



SEA-DOO®



**VEHICLE
Shop Manual**

**2005 4-TEC™
Models**



2005 Vehicle Shop Manual

4-TEC Series

SEA-DOO®



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SAFETY NOTICE

SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2005 SEA-DOO watercraft as describe 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 BRP Training Dept.

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

This *VEHICLE 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

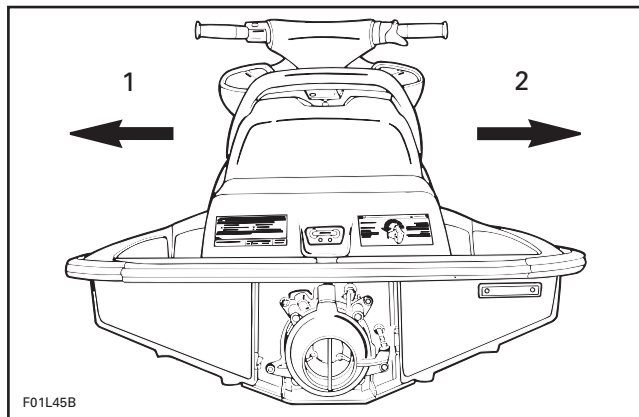
GENERAL INFORMATION

This *VEHICLE SHOP MANUAL* covers the following BRP made SEA-DOO® 2005 watercraft models. It should be used in conjunction with the *1503 4-TEC ENGINE SHOP MANUAL*.

MODEL	COLOR	ENGINE	MODEL NUMBER
GTX	Twilight Blue Pearl	1503 Naturally Aspirated	145A, 145B
GTX Limited	Midnight Black Pearl	1503 Supercharged Intercooled	185A, 185B
GTX Supercharged	Twilight Blue Pearl	1503 Supercharged	165A
RXP	Apple Green	1503 Supercharged Intercooled	215A, 215B
RXP	Viper Red Metallic	1503 Supercharged Intercooled	215C, 215D
RXT	Apple Green	1503 Supercharged Intercooled	175A, 175B
RXT	Viper Red Metallic	1503 Supercharged Intercooled	175C, 175D
WAKE	Viper Red	1503 Naturally Aspirated	155A, 155B

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.



1. Left (port)
2. Right (starboard)

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.

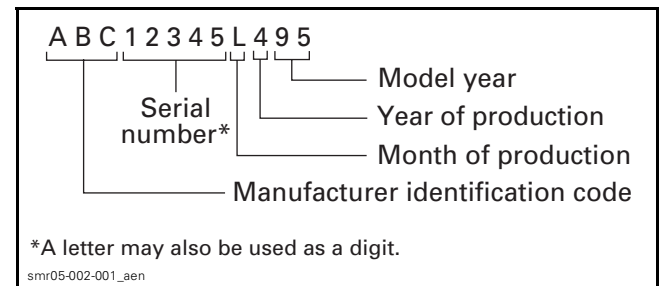
BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

This *VEHICLE 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*.

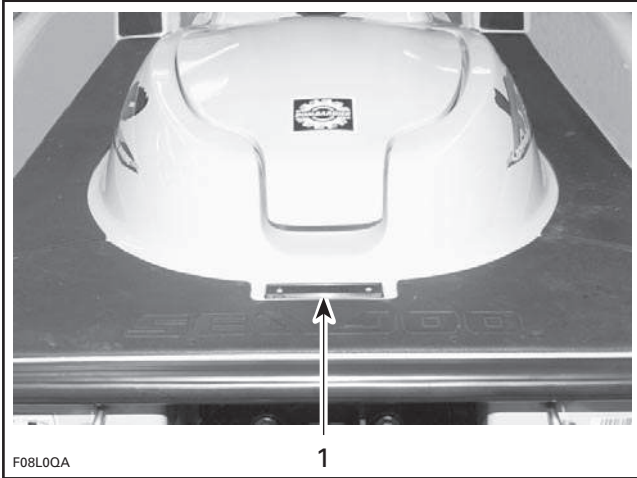
Hull Identification Number (H.I.N.)

The Hull Identification Number is composed of 12 digits:



INTRODUCTION

It is located on footboard at the rear of watercraft.



TYPICAL
1. Hull Identification Number (H.I.N.)



TYPICAL
1. Hull Identification Number (H.I.N.)

Engine Identification Number (E.I.N.)

Refer to the *1503 4-TEC ENGINE SHOP MANUAL*.

ARRANGEMENT OF THIS MANUAL

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

Several sections are divided in various subsections. There is a table of contents at the beginning of many sections.

ABBREVIATIONS USED IN THIS MANUAL

ABBREVIATION	DESCRIPTION
4-TEC NA	Naturally-Aspirated Engine
ADC	Analog to Digital Conversion
AC	Alternate Current
APS	Air Pressure Sensor
ATS	Air Temperature Sensor
B.U.D.S.	BRP Utility and Diagnostic Software
CDI	Capacitor Discharge Ignition
CPS	Crankshaft Position Sensor
CSI	Cooling System Indicator
DC	Direct Current
DESS	Digitally Encoded Security System
DI	Direct Injection
E.I.N.	Engine Identification Number
ECM	Engine Control Module
ECU	Electronic Control Unit
EPA	Environmental Protection Agency (USA)
HP	Horse Power
LED	Light Emitting Diode
IC	Intercooler
LED	Light Emitting Diode
MAG	Magneto
MPEM	Multi-Purpose Electronic Module
MPH	Mile Per Hour
MPI	Multi Protocol Interface
N.A.	Not Applicable
OPT	Optional
P/N	Part Number
PFD	Personal Flotation Device
PSI	Pound Per Square Inch
PTO	Power Take Off

ABBREVIATION	DESCRIPTION
RAVE	Rotax Adjustable Variable Exhaust
RFI	Rotax Fuel Injection
RPM	Revolution Per Minute
Sc	Supercharger
STD	Standard
TBD	To Be Determined
TDC	Top Dead Center
TPS	Throttle Position Sensor
VDC	Volt Direct Current
VCK	Vehicle Communication Kit
Vdc	Volt Direct Current
VTS	Variable Trim System
WTS	Water Temperature Sensor

ILLUSTRATIONS AND PROCEDURES

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.

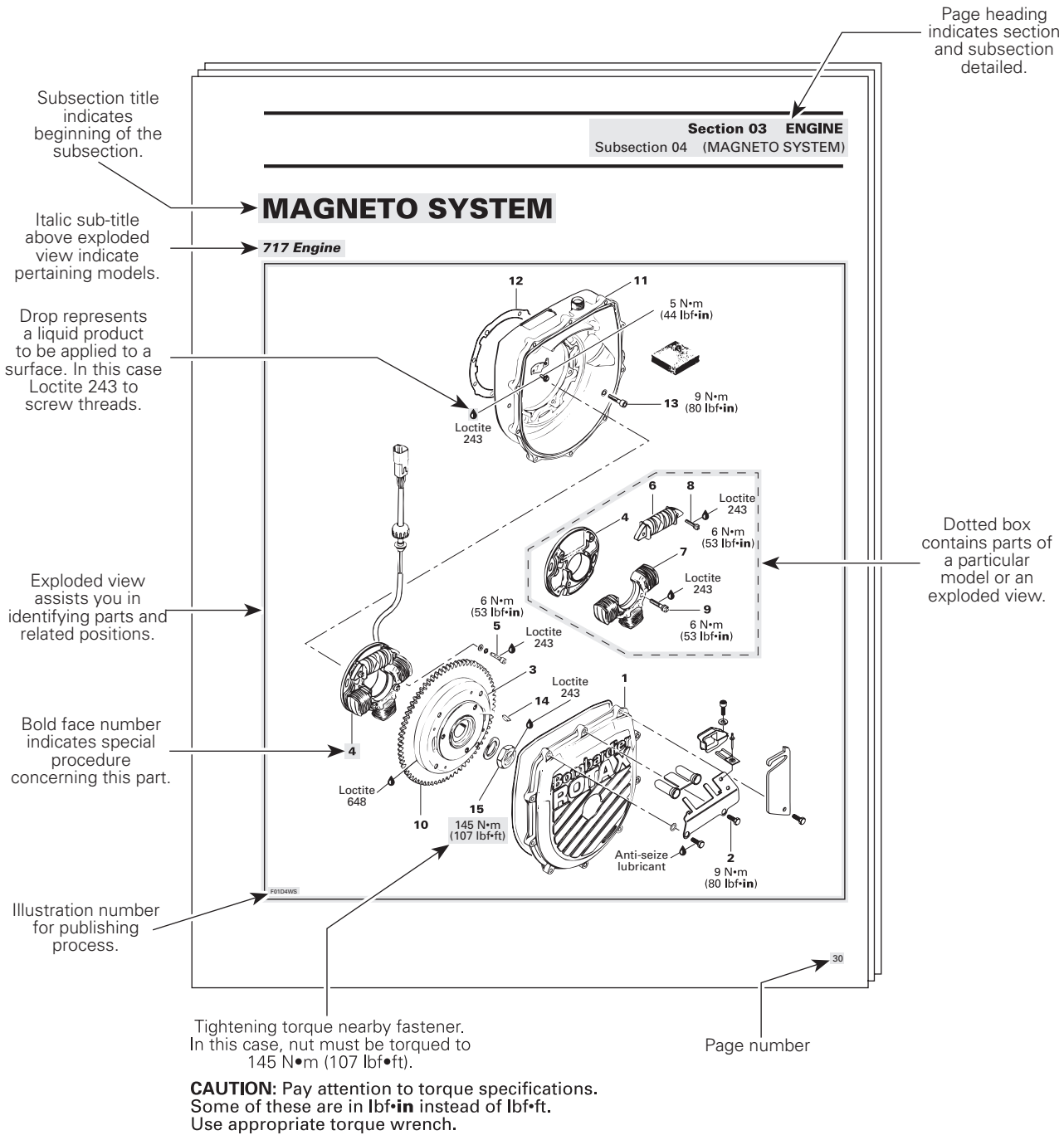
CAUTION: These watercraft are designed with parts dimensioned mostly in the metric system. However some components may be from the imperial system. When replacing fasteners, make sure to use only those recommended by BRP.

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.

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.

INTRODUCTION

TYPICAL PAGE



Subsection title indicates beginning of the subsection.

Italic sub-title above exploded view indicate pertaining models.

Drop represents a liquid product to be applied to a surface. In this case Loctite 243 to screw threads.

Exploded view assists you in identifying parts and related positions.

Bold face number indicates special procedure concerning this part.

Illustration number for publishing process.

Page heading indicates section and subsection detailed.

Dotted box contains parts of a particular model or an exploded view.

Page number

TYPICAL PAGE

Sub-title with part name(s) from exploded view.

Section 06 FUEL SYSTEM
Subsection 03 (CARBURETORS)

CARBURETOR REMOVAL

To remove carburetors from engine, proceed as follows:

- Remove air vent tube support.
- Unlock retaining slides holding air intake silencer base.
- Remove air intake silencer base from watercraft.
- Remove screws holding flame arrester base support to cylinder head cover.
- Unscrew base retaining screws then remove base from carburetors and move to front of watercraft.
- Turn the valve to OFF position.

NOTE: For fuel line removal, use pliers (P/N 295 000 054).

- Disconnect pulse line from fuel pump.
- Disconnect fuel supply line from fuel pump.
- Disconnect fuel return line.
- Disconnect oil injection pump cable, throttle cable and choke cable.

XP Model Only

- Remove screws no. 6 and lock washers no. 7 retaining carburetors.

All Others Models

- Remove 4 bolts no. 8 and lock washers no. 12 from rotary valve cover then move carburetor and rotary valve cover on top of engine.

NOTE: When removing rotary valve cover, pay attention that the rotary valve stay in place, otherwise it must be timed.

- Remove carburetors from intake manifold.
- Disconnect fuel bypass line between carburetors (twin carburetors).
- Remove carburetor(s) from rotary valve cover.

DISASSEMBLY AND INSPECTION

Inspect parts for corrosion damage (shaft, butterfly, spring, etc., check valve housing, etc.).

Diaphragm

PUMP DIAPHRAGM LEAK TEST

Using a suitable pump gauge tester, perform the following test proceeding as follows:

- Install pump gauge tester (P/N 295 000 083) on pulse nipple.
- Pump tester until it reaches 28 kPa (4 PSI).

TYPICAL
 Step 1: Install pump gauge tester to pulse nipple
 Step 2: Pump tester until it reaches the desired pressure
 1: Fuel outlet nipple
 2: Fuel inlet nipple
 A: 28 kPa (4 PSI)

Diaphragm must stand pressure for 10 seconds. If pressure drops, replace diaphragm.

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Bold numbers in the text refer to the parts shown in the exploded view at the beginning of the subsection.

Numbers are used for description of components.

INTRODUCTION

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 emissions 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:

VIA U.S. POSTAL SERVICE:

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

VIA EXPRESS or COURIER MAIL:

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

EPA INTERNET WEB SITE:

<http://www.epa.gov/omswwww>

SELF-LOCKING FASTENERS PROCEDURE

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

Use a metal brush or a screwtap to clean the hole properly then use a solvent (Methyl-Chloride), let act during 30 minutes and wipe off. The solvent utilization is to ensure the adhesive works properly.

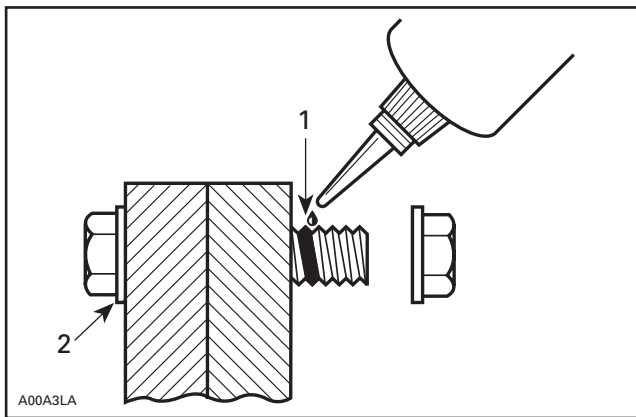
LOCTITE APPLICATION PROCEDURE

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

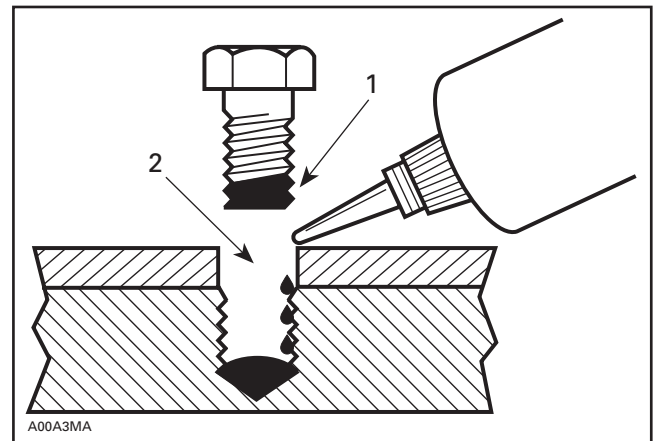
Uncovered Holes (bolts and nuts)



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.

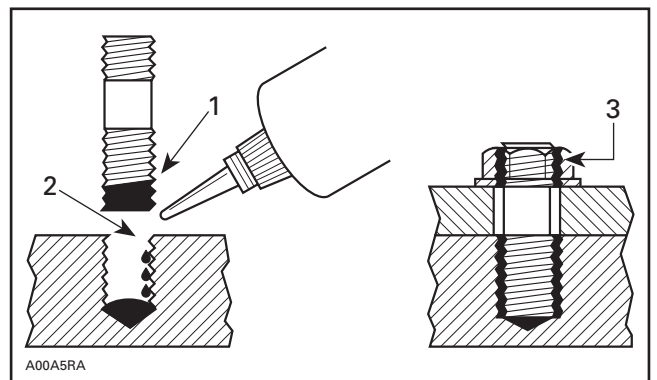
Blind Holes



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

- Clean threads (bolt and hole) with solvent.
- Apply Loctite Primer N (P/N 293 800 041) on threads (bolt and nut) and allow to dry for 30 seconds.
- Choose proper strength Loctite threadlocker.
- Apply several drops along the threaded hole and at the bottom of the hole.
- Apply several drops on bolt threads.
- Tighten as required.

Stud in Blind Holes



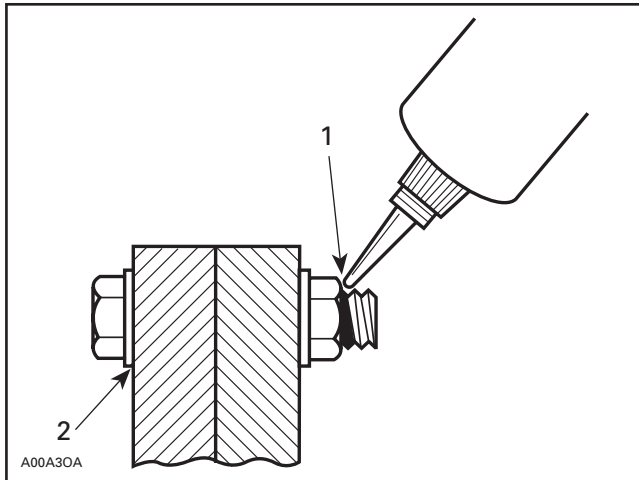
1. On threads
2. On threads and in the hole
3. Onto nut threads

- 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.

INTRODUCTION

- Install stud.
- Install cover, etc.
- Apply drops of proper strength Loctite on uncovered threads.
- Tighten nuts as required.

Preassembled Parts

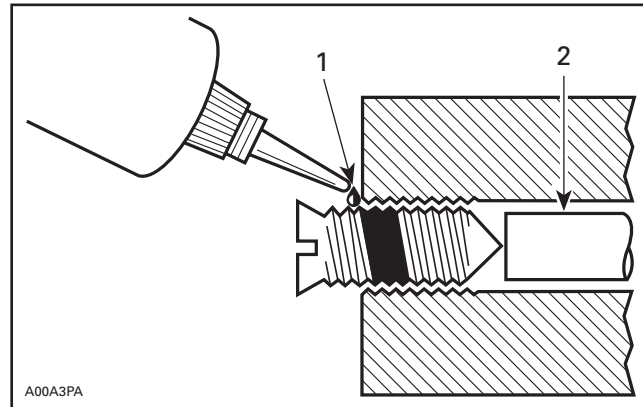


1. Apply here
2. Do not apply

- 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

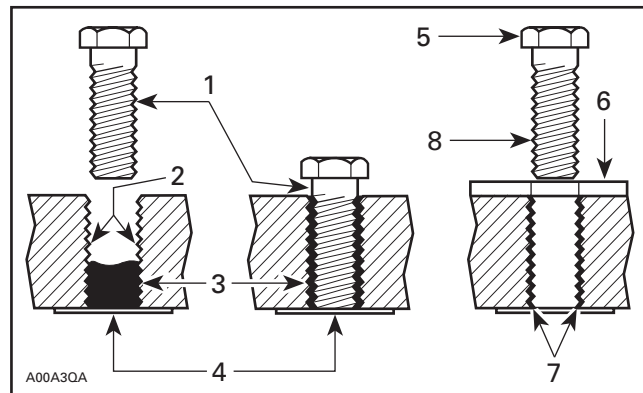


1. Apply here
2. Plunger

- Adjust screw to proper setting.
- Apply drops of proper strength Loctite threadlocker 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

- Follow instructions on Loctite FORM-A-THREAD 81668 package.
- 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

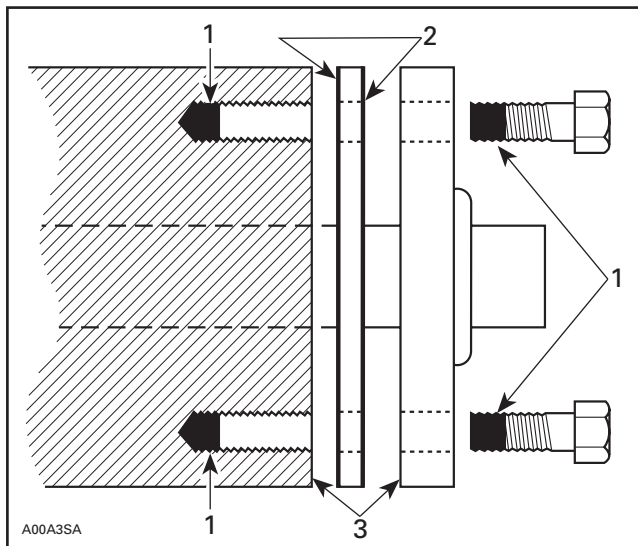
Option 1: Enlarge damaged hole, then follow STANDARD THREAD REPAIR procedure.

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.

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.

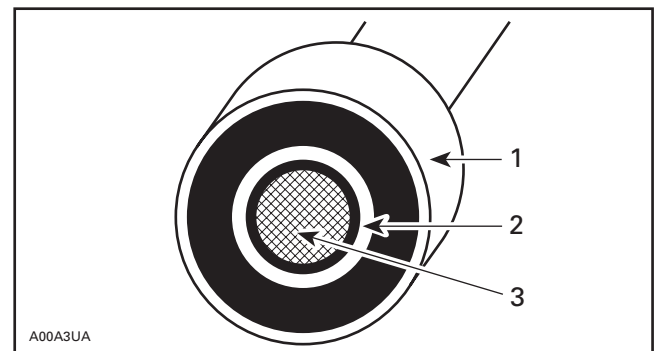
NOTE: If the cover is bolted to blind holes (above), apply proper strength Loctite in the hole and on threads. Tighten.

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 anti-seize Loctite or any similar product.
- No curing period is required.

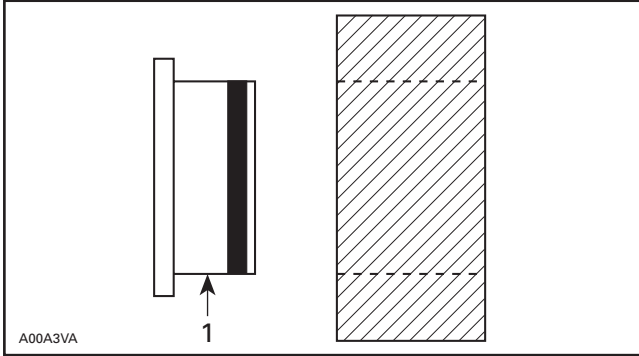
Mounting in Tandem

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

INTRODUCTION

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.

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.

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 (ex.: 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.

INTRODUCTION

Property class and head markings	<p>4.8</p>	<p>8.8 9.8</p>	<p>10.9</p>	<p>12.9</p>
Property class and nut markings	<p>5</p>	<p>10</p>	<p>10</p>	<p>12</p>

A00A8BS

FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 — 2 N•m (13 — 18 lbf•in)	2.5 — 3 N•m (22 — 27 lbf•in)	3.5 — 4 N•m (31 — 35 lbf•in)	4 — 5 N•m (35 — 44 lbf•in)
M5	3 — 3.5 N•m (27 — 31 lbf•in)	4.5 — 5.5 N•m (40 — 47 lbf•in)	7 — 8.5 N•m (62 — 75 lbf•in)	8 — 10 N•m (71 — 89 lbf•in)
M6	6.5 — 8.5 N•m (58 — 75 lbf•in)	8 — 12 N•m (71 — 106 lbf•in)	10.5 — 15 N•m (93 — 133 lbf•in)	16 N•m (142 lbf•in)
M8	15 N•m (11 lbf•ft)	24.5 N•m (18 lbf•ft)	31.5 N•m (23 lbf•ft)	40 N•m (30 lbf•ft)
M10	29 N•m (21 lbf•ft)	48 N•m (35 lbf•ft)	61 N•m (45 lbf•ft)	72.5 N•m (53 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	127.5 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)

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					
A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE T: PROCEED WITH TASK	FIRST 10 HOURS				
	EVERY 25 HOURS OR 3 MONTHS				
	EVERY 50 HOURS OR 6 MONTHS				
	EVERY 100 HOURS OR 1 YEAR				
PART/TASK					LEGEND
GENERAL					
Lubrication/corrosion protection			T		
ENGINE					
Engine oil and filter (including cover's O-rings)	R			R (7)	(5) Emission-related component. (7) Replace for storage period or after 100 hours of use whichever comes first. (10) Every 100 hours of use for supercharged engines. Every 200 hours of use for supercharged intercooled engines.
Support and rubber mount	I		I		
Seals and fasteners	I		I		
Exhaust system fasteners (5)	I			I	
Spark plug (5)				R	
Supercharger slipping moment (if so equipped)				I	
Supercharger drive gear, shaft and lock washer (if so equipped)				I (10)	
COOLING SYSTEM					
Flushing (exhaust system)		T (3)			(3) Daily flushing in salt water or foul water use. (4) Perform every 200 hours or 2 years. (7) Replace for storage period or after 100 hours of use whichever comes first.
Hose and fasteners	I			I	
Coolant	I			R (7)	
Coolant expansion tank cap/cooling system pressure test				T (4)	
FUEL SYSTEM					
Throttle cable		I, A, L			(1) In salt water use. (5) Emission-related component.
Engine management system sensors	I			I	
Fault code reading of engine management system (1) (5)				I	
Fuel lines, fuel rail, connections, pressure relief valve and fuel system pressurization (5)	I			I	
Fuel tank straps	I			I	
AIR INTAKE SYSTEM					
Throttle body (5)	I			I,L	(5) Emission-related component.
Air intake silencer fit/tightness	I			I	

Section 01 MAINTENANCE
Subsection 01 (MAINTENANCE CHART)

4-TEC MODELS					
A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE T: PROCEED WITH TASK	FIRST 10 HOURS				
	EVERY 25 HOURS OR 3 MONTHS				
	EVERY 50 HOURS OR 6 MONTHS				
	EVERY 100 HOURS OR 1 YEAR				
PART/TASK					LEGEND
ELECTRICAL SYSTEM					
Electrical connections and fastening (ignition system, starting system, fuel injectors etc.)	I			I	(1) In salt water use.
MPEM and ECM connectors				I (1)	
MPEM mounting brackets/fasteners				I	
Digitally Encoded Security System and safety lanyard/post	I			I	
Monitoring beeper	I			I	
Battery and fasteners	I			I	
STEERING SYSTEM					
Steering cable	I, A, L		I, A, L		
O.P.A.S. system including filter (if so equipped)	I, A	I, A (8)	I, A		(8) Every 25 hours when riding in weed area.
PROPULSION SYSTEM					
Drive shaft corrosion protection				L (9)	(2) These items have to be initially checked after 25 hours. Thereafter, servicing to be made as specified in this chart. (6) Replace after the vehicle completed 100 hours of use or 2 years. (9) Perform at storage period or after 100 hours of use whichever comes first.
Drive shaft protection boot			I (2)		
Drive shaft/impeller splines (normally aspirated and supercharged engines)			L		
Drive shaft/impeller splines (supercharged intercooled engines)				L	
Sacrificial anode			I		
Shifter system/cable	I, A, L			I, A, L	
VTS (Variable Trim System) (if so equipped)	I, A		I, A		
Impeller shaft seal, sleeve and O-ring				I (6)	
Impeller and impeller/wear ring clearance				I (2)	
Water intake grate				I (2)	
Ride plate including coolant leak	I			I	
Drive shaft/hull sealing system	I			I	
HULL/BODY					
Bailer pick-ups, check for obstructions	I			I	
Hull	I			I	
Ski/wakeboard post and fasteners	I		I		

PRESEASON PREPARATION

PRESEASON PREPARATION	TO BE PERFORMED BY		REFER TO
	CUSTOMER	DEALER	
GENERAL			
Lubrication and corrosion protection	✓		Storage Procedure
Spark plugs replacement (1)		✓	Ignition System
ENGINE			
Exhaust system condition and fasteners		✓	Exhaust System
Condition of seals and fasteners		✓	Appropriate engine <i>SHOP MANUAL</i>
Oil level		✓	Lubrication System
COOLING SYSTEM			
Coolant level		✓	Cooling System
Hoses and components (3)		✓	
FUEL SYSTEM			
Fuel injection sensors verification		✓	Engine Management
Inspection of check valves, lines, fasteners and pressurization (2)		✓	Fuel Tank and Fuel Pump
Filler neck, fuel tank and fuel cap condition (2)		✓	
Fuel tank straps		✓	
Refill fuel tank	✓		Refer to the appropriate <i>OPERATOR'S GUIDE</i>
ELECTRICAL SYSTEM			
Battery condition/charging and installation		✓	Charging System
Connection and routing of electric harness (battery, starter, etc.) (2)		✓	Electrical System
Digitally Encoded Security System (DESS) and monitoring beeper verification		✓	Instruments and Accessories
STEERING SYSTEM			
Steering system adjustment and inspection (2)		✓	Steering System
Check O.P.A.S. system condition		✓	Steering System

Section 01 MAINTENANCE**Subsection 02 (PRESEASON PREPARATION)**

PRESEASON PREPARATION	TO BE PERFORMED BY		REFER TO
	CUSTOMER	DEALER	
PROPULSION SYSTEM			
Shifter system condition and cable adjustment		✓	Reverse System
Variable Trim System (VTS) condition (if so equipped)		✓	VTS System
Propulsion system inspection		✓	Jet Pump and Drive System
HULL and BODY			
Inspection of bailer pick-ups		✓	Hull/Body
Ski/wakeboard post and fasteners (if so equipped)	✓		Hull/Body

- (1) Before installing new spark plugs, it is suggested to burn the excess BOMBARDIER LUBE (P/N 293 600 016) or equivalent by starting the engine using the old spark plugs.
- (2) Safety item covered in the annual safety inspection.
- (3) If antifreeze was not changed for storage, drain and replace with new antifreeze.

N.A.: Not applicable

STORAGE PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
flushing connector adaptor	295 500 473	6
small hose pincher.....	295 000 076	7

SERVICE PRODUCTS

Description	Part Number	Page
anticorrosion coating	219 700 304	9
Bombardier fuel stabilizer	413 408 600	5
BOMBARDIER LUBE lubricant.....	293 600 016	6, 8–9
Loctite 243 (blue).....	293 800 060	8

PROPULSION SYSTEM

Jet Pump

Verify jet pump grease for water contamination. Check for the presence of water in cone and bearing; if so, replace oil seal and sleeve.

CAUTION: Use only Bombardier jet pump grease or equivalent, otherwise components service life could be reduced. Do not mix grease brands or types.

FUEL SYSTEM

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

Bombardier 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 flammable 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.

ENGINE OIL AND FILTER REPLACEMENT

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

OPENED LOOP COOLING SYSTEM

Flushing the open loop cooling 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.

Section 01 MAINTENANCE

Subsection 03 (STORAGE PROCEDURES)

Cooling 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 open loop cooling system, when necessary, will severely damage engine intercooler and/or exhaust system. Make sure engine operates during entire procedure.

⚠ WARNING

Perform this operation in a well ventilated area. Do not touch any electrical part or jet pump area when engine is running.

Proceed as follows:

Clean jet pump by spraying water in its inlet and outlet and then apply a coating of BOMBARDIER LUBE lubricant (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.

Procedure Using Flushing Connector on Jet Pump Support

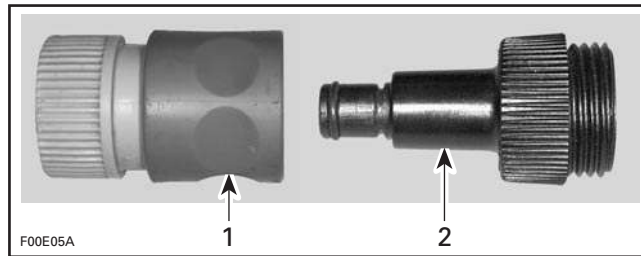
All Models

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

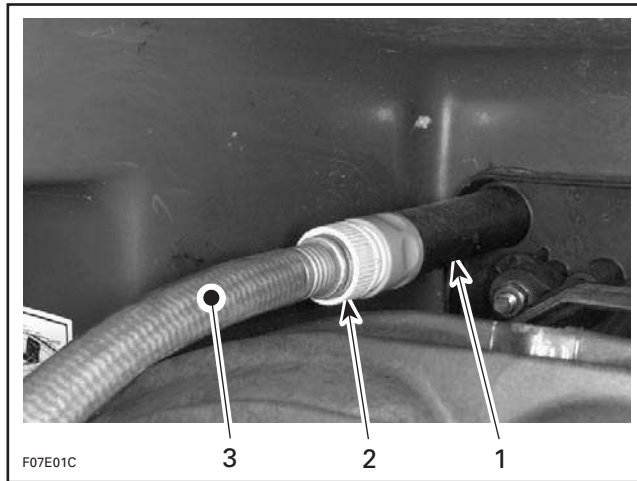
⚠ WARNING

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.

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



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

⚠ WARNING

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.

CAUTION: Never flush a hot engine. 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 cooling system when watercraft is out of water.

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

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

Ensure water flows out of jet pump while flushing.

Section 01 MAINTENANCE

Subsection 03 (STORAGE PROCEDURES)

Close the water tap, then stop the engine.

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

Disconnect the garden hose.

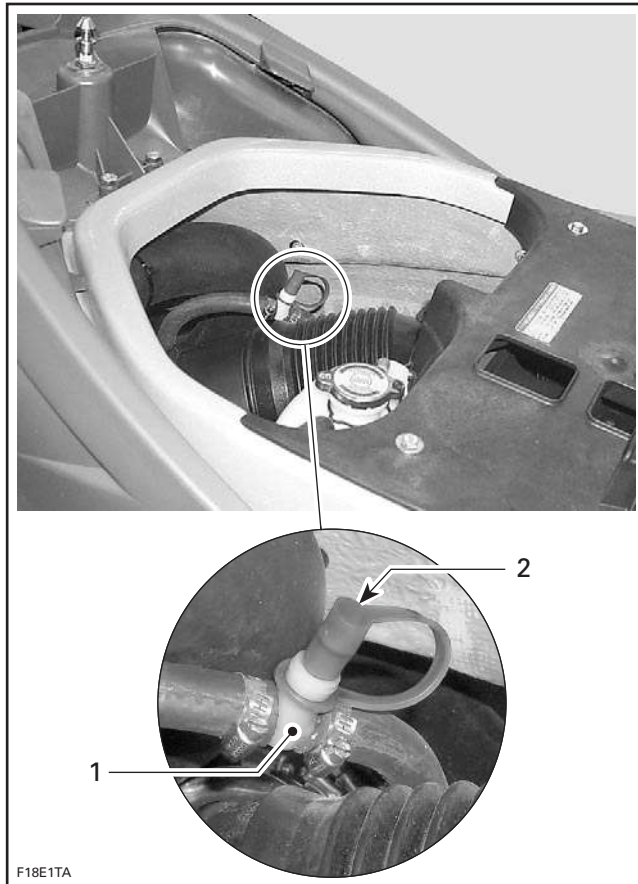
CAUTION: Remove flushing connector adapter after operation (if used).

Procedure Using Flushing Connector in Engine Compartment

GTX 4-TEC Limited Models

This flushing connector allows to flush the exhaust cooling 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.

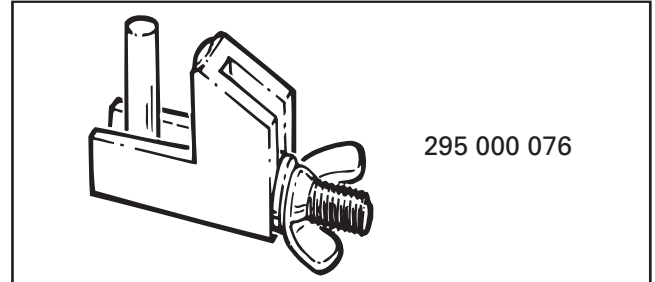
Remove seat to gain access.



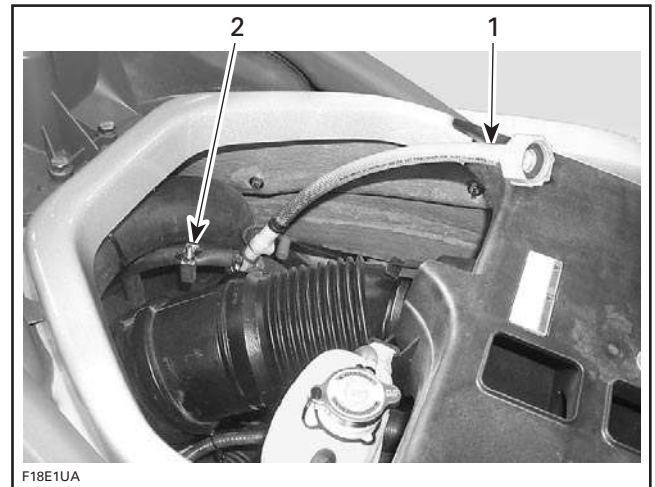
1. Flushing connector
2. Dust cap

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 prevents water from directly exiting exhaust cooling system.



This prevents water from directly exiting exhaust cooling system.



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.

⚠ WARNING

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.

CAUTION: Never flush a hot engine. Always start the engine before opening the water tap. Open water tap immediately after engine is started to prevent overheating.

Section 01 MAINTENANCE

Subsection 03 (STORAGE PROCEDURES)

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

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

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

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.

CLOSED LOOP COOLING SYSTEM (ENGINE)

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 section.

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 LUBRICATION

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 BOMBARDIER LUBE lubricant (P/N 293 600 016) into the intake ports.
- Crank engine several times while keeping throttle fully depressed (drown engine mode) to distribute lubricant in cylinders, on intake valves and exhaust valves.
- Carefully inspect O-rings condition before re-installing 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 N•m (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.

WARNING

If a leak is present, immediately stop the engine. Do not start engine until the leak is repaired.

WARNING

At pre-season preparation, ensure to perform a fuel pressure test and ensure there is no leak. Also run engine and check for leaks. Refer to FUEL TANK AND FUEL PUMP section.

THROTTLE BODY LUBRICATION

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

Remove the air intake hose from throttle body.

Open the throttle body valve by pressing slightly the throttle lever and spray BOMBARDIER LUBE lubricant (P/N 293 600 016) through the throttle body bore to lubricate valve mechanism. Then spray generously the external parts of throttle body.

Install air intake hose.

ANTIFREEZING PROTECTION

Supercharged Intercooled Models

The exhaust system is self draining, but the intercooler and manifold need the following protection.

- Remove both intercooler hoses.

- Let the intercooler drain, then connect the bottom hose.
- Pour approximately 200 mL (6.76 oz U.S.) of antifreeze into the intercooler.
- Then pour approximately 300 mL (10.14 oz U.S.) of antifreeze into the exhaust manifold.
- Reconnect the upper hose.

CAUTION: It is highly recommended to pour antifreeze into the intercooler and exhaust manifold. Failure to do so, may cause severe damage to these components.

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 ran before, to exhaust as much water as possible, from cooling system components.

BATTERY

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

WATERCRAFT 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 Gelcote® 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.

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.

ANTICORROSION TREATMENT

Wipe off any residual water in the engine compartment.

Spray BOMBARDIER LUBE lubricant (P/N 293 600 016) over all metallic components in engine compartment.

Lubricate the throttle cable with BOMBARDIER LUBE lubricant (P/N 293 600 016).

Apply the anticorrosion coating (P/N 219 700 304) on drive shaft. Refer to DRIVE SYSTEM.

The seat and the seat extension should be partially left opened during storage. This will avoid engine compartment condensation and possible corrosion.

Section 01 MAINTENANCE**Subsection 03 (STORAGE PROCEDURES)**

CHECKLIST

OPERATION	✓
Verify jet pump grease.	
Verify fuel system.	
Add Bombardier fuel stabilizer.	
Fill up fuel tank.	
Change engine oil and filter.	
Check engine drain hose(s).	
Flush exhaust cooling system.	
Replace antifreeze. Check solution concentration in the cooling system (in cool regions).	
Lubricate the engine.	
Lubricate throttle body.	
Add antifreeze into intercooler and exhaust manifold (where temperatures are below freezing).	
Remove, clean and store the battery.	
Clean the bilge.	
Wash the body.	
Spray BOMBARDIER LUBE lubricant (P/N 293 600 016) over all metallic components in engine compartment and in throttle cable.	
Apply the anticorrosion coating (P/N 219 700 304) on drive shaft.	
Partially lift the seat and the seat extension.	

SPECIAL PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
large hose pincher	529 032 500	11
oil pump cover fitting	293 710 037	13
pump	529 035 880	13

SERVICE PRODUCTS

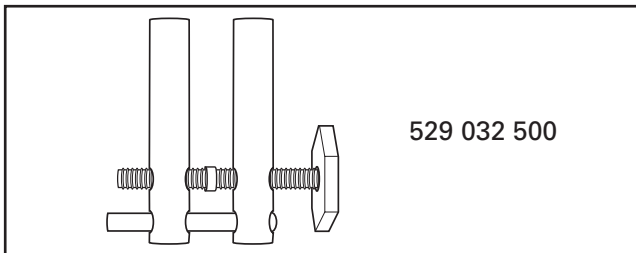
Description	Part Number	Page
Loctite 243 (blue)	293 800 060	13
pulley flange cleaner	413 711 809	13

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).



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

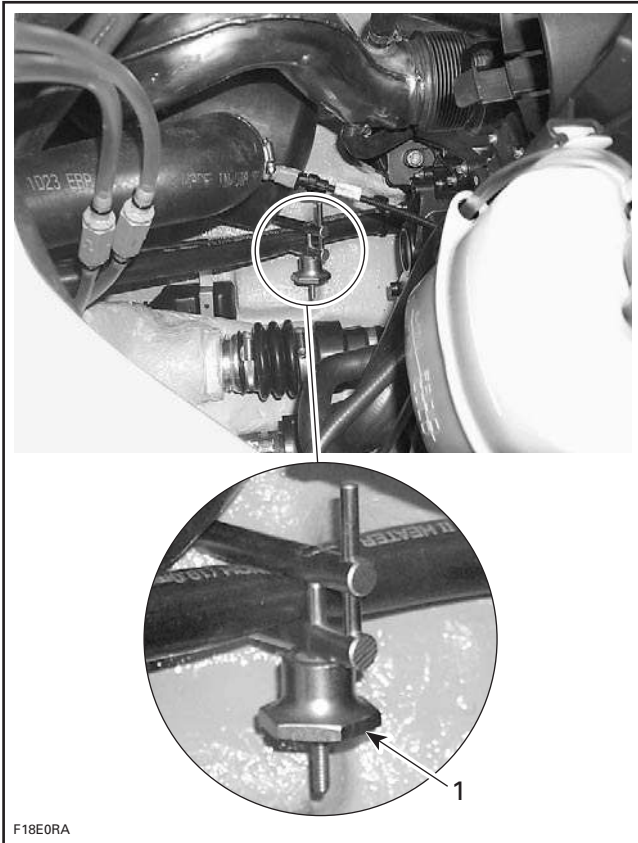
NOTE: Pinch the hose with the red tape (if so equipped).

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).

Section 01 MAINTENANCE

Subsection 04 (SPECIAL PROCEDURES)



TYPICAL
1. Hose pincher

CAUTION: When finished towing the watercraft, the hose pincher must be removed before operating it.

SUBMERGED WATERCRAFT

Drain bilge if water is present.

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 to validate if water is present in engine.

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.

Throttle Body

Throttle body should be lubricated to prevent corrosion if watercraft was submerged. Refer to STORAGE for procedure.

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: A water-flooded engine must be properly lubricated, operated then lubricated again, otherwise parts will be seriously damaged.

Check fuel reservoir for water contamination. If necessary, siphon and refill with fresh fuel.

To limit damages to the engine, perform the following procedure as soon as possible.

Drain bilge if water is present.

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.

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.

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 *1503 4-TEC ENGINE SHOP MANUAL*.

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 subsection 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 for procedure.

Supercharger

Supercharged 4-TEC Engines

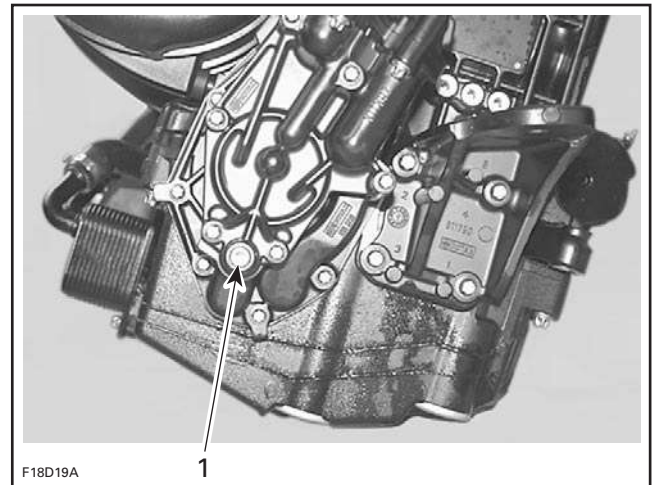
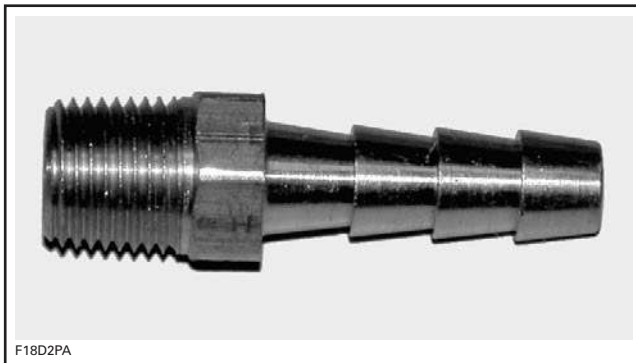
If there was water in the oil or in the intake manifold, it is recommended to take the supercharger apart, dry all the components, replace the slip clutch needle bearings and shaft ball bearings. Refer to *1503 4-TEC ENGINE SHOP MANUAL*.

Oil Change Procedure (water-contaminated oil)

- Using the pump (P/N 529 035 880), siphon oil from 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 oil from the reservoir.
- Put a rag under the scavenge oil pump cover.
- Remove the scavenge oil pump cover drain plug and install the oil pump cover fitting (P/N 293 710 037).



1. Scavenge oil pump cover drain plug

- Connect the 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 boat accordingly. Siphon the oil from the fitting.
- Level the engine.
- Remove the pump and the fitting. Apply Loctite 243 (blue) (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.

- Install a new oil filter and reinstall the oil filter cap.
- Fill up the reservoir with fresh oil.
- Boil out the remaining water as follows:
 - Recommended procedure: BOIL OUT PROCEDURE IN A TEST TANK OR TIED TO A TRAILER WITH WATERCRAFT IN WATER.
 - Optional procedure: BOIL OUT PROCEDURE CONNECTED TO A FLUSH KIT.

Refer to instructions below.

Boil Out Procedure

NOTE: This procedure is intended to evaporate the water contained in the oil.

Procedure in a Test Tank or Tied to a Trailer with Watercraft in Water

- Run the engine for 5 minutes at 3500 RPM.

Section 01 MAINTENANCE

Subsection 04 (SPECIAL PROCEDURES)

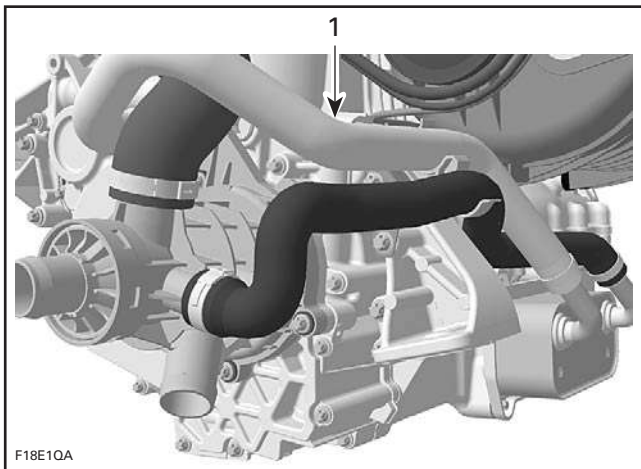
⚠ WARNING

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.



1. Oil cooler coolant inlet hose

- 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.

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.

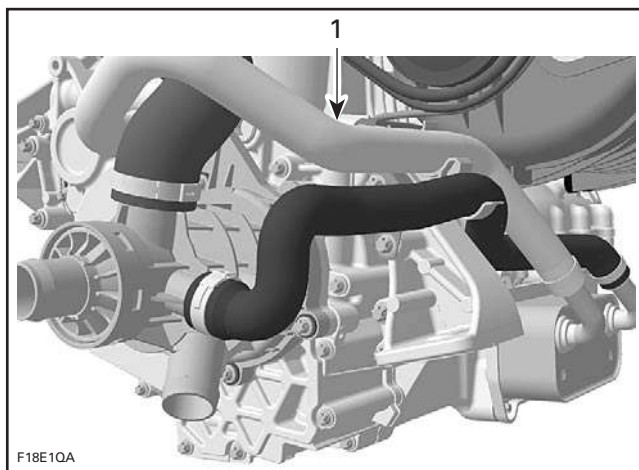
- Connect a flush kit to the coolant line.

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.



1. Oil cooler coolant inlet hose

- Continue to run the engine at 3000 RPM for 15 more minutes (20 minutes total run time).
- Shut off the engine.
- 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.

NOTE: On fuel injection models, always check for fault codes. If a fault code is detected, service the fault code and recheck operating conditions. Refer to DIAGNOSTIC PROCEDURES in ENGINE MANAGEMENT section.

ENGINE WILL NOT START

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine does not turn over	Wrong safety lanyard	Use one that has been programmed
	DESS operation non functional	If 2 short beeps are not heard when installing safety lanyard, refer to ENGINE MANAGEMENT
	Safety lanyard switch faulty or disconnected or harness damaged	Replace
	Burnt fuse: battery, starting system. Also fuel pump	Check wiring then replace fuse
	Starting system fuse keeps on burning	Check wiring, starting system solenoid and MPEM
	Discharged or disconnected battery	Check/recharge
	Defective or disconnected start/stop switch	Check, refer to STARTING SYSTEM
	Battery connections	Check/clean/tighten
	Poor/bad or corroded ground contacts (engine, starter etc.)	Check/clean/repair
	Water/fuel hydro-lock	Check, refer to MAINTENANCE
	Starter malfunction	Check, refer to ELECTRICAL SYSTEM
	Starter solenoid	Check, refer to ELECTRICAL SYSTEM
	Obstructed starter drive gear assembly	Check/repair, refer to PTO HOUSING/MAGNETO in the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Seized or obstructed engine	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Seized or obstructed supercharger (if so equipped)	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Seized jet pump	Check, refer to PROPULSION SYSTEM
Faulty sensor, ECM or MPEM	Check fault codes, refer to ENGINE MANAGEMENT	

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine turns slowly	Loose battery cable connections	Check/clean/tighten
	Discharged/weak battery	Check/charge/replace
	Restriction in jet pump	Check/clean pump
	Partial seizure in jet pump	Inspect, refer to PROPULSION SYSTEM
	Partial engine hydro-lock	Check, refer to MAINTENANCE
	Partial engine seizure	Check compression, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Worn starter	Check, refer to ELECTRICAL SYSTEM
	Timing chain not guided by chain guide)	Check, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Outside temperature too low	Oil is too thick. Change oil viscosity Battery capacity is not sufficient for cold temperature
Engine turns over	Faulty component in the fuel injection system	Check for fault codes. Refer to DIAGNOSTIC PROCEDURES in ENGINE MANAGEMENT
	Engine drowned mode is active	Release throttle lever
	Low battery voltage	Recharge or replace battery
	Low or no fuel pressure	Check fuel pump pressure output Check fuel pump fuse Check wiring harness
	Fuel injectors not working	Check fuel injector operation. Replace as necessary Check output signal from MPEM
	No spark at the spark plug	Check spark plugs condition and replace as necessary
	Defective MPEM or ECM	Check ignition system and repair Replace MPEM or ECM (as applicable)
	Defective CPS	Check operation of CPS and replace if necessary
	Water-contaminated fuel	Check/siphon and refill
	Dirty fuel filter	Clean/replace
	Fouled or defective spark plug	Replace
	Water in engine	Check, refer to MAINTENANCE
	Defective ignition circuit	Check, refer to ELECTRICAL SYSTEM
Internal engine damage	Check, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>	

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine turns over (cont'd)	Defective encoder/trigger wheel	Check, refer to ENGINE MANAGEMENT
	Incorrectly aligned flywheel and trigger wheel	Properly position flywheel and trigger wheel, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Insufficient engine compression	Replace defective part(s)
	Idle bypass valve stuck or not functioning	Check, refer to ENGINE MANAGEMENT
No spark at spark plugs	Spark plug faulty, fouled or worn out	Check spark plug condition
	Ignition	Check, refer to ELECTRICAL SYSTEM
	Faulty ECM	Replace ECM

ENGINE HARD TO START

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Defective idle bypass valve	Refer to ENGINE MANAGEMENT
	Wrong TPS zero setting	Refer to ENGINE MANAGEMENT
	Throttle cable adjustment	Refer to ENGINE MANAGEMENT
	Temperature too low for available battery capacity	Battery capacity is not sufficient for cold temperature
	Air lock in fuel rail	Refer to ENGINE MANAGEMENT
	Water in intake system (defective MAP sensor)	Check and remove water. Refer to SPECIAL PROCEDURES subsection
	Water in fuel reservoir or contaminated fuel	Flush reservoir and refill with fresh gas
	Mechanical engine failure	Check cylinder compression Check for cylinder head leaks Check starting system
	Spark plug faulty, fouled or worn out	Check spark plug condition
	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
	Defective CAPS	Check CAPS and its circuit. Refer to ENGINE MANAGEMENT

Section 02 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

ENGINE STARTS BUT RUNS ONLY AT IDLE SPEED

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	The system is in limp home mode	Refer to ENGINE MANAGEMENT and check the fault codes
	Broken or loose throttle cable	Change/readjust

ENGINE MISFIRES, RUNS IRREGULARLY

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	Fouled, defective, worn spark plugs	Check/verify heat range/gap/replace
	Faulty ECM or MPEM	Check, refer to ENGINE MANAGEMENT
	Defective trigger wheel/CPS	Check, refer to ENGINE MANAGEMENT
	Bad ignition coil wiring	Check wiring condition and proper grounding of ignition coil
	Faulty ignition coil, or bad connector	Check coil. Refer to ENGINE MANAGEMENT or ELECTRICAL SYSTEM
	Poor engine ground	Check/clean/repair
Lean fuel mixture Dry spark plug (except when water fouled)	Low fuel pressure	Check pump, regulator, injectors and hose pinchers or if filter is plugged. Replace if necessary
	Stale or water fouled fuel	Check/siphon and refill
	Fuel filter dirty or restricted	Check/clean/replace
	Clogged fuel injectors	Remove and clean fuel injectors
	Defective sensor or ECM	Check faulty codes in ECM memory, refer to ENGINE MANAGEMENT
Rich fuel mixture Fouled spark plug	Flame arrester dirty or restricted	Check/replace
	Faulty fuel injector(s)	Remove and replace fuel injector(s), refer to ENGINE MANAGEMENT
	Defective sensor or ECM	Check fault codes. Refer to ENGINE MANAGEMENT
	Fuel pressure fluctuating	Inspect fuel pressure regulator. Refer to FUEL SYSTEM
	High fuel pressure	Check pump, regulator, injectors or if filter is plugged. Replace if necessary

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Starts, but runs poorly	Check spark plug condition, check fault codes, check fuel pressure.	Check, refer to IGNITION SYSTEM and ENGINE MANAGEMENT. If some work has been performed on the unit, make sure injector wire connectors were not mixed. Refer to the WIRING DIAGRAM for wire colors and positions
	Bent or missing tooth on trigger wheel	Check, refer to ENGINE MANAGEMENT
Also fuel injection misinjecting	Injector wiring reversed	Refer to the WIRING DIAGRAM
	Damaged fuel injector	Check, refer to ENGINE MANAGEMENT

ENGINE CONTINUALLY BACKFIRES

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	Fouled, defective spark plugs	Clean/replace
Spark plugs	Ignition coil wiring reversed	Refer to WIRING DIAGRAM
Ignition timing	Incorrect setting	Check/reset, refer to ELECTRICAL SYSTEM
	Defective trigger wheel/CPS	Check, refer to ENGINE MANAGEMENT
Engine	Intake or exhaust valve(s) leak	Pressure check engine, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>

ENGINE DETONATION OR PINGING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Ignition	Spark plug heat range too high	Check/change to correct range
Engine/exhaust high temperature	Engine overheats and exhaust overheats	Check, see ENGINE OVERHEATS in this section
	Fuel octane too low of poor fuel quality	Use good quality fuel
	Knock sensor disconnected or faulty	Check, refer to ENGINE MANAGEMENT
	Bad knock sensor connection	Check, refer to ENGINE MANAGEMENT
	Bad ECM connection	Check, refer to ENGINE MANAGEMENT

Section 02 TROUBLESHOOTING
 Subsection 01 (TROUBLESHOOTING CHART)

ENGINE LACKS ACCELERATION OR POWER

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Weak spark	Check/replace, refer to IGNITION SYSTEM
	Throttle does not open fully	Check/readjust, refer to ENGINE MANAGEMENT
	Low compression	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Water in fuel	Check/siphon/replace
	Impeller leading edge damaged	Check/replace, refer to PROPULSION SYSTEM
	Too much engine oil	Siphon or adjust level. Refer to LUBRICATION SYSTEM
	Poor fuel quality	Siphon then refill with fresh fuel
	Clogged fuel injectors	Remove and clean fuel injectors
	Low fuel pressure	Check fuel line and fuel pump pressure
	Incorrect throttle position sensor (TPS) adjustment	Check and adjust TPS, refer to ENGINE MANAGEMENT
	Improper timing chain alignment	Refer to CYLINDER HEAD in the <i>a1503 4-TEC ENGINE SHOP MANUAL</i>
	Defective supercharger	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Overheated engine	See ENGINE OVERHEATS in this chart
Engine revs lower than its maximum operational RPM	Limp home mode activated	Refer to ENGINE MANAGEMENT

ENGINE STOPS RUNNING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine stalls at idle	Contaminated or inappropriate fuel	Syphon reservoir and refill with fresh fuel
	Air in fuel rail	Refill fuel tank
Engine start but stops after approximately 2 seconds	Engine running out of fuel	Check fuel delivery system for proper fuel pressure and delivery
	Air in fuel rail	Refill fuel tank

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE CANNOT REACH MAXIMUM RPM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Low fuel pressure	Check fuel pump pressure output
	Jet pump related problem	Check propulsion components. Refer to JET PUMP
	Limp home mode activated	Refer to ENGINE MANAGEMENT
	Exhaust system blockage/muffler damage	Check and repair
	Exhaust gases in bilge (leak)	Check exhaust system for leaks
	Defective supercharger	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Battery voltage is too low	Check/repair, refer to CHARGING SYSTEM

ENGINE RUNS TOO FAST (VEHICLE CANNOT REACH ITS TOP SPEED)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine RPM too high	Faulty rev limiter	Check, refer to ENGINE MANAGEMENT
	Improper impeller pitch (too low)	Check/replace, refer to PROPULSION SYSTEM
	Damaged impeller	Replace impeller. Refer to PROPULSION SYSTEM
Jet pump cavitation	Damaged leading or trailing edge of impeller	Check/replace NOTE: Leading edge damage contributes to poor performance from start. Trailing edge damage contributes to poor top performance and stator vanes erosion.
	Sealing of ride plate, jet pump support or jet pump	Check/reseal, refer to section PROPULSION SYSTEM or HULL/BODY

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE OVERHEATS

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Coolant level too low	Coolant level low	Refill/check for leaks
	Coolant leaking out of weep hole (PTO housing)	Replace seal
	Hoses or clamps missing/defective	Repair/replace
	Cylinder head gasket leaks (white exhaust gas)	Replace cylinder head gasket
	Thermostat failure	Replace
	Coolant pump failure	Replace
	Internal passage blockage	Inspect and clean
Monitoring beeper sounds continuously	Temperature sensor defective	Check/replace. Refer to ENGINE MANAGEMENT
	Worn water pump impeller	Check/replace
	Cooling system restriction	Check/flush, refer to MAINTENANCE
	Damaged ride plate or hoses	Check, refer to COOLING SYSTEM and HULL/BODY
	Thermostat defective	Check/replace

ENGINE SMOKE IN THE EXHAUST

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
White smoke	Coolant leak	Check/repair. Refer to COOLING SYSTEM
	Intercooler leak (if so equipped)	Check/repair. Refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Damaged cylinder head gasket	Check/replace cylinder head gasket
	Water ingestion	Inspect intake manifold for water infiltration
	Valve guide seals	Check/replace valve guide seals, refer to CYLINDER HEAD in the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
Blue smoke	Oil level too high	Siphon excess of oil
	PTO oil scavenge port blocked or scavenge pump malfunction	Inspect and clean or replace pump
Blue smoke at engine starting	Valve seals worn or damaged	Replace seals
	Oil rings worn out	Replace rings
Blue smoke with engine under load	Oil rings	Inspect/repair oil rings, refer to CYLINDER BLOCK in the <i>1503 4-TEC ENGINE SHOP MANUAL</i>

Section 02 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

LOW OR NO ENGINE OIL PRESSURE

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Oil level too low	Refill. See TECHNICAL DATA for specifications
	Leaking gasket	Replace
	Oil leaking out of weep hole (PTO housing)	Replace oil seal on pump shaft
	Oil pressure sensor defective	Check/replace
	Oil pump malfunctioning	Clean rotor and check wear limits
	Oil regulator valve sticks open, or spring load too small	Clean/replace
	Heavy wear on plain bearings	Replace

ENGINE OIL CONTAMINATION (MILKY)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Water and oil mixture leaking out of leak indicator hole (PTO housing)	Oil seal and rotary seal on coolant pump shaft leaking	Replace both seals. Refer to PTO HOUSING in the appropriate ENGINE SHOP MANUAL. Change oil
	Cylinder head gasket leaking	Replace gasket. Refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i> . Change oil
	Loose screws on cylinder head, PTO housing or oil separator	Retorque. Change oil
	Oil contamination due to metal or plastic particles	Replace possibly damaged parts. Change oil
	Water ingestion (intake manifold, TOPS valve, dipstick)	Refer to MAINTENANCE
Water and oil mixture without leaking out at leak indicator hole (PTO housing)	The same causes as above apply. However, look at the following added cause	
	Leak indicator hole plugged	Check/clean leak indicator hole

Section 02 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

UNUSUAL ENGINE NOISE AND/OR VIBRATION

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Worn chain tensioner	Replace
	Worn chain guide	Replace
	Stretched chain and/or worn out sprockets	Replace chain and sprockets
	Sprocket screws got loose	Retorque
	Hydraulic element inside rocker arm(s) is worn out (valve adjustment) or lifter damaged	Replace faulty rocker arm(s) and/or lifters
	Rocker arm screws not tightened	Retorque
	Heavy wear on crankshaft and/or balancer shaft bearings	Replace
	Crankshaft and balancer shaft not aligned	Check marks and readjust shafts
	Heavy wear on thrust washers, or thrust washers missing	Check/replace
	Defective supercharger (if so equipped)	Check/repair, refer to the <i>1503 4-TEC ENGINE SHOP MANUAL</i>
	Missing/defective air intake hose	Check/replace air intake hose or clamps, refer to AIR INTAKE SYSTEM

INAPPROPRIATE SPEEDOMETER READING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Faulty speed sensor or related circuits.	Refer to INSTRUMENTS AND ACCESSORIES
	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

ABNORMAL NOISE FROM PROPULSION SYSTEM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Weeds/debris caught in intake grate or impeller	Check/clean
	Damaged or bent drive shaft	Check/replace, refer to PROPULSION SYSTEM
	Idle speed too low	Check fault codes
	Broken engine mounts	Check/replace

Section 02 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

NOTE: 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.

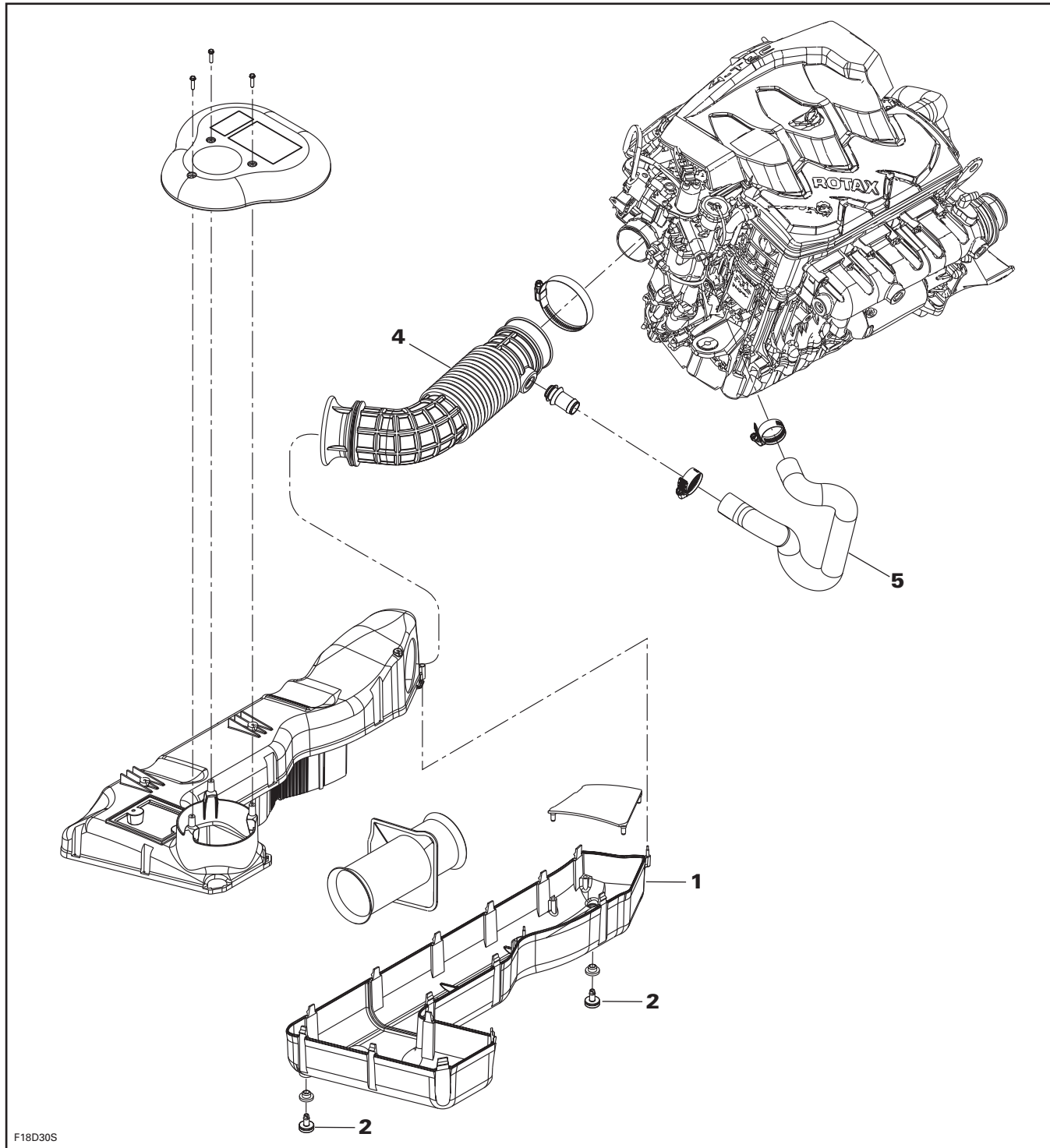
AIR INTAKE SYSTEM

SERVICE TOOLS

<u>Description</u>	<u>Part Number</u>	<u>Page</u>
hook tool.....	529 035 989	30

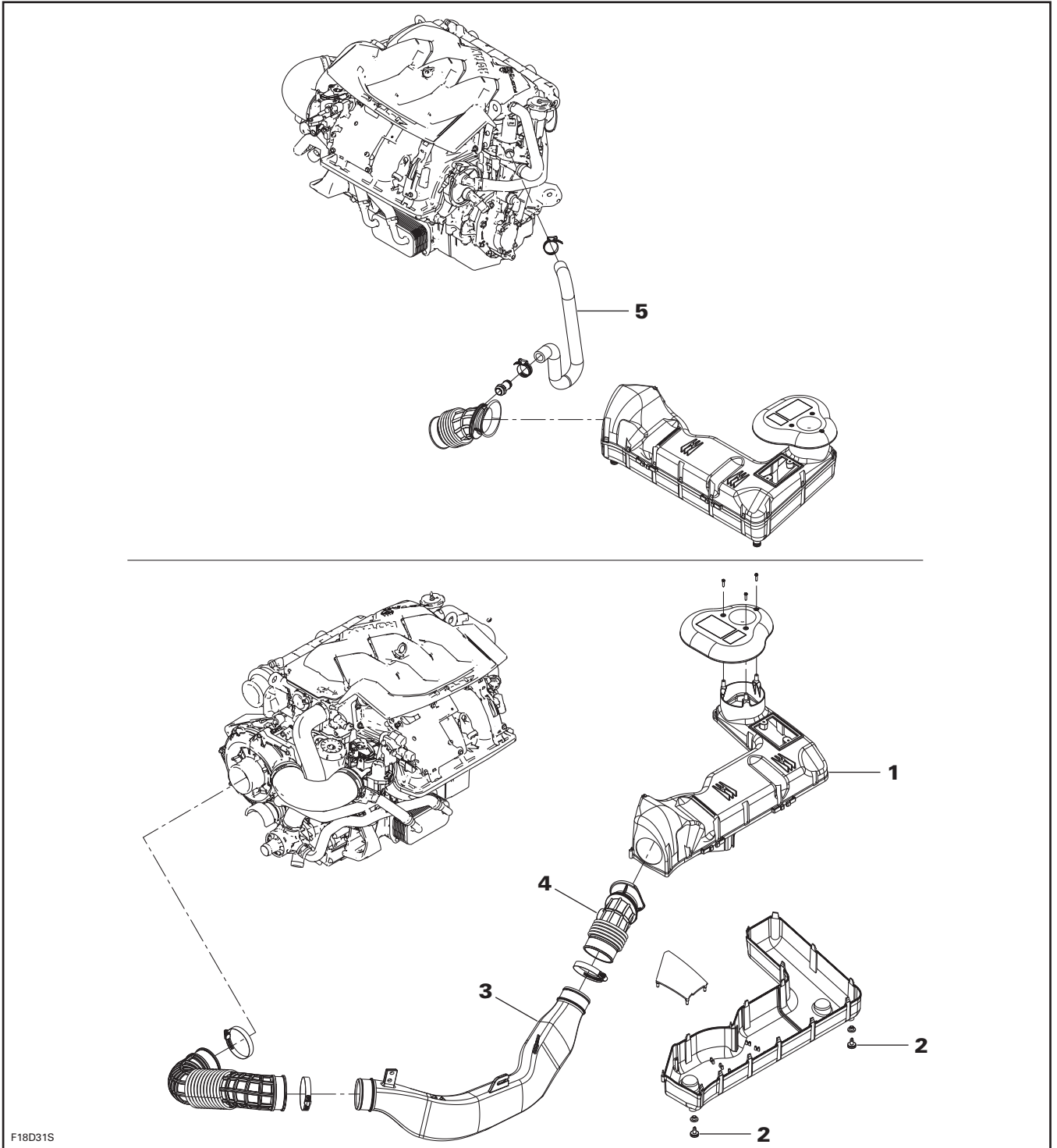
Section 03 ENGINE SYSTEM
Subsection 01 (AIR INTAKE SYSTEM)

4-TEC Naturally Aspirated Engine



F18D30S

4-TEC Supercharged and Supercharged Intercooled Engines



Section 03 ENGINE SYSTEM

Subsection 01 (AIR INTAKE SYSTEM)

INSPECTION

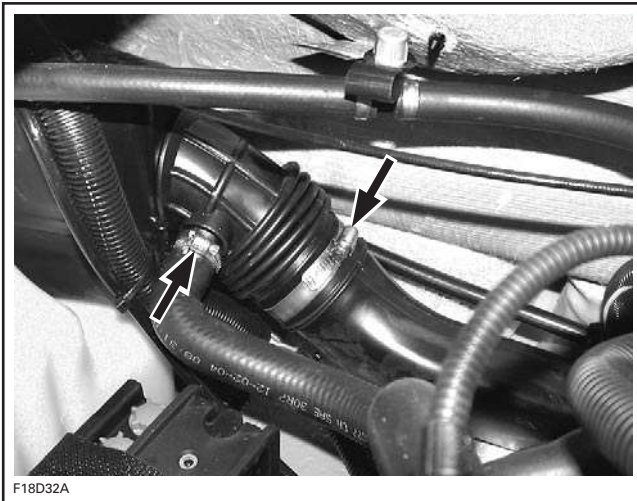
Check for water in air silencer no. 1. If so, replace check valves no. 2. Check collar tightness. Ensure there is no water trapped in tube no. 3 (if so equipped).

Inspect silencer, tube and hose condition. Replace any damaged part.

REMOVAL

From storage compartment, remove/disconnect:

- hose no. 4.

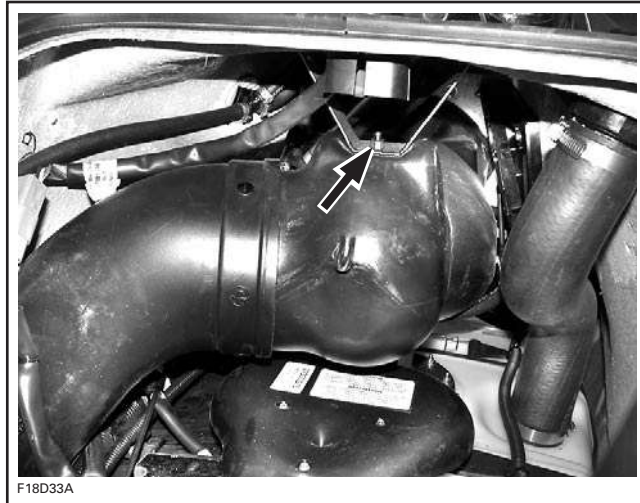


- front access door (if so equipped)

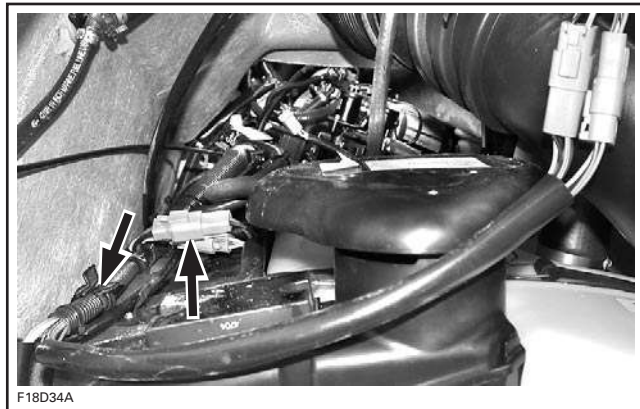


1. Access door

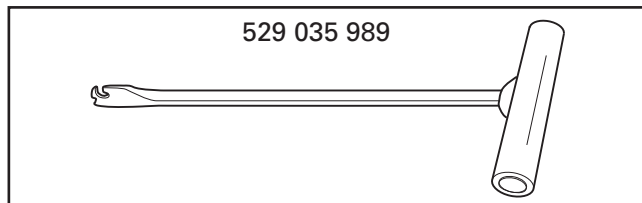
- front vent tube (RXP only)



- rectifier/voltage regulator
- wiring harness from air silencer



- fuel tank straps (refer to FUEL SYSTEM) using hook tool (P/N 529 035 989).



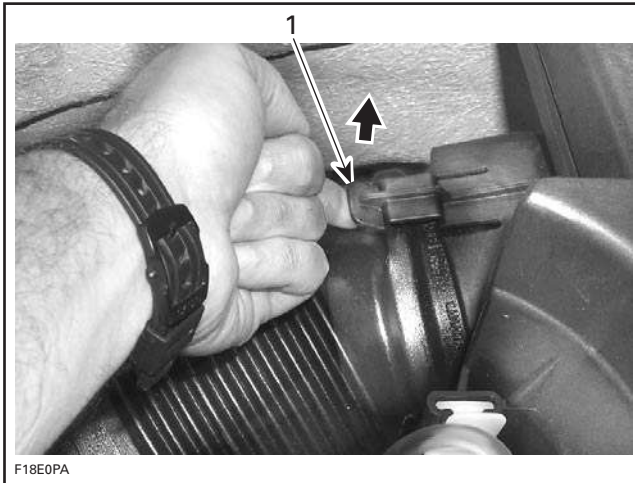
Pull air silencer out.

4-TEC Supercharged and Supercharged Intercooled Engines

From engine compartment, remove/disconnect:

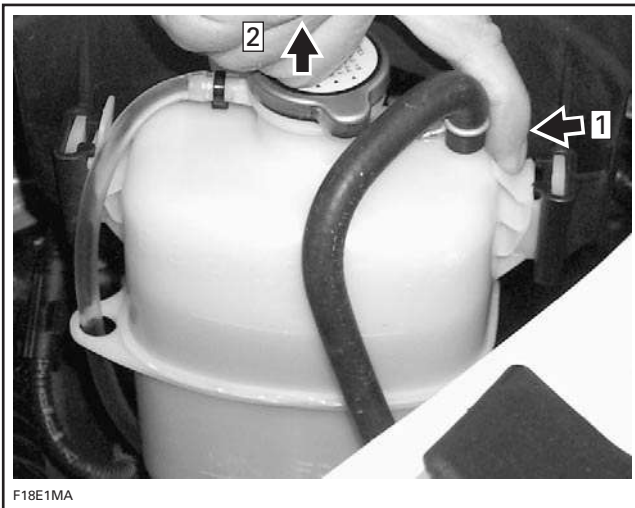
- vent tube

Section 03 ENGINE SYSTEM
Subsection 01 (AIR INTAKE SYSTEM)



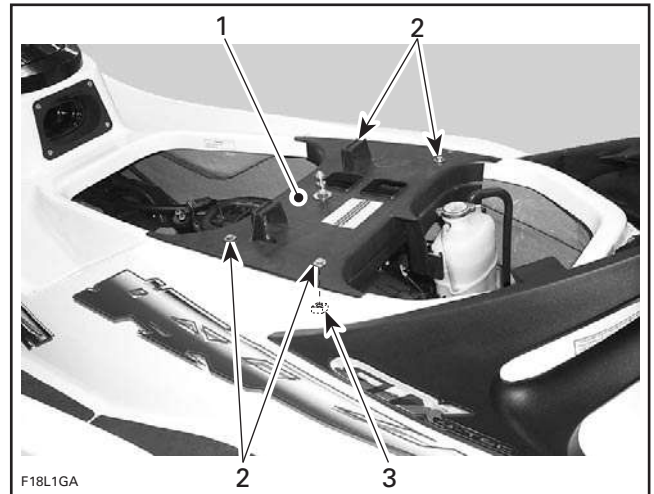
1. Lift lock tab

– coolant expansion tank



Step 1: Push tab (each side) to release
Step 2: Pull tank out

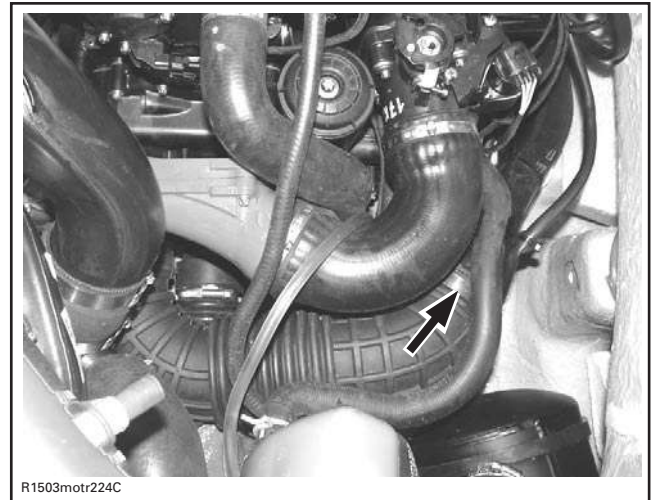
– vent tube support



1. Vent tube support
2. Remove retaining screws
3. Pay attention to nuts underneath

– tube from air intake hose

Pull tube out.



INSTALLATION

Reverse removal operation order and pay attention to the following.

Ensure that tubes are well secured with hoses and there is a tight fit.

LUBRICATION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
suction pump.....	529 035 880	35

SERVICE PRODUCTS

Description	Part Number	Page
pulley flange cleaner.....	413 711 809	35

GENERAL

Prior to changing the oil, ensure vehicle is on a level surface.

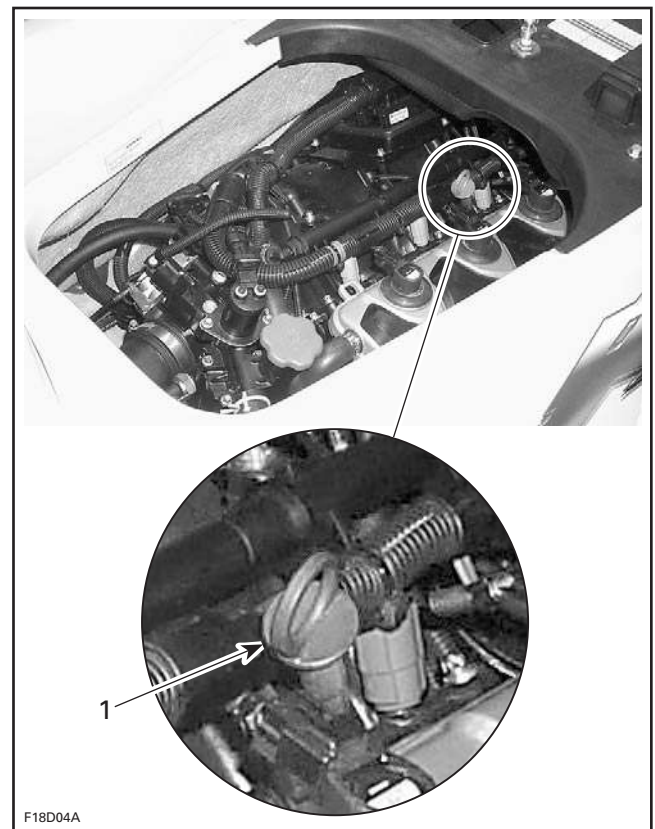
Oil and oil filter must be replaced at the same time. Oil change and oil filter replacement should be done with a warm engine.

⚠ WARNING
The engine oil can be very hot. Wait until engine oil is warm.

Dispose oil and filter as per your local environmental regulations.

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.



1. Dipstick

Section 03 ENGINE SYSTEM

Subsection 02 (LUBRICATION SYSTEM)

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.

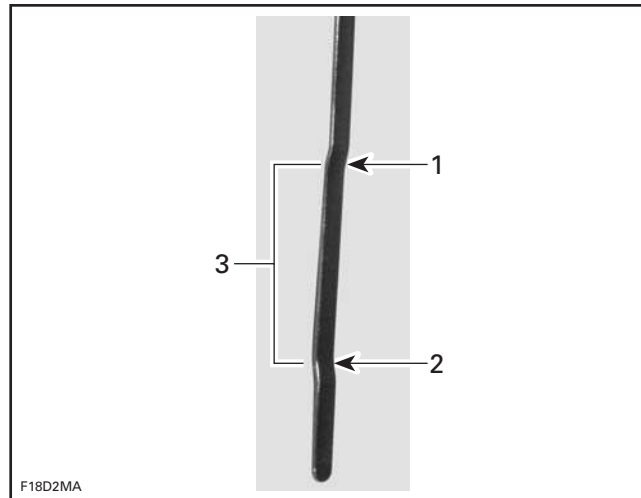
- Warm-up engine then let idle for 30 seconds before stopping.
- Stop engine.
- Wait at least 30 seconds then pull dipstick out and wipe clean.

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.



1. Full
2. Add
3. Operating range

- Otherwise, add oil until its level is between marks as required.
- To add oil, unscrew oil cap. Place a funnel into the opening and add the recommended oil to the proper level. Do not overfill.

OIL CHANGE

NOTE: Oil filter should be replaced whenever replacing the engine oil.

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 cooling system when watercraft is out of water.

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

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.

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.



1. Suction pump
2. Siphon tube in dipstick hole

Pull siphon tube out of dipstick hole then crank engine (do not start) while in engine down 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 TYPE AND SYSTEM CAPACITY

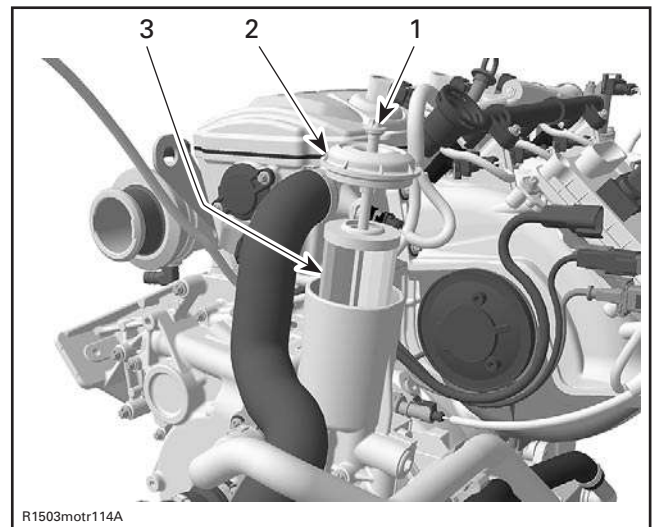
Refer to TECHNICAL SPECIFICATIONS. For refilling procedure, refer to OIL LEVEL VERIFICATION above.

OIL FILTER

Removal

Remove:

- oil filter screw
- oil filter cover
- oil filter



TYPICAL
1. Oil filter screw
2. Oil filter cover
3. Oil filter

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.

⚠ 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.

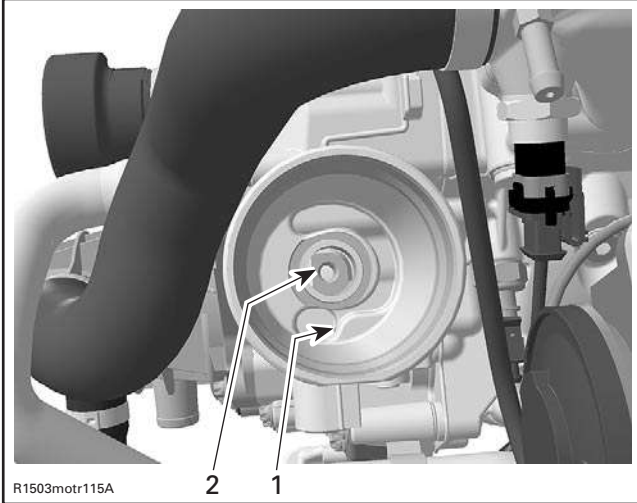
Inspection

Check oil filter cover O-ring and oil filter screw O-ring, change if necessary.

Section 03 ENGINE SYSTEM

Subsection 02 (LUBRICATION SYSTEM)

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



TYPICAL

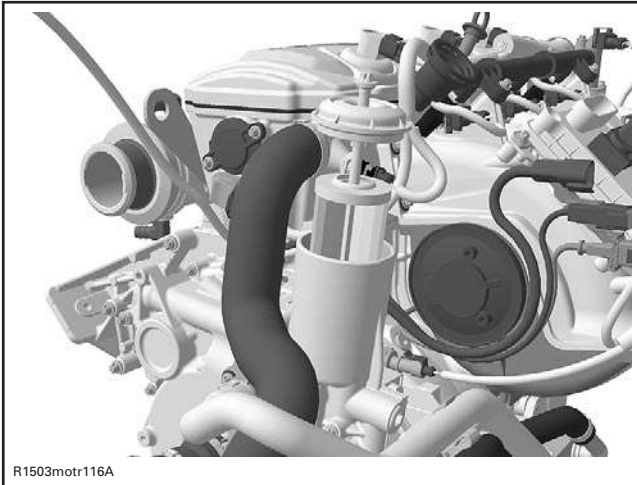
1. Inlet bore from the oil pump to the oil filter
2. Outlet bore to the engine oil providing system

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.



TYPICAL

Torque oil filter screw to 9 N•m (80 lbf•in).

COOLING SYSTEM

SERVICE TOOLS

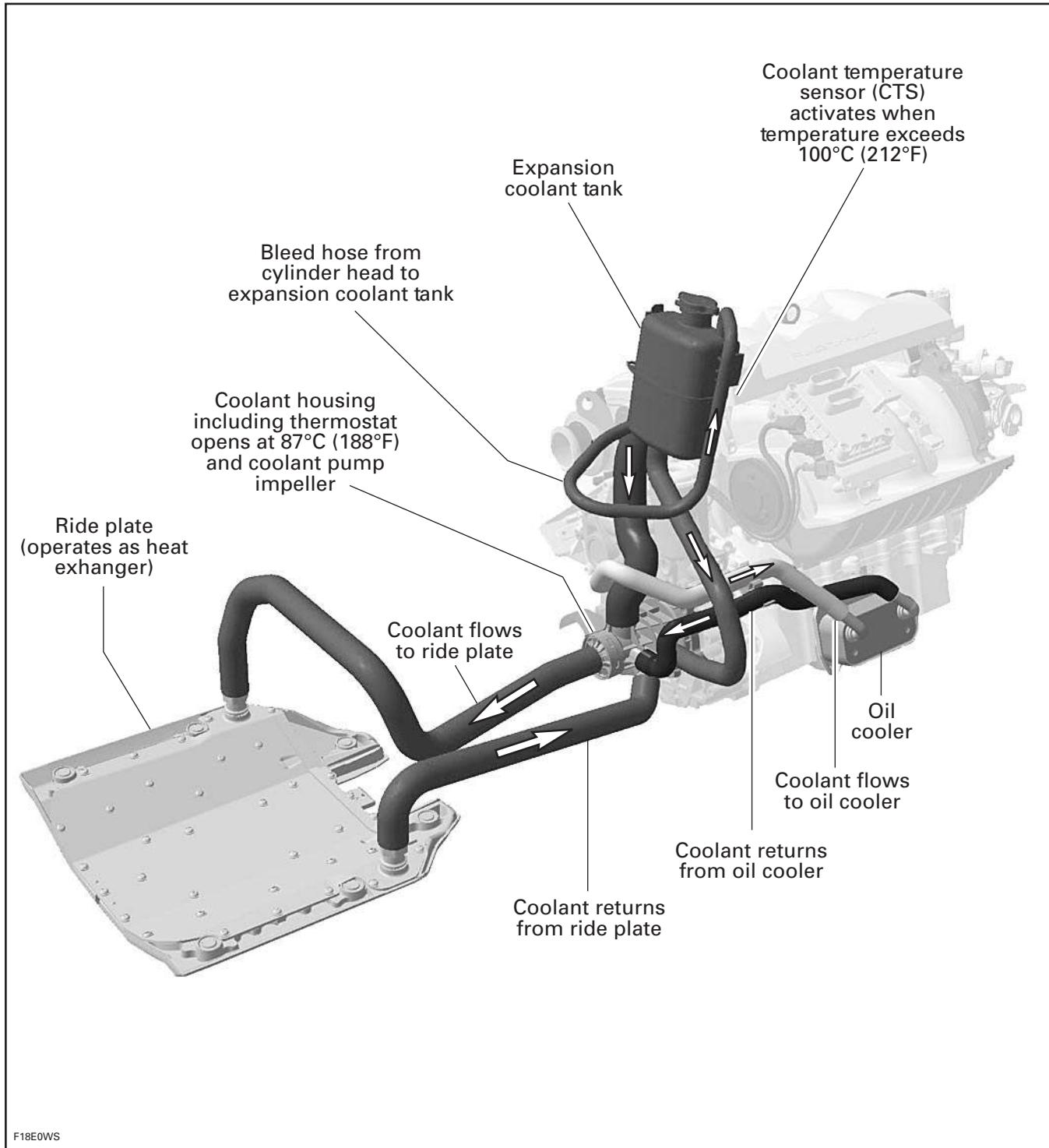
Description	Part Number	Page
pliers Oetiker 1099	295 000 070	46
test cap.....	529 035 991	39
vacuum/pressure pump	529 021 800	39

SERVICE PRODUCTS

Description	Part Number	Page
premixed antifreeze	219 700 362	40

Section 03 ENGINE SYSTEM
Subsection 03 (COOLING SYSTEM)

CLOSED LOOP COOLING SYSTEM (engine)



CIRCUIT

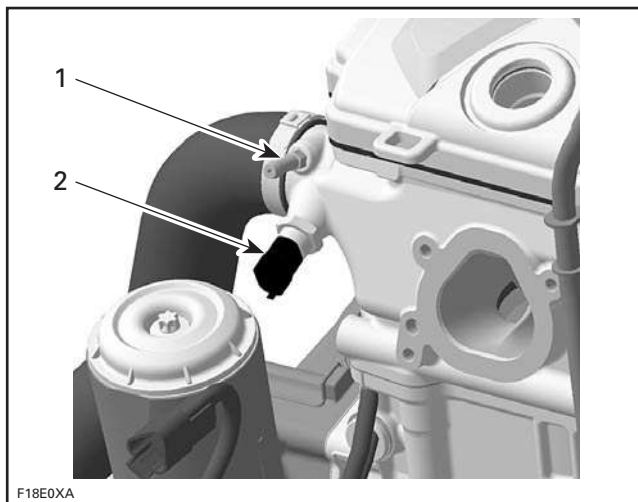
A closed loop cooling system is utilized on the 1503 4-TEC engines, which offers an efficient engine cooling while keeping dirt and salt water out of the cooling system. This system keeps the temperature constant and prevents internal engine corrosion.

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

The coolant flow comes from the coolant 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 coolant pump housing and depending on the engine temperature, it flows through the thermostat directly back to the coolant 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.



F18E0XA

1. Bleed nipple
2. Coolant temperature sensor (CTS)

CAUTION: Never modify cooling system arrangement, otherwise serious engine damage could occur.

COOLING SYSTEM LEAK TEST

WARNING

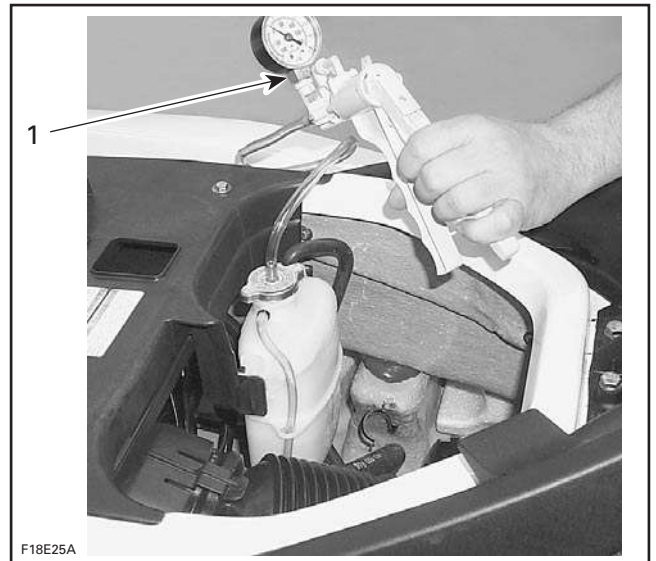
To avoid potential burns, do not remove the expansion tank cap or loosen the ride plate drain plug if the engine is hot.

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).



F18E25A

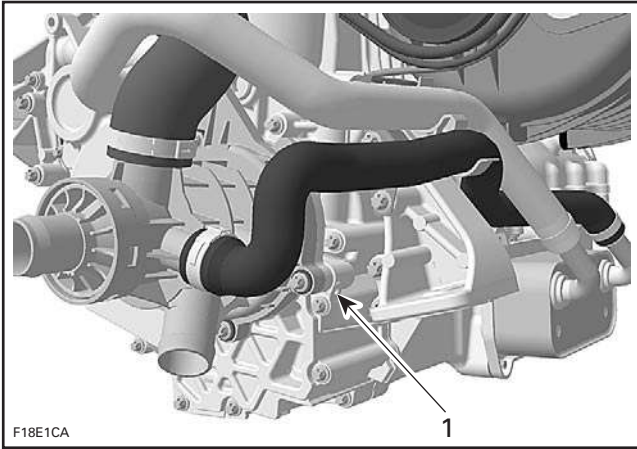
- TYPICAL**
1. Vacuum/pressure pump

Check all hoses, ride plate, engine and oil cooler for coolant leaks. Spray a soap/water solution and look for air bubbles.

Check the leak indicator hole if there is oil or coolant. If so, refer to the *1503 4-TEC ENGINE SHOP MANUAL*.

Section 03 ENGINE SYSTEM

Subsection 03 (COOLING SYSTEM)



1. Leak indicator hole

INSPECTION

Check general condition of hoses and clamp tightness.

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).

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.



1. Cooling drain plug

Use an appropriate container to collect coolant. Dispose coolant as per local regulations.

Do not reinstall drain plug at this time.

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.

Section 03 ENGINE SYSTEM

Subsection 03 (COOLING SYSTEM)

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.

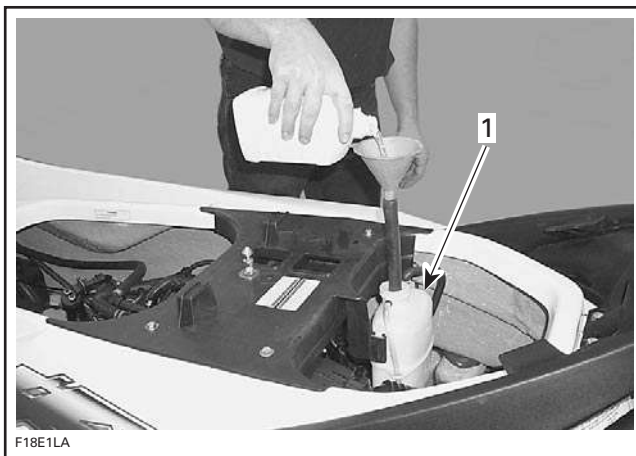
Refill cooling system as described below.

Refilling the System

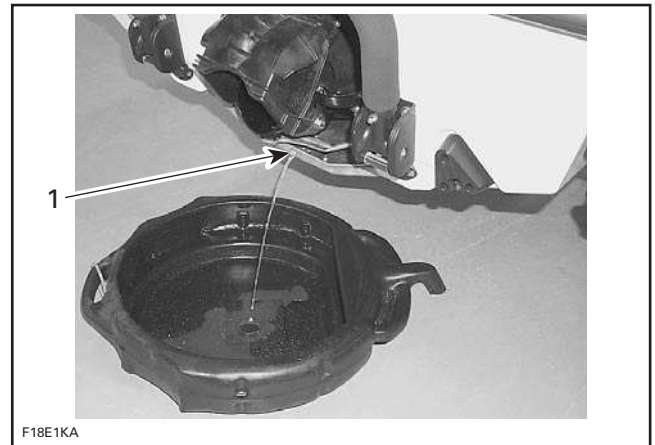
Watercraft should be level, engine cold and drain plug removed for refilling.

Place a container under drain plug to collect antifreeze.

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).

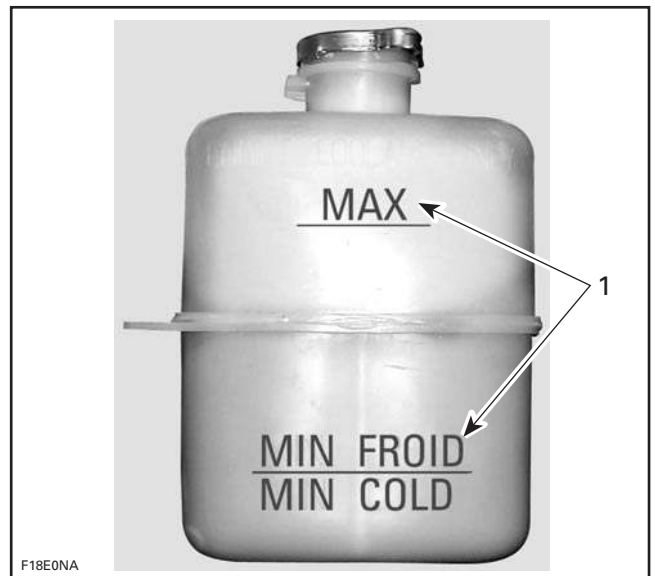


1. Pour antifreeze/water mix in expansion tank



1. Watch air bubbles flowing here

Continue to pour and fill expansion tank between marks.



1. Level between marks when engine is cold

Do not install pressure cap at this time.

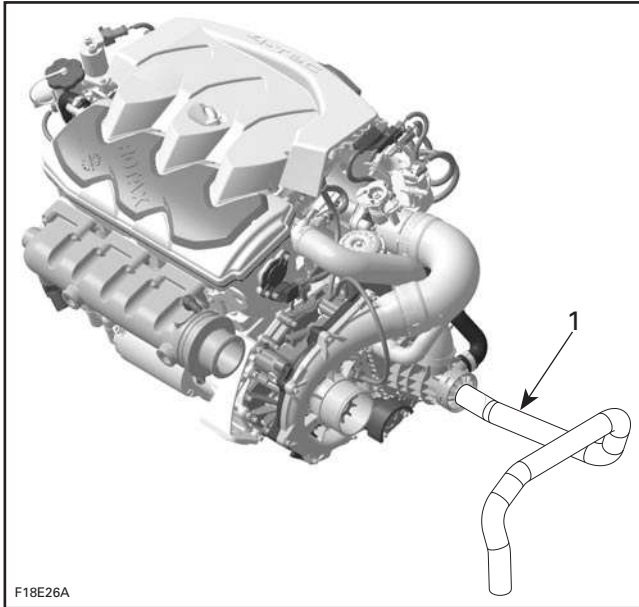
Properly cool exhaust system by installing a garden hose. Refer to STORAGE section.

Start engine and let run for 2 minutes. Stop engine and wait 15 minutes to cool down. Refill tank as necessary.

Repeat this run-stop cycle 2 - 3 times until thermostat opens and stop engine.

Section 03 ENGINE SYSTEM

Subsection 03 (COOLING SYSTEM)



1. This becomes hot when thermostat opens

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.

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.

CARE

The coolant should be replaced annually or every 100 hours of use. Coolant should be replaced prior to storage.

When servicing the hull, rotate watercraft either way (seen from the rear) maximum to 90°.



F18L13A

TECHNICAL SPECIFICATIONS

TYPE	Closed loop cooling system.
COOLANT FLOW	Flow from coolant pump.
TEMPERATURE CONTROL	Thermostat.
SYSTEM BLEEDING	Self-bleed type through expansion tank (hose at uppermost point of circuit).
MONITORING BEEPER	Turns on at 100°C (212°F).
COOLANT LIFE CYCLE	100 hours or 1 year. Should be replaced before storage.

OPENED LOOP COOLING SYSTEM (exhaust system)

GTX 4-TEC and WAKE

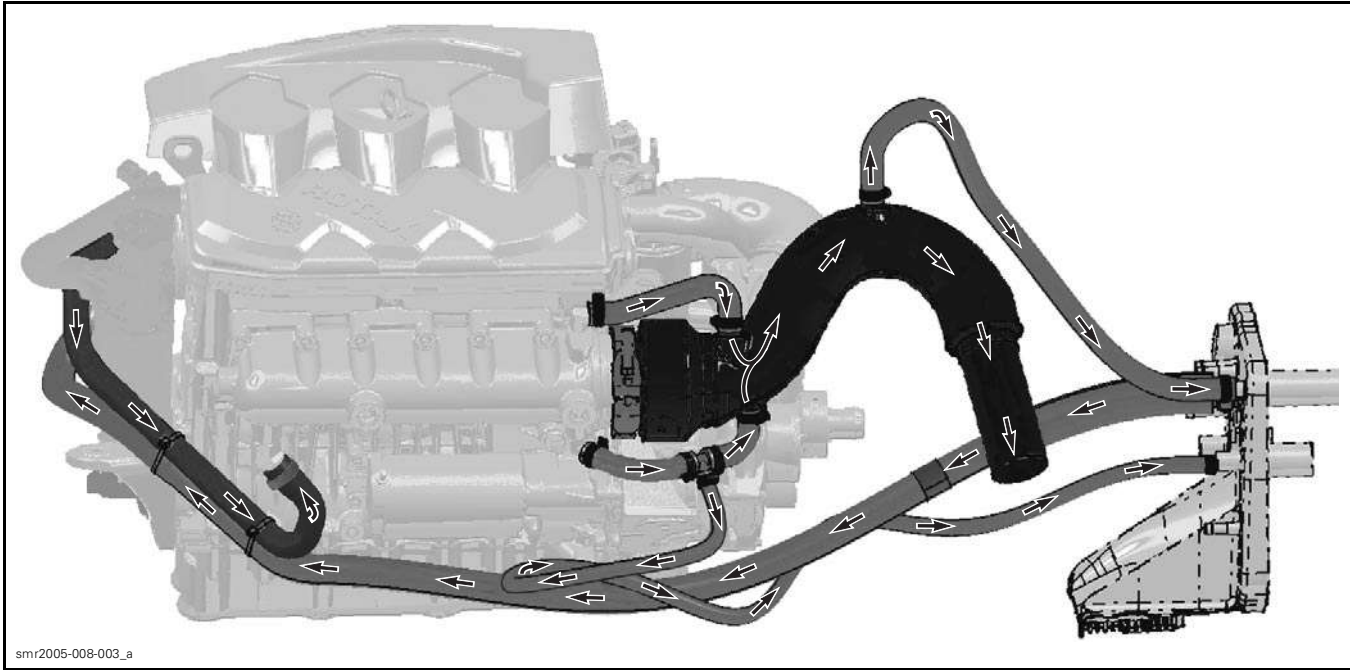


GTX 4-TEC Supercharged

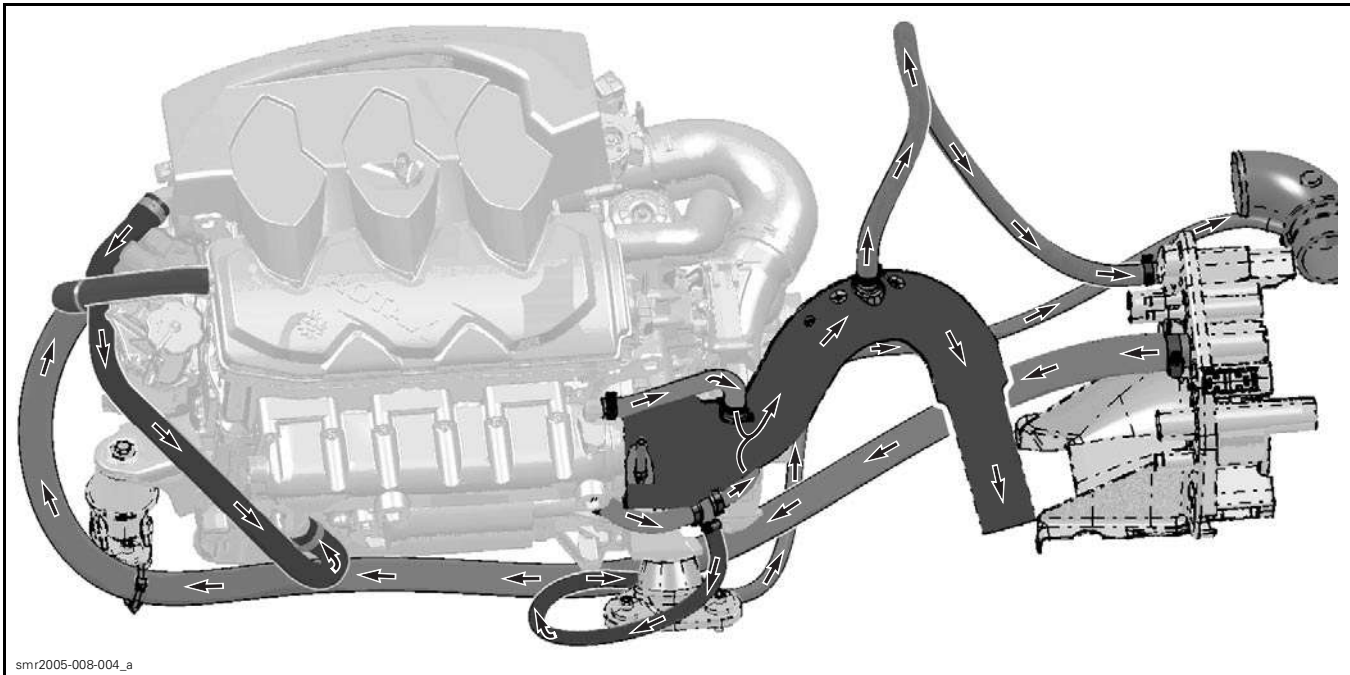


Section 03 ENGINE SYSTEM
Subsection 03 (COOLING SYSTEM)

GTX 4-TEC Limited and RXT



RXP

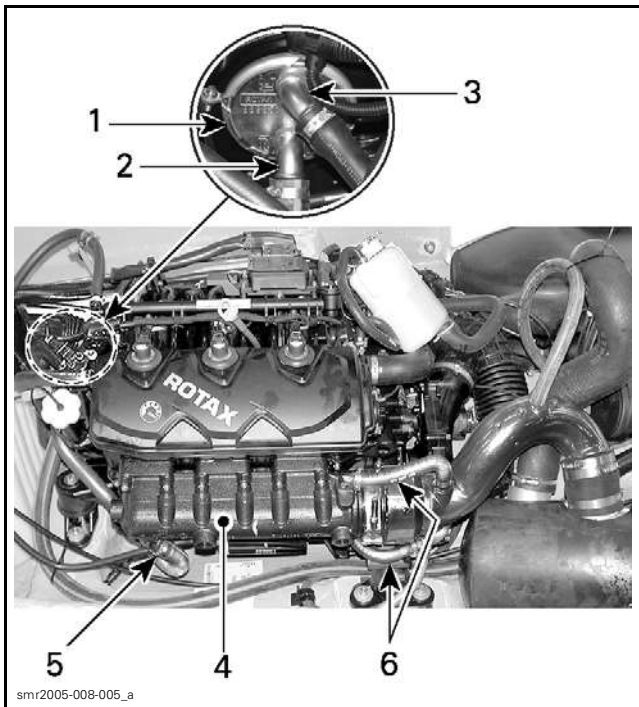


CIRCUIT

The water supply is provided by a pressurized area in the jet pump between the impeller and venturi.

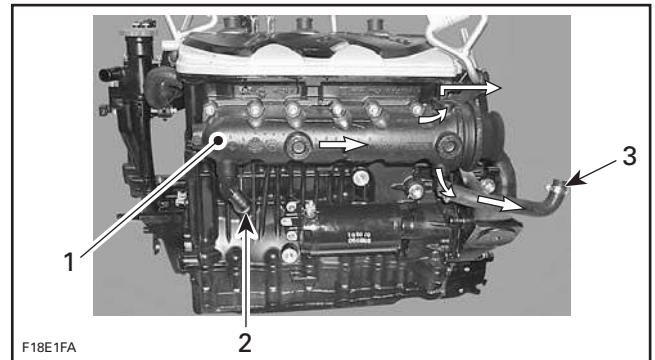
The water flow is controlled by a reducer located between the jet pump support and the jet pump on the inlet side. The reducer is color coded according to watercraft model. Refer to JET PUMP.

Water is directed first through the intercooler or to the exhaust manifold fitting located at front of manifold for the models without intercooler.



TYPICAL — MODELS WITH INTERCOOLER

1. Intercooler
2. Water inlet
3. Toward exhaust manifold
4. Exhaust manifold
5. Water inlet (from intercooler)
6. Water outlet

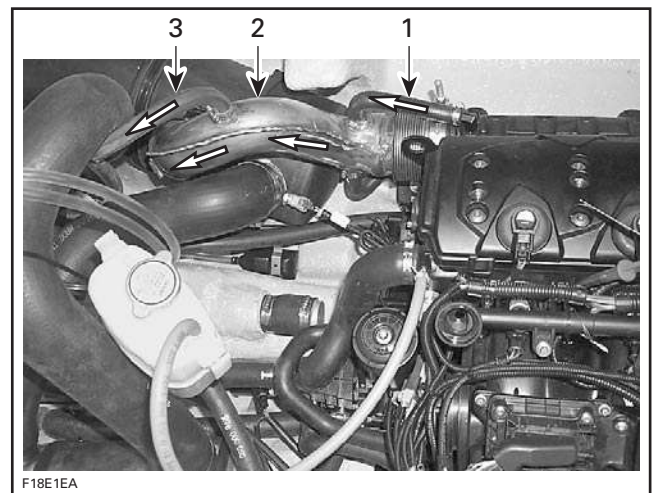


TYPICAL — MODELS WITHOUT INTERCOOLER

1. Exhaust manifold
2. Water inlet
3. Water outlet

Water enters the manifold end and is directed to water jackets of exhaust manifold.

Water exits exhaust manifold through 2 hoses at rear manifold.



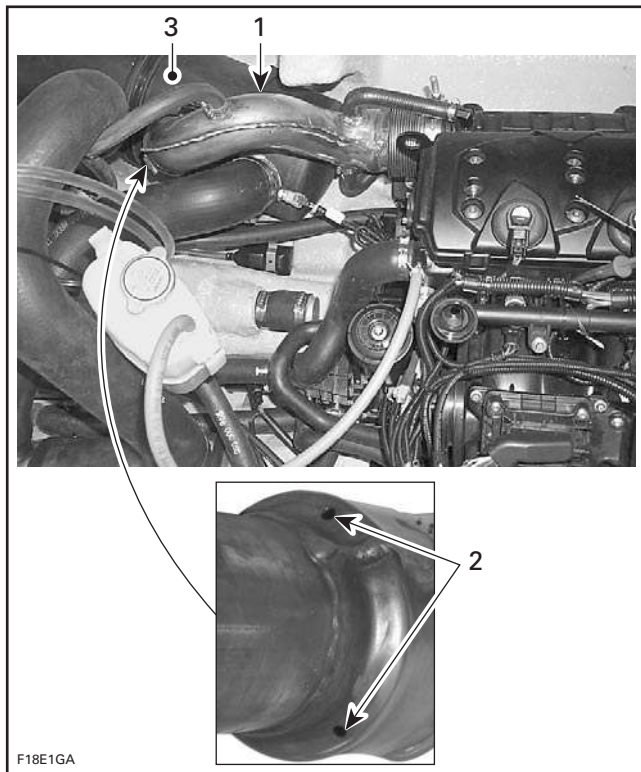
TYPICAL

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

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

Section 03 ENGINE SYSTEM

Subsection 03 (COOLING SYSTEM)



F18E1GA

TYPICAL

1. Exhaust pipe
2. Outlet holes of exhaust pipe
3. Muffler

Bleeding of the exhaust system is accomplished by the bleed hose located at the upper most 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.

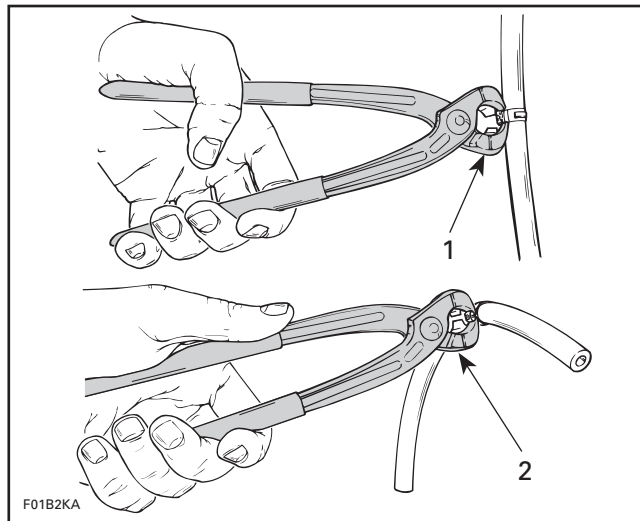
Intercooler

Supercharged Intercooled Engine

For the intercooler servicing, refer to the *1503 4-TEC ENGINE SHOP MANUAL*.

Clamp Replacement

To cut or secure Oetiker clamps of cooling system hoses, use the pliers Oetiker 1099 (P/N 295 000 070).



F01B2KA

1. Cutting clamp
2. Securing clamp

CARE

For flushing and winterization procedures of the opened loop cooling system, refer to STORAGE.

When servicing the hull, rotate watercraft either way (seen from the rear) maximum to 90°.



F18L13A

TECHNICAL SPECIFICATIONS

TYPE	Total Loss Cooling System (TLCS).
COOLANT FLOW	Flow from jet pump (no water pump).
TEMPERATURE CONTROL	Calibrated outlet fittings (no thermostat).
SYSTEM BLEEDING	Self-bleed type (hose at uppermost point of circuit).
SYSTEM DRAINING	Self-drain type (hose at lowest point of circuit).
SYSTEM FLUSHING	Flushing connector adapter on jet pump support.

EXHAUST SYSTEM

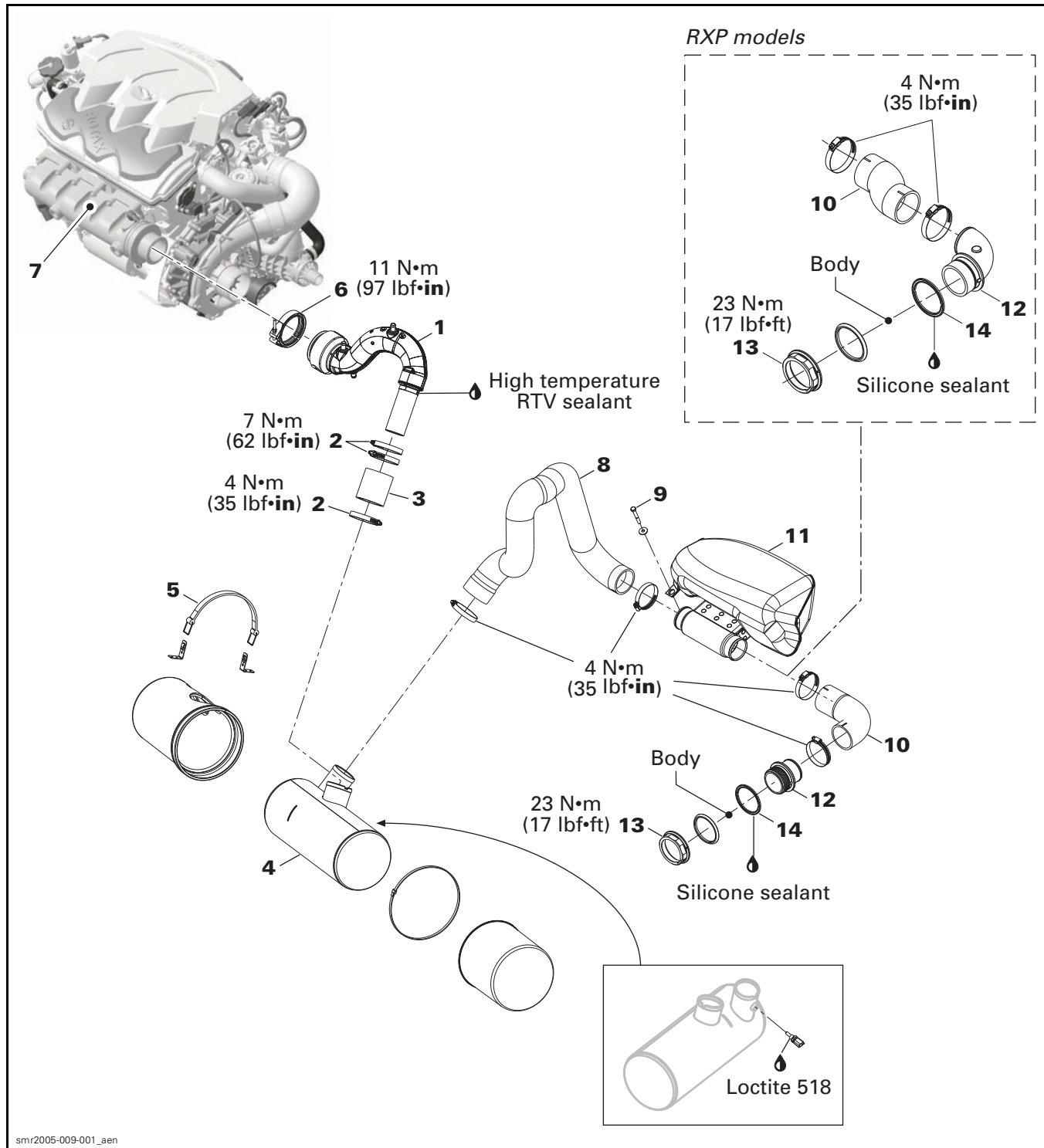
SERVICE TOOLS

Description	Part Number	Page
exhaust outlet tool.....	295 000 132	56
spring installer/remover	529 035 989	51

SERVICE PRODUCTS

Description	Part Number	Page
high temperature RTV sealant.....	293 800 090	52
Loctite 518.....	293 800 038	55
Loctite silicone sealant (clear).....	293 800 086	57

Section 03 ENGINE SYSTEM
Subsection 04 (EXHAUST SYSTEM)



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EXHAUST PIPE

Removal

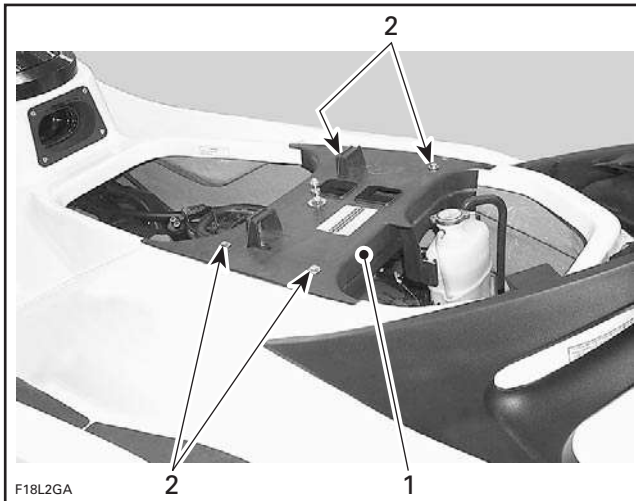
⚠ WARNING

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.



1. Seat support
2. Remove screws

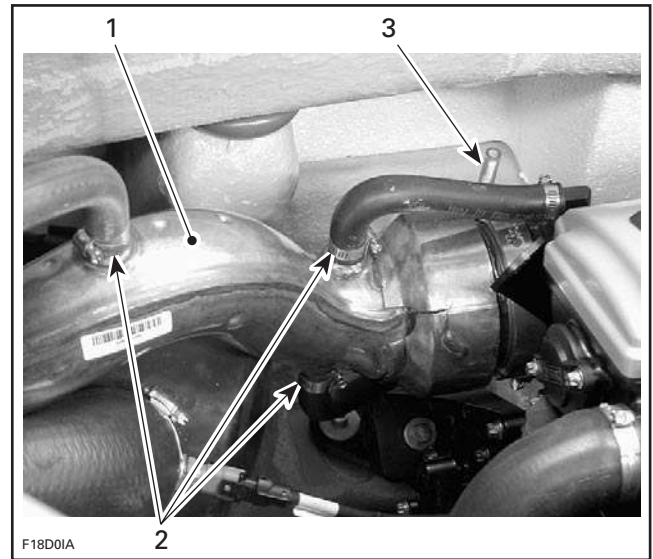
RXP Models

Remove seat.

Remove engine cover. Refer to HULL AND BODY.

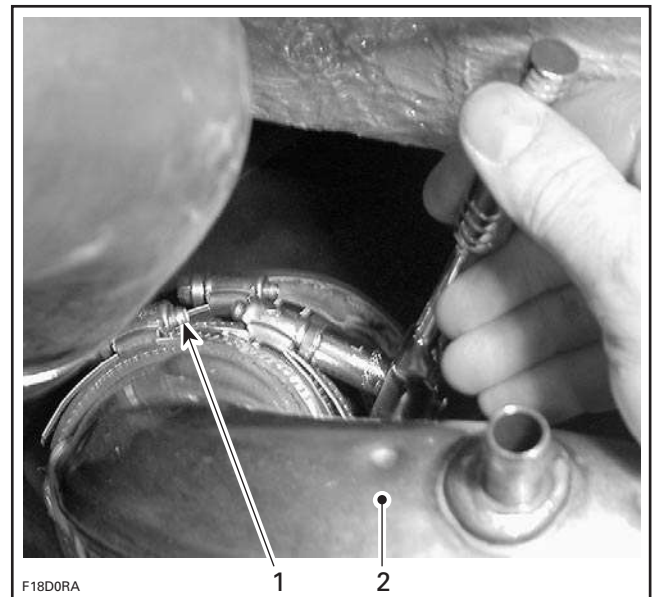
All Models

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



1. Exhaust pipe
2. Gear clamp
3. Exhaust clamp

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.

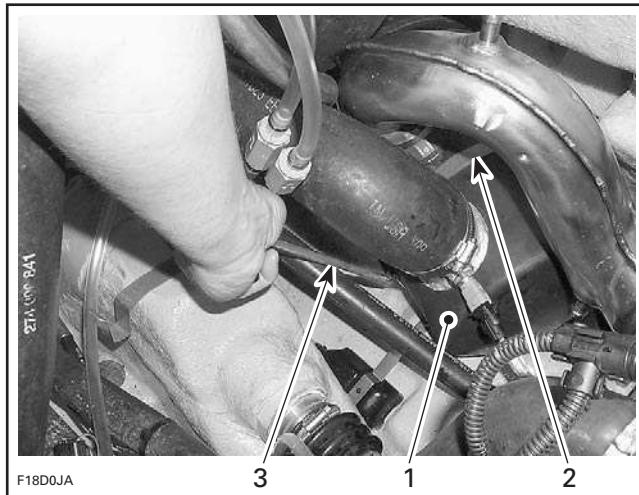
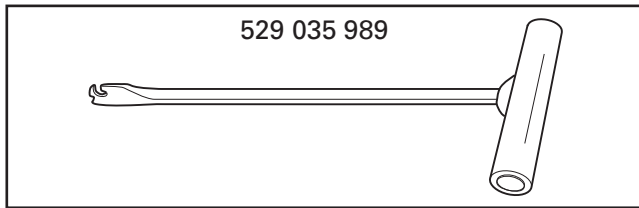


1. Muffler hose clamp
2. Exhaust pipe

Detach the strap no. 5 from the muffler using the spring installer/remover (P/N 529 035 989).

Section 03 ENGINE SYSTEM

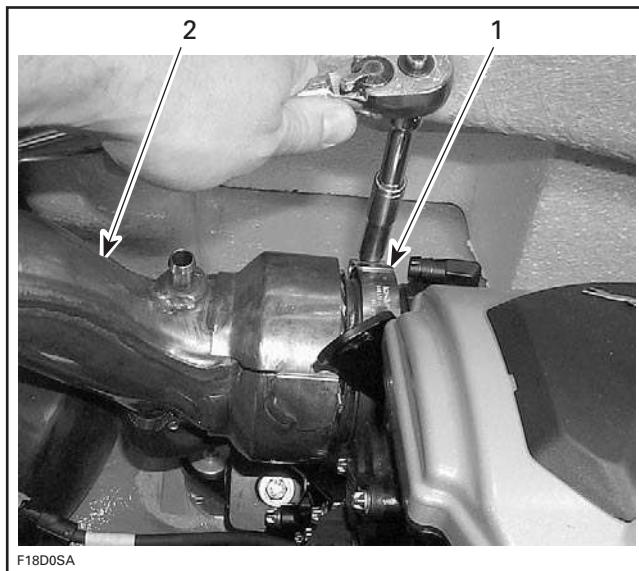
Subsection 04 (EXHAUST SYSTEM)



1. Muffler
2. Strap
3. Spring installer/remover

Slowly unscrew exhaust clamp **no. 6** and remove it.

NOTE: Unscrewing the nut too fast generates heat that will make it harder to unscrew.



1. Exhaust clamp
2. Exhaust pipe

Move muffler **no. 4** backward enough to allow the exhaust pipe to be pulled out.

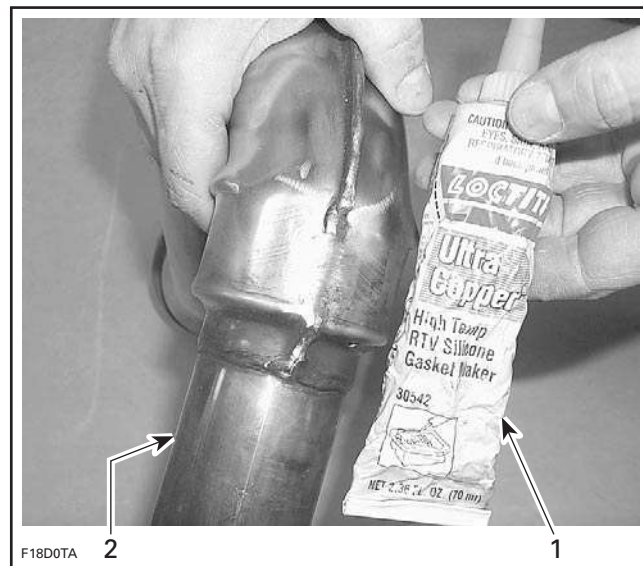
Inspection

Inspect exhaust pipe condition paying attention for cracks or other damage. Check joints, coupling areas, heat shield and hoses. Replace any defective part.

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.



1. High temperature RTV sealant
2. Exhaust pipe straight end

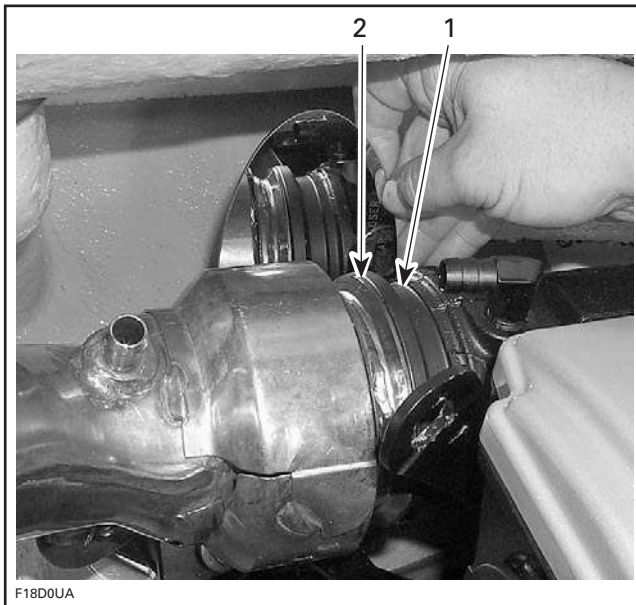
Loosely install clamps **no. 2** on muffler hose **no. 3**.

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.

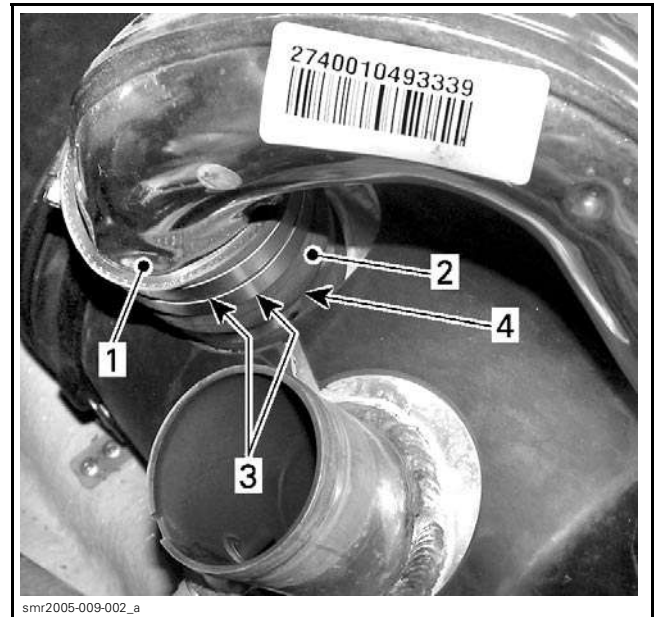
Section 03 ENGINE SYSTEM
Subsection 04 (EXHAUST SYSTEM)



1. Engine manifold
2. Exhaust pipe flange

CAUTION: Exhaust pipe alignment with the manifold is critical to the bellows life. Any constraint on the flexible joint will result in the bellows failure. Gap between the exhaust pipe flange and the engine manifold should not exceed 0.5 mm (1/64 in).

Position clamps **no. 2** to the top portion of the muffler hose. The neighbor clamps must be separated by 4 - 5 mm (5/32 - 3/16 in) and the screws must be at least 25 mm (1 in) apart. Tighten both upper clamps then torque the bottom clamp.



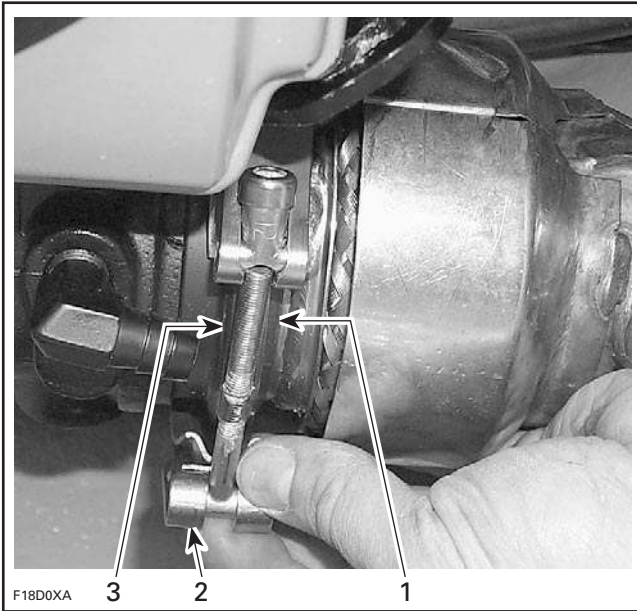
1. Exhaust pipe step
2. Muffler hose
3. Muffler hose clamp 4 - 5 mm (5/32 - 3/16 in) apart
4. Bottom clamp

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.

Section 03 ENGINE SYSTEM

Subsection 04 (EXHAUST SYSTEM)



1. Exhaust pipe flange
2. Exhaust clamp
3. Engine manifold

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

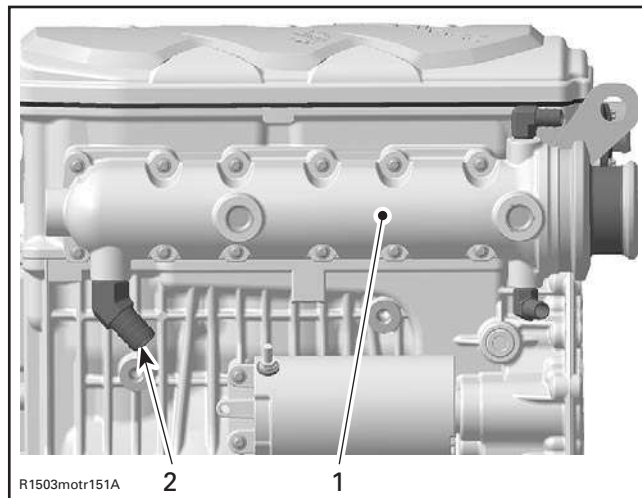
Removal

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.

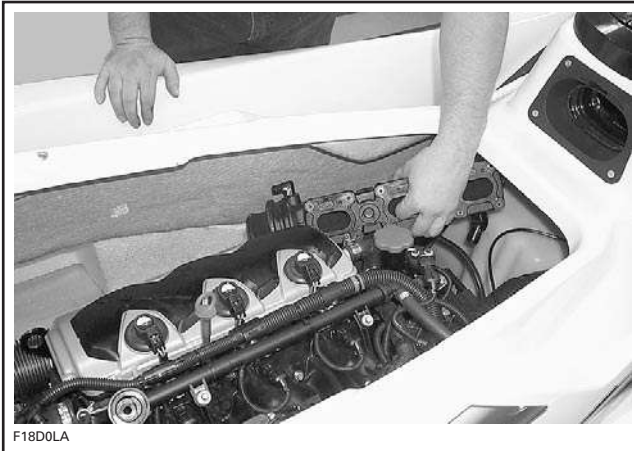


1. Exhaust manifold
2. Cooling system supply hose location

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.



TYPICAL

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

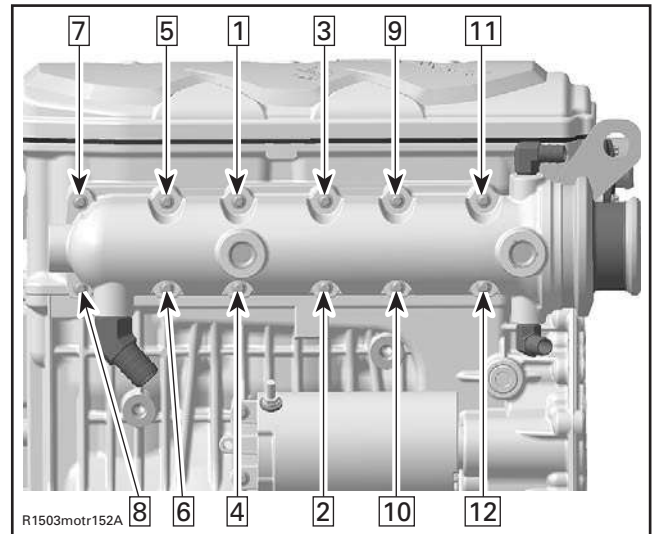
Installation is essentially the reverse of removal procedures. However, pay particular attention to the following.

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).



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.

Section 03 ENGINE SYSTEM

Subsection 04 (EXHAUST SYSTEM)

RESONATOR

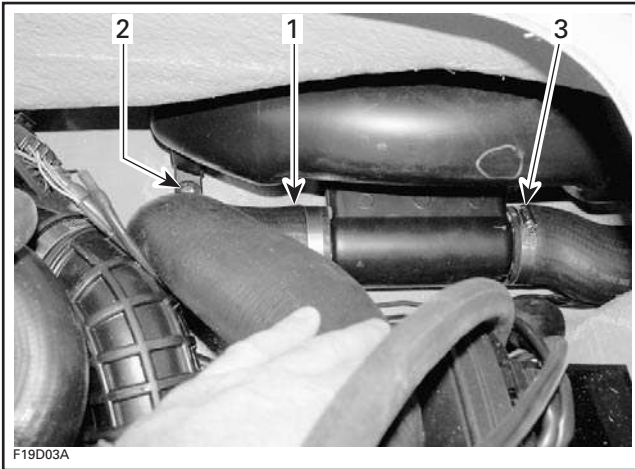
Removal

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 **no. 9** retaining resonator **no. 11**.
Disconnect outlet hose **no. 10** from resonator.



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.

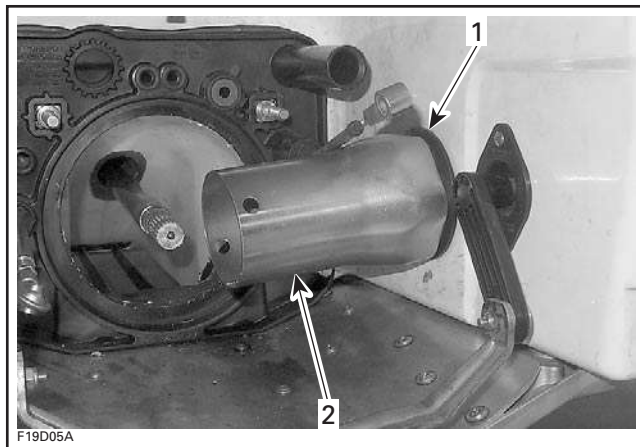
EXHAUST OUTLET

Removal

Remove resonator retaining dart **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 **no. 13** with the exhaust outlet tool (P/N 295 000 132).



TYPICAL

1. Exhaust outlet nut
2. Exhaust outlet 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 293 800 086) on the gasket **no. 14** to seal the bilge.

Test the bilge for water leaks.

REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
Alignment shaft	295 000 141	64
engine alignment adapter	529 035 719	64
Engine alignment adapter	529 035 719	64
plate.....	529 035 507	64
Support plate kit	529 035 506	64
VCK (Vehicle Communication Kit).....	529 035 981	59

SERVICE PRODUCTS

Description	Part Number	Page
BOMBARDIER LUBE	293 600 016	66
dielectric grease	293 550 004	63
Loctite 243 (blue).....	293 800 060	63, 65
pulley flange cleaner.....	413 711 809	63

ENGINE REMOVAL

Use the VCK (Vehicle Communication Kit) (P/N 529 035 981) and release the fuel pressure in the fuel system. Refer to ENGINE MANAGEMENT section.



In order to remove engine from watercraft proceed as follows.

First, 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.

Electrical Connections

It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

Disconnect magneto wiring harness.

Disconnect ground battery cable from engine.

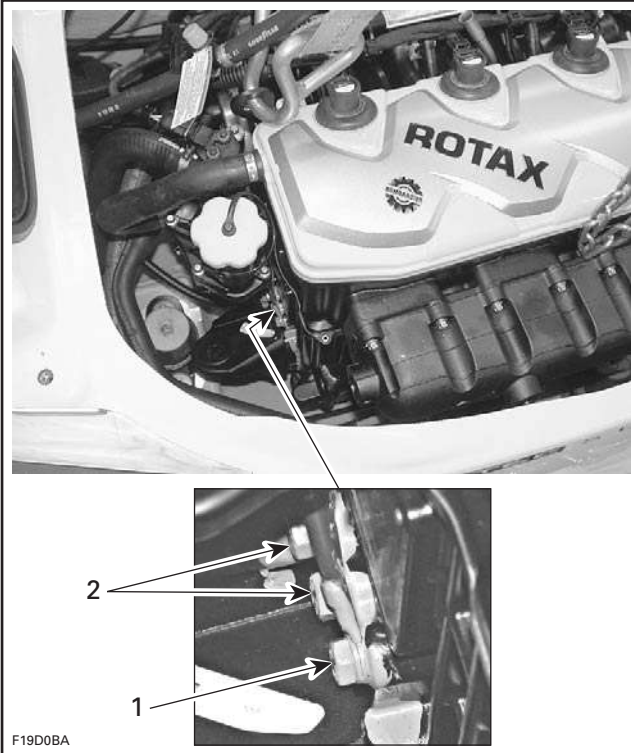
RXP 4-TEC Models

Disconnect ground wires from engine.

Section 03 ENGINE SYSTEM

Subsection 05 (REMOVAL AND INSTALLATION)

All Models



1. Battery ground
2. Engine grounds

GTX 4-TEC Series and RXT 4-TEC

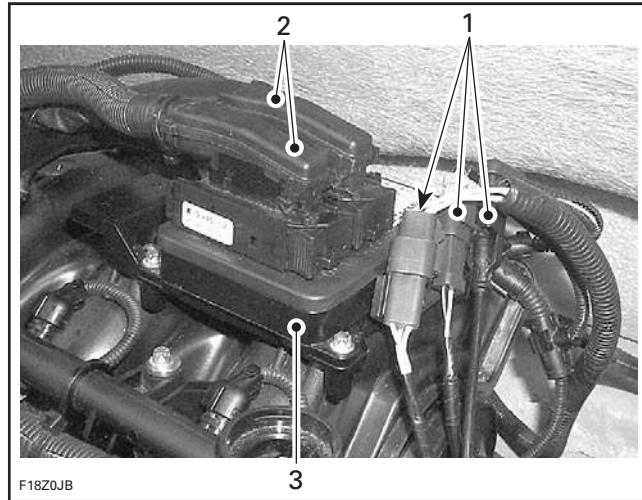
Disconnect the throttle position sensor (TPS), manifold air pressure sensor (MAPS) and manifold air temperature sensor (MATS) (refer to INTAKE section).

Refer to ENGINE MANAGEMENT for location of sensors and connectors.

RXP 4-TEC Models

Remove engine cover. Refer to HULL AND BODY. Remove connectors from engine connector bracket then disconnect. Refer to WIRING DIAGRAMS.

Disconnect ECM and remove from engine to prevent any possible damage while pulling engine out.



1. Remove connectors
2. Disconnect ECM
3. Remove ECM

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

Exhaust Pipe

To remove exhaust pipe, refer to EXHAUST SYSTEM in ENGINE section.

O.P.A.S.

To disconnect O.P.A.S., refer to STEERING section.

Jet Pump Removal

To withdraw jet pump, refer to PROPULSION section.

Drive System

To withdraw drive shaft, refer to PROPULSION section.

Cooling System

Drain cooling system, refer to COOLING SYSTEM section.

To remove cooling system hoses, refer to COOLING SYSTEM section.

Disconnect hoses at engine coming from ride plate and coolant expansion tank.

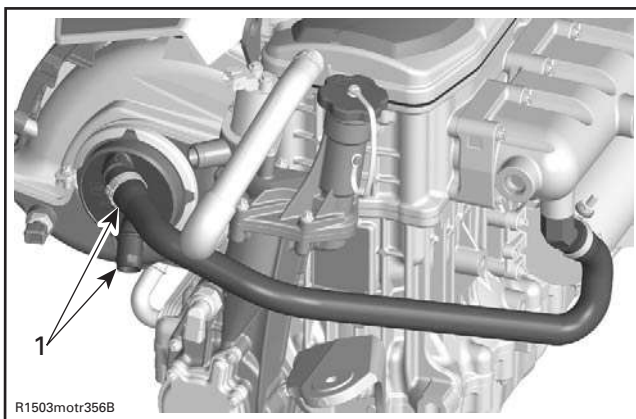
GTX 4-TEC Series and RXT 4-TEC

Intake Manifold

To remove intake manifold, refer to INTAKE section.

On Supercharged models, remove inlet tube from supercharger and air duct.

On Intercooled models, disconnect water hoses from intercooler.



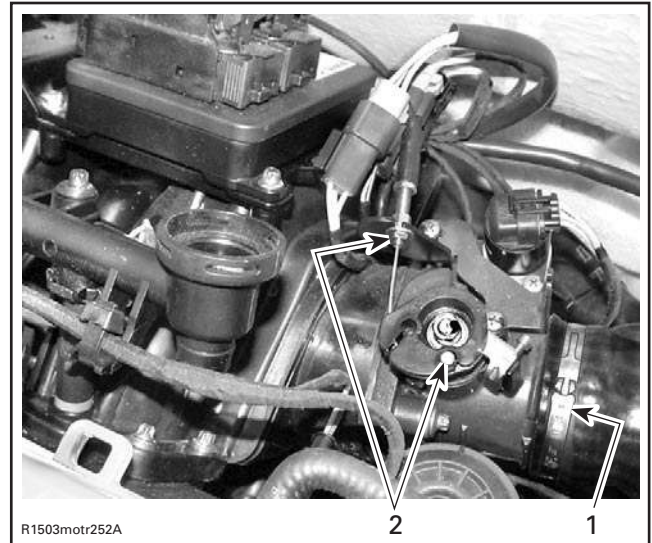
1. Disconnect hoses here

RXP 4-TEC Models

Throttle Cable

Remove inlet hose from throttle body.

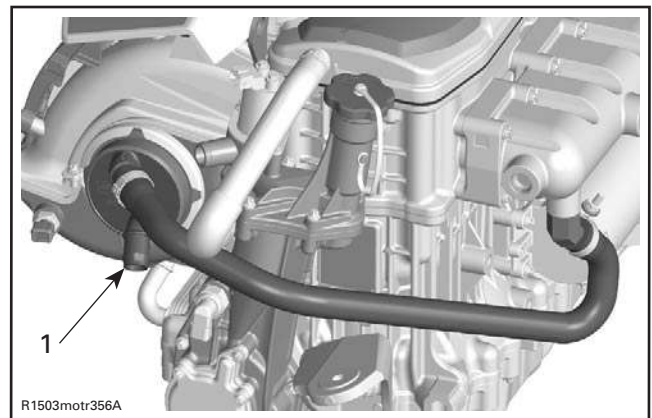
Disconnect throttle cable from throttle body.



1. Detach hose
2. Disconnect cable

Disconnect fuel rail supply line.

Disconnect water inlet hose coming from jet pump connected to the intercooler.



1. Disconnect hose here

Disconnect TOPS valve hose.

All 4-TEC Models

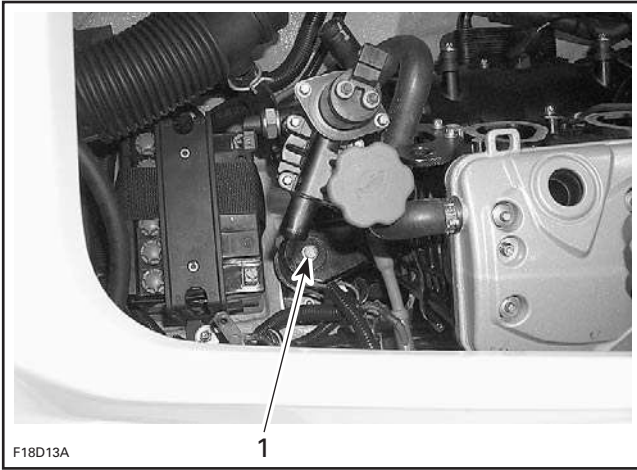
Engine Support

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.

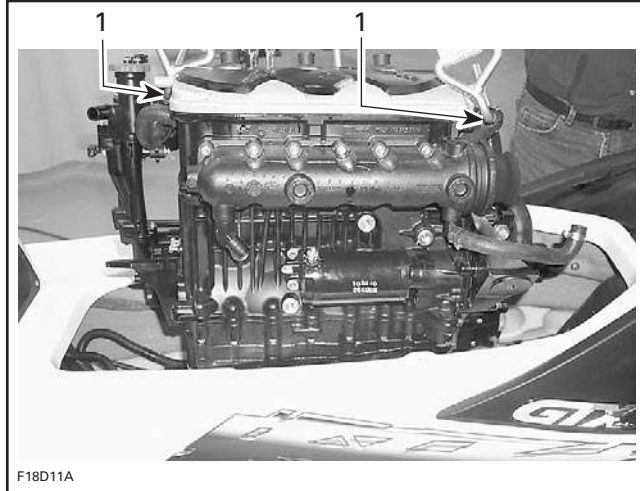
Remove engine support mount screws.

Section 03 ENGINE SYSTEM

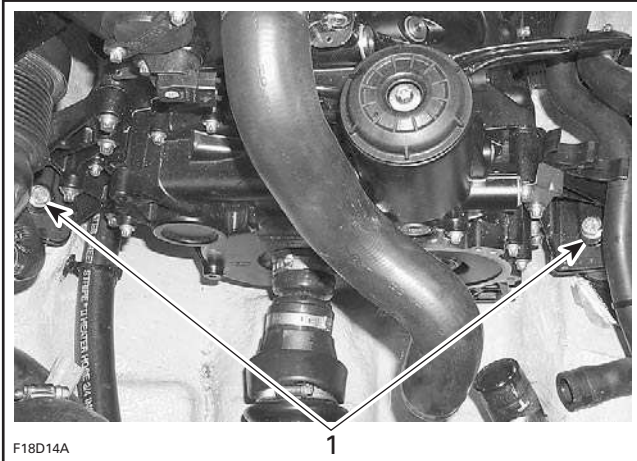
Subsection 05 (REMOVAL AND INSTALLATION)



FRONT SUPPORT
1. Remove screw



TYPICAL
1. Lifting brackets

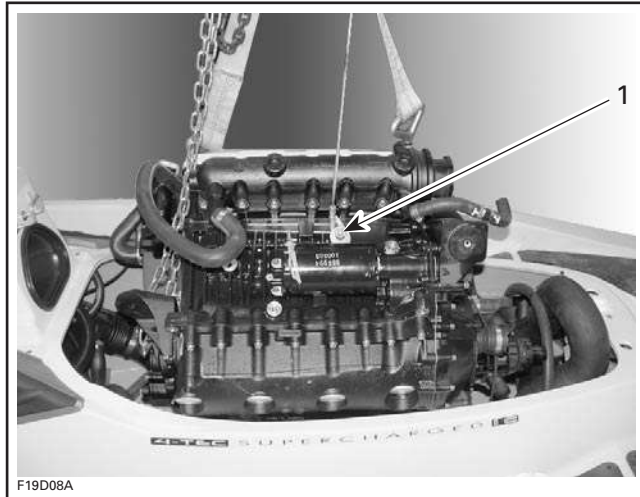


REAR SUPPORT
1. Remove screws

Lifting Engine

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.

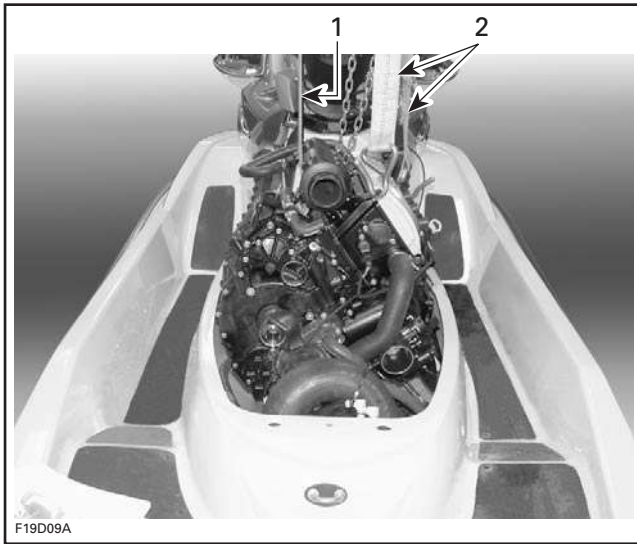


1. Hook-up a steel rope/chain here

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

Section 03 ENGINE SYSTEM

Subsection 05 (REMOVAL AND INSTALLATION)

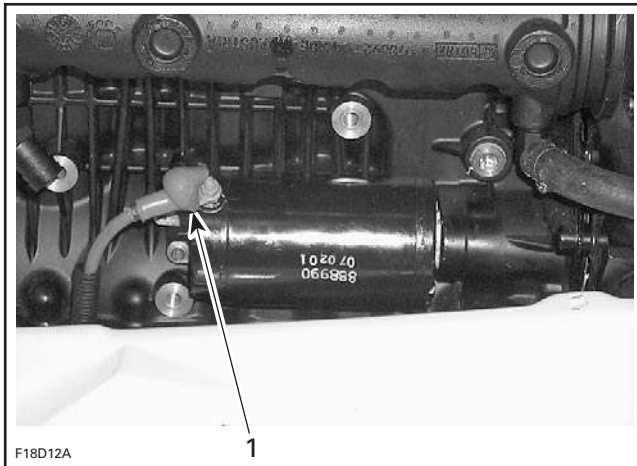


1. Lift steel rope/chain here to rotate engine
2. Usual lifting brackets

All Models

Removal of Remaining Components

Disconnect RED positive cable from starter post.



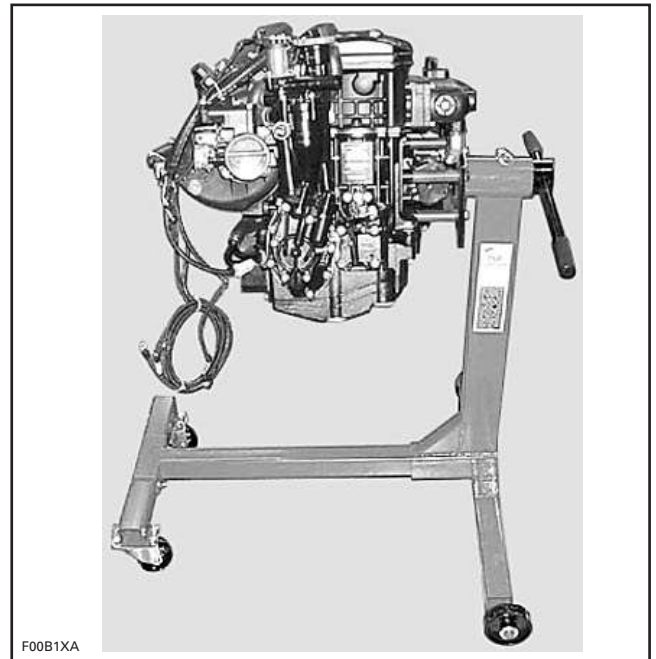
TYPICAL

1. Disconnect RED positive cable

Carry on engine lifting to remove from the body opening.

CAUTION: Be careful not to scratch body or to hit any component.

NOTE: An engine stand may be used to hold engine.



CLEANING

Wipe off any spillage in bilge. Clean with the pulley flange cleaner (P/N 413 711 809).

Clean external parts of engine.

INSTALLATION

CAUTION: Whenever engine is removed from watercraft, engine/jet pump alignment must be performed at reinstallation.

Installation of engine in watercraft is essentially the reverse of removal procedures. However pay particular attention to the following.

Rubber Mount, Shim and Screw

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.

Positive Starter Cable and Grounds

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.

Section 03 ENGINE SYSTEM

Subsection 05 (REMOVAL AND INSTALLATION)

Ensure contact surface is perfectly clean then re-connect grounds wires/cable to engine.

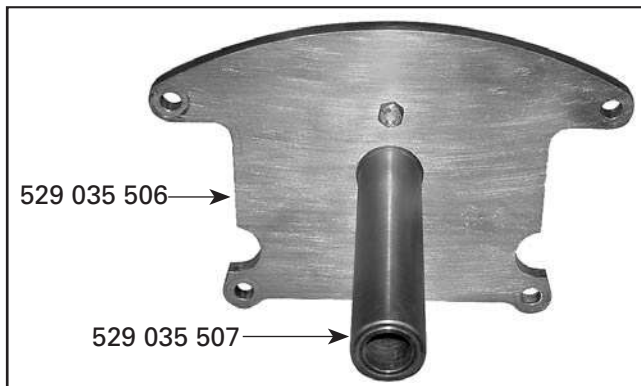
Engine Support

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

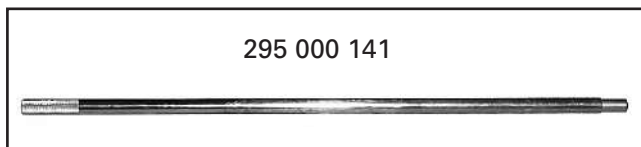
Engine/Jet Pump Alignment

Alignment is necessary to eliminate possible vibration and/or damage to components. Check alignment of engine using the following alignment tools.

Support plate kit (P/N 529 035 506) and plate (P/N 529 035 507).



Alignment shaft (P/N 295 000 141).

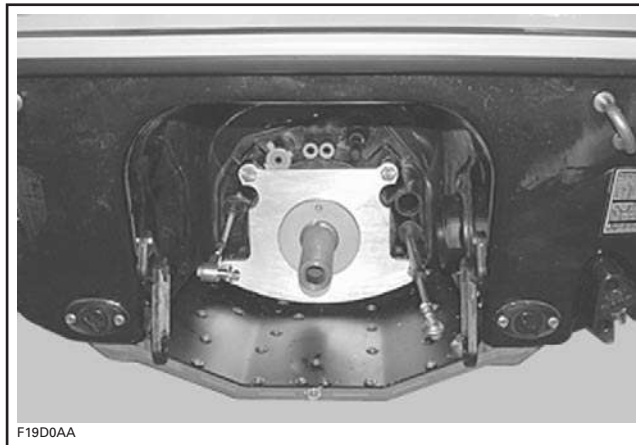


Engine alignment adapter (P/N 529 035 719).

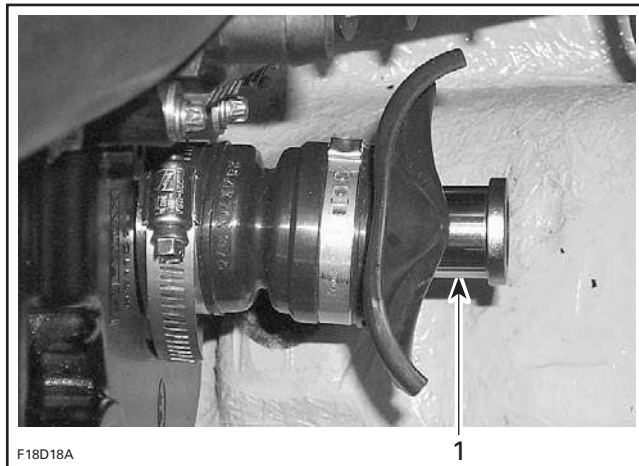


To verify alignment proceed as follows:

- Secure plate and support to hull with four nuts.



- Install engine alignment adapter (P/N 529 035 719) in engine PTO housing.

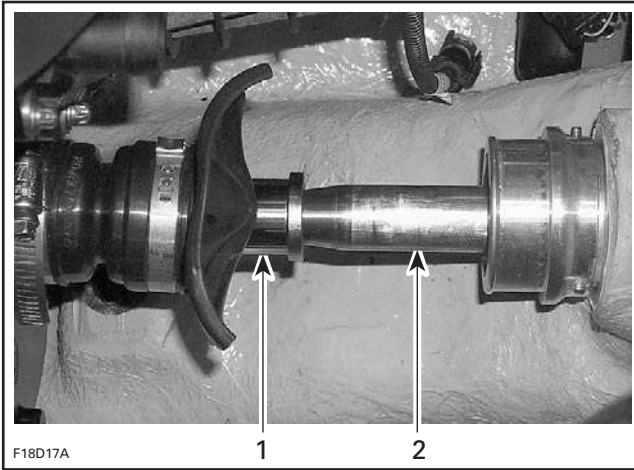


1. Engine alignment adapter

- 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.

Section 03 ENGINE SYSTEM
Subsection 05 (REMOVAL AND INSTALLATION)

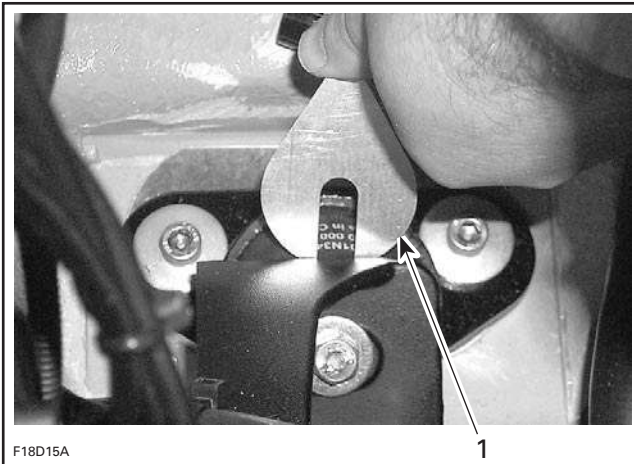


TYPICAL
1. Engine alignment adapter
2. Alignment shaft

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

NOTE: Use shim(s) (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.

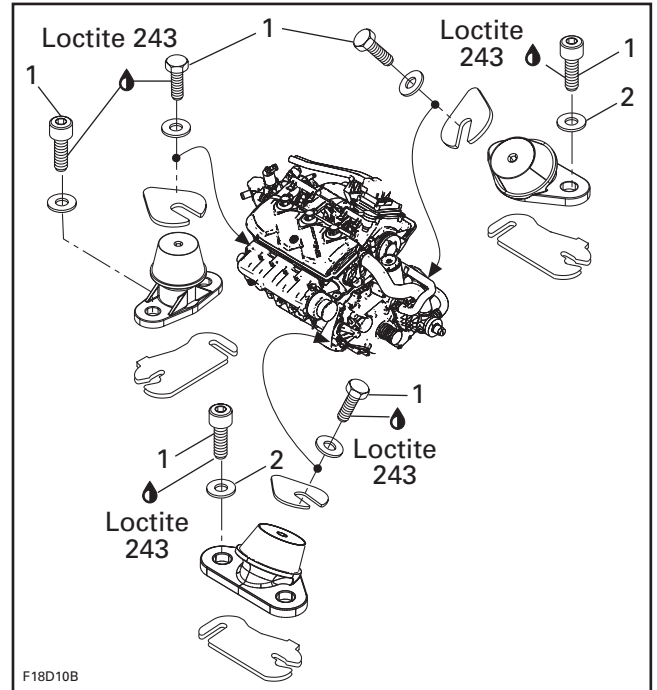


TYPICAL
1. Shim

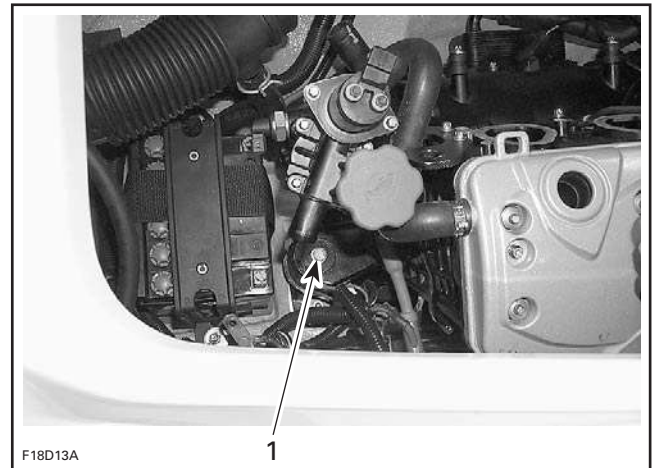
Engine Support Screws

Apply Loctite 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.



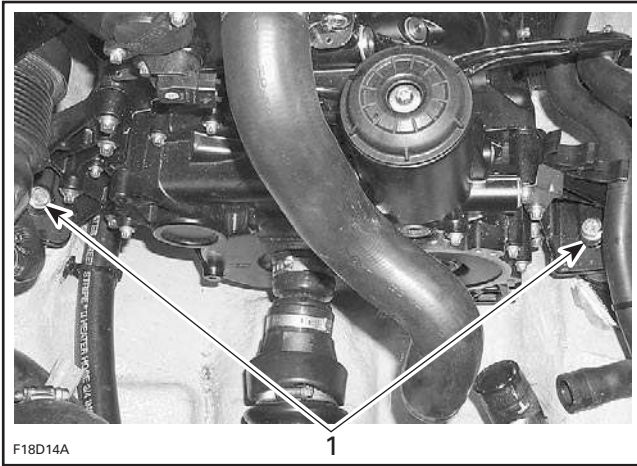
1. Torque to 25 N•m (18 lbf•ft)
2. Position washer to have the "T" mark on top



1. Torque to 25 N•m (18 lbf•ft)

Section 03 ENGINE SYSTEM

Subsection 05 (REMOVAL AND INSTALLATION)



1. Torque to 25 N•m(18 lbf•ft)

Properly align exhaust pipe. Refer to EXHAUST SYSTEM in ENGINE section.

Final Inspection

Check throttle cable condition and lubricate it with BOMBARDIER LUBE (P/N 293 600 016) lubricant.

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 section.

WARNING

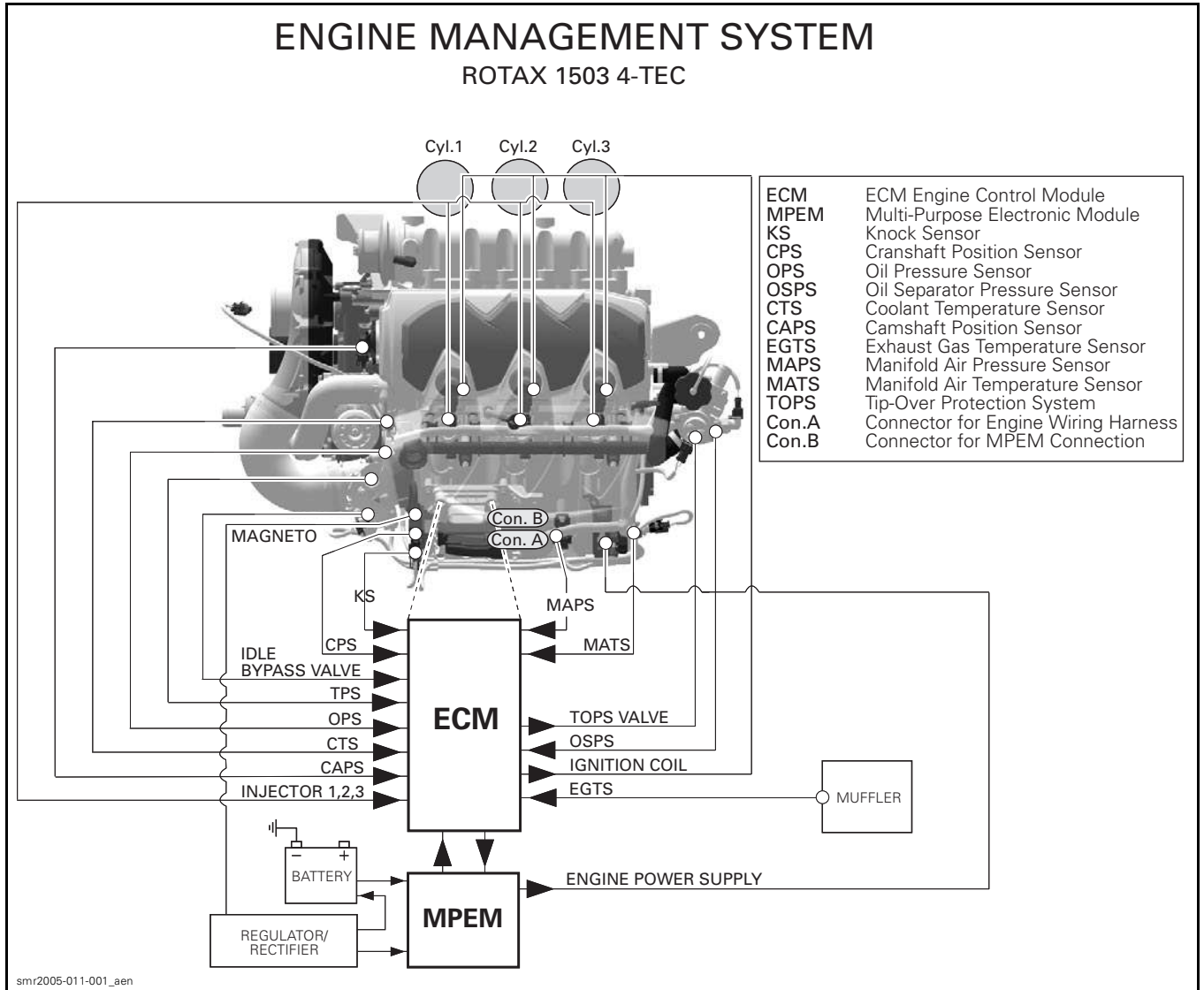
Whenever doing any type of repair on watercraft or if any components of the fuel system are disconnected, a pressure test must be done before starting engine.

Verify all electrical connections.

Run engine and ensure there is no leakage.

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

OVERVIEW



Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 01 (OVERVIEW)

OPERATING PRINCIPLE

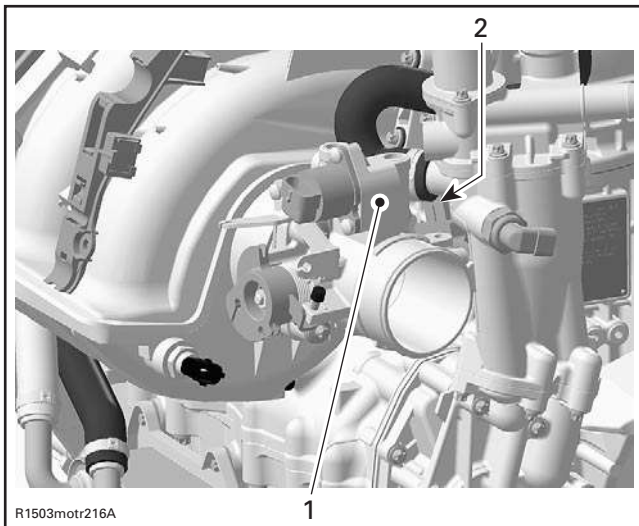
AIR INDUCTION

Throttle Body

It is a 52 mm throttle body mounted on 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.

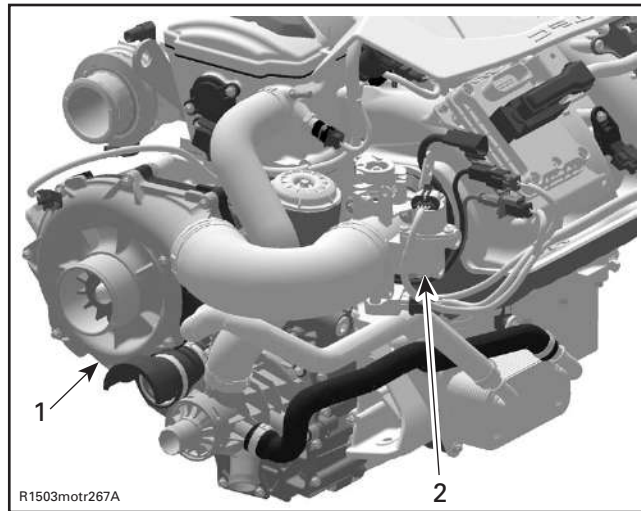


52 MM THROTTLE BODY

1. Idle bypass valve
2. Throttle position sensor (TPS)

4-TEC Supercharged Engine

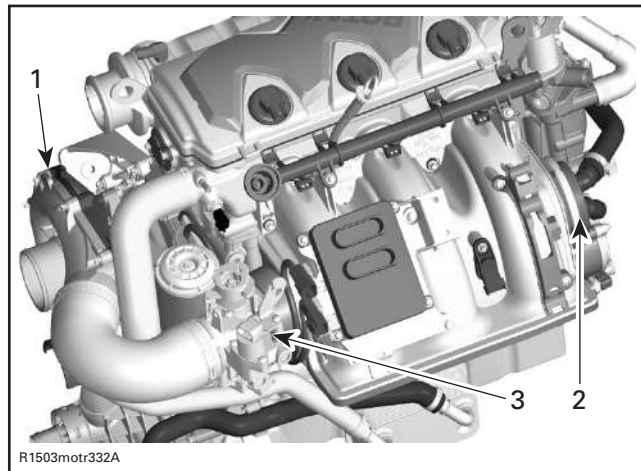
Air for combustion is drawn at the back of the engine by a mechanical driven supercharger. The compressed air flows through the throttle body and is controlled by a throttle plate and an idle bypass valve. The air continues through the intake manifold, which contains the flame arrester and goes into the cylinder head.



1. Supercharger
2. Throttle body

4-TEC Supercharged Intercooled Engine

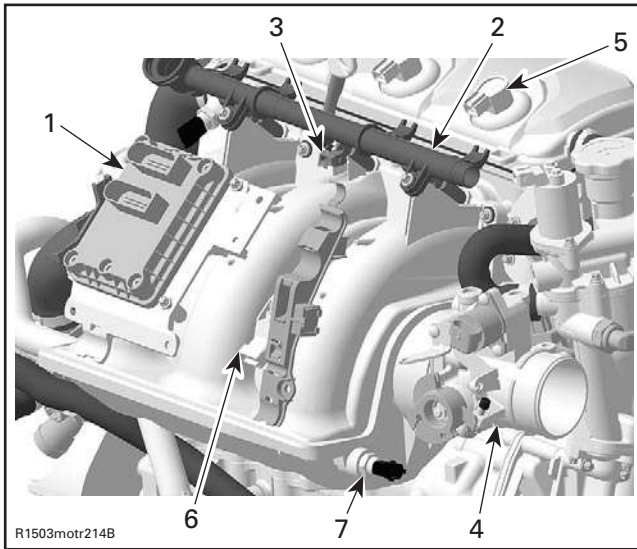
Air for combustion is drawn at the back of the engine by a mechanical driven supercharger. The compressed air flows through the throttle body and is controlled by a throttle plate and an idle bypass valve. The air continues through the intake manifold, which contains the water/air intercooler (which cools down the intake air) and goes into the cylinder head.



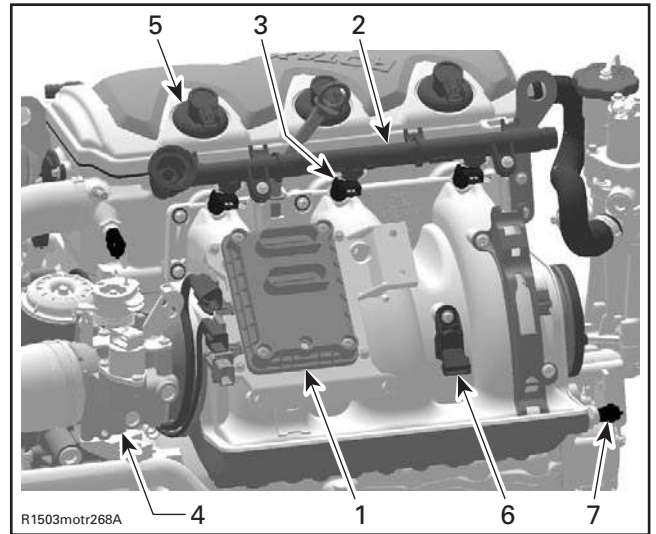
1. Supercharger
2. Intercooler
3. Throttle body

Intake Manifold

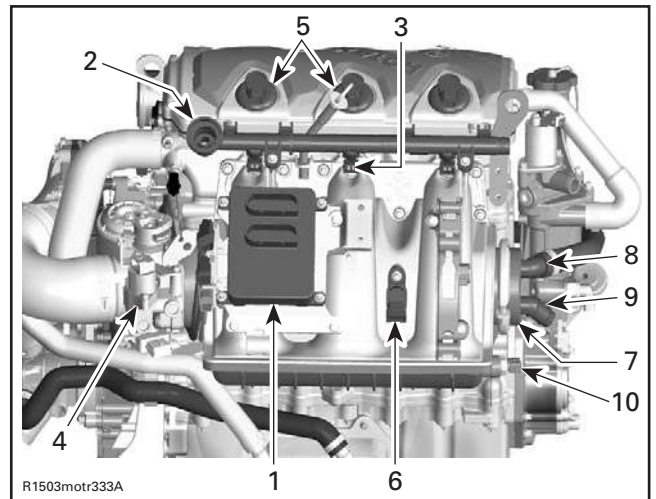
The intake manifold is mounted on the RH side of the cylinder block. It provides support for the fuel injectors, the fuel rail, the ECM, the flame arrester and the throttle body. The intake manifold is a resonator between the throttle body and the cylinder head.



INTAKE MANIFOLD (4-TEC)
 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. Manifold air temperature sensor (MATS)



INTAKE MANIFOLD (4-TEC SUPERCHARGED INTERCOOLED)
 1. Engine Control Module (ECM)
 2. Fuel rail
 3. Injector
 4. Throttle body
 5. Ignition coil
 6. Manifold air pressure sensor (MAPS)
 7. Intercooler
 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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 01 (OVERVIEW)

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, the EMS (engine management system) controls the engine management and the information center is used to display information that comes both from MPEM and EMS.

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).

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

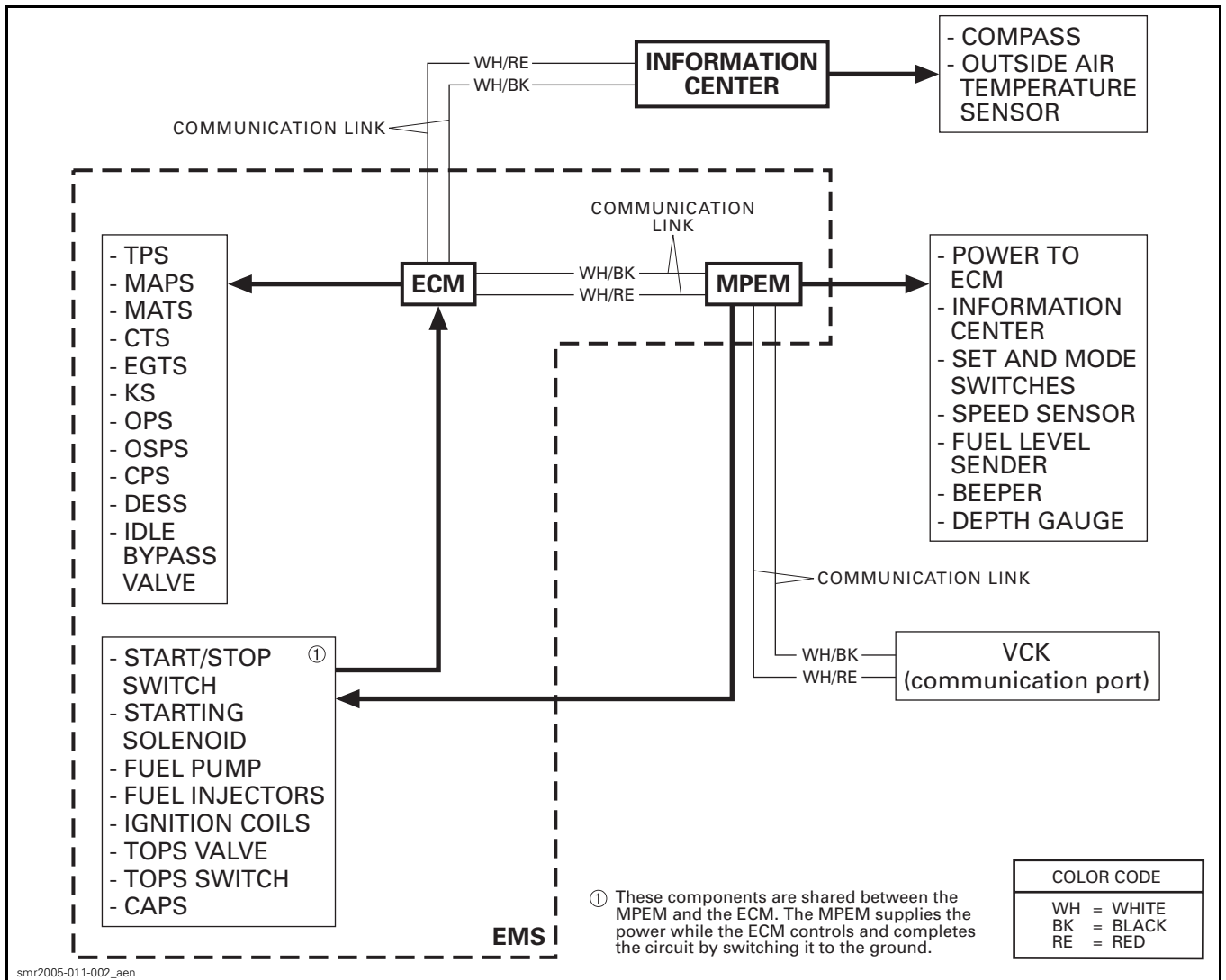
Subsection 01 (OVERVIEW)

For communication link troubleshooting, refer to INSTRUMENTS AND ACCESSORIES in ELECTRICAL section.

The fault codes can be seen from either the information center or B.U.D.S. Refer to DIAGNOSTIC PROCEDURES section.

The communication link is also used to communicate informative messages, monitoring and diagnostic codes to the information center and to the VCK (vehicle communication kit) where B.U.D.S. (Bombardier utility and diagnostic system) is used for diagnosing and troubleshooting the system.

ECM and VCM Interaction with Electrical System



Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 01 (OVERVIEW)

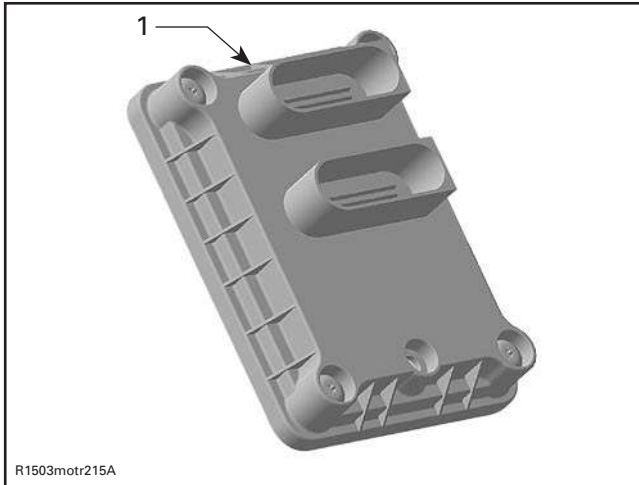
ENGINE MANAGEMENT SYSTEM (EMS)

A highly advanced EMS has been used to ensure a high power output with cleanest combustion. The EMS calculates the proper air/fuel mixture and ignition timing for each cylinder separately.

NOTE: The EMS includes an ECM (engine control module), MPEM (multi-purpose electronic module), sensors, injectors, electromagnetic valves and ignition components.

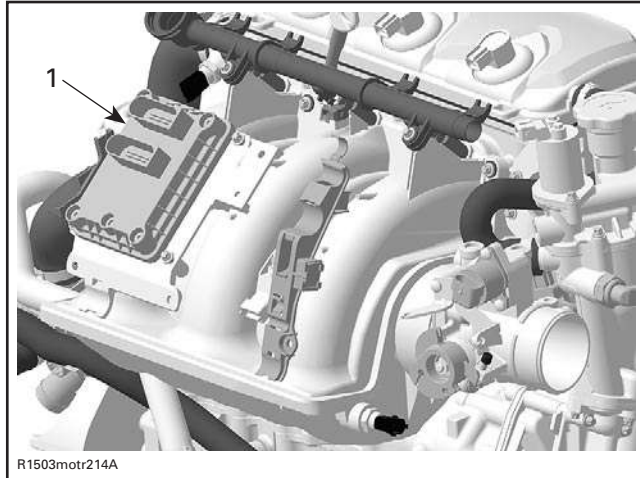
The EMS is controlled by its ECM (Engine Control Module).

ECM (Engine Control Module)



TYPICAL
1. ECM

The ECM is mounted on the intake manifold. It controls all engine management functions, by processing the information given by various sensors.



TYPICAL
1. ECM on intake manifold

The ECM gets its power by the MPEM which is directly powered by the battery. It is responsible for the following engine management/electrical functions:

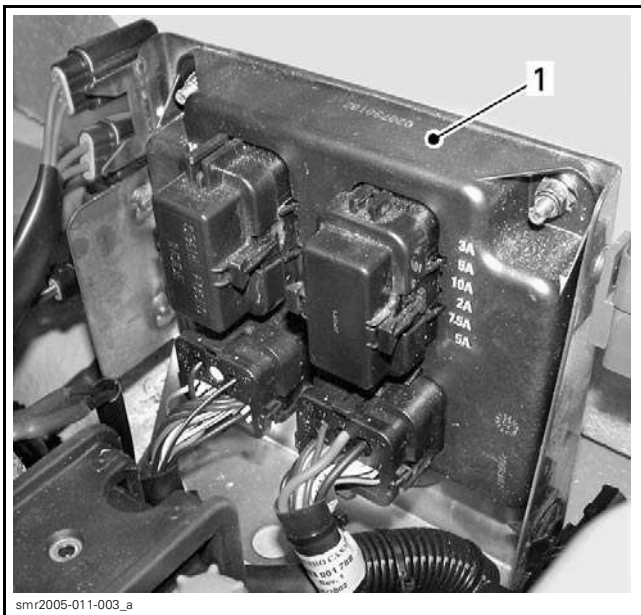
- interpreting information
- distributing information
- start/stop function
- DESS (Digitally Encoded Security System)
- ignition timing control
- injection control
- engine RPM limiter
- etc.

The ECM applies the proper map (injection and ignition) for optimum engine operation in all conditions.

The ECM also stores the fault codes and general information such as: operating conditions, vehicle hours, serial numbers, customer and maintenance information. The ECM features a permanent memory that will keep these informations, even when the battery is removed from the aircraft.

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.



1. MPEM

IMPORTANT: Some components are continuously powered with the supply from the battery through 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.

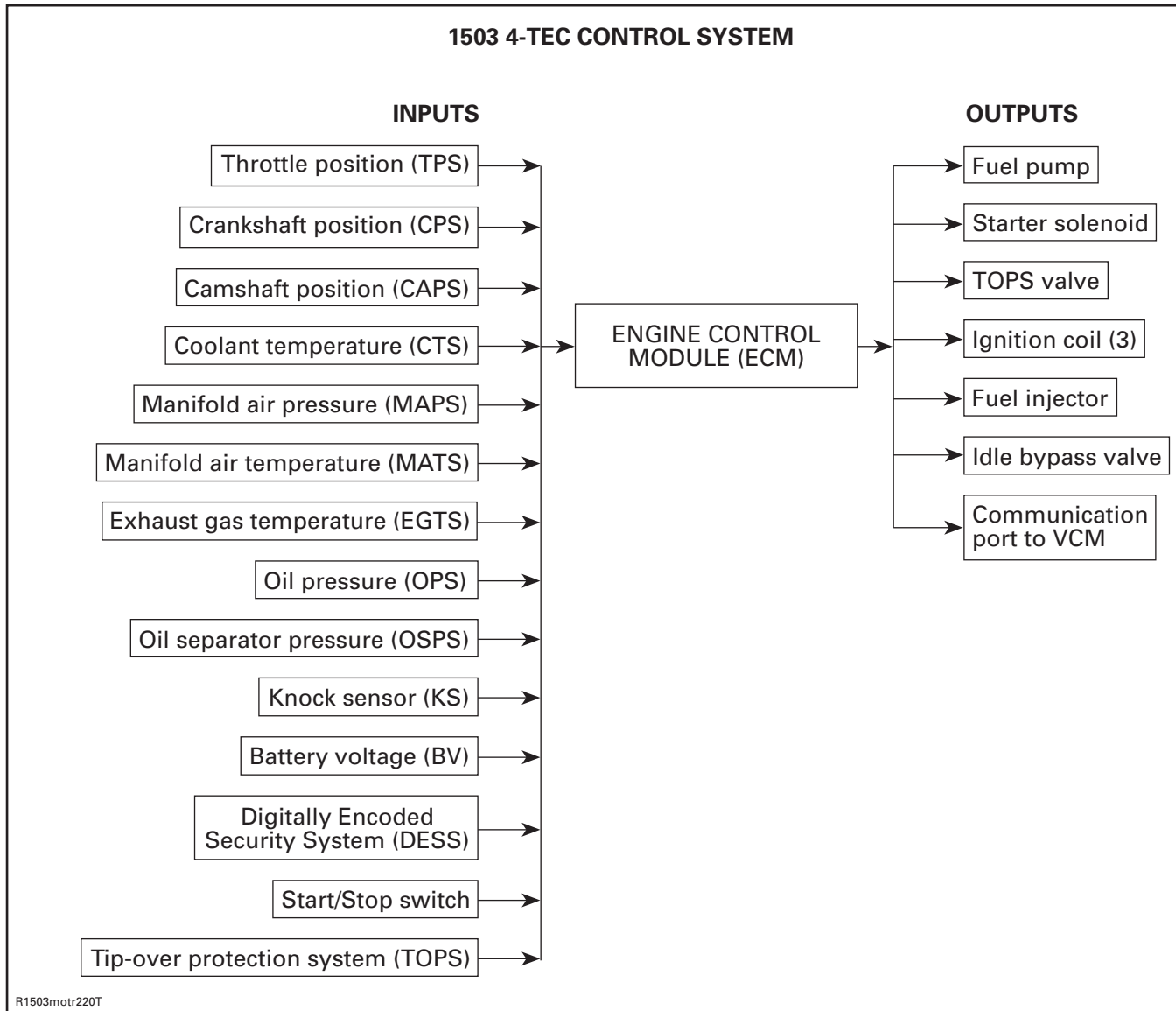
Use the Options area in the **Setting** tab in B.U.D.S.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 01 (OVERVIEW)

EMS — ENGINE MANAGEMENT SYSTEM FUNCTIONS

As shown in the 1503 4-TEC CONTROL SYSTEM illustration, 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.



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 spark timing, duration and firing order to achieve the proper engine requirements. Refer to IGNITION SYSTEM.

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 adjustment of the ignition timing is required.

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 mode) until detonation stops. The ECM is able to evaluate the knocking cylinder and modifies the ignition advance just on the detonating one.

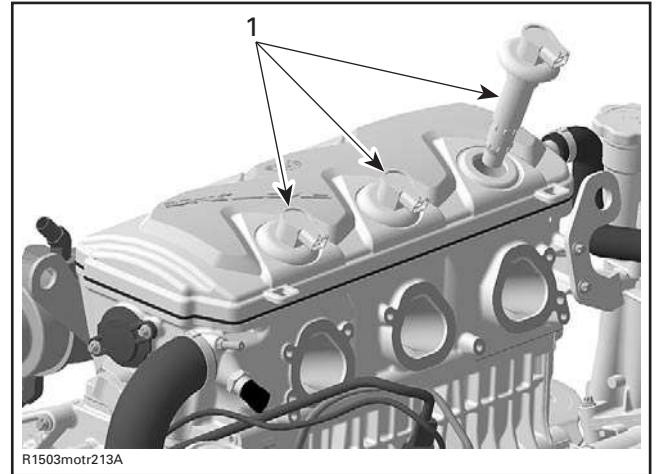
Ignition Coils

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.



R1503motr213A

TYPICAL
1. Ignition coils

Digitally Encoded Security System (DESS)

This system allows starting the vehicle only with safety lanyard(s) that has been programmed to operate a specific watercraft. This functionality is the DESS system.

NOTE: If desired, a safety lanyard can be used on other watercraft equipped with the DESS. It only needs to be programmed for that watercraft.

The DESS circuitry in the ECM is activated at the factory. Therefore, a safety lanyard must be programmed to start the engine.

The following components are specially designed for this system: Multi-Purpose Electronic Module (MPEM), ECM, safety lanyard cap and safety lanyard post.

The safety lanyard 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.

The system is quite flexible. Up to 8 safety lanyards may be programmed in the memory of the ECM. They can also be erased individually.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 01 (OVERVIEW)

NOTE: The memory of the ECM is programmed to recognize the digital code of the safety lanyard cap. This is achieved with the VCK (Vehicle Communication Kit) (P/N 529 035 981). Refer to B.U.D.S. help system to program a safety lanyard.

The ECM also offers a special safety lanyard — the Sea-Doo® Learning Key™ — which can be programmed so that the vehicle can be run only at a limited speed — approximately 55 km/h (35 MPH). Such feature is ideal for first time riders or renters.

WARNING

When programming a Sea-Doo® Learning Key™, use only a lanyard that is identified for that purpose. Otherwise, a customer could use a vehicle with a greater speed than he was expecting.

When connecting a safety lanyard cap on the post, the DESS is activated and will emit audible signals:

- 2 short beeps indicate a working safety lanyard. Engine starting can take place.
- 1 long beep indicates a wrong safety lanyard is being used or that something is defective. Engine starting is not allowed.

The ECM features a self-diagnostic mode. Refer to DIAGNOSTIC PROCEDURES section for more information.

When ordering a new ECM from the regular parts channel, the DESS circuitry will be activated.

Safety Lanyard Reminder

If engine is not started within 5 seconds after installing the safety lanyard on its post, 4 very short beeps every 3 second interval will sound for approximately 4 hours to remind you to start the engine or to remove safety lanyard. Afterwards, the beeps will stop. The same will occur when safety lanyard is left on its post 5 seconds after engine is stopped.

Always ensure safety lanyard is not left on its post after engine is stopped.

IMPORTANT: Leaving the safety lanyard on its post when engine is not running will slowly discharge the battery.

Engine Modes of Operation

The ECM controls different operation modes of the engine to allow proper operation for all possible conditions: Cranking, start-up, idle, warm up, part load, full load, Sea-Doo® Learning Key™ (limited vehicle speed), engine speed limiter, flooded engine and limp home.

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 COMPONENT INSPECTION AND ADJUSTMENT subsection.

WARNING

When disconnecting coil from spark plug, always disconnect coil from main harness first. Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as spark may cause fuel vapor to ignite.

If engine is water-flooded, refer to WATER FLOODED ENGINE in MAINTENANCE section.

Limp Home Modes

Besides the signals as seen above, the ECM may automatically use 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, OPS, OSPA and TOPS.

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 reinstalling 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. Refer to the DIAGNOSTIC PROCEDURES for a complete chart.

If a fault occurs and involves a limp home mode operation, the engine management system will reduce engine RPM gradually to the proper level.

Monitoring System

The ECM monitors the electronic components of the fuel injection system and also the engine components of the electrical system. The MPEM monitors the vehicle electrical system and the accessories. 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. Refer to the DIAGNOSTIC PROCEDURES section for the displayed messages and the beeper coded signals chart.

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 gauge.

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 gauge. 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.

Diagnostic Mode

The malfunctions are recorded in the memory of the ECM. The memory of the ECM can be checked using the VCK (Vehicle Communication Kit) (P/N 529 035 981) to see the fault codes. The ECM and the VCK are able to communicate through a connector on the vehicle. Refer to the DIAGNOSTIC PROCEDURES section.

DIAGNOSTIC PROCEDURES

SERVICE TOOLS

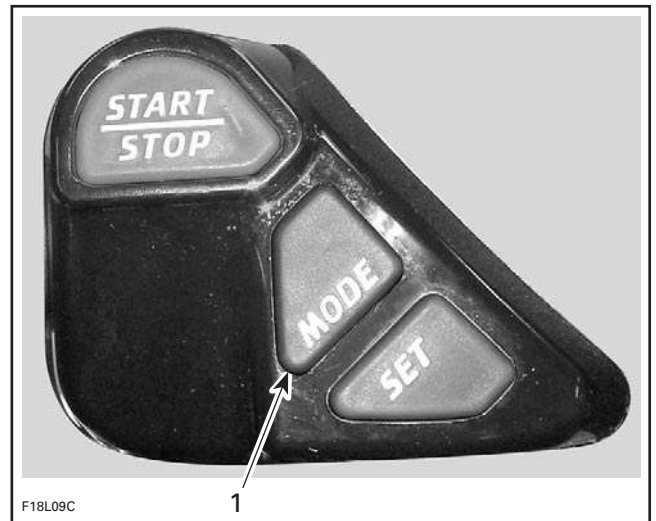
Description	Part Number	Page
VCK (Vehicle Communication Kit)	529 035 981	105

GENERAL

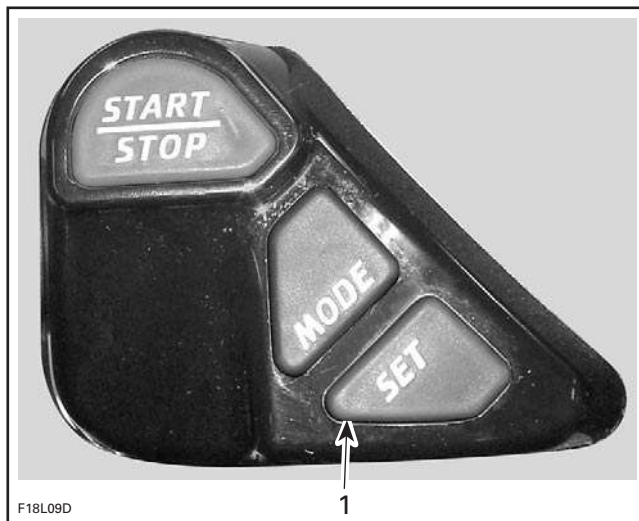
Here is the basic order suggested to diagnose a suspected engine management or fuel injection related problem.

- Check the chart in 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 the VCK (Vehicle Communication Kit) and look for fault codes to diagnose the trouble.

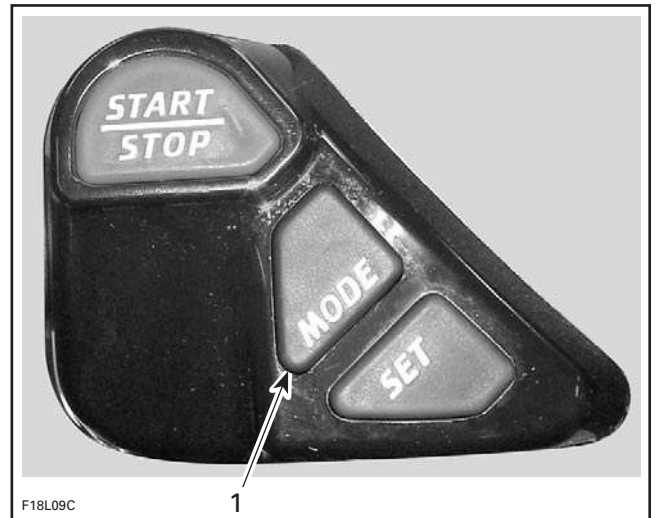
NOTE: Fault codes, the letter P — followed by 4 digits (P-1234), can be displayed in the information center for troubleshooting. With safety lanyard on its post, press 5 times the SET button to start the display of P-codes (onboard diagnostic). Press MODE to scroll codes if more than one is present. When the "list" is over, END will appear. When END appears, press MODE to exit.



1. Press to scroll if more than one P-code



1. Press 5 times to activate display of P-codes (onboard diagnostic)



1. When END appears, press MODE to exit

- Check all fuses.
- Check fuel rail pressure.
- Check spark plugs condition.
- Check fuel pump pressure.
- Check all connections of the wiring harness.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

- Refer to COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT section for procedures.

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.

TERMS USED IN THIS MANUAL	TERMS USED IN OTHER DOCUMENTS SOFTWARES
Camshaft	Cam
Communication link	CAN
Crankshaft	Crank
CTS (Coolant Temperature Sensor)	WTS (Water Temperature Sensor)
ECM	– ECU – Module
EGTS (Exhaust Gas Temperature sensor)	ETS (Exhaust Temperature Sensor)
Idle bypass valve	– DLA (Digital Linear Actuator) – Idle actuator – Idle valve
Information center	Cluster
MAPS (Manifold Air Pressure Sensor)	APS (Air Pressure Sensor) or (Atmospheric Pressure Sensor)
MATS (Manifold Air Temperature Sensor)	ATS (Air Temperature Sensor) or (Intake manifold Temperature Sensor)
Oil separator	Oil tank
OSPS (Oil Separator Pressure Switch)	OTPS (Oil Tank Pressure Switch)
Safety lanyard	– DESS key – key
TOPS valve (Tip-Over Protection System)	– Blow-by valve – BBV

Section 04 ENGINE MANAGEMENT (1503 4-TEC)**Subsection 02 (DIAGNOSTIC PROCEDURES)**

SELF-DIAGNOSTIC MODE

Refer to the following chart. For other problems, refer to COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT section.

CODED SIGNALS	POSSIBLE CAUSE	REMEDY
2 short beeps (while installing safety lanyard on post).	<ul style="list-style-type: none">• Confirms safety lanyard signal operation.• Safety lanyard is recognized by the ECM.• Good contact between safety lanyard and DESS post.	Engine can be started.
1 long beep (while installing safety lanyard on post).	<ul style="list-style-type: none">• Bad DESS system connection.• Wrong safety lanyard. • Defective safety lanyard.• Dried salt water or dirt in safety lanyard cap.• Defective DESS post.• Improper operation of ECM or defective wiring harness.	Reinstall safety lanyard cap correctly over post. Use a safety lanyard that has been programmed for the watercraft. If it does not work, check safety lanyard condition with B.U.D.S. Replace safety lanyard if reported defective. Use another programmed safety lanyard. Clean safety lanyard cap to remove salt water. Refer to ENGINE MANAGEMENT section. Refer to ENGINE MANAGEMENT section.
1 short beep followed by 1 long beep.	<ul style="list-style-type: none">• ECM has been set to onboard diagnosis mode.	Remove and reinstall safety lanyard .
4 short beeps every 3 seconds interval for 4 hours.	<ul style="list-style-type: none">• Safety lanyard has been left on its post without starting engine or after engine was stopped.	To prevent battery discharge, remove the safety lanyard from its post.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

CODED SIGNALS	POSSIBLE CAUSE	REMEDY
2 seconds beep every 1 minute interval.	<ul style="list-style-type: none">• Watercraft is upside down.• Engine coolant temperature sensor or circuit malfunction.• Exhaust temperature sensor or circuit malfunction.• Engine oil pressure sensor or circuit malfunction.• Out of range pressure in oil separator tank (engine oil leak).• TOPS sensor or circuit malfunction.• TOPS valve solenoid or circuit malfunction.• Starter solenoid circuit malfunction.• Communication link fault detected by MPEM.• ECM communication link message missing (detected by MPEM).• Information center communication link message missing (detected by MPEM).• Bilge pump circuit low or high voltage (if so equipped).	<p>Turn watercraft upright. If it does not work, check the TOPS switch. Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p> <p>Refer to ENGINE MANAGEMENT section.</p>
A 2 seconds beep every 5 minutes interval.	<ul style="list-style-type: none">• Low fuel level.• Fuel tank level sensor or circuit malfunction.	<p>Refer to INSTRUMENTS AND ACCESSORIES section.</p> <p>Refer to INSTRUMENTS AND ACCESSORIES section.</p>
Continuously beeps.	<ul style="list-style-type: none">• High engine coolant temperature.• High exhaust temperature.	<p>Refer to COOLING SYSTEM.</p> <p>Refer to COOLING SYSTEM.</p>

ENGINE MANAGEMENT SYSTEM 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 VCK. 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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 02 (DIAGNOSTIC PROCEDURES)

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.

POSSIBLE CAUSES	ACTION
Check if connector is disconnected from TPS.	• Fix.
Check if sensor is loose.	• Fix and reset Closed Throttle and Idle Actuator .
Inspect sensor for damage or corrosion.	• Replace and reset Closed Throttle and Idle Actuator .
Inspect wiring (voltage test).	• Repair.
Inspect wiring and sensor (resistance test).	• If bad wiring, repair. • If bad TPS, replace and reset Closed Throttle and Idle Actuator .
Test sensor operation (wear test).	• Replace and reset Closed Throttle and Idle Actuator .

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 partload or low RPM.

POSSIBLE CAUSES	ACTION
Sensor has been replaced and TPS closed position not reset.	• Reset Closed Throttle and Idle Actuator .
Throttle body has been replaced and TPS closed position not reset.	• Reset Closed Throttle and Idle Actuator .
ECM has been replaced and TPS closed position not reset.	• Reset Closed Throttle and Idle Actuator .
Throttle cable too tight.	• Fix and reset Closed Throttle and Idle Actuator .
Sensor is loose.	• Fix and reset Closed Throttle and Idle Actuator .
Throttle bracket is loose.	• Fix and reset Closed Throttle and Idle Actuator .
Adjustment screw worn or loose.	• Change throttle body.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

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 P1202: See detailed information under OSPS in subsection COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

EMS Fault Code Table

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0106	—	—	Manifold atmospheric pressure sensor out of range	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet.</p> <p>Service action: Check system circuits A-12, A-28 and A-40. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3.</p>										
P0107	—	—	Manifold atmospheric pressure sensor shorted to ground	15	Flash	CHK ENG	N	Y	N	Fault is recovered
	—	—	Manifold barometric pressure sensor shorted to ground	15	Flash	CHK ENG	Y	N	N	Fault is recovered
<p>Possible cause: Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet.</p> <p>Service action: Check system circuits A-12, A-28 and A-40. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3.</p>										

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0108	—	—	Manifold atmospheric pressure sensor shorted to 12 V or open circuit	15	Flash	CHK ENG	N	Y	N	Fault is recovered
	—	—	Manifold barometric pressure sensor open circuit or shorted to 12 V	15	Flash	CHK ENG	Y	N	N	Fault is recovered
<p>Possible cause: Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet.</p> <p>Service action: Check system circuits A-12, A-28 and A-40. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3.</p>										
P0111	—	—	Intake manifold temperature sensor functional problem	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 7 and 21.</p>										
P0112	—	—	Intake manifold temperature sensor shorted to ground	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 7 and 21.</p>										
P0113	—	—	Intake manifold temperature sensor shorted to 12 V or open circuit	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 7 and 21.</p>										

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0116	—	—	Engine temperature sensor functional problem	5	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 11 and 27.</p>										
P0117	—	—	Engine temperature sensor short circuit to ground	5	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 11 and 27.</p>										
P0118	—	—	Engine temperature sensor short circuit to 12 V	5	Flash	CHK ENG	N	Y	N	Fault is recovered
			Engine temperature sensor open circuit	5	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Engine overheated or damaged sensor.</p> <p>Service action: Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins 11 and 27.</p>										

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0122	—	—	Throttle position sensor out of range	15	Flash	CHK ENG	Y	Y	N	Key is removed
	—	—	Throttle position sensor short circuit to ground	15	Flash	CHK ENG	Y	Y	N	Key is removed

Possible cause:

Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.
 Damaged or out of alignment throttle bodies or sensor.

Service action:

Check for 0 volt on sensor connector pin 1.
 Check for 5 volts on sensor connector pin 2.
 Check for 4.5 to 5 volts on sensor connector pin 3.
 With throttle closed, check ECM connector for:
 a) 1000 to 1100 ohms between pins 24 and 39.
 b) 2600 to 2700 ohms between pins 24 and 25.
 c) 1600 to 2400 ohms between pins 125 and 39.
 Check for linear resistance rise when opening throttle.
 Check physical stops for wear.

P0123	—	—	Throttle position sensor out of range – short-circuit to 12 V or open circuit	15	Flash	CHK ENG	N	Y	N	Key is removed
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Possible cause:

Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.
 Damaged or out of alignment throttle bodies or sensor.

Service action:

Check for 0 volt on sensor connector pin 1.
 Check for 5 volts on sensor connector pin 2.
 Check for 4.5 to 5 volts on sensor connector pin 3.
 With throttle closed, check ECM connector for:
 a) 1000 to 1100 ohms between pins 24 and 39.
 b) 2600 to 2700 ohms between pins 24 and 25.
 c) 1600 to 2400 ohms between pins 125 and 39.
 Check for linear resistance rise when opening throttle.
 Check physical stops for wear.

P0231	—	—	Fuel pump shorted to ground or open circuit	15	Flash	CHK ENG	Y	N	N	Fault is recovered
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Possible cause:

Damaged pump, damaged circuit wires, damaged connector or damaged ECM output pins.

Service action:

Check for approximately 1 ohm between pins A and D of the fuel pump connector.
 Check for damaged circuit wires.
 Check for approximately 1 ohm between pins 1-26 and B-29.
 Check for damaged connector, damaged ECM output pins or ECM failure.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0232	—	—	Fuel pump shorted to 12 V	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged pump, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for approximately 1 ohm between pins A and D of the fuel pump connector. Check for damaged circuit wires. Check for approximately 1 ohm between pins 1-26 and B-29. Check for damaged connector, damaged ECM output pins or ECM failure.</p>										
P0261	—	—	Inj. #1 short-circuit to ground or open circuit	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 1 and ECM connector pin 15. Check for 12 volts on pin 2 of injector connector.</p>										
P0262	—	—	Inj. #1 short-circuit to 12 V	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 1 and ECM connector pin 15. Check for 12 volts on pin 2 of injector connector.</p>										
P0264	—	—	Inj. #2 short-circuit to ground or open circuit	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 2 and ECM connector pin 33. Check for 12 volts on pin 2 of injector connector.</p>										
P0265	—	—	Inj. #2 short-circuit to 12 V	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 2 and ECM connector pin 33. Check for 12 volts on pin 2 of injector connector.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0267	—	—	Inj. #3 short-circuit to ground or open circuit	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 3 and ECM connector pin 14. Check for 12 volts on pin 2 of injector connector.</p>										
P0268	—	—	Inj. #3 short-circuit to 12 V	15	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 11.4 to 12.6 ohms between engine connector pin 3 and ECM connector pin 14. Check for 12 volts on pin 2 of injector connector.</p>										
P0326	—	—	Knock sensor out of range	15	Flash	CHK ENG	N	Y	N	Key is removed
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Bring engine to 5000 RPM. If fault code appears then check for approximately 5 Mohms between system circuits A-9 and A-23.</p>										
P0336	—	—	Crank position sensor - wrong engine RPM detected	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.</p> <p>Service action: For the CPS, check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. For the CAPS, refer to camshaft position sensor. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector.</p>										
P0337	—	—	No CPS signal, but CAPS signal detected	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.</p> <p>Service action: Check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. Check for 2 volts AC while cranking the engine.</p>										
P0337	—	—	No CPS signal, but CAPS signal detected	15	Flash	CHK ENG	N	N	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.</p> <p>Service action: Check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0339	—	—	Crank signal fault not plausible with cam signal	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.</p> <p>Service action: For the CPS, check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. For the CAPS, check for 12 volts on sensor connector pin 3. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector.</p>										
P0344	—	—	Cam phase sensor signal missing	15	Flash	CHK ENG	N	Y	N	Engine is stopped
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.</p> <p>Service action: For the CPS, check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. For the CAPS, check for 12 volts on sensor connector pin 3. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector.</p>										
P0351	—	—	Ignition coil #1 open circuit or shorted to ground or to 12 V	15	Flash	CHK ENG	N	Y	5000	Engine is stopped
<p>Possible cause: Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 0.85 to 1.15 ohms between engine connector pin 1 and ECM connector pin A-41. Check for 12 volts on pin 2 of coil connector.</p>										
P0352	—	—	Ignition coil #2 open circuit or shorted to ground or to 12 V	15	Flash	CHK ENG	N	Y	5000	Engine is stopped
<p>Possible cause: Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 0.85 to 1.15 ohms between engine connector pin 2 and ECM connector pin A-1. Check for 12 volts on pin 2 of coil connector.</p>										
P0353	—	—	Ignition coil #3 open circuit or shorted to ground or to 12 V	15	Flash	CHK ENG	N	Y	5000	Engine is stopped
<p>Possible cause: Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for 0.85 to 1.15 ohms between engine connector pin 3 and ECM connector pin A-29. Check for 12 volts on pin 2 of coil connector.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0461	—	Fuel level sensor circuit out of range	—	4	Flash	SENSOR	Y	Y	N	Fault is recovered
Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.										
Service action: Check for 2.6 (full tank) to 93.6 ohms (empty tank) between system circuits 1-1 and 1-21.										
P0462	—	Fuel level sensor shorted to ground	—	4	Flash	SENSOR	Y	Y	N	Fault is recovered
Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.										
Service action: Check for no continuity between system circuit 1-21 and battery ground.										
P0463	—	Fuel level sensor circuit shorted to 12 V or open circuit	—	4	Flash	SENSOR	Y	Y	N	Fault is recovered
Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.										
Service action: Check voltage between system circuit 1-21 and battery ground.										
P0505	—	—	DLA output stage cutoff memory difference	15	Off	CHK ENG	—	—	—	—
	—	—	DLA output stage fault	15	Off	N/A	Y	N	N	Fault is recovered
	—	—	DLA open circuit	15	Off	N/A	Y	N	N	Fault is recovered
	—	—	DLA short circuit to 12 V	15	Off	N/A	Y	N	N	Fault is recovered
Possible cause: Damaged actuator, damaged circuit wires, damaged connector or damaged ECM output pins.										
Service action: Check for approximately 50 ohms between pins A and D and also between pins B and C of the idle bypass valve. Check for damaged circuit wires. Check for approximately 50 ohms between pins A-36 and A-35 and also between pins A-37 and A-38. Check for damaged connector, damaged ECM output pins or ECM failure.										
P0513	—	—	DESS® incorrect key	15	Off	N/A	Y	N/A	N/A	N/A
Possible cause: DESS key not programmed. Wrong DESS key used. DESS key failure.										
Service action: Program the DESS key. Clean DESS key and DESS post contacts.										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0520	—	—	Oil pressure switch functional problem	5	Off	CHK ENG	Y	Y	2500	Fault is recovered
<p>Possible cause: Engine leak, oil pump failure, damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check resistance at 0 RPM and above 3500 RPM. When blow-by pressure exceeds 40 kPa (6 PSI), the resistance is infinitely high.</p>										
P0544	—	—	Exhaust gas temperature sensor functional problem	5	Flash	CHK ENG	N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-10 and A-26.</p>										
P0545	—	—	Exhaust gas temperature sensor shorted to ground	5	Flash	CHK ENG	Y/N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-10 and A-26.</p>										
P0546	—	—	Exhaust gas temperature sensor shorted to 12 V	5	Flash	CHK ENG	N	Y	N	Fault is recovered
	—	—	Exhaust gas temperature open circuit	5	Flash	CHK ENG	Y/N	Y	N	Fault is recovered
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-10 and A-26.</p>										
P0562	—	—	Battery voltage too low	15	Flash	N/A	N	Y	N	Fault is recovered
<p>Possible cause: Battery failure, rectifier failure, damaged circuit wires, battery terminal connection, damaged AC generator or damaged connectors.</p> <p>Service action: Check fuses. Check system circuits 1-25 to positive (+) battery terminal. Check system circuits 1-24 to negative (-) battery terminal.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0563	—	—	Battery voltage too high	15	Flash	N/A	N	Y	N	Fault is recovered
<p>Possible cause: Battery failure, rectifier failure or battery terminal connection.</p> <p>Service action: Check for regulator-rectifier failure.</p>										
P0600	—	—	CAN communication problem detected by EMS	15	Flash	N/A	Y	Y	N	Fault is recovered
<p>Possible cause: Damaged circuit wires, damaged connector, damaged ECM output pins. Diagnostic connector cap not connected.</p> <p>Service action: Check system circuits 1-16 & 1-17, 1-10 & 1-11, 2-10 & 2-11. Connect diagnostic connector cap.</p>										
P0600	—	—	CAN communication problem MPEM message missing	15	Flash	N/A	Y	Y	N	Fault is recovered
<p>Possible cause: Damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check system circuits 2-10 & 2-11.</p>										
P0601	—	—	TPS learns unlikely or checksum fault	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: ECM not coded, damaged ECM or TPS not initialized.</p> <p>Service action: Check cable adjustment. Check idle stop for wear. Check throttle angle at idle. Reset closed TPS.</p>										
P0601	—	—	Module call monitoring	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: Damaged ECM.</p> <p>Service action: Key on and off. Reset closed TPS. Check battery voltage. Replace TPS.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0602	—	—	ECU not coded	15	Flash	CHK ENG	—	—	—	—
Possible cause: ECM not coded or damaged ECM. Service action: No service action available for fault P0602, symptom 142.										
P0604	—	—	RAM faulty	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0604, symptom 136.										
P0605	—	—	EEPROM faulty	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0605, symptom 137.										
P0605	—	—	Checksum fault EEPROM	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0605, symptom 143										
P0605	—	—	Coding ID checksum fault	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0605, symptom 144.										
P0605	—	—	Coding checksum fault	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0605, symptom 145.										
P0605	—	—	Programming checksum fault	15	Flash	CHK ENG	—	—	—	—
Possible cause: Damaged ECM. Service action: No service action available for fault P0605, symptom 146.										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P0608	—	—	Sensor 5 V power supply short to ground	15	Flash	CHK ENG	Y	Y	N	Fault is recovered
<p>Possible cause: Intake pressure sensor or TPS failure. Sensors power line shorted to ground.</p> <p>Service action: Check for MAPS or TPS failure. Check for MAPS or TPS circuit failure.</p>										
P0608	—	—	Sensor 5 V power supply short to 12 V	15	Flash	CHK ENG	Y	Y	N	Fault is recovered
<p>Possible cause: Intake pressure sensor or TPS failure. Sensors power line shorted to battery.</p> <p>Service action: Check for MAPS or TPS failure. Check for MAPS or TPS circuit failure.</p>										
P0616	—	—	Starter relay shorted to ground	5	Flash	CHK ENG	N (fault detected while cranking)	Y	N	Fault is recovered
	—	—	Starter relay open circuit	5	Flash	CHK ENG	Y	Y	N	Key is removed
<p>Possible cause: Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Verify 10 A fuse. Check for 12 volts on pin 2 of the starter relay.</p>										
P0617	—	—	Starter relay shorted to 12 V	5	Flash	CHK ENG	Y/N (sometimes when pressing the Start/Stop switch)	N	N	Fault is recovered
<p>Possible cause: Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Verify if system circuit B-31 is shorted to 12 V.</p>										
P1102	—	—	Throttle position sensor adaption failure	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: No initialisation after throttle body or ECM replacement or throttle idle stop drifted.</p> <p>Service action: Check cable adjustment. Check idle stop for wear. Make sure that the throttle plate is against the throttle stop. Check throttle angle at idle. Reset closed TPS.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1104	—	—	Throttle position sensor adaptation canceled	15	Flash	CHK ENG	—	—	—	—
<p>Possible cause: No initialisation after throttle body or ECM replacement or throttle idle stop drifted.</p> <p>Service action: Check cable adjustment. Check idle stop for wear. Make sure that the throttle plate is against the throttle stop. Check throttle angle at idle. Reset closed TPS.</p>										
P1148	—	—	Fuel injector 1, 2 or 3 - safety fuel cut off detected	15	Off	CHK ENG	—	—	—	—
<p>Possible cause: Idle bypass valve wrong reference, TPS adaptation failure, TPS failure or battery voltage out of range.</p> <p>Service action: Key on and off. Reset closed TPS. Check battery voltage. Replace TPS. Replace idle bypass valve.</p>										
P1200	—	—	Blow by valve shorted to ground or open circuit	5	Flash	CHK ENG	Y/N	Y	5000	Fault is recovered
<p>Possible cause: Blow-by valve failure, damaged circuit wires, damaged connector, damaged ECM pins or ECM failure.</p> <p>Service action: Check for 1.27 to 2.47 ohms on component.</p>										
P1201	—	—	Blow by valve shorted to 12 V	5	Flash	CHK ENG	N	N	N	N/A
<p>Possible cause: Blow-by valve failure, damaged circuit wires, damaged connector, damaged ECM pins or ECM failure.</p> <p>Service action: Check for 1.27 to 2.47 ohms on component.</p>										
P1202	—	—	Oil tank pressure switch implausible or blow-by valve still closed	5	Flash	CHK ENG	N	N	N	N/A
<p>Possible cause: Damaged oil pressure switch, blow-by valve failure, damaged circuit wires, damaged connector or damaged ECM pins.</p> <p>Service action: Check for 1.27 to 2.47 ohms between terminals. Check if TOPS is connected to wiring harness. Check resistance at 0 RPM and above 3500 RPM. At high RPM the resistance should be close to 0 ohm. Check for 12 volts on pin 1 of the blow-by valve.</p>										
P1203	—	—	Unused	—	—	—	—	—	—	—

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1502	—	—	TOPS functional problem	5	Flash	CHK ENG	Y	N/A	5000	Engine is stopped
<p>Possible cause: Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Check for circuit continuity between pins 2-2 and B-9.</p>										
P1509	—	Lake temperature sensor circuit out of range	—	15	Off	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 6528.3 to 25403.3 ohms between system circuits 2-13 and 2-4.</p>										
P1510	—	Lake temperature sensor circuit low voltage	—	15	Flash	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for no continuity between system circuit 2-13 and battery ground. Connect or disable lake water temperature sensor in setting page.</p>										
P1511	—	Lake temperature sensor circuit high voltage	—	15	Off	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 6528.3 to 25403.3 ohms between system circuits 2-13 and 2-4. Connect or disable lake water temperature sensor in setting page.</p>										
P1513	Exterior temperature sensor circuit low voltage	—	—	15	Off	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 200 to 24000 ohms between pins 1 and 9 of the instrument cluster harness connector. Connect or disable exterior air temperature sensor in setting page.</p>										
P1514	Exterior temperature sensor circuit high voltage	—	—	15	Off	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 200 to 24000 ohms between pins 1 and 9 of the instrument cluster harness connector. Connect or disable exterior air temperature sensor in setting page.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1517	Compass out of range	—	—	15	Off	SENSOR	Y	Y	N	N/A
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check compass connection. Connect or disable compass in setting page.</p>										
P1590	—	VTS Position Sensor Circuit – Out of Range	—	15	Off	SENSOR	—	—	N	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 24 to 167.5 ohms between system circuits 2-8 and 2-9. Connect or disable VTS in setting page.</p>										
P1591	—	VTS Position Sensor Circuit – Low Voltage	—	15	Off	SENSOR	—	—	N	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 24 to 167.5 ohms between system circuits 2-8 and 2-9. Connect or disable VTS in setting page.</p>										
P1592	—	VTS Position Sensor Circuit – High Voltage	—	15	Off	SENSOR	—	—	N	—
<p>Possible cause: Damaged sensor, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 24 to 167.5 ohms between system circuits 2-8 and 2-9. Connect or disable VTS in setting page.</p>										
P1593	—	VTS Malfunction	—	15	Off	SENSOR	—	—	N	—
<p>Possible cause: Mechanical failure on VTS or VTS mechanically immobilized.</p> <p>Service action: Check VTS rod.</p>										
P1607	—	MPEM FAULT	—	15	N/A	—	—	—	N	—
<p>Possible cause: Damaged MPEM.</p> <p>Service action: No service action available for fault P1607.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1611	—	—	P+ Test of ISC output signal failed	15	Off	CHK ENG	Y	Y	N	Fault is recovered
<p>Possible cause: Intake pressure sensor or TPS failure. Sensors power line shorted to ground or to battery. Damaged ECM.</p> <p>Service action: Key on and off. Reset closed TPS. Check battery voltage. Replace TPS. Replace idle bypass valve.</p>										
P1655	—	—	DESS line shorted to 12 V	15	Flash	CHK ENG	Y	N	N	N/A
<p>Possible cause: Damaged safety switch, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Remove DESS key and check for an open circuit on system circuit B-38.</p>										
P1656	—	—	DESS line shorted to ground	15	Flash	CHK ENG	Y	N	N	N/A
<p>Possible cause: Damaged safety switch, damaged circuit wires, damaged connector or damaged ECM output pins.</p> <p>Service action: Remove DESS key and check for an open circuit on system circuit B-38.</p>										
P1660	—	Bilge pump shorted to ground or open circuit	—	5	N/A	N/A	Y	N	N	N/A
<p>Possible cause: Damaged bilge pump, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check system circuits 2-20 and 2-3. Connect or disable bilge pump in setting page.</p>										
P1661	—	Bilge pump shorted to 12 V	—	5	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged bilge pump, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check system circuits 2-20 and 2-3.</p>										
P1670	—	Buzzer – Short to Battery Voltage	—	15	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged connector or damaged MPEM output pins.</p> <p>Service action: Check system circuit 1-20.</p>										

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FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1675	—	Spare output 1 shorted to ground or open circuit	—	15	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged component, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Connect component or disable spare output 1 in setting page.</p>										
P1676	—	Spare output 1 shorted to 12 V	—	15	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged component, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Connect component or disable spare output 1 in setting page.</p>										
P1678	—	Spare output 2 shorted to ground or open circuit	—	15	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged component, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Connect component or disable spare output 2 in setting page.</p>										
P1679	—	Spare output 2 shorted to 12 V	—	15	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged component, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Connect component or disable spare output 2 in setting page.</p>										
P1680	—	Communication problem detected by MPEM	—	5	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged circuit wires, damaged connector, damaged MPEM output pins. Diagnostic connector cap not connected.</p> <p>Service action: Connect diagnostic connector cap.</p>										
P1681	—	Communication problem – instrument cluster message missing	—	5	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged circuit wires, damaged connector, damaged MPEM output pins. Instrument cluster not connected.</p> <p>Service action: Check system circuits 1-10 and 1-11. Check for 12 volts between pins 7 and 8 on the instrument cluster harness connector. Check 1A fuse. Connect instrument cluster.</p>										


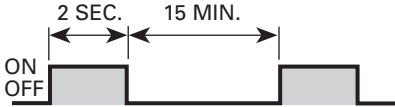
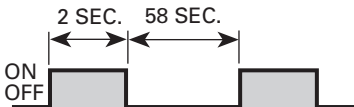
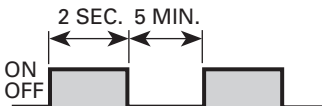

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

FAULT CODE	RESPONSIBLE MODULE			BEEPER CODE	WARNING LIGHT	MESSAGE DISPLAYED (INFO CTR)	FAULT DETECTED WHILE ENGINE NOT RUNNING	FAULT DETECTED WHILE ENGINE RUNNING	LIMP HOME MODE	NORMAL OPERATION RESUME WHEN...
	INFORMATION CENTER	MPEM	ECM							
P1682	—	Communication problem - EMS message missing	—	5	N/A	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged circuit wires, damaged connector, damaged MPEM output pins. ECM not connected.</p> <p>Service action: Check system circuits 2-10 and 2-11. Check for 12 volts between system circuit A-11 and ground. Check 5A fuses. Check connection.</p>										
P1683	—	—	COM RAM Fault	15	Flash	N/A	—	—	—	—
<p>Possible cause: Damaged ECM.</p> <p>Service action: No service action available for fault P1683, symptom 88.</p>										
P1690	—	VTS control up circuit open circuit or shorted to ground	—	15	Off	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged VTS, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 12 volts between system circuits 2-7 and 2-1 when VTS UP is activated.</p>										
P1691	—	VTS control up circuit shorted to battery	—	15	Off	N/A	Y	Y	N	N/A
<p>Possible cause: Damaged VTS, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 12 volts between system circuits 2-7 and 2-1 when VTS UP is activated.</p>										
P1692	—	VTS control down circuit open circuit or shorted to ground	—	15	Off	N/A	y	y	N	N/A
<p>Possible cause: Damaged VTS, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 12 volts between system circuits 2-6 and 2-1 when VTS DOWN is activated.</p>										
P1693	—	VTS control down circuit shorted to battery	—	15	Off	N/A	y	y	N	N/A
<p>Possible cause: Damaged VTS, damaged circuit wires, damaged connector or damaged MPEM output pins.</p> <p>Service action: Check for 12 volts between system circuits 2-6 and 2-1 when VTS DOWN is activated.</p>										

Section 04 ENGINE MANAGEMENT (1503 4-TEC)
Subsection 02 (DIAGNOSTIC PROCEDURES)

Beeper Code Explanation

BEEPER CODE	BEEPER PATTERN	NOTE
15		Always OFF
6		2 second beep every 15 minutes
5		2 second beep every 58 seconds
4		2 second beep every 5 minutes
2		Always ON (continuously beep)

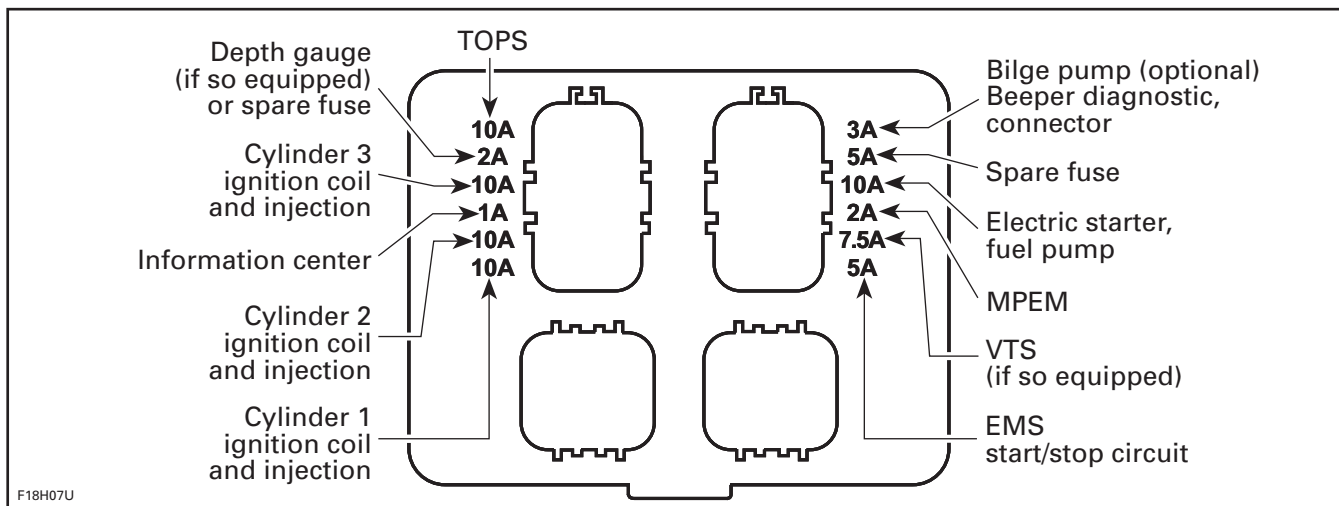
F18R0GS

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)

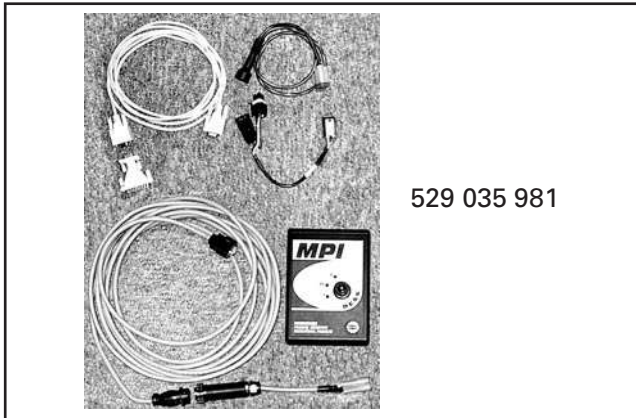
Fuse and Related Fault Code

FUSE	RATING (A)	FAULT CODE	FAULT DETECTED WHILE ENGINE NOT RUNNING
TOPS	10	P0344, P1200	N
Depth gauge (if so equipped) or spare fuse	2	P1675	Y
Cylinder #3 ignition coil and injection	10	P0353, P0267	N
Information center	1	P1680, P1681	N
Cylinder #2 ignition coil and injection	10	P0352, P0264	N
Cylinder #1 ignition coil and injection	10	P0351, P0261	N
Bilge pump (optional), beeper, diagnostic connector	3	P0616	Y
Spare fuse	5	P1678	Y
Electric starter, fuel pump	10	P0231	Y
MPEM	2	P0600	N
VTS (if so equipped)	7.5	P1690, P1692	N
EMS, start/stop circuit	5	None	N



VCK (VEHICLE COMMUNICATION KIT)

The VCK (Vehicle Communication Kit) (P/N 529 035 981) is the primary tool to diagnose engine management and fuel injection related problems.



NOTE: The MPEM programmer does not work on 4-TEC models.

The 4-TEC naturally aspirated and supercharged models require B.U.D.S. version 2 or above.

NOTE: Ensure to use the latest B.U.D.S. version available on BossWeb.

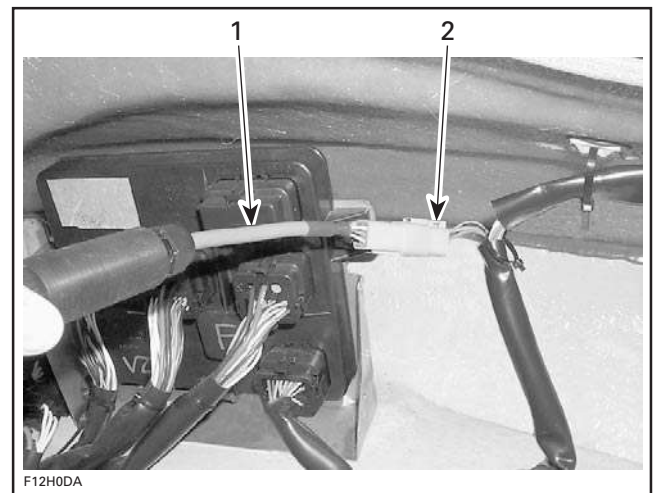
B.U.D.S. (BRP utility and diagnostic software) is designed to allow among other things, the programming of safety lanyard(s), entering customer information, engine monitoring, allowing actuators, sensors and electronic equipments inspection, diagnostic options and reset such as the closed throttle and idle actuator.

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.

Electrical Connections



TYPICAL

1. 6-pin adapter
2. Connector close to MPEM

After all connections are done, connect the safety lanyard to the DESS post to activate the communication.

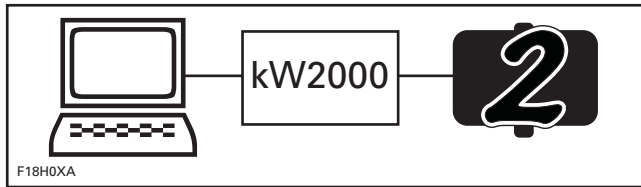
IMPORTANT: When using the software B.U.D.S., with the **4-TEC engines**, ensure that the protocol "kW2000" is properly selected in "MPI" under "Choose protocol".

When B.U.D.S. is connected with MPEM and ECM, the status bar shows the protocol (kW2000) and a number 1 or 2 to the right. To work with the watercraft, number 2 must be displayed.

Number 2 means that 2 "ECUs" are connected (MPEM and ECM).

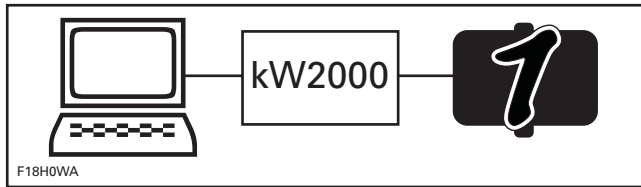
Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 02 (DIAGNOSTIC PROCEDURES)



MPEM AND ECM ARE CONNECTED

Number 1 means that 1 "ECU" is connected (either MPEM or ECM). Therefore, there is a problem. Check fuses and connections.



ONLY ONE "ECU" IS WORKING. THERE IS A PROBLEM

If an "X" is shown, the safety lanyard is not installed on its post or there is a problem with both "ECUs". Ensure VCK is working properly and check connections on VCK and watercraft.

VCK Supply

The VCK (MPI box) can use the watercraft power for its supply.

The safety lanyard must be connected in order to use the watercraft as a power source.

If watercraft power is used, every time the safety lanyard is taken off the DESS post, the kW2000 protocol will have to be re-activated.

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 safety lanyard from its post and wait until the message disappears (it lasts approximately 15 seconds after lanyard removal).

COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT

SERVICE TOOLS

Description	Part Number	Page
ECM adapter.....	420 277 010	110
engine leak test pump	529 021 800	130
Fluke 111	529 035 868	109
tachometer	529 014 500	111
VCK (Vehicle Communication Kit).....	529 035 981	107

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.

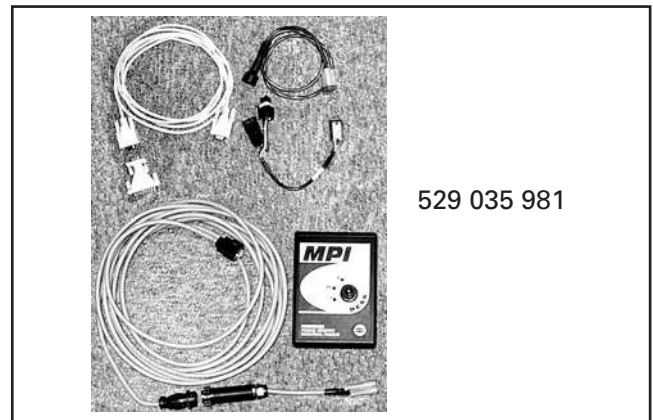
CAUTION: Never run engine without supplying water to the exhaust cooling system when watercraft is out of water.

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 VCK (Vehicle Communication Kit) (P/N 529 035 981) to release the fuel pressure in the system. Look in the **Activation** tab of the B.U.D.S. software.



Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

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 VCK (Vehicle Communication Kit) 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 BATTERY 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 separator 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.

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

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.

WARNING

All electrical actuators (idle bypass valve, TOPS 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 Vehicle Communication Kit (VCK). See DIAGNOSTIC PROCEDURES subsection.

After a problem has been solved, ensure to clear the fault(s) in the ECM using the VCK. Refer to DIAGNOSTIC PROCEDURES subsection.

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

TEMPERATURE		RESISTANCE (OHMS)		
°C	°F	NOMINAL	LOW	HIGH
- 30	- 22	12600	11800	13400
- 20	- 4	11400	11000	11800
- 10	14	9500	8000	11,000
0	32	5900	4900	6900
10	50	3800	3100	4500
20	68	2500	2200	2800
30	86	1700	1500	1900
40	104	1200	1080	1320
50	122	840	750	930
60	140	630	510	750
70	158	440	370	510
80	176	325	280	370
90	194	245	210	280
100	212	195	160	210
110	230	145	125	160
120	248	115	100	125

CONVERSION CHART FOR TEMPERATURE SENSORS

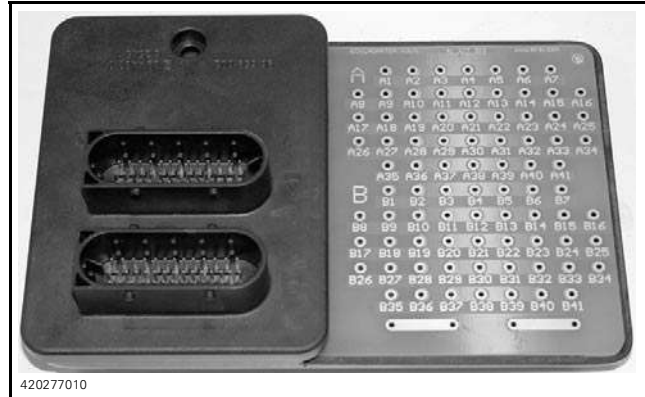
The resistance value of a temperature sensor may test good at a certain temperature but it might be defective at other temperatures. If in doubt, try a new sensor.

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.



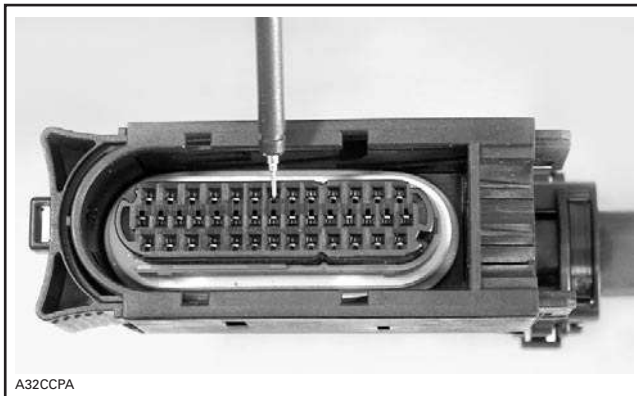
Disconnect the desired connector from ECM and reconnect on the tool connector. Probe required terminals directly in the tool holes.



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.

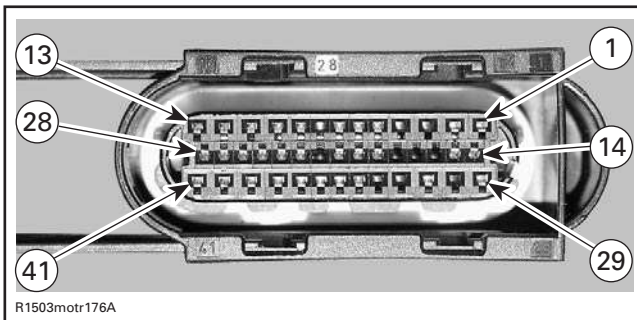
Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



PROBE ONLY TOP OF TERMINAL

Use this diagram to locate the terminal numbers on the ECM connector "A" of the wiring harness when performing tests.



TERMINAL IDENTIFICATION OF ECM CONNECTOR "A"
(WIRING HARNESS SIDE)

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 DIAGRAMS section.

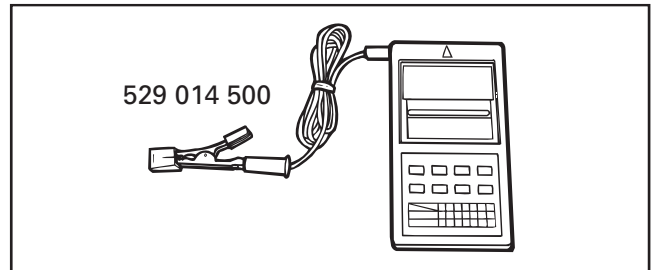
TESTING PROCEDURES

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.



TYPICAL

Start engine to verify engine RPM.

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.

SAFETY LANYARD SWITCH VERIFICATION

If 2 short beeps are not heard when installing the safety lanyard, refer to DIAGNOSTIC PROCEDURES.

The following continuity tests can also be performed using an ohmmeter.

Disconnect switch wires.

Safety Lanyard Removed

Connect test probes to switch BLACK and BLACK/YELLOW wires. Measure resistance, there should be NO continuity (open circuit).

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Connect one test probe to the WHITE/GREY wire and the other test probe to the switch top terminal. Measure resistance, it must be close to 0 ohm.

Connect one test probe to the BLACK wire and the other test probe to the switch ring. Measure resistance, it must be close to 0 ohm.

Safety Lanyard on Switch

Connect test probes to switch BLACK and BLACK/YELLOW wires. Measure resistance, it must be close to 0 ohm.

ECM AND MPEM

General

Prior to replacing a suspected ECM or MPEM, ensure that all the recommendations in the general introduction of this section have been followed.

IMPORTANT: When the ECM is replaced, the **Closed Throttle and Idle Actuator** must be reset. Refer to its specific section for adjustment.

To allow transferring the previous recorded information from the old ECM or MPEM to the new one, use the vehicle communication kit (VCK) with the B.U.D.S. software. Use **Replace ECM or MPEM** in the **Module** menu. Follows instructions in its help system.

NOTE: If the old ECM or MPEM is working, it must be read inside B.U.D.S. prior to removing it from the vehicle to carry vehicle information and history to the new ECM or MPEM. Otherwise, perform the operations described in IF THE PREVIOUS MPEM WAS NOT READ with B.U.D.S. below.

ECM Replacement

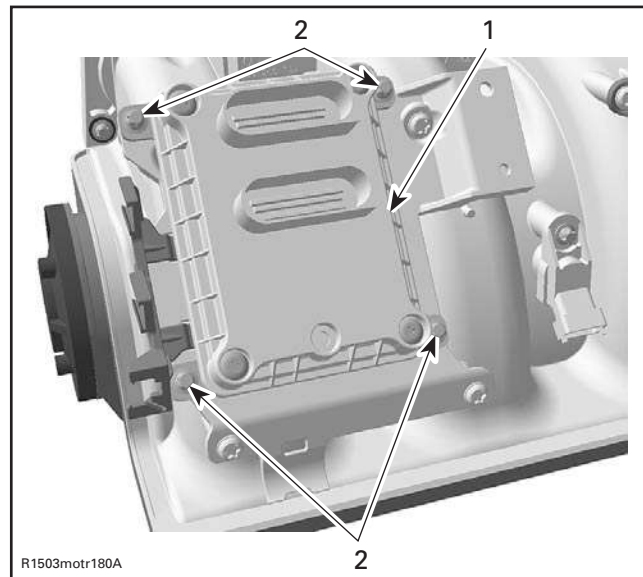
CAUTION: Never try to use a 4-TEC Supercharged ECM on a naturally-aspirated engine. Doing so will automatically lead to a malfunction of the Engine Management System (EMS) and will cause irregular combustion which will damage the engine. Always make sure to replace the ECM by an appropriate unit.

Disconnect battery cables.

WARNING

Battery BLACK negative cable must always be disconnected first and connected last.

Disconnect both ECM connectors from ECM.



TYPICAL

1. ECM
2. Retaining screws

Unscrew all retaining screws and remove the engine ECM from intake manifold.

CAUTION: If ever ECM is replaced, replace it by the same part or by an approved equivalent.

Install the new ECM to the engine.

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Finalizing ECM Replacement

After performing the required resets, 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.

MPEM Replacement

Disconnect battery cables.

WARNING

Battery BLACK negative cable must always be disconnected first and connected last.

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.
- Manually activate the options installed on vehicle under the **Setting** tab.

NOTE: The MPEM serial number can be found on the MPEM sticker that also shows the P/N.

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.

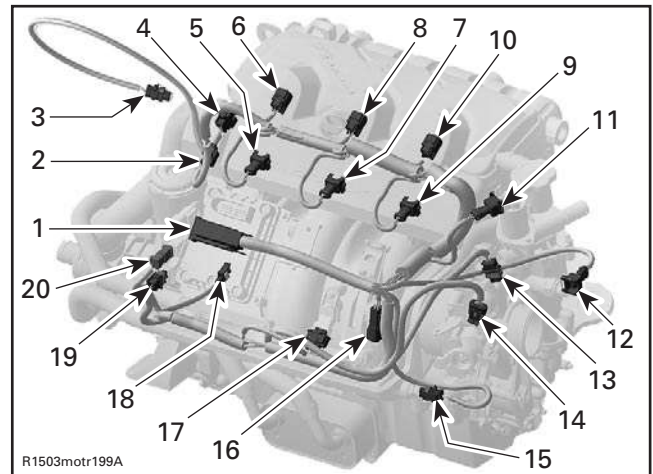
Continue procedure as per FINALIZING MPEM REPLACEMENT below.

Finalizing MPEM Replacement

Ensure to clear all faults from the newly replaced MPEM.

Start engine and ensure no fault is active.

ENGINE WIRING HARNESS

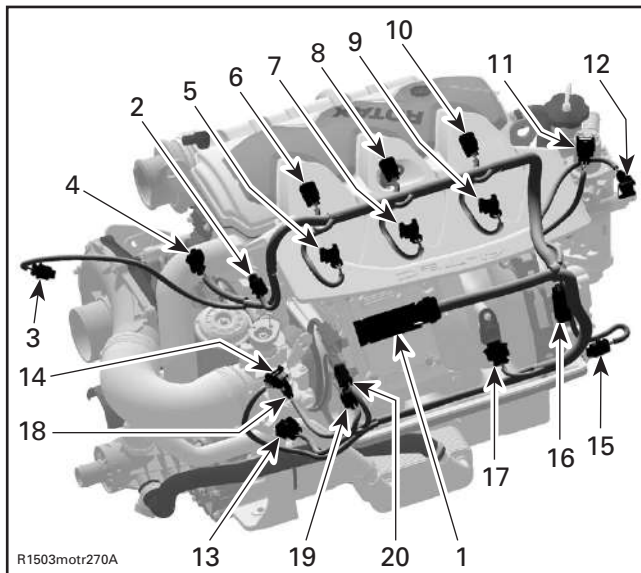


4-TEC ENGINES

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. TOPS valve connector
12. OSPS connector
13. TPS connector
14. Idle bypass valve connector
15. MATS connector
16. Engine connector
17. MAPS connector
18. OPS connector
19. KS connector
20. CPS connector

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



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. TOPS valve connector
12. connector
13. TPS connector
14. Idle bypass valve connector
15. MATS connector
16. Engine connector
17. MAPS connector
18. OPS connector
19. KS connector
20. CPS connector

Resistance Test

Check continuity of the circuits according to the wiring diagram in the ELECTRICAL CONNECTORS AND WIRING DIAGRAMS section of this manual.

If wiring harness is good, check the respective sensor/actuator as described in this section.

Otherwise, repair the connectors, replace the wiring harness or the ECM/MPPEM as diagnosed.

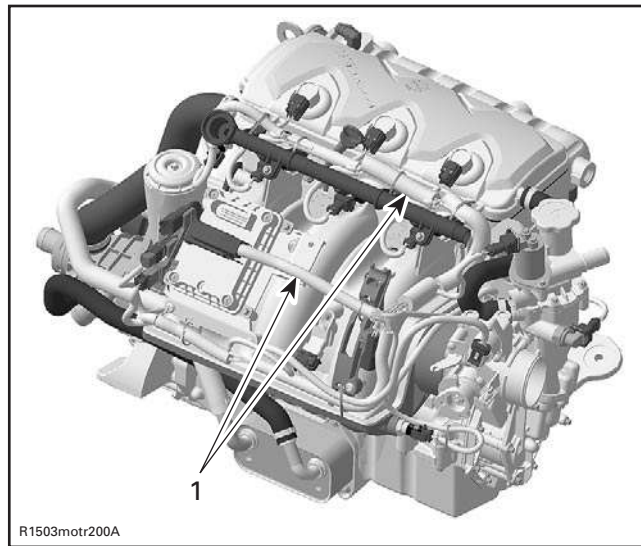
Removal

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.



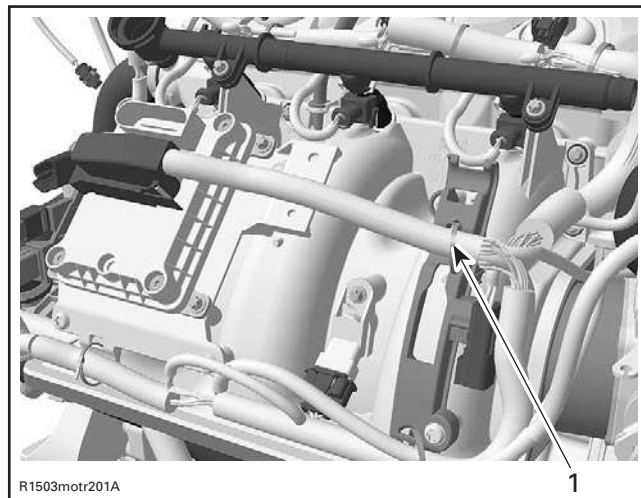
TYPICAL

1. Wiring harness

Remove complete wiring harness.

Installation

First connect the ECM connector A and fix the harness on the wiring support with a locking tie.

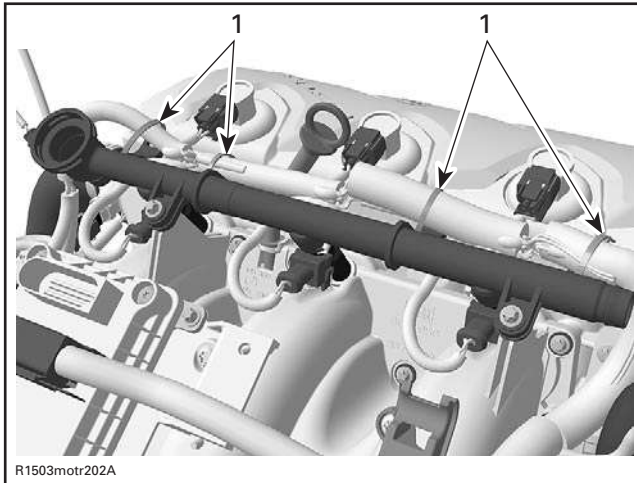


1. Locking tie

Lead the cable bundle with the injector and ignition coil connectors to the fuel rail and fix it also by using 4 locking ties.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



1. Locking ties

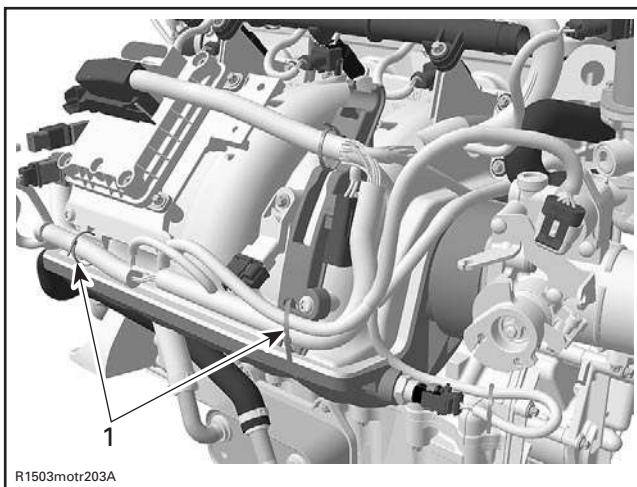
Connect the fuel injectors, ignition coils, CAPS, CTS and EGTS to the wiring harness.

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.

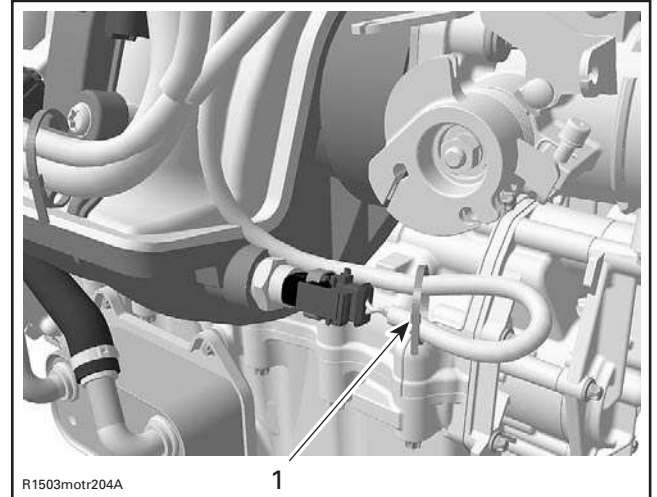


TYPICAL
1. Locking ties

Connect the CPS, KS, OPS, and the MAPS to the wiring harness.

Also connect now the MATS, TPS, idle bypass and TOPS valve to the wiring harness.

Fix the wiring for the MATS with a locking tie to support the cables.



1. Locking tie

Install all remaining parts, which has been removed.

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

The leakage test is validated when performing the FUEL DELIVERY SYSTEM DIAGNOSTIC FLOW CHART elsewhere in this section.

Electrical Test

Voltage Test

Safety lanyard must be on DESS post.

Using the vehicle communication kit (VCK) with 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.

CIRCUIT NUMBER (ECM CONNECTOR "A")	INJECTOR NUMBER
A-15	1
A-33	2
A-14	3

– If it does not read 12 V, check continuity of circuit as per following table. If it is good, try a new MPEM.

CIRCUIT NUMBER (AMP CONNECTOR NO. 2)	INJECTOR NUMBER
2-16	1
2-17	2
2-18	3

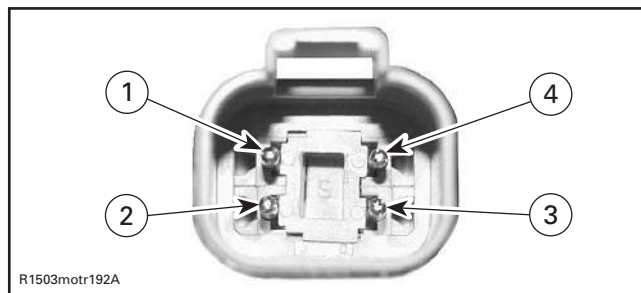
Resistance Test

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.



ENGINE CONNECTOR

COMPONENT	TERMINAL LOCATION
Fuel injector cylinder 1	1 (engine connector) and A-15 (ECM connector)
Fuel injector cylinder 2	2 (engine connector) and A-33 (ECM connector)
Fuel injector cylinder 3	3 (engine connector) and A-14 (ECM connector)

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 ECM AND MPEM 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 ECM AND MPEM in this section.

If resistance value is incorrect, repair the wiring harness/connectors or replace the wiring harness between ECM connector and fuel injector.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Fuel Injector Replacement

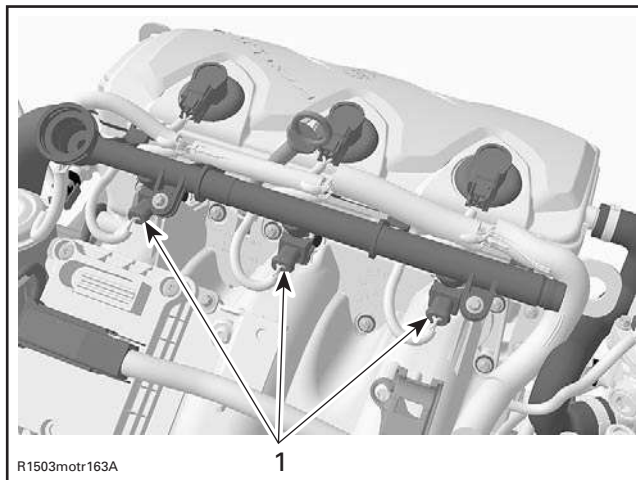
Removal

Remove fuel rail cover from the engine.

Release the fuel pressure in the system using B.U.D.S. Look in the **Activation** tab.

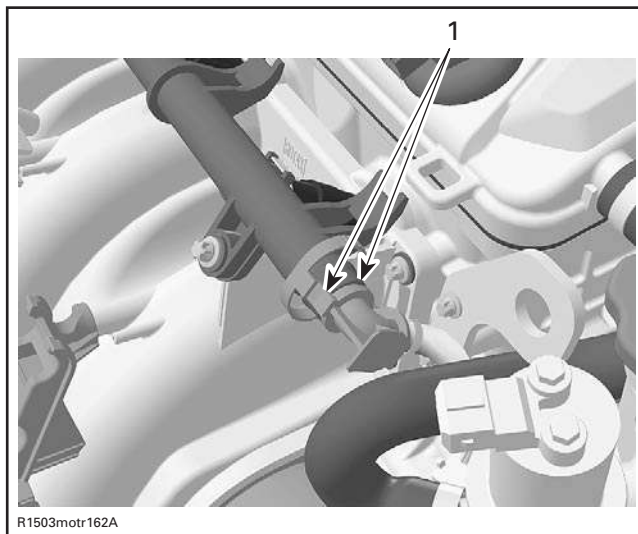
Insert pointed tools each side of fuel hose connector.

Disconnect wiring harness from the three fuel injectors.



1. Fuel injector connectors

Disconnect fuel hose.



1. Insert pointed tools each side

Wrap a rag around the hose end to prevent rail draining.

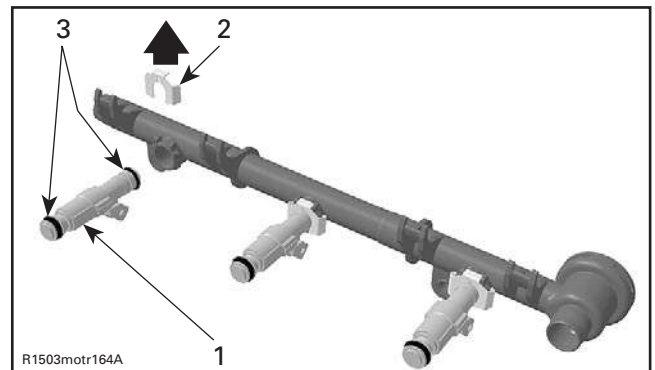
Cut tie raps and remove the wiring harness from the fuel rail.

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

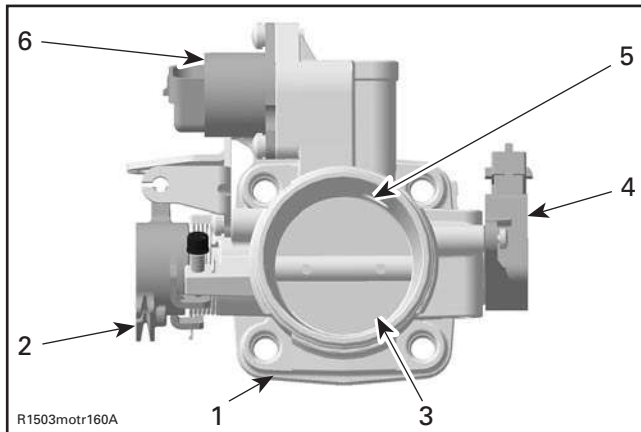
Perform a fuel pressure test and ensure that there is no leak. Refer to FUEL SYSTEM section.

THROTTLE BODY

IMPORTANT: Never mix up throttle bodies of naturally-aspirated and supercharged 4-TEC engines. Doing so will automatically lead to a malfunction of the EMS and will cause a bad engine calibration.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



TYPICAL

1. Throttle body
2. Throttle cable attachment
3. Throttle plate
4. TPS
5. Idle bypass channel
6. Idle bypass valve

Mechanical Inspection

Check that the throttle plate moves freely and smoothly when depressing throttle lever. Take this opportunity to lubricate the throttle cable.

IMPORTANT: The throttle body is designed to be tamper proof. Changing the idle stop or modifying it in any way will not increase performance or change the idle speed but may cause poor startability and erratic idling.

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.
- 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

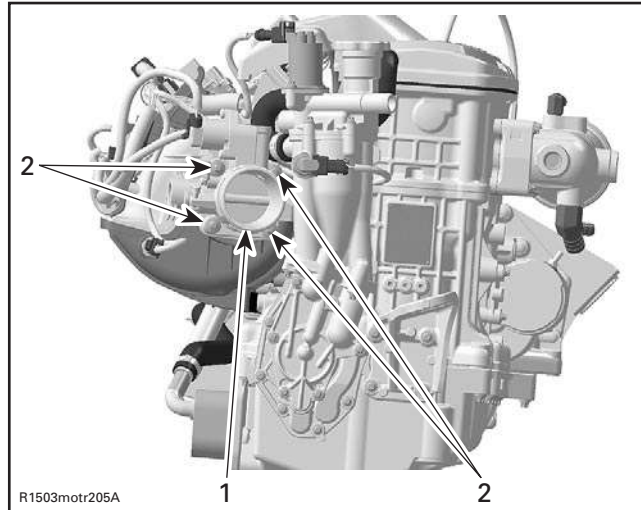
Refer to THROTTLE POSITION SENSOR (TPS) and IDLE BYPASS VALVE further in this section.

Replacement

Removal

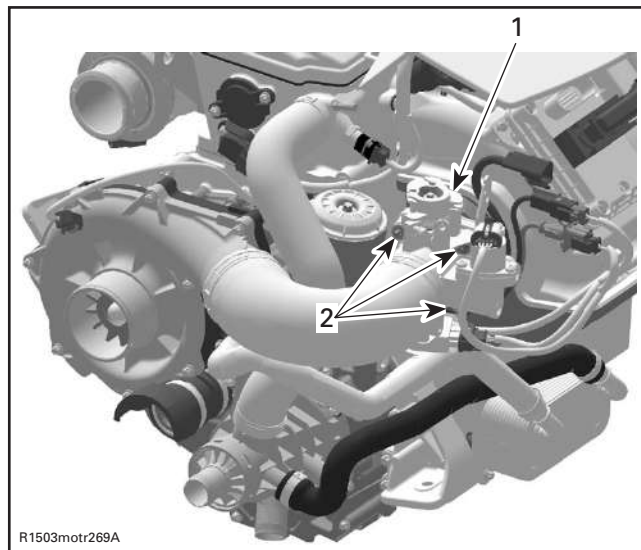
To remove the throttle body from engine, proceed as follows:

- Disconnect air intake silencer from throttle body. Move boot away.
- Remove retaining screws of throttle body.



4-TEC NATURALLY ASPIRATED MODELS

1. Throttle body
2. Screws



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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

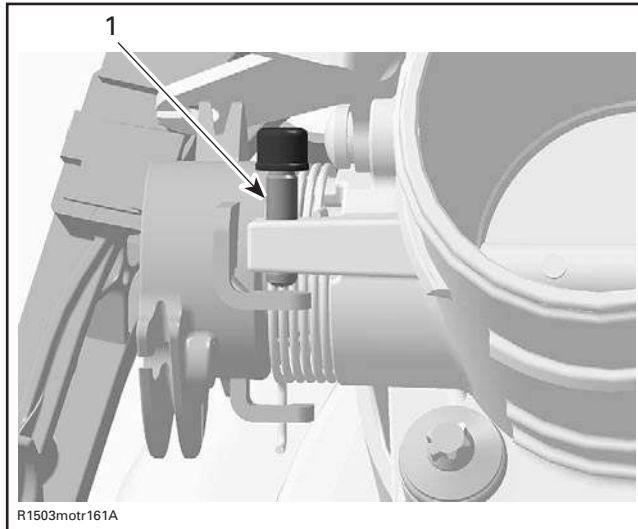
Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Installation

Installation of the new throttle body is the reverse of the removal procedure.

For TPS and idle bypass valve replacement procedures, refer to the respective paragraph further in this section.

Adjustment



THROTTLE BODY

1. Idle stop screw (do not tamper adjustment)

CAUTION: It is not allowed to perform any change on the idle stop screw.

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 the throttle body tamper proof screw. If so, it would impair the idle speed stability. Besides, no adjustment could be performed by the dealer or the factory to correct the idle speed. The throttle body would need to be replaced. Also take into account that it might change the engine emission level and the engine might not meet the EPA/CARB requirements.

CAUTION: Do not alter or tamper with throttle cable adjustment or routing. It may cause poor startability and erratic idling.

When the throttle body has been replaced, perform throttle cable adjustment (see below) and then the **Closed Throttle and Idle Actuator reset**. Refer to THROTTLE POSITION SENSOR (TPS) further in this section.

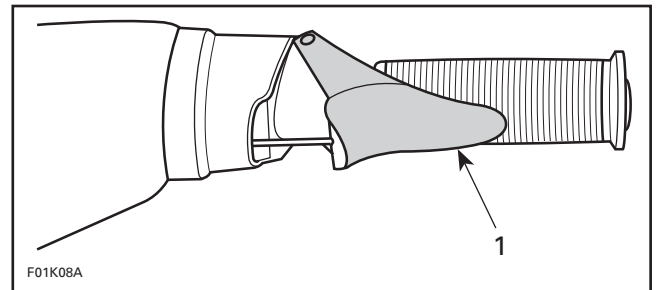
Throttle Cable Adjustment

Mechanically adjust the throttle cable.

Lubricate cable with BOMBARDIER LUBE lubricant.

When throttle is released, cable must have a free play of 0.5 - 4 mm (1/64 - 5/32 in).

Besides, throttle lever must reach handlebar grip without causing strain to cable or brackets. Ensure throttle lever fully closes on it's stopper.



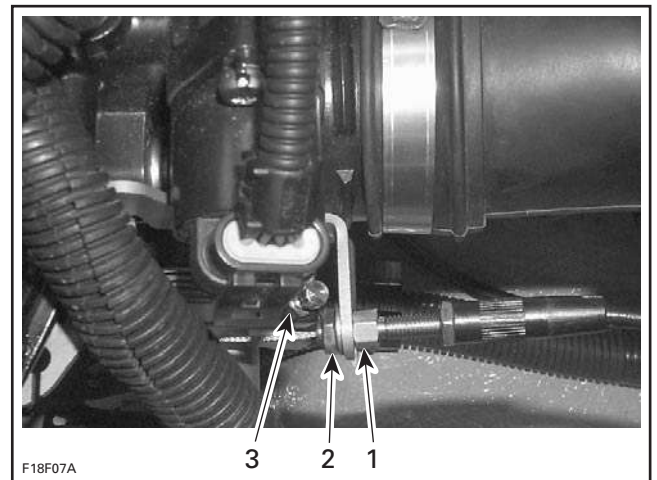
1. Must touch handlebar grip

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.

To adjust, loosen jam nut then turn adjustment nut as necessary.



1. Adjustment nut
2. Jam nut
3. Throttle lever stopper

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Tighten jam nut and recheck adjustment.

WARNING

Make sure idle speed stopper contacts throttle cam when throttle lever is fully released at handlebar.

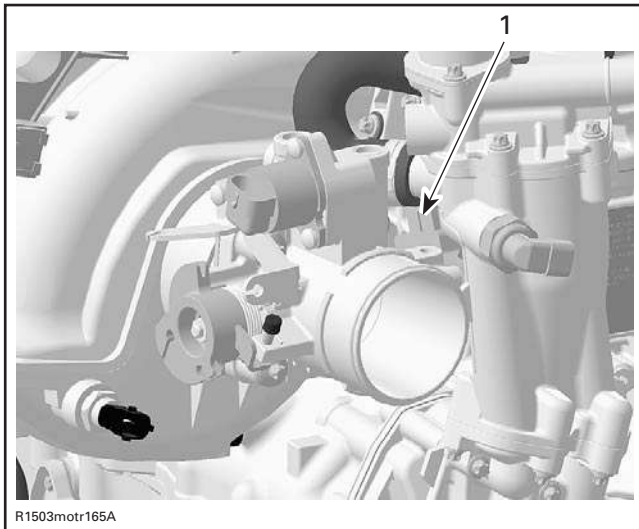
Closed Throttle and Idle Actuator Reset

Perform the CLOSED THROTTLE AND IDLE ACTUATOR RESET as described in THROTTLE POSITION SENSOR (TPS) below.

THROTTLE POSITION SENSOR (TPS)

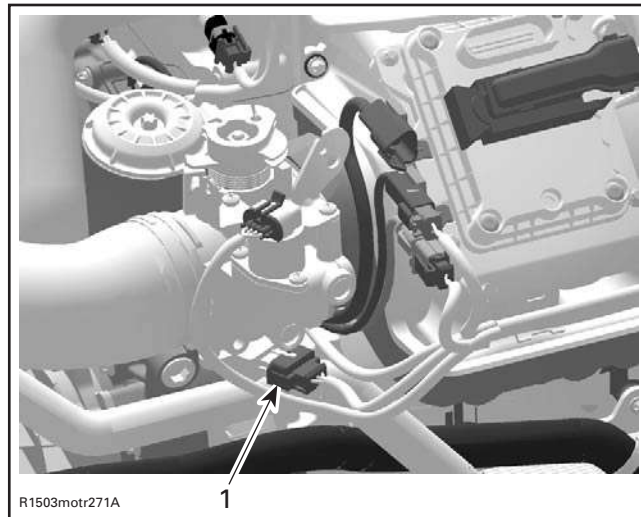
General

The throttle position sensor (TPS) is a potentiometer that sends a signal to the ECM which is proportional to the throttle shaft angle.



4-TEC ENGINES

1. Throttle position sensor (TPS)



ALL 4-TEC SUPERCHARGED ENGINES

1. Throttle position sensor (TPS)

IMPORTANT: Prior to testing the TPS, ensure that mechanical components/adjustments are adequate according to THROTTLE BODY above.

The EMS may generate several fault codes pertaining to the TPS. Refer to SYSTEM FAULT CODES in DIAGNOSTIC PROCEDURES 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 vehicle communication kit (VCK) with 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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

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.

CONNECTION	VOLTAGE
Terminal 1 with engine ground	0 V
Terminal 2 with engine ground	5 V
Terminal 3 with engine ground	4.5 - 5 V

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.

ECM CONNECTOR		THROTTLE IDLE POSITION	WIDE OPEN THROTTLE POSITION
PIN	PIN	RESISTANCE Ω	
A-24	A-25	1000 - 1100	2600 - 2700
A-25	A-39	1600 - 2400	1600 - 2400
A-24	A-39	2500	1000 - 1100

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 ECM AND MPEM in this section.

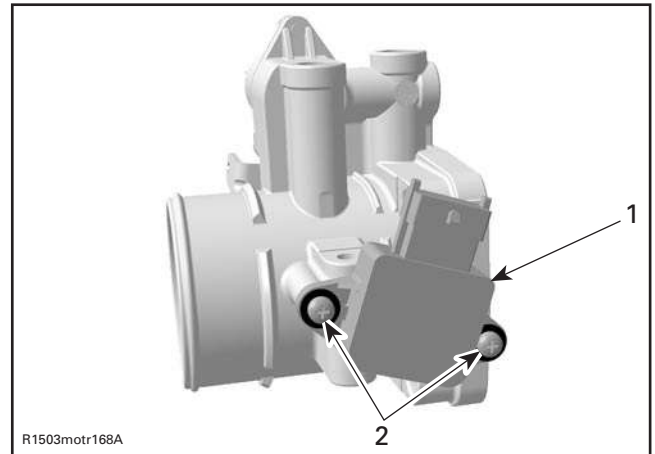
If resistance values are incorrect, replace TPS.

Replacement

Remove the throttle body as described above.

Loosen two screws retaining the TPS.

Remove TPS.



THROTTLE BODY

1. Throttle position sensor (TPS)
2. Screws

Apply Loctite 243 on screw threads, install the new TPS.

Reinstall remaining removed parts.

Proceed with the CLOSED THROTTLE AND IDLE ACTUATOR RESET. See below.

Closed Throttle and Idle Actuator Reset

NOTE: This operation performs a reset of the values in the ECM.

This reset is very important. The setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations and the setting of the idle bypass valve will determine the basic parameters for the idle speed control of the engine.

NOTE: Reset must be done each time the throttle position sensor (TPS) or the idle bypass valve is loosened or removed or throttle body is replaced or ECM is replaced.

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 vehicle communication kit (VCK) with the B.U.D.S. software to perform this adjustment.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

Ensure the throttle body plate stop lever rest 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. Refer to THROTTLE BODY in AIR INDUCTION SYSTEM above.

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: No message will be displayed if operation is good. If operation is wrong, an error message will be displayed.

NOTE: There is no idle speed adjustment to perform. The ECM takes care of that. 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 SYSTEM FAULT CODES in DIAGNOSTIC PROCEDURES section for more information.

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.

If resistance test of valve windings is good, check continuity of circuits A-35, A-36, A-37, A-38.

Visual Inspection

Remove idle bypass valve from throttle body.

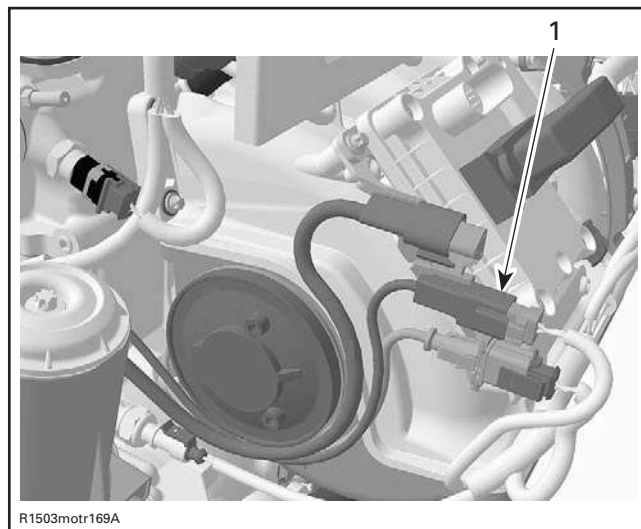
Check the piston and bypass channel for dirt/deposits which can cause a sticking piston.

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**. See above.

CRANKSHAFT POSITION SENSOR (CPS)



TYPICAL
1. CPS connector

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

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/ MAGNETO in the *1503 4-TEC ENGINE SHOP MANUAL*.

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.

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 ECM AND MPEM in this section.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

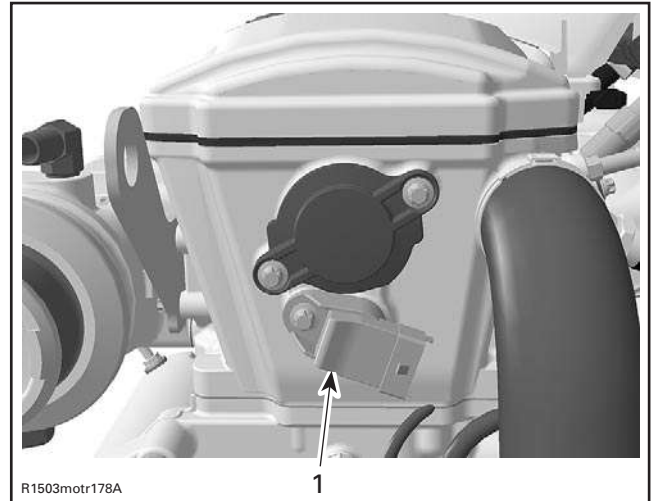
Replacement

Disconnect connectors and remove the PTO cover. Refer to PTO HOUSING/MAGNETO in the *1503 4-TEC ENGINE SHOP MANUAL*.

Trigger Wheel Inspection

Refer to PTO HOUSING/MAGNETO in the *1503 4-TEC ENGINE SHOP MANUAL*.

CAMSHAFT POSITION SENSOR (CAPS)



1. 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.

Remove and reinstall safety lanyard to activate the system.

Probe terminal 3 of CAPS connector (wiring harness side) and battery ground.

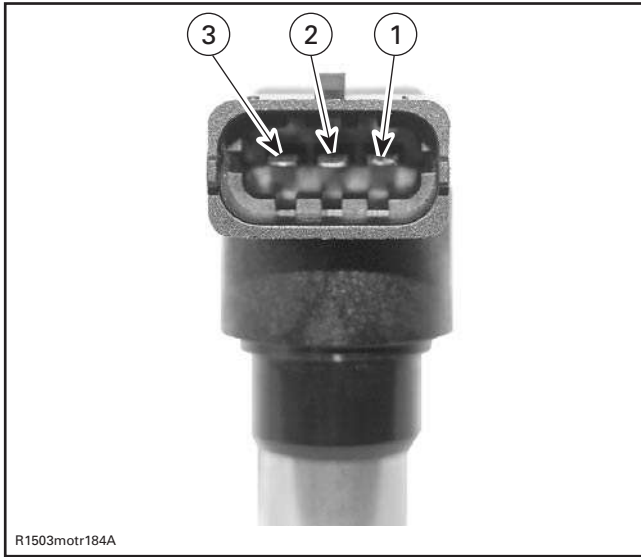
- If 12 V is read, check continuity of circuits A-20 and A-34. If they test good, perform the CAPS voltage test as explained below. If CAPS tests good, try a new ECM.
- If 12 V is not read, check continuity of circuit 2-19 from MPEM to the CAPS. If it tests good, try a new MPEM. Otherwise, repair wiring harness.

Remove the CAPS from the cylinder head.

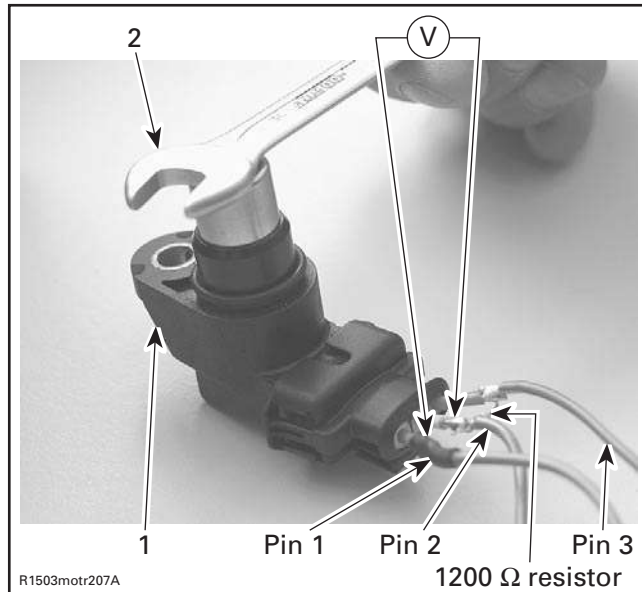
Set up the following electric circuit to perform the voltage test.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



CAPS PIN-OUT



1. CAPS
2. Conductor

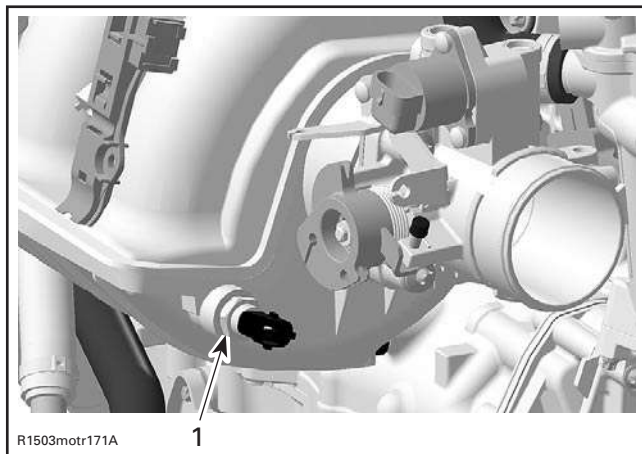
If the voltage is not good, replace the CAPS.

Replacement

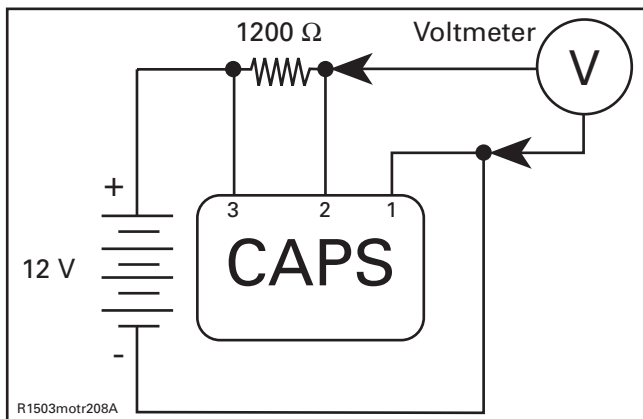
Unscrew the retaining screw and replace the CAPS. Ensure to reinstall O-ring.

Apply Loctite 243 (blue) on thread and torque to 6 N•m (53 lbf•in).

MANIFOLD AIR TEMPERATURE SENSOR (MATS)



TYPICAL — INTAKE MANIFOLD
1. 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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

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).

Otherwise, replace the MATS.

If resistance tests good, reconnect the MATS and disconnect the ECM connector A on the ECM.

Using a multimeter, recheck resistance value between terminals 7 and 21.

If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

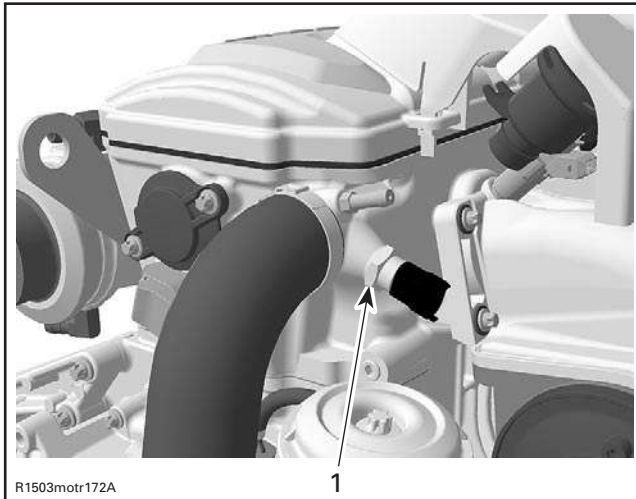
If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the MATS.

Replacement

Disconnect the connector of the MATS.

Screw MATS out and install the new one. Torque to 18 N•m (159 lbf•in).

COOLANT TEMPERATURE SENSOR (CTS)



1. Coolant temperature sensor (CTS)

Resistance Test

Disconnect the connector from the CTS 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 CTS.

If resistance tests good, reconnect the CTS and disconnect the ECM connector A on the ECM.

Using a multimeter, recheck resistance value between terminals 11 and 27.

If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CTS.

Replacement

Unlock expansion separator and temporarily move away to gain access.

Remove the fuel rail cover.

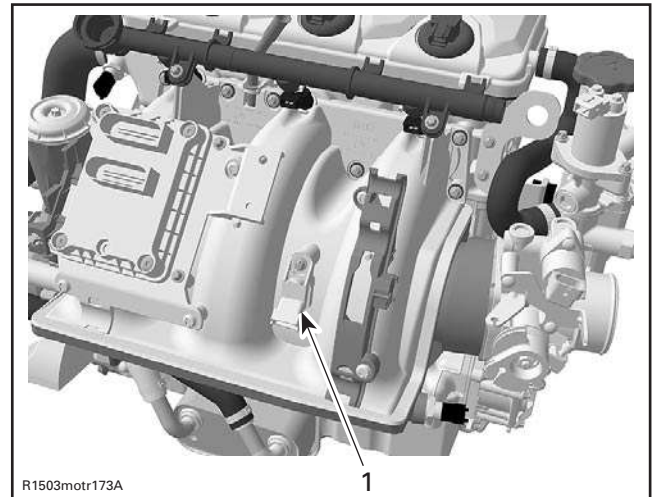
Disconnect CTS connector and remove CTS.

Install the new CTS and torque to 18 N•m (159 lbf•in).

Reinstall remaining removed parts.

MANIFOLD AIR PRESSURE SENSOR (MAPS)

IMPORTANT: Never mix up MAPS of naturally-aspirated and supercharged 4-TEC engines. Doing so will automatically lead to a malfunction of the ECM and will cause a bad engine calibration.



TYPICAL

1. Manifold air pressure sensor (MAPS)

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

NOTE: This sensor is a dual function device. When engine is started and it runs at idle speed, the sensor takes the atmospheric pressure and stores it in the ECM. Thereafter, it takes the manifold air pressure at operating RPMs.

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.

CONNECTION	VOLTAGE
Terminal 1 with engine ground	5 V
Terminal 2 with engine ground	0 V
Terminal 3 with engine ground	0 V

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 ECM REPLACEMENT procedures elsewhere in this section.

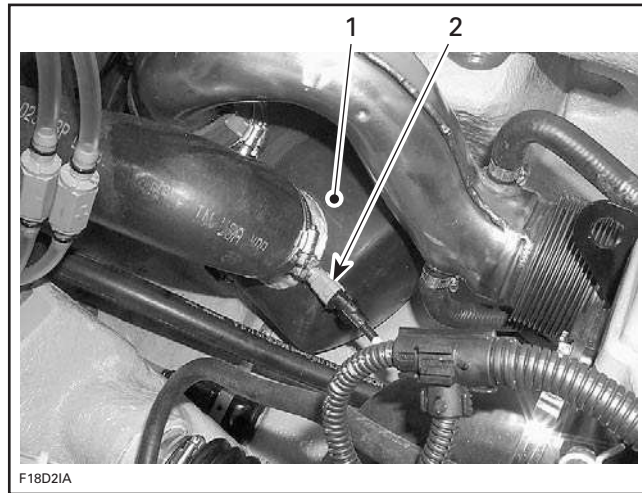
Otherwise, repair the connectors or replace the wiring harness between ECM connector and the MAPS.

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)



TYPICAL

1. Muffler
2. Exhaust gas temperature sensor (EGTS)

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 ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connector or replace the wiring harness between ECM connector and the EGTS.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

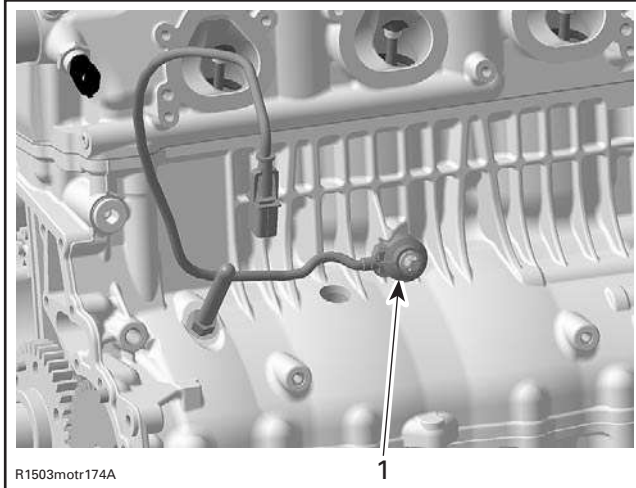
Replacement

Disconnect EGTS connector and remove EGTS.

Apply Loctite 518 on threads of the EGTS then install.

Replug connector.

KNOCK SENSOR (KS)



1. Knock sensor (KS)

Dynamic Test

Using the vehicle communication kit (VCK) with 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 the *1503 4-TEC ENGINE SHOP MANUAL*.

Check the knock sensor resistance.

Disconnect the connector from knock sensor harness.

Static Resistance Test

Using a multimeter, check the resistance between both terminals on the knock sensor.

The resistance should be approximately 5 M Ω .

If resistance is not good, replace knock sensor.

If resistance is good, disconnect the ECM connector A from ECM.



1. ECM "A" connector
2. Knock sensor connector (harness side)

Using a multimeter, check resistors inside harness. Measure resistance values as per following table.

NOTE: Only Supercharged Intercooled engines have resistors in the harness. On other engines, check the continuity of harness.

ECM "A" CONNECTOR	KNOCK SENSOR CONNECTOR (HARNESS SIDE)	RESISTANCE Ω
Pin A-9	Pin 1	1710 - 1890
Pin A-23	Pin 2	19000 - 21000
—	Pin 1 and pin 2	1710 - 1890

Repair/replace resistor/harness/connector if resistance measurement are not within values.

If harness is good, try a new ECM. Refer to ECM AND MPEM in this section.

Replacement

Remove the intake manifold. Refer to INTAKE in the *1503 4-TEC ENGINE SHOP MANUAL*.

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).

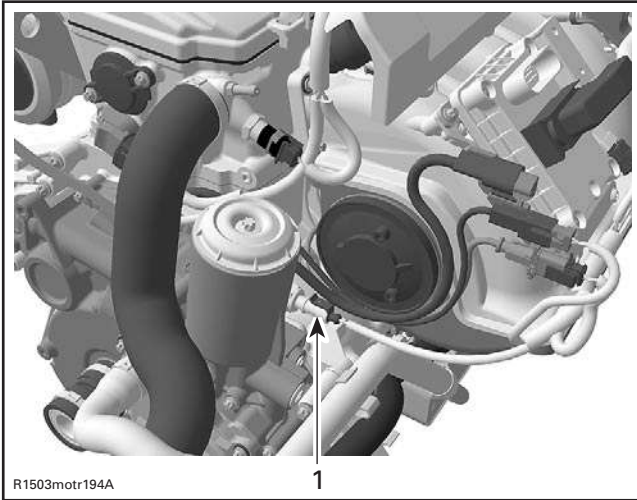
Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

CAUTION: Improper torque might prevent sensor to work properly and lead engine to severe damage of internal components.

Replug connector.

OIL PRESSURE SENSOR (OPS)



TYPICAL
1. 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 *1503 4-TEC ENGINE SHOP MANUAL*.

If the engine oil pressure is good, the OIL message in the cluster 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 infinitely high (normally open switch).

When engine is running and the oil pressure reaches 180 - 220 kPa (26 - 32 PSI), the resistance of the OPS is close to 0 Ω .

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 ECM AND MPEM 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 THEN ground the OPS connector.

If the problem goes away (no OIL message in the cluster and beeper is OFF), either the oil pressure sensor (OPS) is defective or there is a bad connection with the sensor.

If the problem is still there (OIL message in the cluster and beeper is ON), there is a malfunction in the harness (open circuit).

TOPS VALVE

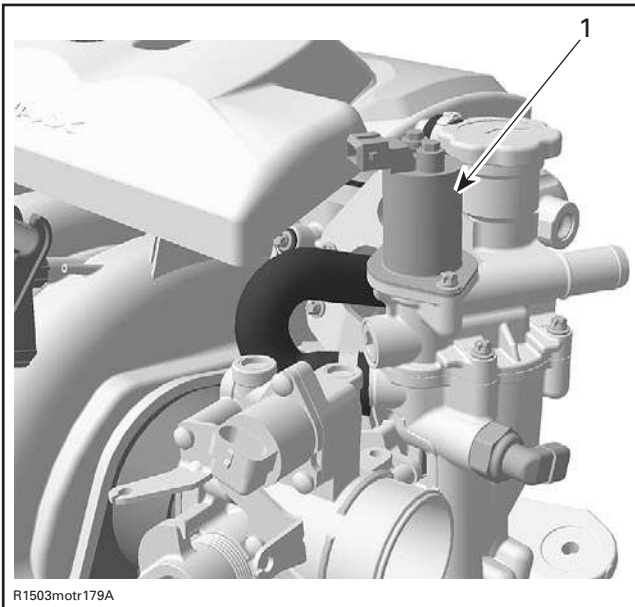
The valve is turned on as soon as safety lanyard is installed on its post. The valve opening allows ventilation of crankcase.

The OSPS monitors the pressure to detect a malfunction of this valve. If pressure rises above a preset threshold (40 kPa (6 PSI)), the valve is re-energized again and if it fails, a fault code is generated.

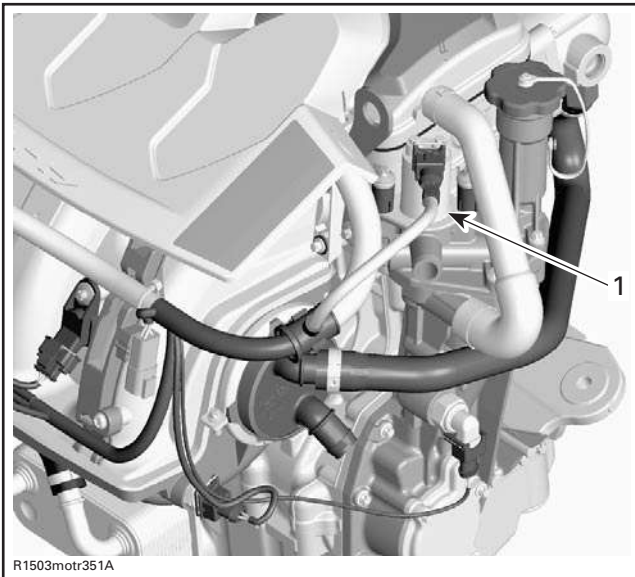
The TOPS switch, located besides the MPEM (on MPEM bracket), monitors the watercraft position. If the watercraft rolls above a preset threshold (or tips over) the switch opens and the ECM closes the valve to prevent oil in engine crankcase to flow towards intake manifold. Besides, the engine RPM will be gradually reduced then engine will be stopped.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



TYPICAL — 4-TEC NATURALLY ASPIRATED AND SUPERCHARGED ENGINES
1. TOPS valve



TYPICAL — 4-TEC SUPERCHARGED INTERCOOLED ENGINE
1. TOPS valve

Resistance Test

Disconnect the connector from the TOPS valve and check the resistance of the solenoid itself.

The resistance should be between 1.27 Ω and 2.47 Ω .

Otherwise, replace the TOPS valve.

Dynamic Test

Activate the TOPS valve by installing the safety lanyard on the DESS post.

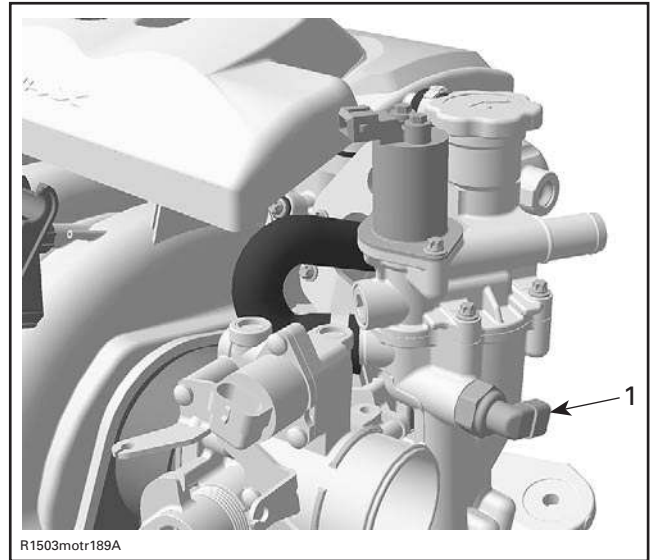
If you can hear the movement of the piston (knocking), the valve works fine, otherwise follow the procedure shown in the following chart.

NOTE: Take into account that you could hear the piston movement and the valve might not be working properly. The retaining washer could be unlocked from the piston shaft. Disassembly will reveal its condition.

Replacement

Refer to the *1503 4-TEC ENGINE SHOP MANUAL*.

OIL SEPARATOR PRESSURE SENSOR (OSPS)



1. OSPS

Limp Home Mode due to OSPS Malfunction

When OSPS loses its ground and does not close, fault code P1202 is activated after 3 to 5 minutes of operation and engine goes into the 5000 RPM limp home mode.

Proceed in this order prior to assume the OSPS is defective:

- Check if TOPS valve is turned on while safety lanyard is installed on the DESS post. If not, inspect TOPS valve.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

- Check if crankcase blow-by pressure stays below 40 kPa (6 PSI) as described in the DYNAMIC TEST below. If not, inspect TOPS valve.
- Check OSPS wiring and connectors. Replace/repair if required.
- Check OSPS.

Dynamic Test

⚠ WARNING

The TOPS system might be pressurized. Stop the engine and wait at least 30 seconds before opening the oil filler cap, to release the pressure.

To check the function of the OSPS (oil separator pressure sensor), proceed as follows.

Remove oil dipstick from engine.

Using appropriate tubes, install the engine leak test pump (P/N 529 021 800) on dipstick tube. Ensure to have a tight fit.

Start engine. Spray soapy water on the tubes from the pump to the dipstick tube to ensure there is no leak. If so, correct the leak before measuring the pressure.

If the engine blow-by pressure does not reach 40 kPa (6 PSI), the CHECK ENGINE message is present in the cluster and the fault code P1202 is active, check the following points:

- Check OSPS wiring and connectors. Replace/repair if required.
- Replace OSPS if wiring and connectors are in good condition.

If the engine blow-by pressure does reach 40 kPa (6 PSI) and does not drop, verify the TOPS valve operation.

⚠ WARNING

Stop the engine and wait at least 30 seconds before removing the pump and tubes, so that pressure drops.

Resistance Test

Disconnect the connector from the OSPS and use a multimeter to check the resistance between OSPS terminal and engine ground while engine is stopped (without blow-by pressure) and while engine is running (with blow-by pressure).

When engine is stopped and the blow-by pressure is released, the resistance of the OSPS is close to 0 Ω (normally closed switch).

When engine is running and the crankcase blow-by pressure exceeds 40 kPa (6 PSI), the resistance is infinitely high.

NOTE: In order to achieve the threshold value, the TOPS valve must be disconnected and the fault code P1200 will be activated. To measure the crankcase blow-by pressure, install the pump gauge tester as per procedure in the DYNAMIC TEST.

If resistance values are incorrect, replace OSPS.

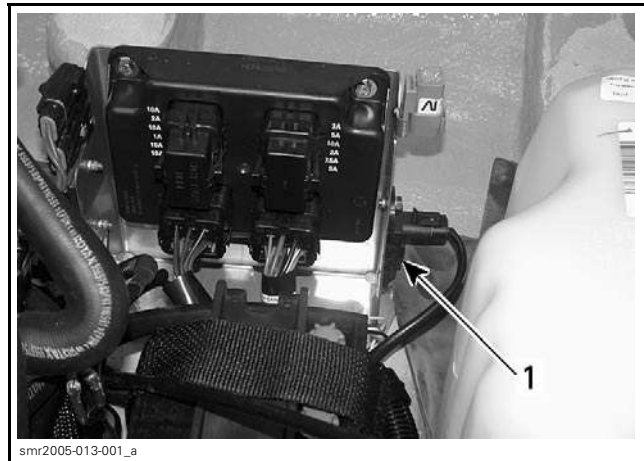
If the values are correct, check the continuity of the wiring harness.

Disconnect the ECM connector A from the ECM and check continuity of circuit 31.

Repair/replace wiring harness as required.

TOPS SWITCH

Disconnect TOPS switch and remove from MPEM bracket.



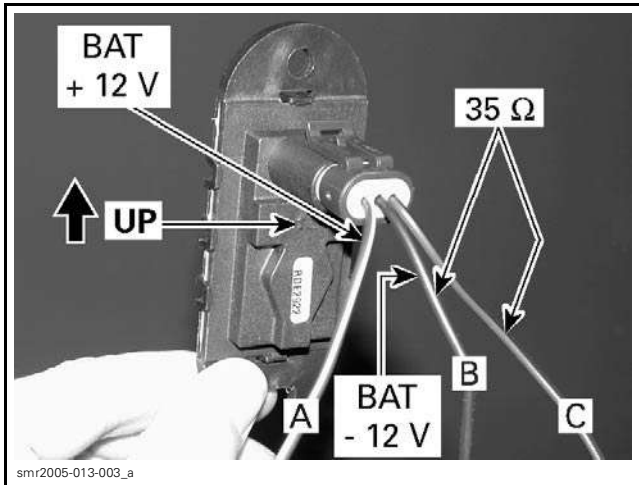
1. Tops switch

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

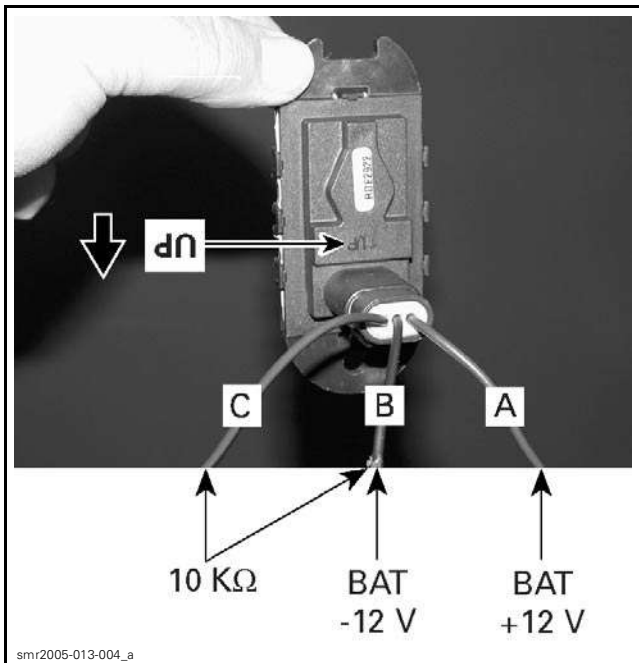
Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)



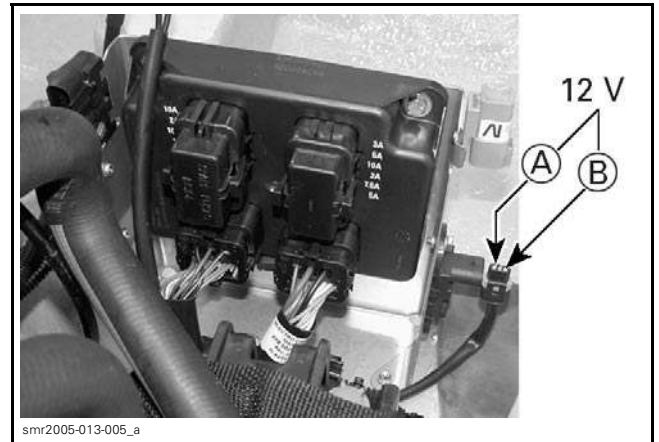
Measure resistance between pin A and C. In the UP position, it should be approximately 35 Ω.

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 $120^\circ \pm 10$ from the vertical axis. From the upside down position, switch resistance should not change before $60^\circ \pm 10$ 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.



MEASURE WHEN DESS KEY IS ON

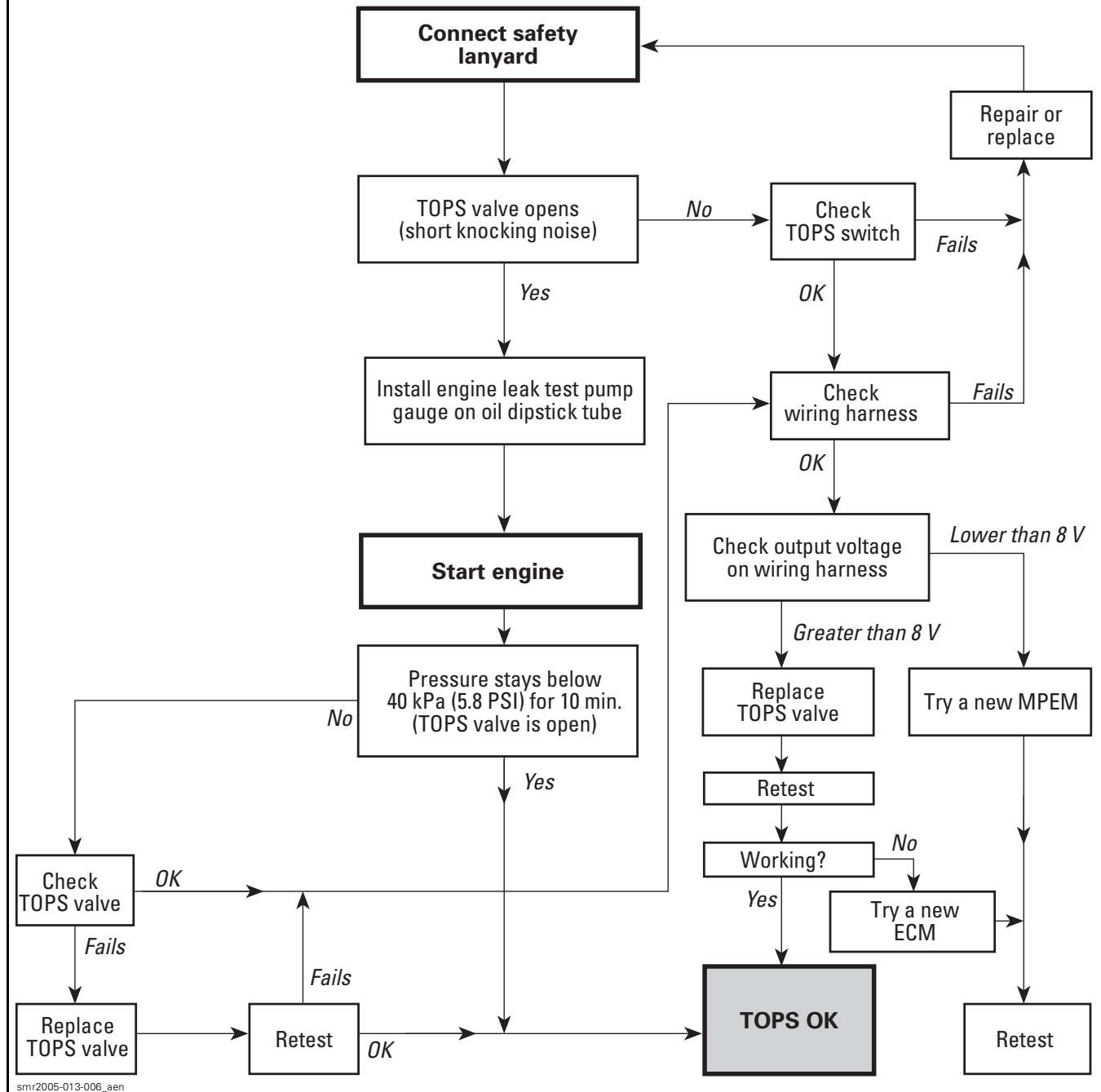
If battery voltage is not read, check TOPS switch fuse condition. If good, check continuity of circuits 2-2 and 2-15 going to MPEM. If continuity does not test good, repair/replace wiring/connector. If it tests good, try a new MPEM.

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.

Section 04 ENGINE MANAGEMENT (1503 4-TEC)

Subsection 03 (COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT)

TOPS DIAGNOSTIC FLOW CHART



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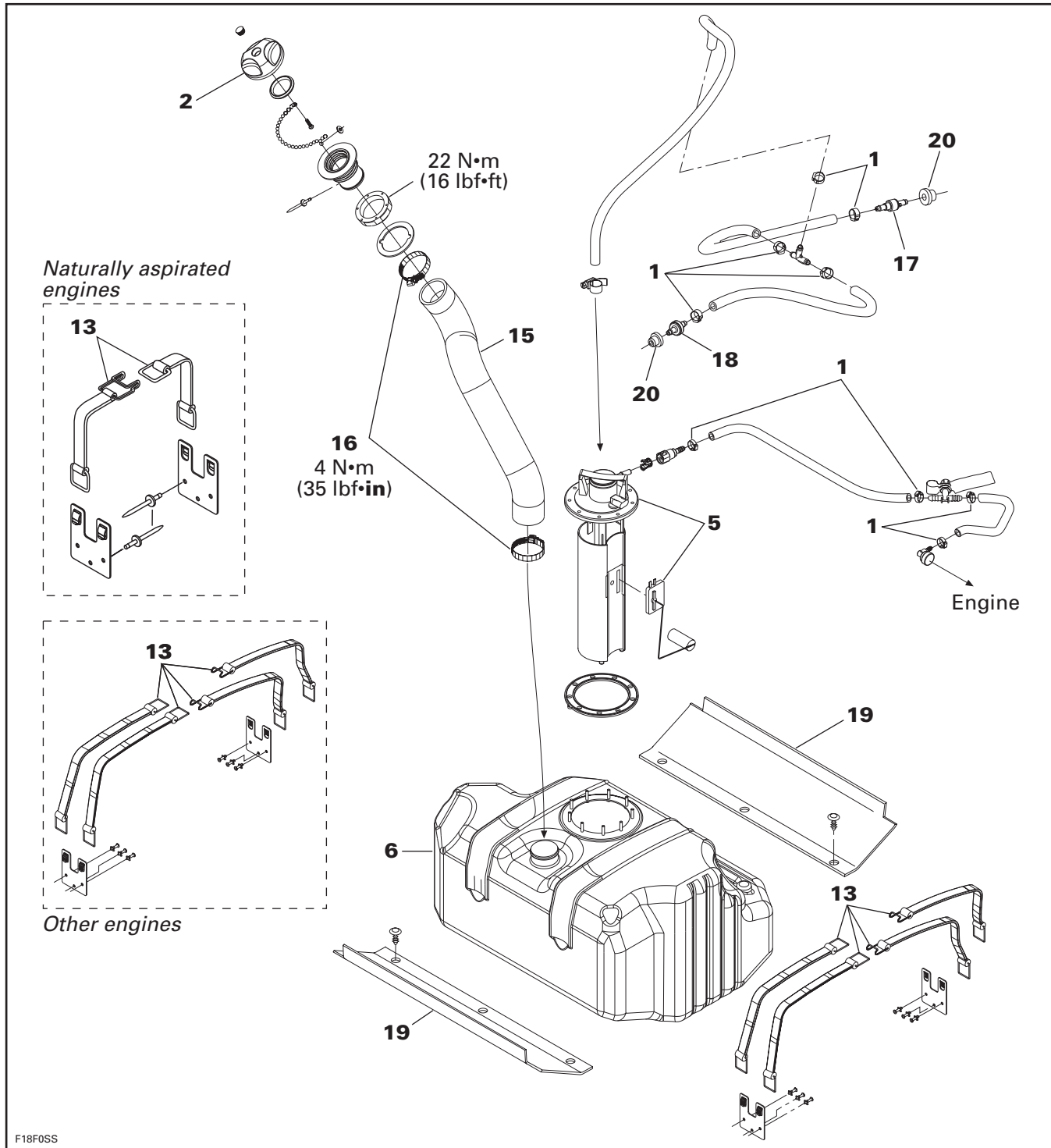
FUEL TANK AND FUEL PUMP

SERVICE TOOLS

Description	Part Number	Page
engine leak test kit	295 500 352	139
fuel pressure gauge	529 035 591	141
hook tool.....	529 035 989	137
pincher.....	295 000 076	139
pliers	295 000 070	135-136
pump gauge tester	529 021 800	139

Section 05 FUEL SYSTEM

Subsection 01 (FUEL TANK AND FUEL PUMP)



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 the VCK (Vehicle Communication Kit) 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.

⚠ WARNING

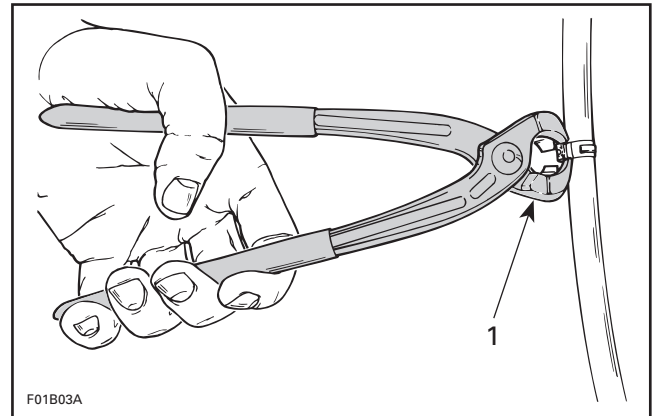
Whenever repairing the fuel system, always verify for water infiltration in reservoir. Replace any damaged, leaking or deteriorated fuel lines. When the repair is completed, ensure that hoses from fuel rail going to fuel pump are properly secured in their supports. Then, pressurize the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

⚠ WARNING

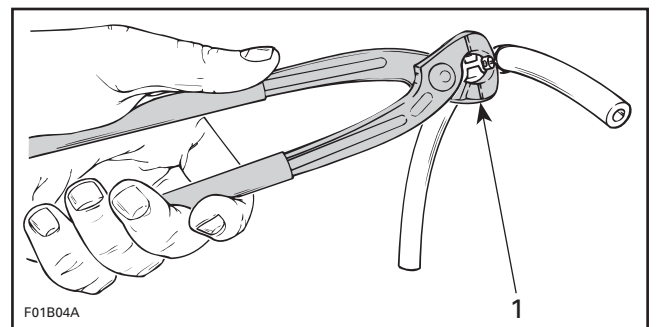
Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the safety lanyard on the DESS post. Always perform the high pressure test if any component has been removed. A pressure test must be done before connecting the safety lanyard. The fuel pump is started each time the safety lanyard is installed and it builds pressure very quickly.

Oetiker Clamps

To secure or cut Oetiker clamps no. 1 on fuel lines, use pliers (P/N 295 000 070).



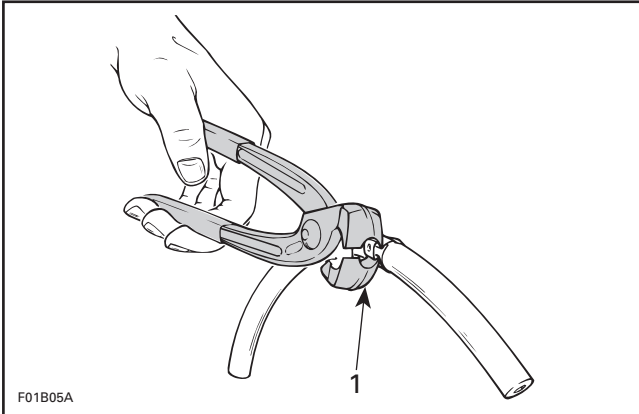
1. Cutting clamp



1. Securing clamp

Section 05 FUEL SYSTEM

Subsection 01 (FUEL TANK AND FUEL PUMP)



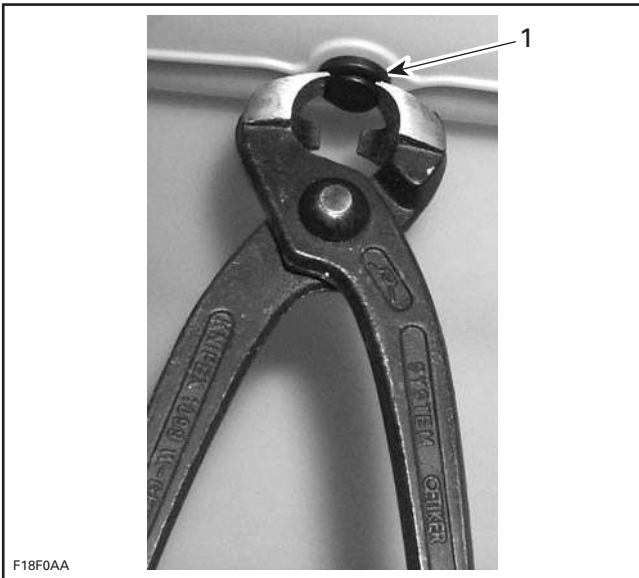
1. Securing clamp in limited access

When replacing the fuel lines on all SEA-DOO models be sure to use "B1". These hoses are available through the BRP. This will ensure continued proper and safe operation.

WARNING

Use of improper fuel lines could compromise fuel system integrity.

To remove the darts from the front access panel (if so equipped), use the pliers (P/N 295 000 070).



1. Dart

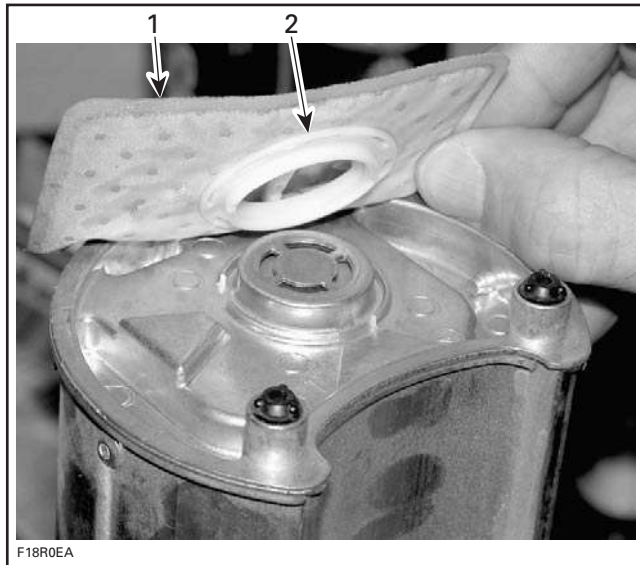
REMOVAL

Fuel Filter

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 up side down. Using a small flat screwdriver, remove the fuel filter by prying the inner plastic ring.



1. Fuel filter
2. Inner plastic ring

Fuel Pump

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. Look 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.

Fuel Tank

The engine removal is necessary to remove fuel tank.

Siphon fuel tank.

Disconnect MPEM connectors.

Detach MPEM assembly and support from bilge.

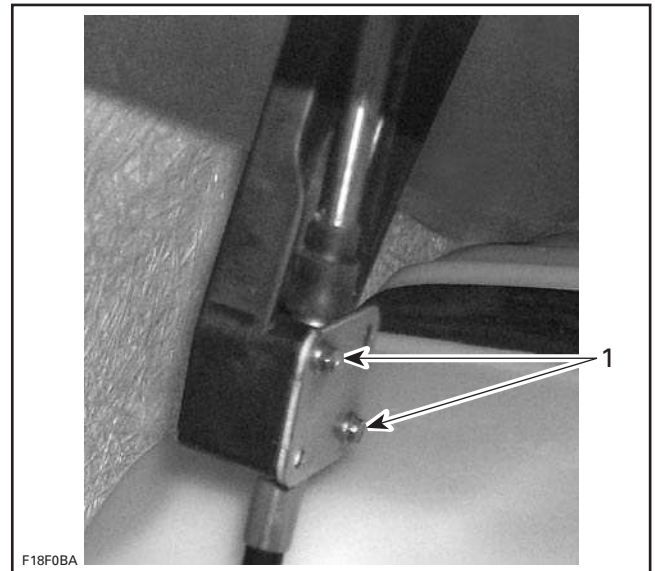
Remove TOPS switch from electrical harness or MPEM bracket.

Remove air box. 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.



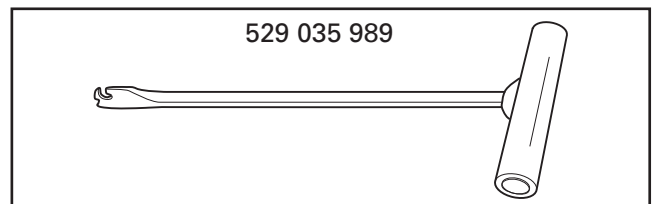
1. Screws

Remove battery. Refer to CHARGING SYSTEM subsection.

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.

WARNING

Check that fiberglass is not exposed.

INSPECTION

Fuel Filter

Check if particles are present in fuel filter. If so, replace it.

Fuel Filler Hose

Verify fuel filler hose **no. 15** for damage. Always ensure that clamps **no. 16** are well positioned and tightened. Torque clamps to 4 N•m (35 lbf•in).

Section 05 FUEL SYSTEM

Subsection 01 (FUEL TANK AND FUEL PUMP)

Pressure Relief Valve

This valve no. 17 will eliminate fuel spillage when the watercraft is upside down. If pressure is built up in fuel system the valve should open to release the pressure.

PRESSURE RELIEF VALVE	
MODELS	PRESSURE
All 4-TEC	3.5 kPa (0.5 PSI)

WARNING

If pressure relief valve is stuck, the pressure in fuel system will build up and it may cause fuel leakage in engine compartment.

NOTE: It is a one-way valve with an arrow to indicate the air flow.

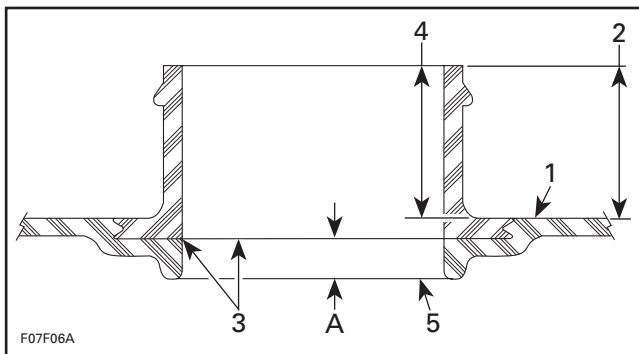
Check Valve

Check if the check valve no. 18 functions properly. Black side of the one-way check valve is the valve outlet. It allows air to get in reservoir.

Fuel Tank

Visually inspect the inside and outside of the fuel tank necks for crack(s). If crack(s) are existing, replace fuel tank no. 6.

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 3 components: the tank, the fuel pick-up neck 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.

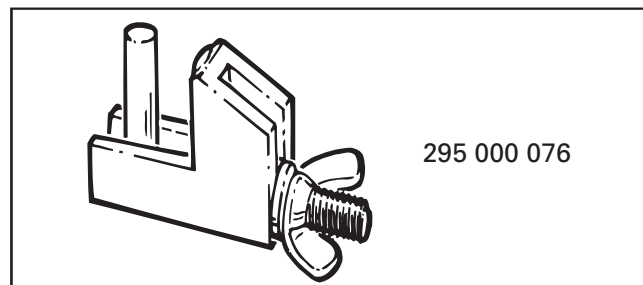
Fuel Tank Pressure Test (Supply and Vent Circuits)

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.

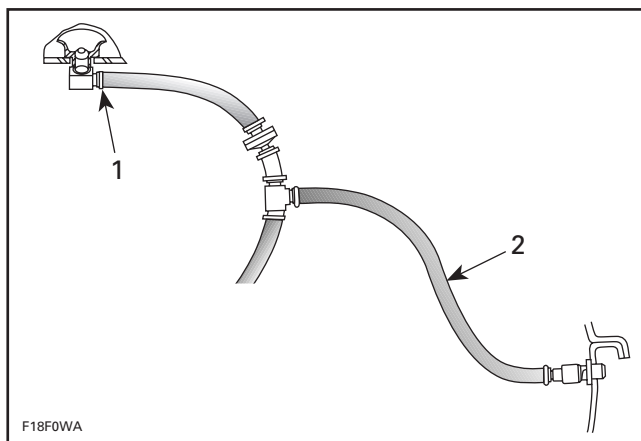
Proceed as follows:

- Fill up fuel tank.
- Disconnect air inlet hose from the black and white valve (attached to upper part of body).



Section 05 FUEL SYSTEM

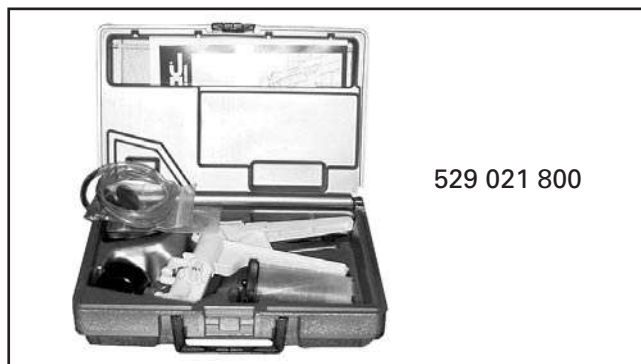
Subsection 01 (FUEL TANK AND FUEL PUMP)



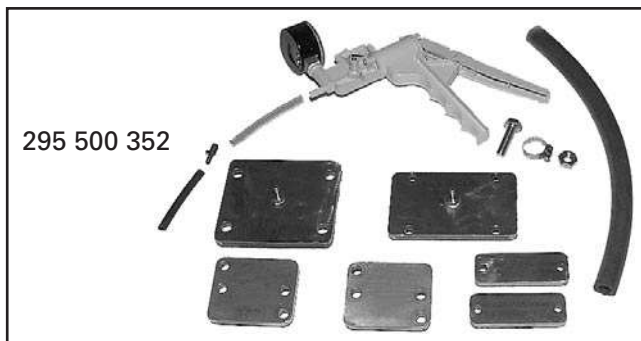
TYPICAL

1. Disconnect hose from black and white valve
2. Hose pincher on vent hose (blue valve)

- Connect pump gauge tester (P/N 529 021 800) to air inlet hose.



NOTE: This pump is included in the engine leak test kit (P/N 295 500 352).



- Install a hose pincher (P/N 295 000 076) on vent hose (blue valve).
- Pressurize fuel system to 34 kPa (5 PSI).
- If pressure is not maintained locate leak and repair/replace component leaking. To ease leak search spray a solution of soapy water on components, bubbles will indicate leak location.

NOTE: The system must maintain a pressure of 34 kPa (5 PSI) during 10 minutes. Never pressurize over 34 kPa (5 PSI).

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.

Before removing hose pincher and pump:

- Alternately touch and release with your finger the blue valve nipple to feel if air is coming out when removing hose pincher. This will indicate that pressure relief valve is not blocked.

NOTE: Ensure that grommets **no. 20** are not plugged.

Reinstall hose to the black and white valve and ensure valve is attached to body.

High Pressure Test (Fuel Pump Circuit)

Refer to FUEL PUMP PRESSURE TEST.

INSTALLATION

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

Fuel Filter

New filter can be pressed back on by hand. Ensure it is fully seated for complete filtering of the fuel.

Reinstall fuel pump.

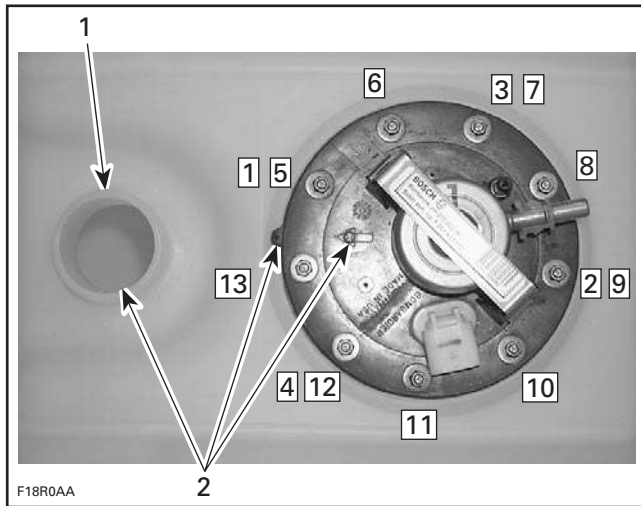
Fuel Pump

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).

Section 05 FUEL SYSTEM

Subsection 01 (FUEL TANK AND FUEL PUMP)



F18R0AA

TIGHTENING SEQUENCE

1. Fuel tank neck
2. Align

Perform a pressure test on fuel tank. Refer to FUEL TANK PRESSURE TEST.

Fuel Tank

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. Refer to the appropriate section.

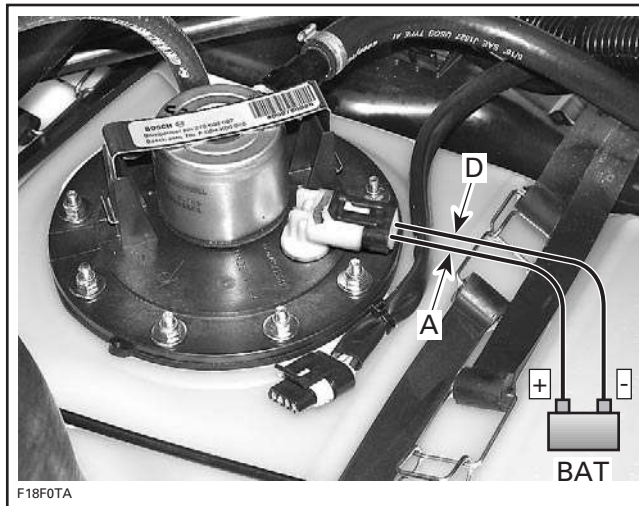
TESTING PROCEDURES

Fuel Pump

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.

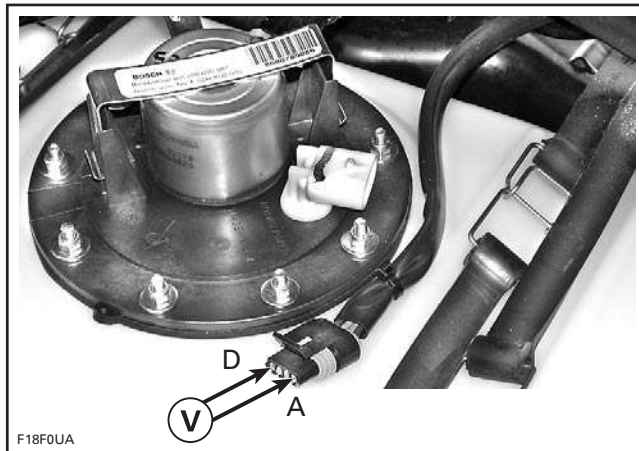


F18F0TA

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.



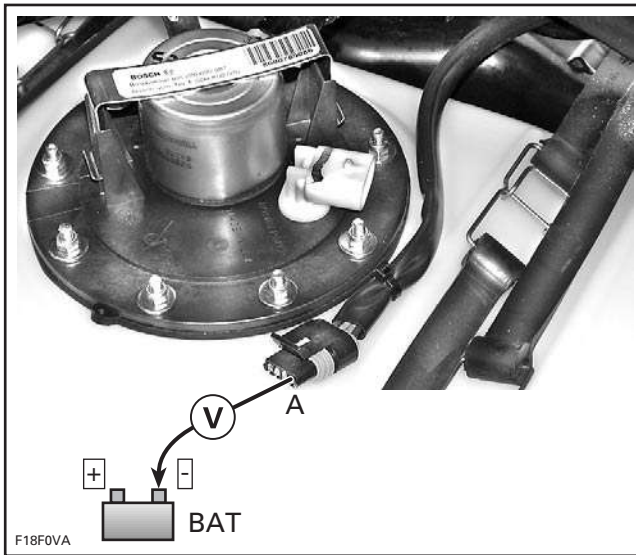
F18F0UA

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.

Section 05 FUEL SYSTEM
Subsection 01 (FUEL TANK AND FUEL PUMP)



- 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.

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.

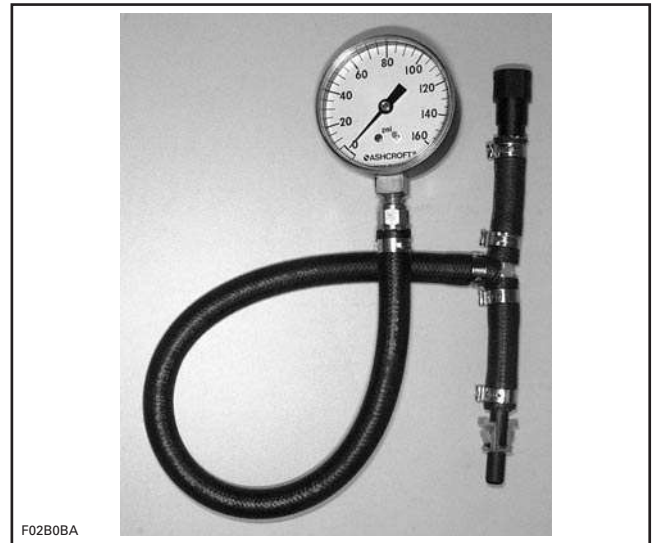
Remove glove box to have access to fuel pump. Refer to HULL/BODY section.

Remove air vent tube from front storage area.

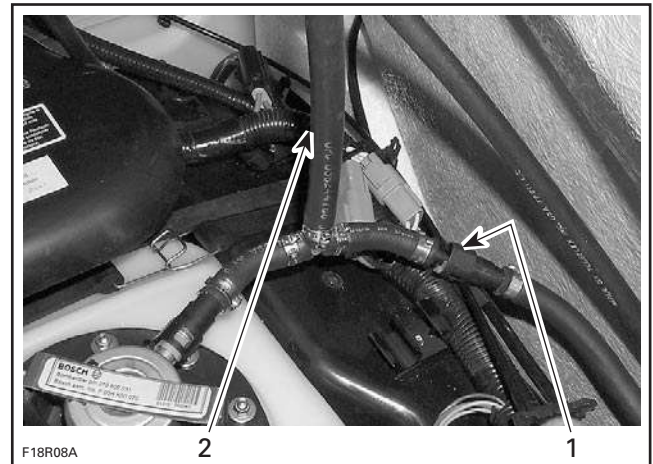
Ensure there is no leak from hoses and fittings. Repair any leak.

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).



FUEL PRESSURE GAUGE



1. Hose disconnected from fuel pump
2. In-line installation of fuel pressure gauge

Install safety lanyard and observe fuel pressure. **Do not crank engine.** Repeat twice. Release pressure using B.U.D.S. between tests so that the gauge is "reset" to zero (0).

MODELS	FUEL PRESSURE (when installing safety lanyard)
4-TEC naturally aspirated/supercharged	290-310 kPa (42-45 PSI)
4-TEC supercharged intercooled	386-414 kPa (56-60 PSI)

Section 05 FUEL SYSTEM

Subsection 01 (FUEL TANK AND FUEL PUMP)

Crank or start engine and observe fuel pressure. The fuel pressure should be the same as above.

If pressure is good, fuel pump and pressure regulator are working adequately.

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.

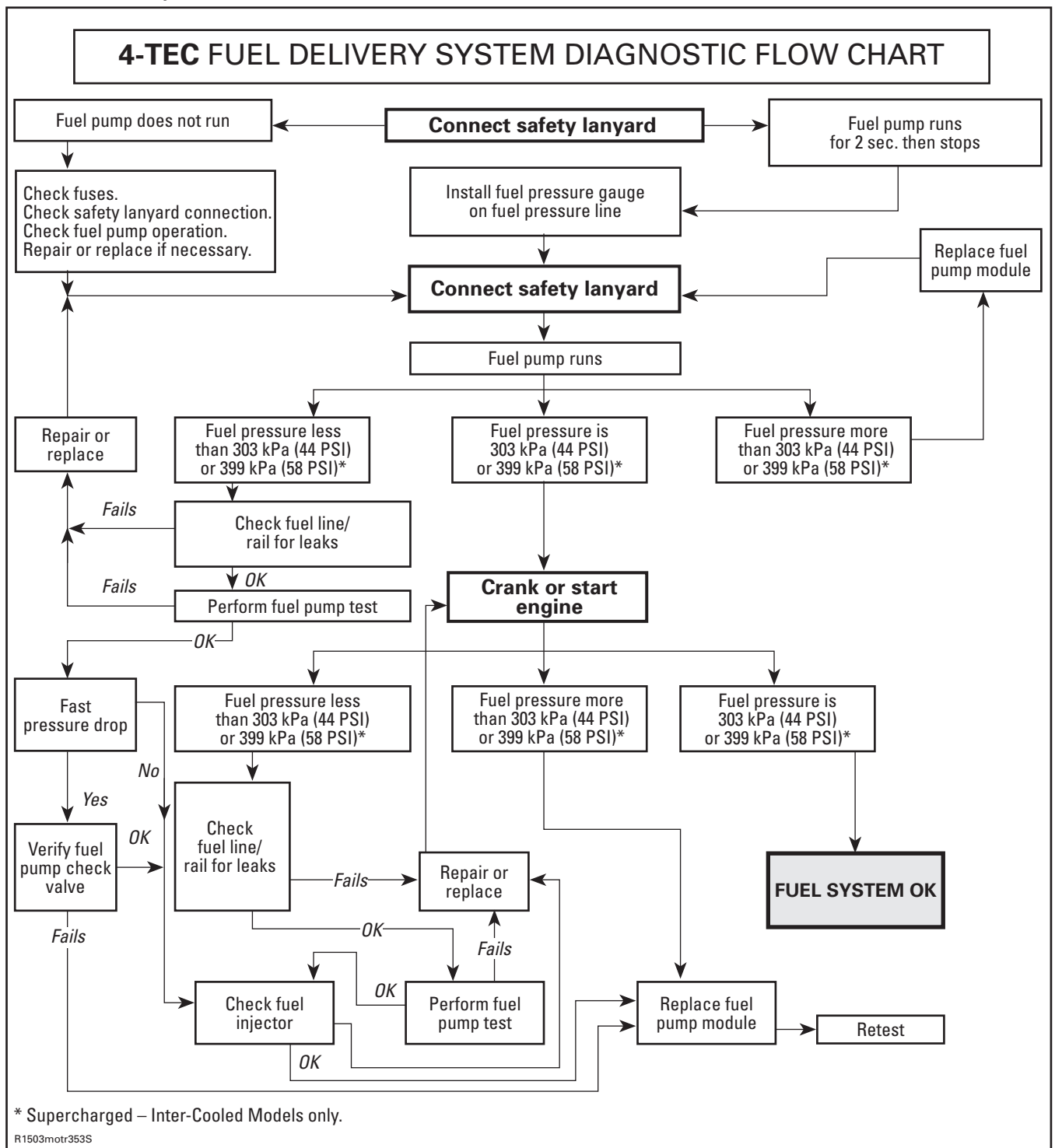
Remove pressure gauge and reinstall fuel hose.

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.

Fuel Delivery Flow Chart



IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM adapter.....	420 277 010	148

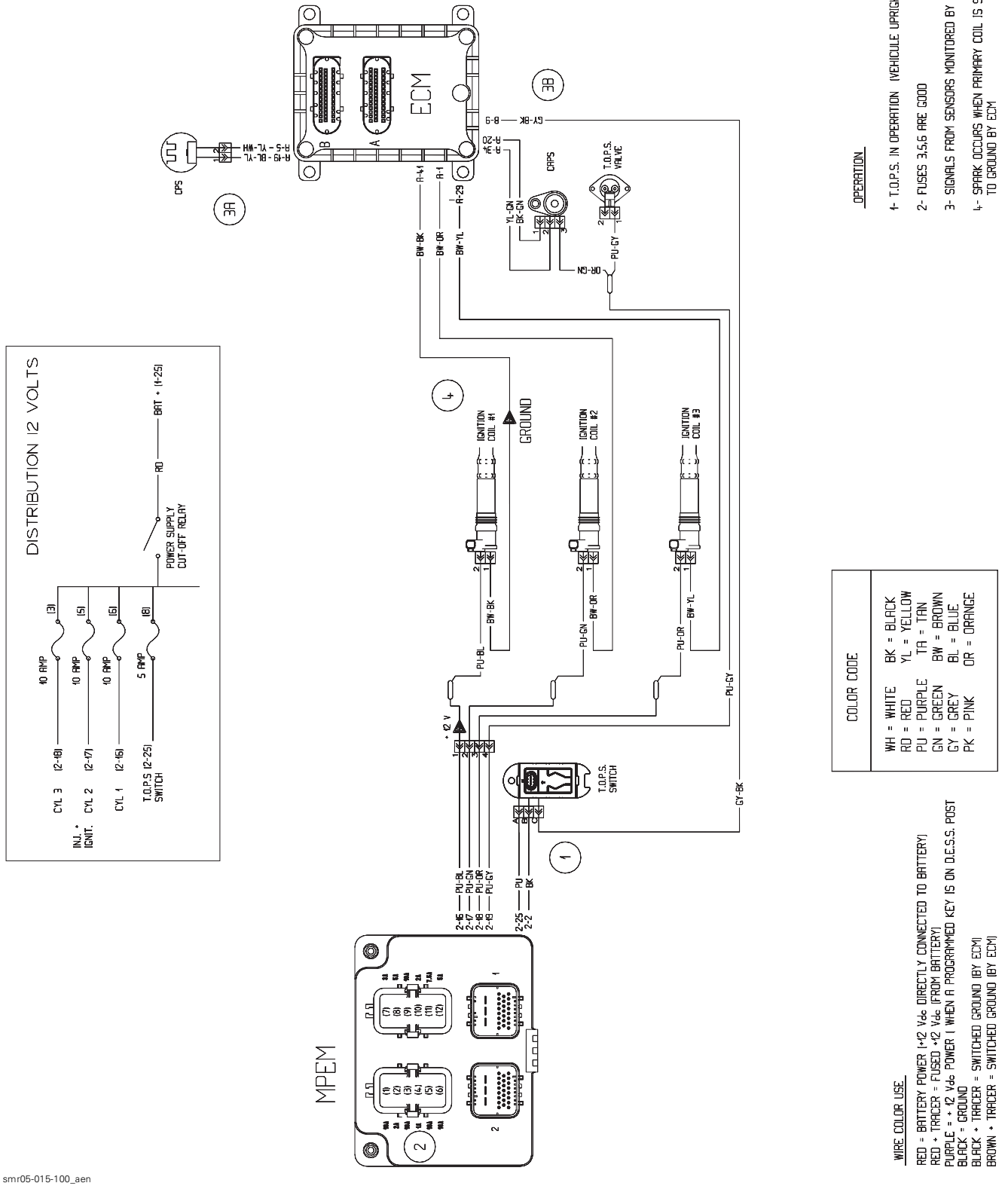
SERVICE PRODUCTS

Description	Part Number	Page
silicone lubricant.....	293 600 041	149

Section 06 ELECTRICAL SYSTEM

Subsection 01 (IGNITION SYSTEM)

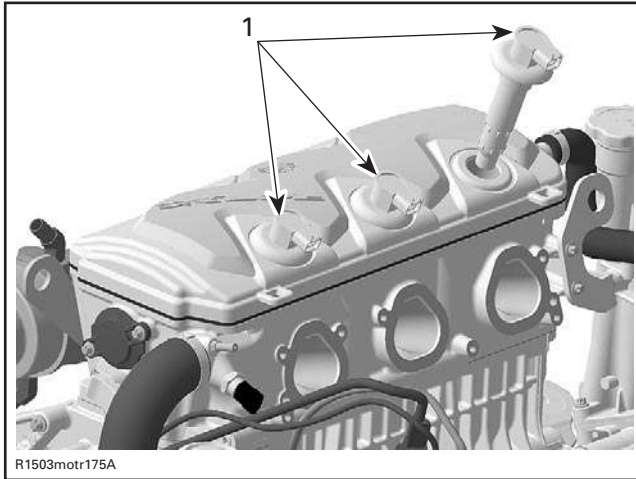
ALL 2005 4-TEC (IGNITION SYSTEM)



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GENERAL

NOTE: The EMS controls the ignition system. For more information, refer to ENGINE MANAGEMENT.



1. Ignition coil

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.

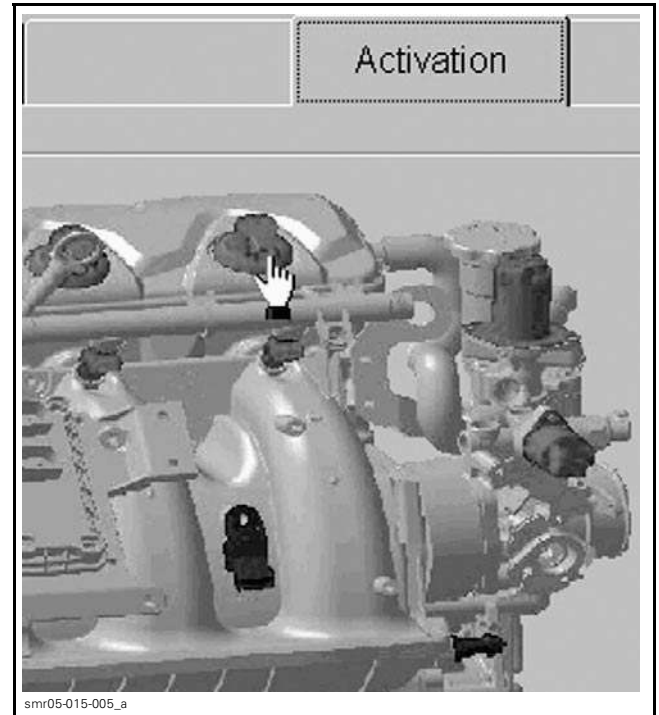
WARNING

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.

QUICK TEST WITH B.U.D.S.

Using the vehicle communication kit (VCK) with 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.

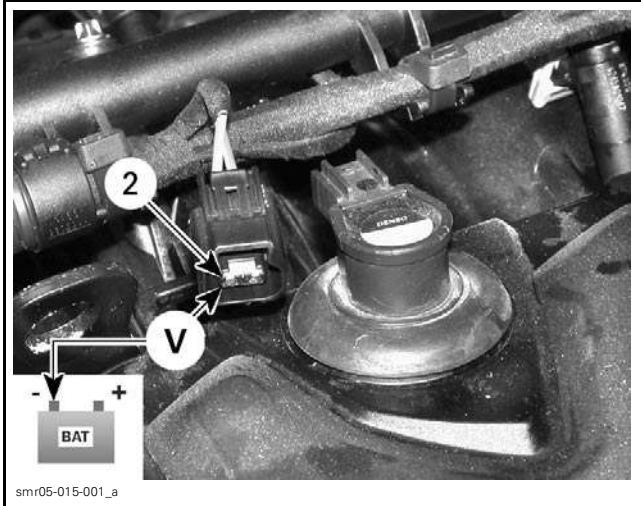
VOLTAGE TEST

Disconnect the connector from the ignition coil and check the voltage supplied by the MPEM.

Install safety lanyard on the DESS post. Read voltage.

Section 06 ELECTRICAL SYSTEM

Subsection 01 (IGNITION SYSTEM)



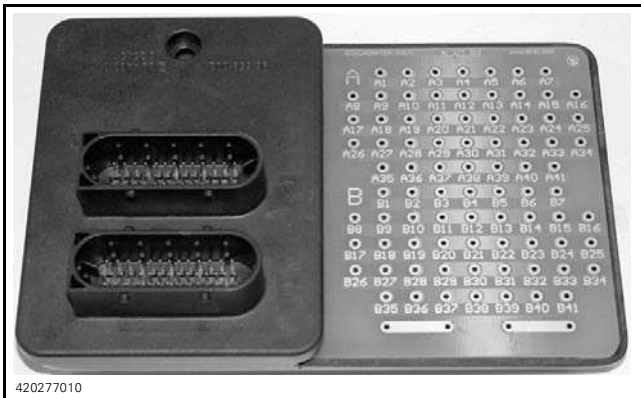
The voltage should be 12 V.

If 12 V is NOT read, check continuity of appropriate circuit.

COMPONENT	CIRCUIT NUMBER
Cylinder 1	2 - 16
Cylinder 2	2 - 17
Cylinder 3	2 - 18

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.



COMPONENT	CIRCUIT NUMBER
Cylinder 1	41
Cylinder 2	1
Cylinder 3	29

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.

IGNITION COIL

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.

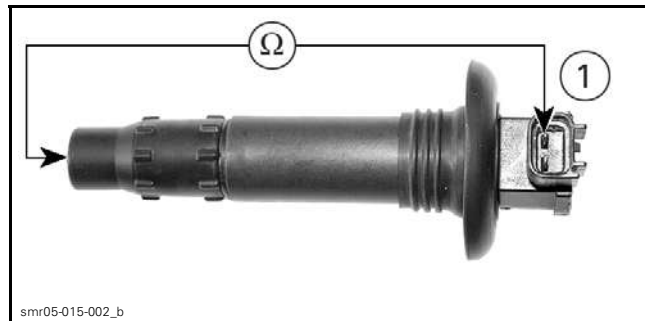
Remove ignition coil from spark plug.

Using a multimeter, check the resistance in both primary and secondary windings.



PRIMARY CIRCUIT

CIRCUIT	TERMINAL	RESISTANCE @ 20°C (68°F)
Primary	1 and 2	0.85 - 1.15 Ω



SECONDARY CIRCUIT

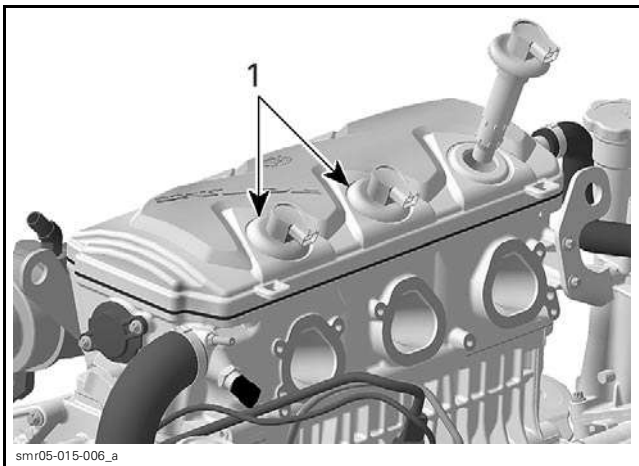
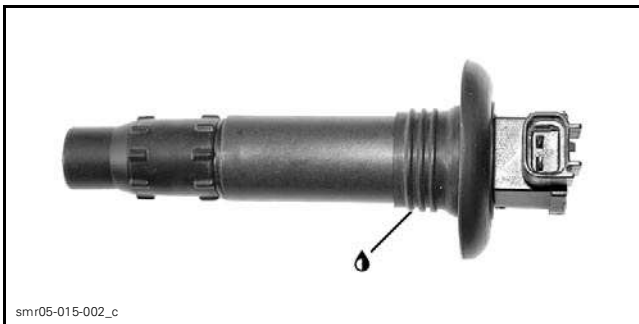
Section 06 ELECTRICAL SYSTEM

Subsection 01 (IGNITION SYSTEM)

CIRCUIT	TERMINAL	RESISTANCE @ 20°C (68°F)
Secondary	1 and spark plug terminal	9.5 - 13.5 kΩ

If any resistance is not good, replace ignition coil. If the windings test good, try a new ECM.

NOTE: Prior to inserting the ignition coil to its location, apply some silicone lubricant (P/N 293 600 041) as shown. After installation, ensure the seal seats properly with engine top surface.



1. Seal properly seated

SPARK PLUGS

Disassembly

⚠ 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.

Disconnect the wiring harness from the ignition coil.

Remove the ignition coil.

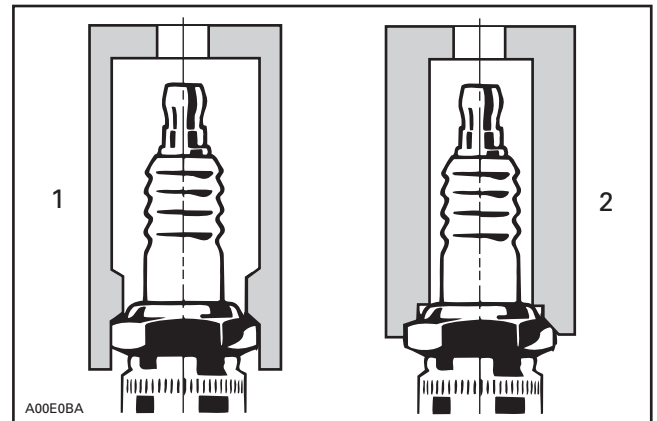
First unscrew the spark plug one turn.

Clean the spark plug and cylinder head with pressurize air then completely unscrew.

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.



1. Proper socket
2. Improper socket

ENGINE	SPARK PLUG	TORQUE	GAP mm (in)
All 4-TEC	NGK DCPR8E	Hand tighten + 1/4 turn with a socket	0.75 (.030)

IGNITION TIMING

There is no ignition timing to perform.

CHARGING SYSTEM

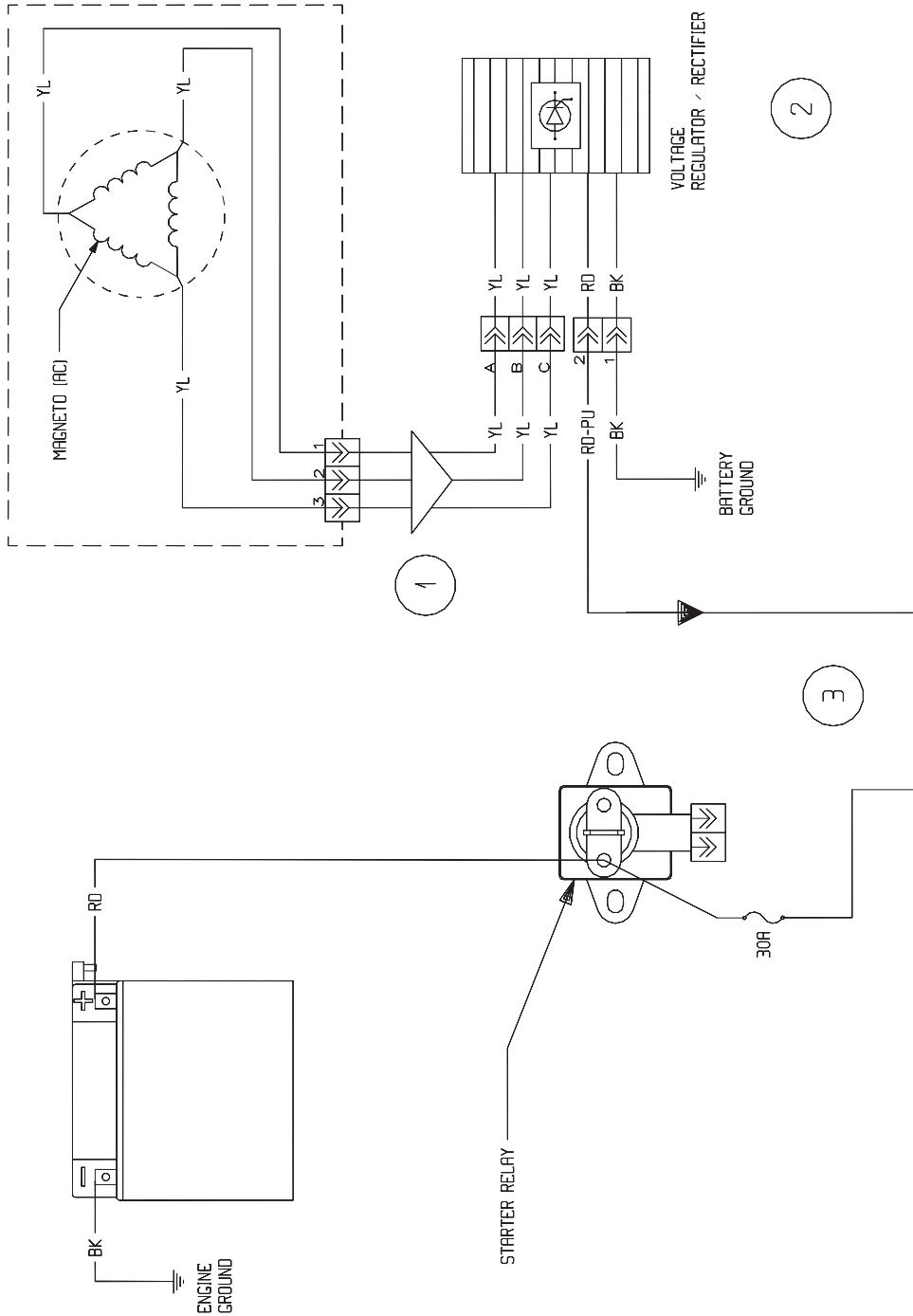
SERVICE TOOLS

Description	Part Number	Page
3-pin magneto harness adapter	529 036 016	155–156
multimeter Fluke 111	529 035 868	153

Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)

ALL 2005 4-TEC (CHARGING SYSTEM)



COLOR CODE	
WH = WHITE	BK = BLACK
RD = RED	YL = YELLOW
PU = PURPLE	TA = TAN
GN = GREEN	BW = BROWN
GY = GREY	BL = BLUE
PK = PINK	OR = ORANGE

OPERATION WHEN ENGINE RUNS

- 1- AC MAGNETO SENDS CURRENT TO VOLTAGE REGULATOR-RECTIFIER
- 2- VOLTAGE REGULATION AND CURRENT RECTIFICATION FROM ALTERNATING CURRENT (AC) TO DIRECT CURRENT (DC)
- 3- DIRECT CURRENT CHARGES BATTERY

WIRE COLOR USE

RED = BATTERY POWER (12 Vdc DIRECTLY CONNECTED TO BATTERY)
 YELLOW = AC CURRENT FROM MAGNETO
 BLACK = GROUND

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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.



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.



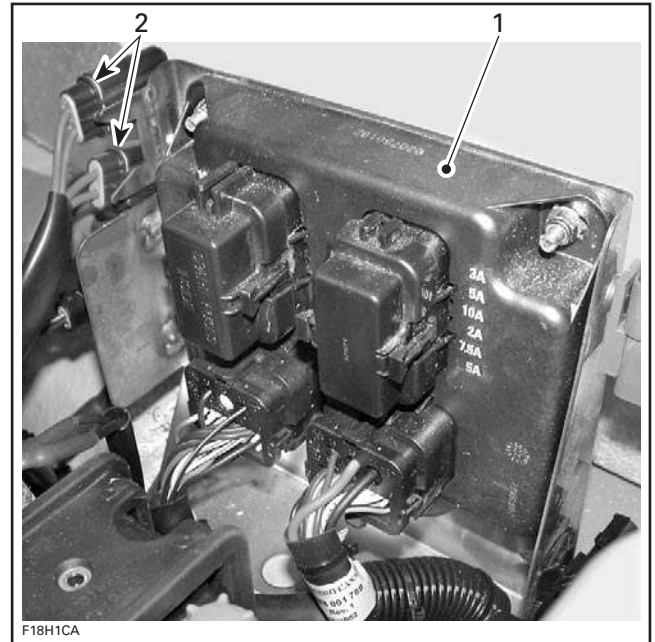
1. Rectifier/Regulator

Battery

The battery is the DC source for the electric starter, the MPEM, ECM and all accessories.

Fuse

If the battery is regularly discharged, check charging system fuse condition.



TYPICAL

1. MPEM

2. Charging system: Fuse connected to the RED/PURPLE wire

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).

Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)



RECTIFIER/REGULATOR

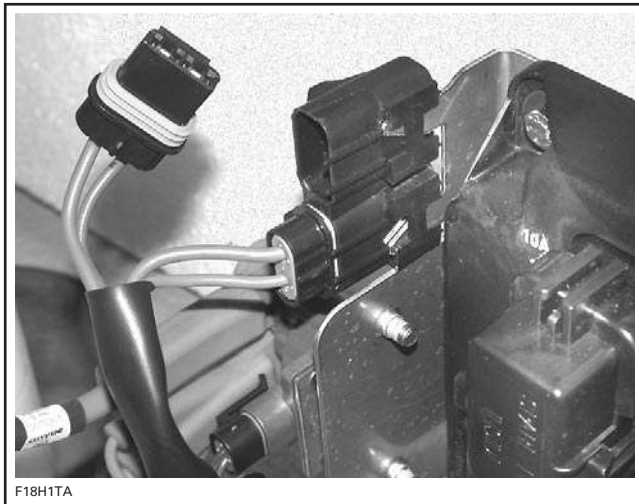
Continuity Test

Due to internal circuitry, there is no static test available to check continuity.

DC Current Test

Proceed as follows:

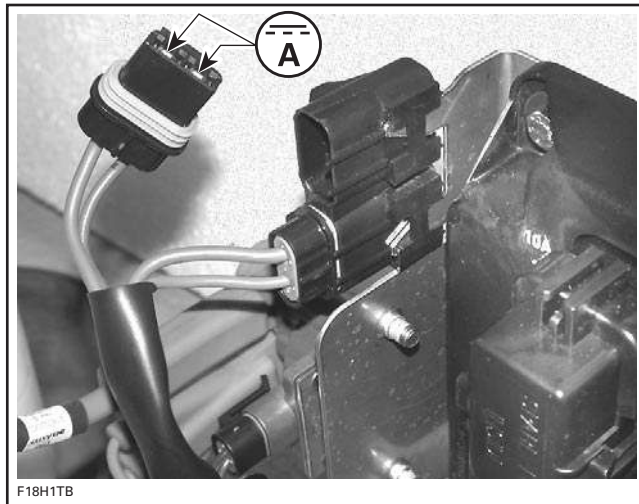
- Remove charging system fuse.



- Connect probes to fuse holder terminals.
- Set multimeter to Adc.
- Start engine.

TEST ENGINE SPEED	CURRENT
6000 RPM	min. 5 A

- Read current.



- If current is below specification, check magneto (stator) output prior to concluding that rectifier is faulty.
- Reinstall fuse.

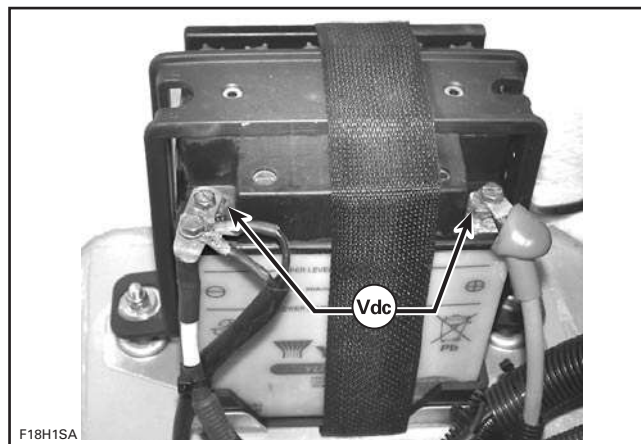
DC Voltage Test

Proceed as follows:

- Set multimeter to Vdc scale.
- Connect multimeter to battery posts.
- Start engine.

TEST ENGINE SPEED	VOLTAGE
5500 RPM	Max. 15 Vdc

- Read voltage.



- If voltage is above specification, replace rectifier/regulator.

Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

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

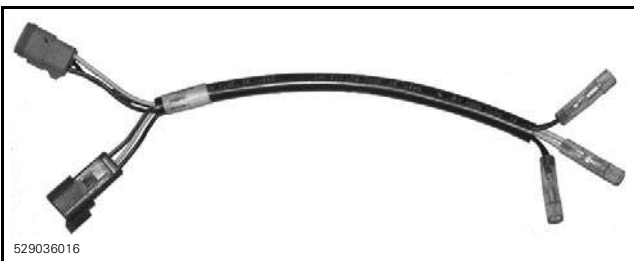
Proceed as follows:

- Disconnect the magneto wiring harness connector.



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- Install the 3-pin magneto harness adapter (P/N 529 036 016) between unplugged connectors.



529036016

- Set multimeter to Ω .
- Connect multimeter between YELLOW wires.

TERMINAL	RESISTANCE @ 20°C (69°F)
1 and 2	0.1 - 1 Ω
1 and 3	
2 and 3	

- Read resistance.



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- If any result is out of specification, replace stator.
- Replug connectors properly.

Insulation Test

- Disconnect the magneto wiring harness connector.



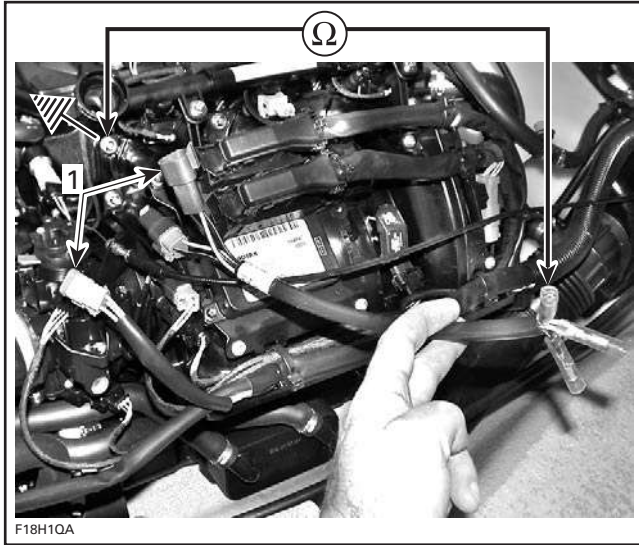
smr05-016-008

- Install the 3-pin magneto harness adapter (P/N 529 036 016) to the magneto wiring harness.

Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)

IMPORTANT: Leave wiring harness side disconnected.



1. Do not plug these connectors

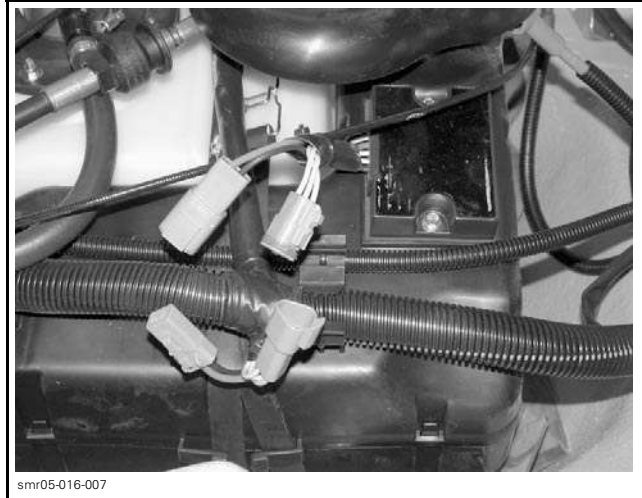
- Set multimeter to Ω .
- Connect multimeter between YELLOW wires.

TERMINAL	RESISTANCE @ 20°C (69°F)
Any YELLOW wire and engine ground	Infinity (open circuit)

- Read resistance.
- If there is a resistance or continuity, the stator coils and/or the wiring is grounded and needs to be repaired or replaced.
- Replug connectors properly.

AC Voltage Test

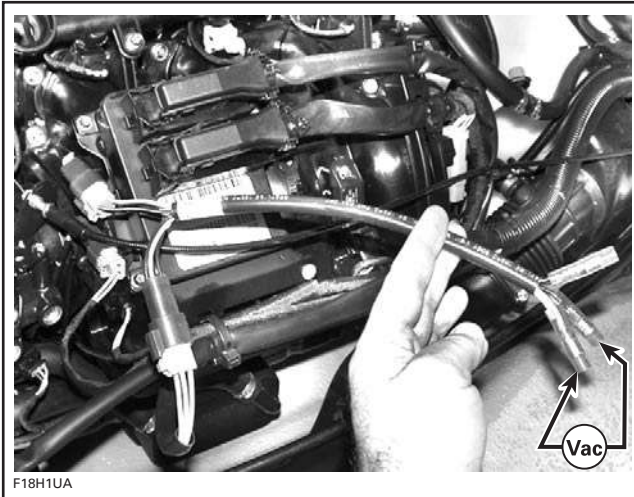
- Disconnect the voltage regulator/rectifier connectors.



- Disconnect the magneto wiring harness connector.



- Install the 3-pin magneto harness adapter (P/N 529 036 016) between unplugged connectors.



- Set multimeter to Vac scale.
- Start engine.
- Connect multimeter between YELLOW wires.

TEST ENGINE SPEED	TERMINAL	VOLTAGE
3500 RPM	1 and 2	Approx. 25 Vac
	1 and 3	
	2 and 3	

- Read voltage.
- If voltage is lower than specification, replace stator.
- Replug connectors properly.

BATTERY

Troubleshooting

SYMPTOM: DISCHARGED OR WEAK BATTERY	
CAUSE	REMEDY
Battery posts and/or cable terminal oxidized.	Clean and coat with dielectric grease.
Loose or bad connections.	Check wiring and connector cleanliness, damaged or short circuit.
Faulty battery (sulfated, doesn't keep a full charge, damaged casing, loose post).	Replace.
Burnt fuse(s) or faulty rectifier.	First check fuse(s). If it is in good condition, check rectifier/regulator.
Faulty battery charging coil (or stator).	Replace.

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 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.

Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)

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 close 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.

⚠ WARNING

Battery caps do not have vent holes. Make sure that vent line is not obstructed.

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 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.

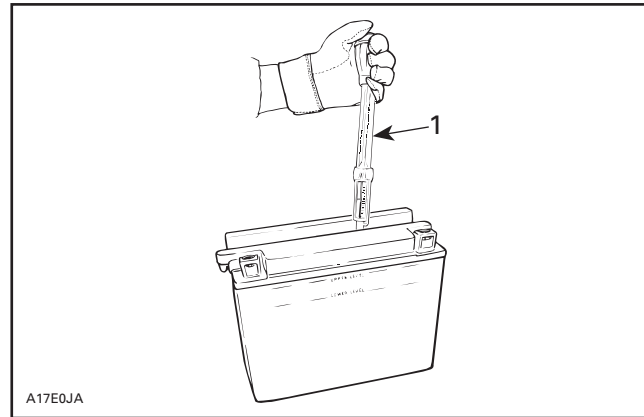
Electrolyte Reading

Check charge condition using either a hydrometer or multimeter.

With a multimeter, voltage readings appear instantly to show the state of charge. Always respect polarity. A fully charge battery will have a reading of 12.6 Vdc.

A hydrometer measures the charge of a battery in terms of specific gravity of the electrolyte. A fully charge battery will have a specific gravity between 1.265 to 1.280.

Most hydrometers give a true reading at 21°C (70°F).



A17E0JA

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.

ELECTROLYTE TEMPERATURE		OPERATION TO PERFORM	
°C	°F		
38	100	.012	Add to the reading
32	90	.008	
27	80	.004	
21	70	CORRECT READING	
16	60	.004	Subtract from the reading
10	50	.008	
4	40	.012	
- 1	30	.016	

Section 06 ELECTRICAL SYSTEM
Subsection 02 (CHARGING SYSTEM)

EXAMPLE NO. 1

TEMPERATURE ABOVE 21°C (70°F):
 Hydrometer reading: 1.250
 Electrolyte temperature: - 1°C (30°F)
 Subtract .016 Sp. Gr.
 Corrected Sp. Gr. is 1.234

EXAMPLE NO. 2

TEMPERATURE ABOVE 21°C (70°F):
 Hydrometer reading: 1.235
 Electrolyte temperature: 38°C (100°F)
 Add .012 Sp. Gr.
 Corrected Sp. Gr. is 1.247

SPECIFIC GRAVITY READING USING A HYDROMETER		
STATE OF CHARGE	ELECTROLYTE TEMPERATURE	
	27°C (80°F)	4°C (40°F)
100%	1.26/1.27	1.27/1.28
75%	1.21/1.22	1.22/1.23
50%	1.16/1.17	1.17/1.18
25%	1.12/1.13	1.13/1.14
0%	1.10 or less	1.11 or less

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. At 14 seconds into the test, check battery voltage; if battery is in good condition, it will have at least 10.5 Vdc.

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 (trickle 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.

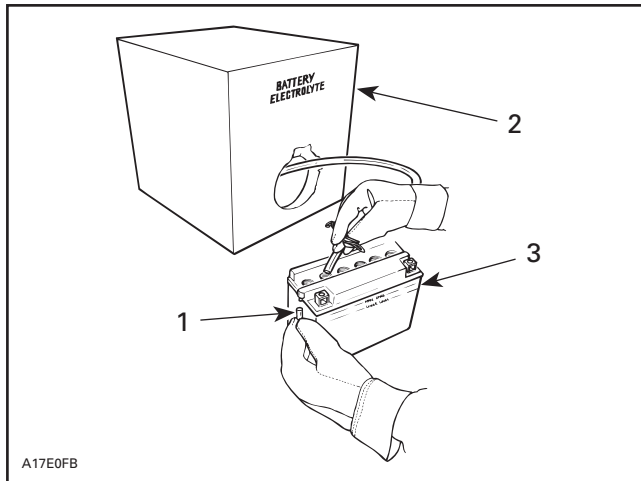
⚠ WARNING
 Failure to remove the sealing tube could result in an explosion.

- 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.

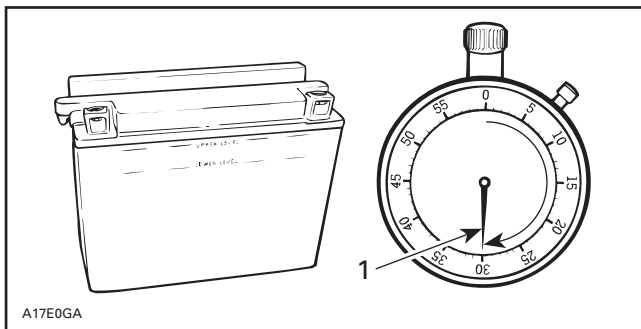
Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)



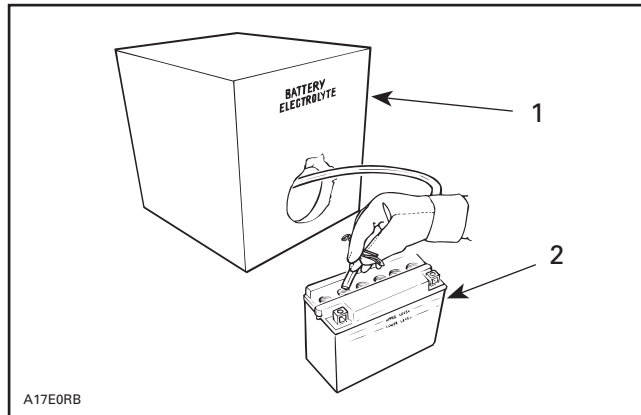
1. Sealing tube removed
2. Battery electrolyte
3. Upper level line

- Allow the battery to stand for 30 minutes MINIMUM so that electrolyte soak through battery cells.



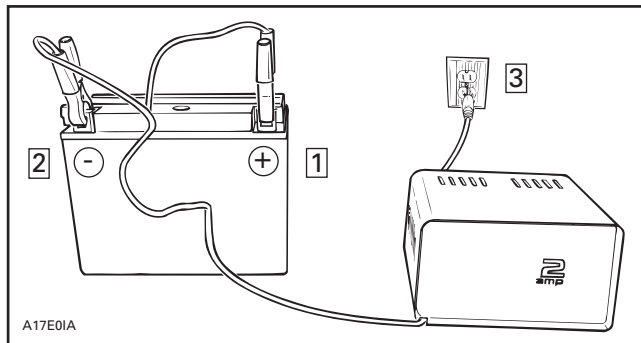
1. 30 minutes

- Readjust the electrolyte level to the UPPER LEVEL line.



1. Battery electrolyte
2. Upper level line

- Connect a 2 A battery charger for 3 to 5 hours.



- Step 1: Connect + lead to battery + post
- Step 2: Connect - lead to battery - post
- Step 3: Plug battery charger

⚠ WARNING

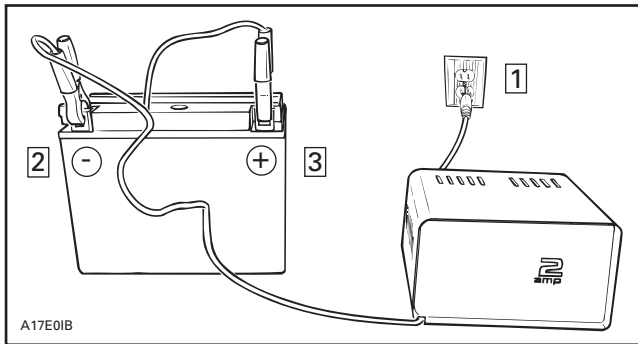
Gases given off by a battery being charged are highly explosive. Always charge in a well ventilated area. Keep battery away from cigarettes or open flames. Always turn battery charger off prior to disconnecting cables. Otherwise a spark will occur and battery might explode.

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.

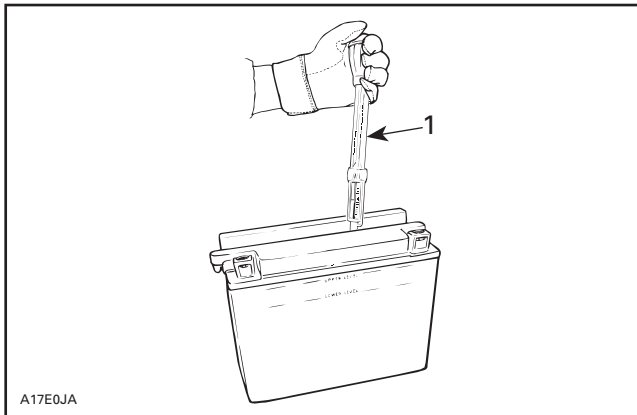
Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)



- Step 1: Unplug battery charger
Step 2: Disconnect - lead
Step 3: Disconnect + lead

- Test battery state of charge. Use a hydrometer.



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.

⚠ WARNING

Battery electrolyte is caustic. To prevent spillage, battery cell cap should be sufficiently tight to properly seal.

Charging a Used Battery

⚠ WARNING

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.

⚠ WARNING

Always charge battery in a well ventilated area.

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.

Section 06 ELECTRICAL SYSTEM

Subsection 02 (CHARGING SYSTEM)

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.

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.

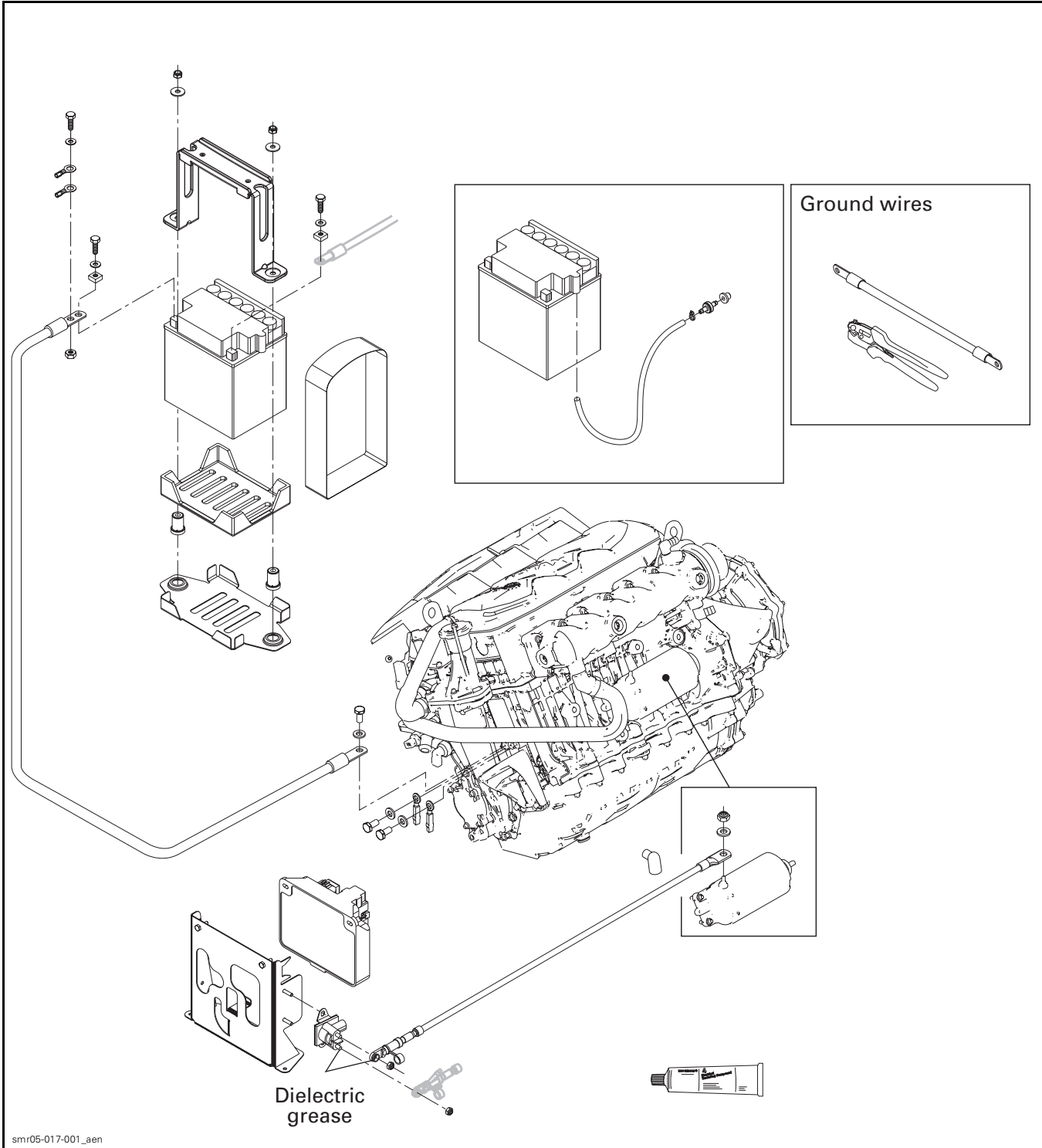
STARTING SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
dielectric grease	293 550 004	170
Isoflex Topas NB52.....	293 550 021	170
Loctite 243	290 897 651	170

Section 06 ELECTRICAL SYSTEM

Subsection 03 (STARTING SYSTEM)



Section 06 ELECTRICAL SYSTEM

Subsection 03 (STARTING SYSTEM)

STARTING SYSTEM TROUBLESHOOTING

SYMPTOM	CAUSE	REMEDY
STARTER DOES NOT TURN.	Burnt fuse.	Check wiring condition and replace fuse.
	Poor contact of battery terminal(s).	Clean and tighten terminal(s).
	Poor battery ground cable connection.	Clean and tighten.
	Weak battery.	Recharge or replace battery.
	Poor contact of start/stop switch, safety lanyard switch or solenoid.	Check connectors and clean contacts. Check and replace defective parts.
	Open circuit: start/stop switch or solenoid.	Check. Replace if necessary.
	Safety lanyard.	Refer to ENGINE MANAGEMENT.
	Defective ECM and/or ECM	Check. Replace if necessary.
STARTER ENGAGES; BUT DOES NOT CRANK THE ENGINE.	Weak battery.	Recharge or replace battery.
	Poor battery cable connections.	Clean battery cable connections.
	Poor contact of brush.	Straighten commutator and brush.
	Burnt commutator.	Turn commutator on a lathe.
	Worn commutator segments.	Undercut mica.
	Shorted armature.	Repair or replace armature.
	Weak brush spring tension.	Replace brush holder or spring.
	Weak magnet.	Replace yoke assembly.
	Worn bushings.	Replace clutch.
STARTER TURNS, BUT OVERRUNNING CLUTCH PINION DOES NOT MESH WITH RING GEAR.	Worn clutch pinion gear.	Replace clutch.
	Defective clutch.	Replace clutch.
	Poor movement of clutch on splines.	Clean and correct.
	Worn clutch bushing.	Replace clutch.
	Worn ring gear.	Replace ring gear.
STARTER KEEPS RUNNING.	Shorted solenoid winding.	Replace solenoid.
	Melted solenoid contacts.	Replace solenoid.
	Sticking or defective starter clutch.	Lubricate or replace.

GENERAL

Causes of troubles are not necessarily related to starter but may be due to a burnt fuse, faulty battery, start/stop switch, safety lanyard switch, MPEM or ECM, solenoid, electrical cables or connections.

Check these components before removing starter. Consult also the starting system troubleshooting table 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.

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 (#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.

Battery

To check battery condition, refer to CHARGING SYSTEM.

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 using the vehicle communication kit (VCK) 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. Using an ohmmeter, connect test probes to YELLOW/RED and PURPLE wires.

Measure resistance, it must be an open circuit (switch is normally open). Depress and hold switch, the ohmmeter should read lower than 200 ohms. Otherwise, replace switch. Reconnect connector.

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

NOTE: Solenoid is located besides the MPEM.

Inspect connections and clean as necessary.

CONTINUITY TEST

With a multimeter, check primary winding resistance.

It should be approximately 5 ohms.

There should be no continuity between the positive posts of the solenoid.

VOLTAGE TEST

Depress start/stop button and measure the voltage on the solenoid positive posts with a multimeter.

If there is no voltage and battery is in good condition, replace the solenoid.

Section 06 ELECTRICAL SYSTEM

Subsection 03 (STARTING SYSTEM)

STARTER REMOVAL

Disconnect BLACK cable ground connection from battery.

⚠ WARNING

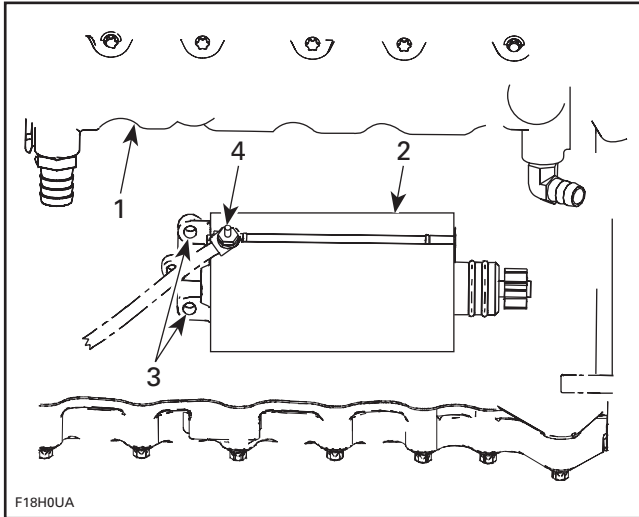
Always disconnect ground cable first and re-connect last.

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.

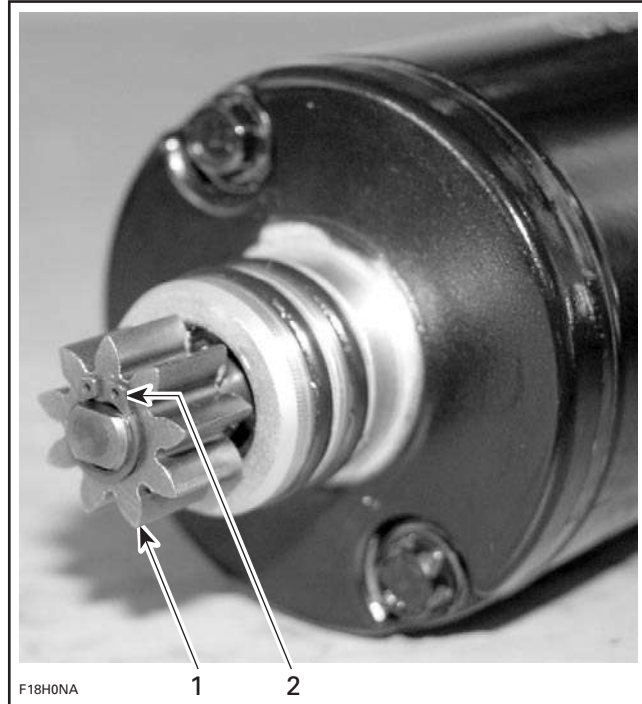
Pull starter out. Lift starter enough to reach starter cable then disconnect from starter.



1. Exhaust manifold
2. Starter
3. Retaining screws
4. Nut

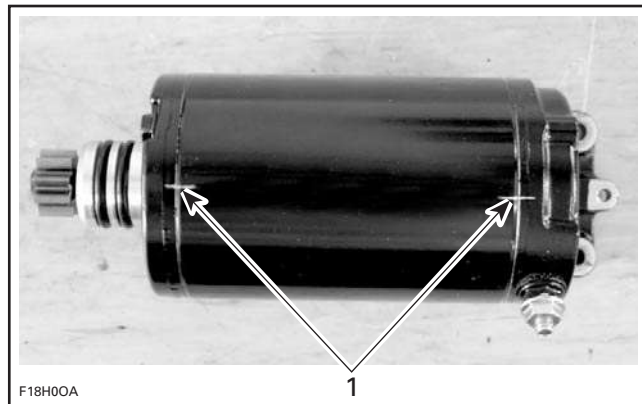
STARTER DISASSEMBLY

Remove bendix retaining circlip and starter bendix.



1. Retaining circlip
2. Starter bendix

Locate index marks on yoke and end covers.



1. Index marks

Loosen through bolts.

Section 06 ELECTRICAL SYSTEM
Subsection 03 (STARTING SYSTEM)

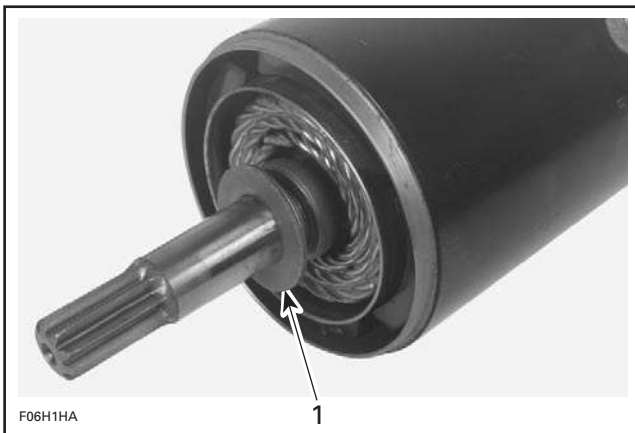


F18H0PA

1. Through bolts

Remove end cover.

Remove thrust washer from armature shaft.

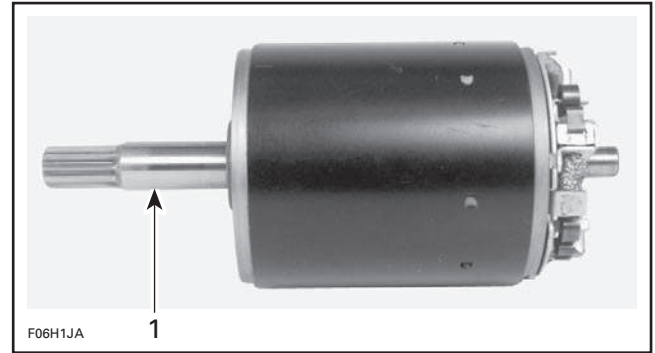


F06H1HA

- TYPICAL*
1. Thrust washers

Remove the other end cover with brushes and brush holder assembly.

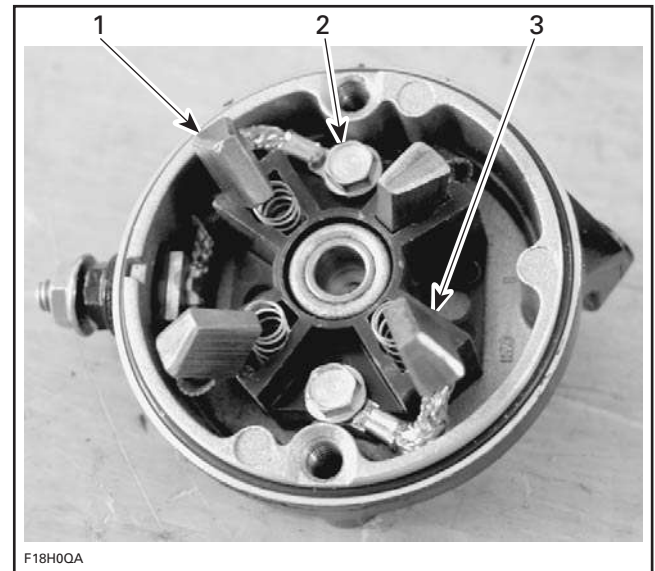
Remove armature.



F06H1JA

- TYPICAL*
1. Pull armature shaft

Remove brushes from brush holder by loosening retaining screws.



F18H0QA

1. Brushes
2. Retaining screw
3. Brush holder

Remove springs.

STARTER CLEANING

CAUTION: Yoke ass'y and drive unit assembly must not be immersed in cleaning solvent.

Discard all O-rings.

Clean brushes and holders with a clean cloth soaked in solvent. Brushes must be dried thoroughly with a clean cloth.

Blow brush holders clean using compressed air.

Section 06 ELECTRICAL SYSTEM

Subsection 03 (STARTING SYSTEM)

WARNING

Always wear safety glasses when using compressed air.

Remove dirt, oil or grease from commutator using a clean cloth soaked in suitable solvent. Dry well using a clean, dry cloth.

Clean engine ring gear teeth and drive unit (clutch).

NOTE: Bushings or bearings must not be cleaned with grease dissolving agents.

Immerse all metal components in cleaning solution. Dry using a clean, dry cloth.

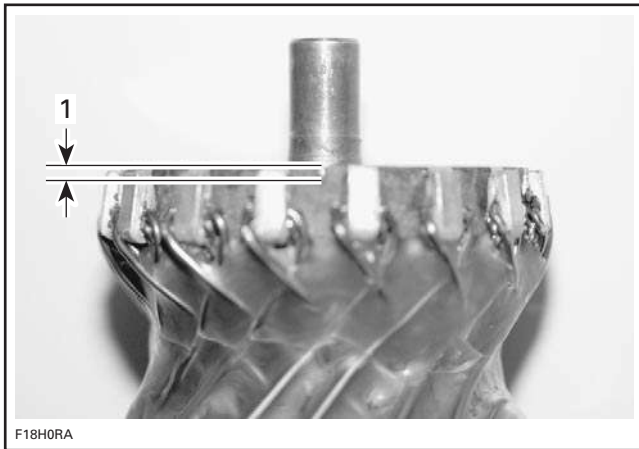
STARTER INSPECTION

Armature

NOTE: An ohmmeter may be used for the following testing procedures, except for the one concerning shorted windings in armature.

Check commutator for roughness, burnt or scored surface. If necessary, turn commutator on a lathe, enough to resurface only.

Check commutator condition with an indicator. If out of specification, replace the starter.



1. Commutator undercut 0.20 mm (.008 in)

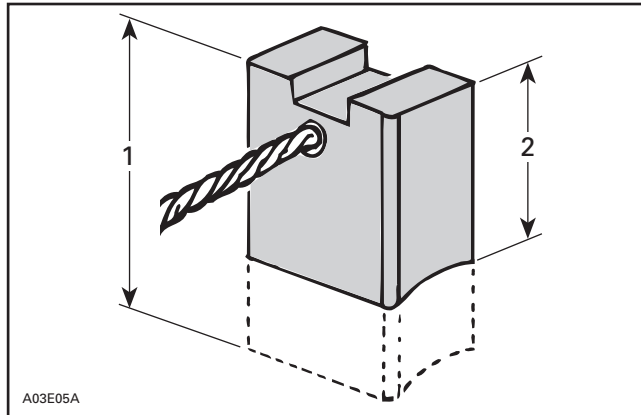
Brush Holder

Check brush holder for insulation using an ohmmeter. Place one test probe on insulated brush holder and the other test probe on brush holder plate. If continuity is found, brush holder has to be repaired or replaced.

Brush

Measure brush length. If less than 8.5 mm (.335 in), replace them.

NOTE: New brush length is 12 mm (.472 in).



1. New
2. Wear limit, 8.5 mm (.335 in)

STARTER ASSEMBLY

Reverse the order of disassembly to reassemble starter.

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 Topas NB52 (P/N 293 550 021) on O-rings of starter.

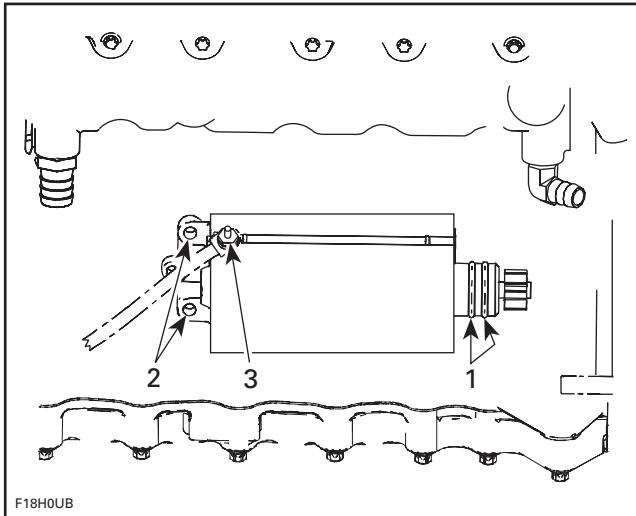
Install starter.

NOTE: If starter does not mesh properly, try to pull it out and slightly rotate the starter gear; then re-install 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 290 897 651) on retaining screws **no. 1** 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.



1. Grease on O-rings.
2. Torque nut to 7 N•m (62 lbf•in) and apply dielectric grease and install protection cover
3. 10 N•m (89 lbf•in)

⚠ WARNING

Always connect RED positive cable first then BLACK negative cable last. Whenever connecting the RED positive cable to the starter motor make sure the battery cables are disconnected to prevent electric shock.

STARTER SPECIFICATION

Nominal output	0.9 kW	
Voltage	12 V	
Rated time	30 seconds	
Rotation	Counterclockwise (viewed from pinion side)	
Weight	2.5 kg (5.39 lb)	
Performance specification at 20°C (68°F)	No load	11.4 V 23 A max. 8600 RPM
	Load	8.5 V 140 A max. 5200 RPM
	Stall	3.75 V 330 A max. 0 RPM
Battery	12 V, 30 Ah	

INSTRUMENTS AND ACCESSORIES

SERVICE TOOLS

Description	Part Number	Page
multimeter FLUKE 111	529 035 868	178-179

GENERAL

Install safety lanyard to activate MPEM to perform testing procedures that requires the device to be supplied with electricity.

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.

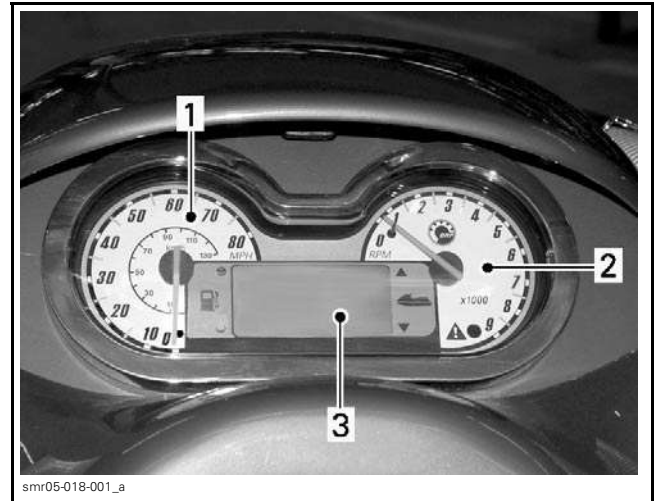
If an option is installed but not checked in B.U.D.S., the information center will not display that option. If an option is checked in B.U.D.S. but not installed in vehicle, a fault code will be generated.

Use the OPTIONS area in the **Setting** tab in B.U.D.S.

COMPONENT DESCRIPTION

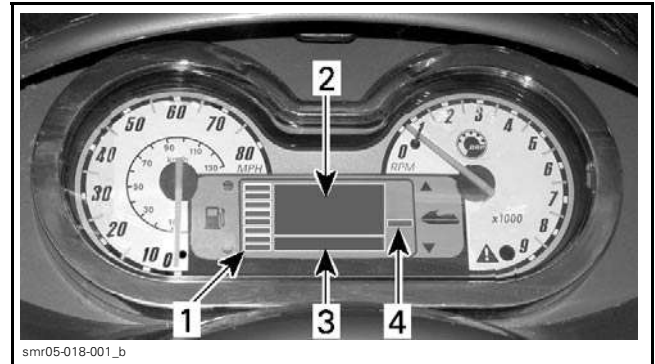
Information Center

This is a multifunction gauge that supplies several real time useful information to the driver.



TYPICAL
1. Analog speedometer
2. Analog tachometer
3. Display area

The display area comprises the following:



TYPICAL
1. Fuel level indicator
2. Numerical section
3. Units and message section
4. VTS position indicator (if so equipped)

Section 06 ELECTRICAL SYSTEM

Subsection 04 (INSTRUMENTS AND ACCESSORIES)

FUEL LEVEL INDICATOR

Bar gauge continuously indicates the amount of fuel in the fuel tank while riding. A low-fuel condition is also indicated in the information center when only one bar is displayed. See UNITS AND MESSAGES SECTION below.

NUMERICAL SECTION

This section shows the digits of the function displayed such as:

Digital Tachometer: Indicates the revolution per minute (RPM) of the engine.

Digital Speedometer: Indicates the speed of the watercraft in miles per hour (MPH) and kilometers per hour (km/h).

Depth Gauge (GTX 4-TEC Limited models): It continuously display the water depth under the hull within 0 to 50 meters (0 to 170 feet).

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.

Compass (all models except RXP and RXT): 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.

Average Speed: The information center approximately calculates and displays the average speed (AV KM/H or AV MPH) of the watercraft since the last engine start.

Distance (KM or MILES): The information center approximately calculates the distance based on the operation time and the watercraft speed and displays the result in kilometers (KM) or miles (MILES).

Hour Meter: Displays the time in hours of the watercraft usage (HOUR).

Water Temperature: Displays the water temperature of the water surface (L TEMP) in degrees Celsius (°C) or Fahrenheit (°F).

Exterior Temperature: Displays the exterior air temperature (E TEMP) in degrees Celsius (°C) or Fahrenheit (°F).

Trip Hour Meter: (TRIPMTR) Allows to measure an interval of time in hours and minutes (hh:mm).

UNITS AND MESSAGE SECTION

This section shows the units related to the numbers displayed. Units such as KMH (MPH), HOUR etc. are displayed.

Also, whenever one of the following circumstances occurs, the following messages will blink in the message section. The abbreviations between parenthesis here are the code displayed:

- engine or exhaust system overheating (H-TEMP)
- low oil pressure (OIL)
- low battery voltage (12 V LOW)
- high battery voltage (12 V HI)
- low fuel level (FUEL-LO)
- maintenance reminder (MAINT)
- check engine (CHK ENG)
- sensor failure (vehicle electronic equipment) (SENSOR)
- invalid safety lanyard (KEY)
- safety lanyard, learning key active (L KEY)
- end of faults (END).

The red warning LED (Light-Emitting Diode) blinks along with the beeper to catch your attention.

Except for low liquid levels, which can be corrected by refilling, it is recommended to see an authorized Sea-Doo dealer when other messages occur.

NOTE: If a fault occurs, this system generates numbered fault codes (P-XXXX) that can be displayed through the information center using a special procedure. In case of a failure, refer to DIAGNOSTIC PROCEDURES in ENGINE MANAGEMENT.

When the watercraft is due for a maintenance inspection, the message MAINT will blink. Afterwards, it will blink at every start-up for 10 seconds. After servicing, ensure to clear it.

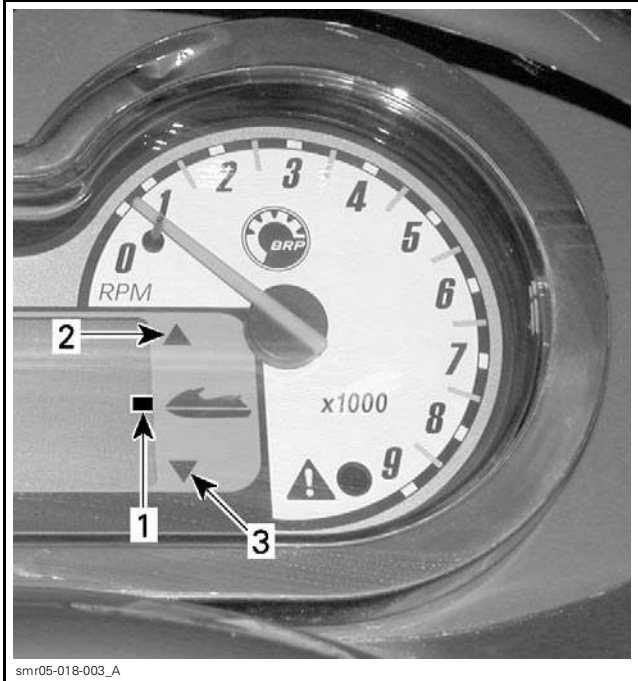
VTS INDICATOR

RXP Models

The VTS position indicator shows the riding attitude of the watercraft.

Section 06 ELECTRICAL SYSTEM

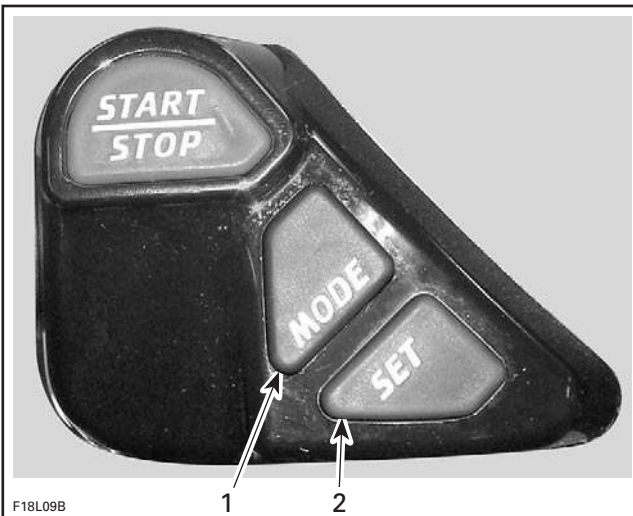
Subsection 04 (INSTRUMENTS AND ACCESSORIES)



1. Position indicator
2. Bow up
3. Bow down

Function Buttons

Different displays and functions can be activated using 2 buttons — MODE and SET — following specific sequences as described below.



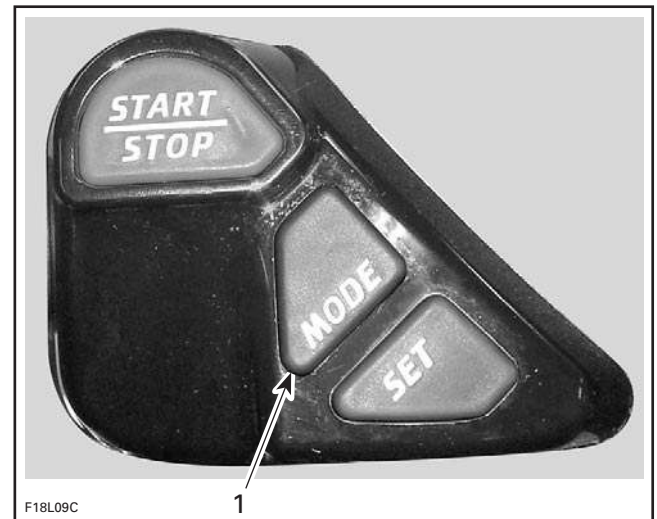
1. To change display mode
2. To set or reset a function

Resetting a Function

To reset a function (such as the trip hour meter, distance, etc.) press and hold the SET button for 2 seconds while in the appropriate mode.

Display Selection

Repeatedly pressing the MODE button scrolls the following displays: Compass, tachometer, speedometer, average speed, distance, hourmeter, water temperature, exterior temperature, depth gauge (GTX 4-TEC Limited models), and trip hour meter.



1. Press to change display mode

When you are satisfied with your choice, stop pressing the button and it will become active. The display you have chosen will remain until it is changed.

Display Priorities

As a self test at start-up, the needles of the speedometer and tachometer will sweep to their maximum position, all LCD segments and the LED will turn on for 3 seconds each time the information center is activated (when safety lanyard is installed). This allows the driver to validate they are all working properly.

When the information center is activated, the last function set will be displayed.

In the event of a warning message, the message will blink and override the units display unless MODE button is pressed. The display will then display the last function after 10 seconds.

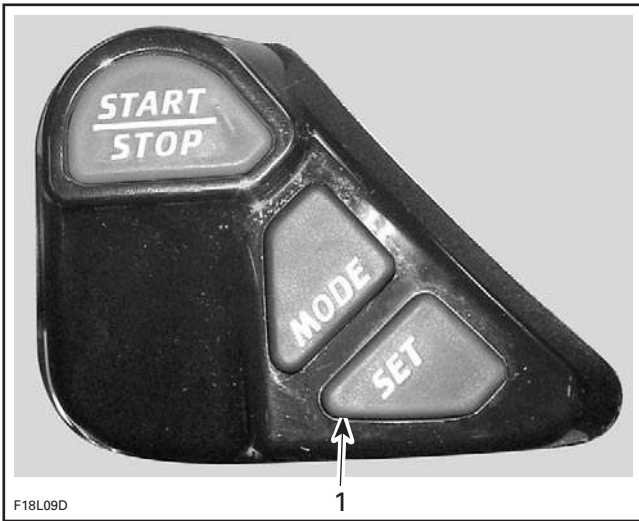
If more than one warning message occurs, the blinking messages will scroll every 4 seconds.

Language Option

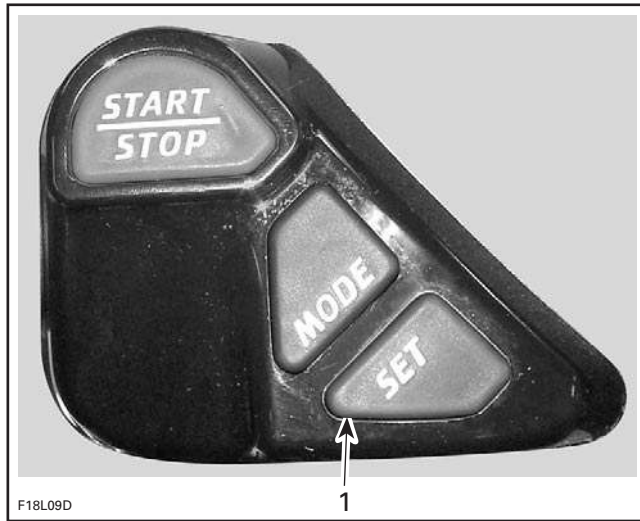
While in the compass mode:

Section 06 ELECTRICAL SYSTEM

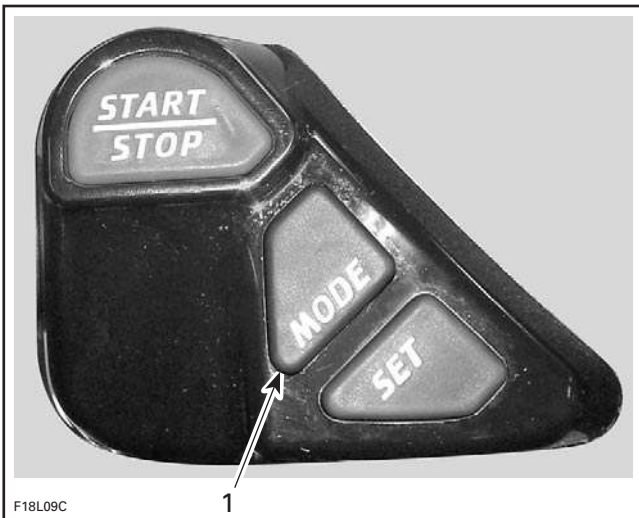
Subsection 04 (INSTRUMENTS AND ACCESSORIES)



1. Press and hold for 2 seconds



1. Press to end



1. Repeatedly press

English/Metric System

Allows to display the units in the metric system or in the SAE English system.

NOTE: This function is not available when information center displays the compass, hourmeter or trip hour meter.



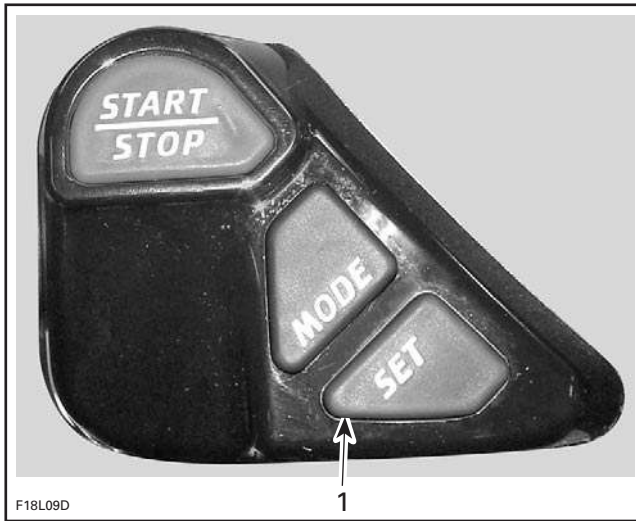
1. Press TOGETHER and hold for 2 seconds

Trip Hour Meter

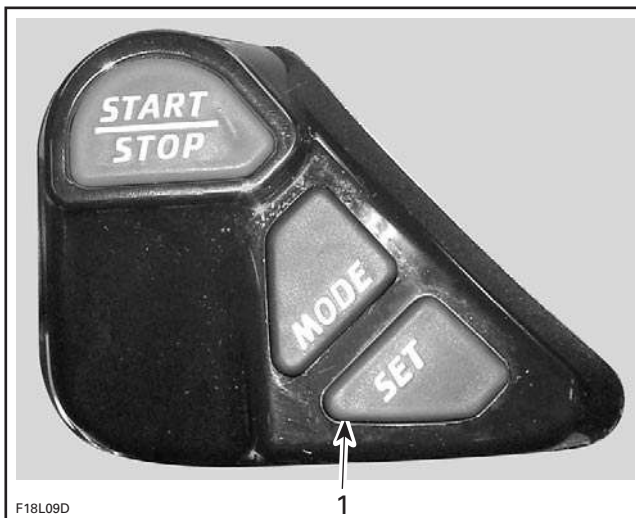
While in the trip hour meter mode:

Section 06 ELECTRICAL SYSTEM

Subsection 04 (INSTRUMENTS AND ACCESSORIES)



1. Press to start or stop trip hour meter



1. Press and hold for 2 seconds to reset engine is turned off

Trip hour meter is reset every time engine is turned off.

PROCEDURES

Information Center

When there is no display at the information center, perform the following:

- B.U.D.S. can be used to check its operation. Look in the **Monitoring** tab.
- Check fuses.
- Check supply wire (1-23) and ground wire (1-8) from MPEM.

- 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 when in onboard diagnostic mode.
 - Check if wires are swapped, unconnected or short circuit.
 - 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.

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

Refer to ENGINE MANAGEMENT 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.

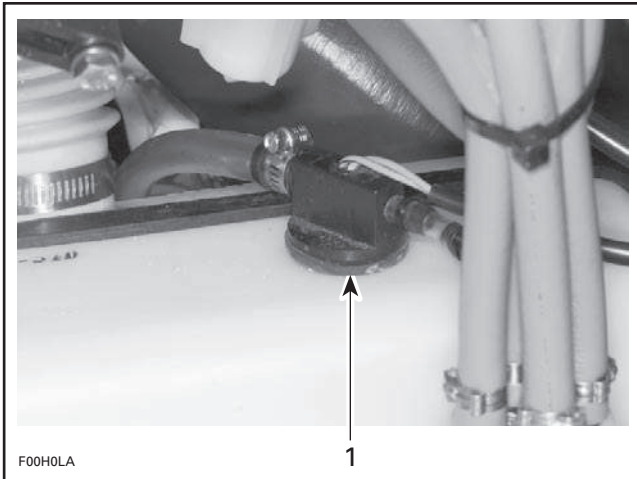
Section 06 ELECTRICAL SYSTEM

Subsection 04 (INSTRUMENTS AND ACCESSORIES)

RESISTANCE (Ω)	FLOAT HEIGHT (bottom of float with bottom of pump module) (mm)
4.8 ± 2.2	247 ± 5.0
17.8 ± 2.2	207 ± 5.0
27.8 ± 2.2	183 ± 5.0
37.8 ± 2.2	158 ± 5.0
47.8 ± 2.2	133 ± 5.0
57.8 ± 2.4	105 ± 5.0
67.8 ± 2.8	76 ± 5.0
77.8 ± 3.6	55 ± 5.0
89.8 ± 3.6	35.3 ± 5.0

Oil Sensor

The sensor sends the signal to the low-oil level light in the fuel gauge or the LED in the Information Center.



1. Oil sensor

The bottom of the sensor has a small reservoir with two small holes underneath to let the oil enter inside and one at the top to let the air enter allowing the oil to flow out.

When there is enough oil inside the oil tank (and therefore in the sensor reservoir), the sensor detects the liquid and the light DOES NOT turn on.

When the oil level goes at critical LOW level inside the oil tank (and therefore in sensor reservoir), the sensor detects the absence of liquid and the light TURNS ON.

To check the oil sensor, unplug its connector and pull sensor out of oil tank.

Using the multimeter FLUKE 111 (P/N 529 035 868), check the continuity between the BLUE and BLUE/BLACK terminals.

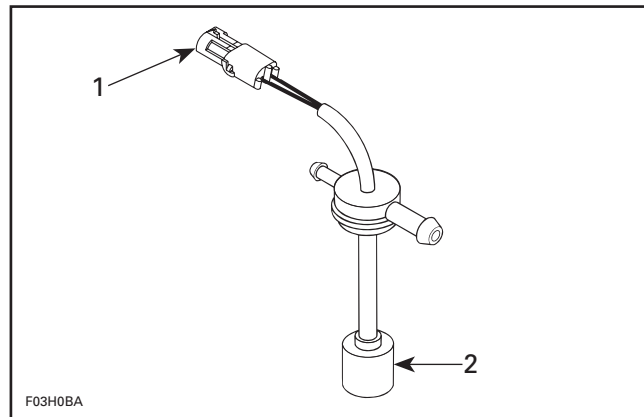


When sensor is out of oil tank and its reservoir is empty, resistance must be infinite (open circuit).

NOTE: Wait about 15 - 20 seconds before taking any reading to give the oil enough time to flow out or inside sensor reservoir.

Soak sensor in oil so that its reservoir fills up. Maximum resistance should be approximately 2Ω (closed circuit).

TEST CONDITION	READING (Ω)
Sensor OUT of oil	∞ (open circuit)
Sensor soaked IN oil	2Ω max. (closed circuit)



1. Measure resistance here
2. Sensor reservoir

To Reinstall Sensor:

- Remove rubber seal from sensor.
- Install seal in oil tank hole.

- Push sensor in seal.
- Plug connector.

NOTE: This sensor turns the LED to ON if the connector has been forgotten unconnected even when there is enough oil in tank.

VTS Switch

RXP Models

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.

VTS Motor

RXP Models

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, refer to VARIABLE TRIM SYSTEM. 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.

VTS Control Module

RXP Models

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 \pm 1%.

Push on VTS switch up position until motor stops.

Read the resistance on the ohmmeter, it should indicate a resistance of 167 ohms \pm 1%.

RESISTANCE (Ω)	NOZZLE POSITION
167 \pm 1%	UP
	
24 \pm 1%	DOWN

NOTE: If the VTS control module passes this resistance test, it does not mean it is in perfect condition.

Water Temperature Sensor

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.

Section 06 ELECTRICAL SYSTEM

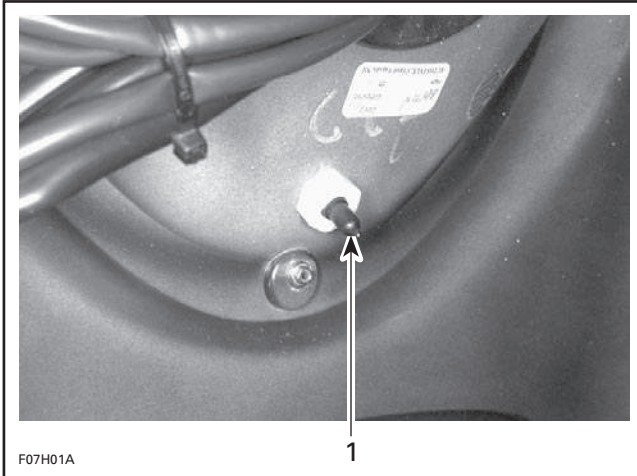
Subsection 04 (INSTRUMENTS AND ACCESSORIES)

Exterior Temperature Sensor

The temperature sensor is located in the storage cover.

B.U.D.S. can be used to check the operation. Look in the **Monitoring** tab.

Remove the back panel of the storage cover to access the temperature sensor.



1. Temperature sensor

To check if the temperature sensor is operational, select the exterior temperature mode in the Information Center.

Use a heat gun to warm up the sensor. The temperature should raise rapidly on the gauge.

If not, replace the temperature sensor.

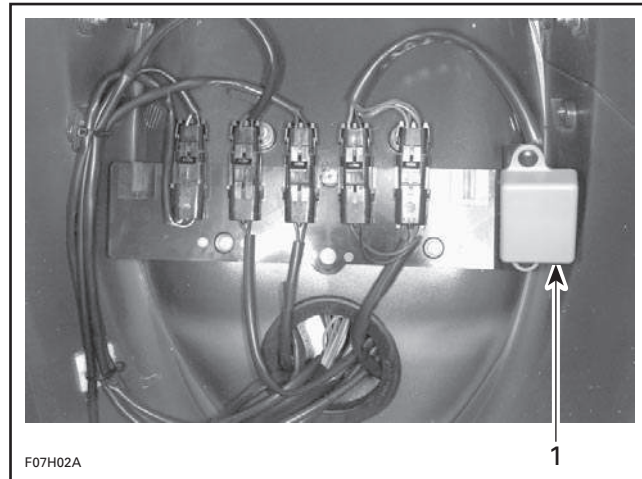
Compass

All Models except RXP and RXT

The compass is located in the storage cover.

B.U.D.S. can be used to check the operation. Look in the **Monitoring** tab.

Remove the back panel of the storage cover to access the compass.



1. Compass

Remove the compass from the support.

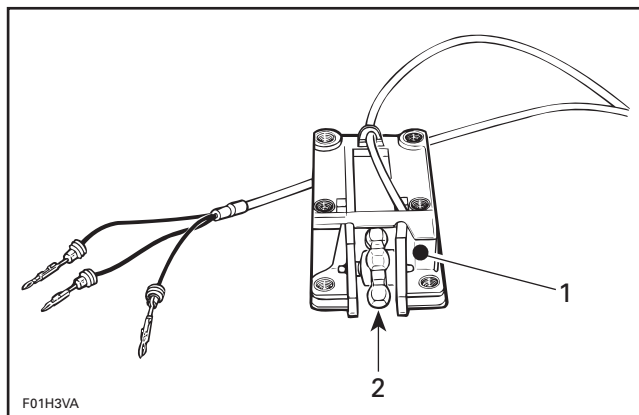
Change the direction of the compass and keep it horizontal ($\pm 10^\circ$). There should be a change of direction on the Information Center.

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.

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.



1. Pick-up housing
2. Paddle wheel

Section 06 ELECTRICAL SYSTEM
Subsection 04 (INSTRUMENTS AND ACCESSORIES)

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.

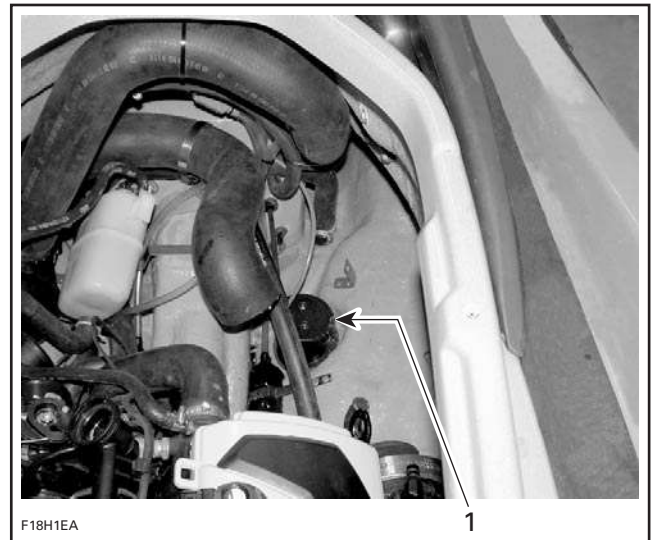
Depth Gauge

GTX 4-TEC Limited Models

Removal

Remove muffler.

Turn depth gauge counterclockwise and pull it out.



1. Depth gauge

Inspection

Ensure the silicone pad is in good condition. There must be no air between the bottom of the depth gauge and the hull. 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.

TROUBLESHOOTING		
SYMPTOM	POSSIBLE CAUSE	REMEDY
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.
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.
	There is a problem with the communication link wires.	Check WHITE/BLACK and WHITE/RED wires.
---- (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 hull.	See procedure below.
	Depth gauge is defective.	Try a new depth gauge.

JET PUMP

SERVICE TOOLS

Description	Part Number	Page
impeller remover/installer	529 035 820	191, 198
impeller remover/installer	529 035 956	191, 198
impeller shaft pusher	529 035 955	192, 196, 198
lift kit.....	295 100 205	186
pressure cap.....	529 035 843	199
seal/bearing pusher	529 035 819	192, 196–197
vacuum/pressure pump kit	529 031 800	199

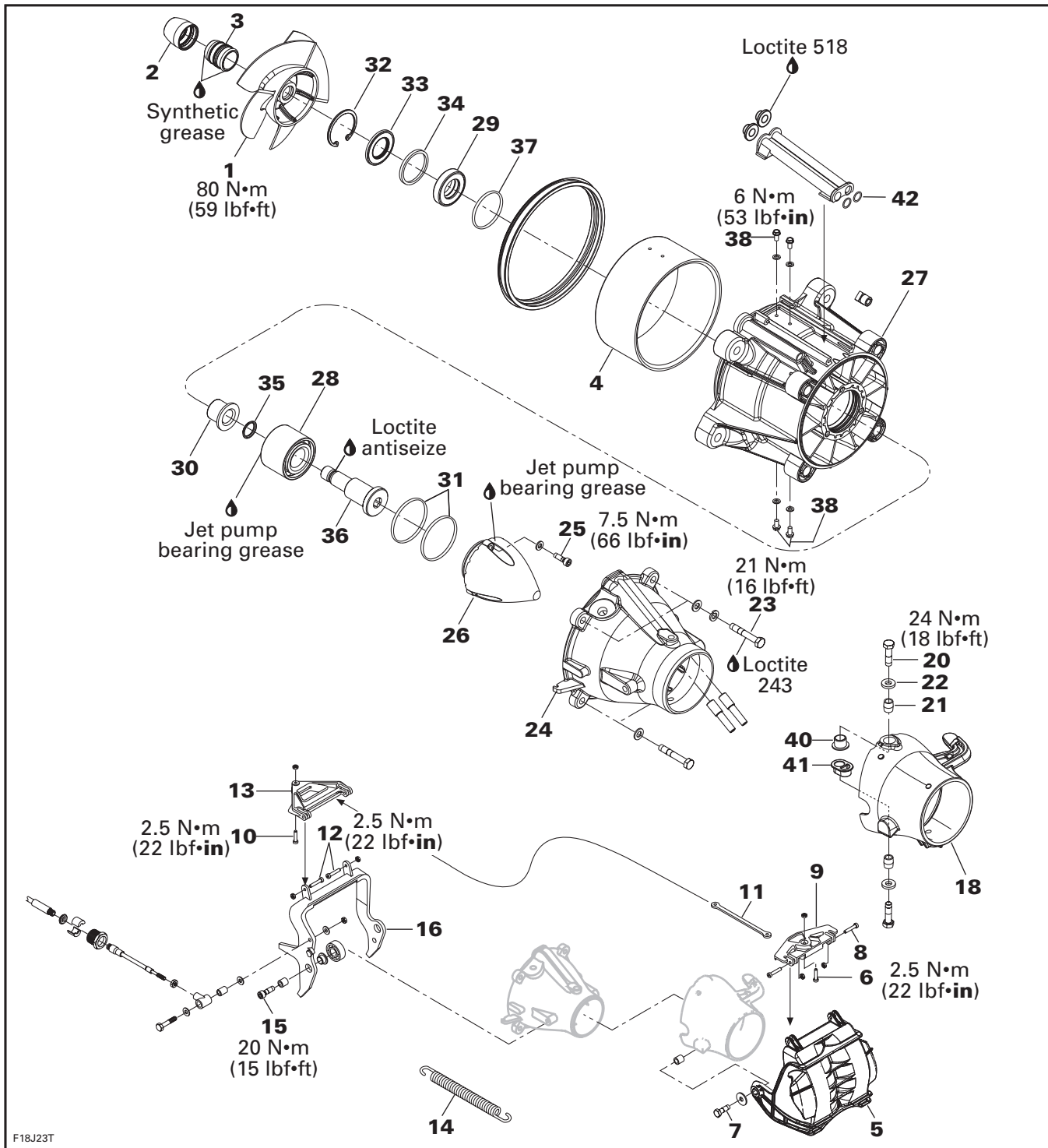
SERVICE PRODUCTS

Description	Part Number	Page
BOMBARDIER LUBE	293 600 016	198, 200
jet pump bearing grease.....	293 550 032	196–198
Loctite 243 (blue).....	293 800 060	198, 200
Loctite antiseize.....	293 800 070	197
pulley flange cleaner.....	413 711 809	193
synthetic grease	293 550 010	200

Section 07 PROPULSION

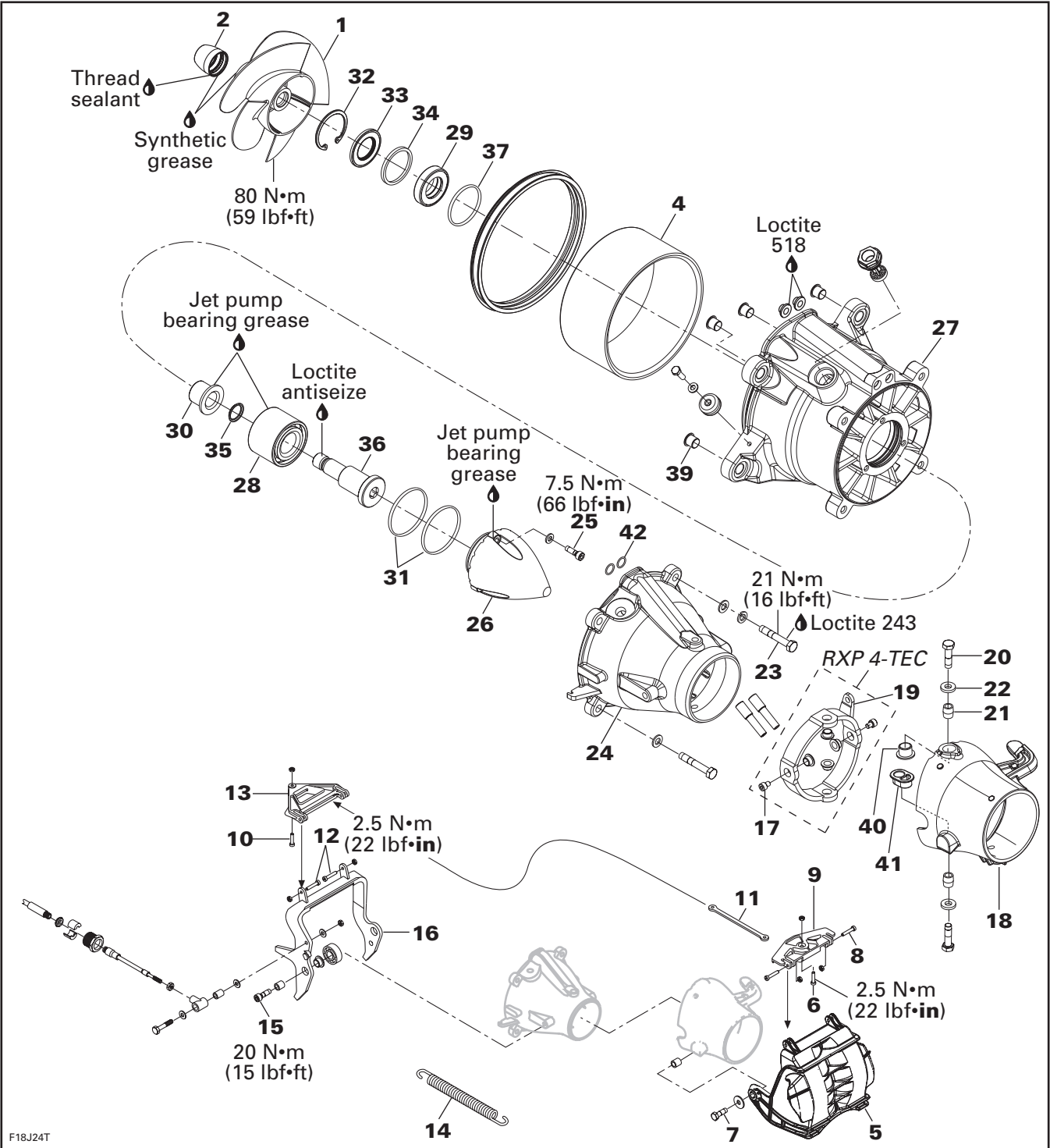
Subsection 01 (JET PUMP)

GTX 4-TEC and Wake Models



Section 07 PROPULSION
Subsection 01 (JET PUMP)

GTX 4-TEC Limited, GTX 4-TEC Supercharged, RXP and RXT Models

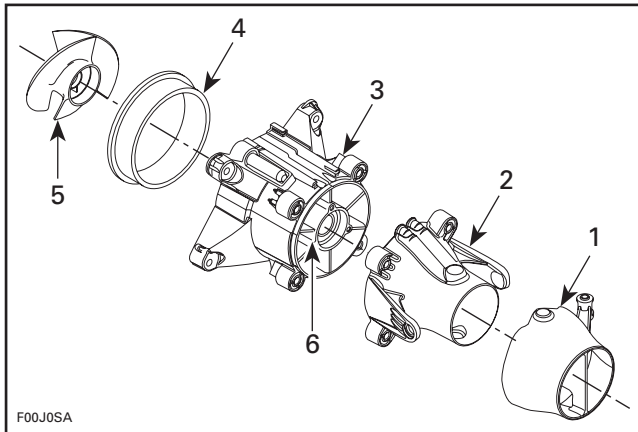


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Section 07 PROPULSION

Subsection 01 (JET PUMP)

GENERAL

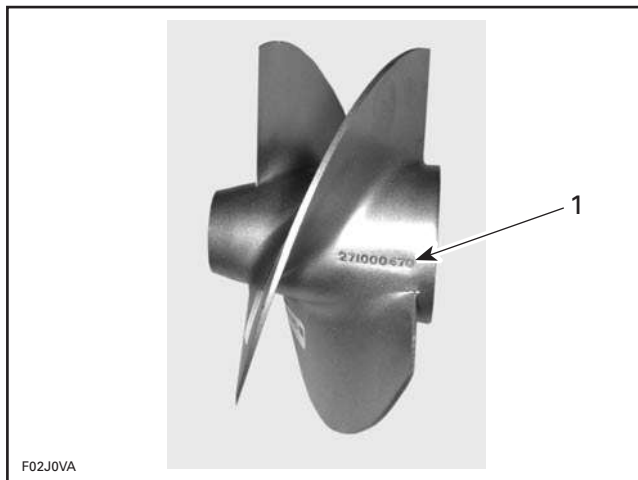


TYPICAL

1. Nozzle
2. Venturi
3. Jet pump housing
4. Wear ring
5. Impeller
6. Stator

Impeller Identification

To identify the impellers no. 1 refer to the following illustration and chart.



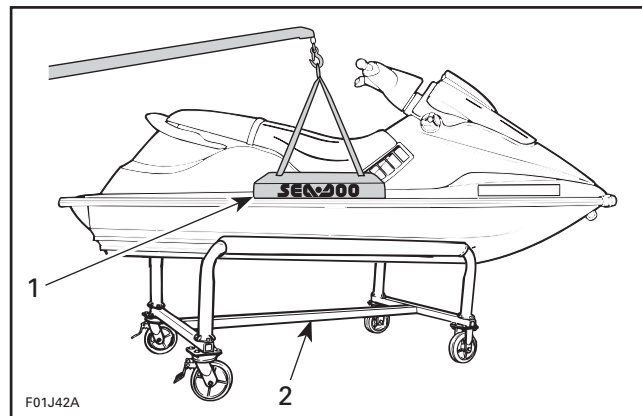
1. Stamped part number

WATERCRAFT MODEL	IMPELLER P/N	MATERIAL	PITCH
GTX 4-TEC and Wake	267 000 115	Stainless steel	Progressive pitch 10° - 21°
GTX 4-TEC Supercharged	267 000 119	Stainless steel	Progressive pitch 10° - 21°
GTX 4-TEC Limited and RXT	267 000 176	Stainless steel	Progressive pitch 12° - 18°
RXP	267 000 096	Stainless steel	Progressive pitch 10° - 21°

JET PUMP INSPECTION 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.

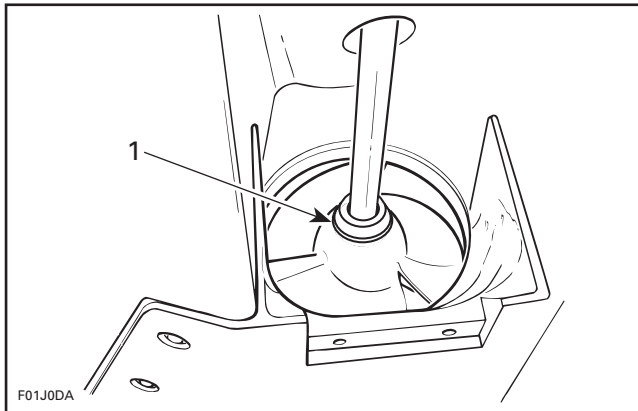


TYPICAL

1. Lift kit
2. Work stand

Impeller Condition

Condition of impeller no. 1, impeller boot no. 2 and impeller ring no. 3 can be quickly checked from underneath of the watercraft. With the vehicle on the trailer, use a flashlight and look through the inlet grate.



TYPICAL
1. Inspect impeller and boot

Impeller/Wear Ring Clearance

This clearance is critical for jet pump performance. To check clearance, remove jet pump. Using a feeler gauge, measure clearance between impeller blade tip and wear ring **no. 4**. Measure each blade at its center.

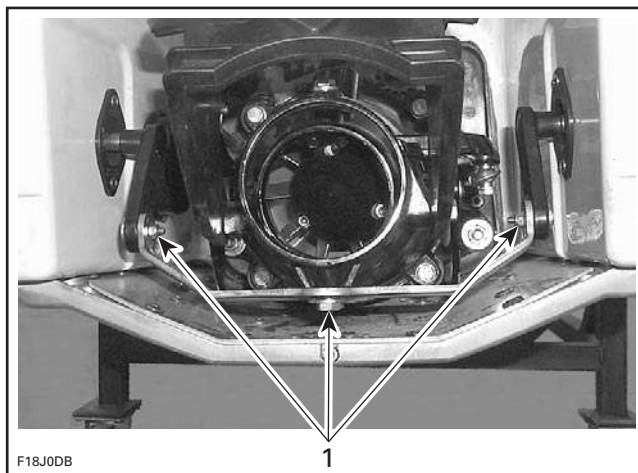
MODEL	MAXIMUM WEAR CLEARANCE mm (in)
All 4-TEC	0.35 (.014)

If clearance is greater, renew worn parts.

REMOVAL

Pump Assembly

Remove O.P.A.S. "U" lever screws.

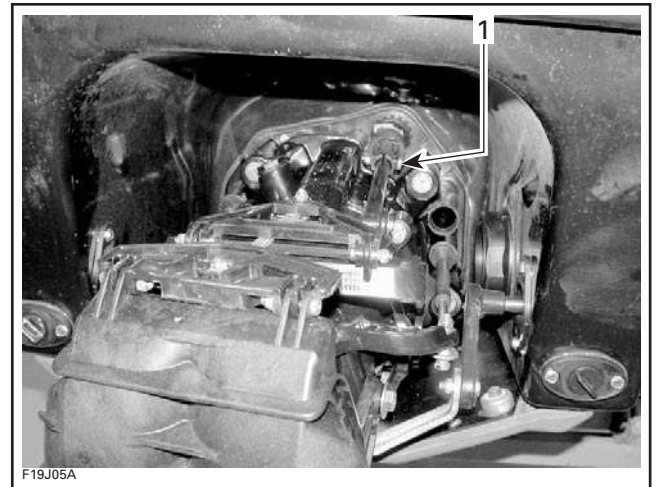


TYPICAL
1. "U" lever screws

Disconnect steering and reverse cables.
Disconnect O.P.A.S. hose from top of pump (if applicable).

RXP Models

Disconnect VTS link rod.



1. Link rod

All Models

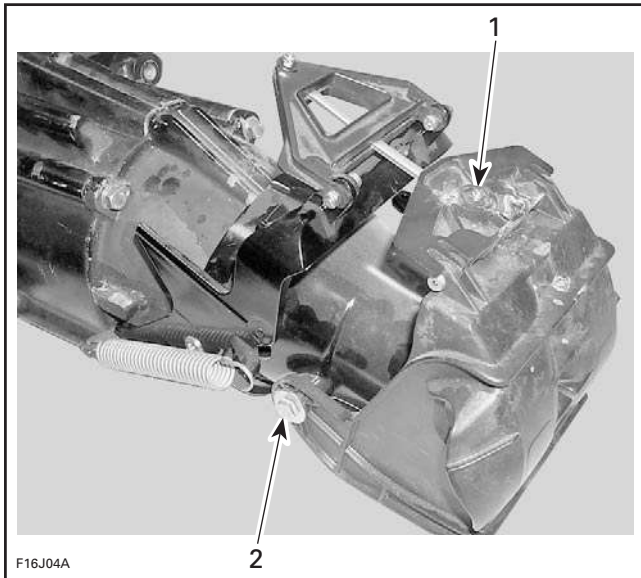
Remove pump retaining nuts/screws.
Pull out pump.

Reverse Gate

To remove reverse gate **no. 5**, put shift lever in reverse position.
Unscrew pivot bolt **no. 6**.

Section 07 PROPULSION

Subsection 01 (JET PUMP)



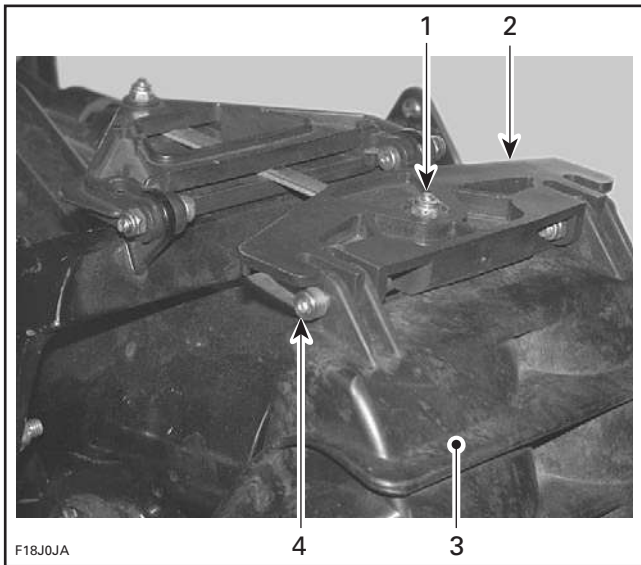
1. Pivot bolt
2. Screw

Remove both reverse gate screws no. 7.

Pivot Support

Remove reverse gate.

Unscrew pivot support bolts no. 8.



1. Pivot bolt
2. Pivot support
3. Reverse gate
4. Pivot support bolt

Withdraw pivot support no. 9.

Connecting Rod

Remove:

- reverse gate
- pivot bolt no. 10.

Withdraw connecting rod no. 11.

Pivot Triangle

Remove:

- reverse gate
- connecting rod
- pivot triangle bolts no. 12.

Withdraw pivot triangle no. 13.

Pivot Arm

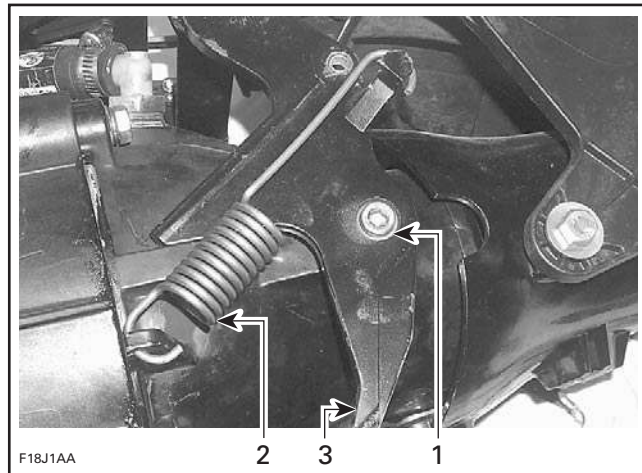
Remove reverse gate and connecting rod.

Position shift lever in forward.

Remove:

- spring no. 14
- reverse cable
- pivot arm bolts no. 15. Take note of bushing size for reinstallation.

Withdraw pivot arm no. 16.



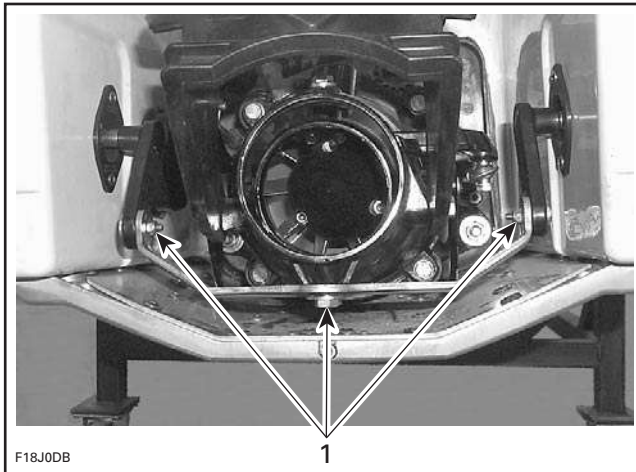
1. Pivot bolts (each side)
2. Spring
3. Pivot arm

Nozzle

Remove reverse gate.

Disconnect steering cable from jet pump nozzle.

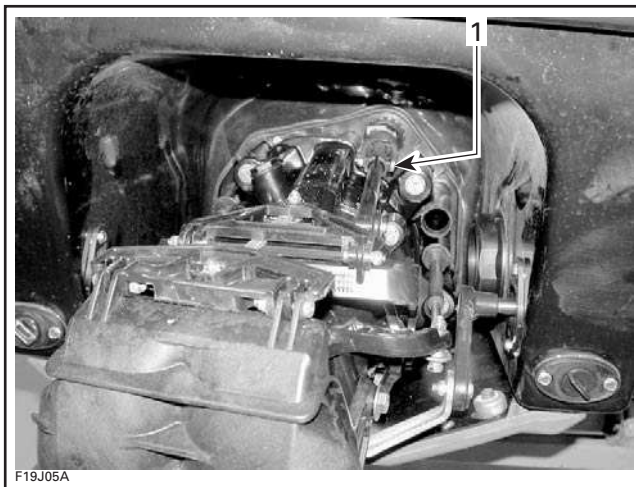
Remove O.P.A.S. "U" lever screws and pull out lever.



TYPICAL
1. "U" lever screws

RXP Models

Disconnect VTS link rod.



1. Link rod

Remove side screws no. 17 from nozzle no. 18.
Pull out nozzle and VTS ring no. 19.
Remove VTS ring.

Other Models

Remove 2 retaining screws no. 20, 2 sleeves no. 21, 2 washers no. 22.
Remove nozzle no. 18.

Venturi

Remove:
– reverse gate no. 5

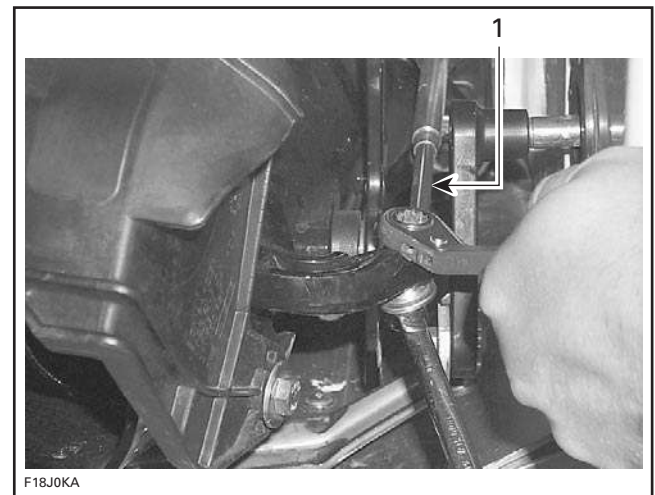
- nozzle no. 18
- pivot arm no. 16.

Unplug O.P.A.S. hose from plastic elbow.
Remove retaining screws no. 23 and withdraw venturi no. 24.

It's possible to remove the venturi without removing the reverse gate and the nozzle, see the following instructions.

Disconnect:

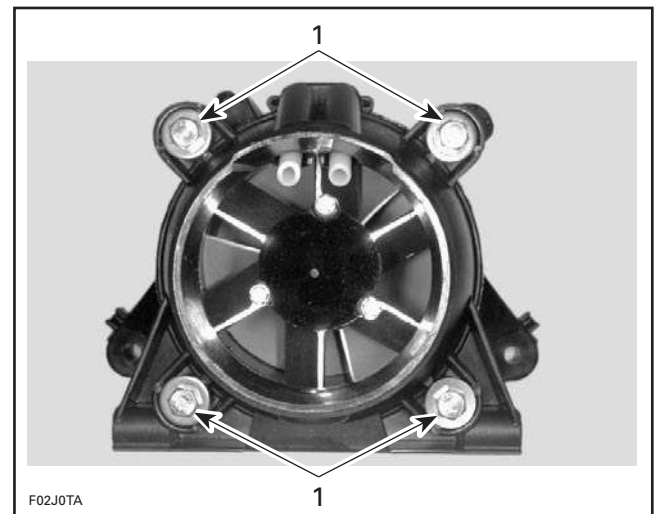
- steering cable



1. Steering cable

- O.P.A.S. hose
- reverse cable.

Remove retaining screws no. 23 and withdraw venturi no. 24.



TYPICAL
1. Remove screws

Section 07 PROPULSION

Subsection 01 (JET PUMP)

Jet Pump Housing

Remove pump as an assembly or remove the following:

- nozzle no. 18
- venturi no. 24.

Remove 4 hexagonal nuts/screws from jet pump housing.

Remove jet pump with a wiggle movement.

CAUTION: When removing pump unit, a shim could have been installed between hull and pump housing. Be sure to reinstall it otherwise engine and jet pump alignment will be altered.

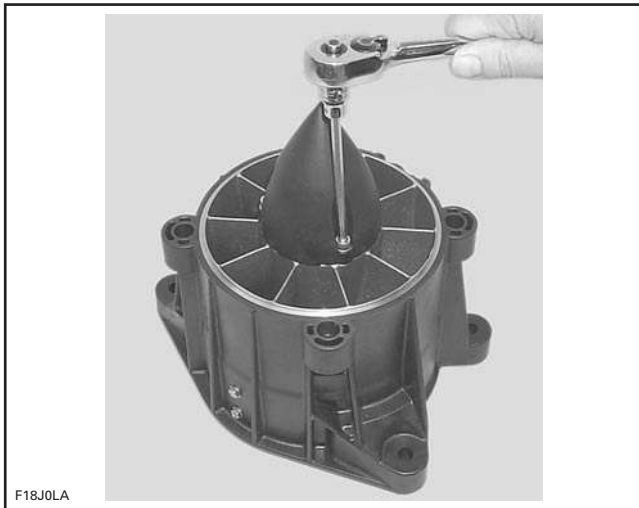
NOTE: If drive shaft is seized in the PTO flywheel, refer to DRIVE SYSTEM.

DISASSEMBLY

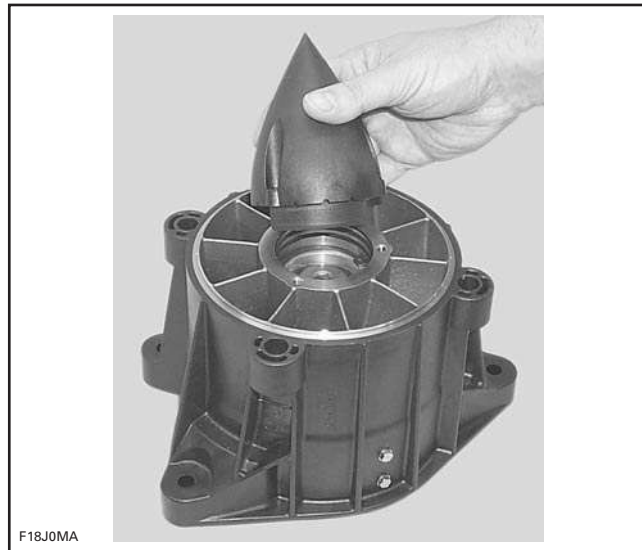
NOTE: Whenever removing a part, visually check for damage such as: corrosion, crack, split, break, porosity, cavitation, deformation, distortion, heating discoloration, wear pattern, missing plating, missing or broken balls in ball bearing, water damage diagnosed by black-colored spots on metal parts, etc. Renew any damaged part. As a quick check, manually feel clearance and end play, where applicable, to detect excessive wear.

Impeller Cover

With pump housing in vertical position, remove 3 retaining screws no. 25.

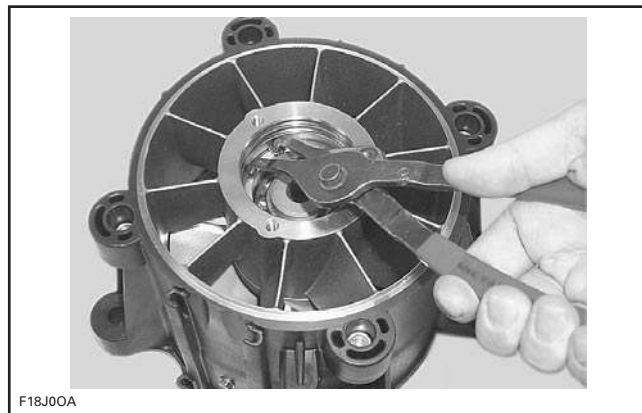
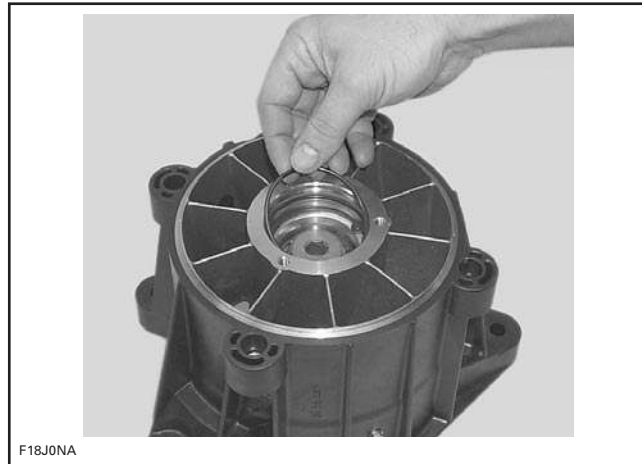


Using a fiber hammer, gently tap impeller cover no. 26 to release it from jet pump housing no. 27. Use flat screwdriver to remove cover.



Check for presence of water in cover and bearing no. 28. If so, replace oil seal no. 29 and sleeve no. 30.

Remove both O-rings no. 31 and circlip no. 32.

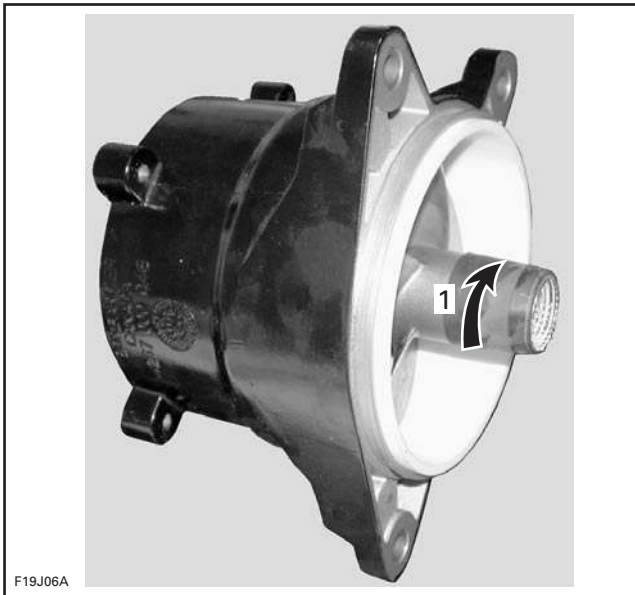


Impeller

Remove impeller ring no. 3 and impeller boot no. 2.

RXP Models

Unscrew impeller boot no. 2 **CLOCKWISE**.



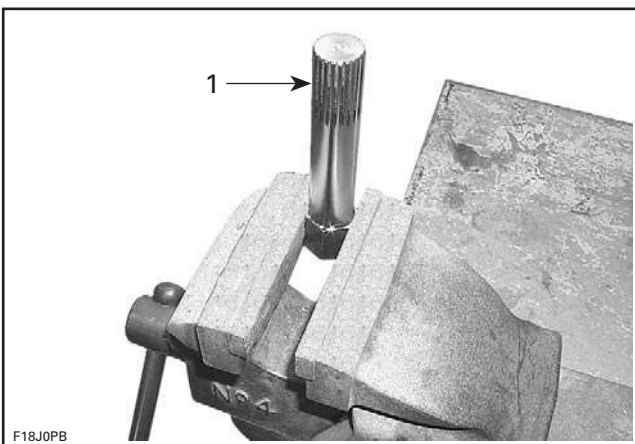
1. Unscrew clockwise

All Models

Replace impeller ring and/or impeller boot if damaged.

Mount impeller remover/installer in a vise.

For **GTX 4-TEC, Wake and GTX 4-TEC Supercharged models**, use the impeller remover/installer (P/N 529 035 820) and for the **GTX 4-TEC Limited, RXP and RXT models**, use the impeller remover/installer (P/N 529 035 956).



1. Impeller remover/installer

Install jet pump housing no. 27 over this tool.



Using a 12 mm Allen key, unscrew the impeller.

NOTE: It may be needed to heat the impeller to release the threads.



CAUTION: Never use any impact wrench to loosen impeller.

To remove impeller, apply a rotating movement and pull at same time. Slide impeller out of housing.

Pull pump housing out.

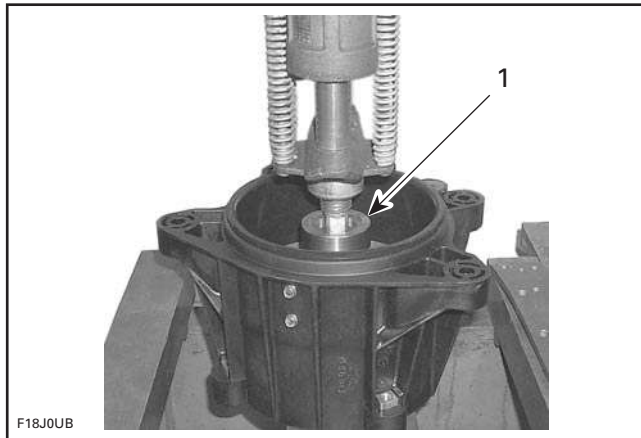
Remove circlip no. 32, seal no. 33 and spacer no. 34.

NOTE: Ensure to keep shaft sleeve no. 30 and O-ring no. 35 in position. The impeller shaft pusher will work against sleeve to properly push bearing out.

Section 07 PROPULSION

Subsection 01 (JET PUMP)

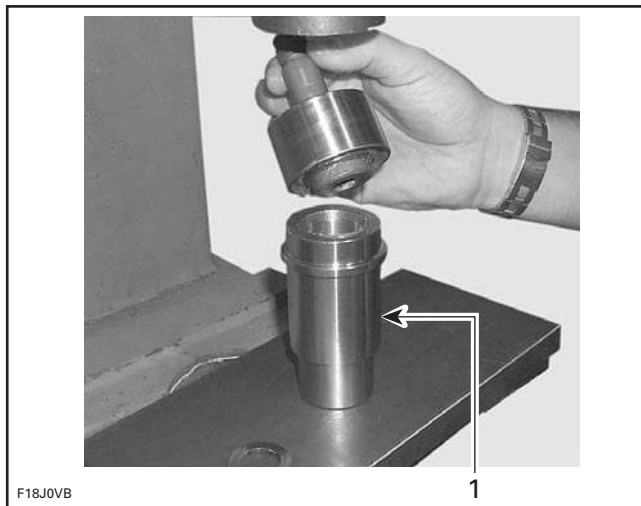
Use the impeller shaft pusher (P/N 529 035 955) to press out impeller shaft no. 36 of pump housing. Bearing no. 28, will come out with the impeller shaft.



1. Impeller shaft pusher

CAUTION: Bearing inner race being in 2 parts, bearing may fall apart during removal.

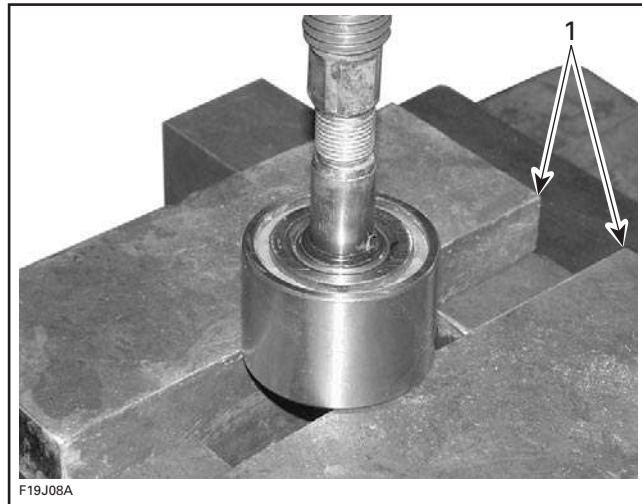
Use the seal/bearing pusher (P/N 529 035 819) to press out bearing no. 28 from impeller shaft.



1. Seal/bearing pusher

RXP Models

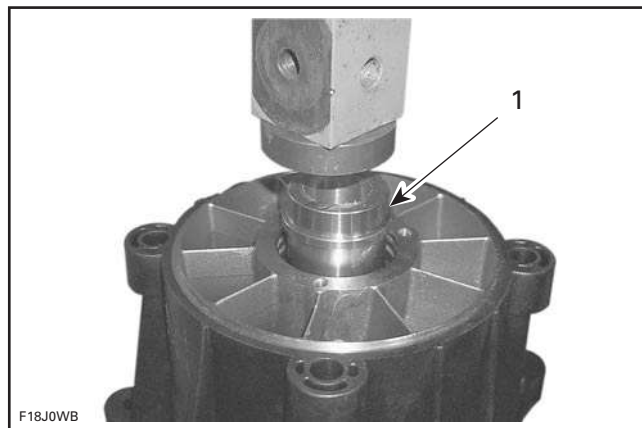
Use steel blocks against inner race of bearing to push bearing out.



1. Steel blocks

All Models

From the outlet side of pump, use the seal/bearing pusher (P/N 529 035 819) to press out the oil seal no. 29.



1. Seal/bearing pusher

Remove large O-ring no. 37 from pump housing.

Wear Ring

Inspect wear ring before removing it. See PARTS INSPECTION further.

Remove the screws no. 38 retaining wear ring no. 4 in the jet pump housing no. 27.

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.

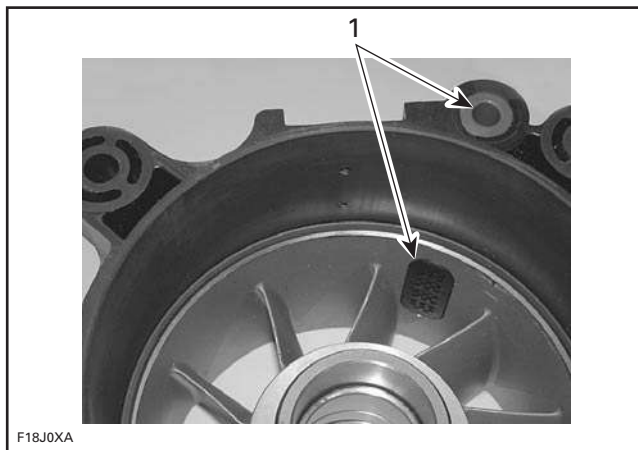
Pull ring out.

CLEANING

Properly clean all threads.

Remove all O-rings and clean parts in a solvent.

Carefully check water passages. Blow low pressure compressed air through them and make sure they are clear.



1. Water passages

Brush and clean impeller shaft threads, impeller and drive shaft splines with pulley flange cleaner (P/N 413 711 809) or equivalent. Free threads and splines from any residue.

PARTS INSPECTION

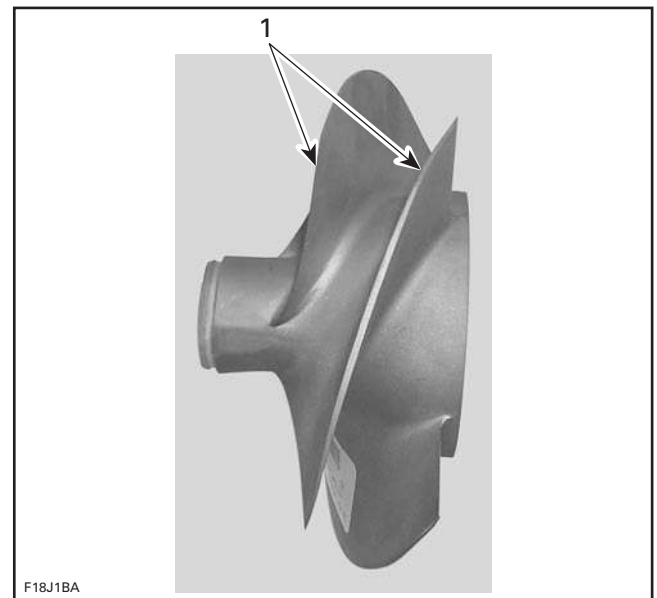
Impeller

Visually inspect impeller splines. Check for wear or deformation. Renew parts if damaged.

NOTE: Check also PTO flywheel and drive shaft condition. Refer to DRIVE SYSTEM and 1503 ENGINE SHOP MANUAL.

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.

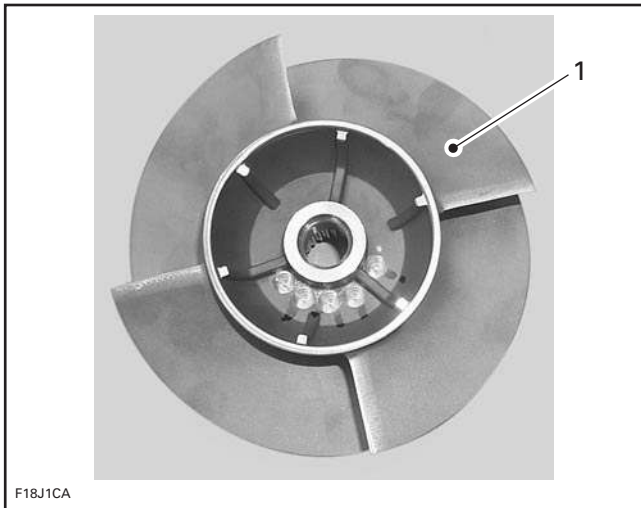


1. Replaced if blunted round or damaged

Check impeller for cavitation damage, deep scratches or any other damage.

Section 07 PROPULSION

Subsection 01 (JET PUMP)



1. Check for cavitation, deep scratches or other damage

Wear Ring

Check wear ring **no. 4** 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.

Ball Bearing and Impeller Shaft

WEAR

IMPORTANT: Make sure to reassemble ball cage, bearing inner and outer races to their original position.

Inspect ball bearing **no. 28**. 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 **no. 30** and seal **no. 29**.

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.

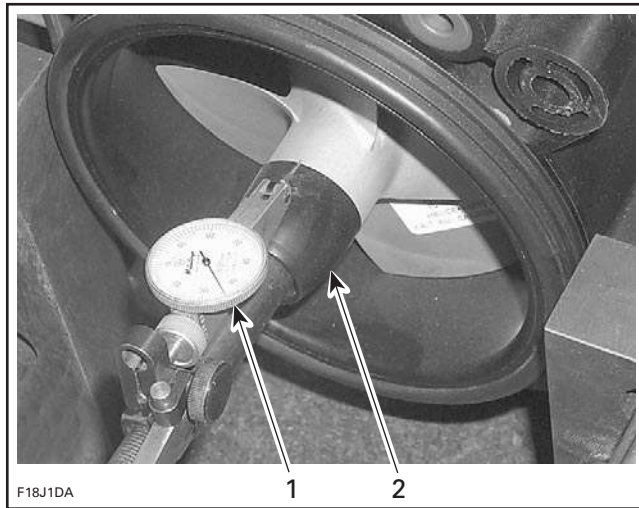
Radial play of impeller shaft is checked with shaft in housing, with impeller.

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.

The radial play should be 0 (zero).



TYPICAL — MEASURING IMPELLER SHAFT RADIAL PLAY

1. Dial gauge

2. Measure close to threads at shaft end

Excessive play can come either from worn bearing or damaged jet pump housing bearing surface.

O.P.A.S. Filter

O.P.A.S. filter is part of plastic elbow. Check for cleanliness. Replace or clean it as necessary.

Sacrificial Anode (if so equipped)

Check for wear. If worn more than half, replace anode.

ASSEMBLY

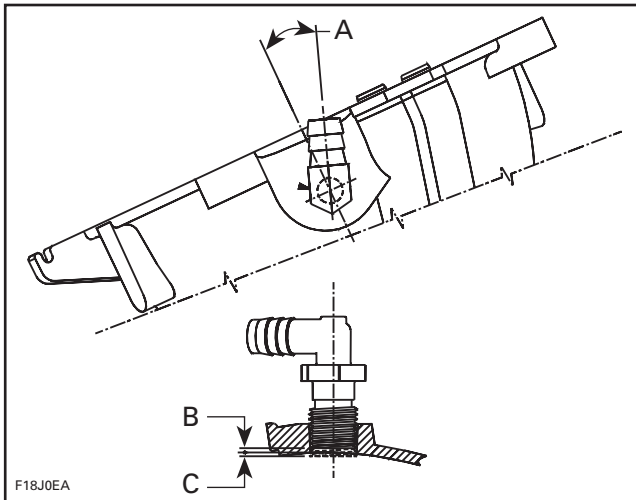
Hands, tools, bench, rags must be clean before pump disassembly.

CAUTION: Pump grease tube must be opened at very last moment to avoid contamination.

Plastic Elbow

Install plastic elbow at 20° angle to the right.

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.



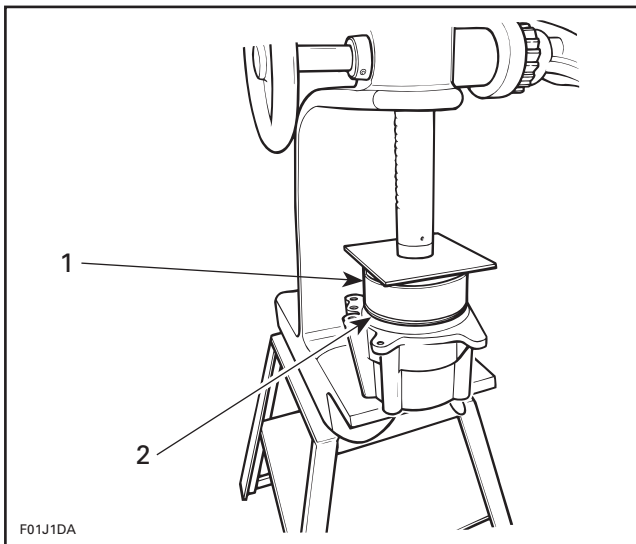
- A. 20°
- B. 2.0 mm (.078 in)
- C. 2.5 mm (.098 in)

Wear Ring

Position wear ring so that its rounded edge is outwards.

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.

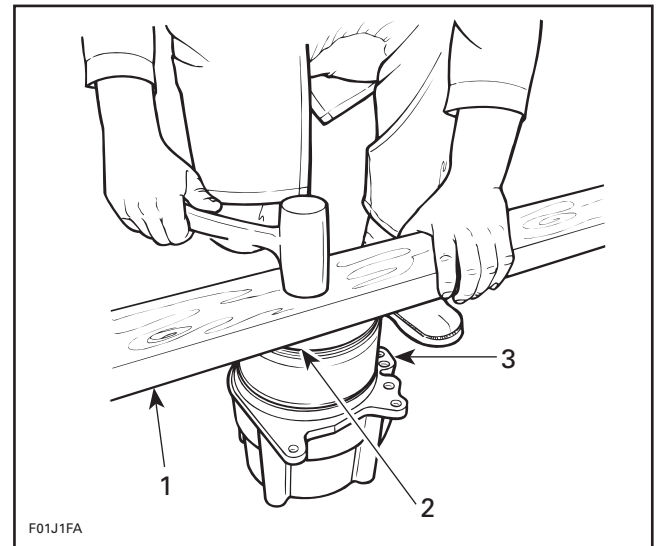
Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.



- 1. Rounded edge
- 2. Press wear ring

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.



- 1. Piece of wood
- 2. Rounded edge
- 3. Wear ring

After wear ring installation, install wear ring screws **no. 38**. If the jet pump wasn't equipped with screws, it is required to fit screws to wear ring. Using their holes in jet pump housing as a drilling guide, drill 4.5 mm (11/64 in) diameter holes in wear ring.

CAUTION: Drill carefully paying attention not to damage threads in jet pump housing. Drilling holes prior to screw installation will avoid wear ring deformation.

Install screws and torque to 6 N•m (53 lbf•in).

Section 07 PROPULSION

Subsection 01 (JET PUMP)



TYPICAL

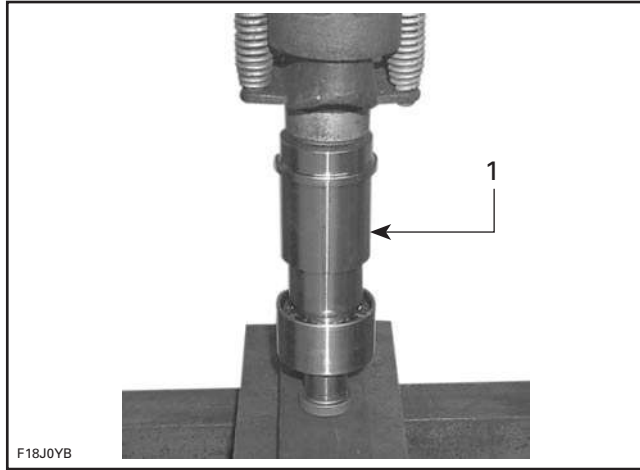
Bearing

Using the seal/bearing pusher (P/N 529 035 819) press the bearing no. 28 by its inner race on the impeller shaft no. 36.



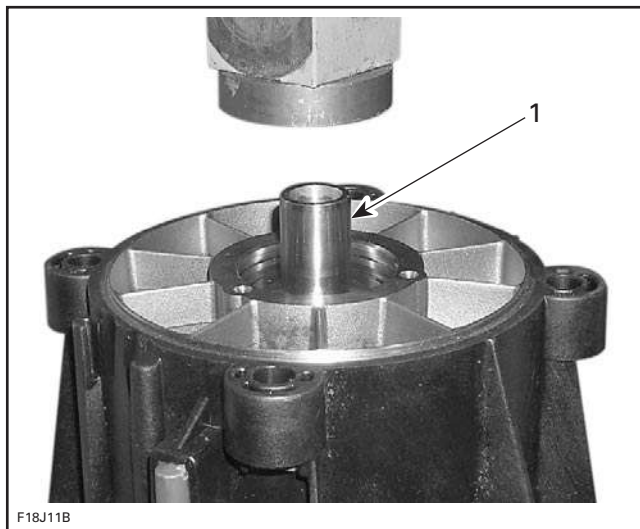
Be careful when removing the plastic retainer from the bearing no. 28 to avoid the inner races from falling apart. Make sure to reassemble bearing parts to their original position.

The bearing can be installed either side.



1. Seal/bearing pusher

From the outlet side of pump, press impeller shaft assembly into housing using the impeller shaft pusher (P/N 529 035 955).



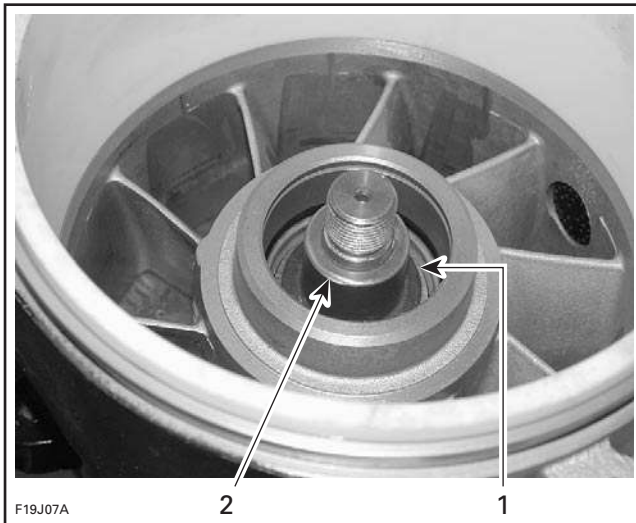
1. Shaft pusher

Coat shaft surface with jet pump bearing grease (P/N 293 550 032).

Install O-ring no. 35 and sleeve no. 30 on shaft no. 36.

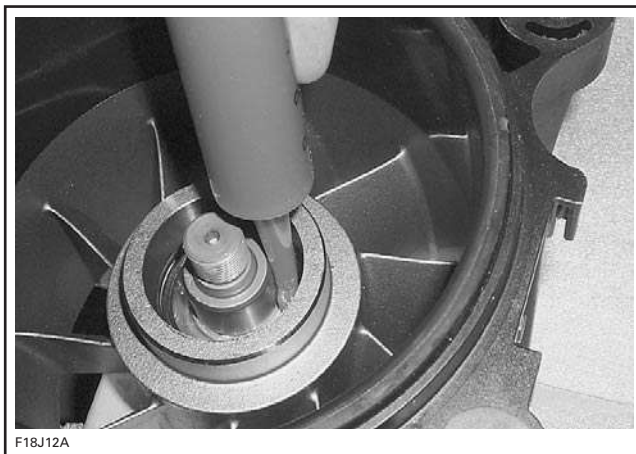
Section 07 PROPULSION

Subsection 01 (JET PUMP)

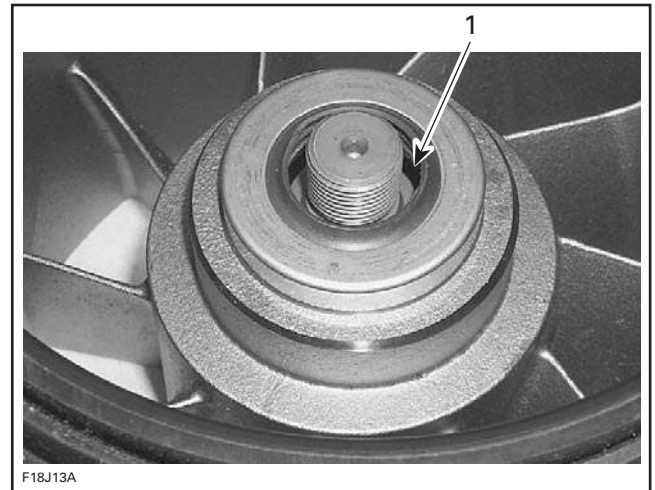


1. O-ring at bottom
2. Sleeve

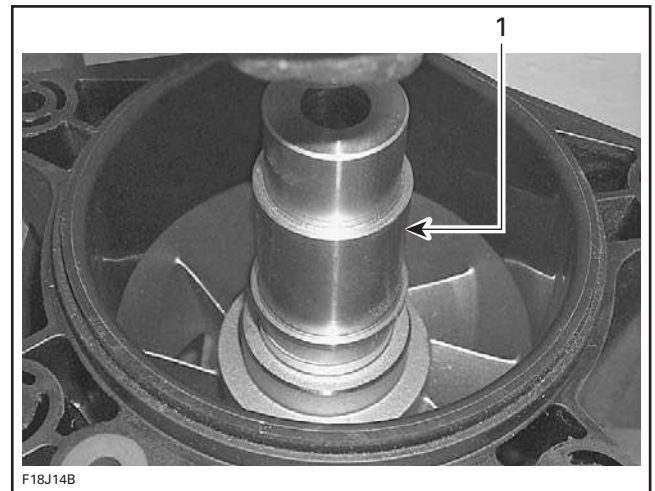
Apply 4 cc of jet pump bearing grease (P/N 293 550 032) on bearing. Use a new tube of grease each time a jet pump is rebuilt (1 tube = 1 pump).



Press oil seal no. 29 using the seal/bearing pusher (P/N 529 035 819) until tool bottoms. Make sure seal lips are facing up.



1. Lips facing up



1. Seal/bearing pusher

Install spacer no. 34 and seal no. 33. Ensure seal lip is facing up.

Install circlip no. 32.

On the outlet side, install 2 O-rings no. 31 in their respective groove.

Before installing any other parts, pump can be pressurized to insure proper seal installation. See PUMP PRESSURIZATION below.

Apply Loctite antiseize (P/N 293 800 070) on impeller shaft.

Section 07 PROPULSION

Subsection 01 (JET PUMP)

Apply BOMBARDIER 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 impeller remover/installer in a vise.

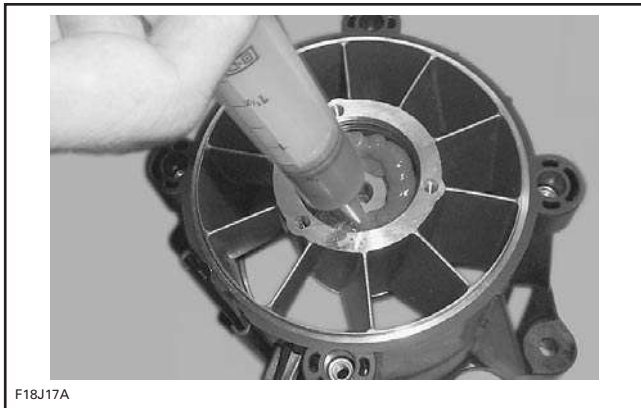
For **GTX 4-TEC, Wake and GTX 4-TEC Supercharged models**, use the impeller remover/installer (P/N 529 035 820) and for the **GTX 4-TEC Limited, RXP and RXT models**, use the impeller remover/installer (P/N 529 035 956).

Install partially screwed impeller on it.

Use a 12 mm Allen key to torque impeller shaft to 80 N•m (59 lbf•ft) then remove tool.

CAUTION: Never use any impact wrench to tighten impeller shaft.

Apply 26 cc of jet pump bearing grease (P/N 293 550 032) in the impeller shaft area.



F18J17A

TYPICAL

Put the rest of the jet pump bearing grease tube in the impeller cover (approximately 80 cc).



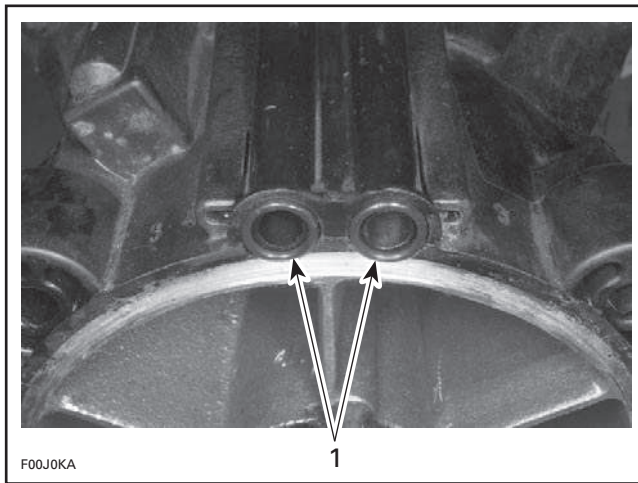
F18J18A

TYPICAL

Install impeller cover with new self-locking screws. Torque to 7.5 N•m (66 lbf•in). Push cover against pump housing while tightening screws.

Venturi

If needed, install new O-rings **no. 42** around bailer passages.



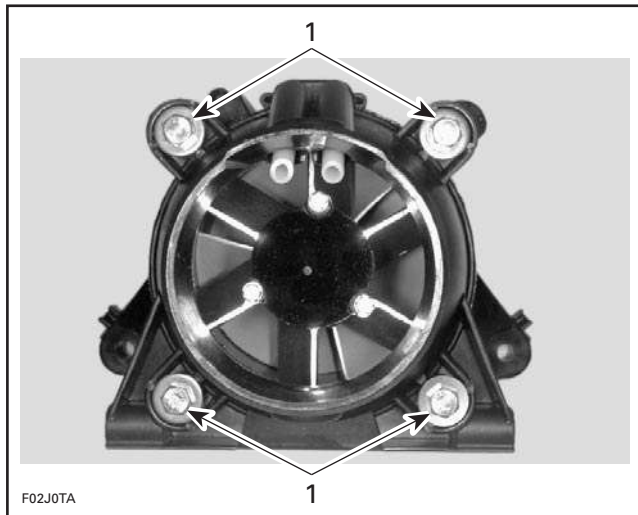
F00J0KA

1. O-rings

Position venturi **no. 24** with bailer passages on top.

Apply Loctite 243 (blue) (P/N 293 800 060) on threads of screws **no. 23**.

Install screws **no. 23**, lock washers and flat washers then torque to 21 N•m (16 lbf•ft).



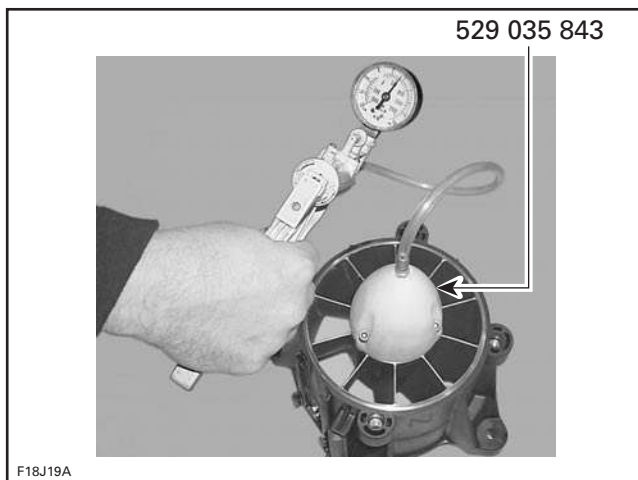
1. Torque screws to 21 N•m (16 lbf•ft)

PUMP PRESSURIZATION

Whenever doing any type of repair on jet pump, a pressure test should be done to check for leakage.

Proceed as follows:

- Remove impeller cover **no. 26**. 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 **no. 30** and its seal **no. 29**. 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.

INSTALLATION

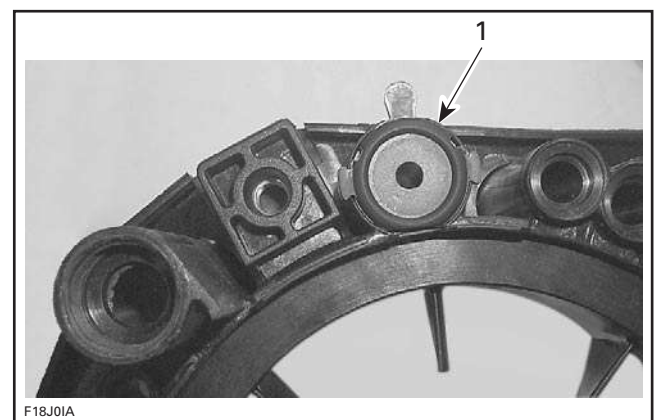
Jet Pump Housing

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.

MODEL	REDUCER COLOR
GTX 4-TEC Wake GTX 4-TEC Limited RXT RXP	Yellow
GTX 4-TEC Supercharged	Red

Make sure that the reducer is installed as shown.

CAUTION: Misinstallation can cause overheating and damage to exhaust system.



1. Color-coded reducer

Section 07 PROPULSION

Subsection 01 (JET PUMP)

Generously apply 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.

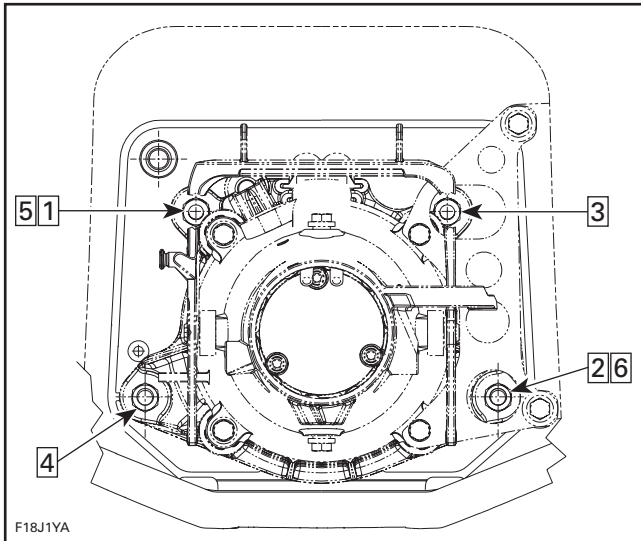
Apply Loctite 243 (blue) (P/N 293 800 060) on stud threads or screws (depending on the model) of jet pump housing.

RXP Models

Ensure to reinstall bushings no. 39 in fastener holes of jet pump housing.

All Models

Install nuts/screws. Tighten as per the following sequence.



TYPICAL

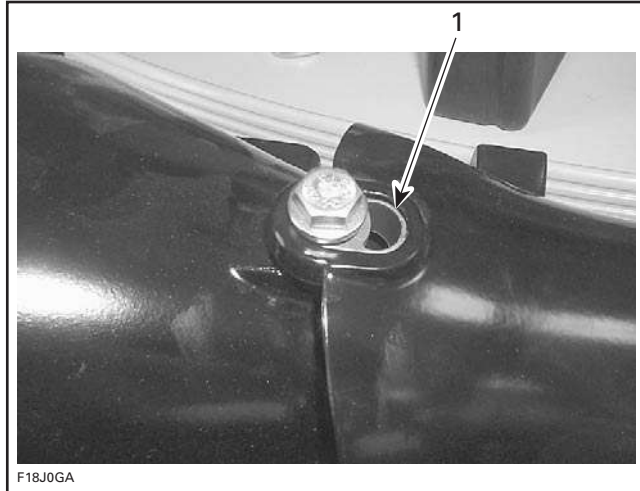
From 1 to 2: 16 N•m (12 lbf•ft)
From 3 to 6: 31 N•m (23 lbf•ft)

NOTE: Slightly lubricate wear ring with BOMBARDIER LUBE (P/N 293 600 016) to minimize friction during initial start.

Nozzle

Insert bushing no. 40 in nozzle no. 18.

Insert bushing no. 41 in nozzle no. 18 with its offset pointing rearward.



1. Bushing offset

Position their flanges from inside of nozzle.

Insert sleeves no. 21 in bushings no. 40 and no. 41.

Install nozzle on venturi no. 24; position its steering arm on RH side. Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads (or use new self-locking screws). Install screws no. 20 and washer no. 22 then torque to 24 N•m (18 lbf•ft).

WARNING

Screws must be torqued as specified.

O.P.A.S.

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).

Pivot Triangle

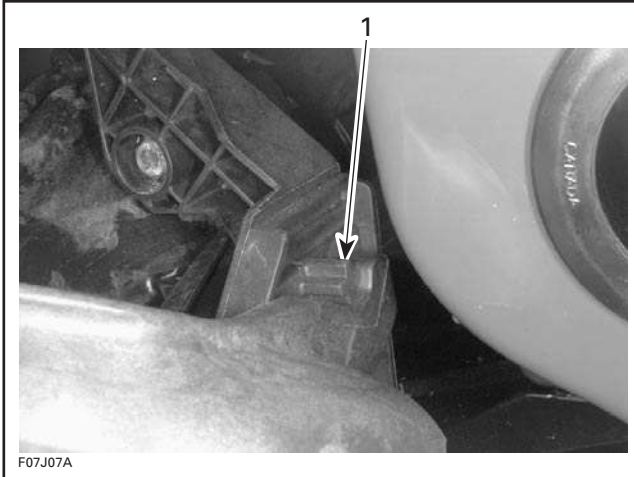
Install head bolts toward inside.

NOTE: Make sure the pivot triangle no. 13 turn freely.

Reverse Gate

Install reverse gate with spacer and washer. Torque to 20 N•m (15 lbf•ft).

NOTE: When installing the reverse gate no. 5, pay attention to position its lever behind the reverse gate support stopper.



1. Stopper

Steering Cable

Refer to STEERING SYSTEM.

Reverse Cable

Refer to REVERSE SYSTEM.

Jet Pump Support and Riding Plate

Refer to HULL AND BODY.

DRIVE SYSTEM

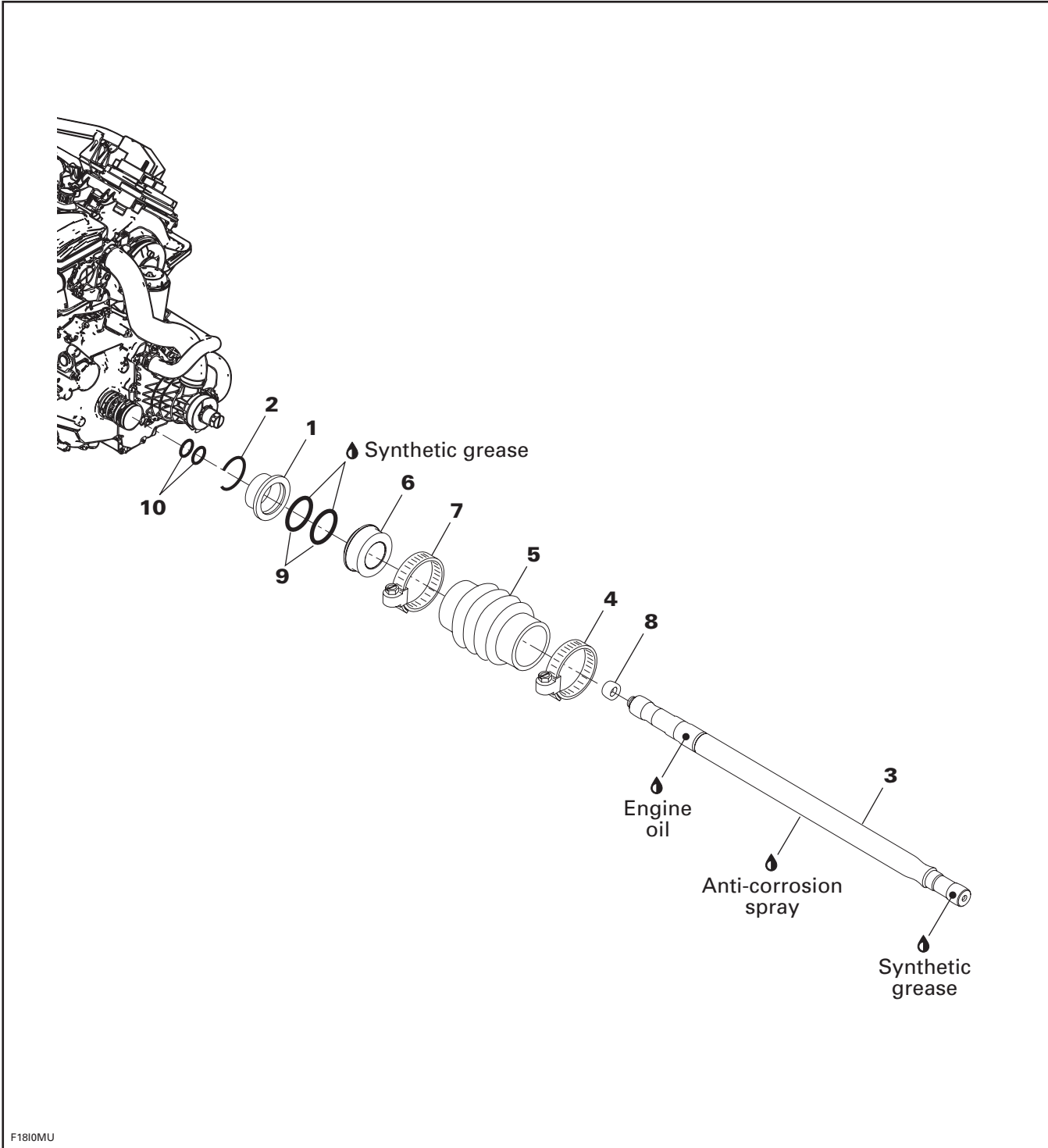
SERVICE TOOLS

Description	Part Number	Page
Drive shaft holder	529 035 986	205, 212
Drive shaft/floating ring tool	529 035 841	206, 212
Drive shaft/floating ring tool	529 035 987	206, 212
PTO seal support tool	529 035 842	205, 211

SERVICE PRODUCTS

Description	Part Number	Page
anti-corrosion spray	219 700 304	210, 213
BOMBARDIER LUBE	293 600 016	207
synthetic grease	293 550 010	210

Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)



F1810MU

GENERAL

Jet pump must be removed to replace any components of the drive system. Refer to JET PUMP for removal procedure.

REMOVAL

Drive Shaft

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, refer to the procedure in PTO HOUSING/MAGNETO section and look for PTO HOUSING REMOVAL.

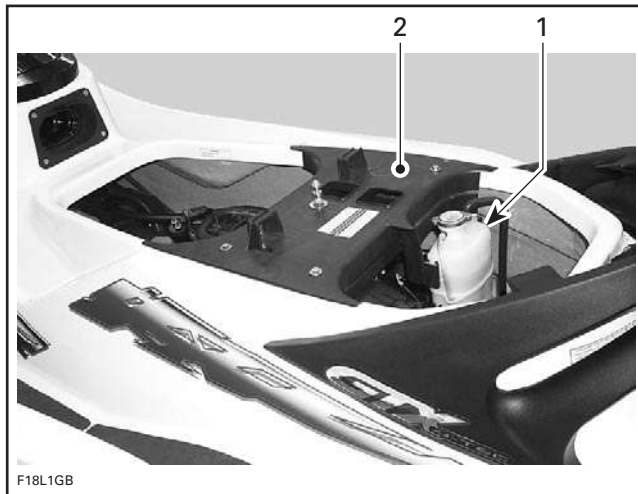
Remove seat.

RXP Models

Remove engine cover.

All Other Models

Detach coolant expansion reservoir from vent tube support then move away.



TYPICAL
 1. Detach expansion reservoir
 2. Remove vent tube support

Detach vent tube.

Remove vent tube support.

All Supercharged Models

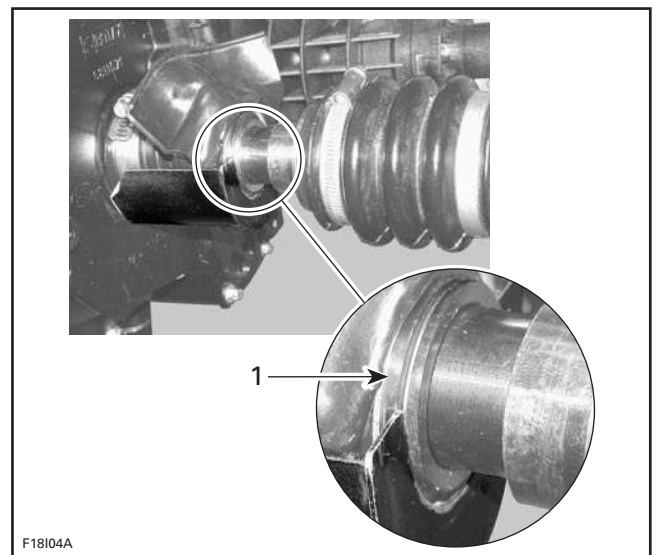
Remove supercharger. Refer to AIR INTAKE SYSTEM in ENGINE SECTION of this shop manual and to INTAKE MANIFOLD AND SUPERCHARGER of the 1503 4-TEC ENGINE SHOP MANUAL.

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.



1. Insert in groove of PTO seal assembly

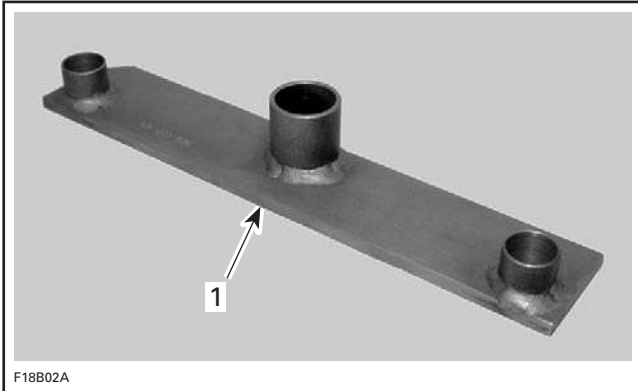
Remove jet pump. Refer to JET PUMP section. Install drive shaft holder on pump support. Refer to the following table to use the appropriate tool according to the model.

MODEL	TOOL
ALL	Drive shaft holder (P/N 529 035 986)

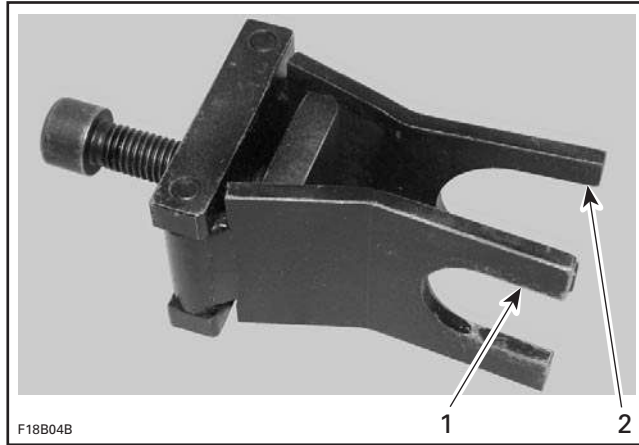
NOTE: This is necessary so the drive shaft cannot move rearwards when using the drive shaft/float-ring tool.

Section 07 PROPULSION

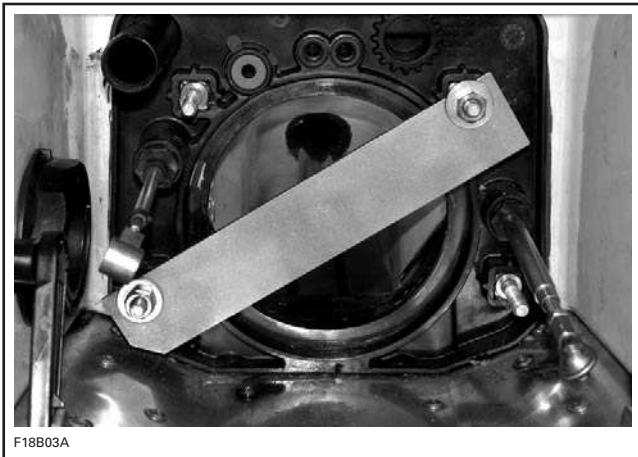
Subsection 02 (DRIVE SYSTEM)



TYPICAL
1. Drive shaft holder



TYPICAL — DRIVE SHAFT/FLOATING RING TOOL
1. Small opening
2. Large opening

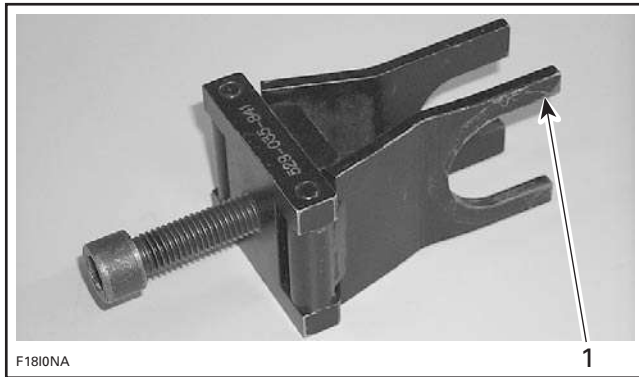


Due to configuration of some models, it may be necessary to disconnect EGTS sensor to make room.

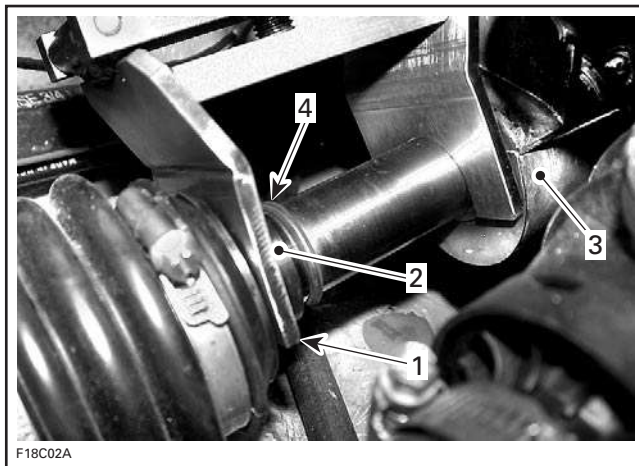
Install the drive shaft/floating ring tool. Refer to the following table to use the appropriate tool according to the model.

MODEL	TOOL
GTX 4-TEC Limited, RXP and RXT	Drive shaft/floating ring tool (P/N 529 035 987)
GTX 4-TEC, Wake and GTX 4-TEC Supercharged	Drive shaft/floating ring tool (P/N 529 035 841)

NOTE: Note that there is a large opening and a small opening on the tool. Depending on the step involved in the procedure, it is sometimes required to reverse its installation position.



TYPICAL
1. Largest opening on through-hull fitting side



TYPICAL
1. Largest opening here
2. Floating ring
3. PTO seal support tool
4. Circlip

Section 07 PROPULSION

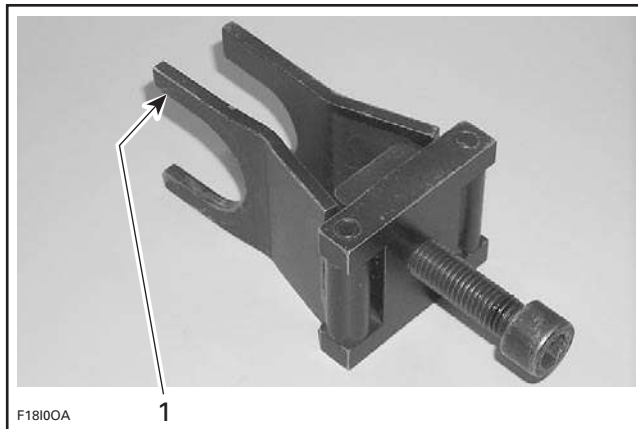
Subsection 02 (DRIVE SYSTEM)

Turn screw clockwise so that the tool pushes the floating ring **no. 1** rearwards to expose the circlip **no. 2**. Do not remove circlip at this time.

NOTE: This step is done to ensure floating ring is free and not stuck on the drive shaft **no. 3**.

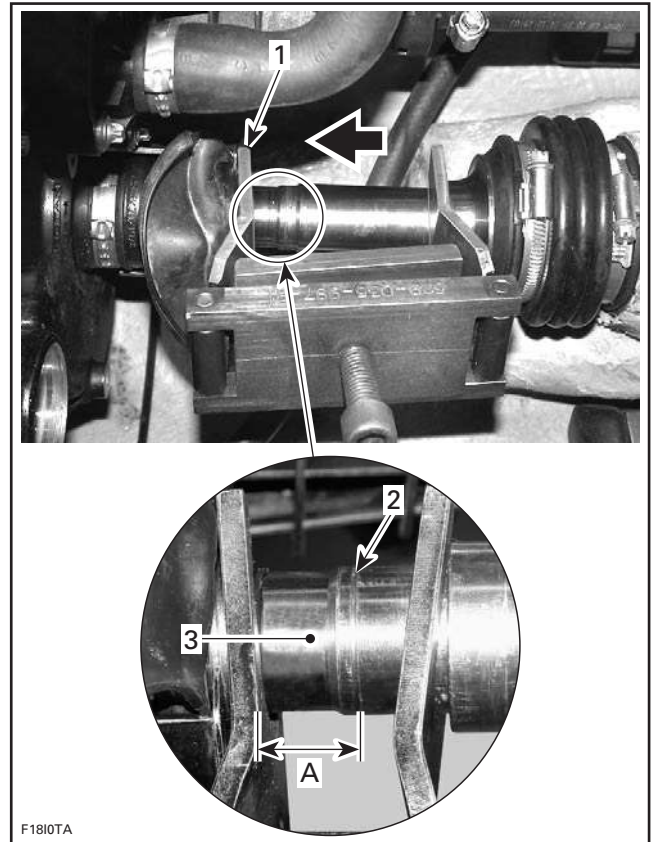
Remove drive shaft/floating ring tool and drive shaft holder.

Reinstall drive shaft/floating ring tool as shown.



TYPICAL

1. Largest opening on PTO seal side



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 BOMBARDIER LUBE (P/N 293 600 016).

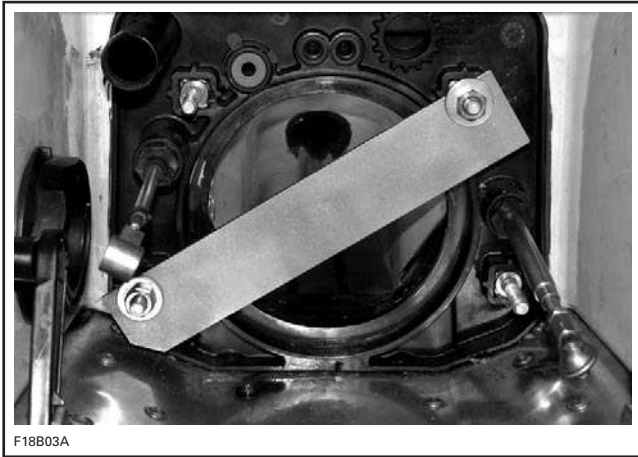
NOTE: This is necessary to ease drive shaft removal later in this procedure.

Remove drive shaft/floating ring tool.

Reinstall drive shaft holder tool.

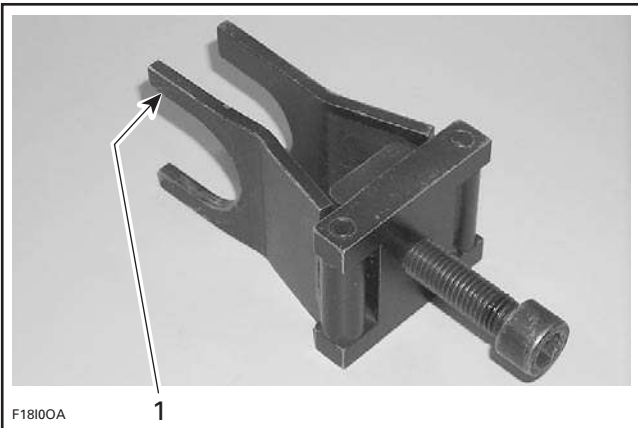
Section 07 PROPULSION

Subsection 02 (DRIVE SYSTEM)



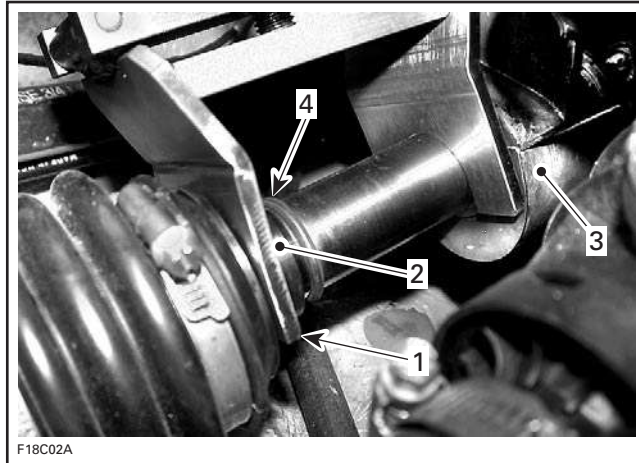
NOTE: It will be necessary to push the shaft in to install the drive shaft holder tool.

Reinstall drive shaft/floating ring tool as shown.



TYPICAL
1. Largest opening on PTO seal side

Push floating ring **no. 1** rearwards to expose circlip **no. 2** and remove it.



TYPICAL
1. Largest opening here
2. Floating ring
3. PTO seal support tool
4. Remove circlip

Remove drive shaft holder tool then drive shaft/floating ring tool.

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.

Boot

Loosen gear clamp **no. 4** holding boot **no. 5**, then carefully pull boot and carbon ring **no. 6** from hull insert.

Carbon Ring

Loosen gear clamp **no. 7** then pull carbon ring **no. 6** from boot **no. 5**.

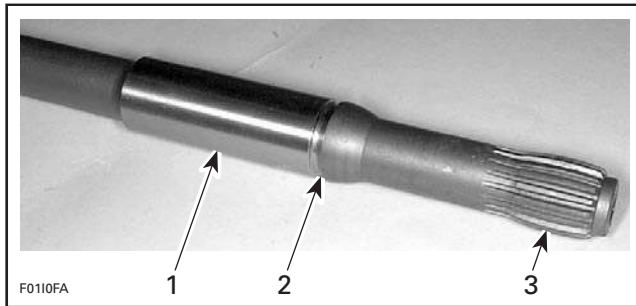
INSPECTION

Drive Shaft

Inspect condition of drive shaft and PTO flywheel splines.

Inspect condition of groove.

With your finger nail, feel machined surface of drive shaft. If any irregular surface is found, re-new drive shaft.

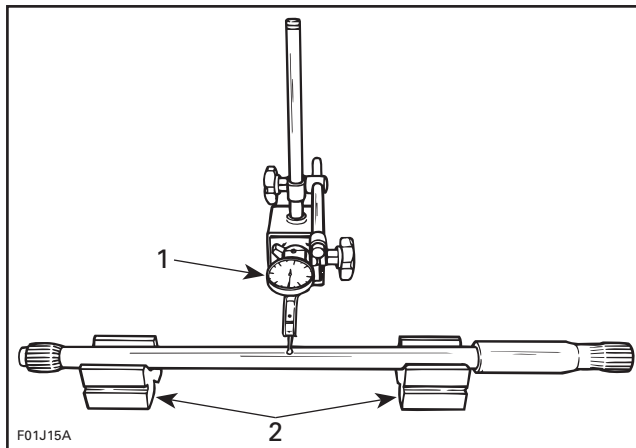


TYPICAL
1. Surface condition
2. Groove condition
3. Splines condition

Excessive deflection could cause vibration and damage to drive shaft splines, impeller, flywheel 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.

Maximum permissible deflection is 0.5 mm (.020 in).



MEASURING DRIVE SHAFT DEFLECTION
1. Dial gauge
2. V-blocks

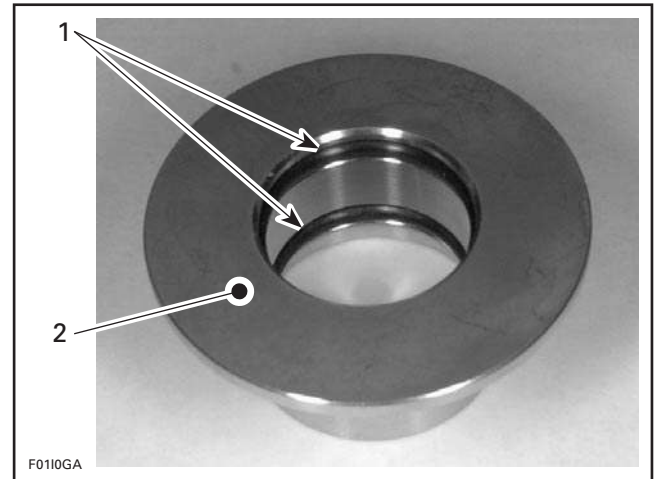
Damper

4-TEC Models

Discard damper no. 8 to install a new one.

Floating Ring and O-Ring

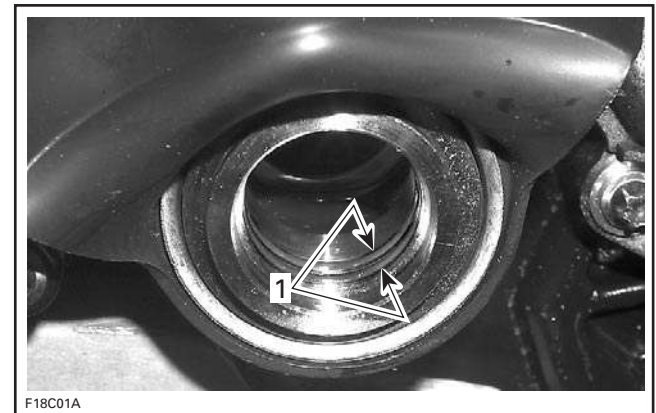
Inspect condition of O-rings no. 9 and floating ring contact surface.



1. O-rings
2. Floating ring contact surface

PTO Seal

Discard both O-rings no. 10 inside PTO seal and install new ones.



1. O-rings

Inspect PTO seal assembly. Refer to PTO HOUSING/MAGNETO section.

Boot

Inspect the condition of boot. If there is any damage or evidence of wear, replace it.

INSTALLATION

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

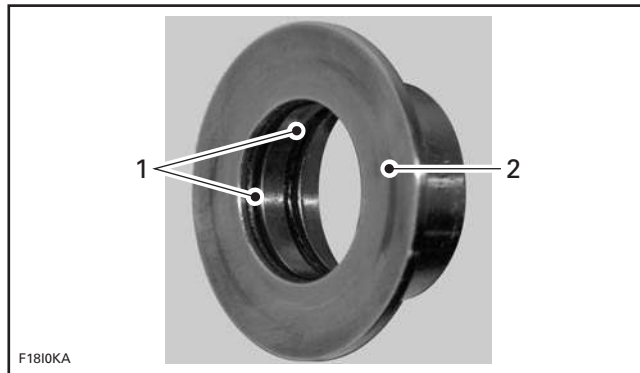
Section 07 PROPULSION

Subsection 02 (DRIVE SYSTEM)

Drive Shaft

NOTE: Ensure to install floating ring **no. 1** before inserting the drive shaft **no. 3** in PTO seal assembly.

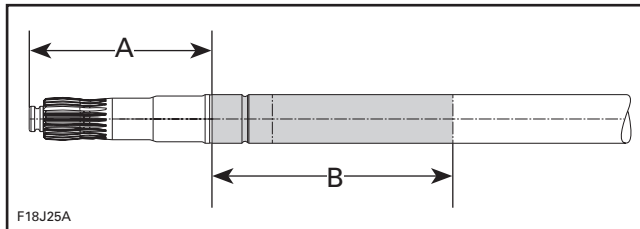
Before installing drive shaft, inspect PTO seal assembly. The inner sleeve must be flush with outer circumference of the assembly. Otherwise, gently push or tap on inner sleeve until flush.



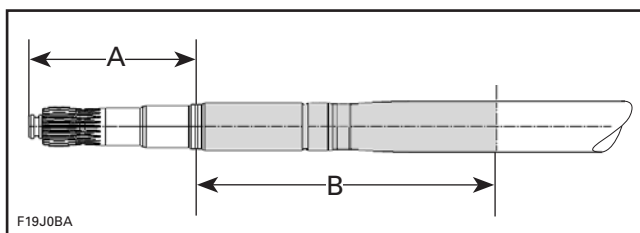
1. Synthetic grease
2. No lubrication

To prevent possible drive shaft corrosion, apply anti-corrosion spray (P/N 219 700 304) on drive shaft where shown.

NOTE: Drive shaft should be dry and clean prior to applying the corrosion protectant. If the drive shaft is corroded, a rotating wire brush may be used.



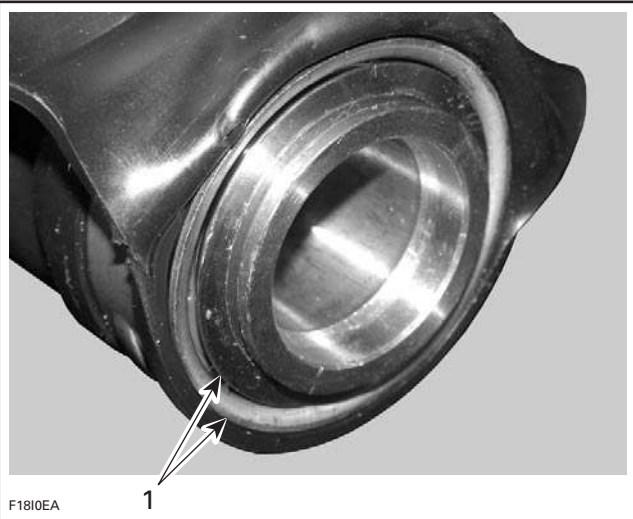
- A. 89 mm (3.3 in)
- B. 131 mm (5.2 in) — zone to apply primer



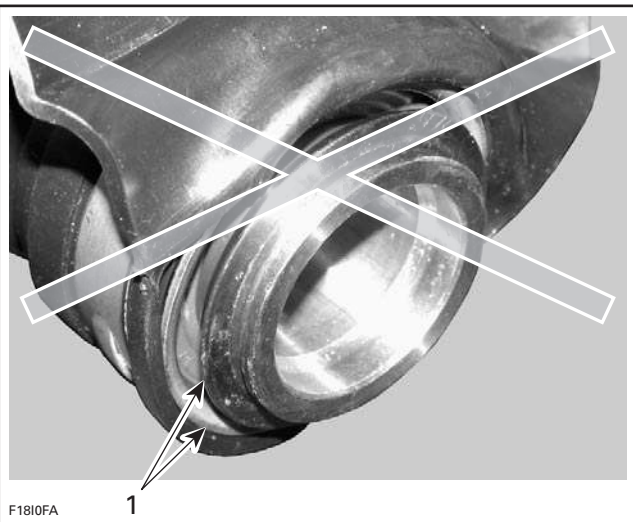
- A. 101 mm (4 in)
- B. 180 mm (7.1 in) — zone to apply primer

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 protectant to dry.



CORRECT INSTALLATION
 1. Inner sleeve flush with outer circumference

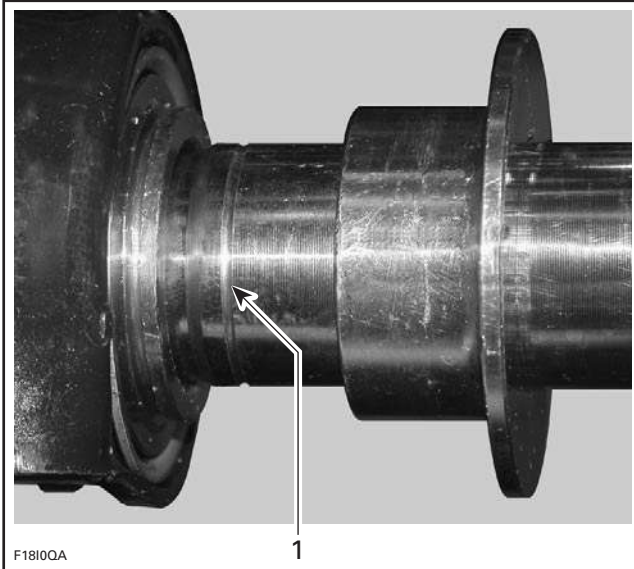


WRONG INSTALLATION
 1. Inner sleeve not flush with outer circumference

Apply a thin coat of synthetic grease (P/N 293 550 010) on the floating ring O-rings **no. 9**. Do not get grease on floating ring sealing surface.

Section 07 PROPULSION
Subsection 02 (DRIVE SYSTEM)

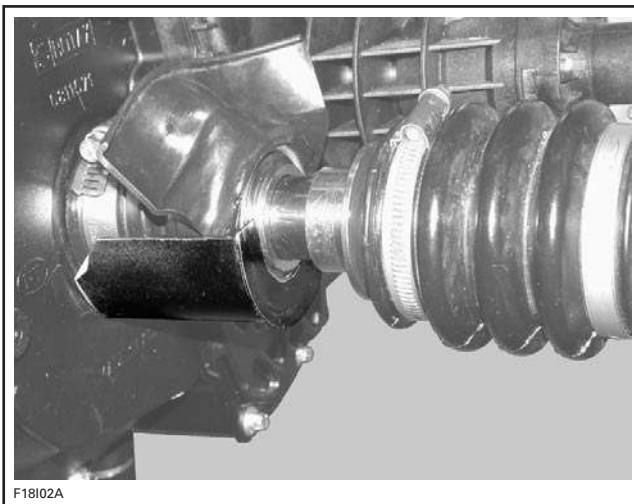
CAUTION: Note that drive shaft features a telltale groove. If exposed after installation, the installation is wrong and PTO seal assembly will be pressed into crankshaft splines which could rub a hole in seal thus creating an oil leak.



1. Telltale groove

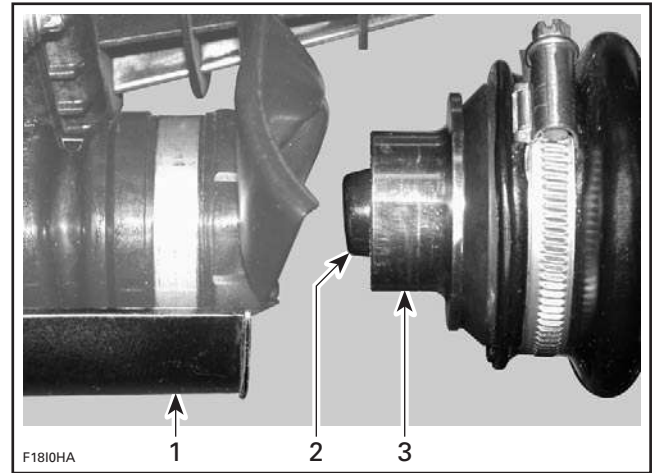
Install the PTO seal support tool (P/N 529 035 842) on PTO seal assembly.

Slide drive shaft far enough to install floating ring.



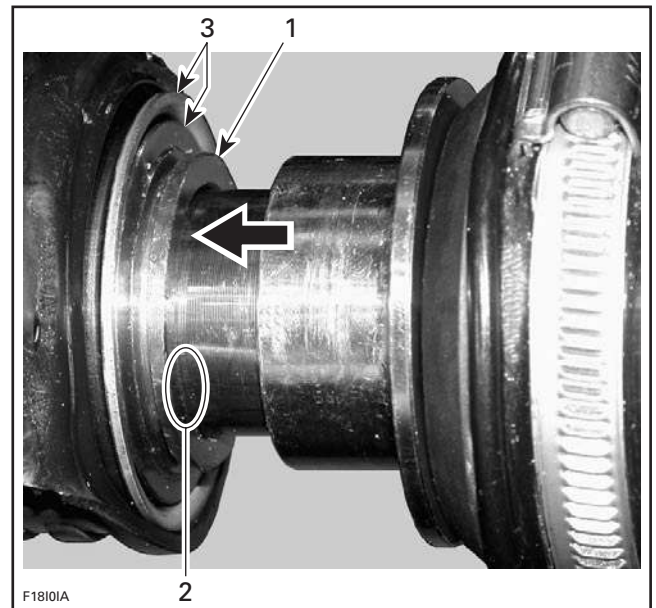
TYPICAL

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.



1. PTO seal support
2. Drive shaft end
3. Insert floating ring on shaft end

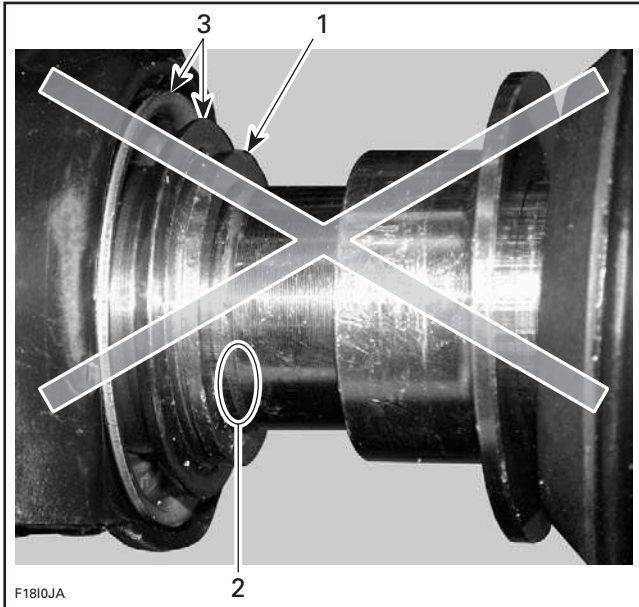
When properly aligned, maintain PTO seal assembly in the proper position and tap shaft end until it bottoms against engine. At this time, the telltale MUST NOT be visible. This validates the correct position.



- GOOD INSTALLATION**
1. PTO seal assembly
 2. Shaft pushed in, hiding telltale groove
 3. Inner sleeve flush with outer circumference

Section 07 PROPULSION

Subsection 02 (DRIVE SYSTEM)



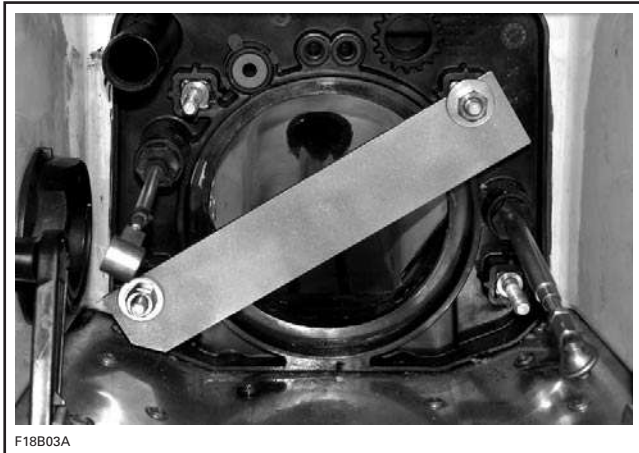
WRONG INSTALLATION

1. PTO seal assembly
2. Telltale groove visible
3. Inner sleeve NOT flush with outer circumference

If drive shaft does not enter into the PTO seal, check engine alignment.

Install drive shaft holder tool. Refer to the following table to use the appropriate tool according to the model.

MODEL	TOOL
ALL	Drive shaft holder (P/N 529 035 986)

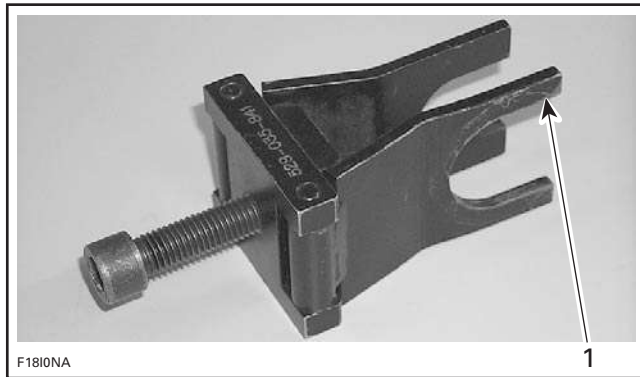


Install drive shaft/floating ring tool as shown. Ensure PTO seal support is still in place.

Refer to the following table to use the appropriate tool according to the model.

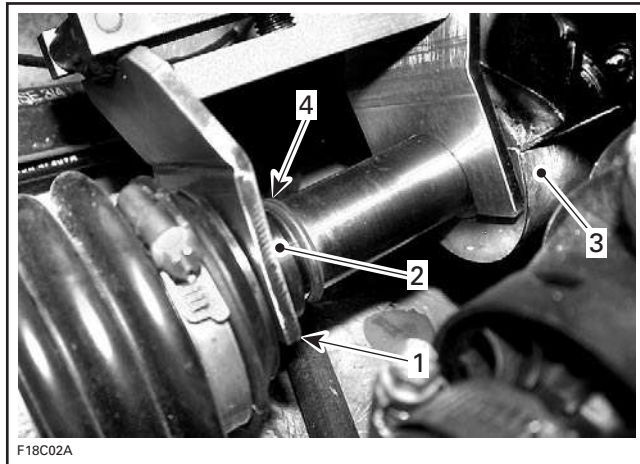
MODEL	TOOL
GTX 4-TEC Limited, RXP and RXT	Drive shaft/floating ring tool (P/N 529 035 987)
GTX 4-TEC, Wake and GTX 4-TEC Supercharged	Drive shaft/floating ring tool (P/N 529 035 841)

Push floating ring rearwards and install circlip.



TYPICAL

1. Largest opening on through-hull fitting side



TYPICAL

1. Largest opening
2. Floating ring
3. PTO seal support tool
4. Install circlip

Remove drive shaft/floating ring tool, drive shaft holder then PTO seal support.

NOTE: Pushing boot **no. 10** rearwards will ease removal of PTO seal support tool.

Now ensure everything is properly positioned: Telltale is not exposed, inner sleeve is flush with outer circumference of PTO seal assembly and C-clip is not exposed.

If telltale mark is exposed, 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 section.

Check engine oil level. Refill as necessary.

Run watercraft then ensure there is no oil leak in PTO seal area.

Cover carbon seal ring and floating ring with a rag or plastic wrap to prevent the protectant to reach the carbon ring. Place a rag on bottom of hull to recover the excess of sprayed corrosion protectant. 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 protectant to dry.

LUBRICATION

Corrosion Protection

To prevent possible drive shaft corrosion, apply anti-corrosion spray (P/N 219 700 304) as per MAINTENANCE CHART.

WARNING

Always work in a well ventilated area. Carefully read application instructions on product can.

If drive shaft has been removed and lubricated before installation, this procedure is not required. Otherwise, proceed as follows.

Drive shaft should be dry and clean prior to applying the corrosion protectant.

Place a plastic sheet underneath hull to recover the excess of sprayed corrosion protectant.

From underneath hull, spray the corrosion protectant 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.

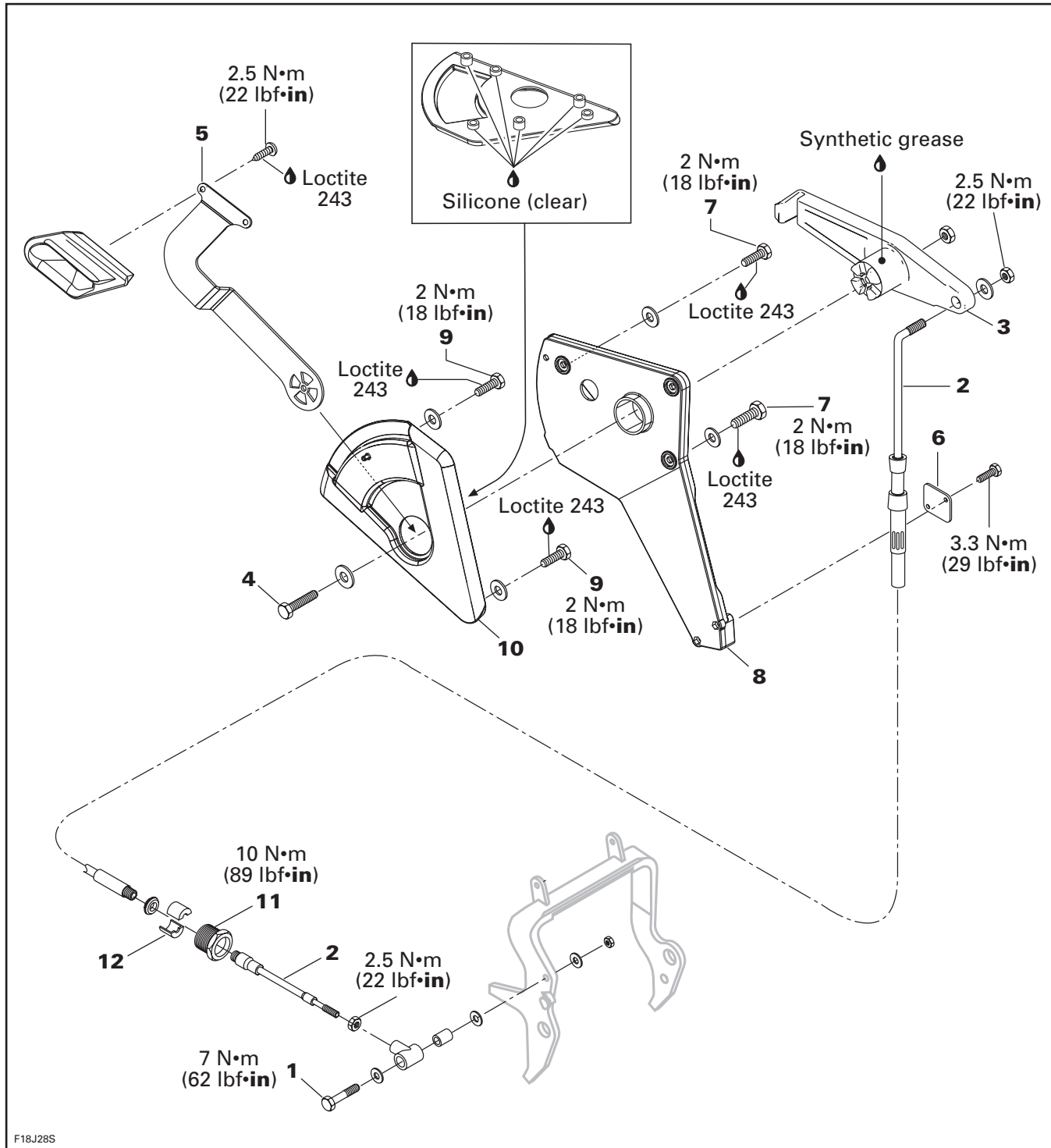
NOTE: On **Supercharged models**, remove inlet hose from supercharger to gain access.

REVERSE SYSTEM

SERVICE PRODUCTS

<u>Description</u>	<u>Part Number</u>	<u>Page</u>
Loctite 243 (blue).....	293 800 060	219
synthetic grease	293 550 010	219

Section 07 PROPULSION
Subsection 03 (REVERSE SYSTEM)



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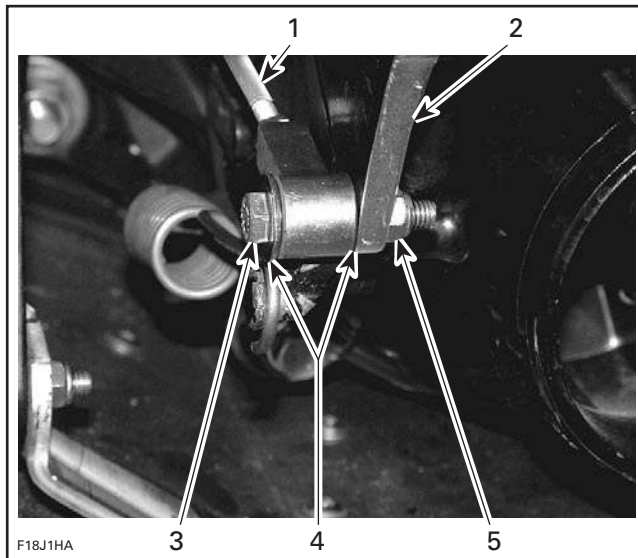
DISASSEMBLY

Reverse Gate

To remove reverse gate, refer to JET PUMP section.

Reverse Cable

Unscrew bolt no. 1, washers and the elastic stop nut retaining reverse cable no. 2 on pivot arm.



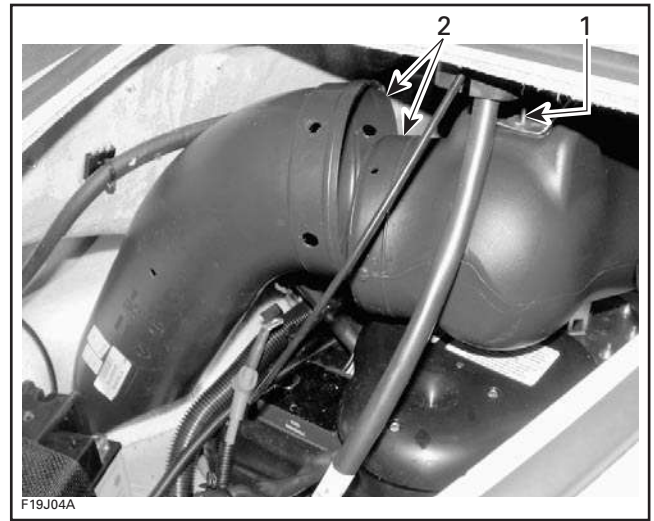
1. Reverse cable
2. Pivot arm
3. Bolt
4. Washer
5. Elastic stop nut

Unscrew the cable lock no. 11 then remove the half rings no. 12.

RXP Models

Open storage compartment and remove basket.

Remove nut of front vent tube, unsnap wiring harness and separate vent tube.



1. Remove nut
2. Separate bottom and top parts

Pull out bottom part first then top part.

All Other Models

Remove the seat and the glove box. Refer to HULL/BODY.

Push the vent tube toward the front of the vehicle to get greater access to the interior lever and the reverse cable support.

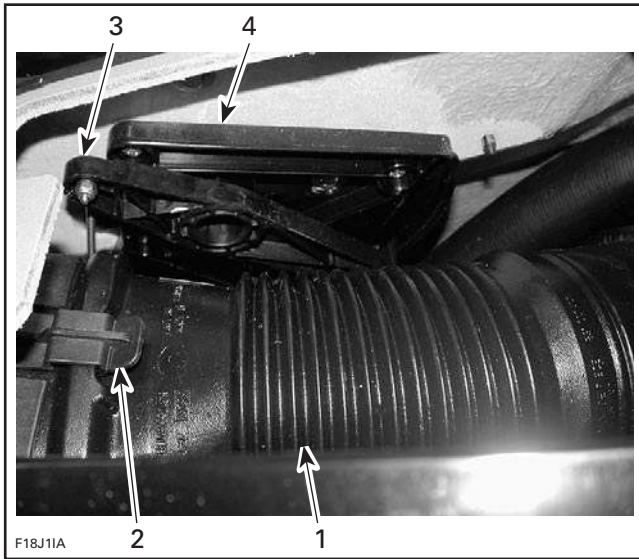
To release the vent tube, press down its locking tabs and move the tube.

There are two locking tubes; one above and one underneath the hose.

DO NOT REMOVE the vent tube completely.

Section 07 PROPULSION

Subsection 03 (REVERSE SYSTEM)



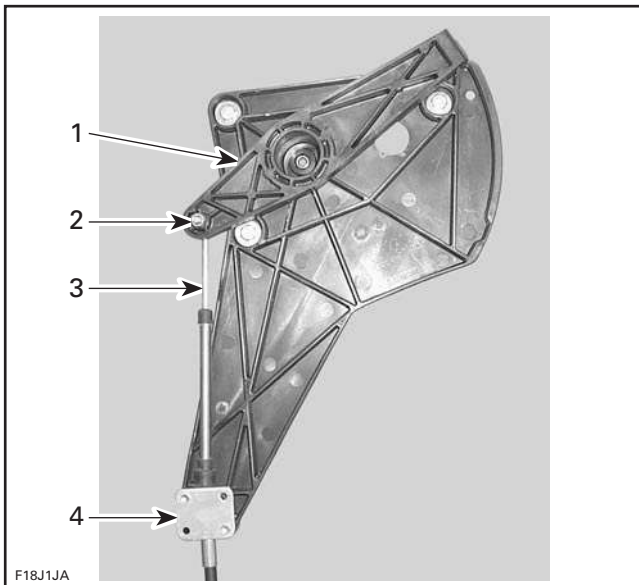
TYPICAL
 1. Engine vent tube
 2. Vent tube locking tab
 3. Interior lever
 4. Reverse cable support

All Models

On the interior lever **no. 3**, unscrew the elastic stop nut and the washer retaining the reverse cable.

Remove the bracket **no. 6**.

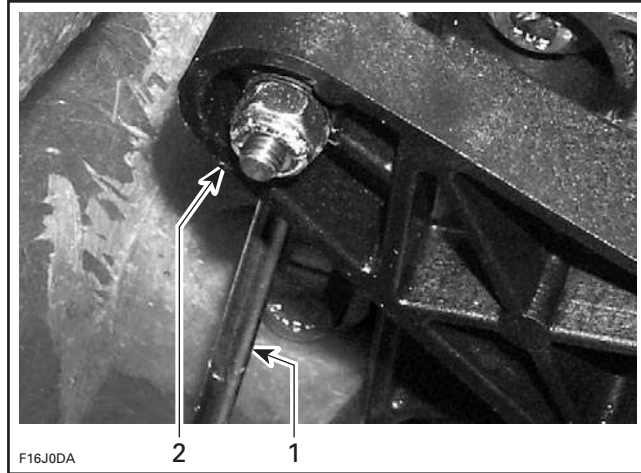
NOTE: Before removing reverse cable from hull, note cable routing for reinstallation.



TYPICAL
 1. Interior lever
 2. Elastic stop nut and washer
 3. Reverse cable
 4. Bracket

Interior Lever

Detach the reverse cable from interior lever **no. 3**. Unscrew the shift lever retaining bolt **no. 4**, washer and nut, then remove interior lever.

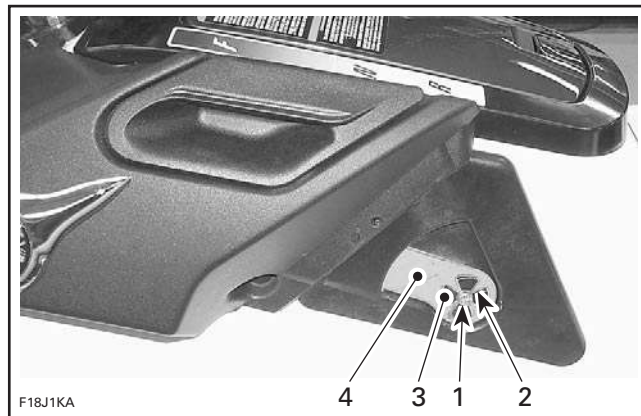


TYPICAL
 1. Reverse cable
 2. Interior lever

Shift Lever

Unscrew the shift lever retaining bolt **no. 4**, washer and nut.

Disengage the shift lever slots from interior lever tabs, then remove the shift lever **no. 5**.

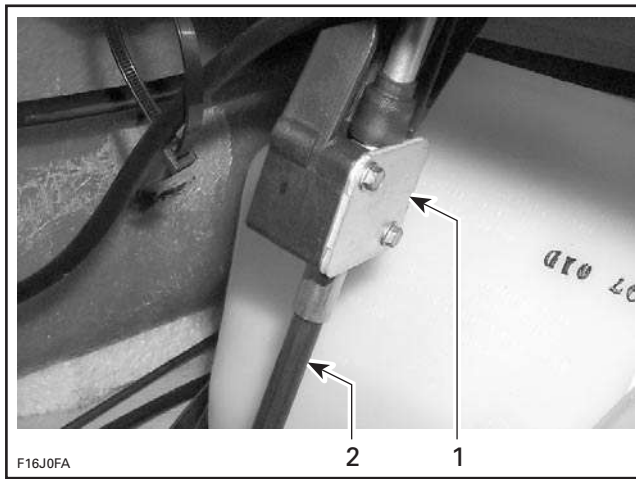


TYPICAL
 1. Shift lever retaining bolt
 2. Shift lever slot
 3. Interior lever tab
 4. Shift lever

Reverse Cable Support

Remove:
 – shift lever
 – interior lever

- bracket no. 6



TYPICAL
1. Bracket
2. Reverse cable

- bolts no. 7.
- Withdraw reverse cable support no. 8.

Handle Housing

Remove:

- shift lever
- interior lever
- reverse cable support
- bolts no. 9.

Then, remove handle housing no. 10.

INSPECTION

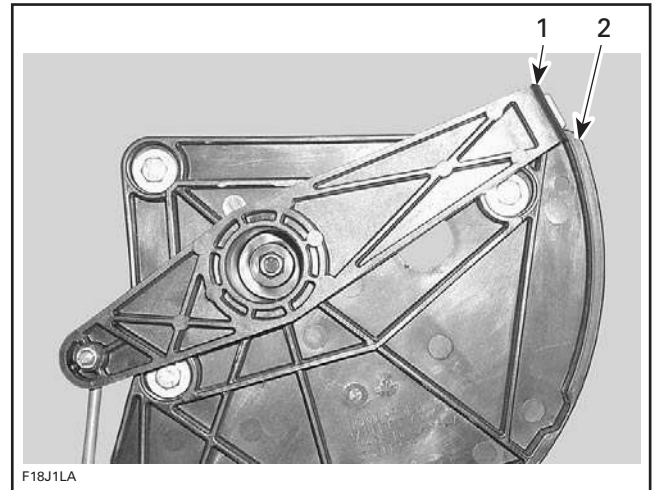
Visually inspect parts for wear or cracks on friction parts. Replace all defective parts.

ASSEMBLY

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

When installing handle housing, apply Loctite 243 (blue) (P/N 293 800 060) on threads of screws.

Insert interior lever cursor into reverse cable support slider and make sure that the cursor slides freely in the slider.



TYPICAL
1. Interior lever cursor
2. Reverse cable support slider

Interior Lever

Apply synthetic grease (P/N 293 550 010) on the interior lever pivot and in the reverse cable support hole.

Install the interior lever in a rotating movement. Engage properly the interior lever tabs in the shift lever slots.

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.

Reverse Gate

Refer to JET PUMP section.

Reinstall removed parts.

ADJUSTMENT

Put shift lever in forward position.

⚠ 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).

VARIABLE TRIM SYSTEM

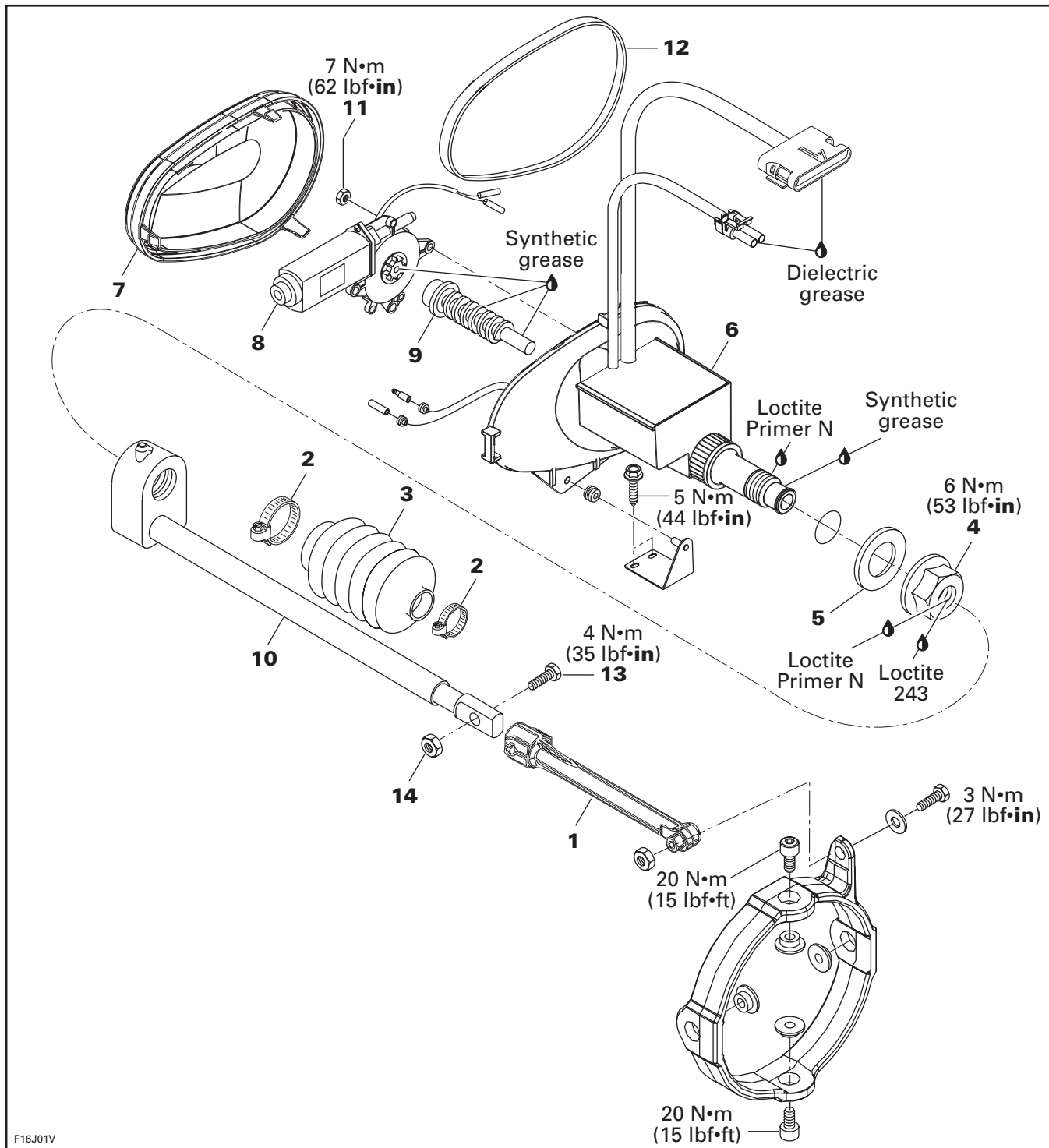
SERVICE TOOLS

Description	Part Number	Page
VTS socket tool.....	295 000 133	223, 225

SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue).....	293 800 060	225
Loctite Primer N	293 800 041	224
synthetic grease	293 550 010	224–225

Section 07 PROPULSION
Subsection 04 (VARIABLE TRIM SYSTEM)



GENERAL

To test VTS control module, motor or switch, refer to INSTRUMENTS AND ACCESSORIES.

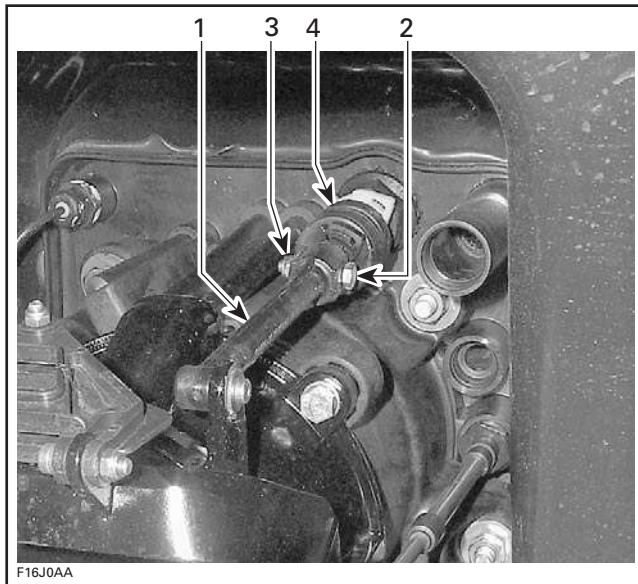
REMOVAL

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.

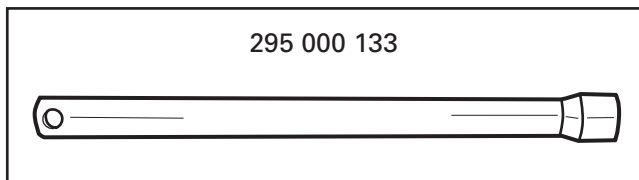
Remove clamps no. 2.

Remove rubber boot no. 3.



1. VTS rod
2. Bolt
3. Stop nut
4. Rubber boot

To loosen nut no. 4, use the VTS socket tool (P/N 295 000 133).



Remove sealing washer no. 5.

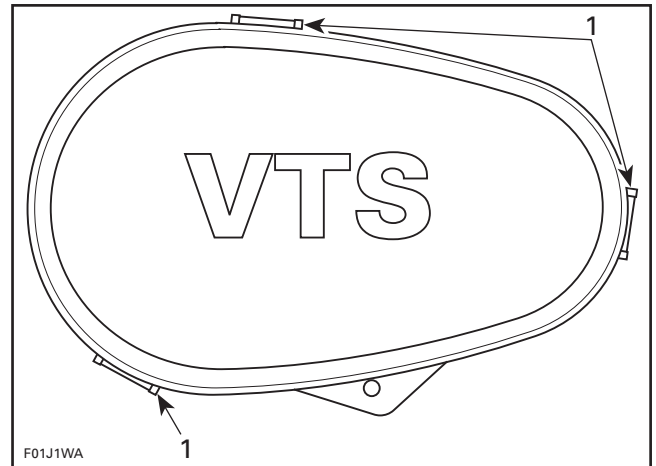
Disconnect wiring harnesses.

Pull out VTS assembly no. 6 from bilge.

DISASSEMBLY

Cover

Remove VTS cover no. 7 by pressing on tabs.

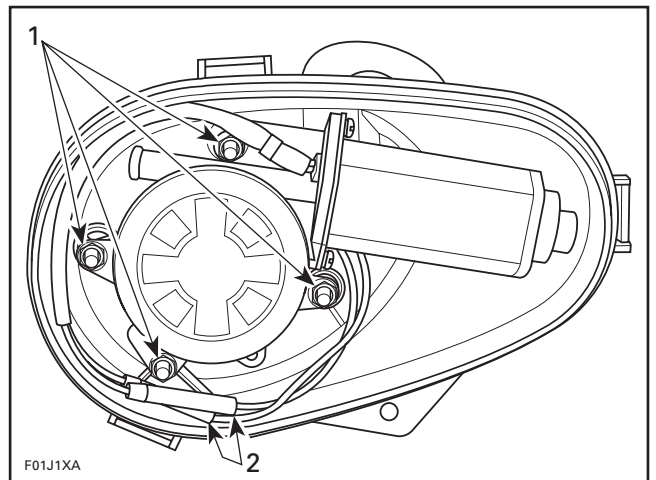


1. Press tabs to remove cover

Motor

Disconnect wires from motor no. 8.

Remove retaining nuts no. 11.



1. Remove nuts
2. Disconnect wires

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.

Section 07 PROPULSION

Subsection 04 (VARIABLE TRIM SYSTEM)

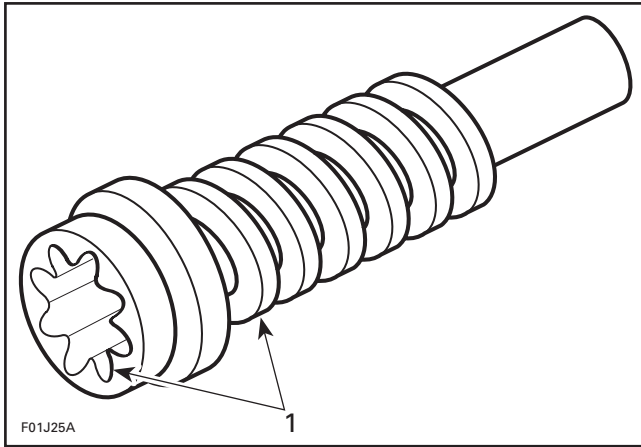
INSPECTION

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.



1. Inspect threads and splines

ASSEMBLY

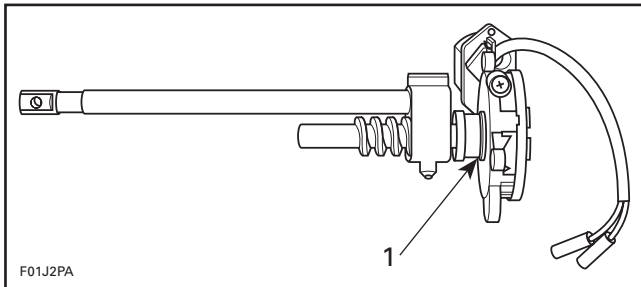
Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

Motor, Worm and Sliding Shaft

Apply synthetic grease (P/N 293 550 010) to worm.

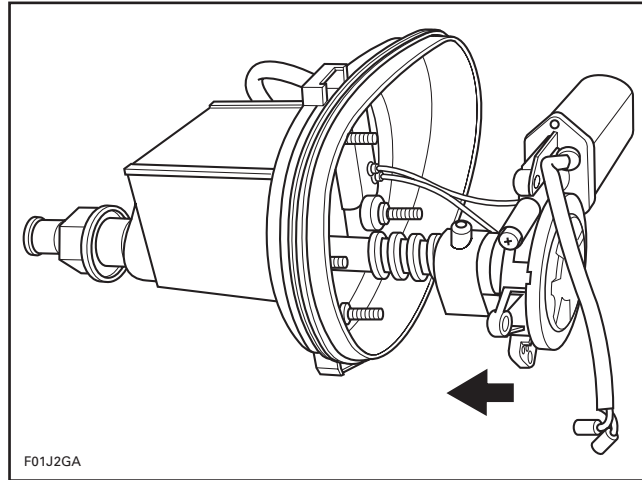
Screw worm **no. 9** to sliding shaft **no. 10**.

Mesh worm splines to gear of motor.



1. Mesh worm spline to gear of motor

Install motor **no. 8**, worm and sliding shaft in VTS housing.



Tighten nuts **no. 11** to 7 N•m (62 lbf•in).

Connect wires of motor.

CAUTION: Make sure wire color codes match.

Install cover **no. 7**.

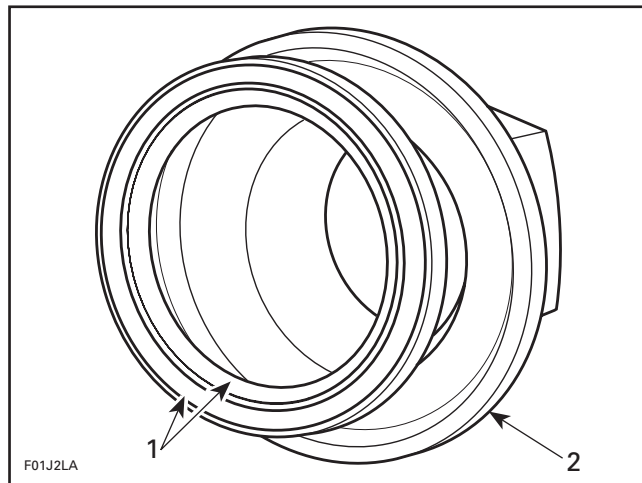
NOTE: Make sure seal **no. 12** is in place.

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.



1. Seal lips facing hull
2. Nut

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 lbf•in) using the VTS socket tool (P/N 295 000 133).

Apply synthetic grease (P/N 293 550 010) to sliding shaft.

Rubber Boot and Clamps

Install rubber boot **no. 3** over sliding shaft and secure with clamps.

VTS Rod

Install rubber boot **no. 3**, over sliding shaft and secure with clamps.

Secure the VTS rod onto the sliding shaft end using bolt **no. 13** and nut **no. 14**. Torque nut to 4 N•m (35 lbf•in).

ADJUSTMENT

No adjustment is required.

STEERING SYSTEM

SERVICE TOOLS

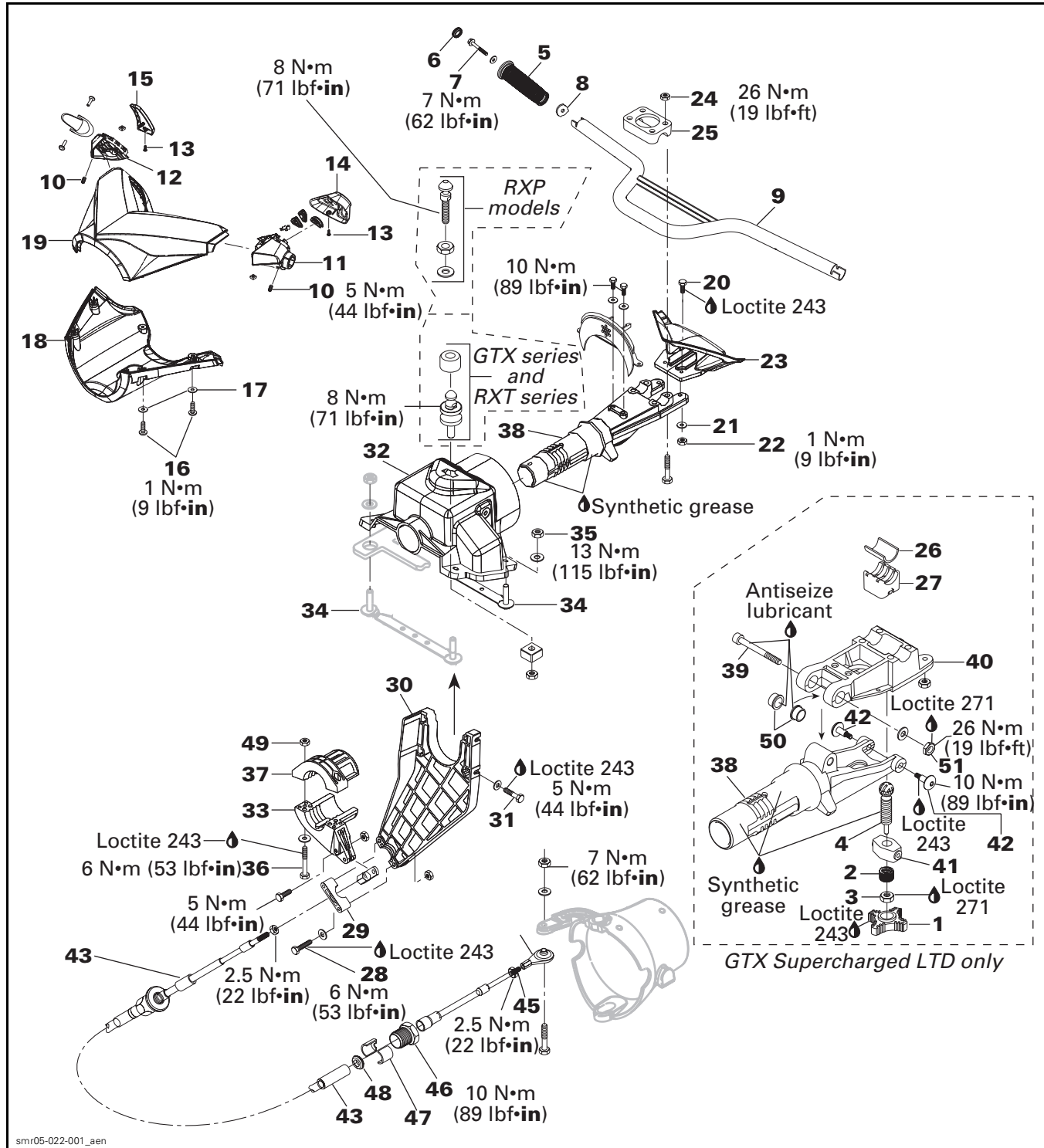
Description	Part Number	Page
safety lanyard switch tool.....	529 035 943	230
steering cable tool	295 000 145	234

SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue).....	293 800 060	235
Loctite 271 (red)	293 800 005	235
Loctite antiseize lubricant.....	293 800 070	234–235

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)



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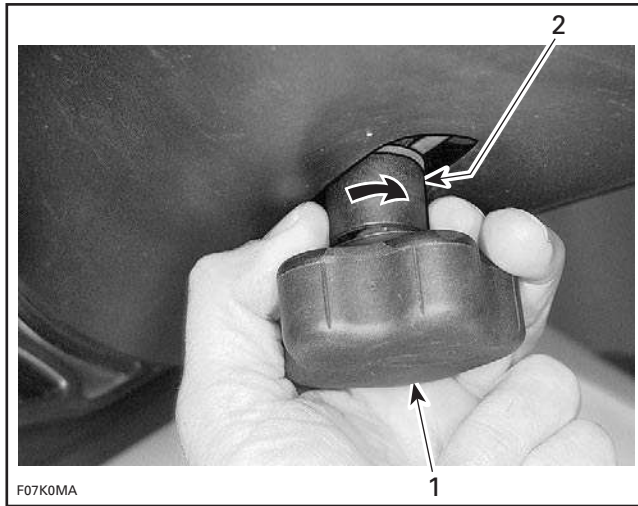
DISASSEMBLY

Adjustment Handle

GTX Supercharged Limited Models Only

Set handlebar to its lowest position by turning adjustment handle no. 1 counterclockwise.

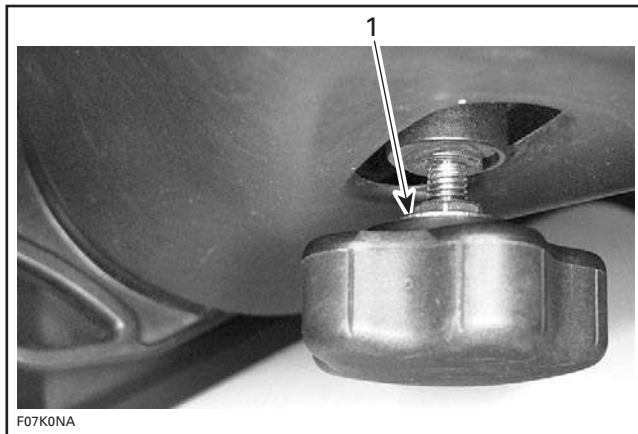
While holding adjustment handle, turn support bushing no. 2 clockwise.



TYPICAL

1. Adjustment handle
2. Support bushing

Hold jam nut no. 3 and unscrew adjustment handle from adjuster screw no. 4.

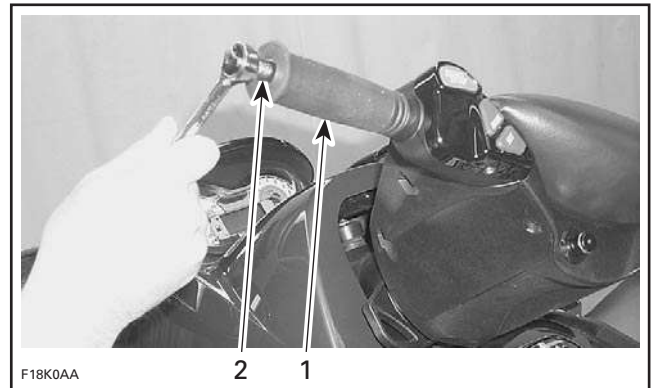


TYPICAL

1. Loosen jam nut

Handle Grip and Grip Insert

To remove handle grip no. 5, pull out cap no. 6 and remove screw no. 7.



1. Handle grip
2. Remove screw

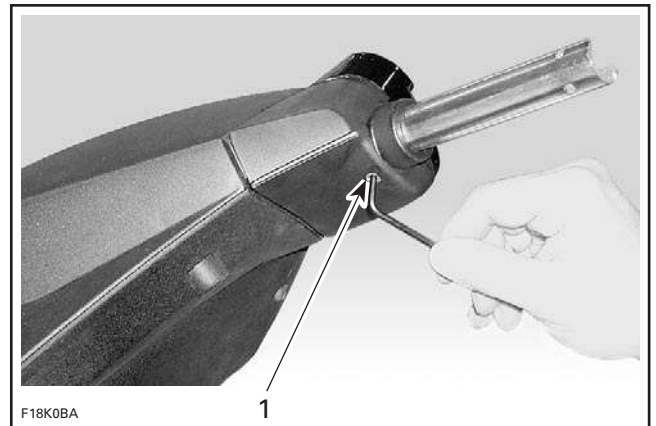
Pull out grip and remove grip insert no. 8 from handlebar no. 9.

NOTE: Verify grip insert for damage.

Steering Cover

Remove grips no. 5.

Loosen screws no. 10 of throttle handle housing no. 11 and of multifunction switch housing no. 12.

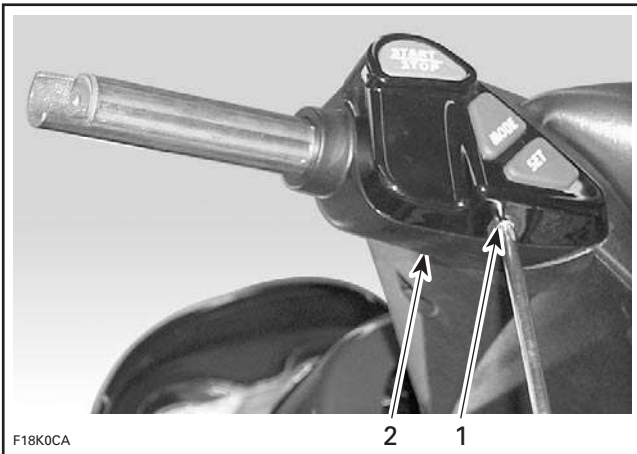


1. Screw

Remove tapping screws no. 13.

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)

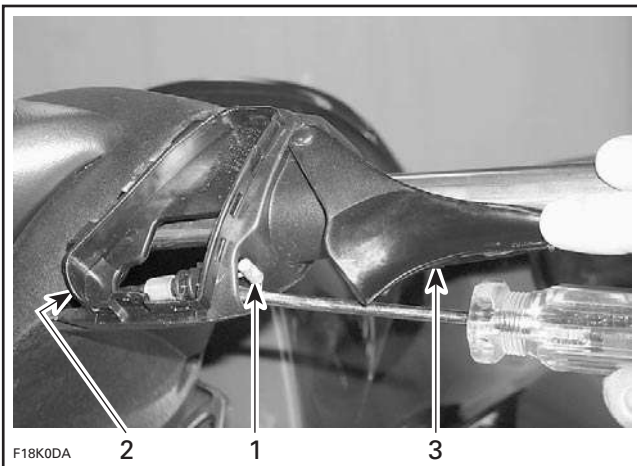


1. Tapping screw
2. Multifunction switch housing

Remove covers **no. 14** and **no. 15** then the throttle handle housing **no. 11**.

Unhook throttle cable from throttle handle.

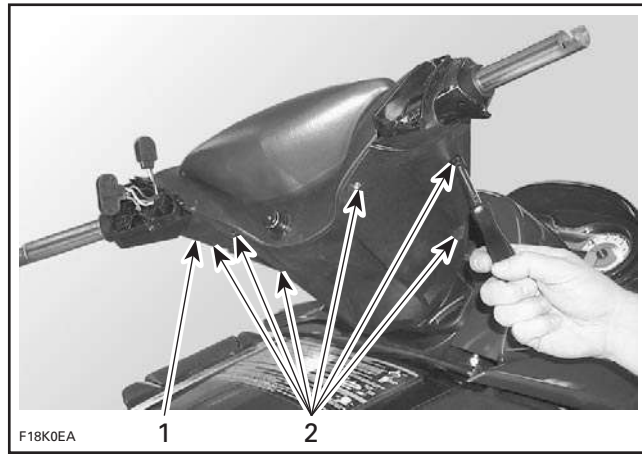
Pry out the throttle cable housing from throttle handle housing **no. 11**.



1. Throttle cable
2. Throttle handle housing
3. Throttle handle

Unplug and remove the multifunction switch housing **no. 12**.

Remove 6 screws **no. 16** and flat washers **no. 17** each side of cover.

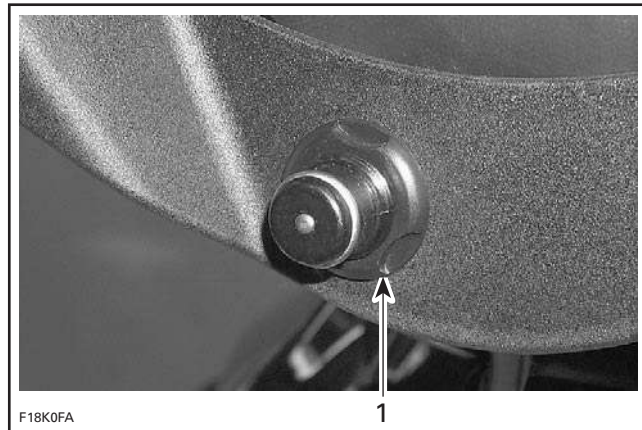


1. Steering cover
2. Screws

On **GTX Supercharged Limited** models, unscrew the adjustment handle **no. 1**.

Remove lower steering cover **no. 18**.

Unscrew DESS switch nut using safety lanyard switch tool (P/N 529 035 943).



1. DESS switch nut

Remove upper steering cover **no. 19**.

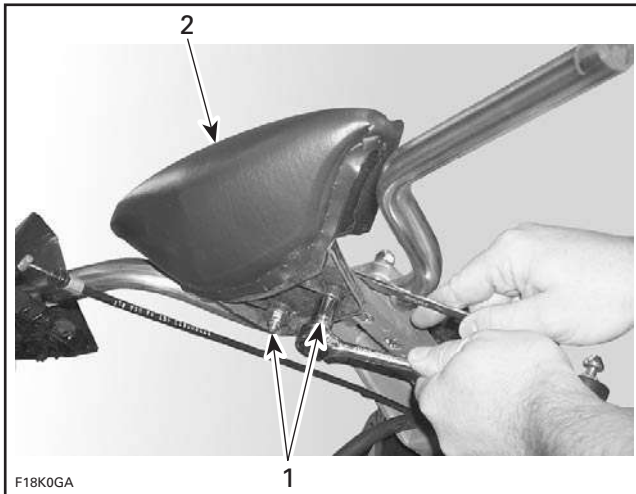
Steering Padding

Remove steering cover as mentioned above.

Remove 2 screws **no. 20**, flat washers **no. 21** and nuts **no. 22**.

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)



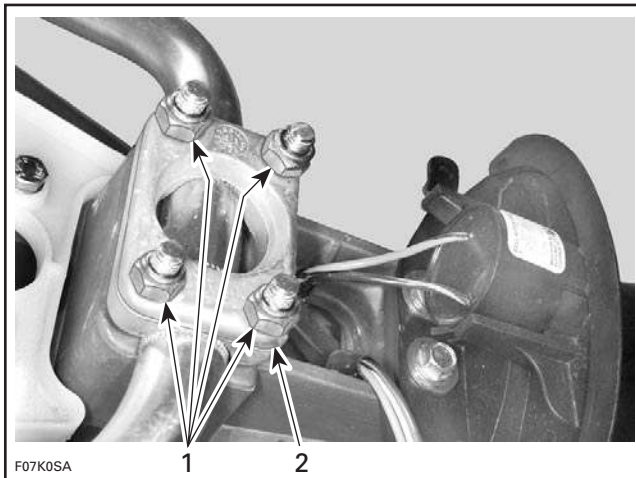
1. Screws
2. Steering padding

Remove steering padding no. 23.

Handlebar

Remove steering cover and steering padding as mentioned above.

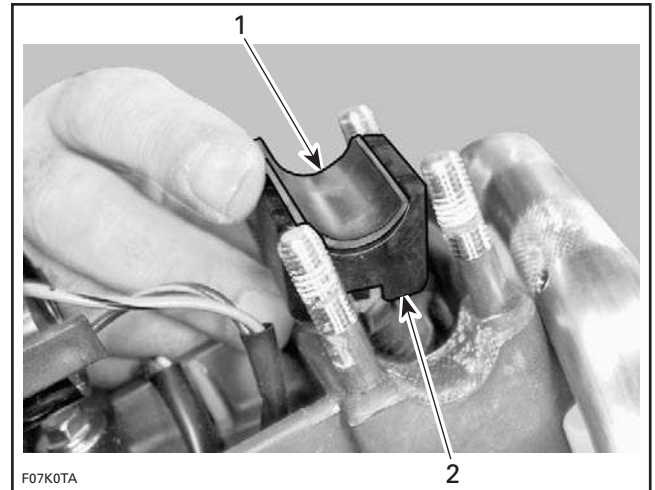
Remove 4 elastic stop nuts M8 no. 24 retaining steering clamp no. 25.



- TYPICAL**
1. Remove nuts
 2. Steering clamp

Detach steering clamp no. 25 and remove handlebar no. 9.

On **GTX Supercharged Limited models**, withdraw rubber pad no. 26 and stopper no. 27.



- TYPICAL**
1. Rubber pad
 2. Stopper

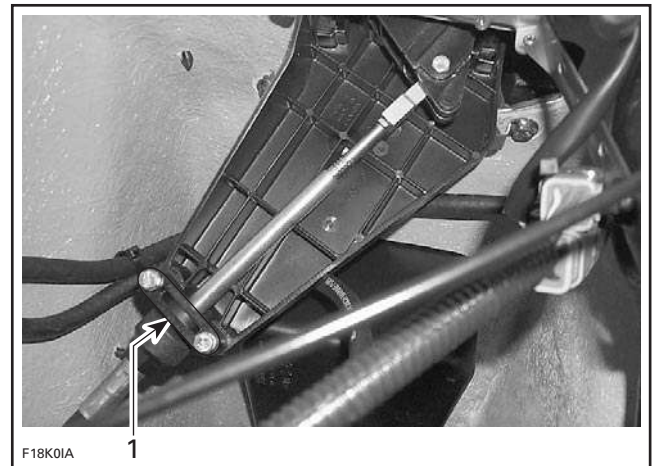
Cable Support

RXP Models

Remove front vent tube.

All Models

Loosen bolts no. 28 and remove retaining block no. 29 from cable support no. 30.

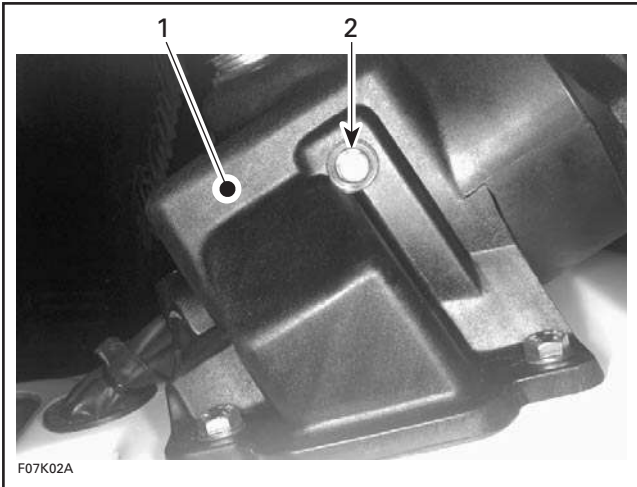


1. Retaining block

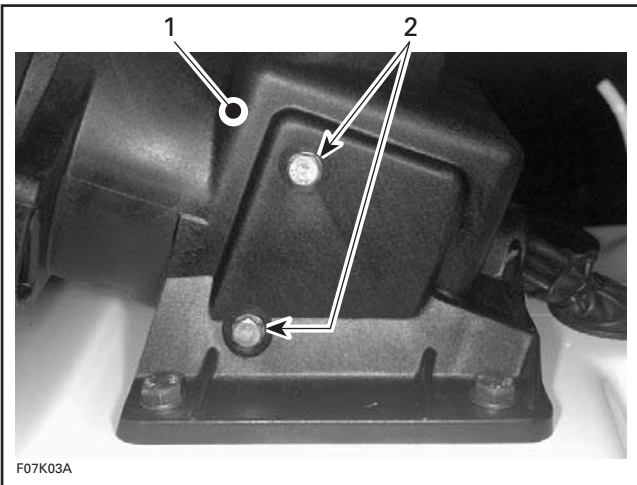
Loosen bolts no. 31 each side of steering support no. 32.

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)



1. Steering support
2. Bolt

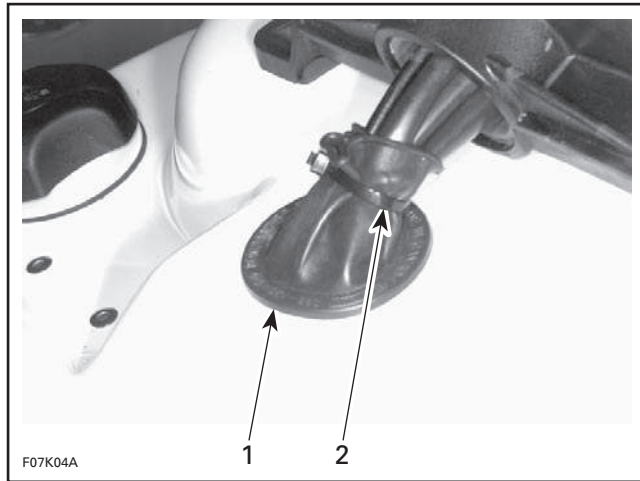


1. Steering support
2. Bolts

Remove cable support no. 30.

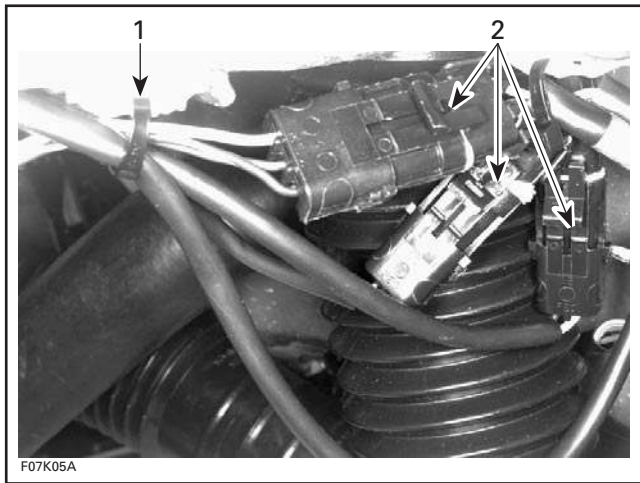
Steering Support

Cut locking tie securing wiring harness boot.



1. Boot
2. Locking tie

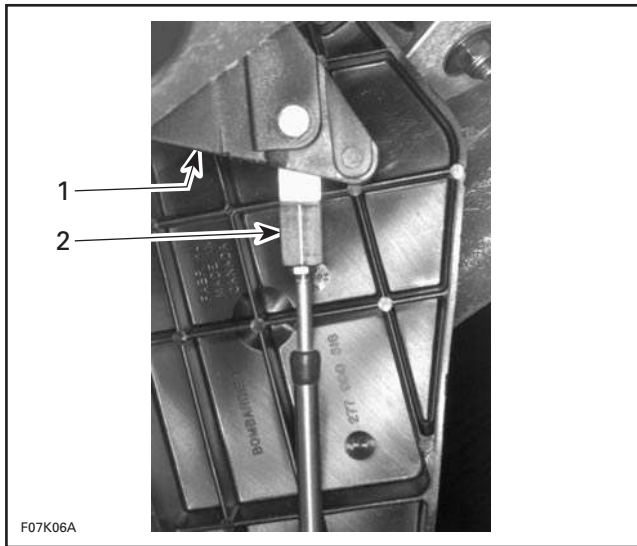
Disconnect the throttle cable from throttle body.
Disconnect the wiring harnesses leading out of steering stem and cut locking tie.



1. Tie rap
2. Connectors

Disconnect the steering cable from the steering stem arm no. 33.

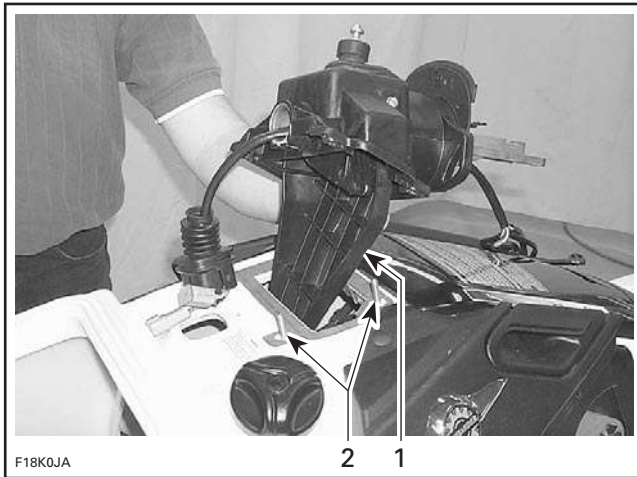
Section 08 STEERING SYSTEM
Subsection 01 (STEERING SYSTEM)



1. Steering stem arm
2. Steering cable

Remove bolts no. 31 retaining cable support no. 30 to steering support no. 32.

Remove bolts no. 34 and lock nuts no. 35 from steering retaining strip studs.

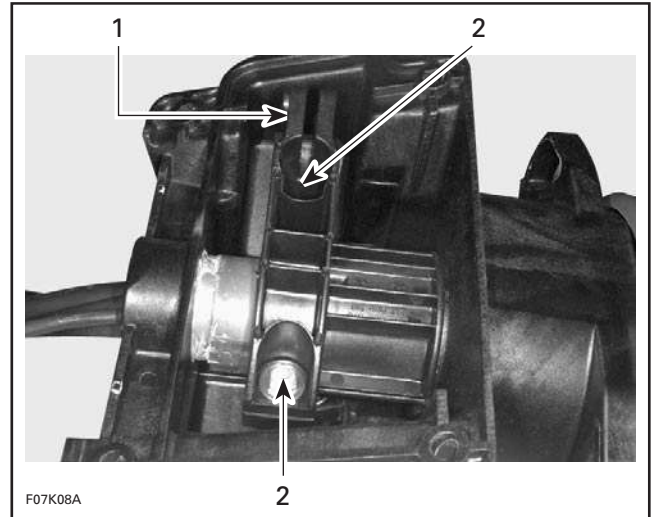


1. Steering support
2. Retaining strip studs

Remove steering support no. 32 with handlebar, wiring harnesses and cables.

Steering Stem

Loosen bolts no. 36 retaining steering stem arm no. 33 to support no. 37.



1. Steering stem arm
2. Bolts

Pull steering stem no. 38 out of steering support.

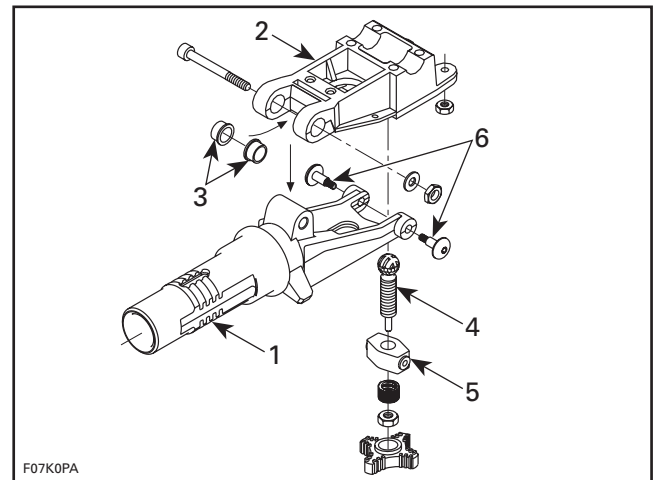
Handlebar Support

GTX Supercharged Limited Models Only

Unscrew nut and remove pivot bolt no. 39 retaining handlebar support no. 40 to steering stem no. 38.

Remove adjuster screw no. 4 from threaded block no. 41 and detach handlebar support from steering stem.

Unscrew threaded pivots no. 42 to remove threaded block from steering stem.



1. Steering stem
2. Handlebar support
3. Support bushing
4. Adjuster screw
5. Threaded block
6. Threaded pivots

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)

Steering Cable

Disconnect steering cable no. 43 from steering stem arm no. 33.

Remove retaining block no. 29.

Disconnect ball joint no. 44 from jet pump nozzle.

Remove ball joint and jam nut no. 45 from cable.

Loosen nut no. 46, then remove half rings no. 47 and O-ring no. 48.

NOTE: To loosen nut, use the steering cable tool (P/N 295 000 145).

Remove steering cable from watercraft.

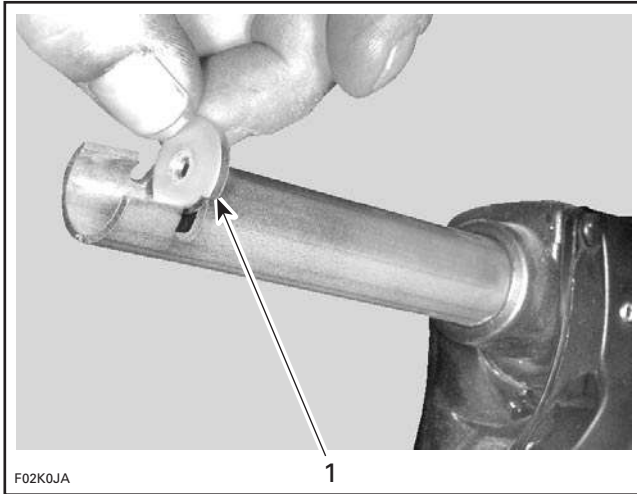
ASSEMBLY

Assembly is essentially the reverse of disassembly procedures. However, pay particular attention to the following.

CAUTION: Apply all specified torques and service products as per main illustration at the beginning of this subsection.

Handle Grip and Grip Insert

When installing the grip insert no. 8 in the handlebar no. 9, ensure that it is properly inserted in the slot at the end of the handlebar tubing.



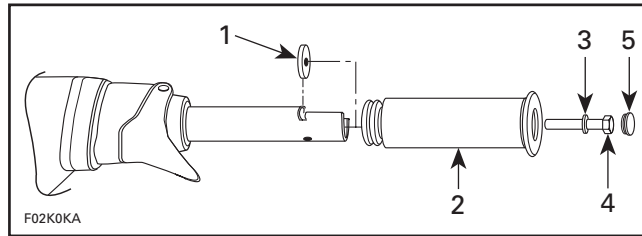
1. Grip insert

Install grip no. 5 on handlebar no. 9 matching it to the notch in the handlebar.

Install flat washer and screw no. 7.

Torque screw to 7 N•m (62 lbf•in).

Install cap no. 6.



1. Grip insert
2. Grip
3. Flat washer
4. Screw
5. Cap

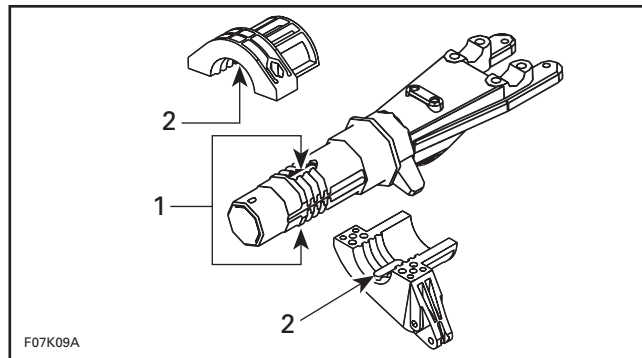
CAUTION: Ensure to install flat washer otherwise screw will damage grip end.

Steering Stem

Position steering stem arm no. 33 and support no. 37 onto steering stem no. 38.

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.



1. Keyways
2. Integrated flat key

Replace lock nuts no. 49 by new ones.

Torque bolts no. 36 of steering stem arm to 6 N•m (53 lbf•in).

Handlebar Support

GTX Supercharged Limited Models Only

Apply Loctite antiseize lubricant (P/N 293 800 070) then install support bushings no. 50 on handlebar support.

Section 08 STEERING SYSTEM

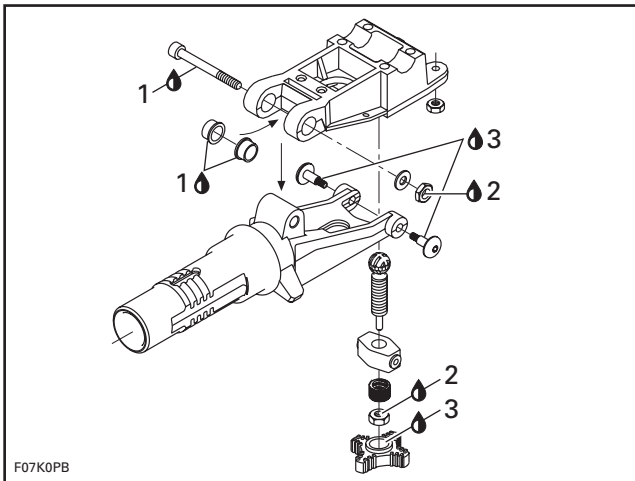
Subsection 01 (STEERING SYSTEM)

Apply Loctite antiseize lubricant (P/N 293 800 070) on pivot bolt no. 39.

CAUTION: Make sure antiseize lubricant does not come in contact with threads of bolt.

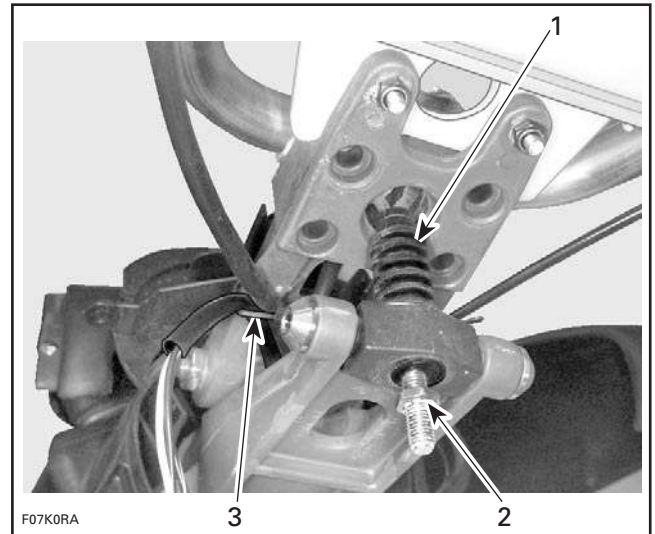
Apply Loctite 271 (red) (P/N 293 800 005) on threads of jam nut no. 3.

Apply Loctite 243 (blue) (P/N 293 800 060) in adjustment handle no. 1 and on threaded pivots no. 42.



1. Antiseize lubricant
2. Loctite 271
3. Loctite 243

Install handlebar support no. 40 to steering stem no. 38 and secure with pivot bolt no. 39. Apply Loctite 271 (red) (P/N 293 800 005) on threads of nut no. 51 then install nut and torque to 26 N•m (19 lbf•ft).



1. Adjuster screw
2. Apply Loctite 271
3. Locking tie

Ensure wire harness is properly secured to handlebar support with a locking tie.



1. Locking tie holding harness to handlebar support

Handlebar

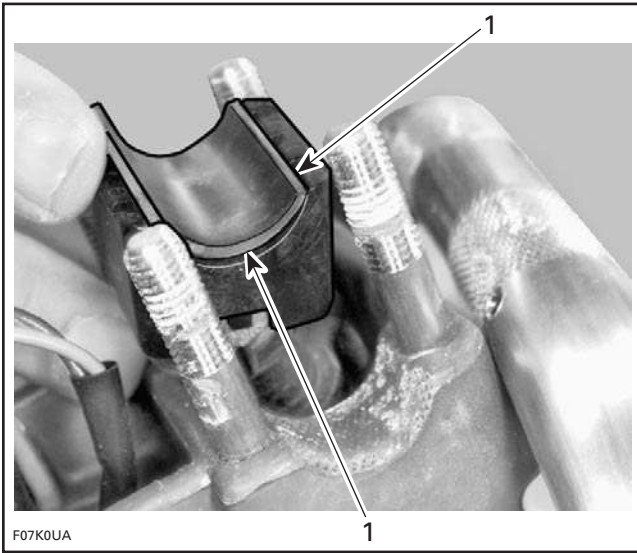
GTX Supercharged Limited Models Only

Before installing handlebar, position stopper no. 27 and rubber pad no. 26.

CAUTION: Rubber pad must not exceed stopper.

Section 08 STEERING SYSTEM

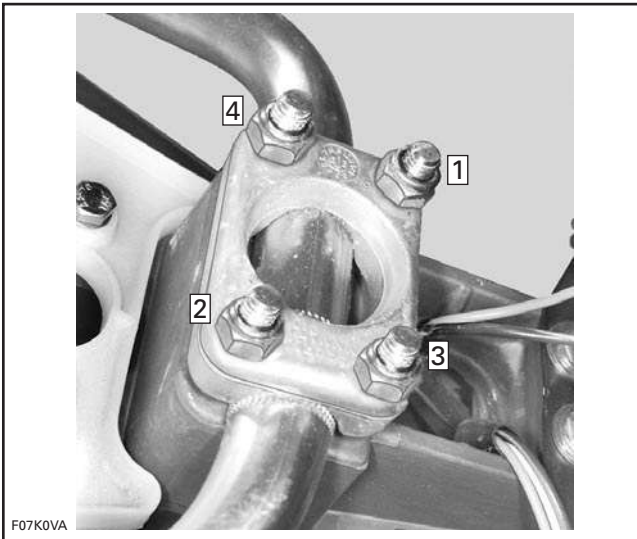
Subsection 01 (STEERING SYSTEM)



1. Pad must not exceed stopper

All Models

Position handlebar **no. 9**. Install steering clamp **no. 25** and secure with new elastic stop nuts M8. Torque nuts to 26 N•m (19 lbf•ft) as per the following sequence.

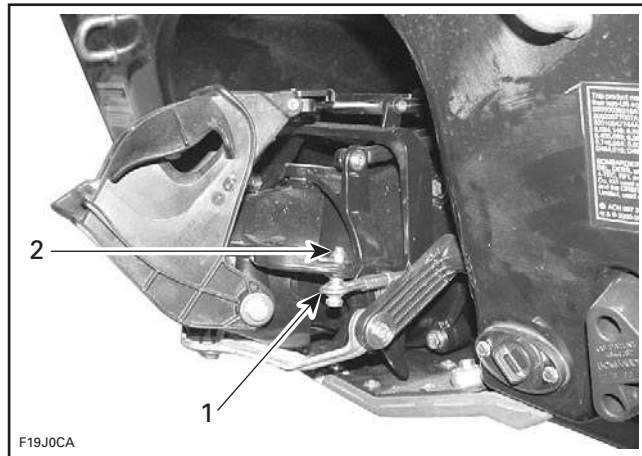


TORQUE SEQUENCE

Ball Joint

Secure the steering cable ball joint **no. 44** to the nozzle as per following illustration.

CAUTION: Ensure the ball joint is parallel ($\pm 10^\circ$) to the nozzle arm.

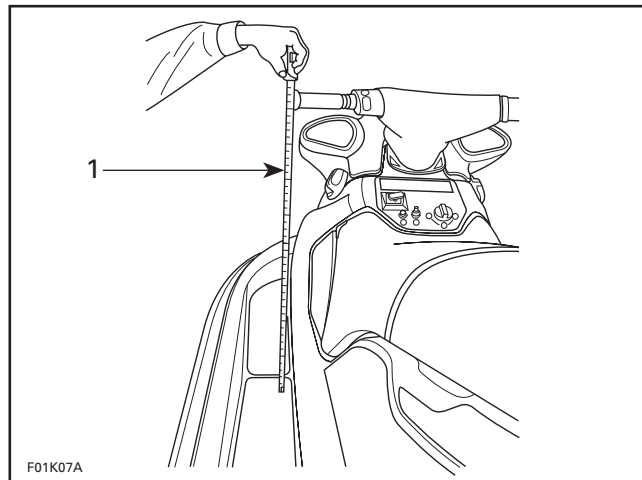


TYPICAL

1. Ball joint below steering arm
2. Torque nut to 7 N•m (62 lbf•in)

ALIGNMENT

Position handlebar in straight ahead position by measuring each side the distance from handlebar grip end to floorboard.



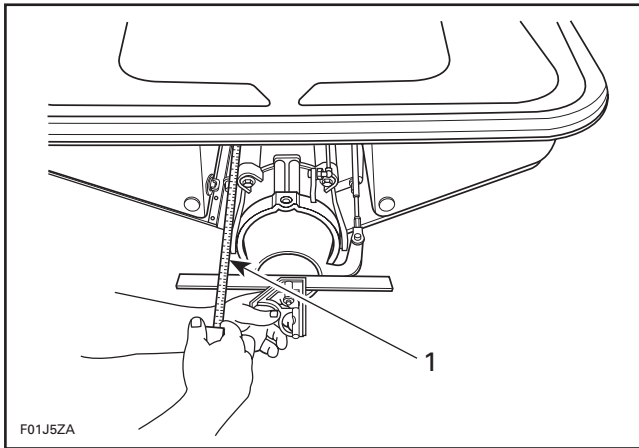
TYPICAL

1. Measuring handlebar grip end/floorboard distance

Check jet pump nozzle position by placing a straight edge on nozzle outer end. Measure the distance on each side of the straight edge. It must be equalled.

Section 08 STEERING SYSTEM

Subsection 01 (STEERING SYSTEM)



TYPICAL

1. Measure the distance on each side of the straight edge

If necessary, steering alignment adjustment should be performed at steering cable support.

GTX Series, Wake and RXT Models

Open storage compartment cover and remove basket (if so equipped).

Remove access panel (if so equipped).

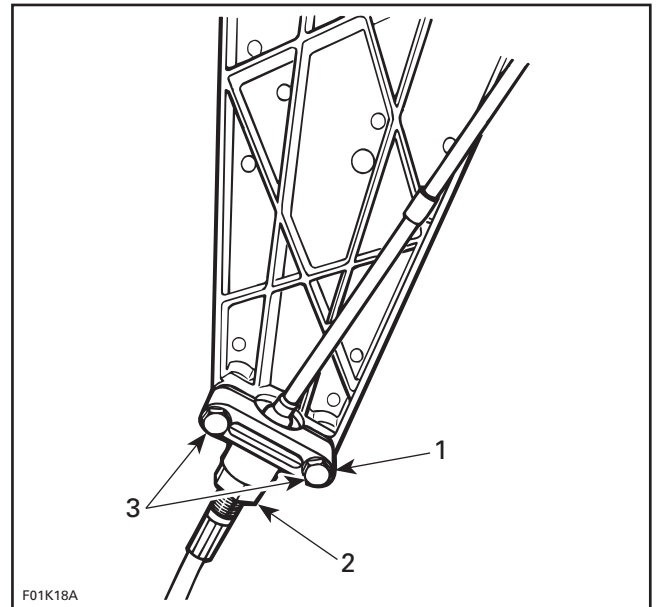
RXP Models

Remove seat.

All Models

Loosen 2 bolts retaining block at cable support.

Turn adjustment nut as required.



ALL MODELS

1. Retaining block
2. Adjustment nut
3. Loosen bolts

After adjustment, torque retaining block bolts to 6 N•m (53 lbf•in).

CAUTION: Verify when the handlebar is turned completely to the left or right side, that there is no interference with venturi or VTS ring (RXT models only).

OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.)

SERVICE TOOLS

<u>Description</u>	<u>Part Number</u>	<u>Page</u>
O.P.A.S. cylinder nut wrench	529 035 840	244, 246–247

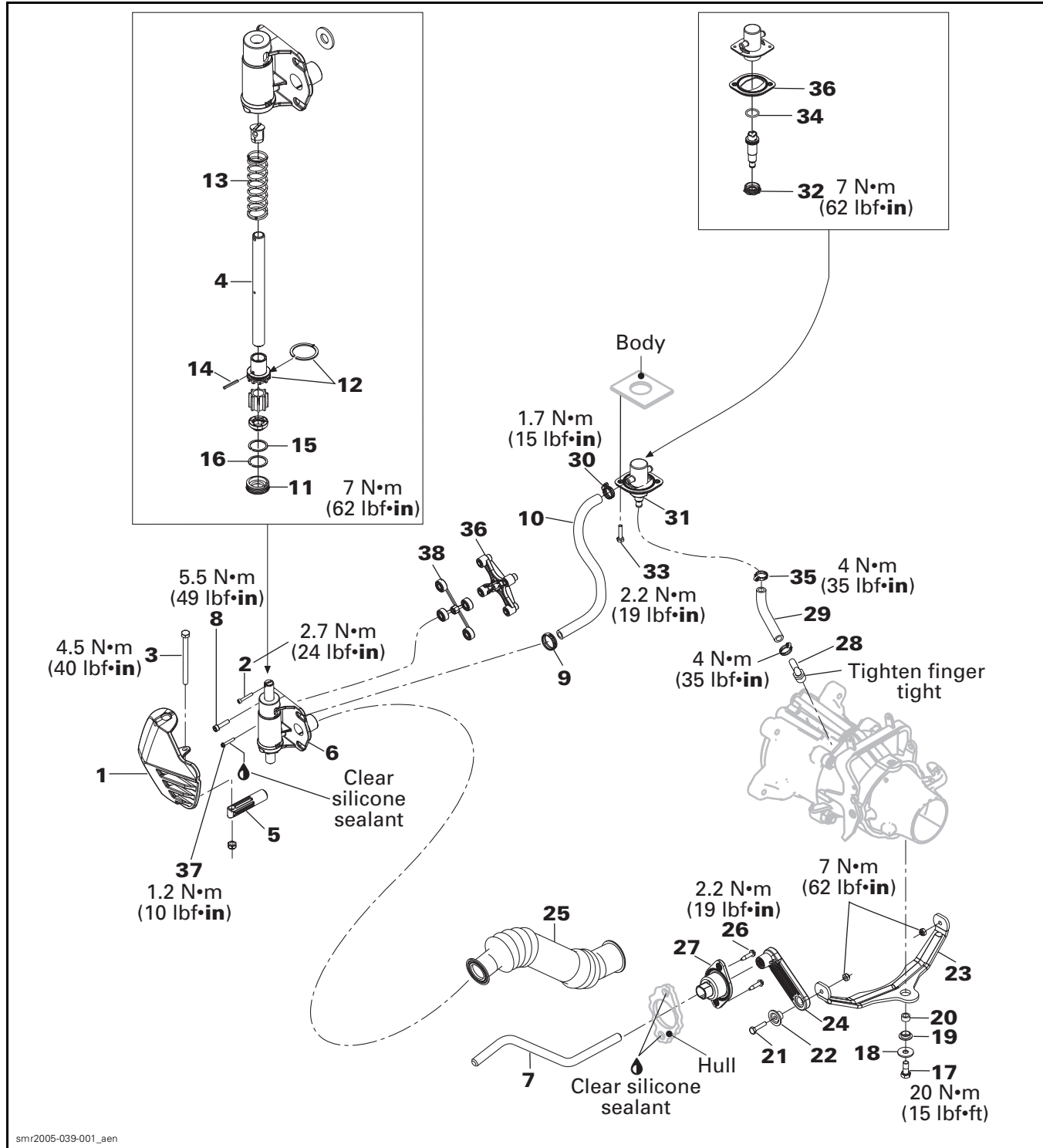
SERVICE PRODUCTS

<u>Description</u>	<u>Part Number</u>	<u>Page</u>
silicone sealant (clear).....	293 800 086	247

Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

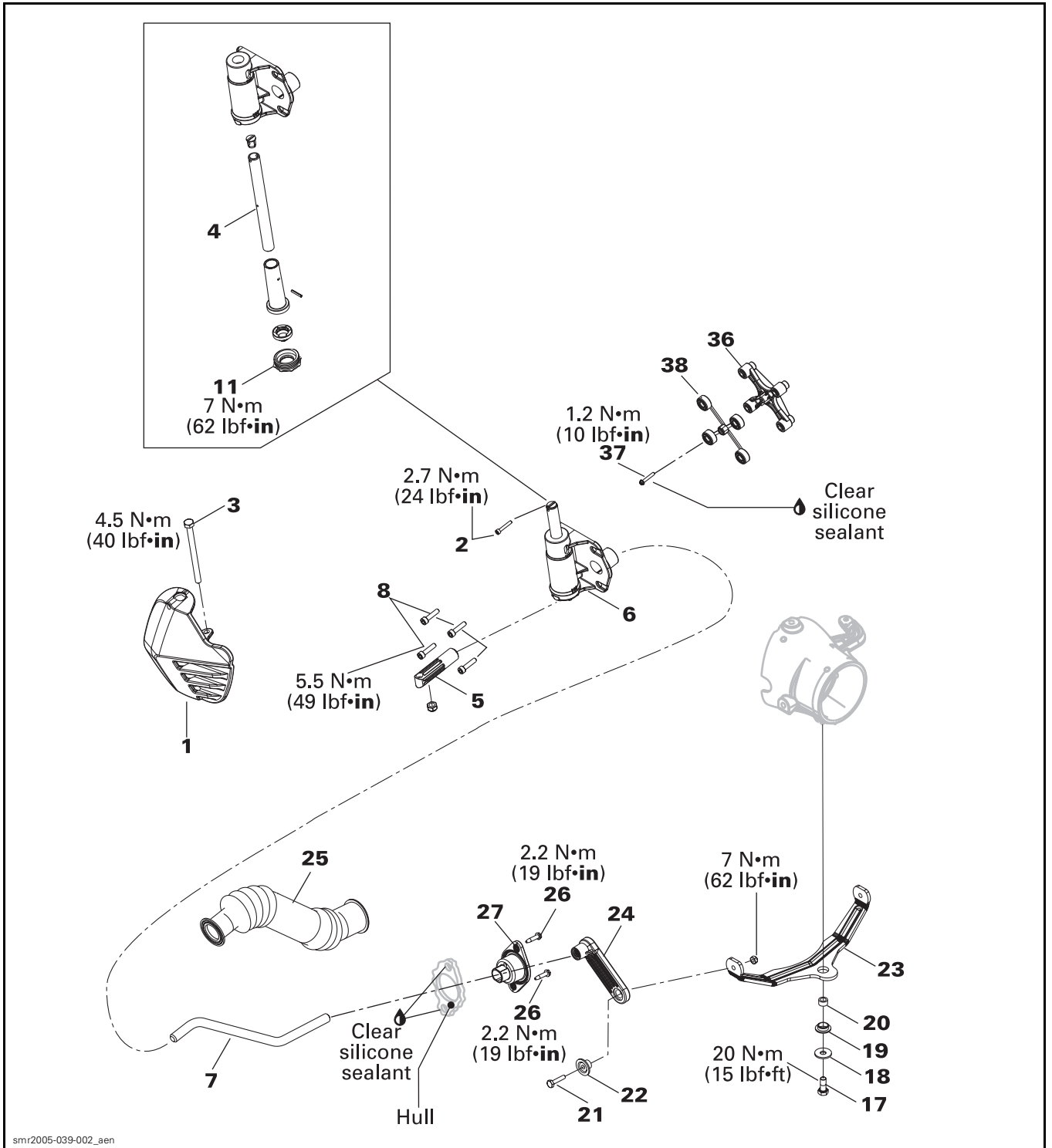
GTX Series, Wake and RXT Models



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Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

RXP Models



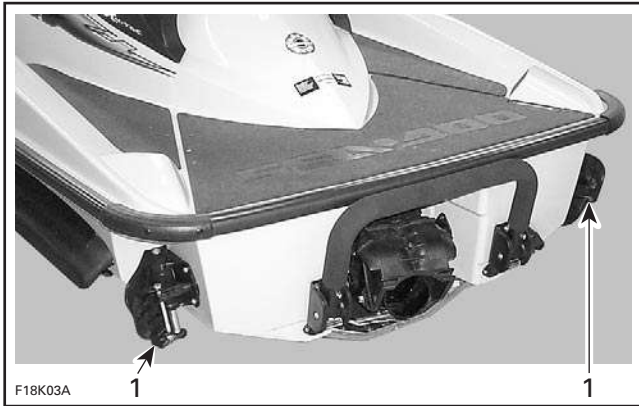
Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

GENERAL

The Off-Power Assisted Steering (O.P.A.S.) system 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 system.



1. Side vanes turn following steering movement

GTX Series, Wake and RXT Models

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.



1. Side vane in lower position

RXP Models

These models do not have any vertical travel.

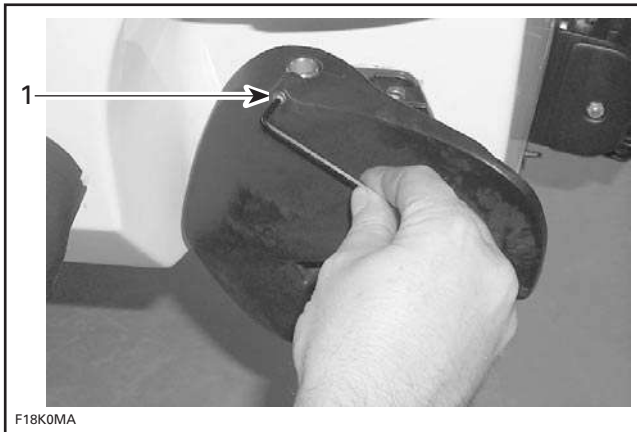
SIDE VANE

Removal

Removal procedure for RH and LH side vane **no. 1** is same.

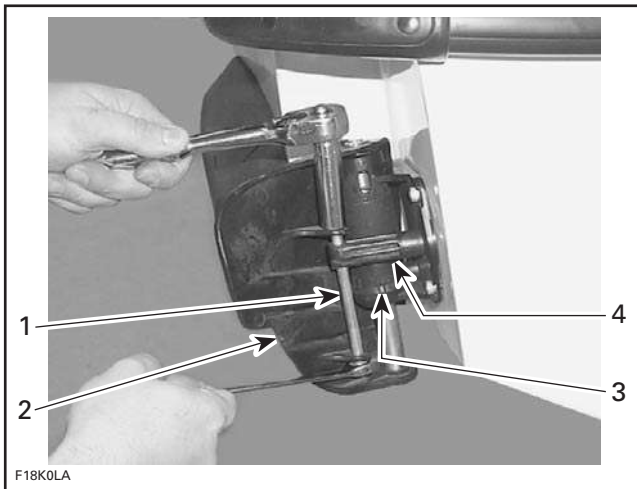
Remove socket screw **no. 2**.

Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))



1. Socket screw

Remove the tie-rod screw **no. 3**.



1. Tie rod screw
 2. Side vane
 3. Cylinder support
 4. Tie rod fitting

Lift pivot shaft **no. 4** while holding top of side vane.
 Pull side vane out.

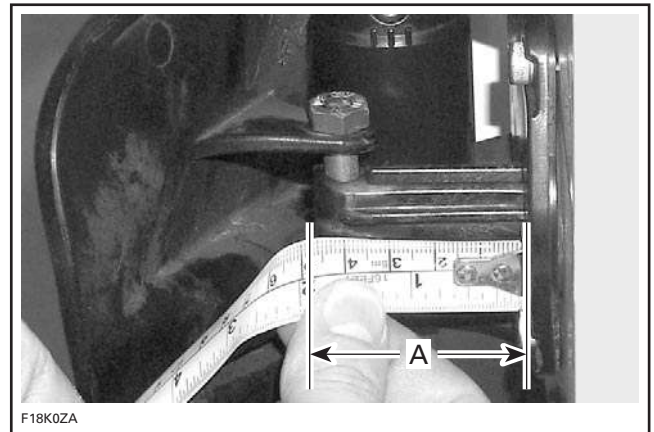
Adjustment

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 ($1.65 \pm .04$ in).



A. 45 ± 1 mm ($1.65 \pm .04$ 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 $4.5 \text{ N}\cdot\text{m}$ ($40 \text{ lbf}\cdot\text{in}$).

Install socket screw **no. 2** and torque it to $2.7 \text{ N}\cdot\text{m}$ ($24 \text{ lbf}\cdot\text{in}$).

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.

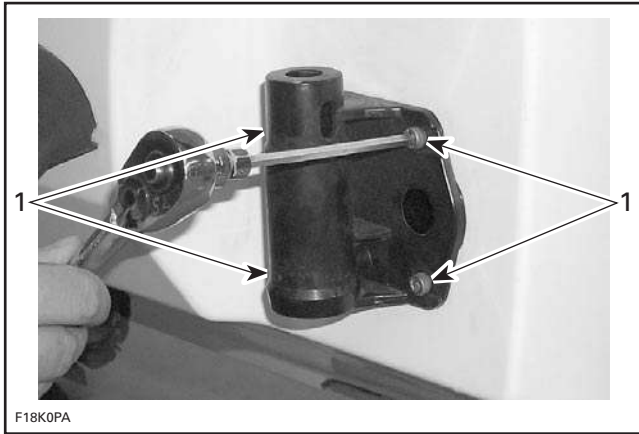
NOTE: To disassemble the cylinder, it is not required to remove it from vehicle. See DISASSEMBLY procedure.

Unscrew tie rod fitting **no. 5** from tie rod **no. 7**.

Unscrew 4 socket screws **no. 8**. Discard them.

Section 08 STEERING SYSTEM

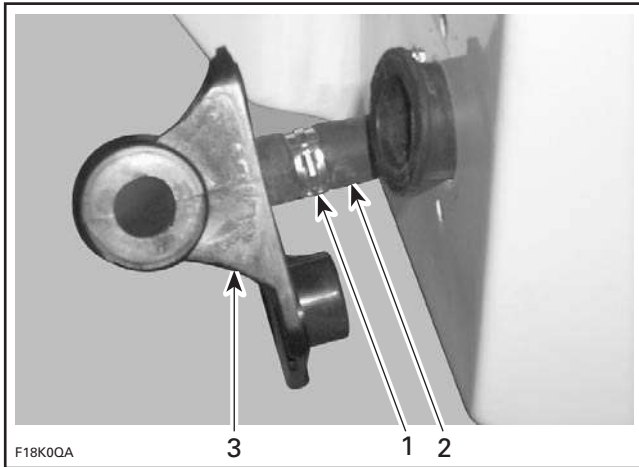
Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))



1. Socket screws

GTX Series, Wake and RXT Models

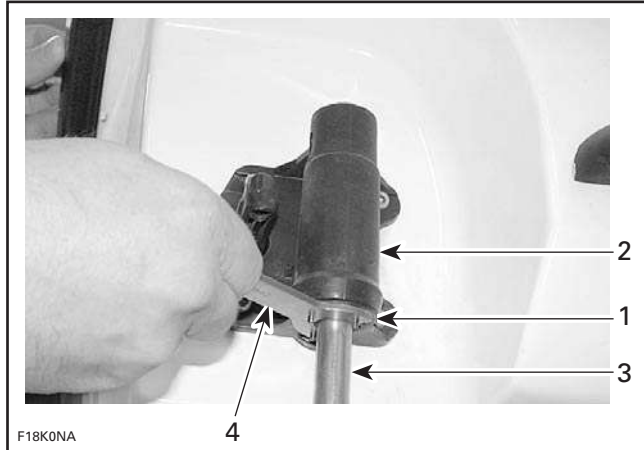
Remove Oetiker clamp no. 9 to remove water hose no. 10 from the cylinder support no. 6.



1. Oetiker clamp
2. Water hose
3. Cylinder support

Disassembly and Assembly

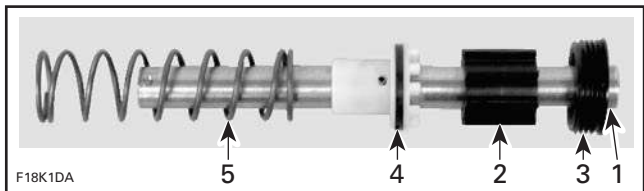
Unscrew cylinder cap no. 11 using the O.P.A.S. cylinder nut wrench (P/N 529 035 840).



1. Cylinder cap
2. Cylinder support
3. Pivot rod
4. O.P.A.S. cylinder nut wrench

Remove cylinder assembly out of cylinder support.

GTX Series, Wake and RXT Models



1. Pivot rod
2. Spacer
3. Cylinder cap
4. Piston
5. Spring

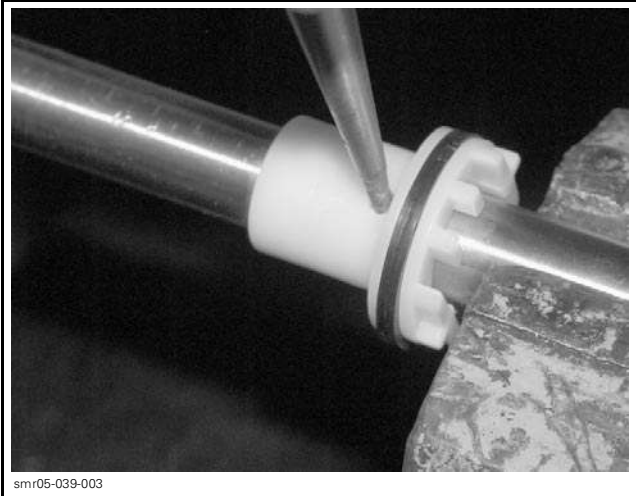
Discard the piston no. 12. Due to the presence of split rings around the piston, it must be replaced each time when removed for proper cylinder functionality.

Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

To do this:

- Remove the spring no. 13.
- Remove the spring pin no. 14 from piston and pivot rod no. 4.



- 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.



- Turn the split ring to remove it from cap.



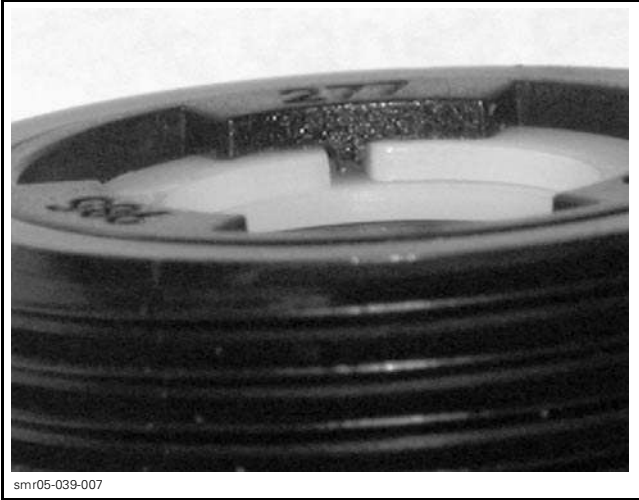
- Repeat the same procedure for the lower split ring no. 16.
- Install new split rings into cylinder cap. The opening of each split ring must be aligned with the appropriate lock inside cap.



LOWER SPLIT RING

Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

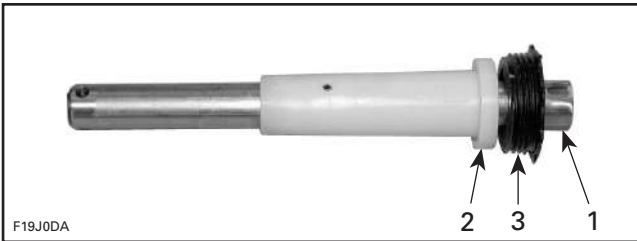


UPPER SPLIT RING

Install removed parts in the cylinder.

Using the O.P.A.S. cylinder nut wrench (P/N 529 035 840) torque the cylinder cap to 7 N•m (62 lbf•in). After tightening, keep turning the cap until the locking tab goes over the stopper.

RXT Models



1. Pivot rod
2. Spacer
3. Cylinder cap assembly

The cylinder disassembly is not necessary for these models.

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

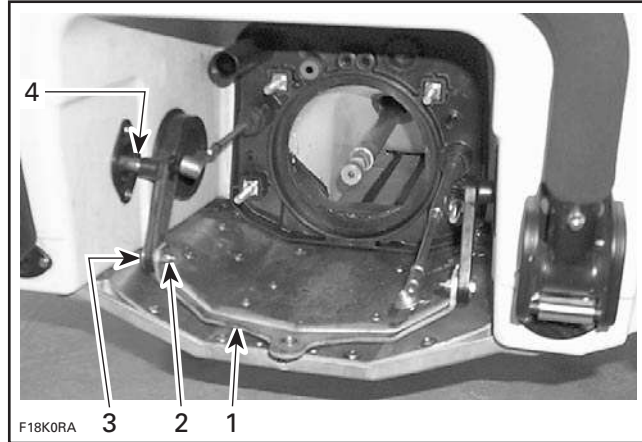
Removal procedure for RH and LH tie rod **no. 7** is same.

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**.



TYPICAL

1. "U" lever screw
2. Screw
3. Tie rod connecting lever
4. Tie rod

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 20 N•m (15 lbf•ft).

SEALED TUBE

Removal

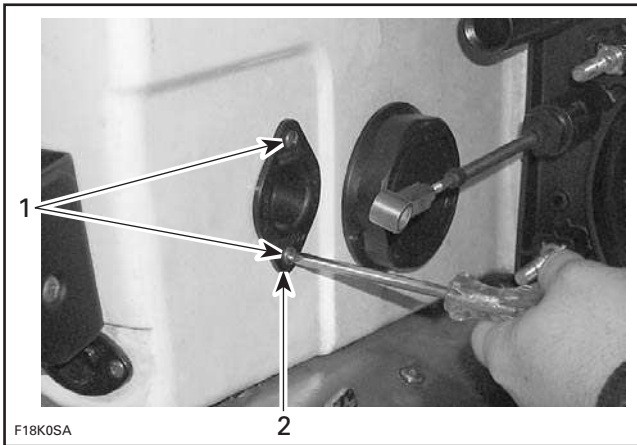
Removal procedure for RH and LH sealed tube **no. 25** is same.

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).

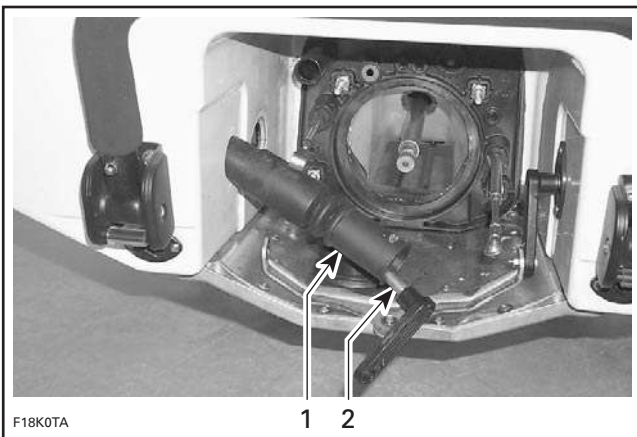
Remove Phillips screws **no. 26** and remove rod grommet **no. 27**.

Section 08 STEERING SYSTEM
Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))



1. Phillips screws
 2. Rod grommet

Pull sealed tube out with tie rod from inside of bilge towards jet pump side.



TYPICAL
 1. Sealed tube
 2. Tie rod

Remove old silicone sealant around screws holes.

Installation

Installation is the reverse process of removal.

Apply silicone sealant (clear) (P/N 293 800 086) on the screws before installing and, inside the hull, around screw holes after torquing.

Torque Phillips screws no. 26 to 2.2 N•m (19 lbf•in).

FILTER

GTX Series, Wake and RXT Models

For removal and installation procedure, refer to JET PUMP.

O.P.A.S. filter is part of plastic elbow no. 28. Check for cleanness. Replace or clean it as necessary.

VALVE

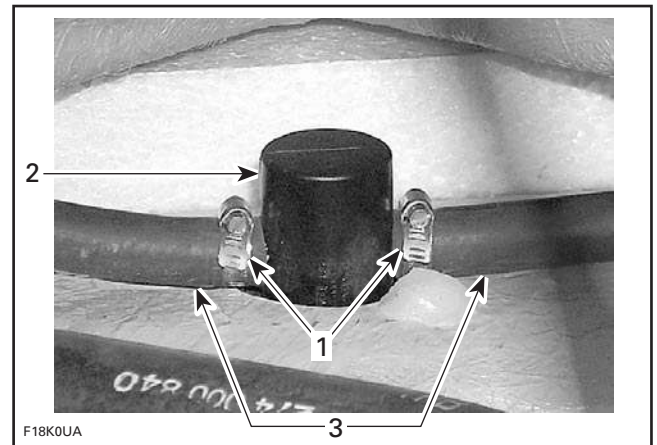
GTX Series, Wake and RXT Models

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 (refer to JET PUMP).

Remove gear clamps no. 30 to remove water hoses no. 31 from valve.

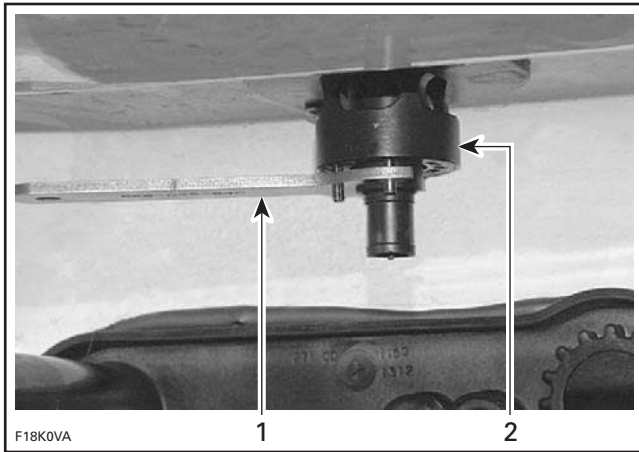


1. Gear clamps
 2. Valve
 3. Water hoses

If the disassembly of valve is necessary, loosen bottom nut of valve no. 32 using the O.P.A.S. cylinder nut wrench (P/N 529 035 840).

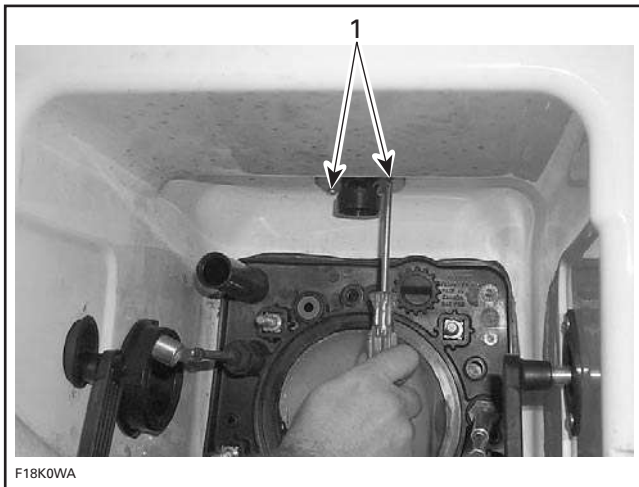
Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))



1. O.P.A.S. cylinder nut wrench
2. Valve

Remove 2 Phillips screws **no. 33** from valve collar.



- TYPICAL**
1. Phillips screws

Remove valve downwards from pump tunnel.

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 need be.

Assemble all parts and torque the bottom nut to **7 N•m (62 lbf•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•m (35 lbf•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 Series, Wake and RXT Models

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)**.

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).

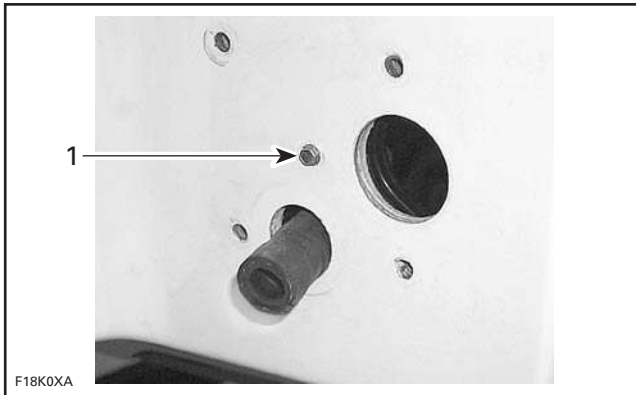
Section 08 STEERING SYSTEM

Subsection 02 (OFF-POWER ASSISTED STEERING SYSTEM (O.P.A.S.))

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.



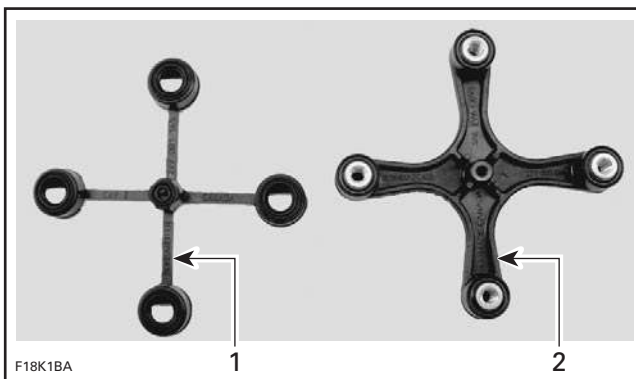
TYPICAL — GTX MODEL SHOWN
1. Remove screw

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.



1. Gasket
2. Support plate

Assembly

Assembly is the reverse process of disassembly, make sure of the following when doing assembly:

Install the gasket on the cross support plate.



GASKET INSTALLED ON 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

Description	Part Number	Page
suction cup	295 000 163	271

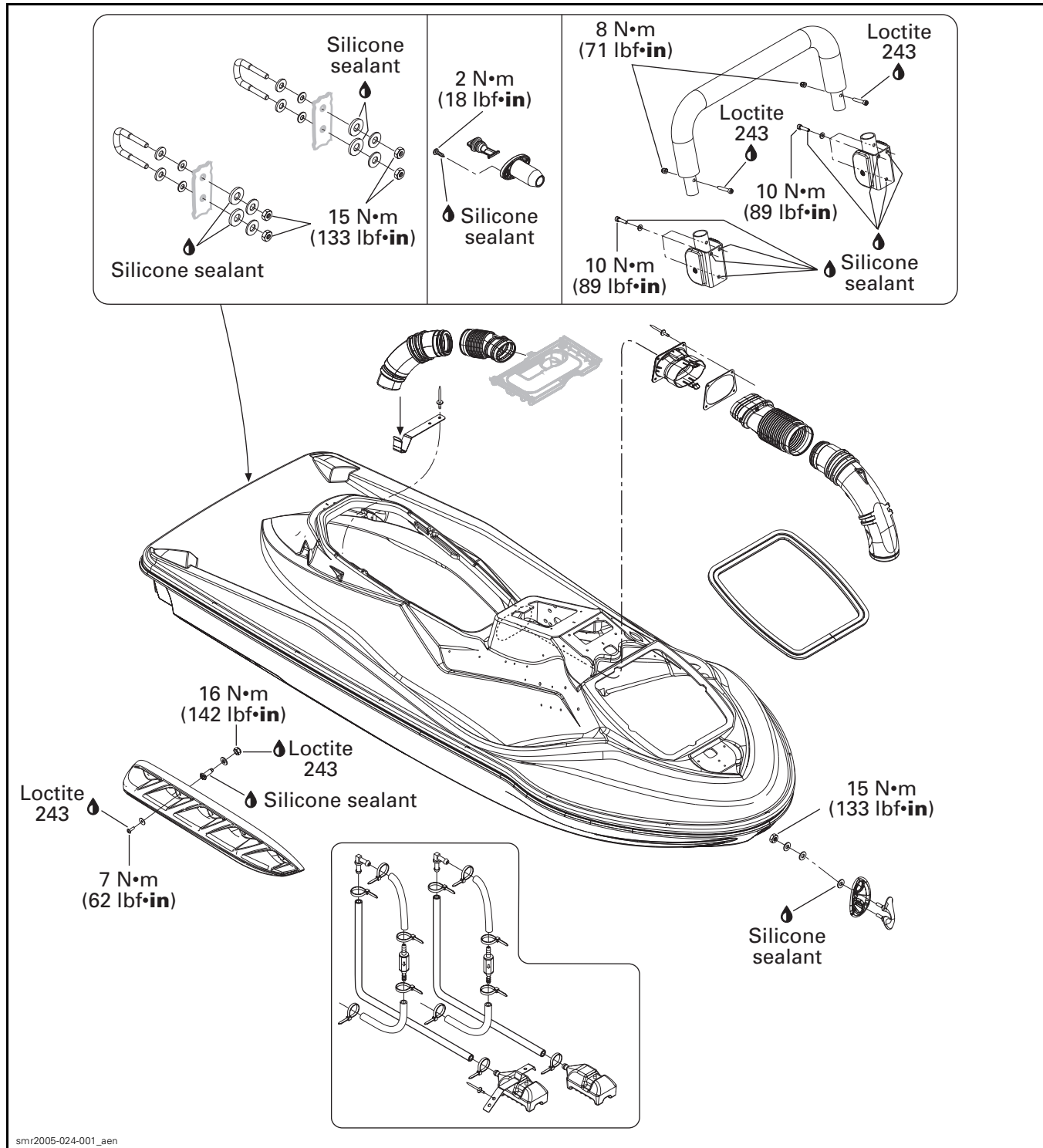
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	263, 270, 278
Loctite 271 (red)	293 800 005	273
Loctite 518.....	293 800 038	275
Loctite 5900.....	293 800 066	274–275
silicone sealant (clear).....	293 800 086	278

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Models (Body Front View)

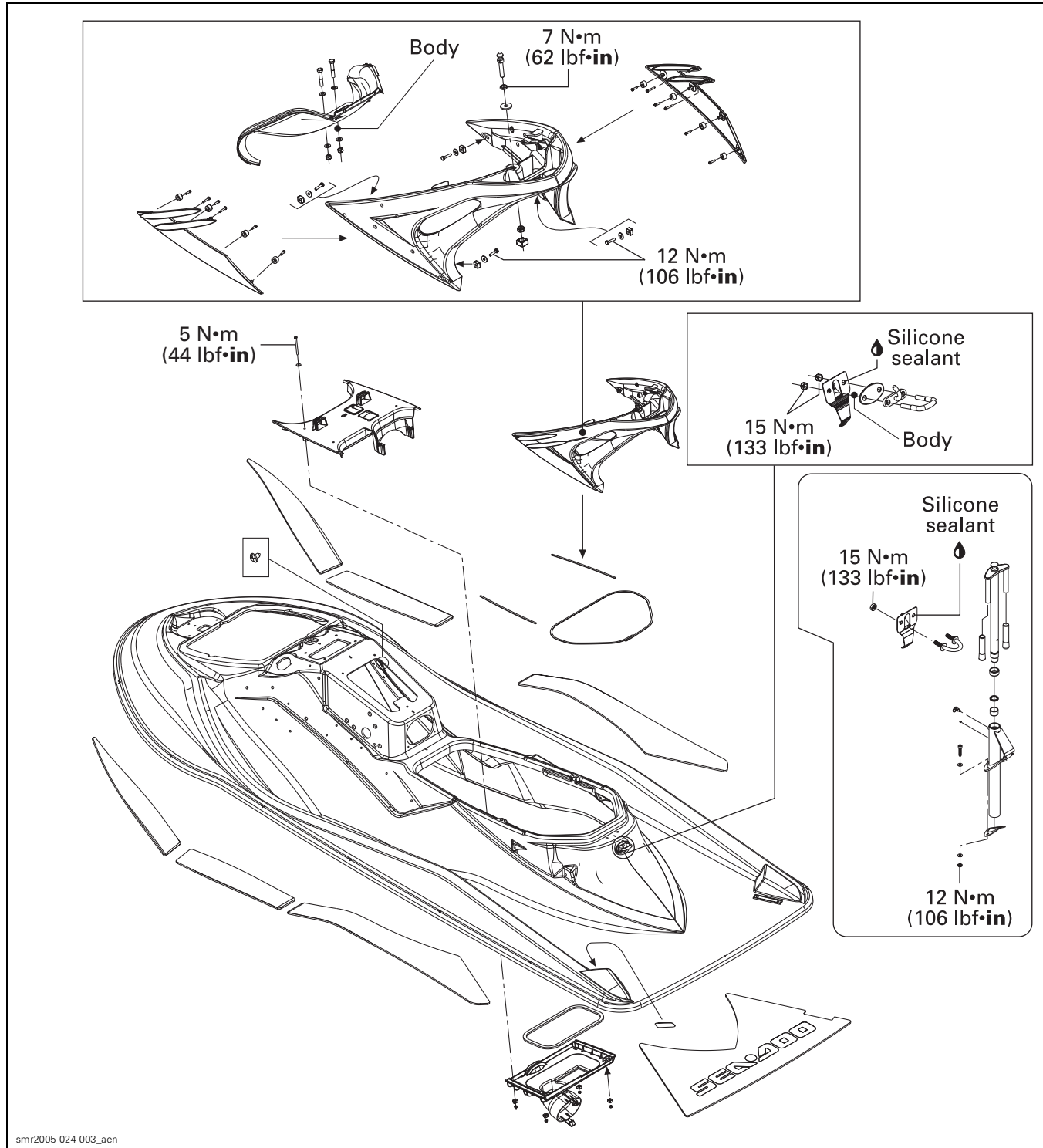


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Section 09 HULL/BODY

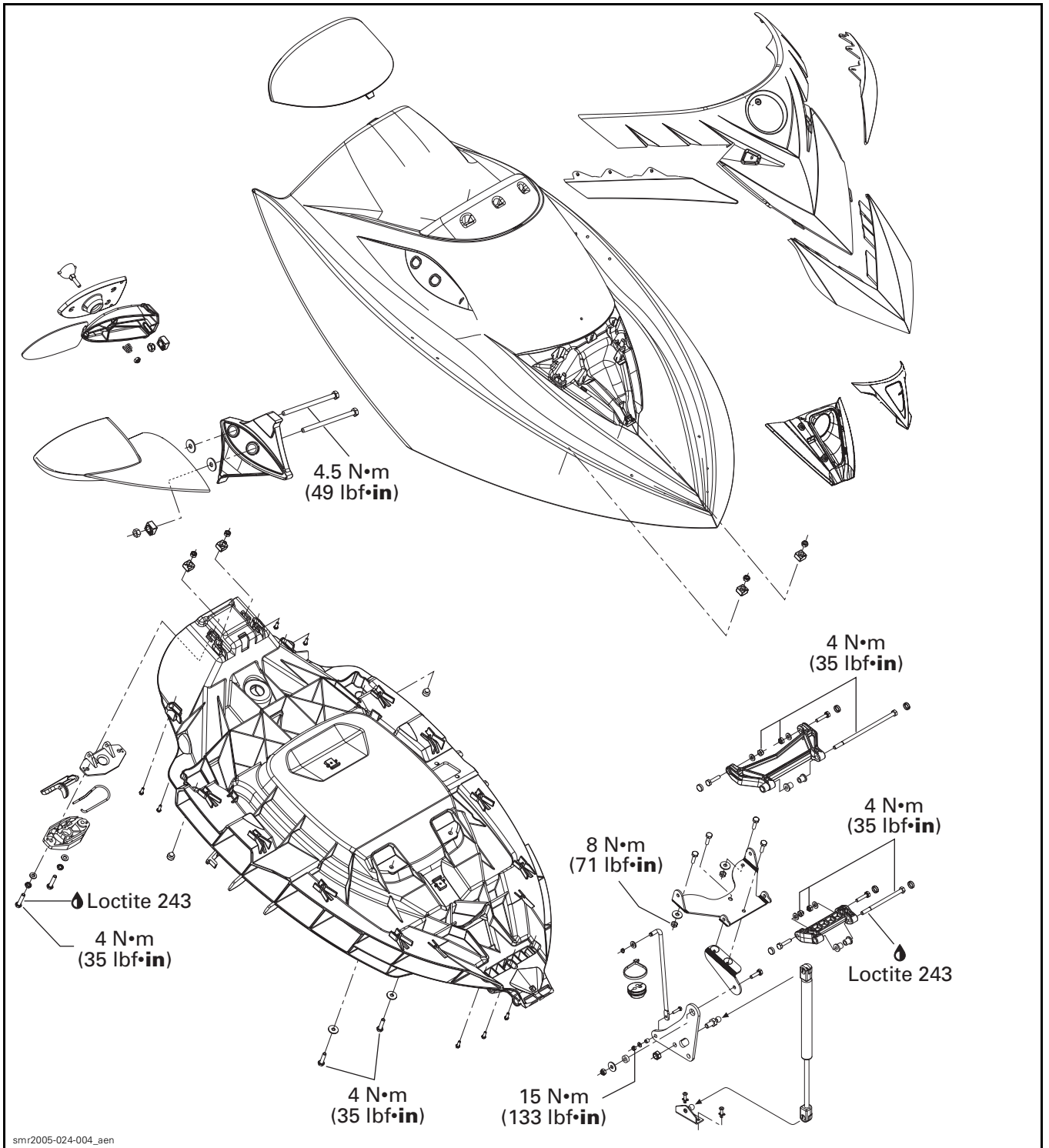
Subsection 01 (ADJUSTMENT AND REPAIR)

GTX Models (Body Rear View)



Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

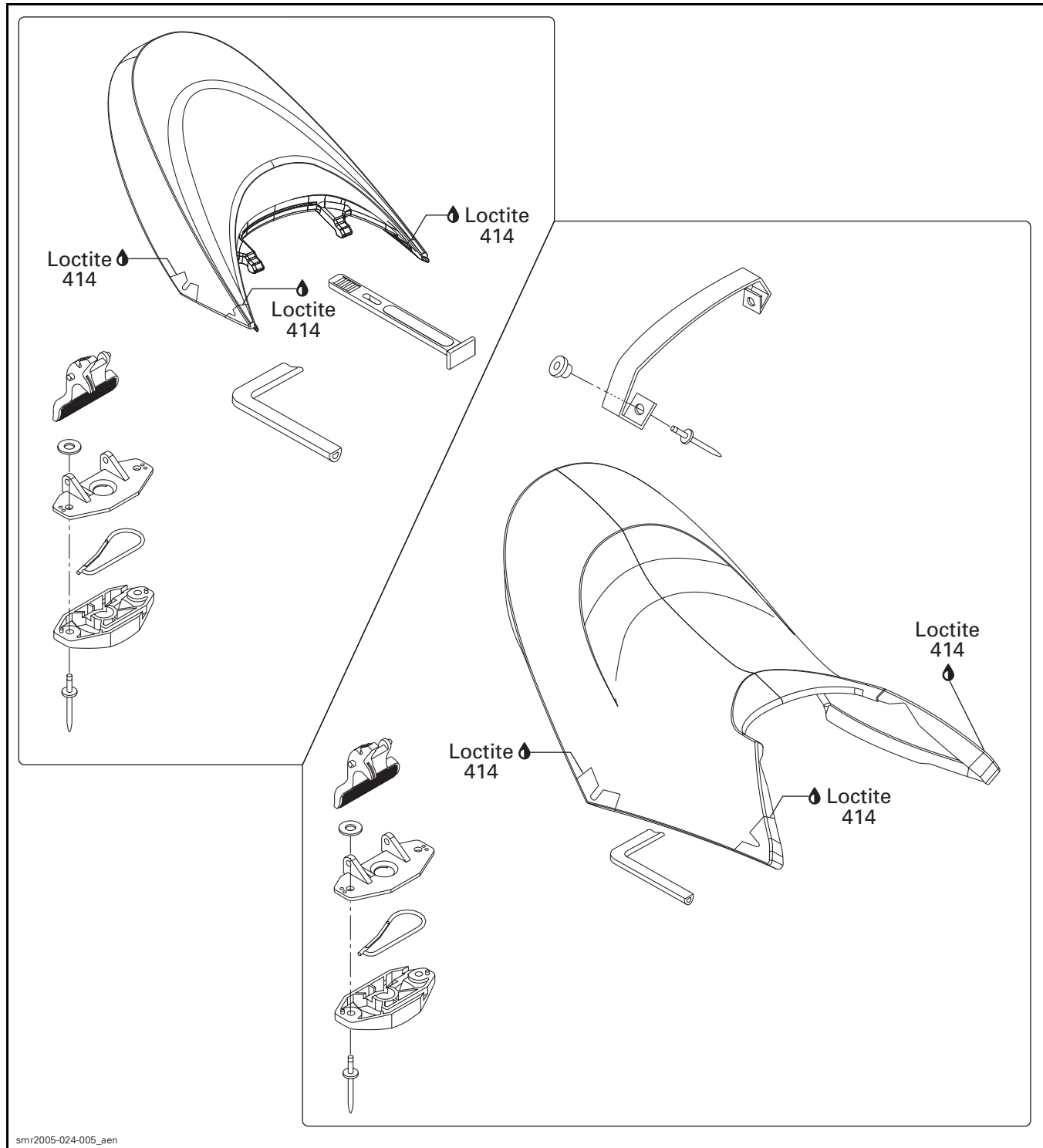
GTX Models (Front Storage Compartment)



Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

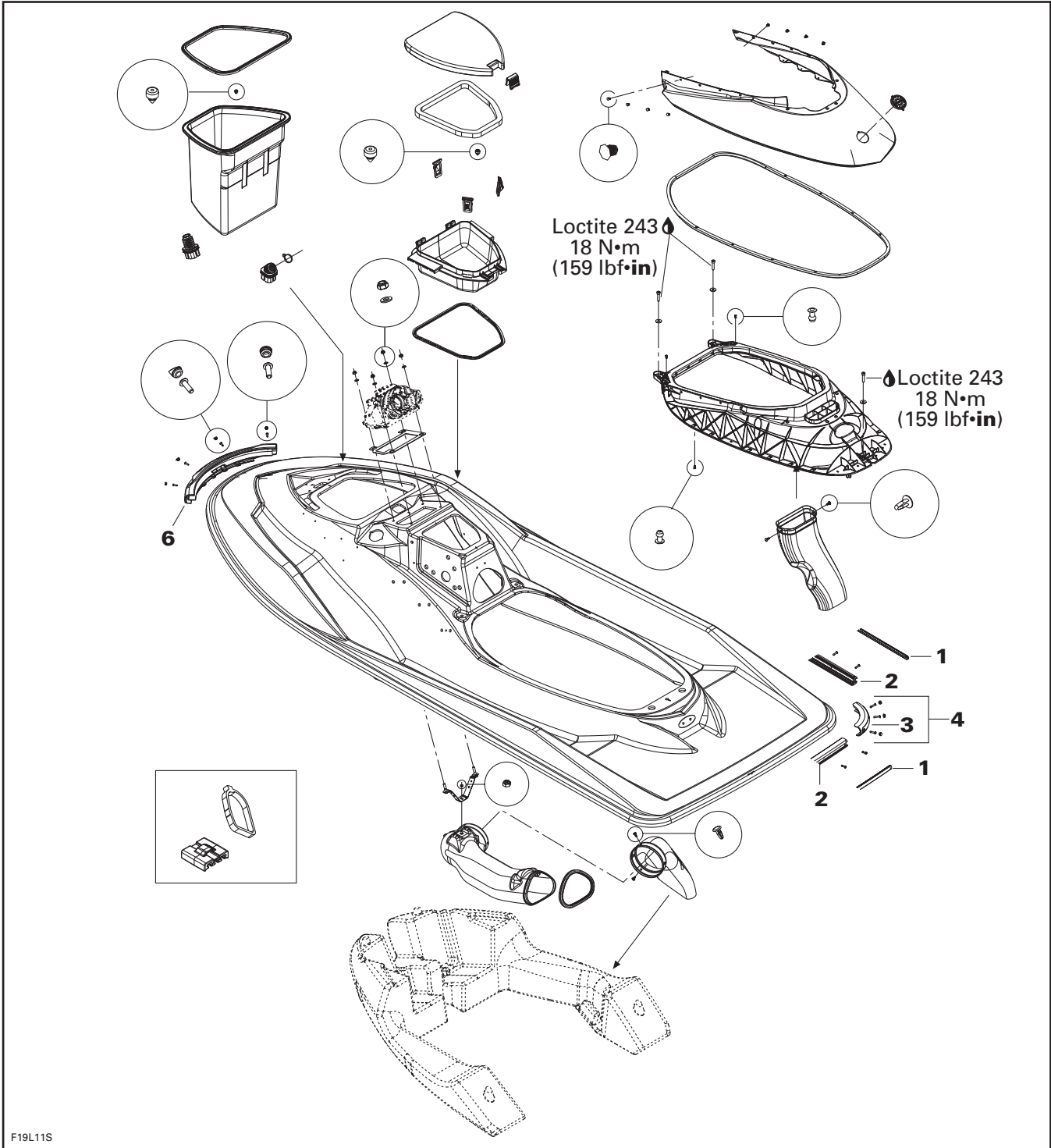
GTX Models (Seats)



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Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (Body Rear View #1)

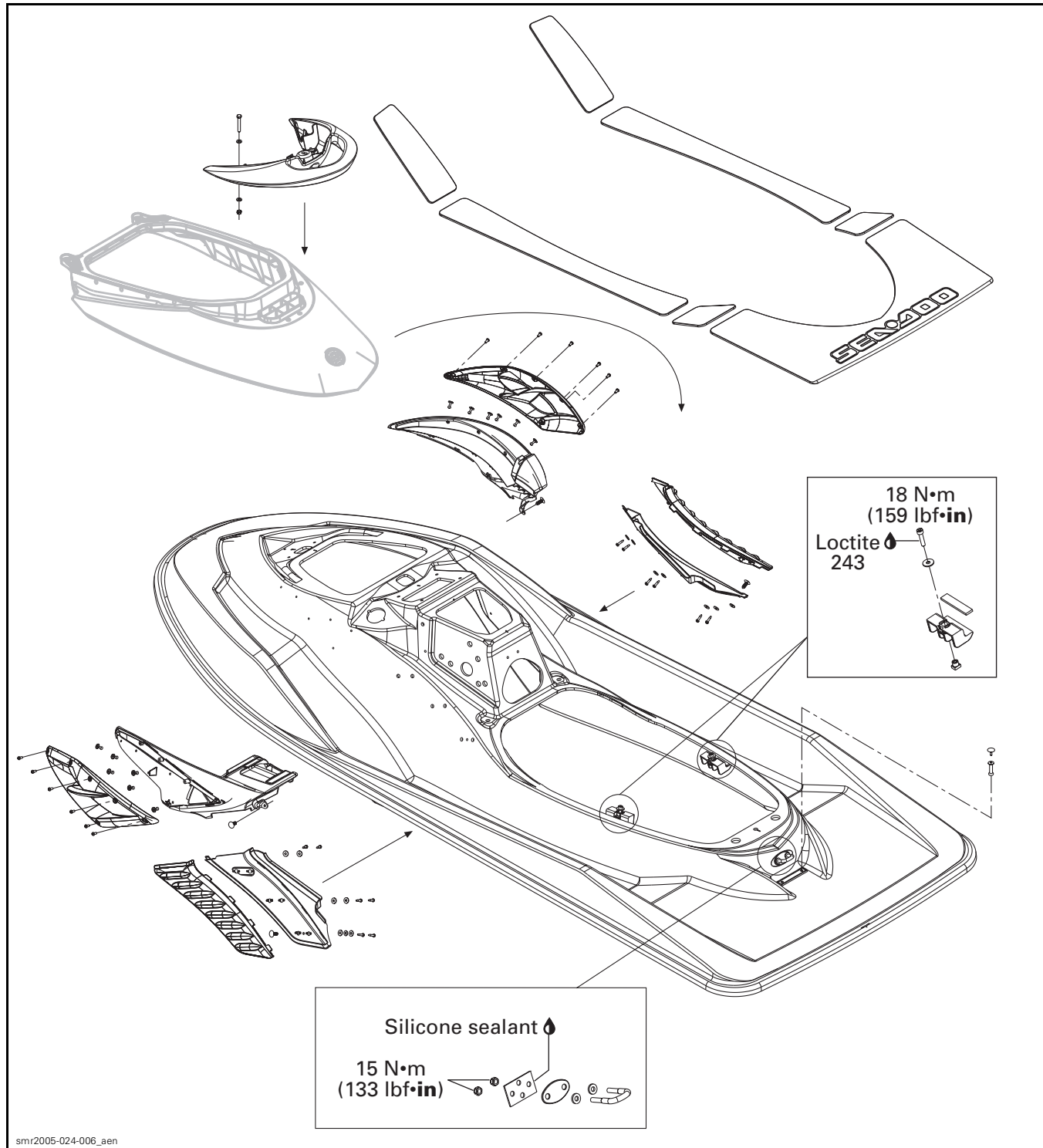


F19L11S

Section 09 HULL/BODY

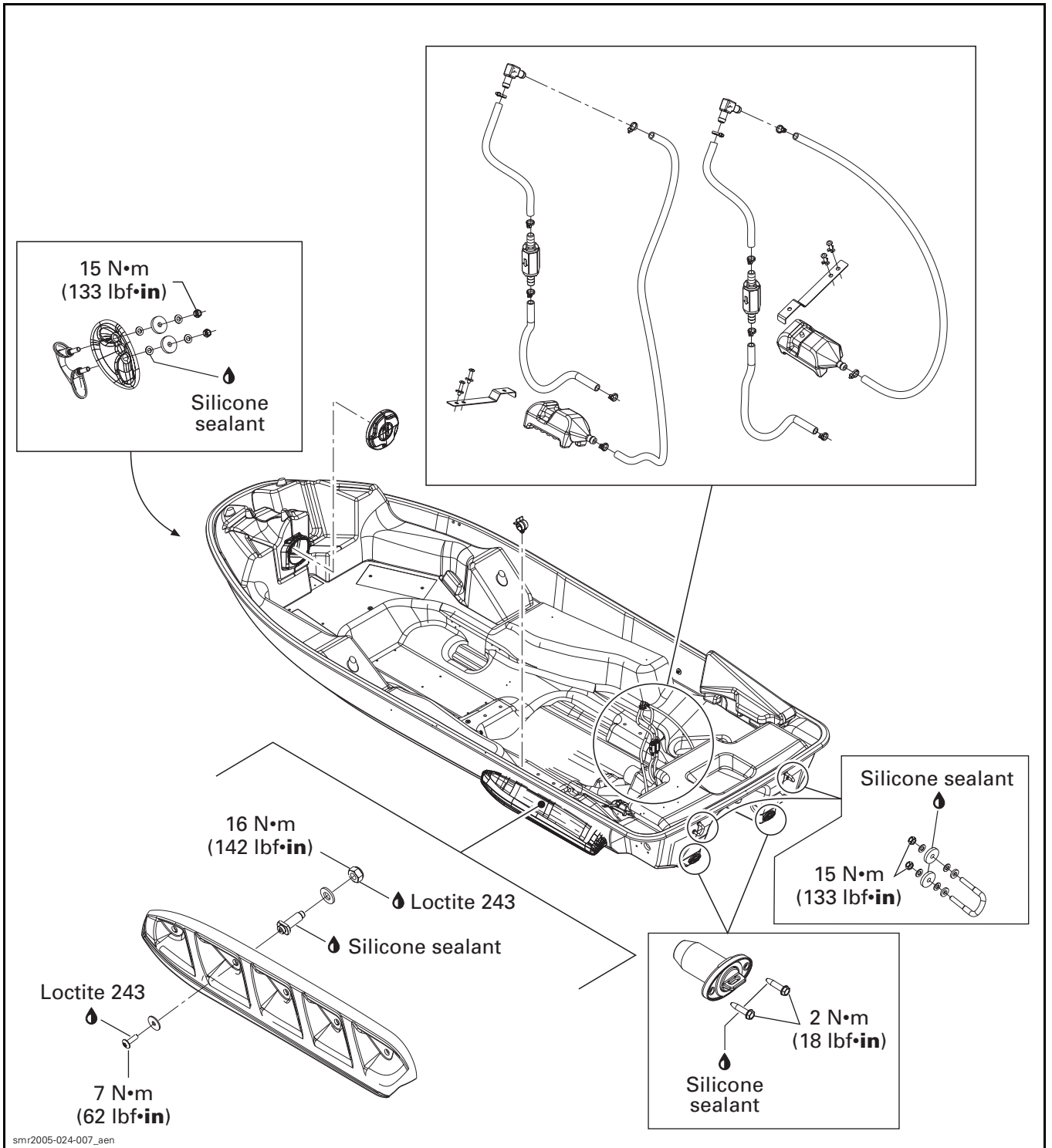
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (Body Rear View #2)



Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

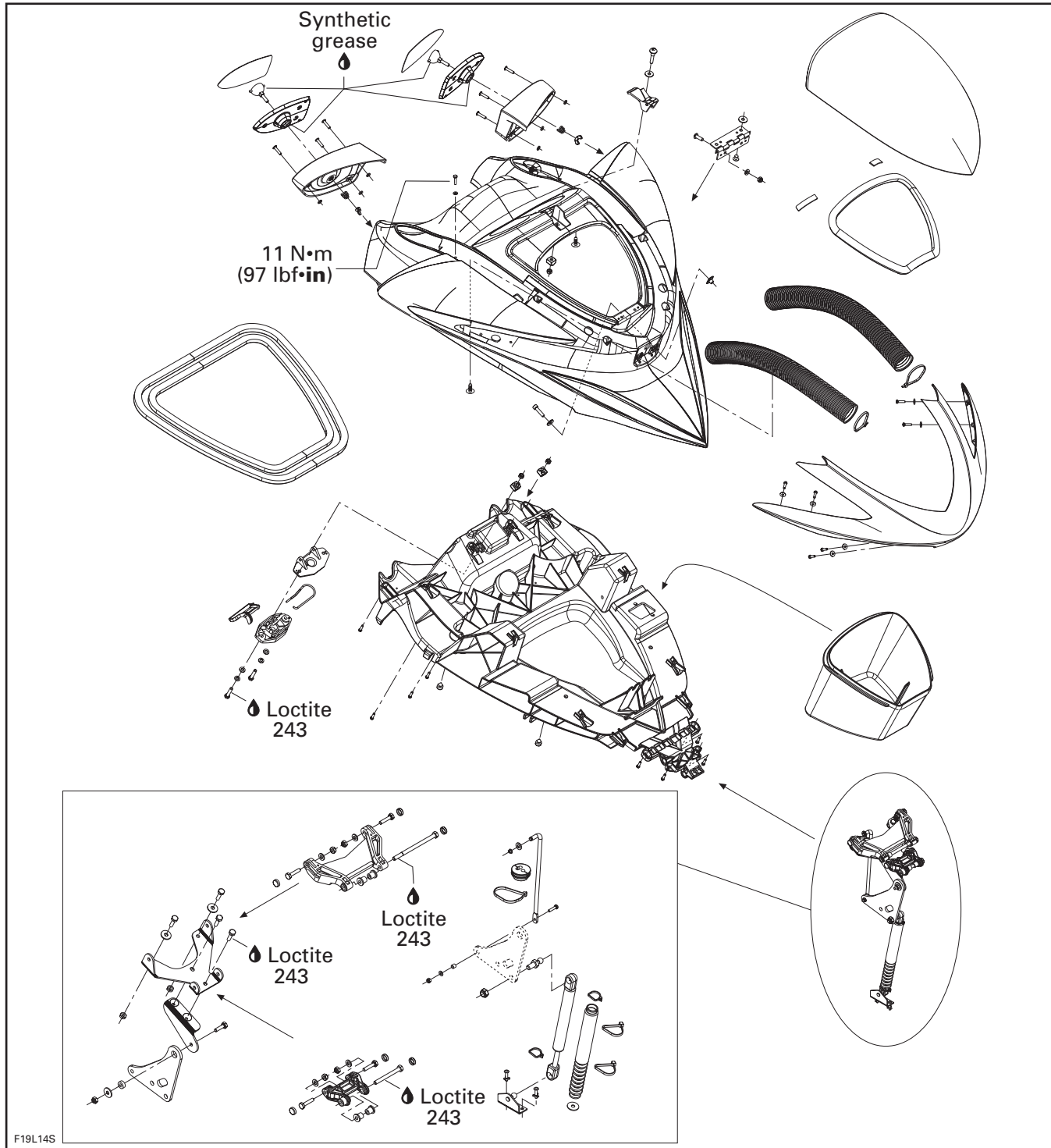
RXP Models (Hull Rear View)



Section 09 HULL/BODY

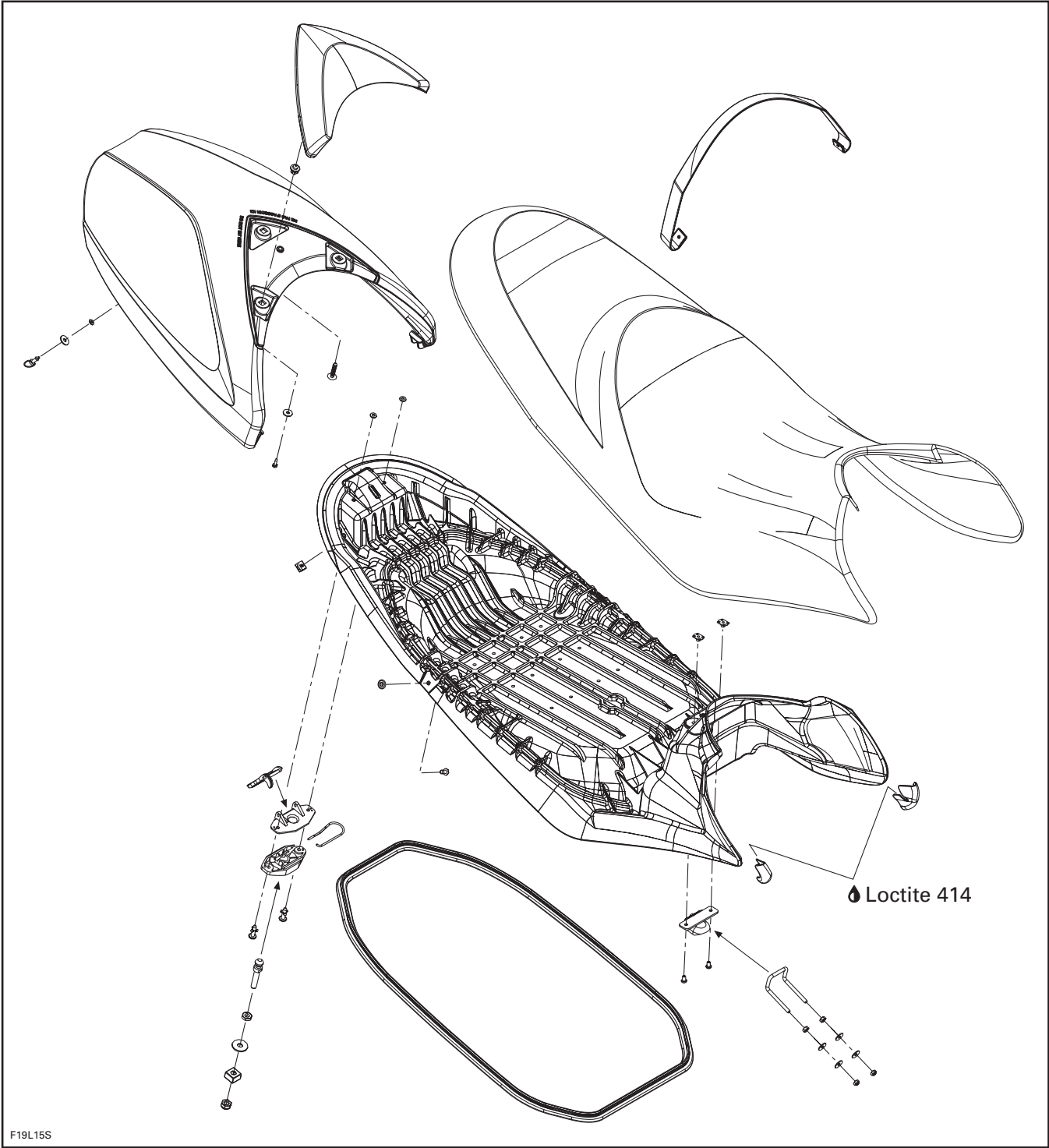
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (Front Storage Compartment)



Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models (Seats)



F19L15S

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

When applying threadlocker Loctite 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.

GLOVE BOX

Removal

All Models except RXP

Lift the glove box top cover.

Gently push on both rear tabs while lifting out rear of glove box compartment.



1. Push tabs

Pull the glove box out of body.

RXP Models

Place shift lever in forward position.

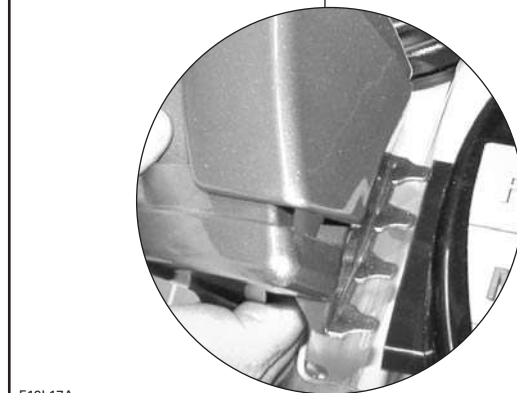
Remove seat.

Pull dart out. See illustration.



1. Pull dart out

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.

ENGINE COVER

RXP Models

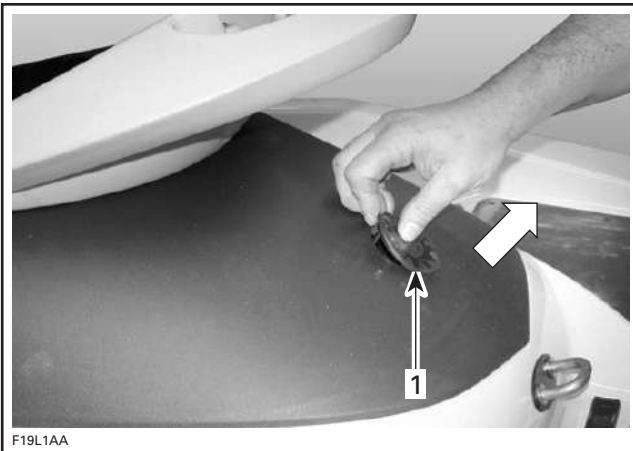
Remove seat.

Detach coolant expansion tank and move away.



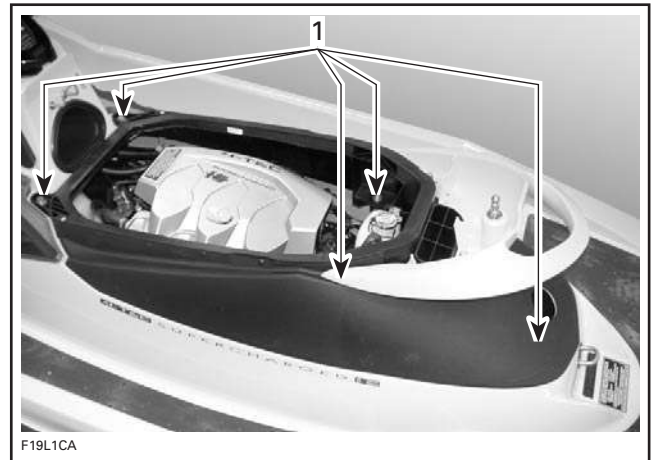
1. Coolant expansion tank

Remove BRP logo at rear.



1. Logo

Remove retaining screws.



1. 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 lbf•in).

SEAT ADJUSTMENT

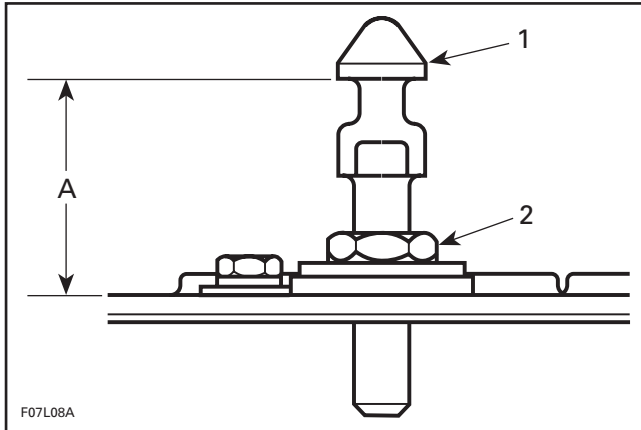
Seat Retainer

GTX Series, Wake and RXT Models

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.

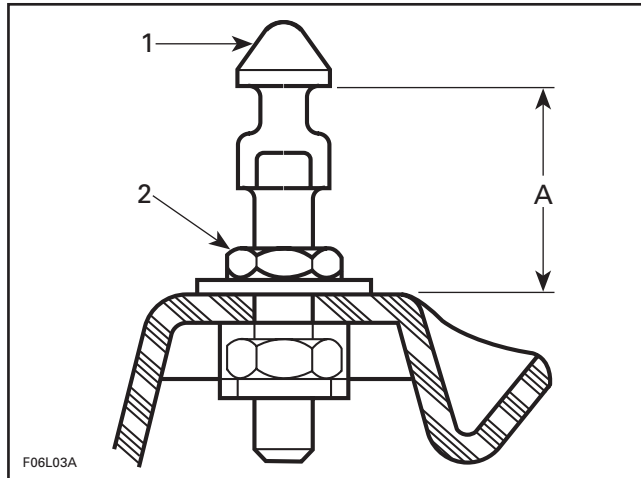
Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



TYPICAL — FRONT SEAT

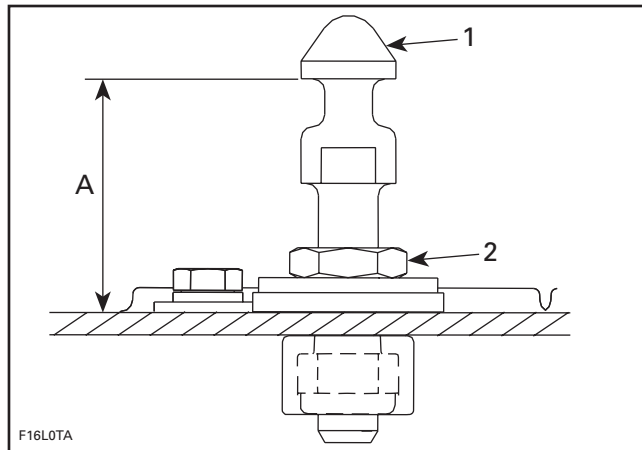
1. Lock pin
 2. Adjustment nut (Loctite 243). Torque to 8 N•m (71 lbf•in)
- A. 33 ± 1 mm (1-35/64 \pm 3/64 in)



TYPICAL — REAR SEAT

1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 35 ± 1 mm (1-5/16 \pm 3/64 in)

RXT Models



1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 8 N•m (71 lbf•in)
- A. 36 ± 1 mm (1-35/64 \pm 3/64 in)

STORAGE COMPARTMENT INNER SHELL

Removal and Installation

GTX Series, Wake and RXT Models

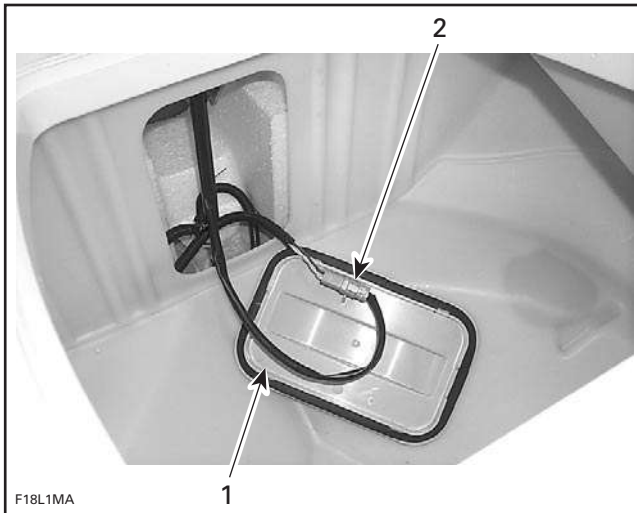
To remove inner shell, proceed as follows:

CAUTION: Failure to follow this order may lead to damaging inner plastic studs.

- Open storage cover.
- Remove access panel.
- Disconnect multifunction connector.

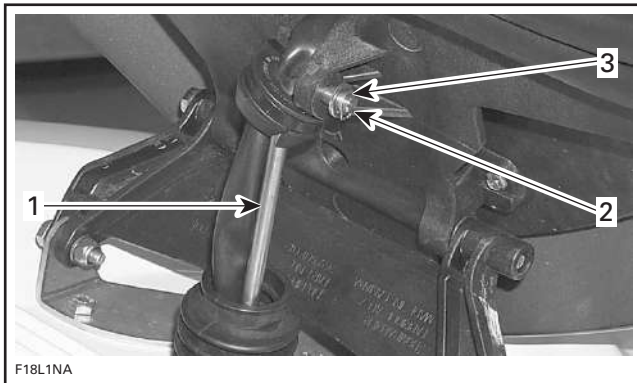
Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



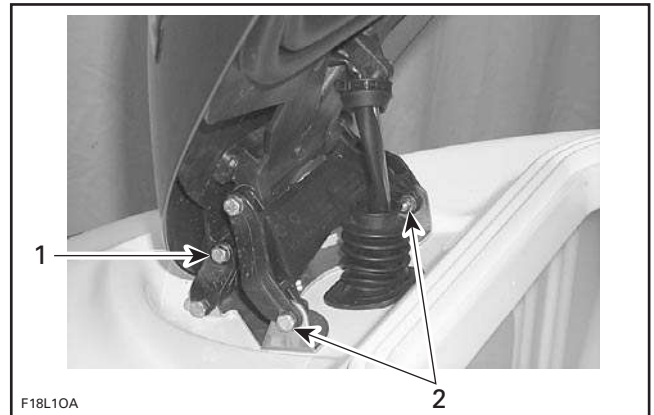
1. Access panel
2. Multifunction connector

- Unlock shock rod from circlip and remove washer.



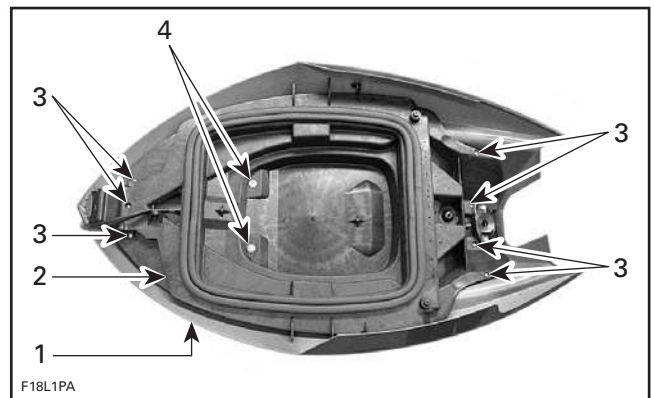
1. Shock rod
2. Circlip
3. Washer

- Remove one long retaining screw (front).
- Remove two short retaining screws locate in the back lower side and hold cover firmly.



1. One long retaining screw (front)
2. Short retaining screw (one on each side to the back)

- Remove storage cover.
- Remove seven inner skin short screws (flanged screws).
- Remove two long inner skin screws (hexagonal screws).



1. Storage cover
2. Inner skin
3. Inner skin short screws (x 7)
4. Inner skin long screws (x 2)

- Use a rubber hammer to remove the inner skin from the cover. If the inner skin is too stiff, install a piece of 2 x 4 against the inner skin and hit it with the rubber hammer.

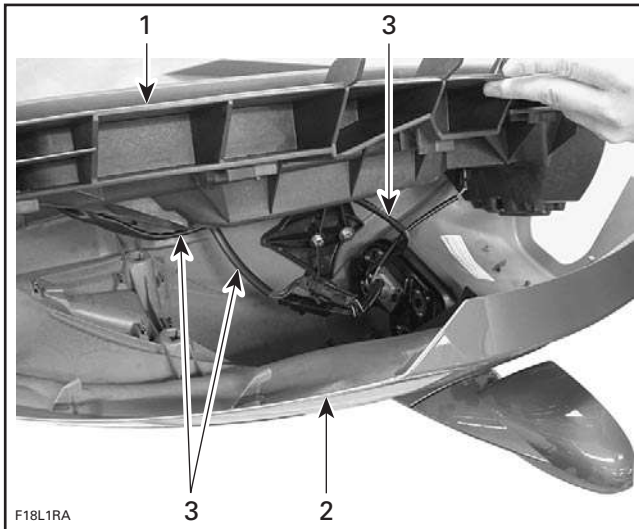
Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



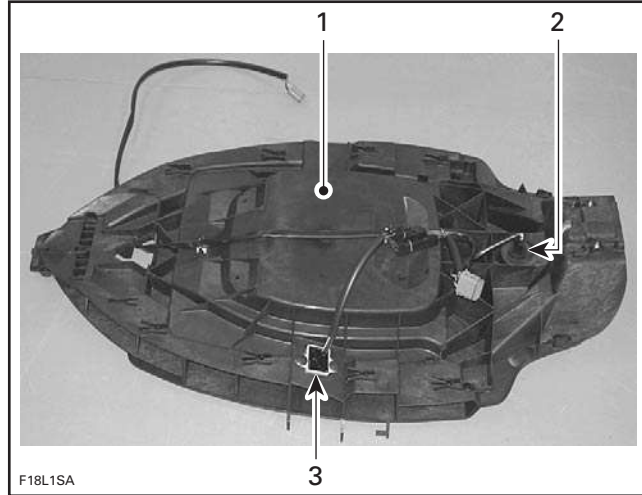
1. Storage cover
2. Inner skin
3. Rubber hammer

– Remove connector harness from the inner skin by cutting tie raps.

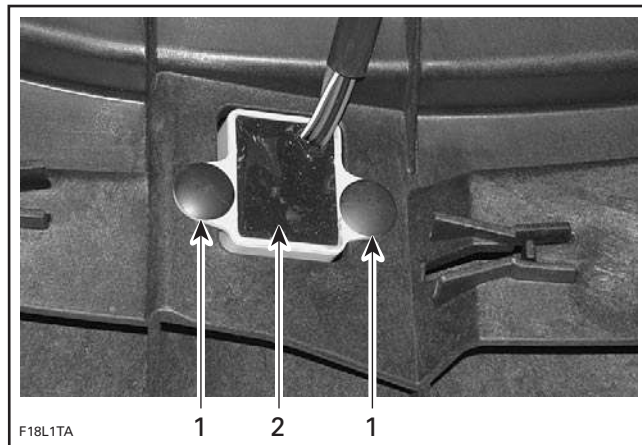


1. Inner skin
2. Storage cover
3. Connector harness

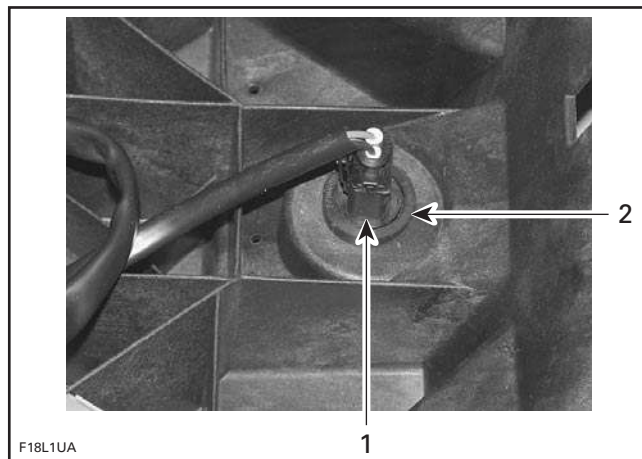
– Remove compass by removing dart (2).
– Remove temperature sensor from grommet.



1. Inner skin
2. Temperature sensor
3. Compass



1. Dart (x 2)
2. Compass



1. Temperature sensor
2. Grommet

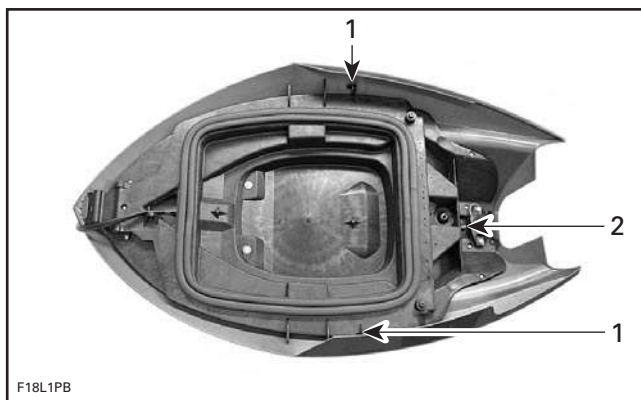
Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

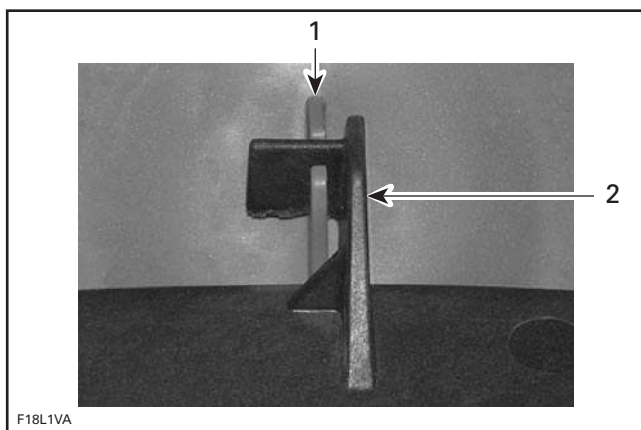
Install new inner skin in the reverse process.

For installation, proceed as follows:

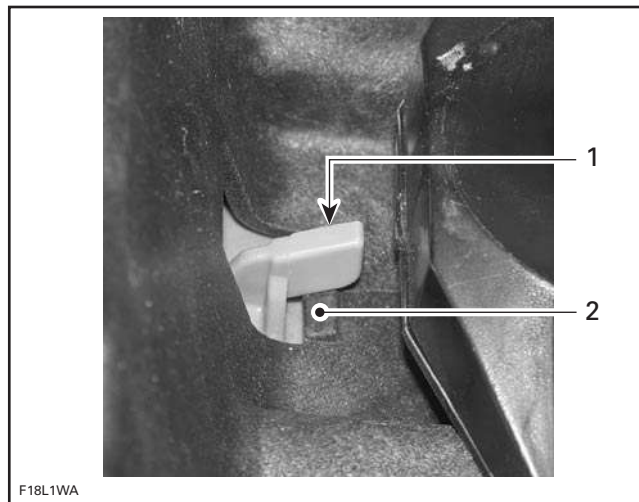
- Install the compass and secure it with the two darts.
- Install the temperature sensor in grommet.
- Install the tie raps around wire harnesses.
- Align inner skin with storage cover and make sure that the lateral locking hooks in the inner skin get engaged in the storage cover locking bracket. If the two lateral locking hooks get properly aligned and engaged the storage cover back locking hook will be engaged properly in the inner skin back locking bracket.



1. Inner skin lateral locking hook
2. Inner skin back locking bracket



1. Storage cover lateral locking bracket
2. Inner skin lateral locking hook



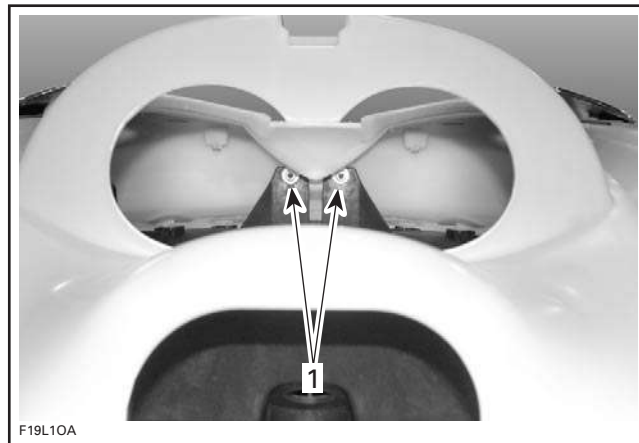
1. Storage cover back locking hook
2. Inner skin back locking bracket

- Secure the inner skin in the storage cover by using the rubber hammer.
- Fasten the seven inner skin short screws and the two inner skin long screws.

RXT Models

Inner Shell

Remove retaining screws from inner shell including the front screws.

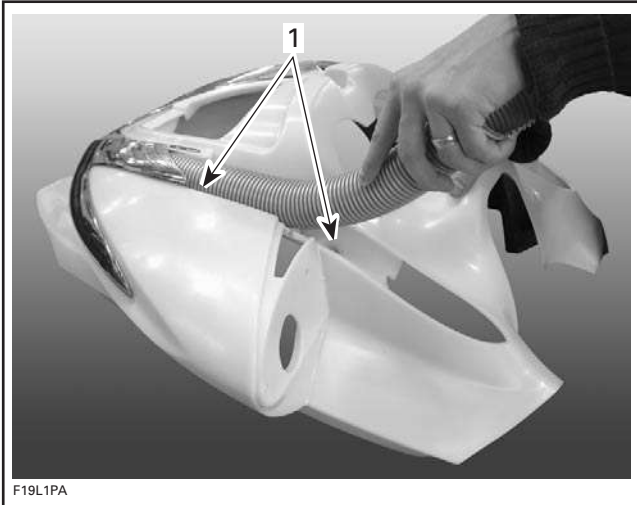


1. Front screws

Lift the end of top tubes and remove retaining screws.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



1. Retaining screws

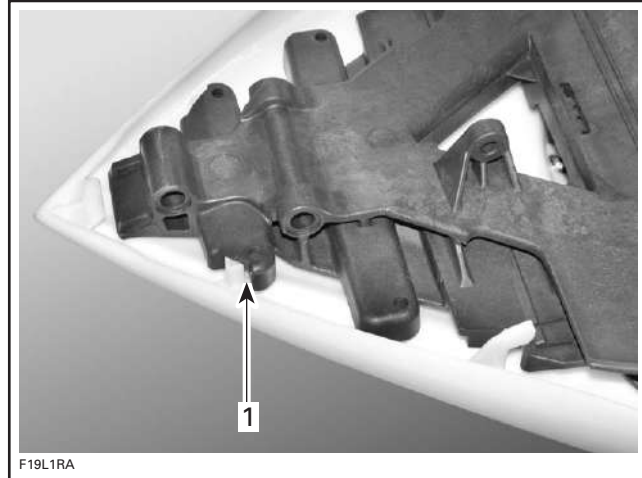
Slide inner shell out as shown.



SLIDE OUT

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.



1. Align cover tab with inner shell slot

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 lbf•in).

Install remaining retaining screws of inner shell.

Front Grill

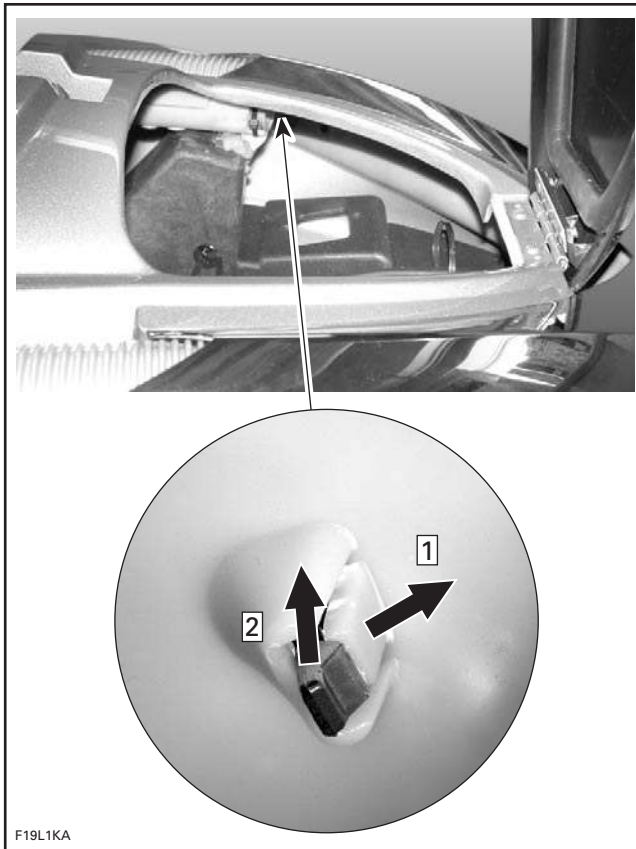
Remove inner shell.

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.

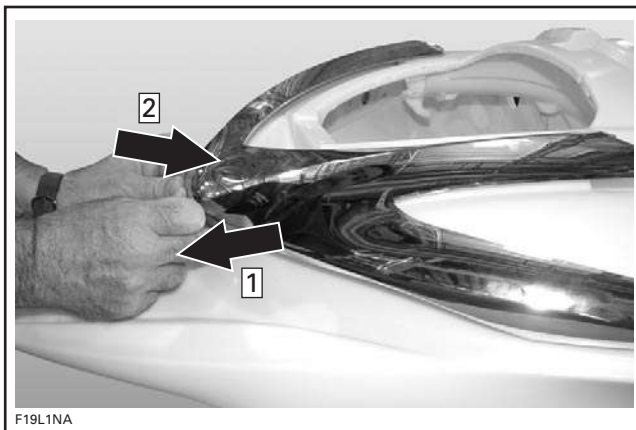
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)



Step 1: Release the locking tab and HOLD
Step 2: Push tab upward

– Release front part of grill and remove it.

At installation, first install the front part of front grill. Do not snap rear tabs yet.



Step 1: Pull out the bottom edges by slightly twisting to hook up
Step 2: Push the top corner to snap in

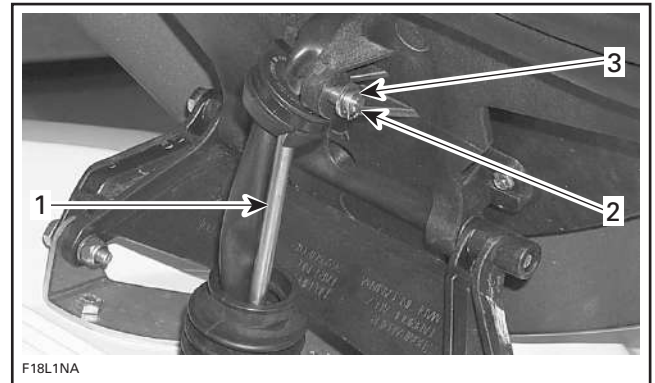
Ensure to properly position and secure top tubes.
Snap the other tabs of front grill.
Install screws to retain front grill.

Reinstall inner shell.

STORAGE COVER SHOCK

To remove storage cover shock proceed as follows:

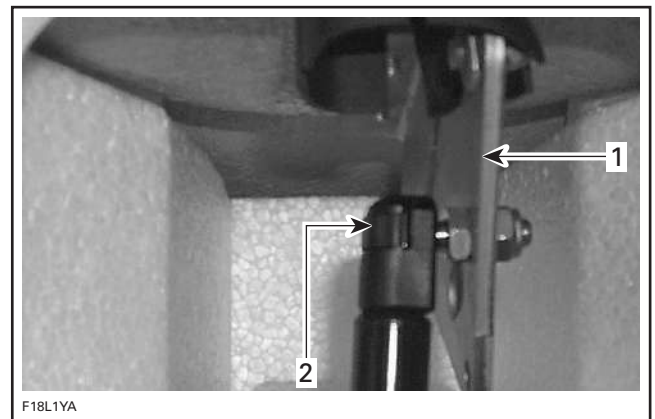
- Unlock shock rod from circlip and remove washer.



1. Shock rod
2. Circlip
3. 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.

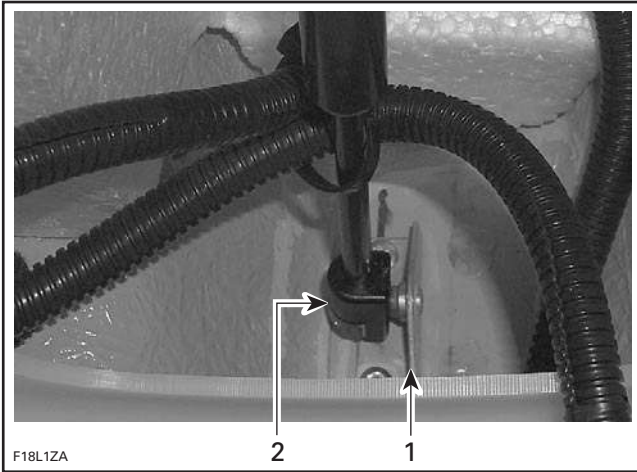
- Release the shock from top linkage bracket and bottom support bracket by inserting a flat screwdriver in the shock top and bottom locking devices.



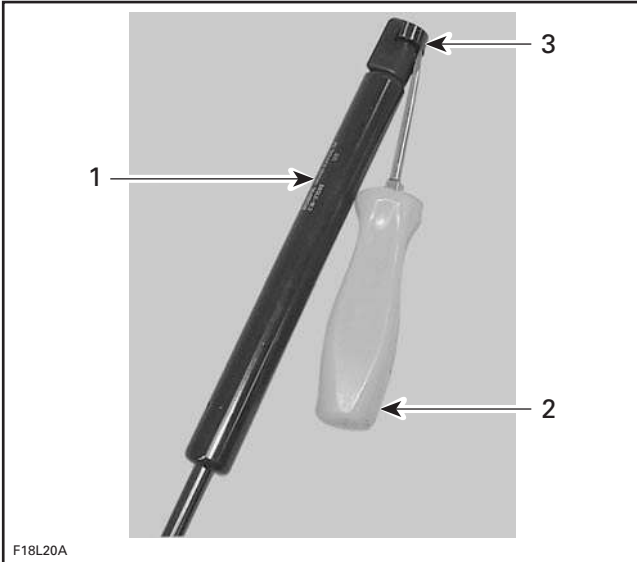
1. Top linkage bracket
2. Shock top locking device

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



1. Bottom support bracket
2. Shock bottom locking device



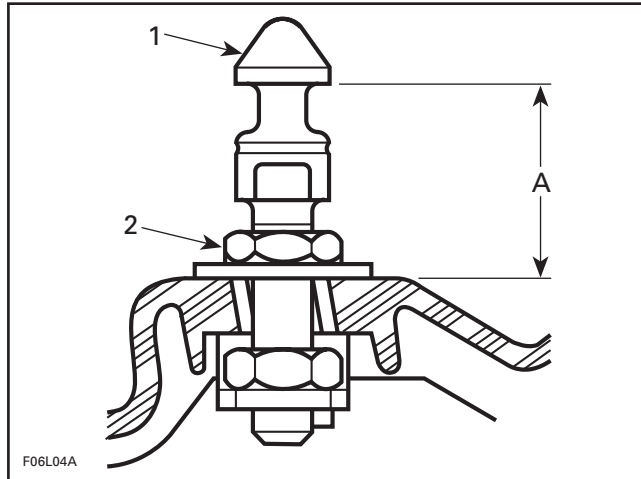
1. Shock absorber
2. Flat screwdriver
3. Shock top locking device

The installation is the reverse of the removal procedure.

STORAGE COMPARTMENT COVER ADJUSTMENT

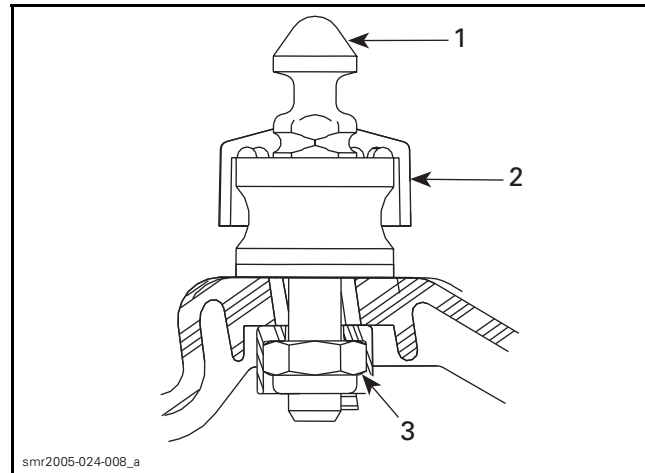
NOTE: Apply Loctite 243 (blue) (P/N 293 800 060) on threads of lock pin when the adjustment is required or when the lock pin is removed then reinstalled. The threads on new lock pin are coated with a self-locking product, do not apply Loctite 243 on threads.

Adjust lock pin as per following specifications:



FIXED TYPE LOCK PIN

1. Lock pin (apply Loctite 243 on threads)
2. Adjustment nut. Torque to 5 N•m (44 lbf•in)
- A. 30 ± 1 mm ($1\text{-}3/16 \pm 3/64$ in)



FLOATING TYPE

1. Lock pin (apply Loctite 243 on threads)
2. Rubber cushion pad
3. Lock nut. Torque to 5 N•m (44 lbf•in)

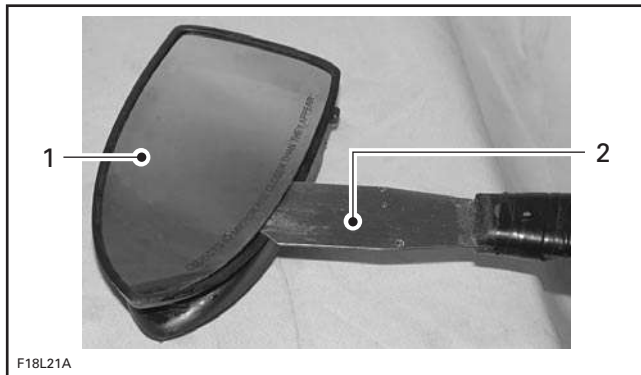
NOTE: Some models have a floating type lock pin. It is normal to have a front and aft play of the rubber cushion pad. To adjust, tighten lock pin until any vertical play is eliminated. Make sure a front and aft play remains when pressing by hands.

MIRROR

To remove mirror proceed as follows:

- Remove storage compartment inner shell from storage cover as described earlier in this section.

- Remove two hexagonal screws and flat washers.
- Remove defective mirror with a spatula.



1. Mirror
2. Spatula

- Place the mirror frame in hot water to "soften" the material to allow mirror installation in its frame.
- Reinstall storage compartment inner shell.

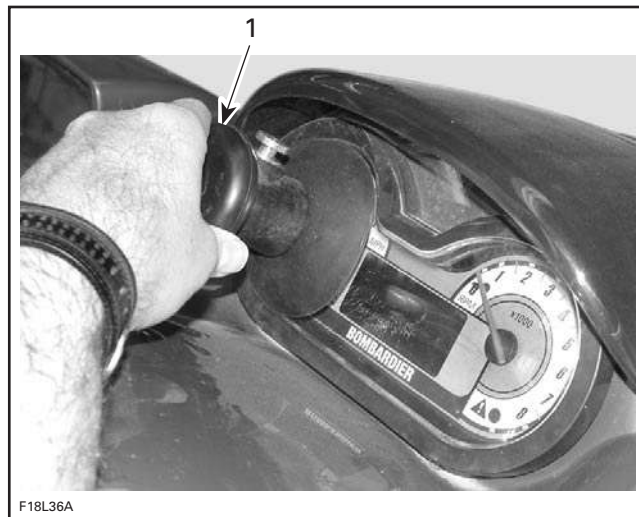
CLUSTER

Removal and Installation

To remove the Info center (Speedometer and LCD Info gauge) proceed as follows:

- Carefully pull each side of the Info Center (LCD Gauges) using the suction cup (P/N 295 000 163) to remove Info Center from the storage cover.

NOTE: Clean the Info Center before installing the suction cup, clean and dry surface helps the tool to hold to remove the Info Center.



1. Suction cup installed on one side of Info Center

NOTE: A pry bar or a screwdriver may also be used to gently pull out Info Center from dashboard. As far as possible, pry out both sides of Info Center at the same time. Take care not to crack or break plastic parts.

Unplug the Info Center.

For the installation, reverse the removal procedure.

DEFLECTOR AND/OR UPPER GRID

Removal and Installation

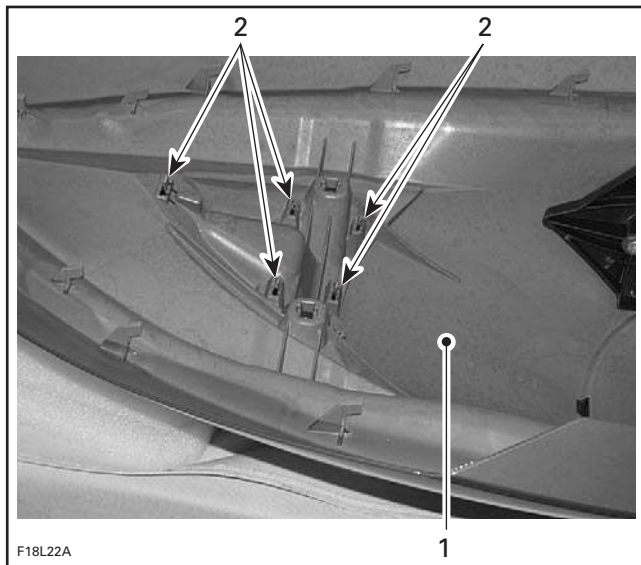
GTX Supercharged Limited

To remove the deflector and/or the upper grid proceed as follows:

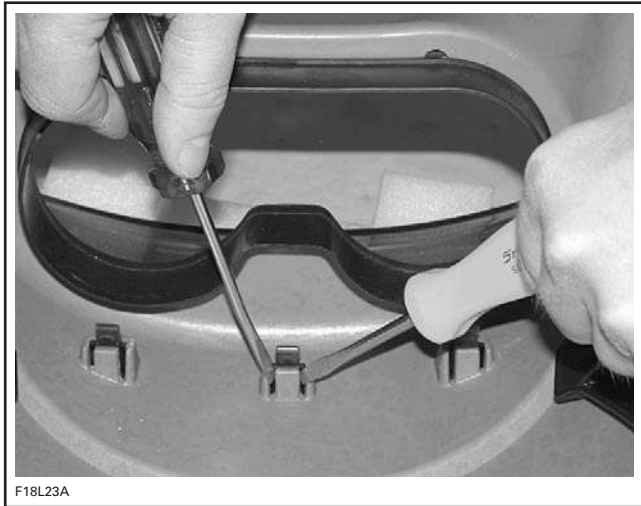
- Remove storage from storage cover compartment inner shell as described earlier in this section to get access.
- Remove the defective deflector and/or the upper grid from plastic retaining clip. Use two screwdrivers to release the deflector or the grid.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



1. Inner skin
2. Deflector retaining clips



RELEASE DEFLECTOR

The installation is the reverse of removal procedure.

SIDE MOLDING

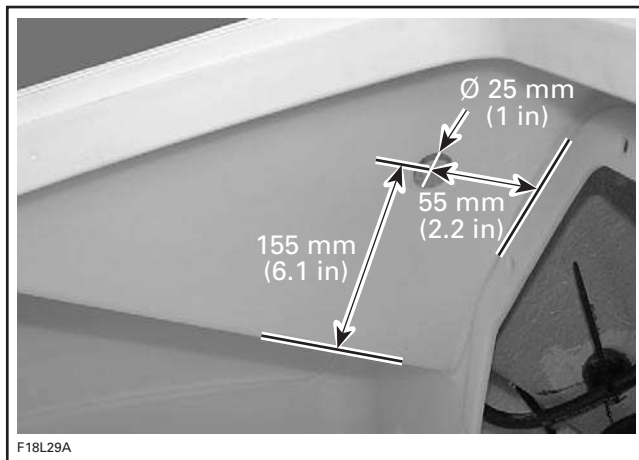
Removal and Installation

All Models except RXT

The removal procedure for RH and LH side moldings with grills is the same.

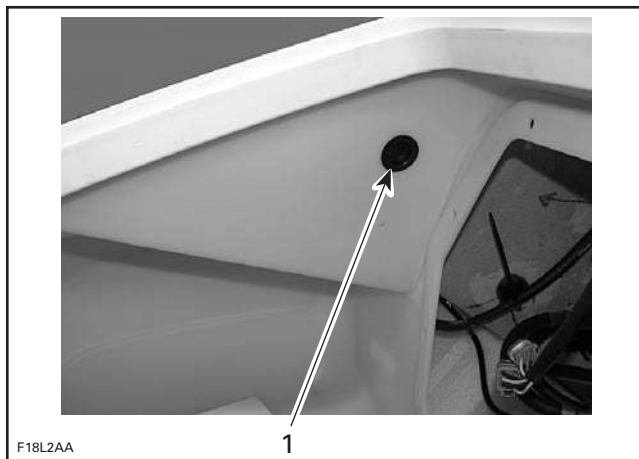
Remove the two darts holding the grill to the body.

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.

After installing side molding, install a plug (P/N 291 000 279) in the side molding screw hole.



1. Plug

GTX Supercharged Limited

Removal procedure for RH and LH side moldings with deflector/grill is the same.

Side molding is mounted on deflector.

Remove three darts holding deflector and grill.

The installation is the reverse of the removal procedure.

INLET GRATE

Removal and Installation

Loosen screws and remove inlet grate.

NOTE: An impact screwdriver should be used to loosen tight screws.

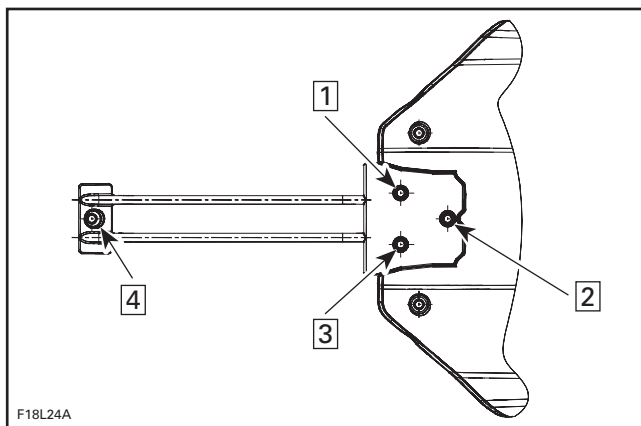
When installing inlet grate, apply Loctite 271 (red) (P/N 293 800 005) on threads of M6 bolts.

Follow this sequence referring to the illustration:

Hand tighten screws from 1 to 4.

Torque screw from 1 to 3 to 11 N•m (97 lbf•in).

Torque screw 4 to 26 N•m (19 lbf•ft).



RIDING PLATE

Removal

Remove inlet grate.

Remove jet pump. Refer to JET PUMP.

Remove the speed sensor from the riding plate (if applicable).

Drain cooling system. Refer to COOLING SYSTEM.

From inside hull, disconnect hoses from ride plate.

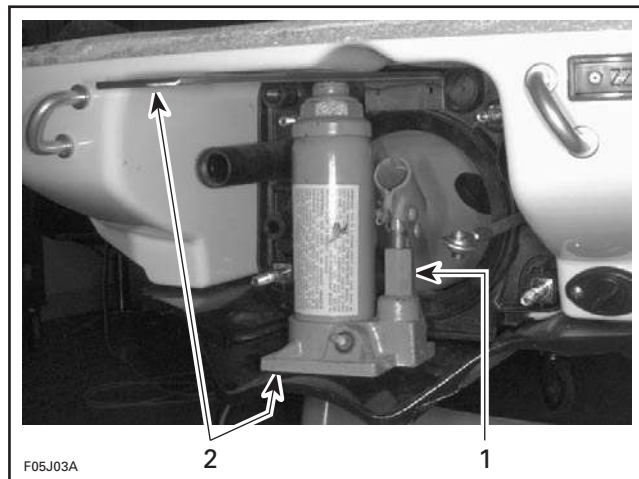
Unscrew hose fittings from ride plate.

CAUTION: Removing hose fittings prior to pulling out ride plate prevents the possibility to damage fittings.

Loosen riding plate screws.

NOTE: An impact screwdriver should be used to loosen tight screws.

Using a low height hydraulic bottle jack and 2 steel plates, pry out riding plate.



TYPICAL
1. Hydraulic bottle jack
2. Steel plates

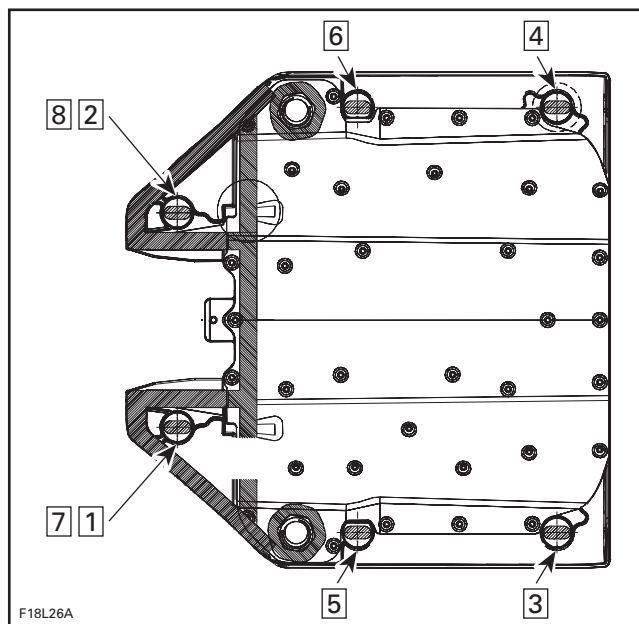
Cleaning

Scrape off all excess of sealant from riding plate and hull.

Clean hull surface with acetone based solvent to eliminate grease, dust and any residue of sealant. Clean fitting threads (4-TEC models).

Installation

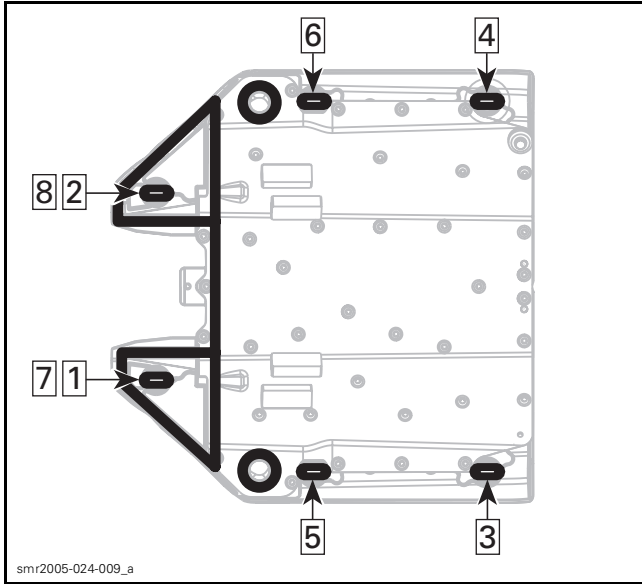
GTX Series, Wake and RXT Models



Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

RXP Models



Properly seal and 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.

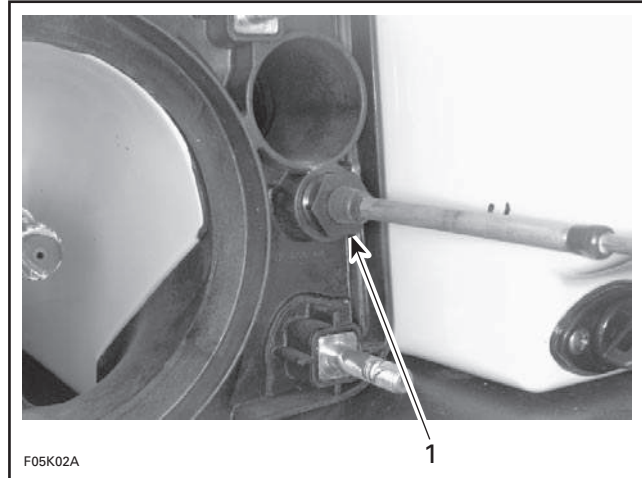
JET PUMP SUPPORT

Removal

Remove jet pump. Refer to JET PUMP.

Remove inlet grate and riding plate.

Remove ball joint, boot, nut, half rings and O-rings from steering cable.



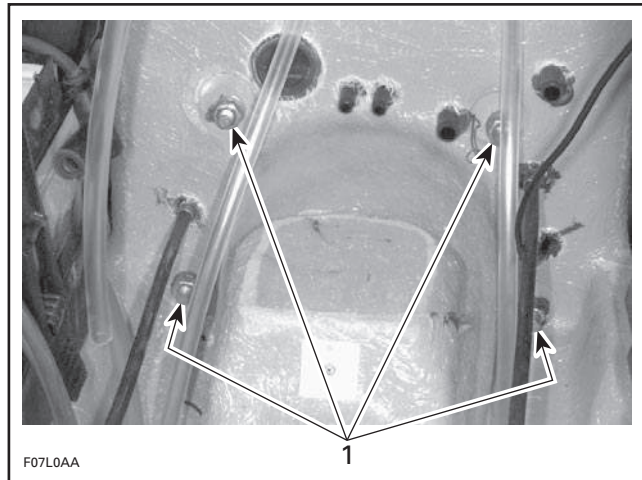
TYPICAL
1. Unscrew nut

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.

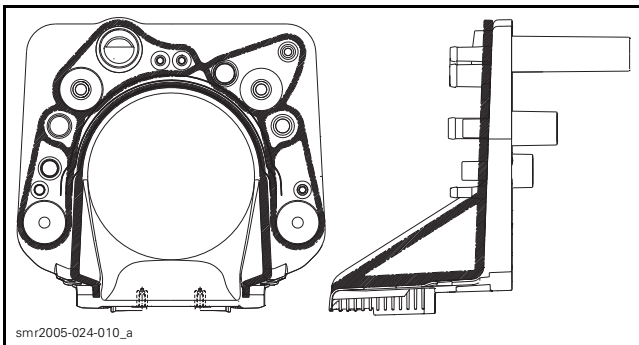
Installation

All Models except RXP

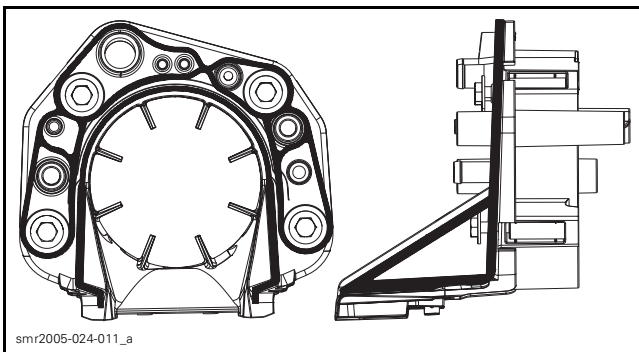
Ensure to position the longest threaded portion of studs towards the jet pump. Apply Loctite 518 (P/N 293 800 038) against contact surface of studs with jet pump support.

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 lbf•ft).

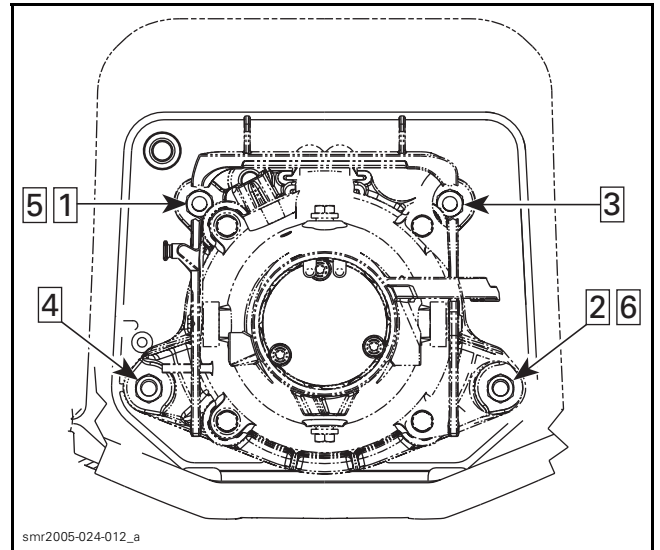


GTX SERIES, WAKE AND RXT MODELS

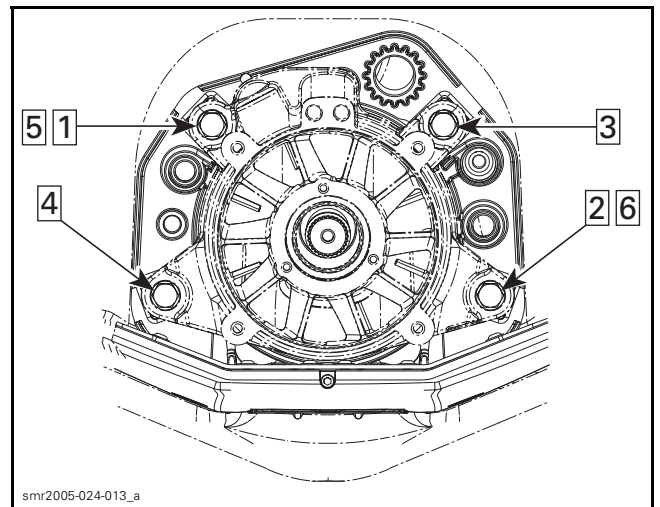


RXP MODELS

Torque jet pump support using the following sequence.



GTX SERIES, WAKE AND RXT MODELS



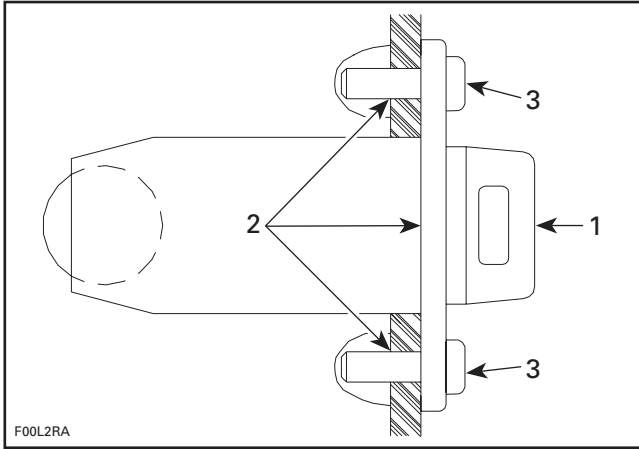
RXT MODELS

DRAIN PLUG INSTALLATION

Refer to the following illustration to install drain plug.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



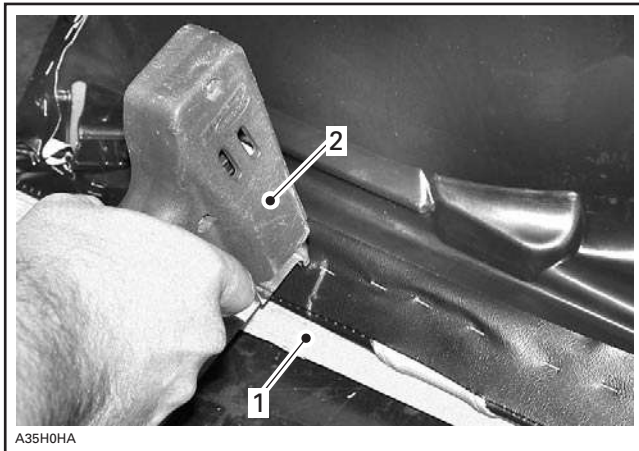
1. Drain plug
2. Silicone sealant around the middle hole and in the screw holes
3. Torque screws to 2.2 N•m (19 lb•in)

SEAT COVER REPLACEMENT

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.



- TYPICAL**
1. Piece of wood
 2. ETN-50 (electric) or T-50 (manual)

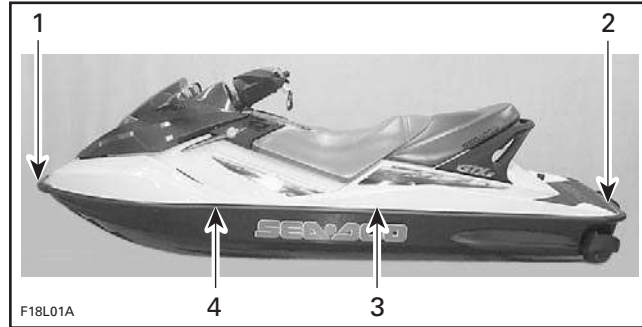
After cover installation cut all around the excess of material.

BUMPER REPLACEMENT

Remove trim from side bumper rail.

Remove screws to remove side bumper rail.

Mark hole positions on body straight and bow sections.



- TYPICAL**
1. Front bumper
 2. Corner bumper
 3. Straight section
 4. Bow section

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

Wake Models Only

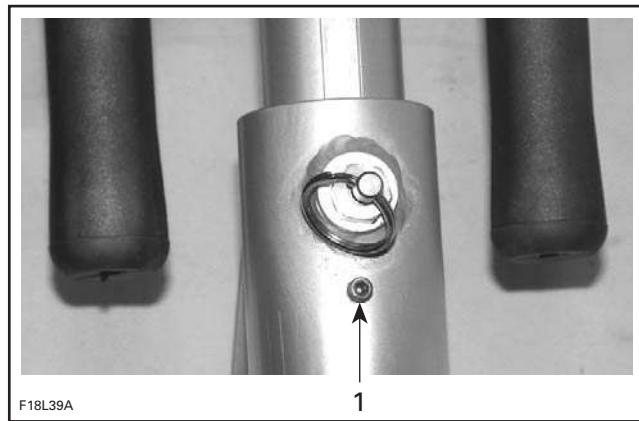
Removal

Remove the rear seat and storage basket under it.
Remove nuts.

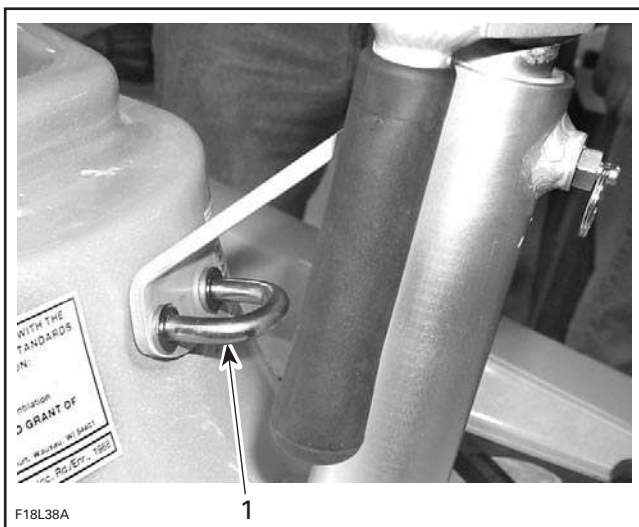
Section 09 HULL/BODY
Subsection 01 (ADJUSTMENT AND REPAIR)



1. Screws to be removed



1. Stopper screw



1. U-clamp

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.



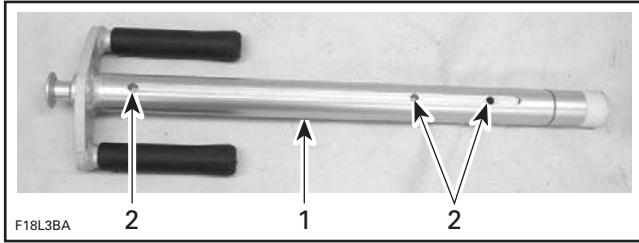
1. Safety lock pin

Assembly

Before assembly verify the physical condition of cylinder groove and adjustment holes.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)



1. Groove
2. 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.

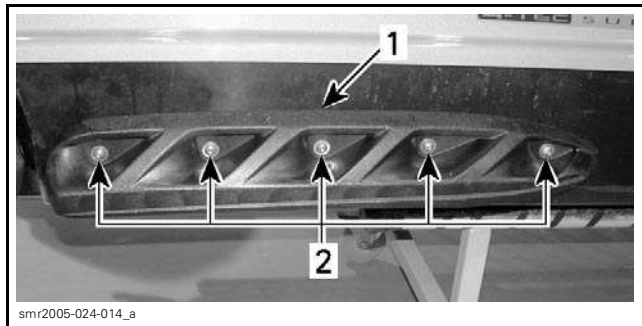
To install the wake post, reverse removal procedure.

SPONSON REPLACEMENT

NOTE: Removal and installation procedure for RH and LH sponson is same.

Removal

Unscrew sponson bolts then remove sponson.



1. Sponson
2. Bolts

Clean any residues of silicone sealant on hull and sponson.

Installation

Apply silicone sealant (clear) (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 same.

Removal

Remove appropriate sponson.

Remove muffler 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

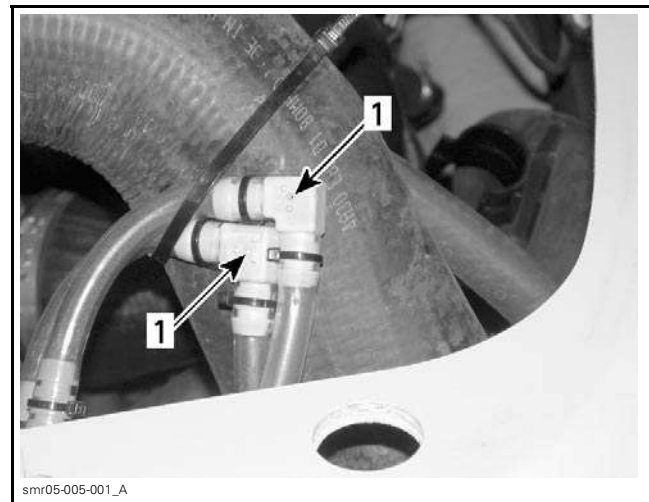
Apply Loctite 243 (blue) (P/N 293 800 060) on sponson adaptor threads.

Torque sponson adaptor nuts to 16 N•m (142 lbf•in).

Install all other removed parts.

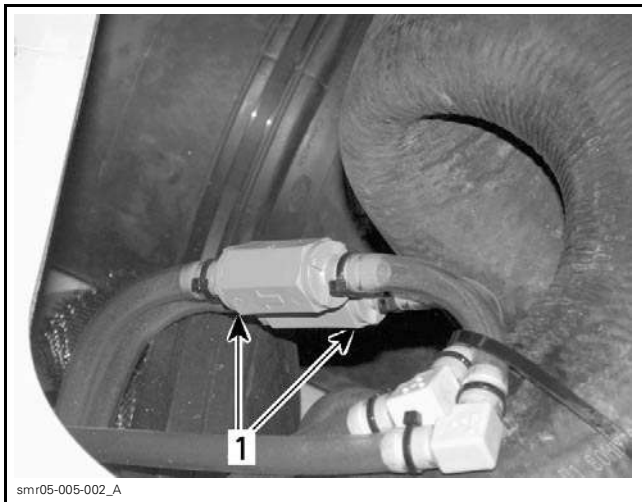
BAILER PICK-UPS INSPECTION

Check if the hole on the elbow fitting is obstructed. Clean both elbow fittings if necessary.



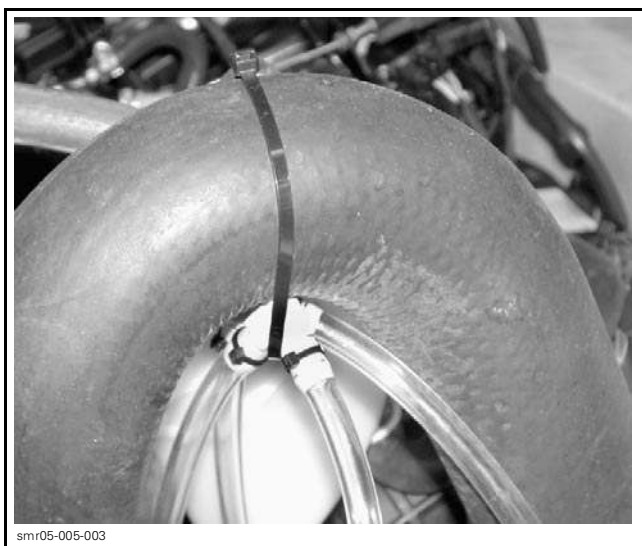
1. Elbow fitting holes

Remove check valves and shake them. If the inner parts move freely, the check valve is in good condition. If not, replace by a new one.



1. Check valves near elbow fittings

Attach elbow fittings at the highest position that you can on the inlet hose.



DECALS REPLACEMENT

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

There are 2 types of decals used on watercraft. One has a protective film on back side and the other has a protective film on both sides. They are used on 3 types of materials; plastic, gelcoat and metal.

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.

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.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

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.

HULL AND BODY REPAIR

General

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.

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 CAVITY

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.

Section 09 HULL/BODY

Subsection 01 (ADJUSTMENT AND REPAIR)

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)

Section 10 TECHNICAL SPECIFICATIONS
Subsection 01 (GTX, WAKE AND GTX SC MODELS)

GTX, WAKE AND GTX SC MODELS

ENGINE		GTX	WAKE	GTX SC
Engine type		BOMBARDIER-ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC), liquid cooled		
		Naturally aspirated		Supercharged
Lubrication	Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler.		
	Oil type	10W40 4-stroke oil (API service classification SL, SJ or SH)		XP-S 10W-40 4-Stroke oil or an equivalent approved by BRP
Exhaust system	Type	Water cooled/water injected. Direct flow from propulsion unit		
ADDITIONAL INFORMATION:				

ELECTRICAL		GTX	WAKE	GTX SC
Magneto generator output		360 W @ 6000 RPM		
Ignition system type		DI (Digital Induction)		
Ignition timing		Not adjustable		
Spark plug	Make and type	NGK DCPR8E		
	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 k Ω		
Engine RPM limiter setting		7650 RPM		
Battery		12 V, 30 A•h		
Fuse	TOPS valve	10 A		
	TOPS switch	5 A		
	Battery fuse	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 bilge 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)			
ADDITIONAL INFORMATION:				

Section 10 TECHNICAL SPECIFICATIONS

Subsection 01 (GTX, WAKE AND GTX SC MODELS)

FUEL SYSTEM		GTX	WAKE	GTX SC
Fuel injection type		Rotax EMS (engine management system) Multipoint Fuel Injection. Single throttle body (52 mm (2.05 in))		
Fuel pressure		290 - 310 kPa (42 - 45 PSI)		379 - 414 kPa (55 - 60PSI)
Idle speed (in water/out of water)		1800 ± 50 RPM		
Throttle Position Sensor (TPS)		1.6 kΩ - 2.4 kΩ idle: 710 — 1380 kΩ		
Crankshaft Position Sensor (CPS)		190 Ω - 290Ω		
Camshaft Position Sensor (CAPS)		12 V		
Manifold Air Temperature Sensor (MATS)		2.28 kΩ - 2.74 kΩ		
Coolant Temperature Sensor (CTS)		2.28 kΩ - 2.74 kΩ		
Exhaust Gas Temperature Sensor (EGTS)		2.28 kΩ - 2.74 kΩ		
Manifold Air Pressure Sensor (MAPS)		6040 Ω (terminals 2-1) 5554 Ω (terminals 3-2) 5822 Ω (terminals 3-1)		
Knock Sensor (KS)		5 MΩ		
Oil Pressure Switch (OPS)		0 Ω, if oil pressure is greater than 180 - 220 kPa (26 - 32 PSI)		
Oil Separator Pressure Switch (OSPS)		0 Ω, if blow-by pressure is less than 40 kPa (6 PSI)		
TOPS valve		1.27 Ω - 2.47 Ω		
Fuel injector		11.4 - 12.6 Ω		14 - 15 Ω
Fuel	Type	INSIDE NORTH AMERICA		
		Recommended	Regular unleaded gasoline with 87 octane (Ron + Mon)/2 specification	Premium unleaded gasoline with 91 octane (Ron + Mon)/2 specification
		Minimum	Regular unleaded gasoline with 87 octane (Ron + Mon)/2 specification	
		OUTSIDE NORTH AMERICA		
		Recommended	Regular unleaded gasoline with 91 octane RON specification	Premium unleaded gasoline with 95 octane RON specification
		Minimum	Regular unleaded gasoline with 91 octane RON specification	
ADDITIONAL INFORMATION:				

COOLING		GTX	WAKE	GTX SC
Type		Liquid cooled. Closed loop for engine (see also exhaust system)		
Coolant		Ethylene-glycol 50%/50% antifreeze/water. Coolant containing corrosion inhibitors for internal combustion aluminum engines		
Monitoring beeper setting		100°C (212°F)		
ADDITIONAL INFORMATION:				

Section 10 TECHNICAL SPECIFICATIONS
Subsection 01 (GTX, WAKE AND GTX SC MODELS)

PROPULSION		GTX	WAKE	GTX SC
Propulsion system		BOMBARDIER Formula pump		
Jet pump type		Axial flow single stage. Greased bearings		
Impeller rotation (seen from rear)		Counterclockwise		
Transmission		Direct drive		
Coupling type		Crown splines		
Reverse system		Yes		
O.P.A.S. system		Yes		
Grease type		Jet pump bearing grease		
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 (.020 in)		
Impeller outside diameter		155.5 ± 0.06 mm (6.122 ± .0024 in)		
Impeller/wear ring clearance	New	0 - 0.23 mm (0 - .009 in)		
	Wear limit	0.35 mm (.0138 in)		
Impeller shaft end play (new)		0		
Impeller shaft side play		0		
Impeller material		Stainless steel		
ADDITIONAL INFORMATION:				

DIMENSIONS		GTX	WAKE	GTX SC
Number of passenger (driver incl.)		3		
Overall length		331 cm (130 in)		
Overall width		122 cm (48 in)		
Overall height		113 cm (44 in)		
Dry weight		384 kg (847 lb)	393 kg (867 lb)	389 kg (857 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		272 kg (600 lb)		
ADDITIONAL INFORMATION:				

CAPACITIES		GTX	WAKE	GTX SC
Engine oil		3 L (2.7 U.S. qt) oil change w/filter: 4.5 L (4.1 U.S. qt) total		
Cooling system (coolant)		5.5 L (4.8 U.S. qt) total		
Fuel tank (including reserve)		60 L (15.9 U.S. gal)		
Fuel tank reserve (from low level signal)		15 L (4 U.S. gal)		
ADDITIONAL INFORMATION:				

MATERIALS		GTX	WAKE	GTX SC
Hull		Composite fiberglass		
Inlet grate		Aluminum		
Steering cover		Thermoplastic		
Impeller housing/stator		Plastic/plastic		Aluminum/aluminum
Venturi/nozzle		Aluminum/aluminum		
Fuel tank		Polyethylene		
Seat		Polyurethane foam		
ADDITIONAL INFORMATION:				

Section 10 TECHNICAL SPECIFICATIONS
Subsection 01 (GTX, WAKE AND GTX SC MODELS)

PERFORMANCE		GTX	WAKE	GTX SC
Estimated pump power		53 kW (71 HP)		62 kW (83 HP)
Maximum fuel consumption at wide open throttle		43.1 L/h (11.4 U.S. gal/h)		59 L/h (15.6 U.S. gal/h)
Cruising time at full throttle	Fuel tank without reserve	63 minutes		46 minutes
	Fuel tank reserve (from low level signal)	20 minutes		15 minutes
ADDITIONAL INFORMATION:				

Section 10 TECHNICAL SPECIFICATIONS
Subsection 02 (GTX LIMITED AND RXT MODELS)

GTX LIMITED AND RXT MODELS

ENGINE		GTX LIMITED	RXT
Engine type		BOMBARDIER-ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC), liquid cooled Supercharged intercooled	
Lubrication	Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler.	
	Oil type	XP-S 10W-40 4-Stroke oil or an equivalent approved by BRP	
Exhaust system	Type	Water cooled/water injected. Direct flow from propulsion unit	
ADDITIONAL INFORMATION:			

ELECTRICAL		GTX LIMITED	RXT
Magneto generator output		360 W @ 6000 RPM	
Ignition system type		DI (Digital Induction)	
Ignition timing		Not adjustable	
Spark plug	Make and type	NGK DCP8E	
	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 k Ω	
Engine RPM limiter setting		8000 RPM	
Battery		12 V, 30 A•h	
Fuse	TOPS valve	10 A	
	TOPS switch	5 A	
	Battery fuse	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 bilge 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)	
ADDITIONAL INFORMATION:			

Section 10 TECHNICAL SPECIFICATIONS
Subsection 02 (GTX LIMITED AND RXT MODELS)

FUEL SYSTEM		GTX LIMITED	RXT
Fuel injection type		Rotax EMS (engine management system) Multipoint Fuel Injection. Single throttle body (52 mm (2.05 in))	
Fuel pressure		379 - 414 kPa (55 - 60PSI)	
Idle speed (in water/out of water)		1800 ± 50 RPM	
Throttle Position Sensor (TPS)		1.6 kΩ - 2.4 kΩ idle: 710 — 1380 kΩ	
Crankshaft Position Sensor (CPS)		190 Ω - 290Ω	
Camshaft Position Sensor (CAPS)		12 V	
Manifold Air Temperature Sensor (MATS)		2.28 kΩ - 2.74 kΩ	
Coolant Temperature Sensor (CTS)		2.28 kΩ - 2.74 kΩ	
Exhaust Gas Temperature Sensor (EGTS)		2.28 kΩ - 2.74 kΩ	
Manifold Air Pressure Sensor (MAPS)		6040 Ω (terminals 2-1) 5554 Ω (terminals 3-2) 5822 Ω (terminals 3-1)	
Knock Sensor (KS)		5 MΩ	
Oil Pressure Switch (OPS)		0 Ω, if oil pressure is greater than 180 - 220 kPa (26 - 32 PSI)	
Oil Separator Pressure Switch (OSPS)		0 Ω, if blow-by pressure is less than 40 kPa (6 PSI)	
TOPS valve		1.27 Ω - 2.47 Ω	
Fuel injector		11.4 - 12.6 Ω	14 - 15 Ω
Fuel	Type	INSIDE NORTH AMERICA	
		Recommended	Premium unleaded gasoline with 91 octane (Ron + Mon)/2 specification
		Minimum	Regular unleaded gasoline with 87 octane (Ron + Mon)/2 specification
		OUTSIDE NORTH AMERICA	
	Recommended	Premium unleaded gasoline with 95 octane RON specification for optimum performance	
	Minimum	Regular unleaded gasoline with 91 octane RON specification	
ADDITIONAL INFORMATION:			

COOLING		GTX LIMITED	RXT
Type		Liquid cooled. Closed loop for engine (see also exhaust system)	
Coolant		Ethylene-glycol 50%/50% antifreeze/water. Coolant containing corrosion inhibitors for internal combustion aluminum engines	
Monitoring beeper setting		100°C (212°F)	
ADDITIONAL INFORMATION:			

Section 10 TECHNICAL SPECIFICATIONS
Subsection 02 (GTX LIMITED AND RXT MODELS)

PROPULSION		GTX LIMITED	RXT
Propulsion system		BOMBARDIER Formula pump	
Jet pump type		Axial flow single stage. Greased bearings	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Coupling type		Crown splines	
Reverse system		Yes	
O.P.A.S. system		Yes	
Grease type		Jet pump bearing grease	
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 (.020 in)	
Impeller outside diameter		159.0 ± 0.06 mm (6.26 ± .0024 in)	
Impeller/wear ring clearance	New	0 - 0.23 mm (0 - .009 in)	
	Wear limit	0.35 mm (.0138 in)	
Impeller shaft end play (new)		0	
Impeller shaft side play		0	
Impeller material		Stainless steel	
ADDITIONAL INFORMATION:			

DIMENSIONS		GTX LIMITED	RXT
Number of passenger (driver incl.)		3	
Overall length		331 cm (130 in)	
Overall width		122 cm (48 in)	
Overall height		113 cm (44 in)	
Dry weight		397 kg (875 lb)	394 kg (869 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		272 kg (600 lb)	
ADDITIONAL INFORMATION:			

CAPACITIES		GTX LIMITED	RXT
Engine oil		3 L (2.7 U.S. qt) oil change w/filter: 4.5 L (4.1 U.S. qt) total	
Cooling system (coolant)		5.5 L (4.8 U.S. qt) total	
Fuel tank (including reserve)		60 L (15.9 U.S. gal)	
Fuel tank reserve (from low level signal)		15 L (4 U.S. gal)	
ADDITIONAL INFORMATION:			

MATERIALS		GTX LIMITED	RXT
Hull		Composite fiberglass	
Inlet grate		Aluminum	
Steering cover		Thermoplastic	
Impeller housing/stator		Aluminum/aluminum	
Venturi/nozzle		Aluminum/aluminum	
Fuel tank		Polyethylene	
Seat		Polyurethane foam	
ADDITIONAL INFORMATION:			

Section 10 TECHNICAL SPECIFICATIONS
Subsection 02 (GTX LIMITED AND RXT MODELS)

PERFORMANCE		GTX LIMITED	RXT
Estimated pump power		76.3 kW (102 HP)	
Maximum fuel consumption at wide open throttle		69 L/h (18 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	40 minutes	
	Fuel tank reserve (from low level signal)	13 minutes	
ADDITIONAL INFORMATION:			

Section 10 TECHNICAL SPECIFICATIONS
Subsection 03 (RXP MODELS)

RXP MODELS

ENGINE		RXP
Engine type		BOMBARDIER-ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC), liquid cooled Supercharged intercooled
Lubrication	Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler
	Oil type	XP-S 10W-40 4-stroke oil or an equivalent approved by BRP
Exhaust system	Type	Water cooled/water injected. Direct flow from propulsion unit
ADDITIONAL INFORMATION:		

ELECTRICAL		RXP
Magneto generator output		360 W @ 6000 RPM
Ignition system type		DI (Digital Induction)
Ignition timing		Not adjustable
Spark plug	Make and type	NGK DCPR8E
	Gap	0.7 - 0.8 mm (.028 - .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 k Ω
Engine RPM limiter setting		8000 RPM
Battery		12 V, 30 A•h
Fuse	TOPS valve	10 A
	TOPS switch	5 A
	Battery fuse	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 bilge 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	
ADDITIONAL INFORMATION:		

Section 10 TECHNICAL SPECIFICATIONS

Subsection 03 (RXP MODELS)

FUEL SYSTEM			RXP
Fuel injection type			Rotax EMS (engine management system) Multipoint Fuel Injection. Single throttle body (52 mm (2.05 in))
Fuel pressure			386 - 414 kPa (55 - 60 PSI)
Idle speed (in water/out of water)			1800 ± 50 RPM
Throttle Position Sensor (TPS)			1.6 kΩ - 2.4 kΩ idle: 710 — 1380 kΩ
Crankshaft Position Sensor (CPS)			190 Ω - 290Ω
Camshaft Position Sensor (CAPS)			12 V
Manifold Air Temperature Sensor (MATS)			2.28 kΩ - 2.74 kΩ
Coolant Temperature Sensor (CTS)			2.28 kΩ - 2.74 kΩ
Exhaust Gas Temperature Sensor (EGTS)			2.28 kΩ - 2.74 kΩ
Manifold Air Pressure Sensor (MAPS)			6040Ω (terminals 2-1) 5554Ω (terminals 3-2) 5822Ω (terminals 3-1)
Knock Sensor (KS)			5 MΩ
Oil Pressure Switch (OPS)			0 Ω, if oil pressure is greater than 180 - 220 kPa (26 - 32 PSI)
Oil Separator Pressure Switch (OSPS)			0 Ω, if blow-by pressure is less than 40 kPa (6 PSI)
TOPS valve			1.27 Ω - 2.47 Ω
Fuel injector			11.4 Ω - 12.6 Ω
Fuel	Type	Recommended	INSIDE NORTH AMERICA
			Premium unleaded gasoline with 91 octane (Ron + Mon)/2 specification for optimum performance
		Minimum	Regular unleaded gasoline with 87 octane (Ron + Mon)/2 specification
		Recommended	OUTSIDE NORTH AMERICA
Premium unleaded gasoline with 95 octane RON specification for optimum performance			
Minimum	Regular unleaded gasoline with 91 octane RON specification		
ADDITIONAL INFORMATION:			

COOLING		RXP
Type		Liquid cooled. Closed loop for engine (see also exhaust system)
Coolant		Ethylene-glycol 50%/50% antifreeze/water. Coolant containing corrosion inhibitors for internal combustion aluminum engines
Monitoring beeper setting		100°C (212°F)
ADDITIONAL INFORMATION:		

Section 10 TECHNICAL SPECIFICATIONS
Subsection 03 (RXP MODELS)

PROPULSION		RXP
Propulsion system		BOMBARDIER Formula pump
Jet pump type		Axial flow single stage. Greased bearings
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Crown splines
Reverse system		Yes
O.P.A.S. system		Yes
Grease type		Jet pump bearing grease
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 (.020 in)
Impeller outside diameter		159.0 ± 0.06 mm (6.260 ± .0024 in)
Impeller/wear ring clearance	New	0 - 0.23 mm (0 - .009 in)
	Wear limit	0.35 mm (.0138 in)
Impeller shaft end play (new)		0
Impeller shaft side play		0
Impeller material		Stainless steel
ADDITIONAL INFORMATION:		

DIMENSIONS		RXP
Number of passenger (driver incl.)		2
Overall length		307 cm (121 in)
Overall width		122 cm (48 in)
Overall height		109 cm (43 in)
Dry weight		359 kg (792 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		181 kg (400 lb)
ADDITIONAL INFORMATION:		

CAPACITIES		RXP
Engine oil		3 L (2.7 U.S. qt) oil change w/filter: 4.5 L (4.1 U.S. qt) total
Cooling system (coolant)		5.5 L (4.8 U.S. qt) total
Fuel tank (including reserve)		60 L (15.9 U.S. gal)
Fuel tank reserve (from low level signal)		15 L (4 U.S. gal)
ADDITIONAL INFORMATION:		

MATERIALS		RXP
Hull		Composite fiberglass
Inlet grate		Aluminum
Steering cover		Thermoplastic
Impeller housing/stator		Aluminum/aluminum
Venturi/nozzle		Aluminum/aluminum
Fuel tank		Polyethylene
Oil injection reservoir		Polyethylene
Seat		Polyurethane foam
ADDITIONAL INFORMATION:		

Section 10 TECHNICAL SPECIFICATIONS**Subsection 03 (RXP MODELS)**

PERFORMANCE		RXP
Estimated pump power		78 kW (105 HP)
Maximum fuel consumption at wide open throttle		69 L/h (18.2 U.S. gal/h)
Cruising time at full throttle	Fuel tank without reserve	40 minutes
	Fuel tank reserve (from low level signal)	13 minutes
ADDITIONAL INFORMATION:		

ELECTRICAL CONNECTORS

SERVICE TOOLS

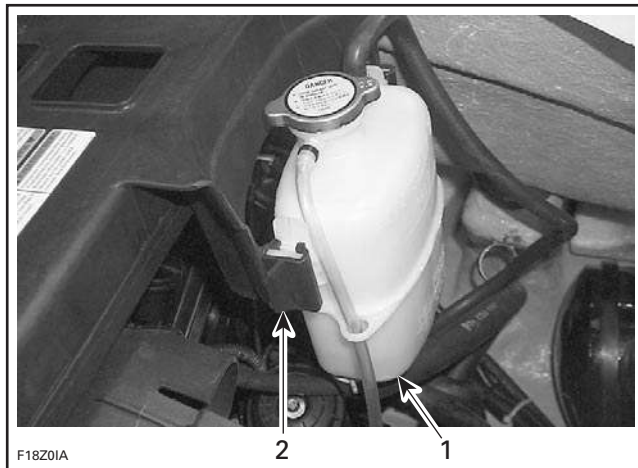
Description	Part Number	Page
crimper die.....	529 035 906	304
crimper die.....	529 035 908	300
crimping pliers	529 035 730	305
crimping tool.....	529 035 909	300, 304

DEUTSCH CONNECTORS

Deutsch connectors are used on some harnesses.

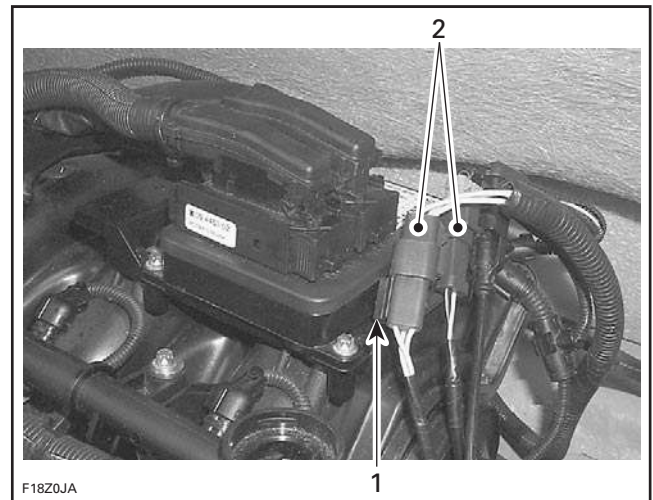
Removal from Engine Connector Bracket

To remove Deutsch connectors from engine connector bracket, remove the expansion coolant tank.

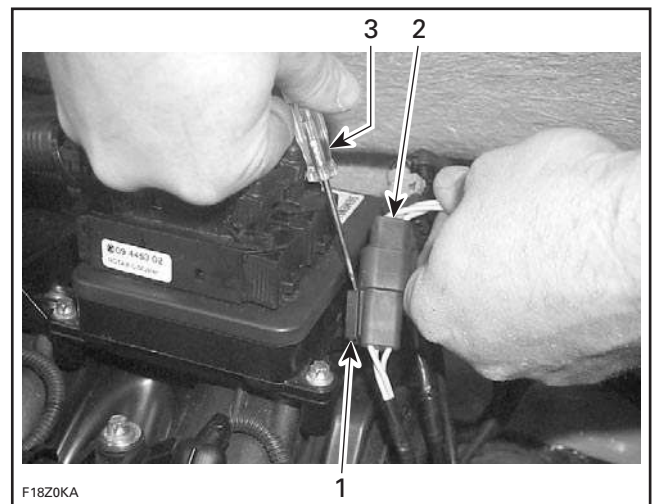


1. Expansion coolant tank
 2. Tank bracket

Slide a flat screwdriver between the connector bracket and the Deutsch connectors and remove connectors.



1. Engine connector bracket
 2. Deutsch connectors

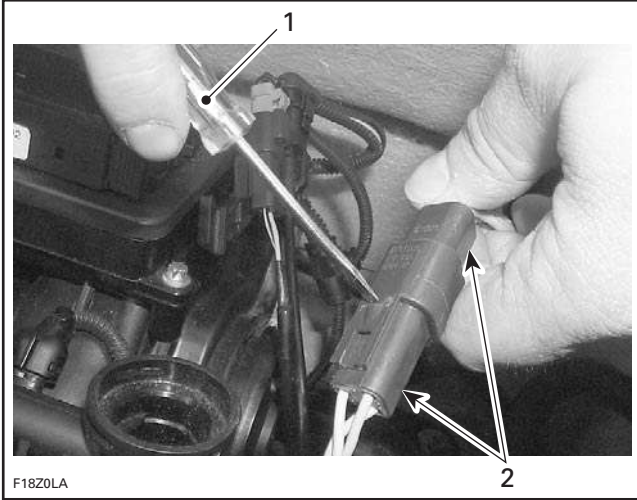


1. Engine connector bracket
 2. Deutsch connectors
 3. Flat screwdriver

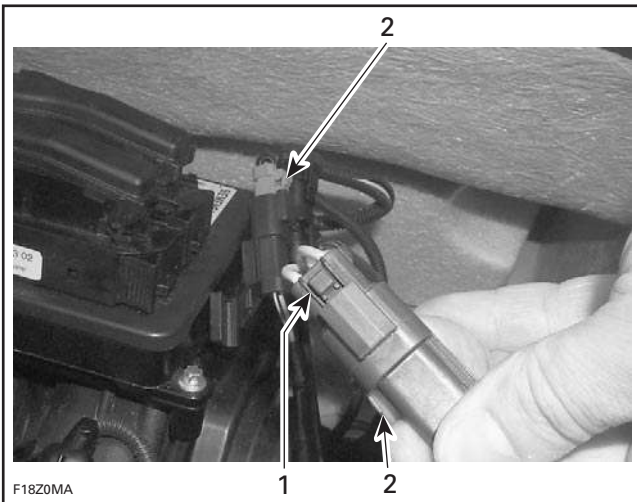
Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)

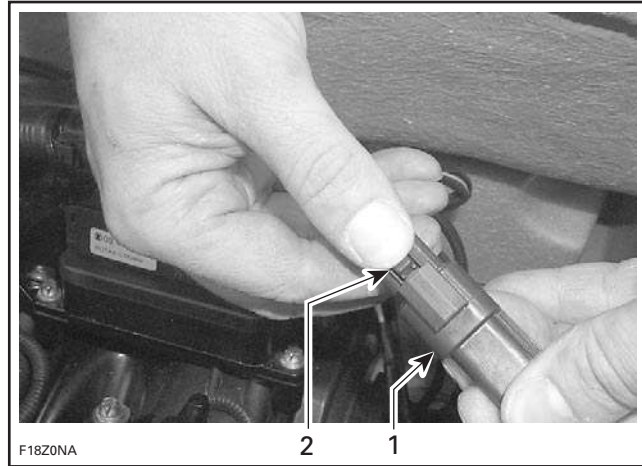
To disconnect the two Deutsch connectors, slide a flat screwdriver between each other to disengage, press the release button and disconnect them.



1. Flat screwdriver
2. Deutsch connectors

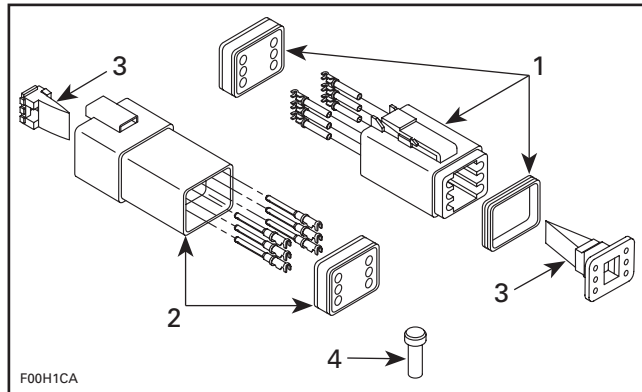


1. Release button
2. Deutsch connectors



1. Deutsch connectors
2. Press release button

Connector Disassembly



1. Male connector
2. Female connector
3. Secondary lock
4. Sealing cap

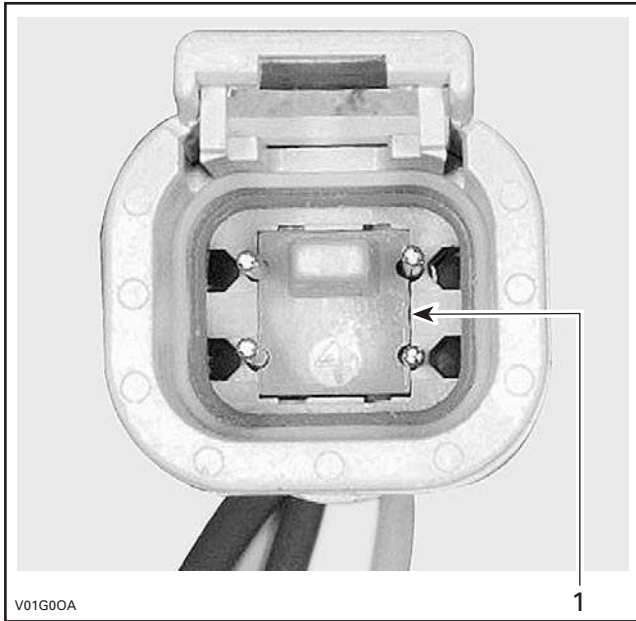
CAUTION: Do not apply dielectric grease on terminal inside connector.

To remove terminals from connector, proceed as follows:

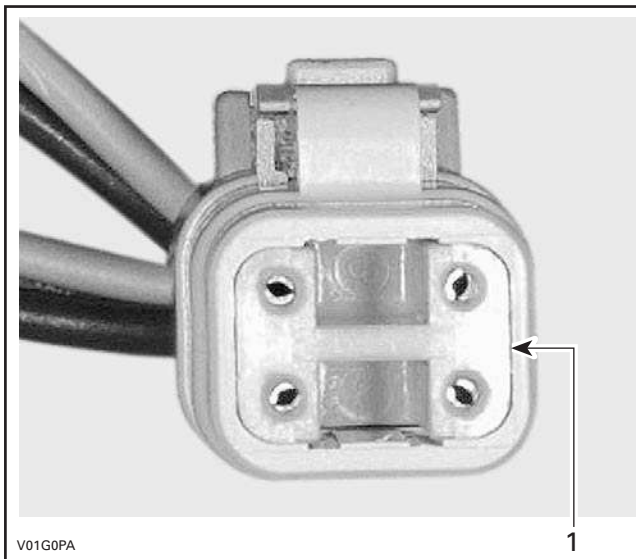
- Using a long nose pliers, pull out the lock.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)



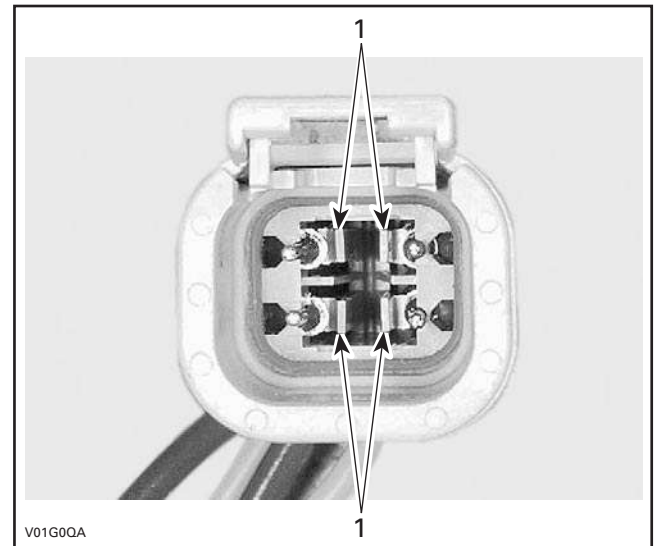
FEMALE CONNECTOR
1. Female lock



MALE CONNECTOR
1. Male lock

NOTE: Before extraction, push wire forward to relieve pressure on retaining tab.

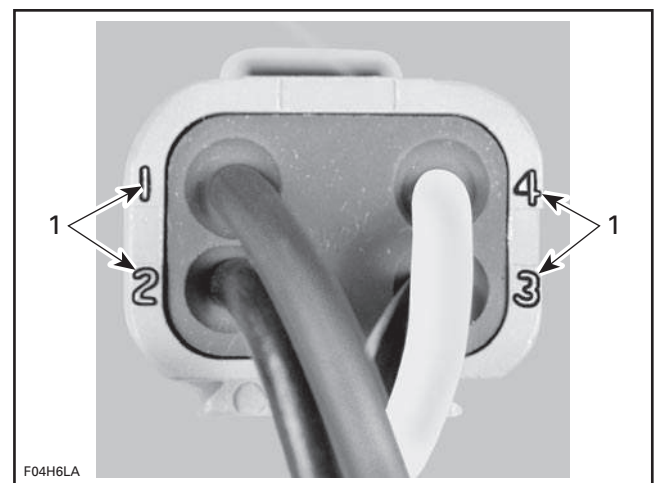
- Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
- Pry back the retaining tab while gently pulling wire back until terminal is removed.



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.



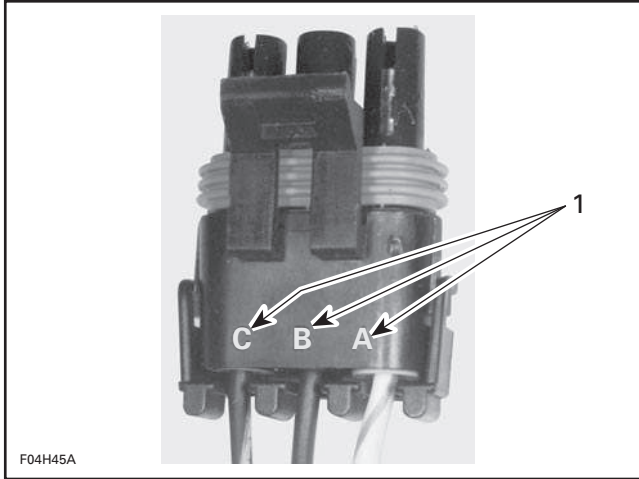
1. Wire identification numbers

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)

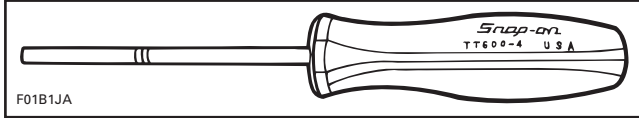
PACKARD CONNECTOR

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

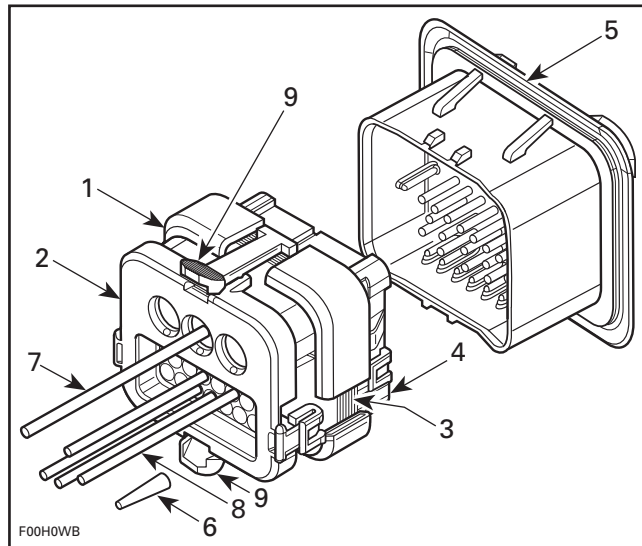
Ensure all terminals are properly crimped on wires and connector are properly fastened.

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

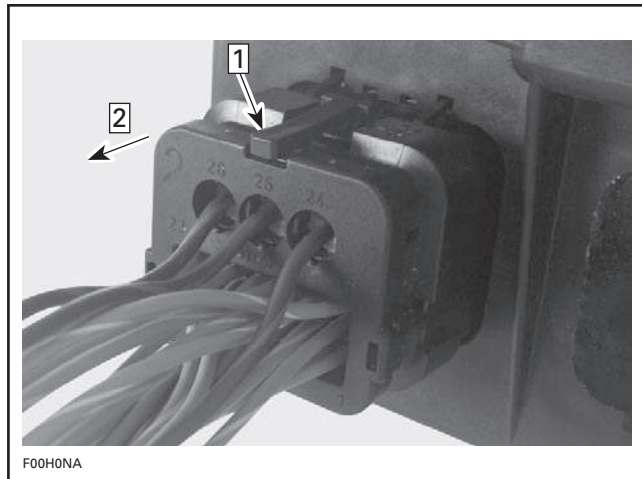


AMP CONNECTOR

1. Male connector
2. Cover assembly
3. Mating seal
4. Wedge lock
5. MPEM connector
6. Seal plug
7. Power wire
8. Signal wire
9. Locking tab

Removal

To remove the male connector from the MPEM, press both tabs and pull connector.



- Step 1: Press tabs (both sides)
Step 2: Pull male connector

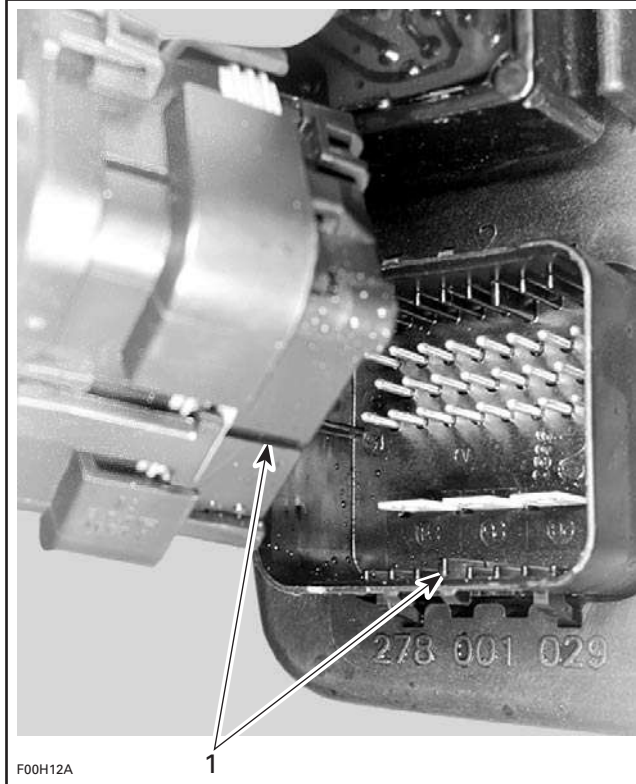
Installation

Do not apply any product to the pins of the connectors on the MPEM.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)

Each male connector is mechanically keyed to mate only with identical mechanical keyed connector on the MPEM.



1. Mechanically keyed

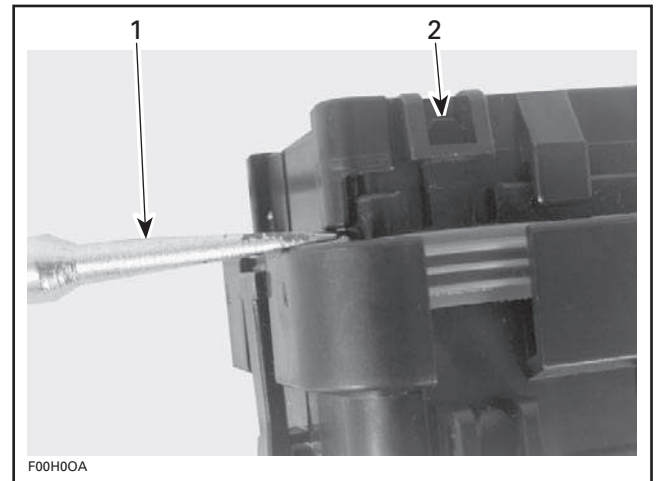
Terminal Removal

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.

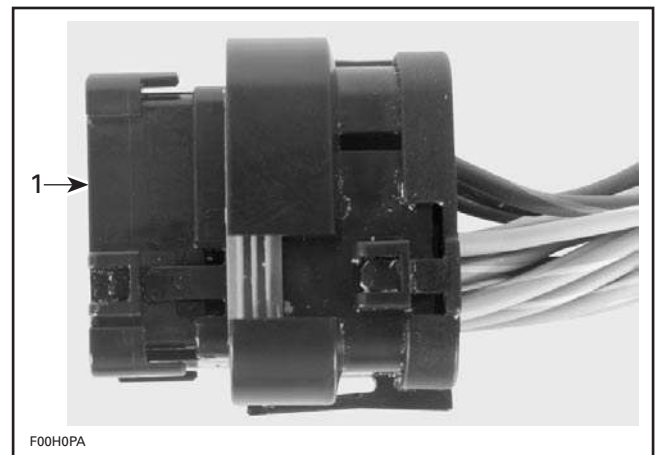
CAUTION: The wedge lock should never be removed from the connector for insertion or removal of the signal wire terminals.



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.

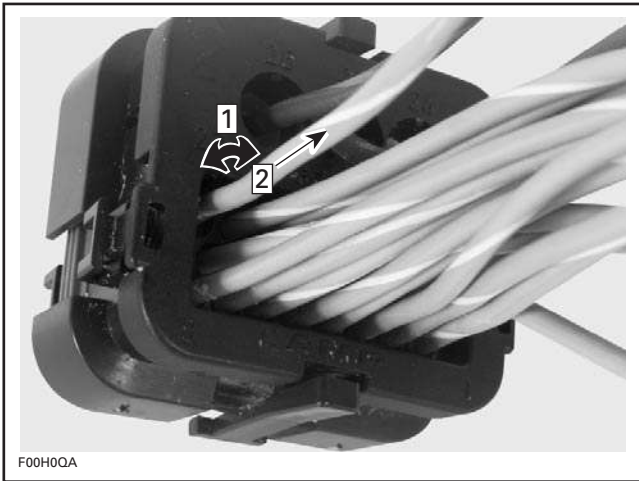


1. Wedge lock opened

While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the terminal is removed.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)



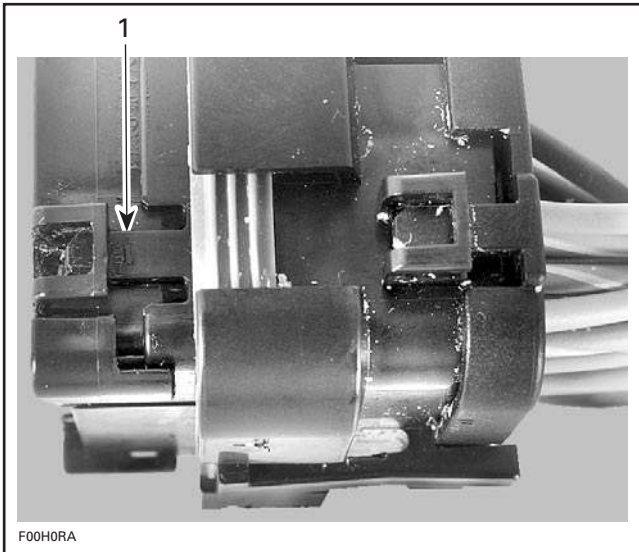
Step 1: Rotate wire back and forth
Step 2: Pull wire

POWER WIRE TERMINAL

NOTE: The wedge lock must be removed to extract power terminal.

Open the wedge lock.

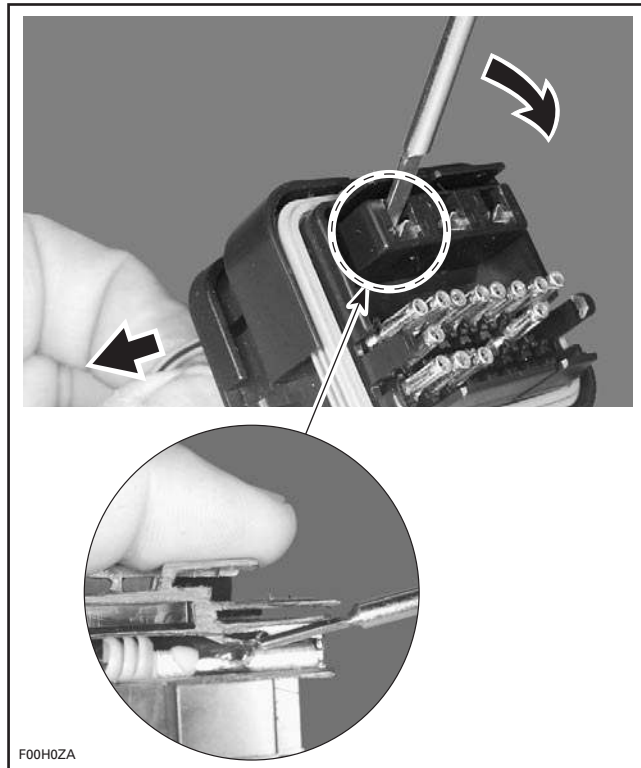
Pull both locking tabs and remove wedge lock from connector.



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.



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).

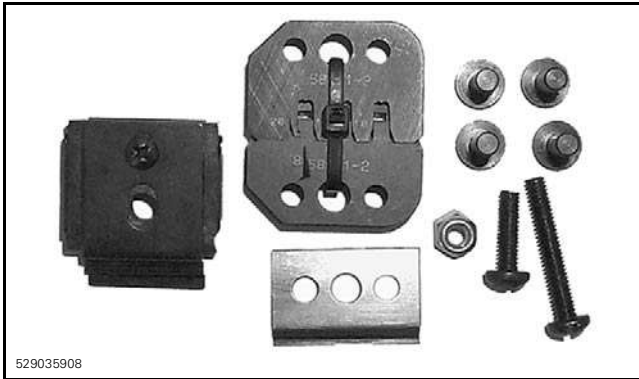
The wire strip length must be 5.1 mm (13/64 in).

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 crimper die (P/N 529 035 908).

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)

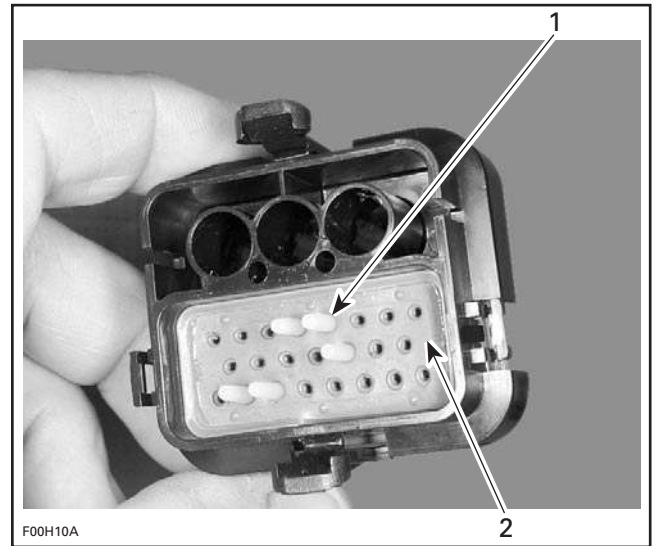


CAUTION: If terminals are not crimped using the proper crimping tool, the wire seal may be damaged.

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.



1. Seal plug
2. Wire seal

CAUTION: Do not pierce the diaphragm with a sharp point when performing electrical troubleshooting. The resulting pinholes in the insulation will allow moisture to penetrate the system and possibly result in system failure.

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.

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.

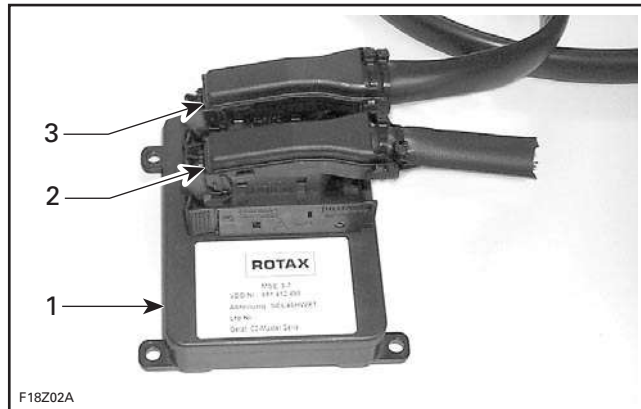
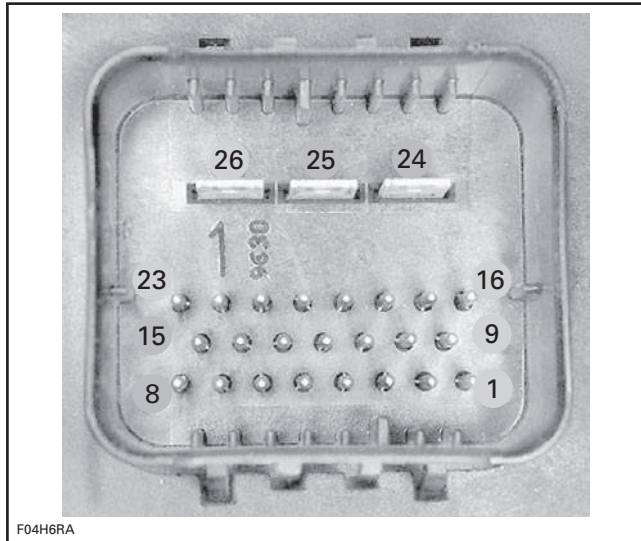
After all required terminals have been inserted, the wedge lock must be closed to its locked position.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)

Terminal Identification

AMP Connectors of MPEM

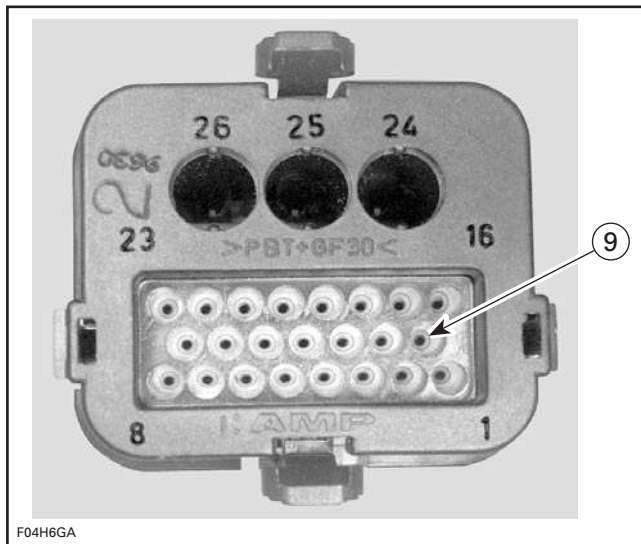


1. ECM
2. A connector (engine harness)
3. B connector (watercraft harness)

For probing techniques and tool, refer to ENGINE MANAGEMENT.

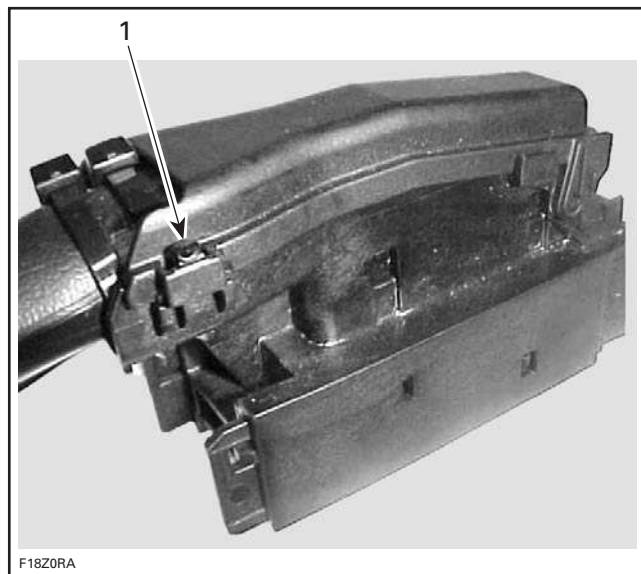
CAUTION: Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected frequently.

AMP Connectors of Wiring Harness



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.



1. Push in tab

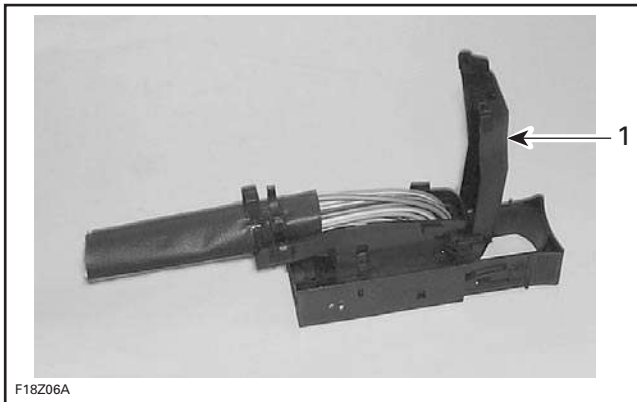
Lift the cover by pushing it forward.

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.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)



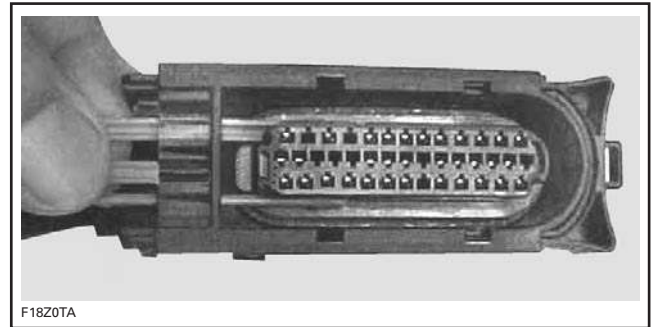
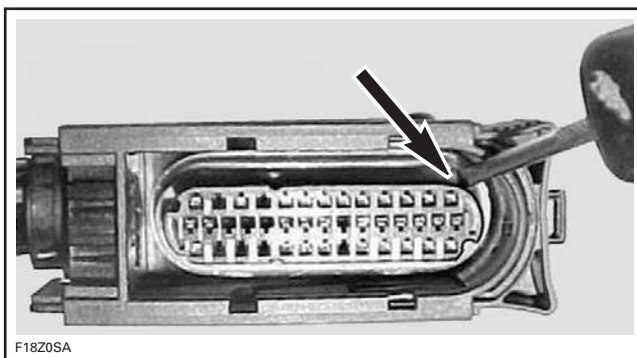
1. Cover

Cut both tie raps that secure the harness to the connector.



1. Tie raps

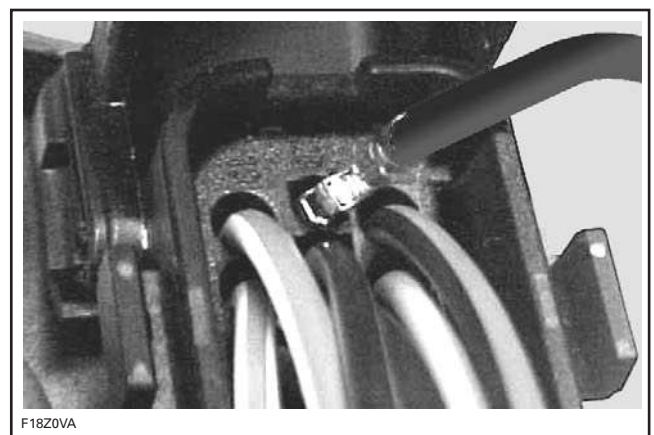
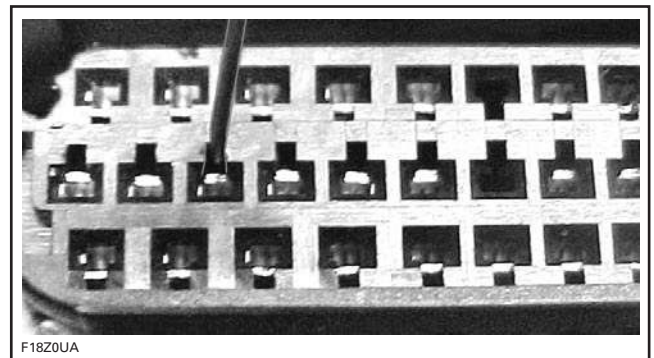
Turn the connector over and remove the orange locking tab by pushing and then pulling toward the wire harness.



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.

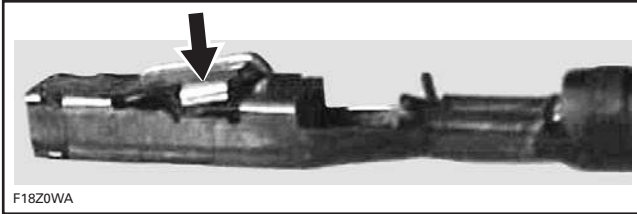
Insert the tool tip into the terminal cavity as shown, and locate its wire in the back of the connector. You may have to pry the tool tip against the locking tab to release it, then remove the terminal from the connector.



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.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

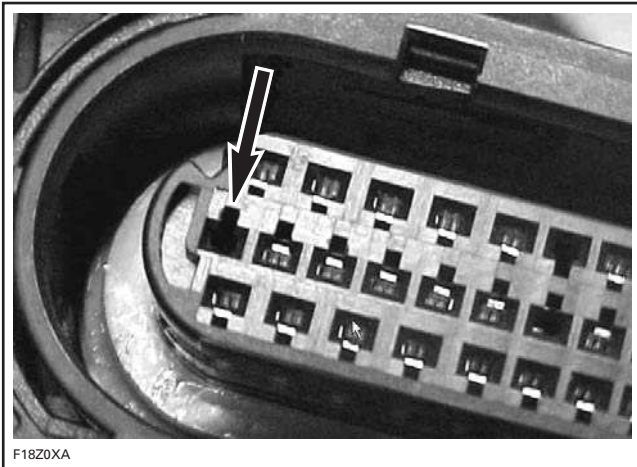
Subsection 01 (ELECTRICAL CONNECTORS)



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.

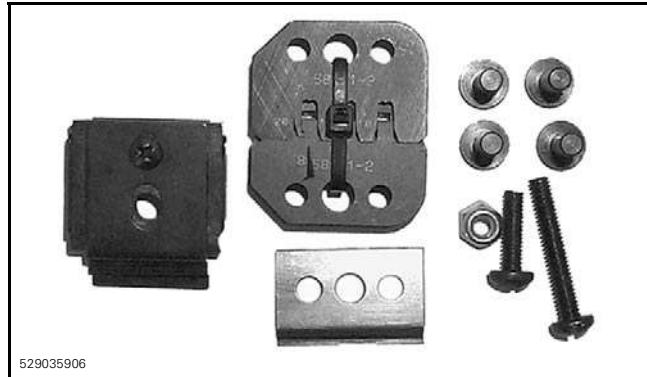


Insert the terminal, ensuring the locking tab snaps into its cavity.

Re-install the orange locking tab, attach the 2 tie raps, and close the connector cover.

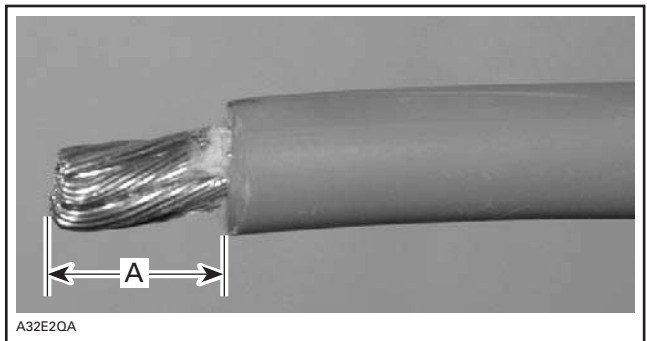
Terminal Crimping (Kostal)

To crimp a new connector terminal, use the crimping tool (P/N 529 035 909) and the crimper die (P/N 529 035 906).



To properly crimp the wires, strictly follow this procedure.

Strip the wire to a maximum of 3 mm (1/8 in).



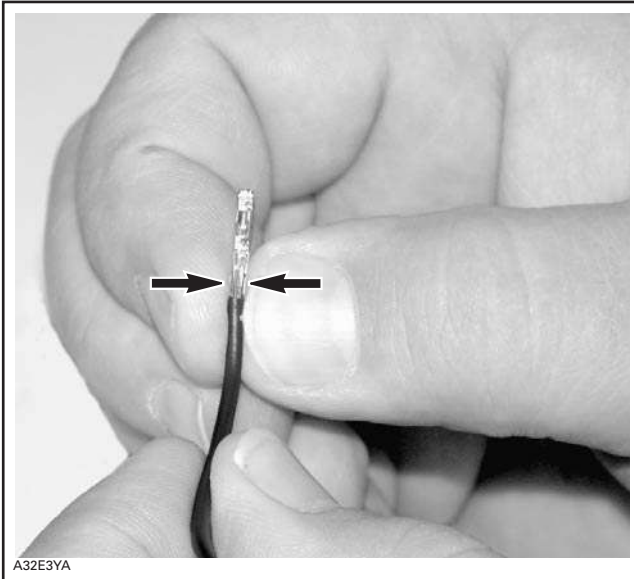
TYPICAL
A. 3 mm (1/8 in) max.

Position wire in terminal.

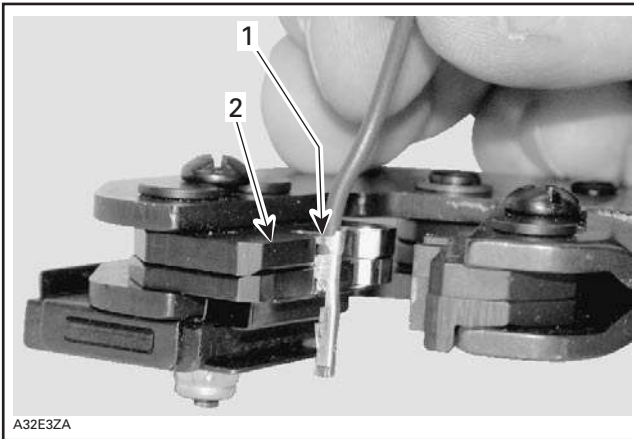
Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)



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.



1. Top of terminal tabs
2. Align tabs with pliers edge

Crimp terminal. Ensure no tiny wire goes out of terminal. This might cause strange problems of the electrical system.

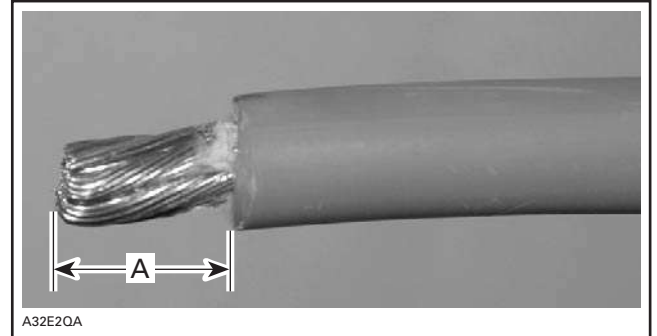
Lubrication

Do not apply any product to the pins of the connector on the ECM.

BATTERY AND STARTER CABLE TERMINALS

Crimping

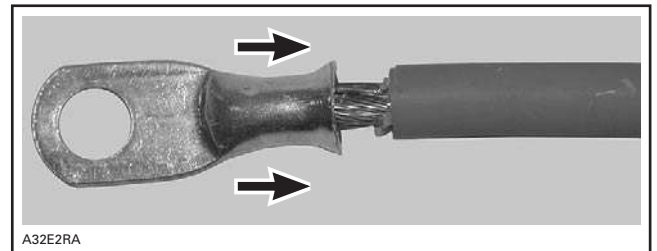
Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.



A. 10 mm (3/8 in)

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

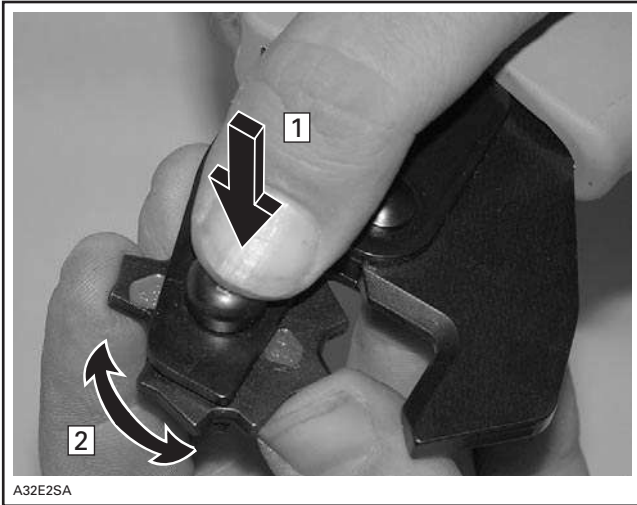
Follow the instructions provided with the crimping pliers (P/N 529 035 730) to select the proper position of the tool.



NOTE: Different wires require different crimping pliers settings, so make sure to follow the instruction supplied with the tool.

Section 11 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

Subsection 01 (ELECTRICAL CONNECTORS)



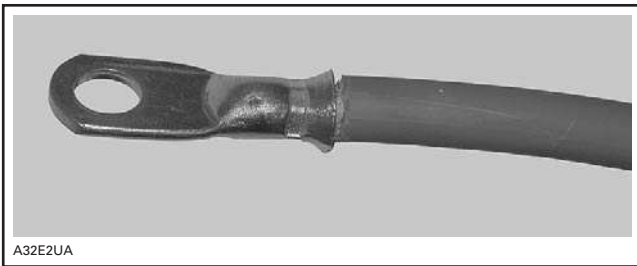
POSITIONING THE CRIMPING PLIERS

- Step 1: Press
Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.



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.

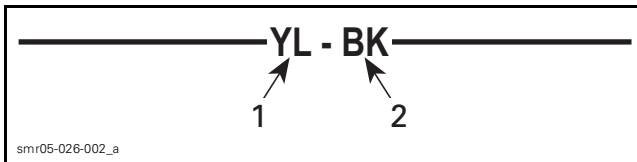
Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

CAUTION: Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.

WIRING DIAGRAMS

NOTE: For wiring diagrams, refer to the end of the manual.

WIRE COLOR CODES

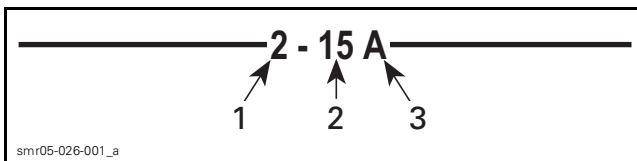


1. Wire main color
2. Tracer (thin colored line)

General Wire Color Use

COLOR	USE
RED	Battery power (12 Vdc directly connected to battery)
RED + tracer	Fused 12 Vdc (from battery)
PURPLE	Continuous power (when there is a programmed key on DESS post)
PURPLE + tracer	Switched power (when there is a programmed key on DESS post)
BLACK	Ground
BLACK + tracer	Switched ground (by DESS post, MPEM, ECM)

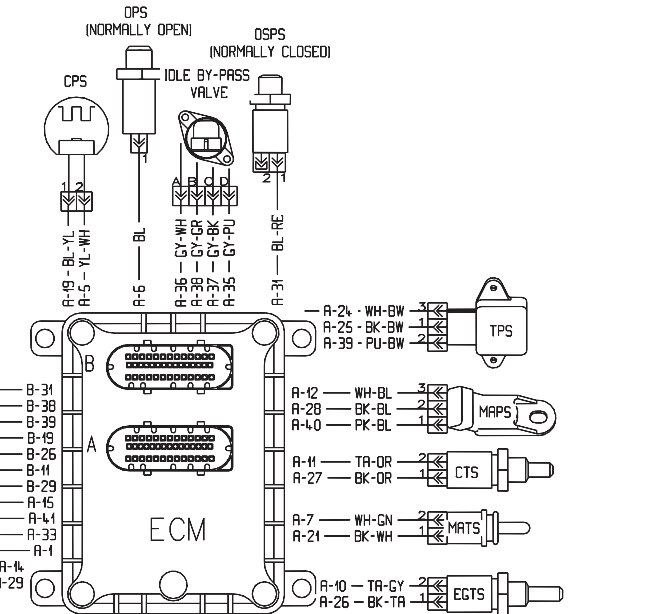
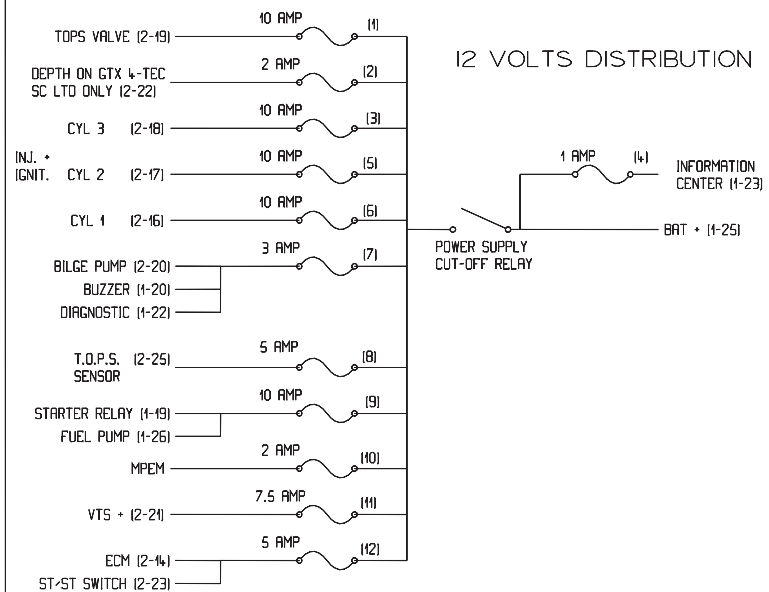
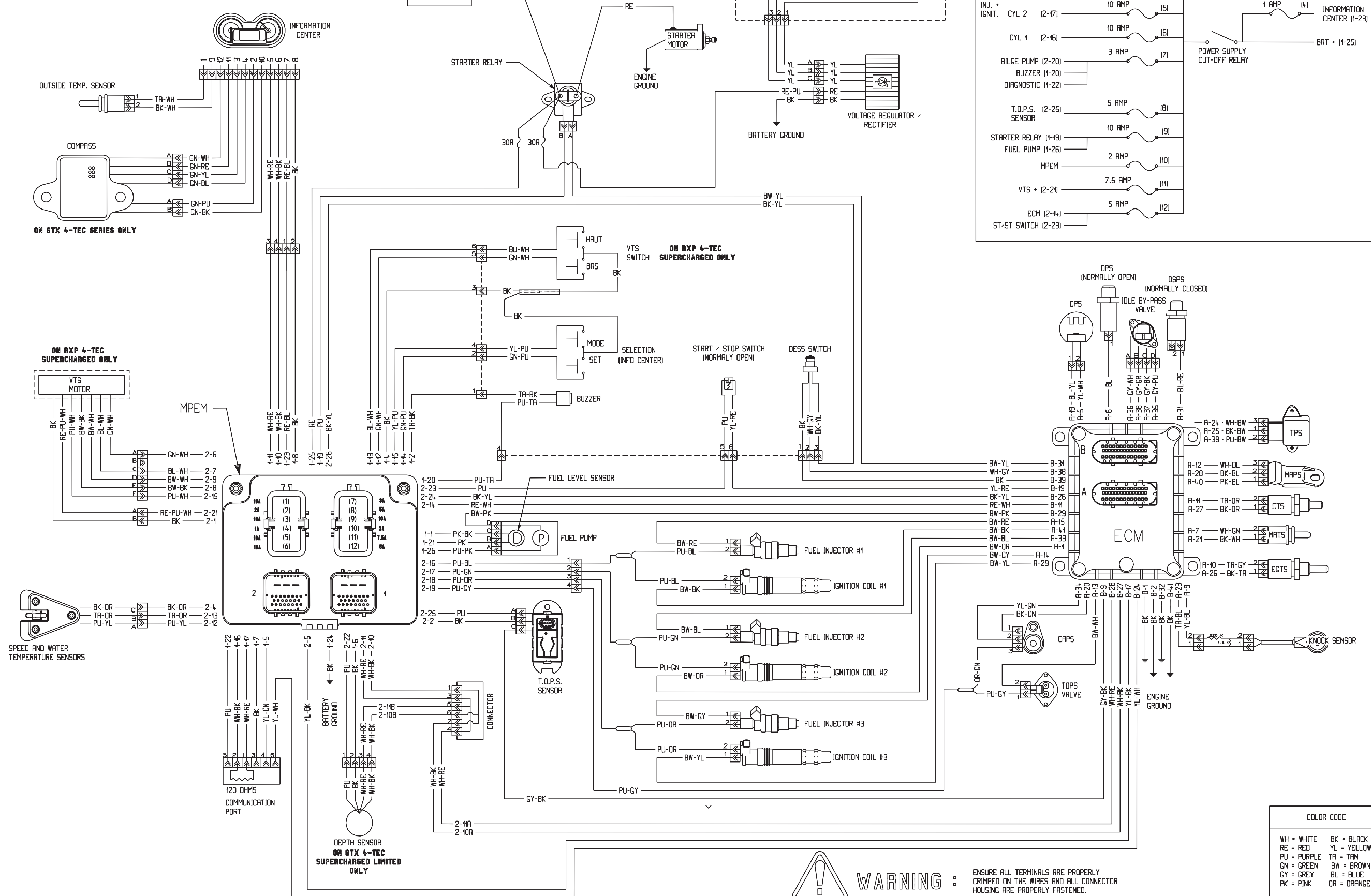
WIRE DIGIT CODES



1. Connector the wire is plugged in
2. Position number of the wire in the connector
3. Common circuit in the MPEM with another wire having the same letter (if applicable)

NOTE: MPEM connectors are numerals (1, 2, etc.) and ECM connectors identification are letters (A, B, etc.).

2005 GTX 4-TEC SERIES, RXT AND RXP 4-TEC SUPERCHARGED



COLOR CODE

WH = WHITE	BK = BLACK
RE = RED	YL = YELLOW
GN = GREEN	TA = TAN
PU = PURPLE	BW = BROWN
GY = GREY	BL = BLUE
PK = PINK	OR = ORANGE

WARNING : ENSURE ALL TERMINALS ARE PROPERLY CRIMPED ON THE WIRES AND ALL CONNECTOR HOUSING ARE PROPERLY FASTENED.



219 100 211

CA

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