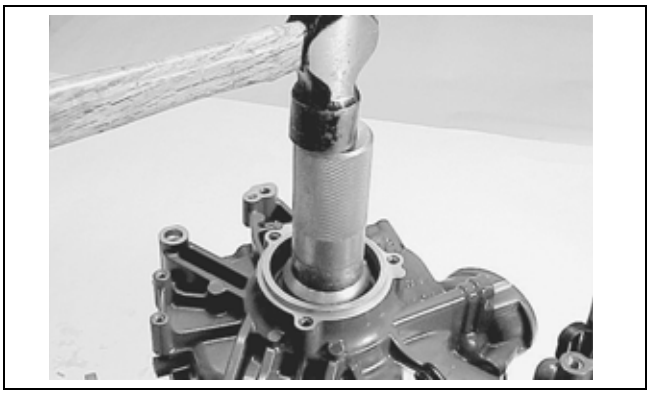
005728

Apply engine oil to outer surface of bearing. Drive bearing into upper cavity until it bottoms on shoulder.



005729

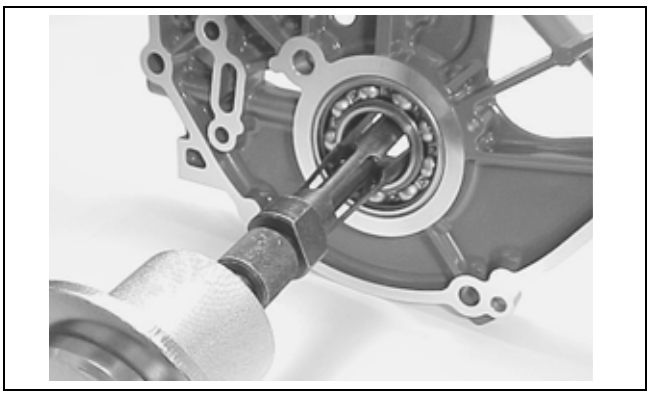
Apply engine oil to outer surface of oil seal. Drive seal into position with lip (spring side) facing inward. Do not contact seal to bearing.



005730

Lower Oil Seal and Bearing

Use a slide hammer and puller to remove the lower bearing from bottom crankcase.

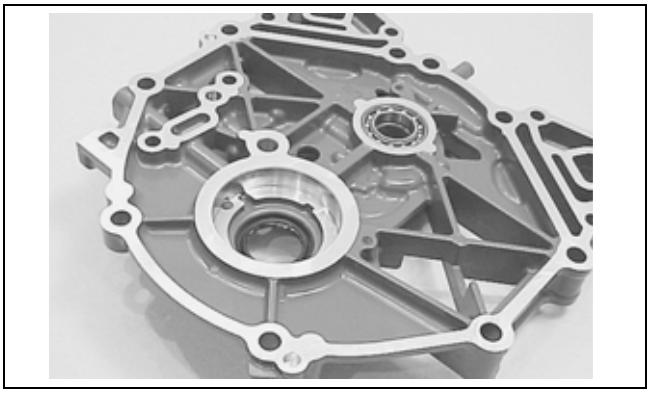


005731

Remove lower crankshaft oil seal.

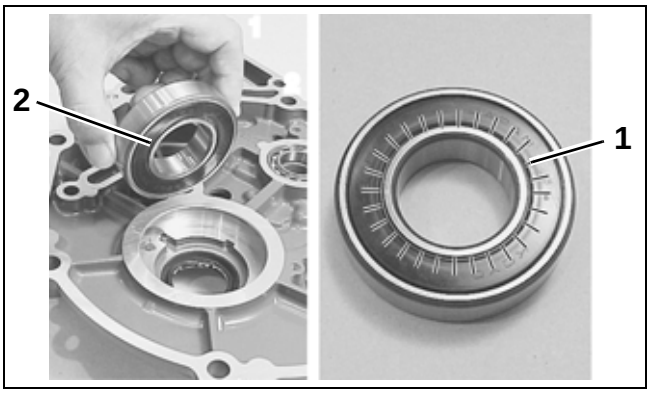
005732

Apply engine oil to outer surface of oil seal. Drive seal into position with lip (spring side) facing inward.



005733

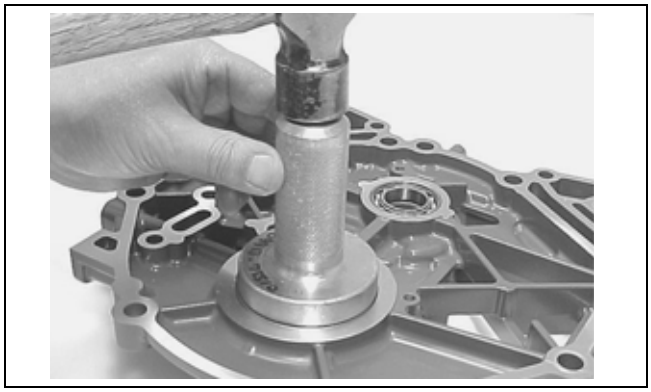
Apply engine oil to outer surface of bearing. Apply *Triple-Guard* grease to hatched area of seal plate. Install bearing with seal plate facing outside.



1. Hatched area
2. Seal plate

005734

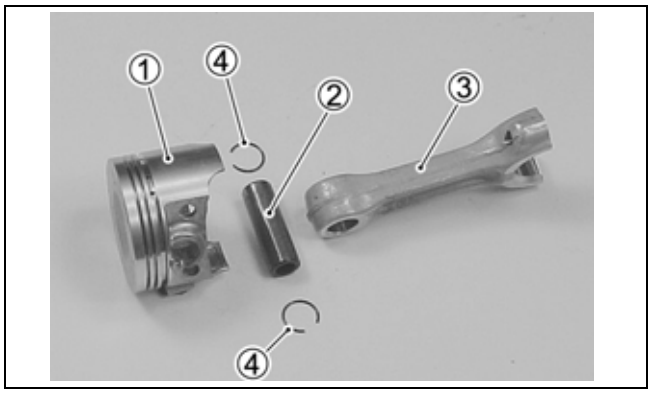
Drive bearing into cavity until it bottoms on shoulder.



005735

Piston and Connecting Rod

Apply engine oil to piston pin, piston pin bore, and connecting rod.



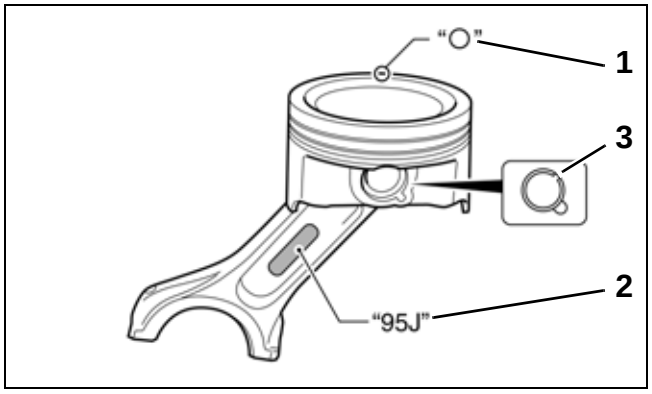
1. Piston
2. Piston pin
3. Connecting rod
4. Circlip

004596

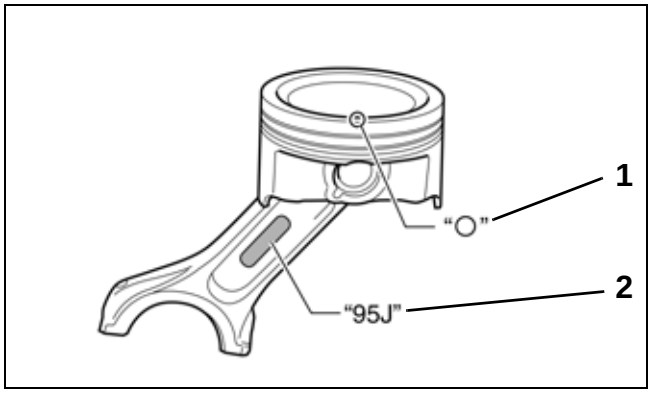
Fit connecting rod to piston and insert piston pin through piston and rod.

Install piston pin circlips with gap facing either up or down.

IMPORTANT: Install connecting rods in direction shown. End gap of circlip should not align with cutaway in piston pin bore.

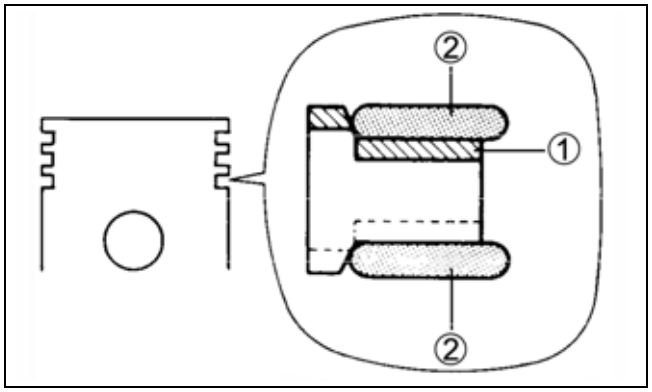


Starboard Cylinder 005736
1. *Up mark*
2. *Connecting rod mark*
3. *Circlip gap*



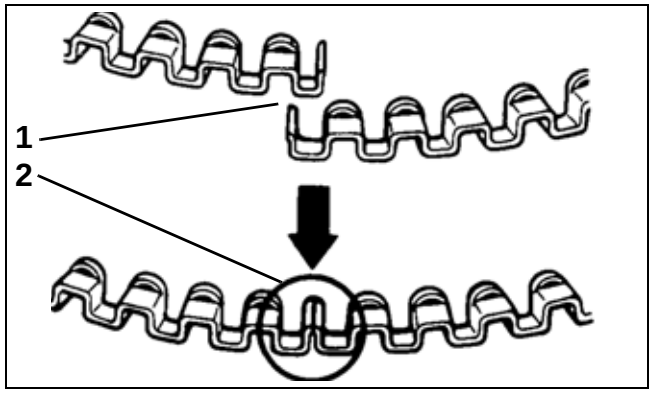
Port Cylinder 005737
1. *Up mark*
2. *Connecting rod mark*

Apply engine oil to piston rings. Install oil ring spacer first, then side rails.



1. *Spacer* 004598
2. *Side rail*

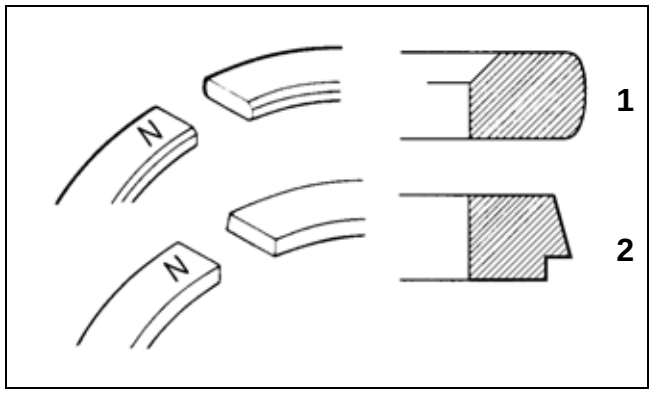
IMPORTANT: When installing spacer, do not allow ends to overlap in the groove.



1. *Incorrect* 004599
2. *Correct*

Install 2nd ring and 1st ring on piston with “N” mark toward the top of piston.

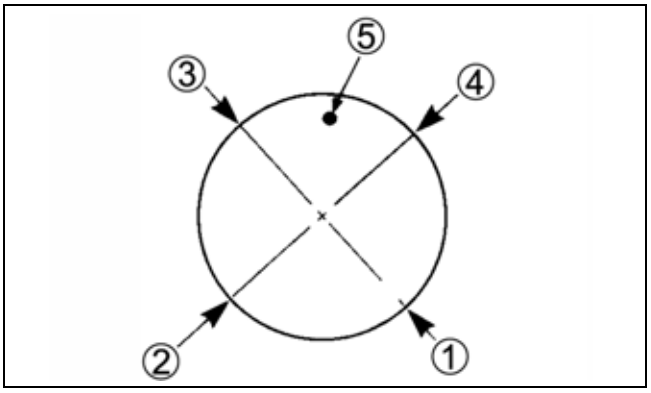
IMPORTANT: 1st and 2nd ring differ in shape as shown.



1. *1st Ring* 005738
2. *2nd Ring*

7

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

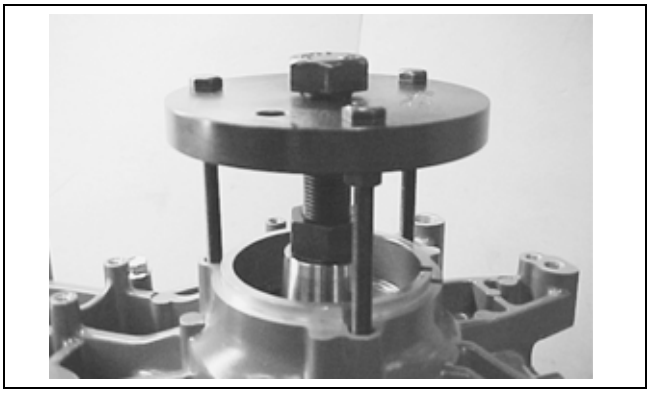
004602

Crankshaft

Apply engine oil to upper oil seal lip and crankshaft bearing.

Apply engine oil to crankshaft journals and crank pin.

Use Crankshaft Remover/Installer, P/N 5037487, to pull crankshaft into position.



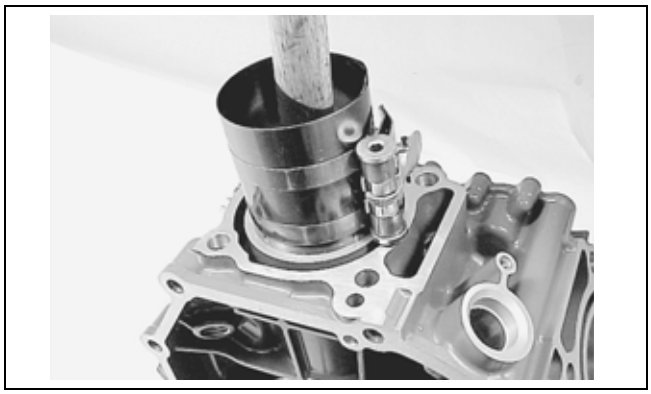
005739

Piston to Cylinder

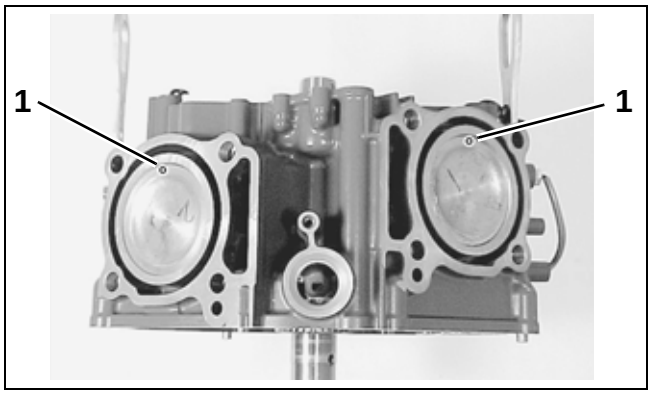
Apply engine oil to piston and cylinder walls.

Place piston and connecting rod assembly into cylinder bore from cylinder head side.

IMPORTANT: Position the up mark (O) on piston toward the flywheel.



005740



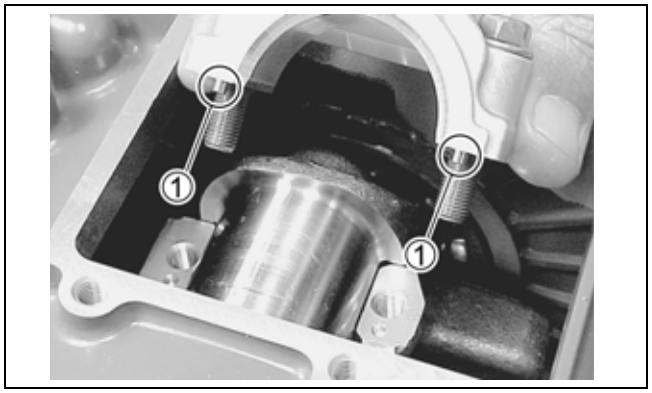
1. Up mark (O)

005741

Apply engine oil to crank pin, connecting rod, and cap.

Install dowel pins and cap to connecting rod.

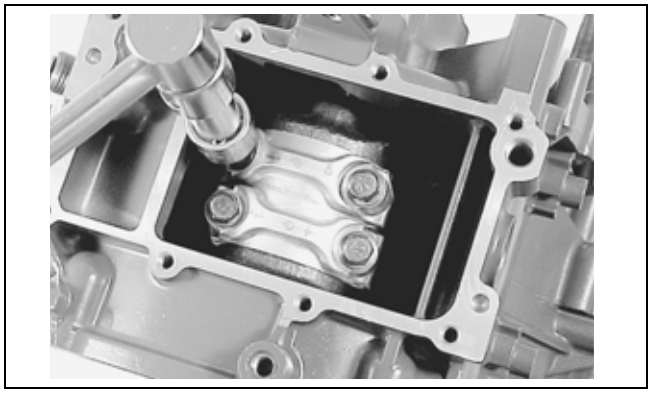
IMPORTANT: Install each connecting rod cap in its original location.



1. Dowel pin 005742

Apply engine oil to connecting rod cap screws.

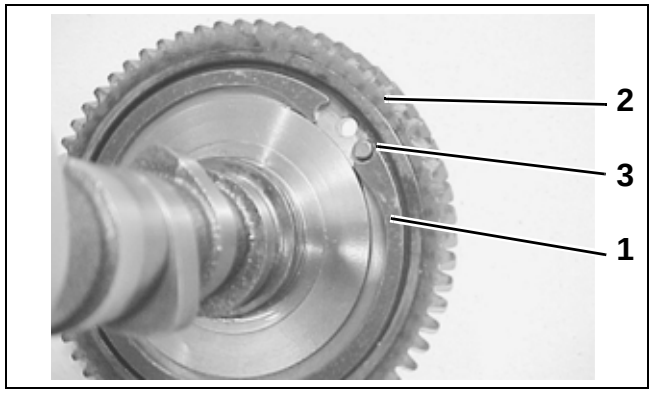
Tighten screws in two stages:
- 1st step: 52 in. lbs. (6 N·m)
- Final step: 105 in. lbs. (12 N·m)



005743

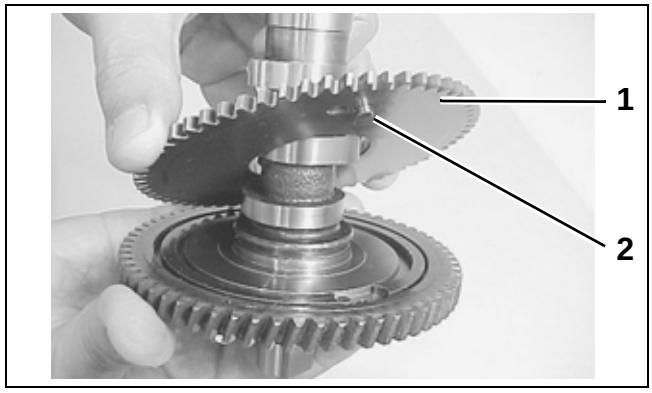
Camshaft Timing Gear

Fit the spring plate on the no. 2 gear so that the pin contacts the end of the spring plate.



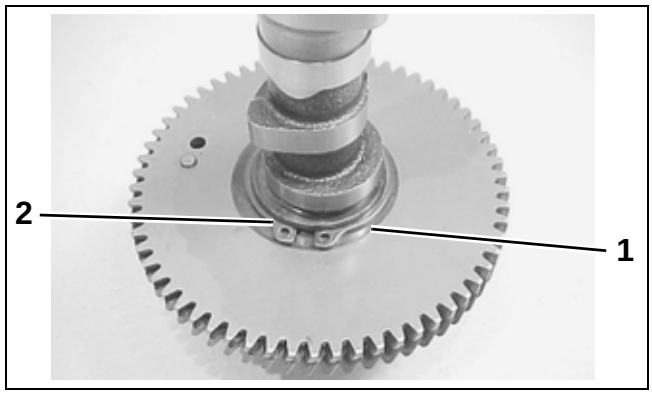
1. Spring plate 005744
2. No. 2 gear
3. Pin

Install the no. 1 gear on the no. 2 gear so that the pin contacts the other end of the spring plate.



1. No. 1 gear 005745
2. Pin

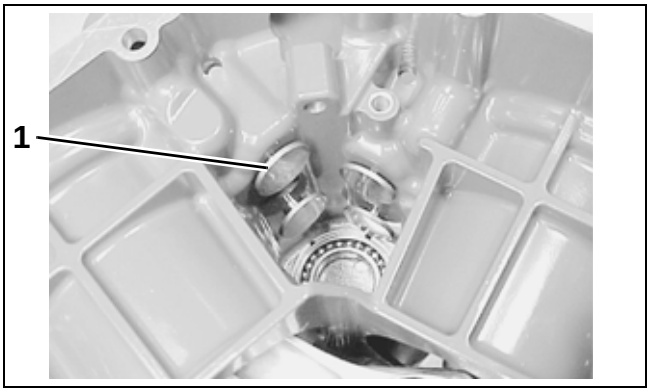
Install washer and circlip.



1. Washer 005746
2. Circlip

Camshaft to Cylinder Block

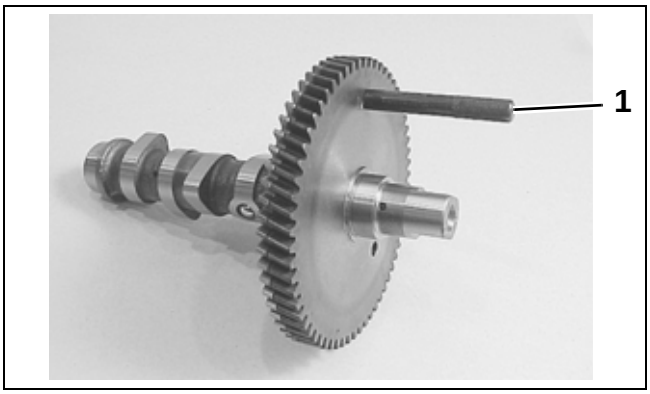
Apply engine oil to tappets and install in block.



1. Tappets 005698

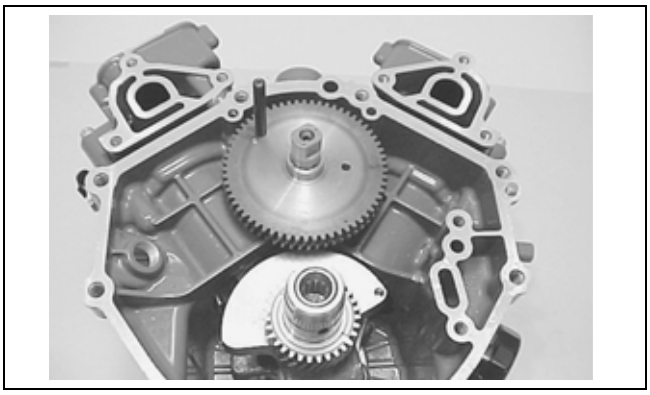
Apply engine oil to each camshaft lobe and journal.

Turn the no. 1 gear counterclockwise, then insert pin from Gear Alignment Pin Set, P/N 5037488, through the holes in both gears as shown.



1. Alignment pin 005747

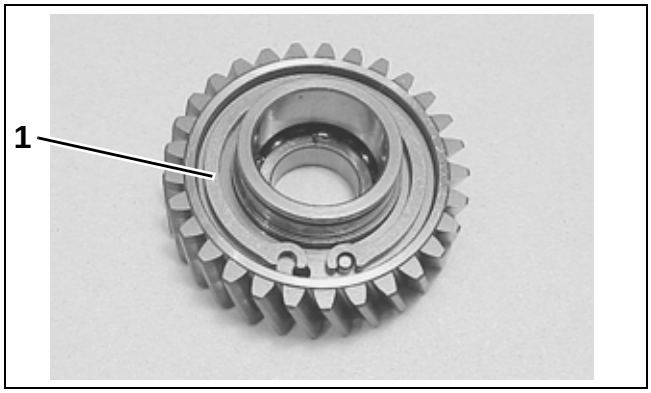
Install camshaft in cylinder block.



005748

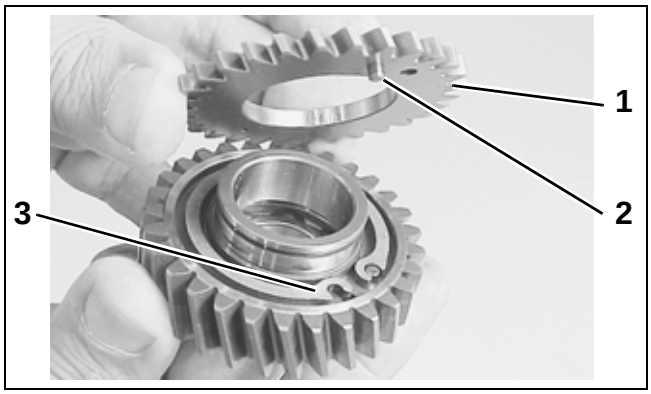
Idle Gear

Fit the scissors gear spring plate on the no. 2 gear as shown.



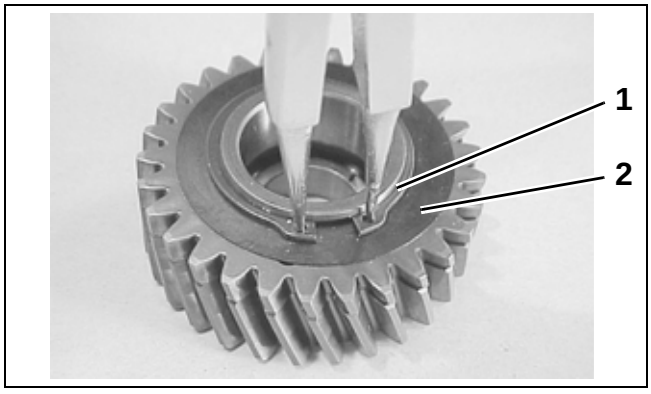
1. Spring plate 005749

Install the no. 1 gear on the no. 2 gear so that the pin fits into the half-round hole on the end of the spring plate.



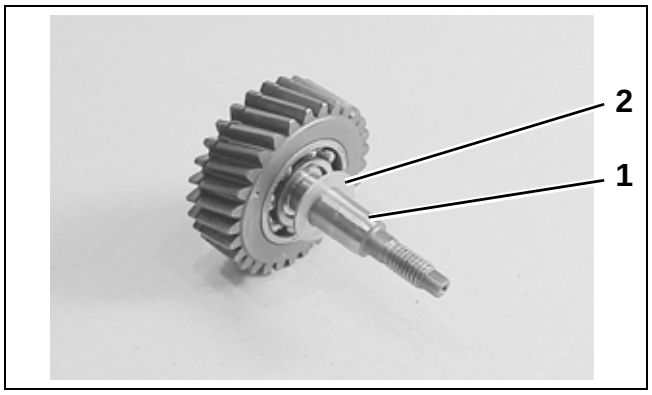
1. No. 1 gear 005750
2. Pin
3. Spring plate

Install washer and circlip.



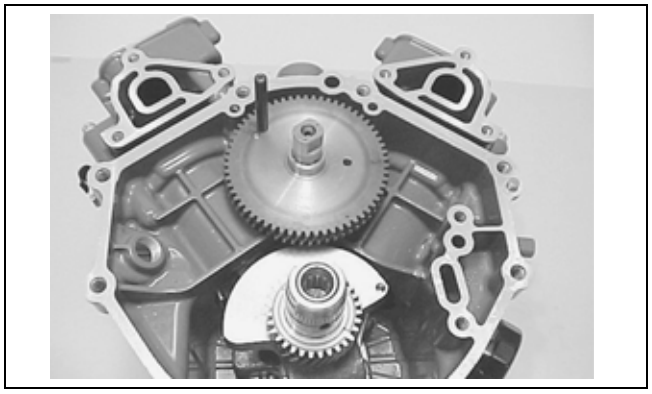
1. Circlip 005704
2. Washer

Install the idle gear shaft and washer.



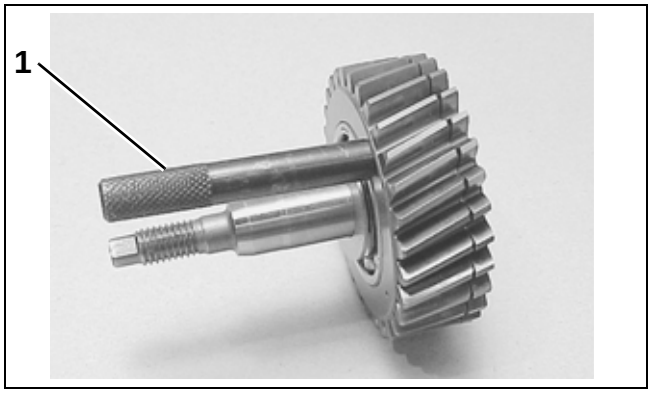
1. Shaft
2. Washer
005703

Turn crankshaft and camshaft into positions shown.



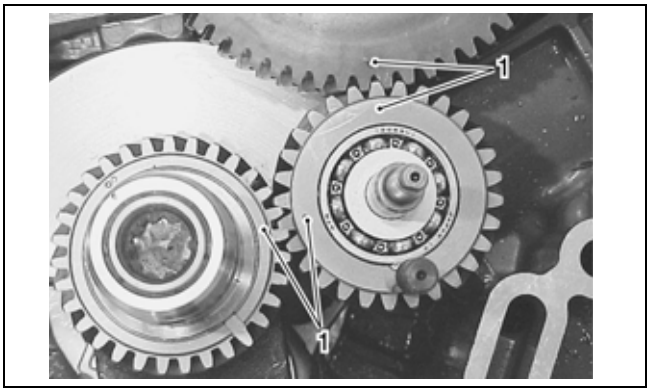
005759

Turn the no. 1 idle gear clockwise, then insert pin from Gear Alignment Pin Set, P/N 5037488, through the holes in both gears as shown.



1. Alignment pin
005760

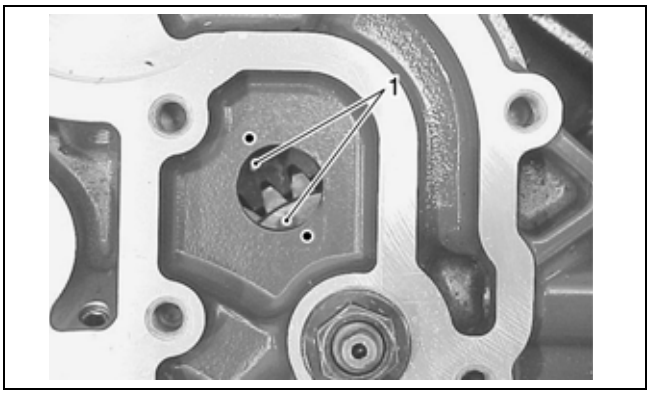
Install the idle gear. Check that aligning marks on all three gears match as shown.



1. Alignment marks
005761

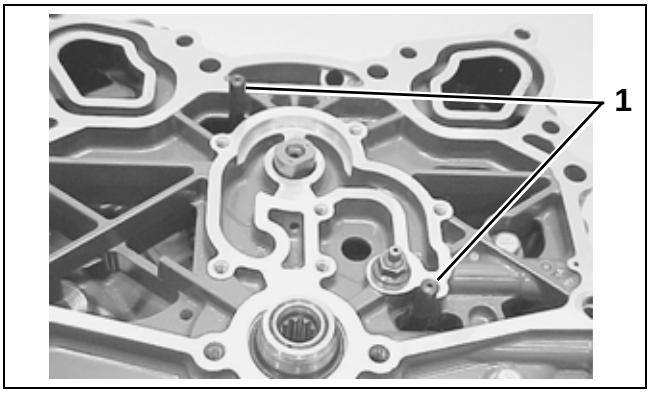
Install cylinder heads and bottom crankcase. Refer to **Installation** on p. 146.

When bottom crankcase has been installed, check that marks on idle gear and camshaft are still in alignment.



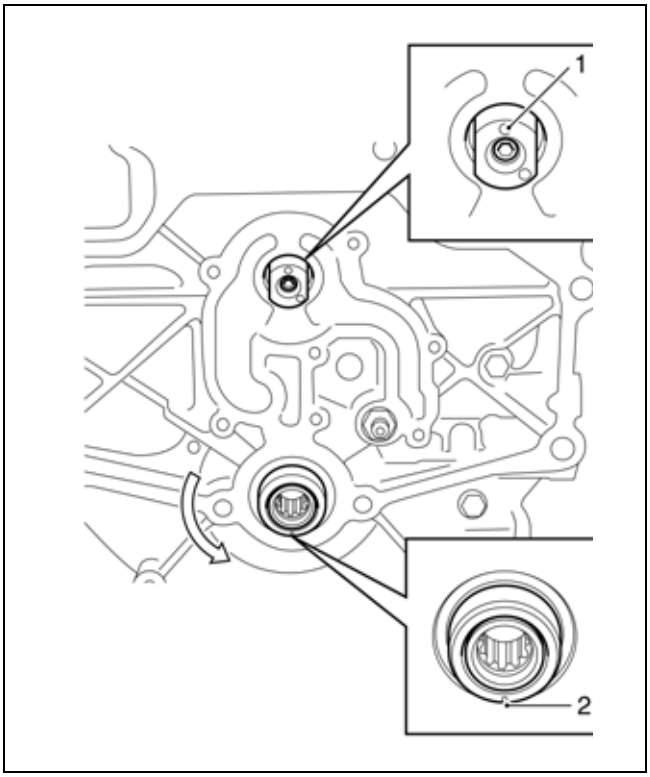
1. Alignment marks
005762

Remove alignment pin tools.



1. Alignment pins
005763

Turn the crankshaft in the normal rotating direction and check that the timing mark on the camshaft is pointing straight up when the crankshaft timing mark is pointing straight down.



1. Camshaft timing mark 005764
2. Crankshaft timing mark

Install the powerhead. Refer to **REMOVAL AND INSTALLATION** on p. 130.

Install oil filter and pressure switch. Check that oil pan is full of recommended lubricant. Refer to **Engine Oil** on p. 54.

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.

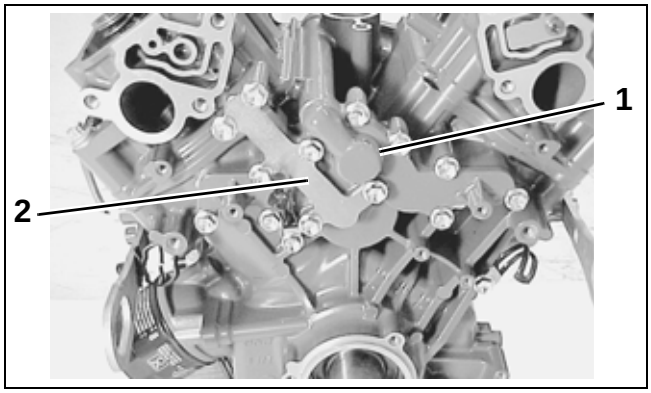
THERMOSTAT SERVICE

Removal

Remove the flywheel. Refer to **COMPONENT SERVICING** on p. 99.

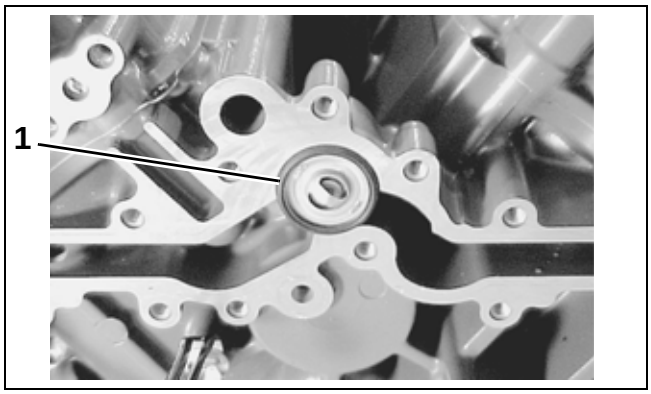
Remove the carburetor. Refer to **CARBURETOR SERVICE** on p. 109.

Remove thirteen screws, thermostat cover, and oil gallery plate.



1. Thermostat cover 005664
2. Oil gallery plate

Remove thermostat.



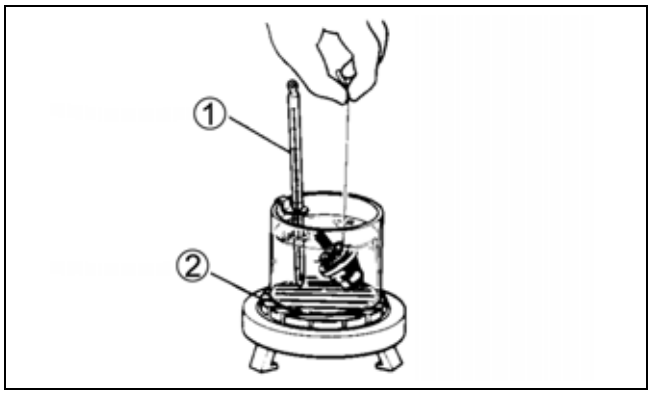
1. Thermostat 005665

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.



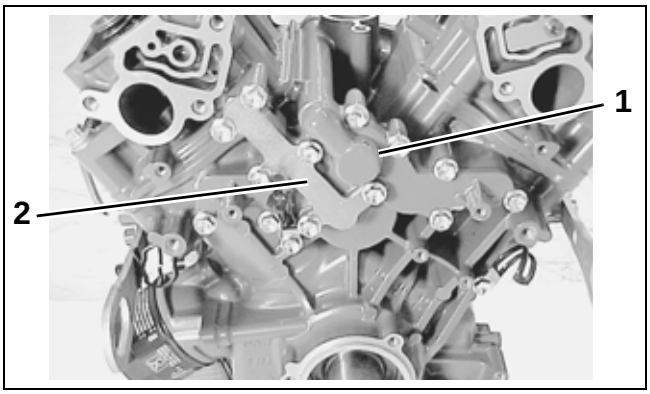
1. Thermometer 004624
2. Heater

Thermostat operating temperature:

- Standard: 136 to 144° F (58 to 62° C).

Installation

Install thermostat, thermostat cover, and oil gallery plate. Tighten screws 88 in. lbs. (10 N·m).



1. Thermostat cover 005664
2. Oil gallery plate

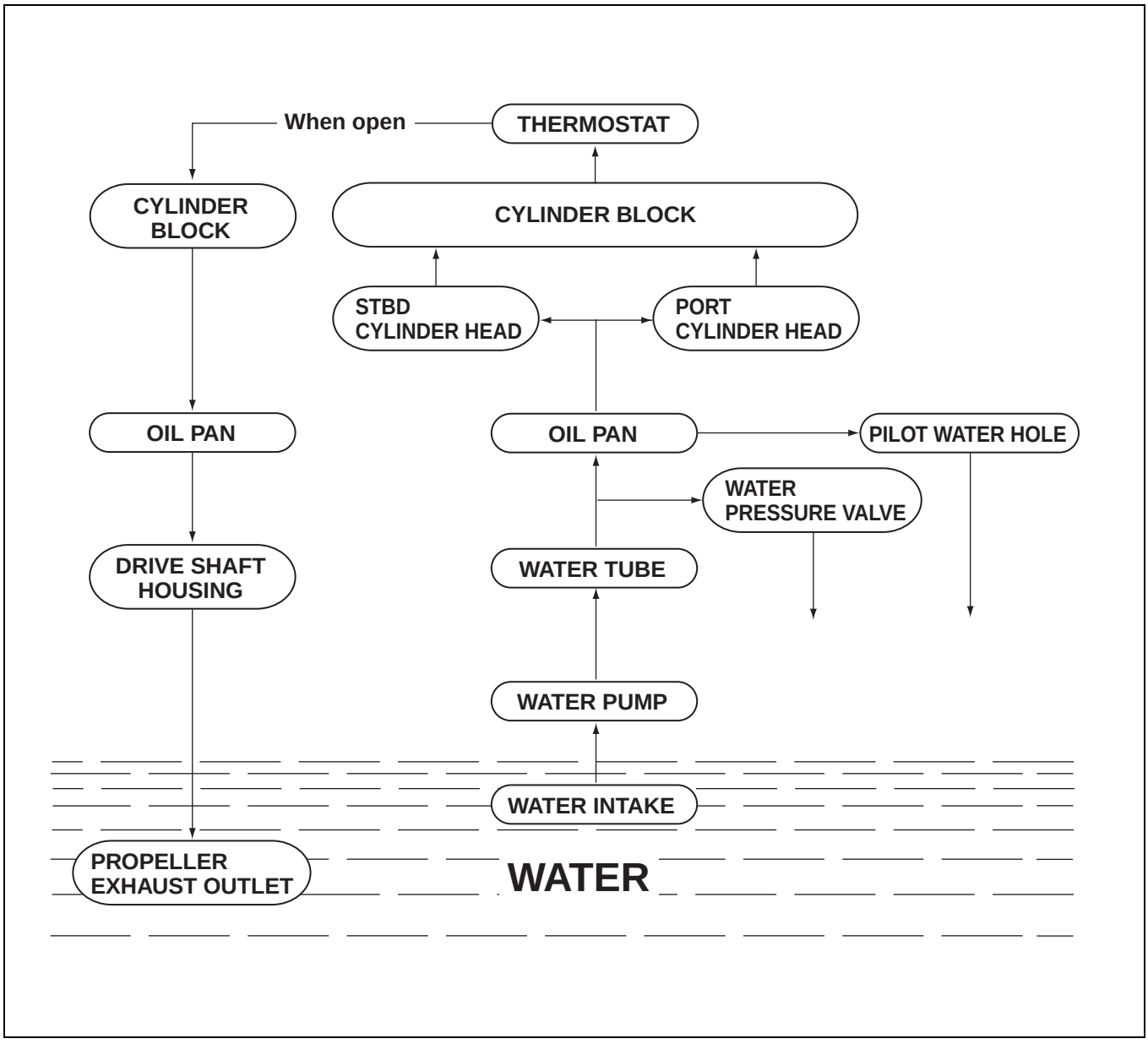
Install the carburetor. Refer to **CARBURETOR SERVICE** on p. 109.

Install the flywheel. Refer to **COMPONENT SERVICING** on p. 99.

COOLING SYSTEM DIAGRAM

The water cooling system includes the lower unit water pump, lower unit to powerhead water supply tube, oil pan water pressure valve, powerhead water passages, and thermostat.

The cooling system cools both the powerhead and exhaust. If overheating occurs, inspect the cooling system for blockage, corrosion, or damage.



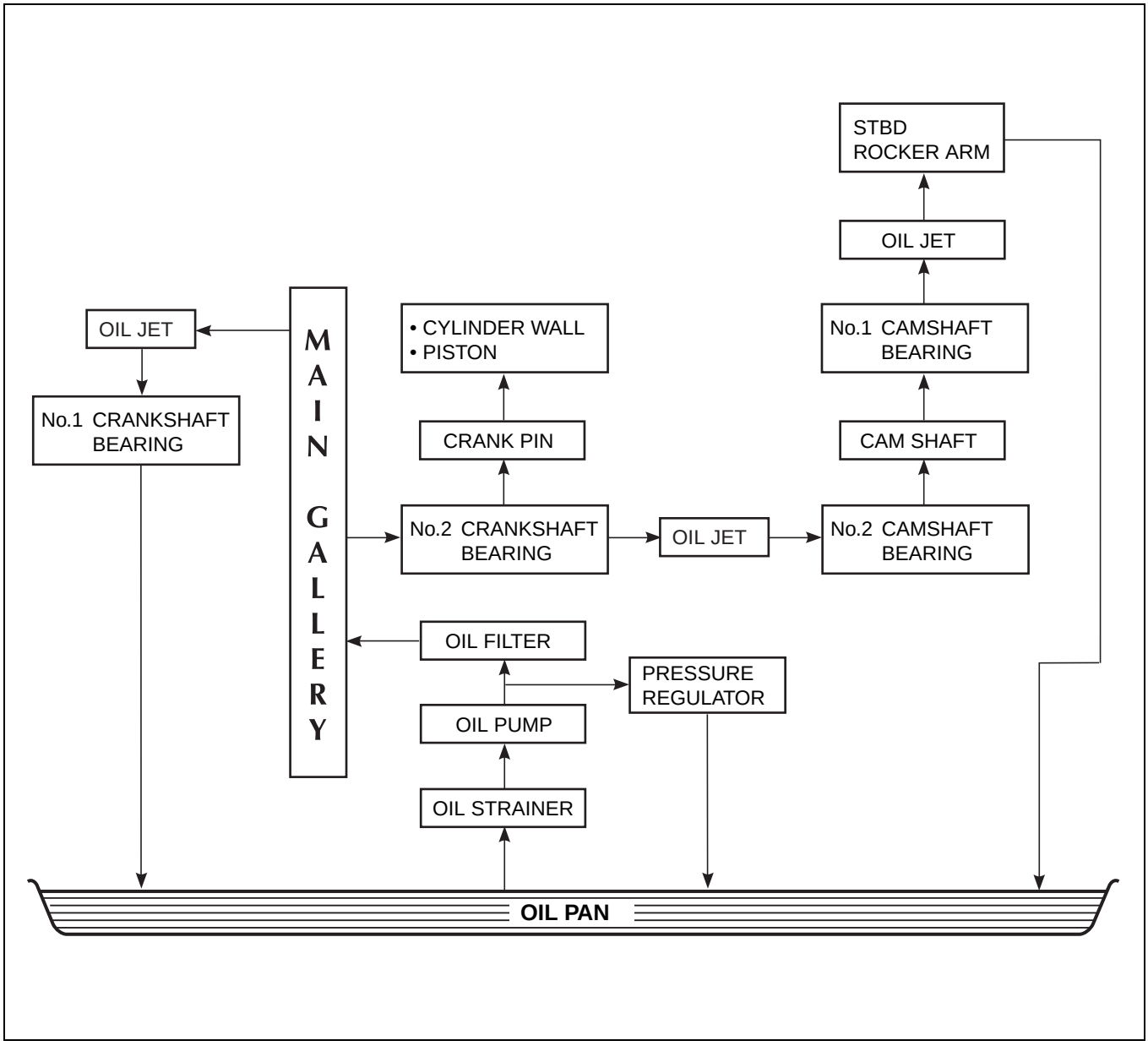
005765

ENGINE LUBRICATION DIAGRAM

A camshaft driven trochoid type pump provides engine oil to all power unit components requiring lubrication. Oil from the pan is drawn through the oil strainer and passed through a spin-on type oil filter before entering the main oil gallery.

A pressure regulator (relief valve) is positioned between the oil pump and oil filter to maintain oil pressure at a constant level.

From the main gallery, oil flow is directed through either drilled internal passages or splashed to those surfaces requiring lubrication.



005766

NOTES

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

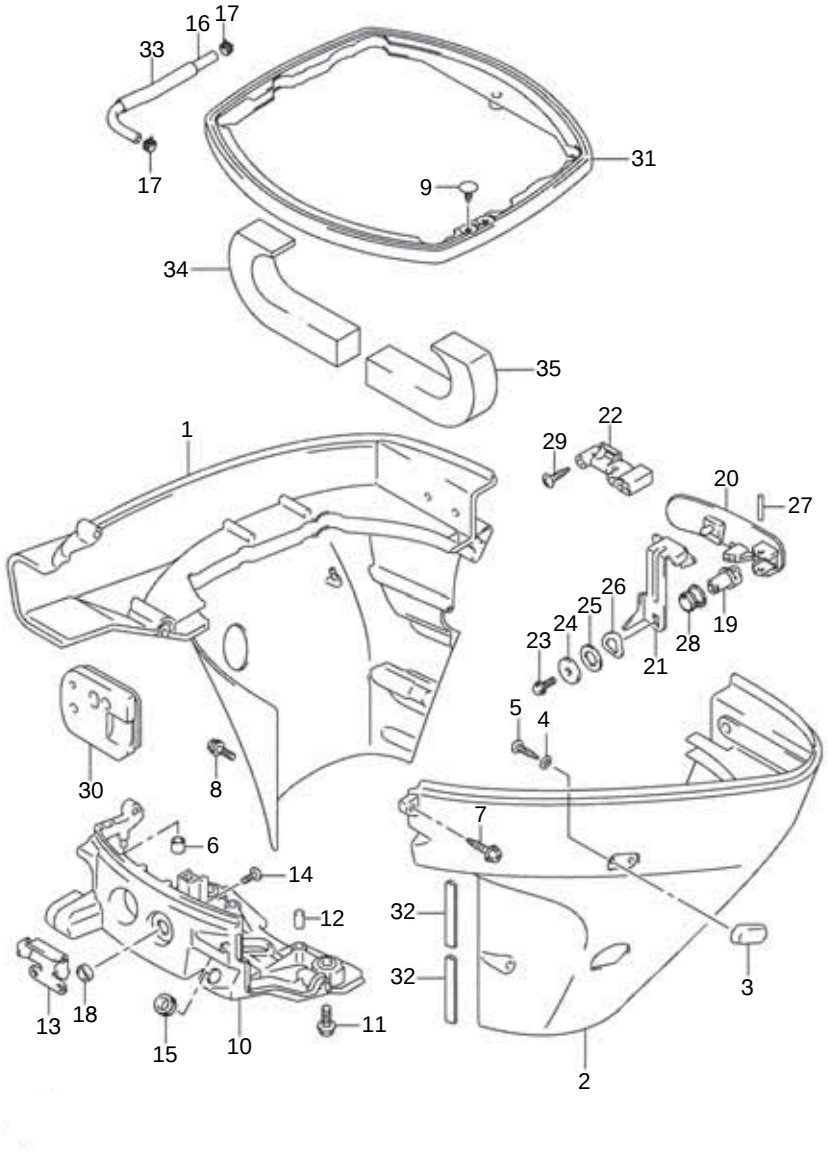
MIDSECTION

TABLE OF CONTENTS

8

SERVICE CHART

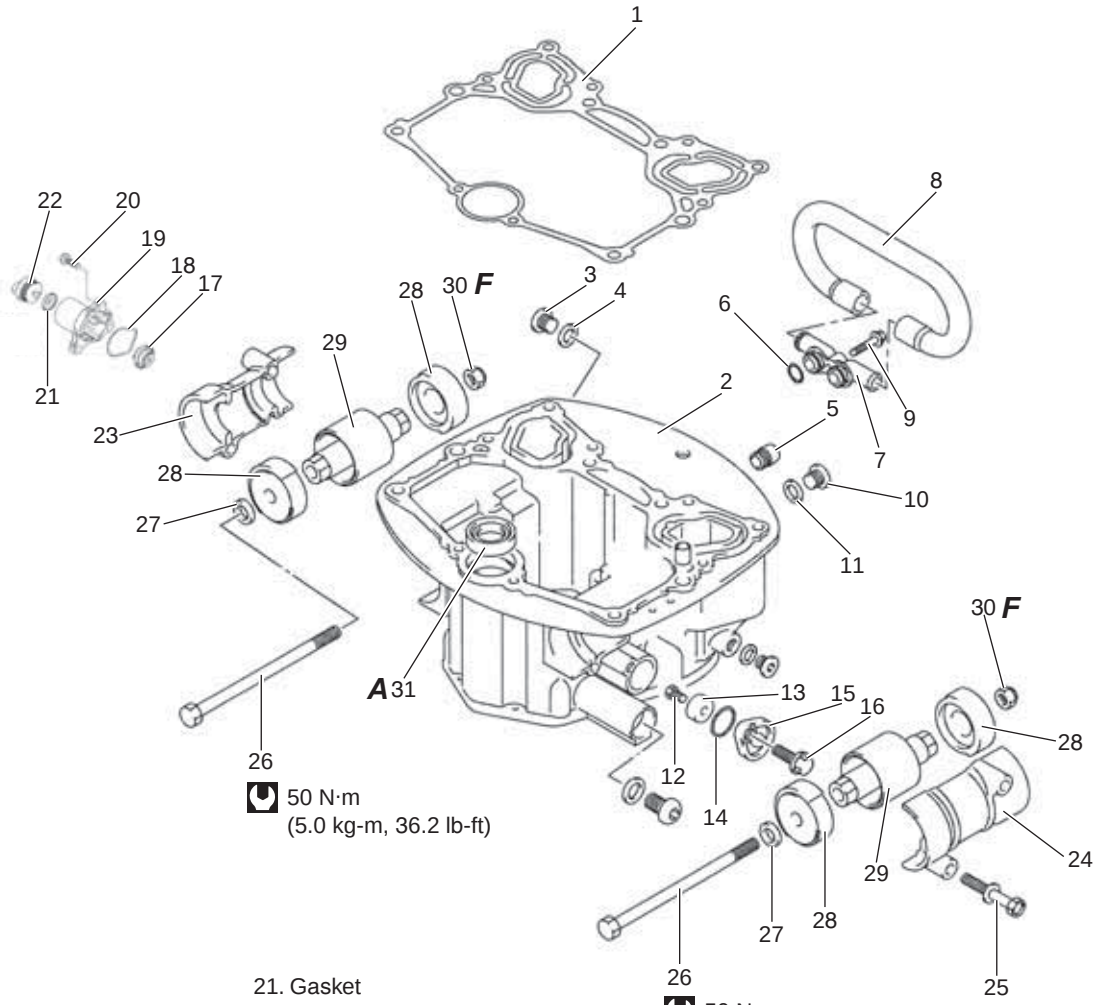
SIDE COVER



005767

1. Side cover STBD
2. Side cover PORT
3. Side cover protector
4. Washer
5. Screw
6. Front panel protector
7. Screw
8. Screw
9. Pin
10. Front panel
11. Bolt
12. Pin
13. Hook
14. Screw
15. Grommet
16. Hose
17. Clip
18. Cushion
19. Shaft
20. Lever
21. Hook
22. Latch
23. Bolt
24. Washer
25. Washer
26. Washer
27. Pin
28. Bush
29. Screw
30. Cable grommet
31. Side cover seal
32. Side cover cushion
33. Protector
34. Upper mount seal STBD
35. Upper mount seal PORT

OIL PAN

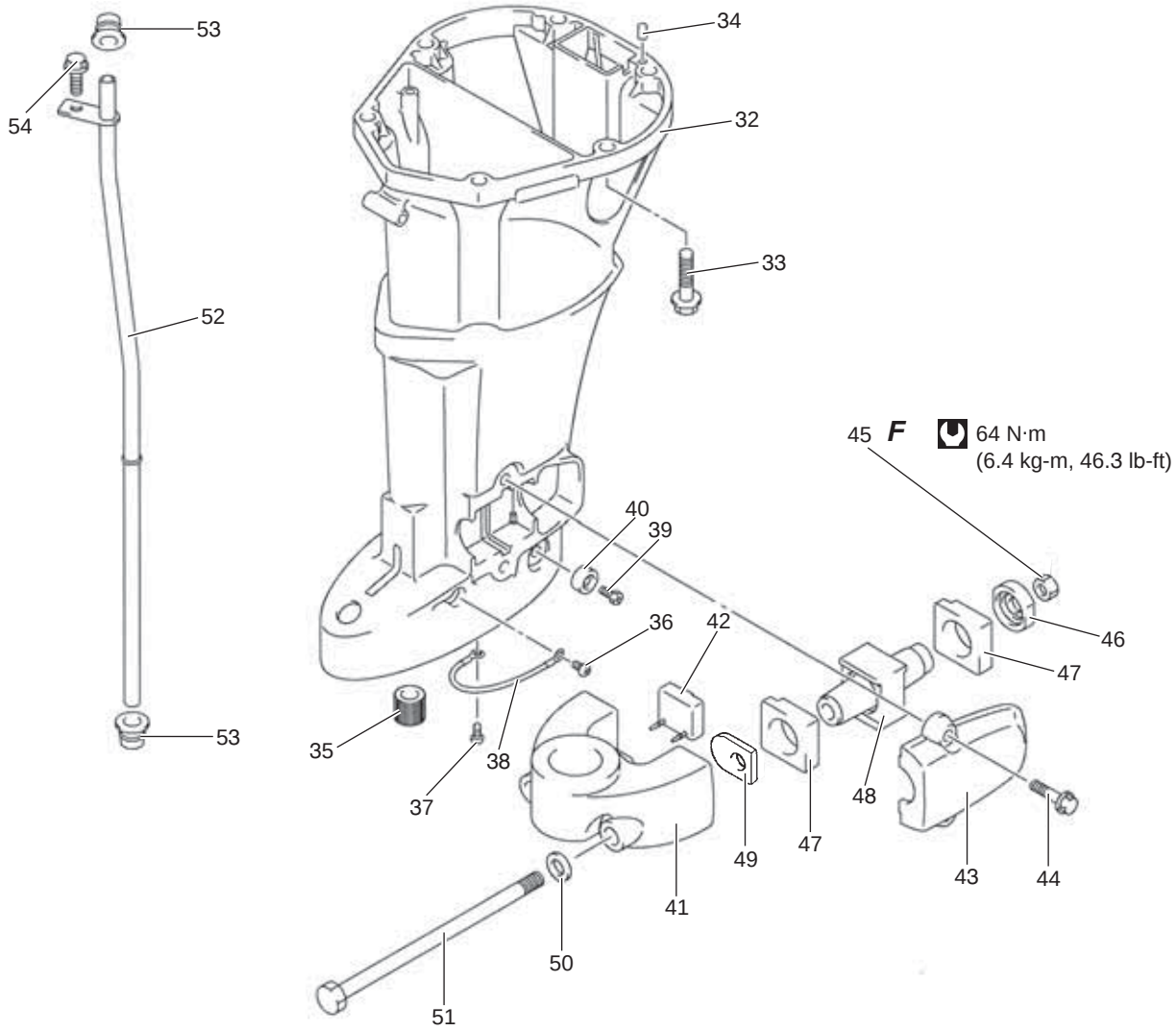


1. Gasket
2. Oil pan
3. Plug
4. Gasket
5. Exhaust pipe
6. O-ring
7. Exhaust pipe
8. Exhaust hose
9. Bolt
10. Plug
11. Gasket
12. Bolt
13. Anode
14. O-ring
15. Anode cover
16. Bolt
17. Water pressure valve
18. Seal ring
19. Water pressure valve cover
20. Bolt
21. Gasket
22. Water flash plug
23. Upper mount cover STBD
24. Upper mount cover PORT
25. Bolt
26. Upper mount bolt
27. Washer
28. Upper thrust mount
29. Upper mount
30. Nut
31. Oil seal

A	***Triple-Guard Grease***
F	***Blue Nut Lock***

005769

DRIVESHAFT HOUSING

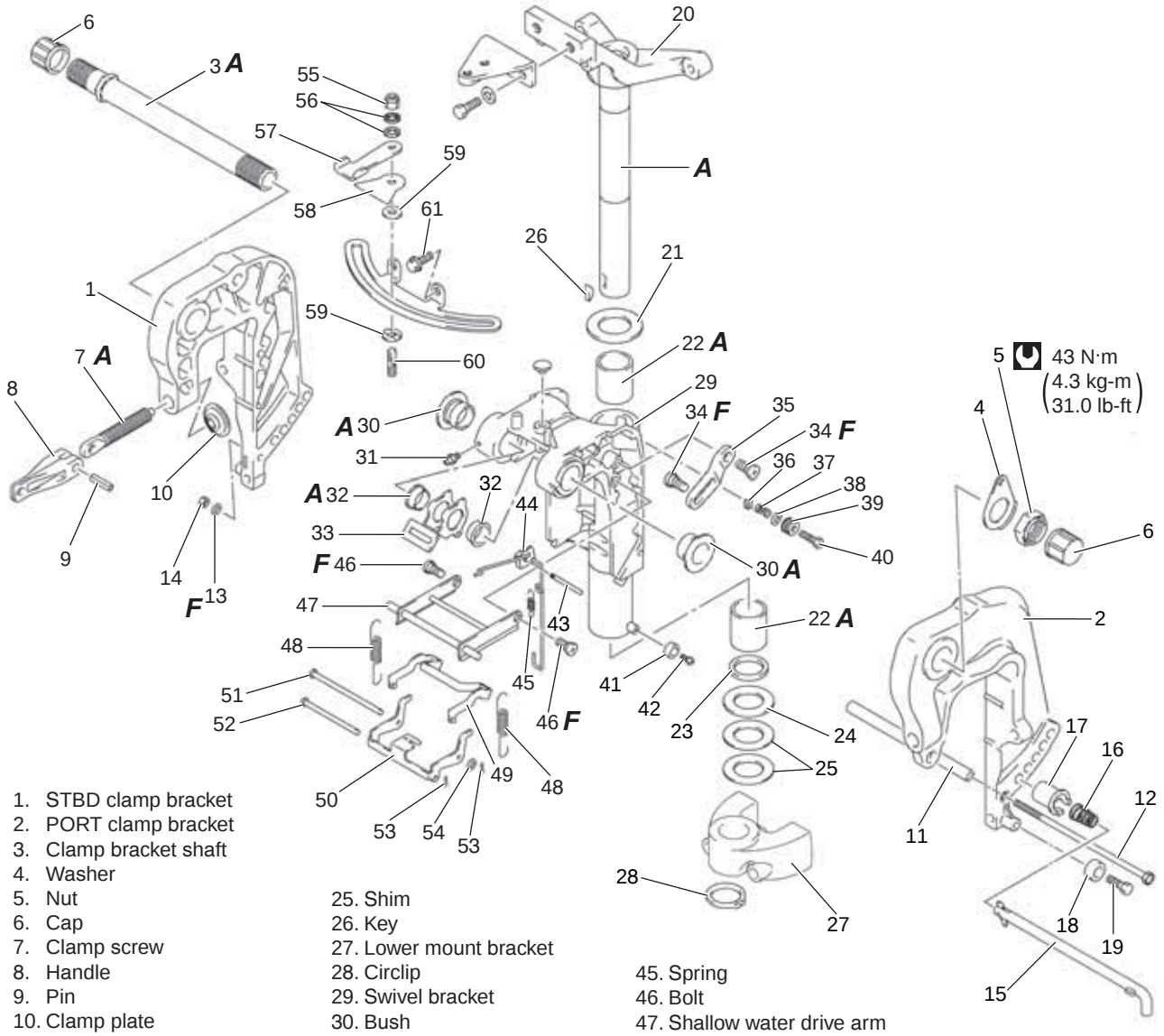


32. Driveshaft housing
33. Bolt
34. Dowel pin
35. Bush
36. Screw
37. Screw
38. Bonding wire
39. Bolt
40. Anode
41. Lower mount bracket
42. Lower thrust mount
43. Lower mount cover
44. Bolt
45. Nut
46. Lower reverse thrust mount
47. Lower side mount
48. Lower mount
49. Lower side cushion
50. Washer
51. Lower mount bolt
52. Water tube
53. Grommet
54. Bolt

A	***Triple-Guard Grease***
F	***Blue Nut Lock***

005770

STERN BRACKET

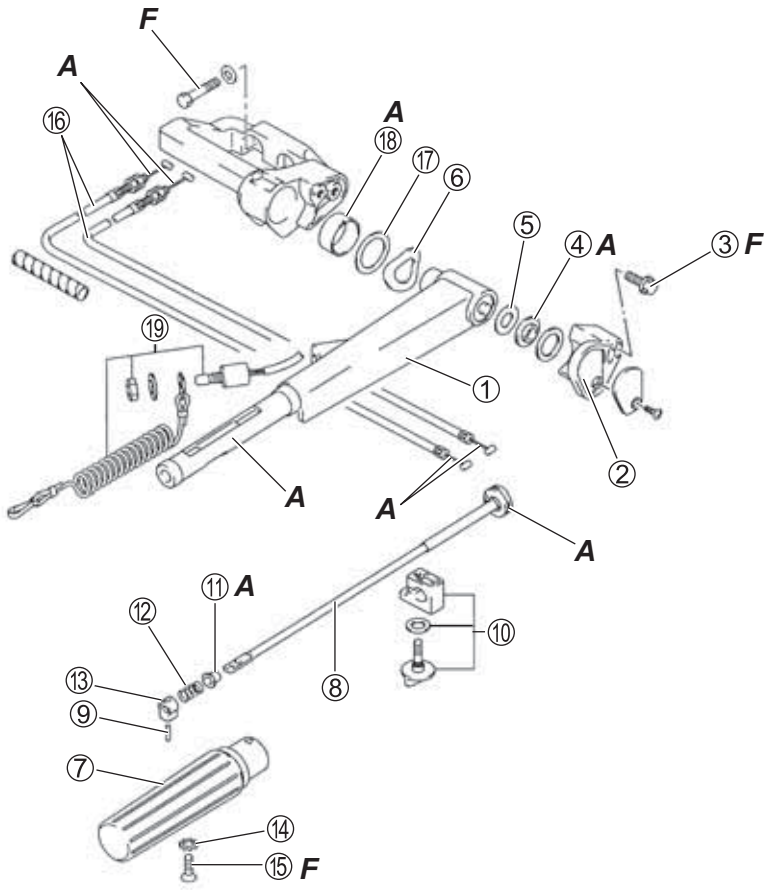


1. STBD clamp bracket
2. PORT clamp bracket
3. Clamp bracket shaft
4. Washer
5. Nut
6. Cap
7. Clamp screw
8. Handle
9. Pin
10. Clamp plate
11. Lower spacer
12. Bolt
13. Washer
14. Nut
15. Tilt lock pin
16. Spring
17. Stopper
18. Anode
19. Bolt
20. Steering bracket
21. Washer
22. Bush
23. Seal
24. Washer
25. Shim
26. Key
27. Lower mount bracket
28. Circlip
29. Swivel bracket
30. Bush
31. Nipple
32. Bush
33. Release lever
34. Bolt
35. Tilt stopper arm
36. Steering adjuster
37. Spring
38. Washer
39. Cover
40. Bolt
41. Anode
42. Bolt
43. Pin
44. Release link
45. Spring
46. Bolt
47. Shallow water drive arm
48. Spring
49. Reverse lock arm
50. Reverse lock arm link
51. Pin
52. Pin
53. Cotter pin
54. Washer
55. Nut
56. Washer
57. Lever
58. Plate
59. Washer
60. Shaft
61. Bolt

A	***Triple-Guard Grease***
F	***Blue Nut Lock***

005771

TILLER HANDLE



① Tiller handle
② Tiller handle cover
③ Bolt
④ Spacer
⑤ Shim
⑥ Wave washer
⑦ Handle grip
⑧ Handle rod
⑨ Pin
⑩ Adjuster
⑪ Bush
⑫ Spring
⑬ Stopper
⑭ Washer
⑮ Screw
⑯ Throttle cable
⑰ Washer
⑱ Bush
⑲ Emergency & engine stop switch

A	***Triple-Guard Grease***
F	***Blue Nut Lock***

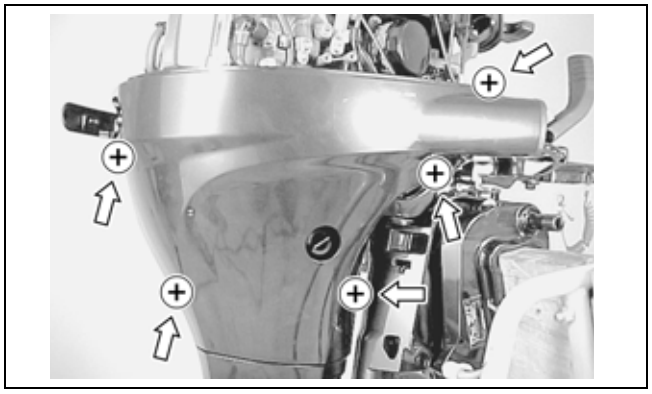
005768

SIDE COVER

Removal and Installation

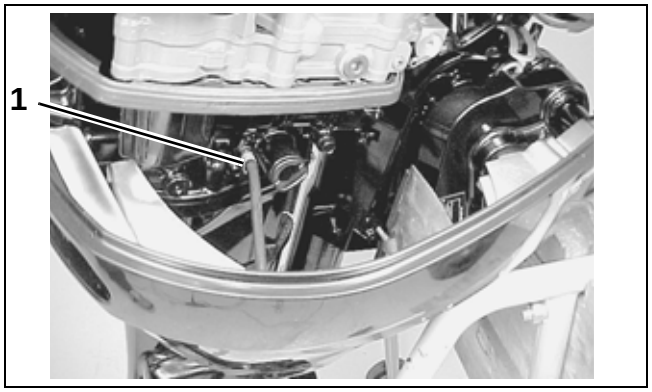
Pull out rear hook lever.

Remove five screws from starboard side cover.



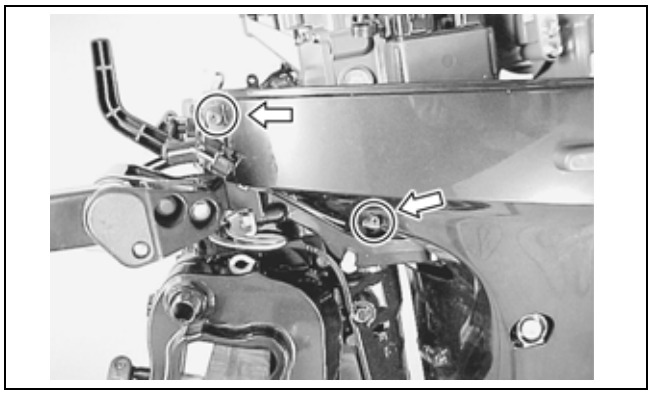
005772

Disconnect water hose and remove stbd cover.



1. Water hose 005773

Remove two screws and port side cover.



005774

Installation is reverse order of removal.

DRIVESHAFT HOUSING AND OIL PAN

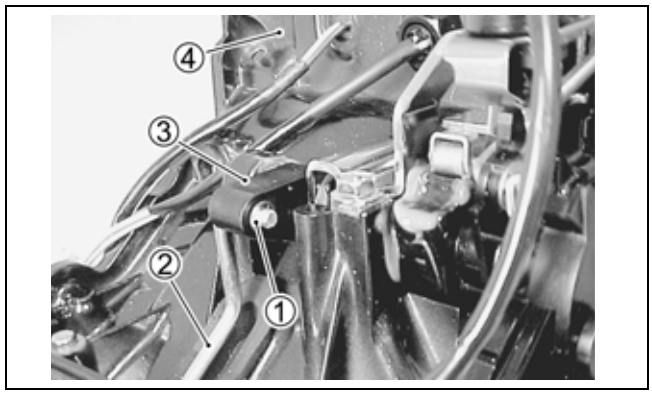
Removal

Remove the powerhead. Refer to Powerhead **Removal** on p. 130.

Remove the gearcase. Refer to Gearcase **REMOVAL AND INSTALLATION** on p. 200.

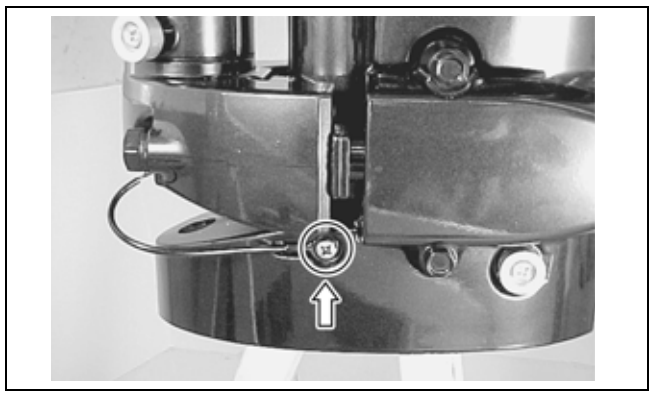
Remove E-clip and pull clutch rod out from clutch arm.

Remove the clutch rod, then slide front panel away from oil pan.



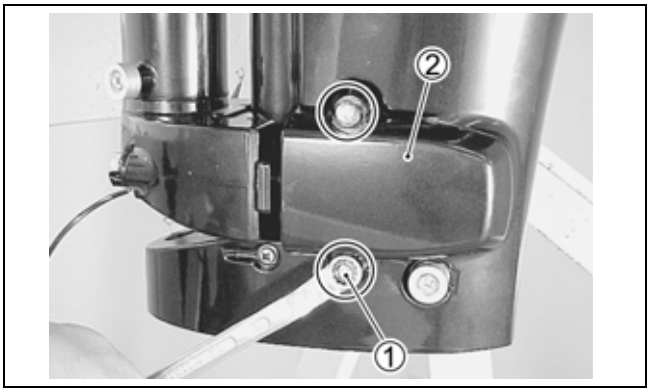
1. E-clip 005775
2. Clutch rod
3. Clutch arm
4. Front panel

Remove screw and bonding wire from driveshaft housing.



00005776

Remove the two lower mount cover screws and remove both lower mount covers.



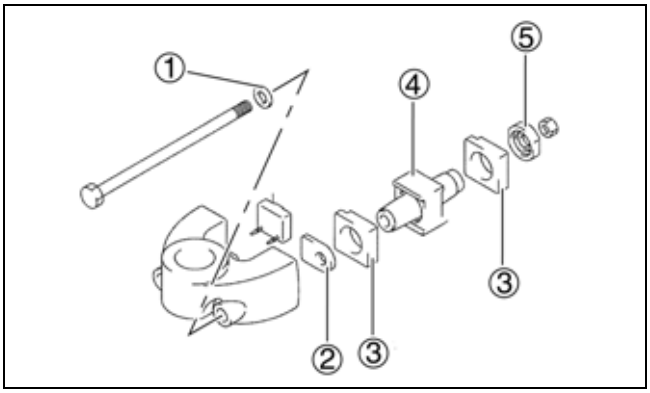
1. *Cover screw*
2. *Mount cover*

005777

Remove port and starboard lower mount nuts and lower mount screws.

005778

Remove washer, lower side cushion, lower side mounts, lower mount, and lower thrust mount.



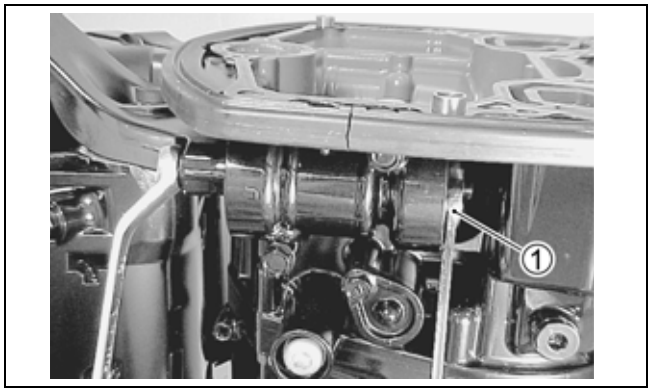
1. *Washer*
2. *Lower side cushion*
3. *Lower side mount*
4. *Lower mount*
5. *Lower thrust mount*

005779

Remove two upper mount nuts and driveshaft housing (with oil pan).

WARNING

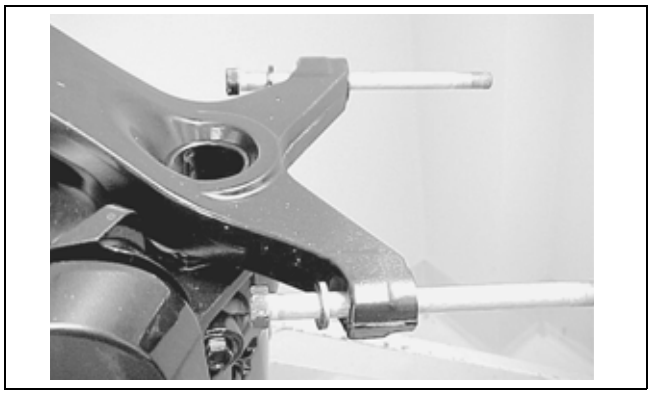
When removing the upper mount nuts, driveshaft housing must be firmly supported.



1. *Upper mount nut*

005780

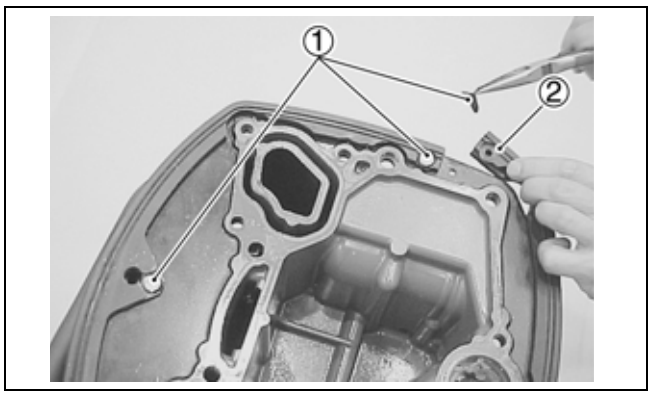
Remove upper mount screws and washers.



005781

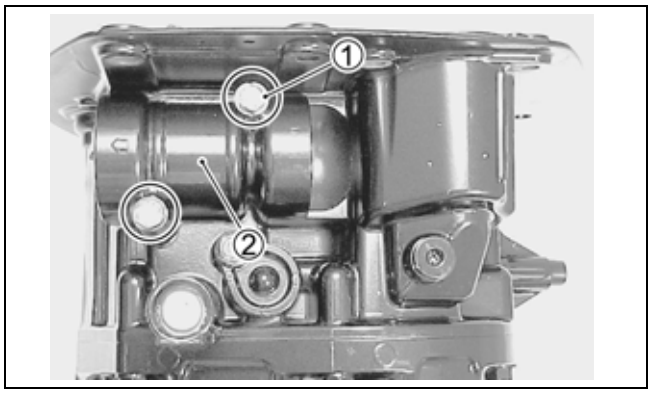
Disassembly

Remove three pins and side cover seal.



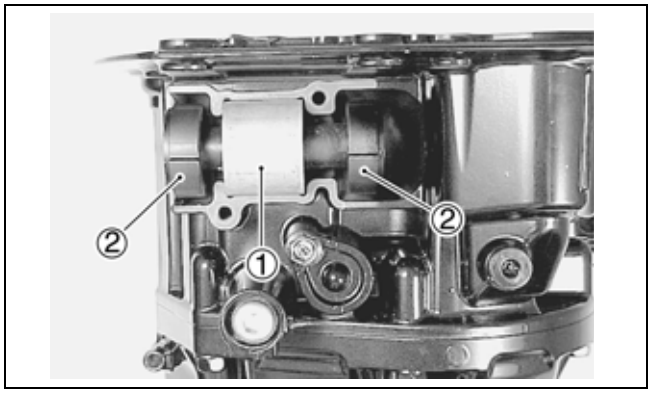
1. *Pins* 005782
2. *Cover seal*

Remove upper mount cover screws and port and starboard mount covers.



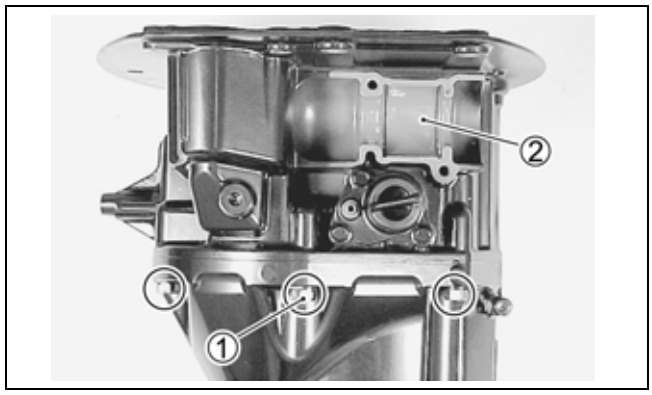
1. *Screws* 005783
2. *Mount cover*

Remove upper mounts and upper thrust mounts.



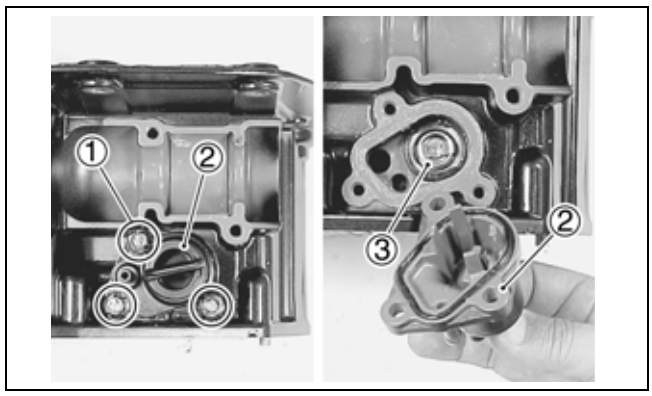
1. *Upper mount* 005784
2. *Upper thrust mount*

Remove six screws and oil pan.



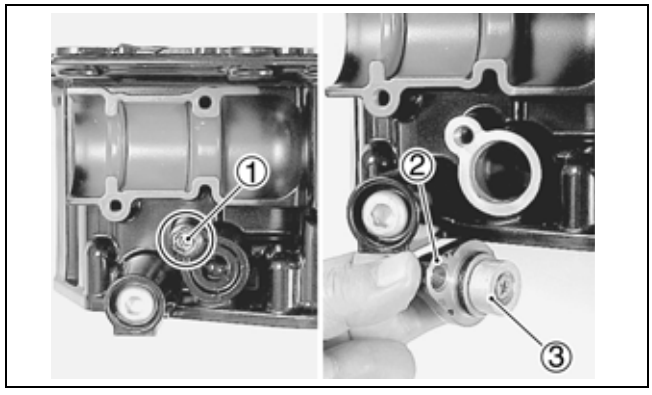
1. *Screws* 005785
2. *Oil pan*

Remove three screws, water pressure valve cover, and valve.



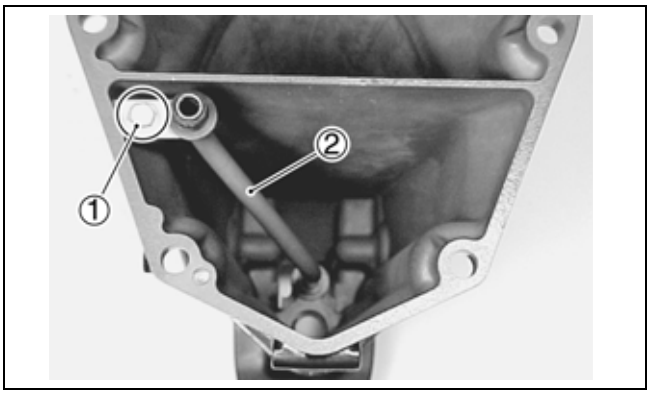
1. *Screw* 005786
2. *Valve cover*
3. *Water pressure valve*

Remove screw and anode cover with anode.



1. *Screw* 005787
2. *Cover*
3. *Anode*

Remove screw and water tube.



1. Screw 005788
2. Water tube

Cleaning and Inspection

⚠ WARNING ⚠

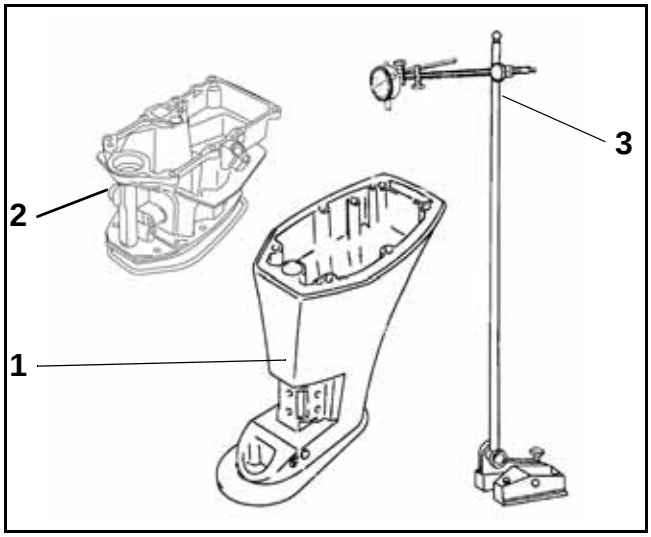
To avoid personal injury, wear eye protection and set compressed air pressure to less than 25 psi (172 kPa).

- 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.



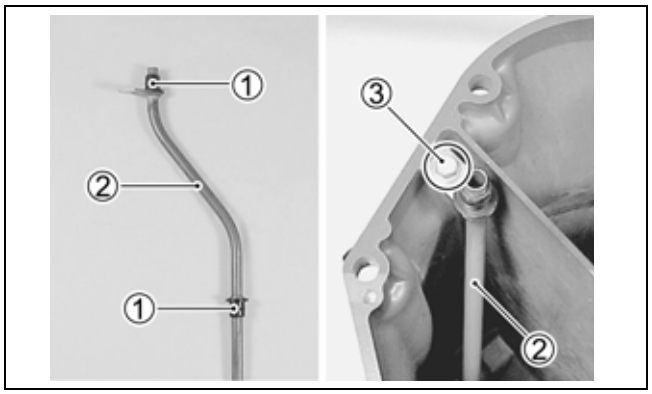
1. Driveshaft housing 004431
2. Oil pan housing
3. Dial indicator

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.

Assembly

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

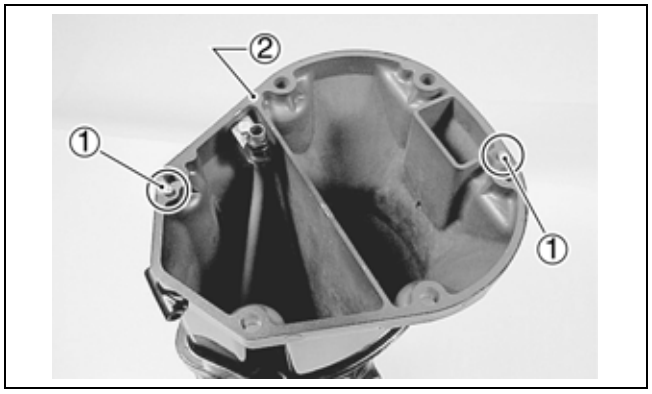
Install water tube grommets and water tube in driveshaft housing. Tighten screw securely.



1. *Grommet* 005797
2. *Water tube*
3. *Screw*

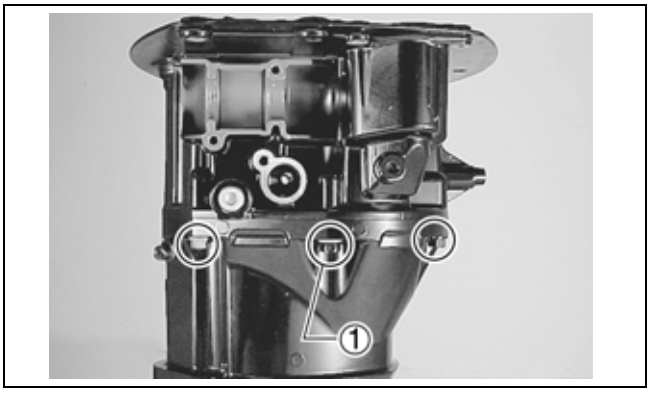
Install two dowel pins in driveshaft housing.

Apply *Gasket Sealing Compound* to mating surfaces of driveshaft housing and oil pan.



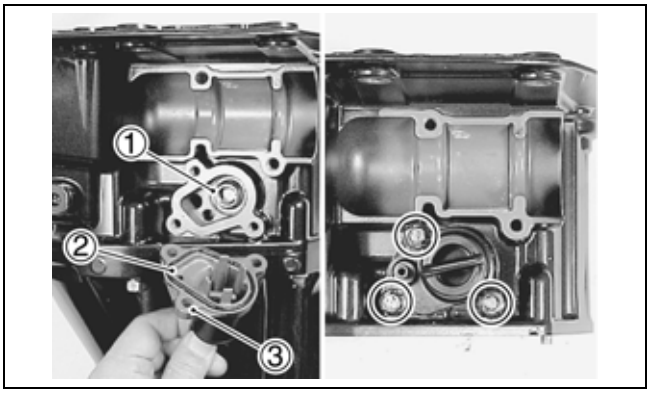
1. *Dowel pins* 005798
2. *Apply* Gasket Sealing Compound

Install the oil pan on the driveshaft housing and tighten six screws 36 ft. lbs. (50 N·m).



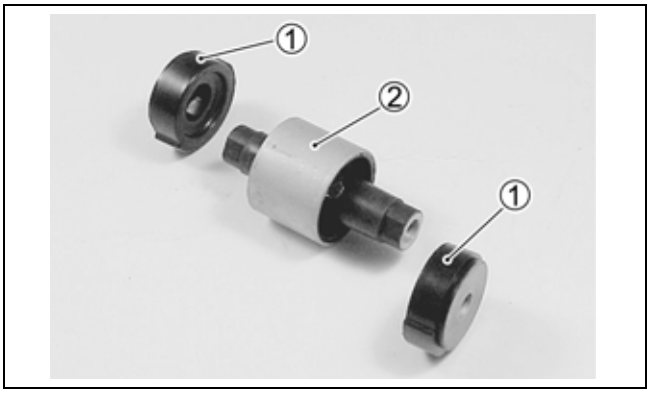
1. *Oil pan to driveshaft housing screws* 005799

Install water pressure valve, seal ring, and pressure valve cover. Tighten cover screws securely.



1. *Pressure valve* 005800
2. *Seal ring*
3. *Cover*

Install the upper thrust mounts to upper mounts.



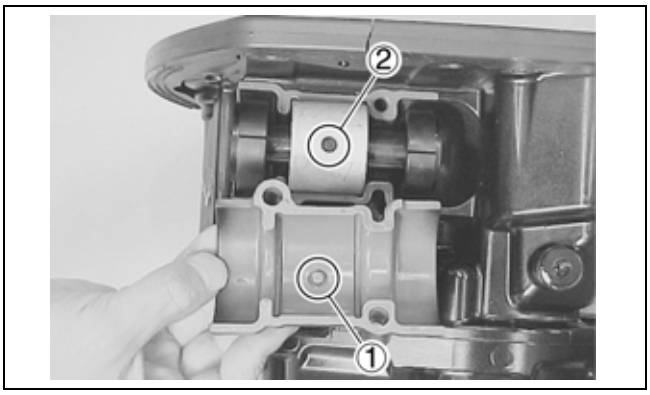
1. *Upper thrust mounts* 005801
2. *Upper mount*

Port Side Mount

Install the upper mount assembly into oil pan.

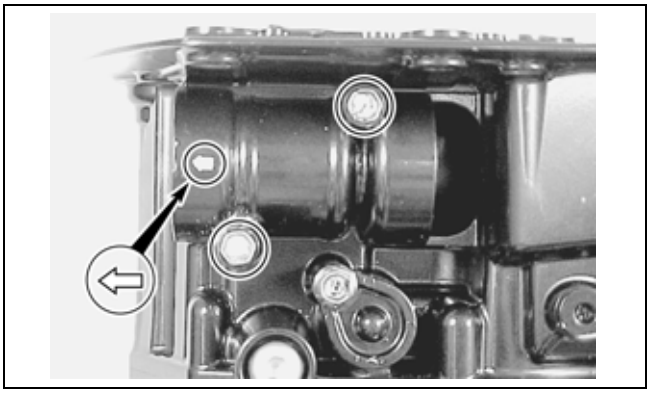
Install mount cover with arrow facing forward. Be sure retaining pin on cover fits into retaining pin hole on the mount.

Apply *Nut Lock* to cover screw threads and tighten cover screws 198 in. lbs. (23 N·m).



1. Retaining pin
2. Retaining pin hole

005802



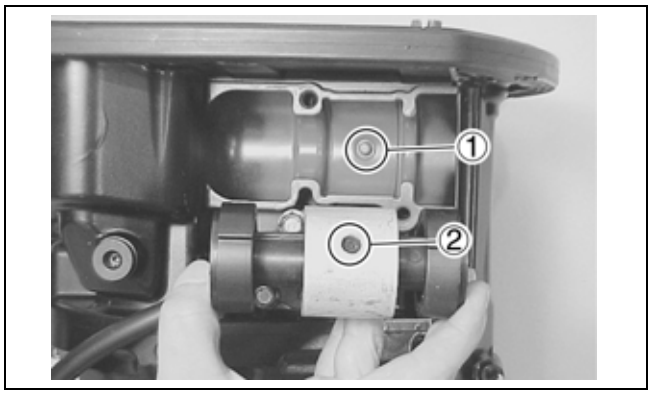
005803

Starboard Side Mount

Install the upper mount assembly into oil pan.

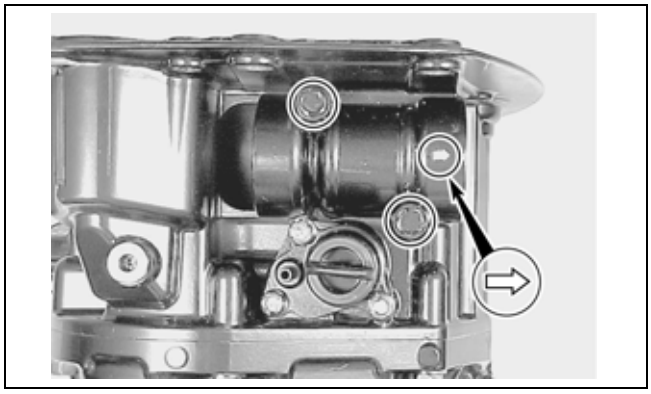
Install mount cover with arrow facing forward. Be sure retaining pin on oil pan fits into retaining pin hole on the mount.

Apply *Nut Lock* to cover screw threads and tighten cover screws 198 in. lbs. (23 N·m).



1. Retaining pin
2. Retaining pin hole

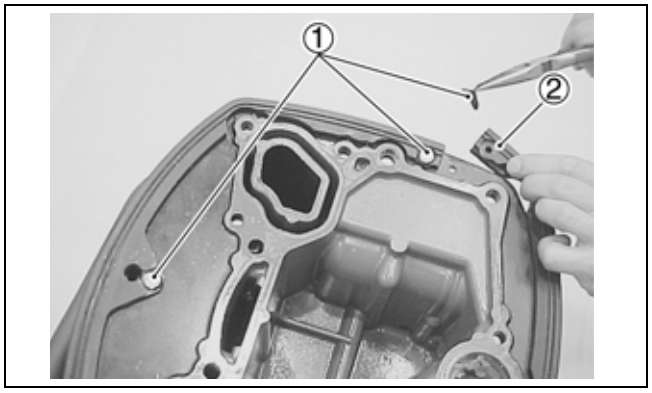
005804



005805

Driveshaft Housing/Oil Pan

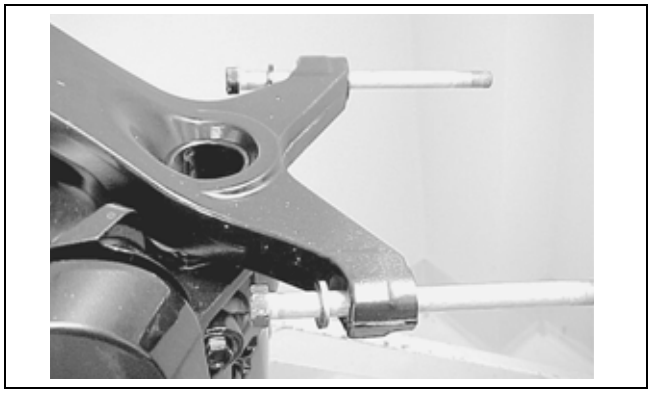
Install side cover seal with three pins.



1. *Pins*
2. *Cover seal*

005782

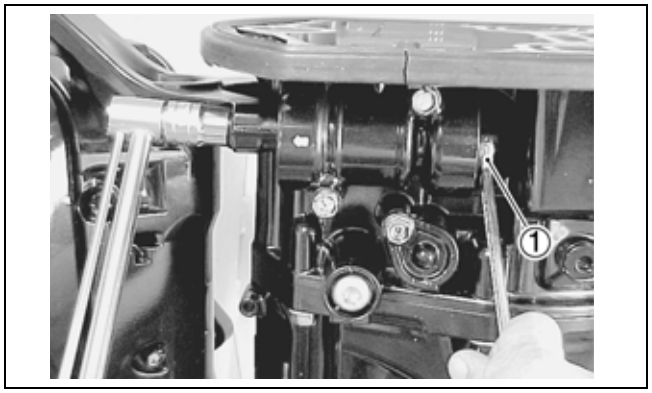
Install upper mount screws and washers on steering bracket.



005781

Install driveshaft housing/oil pan on steering bracket.

Apply *Nut Lock* to threads of upper mount screws and install nuts. Tighten nuts 36 ft. lbs. (50 N·m).



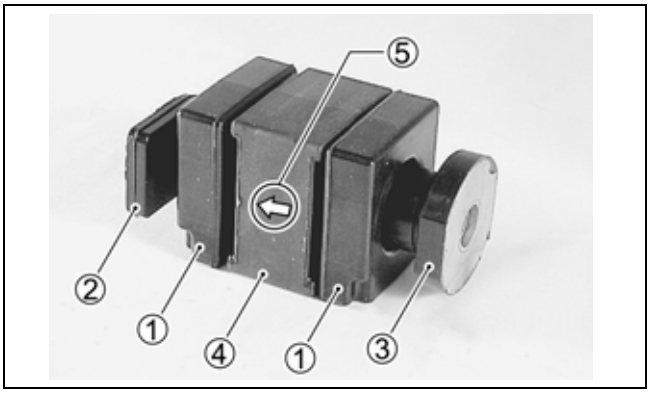
1. *Upper mount nut*

005806

Lower Mount

Assemble the lower side mounts, lower side cushion, and lower thrust mount to lower mount.

Arrow on mount must face forward when installed.

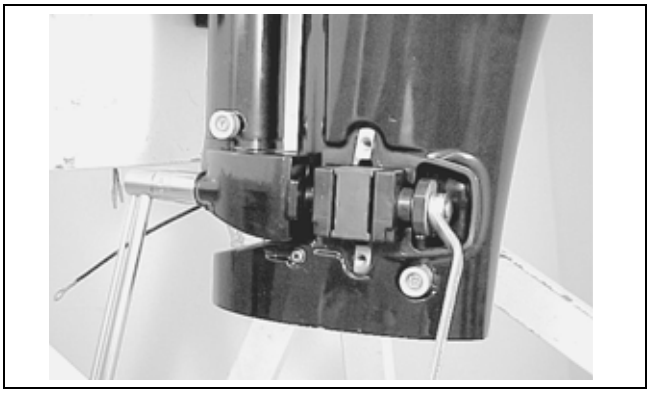


1. *Lower side mount*
2. *Lower side cushion*
3. *Lower thrust mount*
4. *Lower mount*
5. *Arrow*

005807

Place lower mount assembly into driveshaft housing with arrow facing forward.

Install lower mount screw and washer. Apply *Nut Lock* to screw threads and tighten nut 46 ft. lbs. (64 N·m).

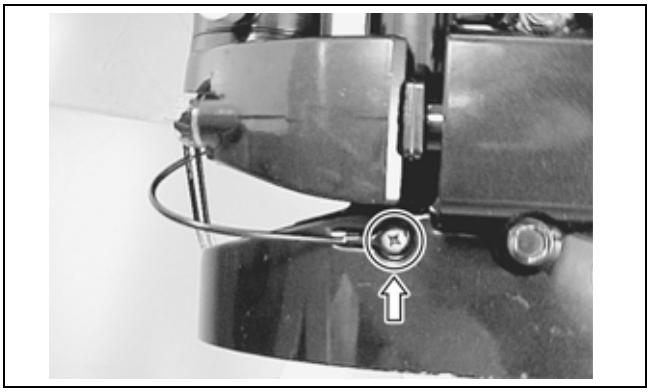


005808

Install lower mount cover. Apply *Nut Lock* to threads of cover screws and tighten to 198 in. lbs. (23 N·m).

005809

Install bonding wire to driveshaft housing and tighten screw securely.



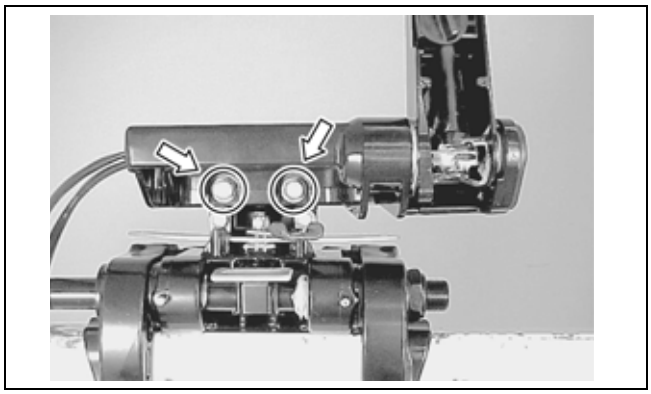
005810

STERN BRACKET

Disassembly

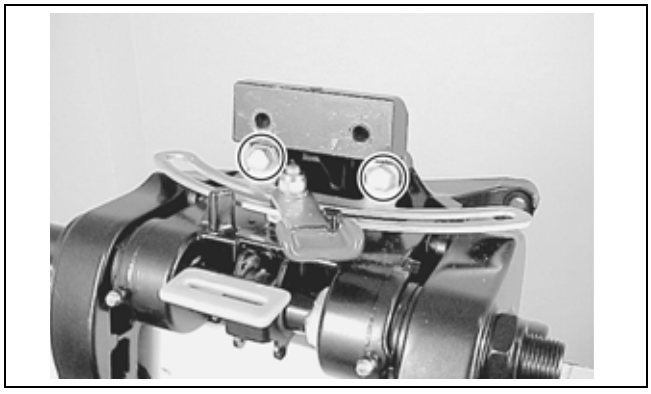
Remove driveshaft housing/oil pan assembly. Refer to **Removal** on p. 177.

Remove the two screws securing tiller handle bracket and tiller handle (tiller models).



005811

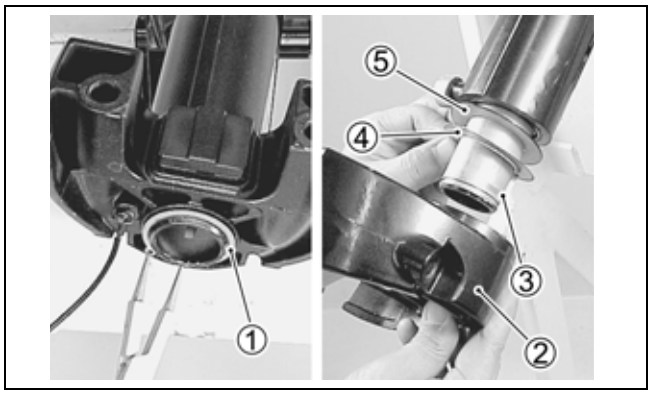
Remove two screws securing steering friction adjuster plate (tiller models).



005812

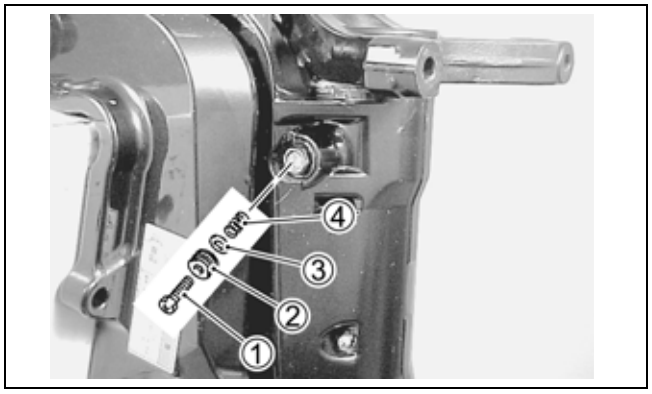
Remove circlip and lower mount bracket from the steering shaft.

Remove key, shim, and washer.



1. *Circlip* 005813
2. *Lower mount bracket*
3. *Key*
4. *Shim*
5. *Washer*

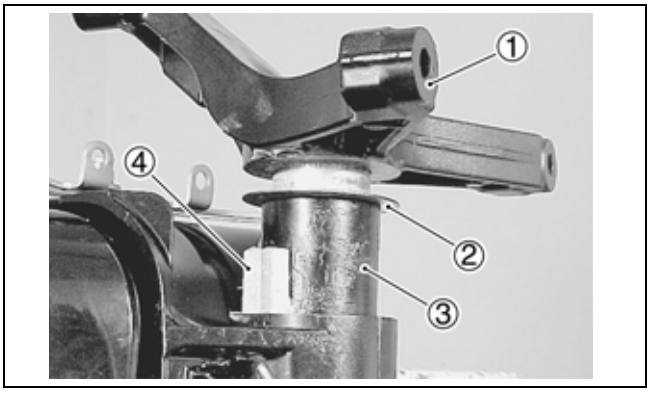
Remove steering friction screw, cover, washer, and spring (remote models).



1. *Steering friction screwr* 005814
2. *Cover*
3. *Washer*
4. *Spring*

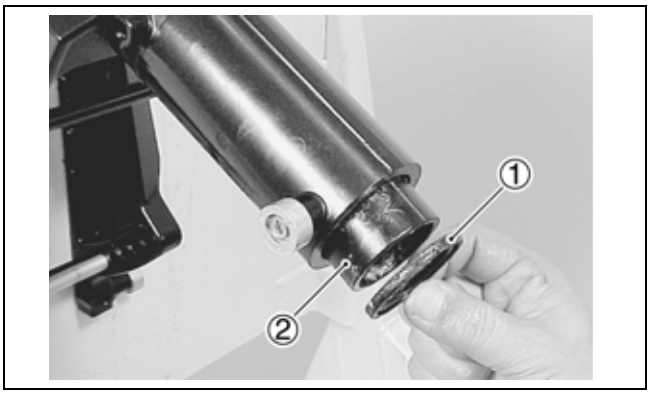
Lift steering bracket upward to remove from swivel bracket.

Remove washer, upper bushing, and steering adjuster plate.



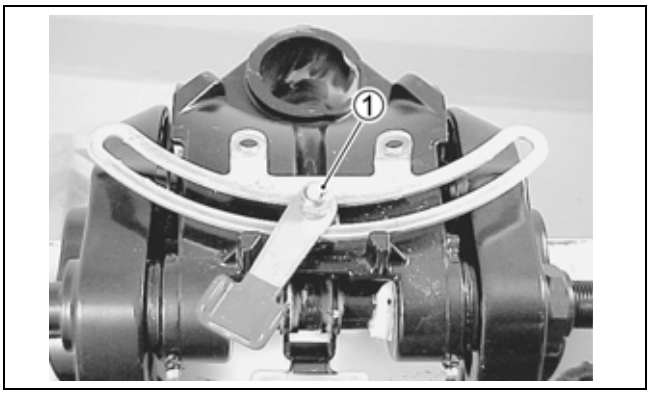
1. *Steering bracket* 005815
2. *Washer*
3. *Bushing*
4. *Steering adjuster plate*

Remove swivel bracket seal and lower bushing.

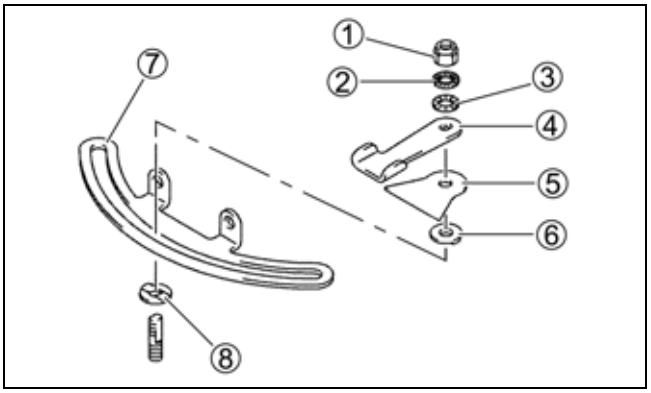


1. *Seal* 005816
2. *Bushing*

Remove nut, washer, washer, steering friction lever, plate, friction plate washer, friction adjuster plate, and friction plate washer (tiller models).

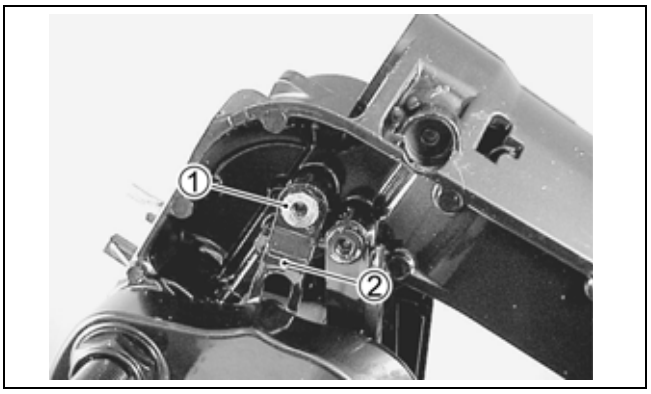


1. Nut 005817



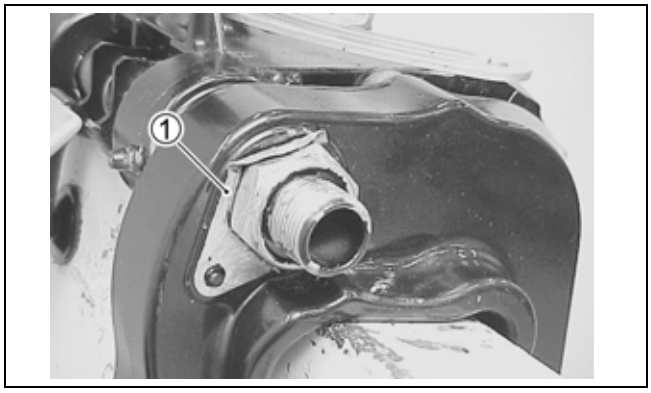
1. Nut 005818
2. Washer
3. Washer
4. Lever
5. Plate
6. Friction plate washer
7. Friction adjuster plate
8. Friction plate washer

Remove screws and tilt support arms.



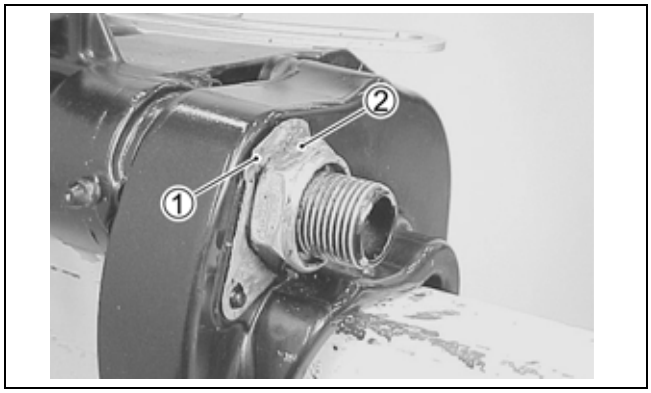
1. Screw 005819
2. Tilt support

Use an appropriate tool to bend lock tab away from tilt tube nut.



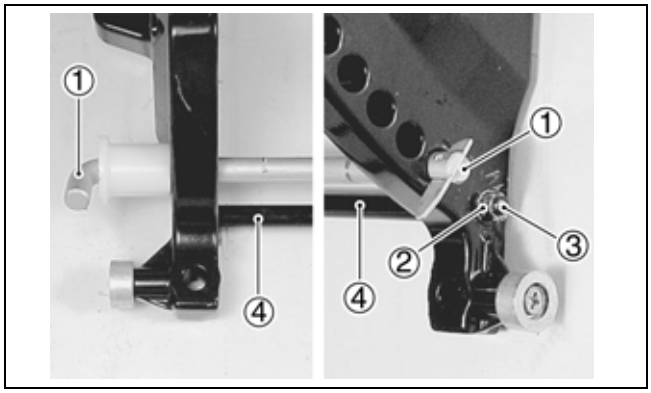
1. Lock tab 005820

Remove nut and washer from clamp bracket shaft.



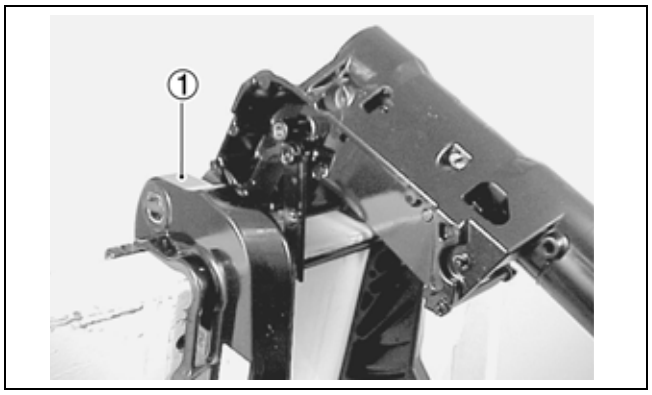
1. Washer 005821
2. Nut

Remove tilt lock pin, nut, lower clamp bracket bolt, and spacer.



1. Tilt lock pin 005822
2. Nut
3. Bolt
4. Spacer

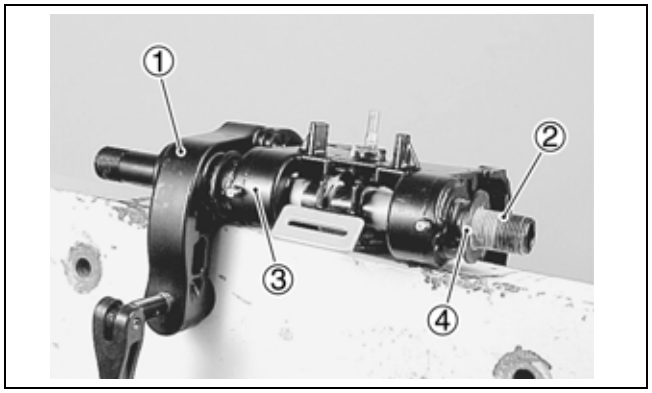
Slide port clamp bracket off clamp bracket shaft.



1. Port clamp bracket 005823

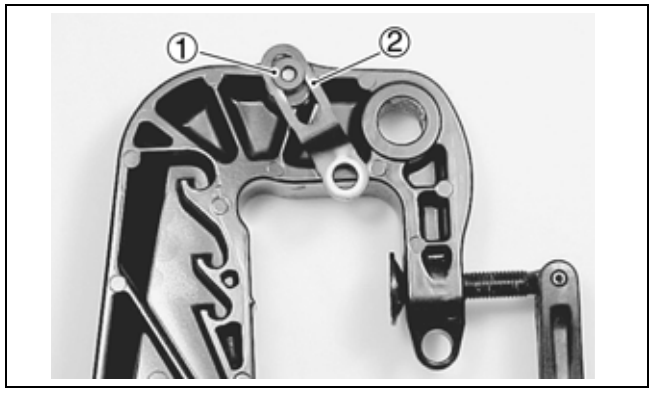
Pull starboard clamp bracket outward to remove clamp bracket and bracket shaft from swivel bracket.

Remove bushings from each side of swivel bracket.



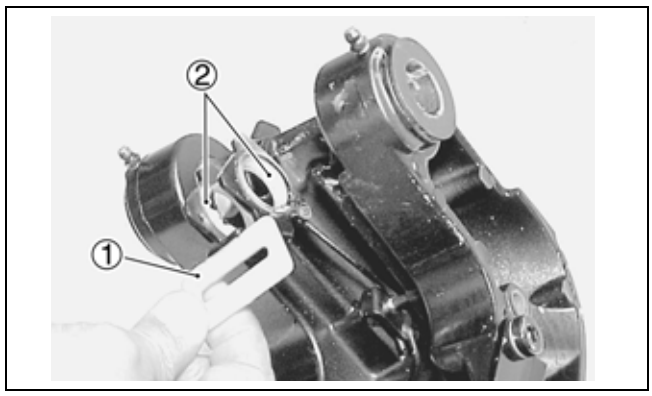
1. Starboard clamp bracket 005824
2. Bracket shaft
3. Swivel bracket
4. Bushing

Remove screws and tilt support arms from clamp brackets.



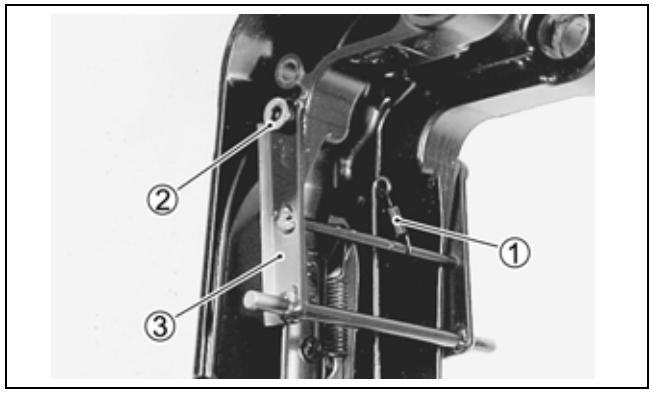
1. Screw 005825
2. Tilt support arm

Remove release lever and bushings.



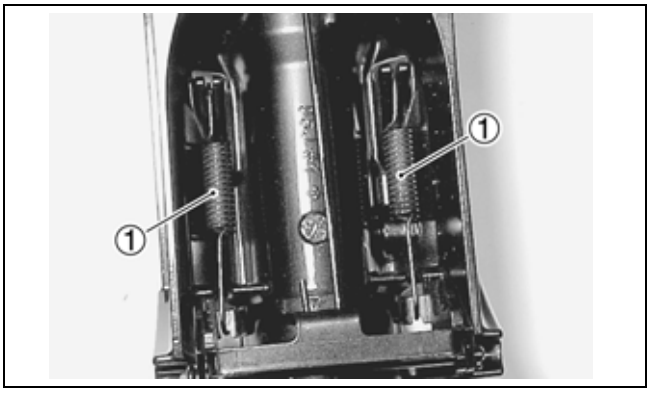
1. Release lever 005826
2. Bushings

Remove small spring, two screws, and shallow drive arm.



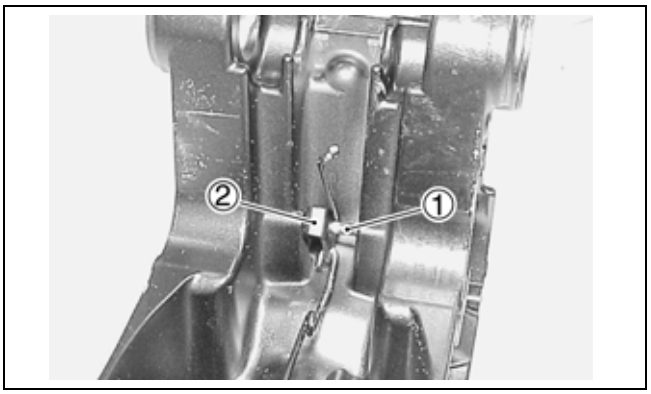
1. Spring 005827
2. Screws
3. Shallow drive arm

Remove two large springs from reverse lock arm and swivel bracket.



1. Reverse lock springs 005828

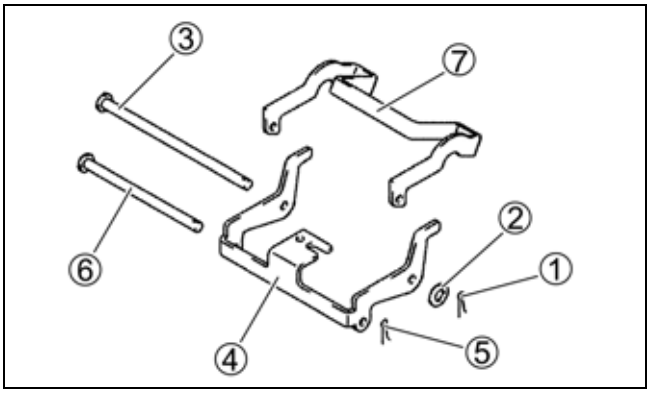
Remove the release arm pin and release link.



1. Release arm pin 005829
2. Release link

Remove cotter pin, washer, pin, and reverse lock.

Remove cotter pin, pin, and reverse lock arm.



1. Cotter pin 005830
2. Washer
3. Pin
4. Reverse lock
5. Cotter pin
6. Pin
7. Reverse lock arm

Inspection

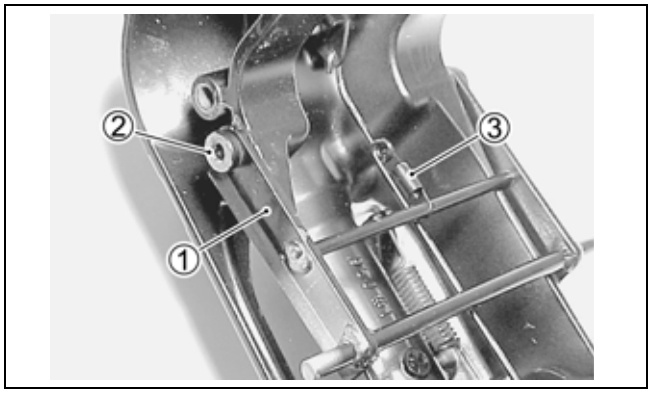
Inspect all parts for excessive wear, cracks, defects, or damage. Replace as necessary.

Assembly

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

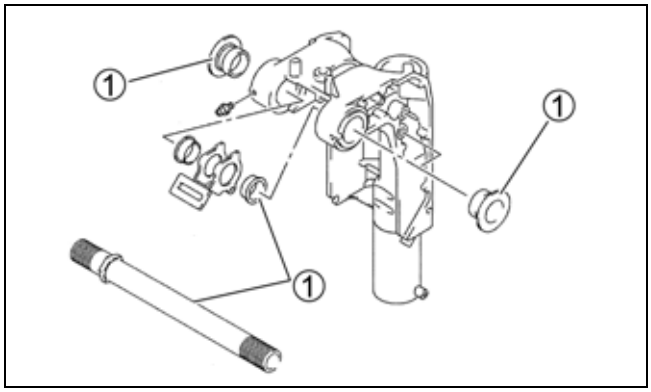
Apply *Nut Lock* to threads of shallow drive arm screws. Install arm and tighten screws 160 in. lbs. (18 N·m).

Install arm spring as shown.



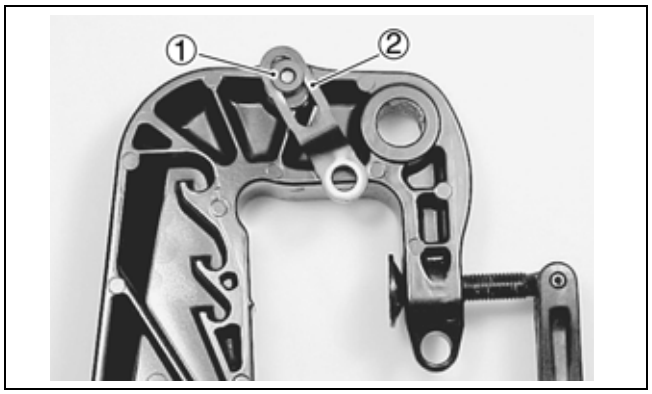
1. Shallow drive arm 005831
2. Screw
3. Spring

Apply *Triple-Guard* grease to clamp bracket shaft and bushings.



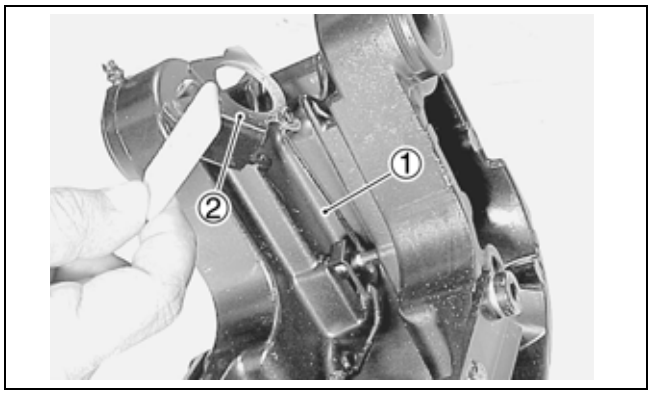
1. Apply grease here 005832

Apply *Nut Lock* to tilt support arm screws. Install tilt support arms. Tighten screws 160 in. lbs. (18 N·m).



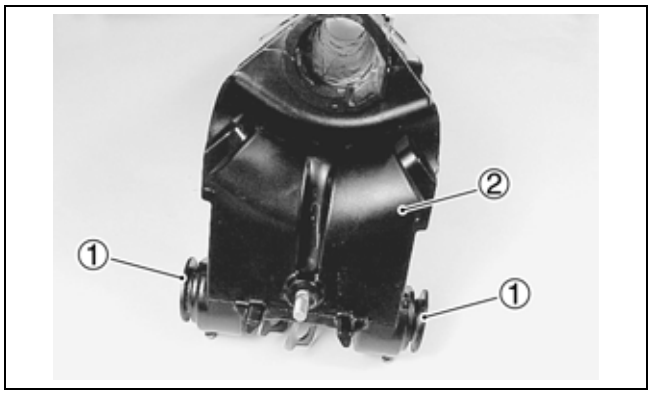
1. *Screw* 005825
2. *Tilt support arm*

Connect the release link to release lever.



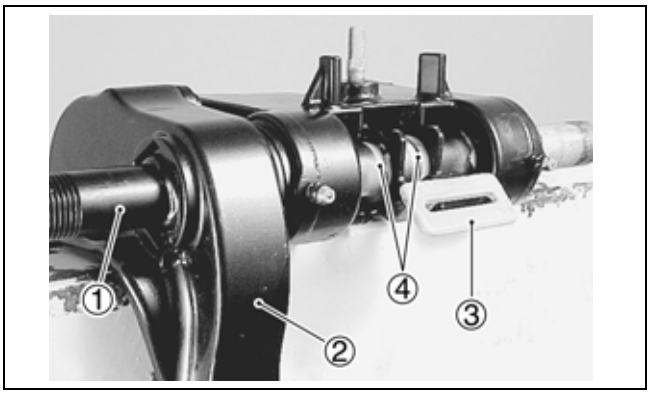
1. *Release link* 005833
2. *Release lever*

Insert port and starboard bushings into the swivel bracket.



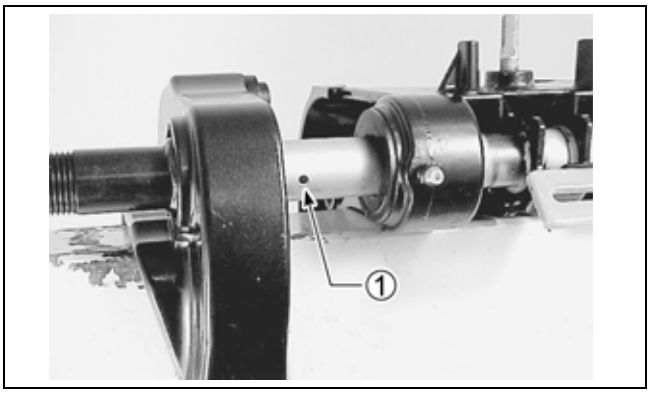
1. *Bushings* 005834
2. *Swivel bracket*

Assemble the clamp bracket shaft, starboard clamp bracket, release lever, bushings, and swivel bracket.



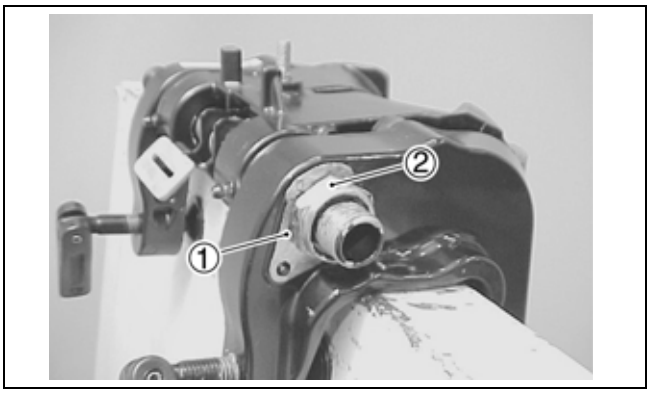
1. *Clamp bracket shaft* 005835
2. *Starboard clamp bracket*
3. *Release lever*
4. *Bushings*

Install clamp bracket shaft into the starboard clamp bracket with hole placed as shown.



1. *Hole* 005836

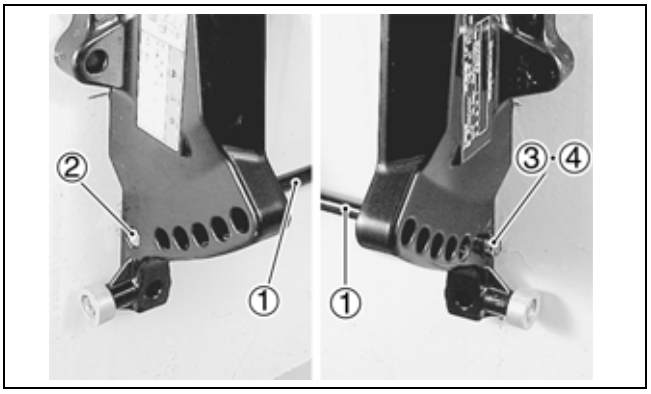
Install PORT clamp bracket and washer. Loosely install clamp bracket shaft nut.



1. *Washer* 005837
2. *Clamp bracket shaft nut*

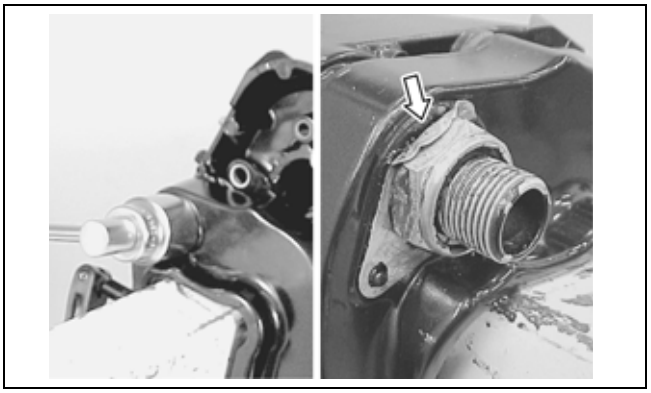
Install spacer, clamp bracket bolt, and washer.

Apply *Nut Lock* to threads of bolt. Install nut and tighten 88 in. lbs. (10 N·m).



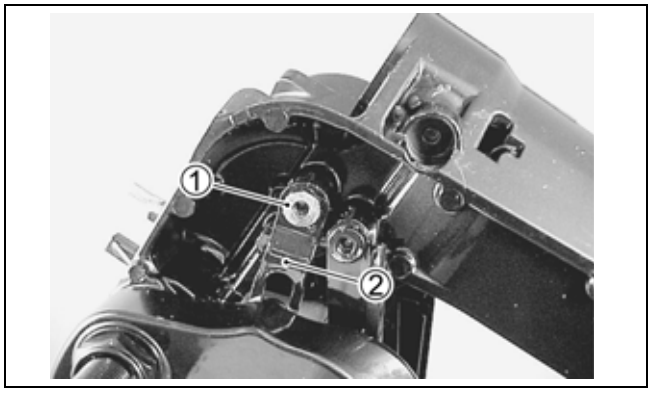
1. *Spacer* 005838
2. *Clamp bracket bolt*
3. *Washer*
4. *Nut*

Tighten clamp bracket shaft nut to 31 ft. lbs. (43 N·m). After tightening nut, bend lock tab to secure nut.



005839

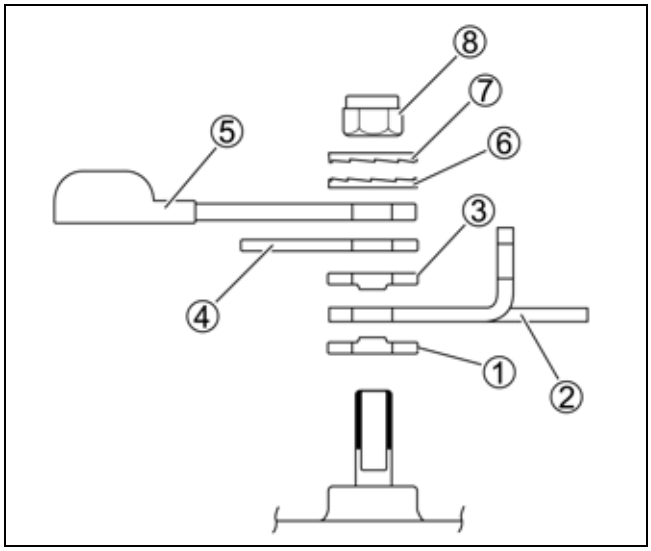
Install tilt support arms. Apply *Nut Lock* to screw threads and tighten 160 in. lbs. (18 N·m).



1. *Screw* 005819
2. *Tilt support*

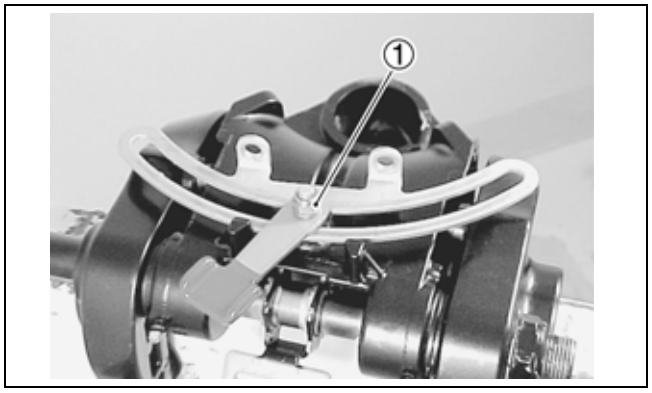
Assemble the steering friction adjuster set in the following order (tiller models).

IMPORTANT: Install the top washers with the rough faces facing each other.



1. *Friction plate washer* 005840
2. *Friction adjuster plate*
3. *Friction plate washer*
4. *Plate*
5. *Friction adjuster lever*
6. *Washer*
7. *Washer*
8. *Nut*

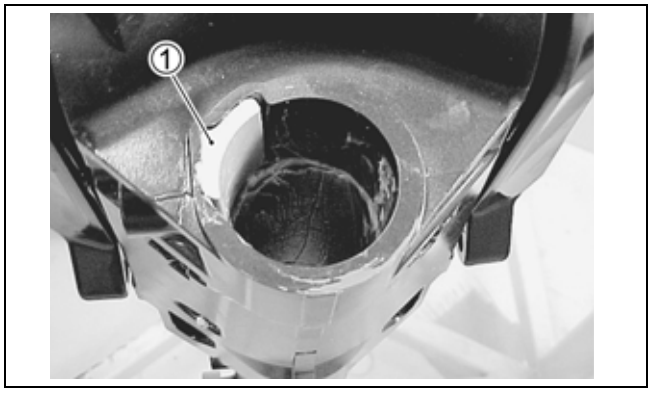
Tighten steering friction adjuster nut 27 in. lbs. (3 N·m).



1. Nut 005841

Apply *Triple-Guard* grease to bushings, oil seal lip, and pilot shaft portion of steering bracket.

Install the steering adjuster plate in swivel bracket.



1. Steering adjuster plate 005842

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.

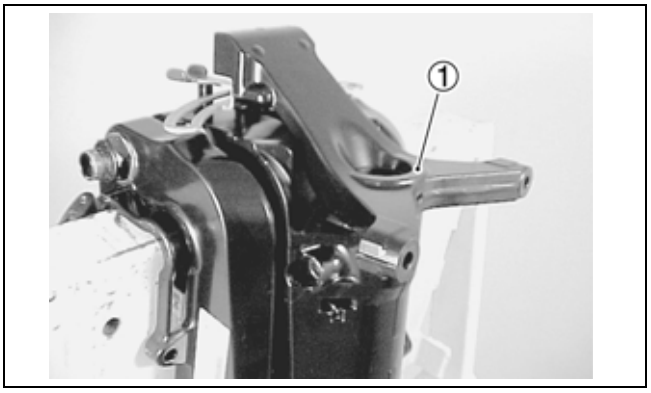
1. Upper bushing 005843
2. Washer

Install lower bushing and seal on swivel bracket. The bushing outside face is tapered—install the smaller diameter first.

IMPORTANT: Install seal with lip (spring side) facing down.

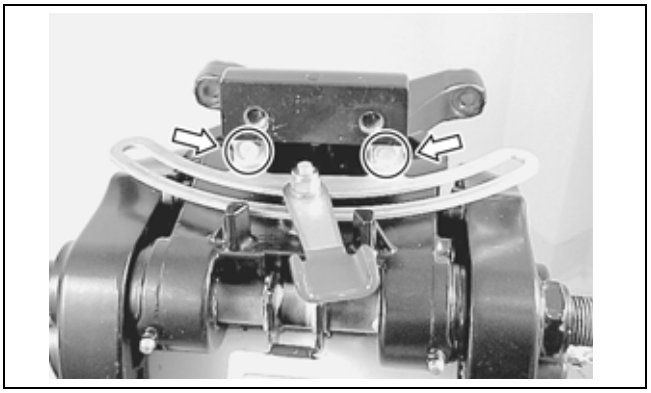
1. Lower bushing 005844
2. Seal

Apply *Triple-Guard* grease to steering bracket shaft and install in swivel bracket.



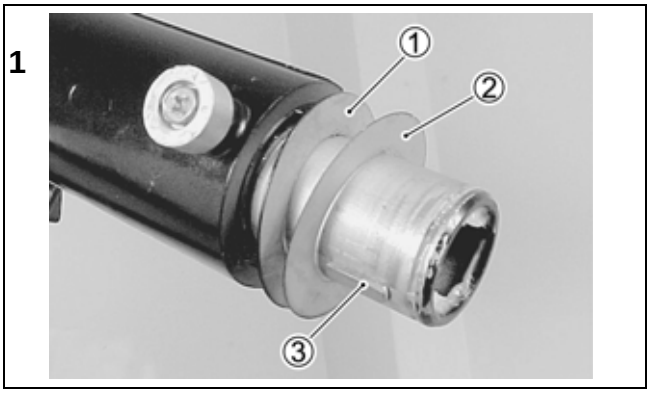
1. Steering bracket shaft assembly 005845

Install steering friction adjuster plate to steering bracket (tiller models).



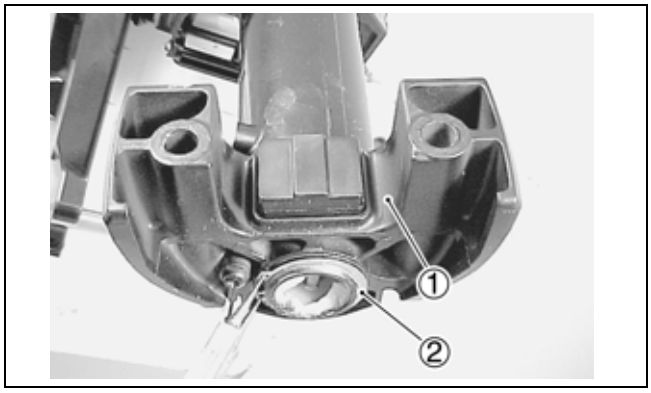
005846

Install washer and shim, then insert key into groove on steering bracket shaft.



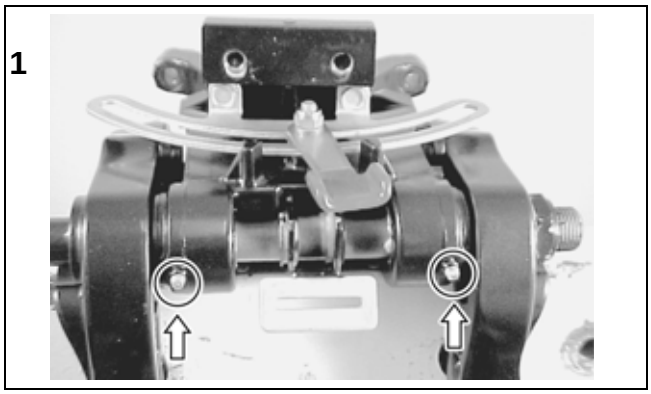
1. Washer 005847
2. Shim
3. Key

Align key with channel in lower mount bracket and install bracket. Install circlip to retain bracket.

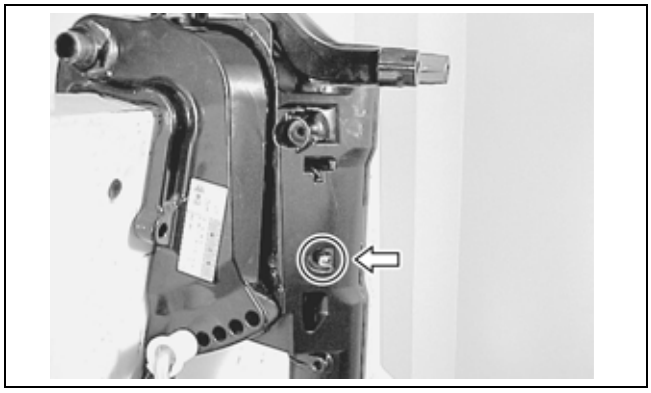


1. Lower mount bracket 005848
2. Circlip

After completing stern bracket assembly, apply *Triple-Guard* grease at each grease fitting.



005849



005850

STEERING HANDLE

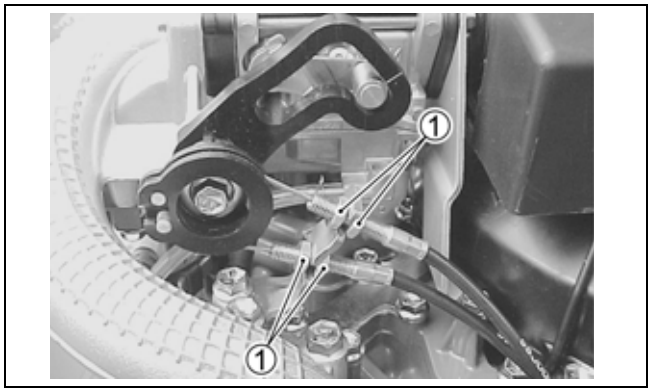
Removal

⚠ WARNING ⚠

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

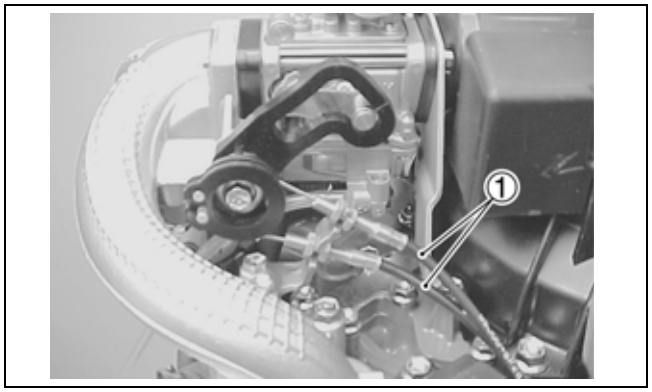
Remove the STBD side cover. Refer to Side Cover **Removal and Installation** on p. 177.

Loosen throttle cable lock nuts.



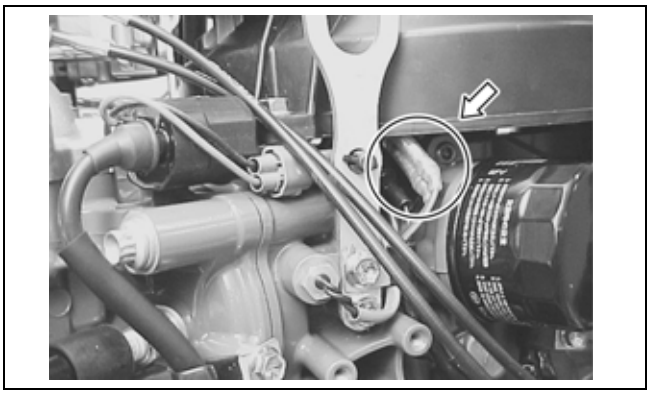
1. Lock nuts 005789

Remove throttle cables from throttle drum and cable bracket.



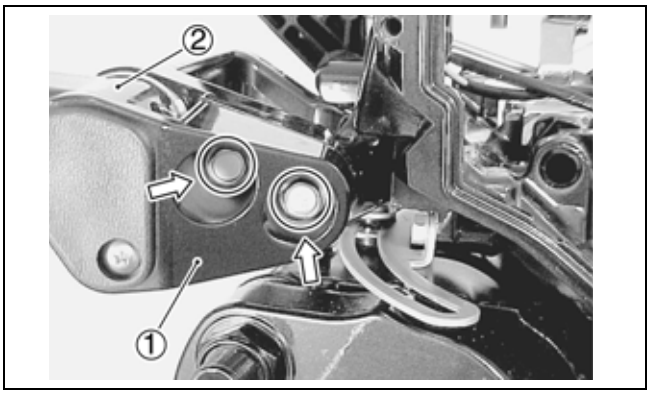
1. Throttle cables 005790

Disconnect emergency stop switch wire.



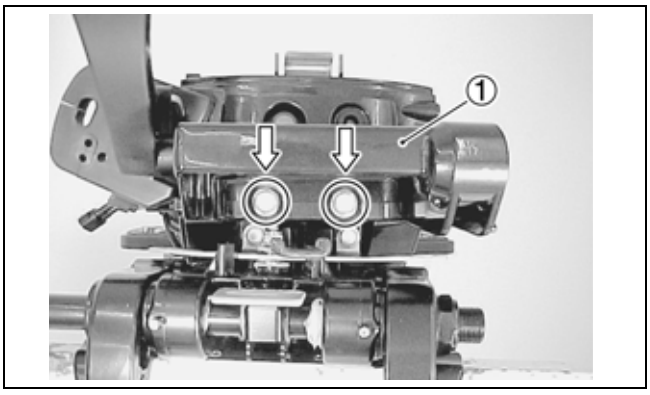
005791

Remove two screws and tiller handle cover. Remove tiller handle and throttle cable assembly.



1. Tiller handle cover 005792
2. Tiller handle assembly

Remove two screws and handle bracket.



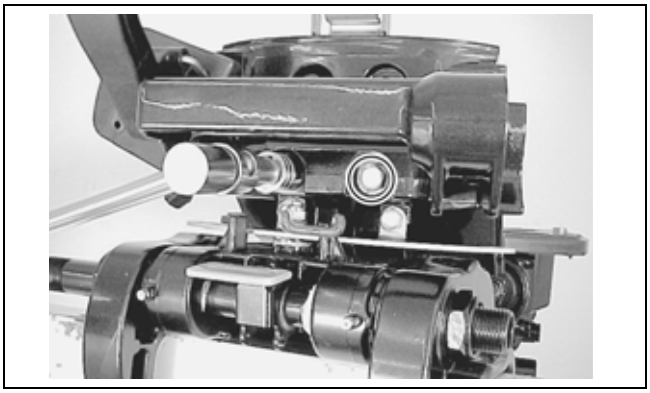
1. Handle bracket 005793

8

Installation

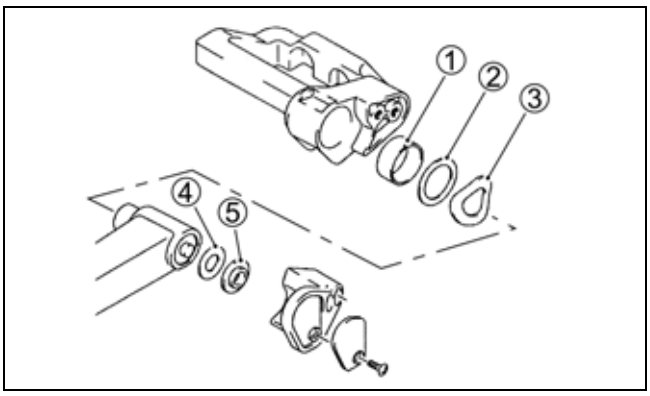
Installation is reverse order of removal with special attention to the following:

Apply *Nut Lock* to threads of handle bracket screws. Install handle and tighten screws 36 ft. lbs. (50 N·m).



005794

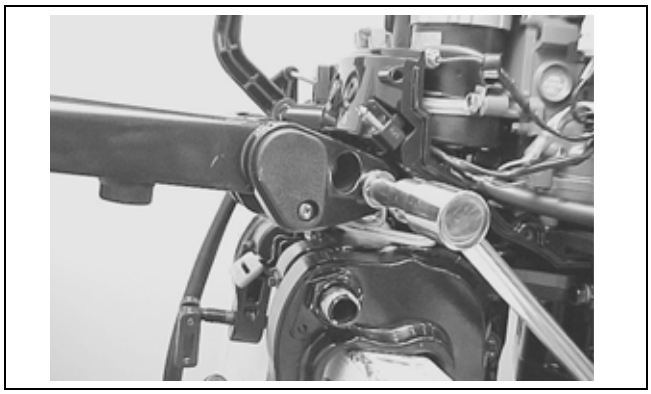
Install bushing, washer, wave washer, shim, and spacer on tiller handle.



005795

1. *Bushing*
2. *Washer*
3. *Wave washer*
4. *Shim*
5. *Spacer*

Apply *Nut Lock* to threads of handle cover screws. Install handle cover and tighten screws 198 in. lbs. (23 N·m).



005796

Install and adjust throttle cables. Refer to **OUTBOARD RIGGING** on p. 36.

Check wire and cable routing. Refer to **WIRE/HOSE ROUTING** on p. 225.

GEARCASE

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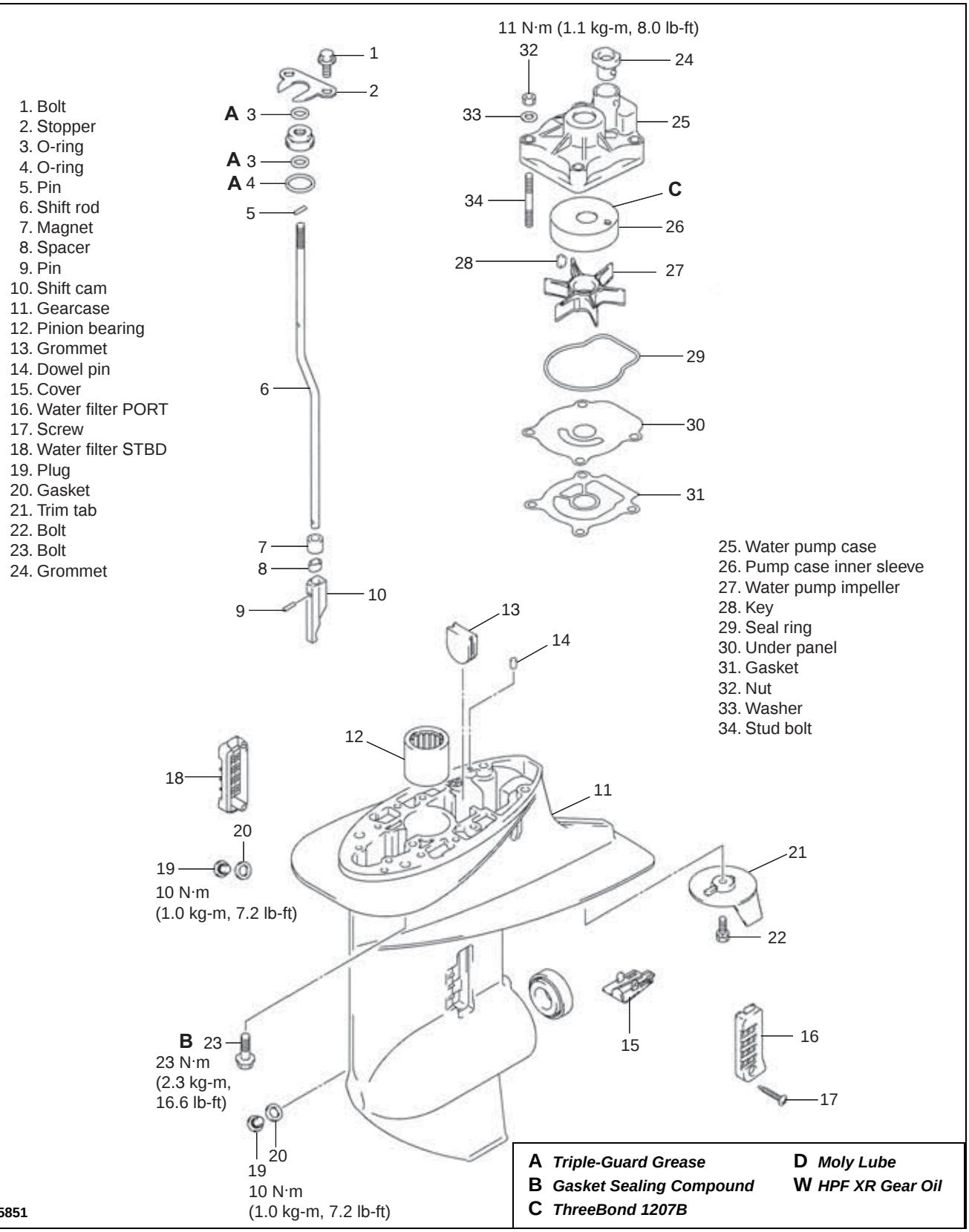
SERVICE CHART

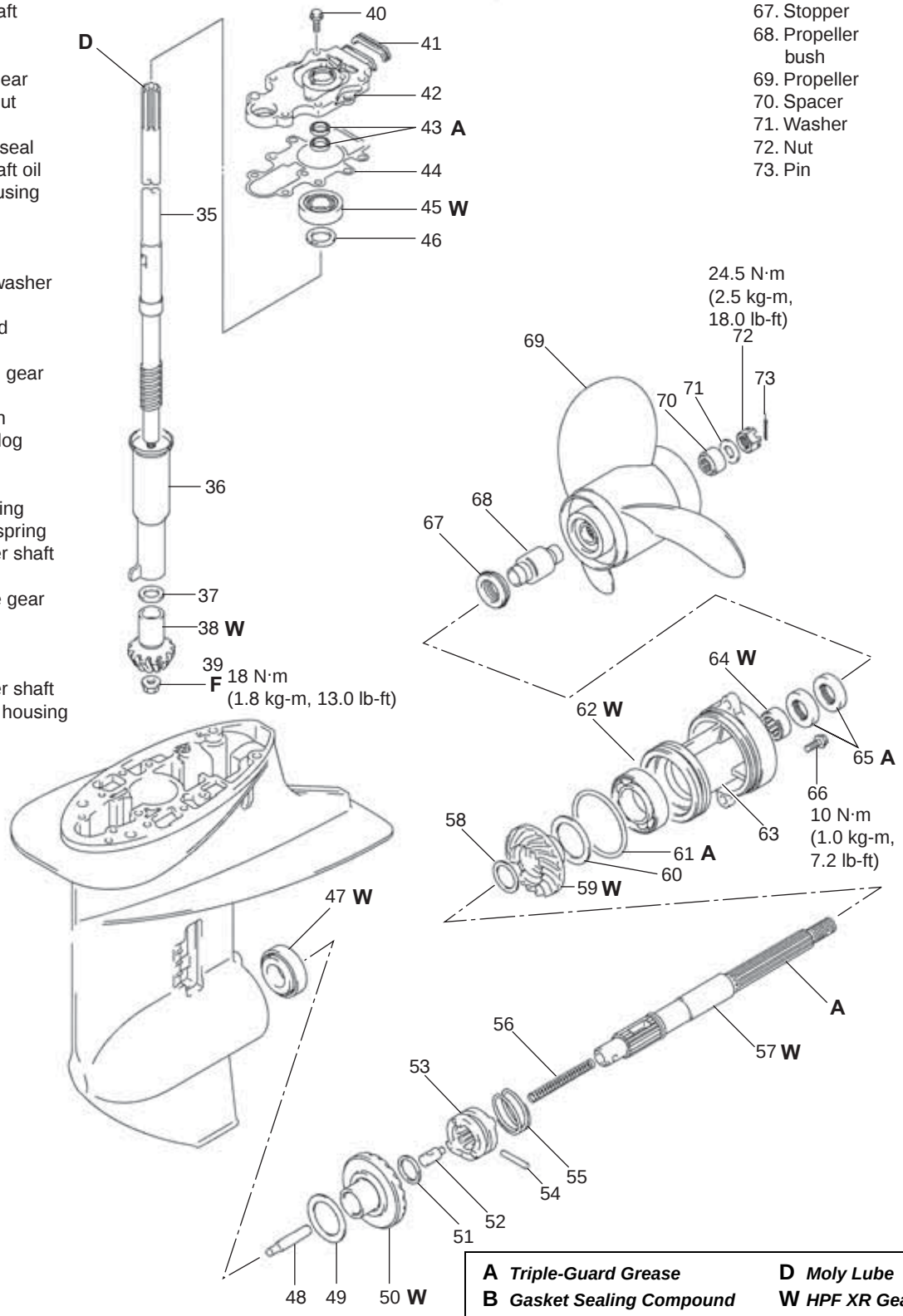


1. Bolt
2. Stopper
3. O-ring
4. O-ring
5. Pin
6. Shift rod
7. Magnet
8. Spacer
9. Pin
10. Shift cam
11. Gearcase
12. Pinion bearing
13. Grommet
14. Dowel pin
15. Cover
16. Water filter PORT
17. Screw
18. Water filter STBD
19. Plug
20. Gasket
21. Trim tab
22. Bolt
23. Bolt
24. Grommet
25. Water pump case
26. Pump case inner sleeve
27. Water pump impeller
28. Key
29. Seal ring
30. Under panel
31. Gasket
32. Nut
33. Washer
34. Stud bolt

A ***Triple-Guard Grease***
B ***Gasket Sealing Compound***
C ***ThreeBond 1207B***
D ***Moly Lube***
W ***HPF XR Gear Oil***

005851

35. Driveshaft
36. Collar
37. Washer
38. Pinion gear
39. Pinion nut
40. Bolt
41. Rubber seal
42. Driveshaft oil seal housing
43. Oil seal
44. Gasket
45. Bearing
46. Thrust washer
47. Bearing
48. Push rod
49. Shim
50. Forward gear
51. Washer
52. Push pin
53. Clutch dog shifter
54. Dog pin
55. Dog spring
56. Return spring
57. Propeller shaft
58. Washer
59. Reverse gear
60. Shim
61. O-ring
62. Bearing
63. Propeller shaft bearing housing
64. Bearing
65. Oil seal
66. Bolt
67. Stopper
68. Propeller bush
69. Propeller
70. Spacer
71. Washer
72. Nut
73. Pin



A *Triple-Guard Grease*
B *Gasket Sealing Compound*
F *Blue Nut Lock*
D *Moly Lube*
W *HPF XR Gear Oil*

005852

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.

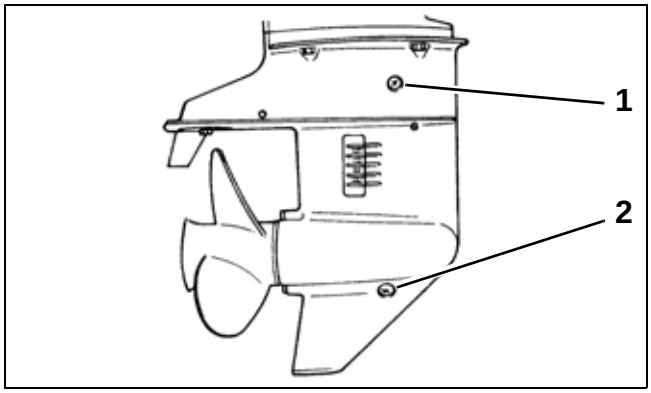
LUBRICANT

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.



1. Lubricant level plug (upper)
2. Lubricant drain/fill plug (lower)

005540

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.

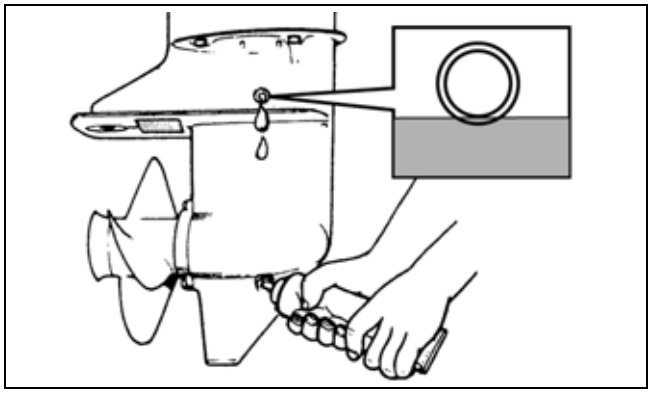
Internal gearcase inspection is recommended when lubricant is contaminated or shows signs of failure.

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.

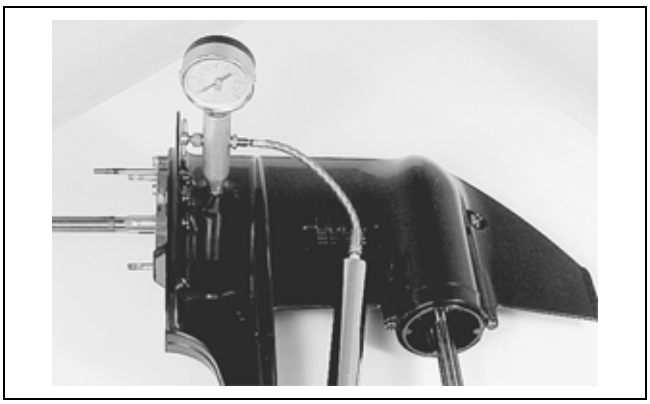
Pressurize 3 to 6 psi (21 to 42 kPa).

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.



005853

REMOVAL AND INSTALLATION

Removal

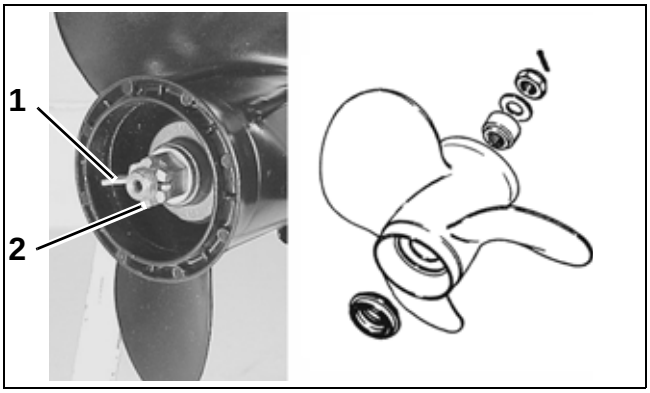
⚠ WARNING ⚠

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.

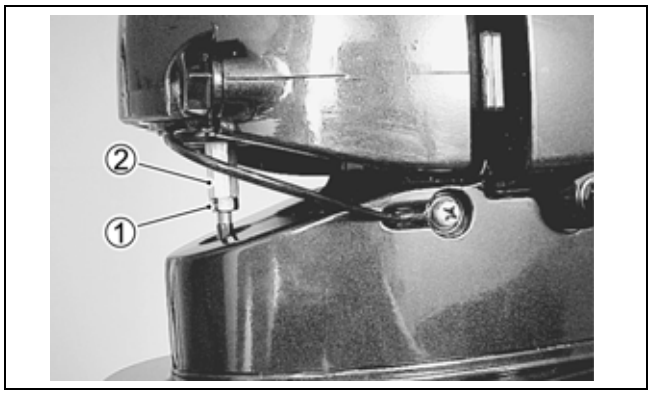
Remove cotter pin and nut, and all propeller hardware from the gearcase.

Inspect the condition of the propeller hub.



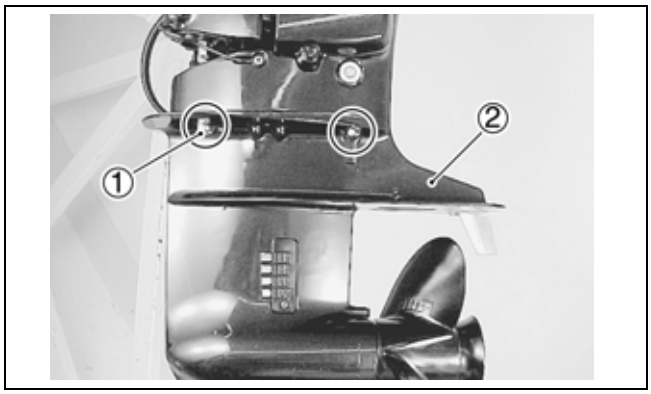
1. Cotter pin 004364
2. Propeller nut

Loosen the clutch rod lock nut. Unscrew the clutch rod connector to separate the clutch rod from the shift rod.



1. Clutch rod lock nut 005854
2. Clutch rod connector

Remove four gearcase retaining screws.



1. Screws 005855
2. Gearcase

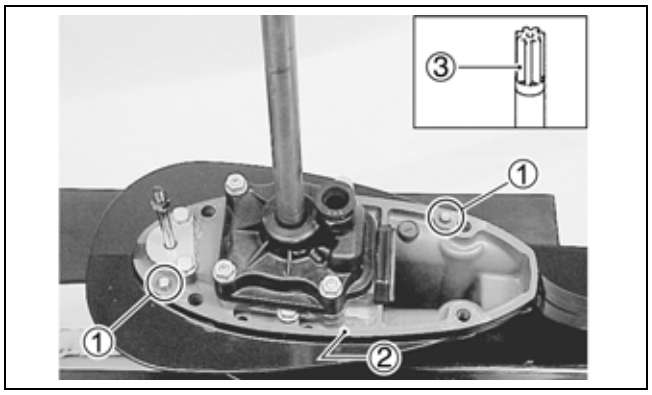
Remove gearcase from the exhaust housing and place in a suitable holding fixture.

Installation

Install two dowel pins.

Apply a light coat of *Gasket Sealing Compound* to mating surfaces of gearcase and driveshaft housing.

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.

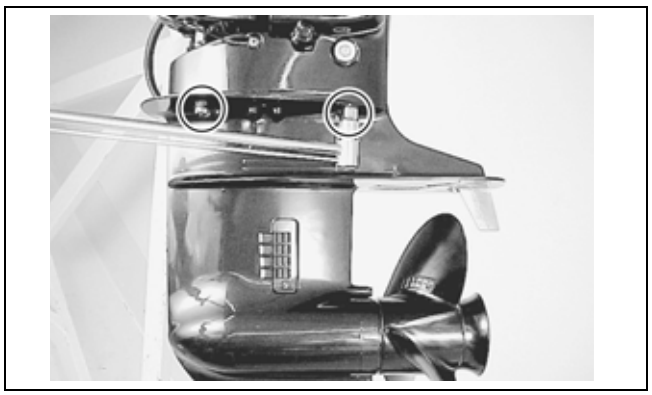


1. *Dowel pins* 005856
2. Gasket Sealing Compound
3. Moly Lube

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).

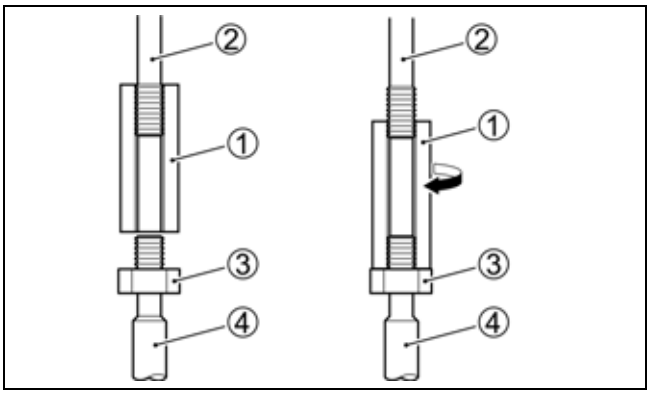


005857

Clutch Adjustment

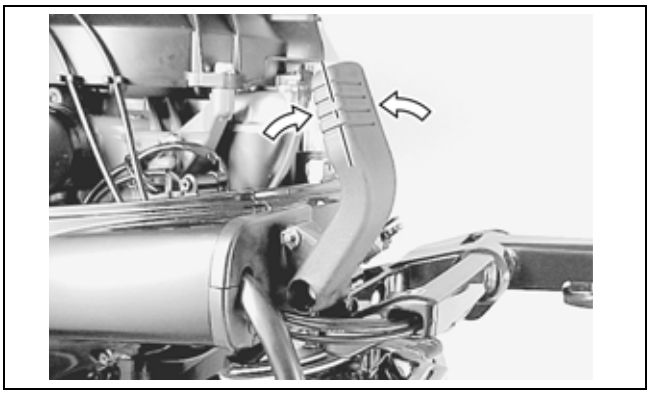
Connect the clutch rod and shift rod in the following sequence:

- Screw the clutch rod connector on the clutch rod to the end of its thread.
- Screw the lock nut on the shift rod to the end of its thread.
- Locate the shift cam at NEUTRAL position by moving shift rod up or down.
- While holding the shift lever and shift cam at NEUTRAL, screw the clutch rod connector on the shift rod until the connector contacts the lock nut.



1. *Clutch rod connector* 005858
2. *Clutch rod*
3. *Lock Nut*
4. *Shift rod*

Move the shift lever from NEUTRAL through FORWARD and REVERSE and check that gear engagement starts at an equal angle from NEUTRAL.



004370

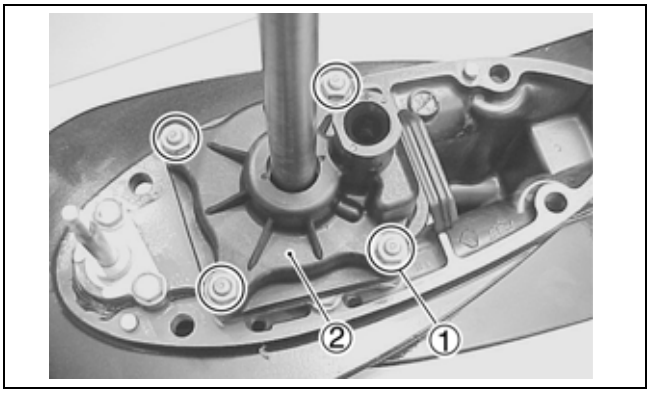
WATER PUMP

Disassembly

Remove gearcase from exhaust housing as described in **REMOVAL AND INSTALLATION** on p. 200.

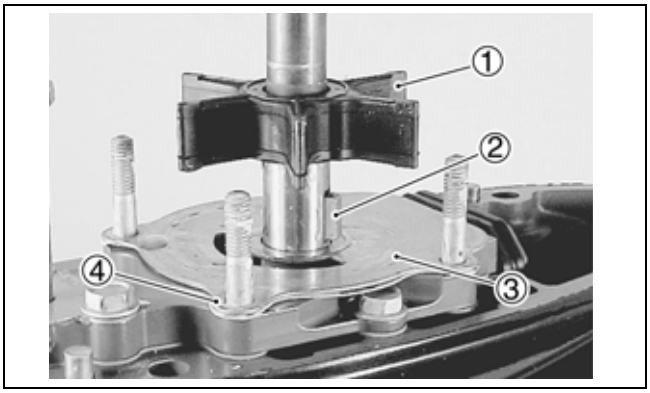
Remove the four water pump housing nuts.

Remove the impeller housing by sliding up and off the driveshaft.



1. *Nuts* 005860
2. *Housing*

Remove the impeller, impeller key, and plate. Discard gasket.



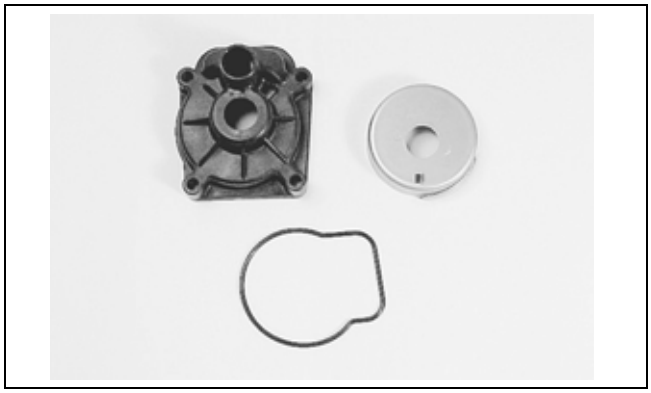
1. *Impeller* 005861
2. *Key*
3. *Plate*
4. *Gasket*

Inspection

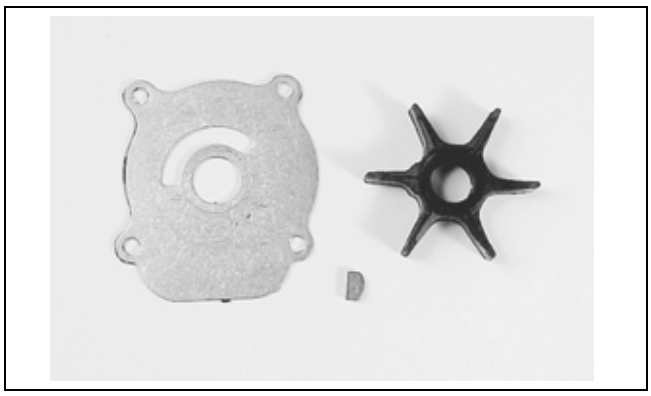
Inspect the impeller vanes for cuts, cracks, tears, or excessive wear. Replace if necessary.

Inspect the pump case and inner sleeve for cracks, distortion, or corrosion. Replace if necessary.

Inspect plate. Replace if cracked, distorted, or corroded.



005862

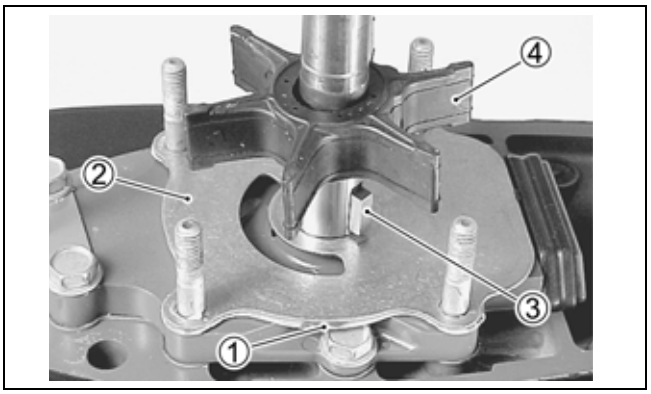


005863

Assembly

Place the gasket and plate into position.

Insert the key in the driveshaft and slide the impeller onto the driveshaft. Make sure key and keyway are aligned.



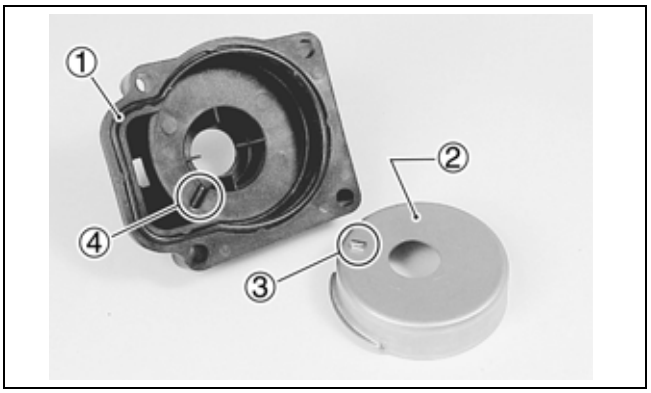
1. Gasket
2. Plate
3. Key
4. Impeller

005864

Place seal ring into groove of pump case.

Apply a light coat of *ThreeBond 1207B* sealant to outer surface of inner sleeve.

Install sleeve into housing. Make sure that tab on sleeve is located in groove of pump case.



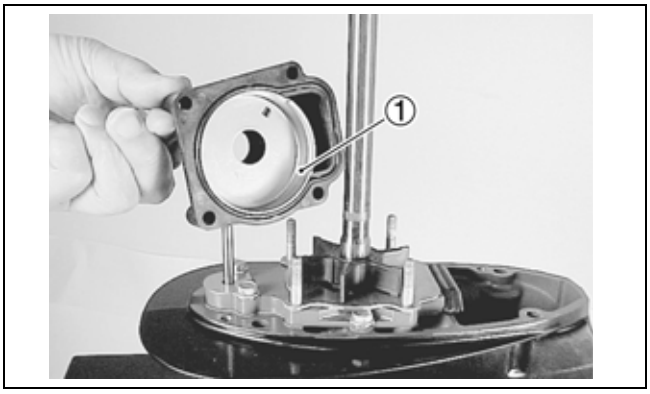
1. Seal ring
2. Sealant
3. Tab
4. Groove

005865

Apply a light coat of *Triple-Guard* grease to the inside of inner sleeve.

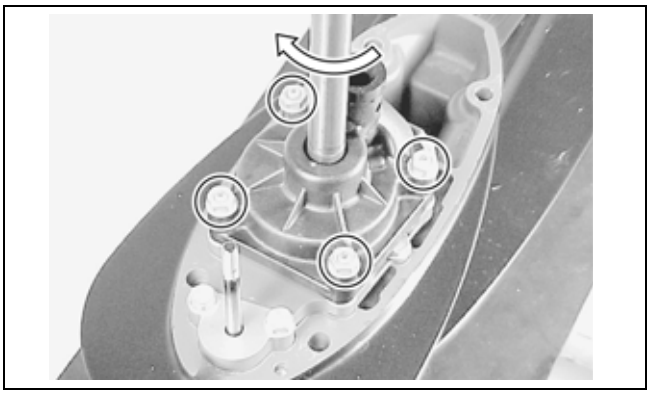
Install the pump case while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.

Install nuts and washers and tighten the four pump housing nuts to 97 in. lbs. (11 N·m).



1. Triple-Guard *grease*

005856



005857

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.

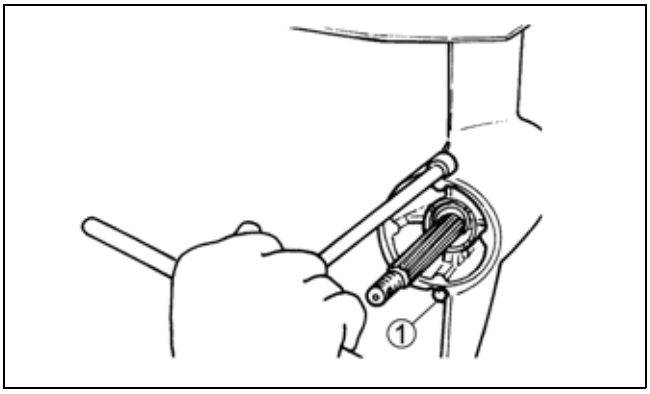
Remove propeller.

Remove gearcase. Refer to **REMOVAL AND INSTALLATION** on p. 200.

Drain gear oil. Refer to **LUBRICANT** on p. 198.

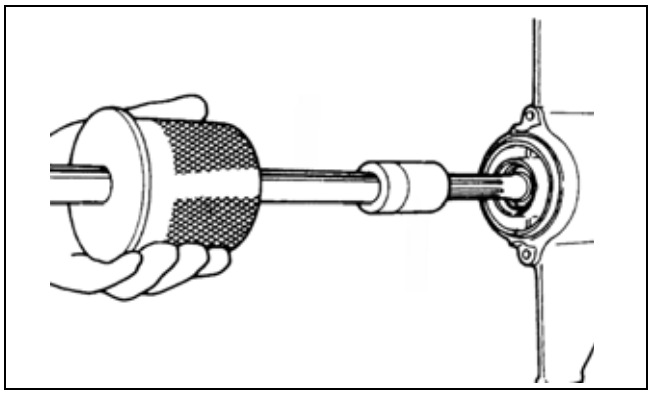
Remove water pump. Refer to **WATER PUMP** on p. 202.

Remove two propeller shaft bearing housing retaining screws.



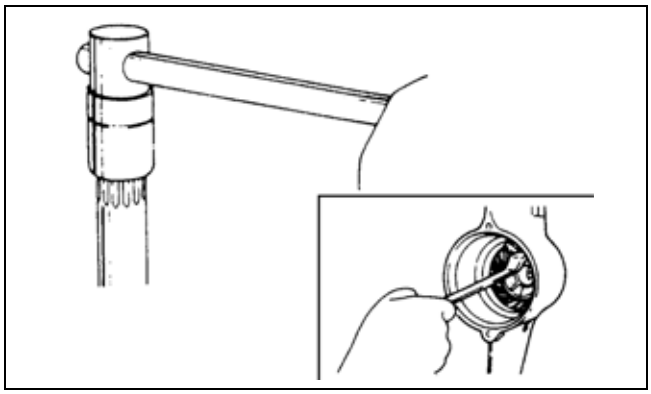
1. Bearing housing screw 005868

Use Slide Hammer, P/N 391008, and Prop Shaft Remover, P/N 5034762, to pull out the propeller shaft bearing housing assembly.



004384

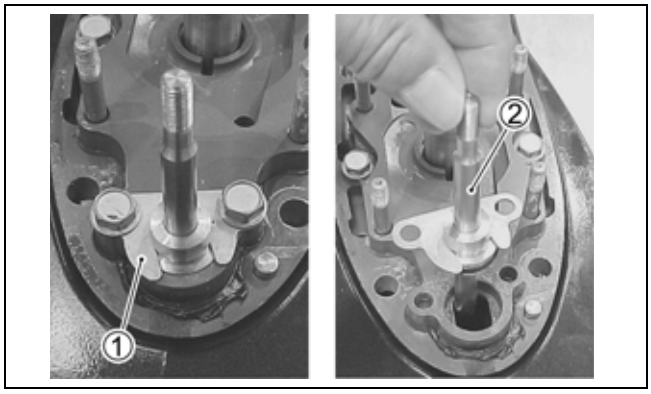
Hold the pinion nut securely with a 12 mm wrench. Use Driveshaft Socket, P/N 5037512, to loosen the pinion nut.



005869

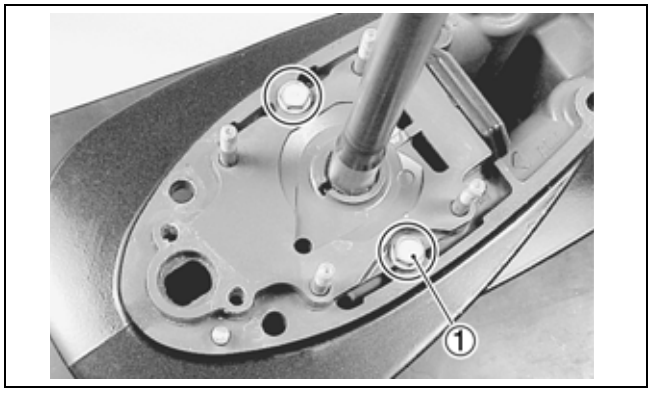
Remove two screws and shift rod guide stopper.

Lift out the shift rod/cam assembly.



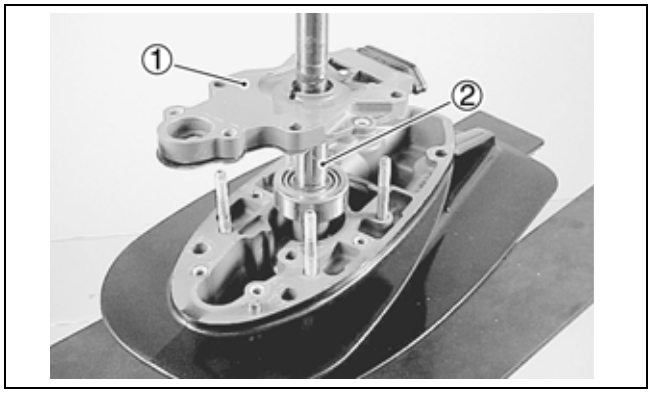
1. Stopper 005870
2. Shift rod/cam assembly

Remove two screws securing the driveshaft oil seal housing to the gearcase.



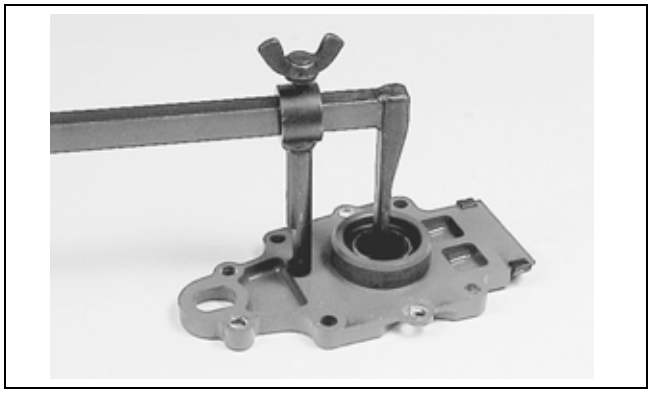
1. Driveshaft seal housing screws 005871

Remove driveshaft oil seal housing and lift out the driveshaft assembly.



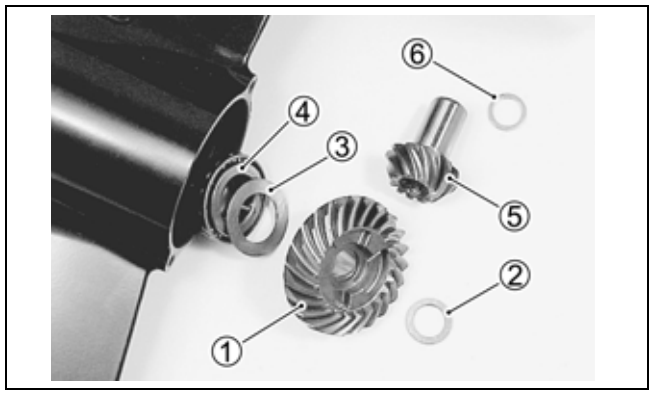
1. Driveshaft oil seal housing 005872
2. Driveshaft assembly

Remove seals from housing.



005881

Remove the forward gear, along with thrust washer, back up shim, and bearing. Remove the pinion gear and shim.



1. Forward gear 005873
2. Thrust washer
3. Back up shim
4. Bearing
5. Pinion gear
6. Shim

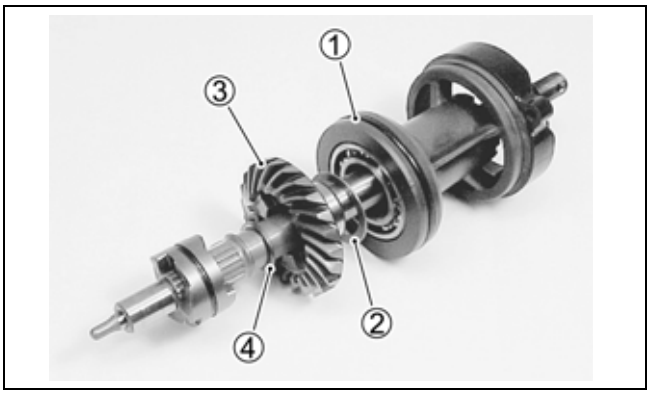
If forward gear bearing is replaced the race must be replaced. 2-jaw puller, P/N 432129, can be used with a plate obtained locally, to remove the bearing race from the gearcase housing.

Remove the driveshaft collar.

005874

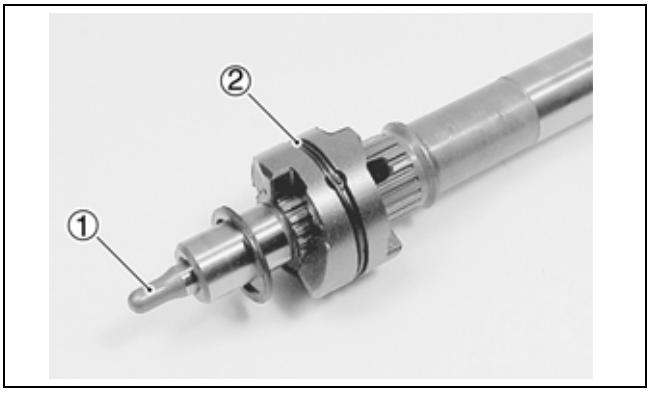
Propeller Shaft Bearing Housing Components

Remove propeller shaft components and reverse gear from bearing housing assembly.



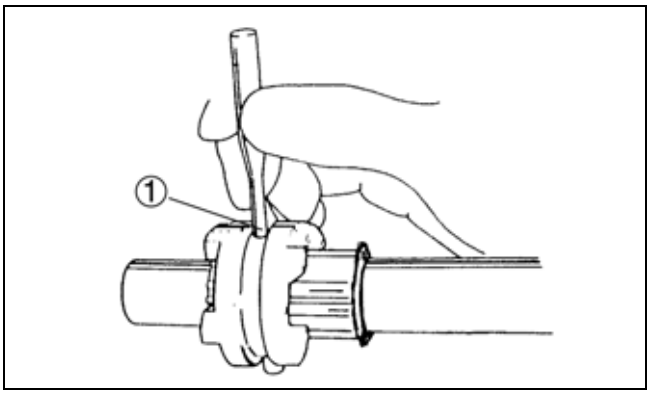
1. *Propeller shaft bearing housing* 005875
2. *Reverse gear backup shim*
3. *Reverse gear*
4. *Thrust washer*

Remove push rod from propeller shaft. Remove the spring from the clutch dog shifter.



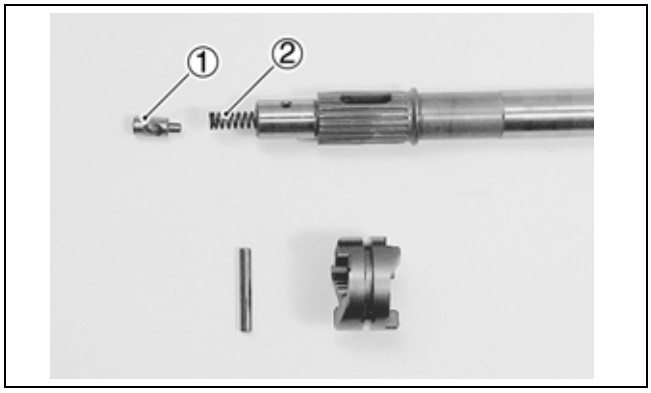
1. *Push rod* 005876
2. *Spring*

Use a punch to push the pin out of the clutch.



1. *Pin* 005877

Remove clutch dog shifter, push pin, and return spring.



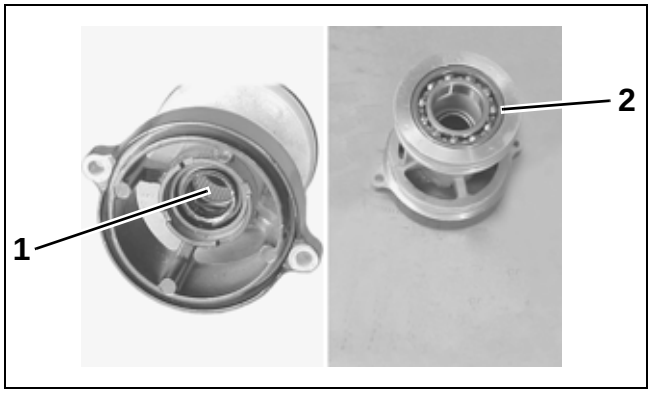
1. *Push pin* 005878
2. *Return spring*

Use Puller Bridge, P/N 432127, and Small Puller Jaws, P/N 432131, to remove oil seals.

8-9 p1

Use 2-jaw puller and plate assembly, P/N 432129, to remove reverse gear bearing.

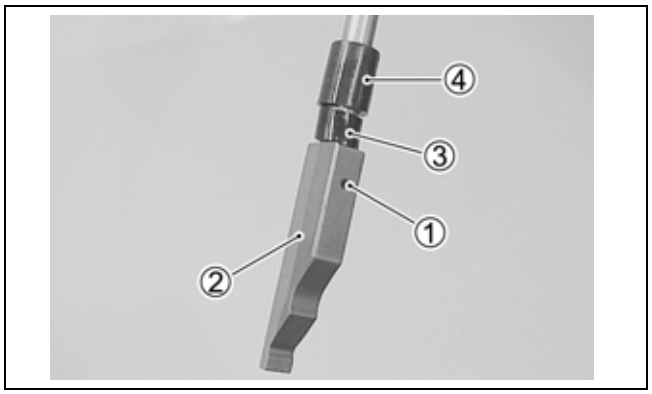
Use Bearing Removal tool, P/N 5034764, to press bearing from housing.



1. *Propshaft bearing* 001857
2. *Reverse gear bearing*

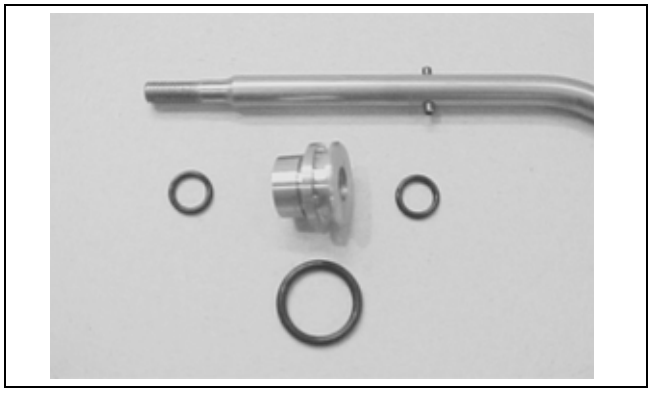
Shift Rod Components

Push out pin and remove the shift cam. Remove spacer and magnet.



1. *Pin* 005879
2. *Cam*
3. *Spacer*
4. *Magnet*

Remove shift rod guide, and and o-rings.

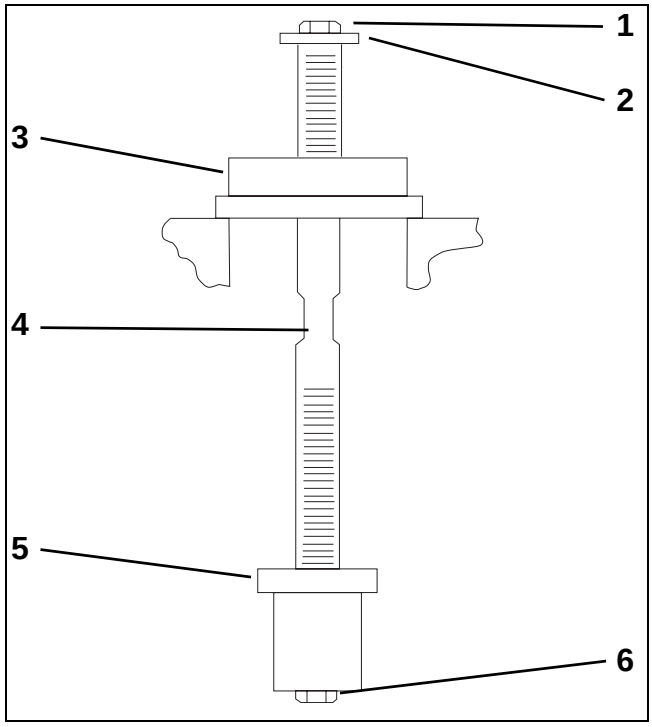


005880

Pinion Bearing

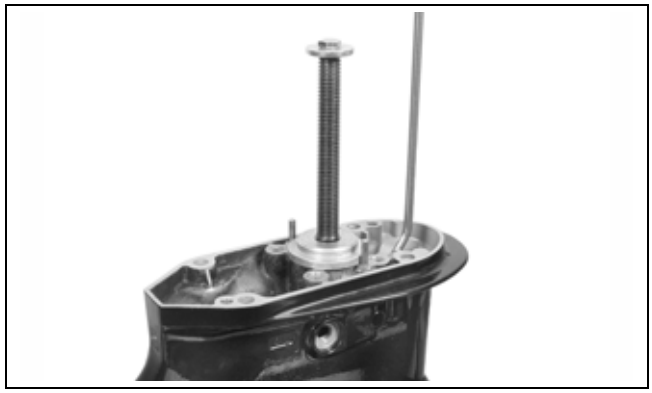
Inspect the pinion bearings in place. If necessary, remove the bearings using Universal Pinion Bearing Remover and Installer kits, P/N 5005927 and P/N 5005928.

Assemble tools as shown:



1. *1/4 x 20 x 1/2 hex-head screw* 005940
2. *1 in O.D. x 1/4 I.D. Flat washer*
3. *Pilot plate, P/N 5000009*
4. *Rod, P/N 326582*
5. *Remover/Installer, P/N 5034763*
6. *1/4 x 20 x 1 1/14 hex-head screw*

Set rod/remover assembly in gearcase. Drive bearing 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.

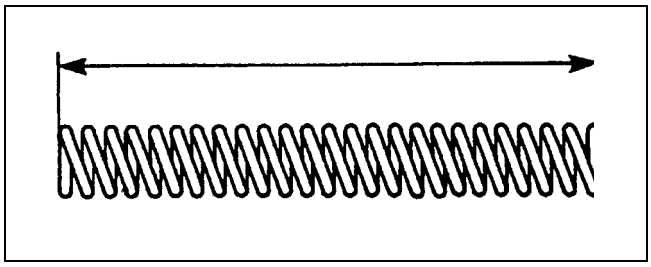
Perform the following inspections:

- **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: 2.30 in. (58.5 mm)
- Service limit: 2.22 in. (56.5 mm)



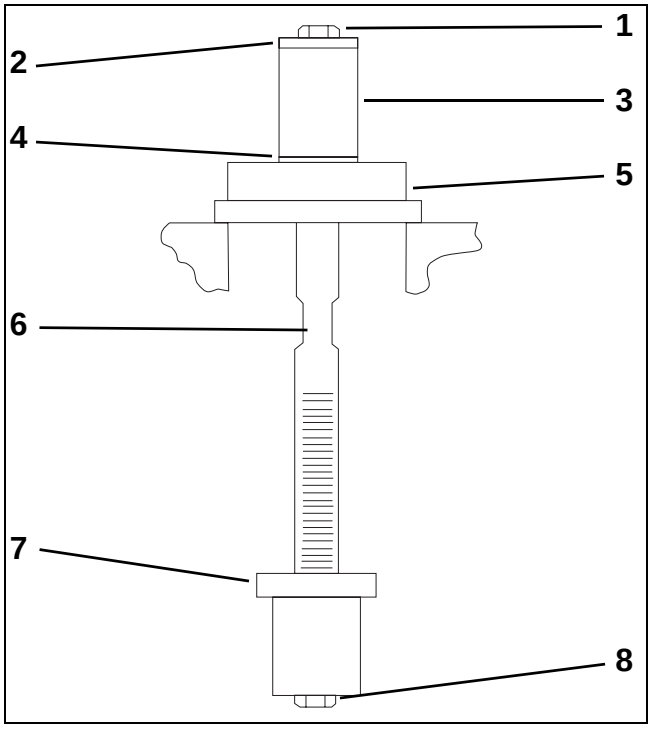
8_8_2

ASSEMBLY

Before beginning assembly, refer to **CLEANING AND INSPECTION**.

Pinion Bearing

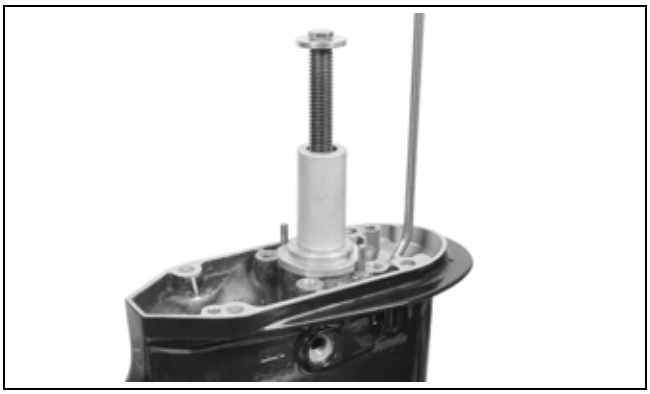
Assemble tools from Universal Pinion Bearing Remover and Installer kits, P/N 5005927 and P/N 5005928, as shown:



1. *1/4 x 20 x 1/2 hex-head screw* 005939
2. *1 in O.D. x 1/4 I.D. Flat washer*
3. *Spacer, P/N 350932*
4. *Flat washer, 1.5 mm thick (obtain locally)*
5. *Pilot plate, P/N 5000009*
6. *Rod, P/N 326582*
7. *Remover/Installer, P/N 5034763*
8. *1/4 x 20 x 1 1/14 hex-head screw*

Place bearing on installation tool with lettered side of bearing facing tool. Use *Needle Bearing* grease to hold bearing on tool.

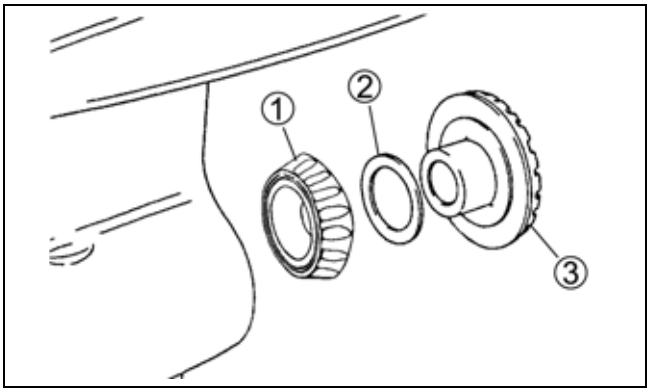
Drive the bearing down into position by gently striking the installer shaft until the washer contacts the spacer.



1. *Bushing installer* 8-11 p3
2. *Rod*
3. *Bushing*

Forward Gear

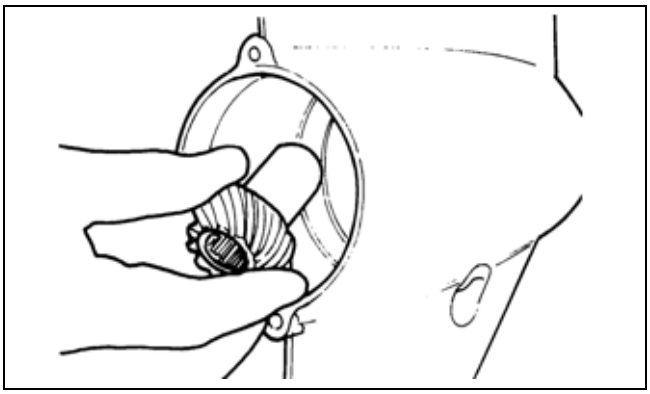
Apply gear oil to the forward gear. Place the forward gear bearing and back-up shim in position and install the gear in the gearcase.



1. *Bearing* 005920
2. *Shim*
3. *Forward gear*

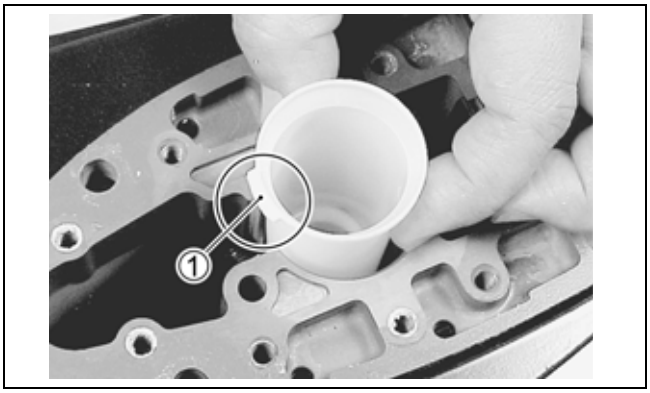
Pinion Gear and Driveshaft

Apply gear oil to the pinion gear and install in gearcase.



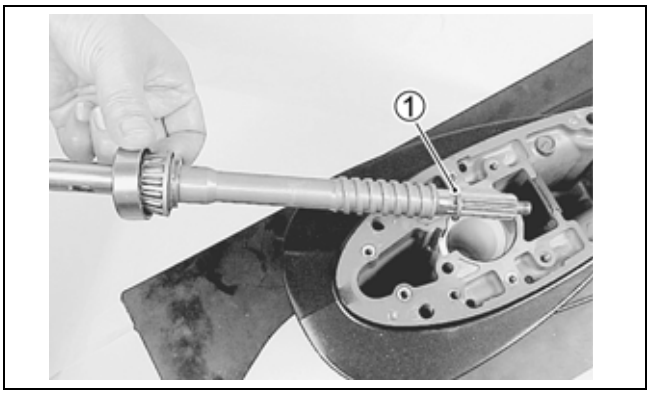
005921

Install driveshaft collar with tongue of collar located in groove on the gearcase.

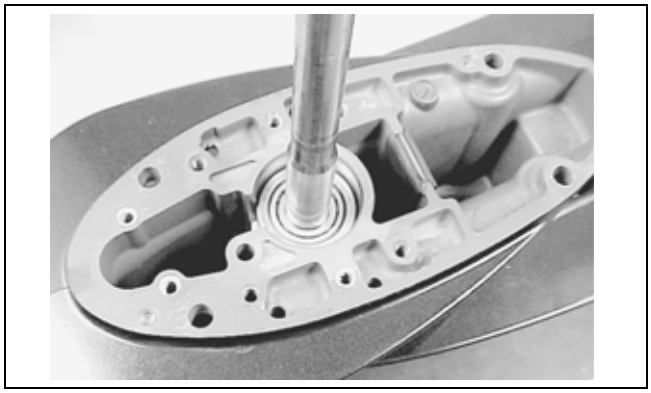


1. Tongue 005922

Install pinion shim, then lower driveshaft assembly down into the gearcase and through the pinion gear.

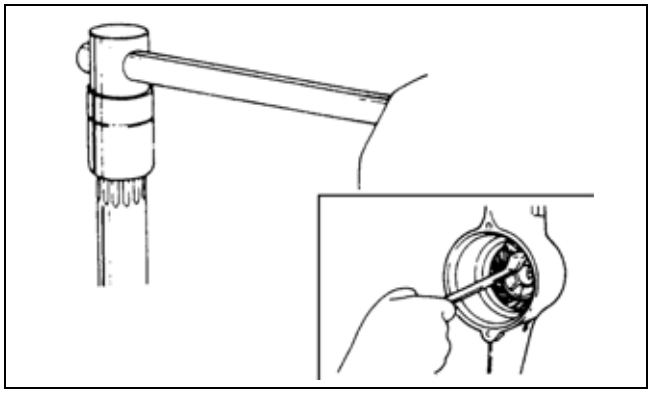


1. Shim 005923



004403

Apply *Nut Lock* to threads of pinion nut. Install nut on driveshaft and tighten to 13 ft. lbs. (18 N·m).



005869

Driveshaft Oil Seal Housing

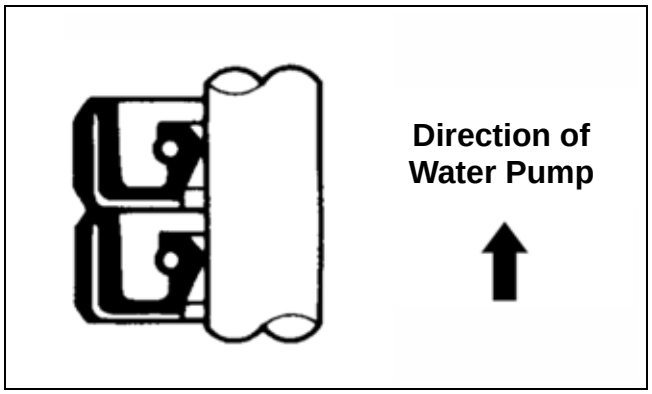
IMPORTANT: Check and adjust shimming **before** installing seals in housing. Refer to **SHIMMING ADJUSTMENTS** on p. 214.

When shimming is correct, remove seal housing for final installation of seals.

Apply *DPL* to the outer casing of two driveshaft housing oil seals.

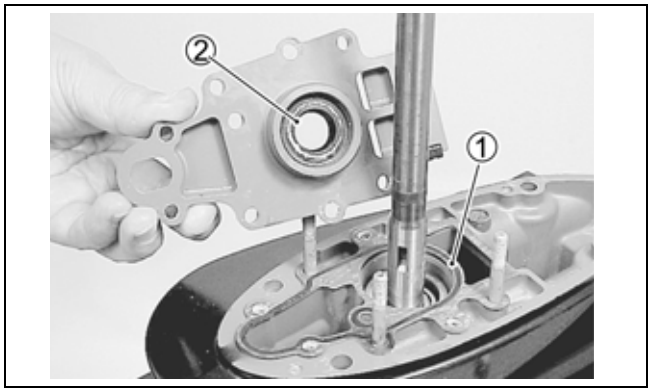
Use seal installer to press seals (one at a time) into the housing.

The lipped portion of the seals should face toward the water pump. Apply *Triple-Guard* grease to the seal lips.



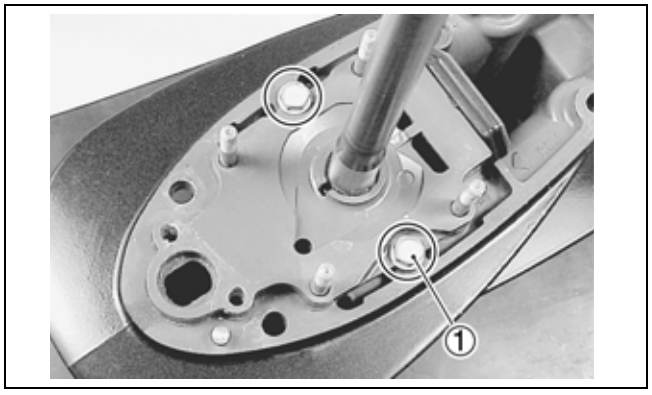
004405

Install gasket and oil seal housing. Tighten screws securely



1. *Gasket*
2. Triple-Guard *grease*

005925



1. *Driveshaft seal housing screws*

005871

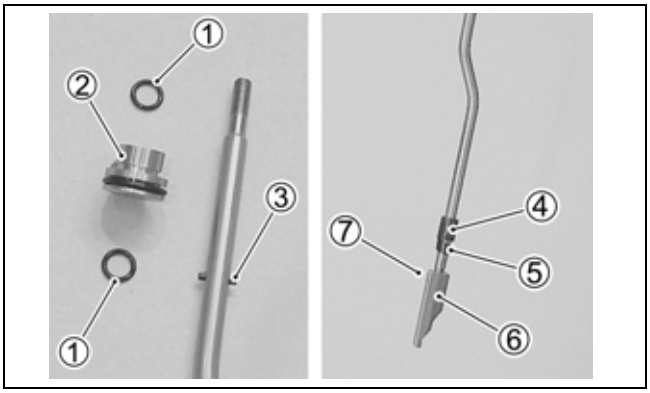
Shift Rod/Shift Cam Assembly

Apply *Triple-Guard* grease to the shift rod guide o-rings.

Slide complete shift rod guide and o-rings on the shift rod and install pin.

Attach magnet and spacer to shift rod.

Attach the shift cam to shift rod and insert pin.

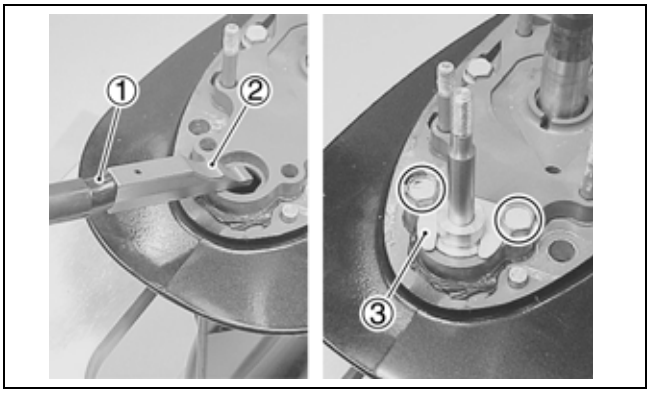


1. *O-Rings*
2. *Shift rod guide*
3. *Pin*
4. *Magnet*
5. *Spacer*
6. *Shift cam*
7. *Pin*

005926

Install the shift rod assembly in the gearcase with the stepped face of the cam facing the propeller.

Install guide stopper in the gearcase and secure with screws.



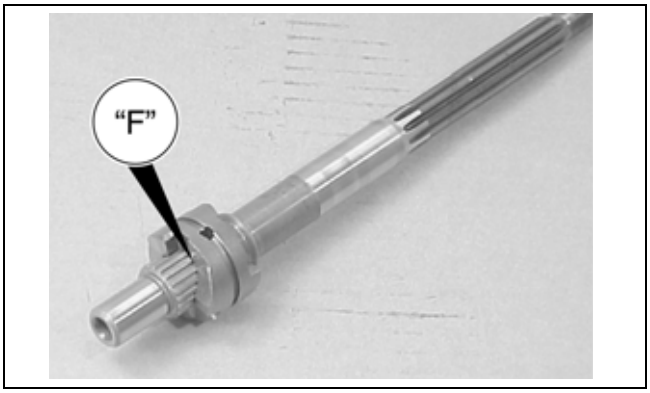
1. *Shift rod assembly*
2. *Stepped face*
3. *Guide stopper*

005927

Propeller Shaft

IMPORTANT: Before installing propeller shaft parts, check driveshaft thrust play. Refer to **SHIMMING ADJUSTMENTS** on p. 214.

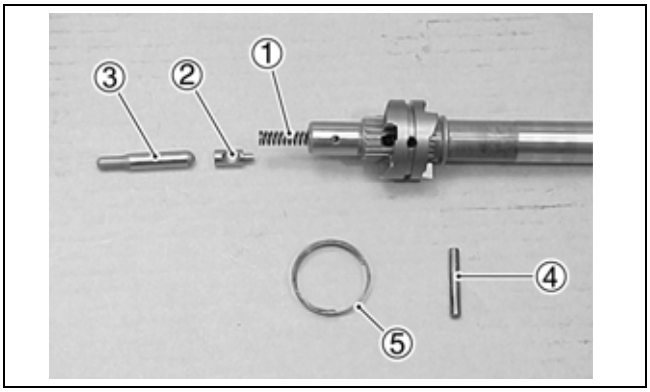
Install the clutch dog shifter with “F” mark toward forward gear.



005928

Insert the return spring, push pin, and push rod into propeller shaft. Depress the push rod and slide the dog pin into both clutch dog and push pin.

Install clutch dog spring, ensuring that it fits snugly into groove on shifter.



005929

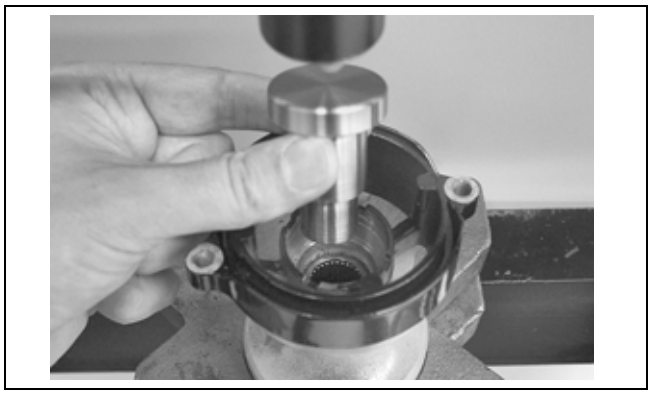
1. *Return spring*
2. *Push pin*
3. *Push rod*
4. *Dog pin*
5. *Spring*

Propeller Shaft Bearing Housing

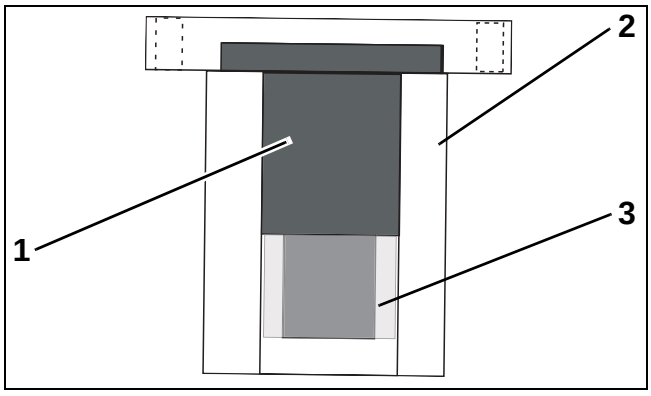
IMPORTANT: Check and adjust shimming **before** installing seals and o-rings in bearing housing. Refer to **SHIMMING ADJUSTMENTS** on p. 214.

Propeller Shaft Bearing

Apply *HPF XR* gearcase lubricant to the bearing. Using Bearing Installation Tool, P/N 5034774, with lettered side of bearing facing tool, carefully press bearing into housing. Bearing is properly installed when tool flange seats against housing.



002513



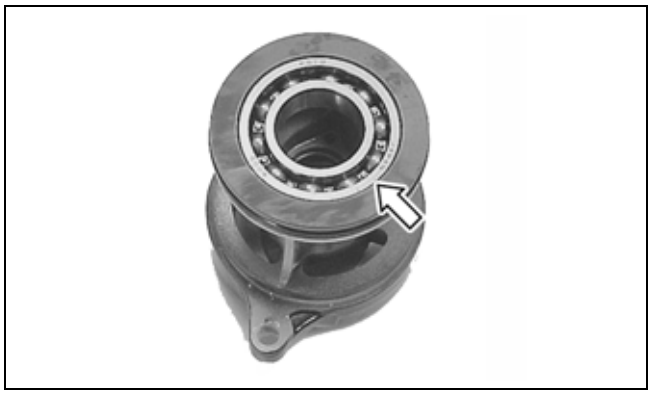
1. *Bearing installation tool, P/N 5034774*
2. *Propeller shaft bearing housing*
3. *Propeller shaft bearing*

002512

Reverse Gear Bearing

Apply *HPF XR* gearcase lubricant to the bearings.

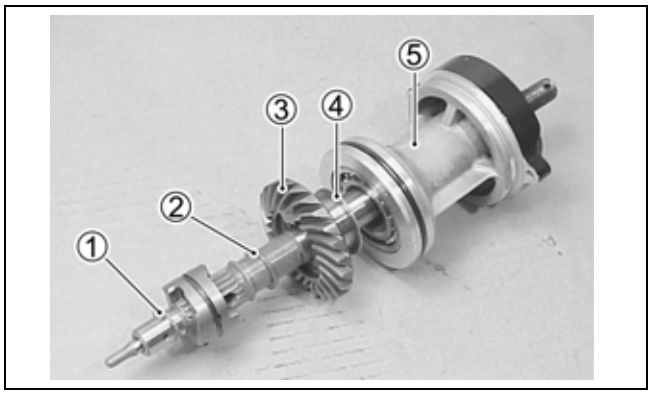
Using suitable bearing installation tool obtained locally, press the bearing against outer race until fully seated in the housing.



Reverse Gear Bearing 005936

Assemble the propeller shaft in the following sequence:

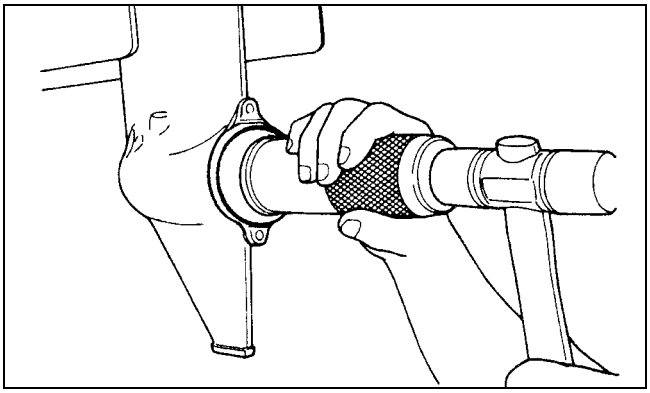
- Forward thrust washer
- Reverse thrust washer
- Reverse gear
- Reverse gear back-up shim
- Propeller shaft housing



1. *Forward thrust washer* 005930
2. *Reverse thrust washer*
3. *Reverse gear*
4. *Reverse gear back-up shim*
5. *Propeller shaft housing*

IMPORTANT: Before installing the propeller shaft and bearing housing assembly, bring shift cam to the forward position by moving shift rod up.

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 89 in. lbs. (10 N·m).

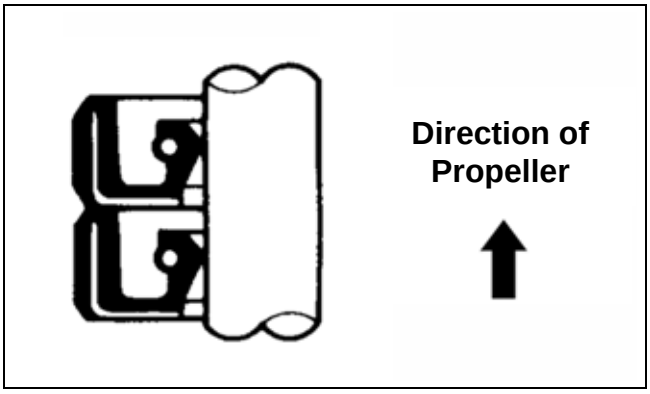
Check and adjust backlash. Refer to **SHIMMING ADJUSTMENTS** on p. 214.

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, P/N 326545 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

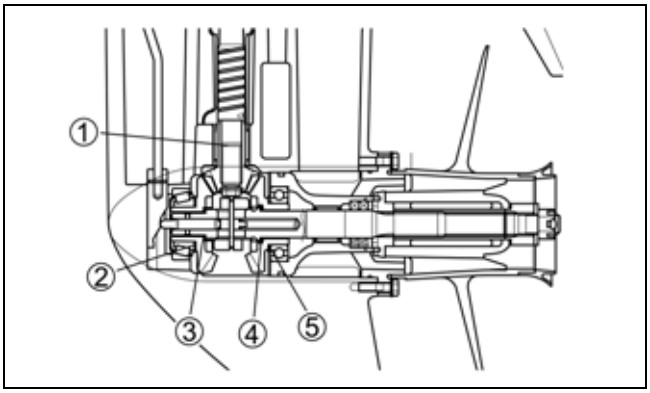
Apply *Triple-Guard* grease to a new bearing housing O-ring. Install O-ring in groove of housing.

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	1.7, 1.8, 1.9, 2.0, 2.1, 2.2	2.0
2	Forward gear back up shim	0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5	1.2
3	Forward gear thrust washer	2.0	2.0
4	Reverse gear thrust washer	1.6, 1.8, 2.0, 2.2, 2.4, 2.6	2.0
5	Reverse gear back up shim	0.2, 0.5, 0.8, 1.0	1.5

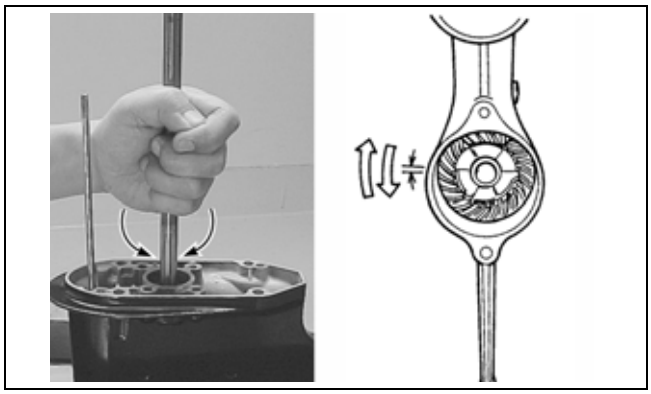
005933

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.



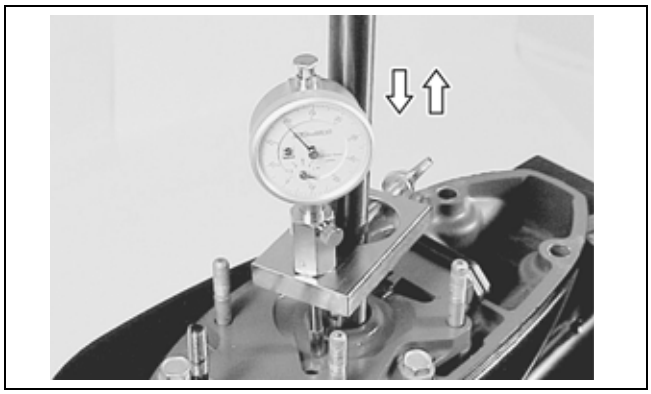
004404

Driveshaft Thrust Play

Connect a dial indicator to driveshaft as shown.

To check driveshaft thrust play, push forward gear inward. Slowly push driveshaft completely downward. Hold shaft in and set dial gauge pointer to zero. Slowly pull upward to read the maximum thrust play:

- 0.016 to 0.023 in. (0.4 to 0.6 mm)



005934

If thrust play is too large, thickness of forward gear back up shim must be increased.

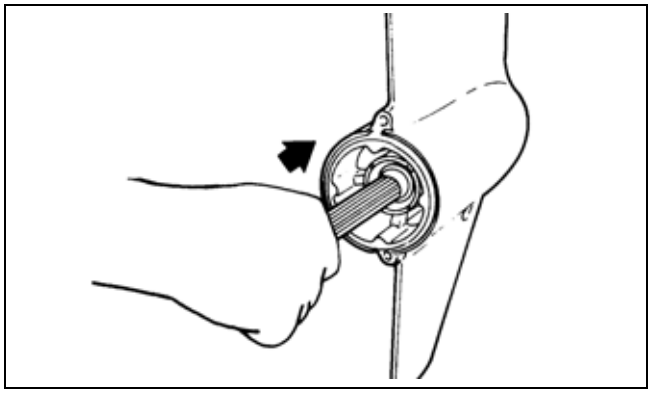
If thrust play is too small, back up shim thickness must be decreased.

Gear Tooth Contact Pattern

Apply a light coat of Prussian Blue on the convex surface of forward gear.

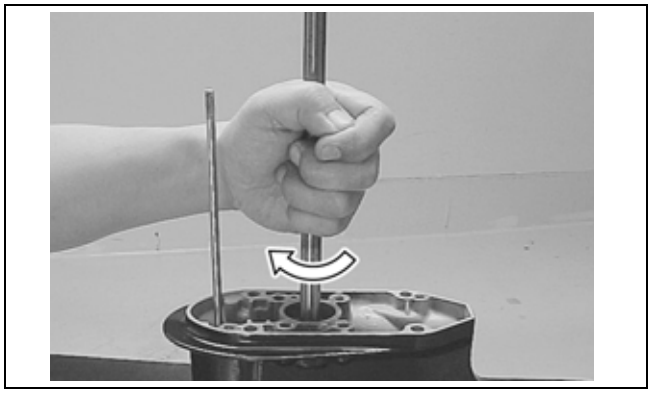
Install propeller shaft and housing assembly (minus reverse gear and internal components).

Push propeller shaft inward and hold in position.



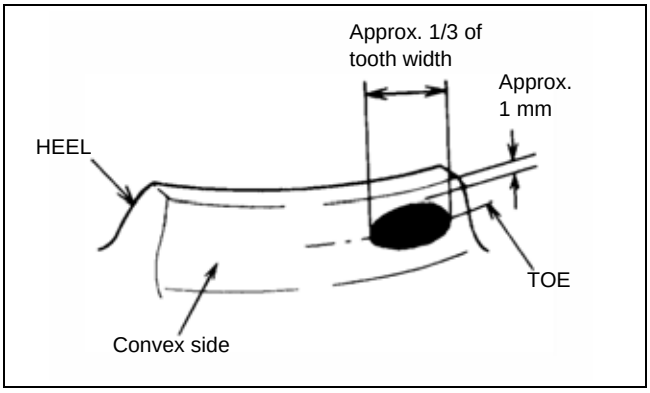
005935

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 driveshaft thrust play if shimming has been adjusted.

Pinion Gear/Reverse Gear

Recheck driveshaft thrust play against forward gear. Note the measurement (A).

Apply outward pressure on the propeller shaft.

Check the amount of driveshaft thrust play against the reverse gear. Not the measurement (B).

Measurement (B) should be equal to measurement (A).

If (B) is less than (A), reduce reverse gear back-up shim thickness.

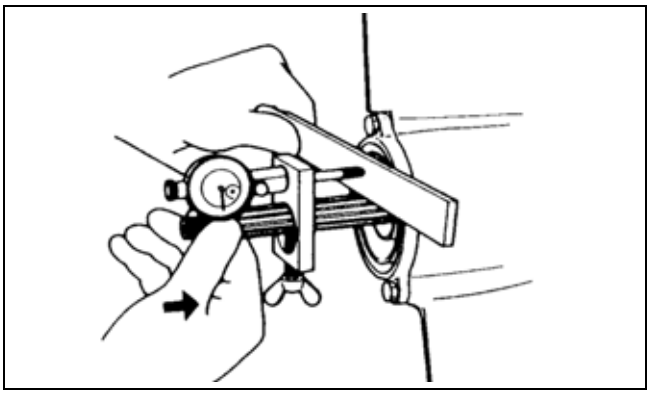
Propeller Shaft Thrust Play

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.

MANUAL STARTER

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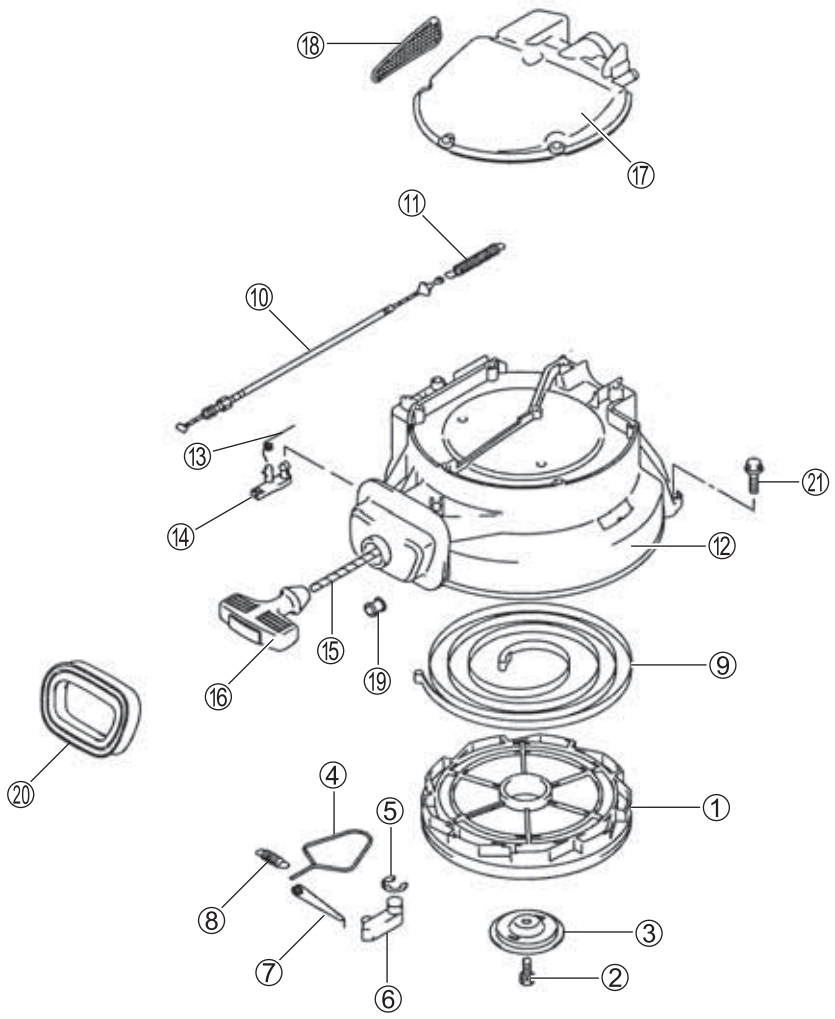
SERVICE CHART



① Reel
② Bolt
③ Friction plate
④ Friction spring
⑤ E-ring
⑥ Ratchet (Pawl)
⑦ Ratchet guide
⑧ Return spring
⑨ Recoil spring
⑩ NSI cable
⑪ Spring
⑫ Recoil case
⑬ Spring
⑭ Reel stopper
⑮ Rope
⑯ Grip
⑰ Upper cover
⑱ Flame arrester
⑲ Rope guide
⑳ Seal
㉑ Bolt

005615

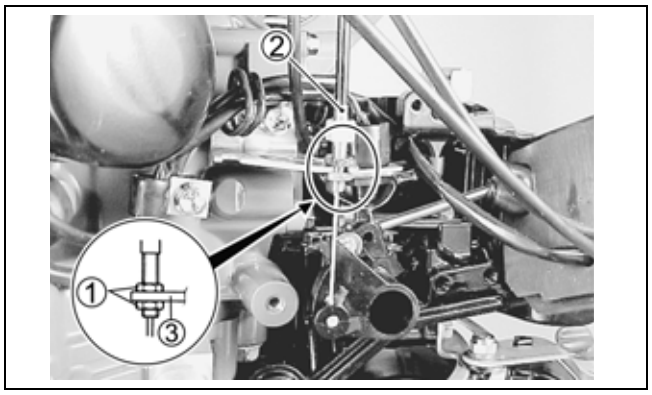
REMOVAL

⚠ WARNING ⚠

Avoid accidental starting of engine while servicing, twist and remove all spark plug leads.

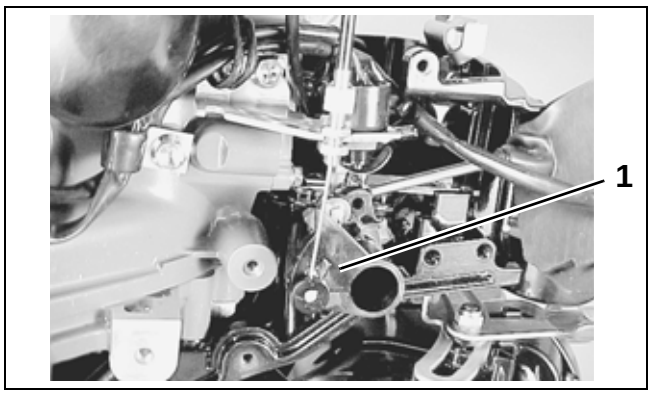
Wear safety glasses while disassembling and assembling manual starters to avoid personal injury caused by rewind spring tension.

Loosen lock nuts and remove NSI cable from cable bracket.



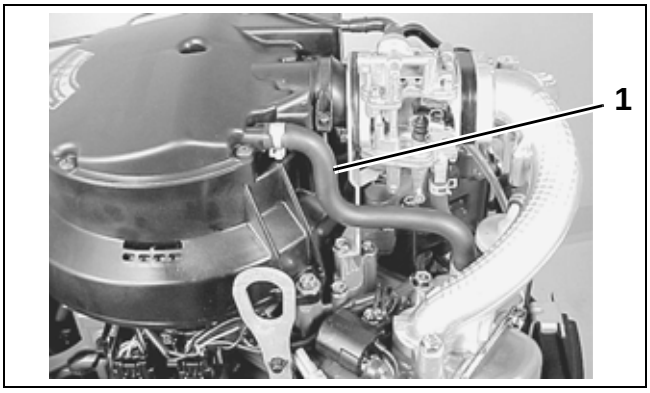
1. Lock nut 005616
2. NSI cable
3. Cable bracket

Remove NSI cable from clutch shaft plate.



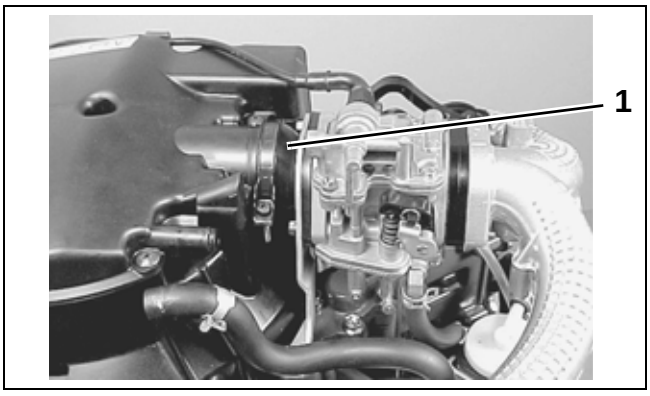
1. Clutch shaft plate 005617

Loosen the clamp securing breather hose, then remove breather hose from starter case.



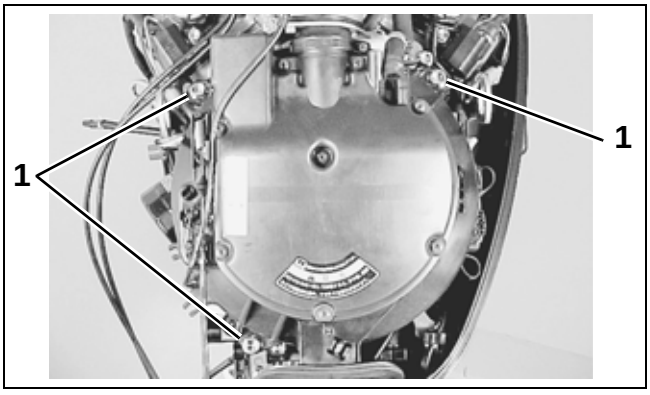
1. Breather hose 005618

Loosen clamp securing outlet tube to starter case.



1. Outlet tube 005619

Remove three screws securing recoil starter. Remove starter.

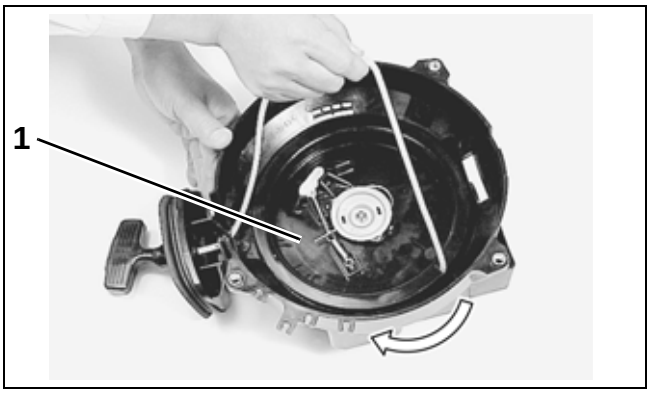


1. Starter mount screws 005620

10

DISASSEMBLY

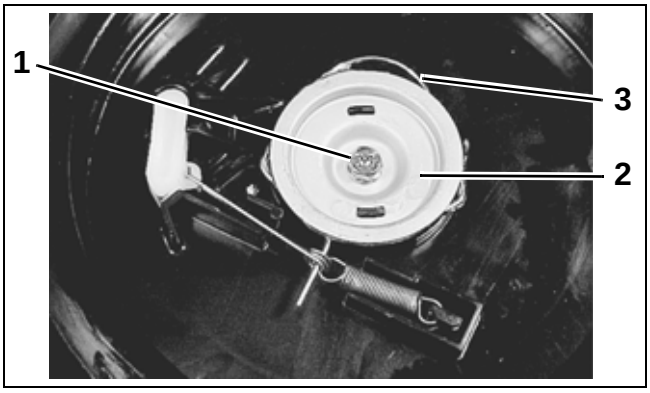
Turn reel clockwise to release the tension in the recoil spring.



1. Reel 005621

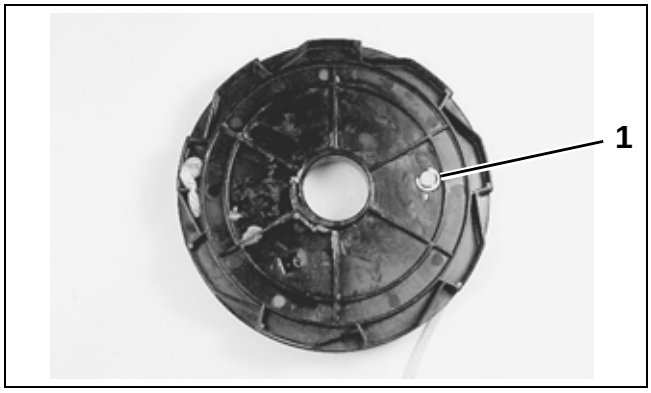
Remove screw and friction plate, with friction spring.

Remove the reel.

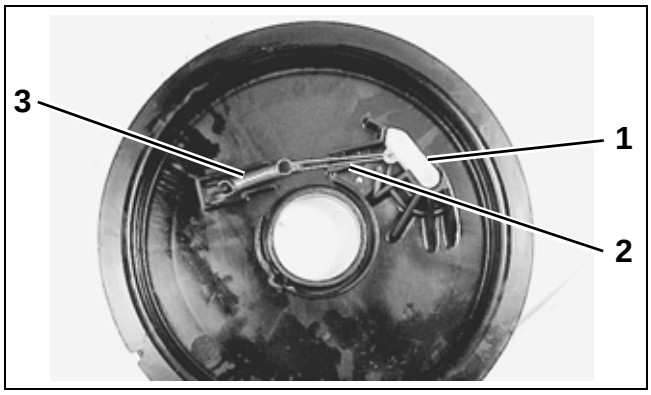


1. Screw
2. Friction plate
3. Spring
005622

Remove the e-ring, ratchet (pawl), ratchet guide, and return spring.



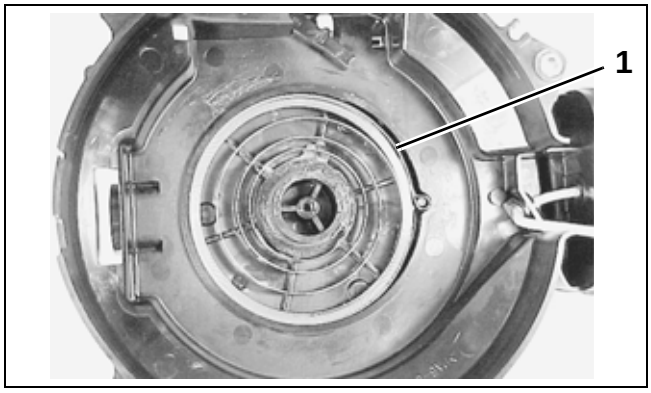
1. E-ring 005623



1. Ratchet (pawl)
2. Ratchet guide
3. Return spring
005624

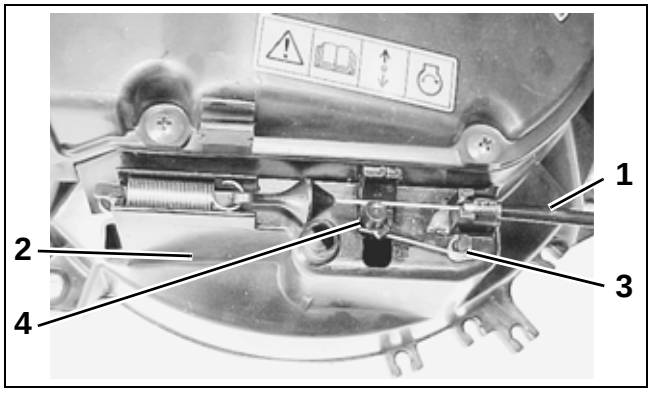
Remove the recoil spring.

IMPORTANT: Do not remove the recoil spring unless replacement is necessary. It should be visually inspected in its assembled position.



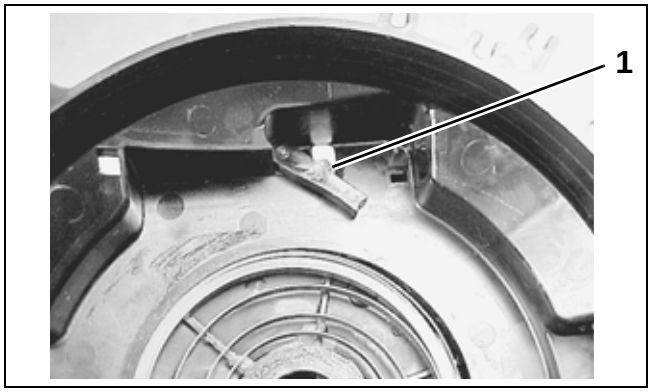
1. Recoil spring 005625

Remove NSI cable from the recoil case. Remove the reel stopper spring and reel stopper.



1. NSI cable
2. Recoil case
3. Stopper spring
4. Reel stopper

005626



1. Reel stopper

005627

INSPECTION

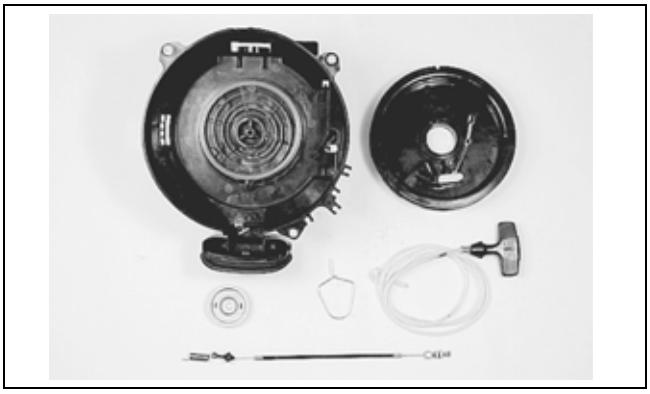
IMPORTANT: If any part is worn excessively, cracked, defective, or damaged, it must be replaced.

Inspect the ratchet (pawl), stopper arm, and all springs.

Inspect the reel and recoil case.

Inspect the recoil rope.

Inspect the recoil spring.

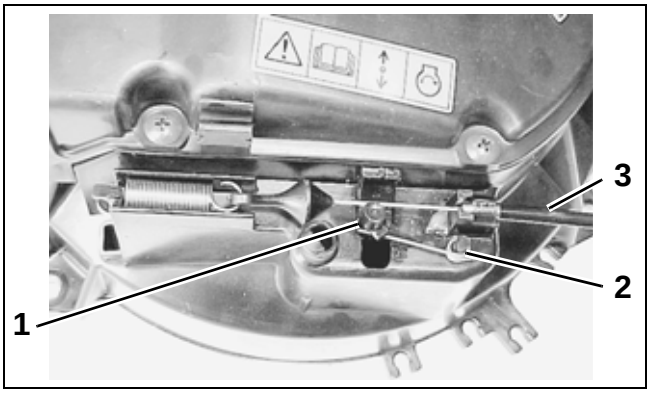


005628

ASSEMBLY

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

Install reel stopper, stopper spring, and NSI cable.

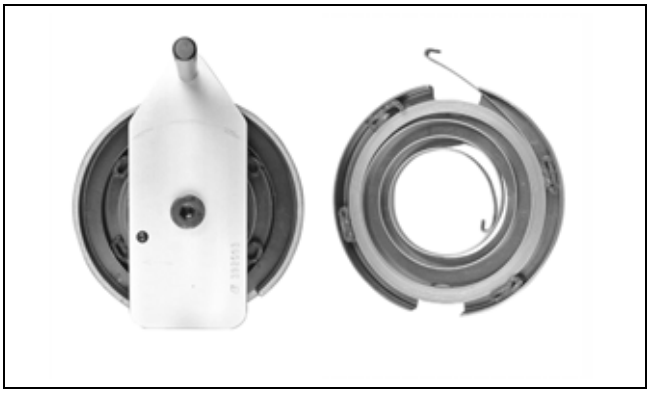


1. *Reel stopper*
2. *Stopper spring*
3. *NSI cable*

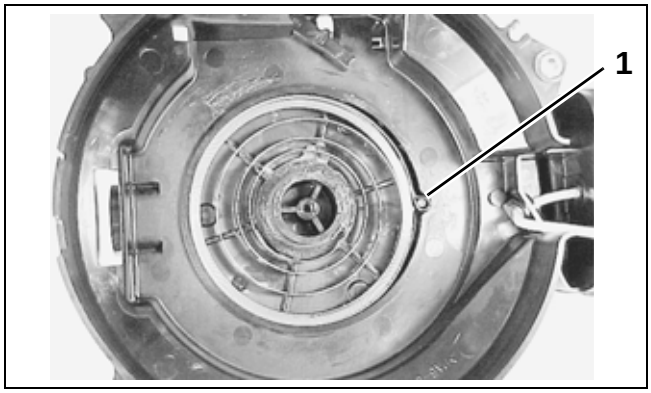
005626

Rewind spring using Starter Spring Winder, P/N 392093. 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 on boss in recoil case.



004643



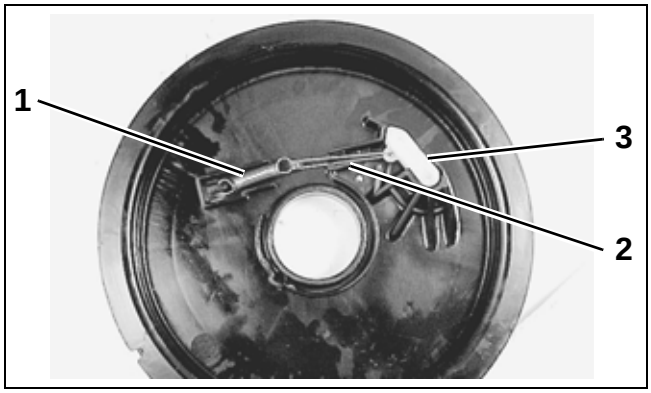
1. *Recoil spring boss*

005625

⚠ WARNING ⚠

Because of the coiled tension in the recoil spring, wear safety glasses and hand protection when winding or unwinding this component.

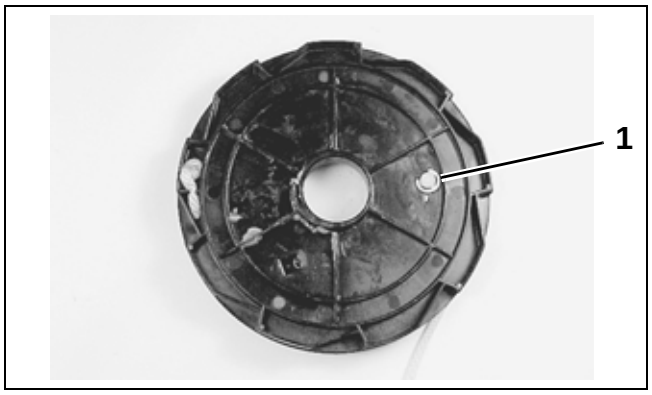
Install return spring, ratchet guide, and ratchet.



1. *Return spring*
2. *Ratchet guide*
3. *Ratchet (pawl)*

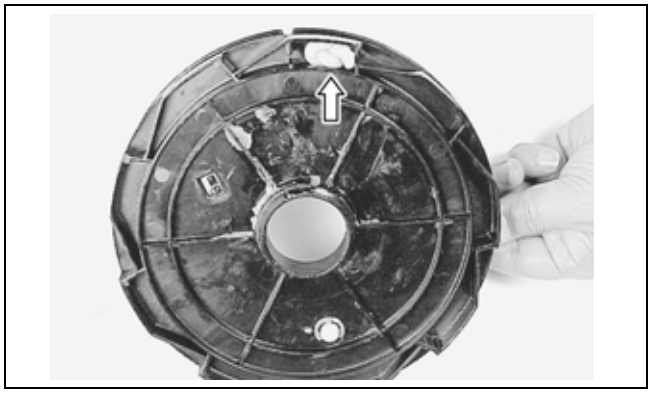
005624

Secure the ratchet with e-ring.



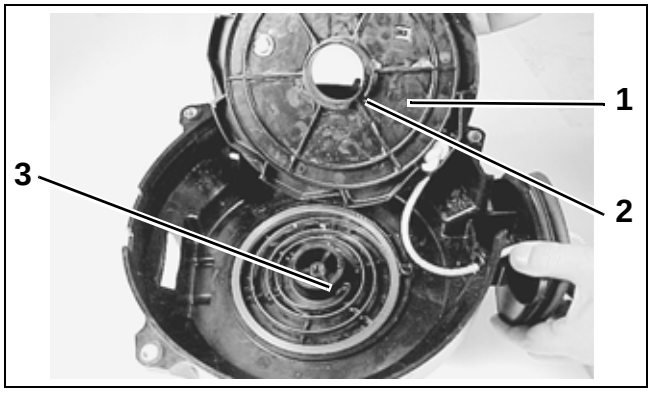
1. E-ring 005623

Install the recoil rope.



005629

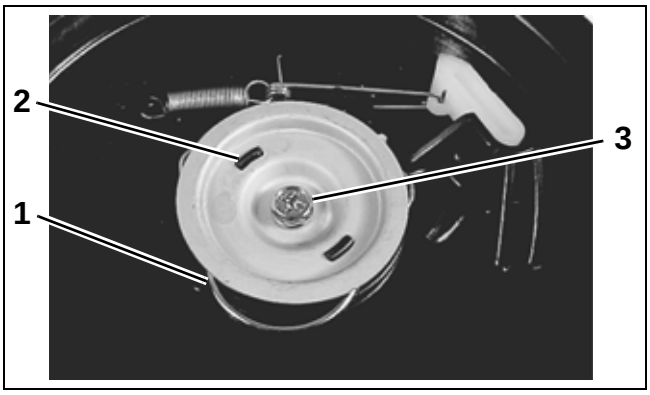
Install the reel. Align groove in reel with bent end of spring.



1. Reel 005630
2. Reel groove
3. Spring end

Install the friction plate (with spring). Twist friction plate slightly to align holes in plate with square lugs on center boss.

Apply *Nut Lock* to screw and tighten securely.



1. Friction spring 005631
2. Square lug
3. Screw

After assembly, guide rope into notch in reel and rotate reel approximately five turns counterclockwise until the spring is tensioned.

005632

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.

NEUTRAL START INTERLOCK (NSI)

Installation/Adjustment

⚠ WARNING ⚠

If the NSI cable is removed or not adjusted properly, there is a high risk of being thrown overboard if motor starts in gear.

Shift into NEUTRAL position.

Install the NSI cable in the recoil starter, the clutch shaft plate, and the cable bracket.

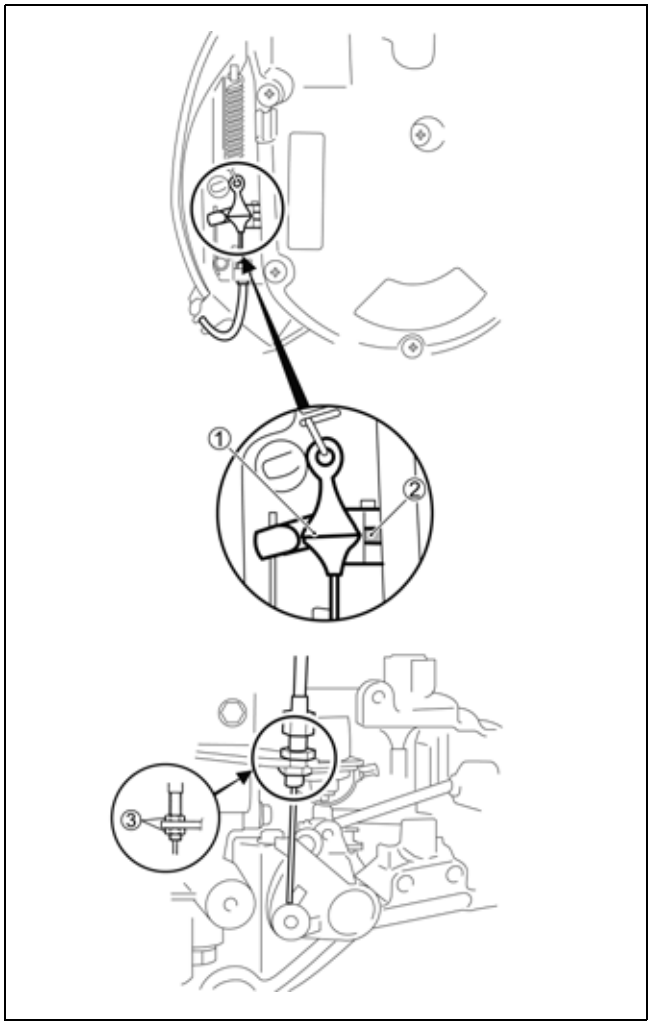
Loosen the adjustment nut.

Turn the adjustment nut to align the center of the cam with the match mark on the recoil starter case.

Pull the recoil starter and make sure that the starter does not work when the shift lever is in FORWARD or REVERSE position.

Tighten the adjustment nut.

Apply *Triple-Guard* grease to the inner cable, cable end, and cam.



005633

WIRE/HOSE ROUTING

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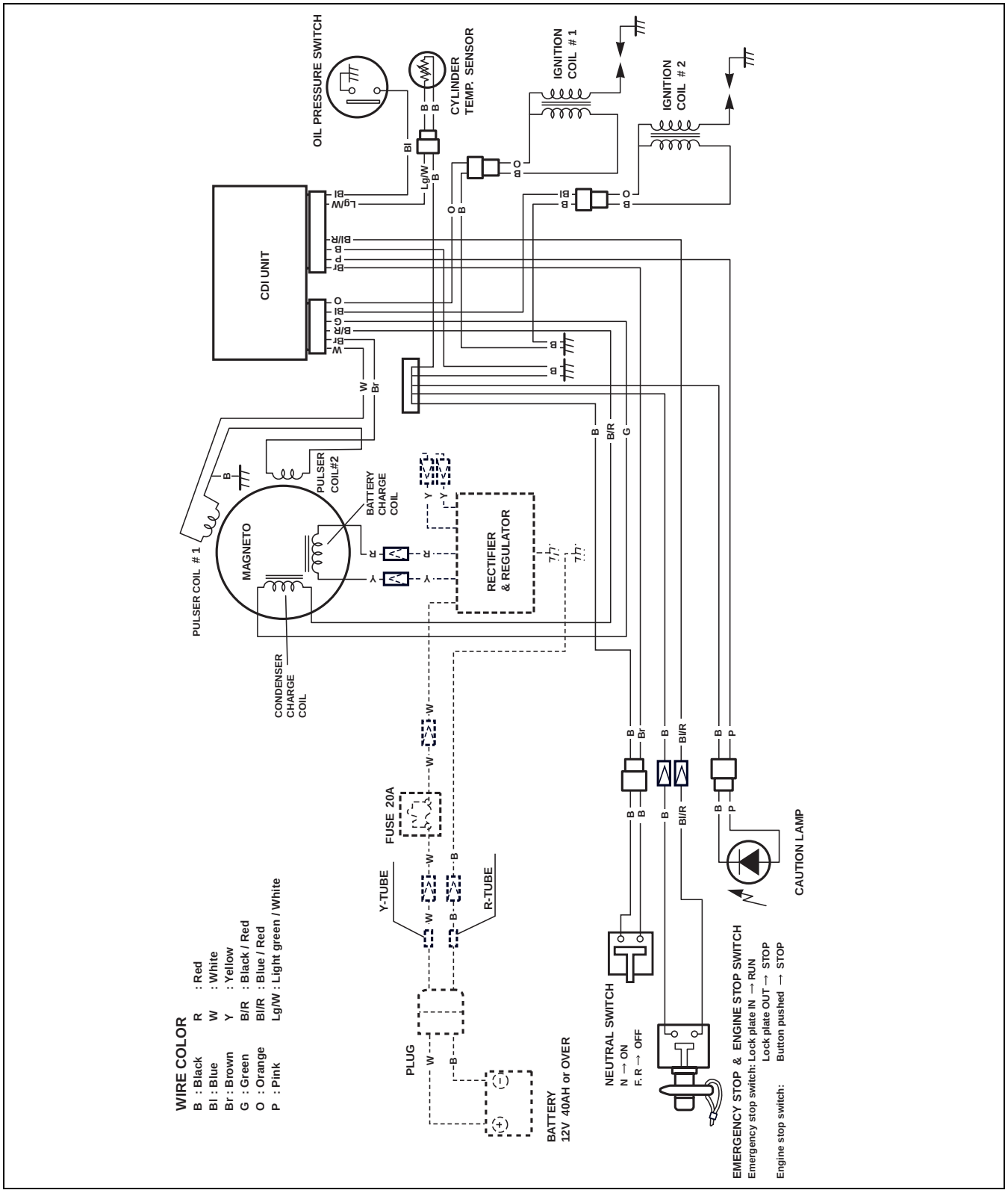
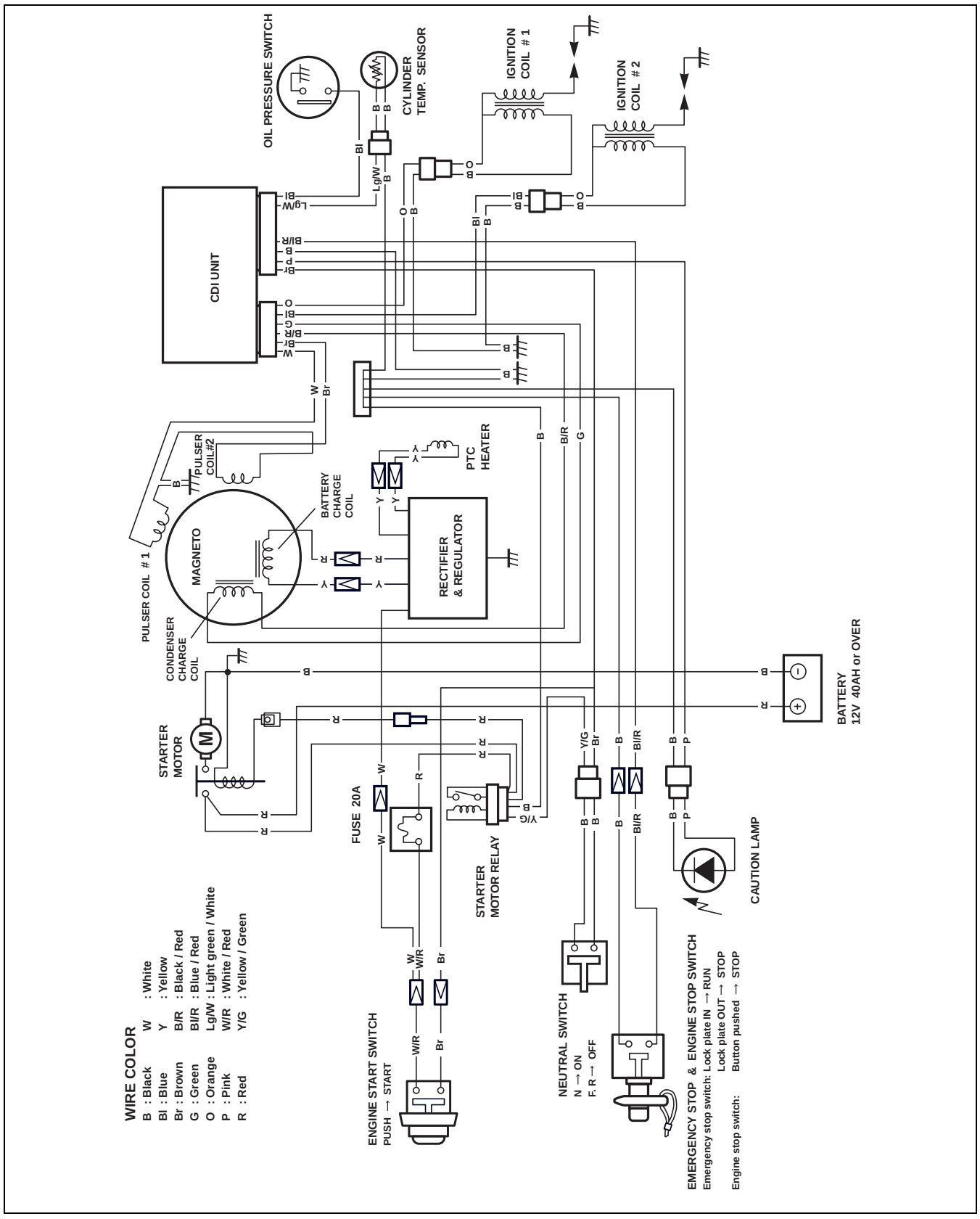
WIRING DIAGRAMS

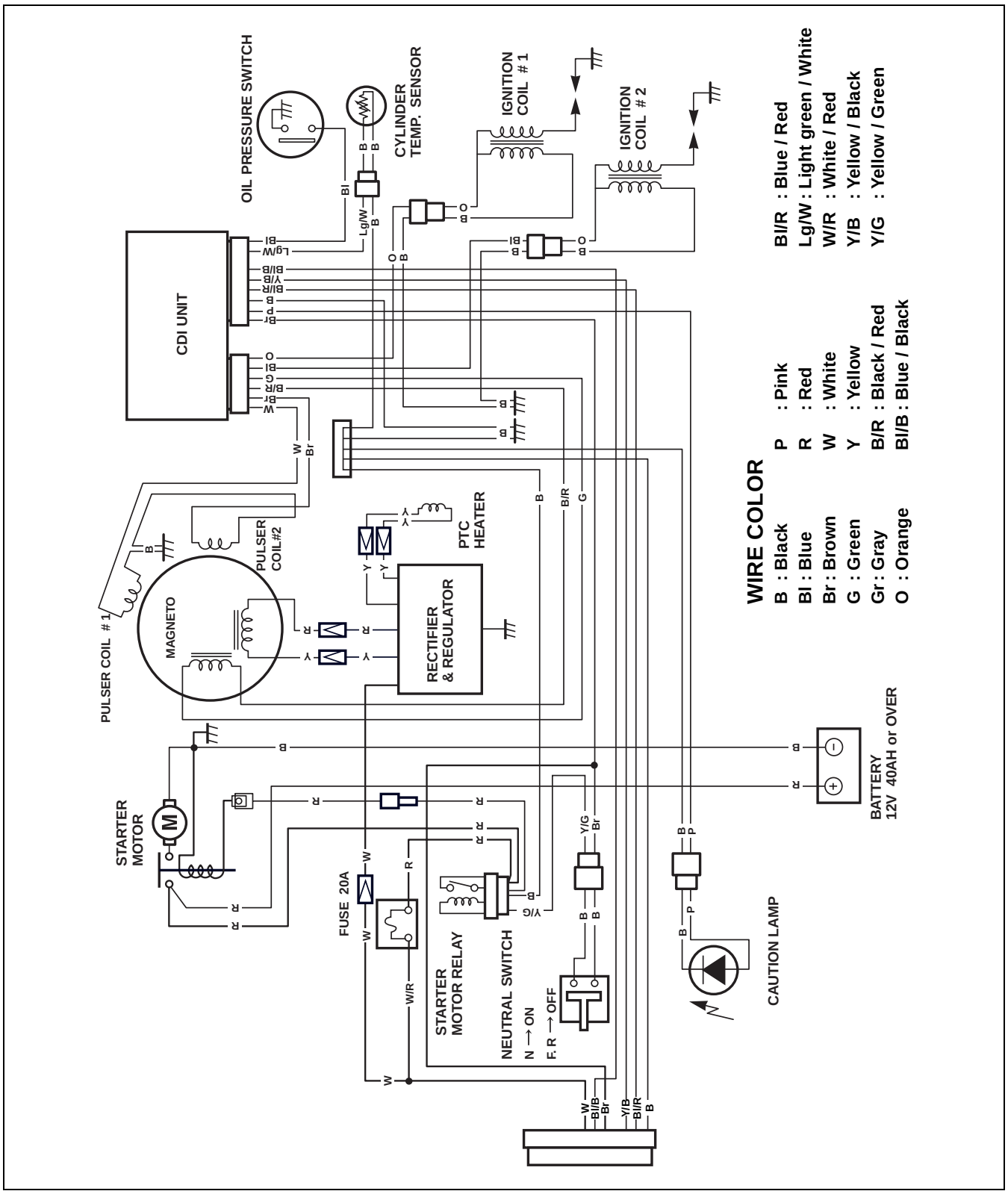
Rope Start Models



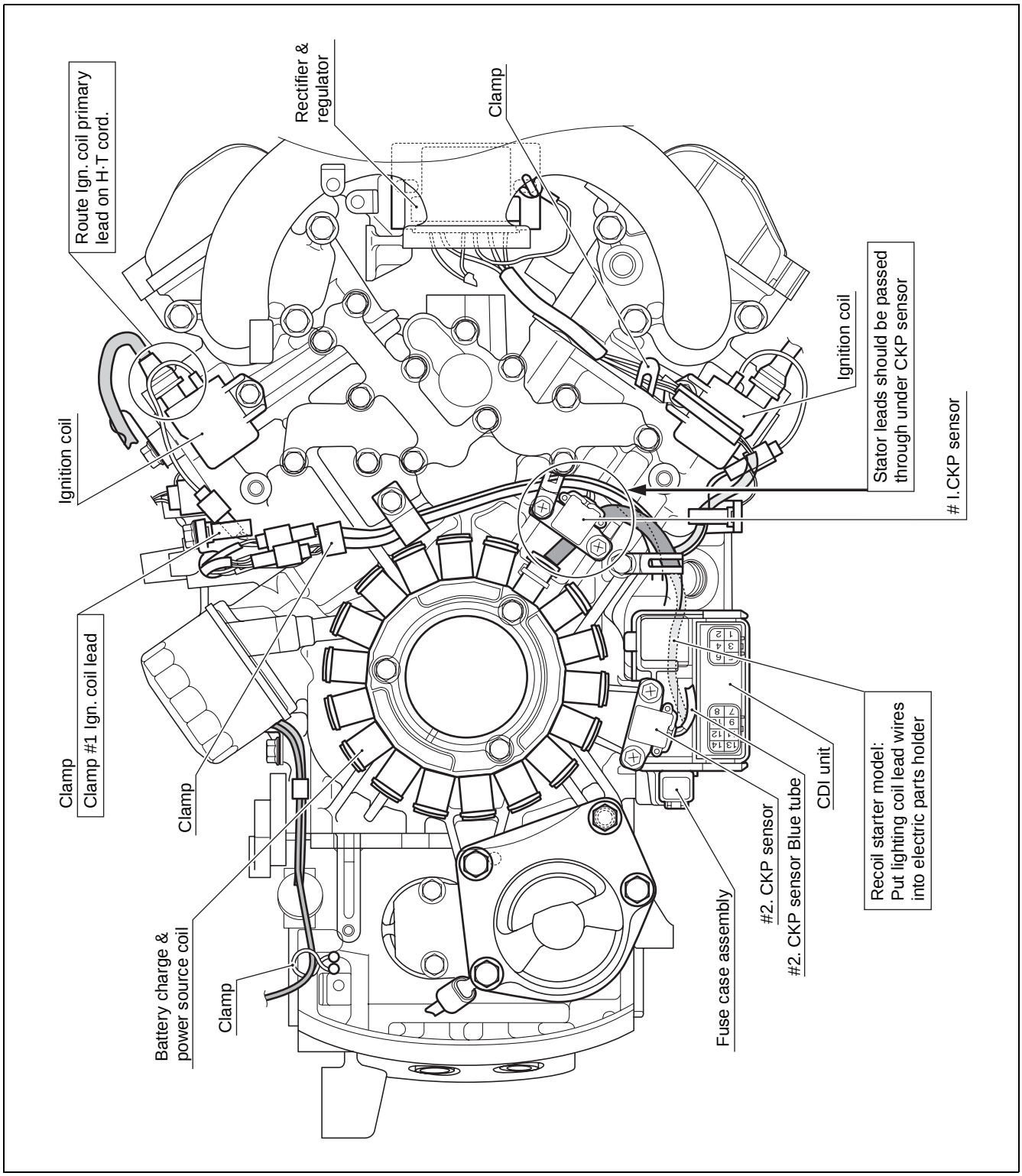
Tiller Electric Models

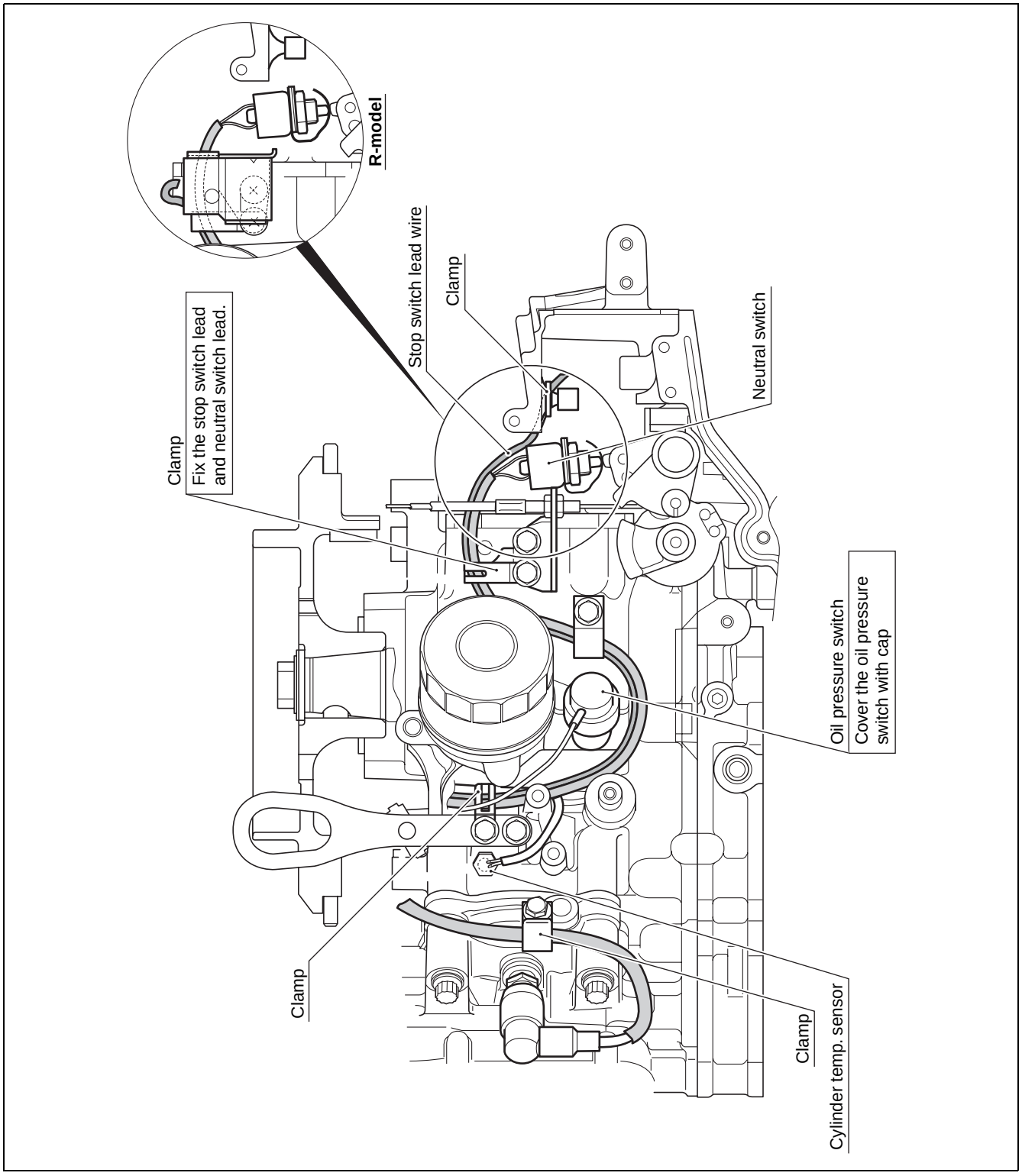


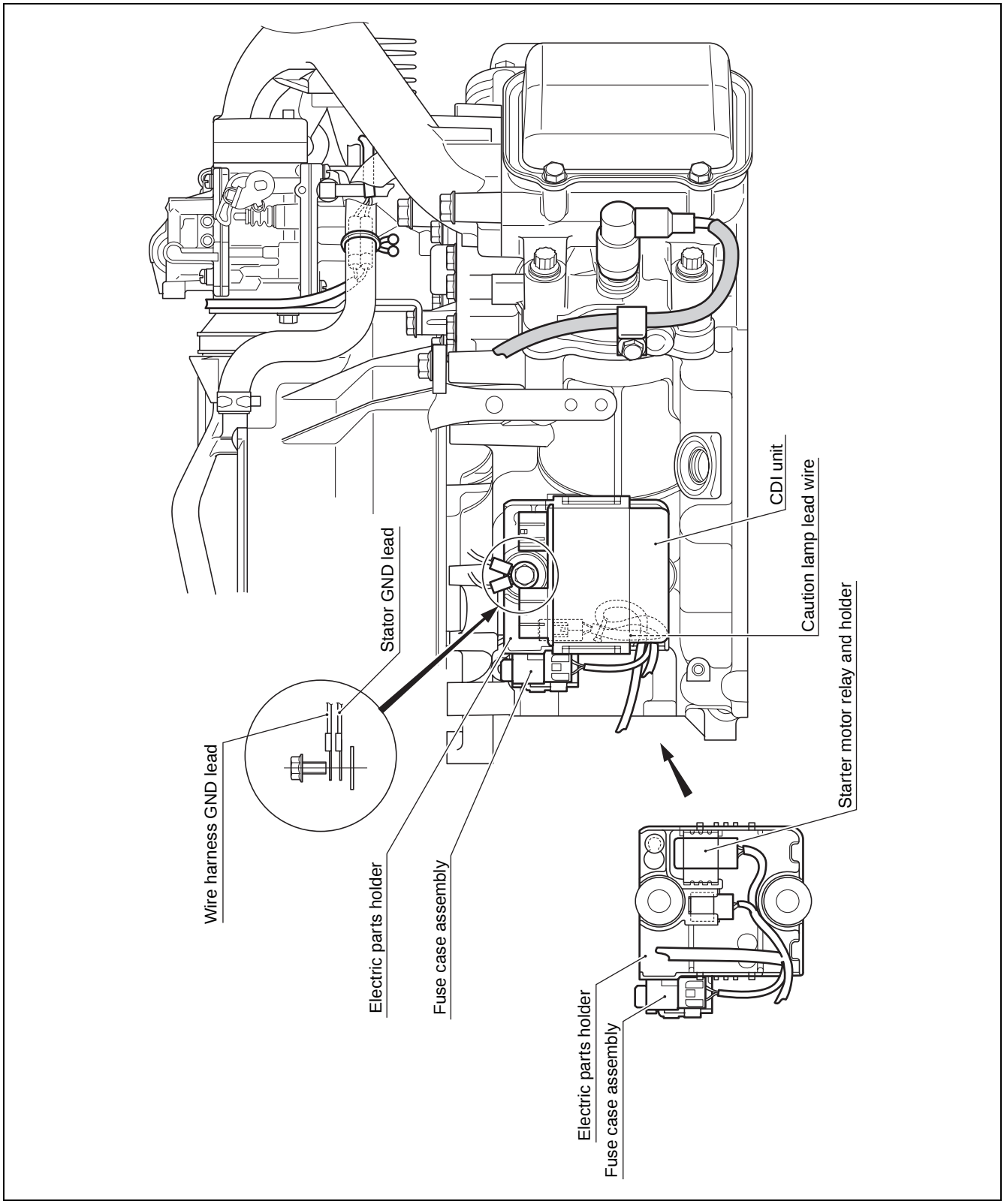
Remote Electric Models

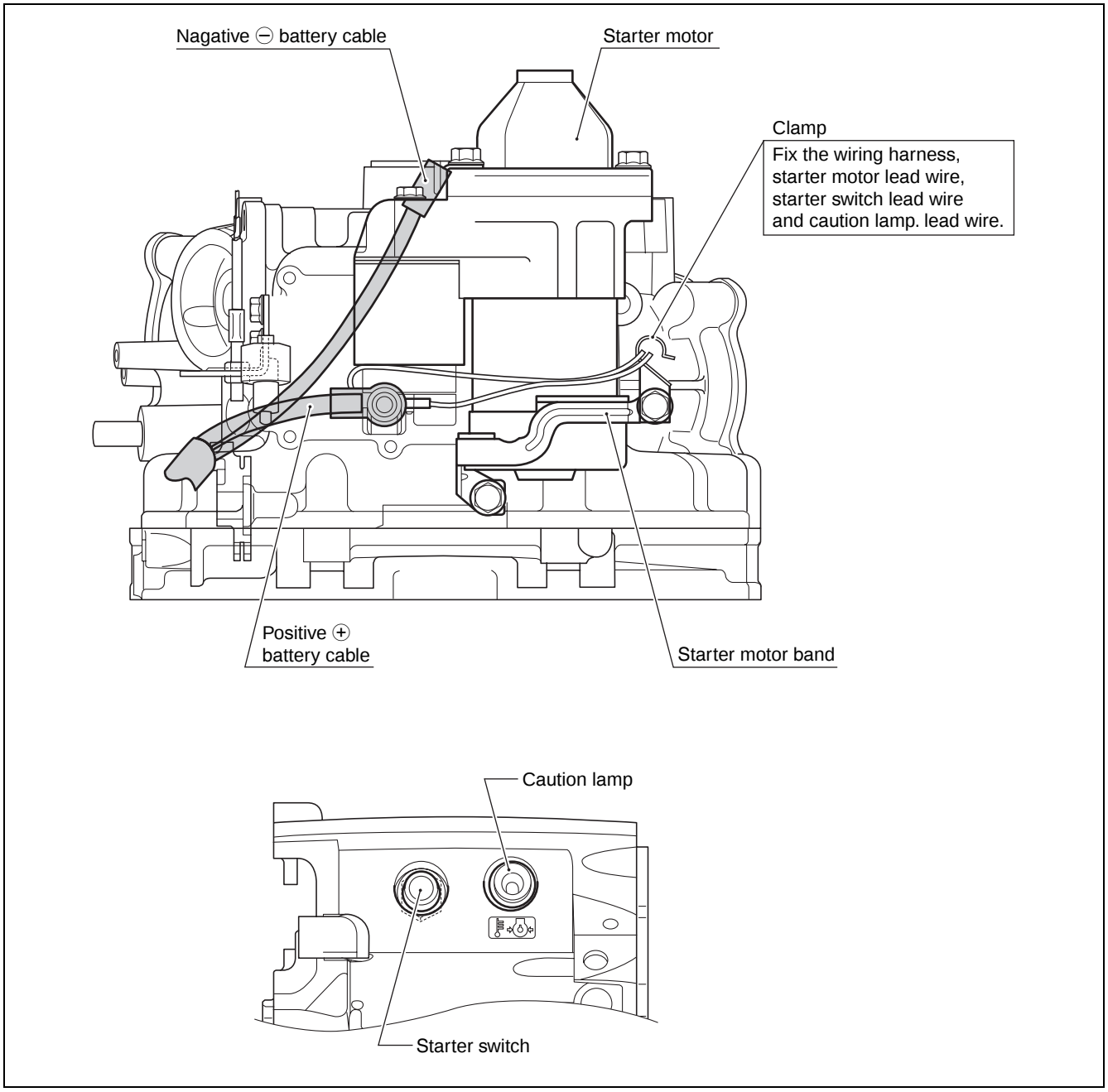


WIRE ROUTING




R-model
Stop switch lead wire
Clamp
Neutral switch
Clamp
Fix the stop switch lead and neutral switch lead.
Oil pressure switch
Cover the oil pressure switch with cap
Clamp
Clamp
Cylinder temp. sensor


Wire harness GND lead
Stator GND lead
Electric parts holder
Fuse case assembly
CDI unit
Caution lamp lead wire
Starter motor relay and holder
Electric parts holder
Fuse case assembly


Nagative ⊖ battery cable
Starter motor
Clamp
Fix the wiring harness, starter motor lead wire, starter switch lead wire and caution lamp. lead wire.
Positive ⊕ battery cable
Starter motor band
Caution lamp
Starter switch

FUEL/WATER HOSE ROUTING

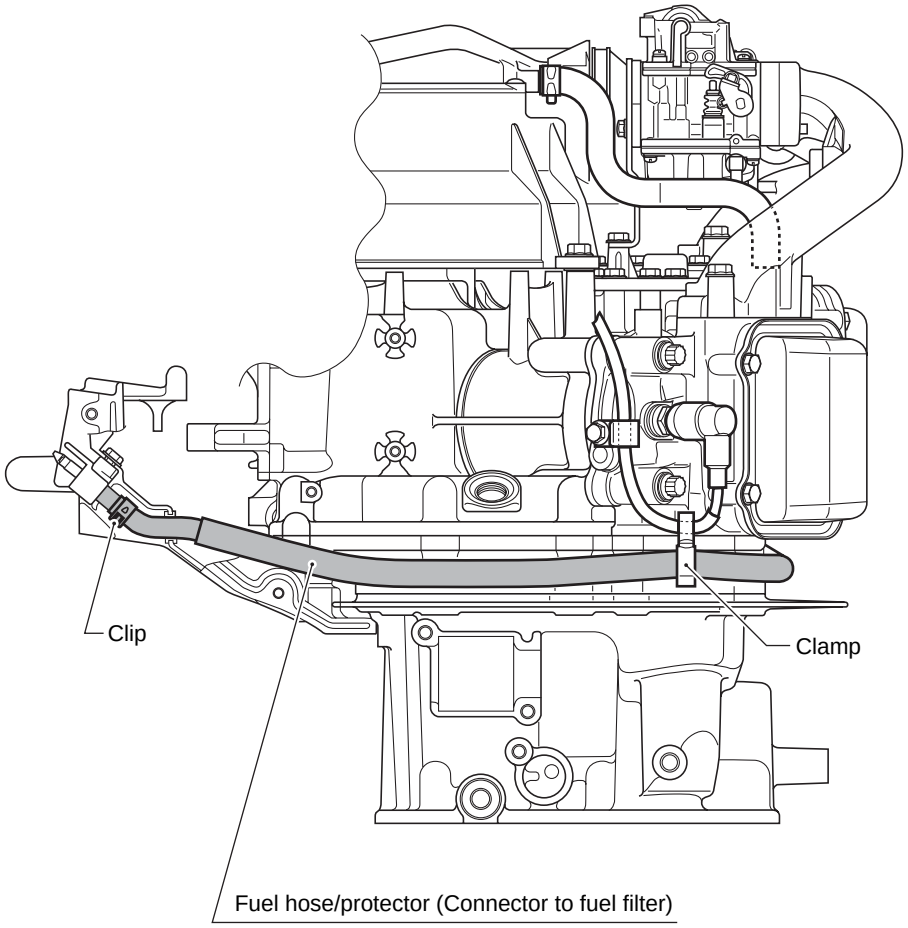
Do not over-bend (kink) or twist hoses when installing.

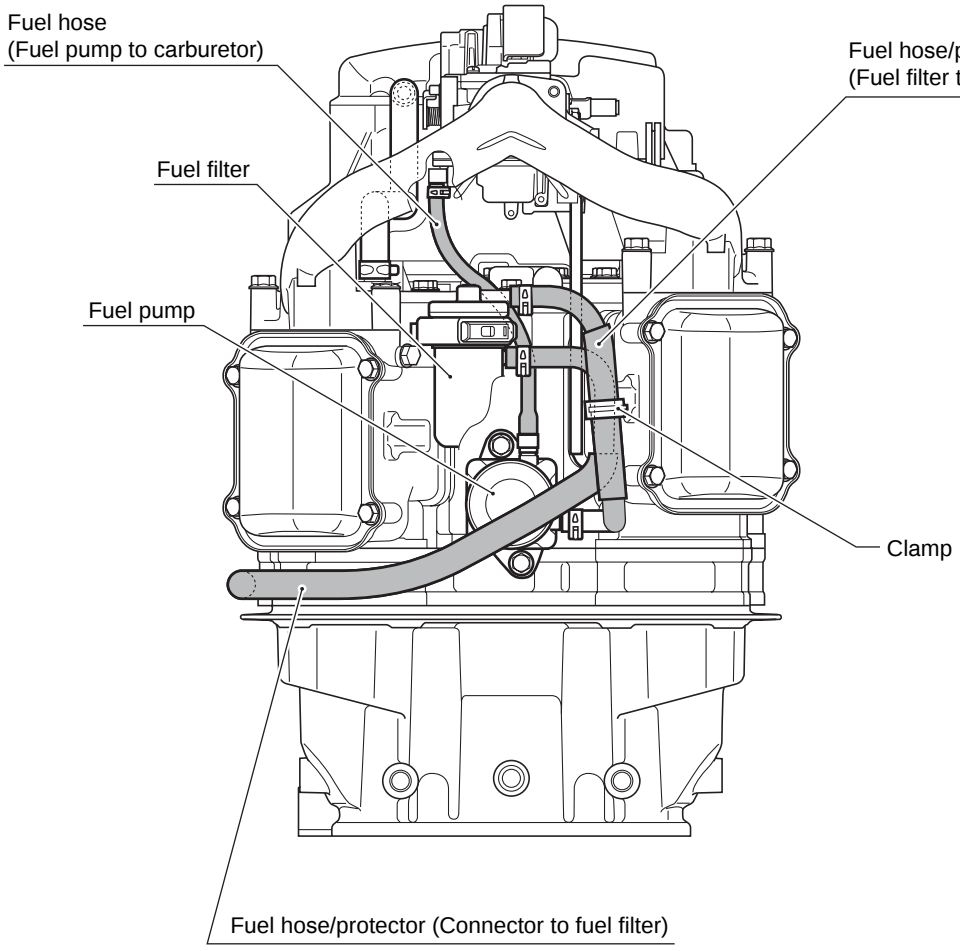
When installing hose clips, position tabs to avoid contact with other parts.

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.




Fuel hose
(Fuel pump to carburetor)
Fuel hose/protector
(Fuel filter to fuel pump)
Fuel filter
Fuel pump
Clamp
Fuel hose/protector (Connector to fuel filter)

SAFETY

TABLE OF CONTENTS

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO USE THEM

⚠ WARNING ⚠

This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you.

It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

- Product user is informed; and
- Products are safe and reliable.

It is up to you, the people who...

- Rig boats;
- Fix machinery; and
- Maintain equipment

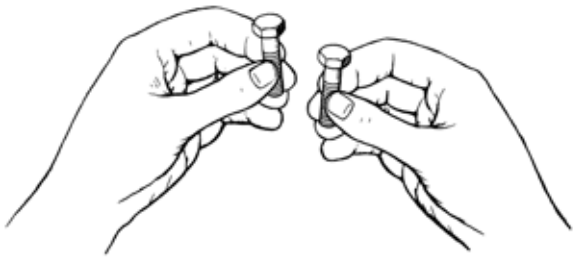
...to keep the products safe **and** reliable.

This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

First!

A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS



“They look the same, but are they the same?”

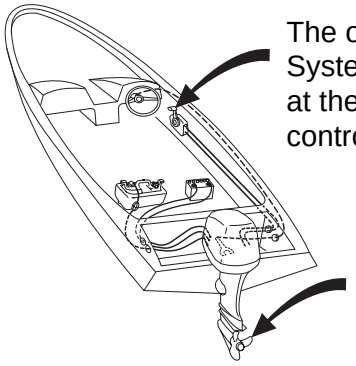
- Same size?
- Same strength?
- Same material?
- Same type?

Don’t substitute unless **you know** they are the **same** in **all** characteristics.

Second!

- Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.
- When the outboard is returned to the boat, use only the special nuts and bolts to hold remote steering, shift, and throttle cables to the outboard.

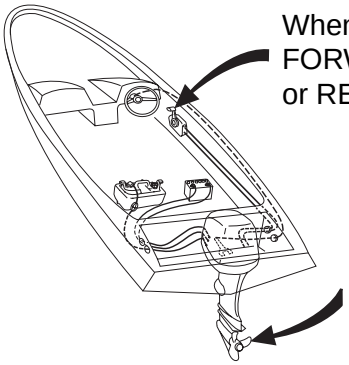
Outboard Shift Systems and Safety



The outboard Shift System starts here at the remote control lever...

...and ends here at the propeller.

What is most important?

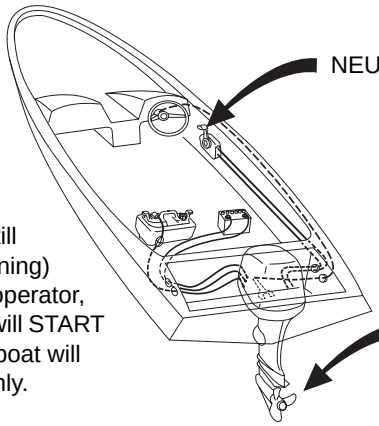


When control lever is in FORWARD, NEUTRAL or REVERSE...

...shift linkage must match control lever position.

What could happen?

IF...

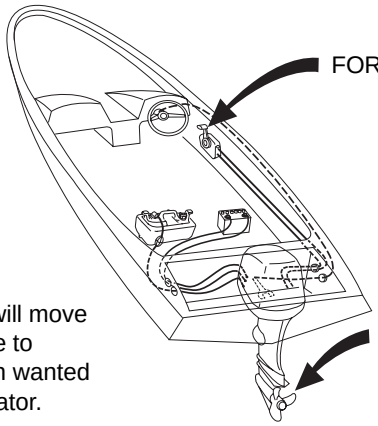


NEUTRAL

...propeller still powered (turning) unknown to operator, or outboard will START in gear, and boat will move suddenly.

FORWARD or REVERSE

IF...



FORWARD

...boat will move opposite to direction wanted by operator.

REVERSE

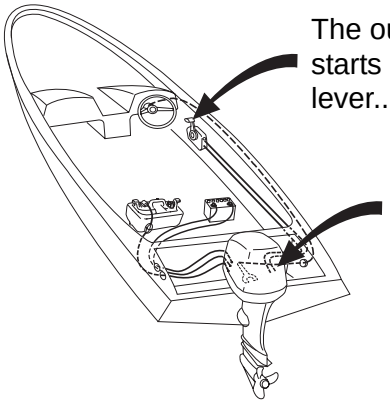
How can loss of shift control be minimized?

When rigging or after servicing

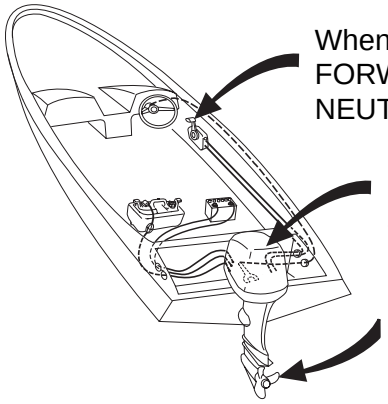
Read, **understand**, and **follow** manufacturer's **instructions**

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure propeller does just what the operator wants and nothing else.
- Do not shift gears on a stopped outboard. Adjustments can be lost and parts weakened.

Outboard Speed Control System and Safety



What is most important?



What could happen?

If Operator cannot slow down the outboard or shift into NEUTRAL gear (stop propeller), Operator could panic and lose control of boat.

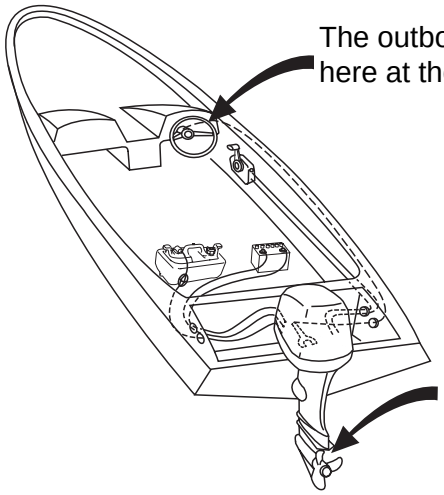
How can loss of speed control be minimized?

When rigging or after servicing

Read, **understand**, and **follow** manufacturer's **instructions**

- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else.
- Make sure full throttle can be obtained so Operator will not overload parts.

Outboard Steering Control System and Safety

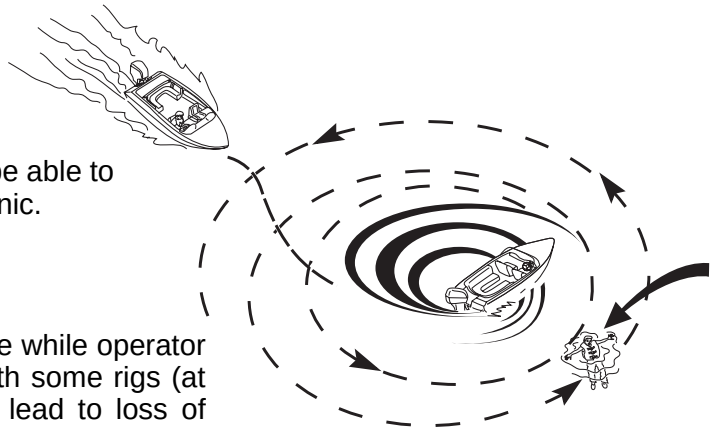


What is most important?

The steering system:
- Must not come apart;
- Must not jam; and
- Must not be sloppy or loose.

What could happen?

- If steering system comes apart, boat might turn suddenly and circle. Persons thrown into the water could be hit.



- If steering jams, operator may not be able to avoid obstacles. Operator could panic.

- If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high speed), loose steering could lead to loss of boat control.

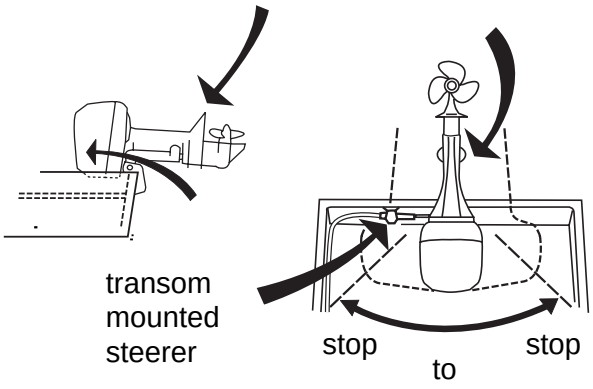
How can loss of steering control be minimized?

When rigging or after servicing

- Use a steering system recommended by the outboard manufacturer which meets Marine Industry Safety Standards (ABYC).
- **Read**, **understand**, and **follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Make adjustments carefully.
- Keep parts moving freely. Lubricate parts as shown in manual.
- Use the bolts, nuts and washers supplied with steering attachment kits—they are a special locking type that will not loosen, rust, or weaken.

Transom Mounted Steering Systems – Check to Uncover Possible Trouble!

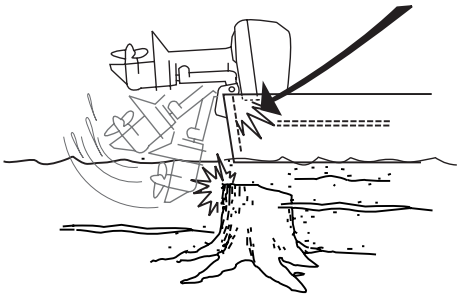
Tilt outboard into boat, then turn it.



During this procedure, steering parts:

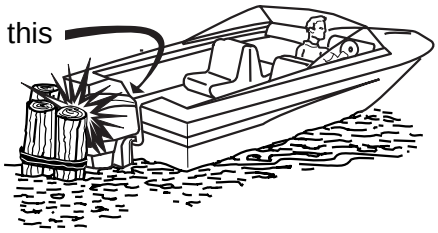
- Must not bind; and
- Must not touch other boat, outboard, or accessory parts in transom area.

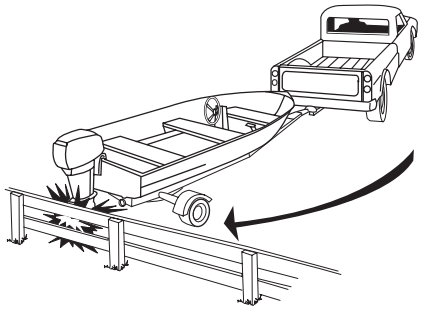
Why? A hard blow to the outboard's gearcase can result in damage to steering parts.



Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.

Check for damaged parts. Blows to the outboard like this



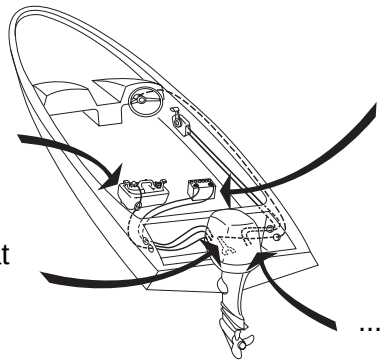


or this can put heavy loads on steering parts. Look for:

- Cracked parts, including steering parts, swivel brackets, and transom brackets;
- Bent parts; and
- Loose nuts and bolts.

Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Outboard Fuel, Electrical System, and Safety



The fuel system starts here at the fuel tank...

...and ends here at the fuel injector.

The electrical system begins here at the battery...

...and ends here on the powerhead.

What is most important?

- Fuel leakage must be eliminated.
- Stray electric sparks must be avoided.

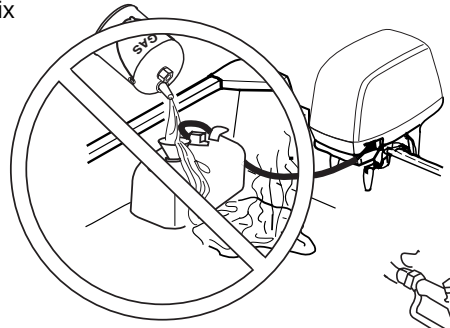
What could happen?

- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

- **Read**, **understand**, and **follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- **Do not** substitute fuel or electrical systems parts with other parts which may look the same. Some electrical parts, like starter motors, are of special design to prevent stray sparks outside their cases.
- Replace wires, sleeves, and boots which are cracked or torn or look in poor condition.

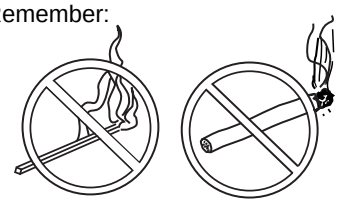
When mixing and refueling, always mix gas and oil outside...



Always fill the tank outside the boat

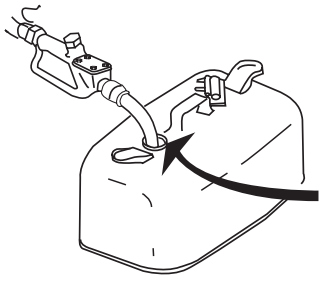
Fumes are hard to control. They collect and hide in the bottom of the boat.

Remember:



Do not use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.

If you use a funnel, it has to be metal to ground the spout to the tank.

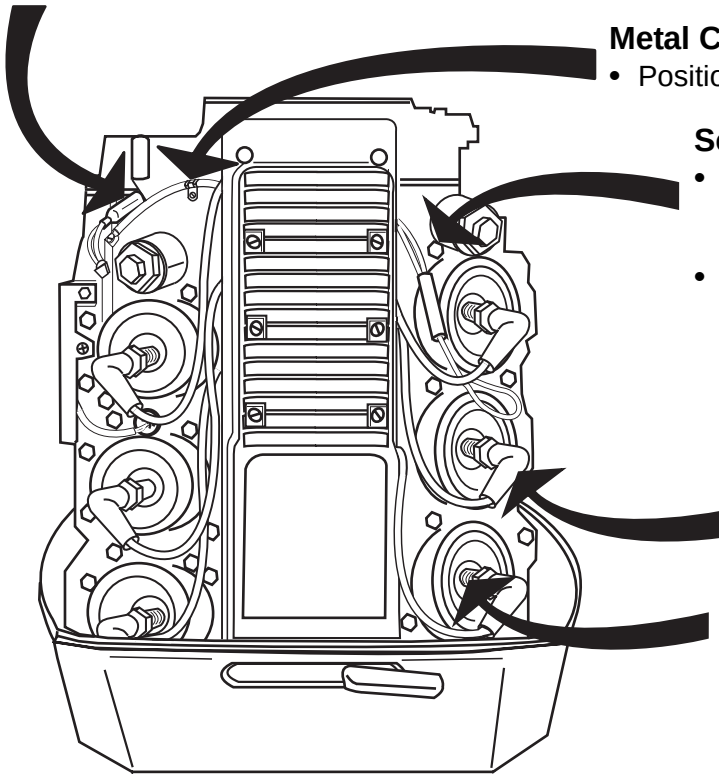


To avoid those static electric sparks, ground (touch) the spout against the tank.

If electrical parts are replaced or even removed from the outboard, check the following:

Wire and high voltage lead routing
- As shown in service manual
- Away from moving parts which could cut wires or wire insulation
- Away from engine cover latches which can catch and cut insulation from high voltage spark plug leads

Sleeves, boots, shields
- In position (to avoid shock hazard)
- Not torn or cracked



Metal Clamps – Tie Straps
- Position as shown in manual

Screws, Nuts, Washers
- Tighten firmly–these keep clamps in position and ends of wires from sparking
- Where lock washers are called for, use them

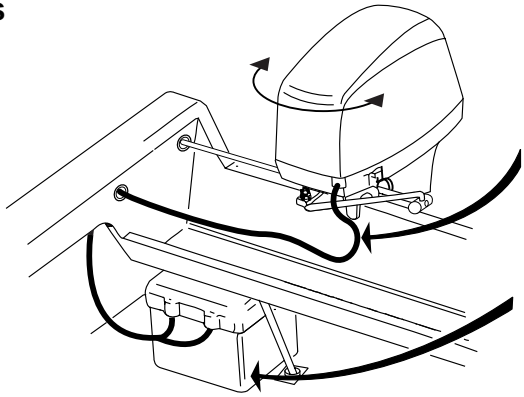
Spark Plug Boots
- Not torn or cracked
- Fully pushed onto spark plug

Spark Plugs
- Avoid rough handling that could crack ceramic part of plug. (Sparks may jump across outside of plug.)

In transom area:

All Connections
- Clean
- Tight

(Prevents sparks)

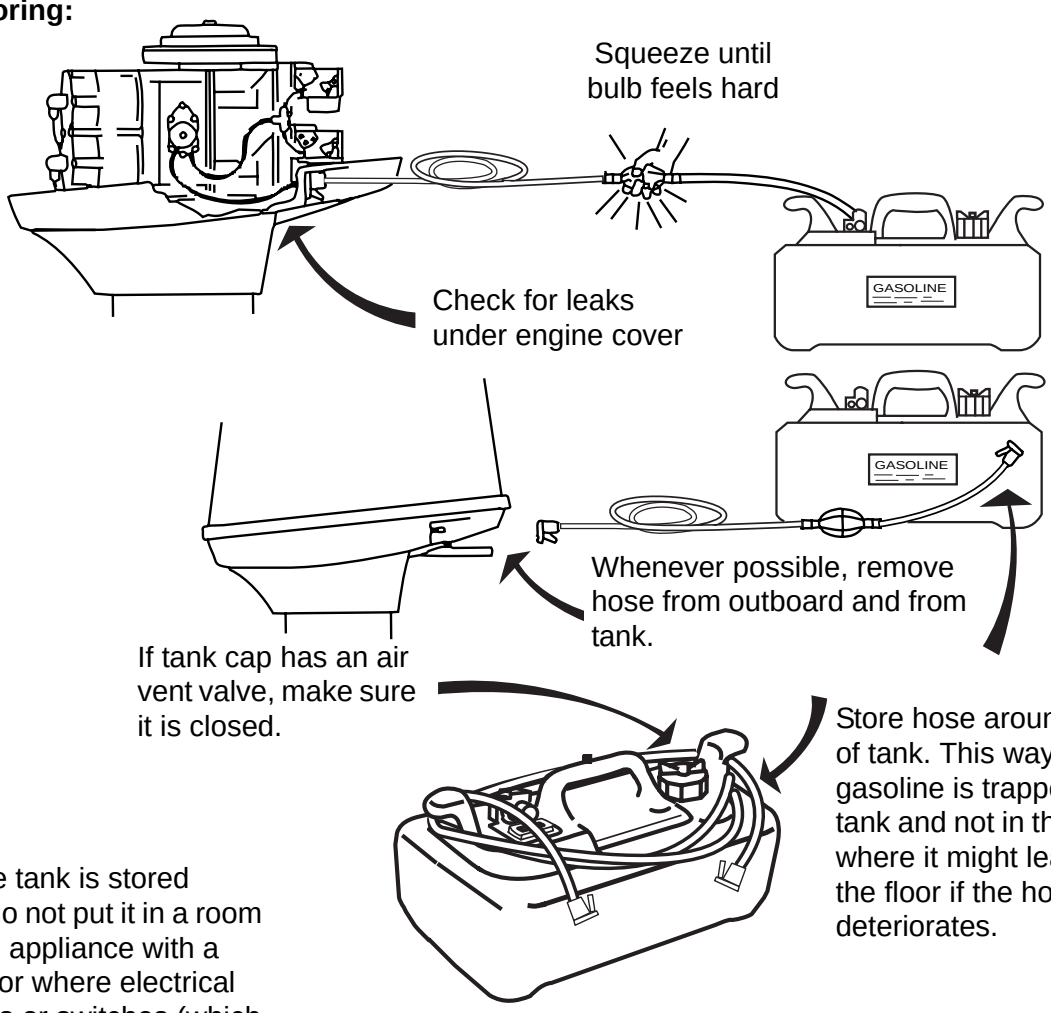


Electric Cable
- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

Batteries
- Secure in approved battery box or battery tray
- Battery terminals insulated
- No strain on cables

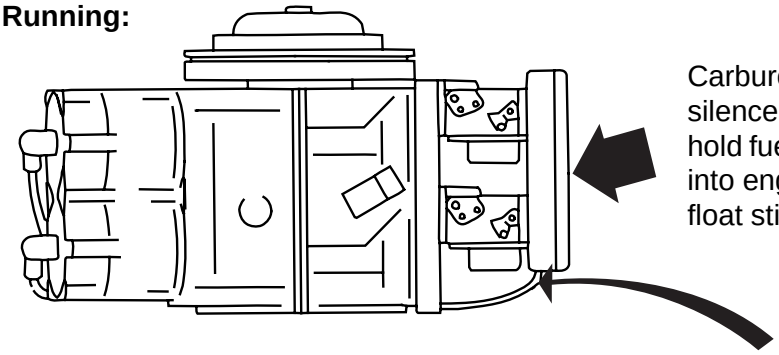
After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When Storing:



If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used.

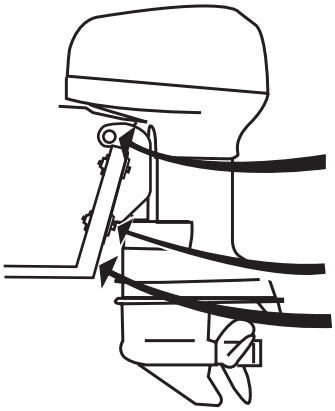
When Running:



- **Make sure silencer and its gaskets are on engine and drain hose is in place.**
- **Air silencer mounting screws are special lock screws. Use only the special screws.**

Outboard Mounting System and Safety

The mounting system includes:



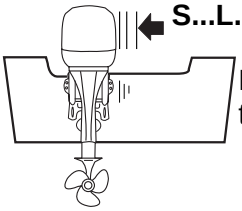
- outboard parts
- bolts, nuts, and washers
- boat's transom

What is most important?

- Outboard must **stay** in position on boat's transom.

What could happen?

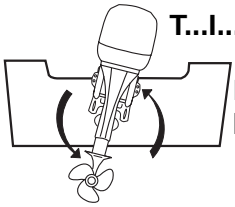
Outboard may



S...L...I...D...E on transom

Boat may turn and be hard to steer.

Outboard may

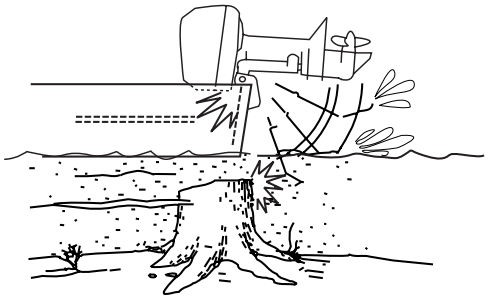


T...I...L...T on transom

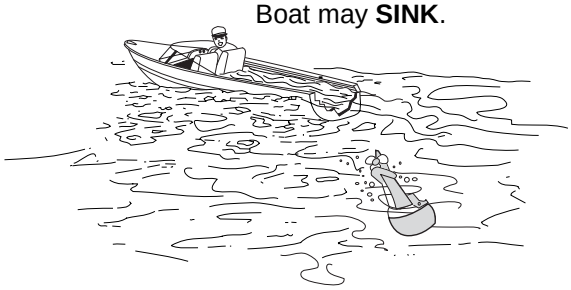
Boat may turn and be hard to steer.

- If outboard hits something solid and does not stay on the transom, boat occupants may be injured from the outboard or its parts entering the boat.

Boat's transom could break away.



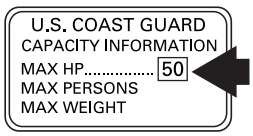
Outboard may be lost overboard.
Boat may **SINK**.



How Can Loss of Mounting Be Minimized?

- **Read**, **understand**, and **follow** manufacturer's **instructions.**
- Follow warnings marked "⚠" closely.

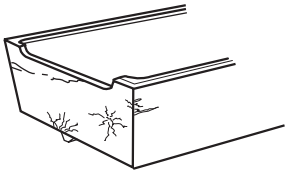
If weakened, parts could fail later on the water, when not expected



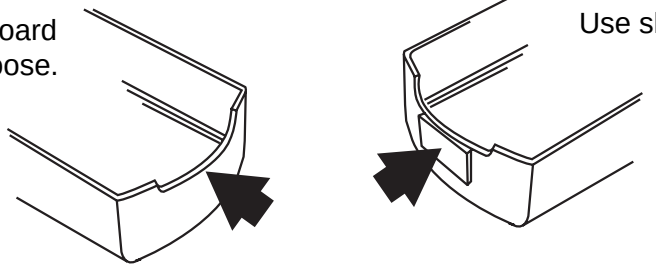
If boat plate shows...

Use only or smaller

When rigging or fixing any boat, if transom looks weak, tell the owner.



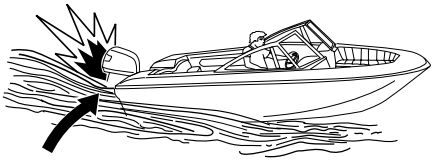
If transom is curved, outboard may come loose.



Mount on flat surface only. Use shims to make surface flat.

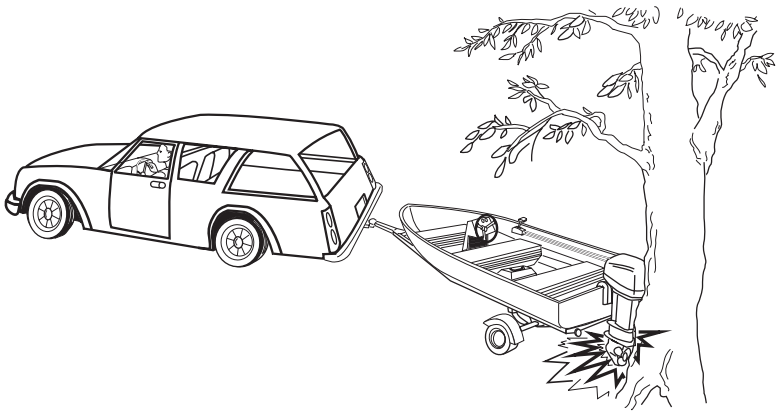
Use bolts, nuts, and washers supplied with outboard. They are usually special, and will not rust or weaken.

If owner tells you “I hit something really hard...”



Check for a high speed blow to the lower unit.

OR...



“I was backing up and I think the outboard may have hit a tree or something.”

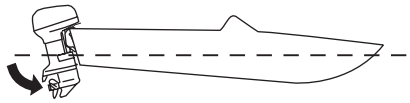
Check for a slow, heavy squash to the outboard.

- Look for damaged parts and loosened nuts and bolts in both the steering and mounting systems. Replace damaged parts.

Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety

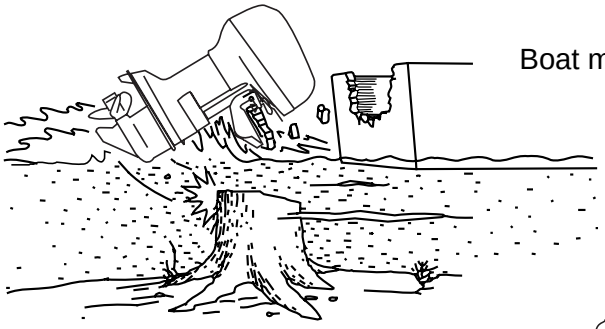
What is most important?

- Shock absorption system must always be ready to absorb some blows to the lower parts of the outboard.
- Outboard must not trim in too far suddenly.

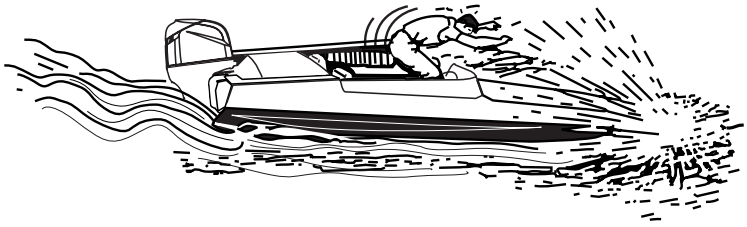


What can happen?

Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.



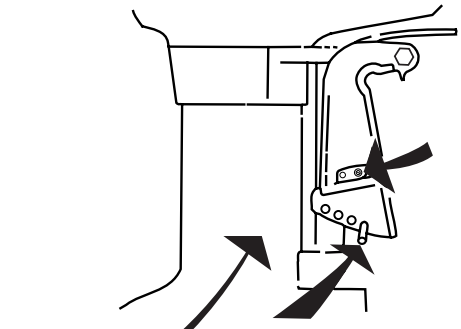
Boat may **SINK**.



At high speeds, sudden trimming in too far may dive boat under water or spin it around.

How can possible conditions be minimized?

- **Read**, **understand**, and **follow** manufacturer's **instructions.**
- Follow warnings marked "⚠" closely.
- Test your work whenever possible.
- If oil leaks are seen in service areas, determine source. Keep reservoir filled.
- If outboard is hydraulic tilt/trim model, always return rod to hole position determined by boat operator and make sure angle adjusting rod retain is in locked position.

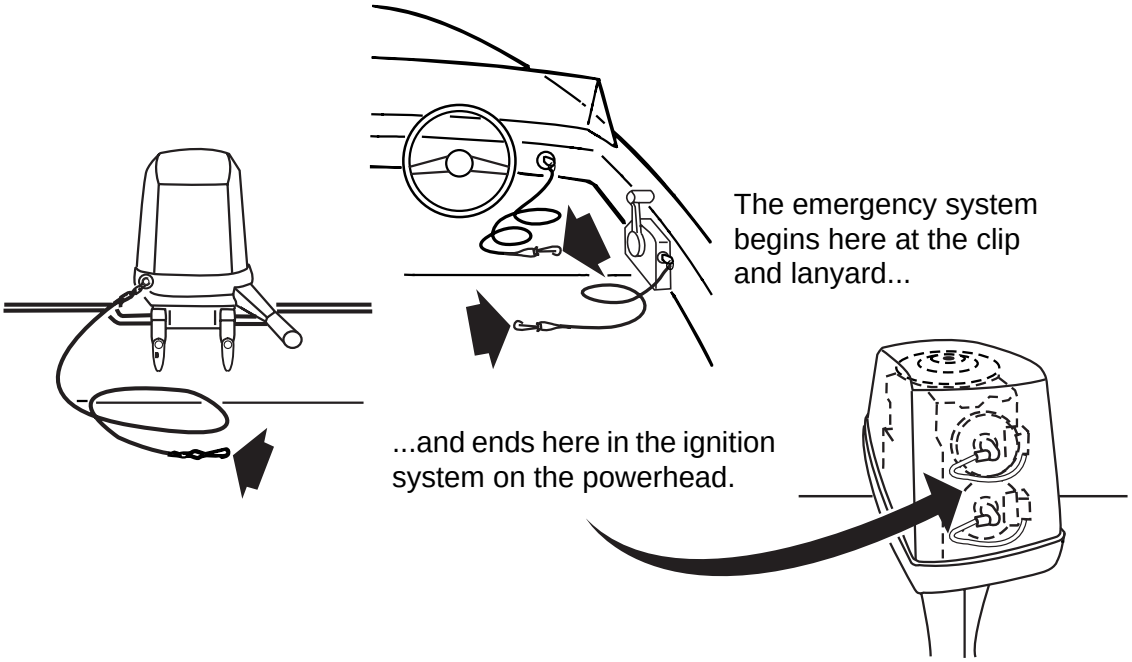


Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

If left open, outboard has no shock protection.

Trimming "in" too far can happen when angle adjusting rod is not in the **right** hole or is not in **any hole** (lost).

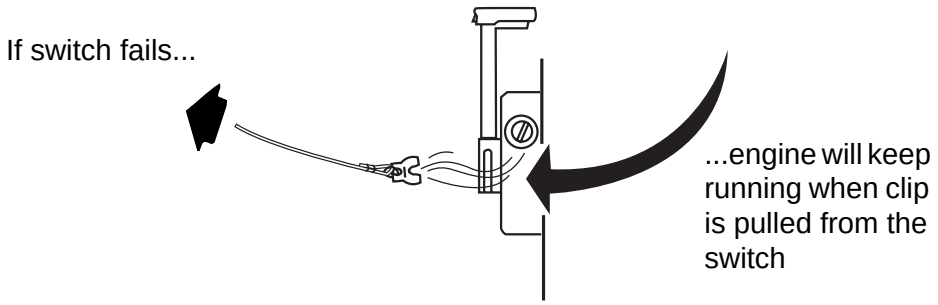
Outboard Emergency Stop System and Safety

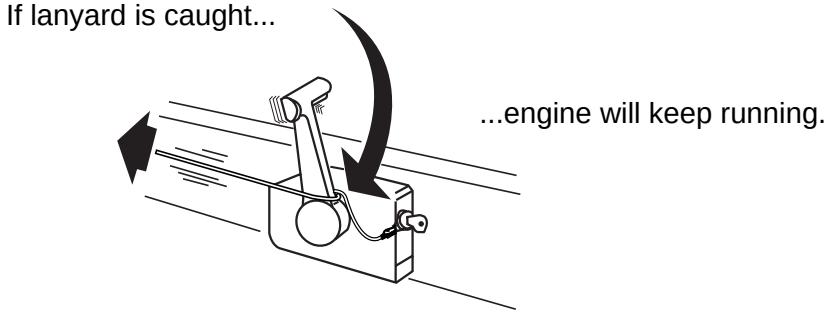


What is most important?

- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

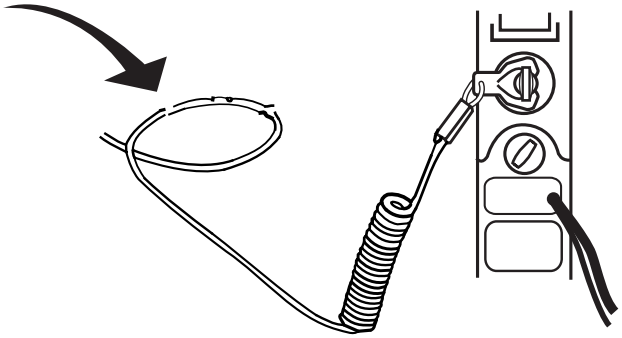
What could happen?



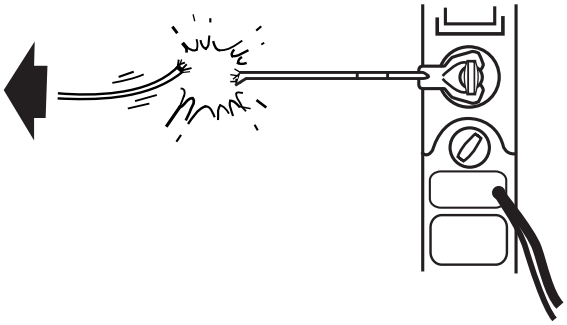


What could happen?

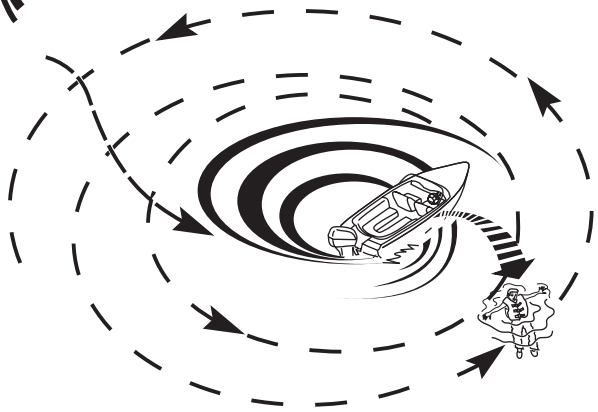
If lanyard is cut or frayed...



...lanyard or clip may break when pulled...



If engine does **NOT** stop when lanyard is pulled, an operator thrown from the boat could be hit as boat circles area. Or, boat may not turn but leave area as a runaway. Operator may drown and boat **WILL** run into something.



How can failure of the emergency stop system be minimized?

When rigging or after servicing

- **Read**, **understand**, and **follow** manufacturer's **instructions**
- Follow warnings marked "⚠" closely.
- Assemble parts carefully.
- Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.
- Locate control box and other items in area to keep lanyard from being caught.
- **ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.**

Summing up

Now you know some things that can take the joy out of boating.

No doubt about it—proper safety takes time!

- Reading and understanding instructions
- Re-reading warnings marked "⚠"
- Putting parts together correctly
- Making correct adjustments
- Testing your work

And making sure

- Worn or damaged parts are replaced
- Replaced parts are like originals in every way
- Customer is told of things which need attention

But, do you really want the alternative?

MARINE PRODUCTS AND THE SAFETY OF PEOPLE WHO FIX THEM

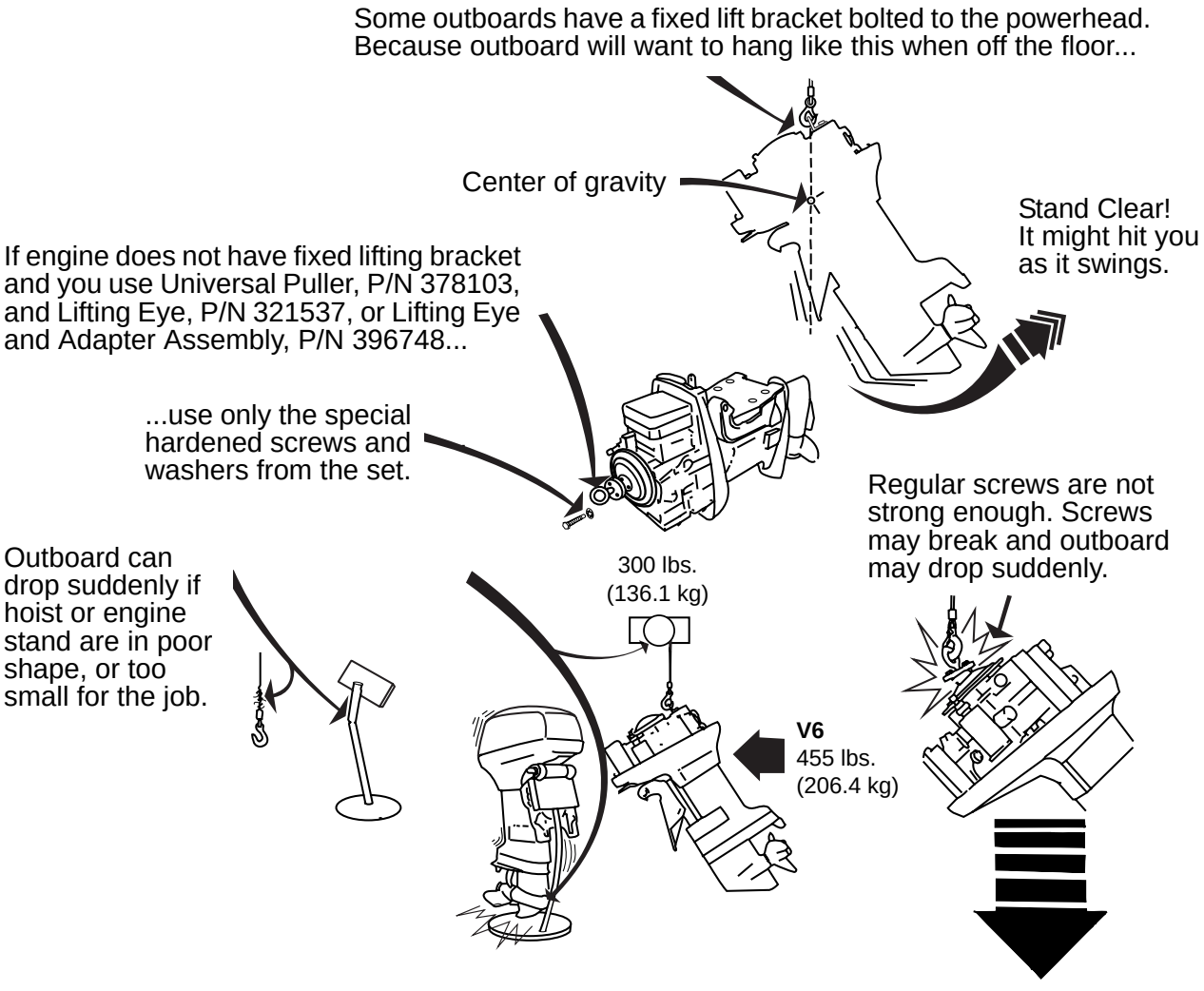
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

- Rigging boats
- Troubleshooting problems
- Fixing components
- Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

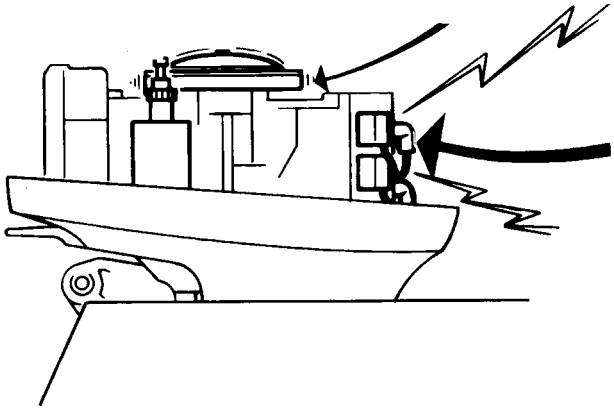
When lifting outboards



- Make sure shop aids have extra capacity, and keep them in good repair.

Running outboard with engine cover removed

Engine cover is a guard. When you remove cover/guard to work on the outboard, remember: loose clothing (open shirt sleeves, neckties), hair, jewelry (rings, watches, bracelets), hands and arms can be caught by the spinning flywheel.



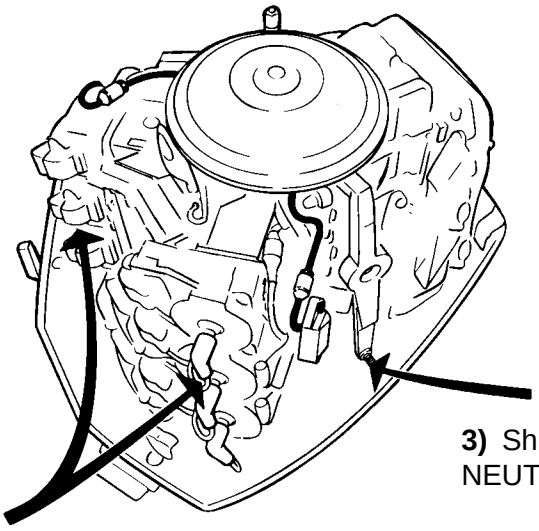
Handling high voltage parts like spark plugs and coils can shock you and may cause you to recoil into the rotating flywheel.

- Two people working together on a live outboard must look out for each other. Never, ever, use the key to start the outboard before signaling your partner. He may be leaning over the outboard with hands on the flywheel, handling a “hot” electrical part, or near the propeller.

Outboard starting at the wrong time

When you do things that turn the flywheel like:

- Off-season storage fogging (oiling) of outboard;
- Removing propeller with a powered tool;
- Electrical system checks;
- Servicing the flywheel; or
- Any other actions **ALWAYS...**



1) Turn key switch OFF

2) Twist and remove ALL spark plug leads

3) Shift to NEUTRAL

Check prop shaft. Is outboard really in NEUTRAL?

NO SPARK → **NO START** → **NO SURPRISES**

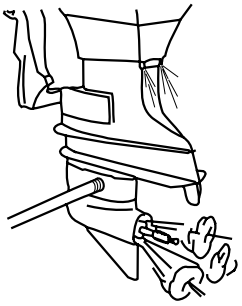
Running outboard too fast (Overspeeding)

- "Too fast" means running faster than outboard normally runs on boat.

Running too fast can happen when:

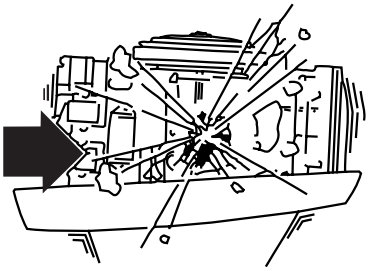
1) Using a flushing device...

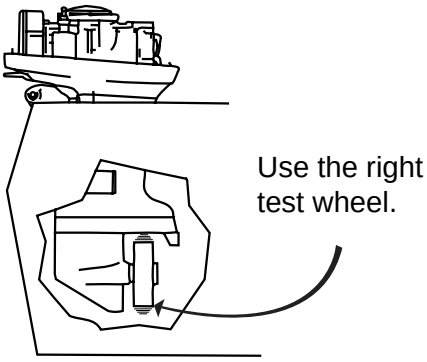
Turn on water before starting outboard. Keep engine speed below 2000 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.



2) Running with the wrong test wheel...

This may happen if outboard runs too fast.





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.

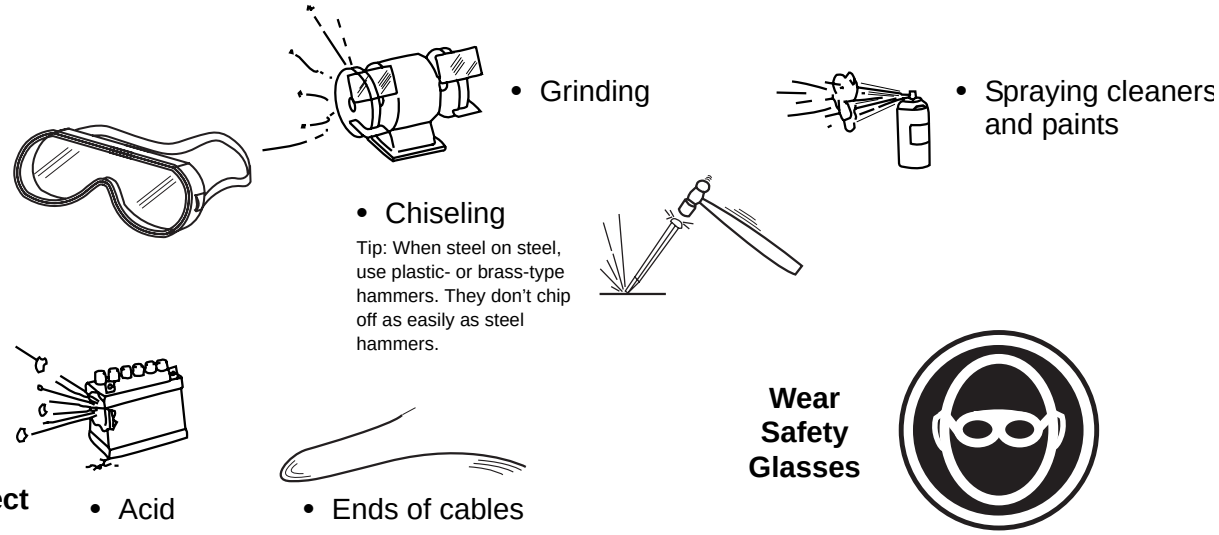
Running outboards: Propellers

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

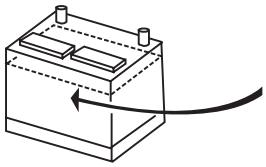
Tip: When steel on steel, use plastic- or brass-type hammers. They don't chip off as easily as steel hammers.

Protect eyes from:

- Acid
- Ends of cables

Wear Safety Glasses

Handling Lead/Acid Batteries

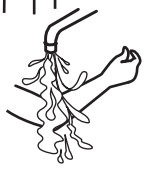


Strong acid solution
(sulfuric acid)

If solution gets into eyes, wash and contact a doctor immediately.

If spilled or splashed on any part of body...

Wash with
lots of water.

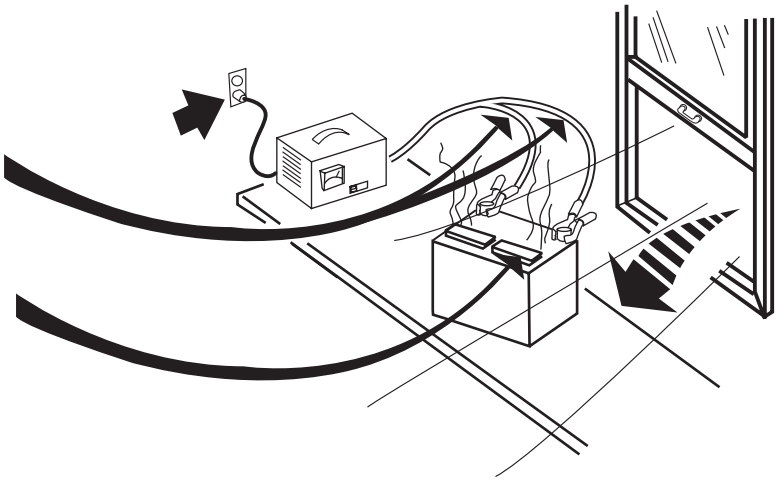


Charging lead acid batteries

1) Attach and remove these cables with charger UNPLUGGED from 110 V wall socket. (This prevents shocks if charger is defective.)

2) Observe correct polarity when connecting these larger leads.

3) Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. **Make sure vents are open.** If clogged, pressure inside may build. Battery may EXPLODE.



Battery gas is explosive!

While charging or discharging, remember:

- No smoking
- No flames
- No sparks

Never remove charger cables from battery posts. It is a sure way to make a lot of sparks in an area surrounded by battery gas.

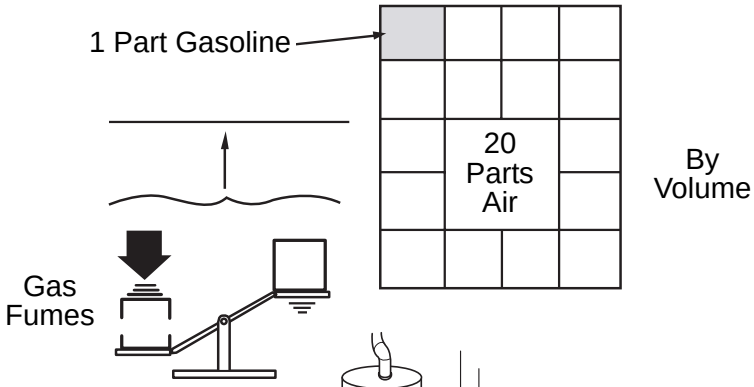
DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.

After charging:

- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

Gasoline – Handle With Care!

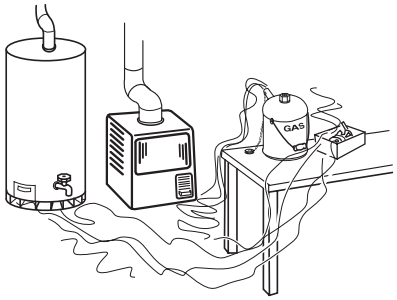
Gasoline vapor and air mixtures explode easily and violently when mixed as shown...



When you smell ANY odor of gasoline, explosion is possible.

Gasoline fumes are heavy and will sink to the lowest point in the boat or room and will STAY there, WAITING...

If the air around you is calm, the pilot light in the heater could **ignite** the heavy fumes before your nose ever **smells** the fumes.



What can you do?

Store gasoline in sturdy, approved, sealed gas can and keep outside.

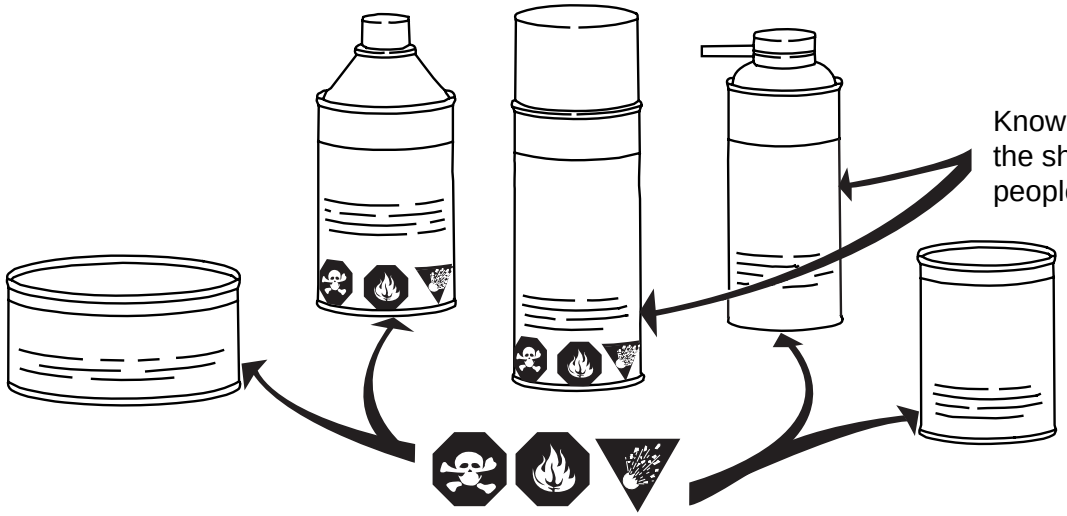
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, **not** for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, **immediately**:
  - Put out open flames, cigarettes, sparking devices;
  - Wipe up spill or leak;
  - Get towels and rags outside fast;
  - Open doors and windows; and
  - Check **lowest** area for fumes.

Be aware of items in and around repair area which can ignite fumes. Control them if fumes are smelled.

- Matches, cigarettes, blow torches, welders
- Electric motors (with unsealed cases)
- Electric generators (with unsealed cases)
- Light switches
- Appliance pilot lights or electric ignitors (furnace, dryer, water heaters)
- Loose wires on running outboards
- Other variables which may ignite fumes

How many of these are in your repair area?

Hazardous Products



Know how items in the shop can hurt people...

READ

- "How and where to use"
- "How to give First Aid." Have recommended First Aid materials on hand should an emergency arise
- "How to dispose of can"

It's all on the **back of the can or bottle label.**

And remember: Little children are very curious and will try to taste everything so **keep containers away from children!**

Safety Awareness Test

The Technician's Safety Awareness Test....

1) Did you read this Safety section from page S–1 to page S–24?

2) Are you ready to take responsibility for the safe maintenance practices and procedures of your repair shop, co-workers, and technicians?

3) Do you understand all the safety precautions and instructions contained in this entire service manual?

4) Will you follow all safety warnings, precautions, instructions and recommendations outlined in this service manual?

5) Do you understand that the service manual as a whole and this Safety section, in particular, contain essential information to help prevent personal injury and damage to equipment and your customers?

6) Have you received training related to common shop safety practices to protect yourself and others around you?

7) When replacement parts are required, will you use *Evinrude®/Johnson® Genuine Parts* or parts with equivalent characteristics, including type, strength and material?

8) Are you ready to follow the recommendations in this service manual before you service any boat or outboard?

9) Do you understand that safety-related accidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?

INDEX

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