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### 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM

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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2006 SEA-DOO watercraft as described in the model list in the INTRODUCTION.

This edition was primarily published to be used by watercraft mechanical technicians who are already familiar with all service procedures relating to BRP made watercraft. Mechanical technicians should attend training courses given by B.R.P.T.I.

Please note that the instructions will apply only if proper hand tools and special service tools are used.

This Shop Manual uses technical terms which may be slightly different from the ones used in the PARTS CATALOG.

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

The content depicts parts and/or procedures applicable to the particular product at time of writing. Service and Warranty Bulletins may be published to update the content of this manual. Make sure to read and understand these.

In addition, the sole purpose of the illustrations throughout the manual, is to assist identification of the general configuration of the parts. They are not to be interpreted as technical drawings or exact replicas of the parts.

The use of BRP parts is most strongly recommended when considering replacement of any component. Dealer and/or distributor assistance should be sought in case of doubt.

The engines and the corresponding components identified in this document should not be utilized on product(s) other than those mentioned in this document.

⚠️ WARNING
Unless otherwise specified, engine should be turned OFF and cold for all maintenance and repair procedures.

This manual emphasizes particular information denoted by the wording and symbols:

⚠️ WARNING
Identifies an instruction which, if not followed, could cause serious personal injury including possibility of death.

CAUTION: Denotes an instruction which, if not followed, could severely damage vehicle components.

NOTE: Indicates supplementary information needed to fully complete an instruction.

Although the mere reading of such information does not eliminate the hazard, your understanding of the information will promote its correct use. Always use common shop safety practice.

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic. It is understood that certain modifications may render use of the vehicle illegal under existing federal, provincial and state regulations.
INTRODUCTION

GENERAL INFORMATION

This Shop Manual covers the following BRP made SEA-DOO® 2006 watercraft models.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>COLOR</th>
<th>ENGINE</th>
<th>MODEL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTI</td>
<td>White</td>
<td>1503 Naturally Aspirated (130 HP)</td>
<td>236A, 236B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>256A, 256B</td>
</tr>
<tr>
<td>GTI SE</td>
<td>Atlantic Blue</td>
<td>1503 Naturally Aspirated (130 HP)</td>
<td>246A, 246B</td>
</tr>
<tr>
<td>GTX</td>
<td>Pewter Grey Met.</td>
<td>1503 Naturally Aspirated (155 HP)</td>
<td>146A, 146B</td>
</tr>
<tr>
<td>GTX Supercharged</td>
<td>Pewter Grey Met.</td>
<td>1503 Supercharged</td>
<td>166A</td>
</tr>
<tr>
<td>GTX Limited</td>
<td>Starlight Blue</td>
<td>1503 Supercharged Intercooled</td>
<td>186A, 186B</td>
</tr>
<tr>
<td>GTX Limited</td>
<td>Midnight Black</td>
<td>1503 Supercharged Intercooled</td>
<td>186C</td>
</tr>
<tr>
<td>GTX WAKE</td>
<td>Viper Red</td>
<td>1503 Naturally Aspirated (155 HP)</td>
<td>156A, 156B</td>
</tr>
<tr>
<td>RXP</td>
<td>Maya Gold</td>
<td>1503 Supercharged Intercooled</td>
<td>216A, 216B</td>
</tr>
<tr>
<td>RXP</td>
<td>Viper Red Metallic</td>
<td>1503 Supercharged Intercooled</td>
<td>216C, 216D</td>
</tr>
<tr>
<td>RXT</td>
<td>Maya Gold</td>
<td>1503 Supercharged Intercooled</td>
<td>176A, 176B</td>
</tr>
<tr>
<td>RXT</td>
<td>Viper Red Metallic</td>
<td>1503 Supercharged Intercooled</td>
<td>176C, 176D</td>
</tr>
</tbody>
</table>

The use of RIGHT (starboard) and LEFT (port) indications in the text, always refers to driving position (when sitting on watercraft).

Besides, in the marine industry, FRONT is called BOW and REAR is called STERN.

Due to late changes, there may be some differences between the manufactured product and the description and/or specifications in this document.

BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

This Shop Manual uses technical terms which may be different from the ones of the PARTS CATALOGS.

When ordering parts always refer to the specific model PARTS CATALOGS.

HULL IDENTIFICATION NUMBER (H.I.N.)

The hull identification number is composed of 12 digits:

<table>
<thead>
<tr>
<th>YDV 12345 L 4 95</th>
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<tbody>
<tr>
<td>Model year</td>
</tr>
<tr>
<td>Year of production</td>
</tr>
<tr>
<td>Month of production</td>
</tr>
<tr>
<td>Serial number</td>
</tr>
<tr>
<td>(a letter may also be used as a digit)</td>
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<tr>
<td>Manufacturer</td>
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It is located on footboard at the rear of watercraft.

The information and component/system descriptions contained in this manual are correct at time of writing. BRP however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.
INTRODUCTION

ENGINE IDENTIFICATION NUMBER (E.I.N.)
The Engine Identification Number is located on front end of the engine.

ARRANGEMENT OF THIS MANUAL, ILLUSTRATIONS AND PROCEDURES

The manual is divided into many major sections as you can see in the main table of contents at the beginning of the manual.

Each section is divided in various subsections, and again, each subsection has one or more division.

The illustrations show the typical construction of the different assemblies and, in all cases, may not reproduce the full detail or exact shape of the parts shown, however, they represent parts which have the same or a similar function.

CAUTION: These watercraft are designed with parts dimensioned mostly in the metric system. However some components may be from the imperial system. When replacing fasteners, make sure to use only those recommended by BRP.

As many of the procedures in this manual are inter-related, we suggest, that before undertaking any task, you read and thoroughly understand the entire section or subsection in which the procedure is contained.
INTRODUCTION

A number of procedures throughout the book require the use of special tools. Before undertaking any procedure, be sure that you have on hand all the tools required, or approved equivalents.
ENGINE EMISSIONS INFORMATION

Manufacturer's Responsibility
Beginning with 1999 model year engines, PWC manufacturers of marine engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States of America Environmental Protection Agency (EPA). An emissions control information label, showing emission levels and engine specifications, must be placed on each vehicle at the time of manufacture.

Dealer Responsibility
When performing service on all 1999 and more recent Sea-Doo watercrafts that carry an emissions control information label, adjustments must be kept within published factory specifications.

Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.

Dealers are not to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturer's prescribed changes, such as altitude adjustments for example.

Owner Responsibility
The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is not to, and should not allow anyone to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

EPA Emission Regulations
All new 1999 and more recent Sea-Doo watercrafts manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new watercraft engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

FOR ALL COURIER SERVICES:
U.S. Environmental Protection Agency
Office of Transportation and Air Quality
1310 L Street NW
Washington D.C. 20005

REGULAR US POSTAL MAIL:
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

INTERNET: http://www.epa.gov/otaq/
E-MAIL: otapublicweb@epa.gov

WORKING ON WATERCRAFT
To work on watercraft, securely install it on a stand. Thus, if access is needed to water inlet area, it will be easy to slide underneath watercraft.

The lift kit (P/N 295 100 205) can be used to install watercraft on a stand.

SELF-LOCKING FASTENERS PROCEDURE
The following describes the most common application procedures when working with self-locking fasteners.

Use a metal brush or a screw tap to clean the hole properly then use a solvent, let act during 30 minutes and wipe off. The solvent utilization is to ensure the adhesive works properly.
INTRODUCTION

LOCTITE APPLICATION PROCEDURE

The following describes the most common application procedures when working with Loctite products.

NOTE: Always use proper strength Loctite product as recommended in this Shop Manual.

Threadlocker

Uncovered Holes (bolts and nuts)

1. Apply here
2. Do not apply

- Clean threads (bolt and nut) with solvent.
- Apply Loctite Primer N (P/N 293 800 041) on threads and allow to dry.
- Choose proper strength Loctite threadlocker.
- Fit bolt in the hole.
- Apply a few drops of threadlocker at proposed tightened nut engagement area.
- Position nut and tighten as required.

Blind Holes

1. On threads
2. On threads and at the bottom of hole

- Clean threads (bolt and nut) with solvent.
- Apply Loctite Primer N (P/N 293 800 041) on threads and allow to dry.
- Put several drops of proper strength Loctite threadlocker on female threads and in hole.
- Apply several drops of proper strength Loctite on stud threads.
- Install stud.
- Install cover, etc.
- Apply drops of proper strength Loctite on uncovered threads.
- Tighten nuts as required.

Stud in Blind Holes

1. On threads
2. On threads and in the hole
3. Onto nut threads

- Clean threads (stud and hole) with solvent.
- Apply Loctite Primer N (P/N 293 800 041) on threads and allow to dry.
- Put several drops of proper strength Loctite threadlocker on female threads and in hole.
- Apply several drops of proper strength Loctite on stud threads.
- Install stud.
- Install cover, etc.
- Apply drops of proper strength Loctite on uncovered threads.
- Tighten nuts as required.
INTRODUCTION

Preassembled Parts

- Clean bolts and nuts with solvent.
- Assemble components.
- Tighten nuts.
- Apply drops of proper strength Loctite on bolt/nut contact surfaces.
- Avoid touching metal with tip of flask.

NOTE: For preventive maintenance on existing equipment, retighten nuts and apply proper strength Loctite on bolt/nut contact surfaces.

Adjusting Screw

- Adjust screw to proper setting.
- Apply drops of proper strength Loctite thread-locker on screw/body contact surfaces.
- Avoid touching metal with tip of flask.

NOTE: If it is difficult to readjust, heat screw with a soldering iron (232°C (450°F)).

Stripped Thread Repair

1. Release agent
2. Stripped threads
3. Form-A-Thread
4. Tape
5. Cleaned bolt
6. Plate
7. New threads
8. Threadlocker

Standard Thread Repair
- If a plate is used to align bolt:
  a. Apply release agent on mating surfaces.
  b. Put waxed paper or similar film on the surfaces.
- Twist bolt when inserting it to improve thread conformation.

NOTE: NOT intended for engine stud repairs.

Repair of Small Holes/Fine Threads

Option 1: Enlarge damaged hole, then follow STANDARD THREAD REPAIR procedure.

Option 2: Apply FORM-A-THREAD on the screw and insert in damaged hole.

Permanent Stud Installation (light duty)
- Use a stud or thread on desired length.
- DO NOT apply release agent on stud.
- Do a STANDARD THREAD REPAIR.
- Allow to cure for 30 minutes.
- Assemble.
INTRODUCTION

Gasket Compound

1. Proper strength Loctite.
2. Loctite Primer N (P/N 293 800 041) and Gasket Eliminator 518 (P/N 293 800 038) on both sides of gasket.
3. Loctite Primer N only.

- Remove old gasket and other contaminants with Loctite Chisel remover (P/N 413 708 500). Use a mechanical mean if necessary.

NOTE: Avoid grinding.
- Clean both mating surfaces with solvent.
- Spray Loctite Primer N on both mating surfaces and on both sides of gasket. Allow to dry 1 or 2 minutes.
- Apply GASKET ELIMINATOR 518 (P/N 293 800 038) on both sides of gasket, using a clean applicator.
- Place gasket on mating surfaces and assemble immediately.

NOTE: If the cover is bolted to blind holes (above), apply proper strength Loctite in the hole and on threads. Tighten.
If holes are sunken, apply proper strength Loctite on bolt threads.
- Tighten as usual.

Mounting on Shaft

Mounting with a Press

1. Bearing
2. Proper strength Loctite
3. Shaft

- Clean shaft external part and element internal part.
- Apply a strip of proper strength Loctite on shaft circumference at insert or engagement point.

NOTE: Retaining compound is always forced out when applied on shaft.
- DO NOT use antiseize Loctite or any similar product.
- No curing period is required.

Mounting in Tandem
1. Apply retaining compound on internal element bore.
2. Continue to assemble as shown above.

Case-In Components

Metallic Gaskets

1. Proper strength Loctite

- Clean inner housing diameter and outer gasket diameter.
- Spray housing and gasket with Loctite Primer N (P/N 293 800 041).
- Apply a strip of proper strength Loctite on leading edge of outer metallic gasket diameter.
INTRODUCTION

NOTE: Any Loctite product can be used here. A low strength liquid is recommended as normal strength and gap are required.
- Install according to standard procedure.
- Wipe off surplus.
- Allow it to cure for 30 minutes.

NOTE: Normally used on worn-out housings to prevent leaking or sliding.
It is generally not necessary to remove gasket compound applied on outer gasket diameter.
INTRODUCTION

TIGHTENING TORQUES
Tighten fasteners to torque mentioned in exploded views and/or text. When they are not specified, refer to following table.

⚠️ WARNING
Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones, where specified. If the efficiency of a locking device is impaired, it must be renewed.

In order to avoid a poor assembling, tighten screws, bolts or nuts in accordance with the following procedure:
- Manually screw all screws, bolts and/or nuts.
- Apply the half of the recommended torque value.

CAUTION: Be sure to use the proper tightening torque for the proper strength grade.

NOTE: When possible, always apply torque on the nut.
- Torque to the recommended torque value.

NOTE: Always torque screws, bolts and/or nuts in a criss-cross sequence.

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<th>9.8</th>
<th>10.9</th>
<th>12.9</th>
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<td>8.8</td>
<td>9.8</td>
<td>10.9</td>
<td>12.9</td>
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<td>10</td>
<td>10</td>
<td>12</td>
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<table>
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<tr>
<td>M4</td>
<td>1.5 – 2 N•m (13 – 18 lbf•in)</td>
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<tr>
<td>M5</td>
<td>3 – 3.5 N•m (27 – 31 lbf•in)</td>
</tr>
<tr>
<td>M6</td>
<td>6.5 – 8.5 N•m (58 – 75 lbf•in)</td>
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<td>M8</td>
<td>15 N•m (11 lbf•ft)</td>
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<tr>
<td>M10</td>
<td>29 N•m (21 lbf•ft)</td>
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<tr>
<td>M12</td>
<td>52 N•m (38 lbf•ft)</td>
</tr>
<tr>
<td>M14</td>
<td>85 N•m (63 lbf•ft)</td>
</tr>
</tbody>
</table>
# MAINTENANCE CHART

The schedule should be adjusted according to operating conditions and use.

**NOTE:** The chart gives an equivalence between number of hours and months/year. Perform the maintenance operation to whatever time comes first.

**IMPORTANT:** Watercraft rental operations or intensive use of watercraft, will require greater frequency of inspection and maintenance.

## 4-TEC MODELS

<table>
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<th>PART/TASK</th>
<th>FIRST 10 HOURS</th>
<th>EVERY 25 HOURS OR 3 MONTHS</th>
<th>EVERY 50 HOURS OR 6 MONTHS</th>
<th>EVERY 100 HOURS OR 1 YEAR</th>
<th>EVERY 200 HOURS OR 2 YEAR</th>
<th>REFER TO</th>
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<tr>
<td>Corrosion protection</td>
<td>L</td>
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<td>STORAGE PROCEDURE</td>
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<td><strong>ENGINE</strong></td>
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<tr>
<td>Engine oil and filter (including cover O-rings)</td>
<td>R (2)</td>
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<td></td>
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<td>LUBRICATION SYSTEM</td>
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<tr>
<td>Rubber mounts</td>
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<td>ENGINE REMOVAL AND INSTALLATION</td>
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<td></td>
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<td>Exhaust system flushing</td>
<td>(3) (P)</td>
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<td>SUPERCHARGER</td>
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<td>Supercharger slipper moment (if so equipped)</td>
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<tr>
<td><strong>COOLING SYSTEM</strong></td>
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<tr>
<td>Hose and fasteners</td>
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<td></td>
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<td>COOLING SYSTEM</td>
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<td>Throttle body (IMPORTANT: see (3))</td>
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<td>FUEL TANK AND FUEL PUMP</td>
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<td>Spark plug (4)</td>
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<td>IGNITION SYSTEM</td>
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<td>Electrical connections and fastening (Ignition system, starting system, fuel injectors etc.)</td>
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<td>ELECTRICAL SYSTEM</td>
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<td>MPEM and ECM connectors (visual inspection without disconnecting)</td>
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<td>ENGINE MANAGEMENT</td>
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<td>Digitally Encoded Security System (DESS) and safety lamp/flasher</td>
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<td>DIGITALLY ENCODED SECURITY SYSTEM</td>
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<td>GAUGE, SENSORS AND FUSES</td>
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<td>Battery and fasteners</td>
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<td>CHARGING SYSTEM</td>
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### Section 01 MAINTENANCE
Subsection 01 (MAINTENANCE CHART)

<table>
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<tr>
<th>PART/TASK</th>
<th>FIRST 10 HOURS</th>
<th>EVERY 25 HOURS OR 3 MONTHS</th>
<th>EVERY 50 HOURS OR 6 MONTHS</th>
<th>EVERY 100 HOURS OR 1 YEAR</th>
<th>EVERY 200 HOURS OR 2 YEAR</th>
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<tr>
<td>Steering cable and connections</td>
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<td>I</td>
<td>STEERING SYSTEM</td>
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<tr>
<td>Steering nozzle bushings</td>
<td>I</td>
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<td>Off-power-assisted steering (O.P.A.S.)</td>
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<td>OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.)</td>
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<td>Drive shaft corrosion protection (6)</td>
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<tr>
<td>Carbon ring and rubber boot (drive shaft)</td>
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<td>DRIVE SYSTEM</td>
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<tr>
<td>Reverse system, cable and connections</td>
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<td>REVERSE SYSTEM</td>
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<tr>
<td>VTS (Variable Trim System) (if so equipped)</td>
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<td>I</td>
<td>VARIABLE TRIM SYSTEM</td>
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<td>I, L</td>
<td>JET PUMP and DRIVE SYSTEM</td>
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<tr>
<td>Impeller boot</td>
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<tr>
<td>Impeller seal, sleeve and O-ring</td>
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<td>I</td>
<td>JET PUMP</td>
<td></td>
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<td>Impeller and wear ring clearance</td>
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<tr>
<td>Sacrificial anode</td>
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<td>Hull plate and water intake grate</td>
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<td>HULL AND BODY</td>
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<td>Drain plugs (inside bilge), check for obstructions</td>
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<td>Hull</td>
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<tr>
<td>Ski/wakeboard post and fasteners</td>
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</tbody>
</table>

(1) Replace for storage period or after 100 hours of use whichever comes first.
(2) Emission-related component.
(3) Daily flushing in salt water or foul water use.
(4) IMPORTANT: When in salt water, the throttle body lubrication is highly recommended after every 10 hours of use. Failure to perform lubrication will result in damage to the throttle body.
(5) In salt water use.
(6) Every 25 hours when riding in weed area.
(7) Perform at storage period or after 100 hours of use whichever comes first.
(8) Inspect each month (more often in salt water) and change when necessary.
# PRESEASON PREPARATION

Proper vehicle preparation is necessary after the winter months or when a vehicle has not been used during several weeks.

Any worn, broken or damaged parts found during the storage procedure should have been replaced. If not, proceed with the replacement.

⚠️ **WARNING**

Unless otherwise specified, engine should be turned off during preseason preparation procedure.

<table>
<thead>
<tr>
<th>PRESEASON PREPARATION</th>
<th>TO BE PERFORMED BY</th>
<th>REFER TO</th>
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<tbody>
<tr>
<td></td>
<td>CUSTOMER</td>
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<td><strong>GENERAL</strong></td>
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<td><strong>ENGINE</strong></td>
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<tr>
<td>Oil level (1)</td>
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<td><strong>COOLING SYSTEM</strong></td>
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<tr>
<td>Hoses and fasteners</td>
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<td><strong>FUEL SYSTEM</strong></td>
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<tr>
<td>Fuel injection sensors verification</td>
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<tr>
<td>Inspection of check valves, lines, fasteners and fuel system leak test</td>
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<td>Filler neck, fuel tank and fuel cap condition</td>
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<td>Fuel tank straps</td>
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<td>Refill fuel tank</td>
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<tr>
<td>Spark plugs (3)</td>
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<tr>
<td>Battery condition/charging and installation</td>
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<tr>
<td>Connection and routing of electric harness (battery, starter, etc.)</td>
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<td>Digitally Encoded Security System (DESS) and monitoring beeper verification</td>
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<td><strong>STEERING SYSTEM</strong></td>
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<tr>
<td>Steering system adjustment and inspection</td>
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<tr>
<td>Check O.P.A.S. condition</td>
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### Section 01 MAINTENANCE
Subsection 02 (PRESEASON PREPARATION)

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<td>Inspection of bilge drain plugs</td>
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<tr>
<td>equipped)</td>
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</table>

(1) If oil and filter were not replaced at storage, proceed with oil change.
(2) If antifreeze was not changed at storage, drain and replace with new antifreeze.
(3) Replace every 200 hours or 2 years.
STORAGE PROCEDURES

SERVICE PRODUCTS

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<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
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<tr>
<td>anticorrosion spray</td>
<td>219 700 304</td>
<td>7</td>
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<tr>
<td>BRP fuel stabilizer</td>
<td>413 408 600</td>
<td>5</td>
</tr>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>7</td>
</tr>
<tr>
<td>XP-S Lube</td>
<td>293 600 016</td>
<td>5-7</td>
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</table>

PROPULSION SYSTEM

Jet Pump
Clean jet pump by spraying water in its inlet and outlet and then apply a coating of XP-S Lube (P/N 293 600 016) or equivalent.

⚠️ WARNING
Always remove safety lanyard cap from post to prevent unexpected engine starting before cleaning the jet pump area. Engine must not be running for this operation.

Remove cone and check if jet pump is water contaminated; if so, refer to JET PUMP for the repair procedure.

FUEL SYSTEM

Verify fuel system. Check fuel hoses for leaks. Replace damaged hoses or clamps if necessary.

Fuel Stabilizer
BRP fuel stabilizer (P/N 413 408 600) or equivalent should be added in fuel tank to prevent fuel deterioration and fuel system gumming. Follow manufacturer's instructions for proper use.

CAUTION: Fuel stabilizer should be added prior to engine lubrication to ensure fuel system components protection against varnish deposits.
Fill up fuel tank completely. Ensure there is no water inside fuel tank.

CAUTION: Should any water be trapped inside fuel tank, severe internal damage will occur to the fuel injection system.

⚠️ WARNING
Fuel is inflammable and explosive under certain conditions. Always work in a well ventilated area. Do not smoke or allow open flames or sparks in the vicinity. Fuel tank may be pressurized, slowly turn cap when opening. When fueling, keep watercraft level. Do not overfill or top off the fuel tank and leave watercraft in the sun. As temperature increases, fuel expands and might overflow. Always wipe off any fuel spillage from the watercraft. Periodically inspect fuel system.

Throttle Body
It is recommended to lubricate the throttle body to prevent corrosion on external and internal parts especially if the watercraft is used in salt water.

Models Equipped with Lubrication Fitting
Use fitting for that purpose provided in the engine compartment.
Make sure to spray XP-S Lube (P/N 293 600 016) at least 3 to 5 seconds for proper lubrication.
Models without Lubrication Fitting

Remove the air intake hose from throttle body.

Open the throttle body valve by pressing slightly the throttle lever.
Spray XP-S Lube (P/N 293 600 016) through the throttle body bore to lubricate valve mechanism.

ENGINE

Engine Oil and Filter

Change engine oil and filter. Refer to LUBRICATION SYSTEM in ENGINE section.

Exhaust System

Flush the exhaust system. Refer to EXHAUST SYSTEM.

Engine Coolant

Antifreeze should be replaced for the storage period to prevent antifreeze deterioration.
Make sure to perform an antifreeze density test.
For the coolant replacement procedure, refer to COOLING SYSTEM.

CAUTION: Improper antifreeze mixture might allow freezing of the liquid in the cooling system if vehicle is stored in area where freezing point is reached. This would seriously damage the engine. Failure to replace the antifreeze for storage may allow its degradation that could result in poor cooling when engine will be used.

Engine Fogging

Engine must be lubricated to prevent corrosion on internal parts. Fogging of the engine is recommended at the end of the season and before any extended storage period to provide additional corrosion protection. This will lubricate the engine intake valves, the cylinders and the exhaust valves.
To fog the engine, proceed as follows:
- Remove the two bolts that hold the fuel rail on.
- Remove the rail along with the three fuel injectors.
- Spray liberally XP-S Lube (P/N 293 600 016) into the intake ports.
- Crank engine several times while keeping throttle fully depressed (drown engine model) to distribute lubricant in cylinders, on intake valves and exhaust valves.
- Carefully inspect O-rings condition before reinstalling fuel injectors. Replace O-rings with new ones if damaged. Lubricate O-rings with injection oil prior to installing.
- Reinstall the injectors.
- Apply Loctite 243 (blue) (P/N 293 800 060) and torque the two bolts to 9 Nm (80 lbf-in) that hold the fuel rail on.
- Make sure there is no leak at injectors when cranking the engine in the upcoming steps.

**CAUTION**: Use only undiluted antifreeze (100% concentration). The premixed antifreeze available from BRP is NOT suitable for this particular application. Its concentration will be reduced when mixed with remaining water trapped in water jackets.

**NOTE**: When available, it is recommended to use biodegradable antifreeze compatible with internal combustion aluminum engines. This will contribute to protect the environment.

**NOTE**: The engine will not have to run during this operation but should have been run before, to exhaust as much water as possible, from cooling system components.

**ELECTRICAL SYSTEM**

**Battery**
For battery removal, cleaning and storage, refer to CHARGING SYSTEM.

**VEHICLE**

**Cleaning**
Clean the bilge with hot water and mild detergent or with bilge cleaner. Rinse thoroughly. Lift front end of watercraft to completely drain bilge. If any repairs are needed to body or to the hull, touch up paint and Gelcoat® repair kit are available. Replace damaged labels/decals.
Wash the body with soap and water solution (only use mild detergent). Rinse thoroughly with fresh water. Remove marine organisms from the hull. Apply a nonabrasive wax.

**CAUTION**: Never clean fiberglass and plastic parts with strong detergent, degreasing agent, paint thinner, acetone, etc.

**Anticorrosion Treatment**
Wipe off any residual water in the engine compartment.
Spray XP-S Lube (P/N 293 600 016) over all metallic components in engine compartment.
If the vehicle is used in salt water, apply the anticorrosion spray (P/N 219 700 304) on drive shaft. Refer to DRIVE SYSTEM.

**Vehicle Protection**
The seat should be partially left opened during storage. This will avoid engine compartment condensation and possible corrosion.
If the watercraft is to be stored outside, cover it with an opaque tarpaulin to prevent sun rays and grime from affecting the plastic components, watercraft finish as well as preventing dust accumulation.

**CAUTION:** The watercraft must never be left in water for storage. Never leave the watercraft stored in direct sunlight.

## CHECKLIST

<table>
<thead>
<tr>
<th>OPERATION</th>
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<tbody>
<tr>
<td>Verify jet pump (water contamination)</td>
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<tr>
<td>Verify fuel system</td>
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<tr>
<td>Add fuel stabilizer</td>
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<tr>
<td>Fill up fuel tank</td>
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<tr>
<td>Change engine oil and filter</td>
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<tr>
<td>Flush exhaust system</td>
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<tr>
<td>Replace antifreeze</td>
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<tr>
<td>Fog the engine</td>
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<tr>
<td>Lubricate throttle body</td>
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<tr>
<td>Add antifreeze into intercooler and exhaust manifold (where temperatures are below freezing)</td>
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<tr>
<td>Remove, clean and store the battery</td>
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<tr>
<td>Clean the bilge</td>
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<tr>
<td>Wash the body</td>
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</tr>
<tr>
<td>Spray XP-S Lube (P/N 293 600 016) over all metallic components in engine compartment</td>
<td></td>
</tr>
<tr>
<td>Apply the anticorrosion spray (P/N 219 700 304) on drive shaft (salt water use)</td>
<td></td>
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<tr>
<td>Partially lift the seat</td>
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SPECIAL PROCEDURES

SERVICE TOOLS

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<tr>
<td>large hose pincher</td>
<td>529 032 500</td>
<td>9</td>
</tr>
<tr>
<td>pump</td>
<td>529 035 880</td>
<td>10</td>
</tr>
</tbody>
</table>

TOWING THE WATERCRAFT IN WATER

Special precautions should be taken when towing a Sea-Doo watercraft in water.

Maximum recommended towing speed is 24 km/h (15 MPH).

When towing your watercraft in water, pinch the water supply hose from the jet pump housing to the engine with a large hose pincher (P/N 529 032 500).

This will prevent the exhaust cooling system from filling which may lead to water being injected into and filling the exhaust system and the engine. Without the engine running there isn’t any exhaust pressure to carry the water out the exhaust outlet.

CAUTION: Failure to do this may result in damage to the engine. If you must tow a stranded watercraft in water and do not have a hose pincher be sure to stay well below the maximum towing speed of 24 km/h (15 MPH).

Snugly install the hose pincher on the water supply hose as shown in the following illustrations.

NOTE: Pinch the hose with the red tape (if so equipped).

SUBMERGED WATERCRAFT

Drain bilge.

If it was submerged in salt water, spray bilge and all components with fresh water using a garden hose to stop the salt corroding effect.

Engine

Refer to WATER-FLOODED ENGINE in this section.
Fuel System
Check fuel reservoir for water contamination. If necessary, siphon and refill with fresh fuel.

WATER-FLOODED ENGINE
If engine is water-flooded, it must be serviced within a few hours after the event. Otherwise engine will have to be overhauled.

CAUTION: Never try to crank or start the engine. Water trapped in the intake manifold would enter the combustion chamber through the intake valves and may cause damage to the engine.

CAUTION: A water-flooded engine must be properly drained, lubricant replaced (oil change), operated (boil out procedure), then lubricant replaced again, otherwise parts will be seriously damaged.

Whenever the engine is stopped, all the valves close thus preventing water from being ingested in the engine.

If water is suspected to be in the intake and the exhaust system, it must be drained as follows:
- Remove the intake manifold and drain it. Then suck out the water from the intake valve ports. Refer to INTAKE MANIFOLD AND INTERCOOLER.
- Remove the water from oil/air separator breather hose.
- Remove the exhaust pipe and drain it. Then either remove the mufflers to drain them or siphon the water out of them. Refer to EXHAUST SYSTEM.
- If water gets in the oil (oil will be milky), change the engine oil and filter as per procedure further in this subsection.

Throttle Body
Throttle body should be lubricated to prevent corrosion. Refer to STORAGE PROCEDURES.

Supercharger
Supercharged 4-TEC Engines
If there was water in the oil or in the intake manifold, it is recommended to take the supercharger apart, dry all the components, replace the slip clutch needle bearings and shaft ball bearings. Refer to SUPERCHARGER.

Oil Change Procedure
(water-contaminated oil)
- Using the pump (P/N 529 035 880), siphon the contaminated oil from the engine reservoir through dipstick hole.

CAUTION: Never crank or start engine when siphon tube is in dipstick hole. Never start engine when there is no oil in engine.
- Remove the pump from the dipstick hole.
- While in drowned engine mode, crank the engine for 5 seconds.
- Remove the oil filter cap and the oil filter.
- Again, siphon the contaminated oil from the reservoir.
- Remove valve cover. Refer to CYLINDER HEAD.

- The contaminated oil in the PTO area of the engine is siphoned using the same pump as above.
- Put a tape at 400 mm (16 in) from the end of the pump tube.
- Insert the tube in the PTO area until the tape reach the cylinder-block edge. Then, siphon contaminated oil out.

- Remove the pump tube.
- Reinstall valve cover.
- Install a new oil filter and reinstall the oil filter cap.
Section 01 MAINTENANCE
Subsection 04 (SPECIAL PROCEDURES)

- Fill up the reservoir with fresh oil.
- Proceed with the boil out procedure below.

Boil Out Procedure

NOTE: This procedure is intended to evaporate the water contained in the oil. The procedure with the watercraft in water is the preferred one, but it can also be done using the flush kit.

Procedure in a Test Tank or Tied to a Trailer with Watercraft in Water
- Connect the vehicle to B.U.D.S. to monitor the coolant temperature. It must exceed 100°C (212°F) in order for the water boil out. Once the boil point is reached, it won’t take long to evaporate the water.
- Run the engine for 5 minutes at 3500 RPM.

⚠️ WARNING
Make sure to safely secure the watercraft.

- With the engine still running at 3500 RPM, install a hose pincher to the coolant line going to the oil cooler.

⚠️ WARNING
Certain components in the engine compartment may be very hot. Direct contact may result in skin burn. Do not touch any electrical parts or jet pump area when engine is running.

CAUTION: Hose pincher must be removed prior to operating the watercraft. Failure to do this will result in damage to the engine.
- Change the oil and filter again.
- Procedure is now completed.

Procedure Connected to a Flush Kit
- On drive shaft, remove the C-clip then move forward the ring seal carrier. Refer to DRIVE SYSTEM section.

CAUTION: Make sure that the ring seal carrier is not in contact with the PTO seal assembly, neither with the carbon ring.
- Connect the vehicle to B.U.D.S. to monitor the coolant temperature. It must exceed 100°C (212°F) in order for the water boil out. Once the boil point is reached, it won’t take long to evaporate the water.
- Connect a flush kit to the coolant line.

CAUTION: Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.
- Run the engine for 5 minutes at 3000 RPM.
- With the engine still running at 3000 RPM, install a hose pincher to the coolant line going to the oil cooler.

⚠️ WARNING
Certain components in the engine compartment may be very hot. Direct contact may result in skin burn. Do not touch any electrical parts or jet pump area when engine is running.

- Continue to run the engine at 3500 RPM for 15 more minutes (20 minutes total run time).
- Shut the engine off.
- Remove the hose pincher on the coolant line going to the oil cooler.

- Continue to run the engine at 3000 RPM for 15 more minutes (20 minutes total run time).
- Shut off the engine.
Section 01 MAINTENANCE
Subsection 04 (SPECIAL PROCEDURES)

- Remove the hose pincher on the coolant line going to the oil cooler.

**CAUTION:** Hose pincher must be removed prior to operating the watercraft. Failure to do this will result in damage to the engine.
- Change the oil and filter again.
- Move rearward the ring seal carrier and reinstall the C-clip. Refer to **DRIVE SYSTEM** section.
TRoubleshooting Chart

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to show all causes for all problems.

Prior to replacing an ECM or MPEM, refer to the appropriate ECM/MPEM section or ECM/MPEM replacement in the ENGINE MANAGEMENT section and read carefully the tests to do before replacing an ECM/MPEM that could otherwise be good.

Always check for fault codes. If a fault code is detected, service the fault code and recheck operating conditions. Refer to EMS DIAGNOSTIC AND COMMUNICATIONS TOOLS in ENGINE MANAGEMENT section.

Engine

Symptom: ENGINE WILL NOT START (engine does not turn over)

1. Wrong safety lanyard
   - Use one that has been programmed.

2. DESS operation non functional
   - If 2 short beeps are not heard when installing safety lanyard, refer to DIGITALLY ENCODED SECURITY SYSTEM.

3. Safety lanyard switch faulty or disconnected or harness damaged
   - Replace.

4. Burnt fuse: battery, starting system. Also fuel pump
   - Check wiring then replace fuse.

5. Starting system fuse keeps on burning
   - Check wiring, starting system solenoid and MPEM.

6. Discharged or disconnected battery
   - Check/recharge. Refer to CHARGING SYSTEM.

7. Defective or disconnected start/stop switch
   - Check, refer to STARTING SYSTEM.

8. Battery connections
   - Check/clean/tighten.

9. Poor/bad or corroded ground contacts (engine, starter etc.)
   - Check/clean/repair.

10. Water/fuel hydro-lock
    - Check, refer to MAINTENANCE.

11. Starter malfunction
    - Check, refer to STARTING SYSTEM.

12. Starter solenoid
    - Check, refer to STARTING SYSTEM.

13. Obstructed starter drive gear assembly
    - Check/repair, refer to PTO HOUSING AND MAGNETO.

14. Seized or obstructed engine
    - Check/repair, refer to the ENGINE.

15. Seized or obstructed supercharger (if so equipped)
    - Check/repair, refer to SUPERCHARGER.
Symptom: **ENGINE WILL NOT START (engine does not turn over)** (cont’d)

16. Seized jet pump
   - Check, refer to PROPULSION SYSTEM.

17. Faulty sensor, ECM or MPEM
   - Check fault codes, refer to ENGINE MANAGEMENT.

Symptom: **ENGINE WILL NOT START (engine turns slowly)**

1. Loose battery cables
   - Check/clean/tighten.

2. Discharged/weak battery
   - Check/charge/replace.

3. Restriction in jet pump
   - Check/clean/pump.

4. Partial seizure in jet pump
   - Inspect, refer to PROPULSION SYSTEM.

5. Partial engine hydro-lock
   - Check, refer to MAINTENANCE.

6. Partial engine seizure
   - Check compression, refer to ENGINE sections.

7. Worn starter
   - Check, refer to STARTING SYSTEM.

8. Timing chain not guided by chain guide
   - Check, refer to CYLINDER HEAD and CYLINDER BLOCK.

9. Outside temperature too low
   - Oil is too thick. Change oil viscosity.
   - Battery capacity is not sufficient for cold temperature.

Symptom: **ENGINE WILL NOT START (engine turns over)**

1. Faulty component in the fuel injection system
   - Check for fault codes. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS in ENGINE MANAGEMENT.

2. Engine drowned mode is active
   - Release throttle lever.

3. Low battery voltage
   - Recharge or replace battery.

4. Wrong info-center
   - Remove and install the recommended info-center for the vehicle.

5. Low or no fuel pressure
   - Check fuel pump pressure output.
   - Check fuel pump fuse.
   - Check wiring harness.

6. Fuel injectors not working
   - Check fuel injector operation. Replace as necessary.
   - Check output signal from MPEM.
### Section 02 TROUBLESHOOTING
**Subsection 01 (TROUBLESHOOTING CHART)**

**Symptom:** ENGINE WILL NOT START (engine turns over) (cont'd)

7. **Defective MPEM or ECM**
   - Check ignition system and repair.
   - Replace MPEM or ECM (as applicable).

8. **Defective CPS**
   - Check operation of CPS and replace if necessary.

9. **Water-contaminated fuel**
   - Check/siphon and refill.

10. **Dirty fuel filter**
    - Clean/replace.

11. **Fouled or defective spark plug**
    - Replace.

12. **Water in engine**
    - Check, refer to MAINTENANCE.

13. **Defective ignition circuit**
    - Check, refer to IGNITION SYSTEM.

14. **Internal engine damage**
    - Check, refer to ENGINE sections.

15. **Defective encoder/trigger wheel**
    - Check, refer to ENGINE MANAGEMENT.

16. **Incorrectly aligned flywheel and trigger wheel**
    - Properly position flywheel and trigger wheel, refer to PTO HOUSING AND MAGNETO.

17. **Insufficient engine compression**
    - Replace defective part(s).

18. **Idle bypass valve stuck or not functioning**
    - Check, refer to ENGINE MANAGEMENT.

**Symptom:** ENGINE WILL NOT START (no spark at spark plugs)

1. **Spark plug faulty, fouled or worn out**
   - Check spark plug condition. Replace if necessary.

2. **Defective ignition circuit**
   - Check, refer to IGNITION SYSTEM.

3. **Faulty ECM**
   - Replace ECM.

**Symptom:** ENGINE HARD TO START

1. **Defective idle bypass valve**
   - Refer to ENGINE MANAGEMENT.

2. **Wrong TPS zero setting**
   - Refer to ENGINE MANAGEMENT.

3. **Throttle cable adjustment**
   - Refer to ENGINE MANAGEMENT.
Symptom: **ENGINE HARD TO START** (cont’d)

4. Temperature too low for available battery capacity
   - Battery capacity is not sufficient for cold temperature.

5. Air lock in fuel rail
   - Refer to ENGINE MANAGEMENT.

6. Water in intake system (defective MAP sensor)
   - Check and remove water. Refer to SPECIAL PROCEDURES subsection.

7. Water in fuel reservoir or contaminated fuel
   - Flush reservoir and refill with fresh gas.

8. Mechanical engine failure
   - Check cylinder compression.
   - Check for cylinder head leaks.
   - Check starting system.

9. Spark plug faulty, fouled or worn out
   - Check spark plug condition. Replace if necessary.

10. Low fuel pressure
    - Check fuel pump operation. Refer to FUEL TANK AND FUEL PUMP.
    - Check fuel pressure regulator. Refer to FUEL TANK AND FUEL PUMP.

11. Defective CAPS
    - Check CAPS and its circuit. Refer to ENGINE MANAGEMENT.

Symptom: **ENGINE STARTS BUT RUNS ONLY AT IDLE SPEED**

1. The system is in limp home mode
   - Refer to ENGINE MANAGEMENT and check the fault codes.

2. Broken or loose throttle cable
   - Change/readjust.

Symptom: **ENGINE MISFIRES, RUNS IRREGULARLY**

1. Fouled, defective, worn spark plugs
   - Check/verify heat range/gap/replace.

2. Faulty ECM or MPEM
   - Check, refer to ENGINE MANAGEMENT.

3. Defective trigger wheel/CPS
   - Check, refer to ENGINE MANAGEMENT.

4. Defective ignition circuit
   - Check coil, wiring condition and proper grounding of ignition coil.

5. Poor engine ground
   - Check/clean/repair.

6. Fuel pressure (low or high)
   - Check pump, regulator, injectors and hose pinchers or if filter is plugged. Replace if necessary.

7. Stale or water fouled fuel
   - Check/siphon and refill.

8. Fuel filter dirty or restricted
   - Check/clean/replace.
Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

Symptom: **ENGINE MISFIRES, RUNS IRREGULARLY** (cont'd)

9. Clogged fuel injectors
   - Remove and clean fuel injectors.

10. Defective sensor
    - Check faulty codes, refer to ENGINE MANAGEMENT.

11. Flame arrester dirty or restricted
    - Check/replace.

12. Faulty fuel injector(s)
    - Replace fuel injector(s), refer to ENGINE MANAGEMENT.

13. Fuel pressure fluctuating
    - Inspect fuel pressure regulator. Refer to FUEL SYSTEM.

14. Injector wiring reversed
    - Refer to the WIRING DIAGRAM.

Symptom: **ENGINE CONTINUALLY BACKFIRES**

1. Fouled, defective spark plugs
   - Clean/replace.

2. Ignition coil wiring reversed
   - Refer to WIRING DIAGRAM.

3. Incorrect timing setting
   - Check/reset, refer to ELECTRICAL SYSTEM.

4. Defective trigger wheel/CPS
   - Check, refer to ENGINE MANAGEMENT.

5. Intake or exhaust valve(s) leak
   - Pressure check engine, refer to LEAK TEST.

Symptom: **ENGINE DETONATION OR PINGING**

1. Spark plug heat range too high
   - Check/change to correct range.

2. Engine overheats and exhaust overheats
   - Check, see ENGINE OVERHEATS in this section.

3. Fuel octane too low or poor fuel quality
   - Use good quality fuel.

4. Knock sensor disconnected or faulty
   - Check, refer to ENGINE MANAGEMENT.

5. Bad ECM connection
   - Check, refer to ENGINE MANAGEMENT.

Symptom: **ENGINE LACKS ACCELERATION OR POWER**

1. Weak spark
   - Check/replace, refer to IGNITION SYSTEM.

2. Throttle does not open fully
   - Check/readjust, refer to ENGINE MANAGEMENT.
Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

Symptom: **ENGINE LACKS ACCELERATION OR POWER** (cont’d)

3. **Low compression**
   - Check/repair, refer to ENGINE sections.

4. **Intake restriction**
   - Check if a restrictive gasket is installed between throttle body and intake manifold (GTI models only).

5. **Water in fuel**
   - Check/siphon/replace.

6. **Impeller leading edge damaged**
   - Check/replace, refer to PROPULSION SYSTEM.

7. **Too much engine oil**
   - Siphon or adjust level. Refer to LUBRICATION SYSTEM.

8. **Poor fuel quality**
   - Siphon then refill with fresh fuel.

9. **Clogged fuel injectors**
   - Remove and clean fuel injectors.

10. **Low fuel pressure**
    - Check fuel line and fuel pump pressure.

11. **Incorrect throttle position sensor (TPS) adjustment**
    - Check and adjust TPS, refer to ENGINE MANAGEMENT.

12. **Improper timing chain alignment**
    - Refer to CYLINDER HEAD.

13. **Defective supercharger**
    - Check/repair, refer to SUPERCHARGER.

14. **Dirt in supercharger due to vapor oil and salt contamination**
    - Check and clean supercharger, refer to SUPERCHARGER.
    - Check engine oil level. Siphon excess of oil.

15. **Overheated engine**
    - See ENGINE OVERHEATS in this chart.

16. **Limp home mode activated**
    - Refer to ENGINE MANAGEMENT.

Symptom: **ENGINE STOPS RUNNING**

1. **Contaminated or inappropriate fuel**
   - Syphon reservoir and refill with fresh fuel.

2. **Engine running out of fuel**
   - Refill fuel tank.
   - Check fuel delivery system for proper fuel pressure and delivery.

3. **Air in fuel rail**
   - Refer to ENGINE MANAGEMENT.

Symptom: **ENGINE CANNOT REACH MAXIMUM RPM**

1. **Low fuel pressure**
   - Check fuel pump pressure output.
Symptom: **ENGINE CANNOT REACH MAXIMUM RPM** (cont’d)

2. Jet pump related problem  
   - Check propulsion components. Refer to JET PUMP.

3. Limp home mode activated  
   - Refer to ENGINE MANAGEMENT.

4. Exhaust system blockage/muffler damage  
   - Check and repair.

5. Exhaust gases in bilge (leak)  
   - Check exhaust system for leaks.

6. Defective supercharger  
   - Check/repair, refer to SUPERCHARGER.

7. Dirt in supercharger due to vapor oil and salt contamination  
   - Check and clean supercharger, refer to SUPERCHARGER.  
   - Check engine oil level. Siphon excess of oil.

8. Battery voltage is too low  
   - Check/repair, refer to CHARGING SYSTEM.

Symptom: **ENGINE RUNS TOO FAST** (vehicle cannot reach its top speed)

1. Faulty rev limiter  
   - Check, refer to ENGINE MANAGEMENT.

2. Improper impeller pitch (too low)  
   - Check/replace, refer to PROPULSION SYSTEM.

3. Damaged leading or trailing edge of impeller  
   - Check/replace. Refer to PROPULSION SYSTEM.  
   **NOTE:** Leading edge damage contributes to poor performance from start. Trailing edge damage contributes to poor top performance and stator vanes erosion.

4. Sealing of ride plate, jet pump support or jet pump  
   - Check/reseal, refer to section PROPULSION SYSTEM or HULL/BODY.

Symptom: **ENGINE OVERHEATS** (coolant level too low)

1. Coolant level low  
   - Refill/check for leaks.

2. Coolant leaking out of leak indicator hole (PTO housing)  
   - Replace seal.

3. Hoses or clamps missing/defective  
   - Repair/replace.

4. Cylinder head gasket leaks (white exhaust gas)  
   - Replace cylinder head gasket.

5. Thermostat failure  
   - Replace.

6. Coolant pump failure  
   - Replace.

7. Internal passage blockage  
   - Inspect and clean.
Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

Symptom: **ENGINE OVERHEATS** *(monitoring beeper sounds continuously)*
1. Temperature sensor defective
   - Check/replace. Refer to ENGINE MANAGEMENT.
2. Worn water pump impeller
   - Check/replace.
3. Cooling system restriction
   - Check/flush, refer to MAINTENANCE.
4. Damaged ride plate or hoses
   - Check, refer to COOLING SYSTEM and HULL/BODY.
5. Thermostat defective
   - Check/replace.

Symptom: **ENGINE SMOKE IN THE EXHAUST** *(white smoke)*
1. Coolant leak
   - Check/repair. Refer to COOLING SYSTEM.
2. Intercooler leak (if so equipped)
   - Check/repair. Refer to INTAKE MANIFOLD.
3. Damaged cylinder head gasket
   - Check/replace cylinder head gasket.
4. Water ingestion
   - Inspect intake manifold for water infiltration.
5. Valve stem seals
   - Check/replace valve stem seals, refer to CYLINDER HEAD.

Symptom: **ENGINE SMOKE IN THE EXHAUST** *(blue smoke)*
1. Oil level too high
   - Siphon excess of oil.
2. PTO oil scavenge port blocked or scavenge pump malfunction
   - Inspect and clean or replace pump.

Symptom: **ENGINE SMOKE IN THE EXHAUST** *(blue smoke at engine starting)*
1. Valve stem seals worn or damaged
   - Replace seals.
2. Oil rings worn out
   - Replace rings, refer to CYLINDER BLOCK.

Symptom: **ENGINE SMOKE IN THE EXHAUST** *(blue smoke with engine under load)*
1. Oil rings
   - Replace oil rings, refer to CYLINDER BLOCK.

Symptom: **LOW OR NO ENGINE OIL PRESSURE**
1. Oil level too low
   - Refill. See TECHNICAL SPECIFICATIONS.
2. Leaking gasket
   - Replace.
Symptom: LOW OR NO ENGINE OIL PRESSURE (cont'd)

3. Oil leaking out of leak indicator hole (PTO housing)
   - Replace oil seal on pump shaft.

4. Oil pressure sensor defective
   - Check/replace.

5. Oil pump malfunctioning
   - Clean rotor and check wear limits.

6. Oil regulator valve sticks open, or spring load too small
   - Clean/replace.

7. Heavy wear on plain bearings
   - Replace.

Symptom: ENGINE OIL CONTAMINATION (milky)

1. Oil seal and rotary seal on coolant pump shaft leaking
   - Replace both seals. Refer to PTO HOUSING AND MAGNETO. Change oil.

2. Cylinder head gasket leaking
   - Replace gasket. Refer to CYLINDER HEAD. Change oil.

3. Loose screws on cylinder head, PTO housing or oil separator
   - Retorque. Change oil.

4. Oil contamination due to metal or plastic particles
   - Replace possibly damaged parts. Change oil.

5. Water ingestion (intake manifold, TOPS valve, dipstick)
   - Refer to MAINTENANCE.

6. Leak indicator hole plugged
   - Check/clean leak indicator hole.

Symptom: UNUSUAL ENGINE NOISE AND/OR VIBRATION

1. Worn chain tensioner
   - Replace.

2. Worn chain guide
   - Replace.

3. Stretched chain and/or worn out sprockets
   - Replace chain and sprockets.

4. Sprocket screws got loose
   - Retorque.

5. Hydraulic element inside rocker arm(s) is worn out (valve adjustment) or lifter damaged
   - Replace faulty rocker arm(s) and/or lifters.

6. Rocker arm screws not tightened
   - Retorque.

7. Heavy wear on crankshaft and/or balancer shaft bearings
   - Replace.

8. Crankshaft and balancer shaft not aligned
   - Check marks and shafts.
Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

Symptom: **UNUSUAL ENGINE NOISE AND/OR VIBRATION** (cont’d)

9. Heavy wear on thrust washers, or thrust washers missing
   - Check/replace.

10. Defective supercharger (if so equipped)
    - Check/repair, refer to SUPERCHARGER.

11. Missing/defective air intake hose
    - Check/replace air intake hose or clamps, refer to AIR INTAKE SYSTEM.

STARTING SYSTEM

Symptom: **STARTER DOES NOT TURN**

1. Burnt fuse
   - Check wiring condition and replace fuse.

2. Poor contact of battery terminal(s)
   - Clean and tighten terminal(s).

3. Poor battery ground cable connection
   - Clean and tighten.

4. Weak battery
   - Recharge or replace battery.

5. Poor contact of start/stop switch, safety lanyard switch or solenoid
   - Check connectors and clean contacts. Check and replace defective parts.

6. Open circuit: start/stop switch or solenoid
   - Check. Replace if necessary.

7. Safety lanyard
   - Refer to ENGINE MANAGEMENT.

8. Defective MPEM and/or ECM
   - Check. Replace if necessary.

Symptom: **STARTER ENGAGES; BUT DOES NOT CRANK THE ENGINE**

1. Weak battery
   - Recharge or replace battery.

2. Poor battery cable connections
   - Clean battery cable connections.

3. Poor contact of brush
   - Straighten commutator and brush.

4. Damaged starter
   - Replace starter.

Symptom: **STARTER TURNS, BUT STARTER DRIVE DOES NOT MESH WITH RING GEAR**

1. Worn starter drive gear
   - Replace drive.

2. Defective drive
   - Replace drive.
Symptom: **STARTER TURNS, BUT STARTER DRIVE DOES NOT MESH WITH RING GEAR**
(cont’d)

3. Poor movement of drive on splines
   - Clean and correct.

4. Worn drive bushing
   - Replace clutch.

5. Worn ring gear
   - Replace ring gear.

Symptom: **STARTER KEEPS RUNNING**

1. Shorted solenoid winding
   - Replace solenoid.

2. Melted solenoid contacts
   - Replace solenoid.

3. Sticking or defective starter drive
   - Lubricate or replace.

**ELECTRICAL SYSTEM**

Symptom: **DEPTH GAUGE OPERATIONAL PROBLEM**

1. Nothing is displayed in the information center
   - The depth gauge is not activated in the MPEM. Activate the depth gauge in Options under Setting tab in B.U.D.S.

2. 0.0 (ft or m) is displayed all the time
   - Connector of the depth gauge is not connected. Connect it properly.
   - There is not 12 V or ground is open at the depth gauge connector. Check fuses and wiring harness.
   - Check fuses and wiring harness. Check WHITE/BLACK and WHITE/RED wires.

3. - - - (ft or m) is displayed and Sensor is blinking after self test for 5 seconds
   - The watercraft is not in water. Launch watercraft in water and recheck.
   - There is air between the depth gauge and the bilge. Check silicone pad under depth gauge.
   - Depth gauge is defective. Try a new depth gauge.

Symptom: **INAPPROPRIATE SPEEDOMETER READING**

1. Faulty speed sensor or related circuits.
   - Refer to GAUGE, SENSORS AND FUSES.

2. MPEM was replaced and speedometer calibration data were not transferred to new MPEM.
   - Install latest B.U.D.S version available in BOSSWeb then connect to vehicle with VCK and it will automatically update MPEM. Refer to ENGINE MANAGEMENT.
PROPULSION

Symptom: **ABNORMAL NOISE FROM PROPULSION SYSTEM**

1. Weeds/debris caught in intake grate or impeller
   - Check and clean.

2. Damaged or bent drive shaft
   - Check and/or replace. Refer to PROPULSION SYSTEM.

3. Idle speed too low
   - Check fault codes.

4. Broken engine mounts
   - Check and repair.

STEERING SYSTEM

Symptom: **O.P.A.S. SYSTEM FAULTS**

1. Watercraft is more responsive than usual while turning
   - Side vanes do not go up while watercraft is at speed. Refer to STEERING SYSTEM.

2. Watercraft pull on one side
   - One side vane does not go up while watercraft is at speed. Refer to STEERING SYSTEM.

3. Side vanes do not go up while watercraft is at speed
   - Clogged filter, square rings damaged, leakage in hoses or mechanical malfunction. Refer to STEERING SYSTEM.

4. Side vanes do not go down while watercraft is at idle
   - Broken spring inside side vane cylinder. Refer to STEERING SYSTEM.
ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

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<tr>
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<td>295 000 141</td>
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<tr>
<td>engine alignment adapter</td>
<td>529 035 719</td>
<td>30</td>
</tr>
<tr>
<td>plate</td>
<td>529 035 507</td>
<td>30</td>
</tr>
<tr>
<td>support plate kit</td>
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SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>dielectric grease</td>
<td>293 550 004</td>
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</tr>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>29,31</td>
</tr>
<tr>
<td>pulley flange cleaner</td>
<td>413 711 809</td>
<td>29</td>
</tr>
<tr>
<td>XP-S Lube</td>
<td>293 600 016</td>
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</tr>
</tbody>
</table>

GENERAL

During assembly/installation, use torque values and service products from exploded views in the appropriate sections.

Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENER and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

⚠️ WARNING

Always disconnect battery cables exactly in the specified order, BLACK (−) cable first then the RED (+) battery cable last.

Disconnect ground wires from engine.

⚠️ WARNING

Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pin, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

PROCEDURES

ENGINE REMOVAL

Place vehicle at workstation that will have access to an engine-lifting hoist.

Drain cooling system, refer to COOLING SYSTEM.

Using B.U.D.S., release fuel pressure from fuel system.

Disconnect battery cables from battery.
All Models except RXP
Disconnect magneto wiring harness.
Disconnect the throttle position sensor (TPS), manifold air pressure sensor (MAPS) and manifold air temperature sensor (MATS). Refer to ENGINE MANAGEMENT for location of sensors and connectors.

RXP Models
Remove engine cover. Refer to HULL AND BODY.
Unplug connectors beside ECM then remove connector housings from the support.
Disconnect ECM and remove from engine to prevent any possible damage while pulling engine out.

Unplug VTS connector.
Cut locking ties retaining vehicle wiring harness to engine.

VEHICLE WIRING HARNESS
1. Cut locking tie
Move wiring harness forward to make room.

All Models
Disconnect TOPS valve hose.

1. TOPS valve
2. TOPS valve hose
Remove exhaust pipe, refer to EXHAUST SYSTEM.
Withdraw jet pump, refer to JET PUMP.
Withdraw drive shaft, refer to DRIVE SYSTEM.
Disconnect cooling hoses at engine coming from ride plate and coolant expansion tank.
Except RXP models, remove the intake manifold. Refer to INTAKE MANIFOLD.

GTX Supercharged, GTX Limited and RXT Models
Remove air inlet tube from supercharger and air duct.

GTX Limited and RXT
Disconnect water hoses from intercooler.
Section 03 ENGINE
Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

RXP Models
Remove inlet hose from throttle body.
Disconnect throttle cable from throttle body.

All Models
Remove engine support mount screws.
NOTE: Be careful when removing engine support(s) or rubber mount adapters, shims could have been installed underneath. Shims control engine/jet pump alignment. Always note position of shims for reinstallation, to avoid altering engine alignment.

Disconnect fuel rail supply line.
Disconnect water inlet hose coming from jet pump connected to the intercooler.
Section 03 ENGINE
Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

REAR SUPPORT
1. Remove screws

Using a chain block, a hoist or other suitable equipment, slightly lift engine to ease the remaining component removal.

CAUTION: Take care not to damage cables.

TYPICAL
1. Lifting brackets

RXP Models
Slightly move engine rearward to take advantage of the larger opening.
The engine have to be hooked-up at an additional location. See illustration.

1. Hook-up a steel rope/chain here

Carefully lift engine by the side with the steel rope/chain and rotate engine so that it can be pulled out of vehicle.

1. Lift steel rope/chain here to rotate engine
2. Usual lifting brackets

All Models
Carry on engine lifting to remove from the body opening.

CAUTION: Be careful not to scratch body or to hit any component.
Disconnect RED (+) cable from starter post.
Check tightness and condition of rubber mounts. If they have been removed, apply Loctite 243 (blue) (P/N 293 800 060) on screw threads. Torque screws to 25 N·m (18 lbf·ft).

**CAUTION:** Strict adherence to this torque is important to avoid damaging threads of aluminum insert in bilge.

Connect starter cable before lowering engine.

Torque nut of positive starter cable to 7 N·m (62 lbf·in). Apply dielectric grease (P/N 293 550 004) on nut.

Ensure contact surface is perfectly clean then reconnect grounds wires/cable to engine.

Place engine into vehicle.

Install engine support screws. Do not apply threadlocker to engine support screws and do not torque yet.

Align engine. Refer to ENGINE ALIGNMENT at the end of this section for complete procedure.

Install and properly align exhaust pipe. Refer to EXHAUST SYSTEM.

Reinstall all removed parts and connect all connectors.

Check throttle cable condition and lubricate it with XP-S Lube (P/N 293 600 016).

After its installation, properly adjust throttle cable then perform the TPS reset as specified in ENGINE MANAGEMENT.

Check hose condition and pressure test fuel system, refer to FUEL SYSTEM.

**WARNING**

Whenever doing any type of repair on watercraft or if any components of the fuel system are disconnected, a pressure test must be done before starting engine.

Verify all electrical connections (ground wires and battery).

Run engine and ensure there is no leakage.

**CAUTION:** If watercraft is out of water, engine must be cooled using the flush kit.

**ENGINE ALIGNMENT**

**NOTE:** To perform this procedure the jet pump and the drive shaft must be removed. Refer to JET PUMP and DRIVE SYSTEM.
Section 03 ENGINE
Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

Check alignment of engine using the following alignment tools:
- the support plate kit (P/N 529 035 506) and the plate (P/N 529 035 507)
- the alignment shaft (P/N 295 000 141)
- the engine alignment adapter (P/N 529 035 719).

To verify alignment proceed as follows:
- Secure plate and support to hull with four nuts or screws.
- Install the engine alignment adapter (P/N 529 035 719) in engine PTO housing.
- Carefully slide shaft through support.
- Insert shaft end into engine alignment adapter.

NOTE: Ensure the protective hose and carbon ring is removed to check engine alignment. If the alignment is correct, the shaft will slide easily without any deflection in engine alignment adapter.

TYPICAL
1. Engine alignment adapter
2. Alignment shaft

If the alignment is incorrect loosen engine support screws to enable to align engine alignment adapter with shaft end.

NOTE: Use shims (P/N 270 000 024) or (P/N 270 000 025) between engine supports and rubber mounts to correct alignment.

CAUTION: Whenever shims are used to correct alignment, never install more than 5 mm (0.196 in) shim thickness.
Remove engine support screws and apply Loc-tite 243 (blue) (P/N 293 800 060) on screw threads.
Torque engine support screws to 25 N·m (18 lbf·ft) when procedure is completed.

1. Torque to 25 N·m (18 lbf·ft)
2. Position washer to have the "T" mark on top

Remove alignment tools.
ENGINE LEAK TEST

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive shaft adapter</td>
<td>529 035 892</td>
<td>34</td>
</tr>
<tr>
<td>Drive shaft adapter</td>
<td>529 035 985</td>
<td>34</td>
</tr>
<tr>
<td>leak down tester</td>
<td>529 035 661</td>
<td>34</td>
</tr>
</tbody>
</table>

SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molykote 111</td>
<td>413 707 000</td>
<td>35</td>
</tr>
</tbody>
</table>

The procedure has to be done when engine operating temperature of approx. 70°C (158°F) is reached.

⚠️ WARNING
Prevent burning yourself due to handling on the hot engine.

PREPARATION

Remove any parts to have access to engine.
Remove safety lanyard.

⚠️ WARNING
Safety lanyard must be removed to prevent engine to be cranked while fuel rail is removed to prevent fuel to be sprayed out. Fuel is flammable.

Remove jet pump (refer to JET PUMP).
Remove coolant tank cap.

⚠️ WARNING
To avoid potential burns, only remove the coolant tank cap by wearing the appropriate safety equipment.

Remove oil dipstick.

Unplug and remove ignition coils.
Remove spark plugs.

NOTE: Ignition coil may be used as an extractor.
Section 03 ENGINE
Subsection 02 (ENGINE LEAK TEST)

Unscrew and remove valve cover.

As the engine is turned over, observe the movement of intake rocker arm of the cylinder to be checked. After it completes the cycle and the intake valve closes, observe the piston. When it reaches its uppermost position that is TDC compression stroke.

With an appropriate wrench lever, engine is rotated using the drive shaft adapter. Refer to the following table.

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1503 4-TEC Supercharged intercooled</td>
<td>Drive shaft adapter (P/N 529 035 885)</td>
</tr>
<tr>
<td>All other 1503 engines</td>
<td>Drive shaft adapter (P/N 529 035 892)</td>
</tr>
</tbody>
</table>

DRIVE SHAFT ADAPTER

PROCEDURE

Leak Test

Rotate engine counterclockwise until the cylinder no. 1 is at Top Dead Center (TDC) compression stroke.

NOTE: Cylinder numbers are molded on valve cover.

Protect the hull area then position the wrench lever so that it rests against hull to prevent further crankshaft rotation.

Install gauge adapter from the leak down tester (P/N 529 035 661) into spark plug hole.

Connect to adequate air supply.

NOTE: Each tester will have specific instruction on the gauge operation and required pressure. Refer to manufacturer's instructions.

Set needle of measuring gauge to zero.

Supply combustion chamber with air.
Section 03 ENGINE
Subsection 02 (ENGINE LEAK TEST)

Pay attention to the following checkpoints:
- clamp(s) tightened
- coolant hoses
- air/oil escaping from crankcase means damaged gasket(s) and/or loosened screws (refer to ENGINE BLOCK)
- air/water escaping from cylinder/head means damaged gasket(s) and/or loosened screws (refer to CYLINDER HEAD)
- oily contamination on leak indicator hole means a damaged oil seal on coolant pump shaft
- coolant escaping from leak indicator hole means a damaged rotary seal on coolant pump shaft (refer to COOLING SYSTEM)

Note the amount of leaking or percentage (depending on tester).

<table>
<thead>
<tr>
<th>LEAKAGE PERCENTAGE</th>
<th>ENGINE CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% to 15%</td>
<td>Excellent condition</td>
</tr>
<tr>
<td>16% to 25%</td>
<td>Good condition</td>
</tr>
<tr>
<td>26% to 40%</td>
<td>Fair condition, engine will run and performance might be down in some cases</td>
</tr>
<tr>
<td>41% and higher</td>
<td>Poor condition, diagnose and repair engine</td>
</tr>
</tbody>
</table>

Proceed the same way with remaining cylinders.

Diagnosis
Pressurize area to be tested, spray soap/water solution at the indicated location and look and/or listen for air bubbles.
- air escaping on intake port means leaking intake valve(s)
- air escaping on exhaust port means leaking exhaust valve(s)
- air bubbles out of coolant tank means leaking cylinder head gasket
- air escaping into crankcase means excessively worn and/or broken piston rings.

Possible Engine Leakage Area
Spray soap/water solution at the indicated location and look and/or listen for air bubbles.

Assembly
For assembly, reverse the preparation procedure. Use torque values and service products from the exploded views (refer to proper ENGINE sections).
Prior to inserting each ignition coil, apply some Molykote 111 (P/N 413 707 000) around the seal area that touches the spark plug hole. After installation, ensure the seal seats properly with the valve cover.
AIR INTAKE SYSTEM

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>hook tool</td>
<td>529 035 989</td>
<td>39</td>
</tr>
</tbody>
</table>

1503 4-TEC Naturally Aspirated Engines
Section 03 ENGINE
Subsection 03 (AIR INTAKE SYSTEM)

All 1503 4-TEC Supercharged Engines
INSPECTION
Check for water in air silencer no. 1. If so, replace check valves no. 2. Check collar tightness. Ensure there is no water trapped in tube no. 3 on supercharged engines. Inspect silencer, tube and hose condition. Replace any damaged part.

REMOVAL
From storage compartment, remove/disconnect:
- hose no. 4.
- rectifier/voltage regulator
- wiring harness from air silencer
- front access door (if so equipped)
- fuel tank straps (refer to FUEL SYSTEM) using hook tool (P/N 529 035 989).

Pull air silencer out.

All 1503 4-TEC Supercharged Engines
From engine compartment, remove/disconnect:
- vent tube
Section 03 ENGINE
Subsection 03 (AIR INTAKE SYSTEM)

- tube from air intake hose,
Pull tube out.

INSTALATION
Reverse removal operation order and pay attention to the following.
Ensure that tubes are well secured with hoses and there is a tight fit.

- coolant expansion tank

Step 1: Push tab on each side to release
Step 2: Pull tab out

- vent tube support

1. Vent tube support
2. Remove retaining screws
3. Pay attention to nuts underneath
# Section 03 ENGINE
Subsection 04 (INTAKE MANIFOLD AND INTERCOOLER)

## INTAKE MANIFOLD AND INTERCOOLER

### SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak test pump</td>
<td>529 021 800</td>
<td>51</td>
</tr>
</tbody>
</table>

### SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loctite 243</td>
<td>293 800 060</td>
<td>49</td>
</tr>
</tbody>
</table>
Naturally Aspirated Engine

- **10 N·m (89 lbf·in)**
- **6 N·m (53 lbf·in)**
- **10 N·m (89 lbf·in)**
- **10 N·m (89 lbf·in)**
- **6 N·m (53 lbf·in)**
- **18 N·m (159 lbf·in)**
- **10 N·m (89 lbf·in)**
Supercharged Engine

- Loctite 243
- Oil
- 10 N·m (89 lbf·in)
- 10 N·m (89 lbf·in)
- 6 N·m (53 lbf·in)
- 18 N·m (159 lbf·in)
- 6 N·m (53 lbf·in)
Supercharged Intercooled Engine

Oil

Loctite 243

6 N•m (53 lbf•in)
Loctite 243

10 N•m (89 lbf•in)
Loctite 243

10 N•m (89 lbf•in)
Loctite 243

6 N•m (53 lbf•in)
Loctite 243

18 N•m (159 lbf•in)

Oil

Oil
PROCEDURES

INTAKE MANIFOLD

Intake Manifold Removal
As necessary, remove: Seat, vent tube, coolant expansion tank and vent tube support.
Remove oil dipstick.
Pull fuel rail cover out.
Release the fuel pressure.
Disconnect battery cables from battery.

⚠ WARNING
Always disconnect battery cables exactly in the specified order, BLACK negative cable first then the RED positive battery cable last.

Disconnect fuel hose connector at fuel rail.

Step 1: Squeeze
Step 2: Pull out
1. Supporting tabs
2. Squeeze in middle of supporting tabs, hold and pull out

Cut locking ties where shown.

NATURALLY ASPIRATED ENGINE
1. Cut locking ties to release harness

SUPERCHARGED ENGINE
1. Cut locking ties to release harness

Unplug electrical connectors.
Naturally Aspirated Engine

1. Ignition coils
2. CPS
3. CAPS (hidden behind water hose)
4. CTS
5. TPS
6. Idle bypass valve
7. "B" Kostal connector
8. Engine connector
9. OPS
10. Magneto
11. KS

NOTE: The CAPS connector is hidden behind the water hose. Slightly pry locking tab of connector to unlock.

Supercharged Engines

1. Ignition coils
2. Idle bypass valve
3. KS
4. CPS
5. Magneto

All Engines

TYPICAL
1. CTS connector

TYPICAL
1. EGTS connector
Disconnect knock sensor (KS) and crankshaft position sensor (CPS) connectors.
Cut locking ties as necessary and pull wiring harness away from intake manifold.

**Naturally Aspirated Engine**
Loosen air intake silencer collar.
Unlock throttle cable housing from throttle body. Cable is to be detached later on.

Unplug the "B" connector from the ECM.

**Supercharged Engines**
Remove inlet hose from throttle body.
Disconnect throttle cable from throttle body.

Pull the connectors for the knock sensor (KS), crankshaft position sensor (CPS) and magneto out of the ECM support. For more details, refer to **ELECTRICAL CONNECTORS.**

**Supercharged Intercooled Engine**
Remove the hoses connected to the intercooler.
Section 03 ENGINE
Subsection 04 (INTAKE MANIFOLD AND INTERCOOLER)

All Engines
Remove manifold retaining screws and push the oil dipstick tube out of the manifold slot.

Lift intake manifold up to pull it out of the mounting brackets just enough to reach throttle cable end.

1. Hose from intercooler to exhaust manifold (outlet nipple)
2. Hose from jet pump

1. Mounting brackets

Naturally Aspirated Engine
Detach throttle cable end from throttle body.

1. Detach cable end from throttle body

All Engines
Pull intake manifold out.
NOTE: The flame arrester and the intercooler (if so equipped) in the intake manifold are maintenance free.

Intake Manifold Installation
Ensure that all gaskets are properly installed and in a good condition.

First, position intake manifold on front mounting bracket then push manifold toward engine to then proceed with rear mounting bracket.

When installing the intake manifold, lift up the oil dipstick tube a little bit to fit in the slot of the manifold.

1. Oil dipstick tube
Apply Loctite 243 (P/N 293 800 060) on the intake manifold screws. Torque them to 10 N·m (89 lbf·in) following the tightening sequence shown.

Ensure to properly route and resecure wiring harness with locking ties.

WARNING
Always check O-ring for damage such as deformation at reinstallation. Replace the O-ring if it is damaged.

When installing throttle cable, ensure cable is in the proper position of bracket and that cable barrel is in the proper position of throttle cam.
Section 03 ENGINE
Subsection 04 (INTAKE MANIFOLD AND INTERCOOLER)

INTERCOOLER

Supercharged Intercooled Engine

Intercooler Leak Test

Perform intercooler leak test when engine looses performance, when there is white exhaust smoke or when temperature in exhaust system is too high.

**WARNING**

Let engine cool down prior to perform leak test. Direct contact with hot engine may result in skin burn.

**NOTE:** The inspection can be done while intercooler remains installed in intake manifold.

Remove:
- outlet hose from exhaust manifold
- inlet hose from intercooler.

Supercharged Intecooled Engine

Make sure the outlet hose of the intercooler is installed in the holding device otherwise the hose will scuff on the engine block.

Readjust throttle cable and reset the TPS using the B.U.D.S. software. Refer to ENGINE MANAGEMENT.
**Section 03 ENGINE**

**Subsection 04 (INTAKE MANIFOLD AND INTERCOOLER)**

Intercooler Removal

Remove intake manifold.

Remove collar from intercooler.

Carefully pull intercooler out of intake manifold.

---

If there is a pressure drop, first spray hoses and adapters with a soapy solution to ensure they are not leaking.

Otherwise, remove intercooler from manifold to spray soapy water on it. If air bubbles are present, replace the intercooler. Refer to procedures farther in this section.

Properly reinstall removed parts.

Make sure the intercooler outlet hose is installed in the holding device otherwise the hose will scuff on the engine block.
Intercooler Installation

Installation is essentially the reverse of removal procedures. However, pay particular attention to the following.

Ensure profile rings are properly installed on intercooler and apply 4-stroke oil on them to ease installation.

While properly aligning the inner end of intercooler in intake manifold, gently push intercooler until it bottoms.

Rotate intercooler to position nipples as shown.

NOTE: If intercooler is hard to push in, a clamp can be used to press intercooler in.
## SUPERCHARGER

### SERVICE TOOLS

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<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
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</tr>
</thead>
<tbody>
<tr>
<td>4-pin socket</td>
<td>529 035 948</td>
<td>59, 61</td>
</tr>
<tr>
<td>camshaft locking tool</td>
<td>529 035 839</td>
<td>55</td>
</tr>
<tr>
<td>gear holder</td>
<td>529 036 025</td>
<td>64</td>
</tr>
<tr>
<td>retaining key</td>
<td>529 036 027</td>
<td>57–58, 63</td>
</tr>
<tr>
<td>support plate</td>
<td>529 035 947</td>
<td>60–61</td>
</tr>
<tr>
<td>support/pusher</td>
<td>529 035 950</td>
<td>60–61</td>
</tr>
<tr>
<td>Torx adapter</td>
<td>529 035 938</td>
<td>56, 65</td>
</tr>
</tbody>
</table>

### SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kluber Isoflex grease</td>
<td>293 550 021</td>
<td>63</td>
</tr>
<tr>
<td>Loctite 243</td>
<td>293 800 080</td>
<td>61–63, 65</td>
</tr>
<tr>
<td>Loctite 5910</td>
<td>293 800 081</td>
<td>63</td>
</tr>
<tr>
<td>Super Lube grease</td>
<td>293 550 030</td>
<td>64</td>
</tr>
</tbody>
</table>
Supercharged Engines

30 N•m (22 lbf•ft)
Loctite 243

Loctite 5910

30 N•m (22 lbf•ft)
Loctite 243

Isoflex grease
Topas NB S2

30 N•m (22 lbf•ft)

Loctite 243

30 N•m (22 lbf•ft)

10 N•m (89 lbf•in)
Antiseize lubricant

Oil

Oil
INSPECTION  
(supercharger installed)

Supercharger Inlet Cleanliness

NOTE: A lower than usual maximum RPM at full throttle might be caused by a dirty supercharger inlet.

Remove supercharger air inlet hose.

Remove supercharger and perform the clutch slipping moment test. Inspect bearings and friction clutch. Replace bearings/clutch components as necessary.

Separate supercharger housing.

NOTE: Since supercharger is disassembled, it is recommended to completely inspect it.

Clean internal housing and impeller using a brush and cleaning solvent to get rid of oil deposits.

Blow dry with compressed air.

CAUTION: Do not let impeller spin when using compressed air.

Complete usual assembly procedures as described in this section.

Supercharger Clutch Slipping Moment

As necessary, remove: seat, vent tube, coolant expansion tank and vent tube support.

Remove air inlet hose from supercharger.

Remove valve cover and install camshaft locking tool (P/N 529 035 839) to prevent camshaft rotation while checking slipping moment of supercharger. Refer to CYLINDER HEAD.

NOTE: Rotate supercharger nut to align camshaft holes and to allow insertion of the locking tool.
INSPECTION
(supercarachter installed)

Supercharger Inlet Cleanliness

NOTE: A lower than usual maximum RPM at full throttle might be caused by a dirty supercharger inlet.

Remove supercharger air inlet hose.

Remove supercharger and perform the clutch slipping moment test. Inspect bearings and friction clutch. Replace bearings/clutch components as necessary.

Separate supercharger housing.

NOTE: Since supercharger is disassembled, it is recommended to completely inspect it.

Clean internal housing and impeller using a brush and cleaning solvent to get rid of oil deposits.

Blow dry with compressed air.

CAUTION: Do not let impeller spin when using compressed air.

Complete usual assembly procedures as described in this section.

Supercharger Clutch Slipping Moment

As necessary, remove seat, vent tube, coolant expansion tank and vent tube support.

Remove air inlet hose from supercharger.

Remove valve cover and install camshaft locking tool (P/N 529 035 839) to prevent camshaft rotation while checking slipping moment of supercharger. Refer to CYLINDER HEAD.

NOTE: Rotate supercharger nut to align camshaft holes and to allow insertion of the locking tool.
If the torque is not within specifications, repair supercharger clutch. Verify supercharger clutch components as per INSPECTION (PARTS DISASSEMBLED) further in this section.

**REMOVAL**

As necessary, remove: seat, vent tube, coolant expansion tank and vent tube support.

Remove air inlet and outlet hoses from supercharger.

Remove retaining screws and pull out the supercharger.

---

**NOTE:** Before checking the supercharger slipping moment it is recommended to turn the clutch a full revolution. This way the parts can mate together and you will get a more accurate reading.

Supercharger should start to turn at a torque within the specified values.

<table>
<thead>
<tr>
<th>SLIPPING MOMENT</th>
<th>NEW SUPERCHARGER</th>
<th>BREAK-IN SUPERCHARGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>applied</td>
<td>7 - 12 N·m</td>
<td>5 - 10 N·m</td>
</tr>
<tr>
<td></td>
<td>(62 - 106 lbf·in)</td>
<td>(44 - 88 lbf·in)</td>
</tr>
</tbody>
</table>

**NOTE:** After supercharger ran for a few hours, the parts break-in and this brings a reduced slipping moment.

To remove the upper screw (not shown on the picture above), use the Torx adapter (P/N 529 035 938).
Section 03 ENGINE
Subsection 05 (SUPERCHARGER)

DISASSEMBLY

CAUTION: Be scrupulous when working on supercharger parts. Supercharger rotation reaches 45 000 RPM. Any modification, improper repair/assembly or damage on the parts, may result in damage of the supercharger. Strictly follow the described procedures.

Take apart supercharger housing.

1. Retaining screws
2. Housing half (intake side)
3. Housing half (engine side)

NOTE: The cap nut on the supercharger shaft has LH threads.
Loosen cap nut (turn clockwise) on supercharger shaft turbine side while holding shaft with a retaining key (P/N 529 036 027).

Remove washer, turbine, O-ring and step collar from supercharger shaft.
Loosen nut on supercharger shaft engine side while holding shaft with a retaining key (P/N 529 036 027).

Carefully push out supercharger shaft towards engine side by using a press.

CAUTION: Every time when removing the supercharger shaft, both ball bearings have to be replaced.

Remove ball bearing from supercharger shaft by using a press and retaining key (P/N 529 036 027).

NOTE: There are 40 loose needle bearings under the gear. Do not reuse.

Remove L-ring, spring washers, lock washer, drive gear and needle pins by turning the supercharger upside down.
Section 03 ENGINE
Subsection 05 (SUPERCHARGER)

PARTS INSPECTION

Supercharger Clutch Components and Gear

Replace worn parts by new ones. A clutch repair kit is available. If all parts are within specifications, replace the 40 needle bearings and spring washer package on supercharger shaft.

NOTE: Ceramic washers are not affected by wear. Check the wear limit on drive gear, lock washer and driven plate on supercharger shaft. Check drive gear for cracks.

<table>
<thead>
<tr>
<th>DRIVEN PLATE JOURNAL DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
</tr>
<tr>
<td>12.460 mm (0.4905 in)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
</tr>
<tr>
<td>12.500 mm (0.4921 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
<tr>
<td>12.800 mm (0.5039 in)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRIVE GEAR THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
</tr>
<tr>
<td>11.000 mm (.4331 in)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
</tr>
<tr>
<td>11.050 mm (.4350 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
<tr>
<td>10.700 mm (.4251 in)</td>
</tr>
</tbody>
</table>
Section 03 ENGINE
Subsection 05 (SUPERCHARGER)

<table>
<thead>
<tr>
<th>LOCK WASHER THICKNESS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
<td>4.050 mm (.1594 in)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
<td>4.150 mm (.1633 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>3.800 mm (.1496 in)</td>
</tr>
</tbody>
</table>

Spring Washer
Put spring washer package together as it is assembled on the supercharger shaft. Measure the height of the unloaded spring washer package.

<table>
<thead>
<tr>
<th>SPRING WASHER PACKAGE HEIGHT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW</td>
<td>10.500 mm (.4134 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>9.700 mm (.3819 in)</td>
</tr>
</tbody>
</table>

ASSEMBLY
Assembly is essentially the reverse of removal procedures. However pay particular attention to the following.

CAUTION: Every time when supercharger shaft has been removed, both ball bearings have to be replaced.

CAUTION: Both ball bearings have to be installed with cages facing supercharger impeller side.

Apply enough engine oil on ball bearing. Install ball bearing on supercharger shaft by using support plate (P/N 529 035 947) to hold bearing.

CAUTION: Ensure to position ball bearing against protrusion of support plate for the installation. This way, the installation pressure will be applied to the inner race and will not be transmitted to the bearing balls which would otherwise shorten the bearing life.

CAUTION: To install ball bearings and supercharger shaft always use a press, never use any beating force like a hammer.

Apply enough engine oil on ball bearing. Press in the ball bearing in supercharger housing half (engine side), by using ball bearing support/pusher (P/N 529 035 950).
Section 03 ENGINE
Subsection 05 (SUPERCHARGER)

1. Bearing support/pusher

Mount supercharger housing half (engine side) on support plate (P/N 529 035 947).

1. Retaining disc;
2. 4-pin socket

To press supercharger shaft in housing half (engine side), properly support bearing, using support plate (P/N 529 035 947) and bearing support/pusher (P/N 529 035 950) under supercharger housing half.

Apply Loctite 243 (P/N 293 800 060) on retaining disc and install it in supercharger housing half by using the 4-pin socket (P/N 529 035 948). Torque to 30 N•m (22 lbf•ft).

NOTE: If a new disc is installed, do not use any Loctite, threadlocker is already applied.

1. Support plate
2. Bearing support/pusher
3. Projection here

CAUTION: Before pressing in the supercharger shaft, be sure to properly support the inner race of ball bearing in supercharger housing half with the recommended tool. This way, the installation pressure will be applied to the inner race and will not be transmitted to the bearing balls which would otherwise shorten the bearing life.
Apply heat outside of the housing with a heat gun to expand its diameter prior to inserting the shaft. Ensure there is no O-ring on the housing half prior to heating.

Apply engine oil on supercharger shaft. Press shaft with thrust washer and distance sleeve together in supercharger housing half.

Install step collar, O-ring, supercharger impeller and washer on supercharger shaft. Apply Loctite 243 (P/N 293 800 060) on cap nut and temporary finger tight cap nut.

NOTE: The cap nut on the supercharger shaft has a left-handed thread. The Loctite has to be applied in a small dose into the nut.

Complete installation of supercharger shaft, engine side as follows:

CAUTION: It is of the utmost importance that all parts be absolutely clean. The compressor shaft spins at up to 45 000 RPM and any debris could cause a failure.

Install the first ceramic washer.

NOTE: The ceramic washers differ in their inner diameter. Install first the ceramic washer with the bigger inner diameter. The ceramic washer with the smaller inner diameter will be installed on the lock washer side.

CAUTION: Manipulate ceramic washers with care, those parts are fragile.
IMPORTANT: Apply Kluber Isoflex grease (P/N 293 550 021) to the inner diameter of the gear thrust surface on the shaft, ceramic washers, needle bearings shaft surface and lock washer.

CAUTION: No other grease can be used, otherwise damage to bearings will occur.

Install the 40 needle bearings on the compressor shaft.

NOTE: The 40 needle bearings comes in a wax strip with an adhesive backing.

Remove the adhesive backing.

Install the drive gear over the needle bearings.

Install the other ceramic washer (ceramic washer with smaller inner diameter).

Install the lock washer.

Apply engine oil to the spring washers.

Position the spring washers as per illustration.

CAUTION: When installing the spring washers, take care of the exact installation direction of the washers.

Hold the lock washer of the supercharger shaft (engine side) using the retaining key (P/N 529 036 027).

Tighten the impeller cap nut to 30 N·m (22 lbf·ft).

Apply LocTite 5910 (P/N 293 800 081) on supercharger housing sealing surface.

Assemble supercharger housing halves. Apply LocTite 243 (P/N 293 800 060) on retaining screws and torque to 10 N·m (89 lbf·in) according to the following sequence.
Section 03 ENGINE
Subsection 05 (SUPERCHARGER)

SUPERCHARGER TIGHTENING SEQUENCE

Use gear holder (P/N 529 035 025) to retain supercharger gear while measuring slipping moment.

Check slipping moment counterclockwise by using a torque wrench with a viewer.

NOTE: Before checking the supercharger slipping moment it is recommended to turn the clutch a full revolution. This way the parts can mate together and you will get a more accurate reading. Supercharger should start to turn at a torque within the specified values.

<table>
<thead>
<tr>
<th>SLIPPING MOMENT</th>
<th>NEW SUPERCHARGER</th>
<th>BREAK-IN SUPERCHARGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque value applied</td>
<td>7 - 12 N•m (62 - 106 lb•in)</td>
<td>5 - 10 N•m (44 - 88 lb•in)</td>
</tr>
</tbody>
</table>

NOTE: After supercharger ran for a few hours, the parts break-in and this brings a reduced slipping moment.

If the torque is not within specifications, check single components of supercharger clutch.

INSTALLATION

Sealing surface between supercharger and PTO housing has to be greased with Super Lube grease (P/N 293 550 030).
Lubricate bearings with engine oil before installation of supercharger in PTO housing.

Install supercharger on PTO housing. Apply Loc-tite 243 (P/N 293 800 060) on the retaining screws. Torque screws to 10 N•m (89 lbf•in).

To tighten and torque the upper screw, use the Torx adapter (P/N 529 035 938).

Ensure to install the tool perpendicularly (90°) to torque wrench to apply the proper torque to the screw.

CAUTION: Not installing the tool as shown will change the torque applied to the screw. Proper torque and tightening sequence are important. After complete installation of the supercharger, the slipping moment has to be rechecked. Refer to INSPECTION (SUPERCHARGER INSTALLED) at the beginning of this section.
# EXHAUST SYSTEM

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>flushing connector adaptor</td>
<td>295 500 473</td>
<td>72</td>
</tr>
<tr>
<td>small hose pincher</td>
<td>295 000 076</td>
<td>73</td>
</tr>
<tr>
<td>spring installer/remover</td>
<td>529 035 989</td>
<td>74</td>
</tr>
</tbody>
</table>

## SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>high temperature RTV sealant</td>
<td>293 800 090</td>
<td>75</td>
</tr>
<tr>
<td>Loctite 518</td>
<td>293 800 038</td>
<td>77</td>
</tr>
<tr>
<td>Loctite silicone sealant (clear)</td>
<td>293 800 086</td>
<td>79</td>
</tr>
</tbody>
</table>
GENERAL

EXHAUST SYSTEM COOLING

Water Flow in the Exhaust System

*GTI 4-TEC, GTX 4-TEC and WAKE*

**GTX 4-TEC Supercharged**
Section 03 ENGINE
Subsection 06 (EXHAUST SYSTEM)

GTX 4-TEC Limited and RXT

RXP
Overview
The exhaust system is protected by its own cooling system, an opened loop type.
The water supply is provided by a pressurized area in the jet pump between the impeller and venturi.
The water flow is controlled by a reducer located between the jet pump support and the jet pump on the inlet side. The reducer is color coded according to watercraft model. Refer to JET PUMP.
Water is directed first through the intercooler or to the exhaust manifold fitting located at front of manifold for the models without intercooler.

Water enters the manifold end and is directed to water jackets of exhaust manifold.
Water exits exhaust manifold through 2 hoses at rear manifold.

TYPICAL — MODELS WITHOUT INTERCOOLER
1. Exhaust manifold
2. Water inlet
3. Water outlet

TYPICAL — MODELS WITH INTERCOOLER
1. Intercorder
2. Water inlet
3. Towards exhaust manifold
4. Exhaust manifold
5. Water inlet (from intercooler)
6. Water outlet

TYPICAL
1. Water coming from exhaust manifold
2. Exhaust pipe
3. Bleed hose

Water enters exhaust pipe and flows in the water jacket of pipe.

TYPICAL
1. Exhaust pipe
2. Outlet holes of exhaust pipe
3. Muffler
Section 03 ENGINE
Subsection 06 (EXHAUST SYSTEM)

Bleeding of the exhaust system is accomplished by the bleed hose located at the uppermost point of the circuit of the exhaust pipe.
Water exits exhaust pipe through holes at the end of the water packet and mixes with exhaust gas in the muffler.
Water is expelled from mufflers then through the exhaust outlet in transom area.

Technical Specifications

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Total Loss Cooling System (TLCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER FLOW</td>
<td>Flow from jet pump (no water pump)</td>
</tr>
<tr>
<td>TEMPERATURE CONTROL</td>
<td>Calibrated outlet fittings (no thermostat)</td>
</tr>
<tr>
<td>SYSTEM BLEEDING</td>
<td>Self-bleed type (hose at uppermost point of circuit)</td>
</tr>
<tr>
<td>SYSTEM DRAINING</td>
<td>Self-drain type (hose at lowest point of circuit)</td>
</tr>
</tbody>
</table>

MAINTENANCE

EXHAUST SYSTEM FLUSHING

Flushing the exhaust system with fresh water is essential to neutralize corroding effects of salt or other chemical products present in water. It will help to clean up sand, salt, shells or other particles in water jackets (exhaust system and intercooler (if so equipped)) and/or hoses.
Exhaust system flushing should be performed when the watercraft is not expected to be used further the same day or when the watercraft is stored for any extended time.

CAUTION: Failure to flush the system, when necessary, will severely damage engine intercooler and/or exhaust system. Make sure engine operates during entire procedure.

WARNING

Perform these operations in a well ventilated area. Certain components in the engine compartment may be very hot. Direct contact may result in skin burn. Do not touch any electrical part or jet pump area when engine is running.

WARNING

When operating the engine while the watercraft is out of the water, the heat exchanger in the ride plate may become very hot. Avoid any contact with ride plate as burns may occur.

Procedure Using Flushing Connector on Jet Pump Support

Connect a garden hose to connector located at the rear of watercraft on jet pump support. Do not open water tap yet.

NOTE: The optional flushing connector adaptor (P/N 295 500 473) can be used with a quick connect adapter to ease garden hose installation.

![Flushing Connector](image)

1. Quick connect adapter
2. Flushing connector adapter

TYPICAL

1. Flushing connector
2. Quick connect adapter and flushing connector adapter (optional)
3. Garden hose

To flush the exhaust system, start the engine then immediately open the water tap.

CAUTION: Always start the engine before opening the water tap. Open water tap immediately after engine is started to prevent overheating.

CAUTION: Never run engine without supplying water to the exhaust system when watercraft is out of water.
Run the engine about 20 seconds at a fast idle between 4000 - 5000 RPM.

**CAUTION:** Never run engine longer than 2 minutes. Drive line seal has no cooling when watercraft is out of water.

Ensure water flows out of jet pump while flushing.

Close the water tap, then stop the engine.

**CAUTION:** Always close the water tap before stopping the engine.

Disconnect the garden hose.

**CAUTION:** Remove flushing connector adapter after operation (if used).

**Procedure Using Flushing Connector in Engine Compartment**

**GTX Limited Models**

This flushing connector allows to flush the exhaust system directly by the engine compartment. The access is easier than the connector on the jet pump support but requires the use of a small hose pincher.

Remove seat to gain access.

Remove dust cap from flushing connector and attach coupler hose (supplied with vehicle). Make sure coupler hose is properly locked to flushing connector.

Install a small hose pincher (P/N 295 000 076) (supplied inside vehicle tool kit) on water outlet hose. This prevent water from directly existing exhaust cooling system.

![Diagram of flushing connector](image)

1. Coupler hose
2. Small hose pincher

Attach other end of coupler hose to a garden hose. Do not open water tap yet.

To flush the exhaust cooling system, start the engine then immediately open the water tap.

**CAUTION:** Always start the engine before opening the water tap. Open water tap immediately after engine is started to prevent overheating.

**CAUTION:** Never run engine without supplying water to the exhaust system when watercraft is out of water.

Run the engine about 20 seconds at a fast idle between 4000 - 5000 RPM.

**CAUTION:** Never run engine longer than 2 minutes. Drive line seal has no cooling when watercraft is out of water.

Ensure water flows out of jet pump while flushing.

Close the water tap, then stop the engine.
CAUTION: Always close the water tap before stopping the engine.
Unlock and remove coupler hose. Reinstall dust cap over flushing connector.
Remove hose pincher from water outlet hose.
CAUTION: Serious damage to exhaust system can occur if hose pincher is not removed.

PROCEDURES

EXHAUST PIPE

Removal

**WARNING**

Certain components in the engine compartment may be very hot. Direct contact may result in skin burn. Let exhaust system cool down prior to removing parts.

**All Models except RXP**

Remove seat and seat extension.
Remove seat support (if so equipped).

**RXP Models**

Remove seat.
Remove engine cover. Refer to HULL AND BODY.

**All Models**

Disconnect the 3 cooling hoses from exhaust pipe no. 1.

Loosen the clamps no. 2 to the top portion of the muffler hose no. 3 between muffler no. 4 and the exhaust pipe no. 1.

Detach the strap no. 5 from the muffler using the spring installer/remover (P/N 529 035 989).
Section 03 ENGINE
Subsection 06 (EXHAUST SYSTEM)

Installation
Installation is essentially the reverse of the removal procedures. However, pay particular attention to the following.

Apply high temperature RTV sealant (P/N 293 800 090) on the welds of the exhaust pipe straight end, while the exhaust pipe is removed from the muffler.

Loosely install clamps no. 2 on muffler hose no. 3. Insert the exhaust pipe straight end in the muffler hose. Align the exhaust pipe flange to the engine manifold no. 7.

NOTE: To achieve a good fit, it could be necessary to push the exhaust pipe straight end further down into the muffler hose over its step. Note distance if pushed over step, then cut hose by obtained measure.

Prealign the exhaust pipe no. 1 by rotating (axially) and moving (longitudinally) the muffler so that the exhaust pipe flange makes perfect contact with the engine manifold.

Inspection
Inspect exhaust pipe condition paying attention for cracks or other damage. Check joints, coupling areas, heat shield and hoses. Replace any defective part.
Finalize alignment by rotating (axially) and moving (longitudinally) the muffler so that the exhaust pipe flange makes perfect contact with the engine manifold. A maximum gap of 0.5 mm (1/64 in) is allowed.

Torque the exhaust clamp no. 6 to 11 N·m (97 lbf·in) while firmly maintaining the exhaust pipe in the proper position.

Apply a soapy solution on inner side of muffler strap no. 5 to prevent muffler rotation at strap installation.

Reinstall muffler strap using the spring installer/remover (P/N 529 035 989). Care must be taken not to induce any rotation of the muffler.

Tighten the bottom clamp of the inlet hose no. 8. Care must be taken not to induce strain on hose to avoid muffler movement.
Reconnect cooling hoses to the exhaust pipe and torque clamps to 8 N·m (71 lbf·in).

After installation, ensure there is no water or exhaust gas leak when engine is running. Test run the engine while supplying water to the flushing connector.

CAUTION: Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.

EXHAUST MANIFOLD

Removal

Disconnect the cooling hoses from the exhaust pipe no. 1.

Remove the exhaust clamp no. 6 and detach the muffler from its support. Move the muffler no. 4 rearwards to separate the exhaust pipe from the manifold. See above in EXHAUST PIPE.

Disconnect the cooling system supply hose underneath the front part of the exhaust manifold no. 7.

NOTE: On inter-cooled engines, the hose comes from the intercooler.

1. Exhaust manifold
2. Cooling system supply hose location

Unscrew the exhaust manifold beginning with the bottom screws. This will help holding the manifold while you remove the screws.

Remove the manifold and move it out toward the front of the watercraft to withdraw.

NOTE: On RXP models, move the manifold rearwards to remove it from vehicle.

Inspection

Inspect exhaust manifold condition paying attention for cracks or other damage. Check contact surfaces and hose. Replace any defective part.

Inspect plane surfaces for warpage. Small deformation can be corrected by grinding surface with a fine sand paper. Install sand paper on a surface plate and rub part against oiled sand paper.

Clean all metal components in a solvent.

Installation

Installation is essentially the reverse of removal procedures. However, pay particular attention to the following.

NOTE: There is no gasket between cylinder block and exhaust manifold.

Apply Loctite 518 (P/N 293 800 038) on threads of screws.

To help holding the manifold while installing screws, first insert the exhaust manifold into the exhaust pipe no. 1 then, install the upper front screw. Continue with the remaining screws.

Torque screws to 10 N·m (89 lbf·in) as per following illustrated sequence. Repeat the procedure, torquing screws again to 10 N·m (89 lbf·in).
**RESONATOR**

**Removal**

**RXP Models**
Remove supercharger inlet hose.
Disconnect speed sensor connector.
Remove VTS. Refer to **VARIABLE TRIM SYSTEM**.

**All Models**
Disconnect inlet hose no. 8.
Remove dart or screw no. 9 retaining resonator no. 11.
Disconnect outlet hose no. 10 from resonator.

After installation, ensure there is no coolant or exhaust gas leak when the engine is running. Test run the engine while supplying water to the flushing connector.

**CAUTION:** Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.

**MUFFLER**

**Removal**
Remove the exhaust pipe no. 1. See above.
Disconnect the temperature sensor connector.
Disconnect the inlet hose no. 8 then pull muffler no. 4 out of vehicle.

**Inspection**
Inspect parts condition paying attention for cracks or other damage. Check hoses. Replace any defective part.

**Installation**
Installation is the reverse of the removal procedures.
After installation, ensure there is no coolant or exhaust gas leak when the engine is running. Test run the engine while supplying water to the flushing connector.

**CAUTION:** Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.

**VEHICLES WITH A DART**
1. Inlet hose
2. Dart
3. Outlet hose

**VEHICLES WITH A SCREW**
1. Inlet hose
2. Retaining screw
3. Outlet hose

Carefully pull out the resonator no. 11.
| Inspection  
Inspect parts condition paying attention for deformation, cracks or other damage. Check hoses. Replace any defective part.  
| Installation  
Installation is the reverse of the removal procedures.  
For resonator installation, remove outlet hose no. 10 from exhaust outlet no. 12.  
Install outlet hose on resonator.  
Install resonator in position while inserting outlet hose no. 10 on exhaust outlet.  
After installation, ensure there is no coolant or exhaust gas leak when the engine is running. Test run the engine while supplying water to the flushing connector.  
**CAUTION:** Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.  
| EXHAUST OUTLET  
Removal  
Remove resonator retaining dart or screw no. 9.  
Move resonator forward and disconnect outlet hose no. 10 from exhaust outlet no. 12.  
Remove the jet pump as an assembly from pump support. Refer to PROPULSION SYSTEM.  
From outside of hull, unscrew nut using a suitable tool.  
| From inside the bilge, remove exhaust outlet.  
Inspection  
Inspect parts condition paying attention for cracks or other damage. Check hose. Replace any defective part.  
Installation  
Installation is essentially the reverse of the removal procedures. However, pay particular attention to the following.  
Apply Loctite silicone sealant (clear) (P/N 293 800 066) on the gasket no. 14 to seal the bilge.  
Test the bilge for water leaks.  

# PTO HOUSING AND MAGNETO

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>fitting</td>
<td>293 710 037</td>
<td>83</td>
</tr>
<tr>
<td>impeller remover/installer</td>
<td>529 035 820</td>
<td>86</td>
</tr>
<tr>
<td>syphon pump</td>
<td>529 035 880</td>
<td>83</td>
</tr>
</tbody>
</table>

## SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoflex Topas NB52 grease</td>
<td>293 550 021</td>
<td>90</td>
</tr>
<tr>
<td>Loctite 243</td>
<td>293 800 060</td>
<td>83, 86, 88–89</td>
</tr>
<tr>
<td>Loctite 648</td>
<td>413 711 400</td>
<td>91</td>
</tr>
<tr>
<td>Loctite anti-seize</td>
<td>293 800 070</td>
<td>87</td>
</tr>
<tr>
<td>pulley flange cleaner</td>
<td>413 711 809</td>
<td>83–84, 86</td>
</tr>
</tbody>
</table>
Section 03 ENGINE
Subsection 07 (PTO HOUSING AND MAGNETO)

GENERAL
Always perform the electric tests before removing or installing any components.
During assembly, use torque values and service products as in the exploded view.
Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

WARNING
Torque wrench tightening specifications must strictly adhered to.
Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

PROCEDURES
PTO HOUSING
Removal
Drain engine oil. Refer to LUBRICATION SYSTEM.
Drain oil from PTO housing using one of the following procedures:

Procedure for Removing Oil in PTO Housing Through the Scavenge Oil Pump Cover
- Remove the scavenge oil pump cover drain plug.

- Install tool fitting (P/N 293 710 037).

- Connect the syphon pump (P/N 529 035 880) to the fitting.

- The front of the engine must be tilted down approximately 15 degrees to facilitate the removal of the oil. Raise the rear of the watercraft accordingly. Siphon the oil from the fitting.
- When done, remove the syphon pump and the fitting. Apply Loctite 243 (P/N 293 800 060) and reinstall the drain plug.

NOTE: If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

Procedure for Removing Oil in the PTO Housing through the Timing Chain Area
As an alternate method, the oil located in the PTO housing can be syphoned through the timing chain area.
- Remove the valve cover. Refer to CYLINDER HEAD section.
- Using the syphon pump (P/N 529 035 880), insert the tube in the lower area of the timing chain. Syphon the oil.
PTO Housing Removal
Place rags under PTO housing to prevent spillage. Up to 250 mL (8 oz) of oil could flow out when removing PTO housing. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains. Disconnect CPS and magneto from wiring harness.

⚠️ WARNING
Always disconnect battery or starter cables exactly in the specified order, BLACK negative cable first. Disconnect electrical connections prior to disconnecting fuel lines.

Slightly lift rear part of engine and safely block in this position. Remove rear LH side engine support no. 1.

- water pump housing no. 2 (refer to COOLING SYSTEM)
- unplug CPS connector
- screws no. 3 and no. 4

NOTE: Carefully separate the PTO housing from the engine using two flat screwdrivers prying equally at the same time. Proceed slowly so that starter gear disc springs no. 6 and washer no. 7 do not fall down.
- PTO housing no. 5

CAUTION: Ensure to use prying lugs to separate PTO housing to prevent damaging contact surface.

- gasket no. 9.
Section 03 ENGINE
Subsection 07 (PTO HOUSING AND MAGNETO)

Inspection
Check PTO housing for cracks or other damages. Replace if necessary.

Installation
NOTE: Clean all metal component in a non-ferrous metal cleaner.

⚠️ WARNING
Wear safety glasses and work in a well-ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

For installation, reverse the removal procedure. However, pay attention to the following.

NOTE: Turn the oil/water pump shaft in the right position to fit into the balance shaft.

Position the disc springs no. 6 and washer no. 7 as per the following illustration.

1. Pay attention that gasket remains properly positioned on this surface

Refer to the following illustration for proper installation of screws.

NOTE: When installing a new starter drive ass’y, oil the shaft and threads of the gear with engine oil.

CAUTION: Ensure the starter drive gear shaft is well engaged in its bore.

Gently install PTO housing.

CAUTION: While installing housing, pay particular attention that gasket does not get pinched or slide out of its contact surface in the area shown in the following illustration. Never force to install cover. If there is a strong resistance, remove housing and check oil/water pump alignment and starter gear alignment.

TYPICAL
1. Washer
2. Disc spring
3. Starter drive ass’y

TYPICAL
1. Screws M6 x 35
2. Screws M6 x 85

Tightening sequence for screws on PTO housing is as per following illustration.
Reinstall LH engine support. Apply Loctite 243 (P/N 293 800 060) on screw threads then torque to 24 N•m (17 lbf•ft).

Remove block under engine.

Refill engine with oil and cooling system with coolant. Refer to LUBRICATION SYSTEM and COOLING SYSTEM sections.

**PTO SEAL**

**Inspection**

Check the PTO seal no. 22 and O-rings no. 10 on the PTO housing. If brittle, hard or damaged, or if you see a sign of oil leakage, replace it.

**Removal**

Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

Remove:
- Oetiker clamp no. 11 located close to the PTO housing
- PTO seal no. 22.

**Installation**

Reinstall removed parts in the reverse order.

**CAUTION:** When installing PTO seal on supercharged engines, make sure to position the Oetiker clamps as shown in the picture.

**COUPLING**

**Removal**

Lock crankshaft. Refer to CYLINDER BLOCK section for procedure.

Remove:
- PTO seal as described above
- coupling no. 12 using impeller remover/installer (P/N 529 035 820).

**NOTE:** PTO coupling has right hand thread.
CAUTION: Apply some oil on the tool to protect the seal located in the PTO coupling.

Inspection
Check if seal no. 13 is brittle, cracked or hard. Check coupling for worn splines. If damaged, replace faulty part.

Installation
For installation, reverse the removal procedure. However, pay attention to the following:
Torque PTO coupling to 250 N•m (184 lbf•ft). Apply Loctite anti-seize (P/N 293 800 070) on threads.

STATOR
Removal
Remove:
- PTO housing (see procedure in this section)
Section 03 ENGINE
Subsection 07 (PTO HOUSING AND MAGNETO)

Installation
For installation, reverse the removal procedure. However, pay attention to the following.
NOTE: There is only one position for the stator (notch in the magneto housing cover).

TYPICAL
1. Stator screws
2. Stator

TYPICAL
1. Grommet on stator cable

Apply Loctite 243 (P/N 293 800 060) on threads. Torque stator and CPS screws to 10 Nm (88 lbf•in).

ROTOR AND TRIGGER WHEEL

Removal
Lock crankshaft. Refer to CYLINDER BLOCK section for procedure.
Remove:
- PTO housing
- hexagonal screws no. 18 retaining rotor.
Withdraw rotor no. 19 with trigger wheel no. 20.

TYPICAL
1. Notch for stator

Place the rubber grommet in the proper notch at the PTO housing.

TYPICAL
1. Hexagonal screws
2. Rotor
3. Trigger wheel

Inspection
Check rotor, bent teeth and trigger wheel condition. If damaged, replace faulty part.
To check the trigger wheel for bent teeth, proceed as follows.

Install a dial indicator on crankcase casting. Position the gauge on a tooth and set it to zero (0). Rotate flywheel and check needle movement. The maximum allowed difference between teeth is 0.15 mm (.006 in). Otherwise, straighten the tooth or replace the trigger wheel.

Properly reinstall cover.

Installation

For installation, reverse the removal procedure. However, pay attention to the following.

Trigger wheel position has to be located with the location pin on the crankshaft gear.

NOTE: Do not reuse rotor screws no. 18, replace all 6 screws. These are stretch screws. Not following this procedure could lead to engine failure.

Apply Loctite 243 (P/N 293 800 060) on threads. Torque rotor screws to 15 N•m (133 lb•ft) in a crisscross sequence.

CAUTION: Always use new OEM screws.
Finish tightening screws with an additional 50° rotation with a torque angle gauge.

RING GEAR

Removal

Lock crankshaft. Refer to CYLINDER BLOCK section for procedure.

Remove:
- PTO housing cover

- hexagonal screws no. 18.
Withdraw rotor no. 19, trigger wheel no. 20 and ring gear no. 21.

Inspection

Check ring gear condition, especially teeth condition. If damaged, replace faulty part.

Installation

For installation, reverse the removal procedure. However, pay attention to the following.

Ring gear and trigger wheel position has to be located with the location pin on the crankshaft gear.

Apply Loctite 243 (P/N 293 800 060) on threads. Torque rotor screws to 24 N•m (17 lb•ft).
STARTER DRIVE

Removal
Remove:
- PTO housing and ring gear as described above
- starter drive ass'y no. 8.

Installation
For installation, reverse the removal procedure. However, pay attention to the following.

NOTE: When installing a new starter drive ass'y, oil the shaft and threads of the gear with engine oil.

Apply some Isoflex Topas NB52 grease (P/N 293550021) on the starter drive bearing located in the cylinder block and on the starter drive support in the PTO housing cover.

CAUTION: Be careful not to lose the distance washer, disc springs no. 6 and washer no. 7 located on the starter drive shaft.

Inspection
Check condition of the teeth, shaft, etc. and if the sprag clutch operates well. If damaged, replace faulty part.
OIL SPRAY NOZZLE
Supercharged Engines Only

Removal
Remove the PTO housing as described above:
- Turn oil spray nozzle no. 23 by using a grip plier to crack the Loctite.
**CAUTION:** Do not try to pull out the oil spray nozzle with a plier. This may damage the force fit in the PTO housing.
- Fix supercharger spray nozzle remover tight on oil spray nozzle.
- Remove oil spray nozzle carefully by using a slide hammer puller.

Installation
For installation, reverse the removal procedure. However, pay attention to the following.
Apply Loctite 648 (P/N 413 711 400) on oil spray nozzle fitting surface.
**CAUTION:** The oil spray nozzle must be in exact position to supply enough oil to the supercharger. Any other installation will lead to a supercharger damage.
Only use supercharger spray nozzle installer to push in the nozzle no. 23. Use retaining screw hole to ensure the exact position.
## LUBRICATION SYSTEM

### SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>hose adaptor</td>
<td>529 035 652</td>
<td>98</td>
</tr>
<tr>
<td>oil filter cover puller</td>
<td>529 036 057</td>
<td>97</td>
</tr>
<tr>
<td>oil filter cover separator</td>
<td>529 036 038</td>
<td>97</td>
</tr>
<tr>
<td>oil pressure gauge</td>
<td>529 035 709</td>
<td>98</td>
</tr>
<tr>
<td>oil seal guide</td>
<td>529 035 822</td>
<td>105</td>
</tr>
<tr>
<td>rotary seal pusher</td>
<td>529 035 823</td>
<td>105</td>
</tr>
<tr>
<td>suction pump</td>
<td>529 035 880</td>
<td>97</td>
</tr>
</tbody>
</table>

### SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loctite 243</td>
<td>293 800 060</td>
<td>101–102, 106, 108, 110–111</td>
</tr>
<tr>
<td>pulley flange cleaner</td>
<td>413 711 809</td>
<td>97, 100, 106</td>
</tr>
<tr>
<td>Super Lube grease</td>
<td>293 600 016</td>
<td>98</td>
</tr>
</tbody>
</table>
MAINTENANCE

OIL LEVEL VERIFICATION

CAUTION: Check level frequently and refill if necessary. Do not overfill - it would make the engine smoke and reduce its power. Operating the engine with an improper level may severely damage engine. Wipe off any spillage.

Check the oil level as follows:

NOTE: It is of the utmost importance to follow this procedure in order to obtain an accurate reading of the engine oil level.

- Watercraft must be level. Check oil level either with watercraft in water or out of water. Engine should be warm.

CAUTION: Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.

- If out of water, raise trailer tongue and block in position when bumper rail is level. Link a garden hose to the hose adapter. Refer to STORAGE PROCEDURES in MAINTENANCE section and follow the procedures.

CAUTION: Failure to flush exhaust cooling system, when watercraft is out of water, may severely damage engine and/or exhaust system.

- Warm-up engine then let idle for 30 seconds before stopping.
- Stop engine.
- Wait at least 30 seconds then pull dipstick out and wipe clean.

WARNING

Engine oil may be hot. Certain components in the engine compartment may be very hot. Direct contact may result in skin burn.

CAUTION: Never run engine longer than 5 minutes. Drive line seal has no cooling when watercraft is out of water.

- Reinstall dipstick, push in completely.
- Remove dipstick and read oil level. It should be between marks.

OLI CHANGE

Oil and oil filter must be replaced at the same time. Oil change and oil filter replacement should be done with a warm engine.

Oil Draining

NOTE: If water is found in oil (oil will be milky), refer to SPECIAL PROCEDURES in MAINTENANCE section and follow the procedure to flush it.
Bring engine to its normal operating temperature.

**CAUTION:** Never run engine without supplying water to the exhaust system when watercraft is out of water.

**CAUTION:** Failure to cool exhaust system, when engine is out of water, may severely damage exhaust system.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil may be hot. Certain components in the engine compartment may be very hot. Direct contact may result in skin burn.</td>
</tr>
</tbody>
</table>

**CAUTION:** Never run engine longer than 5 minutes. Drive line seal has no cooling when watercraft is out of water.

Run engine for 10 seconds at 4000 RPM and shut it off at this RPM. This will move oil from PTO housing to oil tank to allow maximum oil draining.

Remove oil filler cap and dipstick.

Using the suction pump (P/N 529 035 880), siphon oil through dipstick hole.

**CAUTION:** Never crank or start engine when siphon tube is in dipstick hole. Never start engine when there is no oil in engine.

**NOTE:** So that siphon tube is located at the proper height to siphon oil, it is suggested to put some electrical tape on siphon tube at 475 mm (18.7 in) from its end. Then, insert siphon tube until you reach the tape.

Pull siphon tube out of dipstick hole then crank engine (do not start) while in engine drown mode (fully depress throttle lever and HOLD, then crank engine).

Crank engine for 10 seconds. Siphon oil again. Repeat the crank-siphon cycle 2 - 3 times.

**OIL FILLING**

Refill engine with oil meeting the specific requirements of the engine. Refer to **TECHNICAL SPECIFICATIONS**. Reinstall oil filler cap and dipstick.

**OIL FILTER**

**Removal**

Remove:
- oil filter screw
- oil filter cover
- oil filter.

**NOTE:** If the oil filter cover is hard to remove, use the oil filter cover separator (P/N 529 036 038) and the oil filter cover puller (P/N 529 036 057).

Place rags in filler area to prevent spillage. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent stains.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.</td>
</tr>
</tbody>
</table>

---

1. Suction pump.
2. Siphon tube in dipstick hole.

![Diagram of oil filter system](image)
**Section 03 ENGINE**  
Subsection 08 (LUBRICATION SYSTEM)

**Inspection**
Check oil filter cover O-ring and oil filter screw O-ring, change if necessary.
Check and clean the oil filter inlet and outlet area for dirt and other contaminations.

**INSPECTION**

**ENGINE OIL PRESSURE**

**NOTE:** Depending on the oil pressure switch, the threshold value to send a signal of low oil pressure may vary from a minimum of 180 kPa (26 PSI) to a maximum of 220 kPa (32 PSI).

**NOTE:** The engine pressure test should be done with a warm engine and the recommended oil.
Use oil pressure gauge (P/N 529 035 709) and hose adaptor (P/N 529 035 652) and install where shown. A 1/8 NPT pipe extension may ease the installation.

**Test at the Oil Pressure Switch Location**
Remove oil pressure switch and install gauge.

**Installation**
For installation, reverse the removal procedure. Pay attention to the following details.
Install a new oil filter.
Install O-ring on oil filter cover.
**NOTE:** In salt water area, it is recommended to coat mating surface of cover with Super Lube grease (P/N 293 600 016).

Torque oil filter screw to 9 N•m (80 lbf•in).
To prevent the EMS to go in limp home mode (at 2500 RPM) or to generate a fault code, start engine, THEN ground OPS connector to engine.

Read oil pressure at different RPM as per following table.

### OIL PRESSURE MEASURED AT PRESSURE SWITCH LOCATION

<table>
<thead>
<tr>
<th>ALL 1503 4-TEC ENGINES kPa (PSI)</th>
<th>Idle (cold)</th>
<th>448 - 648 (65 - 94) for a very short time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle (at 80°C (176°F))</td>
<td>Min. 228 (33)</td>
<td></td>
</tr>
<tr>
<td>4000 - 7500</td>
<td>400 - 496 (58 - 72)</td>
<td></td>
</tr>
</tbody>
</table>

Reinstall oil pressure switch.

**Test at the Cylinder Head Location**

The oil pressure may be measured from cylinder head if desired.

Remove plug located on cylinder head and install gauge.

Start engine and read pressure at different RPM as per following table.

### OIL PRESSURE MEASURED AT CYLINDER HEAD LOCATION

<table>
<thead>
<tr>
<th>ALL 1503 4-TEC ENGINES kPa (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle (cold)</td>
</tr>
<tr>
<td>Idle (at 80°C (176°F))</td>
</tr>
<tr>
<td>4000 - 7500</td>
</tr>
</tbody>
</table>

Reinstall plug.

**PROCEDURES**

**PTO OIL STRAINER**

**NOTE:** The oil strainer does not need to be cleaned at every oil change. Clean it during other inspections, especially when the engine is disassembled.

**Removal**

Remove:
- engine oil (refer to **OIL CHANGE**)
- PTO cover no. 5 (refer to **PTO COVER AND MAGNETO section**)
- oil strainer no. 6.
**SUCTION PUMP OIL STRAINER**

**NOTE:** The oil strainer does not need to be cleaned at every oil change. Clean it during other inspections, especially when the engine is disassembled.

**Removal**

**NOTE:** The intercooler outlet hose (if so equipped) does not need to be removed to remove the oil strainer.

**Installation**

For installation, reverse the removal procedure. Refill engine at the proper level with the recommended oil. Refer to **OIL LEVEL VERIFICATION** for the procedure.
Clean both contact surfaces of oil suction pump cover.

Check and clean the oil inlet and outlet area for dirt and other contaminations.

**Cleaning and Inspection**

Clean oil strainer with a part cleaner then use an air gun to dry it.

**WARNING**

Always wear eye protector. Chemicals can cause a rash break out in and an injury to your eyes.

Inspect rubber ring gaskets.

If rubber rings are brittle, cracked or hard, replace them.

**Installation**

For installation, reverse the removal procedure.

Position screws according to their length as shown.

**TYPICAL**

1. Screws M6 x 25
2. Screws stainless steel M6 x 45

Torque suction pump cover screws to 10 N•m (89 lbf•in) as per sequence illustrated below. Apply Loctite 243 (P/N 293 800 060) on threads.
ENGINE OIL PRESSURE REGULATOR

The oil pressure regulator is located on the bottom of the PTO housing.

**TYPICAL**
1. Oil pressure regulator

**NOTE:** The oil pressure regulator system opens when the oil pressure exceeds 400 kPa (58 PSI).

**Removal**
Remove:
- engine oil (refer to *OIL CHANGE*)
- oil pressure regulator plug no. 15, compression spring no. 16, valve piston no. 17 and valve piston guide no. 18.

**WARNING**
Oil pressure regulator plug on oil pump housing is spring loaded.

**Inspection**
Inspect valve piston and valve piston guide for scoring or other damages.
Check compression spring for free length.

<table>
<thead>
<tr>
<th>COMPRESSION SPRING FREE LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW NOMINAL</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
</tbody>
</table>

Replace parts if important wear or damage are present.
Clean bore and threads in the PTO housing from metal shavings and other contaminations.

**Installation**
For installation, reverse the removal procedure.
Pay attention to the following details.
Be careful that the O-ring on plug screw is in place.
Torque plug screw to 12 N•m (106 lbf•in) maximum. Apply Loctite 243 (P/N 293 800 060) on threads.

**OIL PRESSURE PUMP**
The oil pressure pump is located in the PTO housing and is driven by the balance shaft.

**Removal**
Remove:
- engine oil (refer to *OIL CHANGE*)
- PTO housing (refer to *PTO HOUSING AND MAGNETO* section)
- water pump housing **no. 19** and impeller **no. 20**
  (refer to **COOLING SYSTEM** section)
- screws **no. 21**
- oil pump cover **no. 22**

**CAUTION**: Be careful not to damage the surface of the rotary seal bore in PTO housing cover.
- oil seal **no. 26**.

**Inspection**
Inspect oil pump shaft, housing and cover for marks or other damages.
Check inner rotor for corrosion pin-holes or other damages. If so, replace oil pump shaft. Ensure to also check oil pump housing and cover and replace if damaged.

- extract the water/oil pump shaft **no. 24** from outside PTO housing with a pusher
- remove rotary seal **no. 25** with a screwdriver
Section 03 ENGINE
Subsection 08 (LUBRICATION SYSTEM)

Using a feeler gauge, measure the clearance between inner and outer rotors.

If clearance between inner and outer rotors exceeds the tolerance, replace water/oil pump shaft. Ensure to also check oil pump housing and cover and replace if damaged.

If clearance between outer rotor and its bore in oil pump exceeds the tolerance, replace the complete oil pump and the PTO housing.

Using a vernier depth gauge, measure side wear as shown.

**OUTER AND INNER ROTOR CLEARANCE**

<table>
<thead>
<tr>
<th>SERVICE LIMIT</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.25 mm (.009 in)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Difference between pump housing and outer rotor should not exceed 0.1 mm (.004 in). If so, replace the complete oil pump assembly.

**NOTE:** When the axial clearance of the oil pump shaft increases, the oil pressure decreases.

Check the inside of oil pump housing and its cover for scoring or other damages and replace if damaged.

**Installation**

For installation, reverse the removal procedure. Pay attention to the following details.

**NOTE:** Never use oil in the press fit area of the rotary seal.

Push water/oil pump shaft seal in place by using thumb.
1. Oil seal

Install the new rotary seal by using the rotary seal pusher (P/N 529 035 823).

CAUTION: Never use a hammer for the rotary seal or water/oil pump shaft installation. Only use a press to avoid damaging the ceramic component.

TYPICAL
1. Rotary seal
2. Rotary seal pusher

Install the water/oil pump shaft using the rotary seal pusher (P/N 529 035 823) on the opposite side to support the rotary seal. Use the oil seal guide (P/N 529 035 822) with a press.

1. Oil seal guide
2. Water/oil pump shaft

1. Water/oil pump shaft with oil seal guide
2. Rotary seal pusher
Tighten oil pump cover screws and torque to 10 N•m (89 lbf•in). Apply Loctite 243 (P/N 293 800 060) on threads.

Final Test
After engine is completely reassembled, start engine and make sure oil pressure is within specifications.

OIL SUCTION PUMP
The oil suction pump is located on the front side of the engine inside of the oil suction pump housing at the bottom of the oil filler tube.

Removal
NOTE: The intercooler outlet hose (if so equipped) does not need to be removed to remove the oil suction pump.

- Detach intake hose from throttle body (naturally aspirated engine only).
- Remove other required parts from vehicle to access the oil suction pump housing.
- Remove retaining screws from oil filler tube no. 39.
- Remove oil filler tube no. 14.
- Remove retaining screws no. 40.
- Place rags under cover to prevent spillage. If spillage occurs, clean with the pulley flange cleaner (P/N 413 711 809).

WARNING
Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

- Remove the oil suction pump housing.
- Remove oil pump screws no. 27 and cover no. 42.

- Remove oil pump shaft no. 29.
- Remove outer rotor no. 30.
Inspection
Inspect oil pump shaft, housing and cover for marks or other damages. Check inner rotor for corrosion, pin-holes or other damages. If so, replace oil pump shaft. Ensure to also check oil pump housing and cover and replace if damaged.

Using a feeler gauge, measure the clearance between inner and outer rotors.

If clearance between outer rotor and its bore in oil pump exceeds the tolerance, replace the complete oil pump and the PTO housing.
Using a vernier depth gage, measure side wear as shown.

Difference between pump housing and outer rotor should not exceed 0.1 mm (.004 in). If so, replace the complete oil pump assembly.

NOTE: When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.
Check the inside of oil pump housing and its cover for scoring or other damages and replace if damaged.

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Torque oil pump cover screws to 10 N•m (89 lb•in)

Tighten suction pump housing screws as per following sequence and torque to 10 N•m (89 lb•in). Apply Loctite 243 (P/N 293 800 060) on threads.

**OIL SEPARATOR COVER**

**Removal**
- Remove the ventilation hose from TOPS valve no. 8.
- Remove CPS cable from TOPS valve.
- Remove retaining screws no. 13 holding TOPS valve.
- Remove TOPS valve.
- Remove retaining screw no. 52 and camshaft sensor no. 51.
- Take off engine cover and valve cover cowl no. 53.
- Remove ignition coils no. 48.
- Remove retaining screw no. 47 and valve cover no. 54.
- Remove thrust washer no. 11 from oil separator cover no. 10.
NOTE: Make sure not to loose thrust washer when removing it from oil separator cover, otherwise thrust washer would fall into the PTO housing.

NOTE: Be careful not to break the holding clips from oil separator cover when its removed from the timing gear.

Inspection
If O-rings and V-rings are brittle, cracked or hard, replace them.
Clean all contact surfaces of oil separator cover and TOPS valve.
Inspect oil separator cover for marks or other damages. Ensure to check also the holding clips of oil separator cover and for thrust washer. If any damage is visible replace oil separator cover.

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Apply grease on O-rings and V-rings.
NOTE: Make sure not to loose thrust washer when installed on oil separator cover.
NOTE: Oil separator cover and thrust washer need to be in a perfect even position with timing gear. Torque screws to 6 N•m (53 lbf•in). Apply Loc-tite 243 (P/N 293 800 060) on threads.

TOPS VALVE
The TOPS valve is a mechanical device that does not require electrical supply for its operation.

Removal
Remove ventilation hose from TOPS valve
Unscrew and remove the TOPS valve.
Remove O-ring and V-ring
NOTE: TOPS valve can not be disassembled.

Turn valve upside down and blow air again. Air must not flow out.

If test fails, replace valve.

Installation
Install the TOPS valve with new O-ring and V-ring. Apply Loc-tite 243 (blue) on threads and torque to 6 N•m (53 lbf•in).
Reinstall remaining removed parts.

Inspection
If O-rings or V-rings are brittle, cracked or hard, replace them.
If TOPS valve is damaged, replace it
Clean all contact surfaces of TOPS valve.
Place a clean rag on valve inlet.
Blow air through inlet port. Air must flow freely to the outlet port.
OIL COOLER

The oil cooler is located below the air intake manifold.

Removal
Remove:
- cooling hoses no. 34 and no. 35
- retaining screws no. 36
- oil cooler no. 37

Inspection
If O-rings are brittle, cracked or hard, replace them.
Clean both contact surfaces of oil cooler.
Check and clean the oil inlet and outlet area for dirt and other contaminations.

Installation
For installation, reverse the removal procedure.
Pay attention to the following details.
Apply grease on O-rings.
Torque oil pump cover screws to 10 N\*m (89 lb\*in). Apply Loctite 243 (P/N 293 800 060) on threads.

- O-rings no. 38.
# COOLING SYSTEM

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil seal protector</td>
<td>529 035 822</td>
<td>123</td>
</tr>
<tr>
<td>pliers Oetiker 1099</td>
<td>295 000 070</td>
<td>119</td>
</tr>
<tr>
<td>rotary seal installer</td>
<td>529 035 823</td>
<td>123</td>
</tr>
<tr>
<td>test cap</td>
<td>529 035 991</td>
<td>116</td>
</tr>
<tr>
<td>vacuum/pressure pump</td>
<td>529 021 800</td>
<td>117</td>
</tr>
</tbody>
</table>

## SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loctite 243</td>
<td>290 897 651</td>
<td>120</td>
</tr>
<tr>
<td>premixed antifreeze</td>
<td>219 700 362</td>
<td>117</td>
</tr>
</tbody>
</table>
CLOSED LOOP COOLING SYSTEM

- Coolant temperature sensor (CTS) activates when temperature exceeds 100°C (212°F)
- Expansion coolant tank
- Bleed hose from cylinder head to expansion coolant tank
- Coolant housing including thermostat opens at 87°C (188°F) and coolant pump impeller
- Ride plate (operates as heat exchanger)
- Coolant flows to ride plate
- Oil cooler
- Coolant flows to oil cooler
- Coolant returns from oil cooler
- Coolant returns from ride plate
ENGINE COMPONENTS
GENERAL

CIRCUIT
A closed loop cooling system is utilized on the 1503 4-TEC engines, which offers an efficient engine cooling while keeping dirt and salt water out of the cooling system. This system keeps the temperature constant and prevents internal engine corrosion.

A separate coolant expansion tank ensures that enough engine coolant is in the circuit during any operating condition.

The coolant flow comes from the water pump impeller into the cylinder block. It goes around the cylinders and straight up to the cylinder head. A smaller quantity of engine coolant enters the cylinder block on the exhaust side for a better cooling. In the cylinder head the water channels flow around the exhaust and then the intake valves and leave the engine through a large hose. From there the coolant goes back to the water pump housing and depending on the engine temperature, it flows through the thermostat directly back to the water pump impeller, or it takes its way through the ride plate which operates as a heat exchanger.

Engine coolant is also directed towards the oil cooler (coolant type).

Coolant temperature sensor and bleed nipple are located on the cylinder head.

TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Closed loop cooling system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOLANT FLOW</td>
<td>Flow from water pump.</td>
</tr>
<tr>
<td>TEMPERATURE CONTROL</td>
<td>Thermostat.</td>
</tr>
<tr>
<td>SYSTEM BLEEDING</td>
<td>Self-bleed type through expansion tank (hose at uppermost point of circuit).</td>
</tr>
<tr>
<td>MONITORING BEEPER</td>
<td>Turns on at 100°C (212°F) on naturally aspirated engines. Turns on at 110°C (230°F) on supercharged engines.</td>
</tr>
<tr>
<td>COOLANT LIFE CYCLE</td>
<td>100 hours or 1 year. Should be replaced before storage.</td>
</tr>
</tbody>
</table>

INSPECTION

PRESSURE CAP
Using a pressure cap tester, check pressure cap efficiency. If the efficiency is feeble, install a new 90 kPa (13 PSI) cap (do not exceed this pressure).

HOSES AND CLAMPS
Check general condition of hoses and clamp tightness.

COOLING SYSTEM LEAK TEST

⚠️ WARNING
To avoid potential burns, do not remove the expansion tank cap or loosen the ride plate drain plug if the engine is hot.

Install the test cap (P/N 529 035 991).

NOTE: It is not necessary to install a hose pincher on overflow hose.
Connect the vacuum/pressure pump (P/N 529 021 800) to test cap and pressurize system through coolant expansion tank to 90 kPa (13 PSI).

MAINTENANCE

COOLANT REPLACEMENT

⚠️ WARNING

To avoid potential burns, do not remove the expansion tank cap or loosen the ride plate drain plug if the engine is hot.

Recommended Coolant

Use premixed antifreeze (P/N 219 700 362) or a blend of 50% antifreeze with 50% demineralized water.

NOTE: Using a blend of 40% antifreeze with 60% demineralized water will improve the cooling efficiency when watercraft is used in particularly hot weather and/or hot water condition.

To prevent antifreeze deterioration, always use the same brand. Never mix different brands unless cooling system is completely flushed and refilled.

CAUTION: To prevent rust formation or freezing condition in cold areas, always replenish the system with 50% antifreeze and 50% demineralized water. Pure antifreeze will freeze at a higher temperature than the optimal water/antifreeze mix. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines. Using water tap instead of demineralized water, would contribute to make deposits in cooling system and to reduce antifreeze efficiency. This could lead to engine overheating.

Draining the System

⚠️ WARNING

Never drain or refill cooling system when engine is hot.

Remove coolant expansion tank cap.

To drain cooling system, unscrew cooling system drain plug at the rear of ride plate.

NOTE: Raising the front of the vehicle will contribute to drain the cooling system.
Ask someone to pour antifreeze in expansion tank while watching antifreeze and air bubble flowing out through drain hole. When no air bubbles escape, reinstall drain plug. Torque to 8.3 N•m (73 lbf•in).

Cleaning the System

**CAUTION:** Cleaning the cooling system as per the following procedure is required when engine overheats (assuming everything else is operating normally) or each time coolant is replaced.

Drain the cooling system. Clean thoroughly using the Valvoline Zerex Super Cleaner (or equivalent).

Add the cleaning product in coolant expansion tank then fill cooling system with demineralized water.

Reinstall cap on coolant expansion tank.

Install watercraft in a water tank or ride on a water plane. Start engine and run for approximately 15 minutes mostly at full throttle.

**IMPORTANT:** Ensure thermostat opens so that the cleaning product flows in ride plate properly.

Stop engine and let the cleaning product work for 12 to 16 hours.

Thereafter, engine can be run one last time to soak off deposits.

Drain and thoroughly rinse the cooling system with clean fresh water.

Refill cooling system as described below.

Refilling the System

Watercraft should be level, engine cold and drain plug removed for refilling.

Place a container under drain plug to collect antifreeze.
Section 03 ENGINE
Subsection 09 (COOLING SYSTEM)

Test the density of the coolant using an antifreeze hydrometer.

NOTE: Follow hydrometer manufacturer instructions for proper use.

The reading should be some degrees below the coldest temperature you expect in the area where the watercraft is to be used. Add demineralized water or antifreeze accordingly. Refill to the proper level.

CAUTION: Pure antifreeze will freeze at a higher temperature than the optimal water/antifreeze mix. Using water tap instead of demineralized water, would contribute to make deposits in cooling system and to reduce antifreeze efficiency. This could lead to engine overheating.

PROCEDURES

CLAMPS

Replacement
To cut or secure Oetiker clamps of cooling system hoses, use the pliers Oetiker 1099 (P/N 295 000 070).

1. Cutting clamp
2. Securing clamp

Last, refill expansion tank and install pressure cap.
When engine has completely cooled down, recheck coolant level in radiator and coolant tank and top up if necessary.
WATER PUMP HOUSING

1. Water pump housing

Removal

**Supercharged Engines**

Remove supercharger inlet and outlet hoses to make room.

1. Supercharger
2. Inlet hose
3. Outlet hose

**All Engines**

Drain cooling system and engine oil.

Remove from housing:
- ride plate inlet and outlet hoses
- cylinder head outlet hose no. 1
- oil cooler inlet hose no. 2
- oil cooler outlet hose no. 3
- screws no. 4 and no. 5 retaining water pump housing no. 6
- water pump housing no. 6.

Installation

The installation is the opposite of the removal procedure. Install screws as per the following illustration.

1. Screws M6 x 25
2. Screws M6 x 105

**CAUTION:** To prevent leaking, take care that the gaskets are exactly in groove when you reinstall the water pump housing.

Apply Loctite 243 (P/N 290 897 651) on screw threads and torque to 10 N•m (89 lbf•in).

Tightening sequence for screws on water pump housing is as per following illustration.

Check if thermostat is in good condition. Refer to THERMOSTAT elsewhere in this section.

Inspection

Check if gasket no. 7 is brittle, hard or damaged and replace as necessary.
WATER PUMP IMPELLER

Removal
Remove:
- water pump housing no. 6 as described in this section
- unscrew the impeller no. 8 clockwise.

CAUTION: Coolant/oil pump shaft no. 9 and impeller no. 8 have left-hand threads. Remove by turning clockwise and install by turning counterclockwise.

Inspection
Check impeller for cracks or other damage. Replace impeller if damaged.

Installation
The installation is the opposite of the removal procedure. Pay attention to the following details.

CAUTION: Be careful not to damage impeller wings during installation.
Torque impeller to 3 N·m (26 lbf·in).

THERMOSTAT
The thermostat is a single action type.

Removal
Remove the water pump housing from the PTO cover. Refer to WATER PUMP HOUSING above in this section.

NOTE: The thermostat is located inside the water pump housing.

Leak Test
Plug the connections of the oil cooler return hose, coolant tank hose, ride plate return hose and cylinder head return hose with a rag.

Fill the water pump housing with water.
If a bigger quantity of coolant leaks out at the ride plate outlet connection, replace the water pump housing. Refer to WATER PUMP HOUSING in this section.
If there is no leak, check the operation of the thermostat.

Dynamic Test
To check the operation of the thermostat, put it in water and heat water. Look inside the cylinder head return hose connection to see the movement of the thermostat. Thermostat should open when water temperature reaches 87°C (187°F).
If there is no operation, replace the water pump housing.
Section 03 ENGINE
Subsection 09 (COOLING SYSTEM)

Installation
For installation, reverse the removal procedure, paying attention to the following details.
Refer to WATER PUMP HOUSING in this section.

ROTARY SEAL

Inspection
Check weep hole for oil or coolant leak.

Coolant leaking out of the hole indicates a defective rotary seal. Leaking oil indicates a faulty oil seal.
However, if seal is disassembled both parts have to be replaced together.

Removal
Remove:
- water pump housing no. 6

CAUTION: Always unscrew the impeller clockwise otherwise you can damage the components.
- unscrew the impeller no. 8 clockwise
- remove PTO cover no. 10 (refer to PTO HOUSING/MAGNETO section)
- remove screws no. 11 retaining oil pump cover

- remove oil pump cover no. 12
- remove outer oil pump rotor no. 13

- extract the coolant/oil pump shaft no. 9 from outside PTO housing cover with a pusher
Section 03 ENGINE
Subsection 09 (COOLING SYSTEM)

NOTE: Never use oil in the press fit area of the oil seal and rotary seal.
Push water pump shaft oil seal in place by using thumb.
Install the new rotary seal using the rotary seal installer (P/N 529 035 823).

CAUTION: Never use a hammer for the rotary seal or water/oil pump shaft installation. Only use a press to avoid damaging the ceramic component.

CAUTION: Be careful not to damage the surface of the rotary seal bore in magneto housing cover.
- always replace also the oil seal no. 15 behind the rotary seal.

Install the coolant/oil pump shaft using the rotary seal installer (P/N 529 035 823) on the opposite side to the rotary seal and the oil seal protector (P/N 529 035 822) with a press.

Installation
The installation is the opposite of the removal procedure. Pay attention to the following details.
1. Coolant/oil pump shaft with oil seal protector
2. Rotary seal installer
CYLINDER HEAD

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>camshaft locking tool</td>
<td>529 035 839</td>
<td>130-131</td>
</tr>
<tr>
<td>valve spring compressor clamp</td>
<td>529 035 724</td>
<td>135</td>
</tr>
<tr>
<td>valve spring compressor cup</td>
<td>529 035 725</td>
<td>135</td>
</tr>
</tbody>
</table>

SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klueber Isoflex grease</td>
<td>293 550 021</td>
<td>135</td>
</tr>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>127</td>
</tr>
<tr>
<td>Molykote G-N paste</td>
<td>413 703 700</td>
<td>139</td>
</tr>
</tbody>
</table>
GENERAL

NOTE: When diagnosing an engine problem, always perform an engine leak test. This will help pinpoint a problem. Refer to ENGINE LEAK TEST section for procedures.
Always place the vehicle on level surface.
Always disconnect the negative wire from the battery before working on the engine.
Even if the removal of many parts is not necessary to reach another part, it is recommended to remove these parts in order to check them.
For installation, use the torque values and Loctite products as mentioned. Clean threads before using Loctite product when installing screws.
When disassembling parts that are duplicated in the engine, (e.g.: valves, bushings), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts (e.g.: you found a worn valve guide. A bent spring could be the cause and it would be easy to know which one among the springs is the cause to replace it if you grouped them at disassembly).
Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

PROCEDURES

EXHAUST MANIFOLD

Removal
Refer to EXHAUST SYSTEM to remove exhaust pipe and cooling hoses.
Unscrew the exhaust manifold no. 28 beginning with the bottom screws. This will help holding the manifold while you remove the screws.
Remove exhaust manifold.

Inspection
Inspect exhaust manifold condition paying attention for cracks or other damage. Check contact surfaces and hose. Replace any defective part.
Inspect plane surfaces for warpage. Small deformation can be corrected by grinding surface with a fine sand paper. Install sand paper on a surface plate and rub part against oiled sand paper.

Installation
NOTE: There is no gasket between cylinder block and exhaust manifold.
Apply Loctite 243 (blue) (P/N 293 800 060) on threads of screws.
Torque screws to 10 Nm (89 lbf-in) as per following illustrated sequence.

VALVE COVER

Removal
Remove:
- ignition coils no. 1
- valve cover cowl no. 3
- valve cover screws no. 4
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

- valve cover no. 5 and gasket no. 6.
- spark plugs
- valve cover no. 5
- spark plug tube no. 7

Inspection
Check if the gasket on the valve cover and the rubber bushing on the valve cover screws are brittle, cracked or hard. If so, replace the gasket or the valve cover screw accordingly.

Installation
For installation, reverse the removal procedure.
NOTE: Install the valve cover screws according to following sequence.

Rocker arm shaft screws no. 8. Discard screws

Torque screws to 10 N•m (89 lbf•in).

ROCKER ARM

Removal
Lock crankshaft, refer to CYLINDER BLOCK section.
Remove:
- ignition coils no. 1

1. Rocker arm shaft
2. Rocker arms (exhaust side)
3. Rocker arm (intake side)
Section 03 ENGINE

Subsection 10 (CYLINDER HEAD)

1. Oil supply from the camshaft to the rocker arm shaft, then to the rocker arms and finally to the valve adjustment.

Inspection

Spark Plug Tube
Check seals on spark plug tube. If seals are brittle, cracked or hard, replace spark plug tube.

Rocker Arm
Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly.
Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly as necessary.

TYPICAL
1. Spark plug tube
2. Seal to the valve cover
3. Seal to the cylinder head

Measure rocker arm bore diameter. If diameter is out of specification, change the rocker arm assembly.

ROCKER ARM BORE DIAMETER

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
<td>20.007 mm (.7877 in)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
<td>20.020 mm (.7881 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>20.035 mm (.7887 in)</td>
</tr>
</tbody>
</table>

Press the hydraulic lifter with your thumb. If the hydraulic lifter groove disappears inside rocker arm casting, replace rocker arm assembly. Lifter must turn freely in rocker arm bore. Otherwise, replace.
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

Rocker Arm Shaft
Check for scored friction surfaces, if so, replace parts.
Measure rocker arm shaft diameter.

<table>
<thead>
<tr>
<th>ROCKER ARM SHAFT DIAMETER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
<td>19.980 mm (.7866 in)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
<td>19.993 mm (.7871 in)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>19.965 mm (.7860 in)</td>
</tr>
</tbody>
</table>

Any area worn excessively will require parts replacement.

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Apply engine oil on rocker arm shaft.

IMPORTANT: The rocker arm shaft can only be installed in one specific position. Therefore crankshaft as well as camshaft has to be positioned with their locking pins when the piston of cylinder no. 3 is on ignition TDC. Refer to CYLINDER BLOCK section for crankshaft and the following for the camshaft locking.

NOTE: Cylinder no. 3 is next to the oil filler tube.

Use camshaft locking tool (P/N 529 035 839). Rotate camshaft so that tool can be pushed in camshaft hole and lock camshaft in place.

Then, the camshaft sprocket lines should be lined up as shown in the following illustration.

Position the rocker arm shaft with the notches on top.
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

CAMSHAFT TIMING GEAR

NOTE: Although it is not necessary to position crankshaft to TDC for disassembly, it is a good practice to do it, as a troubleshooting step, to know before disassembly if valve timing was appropriate.

Removal

Lock crankshaft, refer to CYLINDER BLOCK section.
Remove:
- valve cover no. 5
- chain guide no. 22
- Allen screws no. 25
- camshaft timing gear no. 24.

NOTE: Secure timing chain no. 23 with a retaining wire.

Inspection

Check camshaft timing gear for wear or deterioration.
If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).
For crankshaft timing gear, refer to CYLINDER BLOCK section.

Installation

For installation, reverse the removal procedure. Pay attention to the following details.
Using the camshaft locking tool (P/N 529 035 839), lock camshaft on TDC position.
Check if screws are still loose. If screws are squeezed by the timing gear, remove the chain tensioner again and rotate timing gear by one tooth clockwise. Then install the chain tensioner again.
Tighten screws and torque to 10 N•m (89 lbf•in). Remove locking tools.
**CAUTION:** Crankshaft and camshaft must be locked on TDC position to place camshaft timing gear and timing chain in the proper position. To double check, take a look at the timing gear lines. They must be parallel to the cylinder head surface.

**CAUTION:** Ensure to remove locking tools when finished.

**TIMING CHAIN**
Refer to **CYLINDER BLOCK** section.

**CYLINDER HEAD**

**Removal**
Lock crankshaft, refer to **CYLINDER BLOCK** section.
Drain coolant (refer to **COOLING SYSTEM**).
Disconnect coolant temperature and camshaft position sensors (CTS and CAPS).
Remove:
- exhaust manifold (refer to **EXHAUST MANIFOLD** in this section)
- engine hoses
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

1. Cylinder head screws M6

- cylinder head screws M11 no. 17 retaining cylinder head to cylinder block.

Pull up cylinder head no. 18.
Remove gasket no. 19.

Cleaning
Remove carbon deposits from combustion chamber, exhaust port and piston top.

Inspection
Check for cracks between valve seats and warpage of cylinder head, if so, replace cylinder head.
Check mating surface between cylinder and cylinder head for contamination. If so, clean both surfaces.

If warpage of cylinder head is more then 0.15 mm (.006 in) replace cylinder head.

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Ensure dowel pins are in place.
Install new cylinder head gasket.
CAUTION: Each installation of the cylinder head requires a new cylinder head gasket. Using a gasket twice will cause engine damage, even if the engine had not run.

Install cylinder screws M11 no. 17. Torque screws as per following procedure.

CAUTION: This assembly uses stretch screws. As the screws have been stretched from the previous installation, it is very important to measure each screw at assembly. If screw is out of specification, replace by a new. Failure to replace screws and to strictly follow the torque procedure may cause screws to loosen and lead to engine damage.

<table>
<thead>
<tr>
<th>CYLINDER SCREW M11</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVICE LIMIT</td>
</tr>
<tr>
<td>148.5 mm (5.846 in)</td>
</tr>
</tbody>
</table>

NOTE: Torque screws no. 29 after the tightening of the cylinder head screws is finished.

Torque screws according to following sequence.
First torque to 40 N•m (30 lbf•ft).
Then tighten screws turning an additional 120° rotation with a torque angle gauge and finish tightening with a 90° rotation. Torque screws no. 29 to 10 N•m (89 lbf•in).

CAMSHAFT

Removal
Remove:
- valve cover
- rocker arms
- chain tensioner (refer to CYLINDER BLOCK section)
- camshaft timing gear
- camshaft lock no. 20
- camshaft no. 21.

Inspection
Check each lobe and bearing journal of camshaft for scoring, scuffing, cracks or other signs of wear.
Measure camshaft bearing journal diameter and lobe height using a micrometer.
Measure clearance between both ends of camshaft and cylinder head.

Grease the camshaft bearing journals well by using the Klüber Isoflex grease (P/N 293 550 021) or a similar product.

Install camshaft then place the camshaft lock no. 20 in the slot.

For other parts, refer to proper installation procedure.

**VALVE SPRING**

**Removal**

Remove:
- rocker arms
- cylinder head.

Compress valve springs no. 29 and no. 30. Use valve spring compressor clamp (P/N 529 035 724) and valve spring compressor cup (P/N 529 035 725).

Replace parts that are not within specifications.

**Installation**

For installation, reverse the removal procedure. Pay attention to the following details.

**WARNING**

Always wear safety glasses when disassembling valve springs. Be careful when unlocking valves. Components could fly away because of the strong spring preload.
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

1. Valve spring compressor clamp
2. Valve spring compressor cup

LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve coppers no. 31.
Withdraw valve spring compressor, valve spring retainer no. 32 and valve springs.

1. Valve spring retainer
2. Inner valve spring
3. Outer valve spring

Inspection
Check valve springs for rust, corrosion or other visible damages. If so, replace faulty valve springs.
Check valve springs for free length and straightness.
Replace valve springs if not within specifications.

A. Valve spring length

<table>
<thead>
<tr>
<th>OUTER VALVE SPRING FREE LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW NOMINAL</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
<tr>
<td>INNER VALVE SPRING FREE LENGTH</td>
</tr>
<tr>
<td>NEW NOMINAL</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
</tbody>
</table>

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Colored area of the valve spring must be placed on top.
NOTE: Valve cotters must be properly engaged in valve stem grooves.

VALVE

Removal
Remove valve spring.
Push valve stem then pull valves no. 26 and no. 27 out of valve guides.

Inspection
Valve Stem Seal
Inspection of valve stem seals is not needed because new seals should always be installed whenever cylinder head is removed.

Valve
Inspect valve surface, check for abnormal stem wear and bending. If so, replace by a new one.

Valve Stem and Valve Guide Clearance
Measure valve stem and valve guide in three places, using a micrometer and a small bore gauge.
NOTE: Clean valve guide to remove carbon deposits before measuring.
Change valve if valve stem is out of specification or has other damages such as wear or friction surface.

Remove valve stem seal no. 33 with special pliers such as Snap-on YA 8230.
Valve Guide Replacement

**CAUTION:** Do not heat cylinder head for this procedure.

**CAUTION:** The sharp edge near the top of the valve guide must be machined away. Otherwise it will foul the valve guide hole in the cylinder head and destroy the cylinder head, as the valve guide is removed.

Use a special reamer as far as the top of the notch.

---

**A. Valve stem diameter**

<table>
<thead>
<tr>
<th>VALVE STEM DIAMETER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW MINIMUM</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>5.946 mm (.2341 in)</td>
</tr>
<tr>
<td>Intake</td>
<td>5.961 mm (.2347 in)</td>
</tr>
<tr>
<td><strong>NEW MAXIMUM</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>5.980 mm (.2346 in)</td>
</tr>
<tr>
<td>Intake</td>
<td>5.975 mm (.2352 in)</td>
</tr>
<tr>
<td><strong>SERVICE LIMIT</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>5.93 mm (.233 in)</td>
</tr>
<tr>
<td>Intake</td>
<td></td>
</tr>
</tbody>
</table>

Replace valve guide if it is out of specification or has other damages such as wear or friction surface. Refer to valve guide replacement below.

**TYPICAL**
1. Special reamer
2. Notch

---

**B. Valve guide diameter**

<table>
<thead>
<tr>
<th>VALVE GUIDE DIAMETER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW MINIMUM</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>5.994 mm (.2359 in)</td>
</tr>
<tr>
<td>Intake</td>
<td></td>
</tr>
<tr>
<td><strong>NEW MAXIMUM</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>6.018 mm (.2369 in)</td>
</tr>
<tr>
<td>Intake</td>
<td></td>
</tr>
<tr>
<td><strong>SERVICE LIMIT</strong></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>6.060 mm (.2386 in)</td>
</tr>
<tr>
<td>Intake</td>
<td></td>
</tr>
</tbody>
</table>

Chase valve guide out of the cylinder head towards combustion chamber by using a suitable punch.
Check valve guide bore for abraded material. The inlet and exhaust valve guides have the same length and are interchangeable.

**NOTE:** If valve guide has caused scoring during extraction, replace the cylinder head.

Grease the bore in cylinder head and the leading end of valve guide with Molykote G-N paste (P/N 413 703 700).

![Diagram of valve guide](image)

**TYPICAL**
1. Valve guide leading end
2. Cylinder head bore
3. Jig

With a suitable jig press the valve guide into the cold cylinder head as shown.

**TYPICAL**

<table>
<thead>
<tr>
<th>VALVE GUIDE PROTRUSION</th>
<th>MINIMUM</th>
<th>12.4 mm (.4882 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAXIMUM</td>
<td>12.8 mm (.5039 in)</td>
</tr>
</tbody>
</table>

**NOTE:** For lubrication of the reamer use only cutting oil. Turn the reamer only forward, in cutting direction, never backward. Clean the reamer at short intervals from swarf, moving the reamer only while turning in cutting direction.

Ream the new valve guide with a reamer 6 mm diameter.

Clean cylinder head carefully. Check that the valve seat is concentric with the new guide axis (check contact surface with engineer's blue).
Valve Face and Seat

1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

Measure valve face contact width.

**NOTE:** The location of contact area should be in center of valve seat.

Measure valve seat width, using a caliper.

<table>
<thead>
<tr>
<th>VALVE SEAT CONTACT WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW</td>
</tr>
<tr>
<td>Exhaust</td>
</tr>
<tr>
<td>1.25 to 1.55 mm</td>
</tr>
<tr>
<td>(.049 to .061 in)</td>
</tr>
<tr>
<td>Intake</td>
</tr>
<tr>
<td>1.10 to 1.30 mm</td>
</tr>
<tr>
<td>(.043 to .051 in)</td>
</tr>
</tbody>
</table>

**SERVICE LIMIT**

<table>
<thead>
<tr>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mm (.078 in)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 mm (.07 in)</td>
</tr>
</tbody>
</table>

If valve seat contact width is too wide or has dark spots, replace the cylinder head.

**Valve Seat Grinding**

**NOTE:** The valve seats may be reground with a valve seat grinder which centers on the valve guide.

- Grind the valve seat at 45°. Remove no more material than absolutely necessary to clean the seat up.
- Using a 35° stone, narrow the valve seat until the appropriate outer diameter is obtained.
Section 03 ENGINE
Subsection 10 (CYLINDER HEAD)

VALVE SEAT OUTER DIAMETER

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>37.35 mm (1.4705 in)</td>
</tr>
<tr>
<td>Exhaust</td>
<td>30.3 mm (1.1929 in)</td>
</tr>
</tbody>
</table>

- Using a 55° stone for the intake and an 80° stone for the exhaust valve, reduce the valve seat contact width to the appropriate value mentioned above.
- Finally, coat the valve seating surface with a fine paste of valve grinding compound using a manual valve grinding mandrel. Lightly grind the valves until a smooth, even, uniform sealing surface of the appropriate inside and outside diameter is obtained on both the valve and the seat. Use only a hand held valve grinding mandrel with a suction cup, rotating the valve back and forth through about 45°, and then advancing the valve 45° before repeating this operation.

Installation

For installation, reverse the removal procedure. Pay attention to the following details.
Install valve stem seal no. 33.

Apply engine oil on valve stem and install it.

CAUTION: Be careful when valve stem is passed through sealing lips of valve stem seal.

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

CAUTION: An improperly locked valve spring will cause engine damage.
# CYLINDER BLOCK

## SERVICE TOOLS
<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>crankshaft locking tool...</td>
<td>529 035 821</td>
<td>153, 157, 159, 164</td>
</tr>
<tr>
<td>handle</td>
<td>420 877 650</td>
<td>162</td>
</tr>
<tr>
<td>piston circlip installer</td>
<td>529 035 765</td>
<td>150</td>
</tr>
<tr>
<td>pusher</td>
<td>420 876 502</td>
<td>162</td>
</tr>
</tbody>
</table>

## SERVICE PRODUCTS
<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>chisel gasket remover</td>
<td>413 708 500</td>
<td>163</td>
</tr>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>163</td>
</tr>
<tr>
<td>Loctite 5910</td>
<td>293 800 081</td>
<td>163</td>
</tr>
</tbody>
</table>
GENERAL
When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts. Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you re-assembly them together within their "group".

PROCEDURES

TIMING CHAIN

Inspection
Check timing chain on camshaft gear for excessive radial play.
Check chain condition for wear and rollers condition.

![Timing chain image](image)

1. Timing chain

If chain is excessively worn or damaged, replace it as a set (camshaft timing gear and timing chain).

Removal
Remove:
- engine oil (refer LUBRICATION SYSTEM)
- engine from vehicle (refer to ENGINE REMOVAL AND INSTALLATION)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING AND MAGNETO section)
- crankshaft (refer to CRANKSHAFT in this section)
- timing chain.

Installation
The installation is essentially the reverse of the removal procedure but, pay attention to the following details.

Ensure to perform proper valve timing. Lock crankshaft and camshaft at TDC (refer to CYLINDER HEAD section for the camshaft locking procedure).
Install chain then, install chain tensioner.

CAUTION: Improper valve timing will damage engine components.

CHAIN TENSIONER

Removal
NOTE: Removal of the intake manifold allows easier access to the chain tensioner, but is not necessary. Refer to INTAKE MANIFOLD AND INTER-COOLER section.
Remove:
- chain tensioner plug screw no. 18 with gasket ring no. 19
- chain tensioner no. 20.

![Chain tensioner image](image)

1. Plug screw
2. Gasket ring
3. Chain tensioner

Inspection
Check chain tensioner for excessive wear or cracks. Also check free movement of the chain tensioner piston.

Installation
The installation is essentially the reverse of the removal procedure but, pay attention to the following details.
Torque chain tensioner plug screw to 18 N·m (160 lbf·in).

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PISTON/CONNECTING ROD

Removal
Disassemble cylinder block as per procedure in this section. Refer to CYLINDER BLOCK.

NOTE: It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to INSPECTION below.

Remove connecting rod cap screws.

1. Connecting rod screws

NOTE: Before removing the connecting rod caps, mark them to remember the right position when reassembling.

Pull piston with connecting rod out of the cylinders.

Remove one piston circlip no. 8 and discard it.

1. Piston circlip

NOTE: The removal of both piston circlips is not necessary to remove piston pin.

Push piston pin no. 9 out of piston.

Detach piston no. 10 from connecting rod.

Inspection

Connecting Rod Big End Axial Play
Using a feeler gauge, measure distance between butting face of connecting rod and crankshaft counterweight. If the distance exceeds specified tolerance, replace the worn part.

1. Crankshaft
2. Feelor gauge

<table>
<thead>
<tr>
<th>CONNECTING ROD BIG END AXIAL PLAY mm (in)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
<td>0.150 (.06)</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
<td>0.302 (.01)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>0.5 (.02)</td>
</tr>
</tbody>
</table>

Connecting Rod/Piston Pin Clearance
Measure piston pin. Compare to inside diameter of connecting rod no. 5.
NOTE: For small end bearing sleeve replacement contact a machine shop. After installing a new small end bearing sleeve on the connecting rod, the inner diameter and the oil holes need to be machined to specification.

Connecting Rod Big End Radial Play
Measure inside diameter of connecting rod big end. Compare to crankshaft pin.

To measure the connecting rod big end diameter, use the OLD screws no. 11.

Install the OLD bearings no. 12 as they were mounted initially.

Do the torque procedure as described below.

If the connecting rod small end diameter is out of specification, replace small end bearing sleeve.
1. Measuring perpendicularly (90°) to piston pin axis
   A. 18 mm (0.709 in)

The measured dimension should be as described in the subsequent table. If not, replace piston.

<table>
<thead>
<tr>
<th>PISTON MEASUREMENT mm (in)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW NOMINAL</td>
<td>99.951 to 99.969 (3.935 to 3.936)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>99.90 (3.933)</td>
</tr>
</tbody>
</table>

Piston/Cylinder Wall Clearance
Adjust and lock a micrometer to the piston dimension.

1. Micrometer set to the piston dimension

With the micrometer set to the dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).

1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge

TYPICAL
1. Indicator set to 0 (zero)

Position the dial bore gauge 62 mm (2.44 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.

Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.

<table>
<thead>
<tr>
<th>PISTON/CYLINDER CLEARANCE mm (in)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW NOMINAL</td>
<td>0.024 to 0.056 (.0009 to 0.0022)</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
<td>0.090 (.004)</td>
</tr>
</tbody>
</table>

NOTE: Make sure used piston is not worn.
If clearance exceeds specified tolerance, rehone cylinder sleeve and replace piston ass'y by an oversize one.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

NOTE: It is not necessary to have all pistons replaced with an oversize if they are not all out of specification. Mixed standard size and oversize piston are allowed.

NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

Piston Pin
Using synthetic abrasive woven, clean piston pin from deposits.
Inspect piston pin for scoring, cracking or other damages.
Measure piston pin. See the following illustration for the proper measurement positions.

Piston Pin/Connecting Rod Bearing Clearance
Measure inside diameter of connecting rod.

<table>
<thead>
<tr>
<th>CONNECTING ROD SMALL END DIAMETER mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MINIMUM</td>
</tr>
<tr>
<td>NEW MAXIMUM</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
</tbody>
</table>

Use the piston circlip installer (P/N 529 035 765) to assemble the piston circlip.

CAUTION: Secure piston pin with new piston circlips.
NOTE: Take care that the hook of the piston circlip is positioned properly.

CORRECT POSITION OF THE PISTON CIRCLIP
Using piston ring compressor pliers, such as Snap-On RC-980, slide piston into cylinder.

Installation
For installation, reverse the removal procedure. Pay attention to the following details.
Apply engine oil on the piston pin.
Insert piston pin into piston and connecting rod.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

**CAUTION:** Install piston with punched arrow toward exhaust side.

1. Arrow toward exhaust side

Correctly install bearings and carefully clean split surface on both sides (cracked area).

1. Install bearing of connecting rod big end
2. Split surface of the connecting rod
3. Protrusion of bearing in line with connecting rod groove

Torque NEW connecting rod screws no. 11 as per following procedure:
- Install screws and torque to 45 N•m (33 lbf•ft). Do not apply any thread locker product.
- Finish tightening the screws with an additional 90° turn using an angle torque wrench.

**CAUTION:** Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. Knowing that the screws have been stretched from the previous installation, it is very important to use new screws at assembly.

1. Angle torque wrench

**PISTON RINGS**

Removal
n ass'y as described above.
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Subsection 11 (CYLINDER BLOCK)

Remove rings.

Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

<table>
<thead>
<tr>
<th>RING/PISTON GROOVE CLEARANCE mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW MINIMUM</strong></td>
</tr>
<tr>
<td>RECTANGULAR</td>
</tr>
<tr>
<td>TAPER-FACE</td>
</tr>
<tr>
<td>OIL SCRAPER RING</td>
</tr>
<tr>
<td><strong>NEW MAXIMUM</strong></td>
</tr>
<tr>
<td>RECTANGULAR</td>
</tr>
<tr>
<td>TAPER-FACE</td>
</tr>
<tr>
<td>OIL SCRAPER RING</td>
</tr>
<tr>
<td><strong>SERVICE LIMIT</strong></td>
</tr>
<tr>
<td>ALL</td>
</tr>
</tbody>
</table>

Ring End Gap

<table>
<thead>
<tr>
<th>RING END GAP mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW MINIMUM</strong></td>
</tr>
<tr>
<td>RECTANGULAR</td>
</tr>
<tr>
<td>TAPER-FACE</td>
</tr>
<tr>
<td>OIL SCRAPER RING</td>
</tr>
<tr>
<td><strong>NEW MAXIMUM</strong></td>
</tr>
<tr>
<td>RECTANGULAR</td>
</tr>
<tr>
<td>TAPER-FACE</td>
</tr>
<tr>
<td>OIL SCRAPER RING</td>
</tr>
<tr>
<td><strong>SERVICE LIMIT</strong></td>
</tr>
<tr>
<td>ALL</td>
</tr>
</tbody>
</table>

Measure position for ring end gap in the area of 8 to 16 mm (.315 to .630 in) from top of cylinder.

**NOTE:** In order to correctly position the ring in the cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. Replace ring if gap exceeds above described specified tolerance.

**Installation**

For installation, reverse the removal procedure. Pay attention to the following details.

Install the oil scraper ring first, then the taper-face ring with the word “TO” facing up, then the rectangular ring with the word “T” facing up.

**CAUTION:** Ensure that top and second rings are not interchanged

**NOTE:** Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

Check that rings rotate smoothly after installation.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.

Put a screwdriver or similar tool into the spark plug hole of cylinder no. 3 and feel when the piston reaches TDC.

CRANKSHAFT
Crankshaft Locking
Remove:
- intake manifold (refer to INTAKE MANIFOLD AND INTERCOOLER section)
- engine cover
- spark plugs
- crankshaft access plug screw.

In this position, the crankshaft can be locked by using crankshaft locking tool (P/N 529 035 821).

When finished, reinstall all removed parts.

Removal
Remove:
- engine oil (refer to LUBRICATION SYSTEM)
- engine from vehicle (refer to ENGINE REMOVAL AND INSTALLATION)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING AND MAGNETO section)
- starter gear (refer to PTO HOUSING AND MAGNETO section)
- starter drive
- oil suction pump (refer to LUBRICATION SYSTEM section)
- engine mounting brackets
- oil reservoir plug screws no. 1 with O-ring no. 2
NOTE: Before removing the connecting rod caps, mark them to remember the right position when reassembling. It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to PISTON/CONNECTING ROD in this section for the procedure.
Inspection
Replace crankshaft if the gears are worn or otherwise damaged.

Crankshaft Radial Play
Measure all crankshaft journals. Compare to inside diameter of crankshaft bearings (elsewhere in this section).

Crankshaft Pin
Measure all crankshaft pin diameters. Compare to inside diameter of connecting rod bearings (elsewhere in this section).

CRANKSHAFT PIN DIAMETER mm (in)

<table>
<thead>
<tr>
<th></th>
<th>NEW MINIMUM</th>
<th>NEW MAXIMUM</th>
<th>SERVICE LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45.032 (1.7729)</td>
<td>45.048 (1.7735)</td>
<td>45.029 (1.7728)</td>
</tr>
</tbody>
</table>

CRANKSHAFT PIN RADIAL CLEARANCE mm (in)

<table>
<thead>
<tr>
<th></th>
<th>SERVICE LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.09 (.0035)</td>
</tr>
</tbody>
</table>

CRANKSHAFT AXIAL CLEARANCE mm (in)

<table>
<thead>
<tr>
<th></th>
<th>NEW MINIMUM</th>
<th>NEW MAXIMUM</th>
<th>SERVICE LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.08 (.003)</td>
<td>0.22 (.009)</td>
<td>0.35 (.014)</td>
</tr>
</tbody>
</table>
Installation

For installation, reverse the removal procedure. Pay attention to following details.

**NOTE:** Before installing the crankshaft, make sure that the timing chain is on the crankshaft and the chain guide has been installed first. Those parts cannot be installed when the crankshaft is in place.

**CAUTION:** Crankshaft and balancer shaft marks have to be aligned.

For correct installation of the connecting rods, refer to **PISTON/CONNECTING ROD** in this section.

**CAUTION:** It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.

**CAUTION:** Never forget thrust washers no. 4 on center of crankshaft to control axial adjustment.

Insert thrust washers as soon as crankshaft is in place as per following illustration.

THRUST WASHER INSERT DIRECTION

1. Thrust washer

**CAUTION:** Thrust washers have to be flush with the cylinder block sealing surface.

Install cylinder block lower half. Refer to **CYLINDER BLOCK** in this section.

Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING AND MAGNETO section)
- starter gear (refer to PTO HOUSING AND MAGNETO section)
- starter drive
- oil suction pump (refer to LUBRICATION SYSTEM section)
- engine mounting brackets
- oil reservoir plug screws no. 1 with O-ring no. 2

CAUTION: Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).

ENGINE UPSIDE DOWN
1. Oil reservoir plug screw with O-ring

- cylinder block screws no. 3
- cylinder block lower half
- thrust washers no. 6

BALANCER SHAFT

Removal
Remove:
- engine oil (refer to LUBRICATION SYSTEM)
- engine from vehicle (refer to ENGINE REMOVAL AND INSTALLATION)
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

Balancer Shaft Axial Clearance
When assembling the cylinder-block, measure the balance shaft axial play:

Installation
For installation, reverse the removal procedure. Pay attention to following detail.

CAUTION: Balancer shaft and crankshaft marks have to be aligned.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

1. Mark on balancer shaft
2. Mark on crankshaft

**CAUTION:** Never forget thrust washers no. 6 on PTO side to control axial adjustment on balancer.

Insert thrust washers as soon as balancer shaft is in place as per following illustration.

**THRUST WASHER INSERT DIRECTION**
1. Thrust washer

**CAUTION:** Thrust washers have to be flush with the cylinder block sealing surface.

Install cylinder block lower half. Refer to CYLINDER BLOCK in this section.
Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.

1. O-ring
2. Crankshaft cover

**CAUTION:** Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).
Section 03 ENGINE  
Subsection 11 (CYLINDER BLOCK)

CYLINDER BLOCK

Disassembly
Remove:
- engine oil (refer to LUBRICATION SYSTEM)
- engine from vehicle (refer to ENGINE REMOVAL AND INSTALLATION)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING AND MAGNETO section)
- starter gear (refer to PTO HOUSING AND MAGNETO section)
- starter drive
- oil suction pump (refer to LUBRICATION SYSTEM section)
- balancer shaft (refer to BALANCER SHAFT elsewhere in this section)
- crankshaft (refer to CRANKSHAFT elsewhere in this section)
- piston with connecting rod (refer to PISTON/CONNECTING ROD elsewhere in this section).

Bearings
When bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the following illustration for an example:

Starter Drive Bearing
Check bearing no. 21 of starter drive assembly no. 22 in cylinder block and replace it if damaged.

TYPICAL
1. Bearing of starter drive assembly

Starter drive bearing can be easily removed from crankcase lower half using the following suggested tool or equivalent:
- Snap-on hammer puller including:
  - handle CJ93-1
  - hammer CJ125-6
  - claws CJ93-4.
Close puller claws so that they can be inserted in end bearing. Holding claws, turn puller shaft clockwise so that claws open and become firmly tight against bearing.

Slide puller hammer outwards and tap puller end. Retighten claws as necessary to always maintain them tight against bearing. Continue this way until bearing completely comes out.

**Inspection**

**Cylinder**

Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

**Cylinder Taper**

Measure cylinder bore and if it is out of specifications, rehone cylinder sleeve and replace piston ass'y with first oversize.

**NOTE:** It is not necessary to have all cylinders rehoned if they are not all out of specification. Mixed standard size and oversize cylinders are allowed.

Measure cylinder bore at 3 recommended positions. See the following illustration.

<table>
<thead>
<tr>
<th>CYLINDER TAPER IN DIAMETER mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW MAXIMUM</td>
</tr>
<tr>
<td>SERVICE LIMIT</td>
</tr>
</tbody>
</table>

Distance between measurements should not exceed the service limit mentioned above.

**Cylinder Out of Round**

Measure cylinder diameter in piston axis direction from top of cylinder. Take an other measurement 90° from first one and compare.

**NOTE:** Take the same measuring points as described in CYLINDER TAPER above.

**Borings**

To measure the wear of the crankshaft bearings no. 13 and no. 14 and balance shaft bearings no. 15, both cylinder block halves with OIL bearings have to be screwed together as per tightening procedure described below.

Measure the inside diameter of the bearings with a bore gauge.
Section 03 ENGINE
Subsection 11 (CYLINDER BLOCK)

<table>
<thead>
<tr>
<th>CRANKSHAFT BEARING INSIDE DIAMETER mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVICE LIMIT</td>
</tr>
<tr>
<td>50.1 [1.9724]</td>
</tr>
</tbody>
</table>

Assembly

For assembly, reverse the disassembly procedure. Pay attention to the following details.

Torque oil spray nozzle to 16 N•m (160 lbf•in).

To install starter drive bearing no. 21 of starter drive assembly, use pusher (P/N 420 876 502) and handle (P/N 420 877 650).

Replace bearings if they are out of specifications.

Oil Spray Nozzles

Remove oil spray nozzle no. 16 and banjo screw no. 17 from cylinder block.

Check if ball inside moves freely in the banjo screw. Clean Nozzle and banjo screw from dirt and debris.
Bearings have to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.

CAUTION: Do not use other products to seal crankcase. Do not use an activator with the Loctite 5910. Using other products or non-silicone-based sealant over a previously sealed crankcase with Loctite 5910 will lead to poor adhesion and possibly a leaking crankcase.

NOTE: Refer to the product label for the sealant curing time. Respect the manufacturer's recommendations prior to start engine.

Use a plexiglass plate and apply some sealant on it. Use a soft rubber roller (50 - 75 mm (2 - 3 in)) (available in arts products suppliers) and then roll the sealant to get a thin uniform coat on the plate (spread as necessary). When ready, apply the sealant on crankcase mating surfaces.

Apply engine oil on all bearings, in the bottom area of the cylinder bore and also on the band of the piston ring compressor tool.

For proper installation of pistons, refer to PISTON/CONNECTING ROD in this section.

NOTE: Before installing the crankshaft, make sure that the timing chain is on the crankshaft and that the chain guide has been installed first. Those parts cannot be installed after as the crankshaft is in place.

Clean oil passages and make sure they are not clogged.

Clean all metal components in a solvent.

Cylinder block mating surfaces are best cleaned using a combination of the chisel gasket remover (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

CAUTION: Do not wipe with rags. Use a new clean cloth only.

IMPORTANT: When beginning the application of the crankcase sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.

NOTE: It is recommended to apply this specific sealant as described here to get an uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute this sealant.

Use the silicone-based Loctite 5910 (P/N 293 800 081) on mating surfaces.

Do not apply in excess as it will spread out inside crankcase.

Tighten cylinder block screws as per following procedure:

Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads.

Torque cylinder block screws no. 3 to 40 N•m (29 lbf•ft) following sequence 1 to 8 and then to 55 N•m (41 lbf•ft) (repeat sequence).

Torque cylinder block screws no. 7 to 22 N•m (17 lbf•ft) following sequence 9 to 23.
NOTE: Before continuing the assembly process, the axial clearance of balancer shaft and crankshaft has to be checked. Refer to CRANKSHAFT and BALANCER SHAFT in this section for the procedure.

Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.

CAUTION: Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).
OVERVIEW

ENGINE MANAGEMENT SYSTEM
ROTAX 1503 4-TEC

<table>
<thead>
<tr>
<th>ECM</th>
<th>EC - Engine Control Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPFM</td>
<td>MPFM - Multi-Purpose Electronic Module</td>
</tr>
<tr>
<td>KS</td>
<td>KS - Knock Sensor</td>
</tr>
<tr>
<td>CPS</td>
<td>CPS - Crankshaft Position Sensor</td>
</tr>
<tr>
<td>CPS</td>
<td>CPS - Coolant Temperature Sensor</td>
</tr>
<tr>
<td>CPS</td>
<td>CPS - Crankshaft Position Sensor</td>
</tr>
<tr>
<td>MAPS</td>
<td>MAPS - Exhaust Gas Temperature Sensor</td>
</tr>
<tr>
<td>MATS</td>
<td>MATS - Manifold Air Temperature Sensor</td>
</tr>
<tr>
<td>TOPS</td>
<td>TOPS - Tip-Over Protection System</td>
</tr>
<tr>
<td>Con.A</td>
<td>Con.A - Connector for Engine Wiring Harness</td>
</tr>
<tr>
<td>Con.B</td>
<td>Con.B - Connector for MPFM Connection</td>
</tr>
</tbody>
</table>
GENERAL
There are 3 main systems in interaction with the engine management system:
1. air induction system
2. fuel delivery system
3. electrical system.

OPERATING PRINCIPLE

AIR INDUCTION

Throttle Body
A 52 mm throttle body is mounted on the intake manifold. Fitted on the throttle body, the TPS and the idle bypass valve allow the ECM to control the RPM while the throttle plate is closed.

4-TEC Naturally-Aspirated Engine
Air for combustion is drawn directly at the front of the engine through the throttle body. The air flow is controlled by a throttle plate and an idle bypass valve. The air continues through the intake manifold, which contains the flame arrester and goes into the cylinder head.

52 MM THROTTLE BODY
1. Idle bypass valve
2. Throttle position sensor (TPS)

4-TEC Supercharged Engine
Air for combustion is drawn at the back of the engine by a mechanically-driven supercharger. The compressed air flows through the throttle body and is controlled by a throttle plate and an idle bypass valve. The air continues through the intake manifold, which contains the water/air intercooler (which cools down the intake air) and goes into the cylinder head.

1. Supercharger
2. Intercooler
3. Throttle body

Intake Manifold
The intake manifold is mounted on the RH side of the cylinder block. It provides support for the fuel injectors, the fuel rail, the ECM, the flame arrester and the throttle body. The intake manifold is a resonator between the throttle body and the cylinder head.
INTAKE MANIFOLD (4-TEC NATURALLY ASPIRATED)
1. Engine Control Module (ECM)
2. Fuel rail
3. Injector
4. Throttle body
5. Ignition coil
6. Manifold air pressure sensor (MAPS)
7. Manifold air temperature sensor (MATS)

INTAKE MANIFOLD (4-TEC SUPERCHARGED)
1. Engine Control Module (ECM)
2. Fuel rail
3. Injector
4. Throttle body
5. Ignition coil
6. Manifold air pressure sensor (MAPS)
7. Intake manifold
8. Intercooler outlet
9. Intercooler inlet
10. Manifold air temperature sensor (MATS)

Flame Arrester
The flame arrester is a tube inside the intake manifold. It prevents flames leaving through the intake system if the engine backfires.

Intercooler
The intercooler is a tube which comprises smaller tubes. Water taken from the outside of the watercraft is pumped through the smaller tubes and cools down the intake air. Therefore the air density is higher and you get more air into the engine.

FUEL SYSTEM
When the intake valve reaches the correct position, the ECM (Engine Control Module) opens the fuel injector and fuel is discharged into the intake port at the intake manifold by the high fuel pressure inside the fuel rail. The air/fuel mixture enters then the combustion chamber through the open intake valve. This mixture is then ignited by the spark plug.

Fuel Rail
The fuel rail is a small tube on which the three injectors are mounted. It ensures all the time, that enough fuel at the right pressure can be delivered to the fuel injectors. The fuel rail is fed by the fuel pump.
Fuel Injector
Three fuel injectors (one per cylinder) are used to inject fuel into the intake ports of the cylinder head.

Fuel Pump Module
The fuel pump module is located inside the fuel tank. The module includes the fuel pump, fuel pressure regulator and fuel level sensor.

The fuel pump provides fuel pressure and flow rate to the system.

Fuel Pressure Regulator
A fuel pressure regulator controls the pressure in the system and allows the excess of fuel to return to the fuel tank. The fuel pressure regulator regulates the fuel pressure within 290 - 310 kPa (42 - 45 PSI) for all 4-TEC Naturally-Aspirated, supercharged engines and at 386 - 414 kPa (56 - 60 PSI) for intercooled engines.

Fuel Filter
A mesh filter is located at the bottom of the fuel pump module inside the fuel tank.

ELECTRICAL SYSTEM
The complete electrical system is managed by micro-controllers working together. Overall, the Multi-Purpose Electronic Module (MPEM) manages the vehicle electrical system, while the engine control module (ECM) is the brain of the engine management system (EMS).

The information center is used to display information that comes both from MPEM and ECM.
A communication link is used between the electronic modules to communicate with each other. It consists of a twisted pair of wires (WHITE/RED and WHITE/BLACK).
For communication link troubleshooting, refer to GAUGE, SENSORS AND FUSES in ELECTRICAL SYSTEM section.
The communication link is also used to communicate informative messages, monitoring and diagnostic codes to the information center and to B.U.D.S. software (Bombardier utility and diagnostic system) is used for diagnosing and troubleshooting the system.

Multi-Purpose Electronic Module (MPEM)
The MPEM distributes power from battery to all accessories and the ECM. Accessories are protected by fuses integrated in the MPEM. Fuse ratings is identified besides their holder.

IMPORTANT: Some components are continuously powered with the supply from the battery through the MPEM. The ECM switches the ground to complete the electrical circuits it controls. Take this into account when troubleshooting the electrical system.

Gauges Current Supply
When installing the safety lanyard, it activates the reading of gauges without the engine running. It will give access to most functions of the information center gauge without starting the engine.
Gauges are supplied with current whenever the safety lanyard cap is installed on its post.

Fuel Pump Current Supply
The fuel pump will be activated for 2 seconds to build up pressure in the fuel injection system, only when connecting the safety lanyard cap to the post.

Addition of Electrical Accessories
Every time an accessory is added such as an electric bilge pump or a VTS for instance, it must be “registered” using B.U.D.S. to activate it in the MPEM. Otherwise, the accessory will not work. Use B.U.D.S. Refer to GAUGE, SENSORS AND FUSES.

Low-Fuel Level Warning Device
When the fuel level in the reservoir is low, the fuel level sensor transmits a signal to the MPEM. The MPEM sends out signals to the beeper and to the information center.

ECM (Engine Control Module)

The ECM is mounted on the intake manifold. It controls all engine management functions, by processing the information given by various sensors.
ECM and MPEM Interaction with the Electrical System

- TPS
- MAPS
- MATS
- CTS
- EGTS
- KS
- OPS
- CPS
- DESS
- IDLE BYPASS VALVE

- START/STOP SWITCH
- STARTING SOLENOID
- FUEL PUMP
- FUEL INJECTORS
- IGNITION COILS
- TOPS SWITCH
- CAPS

\[1\) These components are shared between the MPEM and the ECM. The MPEM supplies the power while the ECM controls and completes the circuit by switching it to the ground.

COLOR CODE
\begin{tabular}{|c|c|}
\hline
WH & WHITE \\
BK & BLACK \\
RE & RED \\
\hline
\end{tabular}
ENGINE MANAGEMENT SYSTEM (EMS)

A highly advanced EMS has been used to ensure a high power output with cleanest combustion.

ELECTRONIC FUEL INJECTION

The ECM reads the signals from different sensors which indicate engine operating conditions at millisecond intervals.

Signals from sensors are used by the ECM to determine the injection parameters (fuel maps) required for optimum air-fuel ratio.

The CPS, the MATS, the MAPS and the TPS are the primary sensors used to control the injection and ignition timing. Other sensors (like temperature sensors, etc.) are used for secondary input.

NOTE: The EGTS, CTS and OPS sensors do not provide control inputs to the ECM. Their sole purpose is to protect the engine components by emitting a warning signal in the event of overheating or low oil pressure.

IGNITION SYSTEM

The ignition system is a digital inductive type. The ECM controls the ignition system parameters, such as ignition timing (for each cylinder separately), spark duration and firing order to achieve the proper engine requirements.

Ignition Timing

The ECM is programmed with data (it contains ignition mappings) for optimum ignition timing under all operating conditions. Using engine operating conditions provided by the sensors, the ECM controls the ignition timing for optimum engine operation. No ignition timing adjustment can be performed.

Ignition Coils

Three separate ignition coils induce voltage to a high level in the secondary windings to produce a spark at the spark plug.

The ignition coils receive input from the ECM. Each coil provides high voltage to its corresponding spark plug.

This ignition system allows spark plugs to spark independently.

All three ignition coils are located on the cylinder head directly on the spark plugs.

NOTE: To test ignition coils, refer to IGNITION SYSTEM subsection.

Knock Sensor

A knock sensor is mounted on the cylinder block behind the intake manifold. It detects specific vibration that would be typically generated by engine detonation. If detonation occurs, the knock sensor detects it and the ECM retards the ignition advance temporarily (it goes in a specific model) until detonation stops. The ECM is able to evaluate the knocking cylinder and modifies the ignition advance just on the detonating one.

ENGINE MODES OF OPERATION

The ECM controls different operation modes of the engine to allow proper operation for all possible conditions:

Engine Starting

If the ECM recognizes a valid safety lanyard, it allows engine to start when the start/stop button is pressed.

If start/stop button is held after engine has started, the ECM automatically stops the starter when the engine speed reaches 1600 RPM.

If start button is activated while the throttle lever is depressed more than 65%, the engine will not be allowed to start.

Engine RPM Limiter

The ECM will limit the maximum engine speed.

Drowned Mode

If engine is fuel-flooded and does not start, this special mode can be activated to prevent fuel injection and ignition while cranking. Proceed as follows to activate it.
With safety lanyard on its post while engine is stopped, press and HOLD throttle lever.
Press the start/stop button. The mode is now on.
Releasing throttle lever will bring back to its normal mode.
If engine does not start, it may be necessary to remove spark plugs and crank engine with rags over spark plug holes. Refer to IGNITION SYSTEM subsection.

Limp Home Modes
Besides the signals as seen above, the ECM may automatically uses default parameters for the engine management to ensure the adequate operation of the watercraft if a component of the fuel injection system is not operating properly.
The following components failure will trigger a limp home mode: CTS, EGTS and OPS.
When minor fault occurs, the fault and message/beeper will disappear automatically, if the condition does not exist anymore.
Releasing throttle and letting the engine returning at idle speed may allow normal operation to come back. If it does not work, try removing and re-installing the safety lanyard on its post.
Depending on the malfunction, the watercraft speed may be reduced and not allowed to reach its usual top speed. The engine speed will be limited to 2500 or 5000 RPM.
These performance-reduced modes allow the rider to go back home which would not be possible without this advanced system.
If a fault occurs and involves a limp home mode operation, the engine management system will reduce engine RPM gradually to the required level.

MONITORING SYSTEM
The ECM monitors the electronic components of the fuel injection system and also the engine components of the electrical system. When a fault occurs, it sends visual messages through the information center and/or audible signals through a beeper to inform you of a particular condition.

Low-Oil Pressure Warning Device
When the oil pressure falls under a certain level, the ECM sends out signals to the beeper and to the information center. Additionally the engine goes in limp home mode.

High Coolant Temperature and EGTS Warning Device
When the coolant temperature or the exhaust gas temperature is getting to high, the ECM sends out signals to the beeper and to the information center.

DIAGNOSTIC MODE
The malfunctions are recorded in the memory of the ECM. The memory of the ECM can be checked using the B.U.D.S. software to see the fault codes. The ECM and the B.U.D.S. are able to communicate through a connector on the vehicle. Refer to the EMS DIAGNOSTIC AND COMMUNICATION TOOLS section.
As shown in the 1503 4-TEC CONTROL SYSTEM diagram, the ECM is the central point of the engine management system. It reads the inputs, makes computations, uses pre-determined parameters and sends the proper signals to the outputs for proper engine management.
EMS DIAGNOSTIC AND COMMUNICATION TOOLS

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication kit</td>
<td>529 035 981</td>
<td>179</td>
</tr>
<tr>
<td>DESS post interface</td>
<td>529 036 019</td>
<td>181</td>
</tr>
<tr>
<td>Diagnostic cable</td>
<td>710 000 851</td>
<td>181</td>
</tr>
<tr>
<td>MPI-2</td>
<td>529 036 018</td>
<td>181</td>
</tr>
<tr>
<td>Optional extension cable</td>
<td>529 035 697</td>
<td>181</td>
</tr>
<tr>
<td>Optional extension cable</td>
<td>529 035 703</td>
<td>179</td>
</tr>
</tbody>
</table>

GENERAL

Here is the basic order suggested to diagnose a suspected engine management or fuel injection related problem.
- Check the TROUBLESHOOTING section to have an overview of problems and suggested solutions.
- Check if there is a message displayed by the vehicle information center. If so, use B.U.D.S. software and look for fault codes to diagnose the trouble.

NOTE: Fault codes, the letter P — followed by 4 digits (P-1234), are displayed in the information center for troubleshooting.
- Check all fuses.
- Check fuel pressure.
- Check spark plugs condition.
- Check fuel pump pressure.
- Check all connections of the wiring harness.
- Refer to ADJUSTMENT AND REPAIR PROCEDURE.

Terminology

Some documents or softwares use technical terms that may be different from the one used in this manual. The following table will help to find the equivalence.

<table>
<thead>
<tr>
<th>TERMS USED IN THIS MANUAL</th>
<th>TERMS USED IN OTHER DOCUMENTS SOFTWARES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camshaft</td>
<td>Cam</td>
</tr>
<tr>
<td>Communication link</td>
<td>CAN</td>
</tr>
<tr>
<td>Crankshaft</td>
<td>Crank</td>
</tr>
<tr>
<td>CTS (Coolant Temperature Sensor)</td>
<td>WTS (Water Temperature Sensor)</td>
</tr>
<tr>
<td>ECM</td>
<td>ECU</td>
</tr>
<tr>
<td>EGTS (Exhaust Gas Temperature sensor)</td>
<td>ETS (Exhaust Temperature Sensor)</td>
</tr>
<tr>
<td>Idle bypass valve</td>
<td>DLA (Digital Linear Actuator)</td>
</tr>
<tr>
<td></td>
<td>Idle actuator</td>
</tr>
<tr>
<td></td>
<td>Idle air control valve</td>
</tr>
<tr>
<td></td>
<td>Idle valve</td>
</tr>
<tr>
<td>Information center</td>
<td>Cluster</td>
</tr>
<tr>
<td>MAPS (Manifold Air Pressure Sensor)</td>
<td>APS (Air Pressure Sensor) or</td>
</tr>
<tr>
<td></td>
<td>(Atmospheric Pressure Sensor)</td>
</tr>
<tr>
<td>MATS (Manifold Air Temperature Sensor)</td>
<td>ATS (Air Temperature Sensor) or</td>
</tr>
<tr>
<td></td>
<td>(Intake manifold Temperature Sensor)</td>
</tr>
</tbody>
</table>
# DIAGNOSTIC

## MONITORING SYSTEM

When one of the below conditions occurs, the monitoring system emits the following beep signals.

<table>
<thead>
<tr>
<th>CODED SIGNALS</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
</table>
| 2 short beeps (while installing DESS key on post). | - Confirms key signal operation.     
- Key is recognized by the ECM.     
- Good contact between key and DESS post. | - Engine can be started.                                                                                      |
| 1 long beep (while installing key on post). | - Bad DESS system connection.     
- Wrong key.     
- Defective key.     
- Dried salt water or dirt in key.     
- Defective DESS post.     
- Improper operation of ECM or defective wiring harness. | - Reinstall key correctly over post.                                                                                       
- Use a key that has been programmed for the watercraft. If it does not work, check key with B.U.D.S. Replace key if defective. 
- Use another programmed key.                                                                                       
- Clean key to remove salt water.                                                                                       
- Refer to DESS section.                                                                                              
- Refer to ADJUSTMENT AND REPAIR section.                                                                                   |
| 4 short beeps every 3 seconds interval. | - DESS key has been left on its post without starting engine or after engine was stopped. | - To prevent battery discharge, remove the key from its post. |
| 2 seconds beep every 15 minutes interval. | - Watercraft is upside down.     
- Wrong information center installed.     
- Battery voltage too low.     
- Engine coolant temperature sensor or circuit malfunction.     
- Exhaust temperature sensor or circuit malfunction.     
- Engine oil pressure sensor or circuit malfunction.     
- TOPS, MAP, CPS, TPS, or knock sensor or circuit malfunction.     
- Fuel injector or circuit malfunction.     
- Ignition coil or circuit malfunction.     
- Fuel pump or circuit malfunction.     
- Starter solenoid circuit malfunction. | - Turn watercraft upright. If it does not work, check the TOPS switch. Refer to ADJUSTMENT AND REPAIR section. 
- Refer to GAUGE, SENSORS AND FUSES. 
- Refer to CHARGING SYSTEM section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to ADJUSTMENT AND REPAIR section. 
- Refer to STARTING SYSTEM section. |
| A 2 seconds beep every 5 minutes interval. | - Low fuel level.     
- Fuel tank level sensor or circuit malfunction. | - Refer to GAUGE, SENSORS AND FUSES section. 
- Refer to GAUGE, SENSORS AND FUSES section. |
| Continuously beeps. | - High engine coolant temperature. 
- High exhaust temperature. 
- Low engine oil pressure. | - Refer to COOLING SYSTEM section. 
- Refer to EXHAUST SYSTEM section. 
- Refer to LUBRICATION SYSTEM section. |
FAULT CODES

General

The faults registered in the MPEM/ECM are kept when the battery is disconnected.

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the MPEM/ECM using the B.U.D.S. software. This will properly reset the appropriate counter(s). This will also records that the problem has been fixed in the MPEM/ECM memory.

Many fault codes at the same time is likely to be burnt fuse(s).

For more information pertaining to the code faults (state, count, first, etc.) and report, refer to B.U.D.S. online help.

When using the service action suggested in the Fault section of B.U.D.S., the system circuits are referred as 4-23 for instance. It means Amp connector no. 4 and the circuit wire no. 23 as found in the wiring diagram.

When they are referred as A-41, it means connector “A” on the ECM and the circuit 41.

TPS (Throttle Position Sensor) Faults

Faults which are reported in B.U.D.S. fall into two groups: TPS faults and adaptation faults. These are displayed on the B.U.D.S. system as TPS OUT OF RANGE and TPS ADAPTATION FAILURE.

TPS “OUT OF RANGE” Fault

It is caused by the sensor reading going out of its allowable range. This fault can occur during the whole range of movement of the throttle.

To diagnose this fully, it is recommended to operate the throttle through its full range. It is also recommended to release the throttle quickly as this may also show up a fault that is intermittent.

<table>
<thead>
<tr>
<th>POSSIBLE CAUSES</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check if connector is disconnected from TPS.</td>
<td>Fix</td>
</tr>
<tr>
<td>Check if sensor is loose.</td>
<td>Fix and reset Closed Throttle and Idle Actuator</td>
</tr>
<tr>
<td>Inspect sensor for damage or corrosion.</td>
<td>Replace and reset Closed Throttle and Idle Actuator</td>
</tr>
<tr>
<td>Inspect wiring (voltage test).</td>
<td>Repair</td>
</tr>
<tr>
<td>Inspect wiring and sensor (resistance test).</td>
<td>- If bad wiring, repair.</td>
</tr>
<tr>
<td></td>
<td>- If bad TPS, replace and reset Closed Throttle and Idle Actuator</td>
</tr>
<tr>
<td>Test sensor operation (wear test).</td>
<td>Replace and reset Closed Throttle and Idle Actuator</td>
</tr>
</tbody>
</table>

TPS “ADAPTATION FAILURE” Fault

It is caused by the idle position moving out of an acceptable range.

Following failures can be effected by a TPS “Adaptation Failure”:
- Idle speed is out of range.
- Engine stops, when throttle is released quickly.
- Engine runs inconsistent in low part load or low RPM.

<table>
<thead>
<tr>
<th>POSSIBLE CAUSES</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor has been replaced and TPS closed position not reset.</td>
<td>Reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>Throttle body has been replaced and TPS closed position not reset.</td>
<td>Reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>ECM has been replaced and TPS closed position not reset.</td>
<td>Reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>Throttle cable too tight.</td>
<td>Fix and reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>Sensor is loose.</td>
<td>Fix and reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>Throttle bracket is loose.</td>
<td>Fix and reset Closed Throttle and Idle Actuator.</td>
</tr>
<tr>
<td>Adjustment screw worn or loose.</td>
<td>Change throttle body.</td>
</tr>
</tbody>
</table>
Supplemental Information for Some Specific Faults

Communication link fault code 1681: Sometimes the information center does not synchronize fast enough for the MPEM. That brings this fault code. Simply clear the fault and try again.

ECM fault codes P0601, P0602, P0604 and P605: These codes may occur in the following situations:
- Electrical noise is picked up by the ECM. Ensure that all connections are in good condition, also grounds (battery, ECM, engine and ignition system), they are clean and well tightened and that all electronic components are genuine — particularly in the ignition system. Installing resistive caps, non-resistive spark plugs or improper knock sensor wiring/routing may lead to generate this fault code.
- Electrical noise might also lead engine to occasional cutout without generating a fault code when engine is restarted. When looking at the fault code, pay attention to the “count” value in the software B.U.D.S. A value between 1 and 9 confirms an electrical noise problem. A value of 10 and above will generate a fault code.
- When installing a new ECM. It is not properly programmed from the factory. The ECM must be returned to be properly “activated”.
- If everything is in good condition, try a new ECM.

Fault code P1513: Wrong ECM or information center. Installed part is not appropriate for the vehicle. Engine will crank but will not start. Refer to parts catalogs for proper part according to vehicle.
COMMUNICATION TOOLS

Two different MPI (Multi Purpose Interface) can be used with B.U.D.S. software: MPI and MPI-2. Refer to the following for proper connections.

NOTE: The MPEM programmer does not work on 4-TEC models.

MPI (Multi-Purpose Interface)

<table>
<thead>
<tr>
<th>PART REQUIRED</th>
<th>OPERATION TO PERFORM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALL</td>
</tr>
<tr>
<td>PC computer</td>
<td>X</td>
</tr>
<tr>
<td>B.U.D.S. software</td>
<td>X</td>
</tr>
<tr>
<td>Use latest version available on BOSWeb</td>
<td></td>
</tr>
<tr>
<td>Communication kit (P/N 529 035 981)</td>
<td>X</td>
</tr>
<tr>
<td>Optional extension cable (P/N 529 035 703)</td>
<td>X</td>
</tr>
</tbody>
</table>

MPI Supply

The MPI can use the vehicle power for its supply. Four AA batteries or an AC/DC power supply can also be used. Make sure to respect MPI specification if a power supply is used.

Connections with Vehicle

WARNING

If the computer you are using is connected to the power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the computer.

Remove protective cap from the 6-pin connector.

Connect the 6-pin adapter to the vehicle connector.

Connect the diagnostic cable to the 6-pin adapter.

Connect the other diagnostic cable connector to MPI connector.

Connect serial cable to MPI connector.
Connect remaining serial cable connector to the serial port of a PC (personal computer).

Use B.U.D.S. software as described further in B.U.D.S. SOFTWARE.
## Section 04 ENGINE MANAGEMENT (1503 4-TEC)

### Subsection 02 (EMS DIAGNOSTIC AND COMMUNICATION TOOLS)

**MPI-2 (Multi-Purpose Interface)**

<table>
<thead>
<tr>
<th>PART REQUIRED</th>
<th>OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PROGRAMMING KEY(S)</td>
</tr>
<tr>
<td></td>
<td>ENTERING CUSTOMER INFORMATION</td>
</tr>
<tr>
<td></td>
<td>SETTING IGNITION TIMING/CLOSED TPS</td>
</tr>
<tr>
<td></td>
<td>READING FAULT CODES</td>
</tr>
<tr>
<td></td>
<td>ACTIVATION OF COMPONENTS (IGNITION COIL, FUEL PUMP ETC.)</td>
</tr>
<tr>
<td>PC computer</td>
<td>X</td>
</tr>
<tr>
<td>B.U.D.S. software Use latest version available on BOSSWeb</td>
<td>X</td>
</tr>
<tr>
<td>MPI-2 (P/N 529 036 018)</td>
<td>X</td>
</tr>
<tr>
<td>Optional extension cable (P/N 529 035 697)</td>
<td>X</td>
</tr>
<tr>
<td>Diagnostic cable (P/N 710 000 851)</td>
<td>X</td>
</tr>
<tr>
<td>DESS post interface (P/N 529 036 019)</td>
<td>X</td>
</tr>
</tbody>
</table>
MPI-2 Supply
The MPI can use the vehicle power for its supply. Two AA batteries or an AC/DC power supply can also be used. Make sure to respect MPI-2 specification if a power supply is used.

Connections with Vehicle

**WARNING**
If the computer you are using is connected to the power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the computer.

Remove protective cap from the 6-pin connector.

NOTE: To program key(s), install DESS post interface between vehicle 6-pin connector and MPI-2. You can leave post interface connected for all operations you do with B.U.D.S.

Connect diagnostic cable to vehicle connector.

Use B.U.D.S. software as described further in B.U.D.S. SOFTWARE.

**B.U.D.S. SOFTWARE**

B.U.D.S. (Bombardier Utility and Diagnostic Software) is designed to program key(s), to allow electrical component inspection, diagnostic options and adjustments such as the closed throttle.

For more information pertaining to the use of the B.U.D.S. software, use its help which contains detailed information on its functions.

When using the service action suggested in the Fault section of B.U.D.S., for instance, a system circuit referred to as A-35, means connector “A” on the ECM and the contact 35.

Ensure to use the latest B.U.D.S. version available on BossWeb.

When using the B.U.D.S. software:
- Connect key to vehicle DESS post to activate the communication.
- Ensure that 115200 speed is properly selected in “MPI” under “Choose speed”.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 02 (EMS DIAGNOSTIC AND COMMUNICATION TOOLS)

Changes in ECM

Anytime a change is brought in ECM through B.U.D.S., there will be an “EMS Tracking” message that will say “Remove key from vehicle”. When this occurs, remove the DESS key from its post and wait until the message disappears (it lasts approximately 15 seconds after key removal).

NOTE: If you are using an old PC computer, it may be necessary to use a slower speed so that the communication works.

- Ensure that the protocol “Kw2000” is properly selected in “MPI” under “Choose protocol.”

- Ensure the status bar shows the Kw2000 and the number 3 to the right.

CONNECTION SUCCESSFUL

Number 3 means that 3 “ECUs” are connected (Information center, MPEM and ECM).

If an “X” is shown, the DESS key is not installed on its post or there is a problem with all “ECUs”. Ensure B.U.D.S. is working properly and check connections on MPI and watercraft.

- Information center, MPEM or ECM is not powered-up
- Wrong protocol is used
- Bad connection between MPI and MPEM.
ADJUSTMENT AND REPAIR PROCEDURES

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM adapter</td>
<td>420 277 010</td>
<td>188</td>
</tr>
<tr>
<td>Fluke 111</td>
<td>529 035 868</td>
<td>197</td>
</tr>
<tr>
<td>fuel hose disconnect tool</td>
<td>529 036 037</td>
<td>195</td>
</tr>
<tr>
<td>tachometer</td>
<td>529 014 500</td>
<td>191</td>
</tr>
</tbody>
</table>

SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loctite 243</td>
<td>293 800 060</td>
<td>200</td>
</tr>
</tbody>
</table>

GENERAL

Engine problems are not necessarily related to the engine management system.

It is important to ensure that the mechanical integrity of the engine/propulsion system is present:
- good jet pump/drive system operation
- good engine compression and properly operating mechanical components, no leaks etc.
- fuel pump connection and fuel lines without leaks.

Check the chart in TROUBLESHOOTING section to have an overview of problems and suggested solutions.

When replacing a component, always check its operation after installation.

Whenever watercraft is out of water and engine is running, ensure to supply water through the connector on jet pump support to cool down exhaust system.

CAUTION: Never run engine without supplying water to the exhaust system when watercraft is out of water.

FUEL SYSTEM

⚠️ WARNING

The fuel system of a fuel injection system holds much more pressure than on a carbureted watercraft. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here. Note that some hoses may have more than one clamp at their ends. Ensure to reinstall the same quantity of clamps at assembly.

Use the B.U.D.S. software to release the fuel pressure in the system. Look in the Activation tab.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

**WARNING**
Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Proceed with care when removing/installing high pressure test equipment or disconnecting fuel line connections. Use the B.U.D.S. software to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the bilge. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Always disconnect battery prior to working on the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

Always disconnect battery properly prior to working on the fuel system. Refer to CHARGING SYSTEM section.

When the job is done, ensure that hoses from fuel rail going to fuel pump are properly secured in their supports. Then, pressurize the fuel system. Perform the high pressure test as explained in this section and pressurize the fuel separator and fuel lines as explained in FUEL SYSTEM section. Properly reconnect the battery.

**WARNING**
Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the safety lanyard on the DESS post. Always perform the high pressure test if any component has been removed. A pressure test must be done before connecting the safety lanyard. The fuel pump is started each time the safety lanyard is installed and it builds pressure very quickly.

To check fuel rail for leaks, first pressurize the system then spray soapy water on all hose connections, regulators and injectors. Air bubbles will show the leaking area. Check also for leaking fuel or fuel odor.

**WARNING**
If any gasoline leak and/or odor are present, do not start the engine. Repair the leak.

**WARNING**
Never use a hose pincher on high pressure hoses.

Fuel Rail
Pressure at fuel rail is supplied and controlled by the fuel pump module. Refer to FUEL TANK AND FUEL PUMP subsection for pressure test.

There is a valve on fuel inlet hose connected to the fuel rail. This valve is for manufacturing purpose only.

**WARNING**
PRESSURIZED FUEL. Do not unscrew protective cap. Do not operate the watercraft without cap properly installed.

Fuel Rail Replacement
Refer to FUEL INJECTOR in this section.

Fuel Pump
Refer to FUEL SYSTEM section.

**ELECTRICAL SYSTEM**
It is important to check that the following electrical system components are functioning properly:
- battery
- fuses
- DESS
- ignition (spark)
- ground connections
- wiring connectors.

It is possible that a component seems to operate in static condition but in fact, it is defective. In this case, the best way to solve this problem is to remove the original part and replace it with one which is in good condition.

Never use a battery charger to substitute temporarily the battery, as it may cause the MPEM/ECM to work erratically or not to work at all. Check related-circuit fuse solidity and condition with an ohmmeter. Visual inspection could lead to false results.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

⚠️ WARNING
All electrical actuators (idle bypass valve, injectors, fuel pump, ignition coils and starter solenoid) are permanently supplied by the battery when the safety lanyard is installed. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

To perform verifications, a good quality multimeter such as Fluke 111 (P/N 529 035 868) should be used.

Pay particular attention to ensure that terminals are not out of their connectors or out of shape. The troubleshooting procedures cover problems not resulting from one of these causes.

⚠️ WARNING
Ensure all terminals are properly crimped on wires and connector are properly fastened.

Before replacing a MPEM or ECM, always check electrical connections. Make sure that they are very tight and they make good contact and that they are corrosion-free. Check if wiring harness shows any signs of scoring. Particularly check MPEM and ECM ground connections. Ensure that contacts are good and clean. A “defective module” could possibly be repaired simply by unplugging and replugging the MPEM or ECM. The voltage and current might be too weak to go through dirty wire terminals. Check carefully if terminals show signs of moisture, corrosion or if they look dull. Clean terminals properly and then coat them prior to assembling as follows:

NOTE: Do not apply dielectric grease or any other lubricant on the ECM or MPEM connectors.

Other connectors: Apply a silicon-based dielectric grease or other appropriate lubricant. If the newly replaced MPEM or ECM is working, try the old one and recheck if it works.

Ensure that all electronic components are genuine — any modification on the wiring harness may lead to generate fault codes or bad operation.

NOTE: For diagnostics purposes, use B.U.D.S. software. See EMS DIAGNOSTIC AND COMMUNICATION TOOLS subsection.

After a problem has been solved, ensure to clear the fault(s) in the ECM using the B.U.D.S. software.

Sensor Resistance Measurement
When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (69°F). The value of a resistance varies with the temperature. The resistance value for usual resistor or windings (such as injectors) increases as the temperature increases. However, our temperature sensors are NTC types (Negative Temperature Coefficient) and work the opposite which means that the resistance value decreases as the temperature increases. Take it into account when measuring at temperatures different from 20°C (69°F). Use this table for resistance variation relative to temperature for temperature sensors.

<table>
<thead>
<tr>
<th>TEMPERATURE °C</th>
<th>RESISTANCE (OHMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOMINAL</td>
</tr>
<tr>
<td>-20</td>
<td>-34</td>
</tr>
<tr>
<td>-10</td>
<td>-14</td>
</tr>
<tr>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td>30</td>
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</tr>
<tr>
<td>40</td>
<td>104</td>
</tr>
<tr>
<td>50</td>
<td>122</td>
</tr>
<tr>
<td>60</td>
<td>140</td>
</tr>
<tr>
<td>70</td>
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<td>100</td>
<td>212</td>
</tr>
<tr>
<td>110</td>
<td>230</td>
</tr>
<tr>
<td>120</td>
<td>248</td>
</tr>
</tbody>
</table>

CONVERSION CHART FOR TEMPERATURE SENSORS
The resistance value of a temperature sensor may test good at a certain temperature but it might be defective at other temperatures. If in doubt, try a new sensor.

Also remember this validates the operation of the sensor at ambient temperature. It does not validate the over temperature functionality. To test it, the sensor could be removed from the engine/muffler and heated with a heat gun while it is still connected to the harness to see if the ECM will detect the high temperature condition and generate a fault code.

NOTE: In case of overheating, EGTS and CTS do not generate fault codes. A message will be displayed on the information center, the beeper will be activated and the EMS will be set in limp home mode.

ECM Connectors

The most recommended and safest method to probe ECM connector terminals is to use the ECM adapter (P/N 420 277 010). This tool will prevent deforming or enlarging terminals which would lead to bad ECM terminal contact creating intermittent or permanent problems.

Disconnect the desired connector from ECM and reconnect on the tool connector. Probe required terminals directly in the tool holes.

CAUTION: If not using the ECM adapter, probe on top of terminal only. Do not try to probe inside terminal or to use a paper clip to probe inside terminal, it will damage the square-shaped terminal and this could lead to improper function of the engine management system.

Use this diagram to locate the terminal numbers on the ECM connector "A" of the wiring harness when performing tests.

CAUTION: Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected repeatedly.
NOTE: For more details on ECM connectors servicing, refer to ELECTRICAL CONNECTORS AND WIRING DIAGRAM section.

Engine Wiring Harness

ALL 4-TEC SUPERCHARGED ENGINES
1. ECM connector
2. CTS connector
3. EGTS connector
4. CAPS connector
5. Fuel injector connector (cylinder 1)
6. Ignition coil connector (cylinder 1)
7. Fuel injector connector (cylinder 2)
8. Ignition coil connector (cylinder 2)
9. Fuel injector connector (cylinder 3)
10. Ignition coil connector (cylinder 3)
11. TPS connector
12. Idle bypass valve connector
13. MATS connector
14. Engine connector
15. MAPS connector
16. OPS connector
17. KS connector
18. CPS connector

Resistance Test
Check continuity of the circuits according to the wiring diagram in the ELECTRICAL CONNECTORS AND WIRING DIAGRAM section of this manual.

If wiring harness is good, check the respective sensor/actuator as described in this section.

Otherwise, repair the sensors, connect the wiring harness, or the ECM/MPEM as diagnosed.

Removal
Remove fuel rail cover.
Disconnect the wiring harness from all sensors/actuators.
Disconnect the ECM connector from the ECM.
Cut all tie raps which are holding the wiring harness in position.
Remove complete wiring harness.

**Installation**

First connect the ECM connector A and fix the harness on the wiring support with a locking tie.

Connect the fuel injectors, ignition coils, CAPS, CTS and EGTS to the wiring harness.

**WARNING**

Pay attention not to mix injectors or ignition coils wires between cylinders. The location of the splice connectors indicate which cylinder wires belong to.

Install the engine connector on the appropriate bracket on the wiring support.

Then fix the other bundle on the appropriate supports on the wiring support and the ECM bracket with locking ties.

Connect the CPS, KS, OPS, and the MAPS to the wiring harness.

Also connect now the MATS, TPS, and idle bypass valve to the wiring harness.

Fix the wiring for the MATS with a locking tie to support the cables.
Install all remaining parts, which has been removed.

**BASIC ADJUSTMENTS**

**IDLE SPEED**

The idle speed is not adjustable. The ECM controls the idle speed of the engine.

If desired, the engine RPM can be measured following this procedure:

Use tachometer (P/N 529 014 500).

Wrap the tachometer's wire a few times around the protruding part of ignition coil.

Start engine to verify engine RPM.

**NOTE:** If idle speed is not within specifications, check if there is any occurred or active fault code(s). If not, check throttle cable adjustment and proceed with the Closed Throttle and Idle Actuator reset. If idle speed is still not adequate, there is probably a mechanical problem.

**THROTTLE CABLE**

Mechanically adjust the throttle cable.

When throttle is released, cable must have a free play of 0.5 - 4 mm (1/64 - 5/32 in).

Throttle lever must reach handlebar grip without causing strain to cable or brackets. Ensure throttle lever fully closes on it's stopper.

Ensure throttle body is fully open at full throttle position. At this position, throttle lever stopper is almost in contact with throttle body.

**NOTE:** Apply a light pressure on the throttle plate, a slight play should be obtained.
CAUTION: If there is no free-play at idle position, it may cause poor idling and startability. Improper cable adjustment will cause strain on cable and/or damage cable bracket or throttle lever at handlebar. Do not alter throttle cable routing.

To adjust, loosen jam nut then turn adjustment nut as necessary.

CAUTION: An improperly set TPS or idle bypass valve may lead to poor engine performance and emission compliance could possibly be affected. In addition, improper idle bypass valve reset may lead to poor engine starting, improper idle (too low or too high) and engine stop on deceleration.

Use the B.U.D.S. software to perform this adjustment.

Ensure the throttle body plate stop lever rests against its stopper. Open throttle approximately one quarter then quickly release. Repeat 2 - 3 times to settle throttle plate. If stopper does not rest against its stop lever, perform throttle cable adjustment.

To properly reset valve, first install safety lanyard then remove it and then wait 5 seconds. Repeat this cycle 2 - 3 times.

Push the Reset button in the Setting tab of B.U.D.S.

NOTE: If TPS is not within the allowed range while resetting the Closed Throttle and Idle Actuator, the ECM will generate a fault code and will not accept the setting.

Start engine and make sure it operates normally through its full engine RPM range. If fault codes appear, refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS section for more information.

IGNITION TIMING

The ECM is able to determine the exact position of camshaft and crankshaft. That means that no ignition timing setting has to be performed.

REPAIR PROCEDURES

ENGINE CONTROL MODULE (ECM)

ECM Replacement

Prior to replacing a suspected ECM, ensure that all the recommendations in the general introduction of this section have been followed.

If the defective ECM can be read with B.U.D.S., it is possible to transfer the recorded information of this module to the new ECM. Use Replace ECM in the Module menu of B.U.D.S. Follows instructions in its help system.

If the defective ECM can not be read, continue procedure.

Disconnect battery cables.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

⚠️ WARNING
Battery BLACK negative cable must always be disconnected first and connected last.

Disconnect both ECM connectors from ECM.

Finalizing ECM Replacement

IMPORTANT: When the ECM is replaced, the Closed Throttle and Idle Actuator must be reset. Refer to BASIC ADJUSTMENTS for the procedure.

After performing the required reset, ensure to clear all faults from the newly replaced ECM.

Start the engine and increase engine speed above 5000 RPM to be sure no fault appears.

MULTI-PURPOSE ELECTRONIC MODULE (MPEM)

MPEM Replacement

Prior to replacing a suspected MPEM, ensure that all the recommendations in the general introduction of this section have been followed.

If the defective MPEM can be read with B.U.D.S., it is possible to transfer the recorded information to the new MPEM. Use Replace MPEM in the Module menu of B.U.D.S. Follows instructions in its help system.

If the defective MPEM can not be read, continue procedure.

Disconnect battery cables.

⚠️ WARNING
Battery BLACK negative cable must always be disconnected first and connected last.

Unscrew all retaining screws and remove the engine ECM from intake manifold.

Install the new ECM to the engine.

CAUTION: Always replace ECM by the same part or by an approved equivalent.

Reconnect ECM connectors to ECM then battery cables.

If the Previous ECM was Read with B.U.D.S.

Transfer the data from the previous ECM to the new one using B.U.D.S. then proceed with the required resets.

Continue procedure as per FINALIZING ECM REPLACEMENT below.

If the Previous ECM was NOT Read with B.U.D.S.

- Enter the old ECM serial number in the Part Replacement under History tab. Click on Add part in History.
- Reprogram safety lanyard(s).

NOTE: The ECM serial number can be found on the ECM sticker that also shows the P/N.

Continue procedure as per FINALIZING ECM REPLACEMENT below.

Disconnect AMP connectors from MPEM. Remove retaining nuts on top.

Pull MPEM out.

Install the new MPEM in vehicle. Reconnect AMP connectors to MPEM.

If the Previous MPEM was Read with B.U.D.S.

Transfer the data from the previous MPEM to the new one using B.U.D.S.

Continue procedure as per FINALIZING MPEM REPLACEMENT below.

If the Previous MPEM was NOT Read with B.U.D.S.

- Enter the vehicle and engine serial numbers in the Vehicle tab.
- Enter the old MPEM serial number in the Part Replacement under History tab. Click on Add part in History.

NOTE: The MPEM serial number can be found on the MPEM sticker that also shows the P/N.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

- Manually activate the options installed on vehicle under the Setting tab.

NOTE: If an option is installed but not checked in B.U.D.S., the information center will not display that option. If an option is checked in B.U.D.S. but not installed in vehicle, a fault code will be generated.

Continue procedure as per FINALIZING MPEM REPLACEMENT below.

Finalizing MPEM Replacement
Ensure to clear all faults from the newly replaced MPEM.
Start engine and ensure no fault is active.

FUEL INJECTOR

IMPORTANT: Never mix up fuel injectors of naturally-aspirated and supercharged 4-TEC engines. Doing so will automatically lead to a malfunction of the EMS and will cause a bad engine calibration.

Leakage Test
To perform a leakage test, the injectors and fuel rail have to be removed from the engine. See FUEL INJECTOR REPLACEMENT below for the procedure.

NOTE: Do not detach injectors from the fuel rail. Reconnect the fuel line and the wiring harness.
Place each injector in a clean bowl.
Install the safety lanyard cap on the DESS post to activate the fuel pump.
Check for fuel leakage from the injector nozzle. There should be less than 1 drop per minute. Perform the test for 2 minutes.
If not within specification, replace the fuel injector(s).
Properly reinstall removed parts.
The leakage test is validated when performing the fuel pump pressure test. Refer to FUEL SYSTEM.

Electrical Test
Voltage Test
Safety lanyard must be on DESS post.
Using the B.U.D.S. software, energize the fuel injector from the Activation tab.
If the injector does not work, disconnect the connector from the injector.

Install a temporary connector on the injector with wires long enough to make the connection outside the bilge and apply voltage (12 V) to this test harness.

CAUTION: While doing fuel injector electrical test, do not apply continuous voltage to the connector. This can damage the injector.

This will validate the injector mechanical and electrical operation.
If it does not work, replace it. If it works, continue procedure.
Using B.U.D.S., activate injector while probing terminal 2 (of injector on harness side) and battery ground.
- If 12 V is read, check continuity of circuit as per following table. If it is good, try a new ECM.

<table>
<thead>
<tr>
<th>CIRCUIT NUMBER (ECM CONNECTOR &quot;A&quot;)</th>
<th>INJECTOR NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-15</td>
<td>1</td>
</tr>
<tr>
<td>A-33</td>
<td>2</td>
</tr>
<tr>
<td>A-14</td>
<td>3</td>
</tr>
</tbody>
</table>

- If it does not read 12 V, check continuity of circuit as per following table. If it is good, try a new MPEM.

<table>
<thead>
<tr>
<th>CIRCUIT NUMBER (AMP CONNECTOR NO. 2)</th>
<th>INJECTOR NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-16</td>
<td>1</td>
</tr>
<tr>
<td>2-17</td>
<td>2</td>
</tr>
<tr>
<td>2-18</td>
<td>3</td>
</tr>
</tbody>
</table>

Resistance Test
Reconnect the injector and disconnect the ECM connector A.
Remove safety lanyard and wait 15 seconds. Disconnect engine connector.

CAUTION: Before unplugging engine connector, always remove safety lanyard and wait 15 seconds. Otherwise, damage to CAPS may occur.

Using a multimeter, check resistance value between terminals as follows.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

**ENGINE CONNECTOR**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>TERMINAL LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel injector cylinder 1</td>
<td>1 (engine connector) and A-15 ECM</td>
</tr>
<tr>
<td></td>
<td>connector</td>
</tr>
<tr>
<td>Fuel injector cylinder 2</td>
<td>2 (engine connector) and A-33 ECM</td>
</tr>
<tr>
<td></td>
<td>connector</td>
</tr>
<tr>
<td>Fuel injector cylinder 3</td>
<td>3 (engine connector) and A-14 ECM</td>
</tr>
<tr>
<td></td>
<td>connector</td>
</tr>
</tbody>
</table>

**4-TEC Naturally Aspirated Models**

The resistance should be between 11.4 and 12.6 Ω.

If resistance value is correct, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.

If resistance value is incorrect, repair the wiring harness/connectors or replace the wiring harness between ECM connector and fuel injector.

**All 4-TEC Supercharged Models**

The resistance should be between 14 and 15 Ω.

If resistance value is correct, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.

If resistance value is incorrect, repair the wiring harness/connectors or replace the wiring harness between ECM connector and fuel injector.

**Fuel Injector Replacement**

**Removal**

Remove fuel rail cover from the engine.

Release the fuel pressure in the system using B.U.D.S. Look in the **Activation** tab.

Disconnect wiring harness from the three fuel injectors.

**Connection**

Disconnect fuel hose using the fuel hose disconnect tool (P/N 529 036 037).

1. Insert pointed tool each side

Wrap a rag around the hose end to prevent rail draining.

Cut tie raps and remove the wiring harness from the fuel rail.

Unscrew rail retaining screws.

Gently pull rail up by hand, working each side slightly at a time.

Pull rail out with fuel injectors.

Then remove the injector clip. Now the fuel injector can be easily pulled out of the fuel rail.
FUEL RAIL ASS’Y  
1. Fuel injector  
2. Injector clip  
3. O-ring  

Installation  
For the installation, reverse the removal procedure. Paying attention to the following details.  
If you reinstall a used injector, carefully inspect O-ring condition before reinstalling fuel injector. Replace O-ring with a new one if damaged. Insert the fuel injector in place with your hand.  
NOTE: A thin film of engine oil should be applied to O-rings to ease insertion in fuel rail and intake manifold.  
Apply Loctite 243 on rail retaining screws then torque to 10 N•m (89 lbf•in).  
When installing fuel line connector to the fuel rail, put some oil on the O-ring to ease installation.  

![WARNING]

Perform a fuel pressure test and ensure that there is no leak. Refer to FUEL SYSTEM section.  

THROTTLE BODY  
IMPORTANT: Never mix up throttle bodies of naturally-aspirated and supercharged 4-TEC engines. Doing so will automatically lead to a misfunction of the EMS and will cause a bad engine calibration.  

TYPICAL  
1. Throttle body  
2. Throttle cable attachment  
3. Throttle plate  
4. TPS  
5. Idle bypass channel  
6. Idle bypass valve  

The adjustment of the idle stop screw is optimized by the throttle body manufacturer and locked to prevent any modification.  
CAUTION: Never attempt to adjust the idle speed through this screw. See IDLE SPEED in BASIC ADJUSTMENTS.  

![THROTTLE BODY]

THROTTLE BODY  
1. Idle stop screw (do not tamper adjustment)  

Mechanical Inspection  
Check that the throttle plate moves freely and smoothly when depressing throttle lever. Throttle plate must return freely, quickly and completely. If not, check for salt accumulation on throttle plate shaft. Try lubricating throttle plate shaft, moving plate several times and recheck. Replace throttle body if necessary.
WARNING
Replace throttle body when throttle plate does not return properly.

Before replacing any part, check the following as these could be causing the fault. Perform the test while the engine is not running.
- Throttle cable adjustment too tight. Not returning fully to idle stop.
- Throttle body idle set screw is loose or worn (in this case, throttle body must be replaced).
- TPS is loose.
- Idle bypass valve is loose.
- Corroded or damaged wiring or connectors.
- Throttle body has been replaced and the Closed Throttle and Idle Actuator reset has not been performed.
- ECM has been replaced and the Closed Throttle and Idle Actuator reset has not been performed.

Electrical Inspection
Refer to THROTTLE POSITION SENSOR (TPS) and IDLE BYPASS VALVE further in this section.

Replacement
Removal
To remove the throttle body from engine, proceed as follows:
- Disconnect air intake silencer from throttle body. Move boot away.
- Remove retaining screws of throttle body.

ALL 4-TEC SUPERCHARGED MODELS
1. Throttle body
2. Screws

- Slightly pull throttle body out.
- Disconnect connectors from idle bypass valve, and TPS.
- Disconnect throttle cable.

Installation
Installation of the new throttle body is the reverse of the removal procedure.
Make sure throttle cable is correctly adjusted. Perform the Closed Throttle and Idle Actuator reset. See procedure in BASIC ADJUSTMENTS.

THROTTLE POSITION SENSOR (TPS)

General
The throttle position sensor (TPS) is a potentiometer that sends a signal to the ECM which is proportional to the throttle plate angle.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

ALL 4-TEC SUPERCHARGED ENGINES
1. Throttle position sensor (TPS)

IMPORTANT: Prior to testing the TPS, ensure that mechanical components are adequate according to THROTTLE BODY above.

The EMS may generate several fault codes pertaining to the TPS. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS section for more information.

Wear Test
While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.
Using the B.U.D.S. software, use the Throttle Opening display under Monitoring tab.
Slowly and regularly depress the throttle. Observe the needle movement. It must change gradually and regularly as you move the throttle. If the needle “sticks”, bounces, suddenly drops or if any discrepancy between the throttle movement and the needle movement is noticed, it indicates a worn TPS that needs to be replaced.

Voltage Test
Check the ECM voltage output from to the throttle position sensor.
Disconnect connector from throttle position sensor. To unlock connector, insert a small screwdriver between the folded tab.
NOTE: On the Supercharged models, a mirror is useful to see under throttle body.
To see the connector pin-out, temporarily remove the connector shield joining the harness, to expose the terminal numbers. Connect a voltmeter to the terminals of the wiring harness as per the following table.
Remove and reinstall the safety lanyard to activate the ECM.
Check the voltage readings as follows.

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1 with engine ground</td>
<td>0 V</td>
</tr>
<tr>
<td>Terminal 2 with engine ground</td>
<td>5 V</td>
</tr>
<tr>
<td>Terminal 3 with engine ground</td>
<td>4.5 - 5 V</td>
</tr>
</tbody>
</table>

If voltage test is good, replace the TPS.
If voltage test is not good, check the resistance of the TPS circuit.

Resistance Test
Reconnect the TPS.
Disconnect the ECM connector “A” on the ECM.
Using a multimeter, check resistance values as per the following table.

<table>
<thead>
<tr>
<th>ECM CONNECTOR</th>
<th>THROTTLE IDLE POSITION</th>
<th>WIDE OPEN THROTTLE POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN</td>
<td>PIN</td>
<td>RESISTANCE Ω</td>
</tr>
<tr>
<td>A-24</td>
<td>A-25</td>
<td>1000 - 1100</td>
</tr>
<tr>
<td>A-25</td>
<td>A-39</td>
<td>1600 - 2400</td>
</tr>
<tr>
<td>A-24</td>
<td>A-39</td>
<td>2500</td>
</tr>
</tbody>
</table>

NOTE: The resistance value should change smoothly and proportionally to throttle movement. Otherwise, replace TPS.
If resistance values are correct, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
If resistance values are incorrect, replace TPS.

Replacement
Remove the throttle body as described above.
Loosen two screws retaining the TPS.
Remove TPS.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

CAUTION: Do not try to operate the piston of the idle bypass valve when it is dismounted. Also do not move the piston by hand. The screw drive is very sensitive and will be destroyed.

Clean the parts and install the idle bypass valve on the throttle body.
Proceed with the Closed Throttle and Idle Actuator reset as described in BASIC ADJUSTMENTS.

CRANKSHAFT POSITION SENSOR (CPS)

Ensure that information center works. Needles will sweep, LED and LCD segments will turn on when the safety lanyard is installed. Check for RPM display at the information center while cranking in engine drowned mode. Press and HOLD throttle lever then press start/stop button. 800 - 1000 RPM should display. Otherwise perform the following tests.

NOTE: Take into account that a CPS fault can be triggered by a bent or missing trigger wheel tooth. First check fault codes then CPS as per following procedure; if it tests good, verify trigger wheel teeth condition. Refer to PTO HOUSING AND MAGNETO in the ENGINE section.

Disconnect CPS wiring harness connector. Probe terminals coming from CPS while cranking engine. Voltage should be within 1 - 2 Vac. Otherwise, inspect wiring and replace CPS if wiring is good.

Resistance Test
Disconnect the CPS connector from the wiring harness and check the resistance of the sensor itself.

IDLE BYPASS VALVE
An idle bypass valve with good resistance measurement can still be faulty. It is also possible that a mechanical failure occurs which is not detectable without measuring the air flow. Replacing the idle bypass valve may be necessary as a test.

Resistance Test
Disconnect idle bypass valve from the wiring harness.
Using a multimeter, check the resistance in both windings.
Check the resistance between terminals A and D and also between terminals C and B of the idle bypass valve.
The resistance in each winding should be approximately 50 Ω at 23°C (73°F).
If the resistance of one or both windings is not good, replace the idle bypass valve.

Visual Inspection
Remove idle bypass valve from throttle body.
Check the piston and bypass channel for dirt/ deposits which can cause a sticking piston.

Apply Loctite 243 on screw threads, install the new TPS.
Reinstall remaining removed parts.
Proceed with the Closed Throttle and Idle Actuator reset as described in BASIC ADJUSTMENTS.
The resistance should be between 190 Ω and 290 Ω. Otherwise, replace the CPS.
If resistance tests good, reconnect the CPS and disconnect the ECM connector A on the ECM.
Using a multimeter, recheck resistance value between terminals 5 and 19.
If resistance value is correct, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

Replacement
Drain oil from PTO housing. Refer to PTO HOUSING AND MAGNETO.
NOTE: It is not necessary to drain oil from engine. Disconnect CPS connector.

1. CPS connector

Remove wire retaining clip.
Remove CPS retaining screw.

Pull out CPS.
Reverse procedure for installation. However, pay attention to the following.
Apply Loctite 243 (P/N 293 800 060) on screw threads then torque to 9 N•m (80 lbf•in).
Reajust the engine oil level.

Trigger Wheel Inspection
Refer to PTO HOUSING AND MAGNETO in the ENGINE section.

CAMSHAFT POSITION SENSOR (CAPS)

Voltage Test (harness)
Disconnect the connector from the wiring harness.
To see the connector pin-out, temporarily remove the connector shield joining the harness, to expose the terminal numbers.
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

Remove and reinstall safety lanyard to activate the system.
Probe terminal 3 of CAPS connector (wiring harness side) and battery ground.
- If 12 V is read, check continuity of circuits A-20 and A-34. If they test good, perform the CAPS voltage test as explained below. If CAPS tests good, try a new ECM.
- If 12 V is not read, check continuity of circuit 2-19 from MPEM to the CAPS. If it tests good, try a new MPEM. Otherwise, repair wiring harness.

Remove the CAPS from the cylinder head.
Set up the following electric circuit to perform the voltage test.

If the voltage is not good, replace the CAPS.

Replacement
Unscrew the retaining screw and replace the CAPS. Ensure to reinstall O-ring.
Apply Loctite 243 (blue) on thread and torque to 6 N•m (53 lbf•in).

MANIFOLD AIR TEMPERATURE SENSOR (MATS)

Touch the CAPS with a conductor (ex.: screwdriver) and look if the voltage at the multimeter switches from 12 V to less than 1 V.

Resistance Test
Disconnect the connector from the MATS and check the resistance of the sensor itself.
The resistance should be between 2280 Ω and 2740 Ω at 20°C (68°F).
Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

Ensure sensor is correctly installed on intake manifold. Otherwise, the MAPS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. Remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

Voltage Test
Check the voltage output from ECM to the manifold air pressure sensor (MAPS).
Disconnect connector from MAPS and connect a voltmeter to the terminals of the wiring harness as per the following table.

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1 with engine ground</td>
<td>5 V</td>
</tr>
<tr>
<td>Terminal 2 with engine ground</td>
<td>0 V</td>
</tr>
<tr>
<td>Terminal 3 with engine ground</td>
<td>0 V</td>
</tr>
</tbody>
</table>

Remove and reinstall the safety lanyard to activate the ECM.
If voltage test is good, replace the MAPS.
If voltage test is not good, check the continuity of the MAPS circuit.

Resistance Test
Disconnect the ECM connector A on the ECM.
Using a multimeter, check continuity of circuits 12, 28 and 40.
If wiring harness is good, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
Otherwise, repair the connectors or replace the wiring harness between ECM connector and the MAPS.

Replacement
Disconnect MAPS connector and remove the MAPS.
Install the new MAPS paying attention to index its tab into the adaptor notch. Apply Loctite 243 (blue) on screw then torque to 10 N·m (89 lbf·in).

EXHAUST GAS TEMPERATURE SENSOR (EGTS)

![Diagram]

TYPICAL
1. Muffler
2. Exhaust gas temperature sensor (EGTS)

NOTE: Overheat signals will appear when exhaust temperature reaches:

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 1503</td>
<td>100°C (212°F)</td>
</tr>
</tbody>
</table>

Resistance Test
Disconnect the connector from the EGTS and check the resistance of the sensor itself.
The resistance should be between 2280 Ω and 2740 Ω at 20°C (68°F).
Otherwise, replace the EGTS.
If resistance tests good, reconnect the EGTS and disconnect the ECM connector A on the ECM.
Using a multimeter, recheck resistance value between terminals 10 and 26.
If resistance value is correct, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
If resistance value is incorrect, repair the connector or replace the wiring harness between ECM connector and the EGTS.

Replacement
Disconnect EGTS connector and remove EGTS.
Apply Loctite 518 on threads of the EGTS then install.
Replug connector.
KNOCK SENSOR (KS)

Dynamic Test
Using the B.U.D.S. software, monitor the knock sensor using the Faults section.
Start the engine and bring engine RPM above 5000 RPM. If no fault code occurs, the knock sensor is good.
Otherwise, do the following.
Ensure sensor and cylinder head contact surfaces are clean and mounting bolt and washer are correct and properly torqued down.
NOTE: It is necessary to remove intake manifold to inspect contact surfaces. Refer to INTAKE MANIFOLD AND INTERCOOLER section.
Check the knock sensor resistance.

Static Resistance Test
Disconnect the connector from knock sensor harness.
Using a multimeter, check the resistance between both terminals on the knock sensor.
The resistance should be approximately 5 MΩ.
If resistance is not good, replace knock sensor.
If resistance is good, reconnect the knock sensor connector and disconnect A connector from ECM.
Using a multimeter, recheck resistance value between terminals 9 and 23.

If wiring harness is good, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
Otherwise, repair the connector or replace the wiring harness between ECM connector and knock sensor.

Replacement
Remove the intake manifold. Refer to INTAKE MANIFOLD AND INTERCOOLER in the ENGINE section.
Unscrew and remove knock sensor.
Clean contact surface, apply Loctite 243 in threaded hole then install the new knock sensor.
Torque screw to 24 N•m (18 lbf•ft).
CAUTION: Improper torque might prevent sensor to work properly and lead engine to severe damage of internal components.
Replug connector.

OIL PRESSURE SENSOR (OPS)
Oil Pressure Test
First, carefully check the condition of the connector terminals. Clean to remove dirt and corrosion that could affect proper operation of the sensor.

IMPORTANT: Do not apply dielectric grease on terminal.
To check the function of the oil pressure sensor, an oil pressure test has to be performed. Refer to LUBRICATION SYSTEM in the ENGINE section.
If the engine oil pressure is good, the OIL message in the information center is present and the beeper is ON, check the resistance of the OPS while engine is off and while engine is running. A dynamic test of the circuit can also be conducted.

Resistance Test
Disconnect the connector from the OPS and use a multimeter to check the resistance between OPS terminal and engine ground while engine is stopped (without oil pressure) and while engine is running (with oil pressure).
When engine is stopped the resistance is close to 0 Ω (normally closed switch).
When engine is running and the oil pressure reaches 180 - 220 kPa (26 - 32 PSI), the resistance of the OPS is infinitely high.
If resistance values are incorrect, replace OPS.
If the values are correct, check the continuity of the wiring harness.
Disconnect the ECM connector A from the ECM and check continuity of circuit 6.
If wiring harness is good, try a new ECM. Refer to ENGINE CONTROL MODULE (ECM) in this section.
Otherwise, repair the connector or replace the wiring harness between ECM connector and OPS.

Dynamic Test
First, ensure an oil pressure test is performed and the pressure is within specifications.
Disconnect the connector from the oil pressure sensor (OPS).
Start the engine.
Ground the OPS connector AND bring engine speed above 3300 RPM.
A fault code and low oil should appear in the information center. If so, try a new sensor.
Otherwise, check wiring continuity between sensor and MPEM.

TOPS SWITCH
When watercraft tips over, that changes TOPS switch state and the ECM shuts down engine.
As a quick test, use B.U.D.S. to monitor switch state. Look in Monitoring tab. If it does not work, do the following tests:
Disconnect TOPS switch and remove from MPEM bracket.
Install a temporary connector with 3 wires to TOPS switch.
Connect battery positive terminal to pin A of connector and battery ground to pin B.

Measure resistance between pin A and C. In the UP position, it should be approximately 35 Ω.
Turn switch upside down. It should now read approximately 10 kΩ. Otherwise, replace switch.
NOTE: While turning switch upside down, ensure that switch resistance does not change before it reaches 120° ± 10 from the vertical axis. From the upside down position, switch resistance should not change before 60° ± 10 from the vertical axis.
If switch tests good, make sure DESS key is on, and check if there is battery voltage between pins A and B of switch harness connector.

If battery voltage is not read, check TOPS switch fuse condition. If good, check continuity of circuits 2-2 and 2-25 going to MPEM. If continuity does not test good, repair/replace wiring/connector. If it tests good, try a new MPEM.

If battery voltage is read, check continuity between pin C and B-9 at ECM. If continuity does not test good, repair/replace wiring/connector. If it tests good, try a new ECM.
# FUEL TANK AND FUEL PUMP

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>fuel pressure gauge</td>
<td>529 035 591</td>
<td>211</td>
</tr>
<tr>
<td>hook tool</td>
<td>529 035 989</td>
<td>214</td>
</tr>
<tr>
<td>pliers</td>
<td>295 000 070</td>
<td>212</td>
</tr>
<tr>
<td>small hose pincher</td>
<td>295 000 076</td>
<td>209</td>
</tr>
<tr>
<td>vacuum/pressure pump</td>
<td>529 021 800</td>
<td>209</td>
</tr>
</tbody>
</table>
GENERAL

⚠️ WARNING
The fuel system of a fuel injection system holds much more pressure than on a carbureted watercraft. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here.

⚠️ WARNING
Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses. Always disconnect battery prior to working on the fuel system. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Proceed with care when removing/installing high pressure test equipment or disconnecting fuel line connections. Use B.U.D.S. software to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the bilge. Before reconnecting battery, make sure there is no fuel odor present and if so, vent the bilge area thoroughly.

⚠️ WARNING
Whenever repairing the fuel system, always verify for water infiltration in reservoir. Replace any damaged, leaking or deteriorated fuel lines. When the repair is completed, ensure that hoses from fuel rail going to fuel pump are properly secured in their supports. Then, pressurize the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

⚠️ WARNING
Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the safety lanyard on the DESS post. Always perform the high pressure test if any component has been removed. A pressure test must be done before connecting the safety lanyard. The fuel pump is started each time the safety lanyard is installed and it builds pressure very quickly.

INSPECTION

FUEL SYSTEM LEAK TEST

⚠️ WARNING
Whenever doing any type of repair on watercraft or if any components of the fuel system are disconnected, a pressure test must be done before starting engine. Ensure to verify fuel line ends for damage. Always cut damaged end before reinstallation.

Fill up fuel tank. Reinstall and tighten fuel cap. Install a small hose pincher (P/N 295 000 076) on vent line (OUTLET side).

![295 000 076](image)

Disconnect inlet valve from body. Use the vacuum/pressure pump (P/N 529 021 800).

![529 021 800](image)

Pressurize fuel tank through vent line (INLET side) as follows.
Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)

If pressure drops, locate fuel leak(s) and repair/replace leaking component(s).
To ease locating leak(s), spray soapy water on components; bubbles will indicate leak location(s).

**WARNING**
If any leak is found, do not start the engine and wipe off any fuel leakage. Do not use electric powered tools on watercraft unless system has passed pressure test.

Check Valve and Pressure Relief Valve
Air can enter fuel tank at all times through INLET side.

The check valve no. 18 prevents fuel to flow out. Air cannot go out (unless pressure increases).

**WARNING**
If pressure in fuel tank build up and exceed 3.5 kPa (.5 PSI), pressure relief valve no. 17 open and let excess pressure evacuate through OUTLET side.

Always reinstall valve according to arrow on valve as shown.
Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)

Test
Pressurized fuel tank (see above) and proceed as follows:
When removing hose pincher, alternately touch and release end of pressure relief valve no. 17. You should feel pressurized air flowing out indicating relief valve is working.

Ensure grommets no. 20 are not plugged.
Remove fuel tank cap.
With your mouth, blow air from outlet nipple. Air must freely flows towards fuel tank neck.

Ensure to reinstall inlet valve in its grommet.

High Pressure Test (fuel pump circuit)
Refer to FUEL PUMP PRESSURE TEST below.

FUEL PUMP PRESSURE TEST
Before proceeding to the pressure test ensure the battery is fully charged. Battery voltage must be over 12 volts.
Release the fuel pressure in the system using B.U.D.S. Look in the Activation tab.

⚠️ WARNING
The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the pressure. Wipe off any fuel spillage inside bilge.

The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator, the fuel pump and leaks in the system.
Remove glove box to have access to fuel pump. Refer to HULL/BODY section.
Remove air vent tube from front storage area.
Ensure there is no leak from hoses and fittings. Repair any leak.
Ensure there is enough gas in fuel tank.
Disconnect outlet hose from fuel pump.
Install fuel pressure gauge (P/N 529 035 591) between disconnected hose (inline installation).
Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)

A rapid pressure drop indicates leakage either from the fuel rail or from the fuel pump check valve. Check fuel rail for leaks. If it occurs while installing safety lanyard on DESS and fuel rail is not leaking, then replace fuel pump.

A slow pressure drop indicates leakage either from the fuel injector or from the fuel pressure regulator. Check fuel injector for leaks (see below). If it is not leaking then replace fuel pump module.

Release fuel pressure in the system using B.U.D.S. Look in the Activation tab.

Remove pressure gauge and reinstall fuel hose.

**WARNING**

Wipe off any fuel spillage in the bilge. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area.

Reinstall removed parts.

**PROCEDURES**

**FUEL HOSES AND OETIKER CLAMPS**

**Inspection**

Inspect all fuel hoses for wear or cracks.

Inspect all clamps for tightness.

**Replacement**

When replacing the fuel lines on all SEA-DOO models be sure to use "A1" type for pressurized hoses and "B1" type for ventilation hoses. These hoses are available from BRP. This will ensure continued proper and safe operation.

**WARNING**

Use of improper fuel lines could compromise fuel system integrity.

To secure or cut Oetiker clamps no. 1 on fuel lines, use pliers (P/N 295 000 070).
FUEL FILTER

Removal

NOTE: The fuel filter does not require replacement under normal operating conditions. Replace only if permanently clogged or damaged. The fuel pump assembly has to be removed from the fuel tank to have access to the fuel filter.

Remove fuel pump. Refer to FUEL PUMP for the procedure.

Turn fuel pump upside down. Using a small flat screwdriver, remove the fuel filter by prying the inner plastic ring.

1. Fuel filter
2. Inner plastic ring

Inspection

Check if particles are present in fuel filter. If so, replace it.

Installation

New filter can be pressed back on by hand. Ensure it is fully seated for complete filtering of the fuel.

Reinstall fuel pump.

FUEL TANK

Inspection

Fuel Filler Hose

Verify fuel filler hose no. 15 for wear or cracks. Always ensure that clamps no. 16 are well positioned and tightened. Torque clamps to 4 N•m (35 lbf•in).

Fuel Tank Straps

Inspect retaining straps for wear or cracks.

Fuel Tank

Inspect fuel tank for wear caused by any abnormal contact or rubbing with other component(s).

Disconnect fuel filler hose.

Visually inspect the inside and outside of the fuel tank necks for crack(s). If crack(s) are existing, replace fuel tank no. 6.
Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)

Check with your finger to feel the inside and outside surfaces of fuel tank. Flex fuel tank necks to ensure there are no hidden cracks.

1. Tank upper surface
2. Inspect outside, above upper surface
3. Normal molding seam
4. Inspect inside, above upper surface
5. Base of the neck
A. Approx. 4 mm (5/32 in)

NOTE: A fuel tank is comprised of 2 components: the tank and the filler neck. The necks are injection molded and the tank is then blow molded over the necks. During the molding process, a small molding seam may appear on the inner side of the necks at approximately 4 mm (5/32 in) from the base of the neck. It is a normal situation to have a molding seam and it should not be confused with a crack.

Removal
The engine removal is necessary to remove fuel tank.
Siphon fuel tank.

Models with MPEM besides Engine
Disconnect MPEM connectors.
Detach MPEM assembly and support from bilge.
Remove TOPS switch from electrical harness or MPEM bracket.

All Models
Remove air intake silencer. Refer to AIR INTAKE SYSTEM subsection.
From storage compartment disconnect fuel pump connections.
Remove fuel pump no. 5 from fuel tank no. 6. Refer to FUEL PUMP.
Detach reverse system support.

Models with MPEM besides Engine
Remove battery. Refer to CHARGING SYSTEM subsection.

All Models
Disconnect fuel tank connections.
Cut locking ties as required to release wiring harness.
Detach straps no. 13 with hook tool (P/N 529 035 989).

Remove fuel tank from the vehicle.
Verify hull and rubber pad for wear.

WARNING
Check that fiberglass is not exposed.

Installation
Ensure rubber carpets no. 19 are in place.
Insert tank, air box and straps.
Place straps in clips (bottom) and in guides of air box. Use tape to hold straps on the top of fuel tank.
Insert strap ends in hooks.
Properly secure harnesses.
Reinstall all other removed parts.
Perform a fuel system leak test. See procedure in INSPECTION.

**FUEL PUMP**

**Test**

**NOTE:** See also the FUEL PUMP DIAGNOSTIC FLOW CHART further.

When connecting the safety lanyard to the DESS post, the fuel pump should run for 2 seconds to build up the pressure in the system.

If the pump does not work, disconnect the connector from the fuel pump.

Install a temporary connector on the fuel pump with wires long enough to make the connection outside the bilge.

**CAUTION:** Running pump a few minutes with reverse polarity can damage the pump.

If pump does not run, replace the fuel pump module.

Otherwise, probe terminals as shown.

When installing safety lanyard, you should read battery voltage for approximately 2 seconds (then voltage will drop to approximately 11 V).

If battery voltage is read, the problem can be in fuel pump or in harness connector. Repair or replace appropriate part.

If battery voltage is not read, probe terminals as shown.

![Diagram of fuel pump connections]

a. If battery voltage is read, check continuity of circuit B-29 going towards ECM. If it is good, try a new ECM.

b. If battery voltage is not read, check continuity of circuit 1-26 going towards MPEM. If it is good, try a new MPEM.

**Removal**

Open front storage compartment cover.

Remove the storage basket (if so equipped).

Remove front access panel (see HULL/BODY section).

Remove front vent tubes.

Remove glove box (see HULL/BODY section).

Disconnect electrical connector.

Disconnect vent tube from fuel pump.

Release the fuel pressure in the system using B.U.D.S. Lock in the Activation tab.

Disconnect inlet hose from fuel pump.

From glove box opening, remove fuel pump retaining nuts.
Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)

CAUTION: While pulling out the fuel pump, pay attention to fuel sensor float arm. Float arm can get stuck and bend which can reduce the fuel sensor capabilities.

Pull fuel pump out from glove box opening.

WARNING
Always wipe off any fuel spillage from the watercraft. While dealing with fuel or fuel system always work in well ventilated area.

Installation
Align tab of gasket with tank neck and then align arrow of fuel pump with tab of gasket.

Refer to following illustration for tightening sequence. Torque 1 to 4 at 1 N·m (9 lbf·in) and then 5 to 13 at 2 N·m (18 lbf·in).

TIGHTENING SEQUENCE
1. Fuel tank neck
2. Align

Perform a fuel system leak test. See procedure in INSPECTION.
Fuel Pump Diagnostic Flow Chart

1. Fuel pump does not run
   - Check fuses. Check safety lanyard connection. Check fuel pump operation. Repair or replace if necessary.
   - Repair or replace
     - Fails
       - Check fuel line/rail for leaks
         - OK
           - Perform fuel pump test
           - Crank or start engine
             - Fuel pressure less than 303 kPa (44 PSI) or 399 kPa (58 PSI)*
               - Check fuel line/rail for leaks
                 - OK
                   - FUEL SYSTEM OK
                 - Fails
                   - OK
                     - Repair or replace
                     - Fails
                       - Replace fuel pump module
                       - Retest
                       - OK
                         - Replace fuel pump module
                         - Retest
               - No
                 - Fast pressure drop
                   - Verify fuel pump check valve
                     - OK
                       - Check fuel line/rail for leaks
                         - Fails
                           - Repair or replace
                         - OK
                           - Perform fuel pump test
                           - Replace fuel pump module
                 - No
                   - Fuel pressure more than 303 kPa (44 PSI) or 399 kPa (58 PSI)*
                     - Replace fuel pump module
                     -Retest
                     - OK
                       - Replace fuel pump module
                       - Retest
                 - Yes
                   - Fuel pressure more than 303 kPa (44 PSI) or 399 kPa (58 PSI)*
                     - Replace fuel pump module
                     - Retest
                     - OK
                       - Replace fuel pump module
                       - Retest

* Supercharged – Inter-Cooled Models only.
# IGNITION SYSTEM

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM adapter</td>
<td>420 277 010</td>
<td>222</td>
</tr>
</tbody>
</table>

## SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>silicone lubricant</td>
<td>293 600 041</td>
<td>222</td>
</tr>
</tbody>
</table>
WIRE COLOR USE
RED = BATTERY POWER (+ 12 Vdc DIRECTLY CONNECTED TO BATTERY)
RED + TRACER = FUSED + 12 Vdc (FROM BATTERY)
PURPLE = + 12 Vdc POWER (WHEN A PROGRAMMED KEY IS ON DESS POST)
BLACK + TRACER = SWITCHED GROUND (BY ECM)
BLACK = GROUND
BROWN + TRACER = SWITCHED GROUND (BY ECM)

OPERATION
1 - T.O.P.S. IN OPERATION (VEHICLE UPRIGHT)
2 - FUSES 3, 5 AND 6 ARE GOOD
3 - SIGNALS FROM SENSORS MONITORED BY ECM
4 - SPARK OCCURS WHEN PRIMARY COIL IS SWITCHED TO GROUND BY ECM

COLOR CODE
WH = WHITE
RD = RED
YL = YELLOW
TA = TAN
GY = GREY
PK = PINK
BK = BLACK
BW = BROWN
BL = BLUE
OR = ORANGE

POWER SUPPLY CUT-OFF RELAY
CYL 1 (2-16) 10 A (6)
CYL 2 (2-17) 10 A (5)
CYL 3 (2-18) 10 A (3)
RD-PU - BAT + 11-29
12 VOLTS DISTRIBUTION

12 VDC
IGNITION COIL #1
IGNITION COIL #2
IGNITION COIL #3
GROUND

T.O.P.S. SWITCH

MPERM

ECM

CPS
Section 06 ELECTRICAL SYSTEM
Subsection 01 (IGNITION SYSTEM)

GENERAL

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS.

NOTE: The EMS controls the ignition system. For more information, refer to ENGINE MANAGEMENT.

NOTE: The MPEM energizes the primary side of each ignition coil individually while the ECM completes the circuit by switching it to the ground at the right moment. The ECM can detect open and short circuit in the primary winding but it does not check the secondary winding.

⚠️ WARNING

Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as spark may cause potential fuel vapor to ignite.

CAUTION: Do not remove the ignition coil before disconnecting the connector, or the wires will be damaged. Do not pry up ignition coil with a screwdriver to avoid damage.

PROCEDURES

IGNITION COIL

Quick Test with B.U.D.S.
Using the B.U.D.S. software, energize the ignition coil.

You should hear the spark occurring. In doubt, use an inductive spark tester or a sealed tester available from tool suppliers to prevent spark occurring in the bilge. If there is no spark, perform the following checks.

NOTE: Keep in mind that even if there is a spark during this static test, voltage requirement is higher to produce a spark in the combustion chamber when engine is running. Ignition coil could be not working in real operation. Replacing ignition coil may be necessary as a test.

Voltage Test
Disconnect the connector from the ignition coil and check the voltage supplied by the MPEM. Install safety lanyard on the DESS post. Read voltage.
The voltage should be 12 V.
If 12 V is NOT read, check continuity of appropriate circuit. If wiring harness is good, try a new MPEM.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CIRCUIT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder 1</td>
<td>2 - 16</td>
</tr>
<tr>
<td>Cylinder 2</td>
<td>2 - 17</td>
</tr>
<tr>
<td>Cylinder 3</td>
<td>2 - 18</td>
</tr>
</tbody>
</table>

If 12 V is read, disconnect the ECM connector “A” and check the continuity of appropriate circuit.

NOTE: For this test, use the ECM adapter (P/N 420 277 010) to probe ECM connector. Refer to ENGINE MANAGEMENT for more information.

If wiring harness is defective, repair the connector or replace the wiring harness between ECM connector and the ignition coil.
If wiring harness is good, try a new ECM.

**Resistance Test**
An ignition coil with good resistance measurement can still be faulty. Voltage leak can occur at high voltage level which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Remove ignition coil from spark plug.
Using a multimeter, check the resistance in both primary and secondary windings.
Section 06 ELECTRICAL SYSTEM
Subsection 01 (IGNITION SYSTEM)

SPARK PLUGS

Disassembly
Remove engine cover.
Disconnect the electrical connector from the ignition coil.
Remove the ignition coil.

⚠️ WARNING
Never remove ignition coil from the spark plug without disconnecting it from the wiring harness. Flammable vapors may be present in the bilge and ignited by a spark which could cause an explosion.

Unscrew the spark plug one turn.
Clean the spark plug and cylinder head with pressurize air.
Unscrew spark plug then use the ignition coil to take spark plug out of spark plug hole.

Spark Plug Installation
Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.
1. Using a wire feeler gauge, set electrode gap according to the following chart.
2. Apply anti-seize lubricant over the spark plug threads to prevent possible seizure.
3. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise an additional 1/4 turn with a proper socket.

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>SPARK PLUG</th>
<th>TORQUE</th>
<th>GAP mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 4-TEC</td>
<td>NGK DCPR8E</td>
<td>Hand tighten + 1/4 turn with a socket</td>
<td>0.75 (.030)</td>
</tr>
</tbody>
</table>
# CHARGING SYSTEM

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-pin magneto harness adapter</td>
<td>529 036 016</td>
<td>229–230</td>
</tr>
<tr>
<td>engine leak test kit</td>
<td>295 500 352</td>
<td>231</td>
</tr>
<tr>
<td>multimeter Fluke 111</td>
<td>529 035 868</td>
<td>227</td>
</tr>
</tbody>
</table>
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

GENERAL
The purpose of the charging system is to keep the battery at a full state of charge.

Magneto
The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).
The magneto has a 3 phase-delta wound stator on 18 poles. Capacity is 380 watts.

Fuse
If the battery is regularly discharged, check charging system fuse condition.
NOTE: The fuse holder for the charging fuse is located beside the MPEM.

Rectifier/Regulator
The rectifier receives AC current from the magneto and transforms it into direct current (DC).
The regulator, included in the same unit, limits voltage at a maximum level (14.5 to 14.8 volts) to prevent any damage to electrical components.

The rectifier/regulator could be the culprit of a blown fuse. To check, simply disconnect the rectifier/regulator from the circuit.
If the fuse still burns, check for a defective wire.
CAUTION: Do not use a higher rated fuse as this cause severe damage.

TESTING PROCEDURE
First ensure that battery is in good condition prior to performing the following tests.
For best results, use the multimeter Fluke 111 (P/N 529 035 868).

Battery
The battery is the DC source for the electric starter, the MPEM, ECM and all accessories.
**RECTIFIER/REGULATOR**

**Continuity Test**
Due to internal circuitry, there is no static test available to check continuity.

**Current Test**
Remove charging system fuse.

**NOTE:** The fuse holder for the charging fuse is located beside the MPEM.

![Fuse Holder](image)

Set multimeter to Adc.
Connect probes to fuse holder terminals.

![Multimeter Connection](image)

Start engine.
Read voltage.

<table>
<thead>
<tr>
<th>TEST ENGINE SPEED</th>
<th>VOLTAGE (DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500 RPM</td>
<td>15 V max.</td>
</tr>
</tbody>
</table>

If voltage is above specification, replace rectifier/regulator.

**NOTE:** If it is continually necessary to add distilled water to the battery, this indicates an over voltage situation, requiring replacement of the rectifier/regulator. If the battery will not stay charged, the problem can be any of the charging system components. If these all check good, try a new rectifier/regulator.

**STATOR**

**Continuity Test**
Disconnect the magneto wiring harness connector.
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

Insulation Test
Disconnect the magneto wiring harness connector.

Install the 3-pin magneto harness adapter (P/N 529 036 016) to the magneto wiring harness.

IMPORTANT: Leave wiring harness side disconnected.
Set multimeter to Ω.
Connect multimeter to a YELLOW wire and engine ground.

Set multimeter to Ω.
Connect multimeter between YELLOW wires.

Read resistance.

<table>
<thead>
<tr>
<th>TERMINAL</th>
<th>RESISTANCE @ 20°C (69°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>0.1 - 1 Ω</td>
</tr>
<tr>
<td>1 and 3</td>
<td></td>
</tr>
<tr>
<td>2 and 3</td>
<td></td>
</tr>
</tbody>
</table>

If any result is out of specification, replace stator.
**TERMINAL** | **RESISTANCE @ 20°C (68°F)**  
--- | ---  
Any YELLOW wire and engine ground | Infinity (open circuit)

Repeat test for the other yellow wires. If there is a resistance or continuity, the stator coils and/or the wiring is grounded and need to be repaired or replaced.

**Voltage Test**

Disconnect the voltage regulator/rectifier connectors.

Start engine. Read voltage.

<table>
<thead>
<tr>
<th>TEST ENGINE SPEED</th>
<th>TERMINAL</th>
<th>VOLTAGE (AC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3500 RPM</td>
<td>1 and 2</td>
<td>Approx. 25 V</td>
</tr>
<tr>
<td></td>
<td>1 and 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 and 3</td>
<td></td>
</tr>
</tbody>
</table>

If voltage is lower than specification, replace stator.

**BATTERY**

**Troubleshooting**

<table>
<thead>
<tr>
<th>SYMPTOM: DISCHARGED OR WEAK BATTERY</th>
<th>CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery post and/or cable terminal oxidized.</td>
<td>Clean and coat with dielectric grease.</td>
<td></td>
</tr>
<tr>
<td>Loose or bad connections.</td>
<td>Check wiring and connector cleanliness, damaged or short circuit.</td>
<td></td>
</tr>
<tr>
<td>Faulty battery (sulfated, doesn’t keep a full charge, damaged casing, loose post).</td>
<td>Replace.</td>
<td></td>
</tr>
<tr>
<td>Burnt fuse(s) or faulty rectifier.</td>
<td>First check fuse(s). If it is in good condition, check rectifier/regulator.</td>
<td></td>
</tr>
<tr>
<td>Faulty battery charging coil (or stator).</td>
<td>Check and replace.</td>
<td></td>
</tr>
</tbody>
</table>

Install the 3-pin magneto harness adapter (P/N 529 036 016) between unplugged connectors. Set multimeter to Vac scale. Connect multimeter between YELLOW wires.
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

Removal

⚠️ WARNING
Battery BLACK negative cable must always be disconnected first and connected last. Never charge or boost battery while installed in watercraft.

Proceed as follows:
- Disconnect the BLACK negative cable first.
- Disconnect the RED positive cable last.
- Remove the vent line from the battery.
- Remove the holding strap(s).
- Withdraw battery from watercraft being careful not to lean it so that electrolyte flows out of vent elbow.

⚠️ WARNING
Electrolyte is poisonous and dangerous. Avoid contact with eyes, skin and clothing. Wear a suitable pair of non-absorbent gloves when removing the battery by hand.

CAUTION: Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water.

Cleaning
Clean the battery casing, caps, cables and battery posts using a solution of baking soda and water.

CAUTION: Do not allow cleaning solution to enter battery.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Rinse with clear water and dry well.

Inspection
Visually inspect battery casing for cracks or other possible damage. If casing is damaged, replace battery and thoroughly clean battery tray and area with water and baking soda.

Inspect battery posts for security of mounting.
Inspect for cracked or damaged battery caps, replace defective caps.

NOTE: Hand tighten caps then tighten an additional 1/4 turn using a 20 mm (3/4 in) socket. Using other tool could damage the plastic battery caps.

⚠️ WARNING
Battery electrolyte is caustic. To prevent spillage, battery cell cap should be sufficiently tight to properly seal.

Electrolyte Level
Check electrolyte level in each cell, add distilled water up to upper level line.

CAUTION: Add only distilled water in an activated battery.

Battery Vent and Check Valve

⚠️ WARNING
Battery caps do not have vent holes. Make sure that vent line is not obstructed.

Check vent line condition.
Use pump in engine leak test kit (P/N 295 500 352).

Set pump to PRESSURE and verify check valve operation as follows.
Check valve must let air to flow out when orange side is opposite to pump.

AIR MUST FLOW OUT IN THIS POSITION
Check valve must hold air with 34 kPa (5 PSI) without leaking when orange side is on pump side.

A hydrometer measures the charge of a battery in terms of specific gravity of the electrolyte.

<table>
<thead>
<tr>
<th>BATTERY CONDITION</th>
<th>SPECIFIC GRAVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully charged</td>
<td>1.265 - 1.280</td>
</tr>
</tbody>
</table>

Most hydrometers give a true reading at 21°C (70°F).

1. Specific gravity 1.265

In order to obtain correct readings, adjust the initial reading by adding .004 points to the hydrometer readings for each 5.5°C (10°F) above 21°C (70°F) and by subtracting .004 point for every 5.5°C (10°F) below 21°C (70°F).

This chart will be useful to find the correct reading.

<table>
<thead>
<tr>
<th>ELECTROLYTE TEMPERATURE</th>
<th>OPERATION TO PERFORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td>38</td>
<td>100</td>
</tr>
<tr>
<td>32</td>
<td>90</td>
</tr>
<tr>
<td>27</td>
<td>80</td>
</tr>
<tr>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>16</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>-1</td>
<td>30</td>
</tr>
</tbody>
</table>

Battery Testing
There are 2 types of battery tests: electrolyte reading and load test. An electrolyte reading is made on a battery without discharging current. It is the simplest and commonly used. A load test gives more accuracy of the battery condition.

Electrolyte Reading
Check charge condition using either a hydrometer or multimeter.

Set multimeter to Vdc and measure voltage at battery posts.

<table>
<thead>
<tr>
<th>BATTERY CONDITION</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully charged</td>
<td>12.6 Vdc</td>
</tr>
</tbody>
</table>
**SPECIFIC GRAVITY READING USING A HYDROMETER**

<table>
<thead>
<tr>
<th>STATE OF CHARGE</th>
<th>ELECTROLYTE TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27°C (80°F)</td>
</tr>
<tr>
<td>100%</td>
<td>1.26/1.27</td>
</tr>
<tr>
<td>75%</td>
<td>1.21/1.22</td>
</tr>
<tr>
<td>50%</td>
<td>1.16/1.17</td>
</tr>
<tr>
<td>25%</td>
<td>1.12/1.13</td>
</tr>
<tr>
<td>0%</td>
<td>1.10 or less</td>
</tr>
</tbody>
</table>

**Load Test**

This is the best test of battery condition under a starting load. Use a load testing device that has an adjustable load.

Apply a load of 3 times the ampere-hour rating of the battery for 14 seconds, then check battery voltage.

<table>
<thead>
<tr>
<th>LOAD</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 times the Ah/14 seconds</td>
<td>10.5 Vdc min.</td>
</tr>
</tbody>
</table>

**Battery Storage**

**CAUTION:** Battery storage is critical for battery life. Regularly charging the battery during storage will prevent cell sulfation. Keeping the battery in vehicle for storage may lead to contacts degradation/corrosion and case damage if freezing occurs. A discharged battery will freeze and break in area where freezing point is experienced. Electrolyte leakage will damage surrounding parts. Always remove battery from vehicle for storage and regularly charge to keep an optimal condition.

Disconnect and remove battery from watercraft as explained in REMOVAL.

Check electrolyte level in each cell, add distilled water up to upper level line.

**CAUTION:** Do not overfill.

The battery must always be stored in fully charged condition. If required, charge until specific gravity of 1.265 is obtained.

**CAUTION:** Battery electrolyte temperature must not exceed 50°C (122°F). The casing should not feel hot.

Clean battery terminals and cable connections using a wire brush. Apply a light coat of dielectric grease on terminals.

Clean battery casing and caps using a solution of baking soda and water.

**CAUTION:** Do not allow cleaning solution to enter battery.

Rinse battery with clear water and dry well using a clean cloth.

Store battery in a cool dry place. Such conditions reduce self-discharging and keep fluid evaporation to a minimum. Keep battery away from dew, high moisture and direct sunlight.

During the storage period, recheck electrolyte level and specific gravity readings at least every month. If necessary, keep the battery at its upper level line and near full charge as possible (snickle charge).

**Activation of a New Battery**

**WARNING**

Never charge or boost battery while installed in watercraft.

Perform the following operations anytime a new battery is to be installed.

- Remove the sealing tube from the vent elbow.

**WARNING**

Failure to remove the sealing tube could result in an explosion.

- Remove caps and fill battery to UPPER LEVEL line with electrolyte (specific gravity: 1.265 at 21°C (70°F)).

**NOTE:** This battery may fill slower than others due to the anti-spill check ball design.
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

1. Sealing tube removed
2. Battery electrolyte
3. Upper level line

- Allow the battery to stand for 30 minutes MINIMUM so that electrolyte soak through battery cells.

![Diagram](image1)

1. 30 minutes

- Readjust the electrolyte level to the UPPER LEVEL line.

![Diagram](image2)

1. Battery electrolyte
2. Upper level line

- Connect a 2 A battery charger for 3 to 5 hours.

![Diagram](image3)

Step 1: Connect + lead to battery + post
Step 2: Connect - lead to battery - post
Step 3: Plug battery charger

**WARNING**

Gases given off by a battery being charged are highly explosive. Always charge in a well ventilated area. Keep battery away from cigarettes or open flames. Always turn battery charger off prior to disconnecting cables. Otherwise a spark will occur and battery might explode.

**CAUTION:** If charging rate raises higher than 2.4 A reduce it immediately. If cell temperature rises higher than 50°C (122°F) or if the casing feels hot, discontinue charging temporarily or reduce the charging rate.

- Disconnect battery charger.

Step 1: Unplug battery charger
Step 2: Disconnect - lead
Step 3: Disconnect + lead

- Test battery state of charge. Use a hydrometer.
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

The time required to charge a battery will vary depending on some factors such as:
- Battery temperature: The charging time is increased as the temperature goes down. The current accepted by a cold battery will remain low. As the battery warms up, it will accept a higher rate of charge.
- State of charge: Because the electrolyte is nearly pure water in a completely discharged battery, it cannot accept current as well as electrolyte. This is the reason the battery will not accept current when the charging cycle first begins. As the battery remains on the charger, the current from the charger causes the electrolytic acid content to rise which makes the electrolyte a better conductor and then, the battery will accept a higher charging rate.
- Type of charger: Battery chargers vary in the amount of voltage and current that they can supply. Therefore, the time required for the battery to begin accepting measurable current will also vary.

Charging a Very Flat or Completely Discharged Battery

The battery charger should have an adjustable charging rate. Variable adjustment is preferred, but a unit which can be adjusted in small increments is acceptable.

The battery charger must be equipped with an ammeter capable of accurately measuring current of less than 1 ampere.

Unless this procedure is properly followed, a good battery may be needlessly replaced.
- Measure the voltage at the battery posts with an accurate voltmeter. If it is below 10 volts, the battery will accept current at very low rate, in term of milliamperes, because electrolyte is nearly pure water as explained above. It could be some time before the charging rate increases. Such low current flow may not be detectable on some charger ammeters and the battery will seem not to accept any charge.
- Exceptionally for this particular case, set the charger to a high rate.

Charging a Used Battery

Never charge battery while installed in watercraft.

For best results, battery should be charged when the electrolyte and the plates are at room temperature. A battery that is cold may not accept current for several hours after charging begun.

Do not charge a frozen battery. If the battery charge is very low, the battery may freeze. If it is suspected to be frozen, keep it in a heated area for about 2 hours before charging.

Always charge battery in a well ventilated area.

WARNING
Battery electrolyte is caustic. To prevent spillage, battery cell cap should be sufficiently tight to properly seal.

1. Specific gravity 1.265
- If electrolyte level has dropped after charging, fill with distilled water to UPPER LEVEL line. After water is added, continue charging for 1 to 2 hours to mix water with electrolyte.
- Reinstall caps and clean any electrolyte spillage using a solution of baking soda and water.

NOTE: Hand tighten caps then tighten an additional 1/4 turn using a 20 mm (3/4 in) socket. Using other tool could damage the plastic battery caps.
Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

NOTE: Some chargers have a polarity protection feature which prevents charging unless the charger leads are connected to the correct battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly. This will make it appear that the battery will not accept a charge. Follow the charger manufacturer's instruction on how to bypass or override this circuitry so that the charger will turn on and charge a low-voltage battery.

- Since the battery chargers vary in the amount of voltage and current they provide, the time required for the battery to accept measurable charger current might be up to approximately 10 hours or more.
- If the charging current is not up to a measurable amount at the end of about 10 hours, the battery should be replaced.
- If the charging current is measurable before the end or at the end of about 10 hours, the battery is good and charging should be completed in the normal manner as specified in ACTIVATION OF A NEW BATTERY.
- It is recommended that any battery recharged by this procedure be load tested prior to returning it to service.

Battery Installation

⚠️ WARNING
Always connect battery cables exactly in the specified order, RED positive cable first, BLACK negative cable last.

Proceed as follows:
- Install battery in its emplacement.
- Secure vent line to the battery and support. Ensure vent line is not kinked or obstructed.

⚠️ WARNING
Vent line must be free and open. Avoid skin contact with electrolyte.

- First connect RED positive cable.
- Connect BLACK negative cable last.
- Apply dielectric grease on battery posts.
- Verify cable routing and attachment.
## STARTING SYSTEM

### SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>dielectric grease</td>
<td>293 550 004</td>
<td>242</td>
</tr>
<tr>
<td>Isoflex grease Topas NB52</td>
<td>293 550 021</td>
<td>242</td>
</tr>
<tr>
<td>Loctite 243</td>
<td>290 897 651</td>
<td>242</td>
</tr>
</tbody>
</table>
Starting System Wiring Diagram
GENERAL

Causes of troubles are not necessarily related to starter but may be due to a burnt fuse, faulty battery, start/stop switch, DES body, MPEM or ECM, solenoid, electrical cables or connections. Check these components before removing starter.

To check battery condition, refer to CHARGING SYSTEM.

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS.

Consult also the TROUBLESHOOTING section for a general view of possible problems.

⚠️ WARNING

Short circuiting electric starter is always a danger, therefore disconnect the battery ground cable before carrying out any kind of maintenance on starting system. Do not place tools on battery.

Starter Specifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal output</td>
<td>0.9 kW</td>
</tr>
<tr>
<td>Voltage</td>
<td>12 V</td>
</tr>
<tr>
<td>Rated time</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Rotation</td>
<td>Counterclockwise (viewed from pinion side)</td>
</tr>
<tr>
<td>Weight</td>
<td>2.5 kg (5.39 lb)</td>
</tr>
<tr>
<td>Performance specification at 20°C (68°F)</td>
<td></td>
</tr>
<tr>
<td>No load</td>
<td>11.4 V 23 A max. 8600 RPM</td>
</tr>
<tr>
<td>Load</td>
<td>8.6 V 140 A max. 5200 RPM</td>
</tr>
<tr>
<td>Stall</td>
<td>3.75 V 330 A max. 0 RPM</td>
</tr>
</tbody>
</table>

TEST

ELECTRICAL CABLES OR CONNECTIONS

Check all connections, cables and wires. Tighten any loose cables. Replace any chafed wires.

FUSE

Make sure the 10 A fuse (no. 9 on wiring diagram) fuse on the MPEM and the 30 A main fuse (starting system) besides the MPEM are in good condition.

The solenoid may be the cause of a burnt fuse. If the solenoid checks good, one of the accessory may be defective.

ENGINE CONTROL MODULE (ECM)

If 2 short beeps are not heard when installing the safety lanyard, refer to ENGINE MANAGEMENT.

ENGINE START/STOP SWITCH

A quick operation test can be done with the B.U.D.S. software, using the Monitoring tab. Press the start button and look at the Start button LED. It should turn on, indicating the starting system is working on the input side of the starting system (start button, MPEM, ECM and wiring). You know now the problem is on the output side of the starting system (MPEM output signal to starting solenoid, wiring harness going to the solenoid and starter motor). Otherwise, check the input side as follows.

Disconnect the start/stop switch connector.

Use a multimeter and set it to Ω.

Measure resistance, as follows.

<table>
<thead>
<tr>
<th>SWITCH POSITION</th>
<th>WIRES</th>
<th>RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Released</td>
<td>YELLOW/RED and PURPLE</td>
<td>Infinite (ΩL)</td>
</tr>
<tr>
<td>Pressed and held</td>
<td>Up to 10 Ω</td>
<td></td>
</tr>
</tbody>
</table>
If switch is out of specification, replace it.

Test continuity of circuit 2-23. If it is faulty, repair harness/ connectors. Otherwise, try a new MPEM.

Test continuity of circuit B-19. If it is faulty, repair harness/ connectors. Otherwise, try a new ECM.

SOLENOID

Solennid is located beside the MPEM.

Inspect connections and clean as necessary.

**Continuity Test**

Use a multimeter and set it to Ω.

Measure winding resistance, as follows.

<table>
<thead>
<tr>
<th>PIN</th>
<th>RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and B</td>
<td>Approximately 5 Ω</td>
</tr>
</tbody>
</table>

There should be no continuity between the positive posts of the solenoid.

**Dynamic Test**

Set ECM in engine drowned mode as follows:

Depress throttle lever and install a rubber band to hold lever in full throttle position.

Use a multimeter and set it to Vdc.

Depress start/stop button and while engine is cranking, measure the voltage drop.
Section 06 ELECTRICAL SYSTEM
Subsection 03 (STARTING SYSTEM)

<table>
<thead>
<tr>
<th>SOLENOID POST</th>
<th>VOLTAGE (DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post coming from battery</td>
<td>0.2 V max.</td>
</tr>
<tr>
<td>Post going to starter</td>
<td></td>
</tr>
</tbody>
</table>

If voltage is out of specification, replace solenoid.

**WARNING**
Remove rubber band from throttle lever to release it.

PARTS REPLACEMENT

STARTER

Removal
Disconnect BLACK cable ground connection from battery.

**WARNING**
Always disconnect ground cable first and reconnect last.

Disconnect RED cable connection from battery.
NOTE: To facilitate starter removal on RXP models, remove engine cover. Refer to BODY section.
Remove retaining screws from starter.
Pull starter out. Lift starter enough to reach starter cable then disconnect from starter.

Installation
Installation is essentially the reverse of removal procedure. However, pay particular attention to the following.
Make sure that starter and engine mating surfaces are free of debris. Serious trouble may arise if starter is not properly aligned.
Apply grease Isoflex grease Topas NB52 (P/N 293 550 021) on O-rings of starter.
Install starter.
NOTE: If starter does not mesh properly, try to pull it out and slightly rotate the starter gear; then reinstall starter. One could also temporarily remove both O-rings, properly mesh gears then remove starter to reinstall O-rings, being careful not to rotate gear to keep its position, to finally reinstall starter.
Apply Loctite 243 (P/N 290 697 651) on retaining screws and torque to 10 N•m (89 lbf•in).
Connect the RED positive cable to the starter and torque nut to 7 N•m (62 lbf•in). Apply dielectric grease (P/N 293 550 004) on terminal and nut.
Ensure to slide protector over nut to hide metallic parts.
Section 06 ELECTRICAL SYSTEM
Subsection 03 (STARTING SYSTEM)

1. Dielectric grease on O-rings
2. Torque nut to 7 N*m (62 lb\*in) and apply dielectric
grease and install protection cover
3. 10 N*m (89 lb\*in)

![Diagram 1](image1)

**WARNING**
Always connect RED positive cable first then
BLACK negative cable last. Whenever connec-
ting the RED positive cable to the starter
motor make sure the battery cables are dis-
connected to prevent electric shock.

![Diagram 2](image2)

**STARTER GEAR**

**Removal**
Remove starter.
Remove gear retaining circlip and pull out starter
gear.

**Installation**
Installation is essentially the reverse of removal
procedure. However, pay particular attention to
the following.
It is recommended to use a new circlip.
Section 06 ELECTRICAL SYSTEM
Subsection 04 (DIGITALLY ENCODED SECURITY SYSTEM (DESS))

DIGITALLY ENCODED SECURITY SYSTEM (DESS)

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>multimeter FLUKE 111</td>
<td>529 035 868</td>
<td>247</td>
</tr>
</tbody>
</table>

GENERAL

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS.

This system allows starting the engine only with safety lanyard(s) that has been programmed to operate a specific watercraft. This functionality is the DESS system.

NOTE: If desired, a DESS key can be used on other watercraft equipped with the DESS. It only needs to be programmed for that watercraft.

The following components are specially designed for this system: Multi-Purpose Electronic Module (MPEM), ECM, DESS key and DESS post.

The DESS key cap contains a magnet and a ROM chip. The magnet actually closes the reed switch inside the post which is the equivalent of a mechanical ON/OFF switch. The chip has a unique digital code which is the equivalent of the notch pattern on a conventional key.

The system is quite flexible. Up to 8 keys may be programmed in the memory of the ECM. They can also be erased individually.

The memory of the ECM is programmed to recognize the digital code of the DESS key. This is achieved with the B.U.D.S. software.

In addition to the standard DESS key, the ECM also offers special keys that can be programmed so that the vehicle can be run only at a limited speed. Such feature is ideal for first-time riders or renters.

<table>
<thead>
<tr>
<th>AVAILABLE TYPE OF DESS KEYS</th>
<th>COLOR</th>
<th>MAXIMUM VEHICLE SPEED ALLOWED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Yellow</td>
<td>Full speed allowed</td>
</tr>
<tr>
<td>Learning</td>
<td>White</td>
<td>55 km/h (35 MPH)</td>
</tr>
<tr>
<td>Rental (*)</td>
<td>Orange</td>
<td>70 km/h (45 MPH)</td>
</tr>
</tbody>
</table>

NOTE: (*) Available on GTI Rental models only.

WARNING

When programming a Sea-Doo® Learning Key™ or Rental Key, use only a key that is identified for that purpose. Otherwise, a customer could use a vehicle with a greater speed than he was expecting.

When connecting a key on the post, the DESS is activated and will emit audible signals:

<table>
<thead>
<tr>
<th>BEEP</th>
<th>SIGNIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 short</td>
<td>Indicate a working DESS key. Engine starting can take place.</td>
</tr>
<tr>
<td>1 long</td>
<td>Indicates a wrong DESS key is being used or something is defective. Engine starting is not allowed.</td>
</tr>
</tbody>
</table>

Other beeps can be heard. The ECM features a self-diagnostic mode. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS for more information.

When ordering a new ECM from the regular parts channel, the DESS circuitry will be activated.

Key Reminder

If engine is not started within 5 seconds after installing the DESS key on its post, 4 very short beeps every 3 second interval will sound to remind you to start the engine or to remove the key. Afterwards, the beeps will stop. The same will occur when the key is left on its post 5 seconds after engine is stopped.
Always ensure DESS key is not left on its post after engine is stopped.

IMPORTANT: Leaving the DESS key on its post when engine is not running will slowly discharge the battery.

KEY PROGRAMMING

Use the latest B.U.D.S. software available from BOSSWeb. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS for proper connection instructions.

The B.U.D.S. software is designed to allow, among other things, the programming of DESS key(s) and entering customer information.

For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

⚠️ WARNING

If the computer you are using is connected to the 110 Vac power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

Read ECM using READ DATA button.

Install the new key to be programmed on MPI or DESS post interface tool.

Click on the desired ADD KEY button on bottom of screen according to the type of key you want to program. Ensure to use the color that matches the key usage.

A new key is now saved in the computer.

NOTE: To program other key(s), install a new key and click again on ADD KEY tab.

Ensure to save new data in ECM using WRITE DATA button.
TROUBLESHOOTING

If no beep is heard when installing the DESS key on the post, test beeper operation as follows.

Use the latest B.U.D.S. software available from BOSSWeb. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS for proper connection instructions.

Energize Buzzer from Activation tab.

If beeper properly works, refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS and check for fault codes. If beeper does not work, check it and its wiring.

DESS Post

The following continuity tests can be performed using an ohmmeter.

For best results, use the multimeter FLUKE 111 (P/N 529 035 868).

Disconnect DESS post wires.

DESS Key Removed from Post

Connect test probes to DESS post as per tables and measure resistance.

<table>
<thead>
<tr>
<th>DESS POST</th>
<th>RESISTANCE Ω @ 20°C (68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIRE</td>
<td></td>
</tr>
<tr>
<td>BLACK</td>
<td>BLACK/YELLOW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESS POST</th>
<th>RESISTANCE Ω @ 20°C (68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIRE</td>
<td></td>
</tr>
<tr>
<td>WHITE/GREY</td>
<td>Post terminal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESS POST</th>
<th>RESISTANCE Ω @ 20°C (68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIRE</td>
<td></td>
</tr>
<tr>
<td>BLACK</td>
<td>Post ring</td>
</tr>
</tbody>
</table>
DESS Key on Post

Connect test probes to DESS post as per table and measure resistance.

<table>
<thead>
<tr>
<th>DESS POST</th>
<th>RESISTANCE Ω @ 20°C (68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLACK</td>
<td>BLACK/YELLOW</td>
</tr>
</tbody>
</table>

If any resistance test fails, replace DESS post.
GAUGE, SENSORS AND FUSES

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>multimeter Fluke 111</td>
<td>529 035 868</td>
<td>249</td>
</tr>
</tbody>
</table>

GENERAL

NOTE: For a complete overview of the vehicle electrical system, refer to ENGINE MANAGEMENT.

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to EMS DIAGNOSTIC AND COMMUNICATION TOOLS.

WARNING

It is recommended to always disconnect the battery when replacing any electric or electronic parts. Always disconnect battery exactly in the specified order, BLACK (-) cable first. Do not place tools on battery. Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure. Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

It is possible that a component seems to operate in static condition but in fact, it is defective. In this case, the best way to solve this problem is to remove the original part and replace it with a known good component.

IMPORTANT: When solving an electrical problem, the first thing to do is to check battery condition as well as its cables and connections. Install safety lanyard to activate ECM, MPEM and Information Center to perform testing procedures that requires the device to be supplied with electricity. Check solidity (close to battery) and related-circuit fuse condition with an ohmmeter (visual inspection could lead to false results). Also visually examine harness and connections.

For best results, use the multimeter Fluke 111 (P/N 529 035 868).

Pay particular attention to ensure that pins are not out of their connectors or damaged. The troubleshooting procedures cover problems not resulting from one of these causes.

CAUTION: Ensure all terminals are properly crimped on wires and connector housings are properly fastened. Replacing any electric or electronic part(s), always check electrical connections. Make sure that they are tight and they make good contact and are corrosion-free. The voltage and current might be too weak to go through dirty wire pins. Check the posts for signs of moisture, corrosion or if they look dull. Clean pins properly and then coat them with silicon-based dielectric grease or other appropriate lubricant (except if otherwise specified) when reassembling them. See connectors information in ELECTRICAL CONNECTORS.

Pay attention to ground wires.

Checking for Shorts Between 2 Wires

When checking continuity of a wire in a circuit, wires should be checked for short circuit as follows.

Make sure to isolate circuit by unplugging connectors.

Let’s suppose that the circuit to be checked has a RED and a BLACK wire. Using an ohmmeter, measure the resistance between the RED and the BLACK wire. The resistance should be infinite (OL). Otherwise, there is a short circuit between both wires. We must therefore identify and correct the fault.
Section 06 ELECTRICAL SYSTEM
Subsection 05 (GAUGE, SENSORS AND FUSES)

Addition of Electrical Accessories
Every time an electrical accessory is added such as an electric bilge pump or a VTS for instance, it must be registered using B.U.D.S. to activate it in the MPEM.

If an option is installed but not checked in B.U.D.S., the information center will not display that option. If an option is checked in B.U.D.S. but not installed in vehicle, SENSOR will be displayed in Information Center.

Use the OPTIONS area in the Setting tab in B.U.D.S.

FUSES
If an electrical problem occurs, check the fuses. If a fuse is burnt, replace by one of the same rating.

WARNING
Do not use a higher rated fuse as this can cause severe damage. If a fuse has burnt out, source of malfunction should be determined and corrected before restarting.

MPEM Fuses Identification
Fuses rating are identified on the MPEM, beside the fuse holders.

<table>
<thead>
<tr>
<th>MPEM</th>
<th>Fuse Identifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Camshaft position sensor 10 A</td>
</tr>
<tr>
<td>2</td>
<td>Spare fuse (accessory) 2 A</td>
</tr>
<tr>
<td>3</td>
<td>Depth sounder (GTX LTD)</td>
</tr>
<tr>
<td>4</td>
<td>Cylinder 3 ignition coil 10 A</td>
</tr>
<tr>
<td>5</td>
<td>Cylinder 2 ignition coil 10 A</td>
</tr>
<tr>
<td>6</td>
<td>Cylinder 1 ignition coil 10 A</td>
</tr>
<tr>
<td>7</td>
<td>12V</td>
</tr>
<tr>
<td>8</td>
<td>Spare fuse (permanent) 1 A</td>
</tr>
<tr>
<td>9</td>
<td>Electric starter, fuel pump 10 A</td>
</tr>
<tr>
<td>10</td>
<td>Information center, TOPS sensor 5 A</td>
</tr>
<tr>
<td>11</td>
<td>EMS, start/stop switch 5 A</td>
</tr>
</tbody>
</table>

Fuses can be found on the MPEM and on starting solenoid cable besides MPEM.
Main Fuses Identification

1. Spare fuse
A. Main fuse
B. Charging system fuse

MPEM Fuse Replacement
Squeeze locking tabs together, hold and pull fuse cover from the MPEM.

TYPICAL
Step 1: Press
Step 2: Pull
1. MPEM
2. Fuse cover

Use the tabs of the fuse cover to remove and re-install fuses. Slide cover tabs along fuse top.

One cover contains spare fuses.
To gain access to spare fuses, remove the cover identified ‘SPARE FUSES INSIDE’. Look inside cover and pull the rubber protector with a finger. Take care not to drop the fuses.
When finished, reinstall the remaining fuse(s) and reinstall the protector over fuse(s).

**CAUTION:** Do not install more than 4 fuses in cover to allow proper installation of cover.

**INFORMATION CENTER**

**Overview**

This is a multifunction gauge that supplies several real time useful information to the driver either in English, French or Spanish. Units can be displayed both in SAE custom system or in the metric system. Use B.U.D.S. to change these functions.

At start-up, all LCD segments and indicator lights will turn on for 3 seconds each time the information center is activated (when safety lanyard is installed). This allows the driver to validate that they are all working properly.

1) **Speedometer**

Speedometer indicates the speed of watercraft in miles per hour (MPH) or kilometers per hour (km/h).

2) **Tachometer**

Tachometer indicates the revolutions per minute (RPM) of the engine. Multiply by 1000 to obtain the actual revolutions.

3) **Fuel Level**

Bar gauge continuously indicates the amount of fuel in the fuel tank while riding. A low-fuel condition is also indicated on the information display as only one bar is displayed. See **MESSAGE DISPLAY** below.

4) **Information Display**

**On so Equipped Models**

**Compass**

Displays the cardinal points to indicate the orientation of the watercraft.

**WARNING**

*Use the compass as a guide only. Not to be used for navigation purposes.*

**Water Temperature**

Displays the water temperature of the water surface in degrees Celsius (°C) or Fahrenheit (°F).

**NOTE:** Water temperature and depth gauge will be displayed alternately.
Section 06 ELECTRICAL SYSTEM
Subsection 05 (GAUGE, SENSORS AND FUSES)

Water Depth
Display the water depth under the hull within 0 to 50 meters (0 to 170 feet).

NOTE: Under certain conditions, the gauge may stop displaying. The gauge ability to display the depth depends on the usage conditions.

⚠️ WARNING
Never use the depth gauge as a warning device to ride in shallow water. Use it as a navigation guide only. Not to be used for navigation purposes.

NOTE: Water temperature and depth gauge will be displayed alternately.

All Models

Hourmeter (HR)
Displays the time in hours of the watercraft usage.

Message Display
Displays a message whenever one of the following circumstances occurs. The abbreviations between parenthesis here are the code displayed:
- engine or exhaust system overheating (ExHAUST or ENGINE)
- low oil pressure (OIL)
- low battery voltage (12 V LOW)
- high battery voltage (12 V HI)
- low fuel level (FUEL-LO)
- maintenance reminder (MAINT)

NOTE: When the watercraft is due for a maintenance inspection, the message MAINT will blink. After servicing, clear it using B.U.D.S.
- check engine (CHK ENG)

NOTE: If a fault occurs, this system generates numbered fault codes (P-XXXX) that are displayed through the information center. Use B.U.D.S. to help troubleshooting.
- sensor failure (vehicle electronic equipment) (SENSOR)
- invalid safety lanyard (KEY)
- safety lanyard, learning key active (L KEY) (includes the Rental key as well).

A beeper will sound and indicator light will blinks depending on the fault occurring to catch the driver attention when necessary. Use B.U.D.S. for troubleshooting when such a message is displayed.

5) Indicator Lights
NOTE: Refer to INFORMATION DISPLAY above for additional information regarding messages.

Low oil pressure (OIL)

Check engine (CHK ENG)

Engine or exhaust system overheating (H-TEMP)

Low fuel level (FUEL-LOW)

Low/high battery voltage (12 V LOW/Hi)

Maintenance reminder (MAINT)

6) Water Depth Display
On so Equipped Models
Displays the water depth under the hull within 0 to 50 meters (0 to 170 feet).

NOTE: Under certain conditions, the gauge may stop displaying. The gauge ability to display the depth depends on the usage conditions.

⚠️ WARNING
Never use the depth gauge as a warning device to ride in shallow water. Use it as a navigation guide only. Not to be used for navigation purposes.
7) Water Temperature Display  
On So Equipped Models  
Displays the water temperature of the water surface in degrees Celsius (°C) or Fahrenheit (°F).

8) VTS Position Indicator  
On So Equipped Models  
The VTS position indicator shows the riding attitude of the watercraft.

- Check communication link wires (WHITE/RED and WHITE/BLACK):
  - To quickly check if the communication link is working, temporarily disconnect a sensor on the engine to create a fault code. Start the engine. The information center should display a fault code.
  - Check if wires are swapped, unconnected or short circuited.
  - One faulty wire will cause a longer delay to perform the self-test when safety lanyard is installed.

- If everything tests good, try a new information center.

Information Center Removal  
CAUTION: Information center locking tabs may break when removing its trim; extreme care must be taken while performing trim removal procedure.

Take a small wooden stick (coffee stirrer type) and chamfer its end; refer to photo.

PROCEDURES

INFORMATION CENTER

Setting Language and Units  
Use B.U.D.S. and go to page 2 in Settings tab.

Clearing Maintenance Light  
Use B.U.D.S. and use Reset button in Vehicle tab.

Troubleshooting  
When there is no display at the information center, perform the following:
- Check fuses.
- B.U.D.S. can be used to check its operation.  
  Look in the Monitoring tab.
- Check supply wire (1-18) and ground wire (1-8) from MPEM.
Section 06 ELECTRICAL SYSTEM
Subsection 05 (GAUGE, SENSORS AND FUSES)

Remove and keep both screws retaining information center.

Information Center Installation
The installation is the reverse of the removal procedure. However, pay attention to the following.

Torque screws to a MAXIMUM of 1.5 Nm (13 lbf-in).
Reinstall information center trim simply by pushing it in so it snaps back in place.

New Information Center Settings
Use B.U.D.S. to set parameters in information center.

Install safety lanyard on its post.

NOTE: If an information center from another watercraft model is installed, the following message will be displayed. Also, engine starting will not be allowed.

Click NO and install the appropriate information center for this watercraft.

NOTE: If for some reason, you need to start engine, click YES. Engine starting will be allowed and the message will not appear anymore. Remove and reinstall safety lanyard to start engine. However, since this is not the right gauge, some functions may not work properly.

Set language and units as described above.
Set compass pitch (if so equipped) in page 2 of Settings tab as per following table.
Section 06 ELECTRICAL SYSTEM
Subsection 05 (GAUGE, SENSORS AND FUSES)

<table>
<thead>
<tr>
<th>MODELS</th>
<th>COMPASS PITCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTX and RXT</td>
<td>41</td>
</tr>
<tr>
<td>RXP</td>
<td>51</td>
</tr>
</tbody>
</table>

NOTE: Failure to properly set compass pitch will lead to inaccurate display of compass.

FUEL BAFFLE PICK-UP SENDER

The fuel pick-up system is part of the fuel pump module mounted inside the fuel reservoir.
The fuel level gauge sender is also mounted on this module.

![Typical — Fuel Level Gauge Sender Mounted on Fuel Pump Module](image)

Refer to FUEL TANK AND FUEL PUMP for fuel pump testing. For fuel level sensor, follow procedures below.
The resistance measured between PINK/BLACK and PINK wires must be in accordance with fuel level (measured from under the flange) as specified in the following charts.

<table>
<thead>
<tr>
<th>RESISTANCE (Ω)</th>
<th>FLOAT HEIGHT (bottom of float with bottom of pump module) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8 ± 2.2</td>
<td>247 ± 5.0</td>
</tr>
<tr>
<td>17.8 ± 2.2</td>
<td>207 ± 5.0</td>
</tr>
<tr>
<td>27.8 ± 2.2</td>
<td>183 ± 5.0</td>
</tr>
<tr>
<td>37.8 ± 2.2</td>
<td>158 ± 5.0</td>
</tr>
<tr>
<td>47.8 ± 2.2</td>
<td>133 ± 5.0</td>
</tr>
<tr>
<td>57.8 ± 2.4</td>
<td>105 ± 5.0</td>
</tr>
<tr>
<td>67.8 ± 2.5</td>
<td>76 ± 5.0</td>
</tr>
<tr>
<td>77.8 ± 3.6</td>
<td>55 ± 5.0</td>
</tr>
<tr>
<td>89.8 ± 3.6</td>
<td>35.3 ± 5.0</td>
</tr>
</tbody>
</table>

WATER TEMPERATURE SENSOR

On so Equipped Models
The water temperature sensor is integrated with the speed. As a result, that sensor has 3 wires instead of 2.
B.U.D.S. can be used to check its operation. Look in the Monitoring tab.
To check if the water temperature sensor is operational, select the water temperature mode in the Information Center.
With a garden hose, spray the speed sensor with water. The temperature reading on the Information Center should adjust to the water temperature.
If not, replace the speed sensor.

COMPASS
On so Equipped Models
The compass is located inside the information center.
B.U.D.S. can be used to check the operation. Look in the Monitoring tab.
Change the direction of the vehicle. There should be a change of direction on the Information Center.
NOTE: To check the accuracy of the compass, you can use a portable compass and point it in the same direction. Compare the given directions, they should be the same otherwise, check compass pitch setting with B.U.D.S. If the setting is appropriate, try a new information center.

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SPEED SENSOR

The speedometer gives a reading through a speed sensor. It works with the water flow which turns a magnetic paddle wheel that triggers an electronic pick-up that in turn sends a speed signal to the speedometer through the MPEM.

The paddle wheel is protected by the pick-up housing.

To check if the speed sensor is operational, disconnect the speed sensor connector housing from inside bilge.

Using an appropriate terminal remover (Snap-on TT600-4), remove the PURPLE/YELLOW and BLACK/ORANGE wires from the tab housing of the speed sensor.

**NOTE:** On models with 3 wires, the remaining wire is for the water temperature sensor.

Reconnect the PURPLE/YELLOW and BLACK/ORANGE wires in the receptacle housing.

Connect the positive probe of a multimeter to speed sensor PURPLE/YELLOW wire and the negative probe to speed sensor BLACK/ORANGE wire.

Slowly rotate the paddle wheel. Every 1/8 turn, the observed voltage should fluctuate between 5.5 and 8.5 Vdc.

DEPTH GAUGE

*On so Equipped Models*

Removal

Remove muffler.

Turn depth gauge counterclockwise and pull it out.

**Inspection**

Ensure the silicone pad is in good condition. There must be no air between the bottom of the depth gauge and the bilge. Otherwise, the gauge will not work.

If silicone pad is damaged, replace it.

**Installation**

Ensure O-ring is in good condition and in place.

After installation, try pulling the gauge out to ensure it is properly locked.

Test run gauge.
# JET PUMP

## SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
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<tbody>
<tr>
<td>drive shaft holder</td>
<td>529 035 986</td>
<td>265</td>
</tr>
<tr>
<td>impeller remover/installer</td>
<td>529 035 820</td>
<td>268–269</td>
</tr>
<tr>
<td>impeller remover/installer</td>
<td>529 035 956</td>
<td>268–269</td>
</tr>
<tr>
<td>impeller shaft pusher</td>
<td>529 035 955</td>
<td>269, 271–272</td>
</tr>
<tr>
<td>pressure cap</td>
<td>529 035 843</td>
<td>263</td>
</tr>
<tr>
<td>seal/bearing pusher</td>
<td>529 035 819</td>
<td>271–273</td>
</tr>
<tr>
<td>vacuum/pressure pump kit</td>
<td>529 031 800</td>
<td>263</td>
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</tbody>
</table>

## SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
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<tr>
<td>jet pump bearing grease</td>
<td>293 550 032</td>
<td>272–273</td>
</tr>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>264, 266</td>
</tr>
<tr>
<td>Loctite 767 (antiseize lubricant)</td>
<td>293 800 070</td>
<td>269</td>
</tr>
<tr>
<td>pulley flange cleaner</td>
<td>413 711 809</td>
<td>265, 269</td>
</tr>
<tr>
<td>XP-S Lube</td>
<td>293 600 016</td>
<td>266, 269</td>
</tr>
<tr>
<td>XP-S synthetic grease</td>
<td>293 550 010</td>
<td>266, 269</td>
</tr>
</tbody>
</table>
PLASTIC HOUSING

GTi Series (except GTi Rental), GTX and GTX WAKE Models

- XP-S synthetic grease
- Loctite 577 (thread sealant)
- Jet pump bearing grease
- Loctite 767 (antiseize lubricant)
- 125 N·m (92 lbf·ft)
- 7.5 N·m (66 lbf·in)
- 6 N·m (53 lbf·in)
- 6 N·m (53 lbf·in)
- Loctite 243
- 21 N·m (16 lbf·ft)
- Loctite 243
- 21 N·m (16 lbf·ft)

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ALUMINUM HOUSING

GTI Rental, GTX Limited, GTX Supercharged, RXP and RXT Models
GENERAL

During assembly/installation, use torque values and service products as in the exploded views. Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENER and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g., locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new ones when specified. If the efficiency of a locking device is impaired, it must be renewed.</td>
</tr>
</tbody>
</table>

Jet Pump Main Components

TYPICAL
1. Nozzle
2. Venturi
3. Jet pump housing
4. Wear ring
5. Impeller
6. Stator

INSPECTION

IMPELLER CONDITION

Condition of impeller, impeller boot and impeller ring can be quickly checked from underneath the watercraft. With the vehicle on the trailer, use a flashlight and look through the inlet grate.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MAXIMUM WEAR CLEARANCE mm (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 4-TEC except GTI rental models</td>
<td>0.35 (.014)</td>
</tr>
<tr>
<td>GTI rental</td>
<td>0.76 (.030)</td>
</tr>
</tbody>
</table>

NOTE: The inner diameter of the wear ring on Rentel GTI's aluminum pump is larger than the other models. The minimum clearance between impeller and wear ring is 0.51 mm (.020 in). This wear ring is BLACK and do not replace it with another type.

LEAK TEST

Whenever doing any type of repair on jet pump, a leak test should be done to check for leakage.
Proceed as follows:
- Remove impeller cover. Install the pressure cap (P/N 529 035 843) on pump housing.
- Connect pump includes in the vacuum/pressure pump kit (P/N 529 031 800) to fitting.
- Pressurize pump to a maximum of 70 kPa (10 PSI).

- Pump must maintain this pressure for at least 5 minutes.

**CAUTION:** Repair any leak, failure to correct a leak will lead to premature wear of pump components.

**NOTE:** If there is a pressure drop spray soapy water around cover. If there are no bubbles, impeller shaft, impeller shaft seal, or jet pump housing is leaking through porosity and has to be replaced. Jet pump unit has to be disassembled. There may be 2 or 3 bubbles coming out from the area of sleeve and its seal. This small leak is acceptable. Leaks from other areas must be repaired.
- Disconnect pump and remove pressure cap.
- Reinstall impeller cover with 3 new self-locking screws. Push cover against pump housing while tightening screws.

**PROCEDURES**

**NOTE:** Whenever removing a part, visually check for damage such as: corrosion, crack, split, break, porosity, cavitation, deformation, distortion, heating discoloration, wear pattern, defective plating, missing or broken balls in ball bearing, water damage diagnosed by black-colored spots on metal parts, etc. Renew any damaged part. As a quick check, manually feel clearance and end play, where applicable, to detect excessive wear.

**SACRIFICIAL ANODE**

**GTI rental, GTX Limited, GTX Supercharged, RXP and RXT Models**

**Inspection**
Check for wear. If worn more than half, replace anode.

**Removal**
Unscrew sacrificial anode bolt then remove anode.

**Installation**
The installation is the reverse of the removal procedure.

**VENTURI**

**Removal**
**NOTE:** In this procedure, the venturi is removed as an assembly with the reverse gate and the steering nozzle.

**GTX Series and RXT Models**
Unplug O.P.A.S. hose from filter.

**RXP Models**
Disconnect VTS link rod.
Section 07 PROPULSION
Subsection 01 (JET PUMP)

Remove bolts securing venturi to jet pump housing.

Installation
The installation is the reverse of the removal procedure. Pay attention to the following.
If needed, install new O-rings around bailer passages.

Remove O.P.A.S. "U" lever screws.

Position venturi with bailer passages on top.
Apply Loctite 243 (blue) (P/N 293 800 060) on threads of venturi bolts.
Install venturi bolts and flat washers then torque to 21 N•m (16 lbf•ft).

JET PUMP HOUSING
NOTE: The jet pump housing can be removed as an assembly with the reverse gate, nozzle and venturi. This is the preferred procedure when either the drive shaft or engine removal is required.

Removal
Remove venturi, see procedure above.
NOTE: To remove jet pump as an assembly, follow venturi removal procedure but do not unscrew venturi from jet pump housing.
Section 07 PROPULSION
Subsection 01 (JET PUMP)

Remove nuts or bolts that attach jet pump housing to pump support.

Remove jet pump with a wiggle movement.

**CAUTION:** When removing pump unit, shims could have been installed between hull and pump housing. Be sure to reinstall them otherwise engine and jet pump alignment will be altered.
When removing jet pump from vehicle, install the drive shaft holder (P/N 529 035 986) to support drive shaft and avoid engine oil seal damages.

![Typical Jet Pump](image)

**Typical**
1. Drive shaft holder

**Installation**
Properly clean all threads.
Remove all O-rings and clean parts in a solvent.
Brush and clean impeller splines and drive shaft splines with pulley flange cleaner (P/N 413 711 809) or equivalent. Free threads and splines from any residue.
The water flow is controlled by a reducer located between the jet pump support and the jet pump on the inlet side. The reducer is color coded according to watercraft model. See table below.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>REDUCER COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Models except GTX Supercharged</td>
<td>Yellow</td>
</tr>
<tr>
<td>GTX Supercharged</td>
<td>Red</td>
</tr>
</tbody>
</table>

Make sure that the reducer is installed as shown.

**CAUTION:** Misinstallation can cause overheating and damage to exhaust system.

![Reducer Installation](image)

1. Color-coded reducer

**Inspection and Cleaning**
Carefully check water passages. Blow low pressure compressed air through them and make sure they are clear.
Generously apply XP-S synthetic grease (P/N 293 550 010) on drive shaft splines.

Install jet pump. If necessary, wiggle jet pump to engage drive shaft splines in impeller.

CAUTION: Some watercraft require a shim between hull and pump; if shim has been removed at pump removal, be sure to reinstall it, otherwise engine alignment will be altered.

Apply Loctite 243 (blue) (P/N 293 800 060) on stud threads or screws (depending on the model) of jet pump housing.

On models with aluminum housing, ensure to reinstall bushings in fastener holes.

NOTE: Slightly lubricate wear ring with XP-S Lube (P/N 293 600 016) to minimize friction during initial start.

Reconnect O.P.A.S. hose. Torque clamp screw to 1.7 N•m (15 lbf•in).

Fasten O.P.A.S. “U” lever to nozzle and side levers. Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads (or use new self-locking screws). Torque center screw to 20 N•m (15 lbf•ft) and side screw to 7 N•m (62 lbf•in).

**IMPELLER COVER**

**Removal**

With pump housing in vertical position, remove 3 retaining screws.

Using a fiber hammer, gently tap impeller cover to release it from jet pump housing. Use flat screwdriver to remove cover.

Remove both O-rings.
Make sure the cover has the correct amount of grease. When the jet pump is overhauled, put the rest of the grease from the tube used in the cover (approximately 26 grams).

**Typical**

Install impeller cover with new self-locking screws. Torque to 7.5 N•m (66 lb•in). Push cover against pump housing while tightening screws. Make sure O-rings are positioned correctly and they are not damaged when pushing the cover.

**IMPELLER**

**Removal**

Remove jet pump housing. Refer to *JET PUMP HOUSING* in this section.

Remove impeller cover. Refer to *IMPELLER COVER* in this section.

Remove impeller boot by turning it clockwise.

---

**Inspection**

Check for presence of water in cover and bearing. If so, replace seal and sleeve on impeller side. Also replace O-rings and/or impeller cover.

1. Seal
2. Sleeve

Perform a leak test. Refer to *LEAK TEST* at the beginning of this section.

**Installation**

Install 2 new O-rings in their respective groove.
Mount the proper impeller remover/installer in a vise.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTI Series, GTX, GTX Wake</td>
<td>Impeller remover/installer</td>
</tr>
<tr>
<td>and GTX Supercharged</td>
<td>(P/N 529 035 820)</td>
</tr>
<tr>
<td>GTX Limited, RXP and RXT</td>
<td>Impeller remover/installer</td>
</tr>
<tr>
<td></td>
<td>(P/N 529 035 956)</td>
</tr>
</tbody>
</table>

CAUTION: Never use any impact wrench to loosen impeller.
To remove impeller, apply a rotating movement and pull at the same time. Slide impeller out of housing.

**Inspection**
Check impeller boot for damages. Replace if necessary.
Visually inspect impeller splines. Check for wear or deformation. Renew parts if damaged.
**NOTE:** Check also the drive shaft condition. Refer to DRIVE SYSTEM.
Examine impeller in wear ring for distortion.
Check if blade tips are blunted round, chipped or broken. Such impeller is unbalanced and will vibrate and damage wear ring, impeller shaft, shaft seal or bearings. Renew if damaged.

Using a 12 mm Allen key, unscrew the impeller.
**NOTE:** It may be needed to heat the impeller to release the threads.

1. Impeller remover/installer

Install jet pump housing over this tool.

1. Replaced if blunted round or damaged
Check impeller for cavitation damage, deep scratches or any other damage.

1. Check for cavitation, deep scratches or other damage

Cleaning
Brush and clean impeller shaft threads, impeller splines and drive shaft splines with pulley flange cleaner (P/N 413 711 809) or equivalent. Free threads and splines from any residue.

Installation
Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on impeller shaft.
Apply XP-S Lube (P/N 293 600 016) on the wear ring surface. Start screwing the impeller on its shaft. If impeller is too tight, use the impeller shaft pusher (P/N 529 035 955) to turn impeller to machine wear ring before installing on vehicle. Make sure to turn it smooth enough so that engine starter should turn it.
Mount the proper impeller remover/installer in a vise.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTI Series, GTX, GTX Wake and GTX Supercharged</td>
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</tr>
<tr>
<td>GTX Limited, RXP and RXT</td>
<td>Impeller remover/installer (P/N 529 035 956)</td>
</tr>
</tbody>
</table>

Install partially screwed impeller on it.
Use a 12 mm Allen key to torque impeller shaft to 125 N•m (92 lb•ft) then remove tool.

CAUTION: Never use any impact wrench to tighten impeller shaft.
Apply XP-S synthetic grease (P/N 293 550 010) on impeller boot threads.

WEAR RING

Inspection
Check wear ring for deep scratches, irregular surface or any apparent damage.
If impeller/wear ring clearance is too large and impeller is in good shape, renew wear ring.

Removal
Remove jet pump housing and impeller. See procedures above.
On plastic pump housing, remove the screws retaining wear ring in the jet pump housing.
Place jet pump housing in a vise with soft jaws. It is best to clamp housing using a lower ear.
Cut wear ring at two places.

CAUTION: When cutting ring, be careful not to damage jet pump housing.

NOTE: Wear ring can be cut using a jigsaw, a small grinder or a low clearance hacksaw such as Snap-on HS3 or equivalent.
After cutting ring, insert a screwdriver blade between jet pump housing and ring outside diameter.
Push ring so that it can collapse internally.
Pull ring out.

Installation
To install ring in housing, use a square steel plate of approximately 180 x 180 mm x 6 mm thick (7 x 7 in x 1/4 in) and a press.
Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.
Section 07 PROPULSION
Subsection 01 (JET PUMP)

CAUTION: Drill carefully paying attention not to damage threads in jet pump housing. Drilling holes prior to screw installation will avoid wear ring deformation. Do not drill through wear ring.

Install screws and torque to 6 N·m (53 lbf·in).

If a press is not readily available, a piece of wood such as a 2 x 4 in x 12 in long, can be used.

Manually engage ring in housing making sure it is equally inserted all around. Place wood piece over ring. Using a hammer, strike on wood to push ring. Strike one side then rotate wood piece about 90° and strike again. Frequently rotate wood piece so that ring slides in evenly until it seats into bottom of housing.

Models with a Plastic Pump Housing

After wear ring installation, install wear ring screws. Using their holes in jet pump housing as a drilling guide, drill 4 mm (5/32 in) diameter holes in wear ring. The depth of holes does not exceed 5 mm (3/16 in).

**TYPICAL**

**All Models**

Install all other removed parts.

**IMPELLER SHAFT AND BEARING**

**Inspection**

**Wear**

**IMPORTANT:** Make sure to reassemble ball cage, bearing inner and outer races to their original position.

Inspect ball bearing. Check for corrosion, scoring, pitting, chipping or other evidence of wear. With your finger nail, feel contact surface of sleeve. If any irregular surface is found, renew sleeve and seal.

Install bearing, then install impeller shaft and rotate it. Make sure it turns smoothly.

**Radial Play**

Radial play is critical for jet pump unit life span.

Radial play of impeller shaft is checked with shaft in housing, with impeller.

Retain housing in a soft jaw vise making sure not to damage housing lug.

Set a dial gauge and position its tip onto metal end, close to end of threads.

Move shaft end up and down. Difference between highest and lowest dial gauge reading is radial play.

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The radial play should be 0 (zero).

Removal
Remove impeller cover. See procedure in this section.
Remove impeller.
Remove circlip, seal and shaft sleeve.

NOTE: Ensure to keep shaft sleeve and O-ring in position. The impeller shaft pusher will work against shaft sleeve to properly push bearing out.
Use the impeller shaft pusher (P/N 529 035 955) to press out impeller shaft of pump housing. Bearing, will come out with the impeller shaft.

CAUTION: Bearing inner race being in 2 parts, bearing may fall apart during removal.
Use the seal/bearing pusher (P/N 529 035 819) to press out bearing from impeller shaft.

From the outlet side of pump, use the seal/bearing pusher (P/N 529 035 819) to press out the seal.
Section 07 PROPULSION
Subsection 01 (JET PUMP)

1. Seal/bearing pusher

Remove large O-ring from pump housing.

Installation
The installation is essentially the reverse of the removal procedure. However, pay attention to the following.

Using the seal/bearing pusher (P/N 529 035 819) press the bearing by its inner race on the impeller shaft.

Be careful when removing the plastic retainer from the bearing to avoid the inner races from falling apart. Make sure to reassemble bearing parts to their original position.

The bearing can be installed either side.

1. Shaft pusher

Coat shaft surface with jet pump bearing grease (P/N 293 550 032).

Install O-ring and shaft sleeve on shaft.
Section 07 PROPULSION
Subsection 01 (JET PUMP)

1. O-ring at bottom
2. Shaft sleeve

Apply 4 grams of jet pump bearing grease (P/N 293 550 032) on bearing. Use a new tube of grease each time a jet pump is rebuilt.

Press NEW seal using the seal/bearing pusher (P/N 529 035 819) until tool bottoms. Make sure seal lips are facing up.

1. Seal/bearing pusher

Install spacer and the other seal. Ensure seal lip is facing up.

Install circlip.

Before installing any other parts, pump can be pressurized to insure proper seal installation. See LEAK TEST at the beginning of this section.

Apply 26 grams of jet pump bearing grease (P/N 293 550 032) in the impeller shaft area.
NOTE: The remaining grease in the tube will be used for the impeller cover.
## DRIVE SYSTEM

### SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>drive shaft circlip remover</td>
<td>529 036 026</td>
<td>278</td>
</tr>
<tr>
<td>drive shaft holder tool</td>
<td>529 035 986</td>
<td>277, 283</td>
</tr>
<tr>
<td>Drive shaft/floating ring tool</td>
<td>529 035 841</td>
<td>279, 283</td>
</tr>
<tr>
<td>Drive shaft/floating ring tool</td>
<td>529 035 987</td>
<td>279, 283</td>
</tr>
<tr>
<td>PTO seal support tool</td>
<td>529 035 842</td>
<td>278, 282</td>
</tr>
</tbody>
</table>

### SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>anticorrosion spray</td>
<td>219 700 304</td>
<td>277, 281</td>
</tr>
<tr>
<td>XP-S Lube</td>
<td>293 600 016</td>
<td>279</td>
</tr>
<tr>
<td>XP-S synthetic grease</td>
<td>293 550 010</td>
<td>281</td>
</tr>
</tbody>
</table>
Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

GTX Limited and RXT

XP-S synthetic grease

GTI series, GTX, GTX Wake and GTX Supercharged

XP-S synthetic grease

RXP

2 N·m (18 lbf·in)

XP-S synthetic grease
GENERAL
Jet Pump must be removed to replace any components of the drive system. Refer to JET PUMP for removal procedure.
During assembly/installation, use torque values and service products as in the exploded view.
Clean threads before applying a threadlock. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

⚠️ WARNING
Torque wrench tightening specifications must strictly be adhered to.
Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new one where specified. If the efficiency of a locking device is impaired, it must be renewed.

MAINTENANCE
CORROSION PROTECTION
To prevent possible drive shaft corrosion in salt water, apply anticorrosion spray (P/N 219 700 304) as per interval in MAINTENANCE CHART.

⚠️ WARNING
Always work in a well ventilated area. Carefully read application instructions on product can.

Drive shaft should be dry and clean prior to applying the anticorrosion product.
Place a plastic sheet underneath hull to recover the excess of sprayed anticorrosion product.
From underneath hull, spray the anticorrosion product through the intake grate all over the visible portion of drive shaft.
Dispose of the soiled plastic sheet as per your local environmental regulations.
From inside bilge, lift rubber protector to expose PTO seal assembly.
NOTE: On Supercharged models, remove inlet hose from supercharger to gain access.

Cover carbon seal ring and floating ring with a rag or plastic wrap to prevent the anticorrosion product to reach the carbon ring. Place a rag on bottom of hull to recover the excess of sprayed anticorrosion product. Spray the visible portion of drive shaft. When done, dispose soiled rag as per your local environmental regulations.
Install inlet hose to supercharger.
Reposition rubber protector.
Wait 2 hours prior to using the watercraft to allow the anticorrosion product to dry.

PROCEDURES
DRIVE SHAFT
Removal
NOTE: When drive shaft will be removed, some oil will flow out. To prevent it, start engine, run at 4000 RPM for 10 seconds and stop engine at this RPM. This will move oil out of PTO housing into oil tank. If engine cannot be started, remove oil from the PTO area by following the procedure in PTO HOUSING REMOVAL of the PTO HOUSING AND MAGNETO section.
Remove jet pump. Refer to JET PUMP.
Install the drive shaft holder tool (P/N 529 035 986) on pump support. Secure it with jet pump housing fastener (nuts/bolts and washers).
NOTE: This is necessary so the drive shaft cannot move rearwards when using the drive shaft/float ring tool.

Remove seat.
RXP Models
Remove engine cover.
Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

**GTX Series and RXT Models**

Detach coolant expansion reservoir from vent tube support then move away.

1. Insert in groove of PTO seal assembly.

Due to configuration of some models, it may be necessary to disconnect EGTS sensor to make room.

Using the drive shaft circlip remover (P/N 529 036 026), push the floating ring rearwards to expose the circlip. This step is done to ensure floating ring is free and not stuck on the drive shaft. Do not remove circlip at this time.

**All Models**

NOTE: Use this sequence to minimize the amount of movement the drive shaft will slide back into PTO seal assembly.

Lift rubber protector to expose PTO seal assembly. Install the PTO seal support tool (P/N 529 035 842) on bottom of PTO seal assembly as shown.

CAUTION: Strictly follow this procedure otherwise damage to component might occur.

NOTE: Place the fork of drive shaft circlip remover against floating ring and the adjustable arm on engine. Move the tool handle toward the front of vehicle to push floating ring.

Remove the drive shaft circlip remover and the drive shaft holder.
**Section 07 PROPULSION**  
**Subsection 02 (DRIVE SYSTEM)**

Use the drive shaft/floating ring tool. Refer to the following table to use the appropriate tool according to the model.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTX Limited, RXP and RXT</td>
<td>Drive shaft/floating ring tool (P/N 529 035 987)</td>
</tr>
<tr>
<td>GTI Series, GTX, GTX Wake and GTX Supercharged</td>
<td>Drive shaft/floating ring tool (P/N 529 035 841)</td>
</tr>
</tbody>
</table>

Install tool as shown.

![Diagram](image1)

**TYPICAL**
1. Largest opening on PTO seal side

![Diagram](image2)

**TYPICAL**
1. Largest opening here
2. Telltale groove
3. Lubricate O-rings contact area
A. 18 mm (.71 in)

Turn screw clockwise so that the tool pushes the PTO seal forward and the drive shaft to the rear to expose the O-rings contact area. Continue to pull drive shaft out until there is a distance of 18 mm (.71 in) between the telltale groove and the tool edge. Lubricate O-rings contact area with XP-S Lube (P/N 293 600 016).

**NOTE:** This is necessary to ease drive shaft removal later in this procedure.

Remove drive shaft/floating ring tool.

Push drive shaft in and reinstall drive shaft holder tool.
Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

Remove drive shaft.

NOTE: A slight jerk to the rear may be required to remove the drive shaft from the PTO seal assembly.

Inspection and Lubrication

Drive Shaft

Inspect condition of circlip groove. If there is any damage or severe wear, replace drive shaft.

Push floating ring rearwards to expose circlip and remove it. Discard circlip.

Inspect condition of drive shaft splines. If splines are damaged, replace drive shaft.

With your finger nail, feel machined surface of drive shaft. If any irregular surface is found, renew drive shaft.

Remove drive shaft holder tool then drive shaft/floating ring tool.

Excessive deflection could cause vibration and damage to drive shaft splines, impeller or floating ring.
Place drive shaft on V-blocks and set-up a dial gauge in center of shaft. Slowly rotate shaft; difference between highest and lowest dial gauge reading is deflection. Refer to the following illustration.

**WARNING**

Always work in a well ventilated area. Carefully read application instructions on product can.

Wait 2 hours prior to using the watercraft to allow anticorrosion product to dry.

**Floating Ring**

Inspect condition of O-rings and contact surface floating ring. Apply a thin coat of XP-S synthetic grease (P/N 293 550 010) on the floating ring O-rings. Do not get grease on floating ring contact surface.

**Installation**

Before installing drive shaft, discard both O-rings inside PTO seal and install new ones.

Inspect PTO seal assembly. The inner sleeve must be flush with outer circumference of the assembly. Otherwise, gently push or tap on inner sleeve until flush.
Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

CORRECT POSITION
1. Inner sleeve flush with outer circumference

INCORRECT POSITION
1. Inner sleeve not flush with outer circumference

Remove the damper at the end of drive shaft and replace it with a new one.

1. Damper

Install the PTO seal support tool (P/N 529 035 842) on PTO seal assembly.
Slide drive shaft far enough to install floating ring.

1. PTO seal support
2. Drive shaft end
3. Insert floating ring on shaft end

Continue pushing drive shaft towards engine carefully guiding it in the PTO seal then in crankshaft splines. It may be necessary to move PTO seal assembly up and down to position it in the same axis as the drive shaft.

NOTE: If drive shaft does not enter into the PTO seal, check engine alignment.

TYPICAL

Maintain PTO seal assembly in the proper position and tap shaft end until it bottoms against engine. At this time, the telltale groove MUST NOT be visible. This validates the correct position.

CAUTION: If the telltale groove is exposed, the installation is wrong and PTO seal assembly will be pressed into crankshaft splines which could rub a hole in seal thus creating an oil leak.
Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

**CORRECT INSTALLATION**
1. PTO seal assembly
2. Shaft pushed in, riding telltale groove
3. Inner sleeve flush with outer circumference

**IMPROPER INSTALLATION**
1. PTO seal assembly
2. Telltale groove visible
3. Inner sleeve NOT flush with outer circumference

Install the drive shaft holder tool (P/N 529 035 986).

TYPICAL
1. Drive shaft holder

Install drive shaft/floating ring tool as shown. Ensure PTO seal support is still in place.

TYPICAL
1. Largest opening on through-hull fitting side

Refer to the following table to use the appropriate tool according to the model.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTX Limited, RXP and RXT</td>
<td>Drive shaft/loating ring tool (P/N 529 035 987)</td>
</tr>
<tr>
<td>GTI Series, GTX, GTX Wake and GTX Supercharged</td>
<td>Drive shaft/loating ring tool (P/N 529 035 841)</td>
</tr>
</tbody>
</table>

Push floating ring rearwards and install a NEW circlip.
Installation
The installation is the reverse of the removal procedure.

CARBON RING

Removal
Remove drive shaft. Refer to DRIVE SHAFT in this section.
Loosen gear clamp then pull carbon ring from boot.

Installation
The installation is the reverse of the removal procedure.

Remove drive shaft/floating ring tool, drive shaft holder then PTO seal support.

NOTE: Pushing boot rearwards will ease removal of PTO seal support tool.

Now ensure everything is properly positioned:
- telltale groove is not visible
- inner sleeve is flush with outer circumference of PTO seal assembly
- circlip is not exposed.

If telltale groove is visible, push PTO seal assembly rearwards to fully extend it.
If inner sleeve is not flush, gently tap it until it is flush.

Reposition rubber protector.
Reconnect EGTS sensor.
Install jet pump. Refer to JET PUMP.
Check engine oil level. Refill as necessary.
Run watercraft then ensure there is no oil leak in PTO seal area.

BOOT

Inspection
Inspect the condition of boot. If there is any damage or evidence of wear, replace it.

Removal
Remove drive shaft. Refer to DRIVE SHAFT in this section.
Loosen gear clamp holding boot, then carefully pull boot and carbon ring from hull insert.
## REVERSE SYSTEM

### SERVICE PRODUCTS

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<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
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</thead>
<tbody>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>291</td>
</tr>
<tr>
<td>Loctite 5150 (silicone sealant)</td>
<td>293 800 086</td>
<td>290</td>
</tr>
<tr>
<td>XP-S synthetic grease</td>
<td>293 550 010</td>
<td>289</td>
</tr>
</tbody>
</table>
GENERAL
During assembly/installation, use torque values and service products as in the exploded view.
Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

WARNING
Torque wrench tightening specifications must strictly adhered to.
Locking devices (e.g., locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

PROCEDURES
REVERSE CABLE
Removal
Unscrew bolt, washers and the elastic stop nut retaining reverse cable on pivot arm.

![Diagram](image1)
1. Reverse cable
2. Pivot arm
3. Bolt
4. Washer
5. Elastic stop nut

Unscrew the cable lock then remove the half rings.

RXP Models
Open storage compartment and remove basket.

Remove nut of front vent tube, unsnap wiring harness and separate vent tube.

![Diagram](image2)
1. Remove nut
2. Separate bottom and top parts

Pull out bottom part first then top part.

GTX and RXT Series
Remove the seat and the glove box. Refer to HULL AND BODY.
Push the vent tube toward the front of the vehicle to get greater access to the reverse cable lever and the reverse cable support.
To release the vent tube, press down its locking tabs and move the tube.
There are two locking tabs; one above and one underneath the hose.
DO NOT REMOVE the vent tube completely.
Section 07 PROPULSION
Subsection 03 (REVERSE SYSTEM)

TYPICAL
1. Engine vent tube
2. Vent tube locking tab
3. Reverse cable lever
4. Reverse cable support

GTI Series
Remove glove box. Refer to HULL AND BODY.

All Models
On the reverse cable lever, unscrew the elastic stop nut and the washer retaining the reverse cable.

TYPICAL
1. Reverse cable
2. Reverse cable lever

Remove the bracket securing reverse cable at the bottom of reverse cable support.
NOTE: Before removing reverse cable from hull, note cable routing for reinstallation.

WARNING
When adjusting reverse cable, make sure lever is well engaged into the spring slot.

Place reverse gate in the up position.
Turn the joint at the end of reverse cable and align its hole with hole in pivot arm.
Secure with bolt, washers, spacer and elastic stop nut. Torque to 7 N\*m (62 lbf\*in).

REVERSE CABLE LEVER

Removal
Detach the reverse cable from reverse cable lever.
Section 07 PROPULSION
Subsection 03 (REVERSE SYSTEM)

Unscrew the shift lever retaining bolt, washer and nut, then remove reverse cable lever.

Make sure the shift lever action is smooth and precise. Forward and reverse positions should be easy to select with a decent position between each.

SHIFT LEVER

Removal
Remove shift lever handle.

Inspection
Check reverse cable lever for cracks or wear. Replace as required.

Installation
Apply XP-S synthetic grease (P/N 293 550 010) on the reverse cable lever pivot and in the reverse cable support hole.
Install the reverse cable lever in a rotating movement. Engage properly the reverse cable lever tabs in the shift lever slots.
Insert reverse cable lever into reverse cable support slider and make sure that the lever slides freely in the support.
Disengage the shift lever slots from reverse cable lever tabs, then remove the shift lever.

Unscrew all bolts securing reverse cable support then remove it.

**Inspection**

Check the reverse cable support for cracks or wear. Replace as required.

**Installation**

The installation is the reverse of the removal procedure.

---

**SHIFT LEVER HOUSING**

**Removal**

Remove shift lever, reverse cable lever and reverse cable support. See procedures above. Unscrew all bolts securing shift lever housing and remove it.

**Installation**

The installation is the reverse of the removal procedure. However, pay attention to the following. Apply Loctite 5150 (silicone sealant) (P/N 293 800 086) around screws locations on shift lever housing as indicated by the shaded areas in the next illustration.
When installing shift lever housing, apply Loc-tite 243 (blue) (P/N 293 800 060) on threads of screws.

REVERSE GATE

Removal
To remove reverse gate, put shift lever in reverse position.
Unscrew pivot bolt.
Remove both reverse gate screws.

Installation
Install reverse gate with spacer and washer.
Torque to 20 N•m (15 lbf•ft).

PIVOT SUPPORT

Removal
Unscrew pivot support bolts.

Remove pivot bolt that attach link rod to pivot support.

Withdraw pivot support.

Installation
The installation is the reverse of the removal procedure.

LINK ROD

Removal
Unscrew both pivot bolts and remove link rod.

Installation
The installation is the reverse of the removal procedure.
PIVOT TRIANGLE

Removal
Remove link rod.
Unscrew pivot triangle bolts and remove pivot triangle.

Installation
For installation, reverse the removal procedure.

PIVOT ARM

Removal
Remove reverse gate. Refer to REVERSE GATE
Position shift lever in forward.
On left side, remove the reverse cable, spring and pivot arm bolt.
On right side, remove steering cable and pivot arm bolt.

Withdraw pivot arm.
VARIABLE TRIM SYSTEM

SERVICE TOOLS

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<th>Description</th>
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<tr>
<td>multimeter FLUKE 111</td>
<td>529 035 868</td>
<td>295</td>
</tr>
<tr>
<td>VTS socket tool</td>
<td>295 000 133</td>
<td>296–297</td>
</tr>
</tbody>
</table>

SERVICE PRODUCTS

<table>
<thead>
<tr>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>297</td>
</tr>
<tr>
<td>Loctite Primer N</td>
<td>293 800 041</td>
<td>297</td>
</tr>
<tr>
<td>XP-S synthetic grease</td>
<td>293 550 010</td>
<td>297</td>
</tr>
</tbody>
</table>
GENERAL
During assembly/installation, use torque values and service products as in the exploded view.
Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

⚠️ WARNING
Torque wrench tightening specifications must strictly adhered to.
Locking devices (e.g., locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

TEST
SWITCH
Always confirm first that the fuse is in good condition.
Disconnect BLACK wire, BLUE/WHITE wire and GREEN/WHITE wire of VTS switch.
Using the multimeter FLUKE 111 (P/N 529 035 868), connect test probes to switch BLACK and BLUE/WHITE wires; then, connect test probes to switch BLACK and GREEN/WHITE wires.
Measure resistance; in both test it should be high when button is released and must be close to zero when activated.

MOTOR
Always confirm first that the fuse is in good condition.
The fuse is located on the MPEM module.
Motor condition can be checked with the multimeter FLUKE 111 (P/N 529 035 868). Install test probes on both RED/PURPLE/WHITE and ground wires of the 2-circuit connector housing. Measure resistance, it should be close to 1.5 ohm.
If motor seems to jam and it has not reached the end of its stroke, the following test could be performed.
First remove motor. Then manually rotate worm to verify VTS system actuating mechanism for free operation.
Connect motor through a 15 A fuse directly to the battery.
Connect wires one way then reverse polarities to verify motor rotation in both ways.
If VTS actuating mechanism is correct and the motor turns freely in both ways, VTS module could be defective.
If VTS motor does not stop at the end of its stroke while installed, the motor could be defective.

CONTROL MODULE
It receives its current from the battery. It is protected by its own fuse located on the MPEM module.

Resistance Test
Disconnect BROWN/BLACK wire and BROWN/WHITE wire of VTS control module.
Connect test probes of a multimeter to BROWN/BLACK wire and BROWN/WHITE wire of VTS control module.
Push on VTS switch down position until motor stops.
Read the resistance on the ohmmeter, it should indicate a resistance of 24 ohms ± 1%.
Push on VTS switch up position until motor stops.
Read the resistance on the ohmmeter, it should indicate a resistance of 167 ohms ± 1%.

<table>
<thead>
<tr>
<th>RESISTANCE (Ω)</th>
<th>NOZZLE POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>167 ± 1%</td>
<td>UP</td>
</tr>
<tr>
<td>24 ± 1%</td>
<td>DOWN</td>
</tr>
</tbody>
</table>

NOTE: If the VTS control module passes this resistance test, it does not mean it is in perfect condition.

PROCEDURES
CONTROL MODULE AND MOTOR
Removal
Remove seat and engine cover to have access to VTS module.
Remove nut no. 14 and bolt no. 13 retaining VTS rod no. 1 to sliding shaft no. 10.
Remove clamps no. 2.
Remove rubber boot no. 3.
Motor
Disconnect wires from motor no. 8.
Remove retaining nuts no. 11.

Pull on motor to remove it.

Worm and Sliding Shaft
Simply pull on worm no. 9 and sliding shaft no. 10 in order to remove them.

Inspection
Rubber Boot
Make sure rubber boot no. 3 is in good condition. If it is cracked or torn, replace boot.

Worm
Inspect threads and splines of worm no. 9 for wear. If worm replacement is necessary, renew also sliding shaft.
Assembly
Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

Motor, Worm and Sliding Shaft
Apply XP-S synthetic grease (P/N 293 550 010) to worm.
Screw worm no. 9 to sliding shaft no. 10.
Mesh worm splines to gear of motor.

Install motor no. 8, worm and sliding shaft in VTS housing.

Tighten nuts no. 11 to 7 N·m (62 lb·in).
Connect wires of motor.

CAUTION: Make sure wire color codes match.
Install cover no. 7.
NOTE: Make sure seal no. 12 is in place.

Installation
Installation is essentially the reverse of removal procedures. However pay particular attention to the following.

Nut and Sealing Washer
Place sealing washer no. 5 on nut no. 4. Make sure seal lips are facing toward hull.

Apply Loctite Primer N (P/N 293 800 041) to threads of VTS housing, and to nut no. 4.
Apply Loctite 243 (blue) (P/N 293 800 060) to nut no. 4.
Install nut with sealing washer and torque to 7 N·m (62 lb·in) using the VTS socket tool (P/N 295 000 133).

Sliding Shaft and Rubber Boot
Apply XP-S synthetic grease (P/N 293 550 010) to sliding shaft.
Install rubber boot no. 3, over sliding shaft and secure with clamps.

VTS Rod
Secure the VTS rod onto the sliding shaft end using bolt no. 13 and nut no. 14. Torque nut to 4 N·m (35 lb·in).

Adjustment
No adjustment is required.
# STEERING SYSTEM

## SERVICE TOOLS

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<tr>
<td>safety lanyard switch tool</td>
<td>529 035 943</td>
<td>304</td>
</tr>
<tr>
<td>steering cable tool</td>
<td>295 000 145</td>
<td>310</td>
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</table>

## SERVICE PRODUCTS

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<thead>
<tr>
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<tbody>
<tr>
<td>Loctite 243 (blue)</td>
<td>293 800 060</td>
<td>302–303, 307–309</td>
</tr>
<tr>
<td>Loctite 271 (red)</td>
<td>293 800 005</td>
<td>304, 309</td>
</tr>
<tr>
<td>Loctite 767 (antiseize lubricant)</td>
<td>293 800 070</td>
<td>309</td>
</tr>
<tr>
<td>XP-S synthetic grease</td>
<td>293 550 010</td>
<td>308</td>
</tr>
</tbody>
</table>
CAUTION: Verify when the handlebar is turned completely to the left or right side, that there is no interference with venturi, O.P.A.S. or VTS ring.

PROCEDURES

NOZZLE

Removal
Remove O.P.A.S. "U" lever screws and pull out lever.

Other Models
Remove retaining screws, sleeves and washers on top and underneath nozzle.
Remove nozzle.

Installation
The installation is the reverse of the removal procedure. However, pay attention to the following.
Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads (or use new self-locking screws).

HANDLEBAR GRIP

Removal
To remove handlebar grip, pull out cap and remove screw.

Pull out handlebar grip and remove grip insert from handlebar.

NOTE: Verify grip insert for damage.
Installation
When installing the grip insert in the handlebar, ensure that it is properly inserted in the slot at the end of the handlebar tubing.

Install handlebar grip on handlebar matching it to the notch in the handlebar.
Install flat washer and handlebar grip screw. Apply Loctite 243 (blue) (P/N 293 800 060) on threads screw.

CAUTION: Ensure to install flat washer otherwise screw will damage grip end.
Torque handlebar grip screw to 7 N•m (62 lb•in).
Install cap.

STEERING COVER
Removal
Remove handle grips.
Loosen screws of throttle handle housing and of multifunction switch housing.

Remove tapping screws.
Remove throttle housing cover then the throttle handle housing.
Unhook throttle cable from throttle handle.
Pry out the throttle cable housing from throttle handle housing.
Unplug and remove the multifunction switch housing. 
Remove 6 screws and flat washers each side of steering cover.

**GTX Limited Models**
Set handlebar to its lowest position by turning adjustment knob counterclockwise. 
While holding adjustment knob, turn support bushing clockwise.

Hold jam nut and unscrew adjustment knob from adjuster screw.

**Typical**
1. Adjustment knob
2. Support bushing

**All Models**
Remove lower steering cover.
Unscrew DESS switch nut using safety lanyard switch tool (P/N 529 035 943).

**Installation**
For installation, reverse the removal procedure.

**GTX Limited Model**
Apply Loctite 271 (red) (P/N 293 800 005) on threads of jam nut.

**STEERING PADDING**
**Removal**
Remove steering cover as mentioned above.
Remove 2 screws, flat washers and nuts securing steering padding to steering stem.
Section 08 STEERING SYSTEM
Subsection 01 (STEERING SYSTEM)

1. Screws
2. Steering padding

Remove steering padding.

Installation
The installation is the reverse of the removal procedure.

HANDLEBAR

Removal
Remove steering cover and steering padding as mentioned above.
Remove 4 elastic stop nuts retaining steering clamp. Discard elastic stop nuts.

Detach steering clamp and remove handlebar.
On GTX Limited models, withdraw rubber pad and stopper.

Installation

GTX Limited Models Only
Before installing handlebar, position stopper and rubber pad.
CAUTION: Rubber pad must not exceed stopper.

All Models
Position handlebar. Install steering clamp and secure with NEW elastic stop nuts.
Torque nuts to 26 N•m (19 lbf•ft) as per the following sequence.
STEERING CABLE SUPPORT

Removal

**RXP Models**
Open front storage cover and remove basket.
Remove front vent tube.

**GTI Series**
Remove glove box and console. Refer to **BODY AND HULL**.

**GTX Series and RXT Models**
Open front storage cover and remove rear access panel.

**All Models**
Unscrew bolts securing retaining block then remove it from steering cable support.

Detach fuel lines from steering cable support.

Remove steering cable support.

1. Retaining block

Loosen bolts each side of steering support.
Installation
For installation, reverse the removal procedure.
Apply Loctite 243 (blue) (P/N 293 800 060) on threads of bolts before installing them.

STEERING SUPPORT

Removal
GTI Series
Remove console. Refer to BODY AND HULL.

All Models except GTI Series
Open front storage cover.

All Models
Cut locking tie securing wiring harness boot.

Disconnect the throttle cable from throttle body.
Disconnect the wiring harnesses leading out of steering stem and cut locking tie.

Remove bolts retaining cable support to steering support.
Remove bolts and lock nuts from steering retaining strip studs.
Installation
Apply XP-S synthetic grease (P/N 293 550 010) on contact surfaces of steering stem before installing it into steering support.

Position steering stem arm onto steering stem.

**WARNING**
Make sure the integrated flat keys of the steering stem arm and support are properly seated in steering stem keyways. Steering stem arm must be locked in place before torquing the bolts.

Torque bolts of steering stem arm to 6 N•m (53 lb•in). Install NEW elastic stop nuts. Install all other removed parts.

**HANDLEBAR SUPPORT**

Removal

**GTX Limited Models**
Remove steering stem from vehicle. See procedure above.

Unscrew nut and remove pivot bolt retaining handlebar support to steering stem.
Unscrew threaded pivots to remove threaded block from steering stem.

Installation
Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) then install support bushings on handlebar support.

Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on pivot bolt.

**CAUTION**: Make sure antiseize lubricant does not come in contact with threads of bolt.

Apply Loctite 271 (red) (P/N 293 800 005) on threads of jam nut.

Apply Loctite 243 (blue) (P/N 293 800 060) in adjustment knob and on threaded pivots.

Install handlebar support to steering stem and secure with pivot bolt. Apply Loctite 271 (red) (P/N 293 800 005) on threads of nut then install nut and torque to 26 N•m (19 lbf•ft).

Ensure wire harness is properly secured to handlebar support with a locking tie.

**STEERING CABLE**

**Removal**
Disconnect steering cable from steering stem arm.
Remove retaining block.
Disconnect ball joint from jet pump nozzle.
Remove ball joint and jam nut from cable.
Loosen nut retaining the steering cable to jet then remove half rings and O-ring.
NOTE: To loosen nut, use the steering cable tool (P/N 295 000 145).

Remove steering cable from watercraft. Note routing for installation.

Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

The threaded portion of steering cable inserts into ball joint should have between 8 and 10 mm (5/16 and 25/64 in).

![Diagram of steering cable](image)

A 8 to 10 mm (5/16 to 25/64 in)

Torque jam nut to 2.5 N•m (22 lbf•in).

Install cable and make sure its routing is same as the previous cable.

Torque retaining block screws on cable support to 6 N•m (53 lbf•in). Use NEW elastic stop nuts.

Secure the steering cable ball joint to the nozzle as per following illustration.

**CAUTION:** Ensure the ball joint is parallel (± 10°) to the nozzle arm.

![Typical steering cable setup](image)

**TYPICAL**

1. Ball joint below steering arm.
2. Torque nut to 7 N•m (62 lbf•in).

Check steering alignment.
## OFF-POWER ASSISTED STEERING (O.P.A.S.)

### SERVICE TOOLS

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<th>Description</th>
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<tbody>
<tr>
<td>O.P.A.S. cylinder nut wrench</td>
<td>529 035 840</td>
<td>315, 317, 319</td>
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</tbody>
</table>

### SERVICE PRODUCTS

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<tr>
<td>Loctite 5150 (silicone sealant)</td>
<td>293 800 086</td>
<td>320</td>
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</table>
Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING (O.P.A.S.))

GTI and RXP Series

[Diagram showing steering system components with torque values and labels: 7 N·m (62 lb·in), 1.2 N·m (10 lb·in), 2.7 N·m (24 lb·in), 5.5 N·m (49 lb·in), 4.5 N·m (40 lb·in), 19 N·m (162 lb·in), 24 N·m (17 lb·ft), Loctite 5150 (silicone sealant).]
GENERAL

The Off-Power Assisted Steering (O.P.A.S.) uses a dual side vanes design that assists the watercraft steering in deceleration, to redirect watercraft path when steering is turned after throttle has been released or engine stopped.

The side vanes on the rear sides of the hull, turn as the steering is turned to assist the watercraft turning. At first, carefully experiment turning with this feature.

1. Side vanes turn following steering movement

GTX and RXT Series

When engine is running at approximately 75% or more RPM, the side vanes are automatically raised to upper position since they are not required at that vehicle speed range.

Between 30% and 75% engine RPM, side vanes are gradually raised from lower position to upper position.

1. Side vane in upper position

When throttle is released and engine RPM drops, the side vanes are automatically lowered thus assisting steering control.

GTI and RXP Series

These models do not have any vertical travel.

PROCEDURES

FILTER

GTX and RXT Series

Inspection

Check filter cleanliness as per the maintenance chart recommendations. Replace or clean it as necessary.

Removal

Unplug O.P.A.S. hose no. 29 from filter no. 28. Unscrew filter.

Installation

Install filter elbow at 20° angle to the right.
Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING (O.P.A.S.))

It may exceed inside housing by 2.5 mm (.098 in).
It may be positioned up to 2.0 mm (.078 in) from housing edge.

Plug O.P.A.S. hose to filter.

VALVE
GTX and RXT Series

Removal
Remove O.P.A.S. "U" lever screw no. 17, flat washer no. 18, bushing no. 19 and venturi bushing no. 20 from nozzle.
Remove jet pump, filter and formed hose no. 29.
Remove gear clamps no. 30 to remove water hoses no. 31 from valve.

Disassembly and Assembly
Unscrew the bottom nut of valve completely, this will release all parts from the valve body.
Check if the O-ring no. 34 is brittle or hard. Replace if necessary.
Assemble all parts and torque the bottom nut to 7 N\(\cdot\)m (62 lbf\(\cdot\)in).

Installation
Installation is the reverse process of removal, make sure of the following when doing installation:
- Check for cracks on formed hose no. 29, change if necessary.
- Install formed hose on valve. Torque clamp no. 35 manually to 4 N\(\cdot\)m (35 lbf\(\cdot\)in).
- Install a new gasket no. 36.
- Install the valve.
- Torque Phillips screws no. 33 to 2.2 N•m (19 lbf•in).
- Install water hoses no. 10 on valve.
- Tighten gear clamps no. 30 manually to 1.7 N•m (15 lbf•in).

**WATER HOSE**

*GTX and RXT Series*

**Removal**
Removal procedure for RH and LH water hose no. 10 is same.
Remove side vane no. 1 and cylinder support no. 6 as mentioned above.
Remove gear clamps no. 30 to remove water hose no. 10 from valve no. 31.
Pull out the water hose from exterior.

**Installation**
Installation is the reverse process of removal, make sure of the following when doing installation:
- Water hose must be installed from the outside to the inside of hull by turning it, oriented towards valve.
- Tighten gear clamps no. 30 manually to 1.7 N•m (15 lbf•in).

**SIDE VANE**

**Removal**
Removal procedure for RH and LH side vane no. 1 is same.
Remove socket screw no. 2.

Remove the tie-rod screw no. 3.

Lift pivot shaft no. 4 while holding top of side vane. Pull side vane out.

**Adjustment**
During tie-rod fitting adjustment, tie-rod screw no. 3 must be loose and socket screw no. 2 removed.
Put the steering in straight ahead position.
Measure the portion of tie rod fitting no. 5 exceeding from cylinder support no. 6.
The exceeding distance of tie rod fitting from the cylinder support should be 45 ± 1 mm (1.65 ± 0.04 in).

To adjust the tie-rod fitting no. 5, remove tie-rod screw no. 3 and turn tie-rod fitting. Place tie-rod screw in its place and measure again. Repeat the procedure until the distance is reached.
When the adjustment is done, torque the tie-rod screw to 4.5 N•m (40 lbf•in).
Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING (O.P.A.S.))

Install socket screw no. 2 and torque it to 2.7 N•m (24 lbf•in).

NOTE: The socket screw no. 2 should be turned 2-3 turns before using a tool.

Installation
Installation is the reverse process of removal.
Install the tie-rod screw no. 3. Do not torque yet.
Perform the tie-rod fitting adjustment. See above.

CYLINDER SUPPORT

Removal
Removal procedure for RH and LH cylinder support assembly is same.
Remove side vane as mentioned above.

NOTE: To disassemble the cylinder, it is not required to remove it from vehicle. See DISASSEMBLY procedure.
Unscrew tie rod fitting no. 5 from tie rod no. 7.
Unscrew 4 socket screws no. 8. Discard them.

GTX and RXT Series
Remove Oetiker clamp no. 9 to remove water hose no. 10 from the cylinder support no. 6.

Disassembly and Assembly
Unscrew cylinder cap no. 11 using the O.P.A.S. cylinder nut wrench (P/N 529 035 840).

Remove cylinder assembly out of cylinder support.
GTX and RXT Series

1. Pivot rod
2. Spacer
3. Cylinder cap
4. Piston
5. Spring

Discard the piston no. 12. Due to the presence of split rings around the piston, it must be replaced each time when removed for proper cylinder functionality.

To do this:
- Remove the spring no. 13.
- Remove the spring pin no. 14 from piston and pivot rod no. 4.
- Turn the split ring to remove it from cap.
- Remove the piston.
- Check pivot rod no. 4 for cracks or scratches. Replace it, if necessary.
- Install a new piston with a new spring pin.

Before assembly, it will be necessary to change the split rings no. 15 and no. 16 inside cylinder cap no. 11. Do the following:
- To remove the upper split ring no. 15, lift one end over the cap tab.
- Repeat the same procedure for the lower split ring no. 16.
- Install new split rings into cylinder cap. The opening of each split ring must be aligned with the appropriate lock inside cap.
Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING (O.P.A.S.))

Check pivot rod no. 4 for cracks or scratches. Replace pivot rod, if necessary.

Installation
The installation is the reverse of the removal procedure. However, pay attention to the following detail. Perform the tie-rod fitting adjustment. See above.

TIE ROD

Removal
Removal procedure for RH and LH tie rod no. 7 is same.
Remove side vane no. 1 and cylinder support no. 6 as mentioned above.
Remove O.P.A.S. "U" lever screw no. 17, flat washer no. 18, bushing no. 19 and venturi bushing no. 20 from nozzle.
Remove jet pump (refer to JET PUMP).
Remove screw no. 21 and washers no. 22 to remove "U" lever no. 23 from tie rod connecting levers no. 24.

GTI and RXP Series

1. Pivot rod
2. Spacer
3. Cylinder cap assembly

The cylinder disassembly is not necessary for these models.

Pull tie rod out from jet pump side with the sealed tube no. 25.
Unscrew lever from the tie rod.

Installation
Installation is the reverse process of removal.
Torque screw no. 21 to 7 N•m (62 lbf•in).
Torque O.P.A.S. "U" lever screw no. 17 to 24 N•m (17 lbf•ft).
Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING (O.P.A.S.))

SEALED TUBE

Removal
Removal procedure for RH and LH sealed tube no. 25 is same.
Remove side van no. 1, cylinder housing no. 6 and O.P.A.S. "U" lever no. 23 as mentioned above.
Remove jet pump (refer to JET PUMP).
Remove Phillips screws no. 26 and remove rod grommet no. 27.

Torque Phillips screws no. 26 to 2.2 N•m (19 lbf•in).

CROSS SUPPORT PLATE

Removal
For LH Side Cross Support Plate
Remove inlet hose, exhaust pipe and muffler (refer to EXHAUST SYSTEM).
For RH Side Cross Support Plate
Remove resonator (refer to EXHAUST SYSTEM).
NOTE: Use the same procedure for the RH or the LH cross support plate no. 36.
Remove side vane no. 1 and cylinder support no. 6 as mentioned above.
Unscrew the screw no. 37 retaining cross support plate no. 36 to hull.

TYPICAL — GTX MODEL SHOWN
1. Remove screw

Remove cross support plate from the inside of bilge.

Inspection
Check for cracks and deterioration of screw threads on cross support plate, replace if necessary.
Verify the condition of gasket no. 38 before installation, replace if necessary.

Installation
Installation is the reverse process of removal.
Apply Loctite 5150 (silicone sealant) (P/N 293 800 086) on the screws before installing and, inside the hull, around screw holes after torquing.
Assembly
Assembly is the reverse process of disassembly. Make sure of the following when doing assembly:
Install the gasket on the cross support plate.

From inside the bilge, install the cross support plate. Place the gasket against the hull then align the holes.
Torque screw no. 37 to 1.2 N•m (10 lbf•in).
# ADJUSTMENT AND REPAIR

## SERVICE TOOLS

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## SERVICE PRODUCTS

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Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

GTi Models (body front view)
GTI Models (body rear view)
GTI Models (front storage compartment)

8 N·m
(71 lbf·in)

8 N·m
(71 lbf·in)

3 N·m
(27 lbf·in)

3 N·m
(27 lbf·in)
GTI Models (hull)
GTI Models (seats)
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Series and RXT Models (body front view no. 1)
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Series and RXT Models (body front view no. 2)
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Series and RXD Models (body rear view)

- Body: 8 N·m (71 lbf·in)
- 8 N·m (71 lbf·in)
- 12 N·m (106 lbf·in)
- 14 N·m (124 lbf·in)
- Loctite 243
- Loctite 5150 (silicone sealant)
GTX Series and RXT Models (front storage compartment)
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Series and RTX Models (hull)
GTX Series and RXT Models (seats)
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (body rear view no. 2)
RXP Models (front storage compartment)

- Synthetic grease
- 11 N.m (97 lbf-in)
- Loctite 243
- Loctite 243

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Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (seats)
GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

During assembly/installation, use torque values and service products as in the exploded views.

Clean threads before applying a threadlocker. Refer to SELF-LOCKING FASTENERS and LOCTITE APPLICATION at the beginning of this manual for complete procedure.

CAUTION: When applying threadlocker products (anaerobic products), pay attention so that it does not come in contact with ABS plastic parts (painted parts). It could lead to plastic cracks or other damage.

WARNING

Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new one where specified. If the efficiency of a locking device is impaired, it must be renewed.

PARTS REPLACEMENT

DECALS

Removal

Using a heat gun warm up one end of decal for a few seconds until decal can roll off when rubbing with your finger.

NOTE: When heating near light surfaces, duct tape should be applied to protect the surface. Otherwise the light color could become a yellowish color.

Pull decal slowly and when necessary apply more heat to ease removal on the area that has to be peeled off.

If decal tears while pulling off, it has to be heated for a few seconds longer. If decal tends to stretch while pulling off, stop heating and wait a few seconds to let it cool, then peel it off.

Installation of Decals Having a Protective Film on Back Side Only

These decals usually contain written information (e.g.: warning) and are used on gelcoat or metal.

Using isopropyl alcohol, clean the surface and dry thoroughly.

Using a pencil and the decal as a template, mark the area where decal will be located.

Remove half of the decal back protective film and align decal with marks. Start sticking it from center and remove the other half of the film to stick it completely. Carefully squeegee decal beginning at center and working outward using, firm, short, overlapping strokes.

Installation of Decals Having a Protective Film on Both Sides

These decals usually contain graphics and are used on gelcoat or plastic.

INSTALLATION ON GELCOAT

Using isopropyl alcohol, clean the surface and dry thoroughly.

Using a pencil and the decal as a template mark the area where decal will be located.

For better adhesion a dry application is recommended, however, to ease decal installation a mild solution of soapy water can be sprayed over surface where decal will be installed.

Remove back protective film from decal and align decal with marks. When well aligned squeegee decal beginning at center and working outward using firm, short, overlapping strokes.

Remove front protective film once decal has adhered to hull.

INSTALLATION ON PLASTIC (storage cover)

Clean surface with isopropyl alcohol and dry thoroughly.

Using a pencil and the decal as a template, mark the area where decal will be located.

CAUTION: Do not use soapy water to locate decal on plastic parts.

Remove back protective film from decal and carefully align decal with marks. When well aligned squeegee decal beginning at center and working outward using firm, short, overlapping strokes.

Remove front protective film once decal has adhered.

GLOVE BOX

Removal

GTI Series

Place shift lever in forward position.

Lift the glove box cover.
Using a Supertanium™ drill bit (P/N 529 031 800), drill both rivets holding glove box to body.

Slide glove box cover to open it, and drill the rivets on each side of glove box.

Pull glove box to remove it.

**GTX Series and RXT Models**

Lift the glove box top cover.

Gently push on both rear tabs while lifting out rear of glove box compartment.

**RXP Models**

Place shift lever in forward position.

Remove seat.

Pull dart out. See illustration.

Carefully pull the side molded part to release the glove box. Pulling too much might lead to damaging the part.

*RELEASE SIDE MOLDED PART FROM GLOVE BOX*

Slightly lift glove box to free it.
Proceed with the other side the same way to finally pull glove box out.

Installation
Reverse the removal procedure.

SEAT
Removal
Rear Seat
*GTX Series and RXT Models*
Removing the rear seat allows access to the rear storage basket. It also gives access to the front seat latch.

Front Seat
The front seat latch is located at the rear end and underneath the seat.

To remove front seat, pull the latch lever upward and hold. Lift and pull the seat rearward.

Installation
Front Seat
To latch front seat, align latch hole with pin then, firmly push down on the rear portion of the seat.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

REMOVABLE SEAT COWLING

RXP Models

Removal

The removable seat cowlings allows to install a number on its side panels. It is removable to expose the seat for a passenger.

To remove cover:
- Unlatch and pull seat out.
- Unlock the quarter-turn screws.

Installation

To reinstall seat cowlings:
- Unlatch and pull seat out.
- Position rear of seat cowlings in place without inserting front tabs yet.
- Carefully pull tabs outward each side of seat and insert seat cowlings in place.

Finish pushing seat cowlings in position then lock the quarter-turn screws.
- Install seat and properly relatch.

SEAT COVER

Replacement

Remove the old seat cover. Check the foam and replace it if necessary.

Install staples with an electric tacker such as Arrow tacker no. ETN-50 or with a manual tacker such as Arrow tacker no. T-50.

NOTE: For an easier installation, it's highly recommended to use an electric tacker.

Ensure that the seat rest firmly against a hard surface such as a piece of wood. This is done to get the staples completely pushed in place.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

TYPICAL
1. Piece of wood
2. ETN-50 (electric) or T-50 (manual)

After seat cover installation, cut all around the excess of material.

SEAT LATCH

Adjustment

NOTE: Apply Loctite 243 (blue) (P/N 293 800 060) on threads of lock pin when the adjustment is required or when the lock pin is removed then reinstalled. The threads on new lock pin are coated with a self-locking product, do not apply Loctite 243 on threads.

GTI Series

TYPICAL
1. Lock pin
2. Adjustment nut (Loctite 243). Torque to 8 N·m (71 lb ft)
A. 32.5 ± 1 mm (1-9/32 ± 3/64 in)

GTX Series, Wake and RXT Models

TYPICAL — FRONT SEAT
1. Lock pin
2. Adjustment nut (Loctite 243). Torque to 8 N·m (71 lb ft)
A. 33 ± 1 mm (1-35/64 ± 3/64 in)

TYPICAL — REAR SEAT
1. Lock pin
2. Adjustment nut (apply Loctite 243). Torque to 5 N·m (44 lb ft)
A. 35 ± 1 mm (1-3/16 ± 3/64 in)

RXP Models

1. Lock pin
2. Adjustment nut (apply Loctite 243). Torque to 8 N·m (71 lb ft)
A. 36 ± 1 mm (1-35/64 ± 3/64 in)
ENGINE COVER

*RXP Models*

Remove seat.
Detach coolant expansion tank and move away.

1. Coolant expansion tank

Remove BRP logo at rear.

1. Logo

Remove retaining screws.

**NOTE:** Pay attention not to drop retaining blocks under cover when removing screws.
Pull out engine cover.

Assembly is the opposite procedure of removal.
Ensure to tighten screws in a criss-cross order and to torque to 18 N•m (159 lb•in).

STORAGE COMPARTMENT COVER

**Removal**

*GTI Series*

Open storage compartment cover.
Unscrew bolts retaining the cover to its hinge (two on each side). Discard them.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

Remove storage compartment cover.

**All Models except GTI Series**

Open storage compartment cover.

Remove access panel. To remove access panel darts, use the Ötiker pliers (P/N 295 000 070).

Unlock shock rod from circlip and remove washer.

Disconnect multifunction connector.

Remove one long retaining screw (front).

Remove two short retaining screws located in the back lower side and hold cover firmly.
Remove storage compartment cover.

**Installation**
The installation is the reverse of the removal procedure.

**GTI Series**
When installing screws retaining storage compartment cover, use NEW screw with Scotch Grip. NEVER use liquid threadlocker with this cover.

**STORAGE COMPARTMENT COVER HINGE**

**Removal**

**GTI Series**
Remove storage compartment cover, see above. Unscrew the 5 bolts securing the hinge to the body.

Pull hinge to remove it from body.
Cut a push nut retaining hinge shaft.

Remove hinge shaft and separate both parts of hinge.

**STORAGE COMPARTMENT COVER SHOCK**

**Removal**

**All Models except GTI Series**
Unlock shock rod from circlip and remove washer.

Install a 2 x 4 piece of wood between storage cover and body. This piece of wood will support the storage cover while changing the cover shock.
Release the shock from top linkage bracket and bottom support bracket by inserting a flat screwdriver in the shock top and bottom locking devices.
Installation
The installation is the reverse of the removal procedure.

STORAGE COMPARTMENT COVER LATCH

Adjustment

All Models except GTI Series

NOTE: Apply Loctite 243 (blue) (P/N 293 800 060) on threads of lock pin when the adjustment is required or when the lock pin is removed then reinstalled. The threads on new lock pin are coated with a self-locking product, do not apply Loctite 243 on threads.
Adjust lock pin as per following specifications:

FIXED TYPE LOCK PIN
1. Lock pin (apply Loctite 243 on threads)
2. Adjustment nut. Torque to 8 N•m (71 lb•in)
3. 30 ± 1 mm (1 3/16 ± 3/64 in)

FLOATING TYPE
1. Lock pin (apply Loctite 243 on threads)
2. Rubber cushion pad
3. Lock nut. Torque to 8 N•m (71 lb•in)

NOTE: It is normal to have a front and aft play of the rubber cushion pad when using a floating type lock pin. To adjust, tighten lock pin until any vertical play is eliminated. Make sure a front and aft play remains when pressing by hands.

STORAGE COMPARTMENT COVER INNER SHELL

Removal

GTX Series and RXT Models
Remove storage compartment cover. See STORAGE COMPARTMENT COVER above.

CAUTION: Failure to follow this order may lead to damaging inner plastic studs.
Remove seven inner shell short screws (flanged screws).
Remove two long inner shell screws (hexagonal screws).

Remove compass by removing dart (2).
Remove temperature sensor from grommet.

Use a rubber hammer to remove the inner shell from the cover. If the inner shell is too stiff, install a piece of 2 x 4 against the inner shell and hit it with the rubber hammer.

Remove connector harness from the inner shell by cutting tie downs.

Remove inner shell.
**RXP Models**

Remove retaining screws from inner shell including the front screws.

**Installation**

**GTX Series and RXT Models**

Install new inner shell in the reverse process.

For installation, proceed as follows:
- Install the compass and secure it with the two darts.
- Install the temperature sensor in grommet.
- Install the tie raps around wire harnesses.
- Align inner shell with storage cover and make sure that the lateral locking hooks in the inner shell get engaged in the storage cover locking bracket. If the two lateral locking hooks get properly aligned and engaged the storage cover back locking hook will be engaged properly in the inner shell back locking bracket.

**Slide out**
FRONT GRILL OF COMPARTMENT COVER

RXP Models

Removal
Remove inner shell.
Remove retaining screws of grill.
Carefully release the locking tabs.

CAUTION: Proceed with caution. Damaging the locking part of the storage cover will prevent proper retaining of the front grill after reinstallation.

RXP Models

Installation is the reverse of removal procedure. However, pay attention to the following.
Lay down inner shell in storage cover. Align inner shell slot with cover tab. Do not force inner shell forward.

- Install front screws. This will properly move inner shell forward and lock it into cover tabs.
- Install top retaining screws (those located under the top tubes). Torque screws to 11 N•m (97 lb•in).
- Install remaining retaining screws of inner shell.

- Release front part of grill and remove it.

Installation
At installation, first install the front part of front grill. Do not snap rear tabs yet.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

Step 1: Pull out the bottom edges by slightly twisting to hook up
Step 2: Push the top corner to snap in

Ensure to properly position and secure top tubes.
Snap the other tabs of front grill.
Install screws to retain front grill.
Reinstall inner shell.

ACCESS COVER

Removal

**GTI Series**
The access cover is located on the top of console.
Pull access cover to remove it.

**RXP Models**
On this models, the access cover is located on the top of the storage compartment cover.
Press latch and lift up cover to open it.

Installation

**GTI Series**
The installation is the reverse of the removal procedure.

**RXP Models**
When installing the access cover, adjust its locking pin. Refer to the following illustration.

CONSOLE

**GTI Series**

Removal
Remove access cover and unplug the information center.
On GTI SE models, using a 8 mm Allen screw, remove the socket screw holding mirror support to steering support.

Remove shift lever handle.
Installation

The installation is the reverse of the removal procedure. However, pay attention to the following:

- Install console with its foam. Do not apply products such as glue or silicone, to retain foam on body or foam to console. The foam must move freely to allow a good air flow toward engine.

During installation of front rivets if a rivet does not keep console against body, use the following procedure:

- On each side, using a 6 mm (15/64 in) drill bit, drill front rivet holes. Install a tip of adhesive tape over holes to avoid gelcoat damages.

- Install the following fasteners to attach console to body.

| QUANTITY | FASTENERS DESCRIPTION
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<tr>
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<td>Pan head Phillips screw M5 x 35 (P/N 208 653 560)</td>
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<tr>
<td>4</td>
<td>Flat washer (P/N 234 091 600)</td>
</tr>
<tr>
<td>2</td>
<td>Elastic stop nut M5 (P/N 232 561 600)</td>
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</table>

Remove glove box. Refer to GLOVE BOX above. Using a Supertanium™ drill bit (P/N 529 031 800), drill rivets holding console to body.
MIRROR

Removal

**GTI SE Models**

Remove the information center. See GAUGE, SENSORS AND FUSES.

Unscrew mirror bolts.

![Image of mirror with labels: 1. Mirror, 2. Spatula]

Remove defective mirror with a spatula.

**All Other Models**

Remove storage compartment inner shell from storage cover as described earlier in this section.

Unscrew mirror bolts and their flat washers.

Remove defective mirror with a spatula.

Installation

**All Models**

Place mirror frame in hot water to allow mirror installation in frame.

Install all removed parts.

DEFLECTOR AND/OR UPPER GRID

Removal

**GTX Supercharged Limited**

To remove the deflector and/or the upper grid proceed as follows:
- Remove storage from storage cover compartment inner shell as described earlier in this section to get access.
- Remove the defective deflector and/or the upper grid from plastic retaining clip. Use two screwdrivers to release the deflector or the grid.

![Image of deflector with labels: 1. Inner shell, 2. Deflector retaining clips]
Installation
The installation is the reverse of removal procedure.

SIDE MOLDING

Removal

GTX Series except GTX LTD
The removal procedure for RH and LH side moldings with grills is the same.
Remove the two darts holding the grill to the body.
Make a hole into the luggage compartment as shown in the illustration below to gain access to the side molding screw.

Remove screw and side molding.

GTX Limited
Removal procedure for RH and LH side moldings with deflector/grill is the same.
Side molding is mounted on deflector.

Installation

GTX Series except GTX LTD
After installing side molding, install a plug (P/N 291 000 279) in the side molding screw hole.

GTX Limited
The installation is the reverse of the removal procedure.

INLET GRATE

Removal
Using a heat gun, heat screws to break threadlocker.
Loosen screws and remove inlet grate.
NOTE: An impact screwdriver should be used to loosen screws.

Installation
When installing inlet grate, apply Loctite 271 (red) (P/N 293 800 005) on threads of M6 bolts.
Apply Loctite 5900 (P/N 293 800 066) on the parts of inlet grate as indicated by the shaded areas in the next illustrations.
RIDING PLATE

Removal
Remove inlet grate.
Remove jet pump. Refer to JET PUMP.
Drain cooling system. Refer to COOLING SYSTEM.
From inside hull, disconnect hoses from ride plate.
Unscrew hose fittings from ride plate.

CAUTION: Removing hose fittings prior to pulling out ride plate prevents the possibility to damage fittings.

Using a heat gun, heat riding plate screws to break threadlocker then remove them.

NOTE: An impact screwdriver should be used to loosen screws.
Using a low height hydraulic bottle jack and 2 steel plates, pry out riding plate. Heat the riding plate with a heat gun before prying.
**Section 09 HULL/BODY**

Subsection 01 (ADJUSTMENT AND REPAIR)

---

**JET PUMP SUPPORT**

**Removal**

Remove jet pump.
Remove inlet grate and riding plate.
Remove ball joint, boot, nut, half rings and O-rings from steering cable.

**Installation**

*All Models*

Propersly reinstall hose fittings to ride plate.
Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the previous illustrations.
Follow also the torquing sequence as shown in the same illustration. Torque screws to 26 N·m (19 lbf·ft).
Reinstall hoses to ride plate and refill cooling system. Refer to COOLING SYSTEM.

---

**Typical**

1. Hydraulic bottle jack
2. Steel plates

**Typical**

1. Uninstall nut

Remove ball joint, boot, nut, half rings and O-rings from reverse cable.
Remove boot and nut from VTS sliding shaft (RXP models).
Disconnect water supply hose, water return hose and bailer hoses.
Remove nuts, lock washers and flat washers retaining jet pump support.

---

**Typical**

1. Remove nuts

Using a heat gun, heat jet pump support until it is possible to pull it.
NOTE: Shims may have been installed between support and body. Do not remove these shims, otherwise jet pump alignment will be altered.

Installation

All Models except RXP
Apply Loctite 518 (P/N 293 800 038) against contact surface of studs with jet pump support.

All Models
Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the next illustrations. Follow also the torquing sequence as shown in the same illustrations. Torque to 31 N•m (23 lb•ft).

Torque jet pump support using the following sequence.

THRU-HULL FITTING

Replacement
Cut plastic hull insert flush with hull using a saw.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

Mix epoxy glue such as (3M-05900), follow manufacturer's instructions.
Apply epoxy glue on aluminum insert knurled surface and inside plastic insert.
Install aluminum insert into plastic insert.

Slide bumper rail under front bumper.
Using a 4.80 mm (3/16 in) drill bit, drill first hole through bumper rail at front of bow section.

CAUTION: When drilling, be careful not to damage bumper rail and/or hull.
Position bumper rail properly onto body and cut excess length if necessary.
Slide bumper rail in corner bumper.
Install trim using soapy water.
Repeat procedure for the other side.

WAKE PYLON
GTX Wake Models

Removal
Remove the rear seat and storage basket under it.
Remove nuts.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

Remove finition U-clamp, and screws then pull out wake post.

Disassembly
Loosen the stopper screw.

Pull the safety lock pin to unlock and pull out the cylinder.

Assembly
Before assembly verify the physical condition of cylinder groove and adjustment holes.

Align groove with stopper screw, while inserting the cylinder into housing.
Tighten the stopper screw.

Installation
Before Installation, make sure:
- inside cylinder slides up and down freely without obstruction from grab handle
- safety lock pin operates properly
- stopper screw stops cylinder at its most upwards position.

To install the wake post, reverse removal procedure.

SPONSON

NOTE: Removal and installation procedure for RH and LH sponson is the same.
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

Removal
Unscrew sponson bolts then remove sponson.

Check if the hole on the elbow fitting is obstructed. Clean both elbow fittings if necessary.

1. Sponson
2. Bolts

Clean any residues of silicone sealant on hull and sponson.

Installation
Apply Loctite 5150 (silicone sealant) (P/N 293 800 086) around sponson adaptors.
Apply Loctite 243 (blue) (P/N 293 800 060) on sponson bolt threads.
Install sponson and torque sponson bolts to 7 N•m (62 lbf•in).

SPONSON ADAPTOR
NOTE: Removal and installation procedure for RH and LH sponson adaptor is the same.

Removal
Remove appropriate sponson.
Remove muffler and/or resonator. Refer to EXHAUST SYSTEM.
Hold sponson adaptors and unscrew sponson adaptor nuts.
Clean any residues of silicone sealant on hull and sponson.

Installation
Apply Loctite 243 (blue) (P/N 293 800 060) on sponson adaptor threads.
Torque sponson adaptor nuts to 16 N•m (142 lbf•in).
Install all other removed parts.

DRAIN PLUG

Inspection
Inside hull, check if holes at the end of drain plug are obstructed. Clean if necessary.
Vinyl Cleaning Recommendations for Special Stains

<table>
<thead>
<tr>
<th>TYPE OF STAIN</th>
<th>STEP 1</th>
<th>STEP 2</th>
<th>STEP 3</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballpoint ink*</td>
<td>E</td>
<td>B</td>
<td>A</td>
<td>A. Medium-soft brush, warm soapy water, rinse/dry.</td>
</tr>
<tr>
<td>Chewing gum</td>
<td>D</td>
<td>A</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Coffee, tea, chocolate</td>
<td>B</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Crayon</td>
<td>D</td>
<td>B</td>
<td>—</td>
<td>B. Vinyl Finish Cleaner, rinse/dry.</td>
</tr>
<tr>
<td>Grease</td>
<td>D</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Household soil</td>
<td>A</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Ketchup</td>
<td>A</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Latex paint</td>
<td>A</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Lipstick</td>
<td>A</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Mildew or wet leaves*</td>
<td>C</td>
<td>B</td>
<td>A</td>
<td>C. One (1) tablespoon of ammonia, one-fourth (1/4) cup of hydrogen peroxide, three-fourth (3/4) cup of water, rinse/dry.</td>
</tr>
<tr>
<td>Motor oil</td>
<td>B</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Oil-based paint</td>
<td>D</td>
<td>B</td>
<td>—</td>
<td>D. Wipe or scrape off excess (chill gum with ice before hand).</td>
</tr>
<tr>
<td>Permanent marker*</td>
<td>E</td>
<td>B</td>
<td>C</td>
<td>E. Denatured alcohol, rinse/dry.</td>
</tr>
<tr>
<td>Spray paint</td>
<td>B</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Sun tan lotion</td>
<td>A</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Tar/asphalt</td>
<td>D</td>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Yellow mustard</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>—</td>
</tr>
</tbody>
</table>

* Sun tan lotion, tree pollen, wet leaves and some other products can contain dyes that stain permanently.

All cleaning methods must be followed by a thorough rinse with warm water.

Certain household cleaners, powdered abrasives, steel wool, and industrial cleaners can cause damage and discoloration and are not recommended. Dry cleaning fluids and lacquer solvents should not be used as they will remove printed pattern and gloss. Waxes should be used with caution as many contain dyes or solvents that can permanently damage the protective coating.

Please contact G&I Industries "Marine Specialties Group" hotline at 1 800 318-2887 for any cleaning and care questions.

BODY AND HULL

Occasionally, wash the body with water and soap (only use mild detergent). Remove any marine organisms from engine and/or hull. Apply non-abrasive wax such as silicone wax.

CAUTION: Never clean fiberglass and plastic parts with strong detergent, degreasing agent, paint thinner, acetone, etc.

Stains may be removed from seat with Spray-Nine® from Korkay System Ltd or the equivalent.

CARPET

To clean the carpets, use 3M™ Citrus Base Cleaner (24 oz spray can) or the equivalent. See the manufacturer’s instructions.

REPAIR

HULL AND BODY

General

When servicing the hull, drain engine oil and fuel tank to avoid flowing. Rotate watercraft either way (seen from the rear) maximum to 90°.

Gelcoat is the smooth and durable cosmetic finish which coats the fiberglass hull and body of a Sea-Doo watercraft. It also provides a protective barrier against water and sun. It consists of a mixture of resin, pigment (coloring), fillers, monomers and catalyst which is sprayed into the mold.

The body and hull of the Sea-Doo are constructed of chopped fiberglass, saturated with resin. It is sprayed on the layer of gelcoat along with pieces of fiberglass mat, cloth and woven roving which are added at required areas. This type of construction is very accommodating for high quality repairs. With patience, the proper techniques and materials, a damaged area can be restored to an original finish.
NOTE: Fiberglass repair kit is available through automotive or marine suppliers. Gelcoat repair kits are available directly from Gelcote International Ltd.

**WARNING**

Protect skin, wear gloves when in contact with resin, hardeners and gelcoat. A barrier skin cream may also be used. Do not expose area to open flame or lit cigarette. Some of the materials are flammable. Protect eyes, wear safety glasses when grinding, sanding or spraying. Use a dust mask when sanding or grinding. When spraying wear a respirator or paint mask. Always read warning labels on products.

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**Air Bubbles**

Possible cause:
- Air pocket trapped between layers of laminate and gelcoat.

**PREPARATION OF SURFACE**

Remove all of the damaged gelcoat surrounding the air bubble with a putty knife or preferably a carbide grinding tip. Make sure all loose and weak areas are completely removed. Sand a small area of the gelcoat surface with 220-grit sandpaper. If needed, sand the cavity itself. These areas must have a rough surface to allow the gelcoat putty to bond properly.

**FILLING THE CAVEAT**

The prepared surface must be cleaned with acetone on a cloth. Use a gelcoat repair kit. Follow the mixing instructions in the kit when preparing the gelcoat putty. Carefully mix the required amount while making sure there are no air bubbles in the mixture. With a putty knife, fill the repair area and cover with plastic film. Curing time may depend on temperature, amount of putty and percentage of catalyst. After 2 hours, press lightly on the surface with fingers to test the hardness. When the area becomes hard, remove the plastic film.

**SANDING**

Begin block sanding the patch with 320-grit sandpaper until you come close to the original surface. Remove dust with a water soaked cloth and continue sanding with a 400-grit wet paper. Finish wet sanding with a 600-grit to remove deeper scratches. If needed you can wet sand with finer grit paper such as 1000-grit.

---

**BUFFING AND WAXING**

Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound. Finish off using a fine compound. While buffing, pay close attention to avoid overheating the surface.

**Blisters**

Possible causes:
- Insert catalyst.
- Improper catalyst/gelcoat ratio.

A blister is a visible bump on the watercraft surface that may not necessarily come right through the gelcoat layer. In the case of only a few blisters, follow the same repair procedure as for air bubbles. If they are numerous and in close concentration, spray liquid gelcoat to achieve proper repair. This procedure is covered in **MINOR GELCOAT FRACTURES**.

**Minor Gelcoat Fractures**

Possible causes:
- Flexing of fiberglass laminate.
- Gelcoat thickness.
- Direct result of impact.

In case of fractures which have not penetrated past the gelcoat layer, the repair concerns the gelcoat only. If flex cracking or impact are evident, then additional reinforcement may be necessary. This subject will be covered in **COMPOUND FRACTURES**.

**PREPARING THE SURFACES**

**Small Fractures**

Open the cracks up with a sharp triangular can opener or preferably a carbide tipped die grinder. The V groove will provide a good bonding area for the gelcoat. With 220-grit sandpaper, sand the sides of the notched out areas.

**Numerous Fractures**

Using a grinder with a 24-grit disk, remove the gelcoat. Sand the area edge with 220-grit sandpaper.

**FILLING THE REPAIR AREA**

**Small Fractures**

Refer to the same procedure as in the **AIR BUBBLES**.
Numerous Fractures Over Large Surface:
Prepare the area for spray application of liquid gelcoat. Wipe down the surface with acetone. Mask the area off to protect the watercraft from overspray.
Mix the needed quantity of gelcoat and catalyst according to suppliers recommendations. The gelcoat can be thinned with acetone up to 10%. If it needs more consistency you can add cabosil.
Make sure that the air supply is free of oil, dirt and water.
Test spray the gelcoat mixture on paper to verify its consistency and pattern. You may have to apply 5 or 6 coats to cover the area properly. Overlap each coat further than the last, leaving at least 30 seconds between passes. Avoid trying to coat the surface with only a few heavy coats, this will not allow the gelcoat to dry properly.
Apply a coat of polyvinyl alcohol (PVA) to seal off the air and protect the gelcoat surface from dust. PVA speeds up the curing process because gelcoat will not cure properly when exposed to air.

SANDING
Wash the polyvinyl alcohol off with water. Depending on the size of the area repaired, you can either block sand as per previous procedure or you may use an air sander. Sand the surface down with progressively finer grits of sandpaper until the desired finish is achieved.

BUFFING AND WAXING
Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound. Finish off using a fine compound. While buffing, pay close attention to avoid overheating the surface.

Compound Fractures
Possible causes:
- Thickness of fiberglass laminate.
- Direct result of impact.

Compound fractures are those that have gone past the gelcoated surface and in through the layers of fiberglass laminate. Two types of repairs have to be performed. The first is to restore the structural integrity of the damaged area. Fracture types can vary from a simple crack to a large hole. Usually, fiberglass reinforcement becomes necessary, especially if the fracture can be attributed to weakness. The final part of the repair is the gelcoating, which cannot be done until the interior and exterior laminate surfaces have been repaired.

Outside
Remove the damaged gelcoat and fiberglass with a 24-grit disk using a power sander. Grind outward at least 2 inches from the fracture to allow the patch to bond to strong material. Cut enough pieces of fiberglass mat necessary to build up the area. The pieces should be cut so they overlap each other by at least a half inch. For a smoother finish, the last layer should be fiberglass cloth. If the fracture is small enough all you may have to do is fill the area with an epoxy filler.

Inside
For the interior repair, you can grind more. This will allow for more fiberglass material which will strengthen the area. If the fracture opening is too large after surface preparation, you may need a backing support to cover the opening. Cut alternating pieces of fiberglass mat and cloth in overlapping sizes.

PATCHING THE REPAIR AREA
Outside
The outside should be done first. Wipe clean the area with acetone on a cloth, then mask off area. For a small crack use an epoxy filler in the same way you would use gelcoat repair putty. When laying up a larger area you will use mat, cloth and fiberglass resin and catalyst. Use a clean container to mix the resin, mix only what you will need. Follow the recommended catalyst ratio.

Using a clean paintbrush, brush the mixed resin on the surface. Place the smallest piece of mat over the fracture and then wet out the mat. Follow with the remaining pieces of mat and final layer of cloth. While wetting the pieces make sure you work the air bubbles out and saturate all the pieces evenly. Try to work quickly, you may only have 15 or 20 minutes. You may clean the brush with acetone.
Wait until the repair has hardened before moving on to the interior repair. If the size of the opening is too large for the pieces to maintain the proper shape, you will have to use a backing support. It is a shaped piece of cardboard that fits flush to the interior surface and has a plastic layer on the repair side. It is held in place by tape or a support.

**Inside**

Wipe down the area with acetone on a cloth. Apply the same procedure as for outside repair when laminating the alternating pieces of fiberglass material. If a backing support was used, remove it before starting the repair. After the area has hardened, remove sharp edges of material from surface. If required paint the surface.

**SANDING**

**Outside**

This surface will have to be prepared for application of gelcoat. The size of the area will determine the gelcoating procedure to be used. Refer to the **REPAIR PROCEDURE FOR MINOR GELCOAT FRACTURES**.

**BUFFING AND WAXING**

Refer to the **BUFFING AND WAXING FOR MINOR GELCOAT FRACTURES**.

**TOOLS AND MATERIALS LIST**

**Tools**
- safety glasses
- air mask
- white cloths
- sanding block
- putty knife
- plastic film
- stirring stick
- cover sheets (for Sea-Doo)
- scissors
- buffing pad
- heavy-duty polisher
- power sander
- paint brush
- plastic squeegee
- spray gun
- plastic container (mixing).

**Materials**
- fiberglass mat
- fiberglass cloth
- polyester resin
- cardboard
- gelcoat putty
- masking tape
- fine compound (white)
- sandpaper (100-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit)
- liquid gelcoat
- acetone
- cabosil
- epoxy filler
- wax
- 24-grit sanding disks
- medium compound (white).
## GTI AND GTI SE

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTI</th>
<th>GTI SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine type</td>
<td>ROTAX® 1503 4-TEC, 4-stroke. Single Over Head Camshaft (SOHC)</td>
<td></td>
</tr>
<tr>
<td>Induction</td>
<td>Naturally aspirated</td>
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</tr>
<tr>
<td>Number of cylinders</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of valves</td>
<td>Standard</td>
<td>12 valves with hydraulic lifters (no adjustment)</td>
</tr>
<tr>
<td>Bore</td>
<td>100 mm (3.9 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100.25 mm (3.95 in)</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>63.4 mm (2.49 in)</td>
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</tr>
<tr>
<td>Displacement</td>
<td>1493.8 mm³ (95.81 in³)</td>
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</tr>
<tr>
<td>Compression ratio</td>
<td>10.6:1</td>
<td></td>
</tr>
<tr>
<td>Maximum HP RPM</td>
<td>7300 ± 50 RPM</td>
<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>Type</td>
<td>Dry sump (2 oil pumps), Replaceable oil filter, Water-cooled oil cooler</td>
</tr>
<tr>
<td></td>
<td>Oil type</td>
<td>10W40, 4-stroke oil, (API service classification SL, SJ or SH)</td>
</tr>
<tr>
<td>Intake valve opening</td>
<td></td>
<td>10° BTDC</td>
</tr>
<tr>
<td>Intake valve closing</td>
<td></td>
<td>50° ABDC</td>
</tr>
<tr>
<td>Exhaust valve opening</td>
<td></td>
<td>50° BBDC</td>
</tr>
<tr>
<td>Exhaust valve closing</td>
<td></td>
<td>10° ATDC</td>
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<tr>
<td>Valve stem diameter</td>
<td>Intake</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit</td>
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<tr>
<td></td>
<td>Exhaust</td>
<td>New</td>
</tr>
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<td></td>
<td></td>
<td>Wear limit</td>
</tr>
<tr>
<td>Valve guide diameter</td>
<td>New</td>
<td>5.99 to 6.01 mm (0.2358 to 0.2366 in)</td>
</tr>
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<td></td>
<td>Wear limit</td>
<td>6.060 mm (0.238 in)</td>
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<tr>
<td>Valve spring free length</td>
<td>Inner</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit</td>
</tr>
<tr>
<td></td>
<td>Outer</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit</td>
</tr>
<tr>
<td>Valve seat contact width</td>
<td>Intake</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit</td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit</td>
</tr>
<tr>
<td>Rocker arm bore diameter</td>
<td>New</td>
<td>20.00 to 20.02 mm (0.7874 to 0.7882 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>20.03 mm (0.7886 in)</td>
</tr>
<tr>
<td>Rocker arm shaft diameter</td>
<td>New</td>
<td>19.98 to 19.99 mm (0.7866 to 0.7870 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>19.96 mm (0.7858 in)</td>
</tr>
</tbody>
</table>
## Section 10 TECHNICAL SPECIFICATIONS

### Subsection 01 (GTI AND GTI SE)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTI</th>
<th>GTI SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE (con’d)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder head screw</td>
<td>Service limit</td>
<td>148.5 mm (5.846 in)</td>
</tr>
<tr>
<td>Cylinder head maximum warpage</td>
<td>Service limit</td>
<td>0.15 mm (.006 in)</td>
</tr>
<tr>
<td>Piston ring type and quantity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>Upper compression ring, rectangular</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>Lower compression ring, tapered face</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Oil scraper ring</td>
<td></td>
</tr>
<tr>
<td>Ring end gap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
<td></td>
</tr>
<tr>
<td>Taper-face</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
<td></td>
</tr>
<tr>
<td>Oil scraper ring</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Wear Limit</td>
<td>1.0 mm (.039 in)</td>
</tr>
<tr>
<td>Ring/piston groove clearance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>0.02 to 0.07 mm (.0008 to .0028 in)</td>
<td></td>
</tr>
<tr>
<td>Taper-face</td>
<td>0.015 to 0.06 mm (.0006 to .0024 in)</td>
<td></td>
</tr>
<tr>
<td>Oil scraper ring</td>
<td>0.02 to 0.055 mm (.0008 to .0021 in)</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Wear Limit</td>
<td>0.15 mm (.006 in)</td>
</tr>
<tr>
<td>Piston/cylinder wall clearance</td>
<td>New</td>
<td>0.024 - 0.056 mm (.001 - .0022 in)</td>
</tr>
<tr>
<td></td>
<td>Wear Limit</td>
<td>0.1 mm (.0039 in)</td>
</tr>
<tr>
<td>Cylinder taper</td>
<td>Wear Limit</td>
<td>0.1 mm (.0039 in)</td>
</tr>
<tr>
<td>Cylinder out of round (maximum)</td>
<td></td>
<td>0.015 mm (.0006 in)</td>
</tr>
</tbody>
</table>

| Camshaft bearing journal     |                      |                    |
| Front                        | New                  | 24.93 to 24.96 mm (.9815 to .9827 in) |
|                             | Wear Limit           | 24.93 mm (.9815 in) |
| PTO and center               |                      |                    |
| Front                        | New                  | 39.89 to 39.99 mm (1.5705 to 1.5709 in) |
|                             | Wear Limit           | 39.88 mm (.15701 in) |
| Camshaft bore                |                      |                    |
| Front                        | New                  | 25.00 to 25.01 mm (.9842 to .9846 in) |
|                             | Wear Limit           | 25.02 mm (.9850 in) |
| PTO and center               |                      |                    |
| Intake                       | New                  | 31.48 to 31.68 mm (1.2394 to 1.2472 in) |
|                             | Wear Limit           | 31.43 mm (1.2374 in) |
| Exhaust                      | New                  | 31.55 to 31.75 mm (1.2421 to 1.2499 in) |
|                             | Wear Limit           | 31.65 mm (1.2461 in) |
| Crankshaft deflection        | Maximum              | 0.050 mm (.002 in) |
| Crankshaft axial clearance   | New                  | 0.09 to 0.22 mm (.0031 to .0087 in) |
|                             | Wear Limit           | 0.35 mm (.014 in)  |
| Crankshaft journal diameter  | New                  | 49.991 to 50.000 mm (1.9681 to 1.9685 in) |
|                             | Wear Limit           | 49.950 mm (1.9685 in) |
| Crankshaft radial clearance  | Wear Limit           | 0.007 mm (.0028 in) |
| Connecting rod big end diameter| Service limit        | 45.080 mm (1.7740 in) |
| Connecting rod big end clearance| Service limit        | 0.09 mm (.0039 in) |
| Connecting rod big end axial play| New                | 0.135 to 0.287 mm (.0053 to .0113 in) |
|                             | Wear Limit           | 0.500 mm (.0197 in) |
| Connecting rod small end diameter| New                | 23.010 to 23.020 mm (0.9059 to .9063 in) |
|                             | Wear Limit           | 23.070 mm (0.9080 in) |
### Section 10 TECHNICAL SPECIFICATIONS
Subsection 01 (GTI AND GTI SE)

<table>
<thead>
<tr>
<th>MODEL</th>
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<th>GTI SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGINE (con'd)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston pin diameter</td>
<td>New</td>
<td>22.99 to 23.000 mm (0.9051 to 0.9055 in)</td>
</tr>
<tr>
<td>Piston pin bore clearance</td>
<td>Wear limit</td>
<td>22.980 mm (0.9047 in)</td>
</tr>
<tr>
<td>Balance shaft journal diameter</td>
<td>Wear limit</td>
<td>0.080 mm (0.0035 in)</td>
</tr>
<tr>
<td>Balance shaft radial clearance</td>
<td>New</td>
<td>31.98 to 32.000 mm (1.2591 to 1.2596 in)</td>
</tr>
<tr>
<td>Balance shaft axial clearance</td>
<td>Wear limit</td>
<td>31.850 mm (1.2579 in)</td>
</tr>
</tbody>
</table>

**ENGINE COOLING SYSTEM**

| Type | Closed loop cooling system |
| Coolant | Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines |
| Thermostat | 87°C (188°F) |
| Monitoring beeper setting | 100°C (212°F) |

**EXHAUST SYSTEM**

| Type | Water cooled/water injected (opened loop). Direct flow from jet pump |

**ELECTRICAL SYSTEM**

| Magneto generator output | 380 W @ 6000 RPM |
| Ignition system type | DI (Digital Ignition) |
| Ignition timing | Not adjustable |
| Spark plug Make and type | NGK DCPR8E |
| Spark plug Gap | 0.7 - 0.8 mm (0.028 to .031 in) |
| Generating coil | N.A. |
| Battery charging coil | 0.1 - 1.0 Ω |
| Ignition coil Primary | 0.85 - 1.15 Ω |
| Ignition coil Secondary | 9.5 - 13.5 kΩ |
| Engine RPM limiter setting | 7650 RPM |
| Battery | 12 V, 30 Ah |

**Fuse**

| Accessories | 2 A - 5 A |
| Battery | 30 A |
| Cylinder 1, ignition coil and injection | 10 A |
| Cylinder 2, ignition coil and injection | 10 A |
| Cylinder 3, ignition coil and injection | 10 A |
| Electric bige pump (optional) | 3 A |
| Starting system, electric fuel pump | 10 A |
| EMS, start/stop circuit | 5 A |
| Main | 30 A |
| MPEM | 2 A |
| Charging system | 30 A |
| Information center | 1 A |
| VTS | 7.5 A (installed but not in use) |
**Section 10 TECHNICAL SPECIFICATIONS**

**Subsection 01 (GTI AND GTI SE)**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTI</th>
<th>GTI SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUEL SYSTEM</strong></td>
<td><strong>Rotax EMS (engine management system) Multipoint Fuel Injection. Single throttle body (52 mm)</strong></td>
<td><strong>Unleaded gasoline with a minimum of 87 octane ifRON &gt; MON/2</strong></td>
</tr>
<tr>
<td>Fuel injection type</td>
<td><strong>290 - 310 kPa (42 - 45 PSI)</strong></td>
<td><strong>Unleaded gasoline with a minimum of 91 octane RON</strong></td>
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<tr>
<td>Fuel pressure</td>
<td><strong>Inside North America</strong></td>
<td></td>
</tr>
<tr>
<td>Fuel type</td>
<td><strong>Outside North America</strong></td>
<td></td>
</tr>
<tr>
<td>Idle speed</td>
<td><strong>1750 ± 50 RPM (NOT ADJUSTABLE)</strong></td>
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</tr>
<tr>
<td><strong>PROPULSION SYSTEM</strong></td>
<td><strong>Axial flow single stage</strong></td>
<td></td>
</tr>
<tr>
<td>Jet pump type</td>
<td><strong>Bearing grease (P/N 293 550 032)</strong></td>
<td></td>
</tr>
<tr>
<td>Jet pump grease type</td>
<td><strong>Counterclockwise</strong></td>
<td></td>
</tr>
<tr>
<td>Impeller rotation (seen from rear)</td>
<td><strong>Direct drive</strong></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td><strong>Crowned spines</strong></td>
<td></td>
</tr>
<tr>
<td>Coupling type</td>
<td><strong>Yes</strong></td>
<td></td>
</tr>
<tr>
<td>Reverse system</td>
<td><strong>Yes</strong></td>
<td></td>
</tr>
<tr>
<td>O.P.A.S. system</td>
<td><strong>Yes</strong></td>
<td></td>
</tr>
<tr>
<td>Steering nozzle pivoting angle</td>
<td><strong>20°</strong></td>
<td></td>
</tr>
<tr>
<td>Minimum required water level</td>
<td><strong>90 cm (35 in) underneath the lowest rear portion of hull</strong></td>
<td></td>
</tr>
<tr>
<td>Drive shaft deflection (maximum)</td>
<td><strong>0.5 mm (.020 in)</strong></td>
<td></td>
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<tr>
<td>Impeller outside diameter</td>
<td><strong>155.5 ± 0.06 mm (.6122 ± .0024 in)</strong></td>
<td></td>
</tr>
<tr>
<td>Impeller/wear ring clearance</td>
<td><strong>GTI: see GTI SE</strong></td>
<td><strong>GTI Rental: 0.020 in minimum</strong></td>
</tr>
<tr>
<td>New</td>
<td><strong>0.51 mm (.020 in) minimum</strong></td>
<td></td>
</tr>
<tr>
<td>Wear limit</td>
<td><strong>GTI: see GTI SE</strong></td>
<td><strong>GTI Rental: 0.76 mm (.030 in)</strong></td>
</tr>
<tr>
<td>Impeller shaft end play (new)</td>
<td><strong>0</strong></td>
<td></td>
</tr>
<tr>
<td>Impeller shaft side play</td>
<td><strong>0</strong></td>
<td></td>
</tr>
<tr>
<td>Impeller pitch</td>
<td><strong>10° — 21°</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DIMENSIONS</strong></td>
<td><strong>GTI — 333 kg (734 lb)</strong></td>
<td><strong>GTI Rental — 340 kg (750 lb)</strong></td>
</tr>
<tr>
<td>Number of passenger (driver incl.)</td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td>Overall length</td>
<td><strong>322.5 cm (127 in)</strong></td>
<td></td>
</tr>
<tr>
<td>Overall width</td>
<td><strong>124.5 cm (49 in)</strong></td>
<td></td>
</tr>
<tr>
<td>Overall height</td>
<td><strong>113 cm (44 in)</strong></td>
<td></td>
</tr>
<tr>
<td>Dry weight</td>
<td><strong>GTI — 333 kg (734 lb)</strong></td>
<td></td>
</tr>
<tr>
<td>Load limit (passenger and 10 kg (22 lb) luggage)</td>
<td><strong>272 kg (600 lb)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CAPACITIES</strong></td>
<td><strong>Engine oil</strong></td>
<td><strong>3 L (2.7 U.S. qt) oil change w/filter</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Engine cooling system</strong></td>
<td><strong>4.5 L (4.1 U.S. qt) total</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Fuel tank (including reserve)</strong></td>
<td><strong>5.5 L (4.8 U.S. qt) total</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Fuel tank reserve (from low level signal)</strong></td>
<td><strong>60 L (15.9 U.S. gal)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Fuel tank reserve</strong></td>
<td><strong>15 L (4 U.S. gal)</strong></td>
</tr>
</tbody>
</table>
## Section 10 TECHNICAL SPECIFICATIONS

### Subsection 01 (GTI AND GTI SE)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTI</th>
<th>GTI SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hull</td>
<td>Composite fiberglass</td>
<td></td>
</tr>
<tr>
<td>Inlet grate</td>
<td>Nylon</td>
<td></td>
</tr>
<tr>
<td>Steering cover</td>
<td>Thermoplastic</td>
<td></td>
</tr>
<tr>
<td>Impeller material</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>Impeller housing/stator</td>
<td>Plastic/plastic</td>
<td></td>
</tr>
<tr>
<td>Venturi</td>
<td>GTI — Plastic</td>
<td>GTI Rental — Plastic</td>
</tr>
<tr>
<td></td>
<td>GTI Rental — Aluminum</td>
<td></td>
</tr>
<tr>
<td>Nozzle</td>
<td>GTI — Plastic</td>
<td>GTI Rental — Plastic</td>
</tr>
<tr>
<td></td>
<td>GTI Rental — Aluminum</td>
<td></td>
</tr>
<tr>
<td>Fuel tank</td>
<td>Polyethylene</td>
<td></td>
</tr>
<tr>
<td>Seat</td>
<td>Polyurethane foam</td>
<td></td>
</tr>
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### PERFORMANCE

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Estimated pump power</td>
<td>46.3 kW (62 HP)</td>
<td></td>
</tr>
<tr>
<td>Maximum fuel consumption at wide open throttle</td>
<td>40.8 L/h (10.8 U.S. gal/h)</td>
<td></td>
</tr>
<tr>
<td>Cruising time at full throttle</td>
<td>Fuel tank without reserve</td>
<td>± 70 minutes</td>
</tr>
<tr>
<td></td>
<td>Fuel tank reserve</td>
<td>± 20 minutes</td>
</tr>
<tr>
<td></td>
<td>(from low level signal)</td>
<td></td>
</tr>
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</table>
# GTX AND GTX WAKE

## ENGINE

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine type</strong></td>
<td>ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)</td>
<td></td>
</tr>
<tr>
<td><strong>Induction</strong></td>
<td>Naturally aspirated</td>
<td></td>
</tr>
<tr>
<td><strong>Number of cylinders</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Number of valves</strong></td>
<td>12 valves with hydraulic lifters (no adjustment)</td>
<td></td>
</tr>
<tr>
<td><strong>Bore</strong></td>
<td>Standard 100 mm (3.9 in)</td>
<td>100.25 mm (3.95 in)</td>
</tr>
<tr>
<td></td>
<td>1st Oversize 63.4 mm (2.49 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td>63.4 mm (2.49 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Displacement</strong></td>
<td>1493.8 mm³ (58.81 in³)</td>
<td></td>
</tr>
<tr>
<td><strong>Compression ratio</strong></td>
<td>10.6:1</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum HP RPM</strong></td>
<td>7300 ± 50 RPM</td>
<td></td>
</tr>
<tr>
<td><strong>Lubrication</strong></td>
<td>Type Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil type 10W40 4-stroke oil (API service classification SL, SJ or SH)</td>
<td></td>
</tr>
<tr>
<td><strong>Intake valve opening</strong></td>
<td>0° BTDC</td>
<td></td>
</tr>
<tr>
<td><strong>Intake valve closing</strong></td>
<td>50° ATDC</td>
<td></td>
</tr>
<tr>
<td><strong>Exhaust valve opening</strong></td>
<td>50° BBDC</td>
<td></td>
</tr>
<tr>
<td><strong>Exhaust valve closing</strong></td>
<td>0° ATDC</td>
<td></td>
</tr>
<tr>
<td><strong>Valve stem diameter</strong></td>
<td>Intake New 5.961 to 5.975 mm (0.2347 to .2352 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 5.930 mm (0.2330 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust New 5.946 to 5.960 mm (0.2341 to .2346 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 5.930 mm (0.2330 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Valve guide diameter</strong></td>
<td>New 5.99 to 6.01 mm (0.2358 to .2368 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 6.060 mm (0.2386 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Valve spring free length</strong></td>
<td>Inner New 41.02 mm (1.615 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 30.88 mm (1.216 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outer New 45.45 mm (1.789 in)</td>
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<tr>
<td></td>
<td>Wear limit 43 mm (1.693 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Valve seat contact width</strong></td>
<td>Intake New 1.1 to 1.3 mm (.043 to .063 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 1.6 mm (.063 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust New 1.25 to 1.55 mm (.049 to .061 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 1.8 mm (.071 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Rocker arm bore diameter</strong></td>
<td>New 20.00 to 20.02 mm (.7874 to .7882 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 20.03 mm (.7886 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Rocker arm shaft diameter</strong></td>
<td>New 19.96 to 19.99 mm (.7866 to .7870 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wear limit 19.96 mm (.7858 in)</td>
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### Section 10 TECHNICAL SPECIFICATIONS
### Subsection 02 (GTX AND GTX WAKE)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
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<tbody>
<tr>
<td><strong>ENGINE (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder head screw</td>
<td>Service limit</td>
<td>148.5 mm (5.846 in)</td>
</tr>
<tr>
<td>Cylinder head maximum warpage</td>
<td>Service limit</td>
<td>0.15 mm (.006 in)</td>
</tr>
<tr>
<td>Piston ring type and quantity</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Upper compression ring, rectangular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Lower compression ring, tapered face</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Oil scraper ring</td>
<td></td>
</tr>
<tr>
<td>Ring end gap</td>
<td>Rectangular</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
</tr>
<tr>
<td></td>
<td>Taper-face</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
</tr>
<tr>
<td></td>
<td>Oil scraper ring</td>
<td>0.3 to 0.5 mm (.012 to .020 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>1 mm (.039 in)</td>
</tr>
<tr>
<td>Ring/piston groove clearance</td>
<td>Rectangular</td>
<td>0.02 to 0.07 mm (.0008 to .0028 in)</td>
</tr>
<tr>
<td></td>
<td>Taper-face</td>
<td>0.015 to 0.06 mm (.0006 to .0024 in)</td>
</tr>
<tr>
<td></td>
<td>Oil scraper ring</td>
<td>0.02 to 0.055 mm (.0008 to .0021 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>0.15 mm (.006 in)</td>
</tr>
<tr>
<td>Piston/cylinder wall clearance</td>
<td>New</td>
<td>0.024 - 0.056 mm (.001 - .0022 in)</td>
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<tr>
<td></td>
<td>Wear limit</td>
<td>0.1 mm (.0039 in)</td>
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<tr>
<td>Cylinder taper</td>
<td>Wear limit</td>
<td>0.1 mm (.0039 in)</td>
</tr>
<tr>
<td>Cylinder out of round</td>
<td>Service limit</td>
<td>0.015 mm (.0006 in)</td>
</tr>
<tr>
<td>Camshaft bearing journal</td>
<td>Front</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>24.93 to 24.96 mm (.9815 to .9827 in)</td>
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<tr>
<td></td>
<td>PTO and center</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>39.88 to 39.9 mm (.15705 to .15709 in)</td>
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<tr>
<td>Camshaft bore</td>
<td>Front</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>25.00 to 25.01 mm (.9842 to .9846 in)</td>
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<tr>
<td></td>
<td>PTO and center</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>40.00 to 40.01 mm (.15748 to .15752 in)</td>
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<tr>
<td>Cam lobe</td>
<td>Intake</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>31.54 to 31.74 mm (.12417 to .12496 in)</td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>31.43 to 31.63 mm (.12373 to .12452 in)</td>
</tr>
<tr>
<td>Crankshaft deflection</td>
<td>Maximum</td>
<td>0.050 mm (.002 in)</td>
</tr>
<tr>
<td>Crankshaft axial clearance</td>
<td>New</td>
<td>0.08 to 0.22 mm (.0031 to .0087 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>0.35 mm (.014 in)</td>
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<tr>
<td>Crankshaft journal diameter</td>
<td>New</td>
<td>49.991 to 50.000 mm (.19681 to .19685 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>49.950 mm (.19665 in)</td>
</tr>
<tr>
<td>Crankshaft radial clearance</td>
<td>Wear limit</td>
<td>0.007 mm (.00028 in)</td>
</tr>
<tr>
<td>Connecting rod big end diameter</td>
<td>Service limit</td>
<td>45.080 mm (.17740 in)</td>
</tr>
<tr>
<td>Connecting rod big end clearance</td>
<td>Service limit</td>
<td>0.09 mm (.0039 in)</td>
</tr>
<tr>
<td>Connecting rod big end axial play</td>
<td>New</td>
<td>0.135 to 0.287 mm (.0053 to .0113 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>0.500 mm (.0197 in)</td>
</tr>
<tr>
<td>Connecting rod small end diameter</td>
<td>New</td>
<td>23.010 to 23.020 mm (.9059 to .9063 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>23.070 mm (.9080 in)</td>
</tr>
</tbody>
</table>

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### Section 10 TECHNICAL SPECIFICATIONS
Subsection 02 (GTX AND GTX WAKE)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston pin diameter</td>
<td>New</td>
<td>22.99 to 23.000 mm (.9051 to .9055 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>22.980 mm (.9047 in)</td>
</tr>
<tr>
<td>Piston pin bore clearance</td>
<td>Wear limit</td>
<td>0.080 mm (.0035 in)</td>
</tr>
<tr>
<td>Balance shaft journal diameter</td>
<td>New</td>
<td>31.98 to 32.000 mm (1.2591 to 1.2598 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>31.950 mm (1.2579 in)</td>
</tr>
<tr>
<td>Balance shaft radial clearance</td>
<td>Wear limit</td>
<td>0.07 mm (.0028 in)</td>
</tr>
<tr>
<td>Balance shaft axial clearance</td>
<td>New</td>
<td>0.02 to 0.25 mm (.0008 to .0098 in)</td>
</tr>
<tr>
<td><strong>ENGINE COOLING SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Closed loop cooling system</td>
<td></td>
</tr>
<tr>
<td>Coolant</td>
<td>Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines</td>
<td></td>
</tr>
<tr>
<td>Thermostat</td>
<td>87°C (189°F)</td>
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</tr>
<tr>
<td>Monitoring beeper setting</td>
<td>100°C (212°F)</td>
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</tr>
<tr>
<td><strong>EXHAUST SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Water cooled/water injected (opened loop). Direct flow from jet pump</td>
<td></td>
</tr>
<tr>
<td><strong>ELECTRICAL SYSTEM</strong></td>
<td></td>
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</tr>
<tr>
<td>Magneto generator output</td>
<td></td>
<td>380 W @ 6000 RPM</td>
</tr>
<tr>
<td>Ignition system type</td>
<td>DI (Digital induction)</td>
<td></td>
</tr>
<tr>
<td>Ignition timing</td>
<td>Not adjustable</td>
<td></td>
</tr>
<tr>
<td>Spark plug Make and type</td>
<td>NGK DCR8E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gap</td>
<td>0.7 - 0.8 mm (.028 to .031 in)</td>
</tr>
<tr>
<td>Generating coil</td>
<td>N.A.</td>
<td></td>
</tr>
<tr>
<td>Battery charging coil</td>
<td>0.1 - 1.0 Ω</td>
<td></td>
</tr>
<tr>
<td>Ignition coil Primary</td>
<td>0.85 - 1.15 Ω</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>9.5 - 13.5 kΩ</td>
<td></td>
</tr>
<tr>
<td>Engine RPM limiter setting</td>
<td>7650 RPM</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td></td>
<td>12 V, 30 A*1</td>
</tr>
<tr>
<td>Fuse</td>
<td>Accessories</td>
<td>2 A — 5 A</td>
</tr>
<tr>
<td></td>
<td>Battery</td>
<td>30 A</td>
</tr>
<tr>
<td></td>
<td>Cylinder 1, ignition coil and injection</td>
<td>10 A</td>
</tr>
<tr>
<td></td>
<td>Cylinder 2, ignition coil and injection</td>
<td>10 A</td>
</tr>
<tr>
<td></td>
<td>Cylinder 3, ignition coil and injection</td>
<td>10 A</td>
</tr>
<tr>
<td></td>
<td>Electric bilge pump (optional)</td>
<td>3 A</td>
</tr>
<tr>
<td></td>
<td>Starting system, electric fuel pump</td>
<td>10 A</td>
</tr>
<tr>
<td></td>
<td>EMS, start/stop circuit</td>
<td>5 A</td>
</tr>
<tr>
<td></td>
<td>Main</td>
<td>30 A</td>
</tr>
<tr>
<td></td>
<td>MPEM</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>Charging system</td>
<td>30 A</td>
</tr>
<tr>
<td></td>
<td>Information center</td>
<td>1 A</td>
</tr>
<tr>
<td></td>
<td>VTS</td>
<td>7.5 A (installed but not in use)</td>
</tr>
</tbody>
</table>
## Section 10 TECHNICAL SPECIFICATIONS

### Subsection 02 (GTX AND GTX WAKE)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
</table>

### FUEL SYSTEM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel injection type</td>
<td>Rotax EMS (engine management system)</td>
<td>Multiple point fuel injection. Single throttle body (52 mm)</td>
</tr>
<tr>
<td>Fuel pressure</td>
<td>290 - 310 kPa (42 - 45 PSI)</td>
<td></td>
</tr>
<tr>
<td>Fuel type</td>
<td>Inside North America</td>
<td>Unleaded gasoline with a minimum of 87 octane (RON + MON)/2</td>
</tr>
<tr>
<td></td>
<td>Outside North America</td>
<td>Unleaded gasoline with a minimum of 91 octane RON</td>
</tr>
<tr>
<td>Idle speed</td>
<td>1800 ± 50 RPM (NOT ADJUSTABLE)</td>
<td></td>
</tr>
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</table>

### PROPULSION SYSTEM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet pump type</td>
<td>Axial flow single stage</td>
<td></td>
</tr>
<tr>
<td>Jet pump grease</td>
<td>Bearing grease (PN 293 550 032)</td>
<td></td>
</tr>
<tr>
<td>Impeller rotation (seen from rear)</td>
<td>Counterclockwise</td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>Direct drive</td>
<td></td>
</tr>
<tr>
<td>Coupling type</td>
<td>Crowned splines</td>
<td></td>
</tr>
<tr>
<td>Reverse system</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>O.P.A.S. system</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Steering nozzle pivoting angle</td>
<td>20°</td>
<td></td>
</tr>
<tr>
<td>Minimum required water level</td>
<td>90 cm (35 in) underneath the lowest rear portion of hull</td>
<td></td>
</tr>
<tr>
<td>Drive shaft deflection (maximum)</td>
<td>0.5 mm (.020 in)</td>
<td></td>
</tr>
<tr>
<td>Impeller outside diameter</td>
<td>155.5 ± 0.06 mm (6.122 ± .004 in)</td>
<td></td>
</tr>
<tr>
<td>Impeller/wear ring clearance</td>
<td>New</td>
<td>Wear limit: 0.35 mm (.0138 in)</td>
</tr>
<tr>
<td>Impeller shaft end play (new)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Impeller shaft side play</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Impeller pitch</td>
<td>10° — 21°</td>
<td></td>
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### DIMENSIONS

<table>
<thead>
<tr>
<th>Customer (driver incl.)</th>
<th>3</th>
</tr>
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<tbody>
<tr>
<td>Overall length</td>
<td>331 cm (130 in)</td>
</tr>
<tr>
<td>Overall width</td>
<td>122 cm (48 in)</td>
</tr>
<tr>
<td>Overall height</td>
<td>113 cm (44 in)</td>
</tr>
<tr>
<td>Dry weight</td>
<td>364 kg (847 lb)</td>
</tr>
<tr>
<td>Load limit (passenger and 10 kg (22 lb) luggage)</td>
<td>272 kg (600 lb)</td>
</tr>
</tbody>
</table>

### CAPACITIES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil</td>
<td>3 L (2.7 U.S. qt) oil change w/filter</td>
<td>4.5 L (4.1 U.S. qt) total</td>
</tr>
<tr>
<td>Engine cooling system</td>
<td>5.5 L (4.8 U.S. qt) total</td>
<td></td>
</tr>
<tr>
<td>Fuel tank (including reserve)</td>
<td>60 L (15.9 U.S. gal)</td>
<td></td>
</tr>
<tr>
<td>Fuel tank reserve (from low level signal)</td>
<td>15 L (4 U.S. gal)</td>
<td></td>
</tr>
</tbody>
</table>
### Section 10 TECHNICAL SPECIFICATIONS

Subsection 02 (GTX AND GTX WAKE)

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>GTX</th>
<th>GTX WAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hull</td>
<td>Composite fiberglass</td>
<td></td>
</tr>
<tr>
<td>Inlet grate</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Steering cover</td>
<td>Thermoplastic</td>
<td></td>
</tr>
<tr>
<td>Impeller material</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>Impeller housing/stator</td>
<td>Plastic/plastic</td>
<td></td>
</tr>
<tr>
<td>Venturi</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Nozzle</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Fuel tank</td>
<td>Polyethylene</td>
<td></td>
</tr>
<tr>
<td>Seat</td>
<td>Polyurethane foam</td>
<td></td>
</tr>
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<table>
<thead>
<tr>
<th>PERFORMANCE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated pump power</td>
<td>52.6 kW (71 HP)</td>
<td></td>
</tr>
<tr>
<td>Maximum fuel consumption at wide open throttle</td>
<td>43.1 L/h (11.4 U.S. gal/h)</td>
<td></td>
</tr>
<tr>
<td>Cruising time at full throttle</td>
<td>Fuel tank without reserve</td>
<td>± 60 minutes</td>
</tr>
<tr>
<td></td>
<td>Fuel tank reserve</td>
<td>± 20 minutes</td>
</tr>
<tr>
<td></td>
<td>(from low level signal)</td>
<td></td>
</tr>
</tbody>
</table>
# GTX SUPERCHARGED AND GTX LIMITED

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX SUPERCHARGED</th>
<th>GTX LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine type</td>
<td>ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)</td>
<td>Supercharged, Supercharged intercooled</td>
</tr>
<tr>
<td>Induction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cylinders</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of valves</td>
<td>12 valves with hydraulic lifters (no adjustment)</td>
<td></td>
</tr>
<tr>
<td>Bore</td>
<td>Standard: 100 mm (3.9 in)</td>
<td>63.4 mm (2.49 in)</td>
</tr>
<tr>
<td></td>
<td>1st Over size: 100.25 mm (3.95 in)</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement</td>
<td>1493.8 mm³ (88.81 in³)</td>
<td></td>
</tr>
<tr>
<td>Compression ratio</td>
<td>8:1:1</td>
<td>8:4:1</td>
</tr>
<tr>
<td>Maximum HP RPM</td>
<td>7500 ± 50 RPM</td>
<td>8000 ± 50 RPM</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Type: Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil type: XP-S 10W40 4-stroke oil or an equivalent approved by BRP</td>
<td></td>
</tr>
<tr>
<td>Intake valve opening</td>
<td>10° BTDC</td>
<td>0° BTDC</td>
</tr>
<tr>
<td>Intake valve closing</td>
<td>45° ABDc</td>
<td>50 ABDC</td>
</tr>
<tr>
<td>Exhaust valve opening</td>
<td>50° BBDC</td>
<td>50° BBDC</td>
</tr>
<tr>
<td>Exhaust valve closing</td>
<td>0° ATDC</td>
<td>0° ATDC</td>
</tr>
<tr>
<td>Valve stem diameter</td>
<td>Intake: New: 5.961 to 5.975 mm (0.2347 to 0.2352 in)</td>
<td>Wear limit: 5.930 mm (0.2330 in)</td>
</tr>
<tr>
<td></td>
<td>New: 5.946 to 5.960 mm (0.2341 to 0.2346 in)</td>
<td>Wear limit: 5.930 mm (0.2330 in)</td>
</tr>
<tr>
<td></td>
<td>Exhaust: New: 5.99 to 6.01 mm (0.2358 to 0.2386 in)</td>
<td>Wear limit: 6.060 mm (0.2386 in)</td>
</tr>
<tr>
<td>Valve guide diameter</td>
<td>New: 41.02 mm (1.615 in)</td>
<td>Wear limit: 38.8 mm (1.499 in)</td>
</tr>
<tr>
<td></td>
<td>New: 45.45 mm (1.789 in)</td>
<td>Wear limit: 43 mm (1.693 in)</td>
</tr>
<tr>
<td>Valve spring free length</td>
<td>Inner: New: 1.1 to 1.3 mm (0.043 to 0.051 in)</td>
<td>Wear limit: 1.6 mm (0.063 in)</td>
</tr>
<tr>
<td></td>
<td>Outer: New: 1.25 to 1.55 mm (0.049 to 0.061 in)</td>
<td>Wear limit: 1.8 mm (0.071 in)</td>
</tr>
<tr>
<td>Valve seat contact width</td>
<td>Intake: New: 20.00 to 20.02 mm (0.7874 to 0.7882 in)</td>
<td>Wear limit: 20.03 mm (0.7886 in)</td>
</tr>
<tr>
<td></td>
<td>Exhaust: New: 19.98 to 19.99 mm (0.7866 to 0.7870 in)</td>
<td>Wear limit: 19.96 mm (0.7858 in)</td>
</tr>
</tbody>
</table>
### Section 10 TECHNICAL SPECIFICATIONS

**Subsection 03 (GTX SUPERCHARGED AND GTX LIMITED)**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX SUPERCHARGED</th>
<th>GTX LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder head screw</td>
<td>Service limit</td>
<td>148.5 mm (5.846 in)</td>
</tr>
<tr>
<td>Cylinder head maximum warpage</td>
<td>Service limit</td>
<td>0.15 mm (0.006 in)</td>
</tr>
<tr>
<td>Piston ring type and quantity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>Upper compression ring, rectangular</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>Lower compression ring, tapered face</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Oil scraper ring</td>
<td></td>
</tr>
<tr>
<td>Ring end gap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>New</td>
<td>0.3 to 0.5 mm (0.012 to 0.020 in)</td>
</tr>
<tr>
<td>Taper-face</td>
<td>New</td>
<td>0.3 to 0.5 mm (0.012 to 0.020 in)</td>
</tr>
<tr>
<td>Oil scraper ring</td>
<td>New</td>
<td>0.3 to 0.5 mm (0.012 to 0.020 in)</td>
</tr>
<tr>
<td>All</td>
<td>Wear limit</td>
<td>1 mm (0.039 in)</td>
</tr>
<tr>
<td>Ring/piston groove clearance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>New</td>
<td>0.02 to 0.07 mm (0.0008 to 0.0028 in)</td>
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<tr>
<td>Taper-face</td>
<td>New</td>
<td>0.02 to 0.06 mm (0.0008 to 0.0024 in)</td>
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<tr>
<td>Oil scraper ring</td>
<td>New</td>
<td>0.02 to 0.055 mm (0.0008 to 0.0021 in)</td>
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<tr>
<td>All</td>
<td>Wear limit</td>
<td>0.15 mm (0.006 in)</td>
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<tr>
<td>Piston/cylinder wall clearance</td>
<td>New</td>
<td>0.04 mm (0.0016 in)</td>
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<tr>
<td></td>
<td>Wear limit</td>
<td>0.06 mm (0.0023 in)</td>
</tr>
<tr>
<td>Cylinder taper</td>
<td>Wear limit</td>
<td>0.1 mm (0.0039 in)</td>
</tr>
<tr>
<td>Cylinder out of round</td>
<td>Service limit</td>
<td>0.015 mm (0.0006 in)</td>
</tr>
<tr>
<td>Camshaft bearing journal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front</td>
<td>New</td>
<td>24.93 to 24.96 mm (0.9815 to 0.9827 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>24.93 mm (0.9815 in)</td>
</tr>
<tr>
<td>PTO and center</td>
<td>New</td>
<td>39.89 to 39.9 mm (1.5705 to 1.5709 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>39.88 mm (1.5701 in)</td>
</tr>
<tr>
<td>Camshaft bore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front</td>
<td>New</td>
<td>25.00 to 25.01 mm (0.9842 to 0.9846 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>25.02 mm (0.9850 in)</td>
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<tr>
<td>PTO and center</td>
<td>New</td>
<td>40.00 to 40.01 mm (1.5748 to 1.5752 in)</td>
</tr>
<tr>
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<td>Wear limit</td>
<td>40.02 mm (1.5756 in)</td>
</tr>
<tr>
<td>Cam lobe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>New</td>
<td>31.65 to 31.85 mm (1.2460 to 1.2539 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>31.60 mm (1.2440 in)</td>
</tr>
<tr>
<td>Exhaust</td>
<td>New</td>
<td>31.43 to 31.63 mm (1.2373 to 1.2452 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>31.38 mm (1.2354 in)</td>
</tr>
<tr>
<td>Crankshaft deflection</td>
<td>Maximum</td>
<td>0.050 mm (0.002 in)</td>
</tr>
<tr>
<td>Crankshaft axial clearance</td>
<td>New</td>
<td>0.08 to 0.22 mm (0.0031 to 0.0087 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>0.35 mm (0.014 in)</td>
</tr>
<tr>
<td>Crankshaft journal diameter</td>
<td>New</td>
<td>49.991 to 50.000 mm (1.9681 to 1.9685 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>49.950 mm (1.9665 in)</td>
</tr>
<tr>
<td>Crankshaft radial clearance</td>
<td>Wear limit</td>
<td>0.007 mm (0.00028 in)</td>
</tr>
<tr>
<td>Connecting rod big end diameter</td>
<td>Service limit</td>
<td>45.080 mm (1.7740 in)</td>
</tr>
<tr>
<td>Connecting rod big end clearance</td>
<td>Service limit</td>
<td>0.09 mm (0.0035 in)</td>
</tr>
<tr>
<td>Connecting rod big end axial play</td>
<td>New</td>
<td>0.135 to 0.287 mm (0.0053 to 0.0113 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>0.500 mm (0.0197 in)</td>
</tr>
<tr>
<td>Connecting rod small end diameter</td>
<td>New</td>
<td>23.010 to 23.020 mm (0.9059 to 0.9063 in)</td>
</tr>
<tr>
<td></td>
<td>Wear limit</td>
<td>23.070 mm (0.9080 in)</td>
</tr>
</tbody>
</table>
### Section 10 TECHNICAL SPECIFICATIONS

**Subsection 03 (GTX SUPERCHARGED AND GTX LIMITED)**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX SUPERCHARGED</th>
<th>GTX LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston pin diameter</td>
<td>New 22.99 to 23.000 mm (.9051 to .9055 in)</td>
<td>Wear limit 22.980 mm (.9047 in)</td>
</tr>
<tr>
<td>Piston pin bore clearance</td>
<td>Wear limit 0.080 mm (.0035 in)</td>
<td></td>
</tr>
<tr>
<td>Balance shaft journal diameter</td>
<td>New 31.98 to 32.000 mm (1.2591 to 1.2593 in)</td>
<td>Wear limit 31.950 mm (1.2579 in)</td>
</tr>
<tr>
<td>Balance shaft radial clearance</td>
<td>Wear limit 0.07 mm (.0028 in)</td>
<td></td>
</tr>
<tr>
<td>Balance shaft axial clearance</td>
<td>New 0.02 to 0.25 mm (.0008 to .0098 in)</td>
<td></td>
</tr>
<tr>
<td>Supercharger shaft driven plate journal depth</td>
<td>New 12.46 to 12.50 mm (.490 to .492 in)</td>
<td>Wear limit 12.80 mm (.503 in)</td>
</tr>
<tr>
<td>Supercharger drive gear thickness</td>
<td>New 11.00 to 11.05 mm (.433 to .435 in)</td>
<td>Wear limit 10.50 mm (.413 in)</td>
</tr>
<tr>
<td>Supercharger lock washer thickness</td>
<td>New 4.05 to 4.15 mm (.159 to .163 in)</td>
<td>Wear limit 3.75 mm (.147 in)</td>
</tr>
</tbody>
</table>

### ENGINE COOLING SYSTEM

- **Type**: Closed loop cooling system
- **Coolant**: Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines
- **Thermostat**: 87°C (188°F)
- **Monitoring beeper setting**: 100°C (212°F)

### EXHAUST SYSTEM

- **Type**: Water cooled/water injected (opened loop). Direct flow from jet pump

### ELECTRICAL SYSTEM

- **Magneto generator output**: 360 W @ 6000 RPM
- **Ignition system type**: DI (Digital Induction)
- **Ignition timing**: Not adjustable
- **Spark plug**: NGK DCPR6E
- **Gap**: 0.7 - 0.8 mm (.028 to .031 in)
- **Generating coil**: N.A.
- **Battery charging coil**: 0.1 - 1.0 Ω
- **Ignition coil**: Primary 0.85 - 1.15 Ω, Secondary 9.5 - 13.5 kΩ
- **Engine RPM limiter setting**: 7650 RPM, 8200 RPM
- **Battery**: 12 V, 30 A•h

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[www.SeaDooManuals.net](http://www.SeaDooManuals.net)
**Section 10 TECHNICAL SPECIFICATIONS**  
Subsection 03 (GTX SUPERCHARGED AND GTX LIMITED)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>GTX SUPERCHARGED</th>
<th>GTX LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICAL SYSTEM (con’d)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>2 A — 5 A</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 1, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 2, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 3, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Electric bilge pump (optional)</td>
<td>3 A</td>
<td></td>
</tr>
<tr>
<td>Starting system, electric fuel pump</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>EMS, start/stop circuit</td>
<td>5 A</td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>MPEM</td>
<td>2 A</td>
<td></td>
</tr>
<tr>
<td>Charging system</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>Information center</td>
<td>1 A</td>
<td></td>
</tr>
<tr>
<td>VTS</td>
<td>7.5 A (installed but not in use)</td>
<td></td>
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<tr>
<td><strong>FUEL SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel injection type</td>
<td>Rotax EMS (engine management system) Multi-point Fuel Injection, Single throttle body (52 mm)</td>
<td></td>
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<tr>
<td>Fuel pressure</td>
<td>290 - 310 kPa (42 - 45 PSI)</td>
<td>380 - 414 kPa (56 - 60 PSI)</td>
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<tr>
<td>Fuel type</td>
<td>Inside North America: Premium unleaded gasoline with a minimum of 91 octane RON + MON, Outside North America: Premium unleaded gasoline with a minimum of 95 octane RON</td>
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<tr>
<td>Idle speed</td>
<td>1800 ± 50 RPM (NOT ADJUSTABLE)</td>
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</tr>
<tr>
<td><strong>PROPELLSION SYSTEM</strong></td>
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<tr>
<td>Jet pump type</td>
<td>Axial flow single stage</td>
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</tr>
<tr>
<td>Jet pump grease type</td>
<td>Bearing grease (P/N 293 550 032)</td>
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</tr>
<tr>
<td>Impeller rotation (seen from rear)</td>
<td>Counterclockwise</td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>Direct drive</td>
<td></td>
</tr>
<tr>
<td>Coupling type</td>
<td>Crowned splines</td>
<td></td>
</tr>
<tr>
<td>Reverse system</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>O.P.A.S. system</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Steering nozzle pivoting angle</td>
<td>20°</td>
<td></td>
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<tr>
<td>Minimum required water level</td>
<td>90 cm (35 in) underneath the lowest rear portion of hull</td>
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</tr>
<tr>
<td>Drive shaft deflection (maximum)</td>
<td>0.5 mm (.020 in)</td>
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</tr>
<tr>
<td>Impeller outside diameter</td>
<td>155.5 ± 0.06 mm (6.122 ± .0024 in)</td>
<td>159 ± 0.06 mm (6.220 ± .0024 in)</td>
</tr>
<tr>
<td>Impeller/wear ring clearance</td>
<td>New: 0 - 0.23 mm (0 - .009 in)</td>
<td>Wear limit: 0.35 mm (.0138 in)</td>
</tr>
<tr>
<td>Impeller shaft end play (new)</td>
<td></td>
<td>0</td>
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<tr>
<td>Impeller shaft side play</td>
<td></td>
<td>0</td>
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<tr>
<td>Impeller pitch</td>
<td>10° — 21°</td>
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### Section 10 TECHNICAL SPECIFICATIONS

**Subsection 03 (GTX SUPERCHARGED AND GTX LIMITED)**

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<thead>
<tr>
<th>MODEL</th>
<th>GTX SUPERCHARGED</th>
<th>GTX LIMITED</th>
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<tbody>
<tr>
<td><strong>DIMENSIONS</strong></td>
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<tr>
<td>Number of passenger (driver incl.)</td>
<td>3</td>
<td></td>
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<tr>
<td>Overall length</td>
<td>331 cm (130 in)</td>
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</tr>
<tr>
<td>Overall width</td>
<td>122 cm (48 in)</td>
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<tr>
<td>Overall height</td>
<td>113 cm (44 in)</td>
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</tr>
<tr>
<td>Dry weight</td>
<td>389 kg (857 lb)</td>
<td>397 kg (875 lb)</td>
</tr>
<tr>
<td>Load limit (passenger and 10 kg (22 lb) luggage)</td>
<td>272 kg (600 lb)</td>
<td></td>
</tr>
<tr>
<td><strong>CAPACITIES</strong></td>
<td>3 L (2.7 U.S. qt) oil change w/filter</td>
<td>4.5 L (4.1 U.S. qt) total</td>
</tr>
<tr>
<td>Cooling system (coolant)</td>
<td>5.5 L (4.8 U.S. qt) total</td>
<td></td>
</tr>
<tr>
<td>Fuel tank (including reserve)</td>
<td>60 L (15.9 U.S. gal)</td>
<td></td>
</tr>
<tr>
<td>Fuel tank reserve (from low level signal)</td>
<td>15 L (4 U.S. gal)</td>
<td></td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td>Hull</td>
<td>Composite fiberglass</td>
</tr>
<tr>
<td></td>
<td>Inlet grate</td>
<td>Aluminum</td>
</tr>
<tr>
<td></td>
<td>Steering cover</td>
<td>Thermoplastic</td>
</tr>
<tr>
<td></td>
<td>Impeller material</td>
<td>Stainless steel</td>
</tr>
<tr>
<td></td>
<td>Impeller housing/stator</td>
<td>Aluminum/Aluminum</td>
</tr>
<tr>
<td></td>
<td>Venturi</td>
<td>Aluminum</td>
</tr>
<tr>
<td></td>
<td>Nozzle</td>
<td>Aluminum</td>
</tr>
<tr>
<td></td>
<td>Fuel tank</td>
<td>Polyethylene</td>
</tr>
<tr>
<td></td>
<td>Seat</td>
<td>Polyurethane foam</td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td>Estimated pump power</td>
<td>61.7 kW (82.7 HP)</td>
</tr>
<tr>
<td></td>
<td>Maximum fuel consumption at wide open throttle</td>
<td>59 L/h (15.6 U.S. gal/h)</td>
</tr>
<tr>
<td></td>
<td>Cruising time at full throttle</td>
<td>Fuel tank without reserve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel tank reserve (from low level signal)</td>
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## RXP AND RXT MODELS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>RXP</th>
<th>RXT</th>
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<tr>
<td><strong>ENGINE</strong></td>
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</tr>
<tr>
<td>Engine type</td>
<td>ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)</td>
<td></td>
</tr>
<tr>
<td>Induction</td>
<td>Supercharged intercooled</td>
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</tr>
<tr>
<td>Number of cylinders</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of valves</td>
<td>12 valves with hydraulic lifters (no adjustment)</td>
<td></td>
</tr>
<tr>
<td>Bore</td>
<td>Standard 100 mm (3.9 in)</td>
<td>100.25 mm (3.95 in)</td>
</tr>
<tr>
<td></td>
<td>1st Oversize 100.25 mm (3.95 in)</td>
<td>63.4 mm (2.49 in)</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement</td>
<td>1493.8 mm³ (88.81 in³)</td>
<td></td>
</tr>
<tr>
<td>Compression ratio</td>
<td>8.4:1</td>
<td></td>
</tr>
<tr>
<td>Maximum HP RPM</td>
<td>9000 ± 50 RPM</td>
<td></td>
</tr>
<tr>
<td><strong>Lubrication</strong></td>
<td>Type</td>
<td>Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler.</td>
</tr>
<tr>
<td></td>
<td>Oil type</td>
<td>XPS 10W40 4-stroke oil or an equivalent approved by BRP</td>
</tr>
<tr>
<td>Intake valve opening</td>
<td></td>
<td>0° BTDC</td>
</tr>
<tr>
<td>Intake valve closing</td>
<td></td>
<td>50° ABDC</td>
</tr>
<tr>
<td>Exhaust valve opening</td>
<td></td>
<td>50° BBDC</td>
</tr>
<tr>
<td>Exhaust valve closing</td>
<td></td>
<td>0° ATDC</td>
</tr>
<tr>
<td><strong>Valve stem diameter</strong></td>
<td>Intake</td>
<td>New 5.961 to 5.975 mm (0.2347 to 0.2352 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit 5.930 mm (0.2330 in)</td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>New 5.946 to 5.960 mm (0.2341 to 0.2346 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wear limit 5.930 mm (0.2330 in)</td>
</tr>
<tr>
<td><strong>Valve guide diameter</strong></td>
<td>New 5.99 to 6.01 mm (0.2356 to 0.2366 in)</td>
<td></td>
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<tr>
<td></td>
<td>Wear limit 6.060 mm (0.2386 in)</td>
<td></td>
</tr>
<tr>
<td><strong>Valve spring free length</strong></td>
<td>Inner</td>
<td>New 41.02 mm (1.615 in)</td>
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<tr>
<td></td>
<td></td>
<td>Wear limit 38.8 mm (1.499 in)</td>
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<tr>
<td></td>
<td>Outer</td>
<td>New 45.45 mm (1.793 in)</td>
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<td></td>
<td>Wear limit 43.3 mm (1.693 in)</td>
</tr>
<tr>
<td><strong>Valve seat contact width</strong></td>
<td>Intake</td>
<td>New 1.1 to 1.3 mm (.043 to .051 in)</td>
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<td></td>
<td>Wear limit 1.6 mm (.063 in)</td>
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<tr>
<td></td>
<td>Exhaust</td>
<td>New 1.25 to 1.55 mm (.049 to .061 in)</td>
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<tr>
<td></td>
<td></td>
<td>Wear limit 1.8 mm (.071 in)</td>
</tr>
<tr>
<td><strong>Rocker arm bore diameter</strong></td>
<td>New 20.00 to 20.02 mm (.7874 to .7882 in)</td>
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<td></td>
<td>Wear limit 20.03 mm (.7886 in)</td>
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<tr>
<td><strong>Rocker arm shaft diameter</strong></td>
<td>New 19.93 to 19.99 mm (.7866 to .7870 in)</td>
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<td></td>
<td>Wear limit 19.96 mm (.7858 in)</td>
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Section 10 TECHNICAL SPECIFICATIONS
Subsection 04 (RXP AND RXT MODELS)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>RXP</th>
<th>RXT</th>
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<tbody>
<tr>
<td><strong>ENGINE (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder head screw</td>
<td>Service limit</td>
<td>148.5 mm (5.846 in)</td>
</tr>
<tr>
<td>Cylinder head maximum warpage</td>
<td>Service limit</td>
<td>0.15 mm (0.006 in)</td>
</tr>
<tr>
<td>Piston ring type and quantity</td>
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<td></td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Upper compression ring, rectangular</td>
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</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Lower compression ring, tapered face</td>
<td></td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Oil scraper ring</td>
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<tr>
<td><strong>Ring end gap</strong></td>
<td></td>
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<tr>
<td>Rectangular</td>
<td>New</td>
<td>0.3 to 0.5 mm (0.012 to 0.20 in)</td>
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<tr>
<td>Taper-face</td>
<td>New</td>
<td>0.3 to 0.5 mm (0.012 to 0.20 in)</td>
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<tr>
<td>Oil scraper ring</td>
<td>Wear limit</td>
<td>0.3 to 0.5 mm (0.012 to 0.20 in)</td>
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<tr>
<td>All</td>
<td>Wear limit</td>
<td>1 mm (0.039 in)</td>
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<td><strong>Ring/piston groove clearance</strong></td>
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<tr>
<td>Rectangular</td>
<td>New</td>
<td>0.02 to 0.07 mm (0.0008 to 0.0028 in)</td>
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<td>Taper-face</td>
<td>New</td>
<td>0.02 to 0.06 mm (0.0008 to 0.0024 in)</td>
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<td>Oil scraper ring</td>
<td>Wear limit</td>
<td>0.02 to 0.05 mm (0.0008 to 0.0021 in)</td>
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<td>All</td>
<td>Wear limit</td>
<td>0.15 mm (0.006 in)</td>
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<td><strong>Piston/cylinder wall clearance</strong></td>
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<tr>
<td>New</td>
<td>Wear limit</td>
<td>0.06 mm (0.0023 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>0.1 mm (0.039 in)</td>
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<tr>
<td><strong>Cylinder taper</strong></td>
<td>Wear limit</td>
<td>0.1 mm (0.039 in)</td>
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<tr>
<td><strong>Cylinder out of round</strong></td>
<td>Service limit</td>
<td>0.015 mm (0.0006 in)</td>
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<tr>
<td><strong>Camshaft bearing journal</strong></td>
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<tr>
<td>Front</td>
<td>New</td>
<td>24.93 to 24.96 mm (0.9815 to 0.9827 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>24.93 mm (0.9815 in)</td>
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<tr>
<td>PTO and center</td>
<td>New</td>
<td>39.89 to 39.9 mm (1.5705 to 1.5709 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>39.88 mm (1.5701 in)</td>
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<tr>
<td><strong>Camshaft bore</strong></td>
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</tr>
<tr>
<td>Front</td>
<td>New</td>
<td>25.00 to 25.01 mm (0.9842 to 0.9846 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>25.02 mm (0.9850 in)</td>
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<tr>
<td>PTO and center</td>
<td>New</td>
<td>40.00 to 40.01 mm (1.5748 to 1.5752 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>40.02 mm (1.5756 in)</td>
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<tr>
<td><strong>Cam lobe</strong></td>
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<tr>
<td>Intake</td>
<td>New</td>
<td>31.54 to 31.74 mm (1.2417 to 1.2496 in)</td>
</tr>
<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>31.49 mm (1.2397 in)</td>
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<tr>
<td>Exhaust</td>
<td>New</td>
<td>31.43 to 31.63 mm (1.2373 to 1.2452 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>31.36 mm (1.2364 in)</td>
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<tr>
<td><strong>Crankshaft deflection</strong></td>
<td>Maximum</td>
<td>0.060 mm (0.002 in)</td>
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<tr>
<td><strong>Crankshaft axial clearance</strong></td>
<td>New</td>
<td>0.08 to 0.22 mm (0.0031 to 0.0087 in)</td>
</tr>
<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>0.35 mm (0.014 in)</td>
</tr>
<tr>
<td><strong>Crankshaft journal diameter</strong></td>
<td>New</td>
<td>49.991 to 50.000 mm (1.9681 to 1.9685 in)</td>
</tr>
<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>49.950 mm (1.9695 in)</td>
</tr>
<tr>
<td><strong>Crankshaft radial clearance</strong></td>
<td>New</td>
<td>0.007 mm (0.0028 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>0.007 mm (0.0028 in)</td>
</tr>
<tr>
<td><strong>Connecting rod big end diameter</strong></td>
<td>Service limit</td>
<td>45.080 mm (1.7740 in)</td>
</tr>
<tr>
<td><strong>Connecting rod big end clearance</strong></td>
<td>Service limit</td>
<td>0.09 mm (0.0039 in)</td>
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<tr>
<td><strong>Connecting rod big end axial play</strong></td>
<td>New</td>
<td>0.135 to 0.287 mm (0.0053 to 0.0113 in)</td>
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<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>0.500 mm (0.0197 in)</td>
</tr>
<tr>
<td><strong>Connecting rod small end diameter</strong></td>
<td>New</td>
<td>23.010 to 23.020 mm (0.9059 to 0.9063 in)</td>
</tr>
<tr>
<td>Wear limit</td>
<td>Wear limit</td>
<td>23.070 mm (0.9080 in)</td>
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### Section 10 TECHNICAL SPECIFICATIONS

#### Subsection 04 (RXP AND RXT MODELS)

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<thead>
<tr>
<th>MODEL</th>
<th>RXP</th>
<th>RXT</th>
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</thead>
<tbody>
<tr>
<td><strong>ENGINE (con’d)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston pin diameter</td>
<td>New 22.99 to 23.000 mm (.9051 to .9055 in)</td>
<td>Wear limit 22 980 mm (.9047 in)</td>
</tr>
<tr>
<td>Piston pin bore clearance</td>
<td>Wear limit 0.080 mm (.0035 in)</td>
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</tr>
<tr>
<td>Balance shaft journal diameter</td>
<td>New 31.98 to 32.000 mm (1.2591 to 1.2598 in)</td>
<td>Wear limit 31.950 mm (1.2579 in)</td>
</tr>
<tr>
<td>Balance shaft radial clearance</td>
<td>Wear limit 0.07 mm (.0028 in)</td>
<td></td>
</tr>
<tr>
<td>Balance shaft axial clearance</td>
<td>New 0.02 to 0.25 mm (.0008 to .0098 in)</td>
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</tr>
<tr>
<td>Supercharger shaft driven plate journal depth</td>
<td>New 12.46 to 12.500 mm (0.490 to 0.492 in)</td>
<td>Wear limit 12.80 mm (0.503 in)</td>
</tr>
<tr>
<td>Supercharger drive gear thickness</td>
<td>New 11.00 to 11.05 mm (0.433 to 0.435 in)</td>
<td>Wear limit 10.59 mm (.413 in)</td>
</tr>
<tr>
<td>Supercharger lock washer thickness</td>
<td>New 4.05 to 4.15 mm (.159 to .163 in)</td>
<td>Wear limit 3.75 mm (.147 in)</td>
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#### ENGINE COOLING SYSTEM

<table>
<thead>
<tr>
<th>Type</th>
<th>Closed loop cooling system</th>
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</thead>
<tbody>
<tr>
<td>Coolant</td>
<td>Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines</td>
</tr>
<tr>
<td>Thermostat</td>
<td>87°C (188°F)</td>
</tr>
<tr>
<td>Monitoring beeper setting</td>
<td>100°C (212°F)</td>
</tr>
</tbody>
</table>

#### EXHAUST SYSTEM

| Type                             | Water cooled/water injected (open loop). Direct flow from jet pump |

#### ELECTRICAL SYSTEM

| Magneto generator output         | 380 W @ 6000 RPM                         |
| Ignition system type             | DI (Digital Ignition)                    |
| Ignition timing                  | Not adjustable                           |
| Spark plug Make and type         | NGK DCPR8                                |
| Spark plug Gap                   | 0.7 - 0.8 mm (.028 to .031 in)           |
| Generating coil                  | N.A                                      |
| Battery charging coil            | 0.1 - 1.0 Ω                              |
| Ignition coil Primary            | 0.85 - 1.15 Ω                           |
| Ignition coil Secondary          | 9.5 - 13.5 Ω                            |
| Engine RPM limiter setting       | 8200 RPM                                 |
| Battery                          | 12 V, 30 Ah                              |
### Section 10 TECHNICAL SPECIFICATIONS

Subsection 04 (RXP AND RXT MODELS)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>RXP</th>
<th>RXT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICAL SYSTEM (con'd)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>2 A — 5 A</td>
<td></td>
</tr>
<tr>
<td>Battery fuse</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 1, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 2, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Cylinder 3, ignition coil and injection</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>Electric bilge pump (optional)</td>
<td>3 A</td>
<td></td>
</tr>
<tr>
<td>Starting system, electric fuel pump</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>EMS, start/stop circuit</td>
<td>5 A</td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>MPEM</td>
<td>2 A</td>
<td></td>
</tr>
<tr>
<td>Charging system</td>
<td>30 A</td>
<td></td>
</tr>
<tr>
<td>Information center</td>
<td>1 A</td>
<td></td>
</tr>
<tr>
<td>VTS</td>
<td>7.5 A</td>
<td>7.5 A (installed but not in use)</td>
</tr>
</tbody>
</table>

### FUEL SYSTEM

- Fuel injection type: Rotax EMS (engine management system) Multi-point Fuel Injection. Single throttle body (52 mm)
- Fuel pressure: 396 - 414 kPa (66 - 60 PSI)
- Fuel type: Inside North America - Premium unleaded gasoline with a minimum of 91 octane (RON + MON)/2
  - Outside North America - Premium unleaded gasoline with a minimum of 95 octane RON
- Idle speed: 1800 ± 50 RPM (NOT ADJUSTABLE)

### PROPULSION SYSTEM

- Jet pump type: Axial flow single stage
- Jet pump grease type: Bearing grease (P/N 293 550 032)
- Impeller rotation (seen from rear): Counterclockwise
- Transmission: Direct drive
- Coupling type: Crowned spines
- Reverse system: Yes
- O.P.A.S. system: Yes
- Steering nozzle pivoting angle: 20°
- Minimum required water level: 90 cm (35 in) underneath the lowest rear portion of hull
- Drive shaft deflection (maximum): 0.5 mm (0.020 in)
- Impeller outside diameter: 159 ± 0.06 mm (6.260 ± 0.024 in)
- Impeller/wear ring clearance: New - 0 - 0.23 mm (0 - 0.009 in)
  - Wear limit - 0.35 mm (0.0138 in)
- Impeller shaft end play (new): 0
- Impeller shaft side play: 0
- Impeller pitch: 10° — 21°
### Section 10 TECHNICAL SPECIFICATIONS
#### Subsection 04 (RXP AND RXT MODELS)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>RXP</th>
<th>RXT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIMENSIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of passenger (driver incl.)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Overall length</td>
<td>307 cm (121 in)</td>
<td>331 cm (130 in)</td>
</tr>
<tr>
<td>Overall width</td>
<td>122 cm (48 in)</td>
<td></td>
</tr>
<tr>
<td>Overall height</td>
<td>109 cm (43 in)</td>
<td>113 cm (44 in)</td>
</tr>
<tr>
<td>Dry weight</td>
<td>359 kg (792 lb)</td>
<td>394 kg (869 lb)</td>
</tr>
<tr>
<td>Load limit (passenger and 10 kg (22 lb) luggage)</td>
<td></td>
<td>272 kg (600 lb)</td>
</tr>
<tr>
<td><strong>CAPACITIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine oil</td>
<td>3 L (2.7 U.S. qt) oil change w/filter</td>
<td>4.5 L (4.1 U.S. qt) total</td>
</tr>
<tr>
<td>Engine cooling system</td>
<td>5.5 L (4.8 U.S. qt) total</td>
<td></td>
</tr>
<tr>
<td>Fuel tank (including reserve)</td>
<td>60 L (15.9 U.S. gal)</td>
<td></td>
</tr>
<tr>
<td>Fuel tank reserve (from low level signal)</td>
<td>15 L (4 U.S. gal)</td>
<td></td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hull</td>
<td>Composite fiberglass</td>
<td></td>
</tr>
<tr>
<td>Inlet grate</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Steering cover</td>
<td>Thermoplastic</td>
<td></td>
</tr>
<tr>
<td>Impeller material</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>Impeller housing/stator</td>
<td>Aluminum/Aluminum</td>
<td></td>
</tr>
<tr>
<td>Venturi</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Nozzle</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Fuel tank</td>
<td>Polyethylene</td>
<td></td>
</tr>
<tr>
<td>Seat</td>
<td>Polyurethane foam</td>
<td></td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated pump power</td>
<td>77.5 kW (104 HP)</td>
<td>85.1 kW (114 HP)</td>
</tr>
<tr>
<td>Maximum fuel consumption at wide open throttle</td>
<td></td>
<td>69 L/h (18.2 U.S. gal/h)</td>
</tr>
<tr>
<td>Cruising time at full throttle: Fuel tank without reserve</td>
<td>± 40 minutes</td>
<td></td>
</tr>
<tr>
<td>Fuel tank reserve (from low level signal)</td>
<td>± 13 minutes</td>
<td></td>
</tr>
</tbody>
</table>
ELECTRICAL CONNECTORS

SERVICE TOOLS

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>crimper die</td>
<td>529 035 906</td>
<td>399</td>
</tr>
<tr>
<td>crimper die</td>
<td>529 035 908</td>
<td>396</td>
</tr>
<tr>
<td>crimping pliers</td>
<td>529 035 730</td>
<td>400</td>
</tr>
<tr>
<td>crimping tool</td>
<td>529 035 909</td>
<td>396, 399</td>
</tr>
</tbody>
</table>

DEUTSCH CONNECTORS

Deutsch connectors are used on some harnesses.

Removal from Engine Connector Bracket

To remove Deutsch connectors from engine connector bracket, remove the expansion coolant tank.

Slide a flat screwdriver between the connector bracket and the Deutsch connectors and remove connectors.

To disconnect the two Deutsch connectors, slide a flat screwdriver between each other to disengage, press the release button and disconnect them.
Connector Disassembly

1. Male connector
2. Female connector
3. Secondary lock
4. Sealing cap

**CAUTION:** Do not apply dielectric grease on terminal inside connector.

To remove terminals from connector, proceed as follows:
- Using a long nose pliers, pull out the lock.

**FEMALE CONNECTOR**
1. Female lock
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

MALE CONNECTOR
1. Male lock

NOTE: Before extraction, push wire forward to relieve pressure on retaining tab.
- Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
- Pry back the retaining tab while gently pulling wire back until terminal is removed.

FEMALE CONNECTOR
1. Retaining tab

To install:
- For insertion of a terminal, make sure the lock is removed.
- Insert terminal into appropriate cavity and push as far as it will go.
- Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
- After all required terminals have been inserted, the lock must be installed.

PACKARD CONNECTOR

Packard connectors are used to connect electrical harnesses and gauges.

VIEW OF A 3-PIN PACKARD CONNECTOR
1. Identification letters

To remove terminal from Packard connector, use Snap-on TT600-4 tool.

WARNING
Ensure all terminals are properly crimped on wires and connector are properly fastened.

AMP CONNECTOR

These connectors are found on the MPEM.
When servicing electrical system, special care must be taken when working with AMP connectors in order to prevent any malfunction of the system.

**Description**

Each male connector is mechanically keyed to mate only with identical mechanical keyed connector on the MFEM.

**Removal**

To remove the male connector from the MFEM, press both tabs and pull connector.

**Terminal Removal**

**Signal Wire**

Insert a screwdriver blade between the connector and the wedge lock tab.

Release the locking tab and at the same time, pry the wedge lock to the open position.

**CAUTION:** The wedge lock should never be removed from the connector for insertion or removal of the signal wire terminals.

**Installation**

Do not apply any product to the pins of the connectors on the MFEM.
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

1. Screwdriver between wedge lock and connector
2. Locking tab

Repeat the same steps for the other locking tab retaining the wedge lock.
The wedge lock is now in the open position.

Step 1: Rotate wire back and forth
Step 2: Pull wire

Power Wire Terminal
NOTE: The wedge lock must be removed to extract power terminal.
Open the wedge lock.
Pull both locking tabs and remove wedge lock from connector.

1. Pull locking tab (both sides)

Before extraction, push wire forward to relieve pressure on retaining tab.
Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

Pry back the retaining tab while gently pulling wire back until terminal is removed.

Terminal Crimping
The size of the wires must be 20 to 16 AWG with a wire insulation diameter having a minimum dimension of 1.7 mm (.067 in) and a maximum dimension of 2.78 mm (.106 in).
The wire strip length must be 5.1 mm (13/64 in).
NOTE: When stripping wires, ensure conductor is not nicked, scrapped or cut. Wire stripping tool jaws may leave marks on the surface of the wire insulation. If these marks occur at the location of the wire seal, leakage may result. Insulation surface within 25 mm (1 in) from the tip of the terminal must be smooth.
All terminals in AMP connectors must be crimped using the crimping tool (P/N 529 035 909) and crimmer die (P/N 529 035 908).

CAUTION: If terminals are not crimped using the proper crimping tool, the wire seal may be damaged.
All circuits are sealed by a diaphragm in the rubber wire seal. When installing a terminal in connector, the diaphragm is pierced as the terminal passes through it.
If the diaphragm is pierced and the cavity is not used, install a seal plug, large end first, into circuit cavity as far as it will go.
NOTE: It is suggested that all unused circuit cavities be sealed with a seal plug, even if they are not pierced.

Terminal Installation
For insertion of signal terminal, make sure the wedge lock is in the open position.
NOTE: For insertion of power terminal, the wedge lock may or may not be on the open position.
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

Insert terminal into appropriate circuit cavity and push as far as it will go.
Pull back on the terminal wire to be sure the retention fingers in the connector are holding the contact properly.
After all required terminals have been inserted, the wedge lock must be closed to its locked position.

Terminal Identification
AMP Connectors of MPEM

AMP Connectors of Wiring Harness

ECM CONNECTORS

There are two ECM connectors used on the 4-TEC models and they are connected on the ECM. The engine harness female connector is connected on the module male connector "A" and the watercraft system control harness female connector is connected to the module male connector "B". The ECM connectors have 41 pins.

1. ECM
2. A connector (engine harness)
3. B connector (watercraft harness)

For probing techniques and tool, refer to ENGINE MANAGEMENT.

CAUTION: Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected frequently.

Terminal Removal
Unlock the connector cover by pushing in the tabs on top of the connector with a flat screwdriver to be able to flip the top cover up.
Lift the cover by pushing it forward.

![Image of cover]

1. Cover

Cut both tie raps that secure the harness to the connector.

![Image of tie raps]

1. Tie raps

Turn the connector over and remove the orange locking tab by pushing and then pulling toward the wire harness.

![Image of connector]

Check the locking tab on the terminal, it may have to be bent out a little so it will lock in its cavity when it is re-inserted.

A terminal remover such as Snap-On TT600-1 tool (or a 0.76 mm (.030 in) oxyacetylene torch tip cleaner or a #68 drill bit) must be inserted into the terminal cavity to release the locking tab from the connector.

**CAUTION:** Using a tool tip larger than 0.76 mm (.030 in) may damage the terminal.

Insert the tool tip into the terminal cavity as shown, and locate its wire in the back of the connector. You may have to pry the tool tip against the locking tab to release it, then remove the terminal from the connector.
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

If the wire is in good condition but the terminal is rusted or corroded, remove defective terminal and crimp a new one. If wire and terminal are defective, replace with a new genuine wire and new terminal and crimp them together as explained below.

IMPORTANT: Use genuine wires only. Otherwise wires will not fit properly.

When re-inserting the terminal, the locking tab must be installed facing the smaller cutout of the terminal cavity.

Insert the terminal, ensuring the locking tab snaps into its cavity.

Re-install the orange locking tab, attach the 2 tie raps, and close the connector cover.

Terminal Crimping (Kostal)
To crimp a new connector terminal, use the crimping tool (P/N 529 035 909) and the crirper die (P/N 529 035 906).

Insert terminal with wire in crimping pliers and position so that top of terminal tabs are flush with pliers edge or a little bit lower as shown.

To properly crimp the wires, strictly follow this procedure.
Strip the wire to a maximum of 3 mm (1/8 in).

TYPICAL
A. 3 mm (1/8 in) max.

Position wire in terminal.
Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.
Crimp terminal. Ensure no tiny wire goes out of terminal. This might cause strange problems of the electrical system.

Lubrication
Do not apply any product to the pins of the connector on the ECM.

BATTERY AND STARTER CABLE TERMINALS

Crimping
Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.

NOTE: Make sure not to cut wire strands while stripping the wire.
Install the appropriate terminal on the wire according to the requirement. Refer to appropriate parts catalog.

Installation of Terminal
Follow the instructions provided with the crimping pliers (P/N 529 035 730) to select the proper position of the tool.

NOTE: Different wires require different crimping pliers settings, so make sure to follow the instructions supplied with the tool.

Positioning the Crimping Pliers
Step 1: Press
Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAM
Subsection 01 (ELECTRICAL CONNECTORS)

CRIMPING OF WIRE

PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

CAUTION: Never weld the wire to the terminal. Welding can change the property of the wire and it can become brittle and break.

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

CAUTION: Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.