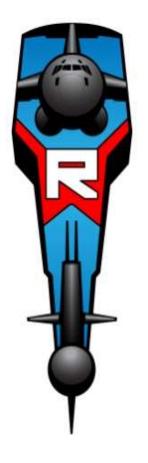
# 2015

Raider Outboards Titusville, FL 32796



# SERVICE MANUAL

**Raider 40 Horsepower** 

Submersible / Multi-Fuel Outboard Motor

Part No. R40-ES-001

[Raider Service Manual No. R40-ES-001-15-3 Instructions for repair the Raider 40 Outboard Engine — Shop Manual

For Military Use Only

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# SECTION 1 - SERVICE SAFETY

Inadequate knowledge of safe shop practices can result in severe injury or death. Review general safety procedures and specific safety information provided for each procedure prior to beginningany repairs.

#### INTRODUCTION

Raider outboards is required to comply with special EPA regulations and standards to ensure your military products are safe and reliable. As the military technician, it is your responsibility to keep these products safe when performing normal repair and maintenance operations.

It is not possible to foresee all safety hazards which may occur or to include all the knowledge of an experienced technician in a single service manual. Therefore, it is assumed those using this manual have a working knowledge of 2-cycle outboard engines and the proper technical training for servicing.

Raider outboards is considered a Commercial Off The Shelf (COTS) outboard engine. The engine comes from a family of engines: Mercury, Nissan and Tohatsu. Most major parts can be obtain from any dealer – world wide. For Raider specific parts these are available within one day.

This section discusses safe shop practices and general safety concerns relevant to the operations performed throughout this manual. Read this section carefully and follow all safety statements in this manual as they pertain to the procedures at hand. Remember, always use common sense when servicing outboard engines!

Raider supports three manuals:

Owner/Operators Manual; R40-ES-001-15-1; Parts and Assembly Manual: R40-ES-001-15-2 which has all part numbers and assembly information; and Service Manual R40-ES-001-15-3 that provides complete information to repair the Raider 40.

#### SAFETY STATEMENTS

The following safety statements are found throughout this manual indicates information which, if ignored, could result in safety hazards or faulty service.

# A DANGER

Indicates the presence of a hazard which, if ignored, **WILL** result in severe injury or death.

# 

Indicates the presence of a hazard which, if ignored,  $\ \mbox{COULD}$  result in severe injury or death.

# 

Indicates the presence of a hazard which, if ignored, **COULD** result in minor personal injury or damage to product, equipment, or other property.

#### NOTE

Indicates special information to facilitate the installation, operation, or maintenance of the product or further clarify information which is important but not hazard related.

# SAFETY PRECAUTIONS

#### Raider Outboard Engines

Never disable the neutral switch start-in-gear prevention system. Always test the neutral switch and emergency stop switch before returning an engine to the user.

Lifting devices and hardware must be of suitable capacity for the weight of the outboard engine. Be aware the engine may swing outward when lifted.

The Raider engine stand must be in good condition; Raider engine must be mounted properly to prevent unexpected shifting.

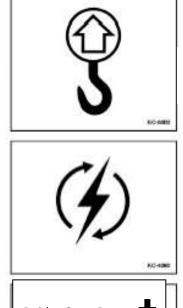
Engine covers (cowling) are guards to prevent personal contact with the spinning flywheel and high voltage components such as spark plugs and coils. Never wear jewelry or loose clothing near a running engine. Keep hands, arms and hair away from the flywheel. Never touch electrical components when the engine is running.

Two people working on a running engine must use extreme caution and be aware of one another. Never attempt to start an engine or operate any controls before signaling your partner.

To prevent accidental startup during operations which may cause the flywheel to turn, always perform the following steps:

- 1. Insure battery is disconnected or removed.
- 2. Disable the engine ignition system.
- 3. Shift engine to NEUTRAL and verify propeller shaft is not in gear.

Rotating propellers are not equipped with guards and can cause severe injury or dismemberment. Always stay clear of rotating propellers and make sure there is no possibility of engine startup before removing or installing a propeller. The propeller nut must always be tightened to torque specification prior to starting the engine.





# **Additional Safety Precautions**

Avoid running the engine at high RPM. Engine speed can easily increase to excessive RPM when under a no load condition. To avoid engine damage during testing, always use the correct test propeller and keep engine speed below 2000 RPM.

Run engines only in well ventilated areas to prevent exposure to Carbon Monoxide (CO) gas. Direct and prolonged exposure to CO will cause brain damage or death.

Always wear eye protection, protective clothing, gloves and use other applicable safety equipment when work activities present the risk of personal injury.

#### **Batteries**

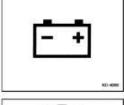
Never leave batteries in Raider outboards for long periods of time. Always unplug when not in use.

Place batteries on "maintainer" when not in use.

Never use "fast" charge on batteries that are used on vehicles. These batteries are sealed lithium Iron; 270 Cranking Amps.

- Prior to Mission place on maintainer for 6 hours
- Battery can be left in RAMZ for up to three months.
- Disconnect internal connection when placed in RAMZ.
- If detection of heat in battery remove and discard.
- Make sure battery looks in good condition.







# **Hazardous Materials**

Gasoline vapors are highly flammable and can cause an explosion. Never smoke or allow sparks or flames nearby when handling fuel Always store gasoline in a shaded, well ventilated area in an approved safety container. Heavy Fuels that can be burned in the Raider 40 has harmful fumes that must be considered hazardous. Wear masks.

Ventilate all fumes as soon as detected. Be aware that appliance pilot lights, such as those in furnaces and water heaters, can ignite gasoline vapors and cause explosion.

Never use gasoline as a cleaner, and always clean up fuel spills immediately and properly dispose of rags in an approved safety container.

Read and follow the safety labels on products used around the shop. Adhesives, lubricants, solvents, and fuel additives are usually poisonous and flammable. Store and dispose of these products properly.

# **Shop Environment**

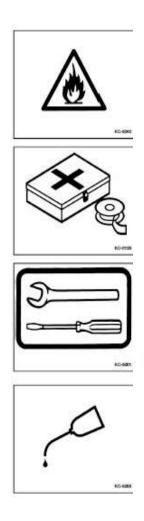
Make sure the shop and your work area are properly ventilated.

Shops must be equipped with the proper tools and safety equipment such as fire extinguisher, eye flushing device, and first aid kit.

Keep the shop clean and free of clutter. Clean up spills on the floor as soon as possible to prevent someone from slipping.

# WORKMANSHIP STANDARDS

- 1. Avoid damage to the mating surfaces of crankcase and cylinder assembly. Do not use a sharp metal scraper to clean these areas.
- 2. Replace gaskets, 0-rings, seals, cotter pins, lock nuts, and spring pins when removed during repair operations.
- 3. Use only genuine factory replacement parts and accessories.
- 4. Use recommended special tools when specific repairs require them.
- 5. Calibrate measurement tools and test equipment on a regular basis.
- 6. Clean all metal parts with solvent before inspection and assembly operations.
- 7. Use penetrating solvents when necessary to remove rusted or seized hardware.

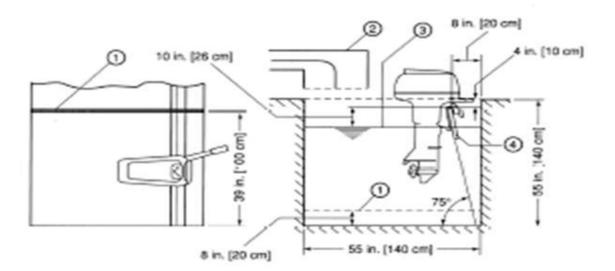


- 8. Keep all removed parts separated for ease of identification during assembly.
- 9. Locate alignment marks on components being disassembled. If marks are not present and should be, scribe or match mark them yourself to ensure the pieces are assembled properly.
- 10. Follow torque sequences and specifications where they apply. First, tighten each bolt in the specified sequence. Use the same sequence to torque each bolt to final specification. Special torquespecifications are listed at the beginning of each section. Standard torque specifications for common fasteners are listed in Section 3.
- 11. Use lubricant when assembling seals to prevent damage to the seal lips. Make sure seal lips are facing the correct direction.
- 12. Use the correct type and amount of sealing compound on metal to metal surfaces.
- When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa /1.76 kg/cm'].
- 14. Replace missing or damaged safety labels on the engine before returning it to the user.

# **TEST TANK GUIDELINES**

When properly setup, test tanks provide a safe and controlled environment in which to perform outboard engine adjustment and testing procedures. Test tanks must be setup to the minimum dimensions shown. If multiple engines will be installed in the tank, secure partition plate (1) so that the minimum dimensions are maintained for each outboard engine installed. In addition, adhere to the following guidelines to prevent engine damage:

- Continuous usage raises the water temperature in the tank which can lead to engine seizure. Make sure water temperature in the tank does not exceed 77°F [25°C].
- Repeated use introduces carbon into the water which can adhere to the engine cooling system and degrade its ability to cool the engine. Always replace dirty tank water at regular intervals with clean, fresh water.
- Exhaust gases produced during engine operation can collect around the engine, causing suction into the carburetors and affecting engine performance. To prevent this condition, install forced ventilation equipment (2) to remove gases away from the engine and work area.
- Water may splash out of the tank during testing. Maintain water level (3) in the tank as illustrated.
- Keep transom board (4) at an approximately 75° angle to the tank bottom to ensure near vertical engine position.
- Test Tank Drawing:



# SECTION 2 – General Information

# **General Precautions**

Before performing any service work on the outboard engine, read and understand Section 1 - Service Safety.

Use only genuine factory replacement parts with equivalent characteristics such as type, material, and strength. Failure to do so may result in product malfunction and injury to the operator or passengers.

Follow the **Standard Torque Values** chart. When a special torque value for a certain fastener is not listed in the **Special Torque Values** chart at the beginning of each section tighten as normal.

Rather than just repairing a bad part, use repair kits and overhaul kits when applicable to ensure complete and efficient repair of the complete component. Wear not readily noticed on other parts can lead to malfunction soon after the repair.

When indicated in a procedure, use manufacturer special tools. In some cases, the use of substitute tools will damage the part.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm'].

# Abbreviations and Symbols

# Abbreviations

| A ampere L liter   |                         |
|--|-------------------------|
| AC alternating current L/hr liter per                          | hour                    |
| AH ampere-hour Ib pound  |                         |
| approx. approximately mL milliliter                            |                         |
| API American Petroleum Institute mm millimete                  | ər                      |
| ATDC after top dead center mV millivolt                        |                         |
| BTDC before top dead center N newton                           |                         |
| °C degree Celsius N·m newton                                   | meter                   |
| CCA cold cranking amp NMMA National                            | Marine                  |
|  | turers Association      |
| cm <sup>3</sup> cubic centimeter No. number                    |                         |
| cm³/min cubic centimeter per minute O.D. outside of            | diameter                |
| cu-in cubic inch oz ounce                                      |                         |
| DC direct current PS horsepo                                   | wer (metric)            |
|  | er square inch          |
| Kg-m kilogram meter qt quart (U.                               |                         |
|  | n per minute            |
|  | of Automotive Engineers |
| fl oz/min fluid ounce (U.S.) per minute sec. second            |                         |
|  | 1 2000 lb               |
| ft-lb foot pound TDC top dead                                  | d center                |
| ft-lbf/min foot pound force per minute V volt                  |                         |
|  | mating current          |
|  | ct current              |
| gal gallon (U.S.) W watt                                       |                         |
| GL gear lubricant  |                         |
| GM General Motors Company Symbols                              |                         |
| HP horsepower (U.S.)   |                         |
| I.D. inside diameter   | dearee                  |
| in inch + plus   |                         |
| in-lb inch pound _ minus                                       |                         |
| kg kilogram ± plus or n  | ninus                   |
| kg/cm <sup>2</sup> kilogram per square centimeter $\Omega$ ohm |                         |
| ESG electronic speed governor µ micro                          |                         |
| kPa kilopascal % percent                                       |                         |
| kW kilowatt  |                         |

# **Unit Conversions**

#### Unit Prefixes

| Prefix | Symbol | Power       |
|--------|--------|-------------|
| mega   | M      | x 1,000,000 |
| kilo   | k      | x 1,000     |
| centi  | C      | x 0.01      |
| milli  | m      | x 0.001     |
| micro  | μ      | x 0.000001  |

#### Units of Length

| mile | х | 1.6090 = km   |
|------|---|---------------|
| ft   | x | 0.3050 = m    |
| in   | x | 2.5400 = cm   |
| in   | x | 25.4000 = mm  |
| km   | x | 0.6210 = mile |
| m    | х | 3.2810 = ft   |
| cm   | x | 0.3940 = in   |
| mm   | х | 0.0394 = in   |
|      |   |               |

### Units of Volume

| gal (U.S.)      | x | 3.78540 = L            |
|-----------------|---|------------------------|
| qt (U.S.)       | х | 0.94635 = L            |
| cu-in           | x | 0.01 639 = L           |
| cu-in           | x | 16.38700 = mL          |
| fl oz (U.S.)    | х | 0.02957 = L            |
| fl oz (U.S.)    | x | 29.57000 = mL          |
| cm <sup>3</sup> | х | 1.00000 = mL           |
| cma             | х | 0.03382 = fl oz (U.S.) |

#### Units of Mass

| lb | х | 0.45360 = kg |
|----|---|--------------|
| oz | x | 28.35000 = g |
| kg | x | 2.20500 = lb |
| g  | x | 0.03527 = oz |

#### Units of Force

| lbf | × | 4.4480 = N   |
|-----|---|--------------|
| lbf | x | 0.4536 = kgf |
| N   | х | 0.2248 = lbf |
| N   | x | 0.1020 = kgf |
| kgf | x | 2.2050 = lbf |
| kgf | х | 9.8070 = N   |

#### Units of Torque

| ft-lb | x | 1.3558 = N-m    |
|-------|---|-----------------|
| ft-lb | x | 0.1383 = kg-m   |
| in-lb | x | 0.1130 = N-m    |
| in-lb | х | 0.0115 = kg-m   |
| kg-m  | x | 7.2330 = ft-lb  |
| kg-m  | x | 86.8000 = in-lb |
| kg-m  | x | 9.8070 = N-m    |
| N-m   | x | 0.7376 = ft-lb  |
| N-m   | x | 8.8510 = in-lb  |
| N-m   | x | 0.1020 = kg-m   |
|       |   |                 |

#### Units of Pressure

| psi                | х | 0.0689 = bar                |
|--------------------|---|-----------------------------|
| psi                | × | 6.8950 = kPa                |
| psi                | × | 0.0703 = kg/cm <sup>2</sup> |
| bar                | × | 14.5030 = psi               |
| bar                | x | 100.0000 = kPa              |
| bar                | x | 29.5300 = in Hg (60°F)      |
| kPa                | × | 0.1450 = psi                |
| kPa                | x | 0.0100 = bar                |
| kPa                | × | 0.0102 = kg/cm <sup>2</sup> |
| kg/cm <sup>2</sup> | x | 14.2200 = psi               |
| kg/cm <sup>2</sup> | x | 0.9807 = bar                |
| kg/cm <sup>2</sup> | x | 98.0700 = kPa               |
| in Hg (60°F)       | x | 0.0333 = bar                |
| in Hg (60°F)       | x | 3.3770 = kPa                |
| in Hg (60°F)       | x | 0.0344 = kg/cm <sup>2</sup> |
|                    |   |                             |

#### Units of Power

| HP       | x | 1.01400 = PS         |
|----------|---|----------------------|
| HP       | × | 745.70000 = W        |
| HP       | x | 550.00000 = ft-lbf/s |
| PS       | x | 0.98630 = HP         |
| PS       | x | 735.50000 = W        |
| PS       | x | 542.50000 = ft-lbf/s |
| W        | x | 0.00134 = HP         |
| W        | x | 0.00136 = PS         |
| W        | × | 0.73760 = ft-lbf/s   |
| kW       | x | 1.34100 = HP         |
| kW       | x | 1.36000 = PS         |
| kW       | x | 737.56000 = ft-lbf/s |
| ft-lbf/s | x | 0.00181 = HP         |
| ft-lbf/s | x | 0.00184 = PS         |
| ft-lbf/s | x | 1.35600 = W          |
|          |   |                      |

#### Units of Temperature

°F = (1.8 • °C) + 32 °C = 0.556 • (°F - 32)

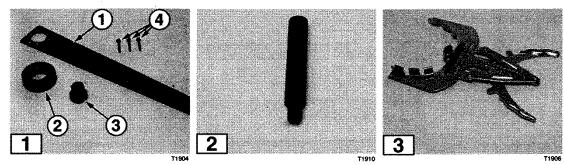
# **Service Specifications**

Standard Torque Values

|      | Torque   |           |         |           |  |  |  |
|------|----------|-----------|---------|-----------|--|--|--|
| Size | in-lb    | ft-Ib     | N-m     | kg-m      |  |  |  |
| M4   | 10 - 17  | 0.8 - 1.4 | 1 - 2   | 0.1 - 0.2 |  |  |  |
| MS   | 26 - 35  | 2.2 - 2.9 | 3 - 4   | 0.3 - 0.4 |  |  |  |
| MS   | 44 - 52  | 3.6 - 4.3 | 5 - 6   | 0.5 - 0.6 |  |  |  |
| MS   | 97 - 133 | 8 - 11    | 11 - 15 | 1.1 - 1.5 |  |  |  |

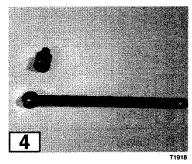
These torque values apply only when a special torque specification is not listed in the Special Torque Values chart at the beginning of each section.

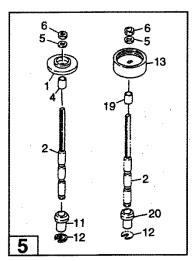
# Special Tools for Repair – Raider 40

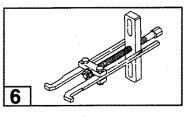


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|--------------------------------------|-------------|--|
| Tool Description                     | Part No.    | Components                                       |
| 1 Flywheel Puller<br>Assembly        | 369-72211-0 | Arm ①<br>Adapter ②<br>Pressing Bolt ③<br>Bolts ④ |
| 2 Piston Pin Tool                    | 345-72215-0 |  |
| 3 Piston Ring Tool                   | 353-72249-0 |  |
| <b>4</b> Wrench, Bevel Gear<br>B Nut | 346-72231-0 | Wrench   |
| <b>4</b> Socket, Bevel Gear<br>B Nut | 345-72232-0 | Socket   |
| 5 Needle Roller<br>Bearing Puller    | 3C8-72700-0 | Kit  |
| 5 Flange A                           | 3C8-72701-0 | 1  |
| 5 Shaft                              | 346-72702-0 | 2  |
| 5 Shaft Stopper A                    | 346-72704-0 |  |
| 5 Washer                             | 346-72707-0 | 5  |
| <b>5</b> Nut, 12P=1.25               | 346-72706-0 | 6  |
| <b>5</b> Guide A                     | 345-72705-0 | 1  |
| 5 Retainer A                         | 345-72703-0 | 12   |
| 5 Flange B                           | 346-72701-5 | 13   |
| 5 Shaft Stopper B                    | 345-72704-5 | 19   |
| 5 Guide                              | 345-72705-5 | 29   |
| 6 Bevel Gear<br>Bearing Puller       | 3A3-72755-0 | Assembly   |
|                                      |             |  |



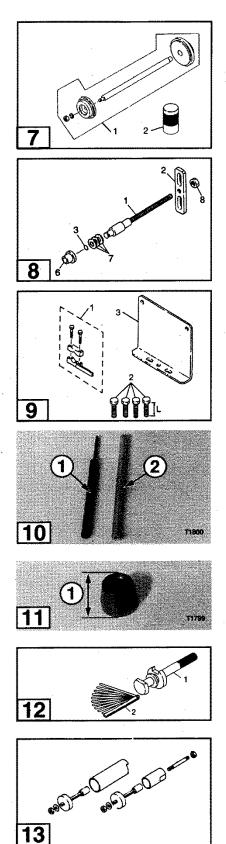




# **Continued - Raider 40**

#### 40 Continued

| Tool Description                     | Part No.     | Components                 |
|--------------------------------------|--------------|----------------------------|
| Bearing Outer<br>Press Kit           | 3B7-72739-0  | Kit, ①                     |
| Bevel Gear Bering<br>Installing Tool | 3C8-72719-0  | ② , Ø 42 mm                |
| Backlash Measuring<br>Tool           | 3C8-72234-0  | Kit                        |
| 8 Shaft                              | 345-72723-0  | 1                          |
| 8 Plate                              | 3A3-72724-0  | 2                          |
| <b>8</b> O-ring                      | 332-60002-0  | 3                          |
| 8 Collar                             | 353-72245-1  | 6                          |
| 8 Cone Disk<br>Spring, d=12          | 345-72763-0  | (7), 3 pcs                 |
| 8 Nut, M10                           | 930191-1000  | 8                          |
| <b>9</b> Clamp Assembly              | 3B7-72720-0  | 1                          |
| <b>9</b> Bolt, H625                  | 910191-0625  | (2) for lower<br>pump case |
| <b>9</b> Plate, Dial Gauge           | 3B7-72729-0  | 3                          |
| <b>10</b> Spring Pin Tool A          | 345-72227-0  | Pin Punch                  |
| 10 Spring Pin Tool B                 | 345-72228-0  | Hollow Punch               |
| <b>11</b> Clutch Pin Snap Tool       | 345-72229-0  | (1) = 2.36 in<br>60 mm     |
| 12 Shimming Gauge                    | 3C8-72250-0  | 1                          |
| 12 Thickness Gauge                   | 353-72251-0  | 2                          |
| <b>13</b> Rubber Mount Puller        | 361 -72760-0 | Kit                        |
| Tool Box                             | 353-72254-0  |                            |



## **General Equipment Required**

Water Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm2] Fuel Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm<sup>2</sup>] Torque Wrench, 0 - 150 in-lb [0 - 17 N·m / 0- 1.7kg-m] Torque Wrench, 0 - 750 ft-lb [0 - 1000 N·m / 0 - 100 kg-m] Dial Gauge, minimum scale 0.0001 in [0.01 mm] Micrometer Set or Dial Caliper, minimum scale 0.0001 in [0.01 mm] Telescoping Gauge, Inside Micrometer Set, or Dial Caliper, minimum scale 0.0001 in [0.01 mm] Variable Load High Rate Discharge Tester, Electronic Specialties® Model 700 or equivalent Analog Multimeter, Electronic Specialties® Model M-530 or equivalent Digital Multimeter, Electronic Specialties\* Model KD 3200 or equivalent Digital Pulse Tachometer, 10 - 6000 RPM, Electronic Specialties® Model 321 or equivalent Ammeter, 0 - 100 A Gearcase Pressure Tester, Stevens\* S-34 or equivalent Gearcase Vacuum Tester, Stevens® V-34 or equivalent Engine Compression Gauge, 0 - 300 psi [0 - 2000 kPa / 0 - 20 kg/cm2] Spark Gap Tester, Stevens\* S-13C, S-48, or equivalent Flexible Fuel Tubing, 1/4 in I.D. x 5 in [6 mm I.D. x 127 mm] Flexible Fuel Tubing, 3/8 in I.D. x 5 in [9.5 mm I.D. x 127 mm] Industrial Thermometer, minimum 300°F [150°C] Heat-Resistant Container, Pyrex® Bearing Puller Seal Pullers Seal Installers Heat Gun Hydrometer

# **Consumables Required**

Threadlocker, Loctite 242 Threadlocker, Loctite 243 Gasket Dressing, Permatex Hylomar Aerosol High-Temp Gasket Dressing Gasket Sealant, Permatex High Tack Gasket Sealant Anaerobic Gasket Maker, Loctite 518 Silicone Sealant, Permatex" Hi-Temp RTV Silicone Gasket Super Bond Adhesive, Permatex Super Glue Gel Cleaning Pads, Scotch-Brite Abrasive Pads Low Temperature Lithium Grease Genuine Grease or Equivalent Friction Surface Marine Grease Power Trim/Tilt Fluid, Raider• power torque fluid or GM approved automatic transmission fluid isopropyl Alcohol Cleaning Solvent Gasket Remover Gear Lubricant, Genuine gear oil or AP/grade GLS, SAE #80-#90 Engine Lubricant, Genuine engine oil or NMMA certified TC-W3 oil Automotive Crankcase Oil, flashpoint above 300'F [150°C] Battery Spray Protector, Permatex Battery Protector & Sealer Electrical Shrink Tubing, various diameters Form-A-Gasket, Permatex (Aviation Sealant Liquid) – Head Gasket

Corrosion Zero - anti-corrosion spray can

# **Raider 40 – Specifications**

#### Operational

Power

Raider ......40 HP [29.4 kW]

Fuel Consumption at Full Throttle Raider ......4.0 g/hr

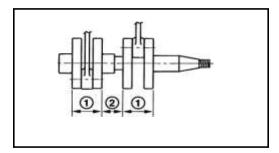
#### **Multiple Fuels**

Gasoline – primary – Heavy Fuel Optional JP-5/8; Kerosene; Diesel; Bio-diesel]

#### Submersible – special dewatering

66 feet underwater/18 hours - start 5 min.

#### Crankshaft Dimensions



Dimension 1 Raider 40 .....2.071 + 0 in [52.6 + 0 mm] - 0.002 - 0.05

Dimension 2 Raider 40 ...... 1.591  $\pm$  0.002 in [40.4  $\pm$  0.05 mm]

#### **Clutch System**

Raider 40 ..... Dog clutch type (Forward-Neutral-Reverse

#### **Electrical System**

Ignition Type ..... Flywheel magneto capacitor discharge

Ignition Timing See Ignition Timing Adjustment in Section 2

Spark Plug Raider 40 ..... Pulstar Model SBE 1/10

Spark Plug Gap Raider 40 .....0.035 0.055 (not to exceed)

Battery (Sealed) Raider 40 .....Lithium Iron 270 CA

#### Powerhead

Number of Cylinders Raider ......2

Standard Bore Raider .....2.76in[70mm]

Stroke Raider.....2.520 in [64 mm]

Piston Clearance Raider 40 ...0.0020 - 0.0039 in [0.05 - 0.10 mm]

Piston Ring End Gap Raider 40 .....0.008 - 0.016 in [0.20 - 0.40 mm]

#### Alternator

Raider 40 ......12V BOW

Charging Performance (at 5500 RPM) Raider 40 ......5 A

Number of Tachometer-to-Alternator Coil Impulses Raider 40 ...... 4

#### Alternator Coil Resistance

 $\begin{array}{rl} \mbox{Raider 40} & .... \mbox{Y-W}: 0.65 - 0.98 \, \Omega \\ \mbox{Y-B}: 0.31 - 0.47 \, \Omega \\ \mbox{W-B}: 0.37 - 0.55 \, \Omega \end{array}$ 

#### Ignition Coil Resistance (±25%)

| Primary Coil |             |
|--------------|-------------|
| Raider 40    | 0.2 - 0.3 Ω |

| Secondary Coil |                     |
|----------------|---------------------|
| Raider 40      | 4.1 <b>-</b> 6.1 KΩ |

# Heavy Fuels: Raider Additive Required.

#### **Fuel and Lubricant System**

#### Required Fuel, Lubricant, and Mix Ratio

See Fuel System Requirements in Section 3 50:1 normal mix; 30:1 break-in period.

#### NOTE

A special mix ratio is required during break-in. See "Break-In" at end of this section.

#### Carburetor (Fuel Induction System)

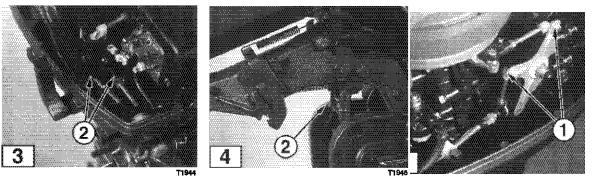
Raider 40 ..... Heavy Fuel Additive Check levers

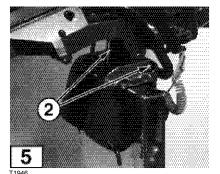
# Lubrication of Raider 40

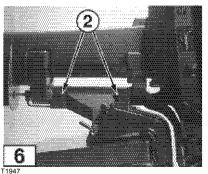
#### NOTE

Recommended intervals are for <u>freshwater</u> military operation. Decrease interval by 50% for salt water and severe duty operation.

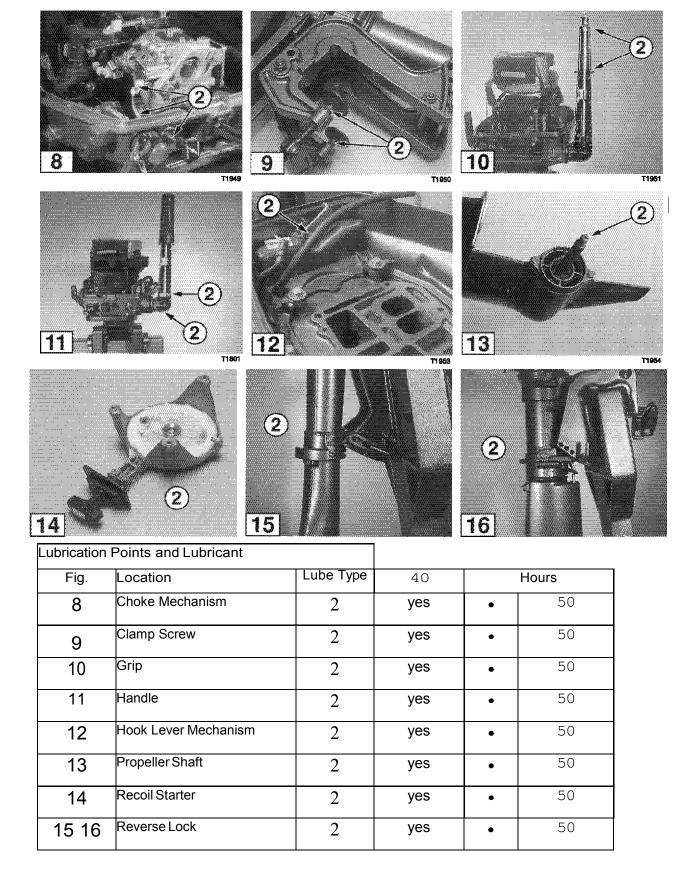
Lube Type: Low Temperature Lithium Grease Genuine Grease or equivalent Friction Surface Marine Grease Non-flammable solvent Genuine Gear Oil or API Grade GL5 #80 - #90

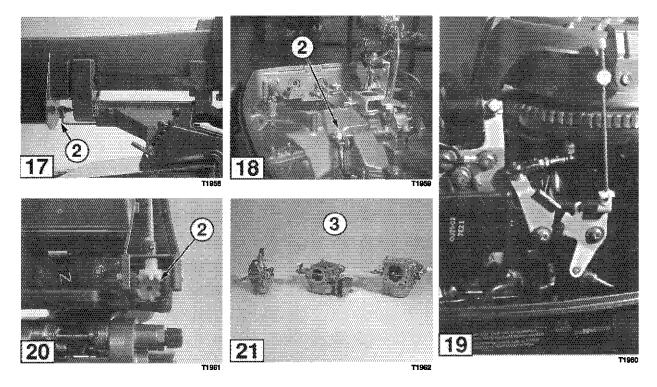






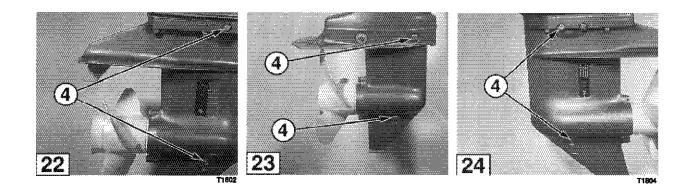
|      | Lubrication Points and Lubric |           |     |               |
|------|-------------------------------|-----------|-----|---------------|
| Fig. | Location                      | Lube Type | 40  | Running Hours |
| 1    | Shift Lever Mechanism         | 1         | yes | 50            |
| 2    | Throttle Linkage              | 1         | yes | 50            |
| 3    | Throttle Cable                | 2         | yes | 50            |
| 4    | Tilt Stopper                  | 2         | yes | 50            |
| 5    | Bracket Bolt                  | 2         | yes | 50            |
| 6    | Bracket Shaft                 | 2         | yes | 50            |
| 7    | Fuel Ind. Sys. Cable          | 2         | yes | 50            |





| Lubricatio | on Points and Lubricant |           |      |       |
|------------|-------------------------|-----------|------|-------|
| Fig.       | Location                | Lube Type | 40   | Hours |
| 17         | Reverse Lock            | 2         | •yes | 50    |
| 18         | Shift Lever Stopper     | 2         | •yes | 50    |
| 19         | Starter Lock            | 2         | •yes | 50    |
| 20         | Throttle Mechanism      | 2         | •yes | 50    |
| 21         | Carburetor (Note 1)     | 2         | •yes | 100   |

**Note 1:** Disassemble, remove dust and clean with air and non-flammable solvent. Completely dry all components and reassemble.



| Lubrica | tion points and Lubricant | Free      | quency |      |
|---------|---------------------------|-----------|--------|------|
| Fig.    | Location                  | Lube Type | Н      | ours |
| 22      | First Gear Oil Change     | 4         | Yes    | 10   |
| 23      | Top Off Gear Oil          | 4         | Yes    | 50   |
| 24      | Oil Change (Note 2)       | 4         | Yes    | 100  |

Note 2: Change Gearcase oil after every 100 hours of operation, and prior to prolonged storage, such as over the winter.

Commercial Fogger can be used in Fuel Induction System prior to long term storage.

# **Periodic Inspections**

**NOTE:** It is recommended that a complete engine overhaul *be* performed after 400 operating hours.

| ltem   | Inspection  | Before<br>Each Use | After 1st<br>10 Hours<br>2 Days | Every<br>30 Hrs<br>or<br>7 Days | Every SO<br>Hrs or<br>30 Days | Every 100 Hrs<br>or<br>60 Days | Remarks                                      |
|--|---|--------------------|---------------------------------|---------------------------------|-------------------------------|--------------------------------|--|
| Fastener<br>torque                                       | Check the following:<br>Cylinder head bolts<br>Cylinder head cover<br>bolts<br>Exhaust cover bolts<br>Carburetor mounting<br>bolts<br>Intake manifold bolts<br>Crankcase bolts<br>Flywheel nut<br>Starter motor installation<br>bolts (where applicable)<br>Driveshaft housing bolts<br>Gearcase bolts<br>Propeller shaft housing<br>bolts<br>Propeller nut<br>Lower engine cover<br>mounting bolts<br>Engine mounting<br>bolts |                    | •                               |                                 | •                             |                                | Torque to<br>specification.                  |
| Gearcase   | Check oil level andadd<br>oil as required.<br>Check for water or<br>metallic matter in gear<br>oil.   |                    |                                 | •                               |                               |                                | See Lubrication<br>Chart in this<br>section. |
| Spark Plugs  | Check plug gap.<br>Remove carbon<br>deposits.   |                    | •                               |                                 | •                             |                                | Replace plugs<br>when electrodes<br>are      |
| System   | Disassemble and clean.<br>Check float valve for<br>wear.  |                    |                                 |                                 |                               |                                | Replace worn partsas required.               |
| Fuel Tank,<br>Pick-up Tube,<br>Filters, and<br>Fuel Pump | Disassemble, clean, and<br>inspect.<br>Check for leakage.<br>Check for cracks.  |                    | •                               |                                 | •                             |                                |  |
| Fuel and<br>Recirculation<br>Hoses                       | Clean and inspect<br>Check all hose clips.  |                    |                                 |                                 |                               |                                | Replace hoses<br>every 2 years.              |

| ltem                                   | Inspection  | Before<br>Each Use | After 1st<br>10 Hours<br>2 Days | Every 30<br>Hrs or<br>7 Days | Every 50<br>Hrs or<br>30<br>Days | Every 100<br>Hrs or<br>60<br>Days | Remarks  |
|--|---|--------------------|---------------------------------|------------------------------|----------------------------------|-----------------------------------|--|
| Engine<br>Compression                  | Check with compression<br>gauge   |                    |                                 |                              | •                                |                                   | Obtain normal<br>operating<br>temperature and<br>check at full throttle. |
| Water Pump                             | Check for wear and damage.  |                    |                                 |                              | •                                |                                   | Replace impeller<br>every 200 hours<br>(12 months).                      |
| Coolingand<br>Exhaust<br>Components    | Remove dirt and<br>deposits from the<br>following:<br>Water pump and<br>impeller<br>Water pipe<br>Thermostat<br>Exhaust cover<br>Exhaust pipe<br>Engine base<br>Reverse gas passage |                    |                                 |                              |                                  | •                                 |  |
| Power head<br>Cleaning                 | Inspect and remove<br>carbon deposits from<br>the following:<br>Cylinder head<br>Pistons<br>Rings<br>Inner exhaust cover<br>Outer exhaust cover                                     |                    |                                 |                              |                                  | •                                 | Check every200 hours<br>(12 months).                                     |
| Electrical<br>Wiring                   | Check for loose<br>connections<br>Inspect wires and<br>insulation fordamage   |                    | •                               |                              |                                  | •                                 |  |
| Ignition<br>Timingand<br>FIS           | Check andadjust timing<br>Adjust linkage.   |                    | •                               |                              |                                  | •                                 | See Synchronization<br>and Linkage<br>Adjustments in this<br>section.    |
| Throttle and<br>Choke Valve<br>Linkage | Inspect for the<br>following:<br>Loose balljoints and<br>lock nuts<br>Bent link rods<br>Loose rod snaps   |                    | •                               | •                            |                                  |                                   |  |

| ltem                    | Inspection   | Before<br>Each<br>Use | After 1st<br>10 Hours<br>2 Days | Every 30<br>Hrs or<br>7 Days | Every 50<br>Hrs or<br>30<br>Days | Every 100<br>Hrsor 60<br>Days | Remarks  |
|-------------------------|--|-----------------------|---------------------------------|------------------------------|----------------------------------|-------------------------------|--|
| Sacrificial<br>Anodes   | Inspect amount of<br>erosion.<br>Test for proper<br>installation.  |                       |                                 |                              | •                                |                               | Replace when anode has<br>been reduced<br>to 2/3 its original size(1/3<br>eroded).<br>See Anodes - Inspection<br>and Testing<br>in this section. |
| Water Intake<br>Screens | Check for blockages.   | •                     |                                 |                              |                                  |                               | Remove and clean as required.  |
| Operational<br>Checks   | Check function and<br>condition of the following:<br>Water discharge from<br>check ports<br>Tiller or remotesteering<br>controls<br>Manual or remote<br>clutch engagement<br>Main switch key<br>Emergency stop switch<br>Drag link<br>and hardware | •                     |                                 |                              |                                  |                               |  |

## Break In Procedure – Raider 40

#### 

Failure to follow the Break-In Procedure I Owner's Manual and special fuel mixture requirements for break-in may lead to serious engine damage and shortened engine life.

To prevent serious engine damage and ensure long engine life, new engines, used engines with new powerhead, used engines with newly rebuilt powerhead, and engines coming out of storage must be run for a period of 10 hours in accordance with break-in procedure.

#### 

After break-in has been successfully completed fuel bladder should be filled with a 50:1 ration gas/oil premix. If heavy fuels are to be used follow instructions on label.

First 10 Minutes {0 - 0.16 Hours)

- 1. Fill the fuel tank with a 25:1 gasoline to oil premix full synthetic only for Raider 40.
- 2. Operate the engine at minimum idle speed ONLY.
- 3. Verify a steady stream of water from the cooling water check port and idle port on the engine, indicating the water pump is functioning property.

#### Next 50 Minutes {0.16 to 1 Hour)

- 1. DO NOT operate the engine above 1/2 throttle.
- 2. DO NOT maintain a constant throttle setting. Vary engine speed from 1/4 to 1/2 throttle every 15 minutes.

#### NOTE

Zodiac boats which comeon to plane easily, use full throttle to quickly accelerate onto plane; then immediately reduce throttle to 1/2 and maintain this speed. Wing Inflatable's – with Raider should not be any different.

#### Next Hour (1 to 2 Hours)

- 1. Use full throttle to quickly accelerate boat onto plane; then immediately reduce throttle to 3/4 and maintain this speed.
- 2. At intervals, run engine at ¾ throttle for 1-10 minutes then return to ½ throttle for a cooling period.
- 3. Vary engine speed every 15 minutes.
- 4. Check for water discharge from cooling water check ports.

#### Next Eight Hours (2 to 10 Hours)

- 1. Run engine at 3/4 throttle.
- 2. For short periods of time, run engine at full throttle and then reduce speed back to 3/4 throttle. As this part of the break-in period progresses, open to full throttle for longer and longer periods of time, but never longer than 5 minutes.
- 3. Vary engine speed every 15 minutes.

DO NOT exceed the Full Throttle RPM Range of the engine. See Engine Specifications in this section.

After Break-in Re-torque cylinder head bolts to specification after engine has been run and cylinder head has cooled to the touch.

Empty fuel tank and replenish with a 50:1 gasoline/oil mixture.

# **Tune Up Procedures**

#### 

Deteriorated or damaged parts identified during engine tune-up must be replaced in order to maintain safe engine operation.

- 1. Inspect engine for leaks, missing, loose or damaged parts, or other visible defects.
- 2. Remove each spark plug and check for fouling, cracks in ceramic, and incorrect gap. Replace plugs if needed.
- 3. Check engine compression. Refer to Cylinder Compression Test in Section 4.
- 4. Check all wiring, connectors, and clamps for damage. Replace parts as needed.
- 5. Replace fuel filter and inspect carburetor. Check fuel hoses for deterioration. Replace as needed.
- 6. Check for proper clutch engagement and make shift linkage adjustments as needed for proper operation of the reverse lock mechanism.

| Model | AdjustmentPart  |
|-------|---|
|       | Shift lever stopper holder : Position onto Shift<br>lever stopper plate |

Adjust the engine ignition timing and Fuel Induction System. See Synchronization and Linkage Adjustments, this section.

Remove propeller and inspect propeller shaft oil seal for leakage. Inspect propeller thrust washer, and other propeller shaft hardware for damage. Replace as needed.

- 1. Drain and refill the Gearcase with gear oil. See Engine Specifications in this section.
- 2. Lubricate all engine components as specified in the Lubrication Chart, this section.
- 3. Verify that all bolts and screws are torque to specification by applying a torque wrench to each.
- 4. Run engine intest tank with propertest propeller and check for the following:
- Abnormal engine noise.
- Improper clutch operation.
- Little or no cooling water discharge from check port and idle port.
- Fuel leaks from mating surfaces of crankcase.
- Fuel leaks from mounting surface of intake manifold.
- Cooling water leaks from mating surfaces of cylinder head.
- Cooling water leaks from engine mounting surfaces.
- Cooling water leaks from exhaust cover mountingsurfaces.
- Improper idle RPM and stability.
- Defective stopswitch.

# **Emergency Stop Switch and Lanyard**

The emergency stop switch and lanyard should be inspected and tested after servicing outboard. The operator should perform Emergency Stop function test with the boat in the water prior to leaving the launch area.

# 

Do not attempt to repair worn of faulty stop switch and lanyard. Replace only with genuine parts. Do not substitute.

#### Inspection

1. Inspect lanyard (1) for cuts or fraying, lock clip(2) for cracks.

2. Inspect stop switch assembly {3) for signs of wear and make sure the switch has adequate spring tension to hold the lanyard lock clip in place.

#### **Stop Switch Test**

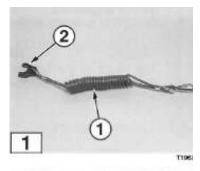
- 1. Attach the lanyard lock clip to the stop switch.
- 2. Start the engine.
- 3. With the engine running, pull the lanyard to disengage the lock clip. Engine should stop running.

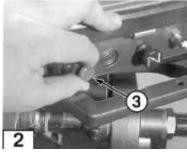
#### NOTE

The stop switch also operates as a push-button switch with the lanyard left attached.

4. Repeat the test but do not remove the lanyard. Press down firmly and hold the stop switch until engine stops running.

If engine continues to run in either test, the stop switch or wiring are faulty and must be replaced before engine is operated.





# Synchronization and Linkage Adjustments

To ensure consistent engine idling and smooth operation throughout the full RPM range, it is important that each procedure be performed exactly as written and in the following sequence:

- 1. Ignition Timing Adjustment
- 2. Fuel Induction Synchronization

# 

Before beginning procedures, disable the ignition system (battery) to prevent accidental engine startup.

#### NOTE

*The* seam at the mating surfaces of the crankcase halves is the alignment point for all ignition timing degree measurements.

| Throttle Setting | Full Open  |             | Full Close | ed (In Gear) |
|------------------|------------|-------------|------------|--------------|
| Raider           | Match Mark | Target RPM  | Match Mark | Target RPM   |
| 40               | BTOC 25°   | 5200 - 5800 | ATOC 2°    | 850          |

#### **Raider 40 Adjustment Procedure**

Rotate the throttle grip to the FAST side until the throttle stops

Adjust ignition timing link so that the timing full open match mark is aligned with the fitting line (Crankcase Mating Surfaces).

Adjust the stopper bolt so that the advancer arm touches the full open stopper bolt when throttle is fully opened.

Turn the throttle grip toward SLOW side.

Adjust the stopper bolt (for full close adjustment) so that it hits the stopper bolt at the position where the magneto coil plate timing mark (fully closed side) meets the ignition timing inspection line (crank case mating surface).

#### ▲ CAUTION

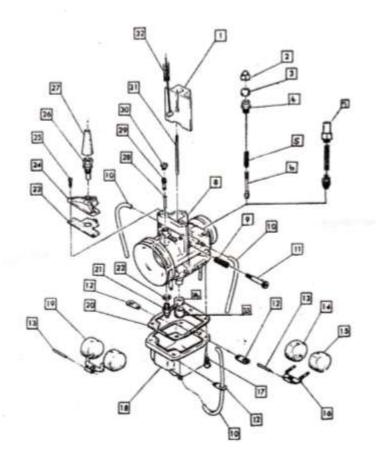
After making adjustments, check that the advancer arm moves freely and smoothly. Tighten adjusting nut after completing adjustments.

# **Fuel Induction System Adjustment**

The Fuel Induction System (FIS) allows the Raider 40 to operate with multiple fuels. Advantages it can operate at any altitude without adjustments. To change from gasoline to heavy fuels turn three levers to "Green." Below is picture of FIS.



The cover on the front keeps debris from entering when submerged. The FIS breaks down the fuels to microscopic droplets due to the design of the venture; metering rod and engine harmonics. A rebuild kit is provided with spare parts.



# ANODES - INSPECTION AND TESTING

Engines are equipped with several sacrificial anodes to help protect metal parts from the effects of galvanic corrosion (electrolysis). Disintegration of the anodes indicates they are performing their function. An anodes must be replaced when it has been reduced to 2/3 its original size (1/3 eroded). Engine corrosion will increase if eroded anodes are not replaced.

## 

Do not paint or coat anodes or their mounting surfaces.

#### External Anodes

Anodes mounted externally on the engine should be inspected every 3 months, or more frequently if the engine is operated in salt or polluted water.



Inspect the sacrificial trim tab (1) for erosion.

Inspect the mid-section or lower unit anode (2) for erosion.

#### **Powerhead Anode**

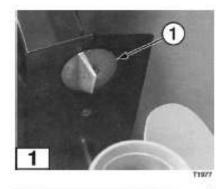
The powerhead is protected by an anode mounted in the cylinder head or cylinder. The anode should be replaced whenever service work requires removal of the cylinder head, or when a complete overhaul of the engine is performed.

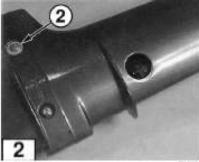
#### Installation Test

Use the following procedure to test for proper installation of the anode. Make sure the surface of the anode is clean before testing.

1. Calibrate an ohmmeter on high ohms scale.

 Connect one meter lead to a ground on the powerhead and the other lead to the anode. The ohmmeter should show a low reading.
 If not, remove the anode and clean the surface where it was mounted. The anode and its mounting hardware should also be cleaned. Install anode and retest.





# **SECTION 3 - FUEL SYSTEM**

# **General Precautions**

## 

Gasoline is extremely flammable and can explode if mishandled. JP-5/8 is also hazardous.

- 1. Before performing any service work on the fuel system, read and understand Section 1 Service Safety.
- 2. Before servicing the fuel system, disable the ignition system by removing all spark plug leads to prevent accidental starting of engine.
- 3. Fuel leakage can contribute to a fire or explosion. After service work is complete and engine is fully assembled, always run the engine momentarily to pressurize the fuel system. Then check for leaks.
- 4. Never attempt to run the engine with any fuel system component removed or disconnected.
- Check fuel hoses and other non-metallic component's for indications of damage or deterioration. Always replace components with authorized factory replacement parts suitable for fuel systems.
- 6. Clean up fuel spills immediately and store rags in approved containers. Keep drained fuel in approved containers for proper disposal.
- 7. When using compressed air to clean or dry parts, make sure the air supply is regulated not to exceed 25 psi [172kPa/1.76kg/cm2].

# Service Specifications,

#### NOTE

Refer to Section 2 for Standard Torque Values chart.

| Description                       | 40                                      | Torque               |
|-----------------------------------|---|----------------------|
| Fuel Induction Mounting Bolt      | 40 - 55<br>4.6 - 6.2<br>0.47 - 0.64     | in-lb<br>N⋅m<br>kg-m |
| Air Silencer Cover<br>Bolt/Screw• | 43.2 - 54.6<br>4.9 - 6.4<br>0.50 - 0.65 | in-lb<br>N⋅m<br>kg-m |
| Inlet Manifold Mounting Bolts     | 43.2 - 54.6<br>4.9 - 6.4<br>0.50 - 0.65 | in-lb<br>N⋅m<br>kg-m |

•Loctite #242 required

No Manufacturer Special Tools are required.

## **General Equipment Required**

Fuel Pressure Gauge, 0 - 15 psi [0 - 1 kg/cm•] Tee Fitting with 3/8 in O.D. barbs [9.5 mm O.D.] Torque Wrench, 0 - 150 in-lb [0- 17 N·m/0 - 1.7kg-m] Digital Pulse Tachometer Flexible Fuel Tubing, 3/8 in I.D. x 5 in. [9.5 mm I.D. x 127 mm]

#### **Consumable Supplies Required**

Thread Locking Compound, Loctite 272 Isopropyl Alcohol Cleaning Solvent Lint-free Wipes

## **Fuel System Requirements**

#### Acceptable Fuel - Gasoline

Any gasoline with pump posted octane rating over 87 (research octane rating of 91) and with no more that 10% Ethanol by volume.

#### Acceptable Fuel – Heavy Fuels

JP-5/8; kerosene; diesel #2; are acceptable. It is critical to insert additive in 50:1 mix. 50:1 mix must be used in addition to the additive.

#### **Unacceptable Fuel**

Gasoline with more than 5% Methanol (even if it contains co-solvents or corrosion inhibitor) or more than 10% Ethanol, regardless of the octane rating.

#### **Fuel Storage Life**

Fuel of storage should not be used after a period of 3 months.

#### Acceptable Lubricant

Any NMMA certified TC-W3 2-cycle outboard engine oil is acceptable for fuel tank premix applications on gasoline. Do not use automotive oils which can damage the engine and shorten spark plug life. For Heavy Fuels (JP-5/8, kerosene, diesel) use additive (Mercury JP or Raider JP with additive).

#### **Mix Ratios**

#### 

A 25 : 1 gasoline/oil mixture is required during engine break in. Refer to Break-In Procedure in Section 2.

#### **Gasoline Premixing**

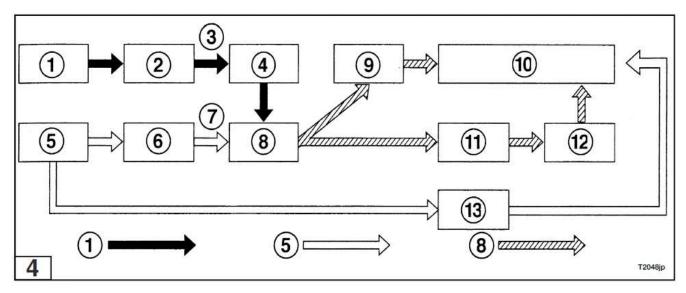
A 50:1 gasoline/oil mixture (2% oil) is required. New engines or reconditioned power heads require a 25:1 gasoline/oil mixture (4% oil) during break-in.

#### Heavy Fuel Premixing

A 50:1 Heavy Fuel Additive is required. Each container will support a 6 gallon bladder.

All mixing must be done prior to mission.

## **Fuel System Operation – Raider**



Each step of the fuel entering the Raider 40 will be explained in this section.

Under idling conditions, the mixture of fuel and air is mainly output from the pilot outlet. As throttle is increased, the negative pressure applied to the pilot system increases and allows more of the mixture to flow from the bypass. When the throttle is opened further, the increase of air causes a pressure drop which allows the main system to assume full control of fuel delivery.

## **Troubleshooting fuel issues**

The troubleshooting chart lists common engine symptoms related to problems with the fuel system. It also indicates specific malfunctions in the fuel system which may be causing the problem so it can be isolated more effectively. Before beginning major troubleshooting operations on the fuel system, perform the following operations:

- Disconnect fuel tank hose from the engine. Connect a known good bladder and hose and determine if the problem persists.
- Remove and clean the engine fuel filter assembly and replace the filter element.
- Replace filter element in the fuel tank pickup tube.

| Iroubles  | snc                                | ot                      | Ing                   | <b>ј</b> Г                                 | ue                       |                                     | SSI  | Je  | S  |   |                          |                          |                               |
|---|------------------------------------|-------------------------|-----------------------|--|--------------------------|-------------------------------------|--|---|--|---|--------------------------|--------------------------|-------------------------------|
| Symptom<br>Checks                                     | Hard to start or<br>will not start | Misses at low<br>speeds | Misses at high speeds | Poor acceleration,<br>hesitation or coughs | Runs rough<br>and smokes | Idles well, then<br>slows and stops | Will not start and after fires<br>into exhaust housing | No acceleration,<br>low/full throttle RPM | Idles well but<br>slows when accelerated | Runs at high speed only<br>when hand primer is used | Engine stops<br>suddenly | Runs noisy<br>and knocks | Excessive fuel<br>consumption |
| · · · · · · · · · · · · · · · · · · ·                 | FUEL TANK AND FILTERS              |                         |                       |  |                          |                                     |  |   |  |   |                          |                          |                               |
| Empty fuel tank                                       | •                                  |                         | <u> </u>              |  |                          |                                     |  |   |  | ļ   | ٠                        | L                        | L                             |
| Low fuel in tank                                      |                                    | •                       |                       | •  |                          |                                     |  |   |  | L .   |                          |                          |                               |
| Fuel tank air vent closed                             | •                                  |                         |                       |  |                          | •                                   |  |   |  | • •   | ٠                        |                          |                               |
| Poor quality or old fuel                              | ٠                                  | ٠                       | ٠                     |  | <b>`•</b>                |                                     |  |   |  |   |                          |                          |                               |
| Water in fuel system                                  | •                                  |                         | •                     |  |                          |                                     |  |   | ٠  | 1   |                          |                          |                               |
| Fuel hose pinched<br>or disconnected                  | •                                  |                         |                       |  |                          |                                     |  | •   | •  | •   |                          |                          |                               |
| Restricted fuel pickup pipe or<br>clogged pipe filter | •                                  |                         |                       |  |                          |                                     |  | •   | ٠  | •   |                          |                          |                               |
| Faulty primer bulb                                    | ٠                                  |                         |                       |  |                          |                                     |  |   |  |   |                          |                          |                               |
| Improper or faulty<br>anti-siphon valve               | •                                  |                         |                       |  |                          |                                     |  | ٠   | •  | •   |                          |                          |                               |
| Clogged fuel filter                                   | •                                  |                         |                       |  |                          |                                     |  | ٠   | ٠  | •   |                          |                          |                               |
| Loose connector or vacuum leak                        | •                                  |                         |                       |  |                          |                                     |  |   | •  |   |                          |                          |                               |

## Troubleshooting Fuel Issues

## Oil and Fuel Induction (Carburetor)

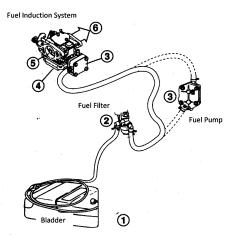
| Symptom<br>Checks  | Hard to start or<br>will not start | Misses at low<br>speed | Misses at high speed | 1  | Runs rough<br>and smokes | Idles well, then<br>slows and stops | Will not start and after fires<br>into exhaust housing | No acceleration,<br>low/full throttle RPM | Idles well but slows<br>when accelerated | Runs at high speed only<br>when hand primer is used | Engine stops<br>suddenly | Runs noisy<br>and knocks | Excessive fuel<br>consumption |
|--|------------------------------------|------------------------|----------------------|----|--------------------------|-------------------------------------|--|---|--|---|--------------------------|--------------------------|-------------------------------|
|  | <u> </u>                           | IL MI                  | XTUF                 | ۲E |                          |                                     | r  |   |  |   |                          |                          |                               |
| Mixture too rich<br>(too much oil)                                 |                                    | •                      |                      |    | ٠                        |                                     |  |   |  |   |                          |                          |                               |
| Mixture too lean<br>(not enough oil)                               |                                    | ٠                      |                      |    |                          | •                                   |  | •   | ٠  |   |                          | •                        |                               |
| na se anna an tha anna an tha anna ann ann ann ann ann ann ann ann | CA                                 | RBU                    | RETO                 | DR |                          |                                     | h.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,                 |   |  |   |                          |                          |                               |
| Carburetor out of adjustment                                       | •                                  | •                      |                      | •  | •                        |                                     |  | ٠   | ٠  | •   |                          |                          |                               |
| Carburetor obstruction or faulty<br>needle valve                   | •                                  |                        |                      |    |                          |                                     |  |   |  |   |                          |                          |                               |
| Restricted air flow to<br>carburetor                               |                                    |                        |                      |    | •                        |                                     |  |   |  |   |                          |                          |                               |
| Faulty choke valve   | •                                  |                        |                      |    | •                        |                                     |  |   | ٠  |   |                          |                          |                               |
| Carburetor and ignition timing not synchronized                    | •                                  |                        |                      |    |                          |                                     |  | •   |  |   |                          |                          |                               |
| Float position too high  |                                    |                        |                      |    | ٠                        |                                     |  |   |  |   |                          |                          | •                             |
| Float position too low   |                                    |                        |                      | ٠  |                          |                                     |  |   | ٠  | ٠   |                          |                          |                               |
| Jet obstructed or defective  |                                    |                        |                      | ٠  |                          |                                     |  |   | ٠  | ٠   |                          |                          | •                             |
| Carburetor gasket leakage  |                                    |                        |                      | ٠  |                          |                                     |  |   |  |   |                          |                          | •                             |

## Troubleshooting Recirculation, Fuel Pump, Inlet Manifold

| Symptom<br>Checks                              | Hard to start or<br>will not start | Misses at low<br>speed | Misses at high speed | Poor acceleration,<br>hesitation or coughs | Runs rough<br>and smokes | Idles well, then<br>slows and stops | Will not start and after fires<br>into exhaust housing | No acceleration,<br>low/full throttle RPM | Idles well but slows<br>when accelerated | Runs at high speed only<br>when hand primer is used | Engine stops<br>suddenly | Runs noisy<br>and knocks | Excessive fuel<br>consumption |
|--|------------------------------------|------------------------|----------------------|--|--------------------------|-------------------------------------|--|---|--|---|--------------------------|--------------------------|-------------------------------|
|  | REC                                | IRCUI                  | ATIO                 | N  |                          |                                     |  |   |  |   |                          |                          |                               |
| Puddle drain valve or hose<br>blockage         |                                    | •                      |                      |  | •                        | •                                   |  |   |  |   |                          |                          |                               |
| Recirculation hose<br>misrouted                |                                    | ٠                      |                      | •  |                          |                                     |  |   |  |   |                          |                          |                               |
|  | F                                  | UEL                    | PUMI                 | p  |                          |                                     |  |   |  |   |                          |                          |                               |
| Mounting gasket leakage                        |                                    |                        |                      |  |                          | •                                   |  |   |  | •   |                          |                          |                               |
| Check valve sticking open or<br>closed         |                                    |                        |                      | •  |                          |                                     |  |   | . <u> </u>                               | ٠   |                          |                          |                               |
| Ruptured diaphragm                             |                                    |                        |                      | •  |                          |                                     |  |   |  |   |                          |                          | •                             |
| INLET MANIFOLD                                 |                                    |                        |                      |  |                          |                                     |  |   |  |   |                          |                          |                               |
| Warped inlet manifold                          |                                    | •                      |                      | •  |                          |                                     |  |   |  |   |                          |                          |                               |
| Manifold gasket leakage                        |                                    | ٠                      |                      | •  |                          |                                     |  |   |  |   |                          |                          |                               |
| Faulty reed valve operation or<br>broken valve |                                    | ٠                      |                      | ٠  |                          |                                     |  | ٠   |  |   |                          |                          |                               |
| Reed valve gasket leakage                      |                                    | ٠                      |                      | ٠  |                          |                                     | ٠  | •   |  |   |                          |                          |                               |

## **Raider – Description of Operation**

Upon engine startup, premixed fuel is drawn from fuel tank (1) by vacuum pressure on the suction side of the fuel pump through the fuel filter (2) and, into fuel pump (3). Fuel flows from the fuel pump into the Fuel Induction chamber (4). Fuel is drawn from the fuel induction metering rod into the FIS (5) where it is mixed with a ir and pulled into the crankcase (6).



#### Fuel Pump [3] above

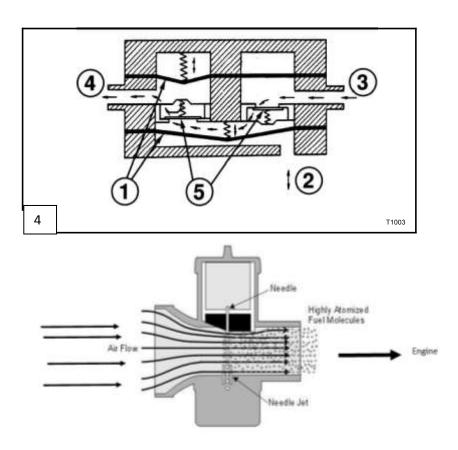
The fuel pump is integral with the Fuel Induction Unit and mounted on the side of the crankcase and contains one or more internal diaphragms (1). The diaphragms move in response to changing crankcase pressures (2) which draws fuel in (3) and pumps fuel out (4). A series of check valves (5) in the pump ensure that fuel moves only in one direction.

#### Fuel Induction System (FIS) [4] above

The FIS use a pilot system and main system to meter and deliver an atomized fuel mixture to the engine for combustion under varying operating conditions.

#### Fuel Induction System operating system

The operation of the FIS is shown below.



Single Point Fuel Pickup (No Jets) Extremely High Atomization *Altitude Compensation Low HC and CO Emission* 

#### Main System

**5** The main system in the carburetors is a high speed system consisting of the main jet, main nozzle and main air jet. As the throttle valve opens, mixed fuel (14) enters the carburetor and flows from the carburetor float chamber (15) to main jet (16). The fuel is then measured and directed to the main nozzle (17) bleed hole where it combines with air (18) from the main air jet (19). The increased air quantity and flow rate at venturi (22) allows pressure drop at the tip of main nozzle (20), causing increased output of fuel/air mixture (21). The fuel mixture combines with main air at the venturi (22) before entering the engine (23).

## Recirculation

Recirculation hoses at the inlet manifold and crankcase re-circulate unburned fuel for engine consumption.

## **Fuel Bladder Connection**

Fuel bladder connectors need to change over from MARS OMC to a new improved snap on connector. A male fuel connector should be used.

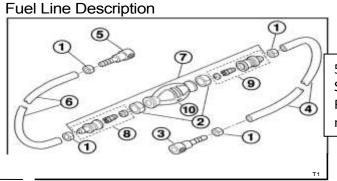
#### Cleaning

Water or dirt in the fuel bladder can cause fuel starvation and engine problems. Clean and inspect fuel bladder once a year or after long timestorage (more than 3 months).

- 1. Disconnect fuel line from fuel bladder.
- 2. Empty remaining fuel from bladder and properly dispose.
- 3. Fill tank 1/4 with fresh gasoline and install cap. Rigorously shake tank for 30 seconds to loosen dirt particles.
- 4. Empty gasoline from tank and properly dispose.
- 5. Inspect tank components before refilling.

#### Inspection

All worn, damaged, or missing parts must be replaced.



5-Bladder connection to Raider See Parts and Assembly Manual R40 ES-001-15-2 for part numbers.

- 1. Clamp P/N 332702010M
- 2. Clamp P/N 3C7702170M
- 3. Fuel Connector to Bladder P/N 3B2702810M
- 4. Fuel Hose 7MM (5/16") Use fuel line material
- 5. Fuel Connector Engine side female P/N 3B2702501M
- 6. Fuel Hose 7MM (5/16")
- 7. Complete Assembly No Part No. available
- 8. Joint Assembly outer P/N: 3C7702241M
- 9. Joint Assembly inner P/N: 3C7702201M
- 10. Primer Bulb P/N 3C7702111M

#### \*MALE QUICK CONNECTOR

The connector that should be inserted into Fuel Bladder is Part Number 9999800MA2 is the complete fuel line assembly that can be cut and inserted in the fuel bladder (1/4 inch NPT).

Fuel bladder is connected to the engine by a hose with a primer bulb. The primer bulb forces fuel into the Fuel Induction System for engine starting. Check valves on each side of the primer bulb maintain fuel flow, in one direction only, from the tank to the engine.

#### Disassembly

#### NOTE

Direction of fuel flow as indicated by the arrow on the primer bulb.

- 1. Remove and discard hose clamps (1) and primer bulb clamps (2) as required.
- 2. Remove tank connector (3) and hose (4).
- 3. Remove engine connector (5) and hose (6).
- 4. Remove primer bulb assembly 7. Remove check valves
- 5. (8) and (9) from primer bulb (10).

#### **Cleaning and Inspection**

- 1. Clean components using soap and water.
- 2. Dry all components with low pressure compressed air. Make sure all parts and passages are completely dry. Inspect primer bulb and hoses for oracks and deterioration.
- 3. Inspectbladderandenginequick connectors for damage and wear. Make sure check valves in quick disconnects open freely when pressed.
- 4. Inspect primer bulb check valves for damage.
- 5. Reassemble all components.

#### **In-Line Fuel Filter Replacement**

#### NOTE

In-line fuel filters cannot be serviced. Replace in-line fuel filters once a *year* or with each tune-up. When replacing an in-line fuel filter, note direction of fuel flow as indicated by the arrow on the filter housing for proper installation.

- 1. Loosen clips (1) on each side of the filter (2) and slide down the hose.
- 2. Separate the fuel filter from the hoses and discard.
- 3. Replace with new filter
- 4. Attach hoses and secure clips

## $\triangle$ CAUTION

Before servicing the fuel pump, disconnect the fuel hose from the engine to prevent excessive spillage.

## **Disassembly – Fuel Pump**

NOTE

Match mark *parts* before disassembly and reference the illustrations in the Inspection procedure to ensure proper orientation of internal components.

Expand and move clips (1) on fuel hose(s) (2).

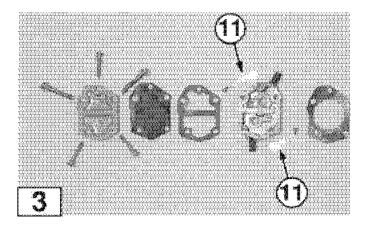
Disconnect fuel hoses from fuel pump.

Loosen pump mounting screws (3) and remove fuel pump (4) and gasket from crankcase.

Remove fuel pump cover screws (5) and cover (6). Gently separate the pump components.

Remove all check valves (11) from pump body.

Remove and discard all serviceable gaskets and diaphragms



#### Cleaning

- 1. Clean all pump components with kerosene.
- 2. If necessary, clean pump mounting surface on FIS with isopropyl alcohol.
- 3. Dry all components with low pressure compressed air.

#### Inspection

Inspect pump body (1) for cracks.

Inspect check valves (2) for deformation.

Inspect pump covers (3) for cracks and surface deformation.

Inspect guide plate (4) and spring (5), if equipped, for deformation and tension. Inspect gasket between crankcase and fuel pump for dryness (crankcase-mounted

pumps).

#### Assembly

- 1. Install all check valves in pump body.
- 2. Fully assemble fuel pump. All serviceable gaskets and diaphragms must be replaced.
- 3. Install fuel pump. Use Loctite 242 on mounting screw threads.
- 4. Connect fuel hoses to fuel pump.

#### Fuel Induction System

The fuel induction System looks like a carburetor however is much different. Air flows into the FIS through a venture system that increases flow. That air flow, via a metering rod and harmonics breaks the fuel into a fine mist – just like direct injection. The droplets allow for better fuel burn which increases power and extends mileage.

When burning heavy fuels (JP-3/5/8, kerosene, and diesel) three settings are defined in the User's Manual.

The FIS compensates for altitudes with no modifications

#### Removal

- 1. Remove motor cover.
- 2. Disconnect fuel supply.
- 3. Removefuelhose from FIS.
- 4. Loosen clamp bolts and remove Fuel Induction unit.

#### $\triangle$ CAUTION

Use the following precautions during Fuel Induction disassembly

- 1. Clean plastic parts with warm soapy water.
- 2. Dry all components with low pressure compressed air.
- 3. When drying passages, direct the flow of air opposite the direction of fuel flow.

4. DO NOT inspect passages or holes with wire or similar materials. Doing so may scratch or enlarge jet holes and alter the fuel-air ratio.

#### NOTE

Before inspection, all fuel induction components must be cleaned. All worn or damaged parts must be replaced.

#### **Reed Valve**

#### Disassembly

1. Follow steps listed in Carburetor Removal procedure, this section.



2. Disconnect the linkage at the throttle cam.

3. Remove the crankcase recirculation hose from the manifold.

 Remove recoil starter or flywheel cover as applicable, refer to Powerhead section.



5. Remove the intake manifold.

 Remove the reed valve assemblies from the manifold or lift them from the crankcase as applicable. DO NOT disassemble the reed valve assemblies. (Except 8/9.8)

#### Inspection



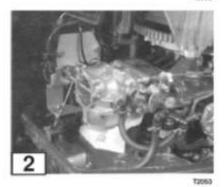
1. Inspect the reed valve assemblies:

- All gasket surfaces must be flat, within ± 0.003 in [0.08 mm].
- Inspect reeds (1) for cracks or chips. Reeds must be seated flat without any preload.
- Check tightness of reed valve stoppers (2). If loose, tighten screws using Loctite 242.
- · Inspect valve seat surface (3) for rise, wear, or damage.

Lift height of each reed valve and stopper must meet specification.

## 5 Reed Valves Raider

|                     | 40             |
|---------------------|----------------|
| No. Valves          | 12             |
| Strips Valves/Strip | 4 Strips       |
|                     | 3 Valves/Strip |
| A=Valve             | 0.236-0.244 in |
| Height              | (6.0-6.2 mm)   |





| B=Gap Valve End Valve Seat |  |
|----------------------------|--|
|                            |  |
|                            |  |

0.0079 in (0.2 mm)

Inspect entire valve assembly

If any part of the reed valve assembly is worn, damaged, or corroded, entire valve assembly must be replaced.

#### CAUTION

Used reeds must never be turned over and re- used. Reed could break when returned to service, causing serious powerhead damage.

2. Inspect the intake manifold:

All gasket surfaces must be smooth and free of nicks

**6** Check manifold surface for flatness in all directions. Mounting surface must be flat, within  $\pm 0.004$  in [0.10 mm].

#### NOTE

All intake manifold components must be perfectly clean before assembly. Use isopropyl alcohol. DO NOT use a carburetor cleaner or a soaking tank.

Never reinstall the used reed valve screws because the effect of the adhesive has been lost and may Lead to reed valve failure during operation.

Verify that the clearance between the reed valve and the valve seat is 0.0078 inches (0.2 mm) or Less after assembly.



1. Assemble the intake manifold components as illustrated:

- Install all gaskets dry.
- Torque manifold bolts evenly to specification.
- 2. Connect the crankcase recirculation hose to the manifold.
- 3. Follow steps listed in Carburetor Installation procedure, this section.
- 4. Connect the linkage at the throttle cam.

5. Install recoil starter or flywheel cover as applicable, refer to Powerhead section.

## **SECTION 4 - POWERHEAD**

## **General Precautions**

Before performing any service work on the powerhead, read and understand the Service Safety section at the beginning of this manual.

Use the manufacturer special tools as indicated during servicing of the powerhead.

Use caution when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel.

Check entire fuel system for leaks after servicing the powerhead to prevent fire or explosion.

Make sure all ignition and electrical leads are properly routed and clamped in their original positions.

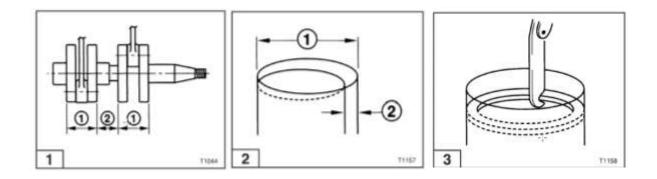
Disable the ignition system and disconnect the battery when servicing the powerhead.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

Always inspect and test the start-in-gear prevention system before returning engine to customer.

#### Service Specifications - (Standard Value)

| Fig                        | Description                       |          | Unit  | Raider 40   |
|----------------------------|-----------------------------------|----------|---|---|
|                            | Compression                       |          | psi kPa<br>kg/cm•   | 106.6<br>735<br>7.5   |
|                            | Thermostat Opening<br>Temperature |          | OF<br>OC  | 125.6<br>52   |
|                            | Crankshaft<br>(off center)        |          | in<br>mm  | <0.002<br><0.05   |
| Crankshaft<br>(dimensions) | 1                                 | in<br>mm | $\begin{array}{c} 2.071 \pm 0.002 \\ 52.6 \pm 0.05 \end{array}$ |   |
| 1                          |                                   | 2        | in<br>mm  | $\begin{array}{c} 1.591 \pm 0.002 \\ 40.4 \pm 0.05 \end{array}$ |
| 2                          | Cylinder Bore                     | 1        | in<br>mm  | 2.756<br>70   |
| 2                          | Piston Clearance                  | 2        | in<br>mm  | 0.0024 - 0.0039<br>0.05 - 0.10                                  |
| 3                          | Piston Ring End Cap               |          | in<br>mm  | 0.008 - 0.016<br>0.20 - 0.40                                    |



#### Manufacturer Special Tools Required

Flywheel Puller Assembly, 336-72214-0 Flywheel Stripper, 386-72214-1 Piston Pin Tool, 332-72215-0 Piston Ring Tool, 353-72249-0Thickness Gauge Set, 353-72251-0

#### **General Equipment Required**

Compression Gauge, 0 - 199 psi [0 - 1,350 kPa / 0 - 13.7 kg/cm<sup>2</sup>] Water Pressure Gauge, 0 - 15 psi [0 - 98 kPa / 0 - 1 kg/cm<sup>2</sup>] Torque Wrench, 0 - 150 in-lb [0 - 17 N-m / 0 - 1.7kg-m] Torque Wrench, 0 - 750 ft-lb [0 - 1000 N-m / 0 - 100 kg-m] Micrometer Set or Vernier Caliper, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range Telescoping Gauge, Inside Micrometer Set, or Vernier Caliper, graduation 0.0001 in [0.01 mm], 1.5 - 4 in [40 - 100 mm] Dial Indicator, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range Analog Multimeter, Electronic Specialties® Model M-530 or equivalent Digital Pulse Tachometer, 10 - 6000 RPM, Electronic Specialties® Model 321 or equivalent Industrial Thermometer, minimum 300°F [150°C] Heat-Resistant Container, Pyrex® **Bearing Puller** Seal Pullers Seal Installer Surface Plate, 20 x 20 in [500 x 500 mm], 0.0001 in [0.01 mm] accuracy

#### **Consumables Required**

Threadlocker, *Loctite® 242* Threadlocker, *Loctite® 243* Gasket Dressing, *Permatex® Hylomar® Aerosol High-Temp Gasket Dressing* Gasket Sealant, *Permatex® High Tack Gasket Sealant* Anaerobic Gasket Maker, *Loctite® 518* Dielectric Lubricant, *Permatex® Dielectric Tune-Up Grease* 

## **Troubleshooting – Power Head**

The troubleshooting chart lists common engine symptoms related to problems with the powerhead. It also indicates specific component failures which may be causing the problem so it can be isolated more effectively.

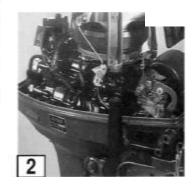
| Checks   | Hard to<br>Start<br>Or<br>Will not<br>start | Low<br>Comp-<br>ression | Runs<br>Rough<br>or<br>Erratically | Idles<br>Poorly | No<br>Accel-<br>eration<br>fails to<br>reach<br>full<br>RPM |   | Engine<br>Over-<br>heats | Runs<br>Noisy<br>Excess.<br>Vibrati<br>on |
|--|---|-------------------------|------------------------------------|-----------------|---|---|--------------------------|---|
| Poor crankcase seal  | •   |                         |                                    |                 |   |   |                          |   |
| lgnition timing or throttle linkage out of adjustment, see Section 2                 | •   |                         | •                                  |                 | •   |   |                          |   |
| Water entering crankcase   | •   |                         |                                    | •               |   | • |                          |   |
| Defective thermostat   |   |                         |                                    |                 | •   |   | •                        |   |
| Fouled, defective or incorrect spark plug;<br>wrong gap setting                      | •   |                         | •                                  | •               |   | • | •                        |   |
| Worn or defective cylinder, piston,rings or warped head                              | •   | •                       |                                    |                 | •   |   |                          | •   |
| Blown cylinder head or engine base gasket  | •   | •                       | •                                  | •               | •   | • |                          | •   |
| Worn connecting rod or crankshaft bearings, internalwear limits out of specification | •   |                         | •                                  |                 |   |   |                          | •   |
| Defective ignition components, see Section 7   | •   |                         | •                                  |                 | •   |   |                          |   |
| Carbon accumulation in combustion chamber  | •   |                         |                                    |                 | •   | • |                          |   |

## DESCRIPTION OF OPERATION

1 2 The power head of this outboard motor is a twostroke engine (or two-stroke cycle engine). The engine completes its one cycle operation including gas mixture suction, compression, explosion and exhaust while the crankshaft rotates once i. e. the piston moves upward and then downward (two strokes).

As the piston starts to move toward top dead center (TDC), the interior of the crank case is made vacuum pressure causing the reed valve to open and the gas mixture to be taken into the crankcase. As the piston comes near the TDC, the spark plug produces the sparks to ignite the compressed gas mixture for combustion. As the fuel mixture is exploded, the piston moves toward bottom dead center (BDC) and open the exhaust port and then scavenging port. The scavenging is an action that sends the fresh gas mixture in the crankcase to the cylinder.





The Raider outboards are unusual from commercial outboards; the head of the Raider has included two dewatering valves that allow water to escape after submersion – when opened. The heads have also been modified to allow more water flow which keeps the engine cooler that will increase reliability and life of the Raider.

## **Cylinder Compression Test**

- 1. Operate engine to normal operating temperature.
- 2. Stop engine.
- 3. Disconnect the magneto leads to disable the ignition system.

#### 

Ignition system – battery must be disabled to prevent accidental engine start up.

- 4. Remove spark plug(s) and install thread-type compression tester in spark plug hole.
- 5. Place throttle in fully open position and crank engine with starter through at least four compression strokes.
- 6. Take reading for each cylinder and verify specified pressure is obtained:

| Raider | Cylinder Compression* psi [kPa/kg/cm2] |
|--------|--|
| 40     | 106.6 [735.0/7.5]                      |

\*Compression variation among cylinders should not exceed 15 psi [103 kPa / 1.05 kg/cm2] on two cylinder engines.

If variation of cylinder compression, on two cylinder engines, exceeds 15 psi[103 kPa/ 1.05 kg/cm2], check for the following:

- Scored cylinder walls.
- Piston damage.
- Head gasket damage.
- Stuck or broken piston rings.

On two cylinder models, if cylinder compression is equal, engine is difficult to start and runs poorly, check for the following:

- Scored cylinder walls.
- Piston damage.
- Stuck or worn piston rings.

## Thermostat

#### Removal

- Remove thermostat cap screws. Gently tap thermostat cap

   (3) with rubber mallet to loosen and remove cap and gasket.
  - Discard gasket.
- 2. Remove thermostat and inspect for obvious damage and corrosion.
- 3. Check pressure relief valve for proper operation.
- 4. Perform thermostat Function Test if thermostat is suspect.

#### Installation

Install thermostat in cylinder head.

Lightly coat both sides of new thermostat cap gasket (1) with gasket sealant. Mount gasket on cap (2).

Install thermostat cap and gasket and torque to specification.

#### **Function Test**

Suspend thermostat and thermometer in a heat-resistant container filled with water.

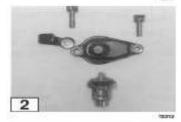
Slowly heat and stir the water. Verify the thermostat opens at 140°F 60°C If it does not open at specified temperature, replace thermostat.

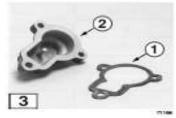
#### 

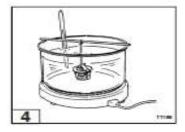
Use a heat-resistant container such as Pyrex® glassware. DO NOT allow Thermostat or thermometer to rest against the glass. Items could overheat and rupture.

1. Remove thermostat and observe its closing action as it cools. If closing action is not slow and smooth, replace thermostat.









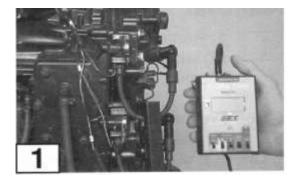
## **RPM Performance Test**



Do not perform RPM test if engine shows signs of overheating.

Perform this test with correct test propeller Installed and with the engine in a test tank.

- 1. Operate engine up to normal operating temperature.
- 2. Stop engine and install tachometer.
- 3. Start and run engine at NEUTRAL idle and verify specified RPM is obtained.
- 4. If test tank conditions permit, run engine in forward gearattrolling and full throttle speeds and check for correct RPM:



| Raider 40 | NEUTRAL<br>RPM | Trolling Speed<br>RPM | I Throttle Speed RPM |
|-----------|----------------|-----------------------|----------------------|
|           | 950            | 850                   | 5200-5800            |

If test results vary, refer to Troubleshooting in this section.

## **Recoil Starter**

#### 

The Raider 40 engines have neutral start mechanism (start-in-gear protection) attached to the recoil starter. This feature disables the engine from starting while in gear (forward or reverse). During reassembly of the engine following repair, ensure that you DONOT DISABLE THE START-IN-GEAR PROTECTION.

#### 

Ignition system must be disabled to prevent accidental engine startup during servicing of the recoil starter.

#### **Removal for Emergency Operation**

Using the tools found in the Emergency Tool Kit; use the socket that has 10 mm on one side and 13 mm on the other end.

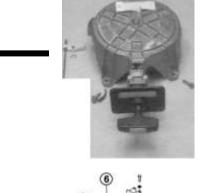
1. Remove the neutral start mechanism components and remove the recoil starter unit from the engine.

2. Rewind the reel and loosen the recoil starter spring. Use a screw driver to put the starter rope in the reel notch. With the rope hooked in the notch, rotate the reel slowly to loosen the rope.

Repeat this process until the starter spring does not pull the reel.

3. Remove the handle from the starter rope (8).







4. Remove ratchet e-ring (7), ratchet (5), ratchet guides A and B (8) and (9), starter shaft bolt (14), starter shaft (11) and finally the reel.

#### **Cleaning and Inspection**

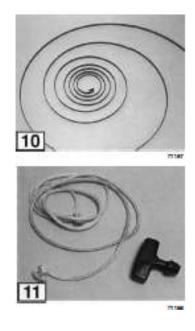
All worn, damaged, or missing parts must be replaced.

- 1. Clean metal parts with solvent and dry with low pressure compressed air. Clean plastic parts with dry cloth.
- 2. Inspect following components as follows:
- 3. Starter rewind spring for cracked or broken and loops.
- 4. Ratchet and reel stopper springs for deformation or poor tension.
- 5. Sliding plates, stopper components, and busing for cracks or signs of wear.
- 6. Reel assembly for wear.
- 7. Starter housing for sharp or rough edges which could fray starter rope. Starter rope for frays and rope handle for damage.

## Assembly -

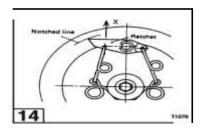
For assembling, use the procedure reverse to the disassembly while observing the following notes.

- When setting the starter spring (2) on the starter spring case (1), direct the outer edge hook of the coil spring to the right and set it in the notch of the starter spring case outer circumference.
- When winding the starter spring (2), rotate the reel (3) to the direction of turn (*left* turn) at pulling out the rope. Then, set the spring so that the reel rotates 1/4 of a turn to one and 1/4 of a turn when rope is fully pulled out.
- Apply anti-freeze grease to both ends of the starter spring (2) and sliding area between the starter shaft bolt (14) and friction plate.
- Tighten the starter shaft bolt to the specified toque.



# **Pull Starter Diagram** 10 1 з 8 9 (11 (1:

- Install the starter locking rod, the starter locking cam shaft and the starter handle.
   Verify that the ratchet operates when the proper load is applied to the ratchet.
   Set ratchet face up, apply grease and measure force.



| Ratchet Load Re | equirements      |
|-----------------|------------------|
| 40:             | 300 to 500 grams |

## Flywheel

#### NOTE

Flywheel magneto must be of a particular strength in order to run the ignition system. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

## ▲ CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

## 

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

#### NOTE

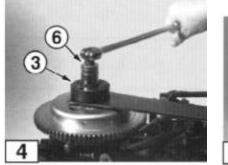
Reference the following specification table for flywheel Removal and Installation special tool requirements.

Wheel Puller Part Number: 211-0 (336-72214-1) for Raider 40 Outboard



Ignition System must be disabled to prevent accidental engine startup during removal of the flywheel.

- 1. Remove recoil starter and starter pulley
- 2. Determine the direction of rotation for removing flywheel nut by running your thumbnail along the threads of the crankshaft.





#### Inspection

- 1. Inspectflywheel forcracks, chips, and damaged taper.
- 2. Inspect crankshaft for thread damage and damaged taper.
- 3. Inspect flywheel key and keyway for damage.

#### Installation of Flywheel

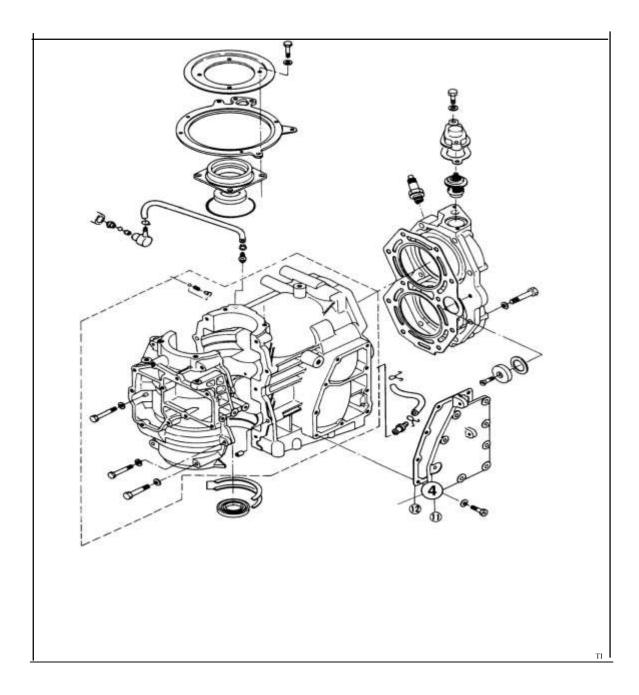
#### 

Ignition system must be disabled to prevent accidental engine startup during installation of the flywheel.

- 1. Remove all grease from tapered portion of flywheel and crankshaft with solvent.
- 2. Check flywheel key is inserted in crankshaft.
- 3. Alignflywheel keyway and install on crankshaft.
- 4. Install the flywheel washer. Install puller arm (1) on flywheel using bolts (2).
- 5. Hold puller arm and torque flywheel nut to specification.
- 6. Install recoil starter.

| Model     | Flywheel Torque                                    |
|-----------|--|
| Raider 40 | 1043 - 1217 in-lb<br>118 - 137 N-m<br>12 - 14 kg-m |

## Raider Engine Block – 2 Cylinder/2 Stroke



#### **Removal of Raider Engine**

#### 

Ignition system must be disabled during removal of the powerhead.

#### NOTE

If service work requires flywheel to be removed, remove flywheel before lifting powerhead from the rest of the engine. See Flywheel, this section.

#### NOTE

Mark the mounting location of all clamps so they can *be* returned to their original positions during assembly of the powerhead.

- 1. Disconnect the battery and fuel tank.
- 2. Disable the ignition system and disconnect the battery terminals on the power head.
- 3. Disconnect all electrical connections
- 4. Disconnect fuel INPUT hose from fuel filter.
- 5. Disconnect pilot water hose from exhaust cover.

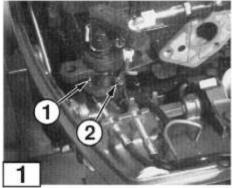
Complete the following operations.

- Remove link rod (3) from advancer arm
- Disconnect shift cable from shift arm.
- Disconnect throttle cable from advancer arm.

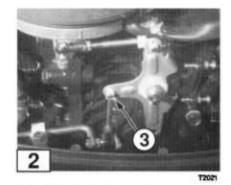
Remove engine mounting bolts.

Rock engine back and forth to break seal, then remove the powerhead by lifting straight up.

Remove lower crankcase head bolts (4). Insert screwdriver in pinch groove and remove lower crankcase head.



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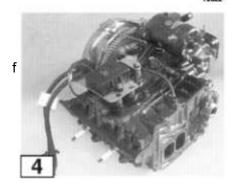


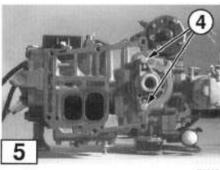
Remove bolts from outside holding Raider powerhead.

Remove Link Rod (3) from Advancer arm

7. Remove engine mounting bolts.8. Rock engine back and forth to break seal, then remove the powerhead by lifting straight up. 9. Remove lower crankcase head bolts **(4)** . Insert screwdriver in pinch groove and remove lower

crankcase head.





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## **Disassembly – Power Head**

1. Remove all Fuel Induction System (carburetor), ignition, and electrical components from the powerhead.

2. Remove the intake manifold and reed valves. See Intake Manifold in Section 3.

NOTE

The reed value of the single cylinder models is attached directly to the crankcase. Therefore, it is removed after dividing the crankcase.

## Cylinder Head

3. Remove and inspect the thermostat. See Thermostat, this section.



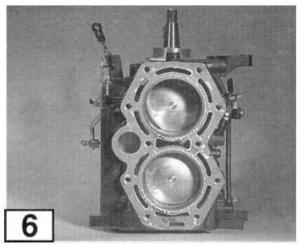
4. Remove the cylinder head bolts. Separate and remove cylinder head.

7

# NOTE

Start with those farthest from the center of the cylinder head and work inward.

5. Using a pointed scribe, identify the heads of the cylinders for correct positioning during assembly operations.



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Inside view of Raider 40 Powerhead

- 1. Look for any damage
- 2. Replace gasket
- 3. Use Permatex Aviation gasket cement when assembly

**89** 6. Remove the exhaust cover bolts. Insert screwdrivers into pinch grooves to separate and remove outer and inner exhaust covers.

#### Crankcase and Crankshaft

**10** 7. Remove and discard oil seal **(1)** and o-ring **(2)** from lower crankcase head (or engine base or lower cowl). Use a seal puller to prevent damage to the head.

11

8. Remove the crankcase bolts and separate the crankcase from the cylinder block.

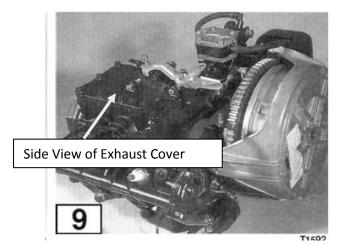
## NOTE

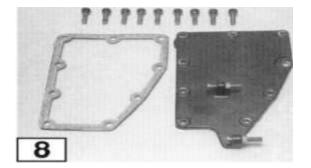
Start with the bolts farthest from the center of the crankcase and work inwald.

**12 13** 9. Tap the tapered portion of the crankshaft **(3)** with a rubber mallet to loosen it. Lift the crankshaft and pistons from the cylinder block and place on bench for disassembly.

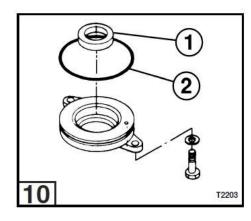


10. Slide the upper main bearing off the crankshaft. Remove and discard bearing oil seal (4) and o-ring (5).

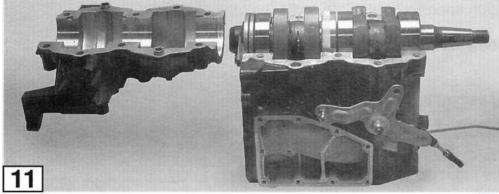




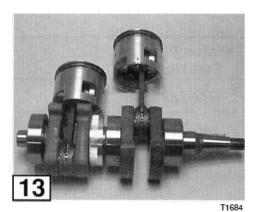
8. Exhaust Cover. Remove (9) cover bolts. Insert screwdriver into pinch grooves to separate and remove.

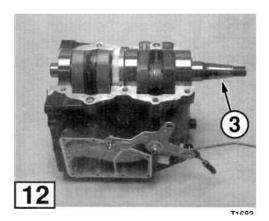


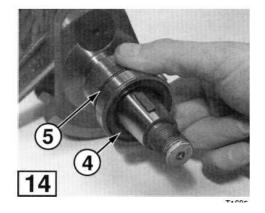
Remove Replace Oil Seals



T1690





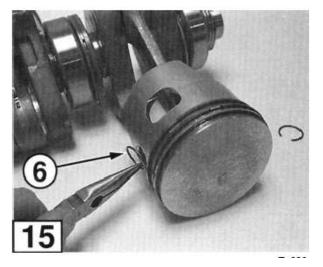


## Pistons

#### NOTE

Pistons, rings, and connecting rod bearings are wear parts which seat with operation of the engine. Make sure these parts are marked and kept together so they can be returned to their original positions during assembly.

15. Remove piston pin clip (6) from both sides of each piston. (Discard the clips).

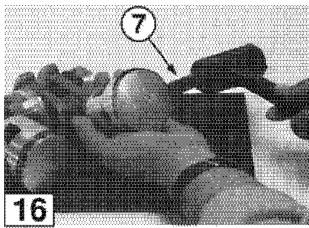


16. Tap out the piston pins using specified piston pin tool (7).

| Piston PinTool Part<br>Number | Raider |
|-------------------------------|--------|
| 345-72215-0                   | 40     |

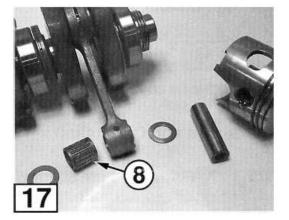
15. .

16 Remove each piston ring using the piston ring tool (Part No. 353-72249-0).



**NOTE** *Identify each ring so it can be returned to its original piston and ring groove.* 

17. Remove the piston and bearing **(8)** from the connecting rod

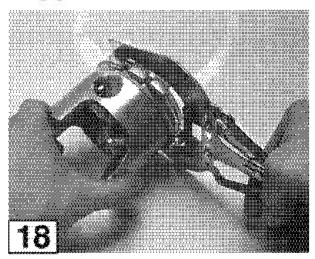




**18** 14. Remove each piston ring using the piston ring tool (Part No. 353-72249-0).

## NOTE

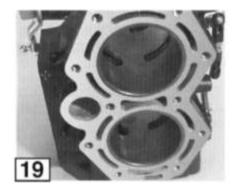
Identify each ring so it can be returned to its original piston and ring groove.



#### Cleaning

1. Remove all carbon accumulation from exhaust port areas and cylinder head combustion chambers.

2. Use gasket remover and Scotch-Brite Abrasive Pads to remove all traces of gasket and sealer from the cylinder block, crankcase, cylinder head, intake manifold, exhaust covers, and air silencer.



#### A CAUTION

DO NOT use a metal scraper on gasket surfaces or the mating surfaces of the crankcase.



20 3. Remove all carbon deposits from the tops and ring grooves of the pistons.

#### NOTE

A ring groove cleaning tool can be made by breaking an old ring and grinding an ang/e on its end. Do not damage the grooves when cleaning.

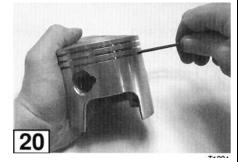
4. Wipe off all traces of oil and thoroughly wash the cylinder 21 block and crankcase with warm, soapy water. Air dry the cylinder block and crankcase. Dry all holes and passages with low pressure compressed air.

5. Coat the cylinder walls with genuine engine oil or certified TC-W3 oil to protect them from corrosion.

#### Inspection

#### NOTE

Before inspection of the powerhead, all components must be perfectly clean and free of contaminants.





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## **△** CAUTION

After the inspection, when it is found that the cylinder(s) requires re-finishing or boring, all the works have to be done in the approved machining plant. Light scuffing or burn does not require boring for removal. Use water-resistant sand paper of around #320 to remove the damages, and then use #400 and #600 to finish.

- 1. Visually inspect all internal components. Inspect for unusual wear patterns, heat-related discoloration of bearings, broken parts, and scuffing or damage to aluminum parts.
- 2. Inspect the intake manifold and reed valves. See intake Manifold Section 3.

**22** 3. Check the cylinder head for warpage using a machinist straight edge and the thickness gauge set (Part No. 353-72251-0). If warpage exceeds 0.004 in [0.10 mm], replace the cylinder head.

4. Using an accurate dial indicator, measure the crankshaft deflection with the upper and lower main bearings installed. Measure as follows:

- Support both ends of the crankshaft at the main bearings in precision V-blocks or an alignment jig.
- Slowly rotate crankshaft and record measurement at each crankshaft bearing (1) and at both ends of the crankshaft.

If deflection is more than 0.002 in [0.05 mm], replace the crankshaft.

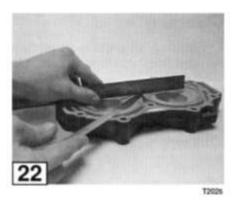
5. Measure and record the following crankshaft dimensions and check for signs of wear:

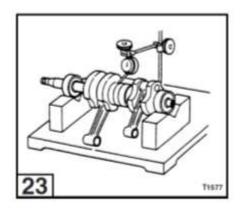


Dimension 1 : Distance between the outside edges of each pair of cranks haft webs. Measure at both ends of the webs.



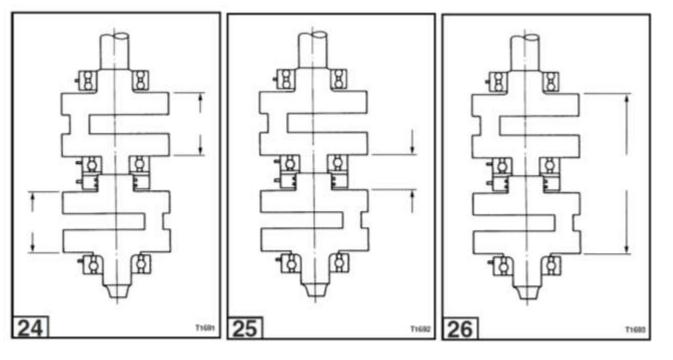
 Dimension 2: Distance between each pair of crankshaft webs.







 Dimension 3: Distance between the outside edges of the first and last crankshaft webs.



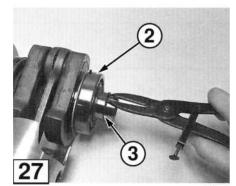
| Model | Dimension 1  | Dimension 2                    | Dimension 3                     |
|-------|--|--------------------------------|---------------------------------|
|       | in [mm]  | in [mm]                        | in [mm]                         |
| 40    | $2.071 \stackrel{+}{_{-}} \stackrel{0}{_{-}} \stackrel{0}{_{-}} \stackrel{0}{_{-}} \stackrel{0}{_{-}} \stackrel{0}{_{-}} \stackrel{1}{_{-}} 1$ | 1.591 ± 0.002<br>[40.4 ± 0.05] | 5.733<br>[145. <mark>6</mark> ] |

**27** 6. Check for smooth operation of all crankshaft and connecting rod bearings. Upper and lower main bearings and small end connecting rod bearings are serviceable. Wear of other parts requires replacement of the crankshaft assembly. If lower main bearing **(2)** is defective, proceed to remove the components as follows:

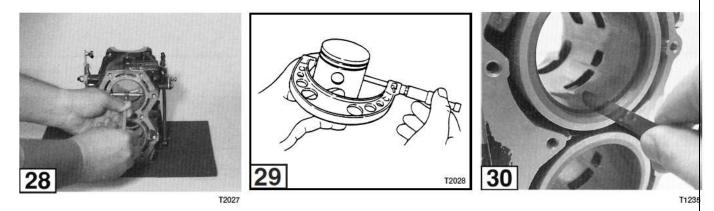
- Remove snap ring (3).
- Install a universal bearing puller with bearing retainer plate and remove lower main bearing (2) from the crankshaft.
- See powerhead Assembly procedure for installation.

#### NOTE

DO NOT fully disassemble the crankshaft assembly unless further wear or damage is suspect.



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**28 29** <sup>7</sup>. Measure and record the diameter of each cylinder bore and the outside diameter of its respective piston. Subtract the values to calculate the piston clearances. If any bore diameter or piston clearance exceeds the specified limit, the cylinder must be professionally bored oversize for use with an oversize piston.

| Model | Standard      | Standard                         | Repair Limit                    |
|-------|---------------|----------------------------------|---------------------------------|
|       | Bore Diameter | Piston Clearance                 | Piston Clearance                |
|       | in [mm]       | in [mm]                          | in [mm]                         |
| 40    | 2.76 [70]     | 0.0020 - 0.0039<br>[0.05 - 0.10] | 0.006 or over<br>[0.15 or over] |

**30** 8. Complete the following inspection for new or used piston ring sets. Inspect each ring separately:

- Place ring in its respective cylinder bore.
- Use a piston to square the ring in the bore.
- Use the thickness gauge set (Part No. 353-72251-0) to measure the ring end gap.

The ring end gap must be within specification:

| Model | Standard Ring End Gap<br>in [mm] | Repair Limit Ring End Gap<br>in [mm] |
|-------|----------------------------------|--------------------------------------|
| 40    | 0.08 - 0.019 [0.33 - 0.48]       | 0.031 [0.8] or over                  |

#### Assembly

#### NOTE

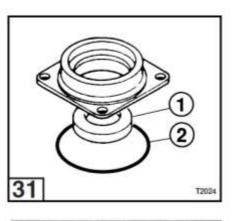
Before assembly of the powerhead, all components must be perfectly clean and lightly coated with genuine engine oil or a NMMA certified TC-W3 oil. All serviceable gaskets and seals must be replaced.

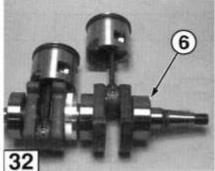
#### Preliminary

1. Before installation, lightly coat the outside surfaces of 31 new bearing seals and o-rings with genuine engine oil or TC-W3 oil. Apply bearing cup grease to the seal lips. Press fit the seals into place using an appropriate size seal installer to avoid damaging the seal or component.

- · Install a new oil seal in lower crankcase head and a new o-ring on base of lower crankcase head (or engine base or lower cowl).
- Install new oil seal (1) in upper magneto base and new o-ring (2).

Coat the rotating surfaces of the crankshaft and connecting rod bearings, bearing washers, and bearing thrust plates (model 40) with genuine engine oil or TC-W3 oil.

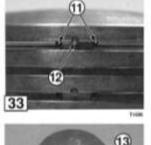




#### Crankshaft

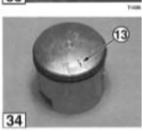
3. If upper main bearing was removed, slide and install the 32 upper main bearing onto crankshaft (6).

4. If lower main bearing was removed, coat lower end of crankshaft with genuine engine oil or TC-W3 oil and install the bearing.



#### Pistons

**33** 5. Install each piston ring in its original groove on its original piston using the piston ring tool (Part No. 353-72249-0). Each ring must be installed so end notches (11) fit the contour of piston knock (12) when the ring is compressed.





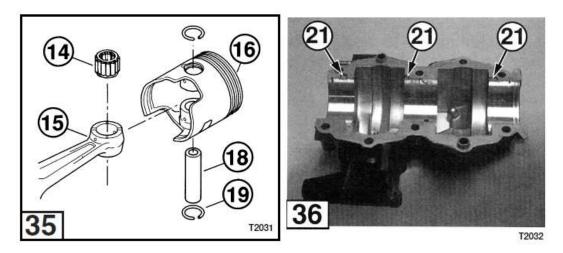
34 6. Install each piston on its respective connecting rod as follows:

#### NOTE

An arrow (13) or the word "UP" is cast on the top of the piston. This mark is used to align the piston in a specific orientation. See chart for proper orientation.

40

"Up" mark points to flywheel





Insert bearing (14) into small end of connecting rod (15).



Correctly position piston (16) onto the connecting rod.



Align components so piston pin hole is not obstructed and install piston pin (18) using piston pin tool.



Install new piston pin clips (19). Do not reuse old clips.



Align components so piston pin hole is not obstructed and install piston pin (18) using piston pin tool.

**35** Install new piston pin clips (19). Do not reuse old clips.

## Cylinder Block and Crankcase

7. Coat the pistons, rings and cylinder walls with genuine engine oil or TC-W3 oil. Install the bearing washers or thrust plates (model 40) into cylinder block, guiding each piston into its respective cylinder. Ensure the following:



All main bearing knocks (21) are seated against the crankcase mating flange of the cylinder block.

 Bearing washers or thrust plates (model 40) are seated properly in the cylinder block. 8. Degrease the crankcase flange and mating surface of the cylinder block. Apply anaerobic gasket maker(Loctite 518) to the cylinder block frange. The application must cover the flange evenly and not be excessive.

9. Install crankcase on cylinder block.

10. Install crankcase mounting bolts and torque to specification:

#### NOTE

Start with the bolts closest to the center of the crankcase and work outward.

**Cylinder Head** 

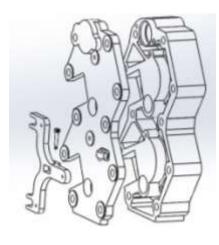


**38 39** 11. Head gasket requires adhesive. Recommended is Permatex Aviation cement. Install head gasket to Raider 40 outboard. Gasket is required between head and dewatering cover plate. Permatex Aviation cement is recommended. This gasket material does not harden like typical cement; excellent for submersion characteristics.

12. Install cylinder head. Torque bolts to specifications.

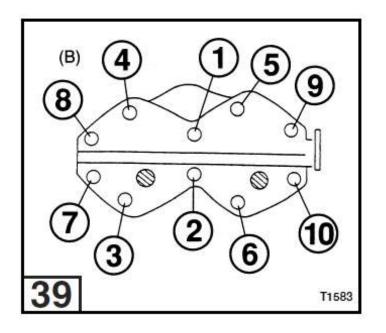
#### <u>NOTE</u>

Start with bolts closest to the center of the crankcase and work outward.



38

Head Assembly with dewatering lever



13. Install thermostat and torque thermostat cap bolts to specification. See Thermostat, this section.



Thermostat located outside dewatering plate.

#### Exhaust Cover

**41** 14. Lightly coat both sides of new (inner and outer) exhaust cover gaskets with gasket sealant. Install gaskets and mount exhaust covers to cylinder block. Torque exhaust cover bolts to specification from lowest embossed number to highest.

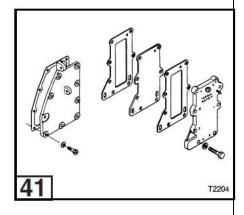
#### Final Assembly

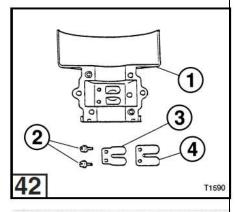
**42 43** 15. Install the reed valves and intake manifold. Check the reed valve and lift to verify setting. If damaged, replace with new assembly. See Reed Valve in Section 3.

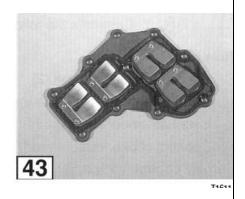
16. Install all carburetion, ignition, and electrical components on the powerhead using the following guidelines. Assemble as much as possible before mounting powerhead to engine midsection.

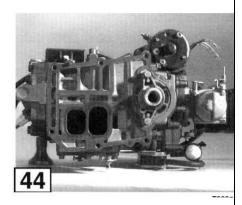
- Follow all relevant procedures and wiring diagrams in other sections of this manual.
- Torque fasteners to specification. Use Loctite 243 on the pulsar coil assembly screws.
- Lubricate powerhead components as specified. See Lubrication Chart in Section 2.
- Route and clamp all wires and hoses away from moving engine parts.
- Do not install flywheel until powerhead has been bolted to engine base.

17. Install lower crankcase head.









19. Apply high temperature gasket dressing to engine base gasket and install gasket on powerhead.

## Installation

1. Degrease the engine base surface and coat driveshaft splines (1) with genuine engine oil or TC-W3 oil.

2. Apply high temperature gasket dressing to bottom surface of engine base gasket. Lower powerhead onto engine base, guiding the driveshaft into the lower crankcase head.



**46** 3. Install the engine mounting bolts and torque to specification.

- 4. Connect fuel INPUT hose to fuel filter.
- 5. Connect pilot water hose to nipple.
- 6. Complete the following electrical connections:
- · Remote control or main key switch wire harness.
- · Neutral safetyswitch.

Reference the appropriate wiring diagram in Section 7 for electrical box connections. Leave ignition system disabled.



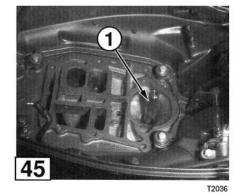
**48** 7. Complete the following operations.

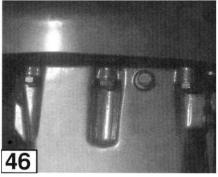
Tiller models:

- Connect starter lock rod (2).
- Secure throttle cable (3) to throttle cable bracket (4).
- Install advancer arm (5).
- · Connect choke knob link rod (6).

Remote control models:

- · Connect shift cable to shift arm.
- Connect throttle cable to advancer arm.





T2037

8. Install flywheel and recoil starter (if equipped). See Flywheel and Recoil Starter, this section.

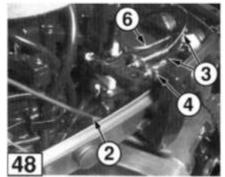
9. Perform all carburetor and ignition timing adjustments. See Synchronization and Linkage Adjustments in Section 2.

10. Perform all tune-up operations. See Tune-Up Procedure in Section 2.

11. Test and inspect all safety features of the engine and instruct operator to repeat the original break-in procedure described in Section 2 before engine is put into normal service.







# **SECTION 5 – MIDSECTION**

## **General Precautions**

Before performing any service work on the midsection, read and understand the Service Safety section at the beginning of this manual.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm'].

Always inspect and test the start-in-gear prevention system before returning engine to customer.

Most service work on the midsection requires preliminary steps to remove major components. Follow all applicable procedures in other sections when indicated.

Use threadlockers and follow torque specifications as indicated to ensure shock-absorbing components remain secure after returning the engine to service.

## Service Specifications Special Torque Values - Raider 40

| Description                         |                               |              |  |
|-------------------------------------|-------------------------------|--------------|--|
|                                     | 4þ                            | Threadlocker |  |
| Bracket Bolt Nut<br>(Tilt Tube Nut) | 23.5 - 25.5<br>2.4 - 2.6      |              |  |
| Shift Lever Shaft<br>Holder Bolt    | 41-55<br>4.6-6.3<br>0.47-0.64 | Loctite 242  |  |

## Required

Spring Pin Tool, 03 and 03.5 : 345-72227-0, 345-72228-0, 369-72217-0, 369-72218-0 Rubber Mount Tool Kit- 40 : 361-72760-0

### **General Equipment Required**

Torque Wrench, 0-150 in-lb [0-17 N-m / 0-1.7 kg-m] Torque Wrench, 0-145 ft-lb [0-200 N-m / 0-20 kg-m] Dial Gauge, minimum scale 0.0001 in [0.01 mm

## **Consumable Supplies Required**

Threadlocker, Loctiteat 242 Threadlocker, Loctiteat 243 Gasket Dressing, Permatexat Hylomarat Aerosol High-Temp Gasket Dressing Silicone Sealant, Permatexat Hi-Temp RTV Silicone Gasket Super Bond Adhesive, Permatexat Super Glue Gel Cleaning Pads, Scotch-Brite® Abrasive Pads Isopropyl Alcohol Cleaning Solvent Gasket Remover Genuine Grease or Equivalent Friction Surface Marine Grease

# **Tiller Steering Handle - Raider 40**

**General Information** 

The tiller steering handle is used for steering, control throttle through a pinion throttle linkage.

The tiller is capable of lifting up the Raider. When two motors are controlled via a single tiller two additional elements must be added; (1) Cable from motor one to motor two; (2) Control rod that is placed in the back of each Raider. This option must be ordered in the initial sale.

For parts description use Raider Parts Assembly Manual; RPAM 40ES-001. Figure 1 shows tiller assembly.

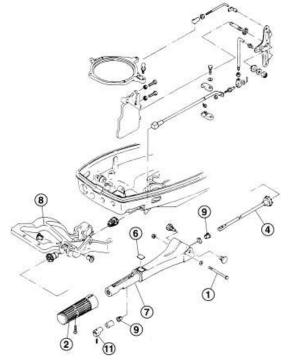


Figure 1. Tiller Assembly

(5) for cracks or deformation caused by wear.

4. Check all fasteners for thread damage, all washers for deformation.

2 3 4

5. Replace throttle label (6) if damaged or missing.

| 1          | 2 | 3 | 4 | 6. |
|------------|---|---|---|----|
| . <u> </u> | - |   |   | th |

6. Verify the following components and their friction surfaces are not cracked,

bent, or wom:

- Steering handle (7)
- Steering bracket (8)



**2** 7. Inspect throttle cables **(3)** for kinks, wear, cracks in the protective covering, and excessive stretch.

## Assembly



## NOTE

Apply genuine grease or equivalent friction surface marine grease to bushings (9), spacer (11), and the grip portion of steering handle (7) before assembly. DO NOT lubricate friction piece (5).

1. Apply spray lubricant to the throttle cables. Work the cables back and forth to ensure full coverage under the protective covering.

**2 3 4 2**. Assemble all components onto throttle shaft **(4)** and connect throttle cables **(3)** to throttle shaft as required. Route opposite end of throttle cables through steering handle **(7)**.

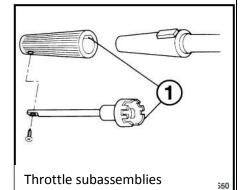


## NOTE

Make sure the throttle position (1) as shown in installation drawing.

4. Install grip (2). 3 2

5. Fully assemble all remaining components as illustrated.



Twist Handle and Linkage Assembly

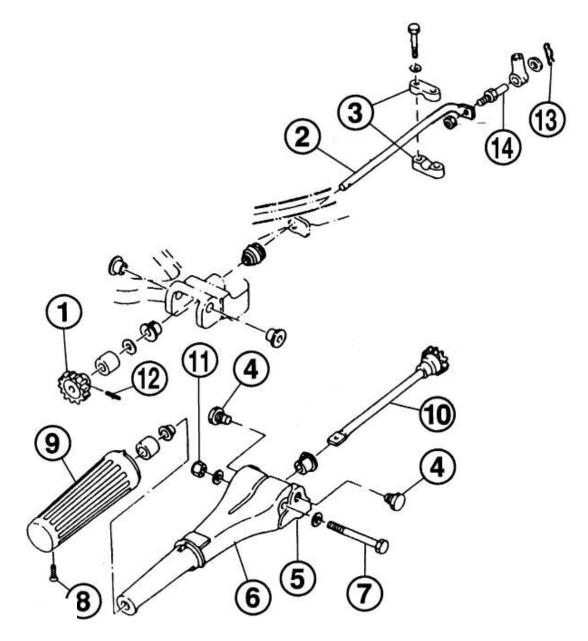


Figure 2. Tiller Arm Subassemblies

## Handle and Linkage Disassembly

1. Loosen the M6 nylon nut (11) and remove the two handle bolts (4).

2. Remove the handle assembly from the steering bracket.

3. Remove the Spring pin (12) from the universal pinion (1).

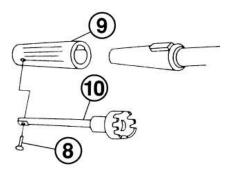
4. Remove the R-pin (13) from the cable pin (14).

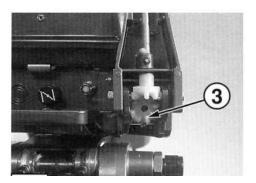
5. Remove the throttle shaft supports (3).

6. Remove the throttle shaft B (2) and the universal pinion (1), and relevant parts.

7. Remove the handle grip mounting screw (8) and pull out the grip (9) from handle (6).

8. Pull out the throttle shaft A (10), and relevant parts.





## Twist Handle and Linkage Inspection

1. Check all components for wear or cracks.

2. Lubricate all moving surfaces.

## Twist Handle and Linkage Assembly

1. Install throttle shaft A (10) after applying grease.

2. Install grip on handle A and insert the handle grip (9) and mounting screw (8).

3. Install Throttle Shaft B Assembly in the lower motor cover, installing the tip of inner throttle shaft in the proper orientation for the link rod.

**4**. Install the universal pinion **(3)** after coating with grease. Maintain the relationship between inner throttle shaft and the

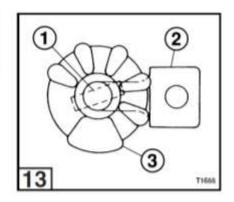
☐ Maintain the relationship between inner throttle shaft and the universal pinion, and inner throttle shaft and the collar as shown.

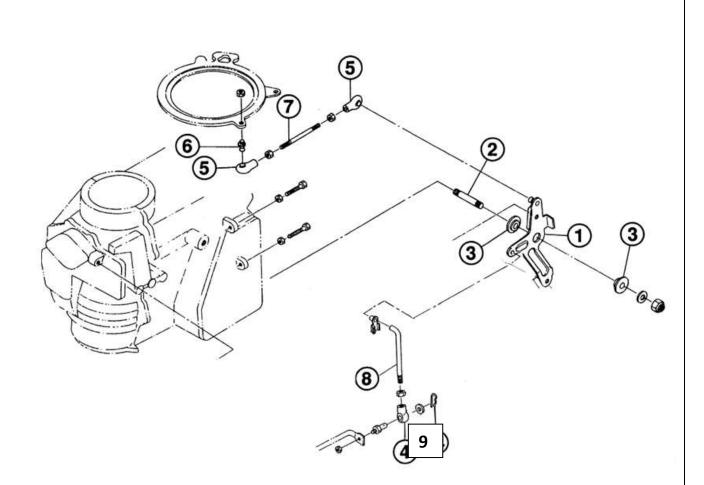
| Item | Description      |  |
|------|------------------|--|
| 1.   | Spring Pin       |  |
| 2.   | Throttle Shaft B |  |
| З.   | Universal Pinion |  |

5. Assemble handle and assembly to the steering bracket.

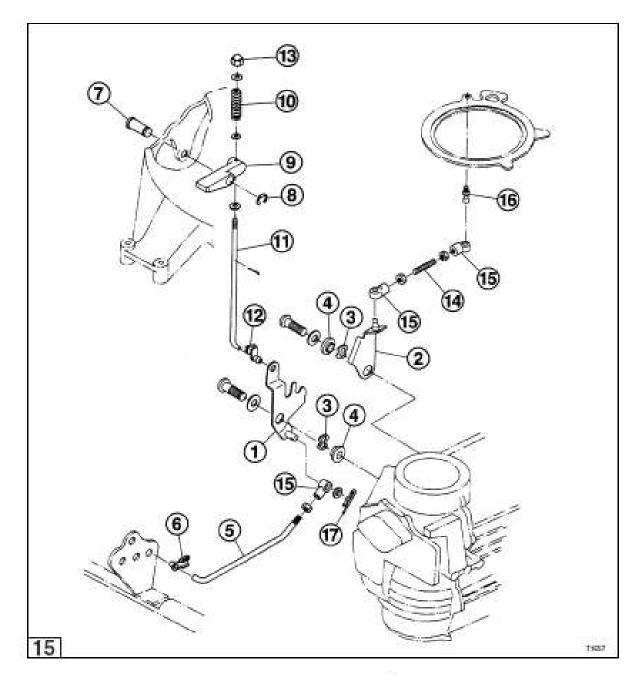
6. Tighten the handle friction bolt so that the handle does not drop from the vertical position.

7. Install the throttle shaft supports.





| <u>Item</u> | <b>Description</b>       |
|-------------|--------------------------|
| 1           | Advancer Arm             |
| 2           | Stud Bolt                |
| 3           | Advancer Arm Bushing     |
| 4           | O5 Rod Joint             |
| 5           | Ball Joint Cap           |
| 6           | Ball Joint B             |
| 7           | Advancer Link Rod, 5-50L |
| 8           | Handle Link Rod, 5-75L   |
| 9           | R-Pin, d=8               |

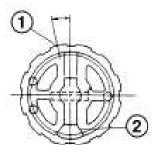


| item | Description                     |
|------|---------------------------------|
| 1.   | Starter Lock Arm                |
| 2.   | Throttle Stop Arm               |
| 3.   | Wave Washer                     |
| 4.   | Bushing                         |
| 5.   | Starter Lock Arm Rod            |
| 6.   | Starter Lock Arm Rod Snap       |
| 7.   | Starter Lock Lever Shaft        |
| 8.   | Starter Lock Lever Shaft E-ring |
| 9.   | Starter Lock Lever              |

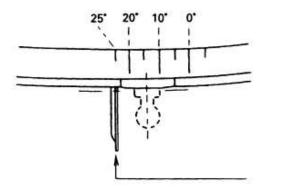
| Item | Description            |  |
|------|------------------------|--|
| 10.  | Starter Lock Spring    |  |
| 11.  | Starter Lock Rod       |  |
| 12.  | Starter Lock Rod Snap  |  |
| 13.  | Starter Lock Lever Cap |  |
| 14.  | Throttle Stop Arm Rod  |  |
| 15.  | Ball Joint Cap         |  |
| 16.  | Ball Joint B           |  |
| 17.  | R-Pin, d=8             |  |



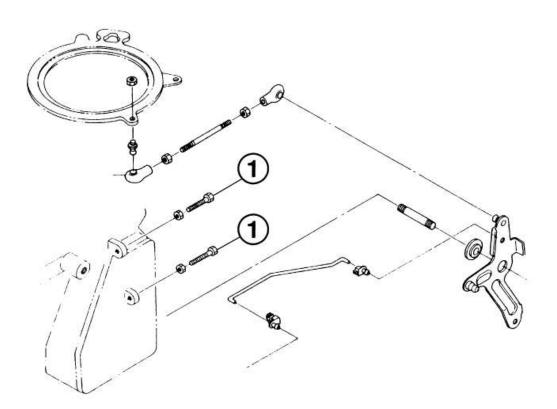
 Turn the handle grip so that the collar center of the carburetor throttle lever in on the "S" marking line.



2. Adjust the length of the handle link rod so that the START match mark on the handle grip is aligned to the START position on the tiller handle.

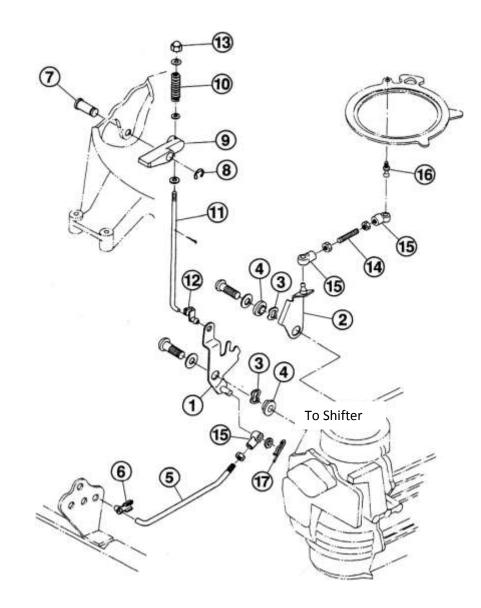


BTDC 25 degrees



20 . Check that the throttle valve is fully open, and the ignition timing mark at starting comes to the crankcase mating surface. Under this state, adjust the advancer arm stopper bolts (1) so that the advancer arm stops at the throttle valve full-open and full-close positions, and lock the bolts with a nuts.

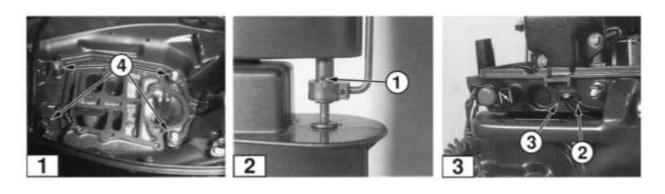
Timing Set at: ATDC 2 degrees

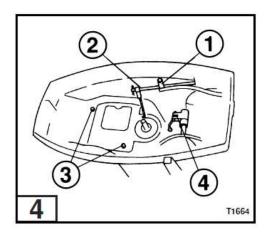


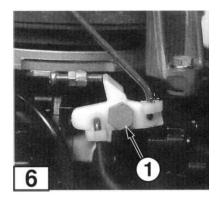
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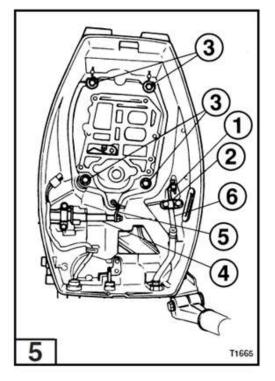
| Item | Description               |
|------|---------------------------|
| 1.   | Starter Lock Arm          |
| 2.   | Throttle Stop Arm         |
| 3.   | Wave Washer               |
| 4.   | Bushing                   |
| 5.   | Starter Lock Arm Rod      |
| б.   | Starter Lock Arm Rod Snap |
| 7.   | Throttle Stop Arm Rod     |
| 8.   | Ball Joint Cap            |
| 9.   | Starter Lock Lever        |

# Lower Engine Cover – Raider 40









## Removal

- 1. Remove powerhead as described in Section 4
- 2. Remove control cables, electrical leads and grommets
- as required from lower engine cover
- 3. Remove lower engine cover bolts (4)
- 4. Lift cover off engine base

- 5 1. Remove throttle shaft ball joint (1).

- 5 2. Remove upper and lower throttle shaft supports (2).
  - 3. Remove lower motor cover bolts (3).
- 5

5

- 4. Raise the cover slightly and remove the shift rod (4) from the shift rod lever (5).

5. Remove the lower cover.

# Installation

6

Installation is done in the reverse order of Removal. Use Loctite 242 on throttle stopper bolt (1) if removed.

# DRIVESHAFT HOUSING

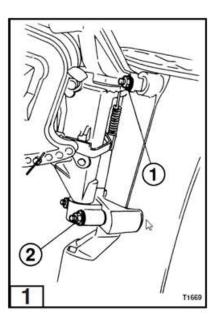
## Removal

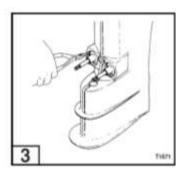
- 1. Remove powerhead as described in Section 4.
- 2. Remove tiller steering handle if equipped, this section.
- 3. Remove lower engine cover, this section.
- 4. Remove gearcase as described in Section 6.

| - |   |   |
|---|---|---|
|   | - | _ |
| L |   |   |
|   |   |   |

5. Remove upper rubber mount nut (1).

6. With driveshaft housing tilted fully down, remove the nut 1 from each lower rubber mount bolt (2). Do not remove the bolts.





### 

# Driveshaft housing is free to fall if lower rubber mount bolts are removed.

7. Hold driveshaft housing securely and pull lower rubber mount bolts and remove driveshaft housing. Place housing on bench for disassembly.



8. Remove the clip from the lower rubber mount and remove the upper and lower rubber mounts.

use the special tool

## NOTE



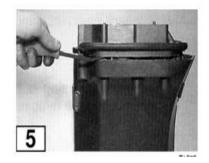
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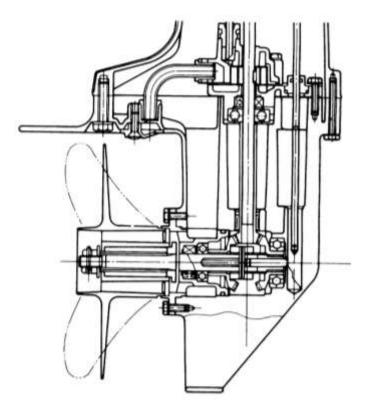


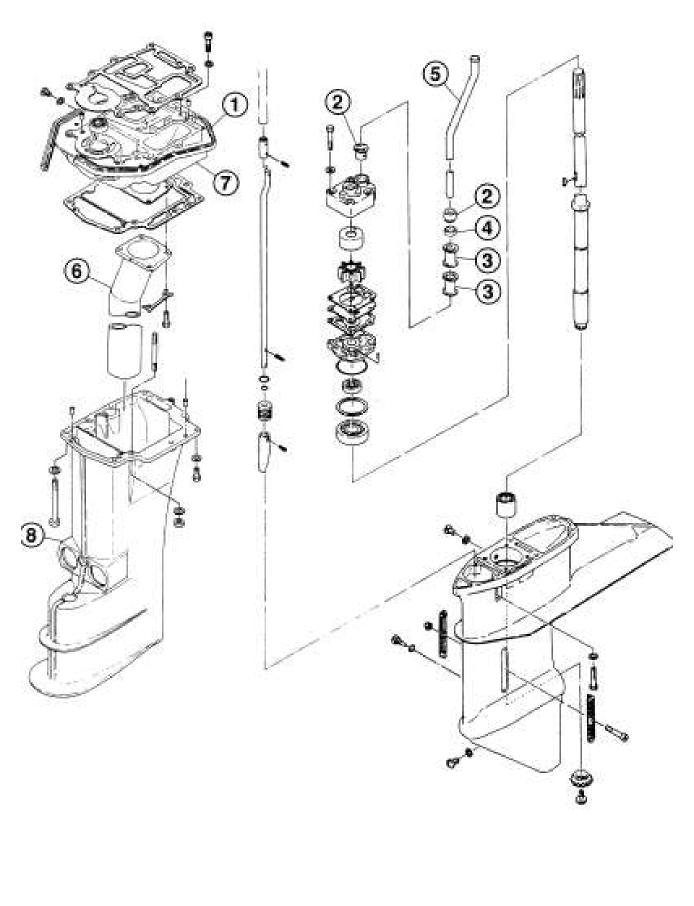
# ▲ CAUTION

361-72760-0 for removing the rubber mounts.

Engine base and driveshaft housing are aligned with dowel pins and may be difficult to separate. Avoid damage to the mating surfaces and gently pry sections apart if necessary.







### Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

1. Before cleaning, examine the following rubber parts as applicable and remove if damaged, dry, or brittle:

- 8
- Lower cover grommets and seal ring
  - Lower engine cover seal (1)
  - · Water pipe seal (2) locking rubber (3), and rubber set ring (4)

Use super bond adhesive to install new rubber parts as needed on metal surfaces. Make sure metal surfaces are clean and dry before installation of rubber parts.

2. Thoroughly clean all parts including fasteners with solvent and dry with low pressure compressed air. Verify all carbon deposits, gasket adhesives, and threadlocker residue have been removed.



3. Inspect water pipe (5) for kinks or obstruction. Replace as needed.



4. Inspect exhaust pipe (6), engine base (7), and driveshaft 4. Inspect exhaus: pipe (e), engres or other damage. housing (8) for cracks, chips, dents or other damage.



5. Examine the upper and lower rubber mount components 

#### Assembly

1. Verify all new rubber replacement parts have been installed on components as needed.

2. Position engine base with powerhead side facing down.

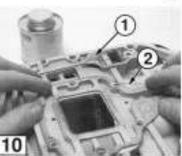
10 3. Mount new exhaust pipe gasket (2) on engine base (1). Apply high temperature gasket dressing to both sides of gasket.



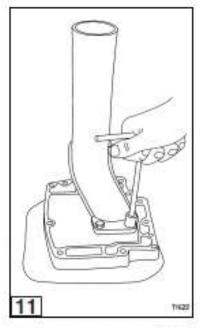
11 4. Install exhaust pipe.

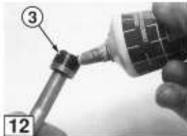
5. Apply genuine grease or equivalent friction surface marine 12 grease to water pipe seal (3).













6. Install water pipe (4) in engine base (5) and align for 13 installation in the driveshaft housing.

7. Verify knocks (where used) are installed in driveshaft 14 housing. Apply high temperature gasket dressing to both sides of new driveshaft housing gasket and install gasket on housing.

### Installation

1. Insert the damper cap (1) and damper collar (2) into the 16 drive shaft housing.

2. Assemble the lower rubber mount components and install them into the drive shaft housing.

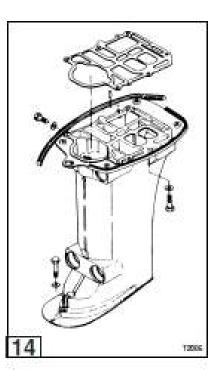
- 3. Apply Loctite 243 to bolt threads and torque to specification.
- 4. Install clip.

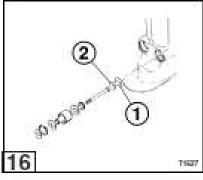


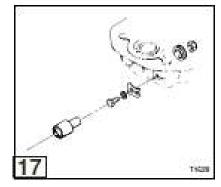
5. Assemble the upper rubber mount components and install them into the engine base.

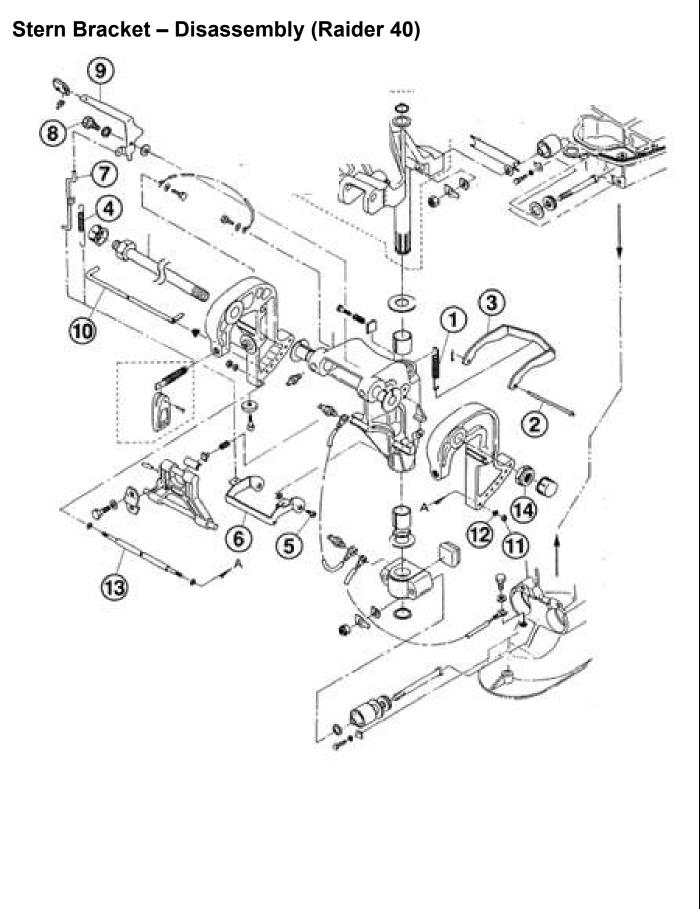
6. Apply Loctite 242 to bolt threads, install the retainer and torque to specification.

- 7. Install gearcase as described in Section 6.
- 8. Install lower engine cover, this section.
- 9. Install tiller steering handle if equipped, this section.
- 10. Install powerhead as described in Section 4.









## Stern Bracket – Disassembly

1. Remove the reverse lock spring (1)

2. Remove the split pin from the reverse lock rod (2) and remove the reverse lock rod (2) and reverse lock (3).

- 3. Remove the reverse lock lever spring (4)
- 4. Remove the reverse lock arm shafts (5) and remove the reverse lock arm (6).
- 5. Remove the reverse lock link (7).
- 6. Remove the reverse lock lever shafts (8) and remove the reverse lock lever (9).
- 7. Remove the thrust rod (10).

8. Remove the bracket distance piece nuts (11) and washer (12) and pull out the bracket distance piece (13)

9. Remove the bracket nut (14) and separate the brackets.

# **Swivel Bracket and Reverse Lock**

Raider 40

<u>Swivel Bracket</u>

<u>Reverse lock</u>

Turning Radius 80 degrees Port: 40 degrees Starboard: 40 degrees Lock all of shifting positions Unlocking is carried out by Operating the reverse lock lever.

# **SECTION 6 - GEARCASE**

# **General Precautions**

Before performing any service work on the gearcase, read and understand the Service Safety section at the beginning of this manual.

Full servicing of the gearcase requires manufacturer special tools. Follow all special tool requirements as specified. Substituting special tools with those not provided by the manufacturer may result in severe personal injury, equipment or engine damage, or faulty service work.

Perform bearing removal and installation operations exactly as specified to avoid damage to the bearing or housing during pressing operations.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa *I* 1.76 kg/cm'].

| SERVIC     | E SP | ECIFI    | CATI    | ONS   |
|------------|------|----------|---------|-------|
| Special To | rque | /alues - | - Raide | er 40 |

| Torque<br>In-lb (ft-lb)<br>N-m<br>Kg-m           | Thread –<br>locker   |
|--|--|
| (21.7-28.9)<br>29.4-39.2<br>3.0-4.0              |  |
| 41-55<br>4.6-6.2<br>0.47-0.64                    | Locte 242  |
| (17.3 - 18.8)<br>23.5 - 25.5<br>2.4 - 2.6<br>日이t |  |
|  | In-lb (ft-lb)<br>N-m<br>Kg-m<br>(21.7-28.9)<br>29.4 - 39.2<br>3.0-4.0<br>41-55<br>4.6-6.2<br>0.47-0.64<br>(173-18.8)<br>23.5 - 25.5<br>2.4 - 2.6 |

# **Special Equipment Required**

| Part Name                          | Part<br>Number | 40               |
|------------------------------------|----------------|------------------|
| Bevel Gear A Bearing Puller Ass'y  | 3A3-72755-0    | (93 <b>•</b> 3)  |
| Bearing Outer Press Rod            | 3B7-72731-0    | 12 <b>.</b>      |
| Bearing Outer Press Plate          | 353-72732-0    | (                |
| Bearing Outer Press Plate          | 346-72732-0    | 1                |
| Bearing Outer Press Guide          | 346-72733-0    | 12.0             |
| Bevel Gear A Set Tool              | 346-72719-0    |                  |
| Bevel Gear A Set Tool              | 3C8-72719-0    |                  |
| Backlash Measuring Tool Kit        | 387-72740-0    |                  |
| Backlash Measuring -Tool Sub-Ass'y | *369-72730-0   |                  |
| Backlash Measuring Tool Arm        | *369-72727-0   |                  |
| Backlash Measuring Tool Arm        | *3B2-72727-0   |                  |
| Backlash Measuring Tool Kit        | 3C8-72234-0    | 1.50             |
| Measuring Tool Shaft               | *345-72723-0   | [:2 <b>.</b> .?  |
| Backlash Measuring Tool Plate      | *3A3-72724-0   | 2 ( <b>•</b> )   |
| O-Ring, 2-9                        | *332-60002-0   | (33 <b>.</b>     |
| Backlash Measuring Tool Collar     | *350-72245-0   |                  |
| Backlash Measuring Tool Collar     | *346-72245-1   |                  |
| Backlash Measuring Tool Collar     | *353-72245-1   | 01.05            |
| Nut, 10P1.5                        | *930191-1000   | • (2)            |
| Conedisk Spring, d=12              | *3B7-72734-0   | • (3)            |
| Clamp Ass'y Backlash Measur'g Tool | 387-72720-0    | [23 <b>.</b> 54] |
| Bolt                               | 910191-0625    | • (4)            |
| Dial Gauge Plate                   | 387-72729-0    | •                |
| Shimming Gauge                     | 346-72250-0    |                  |
| Shimming Gauge                     | 3C8-72250-0    | 1.000            |
| Thickness Gauge                    | 353-72251-0    |                  |

## **General Equipment Required**

TorqueWrench, 0- 150 in-lb[0 - 17 N-m / 0- 1.7 kg-m] TorqueWrench, 0 - 150 ft-lb [0 - 200 N-m / 0 - 20 kg-m] Dial Gauge, minimum scale0.0001 in [0.01 mm] Gearcase Pressure Tester, Stevens® S-34 or equivalent Gearcase Vacuum Tester, Stevens® V-34 or equivalent Seal Pullers Seal hIStallers Heat Gun

#### **Consumables Required**

Threadlocker, Loctite® 242 Gasket Sealant, Permatex® High Tack Gasket Sealant Anaerobic Gasket Maker, Loctite® 518 Silicone Spray Lubricant, Permatex® Silicone Spray Lubricant Genuine Grease or Equivalent Friction Surface Marine Grease Isopropyl Alcohol Cleaning Solvent Engine Lubricant, Genuine engine oil or NMMA certified TC-W3 oil Gear Lubricant, Genuine gear oil or API grade GL5, SAE #80 - #90 Cleaning Pads, Scotch-Brite® Abrasive Pads

Gasket Remover

# WATER PUMP

If the engine has been run without water for any length of time, the water pump should be serviced with a water pump repair kit. Use the following procedures to install the repair kit.

### Removal

1. Remove the gearcase. See Gearcase, this section.



2

Remove water pump mounting bolts (1).

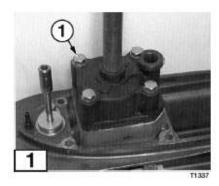
3. Hold upper pump case (2) securely and rotate driveshaft clockwise to free impeller from upper pump case.

## 1 CAUTION

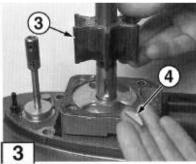
Do not rotate driveshaft counterclockwise. Doing so will bend impeller fins in wrong direction and may weaken or damage the impeller.

4. Slide upper pump case off driveshaft and remove pump impeller (3) and impeller key (4).

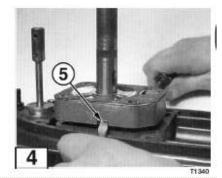
5. Insert a screwdriver in each lower pump case notch (5) and gently pry upward to remove. Slide lower pump case off driveshaft.

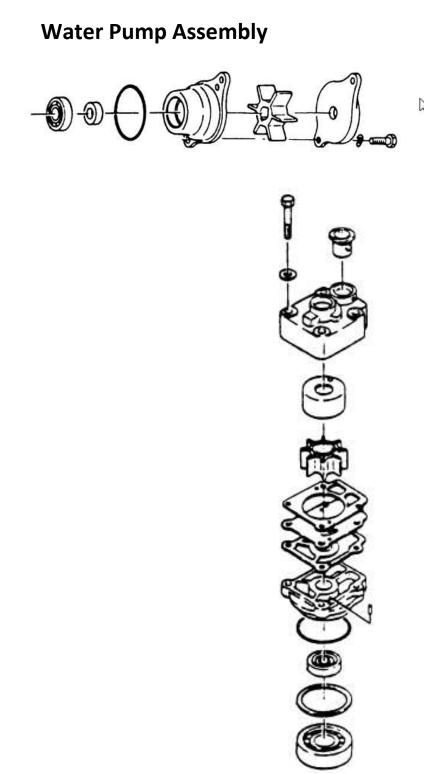




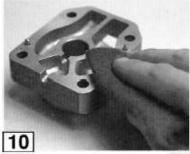


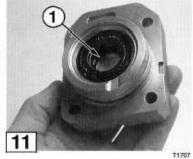


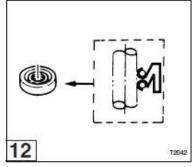




1. Disassemble the water pump component as illustrated and verify the kit parts match the originals before discarding old parts.







10 2. Remove all gasket residue from lower pump case with abrasive cleaning pads and gasket remover. Do not scrape the gasket surface with metal scraper. Thoroughly clean all components with isopropyl alcohol and dry with lou pressure compressed air.

3. Inspect the upper and lower pump cases for signs of melting and cracks. Replace as needed.



4. Examine lower pump case oil seals (1) for signs of damage and deterioration.



#### NOTE

If necessary to replace seals, use appropriate size seal puller and installer to avoid damaging new seals and seating surfaces in lower pump case. Apply silicone spray lubricant to seals and install so lips face direction indicated.



**13** 5. Apply anaerobic gasket maker to seating surface of water pipe lower seal (2).

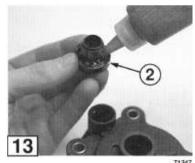


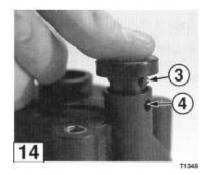
6. Install seal in upper pump case so locking tabs (3) align with holes (4).

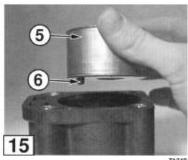
**15** 7. Slide pump case liner (5) partially into upper pump case housing so locking tab (6) is aligned with notch in housing.

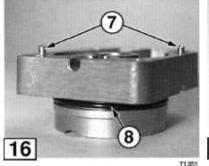
#### NOTE

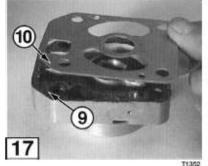
Pump case liner must be flush with flanged surface of upper pump case. If not, remove liner and re-align locking tab with notch in upper pump case housing.

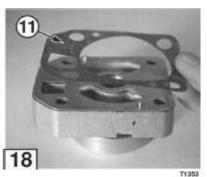




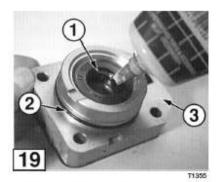








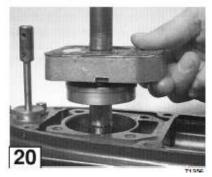
- **16** 8. Install lower pump case dowel pins (7) if removed and oring (8).
- 9. Apply gasket sealant to both sides of guide plate gasket (9). Mount gasket and guide plate (10) on lower pump case.
- **10**. Apply gasket sealant to guide plate side of upper pump case gasket (11). Mount gasket on guide plate.



#### Installation

**19** 1. Apply a light coating of genuine grease or equivalent friction surface marine grease to the lower pump case driveshaft passage, oil seal lips (1), and o-ring (2). Apply an aerobic gasket maker to flanged surface (3) to provide adequate seal between lower pump case and gearcase.

20 2. Slide lower pump case down driveshaft and seat into position on gearcase.



3. Slide the impeller down the driveshaft onto lower pump case.

**21** 4. Insert impeller key **(4)** in driveshaft and align impeller slot with key. Hold the impeller key in place and push impeller down until seated in position.

22 5. Lubricate the impeller blades with soapy water and slide upper pump case down driveshaft. Hold pump case securely and push downward while rotating driveshaft clockwise to seat the impeller.

## 

Do not rotate driveshaft counterclockwise. Doing so will bend impeller blades in wrong direction and may weaken or damage the impeller.

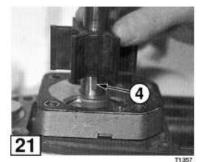
6. Ensure upper pump case is aligned and fully seated on the dowel pins. Hold the upper pump case in position and rotate driveshaft clockwise to ensure free movement.

## 

Make sure impeller blades are not caught or pinched between upper and lower pump cases when upper pump case is fully seated.

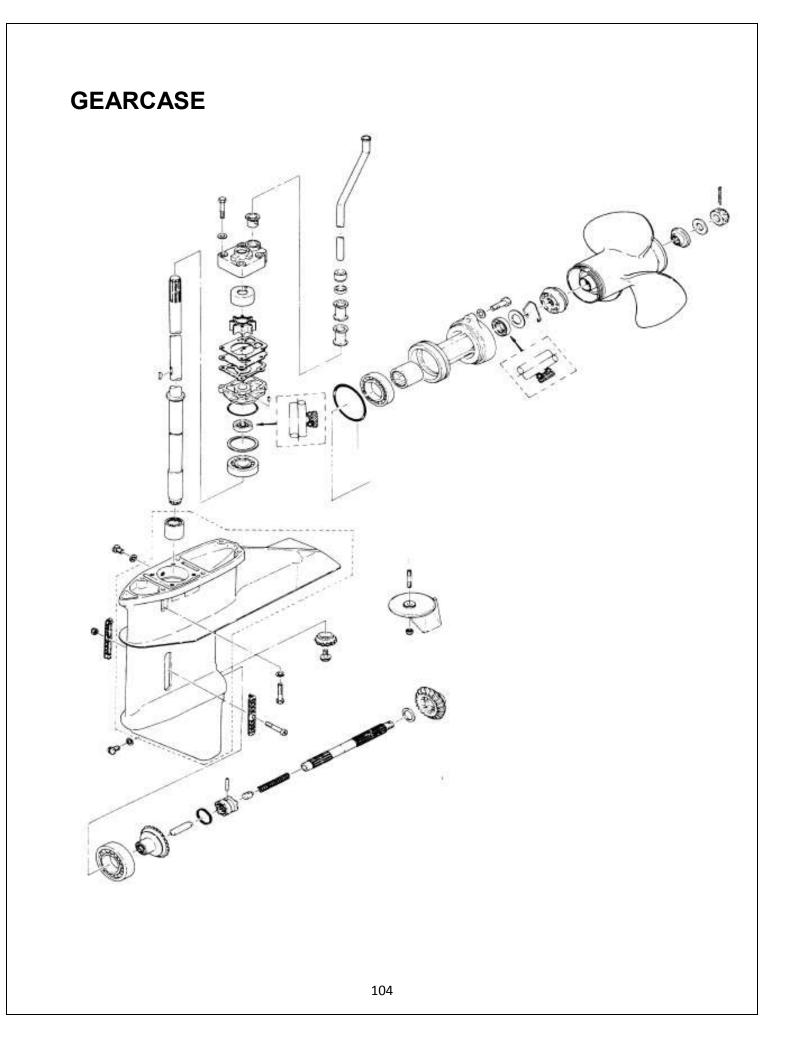
7. Apply genuine grease or equivalent friction surface marine grease to neck portion of water pump mounting bolts. Install the bolts.

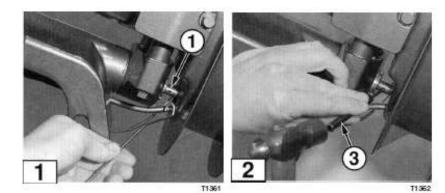
8. Install the gearcase. See Gearcase, this section.











## Removal

# 

Ignition system must be disabled to prevent accidental engine start-up during removal of the gearcase.

1

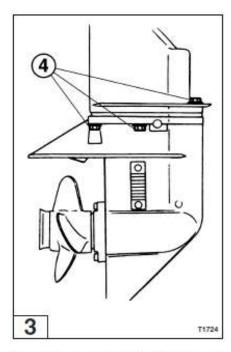
1. Place engine in FORWARD gear so shift rod joint (1) is accessible.

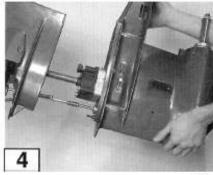
2. Use spring pin tool A (3) (Part No. 345-72227-0) to remove 2 upperspring pin from shift rod joint. Discard the spring pin.

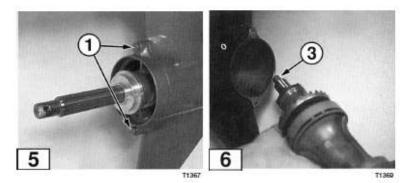
3

3. Remove gearcase mounting bolts (4) from both sides of gearcase.

4 4. Separate gearcase from driveshaft housing.







#### Disassembly

## 1 CAUTION

Gearcase must be secured in a suitable holding fixture during disassembly.

1. Drain all gearcase oil into a container and inspect the oil for metal chips.

#### NOTE

Small metal fragments may indicate normal wear of gears, bearings, and shafts. Large metal chips usually indicate extensive internal damage. Record your observations for future reference when inspecting internal components.

2. Remove the water pump and install a water pump repair kit if gearcase has been in service for any length of time. See Water Pump, this section.

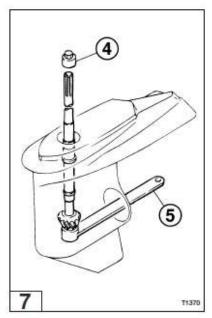
3. Remove propeller mounting nut, washers and propeller.

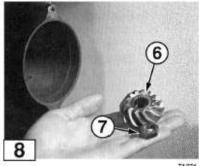


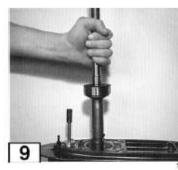
4. Remove propeller shaft housing bolts (1).

5. Remove propeller shaft and housing from gearcase. Make 6 sure clutch push rod (3) is also removed. The push rod and spring may "pop" out with removal. Set the assembly aside.

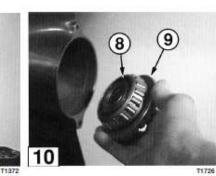
6. Install socket (4) (Part No. 9.9/15/18: 350-72232-0, 25/ 30: 346-72232-0, 40: 345-72232-0) and wrench (5) (Part No. 346-72231-0). Hold bevel gear B nut with wrench and turn driveshaft counterclockwise to loosen the nut. Remove bevel gear B (6) and nut (7) from gearcase.

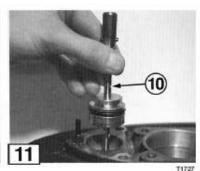






9





8. Lift the driveshaft from the gearcase and set it aside.

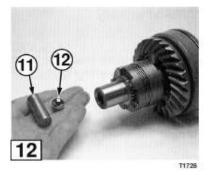
9. Reach inside gearcase and remove roller bearing (8) and bevel gear A (9).

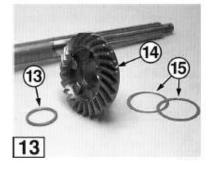
#### NOTE

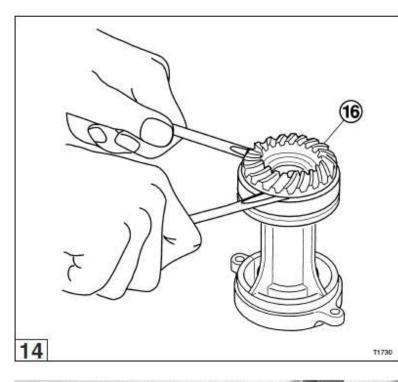
Taper bearing for bevel gear A is only used on Model 40.

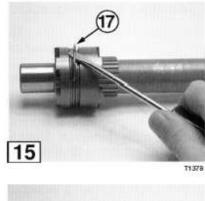
**10**. Remove the stopper and lift cam rod **(10)** from gearcase. Fullydisassemble the cam rod components, including the cam rod bushing internal and external o-rings.

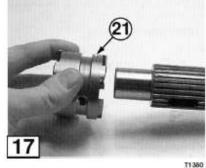
- **12** 11. Remove clutch push rod **(11)** and ball **(12)** from propeller shaft. Pull propeller shaft out of housing.
- 12. Remove washer (13), bevel gear A (14), and all shims (15) (25/30 and 40) from propeller shaft.











1 13 Bon

14 13. Remove bevel gear C (16) from the propeller shaft housing.

**15** 14. Insert screwdriver under one end of clutch pin snap spring (17). Remove spring from groove by unwrapping it from clutch. Discard the spring.

**16** 15. Place propeller shaft open end against bench surface and push out clutch pin (18). Remove clutch spring (19) and spring holder (20).

### 

Wear safety glasses and DO NOT hold open end of propeller shaft towards face or body when removing clutch pin. Clutch spring and spring holder come out with great force.

17 16. Pull clutch (21) off propeller shaft.

## **Cleaning and Inspection**

### NOTE

All worn, damaged, and missing palls must be replaced.

 Discard the clutch pin snap spring and all seals and o-rings that have been removed.

Clean all gearcase components with solvent and dry with low pressure compressed air. After cleaning, apply specified gear oil to all internal components to prevent rusting.

3. Perform the following inspections:

### **Gearcase Housing**

- Inspect internal and external surfaces of housing for cracks and other damage. All threaded holes must be undamaged and free of corrosion and sealing agents.
- Checkthe sacrificial trim tab ford amage and erosion. See Anodes - Inspection and Testing in Section 2.
- Inspect the water intake screens for damage and blockage. If screens cannot be fully cleaned, replace them.

### Propeller and Shaft

- Verify the propeller is true and free of nicks, chips, and other damage that will affect performance. Inspect the thrust washer and mounting hardware for damage.
- · Check the propeller shaft threads and splines for wear and damage.

### Propeller Shaft Housing

18 Examine propeller shaft housing and components for wear, damage, and deterioration. If necessary, disassemble and repair as needed. See Gearcase Repair Procedures, this section.

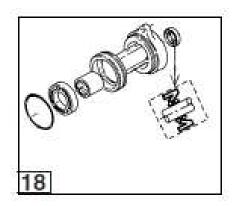
### Driveshaft

- Check driveshaft threads and splines for wear, chips, and cracks. Severe spline wear or the appearance of spline "twisting" indicates the gearcase or exhaust housing has been distorted, possibly by impact damage.
- Bearing(s) must be free of damage, corrosion, and discoloration. Replace bearing(s) as required. See Gearcase Repair Procedures, this section.

### All Internal Components

Inspect all internal components for signs of wear, chipping, pitting, distortion, and discoloration due to improper lubrication. Special attention to the following:

- Check the bevel gear A tapered roller bearing outer race. If damaged or corroded, replace both the race and the bearing. See Gearcase Repair Procedures in this section.
- Inspect clutch and gear teeth and the clutch cam for chips and signs of metal transfer. Replace parts as needed.



#### Assembly ·

 Install new gearcase needle bearing, bevel gear A & B roller bearing and outer race, and driveshaft bearing(s) if any of these parts were removed. See Gearcase Repair Procedures, this section.

Secure gearcase in holding fixture with water pump side facing upward.

3. Apply Loctite 242 to the thread of bevel gear B nut (3). Slide bevel gear B (4) onto driveshaft (5) as shown from propeller shaft side of gearcase. Hand tighten nut (3) to secure the gear in place.

#### NOTE

Before applying Loctite 242, remove all grease from tapered portion of bevel gear B and driveshaft with solvent, and thread of driveshaft and bevel gear B nut also.

4. Install specified socked (6) Part No. 345-72232-0 and wrench (7) (Part No. 346-7223-1-0). Hold bevel gear B nut with wrench and turn driveshaft clockwise to tighten the nut. Torque bevel gear B nut to specification

Perform all adjustment steps before proceeding. See Adjustments, this section.

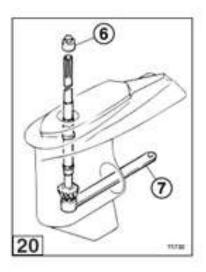
### CAUTION

Failure to perform the adjustment steps may result in poor engine performance, premature wear of parts, or severe damage to gearcase components.

6. Install the water pump. See Water Pump, this section.

#### NOTE

Make sure all necessary adjustment shims are installed on driveshaft bearing before installing lower pump case.







7. Install bevel gear A (8) so tapered roller bearing (9) is seated in outer race.

8. Replace cam rod bushing internal o-rings (10) and external o-ring (11). Coat the internal o-rings and inner surface of bushing with specified gear oil. Then fully assemble the cam rod components.



23 9. Apply genuine grease or equivalent friction surface marine grease to the exterior of the cam rod bushing and o-ring.

10. Insert the cam rod into the cam rod port on the gearcase and seat the bushing. Install stopper with stopper bolt.

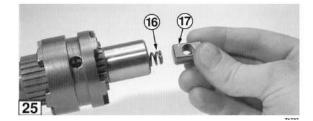
24 11. Align hole in clutch with slot in propeller shaft. Slide clutch onto shaft so the side with the groove (1) faces the side with bevel gear A (2).

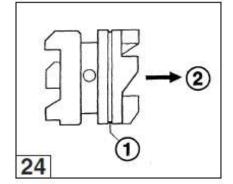
## CAUTION

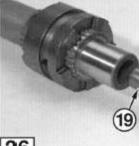
The clutch is not symmetrical (except 5 HP). If installed backwards, clutch and gears will be damaged.

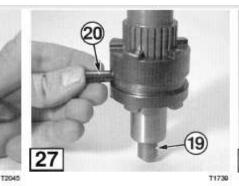


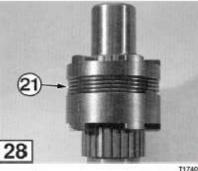
25 12. Insert clutch spring (16) and install spring holder (17) so hole in spring holder is aligned with clutch hole.











26

26 13. Install clutch push rod (19) so tapered end faces bevel gearA.

**27** 14. Compress the clutch spring by applying pressure to push rod (19). Align the holes of the clutch and spring holder and insert clutch pin (20).

## 

Wear safety glasses and DO NOT hold spring end of propeller shaft towards face or body when compressing the clutch spring.

**28** 15. Install new clutch pin snap spring **(21)** using the clutch pin snap tool. Do not reuse old snap Spring.

Part number of clutch pin snap tool

40

: 345-72229-0

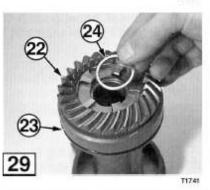
## ▲ CAUTION

DO NOT reuse clutch pin snap spring (21), it must be replaced. Reusing clutch pin snap spring may cause severe damage to gears and other components.

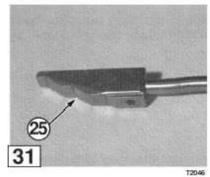
 16. Make sure all necessary adjustment shims are installed on bevel gear C (22) and install gear onto propeller shaft housing
 (23). Install washer (24) onto bevel gear.

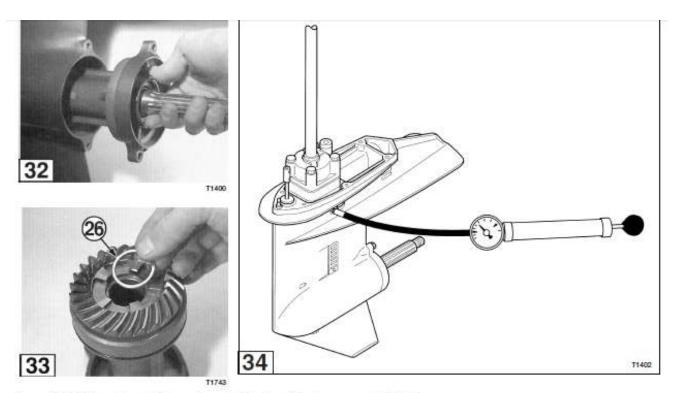
**30** 17. Apply genuine grease or equivalent to the propeller shaft housing o-ring and oil seal. Slide the propeller shaft into the propeller shaft housing.

18. Lift the cam rod to the fully UP position and verify through the gearcase opening that clutch cam beveled side (25) faces gearcase opening.









**32** 19. Align the clutch push rod with the clutch cam and slide the propeller shaft and housing into the gearcase opening. Push forward and rotate the propeller shaft as needed until bevel gears have engaged. Ensure the propeller shaft housing bolts are completely clean and apply Loctite 242 to the bolt threads. Install and torque the bolts evenly to prevent improper seating of the housing.

20. Move the cam rod to each position and rotate the driveshaft to test gearcase function in all gears. Check the propeller shaft for looseness in the forward and reverse directions. If looseness exceeds 0.016 in [0.40 mm], replace bevel gear C washer (26) with one of correct thickness.

## NOTE

Refer to current Parts Catalog for washer availability

34 21. Before adding gear oil, pressure test and vacuum test the gearcase as follows:

- Remove the oil level plug and install gearcase pressure tester.
- Pump pressure tester until gauge indicates 3 6 psi [20 39 kPa / 0.2 0.4 kg/cm<sup>2</sup>]. If pressure loss occurs, determine source of leakage by submerging gearcase in water. Make necessary repairs to correct the problem and retest.
- Remove the pressure tester and install gearcase vacuum tester.

 pump vacuum tester until gauge indicates 3 - 5 in [76 - 127mm] of mercury. If loss of vacuum occurs at either range, apply oil around suspected seal. If leak stops or oil is drawn in, the seal is defective and must be replaced. Make necessary repairs to correct the problem and retest.

 Fill gearcase with specified gear lubricant. See Engine Specifications in Section 2 for gearcase capacities.

 Apply genuine grease or equivalent to the propeller shaft and propeller mounting hardware. Install the propeller and propeller mounting hardware.

## 

Make sure propeller thrust holder is installed and seated against the propeller shaft oil seal before installing propeller. If installed improperly, propeller may be pushed into gearcase housing during tightening.

### Adjustments

### 

DO NOT attempt gearcase adjustments without proper manufacturer special tools and adequate knowledge of gearcase setup.

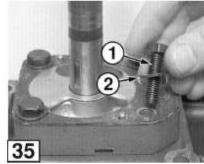
### NOTE

Specific assembly steps must be completed in order to perform the gearcase adjustments. If these steps have not been performed, refer to Assembly, this section.

### NOTE

Unless otherwise indicated, all gearcase adjustment specifications are based on measurements obtained with manufacturer special tools.

1. Slide lower pump case onto driveshaft and seat into position on gearcase. Secure lower pump case with bolts (1) and plain washers (2).



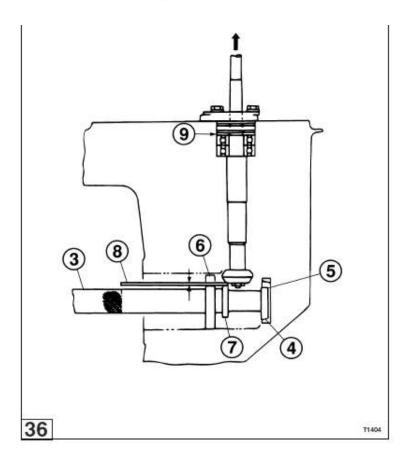
T1403



2. Insert shimming gauge (3) into gearcase . 40 gauge: 3C8-72250-0).

# NOTE

Correct positioning of the shimming gauge in the gearcase is critical, Make sure tapered side (4) is fully seated I'n bevel gearA bearing outer race with ilat side (5) and notch (6) facing upward.





Eliminate all looseness between driveshaft and gearcase using one of the following methods:

- Lift driveshaft upward and tap down on gearcase with rubber mallet.
- Slide acompression spring (obtain locally) over driveshaft and seat onto lower pump case. Install backlash measuring tool clamp assembly (Part No. 3B7-72720-0) on driveshaft. Compress the spring and tighten the clamp to maintain the spring compression and provide constant upward pressure against driveshaft.

With all looseness eliminated, measure the gap between collar (7) and bevel gear B using thickness gauge set (8) (Part No. 353-72251-0). If gap measurement is not within 0.023 - 0.025 in [0.60 -0.64 mm], remove the lower pump case and install correct size shim onto roller bearing outer race at location (9).

# NOTE

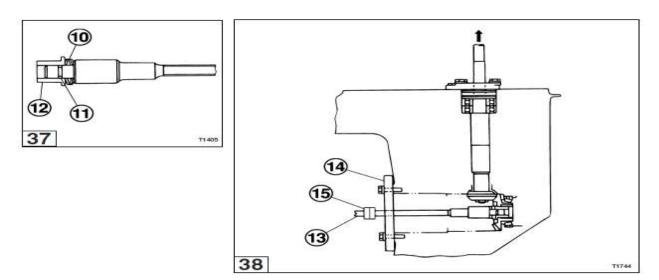
## Refer to current Parts Catalog for shim availability.

If shimming was necessary re-install the lower pump case before proceeding with Backlash Adjustment - Bevel Gears A and B.

Backlash Adjustment - Bevel Gears A and B

# **Backlash**

Special tools are required for measuring backlash. The following describes how to measure and correct backlash in the Raider 40 outboard.



5. With the tapered roller bearing installed, position bevel gear A in gearcase so bearing is fully seated in outer bearing race. Rotate the driveshaft to ensure gears are property meshed.

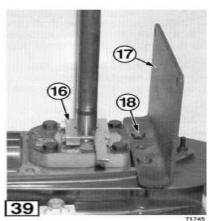
6. Assemble the following backlash tool components. Note the correct quantity and orientation of conedisk spring washers:

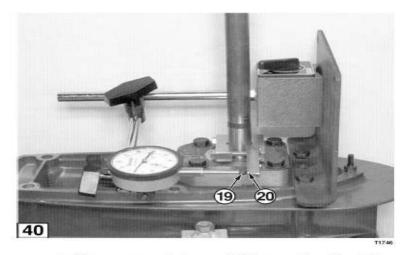
37 Assemble three conedisk spring washers (10), o-ring (11), and collar (12).

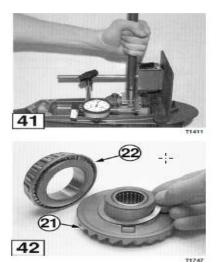
**38** 7. Insert shaft **(13)** into gearcase and seat collar/guide end in bevel gear A. Install plate **(14)** using appropriate size bolts. Turn shaft nuts **(15)** onto shaft. Tighten the nuts against each other so outer nut can be used to tighten shaft **(13)**.

8. Look the nuts (15).

**39** 9. Mount clamp assembly (16) on driveshaft as close as possible to lower pump case. Install dial gauge plate (17) on gearcase with appropriate size bolts (18).





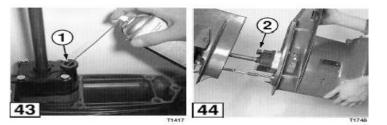


[40] 10. Mount a magnetic base and dial gauge (obtain locally) as shown. Lift driveshaft upward and tap down on gearcase with rubber mallet to eliminate all looseness and proceed to adjust the setup so dial gauge (19) is aligned with V-notch (20).

[41] 11. Set dial gauge to zero. Lift driveshaft upward and rotate driveshaft in both directions and record the dial gauge reading.

[42] If the dial gauge reading is not within the specified range, adjust shim thickness between bevel gear A (21) and tapered roller bearing (22) in accordance with the Backlash - Shim Adjustment Table, this section. See Gearcase Repair Procedures in this section for removal and installation of the bevel gearA roller bearing.

| Madal     | Acceptable Dial Gau | ige Reading |
|-----------|---------------------|-------------|
| Model     | in                  | mm          |
| Raider 40 | 0.0236 – 0.0394     | 0.60 - 1.00 |



#### Installation

#### 

Ignition system must be disabled to prevent accidental engine start-up during installation of the gearcase.

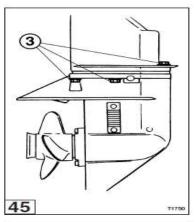
**43** 1. Lightly coat the driveshaft splines with genuine engine oil or TC-W3 oil and apply silicone spray lubricant to water pipe lower seal (1).

**44** 2. Slide driveshaft into lower crankcase head. Align water pipe with lower seal (2) before seating gearcase on driveshaft housing.

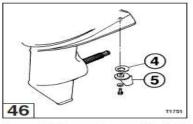
**45** 3. Apply Loctite 242 to threaded portion of gearcase mounting bolts. Install the gearcase mounting bolts (3) and torque all bolts to specification.

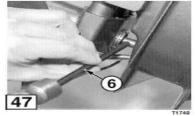
4. Inspect trim tab (5) and replace if corroded. Install trim tab packing (4) and trim tab (5).

**47** 5. Use spring pin tool B **(6)** (Part No. 345-72228-0) to install new upper spring pin in shift rod joint. DO NOT reuse the old spring pin.



Ι





| Dial Gauge Setting 40 |             | Shim Thickness<br>+ Increase shim thicknes |       |
|-----------------------|-------------|--|-------|
|                       |             | - Decrease shim thickness                  |       |
| in                    | mm          | in   | mm    |
| 0 - 0.002             | 0.00 - 0.05 | -0.0098                                    | -0.25 |
| 0.002 - 0.006         | 0.06 0.15   | -0.0079                                    | -0.20 |
| 0.005 - 0.014         | 0.16 - 0.35 | -0.0059                                    | +0.15 |
| 0.014 - 0.018         | 0.36 - 0.45 | -0.0039                                    | -0.10 |
| 0.018 - 0.023         | 0.46 - 0.59 | -0.002                                     | +0,05 |
| 0.024 - 0.039         | 0.60 - 1.00 | 0  | 0.00  |
| 0.04 - 0.041          | 1.01 - 1.05 | +0.002                                     | +0.05 |
| 0.042 - 0.045         | 1.06 - 1.14 | +0.0039                                    | +0.10 |
| 0.045 - 0.047         | 1.15 - 1.20 | +0.0059                                    | +0.15 |
| 0.048 - 0.053         | 1.21 - 1.35 | +0.0079                                    | +0.20 |
| 0.054 - 0.059         | 1.36 - 1.50 | +0.0098                                    | +0.25 |
| 0.059 - 0.065         | 1.51 1.65   | +0.0118                                    | +0.30 |
| 0,065 - 0,071         | 1.66 1.80   | +0.0138                                    | +0.35 |
| 0,071 - 0,077         | 1.81 1.95   | +0.0157                                    | +0.40 |
| 0.077 0.083           | 1.96 2.10   | +0.0177                                    | +0.45 |
| 0.083 0.089           | 2.11 2.25   | +0.0197                                    | +0.50 |
|                       |             | +0,0217                                    | +0,55 |
|                       |             | +0,0236                                    | +0,60 |

# **GEARCASE REPAIR PROCEDURES**

### 

DO NOT attempt gearcase repairs without proper manufacturer special tools.

Use this section when service work requires disassembly or replacement of the following gearcase components:

- Driveshaft roller bearings.
- · Gearcase needle bearing.
- Propeller shaft housing needle bearing.
- Bevel gear A bearing outer race.
- Bevel gear A roller bearing.

### **Driveshaft Roller Bearings**



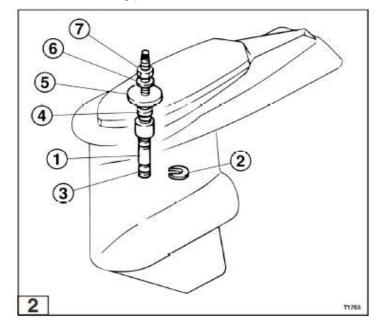
### 

If it is determined after complete inspection that replacement of driveshaft roller bearing (1) is necessary, all pressing operations during removal and installation must be performed at a qualified machine shop equipped with minimum 1 ton Press.



### Gearcase Needle Bearing:

Note: Obtain needle roller bearing puller kit: P/N: 3C8-72700-0.



#### Removal

| 12.2 | 545 |
|------|-----|
| 0    | 12  |
| 2    | 1.3 |
|      |     |

1. Insert shaft (1) through needle bearing from water pump side of gearcase.

2. Attach retainer (2) from propeller shaft side of gearcase to shaft groove (3). Make sure retainer is fully seated in groove with raised surface facing bearing:

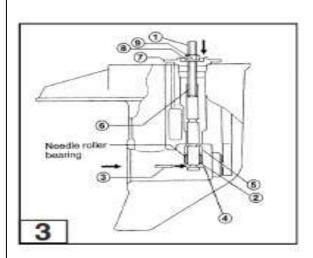


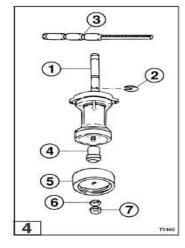
 Slide guide (4) onto shaft from water pump side of gearcase. Make sure guide is seated in bearing.

4. Install plate/flange (5), washer (6), and nut (7) onto shaft.

5. Hold end of threaded shaft with wrench and tighten nut (7) until bearing releases from housing.

| Installatio   | on   |
|---------------|--|
| <b>3</b> 1. I | nsert shaft (1) through needle bearing housing in gearcase.  |
| bea           | Coat the new needle bearing with genuine gear oil. Slide<br>aring onto shaft from propeller shaft side of gearcase so<br>amped surface (2) faces propeller shaft side. |
|               |  |
| pro           | amped surface of needle bearing must face<br>opeller shaft side of gearcase or bearing could<br>damaged during installation.   |
| Spe spe       | Attach retainer (3) from propeller shaft side of gearcase to<br>acified shaft groove (4). Make sure retainer is fully seated<br>with raised surface facing bearing.    |
| 3 4.8<br>Ma   | Slide guide (5) onto shaft from water pump side of gearcase.<br>ke sure guide is seated in bearing.  |
|               | nstall stopper (6), plate/flange (7), washer (8), and nut (9)<br>o shaft from water pump side of gearcase.   |
|               | Hold end of threaded shaft with wrench and tighten nut (9) il stopper (6) contacts plate/flange (7).   |
| 7 Remove      | tools and verify needle bearing is fully seated in housing   |





#### Propeller Shaft Needle Bearing

#### 4 Removal

- 1. Remove oil seal from propeller shaft housing.
- 2. Remove roller bearing from propeller shaft housing by heating the housing with hot water.
- 3. Place shaft (1) through needle bearing.
- 4. Attach retainer A (2) to shaft groove (3) with raised surface of retainer facing bearing.

5. Slide guide B (4) and flange B (5) onto shaft and secure with washer (6) and nut (7).

6. Tighten nut (7) until needle bearing releases from housing.

#### 5 Installation

1. Attach retainer A (2) to shaft groove (3) with raised surface of retainer facing bearhg.

2. Coat new needle bearing with gear oll. Slide bearing onto shaft so bearing stamped surface faces retainer A (2).

#### 

Stamped surface of needle bearing must face retainer or bearing could be damaged during installation.

3. Slide stopper B (8) and guide B (4) onto shaft and insert shaft in propeller shaft housing.

4. Slide flange B (5) onto shaft and secure with washer (6) and nut (7).

5. Tighten nut (7) until stopper B (8) contacts flange B (5).

6. Remove tools and verify needle bearing is fully seated in housing.

#### **Bevel Gear A Bearing Outer Race**

#### Removal

1. Install bevel gear A bearing puller assembly (Part No. 3A3-72755-0).

2. Tighten bolt (1) until bearing race releases from housing.

#### Installation

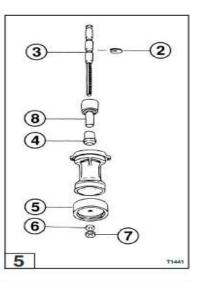
1. Secure gearcase horizontally in padded vice or other fixture so propeller shaft opening faces upward.

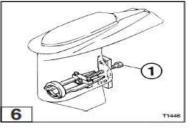
Verify bearing race seating surface in gearcase is clean and smooth.

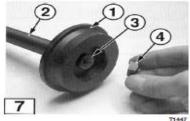
3. Apply specified gear oil to exterior of bearing race. Position race in gearcase so stamped surface faces closed end of gearcase.

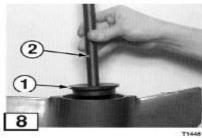
4. Attach plate (1) to threaded end of rod (2) using spring washer (3) and nut (4). Tighten nut with wrench.

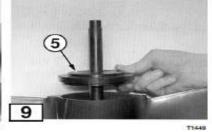
| Tool                    | Part Number | Model |
|-------------------------|-------------|-------|
| Bearing Outer Press Kit | 3B7-72739-0 | 40    |

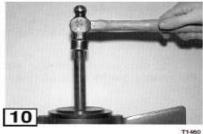








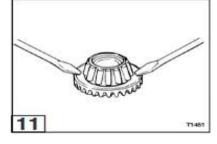




5. Insert rod (2) into gearcase so plate (1) is seated within the bearing race.

6. Slide guide (5) onto rod and seat into position on gearcase. Raised surface of guide must fit tightly within the circumference of the gearcase opening.

**10** 7. Fully seat bearing race in gearcase by hammering the rod end.

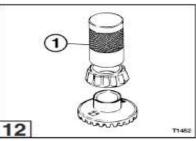


### **Bevel Gear A Roller Bearing**

#### **Removal and Installation**

1. Insert screwdrivers in notches of bevel gear A and gently pry gear and bearing apart.

12 2. Use specified set tool (1) to press fit bearing onto bevel gear.



| Tool                           | Part Number | Model |  |
|--------------------------------|-------------|-------|--|
| Set Tool, Bevel Gear A Bearing | 3C8-72719-0 | 40    |  |

# SECTION 7 – ELECTRICAL SYSTEM General Precautions

Before performing any service work on the electrical system, read and understand the Service Safety section at the beginning of this manual.

Use the manufacturer and special tools as indicated during servicing of the electrical system.

Avoid electrical shock:

- Do not handle spark gap tester leads during performance testing.
- Do not touch ignition coils, exciter coil, pulser coils, or alternator coils while the engine is cranking or running.

Use the spark gap tester to prevent the engine from starting when performing static ignition performance tests.

Use caution when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

After repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

Always inspect and test the start-in-gear prevention system before returning engine to customer.

## SERVICE SPECIFICATIONS

#### **Special Torque Values**

| Description  | Torque<br>in-lb (ft-lb)<br>N-m<br>kg-m | Threadlocker |
|--------------|--|--------------|
| 5            | 40                                     | -            |
| Spark Plug   | (19 - 21)<br>25 - 29<br>2.6 - 3.0      | -            |
| Flywheel Nut | (87 - 101)<br>118 - 137<br>12 - 14     | -            |

#### NOTE

Verify direction of flywheel nut rotation. Most are right-hand threads, however, some will have left-hand threads (past production models 9.9/15/18 and 40).

\*Refer to Section 2 for Standard Torque Values chart.

#### Manufacturer Special Tools Required

None

# **General Precautions**

Before performing any service work on the Raider electrical system, read and understand the Service Safety section at the beginning of this Service Manual. Use the manufacturer and special tools as indicated during servicing of the electrical system.

Avoid electrical shock:

- Do not handle spark gap tester during performance testing.
- Do not tough ignition coils, exciter coil, pulser coils or alternator coils while engine is cranking or running.

Use the spark gap tester to prevent the engine from starting when performing static ignition performance tests.

Use caution when performing tests with the engine cowling removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

After repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions.

Replace locking fasteners when their locking feature becomes weak.

Use only COTS factory parts (Mercury, Nissan or Tohatsu) or Raider replacement parts.

Always inspect and test the start-in-gear prevention system before returning engine to mission readiness.

Always disconnect battery when not in use.

### **General Equipment Required**

Analog Multimeter, Electronic Specialties® Model M-530 or equivalent Digital Multimeter, Electronic Specialties® Model KD 3200 or equivalent Spark Gap Tester, Stevens® S- 13C, S-48, or equivalent Digital Pulse Tachometer, 10 - 6000 RPM, Electronic Specialties® Model 321 or equivalent Variable Load High Rate Discharge Tester, Electronic Specialties® Model 700 or equivalent Hydrometer Heat Gun Torque Wrench, 0 - 150 in-lb [0 - 17N-m / 0 - 1.7kg-m]

### **Consumables Required**

Dielectric Lubricant, Permatex® Dielectric Tune-Up Grease Battery Spray Protector, Permatex® Battery Protector and Sealer Low Temperature Lithium Grease Genuine Grease or Equivalent Friction Surface Marine Grease Threadlocker, Loctite® 243 Isopropyl Alcohol Cleaning Solvent Thermomelt Stik, 125°F [52°C] and 163°F [73°C] Electrical Shrink Fit Tubing, various diameters

## **Electrical System - Overview**

Ignition Type: Flywheel Magneto Capacitor Discharge Ignition Timing: Before Top Dead Center (BTDC) – 25 Degrees ATDC – 2 Degrees Spark Plug: Pulstar – Model SBE 1/10 Spark Plug Gap: .033 (No larger than .050) Battery: Part No. 365-265-001 (Raider sealed Lithium Iron - 265 CA) Alternator: 12V 80W Charging Performance @ 5500 – 5 Amps Ignition Coil Resistance – Primary Coil: 0.2 – 0.3 KOhms Secondary Coil: 4.1 – 6.1 K Ohms CD Unit Output (Cranking): 198-220 DVA Exciter Coil Output (Cranking): 100 DVA Mim Pulser Coil Output (Cranking): 4.75 – 5.0 DVA Coil Resistance – Exciter Coil: 130-195 Ohms Alternator W-Y: Y-W 0.65 - 0.98 Y-B 0.31 - 0.47 W-B = 0.37 = 0.55

## **Electrical Connectors**

When you replace electrical components or perform diagnostic tests, you must disconnect electrical connectors in many instances.

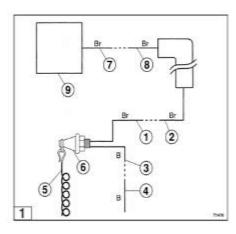
The following discussion will help you recognize connectors in electrical drawings and show you how to disconnect and connect them.

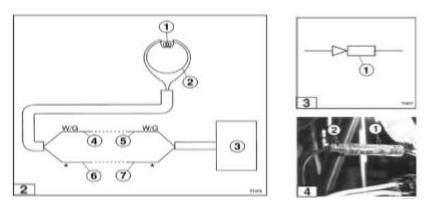
## **Electrical Connector Drawings**

In most of the electrical drawings in this section, the physical shape of electrical connectors has been eliminated to clarify testing procedures.

1 A typical electrical drawing illustrates several connectors. Items (1), (2), (3), (4), (7) and (8) are terminals that are located inside of electrical connectors. The dashed line between two terminals [e.g., between terminal (7) and (8)] means that they are a part of the same connector but have been disconnected for testing.

Note that Terminal (7) is directly connected to the CD Unit (9) (no connectors between the terminal and CD Unit). When you disconnect an electrical connector to test a component, it is very important that you disconnect the FIRST CONNECTOR. Terminals (1), (3) and (7) are examples of how the first connector is illustrated.





Special cases are the connectors used to test components located on the coil plate assembly. For testing purposes, the first connector is located at the far end of the cable (away from the coil plate assembly).

### **Bullet Connectors**

### NOTE

3

Bullet connectors (1) are shown like this in electrical drawings.

#### **Disconnecting Bullet Connectors**

 Carefully examine the connector to determine which end is removable and which end is fixed. Typically the insulation surrounding the removable end is tapered so it fits inside of the insulation for the fixed end.

2. Grasp the fixed end (1) of the connector and carefully pull the removable end (2) straight out without twisting or bending it.

#### NOTE

Never twist or bend bullet connectors or damage to the connectors will occur. Always PULL these connectors apart.

#### Electrical Cable Color Codes

Electrical cables have color coded conductors so you can locate the correct conductor during troubleshooting and repair procedures. All conductor colors are in capital letters in this manual.

Some conductors have a background color and a different color stripe that runs the length of the conductor. These conductors are designated as follows:

A/B Where A = Background Color B = Stripe Color

Example: BLACK/WHITE This conductor has a BLACK background with a WHITE stripe.

#### Electrical Drawings

All electrical drawings shown in this manual have been simplified to clarify the circuit that is being tested. They represent typical configurations and may not look exactly like the electrical wiring for your engine. Complete electrical schematics are provided in the Outboard Motors Service Data publication.

#### **Troubleshooting - Electrical**

The troubleshooting chart lists common engine symptoms related to problems with the electrical system. It also indicates specific malfunctions in the electrical system which may be causing a problem so it can be isolated more effectively. Before beginning major troubleshooting on the electrical system, perform the following operations:

- Check battery fluid level and specific gravity. Charge or replace as required. See Battery Care and Maintenance, this section.
- Check the following electrical connections and make sure they are secure and free of corrosion:
  - Battery cables
  - Starter solenoid wiring
  - Starter motor wiring (including ground connection)
  - Spark plug leads
  - Ignition circuit wiring
  - Stop circuit wiring
  - Charge circuit wiring
- Make sure shift lever or remote control lever operates freely.
- Attach lanyard to emergency stop switch, see Section 2.

# Ignition System

| SYMPTOM  | Cranks but<br>will not start | Wilt not start<br>and pops or<br>backfi res | Starts but<br>stops<br>immediately | Low or high<br>speed miss | Poor accel-<br>eration, low<br>top end RPM | Engine will<br>not shut<br>off |
|--|------------------------------|---|------------------------------------|---------------------------|--|--------------------------------|
| Faulty stop circuit - see Test 2 -<br>stop Circuit Test, this section                |                              |   |                                    |                           |  | ٠                              |
| Faulty ignition system -<br>see Ignition System Performance<br>Testing, this section |                              | •   |                                    | •                         | •  | •                              |
| Faulty spark plug(s) -<br>See Section 2  | •                            |   | •                                  | •                         | •  |                                |
| Incorrect ignition timing or<br>carburetor synchronization -<br>See Section 2        |                              | •   | •                                  | •                         | •  |                                |

# Starting System

| SYMPTOM  | Will not crank |
|--|----------------|
| Internal battery   | •              |
| Fauley switch  | •              |
| Not in Neutral,<br>defective Neutral switch                            | •              |
| Faulty battery, starter solenoid/<br>starter motor cable               | •              |
| Faulty starter solenoid  | •              |
| Faulty starter motor:<br>- Faulty brushes<br>- Damaged pinion assembly | •              |
|  |                |

### **Charging System**

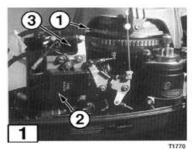
| SYMPTOM                              | Battery does not maintain<br>charge ercharges |
|--------------------------------------|---|
| Wiring/Connector                     | •   |
| Shorted or faulty<br>alternator coil | •   |
| Faulty recitier/regulator            | •   |
| Faulty charge circuit wiring         | •   |

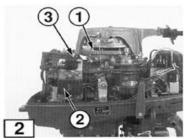
# DESCRIPTION OF OPERATION

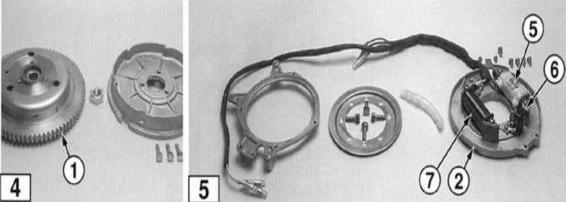
### Ignition System

Magneto

1 2 3 The ignition system consists of the magneto (1), Capacitive Discharge (CD) unit (2), ignition coil (3), main key switch (4) and emergency stop switch (5). The purpose of this system is to provide an electric spark inside each cylinder at the precise moment needed by the combustion chamber.



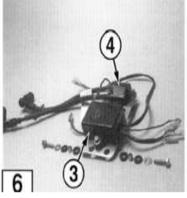




The electrical system consists of a

4 5 6 7 flywheel (1), coil plate assembly (2), a CD unit (3) and an ignition coil (4). The 1/2 cylinder engines are comprised of seven basic electrical systems. The following chart demonstrates not only the differences but the similarities:

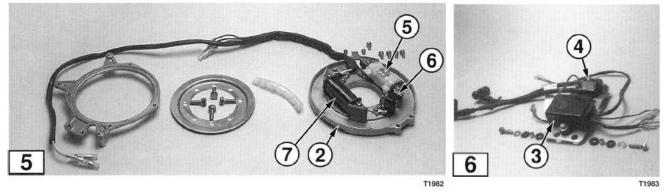
Raider has: (1) CD Unit; (2) Coil Plate; (3) Exciter Coil; (4) Ignition Coil; (5) Pulser Coil; (6) Alternation/Lighting coil.

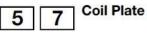


T1982

#### Flywheel 4

Mounted radially inside the flywheel (1) are a number of high performance ferrite magnets. As the flywheel rotates, the magnets pass in front of the coils (exciter / alternator) to produce voltage in the coils.

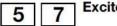




The coil plate is a part to which exciter coil, pulser coil and alternator coil are attache

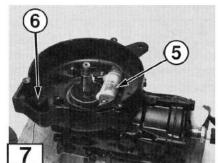
).) The

coil plate is rotated for ignition advance.



## **Exciter Coil**

The exciter coil (5) consists of many windings of wire wrapped around a metal lamination. Once the flywheel exceeds a minimum cranking RPM, the lines of force from the ferrite magnets contained within the flywheel cut through the exciter coil windings. This will produce about 100 DVA or over(peak voltage) at cranking speed. A minimum of 100 DVA(peak voltage) at cranking speed must be detected. The output of the exciter coil provides power to the CD Unit.





#### **Pulser Coil** 7 5

The pulser coil (6) consists of an iron core with numerous windings of a wire wrapped around it. The flywheel is equipped with a metallic cam called an interrupter molded into it. When the interrupter passes in close proximity to the pulser coil, the permanent magnet's lines of force collapse momentarily. At cranking speed this produces a 4.75 to 5.0 DVA signal in the coil. A minimum of 3 DVA must be detected during testing.

The output voltage from the pulser coil is used to control a small electronic switch (SCR) located inside the CD Unit. When the CD Unit receives an output from a pulser coil, it directs an output, approximately 220 DVA, to the appropriate ignition coil primary.

# 5

### Alternator/Lighting Coil

The larger 1/2 cylinder engines (9.9-40) are provided with an alternator coil (7) mounted on the coil plate which may be used to power a lighting circuit and/or recharging circuit if equipped with this option. An Alternator/Lighting Coil is available as an add-on to the 5 and 8/9.8 models.

#### **CD Unit** 6

The CD Units incorporate a printed circuit board (PCB) encased in a black resin housing to protect the circuitry from water and vibration. Major components include a diode used to rectify current generated by the exciter coil, a capacitor which charges the voltage supplied, a thyristor which serves as a breaker and a zener diode used to control the thyristor. Additional components such as resistors and SCR's are also provided depending upon the model.

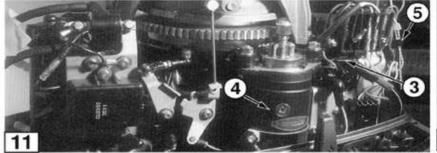
## 6

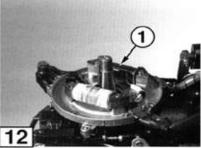
## **Ignition Coil**

Each ignition coil (4) consists of two windings or wire wrapped around a compacted ferrite material. The coil has a primary and secondary terminal connection and a ground plate. Through mutual induction, the ignition coil transforms the output from the CD Unit to as much as 20,000 - 30,000 volts to fire the spark plug. The ignition coil is generally adjacent to the CD Unit and attached to its mounting bracket, with the exception of the 8/9.8 CD Unit where the ignition coil is molded as together as part of the CD Unit.

### Main Key Switch and Emergency Stop Switch

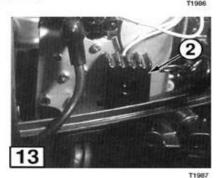
The emergency stop switch is connected to the CD Unit through an engine wiring harness. When lanyard is removed from the emergency stop switch, an input to the CD Unit is grounded. This deactivates the CD Unit and the engine shuts down. If the engine is fitted with the Remote Control feature, pressing the stop switch on the Remote Control Unit will also ground the CD Unit.





#### Starting System - Optional Electric Start

**11** The starting system consists of the battery, main key switch, neutral start switch, starter solenoid (3), starter motor (4) and 15 A engine fuse (5). When the main key switch is in the START position, and the start contacts of the neutral start switch are closed, power is sent to the starter solenoid, energizing it. When the starter solenoid is energized, a connection between the positive terminal of the battery and the starter motor is provided. The connection between the starter motor and ground completes the circuit. The fuse opens if the coil circuit of the starter solenoid shorts or overloads.



#### **Charging System**

**12 13** The charging system consists of the alternator coil set (1), rectifier (2), 10 or 15 A engine fuse, and the battery. When the flywheel is turning approximately 1500 RPM or higher, the alternator coil set provides alternating current (AC) voltage to the rectifier/regulator. The rectifier transforms the AC voltage into direct current (DC) voltage.

Battery Care and Maintenance

### 

The Raider 40 outboard motor has a battery located internal, located under the cowling.

This battery is a fully sealed lithium-iron battery shown below.



The battery has one plug with two connectors (+) and (-). It is constructed that it can be plugged into the mating connector one way.

Battery Size: Length: 5.83 inches x Width 2.63 x Height 4.13 inches Weight: 2.5 pounds Cold Cranking Amps: 270 Polarity: (+) (-) Charging System: Output of 13.1 Volts Lithium-iron: 18 Ah PbEq 12V; eq, "L" polarity, Sealed Fastening System: Slot in base of battery receptacle; single screw at top.

General Procedures

Inspection

Inspect battery case for damage Inspect connector for corrosion Inspect cables Check battery mounting

Cleaning

Disconnect and remove battery Clean battery, connectors Wash with water and let dry Place dielectric grease on both side of connector Replace battery, tighten screw. Do not plug in connector until ready for use

Ignition System

### 

All cranking output tests must be performed with spark plugs installed and torqued in the cylinder head. It necessary to remove the spark plugs, be sure to keep the spark gap tester away from open spark plug holes.

### 

Avoid electrical shock:

- Do not handle spark gap tester heads during performance testing.
- Do not touch ignition coils, exciter coil, pulser coils, or alternator coils while the engine is cranking or running.

### 

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

When repairs are complete; make sure all ignition and electrical Leads are properly routed and clamped in their original systems And the in-gear prevention system must be tested prior to delivering to units.

### Ignition System Performance Testing

Ignition Performance Testing is divided into two sections. The first section consists of a flow chart. This chart presents the correct sequence of performing ignition system performance tests to effectively and efficiently check for problems in starting and running the engine. Follow the steps in the order listed until the problem is resolved and the ignition system meets specifications while the engine is running.

The chart references specific performance tests that must be completed to resolve each problem. These tests are described in detail in the section which follows the flow chart.

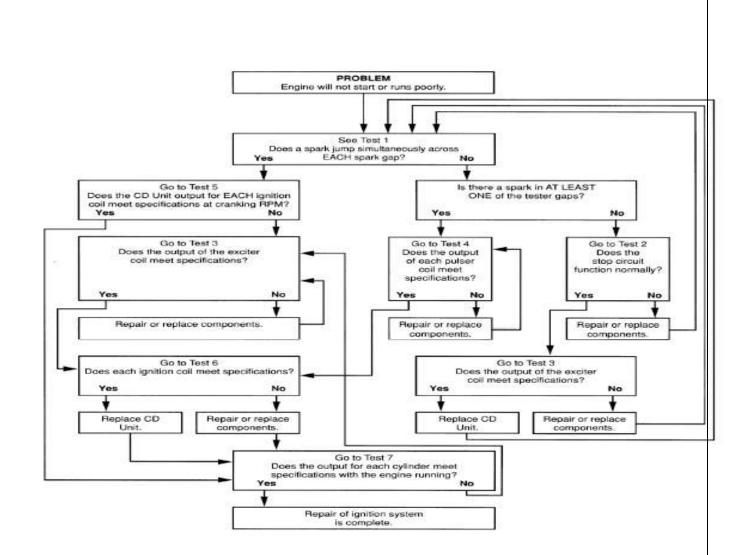
The performance tests, identified as Test 1 through Test 7, contain specific instructions for testing and servicing various ignition system components. Use this section to perform the tests correctly in accordance with the factory recommendations.

### NOTE

After you complete each performance test refer back to the flow chart for the next step. You must follow the flow chart until the ignition system meets specifications while the engine is running. The only way to be sure that you have uncovered and repaired all ignition system problems is to follow these procedures in a systematic fashion.

If you have problems stopping Raider outboard proceed directly to test 2 – Stop Circuit Test

Ignition System Performance Testing Flow Chart



### Test 1 - Spark Test

### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

1. Remove all spark plug leads, and spark plugs (3).

2. Adjust spark gap tester (1) to 7/16 in [11 mm].

3. Connect each spark plug lead to spark gap tester (2).

4. Secure spark gap tester to a clean ground on engine block.

## 

To avoid possible shock hazard, do not handle ignition coils or spark gap tester during cranking tests.

## NOTE

To prevent possible arcing of high voltage, route tester leads at least 2 in [51 mm] from any metal surface.

Ground unused test leads to a clean engine ground.

5. Attach lanyard to emergency stop switch,

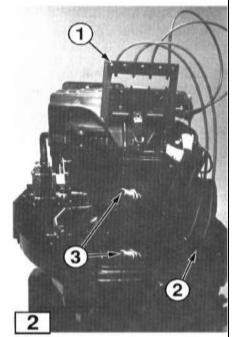
6. Crank engine.

A spark should jump across the gap for each cylinder and alternate from one gap to another.

7. Reconnect all wires disconnected during test.

8. Return to Ignition System Performance Testing Flow Chart.

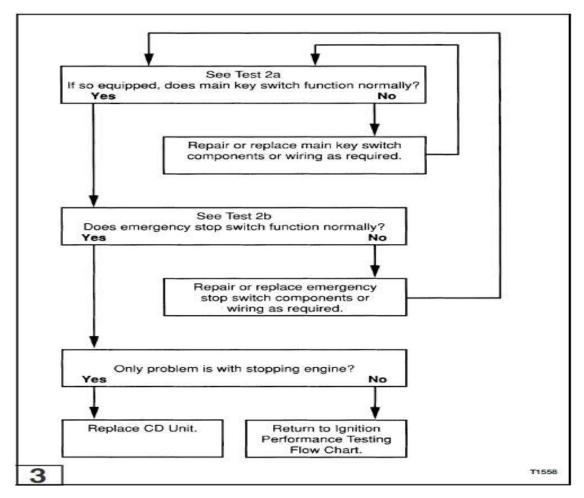
Test 2 – Stop Circuit Test



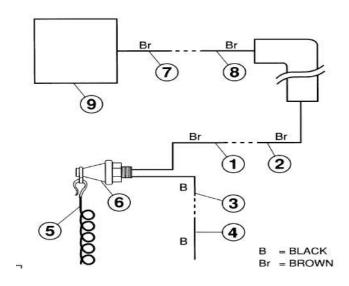
T1988/

Stop circuit malfunction can cause Raider not to start or preventing it from stopping. Several component failures can cause the stop circuit to malfunction. Use this flow Chart to isolate and repair all component failures.

Note: After you complete each stop circuit test, refer back to this flow chart for the Next step.



Test 2b. Stop Circuit Emergency Stop Switch Test



The emergency stop switch test is used to determine whether it is functioning normally.

Note: Make sure all electrical terminals are connected during this test except those that are noted in the test procedure. Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure. All continuity tests must be conducted or you may damage the meter.

Remove plug from Raider battery.

6 2. Disconnect emergency stop switch terminals (1), (2), (3) and (4).



3. Set analog multimeter to check continuity. Connect one meter lead to terminal (1) and the other to terminal (3).

**6** 4. Attach lanyard **(5)** to emergency stop switch **(6)**, meter must not show continuity. If it does, replace emergency stop switch.

**6** 5. Remove lanyard **(5)** from emergency stop switch **(6)**, meter must show continuity. If not, replace emergency stop switch.

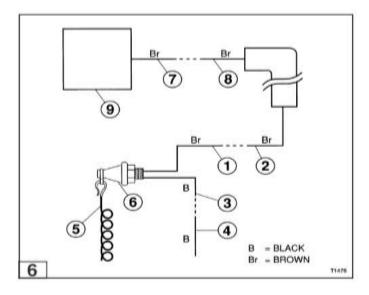


6. Disconnect CD Unit (9) terminals (7) and (8).

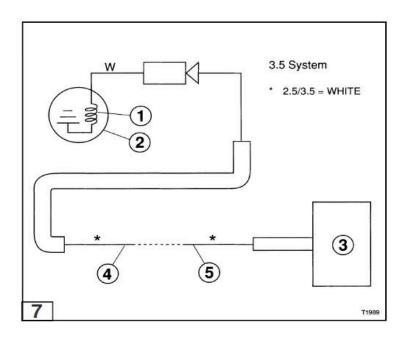
6 7. Connect one meter lead to terminal (8) and the other to terminal (2) and check continuity. If the meter does not show continuity, replace the cable.

**6** 8. Connect one meter lead to terminal **(8)** and the other to a clean engine ground. If the meter shows continuity, replace the cable.

9. Reconnect all wires and return to -Test 2 - Stop Circuit Test flow chart.



Test 3 – Exciter Coil Test



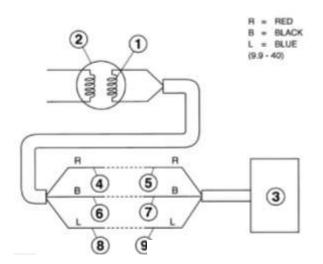
### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and he ground connection for the magneto place, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the exciter coil test. The pulser and alternator coils have been removed from both illustrations for clarity.

Test 3 – Exciter Coil Test



The exciter coil test is used to determine the output voltage, in DVA, from the exciter coil

Located on the coil plate assembly (2) to the CD Unit while you are cranking the engine.

Disconnect terminals 4, 5, 8 and 9.

Set the digital multimeter to ohms and connect the leads between the following Terminals to read the resistance of the exciter coil:

Connect multimeter between 4 and 8 terminals.

The meter should read 200 – 300 ohms +/- 25%

If the resistance is not within the indicated range, replace the exciter coil set. See Ignition System Repair Procedures – Exciter Coil. After repairs are made, return to Ignition System Performance Flow Chart. If the resistance is within indicated range, proceed to the next step.

Connect multimeter between these terminals 4 and 8; set the analog multimeter to "400" on the "DVA" scale. Connect the RED tester lead to terminal "4" and BLACK tester lead to termanal "8".

Attach lanyard to emergency stop switch.

Crank Raider outboard engine.

At cranking RPM, the tester should show the following results: 100 DVA Minimum. If the exciter coil test results are not within the acceptable range, replace the exciter coil set. See Ignition System Repair Procedures Exciter Coil.

Reconnect all wires disconnected during test.

Return to flow chart.

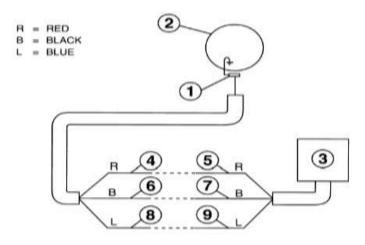
Test 4. Raider Pulser Coil Test

#### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the

ground connection for the magneto plate, CD Unit, and



The Raider pulser coil test is used to determine the output voltage, in DVA, from the pulser coil (1) located on the coil plate assembly (2) to the CD unit (3) while you are cranking the engine.

Disconnect the following terminals: 4, 5, 6, 7, 8 and 9

Set the digital multimeter to ohms and connect the leads to test the resistance of the coil.

Connect multimeter between 6 and 8 terminals.

Multimeter should indicate 30 - 45 ohms +/- 25%

If the resistance is not within the indicated range, replace the Raider pulser coil. See Ignition System Repair Procedures – Pulser Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

If the resistance is within the indicated range, proceed to the next step.

Set the analog multimeter to "20" on the "DVA" scale.

Insert the banana plug of the RED tester lead into the meter connection labeled "DVA" and the banana plug of the BLACK tester lead into the meter connection labeled "COM."

Black lead to Terminal 6 and Red Lead to Terminal 8.

Attached lanyard to emergency stop switch.

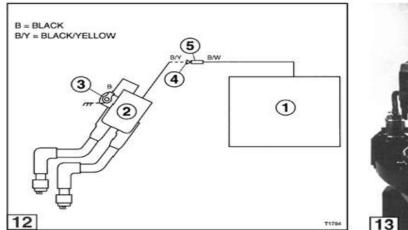
Crank engine.

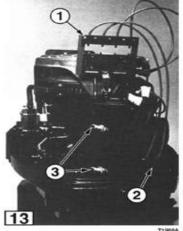
At the cranking RPM; the tester should show the following results – minimum of 3.0 DVA

If the pulser coil test results are not within the acceptable range, replace the pulser coil

set. See Ignition System Repair Procedures – Pulser Coil. Reconnect all wires disconnected during test.

Test 5. CD Unit Output test - Cranking RPM





NOTE

Make sure all electrical terminals on Raider are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, DC Unit and Ignition Coil before conducting the following procedure.

Reference the electrical drawings for the CDE Unit Output Test – Cranking RPM.

[12] The CD Unit Output Test – Cranking RPM is used to determine the output voltage, in DVA, from the CD Unit (1) to the ignition coil (2) while you are cranking the engine.

1. Remove two spark plug leads and remove spark plugs (3)

[13] 2. Adjust spark gap tester (1) to 7/16 inches - 11 mm

- 3. Connect each spark plug lead to spark gap tester (2)
- 4. Secure spark gap tester to a clean ground on engine block.
- 5. Secure spark plug gap tester to a clean ground on engine block.

## 

To avoid possible shock hazard, do not handle Ignition coils or spark gap tester during cranking tests.

### NOTE

To prevent possible arcing of high voltage, route tester leads At least 2 inches from any metal surface.

Ground unused test leads to a clean engine ground.

5. Set the tested to "400" on the "DVA" scale.

Insert the banana plug of the RED tester head into the meter connection labeled "DVA" and the banana plus of the BLACK tester lead into the meter connection labeled "-COM."

Connect the BLACK tester lead to terminal (3).

[12] 8. Carefully slide the RED tester into the bullet connector (terminal 4) sleeve until it makes contact with the terminal.

### NOTE

DO NOT disconnect the CD Unit output connector (terminals (4) and (8). Damage to the CD Unit may result.

9. Attach lanyard to emergency stop switch.

10. Crank engine

At cranking RPM, the tester should show the following result for each CD Unit output – 100 DVA minimum.

If the test results for any CD Unit output is not within acceptable range, replace the CED Unit. See Ignition System Repair Procedures – CD Unit.

Reconnect all wires disconnected during test.

Return to flow chart.

#### Test 6 - Ignition Coil Tests

### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

**14** The following tests check the resistance of the primary and secondary windings in each ignition coil (1).

- 1. Remove spark plug lead (2).
- 2. Set digital multimeter to ohms.
- 3. Disconnect terminals (4) and (5).
- 4. Connect one tester lead to terminal (3) and the other terminal (4).

5. The meter should indicate the following readings for the primary winding.

Repeat readings for each ignition coil: 0.2 - 0.3 ohms +/- 25%

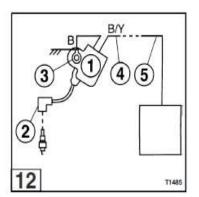
6. If primary winding for any ignition coil is not within the acceptable range, replace the ignition coil. See Ignition System Repair Procedures - Ignition Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

If the primary windings are within the acceptable range, proceed to the next step.

7. Connect one tester lead to terminal (3) and the other to spark plug lead (cap) [terminal (2)].

8. The meter should indicate the following readings for the secondary winding.

4.1 – 6.1 kohms +/- 25%



2

9. If secondary winding for any ignition coil is not within the acceptable range, replace the ignition coil. See Ignition System Repair Procedures - Ignition Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

10. Reconnect all wires disconnected during test.

11. Return to flow chart.

15 Test 7 - Output Tests - Engine Running

#### CAUTION

The following tests must be performed with correct test propeller and with the engine in a test tank. Note that some performance problems cannot be duplicated in a test tank, in these cases the tests must be conducted with the engine mounted on a boat and operated in open water.

#### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

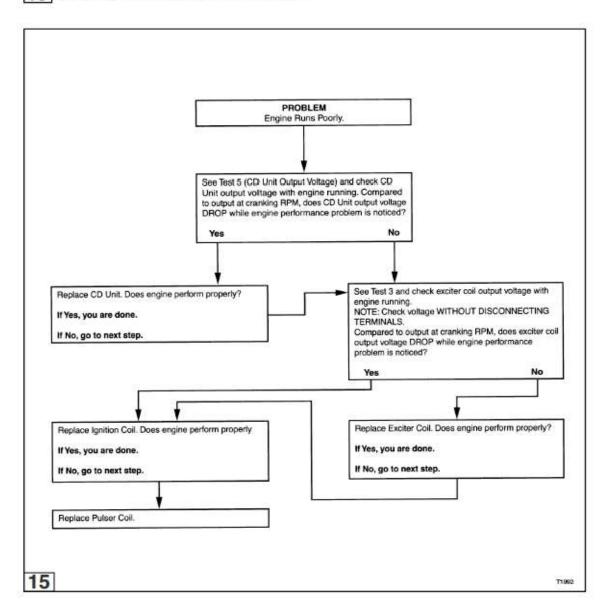
Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

These series of tests are designed to efficiently find faulty ignition components that can cause an engine to run poorly. Use the flow chart to systematically eliminate the possible causes to the problems.

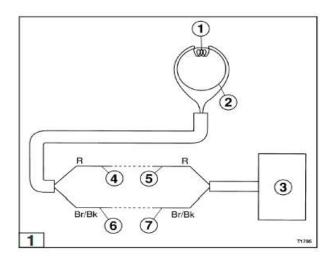
The tests assume that:

- The engine starts.
- Tune-Up Procedure has been performed, see Section 2.
- Ignition Timing and the Carburetor Synchronization Procedure has been performed, see Section 2.
- Engine is at operating temperature.
- Tests are performed with engine running in forward gear.
- Tachometer is installed.





Ignition System Repair Procedures



# 

Disable ignition system, by disconnecting exciter coil terminals (4), (5), (6), (7), to prevent accidental engine startup during removal and replacement of the flywheel.

# 

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

# 

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

# 

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

# ▲ CAUTION

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the startin-gear prevention system must be tested before returning engine to customer.

### Flywheel

Replacing the exciter coil or coil plate assembly requires the removal of the flywheel, see Section 4, Flywheel, for the proper procedure.

### NOTE

Flywheel magnets must be of a particular strength in order to run the ignition system. Weak magnets can cause low ignition voltage which may affect engine performance. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

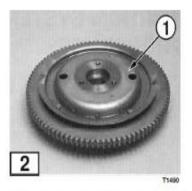
2 3 Carefully inspect flywheel (1) for cracks, chips, and worn taper after it is removed. Also inspect the magnets (2) for cracks and chips and make sure they are firmly attached to the flywheel.

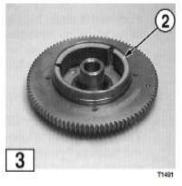
### Exciter Coil

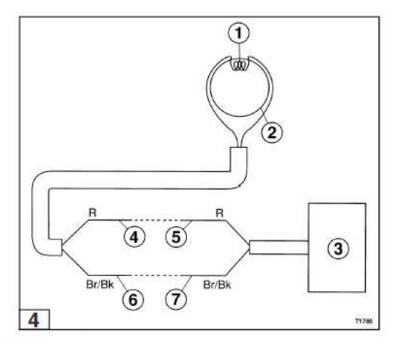
### NOTE

Disconnect negative battery cable from battery before removing exciter coil.

This procedure assumes exciter coil is available as a separate replaceable component. Some engine configurations might require replacement of entire coil plate assembly. Check current Parts Catalog for availability.







#### Removal

1. Remove the flywheel.

2. Disconnect terminals (4), (5), (6) and (7) for exciter coil (1) connectors. Note that these terminals interconnect cable from coil plate assembly (2) to cable from CD Unit (3):

5

3. Remove coil plate assembly cable clamp screws (1) and cable clamp (2).

6

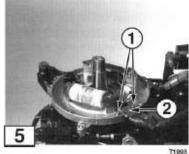
4. For models 9.9 / 15 / 18 / 25 / 30 / 40 ONLY: Carefully slit coil plate assembly cable shield (3).

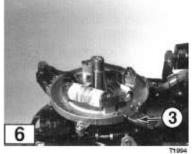
### NOTE

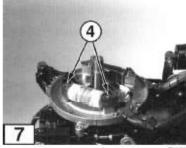
Make sure you don't cut electrical conductors inside of coll plate assembly cable when you slit cable shield.



6. Remove exciter coil screws (4) and exciter coil from the mounting bracket.







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### **Cleaning and Inspection**

Clean coil plate assembly, upper main bearing seal (1), set ring, ignition timing link, alternator coils, pulser coils, coil leads, and coil connectors with isopropyl alcohol as required.

Check for the following and repair or replace as required:

- Bent, chipped, cracked, or corroded coil plate assembly.
- Coil leads for integrity, cut or cracked insulation, and damaged connectors.
- Broken or bent alternator coil Laminations damaged alternator coil windings and missing alternator coil screws.
- Broken, cracked, or misaligned pulser coils and missing pulser coil screws.

 Free motion of ignition timing link (1). Repair, adjust, and lubricate as needed, see Section 2.

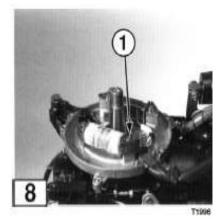
### Installation

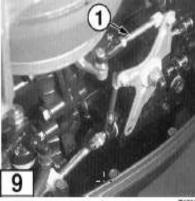
Install in reverse order of removal.

# NOTE

Use threadlocker on screw threads before installing screws.

Use a length of shrink tube to fabricate a new coil plate assembly cable shield as required. Inside diameter of shrink tubing must be large enough to pass over the largest connector.





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<sup>9</sup> 

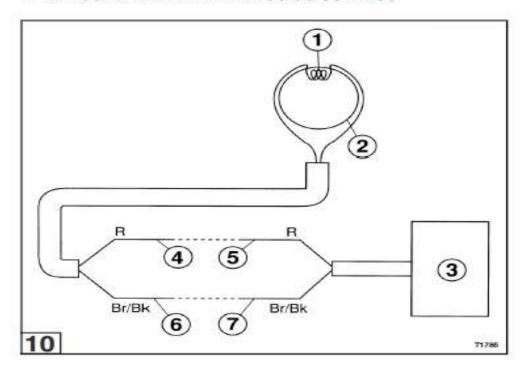
# Coil Plate Assembly

### Removal

I. Remove the flywheel.

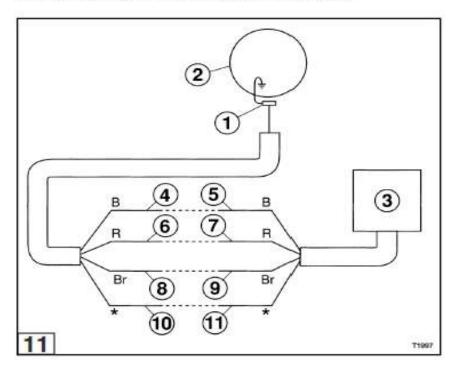
2. Disconnect the following terminals:

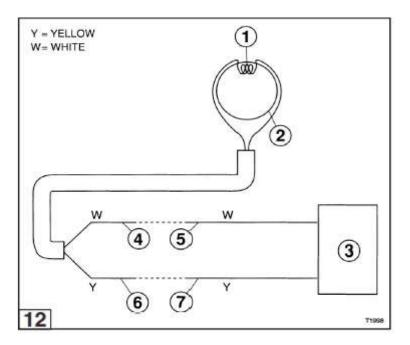
**10** Exciter coil (1) terminals. Note that these terminals interconnect cable from coil plate assembly (2) to cable from CD Unit (3). Disconnect terminals (4), (5), (6) and (7).



**11** pulser coil **(1)** terminals. Note that these terminals interconnect cable from coil plate assembly **(2)** to cable from CD Unit **(3)**. Disconnect terminals **(4)**, **(5)**, **(6)**, **(7)**, **(8)**, **(9)**, **(10)** and **(11)**.

12 Alternator coil (1) terminals. Note that these terminals interconnect cable from coil plate assembly (2) to rectifier/ regulator (3). Disconnect terminals (4), (5), (6) and (7).







3. Remove the screws (1) and remove coil plate assembly (2) from the set ring.

#### **Cleaning and Inspection**



**15** Clean upper main bearing seal (1), guide plate (2) and set ring (3) with dry cloth.

Check for the following and repair or replace as required:

- · Bent, chipped, cracked, or corroded guide plate.
- Broken or bent set ring.

Apply light coat of low temperature lithium grease to guide plate (2).

#### Istallation

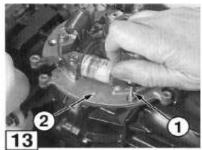
Install in reverse order of removal.

### NOTE

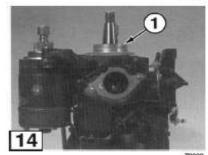
Disconnect negative battery cable from battery before installing coil plate assembly.

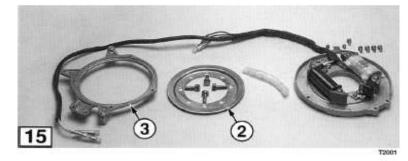
Use threadlocker on screw threads before installing screws.

Apply light coat of low temperature lithium grease to the guide plate.





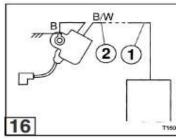


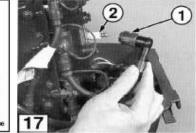


### **Ignition Coil**

### NOTE

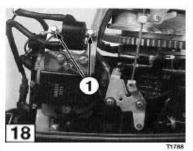
Disconnect negative battery cable from battery before removing ignition coil.





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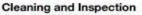
#### Removal

1. Disconnect CD Unit output lead (1) from ignition coil primary cable (2).



17 2. Disconnect spark plug cap (1) from spark plug (2).

18 3. Remove bolts (1) and remove ignition coil.



Clean mounting area with isopropyl alcohol.

Check for the following and repair or replace as required:

**19** Remove spark plug(s) and inspect for fouling, damaged electrodes, or damaged ceramic insulator. CD Unit output connectors and leads for integrity, cut or cracked insulation.

#### Installation

Install in reverse order of removal.

### **CD** Unit

#### NOTE

Disconnect negative battery cable from battery before removing CD Unit.

#### Removal



1. Remove bolts (1).

2. Remove CD Unit.

#### **Cleaning and Inspection**

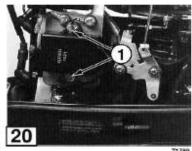
Examine electrical conductors and connectors.

#### Installation

Install in reverse order of removal.

#### NOTE

Make sure that all electrical conductors are properly routed before you insert CD Unit to avoid pinching them.



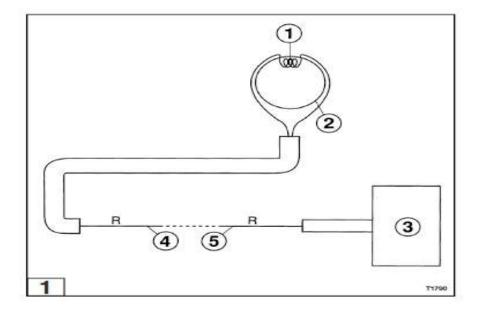
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T1509

## STARTING SYSTEM

### 

Disable ignition system, by disconnecting exciter coil terminals (4) and (5) to prevent accidental engine startup during testing of starter circuit.



#### 

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

#### 

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the startin-gear prevention system must be tested before returning engine to customer.

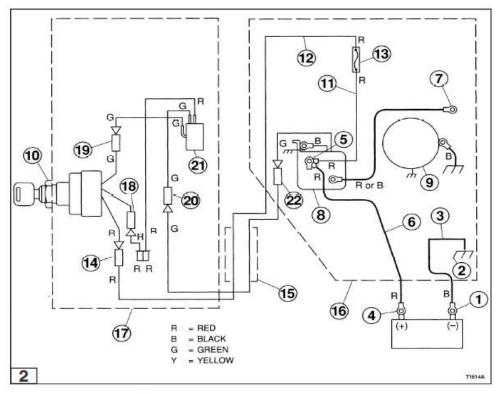
#### Starter System Testing

The starter system may cause three types of problems:

- The engine does not crank, see Starter Circuit Tests in this section.
- The starter motor runs but does not engage or disengage from the flywheel, see Starter Motor Test in this section.
- The starter motor will not shut off, see Starter Solenoid -Test in this section.

Before you begin testing of starting system:

- Check battery fluid level and specific gravity. Charge or replace as required. See Battery Care and Maintenance, this section.
- Check the following electrical connections and make sure they are secure and free of corrosion:
  - Batterycables and clamps.
  - Starter solenoid wiring (including ground connection).
  - Starter motor wiring (including ground connection to engine block and/or cowling).
  - Main key switch and neutral start switch cables.
- Make sure shift lever or remote control lever is in NEUTRAL and it operates freely.



### 2 3 Starter Circuit Tests

These tests are designed to quickly isolate the faulty starter circuit component if the engine does not crank.

#### NOTE

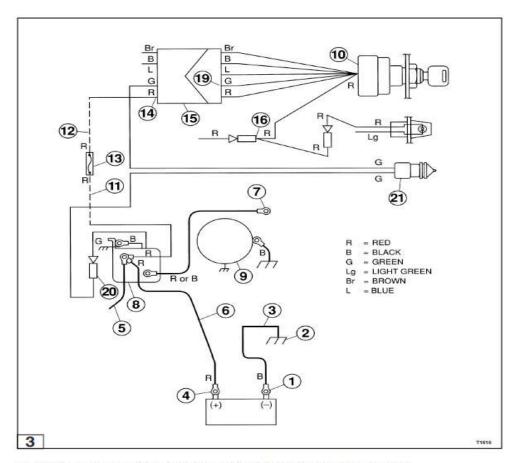
The electrical drawings have been simplified to show only those elements necessary to test the starter circuit.

Two types of starter circuits are used and illustrated in:



· Models with remote control box.

Models without remote control box.



1. Disconnect negative battery cable (3) from negative battery terminal (1).

2. Set analog multimeter to check continuity. Connect one tester lead to negative battery terminal (1) and the other tester lead to the ground connection (2) for negative battery cable (3).

If the meter does not indicate continuity, clean connections and/or replace negative battery cable.

If the meter indicates continuity, go to the next step.

 Set analog multimeter to "iDCV" and set range to "20". Connect BLACK tester lead to "- COM" and the RED tester lead to "+ VΩ".

4. Connect BLACK tester lead to clean engine ground.

5. Connect RED tester lead to positive battery terminal (4).

If meter does not indicate 11.8 to 13.2 VDC (battery voltage), see Battery Care and Maintenance, this section.

If meter indicates battery voltage go to next step.

Reconnect negative battery cable (3) to negative battery terminal (1).

7. Connect RED tester lead to starter solenoid terminal (5).

If meter does not indicate battery voltage, replace battery cable (6).

If meter indicates battery voltage go to next step.

8. Disconnect lead (7) from starter solenoid (8) to starter motor (9).

Connect RED tester lead to starter solenoid lead (7) and turn main key switch (10) to START position.

If meter indicates battery voltage, repair or replace starter motor, see Starter Motor Tests in this section.

If meter does not indicate battery voltage, go to next step.

10. Connect RED tester lead to connector closest to fuse holder (11).

If meter does not indicate battery voltage, repair or replace cable between (5) and (11).

If meter indicates battery voltage, go to next step.

11. Connect RED tester lead to connector closest to fuse holder (12).

If meter does not indicate battery voltage, find source of overload or short and replace 15 A engine fuse (13). Possible sources of short or overload:

- Short in starter circuit wiring or components, such as starter solenoid, main key switch, or neutral start switch.
- Short in charging circuit wiring or components, such as the alternator coils or rectifier/regulator.
- Short in accessories.
- Short in starter motor.

If meter indicates battery voltage, go to next step.

 Connect RED tester lead to connector closest to main key switch (14).

#### NOTE

For models with remote control box - Make sure you test the correct terminal in this step. Terminal (14) is connected directly to the main key switch (10) and the RED lead that comes out of the large cable (15) that connects the engine compartment (16) to the remote control box (17), DO NOT CONFUSE TERMINAL (14) WITH TERMINAL (18).

#### NOTE

For models without remote control box - You might have to pull connector (15) apart and measure voltage at terminal.

Make sure you test the correct terminal in this step.

If meter does not indicate battery voltage, repair or replace cable between (12) and (14).

If meter indicates battery voltage, go to next step.

13. Connect RED tester lead to main button starter switch and push Raider start button.

14. Connect RED tester lead to neutral start switch lead (20) and turn main key switch (10) to START position.

If meter does not indicate battery voltage, test neutral start switch (21). Refer to Neutral Start Switch Test in this section.

If meter indicates battery voltage, go to next step.

For models with remote control box ONLY - Connect RED tester lead to starter solenoid lead (22) and turn main key switch (10) to START position.

If meter does not indicate battery voltage, repair or replace cable between (20) and (22).

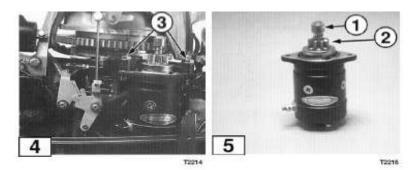
If meter indicates battery voltage, go to next step.

16. Connect RED tester lead to starter solenoid lead (7) and turn main key switch (10) to START position.

If meter does not indicate battery voltage, test starter solenoid (8). Refer to Starter Solenoid Test in this section,

### Starter Motor Tests

- If the engine does not crank and you completed the Starter Circuit Tests previously described, remove the starter motor and inspect the brush assembly. If the brush assembly meets specifications, replace the starter motor or have it rebuilt.
- If the starter motor runs but the starter motor does not engage or disengage from the flywheel, remove the starter motor and inspect the pinion assembly. If the pinion assembly meets specifications, inspect the flywheel for chipped or worn teeth and replace as needed.



#### **Remove Starter Motor**

#### NOTE

Disconnect negative battery cable from battery before removing starter motor.

Disconnect starter solenoid cable and ground cable.

2. Remove starter motor bolts (3).

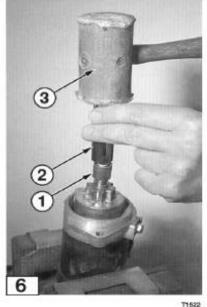
3. Slide starter motor out of bracket.

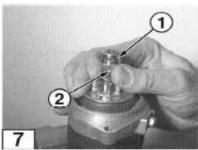
4. Clean bracket with cleaning solvent.

#### Inspect and Remove Pinion Assembly

1. Grasp pinion collar (1) and wind pinion gear (2) in a clockwise 5 direction. Make sure gear moves freely and returns to original position. If any binding is noted, remove and replace pinion assembly.

6 2. Release pinion collar (1) by tapping it with a socket (2) (with same outside diameter as pinion collar and clearance for motor shaft) and mallet (3).

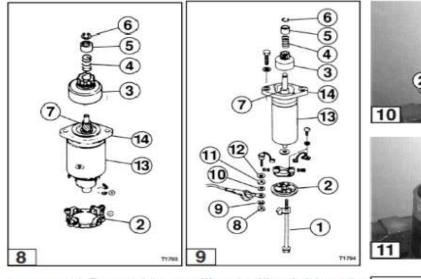


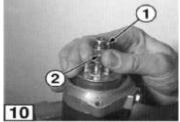


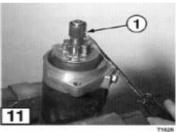


7 3. Push down on pinion collar (2) and remove locking ring (1).

Note: After disassembly prior to assembly spray "Corrosion Zero" on all parts.







8 9 4. Remove pinion gear (3), spring (4) and pinion collar (5).

Clean removed components with cleaning solvent and examine pinion gear for wear and chipped teeth and spring for tension or distortion and replace assembly as required.

#### NOTE

Do not allow cleaning solvent to come in contact with starter motor.

6. Apply a light coat of low temperature lithium grease to motor shaft (7) and slide on pinion gear (3), wind counterclockwise to seat.

7. Slide spring (4) and pinion collar (5) on motor shaft (7).

10 8. Push down on pinion collar (2) and install locking ring (1).

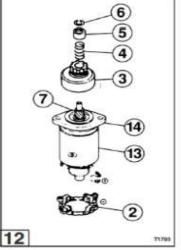
11 9. Tap pinion collar (1) in place.

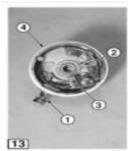
**Disassemble Starter Motor** 



12 1. Remove bolts (1).

2. Remove motor base (2).







#### Inspect Brush Assembly

1. Clean starter motor terminal and hardware (1) with isopropyl alcohol and fine emery cloth and replace brush assembly if terminal or hardware cannot be restored to original condition.

13 14 15 2. Check brushes (2) and (3) for chips, fractures, and wear. If not within specifications, replace brush assembly:

The Raider 40 Original Length (a) is 0.295 inches (7.5 mm). Repair Limit (b) is 0.177 inches (4.5 mm).

3. Check spring tension. If springs are weak, replace brush assembly.

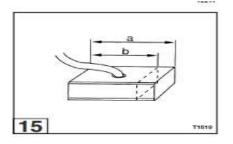
4. Check continuity with analog multimeter between:

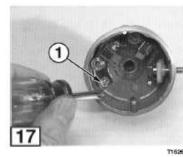
Brush (2) and (3). Replace brush assembly if meter indicates continuity.

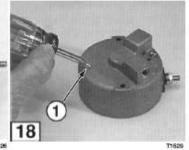
Brush (3) and the motor base (4). Replace brush assembly if meter indicates continuity.

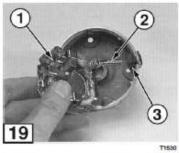
Brush (3) and the starter motor terminal (1). Replace brush assembly if meter does not indicate continuity.

Brush (2) and the motor base (4). Replace brush assembly if meter does not indicate continuity.









#### **Remove Brush Assembly**

17 18 1. Remove screws (1).

Remove brush assembly (1) carefully guiding the starter 19 motor terminal (2) through the bushing (3).

#### Install Brush Assembly

20 1. Apply genuine grease to bearing cup (1).

21 2. Install brush assembly (1). Make sure that the starter motor terminal (2) is fully costed in the brushing (2) terminal (2) is fully seated in the bushing (3).

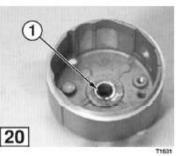
#### Assemble Starter Motor

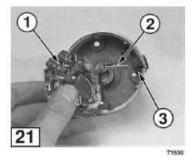
### NOTE

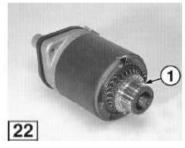
Bolts for models 25 / 30 / 40 may not be available as separate parts. Check current Parts Catalog for availability.

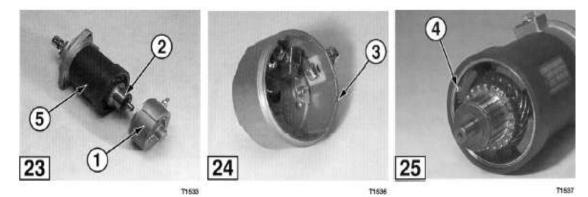


22 1. Clean commutator (1) with fine emery cloth.





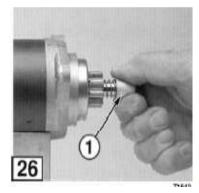




23 24 25 2. Retract brushes as you slide motor base (1) over commutator (2). Align notch (3) in motor base with tab (4) in motor body (5) and seat motor baseto motor body.



**26** 3. Grasp pinion collar (1) and rotate several times to make sure brushes are seated.



### Install Starter Motor

29 1. Slide starter motor into bracket, apply threadlocker to bolt threads, and install mounting bolts.

- 2. Connect starter solenoid cable and ground cable.
- 3. Coat terminals with battery spray protector.

### Starter Solenoid Test



30 1. Disconnect terminals (4) and (5) and disconnect terminal (3) from chassis ground.

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2. Set analog multimeter for continuity. Check for continuity between terminals:

(3) and (5). If meter does not show continuity, replace starter solenoid (1).

(5) and clean chassis ground. If meter shows continuity, replace starter solenoid.

(3) and clean chassis ground. If meter shows continuity, replace starter solenoid.

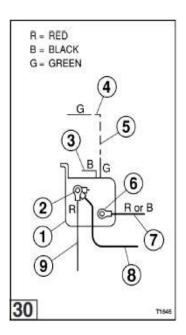
3. Disconnect positive battery lead (8) and RED starter switch lead (9) from starter terminal (2) and disconnect starter motor lead (7) from starter terminal (6).

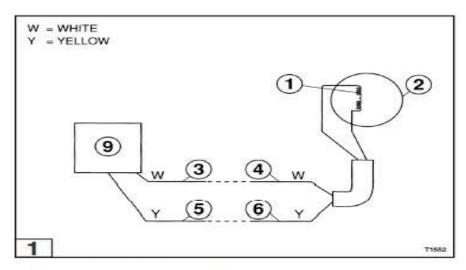
4. Check for continuity between terminals:

(2) and (6). If meter shows continuity, replace starter solenoid.

(2) and clean chassis ground. If the meter shows continuity, replace starter solenoid.

(6) and clean chassis ground. If the meter shows continuity, replace starter solenoid.





### Alternator Coil Tests

#### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the alternator coil test, The pulser and exciter coils have been removed from both illustrations for clarity.

The alternator coil test is used to determine whether the alternator coils (1), located on the coil plate assembly (2) are open or shorted. The output from the alternator coil goes to the rectifier/regulator (9).

1. Disconnect terminals (3), (4), (5) and (6).

2. Set the digital multimeter to ohms and connect the leads between terminals (4) and (6) to read the resistance of the alternator coil.

The meter should indicate the following resistance: Y-W: 0.65 - 0.98

Y-B: 0.31 – 0.47 W-B: 0.37 – 0.55

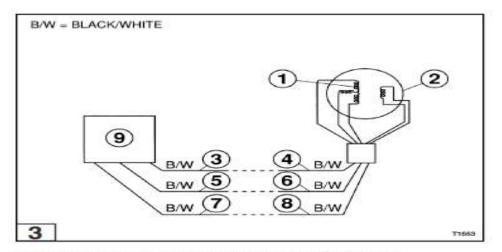
> If the resistance is not within the indicated range, replace the alternator coils. See Charging System Repair Procedures -Alternator Coils.

> If the resistance is within the indicated range, proceed to the next step.

2 3 5. Connect one tester head to a clean engine ground and connect the other tester lead to terminals (4) and (6) (one terminal at a time) to check for any resistance to ground:

 If the meter indicates any resistance to ground, replace the alternator coils. See Charging System Repair Procedures - Alternator Coils.

If the meter does not indicate any resistance to ground, proceed to the next step.



7. Set the analog multimeter to "40" on the "ACV" scale.

8. Insert the banana plug of the RED tester lead into the meter connection labeled "+V $\Omega$ " and the banana plug of the BLACK tester lead into the meter connection labeled "-COM".

9. Connect the BLACK tester lead to a clean engine ground and the RED tester lead to terminals (4) and (6) (one terminal at a time) to check for any voltage to ground:

10. Start engine.

11. At idle and full throttle, if the meter indicates any voltage to ground, replace alternator coils. See Charging System Repair Procedures - Alternator Coils.

If no voltage to ground is indicated, the test is complete.

12. Reconnect alternator terminals.

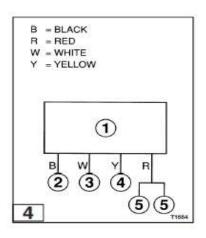
### **Rectifier/Regulator Tests**

#### NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check ior continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the rectifier/regulator test.



The rectifier/regulator tests check whether the rectifier/regulator (1) is shorted or open.

1. Disconnect terminals (2), (3), (4) and (5) from all other wiring:

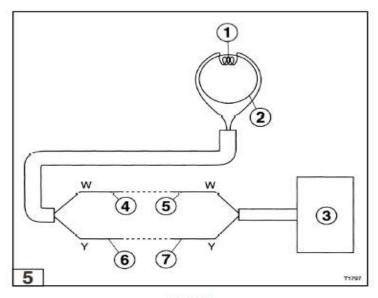
2. Set analog multimeter to check continuity.

3. Insert the banana plug of the RED tester lead into the meter connection labeled "+V $\Omega$ " and the banana plug of the BLACK tester lead into the meter connection labeled "-COM".

Connect the RED and BLACK tester leads to the terminals as shown and note the results:

- Follow the tests listed in the chart starting at the TOP of each COLUMN and going DOWN.
- Follow the tests listed in the chart starting at the LEFT of each ROW and going to the RIGHT.

Replace rectifier/regulator if continuity tests are not as shown. If continuity checks are within specifications, proceed to next step.



#### NOTE

Continuity on chart means that the meter showed continuity (some resistance indicated by meter exact value depends on test conditions). No Continuity on chart means that meter had no deflection.

|                        | (C)          | RED Tester Lead |               |               |              |
|------------------------|--------------|-----------------|---------------|---------------|--------------|
|                        | 8            | Terminal (2)    | Terminal (3)  | Terminal (4)  | Terminal (5) |
| BLACK<br>Teste<br>Lead | Terminal (2) | NA              | Continuity    | Continuity    | Continuity   |
|                        | Terminal (3) | NO Continuity   | NA            | NO Continuity | Continuity   |
|                        | Terminal (4) | NO Continuity   | NO Continuity | NA            | Continuity   |
|                        | Terminal (5) | NO Continuity   | NO Continuity | NA            | NA           |

5. Connect rectifier/regulator leads.

# Charging System - Repair Procedures

5

## 

Disable ignition system, by disconnecting exciter coil terminals (4), (5), (6), (7), to prevent accidental engine startup during removal and replacement of the flywheel.

### **△** CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

### 

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

### 

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

### 

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the startin-gear prevention system must be tested before returning engine to customer.

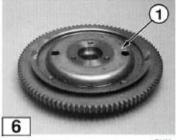
### Flywheel

Replacing the exciter coil or coil plate assembly requires the removal of the flywheel, see Section 4, Flywheel, for the proper procedure.

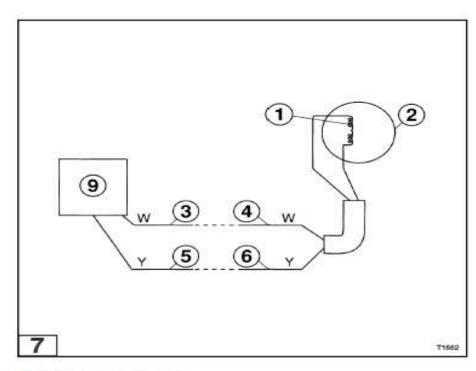
### NOTE

Flywheel magnets must be of a particular strength in order to run the ignition system. Weak magnets can cause low ignition voltage which may affect engine performance. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

Carefully inspect flywheel (1) for cracks, chips, and worn taper after it is removed. Also inspect the magnets for cracks and chips and make sure they are firmly attached to the flywheel.



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# **Alternator** Coils

### NOTE

Disconnect negative battery cable from battery before removing alternator coils.

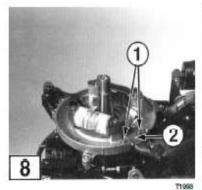
This procedure assumes alternator coils are available as a separate replaceable component. Some engine configurations might require replacement of entire coil plate assembly. Check current Parts Catalog for availability.

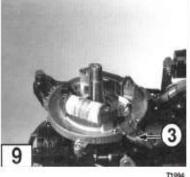
#### Removal

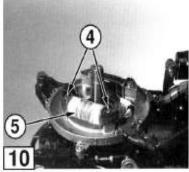
7

1. Remove the flywheel.

Disconnect terminals (3), (4), (5) and (6) for alternator coils
 (1). Alternator coils are located on the coil plate assembly (2).











3. Remove coil plate assembly cable clamp screws (1) and cable clamp (2).

## NOTE

Make sure you don't cut electrical conductors inside of coil plate assembly cable when you slit cable shield.



plate assembly cable shield (1).

: Carefully slit coil

# NOTE

Make sure you don't cut electrical conductors inside of coil plate assembly cable when you slit cable shield.

5.



**10** 6. Remove alternator coil screws (4) and alternator coil (5) from the mounting bracket.

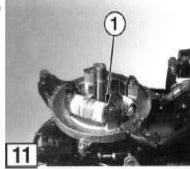
### **Cleaning and Inspection**

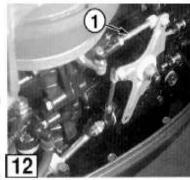
Clean coil plate assembly, upper main bearing housing, set ring, ignition timing link, exciter coil, pulser coil, coil leads, and coil connectors with isopropyl alcohol as required.

Check for the following and repair or replace as required:

- · Bent, chipped, cracked, or corroded coil plate assembly.
- Coil leads for integrity, cut or cracked insulation, and damaged connectors.
- Broken or bent exciter coil laminations, damaged exciter coil windings, and missing exciter coil screws.
- Broken, cracked, or misaligned pulser coils and missing pulser coil screws.

 Free motion of ignition timing link (1), Repair, adjust, and lubricate as needed. see Section 2.





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