SEA-DOO®

BRP

VEHICLE
Shop Manual

2005 2-Strokes
Models

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2005
Vehicle Shop Manual

2-Stroke Models

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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2005 SEA-DOO watercraft as described in the model list of 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.

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 Inc. 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

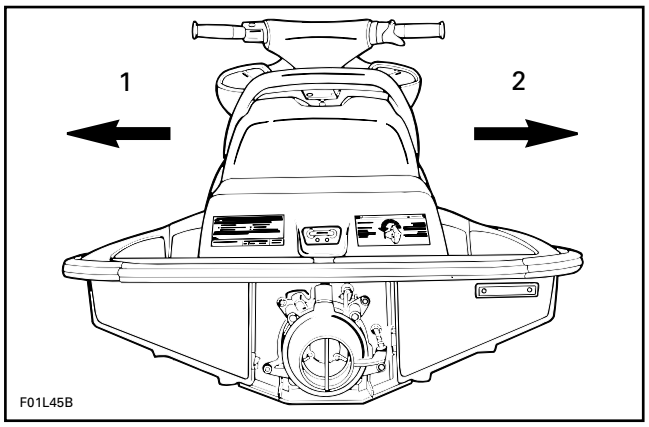
GENERAL INFORMATION

This *VEHICLE SHOP MANUAL* covers the following BRP made SEA-DOO® 2005 watercraft models. It should be used in conjunction with the *717/787 RFI ENGINE SHOP MANUAL*.

MODEL	COLOR	ENGINE TYPE	MODEL NUMBER
3D	Yellow	787 RFI	195A, 195B
3D Premium	Red	787 RFI	205E, 205F
3D Premium	Yellow	787 RFI	205A, 205B
GTI	Yellow	717	105A, 105B
GTI RFI	Yellow	787 RFI	125A, 125B
GTI RFI LE	Yellow	787 RFI	135A, 135B

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.

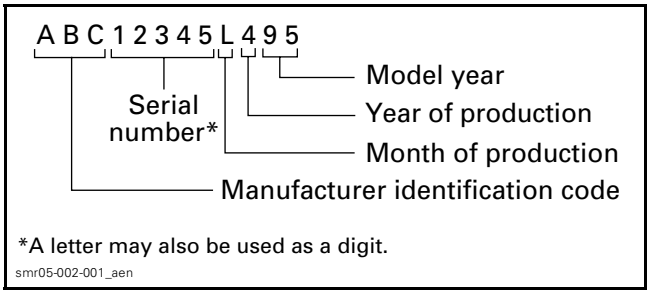
CAUTION: These watercraft are designed with parts dimensioned mostly in the metric system. However some components may be from the imperial system. When replacing fasteners, make sure to use only those recommended by BRP.

This *VEHICLE SHOP MANUAL* uses technical terms which may be slightly different from the ones used in the Parts Catalog.

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

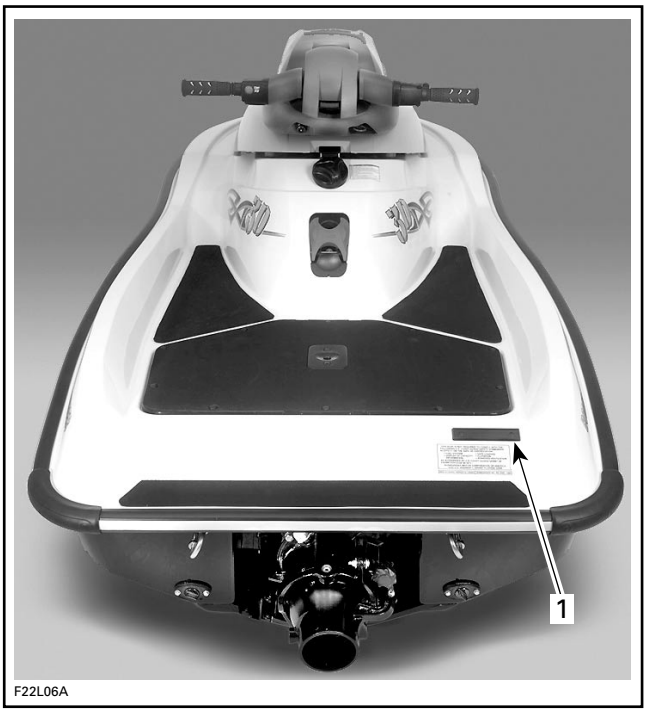
Hull Identification Number (H.I.N.)

The Hull Identification Number is composed of 12 digits:



It is located on footboard at the rear of watercraft.

TYPICAL — GTI SERIES
1. Hull Identification Number (H.I.N.)



TYPICAL — 3D SERIES
1. Hull Identification Number (H.I.N.)

Engine Identification Number (E.I.N.)

Refer to the *717/787 RFI ENGINE SHOP MANUAL*.

ARRANGEMENT OF THIS MANUAL, ILLUSTRATIONS AND PROCEDURES

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

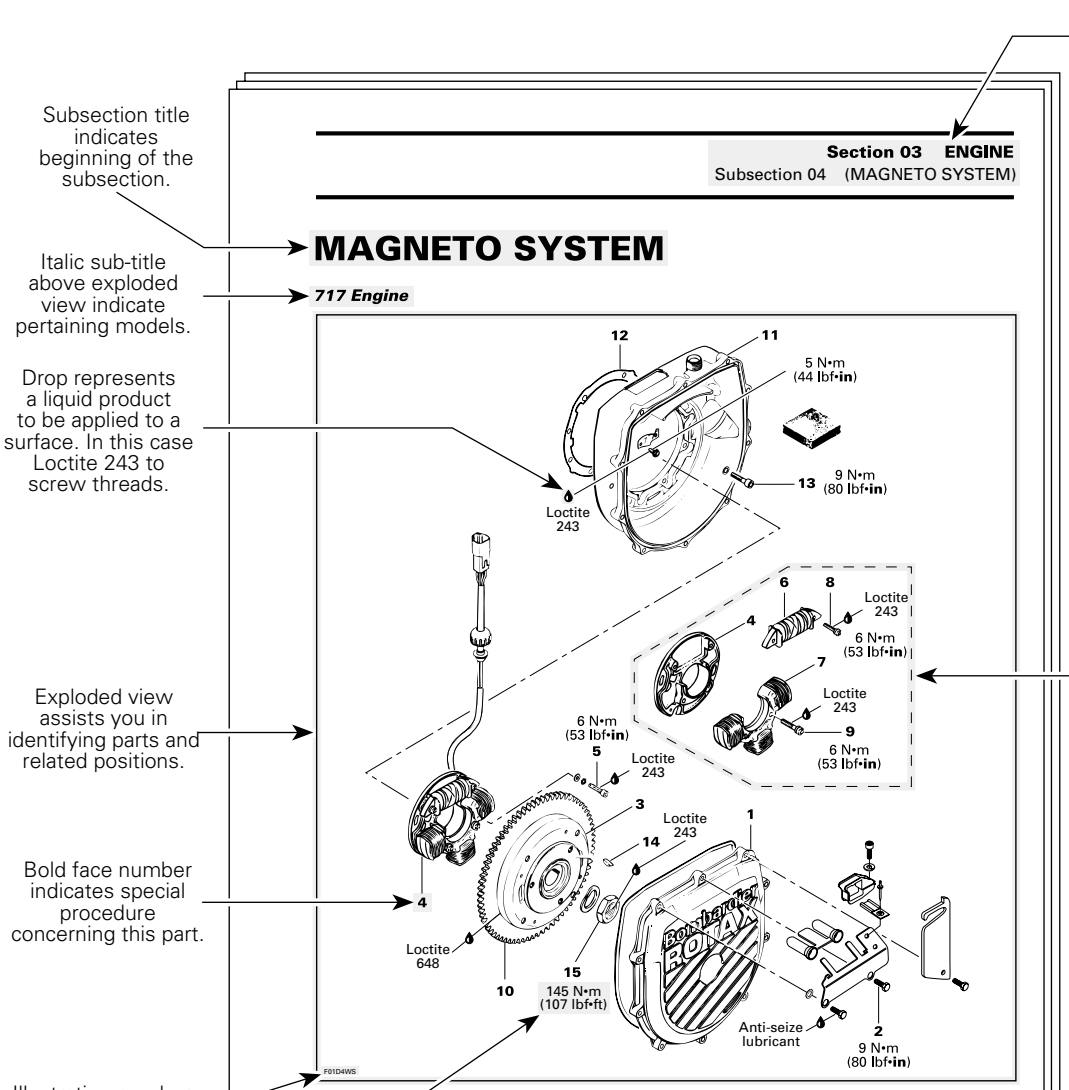
Several sections are divided in various subsections. There is a table of contents at the beginning of many sections.

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.

As many of the procedures in this manual are interrelated, 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.

TYPICAL PAGE



TYPICAL PAGE

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

Title indicates main procedure to be carried-out.

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.

Service tool to be used to perform a certain procedure.

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

Disconnect pulse line from fuel pump.

Disconnect fuel fuel supply line from fuel pump.

Disconnect fuel return line.

Disconnect oil injection pump cable, throttle cable and choke cable.

Title in italic indicates a particular procedure concerning a model.

XP Model Only

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

Sub-sub-title in this case indicates that particular procedure for XP is finished, so from this point, all others models are concerned.

All Others Models

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

NOTE: When removing rotary valve cover, pay attention that the rotary valve stay in place, other-wise 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 dammage (shaft, butterfly, spring screw, check valve housing, etc.).

Diaphragm

PUMP DIAPHRAGM LEAK TEST

Sub-sub-title in capital indicates a particular testing, adjustment or repair procedure.

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).

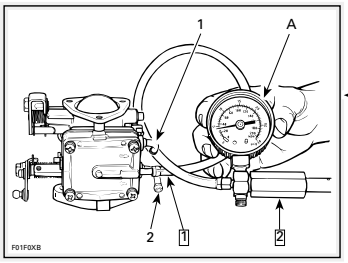


Illustration always follows text it is pertained to.

TYPICAL

"TYPICAL" mention indicates a general view which does not represent full detail.

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.

Numbered step are used to give a sequence to be perfomed.

Letters are used for any measures.

31

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.

F01A0BT

LIST OF 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
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

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/omswww

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, let act during 30 minutes and wipe off. The solventensures the adhesive works properly.

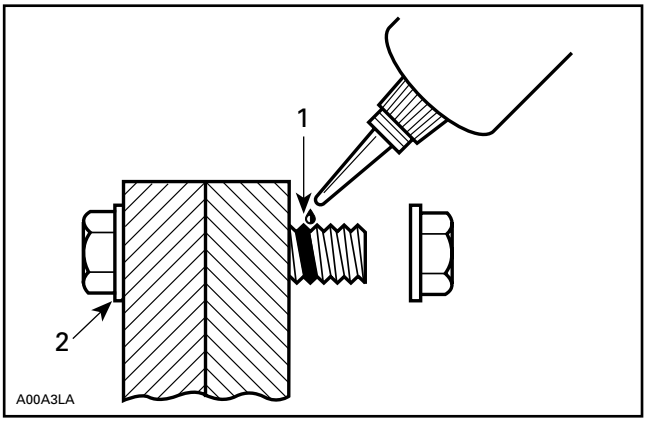
LOCTITE® APPLICATION PROCEDURE

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

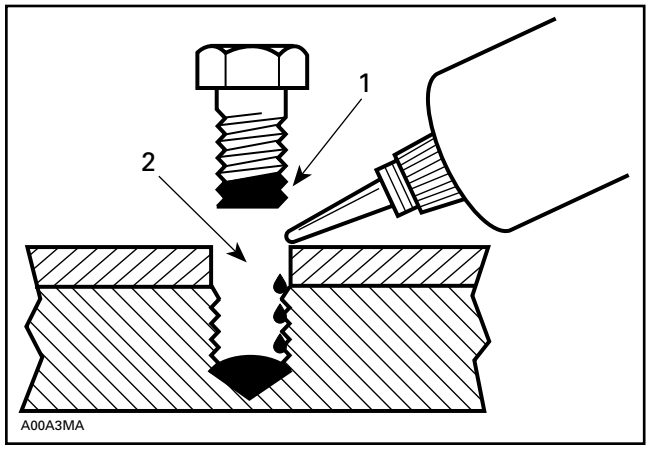
Uncovered Holes (bolts and nuts)



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.

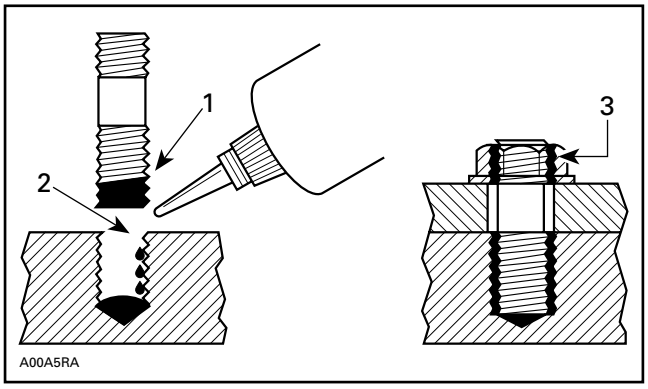
Blind Holes



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.

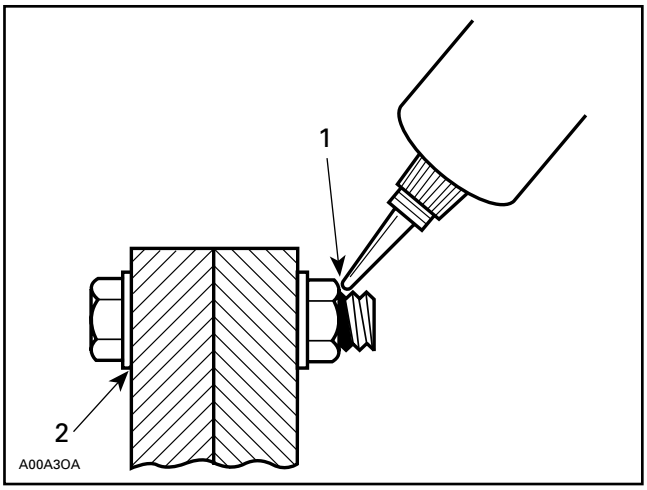
Stud in Blind Holes



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

Pre-assembled Parts

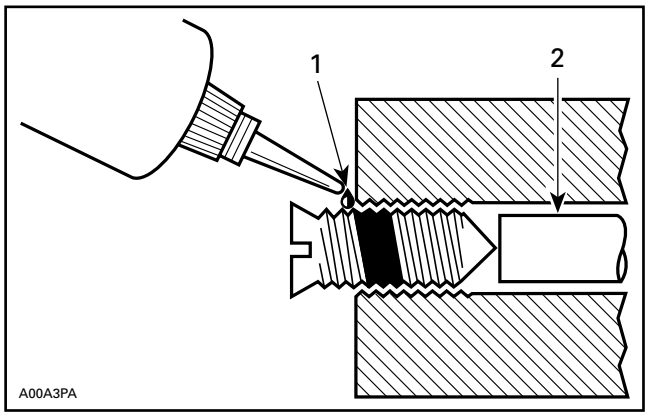


1. Apply here
2. Do not apply

1. Clean bolts and nuts with solvent.
2. Assemble components.
3. Tighten nuts.
4. Apply drops of proper strength Loctite on bolt/nut contact surfaces.
5. 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

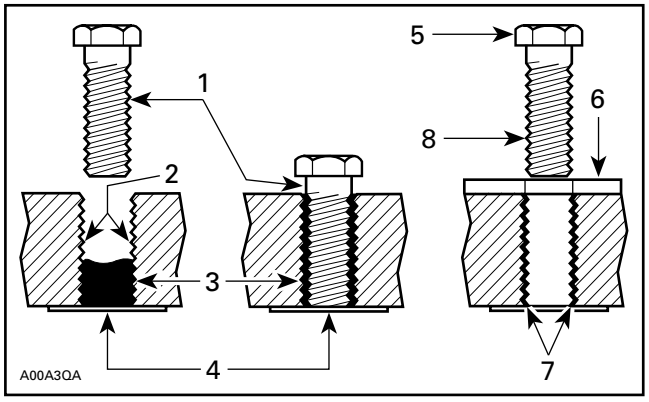


1. Apply here
2. Plunger

1. Adjust screw to proper setting.
2. Apply drops of proper strength Loctite threadlocker on screw/body contact surfaces.
3. 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

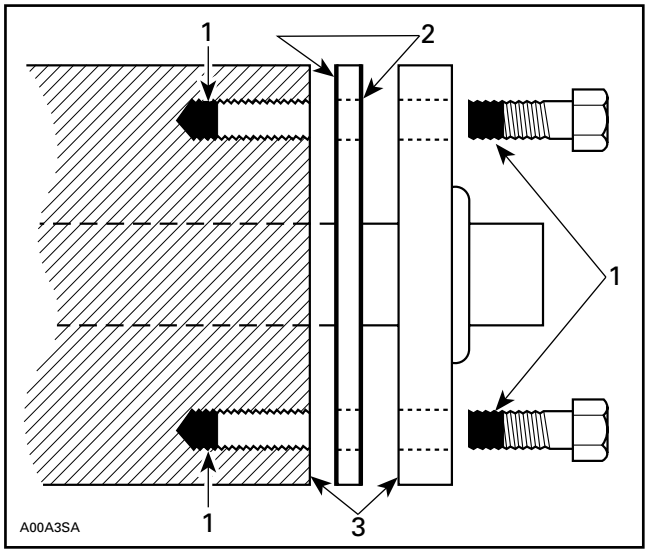
Option 1: Enlarge damaged hole, then follow Standard Thread Repair procedure.

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.

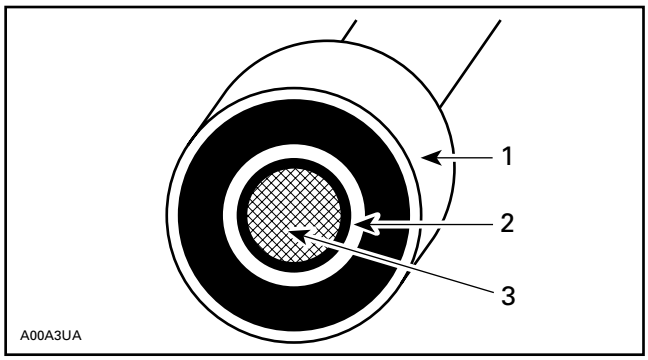
NOTE: If the cover is bolted to blind holes (above), apply proper strength Loctite in the hole and on threads. Tighten.

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

Standard

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

NOTE: Retaining compound is always forced out when applied on shaft.

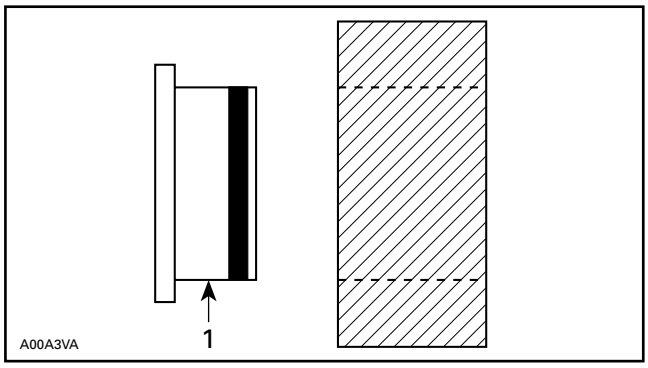
– DO NOT use antiseize Loctite or any similar product.
– No curing period is required.

Mounting in Tandem

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

Case-In Components

Metallic Gaskets



1. Proper strength Loctite

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

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 (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones, where specified. If the efficiency of a locking device is impaired, it must be renewed.

INTRODUCTION

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.

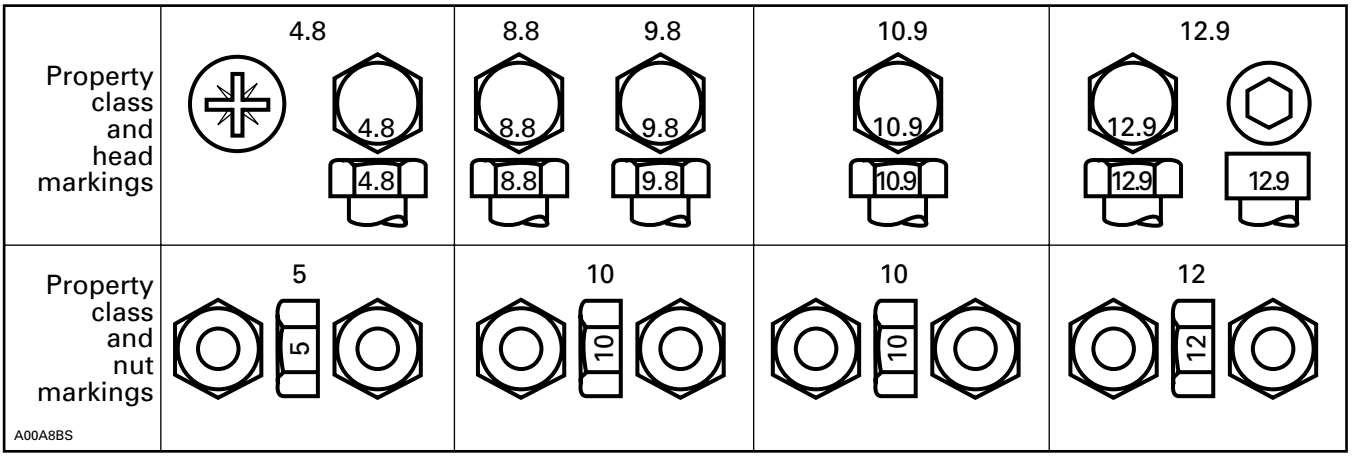
– Apply the half of the recommended torque value.

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.



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: Schedule for watercraft rental operations or higher number of hour use, will require greater frequency of inspection and maintenance.

3D SERIES

A: ADJUST
C: CLEAN
I: INSPECT
L: LUBRICATE
R: REPLACE
T: PROCEED WITH TASK

PART/TASK	FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR	LEGEND
GENERAL					
Lubrication/corrosion protection	(1)		T		(1) Every 10 hours in salt water use.
ENGINE					
Support and rubber mount	I		I		(4) Replace at 150 hours or after 2 years, whichever comes first. (5) Emission-related component.
Seals and fasteners	I		I		
Exhaust system fasteners (5)	I		I		
Expansion pipe				I	
RAVE valve (5)			C	C	
Counterbalance shaft oil level			I	I	
Spark plug (4)(5)	I		R		
Ignition timing (5)				I	
Air intake silencer fit/tightness	I			I	
COOLING SYSTEM					
Flushing		T (3)			(1) Every 10 hours in salt water use. (3) Daily flushing in salt water or foul water use.
Hose and fasteners	I		I		
Engine drain tubes		I (1)			
FUEL SYSTEM					
Throttle cable	(1)	I,A,L			(1) In salt water use. (5) Emission-related component.
Fuel injection system sensors (except throttle body) (5)	I			I	
Throttle body and TPS (5)	I		I		
Fuel lines, fuel rail, fittings, check-valve, relief valve and fuel system pressurization (5)	I	I			
Fuel tank straps	I			I	
LUBRICATION SYSTEM					
Oil injection pump (5)	I			I	(5) Emission-related component.
Oil lines	I	I			
Oil filter	I	I		R	
Oil reservoir straps	I				

3D SERIES

A: ADJUST
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PART/TASK	FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR	LEGEND
ELECTRICAL SYSTEM					
Electrical connections and fastening (ignition system, starting system, fuel injectors etc.) (5)	I			I	(5) Emission-related component.
VCM and ECM mounting support/fasteners			I		
Digitally Encoded Security System and safety lanyard/post	I		I		
Monitoring beeper	I		I		
Battery support/fasteners	I		I		
STEERING SYSTEM					
Steering cable	I,A,L		I,A,L		
Steering pole	I		I		
Handlebar and adjuster operation	I		I		
O.T.A.S. SYSTEM					
O.T.A.S. system operation	I		I		
PROPULSION SYSTEM					
Drive shaft protection bellows			I (2)		(2) These items have to be initially checked after 25 hours. Thereafter, servicing to be made as specified in this chart. (4) Replace at 150 hours or after 2 years, whichever comes first.
Seal carrier	L	L			
Drive shaft/impeller splines			L		
VTS (Variable Trim System) (if so equipped)	I		I		
Jet pump reservoir oil	R	I	R		
Anti-Rattle Pusher in Jet pump cover			I		
Impeller shaft seal				R (4)	
Impeller and impeller/wear ring clearance			I (2)		
Water intake grate			I (2)		
HULL/BODY					
Bailer pick-ups, check for obstructions	I			I	
"Kart" seat (if so equipped)	I		I		
"Moto" seat (if so equipped)	I		I		
Hull	I			I	

GTI SERIES

A: ADJUST
C: CLEAN
I: INSPECT
L: LUBRICATE
R: REPLACE
T: PROCEED WITH TASK

PART/TASK	FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR	LEGEND
GENERAL					
Lubrication/corrosion protection	(1)		T		(1) Every 10 hours in salt water use.
ENGINE					
Support and rubber mount	I		I		(4) Replace at 150 hours or after 2 years, whichever comes first. (5) Emission-related component.
Exhaust system fasteners (5)	I		I		
RAVE valve (if so equipped) (5)			C	C	
Counterbalance shaft oil level (if so equipped)			I	I	
Spark plug (4)(5)	I		R		
Ignition timing (5)				I	
Air intake silencer fit/tightness	I			I	
COOLING SYSTEM					
Flushing		T (3)			(1) Every 10 hours in salt water use. (3) Daily flushing in salt water or foul water use.
Hose and fasteners	I		I		
Engine drain tubes		I (1)			
Water flow regulator valve (if so equipped)				I	
FUEL SYSTEM					
Throttle/choke cables (carburetor equipped models)	(1)			I,A,L	(1) In salt water use. (5) Emission-related component.
Fuel filter (except RFI models)	I	I		R	
Fuel injection system sensor (except throttle body) (RFI models)	I			I	
Fuel lines, connections (RFI), check-valve, relief valve and fuel system pressurization (5)	I	I			
Carburetor/throttle body (RFI), fuel rail and fittings (if so equipped) (5)	I		I		
Fuel tank straps	I			I	
LUBRICATION SYSTEM					
Oil injection pump (5)	I			I	(5) Emission-related component.
Oil lines	I	I			
Oil filter	I	I		R	
Oil reservoir straps	I				

GTI SERIES

A: ADJUST
C: CLEAN
I: INSPECT
L: LUBRICATE
R: REPLACE
T: PROCEED WITH TASK

PART/TASK	FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR	LEGEND
ELECTRICAL SYSTEM					
Electrical connections and fastening (ignition system, electrical box, starting system, fuel injectors (RFI), etc.) (5)	I			I	(5) Emission-related component.
VCM mounting brackets/fasteners			I		
Digitally Encoded Security System	I		I		
Monitoring beeper	I		I		
Battery and strap(s)/fasteners	I		I		
STEERING SYSTEM					
Steering cable	I		I		
O.P.A.S. SYSTEM					
O.P.A.S. system (if so equipped)	I		I		
PROPULSION SYSTEM					
Drive shaft/impeller splines			I (2)		(2) These items have to be initially checked after 25 hours. Thereafter, servicing to be made as specified in this chart. (4) Replace at 150 hours or after 2 years, whichever comes first.
Drive shaft bellow			I (2)		
PTO flywheel	L	L			
Shifter system/cable (if so equipped)	I			I	
Jet pump reservoir oil and oil level			I	R	
Jet pump cover pusher (if so equipped)				I	
Impeller shaft seal				R (4)	
Impeller and impeller/wear ring clearance				I (2)	
Water intake grate			I (2)		
HULL/BODY					
Bailer pick-ups, check for obstructions	I			I	
Hull	I			I	

PRESEASON PREPARATION

PRESEASON PREPARATION	TO BE PERFORMED BY DEALER	TO BE PERFORMED BY CUSTOMER	MODELS	REFER TO
GENERAL				
Lubrication/corrosion protection		✔	All models	Storage
Spark plugs replacement (1)	✔			Ignition System
ENGINE				
Exhaust system condition (fasteners, hoses, etc.)	✔		All models	Exhaust System
Rave valve cleaning (if so equipped)	✔		All RFI models	Appropriate shop manual for this engine
Counterbalance shaft oil level (if so equipped)	✔		All models	
Ignition timing	✔		All RFI models	Ignition System
COOLING SYSTEM				
Inspection of cooling system hoses and components (3)	✔		All models	Cooling System
FUEL SYSTEM				
Carburetor adjustment	✔		GTI	Carburetor
Throttle and choke cable inspection/adjustment (2)	✔			
Fuel filter replacement	✔			Fuel tank and fuel pump
Throttle cable inspection/adjustment	✔		All RFI models	Engine Management
Fuel injection sensors verification	✔			
Fuel filter replacement	✔			Fuel tank and fuel pump
Filler neck, fuel tank, fuel tank straps, fuel cap, check valves, lines, fasteners condition and fuel system pressurization (2)	✔		All models	
High pressure test (fuel pump circuit)	✔		All RFI models	
Refill fuel tank		✔	All models	Refer to the appropriate Operator's Guide
LUBRICATION SYSTEM				
Oil injection pump adjustment and bleeding	✔		All models	Oil Injection Pump
Oil filter replacement	✔			Oil Injection System
Oil injection reservoir straps condition		✔		
Oil injection reservoir filling		✔		Refer to the appropriate Operator's Guide

PRESEASON PREPARATION	TO BE PERFORMED BY DEALER	TO BE PERFORMED BY CUSTOMER	MODELS	REFER TO
TASK				
ELECTRICAL SYSTEM				
Battery condition/charging and installation	✔		All models	Charging System
Battery, starter connections and routing (2)	✔			
Digitally Encoded Security System (DESS) and monitoring beeper	✔			DESS
STEERING SYSTEM				
Steering system adjustment/inspection (2)	✔		All models	Steering System
Steering pole condition	✔		3D Series	
Handlebar and adjuster condition	✔			
O.P.A.S. SYSTEM				
Check O.P.A.S. system condition	✔		GTI Series	O.P.A.S.
O.T.A.S. SYSTEM				
Check O.T.A.S. system condition	✔		3D Series	O.T.A.S.
PROPULSION SYSTEM				
Shifter system condition and cable adjustment	✔		GTI Series	Reverse System
Variable Trim System (VTS)	✔		3D Series	VTS System
Propulsion system inspection	✔		All models	Jet Pump
Jet pump oil replacement	✔			
HULL/BODY				
Inspection of bailer pick-ups	✔		All models	Special Procedures
"Kart" seat condition (if so equipped)	✔		3D Series	Hull and Body
"Moto" seat condition (if so equipped)	✔			

(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 adapter	295 500 473	10
large hose pincher	529 032 500	12, 14–15
small hose pincher	295 000 076	12–13, 15

SERVICE PRODUCTS

Description	Part Number	Page
Bombardier Lube	293 600 016	7, 10–11, 17
fuel stabilizer	413 408 600	7
jet pump synthetic oil	293 600 011	8
Loctite antiseize lubricant	293 800 070	11
synthetic grease	293 550 010	8

FUEL SYSTEM

⚠ WARNING

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

Throttle Cable

Lubricate the throttle cable with Bombardier Lube (P/N 293 600 016).

Fuel Hoses, Carburetor or Injectors

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

Fuel Stabilizer

The fuel stabilizer (P/N 413 408 600) or an equivalent should be added in fuel tank to prevent fuel deterioration and, if so equipped, carburetor 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 system.

OIL INJECTION SYSTEM

Lubricate the oil pump cable with Bombardier Lube (P/N 293 600 016).

PROPULSION SYSTEM

Jet Pump

Lubricant in impeller shaft reservoir should be drained. Reservoir should be cleaned and refilled with jet pump synthetic oil (P/N 293 600 011). Refer to JET PUMP for proper procedure.

CAUTION: Use only jet pump oil or equivalent synthetic gear oil, otherwise component service life could be reduced. Do not mix oil brands or types.

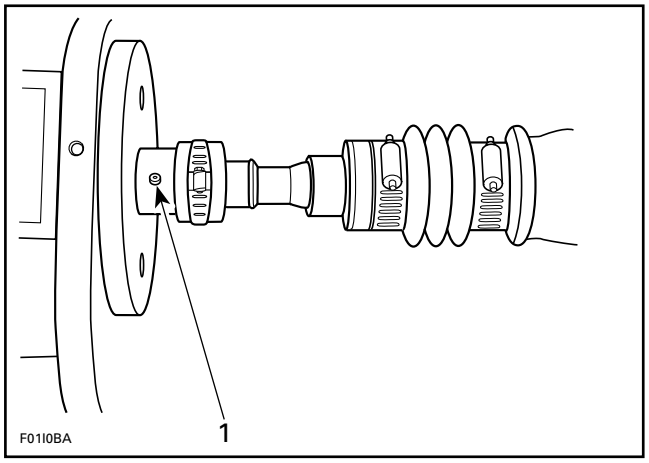
PTO Flywheel

All Models Except 3D RFI

Remove PTO flywheel guard.

Lubricate PTO flywheel at grease fitting with synthetic grease (P/N 293 550 010).

CAUTION: Do not lubricate excessively. Immediately stop when a slight movement is noticed on rubber boot.



1. Grease PTO flywheel

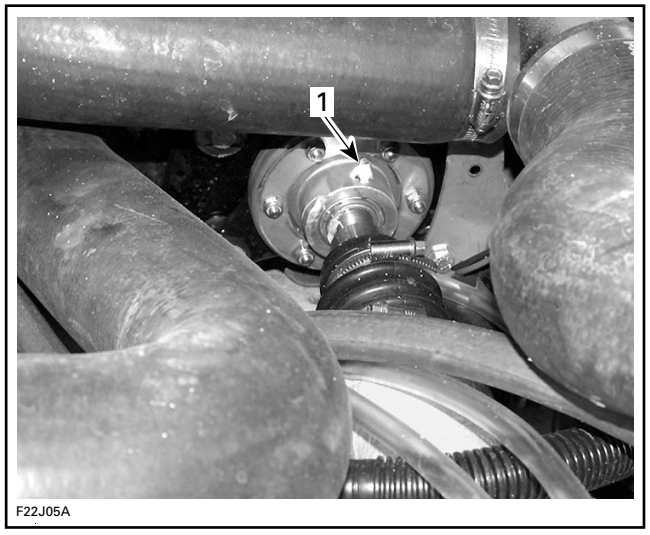
CAUTION: Never leave any clothing, tool or other objects near PTO flywheel and drive shaft.

Seal Carrier

3D RFI Models

Remove rear access cover.

Lubricate seal carrier of drive shaft support with synthetic grease (P/N 293 550 010). Stop lubricating when grease is just coming out of seal.



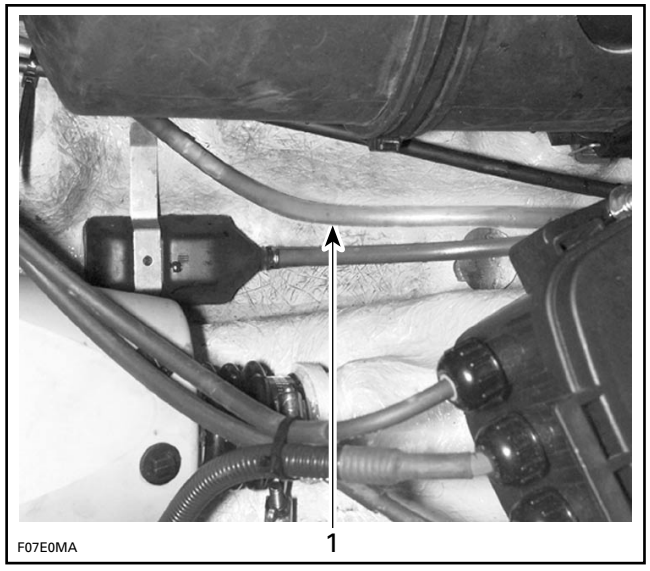
1. Grease seal carrier

ENGINE AND EXHAUST SYSTEM

Engine Draining

Check engine drain hose (lowest hose of engine). Make sure there is no sand or other particles in it and that it is not obstructed so that water can exit the engine. Clean hose and fitting as necessary.

CAUTION: Water in engine drain hose must be free to flow out, otherwise water could be trapped in engine. Should water freeze in engine, severe damage will occur. Check engine drain hose for obstructions.



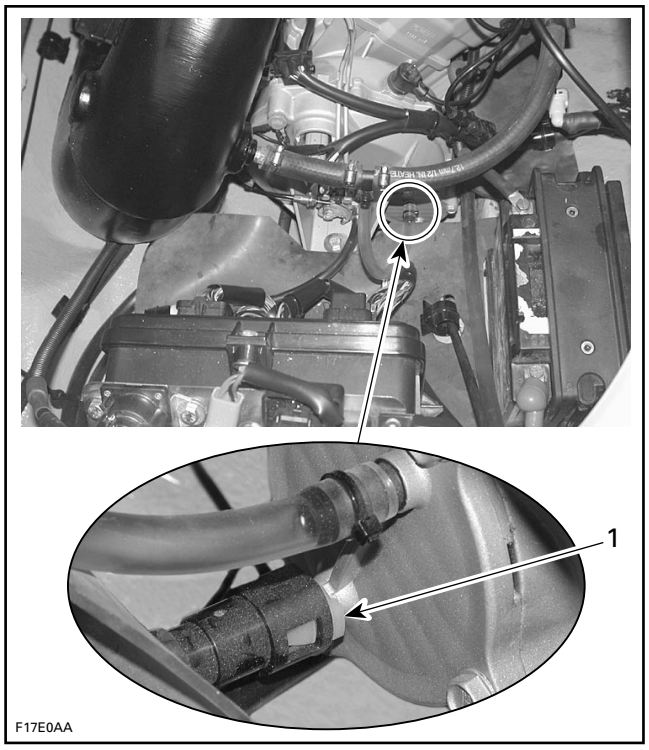
TYPICAL
1. Engine drain hose

Models with 787 RFI Engines

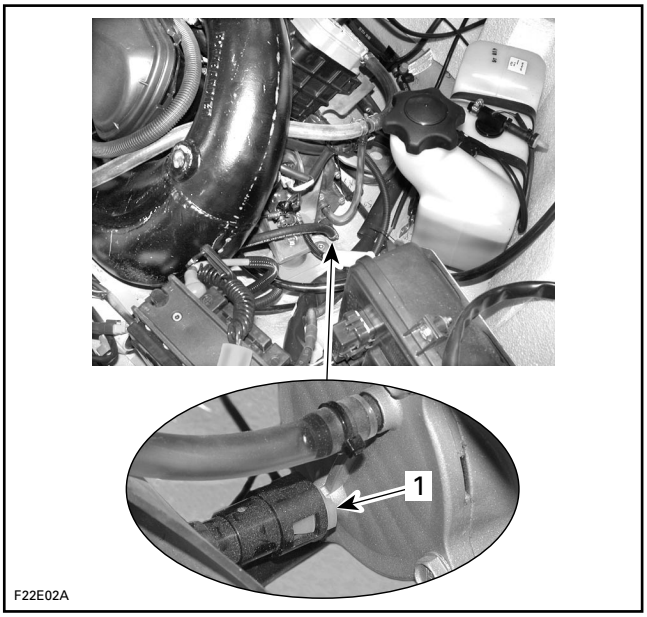
Remove seat (GTI RFI and GTI RFI LE) or engine cover (3D Series).

At the front of engine, disconnect the water supply hose used to cool the magneto. It features a quick connect fitting. Press both tabs and pull fitting in order to disconnect hose.

This hose is located at the bottom of the magneto cover beside the engine support.



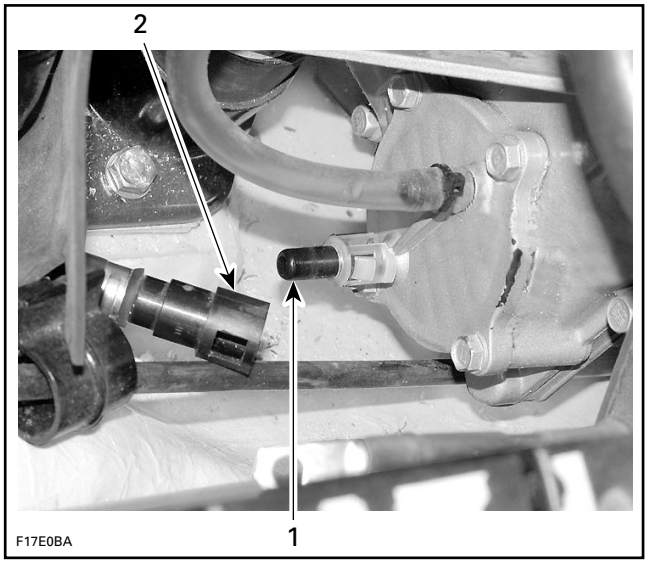
GTI RFI AND GTI RFI LE
1. Press tabs here and disconnect hose



3D SERIES
1. Press tabs here and disconnect hose

Water should flow out of the fitting (magneto cooling circuit) and hose (crankcase heat exchanger). Push and hold hose against bilge so that draining can take place.

NOTE: It may be necessary to position the end of the hose in a lower area of the bilge to allow proper drainage.



1. Fitting
2. Hose

CAUTION: Water in heat exchanger system must be free to flow out. Should water freeze in engine, severe damage will occur.

Reconnect hose when done.

Cooling System Flushing and Engine Lubrication

Flushing the 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 (engine, exhaust manifold, tuned pipe) and/or hoses.

Cooling system flushing and engine internal lubrication should be performed when the boat is not expected to be used further the same day or when the boat is stored for any extended time.

CAUTION: Failure to flush cooling system, when necessary, will severely damage engine and/or exhaust system. Never flush a hot engine. Make sure engine operates during entire procedure.

⚠ WARNING

Perform this operation in a well ventilated area. Do not touch any electrical parts or jet pump area when engine is running. Components inside engine compartment may be hot.

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

Proceed as follows:

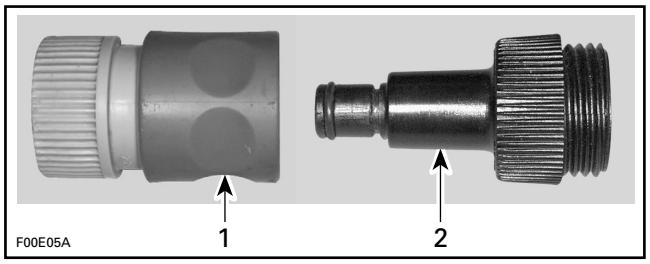
Clean jet pump by spraying water in its inlet and outlet and then apply a coating of Bombardier Lube (P/N 293 600 016) or an equivalent.

⚠ WARNING

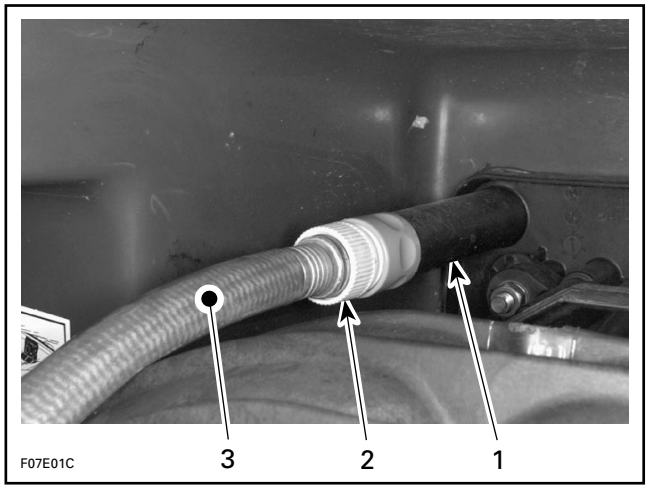
Always remove safety lanyard cap from post to prevent unexpected engine starting before cleaning the jet pump area. Engine must not be running for this operation.

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

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

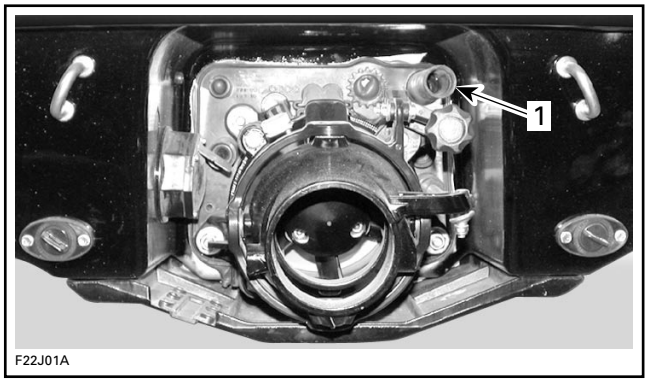


1. Quick connect adapter
2. Flushing connector adapter



TYPICAL
1. Flushing connector
2. Quick connect and flushing adapters (optional, not mandatory)
3. Garden hose

NOTE: On 3D Series, the flushing connector is located on the right hand side on the jet pump support.



1. Flushing connector

Start the engine then immediately open the water tap.

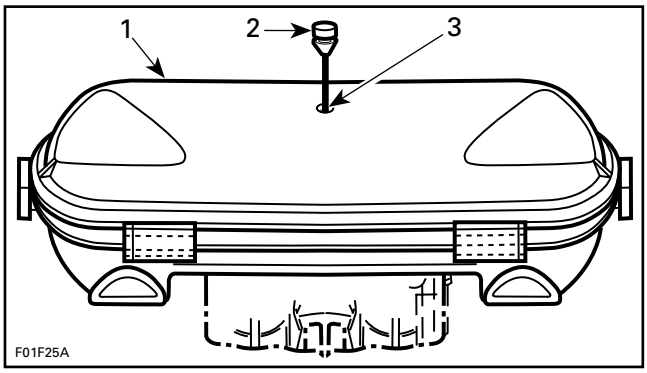
Run the engine about 2 minutes at a fast idle around 3500 RPM.

Ensure water flows out of jet pump while flushing.

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

Spray Bombardier Lube (P/N 293 600 016) through air intake silencer.

NOTE: An increase of engine RPM may be noticed while spraying the lubricant in the air intake silencer.



717 AND 787 RFI ENGINES
1. *Air intake silencer*
2. *Pull plug*
3. *Spray BOMBARDIER LUBE here*

Lubrication of engine should be done for at least 1 minute.

After approximately half a minute, close fuel valve (if so equipped) to run engine out of fuel while lubricating.

CAUTION: When engine begins to run irregularly because of fuel starvation, immediately stop water flow before engine dies.

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 adapter after operation (if used).

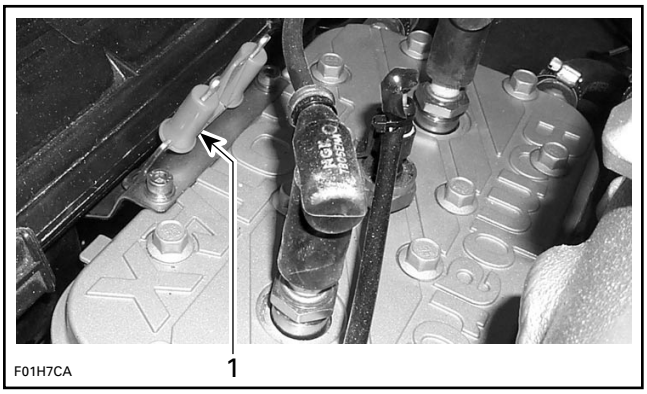
Wipe up any residual water from the engine.

FINAL ENGINE LUBRICATION

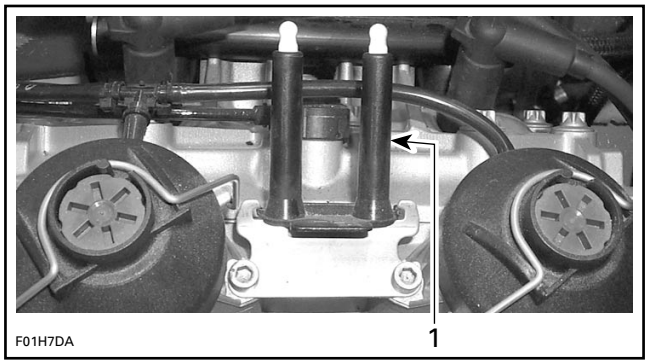
Remove spark plug cables and connect them on the grounding device.

⚠ WARNING

Always use spark plug cable grounding device when removing spark plugs.



717 ENGINES
1. *Grounding device*



787 RFI ENGINES
1. *Grounding device*

Remove both spark plugs and spray Bombardier Lube (P/N 293 600 016) into each cylinder.

GTI Models Equipped with 717 Engines

Connect safety lanyard cap to the post.

Crank the engine a few turns to distribute the oil onto cylinder wall.

Models with 787 RFI Engines

Remove safety lanyard from its post.

Depress the throttle lever at full throttle position and hold.

Reinstall the safety lanyard cap on its post.

Crank the engine a few turns to distribute the oil on cylinder wall.

NOTE: Proceeding in this order, no fuel will be injected into the engine.

All Models

Apply Loctite antiseize lubricant (P/N 293 800 070) on spark plug threads then reinstall them.

Properly reconnect spark plug cables to spark plugs.

Wipe up any residual water from the engine.

Reinstall plug on air intake silencer cover .

CAUTION: Never leave rags or tools in the engine compartment or in the bilge.

Antifreezing Protection

In cool regions (where freezing point may be encountered), cooling system should be filled pure antifreeze.

CAUTION: Antifreeze must be fed in cooling system. Otherwise remaining water will freeze. If antifreezing is not performed adequately engine/exhaust system may freeze and cause severe damage. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines.

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. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines. Never use antifreeze for RV (recreational vehicles).

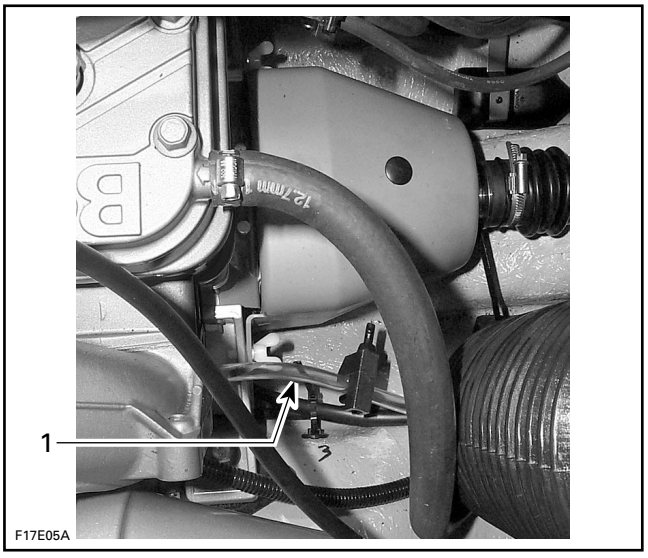
NOTE: When available, it is recommended to use biodegradable antifreeze compatible with internal combustion aluminum engines. This will contribute to protect the environment.

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.

GTI Models-Equipped with 717 Engines

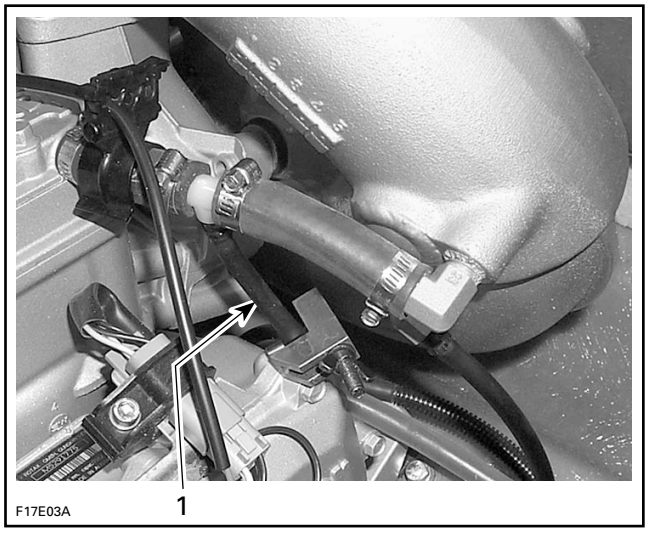
Some hoses have to be blocked to prevent draining, before filling cooling system jackets with the antifreeze.

Install a small hose pincher (P/N 295 000 076) on the engine drain hose.



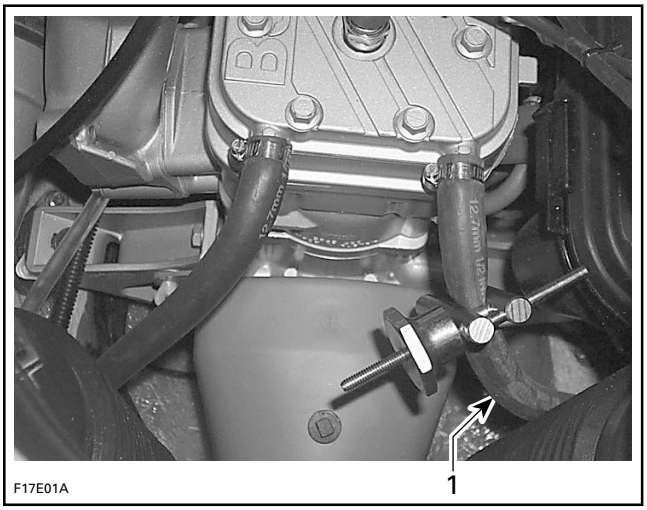
1. Engine drain hose

Install another small hose pincher (P/N 295 000 076) on injection hose going to tuned pipe.



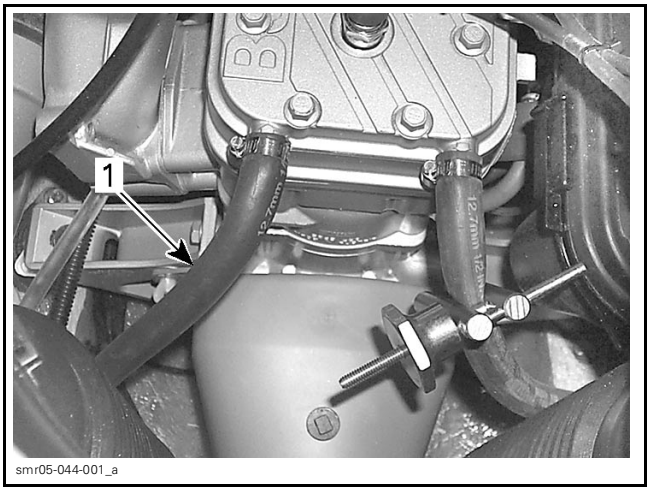
1. Hose pincher on injection hose going to tuned pipe

Block the engine water outlet hose with a large hose pincher (P/N 529 032 500).



1. Engine water outlet hose

Disconnect the engine water inlet hose.



717 ENGINES
1. Disconnect engine water inlet hose

Temporarily install a short piece of hose to engine water inlet at cylinder head.

Insert a funnel into hose and pour antifreeze in engine until the colored solution appears at the cooling system bleed outlet.

Remove temporary hose and reconnect engine water inlet hose.

Remove remaining hose pinchers.

Most of the antifreeze will drain out when removing the hose pinchers. Use a container to recover it. DISPOSE ANTIFREEZE AS PER YOUR LOCAL LAWS AND REGULATIONS.

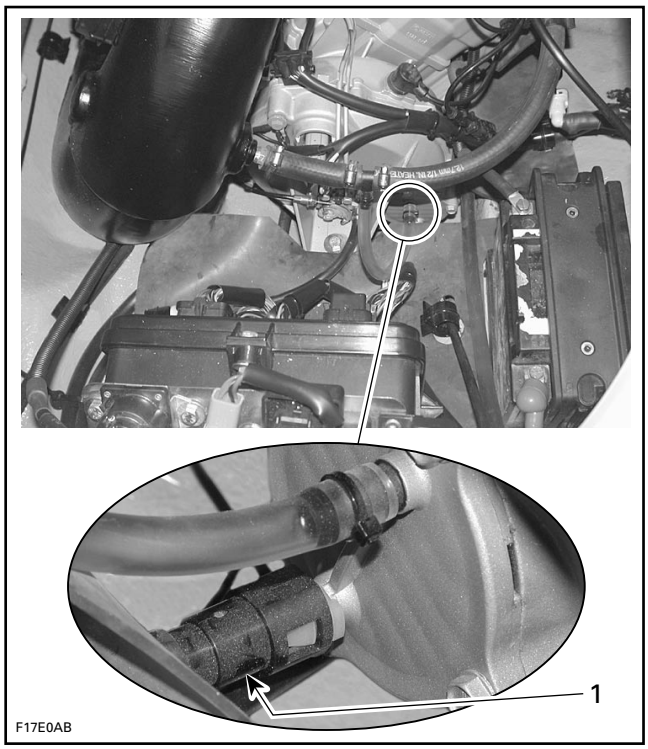
NOTE: Although antifreeze will mainly drain out, the antifreeze has mixed with the water that was possibly trapped in the water jackets and thus preventing freezing problems.

At preseason preparation, drain the remaining antifreeze from cooling system prior to using the watercraft. Ensure no hose pincher was forgotten at storage.

GTI Models-Equipped with 787 RFI Engines

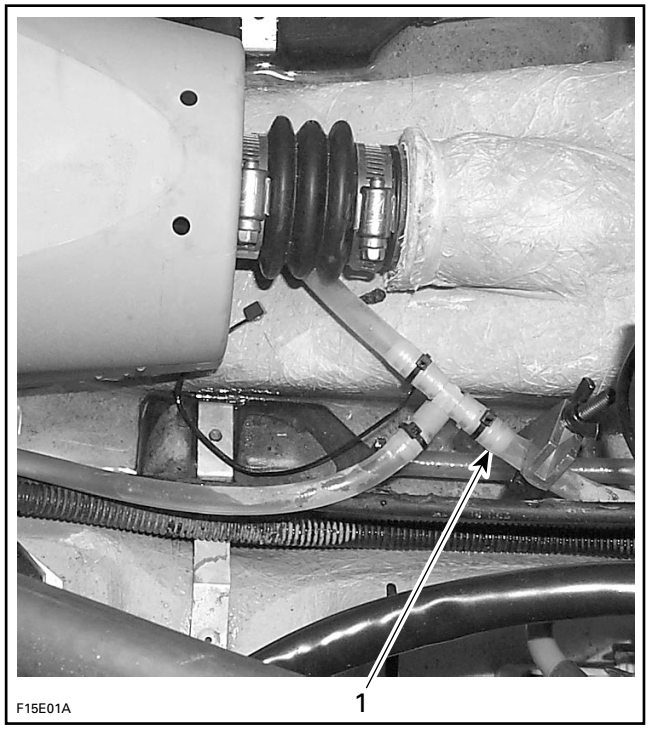
Some hoses have to be plugged to prevent draining, before filling cooling system jackets with the antifreeze.

NOTE: Before beginning the procedure, make sure the hose is properly connected to the magneto cover.



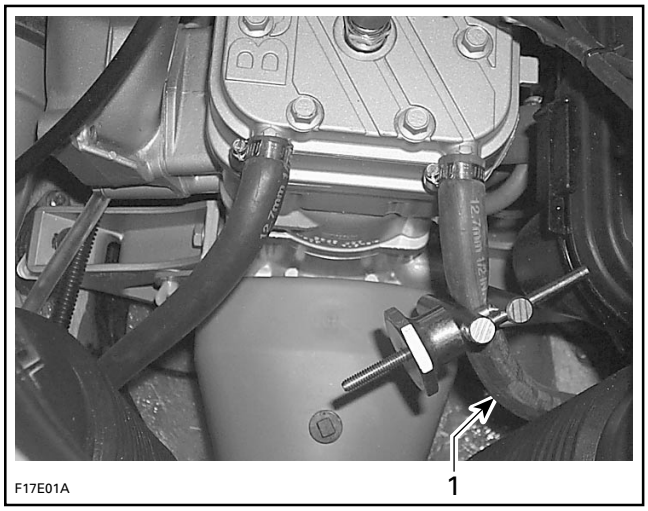
1. Fitting properly connected

Install a small hose pincher (P/N 295 000 076) on engine drain hose.



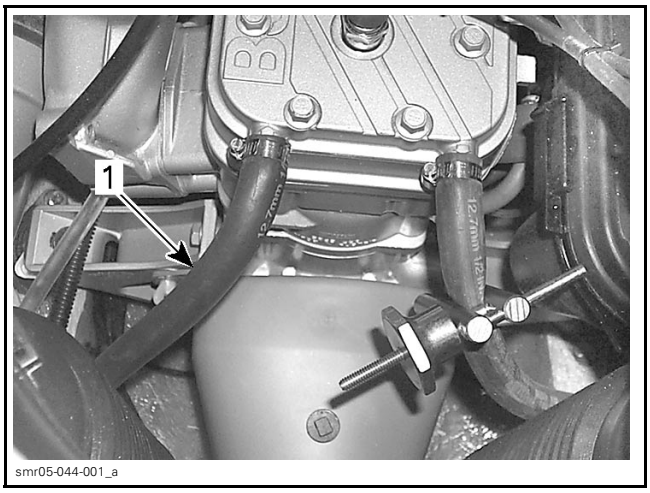
1. Engine drain hose

Block the engine water outlet hose with a large hose pincher (P/N 529 032 500).



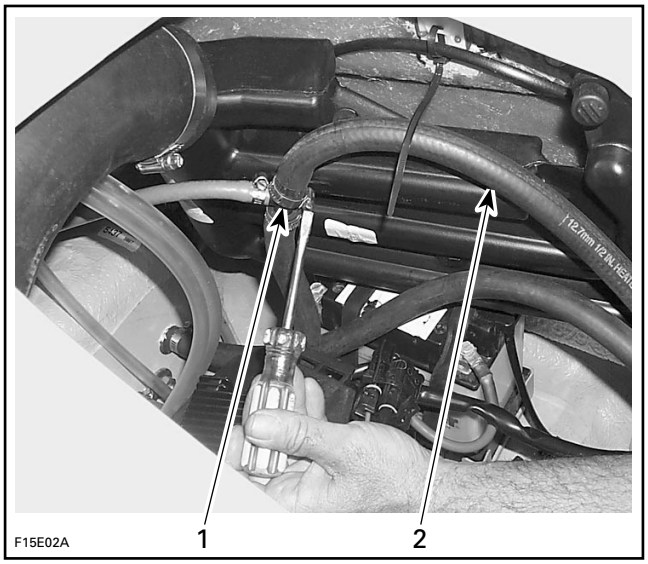
1. Engine water outlet hose

Disconnect the engine water inlet hose.



1. Engine water inlet hose

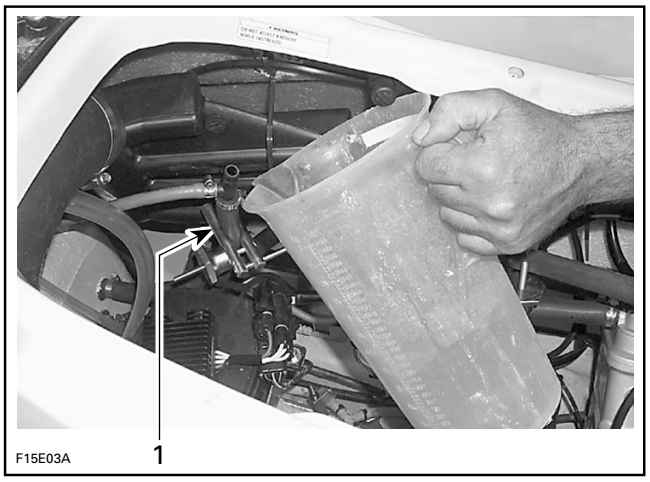
Disconnect hose just above T-fitting as shown.



TYPICAL
1. Hose connecting to cylinder head inlet fitting
2. Disconnect hose above T-fitting

Install a large hose pincher (P/N 529 032 500) just below T-fitting.

Pour approximately 300 mL (10 oz) of antifreeze in the water regulator valve supply hose to allow antifreeze flowing through the valve and into muffler to protect them.



1. Hose pincher below T-fitting

Reconnect hose to T-fitting and remove hose pincher.

Remove remaining hose pinchers.

Most of the antifreeze will drain out when removing the hose pinchers. Use a container to recover it. DISPOSE ANTIFREEZE AS PER YOUR LOCAL LAWS AND REGULATIONS.

NOTE: Although antifreeze will mainly drain out, the antifreeze has mixed with the water that was possibly trapped in the water jackets and thus preventing freezing problems.

At preseason preparation, drain the remaining antifreeze from cooling system prior to using the watercraft. Ensure no hose pincher was forgotten at storage.

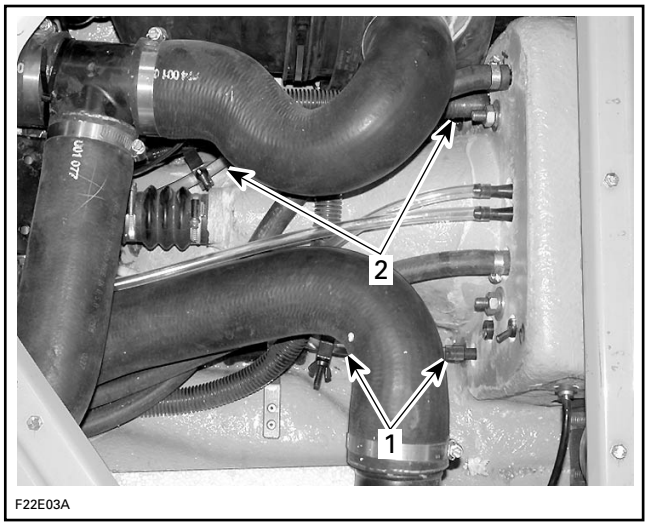
3D Series

Remove rear access panel and engine cover. Lock steering pole in upright position with the holder.

⚠ WARNING

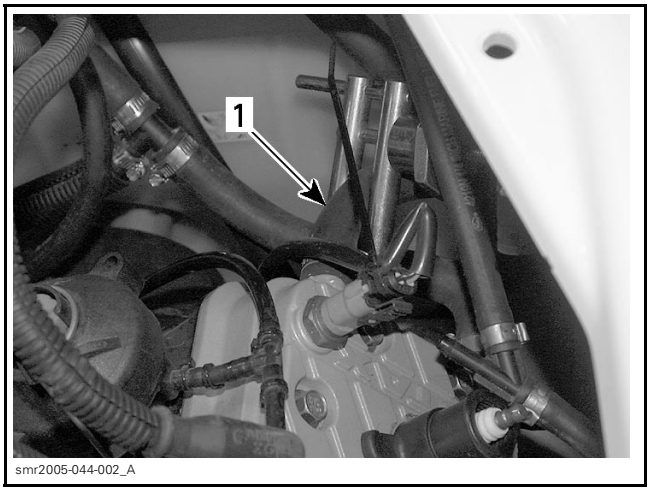
Always install steering pole holder while working in the engine compartment.

Using a small hose pincher (P/N 295 000 076), block heat exchange drain hose and cylinder drain hose.



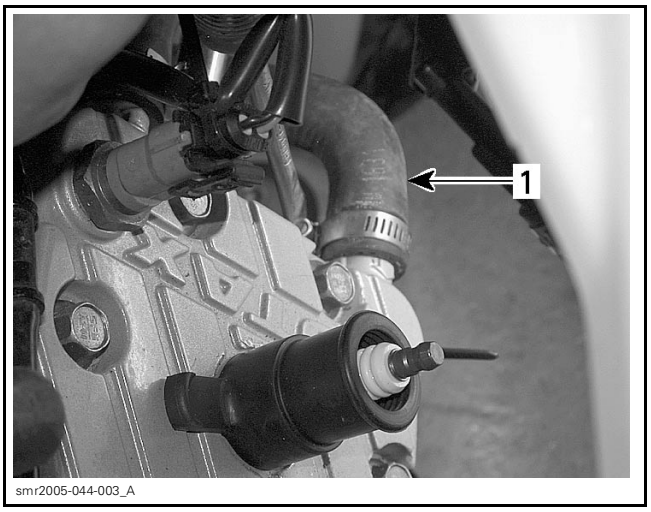
1. Pinch engine cylinder drain hose
2. Pinch engine heat exchanger drain hose

Install a large hose pincher (P/N 529 032 500) on water outlet hose.



1. Water outlet hose

Disconnect the water supply hose from cylinder head.



1. Water supply hose

Install a temporary hose on the engine fitting. To avoid hose bending, remove the storage tray and insert the hose by this opening.

Insert a funnel into the temporary hose and pour antifreeze in engine until the colored solution appears at the cooling system bleed outlet. Use a container to recover the water/antifreeze.

COOLING SYSTEM BLEED OUTLET
1. Recover water/antifreeze from this outlet

Place a container at rear of watercraft to recover the water/antifreeze from the vehicle hose adapter.

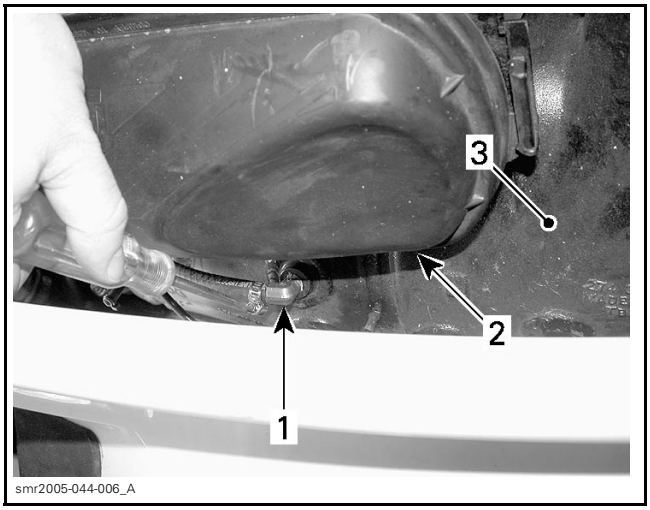
Remove the 2 small hose pinchers from the engine drain hoses.

Most of the antifreeze will drain out when removing the hose pinchers. Use a container to recover it. DISPOSE ANTIFREEZE AS PER YOUR LOCAL LAWS AND REGULATIONS.

Install the water supply hose and remove the large hose pincher.

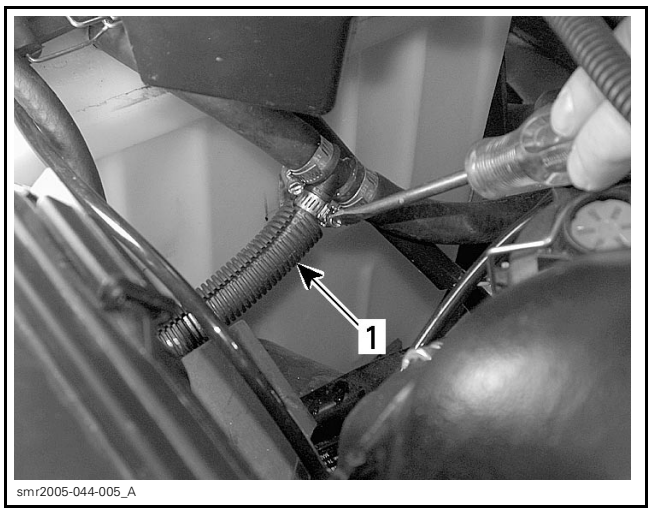
To protect the exhaust parts, do the following.

Disconnect the anti-rollover bypass hose from the calibrated elbow on the tuned pipe water jacket.



1. Calibrated elbow
2. Air intake silencer
3. Tuned pipe

Disconnect the tuned pipe water supply hose at T-fitting.



1. Tuned pipe water supply hose

Insert a funnel into the hose.

Raise the hose as high as possible.

CAUTION: It is important to keep the hose as high as possible so the antifreeze can reach the end of the expansion pipe.

Pour coolant in the hose until the colored solution appears by the calibrated elbow.

Reconnect the hose on the calibrated elbow then the tuned pipe water hose to the T-fitting.

NOTE: For the above engine and exhaust system procedures, although most of the antifreeze drained out, it has mixed with any water in the water jackets.

At preseason preparation, flush out the remaining antifreeze from cooling system prior to using the watercraft.

ELECTRICAL SYSTEM

Battery

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

HULL/BODY

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.

The seat should be partially left opened during storage (the engine cover for the 3D Series). This will avoid engine compartment condensation and possible corrosion.

If the watercraft is to be stored outside, cover it with an opaque tarpaulin to prevent sun rays and grime from affecting the plastic components, watercraft finish as well as preventing dust accumulation.

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

Anticorrosion Treatment

Spray Bombardier Lube (P/N 293 600 016) over all metallic components in engine compartment.

CHECKLIST

OPERATION	✔
Check engine drain hose.	
Replace jet pump oil.	
Lubricate PTO flywheel or seal carrier (depending on model).	
Verify fuel system.	
Add fuel stabilizer.	
Flush the cooling system.	
Lubricate the engine.	
Remove, clean and store the battery.	
Clean the bilge.	
Wash the body.	
Add antifreeze solution to the cooling system (in cool regions).	
Spray Bombardier Lube over all metallic components in engine compartment and in throttle cable.	
Spray Bombardier Lube in oil injection pump cable.	

SPECIAL PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
large hose pincher	529 032 500	19

SERVICE PRODUCTS

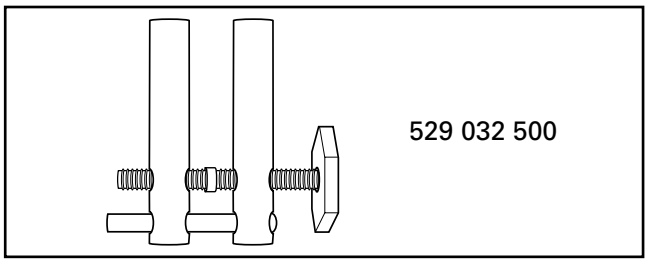
Description	Part Number	Page
Bombardier Lube	293 600 016	21–22
Loctite 518	293 800 038	22

TOWING THE WATERCRAFT IN WATER

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

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

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

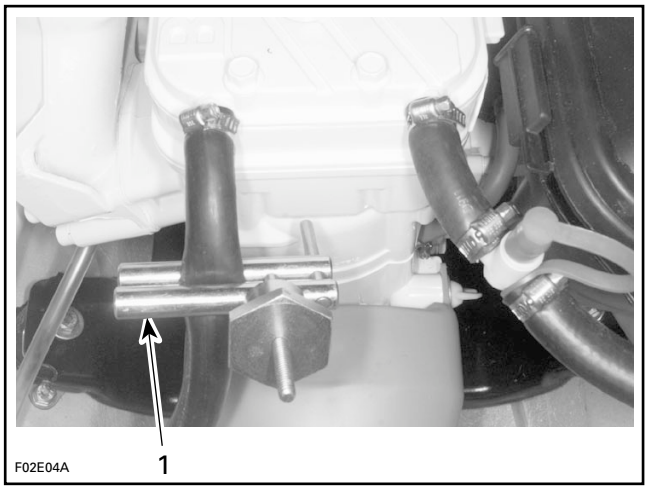


This will prevent the exhaust cooling system from filling which may lead to water being injected into and filling the exhaust system and the engine. Without the engine running there isn't any exhaust pressure to carry the water out the exhaust outlet.

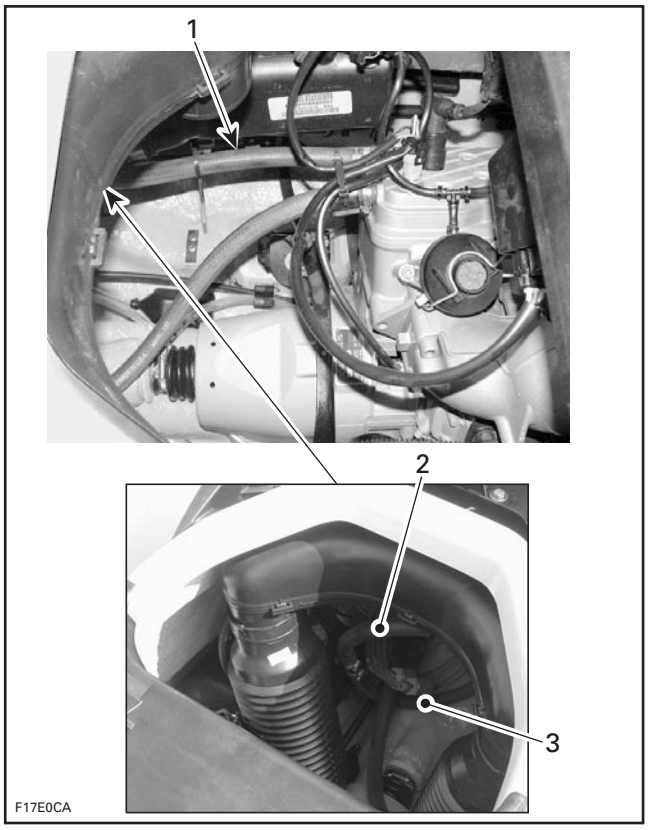
CAUTION: Failure to do this may result in damage to the engine. If you tow this watercraft in water and do not have a hose pincher be sure to stay well below the maximum towing speed of 24 km/h (15 MPH).

Snugly install the hose pincher on the water supply hose as shown.

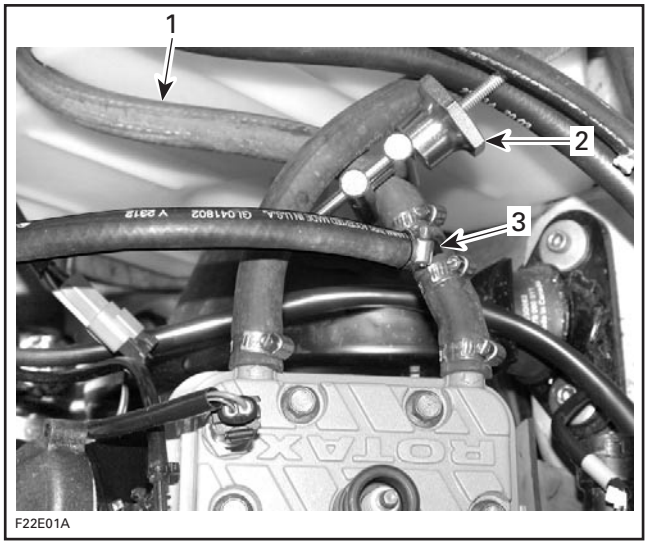
NOTE: A red tape on the water supply hose indicated which hose to pinch.



GTI MODELS
1. Hose pincher



GTI RFI AND GTI RFI LE MODELS
1. *Follow this hose towards rear*
2. *Hose coming from engine*
3. *Install hose pincher here on this side of the T-fitting*



3D SERIES
1. *Water supply hose*
2. *Install hose pincher here on this side of the T-fitting*
3. *T-fitting*

CAUTION: When finished towing the watercraft, the hose pincher must be removed before operating it. Failure to do so will result in damage to the engine.

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.

Refer to WATER-FLOODED ENGINE to validate presence of water.

CAUTION: Never try to crank or start the engine. Water trapped in the engine may cause severe damage to the engine components.

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 and oil reservoirs for water contamination. If necessary, siphon and refill with fresh fluids.

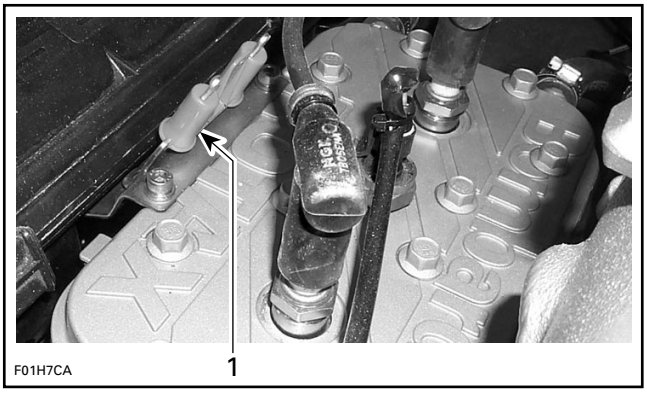
On watercraft equipped with a **717 engine**, turn fuel valve to OFF position then drain fuel filter bowl. Refer to FUEL SYSTEM.

Drain bilge if water is present.

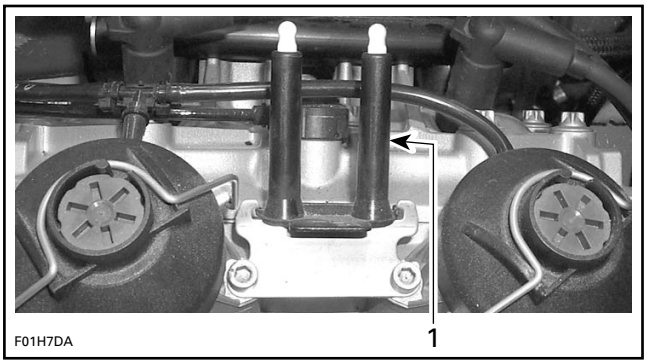
Remove spark plug cables and connect them on the grounding device.

⚠ WARNING

Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.



717 ENGINES
1. Grounding device



787 RFI ENGINES
1. Grounding device

Remove spark plugs and dry them with a clean cloth. A contact cleaner spray can be used. It may be preferable to replace spark plugs. Do NOT install spark plugs on engine yet.

Cover spark plug holes with a rag.

⚠ WARNING

Be careful when cranking engine in the following procedure, water will spray out from spark plug holes.

717 Engines

Fully depress the throttle lever then crank the engine during 10 seconds to drain crankcase.

NOTE: Ensure choke lever is completely pushed in.

787 RFI Engines

NOTE: Proceeding in the following order, no fuel will be injected into the engine.

Remove safety lanyard from its post.

Depress and hold the throttle lever at full throttle position. Wait 2 seconds then, reinstall the safety lanyard cap.

Press the start/stop button to crank the engine during 10 seconds to allow water to escape from spark plug openings.

All Engines

Spray Bombardier Lube (P/N 293 600 016) into spark plug holes.

Crank engine again.

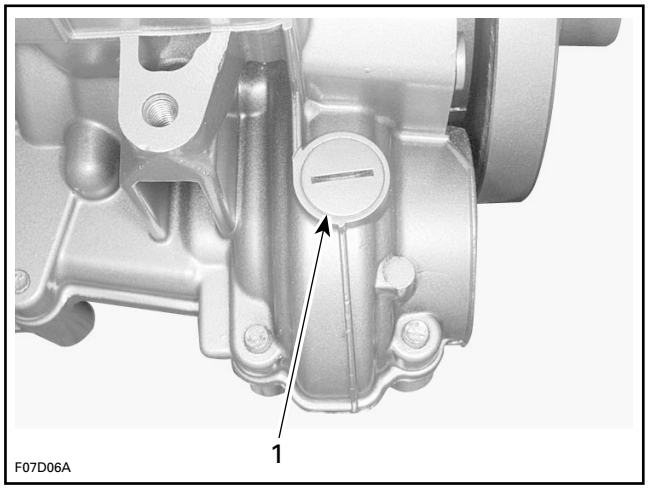
Reinstall spark plugs and spark plug cables.

Turn fuel valve to ON position.

Start engine. It may be necessary to use the choke.

787 RFI Engines

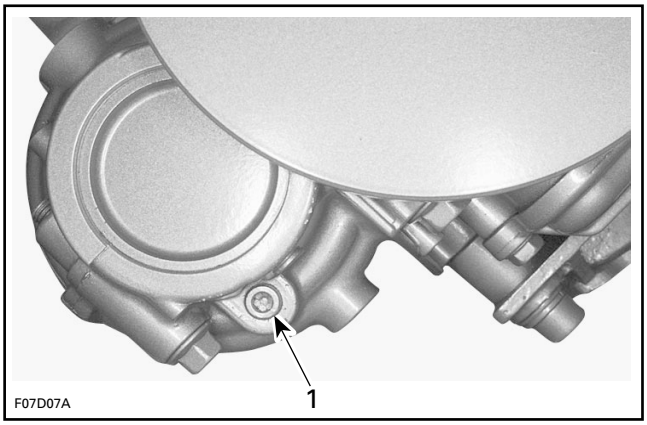
Remove the filler plug of the counterbalance shaft on the engine crankcase.



787 RFI ENGINES
1. Remove filler plug

Insert a wire through oil filler hole to check oil condition. A whitish oil indicates water contamination and must be replaced.

In order to replace the oil, remove the drain plug of the counterbalance shaft located on the PTO side of the lower crankcase.



787 RFI ENGINES
1. Drain plug

Drain completely the crankcase oil of the counterbalance shaft. Reinstall drain plug with Loctite 518 (P/N 293 800 038).

Add 30 mL (1 oz) of SAE 30 motor oil.

Reinstall filler plug.

Start engine according to normal starting procedure.

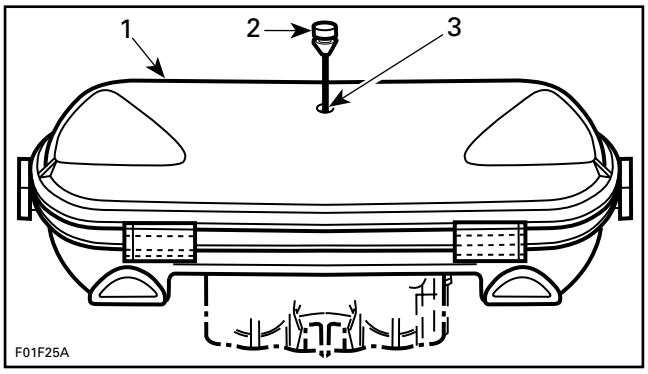
All Engines

CAUTION: To avoid starter overheating, the cranking period should not exceed 5 - 10 seconds and a rest period of 30 seconds should be observed between cranking cycles.

NOTE: If engine does not start after several attempts, check ignition system for spark occurrence. Refer to IGNITION SYSTEM.

Check crankshaft if needed, it may be misaligned or deflected. Refer to BOTTOM END.

After engine has started, spray Bombardier Lube (P/N 293 600 016) for one minute through air intake silencer while engine is running.



717 AND 787 RFI ENGINES
1. Air intake silencer
2. Pull plug
3. Spray BOMBARDIER LUBE here

CAPSIZED ENGINE

If the engine does not cranked after a capsize, check for water ingestion. Refer to WATER-FLOODED ENGINE above.

FUEL-FLOODED ENGINE

717 Engines

Install the safety lanyard cap on its post.

Ensure choke lever is completely pushed in.

Fully depress the throttle lever and hold while starting the engine. Try several times.

RFI Engines

To prevent fuel to be injected in the engine, proceed as follows.

While engine is stopped. fully depress throttle lever and HOLD for cranking.

Crank engine approximately 5 seconds.

Release throttle lever and crank engine.

All Engines

If it does not work, do the following:

Remove spark plug cables and connect them on the grounding device.

⚠ WARNING

Always use spark plug cable grounding device when removing spark plugs. Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.

Remove spark plugs.

Cover spark plug holes with a rag.

Crank engine several times (while keeping throttle fully depressed on **RFI models**).

Install new spark plugs. Reconnect cables.

Start engine as explained above.

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 **RFI 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 ELECTRICAL SYSTEM and ENGINE MANAGEMENT
	Safety lanyard switch faulty or disconnected or harness damaged	Replace
	Burnt fuse: battery, starting system. Also fuel pump on **RFI models**	Check wiring then replace fuse
	Starting system fuse keeps on burning	Check wiring, starting system solenoid and MPEM or ECM (**RFI models**)
	Discharged or disconnected battery	Check/recharge
	Defective or disconnected start/stop switch	Check, refer to STARTING SYSTEM or ENGINE MANAGEMENT
	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 ass'y	Check/repair, refer to PTO HOUSING/MAGNETO
	Seized or obstructed engine	Check/repair, refer to the appropriate ENGINE SHOP MANUAL
	Seized jet pump	Check, refer to PROPULSION SYSTEM
	Faulty sensor or ECM (**RFI models**)	Check fault codes, refer to ENGINE MANAGEMENT

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 ENGINE
	Worn starter	Check, refer to ELECTRICAL SYSTEM
Engine turns over	Faulty component in the fuel injection system (**RFI models**)	Check for fault codes. Refer to DIAGNOSTIC PROCEDURES in ENGINE MANAGEMENT
	Engine drowned mode is active (**RFI models**)	Release throttle lever
	Low battery voltage	Recharge or replace battery
	Low or no fuel pressure (**RFI models**)	Check fuel pump pressure output Check fuel pump fuse Check wiring harness
	Fuel injectors not working (**RFI models**)	Check fuel injector operation. Replace as necessary Check output signal from ECM
	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**)
	Inverted spark plug cables (**RFI models**)	Reposition cables properly.

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine turns over (cont'd)	Defective CPS (**RFI models**)	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
	Carburetion (**carburetor models**)	Check, refer to FUEL SYSTEM
	Defective ignition circuit	Check, refer to ELECTRICAL SYSTEM
	Flooded engine: Carburetor needle valve stuck open (**carburetor models**)	Check, refer to FUEL SYSTEM
	Excessive rotary valve clearance	Check, refer to the appropriate ENGINE SHOP MANUAL
	Incorrect rotary valve timing	Check, refer to the appropriate ENGINE SHOP MANUAL
	Internal engine damage	Check, refer to the appropriate ENGINE SHOP MANUAL
	Defective trigger wheel (**RFI models**)	Check, refer to MAGNETO SYSTEM in the appropriate ENGINE SHOP MANUAL
	Incorrectly aligned flywheel and rotor (**RFI models**)	Properly position flywheel and rotor, refer to MAGNETO SYSTEM in the appropriate ENGINE SHOP MANUAL
	Insufficient engine compression	Replace defective part(s)
No spark at spark plugs	Faulty rev limiter in MPEM (**carburetor models**)	Replace MPEM
	Spark plug faulty, fouled or worn out	Check spark plug condition
	Ignition	Check, refer to ELECTRICAL SYSTEM
	Faulty ECM (**RFI models**)	Replace ECM

NOTE: Prior to replacing an ECM, refer to the ENGINE MANAGEMENT section and read carefully the tests to do before replacing an ECM that could otherwise be good.

ENGINE HARD TO START

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Wrong TPS zero setting (**RFI models**)	Refer to ENGINE MANAGEMENT
	Throttle cable adjustment (**RFI models**)	Refer to ENGINE MANAGEMENT
	Air lock in fuel rail (**RFI models**)	Refer to ENGINE MANAGEMENT
	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 (**RFI models**)	Check fuel pump operation. Refer to FUEL SYSTEM Check fuel pressure regulator. Refer to FUEL SYSTEM
	Missing shim under CPS (**RFI models**)	Refer to COMPONENT ADJUSTMENT, INSPECTION AND REPLACEMENT

ENGINE STARTS BUT RUNS ONLY AT IDLE SPEED

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

ENGINE STARTS BUT RUNS ONLY ON ONE CYLINDER (RFI MODELS)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	In normal conditions engine runs only on one cylinder at idle after engine warm-up is completed.	Engine should run on both cylinders with 3 percent or more of throttle opening. Use the VCK (Vehicle Communication Kit) with B.U.D.S. software to validate.

ENGINE RUNS ON BOTH CYLINDERS AT IDLE AFTER ENGINE IS WARM-UP (RFI MODELS)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	– Water temperature sensor (WTS) and its circuit – ECM parameters – Closed TPS.	Refer to COMPONENT ADJUSTMENT, INSPECTION AND REPLACEMENT.

ENGINE MISFIRES, RUNS IRREGULARLY

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	Fouled, defective, worn spark plugs	Check/verify heat range/gap/replace
	Faulty ECM (**RFI models**)	Check, refer to ENGINE MANAGEMENT
	Defective trigger wheel/CPS (**RFI models**)	Check, refer to ENGINE MANAGEMENT
	Too much oil supplied to engine	Adjust oil injection pump
	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

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Lean fuel mixture Dry spark plug (except when water fouled)	Low fuel level (**carburetor models**)	Check/refill
	Carburetion dirty (**carburetor models**)	Check/clean, refer to FUEL SYSTEM
	Low fuel pressure (**RFI models**)	Check pump, regulator and injectors. Replace if necessary
		Check if filter is plugged.
		Check if a hose pincher is still installed.
	Leaking crankshaft seal(s) or intake manifold (**carburetor models**)	Pressure check engine, to the appropriate ENGINE SHOP MANUAL
	Restricted fuel valve (**carburetor models**)	Check/replace
	Loose carburetor (**carburetor models**)	Tighten carburetor
	Stale or water fouled fuel	Check/siphon and refill
	Fuel filter dirty or restricted	Check/clean/replace
	Clogged fuel injectors (**RFI models**)	Remove and clean fuel injectors
	Defective sensor or ECM (**RFI models**)	Check faulty codes in ECM memory, refer to ENGINE MANAGEMENT
Rich fuel mixture Fouled spark plug	Flame arrester dirty or restricted	Check/replace
	Partially closed choke (**carburetor models**)	Check/adjust choke cable
	Loose main jet (**carburetor models**)	Check, refer to FUEL SYSTEM
	Faulty fuel injector(s) (**RFI models**)	Remove and replace fuel injector(s), refer to ENGINE MANAGEMENT
	Defective sensor or ECM (**RFI models**)	Check faulty codes in ECM memory, refer to ENGINE MANAGEMENT
	Rotary valve shaft seal leaking	Check/replace, refer to the appropriate ENGINE SHOP MANUAL
	Oil injection pump adjustment	Check/adjust, refer to LUBRICATION SYSTEM
	Worn needles and seals (**carburetor models**)	Check, refer to section FUEL SYSTEM
	Excessive rotary valve clearance (**if so equipped**)	Check, refer to the appropriate ENGINE SHOP MANUAL
	Fuel pressure fluctuating (**RFI models**)	Inspect fuel pressure regulator. Refer to FUEL SYSTEM
	High fuel pressure (**RFI models**)	Check pump, regulator, injectors or if filter is plugged. Replace if necessary

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Starts, but runs poorly	Check spark plug condition, check fault codes, check fuel pressure (**RFI models**).	Check, refer to ENGINE MANAGEMENT and FUEL SYSTEM.
	Bent or missing tooth on trigger wheel (**RFI models**)	Check, refer to MAGNETO SYSTEM in the appropriate ENGINE SHOP MANUAL
Also fuel injection misinjecting (**RFI models**)	Damaged fuel injector	Check, refer to ENGINE MANAGEMENT
	Incorrect rotary valve timing	Check/adjust, refer to the appropriate ENGINE SHOP MANUAL
	Excessive rotary valve clearance	Check, refer to the appropriate ENGINE SHOP MANUAL

NOTE: Prior to replacing an ECM, refer to the ENGINE MANAGEMENT section and read carefully the tests to do before replacing an ECM that could otherwise be good.

ENGINE CONTINUALLY BACKFIRES

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	Fouled, defective spark plugs	Clean/replace
Spark plugs	Ignition coil leads or wiring reversed	Refer to WIRING DIAGRAM
Ignition timing	Incorrect setting	Check/reset, refer to ELECTRICAL SYSTEM
	Defective trigger wheel/CPS (**RFI models**)	Check, refer to ENGINE MANAGEMENT
Rotary valve	Incorrect timing	Check/reset, refer to the appropriate ENGINE SHOP MANUAL
Carburetor (**if so equipped**)	Carburetion too lean	Check, refer to FUEL SYSTEM

ENGINE DETONATION OR PINGING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Ignition	Timing too far advanced	Check/reset
	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

ENGINE LACKS ACCELERATION OR POWER

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Weak spark	Check/replace, refer to ELECTRICAL SYSTEM
	Carburetion, jetting too rich/lean (**carburetor models**)	Check/replace, refer to FUEL SYSTEM
	Throttle does not open fully	Check/readjust, refer to FUEL SYSTEM or ENGINE MANAGEMENT
	Low compression	Check/repair, refer to the appropriate ENGINE SHOP MANUAL
	Water in fuel	Check/siphon/replace
	Debris in carburetor needle valve (**carburetor models**)	Check/clean, refer to FUEL SYSTEM
	Impeller leading edge damaged	Check/replace, refer to PROPULSION SYSTEM
	Poor fuel quality	Siphon then refill with fresh fuel
	Clogged fuel injectors (**RFI models**)	Remove and clean fuel injectors
	Low fuel pressure (**RFI models**)	Check fuel line and fuel pump pressure
	Incorrect throttle position sensor (TPS) adjustment (**RFI models**)	Check and adjust TPS, refer to ENGINE MANAGEMENT
	Overheated engine	See ENGINE OVERHEATS in this chart
Engine revs lower than its maximum operational RPM	RAVE valve does not open (**if so equipped**)	Check, refer to the appropriate ENGINE SHOP MANUAL
	Limp home mode activated (**RFI models**)	Refer to ENGINE MANAGEMENT
Peak performance is delayed until higher RPM range is reached	RAVE valve is stuck opened (**if so equipped**)	Check, refer to the appropriate ENGINE SHOP MANUAL

ENGINE STOPS RUNNING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine dies during operation (piston seizure)	Spark plug heat range too high	Check/change to correct range
	Improper ignition timing	Check/reset
	Compression ratio is too high	Check combustion chamber volume
	Poor injection oil quality	Use proper XP–S™ 2–stroke oil
Engine stalls at idle	Contaminated or inappropriate fuel	Syphon reservoir and refill with fresh fuel
	Air in fuel rail (**RFImodels**)	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 (**RFI models**)	Refill fuel tank

ENGINE CANNOT REACH MAXIMUM RPM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	RAVE valve does not open (**if so equipped**)	Check, refer to the appropriate ENGINE SHOP MANUAL and to COOLING SYSTEM
	Faulty water regulator valve (**if so equipped**)	Check, refer to COOLING SYSTEM
	Low fuel pressure (**RFI models**)	Check fuel pump pressure
	Jet pump related problem	Check propulsion components. Refer to JET PUMP
	Limp home mode activated (**RFI models**)	Refer to ENGINE MANAGEMENT
	Exhaust system blockage/muffler damage	Check and repair
	Exhaust gases in bilge (leak)	Check exhaust system for leaks
	Battery voltage is too low (**RFI models**)	Check/repair, refer to CHARGING SYSTEM

ENGINE OVERHEATS

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Monitoring beeper sounds continuously	Temperature sensor defective (**RFI models**)	Check/replace. Refer to ENGINE MANAGEMENT
	Cooling system restriction	Check/flush, refer to MAINTENANCE
	Grounded temperature sensor or sensor wire (**carburetor models**)	Check/repair/replace

VEHICLE CANNOT REACH ITS TOP SPEED

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine RPM to low	Faulty rev limiter	Check/replace MPEM or ECM
	Improper impeller pitch	Check/replace, refer to PROPULSION SYSTEM
Engine RPM too high	Improper impeller pitch	Check/replace, 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

O.T.A.S. SYSTEM FAULTS

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine RPM does not increase when throttle lever is released and steering is turned.	Improper sequence or timing of events when trying it.	Refer to O.T.A.S. SYSTEM

ABNORMAL NOISE FROM PROPULSION SYSTEM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Weeds/debris caught in intake grate or impeller	Check/clean
	Low oil level in jet pump	Check/troubleshoot source of leak/refill supply, refer to PROPULSION SYSTEM
	Worn anti-rattle system	Check/replace pusher in cover, refer to PROPULSION SYSTEM
	Damaged or bent drive shaft	Check/replace, refer to PROPULSION SYSTEM
	Idle speed too low	Adjust (**carbureted models**) Check fault codes (**RFI models**)
	Broken engine mounts	Check/replace, refer to ENGINE

STEERING POLE IS HEAVIER THAN USUAL (3D SERIES)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Steering pole return spring adjustment	Set the adjuster to reduce the weight at the handlebar. Refer to STEERING SYSTEM.
	Steering pole return spring is broken	Refer to STEERING SYSTEM.

STEERING POLE IS STIFFER THAN USUAL (3D SERIES)

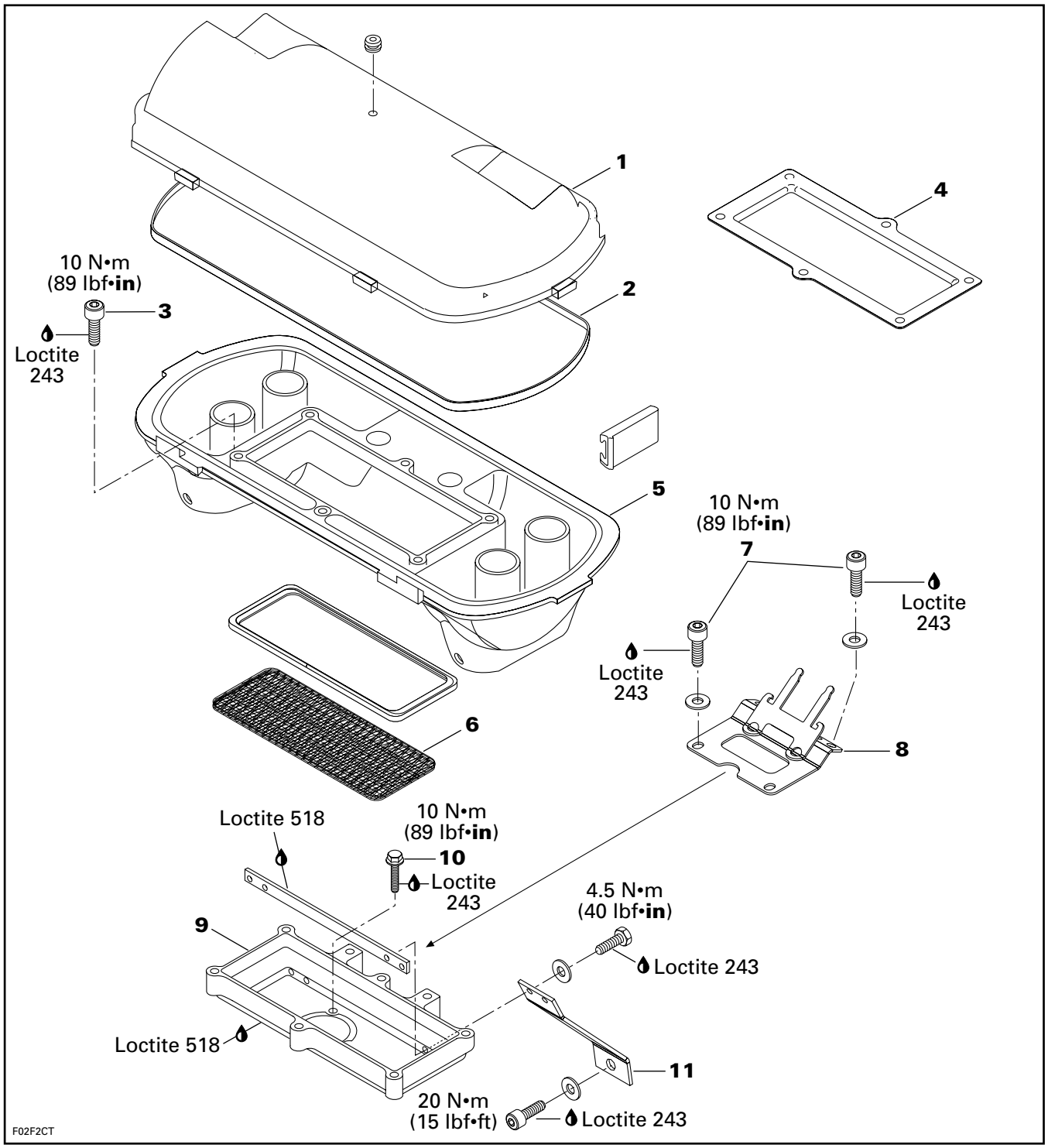
OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	Dirty/damaged parts	Clean. If parts are damaged, refer to STEERING SYSTEM.

AIR INTAKE SYSTEM

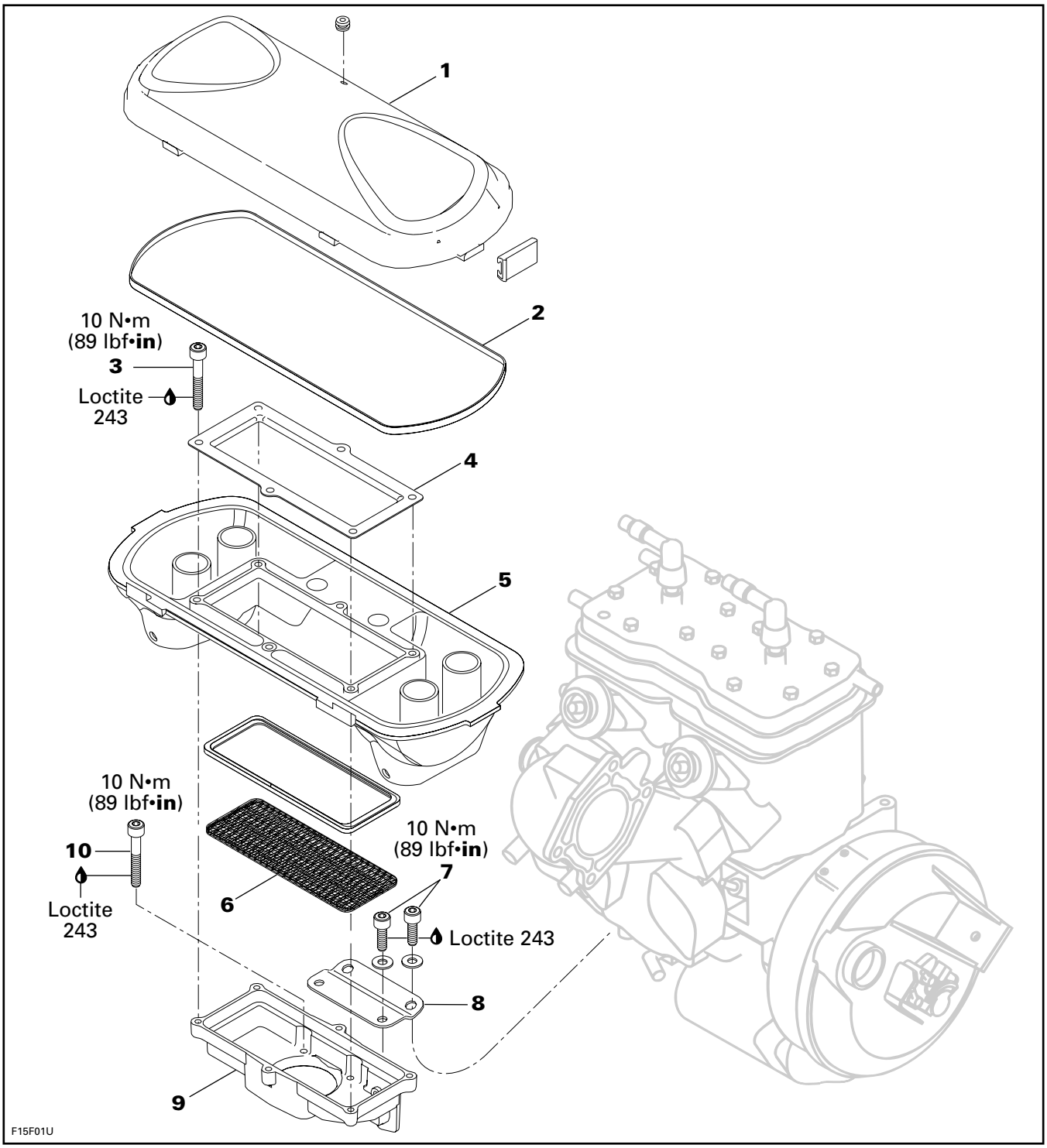
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	41
Loctite 518	293 800 038	41

717 Engines



787 RFI Engines



GENERAL

During assembly, use the torque values and service products as in the exploded views.

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

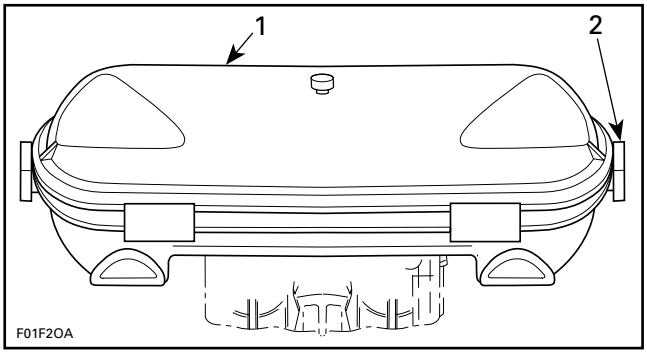
⚠ WARNING

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

REMOVAL

Air Intake Silencer Cover

Unlock the 6 retaining slides holding air intake silencer cover **no. 1**. Remove cover and its gasket **no. 2**.

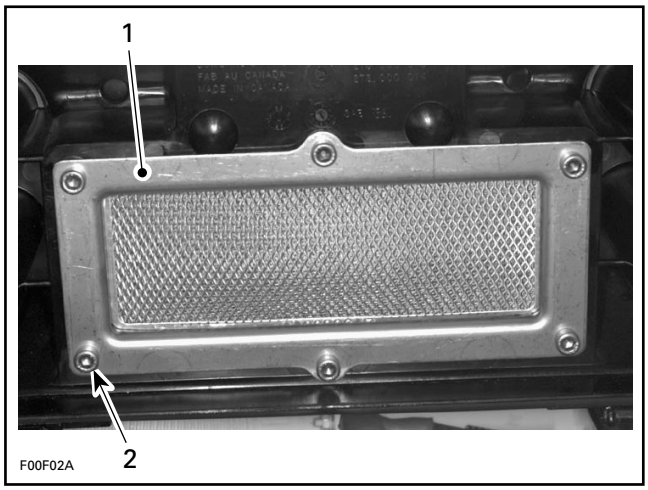


TYPICAL
1. Air intake silencer cover
2. Unlock

Air Intake Silencer Base

Remove screws **no. 3** of retaining plate **no. 4**.

Pull out retaining plate and air intake silencer base **no. 5**.

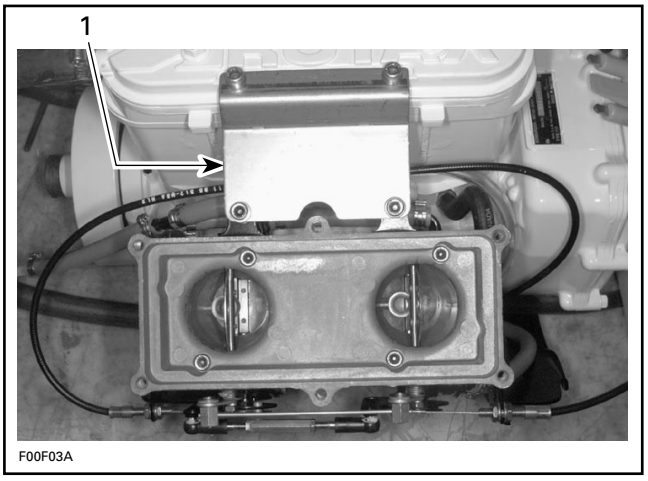


1. Retaining plate
2. Remove screws

Flame Arrester Base

Remove flame arrester **no. 6**.

Remove screws **no. 7** retaining support **no. 8** of flame arrester base **no. 9** to the cylinder head cover **(717 engines)** or to the exhaust manifold **(787 RFI engines)**.



TYPICAL
1. Remove support

Remove screws **no. 10** from flame arrester base then withdraw base.

NOTE: On **717 engines**, withdraw both arrester supports **no. 11**.

ASSEMBLY

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

CAUTION: Do not modify air intake system, otherwise calibration will be affected.

Flame Arrester Base

On **717 engines**, apply Loctite 518 (P/N 293 800 038) on mating surfaces of flame arrester base **no. 9**.

Apply Loctite 243 (blue) (P/N 293 800 060) on screws **no. 10** and torque to 10 N•m (89 lbf•**in**).

Flame Arrester Base Supports

On **717 engines**, before installing arrester supports **no. 11** to flame arrester base **no. 9**, apply Loctite 518 (P/N 293 800 038) around each holes of retaining plate. Apply the product on side toward the base.

Flame Arrester

Inspect condition of flame arrester **no. 6**. Replace or clean as necessary.

⚠ WARNING

Do not operate watercraft without flame arrester.

Gasket

Inspect condition of gasket **no. 2**. Make sure to properly install gasket.

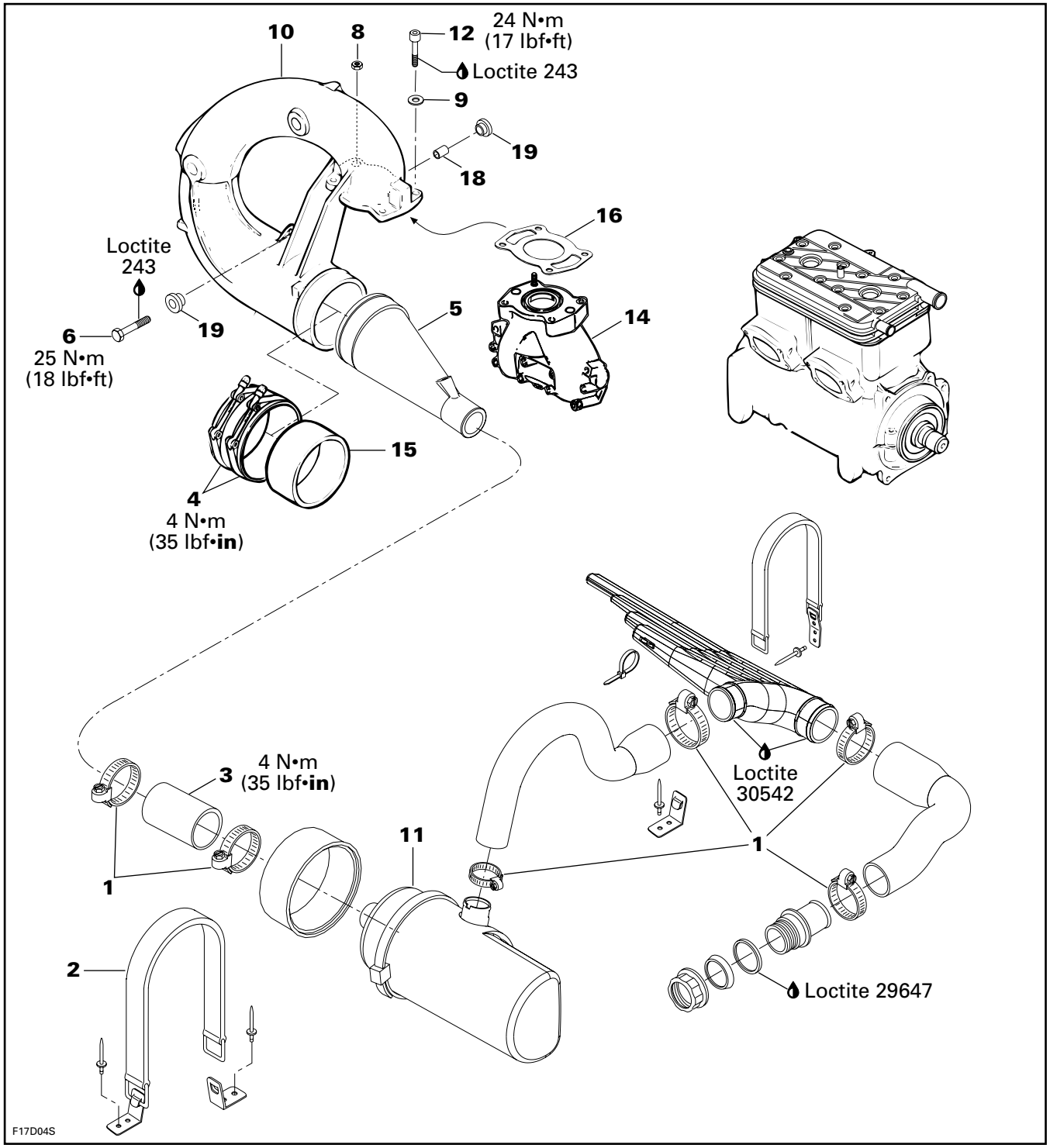
EXHAUST SYSTEM

SERVICE PRODUCTS

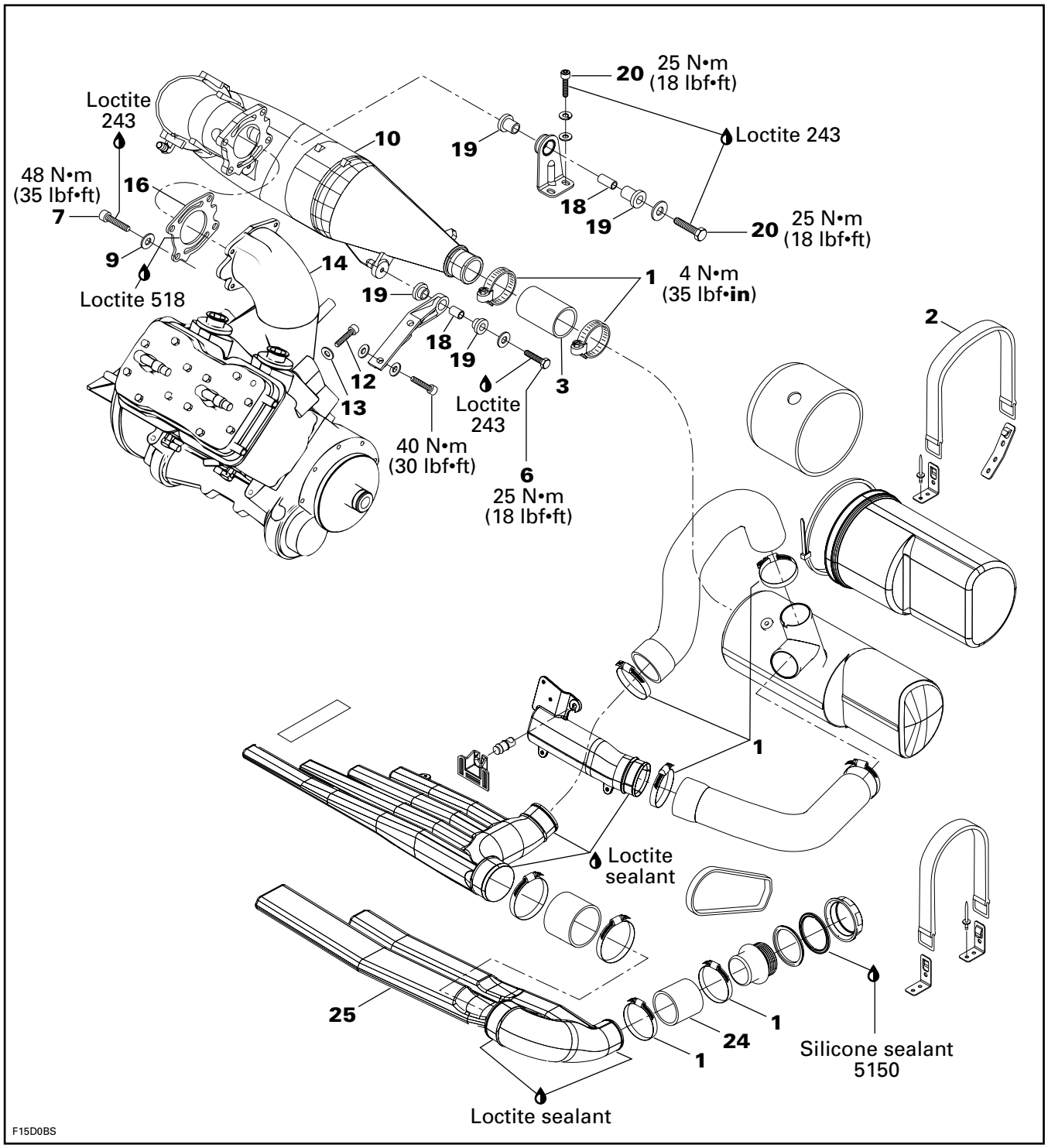
Description	Part Number	Page
Loctite 243 (blue)	293 800 060	48
Loctite 518	293 800 038	56
silicone sealant (clear)	293 800 086	56

GTI SERIES

GTI Model (717 Engine)



GTI RFI and GTI RFI LEmodels (787 RFI Engine)



GENERAL

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

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

⚠ WARNING

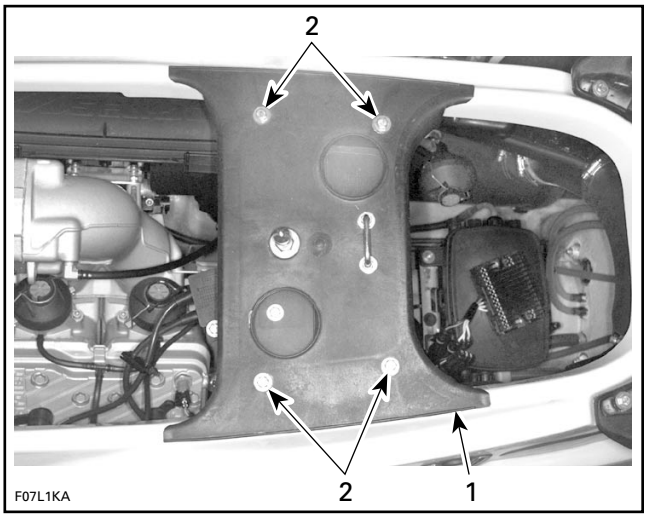
Torque wrench tightening specifications must be strictly adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

REMOVAL

Remove seat(s).

Remove rear vent hose support from body opening.

Remove seat support.



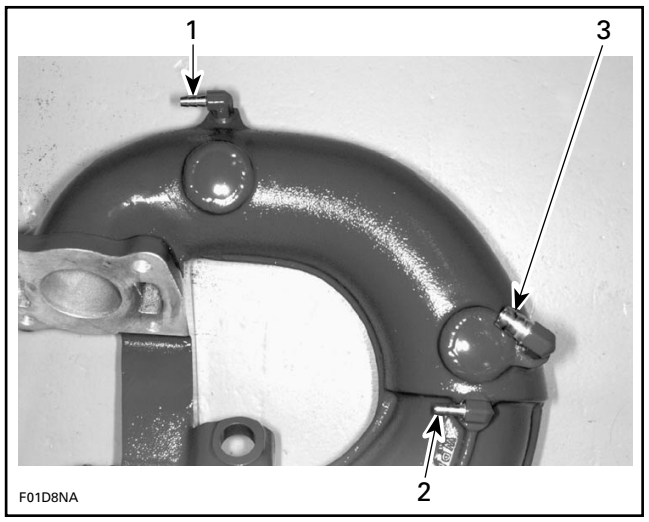
TYPICAL
1. Seat support
2. Remove screws

Tuned Pipe

717 Engine

Disconnect water supply hose and water injection hose.

Disconnect tuned pipe bleed hose.



TYPICAL
1. Bleed hose removed
2. Injection hose removed
3. Supply hose removed

Loosen exhaust hose collar **no. 1** at tuned pipe outlet.

Disconnect strap **no. 2** retaining muffler **no. 11**.

Remove exhaust hose **no. 3** from tuned pipe by pulling muffler.

Remove clamp **no. 4** from tuned pipe.

Remove tuned pipe cone **no. 5**.

Remove tuned pipe retaining screw **no. 6**.

Remove screws **no. 12**, nut **no. 8** and flat washers **no. 9** from tuned pipe flange.

NOTE: Slightly lift tuned pipe to release nut as necessary. Be careful not to drop nut and flat washer.

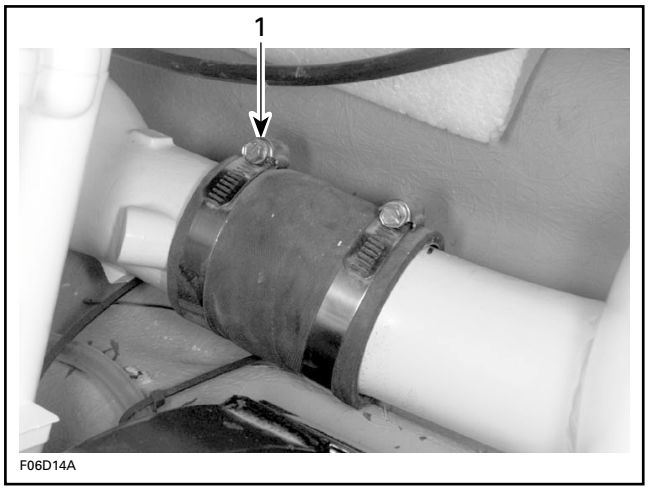
Withdraw tuned pipe head **no. 10** in a forward and rotating movement.

787 RFI Engine

Remove air intake silencer.

Disconnect water supply hose and water injection hose at tuned pipe.

Loosen hose clamp **no. 1** retaining exhaust hose **no. 3** to tuned pipe cone.



1. Loosen clamp

Remove screws **no. 7** and washers **no. 9** at tuned pipe head flange.

Remove screw **no. 6** and screw **no. 20** retaining tuned pipe to supports.

Remove tuned pipe from watercraft.

Exhaust Manifold

For removal procedure of the exhaust manifold **no. 14**, refer to the *717/787 RFI ENGINE SHOP MANUAL*.

Resonators

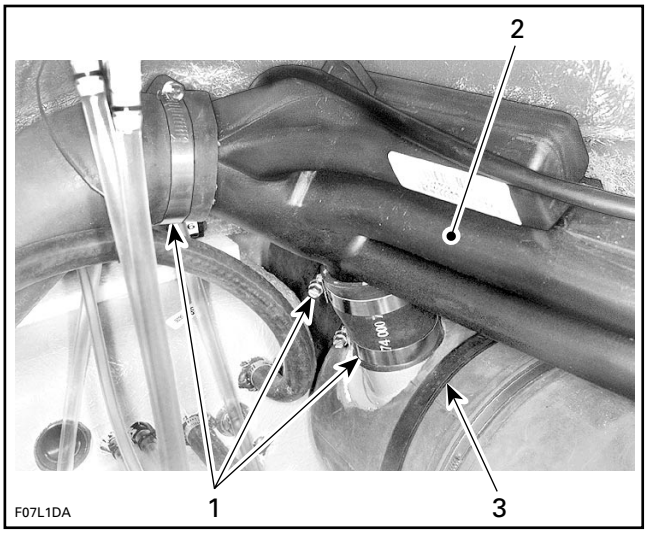
GTI Models

Remove vent tube support.

Upper Type Resonators

Detach resonator from body.

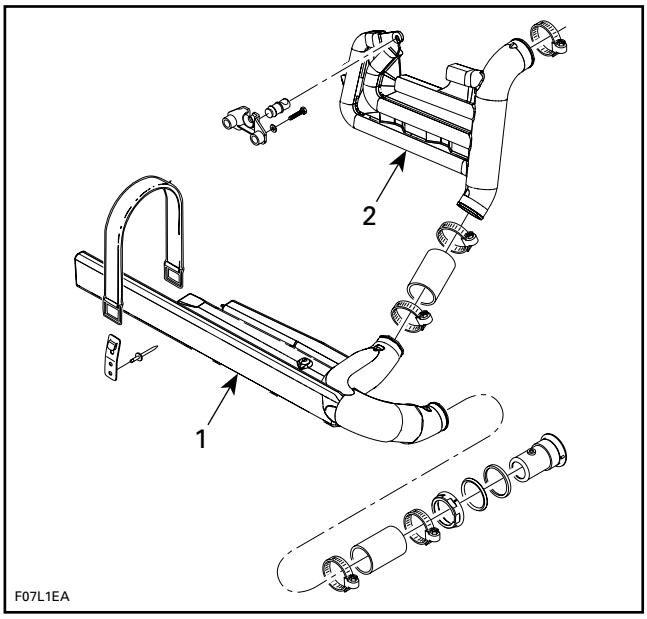
Loosen clamps and disconnect hoses. Withdraw resonator from watercraft.



TYPICAL
1. Loosen hose clamps
2. Upper type resonator
3. Muffler holding strap

Footwell Type Resonators

NOTE: **GTI RFI** and **GTI RFI LE** are equipped with both types of resonators.



TYPICAL
1. Footwell type resonator
2. Upper type resonator

Loosen clamps retaining exhaust hose going from resonator to muffler.

Loosen clamps retaining exhaust hose to exhaust outlet.

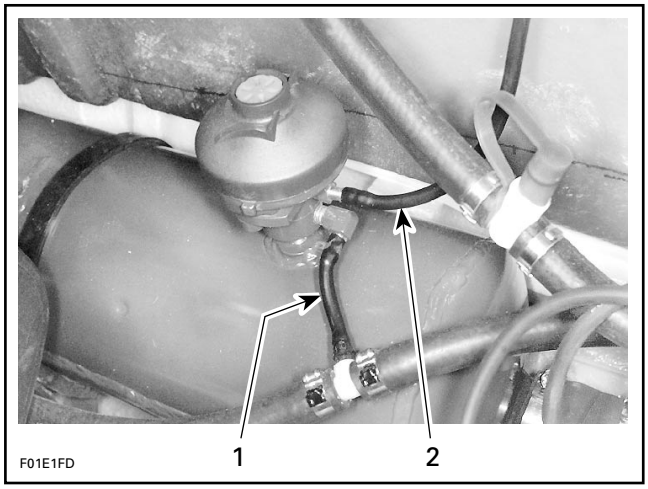
Detach holding strap retaining resonator inside bilge.

Pull resonator out of bilge.

Muffler

Disconnect hoses from muffler **no. 11**.

On **GTI RFI** and **GTI RFI LE** models, disconnect hoses of the water flow regulator valve.



TYPICAL
1. *Water supply hose*
2. *To injection fitting on tuned pipe*

Disconnect retaining strap **no. 2** of muffler.

Pull muffler **no. 11** out of bilge.

REPAIR

Tuned Pipe

This procedure is given to repair tuned pipe cracks using T.I.G. welding process.

– Sand the cracked area to obtain bare metal.
– Perform a 1.50 mm (1/16 in) depth chamfer over crack.
– Use pure argon gas with 5.55 mm (3/32 in) tungsten electrode (puretung "green", zirtung "brown") and AC current.
– Use a 5.55 mm (3/32 in) aluminum welding rod (no. 4043), to fill crack.
– Sand welding slightly to remove material surplus.

Test

– Use compressed air at 124 kPa (18 PSI) to pressurize tuned pipe.

CAUTION: Always ensure water passages are not blocked partially or completely while welding tuned pipe.

NOTE: Prior to verify leaks, plug all holes and pressurize tuned pipe while immerging it in water.

INSTALLATION

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

Exhaust Manifold

For installation procedure of the exhaust manifold **no. 14**, refer to to the *717/787 RFI ENGINE SHOP MANUAL*.

Tuned Pipe

717 Engine

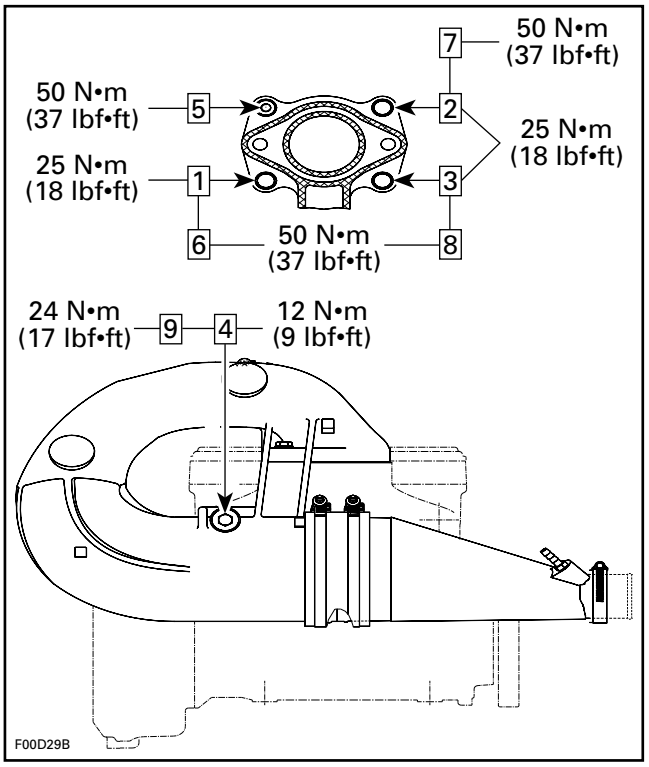
Ensure rubber bushings **no. 19** and sleeve **no. 18** are not damaged and are properly installed into tune pipe support.

CAUTION: Damage to bushings and/or sleeve will eventually cause stress to tuned pipe and may cause cracking.

Make sure that gasket **no. 16** is properly located on exhaust manifold prior to finalizing pipe installation.

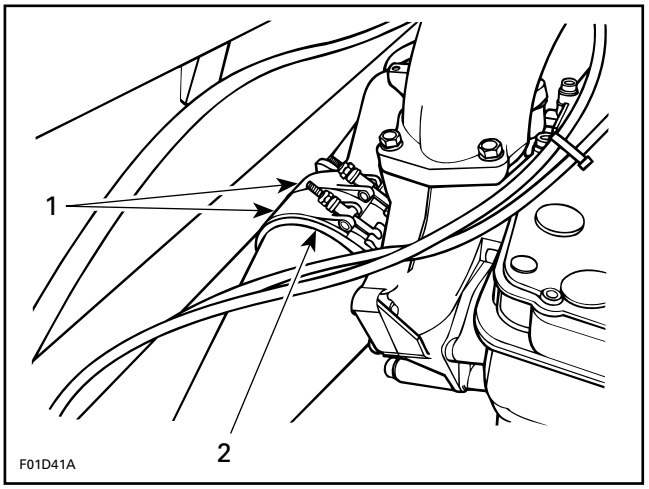
Apply Loctite 243 (blue) (P/N 293 800 060) on nut **no. 8** and screws **no. 6** and **no. 12**.

NOTE: Hand tighten all fasteners before torquing any of them. For torquing sequence, see the following illustrations.



Install tuned pipe cone **no. 5** with sealing ring **no. 15** and clamp **no. 4**.

Position clamp **no. 4** as illustrated. Do not tighten clamp yet.



1. Clamp
2. Exhaust collar

With hose removed, align cone outlet with muffler inlet.

NOTE: Due to exhaust cone angle, it may have to be rotated to obtain alignment.

Push cone **no. 5** until it touches tuned pipe, then tighten exhaust clamp **no. 4** and torque to 4 N•m (35 lbf**•in**).

CAUTION: There must be no gap between tuned pipe cone and tuned pipe head.

NOTE: Exhaust clamp nuts should be tightened alternately to assure no leakage and to obtain specified torque.

787 RFI Engine

NOTE: Loosen all pipe supports from engine before installing tuned pipe.

Ensure rubber bushings **no. 19** and sleeve **no. 18** are not damaged and are properly installed into tune pipe supports.

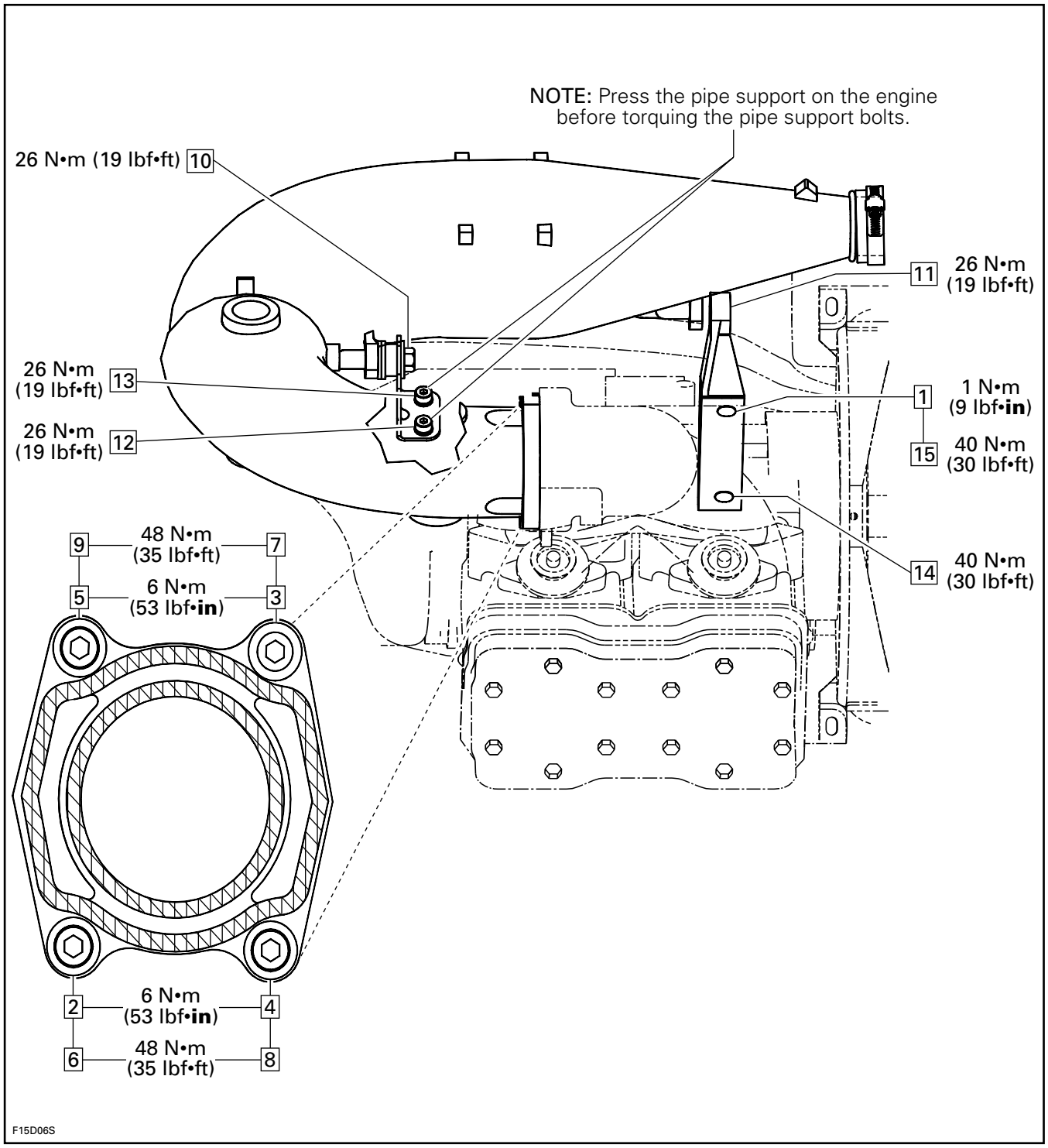
CAUTION: Damage to bushings and/or sleeve will eventually cause stress to tuned pipe and may cause cracking.

Make sure that gasket **no. 16** is properly located on exhaust manifold prior to finalizing pipe installation.

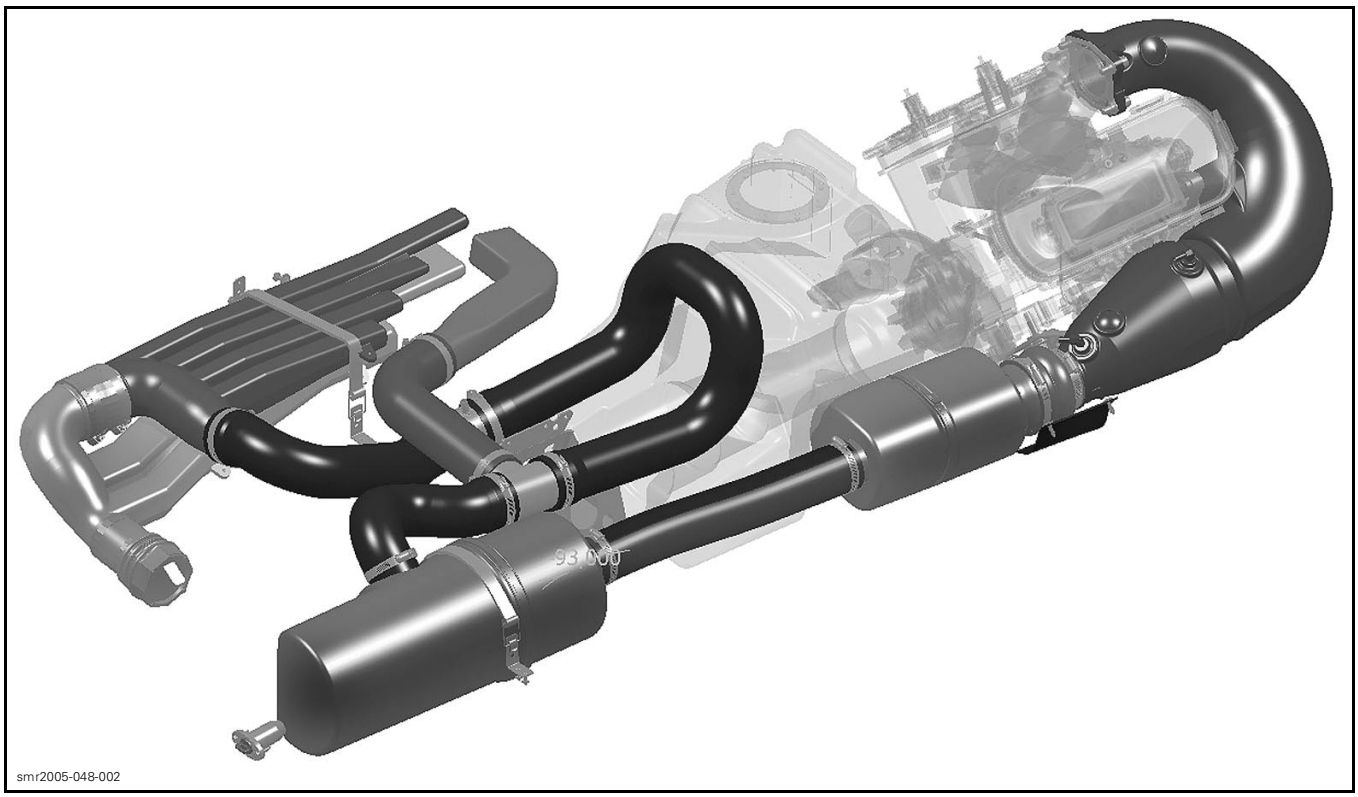
Install the tuned pipe end into exhaust hose **no. 3**. Do not torque yet.

Torquing Sequence

CAUTION: Torque the tuned pipe in accordance with the following sequence, otherwise serious engine damage may occur.



3D SERIES



smr2005-048-002

GENERAL

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

⚠ WARNING

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

REMOVAL

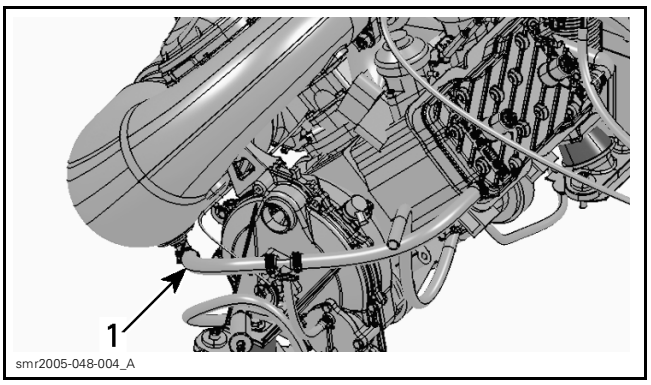
Tuned Pipe

Remove engine cover then lift and lock steering pole.

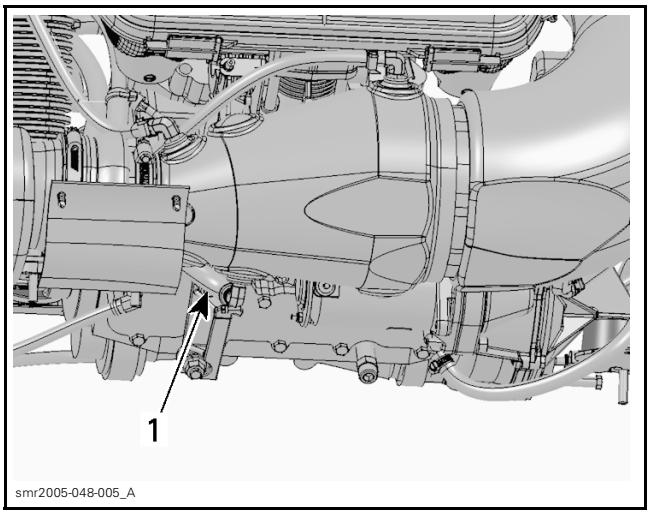
Remove air intake silencer.

NOTE: To ease tuned pipe removal, the throttle body can be removed from engine.

Disconnect hoses from tuned pipe.

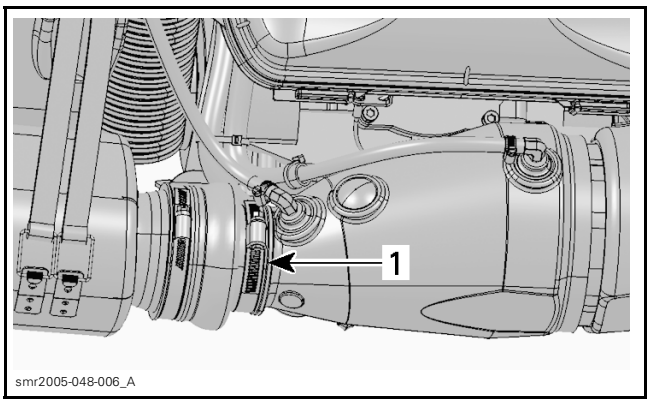


1. Tuned pipe head water jacket supply hose



1. Tuned pipe cone water jacket supply hose

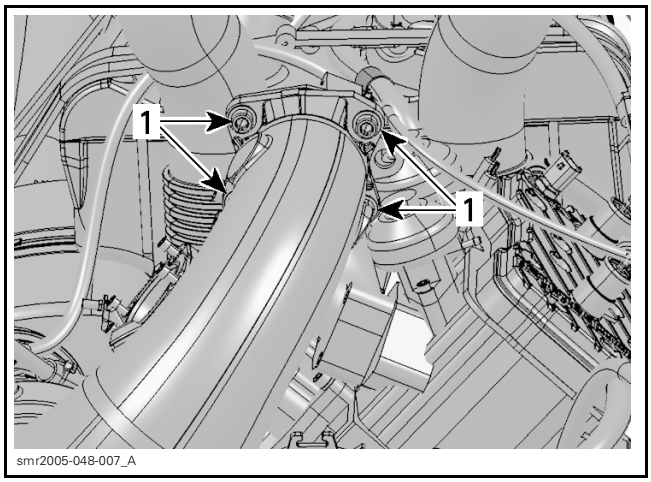
Loosen clamp then slide rearward to release the joint.



1. Tuned pipe clamp

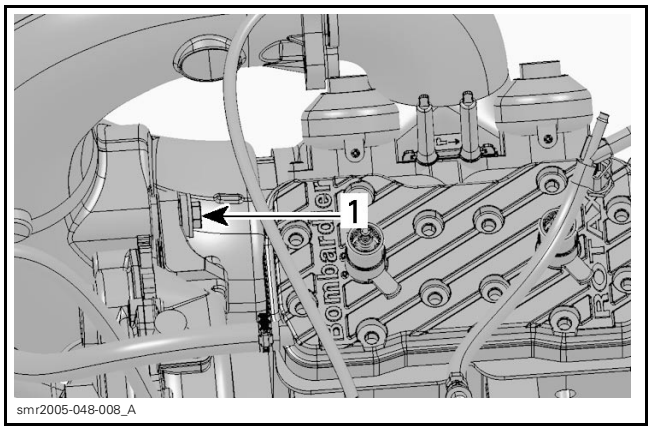
Remove:

– tuned pipe retaining screws

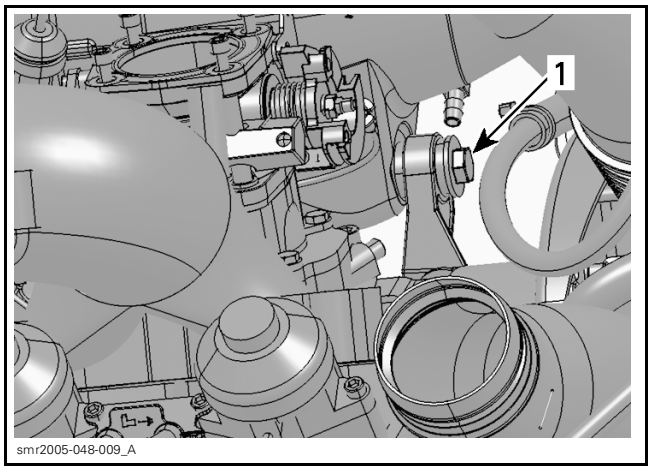


1. Tuned pipe retaining screws

– tuned pipe support screws



1. Upper screw

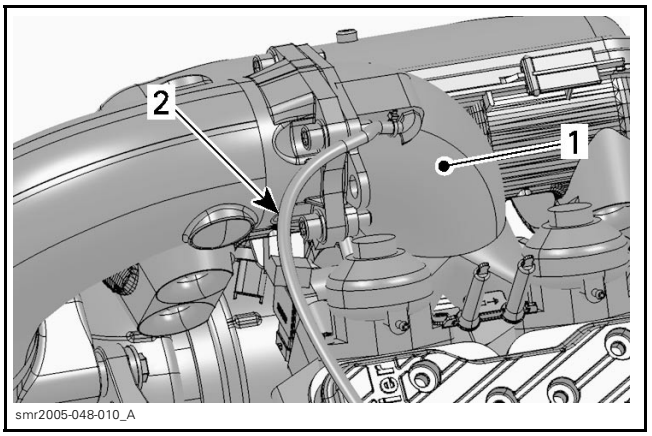


1. Bottom screw

– tuned pipe.

Exhaust Manifold

Disconnect hose from exhaust manifold.



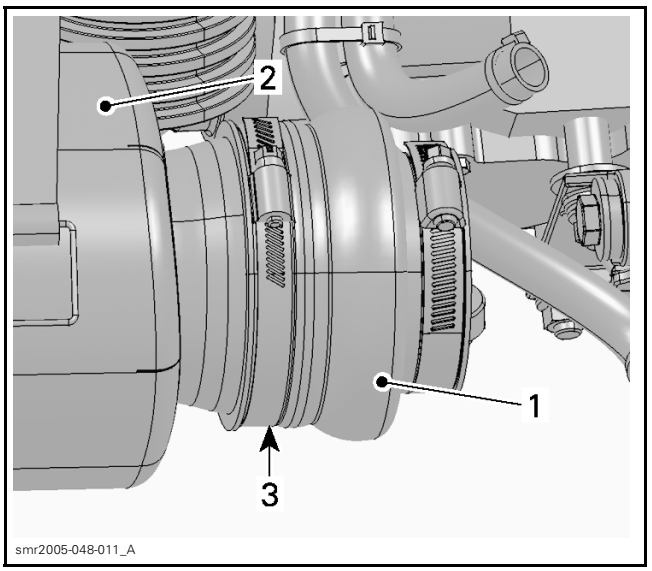
1. Exhaust manifold
2. Cooling system indicator hose

For removal procedure of the exhaust manifold, refer to the *717/787 RFI ENGINE SHOP MANUAL*.

Exhaust Bellow

Remove tuned pipe.

Unscrew clamp holding exhaust bellow to water trap.



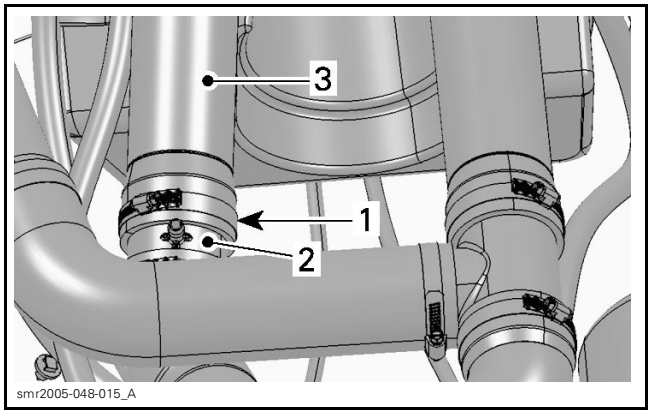
1. Exhaust bellow
2. Water trap
3. Remove this clamp

Remove exhaust bellow.

Muffler

Open rear access panel.

Unscrew hose adaptor clamp then disconnect hose from adaptor.

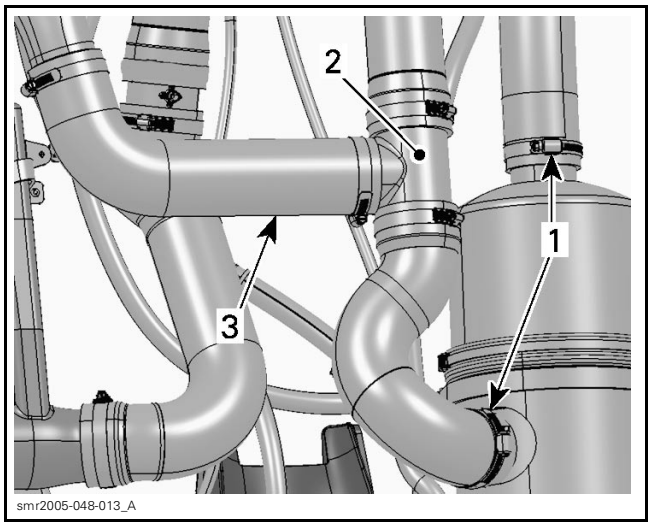


1. *Hose adaptor clamp*
2. *Hose adaptor*
3. *Disconnect this hose*

Unscrew muffler hose clamps.

Remove hose with T-fitting and straight resonator.

Remove muffler strap.



1. *Muffler clamps*
2. *T-fitting*
3. *Straight resonator hose*

Disconnect muffler from extension pipe by pulling muffler rearward.

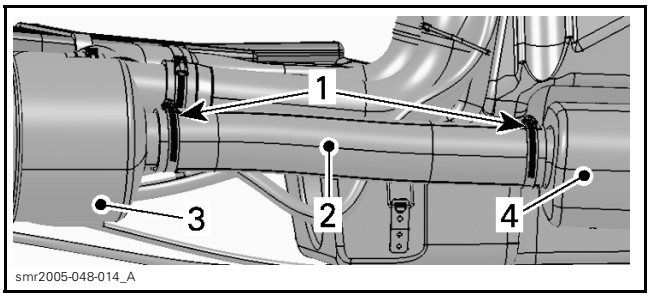
Pull muffler out of vehicle.

Inspect muffler, shell and boot condition.

Water Trap and Exhaust Pipe

Remove tuned pipe and exhaust bellow.

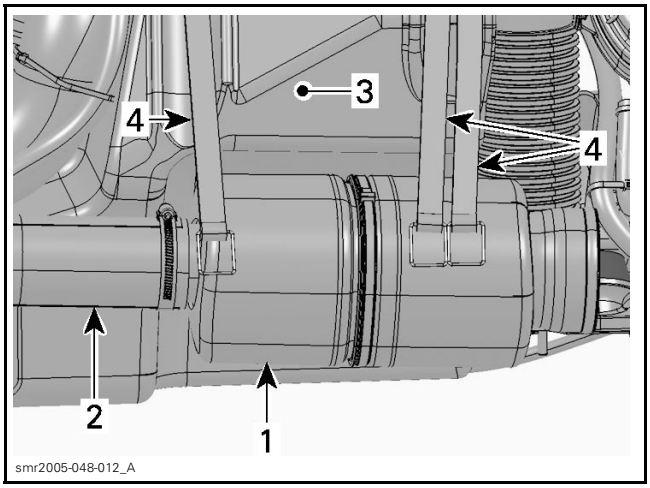
Unscrew clamps retaining extension pipe to muffler and water trap.



1. *Clamps*
2. *Extension pipe*
3. *Muffler*
4. *Water trap*

Remove heat shield from extension pipe.

Detach straps holding water trap against fuel tank.



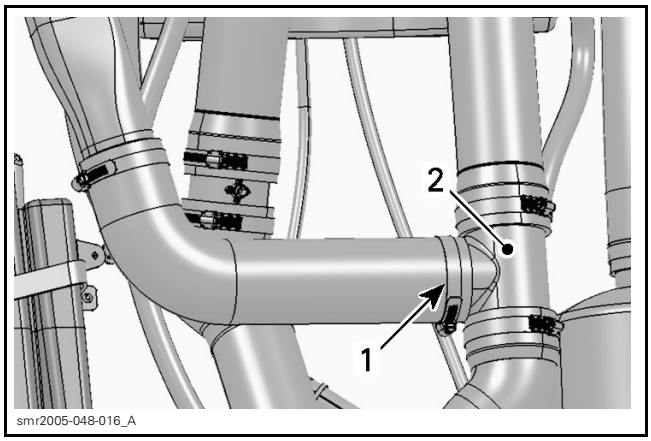
1. *Water trap*
2. *Extension pipe*
3. *Fuel tank*
4. *Retaining straps*

Remove water trap by pulling and turning it rearward.

Resonators

Straight Resonator

Unscrew clamp retaining straight resonator hose to T-fitting.

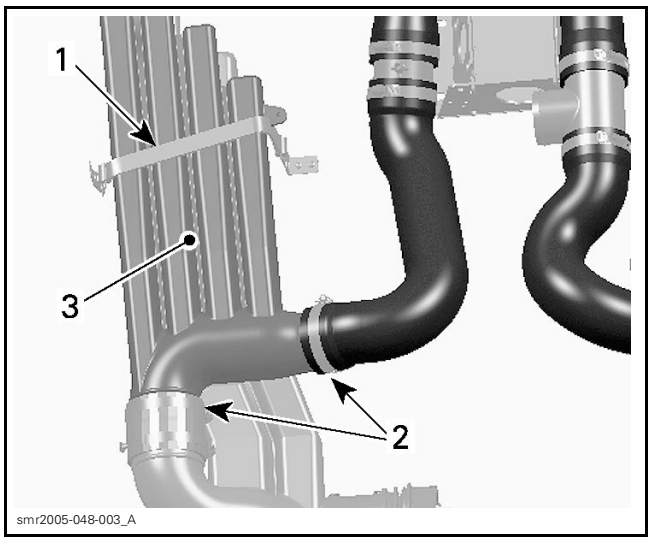


1. *Straight resonator hose clamp*
2. *T-fitting*

Remove hose with resonator.

Upper Resonator

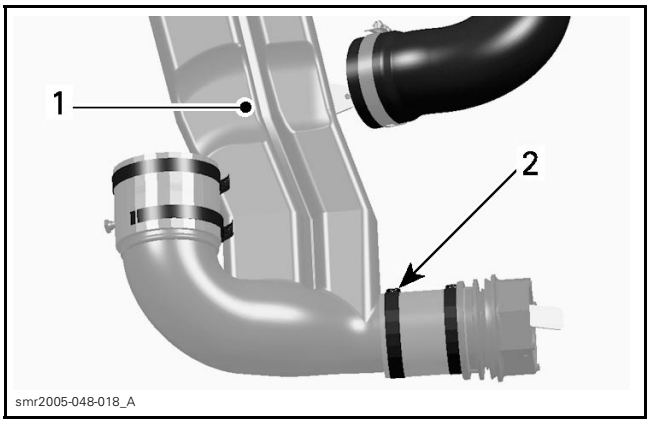
Remove strap, loosen clamps then pull out resonator.



1. *Resonator strap*
2. *Clamps*
3. *Upper resonator*

Lower Resonator

Loosen clamp then pull out resonator.



1. *Lower resonator*
2. *Clamp on hull fitting*

REPAIR

Tuned Pipe

This procedure is given to repair tuned pipe cracks using T.I.G. welding process.

- Sand the cracked area to obtain bare metal.
- Perform a 1.50 mm (1/16 in) depth chamfer over crack.
- Use pure argon gas with 5.55 mm (3/32 in) tungsten electrode (puretung "green", zirtung "brown") and AC current.
- Use a 5.55 mm (3/32 in) aluminum welding rod (no. 4043), to fill crack.
- Sand welding slightly to remove material surplus.

Test

- Use compressed air at 124 kPa (18 PSI) to pressurize tuned pipe.

CAUTION: Always ensure water passages are not blocked partially or completely while welding tuned pipe.

NOTE: Prior to verify leaks, plug all holes and pressurize tuned pipe while immerging it in water.

INSTALLATION

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

Tuned Pipe

NOTE: Loosen all tuned pipe supports from engine before installing tuned pipe.

Ensure rubber bushings **no. 17** and sleeve **no. 18** are not damaged and are properly installed into tuned pipe supports.

CAUTION: Damage to bushings and/or sleeve will eventually cause stress to tuned pipe and may cause cracking.

Apply Loctite 518 (P/N 293 800 038) on both sides of gasket **no. 24**.

Make sure that gasket **no. 24** is properly located on exhaust manifold prior to finalizing pipe installation.

Torquing Sequence

Torque the tuned pipe as per sequence found on last page of this section.

CAUTION: Torque the tuned pipe in accordance with this sequence, otherwise serious engine damage may occur.

Extension Pipe and Muffler

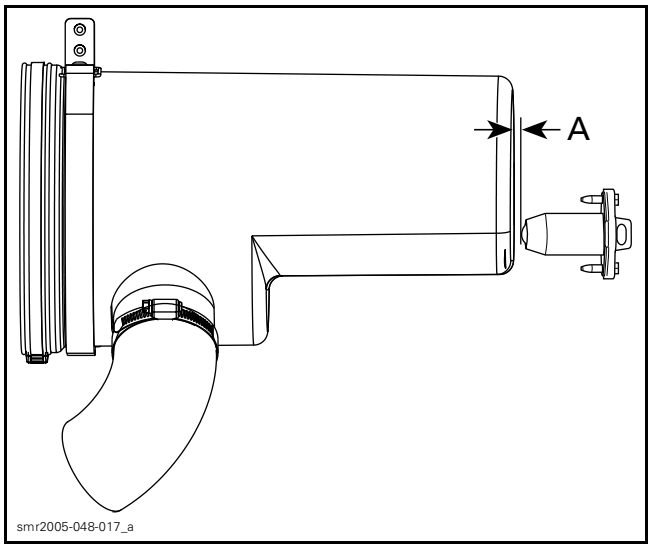
Position muffler in its location. Do not install the strap yet.

Insert muffler into extension pipe. Do not torque clamp yet.

Install all other hoses and resonators.

Torque all clamps and install muffler strap.

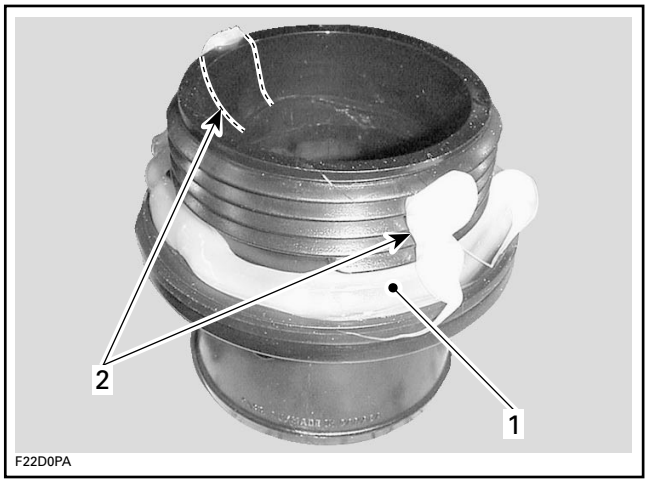
Ensure there is a gap between muffler and drain plug. The gap should be 10 mm (3/8 in) minimum.



A. Gap between muffler and drain plug

Exhaust Outlet

Prior to installing exhaust outlet, apply silicone sealant (clear) (P/N 293 800 086) as shown.



1. All around
2. Opposite vertical lines

Hose adaptor

Always install the hose adaptor with the big fitting on top.

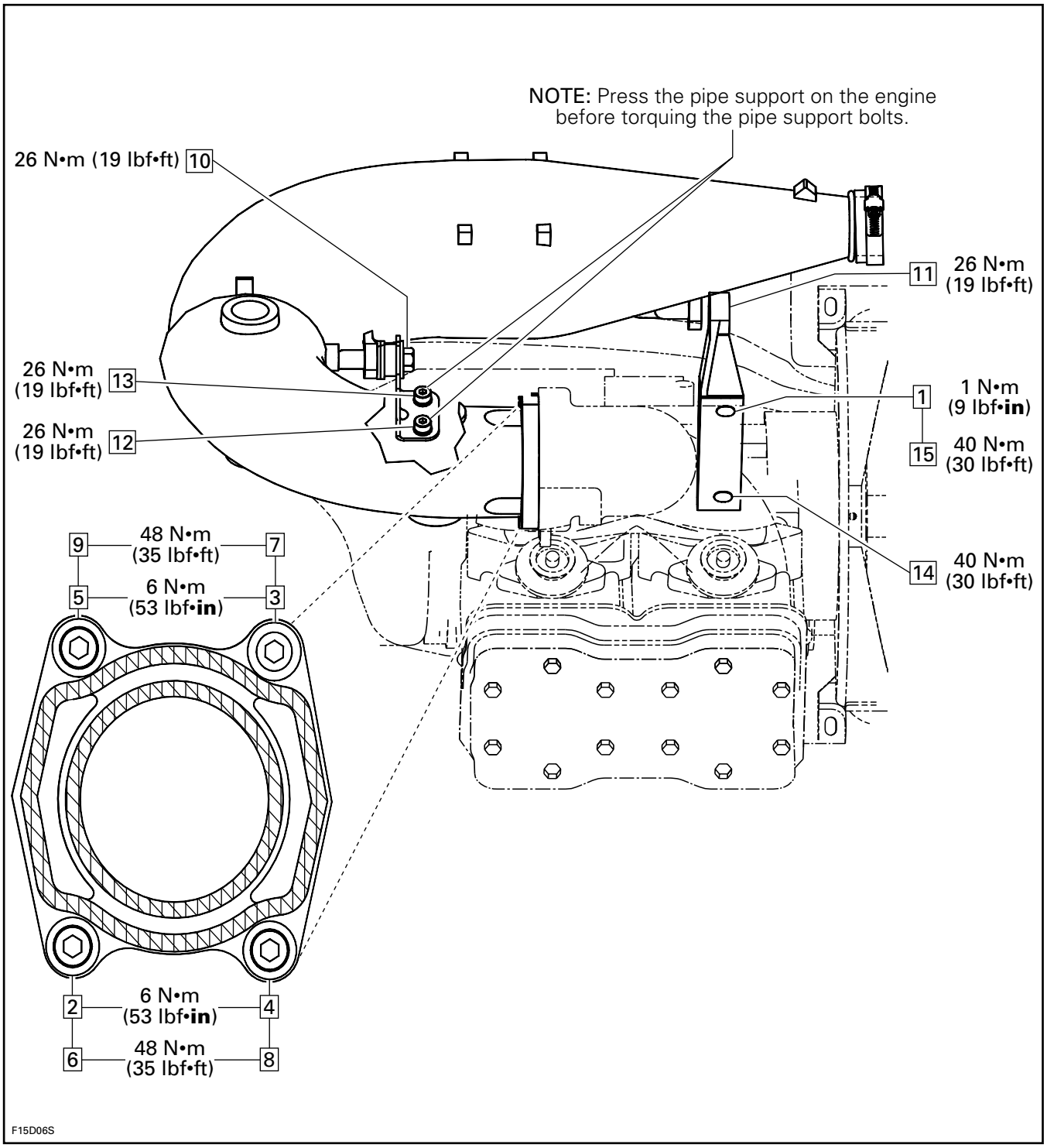
Final Verification

⚠ WARNING

Ensure that tubes and hoses are properly routed away from any rotating, moving, heating or vibrating parts. Also ensure that hot parts are properly positioned away from any part that can be damaged by the heat.

Reinstall any remaining parts.

NOTE: If throttle body was removed, verify throttle lever operation. It should operate smoothly and return to its initial position without any hesitation. Reset the Closed TPS. Refer to ENGINE MANAGEMENT.



TUNED PIPE TORQUING SEQUENCE

REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
alignment shaft	295 000 141	66–67
engine lift tool	529 035 940	62
lifting rings	529 035 830	62
plate	529 035 507	65, 67
PTO flywheel adapter	529 035 590	68
small hose pincher	295 000 076	63
Support plate kit	529 035 506	65

SERVICE PRODUCTS

Description	Part Number	Page
Bombardier Lube	293 600 016	70
dielectric grease	293 550 004	65
Loctite 243 (blue)	293 800 060	65, 69

GENERAL

On some models, it is not necessary to remove engine from watercraft to service TOP END, PTO FLYWHEEL or MAGNETO. However, engine removal is necessary to repair BOTTOM END.

PROCEDURES

ENGINE REMOVAL

In order to remove engine from watercraft proceed as follows.

First, disconnect battery cables from battery.

⚠ WARNING

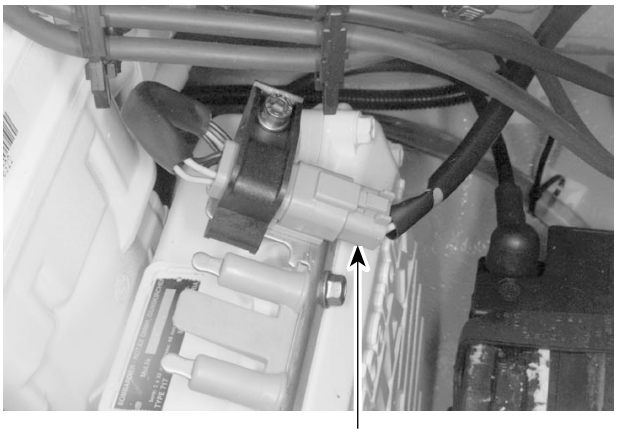
Always disconnect battery cables exactly in the specified order, BLACK (–) cable first then the RED (+) battery cable last.

Electrical Connections

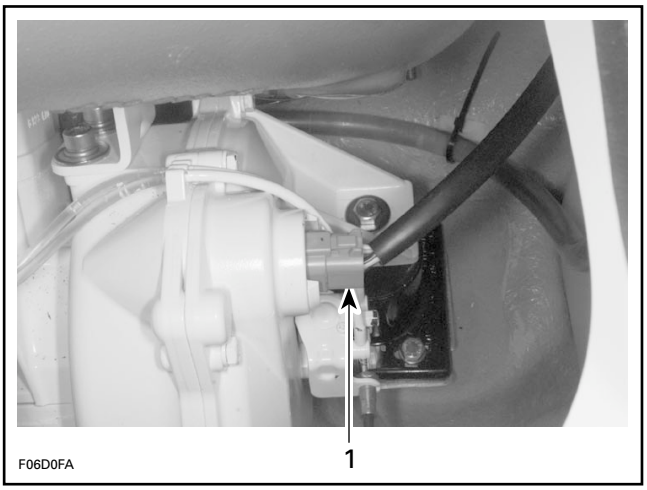
It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

Disconnect temperature sensor wire and spark plug cables.

Disconnect magneto wiring harness.



717 ENGINES
1. Unplug connector



787 RFI ENGINES
1. Unplug connector

787 RFI Engines

Disconnect throttle position sensor (TPS), air pressure sensor (APS) and air temperature sensor (ATS).

Disconnect crankshaft position sensor (CPS).

Disconnect connectors from fuel injectors.

Refer to FUEL INJECTION for location of sensors and connectors.

Jet Pump Removal

To withdraw jet pump, refer to JET PUMP.

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

Drive System

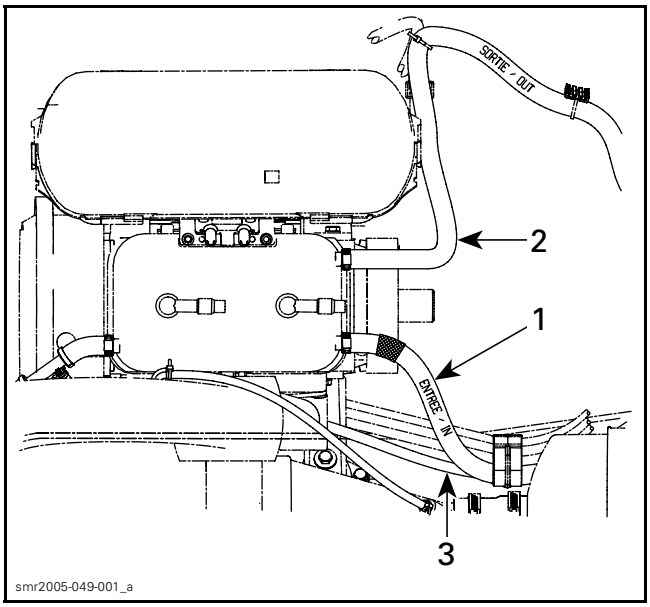
To withdraw drive shaft(s), refer to DRIVE SYSTEM.

Cooling System

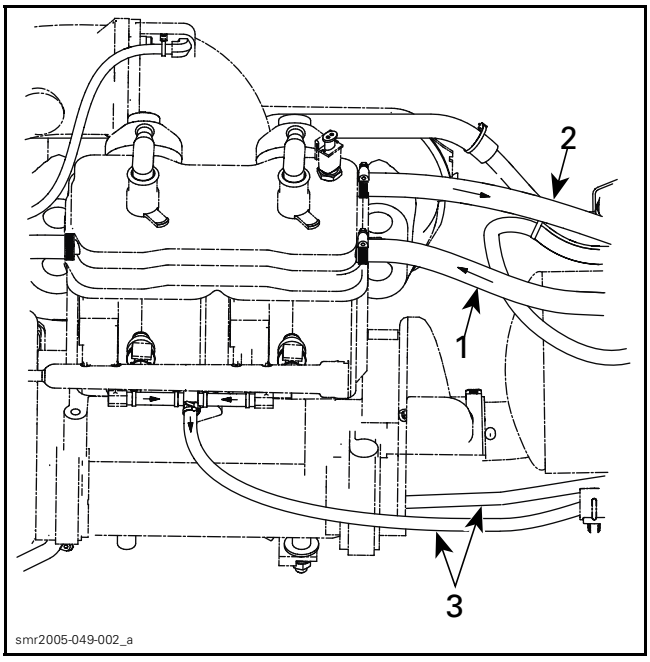
Disconnect the engine water supply hose.

Disconnect the engine water return hose.

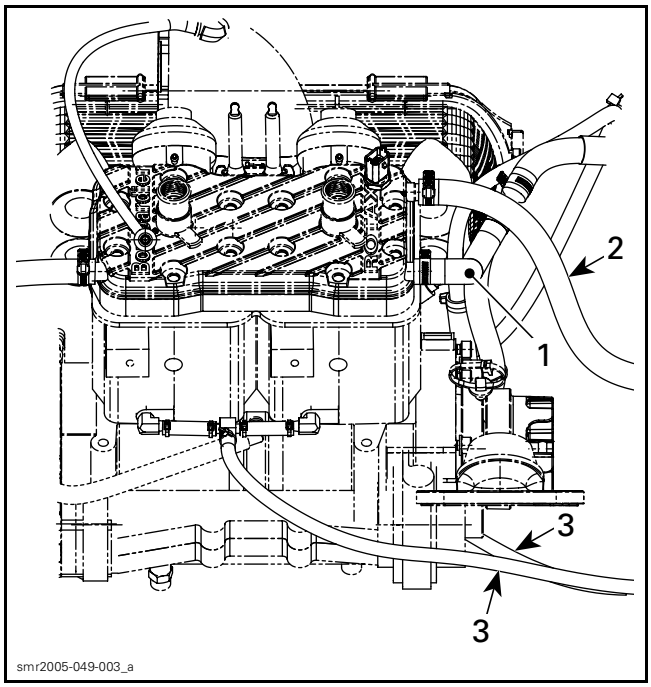
NOTE: Engine will have to be raised inside bilge to disconnect drain hose before removing from bilge.



GTI — 717 ENGINES
1. Water supply hose
2. Water return hose
3. Drain hose



GTI — 787 RFI ENGINES
1. Water supply hose
2. Water return hose
3. Drain hoses



3D — 787 RFI ENGINES
1. *Water supply hose*
2. *Water return hose*
3. *Drain hoses*

Air Intake Silencer

To remove air intake silencer, refer to AIR INTAKE.

Tuned Pipe

To remove tuned pipe, refer to EXHAUST SYSTEM.

Carburetor

717 Engines

Turn fuel valve to OFF.

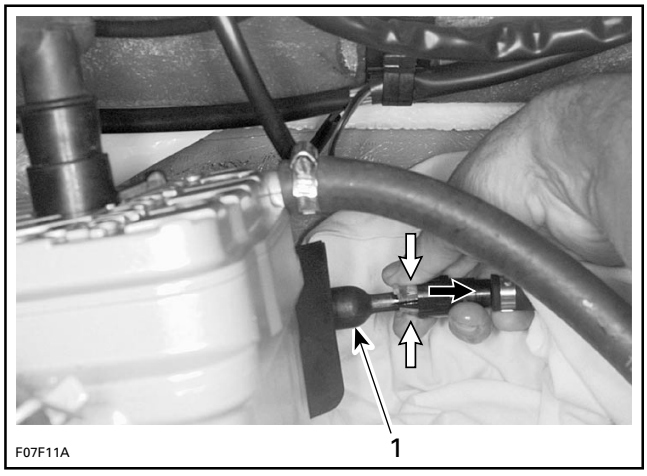
Disconnect fuel supply and fuel return hoses.

To remove carburetor(s), refer to CARBURETOR for proper procedure.

Throttle Body

787 RFI Engines

Disconnect fuel supply hose from fuel rail.



TYPICAL — PRESS TABS AND PULL CONNECTOR
1. *Fuel rail*

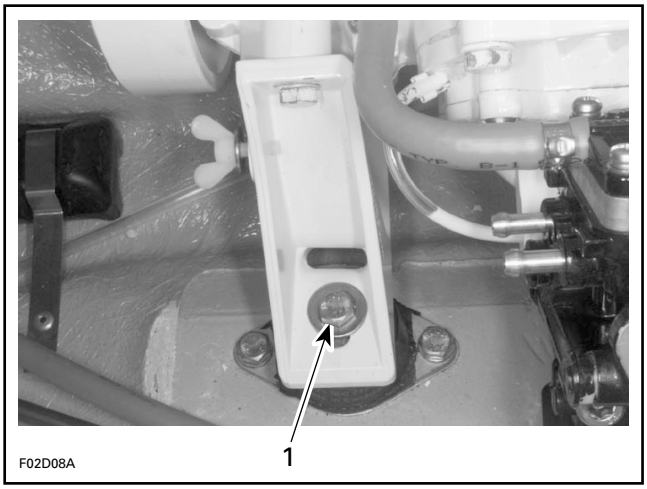
⚠ WARNING

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.

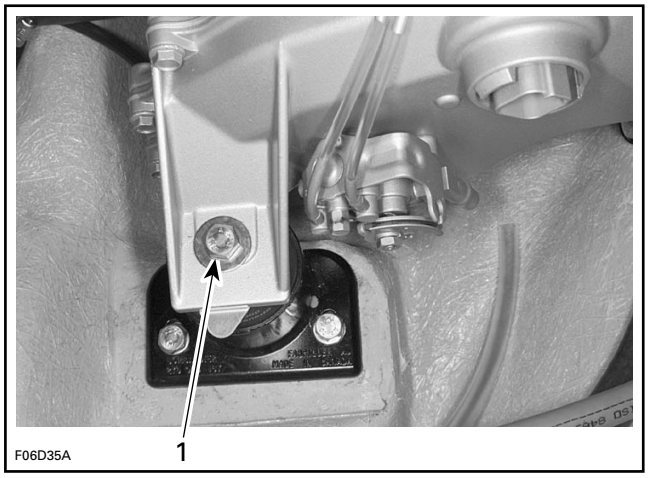
Engine Support

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.

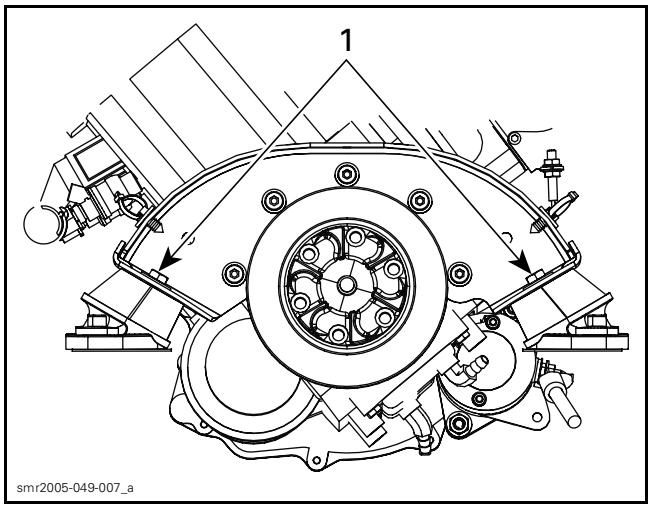
Remove engine support mount screws.



717 ENGINES
1. *Remove screw of each engine support*



TYPICAL — 787 RFI ENGINES — FRONT SUPPORT
1. Remove screw

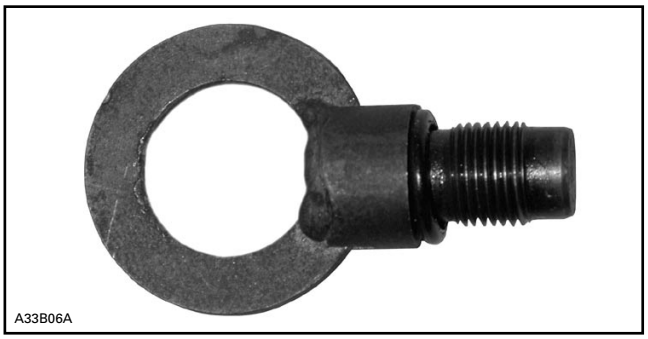


TYPICAL — 787 RFI ENGINES — REAR SUPPORT
1. Remove screws

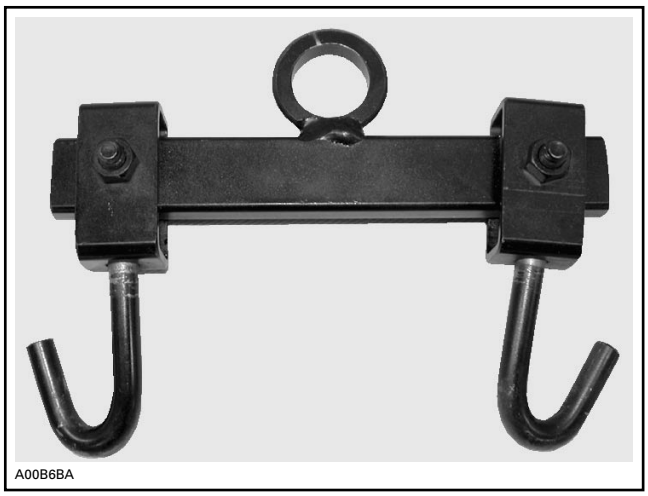
Lifting Engine

717 Engines

Engine can be easily lifted using the lifting rings (P/N 529 035 830) and the engine lift tool (P/N 529 035 940).



LIFTING RING



ENGINE LIFT TOOL

Remove spark plugs and replace by lifting ring.

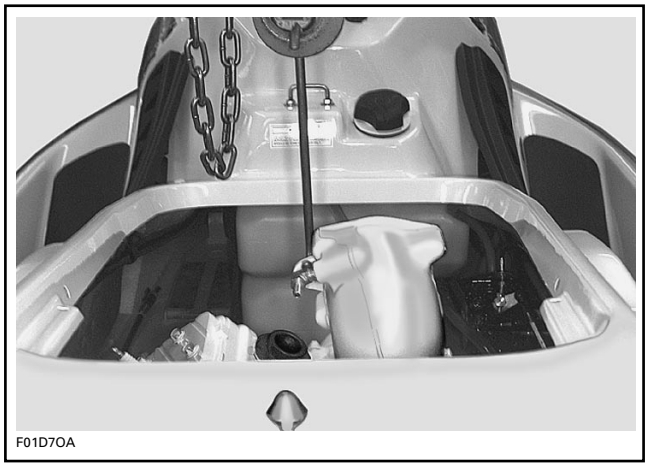
Hook engine lift tool into lifting ring holes.

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 cable or oil injection hoses.

787 RFI Engines

Engine can be easily lifted by inserting a hook into exhaust manifold eyelet.

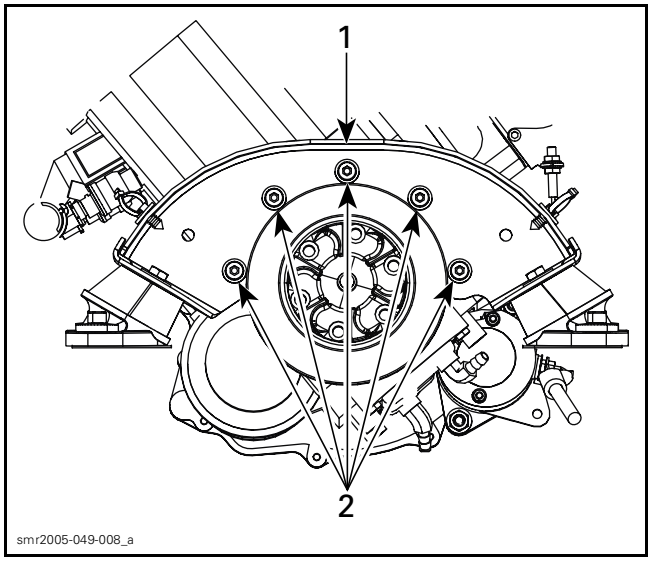


TYPICAL — GTI RFI SHOWN

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 cable or oil injection hoses.

Remove rear engine support bolts then remove engine support from engine.

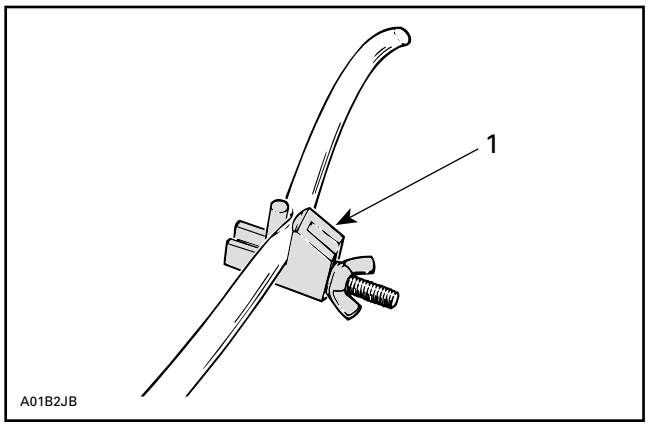


TYPICAL
1. *Rear support*
2. *Engine support bolts*

All Engines

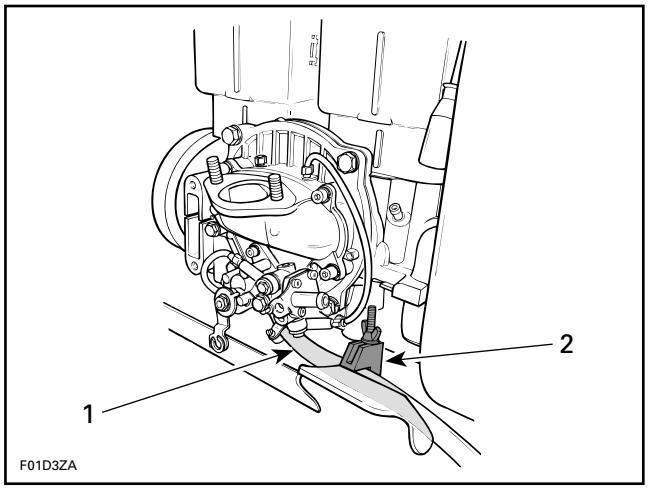
Lift up engine slowly until oil injection hoses can be reached.

Install a small hose pincher (P/N 295 000 076) to oil supply hoses of oil injection pump and rotary valve shaft; then, disconnect hoses.

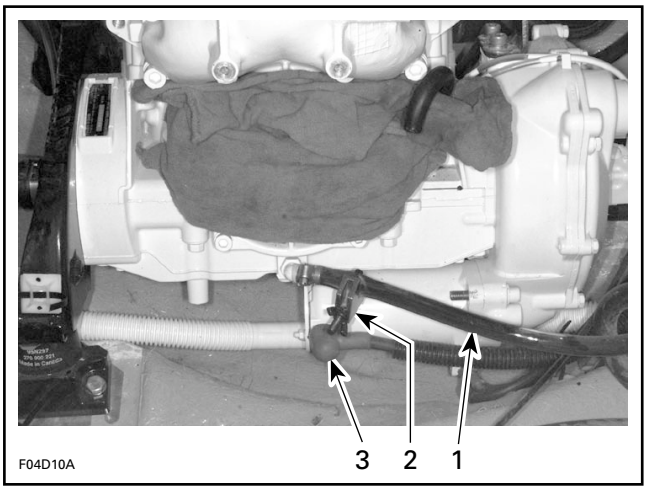


TYPICAL
1. *Small hose pincher*

Install another small hose pincher (P/N 295 000 076) to oil return hose of rotary valve shaft; then, disconnect hose.

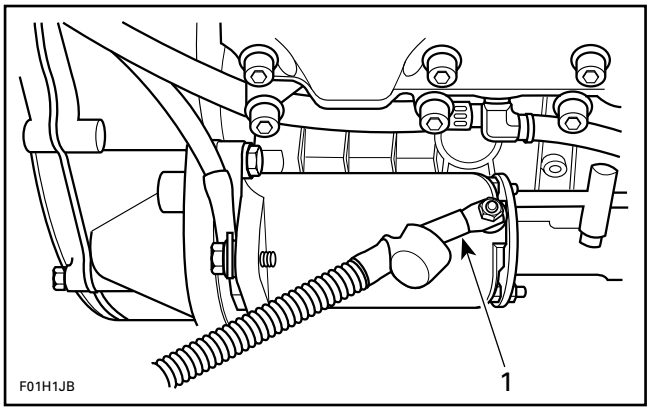


TYPICAL — 717 ENGINES
1. *Rotary valve oil supply line*
2. *Hose pincher installed*



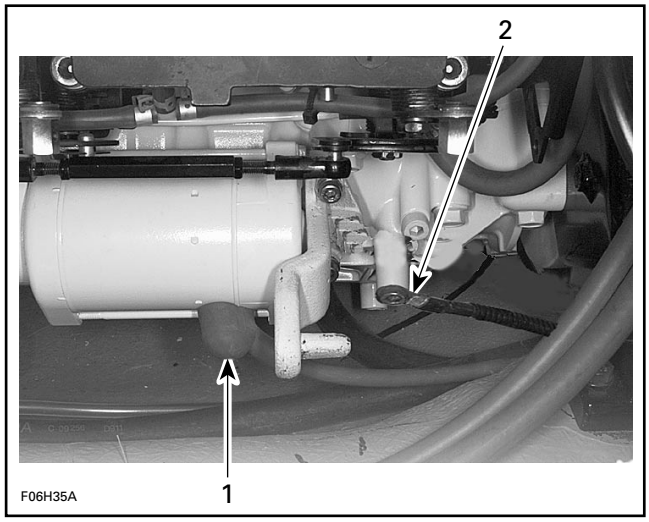
TYPICAL — 787 RFI ENGINES
1. *Rotary valve oil supply line*
2. *Hose pincher installed*
3. *Starter cable*

Disconnect RED (+) cable from starter post.



TYPICAL
1. *Disconnect RED (+) cable*

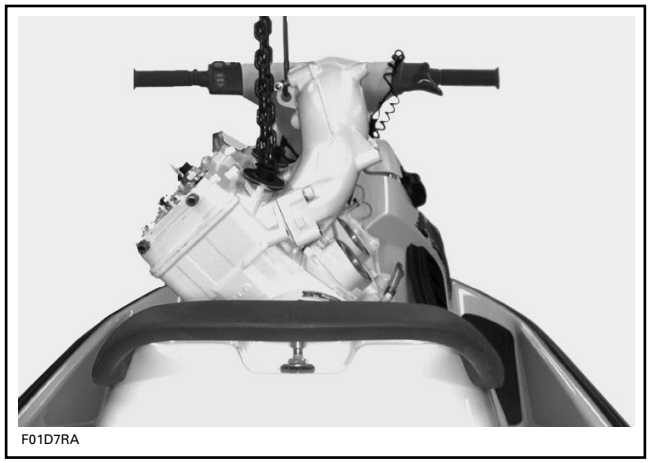
Disconnect BLACK (–) cable from engine crankcase.



1. *Positive starter cable*
2. *Ground cable*

Carry on engine lifting then tilt engine so that it can be removed from the body opening.

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



TYPICAL — GTI RFI SHOWN

CLEANING

Wipe off any spillage in bilge. Clean with a bilge cleaner.

Clean external parts of engine.

INSTALLATION

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

Rubber Mount

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).

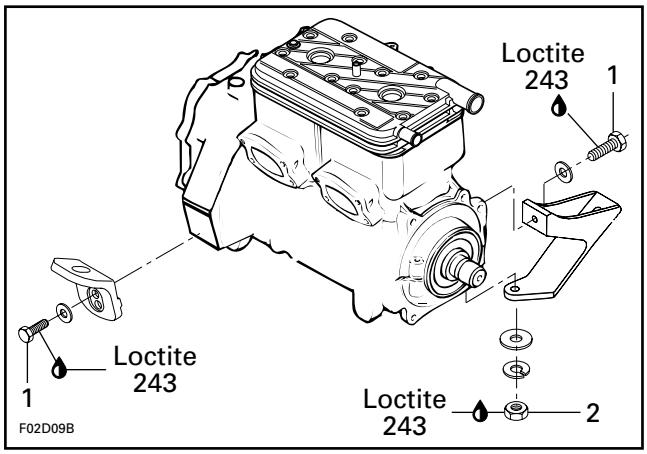
CAUTION: Strict adherence to this torque is important to avoid damaging threads of aluminum insert in bilge.

Engine Support

717 Engines

Torque front and rear engine supports as shown in the following illustration.

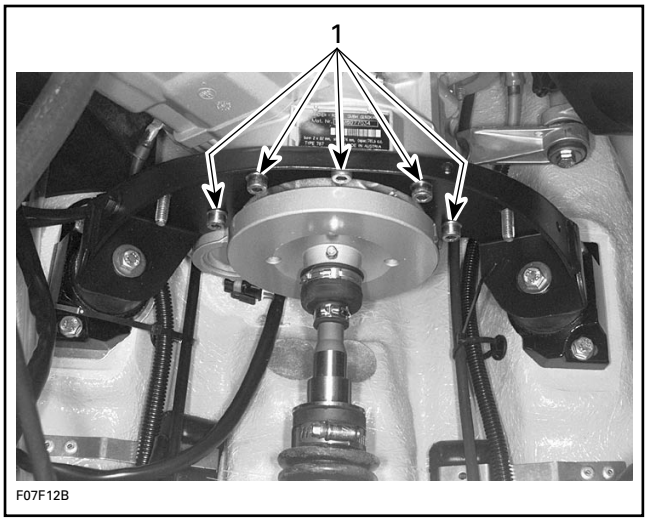
Apply Loctite 243 (blue) (P/N 293 800 060) on threads.



1. *Torque screws to 22 N•m (16 lbf•ft)*
2. *Torque nuts to 39 N•m (29 lbf•ft)*

787 RFI Engines

Apply Loctite 243 (blue) (P/N 293 800 060) to rear engine support screws and install them with flat washers and torque to 24 N•m (17 lbf•ft).



TYPICAL
1. *Torque engine support screws to 24 N•m (17 lbf•ft)*

Oil Injection Hoses

Make sure to reinstall hoses before completely lowering engine in bilge.

Positive Starter Cable

Torque nut of positive starter cable to 6 N•m (53 lbf•**in**). Apply dielectric grease (P/N 293 550 004) on nut.

Engine/Jet Pump Alignment

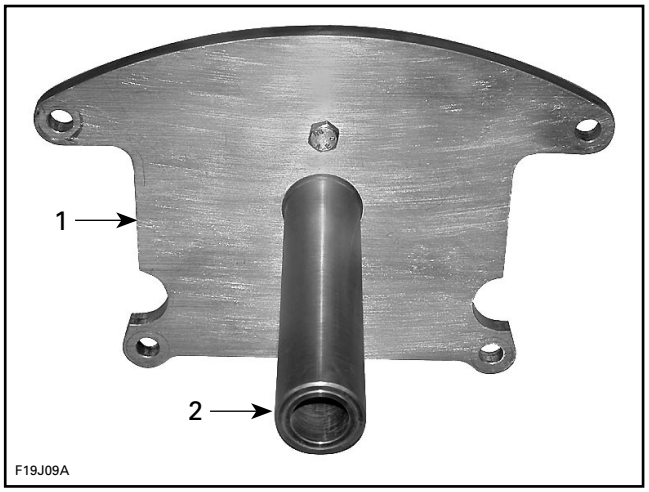
GTI Series

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).

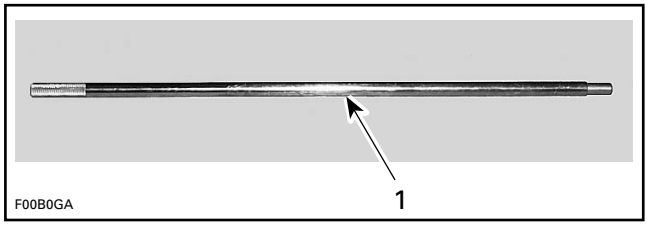
Use:

– plate (P/N 529 035 507)



1. Plate
2. Support

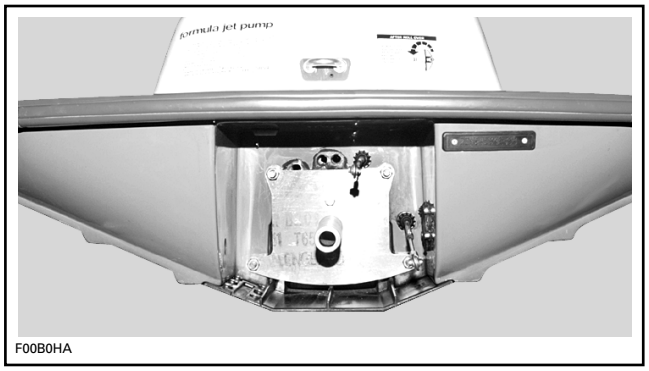
– alignment shaft (P/N 295 000 141)



1. Alignment shaft

To verify alignment proceed as follows:

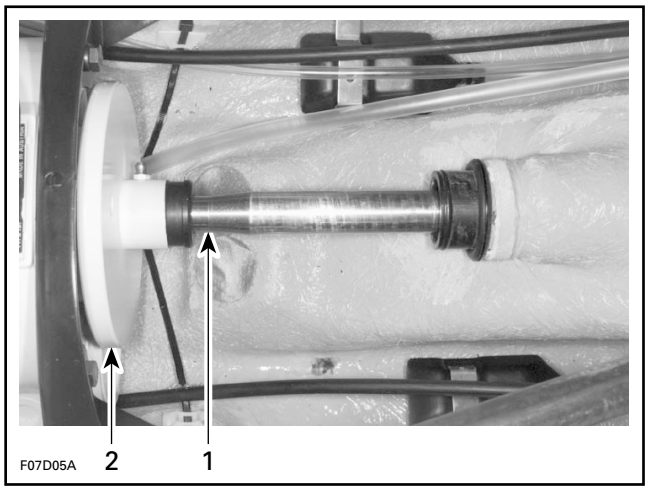
– Install the appropriate plate with the support to hull with four nuts.



– Carefully slide shaft through support.
– Insert shaft end into PTO flywheel.

NOTE: Ensure the protective hose and carbon ring (or seal carrier) is removed to check engine alignment.

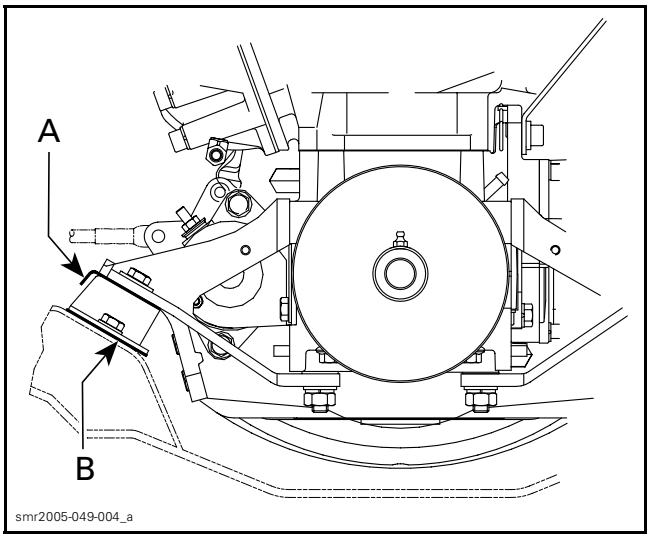
NOTE: If the alignment is correct, the shaft will slide easily without any deflection in PTO flywheel.



TYPICAL
1. Alignment shaft
2. PTO flywheel

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

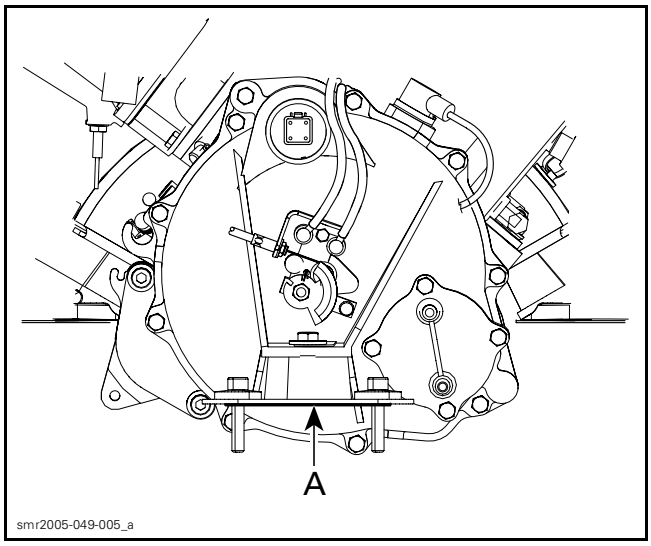
NOTE: Use shim(s) as necessary to correct alignment.



717 ENGINES

SHIM LOCATION	SHIM TO BE USED	MAXIMUM THICKNESS
A	shim 1.3 mm (.0512 in) (P/N 270 000 025)	3 mm (.1181 in)
	shim 0.3 mm (.0118 in) (P/N 270 000 061)	
B	shim 1.3 mm (.0512 in) (P/N 270 000 007)	5 mm (.1968 in)
	shim 0.3 mm (.0118 in) (P/N 270 000 062)	

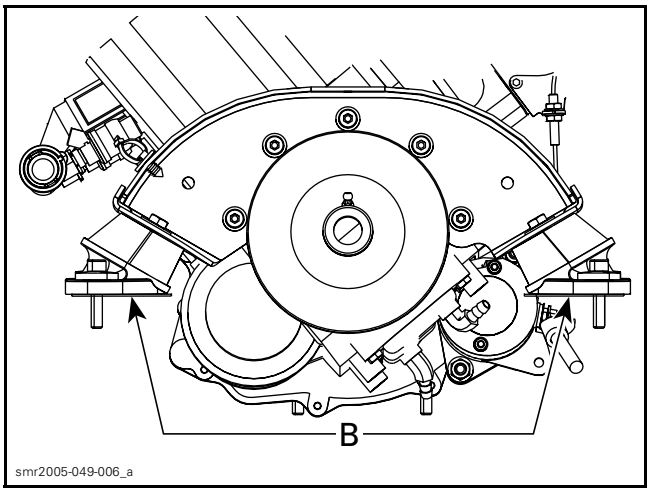
CAUTION: Whenever shims are used to correct alignment, never install more than the specified thickness.



787 RFI ENGINES — FRONT

SHIM LOCATION	SHIM TO BE USED	MAXIMUM THICKNESS
A	shim 1.3 mm (.0512 in) (P/N 270 000 446)	5 mm (.1968 in)

CAUTION: Whenever shims are used to correct alignment, never install more than 5 mm (.1968 in) shim thickness.



787 RFI ENGINES — REAR

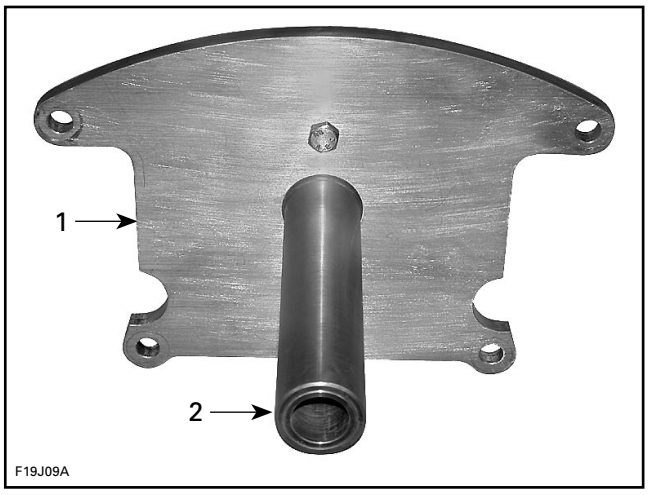
SHIM LOCATION	SHIM TO BE USED	MAXIMUM THICKNESS
B	shim 1.3 mm (.0512 in) (P/N 270 000 446)	5 mm (.1968 in)

CAUTION: Whenever shims are used to correct alignment, never install more than 5 mm (.1968 in) shim thickness.

3D Series

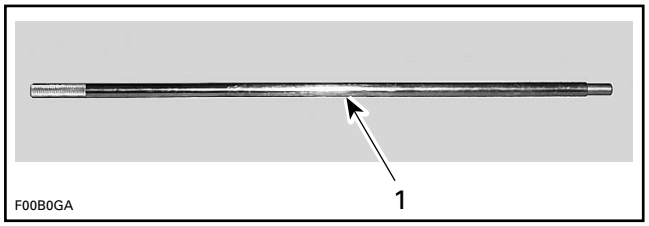
Use:

– plate (P/N 529 035 507)



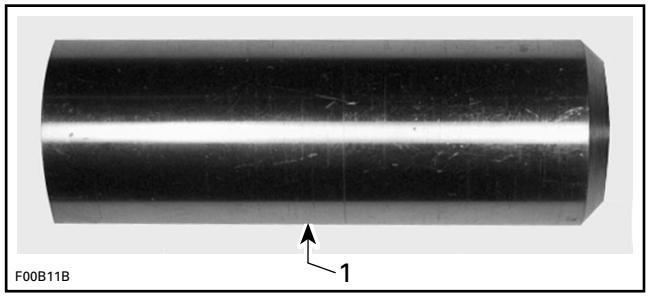
1. *Plate*
2. *Support*

– alignment shaft (P/N 295 000 141)



1. Alignment shaft

– PTO flywheel adapter (P/N 529 035 590).



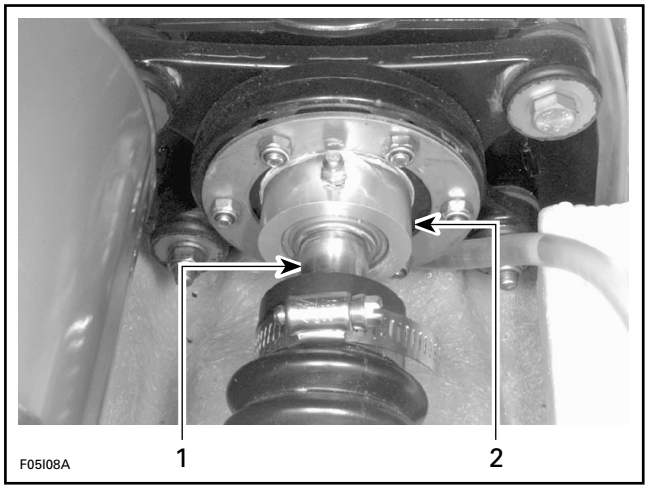
1. Adapter

Install support plate at rear of watercraft.

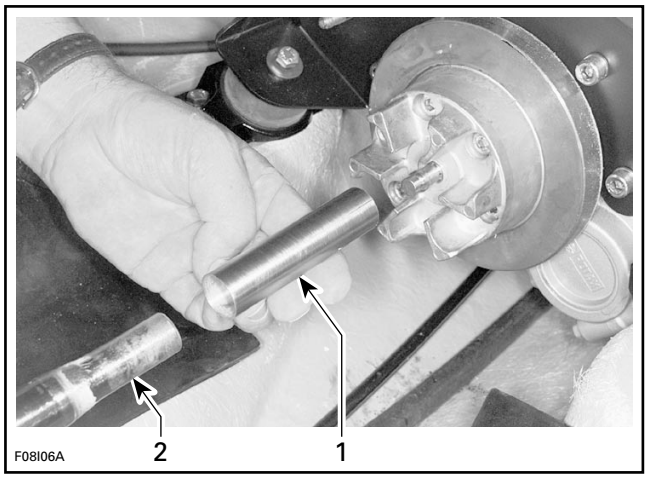
Install adapter on shaft.

NOTE: First ensure the mid bearing shaft support has been properly aligned prior to performing engine alignment. Refer to DRIVE SYSTEM. Then, ensure the mid bearing is loosened to check engine alignment.

Carefully slide alignment shaft through shaft support and seal carrier.



TYPICAL
1. Alignment tool
2. Seal carrier

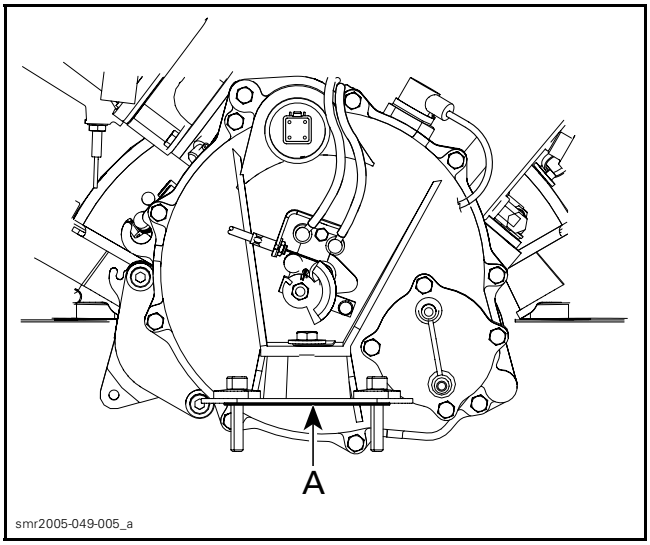


1. Alignment shaft
2. Adapter

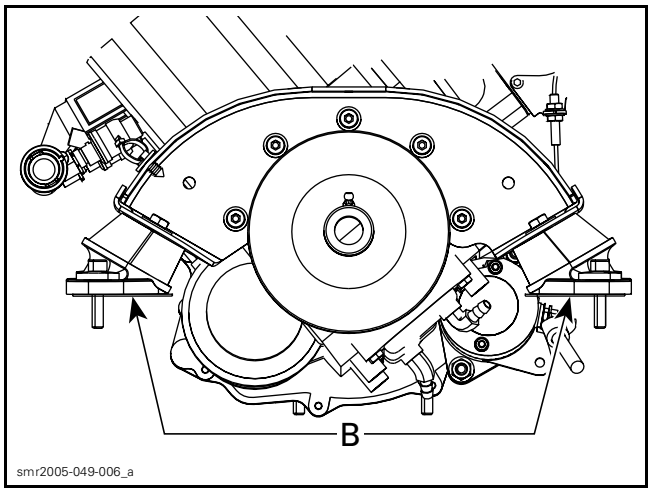
Continue to slide the alignment shaft forward and install PTO adapter on shaft end.

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

NOTE: Use shim(s)as necessary to correct alignment.



787 RFI ENGINES — FRONT



787 RFI ENGINES — REAR

CAUTION: Whenever shims are used to correct alignment, never install more than 5 mm (.1968 in) shim thickness.

Remove alignment shaft. Ensure the alignment washers of mid bearing are still loose.

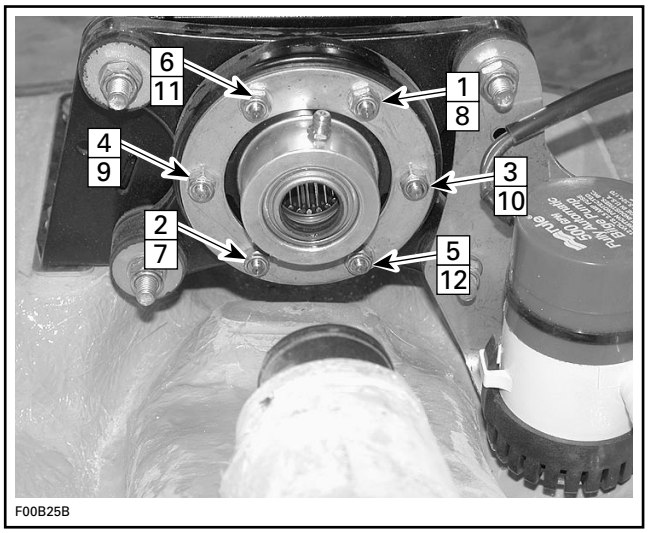
Reinstall drive shaft. Refer to DRIVE SYSTEM.

Ensure grease fitting of seal carrier is located on the top.

Apply Loctite 243 (blue) (P/N 293 800 060) on studs and install nuts.

Refer to following illustration for tightening sequence. Torque 1 to 6 at 3 N•m (27 lbf•**in**) and then 7 to 12 at 10 N•m (89 lbf•**in**).

NOTE: It is very important to tighten nuts of seal carrier in this sequence to maintain its alignment.

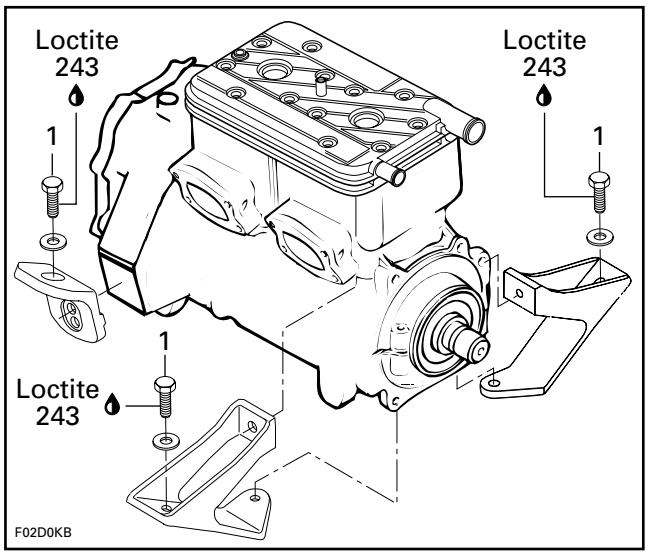


TIGHTENING SEQUENCE

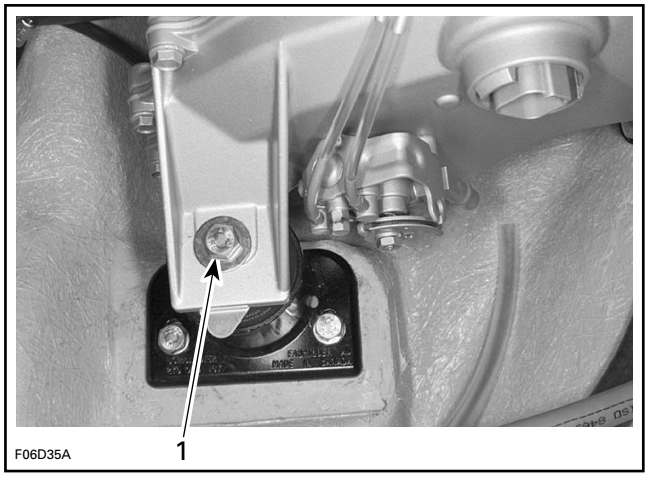
Engine Support Screws

Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads.

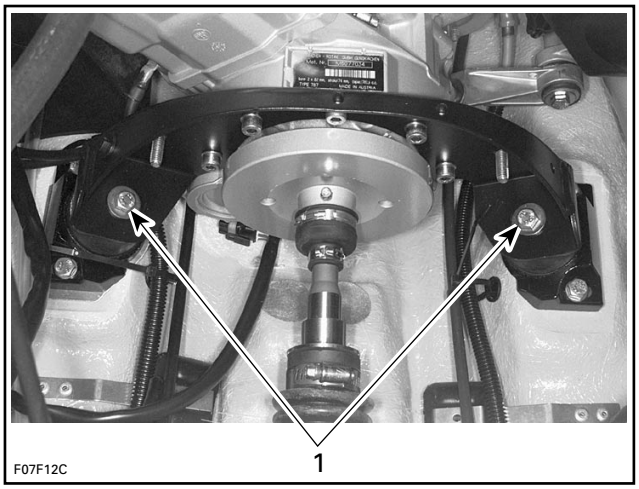
Torque engine support screws to 25 N•m (18 lbf•ft) when procedure is completed.



717 ENGINES
1. Torque to 25 N•m (18 lbf•ft)



FRONT ENGINE SUPPORT — 787 RFI ENGINES
1. Torque to 25 N•m (18 lbf•ft)



REAR ENGINE SUPPORT — 787 RFI ENGINES
1. Torque to 25 N•m (18 lbf•ft)

Final Inspection

Check throttle cable condition and lubricate cable with Bombardier Lube (P/N 293 600 016).

After its installation, properly adjust and bleed oil injection pump as specified in OIL INJECTION PUMP and adjust throttle cable as specified in CARBURETOR or ENGINE MANAGEMENT (RFI).

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

⚠ WARNING

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

Verify all electrical connections.

Run engine and ensure there is no leakage.

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

OIL INJECTION SYSTEM

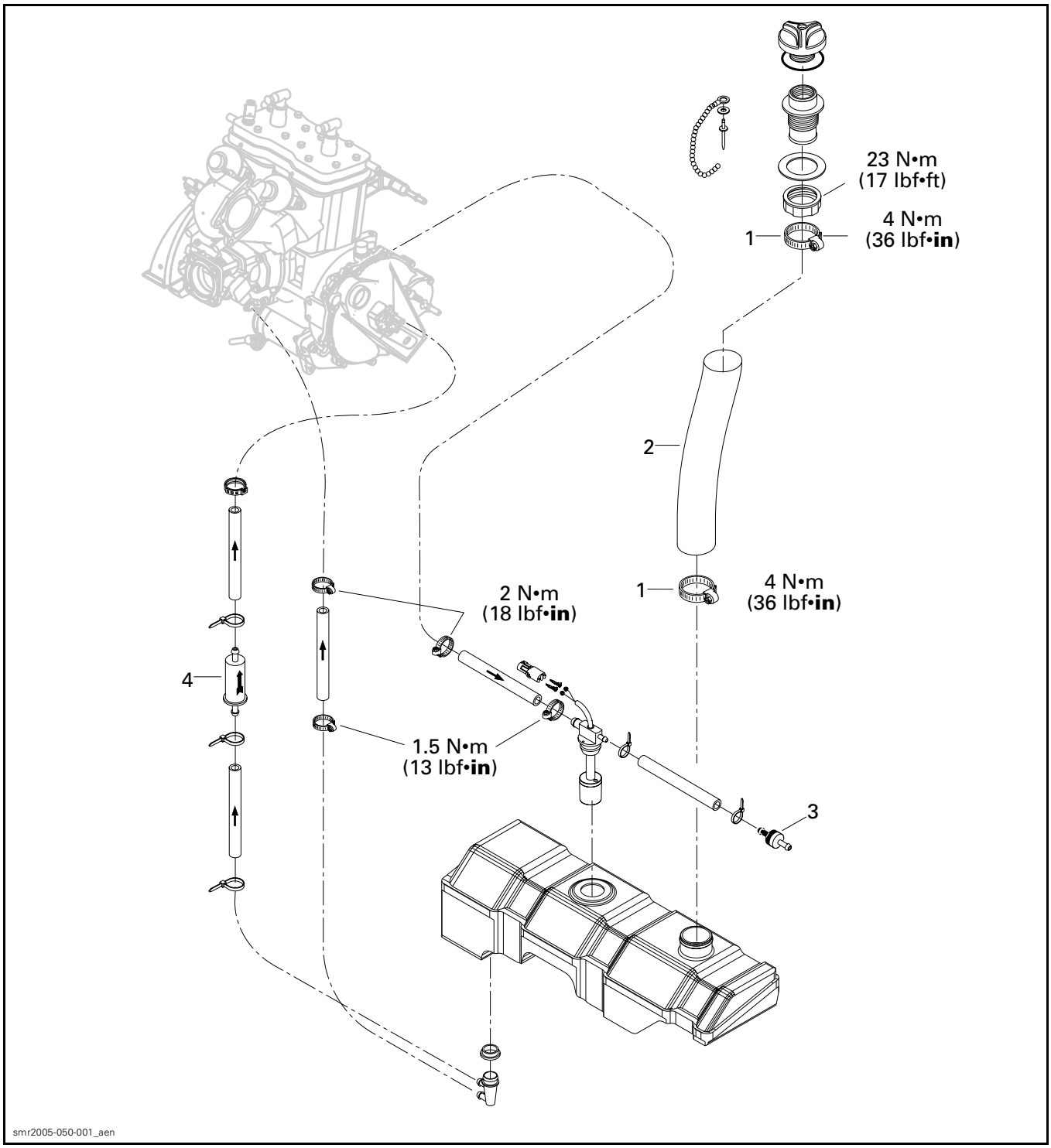
SERVICE TOOLS

Description	Part Number	Page
pump gauge tester	295 000 114	75
small hose pincher	295 000 076	74

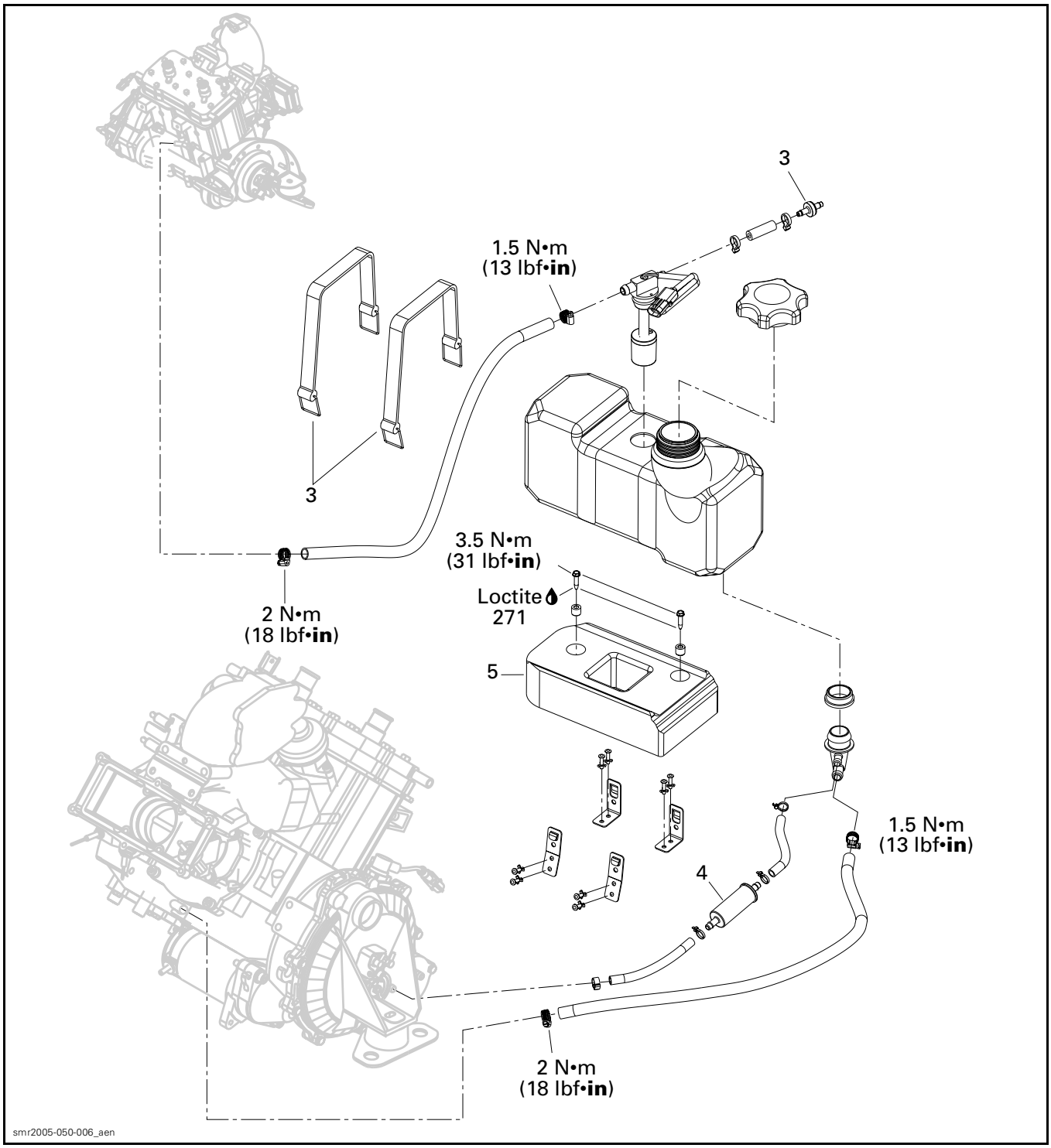
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 271 (red)	293 800 005	74

GTI Series



3D Series



GENERAL

Whenever repairing the oil injection system, always verify for water infiltration in reservoir.

Also pressure test the oil injection system.

GTI Models

Clamp and Hose

Verify oil filler neck hose **no. 2** for damage. Always ensure that clamps **no. 1** are well positioned and tightened. Torque clamps to 4 N•m (36 lbf•**in**).

Check Valve

Black side of the one-way check valve **no. 3** is the valve outlet. It allows air to get in reservoir and prevent oil to flow out.

NOTE: For proper check valve installation, refer to appropriate exploded view given at the beginning of the section.

Oil Filter

Oil filter **no. 4** should be replaced annually. When installing, point the arrow toward the engine.

Oil Reservoir Pad

3D Series

When the foam pad under oil reservoir is installed, apply Loctite 271 (red) (P/N 293 800 005) on screw threads.

OIL SYSTEM PRESSURIZATION

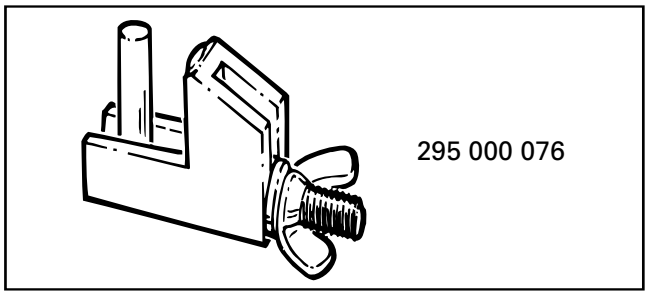
⚠ WARNING

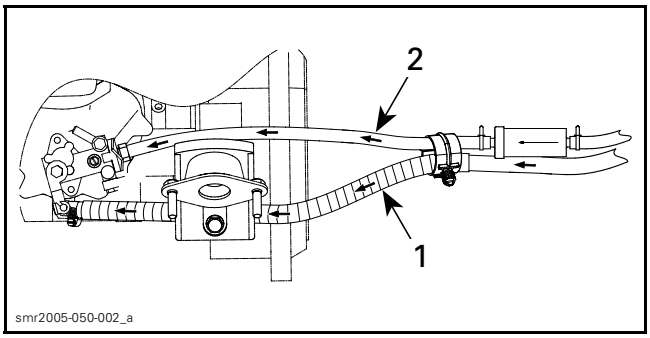
Whenever oil system components are disconnected or replaced, a pressure test must be done before starting engine. Ensure to verify oil line ends for damage. Always cut damaged end before reinstallation.

Pressure Test

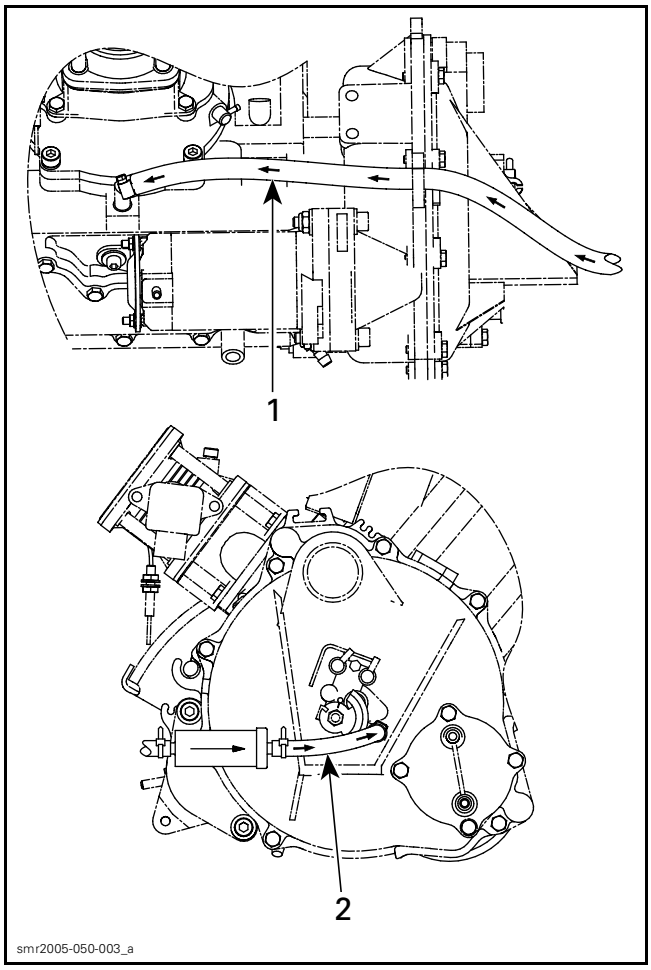
Proceed as follows:

– Fill up oil reservoir.
– Install a small hose pincher (P/N 295 000 076) to rotary valve shaft oil supply hose and to the oil injection pump supply hose.



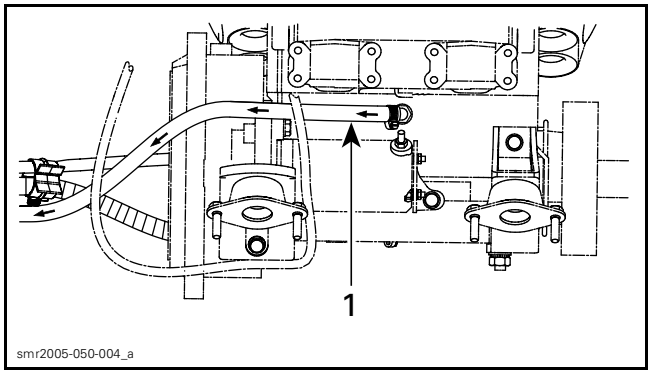


717 ENGINES — RH SIDE OF ENGINE
1. Rotary valve shaft oil supply hose
2. Oil injection pump supply hose

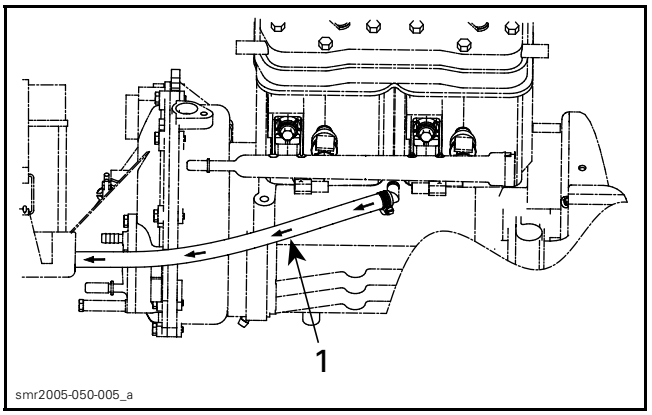


787 RFI ENGINES — FRONT AND RH SIDE OF ENGINE
1. *Rotary valve shaft oil supply hose*
2. *Oil injection pump supply hose*

– Install a hose pincher to rotary valve shaft oil return hose.

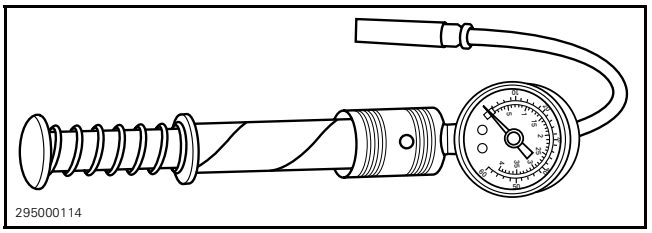


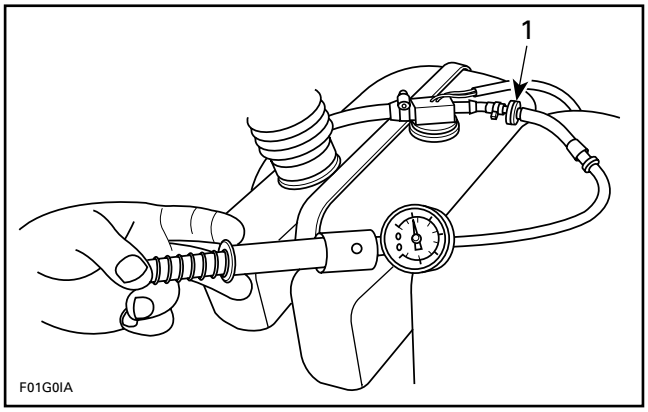
717 ENGINES — LH SIDE OF ENGINE
1. *Rotary valve shaft oil return hose*



787 RFI ENGINES — LH SIDE OF ENGINE
1. *Rotary valve shaft oil return hose*

Connect the pump gauge tester (P/N 295 000 114) to oil injection reservoir vent check valve.





TYPICAL
1. *Connect pump to check valve*

– Pressurize oil system to 21 kPa (3 PSI). The system must maintain a pressure for at least 10 minutes. Never pressurize over 21 kPa (3 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.

CAUTION: If any leak is found, do not start the engine and wipe off any oil leakage.

Disconnect pump gauge tester and remove hose pinchers.

OIL INJECTION PUMP

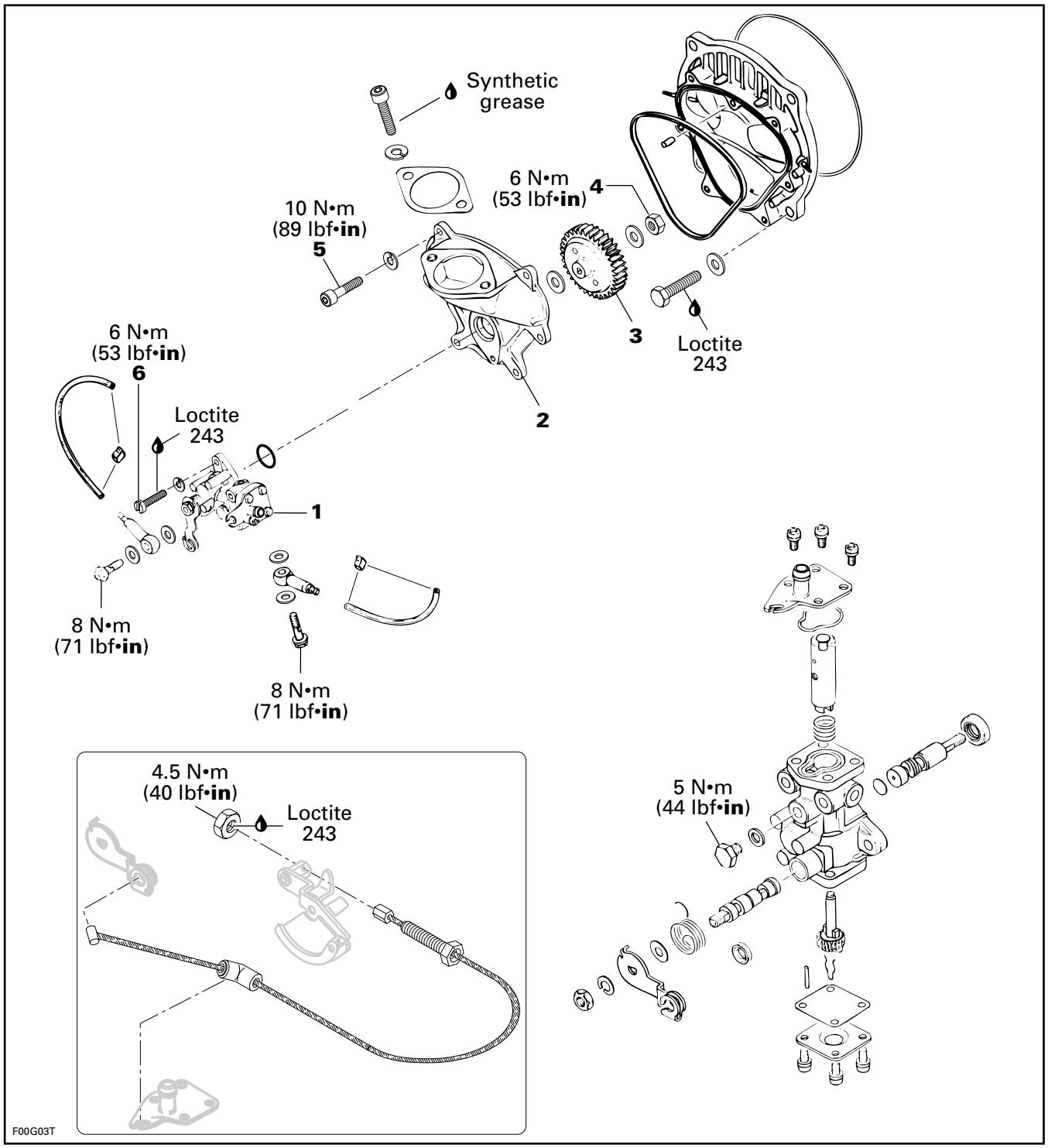
SERVICE TOOLS

Description	Part Number	Page
gear holder	420 277 905	80

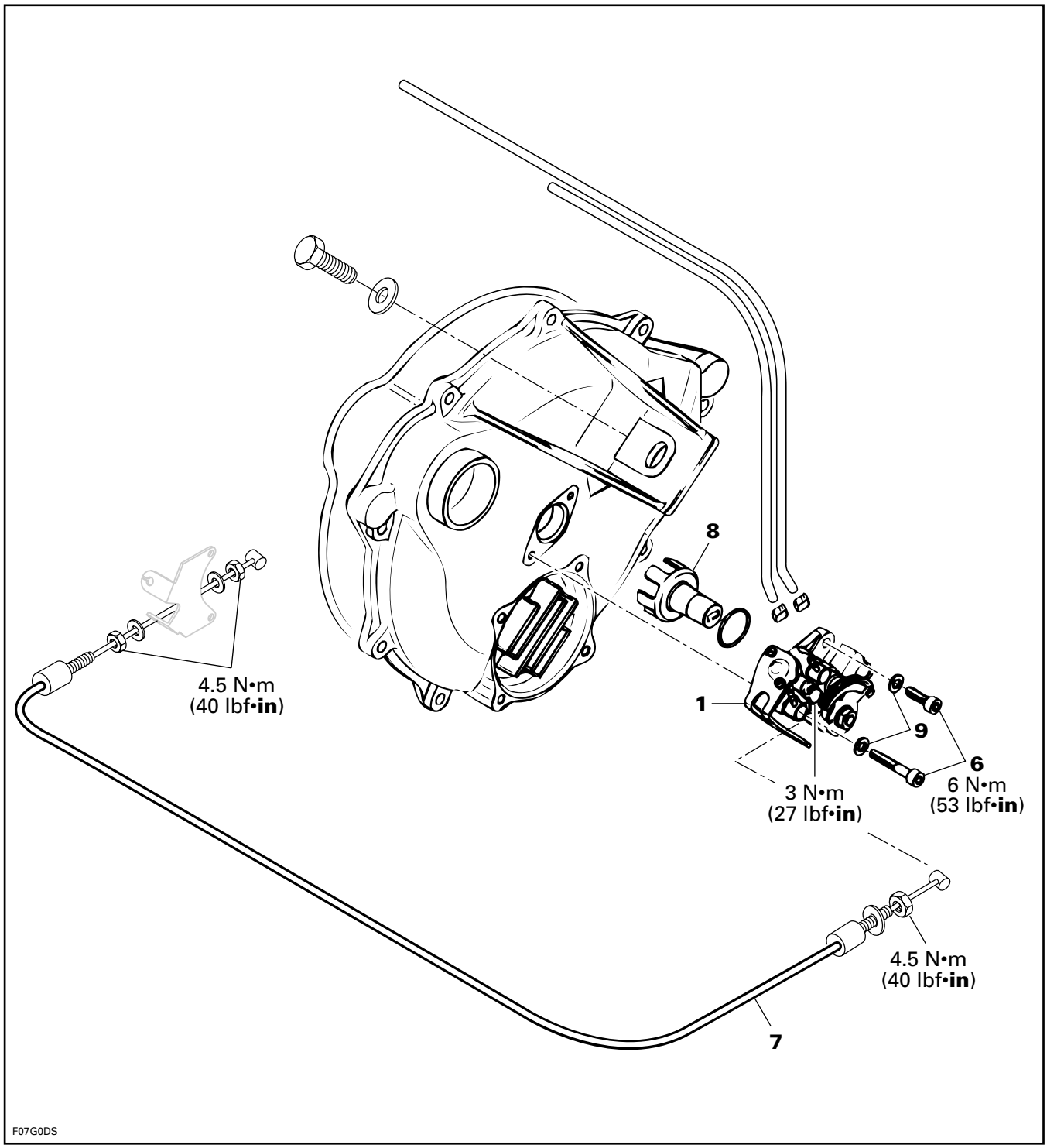
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	80
Loctite anti-seize lubricant	293 800 070	81

717 Engines



787 RFI Engines



OIL PUMP IDENTIFICATION

Pump Lever

Different engines need different pumps. See identification on lever.

CAUTION: Always mount proper pump on engine.

ENGINE TYPE	IDENTIFICATION
717	105Q-5
787 RFI	06

NOTE: The following procedures can be done without removing the engine from bilge.

REMOVAL

Oil Injection Pump

717 Engines

Remove air intake silencer (refer to AIR INTAKE).

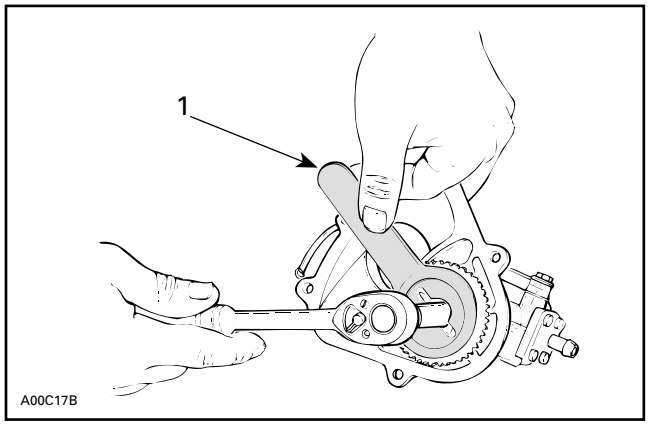
Remove carburetor (refer to CARBURETOR).

Remove rotary valve cover (refer to ROTARY VALVE).

Remove Allen screws **no. 5** retaining intake manifold **no. 2** to rotary valve cover.

Separate intake manifold from rotary valve cover.

To separate oil pump **no. 1** from intake manifold **no. 2**, remove oil pump gear **no. 3** using the gear holder (P/N 420 277 905) and unscrew lock nut **no. 4**.



1. Gear holder

Remove 2 Allen screws **no. 6** with flat washers retaining oil injection pump to intake manifold **no. 2**.

Disconnect oil injection pump cable from oil pump lever.

Disconnect oil hoses from oil pump fittings.

Remove pump.

787 RFI Engines

Disconnect oil injection pump cable **no. 7**.

Remove 2 Allen screws **no. 6** with flat washers **no. 9** retaining oil injection pump to magneto housing cover.

Pull pump.

Disconnect oil hoses from fittings of oil injection pump.

DISASSEMBLY

NOTE: Some oil pump parts are not available in single parts. A gasket set is available for the pump. Refer to parts catalog.

If the pump is found defective, it should be replaced by a new one.

CLEANING

Discard all seals and O-rings. Clean metal components in a solvent.

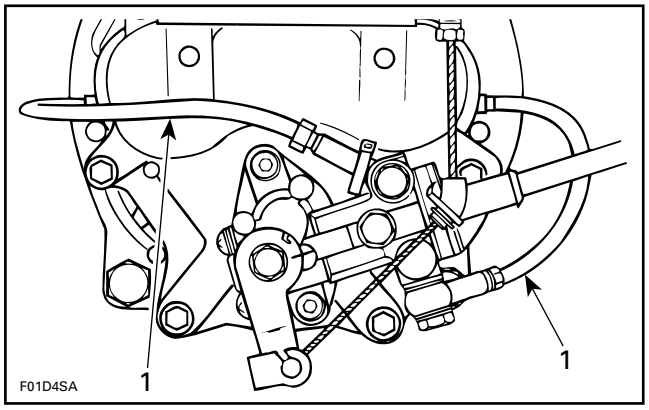
ASSEMBLY

717 Engines

Oil Injection Pump and Intake Manifold

Install oil injection pump **no. 1** to intake manifold **no. 2**. Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads. Torque screws **no. 6** to 6 N•m (53 lbf•**in**).

CAUTION: Whenever oil injection lines are removed, always make the routing as shown.



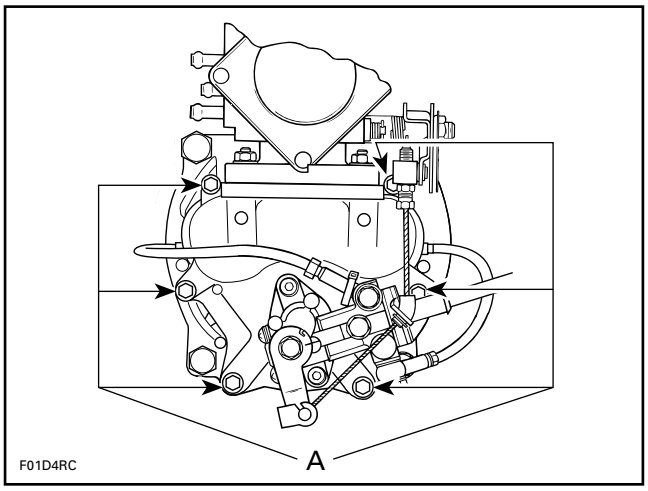
TYPICAL
1. Small oil line

Oil Pump Gear

Install gear **no. 3** to oil injection pump shaft. Torque lock nut **no. 4** to 4.5 N•m (40 lbf•**in**).

NOTE: Make sure 1 washer is installed on each side of gear.

Install intake manifold **no. 2** to rotary valve cover and torque screws **no. 5** to 10 N•m (89 lbf•**in**).



TYPICAL
*A. 10 N•m (89 lbf•**in**)*

787 RFI Engines

Oil Injection Pump and Shaft

Make sure shaft **no. 8** is installed in crankshaft end. Apply Loctite anti-seize lubricant (P/N 293 800 070) on the end of shaft.

Install pump. Secure with flat washers and screws **no. 6**. Torque to 6 N•m (53 lbf•**in**).

Install oil injection pump cable.

ADJUSTMENT

CAUTION: As oil injection pump adjustment is dependent on throttle cable position, make sure to perform throttle cable adjustment first except if otherwise specified.

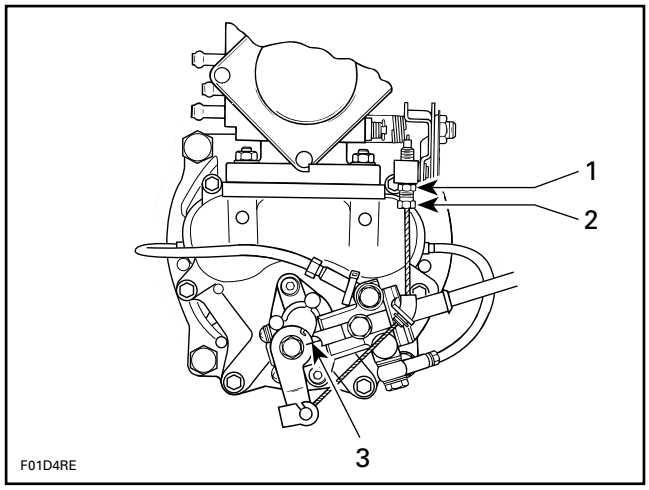
Preliminary Synchronization

NOTE: To check synchronization of pump as a routine maintenance, see FINAL SYNCHRONIZATION.

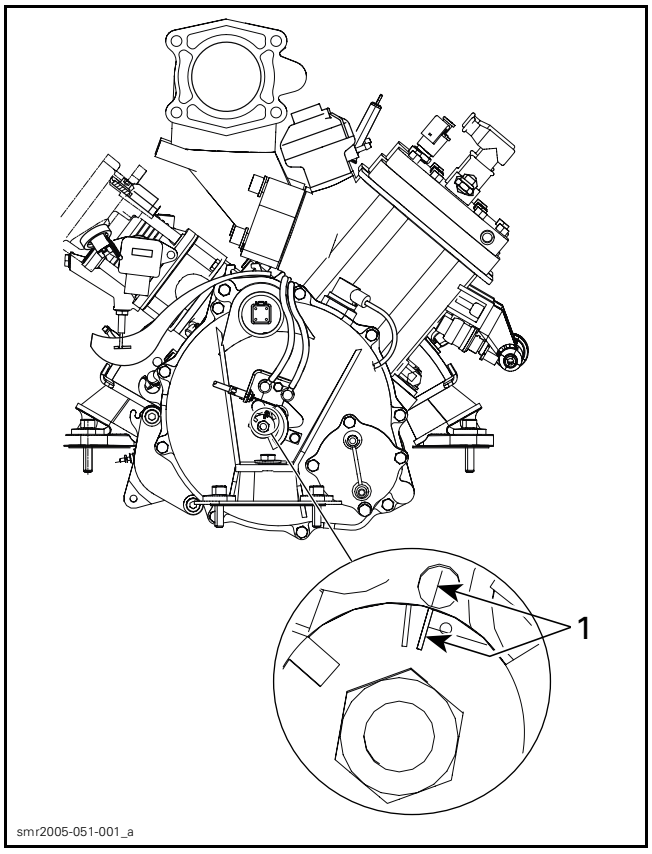
Adjust throttle cable. Refer to CARBURETOR (**717 engines**) or ENGINE MANAGEMENT (**787 RFI engines**).

Turn oil pump cable adjustment nut to align reference marks on pump.

NOTE: A mirror may be used to facilitate this verification.



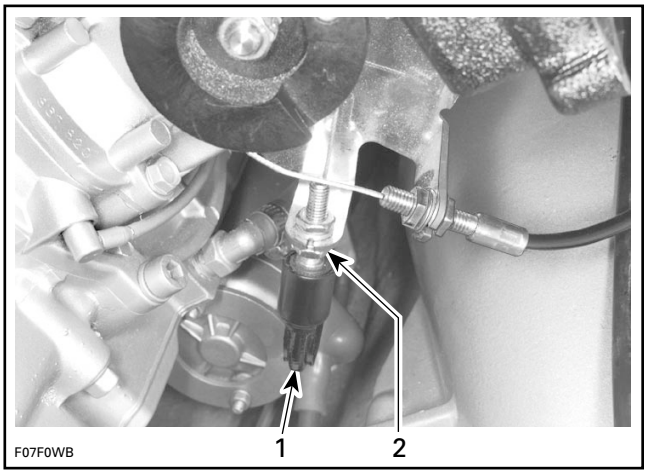
TYPICAL — 717 ENGINES
1. Jam nut
2. Adjustment nut
3. Aligned marks



TYPICAL — 787 RFI ENGINES
1. Aligned marks

Loosen jam nut and turn cable adjustment nut to obtain proper pump setting.

The adjustment nut and jam nut for the oil injection pump cable are located at the cable support on the throttle body.



1. Oil pump cable
2. Adjustment nut

Start and bring engine to normal operating temperature.

CAUTION: If watercraft is out of water, engine must be cooled using the flush kit. If air bubbles are present in the oil injection system, bleed system before operating engine.

Adjust idle speed to specification on **717 engines**. Refer to CARBURETOR.

NOTE: On **787 RFI engines**, there is no idle speed adjustment to perform.

Stop engine.

Final Synchronization

Eliminate throttle cable free-play by depressing throttle lever until a slight resistance is felt. In this position, marks on pump body and lever must align.

If necessary, turn cable adjustment nut to obtain pump mark alignment. Refer to above illustrations.

Tighten jam nut and recheck alignment marks.

CAUTION: Proper oil injection pump adjustment is very important. Any delay in the opening of pump can result in serious engine damage.

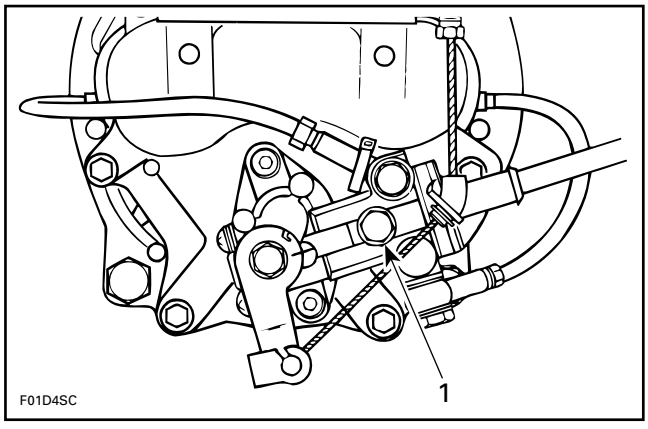
Bleeding

CAUTION: Oil injection system must be bled and adjustment checked before operating engine.

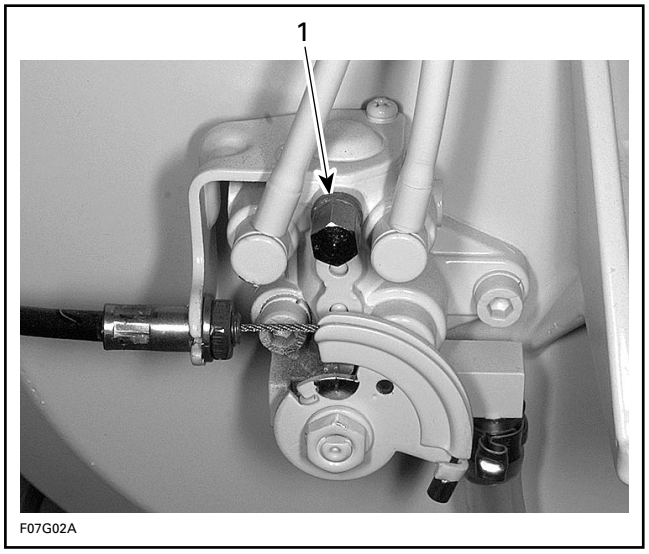
Ensure oil injection reservoir is sufficiently filled.

Install a dry rag below oil injection pump.

Loosen bleed screw to allow oil to flow.



717 ENGINES
1. Bleed screw



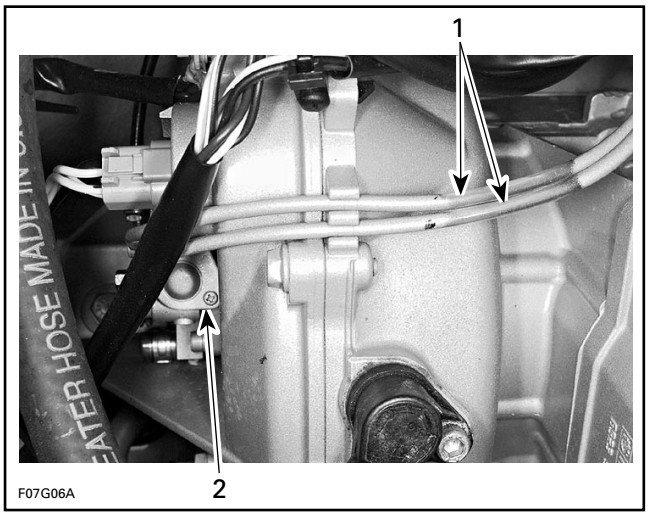
787 RFI ENGINES
1. Bleed screw

Keep bleeding until all air has escaped from line. Make sure no air bubbles remain in oil supply line.

Tighten bleed screw.

Wipe any oil spillage.

Check small oil lines of the pump. They must be full of oil.



TYPICAL
1. Lines must be full of oil
2. Oil pump

If not, proceed as follows.

Run engine at idle speed while manually holding pump lever in fully open position. Do not activate throttle lever.

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

CHECKING OPERATION

On Watercraft

NOTE: Oil line supply must be full of oil. See bleeding procedure above.

Start engine and run at idle while holding the pump lever in fully open position.

Oil must advance into small oil lines.

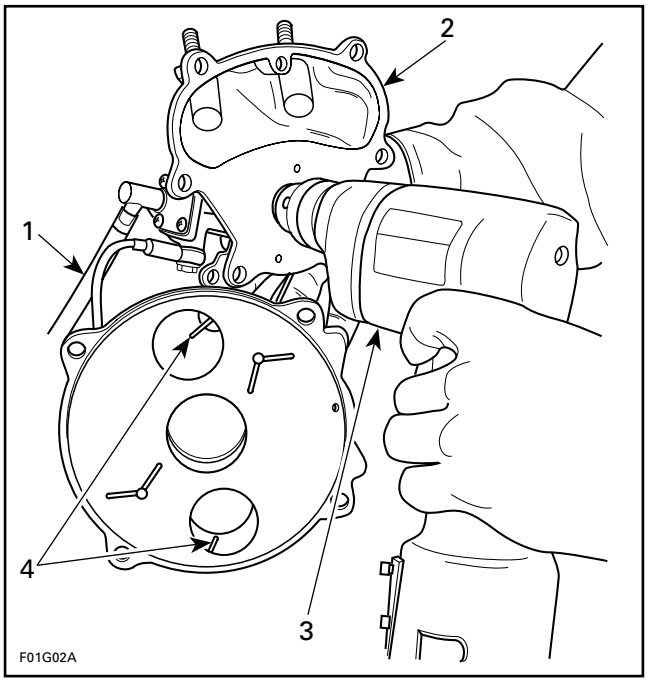
NOTE: The engine should have a rich mixture, idling irregularly and emitting smoke at exhaust outlet.

If not, remove pump assembly and check the pump gear (**717 engines**) or shaft (**787 RFI engines**) for defects, replace as necessary. Test pump as described below:

NOTE: Through normal use, oil level must not drop in small tubes. If oil drops, verify check valve operation. Replace as necessary.

Bench Test

Connect a hose filled with injection oil to main line fitting. Insert other hose end in an injection oil container. Using an electric or rechargeable drill in reverse position, rotate pump shaft. Oil must drip from fittings in parts of rotary valve cover while holding lever in a fully open position.



TYPICAL
1. *Supply oil line to an oil container*
2. *Hold lever in fully open position*
3. *Drill in reverse position*
4. *Oil must drip here*

For an accurate test, each port should be checked separately to ensure equal delivery on both ports.

To obtain a precise result of the oil pump delivery rate, rotate it counterclockwise at 1500 RPM for a total time of 5 minutes.

NOTE: To ensure accuracy of test, oil lines should be completely filled before starting test.

Compare the results with the chart below. If oil pump is out of specification, replace it.

ENGINE	OIL PUMP DELIVERY AT 1500 RPM (pump speed) FOR 5 MINUTES
717	9.9 - 12.1 mL (each port)
787 RFI	5.7 - 6.9 mL (each port)

CARBURETOR

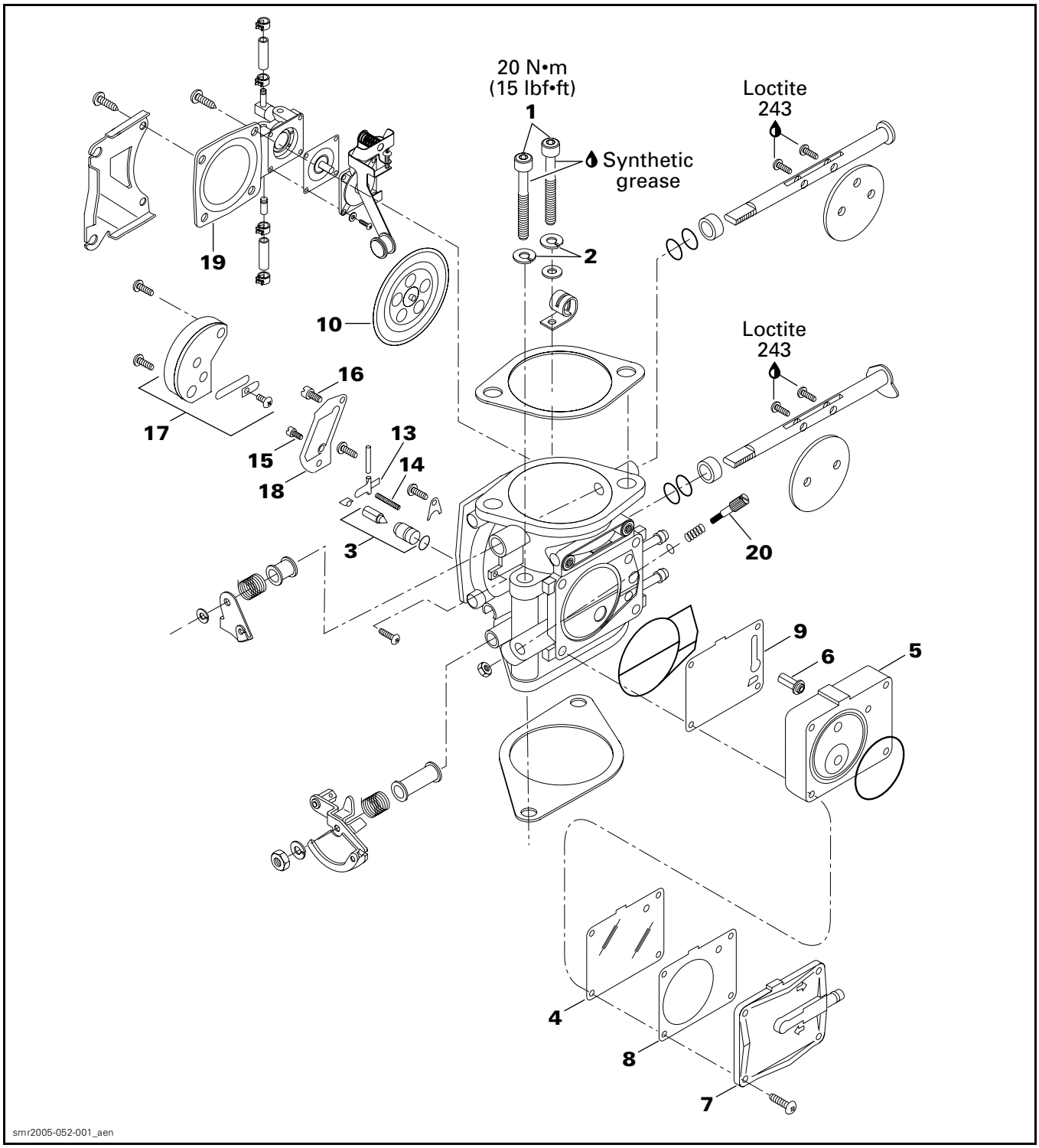
SERVICE TOOLS

Description	Part Number	Page
digital inductive type tachometer	529 014 500	94
pump gauge tester	295 000 114	88–89, 91

SERVICE PRODUCTS

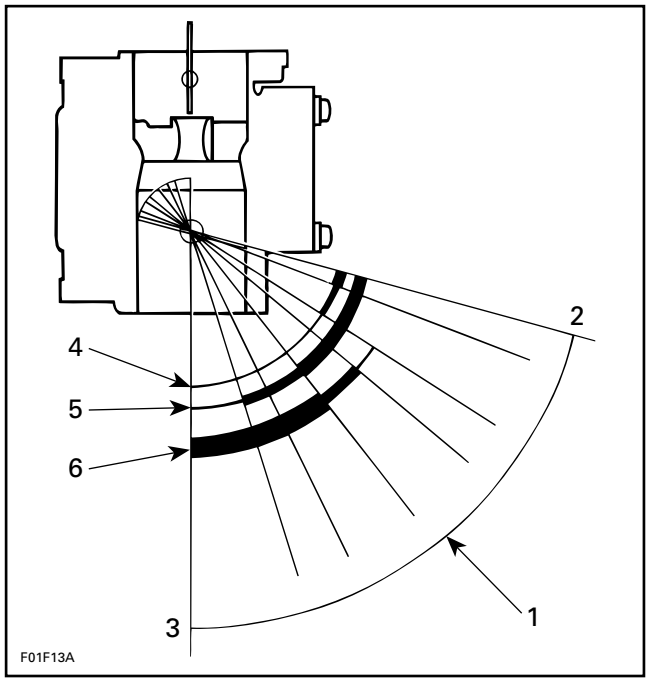
Description	Part Number	Page
Bombardier Lube	293 600 016	92–93
Loctite 243 (blue)	293 800 060	90
synthetic grease	293 550 010	92

Mikuni BN-40i



GENERAL

The following illustration shows which part of the carburetor begins to function at different throttle plate openings.



VIEW FROM AIR INTAKE OPENING
1. *Throttle plate openings*
2. *Throttle plate closed*
3. *Throttle plate wide opened*
4. *Low-speed screw*
5. *Pilot jet*
6. *Main jet and high-speed screw*

The carburetor is equipped with a fuel accelerator pump.

The fuel accelerator pump is linked to the throttle valve via a linkage.

A metering jet in the fuel inlet hose controls fuel flow to the pump.

A check valve on the fuel outlet hose helps to prime the system.

REMOVAL

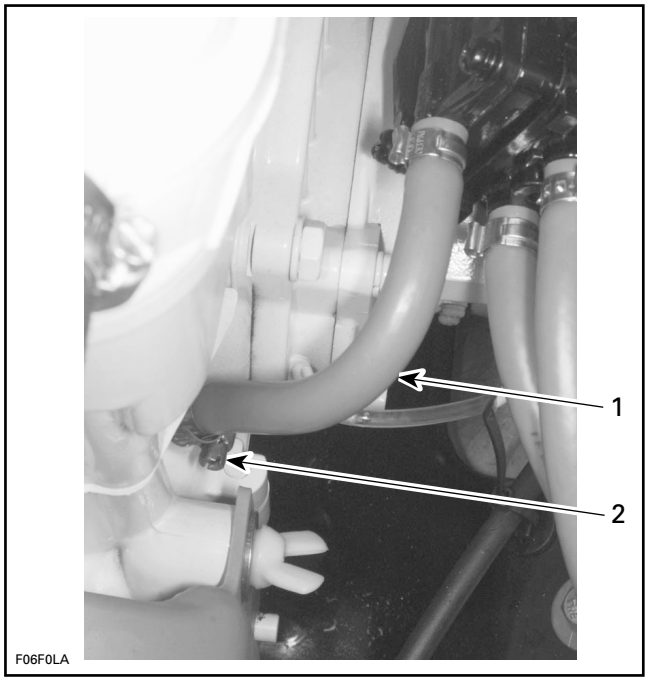
To remove carburetor from engine, proceed as follows:

Remove air vent tube support.

Remove air intake silencer. Refer to AIR INTAKE.

Turn fuel valve to OFF position.

Disconnect pulse line.



TYPICAL
1. *Pulse line*
2. *Loosen gear clamp*

Disconnect fuel supply line from fuel pump.

Disconnect fuel return line.

Disconnect oil injection pump cable, throttle cable and choke cable.

Remove screws **no. 1** and lock washers **no. 2** retaining carburetor.

Remove carburetor.

CLEANING

The carburetor exterior surfaces should be cleaned with a general solvent and dried with compressed air before disassembly.

CAUTION: Be careful at carburetor cleaning not to remove paint. Paint removal will cause carburetor to rust very rapidly. Repaint if necessary.

Carburetor body and jets should be cleaned with a carburetor cleaner. Follow manufacturer's instructions.

⚠ WARNING

Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

CAUTION: Heavy duty carburetor cleaner may be harmful to the rubber parts, O-rings, etc. Therefore, it is recommended to remove these parts prior to cleaning.

INSPECTION

Inspect parts for corrosion damage (shaft, throttle plate, spring, screw, check valve housing, etc.).

Inspect O-rings, diaphragms and gaskets.

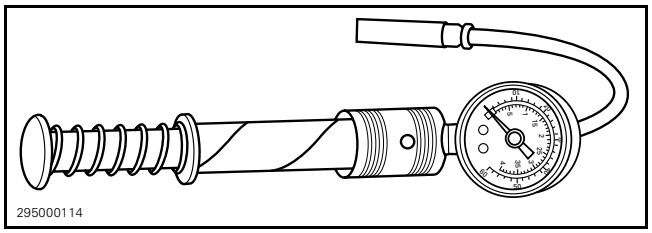
Needle Valve

Inspect the tip of needle valve **no. 3** for a grooved condition. If worn, needle and seat must be replaced as a matched set.

Diaphragm

Using the pump gauge tester (P/N 295 000 114), perform the following test proceeding as follows:

– Install pump gauge tester on pulse nipple.



– Pump tester until it reaches 28 kPa (4 PSI).

Diaphragm **no. 4** must stand pressure for 10 seconds. If pressure drops, replace diaphragm.

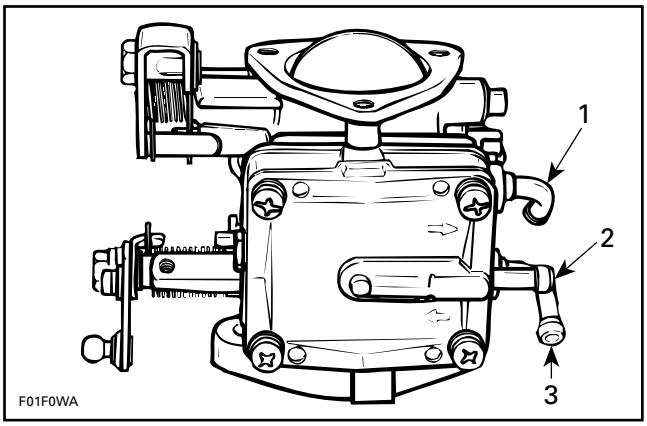
Fuel Pump Valve

Check fuel pump valve operation as follows:

Connect a clean plastic tubing to the inlet nipple of the fuel pump body **no. 5** and alternately apply pressure and vacuum with the mouth. The inlet valve should release with pressure and hold under vacuum.

⚠ WARNING

Some fuel may be present in fuel pump. Be careful not to swallow fuel when under vacuum.



TYPICAL
1. *Fuel outlet nipple*
2. *Pulse nipple*
3. *Inlet nipple*

Repeat the same procedure at the outlet nipple of the fuel pump body. This time the outlet valve should hold with pressure and release under vacuum.

Inspect valves. The pumping area should be free of holes, tears or imperfections. Replace as needed.

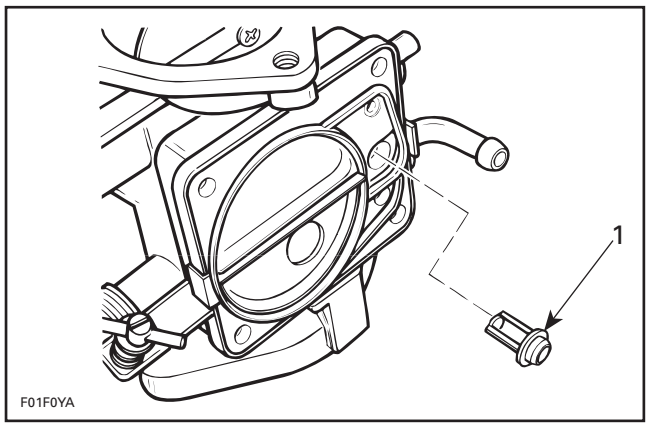
Internal Fuel Filter

To verify condition of filter **no. 6**, proceed as follows:

Remove pump cover **no. 7**, gasket **no. 8**, diaphragm **no. 4** and then pump body **no. 5** and diaphragm **no. 9**.

Remove filter **no. 6** from carburetor body then clean filter and blow carefully with compressed air (low pressure).

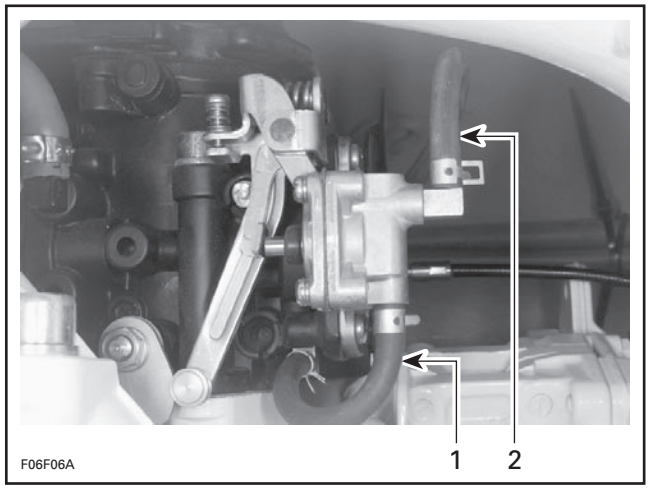
Replace filter if damaged.



TYPICAL
1. *Filter*

Fuel Accelerator Pump

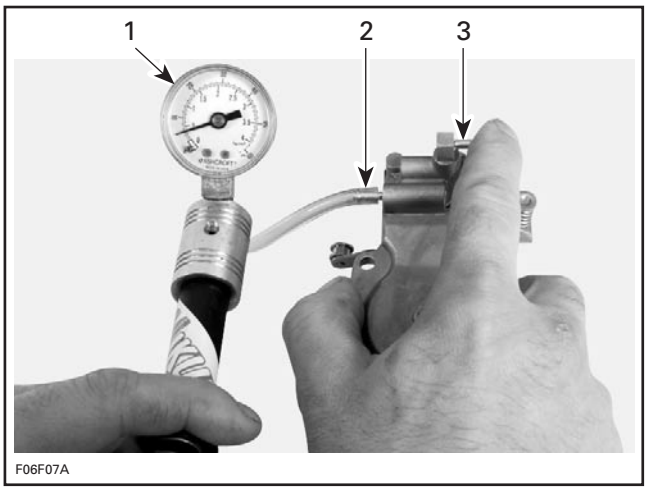
Disconnect inlet and outlet hoses from accelerator pump nipples.



TYPICAL
1. *Fuel inlet hose*
2. *Fuel outlet hose*

Using the pump gauge tester (P/N 295 000 114), perform the following test proceeding as follows:

– Install pump gauge tester on inlet nipple of accelerator pump.
– Obstruct outlet nipple with a finger and hold while pumping.
– Pump tester until it reaches 28 kPa (4 PSI).



1. *Pump gauge tester*
2. *Hose installed to inlet nipple*
3. *Outlet nipple obstructed*

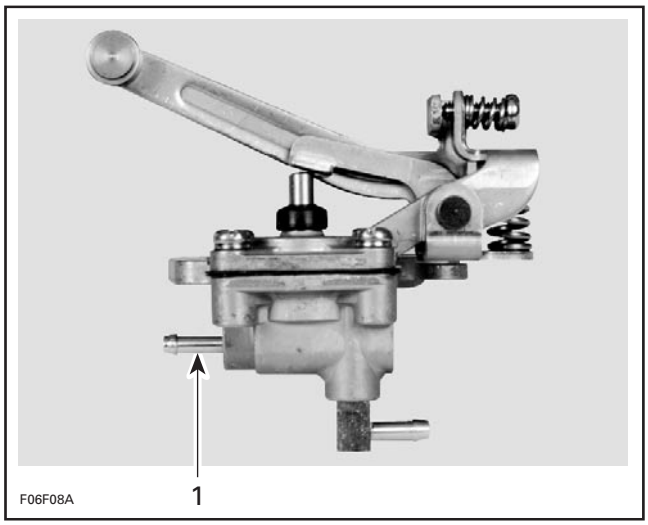
Diaphragm **no. 10** must stand pressure for 10 seconds. If pressure drops, replace accelerator pump diaphragm.

Verify accelerator pump check valves operation as follows:

Connect a clean plastic tubing to the valve inlet nipple and alternately apply pressure and vacuum. The check valve should release with pressure and hold under vacuum.

⚠ WARNING

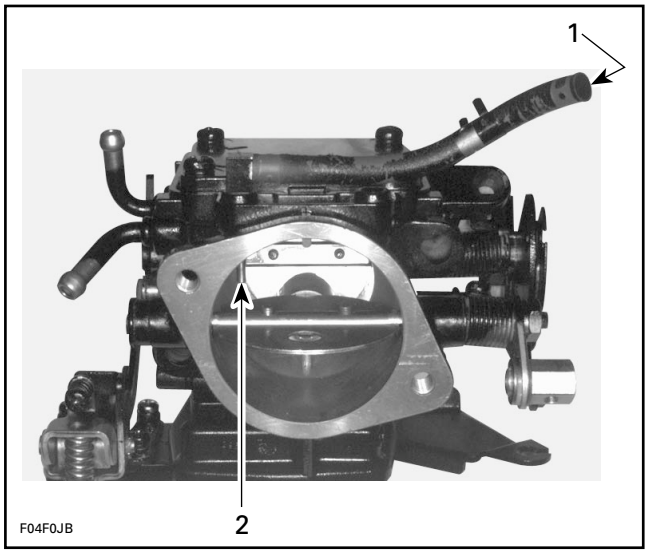
Some fuel may be present in fuel pump.



TYPICAL
1. *Apply pressure and vacuum at inlet nipple*

To check the injector, install the pump gauge tester (P/N 295 000 114) to the injector hose.

NOTE: Injectors are also equipped with check valves.



TYPICAL
1. *Install pump gauge tester to injector hose*
2. *Injector*

Pump tester. Injector check valve should open at 19.4 kPa ± 4.7 (2.8 ± .6 PSI).

NOTE: If the obtained pressure is too low, the check valve is leaking. If it is too high, less fuel will be delivered which may lead to engine hesitation under acceleration.

ASSEMBLY

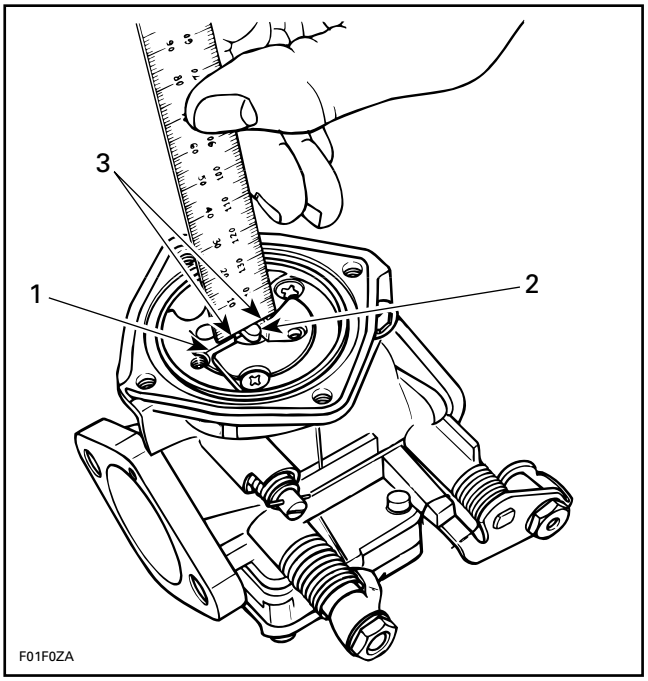
When assembling pump, ensure to properly position components together. Refer to previous illustrations if necessary.

Choke Plate and Throttle Plate

When installing choke plate **no. 11** or throttle plate **no. 12** onto shaft(s), close plate so that it centers into carburetor bore. Apply Loctite 243 (blue) (P/N 293 800 060) on thread screws then firmly tighten screws.

Needle Valve Lever

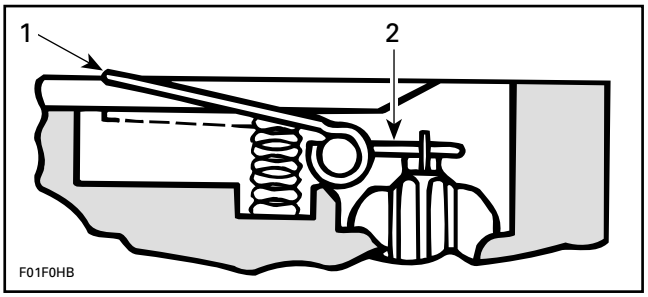
Rounded end of needle valve lever **no. 13** must be flush with surrounding metering chamber floor and not with body assembly. Place the end of a ruler over lever to check adjustment.



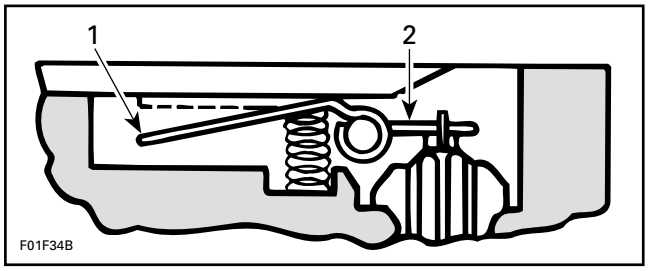
1. *Metering chamber floor*
2. *Lever end*
3. *Flush*

To adjust, bend lever very slightly to change its height.

CAUTION: When adjusting lever, do not pry it so that it applies pressure on needle. This could damage valve seat/needle.



HIGH LEVER
1. *Depress here*
2. *Push tab down*

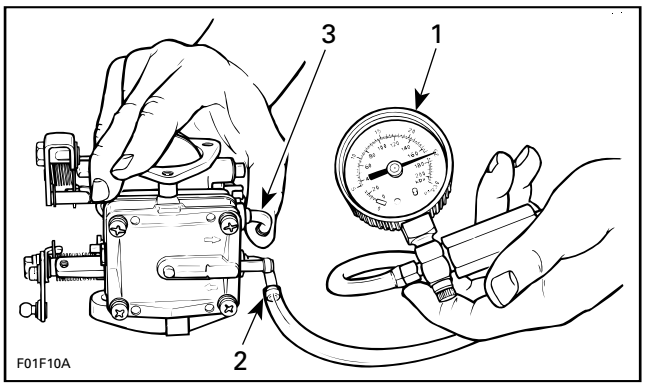


LOW LEVER
1. Depress here
2. Pry up here

POP-OFF Pressure Test

Proceed as follows:

– Install the pump gauge tester (P/N 295 000 114) on carburetor fuel inlet nipple.
– Obstruct fuel return nipple with a finger.
– Pump tester until inlet release pressure is reached (seen by a sudden pressure drop).



TYPICAL
1. Pump gauge tester
2. Install on inlet nipple
3. Obstruct outlet nipple

Refer to the following table for pop-off pressure specifications:

MODELS	POP OFF PRESSURE min./max. kPa (PSI)
GTI	248/414 (36/40)

NOTE: Pressure test should be performed three times to obtain a valid reading.

If pop-off pressure is not within specification, check control lever adjustment. Replace spring **no. 14** as necessary.

CAUTION: Do not stretch or cut spring.

Leak Test

Needle valve **no. 3** must stand a pressure of 69 kPa (10 PSI) for 30 seconds. Otherwise, hold carburetor upside down, pour oil over needle valve and apply pressure.

Check for bubbles. If they come from seat or O-ring, bubbles will exit around seat. Retighten as necessary.

If it still leaks remove needle and seat and replace O-ring.

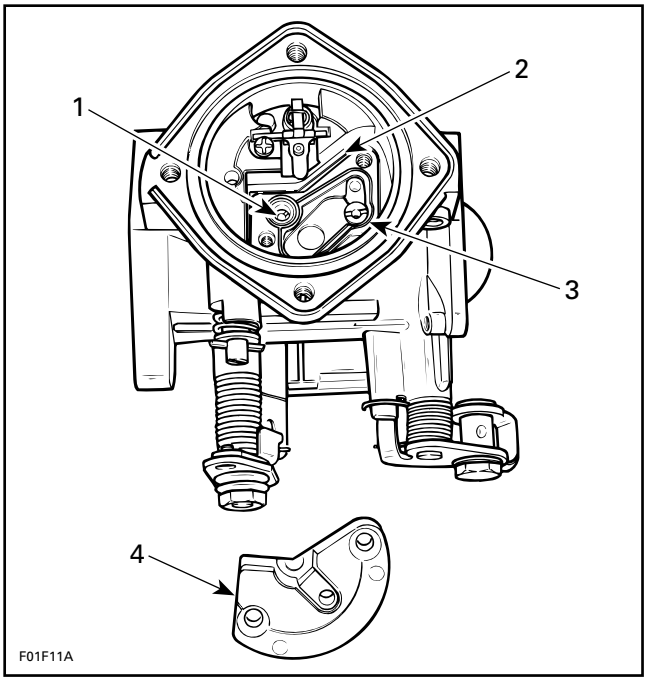
If bubbles come from needle, replace needle and seat.

Main Jet and Pilot Jet

Pilot jet **no. 15** and main jet **no. 16** are replaceable. Different jet sizes are available to suit temperature and altitude conditions. Refer to HIGH ALTITUDE BULLETIN for more informations. Always inspect spark plug tip condition when dealing with pilot jet and main jet. Spark plug tip condition gives a good indication of carburetor mixture setting.

CAUTION: Adjustments vary with temperature and altitude. Always observe spark plug condition for proper jetting.

NOTE: To have access to pilot jet **no. 15** or main jet **no. 16**, check valve housing must be removed.

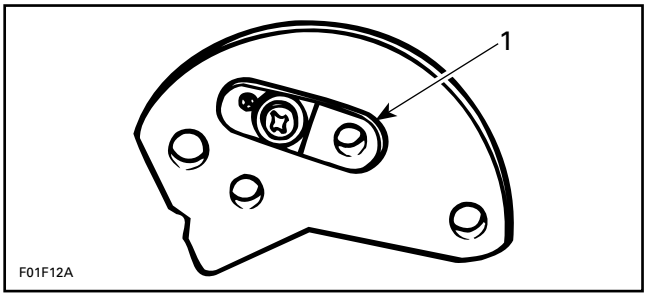


TYPICAL
1. *Pilot jet*
2. *Gasket*
3. *Main jet*
4. *Check valve housing removed*

Check Valve Assembly

The check valve is needed if a back pressure occurs into carburetor. It will prevent fuel from flowing back into carburetor lower portion.

Inspect check valve **no. 17**. It should be free of holes, tears or imperfections. Replace as needed.



1. *Check valve*

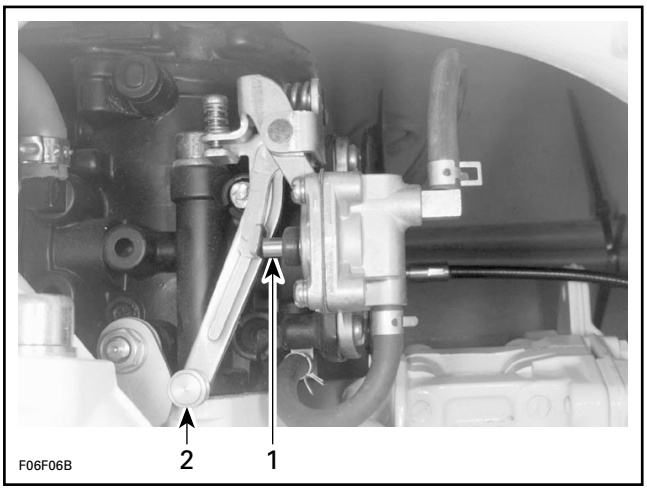
NOTE: Prior to check valve assembly installation, remember to set gasket **no. 18**.

Diaphragm and Cover

Install diaphragm **no. 10** with its integrated O-ring into carburetor groove. Make sure that the tab of cover **no. 19** is inserted into carburetor notch.

Fuel Accelerator Pump

Lubricate pump plunger, roller and cam with synthetic grease (P/N 293 550 010) and roller shaft with Bombardier Lube (P/N 293 600 016).



TYPICAL
1. *Apply synthetic grease to plunger*
2. *Apply Bombardier Lube on roller shaft*

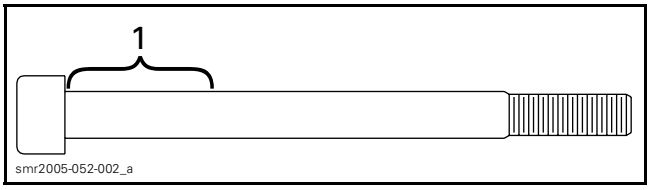
INSTALLATION

Carburetor

At installation, pay attention to the following:

Install carburetor with gasket to intake manifold (rotary valve cover).

Apply synthetic grease (P/N 293 550 010) on screws **no. 1**. Then, install screws with lock washers **no. 2** and torque to 20 N•m (15 lbf•ft).



1. *Apply synthetic grease here*

Fuel Lines and Hose Clamps

If fuel line ends are damaged, cut damaged end before reinstallation.

Properly install clamps.

⚠ WARNING

Make sure there is no leak in fuel system.

For fuel system pressurization, refer to FUEL CIRCUIT.

ADJUSTMENTS

Carburetor Adjustment

There is no mixture adjustment to be performed by the dealer.

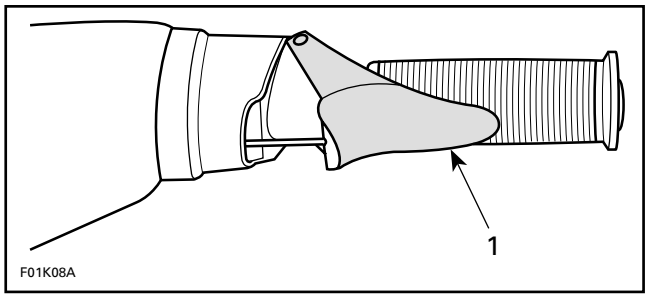
IMPORTANT: Trying to bypass the anti-tamper screws could damage the carburetor. It could also change the engine emission level and lead the engine not to meet the emission control regulations.

Throttle Cable Adjustment

NOTE: Do not activate throttle lever unnecessarily. Carburetor is equipped with fuel accelerator pump. This pump is injecting fuel into carburetors each time throttle lever is depressed.

Lubricate cable with Bombardier Lube (P/N 293 600 016).

Throttle lever must reach handlebar grip without causing strain to cable or carburetor cable bracket.



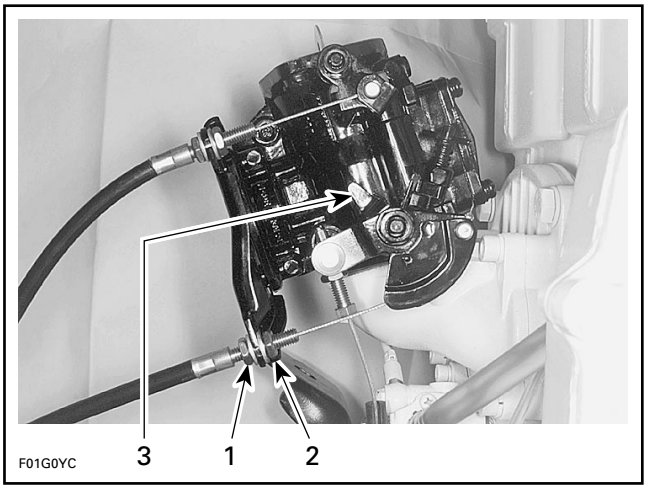
1. Must touch handlebar grip

Ensure carburetor throttle plate is fully open at full throttle position. At this position, throttle lever stopper is almost in contact (0.5 mm (1/64 in)) with carburetor body.

NOTE: Apply a light pressure on the throttle plate, a slight play should be obtained.

CAUTION: 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

Tighten jam nut and recheck adjustment.

⚠ WARNING

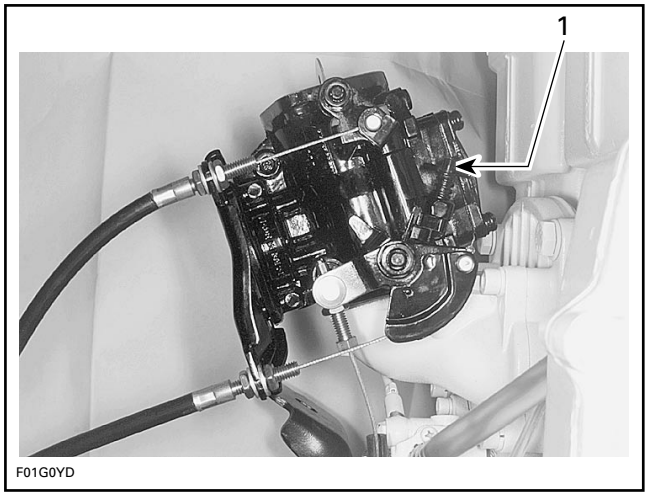
Make sure idle speed screw contacts stopper when throttle lever is fully released at handlebar.

After throttle cable adjustment, always proceed with the oil injection pump cable adjustment. Refer to OIL INJECTION PUMP.

CAUTION: Improper oil injection pump synchronization with carburetor can cause serious engine damage.

Idle Speed Screw

Turning screw **no. 20** clockwise increases engine idle speed and turning screw counterclockwise decreases engine idle speed.



1. Idle speed screw

Connect the digital inductive type tachometer (P/N 529 014 500) on spark plug cable of magneto side to measure engine speed.

NOTE: To adjust idle speed, ensure flame arrester and air intake silencer are installed.

Start engine and bring to normal operating temperature.

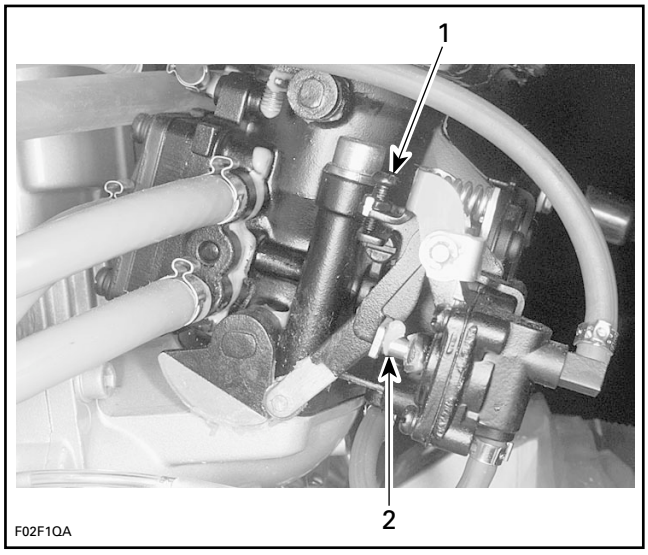
CAUTION: If watercraft is out of water, engine must be cooled using the flush kit.

Turn screw so that engine idles at 1500 RPM in water or 3000 RPM out of water.

Fuel Accelerator Pump

Ensure throttle cable and idle speed are properly adjusted.

With the engine not running, loosen adjustment screw lock nut. Use a feeler gauge between lever tab and pump plunger. Turn adjustment screw to achieve approximately 0.05 - 0.15 mm (.002 - .005 in) gap. Tighten adjustment screw lock nut.

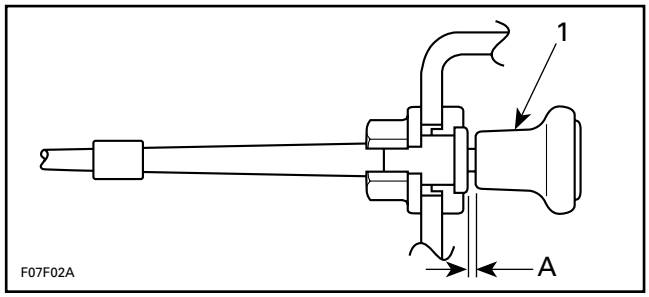


TYPICAL
1. Adjustment screw
2. Small gap

NOTE: Turning the adjustment screw clockwise will increase the gap.

Choke Cable

Ensure choke lever has a free-play of 0.5 to 2.0 mm (1/64 to 5/64 in).



TYPICAL
1. Choke lever
A. Free play of 0.5 to 2.0 mm (1/64 to 5/64 in)

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

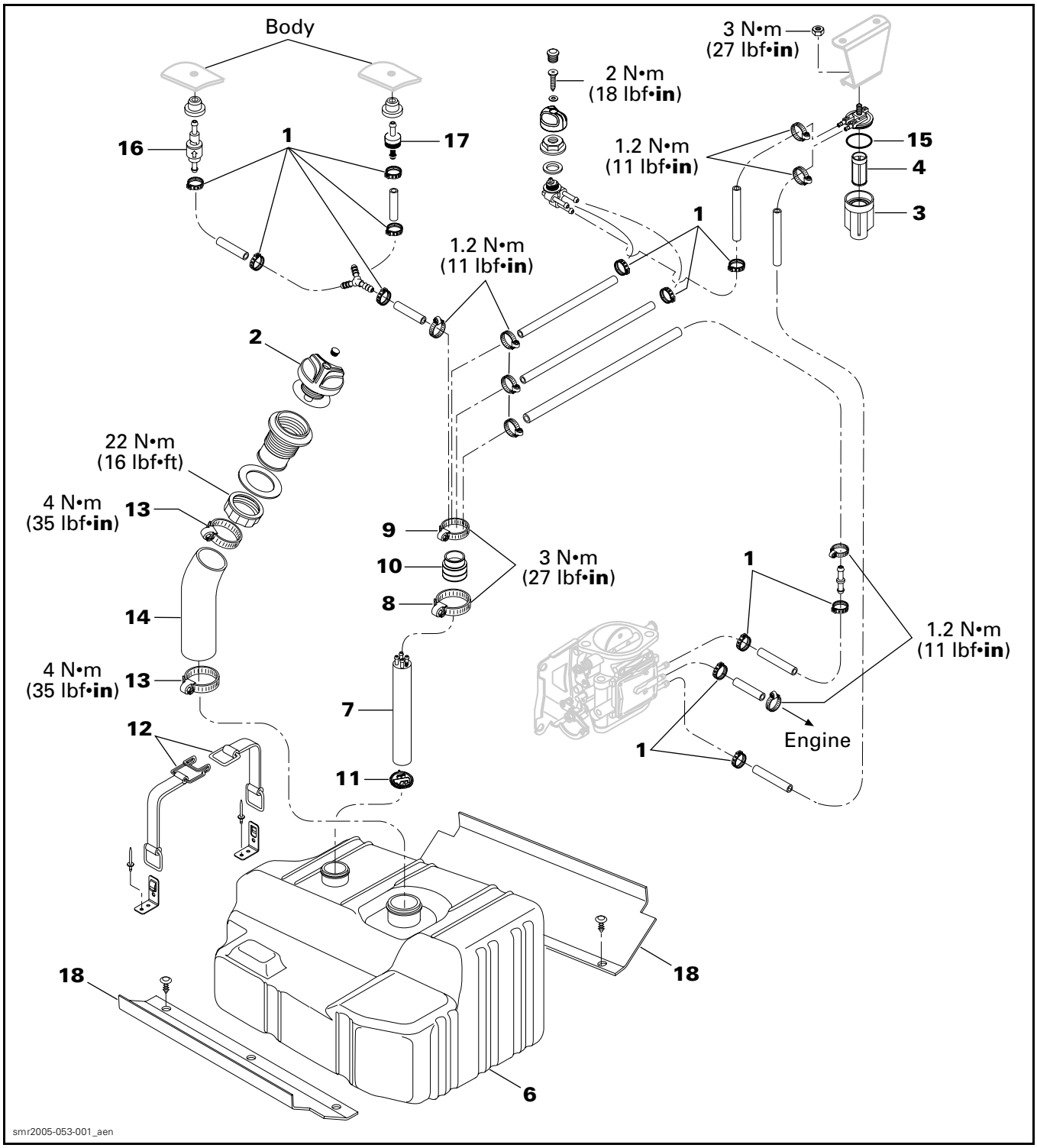
Tighten jam nut and recheck adjustment.

FUEL TANK AND FUEL PUMP

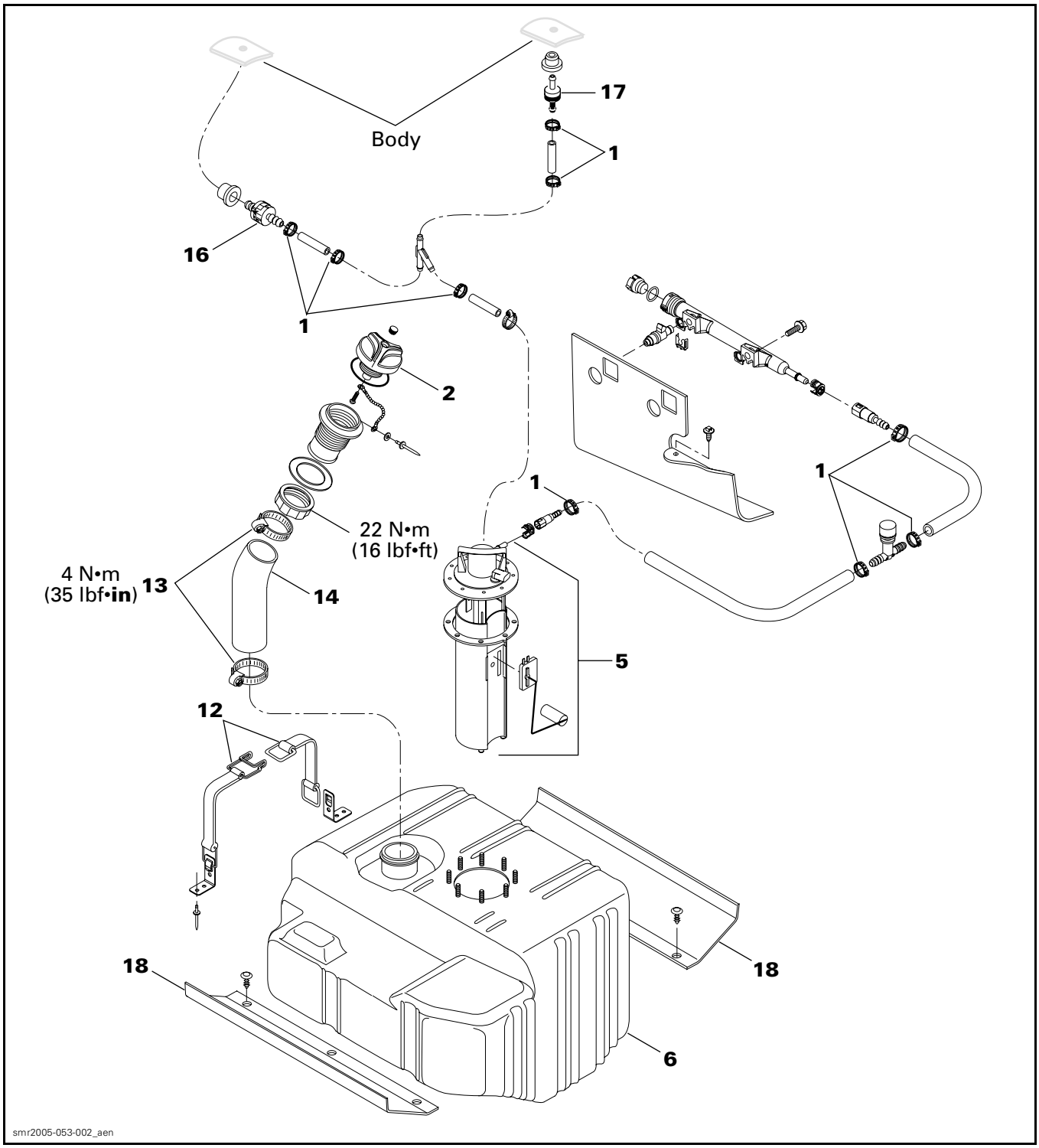
SERVICE TOOLS

Description	Part Number	Page
engine leak test kit	295 500 352	106
fuel pressure gauge	529 035 591	101
pliers Oetiker 1099	295 000 070	99–100
pressure/vacuum pump	529 021 800	106
small hose pincher	295 000 076	106

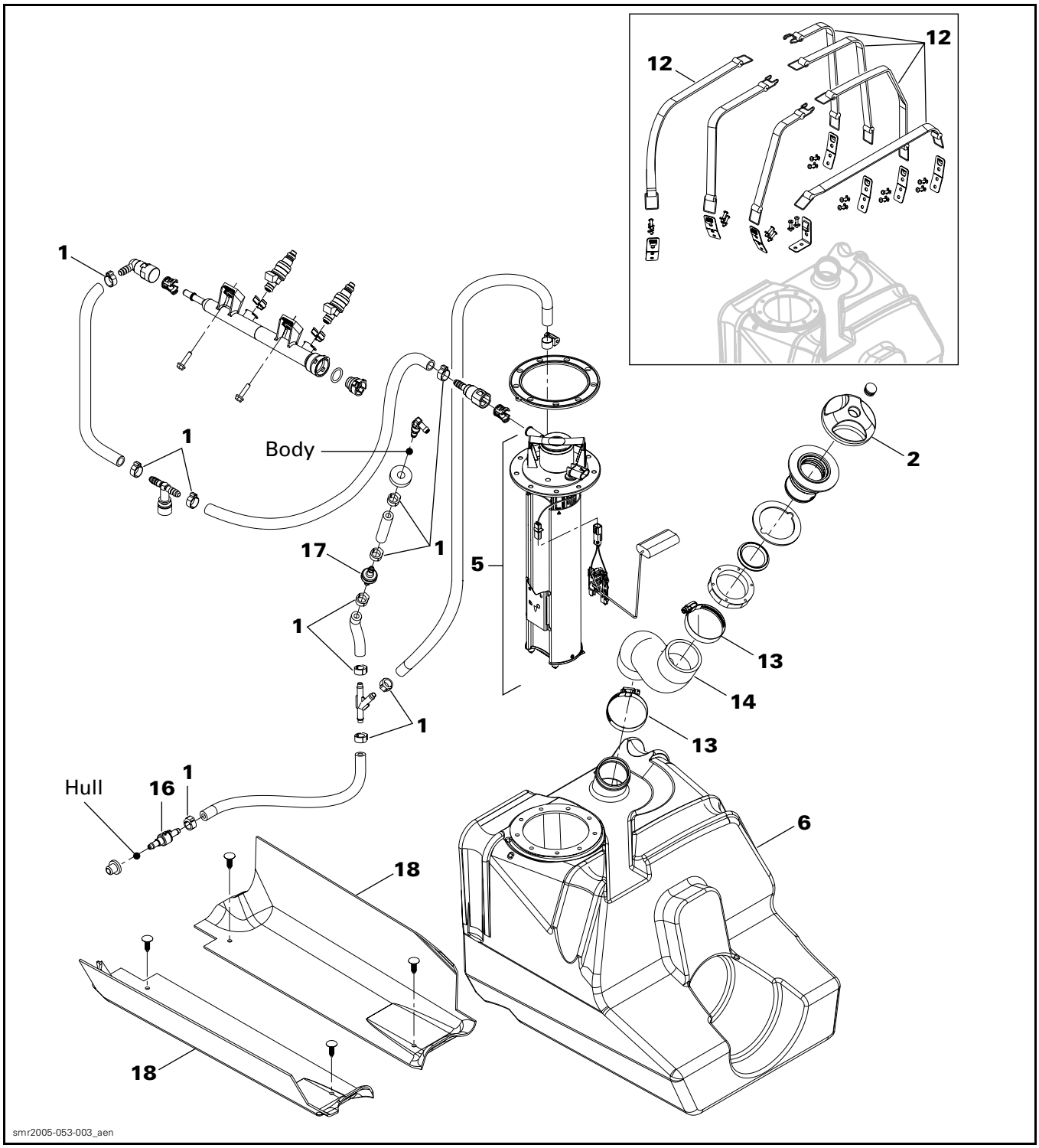
GTI Models



GTI RFI and GTI RFI LE Models



3D Series



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. 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

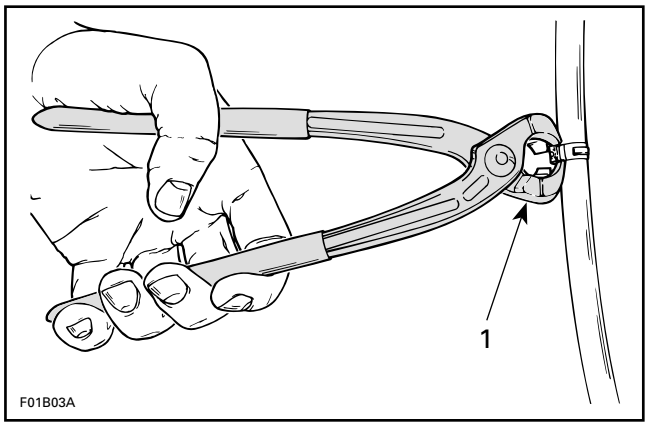
Whenever repairing the fuel system, always verify for water infiltration in reservoir. Replace any damaged, leaking or deteriorated fuel lines. When the repair is completed, ensure that hoses from fuel rail going to fuel pump are properly secured in their supports. Then, pressurize the fuel system. After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

⚠ WARNING

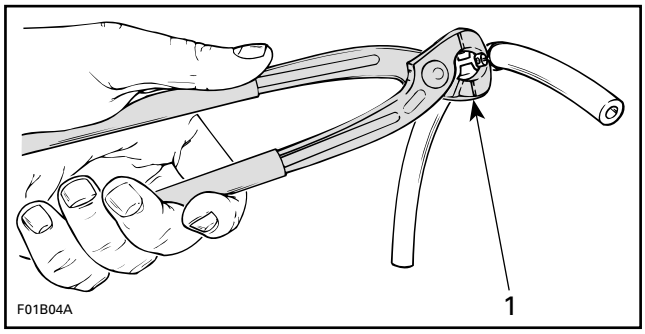
Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the safety lanyard on the DESS post. Always perform the high pressure test if any component has been removed. A pressure test must be done before connecting the safety lanyard. The fuel pump is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

Oetiker Clamps

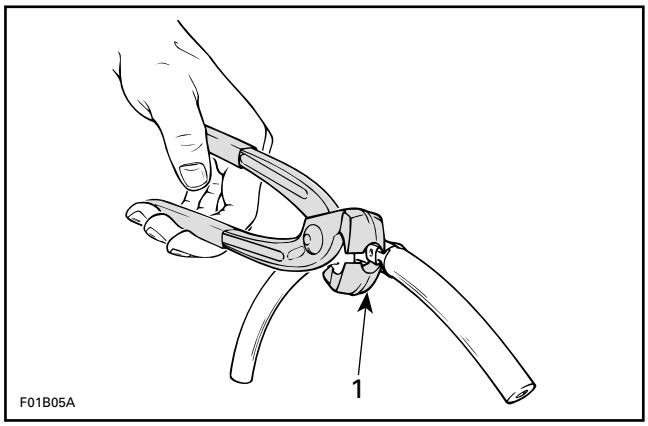
To secure or cut Oetiker clamps **no. 1** on fuel lines, use pliers Oetiker 1099 (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



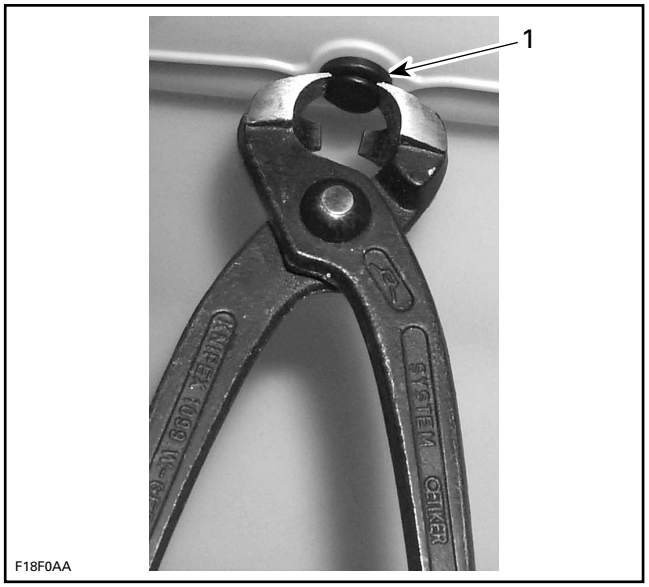
1. Securing clamp in limited access

When replacing the fuel lines on all SEA-DOO models be sure to use "B1". When replacing the fuel supply line to the fuel rail on **RFI models**, use "A1" hoses. These hoses are available through the BRP parts department. 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 Oetiker 1099 (P/N 295 000 070).



1. Dart

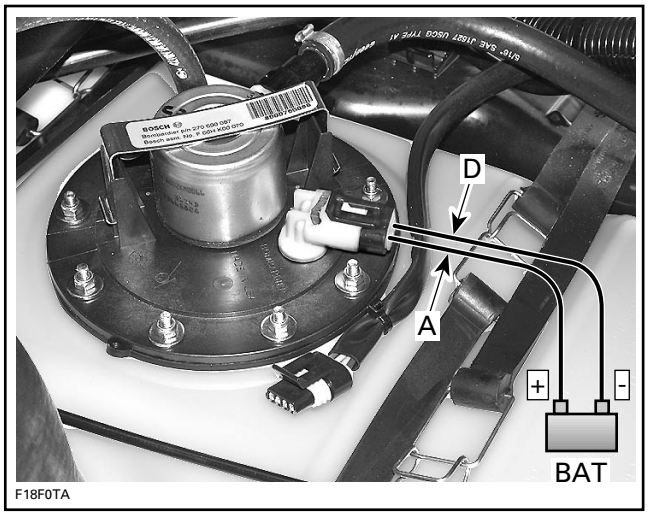
TESTING PROCEDURES

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.

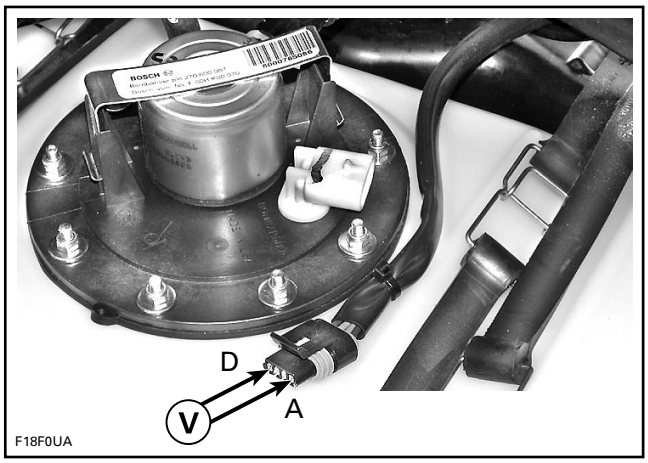
Install a temporary connector on the fuel pump with wires long enough to make the connection outside the bilge.



CAUTION: Running pump a few minutes with reverse polarity can damage the pump.

If pump does not run, replace the fuel pump module.

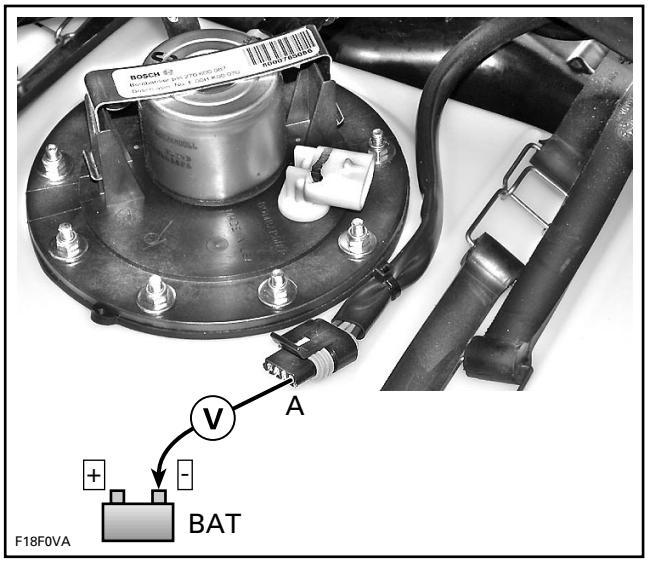
Otherwise, probe terminals as shown.



When installing safety lanyard, you should read battery voltage for approximately 2 seconds (then voltage will drop to approximately 11 V).

If battery voltage is read, the problem can be in fuel pump or in harness connector. Repair or replace appropriate part.

If battery voltage is not read, probe terminals as shown.



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 7-C going towards VCM. If it is good, try a new VCM.

Fuel Pump Pressure Test

Before proceeding to the pressure test ensure the battery is fully charged. Battery voltage must be over 12 volts.

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.

Open the front storage compartment cover (**GTI RFI Series**) or remove the engine cover (**3D Series**).

Remove storage basket.

On **GTI RFI Series**, 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.

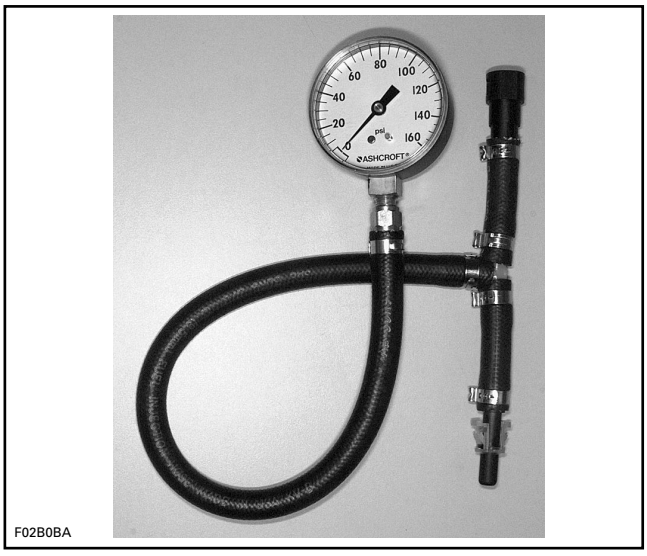
Ensure there is enough gas in fuel tank.

Disconnect outlet hose from fuel pump.

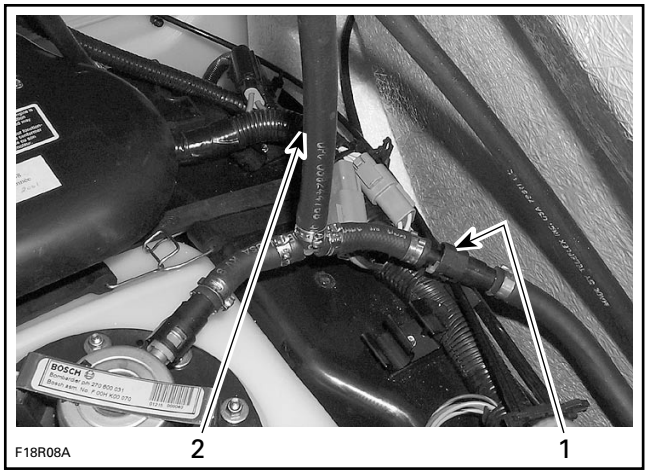
⚠ WARNING

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.

Install fuel pressure gauge (P/N 529 035 591) between disconnected hose (in-line installation).



FUEL PRESSURE GAUGE



TYPICAL
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.

MODELS	FUEL PRESSURE (when installing safety lanyard)
GTI RFI Series and 3D Series	386 - 414 kPa (56 - 60 PSI)

Disconnect the fuel pressure gauge and reconnect it.

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. If it is not leaking then replace fuel pump module.

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.

REMOVAL

Fuel Filter

Carburetor-Equipped Models

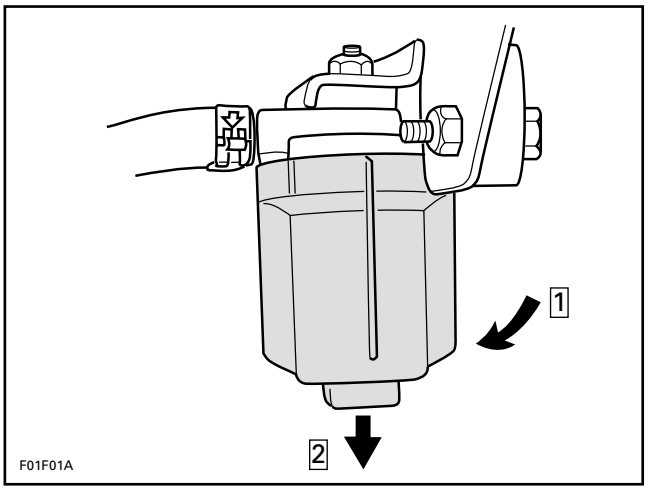
Turn the fuel valve OFF then remove the seat.

⚠ WARNING

The engine must not be running and fuel valve must be set to OFF position. Gasoline is flammable and explosive under certain conditions. Always work in a well ventilated area.

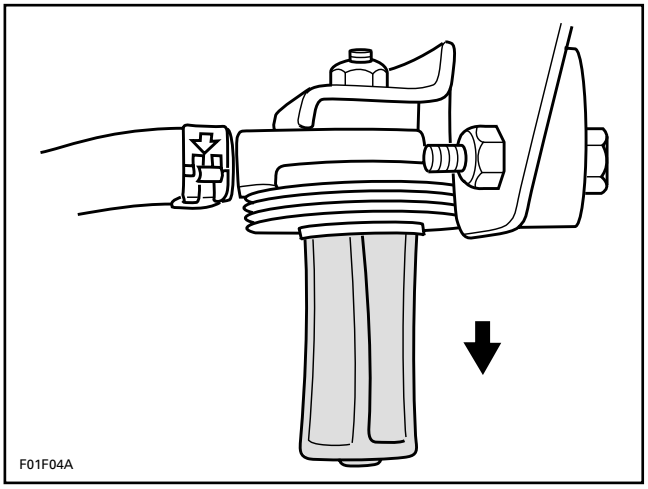
Unscrew fuel filler cap **no. 2** to remove any fuel pressure in system.

Unscrew the fuel filter bowl **no. 3** counterclockwise then pull toward the bottom.



TYPICAL
Step 1: Loosen counterclockwise
Step 2: Pull

Pull fuel filter **no. 4** toward the bottom.



TYPICAL

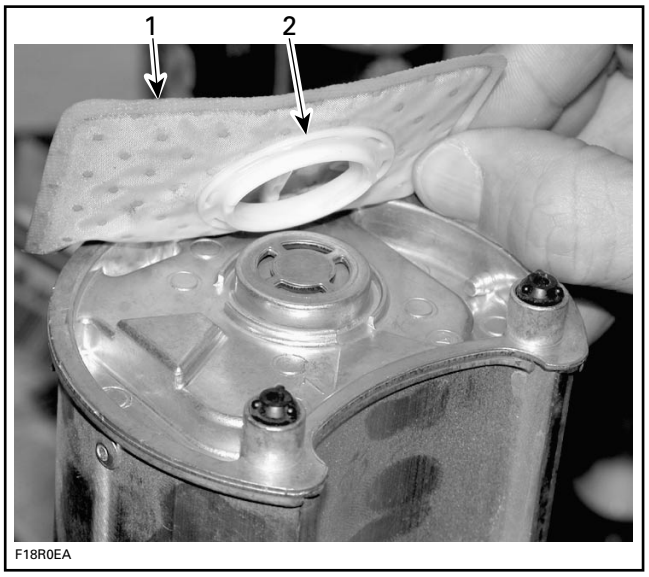
RFI Models

The fuel pump assembly **no. 5** has to be removed from the fuel tank **no. 6** to have access to the fuel filter.

NOTE: The filter does not require replacement under normal operating conditions. Replace only if permanently clogged or damaged.

Remove fuel pump.

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

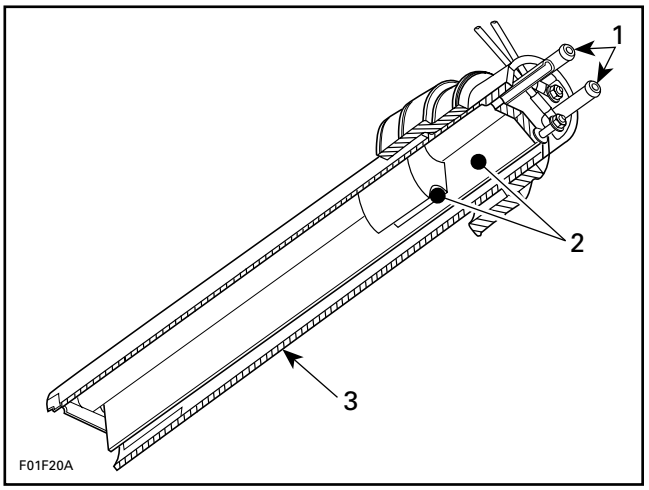
Regulator

The regulator is not serviceable. Replace the fuel pump assembly if the regulator is defective.

Fuel Baffle Pick-Up

Carburetor-Equipped Models

NOTE: The baffle pick-up **no. 7** has an integrated fuel sender for the fuel gauge.



1. Pick-up tube
2. Fuel sensor
3. Baffle pick-up

Disconnect BLACK (–) cable, then RED (+) cable of battery.

⚠ WARNING

Always disconnect battery cables exactly in the specified order, BLACK (–) cable first.

Open storage compartment cover.

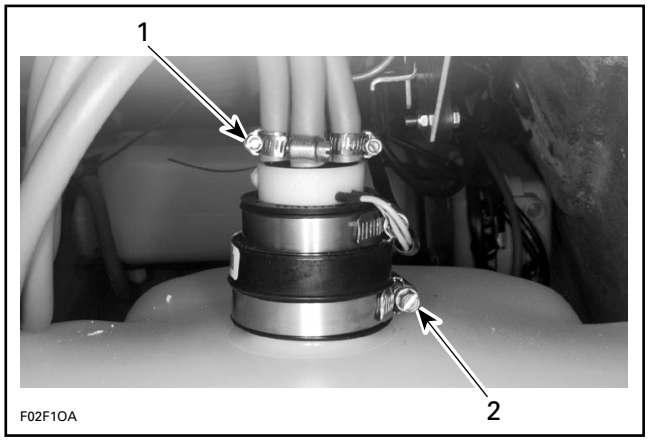
Remove rear panel of storage compartment.

Siphon fuel tank **no. 6**.

Remove steering assembly. Refer to STEERING SYSTEM for procedure.

Disconnect fuel lines from baffle pick-up and loosen lower clamp **no. 8**.

NOTE: Note fuel lines locations for installation.



TYPICAL
1. Disconnect fuel hoses
2. Loosen lower clamp

Disconnect wiring harness of fuel sender.

Remove baffle from fuel tank.

Remove upper clamp **no. 9** from adapter **no. 10** and slide adapter from baffle.

Push inward on the 3 clips at the base of the baffle in order to remove the filter **no. 11**. Pry base off using a small slotted screwdriver (if necessary).

Electric Fuel Pump

RFI Models

Open the front storage compartment cover (**GTI RFI Series**) or remove the engine cover (**3D Series**).

Remove the storage basket.

On **GTI RFI Series**, remove the glove box. For proper removal procedure, refer to HULL/BODY section.

Disconnect the wire connector from the fuel pump assembly.

Disconnect fuel vent hose from fuel pump assembly.

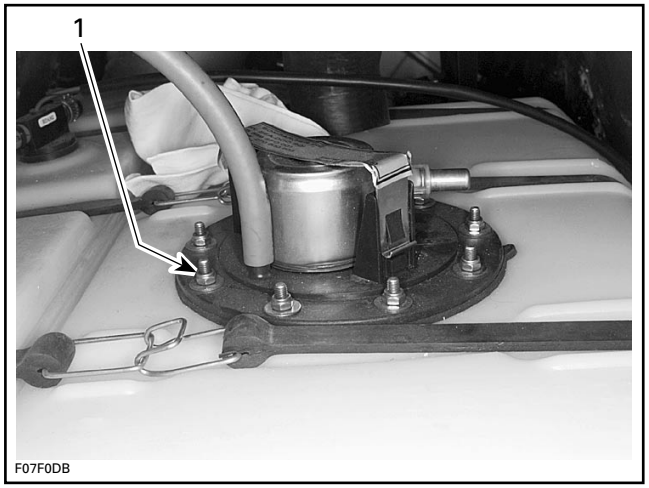
Cover the quick connect fitting with a shop towel.

Press on both tabs and disconnect the quick connect fitting.

⚠ WARNING

Fuel is under pressure. Wipe off any fuel spillage in the bilge. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area.

Loosen nuts retaining the fuel pump assembly to the fuel tank.



TYPICAL
1. Loosen nuts

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.**

Remove fuel pump assembly from fuel tank.

⚠ WARNING

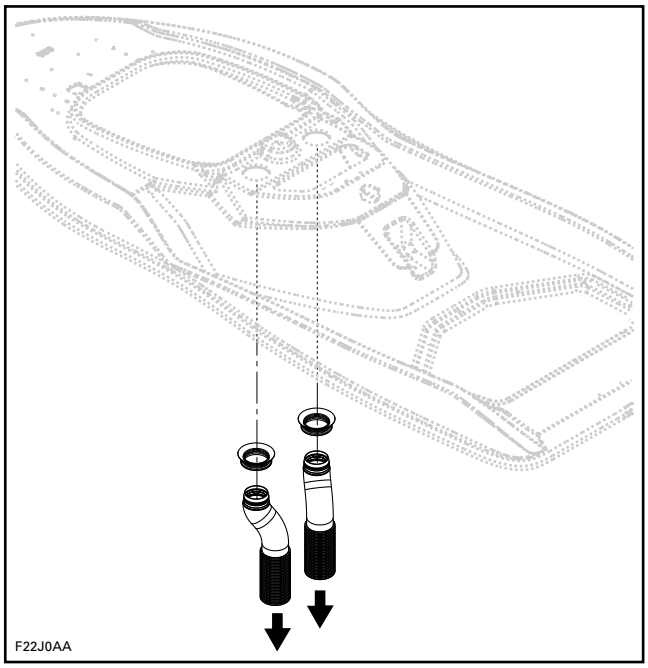
Always wipe off any fuel spillage from the watercraft. While dealing with fuel or fuel system always work in well ventilated area.

Fuel Tank

The engine removal is necessary to remove fuel tank on **all models**.

3D Series

Pull out both vent tubes.



Remove ignition coils.

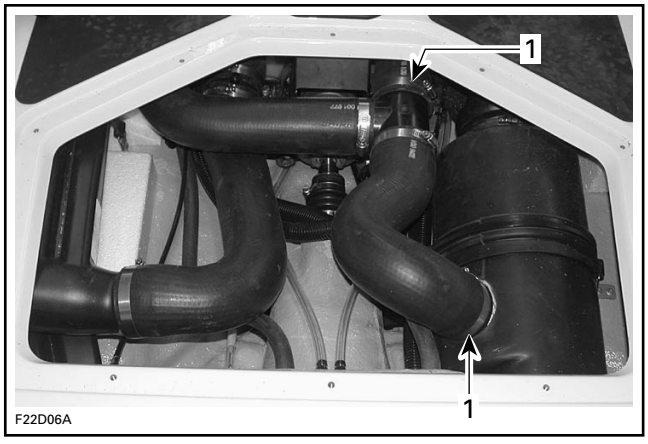
Disconnect fuel hoses. Refer to ENGINE MANAGEMENT (RFI).

All Models

Siphon fuel tank.

Remove fuel baffle pick-up **no. 7** (**carburetor-equipped models**) or electric fuel pump (**RFI Models**). Refer to the above section.

Detach all fuel tank straps **no. 12**. On **3D Series**, to have access to the rear fuel tank holding strap, remove exhaust hoses with the resonator.



1. Loosen clamps and pull out hoses with resonator

Unscrew clamp **no. 13** then detach the fuel filler hose **no. 14** from fuel tank.

Pull out fuel tank.

INSPECTION

Fuel Filter

Carburetor-Equipped Models

Inspect fuel filter **no. 4** condition. Carefully use low pressure compressed air to clean fuel filter. Replace filter if permanently clogged or damaged.

RFI Models

To inspect the fuel filter, the fuel pump assembly has to be removed from the fuel tank. See REMOVAL in this subsection for the procedure.

Fuel Filter Bowl

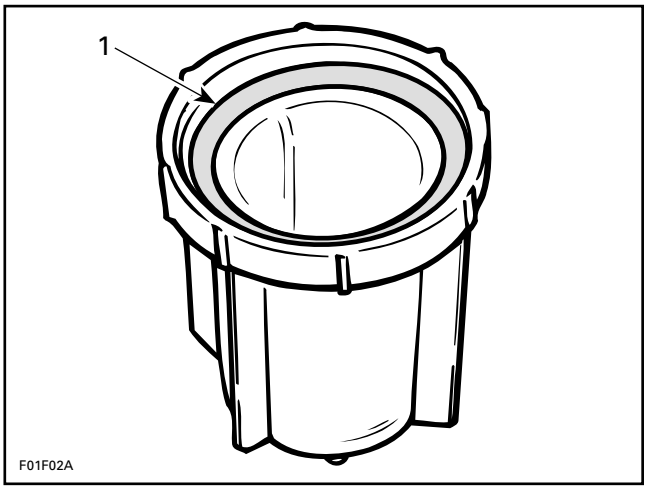
Carburetor-Equipped Models

Check filter bowl **no. 3** for water contamination or other damages.

Gasket

Carburetor-Equipped Models

Inspect gasket condition. Make sure gasket **no. 15** is well positioned into the filter bowl.



1. Gasket in bowl

⚠ WARNING

Ensure that there is no leakage from the fuel filter.

Fuel Filler Hose

All Models

Verify fuel filler hose **no. 14** for damage. Always ensure that clamps **no. 13** are well positioned and tightened. Torque clamps to 4 N•m (35 lbf•**in**).

Pressure Relief Valve

All Models

This valve **no. 16** 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
Carburetor-equipped	10 kPa (1.5 PSI)
RFI	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

All Models

Check if the check valve **no. 17** functions properly.

Black side of the one-way check valve is the valve outlet. It allows air to get in reservoir.

Baffle Pick-Up Filter

Carburetor-Equipped Models

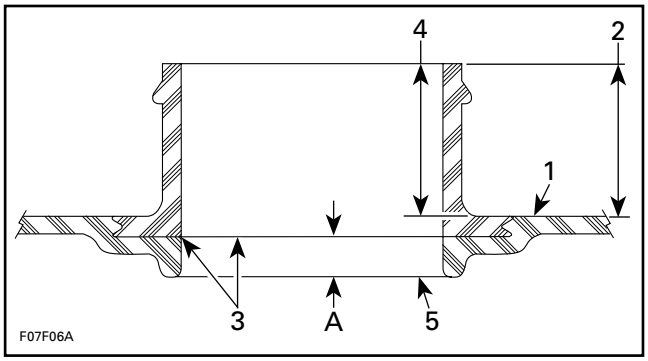
Inspect filter **no. 11** of baffle pick-up **no. 7**. Clean or replace as necessary.

Fuel Tank

All Models

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)

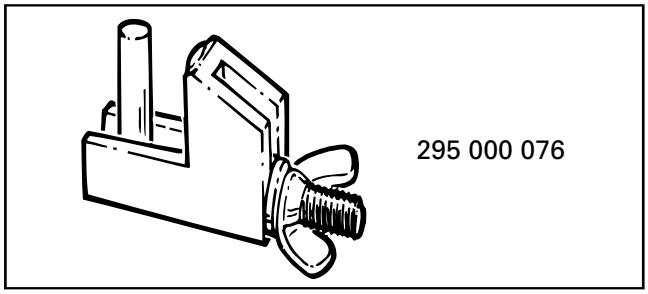
NOTE: A fuel tank is comprised of 3 components: the tank, the fuel pick-up neck and the filler neck. The necks are injection molded and the tank is then blow molded over the necks. During the molding process, a small molding seam may appear on the inner side of the necks at approximately 4 mm (5/32 in) 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)

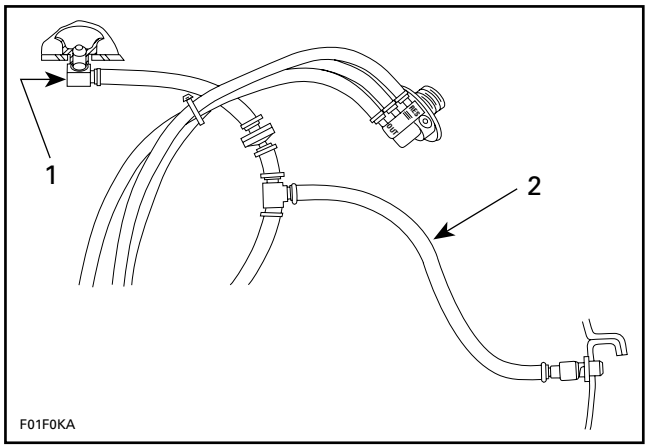
⚠ WARNING

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.

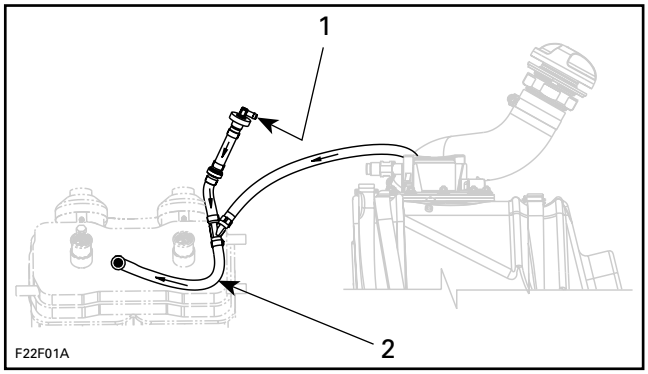
Proceed as follows:
– Fill up fuel tank.
– Disconnect air inlet hose of fuel tank from body.
– Install a small hose pincher (P/N 295 000 076) on fuel tank vent hose.



295 000 076



TYPICAL — GTI SERIES
1. Disconnect air inlet hose
2. Install a hose pincher to vent hose

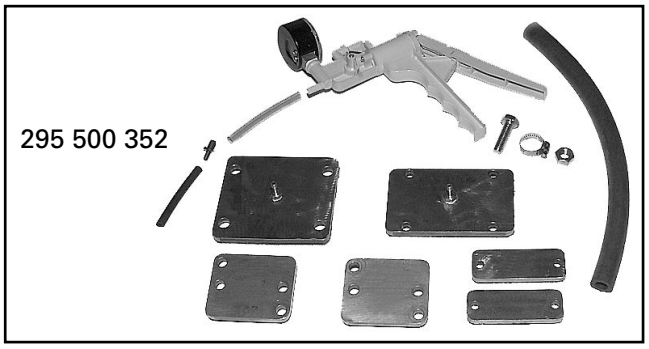


TYPICAL — 3D SERIES
1. Connect pump to air inlet fitting
2. Install hose pincher on the hose

– Connect the pressure/vacuum pump (P/N 529 021 800) to air inlet hose.

529 021 800

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



– Turn fuel valve to OFF position (**carburetor-equipped models**).
– Pressurize fuel system to 34 kPa (5 PSI).
– If no leaks are found, turn fuel valve to ON position and pressurize once more.
– 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.

Remove hose pincher from fuel tank vent hose. Make sure pressure is dropping on pump.

NOTE: Pressure drop indicates that relief valve and the outlet fitting are not blocked.

Remove the pump from the air inlet hose fitting.

High Pressure Test (fuel pump circuit)

RFI Models

Refer to FUEL PUMP PRESSURE TEST.

INSTALLATION

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

Fuel Tank

Ensure rubber carpets **no. 18** are in place.

Insert fuel tank in the vehicle and place straps in bottom clips. Use tape to hold straps on the top of fuel tank.

Insert strap ends in hoops.

Properly secure harnesses.

Reinstall all other removed parts. Refer to the appropriate section.

Baffle Pick-Up

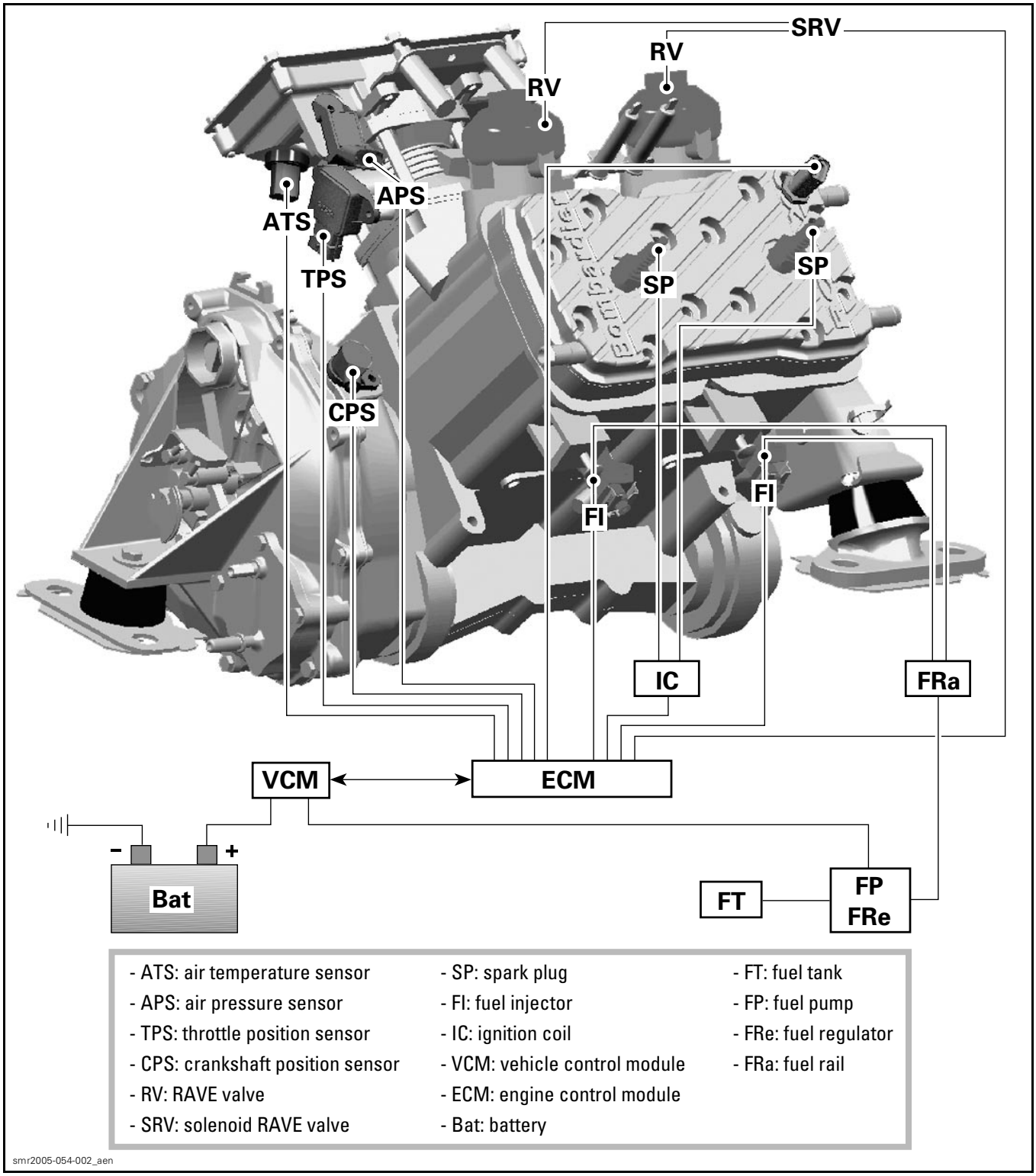
Carburetor-Equipped Models

Slide adapter **no. 10** onto baffle pick-up **no. 7** until it stops on rib. Install clamp **no. 9**.

Install baffle pick-up **no. 7** into fuel tank and push it until it sits on fuel tank neck. Install clamp **no. 8** and torque both clamps to 3 N•m (27 lbf•**in**).

OVERVIEW

ENGINE MANAGEMENT SYSTEM (EMS)



- ATS: air temperature sensor
- APS: air pressure sensor
- TPS: throttle position sensor
- CPS: crankshaft position sensor
- RV: RAVE valve
- SRV: solenoid RAVE valve
- SP: spark plug
- FI: fuel injector
- IC: ignition coil
- VCM: vehicle control module
- ECM: engine control module
- Bat: battery
- FT: fuel tank
- FP: fuel pump
- FRe: fuel regulator
- FRa: fuel rail

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GENERAL

The engine management system (EMS) is responsible of the fuel injection, ignition timing and RAVE valves operation.

NOTE: The EMS includes an engine control module (ECM), vehicle control module (VCM), sensors, injectors and an electromagnetic valve to control these functions.

To reduce the emission level, the 787 RFI engine has been designed to run with only one cylinder at idle (intermittently MAG and PTO) after engine warm-up is completed. While running approximately 2500 RPM and below, engine gradually goes from two cylinder to one at idle.

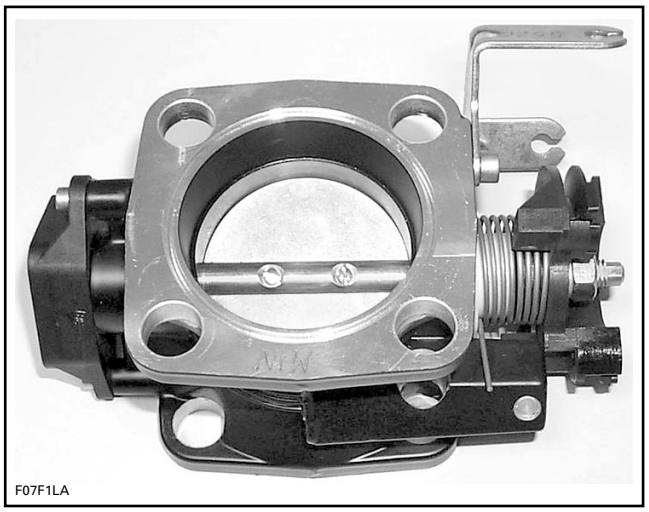
There are 3 main systems in interaction with the engine management system:

1. air induction
2. fuel system
3. electrical system.

OPERATING PRINCIPLE

AIR INDUCTION

A single throttle body (56 mm) breath through the air intake silencer to provide a sufficient amount of air for the engine operation.



THROTTLE BODY

FUEL SYSTEM

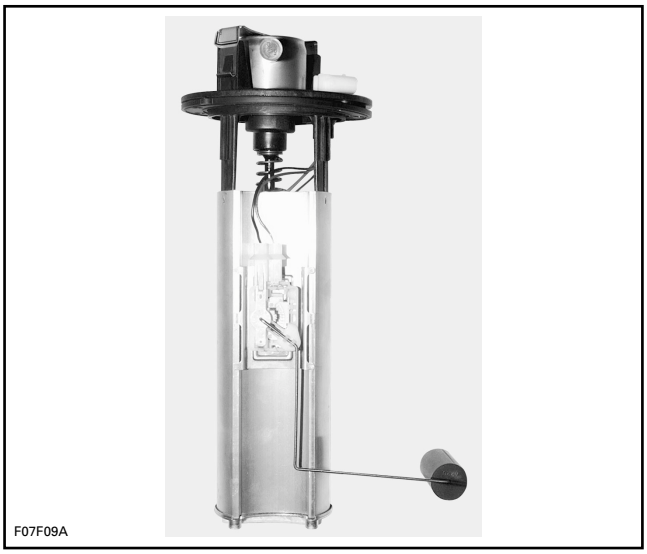
The Rotax Fuel Injection (RFI) is a semi-direct electronic fuel injection system.

The Rotax Fuel Injection (RFI) is composed of the following main components:

Fuel Pump Module

The following components are comprised in a single module mounted in the fuel tank.

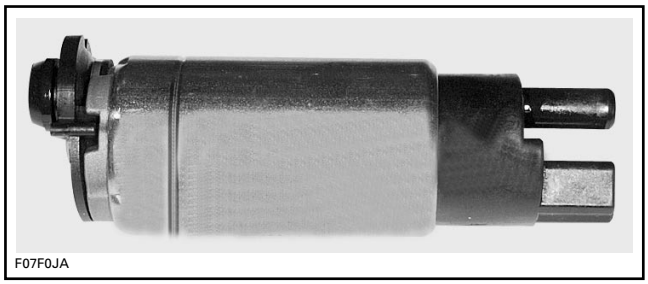
NOTE: The fuel gauge sender is also mounted on this module.



FUEL PUMP MODULE

Fuel Pump

An electric fuel pump provides fuel pressure and flow rate to the system.



FUEL PUMP

Fuel Pressure Regulator

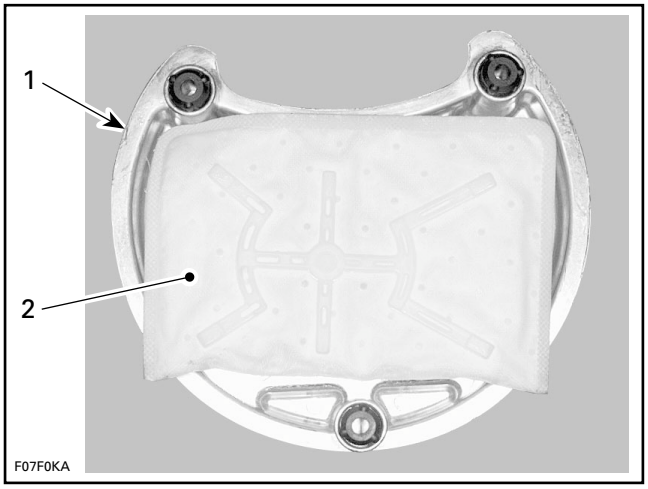
A regulator, mounted on top of fuel pump module, maintains a constant fuel pressure of 386 - 414 kPa (56 - 60 PSI).

REGULATOR

External and Internal Fuel Filters

Fuel filters protect the components of the fuel injection system from foreign particles.

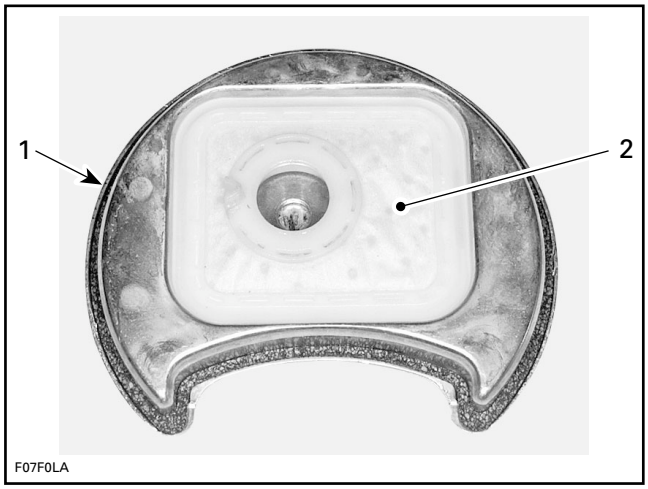
The external fuel filter is located on the end cap of the fuel pump module.



1. *Fuel pump module*
2. *External fuel filter (replaceable)*

Although this filter is replaceable, it should not requires replacement under normal conditions of use.

The internal fuel filter is located inside the end cap of the fuel pump module.

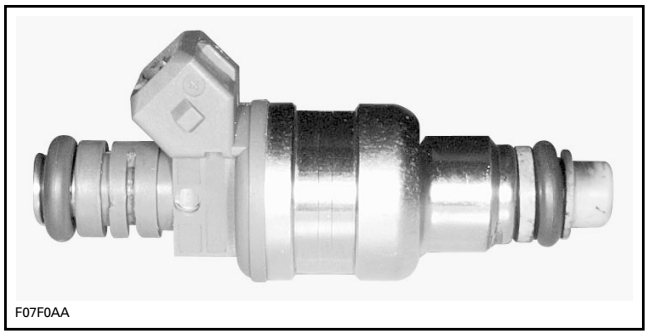


1. *End cap of fuel pump module removed*
2. *Internal fuel filter (not replaceable)*

This filter is not replaceable. If clogged, the fuel pump module should be replaced.

Fuel Injectors

The injectors inject a metered quantity of fuel from the fuel rail into the cylinder rear transfer port in accordance with the signal from the Engine Management System (EMS). With this design, the injector is not exposed to high combustion pressure, temperature and contaminants.

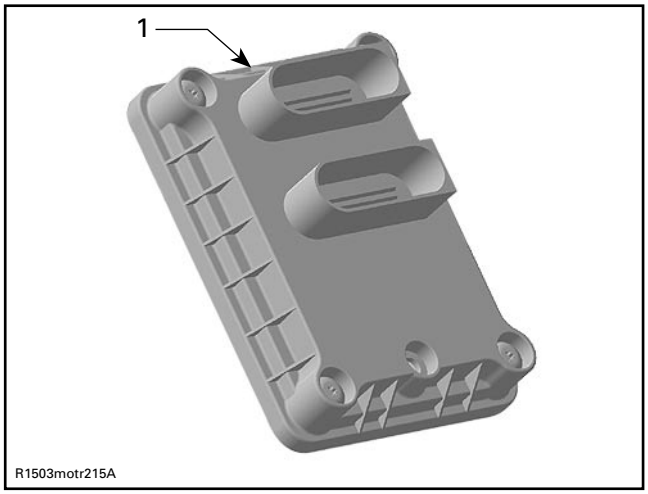


INJECTOR

ELECTRICAL SYSTEM

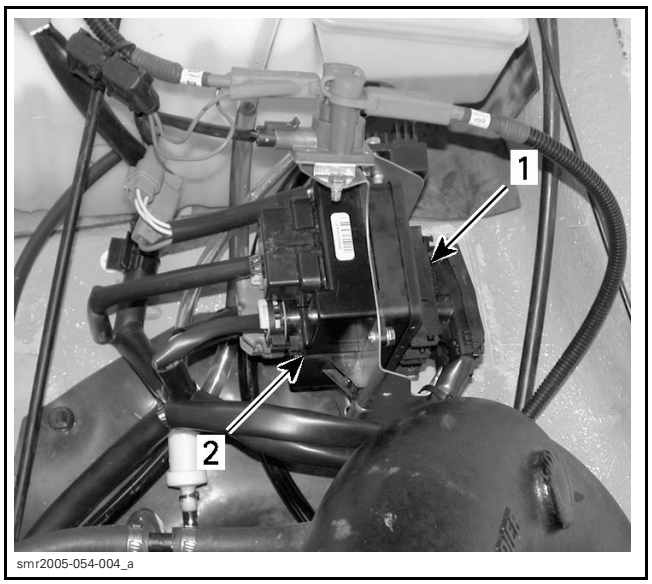
Engine Control Module (ECM)

The ECM is a VDO-Siemens module.



1. ECMS

The ECM is mounted behind the VCM in the front of the engine.



TYPICAL
1. ECM
2. VCM

The ECM is responsible of the following electrical functions:

Digitally Encoded Security System (DESS)

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

Safety Lanyard Reminder

If engine is not started within 5 seconds after installing the safety lanyard on its post, 4 short beeps every 3 second interval will sound for approximately 2 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 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 1000 RPM.

If start button is activated while the throttle lever is depressed more than 70%, the engine will not be allowed to start.

Engine Stopping

There are 2 ways to stop the engine.

Press start/stop button or remove the safety lanyard cap from its post.

Maximum Engine Speed

The ECM limits the maximum allowable engine speed. The RPM rev limiter is set at 7200 ± 50 RPM.

Drowned Mode (Flooded Engine)

This mode allows to crank engine to expel accumulated fuel or water out of cylinders. No fuel is injected and no ignition occurs while cranking in this mode. Proceed as follows to activate the drowned mode:

Remove spark plug cables and connect them on the grounding device.

Remove spark plugs and dry them using a rag.

Cover spark plug holes with a rag.

While engine is stopped, depress and HOLD the throttle lever at full throttle position for cranking.

Crank the engine several times.

Reinstall spark plugs and connect cables.

Start engine normally without applying the throttle.

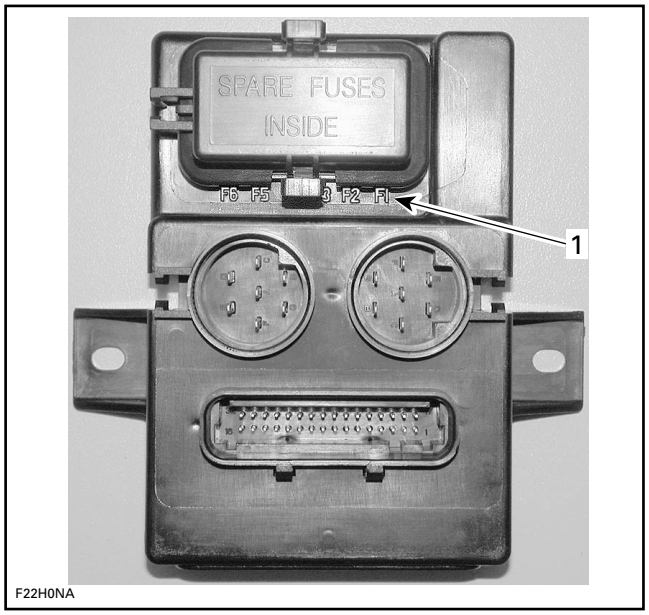
Diagnostic Mode

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. Refer to the DIAGNOSTIC PROCEDURES subsection.

529 035 981

Vehicle Control Module (VCM)

The VCM is mounted on the same support as the ECM, in the front of the engine.



1. VCM

The VCM is responsible of the following electrical functions:

Power Distribution

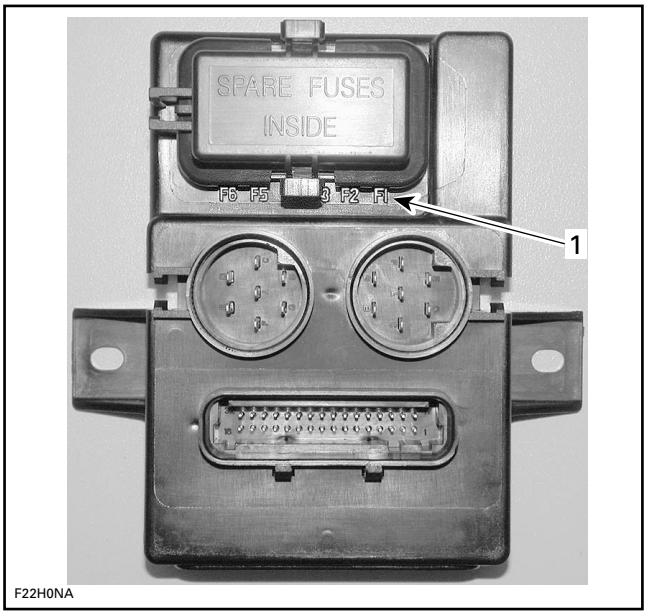
A power supply cut-off relay isolates the battery from the electrical system to prevent battery drain. When the safety lanyard is installed, the relay then supplies current to the VCM.

The relay is located inside VCM.

The VCM distributes power from the battery to the following electrical components:

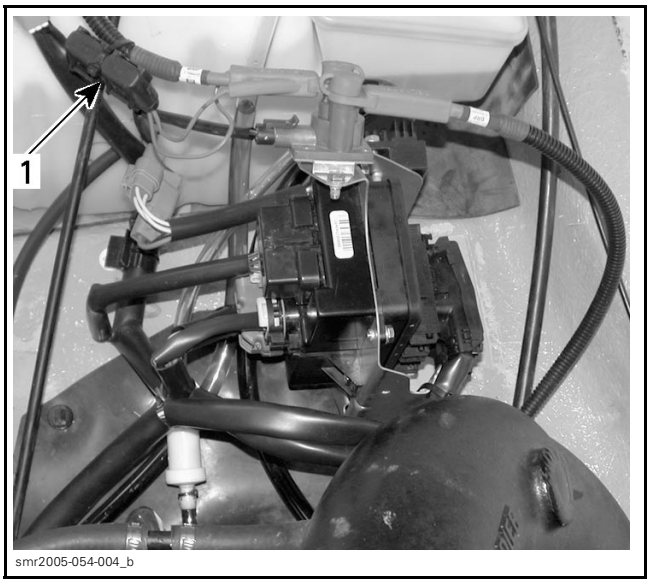
- accessories
- fuel pump
- RAVE solenoid
- Ignition coil
- starter solenoid
- injectors
- ECM

Electrical components are protected by fuses integrated in the VCM and in separate fuse holders close to VCM. Fuses are identified besides their holder on VCM.



1. Fuse location and identification

FUSE IDENTIFICATION	FUSE CAPACITY AND FUNCTION
F1	5 A, Accessories
F2	10 A, Fuel pump
F3	5 A, RAVE solenoid
F4	10 A, Ignition coil and starter solenoid
F5	3 A, Injector 1 (MAG)
F6	3 A, Injector 2 (PTO)



TYPICAL
1. Fuse holders of the main fuse (VCM and charging fuse)

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 (if so equipped) without starting the engine.

NOTE: The fuel pump will be activated for 2 seconds to build up pressure in the fuel injection system.

Low-Fuel and Low-Oil Level Warning Device

When the fuel level in the reservoir is low, the fuel level sensor transmits a signal to the VCM. The VCM sends out signals to the beeper and to the information center gauge or to the indicator light cluster.

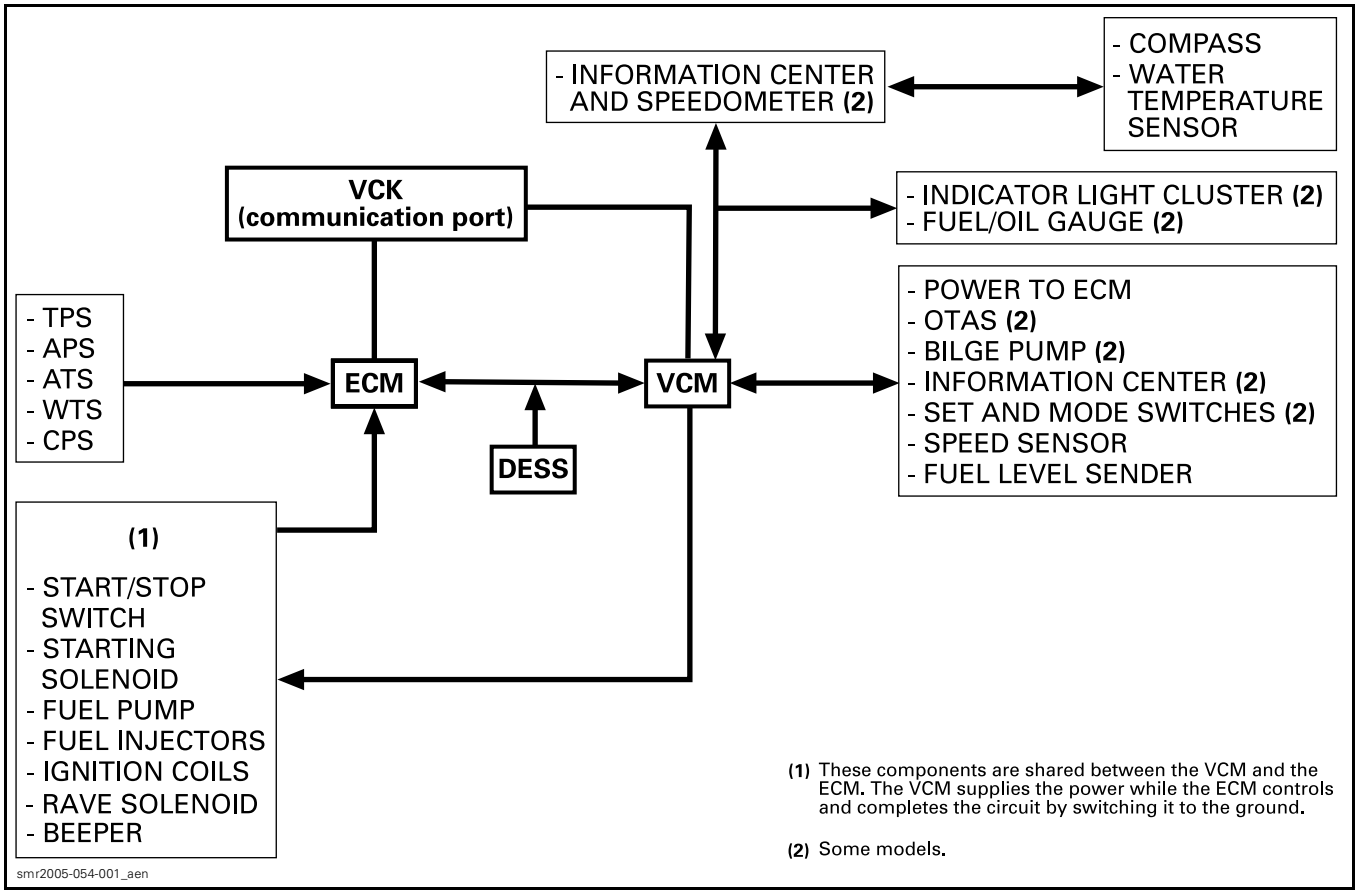
When the oil level is low in the reservoir, the VCM sends out a signal to the information center gauge or to the indicator light cluster and the pilot lamp on the gauge will turn on.

O.T.A.S. (Off-Throttle Assisted Steering)

The O.T.A.S. system is electronically activated by the VCM.

The O.T.A.S. system provides additional maneuverability in some off-throttle situations. Refer to STEERING SYSTEM for more details on this system.

ECM and VCM Interaction with the Electrical System



ENGINE MANAGEMENT

ELECTRONIC FUEL INJECTION

The ECM receives the signals from 5 sensors which indicate engine operating conditions at millisecond intervals.

- Throttle Position Sensor (TPS)
- Crankshaft Position Sensor (CPS)
- Air Temperature Sensor (ATS)
- Water Temperature Sensor (WTS)
- Air Pressure Sensor (APS).

These signals are used by the ECM to determine the injection duration required for optimum air-fuel ratio.

To activate an injector, the ECM completes the injector circuit to ground.

IGNITION TIMING

The ECM is programmed with data for optimum ignition timing under all operating conditions. Using data provided by the sensors, the ECM controls the ignition timing for optimum engine operation.

A double ignition coil provides high voltage to each spark plug individually.

The ECM completes the ignition coil primary winding to ground to produce a spark.

RAVE VALVE ACTIVATION

The ECM is programmed with data to control the RAVE valves operation.

To open the RAVE valves, The ECM completes the RAVE solenoid coil circuit to ground.

For mechanical inspection of the RAVE valves, refer to TOP END in the *717/787 RFI ENGINE SHOP MANUAL*. For RAVE valve solenoid testing, refer to COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT in this manual.

OTHER ENGINE MANAGEMENT FUNCTIONS

Limp Home Mode

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. Refer to EMS Fault Code Table in DIAGNOSTIC PROCEDURES.

Depending on the severity of the malfunction, the watercraft speed may be reduced and not allowed to reach its usual top speed.

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.

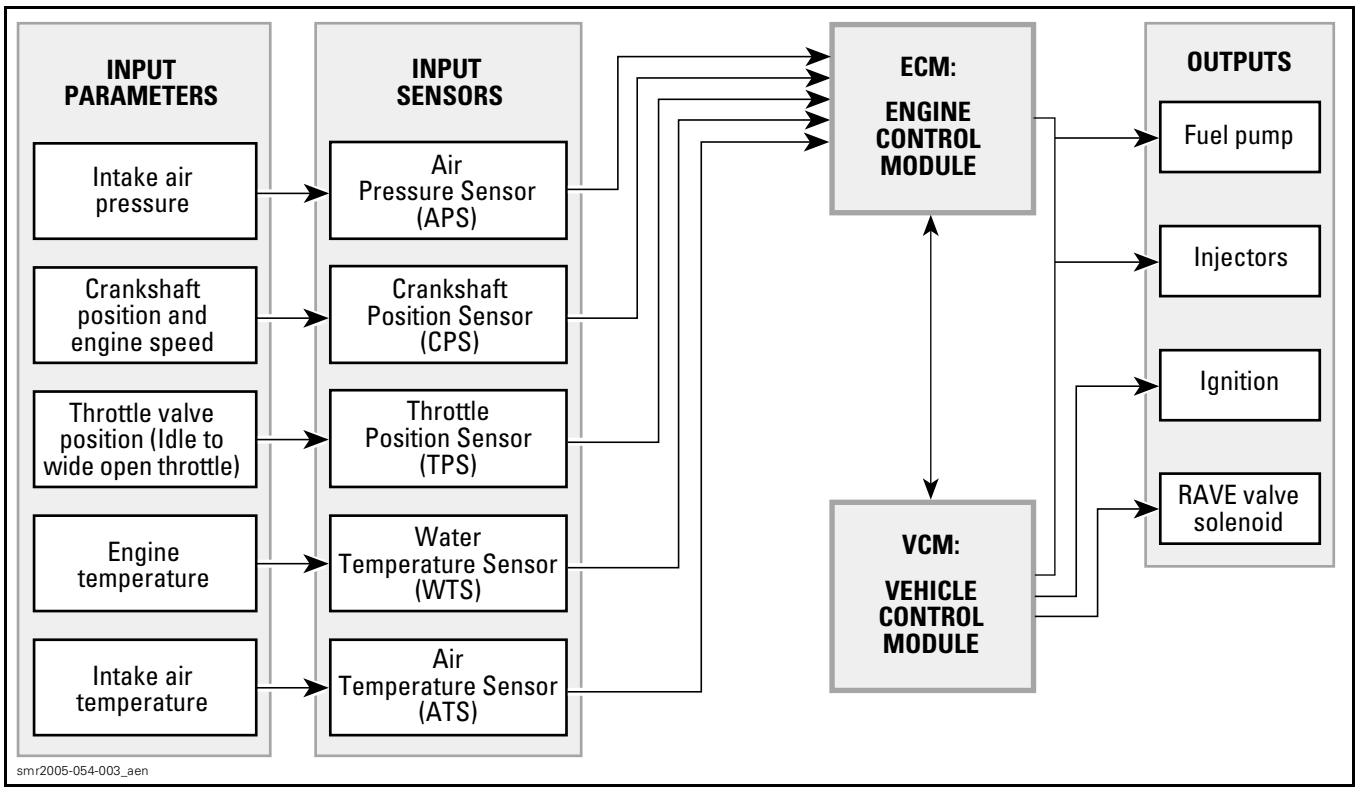
If a fault occurs and involves a limp home mode operation, the EMS system will reduce engine RPM gradually to the proper level.

Monitoring System

The ECM permanently records and stores some engine operation parameters.

The ECM monitors the electronic components of the fuel injection system other electrical components. When a fault occurs, it sends visual messages through the information center or indicator light cluster and/or audible signals through a beeper to inform you of a particular condition. Refer to the DIAGNOSTIC PROCEDURES subsection for the displayed messages and the beeper coded signals chart.

ENGINE MANAGEMENT SYSTEM FLOW CHART



DIAGNOSTIC PROCEDURES

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 blinking check engine light or 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.
- Check all fuses.
- Check fuel rail pressure.
- Check spark plugs condition.
- Check fuel pump pressure.
- Check all connections of the wiring harness.
- Refer to COMPONENT INSPECTION, REPLACEMENT AND ADJUSTMENT section for procedures.

ENGINE MANAGEMENT SYSTEM FAULT CODES

General

The faults registered in the ECM are kept when the battery is disconnected.

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the ECM using the VCK. This will properly reset the appropriate counter(s). This will also record that the problem has been fixed in the 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 5-32 for instance. It means connector no. 5 and the circuit wire no. 32 as found in the wiring diagram.

When they are referred as A-41, it means connector "A" on the ECM and the circuit 41.

TPS (Throttle Position Sensor) Faults

Faults which are reported in B.U.D.S. fall into two groups: TPS faults and adaptation faults. These are displayed on the B.U.D.S. system as TPS OUT OF RANGE and TPS ADAPTATION FAILURE.

TPS "OUT OF RANGE" Fault

It is caused by the sensor reading going out of its allowable range. This fault can occur during the whole range of movement of the throttle.

To diagnose this fully, it is recommended to operate the throttle through its full range. It is also recommended to release the throttle quickly as this may also show up a fault that is intermittent.

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

TPS "ADAPTATION FAILURE" Fault

It is caused by the idle position moving out of an acceptable range.

Following failures can be affected 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**.
Throttle body has been replaced and TPS closed position not reset.	• Reset **Closed Throttle**.
ECM has been replaced and TPS closed position not reset.	• Reset **Closed Throttle**.
Throttle cable too tight.	• Fix and reset **Closed Throttle**.
Sensor is loose.	• Fix and reset **Closed Throttle**.
Throttle bracket is loose.	• Fix and reset **Closed Throttle**.
Adjustment screw worn or loose.	• Change throttle body.

Burnt Fuse and Related Fault Code

FUSE NO	FUSE CAPACITY AND FUNCTION	CODE
Main	5 A Accessories	None
1	10 A Fuel pump	None
2	5 A RAVE solenoid	P-0231
3	10 A Ignition coil and starter solenoid	P-0079
4	3 A Injector 1 (MAG)	P-0616, P0351, P-0352
5	3 A Injector 2 (PTO)	P-261, P-262
6	N	P-264, P-265

NOTE: Fuses are located on the vehicle control module (VCM). Refer to OVERVIEW for more details.

EMS Fault Code Table

CODE	DESCRIPTION	BEEPER CODE	CHECK ENGINE LIGHT	DETECTED WHEN ENGINE STOPPED	DETECTED WHEN ENGINE RUNS	ENGINE SPEED LIMITATION	NORMAL OPERATION RESUMES WHEN...	COMMENT
P0079	Rave valve solenoid signal too low	15	Y	N	Y	(6300)	When the fault is recovered	The engine speed is limited due to the fact that the RAVE aren't opening.
P0080	Rave valve solenoid signal to high	15	Y	N	Y	(6300)	When the fault is recovered	The engine speed is limited due to the fact that the RAVE aren't opening.
P0106	Manifold atmospheric pressure sensor out of range	15	Y	N	Y	N	When the fault is recovered	
P0107	Manifold atmospheric pressure sensor shorted to ground	15	Y	N	Y	N	When the fault is recovered	
P0108	Manifold atmospheric pressure sensor shorted to 12 V or open circuit	15	Y	N	Y	N	When the fault is recovered	
P-0111	Intake manifold temperature sensor functional problem	15	Y	N	Y	N	When the fault is recovered	
P-0112	Intake manifold temperature sensor shorted to ground	15	Y	N	Y	N	When the fault is recovered	
P-0113	Intake manifold temperature sensor shorted to 12 V or open circuit	15	Y	N	Y	N	When the fault is recovered	
P-0116	Engine temperature functional problem	15	Y	N	Y	N	When the fault is recovered	
P-0117	Engine temperature sensor short circuit to ground	15	Y	N	Y	N	When the fault is recovered	
P-0118	Engine temperature sensor short circuit to 12 V	15	Y	N	Y	N	When the fault is recovered	
	Engine temperature sensor open circuit	15	Y	N	Y	N	When the fault is recovered	
P-0122	Throttle position sensor out of range	15	Y	Y	Y	N	When key is removed	
P-0122	Throttle position sensor short circuit to ground	15	Y	Y	Y	(3500)	When key is removed	3500 Because of the default value
P-0123	Throttle position sensor out of range - short-circuit to 12 V or open circuit	15	Y	N	Y	(3500)	When key is removed	3500 Because of the default value
P-0231	Fuel pump shorted to ground or open circuit	15	Y	Y	N	N	When the fault is recovered	
P-0232	Fuel pump shorted to 12 V	15	Y	N	Y	N	When the fault is recovered	

CODE	DESCRIPTION	BEEPER CODE	CHECK ENGINE LIGHT	DETECTED WHEN ENGINE STOPPED	DETECTED WHEN ENGINE RUNS	ENGINE SPEED LIMITATION	NORMAL OPERATION RESUMES WHEN...	COMMENT
P-0261	Inj #1 short-circuit to ground or open circuit	15	Y	N	Y	(3200)	When the fault is recovered	3200 because the engine runs on 1 cylinder only
P-0262	Inj # 1 short-circuit to 12 V	15	Y	N	Y	(3200)	When the fault is recovered	3201 because the engine runs on 1 cylinder only
P-0264	Inj #2 short-circuit to ground or open circuit	15	Y	N	Y	(3200)	When the fault is recovered	3202 because the engine runs on 1 cylinder only
P-0265	Inj #2 short-circuit to 12 V	15	Y	N	Y	(3200)	When the fault is recovered	3203 because the engine runs on 1 cylinder only
P-0336	Engine speed > [rpm] detected	15	Y			N		
P-0351	Ignition coil 1 open circuit or shorted to ground or to 12 V	15	Y	N	Y	N	When engine stop	
P-0352	Ignition coil 2 open circuit or shorted to ground or to 12 V	15	Y	N	Y	N	When engine stop	
P-0513	DESS incorrect key	15	N	Y	N/A	N/A	N/A	
P-0562	Battery voltage too low	15	N	N	Y	0	When the fault is recovered	At 10 V
P-0563	Battery voltage too high	15	N	N	Y	5128	When the fault is recovered	At 18 V
P-0601	TPS learns unlikely or checksum fault	15	Y					
P-0601	Module call monitoring	15	Y					
P-0602	ECM not coded	15	Y					
P-0604	RAM faulty	15	Y					
P-0605	EPROM faulty	15	Y					
P-0605	Checksum fault EEPROM	15	Y					
P-0605	Coding ID checksum fault	15	Y					
P-0605	Coding checksum fault	15	Y					
P-0605	Programming checksum fault	15	Y					
P-0608	Sensor 5 V power supply short to gnd	15	Y	Y	Y	N	When the key is removed	
P-0616	Starter relay shorted to ground	5		N(1)	Y	N	When the fault is recovered	
	Starter relay open circuit	5		Y	Y	N	When the key is removed	
P-0617	Starter relay shorted to 12 V	5	N	Y (2)	N	N	When the fault is recovered	
P-0650	Check engine circuit open circuit or shorted to ground	5	N	Y	Y	N	When the fault is recovered	3D Series and GTI LE RFI only

CODE	DESCRIPTION	BEEPER CODE	CHECK ENGINE LIGHT	DETECTED WHEN ENGINE STOPPED	DETECTED WHEN ENGINE RUNS	ENGINE SPEED LIMITATION	NORMAL OPERATION RESUMES WHEN...	COMMENT
P-1102	Throttle position sensor adaptation failure	15	Y	Y	N	N	When the fault is recovered	
P-1104	Throttle position sensor adaptation canceled	15	Y	Y	N	N	When the fault is recovered	
P-1148	Fuel injector 1, or 2 safety fuel cut off detected	15	Y	N	Y	N	When the fault is recovered	
P-1611	Engine speed > [rpm] detected	15	N	Y	Y	N	When the fault is recovered	
P-1655	DESS® line shorted to 12 V	15	Y	Y	N	N	When the fault is recovered	
P-1656	DESS® line shorted to ground	15	Y	Y	N	N	When the fault is recovered	
P-1670	Buzzer - Short to Battery Voltage	15	N	Y	Y	N	When the fault is recovered	
P-1671	Buzzer short-circuit to ground or open	2	N	Y	Y	N	When the fault is recovered	

(1) fault detected while cranking
(2) Sometimes when pressing the start/stop switch

Beeper Codes

CODE	SIGNAL
2	Continuously beeps.
5	A 2 seconds beep every 1 minute intervals.
15	Off

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.

529 035 981

NOTE: The MPEM programmer does not work on RFI models with the VDO-Siemens ECM.

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**.

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

Locate communication connector in bilge.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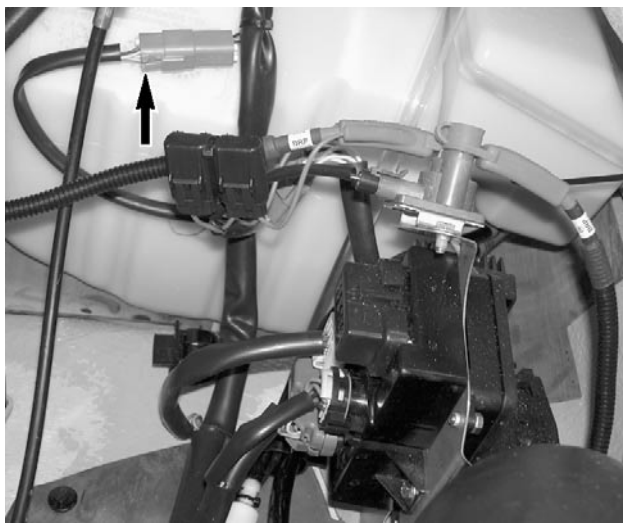
3D MODELS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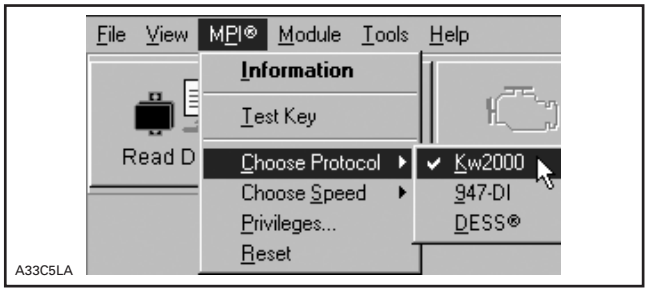
GTI RFI MODELS

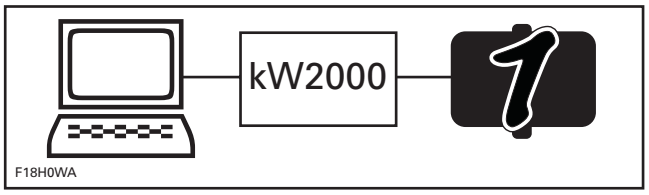
Unplug communication connector and plug VCK connector.

Connect the safety lanyard to the DESS post to activate the communication.

Ensure that the protocol "kW2000" is properly selected.



Ensure the status bar shows the kW2000 and the number 1 to the right. So that B.U.D.S. communicate with the ECM, number 1 must be displayed.



If an "X" is shown instead of a 1, this means that no communication between MPI and ECM takes place. Possible causes are:

– ECM is not powered-up
– wrong protocol is used
– bad connection between MPI and module.

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 ADJUSTMENT, INSPECTION AND REPLACEMENT

SERVICE TOOLS

Description	Part Number	Page
ECM adapter	420 277 010	127
Fluke 111	529 035 868	126
VCK (Vehicle Communication Kit)	295 035 981	131

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.

– Always disconnect battery properly prior to working on the fuel system.

⚠ 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. 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 work on the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

When a repair is completed, ensure that hose from fuel rail going to fuel pump is properly secured in his support. Then, pressurize the fuel system 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. 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.

CAUTION: Never use injector cleaning products. They may contain additive that could damage injector components. A copper wire brush may be used to clean the tip of the direct injectors if necessary.

Engine problems are not necessarily related to the electronic fuel injection system.

It is important to check that the electrical system is functioning properly:

– battery
– fuses
– DESS
– ignition (spark)
– ground connections
– wiring connectors.

If all of the above mentioned items are functioning correctly, the following verifications can be performed to detect any faulty components.

NOTE: Troubleshooting should be performed using the VCK. After a problem has been solved, ensure to clear the fault(s). Refer to DIAGNOSTIC PROCEDURES.

It is possible that a component seems to operate in static condition but in fact, it is defective. In this case, the best way to solve this problem is to remove the original part and replace it with one which is in good condition.

Never use a battery charger to replace temporarily the battery, as it may cause the ECM or VCM 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

Some components are permanently connected to the battery positive terminal, even when the safety lanyard is removed. Always disconnect the battery prior to disconnecting any electric or electronic parts.

To perform verifications, a good quality multimeter such as Fluke 111 (P/N 529 035 868) should be used.

529 035 868

Pay particular attention to ensure that pins 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 housings are properly fastened.

Before replacing a ECM, always check electrical connections. Make sure that they are very tight and they make good contact and that they are corrosion- free. A "defective module" could possibly be repaired simply by unplugging and replugging the ECM. The voltage and current might be too weak to go through dirty wire pins. Check carefully if posts show signs of moisture, corrosion or if they look dull. Clean pins properly and then coat them with silicon-based dielectric grease or other appropriate lubricant (except if otherwise specified) when reassembling them. If the newly replaced ECM is working, try the old one and recheck if it works.

Ignition Components

NOTE: Ensure that all electronic components are genuine – particularly in the ignition system. Installing resistive caps, non-resistive spark plug cables (or modified length) or non-resistive spark plugs may lead to generate fault codes or bad operation.

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (68°F). The resistance 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 (68°F). Use this table for resistance variation relative to temperature for temperature sensors.

TEMPERATURE		RESISTANCE (OHMS)		
°C	°F	NOMINAL	LOW	HIGH
- 30	- 22	12600	11800	13400
- 20	- 4	11400	11000	11800
- 10	14	9500	8000	11000
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

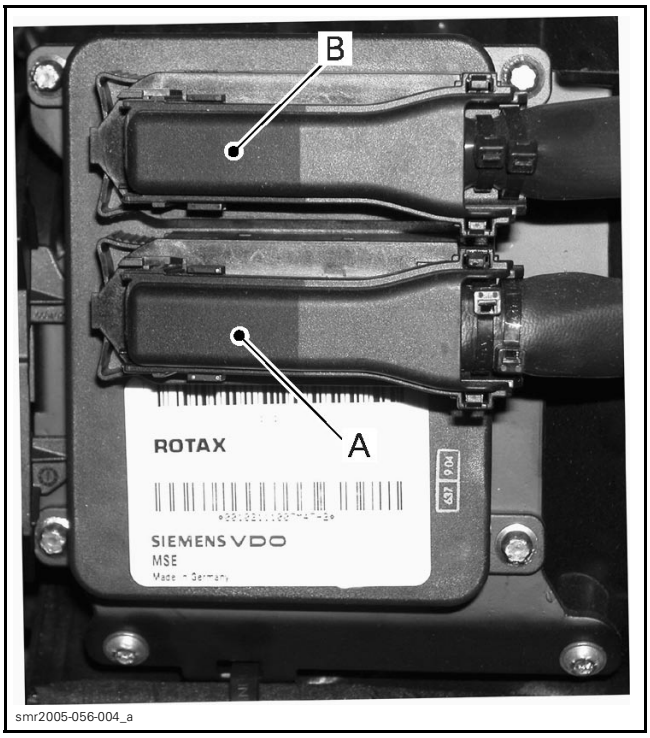
CONVERSION CHART FOR TEMPERATURE SENSORS

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.

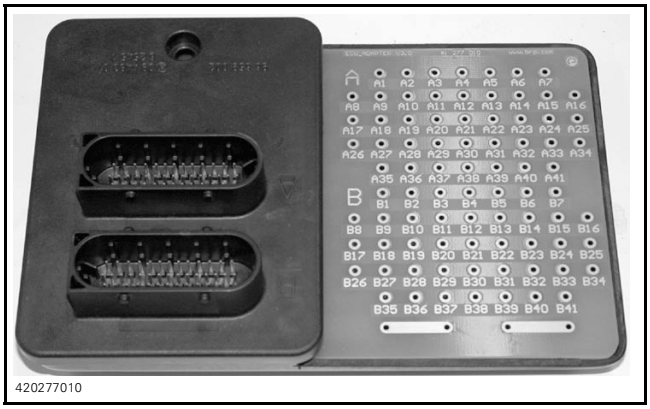
When working with injectors, the resistance value might test good while the complete current would not flow through the wire when pulsating current is supplied to the injector in its normal operation. A solution would be to use a jumper wire to directly supply the injector from the VCM. If it now works, replace the defective wire. A Noid light (available from after-market tool/equipment suppliers) may also be used to validate the injector operation.

ECM Connectors



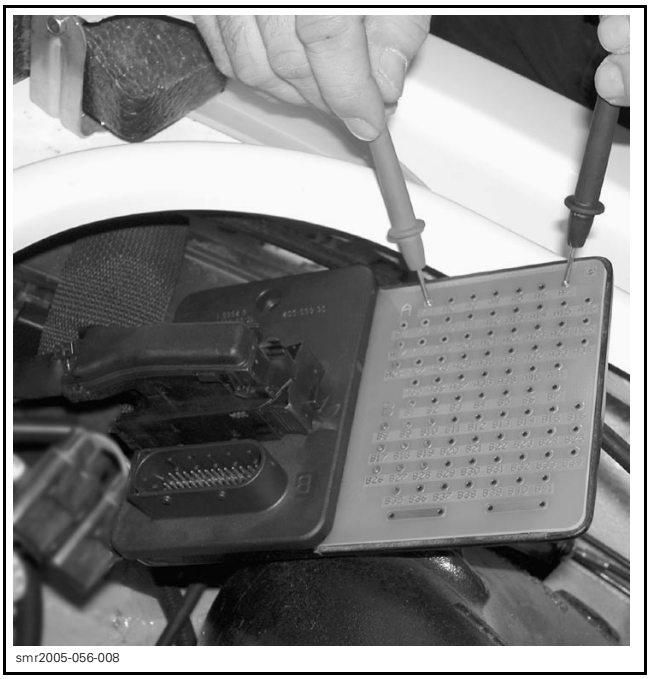
ECM CONNECTORS IDENTIFICATION

The most recommended and safest method to probe ECM connector terminals is to use the ECM adapter (P/N 420 277 010).

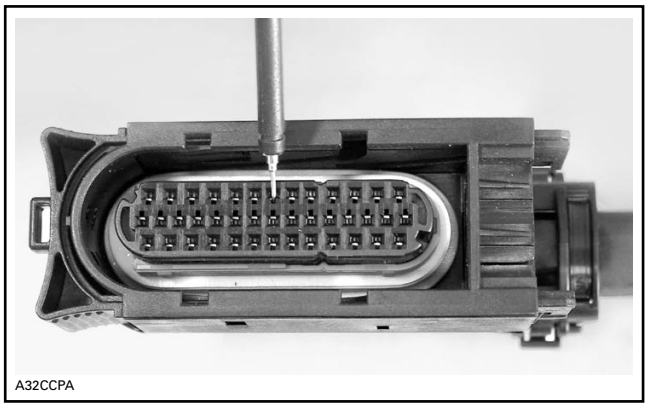


This tool will prevent deforming or enlarging terminals which would lead to bad ECM terminal contact creating intermittent or permanent problems.

Disconnect the desired 1connector from ECM and reconnect on the tool connector. Probe required terminals directly in the tool holes.

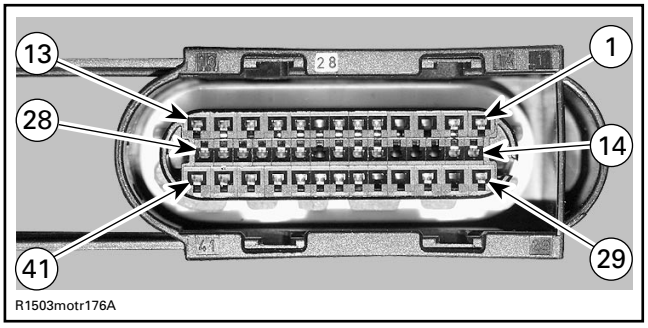

smr2005-056-008

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.


A32CCPA

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.



R1503motr176A

TERMINAL IDENTIFICATION OF ECM CONNECTOR A (WIRING HARNESS SIDE)

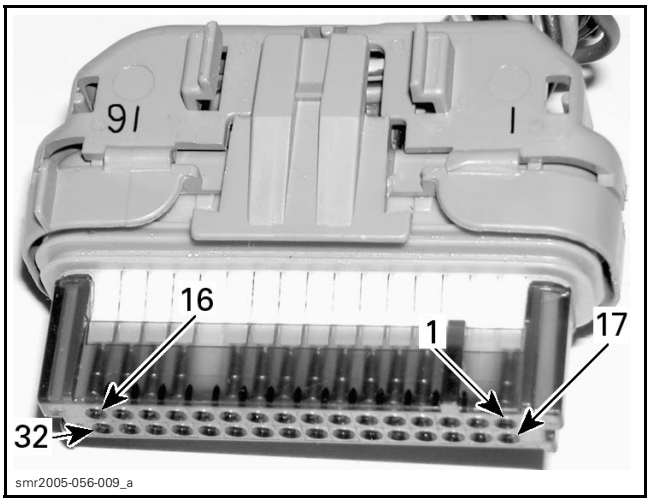
CAUTION: Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected repeatedly.

NOTE: For more details on ECM connectors servicing, refer to ELECTRICAL CONNECTORS AND WIRING DIAGRAMS section.

VCM Connectors

32-Pin Connector

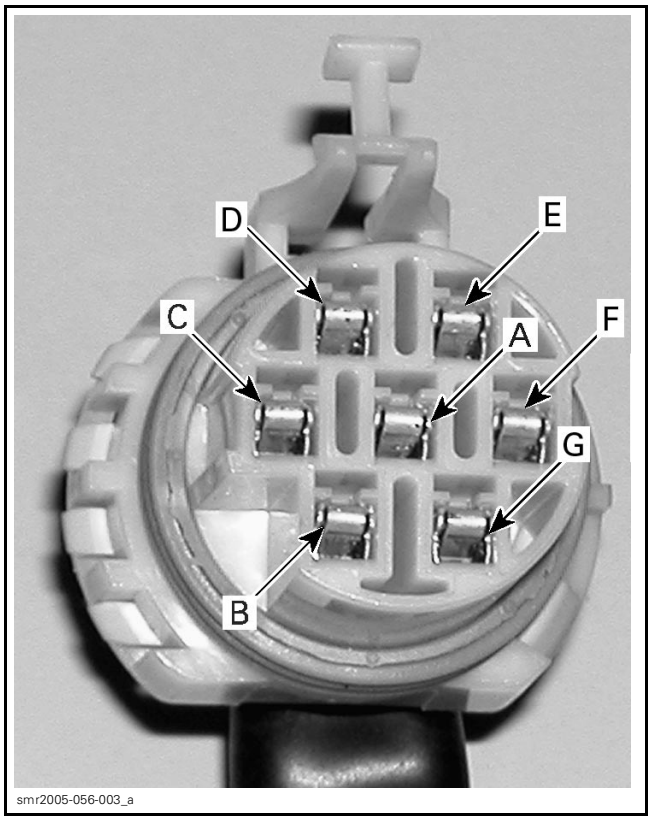
The connector terminals are identified as follows: Starting from the right on the top row, terminals 1 to 16. On the bottom row, terminals 17 to 32.



smr2005-056-009_a

7-Pin Connector no. 6 and 7

The terminals of this connector are identified by letters.



NOTE: For more details on VCM connectors servicing, refer to ELECTRICAL CONNECTORS AND WIRING DIAGRAMS section.

ADJUSTMENT

IDLE SPEED

Idle speed is controlled by the ECM. There is no mechanical adjustment to perform.

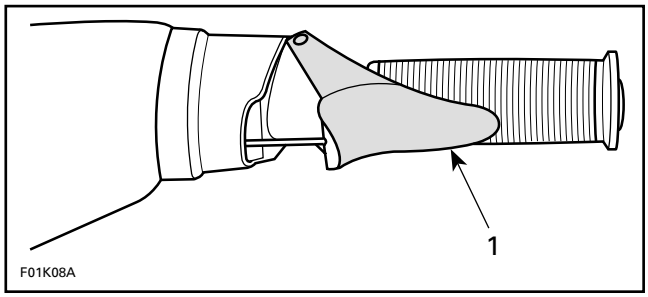
CAUTION: The throttle stopper screw is tamper proof. Breaking the seal and changing the adjustment will lead to poor engine operation and possible engine damaged. If this occurs, the throttle body must be replaced, as it is factory calibrated.

NOTE: Idle speed in water is 1550 ± 100 RPM.

THROTTLE CABLE

GTI RFI Series

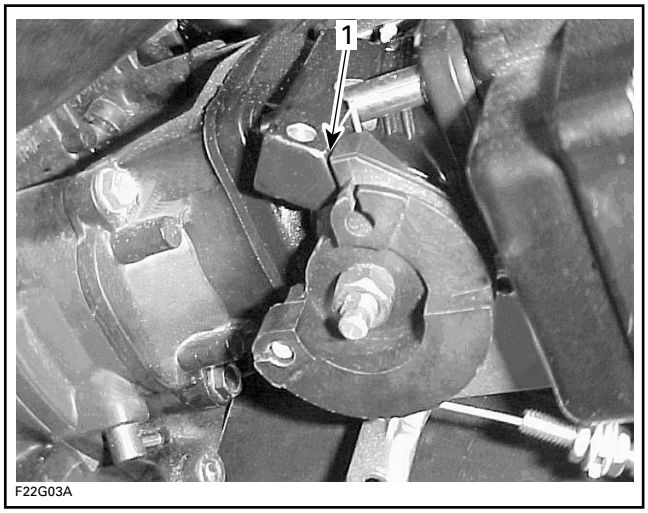
Fully depress throttle lever. Lever must touch handlebar grip without causing strain to cable or brackets.



1. Must touch handlebar grip

Ensure throttle plate is fully open.

Fully depress throttle lever and hold. Throttle lever stopper should almost contact throttle body. To ensure there is free play, apply a light pressure on the throttle plate, a slight play should be obtained.



1. Free play here

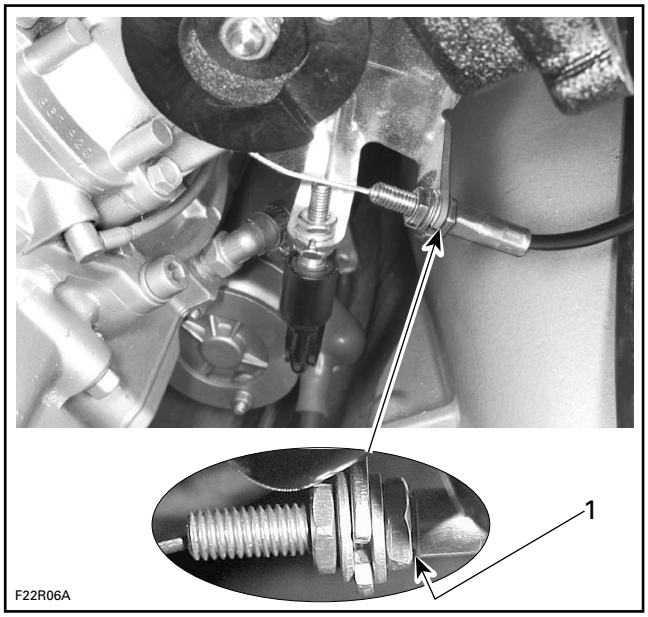
CAUTION: If there is no free-play at idle position, it may cause poor idling and startability. Improper cable adjustment will cause strain on cable and/or damage cable bracket or throttle lever at handlebar. Fault code(s) may be generated.

Ensure to reset the Closed TPS. See below.

3D RFI Series

NOTE: For throttle cable replacement, refer to STEERING SYSTEM.

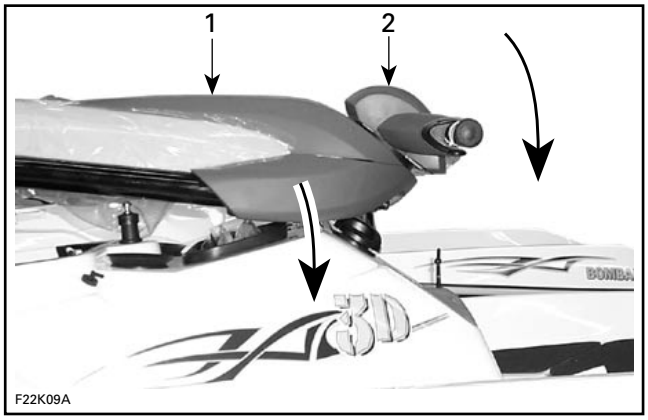
Right throttle cable adjustment is to be done at the adjuster on top of steering pole. However, first ensure adjuster at throttle body is fully screwed in.



1. Adjuster fully screwed in

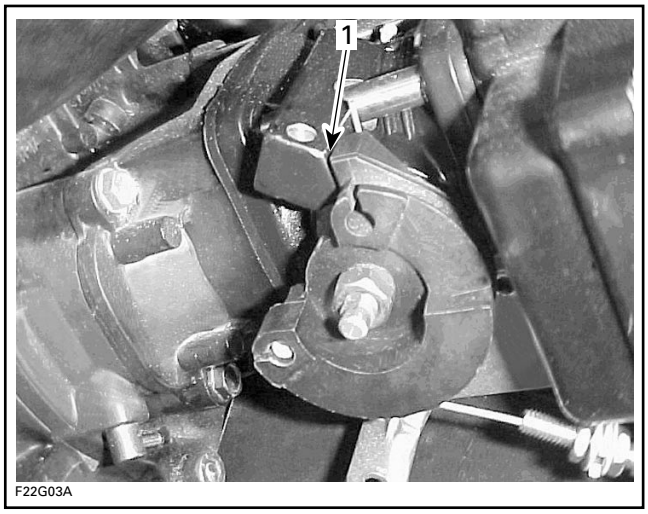
Otherwise, set it. Whenever adjuster is set at the throttle body, the throttle cable must be adjusted at the OTAS solenoid. Refer to STEERING SYSTEM for the procedure.

Position steering pole and handlebar to their lowest position. Place handlebar in the straight ahead position.



1. Steering pole at its lowest position
2. Handlebar at its lowest position and in straight ahead position

Fully depress throttle lever and hold. Throttle lever stopper should almost contact throttle body. To ensure there is free play, apply a light pressure on the throttle plate, a slight play should be obtained.



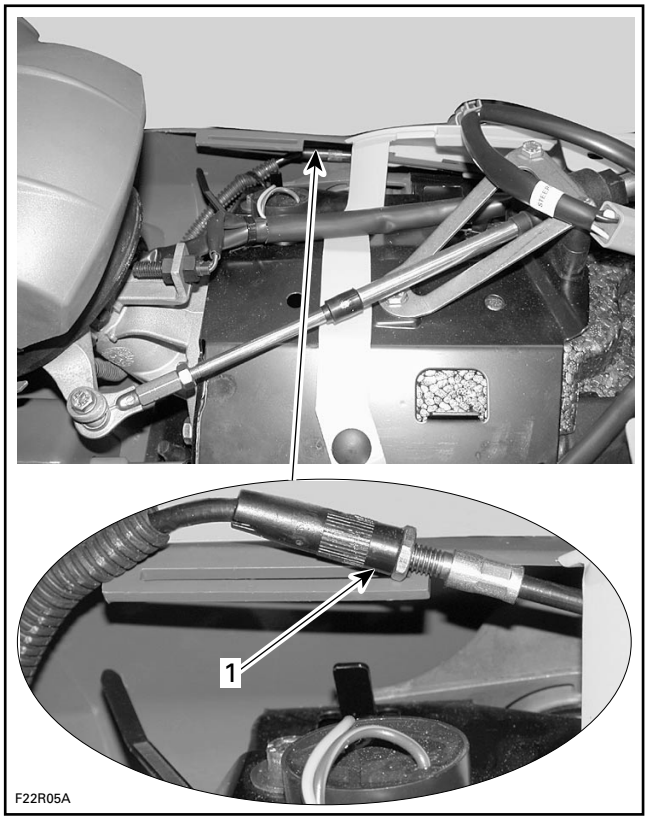
1. Free play here

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. Fault code(s) may be generated.

When released, throttle lever must have a free play of 1 - 7 mm (1/32 - 9/32 in).

To adjust cable, remove top cover of steering pole. Refer to STEERING SYSTEM.

Set cable with the adjuster.



1. Cable adjuster

NOTE: When throttle cable is adjusted from this adjuster, there is no need to readjust throttle cable at the OTAS solenoid.

Reinstall removed parts.

Ensure to reset the Closed TPS. See below.

Ensure the OTAS system works adequately. Refer to STEERING SYSTEM.

NOTE: It is not necessary to adjust the oil injection pump cable after throttle cable adjustment. It is not changed when throttle cable is adjusted.

THROTTLE POSITION SENSOR (TPS)

Closed TPS (Reset)

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

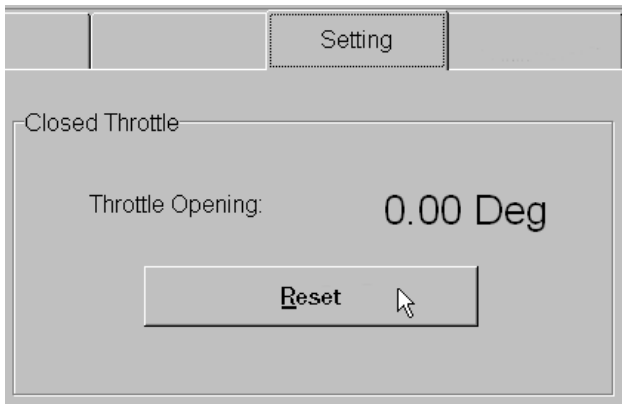
To perform the resetting, proceed as follows:

Use the VCK (Vehicle Communication Kit) (P/N 295 035 981) with B.U.D.S. software.

529 035 981

Click Reset button to reset the TPS value to provide the zero scale value to ECM.

NOTE: 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).

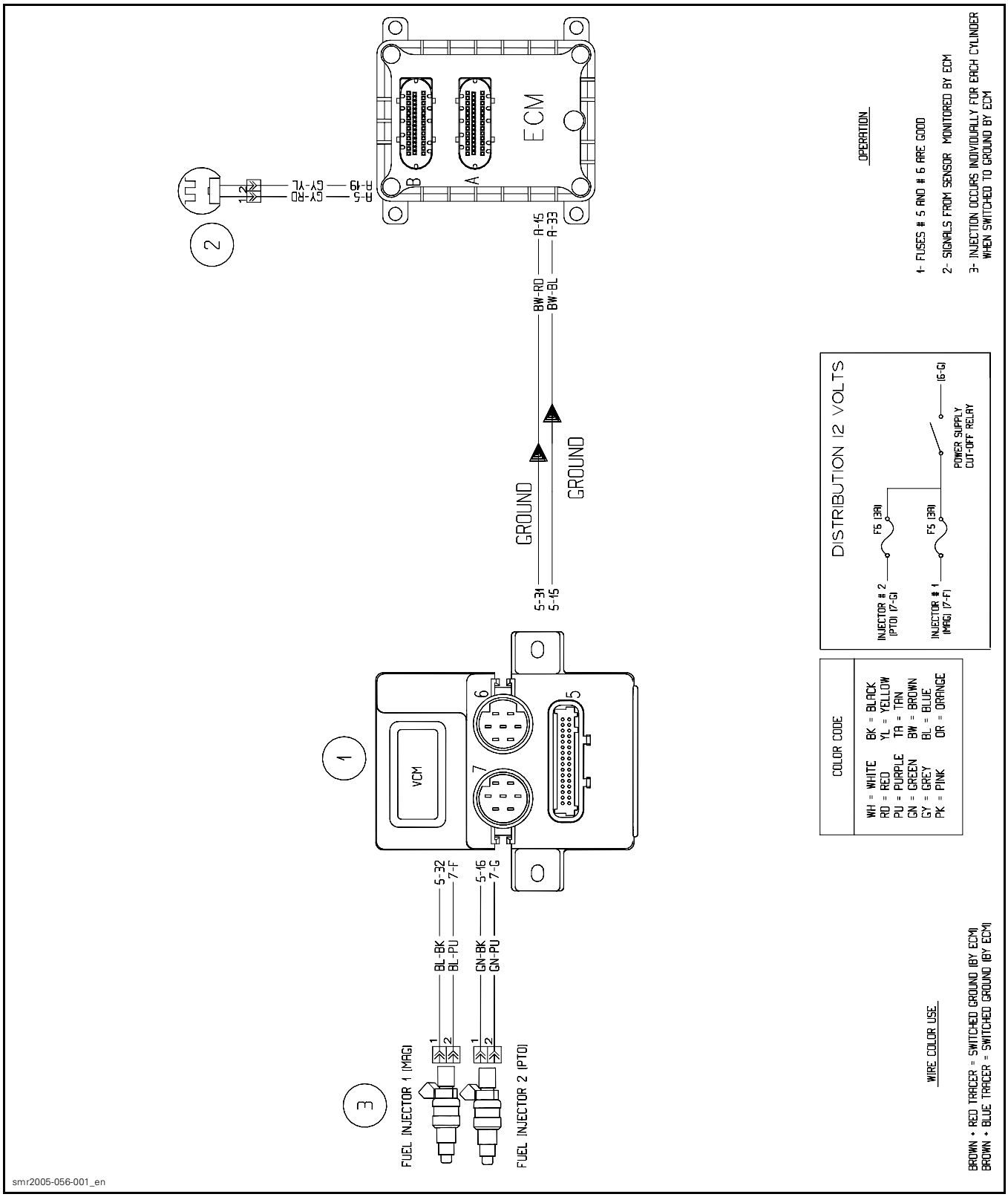


TESTING PROCEDURES

FUEL PUMP

Refer to FUEL SYSTEM.

FUEL INJECTOR



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.

You should hear the injector working.

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.

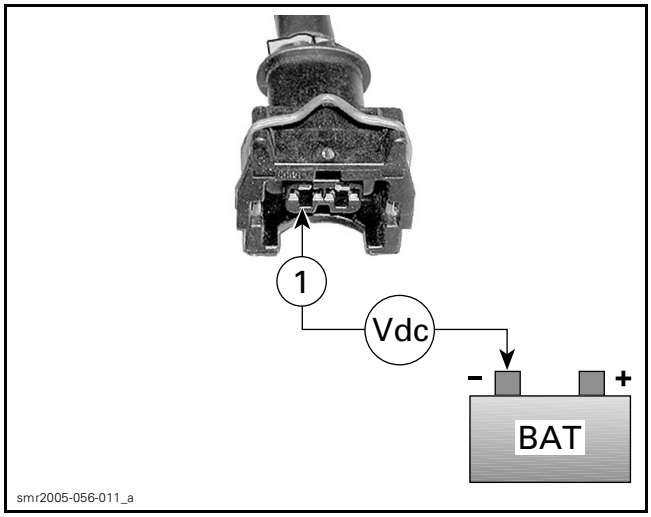
CAUTION: While doing fuel injector electrical test, do not apply continuous voltage to the connector for more than 10 seconds. This can damage the injector.

This will validate the injector mechanical and electrical operation.

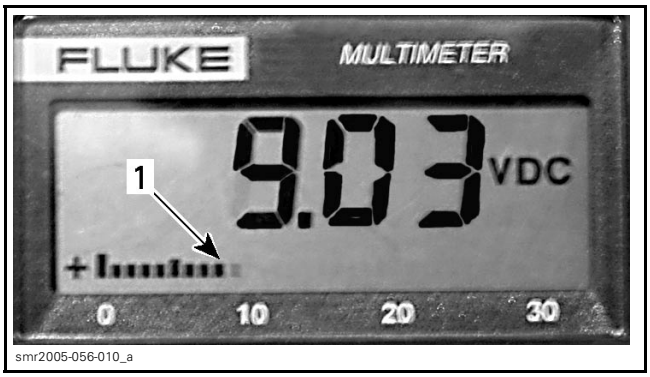
If it does not work, replace it. If it works, continue procedure.

Using B.U.D.S., activate injector while probing terminal as shown.

INJECTOR CONNECTOR	MEASUREMENT
Pin 1 and battery ground	Pulsating voltage approx 9 Vdc



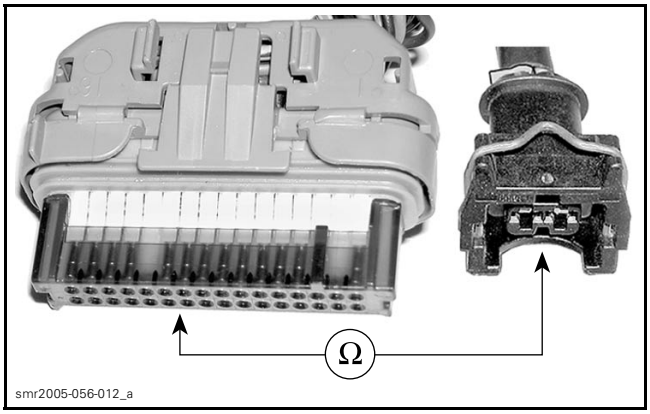
NOTE: Because B.U.D.S. sends pulsating voltage to the injector, you will not read full 12 V. Short readings of approximately 9 V indicate a working injector. Since the analog display of the multimeter is faster than the numeric display, watching the analog scale movement is better to see voltage bursts.



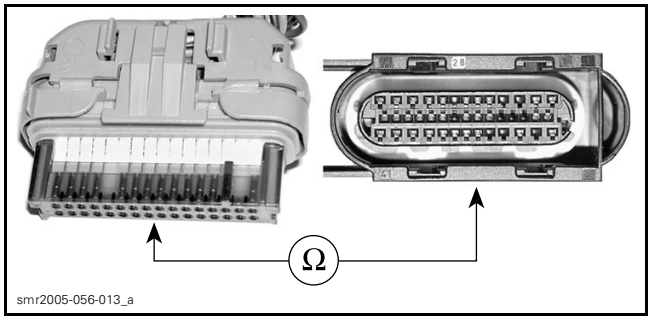
1. Analog scale

– If proper voltage is read, check continuity of ground and power circuits as follows.

VCM CONNECTOR	INJECTOR
PIN	
5-32	1 (MAG), pin 2
5-16	2 (PTO), pin 2



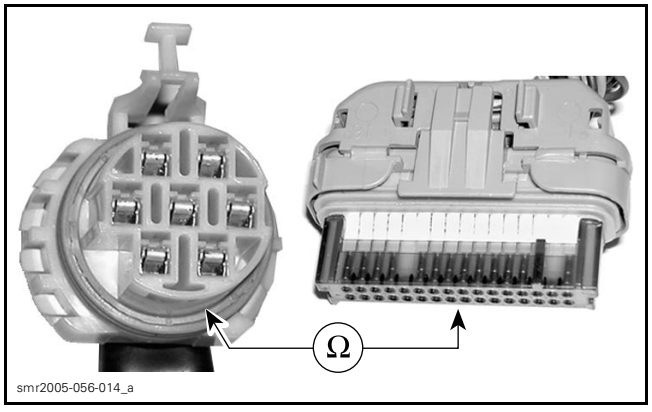
VCM CONNECTOR	ECM CONNECTOR	INJECTOR
PIN	PIN	
5-31	A-15	1 (MAG)
5-15	A-33	2 (PTO)



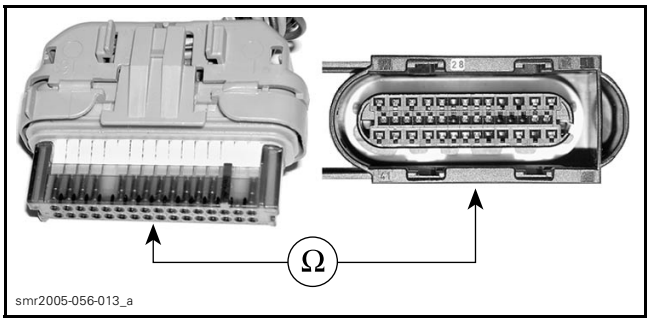
– Repair wire/connector if defective. If wires test good and there was a fault code, try a new ECM. If wires test good and there was no fault code, try a new VCM.

– If it does not read proper voltage, check continuity of injector supply and signal circuits as per following table.

VCM CONNECTOR	INJECTOR
PIN	
7-F	1 (MAG), pin 1
7-G	2 (PTO), pin 1



VCM CONNECTOR	ECM CONNECTOR	INJECTOR
PIN	PIN	
5-31	A-15	1 (MAG)
5-15	A-33	2 (PTO)



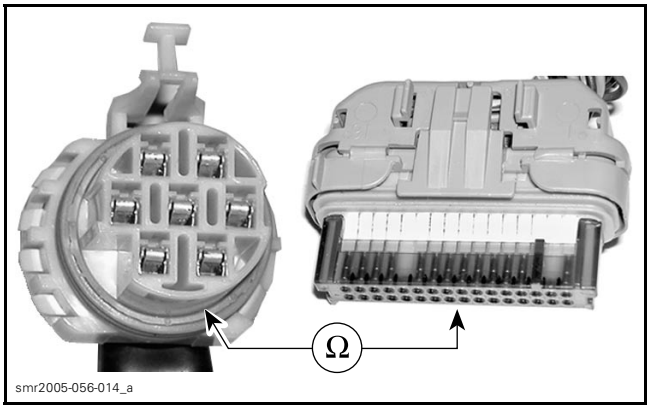
– Repair wire/connector if defective. If wires test good and there was a fault code, try a new ECM. If wires test good and there was no fault code, try a new VCM.

Resistance Test

Ensure injector is connected and safety lanyard is removed from DESS post. Disconnect the VCM connectors 5 and 7.

Using a multimeter, check resistance value between terminals as follows.

COMPONENT	VCM CONNECTOR		RESISTANCE Ω @ 20°C (68°F)
	PIN		
Fuel injector cylinder 1 (MAG)	5-32	7-F	2.3 - 2.5
Fuel injector cylinder 2 (PTO)	5-16	7-G	



If resistance value is incorrect, check/repair wiring harness/connectors. Repair/replace as necessary.

Recheck resistance value. If still not within specifications, replace fuel injector.

Leakage Test

To perform a leakage test, the injectors and fuel rail have to be removed from engine. See REMOVAL in this subsection for the procedure.

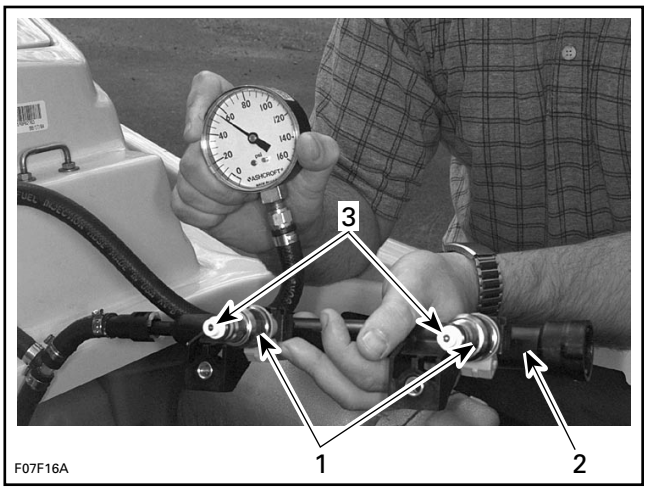
NOTE: Do not detach injectors from fuel rail.

Reconnect the wire connector of the injector.

Place each injector in a clean bowl.

Install the safety lanyard cap on the switch to activate the fuel pump.

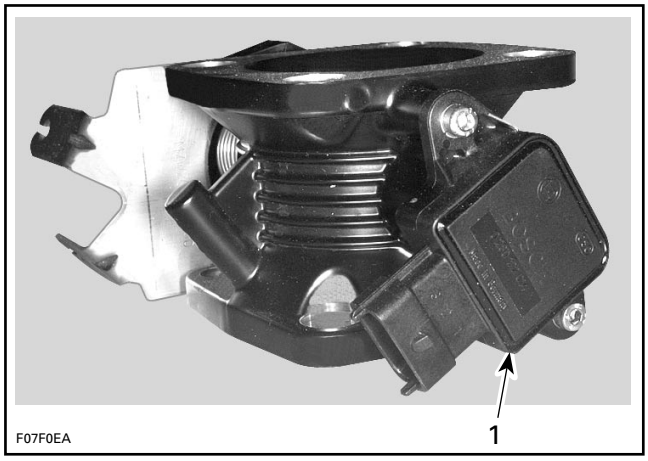
Check for fuel leakage from the injector nozzle. There should be less than 1 drop of fuel per minute.



1. *Fuel injectors*
2. *Fuel rail*
3. *Injector nozzles*

If not within specification, replace the fuel injector(s).

THROTTLE POSITION SENSOR (TPS)



1. *TPS*

IMPORTANT: Prior to testing the TPS, ensure that mechanical components/adjustments of throttle body are adequate.

The EMS may generate several fault codes pertaining to the TPS. Refer to 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.

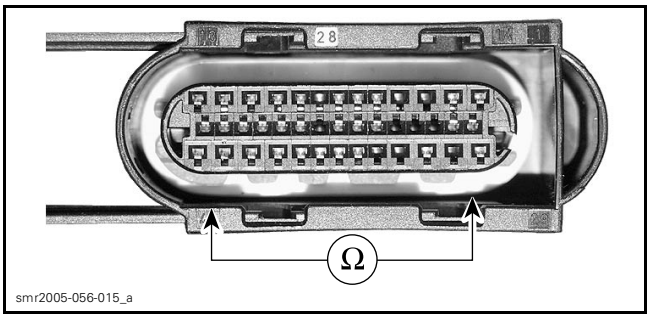
Resistance Test

Ensure TPS is connected to wiring harness.

Disconnect the A connector from the ECM.

Using a multimeter, check resistance values on ECM connector as per the following table.

ECM CONNECTOR		THROTTLE IDLE POSITION	WIDE OPEN THROTTLE POSITION
PIN		RESISTANCE Ω @ 20°C (68°F)	
A-24	A-25	2600 - 2700	710 - 1300
A-25	A-39	1600 - 2400	1600 - 2400
A-24	A-39	710 - 1300	2600 - 2700



NOTE: The resistance value should change proportionally to throttle movement. Otherwise, replace TPS.

If resistance values are correct, perform the VOLTAGE TEST below.

If resistance values are incorrect, check wiring harness. If wiring is faulty, repair/replace. If wiring is good, replace TPS.

Voltage Test

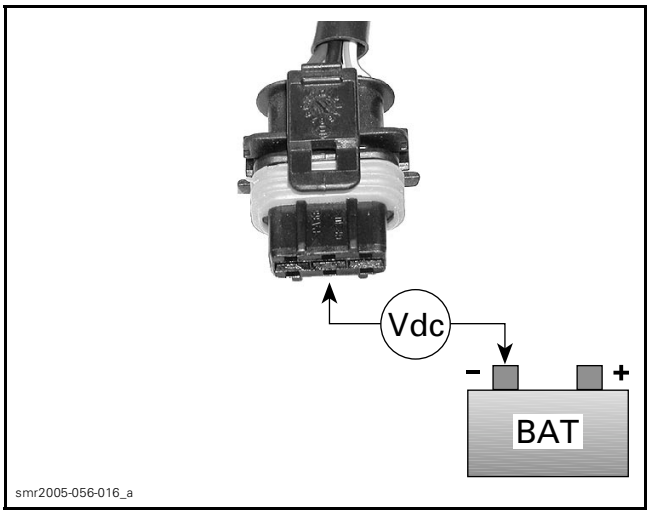
Check the ECM voltage output to the TPS.

Disconnect connector from TPS.

Remove and reinstall the safety lanyard to activate the ECM.

Check the voltage readings from harness connector as follows.

TPS CONNECTOR	VOLTAGE
Pin 1 with battery ground	0 V
Pin 2 with battery ground	5 V
Pin 3 with battery ground	4.5 - 5 V



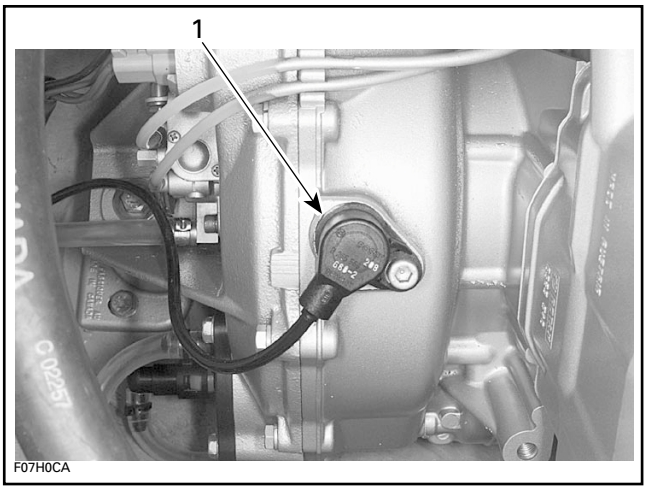
If voltage test is not good, try a new ECM.

If voltage test is good, everything is in order.

THROTTLE BODY

Check that the throttle plate moves freely and smoothly when depressing throttle lever. Verify if throttle body is free of corrosion.

CRANKSHAFT POSITION SENSOR (CPS)



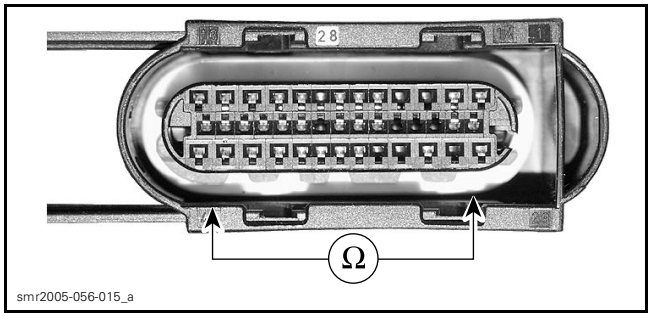
1. Crankshaft position sensor (CPS)

Resistance Test

Disconnect the A connector from the ECM.

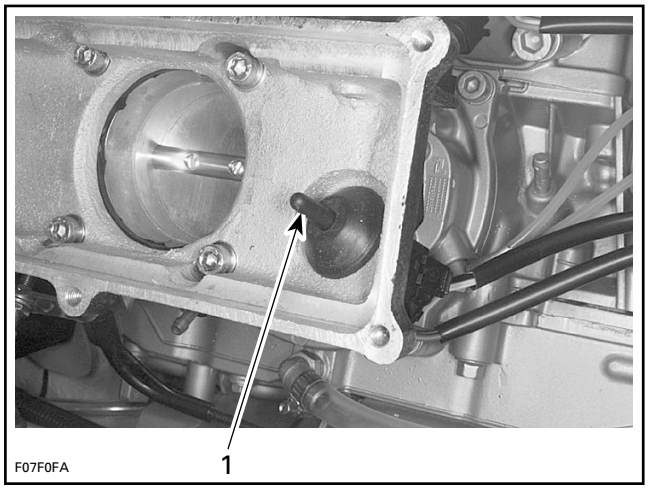
Using a multimeter, check the resistance on the ECM connector as per table.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-5	A-19	774 - 946



If not within specification, check wiring harness. If wiring is faulty, repair/replace. If wiring is good, measure resistance of sensor itself. If sensor is faulty, replace it. If sensor is good, try a new ECM.

AIR TEMPERATURE SENSOR (ATS)



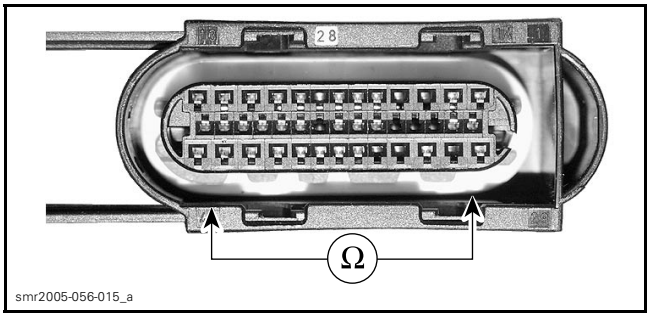
1. Air temperature sensor (ATS)

Resistance Test

Disconnect the A connector from ECM.

Using a multimeter, check the resistance on the ECM connector as per table.

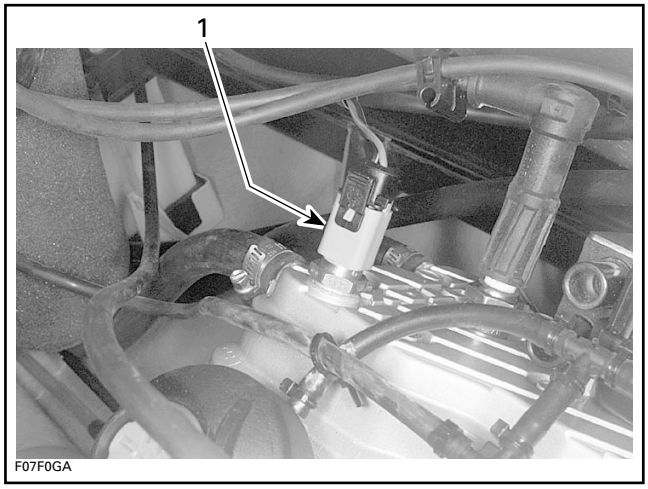
ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-7	A-21	2280 - 2736



If not within specification, check wiring harness. If wiring is faulty, repair/replace. If wiring is good, measure resistance of sensor itself. If sensor is faulty, replace it. If sensor is good, try a new ECM.

WATER TEMPERATURE SENSOR (WTS)

Resistance Test

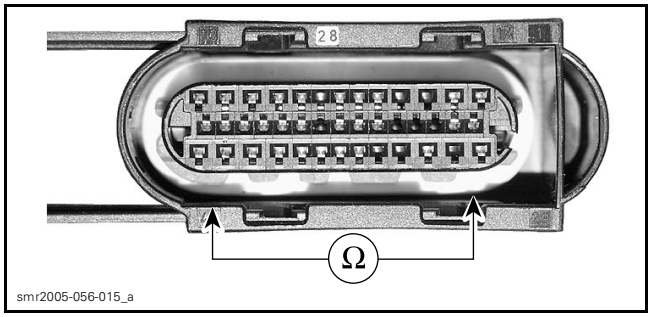


1. Water temperature sensor (WTS)

Disconnect the A connector from the ECM.

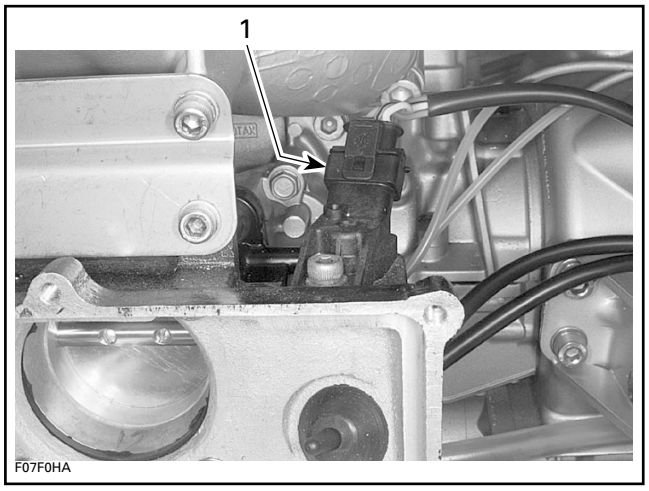
Using a multimeter, check the resistance on the ECM connector as per table.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-11	A-27	2280 - 2736



If not within specification, check wiring harness. If wiring is faulty, repair/replace. If wiring is good, measure resistance of sensor itself. If sensor is faulty, replace it. If sensor is good, try a new ECM.

AIR PRESSURE SENSOR (APS)



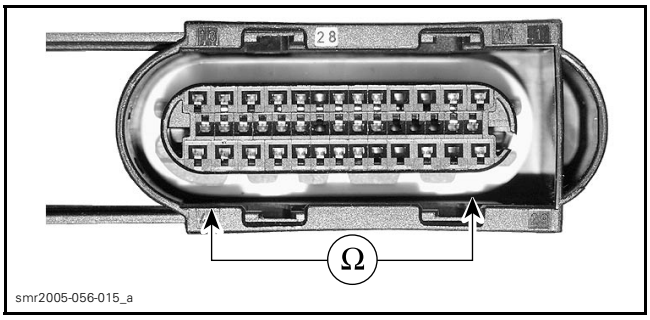
1. Air pressure sensor (APS)

Resistance Test

Disconnect the A connector from the ECM.

Using a multimeter, check the resistance on the ECM connector as per table.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-3	A-4	3400 - 8200
A-4	A-18	2400 - 8200



If not within specification, check wiring harness. If wiring is faulty, repair/replace. If wiring is good, measure resistance of sensor itself. If sensor is faulty, replace it. If sensor is good, perform the VOLTAGE TEST below.

Voltage Test

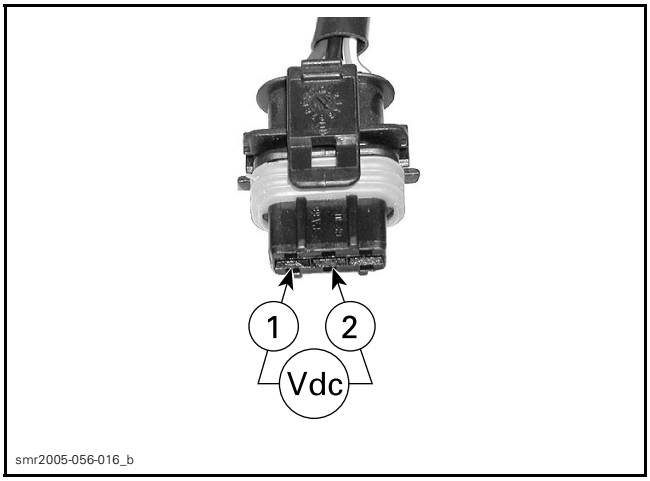
Check ECM voltage output to APS.

Disconnect connector from APS.

Remove and reinstall the safety lanyard to activate the ECM.

Check the voltage readings from harness connector as follows.

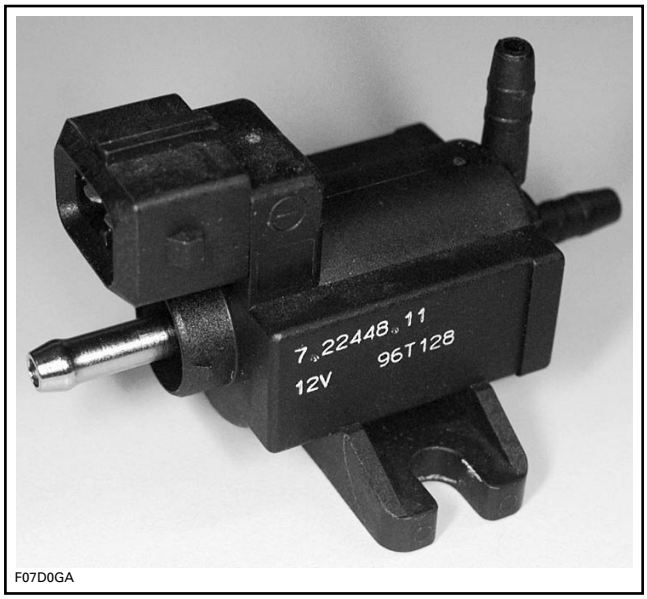
APS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
1	2	5 Vdc



If voltage test is not good, try a new ECM.

If voltage test is good, everything is in order.

RAVE SOLENOID



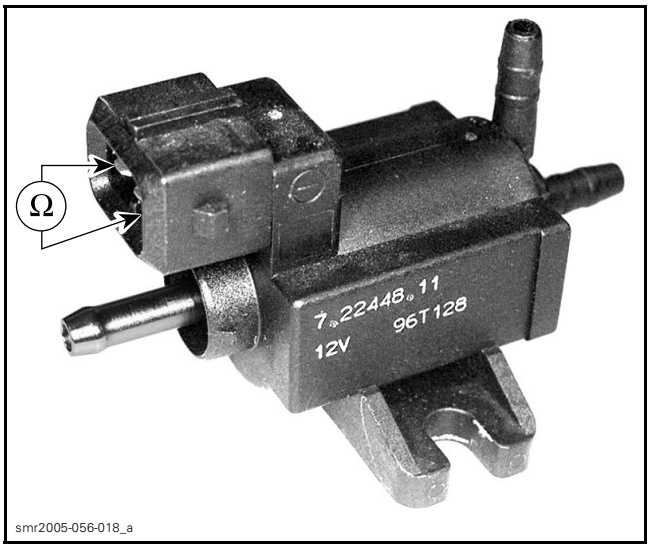
RAVE SOLENOID

Resistance Test

Disconnect the connector from RAVE solenoid.

Using a multimeter, check the resistance on the RAVE solenoid connector as per table.

RAVE SOLENOID CONNECTOR		MEASUREMENT
PIN	PIN	RESISTANCE Ω @ 20°C (68°F)
1	2	30



If resistance is incorrect, replace RAVE solenoid.

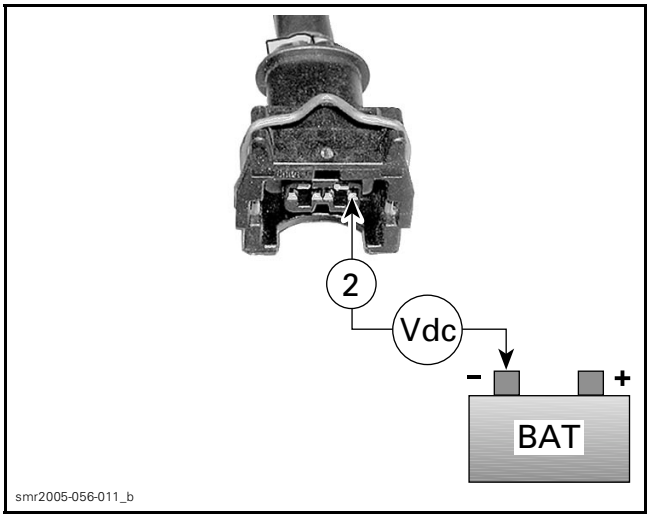
If resistance is correct, proceed with the VOLTAGE TEST below.

Voltage Test

Safety lanyard must be on DESS post.

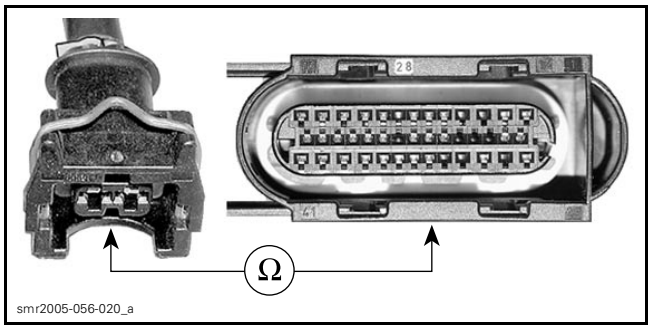
Disconnect RAVE solenoid connector.

Probe terminal as shown.



– If 12 V is read, check continuity of ground circuit going to ECM connector as per following table.

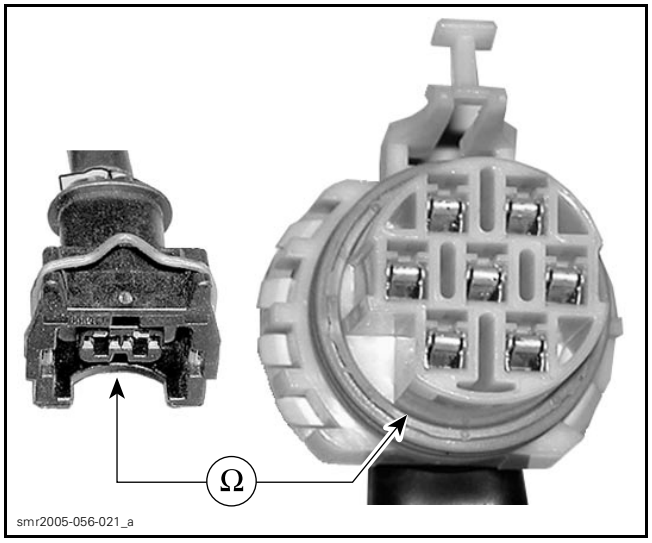
RAVE SOLENOID CONNECTOR	ECM CONNECTOR
1	B-15



– Repair wire/connector if defective. If wires test good, try a new ECM.

– If it does not read 12 V, check continuity of RAVE solenoid supply circuit from VCM as per following table.

RAVE SOLENOID CONNECTOR	VCM ROUND CONNECTOR
2	7-D



– Repair wire/connector if defective. If wires test good, try a new VCM.

PARTS REPLACEMENT

ECM AND VCM

General

Prior to replacing a suspected ECM or VCM, ensure that all the recommendations in GENERAL at the beginning of this section have been followed.

IMPORTANT: When the ECM is replaced, the **Closed TPS** and **ignition timing** must be reset. Refer to ADJUSTMENT in this section for the TPS and to IGNITION SYSTEM section for the ignition timing.

NOTE: If Closed TPS reset or ignition timing setting are not performed, the engine will run with reduced performance. No fault code will be generated.

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

NOTE: If the old ECM 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. Otherwise, perform the operations described in IF THE PREVIOUS ECM WAS NOT READ with B.U.D.S. below.

ECM Replacement

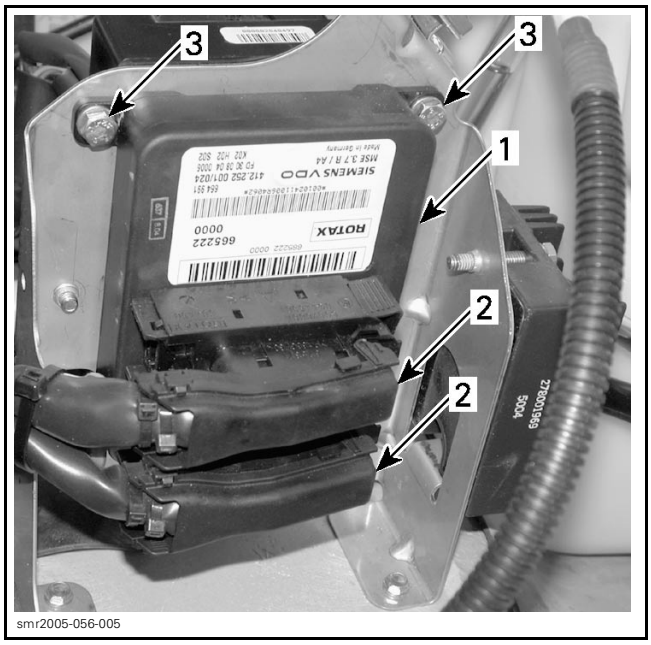
Disconnect battery cables.

⚠ WARNING

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

Disconnect both ECM connectors.

Unscrew retaining screws and remove the ECM from its bracket.



smr2005-056-005

TYPICAL
1. *ECM*
2. *ECM connectors*
3. *Retaining screws*

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

Install the new ECM to its bracket.

Reconnect ECM connectors 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.

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.

Finalizing ECM Replacement

Perform the required resets then, clear all faults from the newly replaced ECM.

Start the engine and increase engine speed above 5000 RPM to be sure no fault appears.

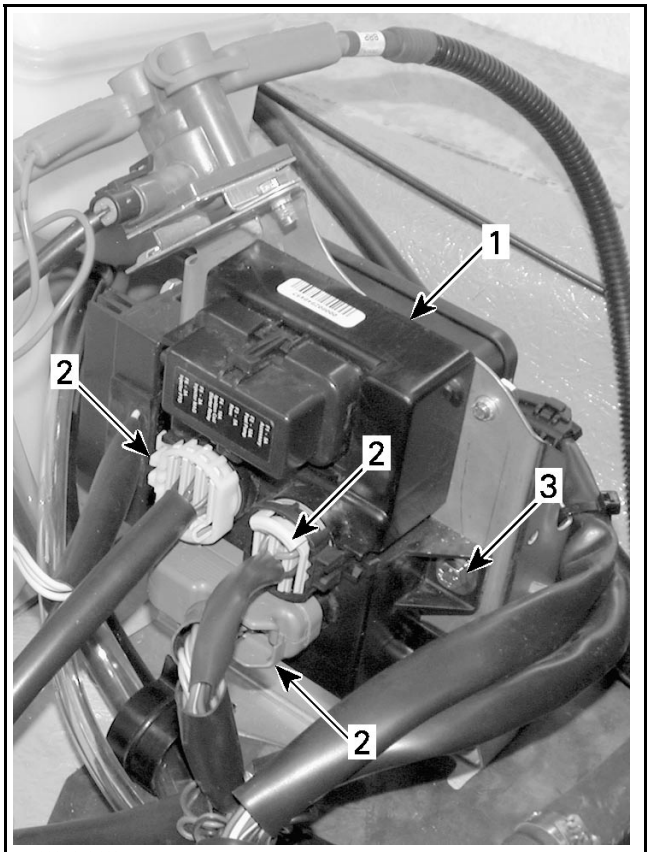
VCM Replacement

Disconnect battery cables.

⚠ WARNING

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

Disconnect connectors from VCM. Remove retaining nuts on top.



smr2005-056-006

TYPICAL
1. *VCM*
2. *VCM connectors*
3. *Retaining screws*

Pull VCM out.

Install the new VCM on its bracket. Reconnect connectors to VCM.

THROTTLE POSITION SENSOR (TPS)

Remove the air intake silencer.

Remove the flame arrester.

Remove the air temperature sensor to ease removal of the TPS.

Disconnect the TPS connector.

Loosen 2 Allen screws retaining the TPS.

Remove TPS.

NOTE: Resetting should be done using VCK each time the TPS is loosened, removed or changed. Refer to ADJUSTMENT in this section.

AIR TEMPERATURE SENSOR (ATS)

Remove the air intake silencer.

Remove the flame arrester.

Disconnect the ATS the connector.

Pull the ATS from the grommet retaining it.

AIR PRESSURE SENSOR (APS)

Remove the air intake silencer.

Disconnect the APS connector.

Loosen Allen screw retaining the APS.

Remove the APS.

At installation, apply Loctite 243 (P/N 293 800 060) on screw threads.

WATER TEMPERATURE SENSOR (WTS)

Disconnect the WTS connector.

Loosen the WTS from the cylinder head.

At installation, apply Loctite 518 (P/N 293 800 038) on threads of the WTS.

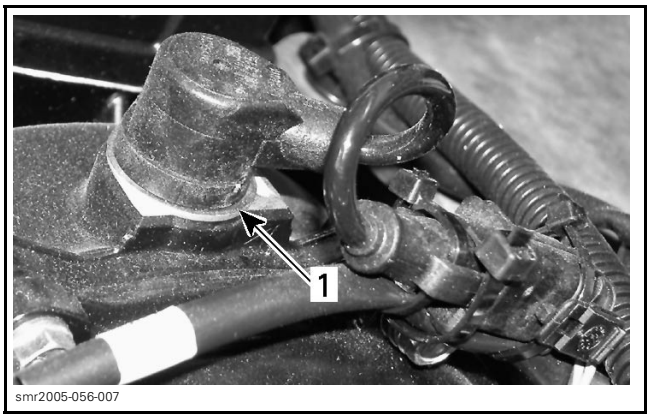
CRANKSHAFT POSITION SENSOR (CPS)

Disconnect the CPS connector.

Loosen Allen screw retaining the CPS.

Remove the CPS.

At installation, ensure to reinstall shim between crankcase and CPS.



1. Shim under CPS

Apply Loctite 243 (P/N 293 800 060) on the Allen screw.

NOTE: Clean threads prior to installing screw.

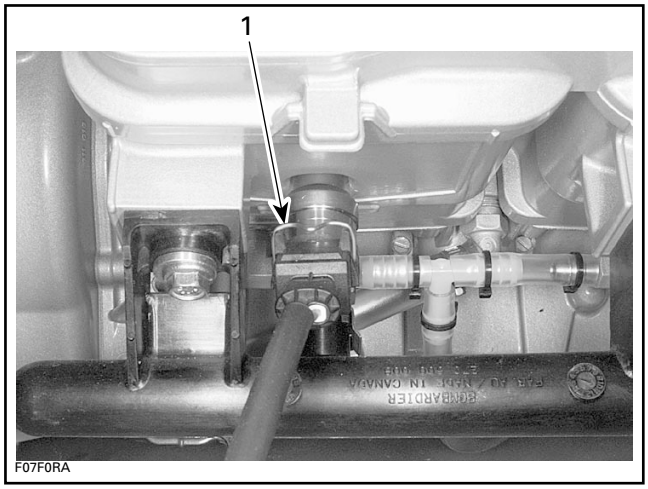
FUEL INJECTORS

Place a suitable container below the quick connect fitting of the fuel rail.

Cover the quick connect fitting of the fuel rail with a shop towel.

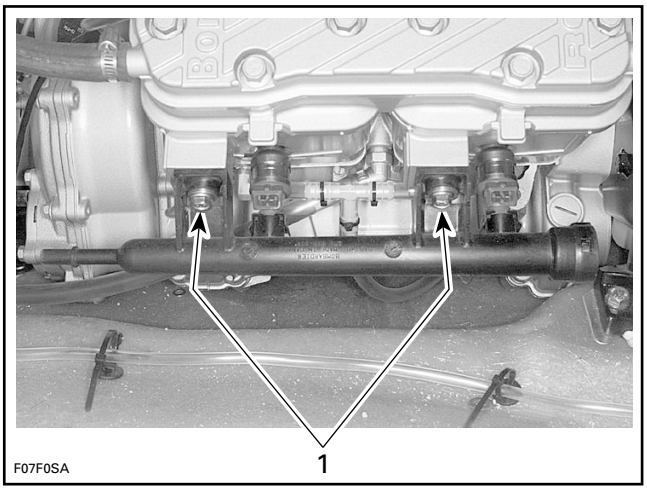
Press on both tabs and disconnect the quick connect fitting.

Disconnect the wire connectors of both fuel injectors.



1. Press retaining clip to unlock the connector

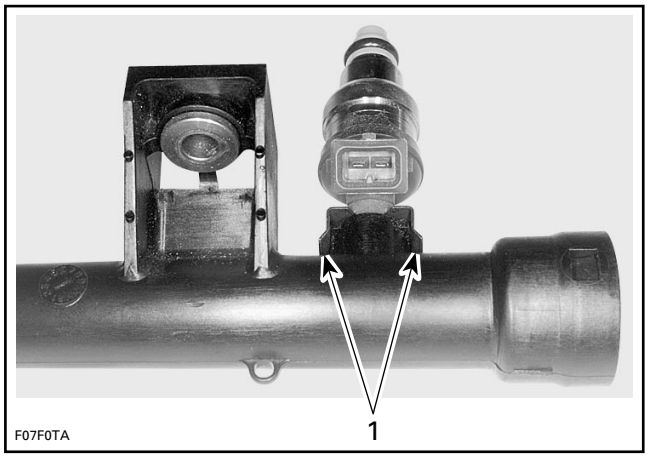
Loosen both screws retaining the fuel rail to the cylinders.



1. Loosen screws retaining the fuel rail

Remove the fuel rail with both fuel injectors.

To remove the fuel injector from the fuel rail, pry off the retaining clip.



1. Pry the clip

– Carefully inspect O-rings condition before re-installing fuel injectors. Replace O-rings with new ones if damaged.

When reinstalling the fuel injector, install the retaining clip to the injector, then insert the injector into the fuel rail.

Apply a thin layer of injection oil to O-rings of fuel injectors to ease fuel rail installation.

– Check injectors to ensure there is no leak.

⚠ WARNING

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

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
4-pin magneto harness adapter	295 000 131	150
787 RFI Timing tool	529 036 017	158
ECM adapter	420 277 010	161
Fluke 111	529 035 868	150
tachometer	529 014 500	147, 151, 157
TDC gauge	295 000 143	146, 156
timing mark pointer tool	295 000 130	146
timing mark pointer tool	295 000 135	155
VCK (Vehicle Communication Kit	295 035 981	159

SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243	293 800 060	149

717 ENGINE

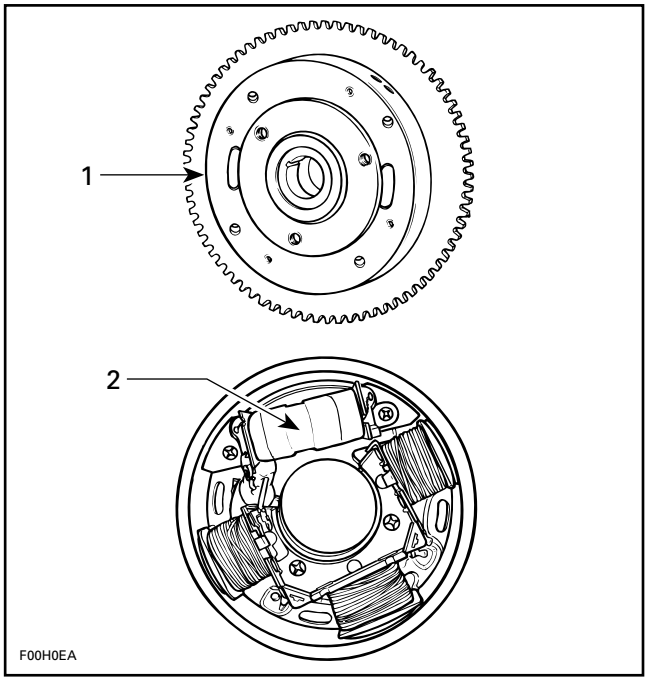
GENERAL

The magneto ignition generator coil, MPEM and the ignition coil work together in this Digital CDI ignition system.

Magneto

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

The flywheel contains 4 permanent magnets and spins around the generating coil.



1. *Flywheel*
2. *Generating coil*

The unregulated AC current from the magneto generator coil supplies the Multi-Purpose Electronic Module (MPEM) for its ignition functions.

Multi-Purpose Electronic Module (MPEM)

The Multi-Purpose Electronic Module (MPEM) is powered with DC current from the battery.

AC current from the magneto is supplied to the MPEM for its ignition functions.

The MPEM is responsible of the following electrical functions related to the ignition system:

– input voltage of ignition coil
– ignition timing curve
– engine rev limiter.

Ignition Coil

Ignition coil induces voltage to a high level in secondary windings to produce a spark at spark plug.

The ignition coil steps up the voltage input from the Multi-Purpose Electronic Module to high voltage current for both spark plugs.

The ignition coil is located in the rear electrical box located under air intake.

ADJUSTMENT

IGNITION TIMING

Before checking ignition timing with a stroboscopic timing light (dynamic test), it is mandatory to scribe a timing mark on the PTO flywheel (static test) corresponding to the specific engine.

Also, the timing mark scribed on the PTO flywheel can be used to troubleshoot a broken magneto woodruff key.

CAUTION: The relation between the PTO flywheel mark and crankshaft position may change as the PTO flywheel might move on crankshaft when engine is ran. This will result in false ignition timing readings. If timing mark does not align with pointer tool when checking the ignition timing with an appropriate timing light (dynamic test), verify timing mark again (static test) to ensure flywheel has not moved.

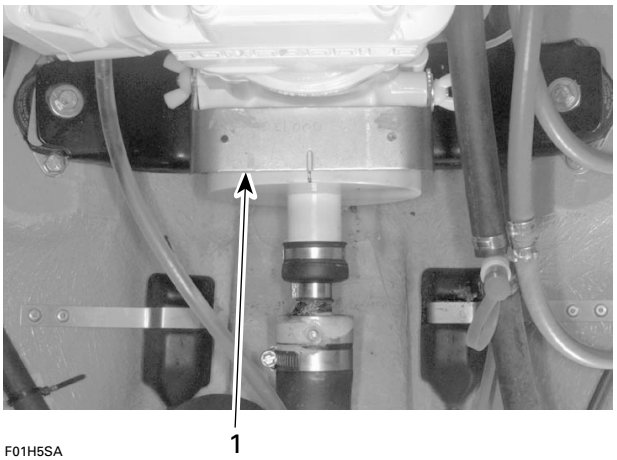
NOTE: Do not use the factory mark found on the PTO flywheel to check ignition timing or troubleshoot any problems.

Scribing a Timing Mark (Static Test)

– Disconnect MAG side spark plug wire and connect wire to grounding device then remove spark plug.

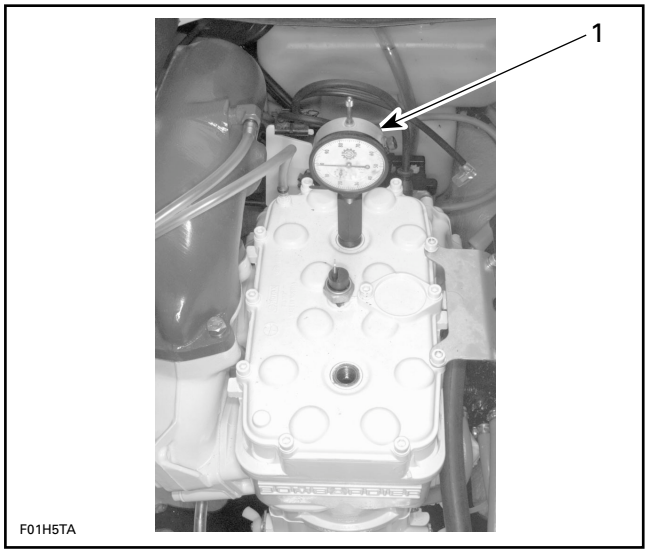
CAUTION: Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.

– Remove PTO flywheel guard.
– Install timing mark pointer tool (P/N 295 000 130) on engine using wing nuts previously removed.



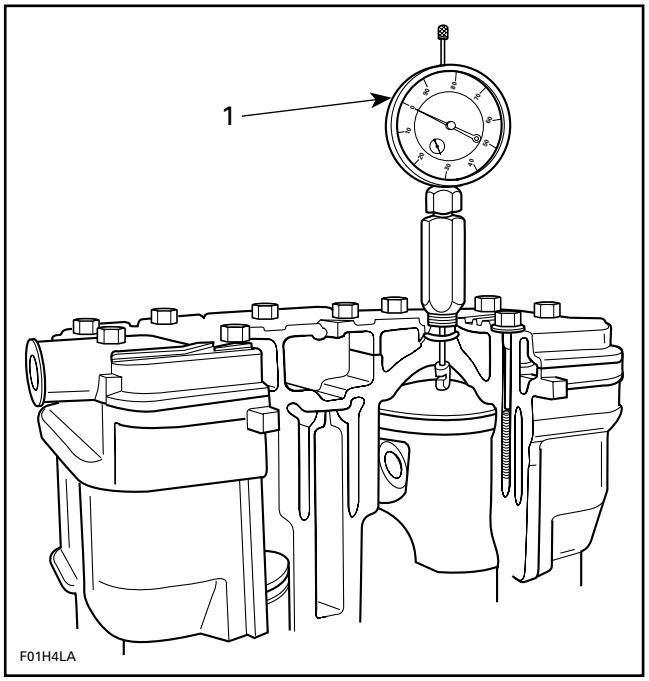
TYPICAL
1. Timing mark pointer tool

– Install and adjust a TDC gauge (P/N 295 000 143) in MAG side spark plug hole.



TYPICAL
1. TDC gauge on MAG side

– Rotate PTO flywheel counterclockwise (when facing it) until piston is at top dead center.

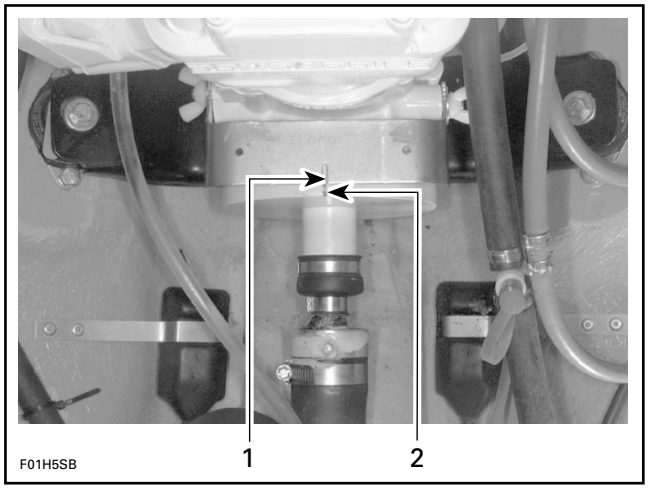


TYPICAL
1. Adjust gauge dial at zero

– From this point, rotate flywheel clockwise to reach proper specification according to engine. Refer to the following chart.

ENGINE	IGNITION TIMING (BTDC)
717	2.59 mm (.102 in)

– Scribe a thin mark on PTO flywheel in the middle of tool slot.



TYPICAL
1. Tool slot
2. Flywheel mark

NOTE: This mark becomes the reference when verifying the ignition timing (dynamic test).

– Remove TDC gauge.
– Reinstall spark plug and connect wire.

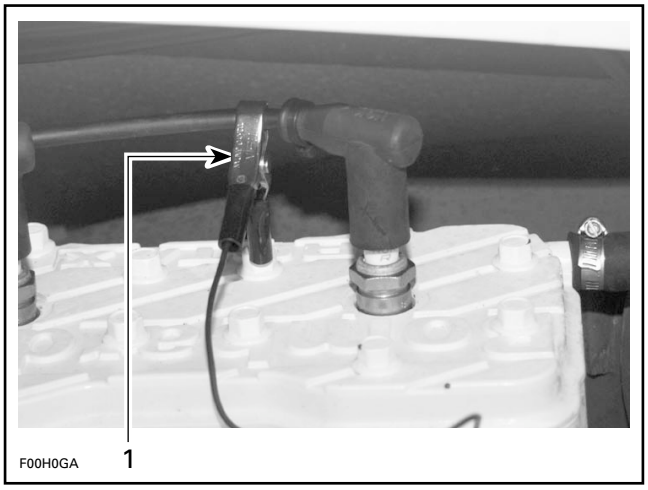
Ignition Timing Verification (Dynamic Test)

To check ignition timing, use a timing light (available at local facilities).

NOTE: Ensure to use a timing light capable to work with 2-stroke engines and rated up to 6000 RPM. Otherwise, an inaccurate reading will be obtained.

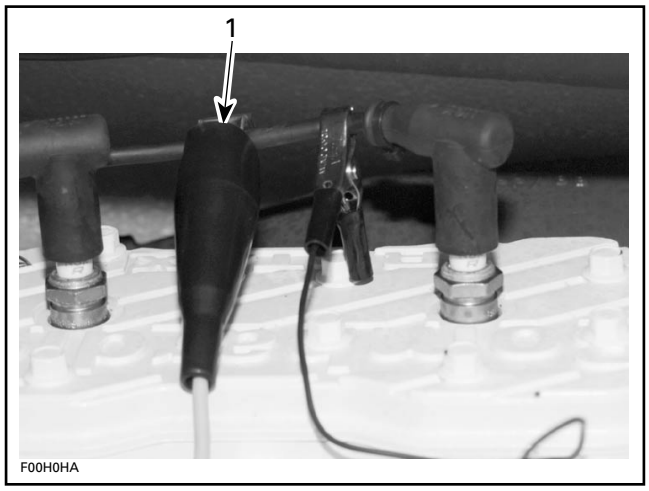
The ignition components are affected by temperature variation, therefore, timing must be checked when engine is cold, after idling for a MAXIMUM of 20 seconds.

– Connect an induction-type tachometer (P/N 529 014 500) to spark plug wire.



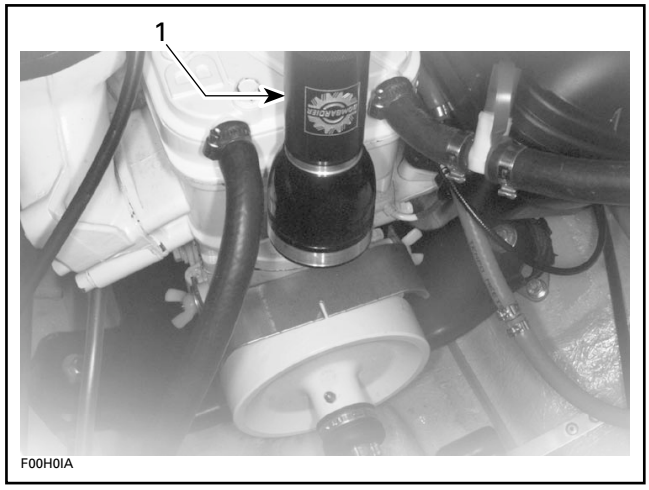
1. Tachometer pick-up

– Connect timing light pick-up to MAG side spark plug wire.



1. Timing light pick-up

– Start engine and point timing light straight in line with timing tool slot. Bring engine to 6000 RPM.



1. Timing light straight in line with tool slot

CAUTION: If engine is to be run more than a few seconds, engine must be cooled using the flush kit.

– Check if PTO flywheel mark aligns with timing tool slot.

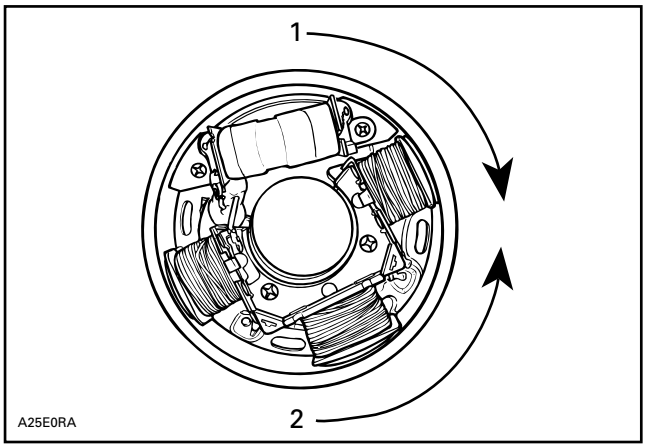
NOTE: On this system, timing advance decreases as engine speed increases.

If timing mark aligns with tool slot, timing is properly set. If mark does not align with tool slot, recheck PTO flywheel mark (static test) before adjusting ignition timing to ensure PTO flywheel has not loosen or tightened.

Ignition Timing Adjustment

Remove magneto housing cover and wire support. Refer to MAGNETO SYSTEM.

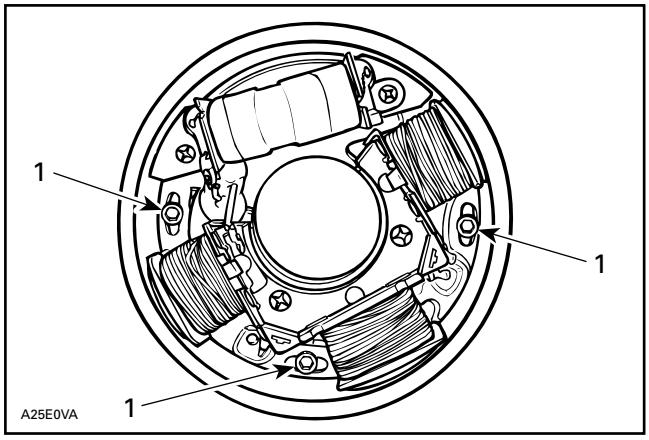
Timing is performed by moving armature plate; clockwise to retard spark occurrence or counterclockwise to advance.



TYPICAL
1. *To retard*
2. *To advance*

To adjust, loosen 3 armature plate retaining screws and slightly rotate armature plate in proper direction.

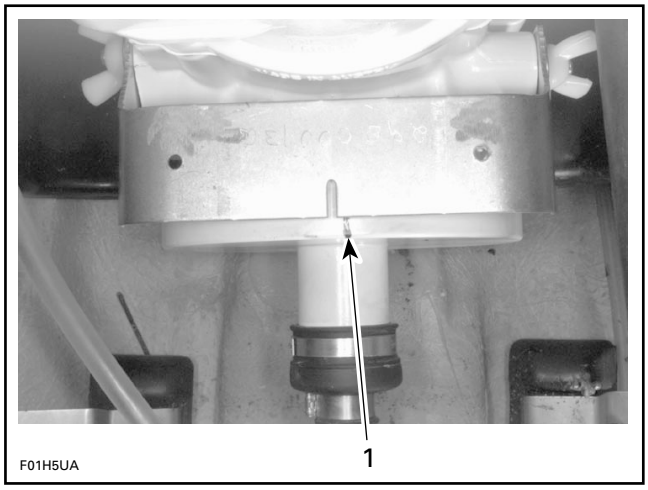
NOTE: As a guideline, turn the armature plate the same amount needed to align mark on PTO flywheel.



TYPICAL
1. *Retaining screw*

Example 1

When PTO flywheel mark is on right side of timing tool slot, it indicates advanced timing.

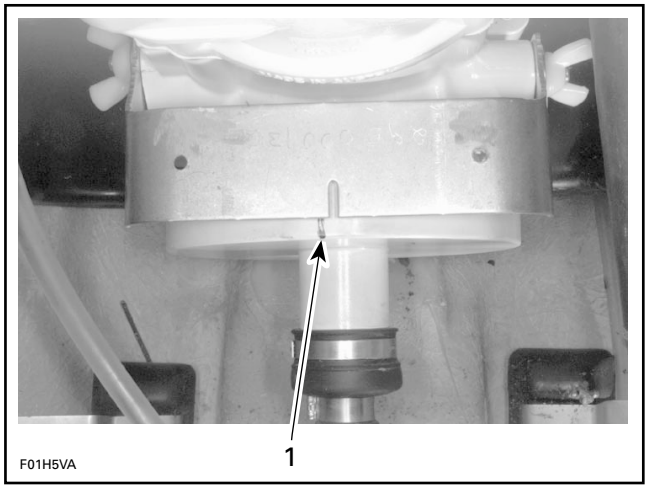


1. *Too advanced timing*

In this case, turn armature plate clockwise when facing it.

Example 2

When PTO flywheel mark is on left side of timing tool slot, it indicates retarded timing.



1. *Retarded timing*

In this case, turn armature plate counterclockwise when facing it.

After adjustment, tighten armature plate retaining screws.

CAUTION: Armature plate screws must have Loctite 243 (P/N 293 800 060) applied before tightening. Make sure armature plate screws are well secured.

Reinstall removed parts. Refer to MAGNETO SYSTEM.

Recheck ignition timing (make sure engine is cold).

Repeat armature plate positioning procedure if timing mark position is not adequate.

TESTING PROCEDURES

When dealing with ignition problems, the following items should be verified in this order:

1. Spark occurrence/spark plug condition.
2. Electrical connections.
3. Magneto output.
4. Multi-Purpose Electronic Module (MPEM).
5. Ignition coil output.

CAUTION: Whenever replacing a component in ignition system, check ignition timing.

NOTE: To perform verifications, a good quality multimeter such as Fluke 111 (P/N 529 035 868) should be used.

529 035 868

SPARK PLUGS

Refer to TESTING PROCEDURES of the 787 RFI engine further in this section.

GENERATING COIL

Static Test

Disconnect magneto wiring harness connector.

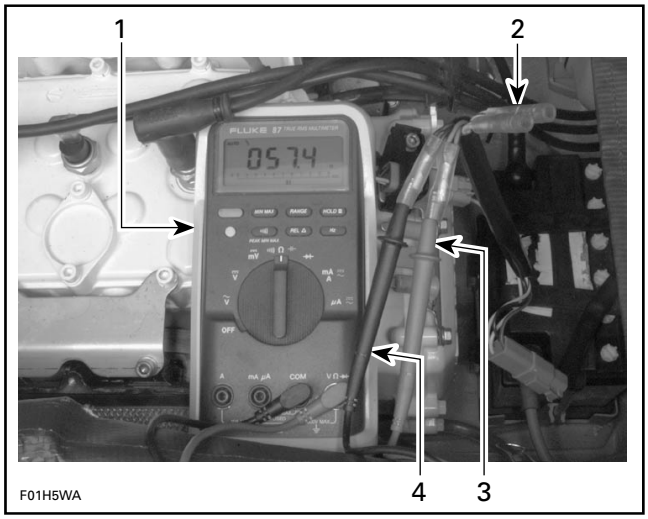
Install the 4-pin magneto harness adapter (P/N 295 000 131).

F01B28A

TYPICAL

Check resistance with a multimeter. Refer to the following table for values and wire colors.

PART NAME	ADAPTER WIRE	RESISTANCE
Generating coil	BLACK with RED/BLACK	40 - 76 Ω



1. Multimeter
2. 4-pin magneto harness adapter
3. RED/BLACK wire
4. BLACK wire

Dynamic Test

1. Connect spark plug cables to grounding device.
2. Disconnect magneto wiring harness connector.
3. Install the 4-pin magneto harness adapter (P/N 295 000 131).
4. Connect positive test probe of the multimeter to the RED/BLACK wire of the 4-pin magneto harness adapter.
5. Connect negative test probe of the multimeter to BLACK wire of the 4-pin magneto harness adapter.
6. Set multimeter to Vac scale.
7. Crank engine and note result. The obtained value should be between 18 and 25 Vac.
8. If the generating coil is out of specification, replace it.

NOTE: If the generating coil tests good, disconnect the primary wires of the ignition coil. Crank engine and check voltage at primary wires. It should be at least 20 Vac. If there is insufficient or no voltage, either the MPEM or wiring harness is defective.

MULTI-PURPOSE ELECTRONIC MODULE (MPEM)

It is not possible to accurately check the MPEM condition without specialized tools.

However, the ignition output voltage can be verified. There should be at least 12 V on the WHITE wire that power the primary winding of the ignition coil when starting engine.

If there is no voltage, replace MPEM.

NOTE: Before replacing the MPEM, make sure all connectors are properly secured and there is no water in connectors. Check the grounds and the signal and power contacts in the AMP plug connectors. See WIRING DIAGRAMS.

Rev Limiter

To check engine rev limiter, connect an induction tachometer (P/N 529 014 500), start engine and check its maximum speed.

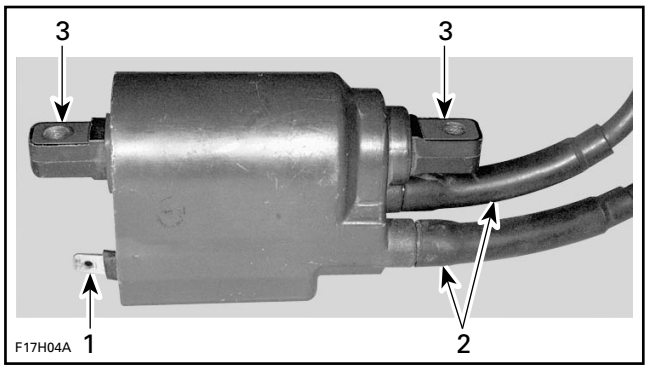
MODEL	RPM LIMITER SETTING
717	7100 ± 50

IGNITION COIL

Static Test

NOTE: 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.

Primary Winding



1. *Primary side*
2. *Secondary side*
3. *Ground plate*

Disconnect the wire connectors on primary side of the ignition coil.

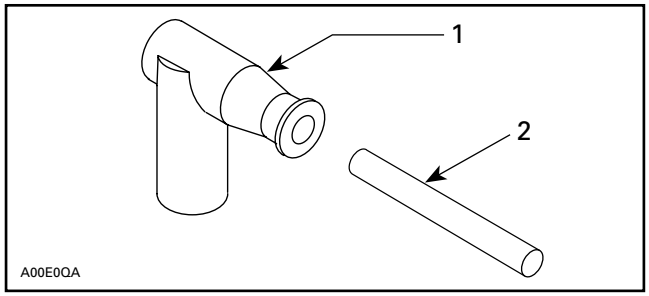
Using a multimeter, check the resistance between the primary side connectors of the coil.

The resistance should be 0.34 to 0.62 Ω at 20°C.

If not within specification, replace the ignition coil.

Secondary Winding

The spark plug caps must be removed from high tension cables, because they are resistor caps. The cap resistance is 4.48 kΩ.



1. *Resistor cap*
2. *High-tension cable*

Using a multimeter, check the resistance between the two high tension leads with the spark plug caps removed.

The resistance should be 12 ± 3 kΩ at 20°C.

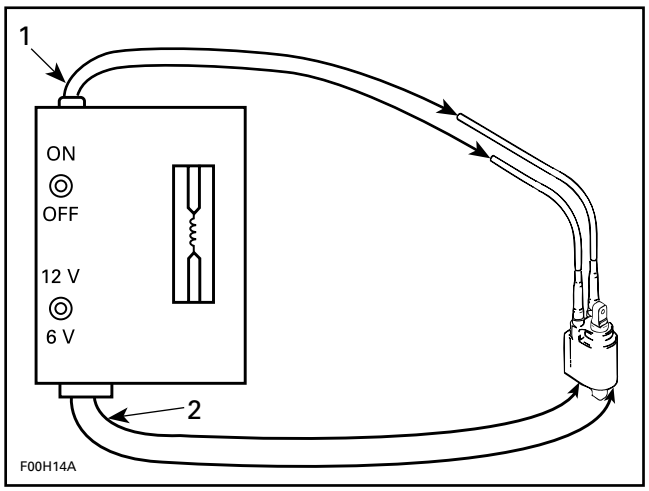
NOTE: A short circuit will read 0 ohm (or close to) on ohmmeter.

Dynamic Test

Use an ignition coil tester, available from after-market tool/equipment suppliers.

CAUTION: Do NOT use coil tester on metal work bench. Follow manufacturer instructions.

– With ignition coil removed from craft, disconnect spark plug caps from high tension cables.
– Hook high tension leads from tester to ignition coil high tension cables.
– Connect 2 smaller tester leads to primary of ignition coil.

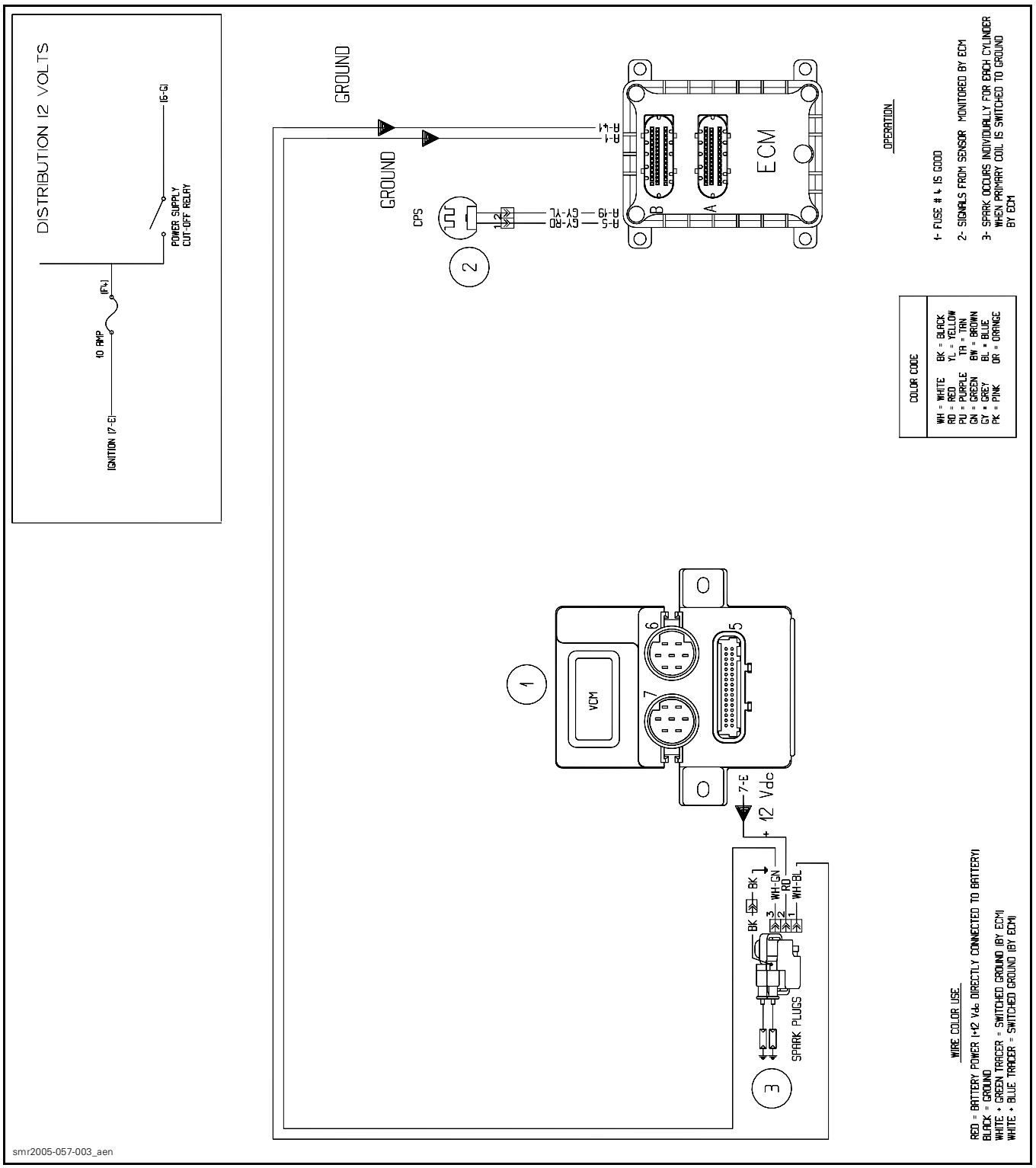


TYPICAL
1. Leads to secondary
2. Leads to primary

– Turn power switch to 12 volts and you should observe spark jumping at a predetermined gap of 7 to 8 mm (.276 to .311 in).

If there is no spark, if it is weak or intermittent, the coil is defective and should be replaced.

787 RFI ENGINE



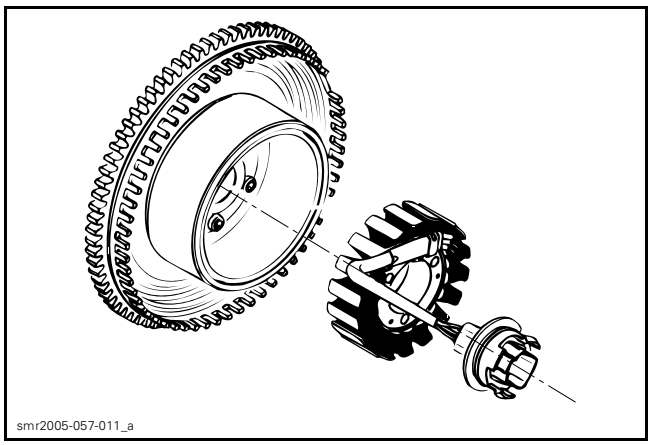
IGNITION SYSTEM ELECTRICAL DIAGRAM

GENERAL

Prior to troubleshooting any ignition problems, verify for any fault codes from the engine management system. Refer to ENGINE MANAGEMENT for more details.

Magneto

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).



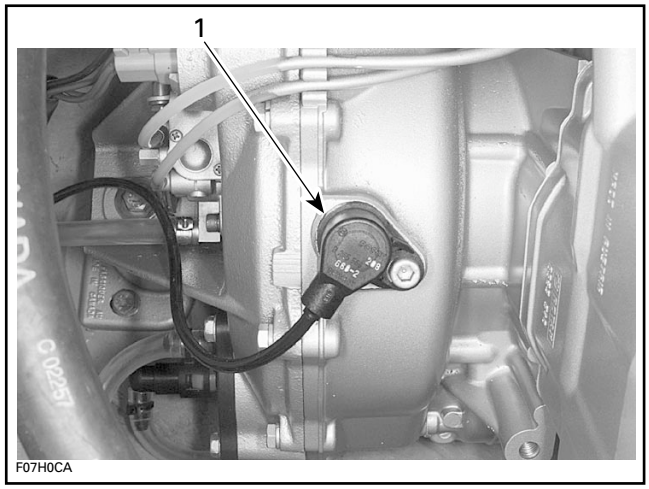
Unregulated AC current is produced by the magneto. This AC current is rectified and regulated by the charging system. The resulting regulated DC is used to charge the battery.

Battery

The battery supplies the VCM and ECM with DC current.

Crankshaft Position Sensor

The CPS is an inductive speed sensor located on the magneto housing and is working in conjunction with a trigger wheel.



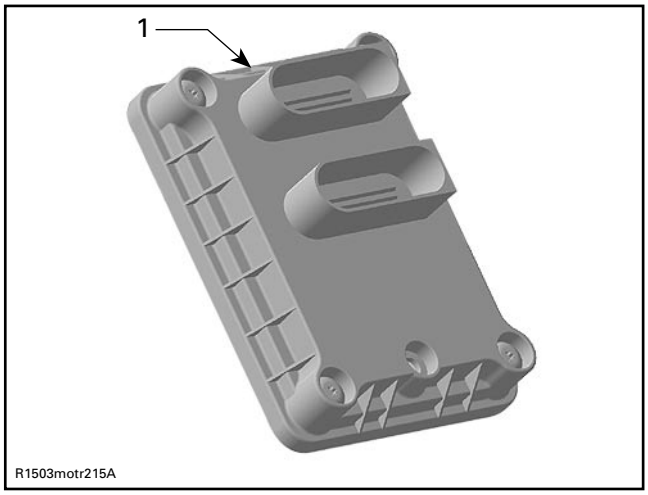
1. Crankshaft position sensor (CPS)

An AC voltage is generated by the sensor and is sent to the ECM to calculate the crankshaft position and the engine speed.

For troubleshooting the CPS, refer to ENGINE MANAGEMENT.

Engine Control Module (ECM)

The ECM controls the ignition system.

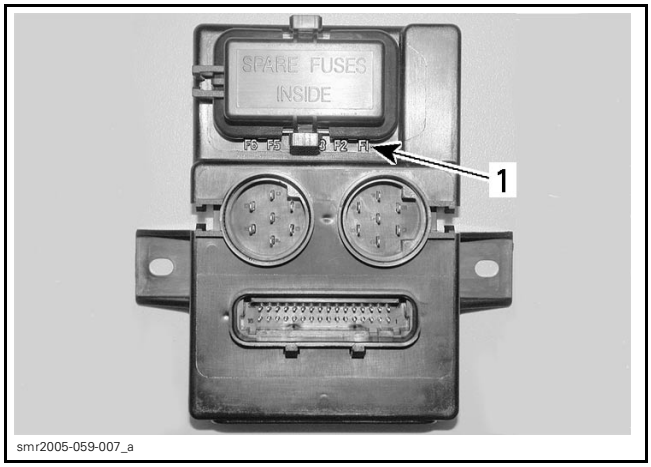


1. ECM

With the input from the sensors of the engine management system, the ECM determines the proper ignition timing of the engine. When it is time to trigger the ignition coil, the ECM completes the ignition coil primary circuit to the ground, to produce a spark.

Vehicle Control Module (VCM)

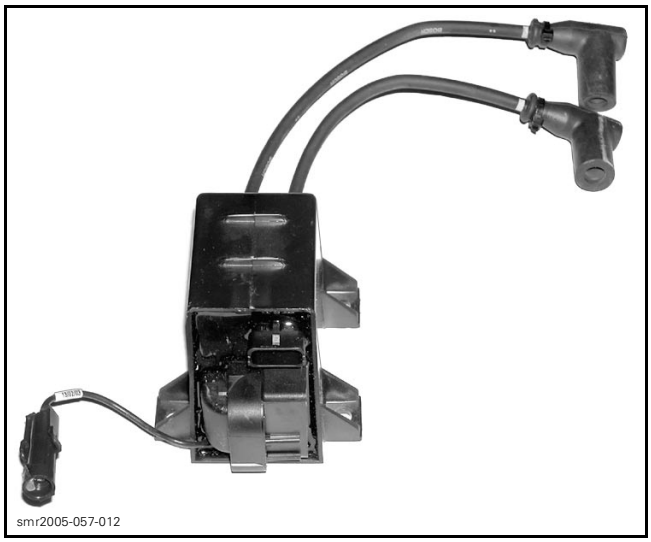
The VCM energizes the primary side of each ignition coil individually (positive voltage).



1. VCM

Ignition Coil

Ignition coil induces voltage to a high level in secondary windings to produce a spark at spark plug.



The digital inductive ignition system is used to allow the spark plugs to spark independently on each piston stroke.

CAUTION: Do not interchange spark plug cables. Reversed spark plug cables will not allow the engine to run and will cause backfires.

ADJUSTMENT

IGNITION TIMING

Before checking ignition timing with a stroboscopic timing light (dynamic test), it is mandatory to scribe a timing mark on the PTO flywheel (static test) corresponding to the specific engine.

Also, the timing mark scribed on the PTO flywheel can be used to troubleshoot a broken magneto woodruff key.

CAUTION: The relation between the PTO flywheel mark and crankshaft position may change as the PTO flywheel might move on crankshaft when engine is ran. This will result in false ignition timing readings. If timing mark does not align with pointer tool when checking the ignition timing with an appropriate timing light (dynamic test), verify timing mark again (static test) to ensure flywheel has not moved.

NOTE: Do not use the factory mark found on the PTO flywheel to check ignition timing or troubleshoot any problems.

Normally ignition timing adjustment should not be required. It has been set at factory and it should remain correctly adjusted since every part is fixed and not adjustable. The only time the ignition timing might have to be changed would be when replacing the crankshaft, the magneto rotor the CPS and the VCM or the ECM. If the ignition timing is found incorrect, you should first check for proper crankshaft alignment. This might be the indication of a twisted crankshaft.

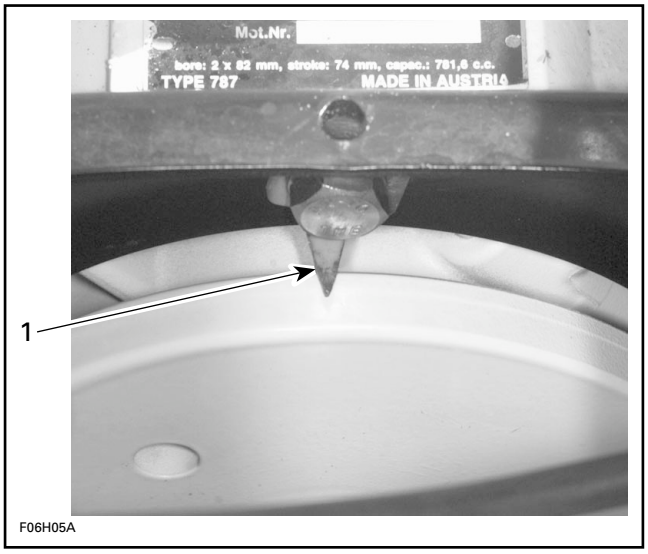
The fixed timing mode must be activated before checking ignition timing. See FIXED TIMING FUNCTION paragraph.

Scribing a Timing Mark (Static Test)

– Disconnect MAG side spark plug wire and connect wire to grounding device then remove spark plug.

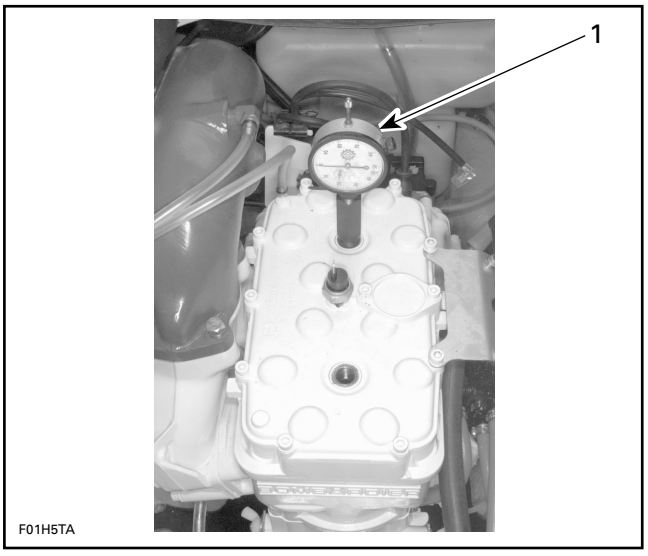
CAUTION: Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.

– Remove PTO flywheel guard.
– Remove middle screw securing the engine to the rear engine mount. Reinstall screw with timing mark pointer tool (P/N 295 000 135).



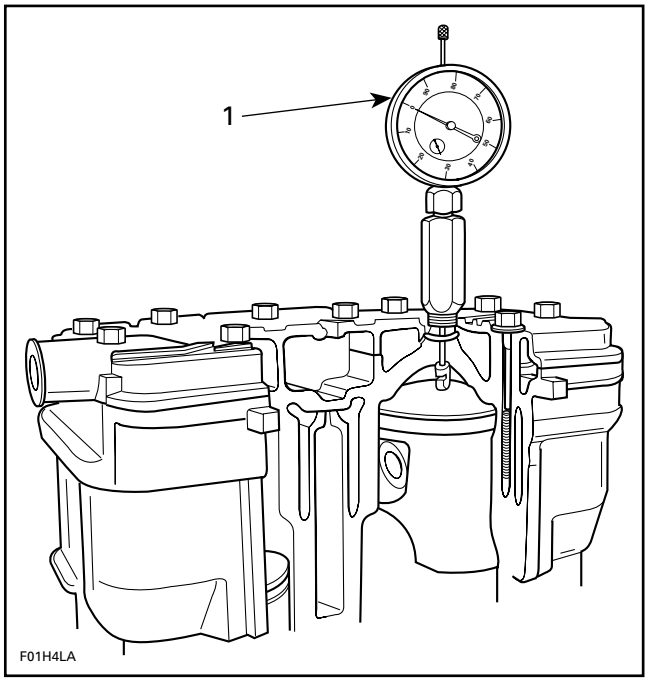
1. Timing mark pointer tool

– Install and adjust a TDC gauge (P/N 295 000 143) in MAG side spark plug hole.



TYPICAL
1. TDC gauge on MAG side

– Rotate PTO flywheel counterclockwise (when facing it) until piston is at top dead center.

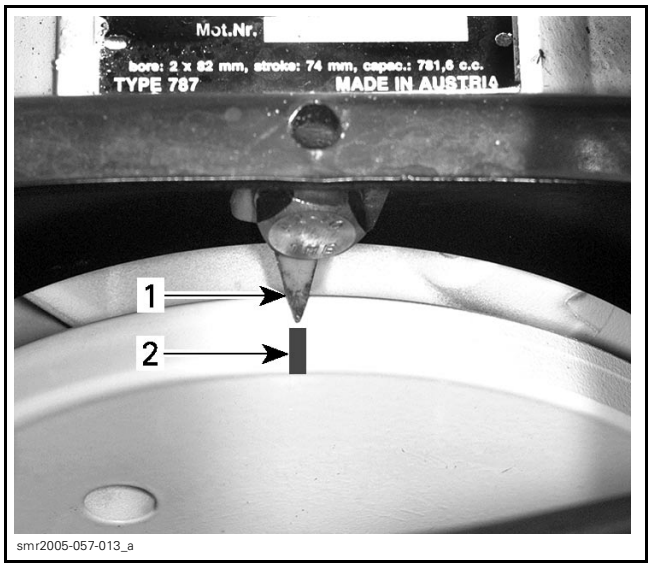


TYPICAL
1. Adjust gauge dial at zero

– From this point, rotate flywheel clockwise to reach proper specification according to engine. Refer to the following chart.

ENGINE	IGNITION TIMING (BTDC)
787 RFI	1.02 mm (.040 in)

– Scribe a thin mark on PTO flywheel aligned with timing mark pointer tool.



1. Tool end
2. Flywheel mark

NOTE: This mark becomes the reference when verifying the ignition timing (dynamic test).

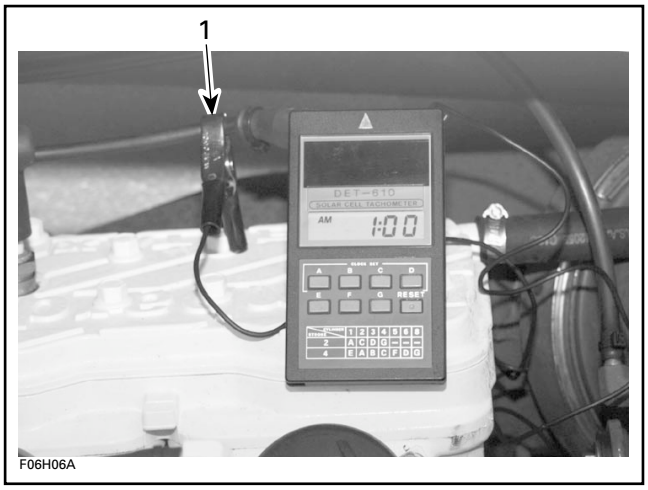
– Remove TDC gauge.
– Reinstall spark plug and connect wire.

Verifying the Ignition Timing (Dynamic Test)

To check ignition timing, use a timing light (available at local facilities).

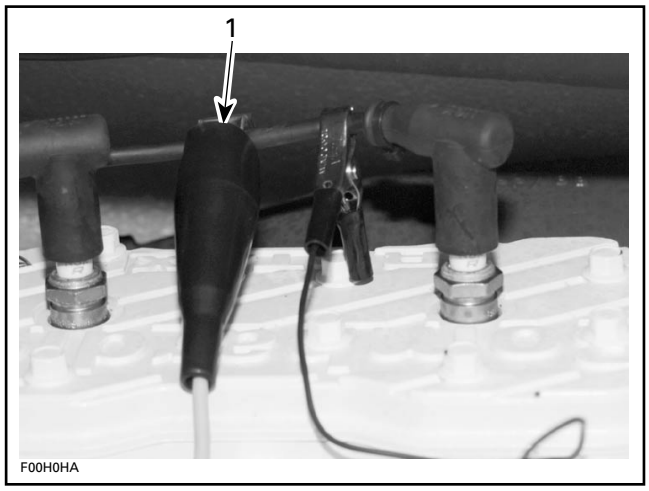
NOTE: Ensure to use a timing light capable to work with 2-stroke engines.

– Connect an induction-type tachometer (P/N 529 014 500) to spark plug wire.



1. Tachometer pick-up

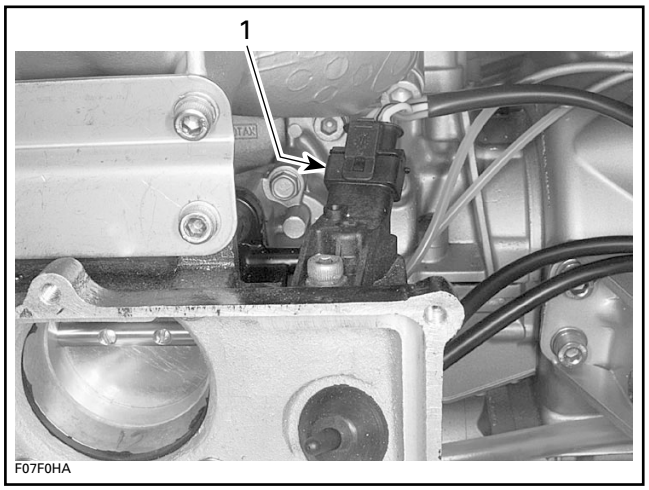
– Connect timing light pick-up to MAG side spark plug wire.



1. Timing light pick-up

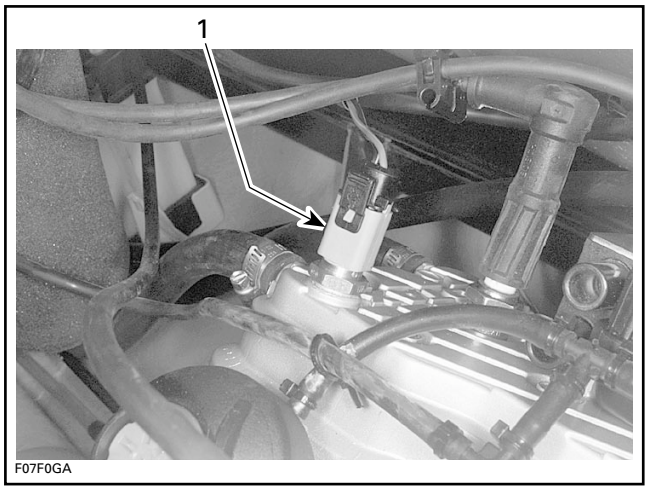
IMPORTANT: To properly check the ignition timing, the APS and WTS must be disconnected and the timing tool installed so that timing advance curve be locked within 800 and 6000 RPM and engine fires on both cylinders at low speed.

– Disconnect APS (air pressure sensor).



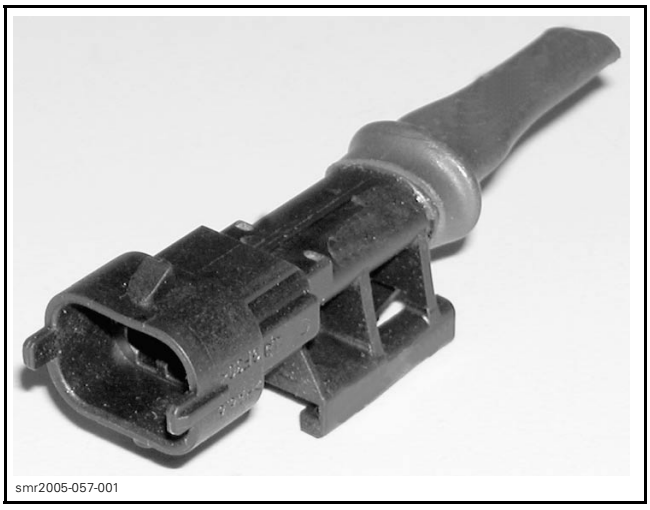
AIR INTAKE SILENCER REMOVED FOR CLARITY PURPOSE ONLY
1. *Air pressure sensor (APS)*

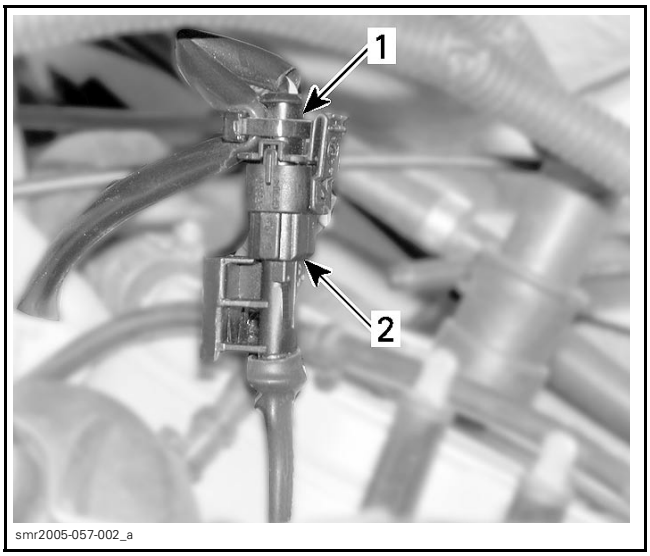
– Disconnect WTS (water temperature sensor).



1. *Water temperature sensor (WTS)*

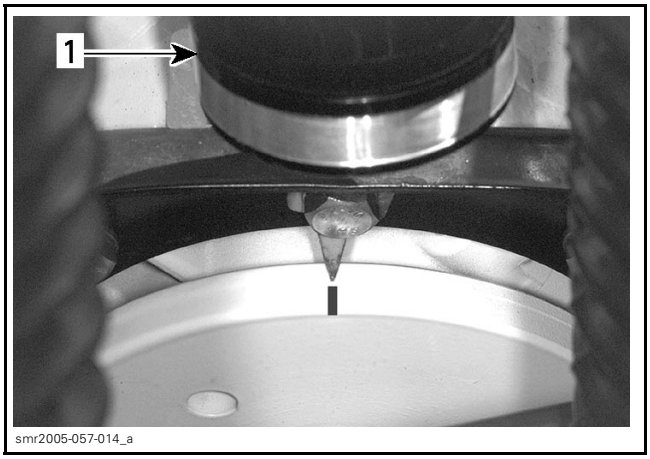
– Install 787 RFI Timing tool (P/N 529 036 017) on WTS open connector.





1. *WTS connector*
2. *Timing tool*

– Start engine and point the beam of a timing light on mark.



1. *Timing light straight in line with tool end*

CAUTION: If engine is to be run more than a few seconds, engine must be cooled using the flush kit.

NOTE: If mark on PTO flywheel is perfectly aligned with timing mark pointer, no adjustment is required. If mark does not align with pointer, recheck PTO flywheel mark (static test) before adjusting ignition timing to ensure PTO flywheel has not loosen or tightened.

Ignition Timing Adjustment

CAUTION: If the ignition timing is adjusted too advanced, this will cause serious damage to the engine.

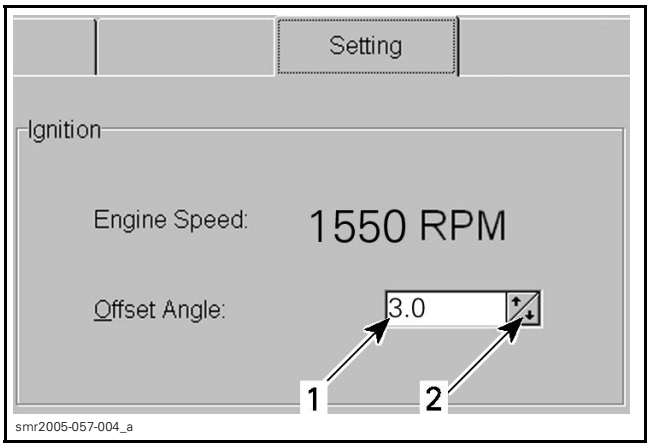
To adjust the timing, use the VCK (Vehicle Communication Kit (P/N 295 035 981)). Refer to ENGINE MANAGEMENT for proper connections.

529 035 981

NOTE: For more information on the VCK, refer to its online help.

The ignition timing correction can be made from 4° (advanced) to - 4° (retarded).

The VCK will display directly the timing correction under "Offset angle". See illustration below.



1. Actual angle
2. Activate arrow to change ancle

When the desired offset angle has been set, click the WRITE DATA button.

NOTE: 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).

Recheck timing marks with stroboscopic lamp. If adjustment is still needed, repeat procedure and enter a new offset angle.

Remove timing tool and re-plug all connectors.

TESTING PROCEDURES

⚠ WARNING

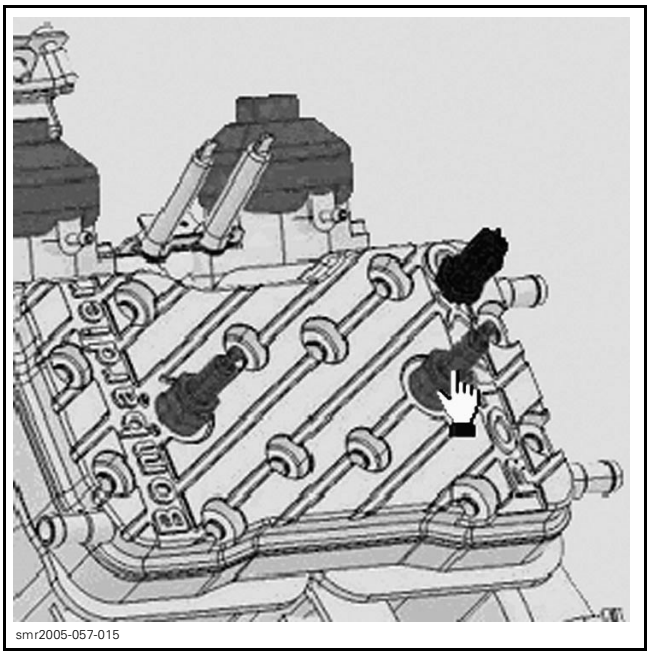
Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as spark may cause potential fuel vapor to ignite.

IGNITION COIL

Test with B.U.D.S.

NOTE: The ECM can detect open and short circuit in the primary winding but it does not check the secondary winding.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the ignition coil.


smr2005-057-015

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.

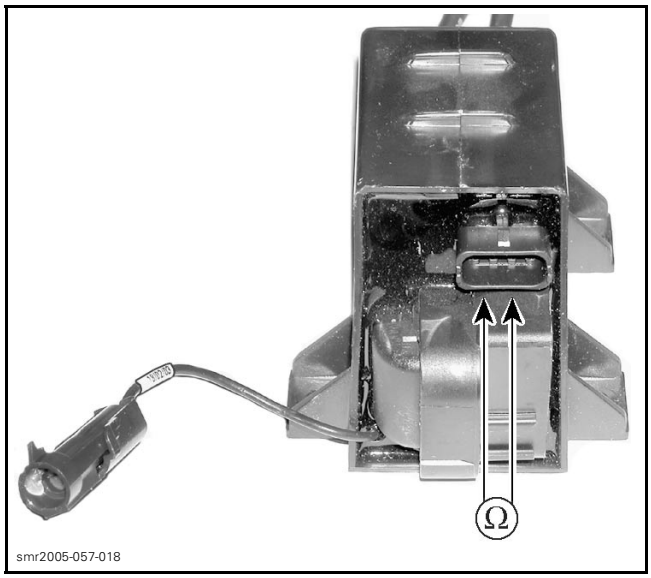
NOTE: Keep in mind that even if there is a spark during this static test, voltage requirement is higher to produce a spark in the combustion chamber when engine is running. Ignition coil could be not working in real operation. Replacing ignition coil may be necessary as a test.

Resistance Test

Primary Side

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.

Using a multimeter, check the resistance in primary windings.



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PRIMARY CIRCUIT

CIRCUIT	TERMINAL	RESISTANCE @ 20°C (68°F)
Primary	1 and 2	0.3 - .6 Ω
	2 and 3	

If any resistance is not good, replace ignition coil.

Secondary Winding

Due to the integrated diode, it is not possible to take any resistance measurement of the secondary winding.

VEHICLE CONTROL MODULE (VCM)

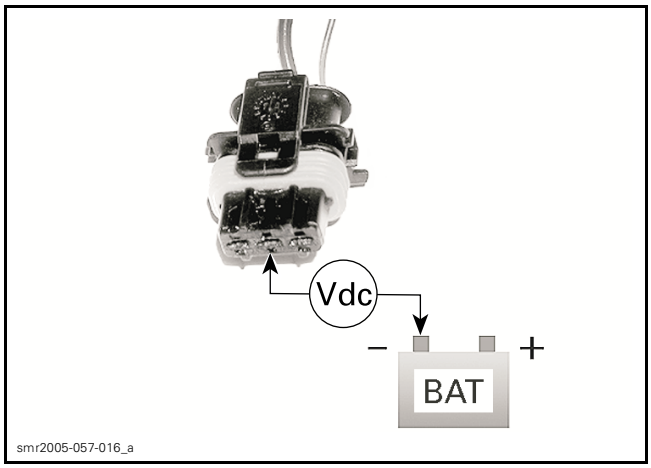
Voltage Test

Verify the VCM output signal to the ignition coil as follows:

Disconnect the 3-pin connector from the ignition coil and check the voltage supplied by the VCM.

Install safety lanyard on the DESS post. Read voltage.

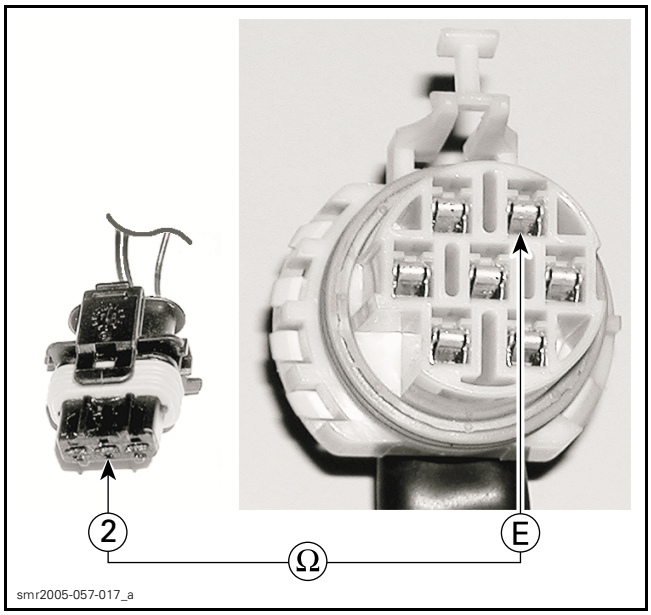
IGNITION COIL CONNECTOR	VOLTAGE
Pin 2 with battery ground	12 V



There is no Voltage

If 12 V is NOT read, disconnect VCM connector 7 and check continuity of circuit.

IGNITION COIL CONNECTOR	VCM CONNECTOR	RESISTANCE @ 20°C (68°F)
Pin 2	7-E	Close to 0 Ω



If wiring/connector is defective, repair/replace. If wiring/connectors are good, try a new VCM.

There is 12 V

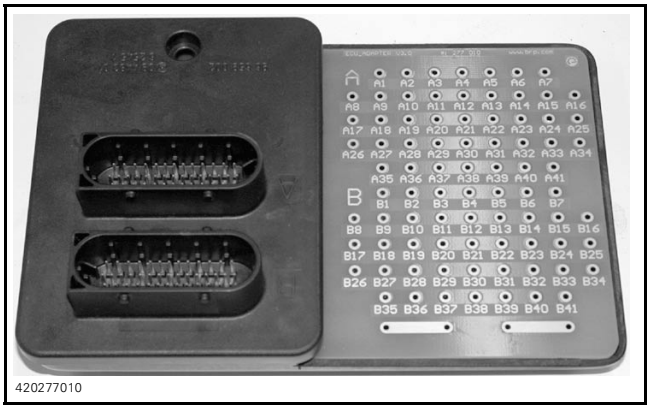
If 12 V is read, verify the ECM ignition ground circuit. Refer to ENGINE CONTROL MODULE (ECM) below.

ENGINE CONTROL MODULE (ECM)

Verify the ECM ignition ground circuit as follows:

Resistance Test

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	IGNITION COIL CONNECTOR	ECM CONNECTOR	RESISTANCE @ 20°C (68°F)
Cylinder 1 (MAG)	Pin 1	A–41	Close to 0 Ω
Cylinder 2 (PTO)	Pin 3	A-1	

If wiring/connector is defective, repair/replace. If wiring/connectors are good, try a new ECM.

SPARK PLUGS

Disassembly

First unscrew the spark plug one turn.

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

Heat Range

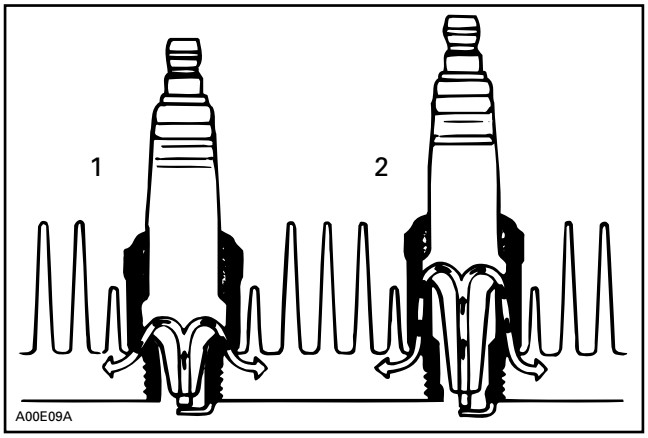
The proper heat range of the spark plugs is determined by the spark plugs ability to dissipate the heat generated by combustion.

The longer the heat path between the electrode tip to the plug shell, the hotter the spark plug operating temperature will be and inversely, the shorter the heat path, the colder the operating temperature will be.

A "cold" type plug has a relatively short insulator nose and transfers heat very rapidly into the cylinder head.

Such a plug is used in heavy duty or continuous high speed operation to avoid overheating.

The "hot" type plug has a longer insulator nose and transfers heat more slowly away from its firing end. It runs hotter and burns off combustion deposits which might tend to foul the plug during prolonged idle or low speed operation.



1. Cold
2. Hot

CAUTION: Severe engine damage might occur if a wrong heat range plug is used.

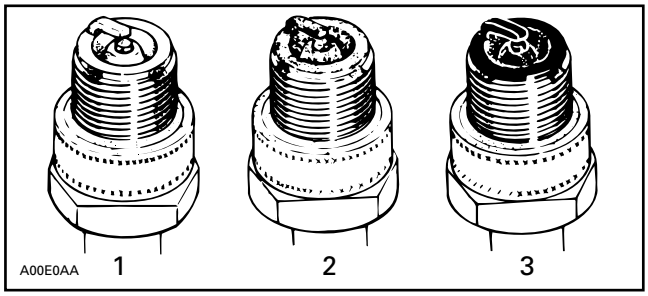
A too "hot" plug will result in overheating and pre-ignition, etc.

A too "cold' plug will result in fouling or may create carbon build up which can heat up red-hot and cause pre-ignition or detonation.

Fouling

Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are: prolonged idling, or running on a too rich mixture due to a faulty carburetor adjustment or incorrect fuel. The plug face of a fouled spark plug has either a dry coating of soot or an oily, glossy coating given by an excess either of oil or of oil with soot. Such coatings form a conductive connection between the center electrode and ground.

Spark Plug Analysis



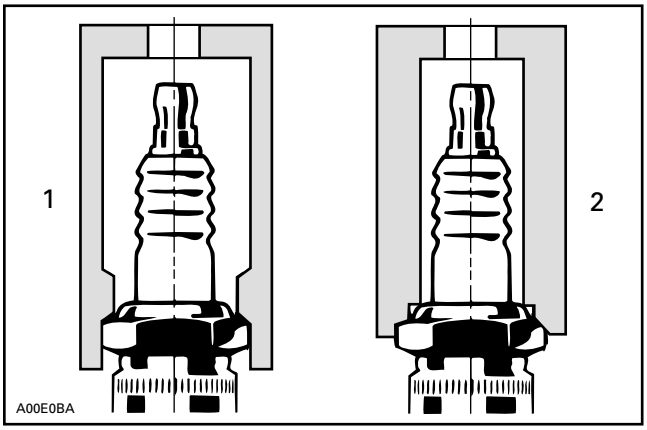
1. Overheated (light grey)
2. Normal (brownish)
3. Fouled (black)

The plug face (and piston dome) reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber) and the piston dome.

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 and tighten with a torque wrench and a proper socket.



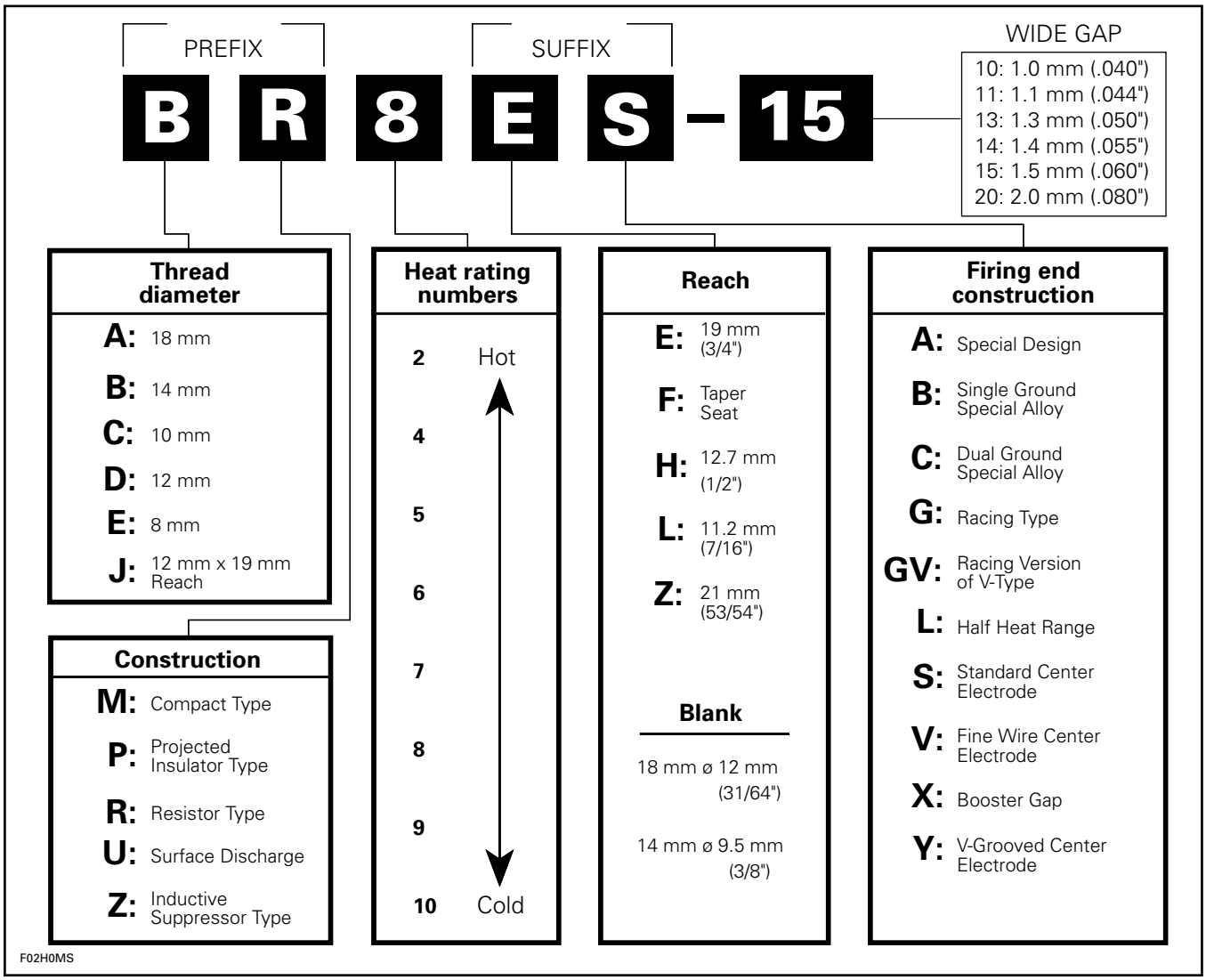
1. Proper socket
2. Improper socket

Spark Plug Chart

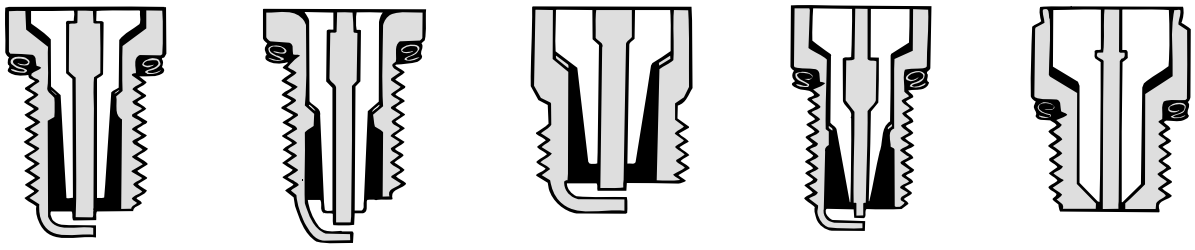
ENGINE	SPARK PLUG	TORQUE	GAP
717 and 787 RFI engines	BR8ES	24 N•m (17 lbf•ft)	0.4 - 0.5 mm (.016 - .020 po)

NOTE: Refer to next page for NGK SPARK PLUG SYMBOL EXPLANATION.

NGK Spark Plug Symbol Explanation



CROSSCUTS AND GAP STYLES OF SPARK PLUGS



CHARGING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
4-pin magneto harness adapter	295 000 131	167–168, 172–174
multimeter Fluke 111	529 035 868	171

SERVICE PRODUCTS

Description	Part Number	Page
dielectric grease	293 550 004	176, 179

717 ENGINE

GENERAL

Magneto

MAGNETO OUTPUT	
ENGINE TYPE	WATT
717	160 @ 6000 RPM

The purpose of the charging system is to keep the battery at a full state of charge.

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current.

The magneto has a three-pole coil.

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 components.

A half-wave rectifier receives magneto current and transforms it into regulated current to allow battery charging.

Battery

The battery is the DC source for the electric starter, the Multi-Purpose Electronic Module and all accessories.

Fuse

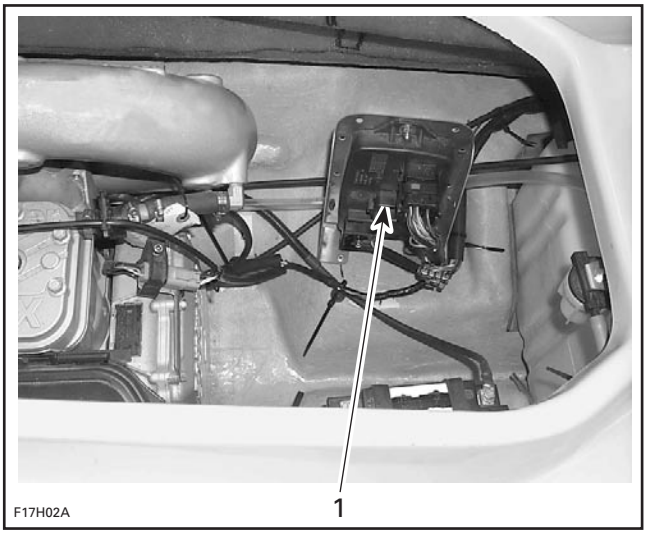
If the battery is regularly discharged, check fuse condition.

The rectifier/regulator could be the culprit of a blown fuse. To check, simply disconnect the rectifier/regulator from the circuit.

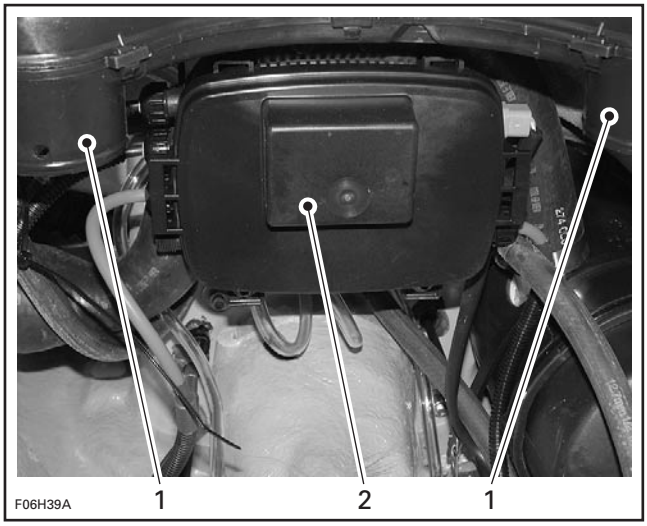
If the fuse still burns, check for a defective wire.

CAUTION: Do not use a higher rated fuse as this cause severe damage.

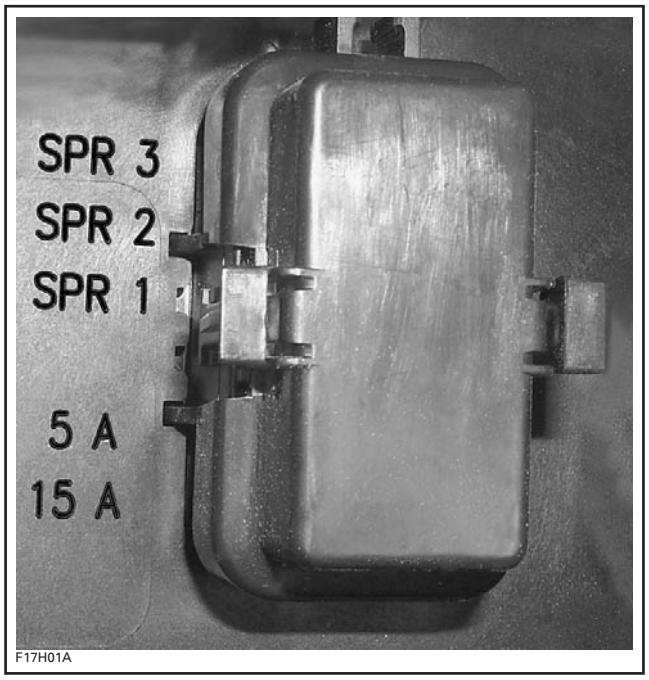
Two 15 A fuses protect the charging system. The first one is mounted on the MPEM and the other one is located in the rear electrical box on the cut-off relay.



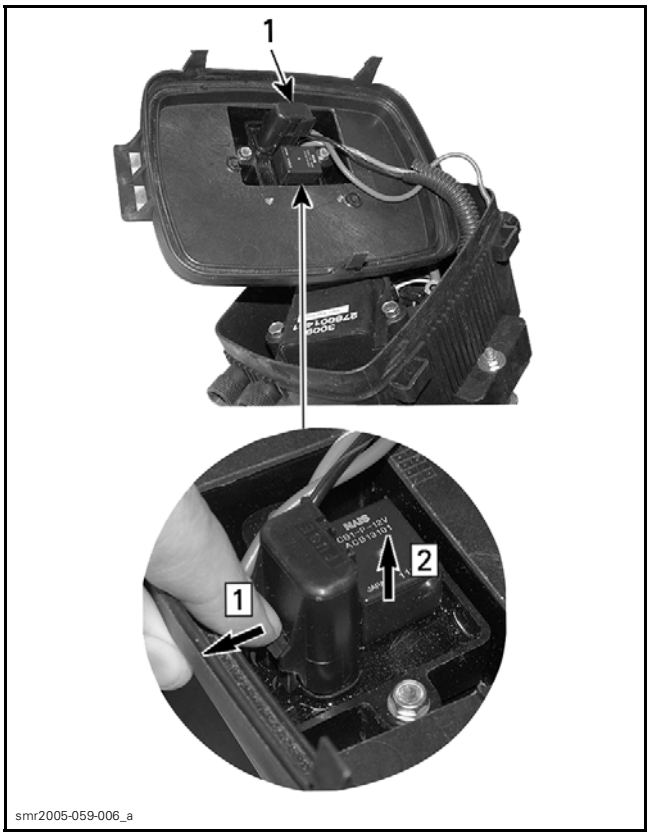
TYPICAL
1. MPEM



TYPICAL
1. Vent tubes removed
2. Electrical box



FUSE IDENTIFICATION — 5 A: MPEM AND 15 A: BATTERY



TYPICAL
1. Fuse
Step 1: Pull tab
Step 2: Pull fuse housing

TESTING PROCEDURES

NOTE: First, ensure that battery is in good condition prior to performing the following tests.

BATTERY

Refer to TESTING PROCEDURE of the 787 RFI ENGINE further in this section for the battery verifications.

RECTIFIER/REGULATOR

Static Test (Continuity)

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

Dynamic Test

Current Test

Proceed with a current test as follows:

– Start engine.
– Lay an inductive ammeter on positive cable of battery.
– Bring engine to approximately 6000 RPM.

Current reading should be approximately 4 amperes for the 717 engine. If not, check magneto output prior to concluding that rectifier is faulty.

DC Voltage Test

Proceed with a voltage test as follows:

– Start engine.
– Connect a multimeter to battery posts. Set multimeter to Vdc scale.
– Bring engine to approximately 5500 RPM.

If multimeter reads over 15 volts, regulator is defective. Replace it.

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, on the other hand, the battery will not stay charged, the problem can be any of the charging circuit components. If these all check good, you would be accurate in assuming the problem to be in the rectifier/regulator.

If there is no charging at the battery with the preceding voltage test, the following test can also be performed.

Disconnect the connector housing of the rectifier/regulator.

Using an appropriate terminal remover (Snap-on TT600-4), remove the RED and BLACK wires from the tab housing of the rectifier/regulator.

Reconnect the connector housing.

Connect the positive probe of a multimeter to the RED wire and the negative probe to the BLACK wire.

Set multimeter to Vdc scale.

Start and rev engine to 3500 RPM. The obtained value should be between 12 and 25 Vdc.

NOTE: If the rectifier/regulator is within the specification, either the MPEM or wiring harness between the rectifier and battery is defective. If the rectifier/regulator is out of specification and the battery charging coil (or stator) test good, the rectifier/regulator is defective.

BATTERY CHARGING COIL

Static Test

Continuity

– Disconnect the magneto wiring harness connector.
– Install the 4-pin magneto harness adapter (P/N 295 000 131) to the magneto wiring harness. Leave wiring harness side disconnected.

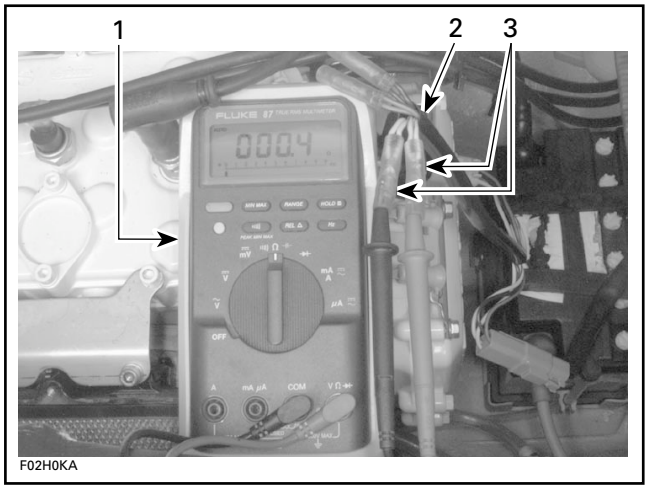

F01B28A

TYPICAL

– Check resistance between the YELLOW and BLACK/YELLOW wires of the magneto harness adapter. Refer to the following table.

PART NAME	WIRE COLOR	RESISTANCE Ω
Battery charging coil	YELLOW with BLACK/YELLOW	0.05 - 0.6

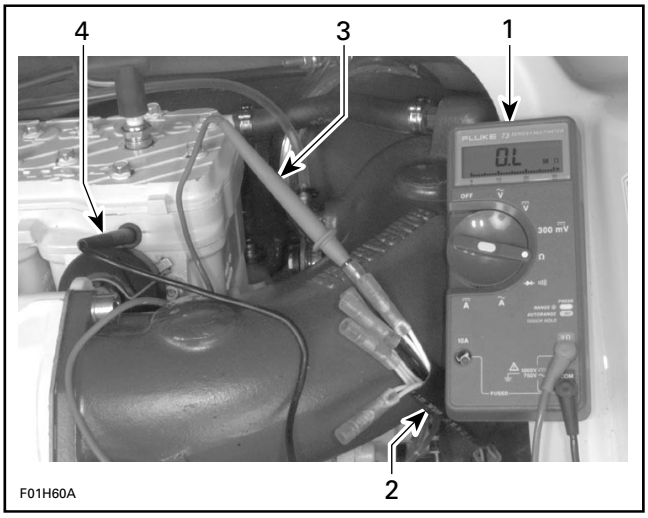
NOTE: A short circuit will read 0 ohm (or close to) on ohmmeter.



1. Multimeter
2. Magneto harness adapter
3. YELLOW and BLACK/YELLOW wires

Insulation

– Disconnect the magneto wiring harness connector.
– Install the 4-pin magneto harness adapter (P/N 295 000 131) to the magneto wiring harness. Leave wiring harness side disconnected.
– Insert multimeter positive (+) probe to the YELLOW wire of the 4-pin magneto harness adapter.
– Ground the multimeter negative (-) probe to the engine or the stator iron core and note the reading.



TYPICAL
1. Multimeter
2. Magneto harness adapter
3. Positive (+) probe to YELLOW wire
4. Negative (-) probe to ground

– Repeat test with the other two YELLOW/BLACK wires of the 4-pin magneto harness adapter.

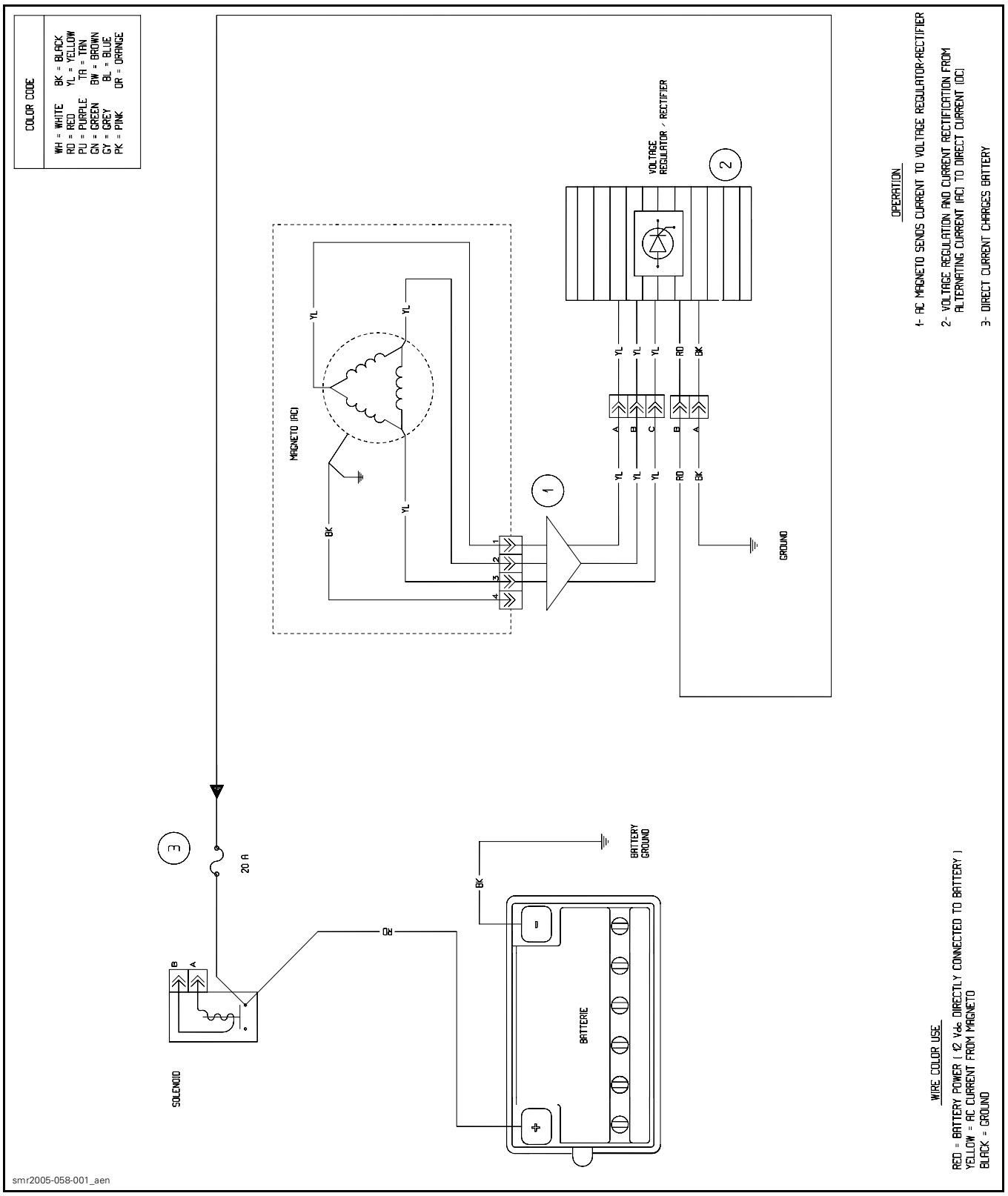
NOTE: There should be no continuity (infinity) between the stator insulated coils and ground. If there is a reading, the stator coils and/or the wiring from the coils is grounded and needs to be replaced or repaired.

Dynamic Test (AC Voltage)

– Disconnect the voltage regulator/rectifier connector.
– Disconnect the magneto wiring harness connector.
– Install the 4-pin magneto harness adapter (P/N 295 000 131) between connectors.
– Connect test probes of the multimeter to the YELLOW and BLACK/YELLOW wires of the 4-pin magneto harness adapter.
– Start and rev engine to 3500 RPM. The obtained value should be between 25 and 40 Vac.
– If the battery charging coil is out of specification, replace it.

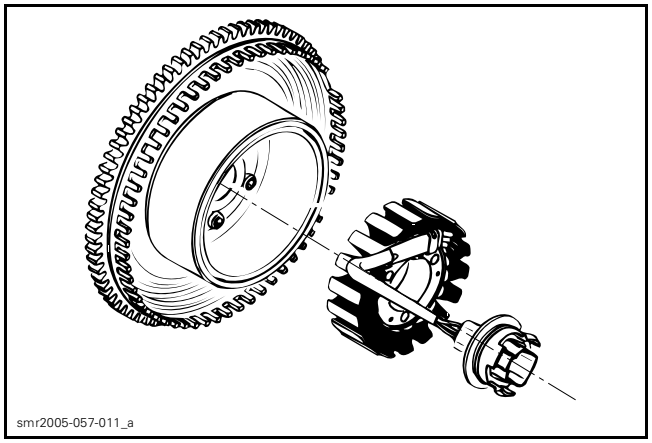
787 RFI ENGINE

Ignition System Electrical Diagram



GENERAL

Magneto



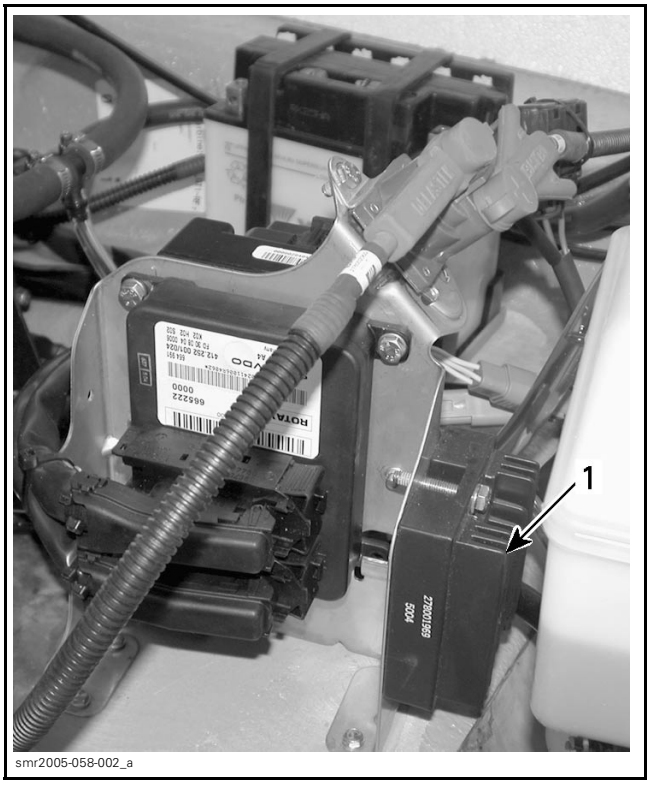
MAGNETO OUTPUT	
ENGINE TYPE	WATT
787 RFI	270 @ 6000 RPM

The purpose of the charging system is to keep the battery at a full state of charge.

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current.

The magneto has a 3 phase, delta wound stator on 18 poles.

Rectifier/Regulator



1. 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 components.

The unit is using a 3 phase in series rectifier/regulator which transforms (AC) from the magneto into (DC) to allow battery charging.

Battery

The battery is the DC source for the electric starter, the Vehicle Control Module (VCM), Engine Control Module (ECM) and all accessories.

Fuse

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

1. Charging system fuse

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 PROCEDURES

NOTE: 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).

529 035 868

BATTERY

Refer to BATTERY at the end of this section for the battery verifications.

RECTIFIER/REGULATOR

Static Test (Continuity)

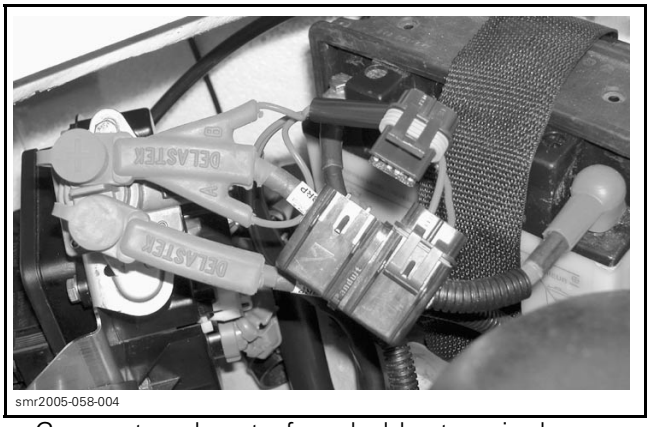
Due to internal circuitry, there is no continuity test available.

Dynamic Test

DC Current Test

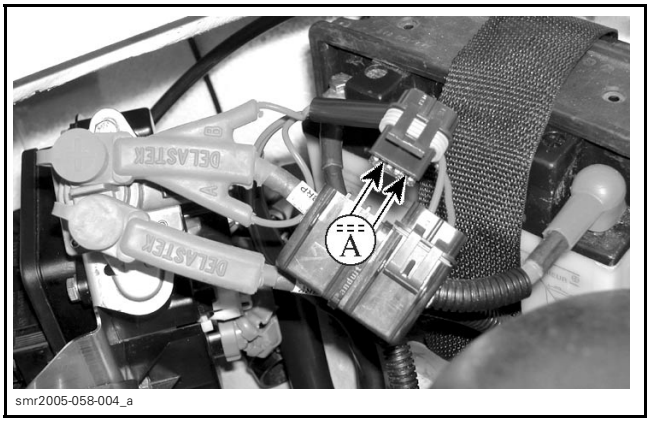
Proceed as follows:

Remove charging system fuse.



– Connect probes to fuse holder terminals.
– Set multimeter to Adc.
– Start engine.
– Read current.

TEST ENGINE SPEED	CURRENT
6000 RPM	3-4 A



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

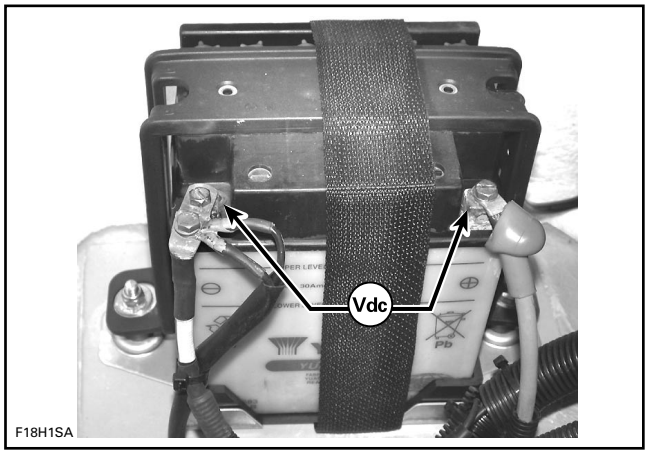
DC Voltage Test

Proceed as follows:

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

– Read voltage.

TEST ENGINE SPEED	VOLTAGE
5500 RPM	max. 15 Vdc



TYPICAL

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

NOTE: If it is continually necessary to add distilled water to the battery, this indicates an over voltage situation, requiring replacement of the rectifier/regulator. If the battery will not stay charged, the problem can be any of the charging system components. If these all check good, try a new rectifier/regulator.

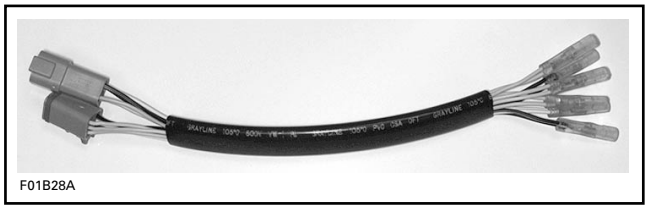
STATOR

Static Test

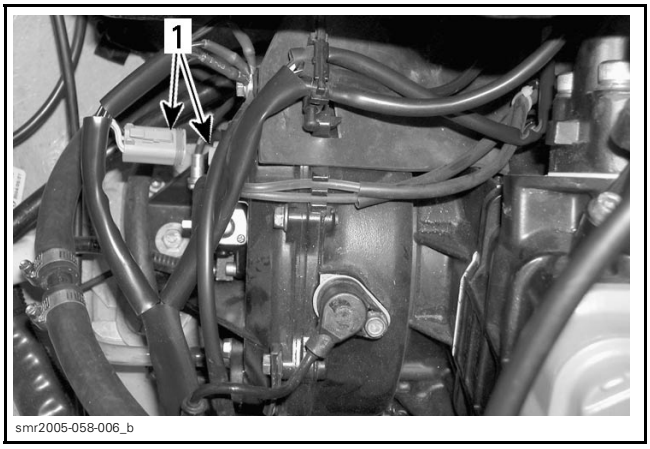
Continuity

– Disconnect the magneto wiring harness connector.

– Install the 4-pin magneto harness adapter (P/N 295 000 131) between unplugged connectors.



TYPICAL

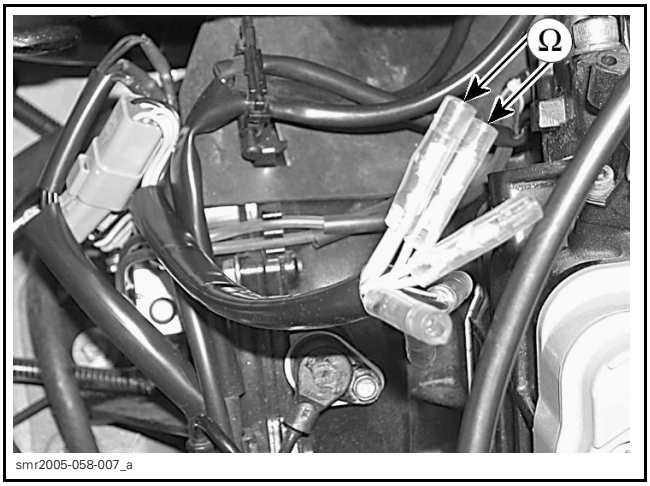


1. Install adapter here between connectors

– 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.



smr2005-058-007_a

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

Insulation

– Disconnect the magneto wiring harness connector.


smr2005-058-006_a

– Install the 4-pin magneto harness adapter (P/N 295 000 131) to the magneto wiring harness.
– **IMPORTANT:** Leave wiring harness side disconnected.

smr2005-058-008_a

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)

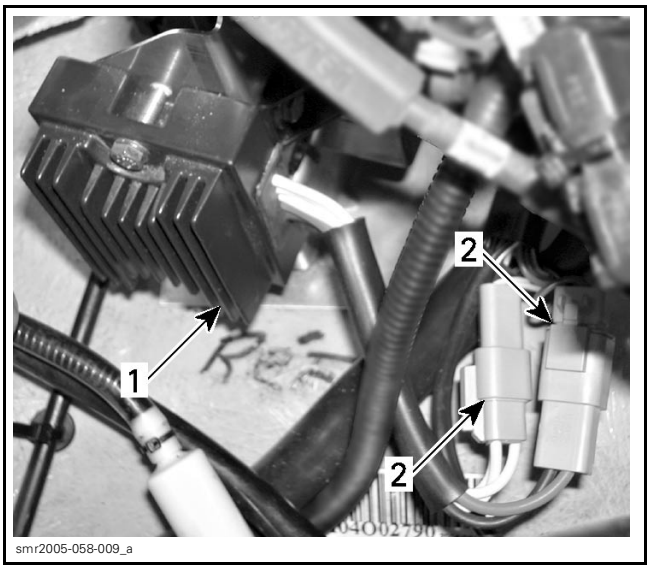
– Read resistance.
– If there is a resistance or continuity, the stator coils and/or the wiring is grounded and needs to be repaired or replaced.

Replug connectors properly.

Dynamic Test

AC Voltage Test

– Disconnect the voltage regulator/rectifier connectors.



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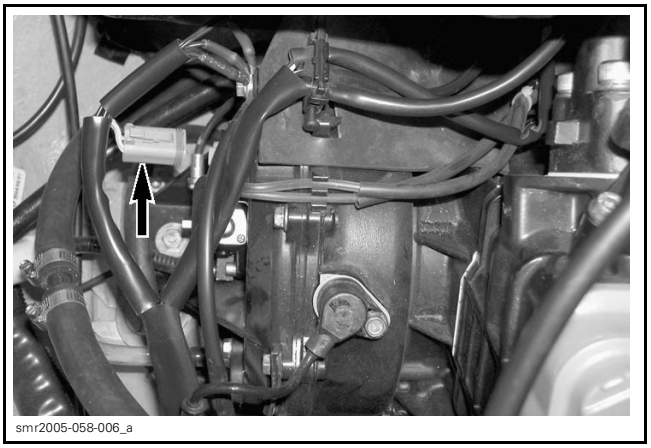
1. Voltage regulator/rectifier
2. Unplug connectors

– Disconnect the magneto wiring harness connector.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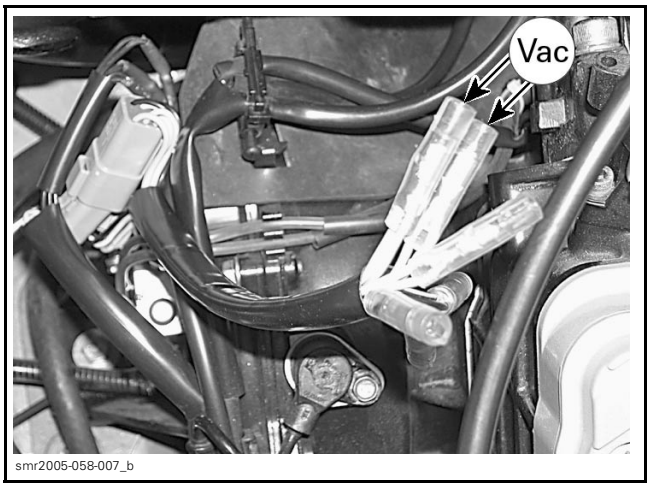
– Install the 4-pin magneto harness adapter (P/N 295 000 131) between unplugged connectors.
– Connect test probes of the multimeter between YELLOW wires.



smr2005-058-007_b

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

TEST ENGINE SPEED	TERMINAL	VOLTAGE
3500 RPM	1 and 2	45 - 70 Vac
	1 and 3	
	2 and 3	

– Read voltage.
– If voltage is out of 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.

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.

⚠ 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.

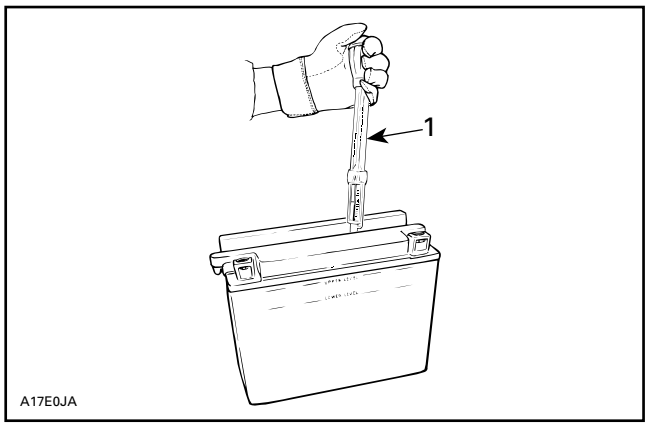
Electrolyte Reading

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).



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	

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 (P/N 293 550 004) 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.

A new battery is factory fresh dry charged. For storage purposes, it is fitted with a temporary sealing tube.

CAUTION: Do not remove the sealing tube or loosen battery caps unless activation is desired.

NOTE: In case of accidental premature removal of caps or sealing tube, battery should be given a full charge.

Perform the following operations anytime a new battery is to be installed.

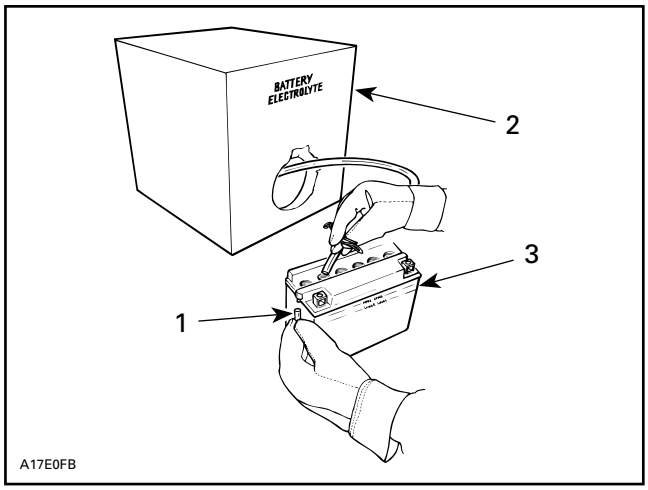
– Remove the sealing tube from the vent elbow.

⚠ WARNING

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

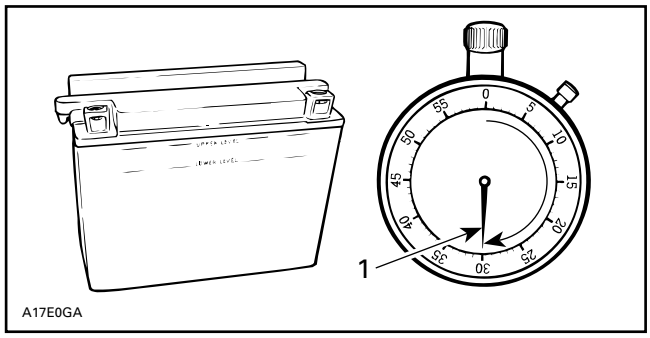
– Remove caps and fill battery to UPPER LEVEL line with electrolyte (specific gravity: 1.265 at 21°C (70°F)).

NOTE: This battery may fill slower than others due to the anti-spill check ball design.



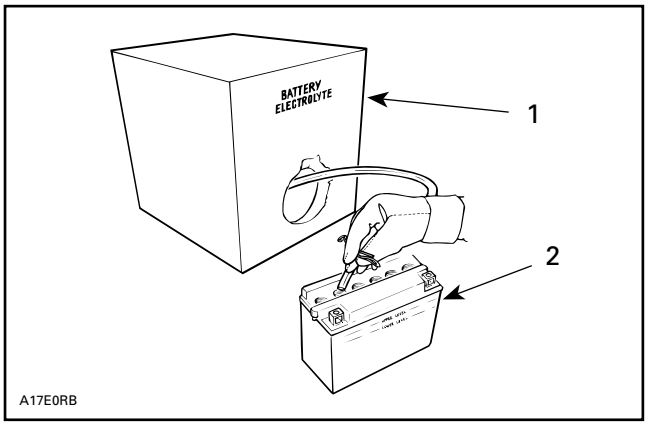
1. Sealing tube removed
2. Battery electrolyte
3. Upper level line

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



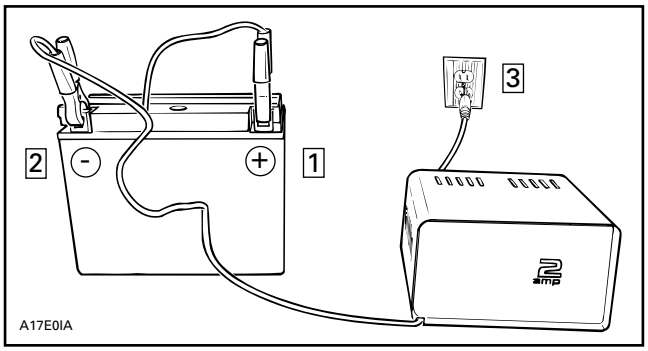
1. 30 minutes

– 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.



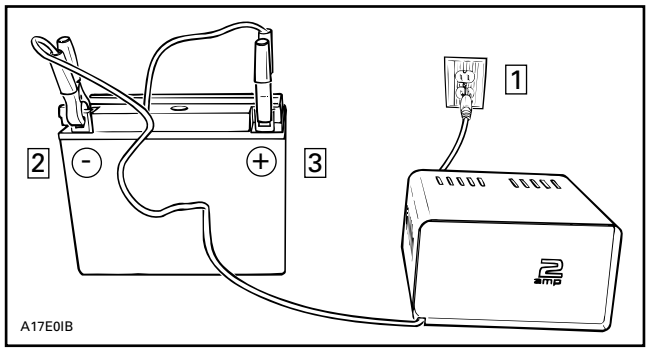
Step 1: Connect + lead to battery + post
Step 2: Connect - lead to battery - post
Step 3: Plug battery charger

⚠ 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.

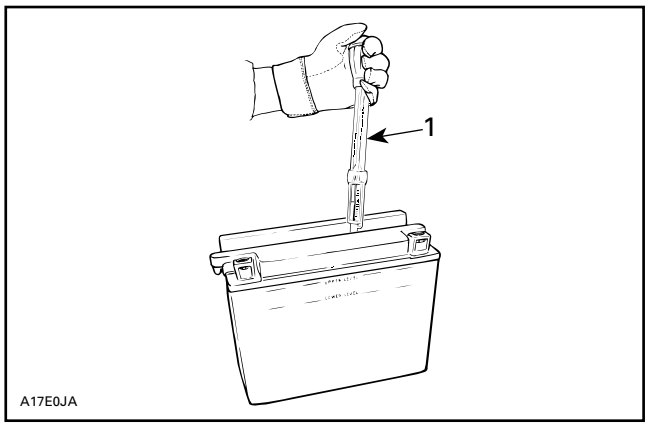
CAUTION: If charging rate raises higher than 2.4 A reduce it immediately. If cell temperature rises higher than 50°C (122°F) or if the casing feels hot, discontinue charging temporarily or reduce the charging rate.

– Disconnect battery charger.



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.

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.

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 (P/N 293 550 004) on battery posts.
– Verify cable routing and attachment.

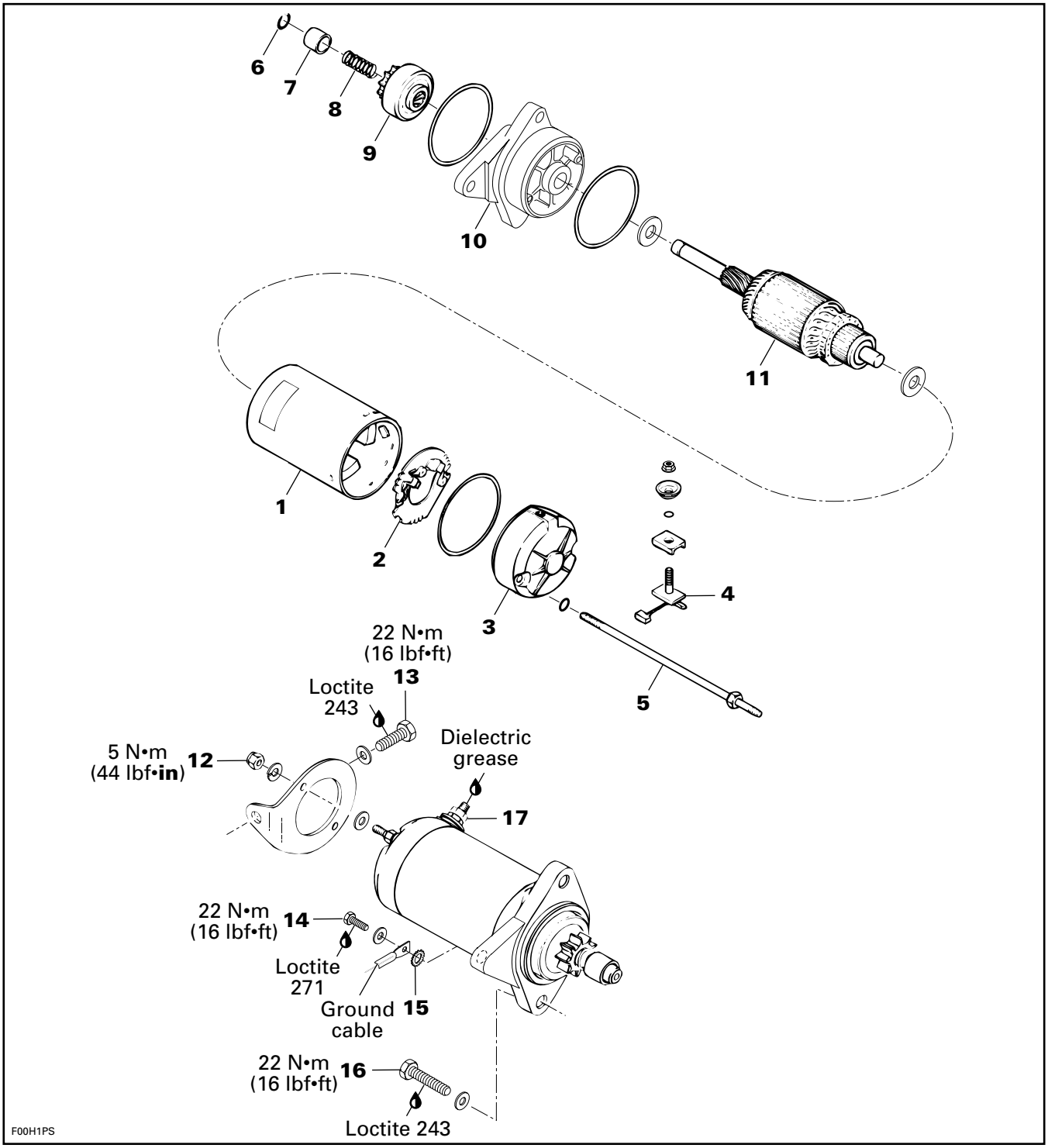
STARTING SYSTEM

SERVICE PRODUCTS

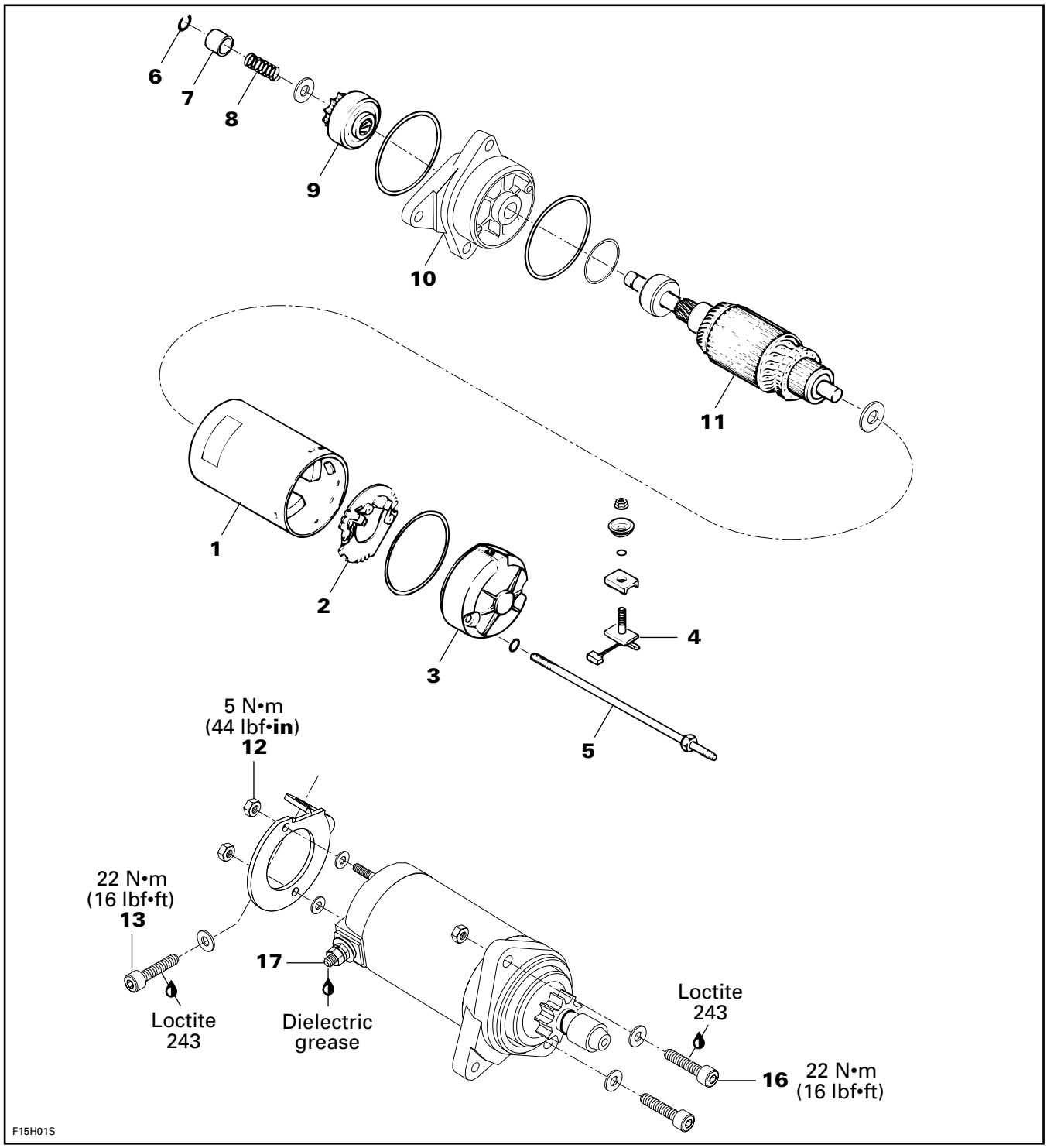
Description	Part Number	Page
dielectric grease	293 550 004	193
Loctite 271	293 800 005	193

ELECTRIC STARTER EXPLODED VIEW

717 Engine

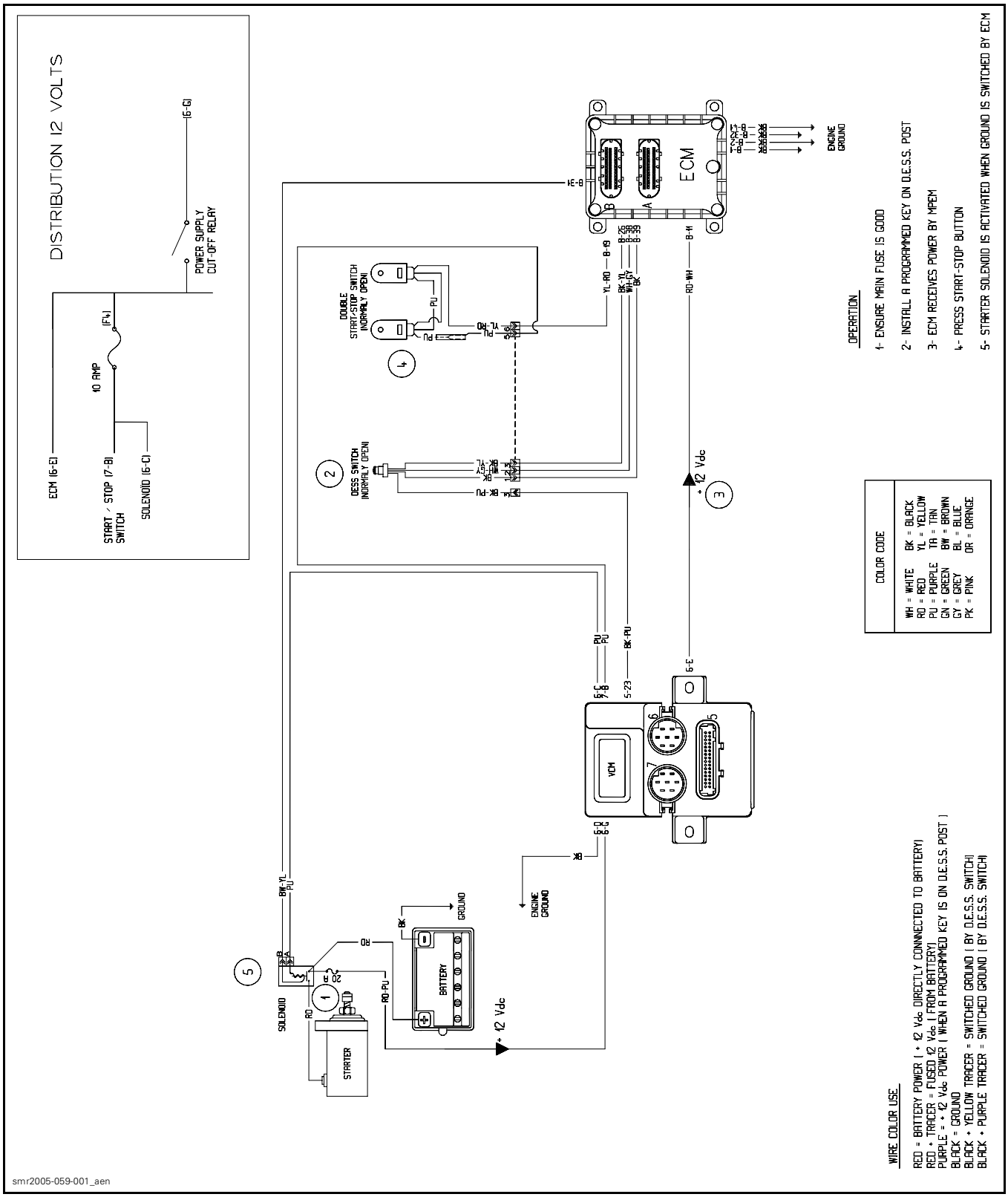


787 RFI Engine



STARTING SYSTEM ELECTRICAL DIAGRAM

RFI Models



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STARTING SYSTEM TROUBLESHOOTING CHART

SYMPTOM	CAUSE	REMEDY
STARTER DOES NOT TURN.	2 short beeps are not heard when installing safety lanyard	Refer to GENERAL in this section.
	Burnt fuse (see text above).	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 and replace.
STARTER ENGAGES; BUT DOES NOT CRANK THE ENGINE.	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.
	Weak battery.	Recharge or replace battery.
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 MOTOR KEEPS RUNNING.	Shorted solenoid winding.	Replace solenoid.
	Melted solenoid contacts.	Replace solenoid.
	Sticking or defective starter clutch.	Lubricate or replace.
	Presence of salt water in the electrical box (if so equipped) which gives continuity.	Verify electrical box watertightness.

GENERAL

Causes of troubles are not necessarily related to starter but may be due to a burnt fuse, faulty battery, bad grounds, start/stop switch, DESS switch, solenoid, electrical cables or connections, MPEM or ECM/VCM (**RFI engines**).

Check these components before removing starter. Consult also the starting system troubleshooting chart for a general view of possible problems.

⚠ WARNING

Short circuit 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.

If no beep is heard when installing the safety lanyard and gauges are not powered, check the following:

– battery voltage/connections (refer to CHARGING SYSTEM)
– fuses
– Power supply cut-off relay (717 engine)
– grounds
– safety lanyard
– DESS switch
– MPEM (717 engine)
– ECM (787 RFI engine)

If other than 2 beeps are heard when installing the safety lanyard, refer to DESS section.

Tool

For best electrical measurement results, use the multimeter Fluke 111 (P/N 529 035 868).

529 035 868

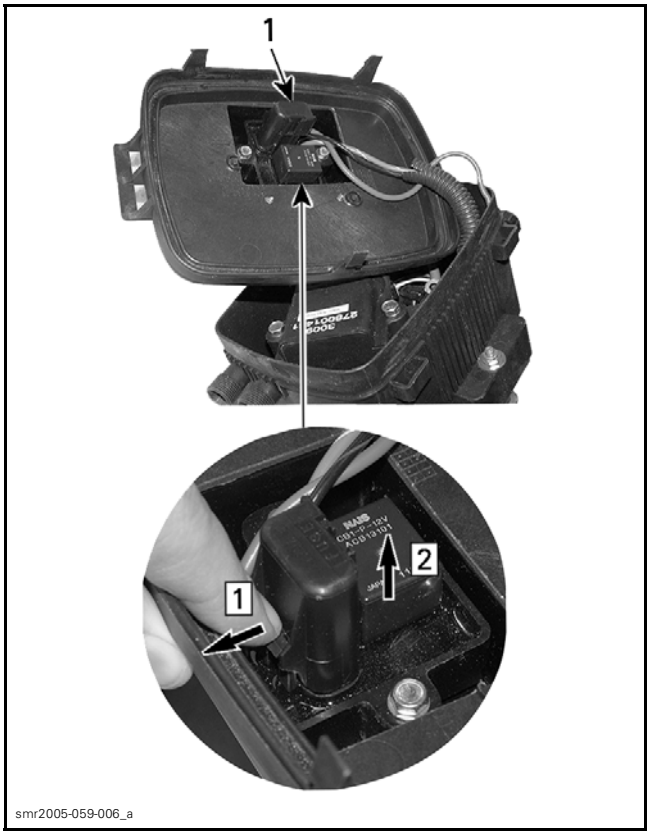
TESTING PROCEDURES

Fuse

Make sure the following fuse(s) is (are) in good condition.

717 Engine

Fuse on the power supply cut-off relay.



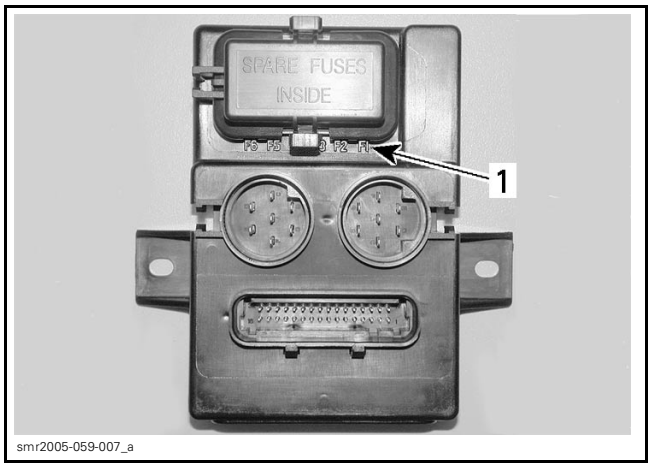
TYPICAL
1. Fuse holder
Step 1: Pull tab
Step 2: Pull fuse housing

787 RFI Engine

Main fuse.

1. Main fuse

Fuse **F4**: 10A, Ignition coil and starter solenoid



1. Fuse location and identification

Power Supply Cut-off Relay

717 Engine

The relay is located in the cover of the electrical box.

First ensure the DESS switch works properly (see testing procedure further).

Test the signal wire (BLACK/PURPLE) to the power supply cut-off relay as follows:

Disconnect the connector on electrical box.

Using a voltmeter, perform the following tests:

Connect test probes to the small RED wire on the starter solenoid and on the RED/PURPLE wire from the cut-off relay. Reading should be 0 V. Otherwise, replace the cut-off relay.

Keeping the test probes on the same wires, connect a jumper wire between the BLACK/PURPLE wire from the cut-off relay to the battery ground. Measure voltage. Reading should be 12 V. Otherwise, check wiring and if it is good, replace the cut-off relay.

If there is no current supply to the electrical components while the DESS switch and the cut-off relay test good, check the wiring harness and connections. If everything test good, the MPEM could be suspected.

Engine Start/Stop Switch

Disconnect start/stop switch connector. Measure resistance between switch wires as per table.

NOTE: On **3D models**, check both switches one at a time.

SWITCH CONNECTOR		SWITCH POSITION	RESISTANCE Ω @ 20°C (68°F)
WIRE			
YELLOW/ RED	PURPLE	Released	Open circuit
		Depressed and held	Close to 0 Ω

If any test fails, replace switch.

DESS Switch

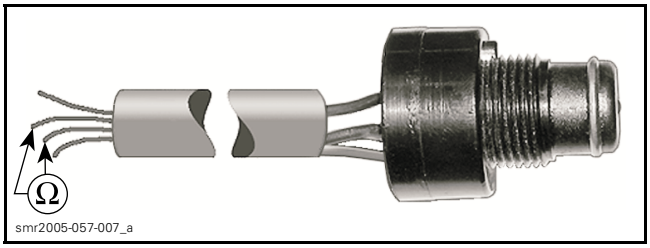
Perform the following continuity tests using an ohmmeter:

Disconnect switch wires.

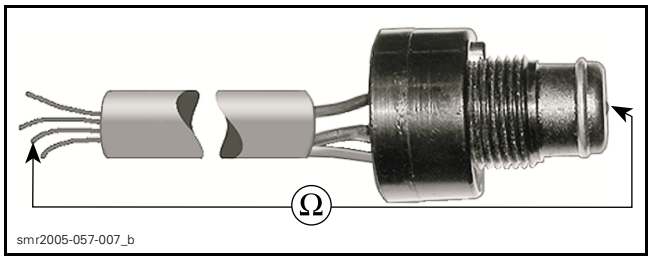
Safety Lanyard Removed

Connect test probes to switch as per tables and measure resistance.

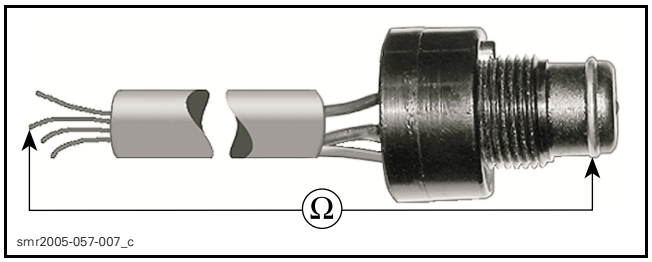
SWITCH CONNECTOR		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK	BLACK/ YELLOW	open circuit



SWITCH CONNECTOR		RESISTANCE Ω @ 20°C (68°F)
WIRE		
WHITE/GRAY	switch terminal	close to 0 Ω



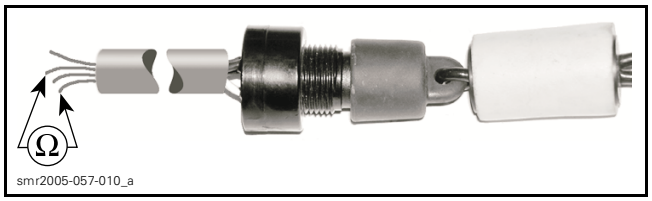
SWITCH CONNECTOR		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK	switch ring	close to 0 Ω



Safety Lanyard on Switch

Connect test probes to switch as per table and measure resistance.

SWITCH CONNECTOR		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK	BLACK/ YELLOW	close to 0 Ω

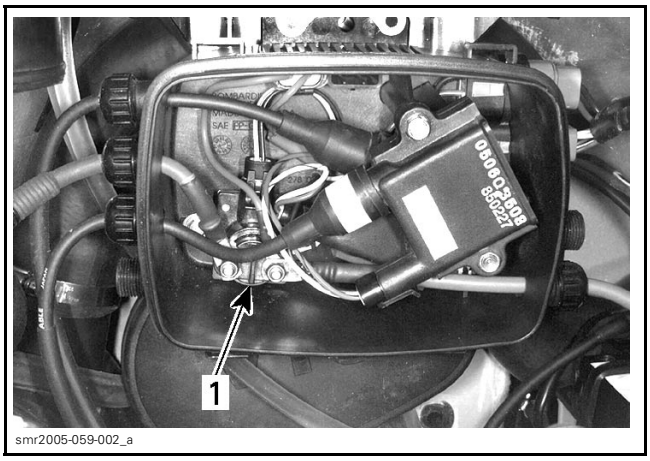


If any resistance test fails, replace DESS switch.

Solenoid

717 Engine

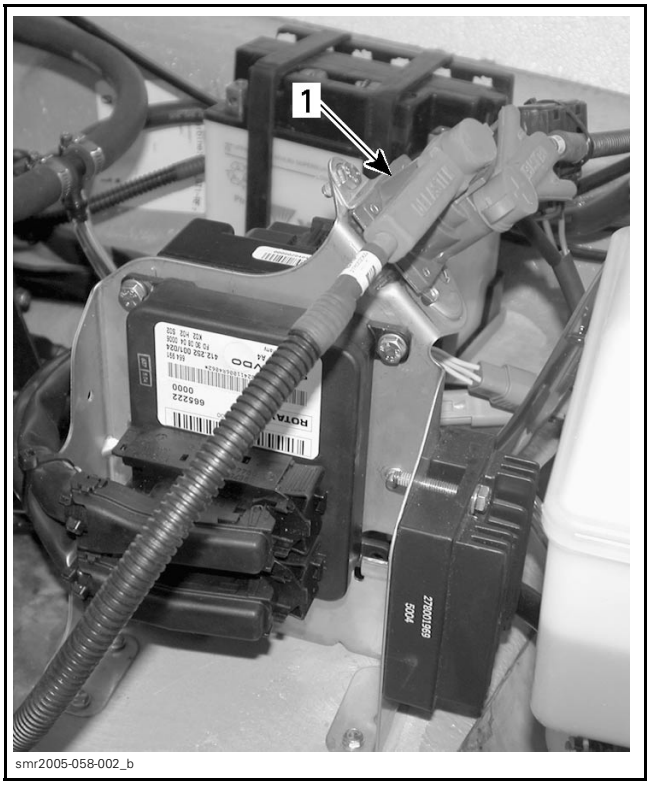
The Solenoid is located inside the rear electrical box.



1. Solenoid

787 RFI Engine

Solenoid is located above ECM/VCM.



1. Solenoid

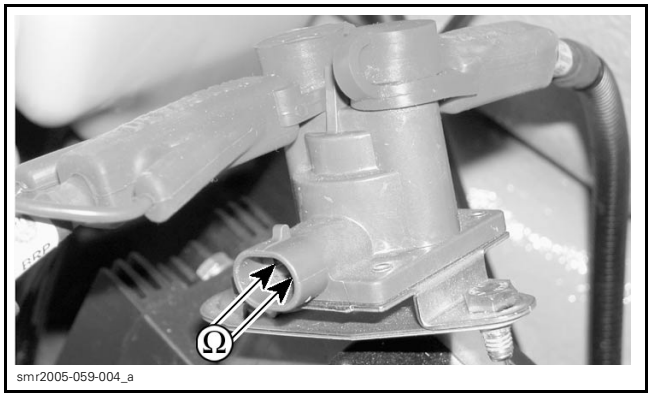
Inspect connections and clean as necessary.

All Engines

Static Test: Continuity

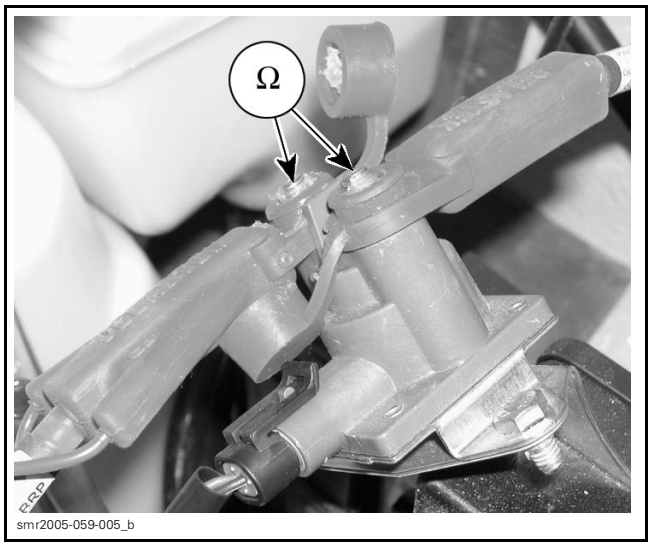
With a multimeter, check primary winding resistance as follows.

SOLENOID CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A	B	approximately 5 Ω



TYPICAL

SOLENOID CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
Battery post	Starter post	Open circuit



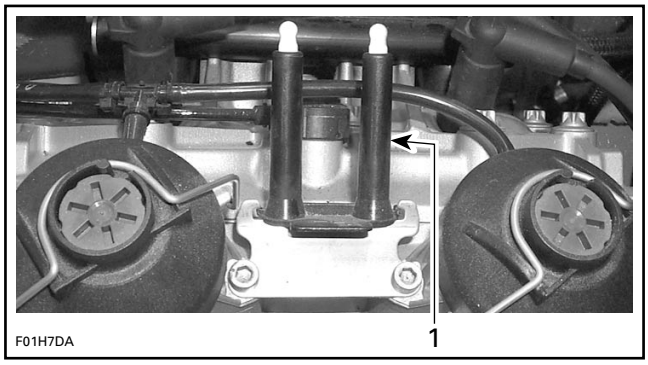
TYPICAL

If any measurement is out of specification, replace solenoid.

Dynamic Test

Disconnect spark plug cables and connect them on grounding device.

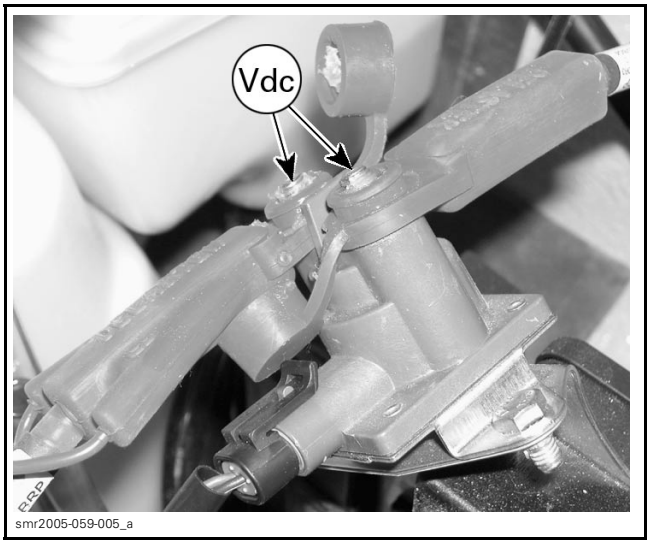
NOTE: This is done to avoid engine starting.



1. Grounding device

Depress start/stop button and while engine is cranking, measure the voltage drop as follows with a multimeter.

SOLENOID CONNECTOR		MEASUREMENT
PIN		VOLTAGE
Post coming from battery	Post going to starter	0.2 Vdc max.



TYPICAL

If voltage is out of specification, replace solenoid.

Electrical Cables or Connections

Check all connections, grounds, cables and wires. Tighten any loose cables. Replace any chafed wires.

REMOVAL

Starter

Disconnect BLACK cable ground connection from battery.

⚠ WARNING

Always disconnect ground cable first and reconnect last.

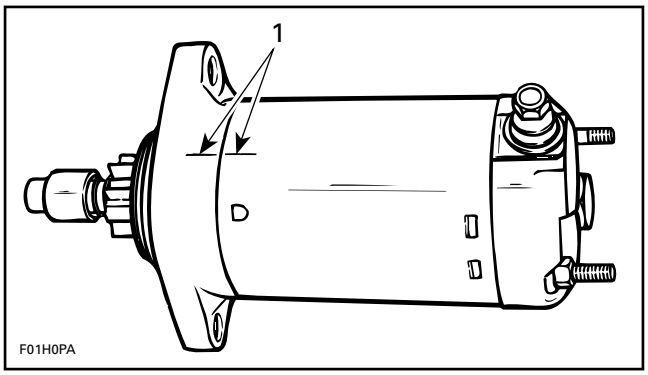
Disconnect RED cable connection from battery.

Remove the following parts:
- cables from starter
- screw **no. 13** of starter rear support
- starter mount screws **no. 16**.

DISASSEMBLY

Starter

Before disassembling, trace index marks on yoke **no. 1** and clutch housing **no. 10** to ease further assembly.



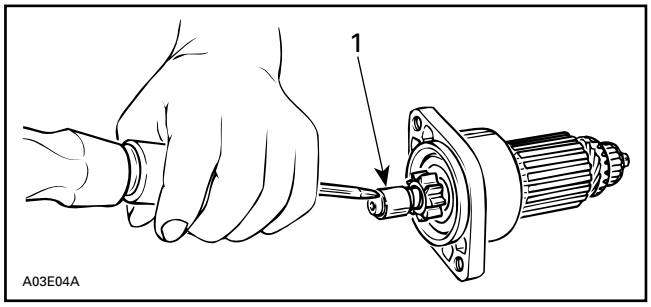
TYPICAL
1. Trace indexing marks

Remove starter support nuts **no. 12** then through bolts **no. 5**. Separate end frame **no. 3** from yoke assembly **no. 1**. Withdraw yoke assembly from armature **no. 11**.

Brush holder **no. 2** can be removed from end frame **no. 3** by unscrewing nut retaining terminal.

Check that the radial play between the armature shaft and end frame is not greater than 0.20 mm (.008 in). Replace end frame if so.

Tap the pinion stop collar **no. 7** using a screwdriver. Remove circlip **no. 6**. Disassemble pinion stop collar **no. 7** and spring **no. 8**.



1. Pinion stop collar

Turn clutch assembly **no. 9** clockwise to remove it from armature assembly **no. 11**.

Pull housing from armature.

CLEANING

Starter Parts

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.

⚠ 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.

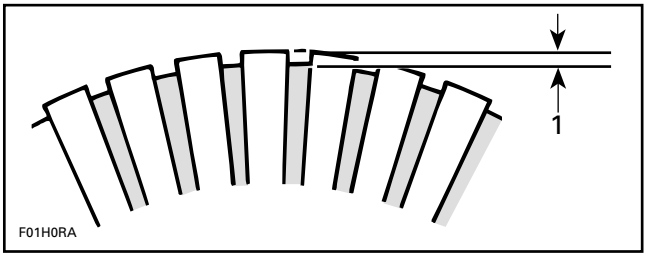
INSPECTION

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.

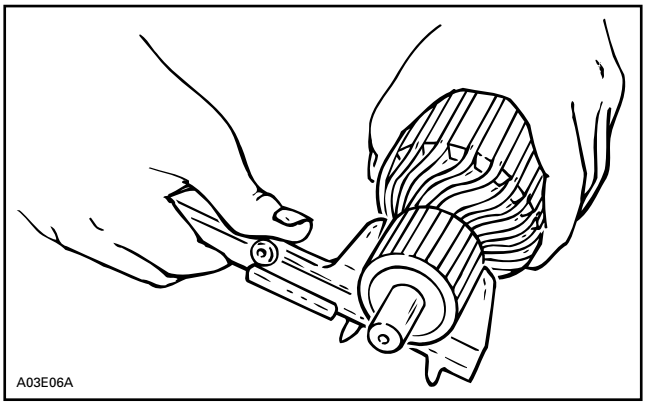
Check commutator for mica depth. If depth is less than 0.20 mm (.008 in), undercut mica. Be sure that no burrs are left and no copper dust remains between segments after undercutting operation is completed.



1. Commutator undercut 0.20 mm (.008 in)

Check commutator out of round condition with V-shaped blocks and an indicator. If commutator out of round is more than 0.40 mm (.016 in), commutator should be turned on a lathe.

Check commutator outer diameter. If less than 27 mm (1.063 in), replace.



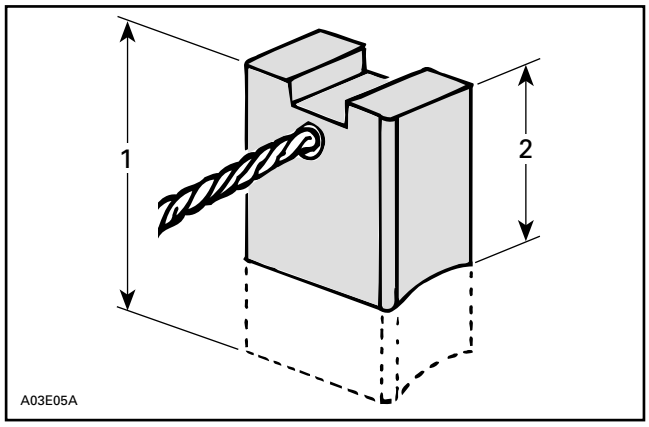
Brush Holder

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)

Overrunning Clutch

Pinion of overrunning clutch should turn smoothly in clockwise direction, and should not slip in a counterclockwise direction. If defective, replace.

Check pinion teeth for wear and damage. If defective, replace.

NOTE: Always check engine ring gear teeth for wear and damage. If defective replace ring gear. Refer to MAGNETO.

ASSEMBLY

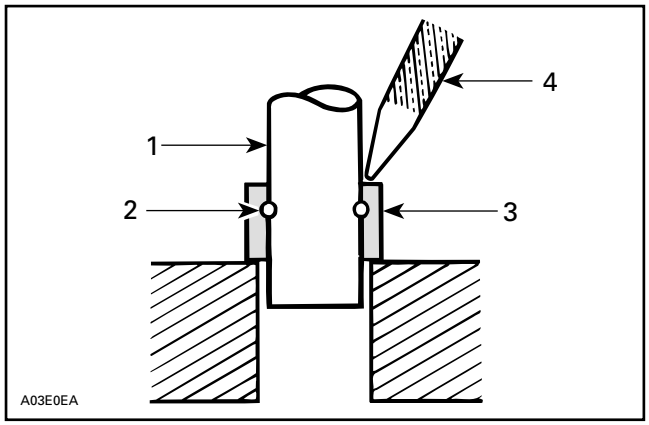
Starter

Reverse the order of disassembly to reassemble starter. However, attention should be paid to the following operations.

Prior to assembling, coat sliding surfaces on armature shaft splines, overrunning clutch and bushing (**717 engines**) with G.E. Versilube G 341 M or ESSO Beacon 325 lubricant or equivalent.

After placing pinion stop collar **no. 7** on armature shaft **no. 11**, fit circlip **no. 6** into armature shaft, then make sure that it is properly secured.

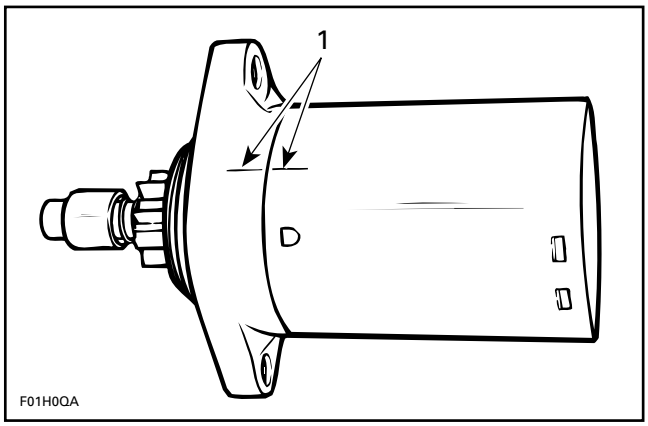
Slide stop collar **no. 7** over circlip **no. 6** and secure in place by punching it at two or three places.



1. *Armature shaft*
2. *Circlip*
3. *Pinion stop collar*
4. *Punch*

Yoke Assembly and Clutch Housing

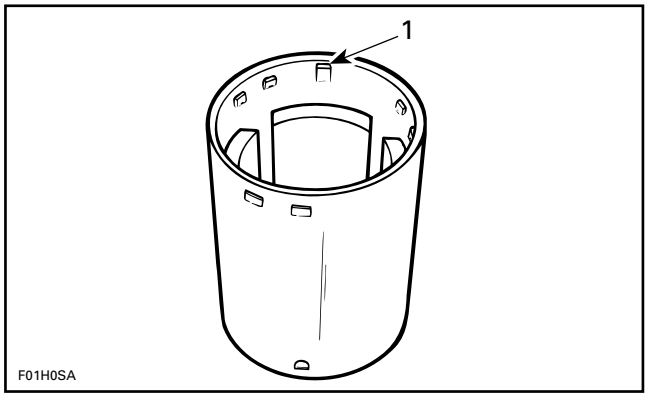
Align previously traced indexing marks.



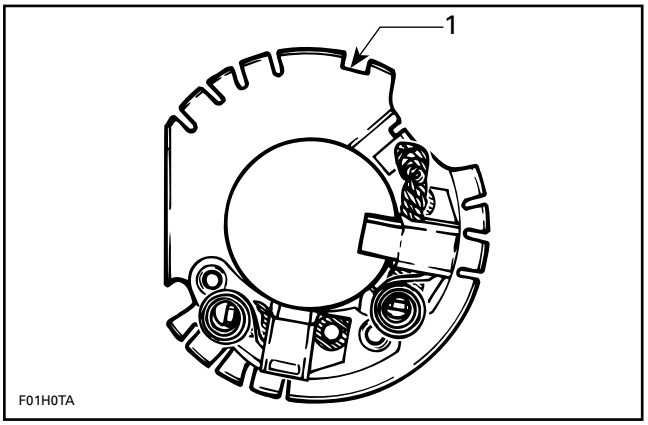
TYPICAL
1. *Align marks*

Open brushes **no. 4** and slide over commutator.

Align end frame locating notch with yoke locating protrusion and properly sit brush holder **no. 2** into yoke **no. 1**.

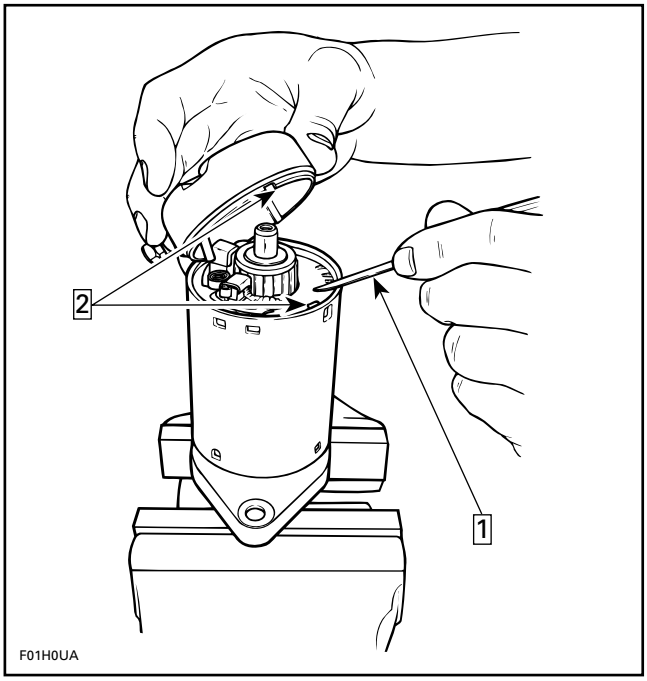


1. *Locating protrusion is the higher one*



1. *Brush holder locating notch*

To ease end frame installation, retain brush holder with a small screwdriver while installing end frame.



Step 1: Retaining brush holder with a screwdriver
Step 2: Align here

Align end frame notch with brush holder notch/yoke protrusion.

CAUTION: Make sure end frame fits perfectly on yoke.

INSTALLATION

Starter

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.

Starter Retaining Screws

Apply service products as per the exploded view given at the beginning of the section, on threads and torque starter screws **no. 13** and **no. 16** to 22 N•m (16 lbf•ft).

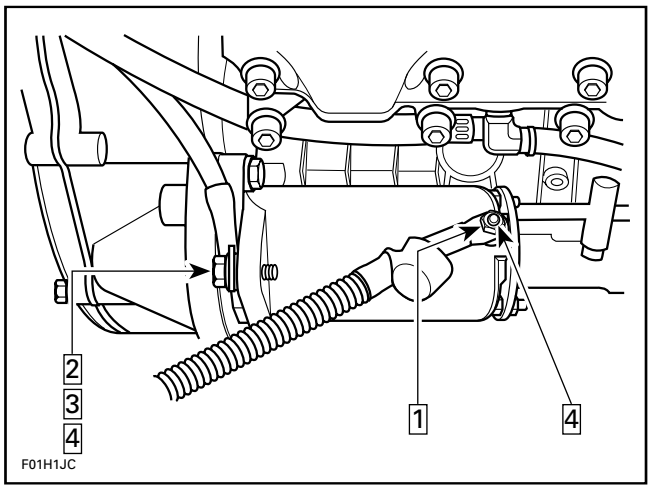
RED Positive Cable Retaining Nut

Connect the RED positive cable to the starter and torque nut **no. 17** to 6 N•m (53 lbf•**in**). Apply dielectric grease (P/N 293 550 004) on terminal and nut.

BLACK Negative Cable Retaining Screw and Teeth Washer

Apply Loctite 271 (P/N 293 800 005) to screw.

Connect BLACK negative cable to starter using flat washer, teeth washer **no. 15** and screw **no. 14**. Torque screw to 22 N•m (16 lbf•ft). Apply dielectric grease (P/N 293 550 004) on terminal and screw.



717 ENGINE SHOWN
*Step 1: Torque nut to 6 N•m (53 lbf•**in**)*
Step 2: Apply Loctite 271 on screw
Step 3: Torque screw to 22 N•m (16 lbf•ft)
Step 4: Apply dielectric grease

⚠ 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		0.6 kW
Voltage		12 V
Rated time		30 seconds
Rotation		Counterclockwise (viewed from pinion side)
Weight		Approx. 2 kg (4.4 lb)
Performance specification at 20°C (68°F)	No load	11.5 V, 20 A max. 5500 RPM
	Load	8.5 V, 170 A max. 2200 RPM
	Stall	5 V, 350 A max. 0 RPM
Battery		12 V, 19 Ah

INSTRUMENTS AND ACCESSORIES

SERVICE TOOLS

Description	Part Number	Page
Fluke 111	529 035 868	195

GENERAL

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

To perform verifications, a good quality multimeter such as Fluke 111 (P/N 529 035 868) should be used.

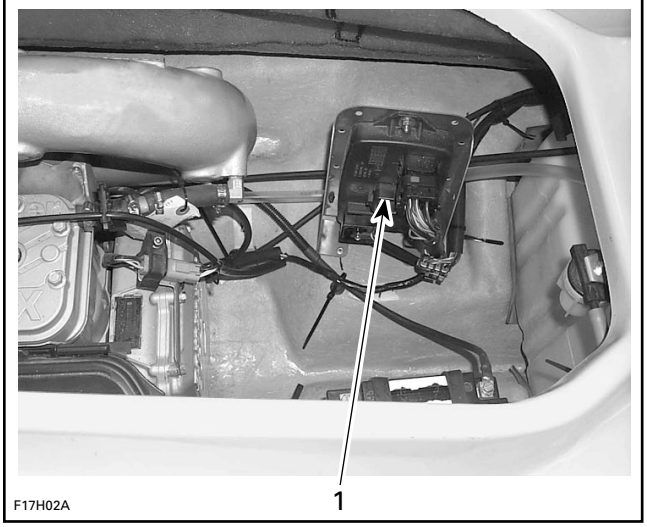
529 035 868

FUSES

GTI Models

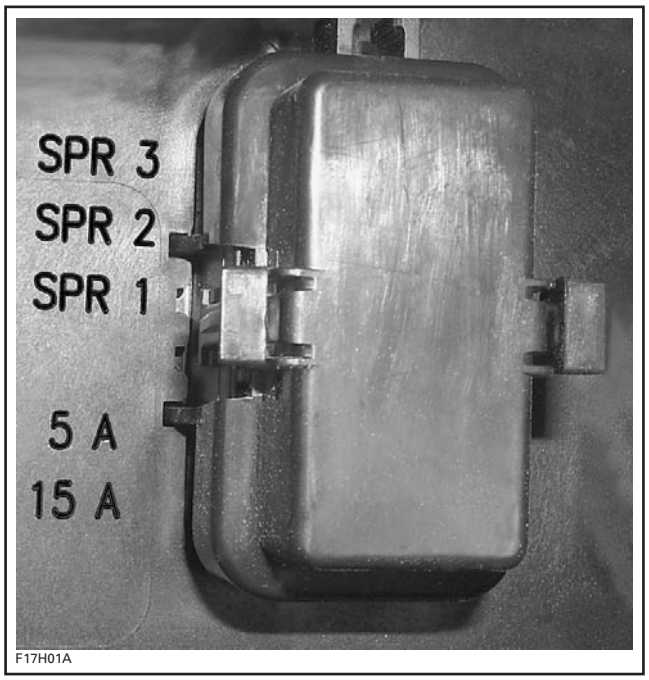
Fuse are located on the Multi-Purpose Electronic Module (MPEM) and in the rear electrical box.

Multi-Purpose Electronic Module (MPEM)



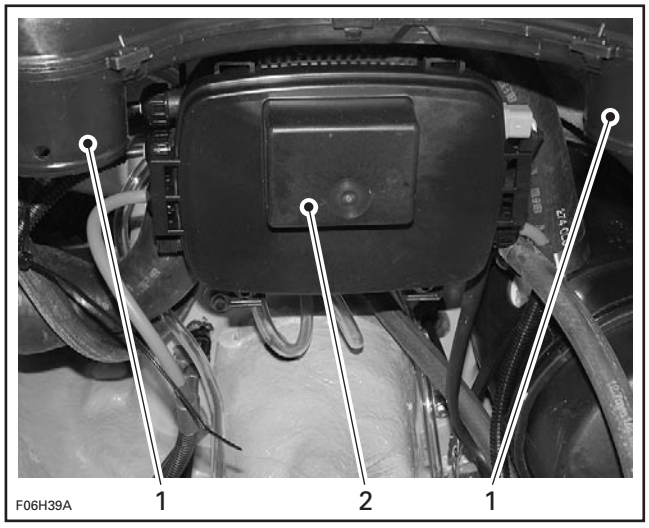
TYPICAL
1. MPEM

Fuse identification is beside the fuse holder. SPR means spare (fuse).



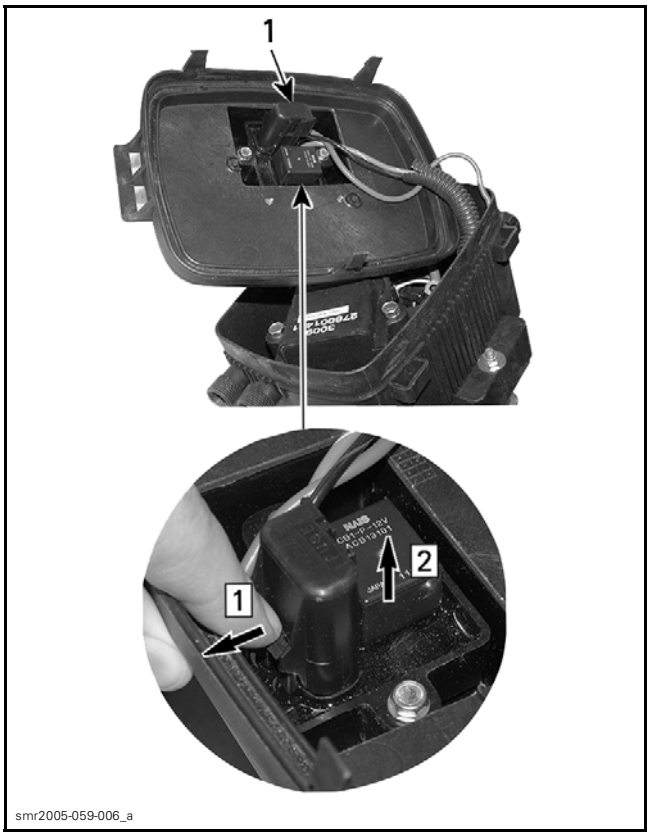
FUSE IDENTIFICATION — 5 A: MPEM AND 15 A: BATTERY

Electrical Box



TYPICAL
1. Vent tubes removed
2. Electrical box

Unclip and remove cover of the electrical box to expose the holder of the main fuse.



TYPICAL
1. Fuse holder
Step 1: Pull tab
Step 2: Pull fuse housing

RFI Models

Refer to ENGINE MANAGEMENT.

MULTI-PURPOSE ELECTRONIC MODULE (MPEM)

NOTE: For models with a 787 RFI Engine, refer to ENGINE MANAGEMENT for more information on VCM/ECM.

GTI Models

The MPEM is directly powered by the battery through the cut-off relay. It has a micro-processor inside of its sealed case.

The MPEM features a permanent memory that will keep the programmed safety lanyard(s) active and other vehicle information, even when the battery is removed from the watercraft.

All the electrical system is controlled by the MPEM. It is in charge of the following electrical functions:

– power distribution

– ignition system
– Digitally Encoded Security System
– monitoring system
– diagnostic mode.

Power Distribution

A power supply cut-off relay supplies the MPEM from the battery.

The MPEM distributes power from the cut-off relay to all accessories.

Accessories are protected by fuses integrated in the MPEM, in fuse holder(s) close to MPEM or in the electrical box. Fuses are identified besides their holder. See below for fuses location and description.

Gauge Current Supply

When the safety lanyard is installed, 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.

Safety Lanyard Reminder

If engine is not started within 5 seconds after installing the safety lanyard on its post, 4 short beeps every 3 second interval will sound for approximately 2 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.

Ignition System

The MPEM controls the ignition timing.

Engine RPM Limiter

The MPEM will limit the maximum engine speed.

Digitally Encoded Security System (DESS)

When connecting a safety lanyard cap on the switch, the DESS system inside the MPEM is activated and will emit audible signals:

– 2 short beeps indicate a right safety lanyard is being used and gauges are supplied with current for 33 seconds. The MPEM will thus allow the engine to start.
– 1 long beep indicates a wrong safety lanyard is being used or that the anti-start feature is defective. Current to gauges is cut after the audible signal is emitted and the engine cannot be started.

A wrong safety lanyard is a safety lanyard which is defective or not programmed in the MPEM memory.

To better understand the anti-start feature, refer to DESS (DIGITALLY ENCODED SECURITY SYSTEM) section.

If the MPEM responds differently than specified, refer to the TROUBLESHOOTING section.

Engine Starting

If the MPEM recognizes a valid safety lanyard, it allows engine to start when the start/stop switch is pressed.

If start/stop button is held after engine has started, the MPEM automatically stops the starter when the engine speed reaches 1000 RPM.

Monitoring System

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 Information Center gauge.

When the oil level is low in the reservoir, the MPEM sends out a signal to the Information Center gauge and the pilot lamp on the gauge will turn on.

Overheat Sensor

When the engine temperature reaches a threshold value, the MPEM triggers a continuous beep to indicate overheating.

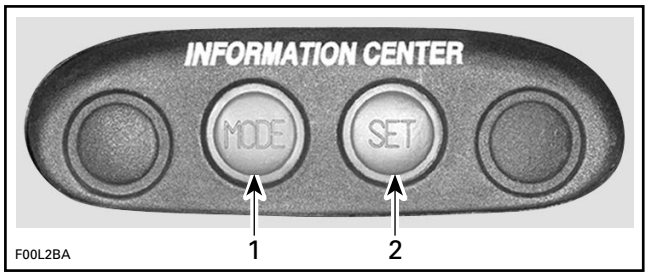
Diagnostic Mode

In order to facilitate the use of the watercraft, a system controls the digitally encoded security system (DESS) and sends, through a beeper, some audible signals informing the operator of a specific situation. The diagnostic mode is automatically activated when connecting the safety lanyard cap to the switch. Refer DIGITALLY ENCODED SECURITY SYSTEM section for more details.

INFORMATION CENTER

GTI LE RFI Models

This is a LCD multifunction gauge. Different displays and functions can be activated using 2 buttons — MODE and SET — following specific sequences as described below.

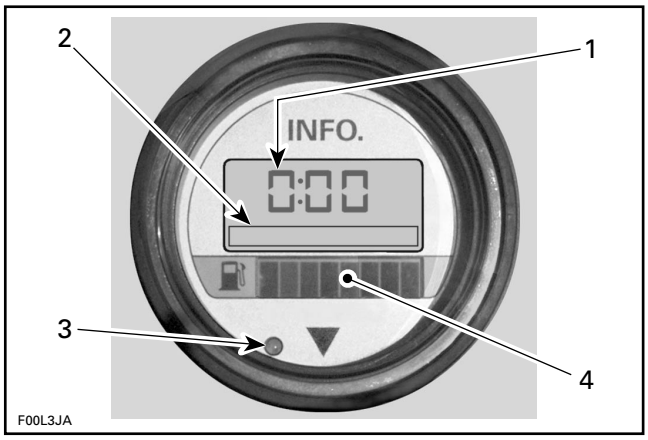


1. *To change display mode*
2. *To set or reset a function*

Resetting a Function

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

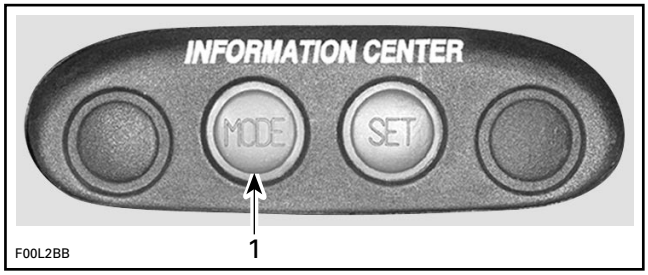
The information center includes the following display areas.



1. *General display*
2. *Message/units display*
3. *Warning light*
4. *Fuel level display*

General Display

Repeatedly pressing the MODE button scrolls the following displays: compass, tachometer, speedometer, average speed, trip meter, hourmeter, water temperature, exterior temperature and chronometer.



1. *Press to change display mode*

When you are satisfied with your choice, stop pressing the button. The display you have chosen will remain until it is changed. When safety lanyard is installed, the last chosen display will come back.

Compass: Displays the cardinal points to indicate the orientation of the watercraft.

⚠ WARNING

Use the compass as a guide only. Not to be used for navigation purposes.

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

Speedometer: Indicates the speed of watercraft in kilometers per hour (KPH) or miles per hour (MPH).

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

Trip Meter: 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.

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).

Chronometer: Allows to measure an interval of time in hours and minutes (hh:mm).

Message Display

The information center features a display area that blinks a message whenever one of the following circumstances occurs:

- compass error (COMPAS)
- maintenance (MAINT)
- engine overheating (H-TEMP)
- low fuel (FUEL-LO)
- low oil (OIL LOW)
- low voltage (12 V LOW).

A beeper will sound when one of the four last circumstances occurs.

Except for low fuel and low oil, which can be corrected by refilling, it is recommended to see an authorized SEA-DOO dealer when other messages occur.

The warning light will blink at the same time.

Warning Light

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

Fuel Level Display

Bar gauge continuously indicates the amount of fuel in the fuel tank while riding. A low-fuel condition is also indicated when it occurs. See MESSAGE DISPLAY above.

Display Priorities

As a self test, all LCD segments and the LED will turn on for 3 seconds each time the information center is activated (when safety lanyard is installed).

When the information center is activated, the last function set will be displayed if it was the tachometer, speedometer or chronometer. If another function was set, the compass will be displayed. **On models without** the compass function, the word "Sea Doo" will be displayed.

In the event of a warning message, the message will blink and override the units display.

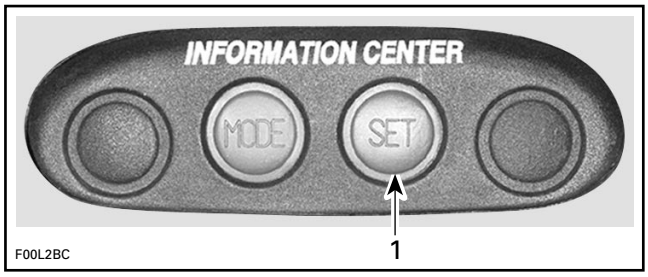
If more than one warning message occurs, the blinking messages will scroll every 4 seconds.

Other Functions

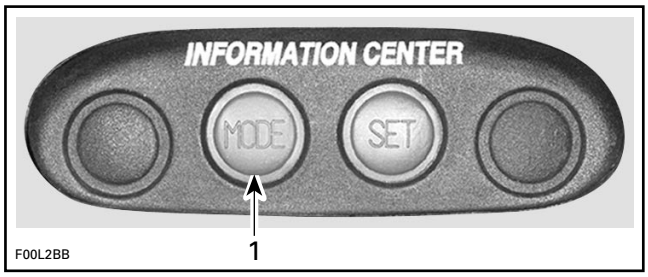
The following describes how to select other available functions.

Language Option

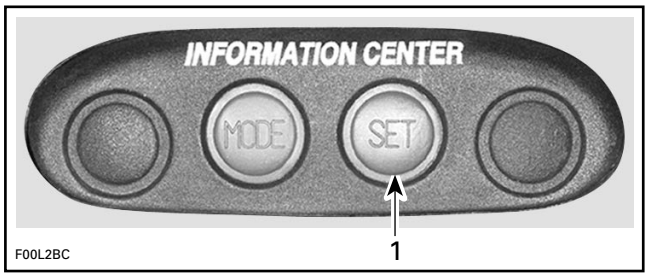
While in the compass mode (while "SeaDoo" is displayed **on models without** compass):



1. Press and hold for 2 seconds



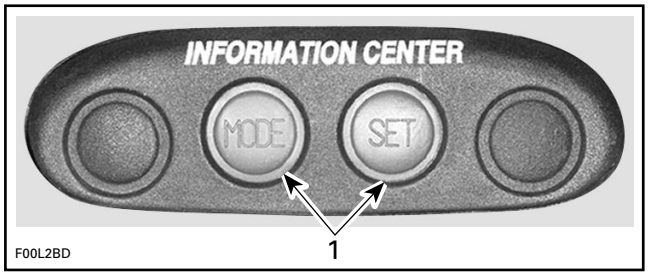
1. Repeatedly press



1. Press to end

English/Metric System

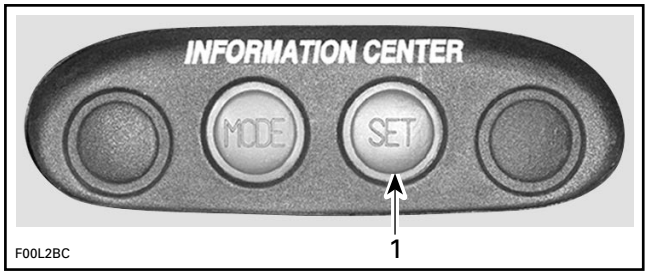
Allows to display the units in the metric system or in the SAE English system.



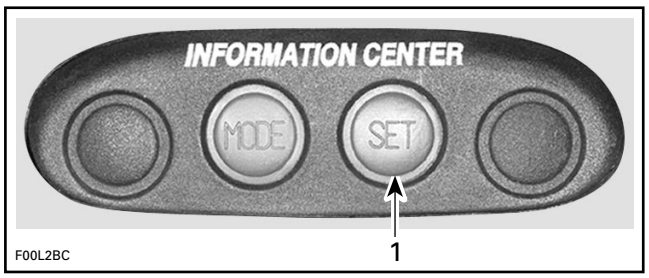
1. Press TOGETHER and hold for 2 seconds

Chronometer

While in the chronometer mode:



1. Press to start or stop chronometer



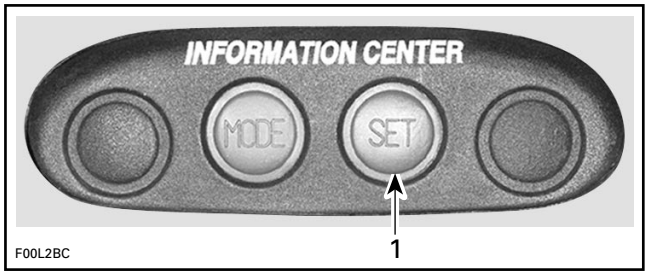
1. Press and hold for 2 seconds to reset

Chronometer is reset every time engine is turned off.

Maintenance Information

When the watercraft is due for a maintenance inspection, the message MAINT will blink.

To clear the warning message while it is blinking:



1. Press and hold for 2 seconds to reset

TESTING PROCEDURES

POWER SUPPLY CUT-OFF RELAY

GTI Models

When the safety lanyard is on its switch, the relay allows current to be supplied from the battery to the RED/PURPLE wire which supplies the MPEM and all the electrical components.

When the safety lanyard is NOT on its switch, the relay cuts the current supply from the battery to the MPEM and the electrical components thus preventing current drain that would slowly discharge the battery.

The relay is located in cover of electrical box.

First ensure the DESS switch works properly. Refer to STARTING SYSTEM.

Test the signal wire (BLACK/PURPLE) to the power supply cut-off relay as follows:

Disconnect the connector on electrical box.

Using a voltmeter, perform the following tests:

Connect test probes to the small RED wire on the starter solenoid and on the RED/PURPLE wire from the cut-off relay. Reading should be 0 V. Otherwise, replace the cut-off relay.

Keeping the test probes on the same wires, connect a jumper wire between the BLACK/PURPLE wire from the cut-off relay to the battery ground. Measure voltage. Reading should be 12 V. Otherwise, check wiring and if it is good, replace the cut-off relay.

If there is no current supply to the electrical components while the DESS switch and the cut-off relay test good, check the wiring harness. If it tests good, the MPEM could be suspected. Try a new one.

INFORMATION CENTER

GTI LE RFI Models

FUNCTION	WIRE
Tachometer signal	GRAY
Battery condition	RED/FURPLE
Lake temp signal	TAN/ORANGE
Speed sensor detection	BLACK/RED
Maintenance signal	BLACK/YELLOW
Lake temperature ground	BLACK/ORANGE
Low oil signal	BLUE
Fuel level signal	PINK
Mode switch	YELLOW/PURPLE
Set switch	GREEN/PURPLE
Switch supply	PURPLE/ORANCE
High temperature signal	TAN/BLUE
Power and speedometer signal	PURPLE/YELLOW
Power supply (12Vdc)	PURPLE
Ground	BLACK
Compass North	GREEN/WHITE
Compass West	GREEN/RED
Compass South	GREEN/YELLOW
Compass East	GREEN/BLUE
Compass supply	PURPLE/GREEN
Compass ground	BLACK/GREEN
Exterior temperature ground	BLACK/WHITE
Exterior temperature signal	TAN/WHITE

The accuracy of some features of the Information Center can be checked with a potentiometer.

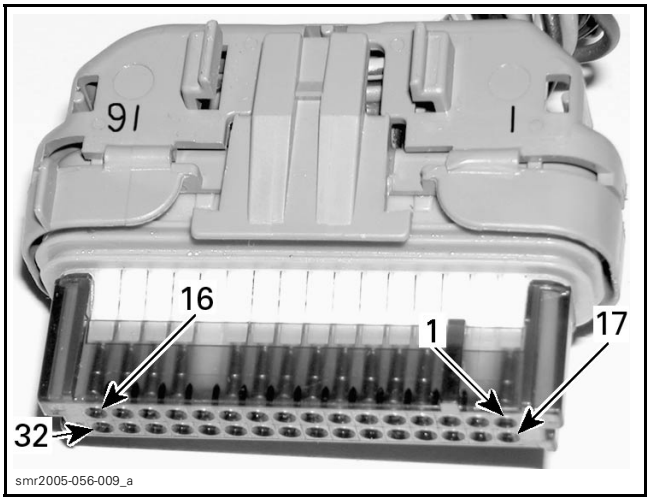
Fuel Level

Fuel Level Sender

Test fuel level sender. See FUEL LEVEL SENDER further in this section. If sender works properly, perform the following test.

Fuel Level Input

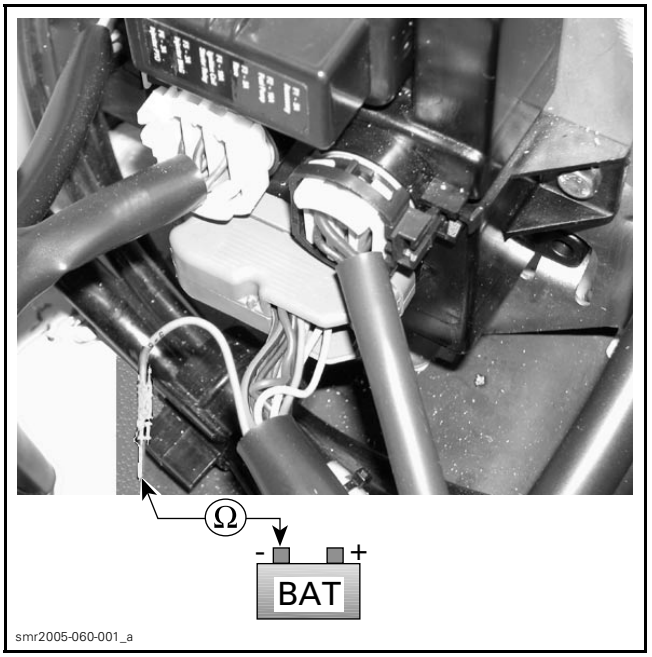
Disconnect the connector #5 from the VCM.



Remove the PINK wire from position 21 in the connector no. 5.

Reconnect the connector to VCM.

Connect potentiometer test probes between PINK wire and battery ground.



Adjust potentiometer to the resistance values as per following chart to test the accuracy of the Information Center.

RESISTANCE (Ω)	DISPLAYED SEGMENT ON FUEL LEVEL LCD	LOW FUEL LEVEL RED LIGHT
4.8 + 2.2	FULL	OFF
17.8 ± 2.2	7/8	OFF
27.8 ± 2.2	6/8	OFF
37.8 ± 2.2	5/8	OFF
47.8 ± 2.2	4/8	OFF
57.8 ± 2.4	3/8	OFF
67.8 ± 2.8	2/8	OFF
77.8 ± 3.6	1/8	ON
89.8 ± 3.6	EMPTY	ON

IMPORTANT

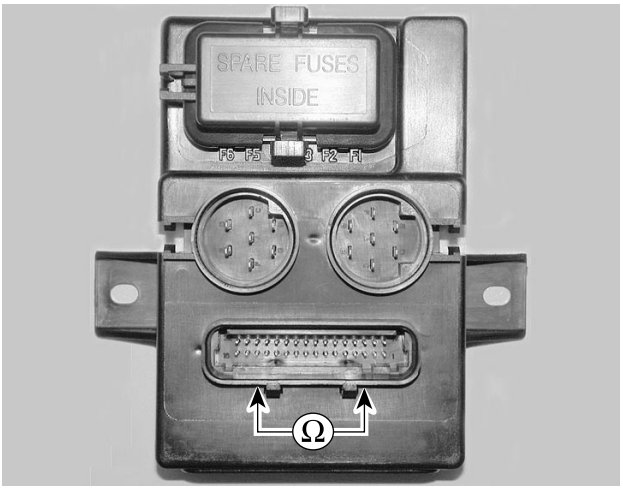
Since fuel gauge is purposely designed to update the display after a certain delay, changing the potentiometer value will not quickly show up on gauge display as you would expect. Proceed as follows for the test.

1. Ensure potentiometer is not connected to circuit.
2. Set potentiometer to desired resistance value.
3. Connect potentiometer to circuit.
4. Ensure fuel gauge display is OFF.
5. Install safety lanyard to DESS post.
6. Read fuel gauge.
7. Repeat steps 1 to 6 for each potentiometer setting.

If out of specification, check wiring harness/connectors. If wiring/connectors are good, try a new Information Center.

If everything test good and fuel gauge still does not work, verify continuity of circuit inside VCM as follows.

VCM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
5–5	5-21	Closed circuit max 0.2 Ω



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If out of specification, replace VCM.

Water Temperature (L temp)

Water Temperature Sensor

NOTE: The water temperature sensor is integrated with the speed sensor.

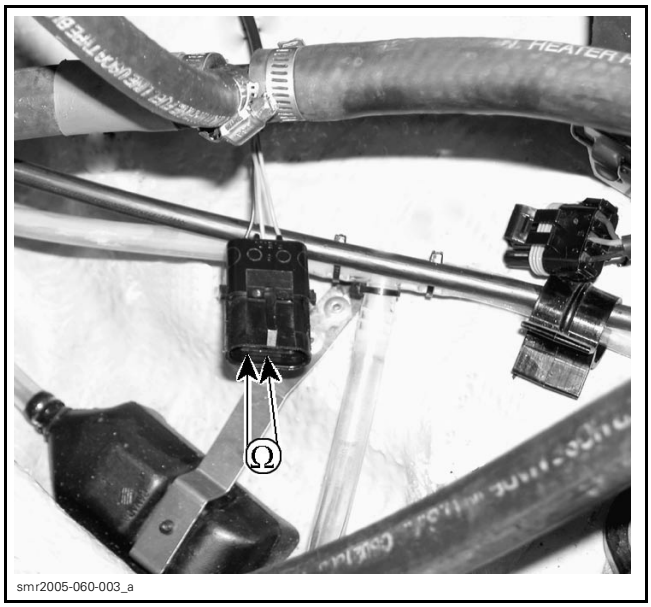
Select the water temperature mode in the Information Center.

Spray the speed sensor with water using a garden hose. The temperature reading on the Information Center should adjust to the water temperature.

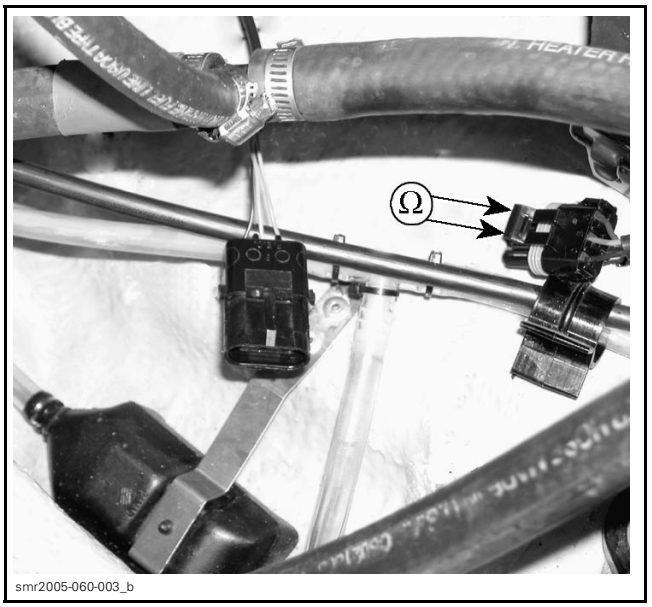
Otherwise, disconnect speed sensor connector.

Measure sensor resistance.

SENSOR CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
B	C	Resistance according to the ambient temperature. See table below.



SENSOR CONNECTOR



MAIN HARNESS CONNECTOR

If resistance is out of specification, replace the speed sensor. Otherwise, perform the following procedure.

Water Temperature Input

Disconnect the speed sensor connector.

Connect potentiometer test probes as follows.

MAIN HARNESS CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
B	C	See table below.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the Information Center.

RESISTANCE (Ω)	TEMPERATURE (°C)
25407	5 ± 2
19911	10 ± 2
15718	15 ± 2
12495	20 ± 2
10000	25 ± 2
8054	30 ± 2
6528	35 ± 2

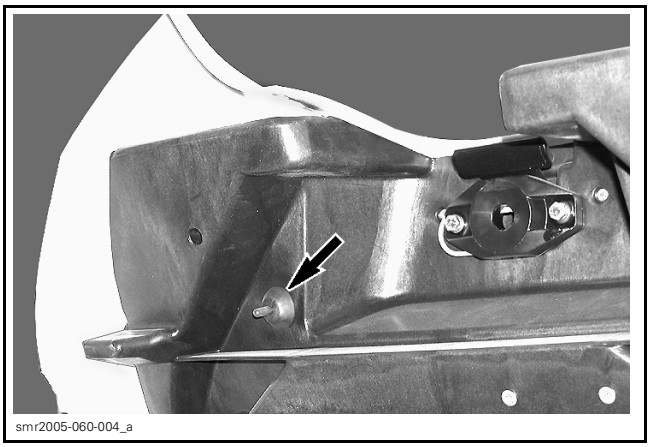
RESISTANCE (Ω)	TEMPERATURE (°F)
22799	45 ± 4
17262	55 ± 4
13470	65 ± 4
10496	75 ± 4
8264	85 ± 4
6528	95 ± 4

If out of specification, check wiring harness/connectors. If good, try a new Information Center.

Exterior Temperature

Exterior Temperature Sensor

Temperature sensor is located on inner side of storage cover.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Select the exterior temperature mode in the Information Center.

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

Otherwise, open top storage compartment cover to reach sensor.


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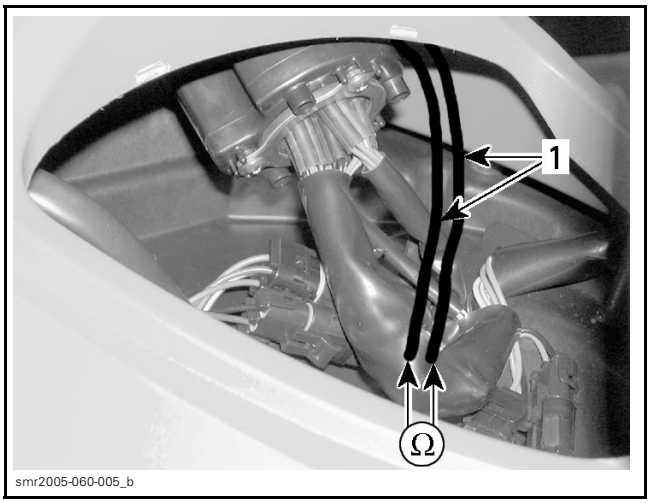
Unplug connector from temperature sensor.

Connect a temporary 2-pin connector with wires to sensor.

Measure sensor resistance to end of temporary wires.

SENSOR TEST WIRES		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A	B	Resistance according to the ambient temperature. See table below.



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1. Sensor test wires

Remove test wires.

If resistance is out of specification, replace sensor. Otherwise, perform the following procedure.

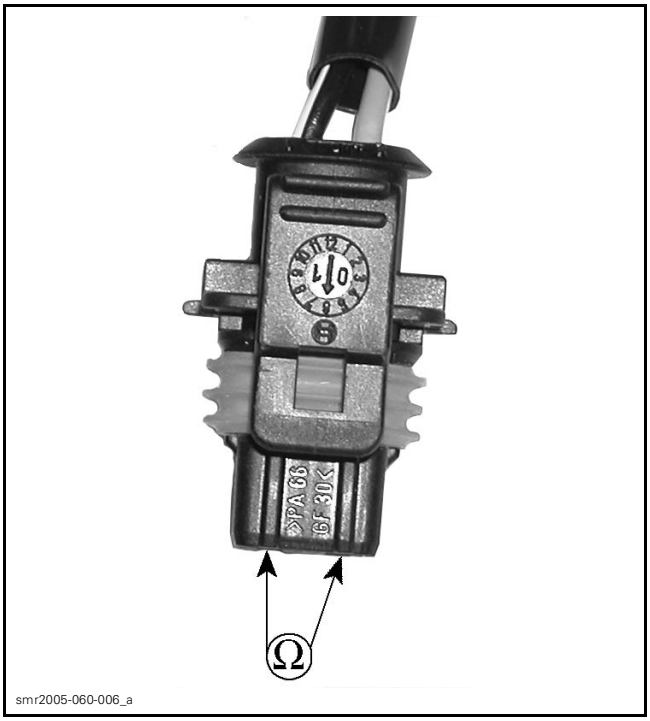
Exterior Temperature Input

Unplug connector from temperature sensor.

Connect potentiometer test probes as follows.

MAIN HARNESS CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
B	C	See table below.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the Information Center.



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RESISTANCE (Ω)	TEMPERATURE (°C)
4712	5 ± 2
3792	10 ± 2
3069	15 ± 2
2500	20 ± 2
2057	25 ± 2
1707	30 ± 2
1412	35 ± 2

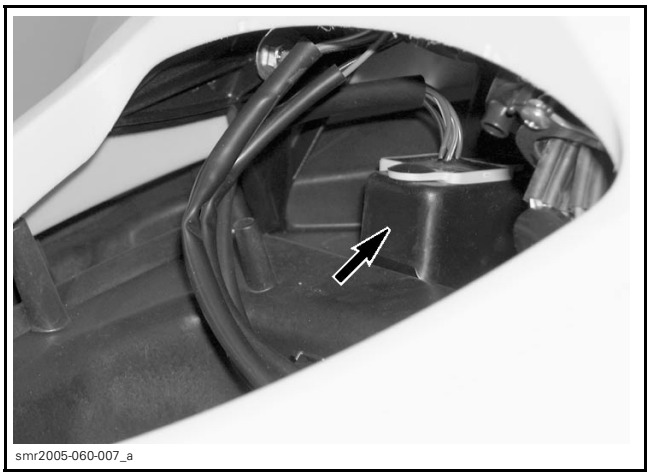
RESISTANCE (Ω)	TEMPERATURE (°F)
4316	45 ± 4
3337	55 ± 4
2712	65 ± 4
2138	75 ± 4
1771	85 ± 4
1412	95 ± 4

If out of specification, check wiring harness/connectors. If good, try a new Information Center.

Compass

The compass is located in the storage cover.

Open top storage compartment cover.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Remove the compass from the support.

Change the direction of the compass and keep it horizontal (± 10°). 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.

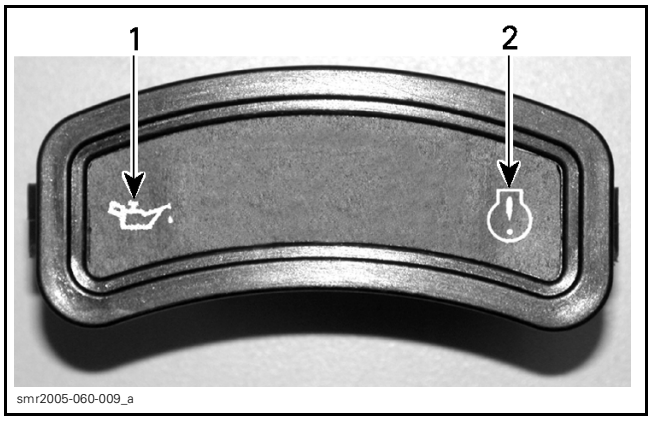
If it does not work, check wiring/connectors. If good, try a new compass. If it still does not work, try a new Information Center.

Low Oil Level

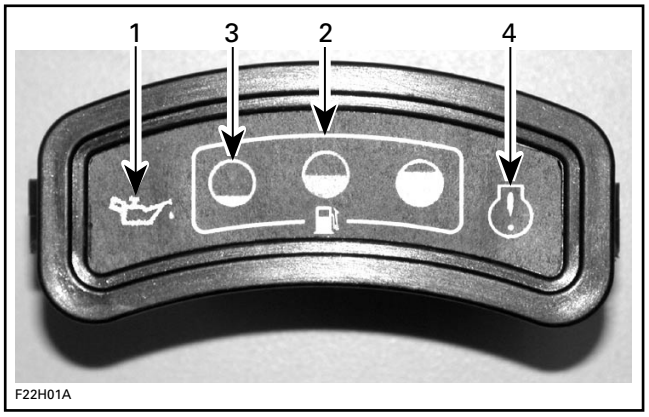
Test oil level sensor. See OIL LEVEL SENSOR further in this section. If sender works properly, check wiring/connectors. If good, try a new Information Center.

INDICATOR LIGHT CLUSTER

3D Series



MODELS WITHOUT FUEL LEVEL LIGHTS
1. *Low oil warning light*
2. *Warning light*



MODELS WITH FUEL LEVEL LIGHTS
1. *Low oil warning light*
2. *Fuel level lights*
3. *Low fuel level light*
4. *Warning light*

The low oil warning light will turn on whenever oil level is low in reservoir.

CAUTION: Always replenish oil reservoir as soon as possible to avoid serious engine damage.

Models without Fuel Level Lights

As a reserve indicator, the beeper will turn on when roughly 5L (1.3 U.S. gal.) is left and will remain on until tank is refilled. Refer to DIAGNOSTIC PROCEDURES for the coded signals.

Models with Fuel Level Lights

When safety lanyard is installed and fuel tank is full, all fuel level lights are continuously turned on. As fuel level goes down, the fuel level lights will turn off one at a time to indicate remaining fuel.

As a reserve indicator, the beeper will turn on and the low level light will continuously blink when roughly 5L (1.3 U.S. gal.) is left. When roughly 3 L (.8 U.S. gal.) is left, the light will turn off. The beeper will remain on until tank is refilled. Refer to DIAGNOSTIC PROCEDURES for the coded signals.

The warning light will turn on whenever there is a problem with the engine management system. It will blink when there is a problem with the O.T.A.S.™ system or the electric bilge pump.

NOTE: When engine is not running and safety lanyard is on its post, the warning light will remain turned on until safety lanyard is removed.

Fuel Level Sender

Test fuel level sender. See FUEL LEVEL SENDER further in this section. If sender works properly, perform the LIGHTS VERIFICATION as described below.

Low Oil Level

Test oil level sensor. See OIL LEVEL SENSOR further in this section. If sender works properly, perform LIGHTS VERIFICATION as described below.

Lights Verification

When installing safety lanyard, all lights will turn on for a brief moment. This confirms their operation.

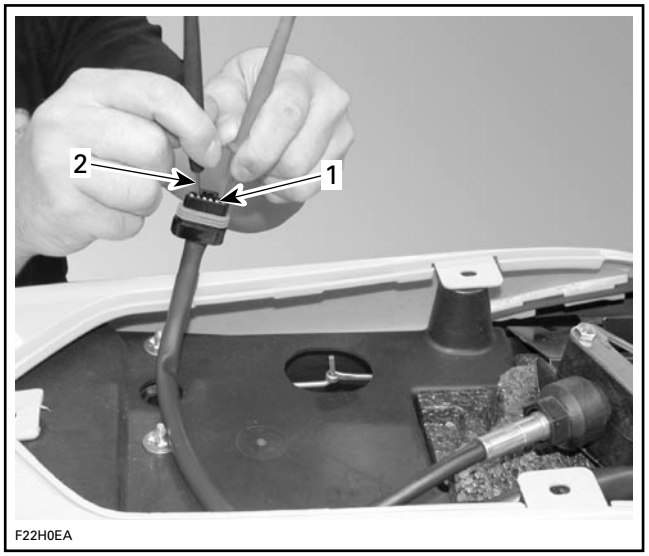
Otherwise, remove steering pole cover (refer to BODY) and unplug cluster connector.

Individually validate the lights supply from VCM as follows:

NOTE: The pin A (PURPLE wire) is the common power wire.

– Install safety lanyard.
– Read voltage between wires as per table.

CLUSTER CONNECTOR		LIGHT	MEASUREMENT
PIN			VOLTAGE Vdc
A	B	Check engine	Battery voltage
	C	Full (fuel level)	
	D	Half	
	E	Empty	
	F	Low oil	



CLUSTER CONNECTOR
1. *Common supply wire, pin A (PURPLE)*
2. *Probe other terminals individually*

NOTE: Perform the voltage reading quickly before the VCM stops sending the test signal to the lights. Reinstalling safety lanyard will re-initialize the VCM.

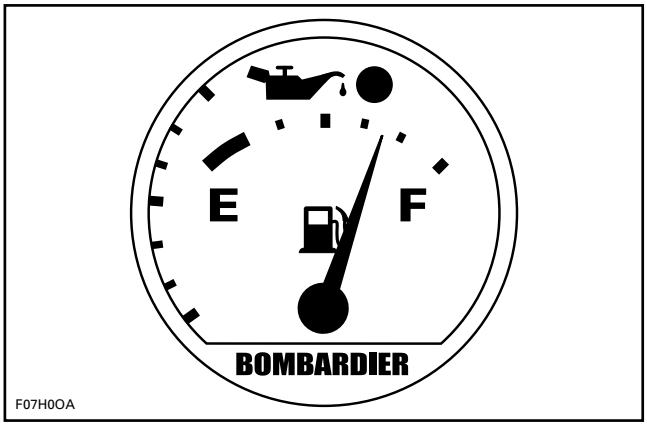
– Battery voltage should be read. Otherwise, check wiring/connectors. If they test good, try a new VCM.
– If battery voltage is read, check connector and if good, replace the indicator light cluster.

FUEL GAUGE/LOW OIL WARNING LIGHT

All GTI Models except GTI LE RFI

The fuel gauge has a pointer which indicates fuel level in the tank. The fuel level sender monitors the fuel level.

The low oil warning light is part of the gauge. It will light when injection oil level is low. The oil sensor monitors the oil level.



TYPICAL

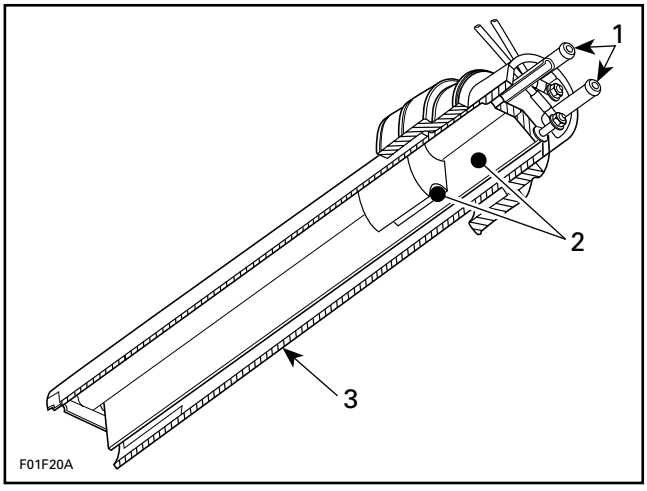
FUNCTION	WIRE
12 Vdc	PURPLE
Ground	BLACK
Fuel level	PINK
Low oil level	BLUE

FUEL LEVEL SENDER

All GTI Models except GTI LE RFI

The baffle pick-up has an integrated fuel sender.

To verify fuel sender, a resistance test should be performed with a multimeter allowing the float to move up through a sequence.



1. *Pick-up tube*
2. *Fuel sender*
3. *Baffle pick-up*

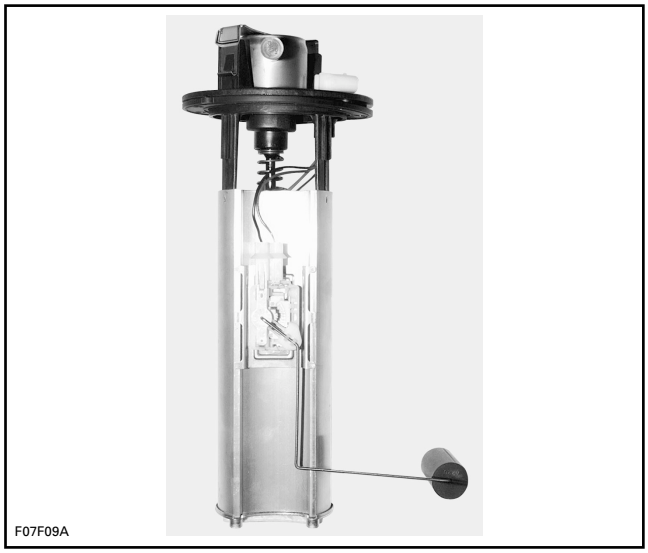
The resistance measured between PINK/BLACK and PINK wires of the sender must be in accordance with fuel level (measured from under the flange) as specified in the following chart.

FUEL LEVEL AND RESISTANCE	
FUEL LEVEL (mm)	RESISTANCE (Ω)
From 248.9 ± 5 and more	0 + 2.2
From 234.4 to 248.8 ± 5	17.8 ± 2.2
From 200.9 to 234.3 ± 5	27.8 ± 2.2
From 167.4 to 200.8 ± 5	37.8 ± 2.2
From 134.0 to 167.3 ± 5	47.8 ± 2.2
From 100.5 to 133.9 ± 5	57.8 ± 2.2
From 67.0 to 100.4 ± 5	67.8 ± 2.2
From 40.1 to 66.9 ± 5	77.8 ± 2.2
From 0 to 40.0 ± 5	89.8 ± 2.2

If out of specification, replace fuel sender. If gauge does not work, check wiring/connectors. If good, try a new gauge. If it still does not work, try a new MPEM.

RFI Models

The fuel level sender is part of the fuel pump module mounted inside the fuel reservoir.



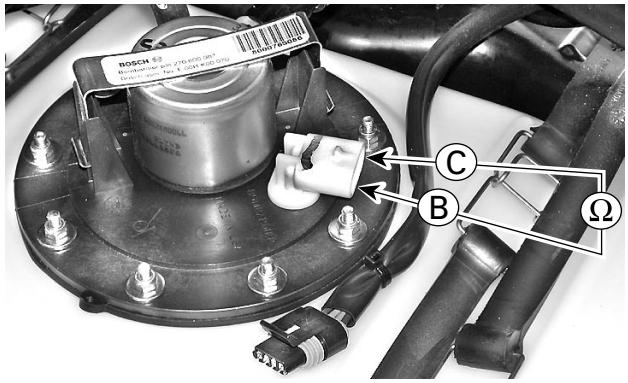
TYPICAL — FUEL LEVEL GAUGE SENDER MOUNTED ON FUEL PUMP MODULE

Refer to FUEL SYSTEM for fuel pump testing. For fuel level sender, follow procedures below.

Disconnect fuel pump connector.

Measure resistance as per table.

FUEL LEVEL SENDER CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
B	C	See table below.



The resistance of the sender must be in accordance with fuel level (measured from under the flange) as specified in the following charts.

GTI RFI Series

RESISTANCE (Ω)	FLOAT HEIGHT (bottom of float with bottom of pump module)
4.8 + 2.2	228 ± 5.0
17.8 ± 2.2	186 ± 5.0
27.8 ± 2.2	164 ± 5.0
37.8 ± 2.2	139 ± 5.0
47.8 ± 2.2	114 ± 5.0
57.8 ± 2.4	86 ± 5.0
67.8 ± 2.8	57 ± 5.0
77.8 ± 3.6	36 ± 5.0
89.8 ± 3.6	16 ± 5.0

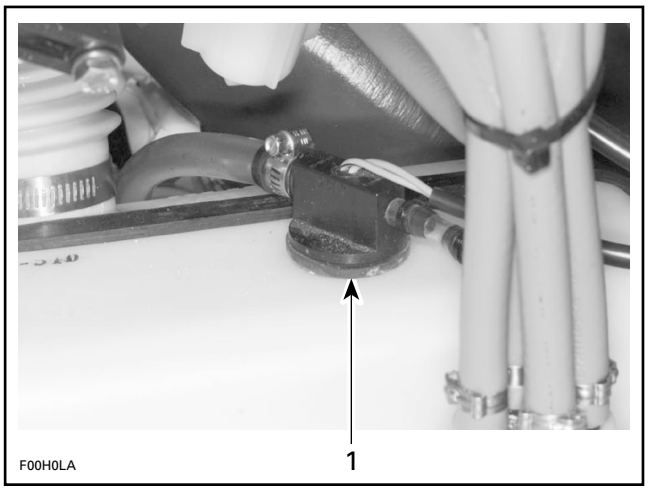
3D RFI Series

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

All Models

The sensor circuit is either open (out of oil) or closed (oil present) and the electronic module/gauge turn lights ON or OFF accordingly.



TYPICAL
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.

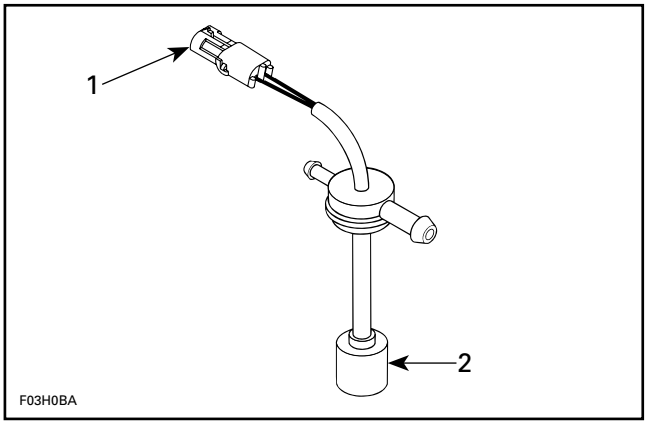
When the oil level goes at critical LOW level inside the oil tank (and therefore in sensor reservoir), the sensor detects the absence of liquid and the light TURNS ON.

Unplug sensor connector.

Using a multimeter, check the continuity as per table.

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

TEST CONDITION	SENSOR CONNECTOR PIN		READING (Ω)
Sensor OUT of oil	A	B	∞ (open circuit)
Sensor soaked IN oil			2 Ω max. (closed circuit)



1. Measure resistance here
2. Sensor reservoir

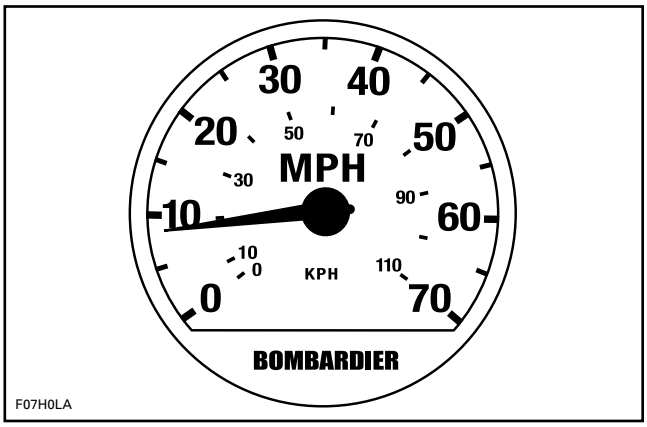
Sensor Installation

– 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.

SPEEDOMETER

GTI LE RFI Models



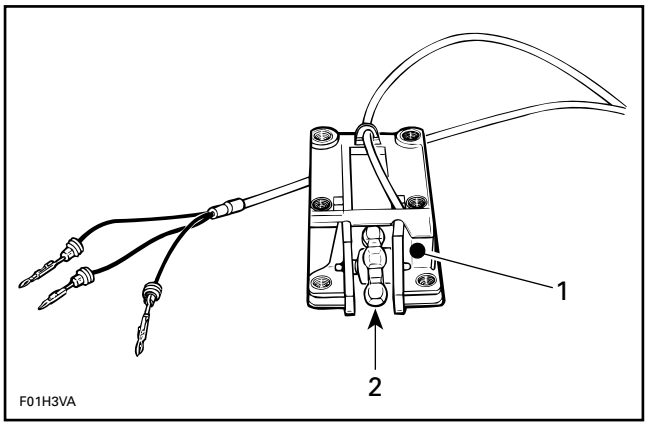
TYPICAL

FUNCTION	WIRE
12 Vdc	PURPLE
Ground	BLACK
Pulse signal	PURPLE/YELLOW

SPEED SENSOR

GTI LE RFI Models

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.



1. *Pick-up housing*
2. *Paddle wheel*

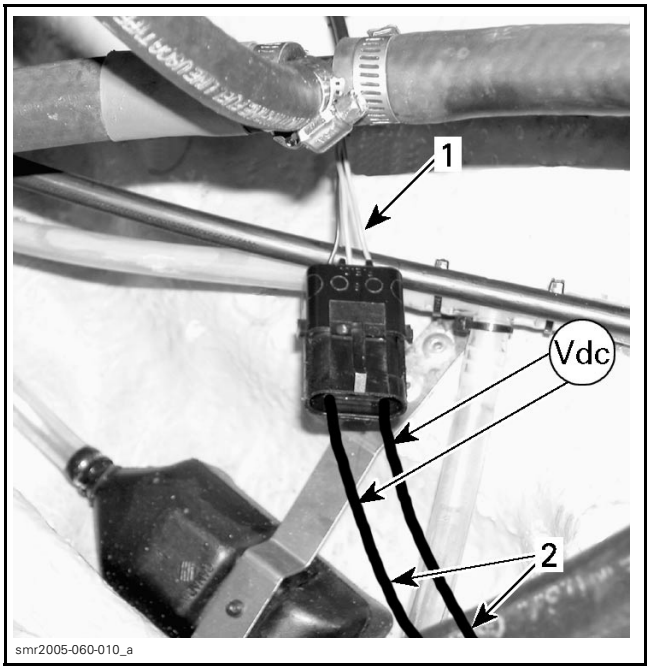
Spray water on paddle wheel using a garden hose.

Disconnect the speed sensor connector housing from inside bilge.

Using an appropriate terminal remover (Snap-on TT600-4), remove wires from position A and C in tab housing of speed sensor.

Reconnect wires in receptacle housing.

Connect multimeter to speed sensor wires and set it to Vdc.



1. *Wires from sensor*
2. *Wires to gauge*

TEST CONDITION	SENSOR CONNECTOR PIN		READING (Vdc)
Slowly rotate paddle wheel	A	C	Fluctuation within 5.5 - 8.5

ELECTRIC BILGE PUMP

3D Series

When safety lanyard cap is installed on its post, the bilge pump is automatically turned on. It will remain on until all water is evacuated (if so), then it will shut down automatically. Then, the pump will start every 10 seconds to perform this cycle.

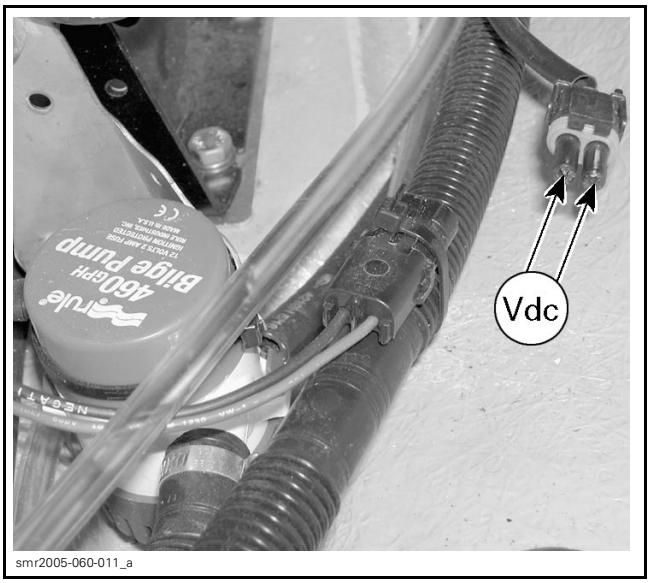
Voltage Test

Remove rear access panel.

Disconnect connector from bilge pump.

smr2005-060-012_a

Using a voltmeter, measure voltage as shown. Battery voltage should be read.



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If so, replace bilge pump. Otherwise, check wiring/connectors. If they test good, try a new VCM.

DIGITALLY ENCODED SECURITY SYSTEM (DESS)

SERVICE TOOLS

Description	Part Number	Page
DESS adapter	529 035 684	215
MPEM programmer	529 035 878	215
Vehicle Communication Kit (VCK)	529 035 981	215

GENERAL

The Digitally Encoded Security System (DESS) features an anti-start protection against unauthorized use of the watercraft.

The following components are specially designed for this system:

– Multi-Purpose Electronic Module (MPEM) on **717 engines** equipped models
– Engine Control Module (ECM) on **787 RFI engines** equipped models
– safety lanyard cap
– safety lanyard switch.

The safety lanyard cap has a magnet and a ROM chip. The chip has a unique digital code.

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

NOTE: Actually, it is the memory of the MPEM/ECM which is programmed to recognize the digital code of the safety lanyard cap.

The system is quite flexible. Up to eight safety lanyards may be programmed in the memory of the watercraft MPEM/ECM. They can also be erased.

NOTE: If desired, a safety lanyard can be used on other watercraft equipped with the DESS.

The memory of the MPEM/ECM is permanent. If the battery is disconnected, no information is lost.

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

The MPEM/ECM features a self-diagnostic mode. Refer to the chart following.

SELF-DIAGNOSTIC MODE

It is self-activated when the safety lanyard cap is being installed on the watercraft switch. It gives immediate monitoring. Refer to the following chart.

717 Engines

CODED SIGNAL	POSSIBLE CAUSE	REMEDY
2 short beeps (while installing safety lanyard on watercraft post).	• Confirms safety lanyard signal operation.	• Engine can be started.
2 seconds beep every 15 minutes intervals.	• Water temperature sensor or circuit malfunction.	• Refer to COOLING SYSTEM.
	• Starter solenoid circuit malfunction.	• Refer to STARTING SYSTEM.
4 short beeps every 3 seconds interval for 2 hours.	• 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.
Continuous beep	• Engine overheats.	• Refer to COOLING SYSTEM.
1 long beep (while installing safety lanyard on watercraft post or when pressing start/stop button).	• Bad DESS system connection.	• Reinstall safety lanyard cap correctly over post.
	• Wrong safety lanyard.	• Use a safety lanyard that has been programmed for the watercraft.
	• Defective safety lanyard.	• Use another programmed safety lanyard.
	• Dried salt water or dirt in safety lanyard cap.	• Clean safety lanyard cap to remove dried salt water or dirt.
	• Defective DESS post. • Improper operation of MPEM or defective wiring harness.	• Verify harness and connectors. • Try a new MPEM.

787 RFI Engines

CODED SIGNAL	POSSIBLE CAUSE	REMEDY
2 short beeps (while installing safety lanyard on post).	• Confirms safety lanyard signal operation.	• Engine can be started.
1 long beep (while installing safety lanyard on watercraft post.	• Bad DESS system connection.	• Reinstall safety lanyard cap correctly over post.
	• Wrong safety lanyard.	• Use a safety lanyard that has been programmed for the watercraft.
	• Defective safety lanyard.	• Use another programmed safety lanyard.
	• Dried salt water in safety lanyard cap.	• Clean safety lanyard cap to remove salt water.
	• Defective DESS post. • Improper operation of ECM or defective wiring harness.	• Refer to DESS SYSTEM AND ENGINE MANAGEMENT.
A **2 seconds beep** every 1 minute intervals.	• Starter relay problems or engine circuit problem.	• Refer to ENGINE MANAGEMENT.
A **2 seconds beep** every 5 minutes intervals.	• Fuel tank level is low or open circuit.	• Refill. If problem persists, refer to FUEL SYSTEM.

CODED SIGNAL	POSSIBLE CAUSE	REMEDY
A **2 seconds beep** every 15 minutes intervals.	• Water temperature sensor or circuit malfunction.	• Refer to COOLING SYSTEM.
	• Starter solenoid circuit malfunction.	• Refer to STARTING SYSTEM.
Continuously beeps.	• Engine overheats.	• See COOLING SYSTEM.

DESS KEY PROGRAMMING

The Vehicle Communication Kit (VCK) (P/N 529 035 981) is the primary tool to program a DESS key.

The software B.U.D.S., included in the VCK, is designed to allow, among other things, the programming of safety lanyard(s) and entering customer information.

For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

⚠ WARNING

If the computer you are using is connected to the 110 Vac power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

717 Engines

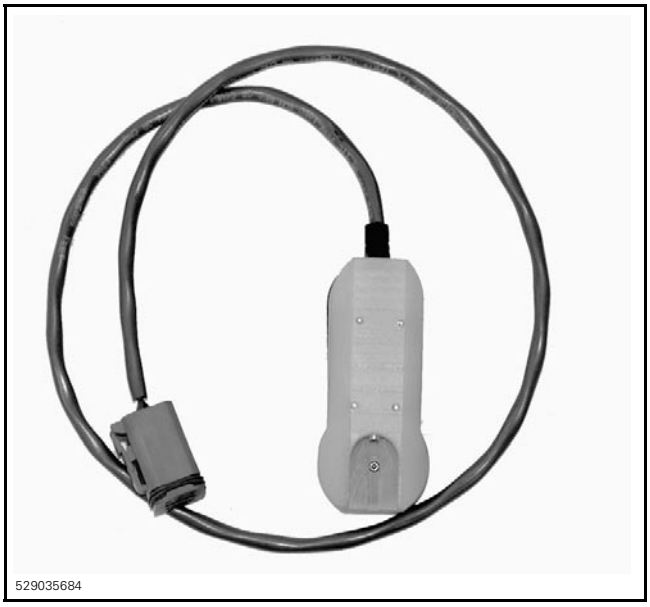
The MPEM programmer (P/N 529 035 878) is an alternative tool to communicate with the MPEM. For a complete overview of this tool, refer to the *MPEM PROGRAMMER GUIDE*.

Programming Keys with B.U.D.S.

717 Engines

To use the VCK on vehicle the following adapter is necessary.

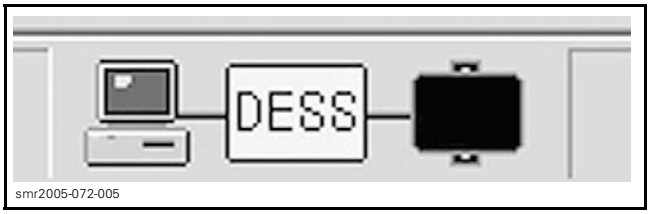
TYPE OF CONNECTION	ADAPTER TO USE
Through DESS post	DESS adapter (P/N 529 035 684)



DESS ADAPTER

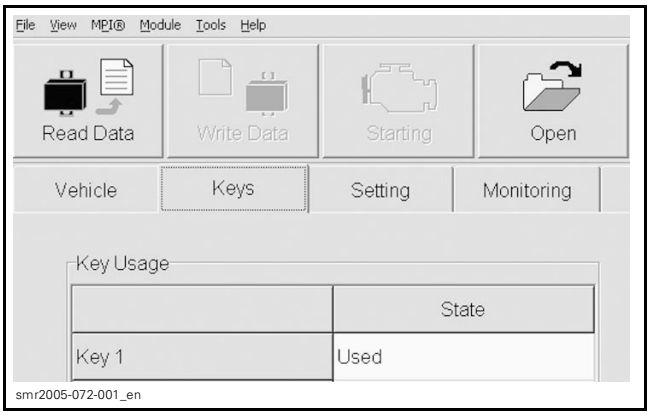
Connect VCK components and open the software B.U.D.S.

IMPORTANT: When using the software B.U.D.S., ensure that the **DESS** protocol is properly selected in "**MPI**" under "**Choose protocol**".



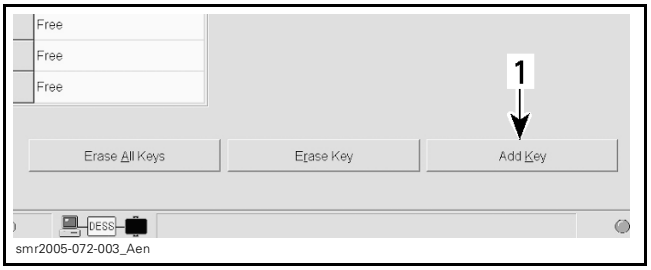
Read MPEM using READ DATA button.

Click on KEYS tab.



Install key on MPI DESS post.

Click on ADD KEY button on bottom of screen.



1. Click on this tab

A new key is now saved in the computer.

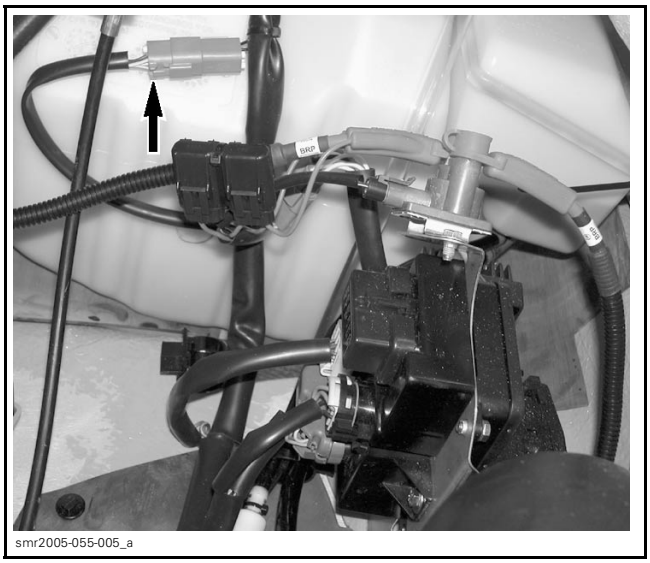
NOTE: To program other key(s), install a new key on MPI DESS post and click again on ADD KEY tab.

Ensure to save new data in MPEM using WRITE DATA button.

787 RFI Engines

Locate communication connector in bilge.

3D MODELS

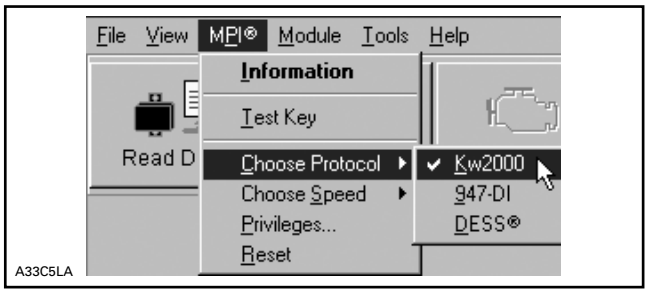


GTI RFI MODELS

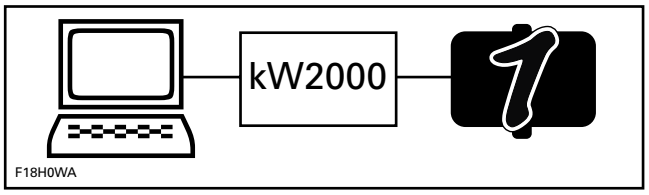
Unplug communication connector and plug VCK connector.

Connect the safety lanyard to the DESS post to activate the communication.

Ensure that the protocol "kW2000" is properly selected.



Ensure the status bar shows the kW2000 and the number 1 to the right. So that B.U.D.S. communicate with the ECM, number 1 must be displayed.

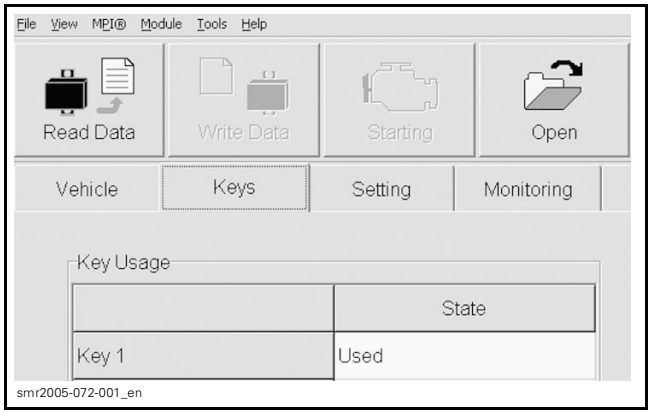


If an "X" is shown instead of a 1, this means that no communication between MPI and ECM takes place. Possible causes are:

– ECM is not powered-up
– wrong protocol is used
– bad connection between MPI and module.

Read ECM using READ DATA button.

Click on KEYS tab.



Install key on MPI DESS post.

Click on ADD KEY button on bottom of screen.

1. Click on this tab

A new key is now saved in the computer.

NOTE: To program other key(s), install a new key on MPI DESS post and click again on ADD KEY tab.

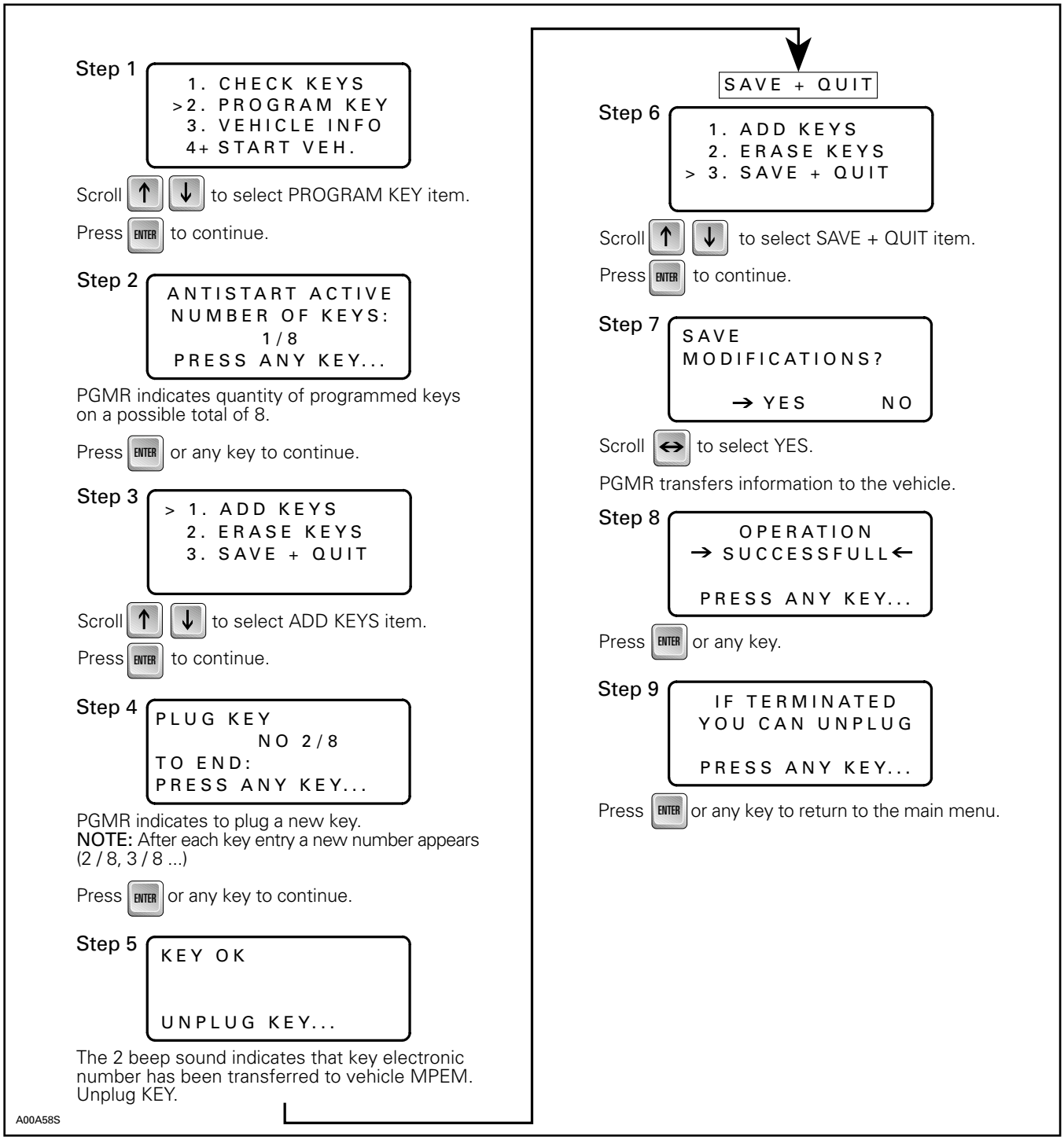
Ensure to save new data in ECM using WRITE DATA button.

Programming Keys with the MPEM Programmer

717 Engines Only

Connect the communication cable of the MPEM programmer to the vehicle DESS post.

The following chart lays out the complete procedure to program a new key.

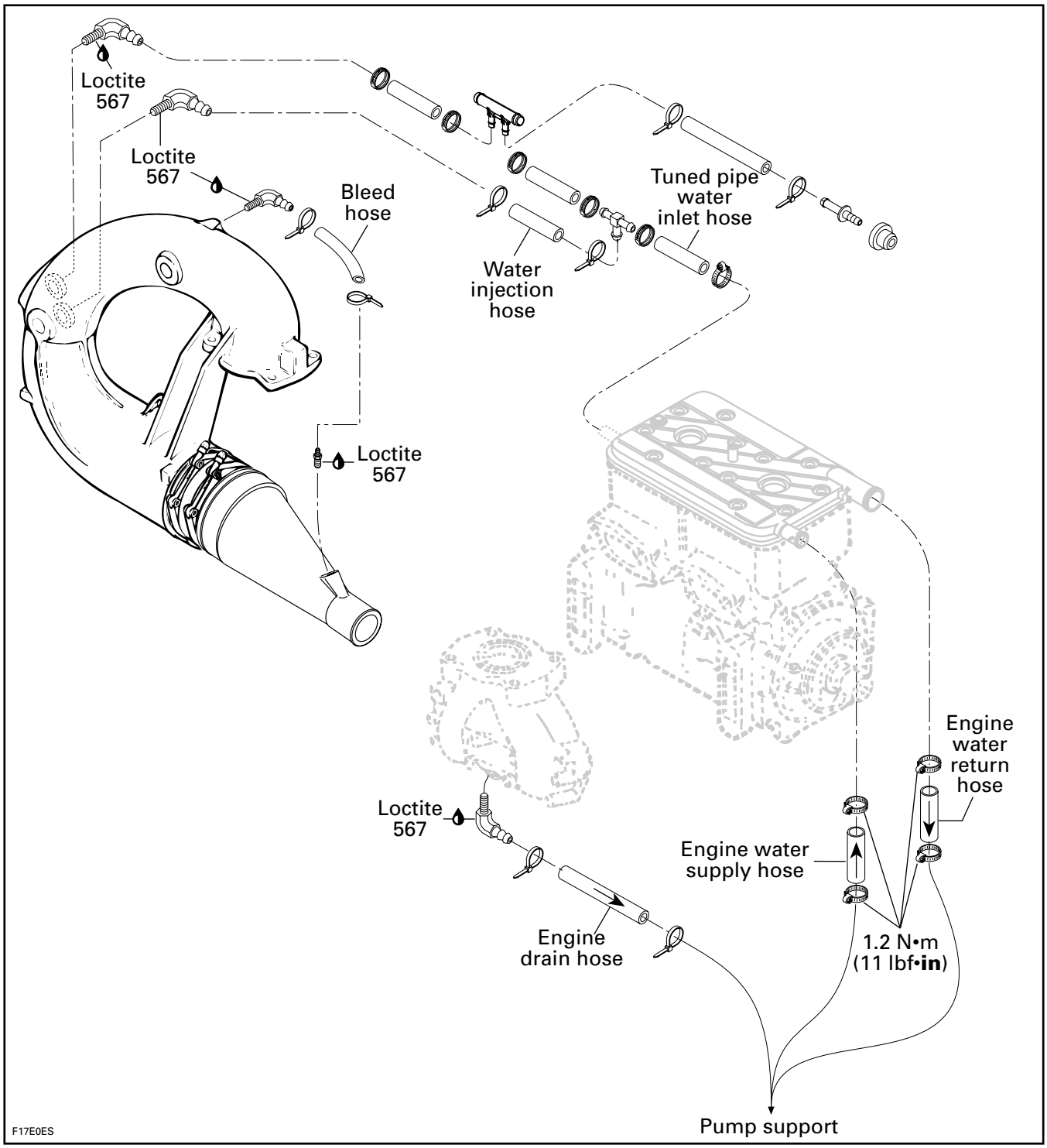


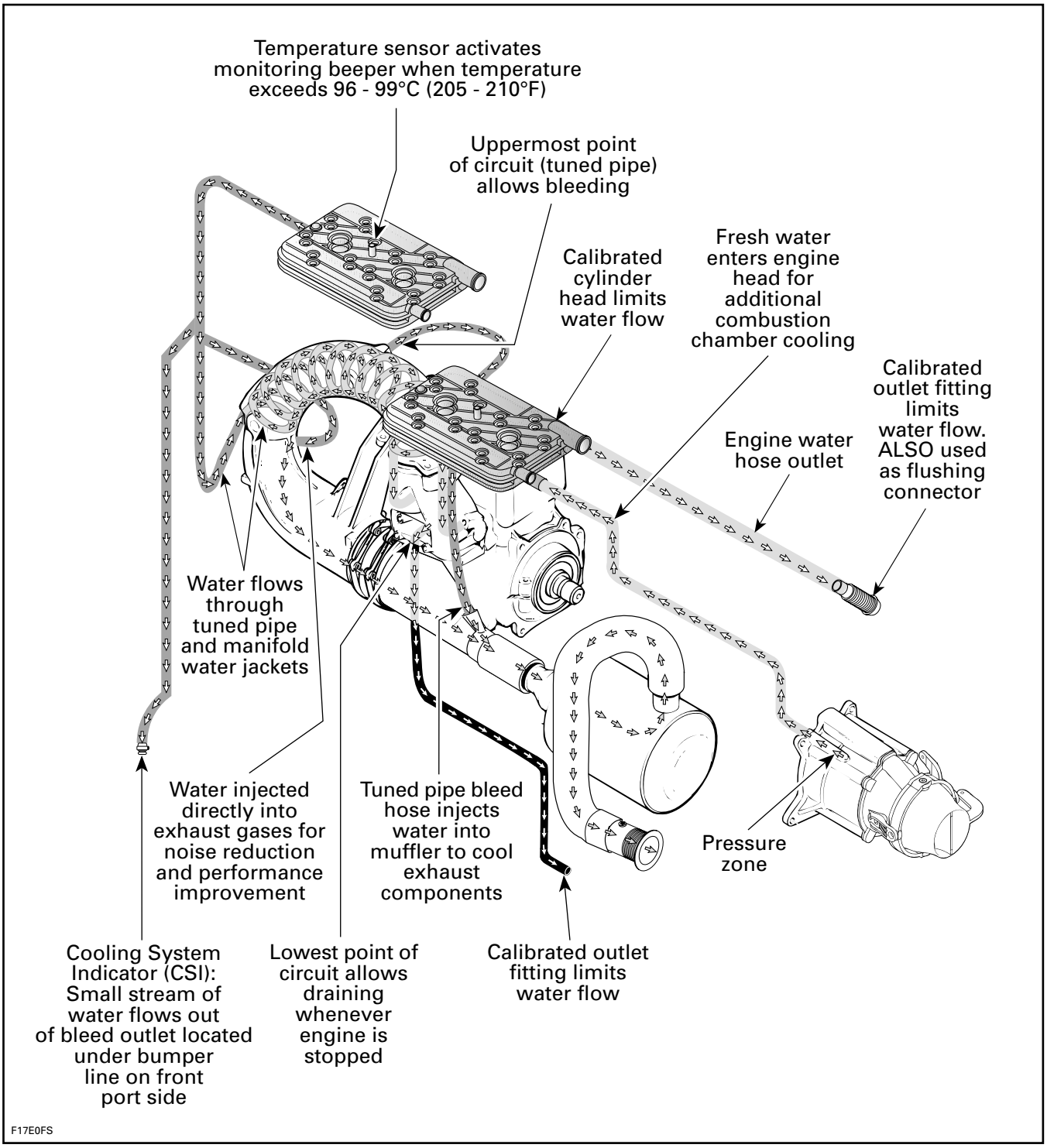
COMPONENTS AND CIRCUIT

SERVICE TOOLS

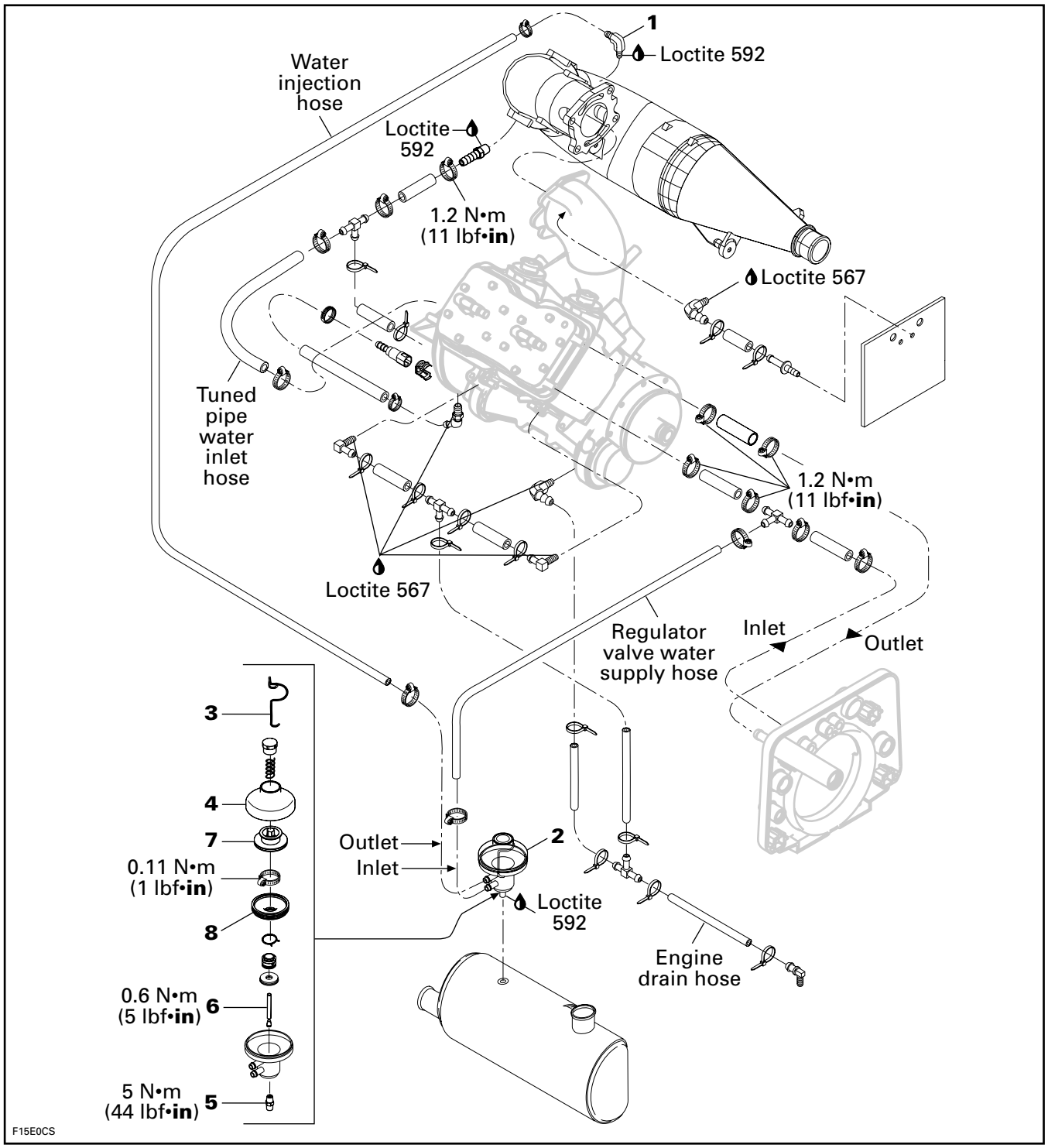
Description	Part Number	Page
pliers Oetiker 1099	295 000 070	228

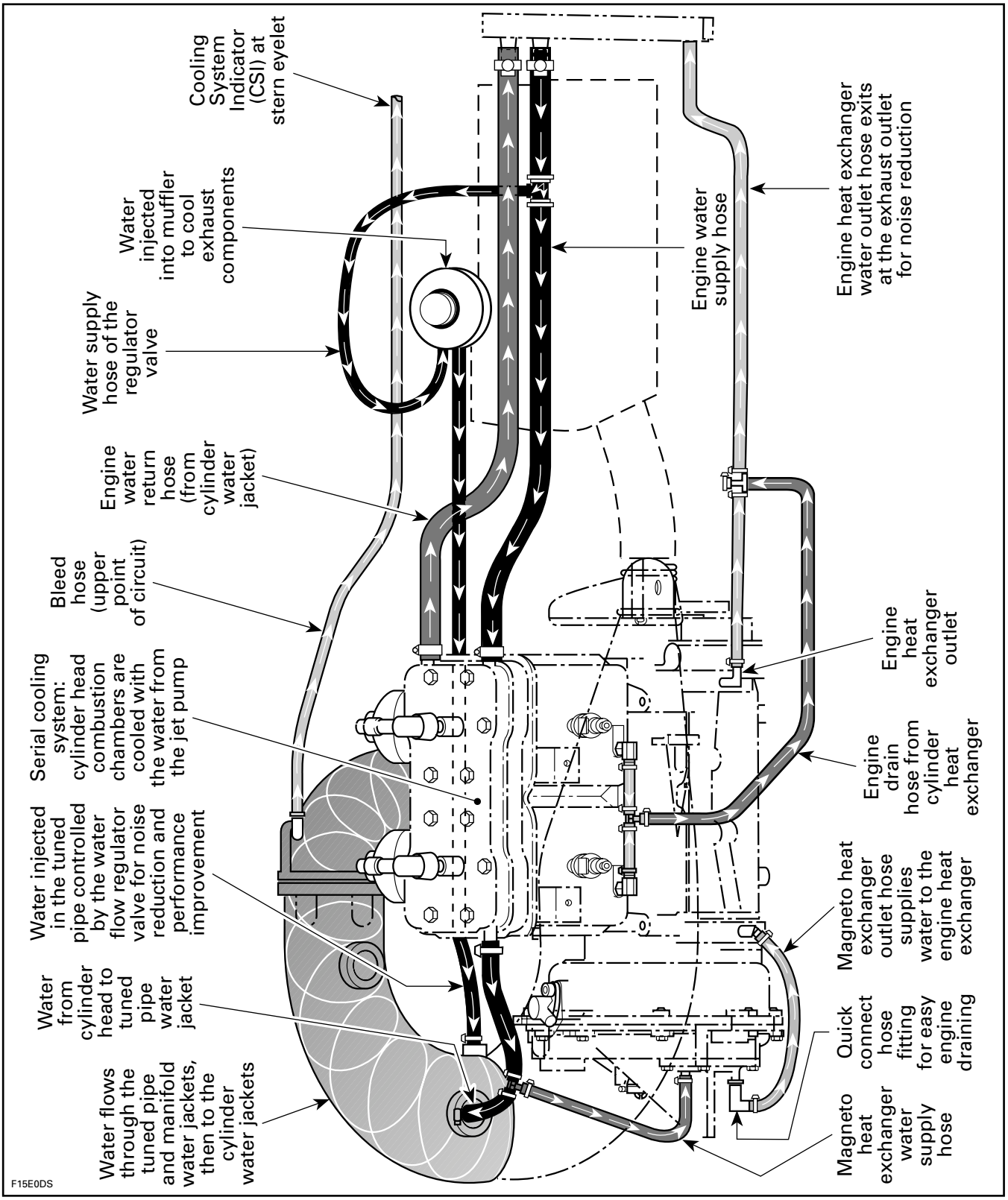
717 Engines



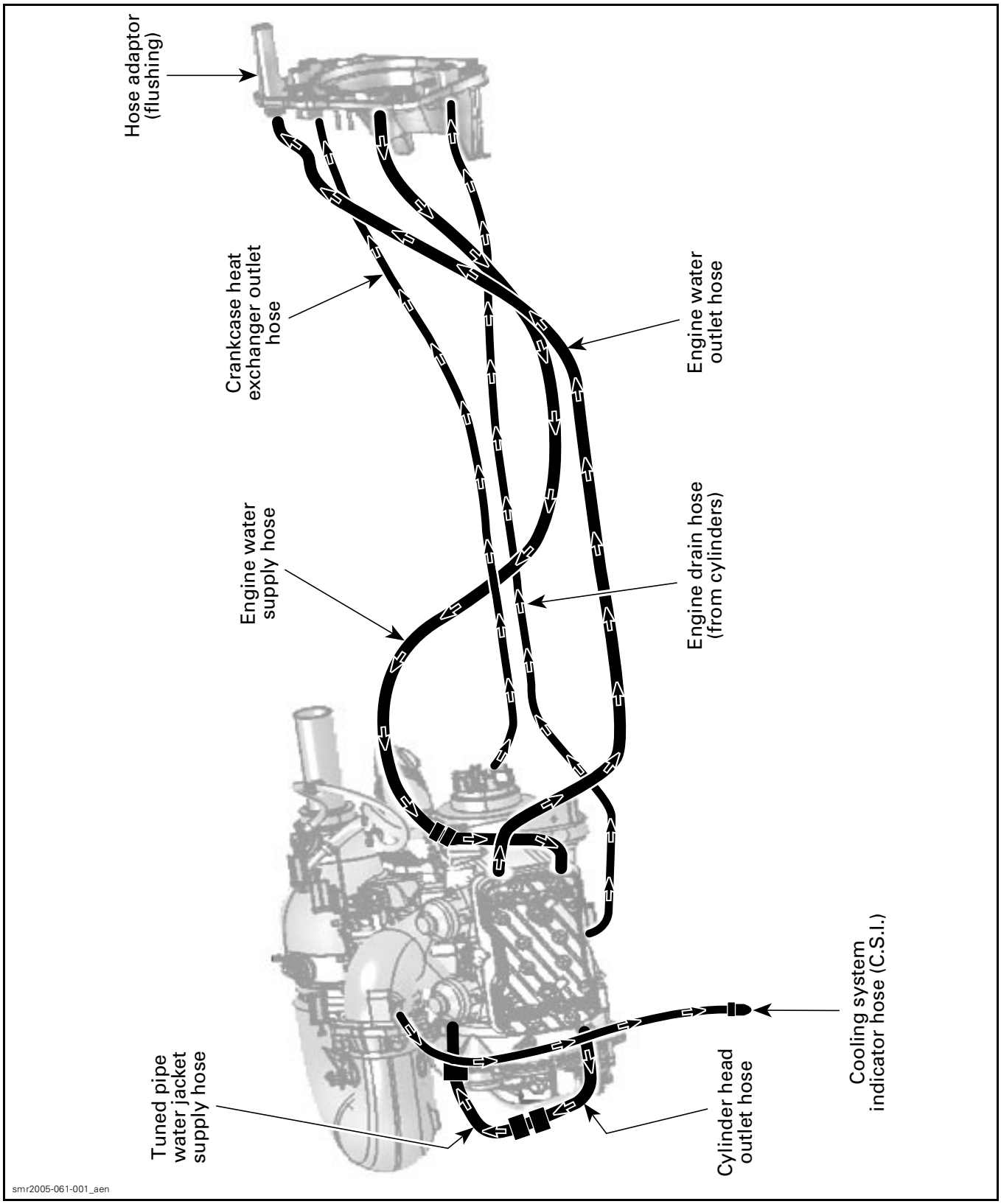


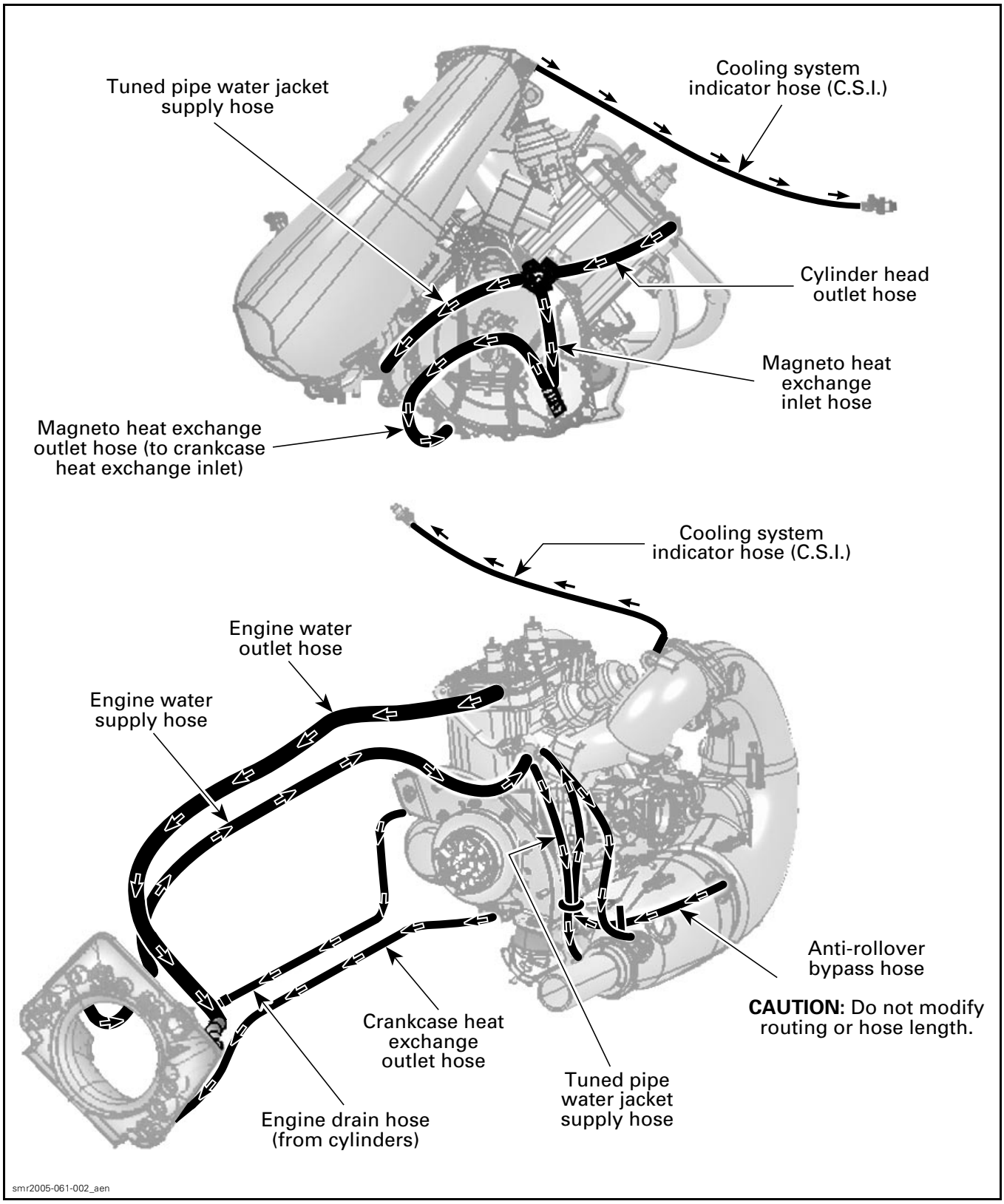
787 RFI Engines (GTI RFI and GTI RFI LE Models)





787 RFI Engines (3D Series)





CIRCUIT

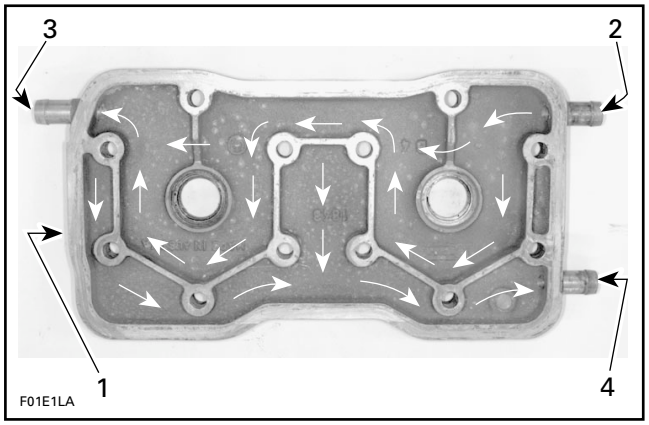
CAUTION: All hoses and fittings of the cooling system have calibrated inside diameters to assure proper cooling of the engine. Always replace using appropriate BRP part number.

717 Engines

A serial cooling system is utilized on the 717 engines, which offers an efficient cooling of the combustion chamber to prevent the possibilities of detonation.

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

Water enters the cylinder head, cooling the combustion chamber to prevent detonations. Then, water exits cylinder head toward tuned pipe.

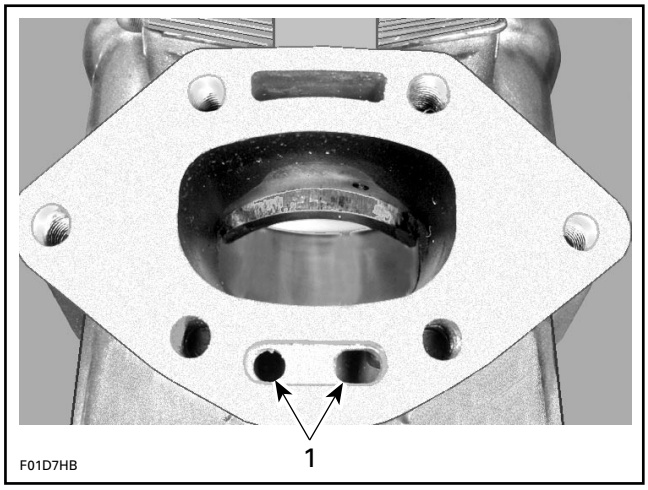


1. *Cylinder head cover*
2. *Fresh water from jet pump*
3. *Water exiting head assembly to tuned pipe, exhaust manifold and cylinders*
4. *Water from cylinder water jackets exiting engine*

The tuned pipe and exhaust manifold are designed with a double wall to allow water circulation.

Water is pre-heated by the exhaust system before entering the cylinder cooling jackets.

Water enters cylinder cooling jacket through passages located below exhaust ports from tuned pipe.



1. *Water passages*

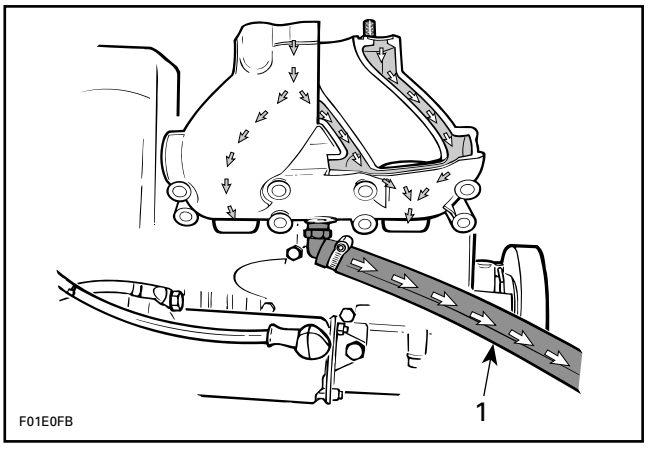
No water enters crankcase.

When engine is running, water must flow from bleed outlet indicating that water circulates.

CAUTION: When investigating for no water flow in the cooling system, check all elbows and straight fittings as well as all hoses for blockage.

For a minimum back pressure in the exhaust, engine water outlet hose is not connected to the exhaust. It has its own outlet at the rear of the hull.

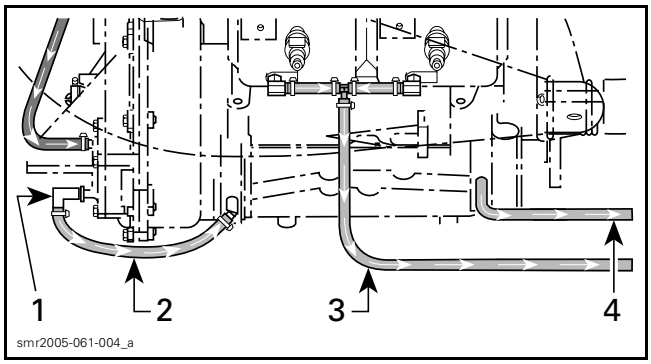
Draining of the cooling system is accomplished by a drain hose located at the lowest point of the circuit.



717 ENGINES
1. *Drain hose*

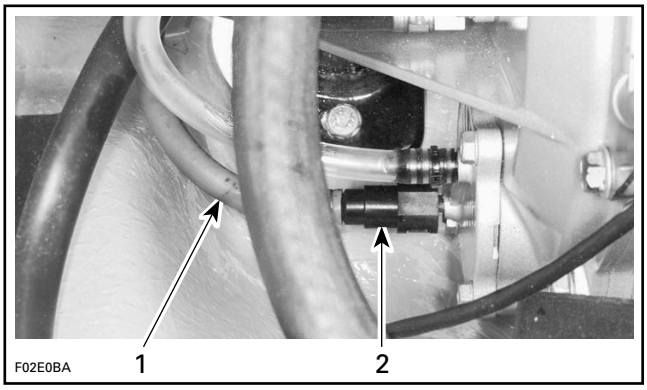
787 RFI Engines

The 787 RFI engines features a heat exchanger system. This system allows water coming out of the cylinder head to circulate through a magneto heat exchanger and the crankcase heat exchanger.



TYPICAL — GTI RFI MODELS SHOWN
1. *Quick connect hose fitting*
2. *Engine heat exchanger water supply hose*
3. *Engine drain hose from cylinder heat exchanger*
4. *Water outlet hose to exhaust outlet*

The engine heat exchanger supply hose has a quick connect hose fitting to facilitate engine draining.



1. *Heat exchanger water supply hose*
2. *Quick connect hose fitting*

The water coming out of the engine heat exchanger is evacuated at the exhaust outlet for noise reduction.

All Models

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

Flushing Procedure

Refer to STORAGE for flushing procedure of cooling system.

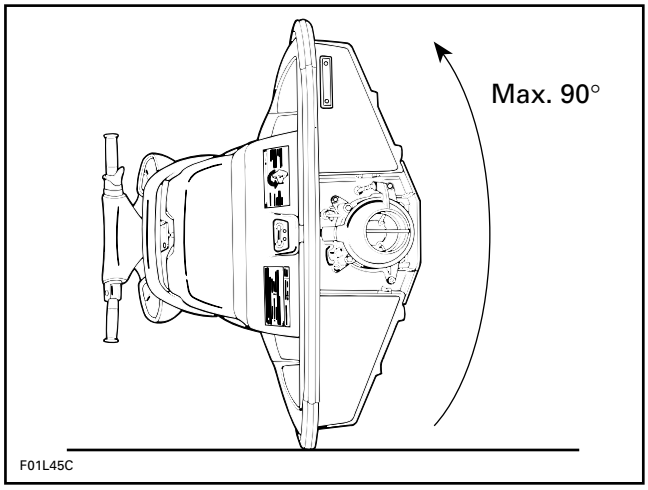
Storage Procedure

Refer to STORAGE for winterization procedure of cooling system.

Hull Servicing

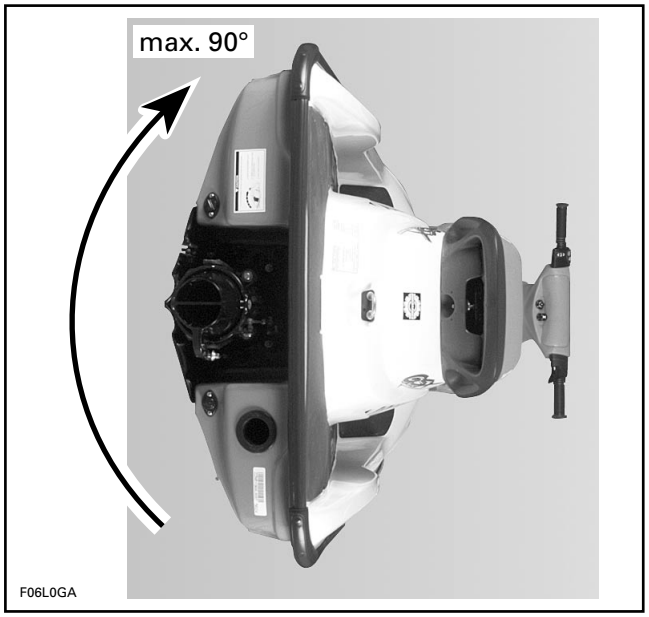
717 Engines

When servicing the hull, always rotate watercraft counterclockwise (seen from the rear). Rotating watercraft on the opposite side could allow residual water in tuned pipe to enter the engine and cause damage.



Other Engines

When servicing the hull, always rotate watercraft clockwise (seen from the rear). Rotating watercraft on the opposite side could allow residual water in tuned pipe to enter the engine and cause damage.



TYPICAL

Technical Data

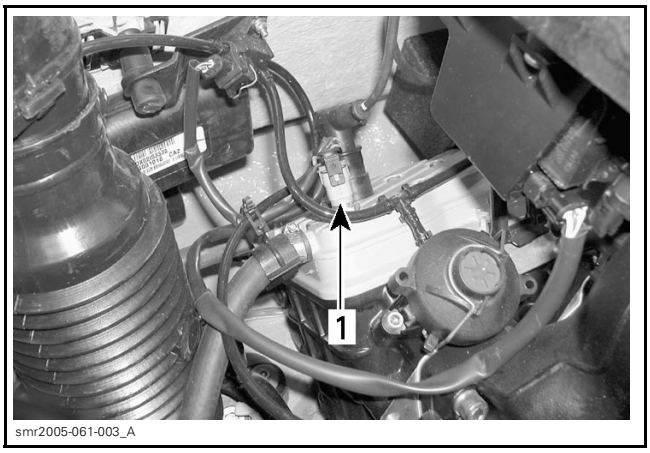
TYPE	TLCS (Total Loss Cooling System).
COOLANT FLOW	Flow from impeller housing (no water pump).
TEMPERATURE CONTROL	Calibrated outlet fittings (no thermostat).
SYSTEM BLEEDING	Self-bleed type (hose at uppermost point of circuit).
SYSTEM DRAINING	Self-drain type (hose at lowest point of circuit).
SYSTEM FLUSHING	Fitting hose adapter.
MONITORING BEEPER	Turns on at 86 - 94°C (187 - 201°F).

COMPONENTS

Temperature Sensor

NOTE: This procedure must be used with **717 engines** only. For the **787 RFI** engines, refer to ENGINE MANAGEMENT (RFI).

The temperature sensor is located on the top of cylinder head.



1. Temperature sensor

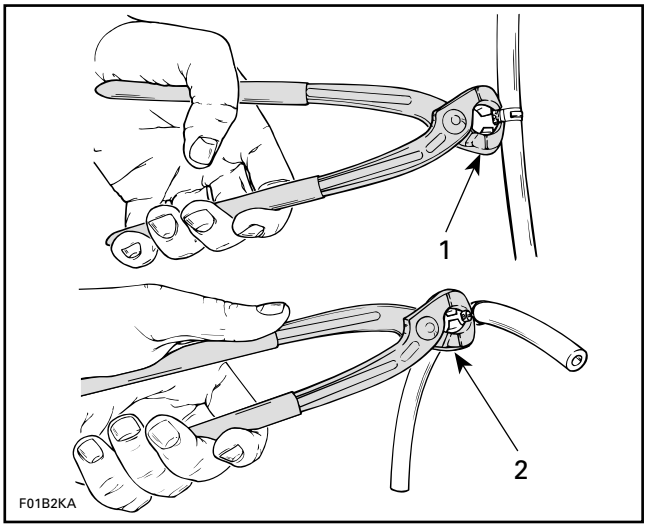
To test the sensor, unplug and remove it from engine.

Put in water and heat water.

The temperature sensor should operate when water temperature reaches 90° C ± 4° C (194° F ± 39° F). Replace as necessary.

Clamp

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



1. Cutting clamp
2. Securing clamp

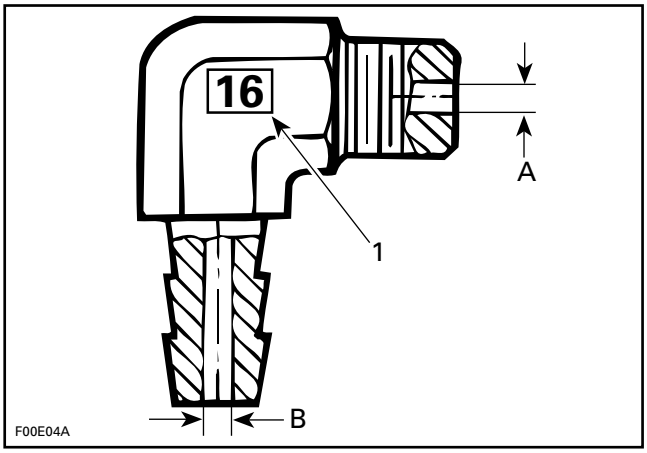
Elbow Fitting

Water injection used on exhaust system cools the exhaust gases to obtain maximum performance from the tuned pipe. The elbow fitting **no. 1** has a calibrated inside diameter to optimize water flow in tuned pipe.

The water injection also helps in reducing noise level and cools components of the exhaust system.

CAUTION: The elbow fittings are calibrated and can not be interchanged with one of a different size as severe engine damage could result.

The elbow fitting can be identified by using the number stamped onto the fitting or by measuring its inside diameter. Refer to the following illustration and chart.



1. Stamped number
A. Outlet diameter = 4.6 mm (.181 in)
B. Inlet diameter = 5.5 mm (.219 in)

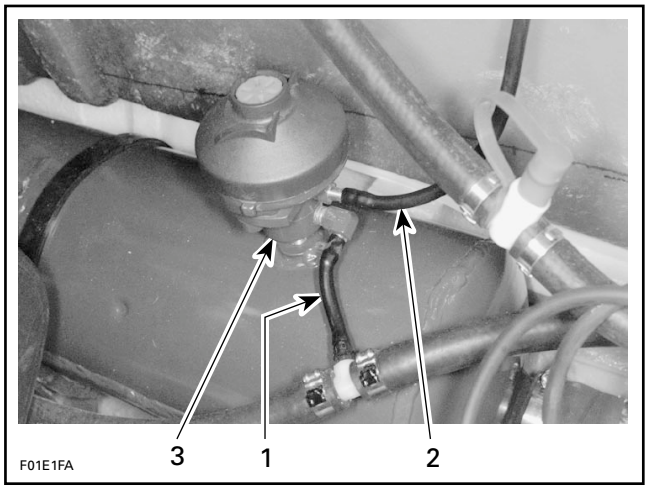
STAMPED NUMBER ON FITTING	FITTING P/N	INLET DIAMETER	OUTLET DIAMETER
18	293 710 018	4.0 mm (.157 in)	5.5 mm (.217 in)
23	293 700 023	8.5 mm (.374 in)	8.7 mm (.343 in)

Water Flow Regulator Valve

GTI Models with 787 RFI Engines

A water flow regulator valve is mounted on these models so that they can produce the maximum horsepower output and yet maintain the necessary diameter of the injection fitting at the tuned pipe head for unobstructed water flow.

The water flow regulator valve **no. 2** is mounted directly onto the muffler.



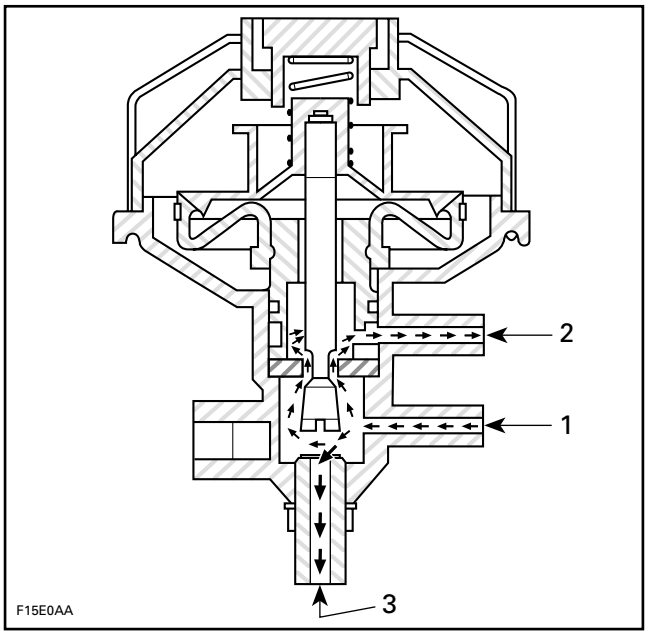
TYPICAL
1. Water supply hose of regulator valve
2. Regulated water to injection fitting
3. Water injected into the muffler

NOTE: The water injected into the muffler is not regulated by the tapered needle of the valve. Instead, a calibrated water injection fitting **no. 5** controls water flow into the muffler. The **GTI RFI** and **GTI RFI LE** models use an injection fitting with an opening of 4.5 mm (.177 in).

The water flow regulator valve has a calibrated spring and a tapered needle which regulate the injected water in the tuned pipe.

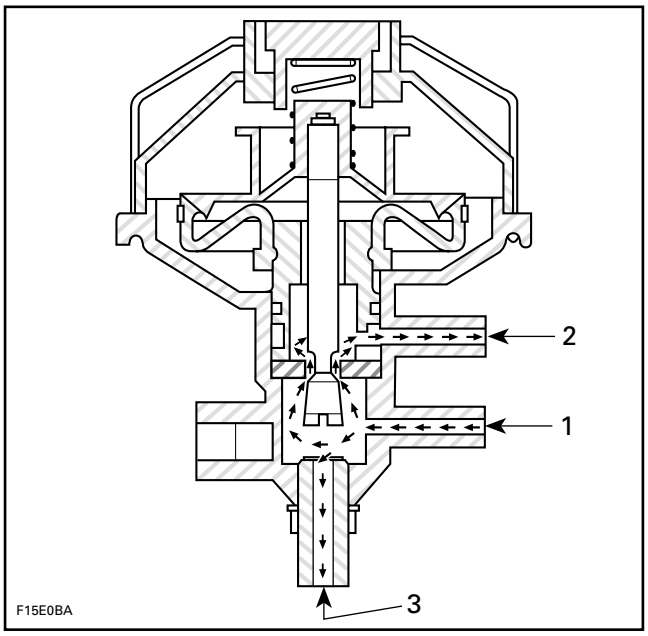
CAUTION: Do not change anything on the water flow regulator valve, otherwise serious engine damage can occur. In many countries it is illegal to tamper with this valve as this will affect the EPA certification.

At low speed, water pressure in the supply hose of the regulator valve is not sufficient to overcome the spring of the regulator valve; more water is being delivered to the injection fitting at the tuned pipe.



LOW SPEED OPERATION
1. *Water entering regulator valve*
2. *Water exiting regulator valve (less restriction)*
3. *Water injected in the muffler*

At higher speed, water pressure increases in the supply hose of the regulator valve and gradually overcomes the return spring of the regulator valve. Less water is being delivered to the injection fitting at the tuned pipe.



HIGH SPEED OPERATION
1. *Water entering regulator valve*
2. *Water exiting regulator valve (more restriction)*
3. *Water injected in the muffler*

Adjustment

The water flow regulator valve has been calibrated at the factory and should not be modified.

NOTE: Water flow regulator valves ordered from the parts channel are also calibrated.

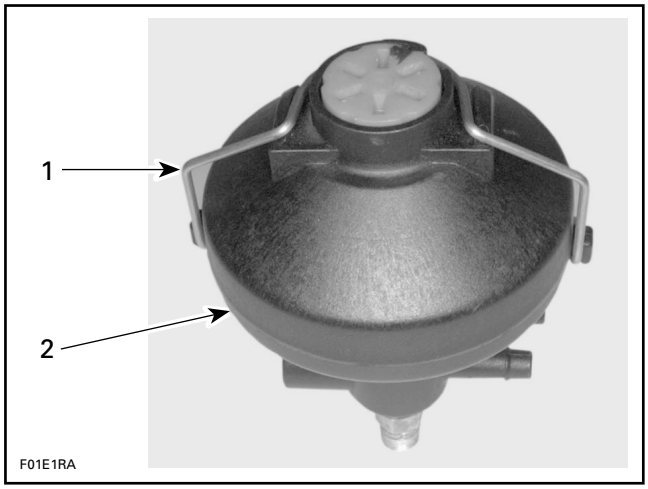
If the maximum engine speed cannot be attained or if the engine has poor performance, the water flow regulator valve should be considered in the troubleshooting of the problem.

Disassembly

Remove the cover **no. 4** of the valve by releasing the spring **no. 3**.

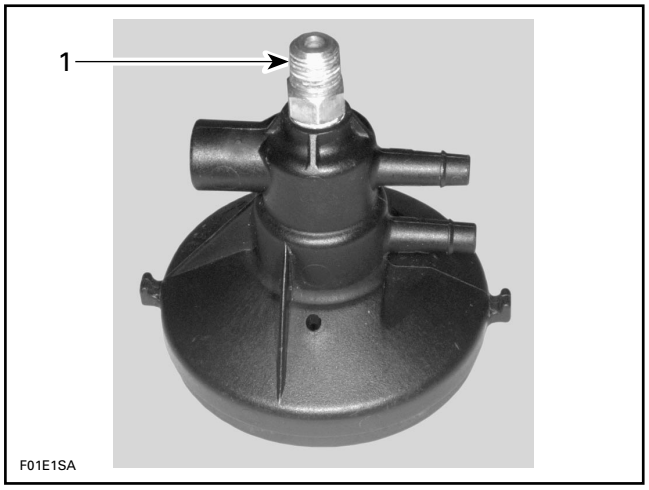
⚠ WARNING

Firmly hold cover to valve base. The spring inside the valve is applying a pressure against the cover.



1. *Spring*
2. *Cover*

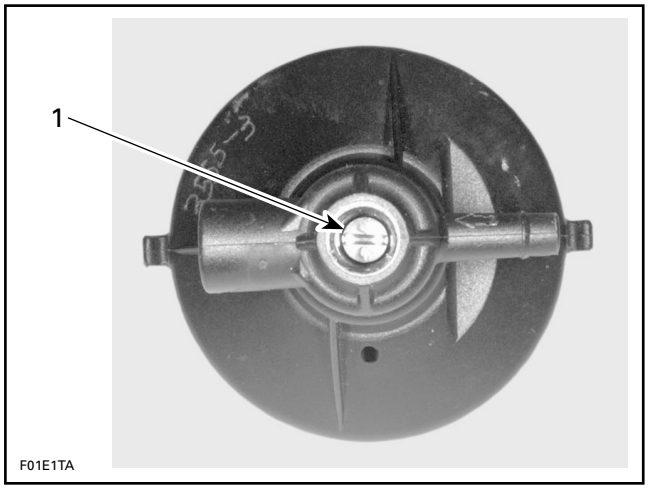
Remove injection fitting **no. 5** from valve housing.



1. Fitting

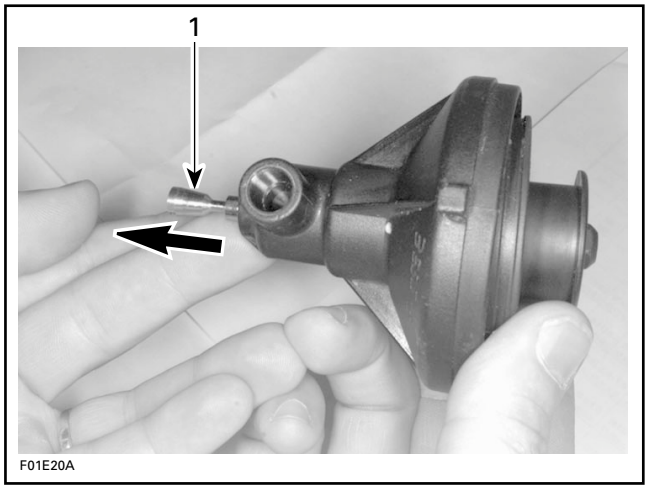
Unscrew the tapered needle **no. 6**.

NOTE: Hold the valve to prevent it from turning.



1. Tapered needle

Remove the tapered needle from valve housing.

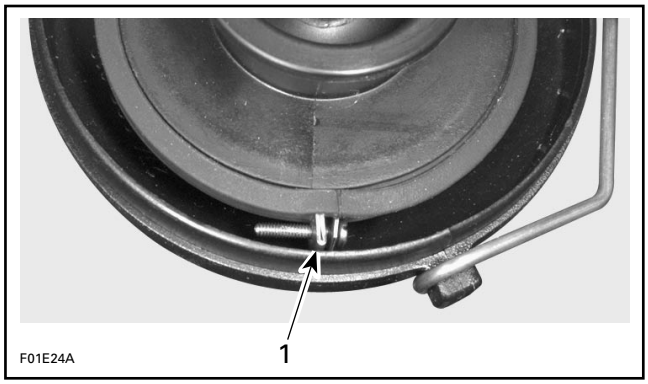


1. Remove tapered needle

Pull the valve slightly. Using pliers, release the clamp which retains the bellows **no. 8**.

Remove valve **no. 7** and bellows **no. 8**.

Loosen clamp to separate valve from bellows.



1. Clamp

Inspection

Inspect parts for damage. Verify especially bellows for cracks.

Assembly

Assembly is essentially the reverse of disassembly procedures.

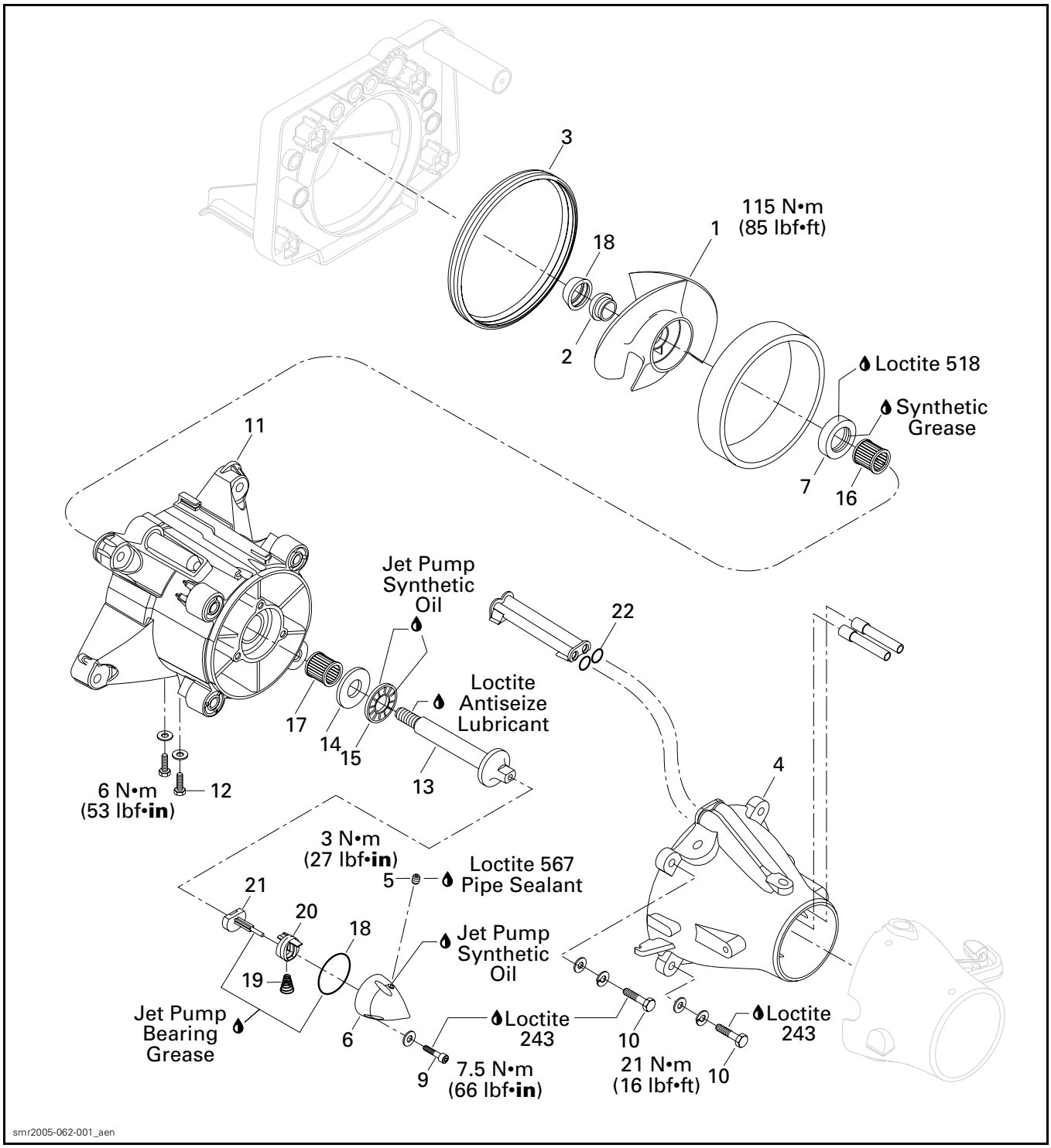
JET PUMP

SERVICE TOOLS

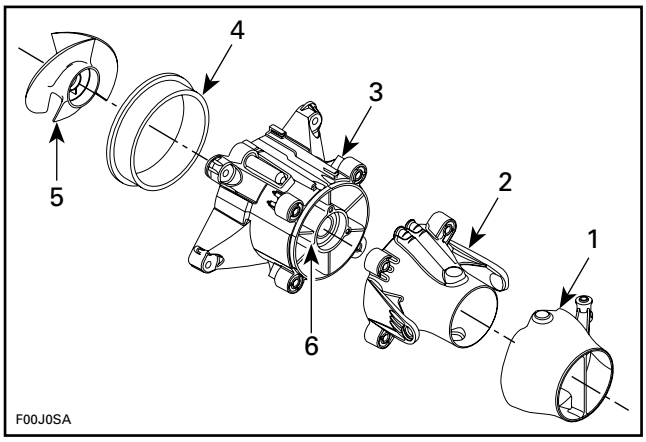
Description	Part Number	Page
bearing/seal installer tool	295 000 107	243
bearing/seal remover tool	295 000 144	239
fitting tool	295 000 086	249
impeller remover/installer tool	295 000 001	238, 247
impeller shaft guide	295 000 002	246
impeller shaft holder tool	295 000 082	238, 247
inner bearing installer tool	529 035 609	245
lift kit	295 100 206	235
pressure/vacuum pump	529 021 800	249

SERVICE PRODUCTS

Description	Part Number	Page
BOMBARDIER LUBE	293 600 016	247, 249
jet pump bearing grease	293 550 032	236, 248
jet pump synthetic oil	293 600 011	237, 246, 249
Loctite 243 (blue)	293 800 060	236, 249
Loctite 518	293 800 038	244
Loctite 567 (pipe sealant)	293 800 013	236–237, 249
Loctite 767 (antiseize lubricant)	293 800 070	246–247
pulley flange cleaner	413 711 809	236, 240
synthetic grease	293 550 010	244, 247, 249



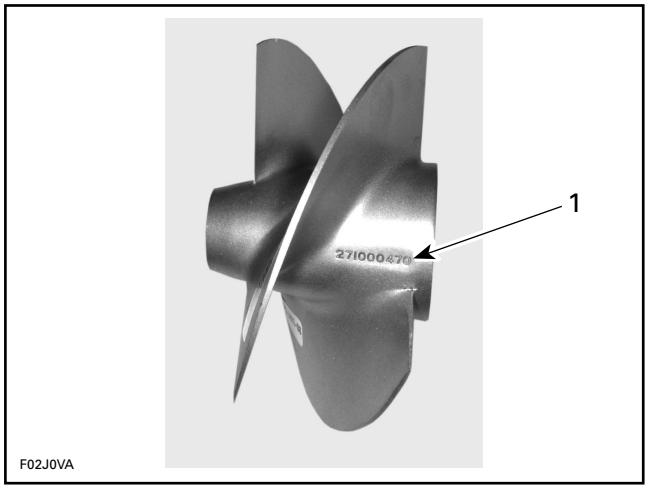
GENERAL



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

Impeller Identification

To identify the impellers refer to the following illustration and chart.



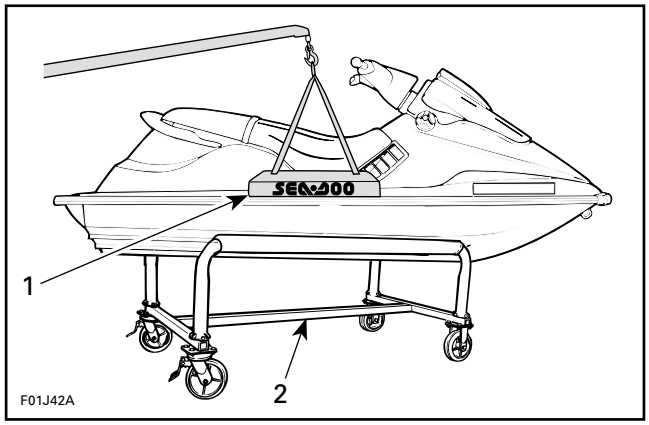
1. *Stamped part number*

WATERCRAFT MODEL	IMPELLER P/N	MATERIAL	PITCH
3D	267 000 201	Stainless steel	Progressive pitch 11° - 20°
GTI	271 001 297	Stainless steel	Progressive pitch 10° - 20°
GTI RFI, GTI RFI LE	271 001 496	Stainless steel	Progressive pitch 11° - 20°

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.

A lift kit (P/N 295 100 206) can be used to install watercraft on a stand.



TYPICAL
1. *Lift kit*
2. *Work stand*

Impeller Condition

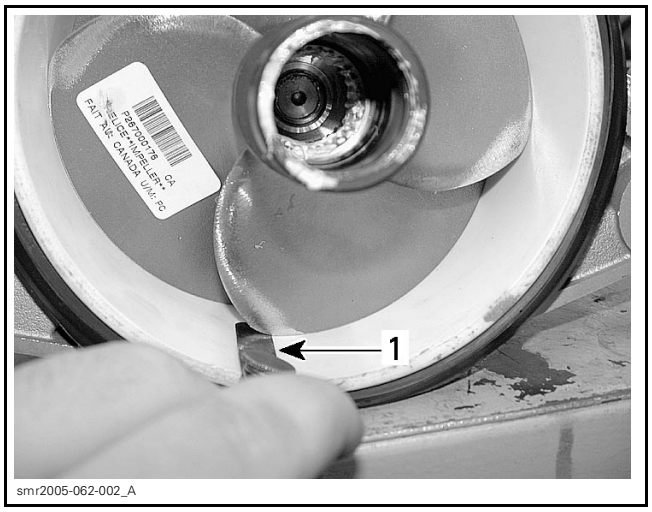
Condition of impeller **no. 1**, boot **no. 2** and wear ring **no. 3** can be quickly checked from underneath of the watercraft. Using a flashlight, look through water inlet.

Impeller/Wear Ring Clearance

This clearance is critical for jet pump performance.

To check clearance, remove jet pump from vehicle. Refer further in this subsection for the complete procedure.

Using a feeler gauge, measure clearance between impeller blade tip and wear ring. Measure each blade at its center. Clearance should not exceed 1.0 mm (.040 in). If clearance is greater, disassemble jet pump and inspect impeller and wear ring. Renew worn parts.

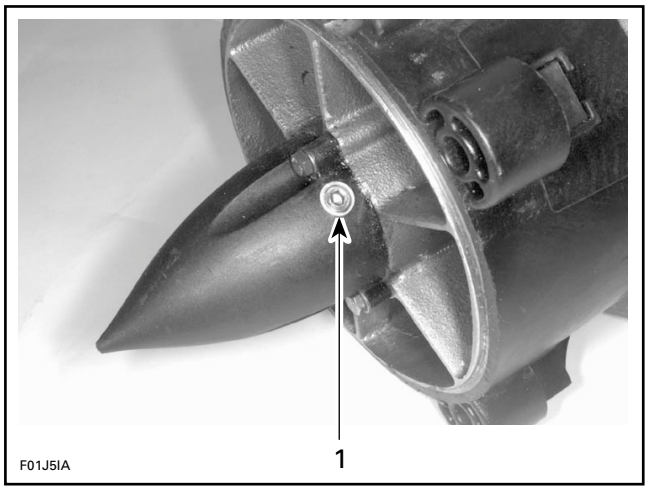


TYPICAL
1. Feeler gauge

Oil Inspection

Remove venturi **no. 4**. Refer further for complete procedure.

Remove filler plug **no. 5** from cover **no. 6**.



TYPICAL
1. Filler plug

Check oil level, it should be at bottom of hole threads.

If oil level is low, check impeller shaft housing for leaks. A pressure test must be performed. See PUMP PRESSURIZATION in this subsection.

To check oil condition, insert a wire through oil level hole then withdraw. A whitish oil indicates water contamination.

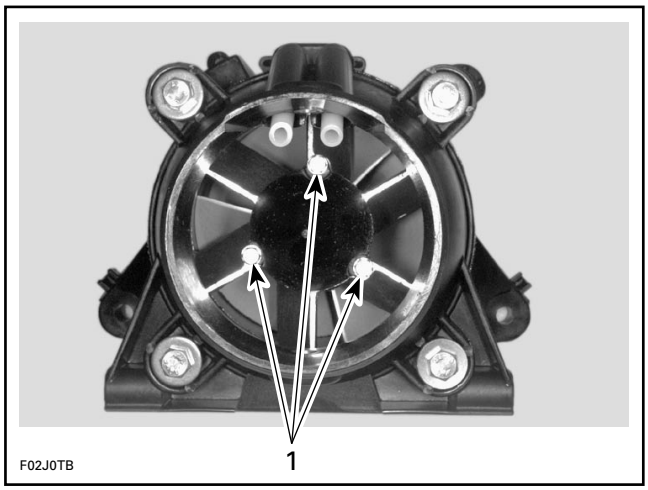
This may involve defective impeller shaft seal **no. 7** and/or O-ring **no. 8** of cover. Jet pump unit should be overhauled to replace seal.

If everything is correct, apply Loctite 567 (pipe sealant) (P/N 293 800 013) on filler plug threads and reinstall it on cover. Properly reinstall removed parts.

Oil Replacement

Remove venturi **no. 4**. Refer further for complete procedure.

Remove 3 screws **no. 9** retaining cover **no. 6**.



TYPICAL
1. Screws

Place a container under cover to catch oil.

Using a fiber hammer, gently tap cover to release it from housing cover.

Thoroughly clean reservoir and inside of cover with pulley flange cleaner (P/N 413 711 809). Check condition of O-ring **no. 8**. Replace as necessary.

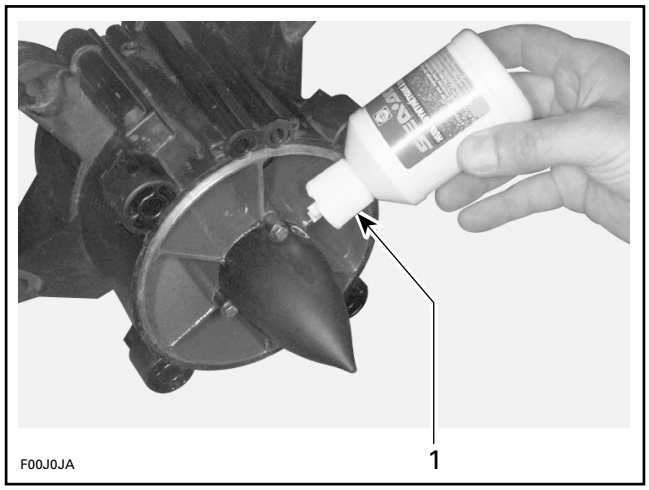
Apply jet pump bearing grease (P/N 293 550 032) on mating surface of cover and reinstall it with its O-ring.

Apply Loctite 243 (blue) (P/N 293 800 060) on cover screw threads and torque them to 7.5 N•m (66 lbf•**in**).

Place housing horizontally with a tilt angle of 15° with the filler plug located on top. Remove filler plug **no. 5** from cover. Pour jet pump synthetic oil (P/N 293 600 011) in reservoir until oil comes level with bottom of hole. Let oil drain into housing and after a few minutes add more oil until it is level with bottom of filler hole.

CAUTION: This is a synthetic oil. Do not mix with mineral based oil. Do not mix oil brands.

NOTE: When filling reservoir, oil must be poured into cover quite slowly to allow complete housing fill.



TYPICAL
1. Pour oil slowly until it is level with bottom of filler hole

Apply Loctite 567 (pipe sealant) (P/N 293 800 013) on filler plug threads and reinstall it on cover.

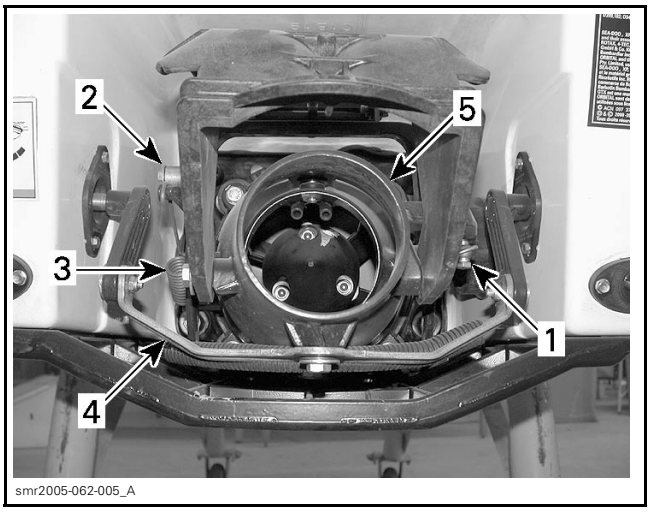
Properly reinstall removed parts.

REMOVAL

Venturi/Nozzle

GTI Series

When the venturi is removed to check or replace jet pump oil, the reverse gate removal is not necessary. Remove steering and reverse cables, reverse spring and screw retaining "U" lever on nozzle.



1. Steering cable
2. Reverse cable
3. Reverse spring
4. U lever
5. Nozzle

All Models

In all other situations, use the following procedure.

Remove reverse gate (**GTI Series**), refer to REVERSE SYSTEM.

Remove retaining screws **no. 10** and withdraw venturi **no. 4** with nozzle.

Jet Pump Housing

Remove venturi with nozzle.

Loosen 4 hexagonal bolts and remove flat washers from jet pump housing **no. 11**.

Remove jet pump with a wiggle movement.

NOTE: If jet pump can not be removed easily, drive shaft may be sized in impeller. If so, remove drive shaft with jet pump. Refer to DRIVE SYSTEM for drive shaft removal procedure.

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 needles in needle 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.

Cover

With pump assembly in horizontal position, remove 3 retaining screws **no. 9**.

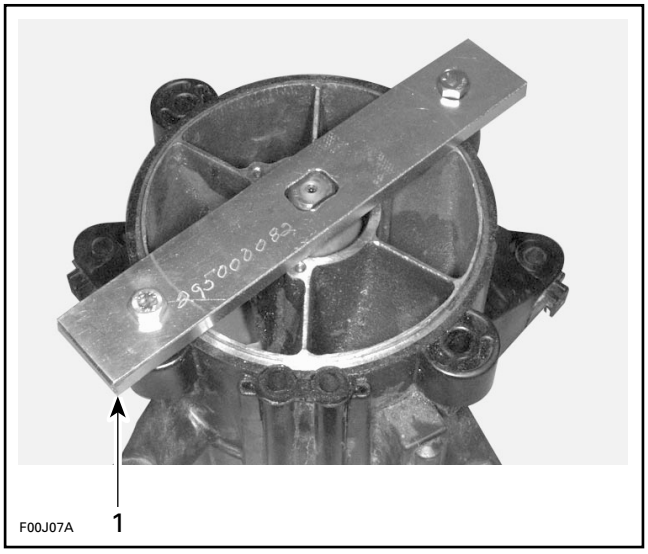
Place container under cover **no. 6** to catch oil.

Using a fiber hammer, gently tap cover to release it from jet pump housing.

Impeller

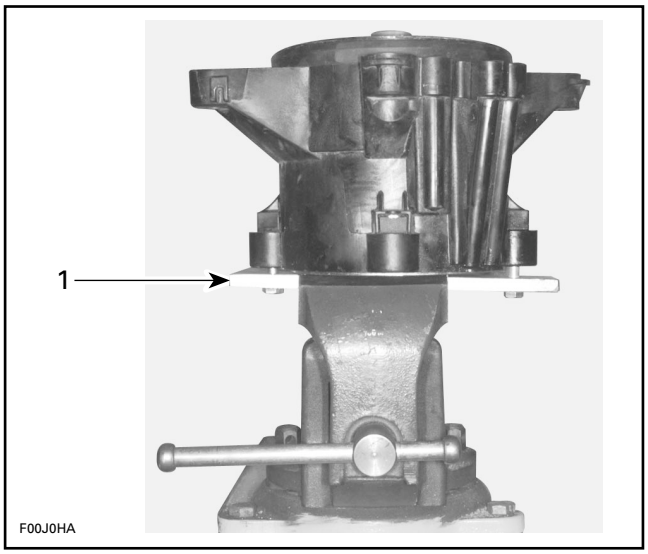
Insert the impeller shaft holder tool (P/N 295 000 082) on impeller shaft flat end.

Using 2 screws previously removed from venturi, secure shaft holder to housing.



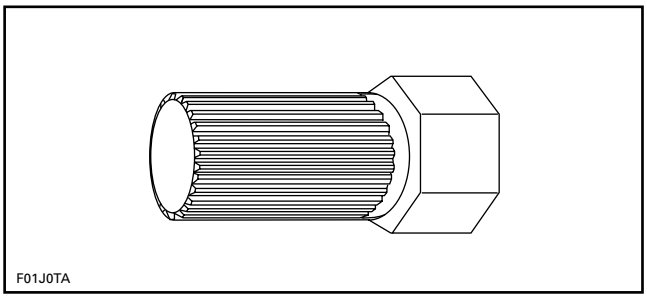
1. Shaft holder

Install shaft holder in a vise.

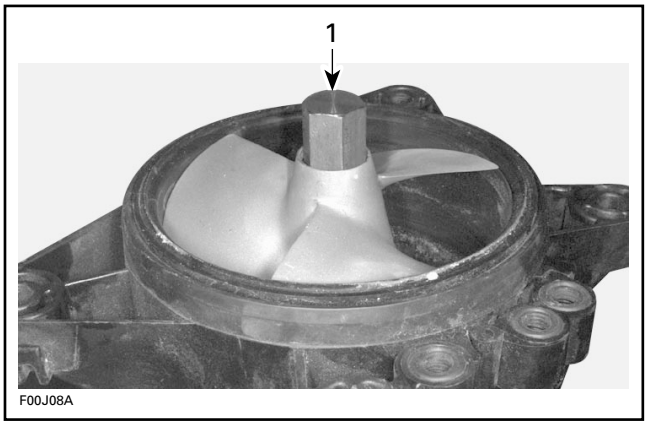


1. Shaft holder

Impeller **no. 1** is loosened using the impeller remover/installer tool (P/N 295 000 001).



Insert the impeller remover tool in impeller splines.



1. Impeller remover tool

Rotate impeller remover tool counterclockwise and unscrew completely impeller.

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. Remove tool from impeller.

Wear Ring

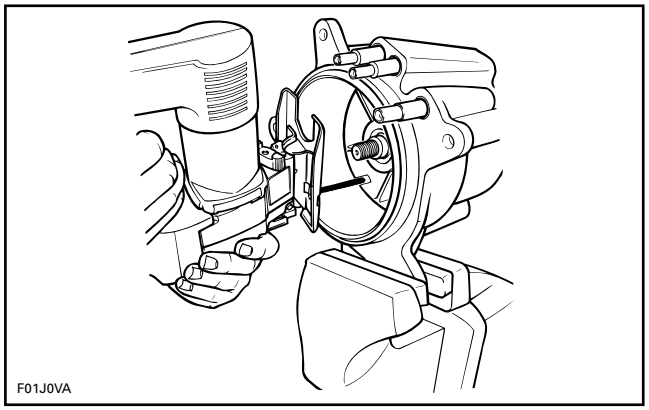
Remove the 4 screws **no. 12** retaining the wear ring **no. 3** in the jet pump housing.

Place jet pump housing in a vise with soft jaws. It is best to clamp housing using a lower ear.

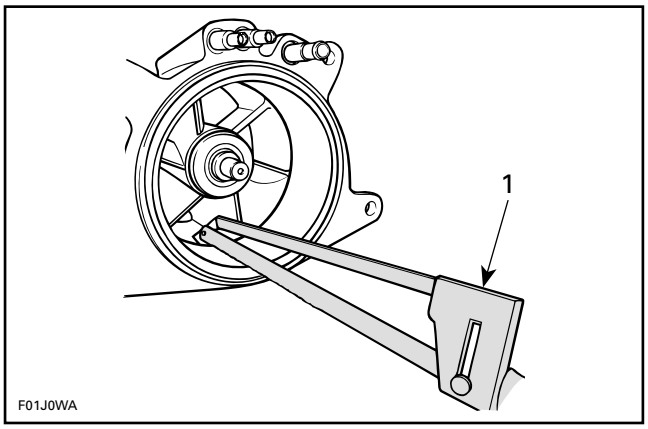
Cut wear ring at two places.

CAUTION: When cutting ring, be careful not to damage jet pump housing.

NOTE: Wear ring can be cut using a jigsaw, a small grinder or a low clearance hacksaw such as Snap-on HS3 or equivalent.



TYPICAL



TYPICAL
1. Snap-on HS3

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.

Impeller Shaft

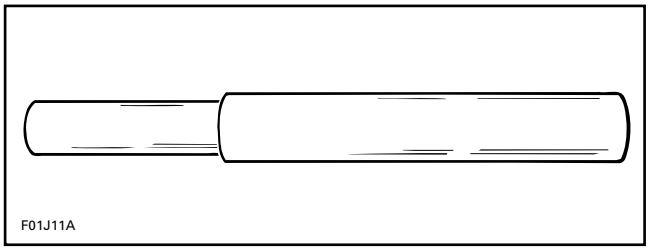
Remove impeller **no. 1**.

Remove shaft holder tool.

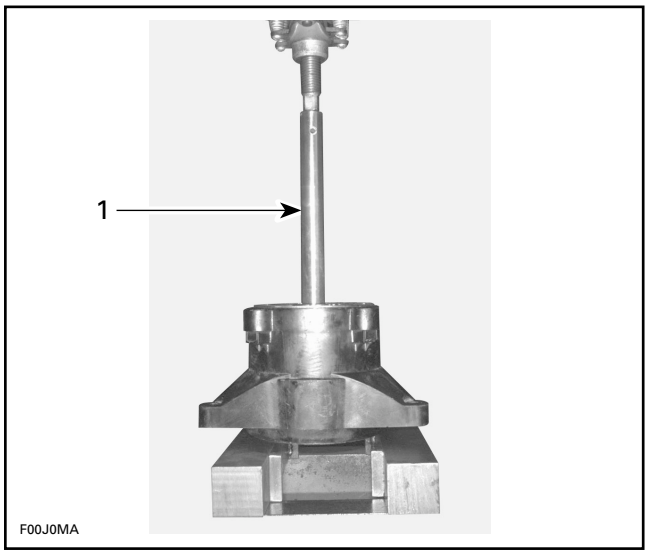
Remove impeller shaft **no. 13** with thrust washer **no. 14** and thrust bearing **no. 15**.

Seal and Needle Bearing

Remove seal **no. 7** and bearings **no. 16** and **no. 17** at the same time using the bearing/seal remover tool (P/N 295 000 144).



Insert bearing remover then press tool using a arbor press until seal and bearings are out. However, care should be taken not to damage bearing journals.



1. Bearing/seal remover tool

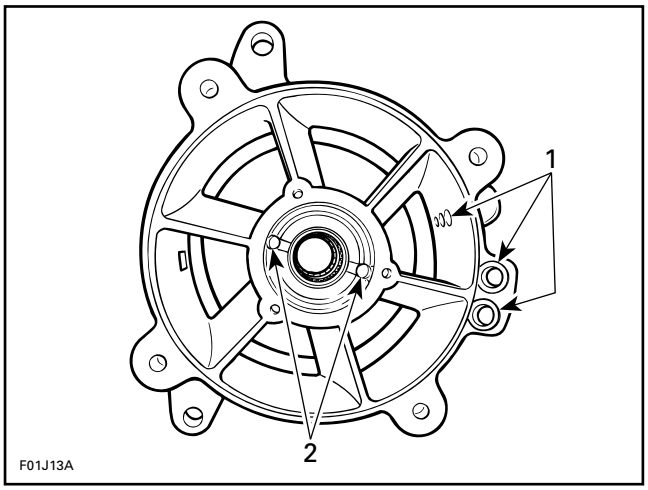
NOTE: It is always recommended to renew both bearings, even if only one bearing needs to be replaced.

CLEANING

Properly clean all threads.

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

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



TYPICAL
1. *Water passages*
2. *Oil 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.

CAUTION: Be careful not to damage impeller shaft diameter.

PARTS INSPECTION

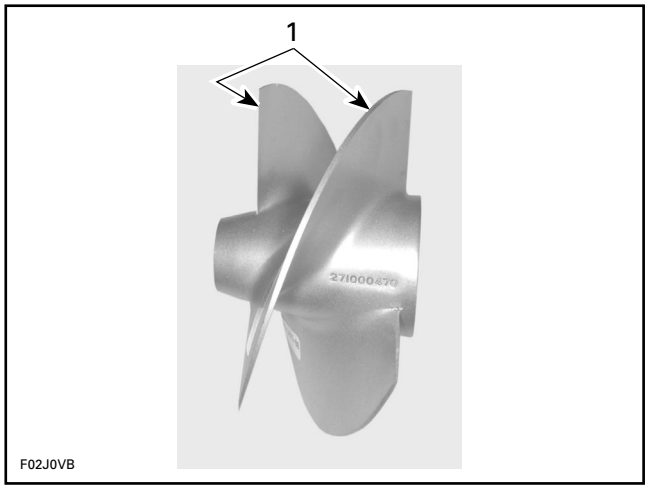
Impeller

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

NOTE: Check also PTO flywheel and drive shaft condition. Refer to BOTTOM END and DRIVE SYSTEM.

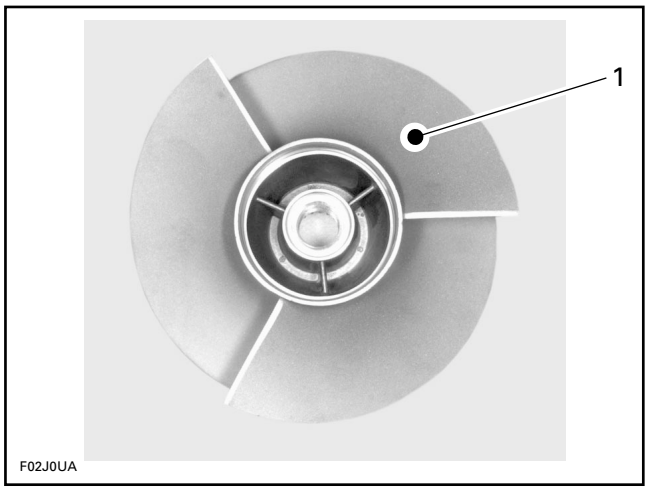
Examine impeller in wear ring for distortion.

Check if blade tips are blunted round, chipped or broken. Such impeller is unbalanced and will vibrate and damage wear ring, impeller shaft, shaft seal or bearings. Renew if damaged.



1. *Replaced if blunted round or damaged*

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



1. *Check for cavitation, deep scratches or other damage*

Wear Ring

Check wear ring **no. 3** 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.

Needle Bearing and Impeller Shaft

WEAR

Inspect needle bearings **no. 16** and **no. 17** and their contact surface. Check for scoring, pitting, chipping or other evidence of wear.

With your finger nail, feel contact surface of seal. If any irregular surface is found, renew impeller shaft **no. 13**.

Install bearings, then install impeller shaft and rotate it. Make sure it turns smoothly.

RADIAL PLAY

Radial play is critical for jet pump unit life span.

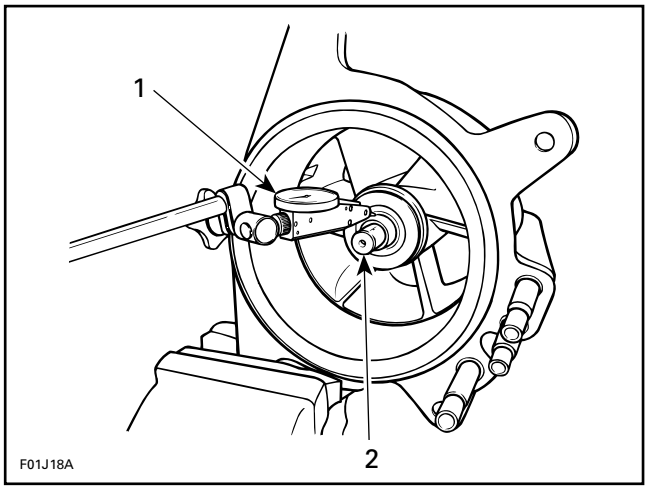
Radial play of impeller shaft is checked with shaft in housing, without impeller.

Retain housing in a soft jaw vise making sure not to damage housing lug.

Set a dial gauge and position its tip onto shaft end, close to end of threads.

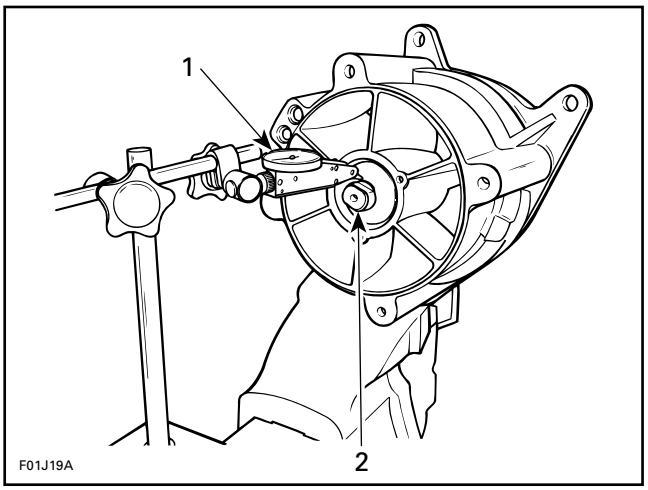
Move shaft end up and down. Difference between highest and lowest dial gauge reading is radial play.

Maximum permissible radial play is 0.05 mm (.002 in).



TYPICAL — MEASURING IMPELLER SHAFT RADIAL PLAY
1. *Dial gauge*
2. *Measure close to threads at shaft end*

To check both bearings, proceed the same way with other shaft end. Position gauge tip on diameter, close to flats on shaft.

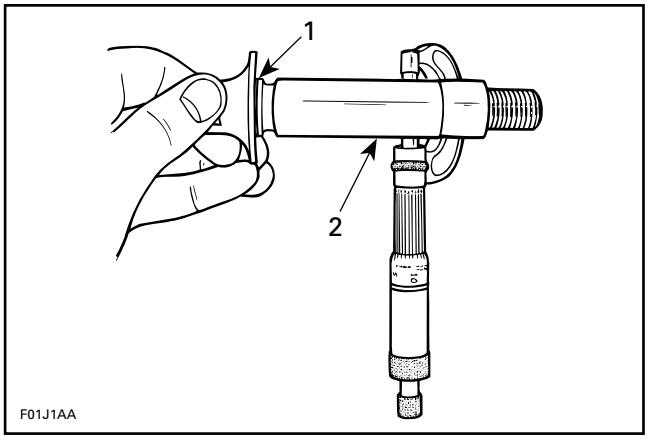


TYPICAL — MEASURING IMPELLER SHAFT RADIAL PLAY
1. *Dial gauge*
2. *Measure close to flats at shaft end*

Excessive play can come either from worn bearings or impeller shaft or damaged jet pump housing bearing surfaces.

Measuring shaft diameter will determine the defective parts.

Using a micrometer, measure diameter on bearing contact surfaces. Minimum shaft diameter should be 22.24 mm (.876 in).

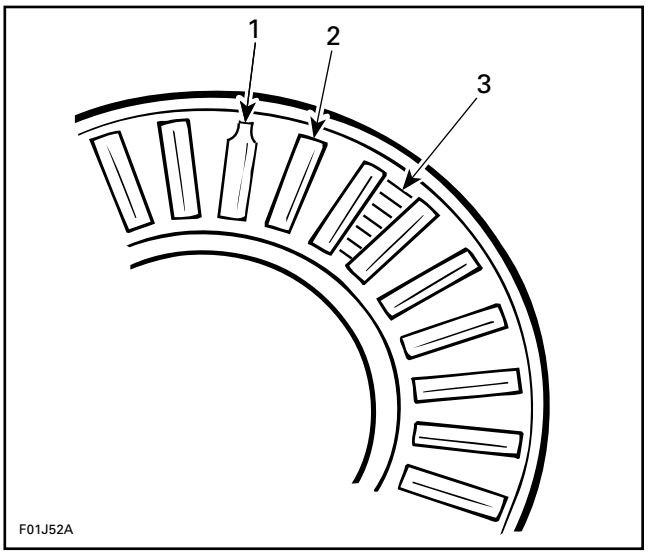


1. *Inspect for wear at the bearing pilot*
2. *Radial bearing raceway*

NOTE: If shaft is to be replaced, it is recommended to replace both bearings at the same time. In addition, it is suggested to replace thrust bearing and thrust washer.

Thrust Washer and Thrust Bearing

Visually inspect thrust washer **no. 14**, thrust bearing **no. 15** and their contact surface. Check for scoring, pitting, flaking, discoloration or other evidence of wear. For best inspection, use a 7X magnifying glass to check wear pattern.

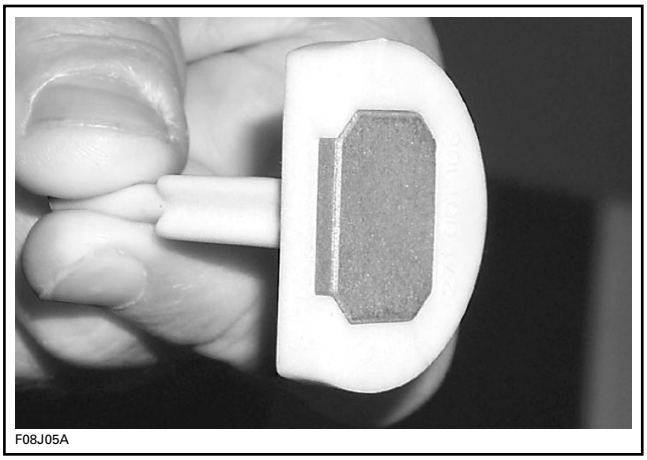


TYPICAL
1. *Worn roller (trunnion worn on end roller)*
2. *Good roller (cylindrical shape)*
3. *Look for scoring on retainer*

NOTE: When replacing either washer or bearing, it is recommended to renew both.

Anti-Rattle Pusher

Check for melted plastic around metal pad. If so, replace it.



Check for excessive wear of pad.

Seal

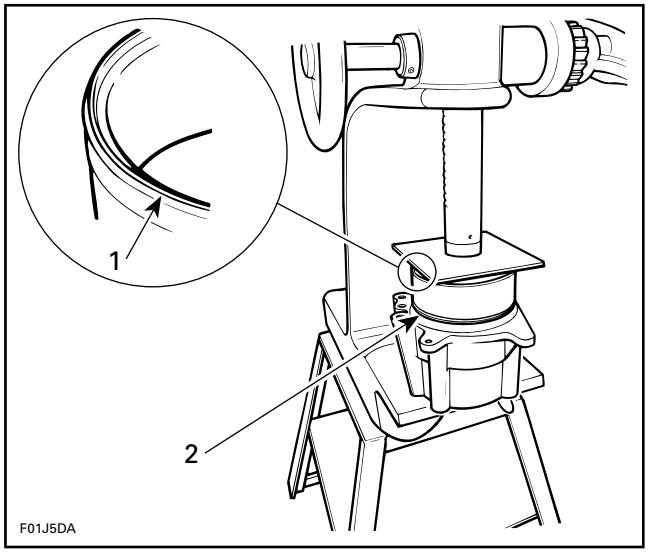
Carefully inspect seal lips. Make sure that lips are not worn, distorted, cracked or show signs of any other damage. Replace after 150 hours even if it seems good.

ASSEMBLY

Wear Ring

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.

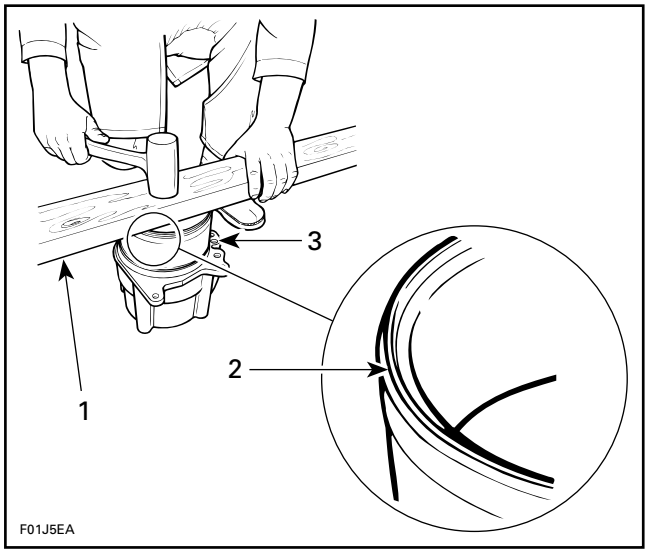
Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.



1. *Seal lip*
2. *Press wear ring*

If a press is not readily available, a piece of wood such as a 2 × 4 in × 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.

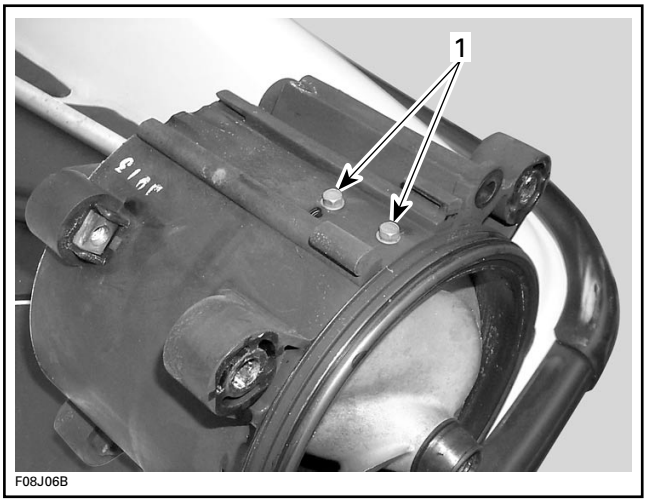


1. *Piece of wood*
2. *Seal lip facing upward*
3. *Wear ring*

After wear ring installation, it is required to fit screws **no. 12** 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**).

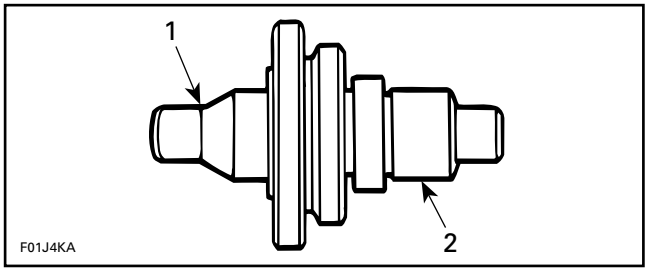


1. *Screws*

Seal and Needle Bearing

Impeller Side

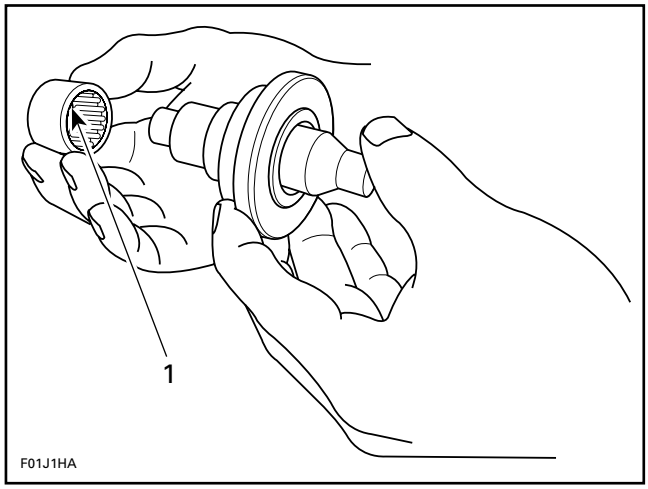
Bearing **no. 16** and seal **no. 7** on impeller side will be properly installed in housing using the bearing/seal installer tool (P/N 295 000 107).



BEARING/SEAL INSTALLER TOOL
1. *Seal side*
2. *Bearing side*

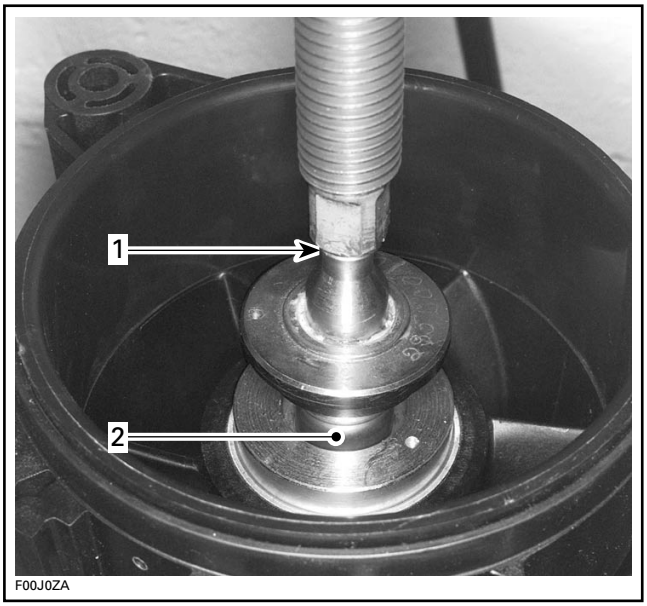
Stamped end of bearings (showing identification markings) must be located toward outside of housing.

Properly insert bearing on tool. Using an arbor press only, push tool until tool flange contacts housing.



1. *Stamped end facing tool*

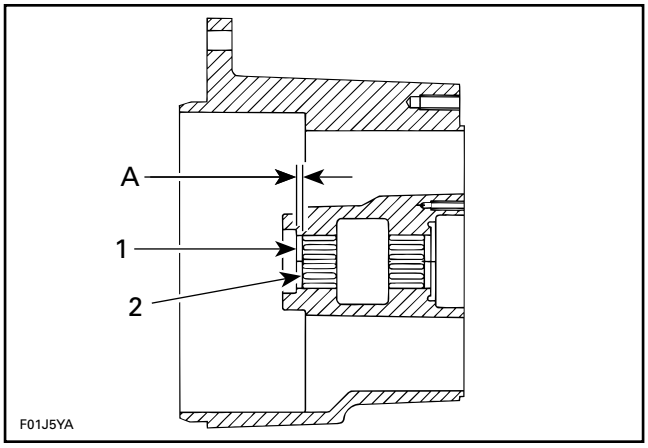
CAUTION: Never hammer the bearing into its housing.



1. Press on tool until it stops
2. Bearing

CAUTION: These tools have been designed to properly position bearings and seal, thus providing space for lubrication purposes. The tool flanges allow this. If a different pusher type is being used, components must be properly positioned as follows.

Bearing on impeller side must be 1.5 to 2.5 mm (.060 - .100 in) inside reservoir measured from seal seat. Refer to following illustration.



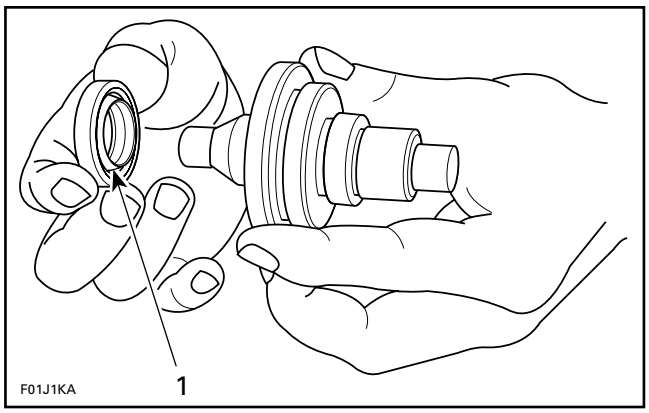
1. Seal seat
2. Stamped end of bearing
A. 1.5 - 2.5 mm (.060 - .100 in)

Apply Loctite 518 (P/N 293 800 038) to seal housing, all around outer diameter and on seal seat.

Properly insert seal on tool.

NOTE: Apply synthetic grease (P/N 293 550 010) on tool to ease seal insertion.

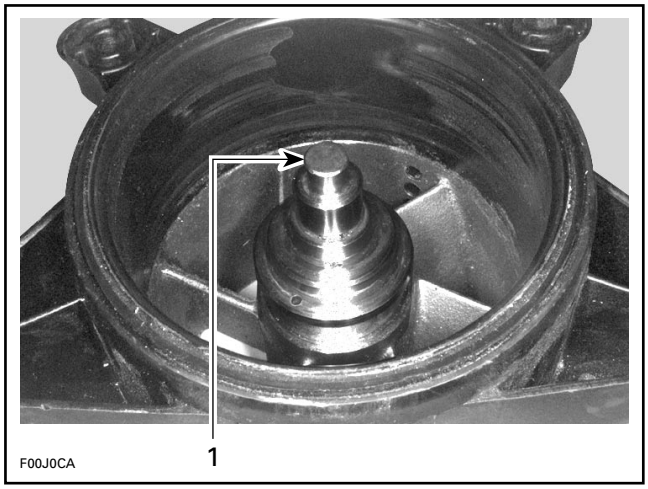
Install seal with the spring toward the outside.



1. Spring of seal facing tool

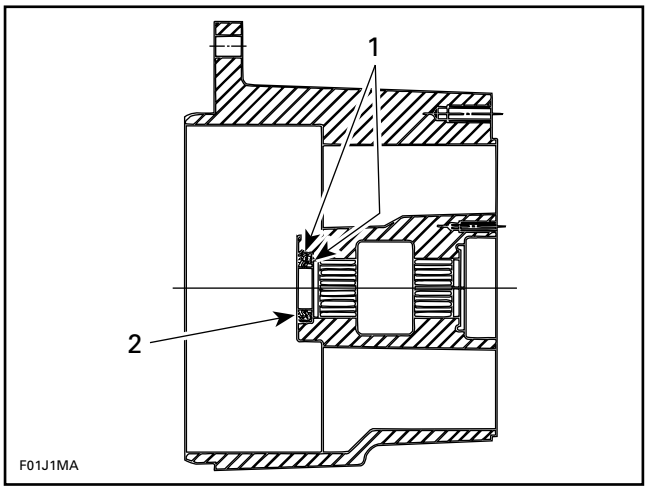
CAUTION: Prevent sealant from contacting any needles of bearing.

Push on tool end with a press until tool flange contacts housing.



1. Press on tool until it stops

Apply synthetic grease (P/N 293 550 010) between seal lips.



1. Loctite 518 all around and behind
2. Spring of seal lip this side

Venturi Side

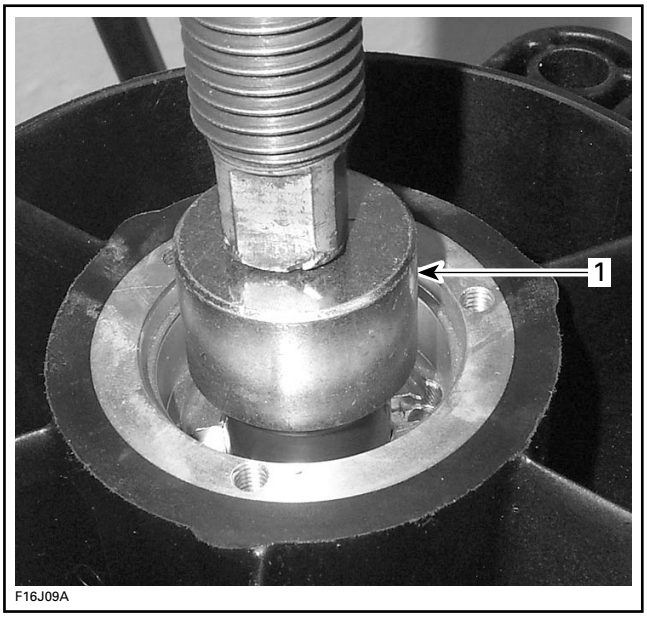
For the bearing **no. 17** on venturi side use the inner bearing installer tool (P/N 529 035 609).

CAUTION: Failure to use this tool will cause major damage to the pump.

Stamped end of bearings (showing identification markings) must be located toward outside of housing.

Properly insert bearing on tool. Using an arbor press only, push tool until tool flange contacts housing.

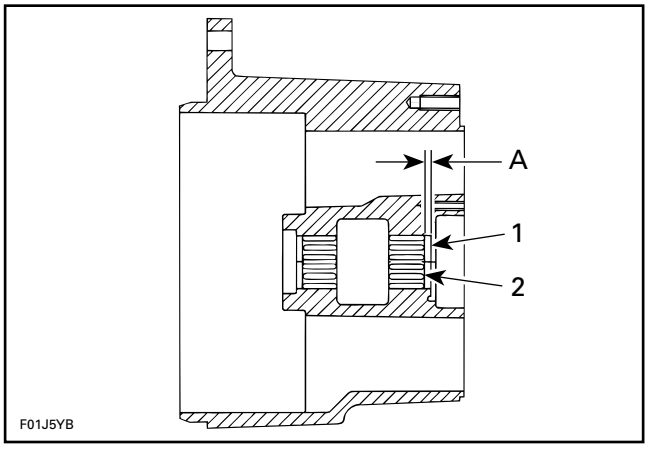
CAUTION: Never hammer the bearing into its housing.



1. Press on tool until it stops

CAUTION: These tools have been designed to properly position bearing, thus providing space for lubrication purposes. The tool flanges allow this. If a different pusher type is being used, components must be properly positioned as follows.

Bearing on venturi side must be 2 to 4 mm (.080 - .157 in) inside reservoir measured from thrust washer seat. Refer to following illustration.

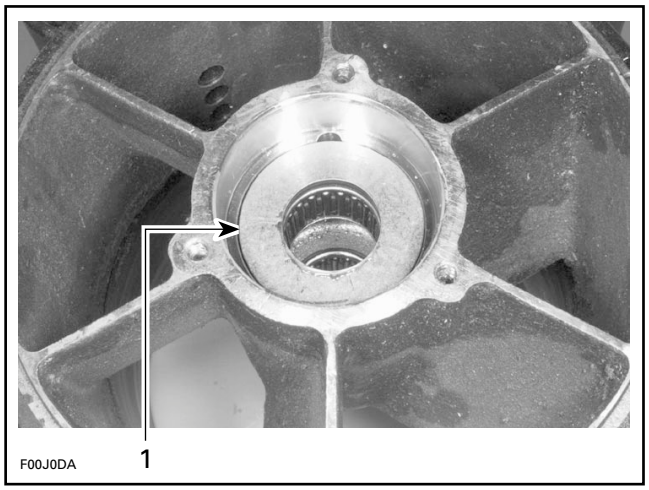


1. Thrust washer seat
2. Stamped end of bearing
A. 2 - 3 mm (.080 - .118 in)

Thrust Washer

Position jet pump housing with the stator vanes on top.

Insert thrust washer **no. 14** in the stator seat.

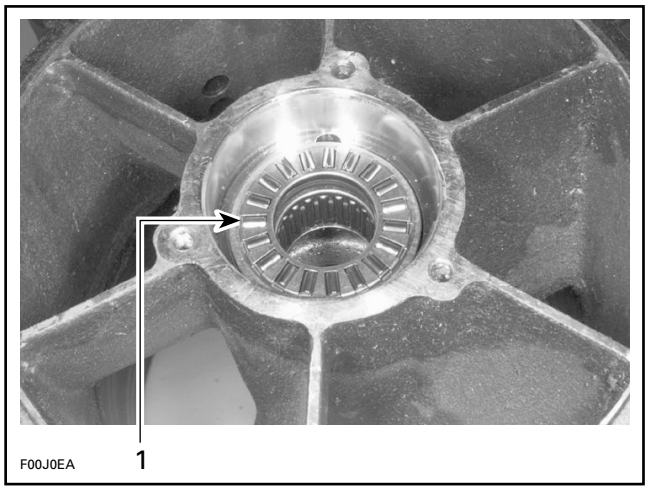


1. Thrust washer properly installed in stator seat

Thrust Bearing

Apply jet pump synthetic oil (P/N 293 600 011) on both sides of thrust bearing.

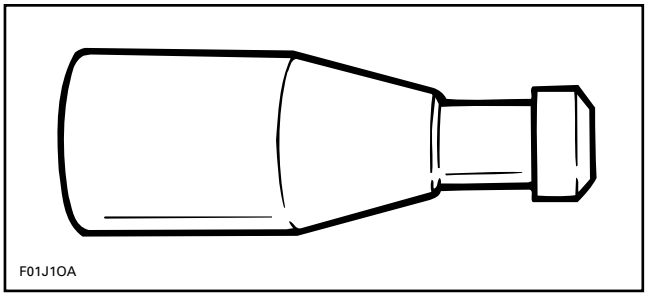
Position thrust bearing **no. 15** on thrust washer **no. 14**.



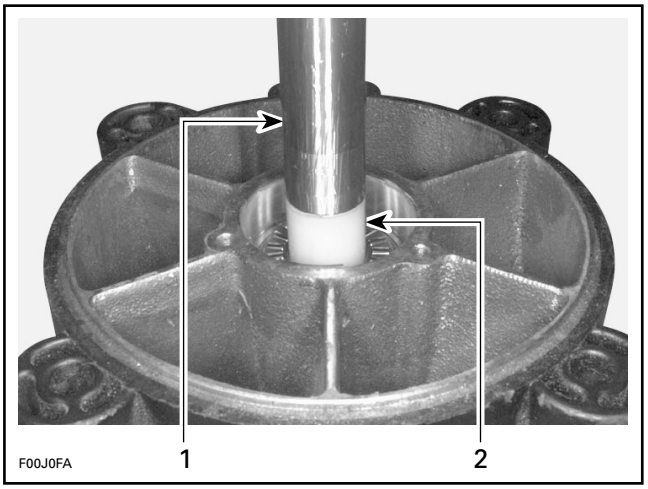
1. Thrust bearing on top of thrust washer

Impeller Shaft

To prevent seal lip damage when inserting impeller shaft **no. 13**, use the impeller shaft guide (P/N 295 000 002).



Insert tool onto shaft end then carefully install shaft in jet pump housing.



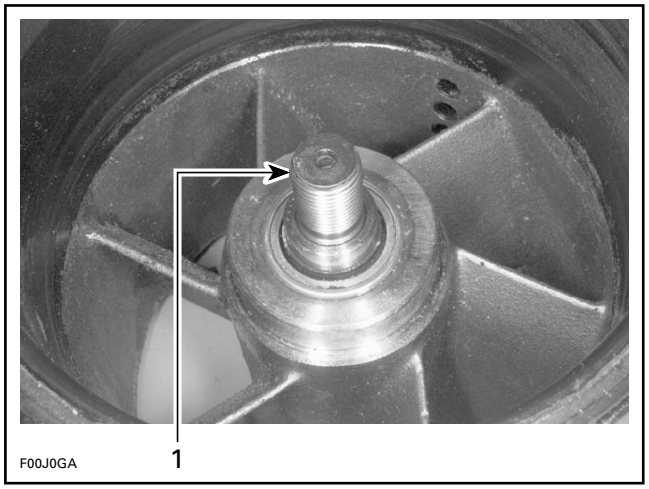
1. Impeller shaft
2. Impeller shaft guide

NOTE: If jet pump housing rest against a table, raise it slightly to allow complete shaft insertion with the shaft guide.

Remove shaft guide.

Impeller

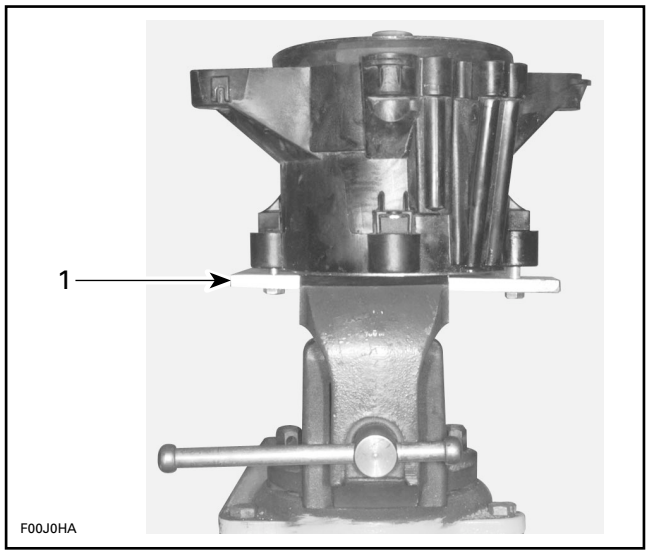
Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on threads of impeller shaft **no. 13**.



1. Apply antiseize on threads

Using 2 screws previously removed from venturi, secure the impeller shaft holder tool (P/N 295 000 082) to housing.

Install the impeller shaft holder tool in a vise.



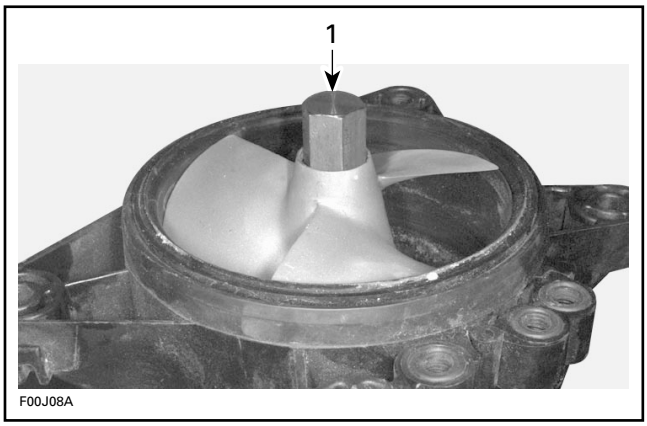
1. Impeller shaft holder secured in a vise

To ease impeller installation, apply BOMBARDIER LUBE (P/N 293 600 016) on wear ring.

Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on impeller shaft threads.

Insert impeller into wear ring. Manually rotate impeller and push so that it slides on impeller shaft threads. Carefully engage threads making sure they are well aligned.

Install the impeller remover/installer tool (P/N 295 000 001) into impeller splines and tighten.



1. Impeller remover/installer tool

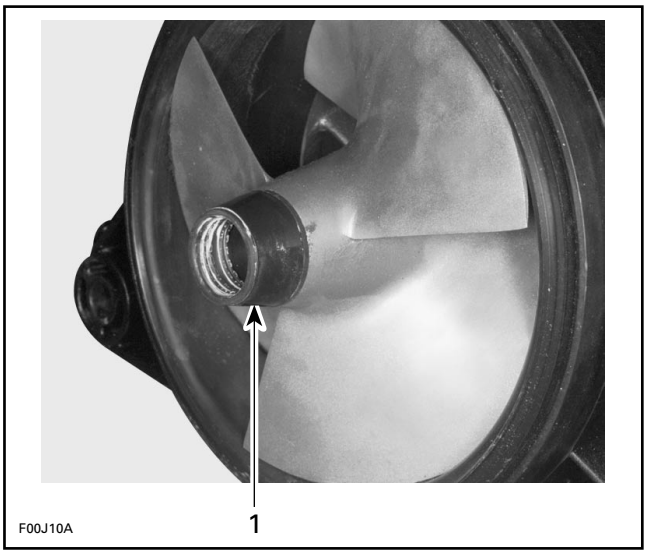
CAUTION: Make sure thrust washer and bearing are not wedged in shaft groove. To check, manually pull and push jet pump housing, some axial play must be felt.

Torque impeller to 115 N•m (85 lbf•ft) then remove tools.

CAUTION: Never use any impact wrench to tighten impeller.

Apply synthetic grease (P/N 293 550 010) on impeller splines.

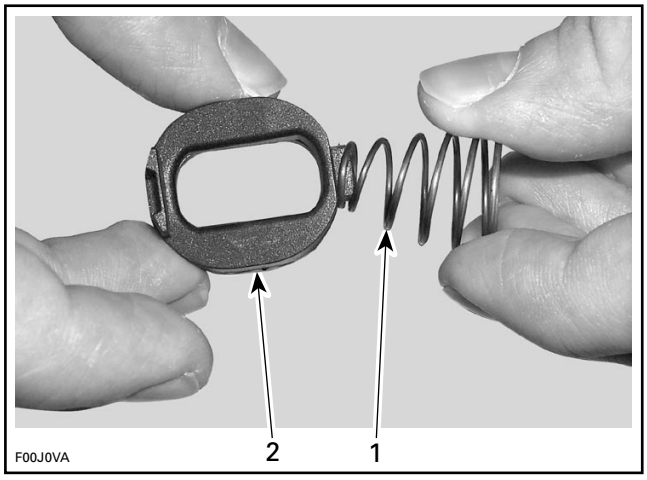
Insert a new boot **no. 2** and impeller ring **no. 18** to impeller.



1. Boot and ring

Cover and Anti-Rattle System

Install spring **no. 19** on slider **no. 20**.



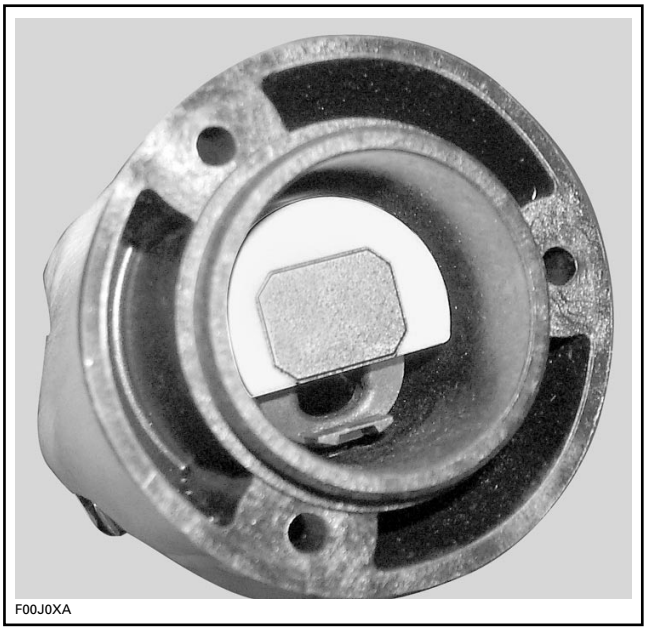
1. *Spring*
2. *Slider*

Insert slider and spring into cover **no. 6**.

NOTE: Align the longer slider tab with hole.

Apply jet pump bearing grease (P/N 293 550 032) in the center hole of the cover.

Install pusher **no. 21** into cover. Place the flat side in front of slider tab.



Install O-ring **no. 8** to cover. Apply jet pump bearing grease (P/N 293 550 032) on mating surface of cover.

Install cover to jet pump housing making sure to properly position filler plug on top side. Do not torque yet, keep a small gap.

Insert a pencil or any other plastic tool in the hole and push on the slider tab.

CAUTION: Do not use a metal tool to push the tab. It is possible to damage the inner threads.

Hold tab and torque screws.

Remove pencil or tool to release locking mechanism.

Check if the mechanism worked properly. Push tab with the pencil or tool; if there is a small play the installation is correct. If not, redo the procedure.

Verify if the impeller is rotating freely.

It is highly recommended to perform a leakage test. Refer to PUMP PRESSURIZATION further

Add oil. Refer to OIL REPLACEMENT, at the beginning of this subsection.

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 filler plug from cover.

– Apply Loctite 567 (pipe sealant) (P/N 293 800 013) on threads of fitting tool (P/N 295 000 086) then secure on cover.
– Connect pressure/vacuum pump (P/N 529 021 800) to fitting.
– Pressurize pump to a maximum of 70 kPa (10 PSI).
– Pump must maintain this pressure for at least 10 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. If jet pump has been overhauled, the impeller shaft seal **no. 7** may be leaking; add a small quantity of jet pump synthetic oil (P/N 293 600 011) to wet the oil seal. Let soak and recheck.

– Disconnect pump and remove fitting.
– Check oil level. Refill as necessary.
– Apply Loctite 567 (pipe sealant) (P/N 293 800 013) to threads of filler plug then secure it in cover.

INSTALLATION

Jet Pump Housing

Generously apply synthetic grease (P/N 293 550 010) on drive shaft splines.

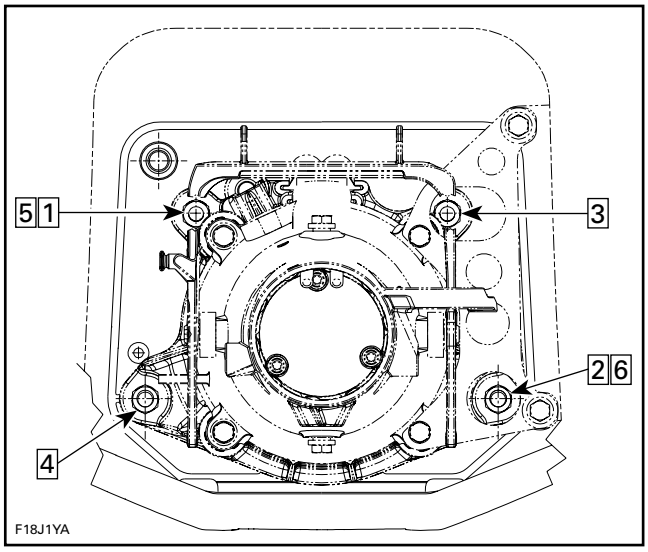
Make sure rubber damper is on drive shaft end.

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 of jet pump housing.

Install flat washers, lock washers and nuts. Tighten nuts of jet pump housing as per the following sequence.

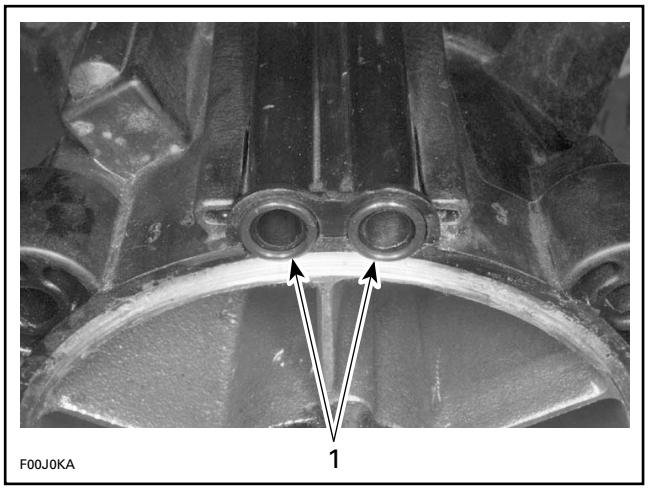


Step 1: From 1 to 2: 16 N•m (12 lbf•ft)
Step 2: From 3 to 6: 31 N•m (23 lbf•ft)

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

Venturi/Nozzle

If needed, install new O-rings **no. 22** around bailer passages.

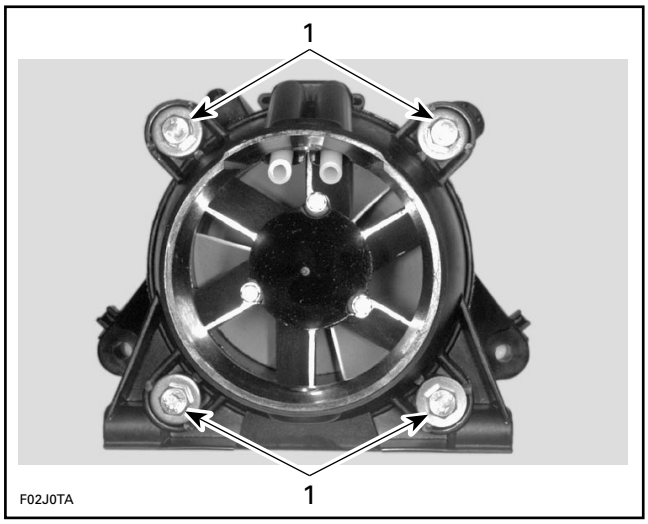


1. O-rings

Position venturi **no. 4** with bailer passages on top.

Apply Loctite 243 (blue) (P/N 293 800 060) on threads of screws **no. 10**.

Install screws **no. 10**, lock washers and flat washers then torque to 21 N•m (16 lbf•ft).



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

Steering Cable

Refer to STEERING SYSTEM.

Reverse Gate and Cable

Refer to REVERSE SYSTEM.

DRIVE SYSTEM

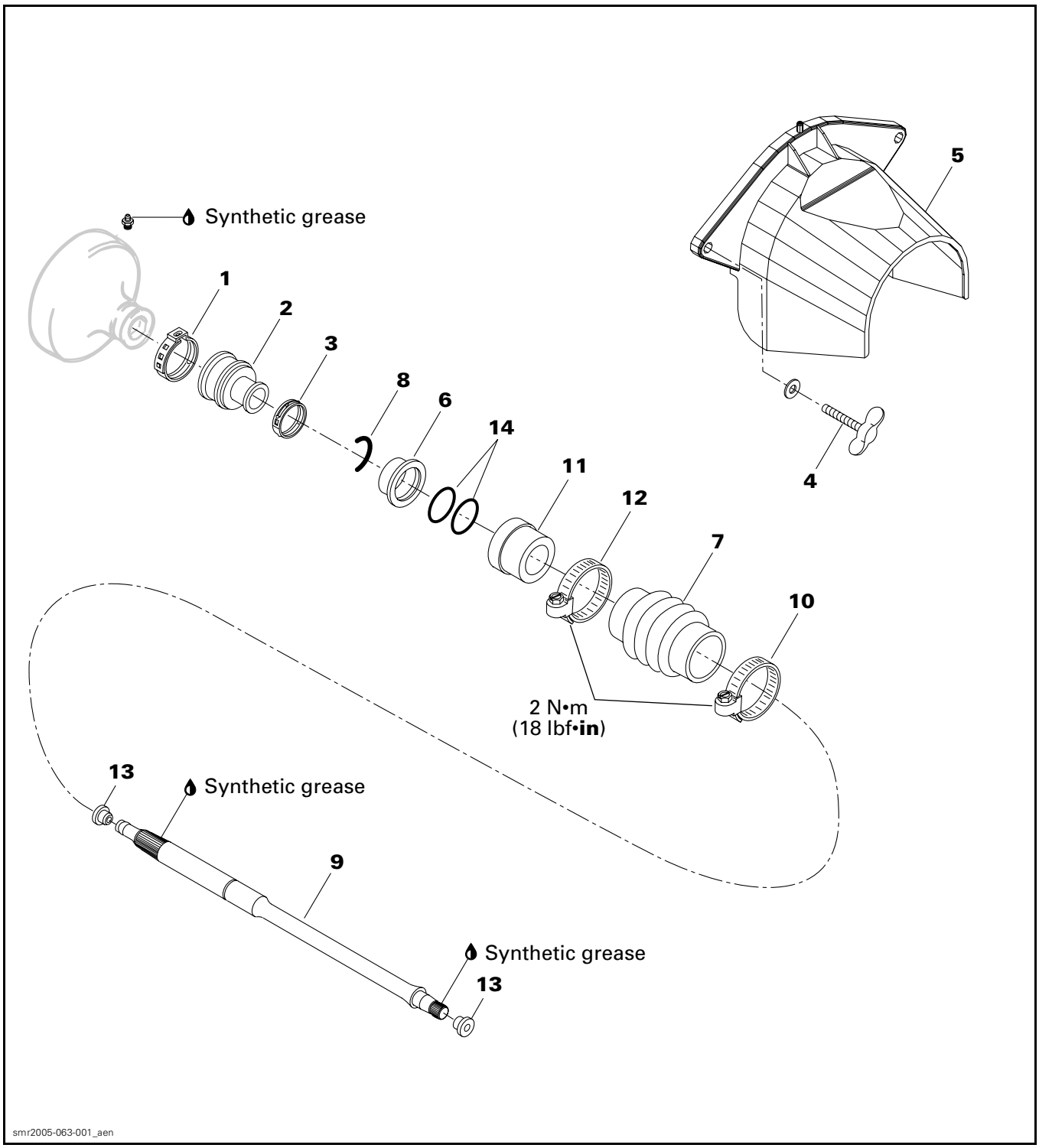
SERVICE TOOLS

Description	Part Number	Page
alignment shaft	295 000 141	264
bearing/seal installer tool	295 000 107	262–263
bearing/seal remover tool	295 000 144	260
Caillau pliers	295 000 054	254
Oetiker pliers 1090	295 000 069	253
support plate kit	529 035 570	264

SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	265–266
Loctite 518	293 800 038	263
synthetic grease	293 550 010	257, 263, 266

GTI SERIES



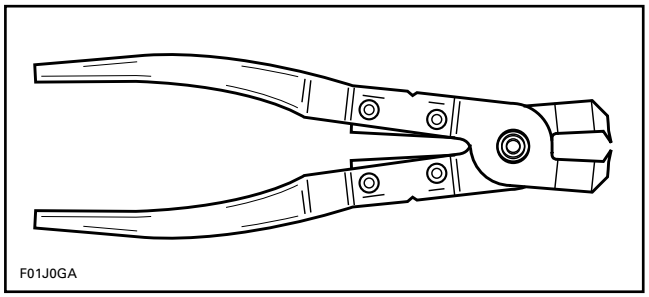
GENERAL

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

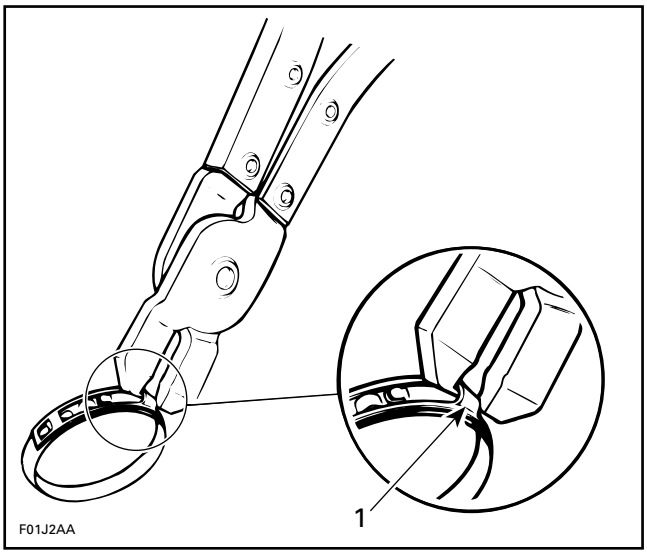
Large Clamp

Unfasten large clamp no. 1 of PTO flywheel boot no. 2 as follows:

– Use Oetiker pliers 1090 (P/N 295 000 069).

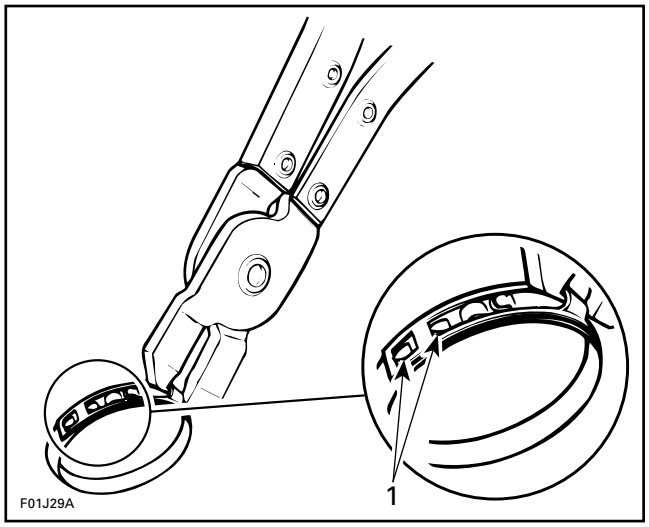


– Insert pointed tips of pliers in closing hooks.



TYPICAL
1. Closing hooks

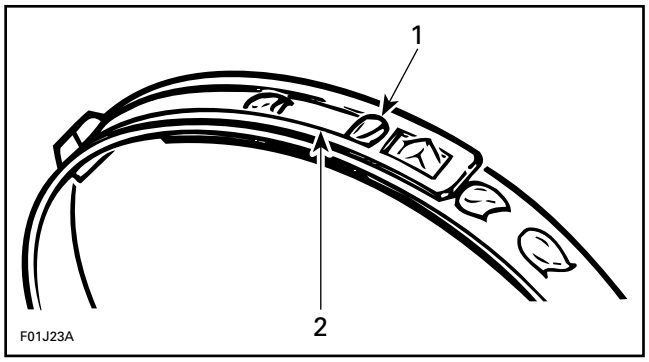
– Squeeze pliers to draw hooks together and disengage windows from locking hooks.



TYPICAL
1. Locking hooks

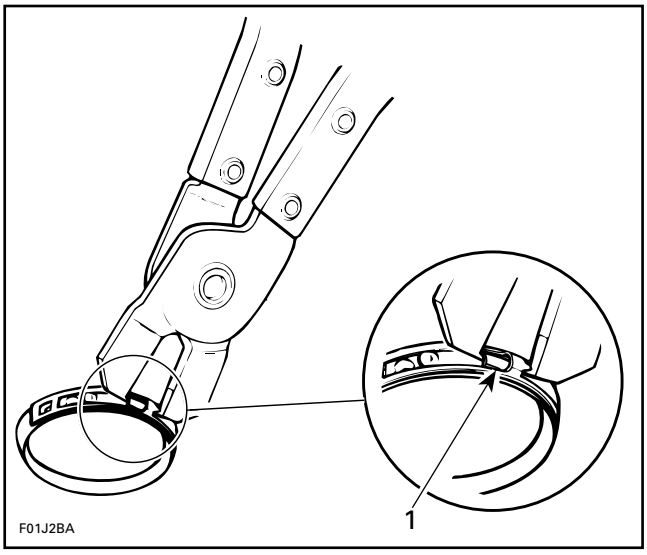
Secure large clamp as follows:

– Manually engage holding hook in large window. This is a pre-clamping position only.



PRE-CLAMPING POSITION
1. Holding hook
2. Large window

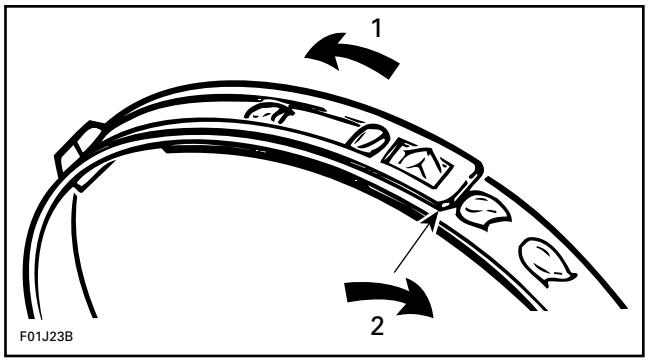
– Insert pointed tips of pliers first in closing hooks.



TYPICAL
1. Closing hooks

– Squeeze pliers. When both large and small windows are directly over the 2 locking hooks, press those windows down to engage hooks in windows.

NOTE: At installation, clamp tail should be in opposite direction of engine rotation.

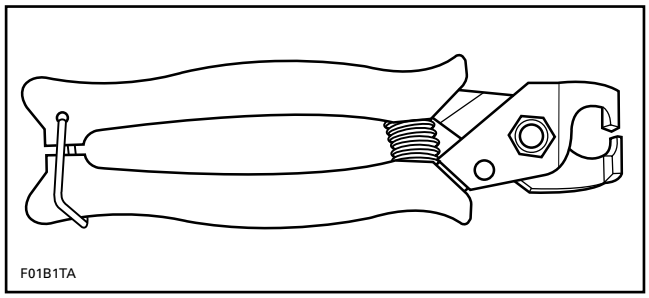


1. Engine rotation (counterclockwise)
2. Tail in opposite direction

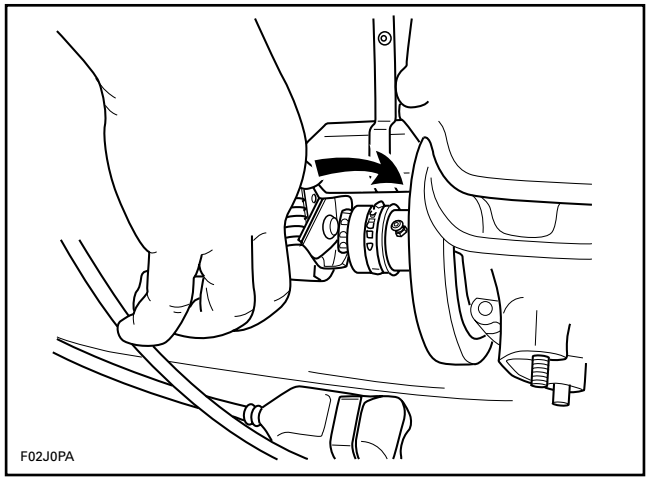
Small Clamp

Unfasten small clamp no. 3 of PTO flywheel boot as follows:

– Use Caillau pliers (P/N 295 000 054).

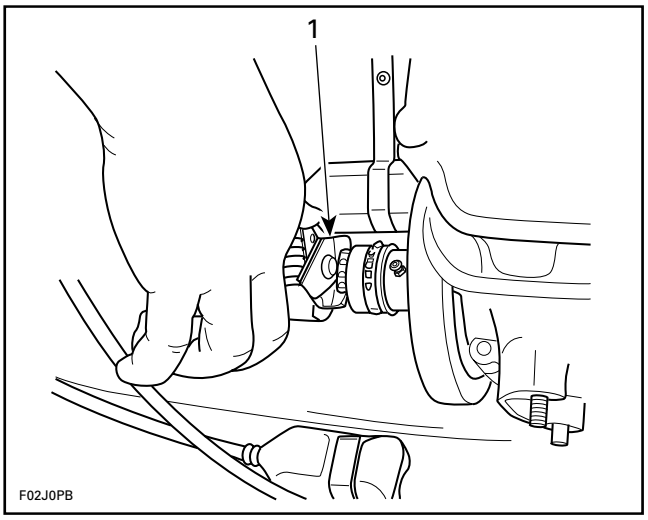


– To open clamp, place flat side of pliers on clamp embossment, squeeze and twist pliers.



To secure small clamp, do the following:

Place notch side of pliers on clamp embossment and squeeze pliers.



1. Squeeze pliers

REMOVAL

PTO Flywheel Guard

Remove seats.

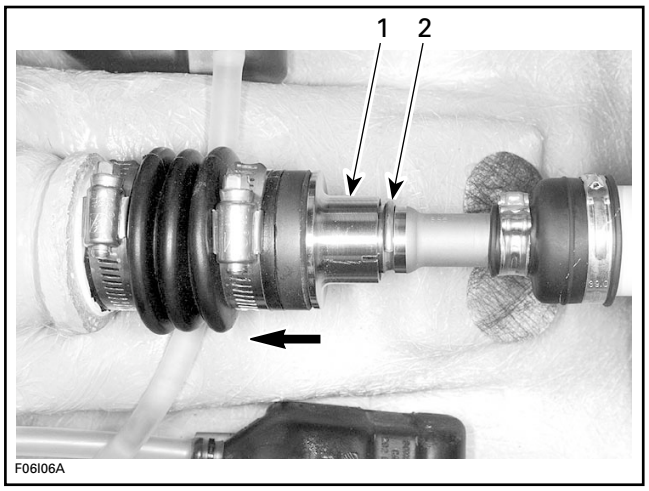
Remove seat support.

Remove plastic wing nuts **no. 4** retaining PTO flywheel guard **no. 5** to engine support.

Detach PTO flywheel guard from engine and withdraw from bilge.

Circlip and Floating Ring

Hold floating ring **no. 6** and compress boot **no. 7**; then, pull out circlip **no. 8** from drive shaft groove.



TYPICAL
1. *Push floating ring*
2. *Remove circlip*

Drive Shaft

Pull out drive shaft **no. 9**.

NOTE: If the drive shaft is jammed into PTO flywheel, it may be necessary to remove PTO flywheel from engine to then remove drive shaft.

Boot

Loosen gear clamp **no. 10** holding boot **no. 7**, then carefully pull boot and carbon ring **no. 11** from hull insert.

Carbon Ring

Loosen gear clamp **no. 12** then pull carbon ring **no. 11** from boot **no. 7**.

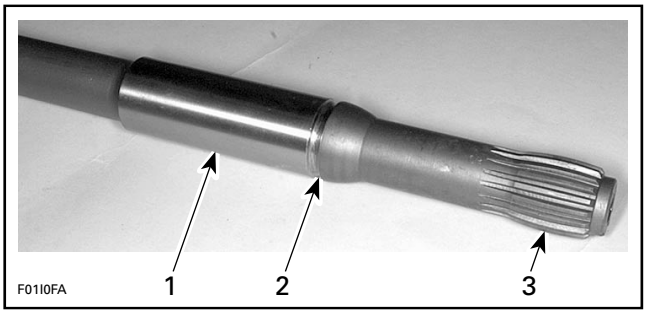
INSPECTION

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, renew drive shaft.

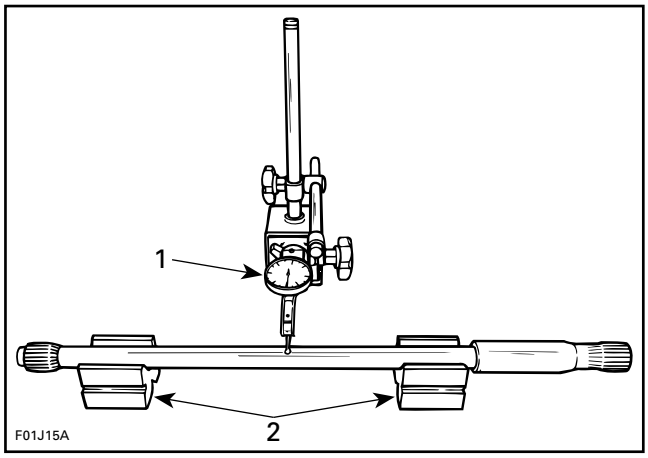


1. *Surface condition*
2. *Groove condition*
3. *Splines condition*

Excessive deflection could cause vibration and damage to drive shaft splines, impeller, flywheel or floating ring (seal carrier depending upon the model).

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).



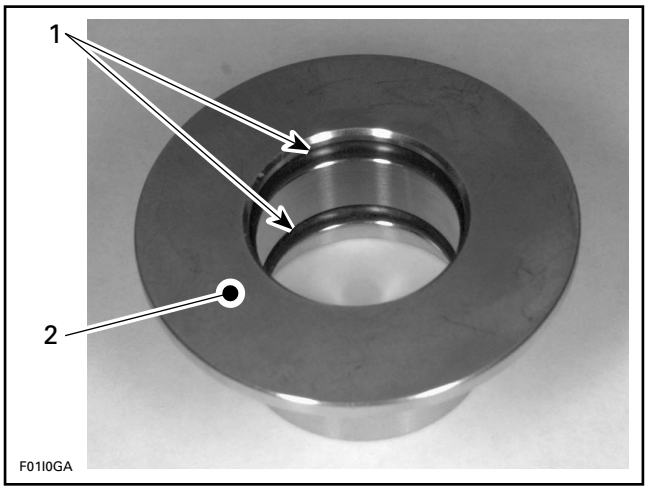
MEASURING DRIVE SHAFT DEFLECTION
1. *Dial gauge*
2. *V-blocks*

Damper

Visually inspect shape of dampers **no. 13** for deformation or other damage.

Floating Ring and O-Ring

Inspect condition of O-rings **no. 14** and contact surface of floating ring **no. 6**.



1. O-rings
2. Floating ring contact surface

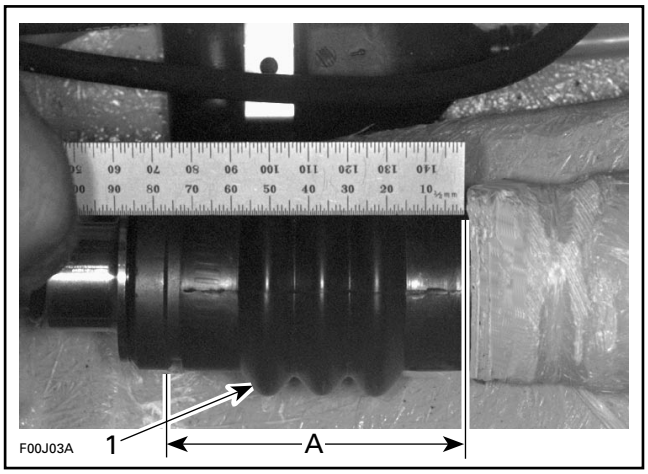
Boot

Inspect the condition of boot **no. 7**. If there is any damage or evidence of wear, replace it.

To verify the preload of the boot **no. 7**, proceed as follows:

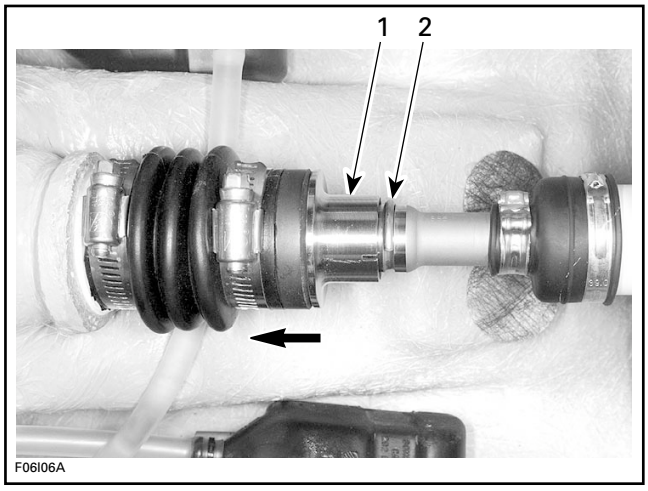
NOTE: To verify the boot preload and free length, jet pump and drive shaft must be installed.

Measure boot length when normally installed on drive shaft. Ensure circlip **no. 8** is properly installed into groove.



1. Boot
A. Measure here

Push floating ring **no. 6** to compress boot **no. 7**; then, remove circlip **no. 8** out of drive shaft groove.



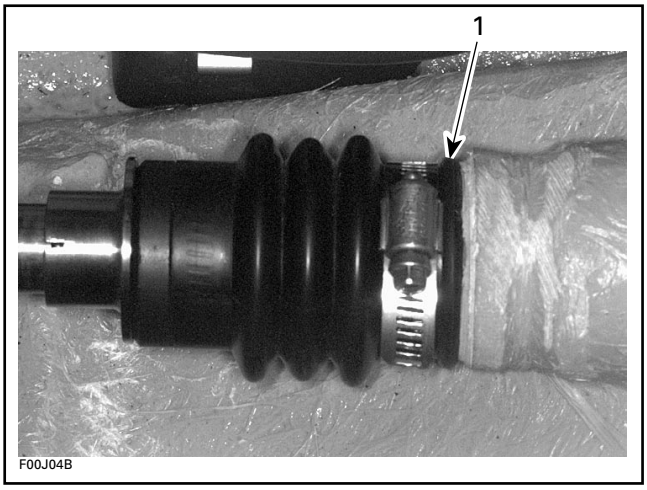
1. Push floating ring
2. Remove circlip

Slide floating ring far enough forward in order to release it from carbon ring **no. 11**.

Measure boot free length.

Subtract the installed length measurement from the free length measurement. A difference of 4 mm to 12 mm (5/32 in to 15/32 in) should be obtained.

If the length is less than 4 mm (5/32 in), install a spacer (P/N 293 250 017) between boot and hull fitting.



1. Spacer

NOTE: Drive shaft must be removed to install spacer.

INSTALLATION

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

Drive Shaft and Dampers

Install dampers **no. 13** on drive shaft **no. 9**.

NOTE: Make sure dampers were not left in PTO flywheel or impeller.

Install drive shaft and jet pump at the same time.

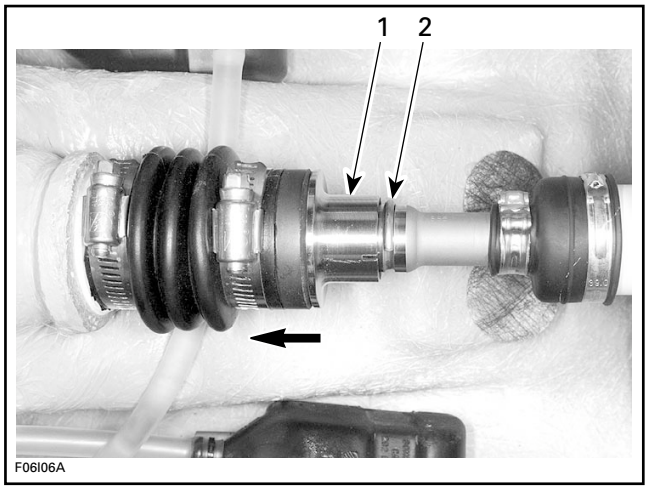
Insert drive shaft through carbon ring **no. 11** and floating ring **no. 6**.

NOTE: Make sure to install floating ring before inserting the drive shaft in the PTO flywheel.

While holding jet pump, guide and engage drive shaft splines in PTO flywheel. Rotate shaft to properly index splines. Make sure boot **no. 2** is well positioned over shaft end.

Circlip

Push the floating ring **no. 6** to compress the boot **no. 7**. Insert the circlip **no. 8** in the drive shaft groove.



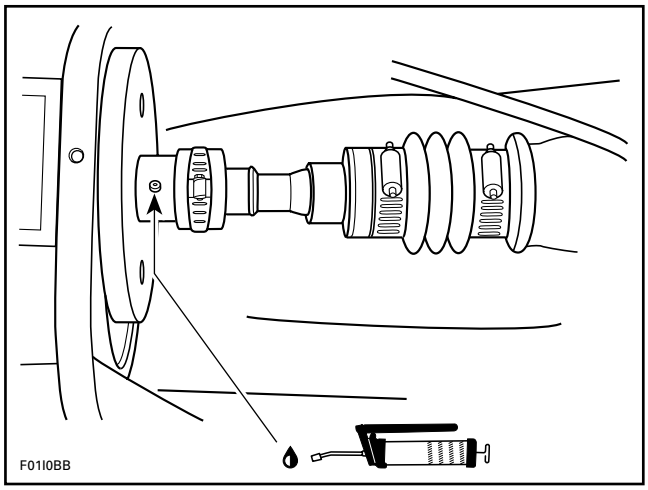
1. Push floating ring
2. Insert circlip in the groove

Slide the floating ring onto the circlip.

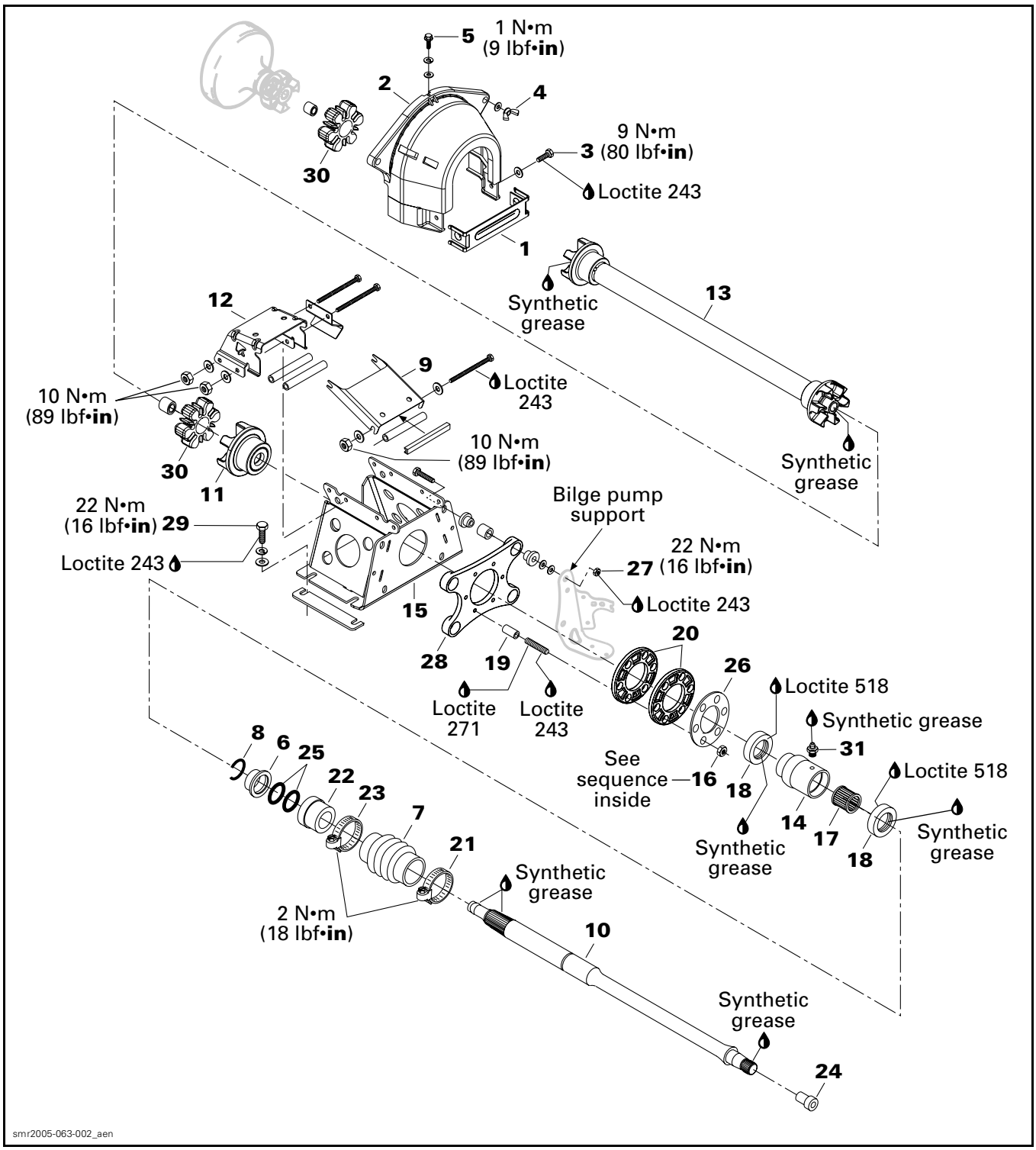
LUBRICATION

PTO Flywheel

Using a grease gun, carefully lubricate PTO flywheel with synthetic grease (P/N 293 550 010), until boot **no. 2** is just beginning to expand. At this point, immediately stop greasing.



3D SERIES



GENERAL

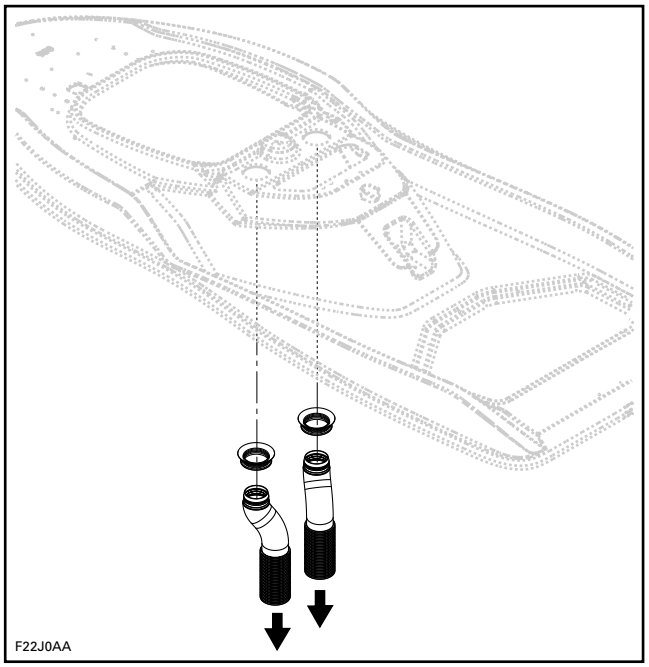
Jet pump must be removed to replace any components of the drive system. Refer to JET PUMP for removal procedure.

REMOVAL

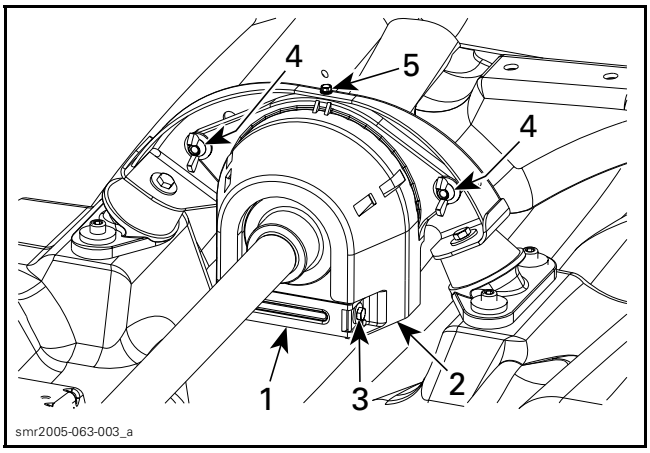
PTO Flywheel Guard

Lift and lock steering pole, remove engine cover and storage tray.

Pull down vent tubes from body.



Detach link plate **no. 1** at the back of flywheel guard **no. 2** then remove guard. The link plate is held with 2 hexagonal bolts M6 **no. 3** and the flywheel with 2 wing nuts **no. 4** and on the top with an hexagonal screw **no. 5**.

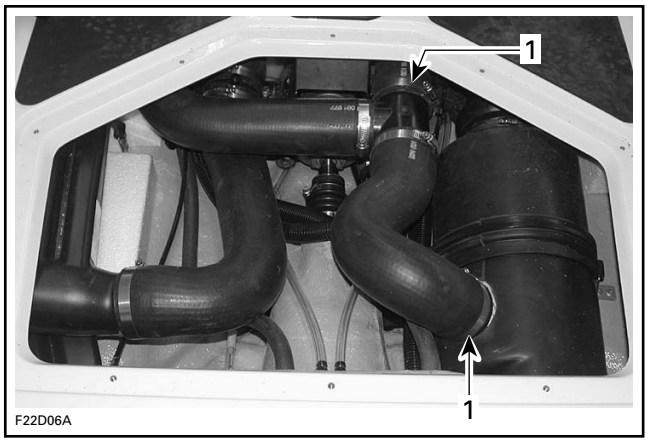


1. Link plate
2. Flywheel guard
3. Link plate bolt
4. Wing nuts
5. Flywheel guard bolt

Circlip and Floating Ring

Remove the rear access panel.

Remove clamps from exhaust hoses where shown.

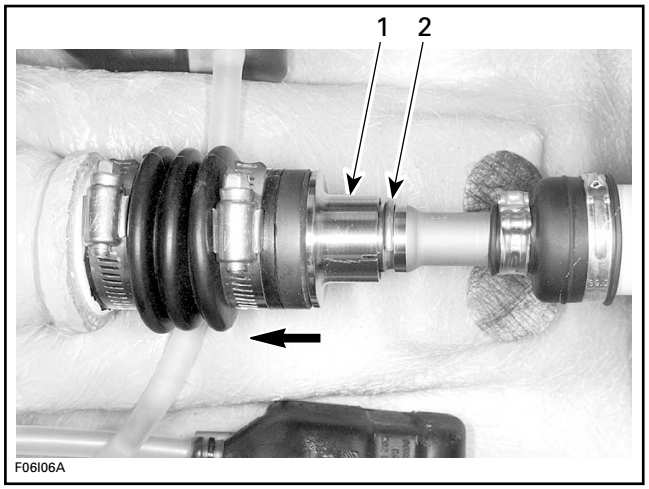


1. Disconnect those clamps

Pull out T-fitting with hoses and resonator.

Move remaining hose away to make room.

Hold floating ring **no. 6** and compress boot **no. 7**; then, pull out circlip **no. 8** from drive shaft groove.



TYPICAL
1. Push floating ring
2. Remove circlip

Rear Drive Shaft

Remove rear access panel.

Remove circlip **no. 8**, see above.

Remove shaft guard **no. 9**.

Pull rear drive shaft **no. 10** until shaft splines are disengaged from coupler **no. 11**.

Remove rear drive shaft.

Remove coupler **no. 11**.

Front Drive Shaft

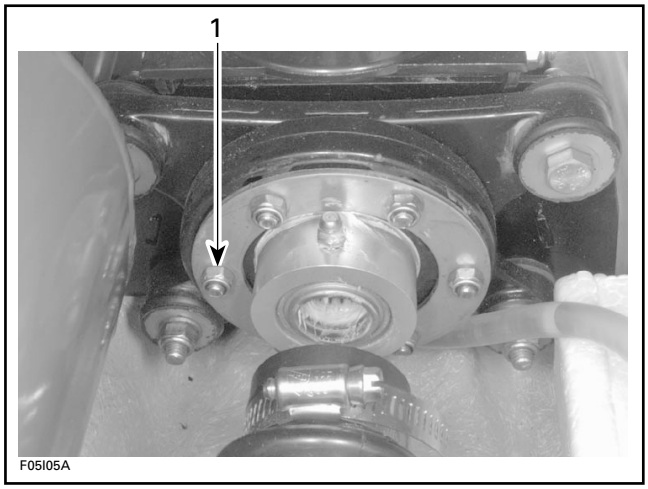
Remove PTO flywheel guard **no. 2**, rear drive shaft **no. 10**, coupler **no. 11** and deck support **no. 12**.

Pull front drive shaft **no. 13** until its coupler is disengaged from engine.

Remove front drive shaft.

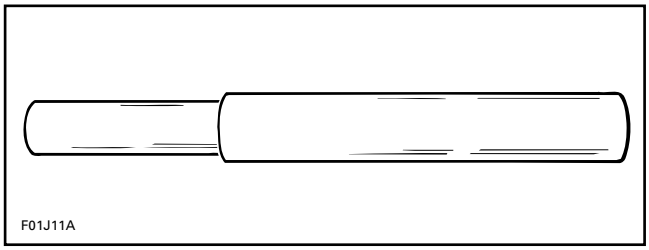
Seal Carrier of Mid Bearing

To remove the seal carrier housing **no. 14** from support **no. 15**, loosen the 6 nuts **no. 16**.



TYPICAL
1. Nut (6)

Bearing **no. 17** and seals **no. 18** can be easily removed using the bearing/seal remover tool (P/N 295 000 144).



NOTE: The same tool is used for bearing and seals removal of jet pump.

Properly support seal carrier housing **no. 14** when removing seals and bearing.

Remove bushings **no. 19** from alignment washer **no. 20**.

Boot

Loosen gear clamp **no. 21** holding boot **no. 7**, then carefully pull boot and carbon ring **no. 22** from hull insert.

Carbon Ring

Loosen gear clamp **no. 23** then pull carbon ring **no. 22** from boot **no. 7**.

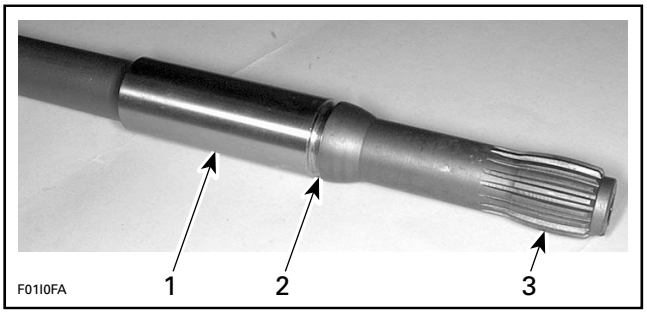
INSPECTION

Rear Drive Shaft

Inspect condition of drive shaft **no. 10** and splines.

Inspect condition of groove.

With your finger nail, feel machined surface of drive shaft. If any irregular surface is found, renew drive shaft.

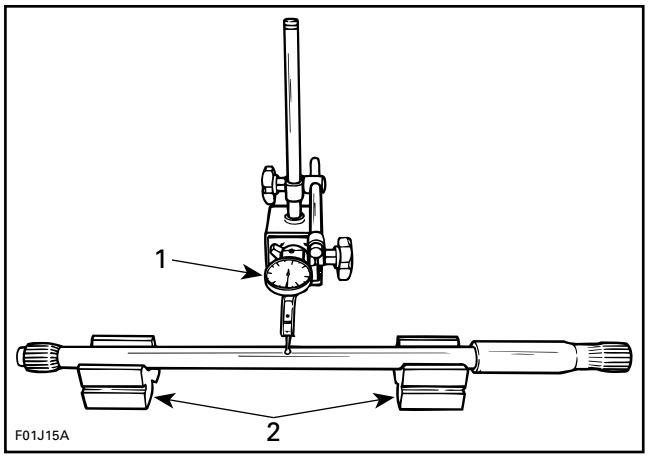


TYPICAL
1. *Surface condition*
2. *Groove condition*
3. *Splines condition*

Excessive deflection could cause vibration and damage to drive shaft splines, impeller, flywheel or seal carrier.

Place rear 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*

Front Drive Shaft

Check condition of front drive shaft **no. 13**.

Check condition of couplers.

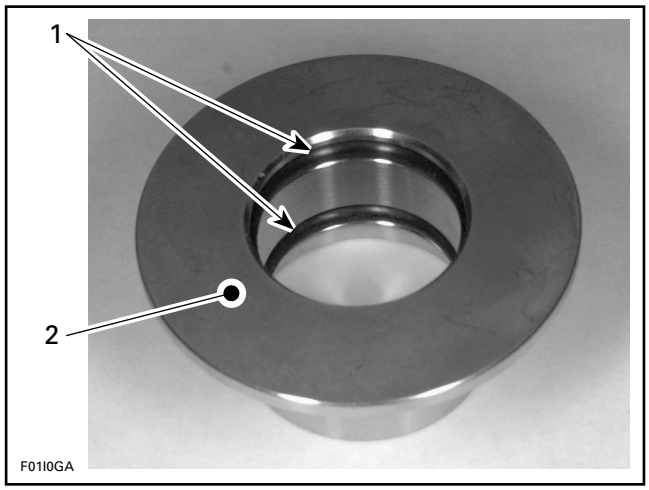
Replace front drive shaft if necessary.

Damper

Visually inspect shape of damper **no. 24** for deformation or other damage.

Floating Ring and O-Ring

Inspect condition of O-rings **no. 25** and contact surface of floating ring **no. 6**.



1. *O-rings*
2. *Floating ring contact surface*

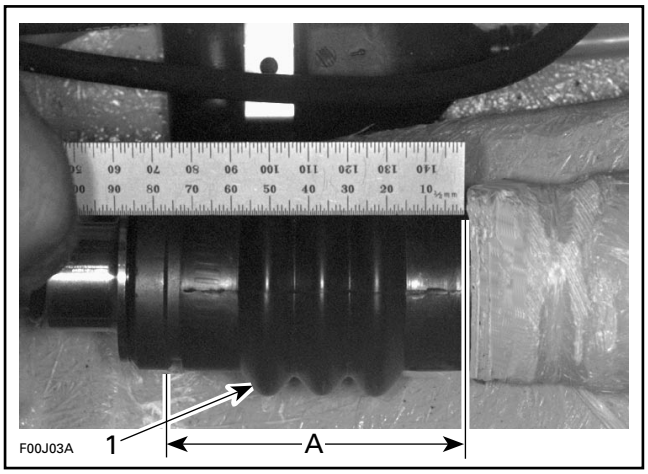
Boot

Inspect the condition of boot **no. 7**. If there is any damage or evidence of wear, replace it.

To verify the preload of the boot **no. 7**, proceed as follows:

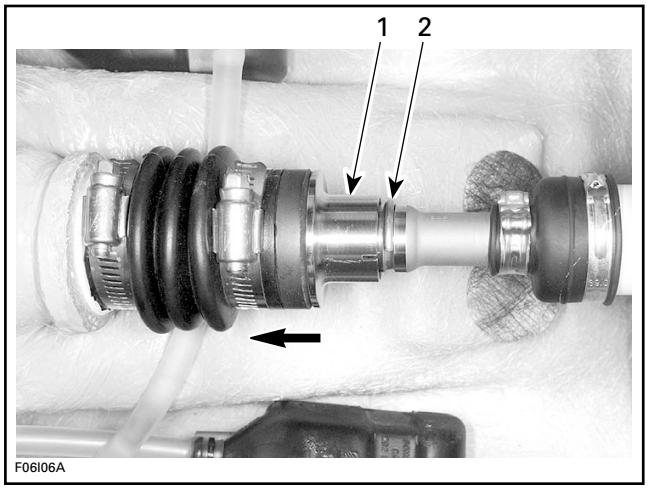
NOTE: To verify the boot preload and free length, jet pump and drive shaft must be installed.

Measure boot length when normally installed on drive shaft. Ensure circlip **no. 8** is properly installed into groove.



1. Boot
A. Measure here

Push floating ring **no. 6** to compress boot **no. 7**; then, remove circlip **no. 8** out of drive shaft groove.



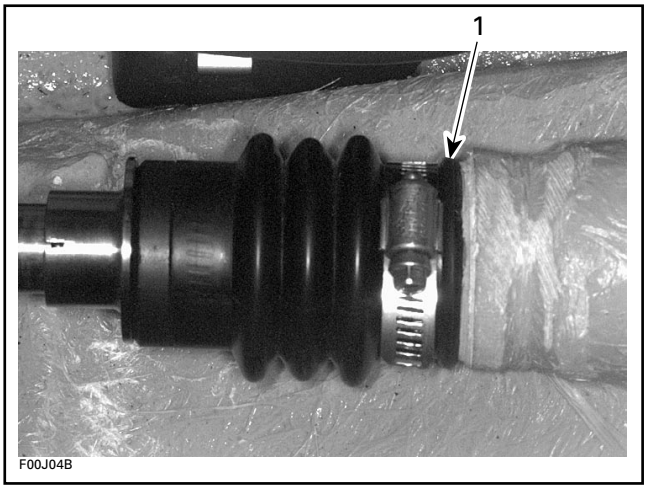
1. Push floating ring
2. Remove circlip

Slide floating ring far enough forward in order to release it from carbon ring **no. 22**.

Measure boot free length.

Subtract the installed length measurement from the free length measurement. A difference of 4 mm to 12 mm (5/32 in to 15/32 in) should be obtained.

If the length is less than 4 mm (5/32 in), install a spacer (P/N 293 250 017) between boot and hull fitting.



1. Spacer

NOTE: Drive shaft must be removed to install spacer.

Seal Carrier of Mid Bearing

Inspect seal carrier needle bearing **no. 17**. Check parts for scoring, pitting, chipping or other evidence of wear.

Inspect seals **no. 18** for deterioration or excessive wear. Replace if necessary.

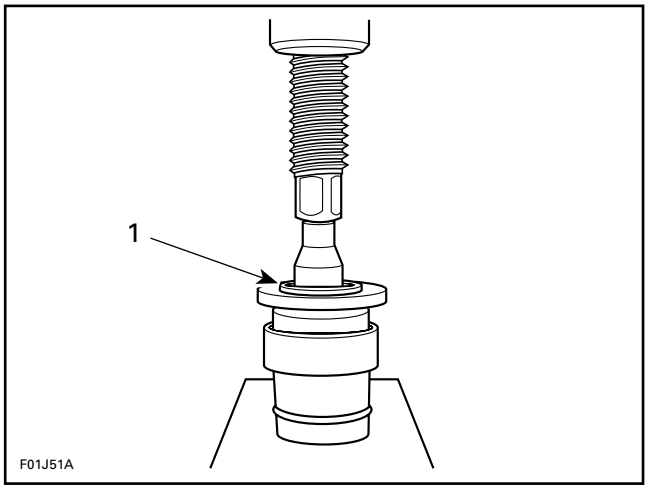
ASSEMBLY

Seal Carrier of Mid Bearing

Properly support seal carrier housing **no. 14** when installing seals **no. 18** and bearing **no. 17**.

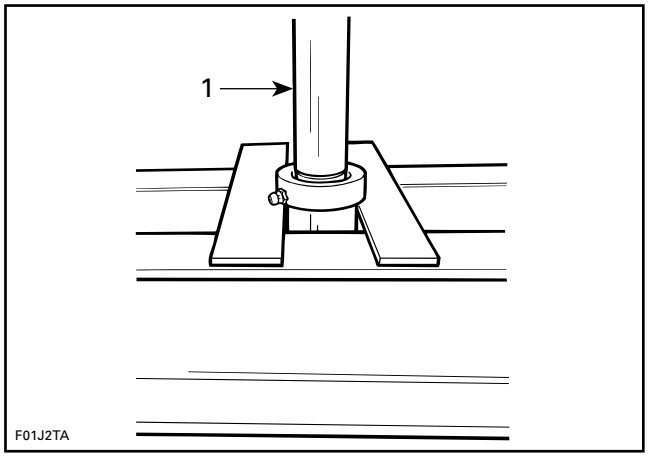
CAUTION: Ensure to install stamped end of bearing (showing identification markings) first on tool. Never hammer the bearing into its housing.

Install bearing **no. 17** with the bearing/seal installer tool (P/N 295 000 107).



1. Press bearing in its housing

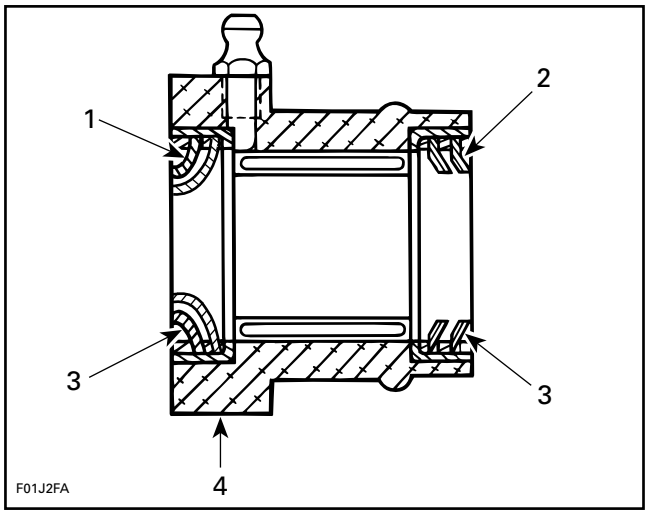
NOTE: Bearing can also be installed with the same driver used at disassembly. Center bearing in longitudinal axis of housing.



1. Push bearing centered in its housing

Install double-lip seal **no. 18** with protector toward jet pump.

On both seals **no. 18**, raised edge of lip must be located outwards of seal carrier.

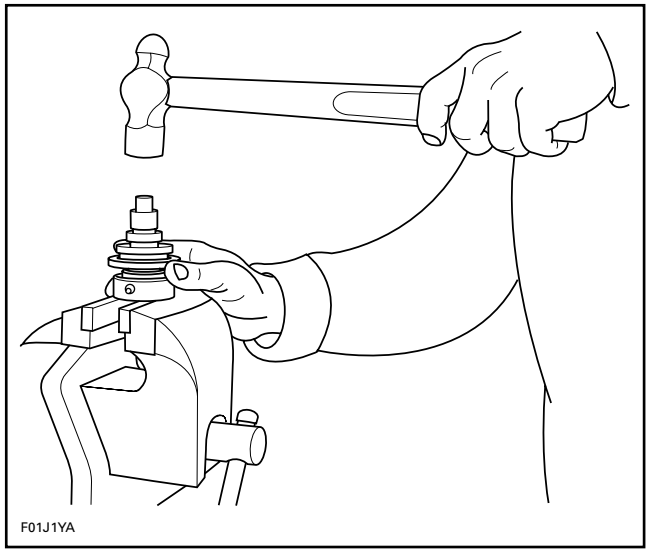


TYPICAL
1. Double-lip seal toward engine
2. Double-lip seal with protector toward jet pump
3. Raised edge of lip outwards
4. Seal carrier

Apply Loctite 518 (P/N 293 800 038) all around seals outside diameter.

Seals **no. 18** can be carefully installed in housing using the bearing/seal installer tool (P/N 295 000 107).

Push seals until tool comes in contact with housing.



TYPICAL

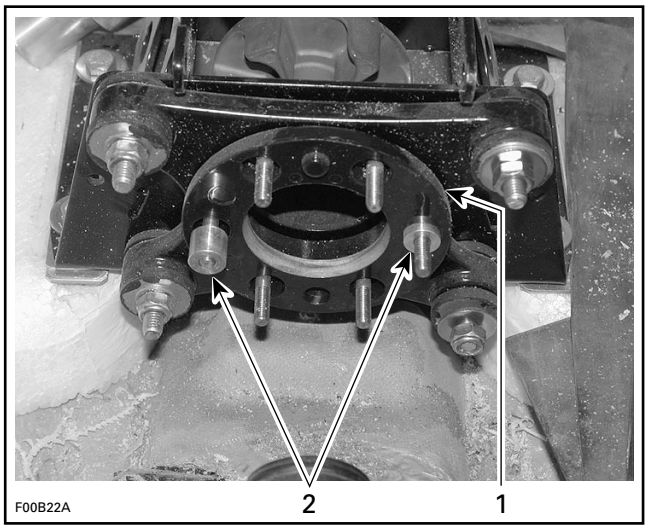
Pack seals and bearing with synthetic grease (P/N 293 550 010).

INSTALLATION

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

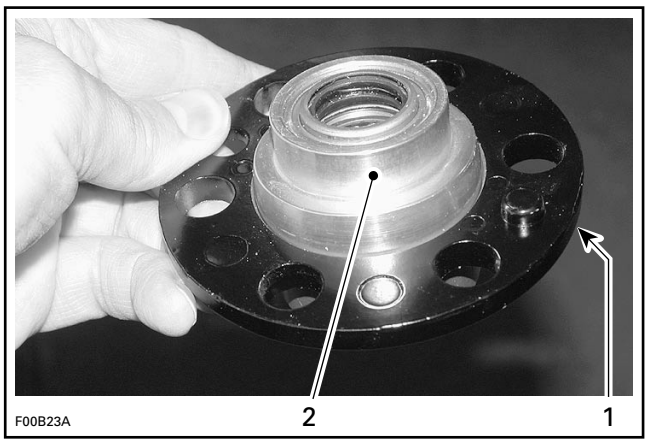
Seal Carrier of Mid Bearing

Install any of the alignment washers **no. 20** as shown. Insert bushings **no. 19** in washer.



TYPICAL
1. *Alignment washer*
2. *Bushings*

Insert seal carrier housing **no. 14** in remaining alignment washer.



TYPICAL
1. *Alignment washer*
2. *Seal carrier housing*

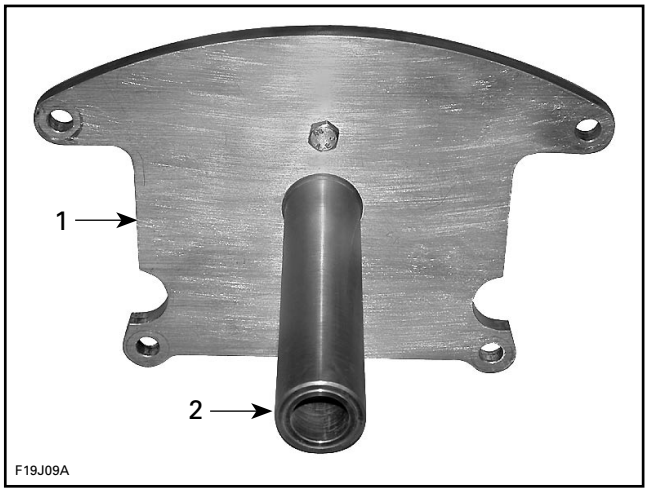
Install alignment washer/seal carrier housing and properly index alignment washers **no. 20** together.

Install the large washer **no. 26** and nuts **no. 16**. Slightly tighten nuts but keep loose so that the assembly still can move and self adjust when inserting the alignment shaft further in this procedure.

NOTE: Completely tightening nuts would make the alignment more difficult.

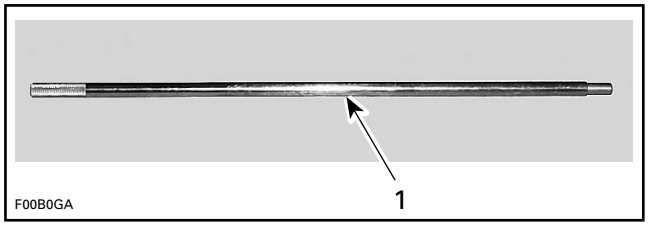
Align the seal carrier using the following tools:

– support plate kit (P/N 529 035 570)



1. *Plate (P/N 529 035 507)*
2. *Support (P/N 529 035 511)*

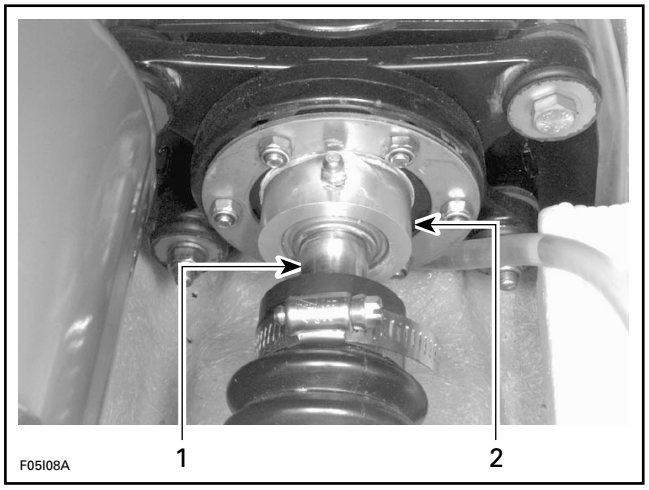
– alignment shaft (P/N 295 000 141).



1. *Alignment shaft*

Install support plate at rear of watercraft.

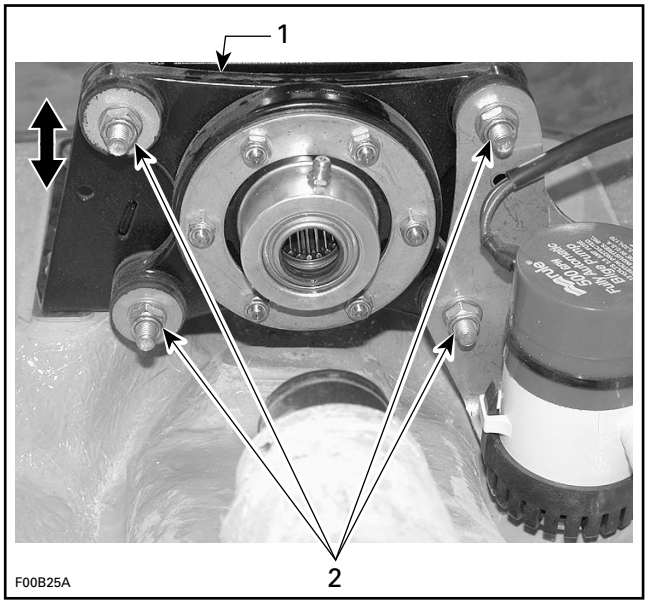
Carefully slide shaft through seal carrier and shaft support. Ensure that shaft goes farther than shaft support.



TYPICAL
1. *Alignment tool*
2. *Seal carrier*

If alignment tool does not slide easily through seal carrier, perform the alignment as follows.

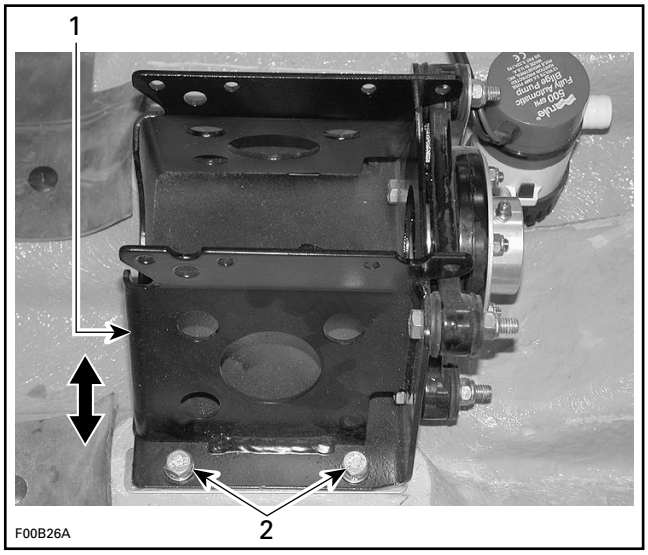
For vertical alignment, loosen damping support nuts **no. 27** and move the support **no. 28** up and down as necessary.



TYPICAL
1. *Damping support*
2. *Loosen nuts*

When done, ensure to apply Loctite 243 (blue) (P/N 293 800 060) on nut threads then torque nuts to 22 N•m (16 lbf•ft) in a criss-cross sequence.

For horizontal alignment, loosen shaft support screws **no. 29** and move the support **no. 15** sideways as necessary.



TYPICAL
1. *Shaft support*
2. *Loosen screws on both sides*

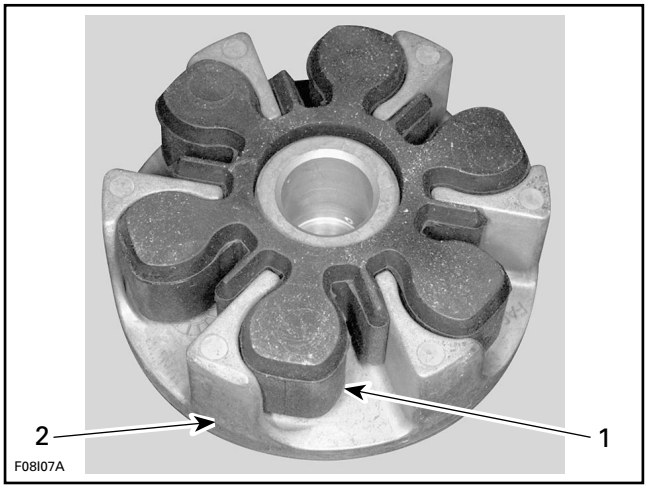
When done, ensure to apply Loctite 243 (blue) (P/N 293 800 060) on screw threads then torque screws to 22 N•m (16 lbf•ft) in a criss-cross sequence.

NOTE: Ensure the alignment washers are still loose.

Check engine alignment. Refer to ENGINE section.

Front Drive Shaft Coupler and Damper

Make sure to install dampers **no. 30** into drive shaft coupler at both ends.



TYPICAL — SAME COUPLER AND DAMPER AT BOTH ENDS
1. *Damper*
2. *Drive shaft coupler*

Front Drive Shaft

Install front drive shaft **no. 13**.

Rear Drive Shaft

NOTE: Ensure the alignment washers are still loose.

Install damper **no. 24** to rear drive shaft **no. 10**.

Install drive shaft and jet pump at the same time.

Insert drive shaft through carbon ring **no. 22** and floating ring **no. 6**.

Insert drive shaft through seal carrier housing **no. 14** and into the coupler assembly. Be careful not to damage seals.

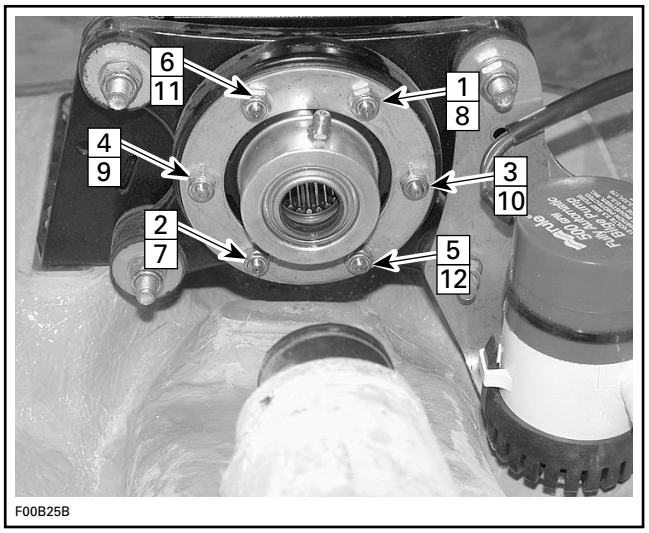
CAUTION: When sliding the drive shaft through seal carrier, the double lip seal can be folded over. This would cause a seal carrier bearing failure.

Ensure grease fitting **no. 31** of seal carrier housing is located on the top.

Apply Loctite 243 (blue) (P/N 293 800 060) on studs and install nuts **no. 16**.

Refer to following illustration for tightening sequence. Torque 1 to 6 at 3 N•m (27 lbf•**in**) and then 7 to 12 at 10 N•m (89 lbf•**in**).

NOTE: It is very important to tighten nuts of seal carrier in this sequence to maintain its alignment.

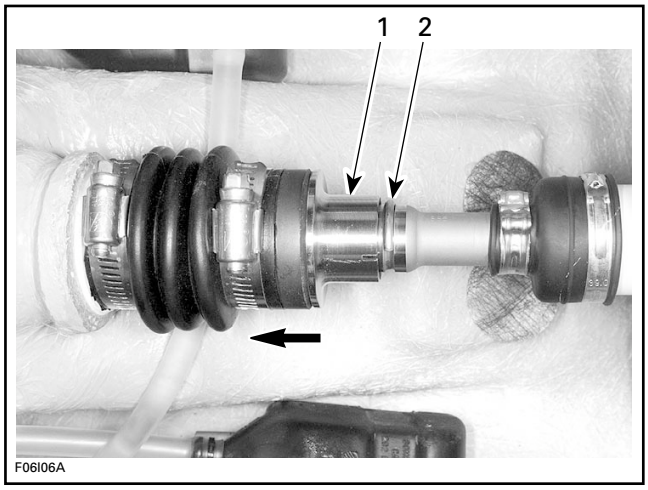


TIGHTENING SEQUENCE

Reinstall shaft guard **no. 9**. Apply Loctite 243 (blue) (P/N 293 800 060) on bolts and torque lock nuts to 10 N•m (89 lbf•**in**).

Circlip

Push the floating ring **no. 6** to compress the boot **no. 7**. Insert the circlip **no. 8** in the drive shaft groove.



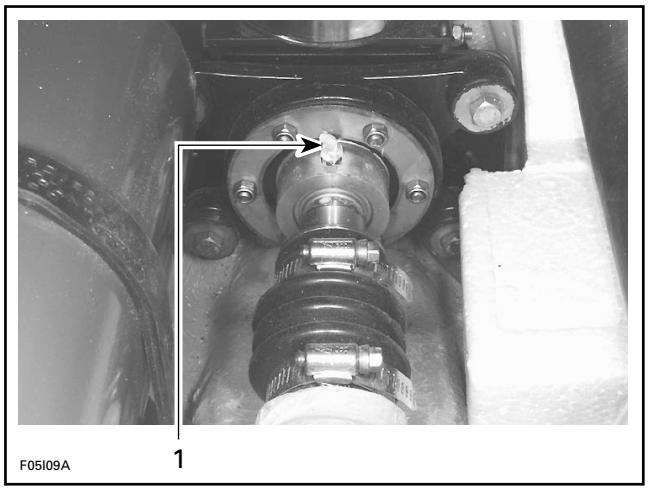
TYPICAL
1. *Push floating ring*
2. *Insert circlip in the groove*

Slide the floating ring onto the circlip.

LUBRICATION

Seal Carrier of Mid Bearing

Using a grease gun, lubricate seal carrier of mid bearing with synthetic grease (P/N 293 550 010).



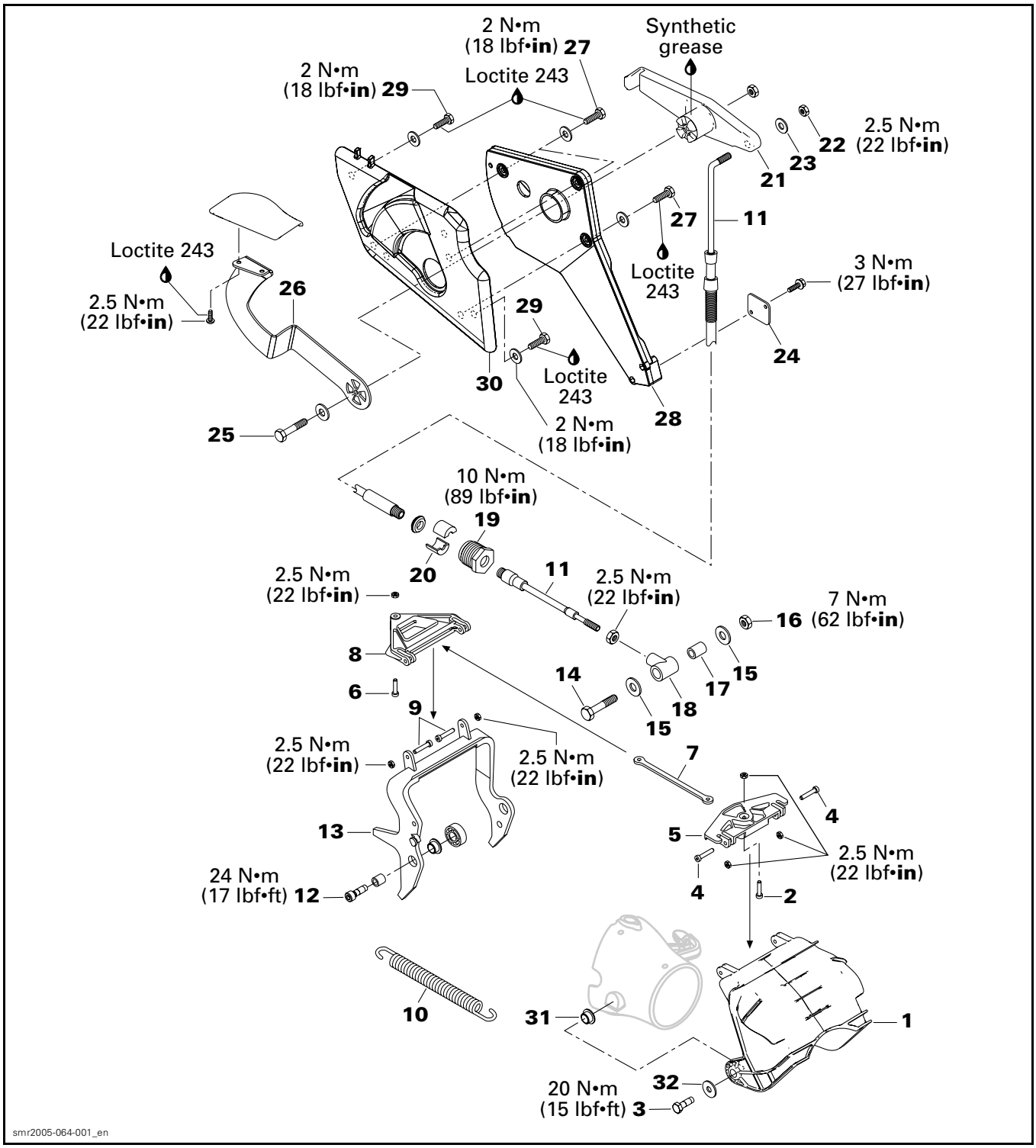
TYPICAL
1. *Grease fitting*

REVERSE SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
synthetic grease	293 550 010	271

GTI Series

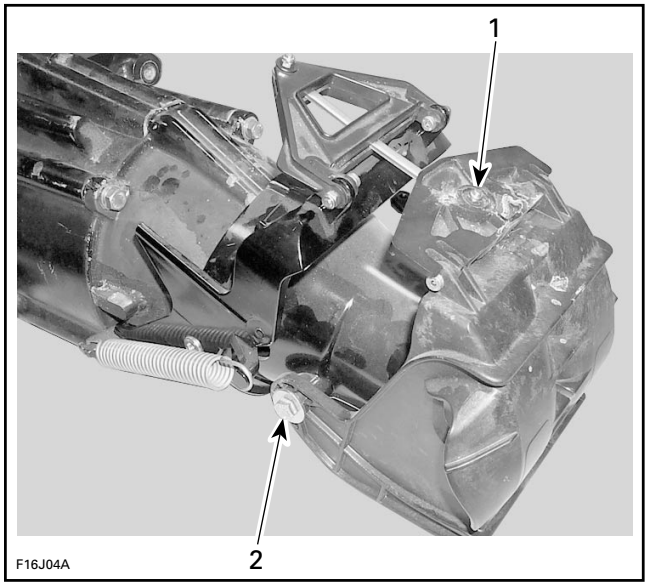


DISASSEMBLY

Reverse Gate

To remove reverse gate **no. 1**, put shift lever in reverse position.

Unscrew pivot bolt **no. 2**, located on the top of reverse gate.



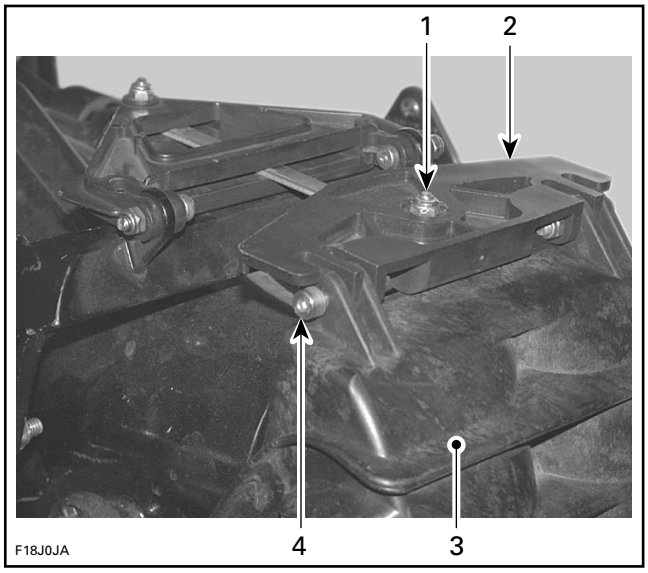
1. Pivot bolt
2. Reverse gate screw

Remove both reverse gate screws **no. 3**.

Pivot Support

Remove reverse gate.

Unscrew pivot support bolts **no. 4**.



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

Withdraw pivot support **no. 5**.

Connecting Rod

Remove:

– reverse gate
– pivot bolt **no. 6** holding connecting rod **no. 7** to pivot triangle **no. 8**.

Withdraw connecting rod.

Pivot Triangle

Remove:

– reverse gate
– connecting rod
– pivot triangle bolts **no. 9**.

Withdraw pivot triangle **no. 8**.

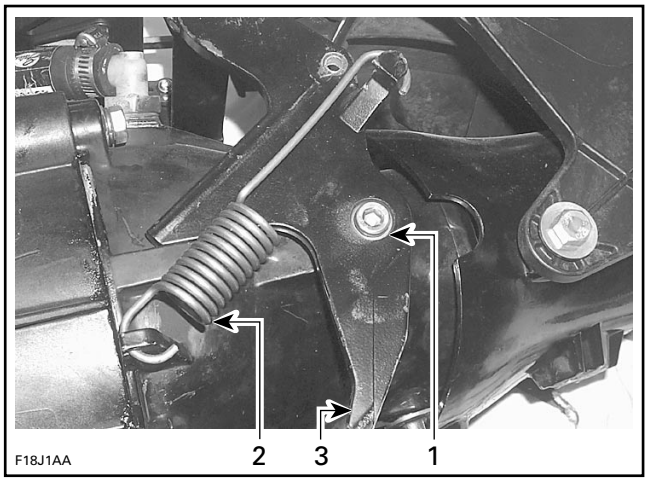
Pivot Arm

Position shift lever in forward.

Remove:

– reverse gate
– connecting rod
– reverse spring **no. 10**
– reverse cable **no. 11**
– pivot arm bolts **no. 12**. Take note of bushing size for reinstallation.

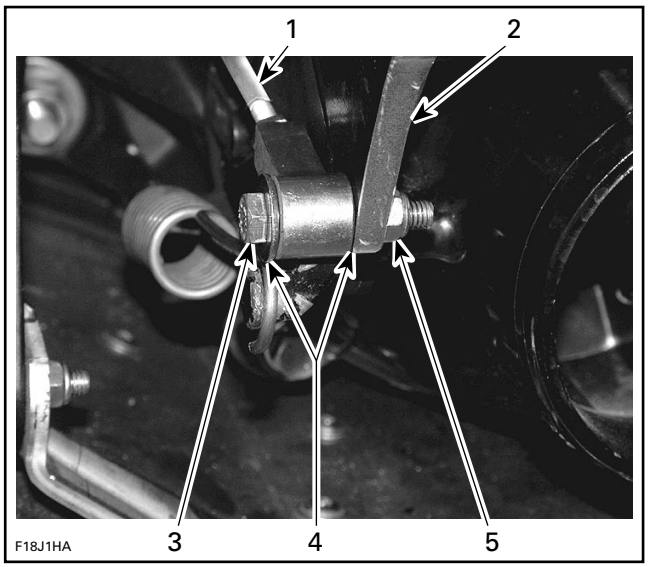
Withdraw pivot arm **no. 13**.



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

Reverse Cable

Unscrew bolt **no. 14**, washers **no. 15** and the elastic stop nut **no. 16** retaining reverse cable **no. 11** on pivot arm **no. 13**.



1. *Reverse cable*
2. *Pivot arm*
3. *Bolt*
4. *Washer*
5. *Elastic stop nut*

Make sure not to loose the bushing **no. 17** inside reverse cable joint **no. 18**.

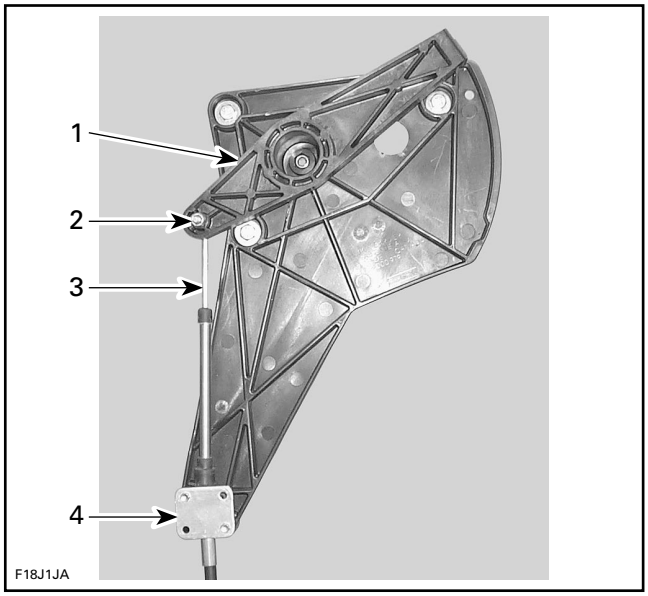
Unscrew the cable lock **no. 19** then remove the half rings **no. 20**.

Remove the seat and the glove box. Refer to HULL/BODY.

On the interior lever **no. 21**, unscrew the elastic stop nut **no. 22** and remove the washer **no. 23** retaining the reverse cable.

Remove the retaining bracket **no. 24**.

NOTE: Before removing reverse cable **no. 11** from hull, note cable routing for reinstallation.

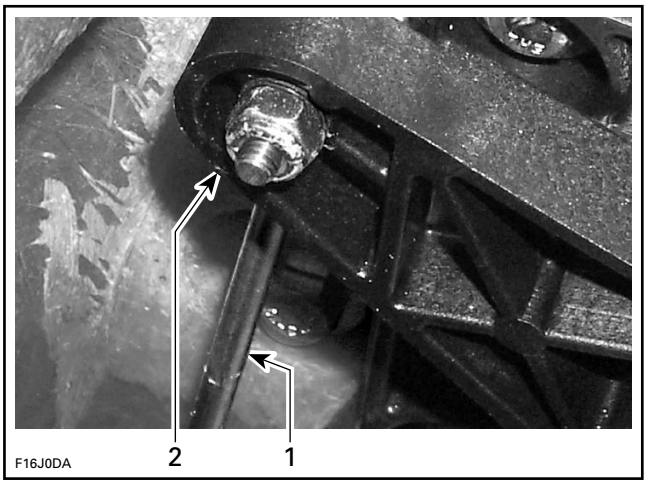


1. *Interior lever*
2. *Elastic stop nut and washer*
3. *Reverse cable*
4. *Retaining bracket*

Interior Lever

Detach the reverse cable from interior lever **no. 21**.

Unscrew the shift lever retaining bolt **no. 25**, washer and nut, then remove interior lever.

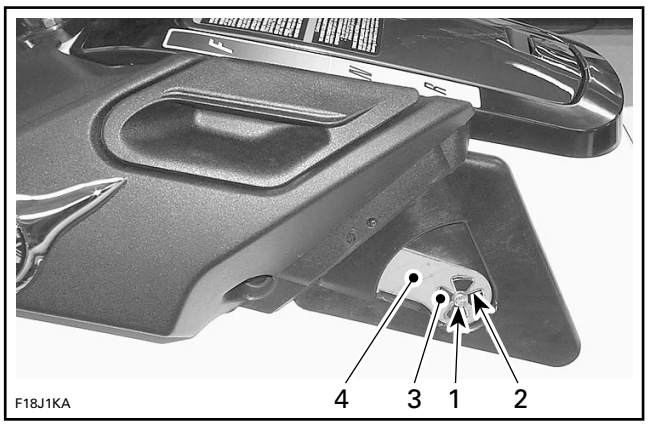


1. *Reverse cable*
2. *Interior lever*

Shift Lever

Unscrew the shift lever retaining bolt **no. 25**, washer and nut.

Disengage the shift lever slots from interior lever tabs, then remove the shift lever **no. 26**.

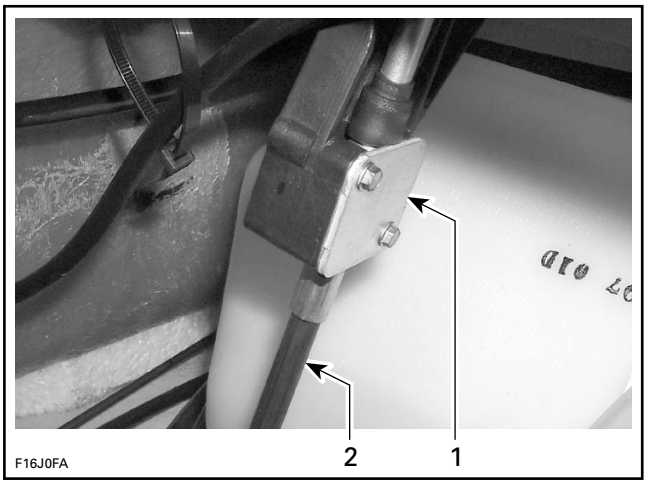


1. *Shift lever retaining bolt*
2. *Shift lever slot*
3. *Interior lever tab*
4. *Shift lever*

Reverse Cable Support

Remove:

– shift lever **no. 26**
– interior lever **no. 21**
– retaining bracket **no. 24**



1. *Bracket*
2. *Reverse cable*

– bolts **no. 27**.

Withdraw reverse cable support **no. 28**.

Handle Housing

Remove:

– shift lever **no. 26**
– interior lever **no. 21**
– reverse cable support **no. 28**
– bolts **no. 29**.

Then, remove handle housing **no. 30**.

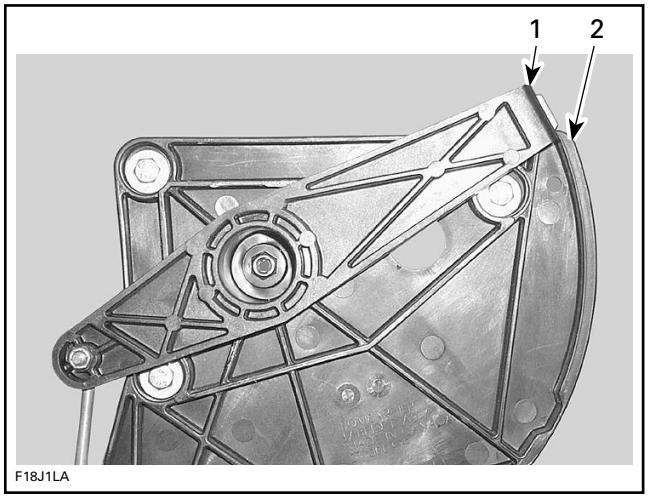
INSPECTION

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.

Insert interior lever cursor into reverse cable support slider and make sure that the cursor slides freely in the slider.



1. *Interior lever cursor*
2. *Reverse cable support slider*

Interior Lever

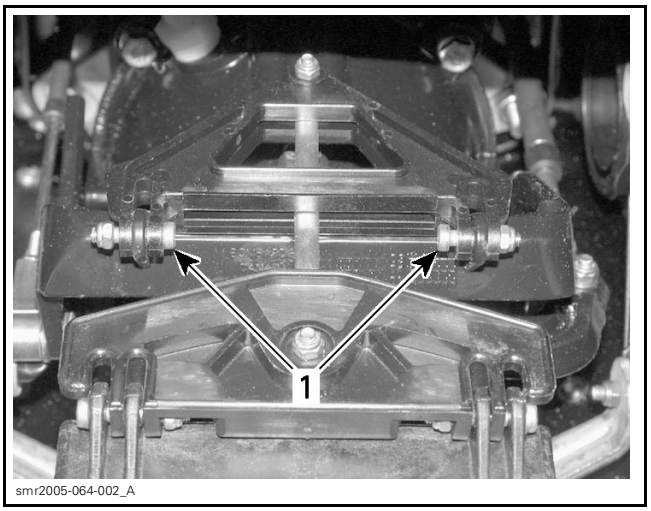
Apply synthetic grease (P/N 293 550 010) on the interior lever pivot and in the reverse cable support hole.

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.

Pivot Triangle

When installing pivot triangle, install head of bolts toward inside. Torque bolts to 2.5 N•m (22 lbf•**in**).



1. Head of bolts inside

Make sure the pivot triangle turns freely.

Reverse Gate

Install reverse gate with spacers **no. 31** and washers **no. 32**. Torque reverse gate bolts **no. 3** to 20 N•m (15 lbf•ft).

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 **no. 18** at the end of reverse cable and align its hole with hole in pivot arm.

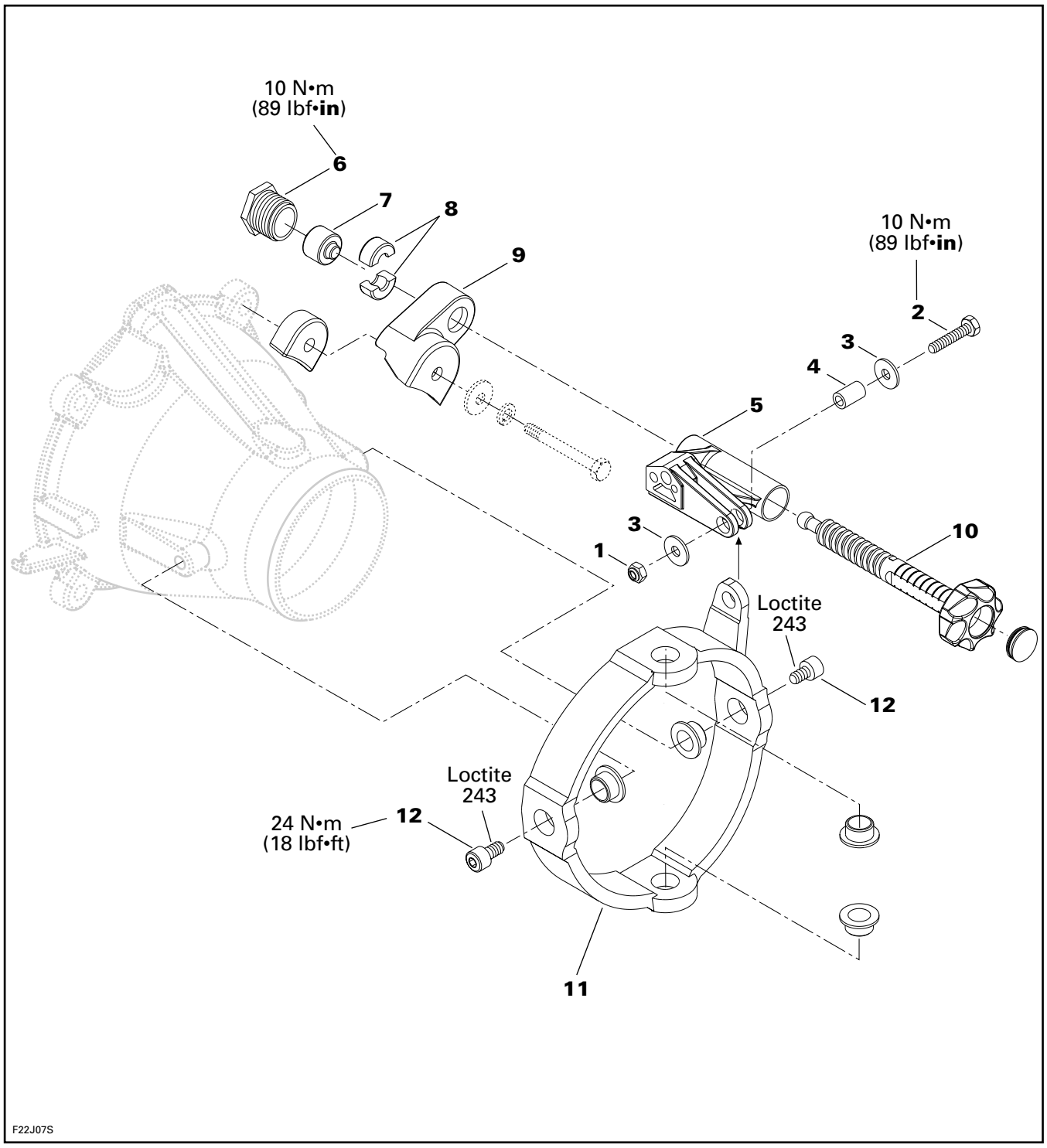
Secure with bolt **no. 14**, washers **no. 15**, bushing **no. 17** and elastic stop nut **no. 16**. Torque to 7 N•m (62 lbf•**in**).

VARIABLE TRIM SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	276

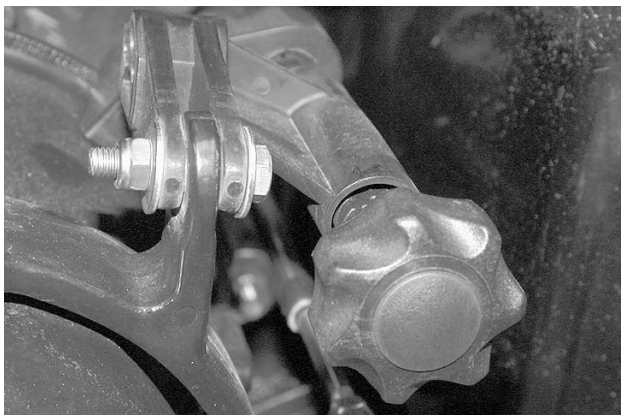
3D PREMIUM



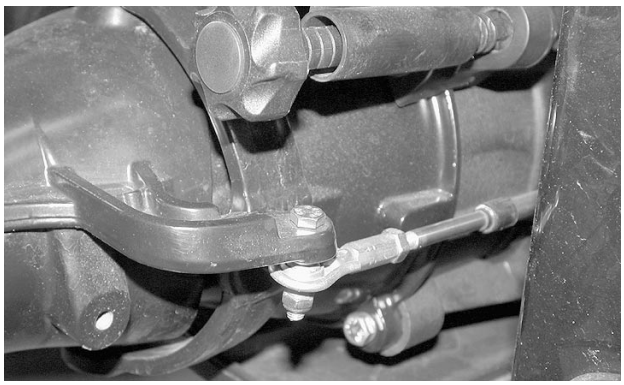
REMOVAL

Trim Ring

Remove nut **no. 1**, bolt **no. 2**, flat washers **no. 3**, and bushing **no. 4** from pivot **no. 5**.

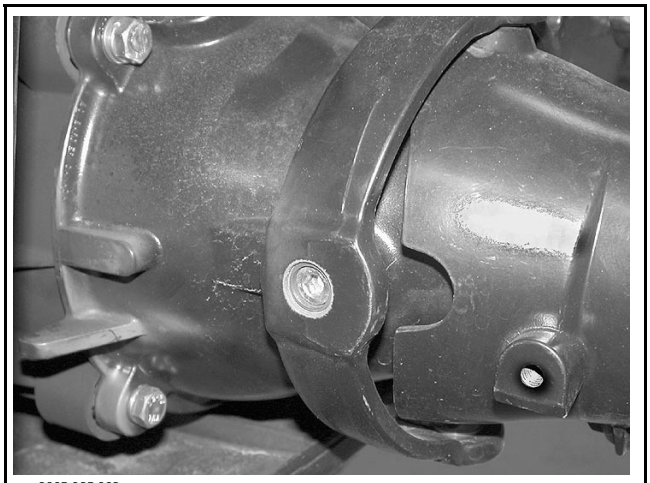

smr2005-065-001

Remove steering cable from nozzle.


smr2005-065-002

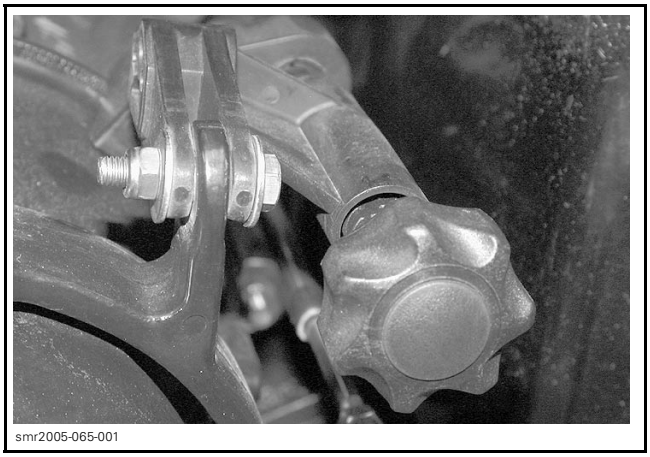
Unscrew bolts holding nozzle to trim ring.

Unscrew bolts retaining trim ring to venturi.


smr2005-065-003

Adjustment System

Remove nut **no. 1**, bolt **no. 2**, flat washers **no. 3**, and bushing **no. 4** from pivot **no. 5**.


smr2005-065-001

Unscrew the upper right venturi bolt then remove the adjustment system.

DISASSEMBLY

Adjustment System

Loosen nut **no. 6** from support **no. 9**.

Remove rubber spacer **no. 7** and half bushings **no. 8**.

Unscrew adjustment knob **no. 10** from pivot **no. 5**.

INSPECTION

Inspect each parts for cracks, wear, distortion or other damages. Replace all defective parts.

ASSEMBLY

Adjustment Screw

Assembly is essentially the reverse of disassembly procedures. Refer to the main illustration at the beginning of this subsection as a guideline and for torque specification.

INSTALLATION

The installation is the reverse of the removal procedure.

Trim Ring

During trim ring installation, apply Loctite 243 (blue) (P/N 293 800 060) on socket screw threads.

Torque socket screws **no. 12** to 24 N•m (18 lbf•ft).

Adjustment Screw

Torque screws **no. 2** to 10 N•m (89 lbf•**in**).

STEERING SYSTEM

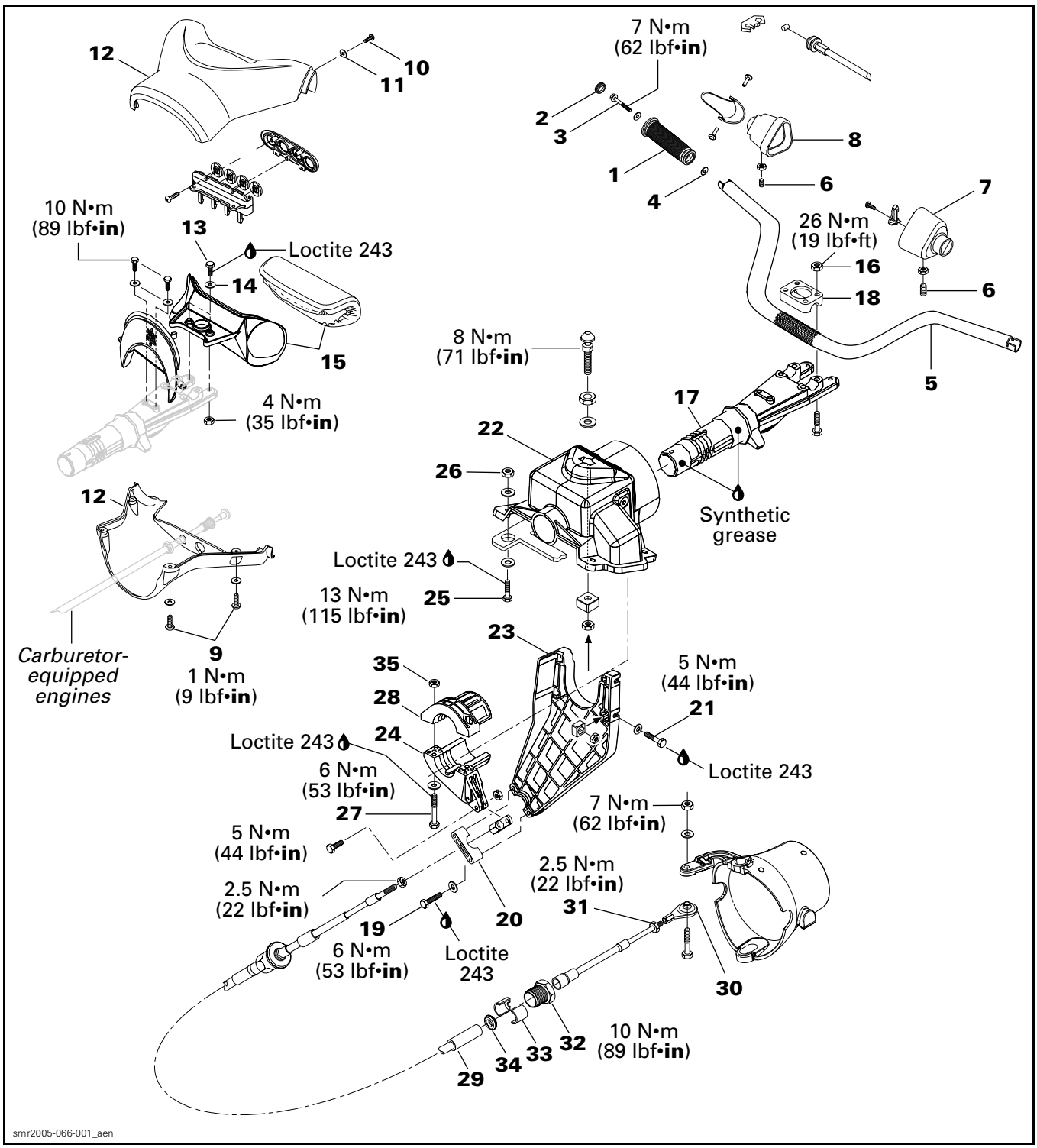
SERVICE TOOLS

Description	Part Number	Page
steering cable tool	295 000 145	282, 292

SERVICE PRODUCTS

Description	Part Number	Page
synthetic grease	293 550 010	300

GTI SERIES

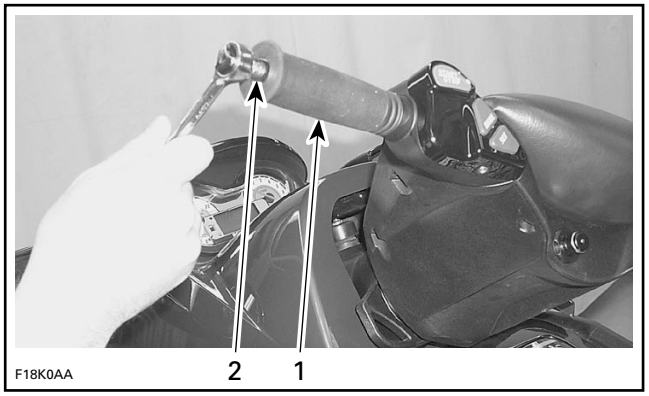


DISASSEMBLY

Handle Grip and Grip Insert

To remove handle grip **no. 1**, pull out cap **no. 2** and remove screw **no. 3**.

Pull out grip and remove grip insert **no. 4** from handlebar **no. 5**.



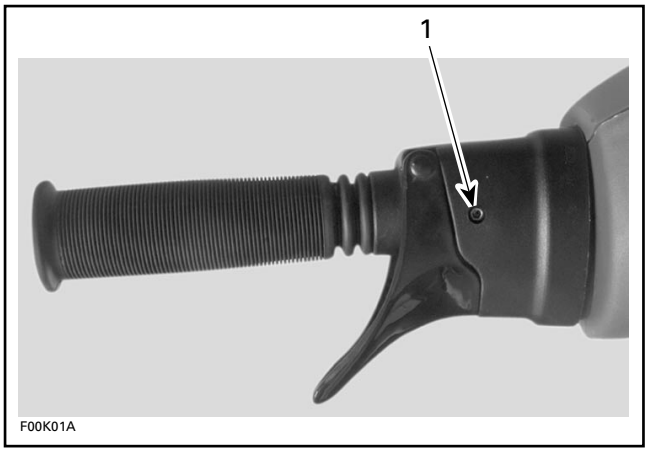
1. *Handle grip*
2. *Remove screw*

NOTE: Verify grip insert for damage.

Steering Cover

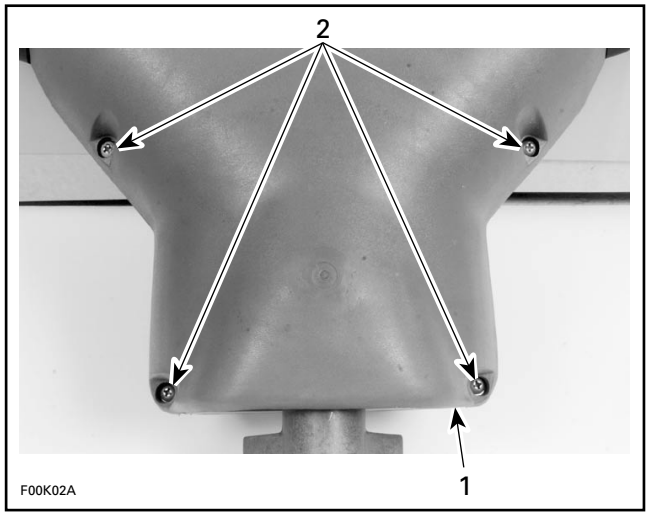
Remove grips **no. 1**.

Loosen set screws **no. 6** of handlebar housings **no. 7** and **no. 8**.



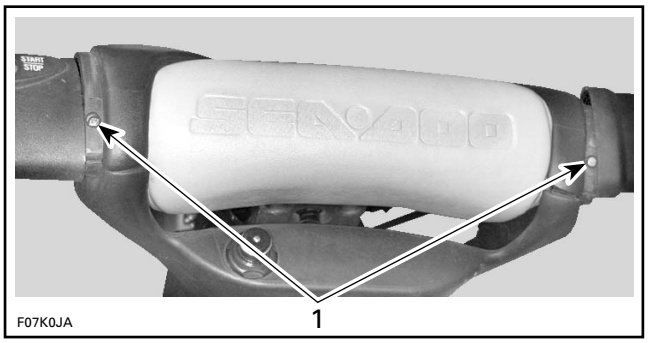
1. *Set screw*

Remove 4 screws **no. 9**.



TYPICAL
1. *Cover*
2. *Screws*

Remove 2 screws **no. 10** and flat washers **no. 11** each side of cover **no. 12**.



1. *Remove screws*

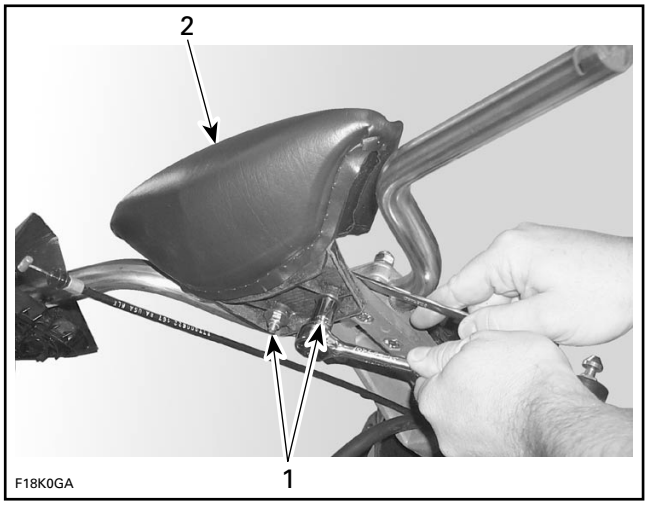
Remove cover.

Steering Padding

Remove steering cover **no. 12**.

Remove 2 screws **no. 13** and flat washers **no. 14**.

Remove steering padding **no. 15**.

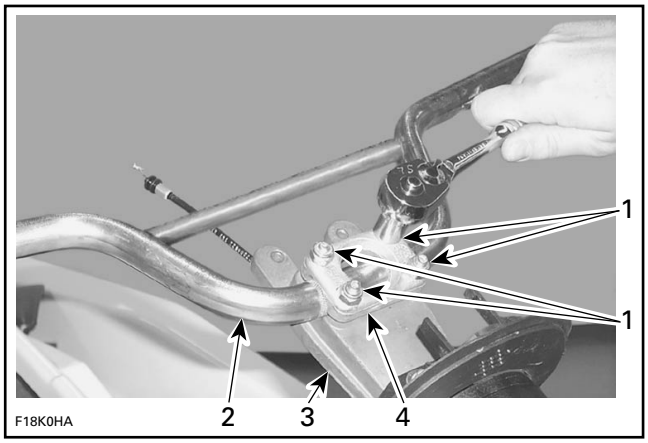


1. *Screws*
2. *Steering padding*

Handlebar

Remove steering cover **no. 12** and steering padding **no. 15**.

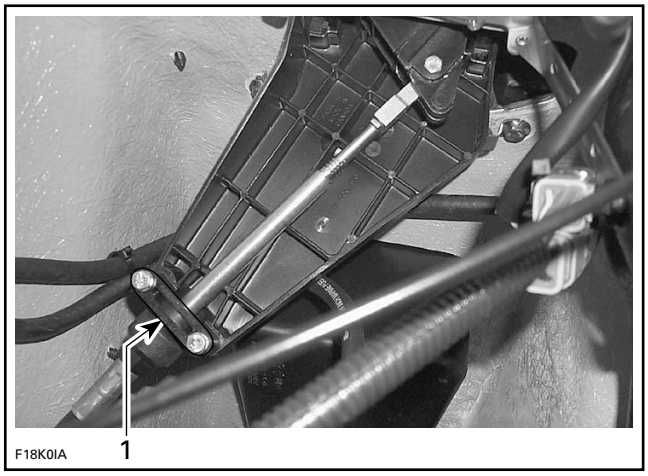
Remove 4 nuts **no. 16** to remove handle bar **no. 5** from steering stem **no. 17** and steering clamp **no. 18**.



1. *Nuts*
2. *Handlebar*
3. *Steering stem*
4. *Steering clamp*

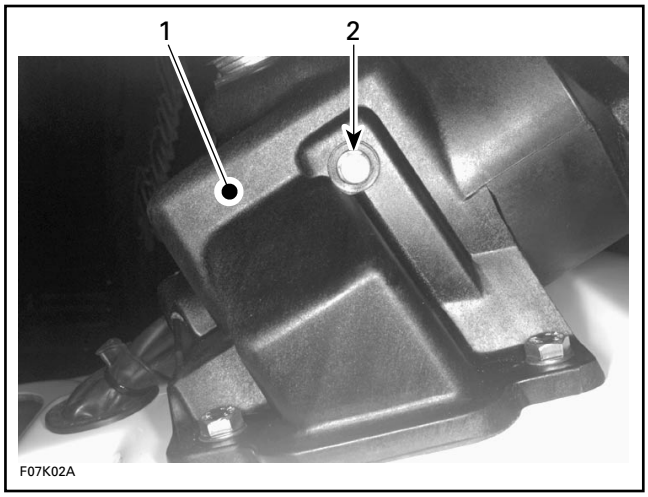
Steering Cable Support

Loosen bolts **no. 19** and remove retaining block **no. 20**.

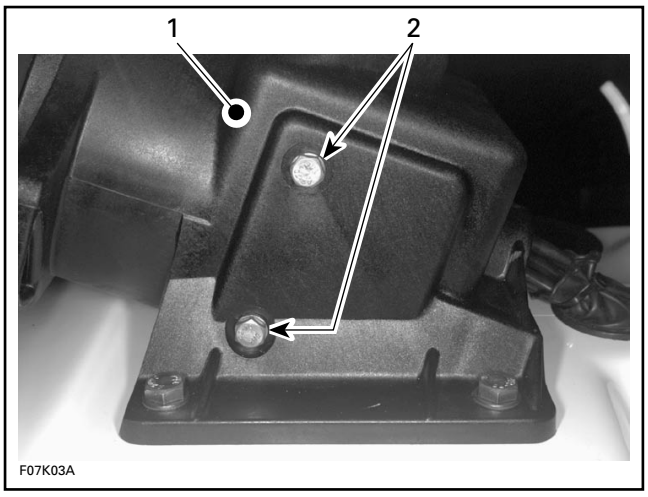


1. *Retaining block*

Loosen bolts **no. 21** each side of steering support **no. 22**.



LEFT SIDE
1. *Steering support*
2. *Bolt*

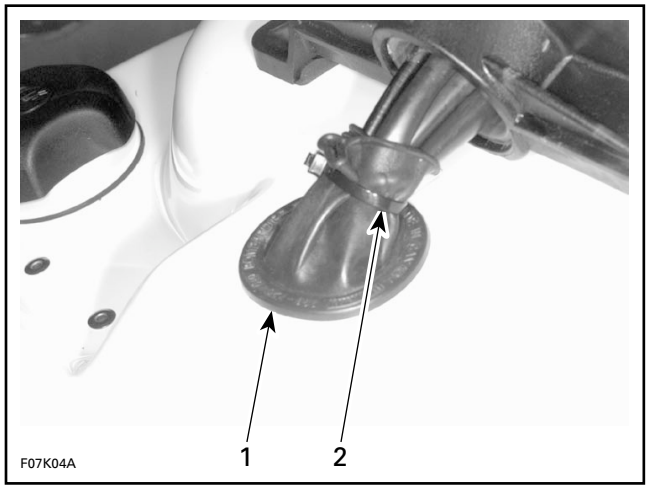


RIGHT SIDE
1. *Steering support*
2. *Bolts*

Remove cable support **no. 23**.

Steering Support

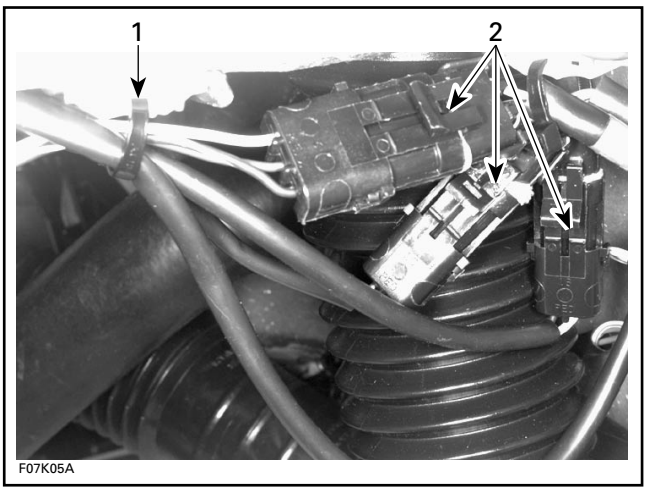
Cut locking tie securing wiring harness boot.



TYPICAL
1. *Boot*
2. *Locking tie*

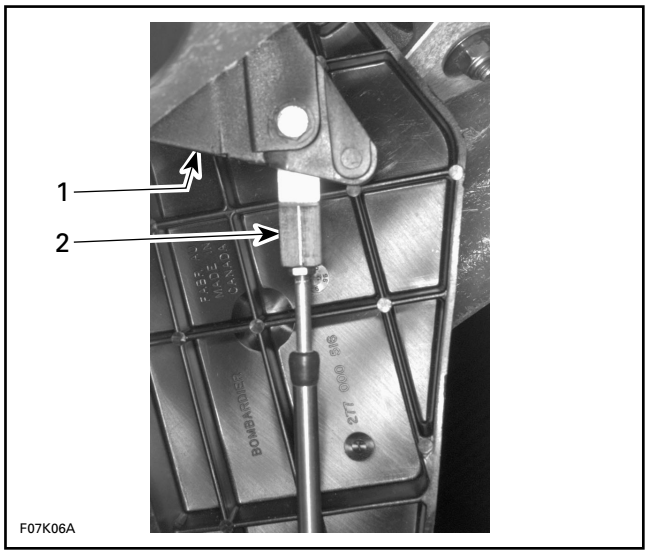
In accordance with the engine, disconnect throttle and choke cables from carburetor or disconnect throttle cable from throttle body.

Disconnect the wiring harnesses leading out of steering stem **no. 17** and cut locking tie.



1. *Tie rap*
2. *Connectors*

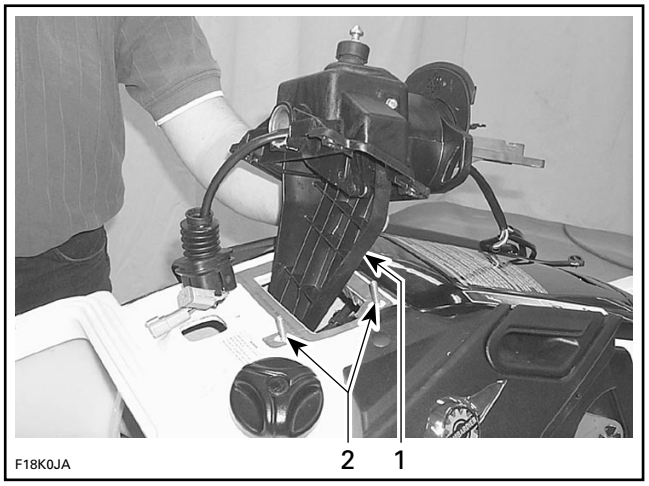
Disconnect the steering cable from the steering stem arm **no. 24**.



1. *Steering stem arm*
2. *Steering cable*

Remove bolts **no. 21** retaining cable support **no. 23** to steering support **no. 22**.

Remove bolts **no. 25** and lock nuts **no. 26** from steering retaining strip studs.

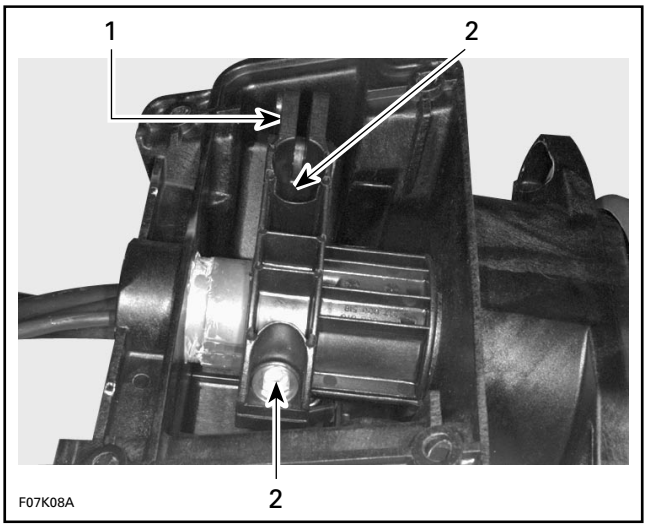


TYPICAL
1. *Steering support*
2. *Retaining strip studs*

Remove steering support **no. 22** with handlebar, wiring harnesses and cables.

Steering Stem Arm and Support

Loosen bolts **no. 27** retaining steering stem arm **no. 24** to support **no. 28**.



1. *Steering stem arm*
2. *Bolts*

Remove steering stem arm and support.

Steering Cable

Disconnect steering cable **no. 29** from steering stem arm **no. 24**.

Remove retaining block **no. 20**.

Disconnect ball joint **no. 30** from jet pump nozzle.

Remove ball joint **no. 30** and jam nut **no. 31** from cable.

Loosen nut **no. 32**, then remove half rings **no. 33** and O-ring **no. 34**.

NOTE: To loosen nut, use the steering cable tool (P/N 295 000 145).

Remove steering cable from watercraft. Note its routing for proper installation.

Nozzle

Disconnect steering cable from jet pump nozzle.

Remove:
– reverse gate, refer to REVERSE SYSTEM
– "U" lever bolt, located under nozzle

– nozzle bolts retaining nozzle to venturi
– nozzle.

Remove nozzle.

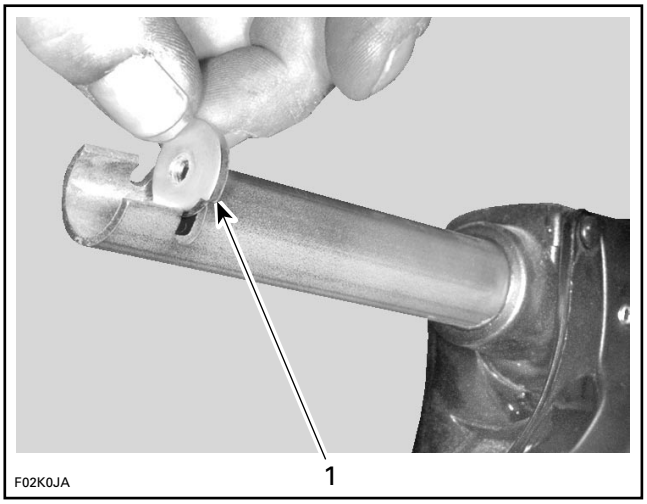
ASSEMBLY

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. 4** in the handlebar **no. 5**, ensure that it is properly inserted in the slot at the end of the handlebar tubing.



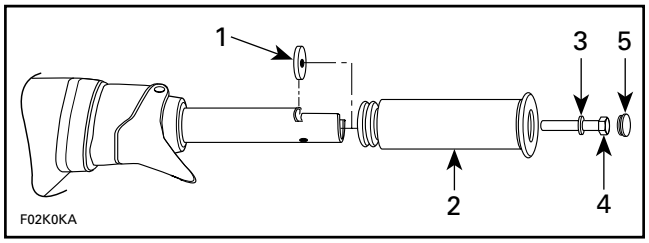
1. Grip insert

Install grip **no. 1** on handlebar **no. 5** matching it to the notch in the handlebar.

Install flat washer and screw **no. 3**.

Torque screw to 7 N•m (62 lbf•**in**).

Install cap **no. 2**.



1. Grip insert
2. Grip
3. Flat washer
*4. Screw. Torque to 7 N•m (62 lbf•**in**)*
5. Cap

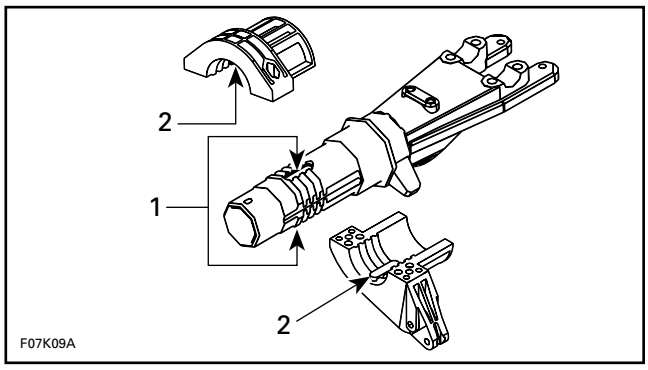
CAUTION: Ensure to install flat washer otherwise screw will damage grip end.

Steering Stem Arm and Support

Position steering stem arm **no. 24** and support **no. 28** onto steering stem.

⚠ WARNING

Make sure the integrated flat keys of the steering stem arm and support are properly seated in steering stem keyways. Steering stem arm must be locked in place before torquing the bolts.



1. Keyways
2. Integrated flat key

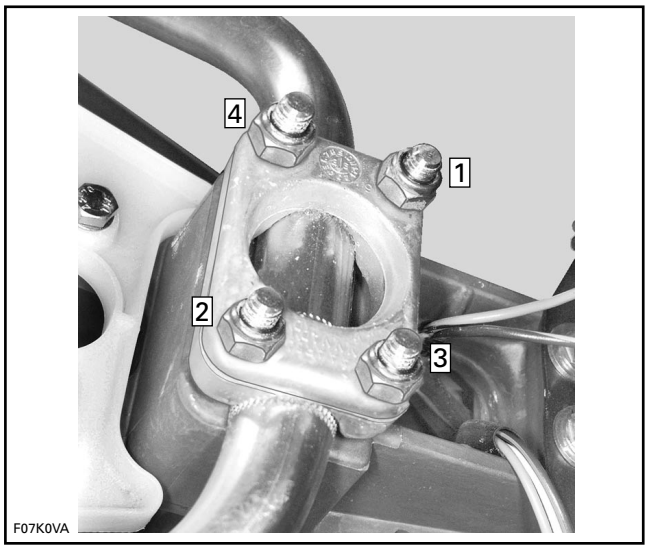
Replace lock nuts **no. 35** by new ones.

Torque bolts **no. 19** of steering stem arm to 6 N•m (53 lbf•**in**).

Handlebar

Position handlebar **no. 5**. Install steering clamp **no. 18** and secure with new elastic stop nuts M8.

Torque nuts to 26 N•m (19 lbf•ft) as per the following sequence.

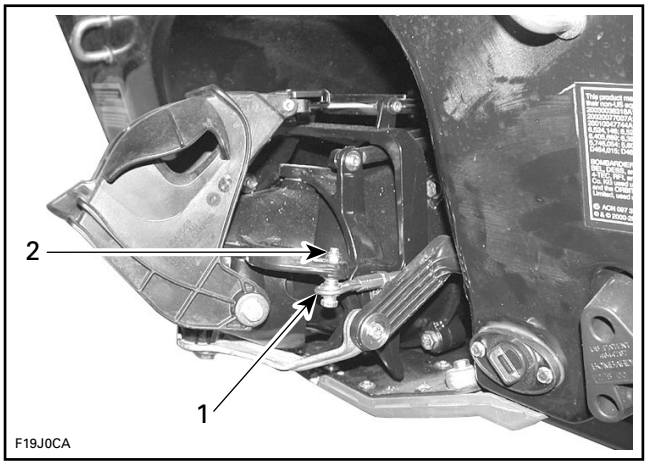


TORQUE SEQUENCE

Ball Joint

Secure the steering cable ball joint **no. 30** to the nozzle as per following illustrations.

CAUTION: Ensure the ball joint is parallel (± 10°) to the nozzle arm.



TYPICAL
1. *Ball joint below steering arm*
2. *Torque nut to 7 N•m (62 lbf•**in**)*

Nozzle

Install nozzle on venturi and torque bolts to 24 N•m (17 lbf•ft).

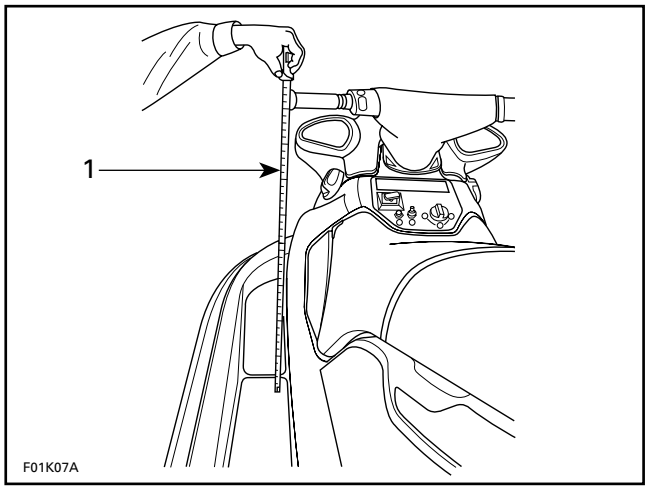
Install reverse spring and reverse gate.

Connect steering cable and perform steering alignment.

After assembling procedure, adjust throttle cable then perform a steering alignment.

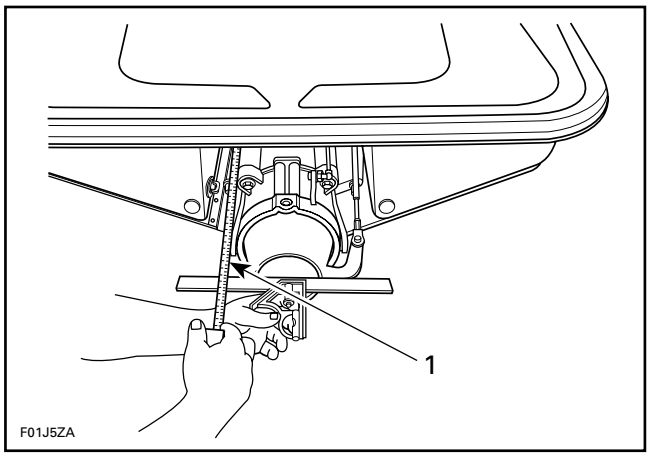
STEERING ALIGNMENT

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.



TYPICAL
1. *Measure the distance on each side of the straight edge*

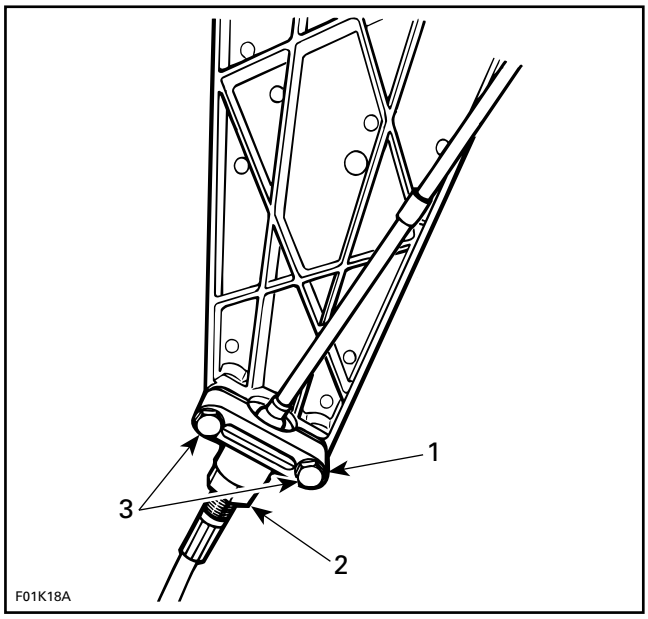
If necessary, steering alignment adjustment should be performed at steering cable support.

Open storage compartment cover.

Remove access panel.

Loosen 2 bolts retaining block **no. 20** at cable support **no. 23**.

Turn adjustment nut as required.

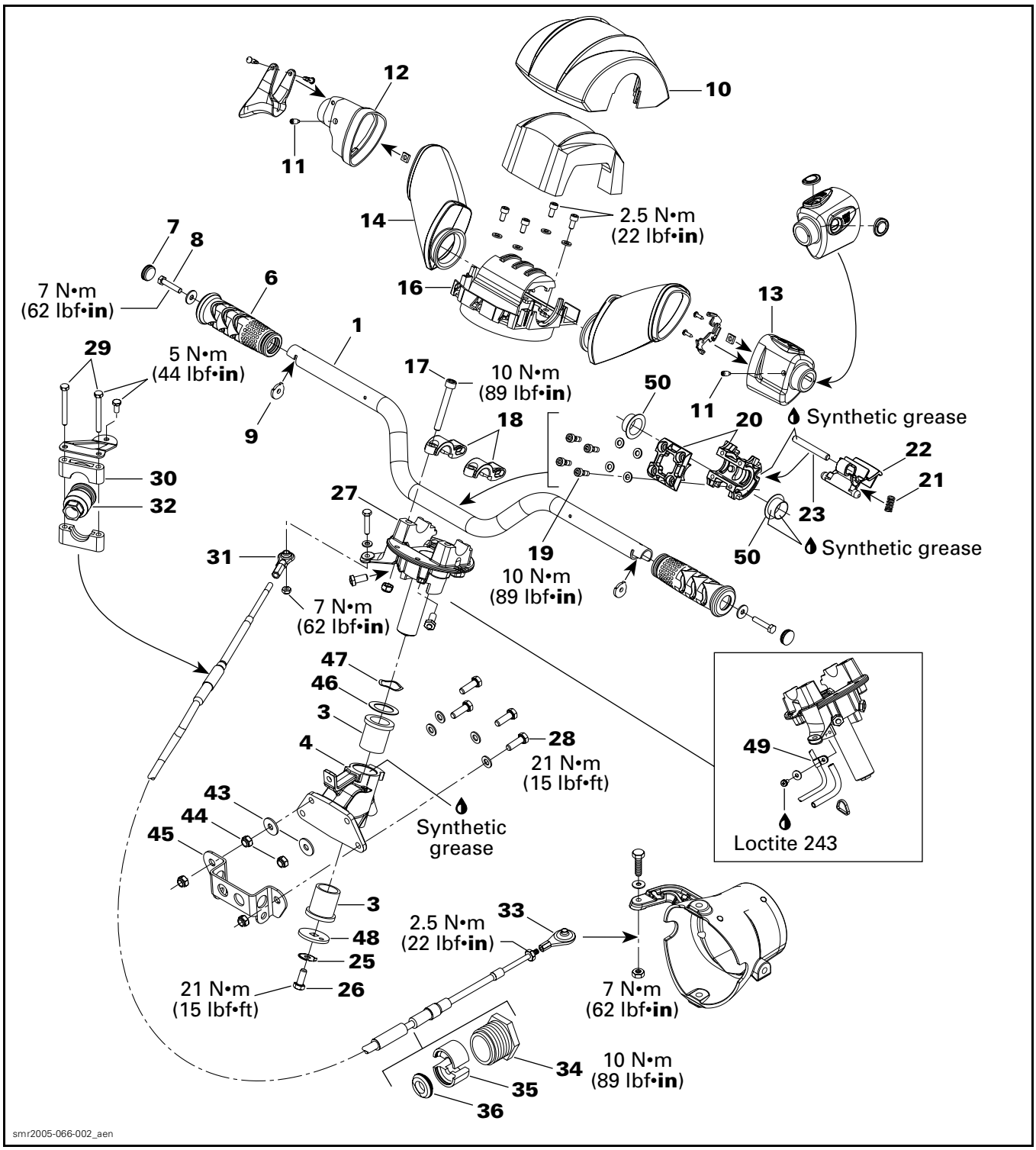


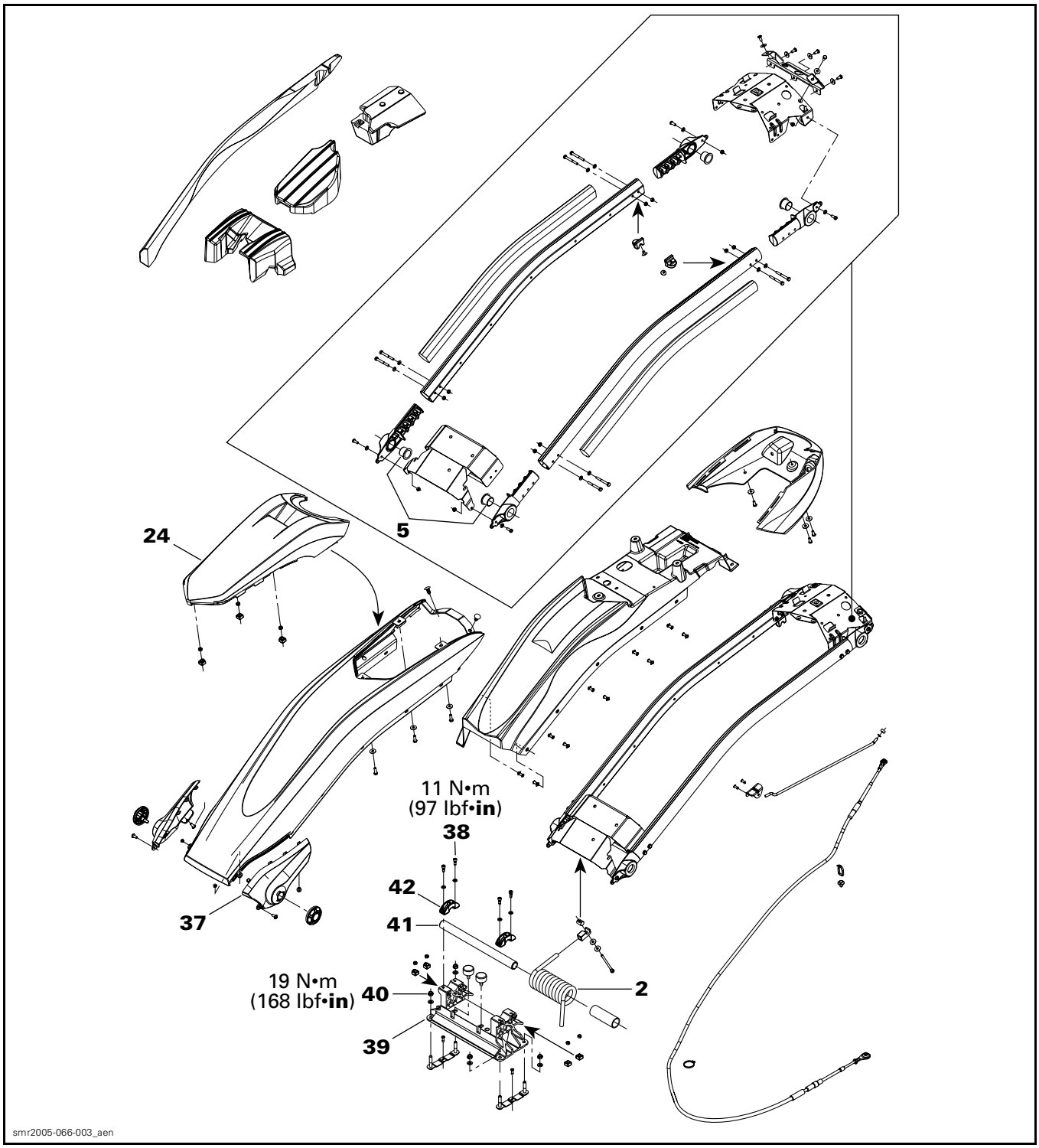
1. *Retaining block*
2. *Adjustment nut*
3. *Loosen bolts*

After adjustment, torque retaining block bolts **no. 19** 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.

3D SERIES





INSPECTION

NOTE: A mechanism that is hard to move might only need to be disassembled, cleaned, lubricated then reinstalled.

If there is excessive play in the following inspections, replace worn bushings or any other worn component.

Handlebar and Adjuster

Move handlebar **no. 1** to each position. It should move easily and lock in each position. Make sure there is no excessive play in the handlebar and in the steering stem.

Steering Pole

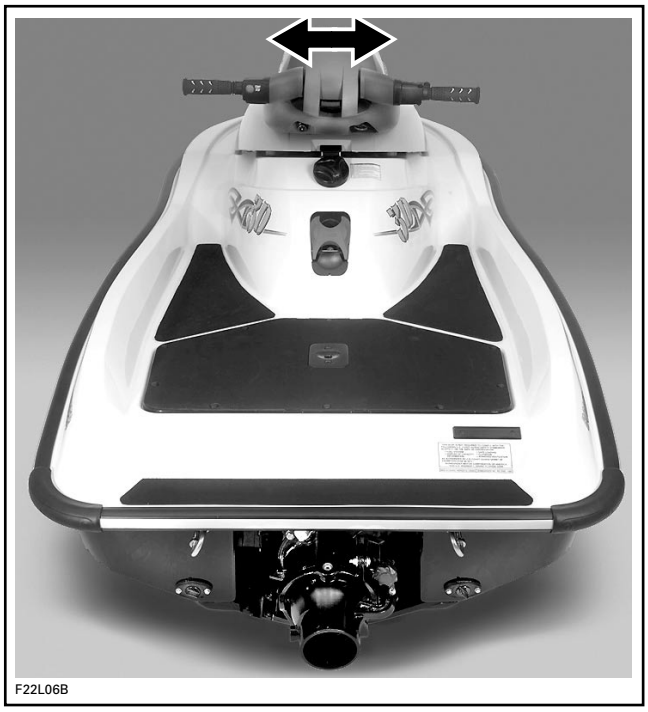
First make sure to stow the moto seat (if so equipped).

Move steering pole up and down. It should move freely and smoothly without resistance. If steering pole feels too heavy, it can be adjusted with the return spring **no. 2**. If it does not help, the return spring **no. 2** could be broken.

1. Steering pole

Lower steering pole to the lowest position and try moving it from side to side to detect any excessive play.

If excessive play is felt, check bushings **no. 3** in steering support **no. 4** and/or bushings **no. 5** near return spring **no. 2**.



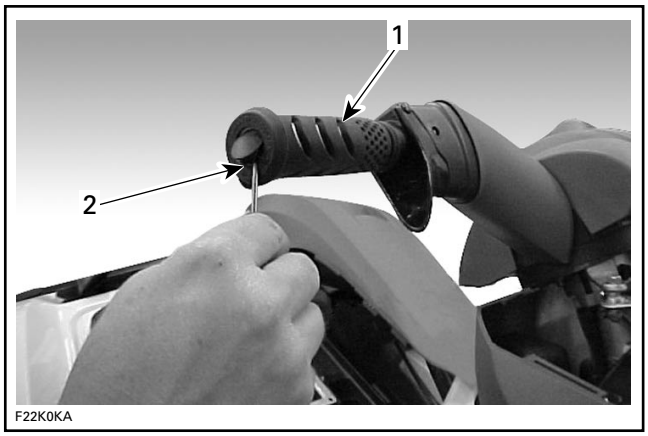
DISASSEMBLY

Moto Seat

To disassemble moto seat from steering pole, refer to HULL/BODY.

Handle Grip and Grip Insert

To remove handle grip **no. 6**, pull out cap **no. 7** and remove screw **no. 8**.



1. Handle grip
2. Remove cap and screw

Pull out grip and remove grip insert **no. 9** from handlebar **no. 1**.

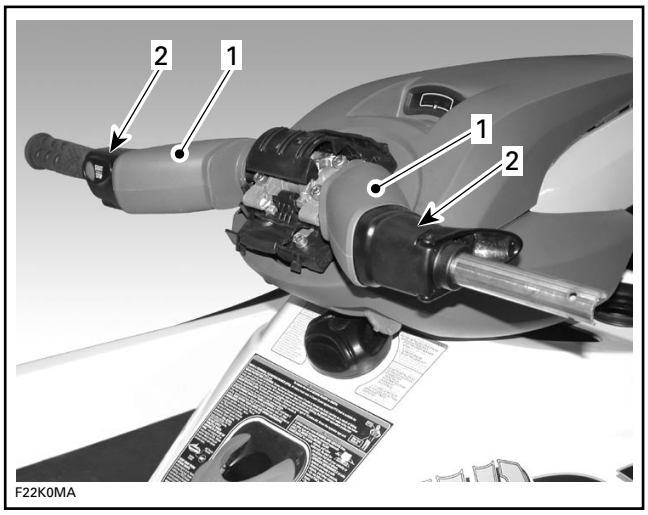
NOTE: Verify grip insert for damage.

Steering Cover

Pull up steering padding **no. 10**.


F22K0LA

Loosen set screws **no. 11** of handlebar housings **no. 12** and **no. 13**.



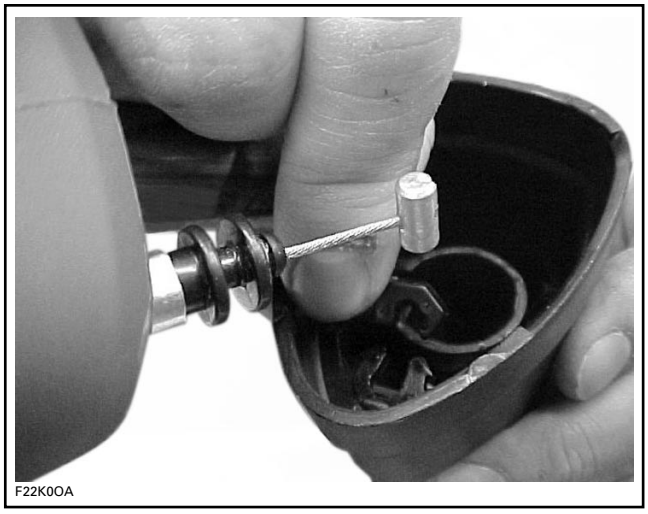
F22K0MA

1. Cover
2. Screw

RH Cover

Unhook throttle cable.


F22K0NA


F22K0OA

Pull out throttle housing **no. 12**.

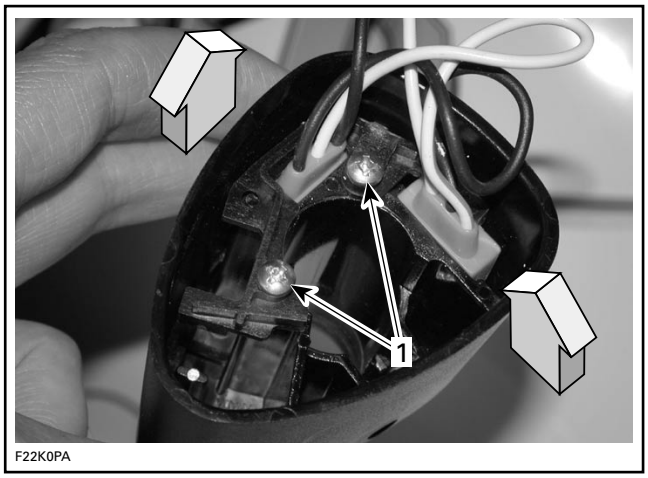
Remove cover **no. 14**.

LH Cover

Pull out start/stop switch housing **no. 13**.

Remove switches from housing.

Remove cover **no. 15**.

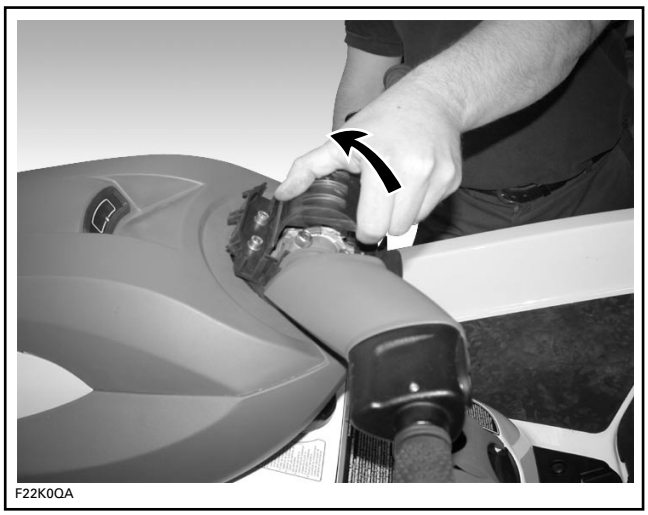


F22K0PA

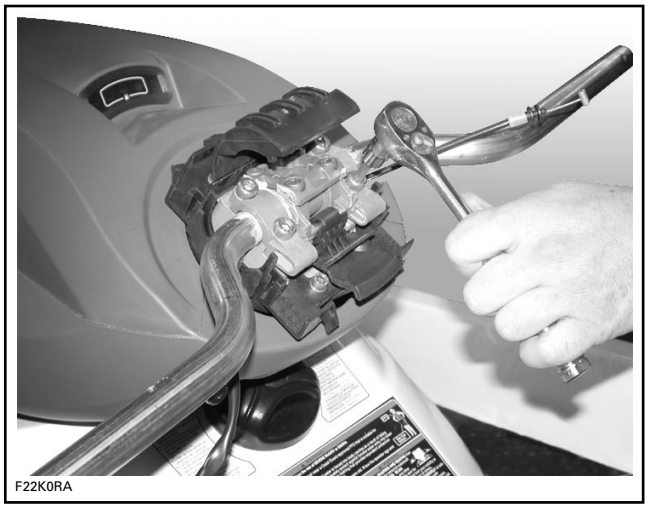
1. Retaining screws

Handlebar and Adjuster

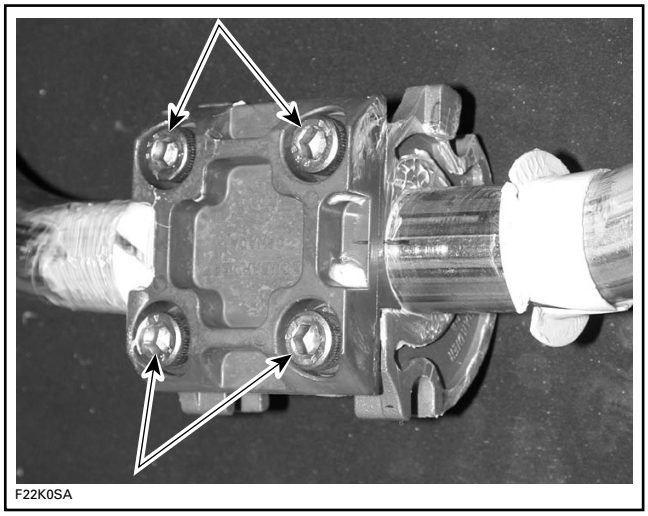
Lift cover of steering padding support **no. 16**.


F22K0QA

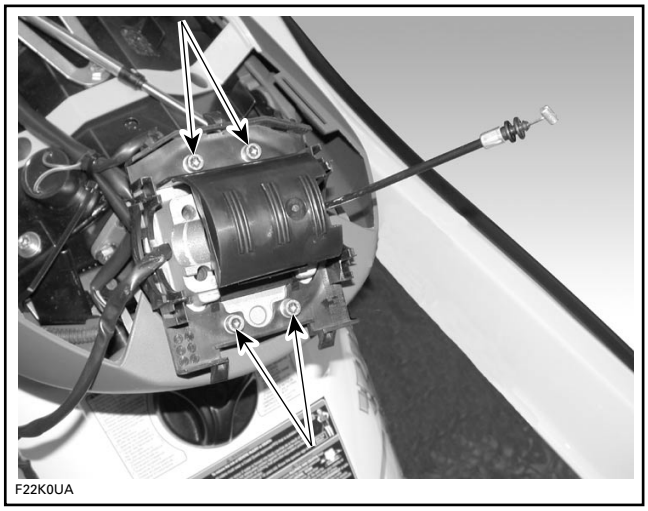
Remove screws **no. 17**, upper clamps **no. 18** and handlebar **no. 1**.


F22K0RA

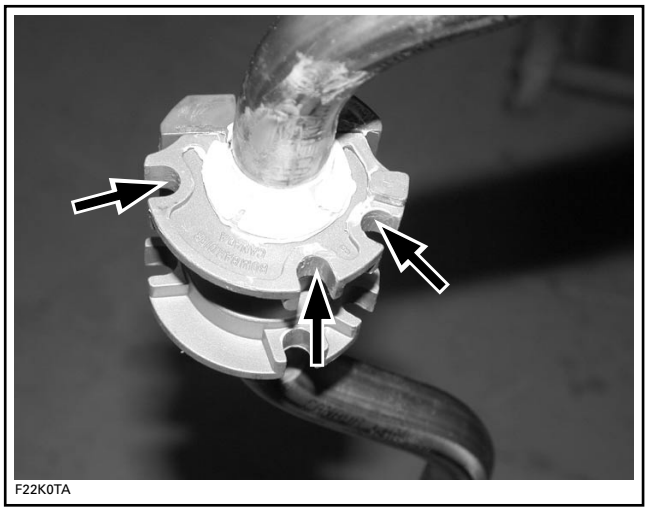
Remove screws **no. 19** of adjuster blocks **no. 20**.


F22K0SA

Remove spring **no. 21**, steering padding support **no. 16** then latch lever **no. 22**.

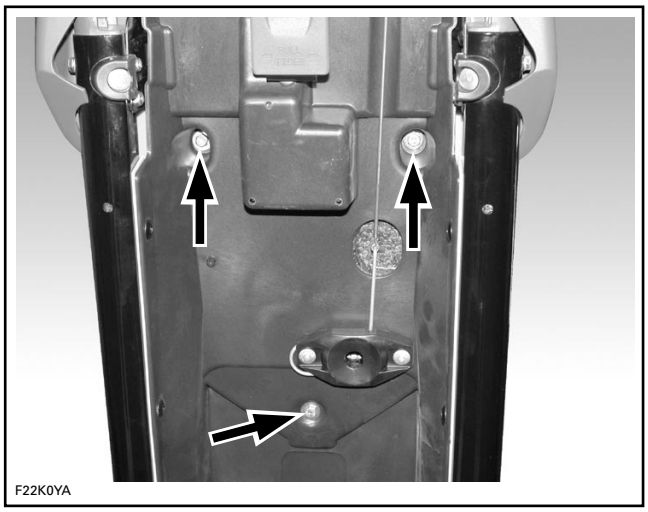

F22K0UA

Inspect notches of adjuster blocks **no. 20** and the pin **no. 23** for wear or other damage.


F22K0TA

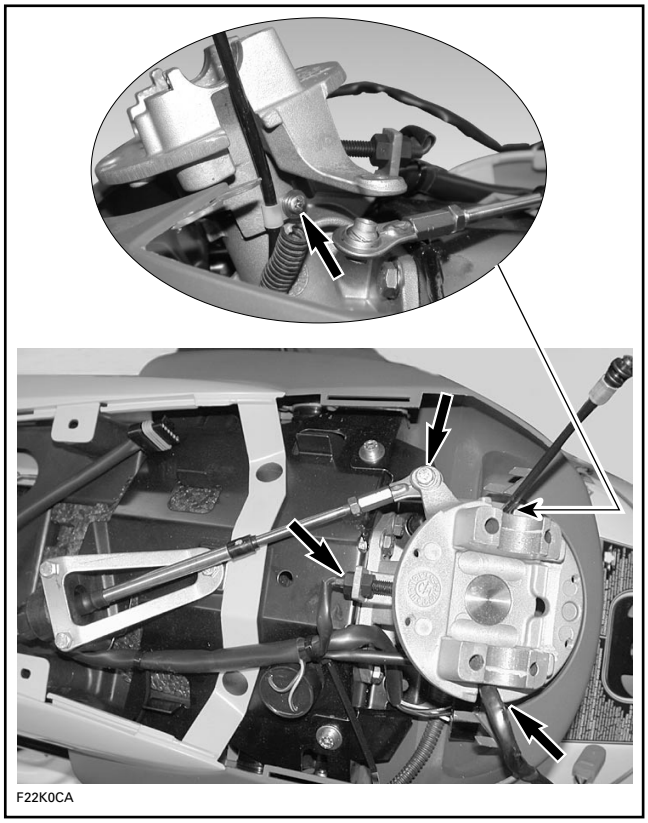
Steering Stem and Support

Remove top cover **no. 24**.


F22K0YA

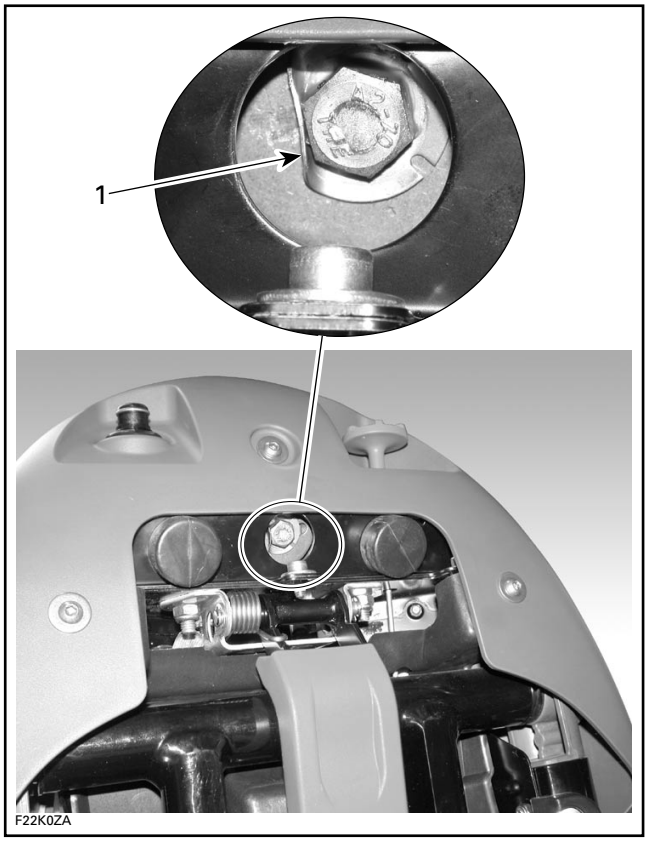
Detach steering cable, switch harness and throttle cable from steering support.

Remove OTAS switch.


F22K0CA

Raise steering pole.

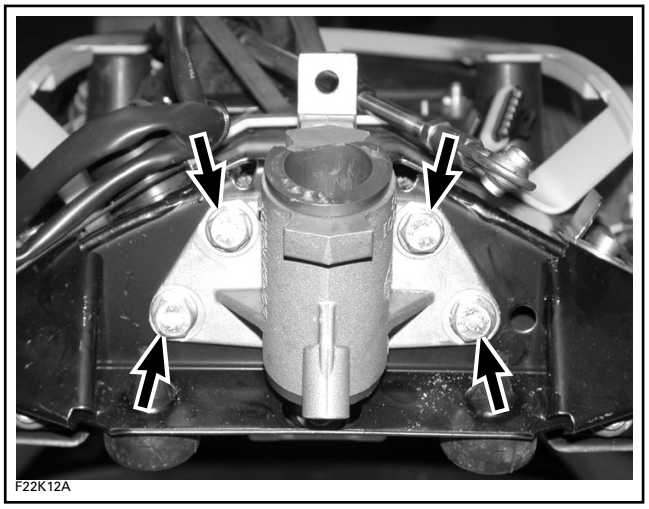
Unbend lock tab **no. 25** then unscrew steering stem screw **no. 26**.



1. Unbend tab

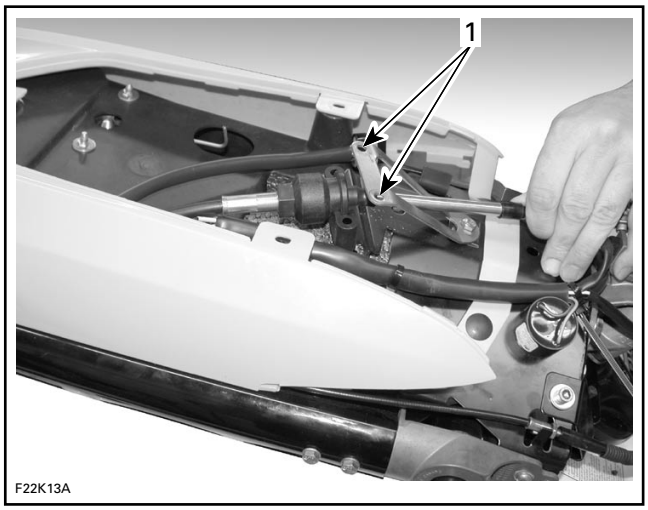
Pull steering stem **no. 27** out.

Remove steering support screws **no. 28**.



Steering Cable

Remove screws **no. 29**.



1. Screws removed

Remove retaining block **no. 30**.

Remove ball joint **no. 31** and adjustment knob **no. 32** from cable.

Disconnect ball joint **no. 33** from jet pump nozzle then from cable.

Use the steering cable tool (P/N 295 000 145) and remove nut **no. 34**, then remove half rings **no. 35** and O-ring **no. 36**.

Raise steering pole.

Cut locking ties as required to allow puling out steering cable.

Remove steering pole to be able to pull steering cable out of bilge. See below.

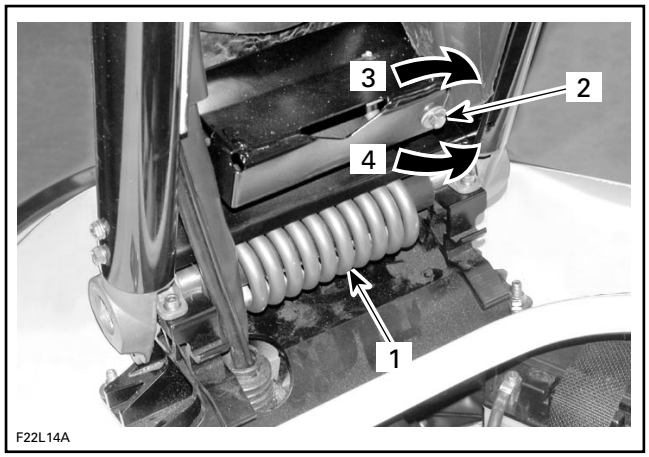
Steering Pole

Raise and lock steering pole with its retainer.

Cut locking ties as required then pull throttle cable out of steering pole.

Pull wiring harness out of pole.

Completely release return spring **no. 2** preload.



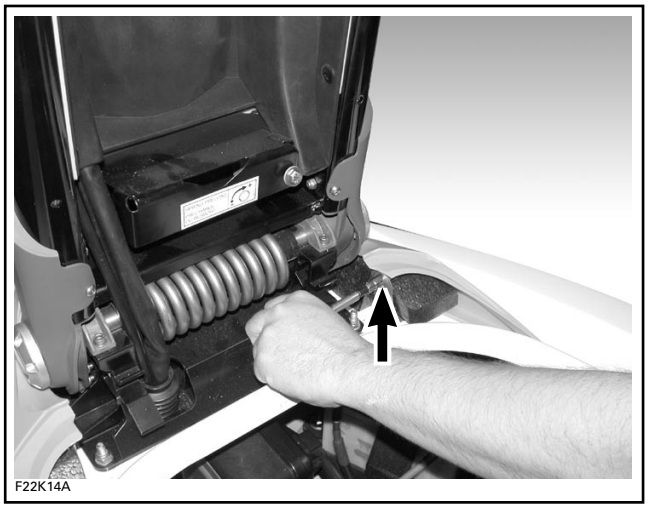
1. *Return spring*
2. *Adjustment*
3. *To increase preload*
4. *To reduce preload*

Lower steering pole.

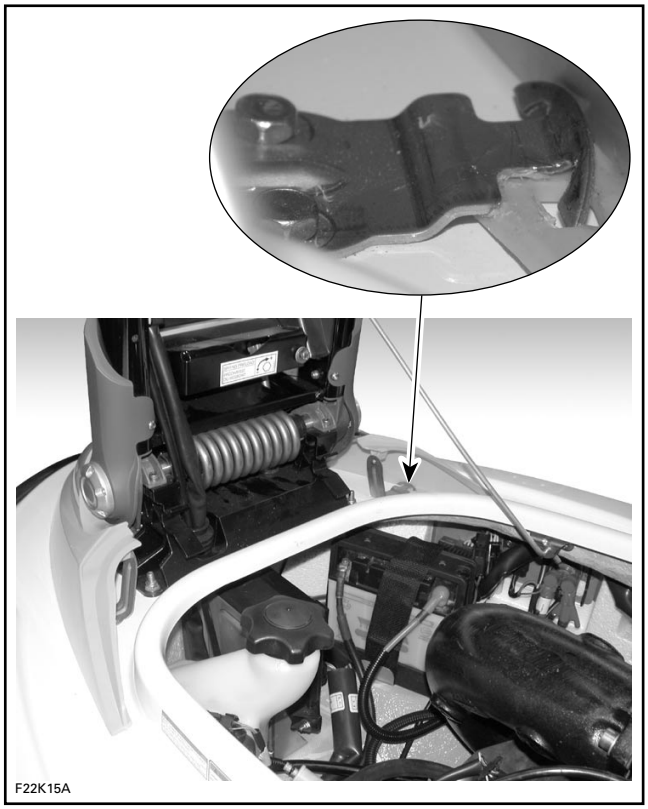
Remove front cover in the following step order.

CAUTION: Work carefully when releasing locking tabs from cover to avoid damaging cover.

Remove side screws.

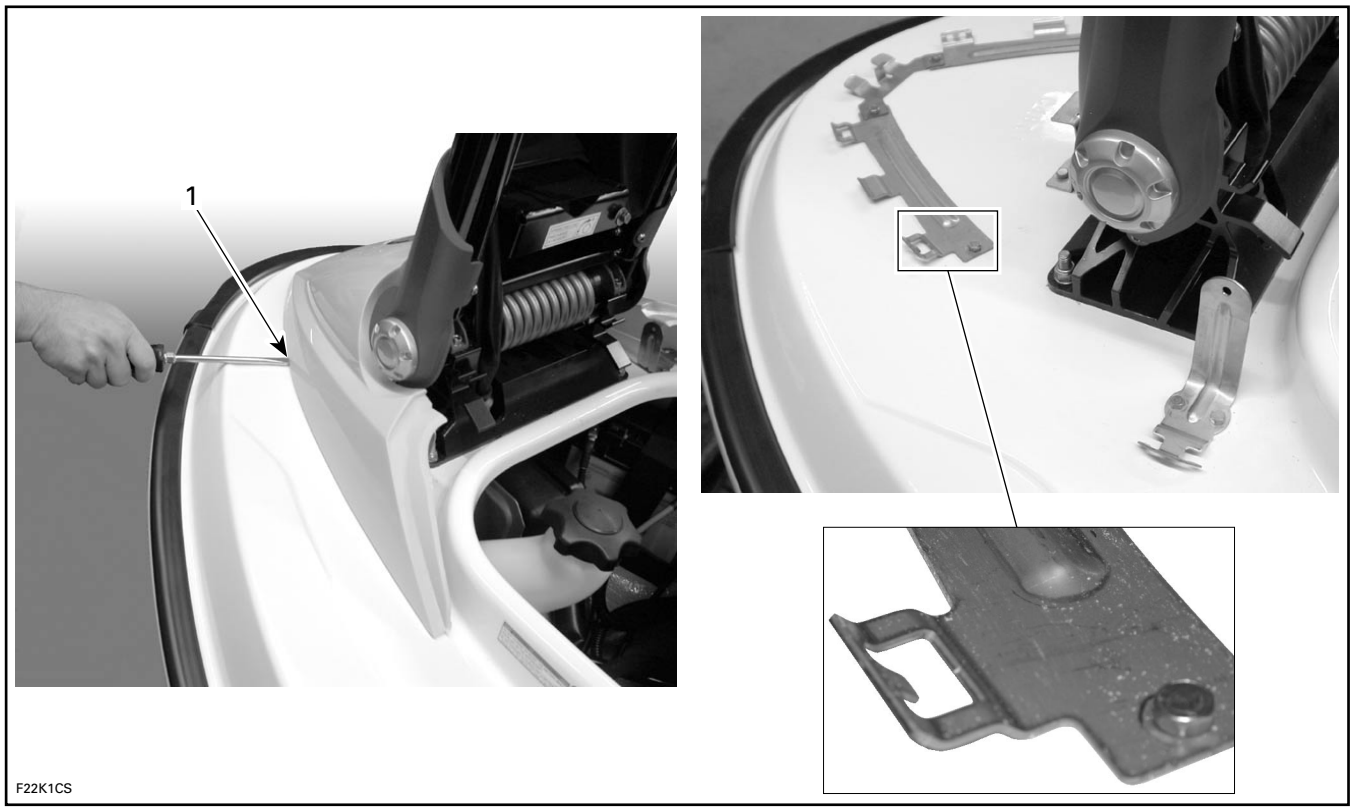


Release rear metal tabs.



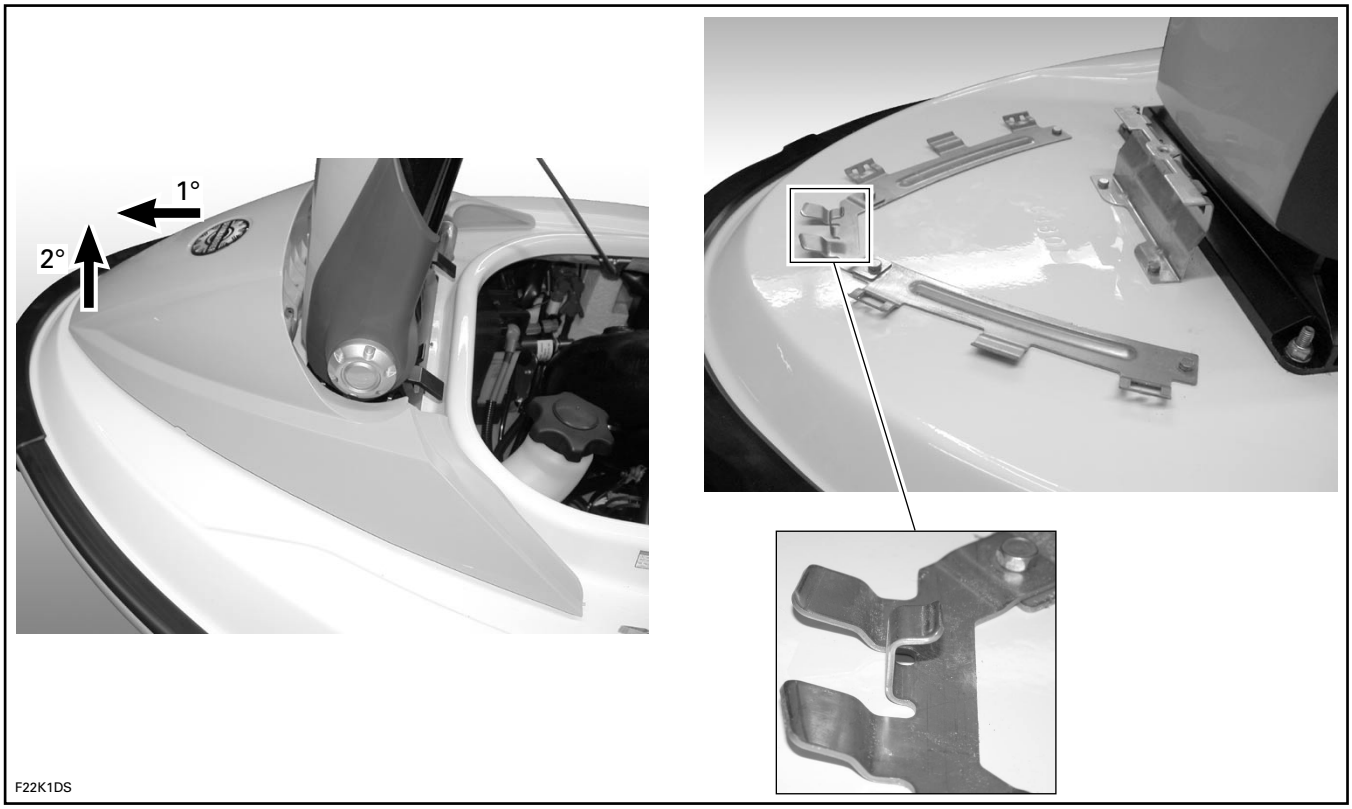
INNER FOAM REMOVED FOR CLARITY PURPOSE

Using the provided openings, release side metal tabs while pulling cover outward.

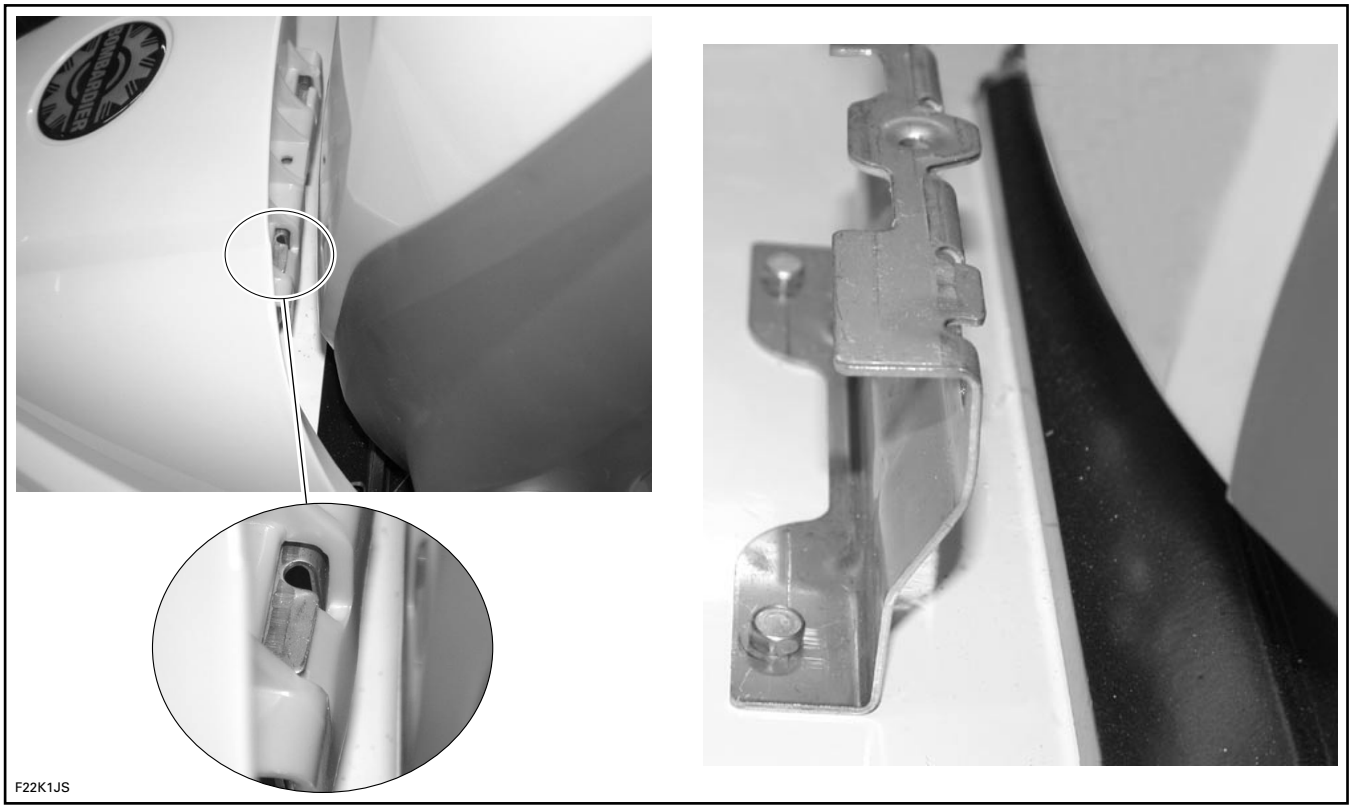


1. Side opening

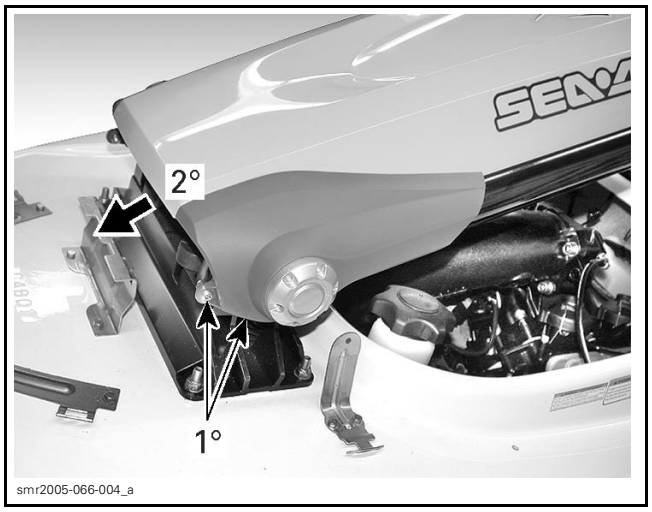
Push cover forward then lift front part to unlock cover.



For the center rear locks, push plastic tabs rearward to release.



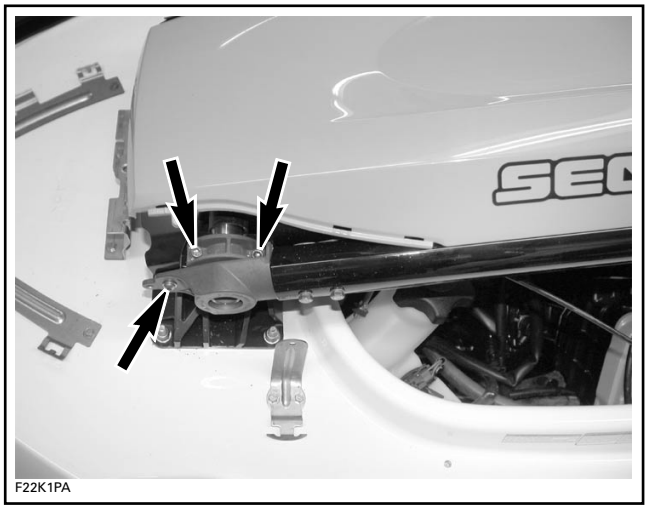
Unscrew side and bottom screws then slide caps **no. 37** forward to remove.



smr2005-066-004_a

NOTE: It is suggested to hook-up steering pole to the ceiling to hold it while removing from vehicle and particularly while removing steering cable.

Remove end screws and clamp screws **no. 38**.


F22K1PA

Maintain steering pole vertically and pull steering cable out.

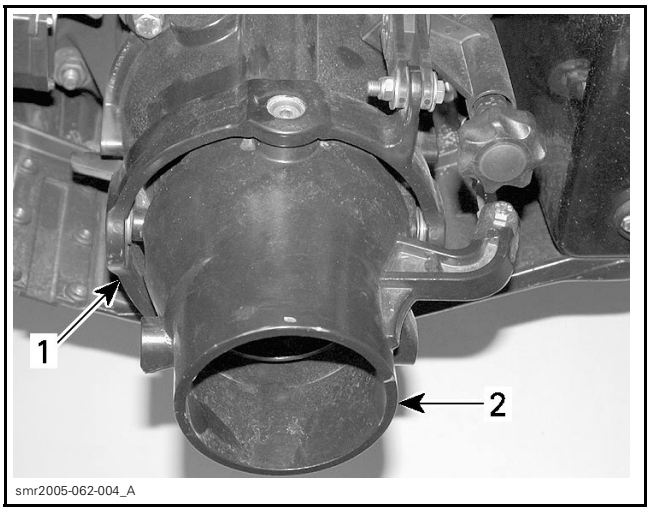
Remove steering pole from body.

Remove bridge mount **no. 39** from body.

Nozzle

Disconnect steering cable from jet pump nozzle.

Remove nozzle bolts retaining nozzle to venturi or bolts retaining nozzle to trim ring (**3D Premium Models only**).



smr2005-062-004_A

3D PREMIUM
1. Trim ring
2. Nozzle

Remove nozzle.

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.

Nozzle

Install nozzle/trim ring assembly.

Torque screws to 24 N•m (17 lbf•ft).

NOTE: Trim ring has a tight fit; to install, insert both sides at the same time, taking care not to break plastic bushings. Carefully use a plastic tip hammer if necessary. Make sure steering arm of jet pump is on right side and trim arm is above venturi.

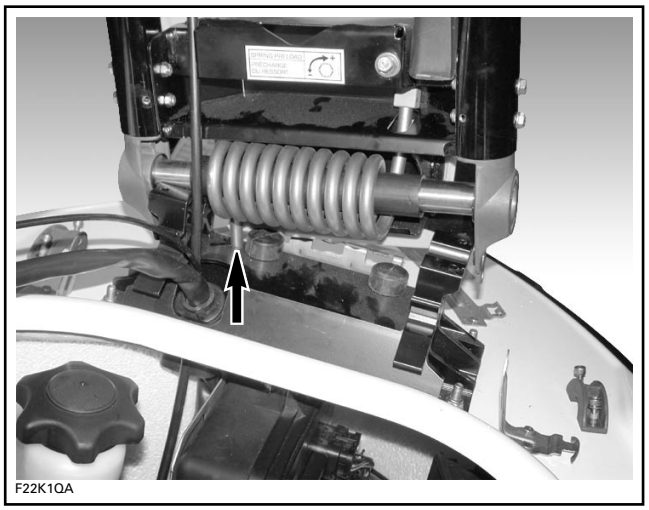
Steering Pole

NOTE: It is suggested to hook-up steering pole to the ceiling to hold it while installing to vehicle and particularly while installing steering cable.

Route steering cable toward jet pump making sure to route along bilge.

Maintain steering pole vertically while inserting steering cable in pole.

Insert return spring end into bridge mount hole.


F22K1QA

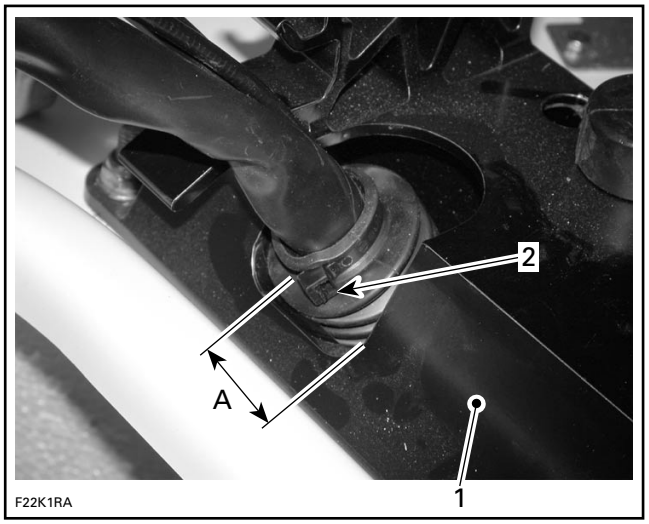
Secure pole to bridge mount. Torque nuts **no. 40** in a criss-cross sequence.

Ensure to center pivot tube **no. 41** with clamps **no. 42**.

Insert wiring harness and throttle cable in pole.

Ensure to stretch boot in the bridge mount **no. 39** to the indicated length. Then install a locking tie and strongly tighten.

NOTE: Ensure steering pole is centered (reference fuel tank cap).



F22K1RA

1. Bridge mount
2. Tightened locking tie
A. 45 mm (1.77 in)

NOTE: A missing or unfastened locking tie would allow water entry in bilge.

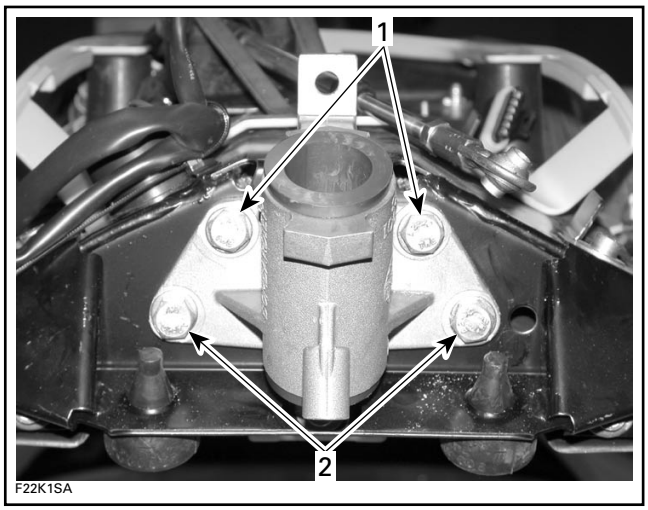
Steering Stem and Support

Position steering support **no. 4** onto steering pole.

Lubricate moving parts and bushings **no. 3**.

Position washers **no. 43** against top nuts **no. 44**.

Install steering pole retainer **no. 45** on bottom screws.

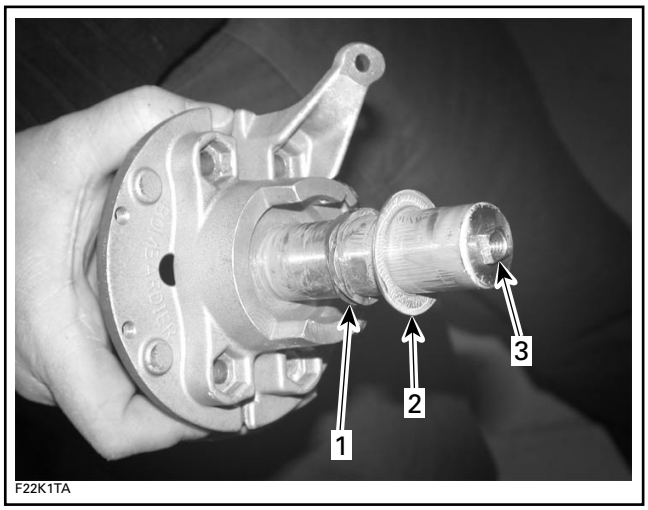


F22K1SA

1. Washers against nuts here
2. Steering pole retainer against nuts here

Torque screws **no. 28** of steering support in a criss-cross sequence.

Ensure spring washer **no. 47** and washer **no. 46** are positioned as shown.



F22K1TA

1. Spring washers
2. Washer
3. Notice the square end

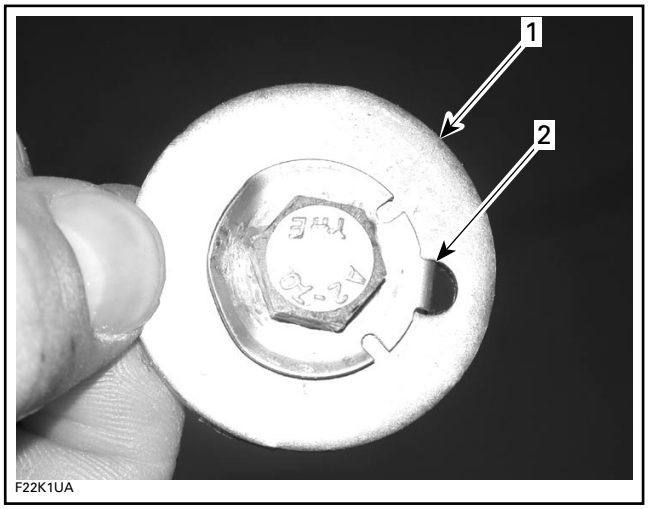
Install steering stem **no. 27** into steering support **no. 4** and position its lever on the RH side.

Position rounded edge of washer **no. 48** opposite of screw head and position washer square hole into square end of stem.

Using a new tab lock **no. 25** position its small tab into hole of washer **no. 48**.

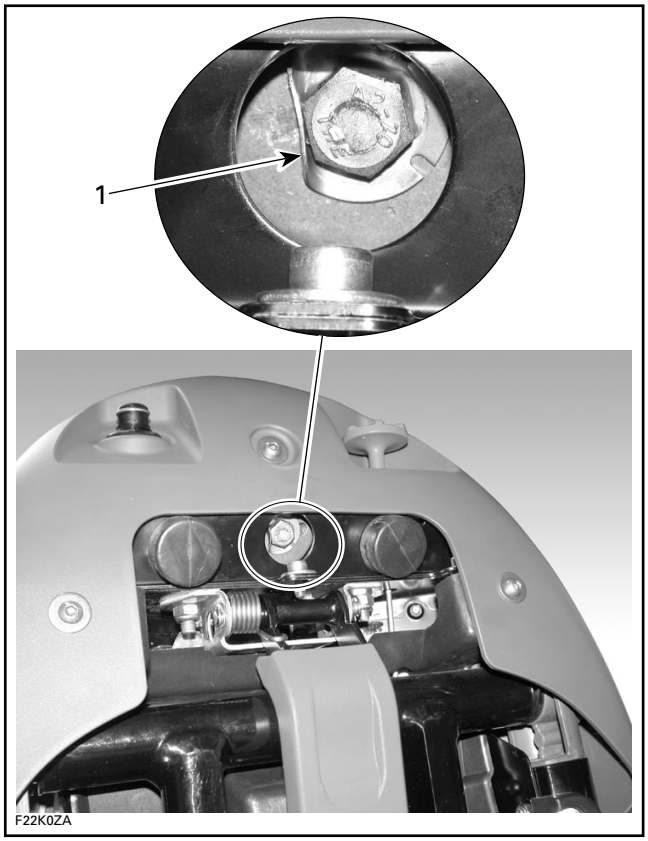
⚠ WARNING

Ensure to use a new tab lock.



1. Rounded edge on backside
2. Small tab into hole of washer

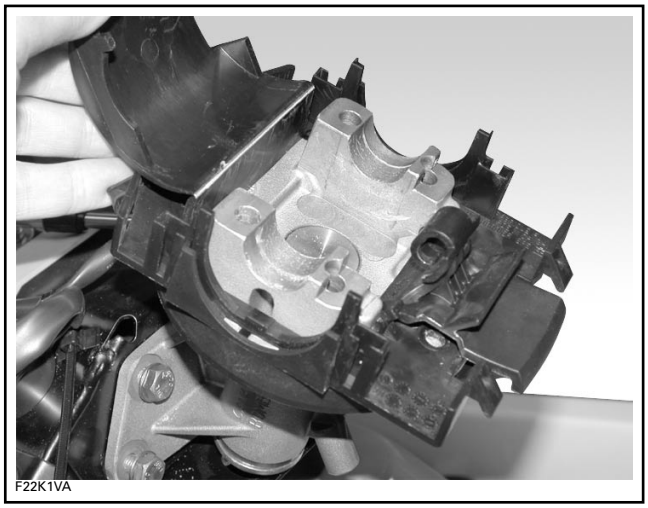
Torque screw **no. 26** then bend tab lock edge against a flat side of screw head.

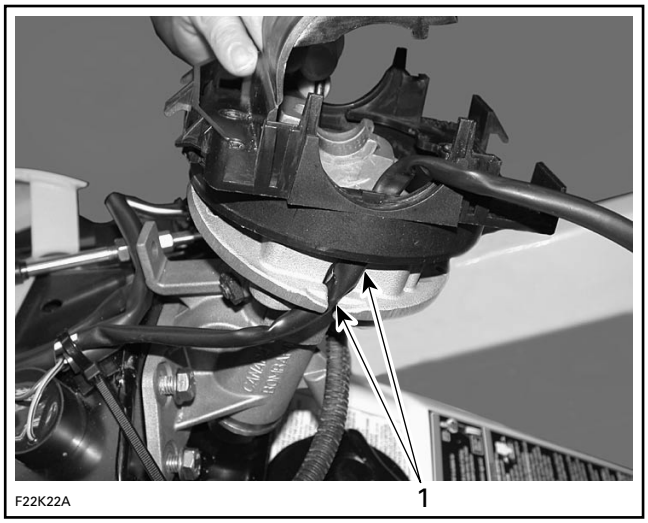


1. Tab lock edge against flat side of screw head

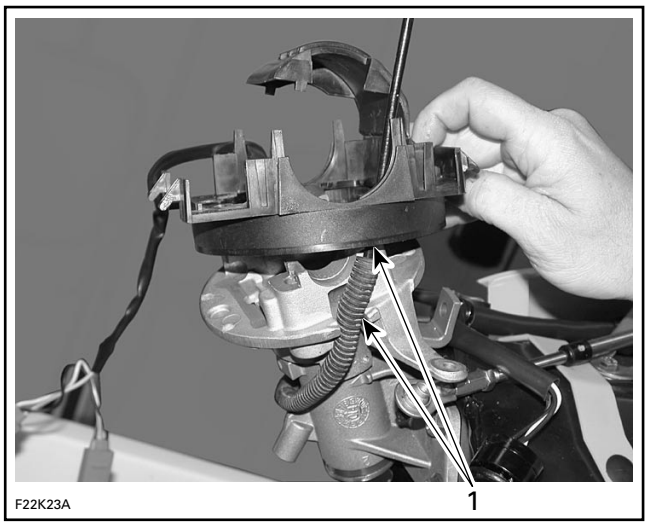
Properly route wiring harness and steering cable in steering support notches.

First install latch lever **no. 22** then steering padding support **no. 16**.



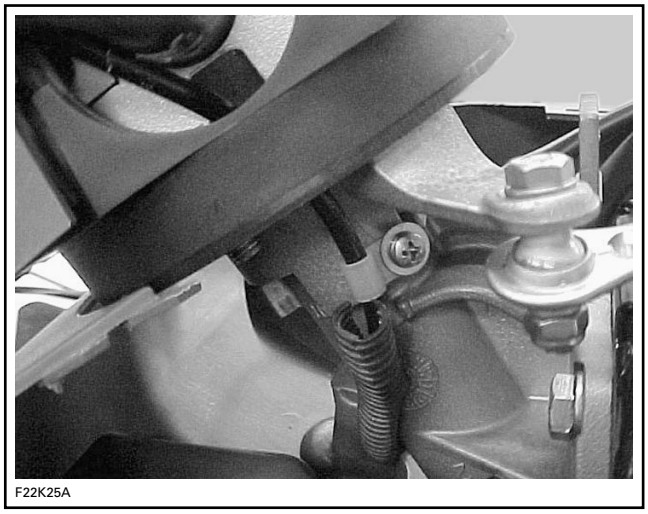


1. Wiring harness routing



1. Throttle cable routing

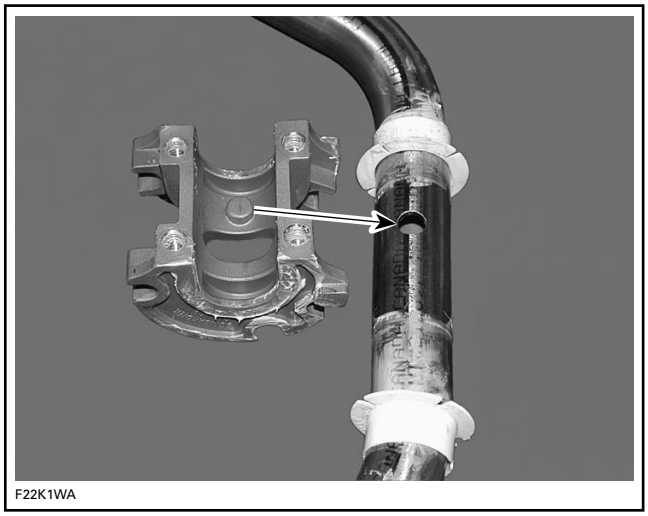
Secure throttle cable to steering support with clamp **no. 49**.



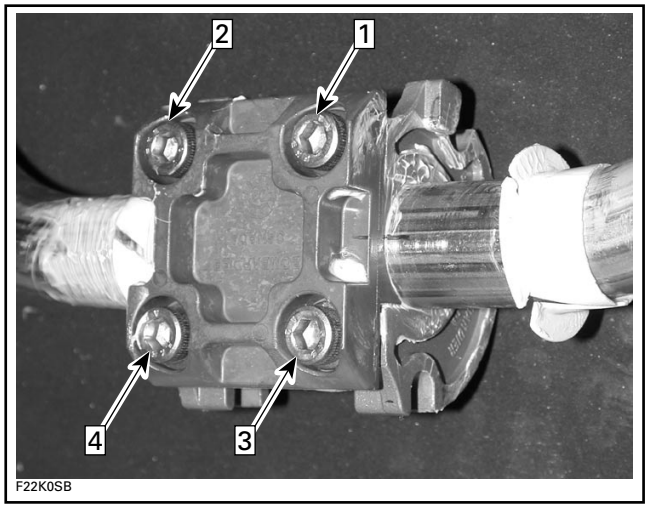
Handlebar and Adjuster

When installing blocks **no. 20** on handlebar, ensure to position block pin into handlebar hole.

NOTE: Block must be centered on handlebar. If not, it is in reverse position.



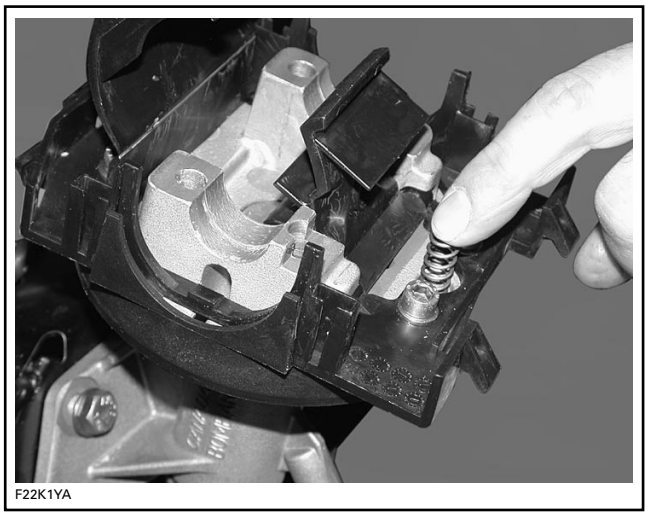
Torque screws **no. 19** as per the following sequence.



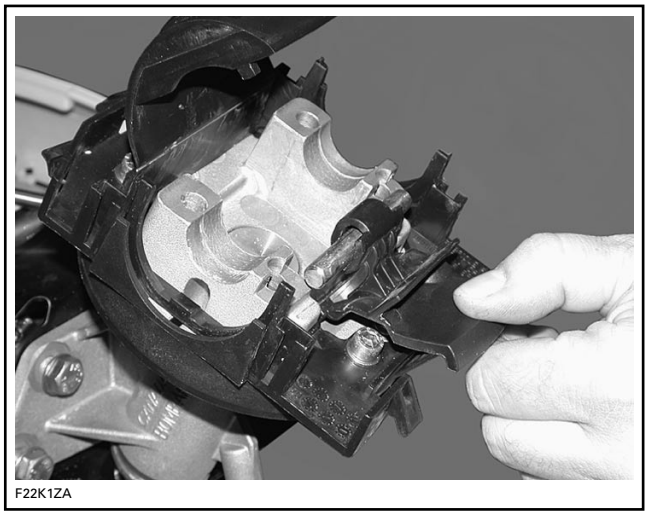
TORQUE SEQUENCE

Lubricate friction areas and bushings **no. 50** with synthetic grease (P/N 293 550 010) then slide bushings against blocks **no. 20**.

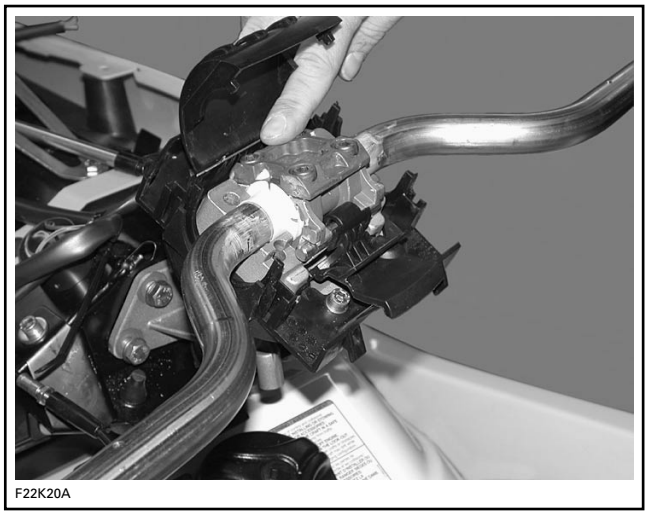
Position compress spring **no. 21**.



Install pin **no. 23**. Hold latch lever depressed.



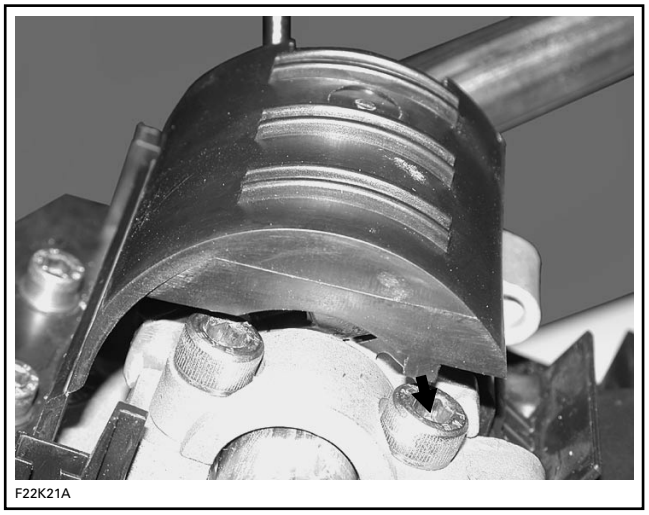
Install handlebar on steering support then upper clamps **no. 18**. Position pin **no. 23** into slots of blocks **no. 20**.



Using synthetic grease (P/N 293 550 010) lubricate pin **no. 23** and the notches on blocks **no. 20**.

Position handlebar vertically then torque screws **no. 17** in a criss-cross sequence.

Snap cover of steering padding support **no. 16** on screw heads.


F22K21A

Ensure handlebar adjuster works adequately.

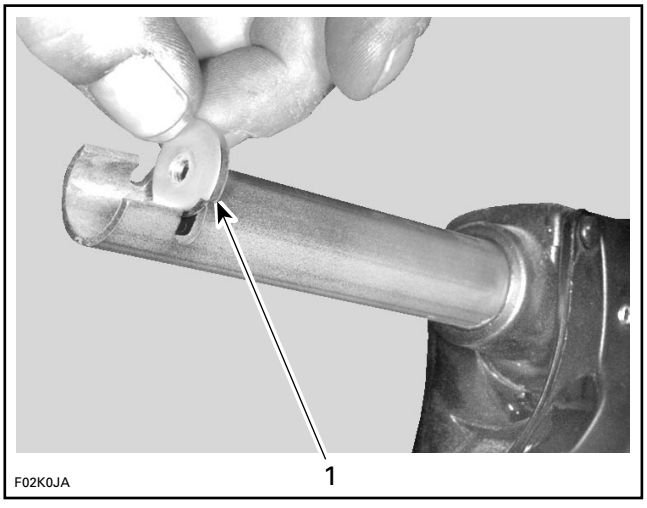
Secure steering cable ball joint **no. 31** to stem arm lever.

CAUTION: Ensure the ball joint is parallel to the stem arm within ±10°.

Properly install remaining components.

Handle Grip and Grip Insert

When installing the grip insert **no. 9** in the handlebar **no. 1**, ensure that it is properly inserted in the slot at the end of the handlebar tubing.



F02K0JA

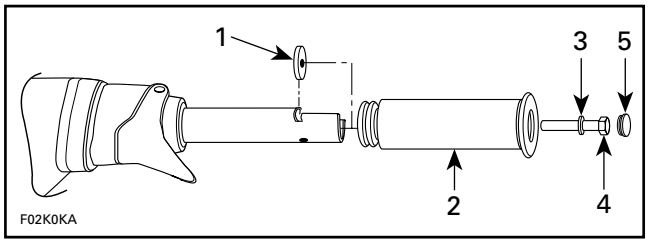
TYPICAL
1. Grip insert

Install grip **no. 6** on handlebar **no. 1** matching it to the notch in the handlebar.

Install flat washer and screw **no. 8**.

Torque screw to 7 N•m (62 lbf•**in**).

Install cap **no. 7**.



F02K0KA

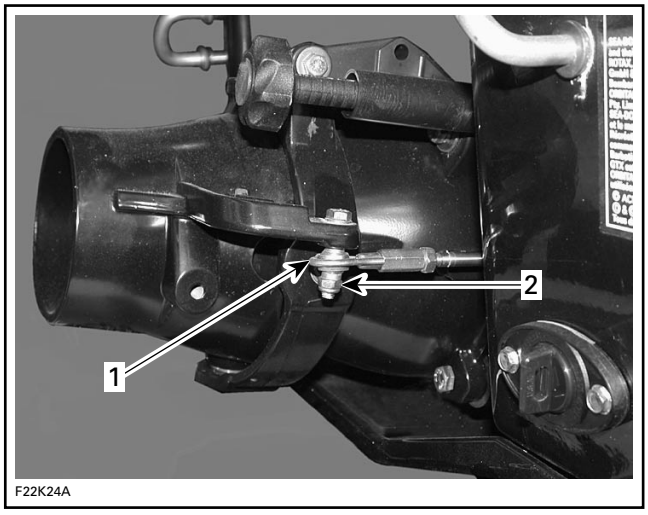
TYPICAL
1. Grip insert
2. Grip
3. Flat washer
*4. Screw. Torque to 7 N•m (62 lbf•**in**)*
5. Cap

CAUTION: Ensure to install flat washer otherwise screw will damage grip end.

Ball Joint

Secure the steering cable ball joint **no. 33** to the nozzle as per following illustration.

CAUTION: Ensure the ball joint is parallel to the nozzle arm within ±10°.



F22K24A

1. Ball joint below steering arm
*2. Torque nut to 7 N•m (62 lbf•**in**)*

Finalizing the Assembly

Install remaining components.

Ensure steering works adequately.

Ensure throttle cable works adequately in all handlebar adjustment position and in all steering pole position.

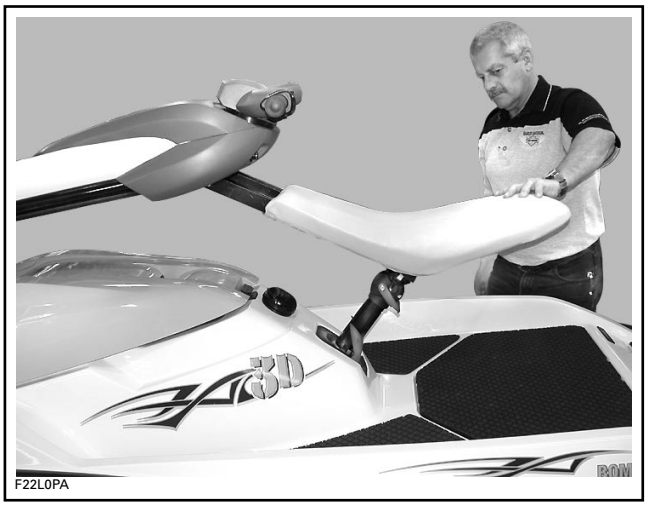
Perform throttle cable adjustment. Refer to ENGINE MANAGEMENT.

Ensure moto seat works and locks adequately (if so equipped).

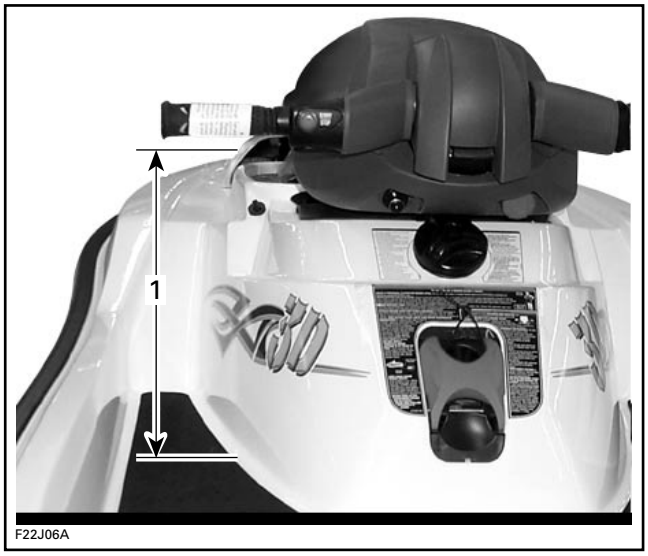
Perform steering alignment.

STEERING ALIGNMENT

Alignment is to be performed when moto seat is deployed and installed or with the steering resting on the engine cover; so it will not move during the procedure.

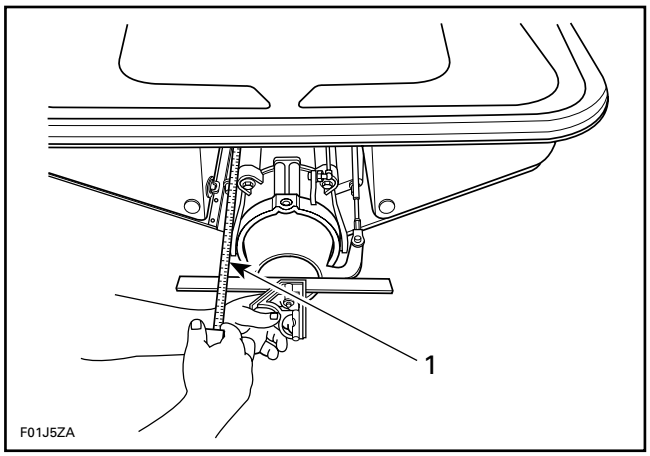


Position handlebar in straight ahead position by measuring each side the distance from handlebar grip end to floorboard.



1. Measuring handlebar grip end/floorboard distance

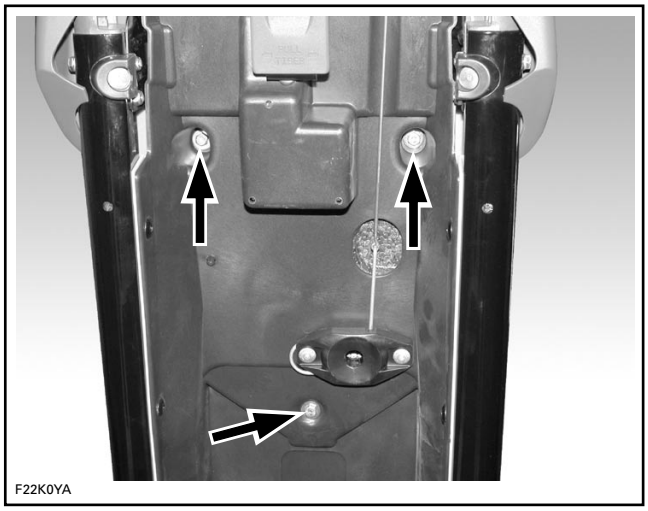
Check jet pump nozzle position by placing a straight edge on nozzle outer end. Measure the distance on each side of the straight edge. It must be equalled.



TYPICAL
1. Measure the distance on each side of the straight edge

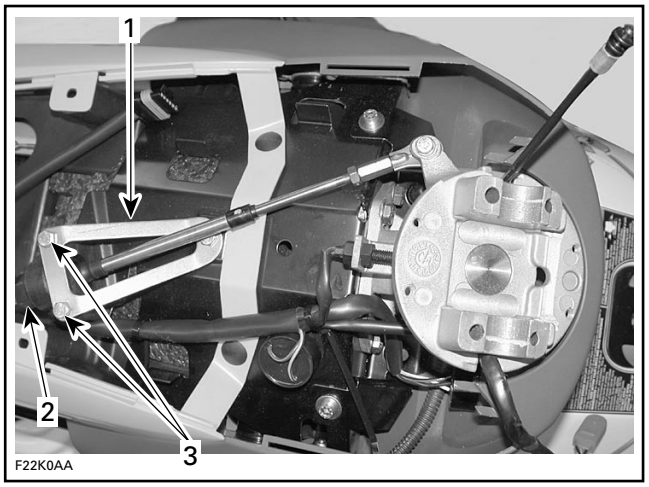
If necessary, steering alignment adjustment should be performed at steering cable support.

Remove top cover.



Loosen 2 bolts retaining block at cable support.

Turn adjustment nut as required.



1. Support
2. Adjustment nut
3. Loosen bolts

After adjustment, torque retaining block bolts to 5 N•m (44 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.

Reinstall top cover.

OFF-POWER ASSISTED STEERING (O.P.A.S.)

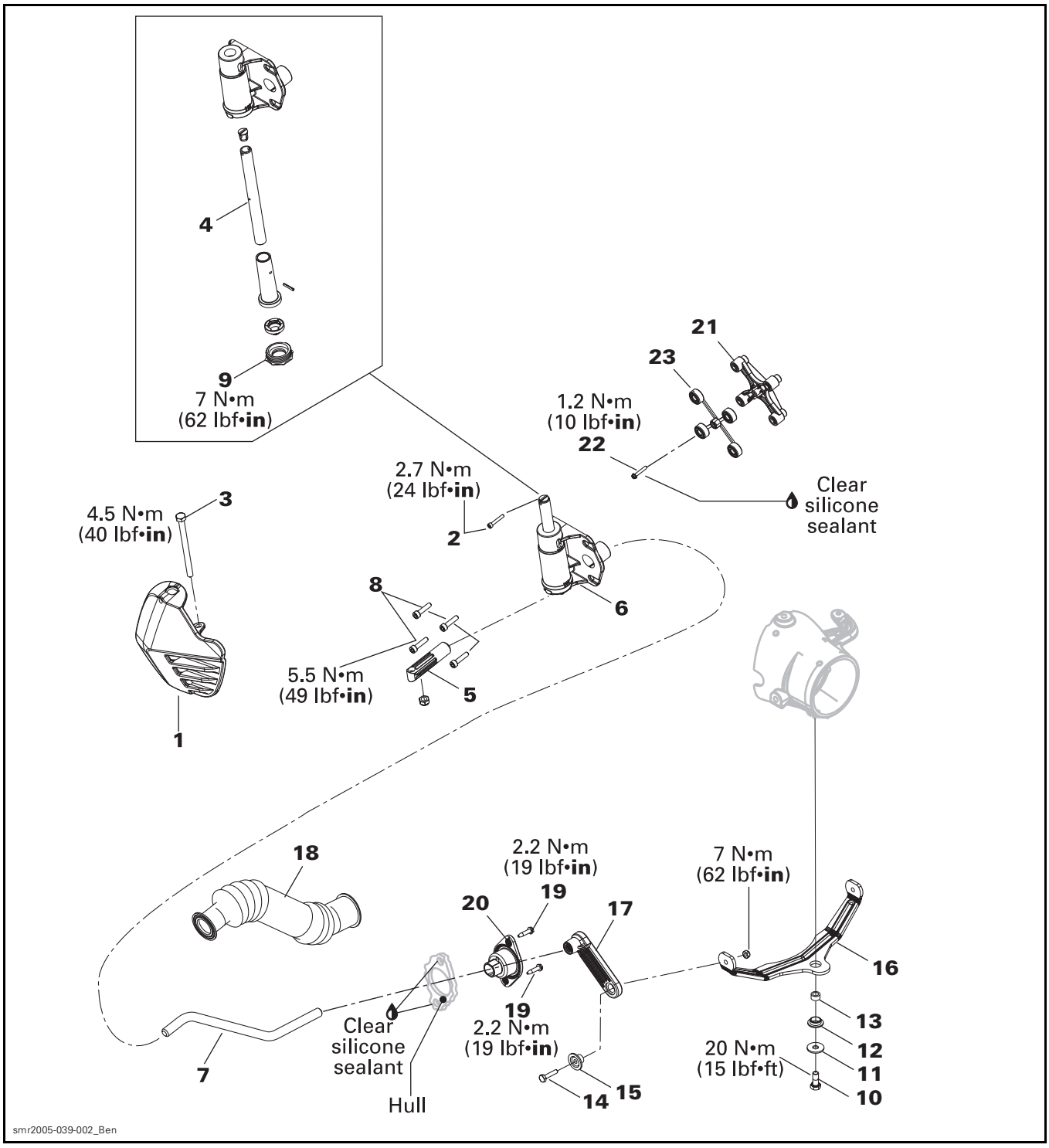
SERVICE TOOLS

Description	Part Number	Page
O.P.A.S. cylinder nut wrench	529 035 840	308

SERVICE PRODUCTS

Description	Part Number	Page
silicone sealant (clear)	293 800 086	309–310

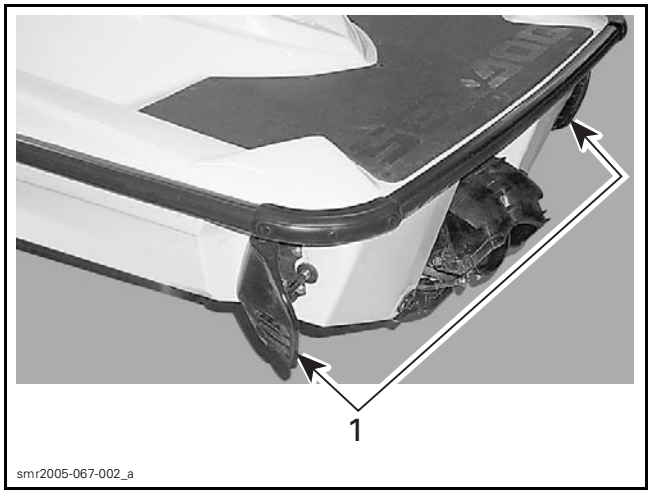
GTI Models



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.



1. Side vanes turn following steering movement

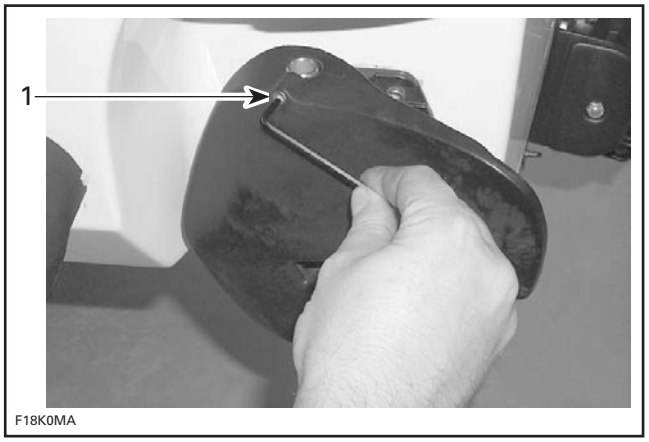
PROCEDURES

Side Vane

Removal

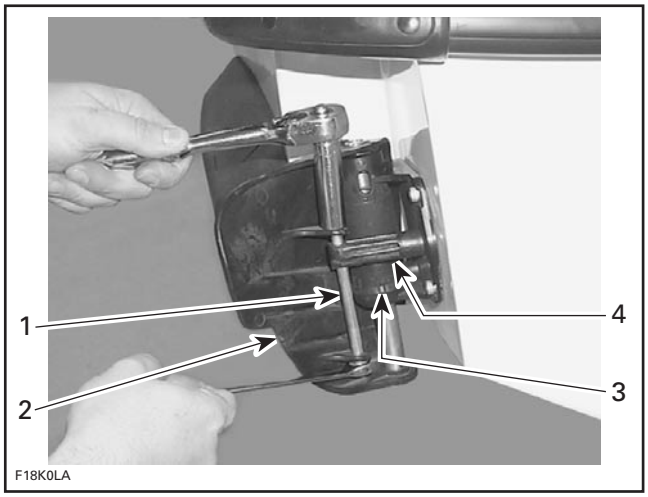
Removal procedure for RH and LH side vane **no. 1** is same.

Remove socket screw **no. 2**.



TYPICAL
1. Socket screw

Remove the tie-rod screw **no. 3**.



TYPICAL
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.

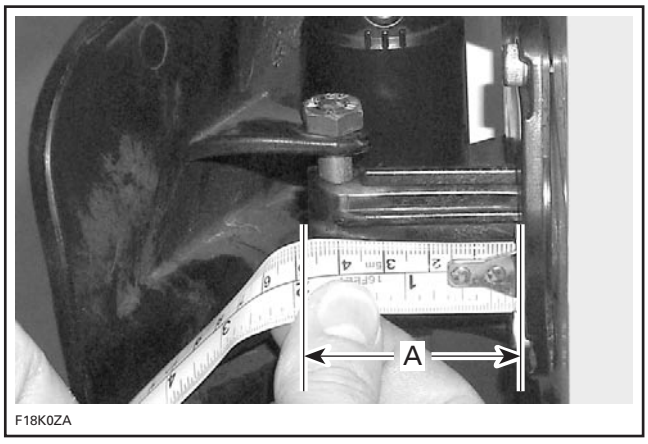
Adjustment

During tie-rod fitting adjustment, tie-rod screw **no. 3** must be loosed 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 ± .04 in).



A. 45 ± 1 mm (1.65 ± .04 in)

To adjust the tie-rod, remove tie-rod screw **no. 3** and turn tie-rod fitting **no. 5**. Place tie-rod screw in its place and measure again. Repeat the procedure until the distance is reached.

When the adjustment is done, torque the tie-rod screw to 4.5 N•m (40 lbf•**in**).

Install socket screw **no. 2** and torque it to 2.7 N•m (24 lbf•**in**).

NOTE: The socket screw **no. 2** should be turned 2 - 3 turns before using a tool.

Installation

Installation is the reverse process of removal.

Install the tie-rod screw **no. 3**. Do not torque yet.

Perform the tie-rod fitting adjustment. See above.

Cylinder Support

Removal

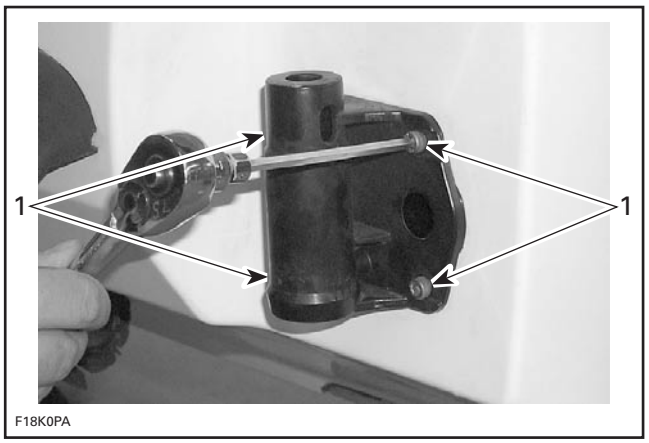
Removal procedure for RH and LH cylinder support assembly is same.

Remove side vane as mentioned above.

NOTE: To disassemble the cylinder, it is not required to remove it from vehicle. See DISASSEMBLY AND ASSEMBLY procedure.

Unscrew tie rod fitting **no. 5** from tie rod **no. 7**.

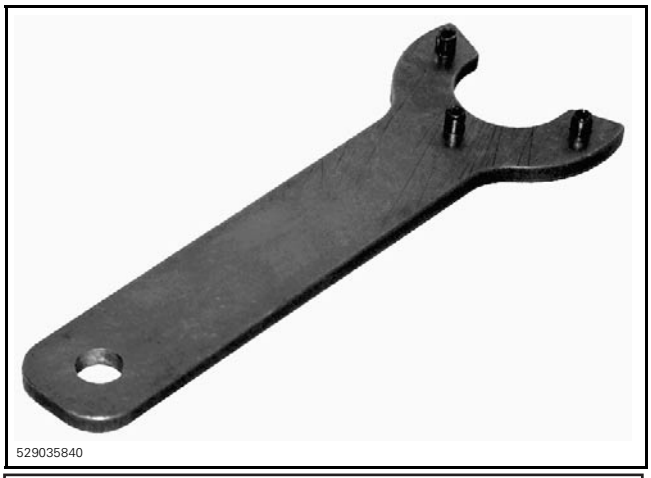
Unscrew 4 socket screws **no. 8**. Discard them.

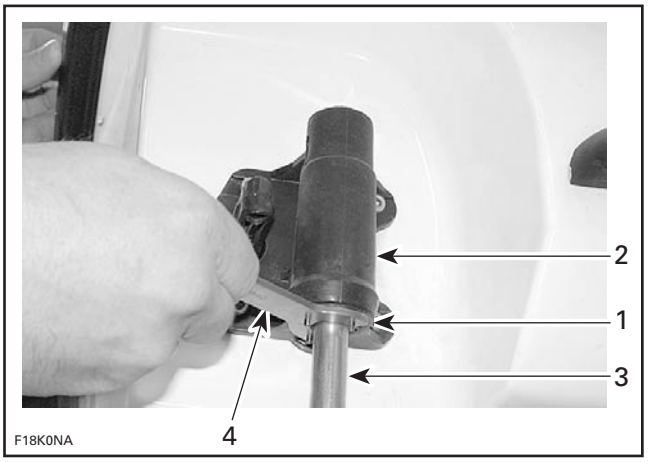


1. Socket screws

Disassembly and Assembly

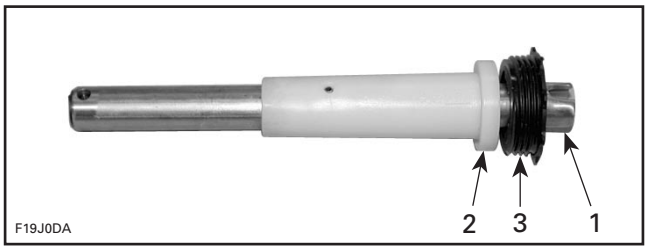
Unscrew cylinder cap **no. 9** using the O.P.A.S. cylinder nut wrench (P/N 529 035 840).





1. Cylinder cap
2. Cylinder support
3. Pivot rod
4. O.P.A.S. cylinder nut wrench

Remove cylinder assembly out of cylinder support.



1. Pivot rod
2. Spacer
3. Cylinder cap assembly

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 details.

Perform the tie-rod adjustment. See above.

Tie Rod

Removal

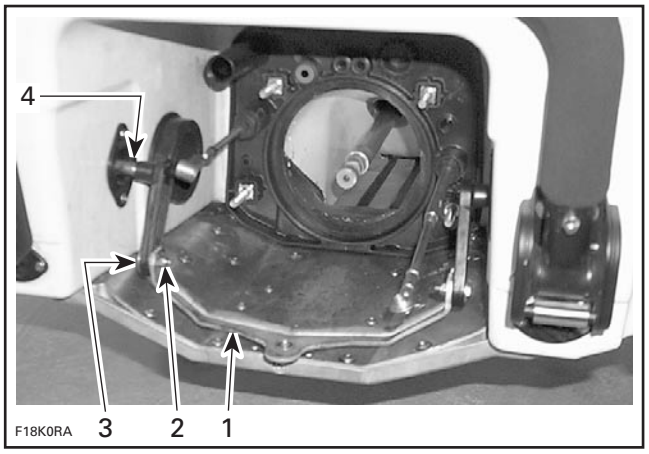
Removal procedure for RH and LH tie rod **no. 7** is same.

Remove side vane **no. 1** and cylinder support **no. 6** as mentioned above.

Remove O.P.A.S. "U" lever screw **no. 10**, flat washer **no. 11**, bushing **no. 12** and venturi bushing **no. 13** from nozzle.

Remove jet pump (refer to JET PUMP).

Remove screw **no. 14** and washers **no. 15** to remove "U" lever **no. 16** from tie rod connecting levers **no. 17**.



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. 18**.

Unscrew lever from the tie rod.

Installation

Installation is the reverse process of removal.

Torque screw **no. 14** to 7 N•m (62 lbf•**in**).

Torque O.P.A.S. "U" lever screw **no. 10** to 20 N•m (15 lbf•ft).

Sealed Tube

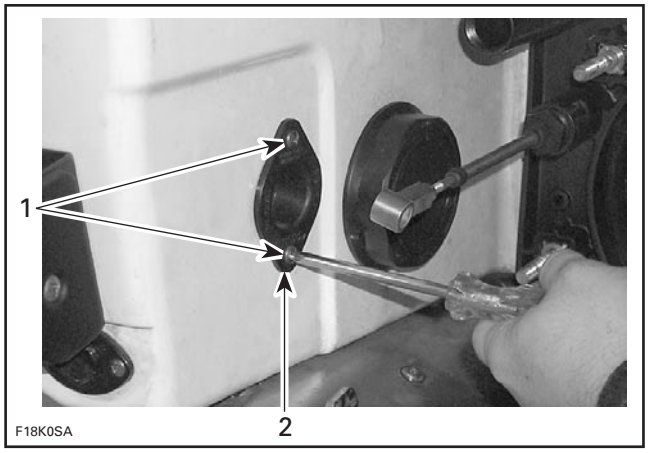
Removal

Removal procedure for RH and LH sealed tube **no. 18** is the same.

Remove side vane **no. 1**, cylinder housing **no. 6** and O.P.A.S. "U" lever **no. 16** as mentioned above.

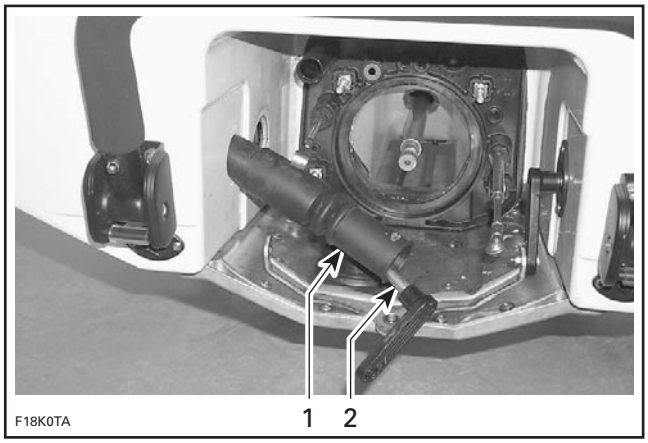
Remove jet pump (refer to JET PUMP).

Remove Phillips screws **no. 19** and remove rod grommet **no. 20**.



TYPICAL
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. 19** to 2.2 N•m (19 lbf•**in**).

Cross Support Plate

For LH Side Cross Support Plate

Remove inlet hose, exhaust pipe and muffler (refer to EXHAUST SYSTEM).

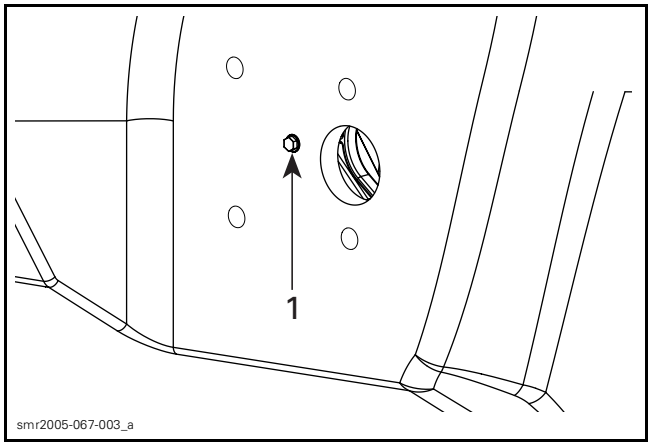
For RH Side Cross Support Plate

Remove resonator (refer to EXHAUST SYSTEM).

Removal

Remove side vane **no. 1** and cylinder support **no. 6** as mentioned above.

Unscrew the screw **no. 22** retaining cross support plate **no. 21** to hull.



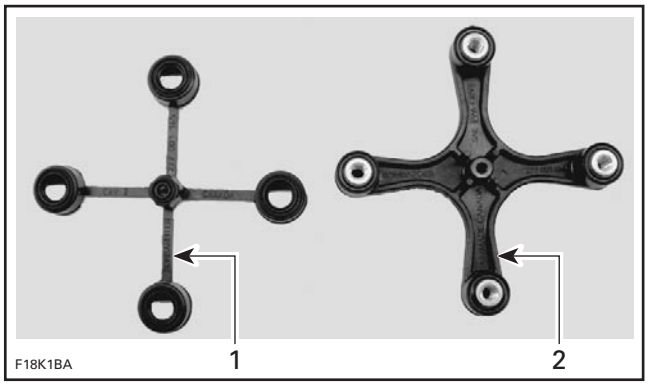
1. Remove screw

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. 23** before installation, change if necessary.

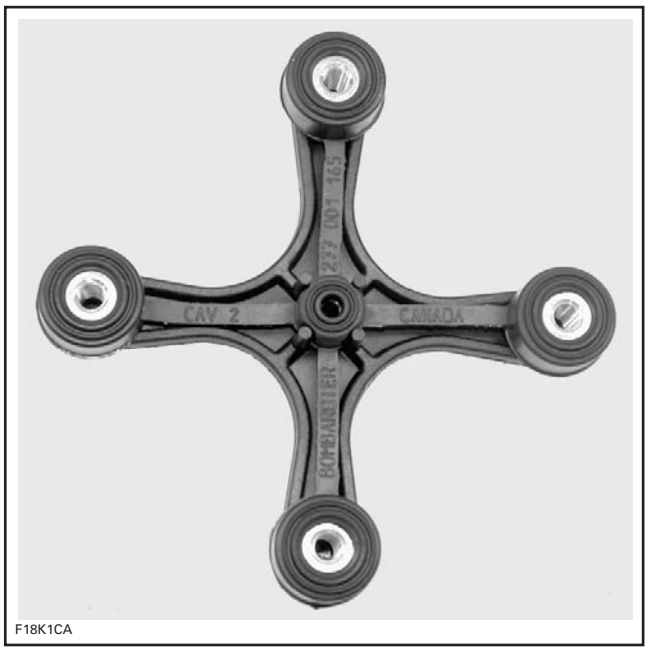


1. Gasket
2. Support plate

Installation

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

Inside the bilge, install the cross support plate. Place the gasket against the hull then align the holes.

Apply silicone sealant (clear) (P/N 293 800 086) in hole of screw **no. 22** then torque screw to 1.2 N•m (10 lbf•**in**).

OFF-THROTTLE ASSISTED STEERING (O.T.A.S.)

SERVICE TOOLS

Description	Part Number	Page
digital tachometer	529 014 500	311
multimeter FLUKE 111	529 035 868	312
Vehicle Communication Kit (VCK)	529 035 981	313

GENERAL

The O.T.A.S. (Off-Throttle Assisted Steering) system provides additional maneuverability in off-throttle situations. The O.T.A.S. system is electronically activated and slightly increases engine speed under a pre-programmed RPM when the driver initiates a full turn. When handlebar is brought back to its center position, the throttle reverts to idle.

Required Conditions to Activate the System

- The engine speed must be above 4000 RPM.
- The throttle lever must be released quickly and completely.
- The handlebar must be fully turned immediately after throttle release.

TESTING PROCEDURES

Dynamic Test

This test is to be performed with the watercraft in the water (regular riding or jet pump in water with watercraft attached on a trailer and using the digital tachometer (P/N 529 014 500)).

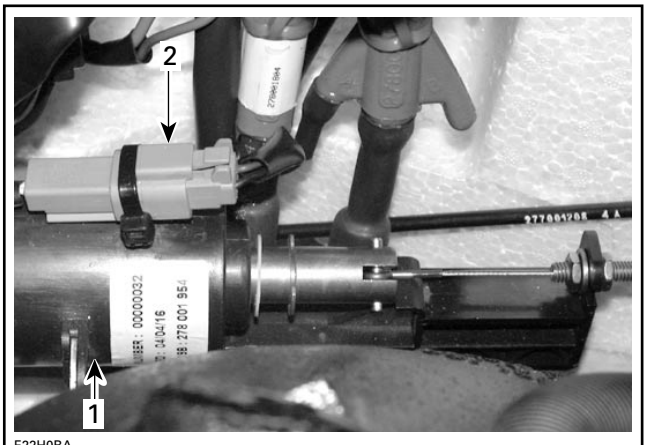
– Make sure the path ahead is clear.
– Raise engine RPM higher than 4000 RPM for more than 1 second.
– Release throttle while steering is in the straight ahead position.
– Within 1 to 3 seconds, turn handlebar all the way to one side.
– The O.T.A.S. should come on for 1/2 second and increase engine RPM within 2900 to 3900.
– If steering is kept in this position, the O.T.A.S. will come on again every 2 seconds.
– Turn handlebar to other side quickly (within 1/2 second).
– The O.T.A.S. should still be active and come on every 2 seconds.

If the RPM is not within the specified range, perform the O.T.A.S. CABLE ADJUSTMENT as described further in this section.

If the RPM does not change, perform the STEERING POSITION SWITCH tests. See below.

Solenoid

Unplug connector close to solenoid.

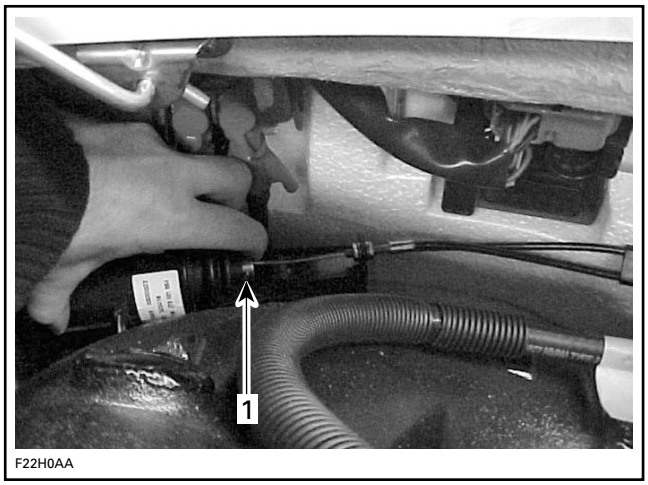


F22H0BA

1. O.T.A.S. solenoid beside VCM
2. Solenoid connector

Connect temporary jumper wires to the solenoid connector using wires long enough to go outside bilge.

Apply 12 V to the jumper wires. Solenoid should pull on the throttle cable and hold it. Also try to push on solenoid rod to make sure it is fully collapsed.



1. Pushing on solenoid rod

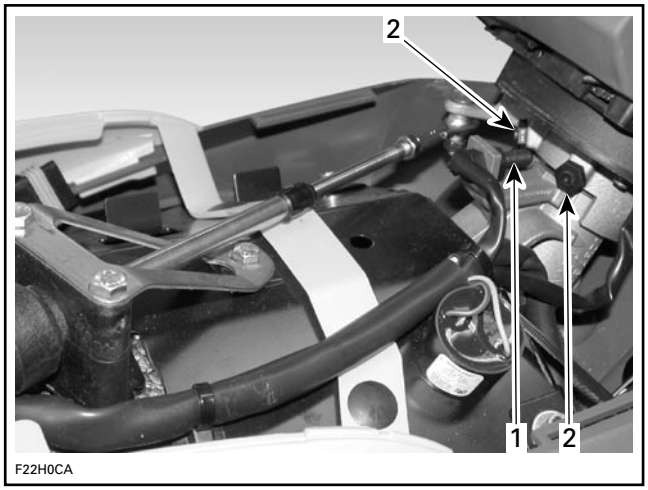
If solenoid fails any test, replace solenoid.

⚠ WARNING

Whenever solenoid is replaced, ensure to perform throttle cable adjustment at the solenoid.

If solenoid tests good, proceed with the sensor test.

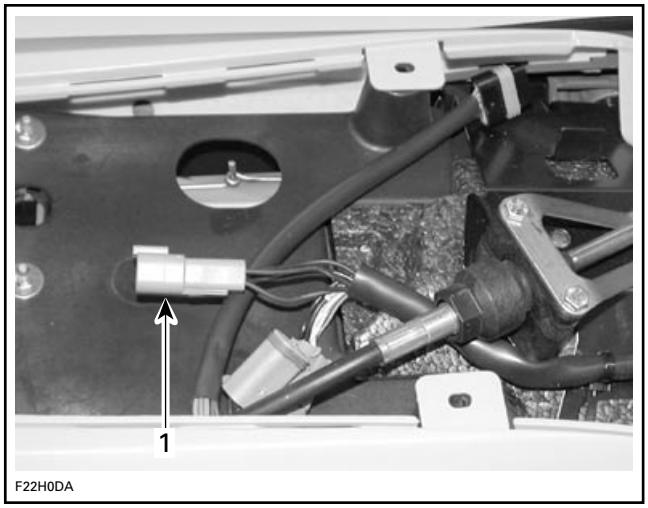
Steering Position Switch



1. Steering position switch
2. Magnet

Remove steering pole cover. Refer to BODY section.

Disconnect the switch 4-pin connector.



1. 4-pin connector

Perform the following tests for left and right sides.

Using the multimeter FLUKE 111 (P/N 529 035 868), measure the resistance between the BLACK/WHITE and BLACK wires of switch while steering is roughly at its center position.

Resistance should be between 446.5 and 493.5 Ω. Otherwise, check wiring harness and if good, replace switch.

Turn steering until it is blocked by its stopper. Keep steering in this position.

Resistance should be 82 Ω.

Otherwise, try any magnet and bring it in front of the switch. If resistance is now good, replace magnet.

If both resistance tests are good, check wiring harness and if good, try a new VCM.

Reinstall steering pole cover.

ADJUSTMENT

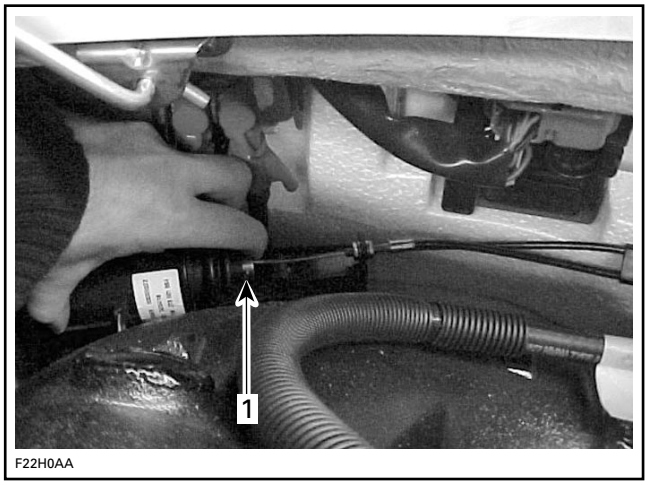
O.T.A.S. Cable

⚠ WARNING

Whenever solenoid or throttle cable has been replaced, ensure to perform the O.T.A.S cable adjustment. Strictly follow the described procedure.

The procedure consists of manually pushing the solenoid rod (which pulls the throttle cable and activates the throttle plate) while reading the TPS opening or resistance value depending on the tool used.

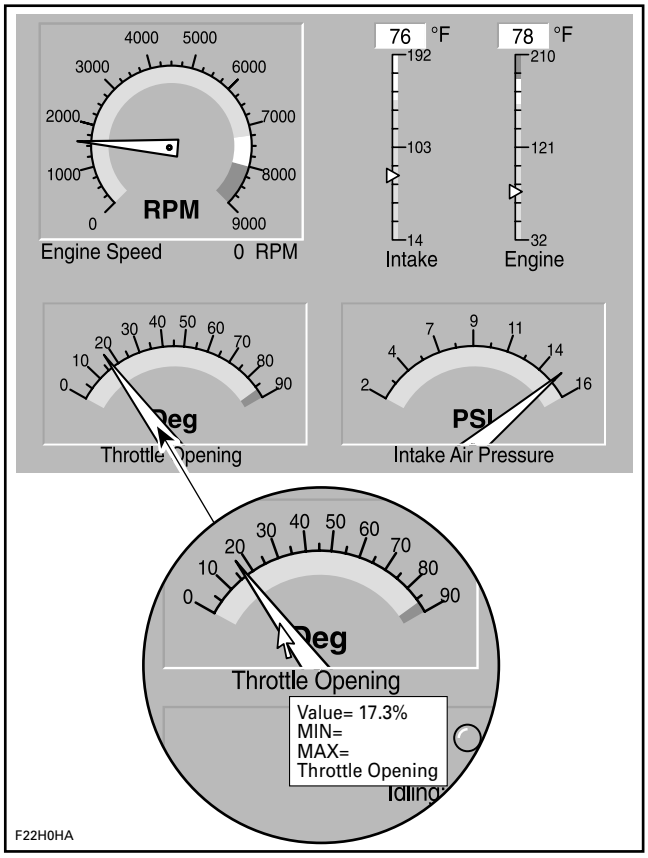
Fully push the solenoid rod in and HOLD (simulating the electrical activation) while reading the value.



1. Push and HOLD solenoid rod

Use B.U.D.S. with the Vehicle Communication Kit (VCK) (P/N 529 035 981) and look in **Throttle Opening** under **Monitoring** tab.

Position and hold the mouse pointer over the needle of the throttle opening to get the actual value. The value should be 17.3% +/-1. If not, adjust cable at solenoid bracket to get the value.



THROTTLE OPENING GAUGE IN BUDS

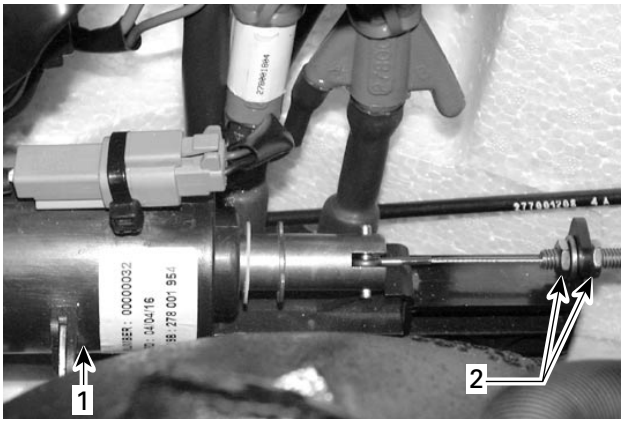
If B.U.D.S. is not available, resistance can be measured with an ohmmeter on wires going to the TPS.

Disconnect the AMP connector no. 4 from the VCM.

Measure and note resistance between pins 4 and 11 of TPS wiring while at the idle position.

Push in solenoid rod and HOLD. Measure resistance again.

Adjust cable at solenoid bracket to get an increased resistance value of 165 Ω.



F22H0BB

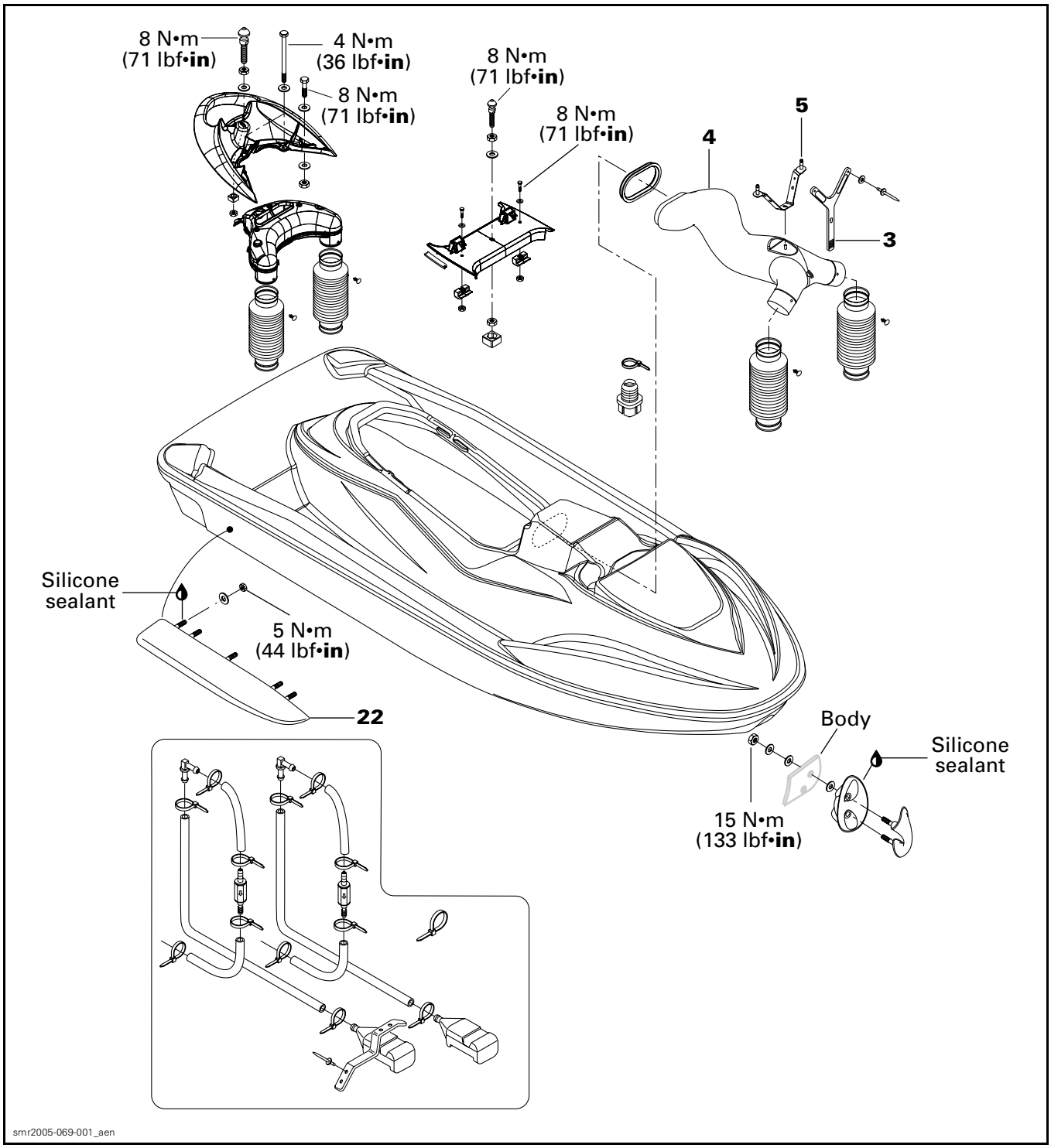
1. *O.T.A.S. solenoid*
2. *Adjust here*

GTI SERIES

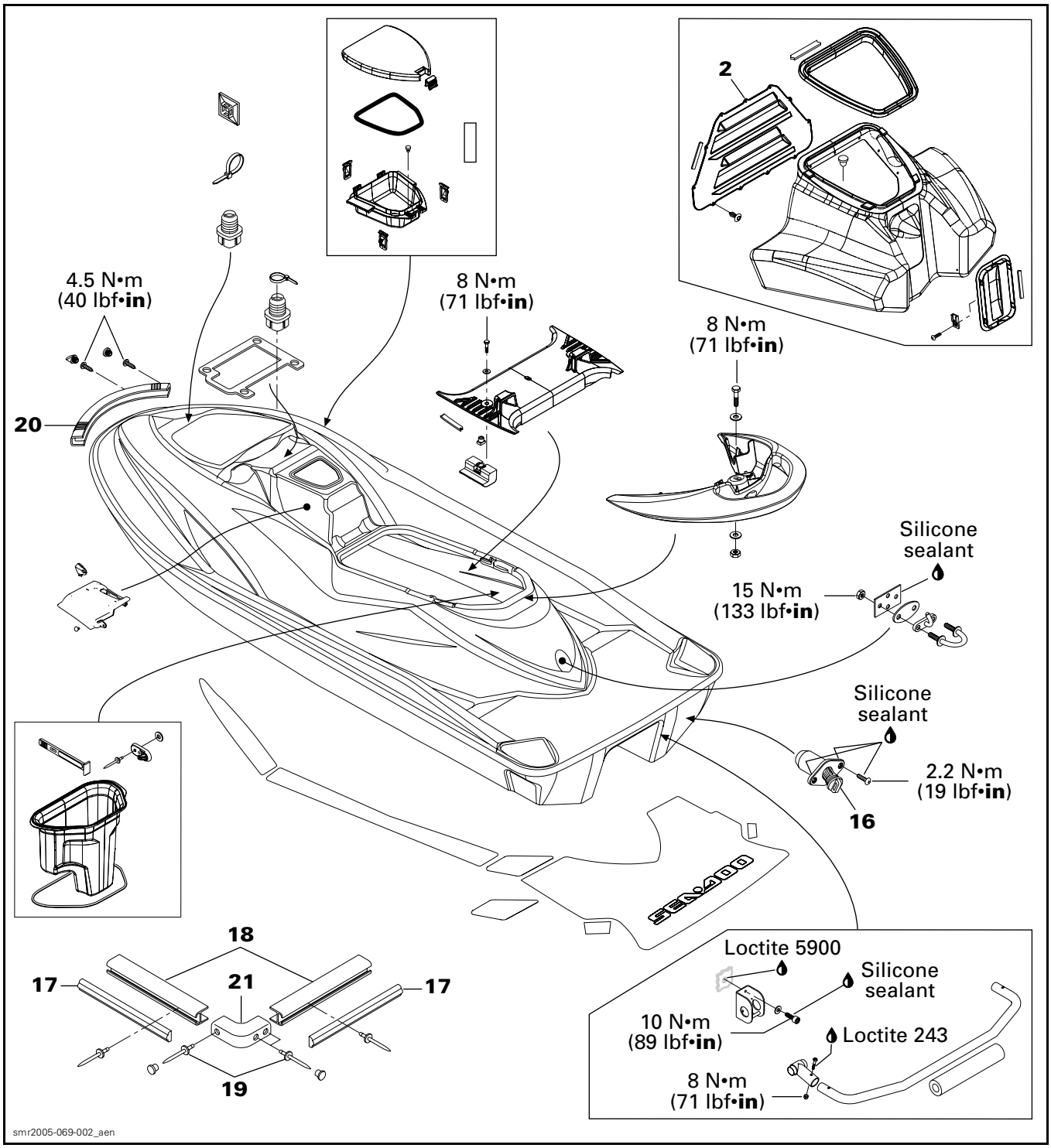
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	321, 323, 327
Loctite 271 (red)	293 800 005	324
Loctite 518	293 800 038	325
Loctite 5900	293 800 066	324–325
silicone sealant (clear)	293 800 086	326–327

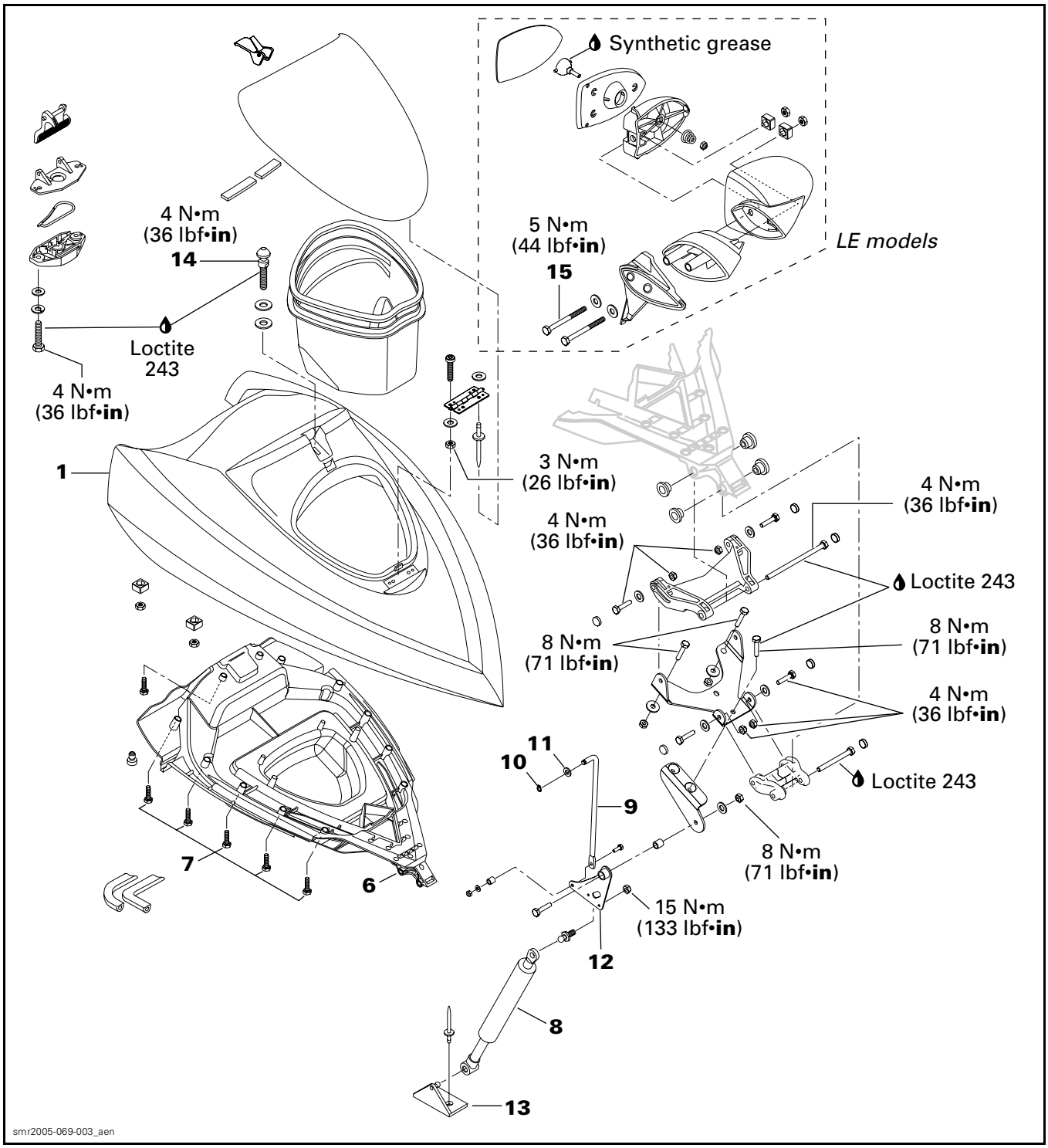
Bow



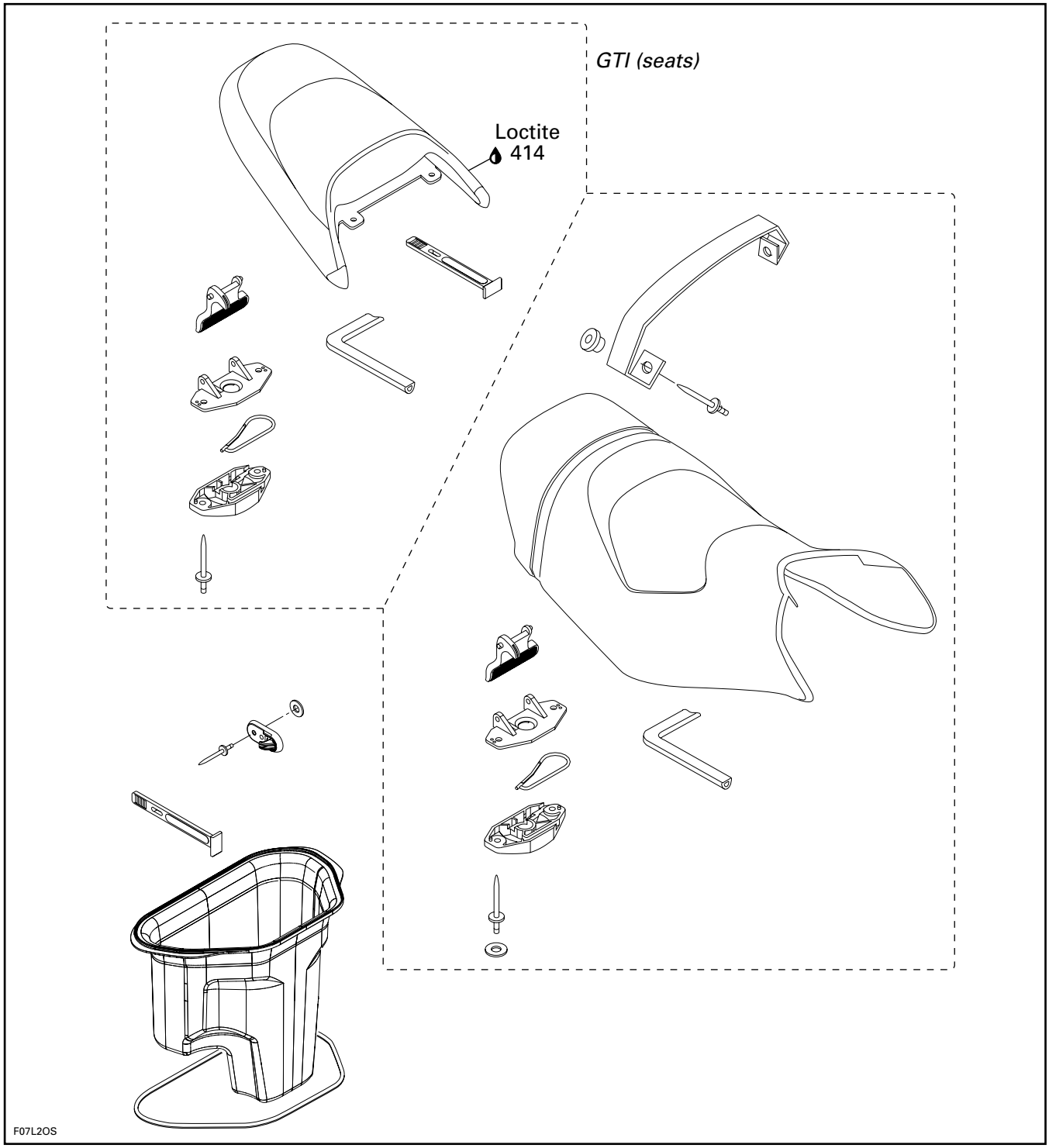
Body



Cover



Seats



GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

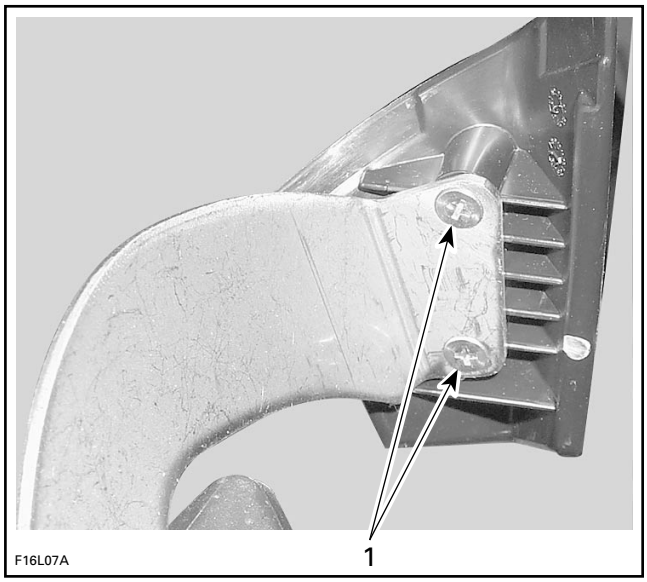
When applying threadlocker products, pay attention so that it does not come in contact with ABS plastic parts (painted parts). It could lead to plastic cracks or other damage.

PROCEDURES

GLOVE BOX

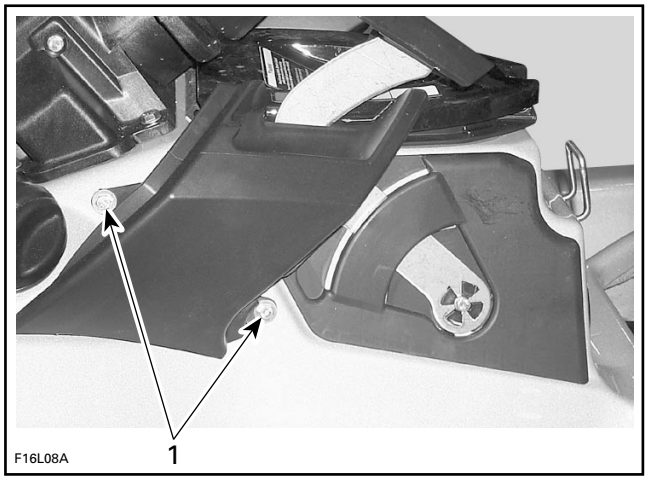
Removal

Remove handle from shift lever.



1. Unscrew

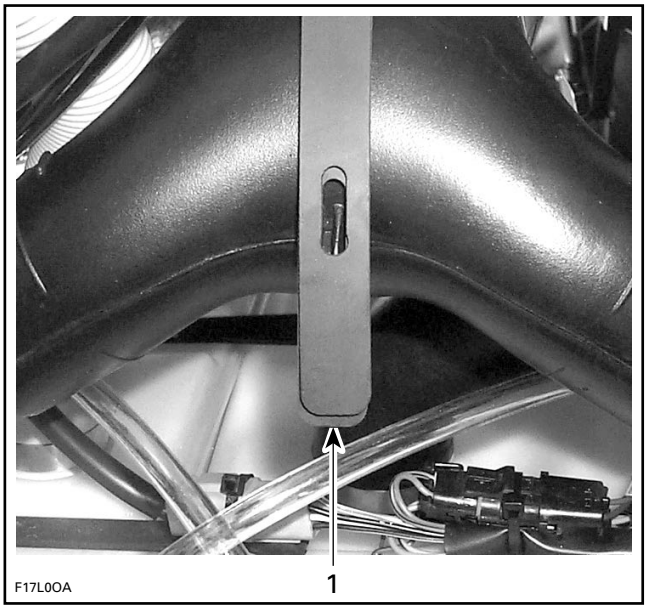
Remove darts and then remove side panels.



1. Unscrew the darts

Open front storage cover **no. 1** and remove the access panel **no. 2**.

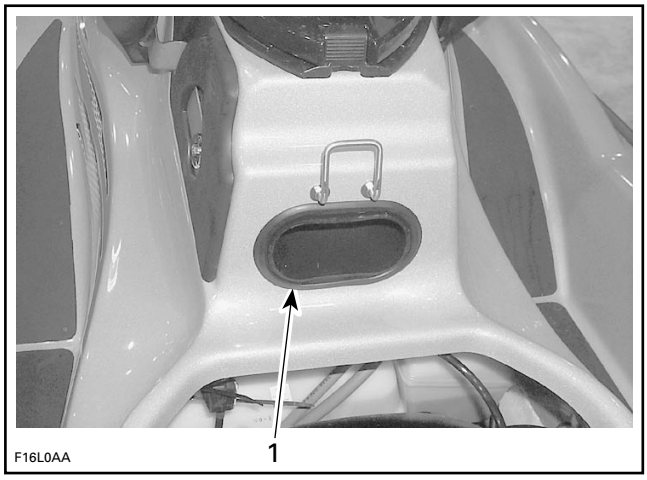
Detach the latch **no. 3** retaining vent tube **no. 4** to bracket **no. 5**.



1. Unlatch

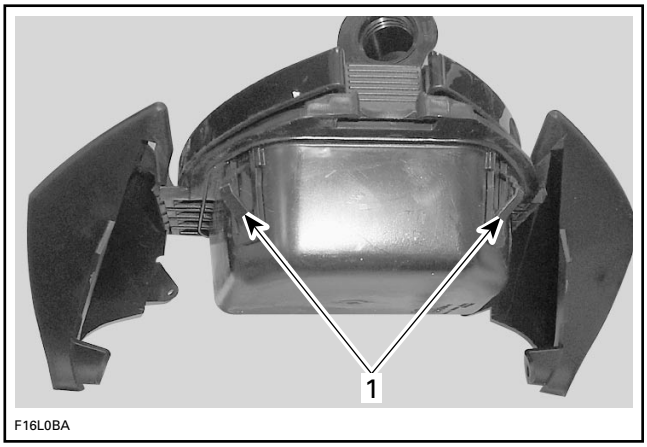
Pull vent tube out.

From the engine compartment, insert a hand through the vent tube hole and press glove box lock tabs to release.



1. Insert your hand here to release the lock tabs

From front storage compartment, pull glove box out.



1. Lock tabs

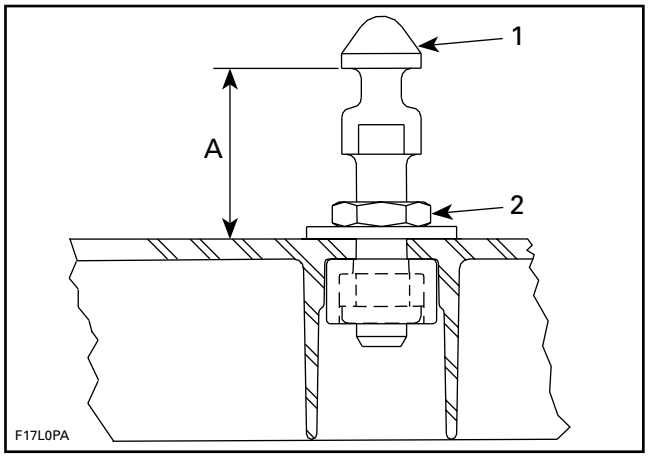
Installation

Reverse the removal procedure.

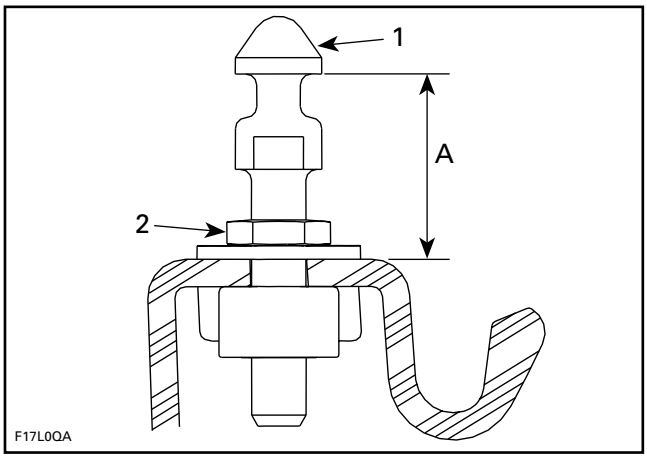
SEAT

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.



FRONT SEAT
1. Lock pin
*2. Adjustment nut (apply Loctite 243). Torque to 8 N•m (71 lbf•**in**)*
A. 34 ± 1 mm (1-11/32 ± 3/64 in)



REAR SEAT
1. Lock pin
*2. Adjustment nut (apply Loctite 243). Torque to 8 N•m (71 lbf•**in**)*
A. 34 ± 1 mm (1-11/32 ± 3/64 in)

STORAGE COMPARTMENT INNER SHELL

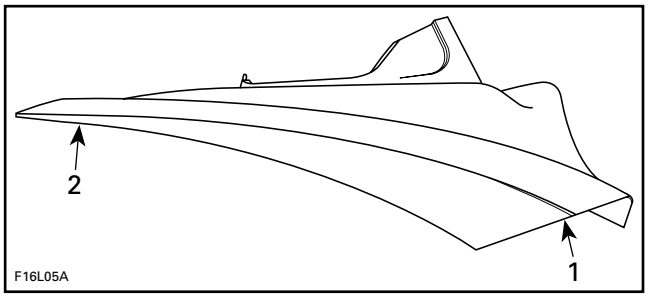
Removal

To remove inner shell **no. 6**, proceed as follows:

CAUTION: Failure to follow this order may lead to damaging inner plastic studs.

Remove retaining screws **no. 7**.

Gently pull on large end (rear end) and pull apart towards the small end (front). See illustration.

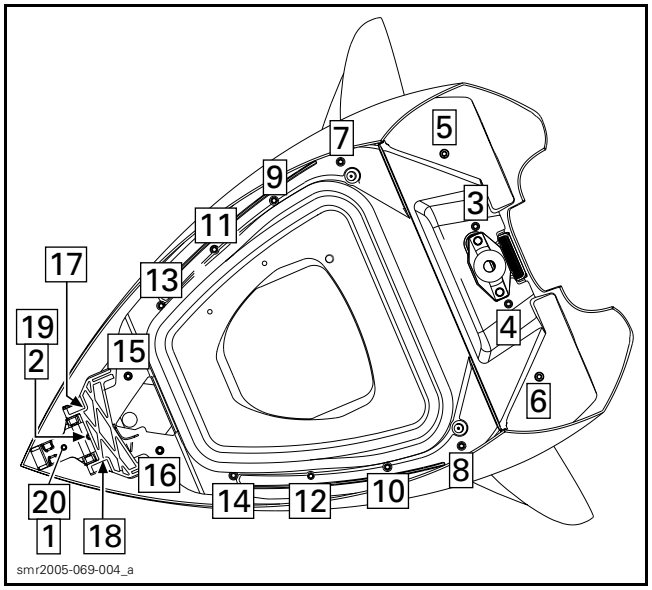


1. *Gently pull starting this end*
2. *Finish with this end*

Installation

For installation, proceed as follows:

- Reinstall inner shell with its retaining screws.
- Carefully hand tighten. Torque screws in accordance with the following sequence.



STORAGE COVER SHOCK

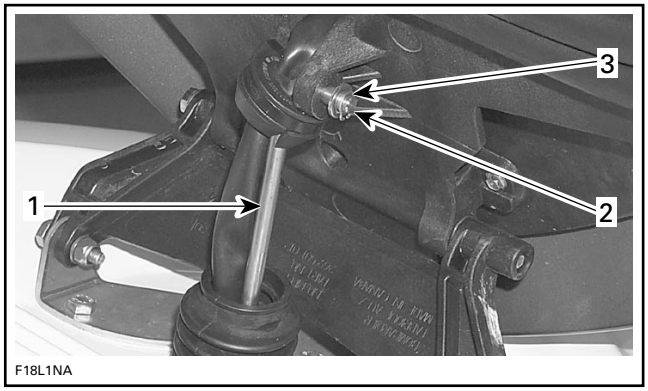
Removal

To remove storage cover shock **no. 8** proceed as follows:

⚠ WARNING

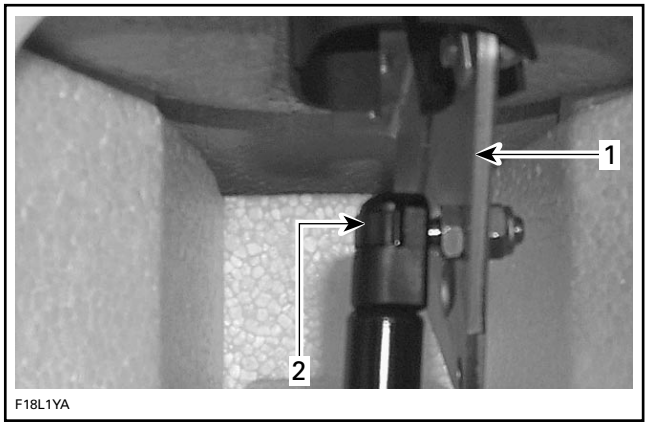
Make sure to have a 2 x 4 piece of wood around the work bench to support the storage cover while changing the cover shock.

– Unlock shock rod **no. 9** from circlip **no. 10** and remove washer **no. 11**.

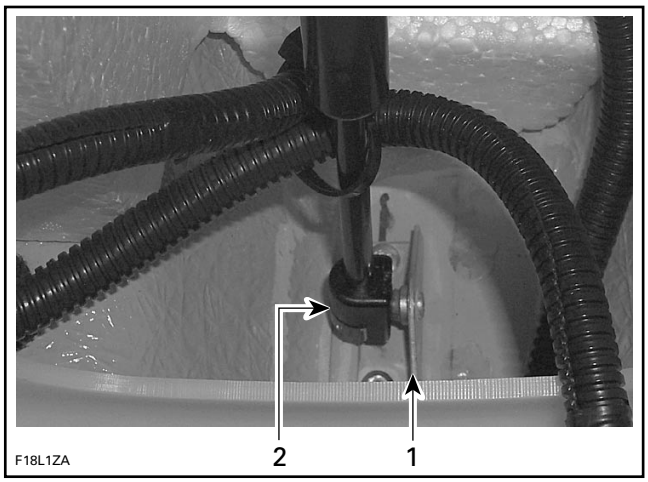


1. *Shock rod*
2. *Circlip*
3. *Washer*

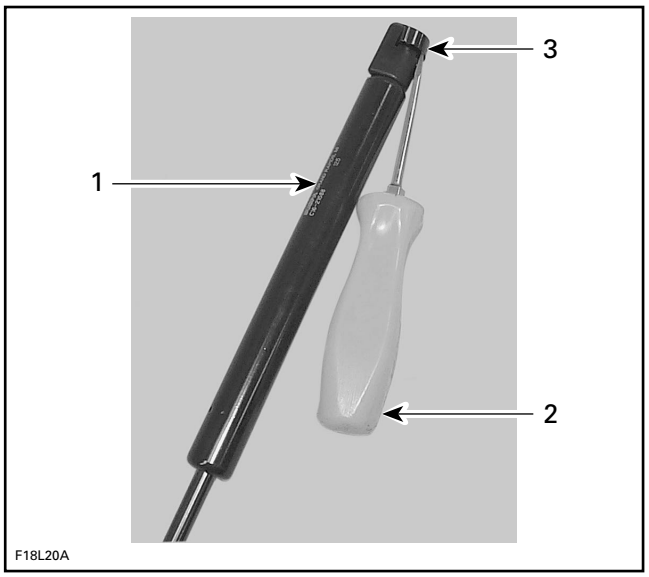
– Release the shock from top linkage bracket **no. 12** and bottom support bracket **no. 13** by inserting a flat screwdriver in the shock top and bottom locking devices.



1. *Top linkage bracket*
2. *Shock top locking device*



1. *Bottom support bracket*
2. *Shock bottom locking device*



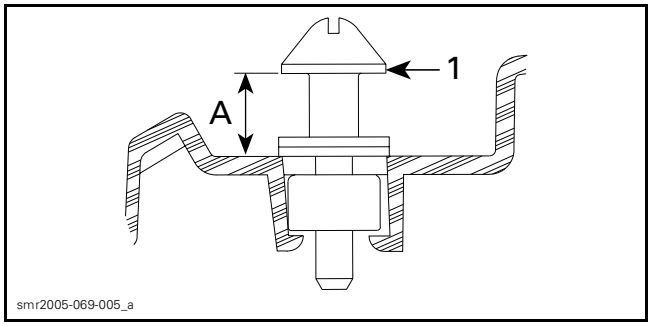
1. Shock absorber
2. Flat screwdriver
3. Shock top locking device

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 **no. 14** as per following specifications:



*1. Lock pin (apply Loctite 243). Torque to 4 N•m (36 lbf•**in**)*
A. 13.6 ± 1 mm (1-17/32 ± 3/64 in)

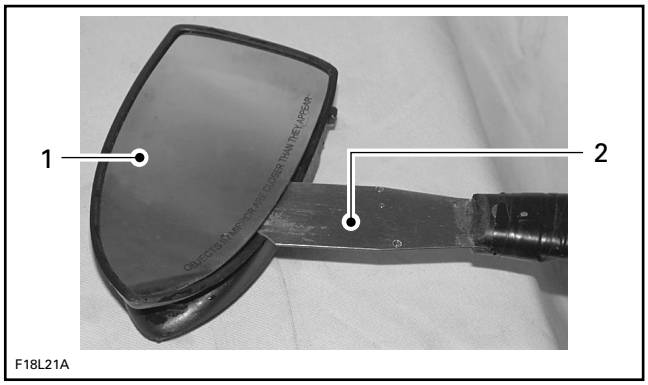
NOTE: Before torquing, move pin forward until it's rested against the body.

MIRROR

Removal and Installation

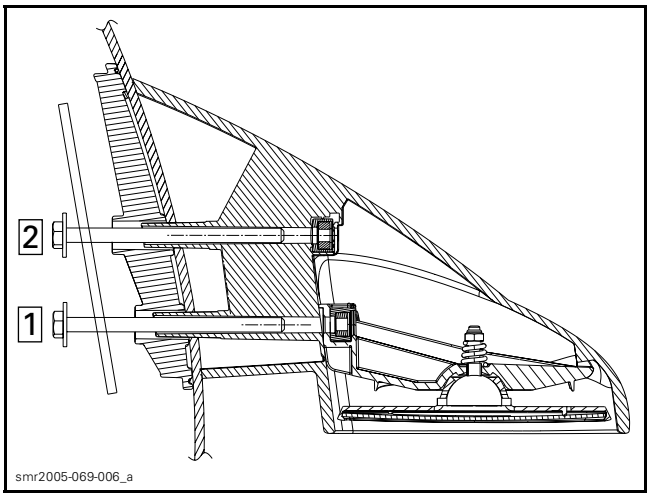
To remove mirror proceed as follows:

– Remove storage compartment inner shell **no. 6** from storage cover **no. 1** as described earlier in this section.
– Remove two hexagonal screws **no. 15** 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.
– Torque mirror screws to 5 N•m (44 lbf•**in**) as per following sequence.



– Reinstall storage compartment inner shell.

INLET GRATE

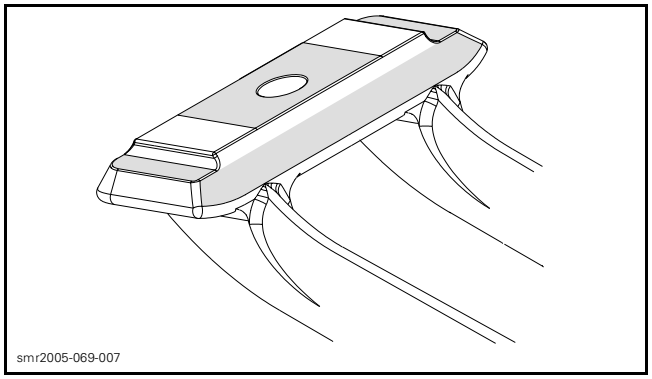
Removal and Installation

Loosen screws and remove inlet grate.

NOTE: An impact screwdriver should be used to loosen tight screws.

When reinstalling inlet grate, apply Loctite 271 (red) (P/N 293 800 005) on threads.

Apply Loctite 5900 (P/N 293 800 066) on the small part of inlet grate as indicated by the shaded areas in the next illustration.

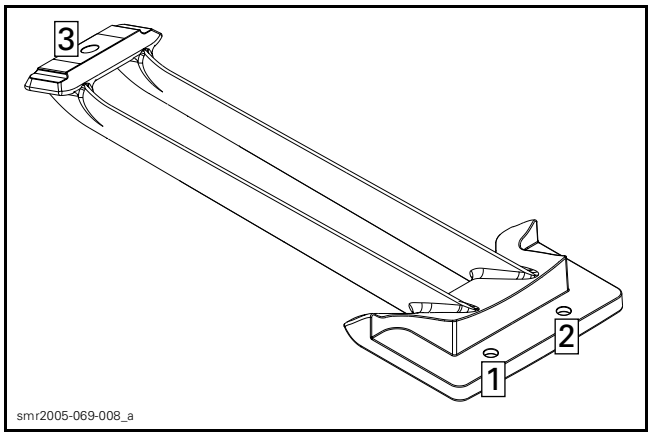


Follow this sequence referring to the illustration:

Hand tighten screws from 1 to 3.

Torque screws 1 and 2 to 11 N•m (97 lbf•**in**) then retorque the first screw.

Torque screw 3 to 26 N•m (19 lbf•ft).



RIDING PLATE

Removal

Remove inlet grate.

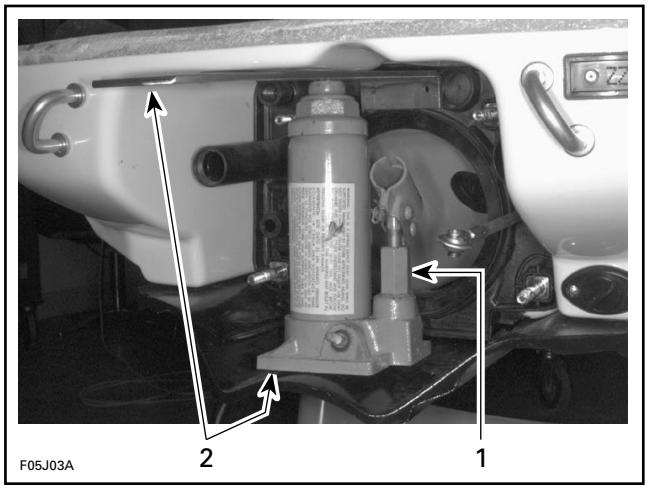
Remove jet pump. Refer to JET PUMP.

Remove the speed sensor from the riding plate (if applicable).

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

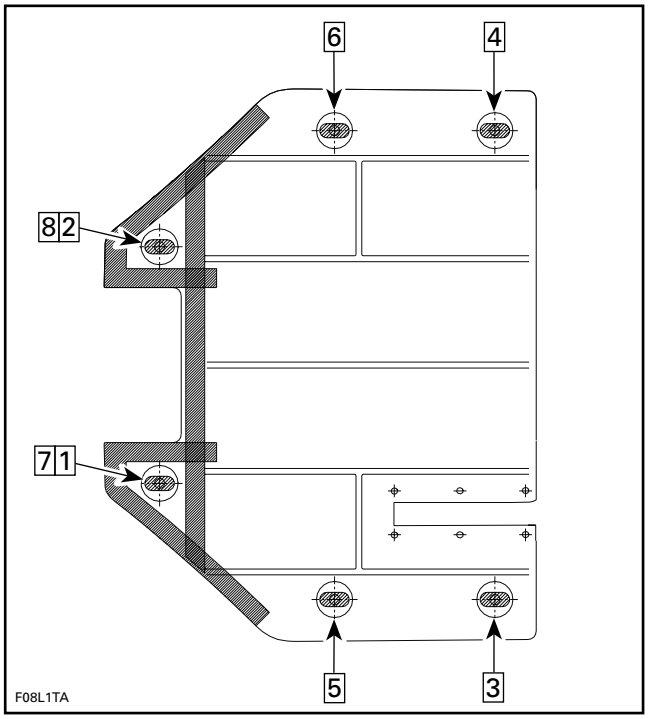
Cleaning

Scrape off all excess of sealant from riding plate and hull.

Clean hull surface with solvent to eliminate grease, dust and any residue of sealant. Clean fitting threads.

Installation

Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the next illustration. Follow also the torquing sequence as shown in the same illustration. Torque screws to 26 N•m (19 lbf•ft).



Install all removed parts.

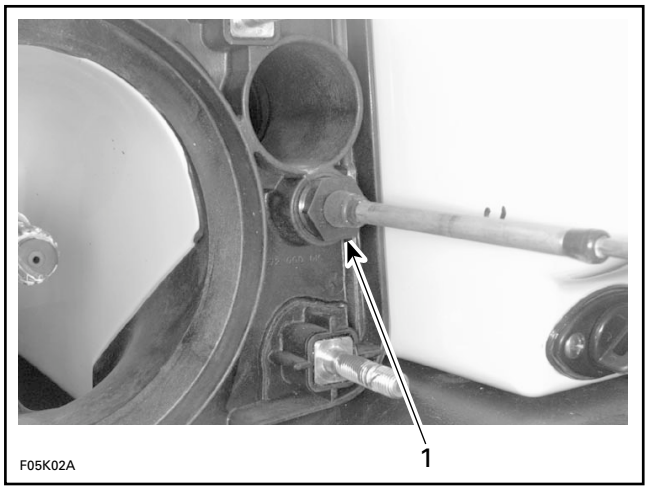
JET PUMP SUPPORT

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.

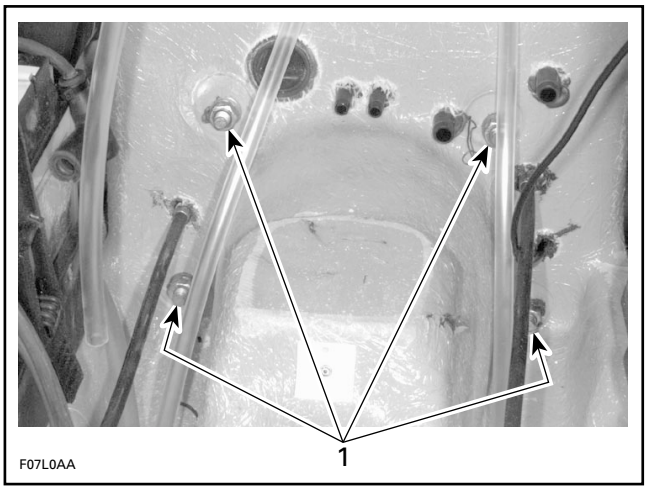


TYPICAL
1. Unscrew nut

Remove ball joint, boot, nut, half rings and O-rings from reverse cable.

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

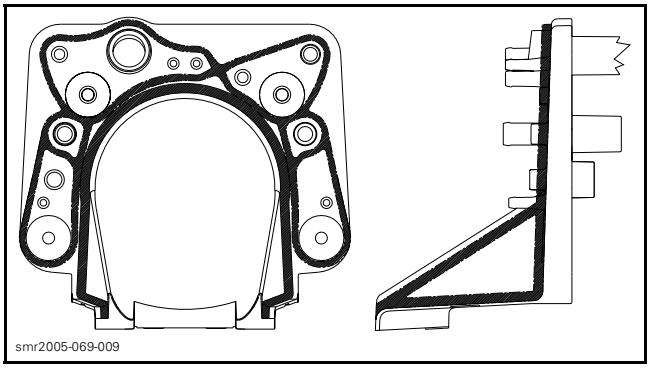
Using a heat gun, heat jet pump support until it is possible to pull it.

NOTE: Shims may have been installed between support and body. Do not remove these shims, otherwise jet pump alignment will be altered.

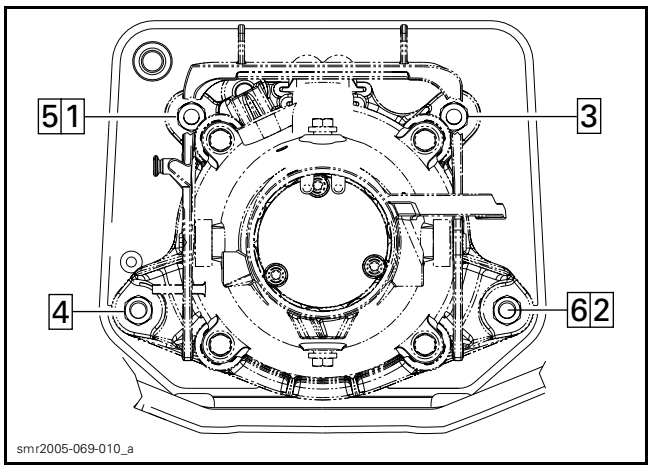
Installation

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.

Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the next illustrations.



Torque nuts to 31 N•m (23 lbf•ft) as per the following sequence.



DRAIN PLUG

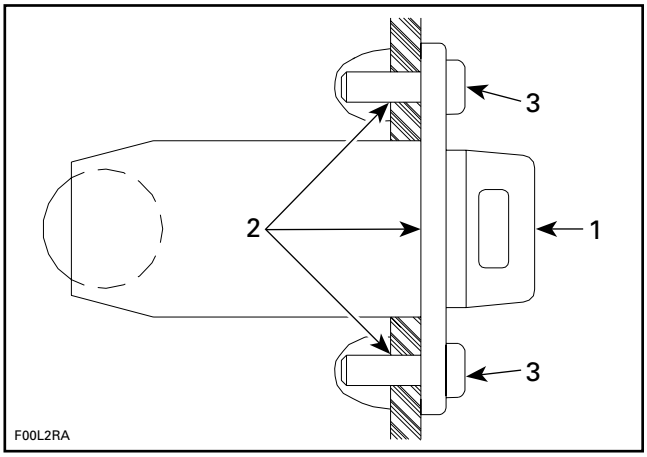
Installation

Before installation of drain plug **no. 16**, clean all residues of old silicone sealant on hull and on drain plug housing.

Apply silicone sealant (clear) (P/N 293 800 086) in the screw holes.

Torque screws to 2.2 N•m (19 lbf•**in**).

From inside of bilge, apply silicone sealant (clear) (P/N 293 800 086) around and on screws.



1. Drain plug
2. Silicone sealant
*3. Torque screws to 2.2 N•m (19 lbf•**in**)*

SEAT COVER

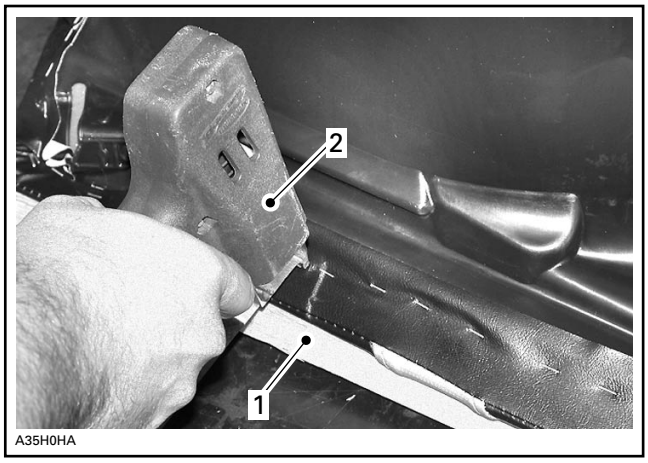
Replacement

Remove the old seat cover. Check the foam and replace it if necessary.

Install staples with an electric tacker such as Arrow tacker no. ETN-50 or with a manual tacker such as Arrow tacker no. T-50.

NOTE: For an easier installation, it's highly recommended to use an electric tacker.

Ensure that the seat rest firmly against a hard surface such as a piece of wood. This is done to get the staples completely pushed in place.



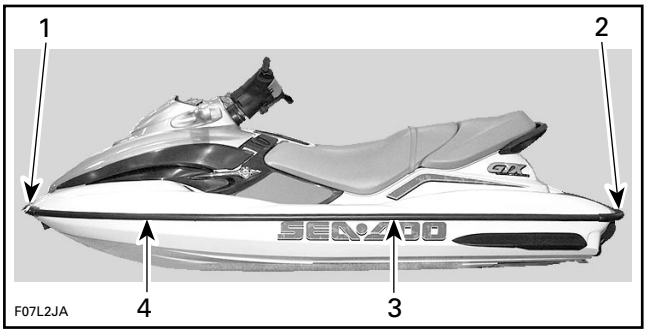
TYPICAL
1. Piece of wood
2. ETN-50 (electric) or T-50 (manual)

After cover installation cut all around the excess of material.

BUMPER

Removal and Installation

– Remove trim **no. 17** from side bumper rail **no. 18**.
– Drill pop rivets **no. 19** to remove side bumper rail **no. 18**.
– 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 **no. 18** under front bumper **no. 20**.
– Using a 4.80 mm (3/16 in) drill bit, drill first hole through bumper rail **no. 18** at front of bow section. Use locating mark as a guide. Then install a rivet **no. 19**.

CAUTION: When drilling, be careful not to damage bumper rail and/or hull.

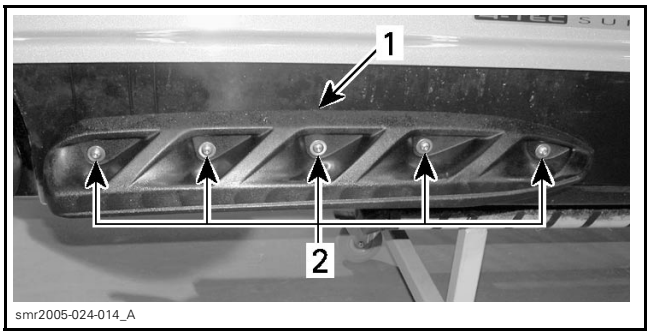
– Position bumper rail **no. 18** properly onto body and cut excess length if necessary.
– Slide bumper rail **no. 18** in corner bumper **no. 21**.
– Using hole positions previously marked on body, drill holes in bumper rail **no. 18** and install rivets **no. 19**.
– Install trim **no. 17** using soapy water.
– Repeat procedure for the other side.

SPONSON

NOTE: Removal and installation procedure for RH and LH sponson is same.

Removal

Unscrew sponson bolts then remove sponson **no. 22**.



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.

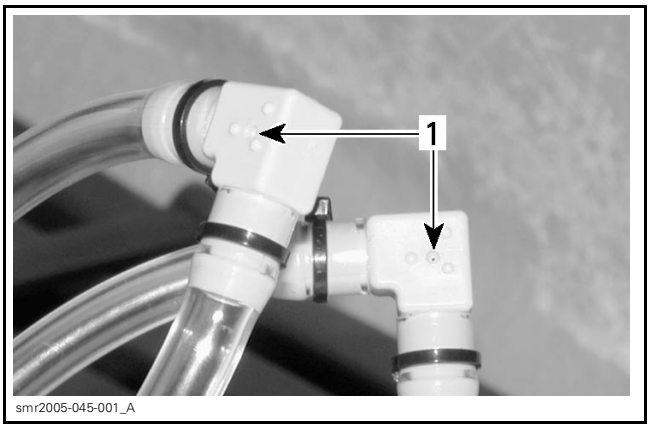
Torque sponson adaptor nuts to 16 N•m (142 lbf•**in**).

Install all other removed parts.

BAILER PICK-UPS

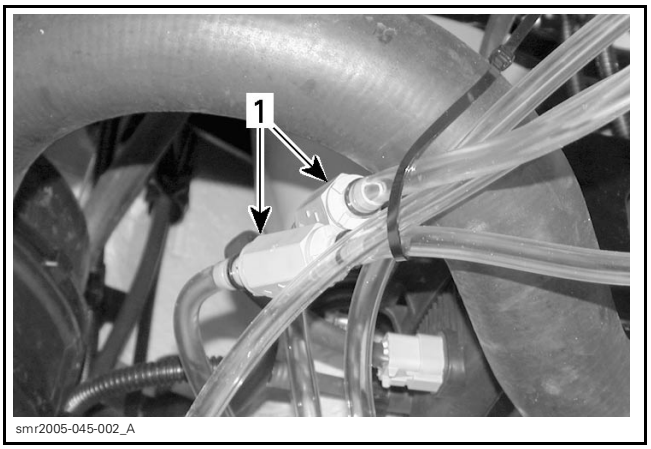
Inspection

Check if the hole on the elbow fitting is obstructed. Clean both elbow fittings if necessary.



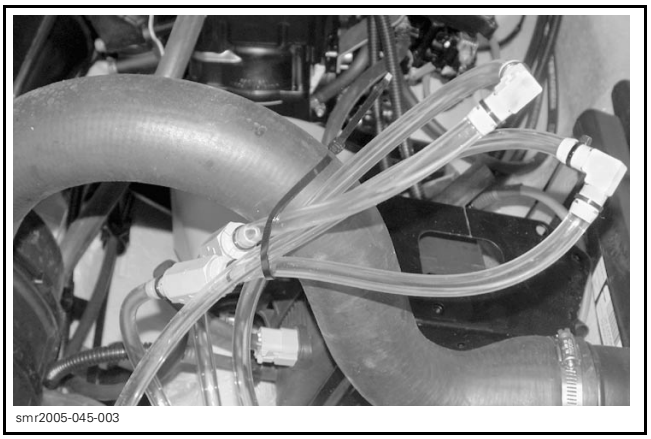
1. Elbow fitting holes

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

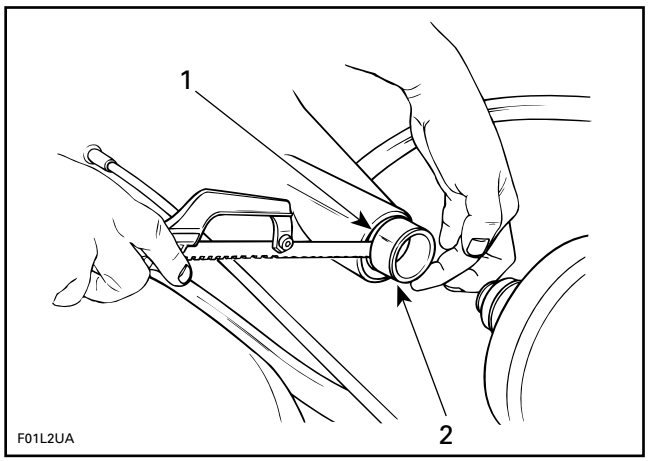
Attach elbow fittings at the highest position that you can on the inlet hose.



THRU-HULL FITTING

For hull insert repair proceed as follows:

Cut plastic hull insert flush with hull using a saw.

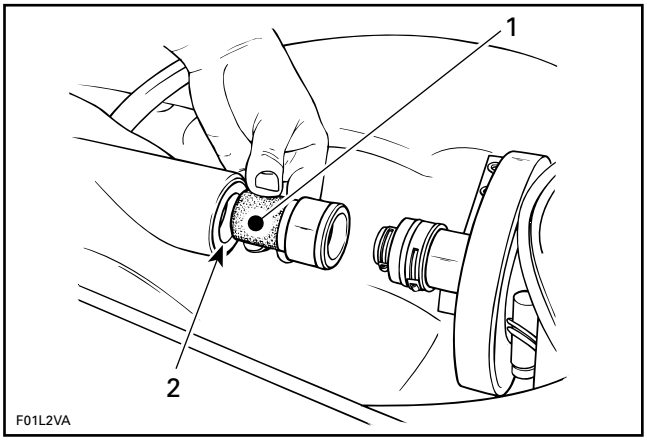


1. Hull
2. Plastic hull insert

Mix epoxy glue (3M-05895), follow manufacturer instructions.

Apply epoxy glue on aluminum insert (P/N 292 000 075) knurled surface and on plastic insert inner bore.

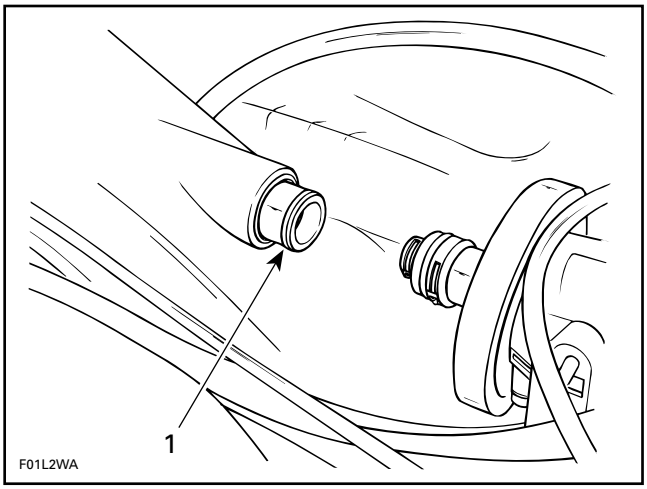
CAUTION: If you notice any clearance between plastic insert and aluminum insert, fill gap with epoxy glue to obtain good adhesion of aluminum insert.



1. Knurled surface
2. Inner bore

Install aluminum insert into plastic hull insert.

NOTE: Align aluminum insert as much as possible with PTO flywheel.



1. Aluminum insert

NOTE: The epoxy glue curing time is 30 minutes.

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.

Clean surface with a good solvent such as ACRYLICLEAN DX 330 from PPG or equivalent (refer to manufacturer instructions).

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.

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.

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
- scissors
- power sander
- spray gun
- cover sheets (for Sea-Doo)
- putty knife
- plastic film
- stirring stick
- buffing pad
- heavy-duty polisher
- paint brush
- plastic squeegee
- plastic container (mixing)

Materials

- fiberglass mat
- fiberglass cloth
- polyester resin
- cardboard
- masking tape
- cabosil
- 24-grit sanding disks
- sandpaper (100-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit)
- gelcoat putty
- liquid gelcoat
- acetone
- epoxy filler
- wax
- fine compound (white)
- medium compound (white)

3D SERIES

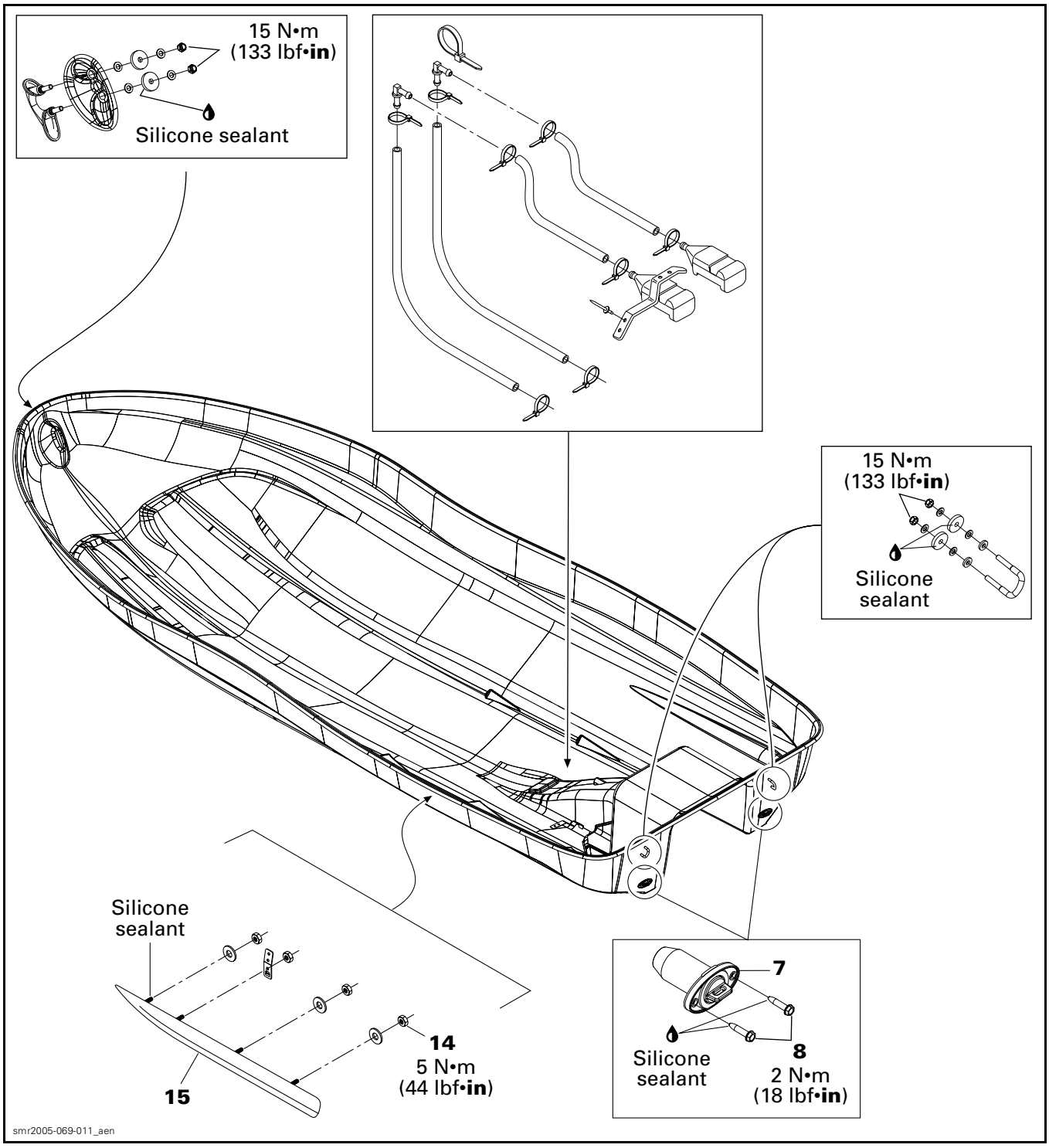
SERVICE TOOLS

Description	Part Number	Page
DESS switch tool	529 034 600	340

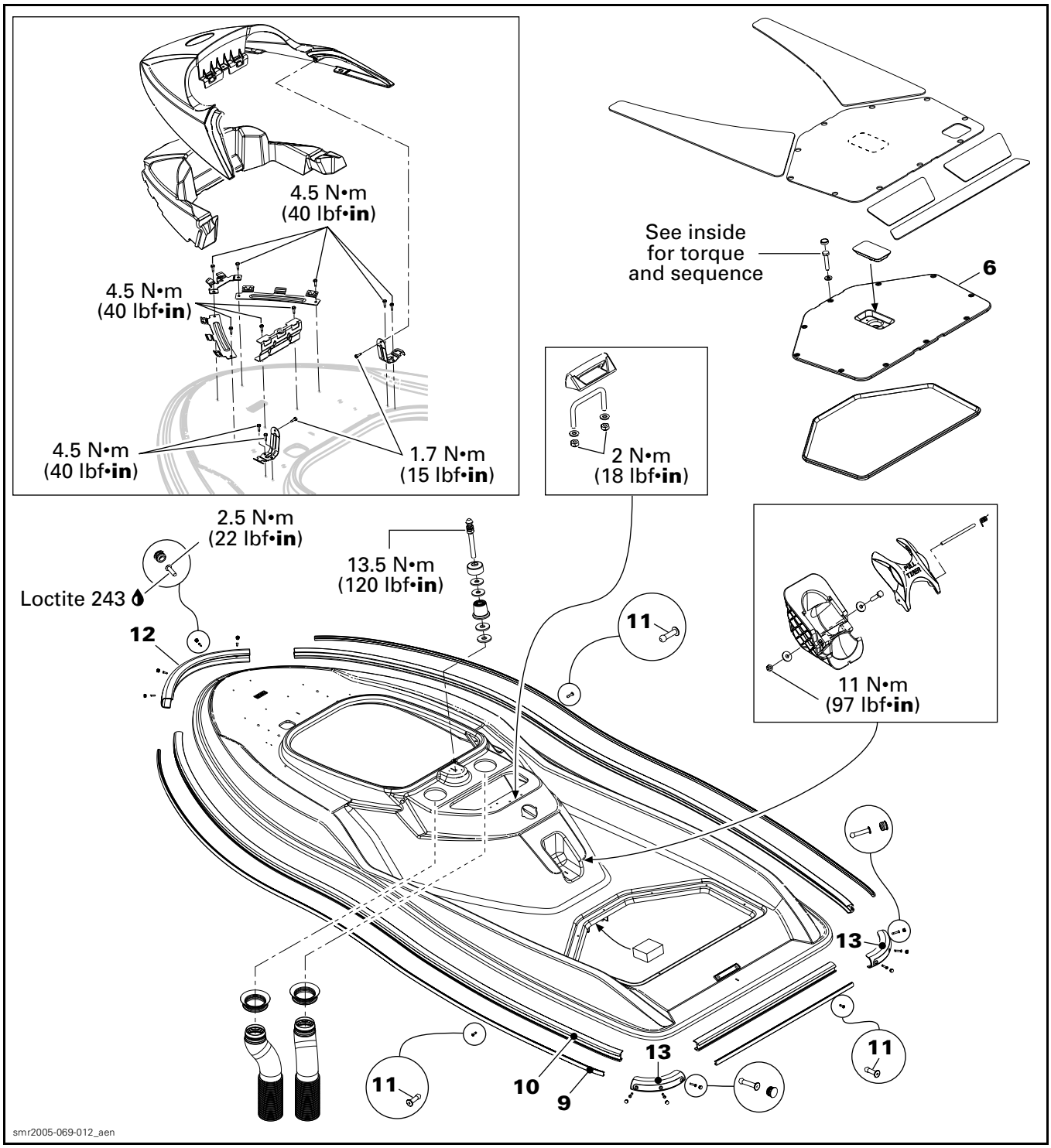
SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue)	293 800 060	345
Loctite 271 (red)	293 800 005	342
Loctite 518	293 800 038	344
Loctite 5900	293 800 066	342–344
Scratch Remover Kit	861 774 800	341
silicone sealant (clear)	293 800 086	344, 346

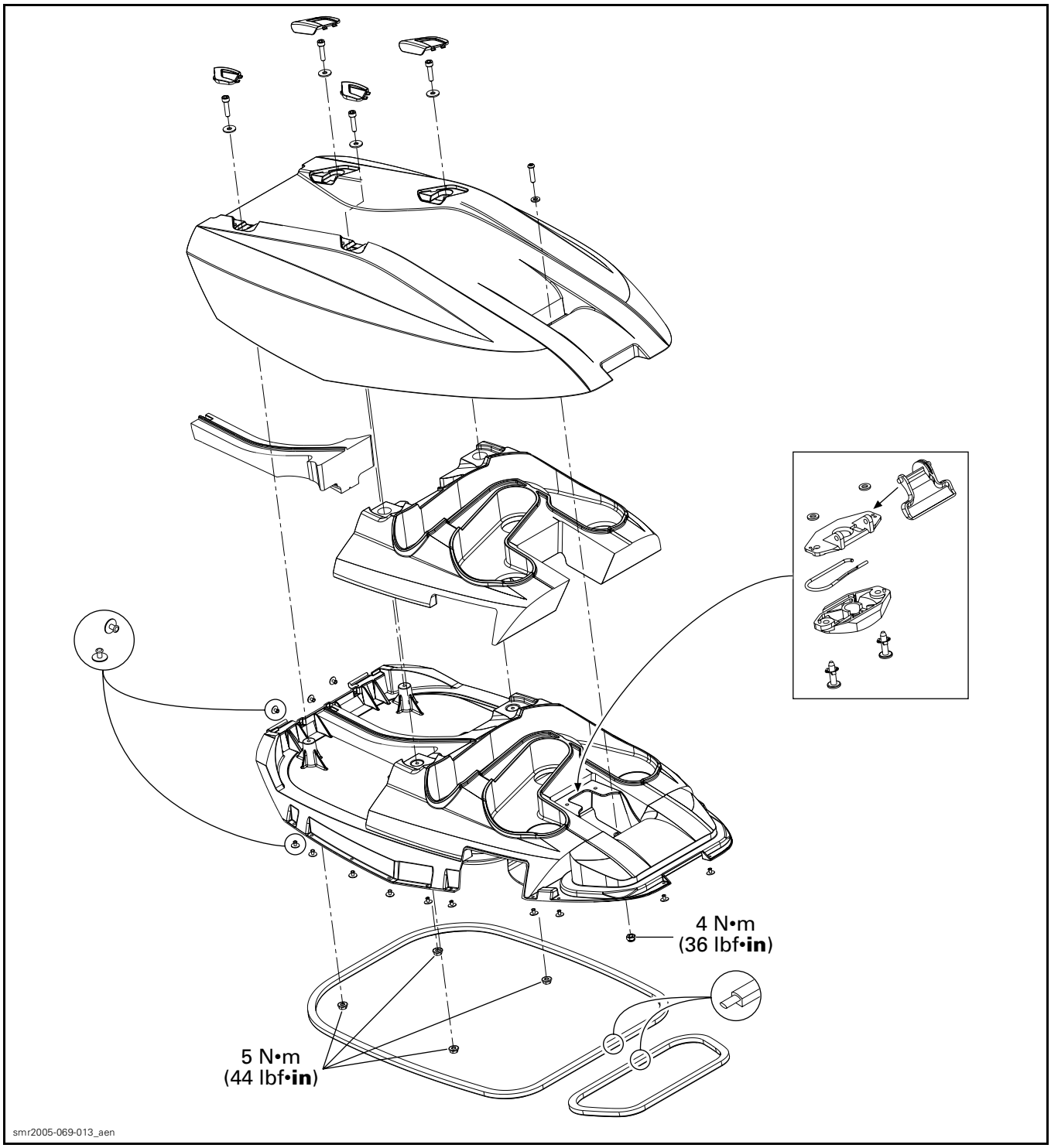
Hull



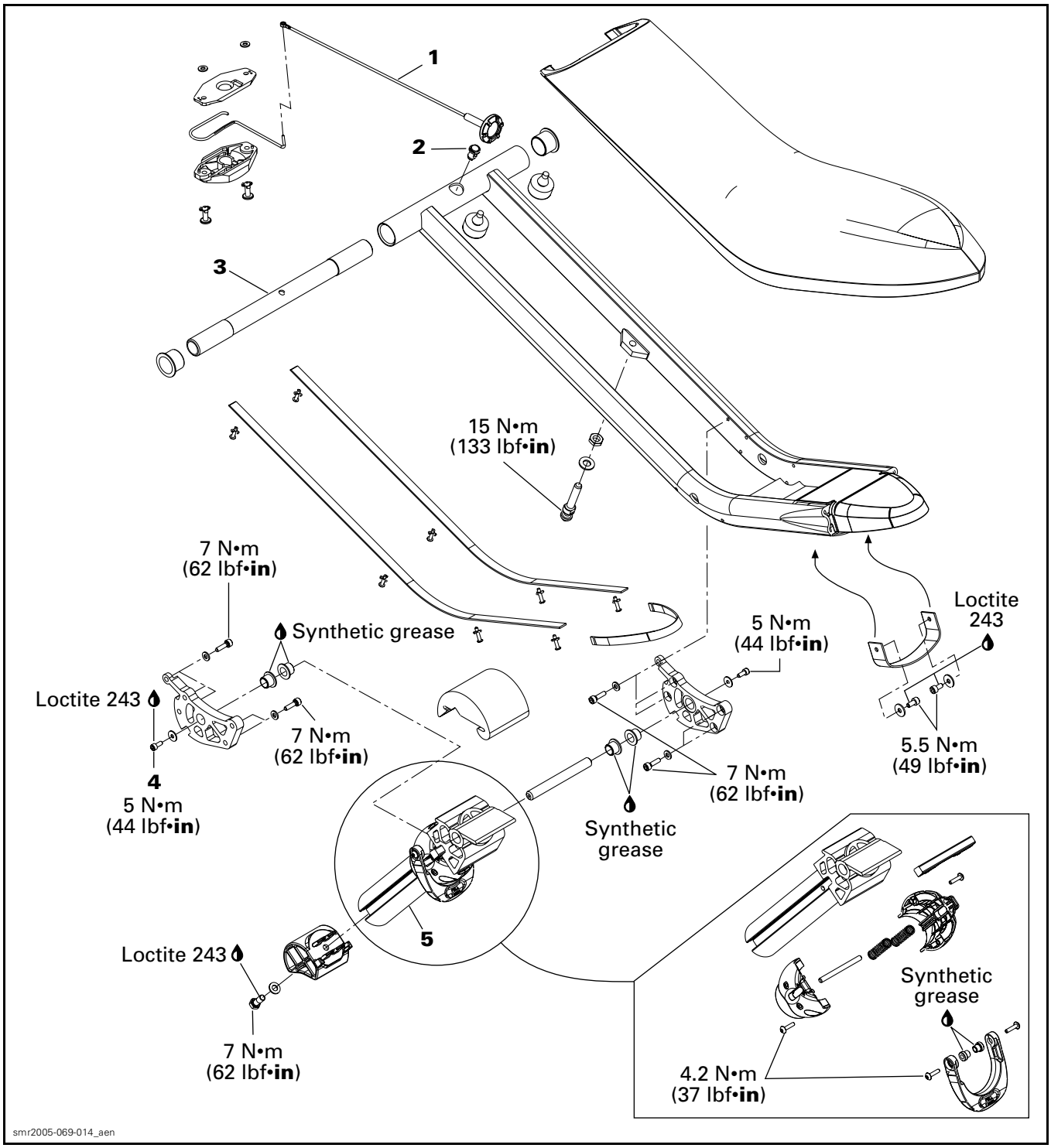
Body



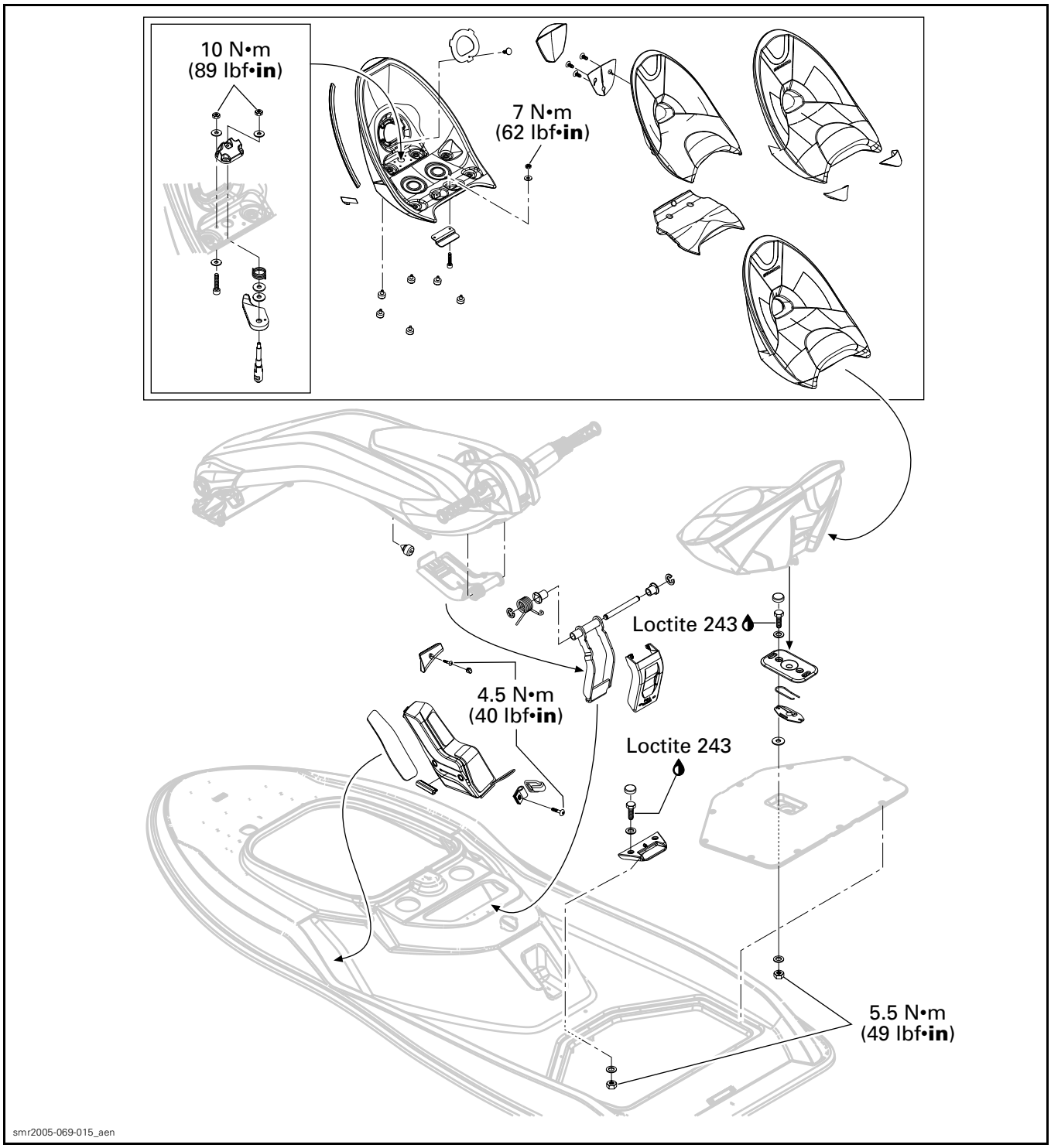
Engine Cover



Moto Seat



Kart Seat



GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

When applying threadlocker 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.

PROCEDURES

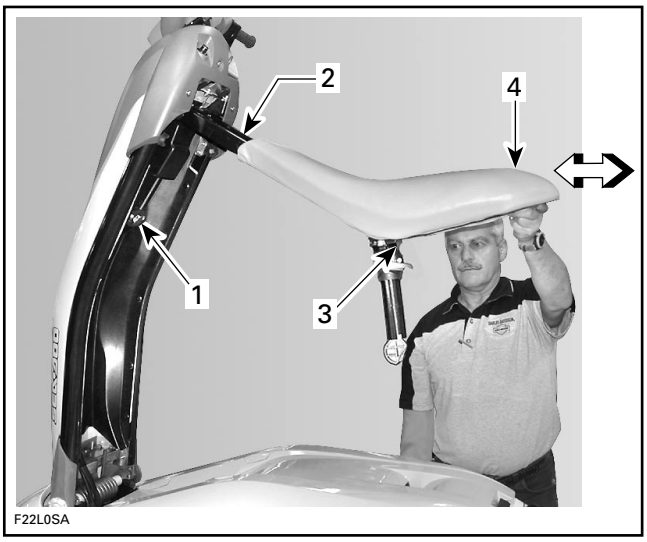
MOTO SEAT (if so equipped)

Inspection

Check that the moto seat properly latches into the steering pole. Inspect the latch mechanism for wear.

Deploy the seat. Ensure that the seat moves freely while rotating. Check for excessive lateral play.

Also check for excessive play of seat post in seat.



1. Latch mechanism
2. Seat structure
3. Check play of seat post
4. Check lateral play of seat structure

Inspect the seat post receiver in the deck. Check for dirt, sand or other debris. Check for excessive wear. Ensure that the cover moves freely.

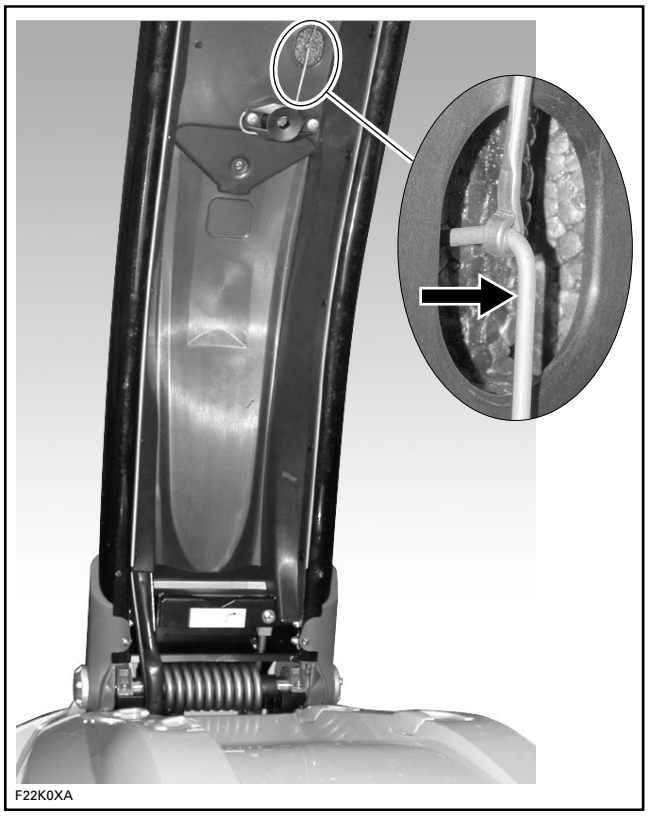
Inspect post knuckle condition. Check for wear, cracks and tightness.

Install the seat post in its receiver and ensure it latches properly. Inspect latch mechanism for wear. Try pulling out the post without releasing the latch.

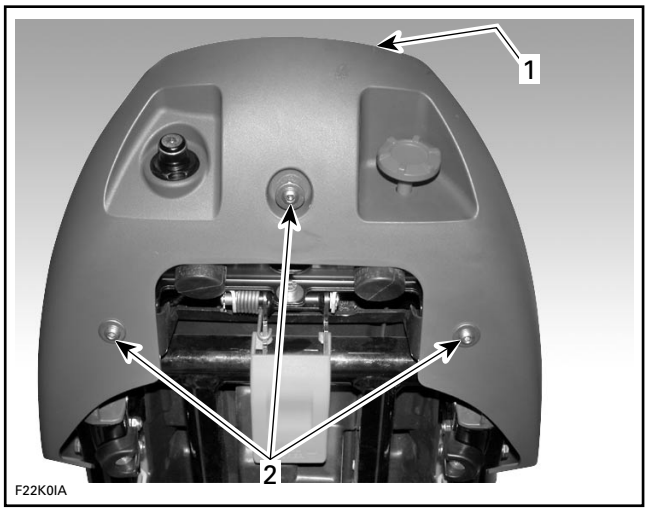
Disassembly

Deploy moto seat.

Disconnect latch rod **no. 1**.

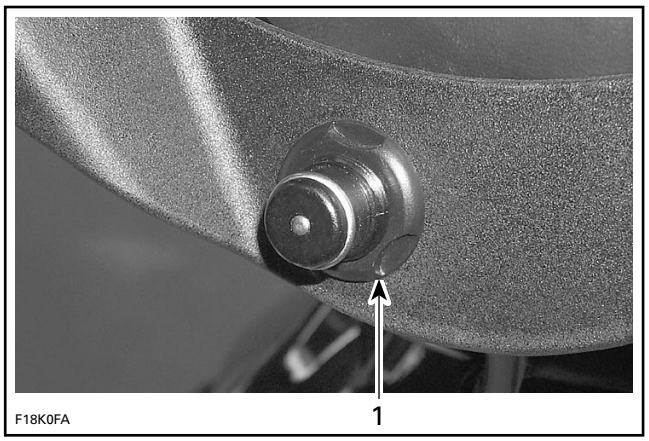


Remove screws of lower cover then slide cover rearward.



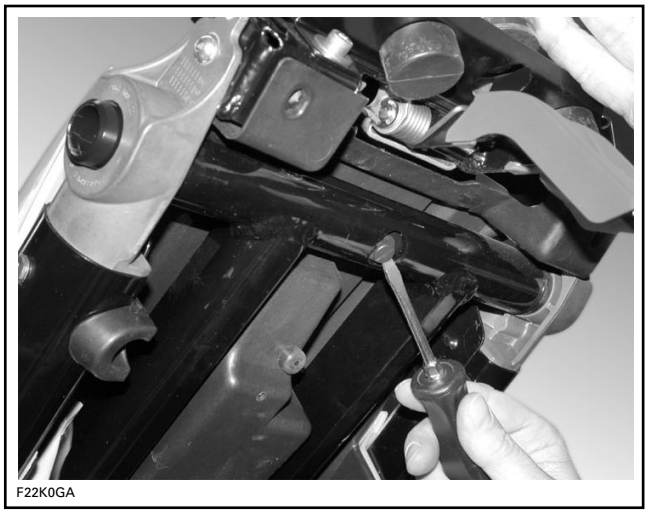
1. Lower cover
2. Remove screws

Unscrew DESS switch nut using the DESS switch tool (P/N 529 034 600).



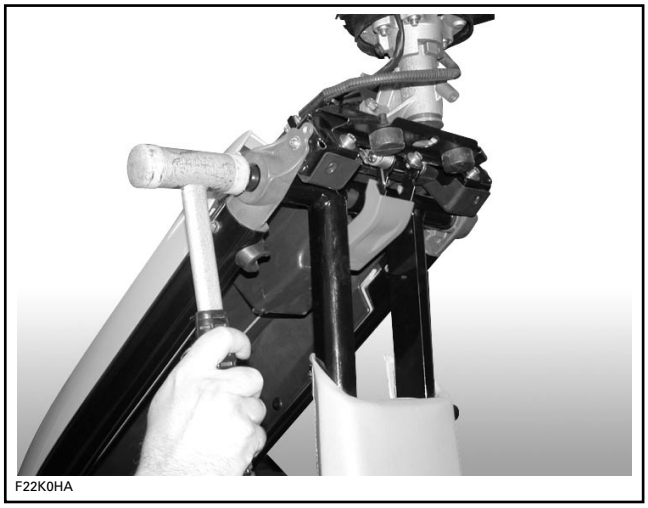
TYPICAL
1. DESS switch nut

Pull plastic rivet **no. 2** out.



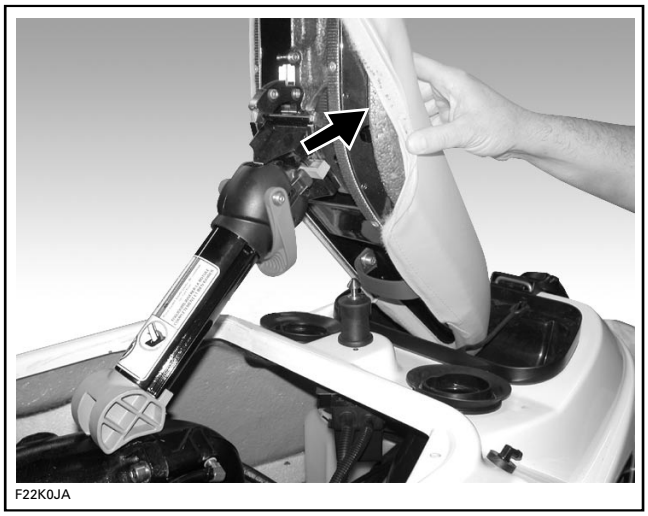
Position seat post in the receiver.

Using a plastic hammer, push moto seat axle **no. 3** out while holding seat.



Post

Partially peel seat cover to expose screw **no. 4**.


F22K0JA

Remove screw and pull out post **no. 5**.

Cleaning

To clean the engine cover and the steering pole nose and top pieces, use only flannel cloths or an equivalent.

1. Engine cover, steering pole nose and top pieces

CAUTION: Use only recommended material to avoid damaging the surfaces.

To remove scratches on these parts, use Scratch Remover Kit (P/N 861 774 800).

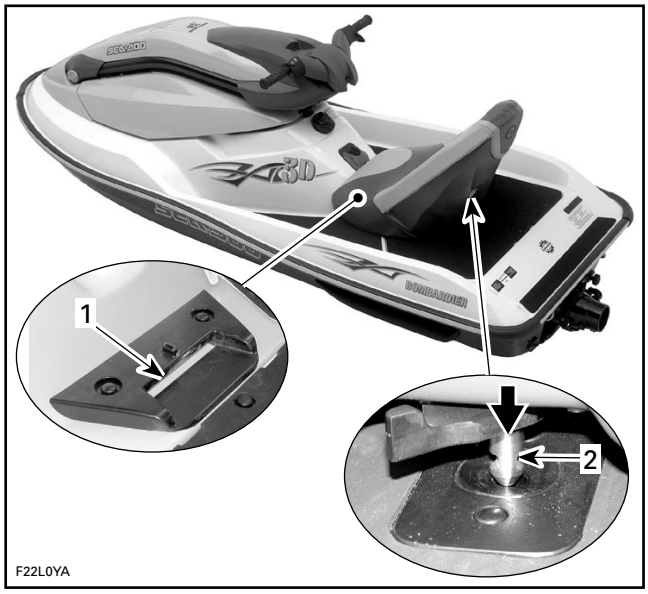
NOTE: Be aware that when using any scratch remover product, the part finish will turn to a dull appearance.

CAUTION: Never clean plastic parts or engine cover with strong detergent, degreasing agent, paint thinner, acetone, products containing chlorine, etc.

To clean the carpets, use 3M™ Citrus Base Cleaner (24 oz spay can) or the equivalent.

KART SEAT (if so equipped)

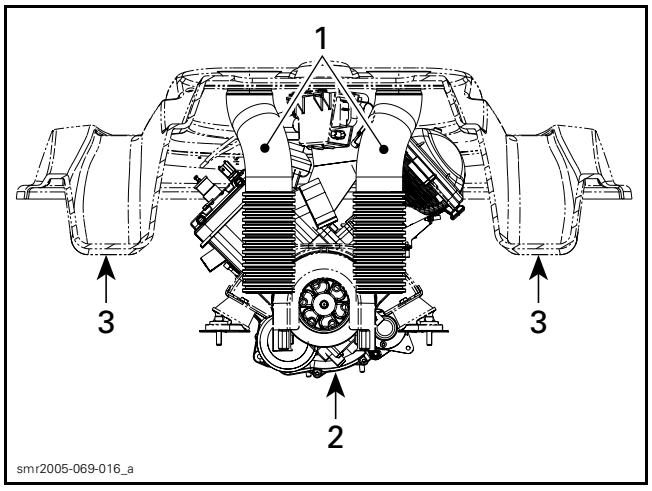
Check seat tab and anchor plate for wear or damage. Check latch mechanism for tightness, wear, cracks or other damage. Try pulling out the seat without releasing the latch.



1. Check seat tab and anchor plate
2. Check latch mechanism

BILGE VENT TUBES

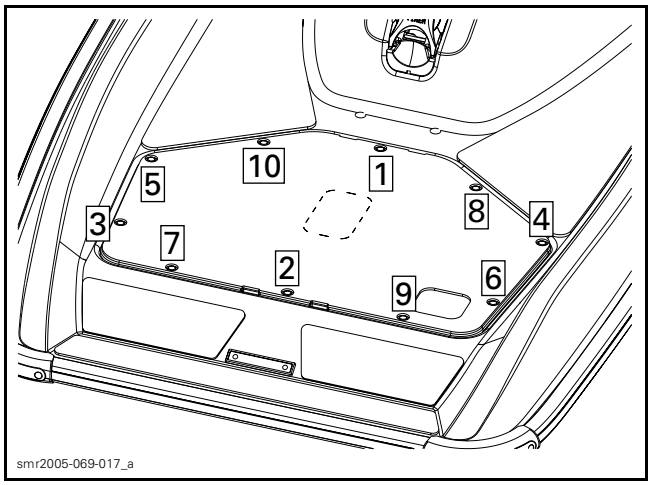
Ensure they are not obstructed and they are well fixed to body. Ensure they do not interfere with any hose.



1. *Vent tubes in optimal position*
2. *Engine*
3. *Hull*

REAR ACCESS COVER

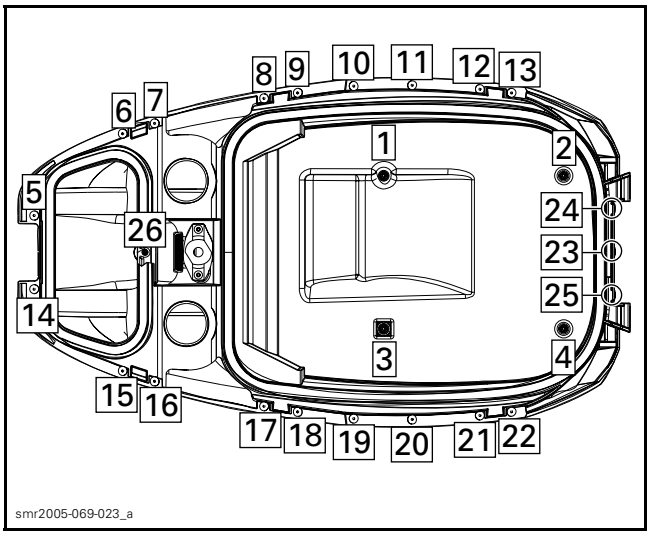
When reinstalling cover **no. 6**, follow this tightening sequence.



ENGINE COVER INNER SHELL

To remove inner shell, remove screws then using a 3/16 drill, remove all rivets.

To assemble inner shell on engine cover it is important to use the following sequence.



Step 1: Install screws, sequence 1 to 4
Step 2: Install rivets, sequence 5 to 26

INLET GRATE

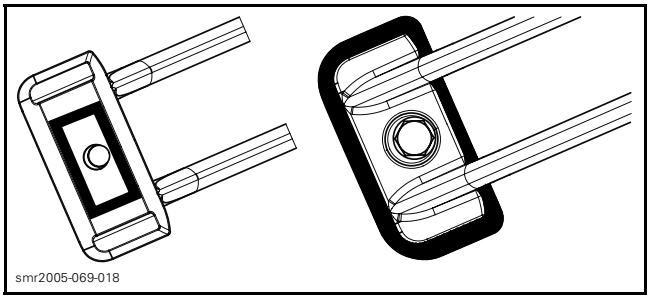
Removal and Installation

Loosen screws and remove inlet grate.

NOTE: An impact screwdriver should be used to loosen tight screws.

When reinstalling inlet grate, apply Loctite 271 (red) (P/N 293 800 005) on threads.

Apply Loctite 5900 (P/N 293 800 066) on the small part of inlet grate as indicated by the shaded areas in the next illustration.

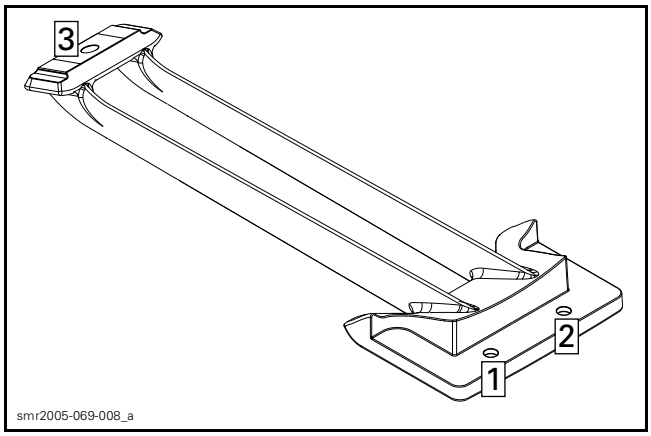


Follow this sequence referring to the illustration:

Hand tighten screws from 1 to 3.

Torque screws 1 and 2 to 11 N•m (97 lbf•**in**) then retorque the first screw.

Torque screw 3 to 26 N•m (19 lbf•ft).



RIDING PLATE

Removal

Remove inlet grate.

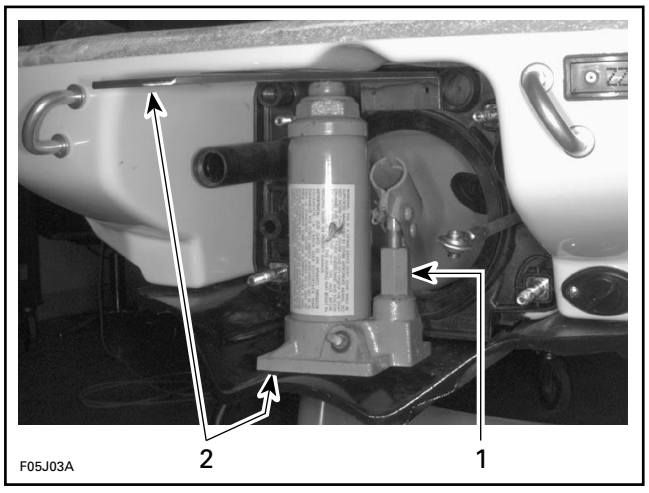
Remove jet pump. Refer to JET PUMP.

Remove the speed sensor from the riding plate (if applicable).

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*

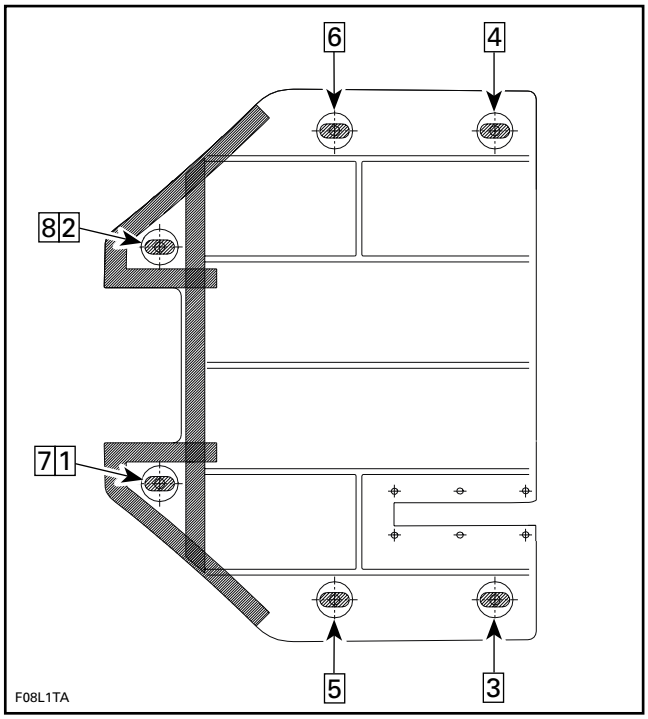
Cleaning

Scrape off all excess of sealant from riding plate and hull.

Clean hull surface with solvent to eliminate grease, dust and any residue of sealant. Clean fitting threads.

Installation

Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the next illustration. Follow also the torquing sequence as shown in the same illustration. Torque screws to 26 N•m (19 lbf•ft).



TYPICAL

Install all removed parts.

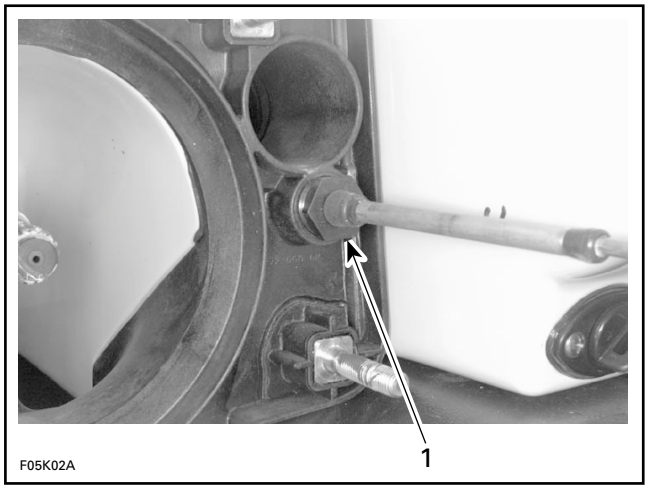
JET PUMP SUPPORT

Removal

Remove jet pump. Refer to JET PUMP.

Remove inlet grate and riding plate.

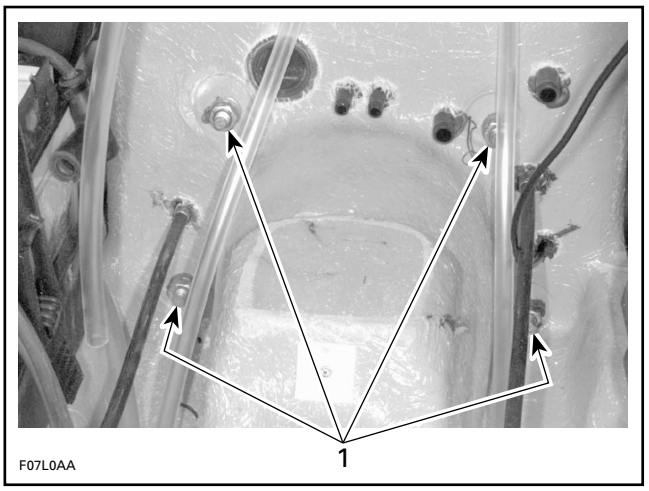
Remove ball joint, boot, nut, half rings and O-rings from steering cable.



TYPICAL
1. Unscrew nut

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

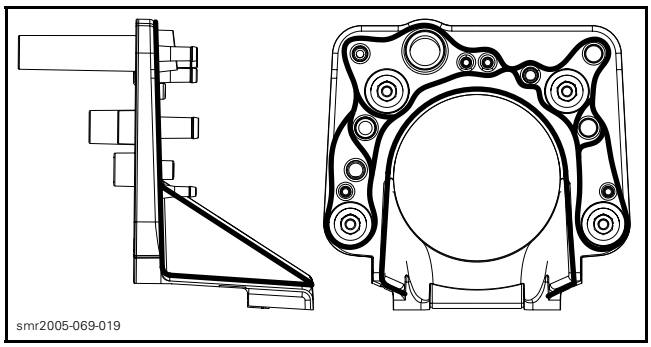
Using a heat gun, heat jet pump support until it is possible to pull it.

NOTE: Shims may have been installed between support and body. Do not remove these shims, otherwise jet pump alignment will be altered.

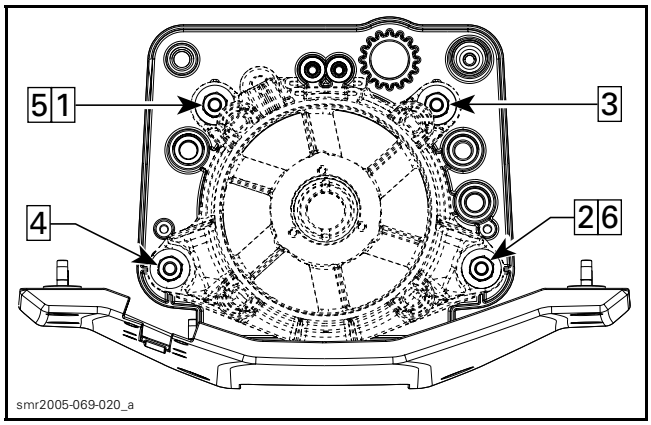
Installation

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.

Apply Loctite 5900 (P/N 293 800 066) as indicated by the shaded areas in the next illustrations.



Torque nuts to 31 N•m (23 lbf•ft) as per the following sequence.



DRAIN PLUG

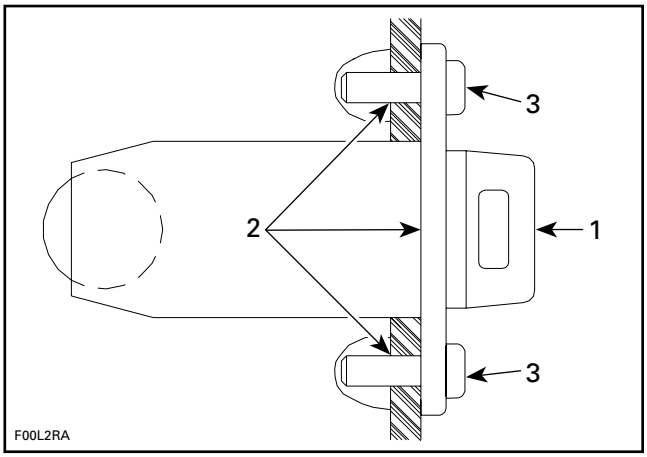
Installation

Before installation of drain plug **no. 7**, clean all residues of old silicone sealant on hull and on drain plug housing.

Apply silicone sealant (clear) (P/N 293 800 086) in the screw holes.

Torque screws **no. 8** to 2.2 N•m (19 lbf•**in**).

From inside of bilge, apply silicone sealant (clear) (P/N 293 800 086) around and on screws.



1. Drain plug
2. Silicone sealant
*3. Torque screws to 2.2 N•m (19 lbf•**in**)*

BUMPER

Removal and Installation

– Remove trim **no. 9** from side bumper rail **no. 10**.
– Drill pop rivets **no. 11** to remove side bumper rail **no. 10**.
– Mark hole positions on body straight and bow sections.

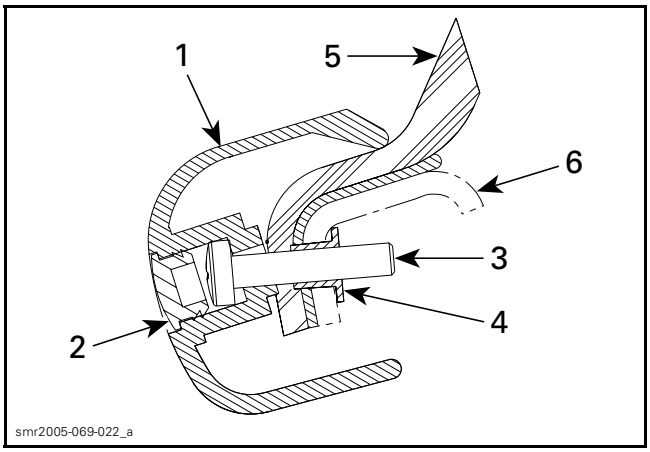
TYPICAL
1. Front bumper
2. Corner bumper
3. Straight section
4. Bow section

– Slide bumper rail **no. 10** under front bumper **no. 12**.
– Using a 4.80 mm (3/16 in) drill bit, drill first hole through bumper rail **no. 10** at front of bow section. Use locating mark as a guide. Then install a rivet **no. 11**.

CAUTION: When drilling, be careful not to damage bumper rail and/or hull.

– Position bumper rail **no. 10** properly onto body and cut excess length if necessary.
– Slide bumper rail **no. 10** in corner bumper **no. 13**.
– Using hole positions previously marked on body, drill holes in bumper rail **no. 10** and install rivets **no. 11**.
– Install trim **no. 9** using soapy water.
– Repeat procedure for the other side.

When installing front bumper **no. 12**, note that bumper screws are installed with a threaded insert. The screws go through the deck and the hull. Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads and torque to 2.5 N•m (22 lbf•**in**).



1. Front bumper
2. Cap
3. Screw
4. Threaded insert
5. Deck
6. Hull

SPONSON

NOTE: Removal and installation procedure for RH and LH sponson is same.

Removal

Remove muffler or resonator. Refer to EXHAUST SYSTEM.

From inside of hull, unscrew sponson nuts **no. 14** then remove sponson **no. 15**.

Clean any residues of silicone sealant on hull and sponson.

Installation

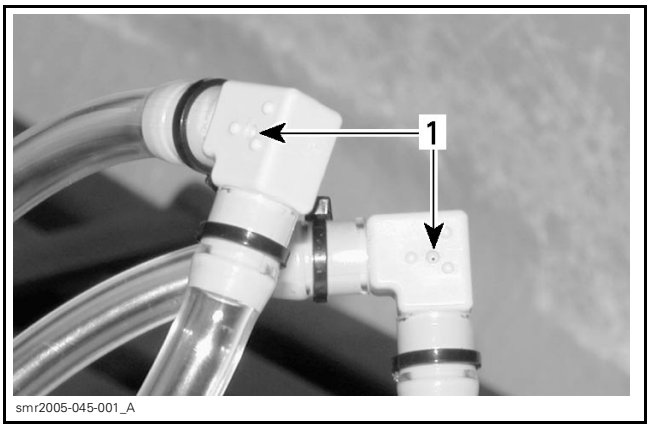
Apply silicone sealant (clear) (P/N 293 800 086) around sponson bolts.

Install sponson and torque sponson nuts to 5 N•m (44 lbf•**in**).

BAILER PICK-UPS

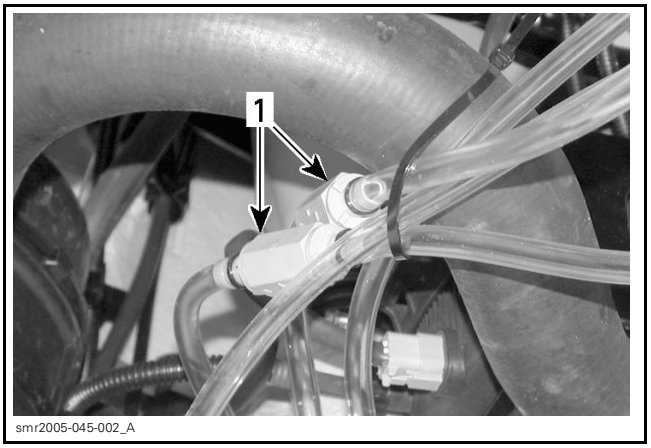
Inspection

Check if the hole on the elbow fitting is obstructed. Clean both elbow fittings if necessary.



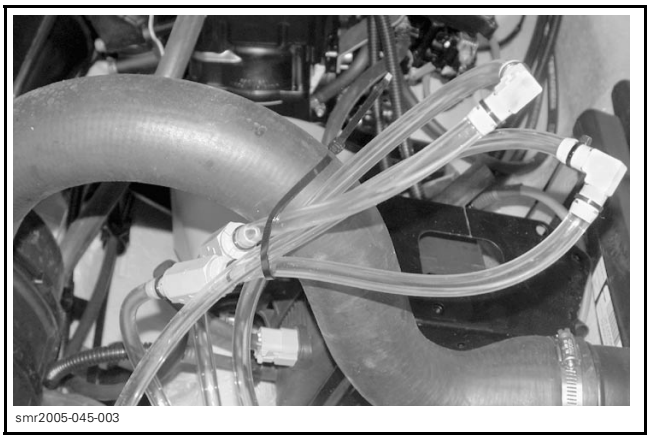
1. Elbow fitting holes

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

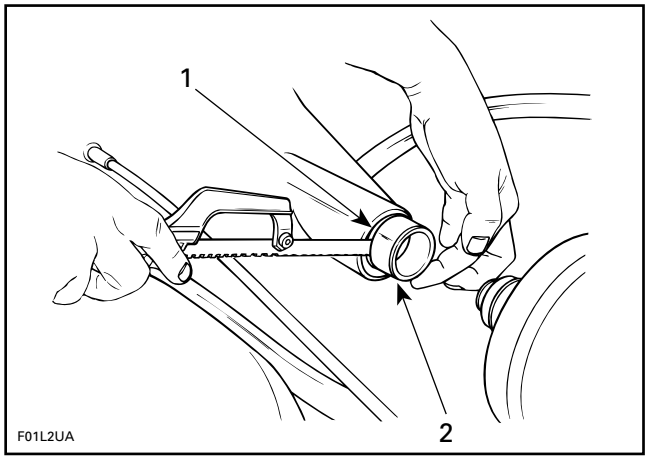
Attach elbow fittings at the highest position that you can on the inlet hose.



THRU-HULL FITTING

For hull insert repair proceed as follows:

Cut plastic hull insert flush with hull using a saw.

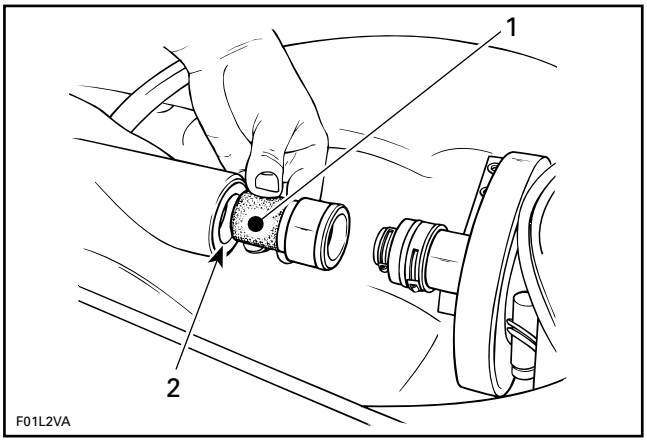


1. Hull
2. Plastic hull insert

Mix epoxy glue (3M-05895), follow manufacturer instructions.

Apply epoxy glue on aluminum insert (P/N 292 000 075) knurled surface and on plastic insert inner bore.

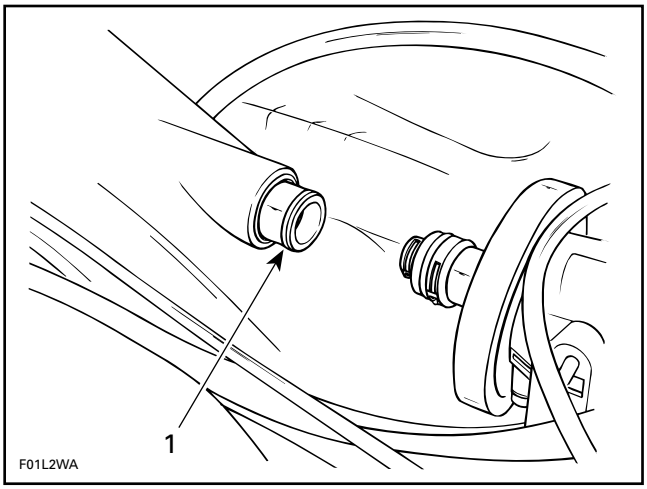
CAUTION: If you notice any clearance between plastic insert and aluminum insert, fill gap with epoxy glue to obtain good adhesion of aluminum insert.



1. Knurled surface
2. Inner bore

Install aluminum insert into plastic hull insert.

NOTE: Align aluminum insert as much as possible with PTO flywheel.



1. Aluminum insert

NOTE: The epoxy glue curing time is 30 minutes.

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.

Clean surface with a good solvent such as ACRYLICLEAN DX 330 from PPG or equivalent (refer to manufacturer instructions).

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.

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.

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
- scissors
- power sander
- spray gun
- cover sheets (for Sea-Doo)
- putty knife
- plastic film
- stirring stick
- buffing pad
- heavy-duty polisher
- paint brush
- plastic squeegee
- plastic container (mixing)

Materials

- fiberglass mat
- fiberglass cloth
- polyester resin
- cardboard
- masking tape
- 24-grit sanding disks
- fine compound (white)
- sandpaper (100-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit)
- gelcoat putty
- liquid gelcoat
- acetone
- epoxy filler
- wax
- cabosil
- medium compound (white)

GTI MODELS

ELECTRICAL SYSTEM		GTI
Magneto generator output		160 W @ 6000 RPM
Spark plug	Make and type	NGK BR8ES
	Gap	0.4 - 0.5 mm (.016 - .020 in)
Ignition timing (BTDC)	mm (in)	2.59 ± 0.38 (.102 ± .015)
	Degrees	20° ± 1.5 (1)
Generating coil		40 - 76 Ω
Battery charging coil		0.05 - 0.6 Ω
Ignition coil	Primary	0.34 - 0.62 Ω
	Secondary	9 - 15 kΩ
Engine rev limiter setting		7100 ± 50 RPM
Battery		12 V, 19 A•h (Yuasa/Exide)
Fuse	MPEM	5 A
	Main electrical system	15 A
	Charging system	20 A
	Battery	15 A
ADDITIONAL INFORMATION : (1) Engine cold @ 6000 RPM		

FUEL SYSTEM		GTI
Carburetor	Type	Mikuni BN-40i diaphragm, fuel accelerator pump
	Quantity	1
Main jet		167.5
Pilot jet		75
Spring		130 g (4.6 oz)
Adjustment	Low-speed screw	No adjustment
	High-speed screw	No adjustment
	Idle speed (in water)	1500 ± 100 RPM
	Idle speed (out of water)	3000 RPM
Fuel	Type	**Regular** unleaded gasoline
	Minimum octane no.	Inside North America: 87 (R + M)/2 Outside North America: 91 RON
Fuel return line orifice		0.8 mm (.031 in)
ADDITIONAL INFORMATION:		

COOLING	GTI
Type	Open circuit — Direct flow from jet propulsion unit
Thermostat	Not applicable
Monitoring beeper setting	86 - 94°C (187 - 201°F)
ADDITIONAL INFORMATION:	

PROPULSION		GTI
Propulsion system		BOMBARDIER Formula Pump
Jet pump type		Axial flow single stage
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Crowned splines
Oil type		XP-S™ synthetic jet pump oil or SAE 75W90 GL5
Steering nozzle pivoting angle		20°
Minimum required water level		90 cm (35 in)
Drive shaft deflection (maximum)		0.5 mm (.020 in)
Impeller outside diameter		155.3 mm (6.114 in)
Impeller/wear ring clearance	New	0.0 - 0.4 mm (.000 - .016 in)
	Wear limit	1.00 mm (.040 in)
Impeller shaft end play (new)		0
Impeller shaft radial play		0.05 mm (.002 in)
Impeller pitch/material		Progressive pitch 10°-20°/stainless steel
ADDITIONAL INFORMATION: Do not mix different brands or oil types.		

DIMENSIONS	GTI
Number of passenger (driver included)	3
Overall length	307 cm (121 in)
Overall width	120 cm (47 in)
Overall height	104 cm (41 in)
Dry weight	274 kg (604 lb)
Load limit passenger and 10 kg (22 luggage)	243 kg (536 lb)
ADDITIONAL INFORMATION:	

CAPACITIES		GTI
Fuel tank (including reserve)		56.5 L (15 U.S. gal)
Fuel tank reserve		11.4 L (3 U.S. gal)
Oil injection reservoir		6 L (1.6 U.S. gal)
Jet pump impeller shaft reservoir	Capacity	100 mL (3.38 U.S. oz)
	Oil level height	Up to plug
ADDITIONAL INFORMATION:		

MATERIALS	GTI
Hull	Composite
Inlet grate	Aluminum
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum
Air intake silencer	Thermoplastic
Flame arrester	Multi-layer wire screen
Steering padding	Thermoplastic
Fuel tank	Polyethylene
Oil injection reservoir	Polyethylene
Seat	Polyurethane foam
ADDITIONAL INFORMATION:	

PERFORMANCE		GTI
Estimated pump power		34.8 kW (46.7 HP)
Maximum fuel consumption at wide open throttle		33.5 L/h (8.8 U.S. gal/h)
Cruising time at full throttle	Fuel tank without reserve	1.21 hour
	Fuel tank reserve	21 minutes
ADDITIONAL INFORMATION:		

GTI RFI AND GTI RFI LE MODELS

ELECTRICAL SYSTEM		GTI RFI	GTI RFI LE
Magneto generator output	Wattage	270 W @ 6000 RPM	
	Amperage	7 A @ 6000 RPM / 13.5 volts	
Ignition system type		Digital, inductive	
Spark plug	Make and type	NGK BR8ES	
	Gap	0.4 - 0.5 mm (.016 - .020 in)	
Ignition timing (BTDC)	mm (in)	1.02 (.040)	
	Degrees	12°± 1.0 (fixed timing mode at any RPM)	
Battery charging coil		0.1 Ω - 1 Ω	
Ignition coil	Primary	0.3 Ω - 0.6 Ω	
	Secondary	Not applicable	
Engine rev limiter setting		7200 ± 50 RPM	
Battery		12 V, 19 A•h (Yuasa/Exide)	
Fuse	Accessories	5 A	
	Main electrical system	20 A	
	Charging system	20 A	
	Ignition	10 A	
	Fuel injector	MAG: 3 A; PTO: 3 A	
	RAVE solenoid	5 A	
	Fuel pump	10 A	
ADDITIONAL INFORMATION:			

FUEL SYSTEM		GTI RFI	GTI RFI LE
Fuel injection type		Rotax Fuel Injection, semi-direct, single throttle body (56 mm)	
Idle speed (in water)		1550 ± 100 RPM	
Throttle Position Sensor (TPS)		1.6 kΩ - 2.4 kΩ (terminals 1-2) 710 Ω - 1380 Ω (terminals 2-3)	
Crankshaft Position Sensor (CPS)		774 Ω - 946 Ω	
Air Temperature Sensor (ATS)		2.28 kΩ - 2.74 kΩ	
Water Temperature Sensor (WTS)		2.28 kΩ - 2.74 kΩ	
Air Pressure Sensor (APS)		3.4 kΩ and 8.2 kΩ (terminals 3-2) 2.4 kΩ and 8.2 kΩ (terminals 1-2)	
RAVE solenoid		30 Ω	
Fuel injector		2.4 ± 0.1 Ω	
Fuel	Type	**Regular** unleaded gasoline	
	Minimum octane no.	Inside North America: 87 (R + M)/2 Outside North America: 91 RON	
ADDITIONAL INFORMATION:			

COOLING	GTI RFI	GTI RFI LE
Type	Open circuit — Direct flow from jet propulsion unit	
Thermostat	Not applicable	
Monitoring beeper setting	86 - 94°C (187 - 201°F)	
ADDITIONAL INFORMATION:		

PROPULSION		GTI RFI	GTI RFI LE
Propulsion system		BOMBARDIER Formula Pump	
Jet pump type		Axial flow single stage	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Coupling type		Crowned splines	
Oil type		XP-S™ synthetic jet pump oil or SEA 75W90 GL5	
Steering nozzle pivoting angle		20°	
Minimum required water level		90 cm (35 in)	
Drive shaft deflection (maximum)		0.5 mm (.020 in)	
Impeller outside diameter		155.0 mm (6.102 in)	
Impeller/wear ring clearance	New	0.0 - 0.4 mm (.000 - .016 in)	
	Wear limit	1.00 mm (.040 in)	
Impeller shaft end play (new)		0	
Impeller shaft radial play		0.05 mm (.002 in)	
Impeller pitch/material		Progressive pitch 11°-20°/stainless steel	
ADDITIONAL INFORMATION: Do not mix different brands or oil types.			

DIMENSIONS	GTI RFI	GTI RFI LE
Number of passenger (driver incl.)	3	
Overall length	307 cm (121 in)	
Overall width	120 cm (47 in)	
Overall height	104 cm (41 in)	
Dry weight	300 kg (661 lb)	302 kg (666 lb)
Load limit (passenger and 10 kg (22 lb) luggage)	243 kg (536 lb)	
ADDITIONAL INFORMATION:		

CAPACITIES		GTI RFI	GTI RFI LE
Fuel tank (including reserve)		56.5 L (15 U.S. gal)	
Fuel tank reserve (from low level signal)		11.4 L (3 U.S. gal)	
Oil injection reservoir		6 L (1.6 U.S. gal)	
Jet pump impeller shaft reservoir	Capacity	100 mL (3.38 U.S. oz)	
	Oil level height	Up to plug	
ADDITIONAL INFORMATION:			

MATERIALS	GTI RFI	GTI RFI LE
Hull	Composite	
Inlet grate	Aluminum	
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum	
Air intake silencer	Thermoplastic	
Flame arrester	Multi-layer wire screen	
Steering padding	Thermoplastic	
Fuel tank	Polyethylene	
Oil injection reservoir	Polyethylene	
Seat	Polyurethane foam	
ADDITIONAL INFORMATION:		

PERFORMANCE		GTI RFI	GTI RFI LE
Estimated pump output		40.2 kW (53.9 HP)	
Maximum fuel consumption at wide open throttle		41.5 L/h (11 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	1 hour 5 minutes	
	Fuel tank reserve	17 minutes	
ADDITIONAL INFORMATION:			

3D RFI MODEL

ELECTRICAL SYSTEM			3D RFI	3D RFI PREMIUM
Magneto generator output	Wattage		270 W @ 6000 RPM	
	Amperage		7 A @ 6000 RPM/13.5 volts	
Ignition system type			Digital Inductive	
Spark plug	Make and type		NGK BR8ES	
	Gap		0.4 - 0.5 mm (.016 - .020 in)	
Ignition timing (BTDC)	mm (in)		1.02 (.040)	
	Degrees		12°± 1.0 (fixed timing mode at any RPM)	
Battery charging coil			0.1 - 1 Ω	
Ignition coil	Primary		0.3 Ω - 0.6 Ω	
	Secondary		Not applicable	
Engine rev limiter setting			7200 ± 50 RPM	
Battery			12 V, 19 A•h (Yuasa/Exide)	
Fuses	Main electrical system		20 A	
	Accessories		5 A	
	Charging		20 A	
	Fuel pump		10 A	
	Ignition		10 A	
	RAVE solenoid		5 A	
	Fuel injector		MAG: 3 A; PTO: 3 A	
O.T.A.S.	Steering switch type		Normally opened	
	Steering switch resistance	Open	470 Ω ± 5%	
	Steering switch resistance	Close	82.5 Ω ± 5%	
	Solenoid resistance		14.9 Ω ± 5%	
ADDITIONAL INFORMATION:				

FUEL SYSTEM		3D RFI	3D RFI PREMIUM
Fuel injection type		Rotax Fuel Injection, semi-direct, single throttle body (56 mm)	
Fuel pressure		56 PSI - 60 PSI	
Idle speed (in water)		1550 ± 100 RPM	
Throttle Position Sensor (TPS)		1.6 kΩ - 2.4 kΩ (terminals 3-4) 710 Ω - 1380 Ω (terminals 4-11)	
Crankshaft Position Sensor (CPS)		774 Ω - 946 Ω	
Air Temperature Sensor (ATS)		2.28 kΩ- 2.74 kΩ	
Water Temperature Sensor (WTS)		2.28 kΩ - 2.74 kΩ	
Air Pressure Sensor (APS)		3.4 Ω - 8.2 Ω (terminals 2-9) 2.4 Ω - 8.2 Ω (terminals 1-2)	
RAVE solenoid		30 Ω	
Fuel injector		2.4 ± 0.1 Ω	
Fuel	Type	**Regular** unleaded gasoline	
	Minimum octane no.	Inside North America: 87 (R + M) / 2	
ADDITIONAL INFORMATION:		Outside North America: 91 RON	

COOLING	3D RFI	3D RFI PREMIUM
Type	Open circuit — Direct flow from jet propulsion unit	
Thermostat	None	
Monitoring beeper setting	86 - 94°C (187 - 201°F)	
ADDITIONAL INFORMATION:		

PROPULSION		3D RFI	3D RFI PREMIUM
Propulsion system		BOMBARDIER Formula pump	
Jet pump type		Axial flow single stage	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Coupling type		Rubber coupling, split FR & RR	
Oil type		XP-S™ synthetic jet pump oil or SAE 75W90 GL5	
Steering nozzle pivoting angle		20°	
VTS nozzle pivoting angle		± 4.3°	± 9°
Minimum required water level		90 cm (35 in)	
Drive shaft deflection (maximum)		0.5 mm (.020 in)	
Impeller outside diameter		155.0 mm (6.102 in)	
Impeller/wear ring clearance	New	0.0 - 0.4 mm (.000 - .016 in)	
	Wear limit	1.0 mm (.040 in)	
Impeller shaft end play (new)		0	
Impeller shaft side play		0.05 mm (.002 in)	
Impeller pitch/material		Progressive pitch 11° - 20°/stainless steel	
ADDITIONAL INFORMATION: Do not mix different brands or oil types.			

DIMENSIONS	3D RFI	3D RFI PREMIUM
Number of passenger (driver incl.)	1	
Overall length	272 cm (107 in)	
Overall width	112 cm (44 in)	
Overall height	Vert: 92 cm (36.25 in) Moto: 112 cm (44.25 in) Kart: 96 cm (37.75 in)	
Dry weight	Vert: 257 kg (565 lb) Moto: 266 kg (585 lb) Kart: 273 kg (600 lb)	
Load limit (passenger and luggage) 10 kg (22 lb)	114 kg (250 lb)	
ADDITIONAL INFORMATION:		

CAPACITIES		3D RFI	3D RFI PREMIUM
Fuel tank (including reserve)		35 L (9.2 U.S. gal)	
Fuel tank reserve (from low level signal)		5 L (1.3 U.S. gal)	
Oil injection reservoir		4 L (1.0 U.S. gal)	
Jet pump impeller shaft reservoir	Capacity	100 mL (3.4 U.S. oz)	
	Oil level height	Up to plug	
ADDITIONAL INFORMATION:			

MATERIALS	3D RFI	3D RFI PREMIUM
Hull	Composite	
Inlet grate	Aluminum	
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum	
Air intake silencer	Thermoplastic	
Flame arrester	Multi-layer wire screen	
Steering padding	Thermoplastic	
Fuel tank	Polyethylene	
Oil injection reservoir	Polyethylene	
Seat	Polyurethane foam	
ADDITIONAL INFORMATION:		

PERFORMANCE		3D RFI	3D RFI PREMIUM
Estimated pump power		42.6 kW (57 HP)	
Maximum fuel consumption at wide open throttle		38 L/h (10 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	47 minutes	
	Fuel tank reserve (from low level signal)	8 minutes	
ADDITIONAL INFORMATION:			

ELECTRICAL CONNECTORS

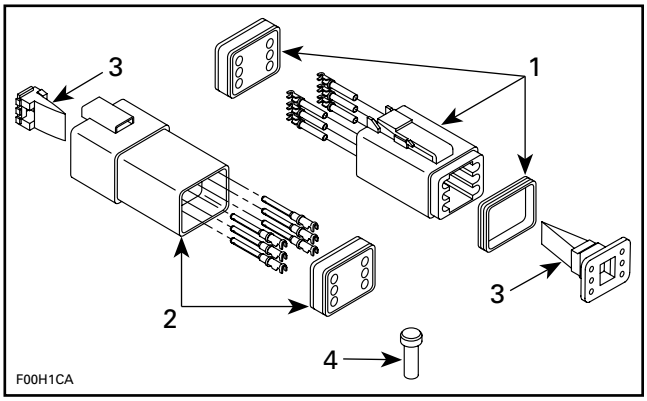
SERVICE TOOLS

Description	Part Number	Page
crimper die	529 035 906	369
crimper die	529 035 908	365
crimping pliers	529 035 730	372
crimping tool	529 035 909	365, 369

DEUTSCH CONNECTORS

Deutsch connectors are used to connect wiring harness to the magneto the electrical box (some models) and the VCK (RFI models).

Connector Disassembly

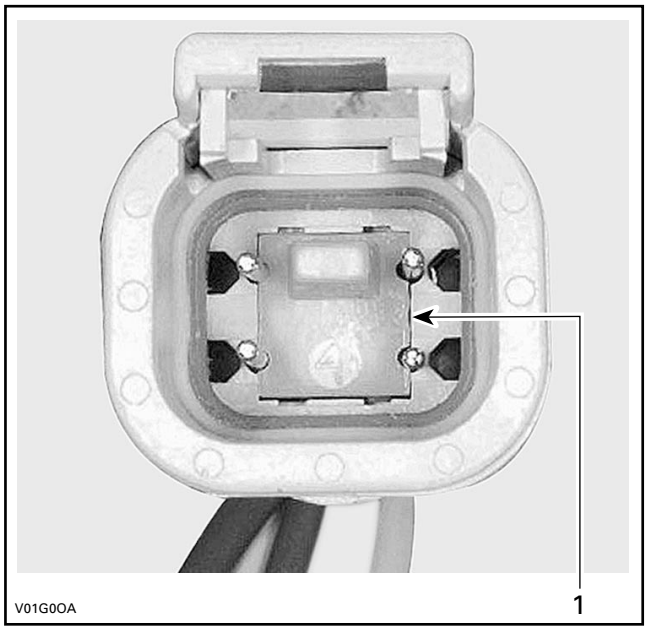


1. *Male connector*
2. *Female connector*
3. *Secondary lock*
4. *Sealing cap*

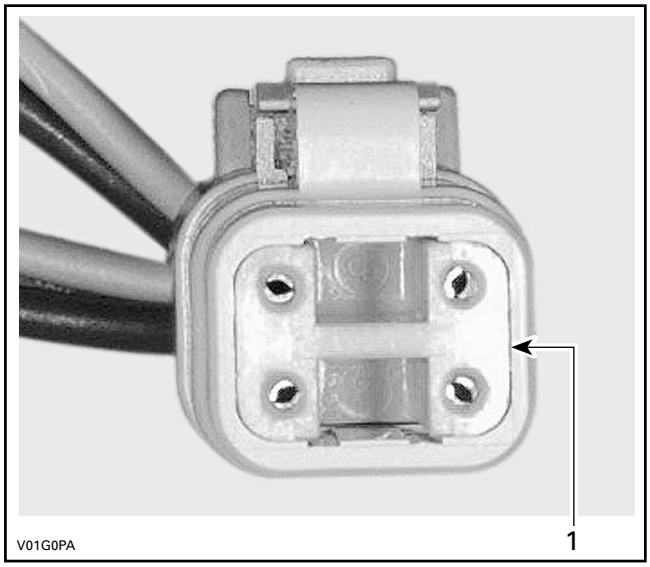
CAUTION: Do not apply dielectric grease on terminal inside connector.

To remove terminals from connector, proceed as follows:

– Using a long nose pliers, pull out the lock.



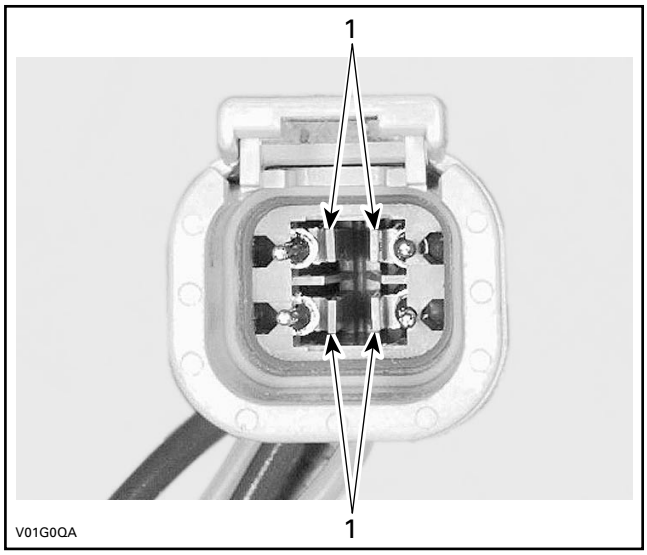
FEMALE CONNECTOR
1. *Female lock*



MALE CONNECTOR
1. Male lock

NOTE: Before extraction, push wire forward to relieve pressure on retaining tab.

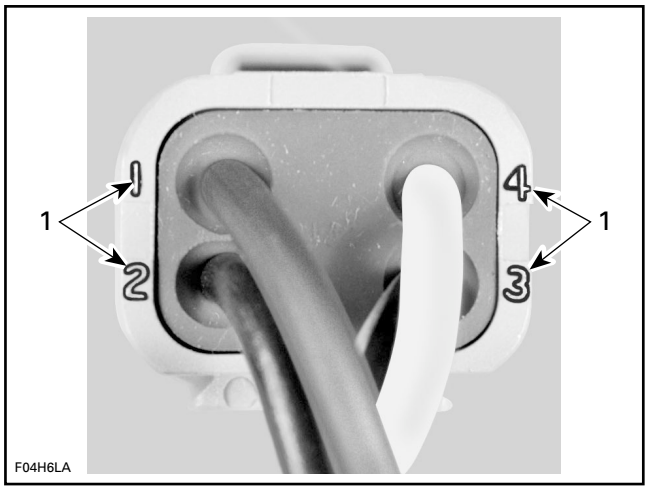
– Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
– Pry back the retaining tab while gently pulling wire back until terminal is removed.



FEMALE CONNECTOR
1. Retaining tab

To install:

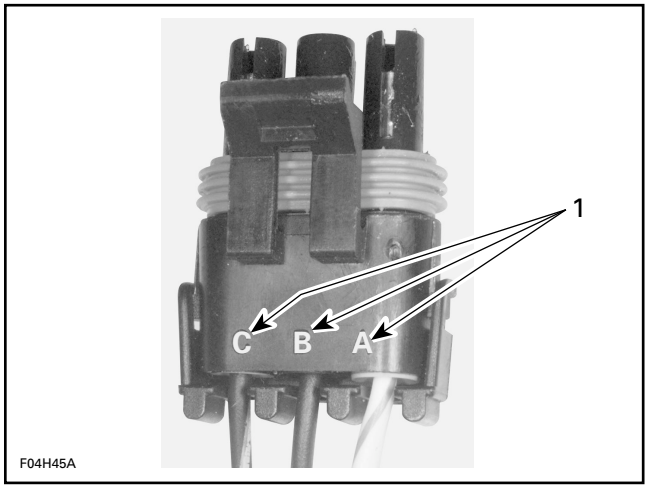
– For insertion of a terminal, make sure the lock is removed.
– Insert terminal into appropriate cavity and push as far as it will go.
– Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
– After all required terminals have been inserted, the lock must be installed.



1. Wire identification numbers

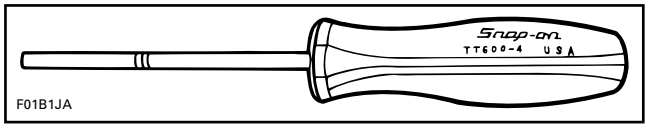
PACKARD CONNECTOR

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.

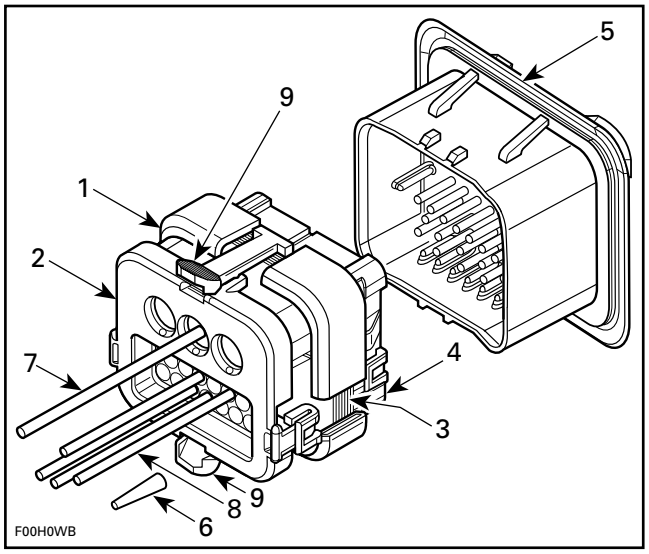
AMP CONNECTOR

GTI Series with 717 Engine

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.

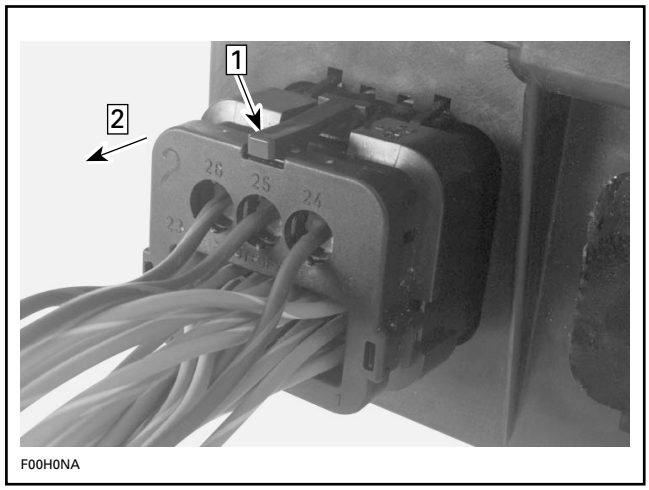
Description



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.

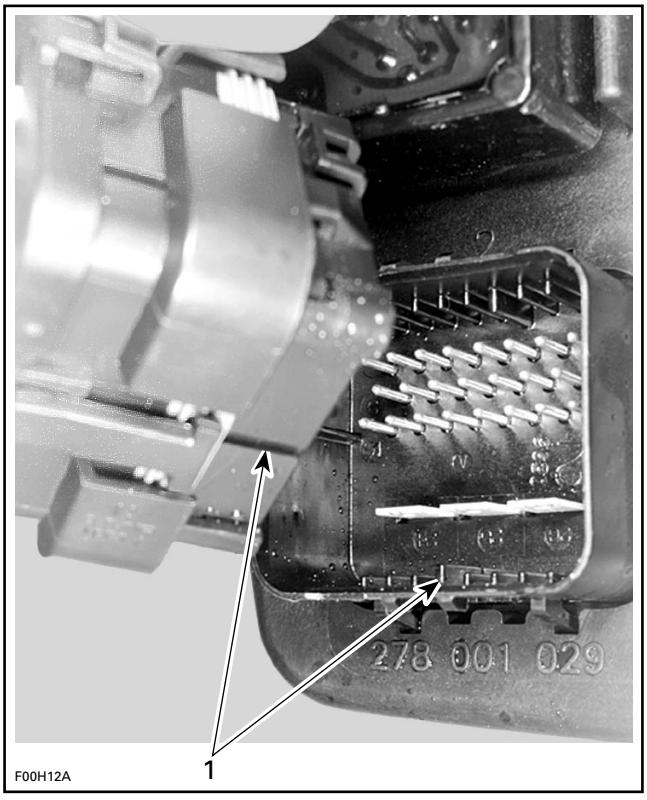


Step 1: Press tabs (both sides)
Step 2: Pull male connector

Installation

Do not apply any product to the pins of the connectors on the MPEM.

Each male connector is mechanically keyed to mate only with identical mechanical keyed connector on the MPEM.



1. *Mechanically keyed*

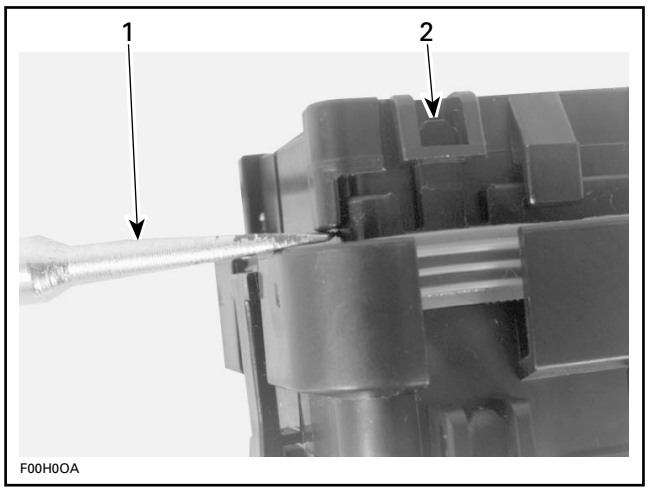
Terminal Removal

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.

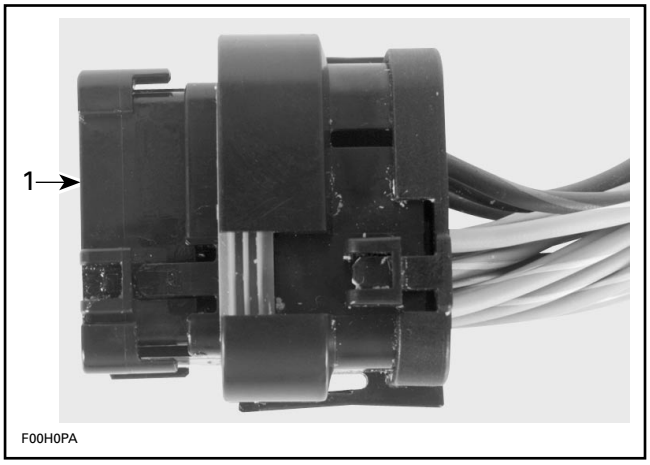
CAUTION: The wedge lock should never be removed from the connector for insertion or removal of the signal wire terminals.



1. Screwdriver between wedge lock and connector
2. Locking tab

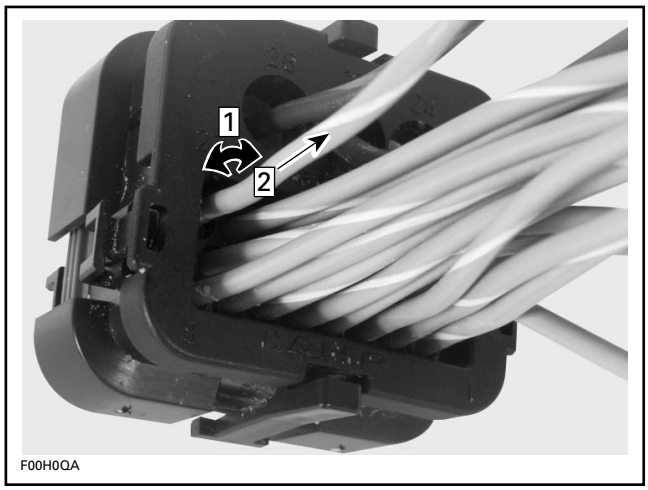
Repeat the same steps for the other locking tab retaining the wedge lock.

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.



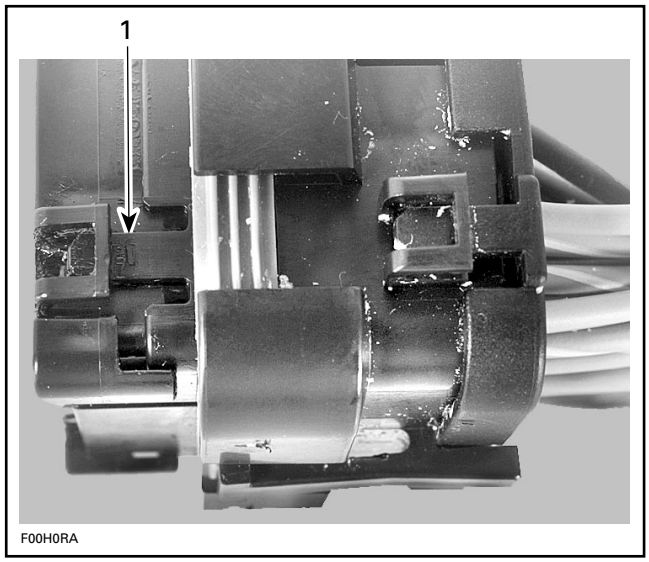
Step 1: Rotate wire back and forth
Step 2: Pull wire

POWER WIRE TERMINAL

NOTE: The wedge lock must be removed to extract power terminal.

Open the wedge lock.

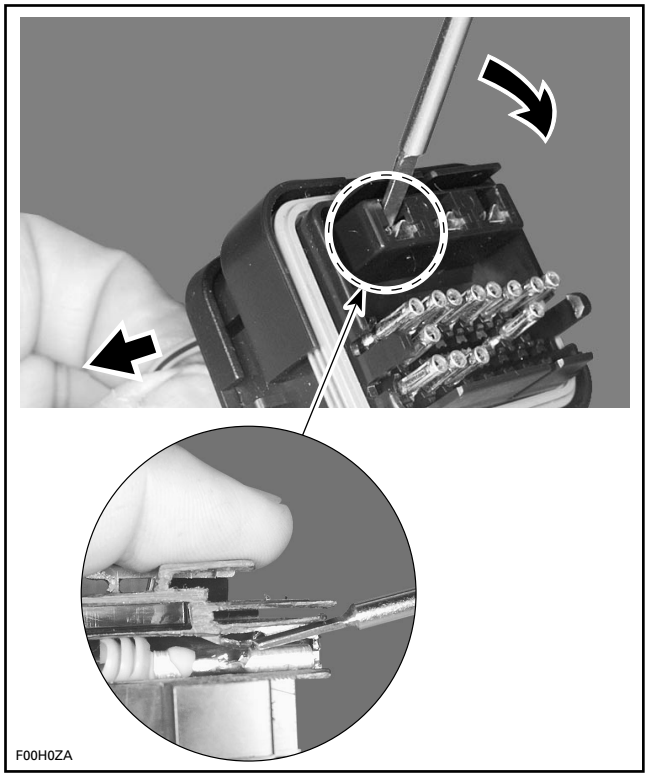
Pull both locking tabs and remove wedge lock from connector.



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

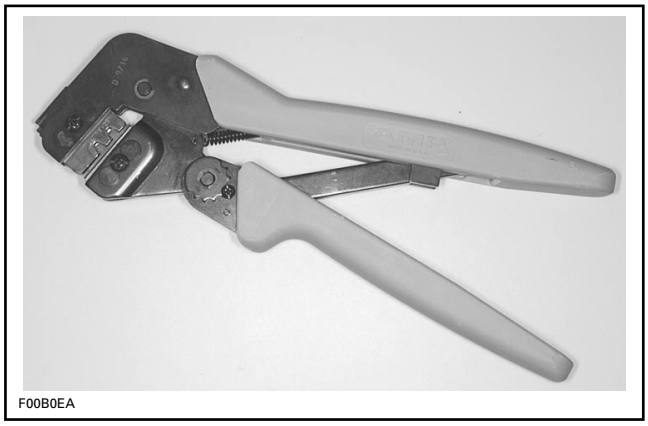
The size of the wires must be 20 to 16 AWG with a wire insulation diameter having a minimum dimension of 1.7 mm (.067 in) and a maximum dimension of 2.78 mm (.106 in).

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).

CAUTION: If terminals are not crimped using the proper crimping tool, the wire seal may be damaged.

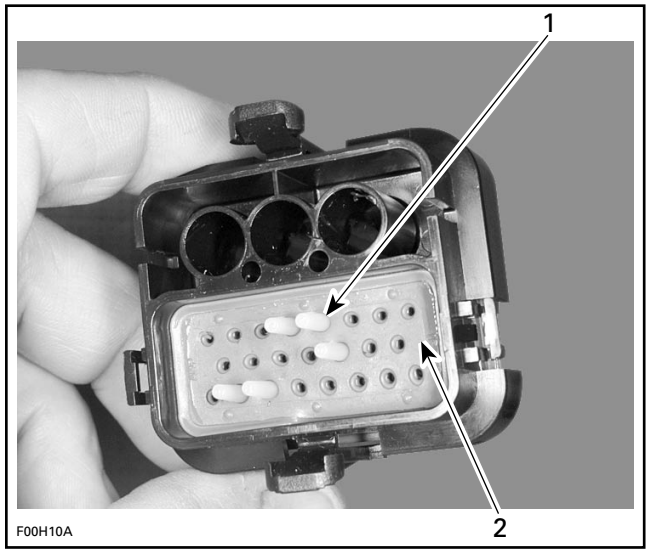


CRIMPING TOOL

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.

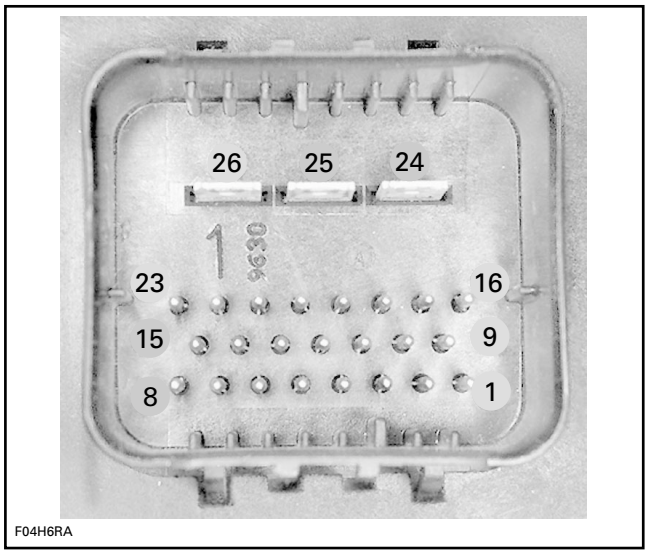
Insert terminal into appropriate circuit cavity and push as far as it will go.

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.

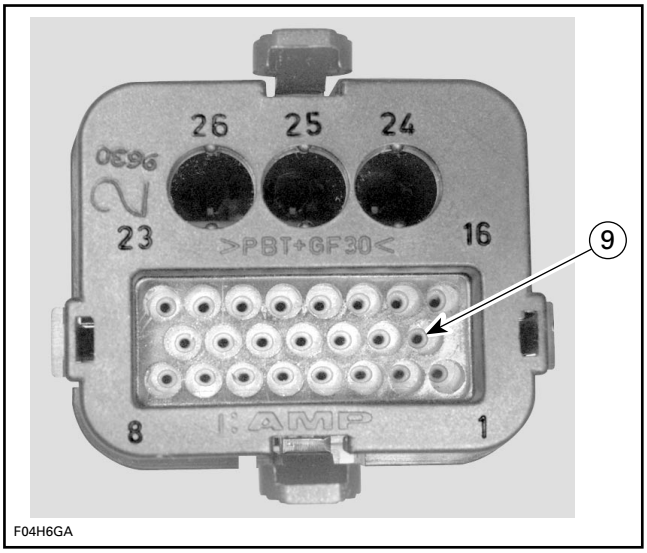
Terminal Identification

AMP Connectors of MPEM



F04H6RA

AMP Connectors of Wiring Harness

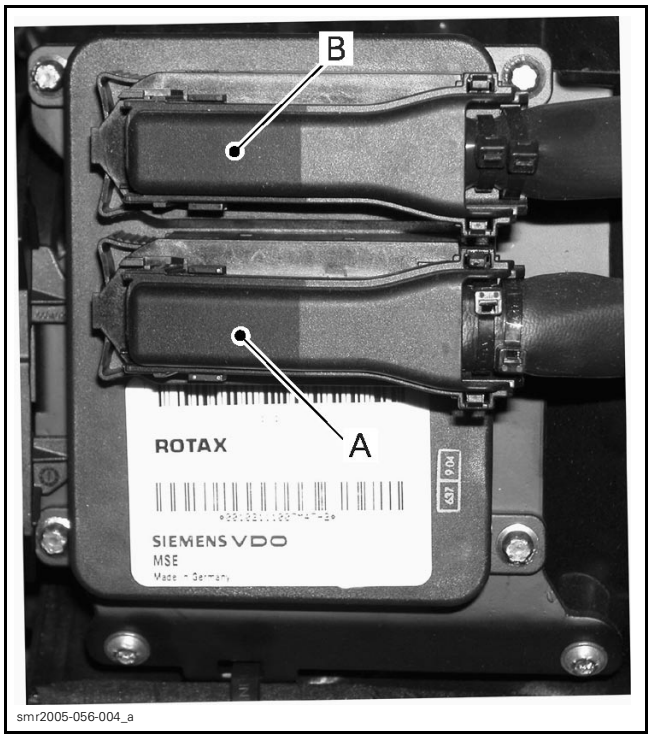


F04H6GA

ECM CONNECTORS

GTI Series with 787 RFI Engine

There are two ECM connectors used on the RFI 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 engine connector has 41 pins.



smr2005-056-004_a

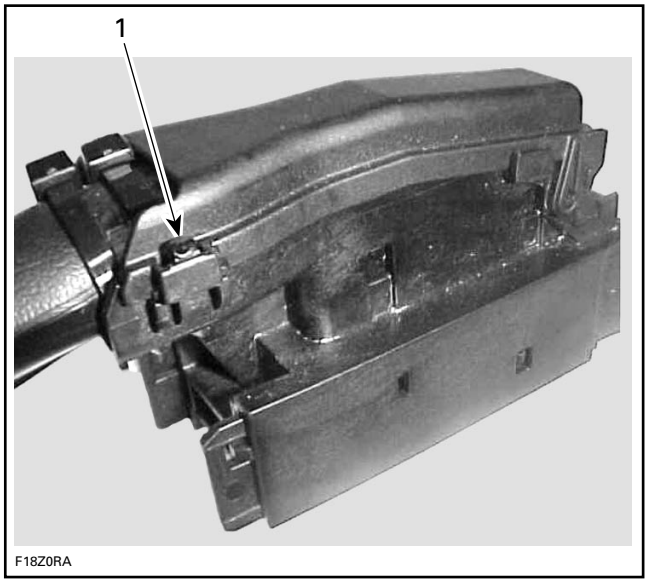
ECM CONNECTORS IDENTIFICATION

CAUTION: Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected frequently.

CAUTION: For adequate probing techniques and tool, refer to ENGINE MANAGEMENT section.

Terminal Removal

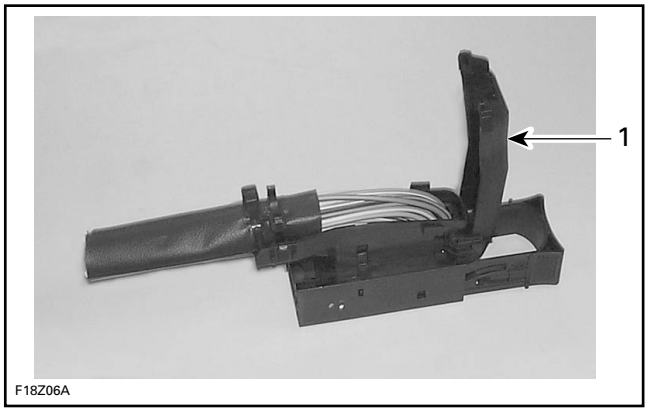
Unlock the connector cover by pushing in the tabs on top of the connector with a flat screwdriver to be able to flip the top cover up.



F18Z0RA

1. Push in tab

Lift the cover by pushing it forward.



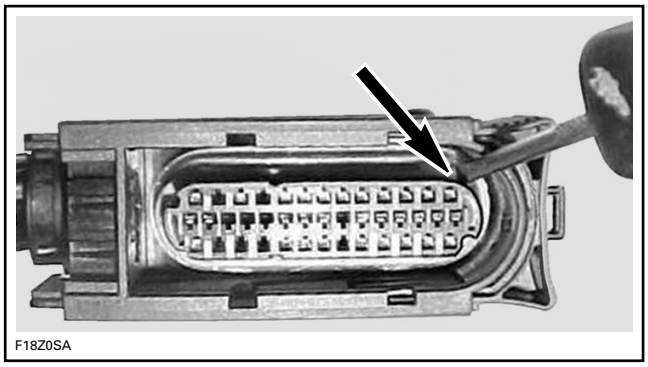
F18Z06A

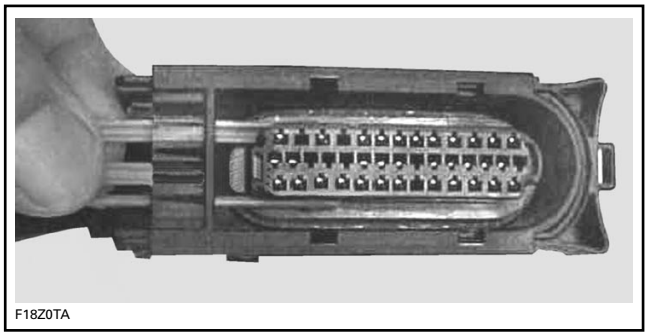
1. Cover

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.

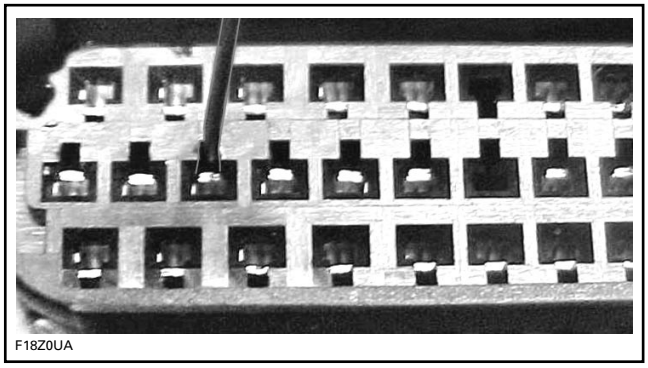


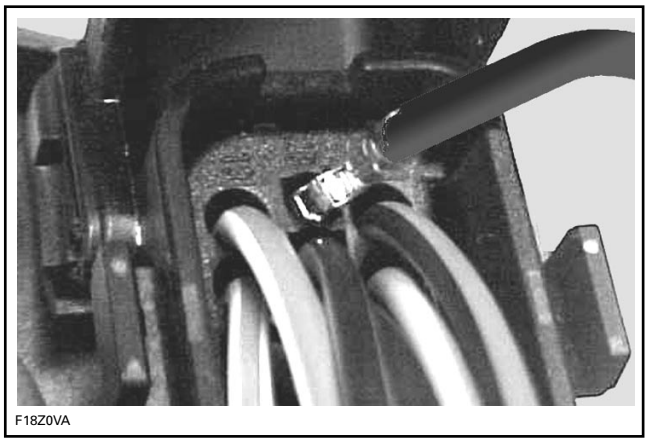


A terminal remover such as Snap-On TT600-1 (or a 0.76 mm (.030 in) oxyacetylene torch tip cleaner or a #68 drill bit) must be inserted into the terminal cavity to release the locking tab from the connector.

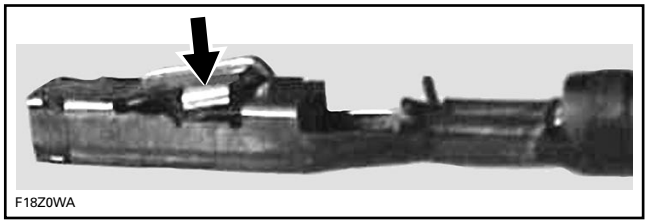
CAUTION: Using a tool tip larger than 0.76 mm (.030 in) may damage the terminal.

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.





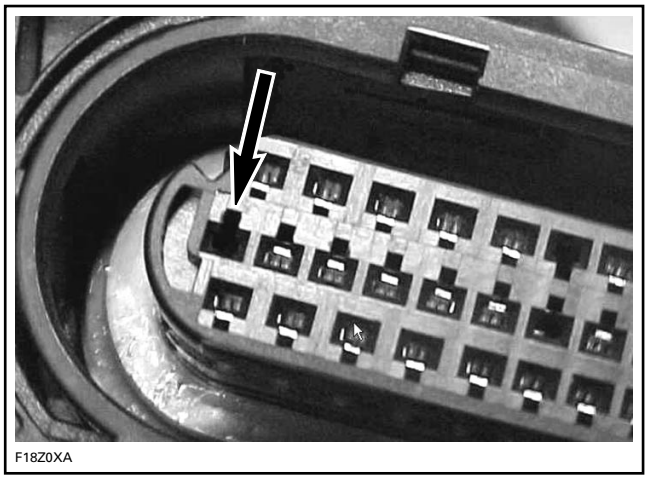
Check the locking tab on the terminal, it may have to be bent out a little so it will lock in its cavity when it is re-inserted.



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.

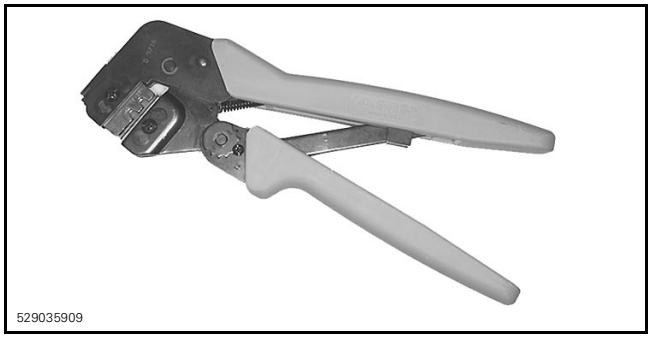

F18Z0XA

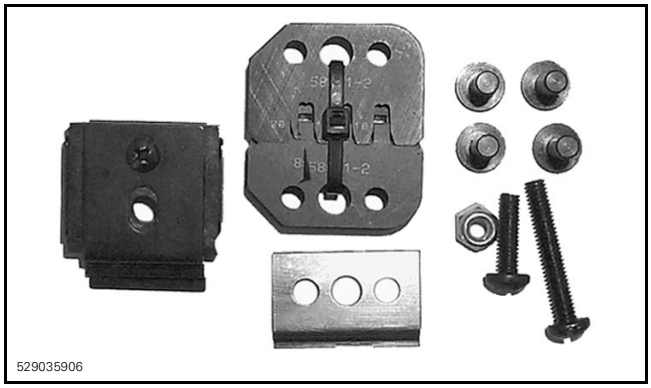
Insert the terminal, ensuring the locking tab snaps into its cavity.

Re-install the orange locking tab, attach the 2 tie raps, and close the connector cover.

Terminal Crimping (Kostal)

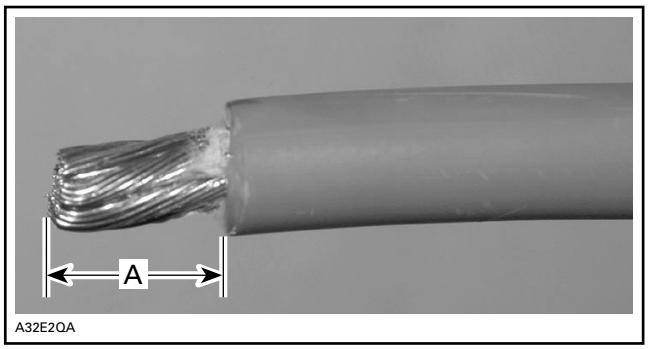
To crimp a new connector terminal, use the crimping tool (P/N 529 035 909) and the crimper die (P/N 529 035 906).


529035909


529035906

To properly crimp the wires, strictly follow this procedure.

Strip the wire to a maximum of 3 mm (1/8 in).

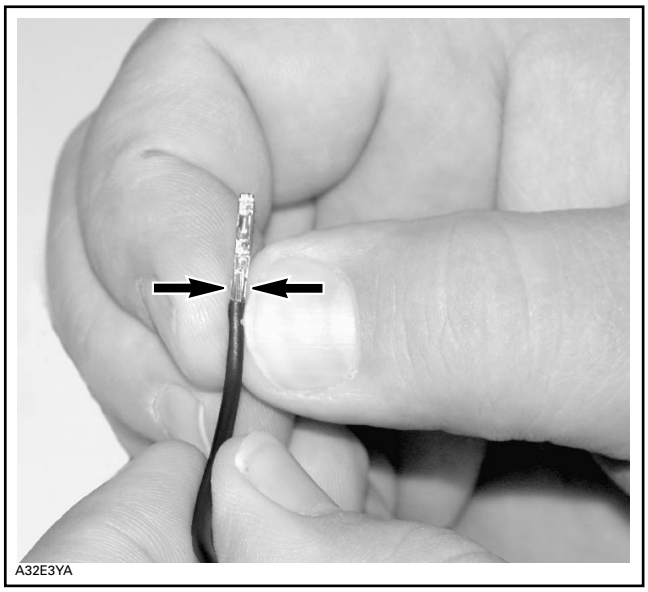


A32E2QA

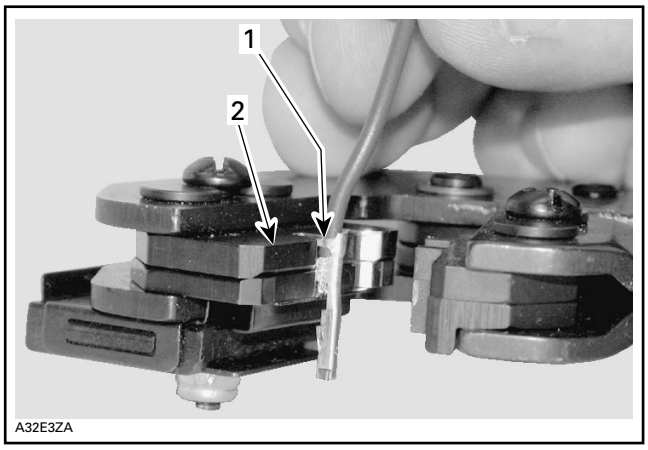
TYPICAL
A. 3 mm (1/8 in) max.

Position wire in terminal.

Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.


A32E3YA

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

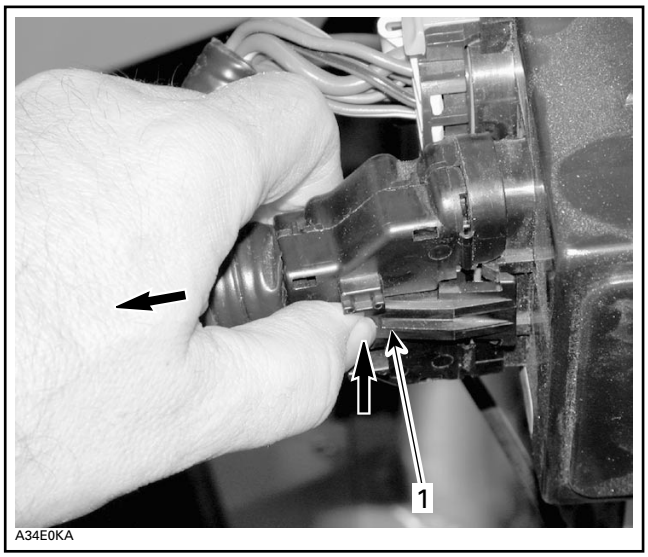
Do not apply any product to the pins of the connector on the ECM.

VCM CONNECTORS

GTI Series with 787 RFI Engine

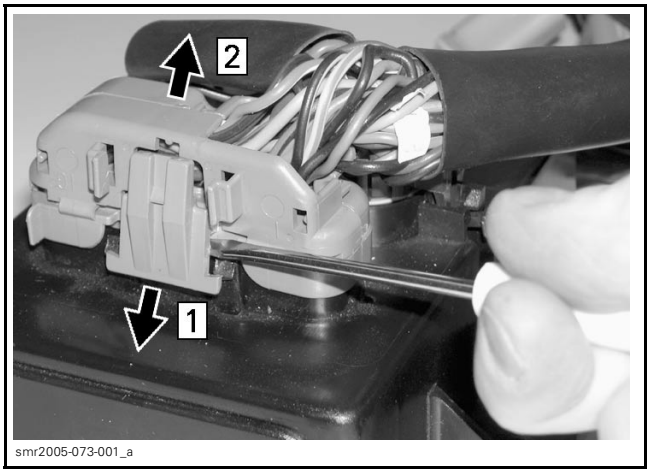
32-Pin Connector

Firmly push down tab and hold to unlock connector while pulling it out.

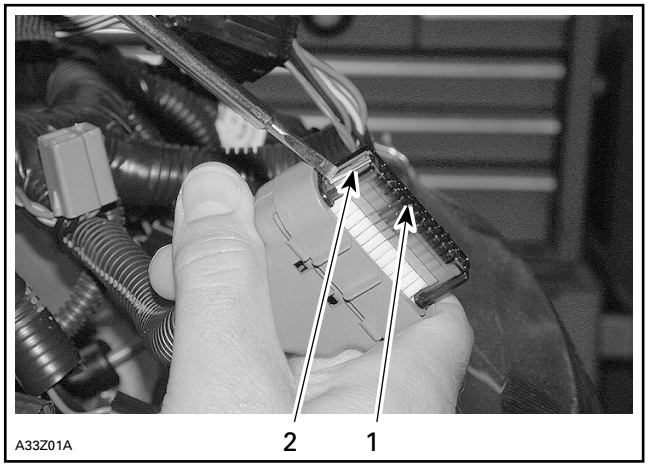


TYPICAL
1. Firmly push tab and hold while pulling connector out

NOTE: A small screw driver may be used to release locking tab while pulling connector out.

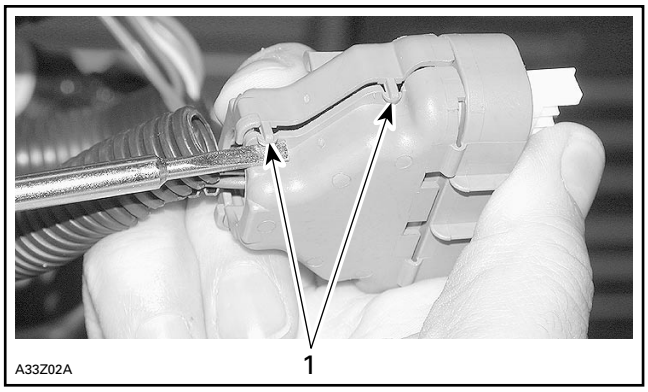


Push on both tabs to remove retainer.



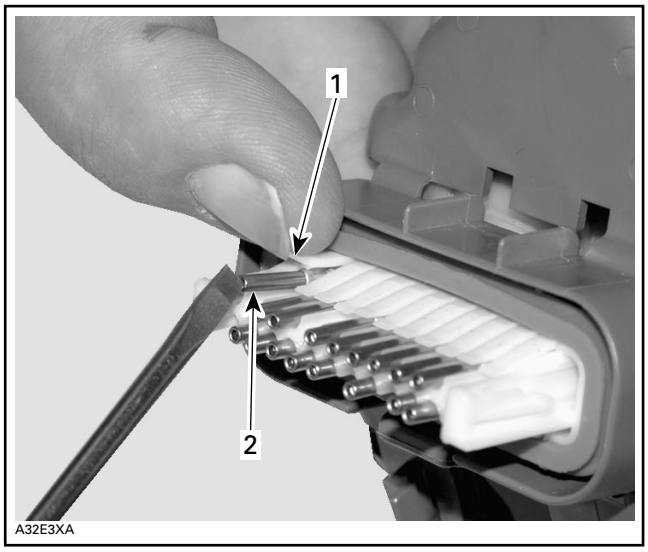
TYPICAL
1. Retainer
2. Tab (one on each side)

Open housing by lifting 4 tabs.



TYPICAL
1. Tabs (2 on each side)

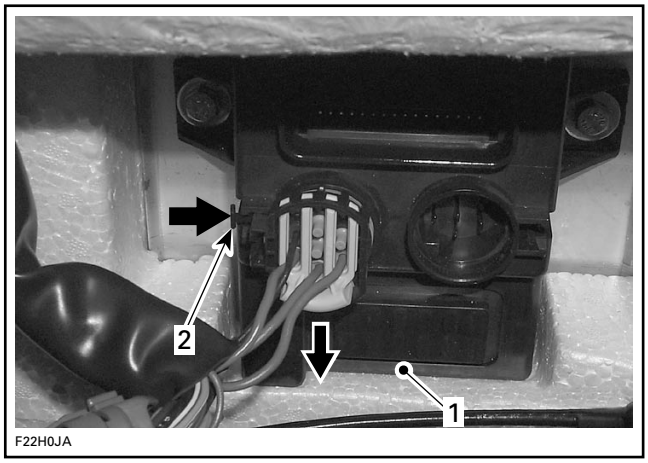
Lift the top plastic lock of the female terminal to be removed and hold in position. Lift the female terminal to unlock from the housing and push out of housing.



TYPICAL
1. Lift and hold plastic lock
2. Lift to unlock and push out

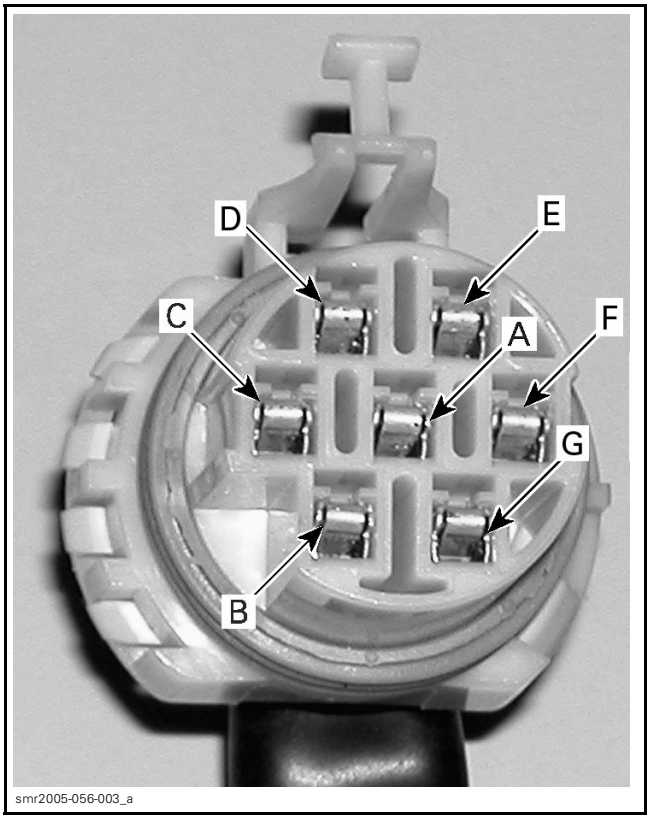
7-Pin Connector

Firmly push down tab and hold to unlock connector while pulling it out.



TYPICAL
1. VCM (vehicle control module)
2. Firmly push down this tab and hold while pulling out connector

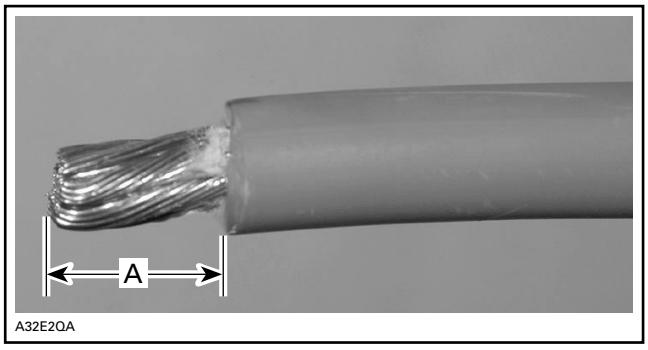
Refer to the illustration for the connector pinout.



BATTERY AND STARTER CABLE CONNECTORS

Crimping

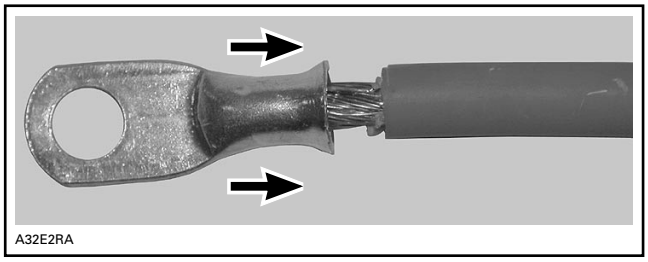
Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.



A. 10 mm (3/8 in)

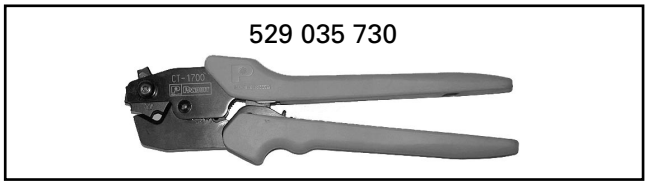
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate parts catalog.

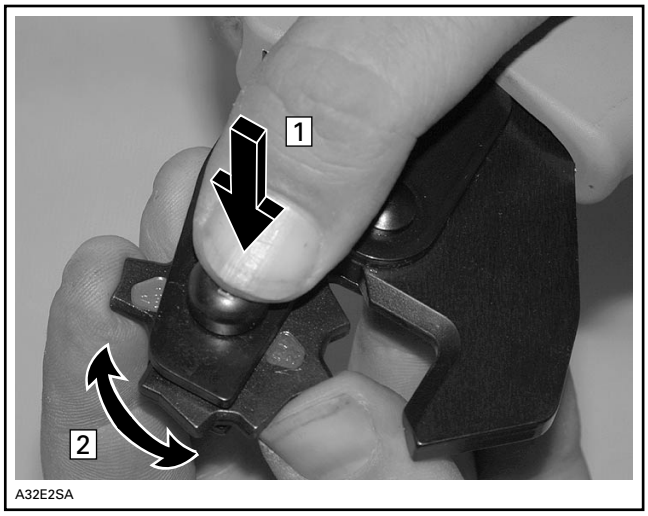


INSTALLATION OF TERMINAL

Follow the instructions provided with the crimping pliers (P/N 529 035 730) to select the proper position of the tool.

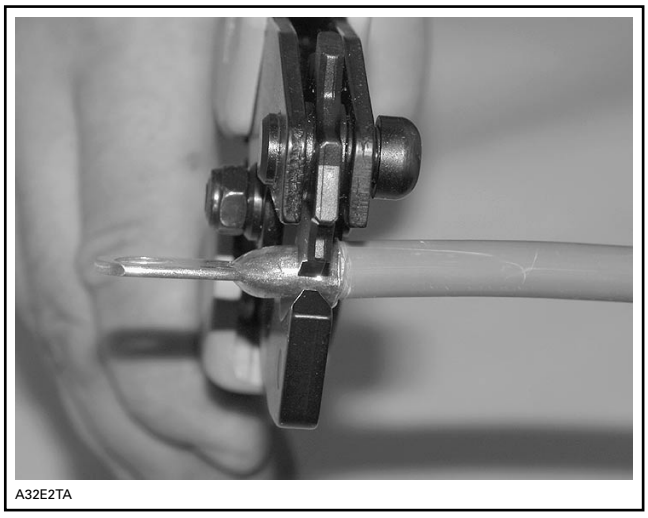


NOTE: Different wires require different crimping pliers settings, so make sure to follow the instruction supplied with the tool.

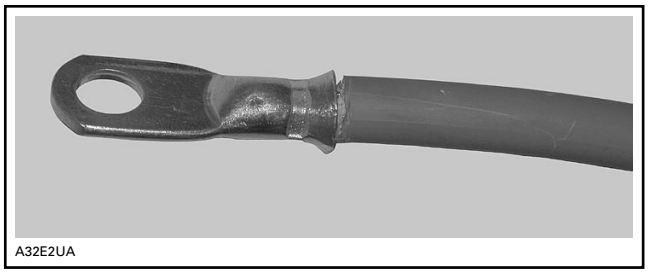


POSITIONING THE CRIMPING PLIERS
Step 1: Press
Step 2: Rotate

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.

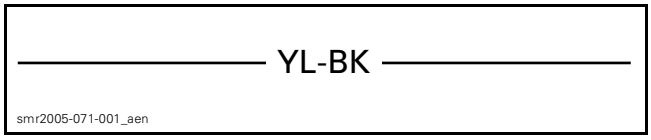
CAUTION: Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.

WIRING DIAGRAMS

WIRE COLOR CODES

First color of a wire is the main color. Second color is the tracer.

Example: YELLOW/BLACK (YL-BK) is a YELLOW wire with a BLACK tracer.

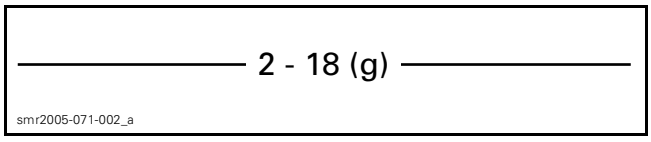


General Wire Color Use

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

On the MPEM, circuits are identified by a number followed by another number and if necessary by a letter.



First number indicates in which connector the wire is plugged in.

Second number indicates the position of the wire in the connector.

The letter at the end of the number (if applicable) indicates a common circuit in the MPEM printed circuit with another wire bearing the same letter.

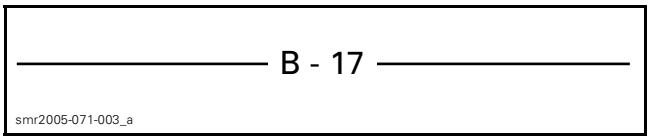
The first number indicates that the wire is positioned in the connector **no. 2** of the MPEM.

The second number indicates that the wire is positioned in cavity **no. 18** of the connector.

The letter (g) indicates a common circuit with another wire(s) bearing the same letter (g) in the circuit.

GTI RFI, GTI RFI LE and 3D Series

On the ECM, circuits are identified by a letter followed by a number.



The letter indicates in which connector the wire is plugged in.

The number indicates the position of the wire in the connector.

The connector "A" is connected to the engine wiring harness.

The connector "B" is connected to the watercraft wiring harness.

NOTES

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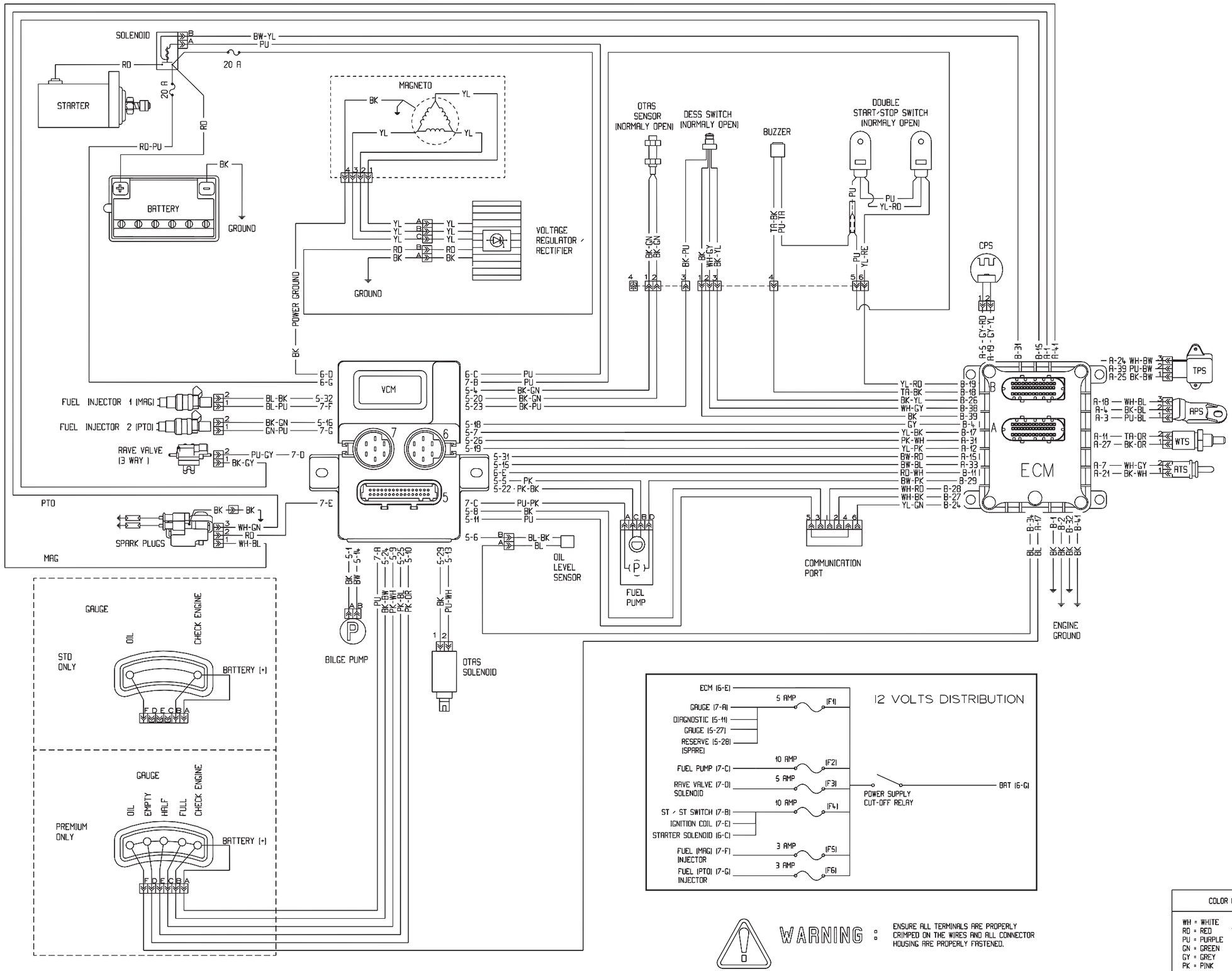
2005 3 D MODEL



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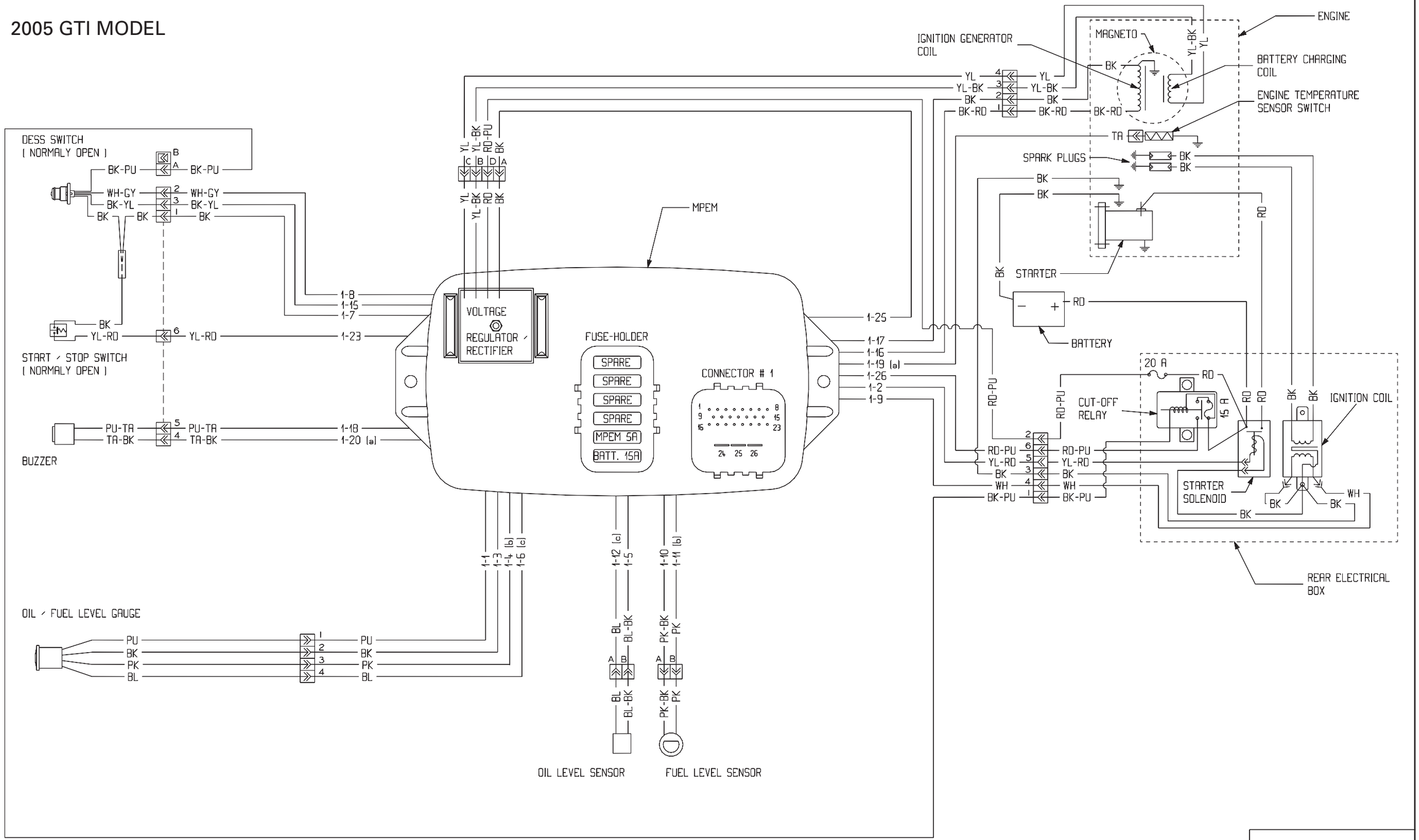
2005 GTI MODEL



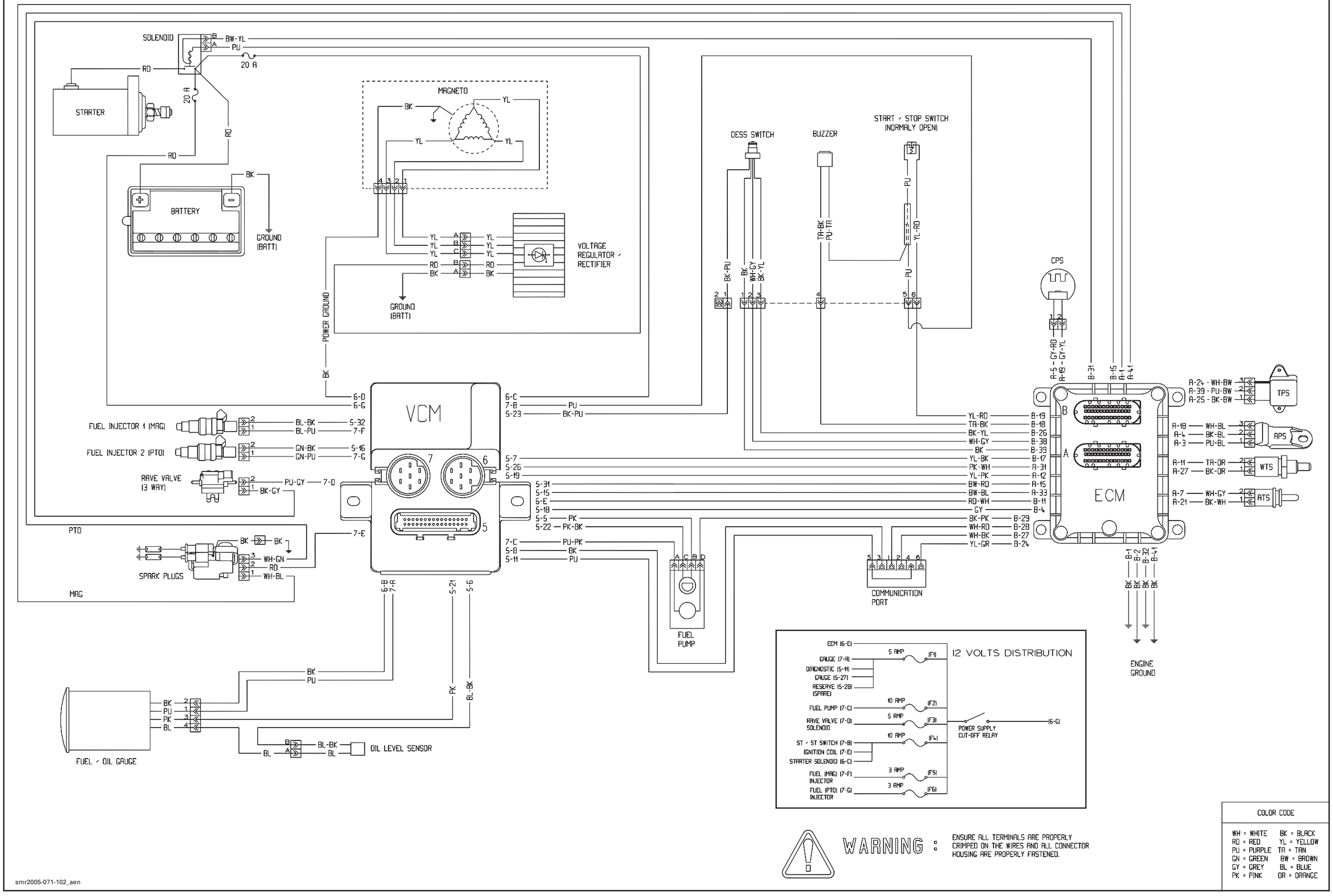
COLOR CODE

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

WARNING : ENSURE ALL TERMINALS ARE PROPERLY CRIMPED ON THE WIRES AND ALL CONNECTOR HOUSING ARE PROPERLY FASTENED.

smr2005-071-101_aen

2005 GTI RFI MODEL



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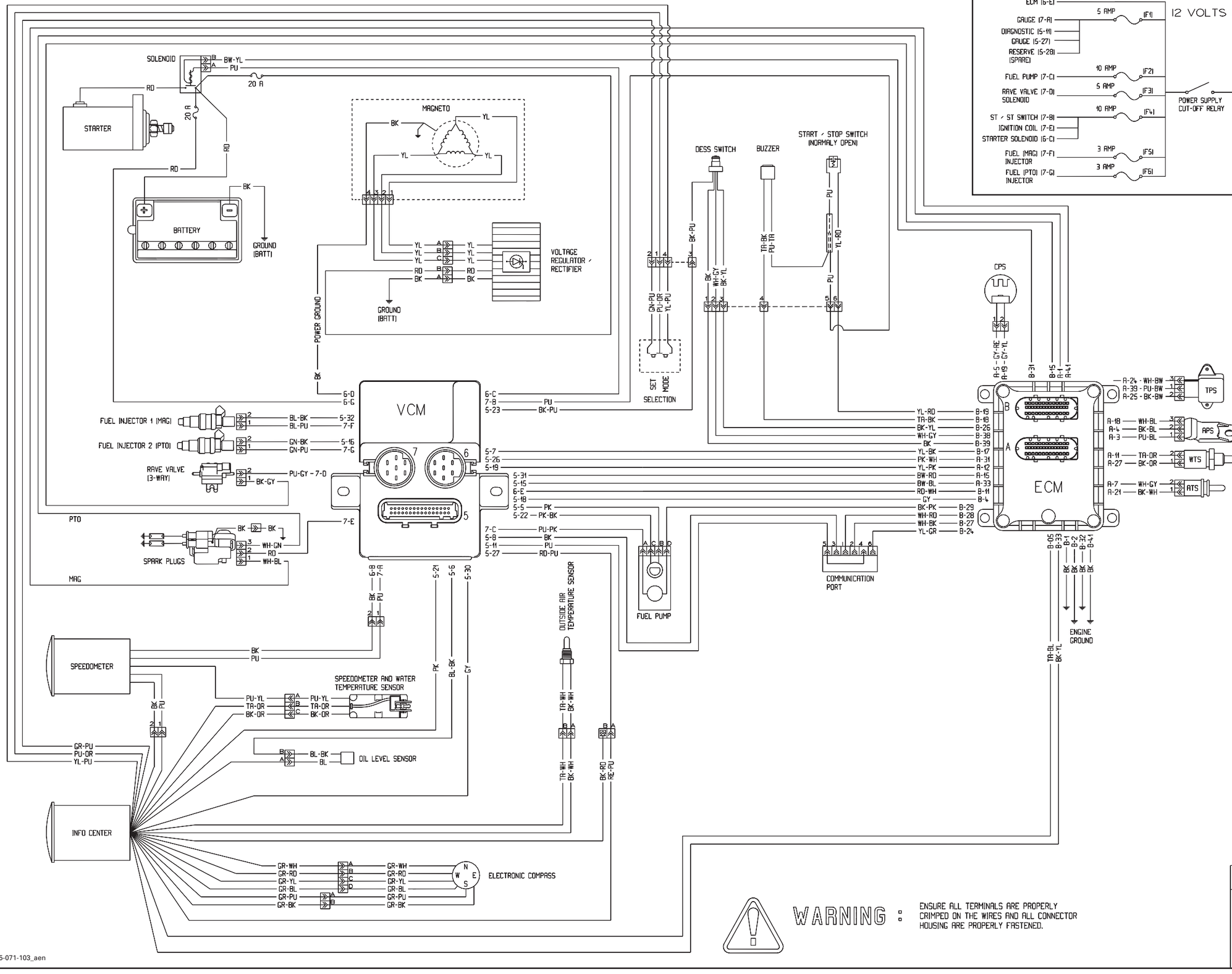
2005 GTI LE RFI MODEL



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VEHICLE SHOP MANUAL, 2-STROKES MODELS / ENGLISH
MANUEL DE RÉP. VÉHICULE, MODÈLES 2 -TEMPS / ANGLAIS

FAIT AU / MADE IN CANADA U/M:P.C.