

SEA-DOO

2001



Shop Manual

GS 5519

GTS 5521

GTI 5523

GTX 5527/5538

GTX RFI 5525/5555

GTX DI 5529/5541

RX 5533/5543

RX DI 5535/5537

XP 5531

219 100 128

2001 Shop Manual

GS, GTS, GTI, GTX, GTX RFI,
GTX DI, XP, RX, RX DI

BOMBARDIER
RECREATIONAL PRODUCTS



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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair all 2001 SEA-DOO watercraft. See model list below.

This edition was primarily published to be used by watercraft mechanical technicians who are already familiar with all service procedures relating to Bombardier made watercraft. Mechanical technicians should attend training courses given by Bombardier Training Dept.

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

This *Shop Manual* uses technical terms which may be slightly different from the ones used in the *Parts Catalog*.

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

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

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

The use of Bombardier 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.

Torque wrench tightening specifications must be strictly adhered to. Locking devices (ex.: locking tab, self-locking fasteners, etc.) must be installed or replaced with new ones. If the efficiency of a locking device is impaired, it must be renewed.

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.

Bombardier 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.

WHAT'S NEW

WHAT'S NEW

THIS SECTION INDICATES PROCEDURES THAT WERE MODIFIED OR NEWLY ADDED IN THIS MANUAL.

RX, RX DI and GTX DI models have been merged with this manual.

RFI fuel injection section has been relocated in its own Engine Management section.

SERVICE TOOLS AND PRODUCTS

The following new tools have been added:

- Oil seal pusher for 787 RFI engines.
- Crankshaft protective cap for all models.
- Deutsch tool for joint connector on DI models.
- New Loctite safety solvent number.
- New Anti-seize lubricant number.

MAINTENANCE

- Updated storage procedure.

TROUBLESHOOTING

- Updated

ENGINE

- New sequence to torque tuned pipe (all models).

ENGINE MANAGEMENT (RFI)

- Added conversion chart for temperature sensors.
- Added the general part.
- Updated fault code table.
- Updated the water temperature sensor tests.

ENGINE MANAGEMENT (DI)

- Updated the conversion chart for temperature sensors.
- Added a quick air/fuel pressure test.
- Updated throttle body synchronization.
- Updated procedures for fuel injector, fuel pressure regulator and air pressure regulator available as single spare parts.
- Updated MPEM replacement procedure.
- Updated the fuel delivery system diagnostic flow chart.

COOLING SYSTEM

- New diagram for the cooling system (all engines).

FUEL SYSTEM

- Updated procedure for air intake silencer removal/installation.
- Revised injector check valve pressure test on accelerator pump.

LUBRICATION SYSTEM

- Revised illustrations for oil injection pump adjustment.

ELECTRICAL SYSTEM

- Updated charging system procedure for RFI model.

PROPULSION SYSTEM

- Updated impeller chart.
- New procedure for oil inspection in jet pump.
- New procedure to remove venturi.
- New procedure to install bearings and seals in the housing.
- New tightening sequence for seal carrier of the mid bearing on the XP.
- New procedure to remove variable trim system on RX series.

HULL/BODY

- Seat adjustment for GTS/GTI/RX and RX DI.
- New drain plug.
- Tightening sequence for ride shoe.

TECHNICAL DATA

- Updated specifications for each model.

WIRING DIAGRAMS

- Added procedure to service the 30 A fuse on DI models.
- Updated wiring diagrams for each model.

INTRODUCTION

INTRODUCTION

This *Shop Manual* covers the following BOMBARDIER made SEA-DOO® 2001 watercraft models.

MODELS	ENGINE TYPE	MODEL NUMBER
GS	717	5519
GS International	717	5518
XP	947	5531
XP International	947	5530
GTS	717	5521
GTS International	717	5520
GTI	717	5523
GTI International	717	5522
GTX (red)	947	5527
GTX International (red)	947	5526
GTX (blue)	947	5538
GTX International (blue)	947	5539
GTX RFI	787	5525
GTX RFI International	787	5524
GTX RFI (green)	787	5555
GTX RFI International (green)	787	5553
GTX DI (blue)	947 DI	5529
GTX DI International (blue)	947 DI	5528
GTX DI (red)	947 DI	5541
GTX DI International (red)	947 DI	5540
RX (blue)	947	5533
RX International (blue)	947	5532
RX (yellow)	947	5543
RX International (yellow)	947	5542
RX DI (blue)	947	5535
RX DI International (blue)	947 DI	5534
RX DI (yellow)	947 DI	5537
RX DI International (yellow)	947 DI	5536

HULL IDENTIFICATION NUMBER (H.I.N.)

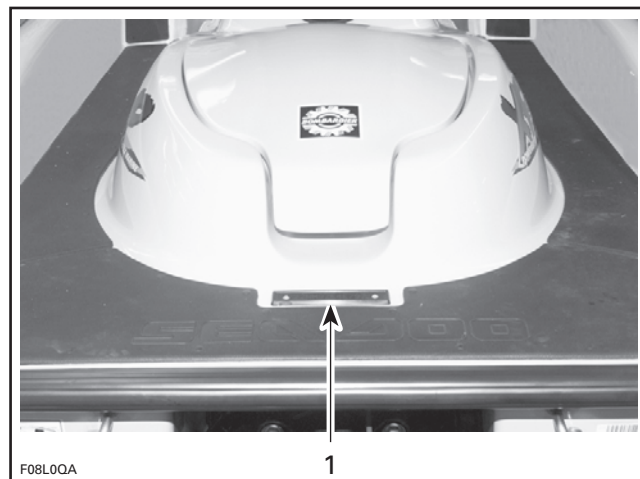
It is located on footboard at the rear of watercraft.

GTS, GTI and RX Series



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

All Other Models

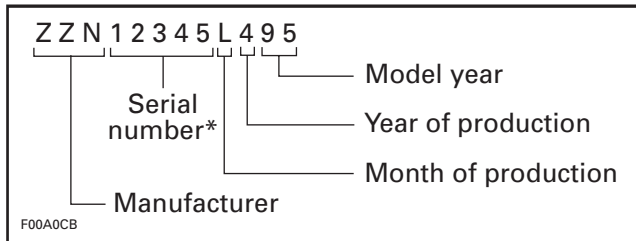


TYPICAL

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

All Models

The Hull Identification Number is composed of 12 digits:

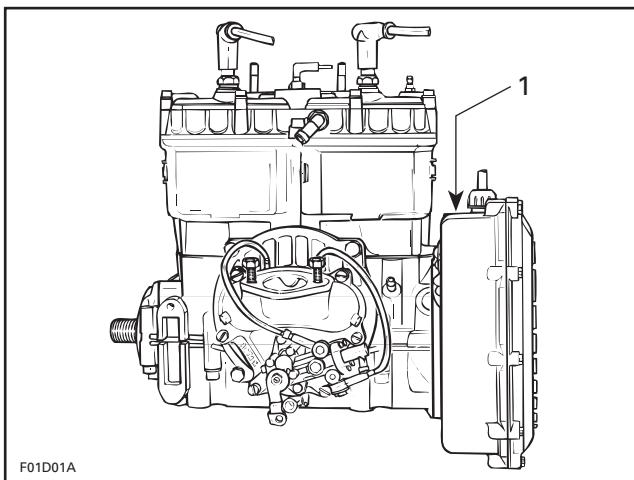


*A letter may also be used as a digit.

ENGINE IDENTIFICATION NUMBER (E.I.N.)

717 Engine

The Engine Identification Number is located on the upper side of the magneto housing.

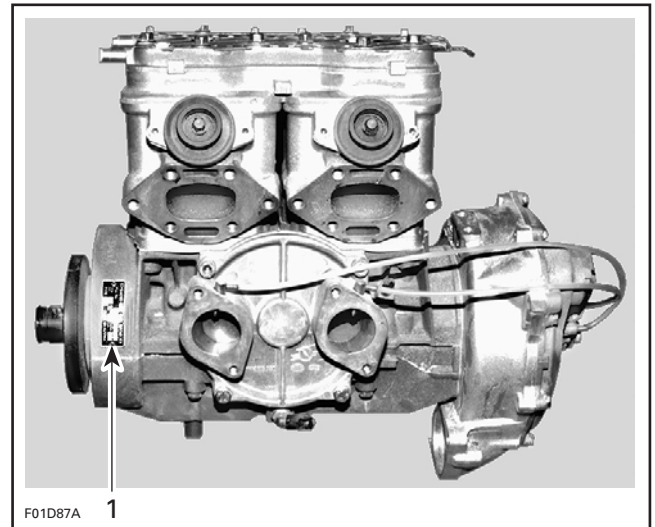


TYPICAL

1. Engine Identification Number (E.I.N.)

787 RFI Engine

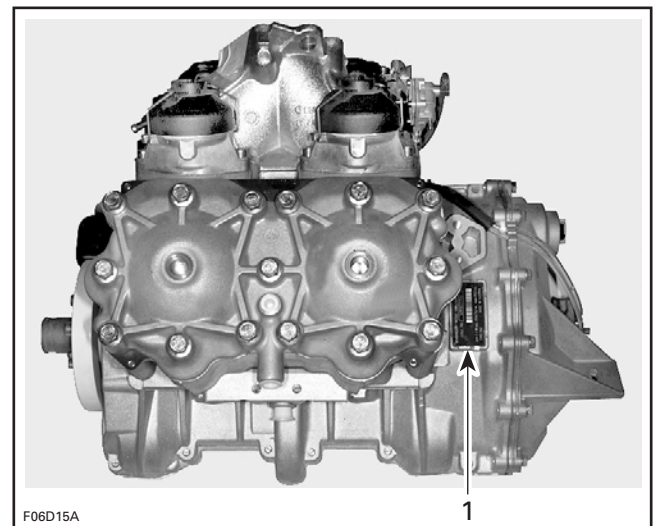
The Engine Identification Number is located on the upper crankcase on PTO side.



1. Engine Identification Number (E.I.N.)

947 Engine

The Engine Identification Number is located on the upper crankcase on MAGNETO side.



1. Engine Identification Number (E.I.N.)

INTRODUCTION

ARRANGEMENT OF THIS MANUAL

The manual is divided into 16 major sections:

- 01 SERVICE TOOLS AND PRODUCTS
- 02 MAINTENANCE
- 03 TROUBLESHOOTING
- 04 ENGINE
- 05 ENGINE MANAGEMENT (RFI)
- 06 ENGINE MANAGEMENT (DI)
- 07 COOLING SYSTEM
- 08 FUEL SYSTEM
- 09 LUBRICATION SYSTEM
- 10 ELECTRICAL SYSTEM
- 11 PROPULSION SYSTEM
- 12 STEERING SYSTEM
- 13 SUSPENSION
- 14 HULL/BODY
- 15 TECHNICAL DATA
- 16 WIRING DIAGRAM

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

TYPICAL PAGE

Section 03 ENGINE
Subsection 04 (MAGNETO SYSTEM)

MAGNETO SYSTEM
717 Engine

12, 11, 13, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 15, 14, 1

5 N•m (44 lbf•in)
9 N•m (80 lbf•in)
6 N•m (53 lbf•in)
6 N•m (53 lbf•in)
6 N•m (53 lbf•in)
9 N•m (80 lbf•in)
145 N•m (107 lbf•ft)
9 N•m (80 lbf•in)

Loctite 243
Loctite 243
Loctite 243
Loctite 243
Loctite 648
Anti-seize lubricant

F01D4WS
03-04-1

Subsection title indicates beginning of the subsection.

Page heading indicates section and subsection detailed.

Italic sub-title above exploded view indicate pertaining models.

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

Exploded view assists you in identifying parts and related positions.

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

Bold face number indicates special procedure concerning this part.

Tightening torque nearby fastener. In this case, nut must be torqued to 145 N•m (107 lbf•ft).

Illustration number for publishing process.

Page numbering system:
03: ENGINE section
04: MAGNETO SYSTEM subsection
1: First page of this subsection

CAUTION: Pay attention to torque specifications. Some of these are in lbf•in instead of lbf•ft. Use appropriate torque wrench.

F01A0CS

INTRODUCTION

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.

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

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

XP Model Only

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

All Others Models

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

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

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

DISASSEMBLY AND INSPECTION

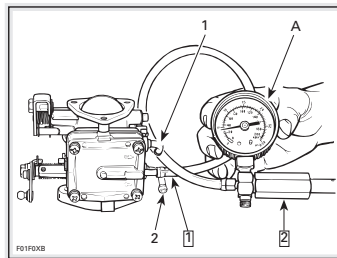
Inspect parts for corrosion damage (shaft, butterfly, spring, etc., check valve housing, etc.).

Diaphragm

PUMP DIAPHRAGM LEAK TEST

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

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



TYPICAL

- Step 1: Install pump gauge tester to pulse nipple.
- Step 2: Pump tester until it reaches the desired pressure.

1: Fuel outlet nipple
2: Fuel inlet nipple
A: 28 kPa (4 PSI)
Diaphragm must stand pressure for 10 seconds. If pressure drops, replace diaphragm.

Service tool to be used to perform a certain procedure.

Title in italic indicates a particular procedure concerning a model.

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

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.

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

Illustration always follows text it is pertained to.

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

Numbers in a frame are used to give a sequence to be performed.

Letters are used for any measures.

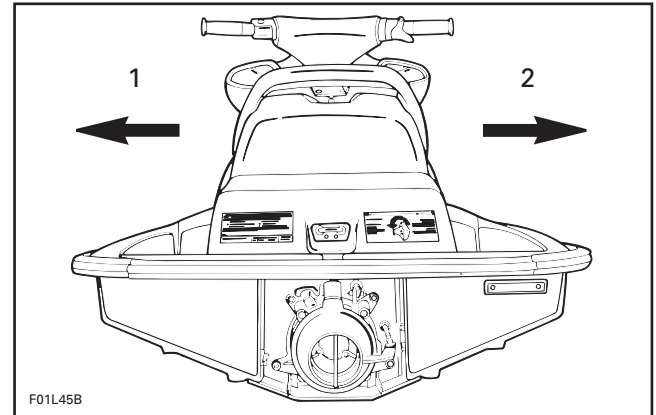
06-03-4

LIST OF ABBREVIATIONS USED IN THIS MANUAL

	DESCRIPTION
AC	Alternate Current
APS	Air Pressure Sensor
ATS	Air Temperature Sensor
B.U.D.S.	Bombardier 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
ECU	Electronic Control Unit
EPA	Environmental Protection Agency (USA)
HP	Horse Power
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
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

GENERAL INFORMATION

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



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

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

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

This *Shop Manual* uses technical terms which may be different from the ones of the *Parts Catalogs*.

When ordering parts always refer to the specific model *Parts Catalogs*.

ILLUSTRATIONS AND PROCEDURES

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

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

INTRODUCTION

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.

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 Bombardier 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 (Methyl-Chloride), let act during 30 minutes and wipe off. The solvent utilization is to ensure the adhesive works properly.

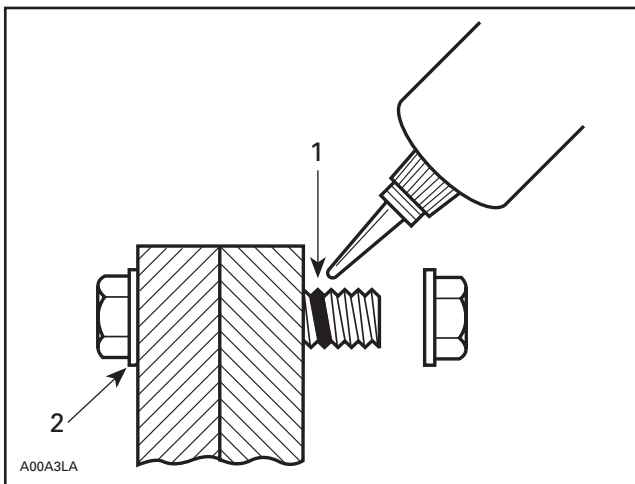
LOCTITE APPLICATION PROCEDURE

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

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

THREADLOCKER

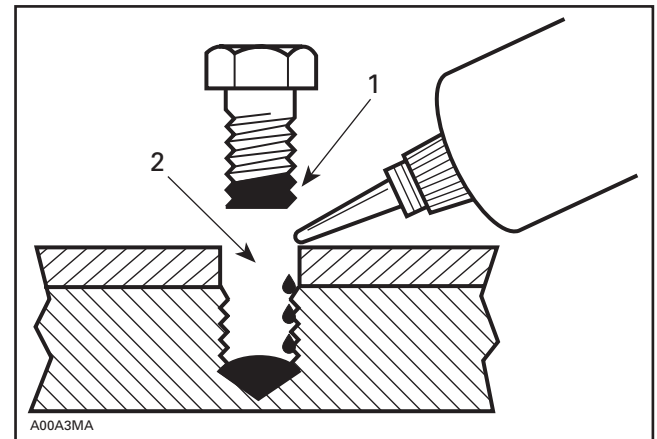
Uncovered Holes (bolts and nuts)



1. Apply here
2. Do not apply

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

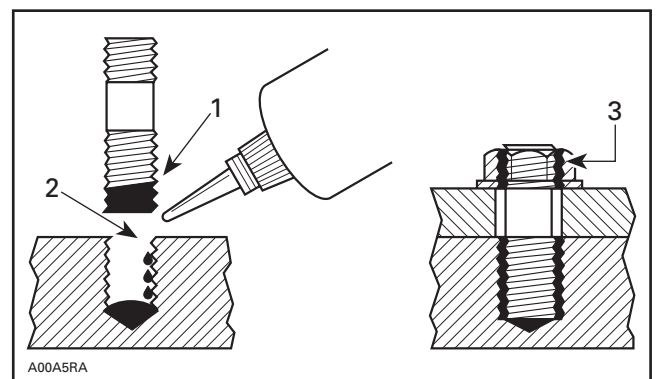
Blind Holes



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

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

Stud in Blind Holes

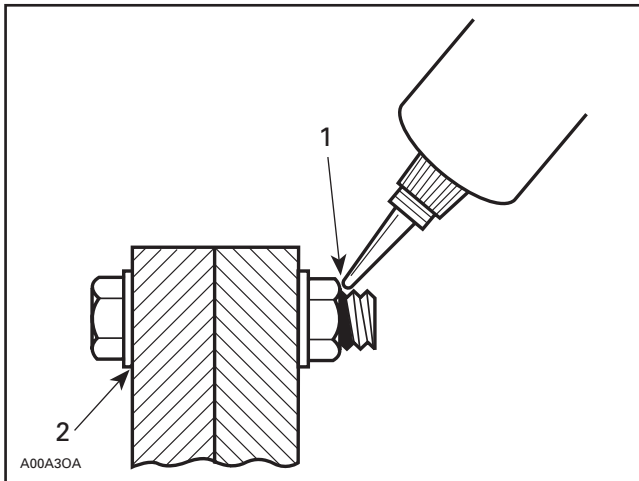


1. On threads
2. On threads and in the hole
3. Onto nut threads

INTRODUCTION

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

Preassembled Parts

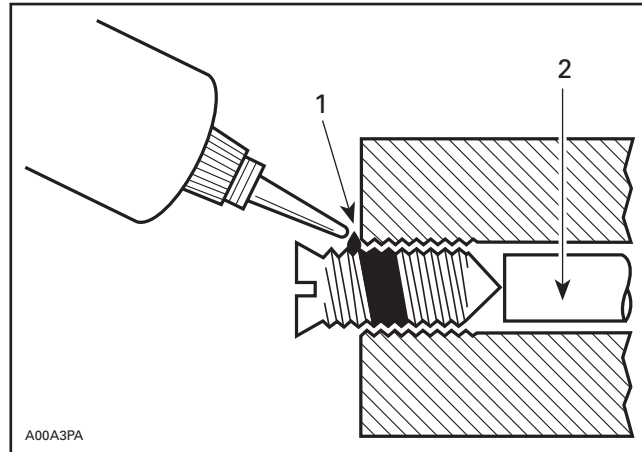


1. Apply here
2. Do not apply

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



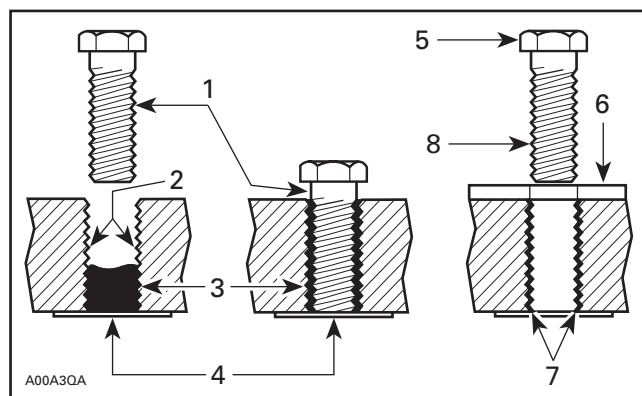
1. Apply here
2. Plunger

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

Stripped Threads



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

1. Follow instructions on Loctite FORM-A-THREAD 81668 package.
2. 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.
3. 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.

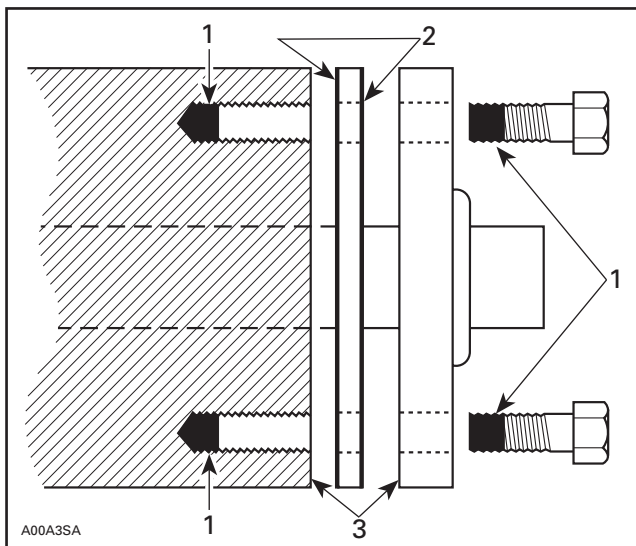
Option 2: Apply FORM-A-THREAD on the screw and insert in damaged hole.

Permanent Stud Installation (light duty)

1. Use a stud or thread on desired length.
2. DO NOT apply release agent on stud.
3. Do a **Standard Thread Repair**.
4. Allow to cure for 30 minutes.
5. Assemble.

GASKET COMPOUND

All Parts



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

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

NOTE: Avoid grinding.

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

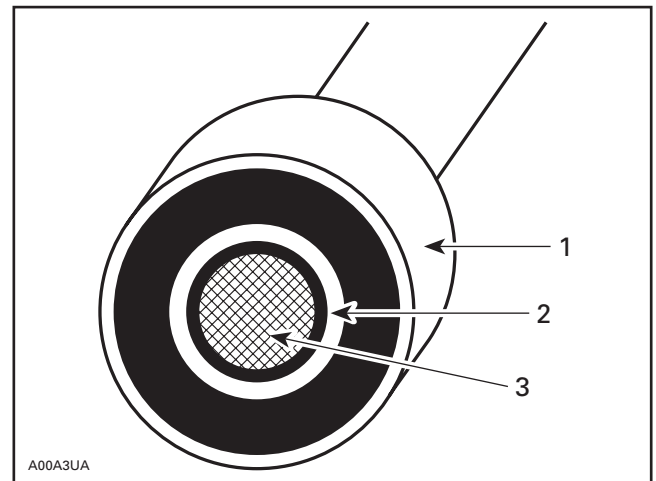
NOTE: If the cover is bolted to blind holes (above), apply proper strength Loctite in the hole and on threads. Tighten.

If holes are sunken, apply proper strength Loctite on bolt threads.

6. 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.

3. DO NOT use anti-seize Loctite or any similar product.
4. No curing period is required.

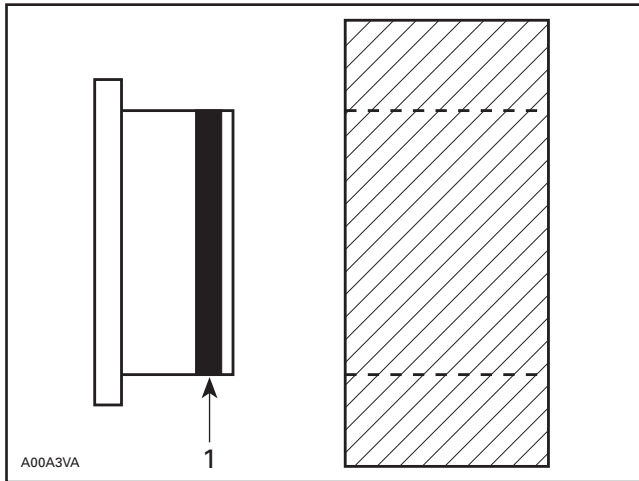
INTRODUCTION

Mounting in Tandem

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

CASE-IN COMPONENTS

Metallic Gaskets



1. Proper strength Loctite

1. Clean inner housing diameter and outer gasket diameter.
2. Spray housing and gasket with Loctite Primer N (P/N 293 800 041).
3. 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.

4. Install according to standard procedure.
5. Wipe off surplus.
6. 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 text. When they are not specified refer to following table. The table also gives the metric conversion.

N•m	FASTENER SIZE (8.8)	Lbf•in
1		9
2	M4	18
3		27
4	M5	35
5		44
6		53
7		62
8		71
9		80
10	M6	89
11		97
12		106
13		115
14		124
15		133
16		142
17		150
18		159
19		168

N•m	FASTENER SIZE (8.8)	Lbf•ft
20		15
21		15
22		16
23	M8	17
24		18
25		18
26		19
27		20
28		21
29		21
30		22
31		23
32		24
33		24
34		25
35		26
36		27
37		27

N•m	FASTENER SIZE (8.8)	Lbf•ft
38		28
39		29
40		30
41		30
42		31
43		32
44		32
45		33
46		34
47		35
48	M10	35
49		36
50		37
51		38
52		38
53		39
54		40
55		41
56		41
57		42
58		43
59		44
60		44
61		45
62		46
63		46
64		47
65		48
66		49
67		49
68		50
69		51
70		52
71		52
72		53
73		54
74		55
75		55
76		56
77		57
78		58
79		58
80	M12	59
81		60
82		60

INTRODUCTION

N•m	FASTENER SIZE (8.8)	Lbf•ft
83		61
84		62
85		63
86		63
87		64
88		65
89		66
90		66
91		67
92		68
93		69
94		69
95		70
96		71
97		72
98		72
99		73
100		74
101		74
102		75
103		76
104		77
105		77
106		78
107		79
108		80
109		80
110		81
111		82
112		83
113		83
114		84
115		85
116		86
117		86

N•m	FASTENER SIZE (8.8)	Lbf•ft
118		87
119		88
120		89
121		89
122		90
123		91
124		91
125		92
126		93
127		94
128		94
129		95
130		96
131		97
132		97
133		98
134		99
135	M14	100
136		100
137		101
138		102
139		103
140		103
141		104
142		105
143		105
144		106
145		107
146		108
147		108
148		109
149		110
150		111

TIGHTENING TORQUES FOR 8.8 GRADE BOLTS AND NUTS

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WORKSHOP	01-02-6

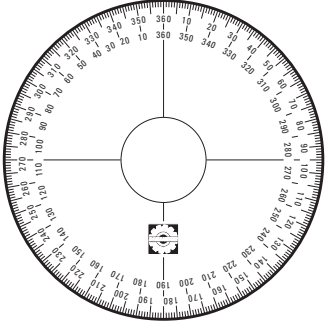
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SERVICE PRODUCTS	01-04-1
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MANDATORY SERVICE TOOLS

ENGINE

Degree wheel
P/N 529 035 607



A00B334

APPLICATION
717 and 787 engines.

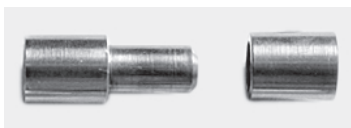
Piston circlip installer
A) P/N 529 035 562
B) P/N 529 035 563



F06B014

APPLICATION
A) 717 and 787 engines.
B) 947 engine.

Sleeve set
A) P/N 529 035 542
(20 mm sleeve)
B) P/N 529 035 543
(21 mm sleeve)



F00B0U4

APPLICATION
A) 717 and 787 engines.
B) 947 engine.


Air compressor ring compressor
P/N 529 035 713



F12B0L4

APPLICATION
947 DI engine.

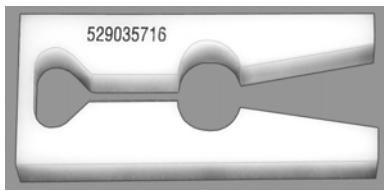
Carbon dam guide
P/N 529 035 715



F12B0M4

APPLICATION
947 DI engine.

Carbon dam compressor
P/N 529 035 716




529035716

F12B0N4

APPLICATION
947 DI engine.

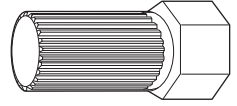
Bearing pusher
P/N 420 876 501



F00B074

APPLICATION
717 and 787 engines.

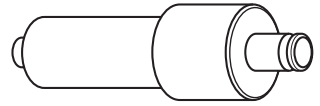
PTO flywheel remover/installer
P/N 295 000 001



F01J0T4

APPLICATION
717 engine.
NOTE: This tool is also used for the impeller.

Starter drive bearing pusher
P/N 290 876 502



F06B054

APPLICATION
947 engine.

Piston pin puller
P/N 529 035 503
Expansion sleeve
P/N 295 000 117 (787 engine)



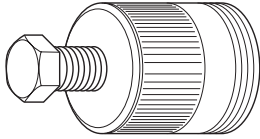
F00B0T4

APPLICATION
All engines.

Section 01 SERVICE TOOLS AND PRODUCTS

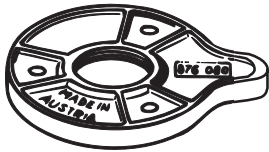
Subsection 02 (MANDATORY SERVICE TOOLS)

Puller
P/N 529 035 547



A00C1A4

Puller plate
P/N 420 876 080



A00C1R4

Extension handle
P/N 295 000 125



F01D164

Screw M8 x 35 (3)
P/N 420 841 591



F00A094

Sleeve (3)
P/N 290 847 220



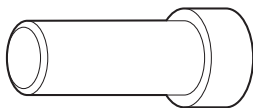
F00A0A4

APPLICATION

717 engine.

Puller is also used for PTO flywheel on 947 engine.

Pusher
P/N 420 876 605

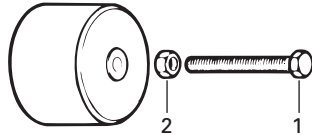


A00C0Y4

APPLICATION

717 engine.

Puller ass'y
P/N 290 876 488
1) Screw P/N 290 240 860
2) Hexagonal nut P/N 290 242 210



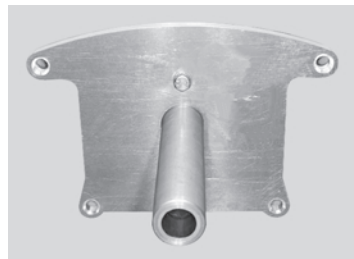
F01B014

APPLICATION

717 and 787 engines.

Alignment support plate kit
P/N 529 035 506

- 1) Alignment plates
A) P/N 529 035 507
B) P/N 529 035 508
- 2) Support
P/N 529 035 511
- 3) Screw (2)
P/N 207 182 544
- 4) Lock washer (2)
P/N 234 181 601
- 5) Flat washer (2)
P/N 234 081 410



F00B0F4

APPLICATION

All models.

- A) 155.6 mm jet pump.
- B) 139.5 mm jet pump.

Alignment shaft
P/N 295 000 141

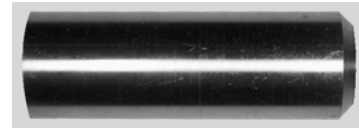


F00B0G4

APPLICATION

All models.

Adapter
P/N 529 035 590



F00B124

APPLICATION

XP model.

VCK (Vehicle Communication Kit)
P/N 529 035 676



F12H0A4

APPLICATION

All models.

Flywheel extractor
P/N 295 000 156



F00B044

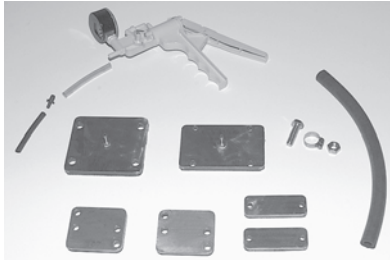
APPLICATION

XP model.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 02 (MANDATORY SERVICE TOOLS)

Engine leak tester kit
P/N 295 500 352
Pump only
P/N 529 021 800



F01B2Q5

APPLICATION

717 and 787 engines.

Supplementary engine leak test kit

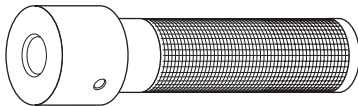
- P/N 295 500 780
- 1) 787 RFI Intake plate
P/N 296 000 024
 - 2) 947 Intake plate
P/N 296 000 025
 - 3) 947 Rave plate
P/N 296 000 026
 - 4) 947 Exhaust plate
P/N 296 000 027

APPLICATION

787 RFI and 947 engines.

NOTE: This kit is supplementary to P/N 295 500 352.

Handle
P/N 420 877 650



A00C3V4

APPLICATION

Use with pushers (P/N 290 876 609 and 290 877 740).

Ring gear puller tool
P/N 420 976 235 (puller ass'y)
P/N 529 035 549 (puller bolt)



F01B294

APPLICATION

787 and 947 engines.

Crankshaft protective cap

- A) P/N 420 876 557
B) P/N 290 877 414

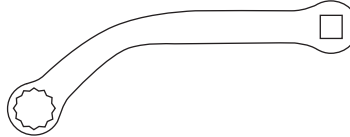


F00B194

APPLICATION

- A) 717 and 787 engines.
B) 947 engine.

Polygonal wrench
P/N 529 035 505

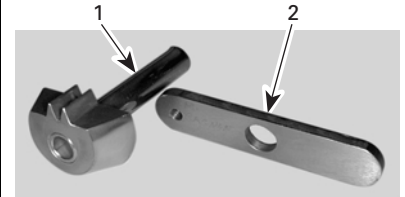


F00B0Y4

APPLICATION

Exhaust system of the 947 engine.

Ring gear blocking tool kit
P/N 295 000 155
1) Ring gear blocking tool
P/N 295 000 134
2) Retaining plate
P/N 295 000 154

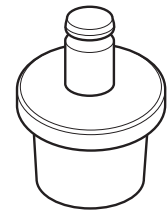


F01B265

APPLICATION

787 engine.

Rotary valve shaft pusher
P/N 290 876 609

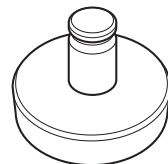


F01B2B4

APPLICATION

787 engine.

Oil seal pusher
P/N 290 877 740



F01B2C4

APPLICATION

787 engine.

Intake plug
P/N 529 035 708

APPLICATION

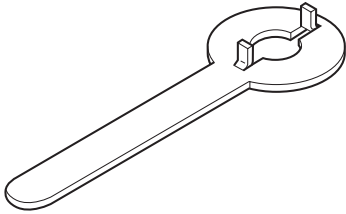
947 DI engine.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 02 (MANDATORY SERVICE TOOLS)

COOLING/FUEL/OIL SYSTEMS

Gear holder
P/N 420 277 905



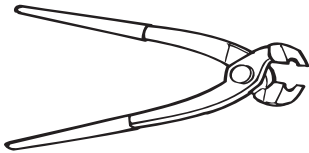
A00C164

APPLICATION

717 engine.

Pliers
P/N 295 000 070

Oetiker 1099



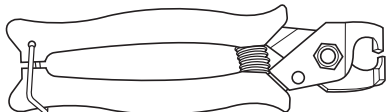
F01D174

APPLICATION

All models.

Pliers
P/N 295 000 054

Caillau



F01B1T4

APPLICATION

All models.

NOTE: This tool is also used for the propulsion system.

Fuel pressure gauge
P/N 529 035 591

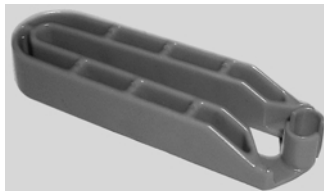


F02B0B4

APPLICATION

787 RFI engine.

Fuel line disconnect tool
P/N 529 035 714

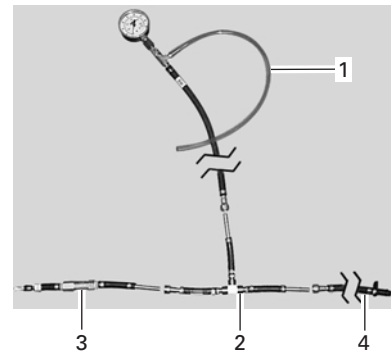


F12B0G4

APPLICATION

947 DI engine.

1. Fuel pressure gauge
P/N 529 035 709
2. Fuel pressure gauge T-fitting
P/N 529 035 710
3. Fuel pressure gauge pressure relief valve
P/N 529 035 711
4. Fuel pressure gauge air compressor adapter
P/N 529 035 712



F12R014

APPLICATION

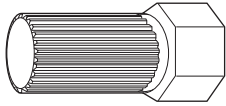
947 DI engine.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 02 (MANDATORY SERVICE TOOLS)

PROPULSION SYSTEM

Impeller remover/installer
P/N 295 000 001



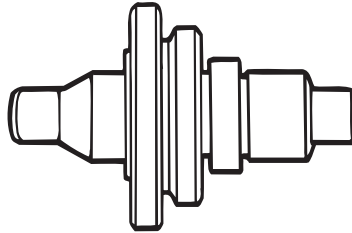
F01J0T4

APPLICATION

All models.

NOTE: This tool is also used for the PTO flywheel (on some models).

Bearing/seal installer
P/N 295 000 107



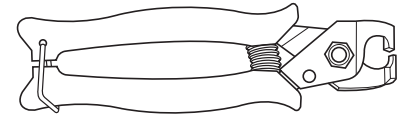
F01J4K4

APPLICATION

All models except GTX and XP.

Pliers
P/N 295 000 054

Caillau



F01B1T4

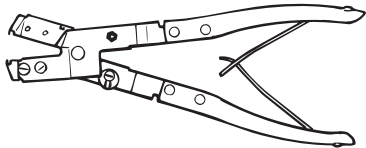
APPLICATION

All models.

NOTE: This tool is also used for the fuel system.

Pliers
P/N 295 000 069

Oetiker 1090



F01D184

APPLICATION

All models.

Inner seal installer
P/N 529 035 609

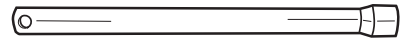


F08B014

APPLICATION

155.6 mm (6-1/8 in) jet pump.

VTS tool
P/N 295 000 133

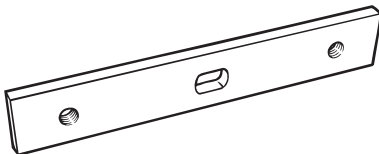


F01B2P4

APPLICATION

XP models.

Impeller shaft holder
P/N 295 000 082

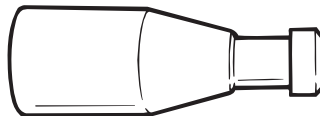


F01B0W4

APPLICATION

All models.

Impeller shaft guide
P/N 295 000 002

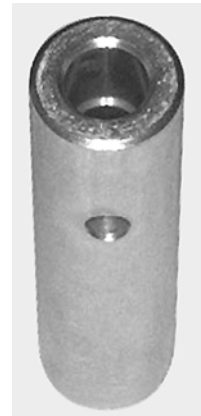


F01J104

APPLICATION

All models.

Drive shaft alignment tool
P/N 529 035 590



F08B024

APPLICATION

XP model.

Jet pump bearing remover
P/N 295 000 144



F01J114

APPLICATION

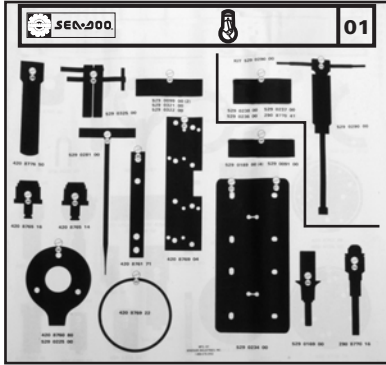
All models.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 02 (MANDATORY SERVICE TOOLS)

WORKSHOP

Tool board
P/N 295 500 608



F00A0S4

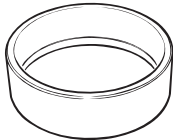
APPLICATION

All models.

OPTIONAL SERVICE TOOLS

ENGINE


Coil centering tool
P/N 420 876 922



A01B1V4

APPLICATION
717 engine.

Cylinder aligning tool
P/N 420 876 904



A00B084

APPLICATION
717 engine.

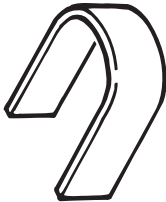
Distance gauge

A) P/N 529 034 800,
14 mm (.551 in)

B) P/N 529 034 900,
15.4 mm (.606 in)

C) P/N 529 035 100,
11.5 mm (.453 in)

D) P/N 529 035 000,
7.5 mm (.295 in)



F01B0H4

APPLICATION
A) 717 engine.
B) 787 engine.
C) 947 engine (MAG).
D) 947 engine (PTO).

Stroboscopic timing light
P/N 529 031 900




A00B4F4

APPLICATION
All models.

A) Four-pin magneto harness
P/N 295 000 131

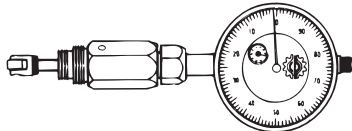
B) Six-pin magneto harness
P/N 295 000 136



F01B284

APPLICATION
A) 717 engine.
B) 787 and 947 engines.

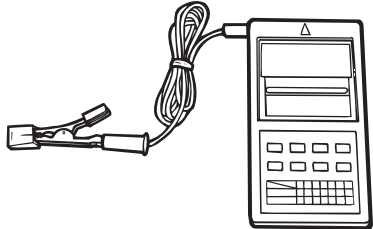
Dial indicator (TDC gauge)
P/N 295 000 143



A00B4E4

APPLICATION
All models.

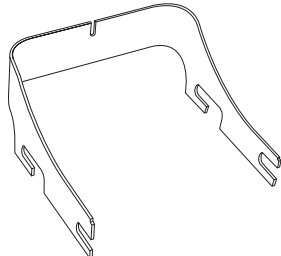
Digital/induction type
tachometer
P/N 529 014 500



F01B1G4

APPLICATION
All models.


Timing mark pointer
P/N 295 000 130



F01B2O4

APPLICATION
717 engine.

Timing mark pointer
P/N 295 000 135



F01H544

APPLICATION
787 and 947 engines.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 03 (OPTIONAL SERVICE TOOLS)

Crimping tool
P/N 295 100 164



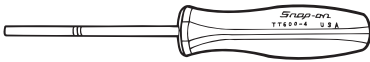
F00B0E4

APPLICATION

Contacts of AMP plug connectors.

Terminal (Packard) remover
Not sold by Bombardier

Snap-on
TT 600-4



F01B1J4

APPLICATION

All models.

Joint connector tool
Not sold by Bombardier

Deutsch
114010

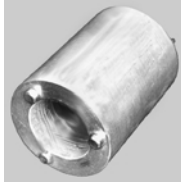


F12B0C4

APPLICATION

DI models.

Safety lanyard switch tool
P/N 529 034 600



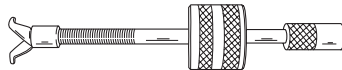
F01B244

APPLICATION

All models.

Slide hammer puller
Not sold by Bombardier

Snap-on:
Handle: CJ93-1
Hammer: CJ125-6
Claws: CJ93-4



F01J0Z4

APPLICATION

717 and 787 engines.

NOTE: This tool is also used to pull out impeller shaft seal.

Protective mat
P/N 295 000 128

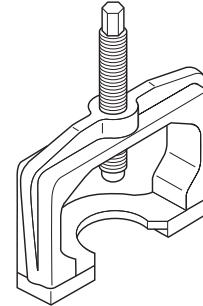


F02B0A4

APPLICATION

All models.

Gear/bearing puller
P/N 290 877 665

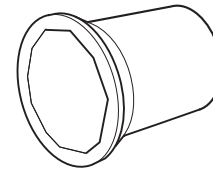


F04B034

APPLICATION

787 engine.

Exhaust outlet tool
P/N 295 000 132



F01B2A4

APPLICATION

All models.

Engine lifting device

Not sold by Bombardier

Do it yourself

Refer to REMOVAL AND INSTALLATION section of engine.



F01D0A4

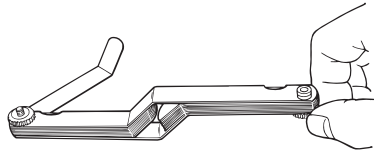
APPLICATION

717 engine.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 03 (OPTIONAL SERVICE TOOLS)

Feeler gauge 45°
Not sold by Bombardier
Snap-on
FB 300 A



F01B1K4

APPLICATION

717 and 787 engines.

MPEM programmer
P/N 529 035 718

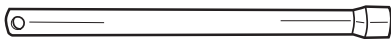


A01B5B4

APPLICATION

All models.

Steering cable tool
P/N 295 000 145

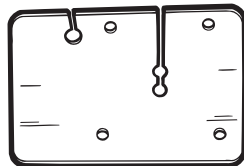


F01B2P4

APPLICATION

All models.

Rubber pad
P/N 295 000 101

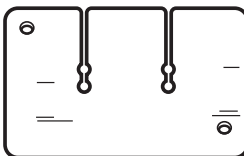


F01B0J4

APPLICATION

717 and 787 engines.

Rubber pad
P/N 290 877 032

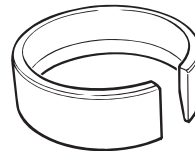


F06B064

APPLICATION

947 engine.

Piston ring compressor (2)
A) P/N 290 876 965 (88 mm)
B) P/N 290 876 979 (82 mm)

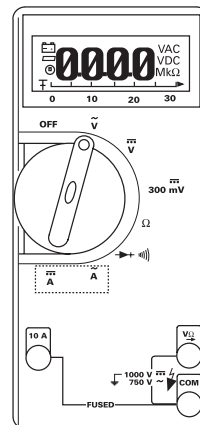


F01B1T4

APPLICATION

A) 947 engine.
B) 717 and 787 engines.

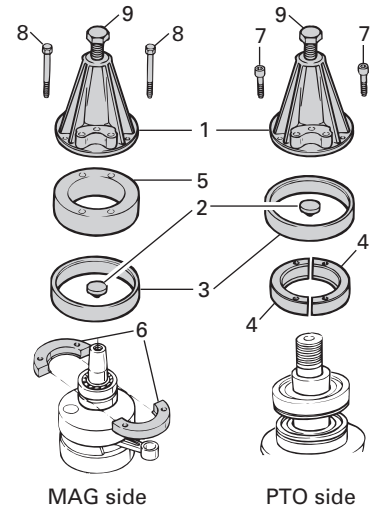
Digital multimeter
P/N 529 022 000



F01B104

APPLICATION

All models.



F01D885

- 1) Puller ass'y
P/N 420 877 635
- 2) Protective cap
P/N 420 876 557
P/N 290 877 414 (947 engine)
- 3) Ring (both ends)
P/N 420 977 490
P/N 420 977 480 (947 engine)
- 4) Ring halves (PTO)
P/N 420 977 475 (2)
P/N 420 876 330 (947 engine)
- 5) Distance ring (MAG)
P/N 420 876 569
- 6) Ring halves (MAG)
P/N 420 276 025 (2)
- 7) Screw M8 x 40
P/N 420 840 681 (2)
- 8) Screw M8 x 70
P/N 420 841 201 (2)
- 9) Puller bolt
P/N 420 940 755

APPLICATION

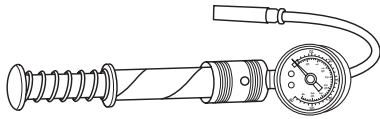
All engines.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 03 (OPTIONAL SERVICE TOOLS)

COOLING/FUEL/OIL SYSTEMS

Pump gauge tester
P/N 295 000 114



F01B0X4

APPLICATION

All models except RFI and DI models.

Lighted adjustable mirror
Not sold by Bombardier

Snap-on
50101

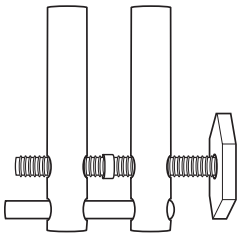


F01B114

APPLICATION

All models.

Hose pincher
P/N 529 032 500

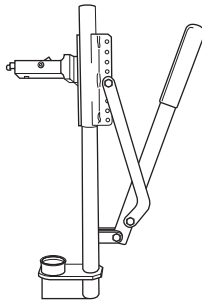


F01B234

APPLICATION

All models.

Spring compressor
P/N 529 035 504

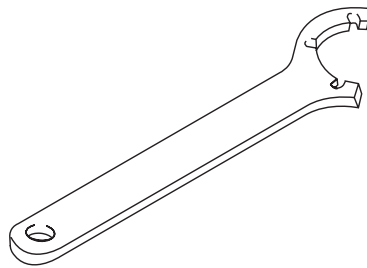


A01B404

APPLICATION

XP model.

Suspension adjustment wrench
P/N 529 012 200

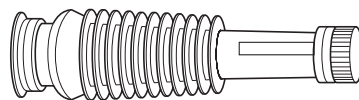


A25A014

APPLICATION

XP model.

Flexible spout (oil)
P/N 414 837 300

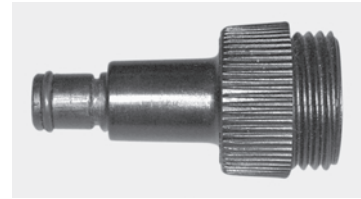


F04B044

APPLICATION

All models.

Flushing adapter
P/N 295 500 473

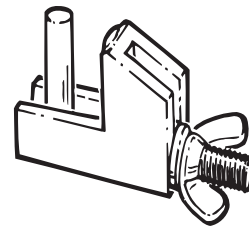


F00B104

APPLICATION

All models.
Use with coupler hose (P/N 295 500 258).

Hose pincher
P/N 295 000 076



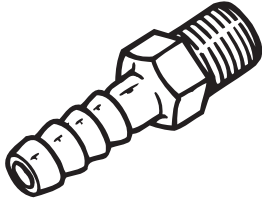
A01B214

APPLICATION

All models.

PROPULSION SYSTEM

Fitting
P/N 295 000 086



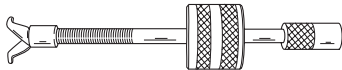
F01B0Z4

APPLICATION

All models.

Slide hammer puller
Not sold by Bombardier

Snap-on:
Handle: CJ93-1
Hammer: CJ125-6
Claws: CJ93-4



F01J0Z4

APPLICATION

All models.

NOTE: This tool is also used to remove rotary valve shaft bearing.

Hacksaw
Not sold by Bombardier

Snap-on
HS3



F01B1M4

APPLICATION

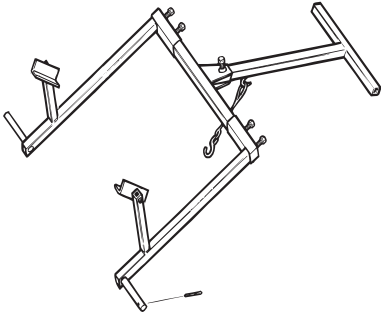
All models.

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 03 (OPTIONAL SERVICE TOOLS)

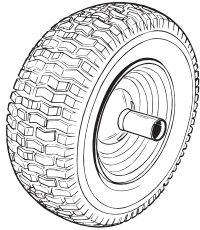
WATERCRAFT HANDLING

Dolly (with wheels)
P/N 295 000 126



F01B014

Beach wheels (set of 2 wheels)
P/N 295 000 005



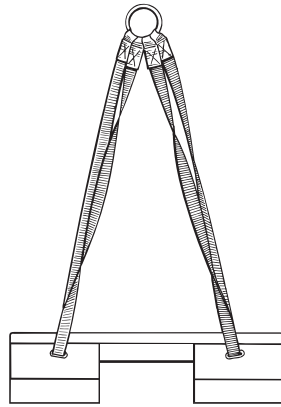
F01B074

APPLICATION
Dolly.

Tie-down with ratchet
3.60 m (12 ft) long
P/N 295 100 104

APPLICATION
All models.

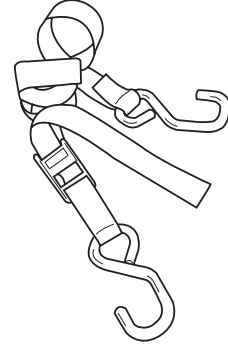
Lift kit
P/N 295 100 044



F00B024

APPLICATION
All models.

Tie-down
1.50 m (5 ft) long
P/N 295 100 103



F00B014

APPLICATION
All models.

SERVICE PRODUCTS

Loctite® is a trademark of Loctite™ Corporation.

Permatex® is a trademark of Loctite™ Corporation.

Dow Corning® is a trademark of Dow Corning Corporation.

Medium strength threadlocker
P/N 293 800 060

Loctite 243 (blue)
(10 mL)



F00A004

High temperature threadlocker
P/N 420 899 788

Loctite 648 (green)
(5 g)



A00B3D4

Retaining compound
P/N 413 703 100

Loctite RC/609 (green)
(10 mL)



A00B2S4

High temperature retaining
compound
P/N 293 800 054

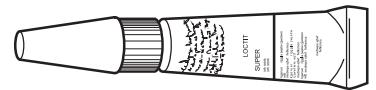
Loctite 642
(50 mL)



F00B024

General purpose instant
adhesive
P/N 293 800 021

Loctite 495



A00B2V4

High strength threadlocker
P/N 293 800 005

Loctite 271 (red)
(10 mL)



A00B2U4

Gasket eliminator
P/N 293 800 038

Loctite 518
(50 mL)



F01B124

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 04 (SERVICE PRODUCTS)

Flange sealant
P/N 293 800 081

Loctite 5910
(300 mL)



F00B1A4

Solvent
P/N 413 711 809

Loctite Safety Solvent
320 g (11 oz)



A00B3M4

Hylomar sealant
P/N 293 800 001

PL-32
(100 g)



A00B3F4

Sealant
P/N 293 530 011

Sikaflex 221 (black)
(350 mL)



F01B1D4

Chisel gasket remover
P/N 413 708 500

(510 mL)



A00B574

Molykote 111
P/N 413 707 000



A00B3W4

Ultra Copper High temp sealant
P/N 413 710 300

(80 g)



A02B044

Primer for gasket eliminator
P/N 293 800 041

Loctite 764



A00B3N4

Thread sealant
P/N 293 800 050

Loctite 577
(250 mL)



F00B0W4

Pipe sealant
A) P/N 293 800 018
B) P/N 293 800 013

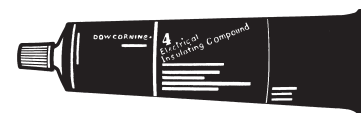
A) Loctite 592 (50 mL)
B) Loctite 567 (250 mL)



A00B2W4

Dielectric grease
P/N 293 550 004

Dow Corning
(150 g)



F01B164

Section 01 SERVICE TOOLS AND PRODUCTS

Subsection 04 (SERVICE PRODUCTS)

Deoxit contact lubricant
P/N 293 550 015

(200 mL)



F00B0X4

Anti-seize lubricant
P/N 293 800 070

Loctite 76764
454 g (16 oz)



F01B174

Sea-Doo fuel stabilizer
P/N 413 408 600

236 mL (8 oz)



A00B3V4

Grease
P/N 293 550 005

(400 g)



A00B2L4

BOMBARDIER LUBE
P/N 293 600 016

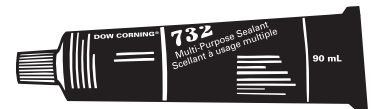
(12 x 14 oz)



F01B0S4

732 Multi-purpose sealant
P/N 293 800 033

Dow Corning (90 mL)
(clear)



F01B1C4

Synthetic grease
P/N 293 550 010

(400 g)



F01B154

BOMBARDIER storage oil
P/N 413 711 600

(12 x 350 g)



A02B054

BOMBARDIER injection oil
P/N 413 802 900

(12 x 1 L)



F01B184

Super Lube grease
P/N 293 550 014



A00B474

Section 01 SERVICE TOOLS AND PRODUCTS

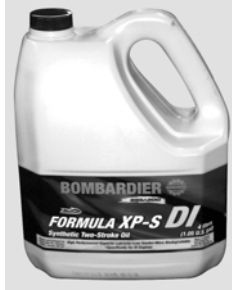
Subsection 04 (SERVICE PRODUCTS)

BOMBARDIER injection oil
P/N 413 803 000 (3 x 4 L)
P/N 413 803 200 (205 L)



F01B2H4

BOMBARDIER Formula XP-S DI
synthetic injection oil
P/N 293 600 032 (12 x 1 L)
P/N 293 600 033 (3 x 4 L)
P/N 293 600 034 (205 L)



F00B1B4

Jet pump oil
P/N 293 600 011 (12 x 6 oz)

Sea-Doo
synthetic jet pump oil



F01B0P4

BOMBARDIER Formula XP-S
synthetic injection oil
P/N 413 710 500 (12 x 1 L)



F01B2G4

Sealant adhesive
P/N 293 800 033

Adchem 4511
(clear)



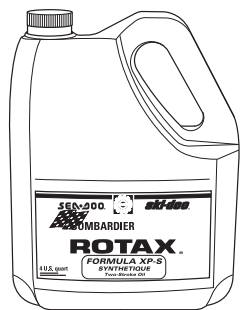
F01B1S4

Sea-Doo Cleaner
P/N 293 110 001 (400 g)
P/N 293 110 002 (4 L)



F01B2J4

BOMBARDIER Formula XP-S
synthetic injection oil
P/N 413 711 000 (3 x 4 L)
P/N 413 710 700 (205 L)



F01B354

The Right Stuff (sealant)
P/N 293 800 053

Permatex®
(198 g)



F00B0V4

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PERIODIC INSPECTION CHART

NOTE: Servicing period is given in hours. Shaded area shows the maintenance frequency.

DESCRIPTION		FREQUENCY			
		FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR
GENERAL	Lubrication/corrosion protection	①		✓	
ENGINE	Support and rubber mount condition/tightness	✓		✓	
	Exhaust system fasteners ⑤	✓		✓	
	RAVE valve cleaning (if so equipped) ⑤			✓	✓
	Counterbalance shaft oil level (if so equipped)			✓	✓
	Spark plug inspection, cleaning and gap adjustment ⑤	④ ✓			
	Spark plug replacement ⑤			✓	
	TDC setting/Ignition timing ⑤				✓
COOLING SYSTEM	Flushing		✓③		
	Hose condition and fasteners	✓		✓	
	Inspect/clean engine drain tubes		✓①		
	Water flow regulator valve inspection (if so equipped)				✓
FUEL SYSTEM	Carburetor adjustment including choke/throttle cable adjustments (carburetor-equipped models)	✓			✓
	Throttle/choke cables (carburetor-equipped models), inspection/lubrication	①	✓		
	Fuel filter (except RFI models) and lines inspection	✓	✓		
	Fuel filter replacement (except DI and RFI models)				✓
	Fuel filter replacement (DI models only)				⑧
	Visually check for oil leakage between cylinder head and injector (DI models) ⑤	✓		✓	
	Fuel injection system sensors (except throttle body), visual inspection (RFI and DI models) ⑤	✓			✓
	Throttle body cleaning and their sensors (DI models) ⑤ ⑥	✓		✓	
	Fuel vent line pressure relief valve inspection		✓		
	Fuel lines, connections (DI models), check-valve and fuel system pressurization ⑤	✓	✓		
	Visual inspection: carburetors/throttle bodies, sensors, fuel lines, fuel rail and fittings (if so equipped) ⑤	✓		✓	
	Air intake silencer fit/tightness	✓			✓
	Fuel tank straps visual inspection	✓			✓
LUBRICATION SYSTEM	Oil injection pump adjustment ⑤	✓			✓
	Oil filter and lines inspection	✓	✓		
	Oil filter replacement				✓
	Oil reservoir straps	✓			

Section 02 MAINTENANCE

Subsection 02 (PERIODIC INSPECTION CHART)

DESCRIPTION		FREQUENCY			
		FIRST 10 HOURS	EVERY 25 HOURS OR 3 MONTHS	EVERY 50 HOURS OR 6 MONTHS	EVERY 100 HOURS OR 1 YEAR
ELECTRICAL SYSTEM	Electrical connections condition and fastening (ignition system, electrical box(es), starting system, fuel injectors (RFI and DI models), etc.)	✓		✓	
	MPEM mounting brackets/fasteners			✓	
	Digitally Encoded Security System	✓			✓
	Monitoring beeper	✓		✓	
	Battery condition and straps	✓		✓	
STEERING SYSTEM	Inspection and cable adjustment	✓		✓	
PROPULSION SYSTEM	Drive shaft boot and spline condition (if so equipped)			✓ ^②	
	Drive shaft protection hose inspection			✓ ^②	
	PTO flywheel and seal carrier lubrication (if so equipped)	✓	✓		
	Shifter system/cable adjustment (if so equipped)	✓			✓
	VTS (Variable Trim System, (if so equipped)	✓		✓	
	Jet pump reservoir oil level/oil condition	Replace	✓	Replace	
	Jet pump cover pusher inspection (if so equipped)				✓
	Impeller shaft seal replacement				⑦
	Impeller condition and impeller/wear ring clearance			✓ ^②	
Water intake grate condition			✓ ^②		
HULL AND BODY	Bailer pick-ups, check for obstructions	✓			✓
	Hull condition	✓			✓

① Every 10 hours in salt water use.

② These items have to be initially checked after 25 hours. Thereafter, servicing to be made as specified in this chart.

③ Daily flushing in salt water or foul water use.

④ Except DI models.

⑤ Emission-related component.

⑥ In salt water use.

⑦ Replace at 150 hours.

⑧ Replace at 250 hours.

FLUSHING AND LUBRICATION

GENERAL

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 watercraft is not expected to be used further the same day or when the watercraft is stored for any extended time.

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

PROCEDURE

⚠ WARNING

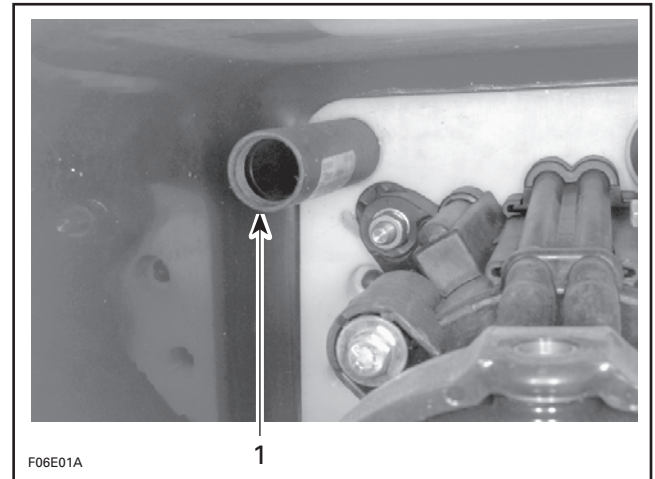
Perform this operation in a well ventilated area. Do not touch any electrical parts or jet pump area when engine is running.

Clean jet pump by spraying water in its inlet and outlet and then spray BOMBARDIER LUBE lubricant.

⚠ WARNING

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

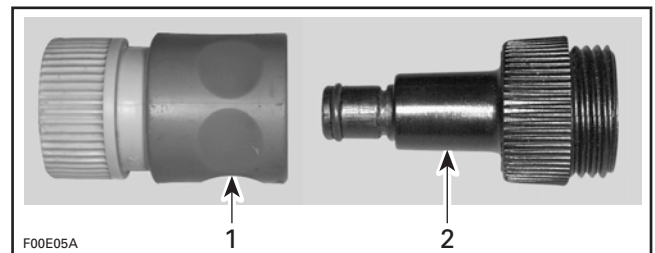
Install flushing adapter (P/N 295 500 473) to the water outlet located at the rear of the watercraft.



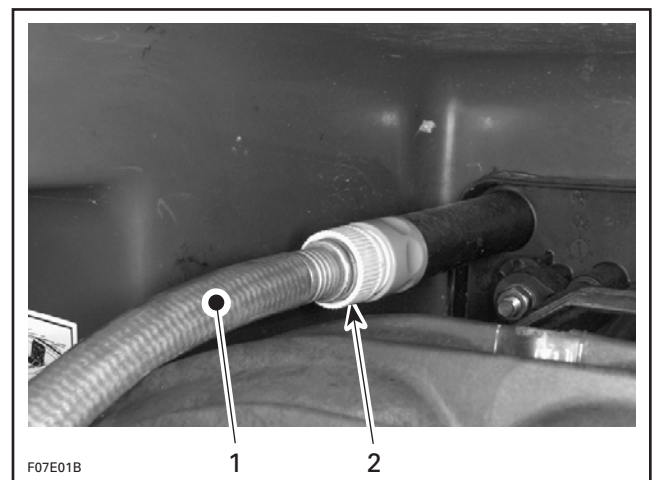
1. Install flushing adaptor

Connect a garden hose to the flushing adaptor.

NOTE: A quick connect adapter can be used to ease garden hose installation.



1. Quick connect adapter
2. Flushing adaptor (P/N 295 500 473)



1. Garden hose installed
2. Quick connector adaptor

Section 02 MAINTENANCE

Subsection 03 (FLUSHING AND LUBRICATION)

All Models

Start the engine then immediately open the water tap.

⚠ WARNING

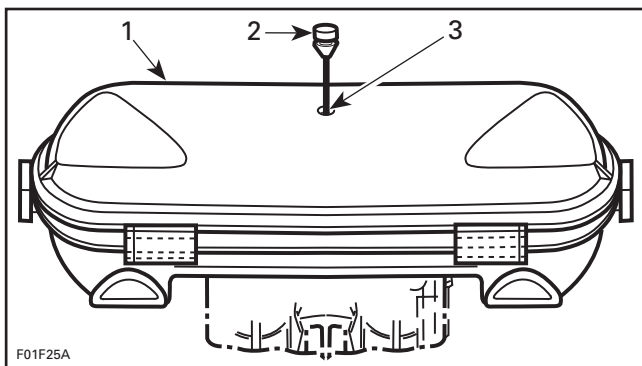
Do not touch any electrical parts or jet pump area when engine is running.

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

Run the engine about 3 minutes at a fast idle around 3500 RPM.

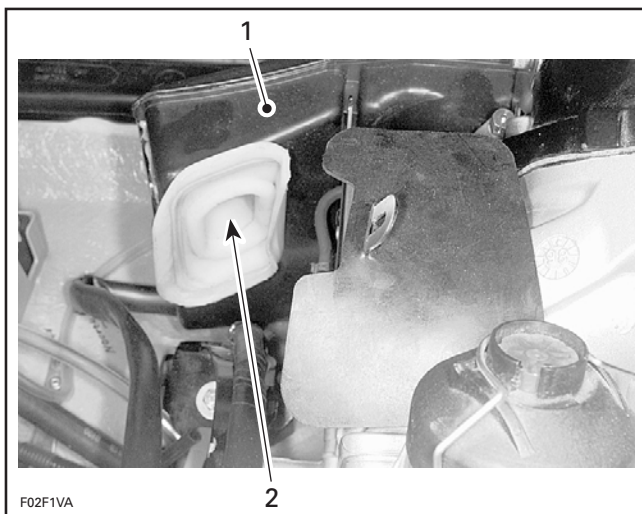
Spray BOMBARDIER LUBE lubricant through air intake silencer keeping engine at fast idle for approximately one minute.

All Models except DI



717 AND 787 ENGINES

1. Air intake silencer
2. Pull plug
3. Spray BOMBARDIER LUBE here



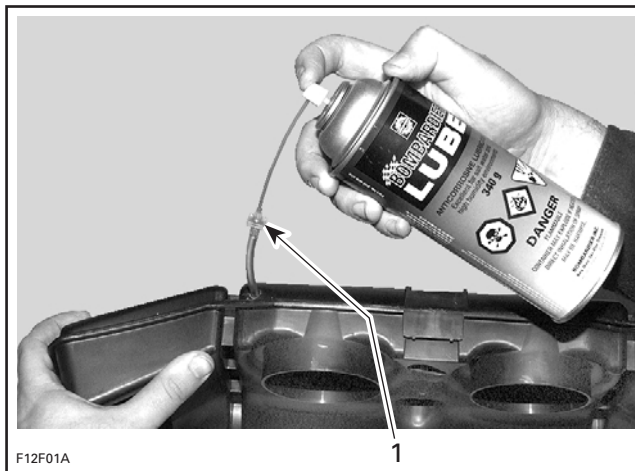
947 ENGINES

1. Air intake silencer
2. Spray BOMBARDIER LUBE here

DI Models

Spray, through hole of air intake silencer.

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



1. Partially pull tube out of air box to inject BOMBARDIER LUBE lubricant or equivalent. Push tube in when finished

Close the water tap then stop the engine.

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

Disconnect the garden hose.

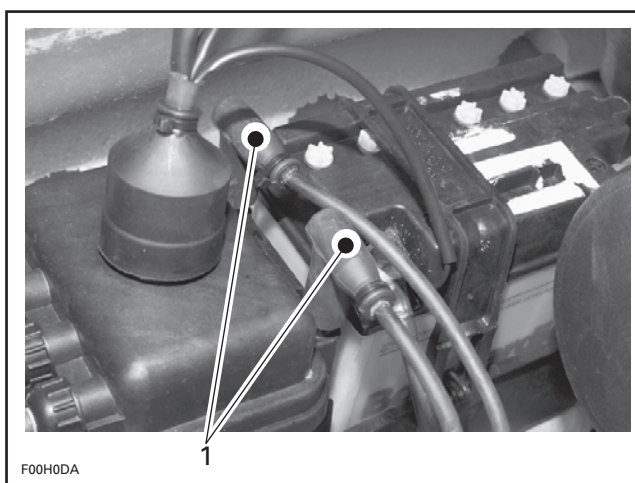
CAUTION: Remove quick connect adapter after flushing operation (if used).

Wipe up any residual water from the engine.

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

⚠ WARNING

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

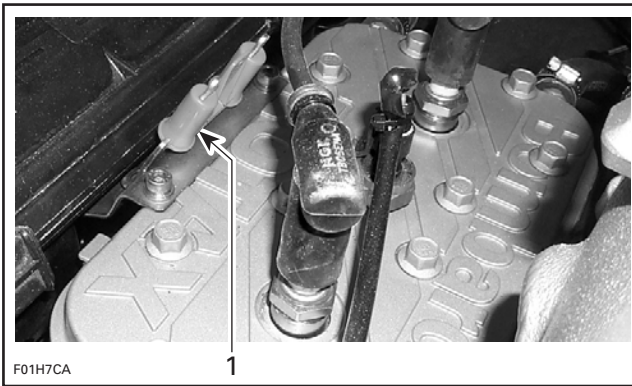


GS MODELS

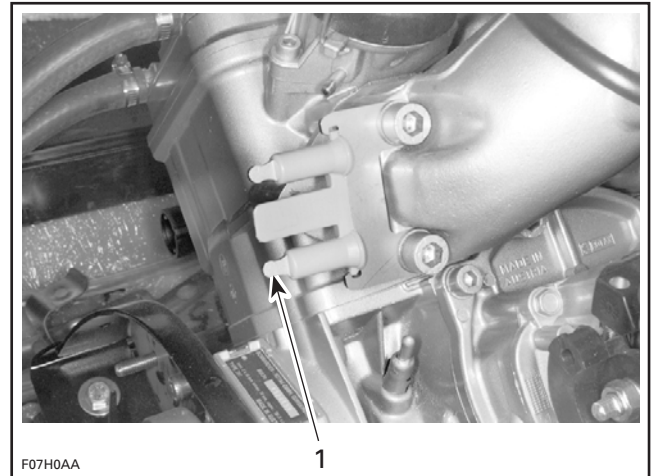
1. Spark plug cables on grounding device

Section 02 MAINTENANCE

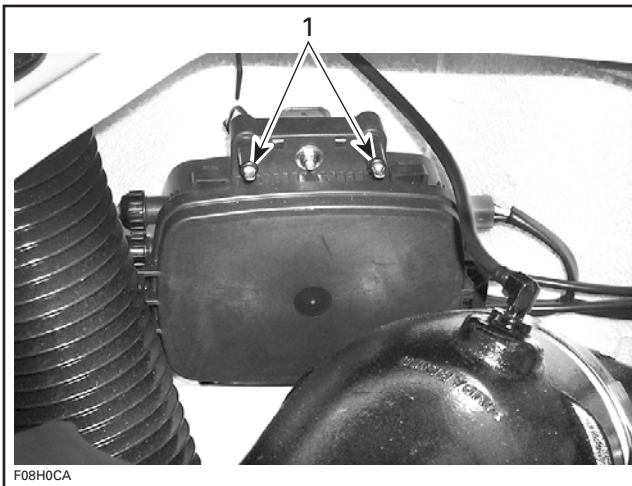
Subsection 03 (FLUSHING AND LUBRICATION)



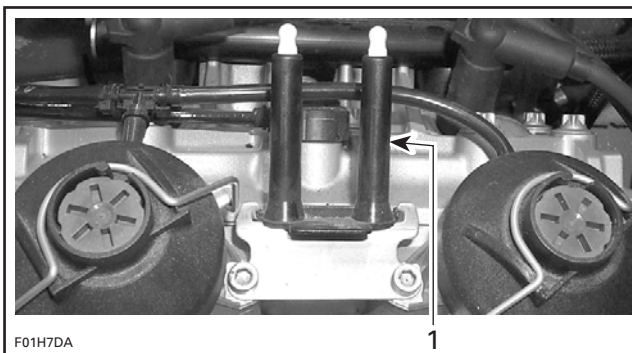
GTS AND GTI MODELS
1. Grounding device



GTX RFI MODELS
1. Grounding device



XP MODELS
1. Grounding device



RX, RX DI, GTX AND GTX DI MODELS
1. Grounding device

Remove both spark plugs and spray BOMBARDIER LUBE lubricant into each cylinder.

All Carburetor-Equipped Models

Connect safety lanyard cap to the switch.

Fully depress the throttle lever then press the start/stop button to crank the engine a few turns to distribute the oil onto cylinder wall.

GTX RFI Models

On RFI models, fully depress throttle lever and connect the safety lanyard to the switch.

Press the start/stop button to crank the engine a few turns and distribute the lubricant onto cylinder walls.

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

DI Models

NOTE: Proceeding in this order, no fuel will be injected and no ignition will occur in the engine.

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

Wait 2 seconds then press the start/stop button to crank the engine a few turns and distribute the lubricant onto cylinder walls.

NOTE: A 1 second beep every second indicates the drowned mode is active.

Section 02 MAINTENANCE

Subsection 03 (FLUSHING AND LUBRICATION)

All Models

Apply anti-seize lubricant on spark plug threads then reinstall them.

Reinstall plug on air intake silencer cover (if so equipped, **on 717 engines**).

NOTE: Engine fogging should be done with BOMBARDIER LUBE lubricant whenever the watercraft is to be stored for a few days or a long period.

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

WATER-FLOODED ENGINE

GENERAL

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.

PROCEDURE

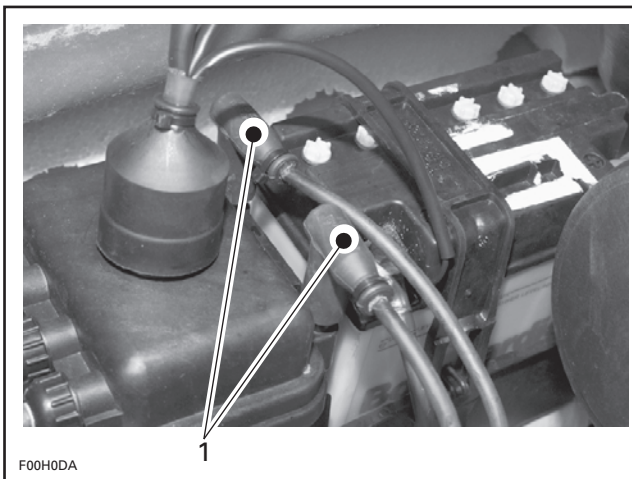
Check fuel and oil reservoirs for water contamination. If necessary, siphon and refill with fresh fluids. Turn fuel valve to OFF position (**carburetor-equipped models**) then drain fuel filter bowl. Refer to FUEL CIRCUIT.

Drain bilge if water is present.

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

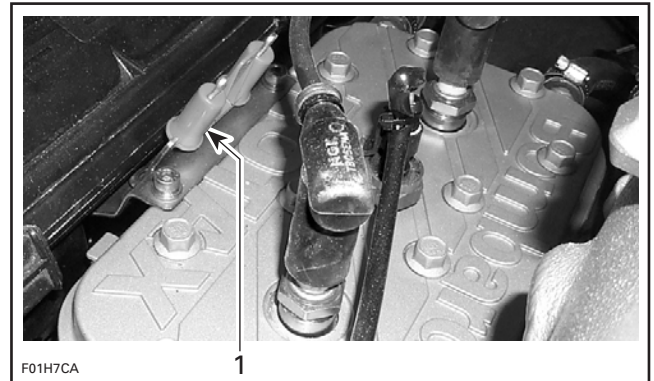
⚠ WARNING

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



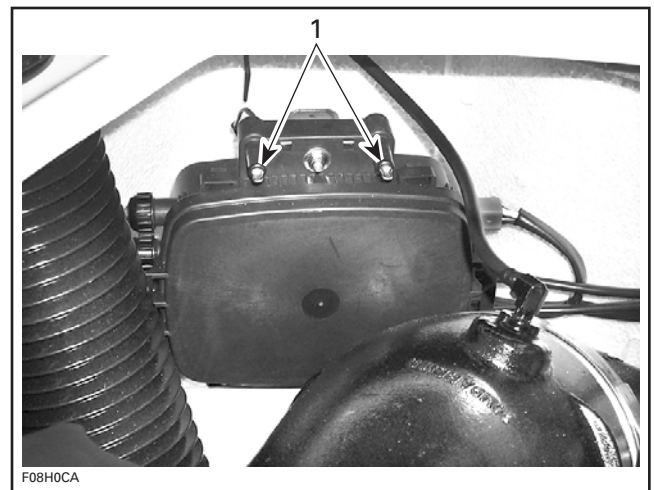
GS MODELS

1. Spark plug cables on grounding device



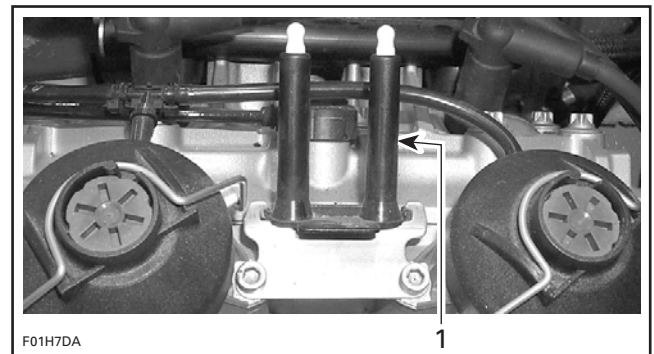
GTS/GTI MODELS

1. Grounding device



XP MODELS

1. Grounding device

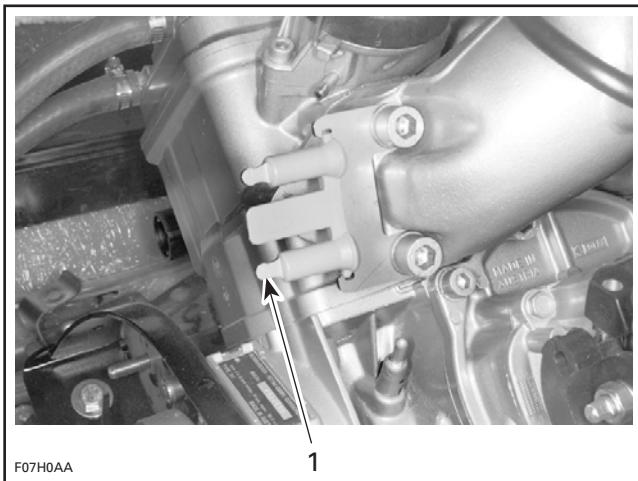


RX, RX DI, GTX AND GTX DI MODELS

1. Grounding device

Section 02 MAINTENANCE

Subsection 04 (WATER-FLOODED ENGINE)



GTX RFI MODELS

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.

⚠ WARNING

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

Carburetor-Equipped Models

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

NOTE: Ensure choke lever is completely pushed in.

GTX RFI Models

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

On RFI models, fully depress throttle lever and connect the safety lanyard to the switch.

Wait 2 seconds then press the start/stop button to crank the engine to allow water to escape from spark plug openings.

DI Models

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

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

Crank engine several times to drain crankcase.

NOTE: A 1 second beep every second indicates the drowned mode is active.

If water does not completely go out, it may be necessary to remove the air intake silencer then to lean the vehicle so that water can flow out from throttle bodies.

All Models

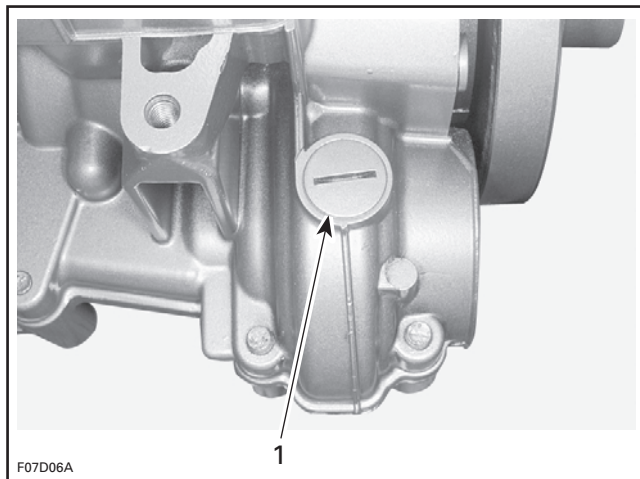
Spray BOMBARDIER LUBE lubricant (P/N 293 600 016) into spark plug holes.

Crank engine again.

Reinstall spark plugs and spark plug cables.

787 RFI Engines

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



787 RFI ENGINE

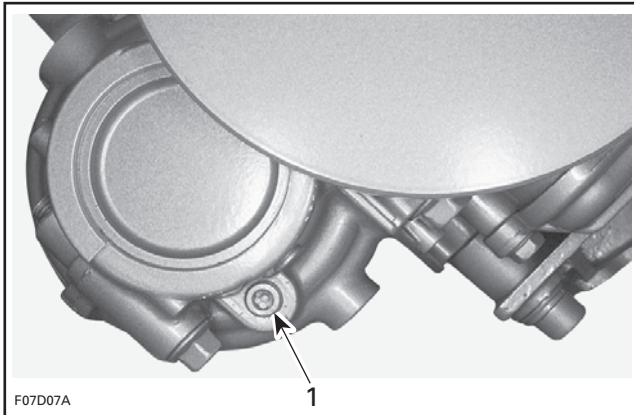
1. Remove filler plug

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

Section 02 MAINTENANCE

Subsection 04 (WATER-FLOODED ENGINE)

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 ENGINE

1. Drain plug

Drain completely the crankcase oil of the counterbalance shaft. Reinstall drain plug with Loctite 515. Add 30 mL (1 oz) of SAE 30 motor oil. Reinstall filler plug.

Carburetor-Equipped Models

Turn fuel valve to ON position.

Start engine. It may be necessary to use the choke. If engine does not start, repeat previous steps as necessary.

RFI and DI Models

Start engine according to normal starting procedure.

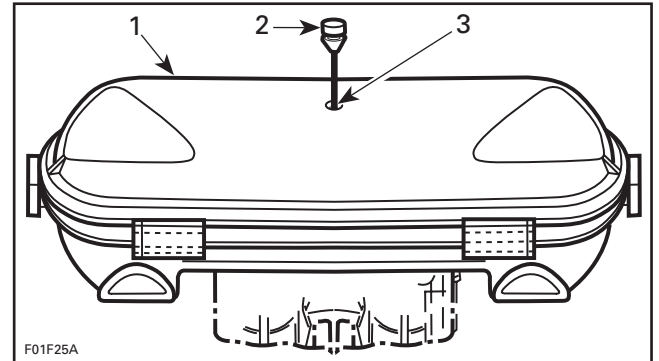
All Models

CAUTION: To avoid starting motor 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.

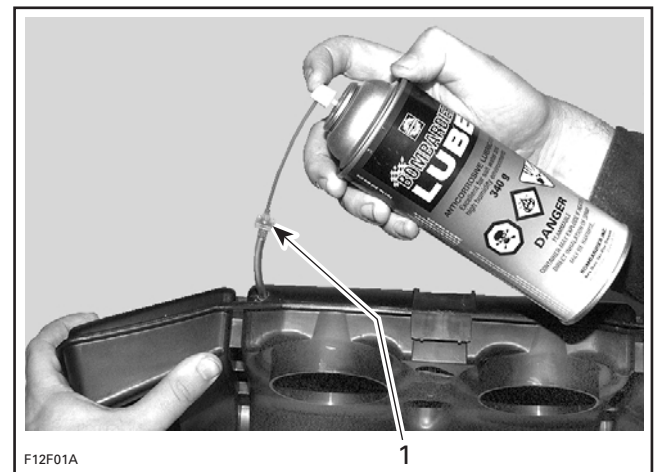
Check crankshaft if needed, it may be misaligned or deflected. Refer to BOTTOM END.

After engine has started, spray BOMBARDIER LUBE lubricant 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



947 ENGINES

1. Air intake silencer
2. Pull plug
3. Spray BOMBARDIER LUBE here

Run engine until it reaches its normal operating temperature.

CAUTION: Engine must be cooled using the flush kit.

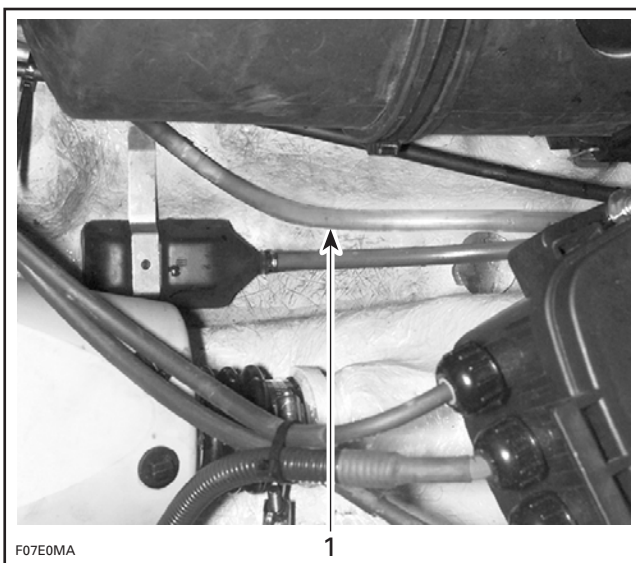
STORAGE

ENGINE DRAINING

All Carburetor-Equipped Engines

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.



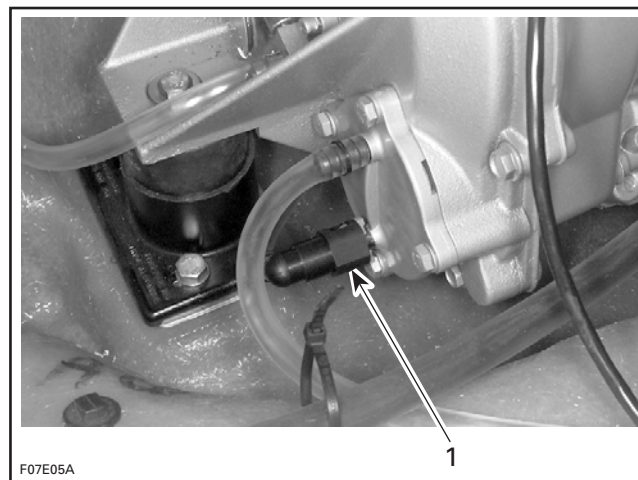
TYPICAL

1. Engine drain hose

RFI Models

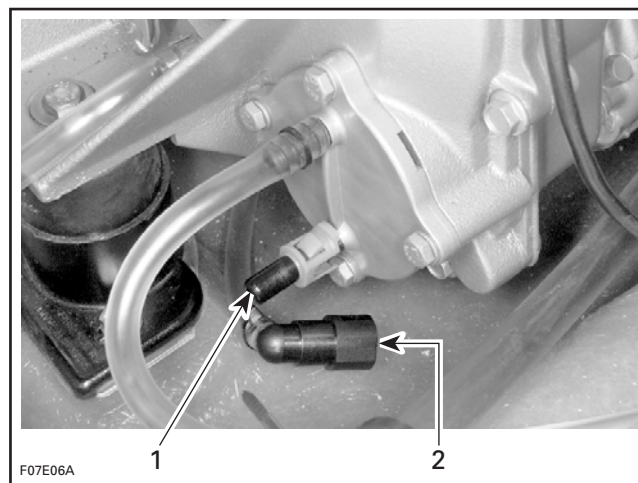
Disconnect the water supply hose used to cool the magneto. It features a quick connect fitting. Press both tabs and pull fitting in order to disconnect hose.

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



1. Disconnect this 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.



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.

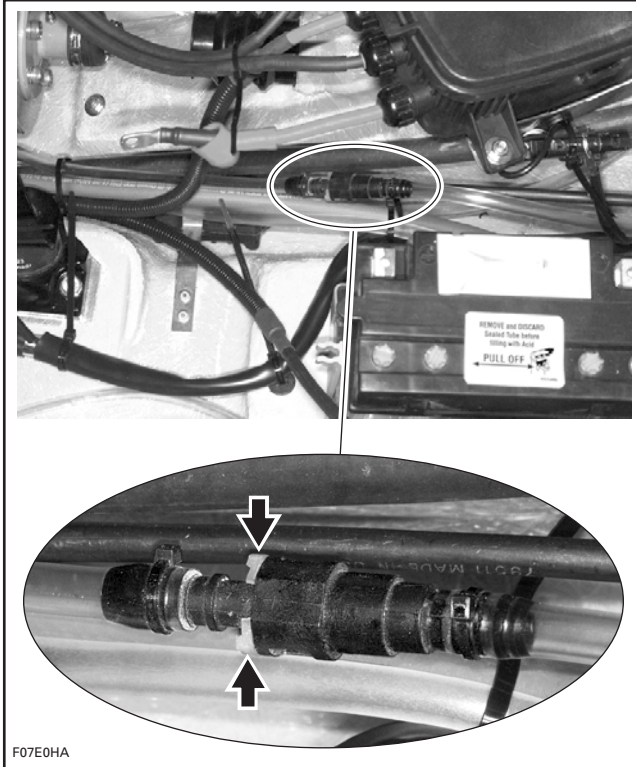
Reconnect hose when done.

Section 02 MAINTENANCE

Subsection 05 (STORAGE)

DI Models

Disconnect the quick connect fitting. Press both tabs and pull fitting.



F07E0HA

DISCONNECT THIS HOSE

Lower hose as necessary so that draining can take place.

Reconnect fitting when done.

Also ensure air compressor drain line is not obstructed. Clean as necessary.

PROPULSION SYSTEM

Jet Pump

Lubricant in impeller shaft reservoir should be drained. Reservoir should be cleaned and refilled with SEA-DOO synthetic 75W90 GL5 polyolester oil. Refer to JET PUMP for proper procedure.

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

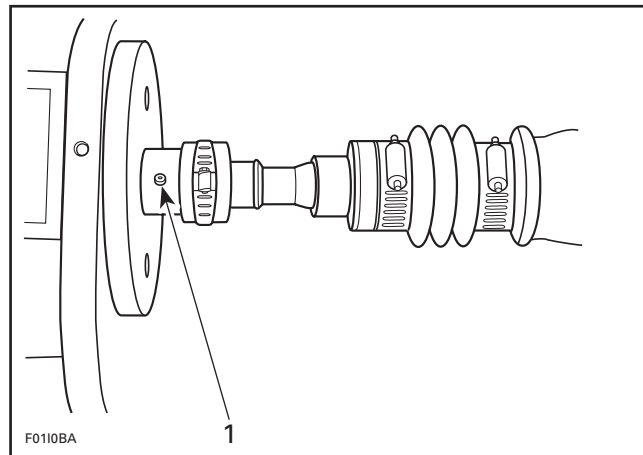
PTO Flywheel

All Models except XP

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.



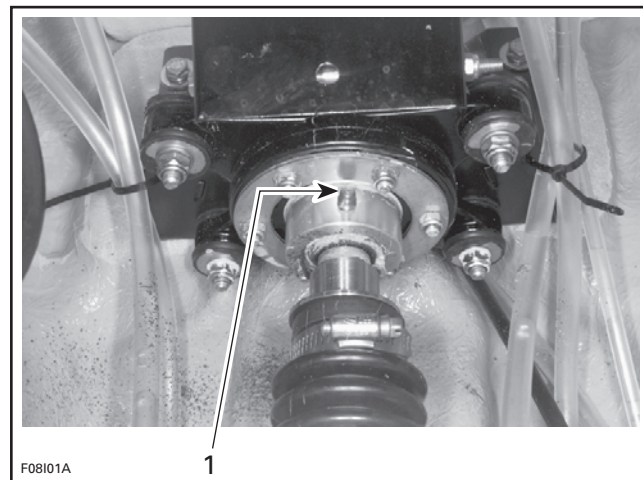
1. Grease PTO flywheel

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

SEAL CARRIER

XP Models

Lubricate seal carrier of drive shaft support with synthetic grease. Stop lubricating when grease is just coming out of seal.



1. Grease seal carrier

FUEL SYSTEM

Verify fuel system. Check fuel lines and carburetor(s), **if so equipped**, for leaks. Replace damaged hoses or clamps if necessary.

Sea-Doo Fuel Stabilizer (P/N 413 408 600) or equivalent should be added in fuel tank to prevent fuel deterioration and, **if so equipped**, carburetor(s) gumming. Follow manufacturer's instructions for proper use.

On **RFI and DI models**, fill up fuel tank completely. Ensure there is no water inside fuel tank.

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

CAUTION: Fuel stabilizer should be added prior to engine lubrication to ensure fuel system components protection against varnish deposits.

WARNING

Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Do not smoke or allow open flames or sparks in the vicinity. Fuel tank may be pressurized, slowly turn cap when opening. Never use an open flame to check fuel level. 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. Always wipe off any fuel spillage from the watercraft. Always turn the fuel tank valve (**if so equipped**) to OFF position when storing the watercraft.

Carburetor-Equipped Models

Always turn the fuel valve to OFF position when storing the watercraft.

COOLING SYSTEM FLUSHING AND ENGINE INTERNAL LUBRICATION

All Models

Cooling system has to be flushed with fresh water to prevent salt, sand or dirt accumulation which will clog water passages.

Engine must be lubricated to prevent corrosion on internal parts.

For proper procedure, refer to FLUSHING AND LUBRICATION.

BATTERY

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

WATERCRAFT CLEANING

Clean the bilge with hot water and mild detergent or with bilge cleaner. Rinse thoroughly. Lift front end of watercraft to completely drain bilge. If any repairs are needed to body or to the hull, touch up paint and Gelcote® repair kit are available. Replace damaged labels/decals.

Wash the body with soap and water solution (only use mild detergent). Rinse thoroughly with fresh water. Remove marine organisms from the hull. Apply a nonabrasive wax.

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

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

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

ADDITIONAL RECOMMENDED PROTECTION

NOTE: This procedure requires approximately 2.5 L (2.6 U.S. qt.) of antifreeze.

All Models

In cool regions (where freezing point may be encountered), cooling system should be filled with water and antifreeze solution (40% water, 60% antifreeze).

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

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.

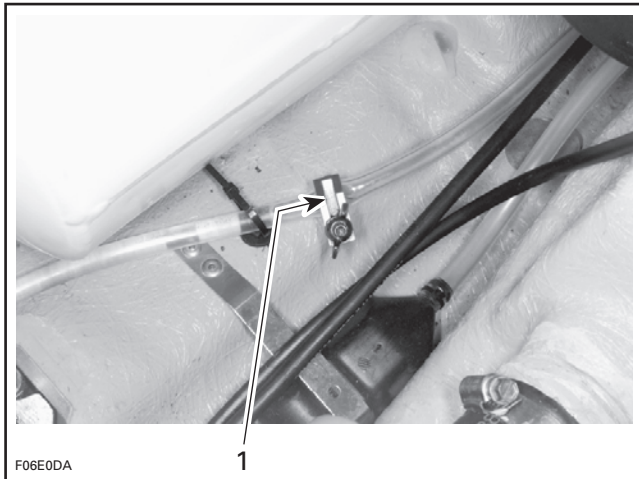
Section 02 MAINTENANCE

Subsection 05 (STORAGE)

Hose Pinchers Installation

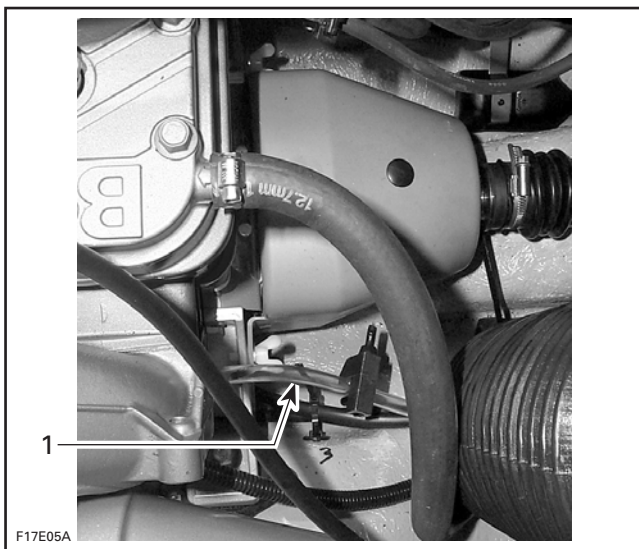
Some hoses have to be plugged to prevent draining, before filling cooling system jackets with the antifreeze.

All Models except DI



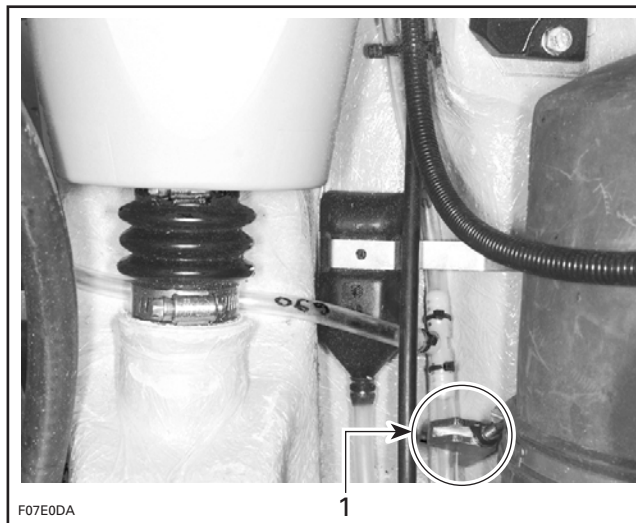
GS MODELS — 717 ENGINE

1. Engine drain hose



GTS AND GTI MODELS — 717 ENGINES

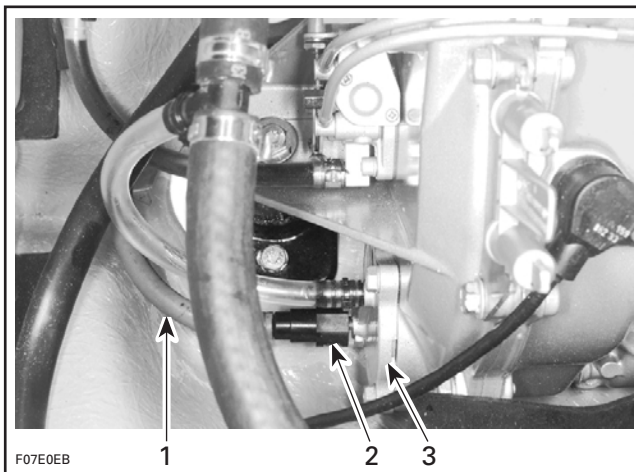
1. Engine drain hose



RFI MODELS — 787 ENGINE

1. Hose pincher installed on engine drain hose

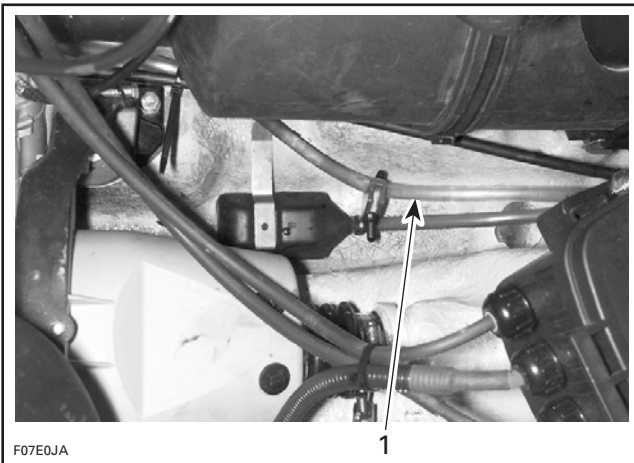
NOTE: On RFI models, make sure the hose is properly connected to the magneto cover.



1. Water supply hose from crankcase heat exchanger
2. Quick connector
3. Magneto heat exchanger

Section 02 MAINTENANCE

Subsection 05 (STORAGE)



947 CARBURETOR-EQUIPPED ENGINES EXCEPT XP

1. Engine drain hose

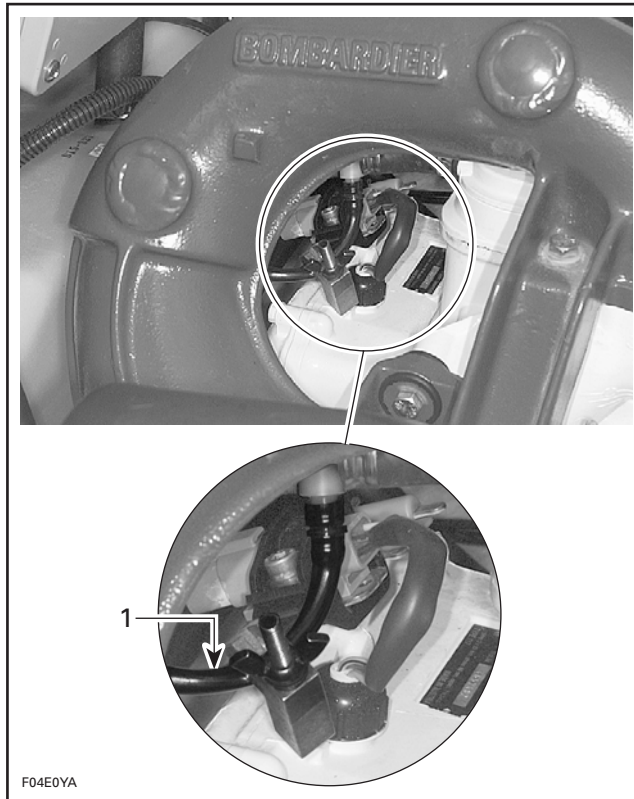
NOTE: On XP models, open rear cover to have access to engine drain hose.



XP MODELS — 947 ENGINE

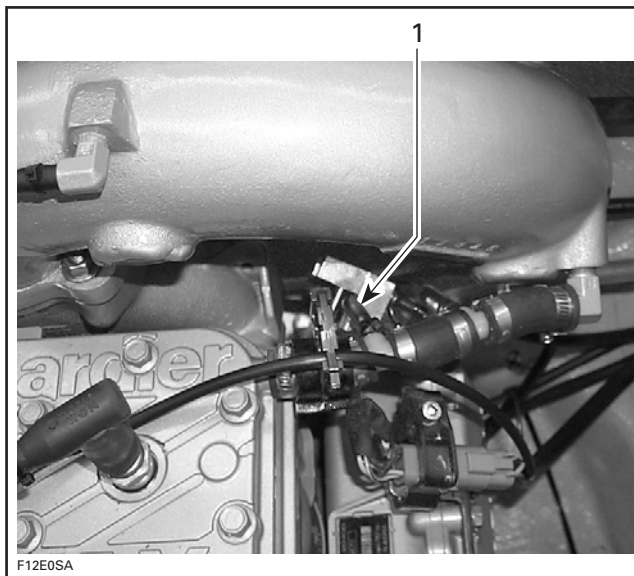
1. Hose pincher installed on engine drain hose

Install hose pincher on injection hose going to tuned pipe.



GTS MODELS — 717 ENGINE

1. Hose pincher on injection hose going to tuned pipe



GTS AND GTI MODELS — 717 ENGINES

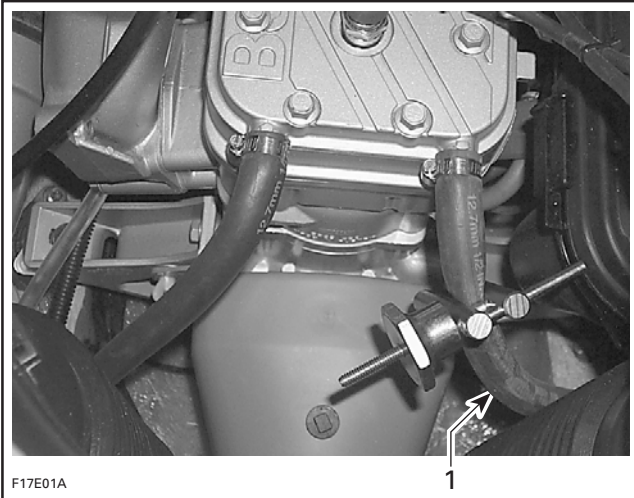
1. Hose pincher on injection hose going to tuned pipe

Section 02 MAINTENANCE

Subsection 05 (STORAGE)

Hose Disconnection

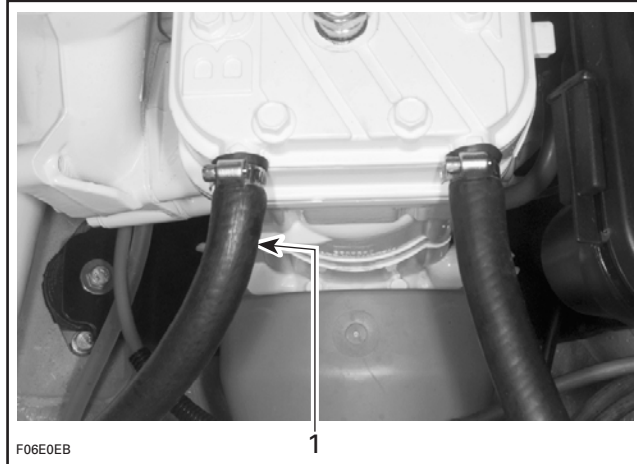
Some hoses have to be disconnected. Disconnect hoses at the following location.



F17E01A

717 AND 787 RFI ENGINES

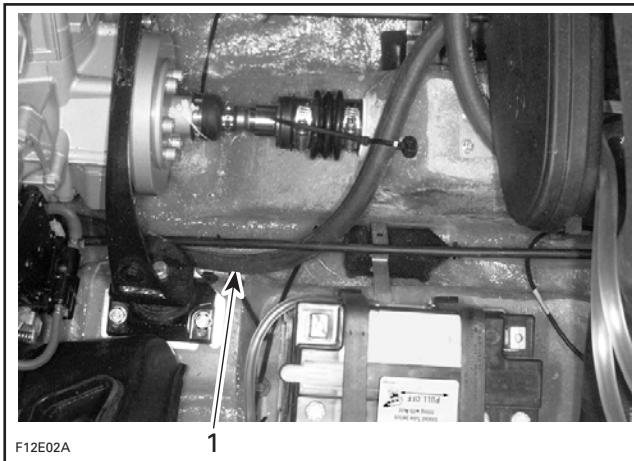
1. Engine water outlet hose



F06E0EB

717 AND 787 RFI ENGINES

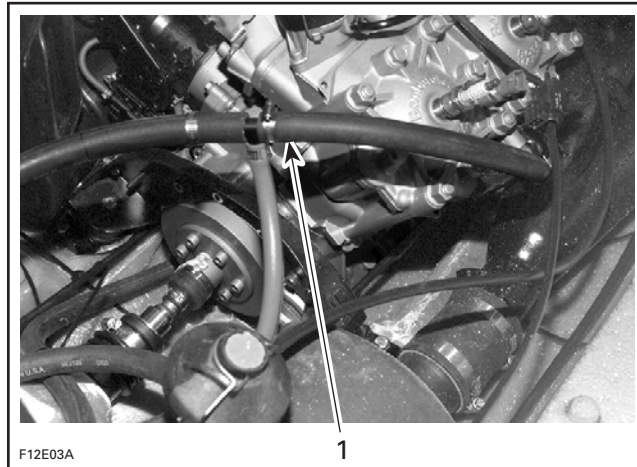
1. Disconnect engine water inlet hose



F12E02A

947 CARBURETOR-EQUIPPED ENGINES

1. Engine water outlet hose



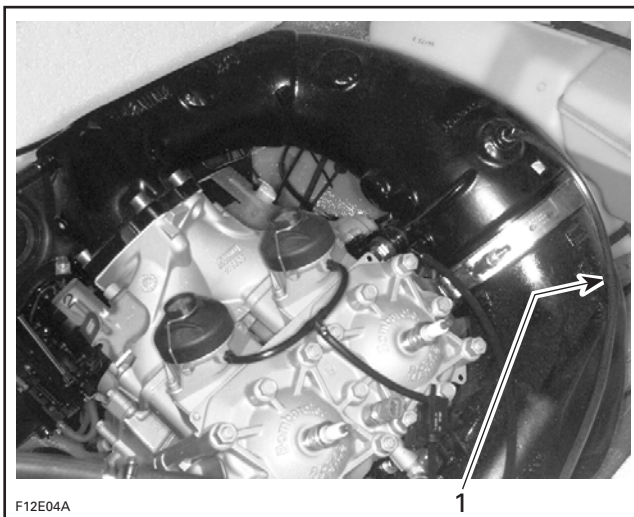
F12E03A

947 CARBURETOR-EQUIPPED ENGINES

1. Disconnect inlet hose this side of T-fitting

717 Engines

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



F12E04A

1. Tuned pipe bleed hose

All Models except DI

Insert a funnel into hose and pour antifreeze mixed with water (40% water, 60% antifreeze) in engine until the colored solution appears at the cooling system bleed outlet.



947 Carburetor-Equipped Engines

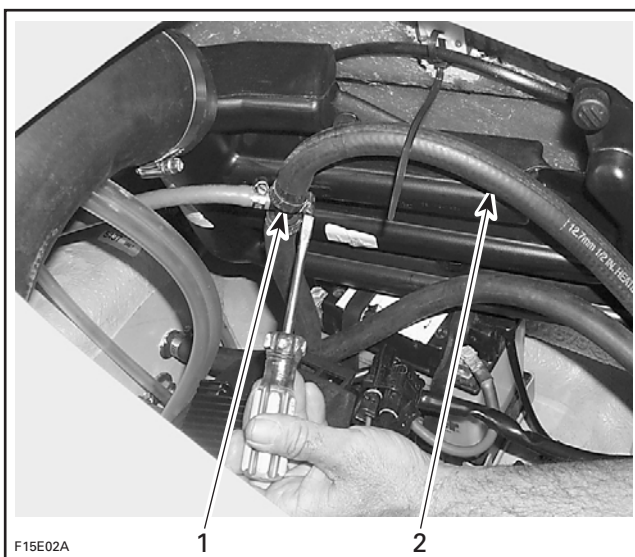
At this point, remove the hose pincher at tuned pipe bleed hose. If necessary, continue to pour antifreeze mix until the colored solution appears at the other cooling system bleed outlet (stern eyelet).

Remove the remaining hose pinchers in this order to allow proper flow of antifreeze.

1. Engine cylinder drain hose.
2. Water outlet hose.

787 RFI Engines

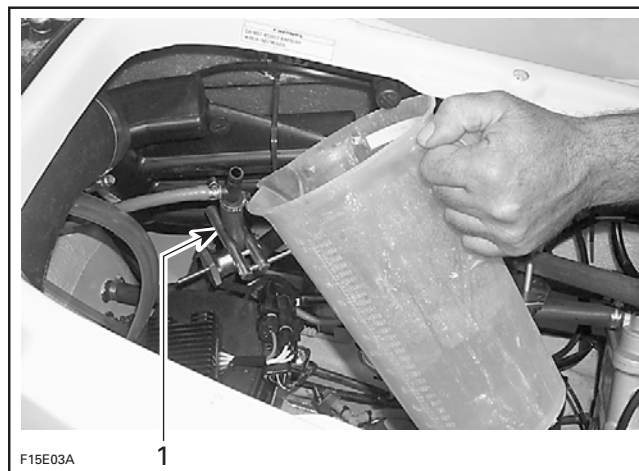
Disconnect hose just above T-fitting from as shown.



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

787 RFI and 947 Carburetor-Equipped Engines

Install a hose pincher just below T-fitting.



1. Hose pincher 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 it.

Reconnect hose to T-fitting and remove hose pincher (if applicable).

All Models except DI

Remove temporary hose on 717 engines and reconnect engine water outlet hose.

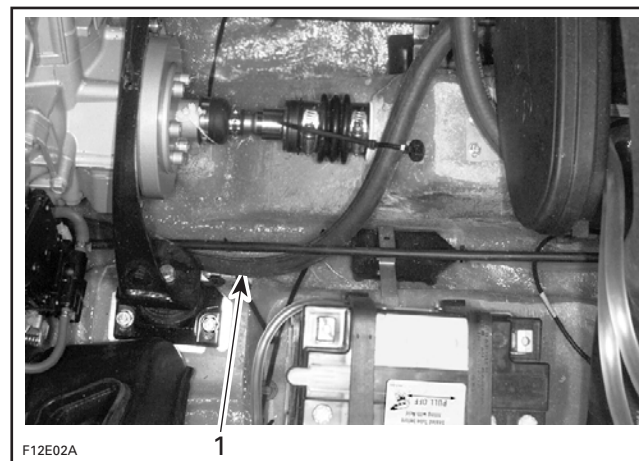
Remove hose pinchers.

DI Models

Hose Pinchers Installation

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

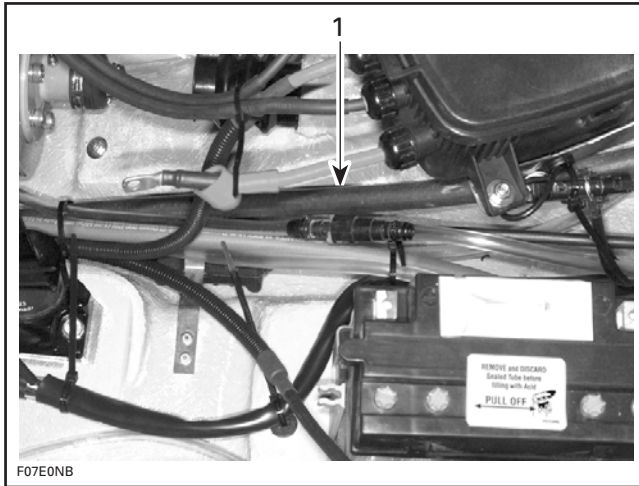
Install hose pinchers at the following location:



- RX DI MODELS**
1. Water outlet hose

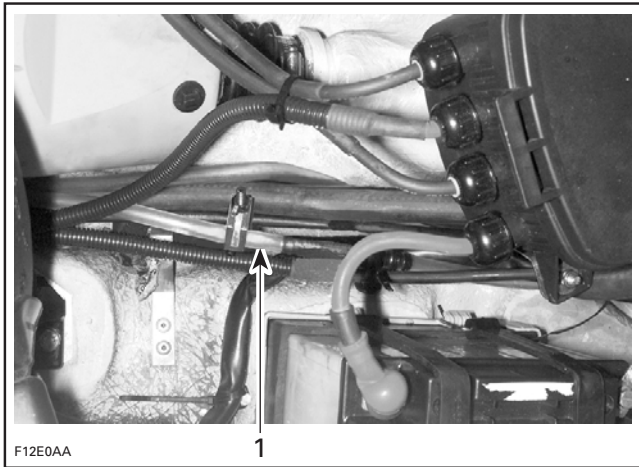
Section 02 MAINTENANCE

Subsection 05 (STORAGE)

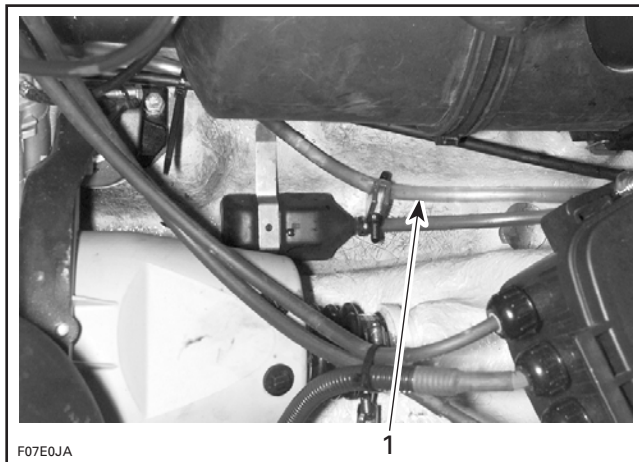


GTX DI MODELS

1. Water outlet hose



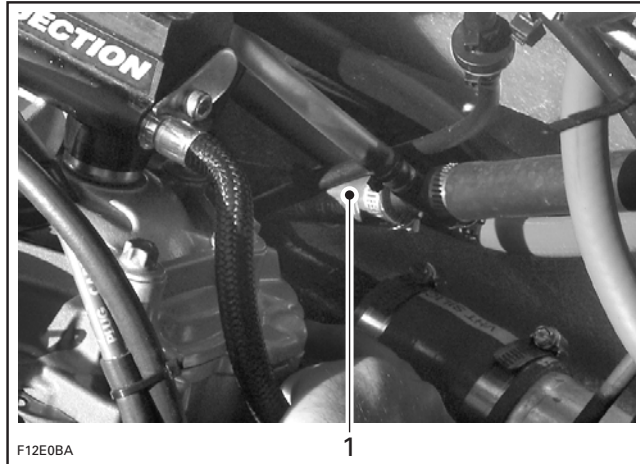
1. Crankcase cooling cover outlet hose



1. Engine cylinder drain hose

Hose Disconnection

Disconnect water **INLET** hose at engine between T-fitting and cylinder head fitting.



1. Disconnect this side of the T-fitting

Temporarily install a short piece of hose to replace the one removed.

Antifreeze

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

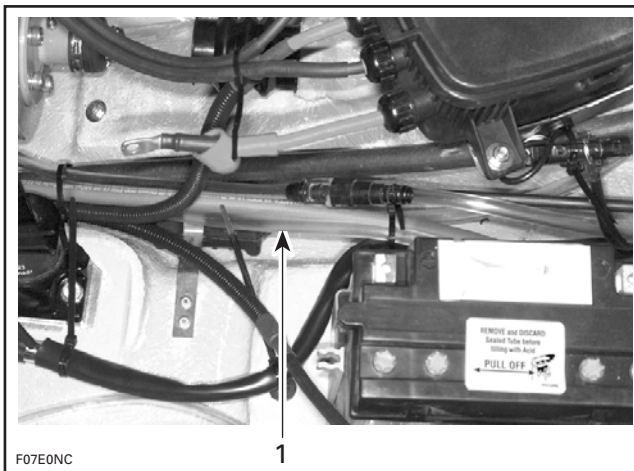


At this point, install a hose pincher on bleed outlet hose.



1. Bleed outlet hose

Continue to pour until antifreeze flows in air compressor water outlet hose.



1. Air compressor water outlet hose

Remove pinchers in this order to allow proper flow of antifreeze.

1. Bleed outlet hose.
2. Crankcase cooling cover outlet hose.
3. Engine cylinder drain hose.
4. Water outlet hose.

Pour approximately 200 mL (7 oz) of antifreeze in the water regulator valve supply hose to allow antifreeze flowing through the valve and into muffler to protect it.

Remove temporary hose and reconnect engine water outlet hose.

All Models

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 cylinder water jackets and thus preventing freezing problems.

At pre-season preparation, drain the remaining antifreeze from cooling system prior to using the watercraft.

ANTICORROSION TREATMENT

Wipe off any residual water in the engine compartment.

Spray BOMBARDIER LUBE lubricant over all metallic components in engine compartment.

Lubricate the throttle cable with BOMBARDIER LUBE lubricant.

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

Section 02 MAINTENANCE

Subsection 05 (STORAGE)

CHECKLIST

OPERATION	✓
Check engine drain hose(s)	
Drain and clean impeller shaft reservoir	
Lubricate PTO flywheel or seal carrier	
Verify fuel system	
Add Sea-Doo 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 on throttle and oil injection pump cables	

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 have all causes for all problems.

NOTE: On RFI and DI models, always check for fault codes recorded in the MPEM first using the VCK (vehicle communication kit (P/N 529 035 676). The MPEM programmer (P/N 529 035 718) can be used on the **RFI models**. 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	<ul style="list-style-type: none"> • DESS operation non functional • Safety lanyard switch or harness damaged • Burnt fuse on MPEM or in rear electrical box: battery, starting system, fuel pump (RFI models) • Starting system fuse keeps on burning • Discharged battery • Defective start/stop switch • Battery connections • Water/fuel hydrolock • Starter • Starter solenoid • Seized engine • Hydraulically locked air compressor (DI models) • Seized jet pump • Faulty sensor (RFI and DI models) or MPEM 	<ul style="list-style-type: none"> • If 2 short beeps are not heard when installing safety lanyard, refer to ELECTRICAL SYSTEM and ENGINE MANAGEMENT • Replace • Check wiring then replace fuse • Check wiring, solenoid and MPEM • Check/recharge • Check, refer to Starting System or ENGINE MANAGEMENT • Check/clean/tighten • Check, refer to section MAINTENANCE • Check, refer to section ELECTRICAL SYSTEM • Check, refer to section ELECTRICAL SYSTEM • Check/repair, refer to section ENGINE • Check/repair as needed • Check, refer to section PROPULSION SYSTEM • Check faulty codes in MPEM memory, refer to section ENGINE MANAGEMENT
Engine turns slowly	<ul style="list-style-type: none"> • Loose battery cable connections • Discharged/weak battery • Restriction in jet pump • Seizure in jet pump • Partial engine hydrolock • Partial engine seizure • Worn starter 	<ul style="list-style-type: none"> • Check/clean/tighten • Check/charge/replace • Check/clean pump • Inspect, refer to section PROPULSION SYSTEM • Check, refer to section MAINTENANCE • Check compression, refer to section ENGINE • Check, refer to section ELECTRICAL SYSTEM

Section 03 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

ENGINE WILL NOT START (cont'd)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine turns over	<ul style="list-style-type: none"> • Faulty component in the fuel injection system (RFI and DI models) • Engine drowned mode is active • Low battery voltage • Low or no fuel pressure (RFI and DI models) • Fuel injectors not working (RFI and DI models) • Low or no air pressure (DI models) • Direct injector not working (DI models) • No spark at the spark plug • Defective MPEM • Defective crankshaft position sensor • Fuel water-contaminated • Dirty fuel filter • Fouled or defective spark plug • Water in engine • Carburetion (carburetor models) • Ignition • Flooded engine <ul style="list-style-type: none"> – Carburetor needle valve stuck open (carburetor models) • Excessive rotary valve clearance (if so equipped) • Incorrect rotary valve timing (if so equipped) • Internal engine damage • Sheared flywheel key • Incorrect rotary valve timing (if so equipped) 	<ul style="list-style-type: none"> • Check for fault codes with the VCK (vehicle communication kit). Refer to Diagnostic Procedures in ENGINE MANAGEMENT • Release throttle lever • Recharge or replace battery • Check fuel pump operation • Check fuel pump pressure output • Check air/fuel rail • Check fuel pump fuse • Check wiring harness • Check fuel injector operation. Replace as necessary • Check output signal from MPEM • Check air/fuel rail • Check air compressor system • Check RAVE valve system for leaks • Check direct injector operation • Check output signal from MPEM • Check spark plugs condition and replace as necessary • Check ignition system and repair • Replace MPEM • Check operation of CPS and replace if necessary • Check/siphon and refill • Clean/replace • Replace • Check, refer to section MAINTENANCE • Check, refer to section FUEL SYSTEM • Check, refer to section ELECTRICAL SYSTEM • Check, refer to section FUEL SYSTEM • Check, refer to section ENGINE • Check, refer to section ENGINE • Check, refer to section ENGINE • Check timing mark, refer to section ELECTRICAL SYSTEM • Check, refer to section ENGINE
No spark at spark plugs	<ul style="list-style-type: none"> • Faulty rev limiter in MPEM (carburetor models) • Faulty MPEM 	<ul style="list-style-type: none"> • Replace MPEM • Replace MPEM

Section 03 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE HARD TO START

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none"> • Water in fuel reservoir • Mechanical engine failure • Spark plug faulty, fouled or worn out • Low fuel pressure (RFI and DI models) • Low air pressure (DI models) 	<ul style="list-style-type: none"> • Flush reservoir and refill with fresh gas • Check cylinder compression • Check for crankcase leaks • Check starting system • Check spark plug condition • Check fuel pump operation. Refer to ENGINE MANAGEMENT • Check fuel pressure regulator. Refer to ENGINE MANAGEMENT • Check air/fuel rail. Refer to ENGINE MANAGEMENT • Check air compressor system. Refer to ENGINE MANAGEMENT • Check RAVE valve for leaks

ENGINE STARTS BUT RUNS ONLY AT IDLE SPEED

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none"> • DI models: The DI system is in limp home mode. 	<ul style="list-style-type: none"> • Refer to section ENGINE and check the fault codes in the MPEM

ENGINE MISFIRES, RUNS IRREGULARLY

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	<ul style="list-style-type: none"> • Fouled, defective, worn spark plugs • Faulty MPEM • Faulty ignition module (if so equipped) • Sheared flywheel key • Too much oil supplied to engine • Bad ignition ground wiring • Faulty ignition coil, ignition generator coil, trigger coil (if so equipped) or bad connector 	<ul style="list-style-type: none"> • Check/verify heat range/gap/replace • Check, refer to section ELECTRICAL SYSTEM or ENGINE MANAGEMENT on RFI and DI models • Check, refer to ELECTRICAL SYSTEM • Check timing mark, refer to section ELECTRICAL SYSTEM • Adjust oil injection pump • Check wiring condition and proper grounding of ignition coil • Check coil. Refer to ELECTRICAL SYSTEM

Section 03 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

ENGINE MISFIRES, RUNS IRREGULARLY (cont'd)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Lean fuel mixture Dry spark plug (except when water fouled)	<ul style="list-style-type: none">• Low fuel level• Low fuel pressure (RFI and DI models)• Stale or water fouled fuel• Fuel filter dirty or restricted• Carburetion dirty or out of adjustment (carburetor models)• Clogged fuel injectors (RFI and DI models)• Clogged direct injectors (DI models)• Defective sensor or MPEM (RFI and DI models)• Leaking crankshaft seal(s) or intake (carburetor models)• Restricted fuel valve (carburetor models)• Loose carburetor (carburetor models)	<ul style="list-style-type: none">• Check/refill• Check pump, regulator, injectors and hose pinchers or if filter is plugged. Replace if necessary• Check/siphon and refill• Check/clean/replace• Check/clean/adjust, refer to section FUEL SYSTEM• Remove and clean fuel injectors• Remove and clean direct injectors• Check faulty codes in MPEM memory, refer to section ENGINE MANAGEMENT• Pressure check engine, refer to section ENGINE• Check/replace• Tighten carburetors

Section 03 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE MISFIRES, RUNS IRREGULARLY (cont'd)

<p>Rich fuel mixture Fouled spark plug</p>	<ul style="list-style-type: none"> • Partially closed choke (carburetor models) • Flame arrester dirty or restricted (if so equipped) • Carburetor adjustment (carburetor models) • Loose main jet (carburetor models) • Improper air/fuel rail pressure (DI models) • Fuel injector(s) (RFI and DI models) • Direct injector(s) (DI models) • Defective sensor or MPEM (RFI and DI models) • Rotary valve shaft seal leaking (if so equipped) • Damaged reed valve (if so equipped) • Leaking crankshaft seal(s) or intake (DI models) • Leak in RAVE valve system (DI models) • Oil injection pump adjustment • Worn needles and seals (carburetor models) • Excessive rotary valve clearance (if so equipped) • Fuel pressure and/or air pressure fluctuating (DI models) • High fuel pressure (RFI and DI models) 	<ul style="list-style-type: none"> • Check/adjust choke cable • Check/replace • Check/adjust, refer to section FUEL SYSTEM • Check, refer to section FUEL SYSTEM • Check pressures, refer to ENGINE MANAGEMENT • Remove and replace fuel injector(s), refer to section ENGINE MANAGEMENT • Remove and replace direct injector(s), refer to section ENGINE MANAGEMENT • Check faulty codes in MPEM memory, refer to section ENGINE MANAGEMENT • Check/replace, refer to ENGINE • Check, refer to Bottom End in ENGINE SECTION • Pressure check engine, refer to section ENGINE • Check, refer to ENGINE MANAGEMENT • Check/adjust, refer to section LUBRICATION SYSTEM • Check, refer to section FUEL SYSTEM • Check, refer to ENGINE • Inspect fuel and air pressure regulators. Refer to ENGINE MANAGEMENT • Check pump, regulator, injectors, hose pinchers or if filter is plugged. Replace if necessary
<p>Start but run poorly</p>	<ul style="list-style-type: none"> • RFI and DI models: Check spark plug condition, check fault codes in the MPEM memory, check fuel pressure, check RAVE valves operation 	<ul style="list-style-type: none"> • Check, refer to section ENGINE MANAGEMENT. If some work has been performed on the unit, make sure injector wire connectors were not mixed. Refer to the wiring diagram for wire colors and positions
<p>Also fuel injection misinjecting</p>	<ul style="list-style-type: none"> • DI models: Bent or missing tooth on encoder wheel • RFI models: Bent or missing tooth on trigger wheel 	<ul style="list-style-type: none"> • Check, refer to ENGINE MANAGEMENT under Component inspection and adjustment
<p>Difficult to start</p>	<ul style="list-style-type: none"> • Incorrect rotary valve timing (if so equipped) • Excessive rotary valve clearance (if so equipped) 	<ul style="list-style-type: none"> • Check/adjust, refer to ENGINE • Check, refer to ENGINE

Section 03 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

ENGINE CONTINUALLY BACKFIRES

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	<ul style="list-style-type: none">Fouled, defective spark plugsMalfunction of rev limiter in MPEM	<ul style="list-style-type: none">Clean/replaceClean/replace, refer to section ELECTRICAL SYSTEM
Spark plugs	<ul style="list-style-type: none">Spark plug leads or wiring reversed	<ul style="list-style-type: none">Check with wiring diagram
Ignition timing/TDC setting	<ul style="list-style-type: none">Incorrect settingSheared flywheel key	<ul style="list-style-type: none">Check/reset, refer to section ELECTRICAL SYSTEMCheck/replace, refer to sections ELECTRICAL SYSTEM and ENGINE
Rotary valve (if so equipped)	<ul style="list-style-type: none">Incorrect timing	<ul style="list-style-type: none">Check/reset, refer to ENGINE
Carburetor (if so equipped)	<ul style="list-style-type: none">Carburetion too lean	<ul style="list-style-type: none">Check/adjust, refer to section FUEL SYSTEM
Engine	<ul style="list-style-type: none">Intake leak/crankshaft seal failure (carburetor models)	<ul style="list-style-type: none">Pressure check engine, refer to section ENGINE

ENGINE DETONATION OR PINGING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Ignition	<ul style="list-style-type: none">Timing too far advancedSpark plug heat range too high	<ul style="list-style-type: none">Check/resetCheck/change to correct range
Engine temperature	<ul style="list-style-type: none">Engine overheatsFuel octane too low of poor quality	<ul style="list-style-type: none">Check, see engine overheatsUse good quality fuel

Section 03 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE LACKS ACCELERATION OR POWER

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none"> • Weak spark • Carburetion, jetting too rich/lean (carburetor models) • Throttle does not open fully • Low compression • Exhaust system restriction • Water in fuel or oil • Debris in carburetor needle valve (carburetor models) • Impeller leading edge damaged • Twisted crankshaft • Clogged direct injectors (RFI and DI models) • Clogged fuel injectors (RFI and DI models) • Low fuel pressure (RFI and DI models) • Incorrect throttle position sensor (TPS) adjustment (RFI and DI models) • Overheated engine 	<ul style="list-style-type: none"> • Check/replace, refer to section ELECTRICAL SYSTEM • Check/adjust, refer to section FUEL SYSTEM • Check/readjust, refer to section FUEL SYSTEM • Check/repair, refer to section ENGINE • Check/clean • Check/siphon/replace • Check/clean, refer to section FUEL SYSTEM • Check/replace, refer to section PROPULSION SYSTEM • Check, refer to section ENGINE • Remove and clean direct injectors • Remove and clean fuel injectors • Check fuel line and fuel pump pressure • Check and adjust TPS, refer to section ENGINE MANAGEMENT • See ENGINE OVERHEATS in this chart
Engine revs lower than its maximum operational RPM	<ul style="list-style-type: none"> • RAVE valve does not open (if so equipped) 	<ul style="list-style-type: none"> • Check, refer to section ENGINE
Peak performance is delayed until higher RPM range is reached	<ul style="list-style-type: none"> • RAVE valve is stuck opened (if so equipped) 	<ul style="list-style-type: none"> • Check, refer to section ENGINE

ENGINE STOPS RUNNING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine was running below 2000 RPM. No maintenance light	<ul style="list-style-type: none"> • Electrical noise (DI models) 	<ul style="list-style-type: none"> • Refer to section ENGINE MANAGEMENT
Engine stalls at idle	<ul style="list-style-type: none"> • Low air pressure (DI models) 	<ul style="list-style-type: none"> • Check air delivery circuit for leaks • Check air compressor
Engine start but stops after approximately 2 seconds	<ul style="list-style-type: none"> • Engine running out of fuel • Low air pressure (DI models) 	<ul style="list-style-type: none"> • Check fuel delivery system for proper fuel pressure (RFI and DI models) and delivery (all models) • Check air system (compressor, air/fuel rail etc.)
Idle gradually go down and engine will die	<ul style="list-style-type: none"> • Scratches on rotary valve cover (RFI models) 	<ul style="list-style-type: none"> • Change the defective part

Section 03 TROUBLESHOOTING

Subsection 01 (TROUBLESHOOTING CHART)

ENGINE CANNOT REACH MAXIMUM RPM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none">• RAVE valve does not open• Faulty water regulator valve• DI models: The DI system is in limp home mode. "MAINT" is displayed on Information Center• Low fuel pressure (RFI and DI models)• Jet pump related problem• Exhaust system blockage	<ul style="list-style-type: none">• Check, refer to section ENGINE and COOLING SYSTEM• Check, refer to COOLING SYSTEM• Refer to section ENGINE and COOLING SYSTEM and check the fault codes in the MPEM• Check fuel pump pressure output• Check propulsion components. Refer to JET PUMP• Check and repair

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

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine RPM too high	<ul style="list-style-type: none">• Faulty rev limiter in MPEM• Improper impeller pitch (too low)• Incorrect throttle position sensor (TPS) adjustment (RFI models)	<ul style="list-style-type: none">• Check, refer to section ELECTRICAL SYSTEM• Check/replace, refer to section PROPULSION SYSTEM• Check and adjust TPS, refer to ENGINE MANAGEMENT
Jet pump cavitation	<ul style="list-style-type: none">• Damaged leading or trailing edge of impeller• Sealing of ride plate, jet pump support or jet pump	<ul style="list-style-type: none">• Check/replace <p>NOTE: Leading edge damage contributes to poor performance from start. Trailing edge damage contributes to poor top performance and stator vanes erosion.</p> <ul style="list-style-type: none">• Check/reseal, refer to section PROPULSION SYSTEM or HULL/BODY

Section 03 TROUBLESHOOTING
Subsection 01 (TROUBLESHOOTING CHART)

ENGINE OVERHEATS

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Monitoring beeper sounds continuously	<ul style="list-style-type: none"> • Restricted jet pump water intake • Cooling system restriction • Grounded temperature sensor or sensor wire (carburetor models) 	<ul style="list-style-type: none"> • Check/clean • Check/flush, refer to section MAINTENANCE • Check/repair/replace

ABNORMAL NOISE FROM PROPULSION SYSTEM

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none"> • Weeds/debris caught in intake grate or impeller • Low oil level in jet pump • Worn anti-rattle system • Damaged or bent drive shaft • Broken engine mounts 	<ul style="list-style-type: none"> • Check/clean • Check/troubleshoot source of leak/refill supply, refer to section PROPULSION SYSTEM • Check/replace pusher in cover, refer to section PROPULSION SYSTEM • Check/replace, refer to section PROPULSION SYSTEM • Check/replace, refer to section ENGINE

NOTE: Prior to replacing a MPEM, refer to the MPEM section or **MPEM replacement** in the ENGINE MANAGEMENT section and read carefully the tests to do before replacing a MPEM that could otherwise be good.

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LEAK TEST

GENERAL

A Sea-Doo Engine Leak Test Kit (P/N 295 500 352) and Supplementary Engine Leak Test Kit (P/N 295 500 780) are available to help diagnose engine problems such as engine seizure, poor performance, oil leakage, etc.

Before disassembling any components of the engine, it is important to perform a leakage test to determine which part is defective.

It is also very important after servicing the engine, even for a complete engine rebuilt, to perform another leakage test; at this stage, it may avoid further engine problems and minimizing the risk of having to remove and reinstall the engine again.

Static bench testing is the most effective way to conduct a leakage test. Inboard testing does not allow complete access to, and observation of all engine surfaces and should be avoided whenever possible.

On the **717 engine**, cylinders can not be verified individually due to leakage from one cylinder to another through a common intake manifold.

When installing hoses of the Engine Leak Test Kit or Supplementary Engine Leak Test Kit, use the collars provided in the kit to ensure a proper sealing.

When pressurizing the engine, first confirm that the components of the Engine Leak Test Kit or Supplementary Engine Leak Test Kit are not leaking by spraying a solution of soapy water on all hoses, connections, fittings, plates, etc. If there is a leak, bubbles will indicate leak location.

Three areas of the engine will be tested in sequence as per the diagnostic flow chart (see the end of this subsection).

1. Engine Cooling System.
2. Bottom End and Top End.
3. Rotary Valve Shaft (**except all 947 engines**).

NOTE: If a leak is found, it is important to continue testing as there is the possibility of having more than one leak. Continue pumping to compensate for the air lost to find another leak.

PREPARATION

Verify fuel system for leaks.

WARNING

If any fuel leak is found, do not start the engine. Correct the leak and wipe off any fuel spillage. Do not use electric powered tools unless fuel system has passed pressure test.

Disconnect battery BLACK negative cable.

WARNING

Always disconnect battery cables in the specified order, BLACK negative cable first.

Disconnect battery RED positive cable.

TESTING PROCEDURE

Engine Cooling System

Remove the tuned pipe. Refer to EXHAUST SYSTEM.

Remove the exhaust manifold gasket and ensure the surface is clean.

Disconnect engine cooling hoses.

Install the appropriate exhaust manifold plate from the Engine Leak Test Kit (P/N 295 500 352) or Supplementary Engine Leak Test Kit (P/N 295 500 780). Tighten plate using fasteners provided in the kit.

NOTE: Do not torque plate excessively.

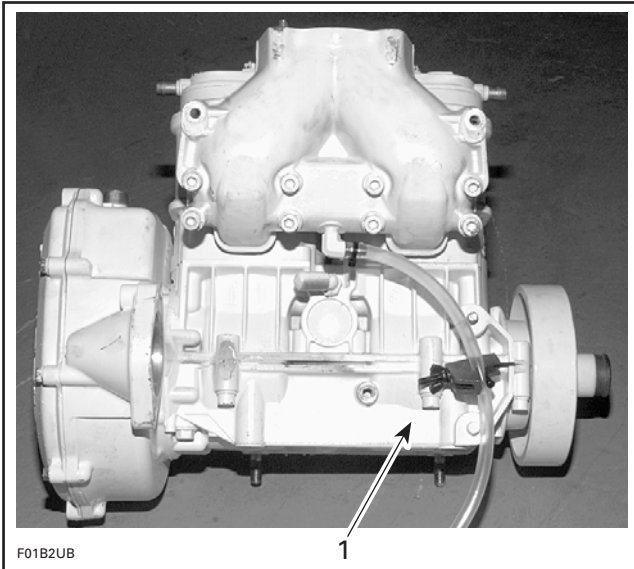
Install a hose pincher on engine drain hose.

Section 04 ENGINE

Subsection 02 (LEAK TEST)

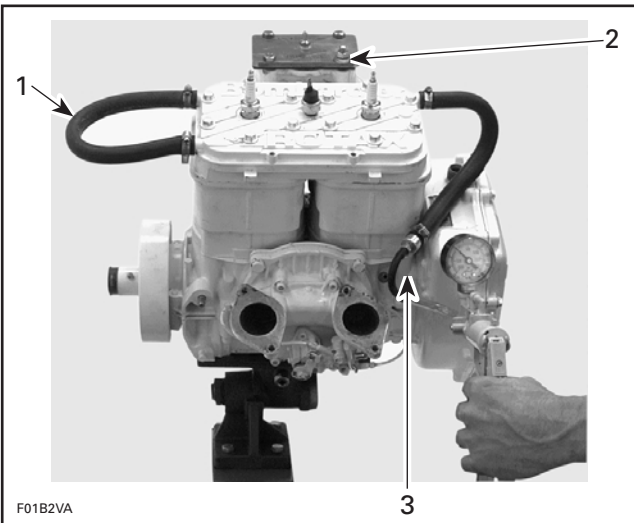
Use hoses provided in the kit and install them on the engine.

Install pump using reducer and appropriate tube(s) as necessary.



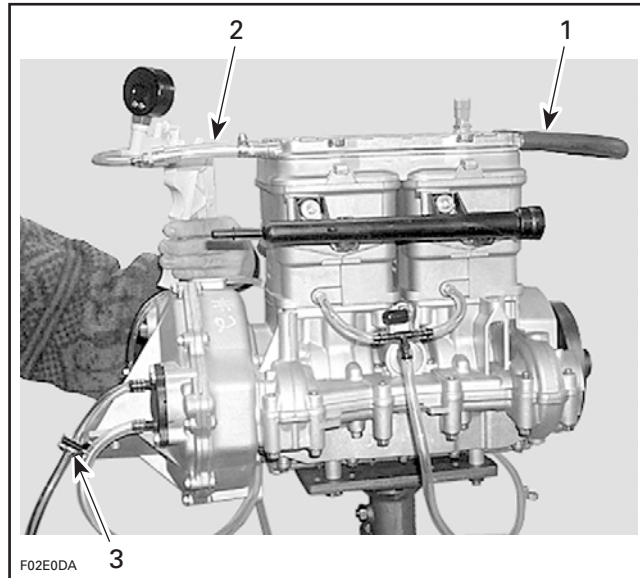
717 ENGINE — REAR VIEW

1. Engine drain hose blocked with a hose pincher



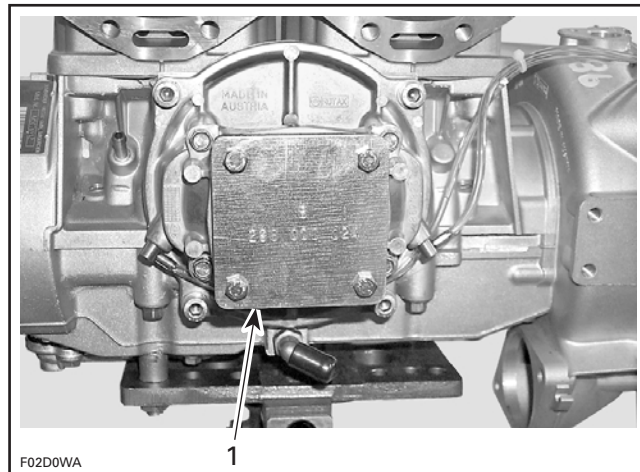
717 ENGINE — FRONT VIEW

1. Loop hose and use clamps
2. Use two washers with exhaust manifold stud
3. Hose with adapter and nipple



787 RFI ENGINE — REAR VIEW

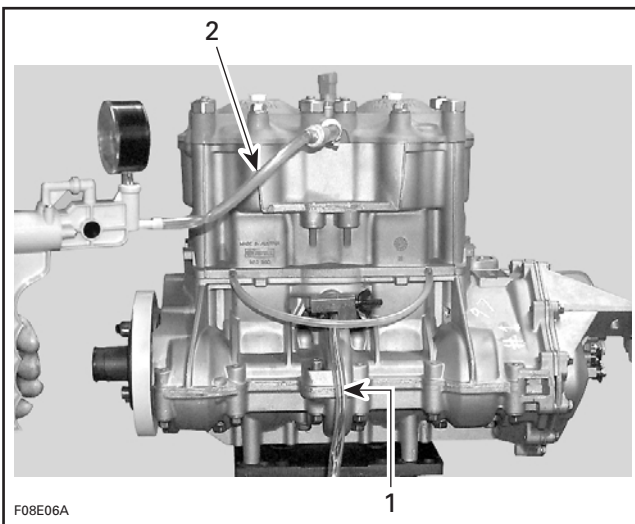
1. Loop hose and use clamps
2. Hose with clamps. Install pump to the end
3. Block engine drain hose with a hose pincher



787 RFI ENGINE — FRONT VIEW

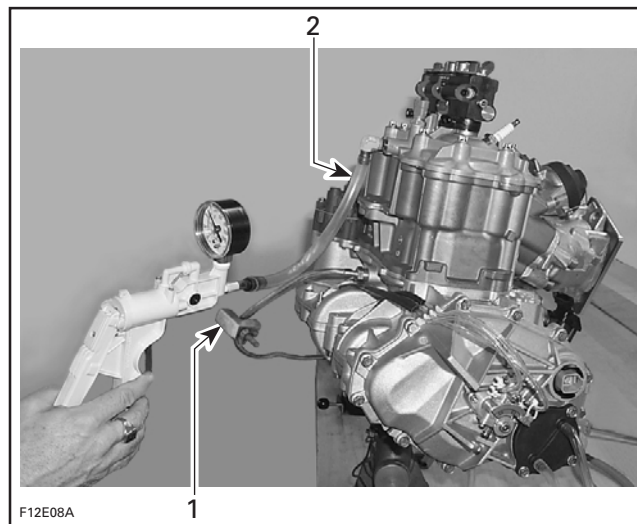
1. Exhaust manifold plate

Section 04 ENGINE
Subsection 02 (LEAK TEST)



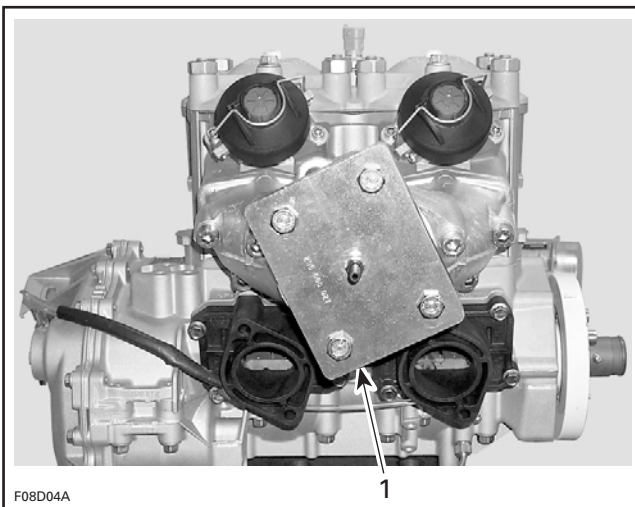
947 CARBURETOR-EQUIPPED ENGINE — REAR VIEW

1. Block engine drain hose with a hose pincher
2. Install pump to water inlet hose



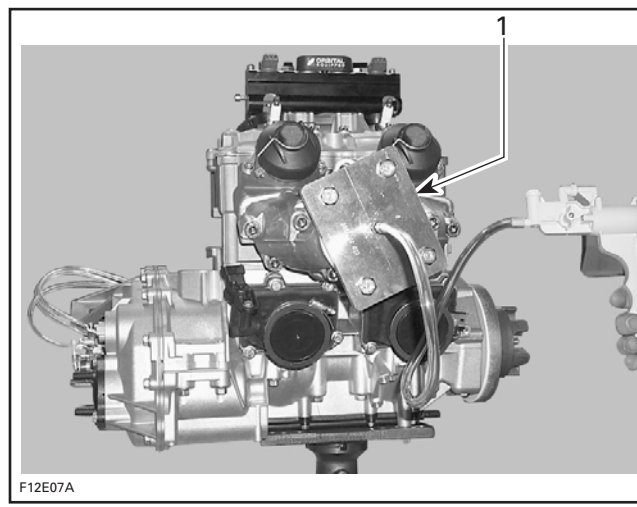
947 DI ENGINE — SIDE VIEW

1. Block engine drain hose with a hose pincher
2. Install pump to water inlet hose



947 CARBURETOR-EQUIPPED ENGINE — FRONT VIEW

1. Exhaust manifold plate



947 DI ENGINE — FRONT VIEW

1. Exhaust manifold plate

NOTE: Water is not required for testing.

DI models, it is not necessary to pressurize the bottom crankcase cover nor the magneto cover. There is no possible water leak path toward the internal components of the engine.

Section 04 ENGINE

Subsection 02 (LEAK TEST)

Activate pump and pressurize engine cooling system to 34 kPa (5 PSI).

Wait 3 minutes and check if pressure drops; if so, verify all testing components.

- If kit components are not leaking and pressure drops, verify all external jointed surfaces, temperature sensor and the O-ring between the spark plug area and the engine cylinder head cover. If none of these components are leaking, there is an internal leak and it can be detected with Bottom End and Top End testing.

Bottom End and Top End

Carburetor-Equipped Models

Remove the carburetor(s) and gasket(s). Make sure the surface of the intake manifold (717 and 947 engines) or rotary valve cover (787 RFI engine) are clean.

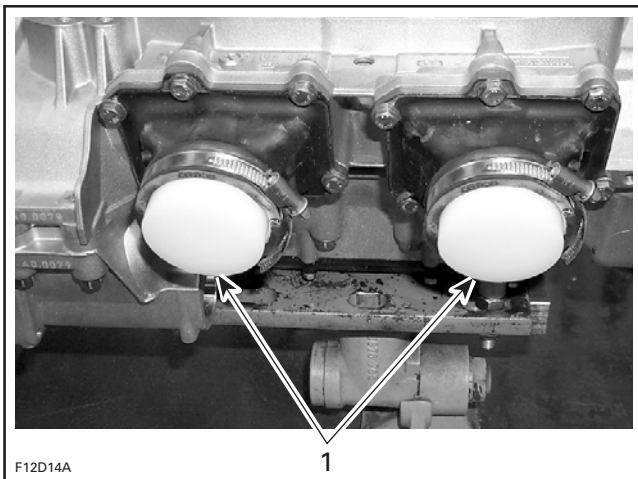
Install the intake plate(s) with fasteners from the kit and tighten adequately.

NOTE: For the 787 RFI and 947 engines, use the intake and exhaust plates included in the Supplementary Engine Leak Test Kit (P/N 295 500 780).

DI Models

Remove throttle bodies on DI models.

Install intake manifold plugs (P/N 529 035 708).



1. Intake manifold plugs

All Models

On engines with the RAVE system, remove the RAVE valves and gaskets.

Install the RAVE valve plates with fasteners from the kit and tighten adequately.

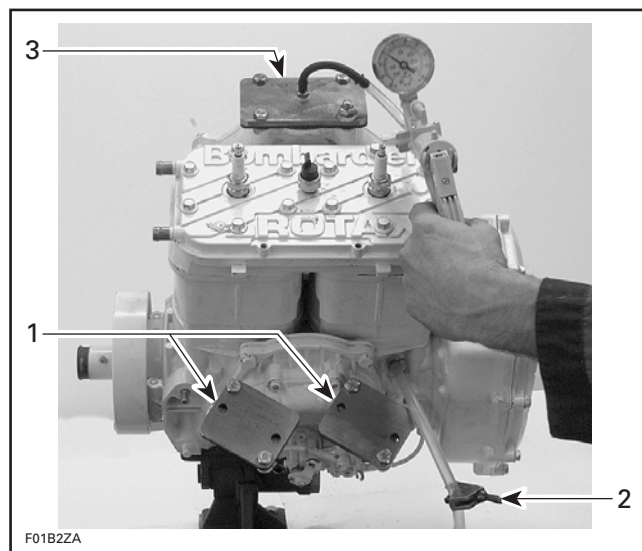
NOTE: Engines with the RAVE system, the boot (carburetor-equipped engines) and O-ring can be checked for leakage with the valve in place. Simply remove the cover to expose the parts.

Make sure the spark plugs (and the air/fuel rail on DI engines) are installed and tightened.

Block pulse hose (carburetor-equipped engines) using a hose pincher.

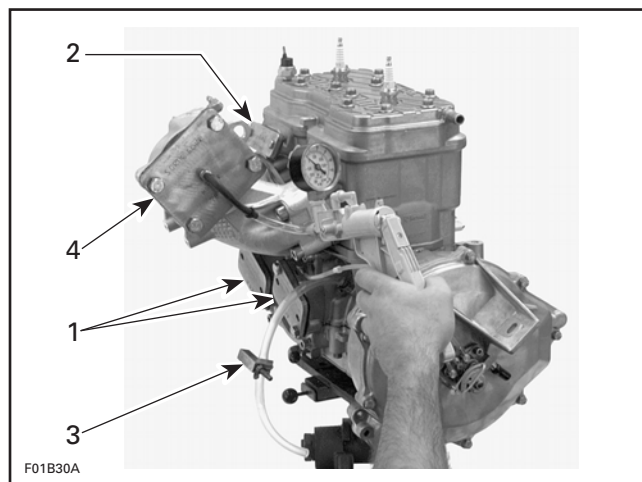
NOTE: Do not block the rotary valve shaft hoses (if so equipped).

Install pump to the exhaust plate fitting.



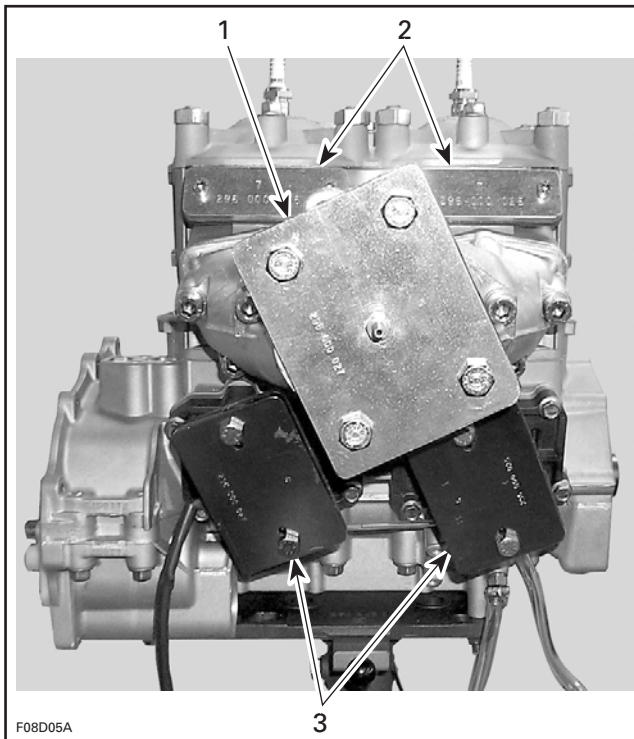
717 ENGINE

1. Intake plates
2. Pulse hose blocked with a hose pincher
3. Exhaust plate



787 RFI ENGINE

1. Intake plates
2. RAVE valve plates
3. Pulse hose blocked with a hose pincher
4. Exhaust plate



947 ENGINE

1. Exhaust plate
2. Valve plates
3. Intake plates

Activate pump and pressurize engine to 34 kPa (5 PSI).

CAUTION: Do not exceed this pressure.

Wait 3 minutes and check if pressure drops; if so, verify all testing components.

If kit components are not leaking, verify engine jointed surfaces as per following areas:

- spark plugs
- direct injector sealing (**DI engines**)
- cylinder head gasket
- cylinder base gasket
- crankcase halves
- rotary valve cover (**except all 947 engines**)
- engine plugs
- exhaust manifold
- intake manifold (**717 engine**)
- intake flanges (**DI engine**)
- oil injection pump (**717 engine**).

Check also small oil injection pump lines and fittings; check for air bubbles or oil column going toward pump, which indicate a defective check valve. Check for leak through counterbalancing shaft seal toward air compressor (**DI engines**). Air bubbles in lowest fitting (oil return line) underneath compressor indicates a seal leakage.

If the above mentioned components are not leaking, block both oil hoses of the rotary valve shaft (**if so equipped**) using hose pinchers.

NOTE: If leakage stops at this point, proceed with **Rotary Valve Shaft testing (if so equipped)**.

If there is still some leakage, remove the PTO flywheel to verify outer seal.

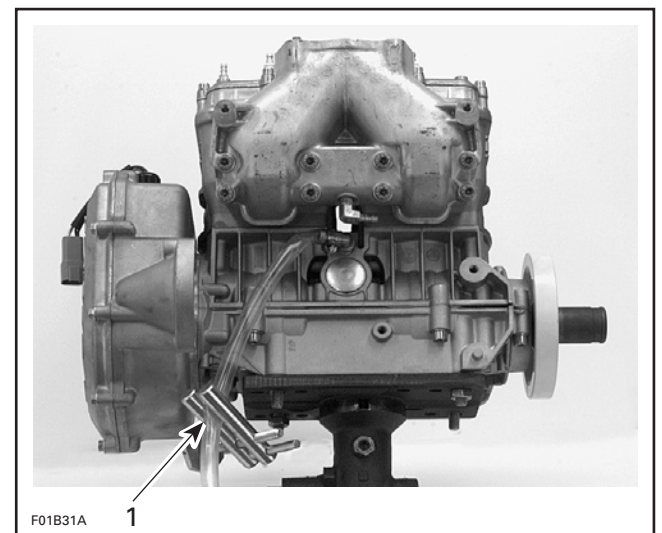
If no leak is found on the PTO side outer seal, remove magneto flywheel and verify crankshaft outer seals.

Proceed with the **Rotary Valve Shaft testing (if so equipped)** if the crankshaft outer seals are not leaking.

Rotary Valve Shaft (if so equipped)

NOTE: It is mandatory to drain the injection oil from the rotary valve shaft.

Block oil return hose of the rotary valve shaft with a hose pincher.

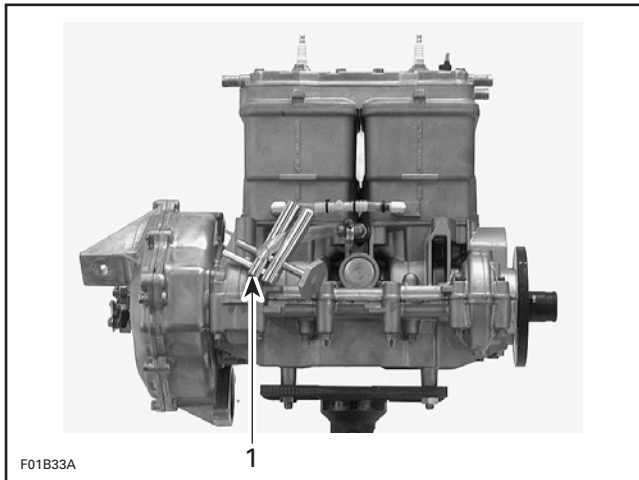


717 ENGINE

1. Oil return hose blocked with hose pincher

Section 04 ENGINE

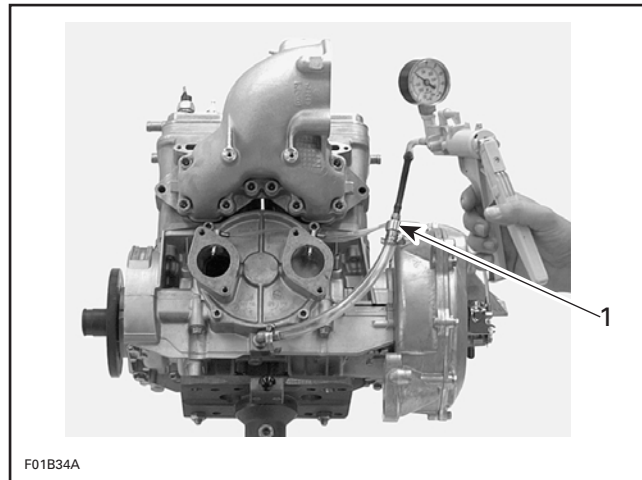
Subsection 02 (LEAK TEST)



787 RFI ENGINE

1. Oil return hose blocked with hose pincher

Install pump with reducer and nipple to the oil supply hose of the rotary valve shaft.



787 RFI ENGINE

1. Pump with reducer and nipple

Activate pump and pressurize to 34 kPa (5 PSI).

Check plug of the rotary valve shaft in crankcase.

Remove PTO side spark plug. If pressure drops, it indicates a defective PTO side crankshaft inner seal or crankcase is not sealed correctly.

Remove MAG side spark plug. If pressure drops, it indicates a defective MAG side crankshaft inner seal or crankcase is not sealed correctly.

If the above mentioned components are not leaking and there is a pressure drops, remove the rotary valve cover. Check the seal of the rotary valve shaft.

If the rotary valve shaft is not leaking, it could indicate a defective engine casting. Disassemble engine and carefully check for defects in castings. Pay attention to tapped holes which may go through sealed areas of engine and thus lead to leakage.

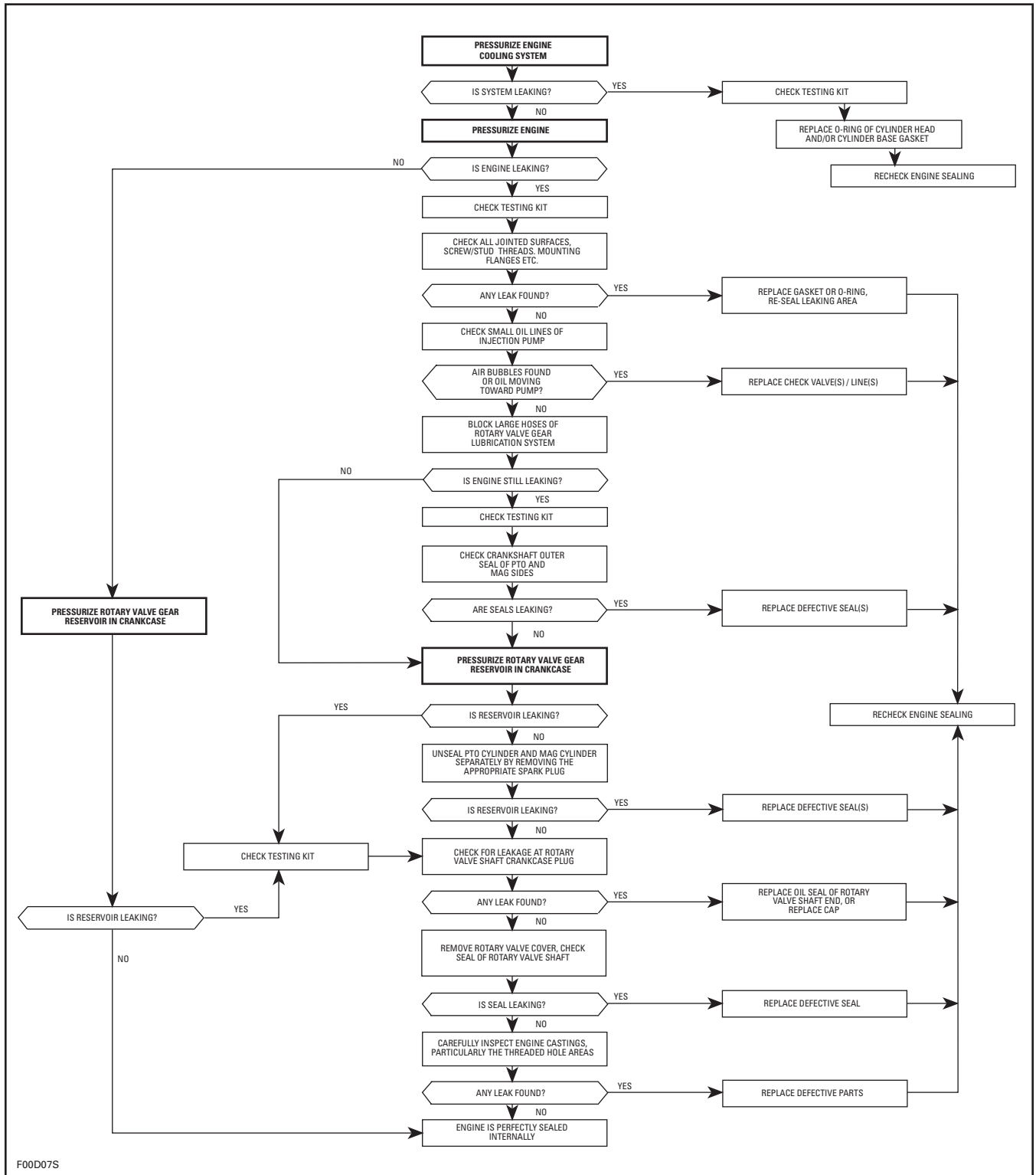


717 ENGINE

1. Pump with reducer and nipple

ENGINE LEAKAGE DIAGNOSTIC FLOW CHART

717 and 787 RFI Engines

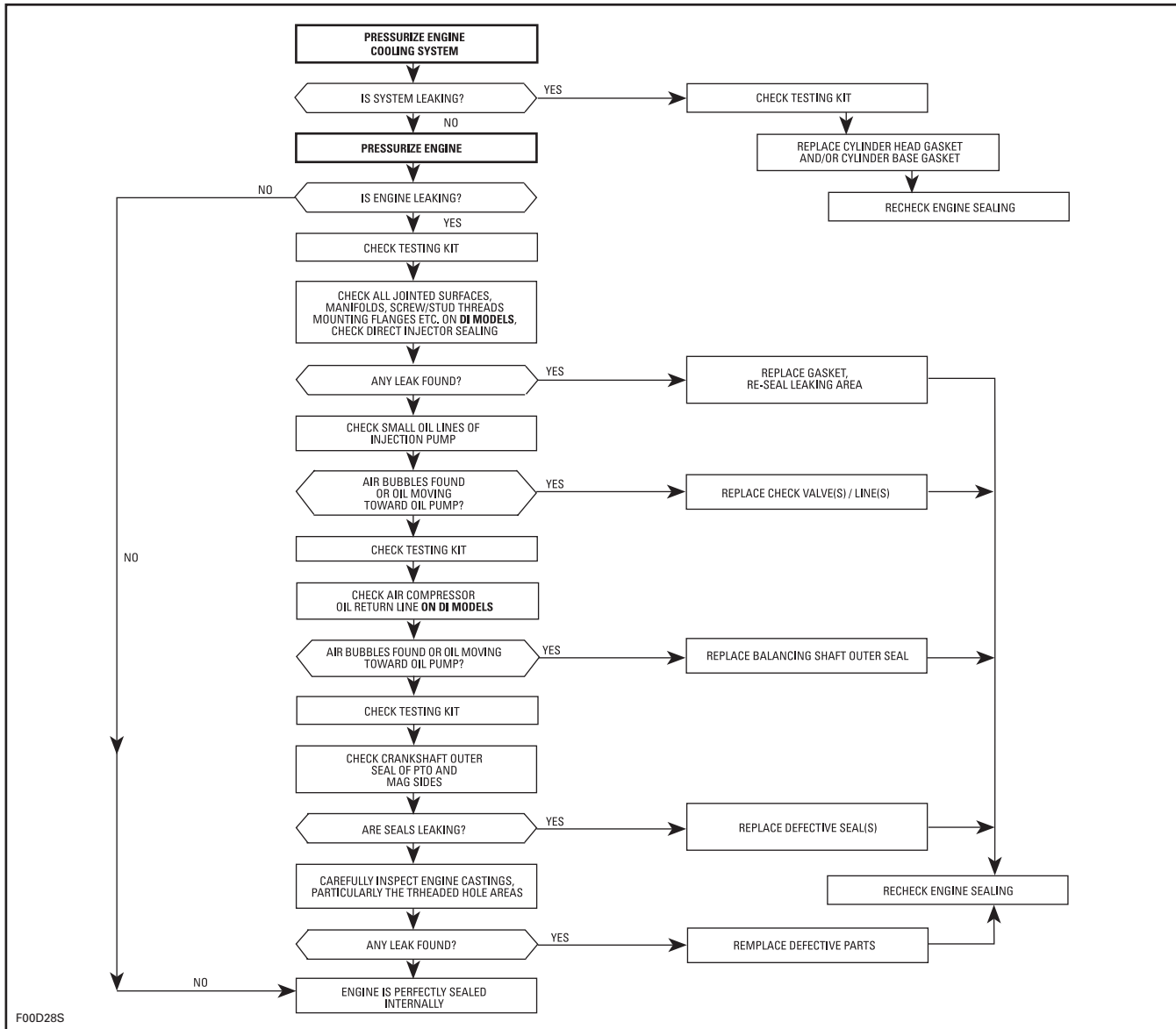


F00D07S

Section 04 ENGINE

Subsection 02 (LEAK TEST)

947 Engine



F00D28S

REMOVAL AND INSTALLATION

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.

ENGINE REMOVAL

DI Models

Use the VCK (Vehicle Communication Kit) (P/N 529 035 676) and release the fuel pressure in the fuel system. Refer to ENGINE MANAGEMENT section.

All Models

In order to remove engine from watercraft proceed as follows.

First, disconnect battery cables from battery.

⚠ WARNING

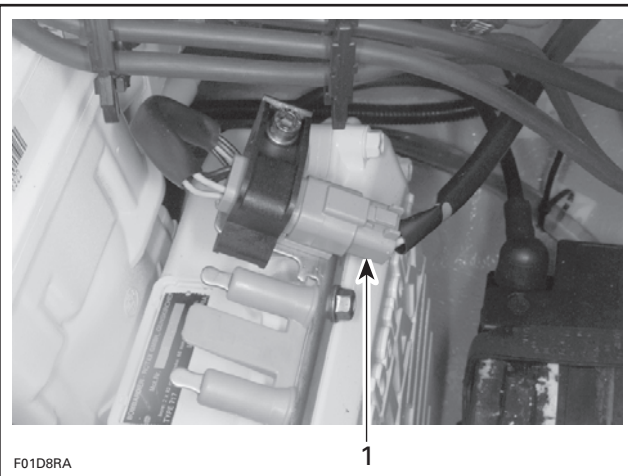
Always disconnect battery cables exactly in the specified order, **BLACK** negative cable first then the **RED** positive battery cable last.

Electrical Connections

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

Disconnect temperature sensor wire and spark plug cables.

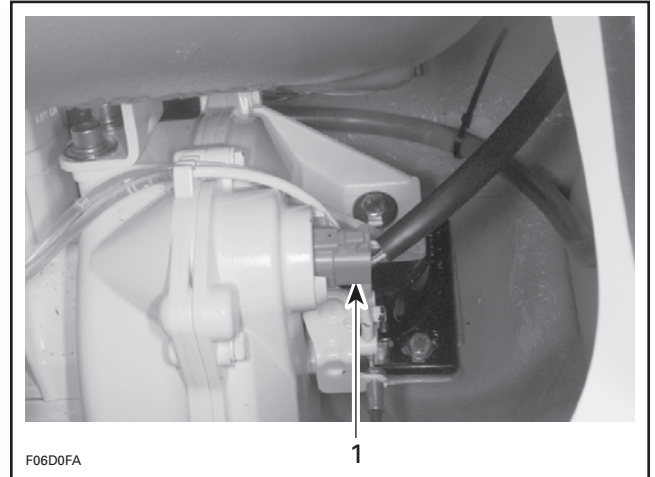
Disconnect magneto wiring harness.



F01D8RA

717 ENGINE

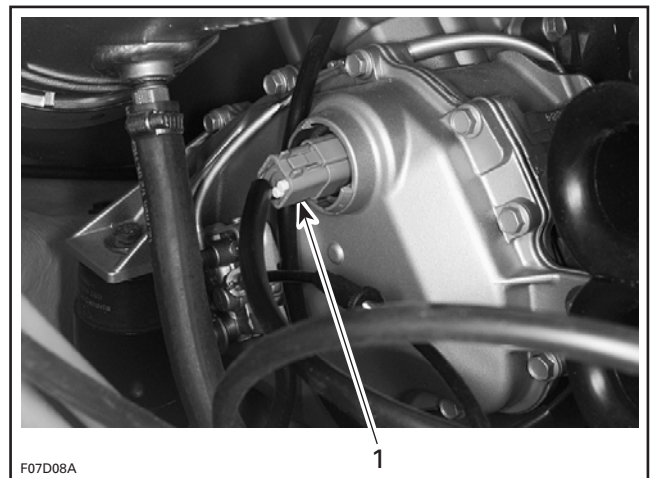
1. Unplug connector



F06D0FA

787 RFI ENGINE

1. Unplug connector



F07D08A

947 ENGINE

1. Unplug connector

GTX RFI Models

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.

DI Models

Disconnect both throttle position sensors (TPS), manifold air pressure sensor (MAPS) and manifold air temperature sensor (MATS).

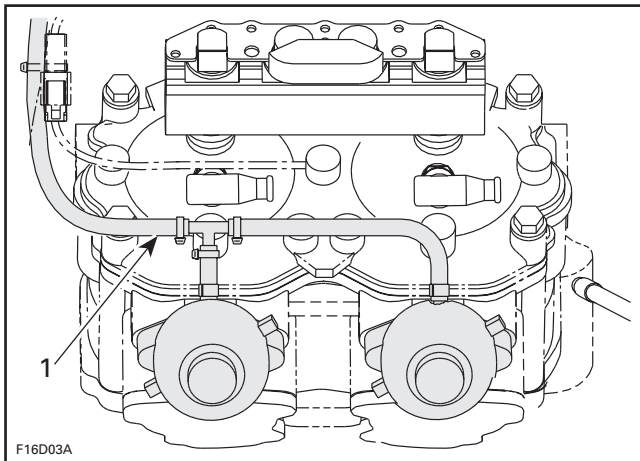
Section 04 ENGINE

Subsection 03 (REMOVAL AND INSTALLATION)

Disconnect connectors from fuel injectors and direct injectors.

Disconnect connector from knock sensor.

Disconnect RAVE valve hose where shown. Inspect hose. If it has hardened or is slit, replace hose.



1. Disconnect hose here

Refer to ENGINE MANAGEMENT for location of sensors and connectors.

Unplug air compressor lines (inlets and outlets): cooling, oil (outlet only) and air (inlet only on throttle body side).

Disconnect vent hose from balancing shaft gear housing.

Jet Pump Removal

All Models

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 driveshaft(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.

Refer to COOLING SYSTEM for proper water hose location.

Tuned Pipe

To remove tuned pipe, refer to EXHAUST SYSTEM.

Air Intake Silencer

To remove air intake silencer, refer to AIR INTAKE.

Carburetor/Throttle Body

Carburetor-Equipped Models

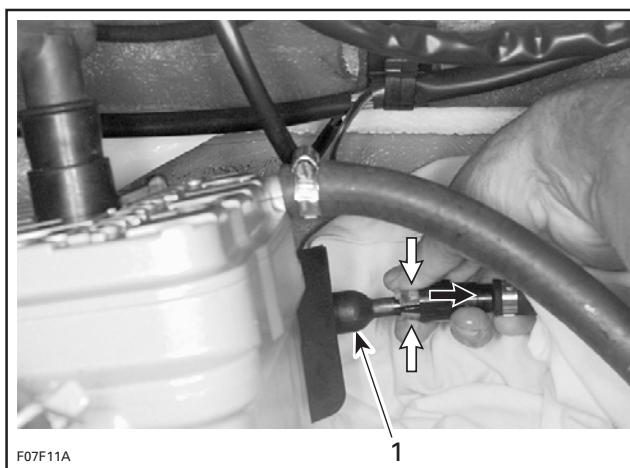
Turn fuel valve to OFF.

Disconnect fuel supply and fuel return hoses.

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

GTX RFI Models

Disconnect fuel supply hose from fuel rail.



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.

DI Models

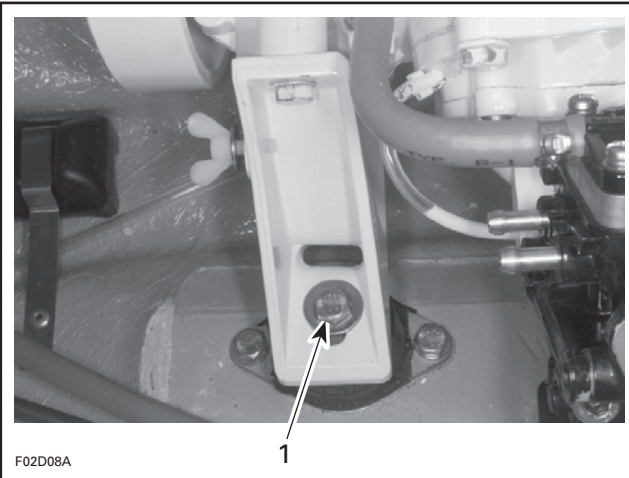
Remove air/fuel rail. Refer to ENGINE MANAGEMENT.

All Models

Engine Support

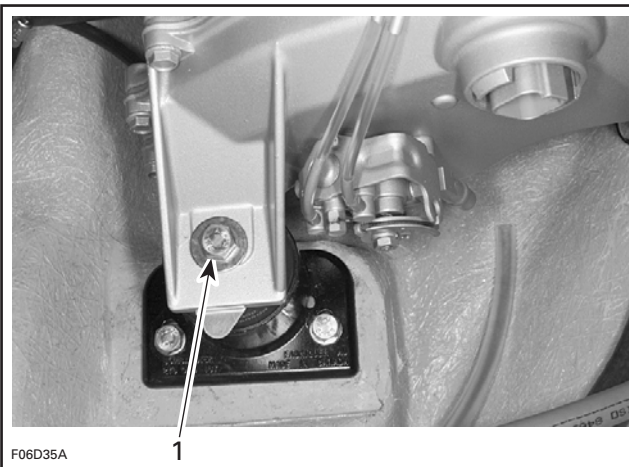
NOTE: Be careful when removing engine support(s) or rubber mount adapters, shims could have been installed underneath. Shims control engine/jet pump alignment. Always note position of shims for reinstallation, to avoid altering engine alignment.

Remove engine support mount screws.



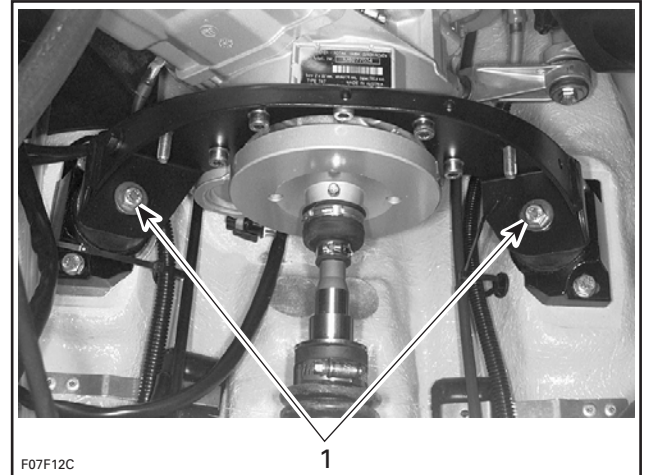
717 ENGINE

1. Remove screw of each engine support



787 RFI AND 947 ENGINES — FRONT SUPPORT

1. Remove screw



787 RFI AND 947 ENGINES — REAR SUPPORT

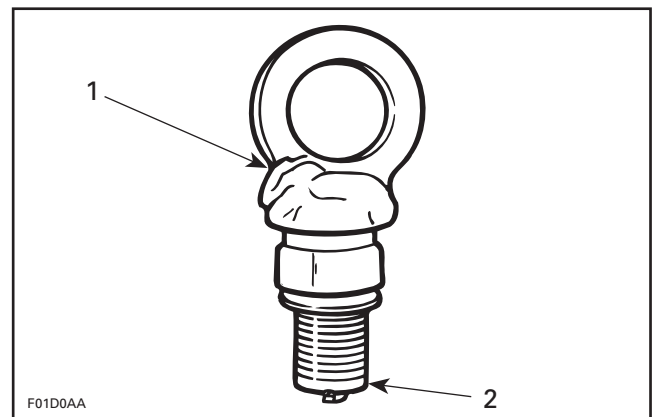
1. Remove screws

Lifting Engine

717 Engine

Engine can be easily lifted using the following suggested tools:

- Cut porcelain from two old spark plugs.
- Weld a lock washer approximately 20 mm (3/4 in) diameter on each spark plug as shown.



1. Weld a lock washer
2. Old spark plug

Remove spark plugs and replace by special tools. Hook a sling into holes of special tools.

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.

Section 04 ENGINE

Subsection 03 (REMOVAL AND INSTALLATION)

787 RFI and 947 Engines

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

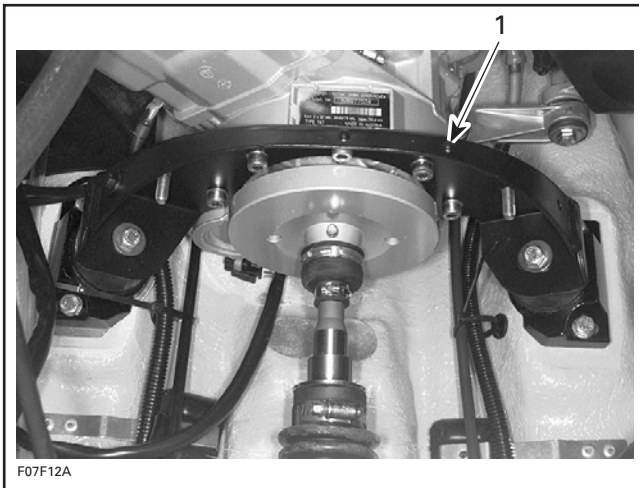


TYPICAL

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.



TYPICAL

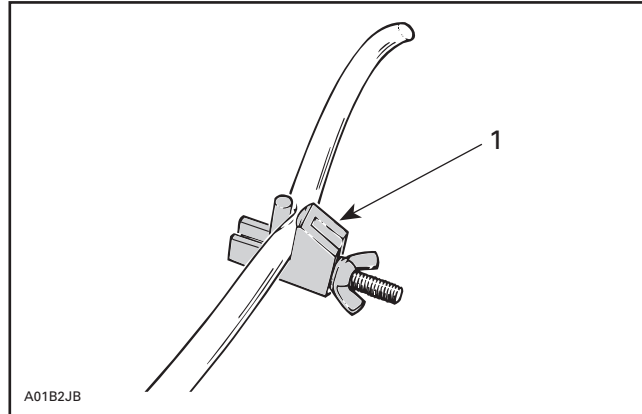
1. Rear support

Removal of Remaining Components

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

All Engines

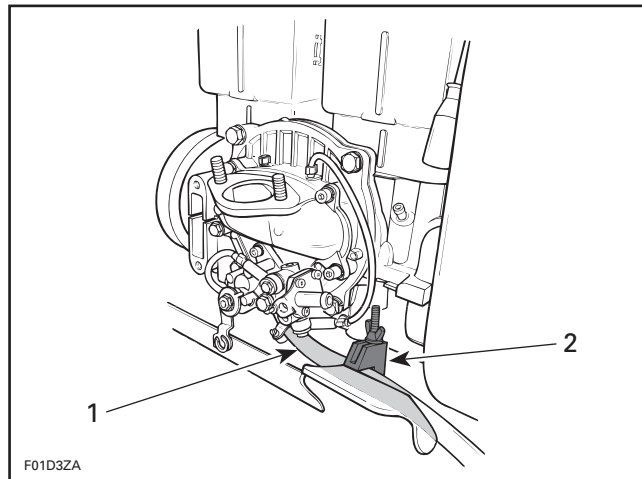
Install a hose pincher to oil supply hoses of oil injection pump and rotary valve shaft (except the 947 engine); then, disconnect hoses.



TYPICAL

1. Hose pincher (P/N 295 000 076)

Install a hose pincher to oil return hose of rotary valve shaft (except the 947 engine); then, disconnect hose.

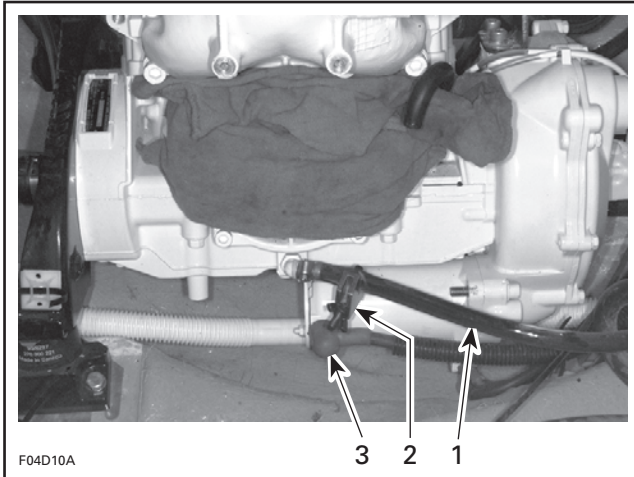


TYPICAL — 717 ENGINE

1. Rotary valve oil supply line
2. Hose pincher installed

Section 04 ENGINE

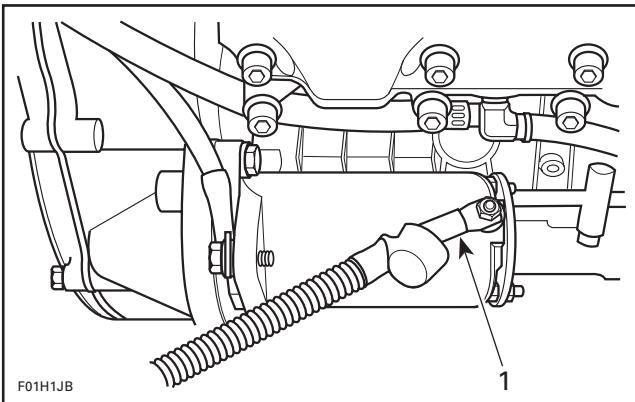
Subsection 03 (REMOVAL AND INSTALLATION)



TYPICAL — 787 RFI ENGINE

1. Rotary valve oil supply line
2. Hose pincher installed
3. Disconnect RED positive cable

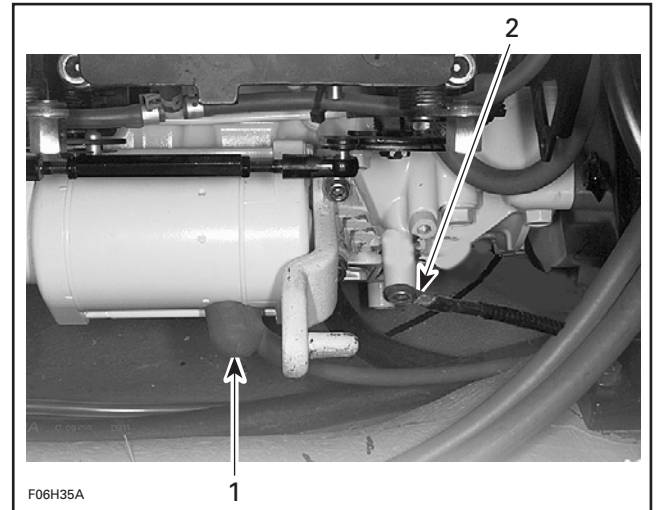
Disconnect RED positive cable from starter post.



TYPICAL

1. Disconnect RED positive cable

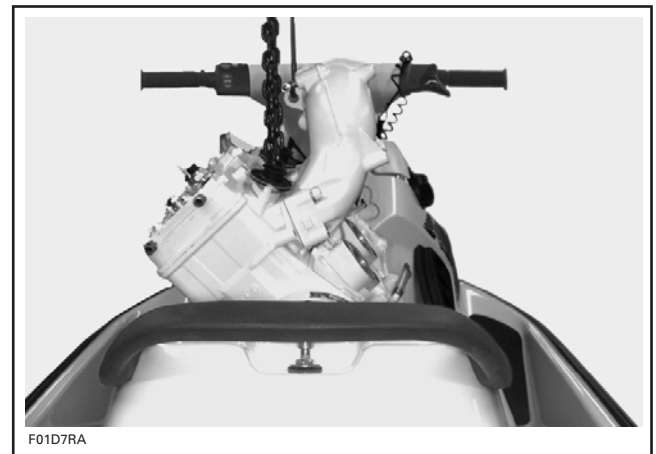
Disconnect black negative cable from engine crankcase.



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

CLEANING

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

Clean external parts of engine.

Section 04 ENGINE

Subsection 03 (REMOVAL AND INSTALLATION)

INSTALLATION

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

Rubber Mount, Shim and Screw

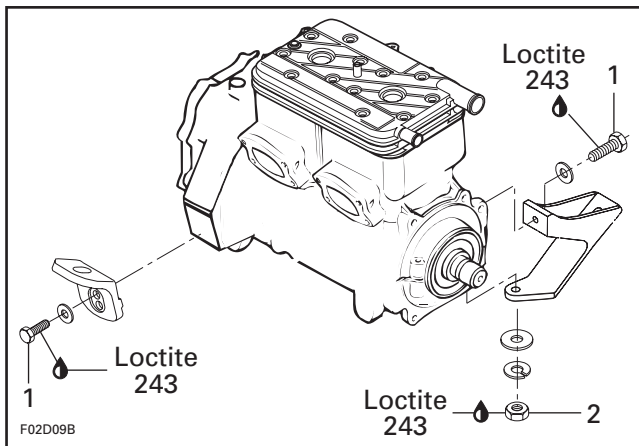
Check tightness and condition of rubber mounts. If they have been removed, apply Loctite 243 (blue) on screw threads. Torque screws to 25 N•m (18 lbf•ft).

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

Engine Support

717 Engine

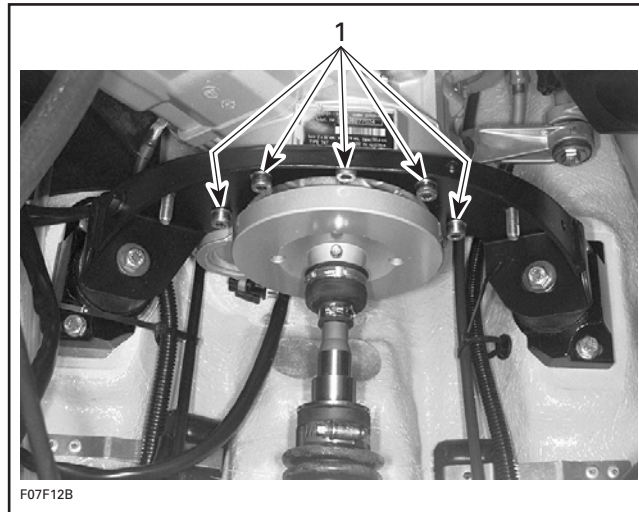
Torque front and rear engine supports as shown in the following illustration.



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

787 RFI and 947 Engines except DI Engine

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

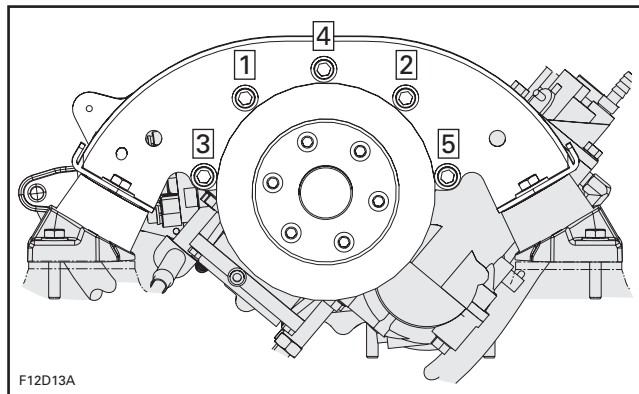


TYPICAL

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

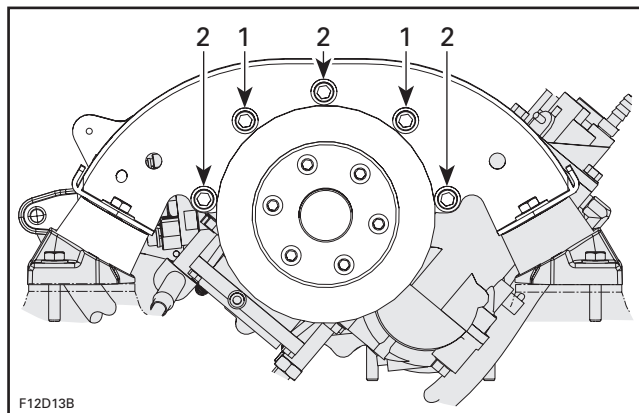
DI Engine

Install and torque the engine support screws to 24 N•m (17 lbf•ft) in the indicated order. Refer to the following illustration.



TORQUE TO 24 N•m (17 lbf•ft) AS PER SEQUENCE

NOTE: Remember to install sleeves and flat washers.



1. Sleeves
2. Flats washers

Oil Injection Hoses

717 and 787 RFI Engines

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

Positive Starter Cable

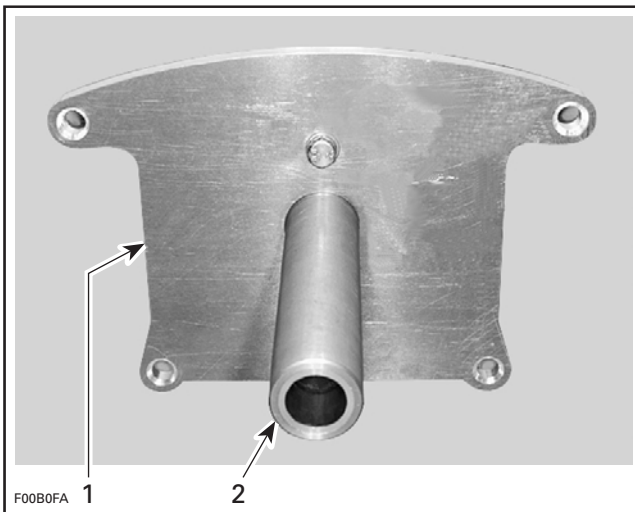
Torque nut of positive starter cable to 6 N•m (53 lbf•in). Apply dielectric grease on nut.

Engine/Jet Pump Alignment

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

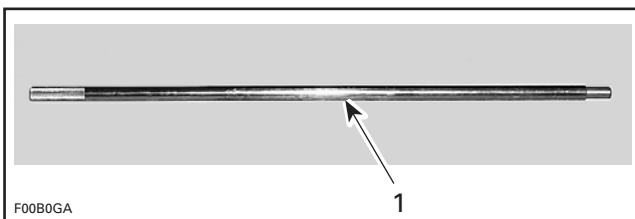
Support plate kit (P/N 529 035 506).

NOTE: Use plate (P/N 529 035 508) for the 139.5 mm (5-1/2 in) jet pump and plate (P/N 529 035 507) for the 155.6 mm (6-1/8 in) jet pump.



1. Plate
2. Support

Alignment shaft (P/N 295 000 141).

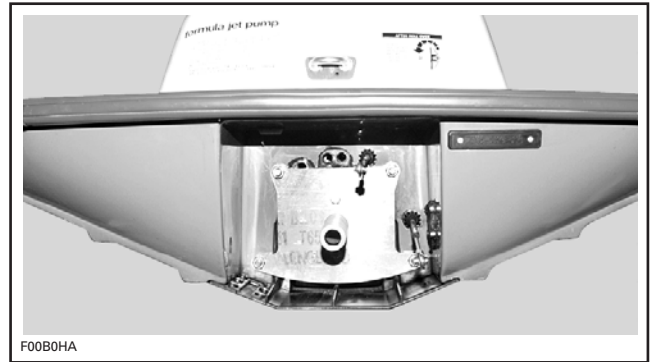


1. Alignment shaft

All Models except XP

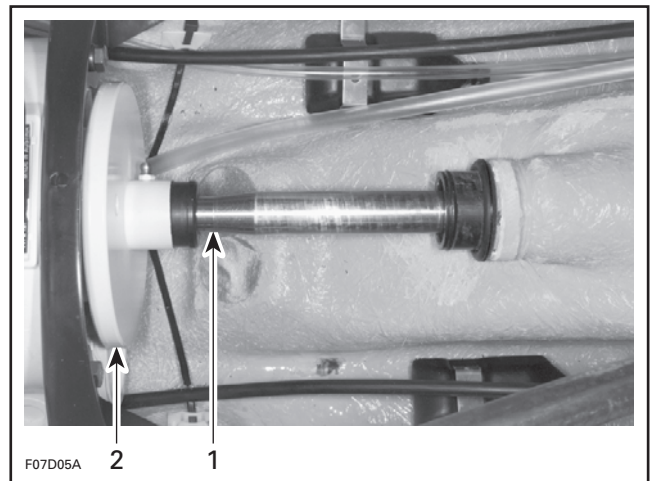
To verify alignment proceed as follows:

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



TYPICAL

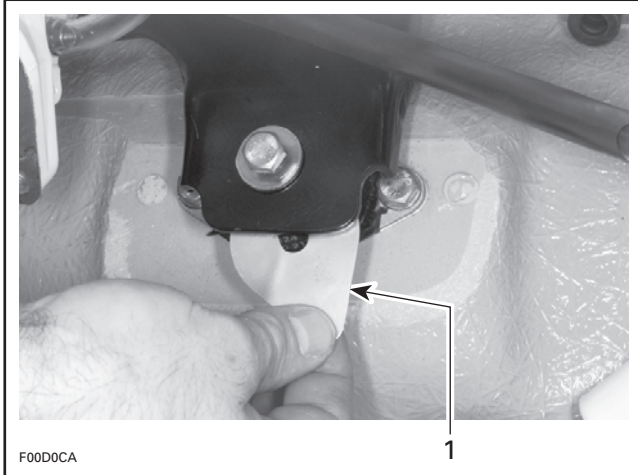
- 1. Alignment shaft
- 2. PTO flywheel

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

Section 04 ENGINE

Subsection 03 (REMOVAL AND INSTALLATION)

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



TYPICAL

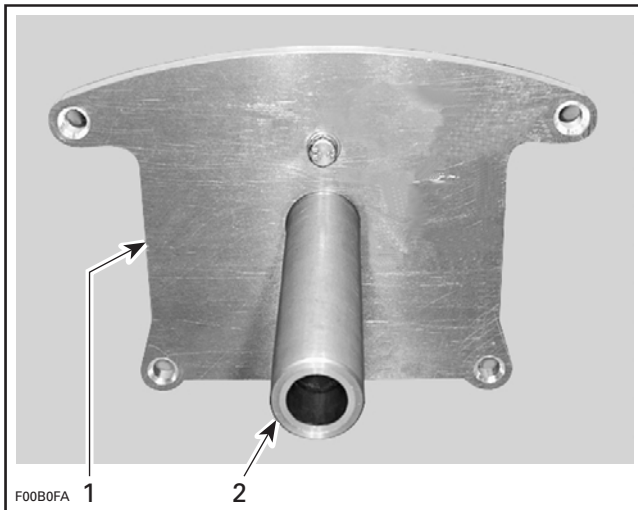
1. Shim

CAUTION: Whenever shims are used to correct alignment, never install more than 1.3 mm (0.051 in) shim thickness on the **947 engines** and 3 mm (0.12 in) on the **717 and 787 engines**.

XP Models

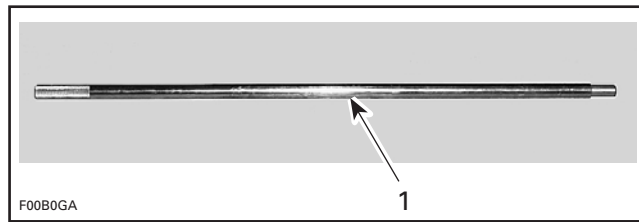
Use:

- plate (P/N 529 035 507) for the 155.6 mm (6-1/8 in) jet pump



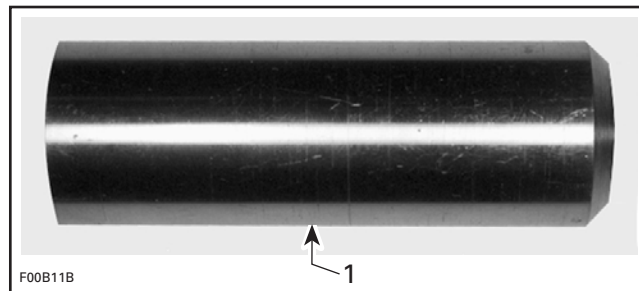
1. Plate
2. Support

- alignment shaft (P/N 295 000 141)



1. Alignment shaft

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



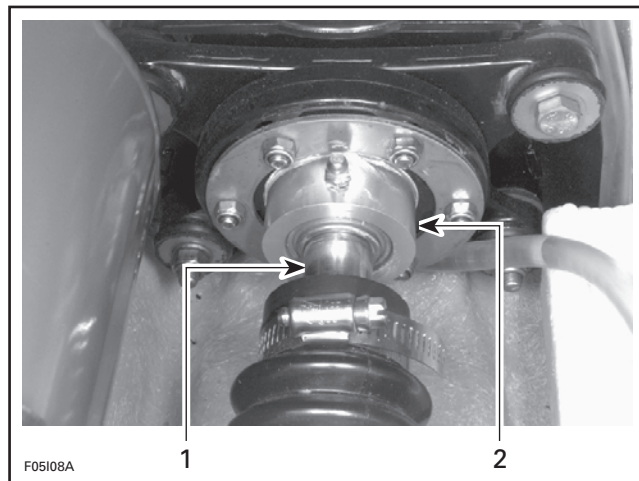
1. Adapter

Install support plate at rear of watercraft.

Install adapter on shaft.

NOTE: Ensure the mid bearing is loosened to check engine alignment.

Carefully slide alignment shaft (P/N 295 000 141) through support plate and seal carrier.

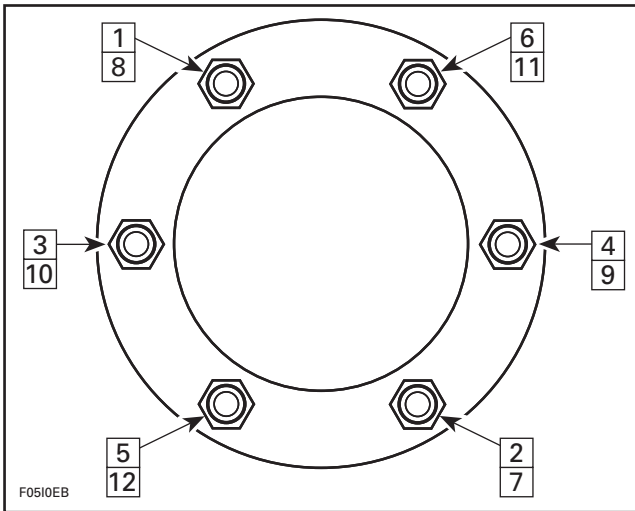


TYPICAL

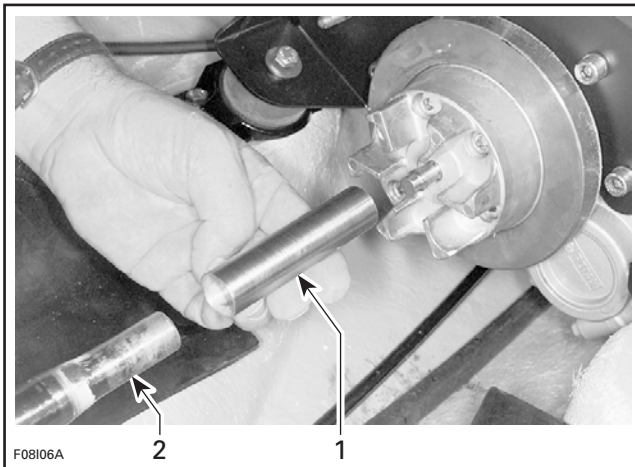
1. Alignment tool
2. Seal carrier

Place grease fitting on the top and torque seal carrier nuts in a criss-cross sequence in two steps as per following illustration.

NOTE: It is very important to tighten nuts of seal carrier in a criss-cross sequence to maintain its alignment.



Step **1**: 1 to 6, torque to 3 N•m (26 lbf•in) as per sequence
 Step **2**: 7 to 12, torque to 10 N•m (88 lbf•in) as per sequence

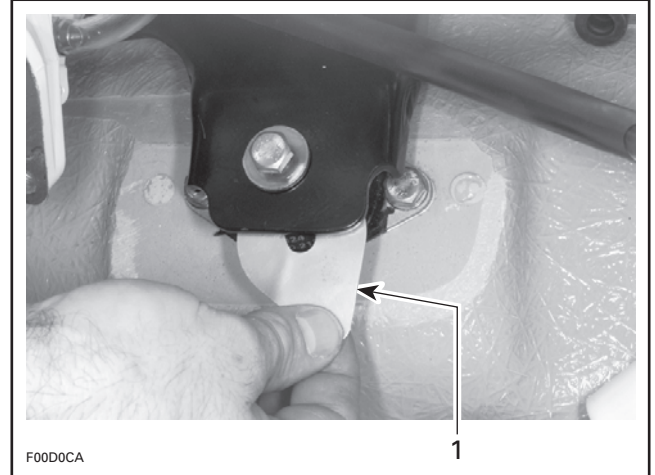


1. Alignment shaft
 2. Adapter

After the mid bearing is torqued, continue to slide the alignment shaft (P/N 295 000 141) forward and install PTO adapter (P/N 529 035 590). Insert adapter end into PTO flywheel.

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

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



TYPICAL
 1. Shim

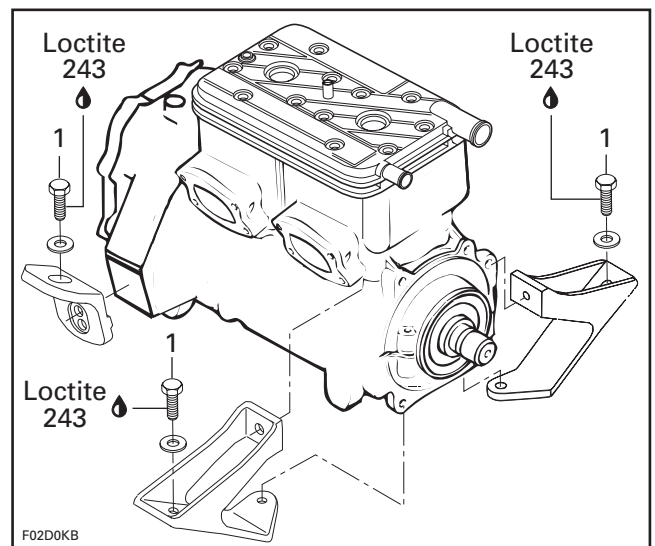
CAUTION: Whenever shims are used to correct alignment, never install more than 1.3 mm (0.051 in) shim thickness.

Engine Support Screws

All Models

Apply Loctite 243 (blue) on screw threads.

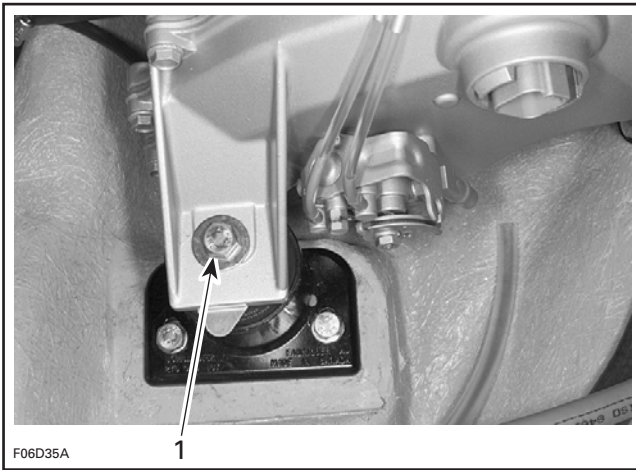
Torque engine support screws to 25 N•m (18 lbf•ft) when procedure is completed.



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

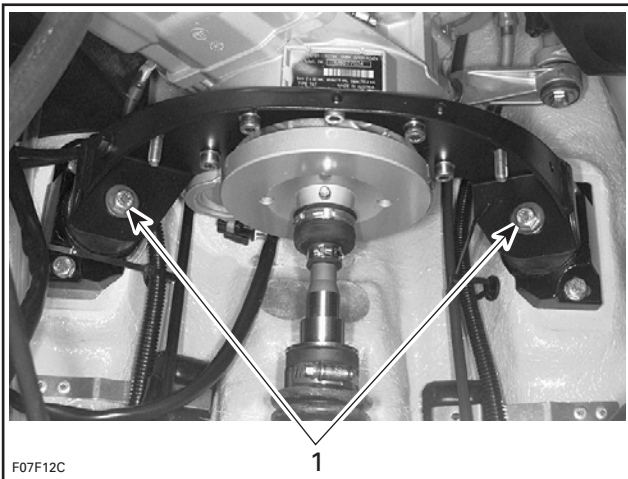
Section 04 ENGINE

Subsection 03 (REMOVAL AND INSTALLATION)



FRONT ENGINE SUPPORT — 787 RFI AND 947 ENGINES

1. Torque to 25 N•m (18 lbf•ft)



REAR ENGINE SUPPORT — 787 RFI AND 947 ENGINES

1. Torque to 25 N•m (18 lbf•ft)

Final Inspection

Check throttle cable condition and lubricate cable with BOMBARDIER LUBE lubricant.

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

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

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.

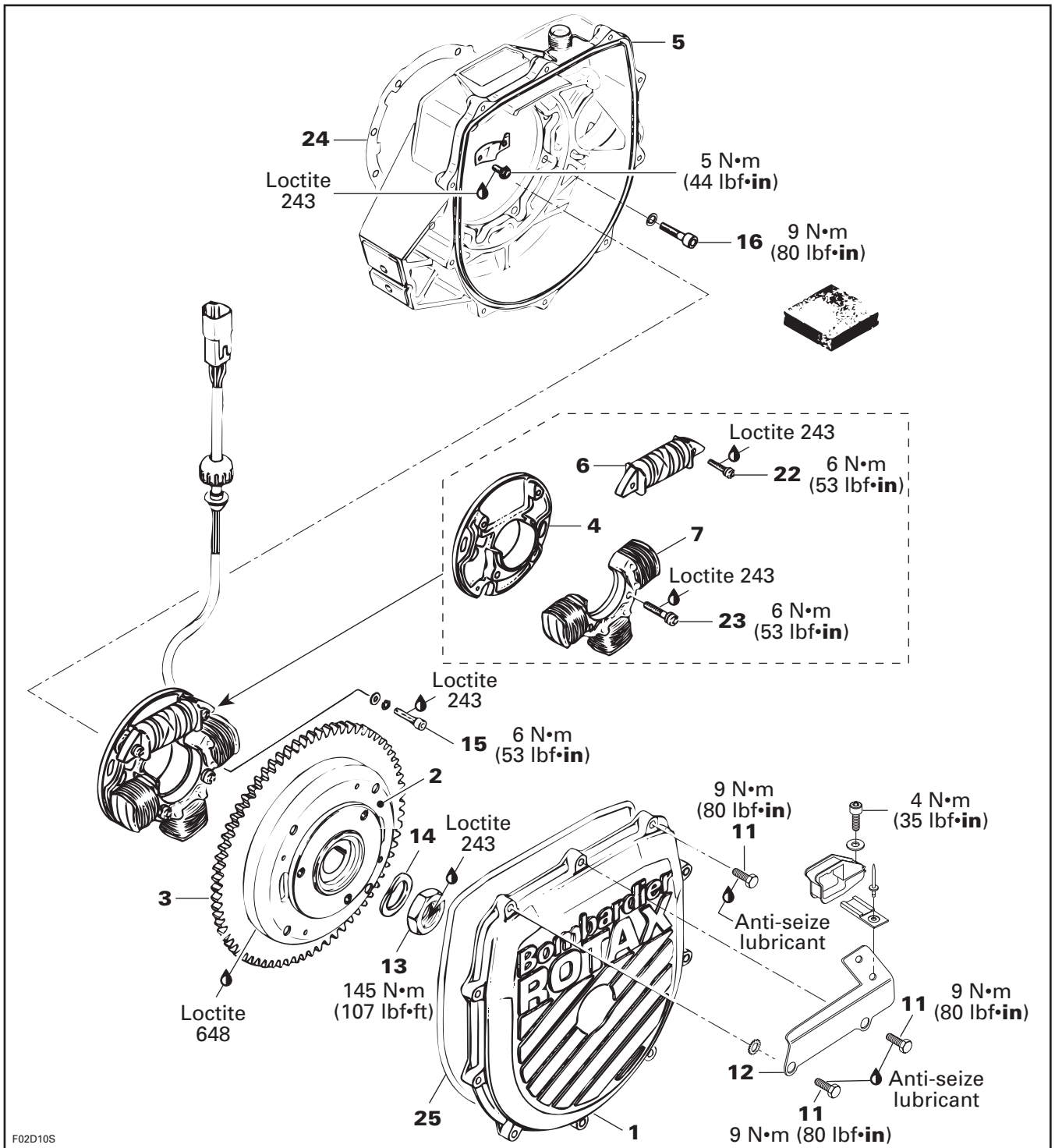
Verify all electrical connections.

Run engine and ensure there is no leakage.

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

MAGNETO SYSTEM

717 Engine

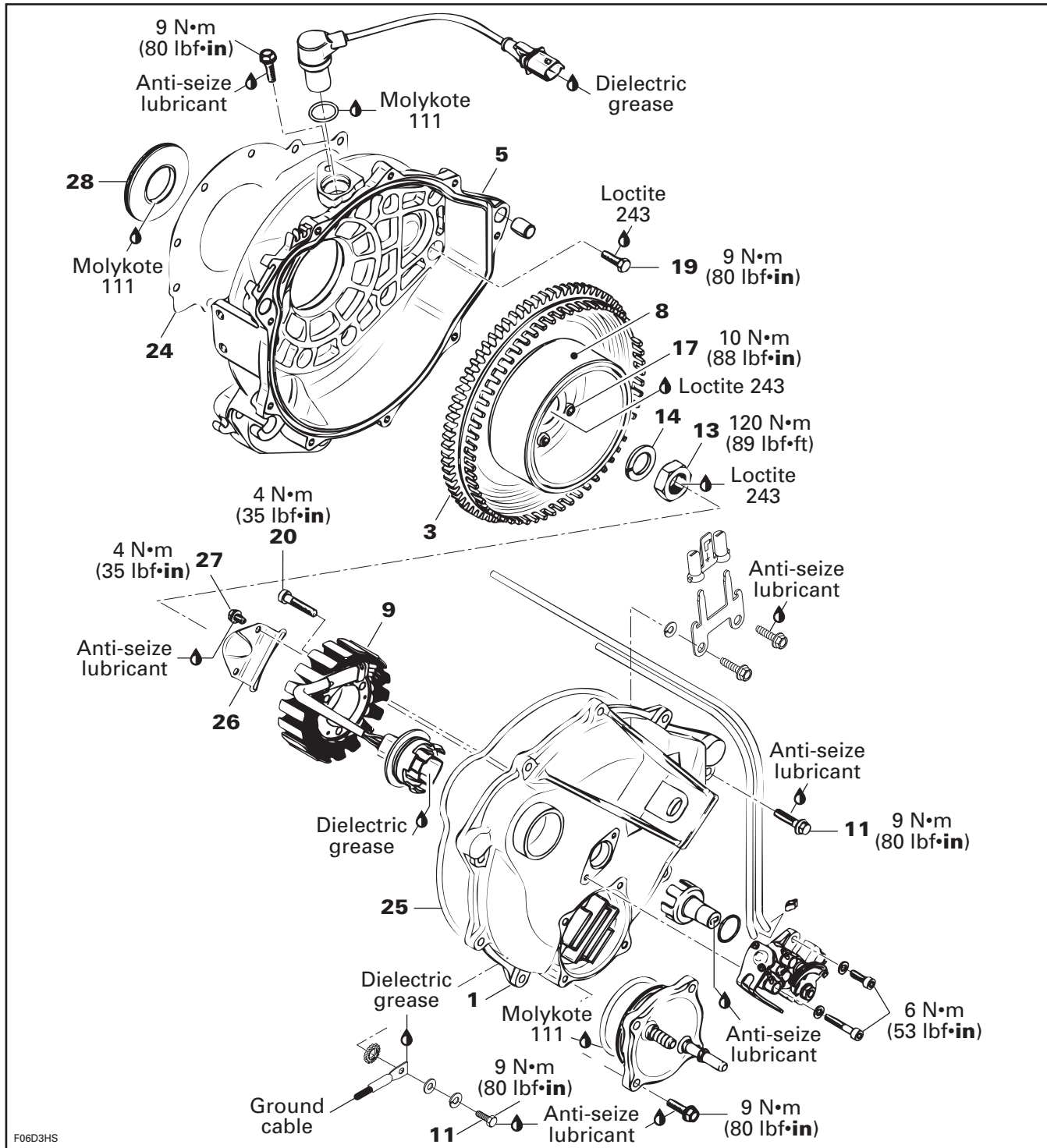


F02D10S

Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)

787 RFI Engine

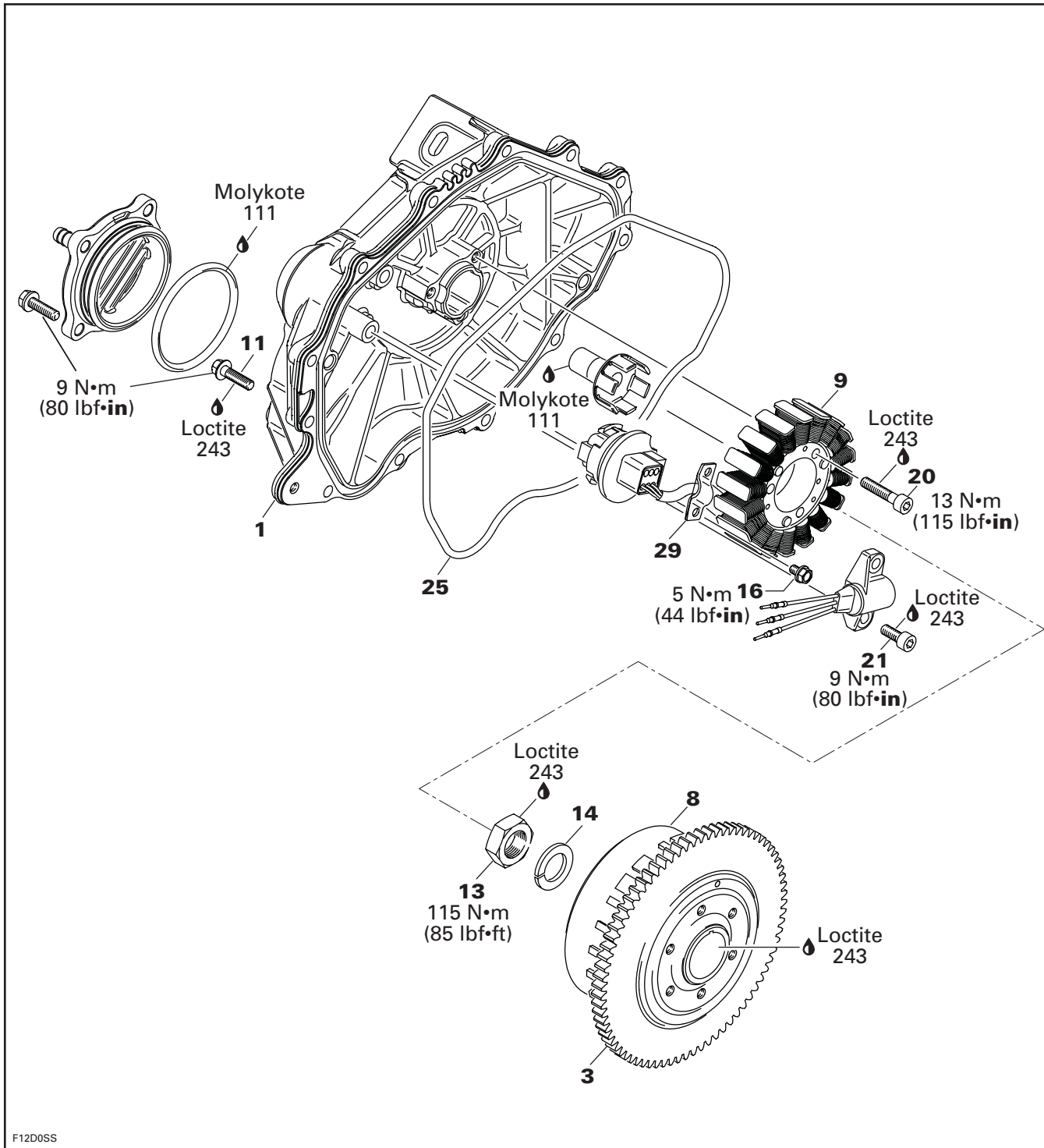


F06D3HS

Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)

947 DI Engines



F12D0SS

DISASSEMBLY

717 Engine

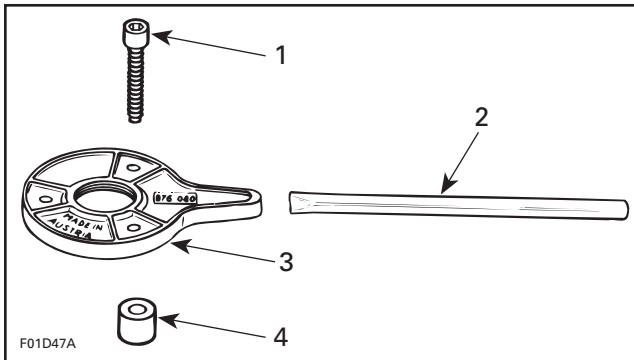
NOTE: On 717 engine, the magneto system can be disassembled without removing the engine from the watercraft.

Magneto Cover

Remove screws **no. 11** and wire support **no. 12**, then withdraw magneto cover **no. 1**.

Magneto Flywheel and Ring Gear

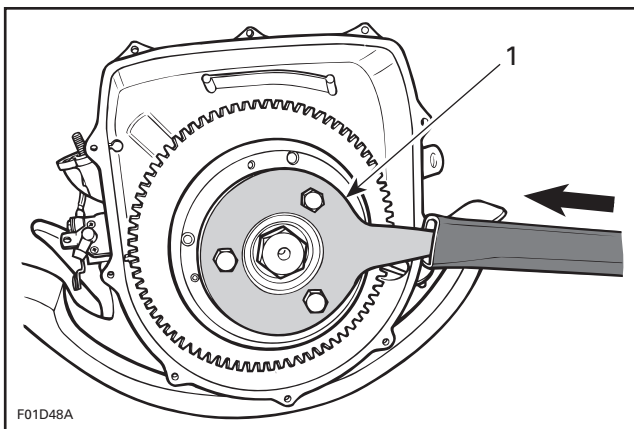
Magneto flywheel **no. 2** is locked with puller plate (P/N 420 876 080), sleeves (P/N 290 847 220) and extension handle (P/N 295 000 125).



1. Screw
2. Extension handle
3. Puller plate
4. Sleeve

Using three M8 x 35 screws (P/N 420 841 591), install screws through puller plate and slide sleeves on screws then secure puller plate on magneto flywheel so that sleeves are against ring gear **no. 3**.

Install extension handle on end of puller plate.

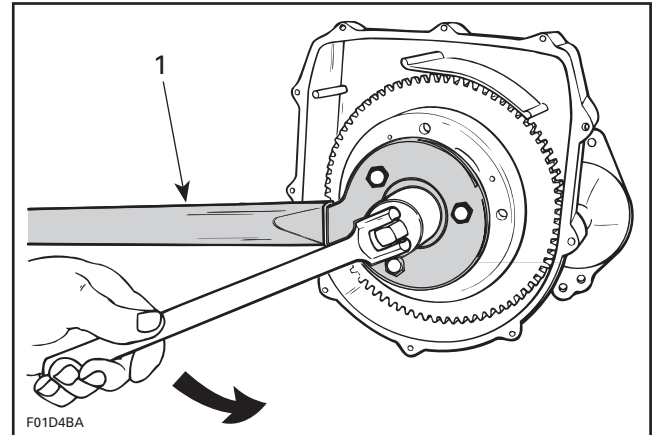


TYPICAL

1. Sleeves on opposite side

Using a suitable socket, unscrew retaining nut **no. 13** COUNTERCLOCKWISE when facing it.

NOTE: If socket is found too large to be inserted in puller plate, machine or grind its outside diameter as necessary.

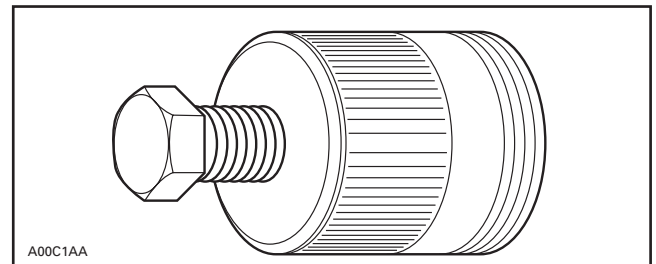


TYPICAL

1. Extension handle locking crankshaft

Remove nut **no. 13** and lock washer **no. 14** from magneto flywheel.

Magneto flywheel is easily freed from crankshaft with puller (P/N 529 035 547).

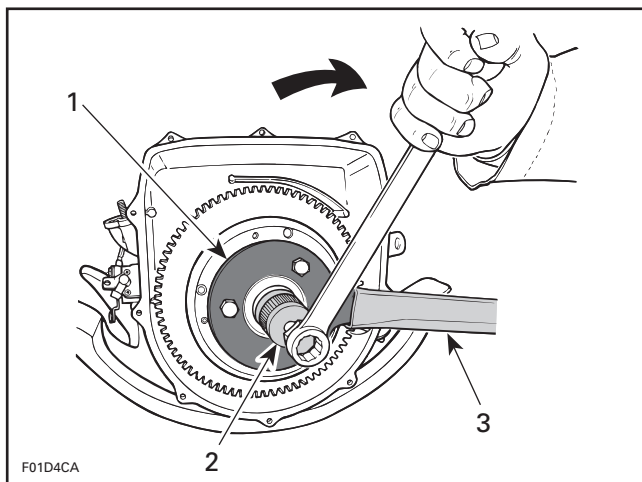


Fully thread on puller in puller plate.

Tighten puller bolt and at the same time, tap on bolt head using a hammer to release magneto flywheel from its taper.

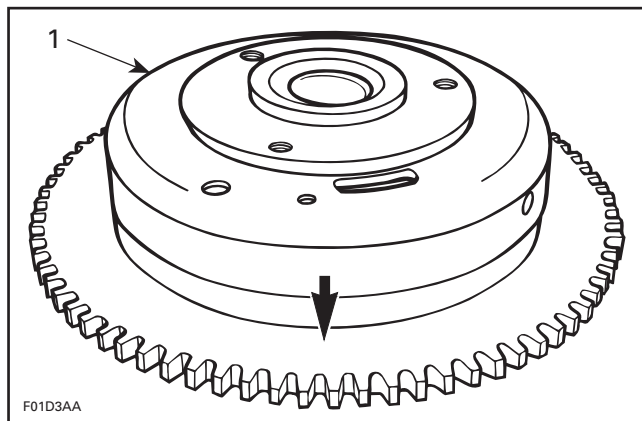
Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)



1. Puller plate
2. Puller
3. Extension handle

Lay magneto flywheel **no. 2** on a steel plate. Tap lightly on ring gear **no. 3** using a hammer to release it from magneto flywheel.



1. Magneto flywheel

Armature Plate

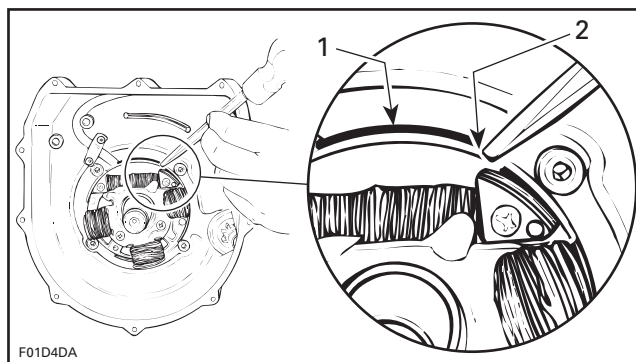
Before removing, locate the manufacturer's reference mark on the armature plate **no. 4** and ensure there is a corresponding indexing mark on the crankcase housing.

NOTE: Since replacement crankcases do not have timing mark for armature plate location, indexing marks should be made on armature plate and crankcase to ease reassembly and further ignition timing.

The following procedure is to find a common reference point on both crankcases (old and new) to position armature plate.

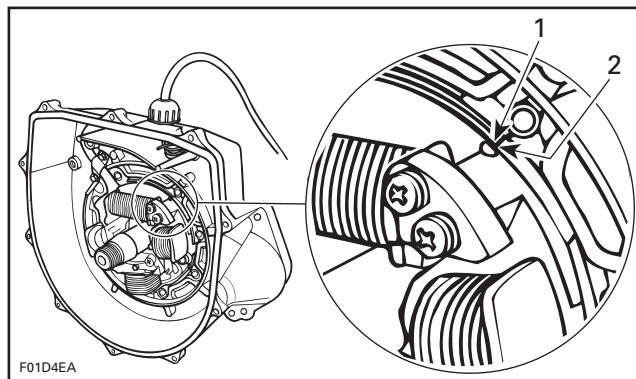
Proceed as follows:

- Before removing the armature plate, find a crankcase locating lug (the top one in this example).
- Place a cold chisel at the end of chosen lug, then punch a mark on armature plate at this point.



1. Crankcase locating lug
2. Mark armature plate at the end of lug

- At assembly, align armature plate mark (previously punched) with the end of the corresponding locating lug on the new crankcase.



TYPICAL

1. Lug end of crankcase
2. Align mark and lug end here

Remove three retaining screws **no. 15** and withdraw armature plate.

Magneto Housing

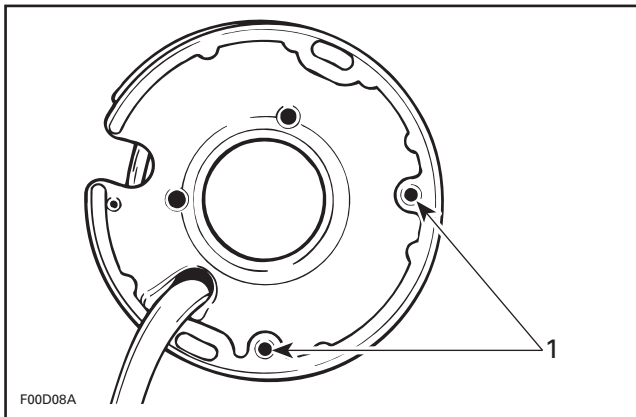
To remove magneto housing no. 5, starter has to be removed. Refer to STARTING SYSTEM.

Unscrew retaining screws, then withdraw housing.

Generating Coil

To replace generating coil no. 6:

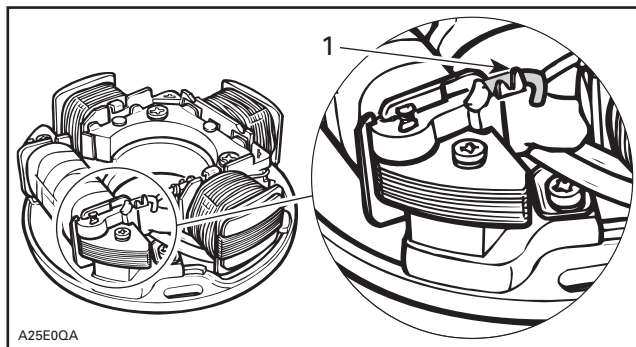
- Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.



1. Heat the armature plate

CAUTION: Protect harness from flame.

- Remove screws.
- Uncrimp and unsolder BLACK/RED wire from coil.

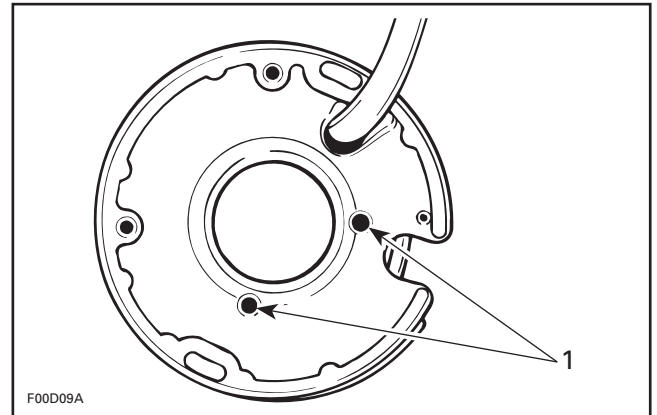


1. Uncrimp and unsolder wire here

Battery Charging Coil

To replace battery charging coil no. 7:

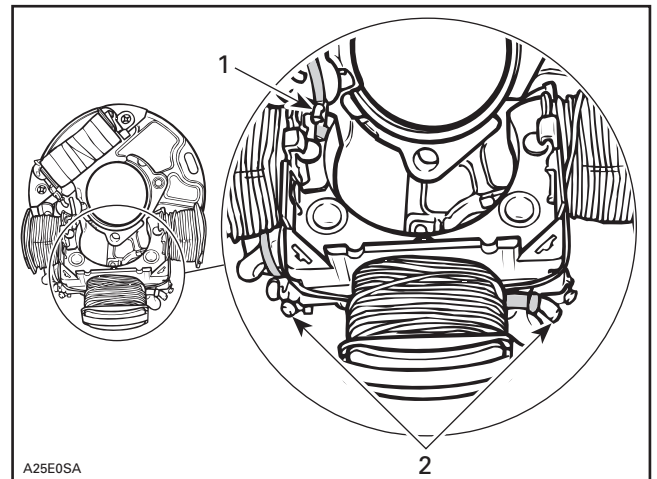
- Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.



1. Heat the armature plate

CAUTION: Protect harness from flame.

- Remove screws.
- Uncrimp and unsolder YELLOW and YELLOW/BLACK wires from coil.
- Uncrimp and unsolder ground wire (BLACK) from coil core.



1. Uncrimp and unsolder ground wire (BLACK)
2. Uncrimp and unsolder YELLOW and YELLOW/BLACK wires

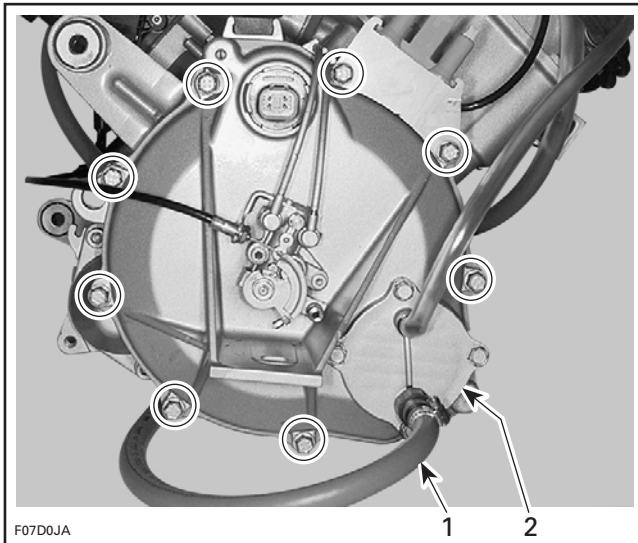
Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)

787 RFI Engine

Magneto Housing Cover

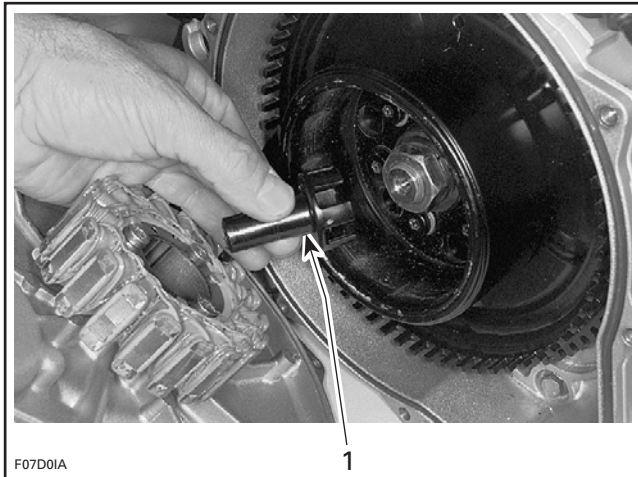
Disconnect water hoses from heat exchanger cover. Loosen screws **no. 11**. Remove engine magneto cover **no. 1**.



787 RFI ENGINE

1. Disconnect water inlet hose
2. Heat exchanger cover

Remove oil pump shaft from magneto rotor nut.



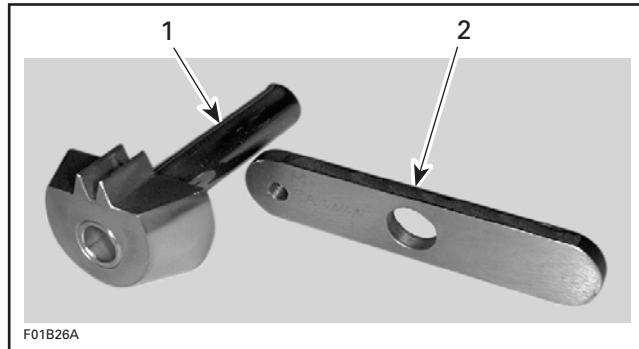
1. Oil pump shaft

Rotor and Ring Gear

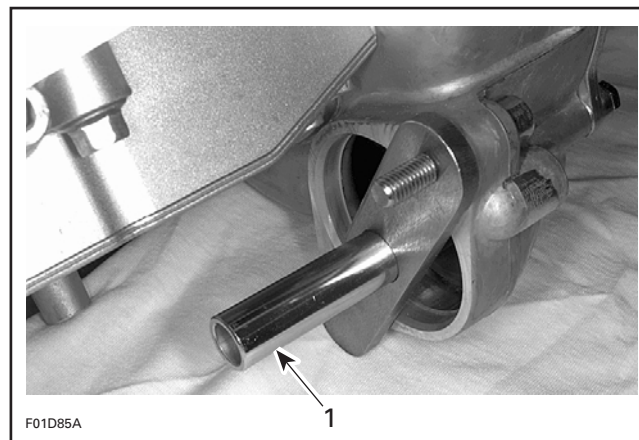
Remove starter. Refer to STARTING SYSTEM.

NOTE: Crankshaft can also be locked by using the PTO flywheel extractor tool. For procedure, refer to BOTTOM END.

Lock ring gear using special tool assembly (P/N 295 000 155).

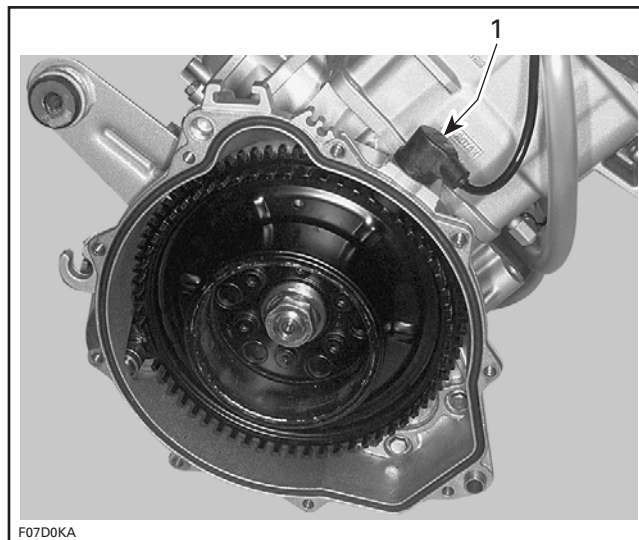


1. Ring gear blocking tool (P/N 295 000 134)
2. Retaining plate (P/N 295 000 154)



1. Ring gear blocking tool with retaining plate

Remove crankshaft position sensor **no. 18** before removing the ring gear.



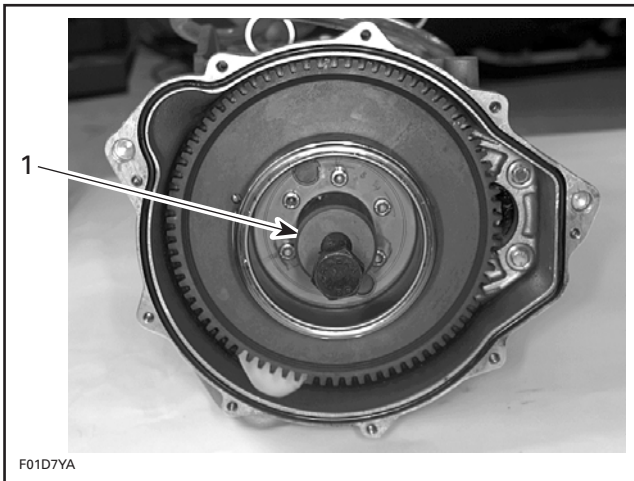
1. Crankshaft position sensor

Using a suitable socket, unscrew retaining nut **no. 13** of magneto rotor **COUNTERCLOCKWISE** when facing it.

Ring gear is easily freed from crankshaft with puller (P/N 420 976 235) and crankshaft protective cap (P/N 420 876 557).

Remove special tool locking ring gear.

Insert crankshaft protector to outer end of crankshaft and fully thread puller in magneto rotor.



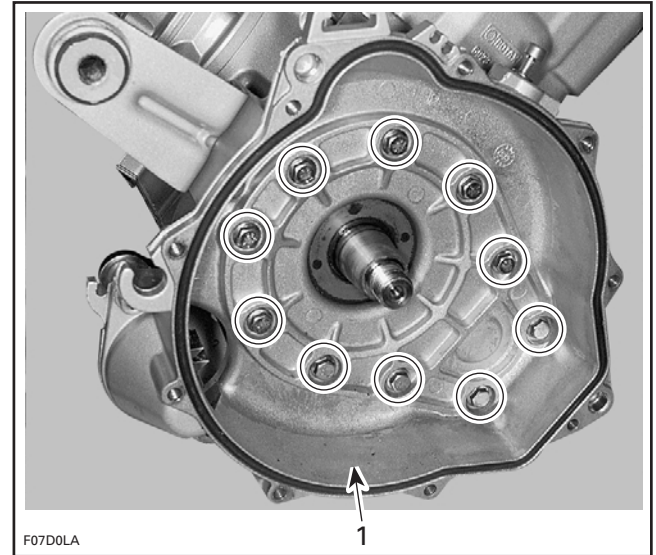
TYPICAL
 1. Puller

Tighten puller screw and at the same time, tap on screw head using a hammer to release magneto rotor from its taper.

Magneto Housing

To remove magneto housing **no. 5**, starter has to be removed. Refer to **STARTING SYSTEM**.

Unscrew retaining screws **no. 19**, then withdraw housing.



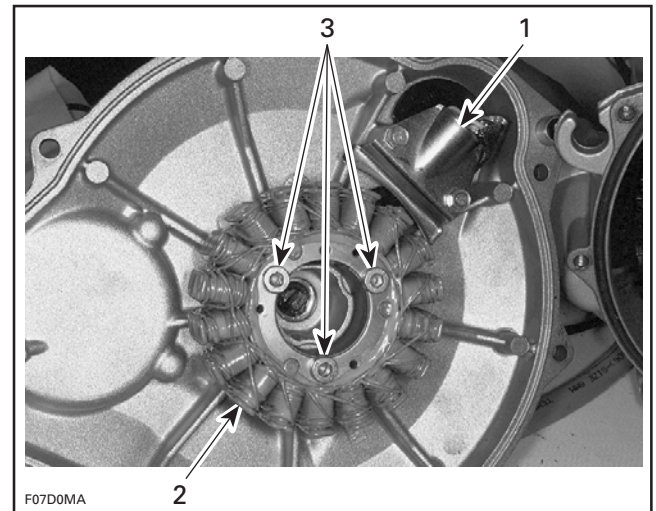
REMOVE SCREWS
 1. Magneto housing

Stator Assembly

787 RFI Engine

Remove holding plate and withdraw plug from cover.

Unscrew bolts **no. 20** and remove stator **no. 9** from magneto cover.



787 RFI ENGINE
 1. Holding plate
 2. Stator assembly
 3. Remove screws

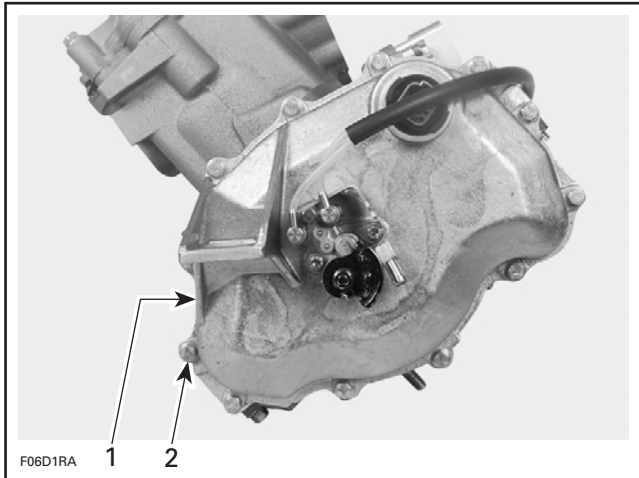
Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)

947 Engines

Cover

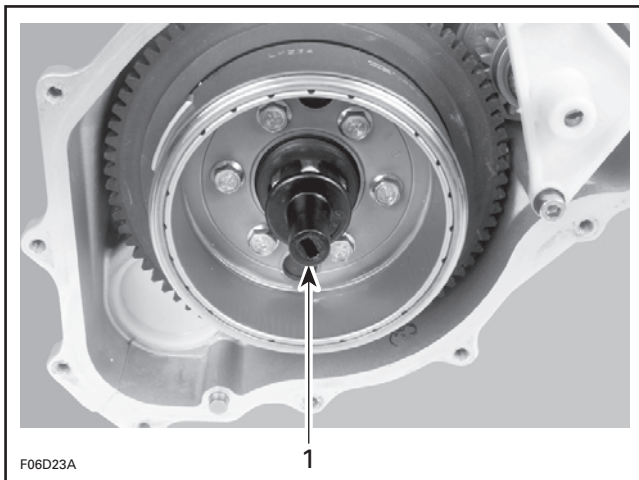
Loosen screws no. 11. Remove engine magneto cover no. 1.



TYPICAL

1. Cover
2. Screw

Remove oil pump shaft from magneto rotor nut.

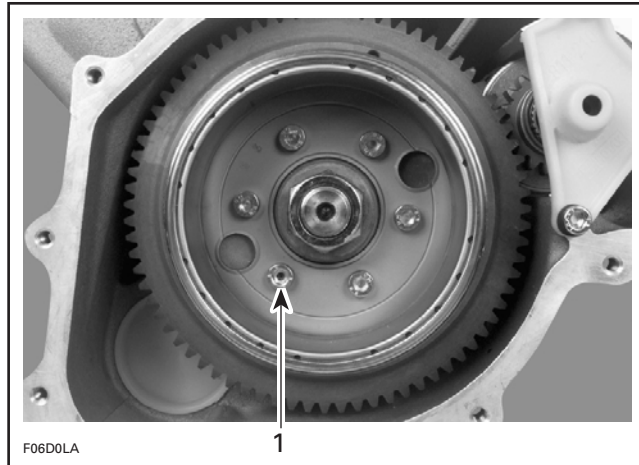


1. Remove oil pump shaft

Rotor and Ring Gear

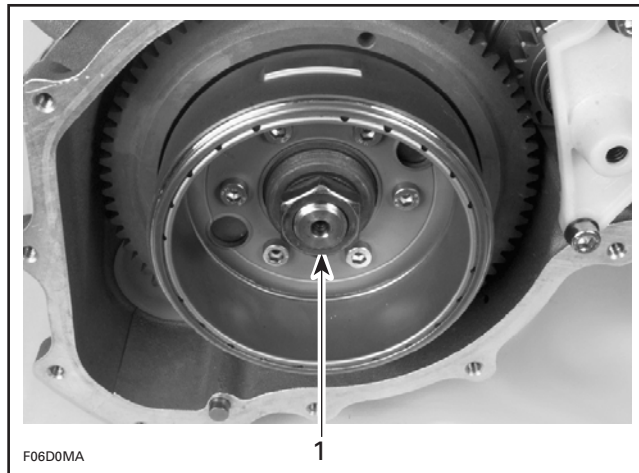
To remove the rotor no. 8 or the ring gear no. 3, the crankshaft must be locked. For procedure, refer to BOTTOM END.

If necessary, the magneto rotor can be removed without removing the ring gear. Remove the six screws no. 17.



1. Screw

To remove the ring gear/rotor assembly, unscrew nut no. 13 counterclockwise when facing it.



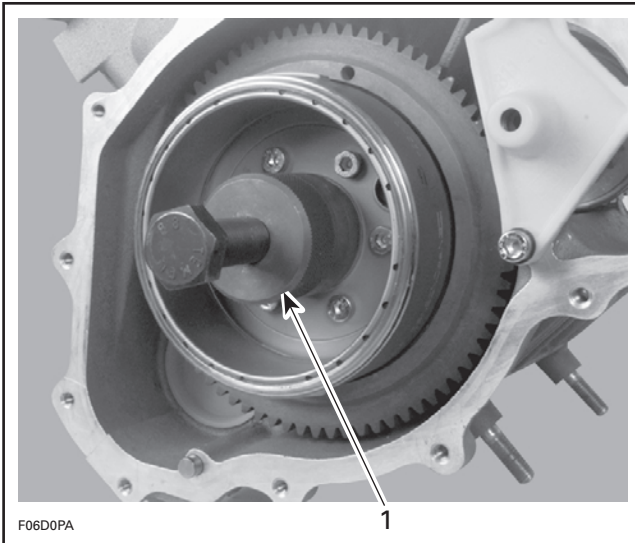
1. Nut

The magneto rotor is easily freed from crankshaft with puller (P/N 420 976 235).

Install protective cap (P/N 290 877 414) to crankshaft.

Fully thread puller in magneto rotor.

CAUTION: Ensure to completely screw the puller until it bottoms. Otherwise, not enough threads would be engaged and damage may occur.



1. Puller

Tighten puller screw and at the same time, tap on screw head using a hammer to release magneto rotor from its taper.

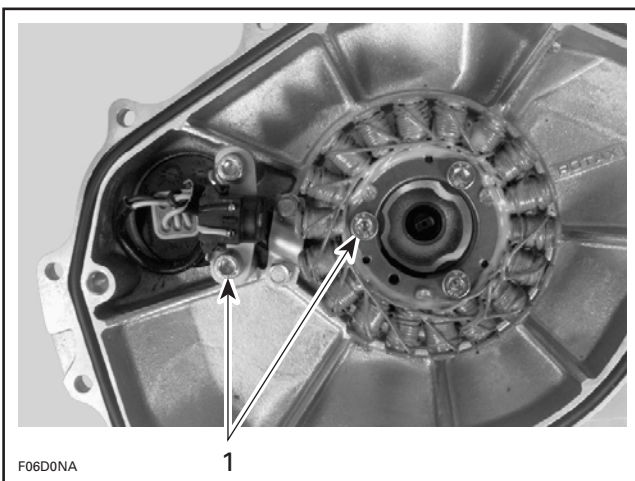
DI Models

CAUTION: Be careful after ring gear removal not to bend the encoder wheel teeth. Also pay attention when putting away. If you suspect a bent tooth, refer to ENGINE MANAGEMENT for inspection procedure.

All 947 Engines

Stator and Trigger Coil/CPS (Crankshaft Position Sensor)

Loosen screws no. 20 and no. 21 to remove the stator no. 9 and trigger coil no. 10 from the engine magneto cover.



1. Remove screws

CLEANING

Clean all metal components in a solvent.

CAUTION: Clean coils and magnets using only a clean cloth.

Clean crankshaft taper and threads using acetone. Apply the acetone on a rag first then clean the crankshaft.

ASSEMBLY

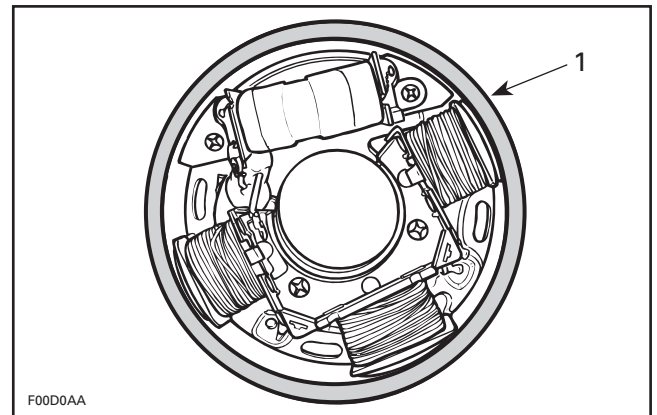
717 Engine

Generating Coil

Strip end of old wire then crimp and solder on new coil.

Apply Loctite 243 (blue) to screws no. 22 and install the new coil on armature plate.

Use magneto coil centering tool (P/N 420 876 922) and install so that it fits around armature plate before tightening screws.



1. Magneto coil centering tool (P/N 420 876 922)

CAUTION: Before reinstalling the magneto, remove the loose epoxy from harness.

Section 04 ENGINE

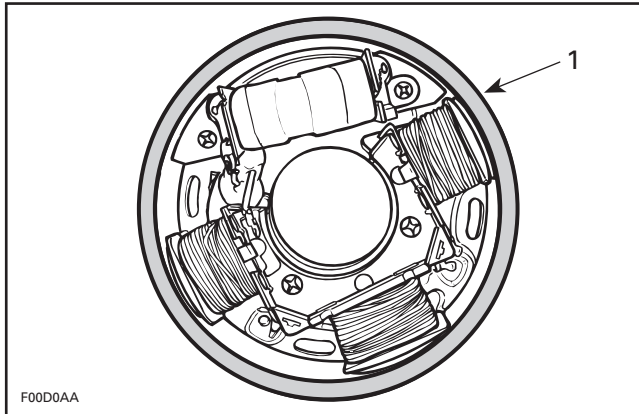
Subsection 04 (MAGNETO SYSTEM)

Battery Charging Coil

Position new coil, crimp and solder all wires.

Prior to assembly, apply Loctite 243 (blue).

Use magneto coil centering tool (P/N 420 876 922) and install it so that it fits around armature plate before tightening screws **no. 23**.

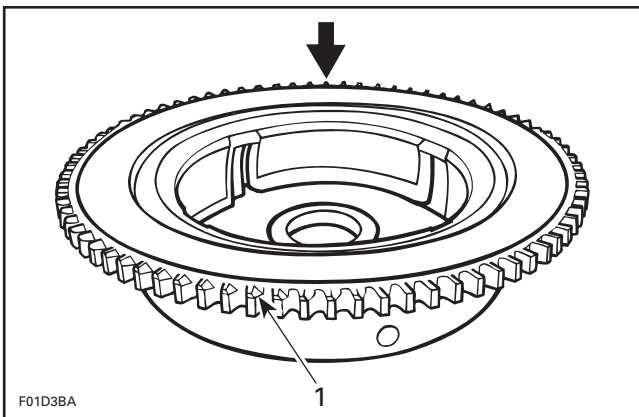


1. Magneto coil centering tool (P/N 420 876 922)

Magneto Flywheel and Ring Gear

Apply Loctite 648 (green) to magneto flywheel mating surface. Lay ring gear on a steel plate, then heat with a propane torch in order to install it on magneto flywheel.

Pay particular attention to position ring gear teeth chamfer side as per following illustration.



1. Teeth chamfer

NOTE: Ensure that ring gear contacts magneto flywheel flange.

Whenever replacing either ring gear or magneto flywheel, Gun Kote must be applied to prevent possible corrosion.

CAUTION: Always assemble magneto flywheel and ring gear prior to apply Gun Kote. If not done correctly, ring gear won't contact magneto flywheel flange.

To apply Gun Kote proceed as follows:

1. Clean thoroughly and degrease replacement part using a non oil base solvent.
2. Apply coating in light thin coats using a spray gun.

NOTE: Do not spray Gun Kote into magneto flywheel threaded holes.

3. Bake parts in oven at 175°C (350°F) for 1 hour to cure Gun Kote.

CAUTION: Do not eliminate Gun Kote heat curing time because it will lose all its resistance and it will not give any protection.

Magneto Housing

Install gasket **no. 24** between magneto housing **no. 5** and engine crankcase.

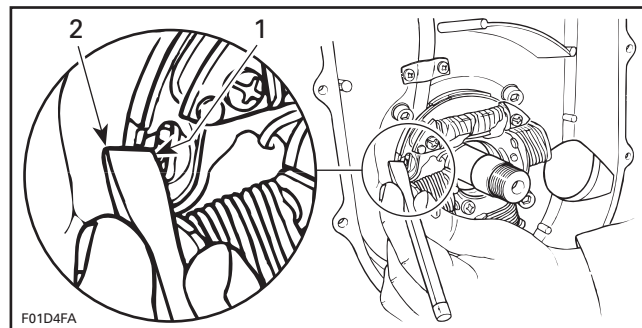
Install magneto housing and torque screws **no. 16** to 9 N•m (80 lbf•in).

Armature Plate

Position the armature plate on the crankcase, aligning the marks on both parts.

When reinstalling armature plate on a new crankcase housing, proceed as follows.

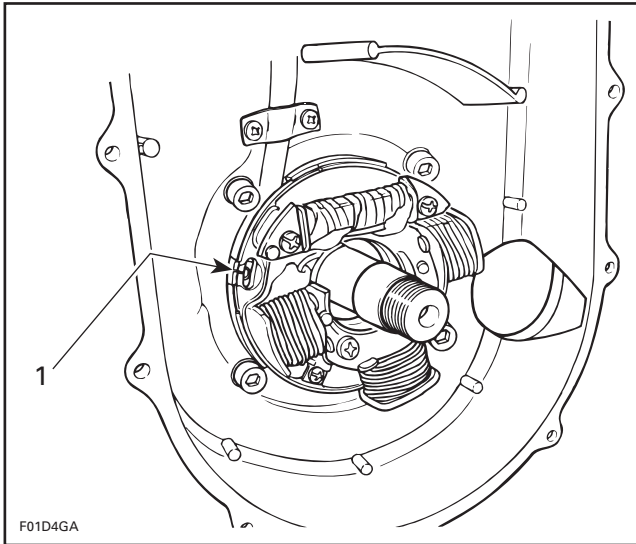
Find manufacturer's mark on armature plate. In line with this mark, punch another mark on adjacent crankcase lug.



TYPICAL

1. Manufacturer's mark on armature plate
2. Punch a mark on crankcase lug aligned with plate mark

The new mark on crankcase will be used for further assembly positioning as a pre-timing position.



TYPICAL

1. For further assembly, use these marks

Apply a drop of Loctite 243 (blue) on threads of screws no. 15 and torque to 6 N•m (53 lbf•in).

Magneto Flywheel

Apply Loctite 243 (blue) on crankshaft taper.

Position Woodruff key and magneto flywheel. Apply Loctite 243 (blue) on nut no. 13. Install nut with lock washer and torque to 145 N•m (107 lbf•ft).

CAUTION: Never use any type of impact wrench at magneto installation.

Ignition Timing

For ignition timing procedures of the 717 engine, refer to IGNITION SYSTEM.

Magneto Housing Cover

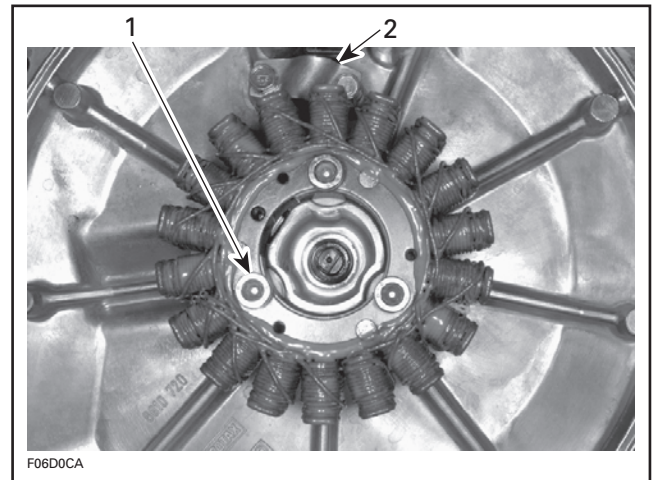
Properly install O-ring no. 25 in magneto housing. Apply Loctite 767 anti-seize on screws no. 11, install cover and wire support no. 12. Torque screws no. 11 in a criss-cross sequence to 9 N•m (80 lbf•in).

787 RFI Engine

Stator

Install the stator no. 9 in magneto housing cover no. 1 and torque screws no. 20 to 9 N•m (80 lbf•in).

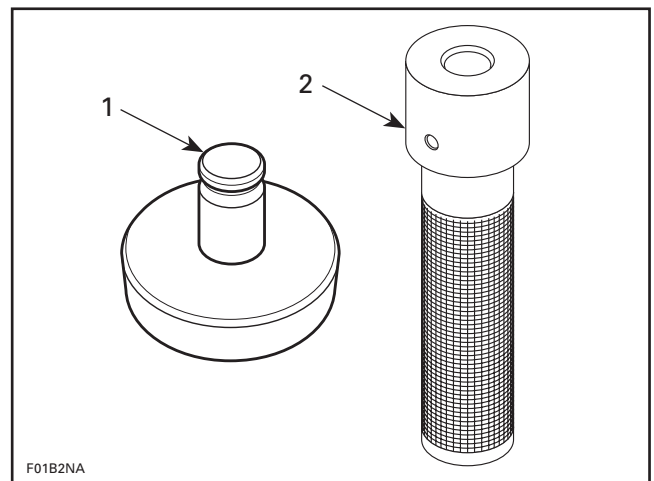
Install wiring harness bracket no. 26 of stator and torque screws no. 27 to 4 N•m (35 lbf•in).



1. Stator screws
2. Bracket

Magneto Housing

To install oil seal no. 28 of magneto housing no. 5, use pusher (P/N 290 877 740) and handle (P/N 420 877 650).



1. Pusher
2. Handle

Section 04 ENGINE

Subsection 04 (MAGNETO SYSTEM)



Install gasket **no. 24** between magneto housing and engine crankcase.

Install magneto housing and torque screws **no. 19** to 9 N•m (80 lbf•in).

Rotor and Ring Gear

Apply Loctite 243 (blue) on crankshaft taper.

Install ring gear on crankshaft.

Apply Loctite 243 (blue) on nut **no. 13**. Install nut with lock washer **no. 14** and torque to 120 N•m (89 lbf•ft).

CAUTION: Never use any type of impact wrench at magneto installation.

Crankshaft Position Sensor

Install crankshaft position sensor **no. 18** on magneto housing. Torque screw to 9 N•m (80 lbf•in).

NOTE: The crankshaft position sensor is not adjustable.

Cover

Before installing cover, make sure oil pump shaft is properly positioned.

Before installation, properly install O-ring **no. 25** in engine magneto cover **no. 1**.

Apply Loctite 767 anti-seize compound on screws **no. 11**. Torque screws in a criss-cross sequence to 9 N•m (80 lbf•in).

947 Engine

Stator and Trigger Coil/CPS (Crankshaft Position Sensor)

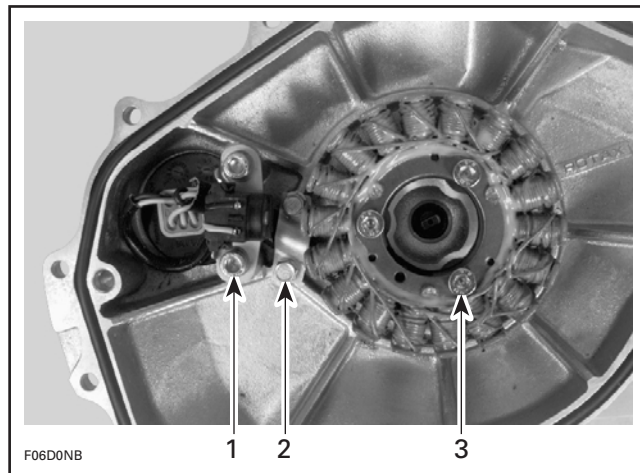
Install the stator **no. 9** and trigger **no. 10** coil in engine magneto cover. Torque screws to 9 N•m (80 lbf•in).

Reinstall wiring harness bracket **no. 29** using tap-tite screws **no. 16**.

Torque trigger coil screws **no. 21** to 9 N•m (80 lbf•in).

Torque stator screws **no. 20** to 13 N•m (115 lbf•in).

NOTE: The trigger coil is not adjustable.



1. Torque to 9 N•m (80 lbf•in)
2. Tap-tite screws
3. Torque to 13 N•m (115 lbf•in)

Cover

Before installing cover, make sure oil pump shaft is properly positioned.

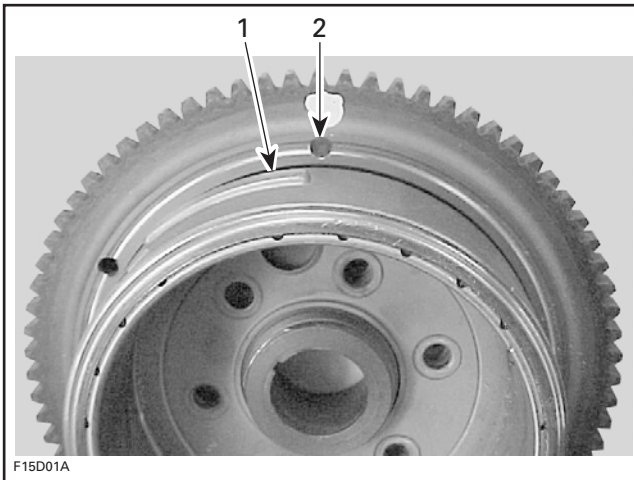
Before installation, properly install O-ring **no. 25** in engine magneto cover **no. 1**.

Apply Loctite 767 anti-seize compound on screws **no. 11**. Torque screws in a criss-cross sequence to 9 N•m (80 lbf•in).

Rotor and Ring Gear

Apply Loctite 648 (green) on mating surface of the rotor **no. 8**.

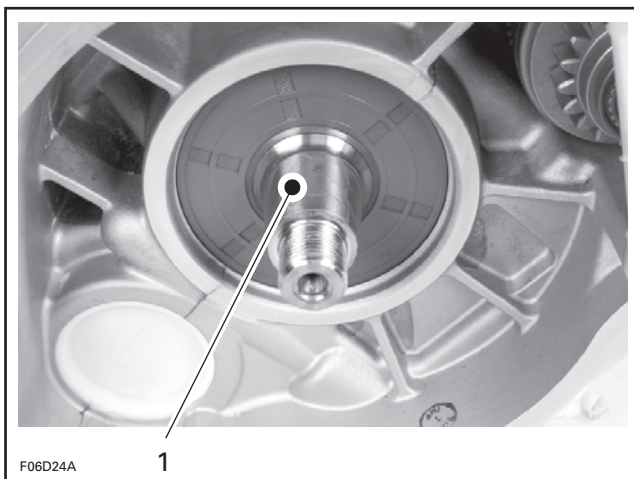
When reinstalling rotor to ring gear **no. 3**, one of the protrusion end of rotor must be aligned with hole in ring gear.



1. Protrusion
2. Hole

Apply Loctite 648 (green) on screws **no. 17** retaining rotor to ring gear and torque screws in a criss-cross sequence to 13 N•m (115 lbf•in).

Apply Loctite 243 (blue) on crankshaft taper.



1. Loctite 243 (blue) on crankshaft taper

Install flywheel and make sure to align keyway with the crankshaft Woodruff key.

Apply Loctite 243 (blue) on nut **no. 13**. Install nut with lock washer and torque to 115 N•m (85 lbf•ft).

CAUTION: Never use any type of impact wrench.

Unlock crankshaft. Reinstall pulse fitting with washer and torque to 19 N•m (14 lbf•ft).

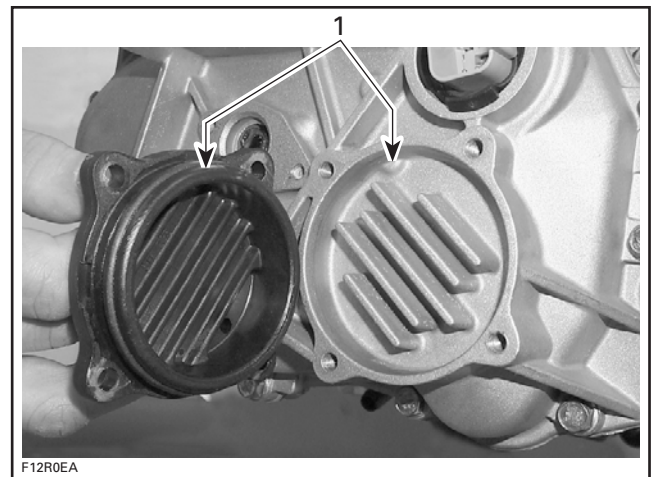
Cover

Before installation, properly install O-ring **no. 25** in engine magneto cover **no. 1**.

Apply Loctite 767 anti-seize compound on screws **no. 11**. Torque screws in a criss-cross sequence to 9 N•m (80 lbf•in).

DI Models

If heat exchanger cover has been removed, ensure to align its notch with the emboss in casing.

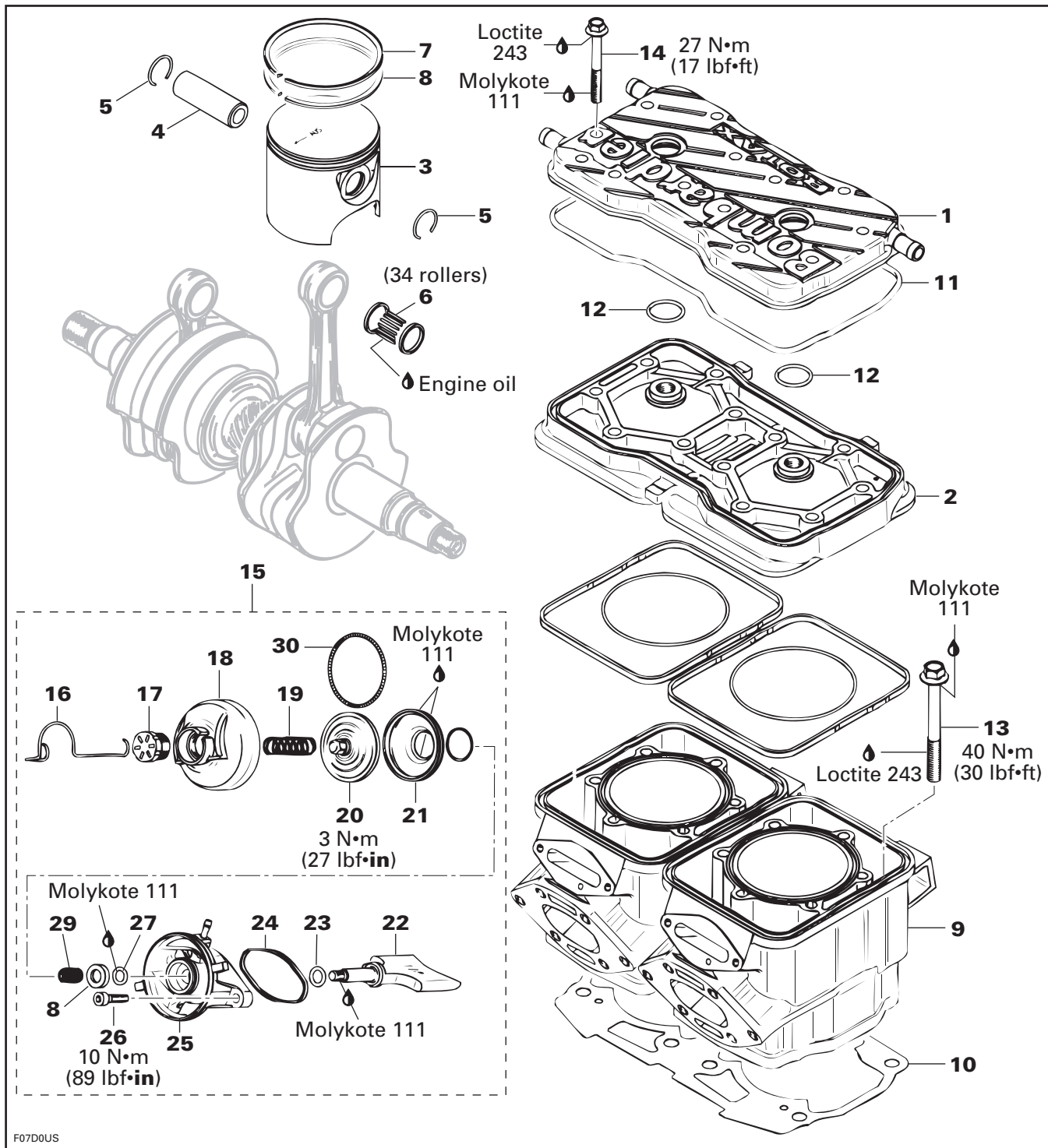


1. Align notch with the emboss

Section 04 ENGINE

Subsection 05 (TOP END)

787 RFI Engine

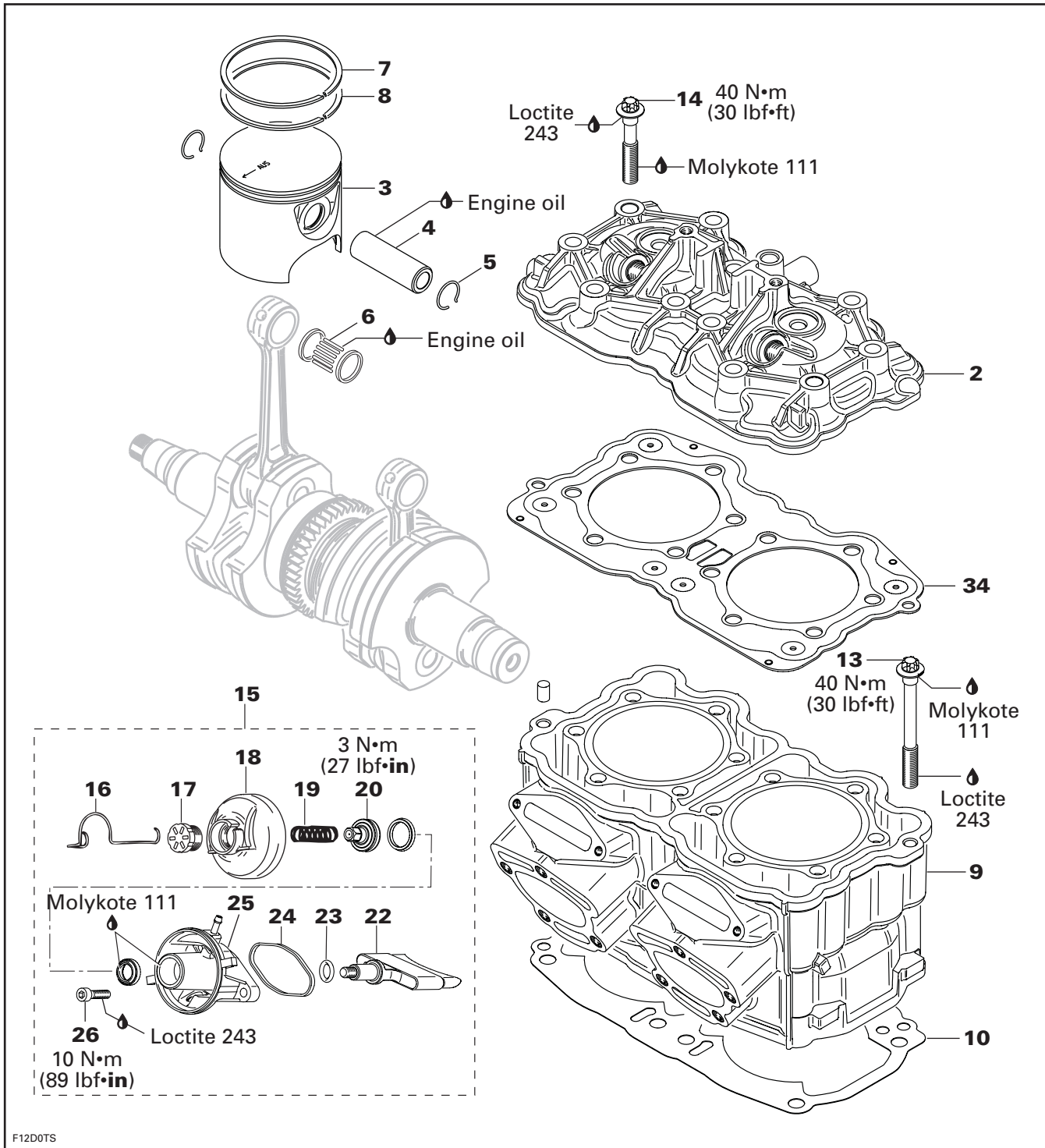


F07D0US

Section 04 ENGINE

Subsection 05 (TOP END)

947 DI Engine



F12D0TS

GENERAL

The 2-stroke ROTAX engine rotates counterclockwise seen from the rear (PTO flywheel).

The **717 and 787 RFI engines** have a rotary valve to control opening and closing of the intake. The **947 engine** uses reed valves in the crankcase.

The **787 RFI and 947 engines** are also equipped with the RAVE system (Rotax Adjustable Variable Exhaust).

CAUTION: No engine components can be interchanged between engines.

RAVE System (Rotax Adjustable Variable Exhaust)

BASIC OPERATION

The RAVE valves change the height of the exhaust port. The RAVE valve solenoid, which is controlled by the MPEM, allows either positive crankcase pressure (**787 RFI and 947 with carburetor**) or a pressure from the air compressor (**947 DI**) to inflate the bellows and open the RAVE valves.

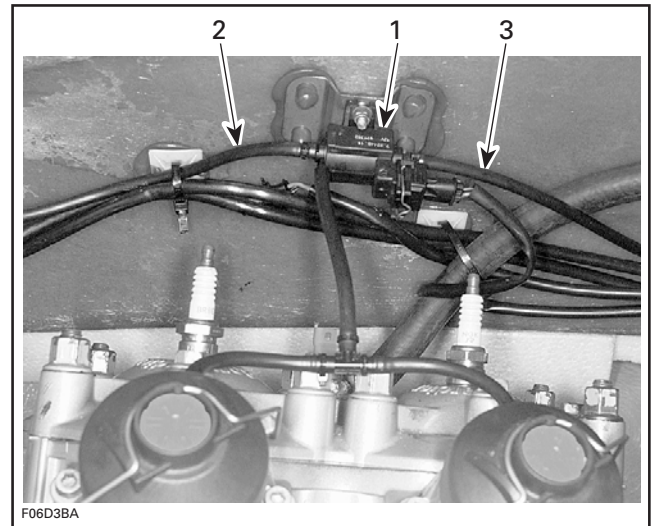
Carburetor-Equipped Engines

On top of the RAVE, there is a red plastic adjustment knob. Turning the adjustment in or out changes the preload on the return spring which, in turn, will change the RPM at which the RAVE valve opens and closes. On **947 engines**, the spring preload does not have a significant effect on the valve operation.

787 RFI and 947 Carburetor-Equipped Engines

On these engines, the RAVE valves are controlled by the Multi-Purpose Electronic Module (MPEM).

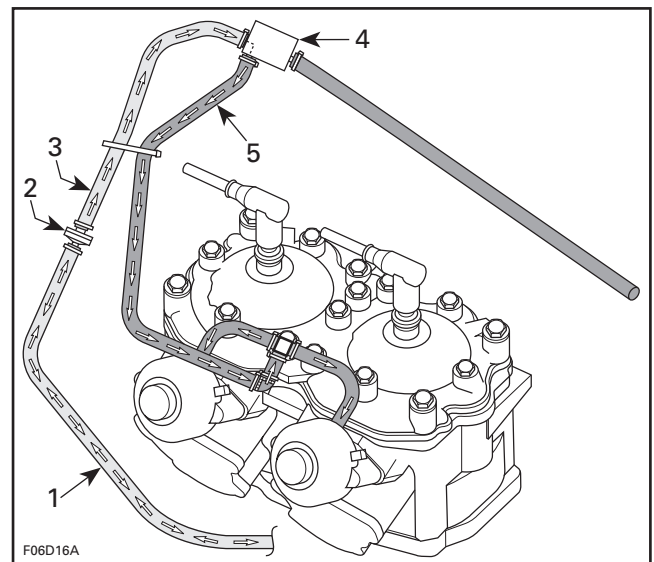
To open the RAVE valves, the MPEM activates a solenoid which directs the positive pressure from engine crankcase to the valves.



1. Solenoid
2. Pressure hose from crankcase
3. To atmospheric pressure

NOTE: A check valve on the pressure line eliminates the negative pressure from the crankcase.

To close the RAVE valves, the MPEM deactivates the solenoid which blocks the crankcase positive pressure. The RAVE valves are opened to the atmosphere.

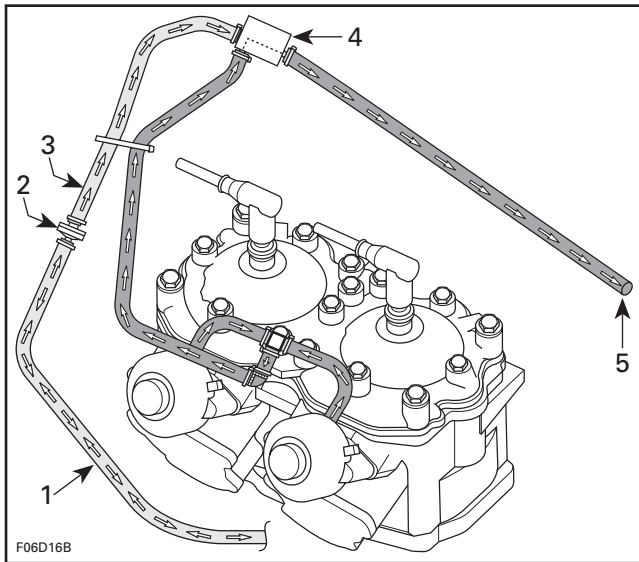


RAVE VALVE OPENED

1. Pulse from crankcase
2. Check valve
3. Positive pressure to solenoid
4. Solenoid activated
5. Positive crankcase pressure to RAVE valves

Section 04 ENGINE

Subsection 05 (TOP END)

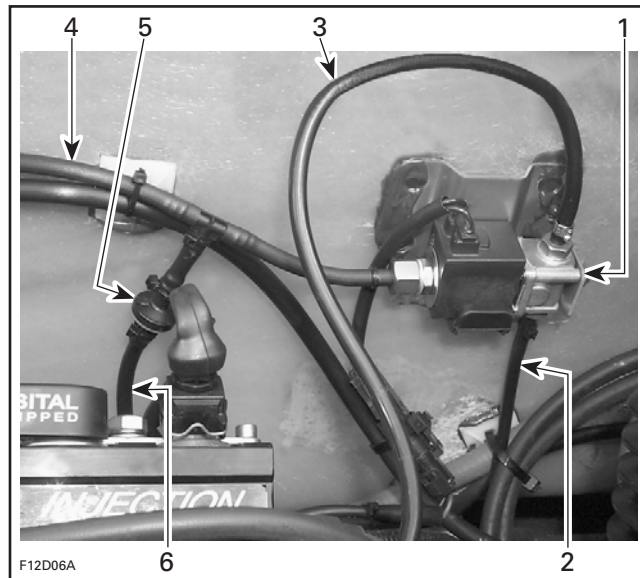


RAVE VALVE CLOSED

1. Pulse from crankcase
2. Check valve
3. Positive pressure blocked by the solenoid
4. Solenoid deactivated
5. RAVE valves are opened to atmosphere

947 DI Engine

To open the RAVE valves, the MPEM activates a solenoid which directs the pressure from air compressor to the valves.



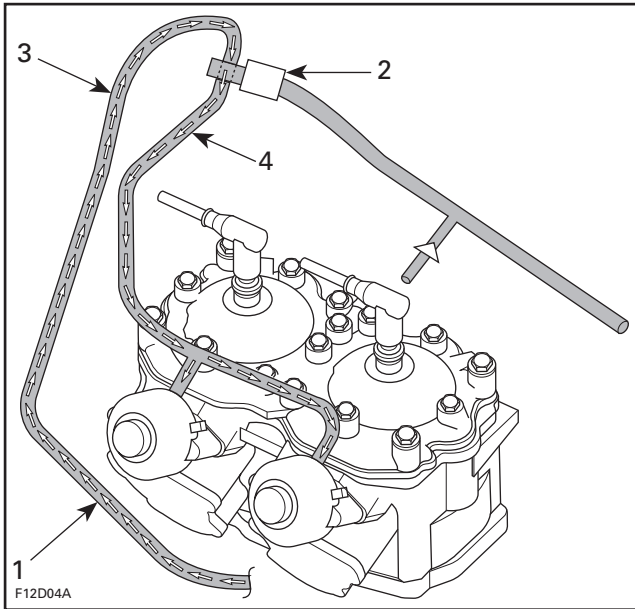
1. Solenoid
2. Pressure from air compressor
3. Pressure to RAVE valves
4. Vent to air intake silencer
5. Check valve
6. Vent from counterbalancing shaft oil cavity

To close the RAVE valves, the MPEM deactivates the solenoid which blocks the air compressor pressure. The RAVE valves are opened to the atmosphere.

The vent on counterbalancing shaft oil cavity is necessary to prevent pressure buildup in the cavity by the air compressor piston movement. The check valve allows pressure to escape from the cavity but does not allow liquid to enter into the cavity.

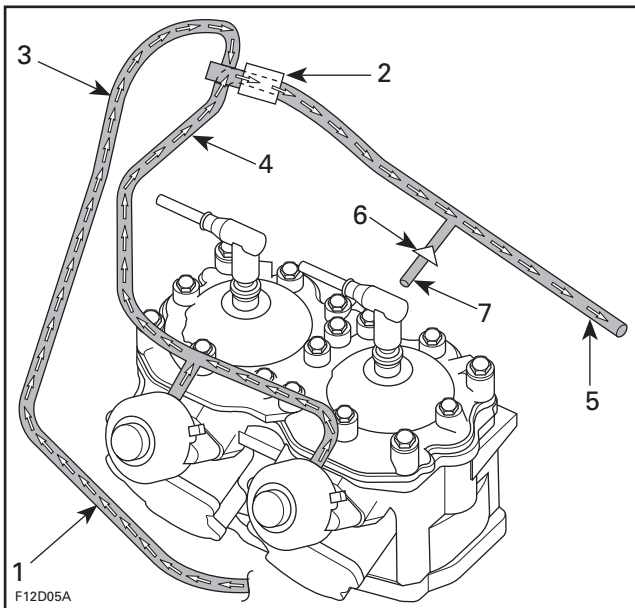


1. Pressure from solenoid



RAVE VALVE OPENED

1. Pressure from air compressor
2. Solenoid activated
3. Pressure to solenoid
4. Pressure to RAVE valves



RAVE VALVE CLOSED

1. Pressure from air compressor
2. Solenoid deactivated
3. Pressure to solenoid
4. Pressure to RAVE valves blocked by the solenoid
5. Vent to air intake silencer
6. Check valve
7. Counterbalancing shaft oil cavity vent

MAINTENANCE

There are no wear parts anywhere in the system and there are no adjustments to be periodically checked. The only possible maintenance required would be cleaning of carbon deposits from the guillotine slide. Cleaning intervals would depend upon the user's riding style and the quality of the oil used. We suggest annual cleaning of the valve. If a customer uses a lower quality oil, than recommended, more frequent cleaning may be required.

No special solvents or cleaners are required when cleaning the valve.

BORING PRECAUTION

In its stock configuration the RAVE valve guillotine has a minimum of 0.5 mm (.020 in) clearance to the cylinder bore measured at the center line of the cylinder. This is the minimum production clearance.

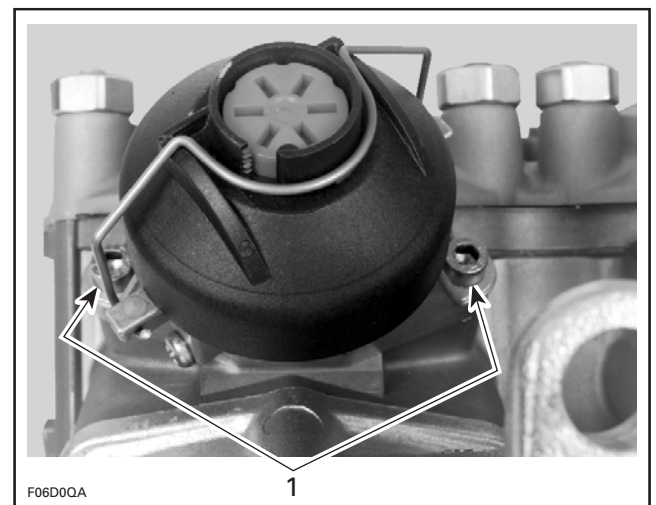
There is only a first oversize piston available for the **787 RFI and 947 engines**. That piston is 0.25 mm (.010 in) larger in diameter than the stock piston. When the oversize is installed, the guillotine will have a minimum clearance of 0.375 mm (.015 in) with the cylinder bore. This is the minimum operating clearance the guillotine should be used with. Clearance less than 0.375 mm (.015 in) will require reworking of the guillotine to achieve the proper clearance and radius.

DISASSEMBLY

RAVE Valve

787 RFI and 947 Carburetor-Equipped Engines

Loosen Allen screws no. 26 each side of RAVE valve.



1. Remove screws

Section 04 ENGINE

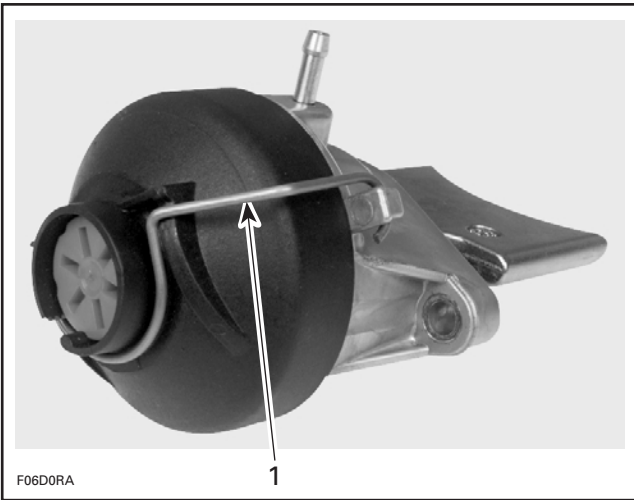
Subsection 05 (TOP END)

Remove RAVE valve no. 15.

Remove the cover no. 18 of the valve by releasing the spring no. 16.

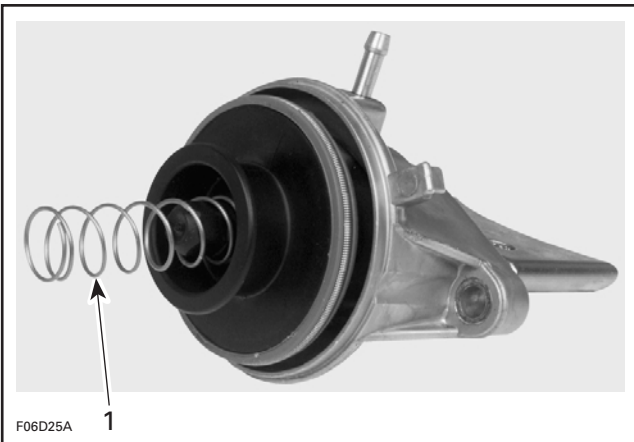
WARNING

Firmly hold cover to valve base. The compression spring inside the valve is applying pressure against the cover.



1. Spring

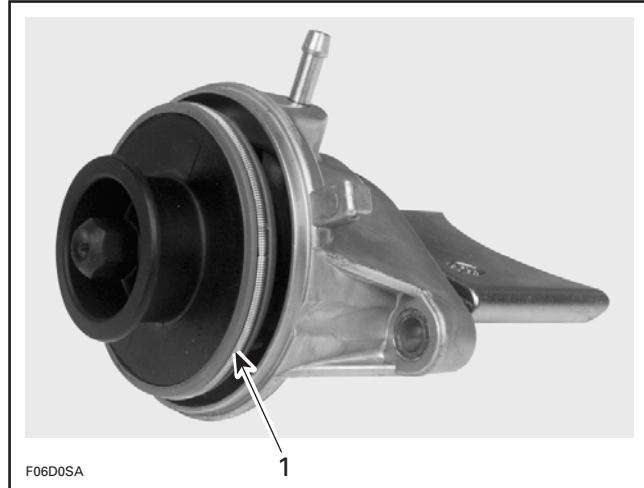
Remove the compression spring no. 19.



1. Remove spring

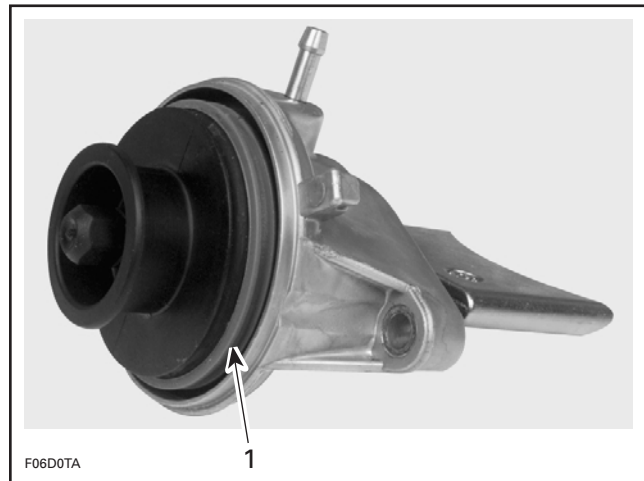
NOTE: The following procedures relates the steps for the 787 RFI and 947 carburetor-equipped engines. The DI engine is explained below.

Remove spring no. 30 retaining bellows no. 21 to valve piston no. 20.



1. Spring

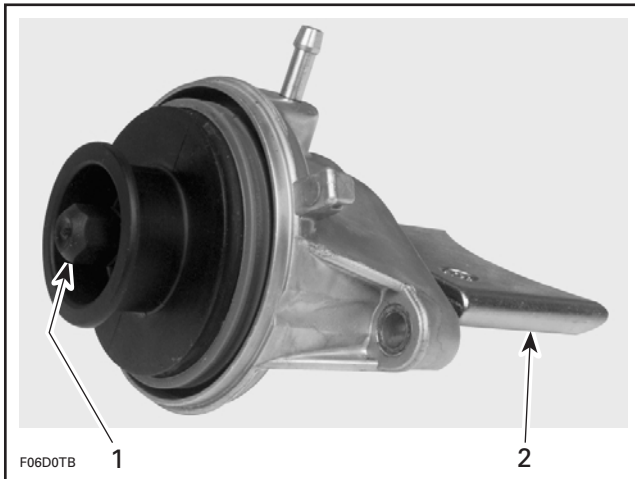
Free bellows no. 21 from valve piston no. 20.



1. Bellows removed from piston

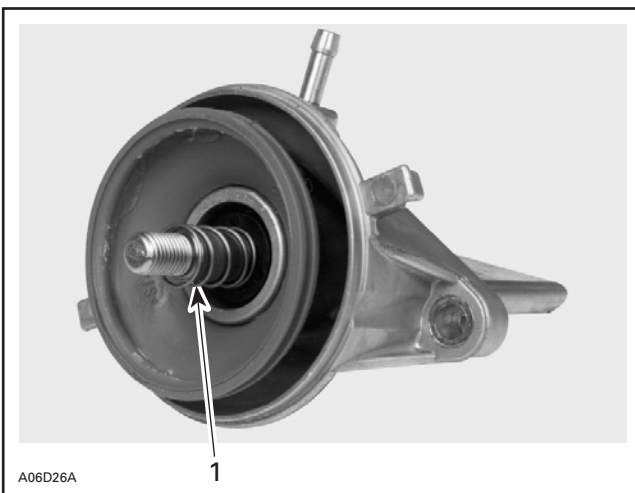
Unscrew valve piston no. 20 from sliding valve no. 22.

NOTE: Hold the sliding valve to prevent it from turning.



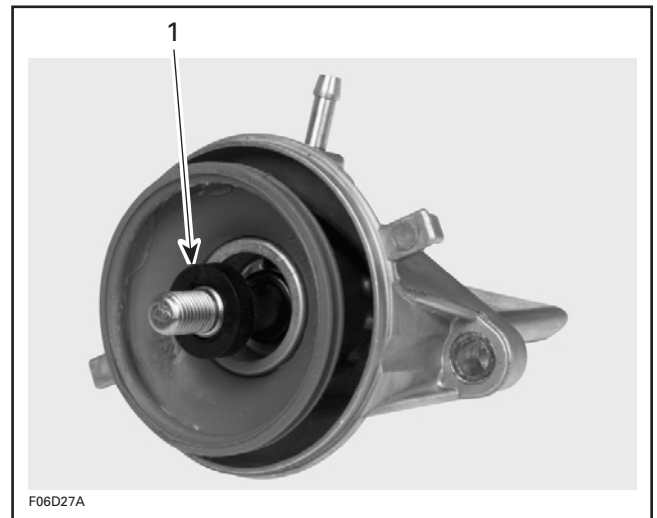
1. Unscrew piston
2. Hold sliding valve

Remove compression spring no. 29.



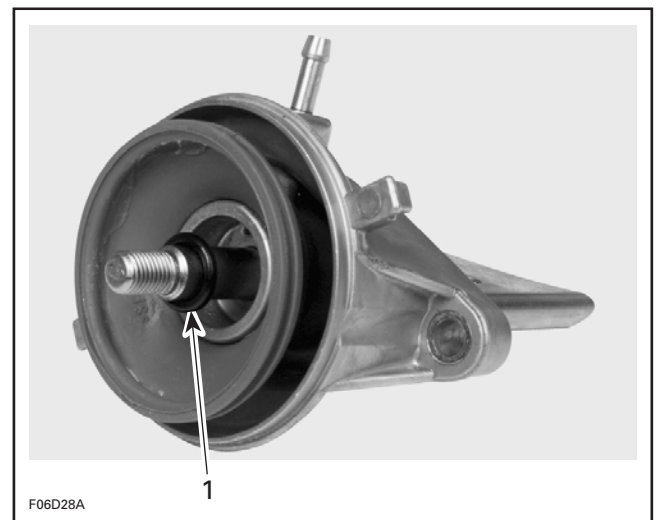
1. Remove spring

Remove supporting ring no. 28.



1. Remove supporting ring

Remove O-ring no. 23.

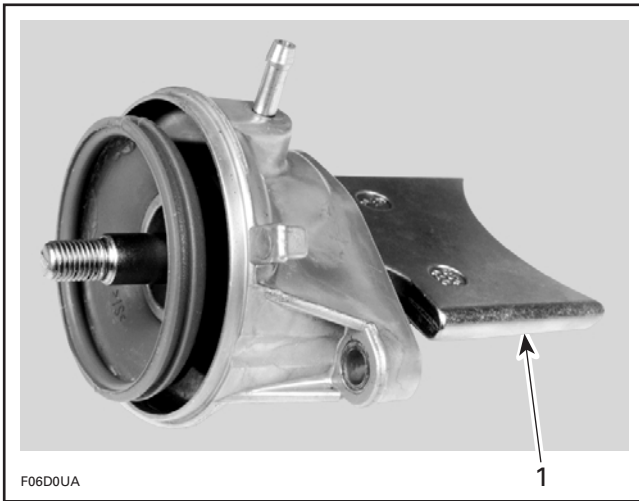


1. Remove O-ring

Section 04 ENGINE

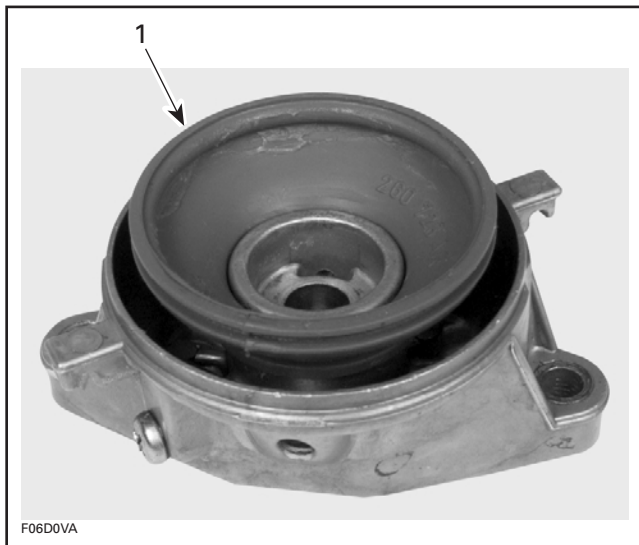
Subsection 05 (TOP END)

Remove sliding valve no. 22.



1. Remove sliding valve

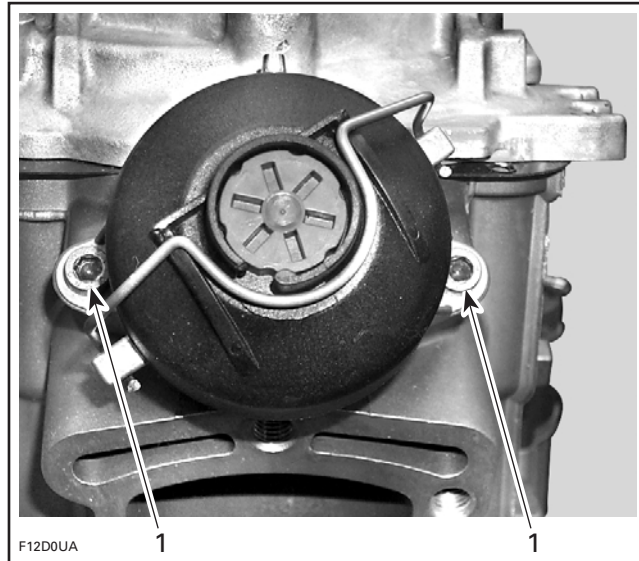
Remove bellows no. 21.



1. Remove bellows

947 DI Engine

Loosen Allen screws no. 26 each side of RAVE valve.



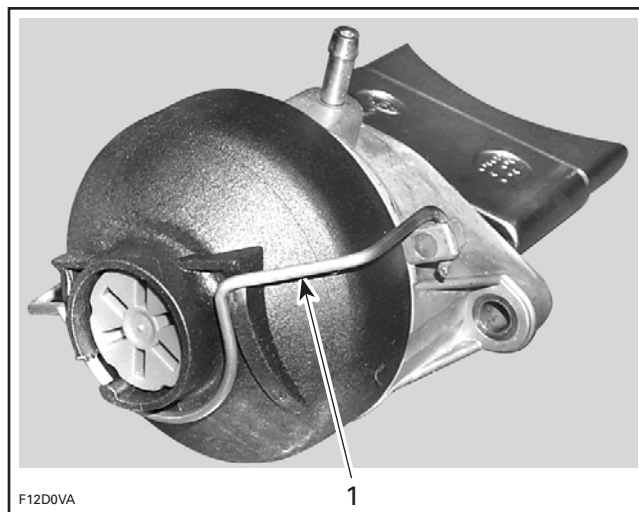
1. Remove screws

Remove RAVE valve no. 15.

Remove the cover no. 18 of the valve by releasing the spring no. 16.

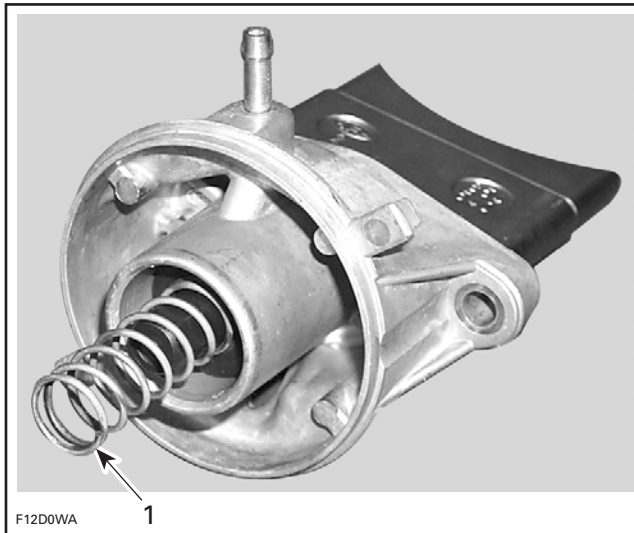
⚠ WARNING

Firmly hold cover to valve base. The compression spring inside the valve is applying pressure against the cover.



1. Spring

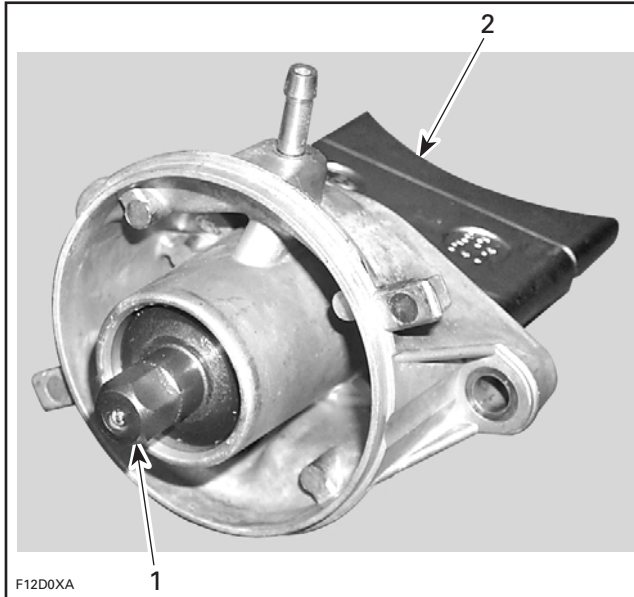
Remove the compression spring no. 19.



1. Remove spring

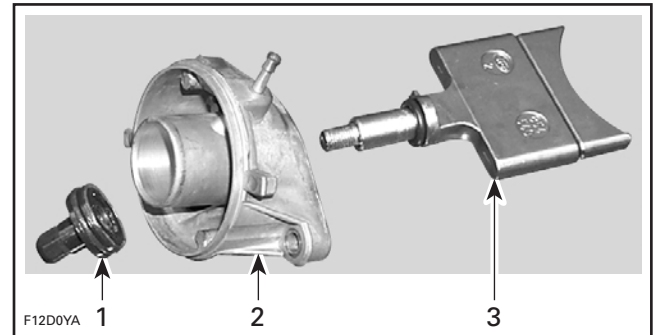
Unscrew valve piston no. 20 from sliding valve no. 22.

NOTE: Hold the sliding valve to prevent it from turning.



1. Unscrew piston
2. Hold sliding valve

Remove sliding valve from valve housing.



1. Valve piston
2. Valve housing
3. Sliding valve

Cylinder Head Cover and Cylinder Head

Disconnect temperature sensor wire and spark plug cables.

Connect spark plug cables on grounding device.

717 Engine

Remove air intake silencer and support, refer to AIR INTAKE.

717 and 787 RFI Engines

Remove screws no. 14.

Remove cylinder head cover no. 1.

If shells, sand, salt or any other particles are present in cylinder head, clean with a vacuum cleaner.

Remove cylinder head no. 2.

If shells, sand, salt water or any other particles are present in cylinder cooling jacket, clean with a vacuum cleaner.

947 Engines

Disconnect hose of RAVE valves.

On DI engines, remove air/fuel rail. Refer to ENGINE MANAGEMENT.

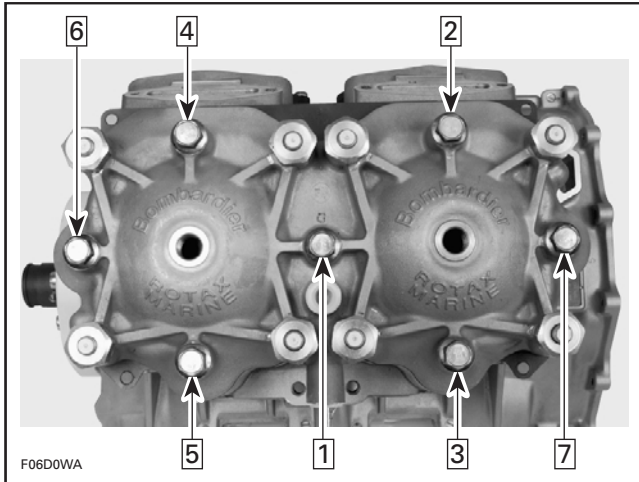
Section 04 ENGINE

Subsection 05 (TOP END)

947 Carburetor-Equipped Engines

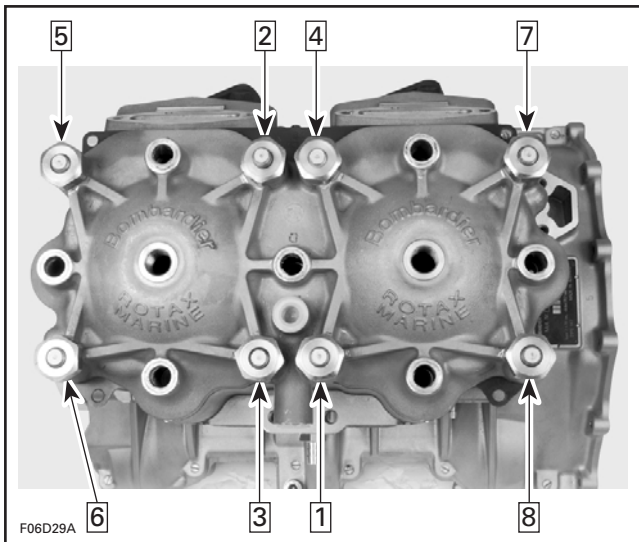
NOTE: Due to the cylinder mounting studs, it is recommended to remove the engine from the hull to service the top end. However, one might unfasten the engine support to allow leaning the engine so that cylinder can be pulled out.

Loosen cylinder head bolts **no. 14** following the sequence shown in the next photo.



UNTORTQUING SEQUENCE FOR THE CYLINDER HEAD BOLTS

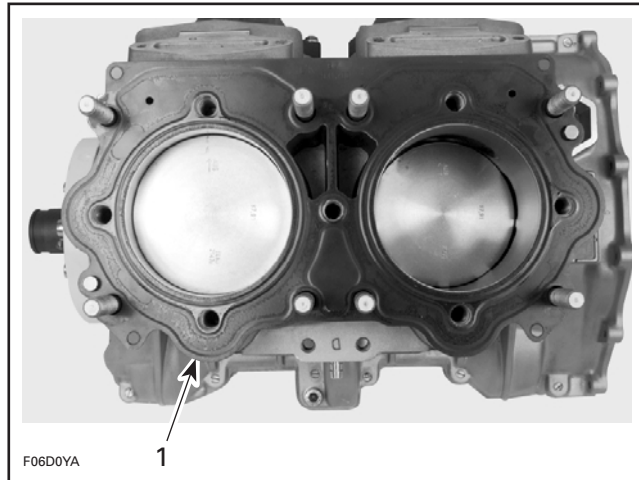
Loosen nuts **no. 33** following the sequence shown in the next photo.



UNTORTQUING SEQUENCE FOR THE NUTS

Remove cylinder head **no. 2**.

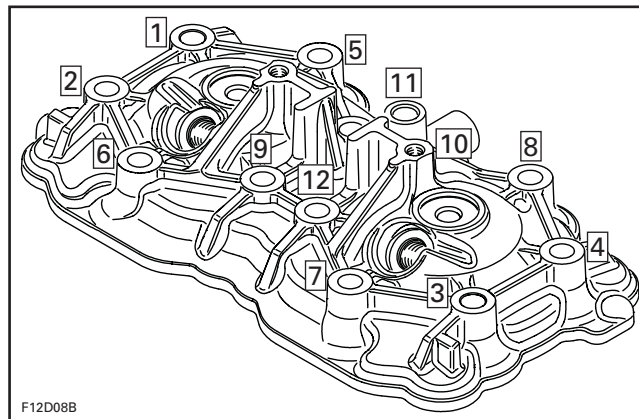
Remove cylinder head gasket **no. 34**.



1. Remove gasket

947 DI Engine

Use Snap-On Torx socket E12 and unscrew cylinder head screws **no. 14** following the sequence shown in the next illustration.



Remove cylinder head **no. 2** and gasket **no. 34**.

Cylinder

NOTE: When removing cylinder, be careful that connecting rods do not hit crankcase edge.

787 RFI Engine

Remove air intake silencer and support, refer to AIR INTAKE.

717 and 787 RFI Engines

Remove tuned pipe and exhaust manifold, refer to EXHAUST SYSTEM.

Remove screws **no. 13**.

Remove cylinders **no. 9**, being careful that connecting rods do not hit crankcase edge.

⚠ WARNING

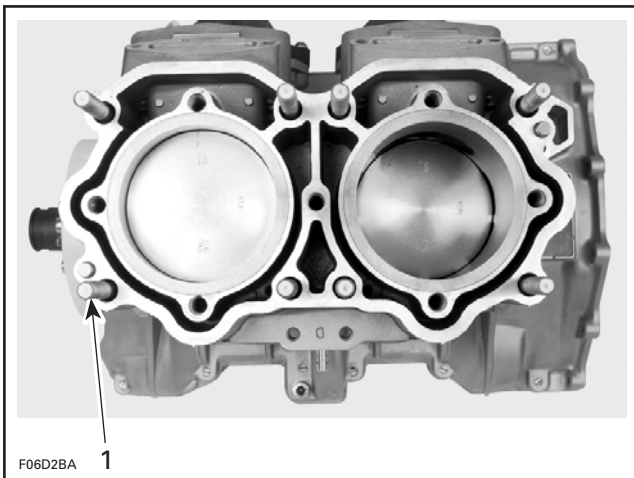
If screws need to be heated for removal when engine is in watercraft, fuel system pressurization must be done first. Do not use open flame; use a heat gun.

NOTE: Even if only 1 cylinder needs repair, both cylinders should be lifted to allow 1-piece cylinder base gasket replacement.

947 Carburetor-Equipped Engines

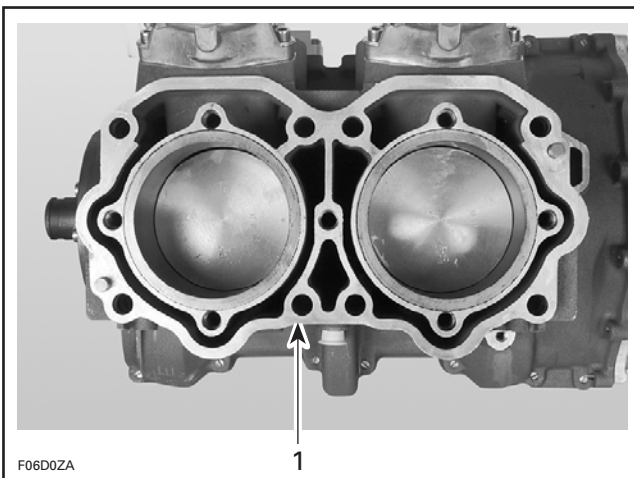
Remove studs **no. 32**. Take two head cover nuts. Screw nuts onto stud. Lock both nuts together and unscrew the stud. Repeat this operation for the other studs.

NOTE: Studs must be removed prior cylinder block.



1. Remove studs

Remove cylinder block **no. 9**.



1. Remove cylinder block

NOTE: To ease removal, a plastic tip hammer can be used.

Remove cylinder base gasket **no. 10**.

947 DI Engine

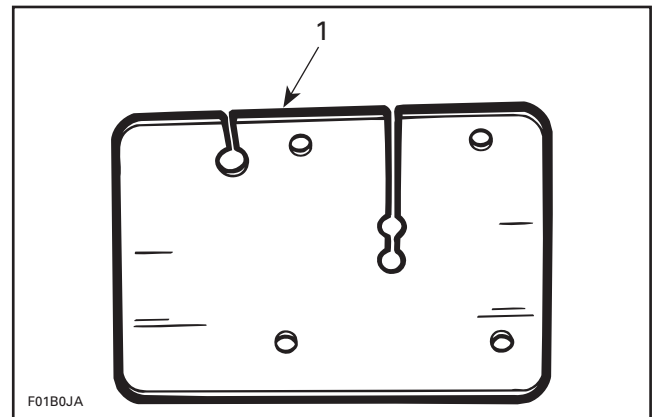
Remove cylinder screws then cylinders **no. 9**.

Piston

NOTE: All engines feature cageless piston pin bearings.

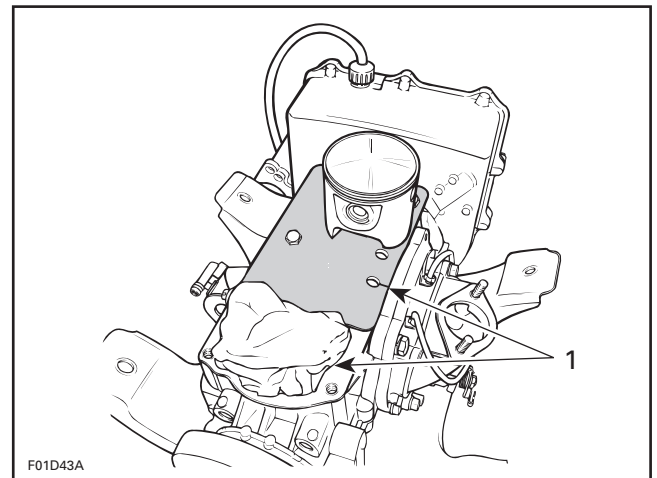
717 and 787 RFI Engines

Bring piston to Top Dead Center and install rubber pad (P/N 295 000 101) over crankcase opening. Secure with screws. Lower piston until it sits on pad.



1. Rubber pad (P/N 295 000 101)

If the other cylinder has been removed, completely cover its opening with a clean rag.



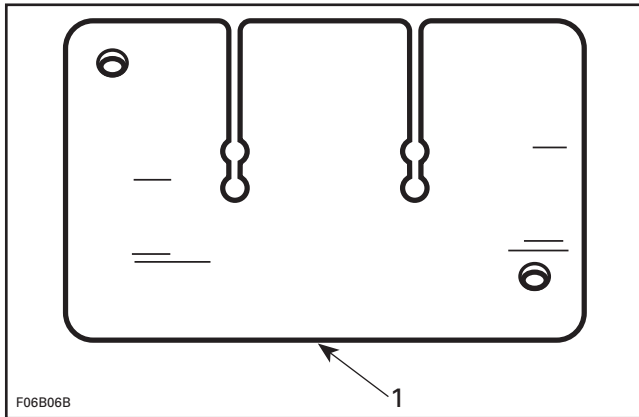
1. Openings covered with rag and rubber pad

Section 04 ENGINE

Subsection 05 (TOP END)

947 Engines

Install rubber pad (P/N 290 877 032) to crankcase. Secure with screws. Lower piston to be removed until it sits on pad.



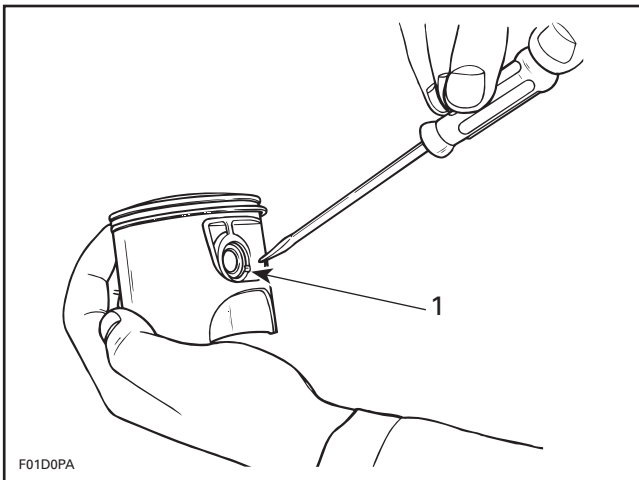
1. Rubber pad (P/N 290 877 032)

All Engines

To remove circlip no. 5, insert a pointed tool in piston notch then pry it out and discard.

⚠ WARNING

Always wear safety glasses when removing piston circlips.

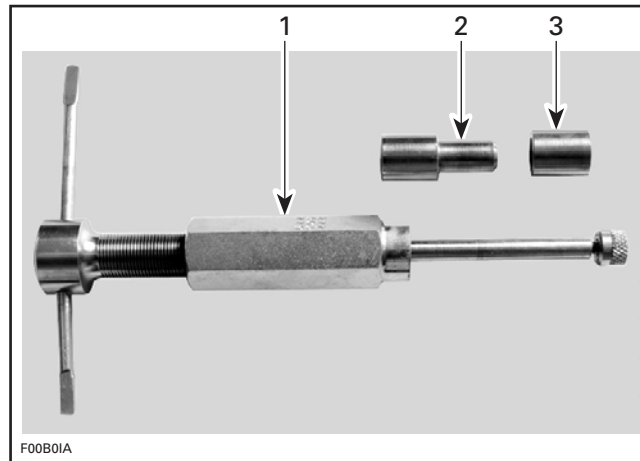


TYPICAL

1. Piston notch

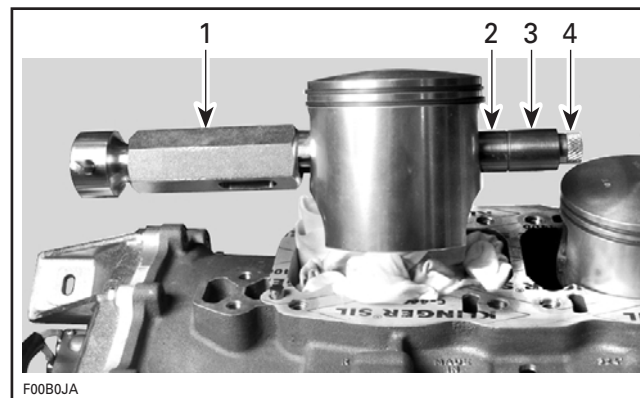
To extract piston pin no. 4, use piston pin puller (P/N 529 035 503) with the appropriate set of sleeves.

ENGINE	SLEEVE SET
717/787 RFI	P/N 529 035 542
947	P/N 529 035 543



1. Puller
2. Shoulder sleeve
3. Sleeve

- Fully thread on puller handle.
- Insert extractor spindle into the piston pin.
- Slide the sleeve and shoulder sleeve onto the spindle.
- Screw in extracting nut with the movable extracting ring towards spindle.



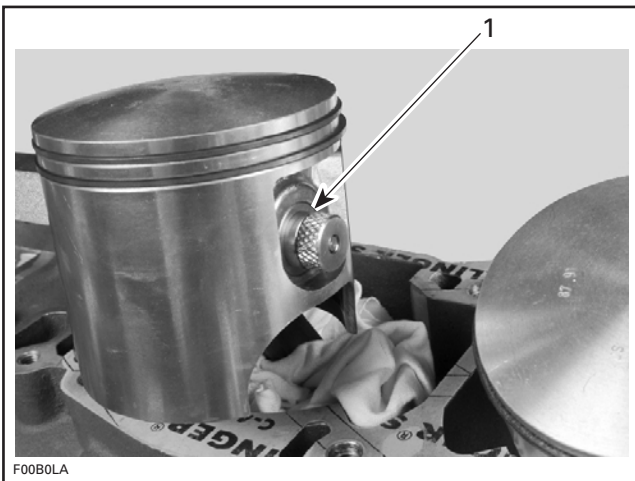
1. Puller
2. Sleeve
3. Shoulder sleeve
4. Extracting nut

NOTE: The tool cutout must be positioned toward the bottom of the piston.



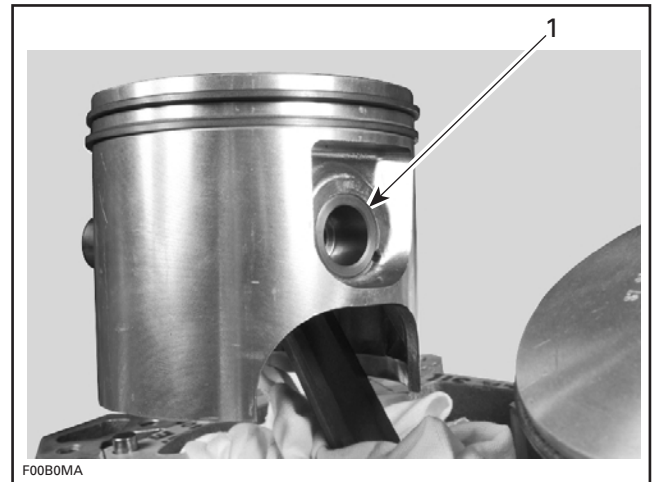
1. Tool cutout toward bottom of piston

- Firmly hold puller and rotate handle to pull piston pin no. 4.
- Rotate spindle until the shoulder sleeve is flushed with the piston recess.



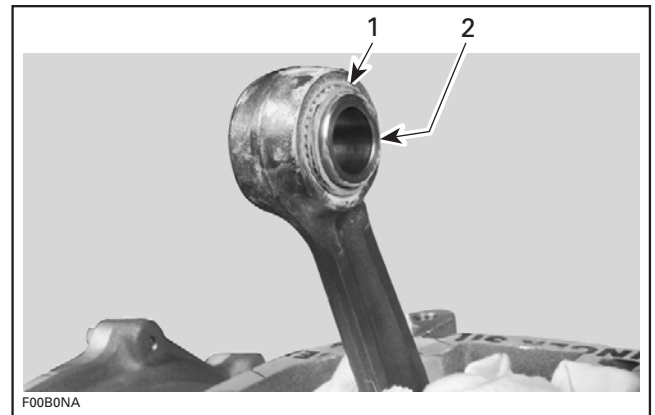
1. Shoulder sleeve flush with piston recess

- Loosen the extracting nut and remove puller.
- Remove the shoulder sleeve from piston.



1. Remove shoulder sleeve

- Carefully remove the piston no. 3.
- The needles, thrust washers and the sleeve remain in the connecting rod bore and may be used again.



1. Needles and thrust washer
2. Sleeve

Section 04 ENGINE

Subsection 05 (TOP END)

CLEANING

Discard all gaskets and O-rings.

Clean all metal components in a solvent.

Clean water passages and make sure they are not clogged.

Remove carbon deposits from cylinder exhaust port, RAVE valve (**787 RFI and 947 engines**), cylinder head and piston dome.

Clean piston ring grooves with a groove cleaner tool, or a piece of broken ring.

INSPECTION

Visually inspect all parts for corrosion damage.

Inspect piston for damage. Light scratches can be sanded with a fine sand paper.

NOTE: When repairing a seized engine, connecting rods should be checked for straightness and crankshaft for deflection/misalignment. Refer to **BOTTOM END** for procedures.

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

The inspection of engine top end should include the following measurements.

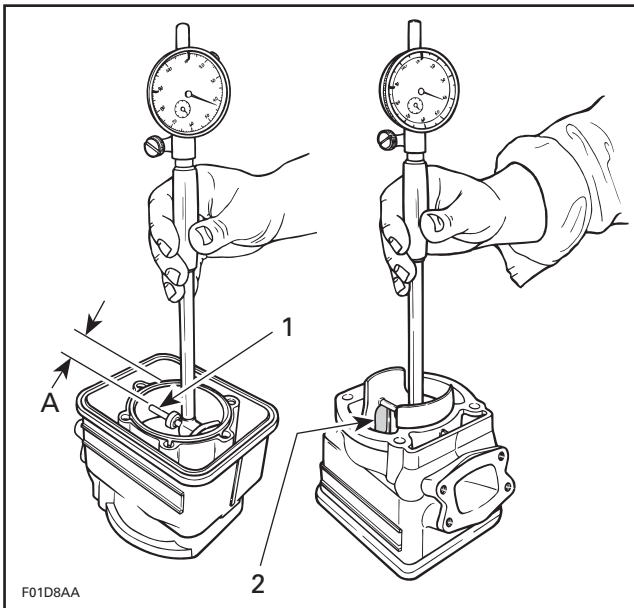
ENGINE MEASUREMENT	TOLERANCES		
	NEW PARTS (min.)	(max.)	WEAR LIMIT
Cylinder taper	N.A.	0.05 mm (.002 in)	0.1 mm (.004 in)
Cylinder out of round	N.A.	0.008 mm (.0003 in)	0.08 mm (.003 in)
Piston/cylinder wall clearance for the 717 engine	0.10 mm (.0039 in)	N.A.	0.20 mm (.008 in)
Piston/cylinder wall clearance for the 787 RFI engine	0.13 mm (.005 in)	N.A.	0.22 mm (.009 in)
Piston/cylinder wall clearance for the 947 engine	0.09 mm (.0035 in)	N.A.	0.20 mm (.008 in)
Piston/cylinder wall clearance for the 947 DI engine	0.12 mm (.0047 in)	N.A.	0.20 mm (.008 in)
Ring/piston groove clearance for the 717 engine	0.025 mm (.001 in)	0.070 mm (.0027 in)	0.20 mm (.008 in)
Ring/piston groove clearance for the 787 RFI engine	0.025 mm (.001 in)	0.070 mm (.0027 in)	0.24 mm (.009 in)
Ring/piston groove clearance for the 947 engine	0.048 mm (.002 in)	0.075 mm (.0029 in)	0.20 mm (.008 in)
Ring/piston groove clearance for the 947 DI engine	0.044 mm (.002 in)	0.089 mm (.003 in)	0.20 mm (.008 in)
Ring end gap for the 717 engine	0.25 mm (.010 in)	0.40 mm (.016 in)	1.0 mm (.039 in)
Ring end gap for the 787 RFI engine	0.40 mm (.016 in)	0.55 mm (.022 in)	1.0 mm (.039 in)
Ring end gap for the 947 engine	0.45 mm (.018 in)	0.60 mm (.024 in)	1.0 mm (.039 in)
Ring end gap for the 947 DI engine	0.55 mm (.022 in)	0.7 mm (.028 in)	1.1 mm (.043 in)

N.A.: Not Applicable

NOTE: Replacement cylinder sleeves are available if necessary. Also, oversize pistons of 0.25 mm (.010 in) are available for all engines and oversize pistons of 0.5 mm (.020 in) are available for the 717 engine.

Cylinder Taper

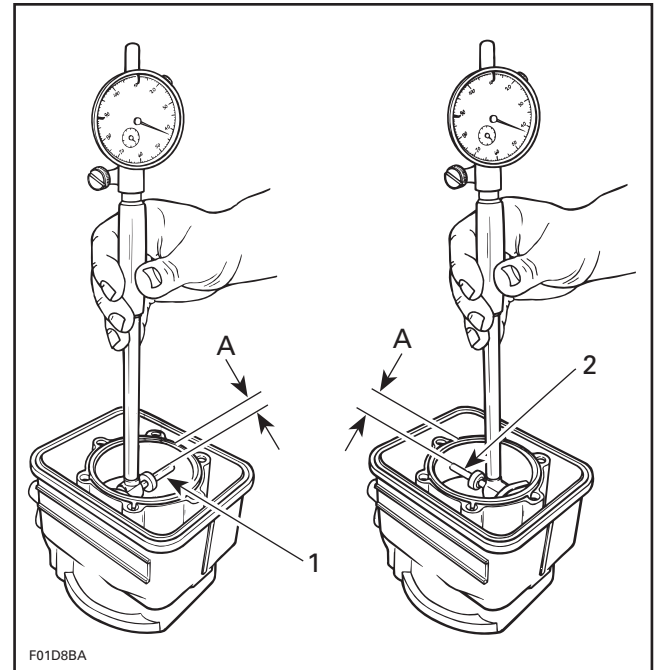
Using a cylinder bore gauge, measure cylinder diameter at 16 mm (5/8 in) from top of cylinder just below auxiliary transfer port, facing exhaust port and just below the auxiliary transfer port facing the exhaust port. Compare readings. If the difference between readings exceed specification, cylinder should be rebored and honed or replaced.



1. Measuring perpendicularly (90°) to piston pin axis
2. Auxiliary transfer port
- A. 16 mm (5/8 in)

Cylinder Out of Round

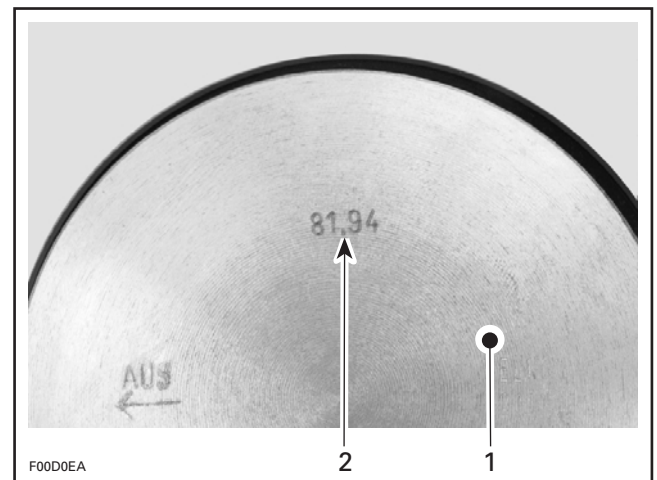
Using a cylinder bore gauge, measure cylinder diameter at 16 mm (5/8 in) from top of cylinder. Measure diameter in piston pin axis direction then perpendicularly (90°) to it. If the difference between readings exceed specification, cylinder should be rebored and honed or replaced.



1. Measuring in piston pin axis
2. Measuring perpendicularly (90°) to piston pin axis
- A. 16 mm (5/8 in)

USED PISTON MEASUREMENT

Note the measurement on the piston dome.



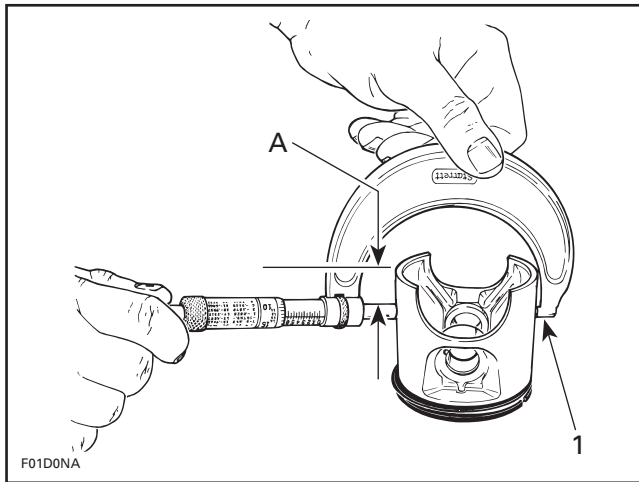
1. Piston dome
2. Piston measurement

Section 04 ENGINE

Subsection 05 (TOP END)

Using a micrometer, measure piston skirt perpendicularly (90°) to piston pin according to the following table.

ENGINE TYPE	MAXIMUM A mm (in)
717	29 (1.142)
787 RFI	28 (1.102)
947	28 (1.102)
947 DI	24 (0.945)



1. Measuring perpendicularly (90°) to piston pin axis
- A. See previous table

ENGINE TYPE	MAXIMUM PISTON SKIRT WEAR mm (in)
All	0.12 (.005)

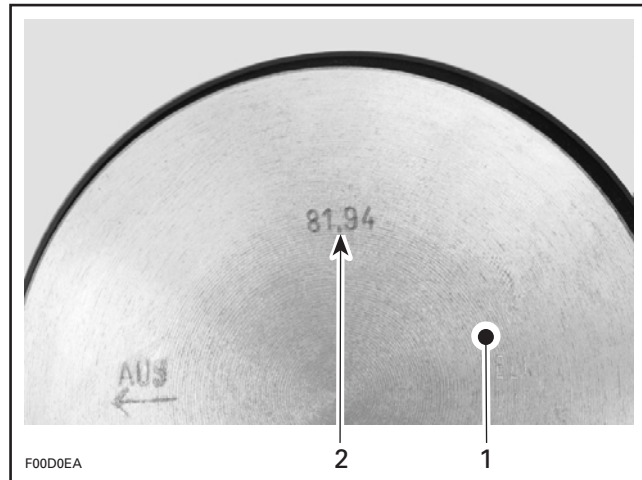
The measured dimension must not be less than 0.12 mm (.005 in) of the one scribed on piston dome. Otherwise, install a new piston.

Piston/Cylinder Wall Clearance

Used and New Pistons

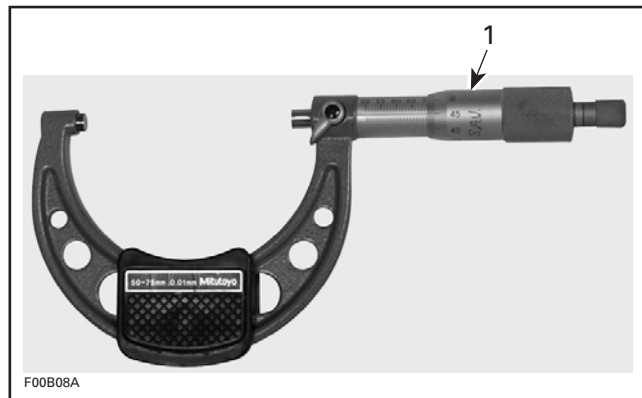
IMPORTANT: Make sure used piston is not worn more than specified. See USED PISTON MEASUREMENT above.

To determine the piston dimension, take the measurement on the piston dome.



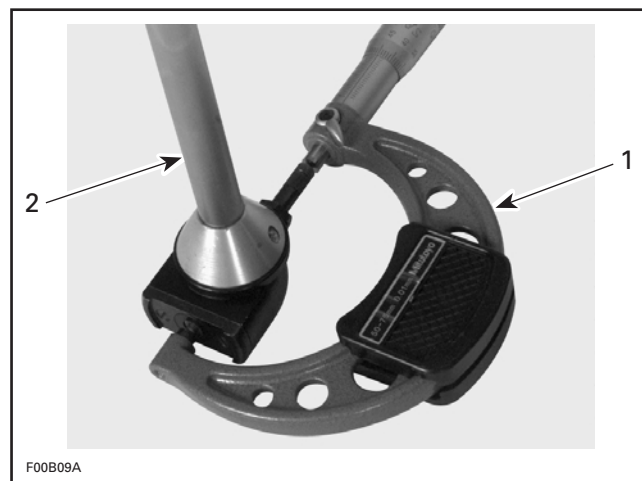
1. Piston dome
2. Piston measurement

Adjust and lock a micrometer to the specified value on the piston dome.



1. Micrometer set to the piston dimension

With the micrometer set to the piston dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to zero.

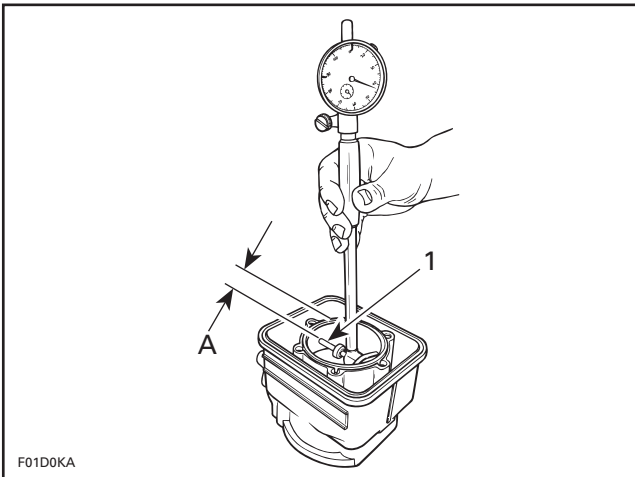


1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge



1. Indicator set to zero

Position the dial bore gauge at 16 mm (5/8 in) below cylinder top edge.



1. Measuring perpendicularly (90°) to piston pin axis
 A. 16 mm (5/8 in)

Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.

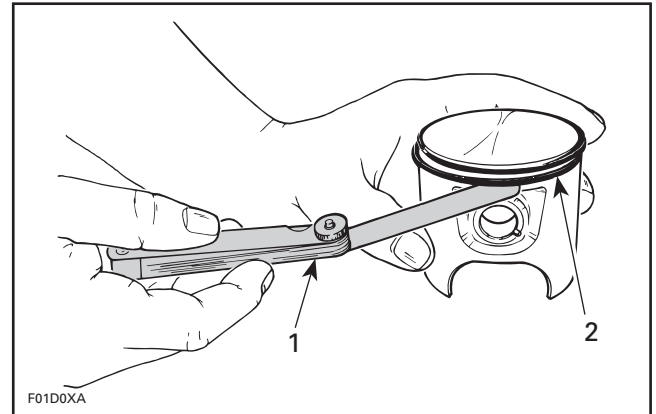
NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

Ring/Piston Groove Clearance

717 and 787 RFI Engines

Using a feeler gauge, check clearance between rectangular ring and groove. If clearance exceeds specified tolerance, replace piston.

NOTE: Ring/piston groove clearance can be correctly measured only on rectangular ring which is bottom ring.



1. Feeler gauge
 2. Rectangular ring (bottom)

947 Engines

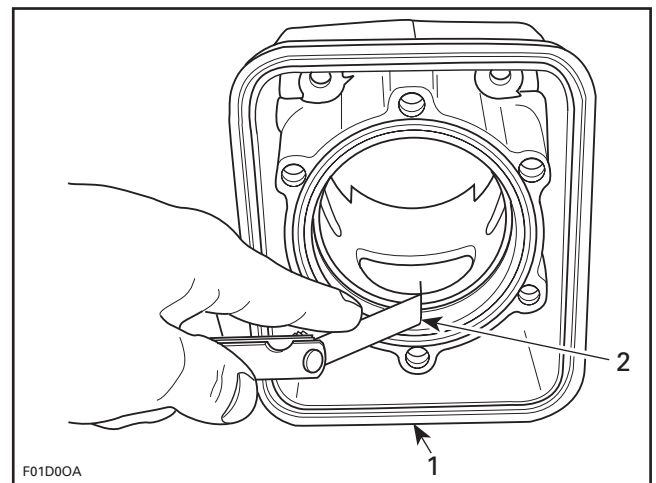
Due to the semi-trapez rings, it is not possible to accurately measure ring/piston groove clearance.

Ring End Gap

Position ring halfway between exhaust port and top of cylinder.

NOTE: In order to correctly position ring in cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. If gap exceeds specified tolerance, rings should be replaced.



1. Top of cylinder
 2. Ring end gap

Section 04 ENGINE

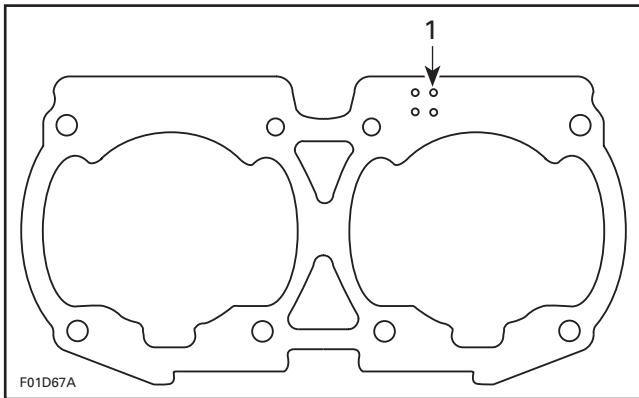
Subsection 05 (TOP END)

Cylinder Base Gasket

NOTE: The general procedure is to install a new gasket of the same thickness. However, if you do not know the gasket thickness that was installed or if a crank repair has involved replacement of connecting rods, refer to the COMBUSTION CHAMBER VOLUME MEASUREMENT to properly determine the required gasket thickness.

Different thicknesses of cylinder base gaskets are used for a precise adjustment of the combustion chamber volume.

To identify gasket thickness, refer to the identification holes on the gasket.



TYPICAL

1. Identification holes

All Engines

GASKET THICKNESS	IDENTIFICATION HOLES
0.3 mm (.012 in)	3
0.4 mm (.016 in)	4
0.5 mm (.020 in)	5
0.6 mm (.024 in)	6
0.8 mm (.031 in)	8

RAVE Valve

787 RFI and 947 Engines

Check RAVE valve bellows no. 21 for cracks.

ASSEMBLY

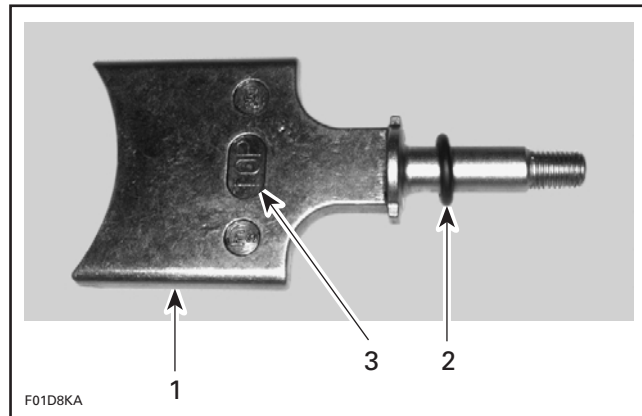
Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

RAVE Valve

787 RFI Engine

Make sure to insert O-ring no. 23 onto rod of sliding valve no. 22.

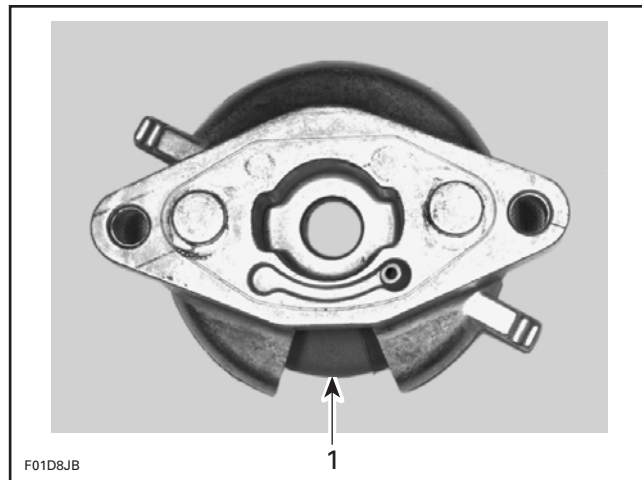
The TOP position of the sliding valve no. 22 is indicated on one side.



1. Sliding valve
2. O-ring
3. TOP

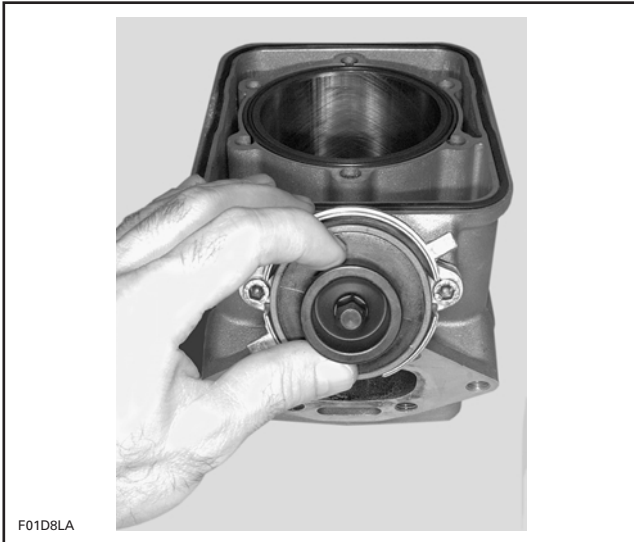
Install a new gasket no. 24. It must be installed at the same time as the sliding valve no. 22.

Position the valve housing no. 25 onto the cylinder so that its opening is toward the bottom.



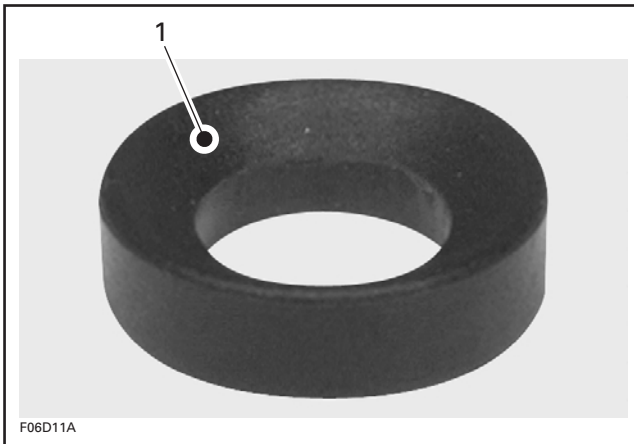
1. Bottom of valve housing

When the valve is mounted onto the cylinder, move the valve piston no. 20 to ensure the sliding valve no. 22 moves easily and doesn't stick.



947 Carburetor-Equipped Engines

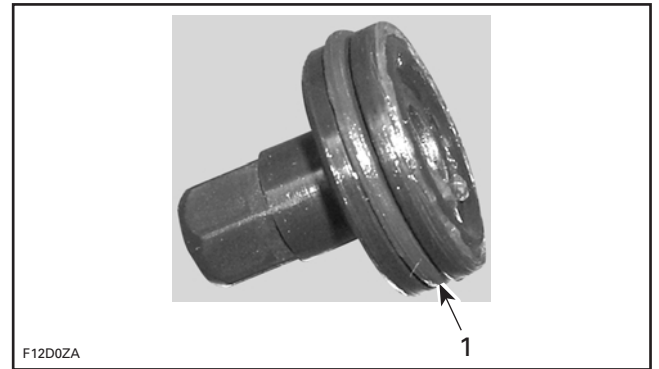
Install the supporting ring no. 28 with the bevel side facing the O-ring no. 27.



1. Bevel facing the O-ring

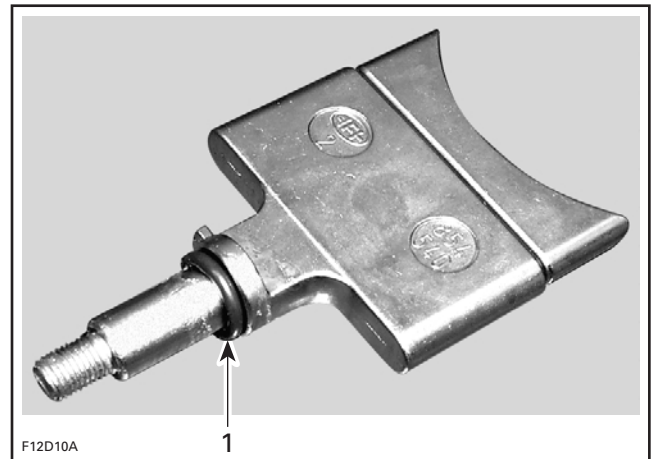
947 DI Engines

Check the piston valve O-ring. Replace if necessary.



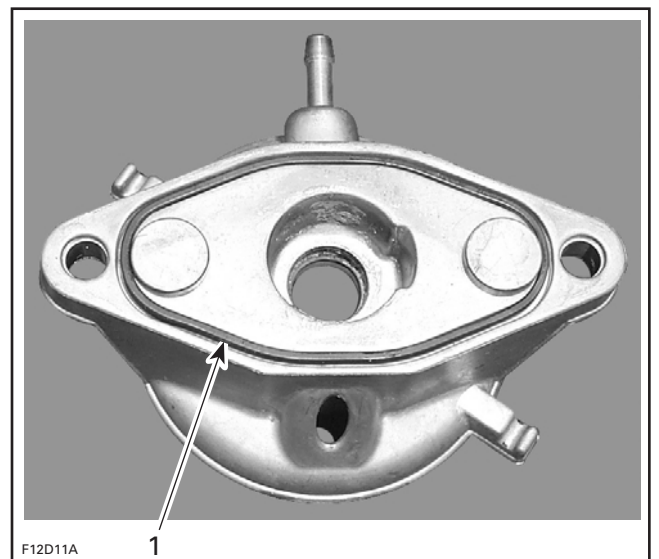
1. Piston valve O-ring

Check the sliding valve O-ring. Replace if necessary.



1. Sliding valve O-ring

Check the O-ring under valve housing. Replace if necessary.



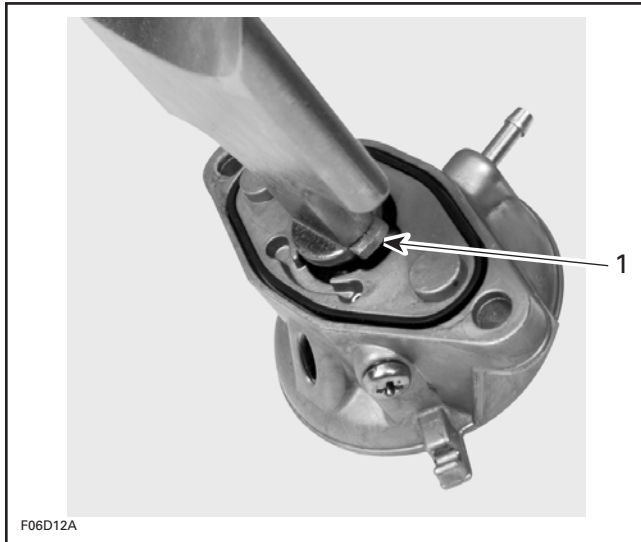
1. Valve housing O-ring

Section 04 ENGINE

Subsection 05 (TOP END)

All RAVE-Equipped Engines

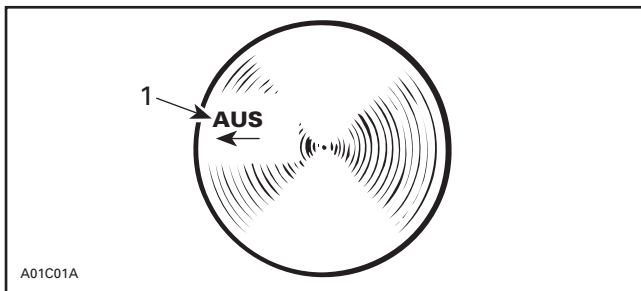
There is only one way to insert the sliding valve no. 22 in valve housing no. 25.



1. Sliding valve ridge toward housing groove

Piston

At assembly, place the pistons no. 3 with the letters "AUS" (over an arrow on the piston dome) facing in direction of the exhaust port.



1. Exhaust side

NOTE: On the 787 RFI and 947 engines, the exhaust ports are located on the same side as the intake.

Carefully cover crankcase opening as for disassembly.

Piston Pin and Roller Bearing

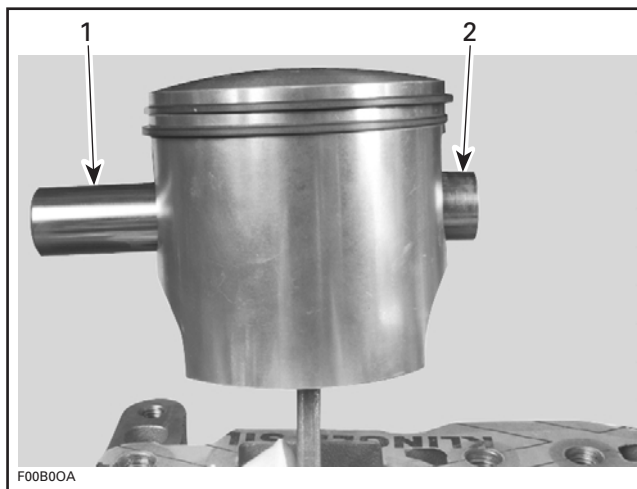
To install roller bearing no. 4 and piston pin no. 6 use, piston pin puller (P/N 529 035 503) with the appropriate set of sleeves as for disassembly.

- Replacement bearings are held in place by a locating sleeve outside and 2 plastic cage halves inside.

- Push needle bearing together with inner halves out of the locating sleeve into the connecting rod bore.
- Replace the inner halves by the appropriate sleeve tool in the connecting rod bore.
- Insert piston pin into piston until it comes flush with inward edge of piston hub.
- Warm piston to approximately 50 - 60°C (122 - 140°F) and install it over connecting rod.

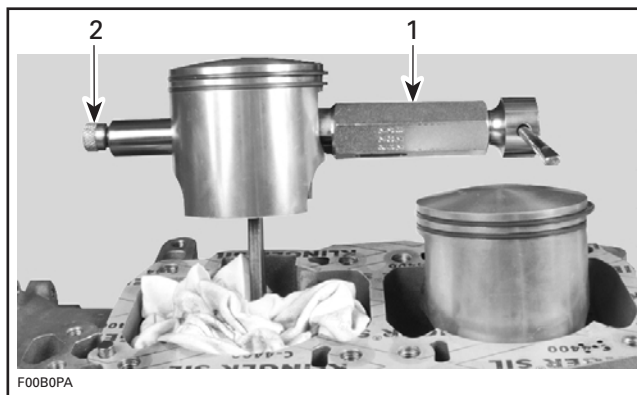
NOTE: Make sure thrust washers are present each side of needles.

- Install the shoulder sleeve tool on the opposite side of the piston pin.



1. Piston pin
2. Shoulder sleeve

- Insert extractor spindle into the piston pin, screw on extracting nut.



1. Puller installed on the opposite side of the piston pin
2. Tighten extracting nut

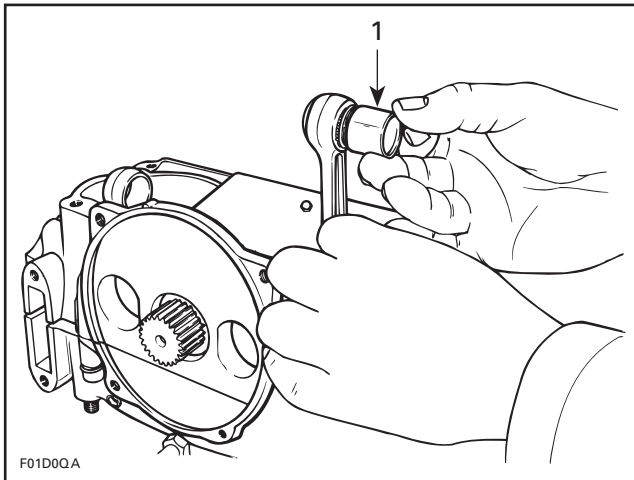
- Rotate handle to pull piston pin carefully into the piston.

Plastic Mounting Device Method

This is an alternate method when no service tool is available.

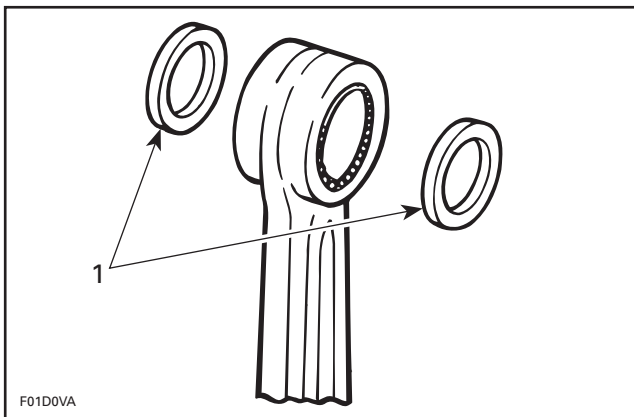
Replacement roller bearings are delivered in a convenient plastic mounting device. For installation, proceed as follows:

- Align replacement roller bearing with connecting rod bore.
- Carefully push inner plastic sleeve into connecting rod bore; outer plastic ring will release rollers.



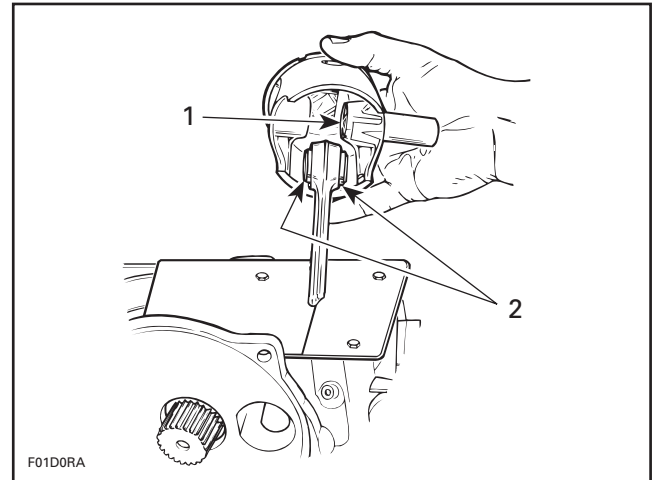
1. Outer ring removal after inner sleeve insertion into bore

- Make sure thrust washers are present each side of rollers.



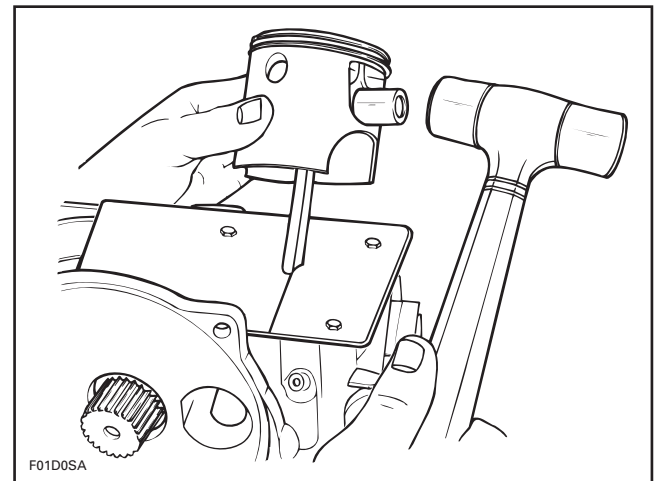
1. Thrust washer each side

- Insert piston pin into piston until it comes flush with inward edge of piston hub.



1. Piston pin flush here
2. Thrust washers

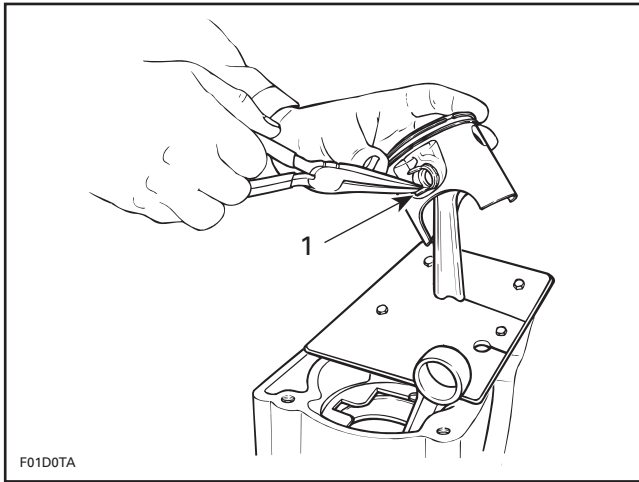
- Place piston over connecting rod and align bores, then gently tap piston pin with a fiber hammer to push out inner plastic ring on opposite side. Support piston from opposite side.



Section 04 ENGINE

Subsection 05 (TOP END)

- As necessary, pull halves of inner sleeve with long nose pliers.



1. Pulling inner sleeve half

Circlip

Always use new circlips.

⚠ WARNING

Always wear safety glasses when installing piston circlips.

CAUTION: Always use new circlips. At installation, take care not to deform them. Circlips must not move freely after installation.

717 and 787 RFI Engines

Secure circlip with its opening located at the bottom of the piston.

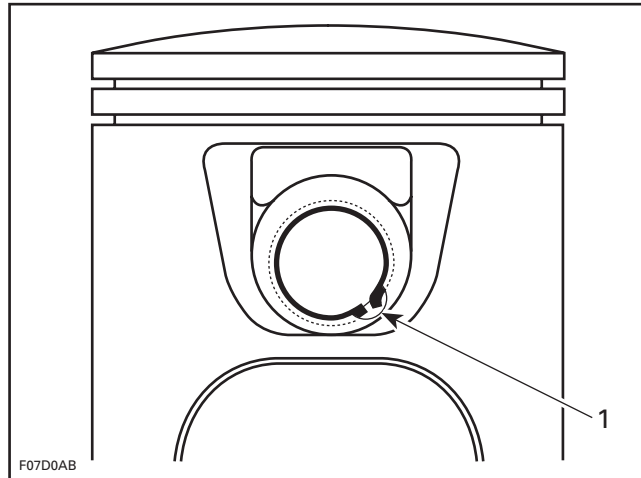
CAUTION: To minimize the stress on the circlips, it is important to install them as described.



1. Circlip opening at 6 o'clock (at bottom)

947 Engines

Secure circlip in piston groove with its bent end in piston notch as shown.

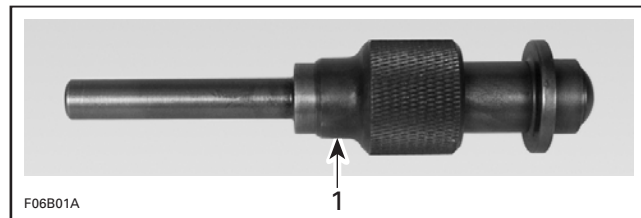


1. Circlip end in piston notch

All Engines

To easily insert circlip into piston, use circlip installer.

ENGINE	TOOL P/N
717 and 787 RFI	529 035 562
947	529 035 563



1. Circlip installer

- Remove sleeve from pusher then insert circlip into its bore.
- Reinstall sleeve onto pusher and push until circlip comes in end of tool.



TYPICAL

1. Circlip near end of tool

- Position end of tool against piston pin opening.
- Firmly hold piston against tool and tap tool with a hammer to insert circlip into its groove.



CAUTION: The hand retaining the piston should absorb the energy to protect the connecting rod.

Cylinder Base Gasket

Install new base gasket.

NOTE: The general procedure is to install a new gasket of the same thickness. However, if you do not know the gasket thickness that was installed or if a crankshaft and/or crankcase repair or replacement was involved, refer to the COMBUSTION CHAMBER VOLUME MEASUREMENT to properly determine the required gasket thickness.

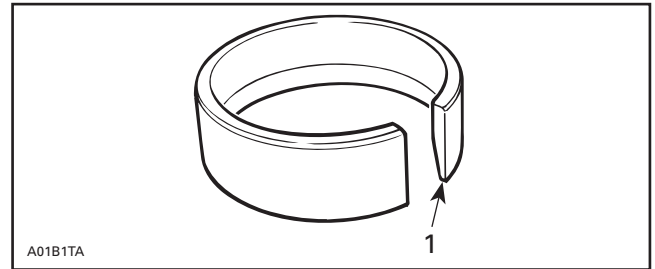
Five thicknesses of cylinder base gaskets are available for a precise adjustment of the squish gap.

To identify gasket thickness, refer to the identification holes on the gasket.

Cylinder

717 and 787 RFI Engines

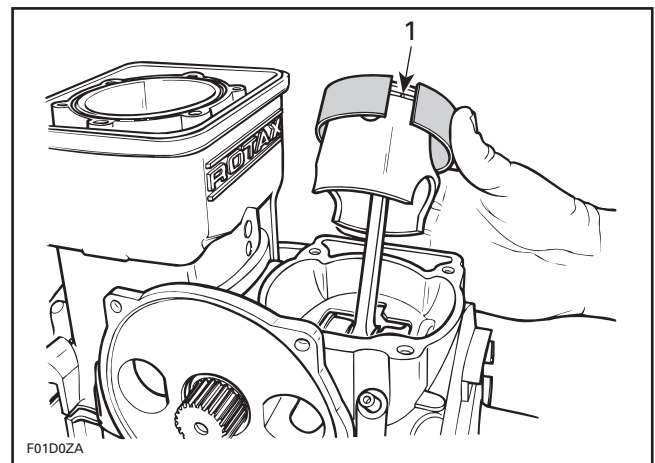
To easily slide cylinder no. 9 over piston, install on piston ring compressor (P/N 290 876 979).



1. Slide this edge

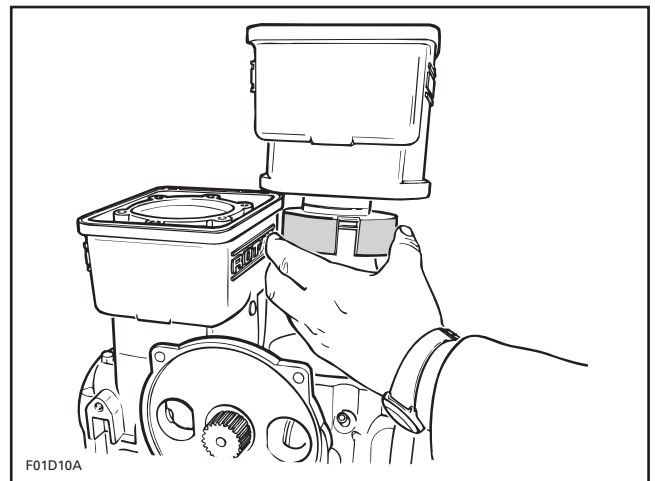
NOTE: Ring compressor will not fit on oversize parts.

Make sure to align ring end gap with piston locating pin. Slide tool over rings.



1. Ring end gap aligned with piston locating pin

Slide cylinder over piston.



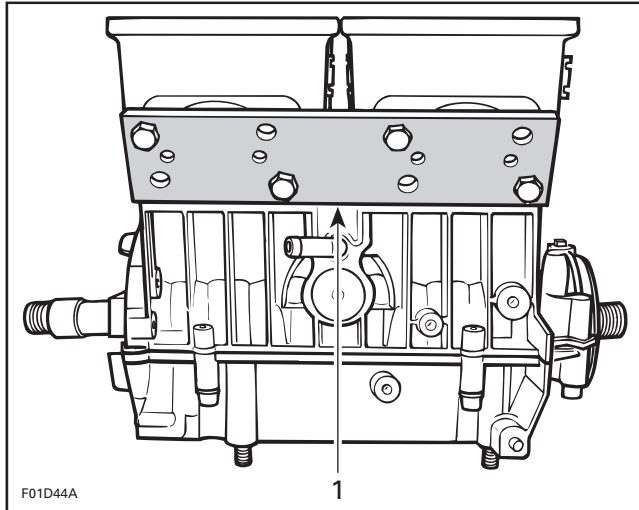
When reassembling cylinders to crankcase, it is important to have them properly aligned so that exhaust flanges properly match up with exhaust manifold.

Section 04 ENGINE

Subsection 05 (TOP END)

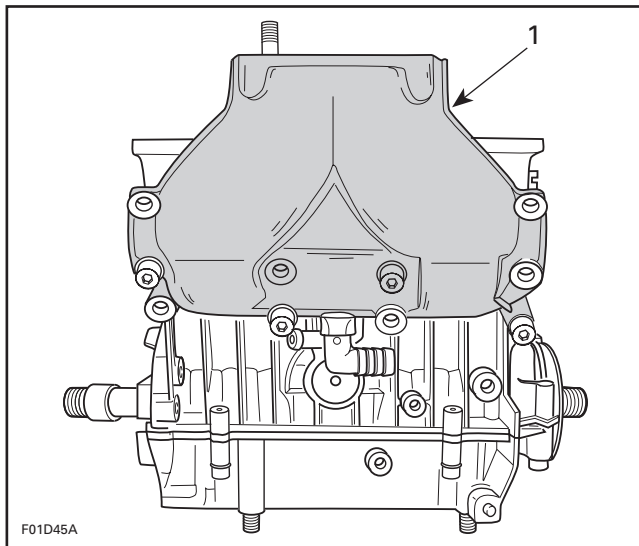
717 Engine

The aligning tool (P/N 420 876 904) or the exhaust manifold can be used to align cylinders.



717 ENGINE

1. Exhaust flange aligning tool

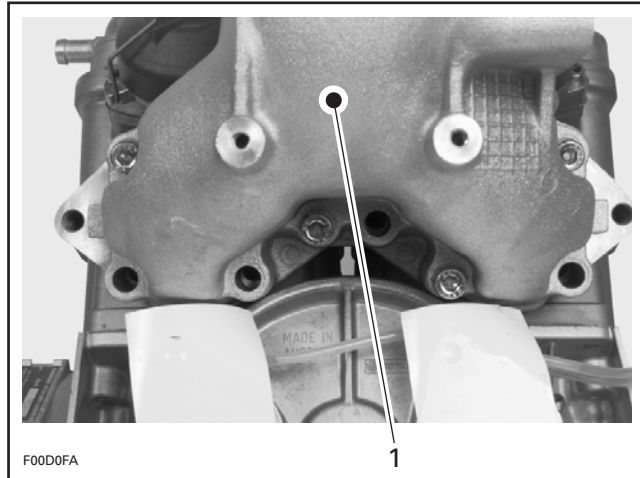


717 ENGINE

1. Aligning cylinders using exhaust manifold

787 RFI Engine

The exhaust manifold is used to align cylinders.



787 RFI ENGINE

1. Aligning cylinders using exhaust manifold

Cylinder Block

947 Carburetor-Equipped Engine

Install studs no. 32. Apply Molykote 111 to threads and torque studs to 15 N•m (133 lbf•in). Refer to exploded view to see what end to insert in crankcase.

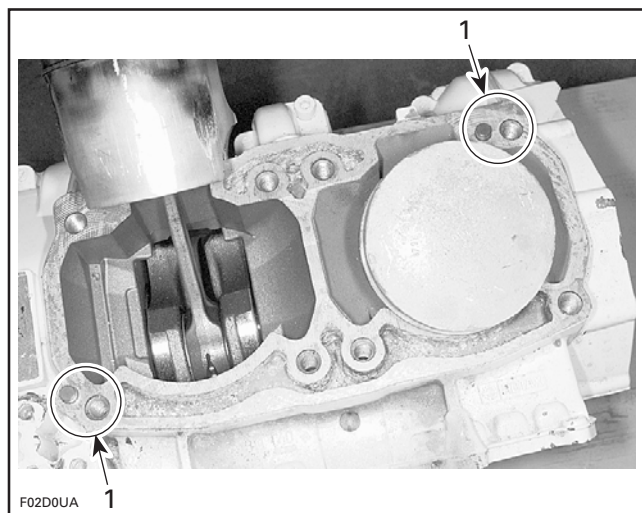
Remove O-rings from studs.

All 947 Engines

Install cylinder base gasket no. 10. There is only one way to install gasket.

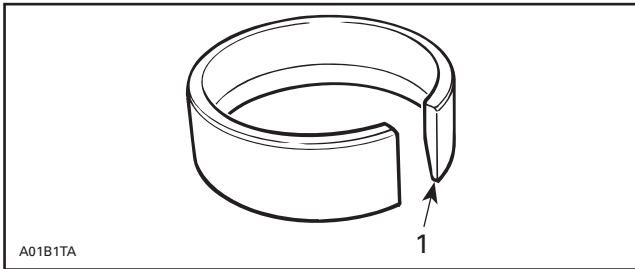
The cylinder block is positioned with locating dowels.

Line up dowels with corresponding holes in cylinder block.



1. Dowels

To easily slide cylinder block over pistons, use ring compressor (P/N 290 876 965).



1. Slide this edge

NOTE: For each ring, make sure to align ring end gap with piston locating pin.

Install cylinder block.

Apply Molykote 111 on O-ring no. 31 and install it.

CAUTION: The O-rings must be installed and properly positioned in the cylinder block. The O-rings are meant to dampen stud vibration.

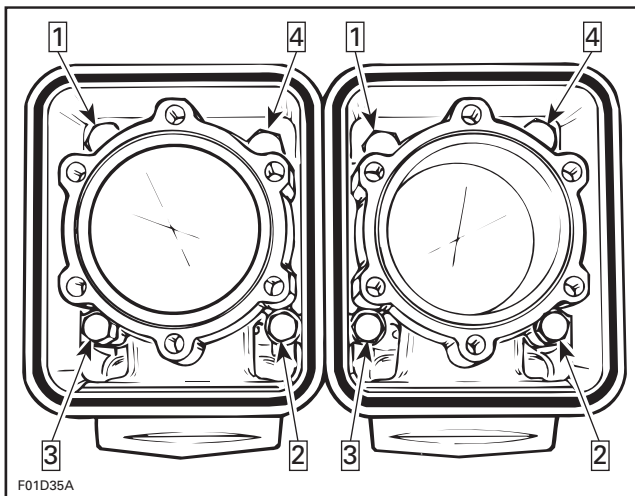
Cylinder Screw

717 Engine

Apply Molykote 111 below the screw head.

Apply also Loctite 243 (blue) on screw threads.

Install and torque screws no. 13 in a criss-cross sequence for each cylinder to 24 N•m (17 lbf•ft). Refer to the following illustration.

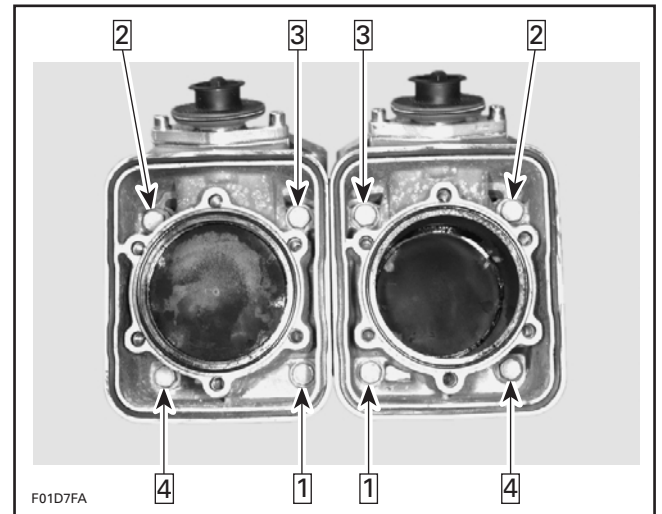


787 RFI Engine

Prior installation, apply Molykote 111 below screw head and Loctite 243 (blue) on screw threads.

Install M10 x 105 screws on exhaust side and the M10 x 73.5 on opposite side.

Torque screws in a criss-cross sequence for each cylinder to 20 N•m (15 lbf•ft). Repeat the procedure, retightening all cylinder screws to 40 N•m (30 lbf•ft).

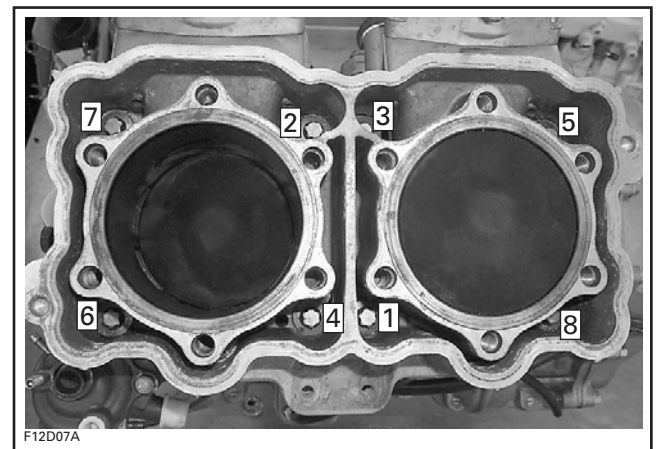


947 DI Engines

Apply Molykote 111 below the screw head.

The blue coating underneath the cylinder screw head can be only used once. Either replace with new bolts or remove blue coating and apply Loctite 243 (blue) below the screw heads.

Install and torque screws to 40 N•m (30 lbf•ft) in the indicated order. Refer to the following illustration.



Section 04 ENGINE

Subsection 05 (TOP END)

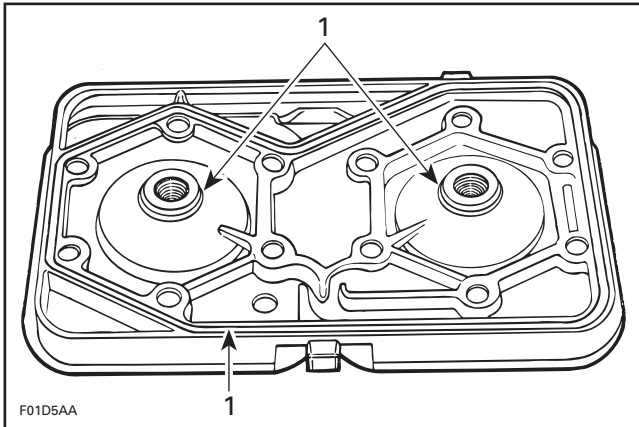
All Engines

Cylinder Head

Install cylinder head gasket.

717 and 787 RFI Engines

Make sure to install O-rings no. 12 around spark plug holes and O-ring no. 11 of cylinder head as shown in the following illustration.



1. O-rings

Apply Loctite 518 in O-ring groove of cylinder sleeves.

947 Carburetor-Equipped Engine

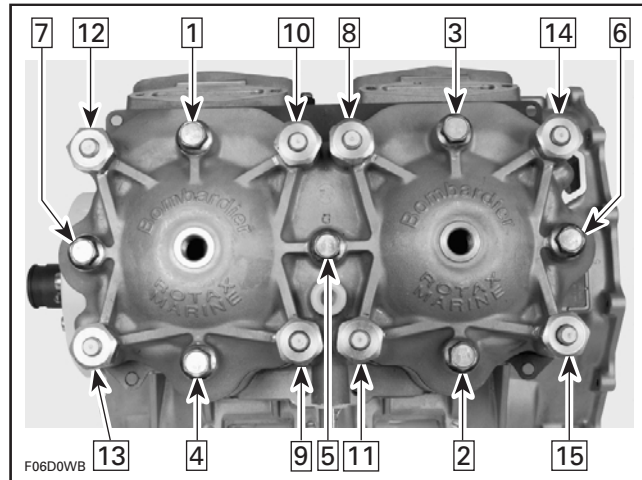
Apply Molykote 111 on the threads of the cylinder block studs no. 32.

Apply Loctite 243 (blue) below head of cylinder head bolts no. 14.

Apply Molykote 111 on threads of cylinder head bolts no. 14.

Apply Loctite 243 under the head of the nuts no. 33.

Torque bolts and nuts to 15 N•m (133 lbf•in) as per following sequence in the next picture. Repeat the torquing sequence by retightening to 34 N•m (25 lbf•ft).



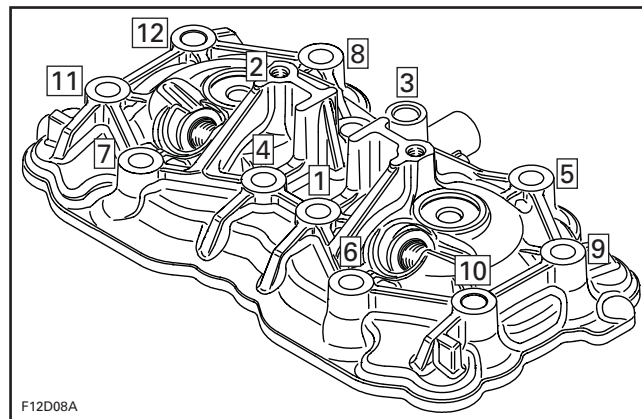
TORQUING SEQUENCE

947 DI Engine

Apply Loctite 243 (blue) below head of cylinder head bolts no. 14.

Apply Molykote 111 on threads of cylinder head bolts no. 14.

Torque bolts to 20 N•m (15 lbf•ft) as per following sequence in the next picture. Repeat the torquing sequence by retightening to 40 N•m (30 lbf•ft).



Cylinder Head Cover

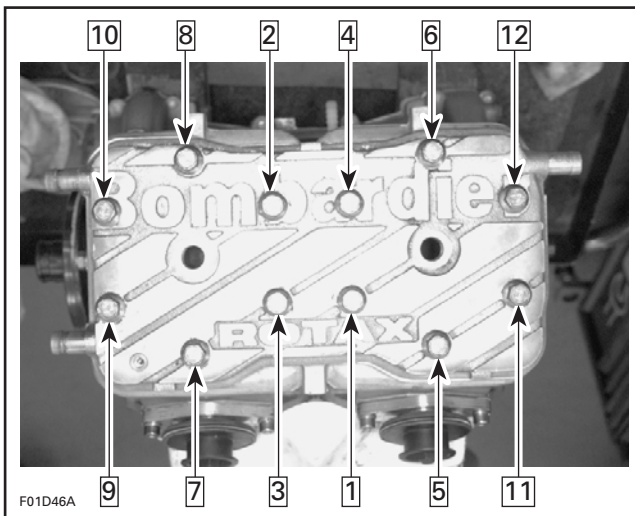
717 and 787 RFI Engines

Install cylinder head cover no. 1.

Apply Loctite 243 (blue) below head of screws no. 14.

Apply also Molykote 111 on threads of screws no. 14.

Torque cylinder head screws no. 14 to 12 N•m (9 lbf•ft) as per following illustrated sequence. Repeat the procedure, retightening all screws to 24 N•m (17 lbf•ft).



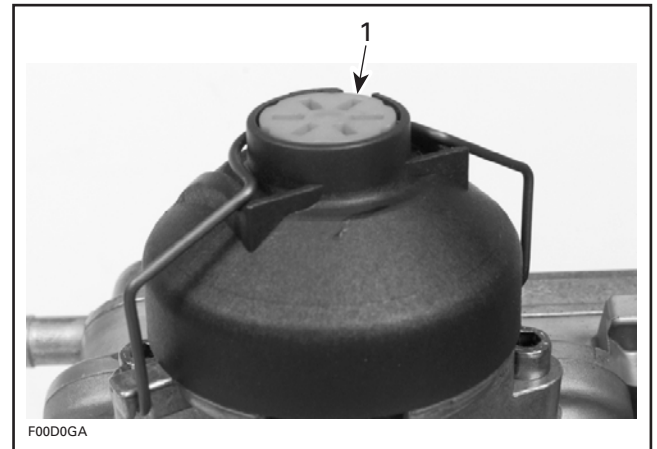
TORQUING SEQUENCE

ADJUSTMENT

RAVE Valve

787 RFI Engine

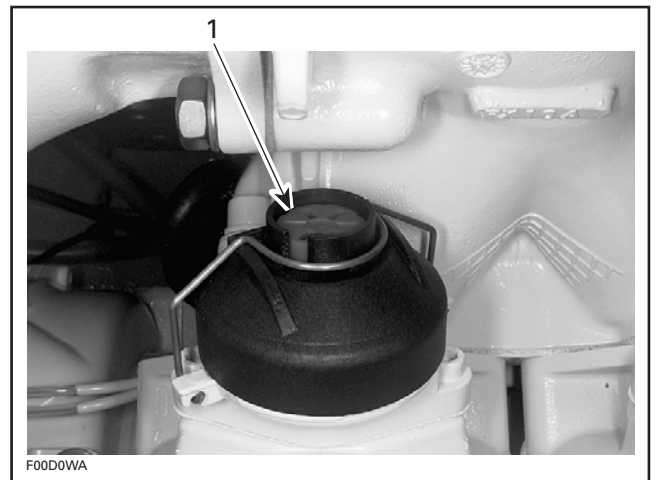
Turn the red plastic knob no. 17 until it is flush to the valve cover.



1. Knob flush with the cover

947 Carburetor-Equipped Engine

Turn the red plastic knob no. 17 until it is fully tightened.



1. Knob fully tightened

This will ensure the correct preload on the return spring no. 19 in order to open and close the RAVE valve at the proper RPM.

Section 04 ENGINE

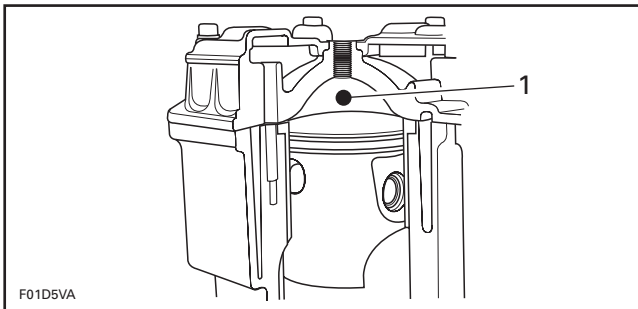
Subsection 05 (TOP END)

Combustion Chamber Volume Measurement

All Engines

NOTE: This procedure is required to determine the thickness of the cylinder base gasket to be installed if a crank repair has involved replacement of connecting rods or if you are experiencing repetitive engine seizure.

The combustion chamber volume is the region in the cylinder head above the piston at Top Dead Center. It is measured with the cylinder head installed on the engine.

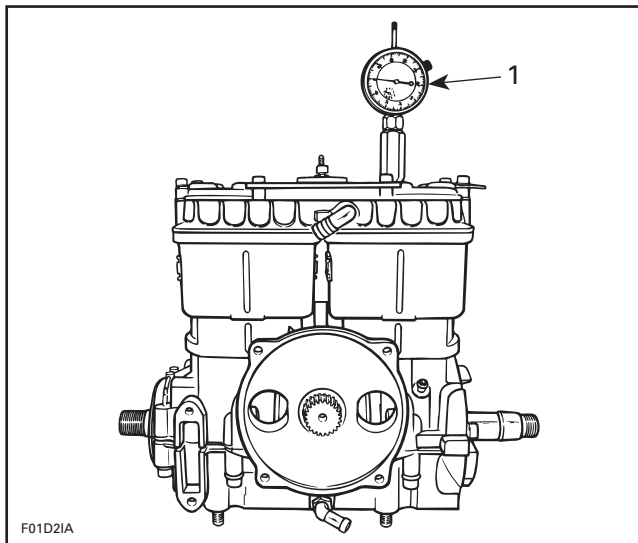


1. Combustion chamber

NOTE: When checking the combustion chamber volume, engine must be cold, piston must be free of carbon deposit and cylinder head must be leveled.

All Engines except 947 DI

1. Remove both spark plugs and bring one piston to Top Dead Center using a TDC gauge.



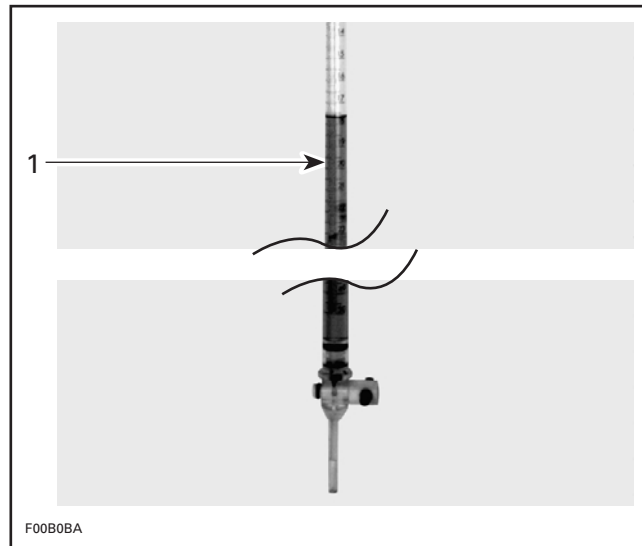
1. Bring piston to TDC

947 DI Engine

1. Remove both direct injectors and bring one piston to Top Dead Center using a TDC gauge. Keep spark plugs in their holes.

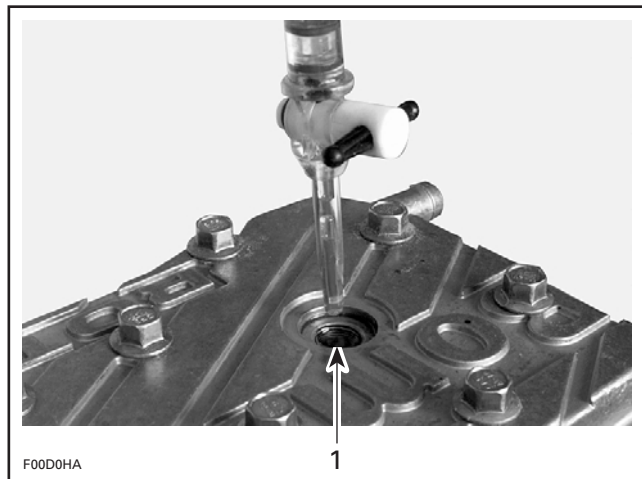
All Engines

2. Obtain a graduated burette (capacity 0 - 50 cc) and fill with an equal part (50/50) of gasoline and injection oil.



1. Graduated burette (0 - 50 cc)

3. Open burette valve to fill its tip. Add liquid in burette until level reaches 0 cc.
4. Inject the burette content through the spark plug hole on **all engines except 947 DI** and through direct injector hole on **DI engines** until liquid touches the top hole.



1. Top of spark plug hole

NOTE: The liquid level in cylinder must not drop for a few seconds after filling. If so, there is a leak between piston and cylinder. The recorded volume would be false.

5. Let burette stand upward for about 10 minutes, until liquid level is stabilized.
6. Read the burette scale to obtain the quantity of liquid injected in the combustion chamber.

Compare the obtained value with the table below. The volume should be within the allowable range.

If the volume of the combustion chamber is not within specifications, change cylinder base gasket thickness as follow.

A higher volume dictates a thinner gasket.

A lower volume dictates a thicker gasket.

All Engines except DI

NOTE: When the combustion chamber is filled to top of spark plug hole, it includes an amount of 2.39 cc corresponding to the spark plug tip. The following table of combustion chamber volume includes this value.

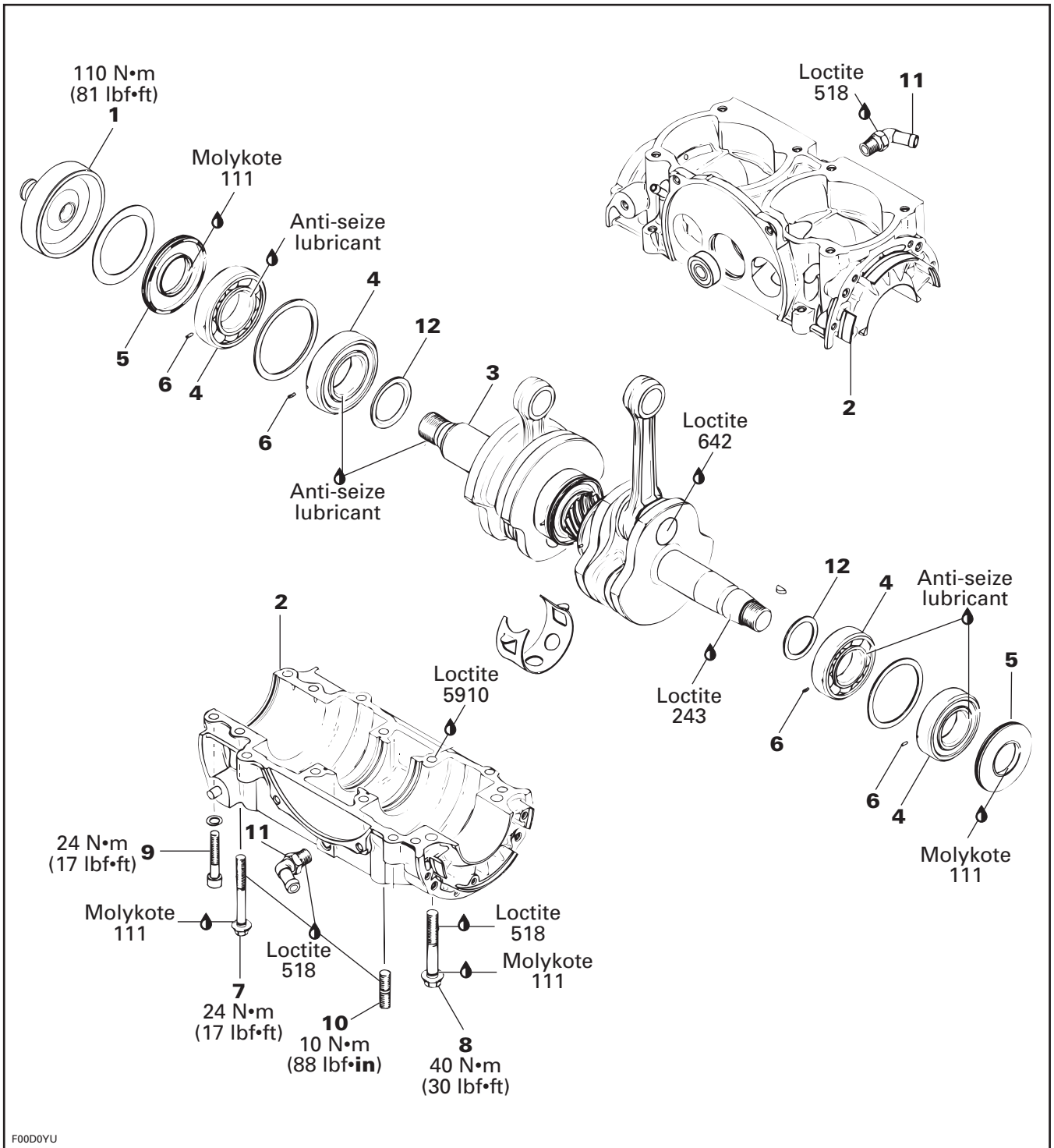
All Engines

ENGINE	COMBUSTION CHAMBER VOLUME
717	31.2 - 34.0 cc
787 RFI	34.7 - 37.9 cc
947	43.3 - 47.3 cc
947 DI	45.7 - 48.4 cc

7. Repeat the procedure for the other cylinder(s).

BOTTOM END

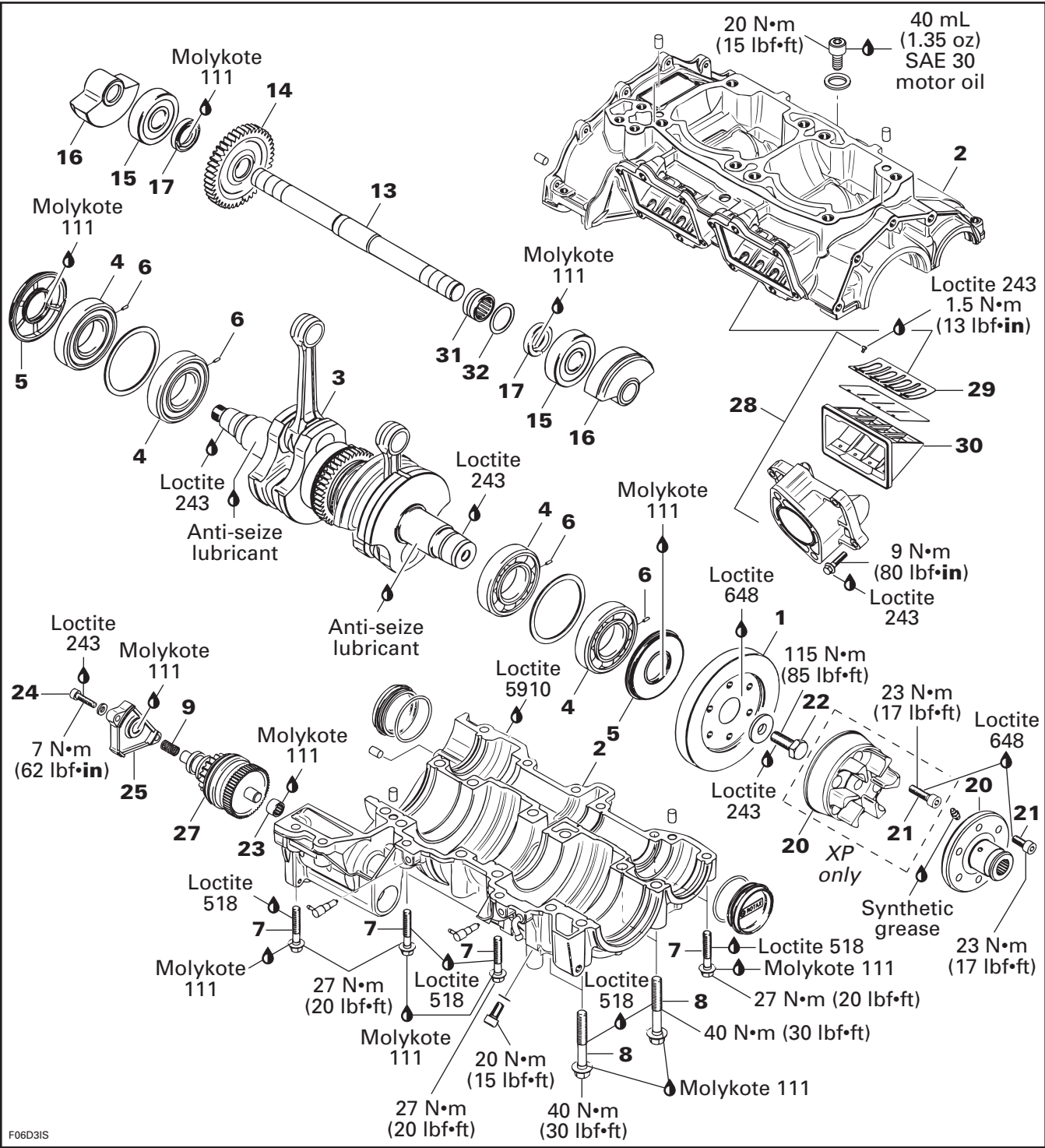
717 Engine



F00DOYU

Section 04 ENGINE
Subsection 06 (BOTTOM END)

947 Carburetor-Equipped Engines



DISASSEMBLY

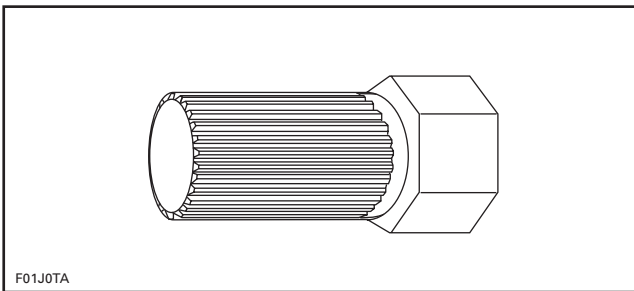
Engine has to be removed from watercraft and top end has to be disassembled to open bottom end. Refer to REMOVAL AND INSTALLATION and TOP END.

PTO Flywheel

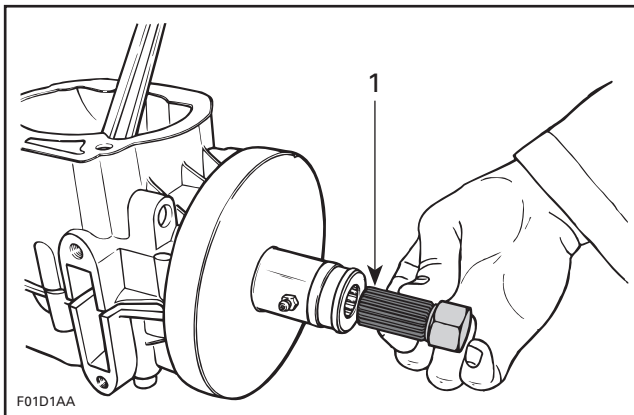
717 Engine

To remove PTO flywheel **no. 1**, the crankshaft must be locked. Refer to MAGNETO SYSTEM and follow the procedure to lock the magneto flywheel.

PTO flywheel is loosened using PTO flywheel remover (P/N 295 000 001).



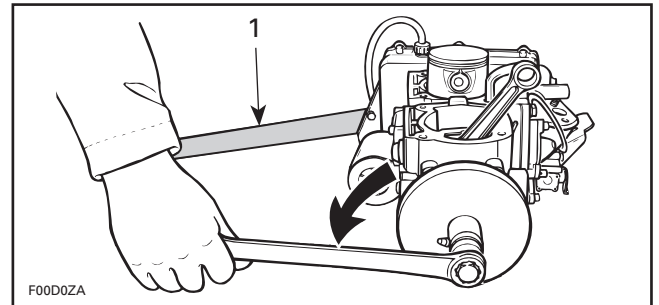
Insert special tool in PTO flywheel splines.



TYPICAL

1. PTO flywheel remover (P/N 295 000 001)

Using a suitable wrench or socket with a breaker bar, unscrew PTO flywheel **COUNTERCLOCKWISE** when facing it and hold extension handle locking the magneto flywheel.

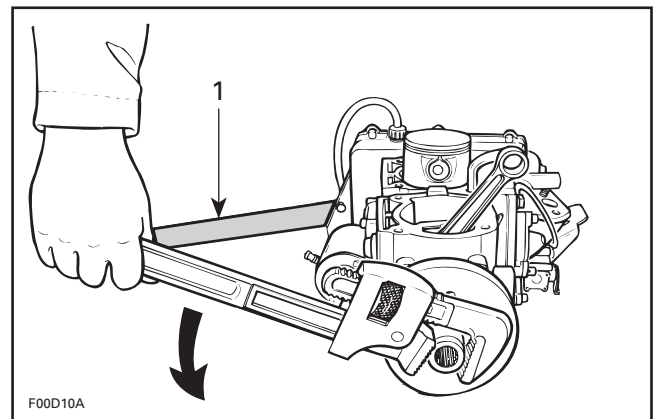


TYPICAL

1. Extension handle locking crankshaft

NOTE: When splines of PTO flywheel are worn out and special tool cannot be used, proceed with the following alternate method.

Use a pipe wrench and install it on PTO flywheel as illustrated.

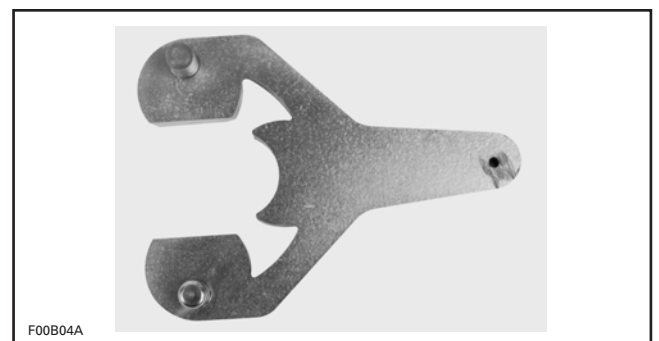


TYPICAL

1. Extension handle locking crankshaft

787 RFI Engine

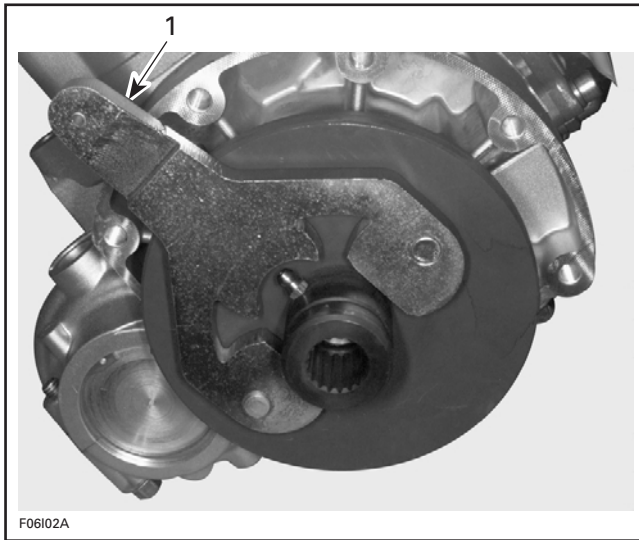
PTO flywheel is loosened using PTO flywheel extractor (P/N 295 000 156).



Section 04 ENGINE

Subsection 06 (BOTTOM END)

Install special tool.

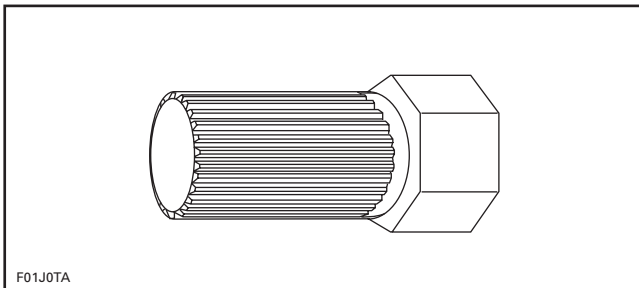


1. PTO flywheel extractor

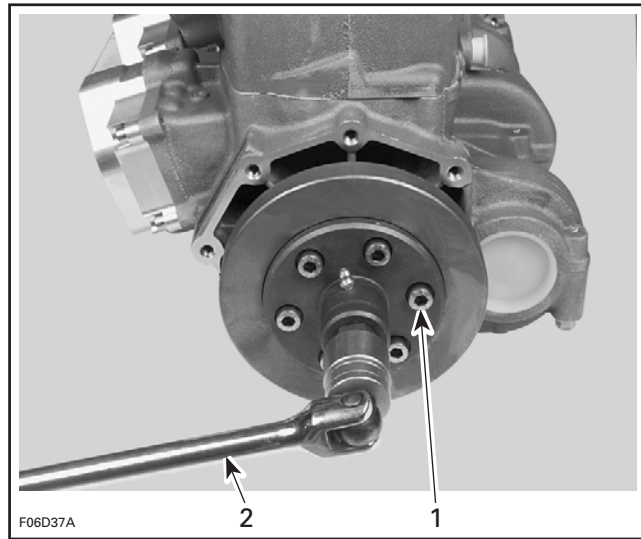
Install the extension handle (P/N 295 000 125) on the PTO flywheel extractor. Loosen PTO flywheel COUNTERCLOCKWISE when facing it.

947 Engines except XP

Use PTO flywheel remover (P/N 295 000 001) to hold flywheel and remove Allen screws no. 21 retaining coupler no. 20 to PTO flywheel.



PTO FLYWHEEL REMOVER TOOL

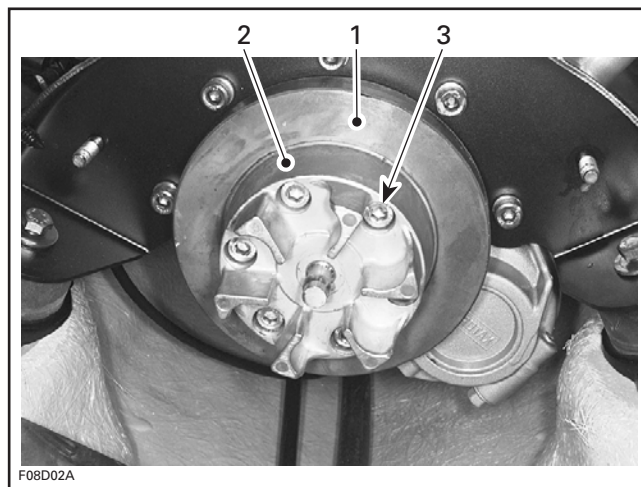


1. Loosen Allen screws
2. Breaker bar locking crankshaft

Remove the coupler no. 20.

XP Models

Remove Allen screws no. 21.



1. PTO flywheel
2. Coupler
3. Loosen Allen screw

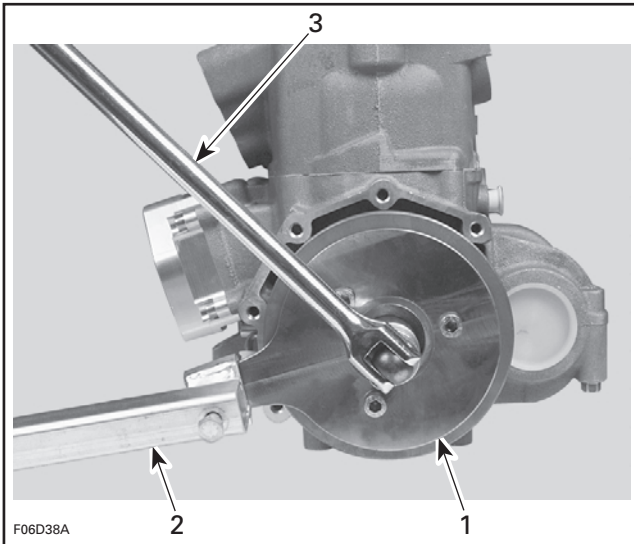
Remove coupler no. 20.

All 947 Engines

Install puller plate (P/N 529 035 533) and extension handle (P/N 295 000 125) to PTO flywheel.

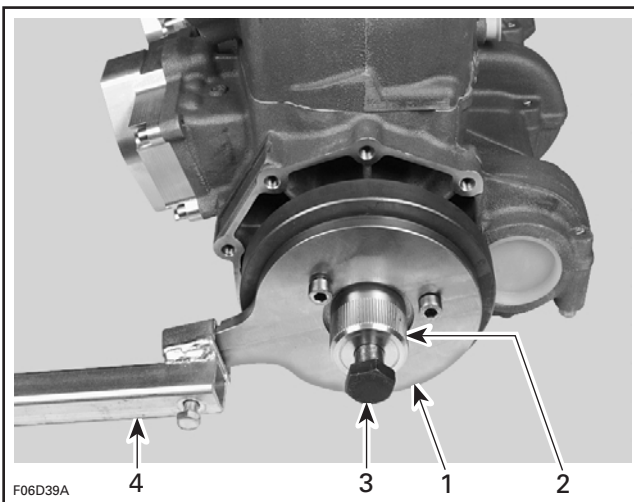
NOTE: Puller plate can be used without the extension handle.

Loosen bolt no. 22 retaining the PTO flywheel to the crankshaft using a suitable socket and breaker bar.



1. Puller plate
2. Extension handle
3. Loosen bolt with socket and breaker bar

Remove the PTO flywheel using puller plate (P/N 529 035 533) and puller (P/N 529 035 547) and bolt (P/N 529 035 549).

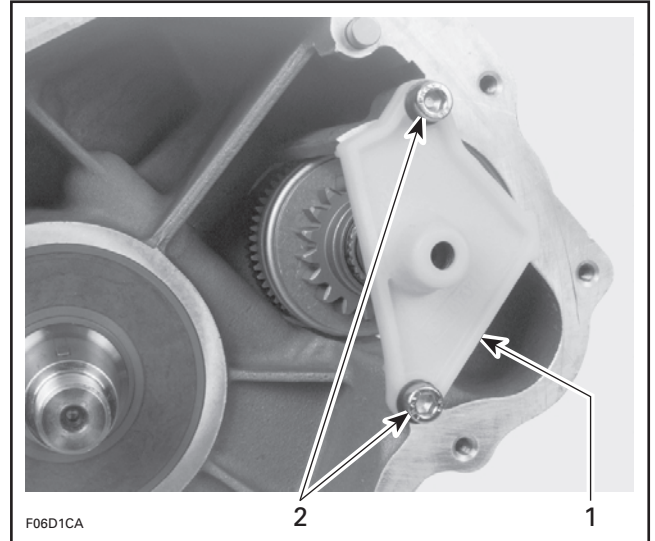


1. Puller plate
2. Puller
3. Bolt
4. Extension handle

Starter Drive Assembly

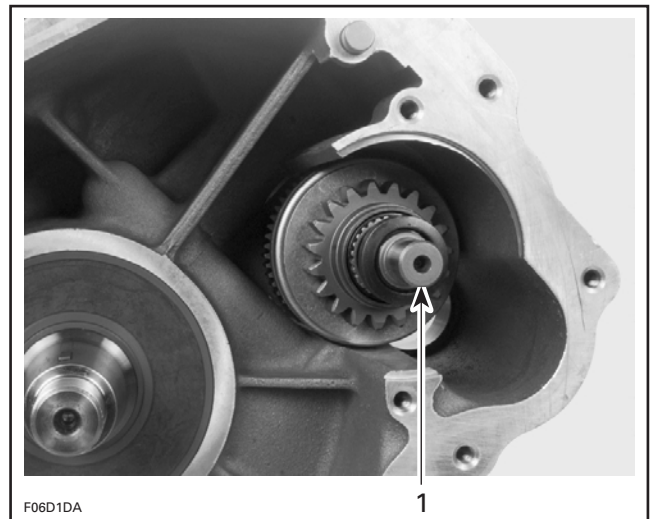
947 Engines Only

Loosen 2 Allen screws no. 24 retaining starter drive cover no. 25.



1. Cover
2. Allen screw

Remove starter drive cover no. 25 and spring no. 9.
Remove starter drive assembly no. 27.



- 947 ENGINE**
1. Starter drive assembly

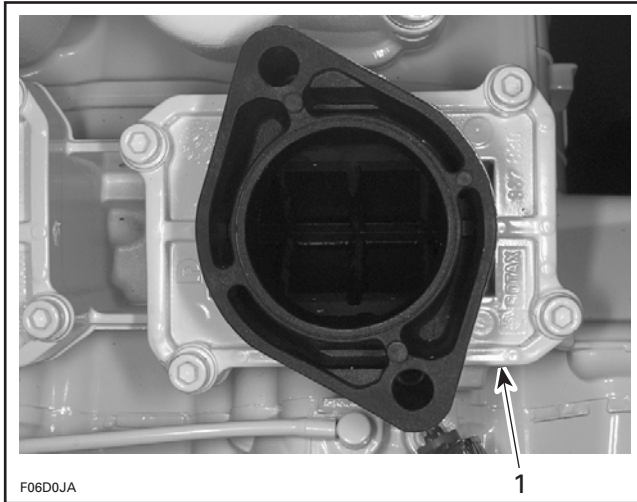
Section 04 ENGINE

Subsection 06 (BOTTOM END)

Reed Valve

947 Engines Only

Remove both carburetor flanges.



1. Carburetor flange

Remove reed valves no. 28 from crankcase.

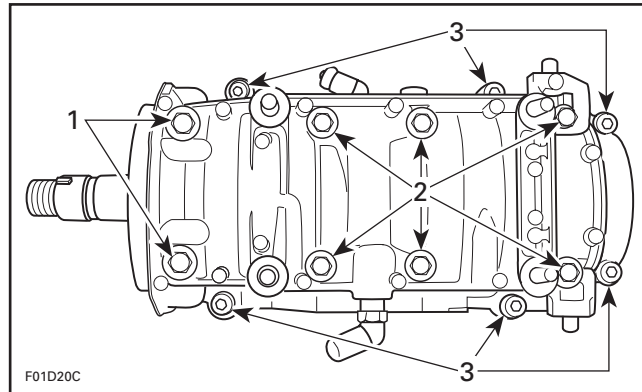
Crankcase

Before opening the bottom end, remove the following parts:

- engine supports (717 engine)
- magneto flywheel, refer to MAGNETO SYSTEM
- magneto housing (except 947 engines)
- starter
- rotary valve cover and valve (except 947 engines)
- starter drive assembly (947 engines)
- reed valves (947 engines)
- air compressor cover (947 DI engines).

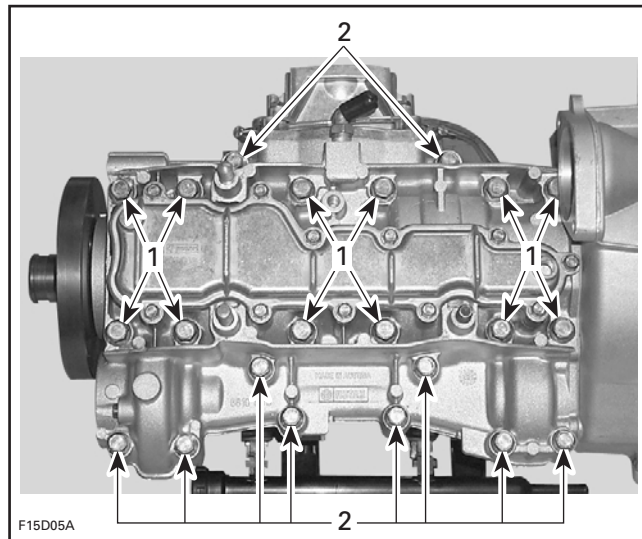
717 and 787 RFI Engines

Put engine on a stand. Loosen crankcase screws.



717 ENGINE

1. M10 x 73.5 flanged screws
2. M8 x 68.5 flanged screws
3. M8 x 45 socket head screws

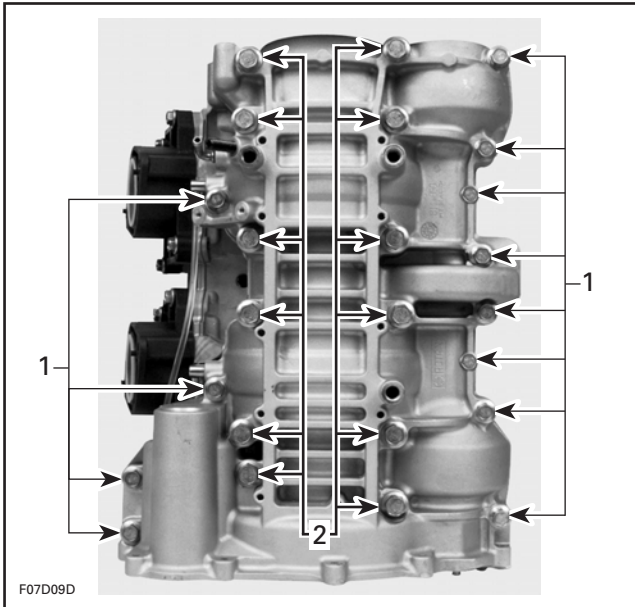


787 RFI ENGINE

1. M10 x 73.5 flanged screws
2. M8 x 53.5 flanged screws

947 Engines

Place engine upright on crankcase magneto side. Loosen crankcase screws.



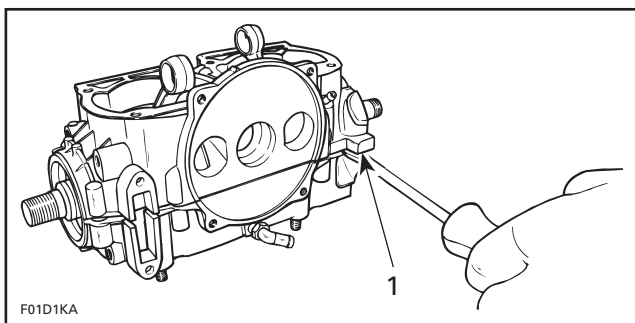
947 ENGINES

1. M8 x 45 flanged screws
2. M10 x 73.5 flanged screws

All Engines

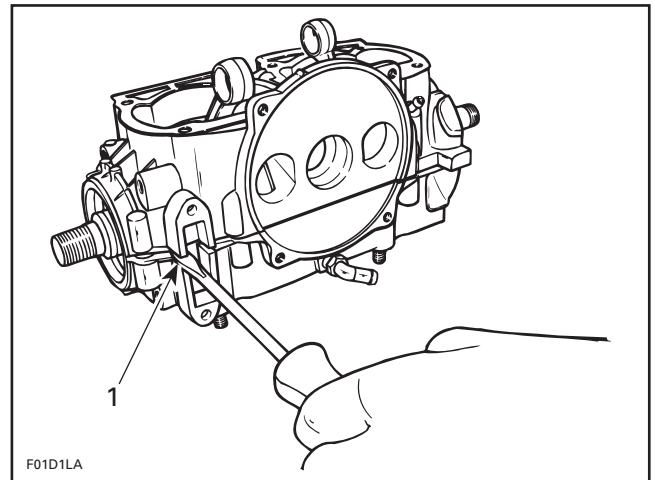
Put engine back on a support. Insert a pry bar between crankcase lugs to separate halves.

CAUTION: Be careful to precision machined surfaces.



TYPICAL

1. Separate halves by prying at provided lugs



TYPICAL

1. Separate halves by prying at provided lugs

Remove crankshaft and counterbalance shaft (787 RFI and 947 engines).

947 DI Engines

Open air compressor and disconnect the piston as described in ENGINE MANAGEMENT.

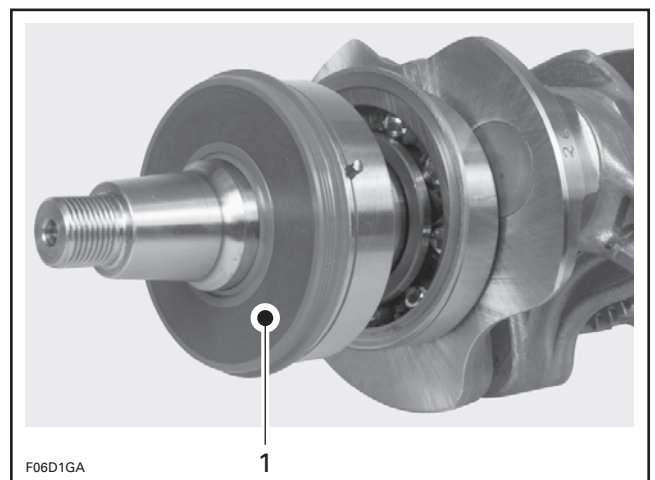
Crankshaft Bearing and Seal

All Engines

If a crankshaft end seal no. 5 has to be replaced, bottom end must be opened (except for the MAG side seal on the 787 RFI engine, which is mounted on the magneto housing).

NOTE: Do not needlessly remove crankshaft bearings.

Remove end seal(s).



TYPICAL

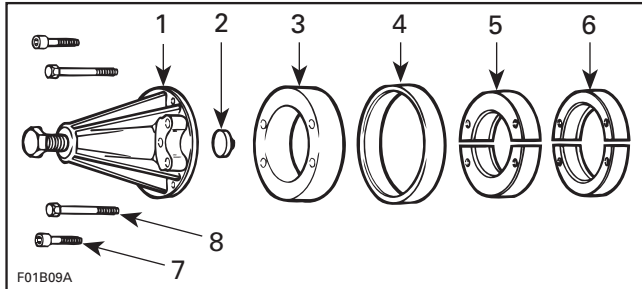
1. End seal

Section 04 ENGINE

Subsection 06 (BOTTOM END)

717 Engine

To remove end bearings no. 4 from crankshaft, use the following tools.



717 ENGINE

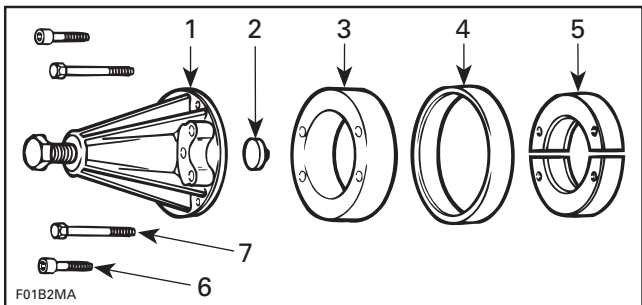
1. Puller (P/N 420 877 635)
2. Protective cap (P/N 420 876 557)
3. Distance ring, MAG side only (P/N 420 876 569)
4. Ring (both sides) (P/N 420 977 490)
5. MAG side ring halves (P/N 420 276 025)
6. PTO side ring halves (P/N 420 977 475)
7. Screw M8 x 40 (P/N 420 840 681)
8. Screw M8 x 70 (P/N 420 841 201)

NOTE: To facilitate ring or distance ring installation, lubricate their inside diameters.

787 RFI Engine

To remove end bearings no. 4 from crankshaft, use the following tools.

NOTE: The outer PTO bearing and crankshaft gear can be removed in one step using another puller. See Crankshaft Gear no. 18.



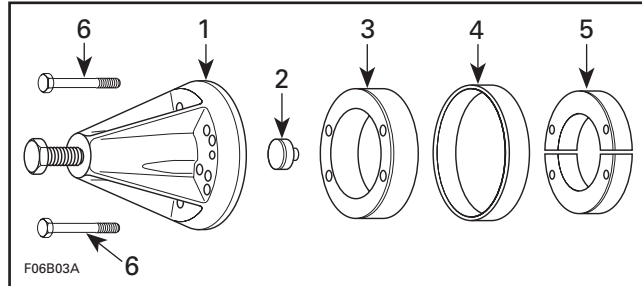
787 RFI ENGINE

1. Puller (P/N 420 877 635)
2. Protective cap (P/N 420 876 557)
3. Distance ring (P/N 420 876 569)
4. Ring (P/N 420 977 490)
5. Ring halves (P/N 420 977 475)
6. Screw M8 x 40 (P/N 420 840 681)
7. Screw M8 x 70 (P/N 420 841 201)

NOTE: To facilitate ring or distance ring installation, lubricate their inside diameters.

947 Engines

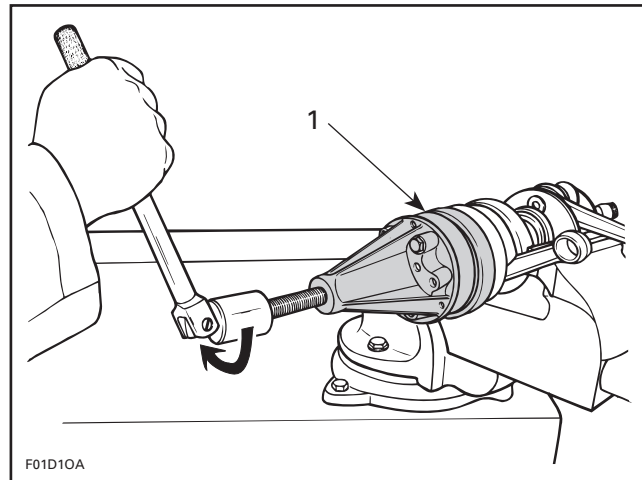
To remove end bearings from crankshaft, use the following tools.



947 ENGINES

1. Puller (P/N 420 877 635)
2. Protective cap (P/N 290 877 414)
3. Distance ring (P/N 420 876 569)
4. Ring (P/N 420 977 480)
5. Ring halves (P/N 420 876 330)
6. Screw (P/N 420 940 755)

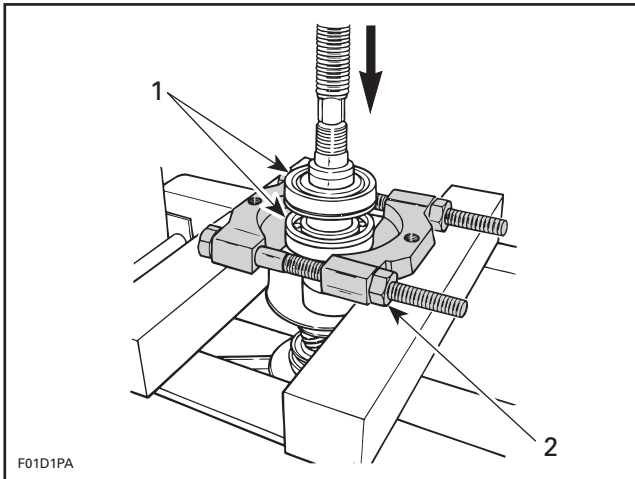
All Engines



TYPICAL

1. Removing crankshaft bearing

Or, use a bearing extractor such as Proto no. 4332 and a press to remove two bearings at a time (except on PTO side for the **787 RFI engine**).

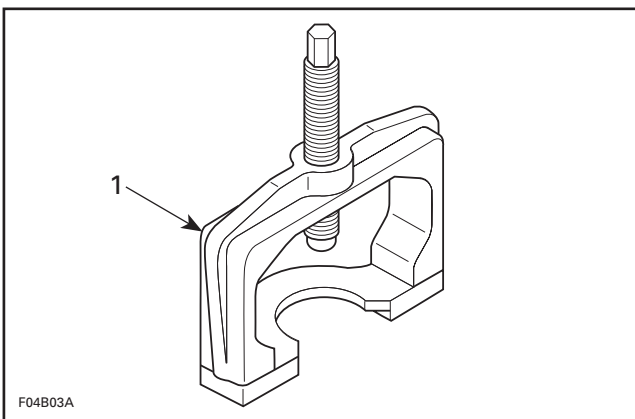


1. Press bearings out
2. Bearing extractor

Crankshaft Gear

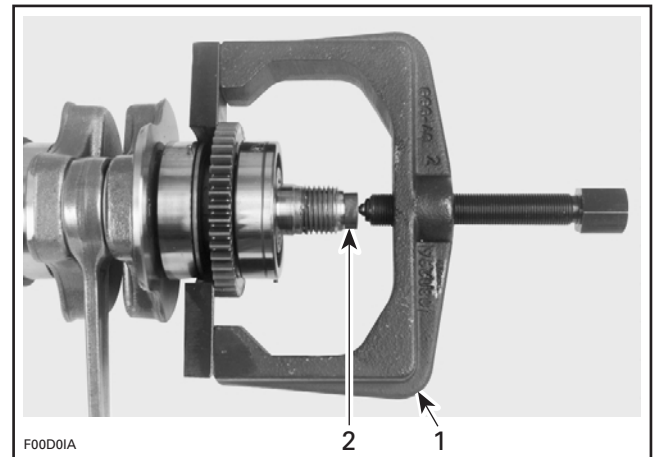
787 RFI Engine

The crankshaft gear **no. 18** and bearing **no. 5** can be removed in one step using the following puller.



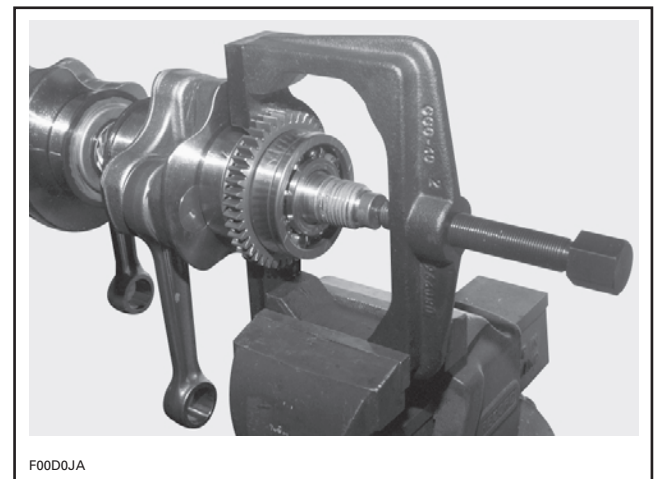
1. Puller (P/N 290 877 665)

Install the puller as per following illustration.



1. Puller
2. Protective cap

Secure puller in a vise and remove gear and bearing.



NOTE: If the inner PTO bearing needs to be replaced, remove the Woodruff key on the crankshaft.

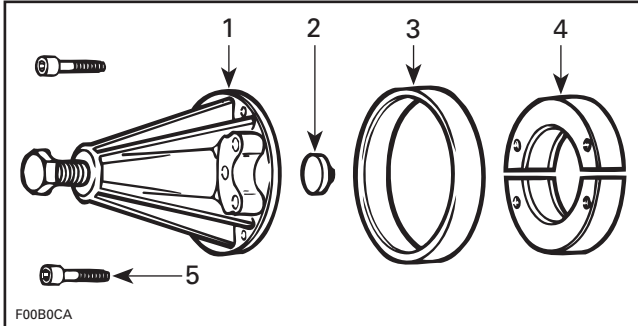
Section 04 ENGINE

Subsection 06 (BOTTOM END)

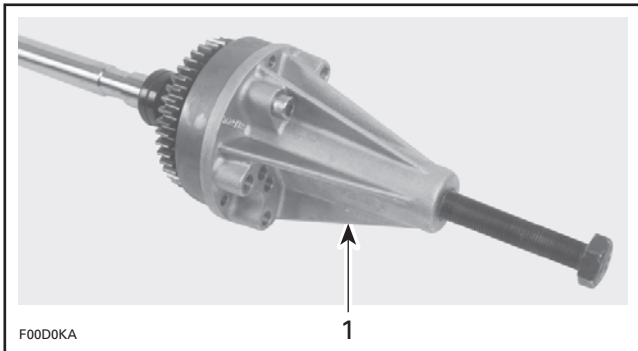
Counterbalance Shaft

787 RFI Engine

Bearings no. 15 on counterbalance shaft no. 13 can be removed by using the following tools:



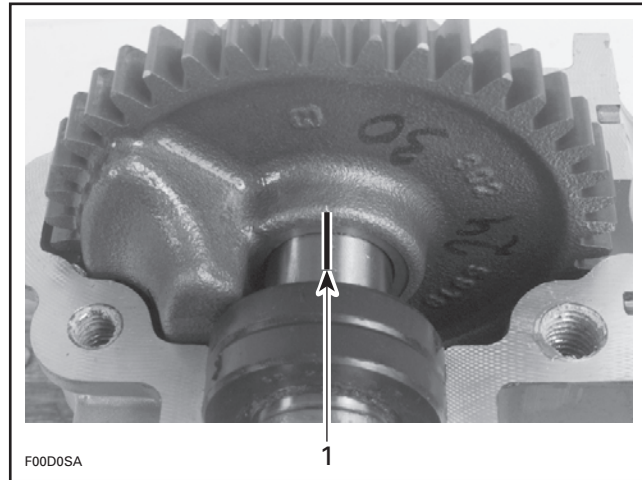
1. Puller (P/N 420 877 635)
2. Protective cap (P/N 420 876 557)
3. Ring (P/N 420 977 480)
4. Ring halves (P/N 420 876 330)
5. Screw M8 x 40 (P/N 420 840 681)



1. Tool installed

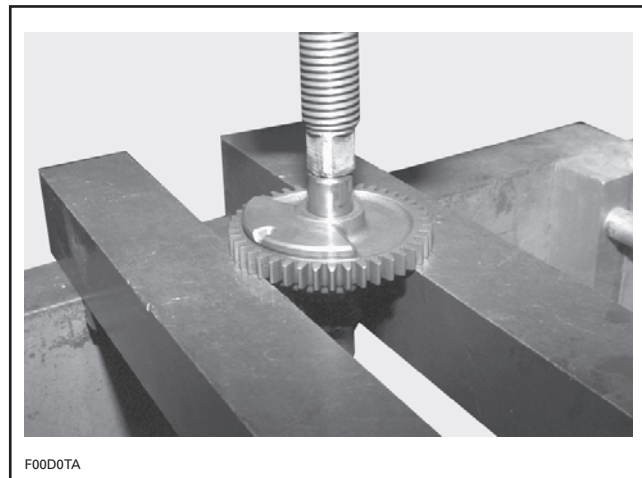
To remove gear no. 14, first trace an index mark on the gear and counterbalance shaft.

NOTE: There is no Woodruff key to position the gear on the counterbalance shaft. An index mark must be traced to ease assembly procedure.



1. Index mark

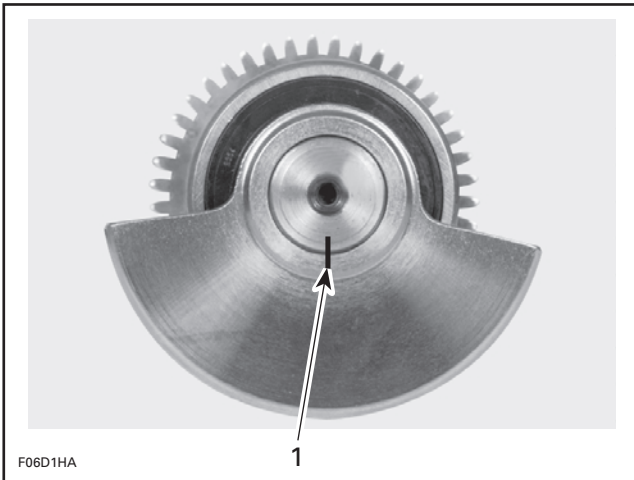
Use a press to remove the gear no. 14 from the counterbalance shaft.



947 Engines

Use a press to remove counterweights no. 16 and bearings no. 15.

CAUTION: There is no woodruff key to position the counterweights. An index mark must be traced to retain the proper position of the counterweight.



1. Trace an index mark

Remove seals no. 17.

Remove bearing no. 31 and washer no. 32.

Use a press to remove gear no. 14.

CLEANING

All Models

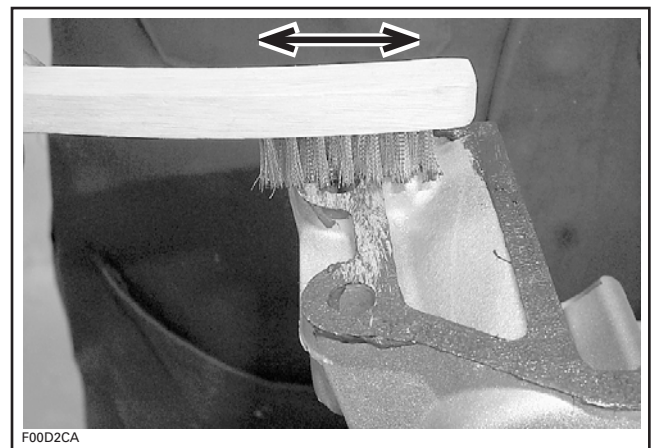
Discard all oil seals, gaskets, O-rings and sealing rings.

Clean oil passages and make sure they are not clogged.

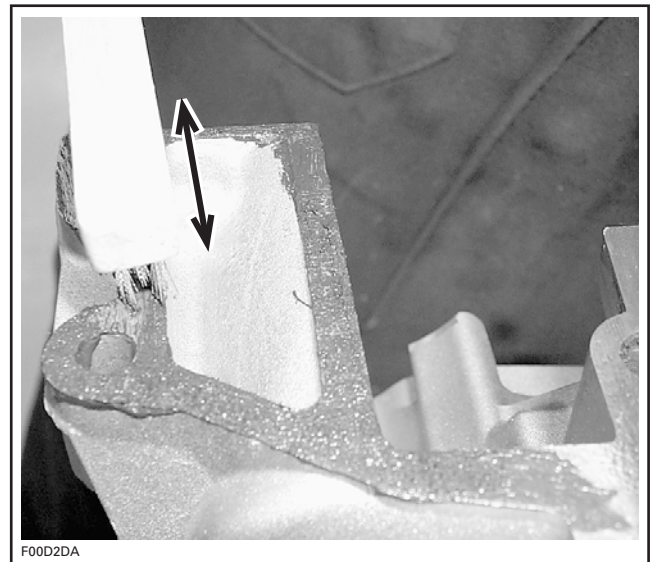
Clean all metal components in a solvent.

Crankcase mating surfaces are best cleaned using a combination of the chisel gasket remover (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

CAUTION: Do not wipe with rags. Use a new clean hand towel only.



FIRST PASS



SECOND PASS

Section 04 ENGINE

Subsection 06 (BOTTOM END)

Finish the cleaning with acetone.

CAUTION: Ensure to clean compressor lubrication nipple.

CAUTION: Be careful not to spray cleaner on the painted surface of the engine.

CAUTION: Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

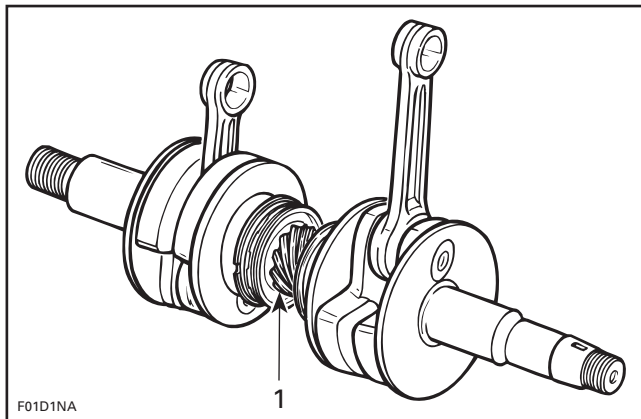
INSPECTION

Assembled Engine

The following checks can be performed with engine in watercraft without overhauling engine.

Crankshaft Alignment at Center Main Journal

Since it is an assembled crankshaft it can become misaligned or deflected. Crankshaft can be twisted on center main journal, changing timing of one cylinder in relation with the other.

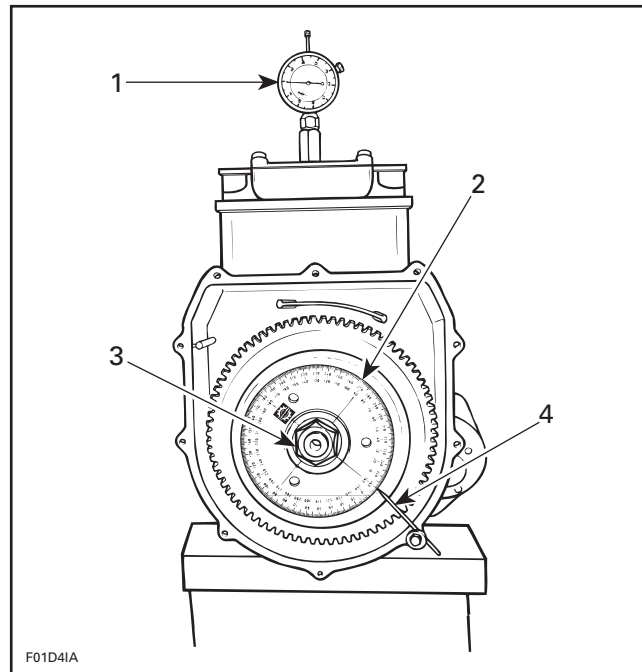


1. Main journal alignment here

To accurately check if crankshaft is twisted on center main journal, proceed as follows:

- Remove magneto housing cover.
- Remove flywheel nut (and magneto rotor for the **787 RFI and 947 engines**). Refer to MAGNETO SYSTEM for procedures.

- Install Bombardier degree wheel (P/N 529 035 607) on crankshaft end. Hand-tighten nut only.
- Remove both spark plugs.
- Install a TDC gauge in spark plug hole on **MAG side**.
- Bring **MAG** piston at Top Dead Center.
- As a needle pointer, secure a wire with a cover screw and a washer.
- Rotate degree wheel (NOT crankshaft) so that needle pointer reads 360°.



TYPICAL

1. TDC gauge
2. Degree wheel
3. Hand tighten nut
4. Needle pointer

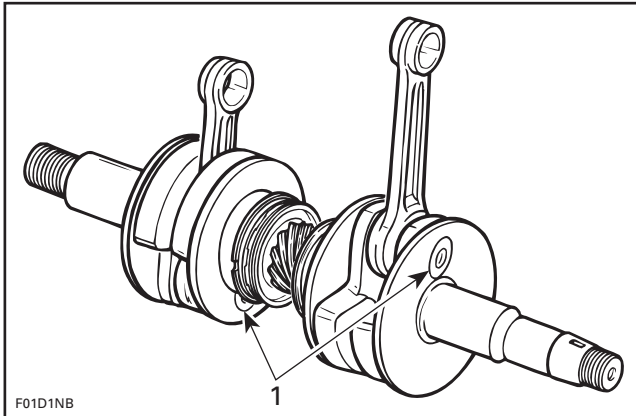
- Remove TDC gauge and install on **PTO side**.
- Bring **PTO** piston at Top Dead Center.

Interval between cylinders must be exactly 180° therefore, needle pointer must indicate 180° on degree wheel (360° - 180° = 180°).

Any other reading indicates a misaligned crankshaft.

Crankshaft Alignment at Connecting Rod Journal

Counterweights can also be twisted on connecting rod journal on any or both cylinder(s).



1. Connecting rod journal alignment here

Such misalignment may cause a crankshaft hard to be manually turned. Verification can be done by measuring deflection each end of crankshaft.

If deflection is found greater than specified tolerance, this indicates worn bearing(s), bent and/or disaligned crankshaft. Proceed with the disassembly of the engine.

Disassembled Engine

The following verifications can be performed with the engine disassembled.

Crankcase

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

Bearing

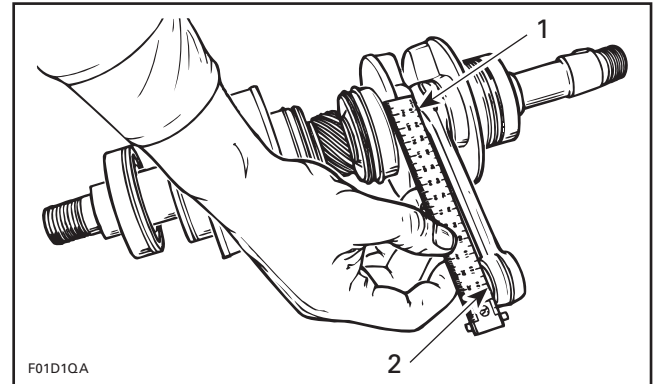
Inspect crankshaft bearings **no. 4**. Check for corrosion, scoring, pitting, chipping or other evidence of wear. Make sure plastic cage is not melted. Rotate and make sure they turn smoothly.

Crankshaft

NOTE: If crankshaft and/or components are found defective, it must be repaired by a specialized shop or replaced.

Connecting Rod Straightness

Align a steel ruler on edge of small end connecting rod bore. Check if ruler is perfectly aligned with edge of big end.



1. Ruler must be aligned with edge of connecting rod here
2. Align ruler here

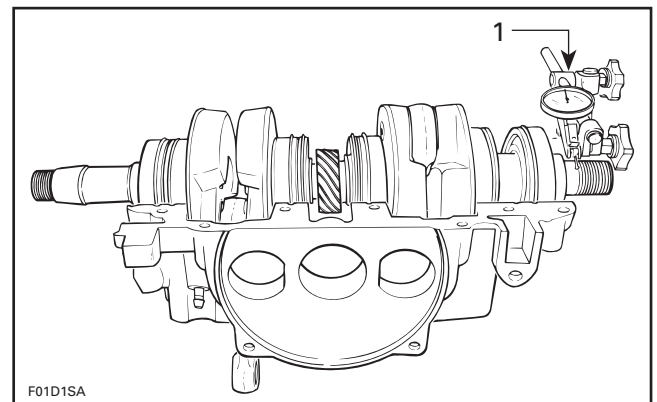
Crankshaft Deflection

All Models

MEASUREMENT	MAG SIDE	PTO SIDE
Crankshaft deflection (max.)	0.050 mm (.002 in)	0.030 mm (.001 in)

Crankshaft deflection is measured each end with a dial indicator.

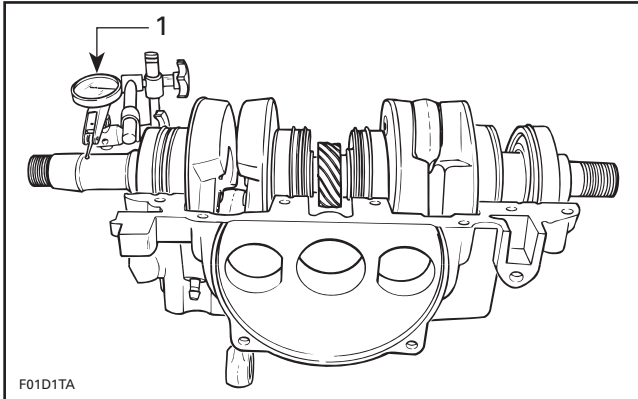
First, check deflection with crankshaft in crankcase. If deflection exceeds the specified tolerance, it can be either ball bearings wear, bent or twisted crankshaft at connecting rod journal.



1. Measuring PTO side deflection in crankcase

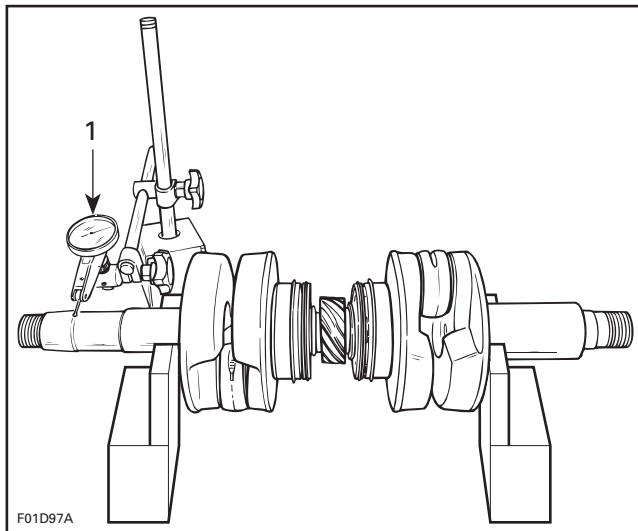
Section 04 ENGINE

Subsection 06 (BOTTOM END)

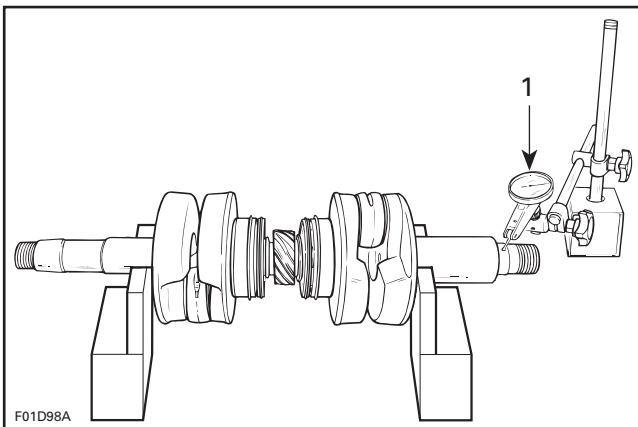


1. Measuring MAG side deflection in crankcase

Remove crankshaft bearings and check deflection again on V-shaped blocks as illustrated.



1. Measuring MAG side deflection on V-shaped blocks



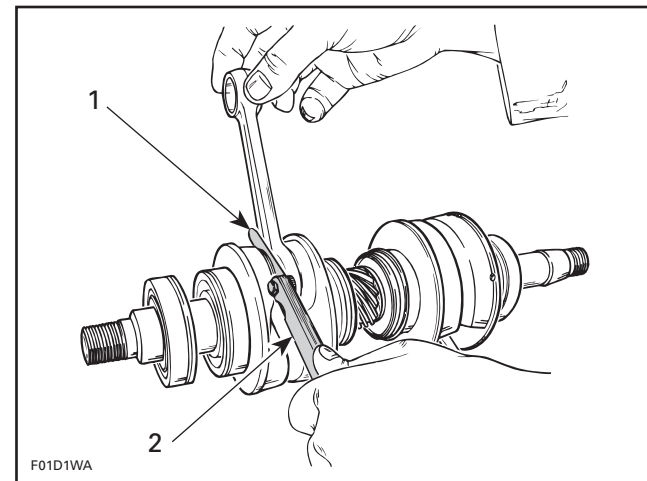
1. Measuring PTO side deflection on V-shaped blocks

NOTE: Crankshaft deflection cannot be correctly measured between centers of a lathe.

Connecting Rod Big End Axial Play

CONNECTING ROD BIG END AXIAL PLAY			
MODEL	NEW PARTS (min.) (max.)		WEAR LIMIT
947 engine	0.390 mm (.015 in)	0.737 mm (.029 in)	1.2 mm (.047 in)
787 RFI engine	0.230 mm (.008 in)	0.617 mm (.024 in)	1.2 mm (.047 in)
717 engine	0.311 mm (.012 in)	0.677 mm (.026 in)	1.2 mm (.047 in)

Using a feeler gauge, measure distance between thrust washer and crankshaft counterweight.

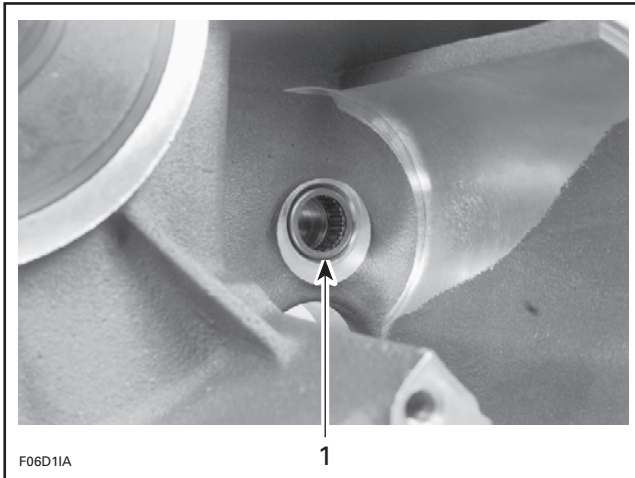


1. Measuring big end axial play
2. Feeler gauge

Starter Drive Bearing

947 Engines Only

Check bearing no. 23 of starter drive assembly no. 27 in crankcase.

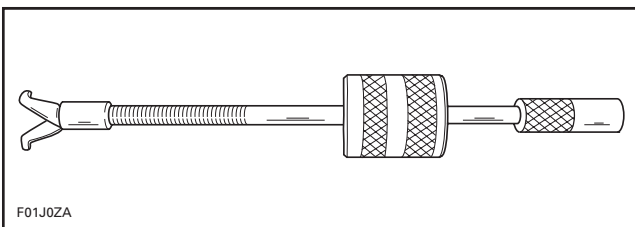


1. Bearing of starter drive assembly

Removal

Starter drive bearing can be easily removed from lower crankcase half using the following suggested tool or equivalent:

- Snap-on hammer puller including:
- handle CJ93-1
- hammer CJ125-6
- claws CJ93-4.



Close puller claws so that they can be inserted in end bearing. Holding claws, turn puller shaft clockwise so that claws open and become firmly tight against bearing.

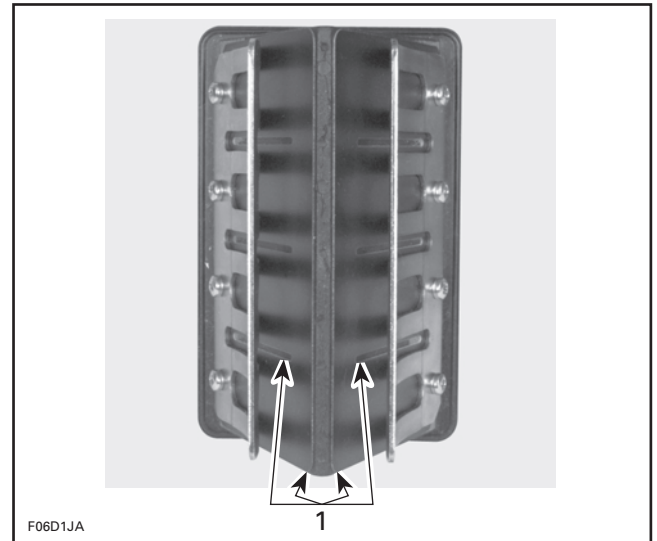
Slide puller hammer outwards and tap puller end. Retighten claws as necessary to always maintain them tight against bearing. Continue this way until bearing completely comes out.

For installation, see below in this section.

Reed Valve

947 Engines Only

Check reed valve petals no. 29 for cracks or other defects. The reed petals must lie completely flat against the reed valve body no. 30. To check, hold against light.

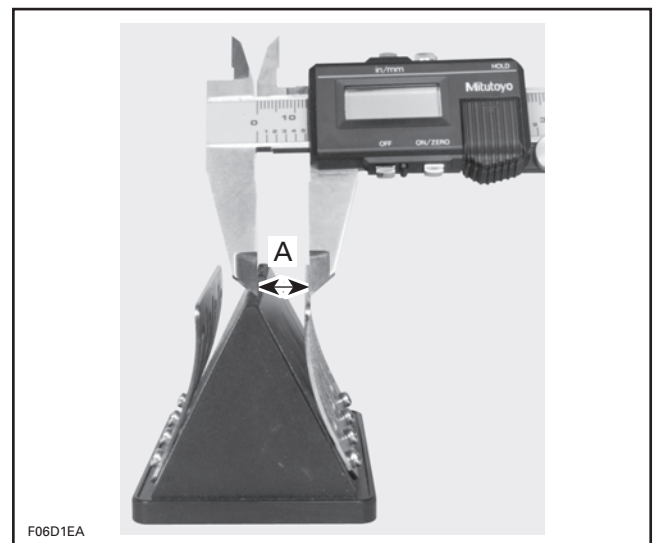


1. No play

In case of a play, turn reed petals upside down and recheck. If there is still a play, replace petals.

Check perfect condition of rubber coating on reed valve body.

Check stopper distance from center of reed valve block.



A. $13 \pm 0.25 \text{ mm}$ ($.512 \pm .010 \text{ in}$)

Section 04 ENGINE

Subsection 06 (BOTTOM END)

NOTE: Distance should be the same on both sides.
Bent stopper as required to obtain the proper distance.

Air Compressor

Refer to ENGINE MANAGEMENT for components inspection. However, if you find aluminum dust or debris in this area, they may have flowed toward the injection oil reservoir. In this case, the oil reservoir and lines must be flushed and the filter replaced.

CAUTION: Failure to properly clean the oil system will result in serious engine damage.

ASSEMBLY

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

NOTE: It is recommended to spray BOMBARDIER-ROTAX injection oil on all moving parts when re-assembling the engine.

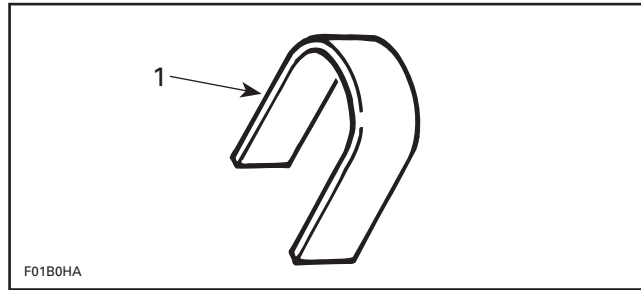
Crankshaft and Bearing

Apply Loctite 767 anti-seize on part of crankshaft where bearing fits.

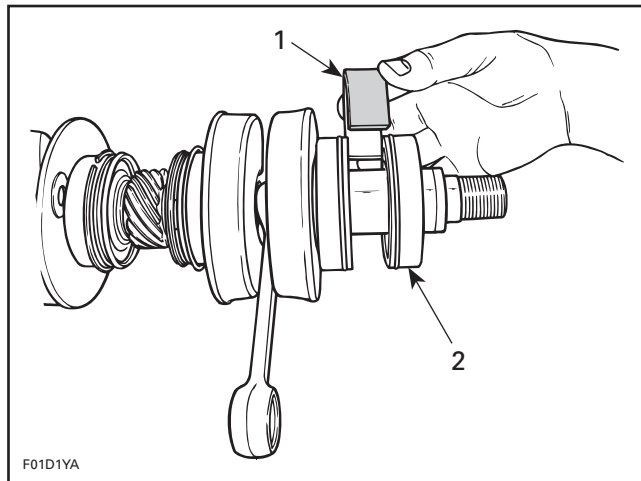
Prior to installation, place bearings **no. 4** into a container filled with oil, previously heated to 75°C (167°F). This will expand bearing and ease installation.

To properly position the outer bearing(s), a distance gauge must be temporarily installed against the inner bearing. Slide the outer bearing until stopped by the distance gauge, then remove it.

ENGINE	DISTANCE GAUGE
717	P/N 529 034 800 (PTO)
787 RFI	P/N 529 034 900 (MAG)
947	P/N 529 035 100 (MAG) P/N 529 035 000 (PTO)



1. Distance gauge



TYPICAL

1. Distance gauge
2. Outer bearing

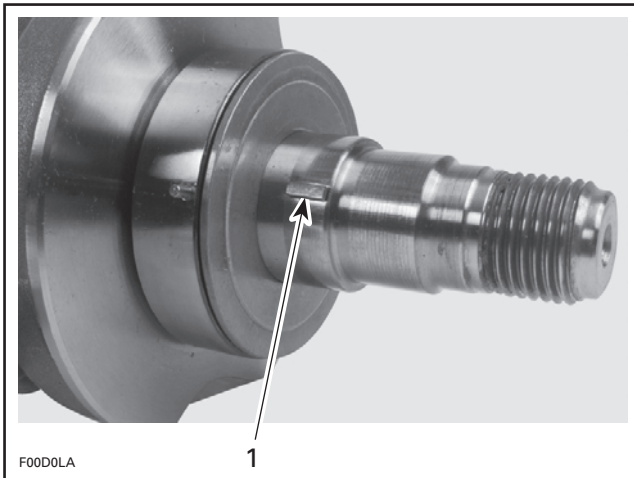
Distance Ring

When installing the distance ring **no. 12**, make sure to position it with its chamfer toward the counterweight of the crankshaft.

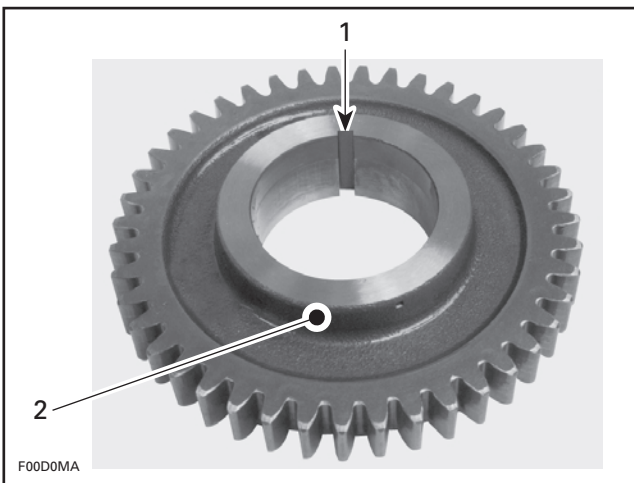
Crankshaft Gear

787 RFI Engine

Position the long flange of the gear **no. 18** toward the counterweight of the crankshaft. Also, make sure to align the gear keyway with the Woodruff key on the crankshaft.



1. Woodruff key on the crankshaft



1. Keyway
2. Long flange toward the crankshaft counterweight

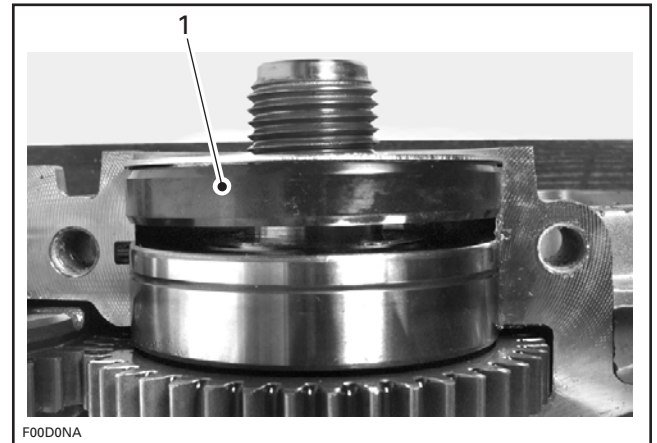
Crankshaft Seal

All Models

When installing seal assembly **no. 5**, apply a light coat of lithium grease on seal lips.

787 RFI Engine

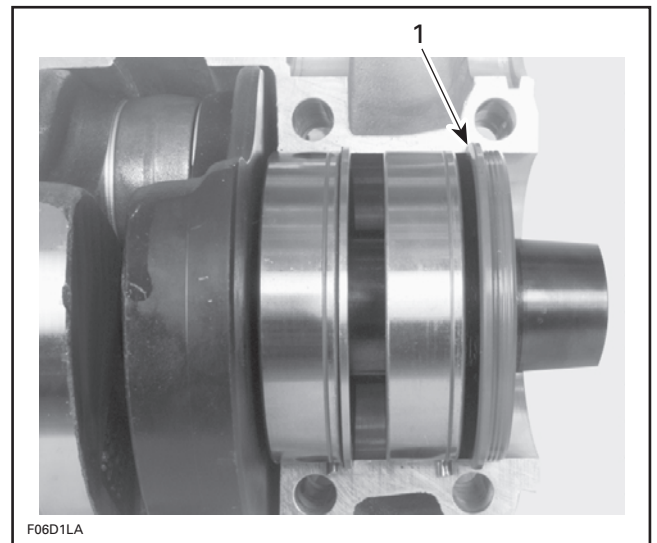
Position PTO seal against the retaining shim; the gap between the seal **no. 5** and bearing **no. 4** will ensure proper lubrication of the bearing.



1. Seal against the retaining shim

947 Engines

Seals are positioned with the outer lip in the crankcase recess.



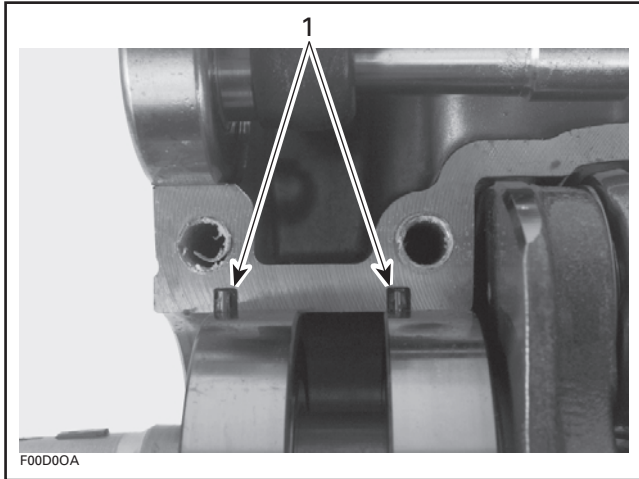
1. Seal lip in crankcase recess

Section 04 ENGINE

Subsection 06 (BOTTOM END)

Drive Pin

Make sure drive pins **no. 6** of bearings are properly installed in crankcase recesses at assembly.



1. Drive pins

Counterbalance Shaft

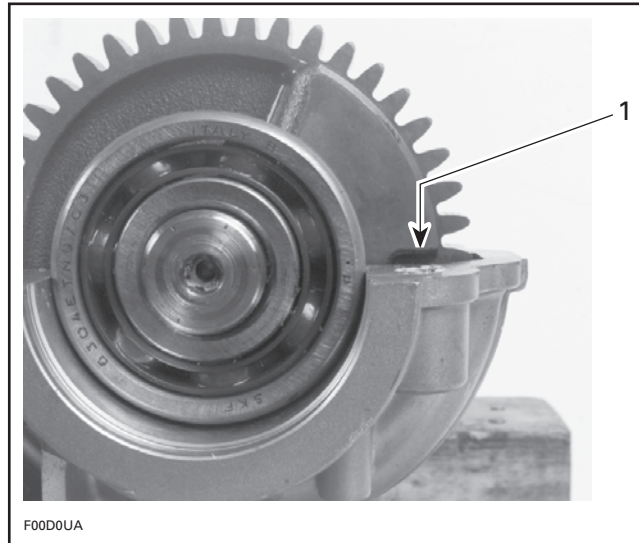
787 RFI Engine

Press gear **no. 14** onto counterbalance shaft **no. 13** taking care to align both marks previously traced.

CAUTION: Counterbalance shaft must be properly assembled, otherwise engine will vibrate and premature wear will occur.

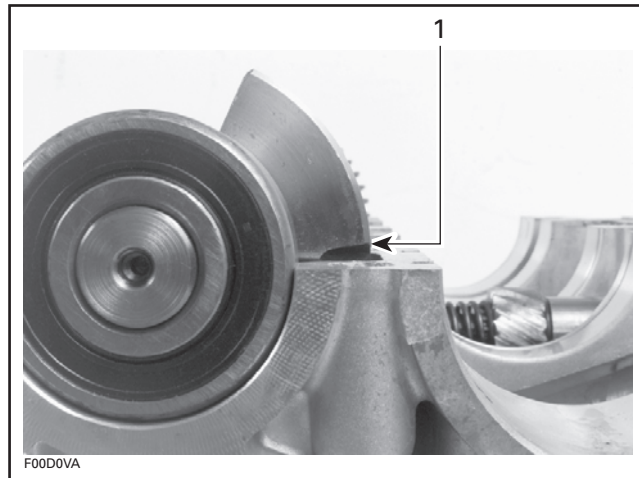
Proceed as follows to check if the gear **no. 14** is properly positioned on the counterbalance shaft:

- Temporarily install the counterbalance shaft in the crankcase.
- Rotate the counterbalance shaft to align the notch of the gear with the crankcase.



1. Gear notch aligned with the crankcase

- The notch of the counterweight on the opposite end of the counterbalance shaft must also be aligned with the crankcase.



1. Counterweight notch aligned with the crankcase

If notches are not aligned with the crankcase, remove the gear and repeat the procedure until the notches are properly aligned.

947 Engines

Install bearing **no. 31** and washer **no. 32**.

When installing seals **no. 17**, apply a light coat of Molykote 111 on seal lips.

Prior to installation, place bearings **no. 15** into a container filled with oil, previously heated to 75°C (167°F). This will expand bearings and ease their installation.

Reinstall counterweights no. 16 using a press and take care to align index marks previously traced.

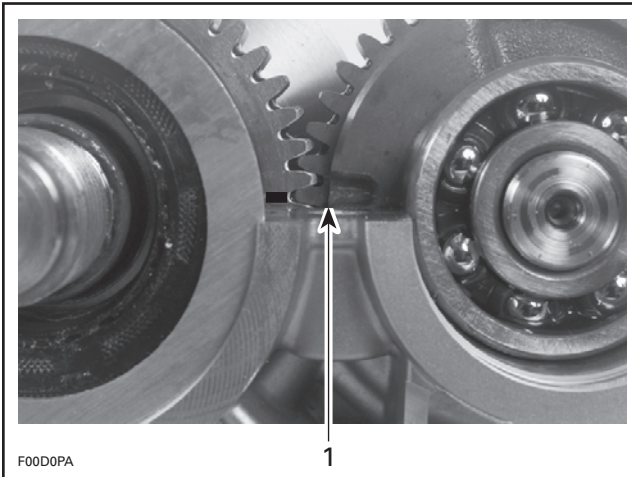
Crankshaft and Counterbalance Shaft

787 RFI and 947 Engines

Install crankshaft no. 3 first in crankcase.

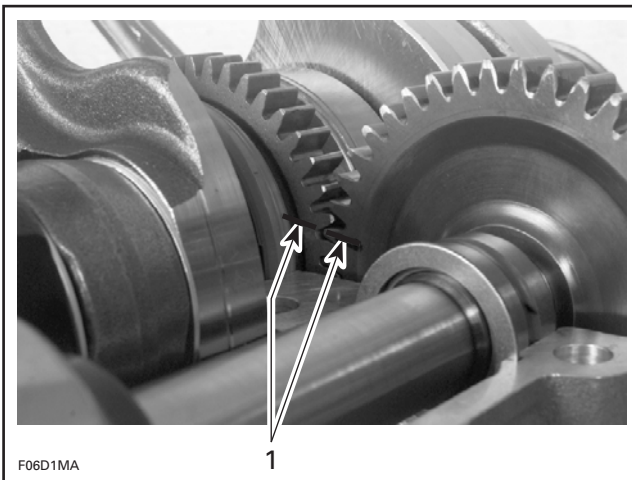
After crankshaft installation, install counterbalance shaft no. 13. Make sure to properly index crankshaft and counterbalance shaft by aligning marks of gears.

CAUTION: Marks on the crankshaft and counterbalance shaft must be aligned, otherwise engine will vibrate and premature wear will occur.



787 RFI ENGINE

1. Marks must be aligned



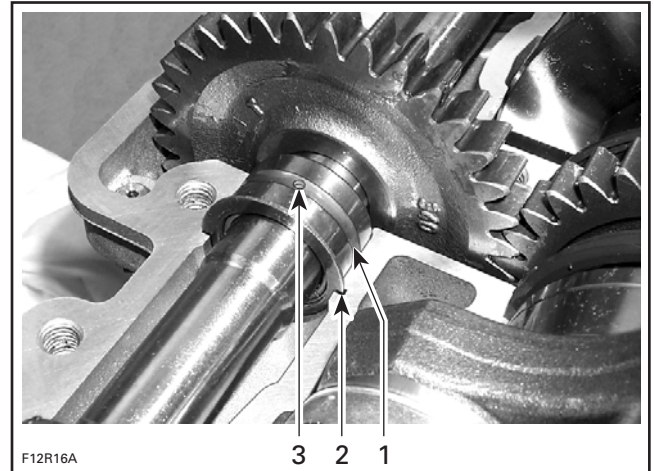
947 ENGINES

1. Marks must be aligned

Turn by hand the crankshaft and counterbalance shaft. Make sure they do not interfere with the crankcase.

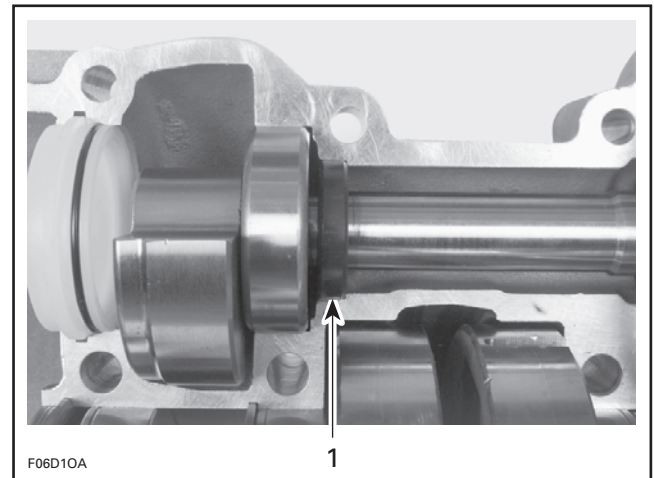
947 Engines

Properly position bearing no. 31 and washer no. 32. Ensure to position lubrication hole on top (if so equipped).



1. Bearing
2. Washer in crankcase groove
3. Lubrication hole on top (if so equipped)

Place seals no. 17 in their respective positions.



1. Seal in place

Air Compressor

947 DI Engines

Refer to ENGINE MANAGEMENT for procedures.

Section 04 ENGINE

Subsection 06 (BOTTOM END)

Crankcase

All Engines

Crankcase halves are factory matched and therefore, are not interchangeable or available as single halves.

717 and 787 RFI Engines

Rotary valve shaft must be installed in crankcase before closing halves.

CAUTION: Before joining crankcase halves, make sure that crankshaft gear is well engaged with rotary valve shaft gear.

717 Engine

Temporarily install armature plate to align crankcase halves with each other.

947 DI Engines

Add 40 mL (1.35 oz) of Sea-Doo synthetic jet pump oil (P/N 293 600 011) or standard gear oil in the counterbalance shaft gear cavity.

CAUTION: Using different type of oil may reduce engine component life.

All Models

IMPORTANT: When beginning the application of the crankcase sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.

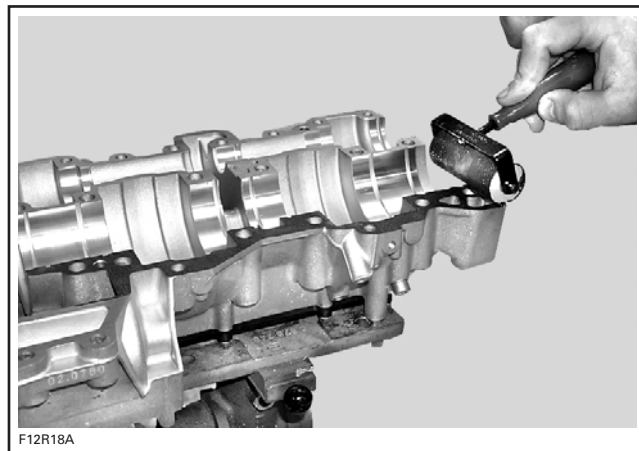
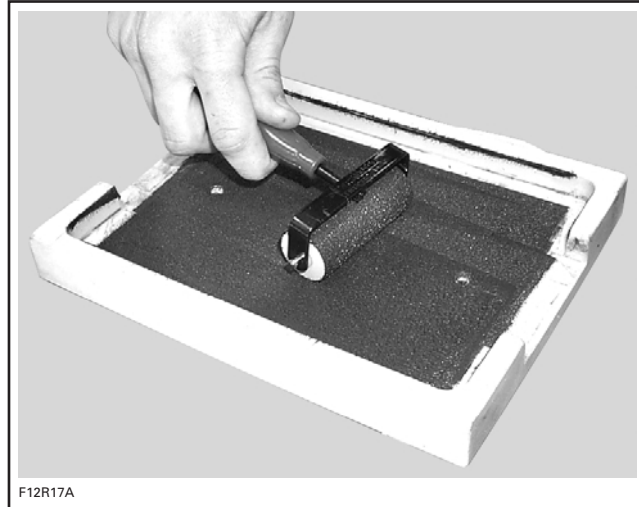
NOTE: It is recommended to apply this specific sealant as described here to get an uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute the sealant (unlike the Drei Bond sealing compound, using a finger will not affect the adhesion).

Use the silicone-based Loctite 5910 (P/N 293 800 081) on mating surfaces.

NOTE: The sealant curing time is similar to the Loctite 518 without using the Primer N.

CAUTION: Do not use Loctite 515 or 518 to seal crankcase. Do not use Loctite Primer N with the Loctite 5910. Using these products or non silicone-based sealant over a previously sealed crankcase with Loctite 5910 will lead to poor adhesion and possibly a leaking crankcase. These products are chemically incompatible. Even after cleaning, the Loctite 5910 would leave incompatible microscopic particules.

Use a plexyglass plate and apply some sealant on it. Use a soft rubber roller (50 - 75 mm (2 - 3 in)) (available in arts products suppliers for printmaking) and roll the sealant to get a thin uniform coat on the plate (spread as necessary). When ready, apply the sealant on crankcase mating surfaces.



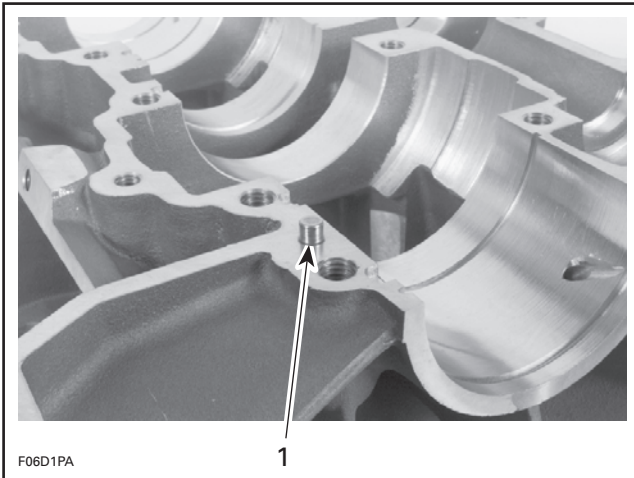
Do not apply in excess as it will spread out inside crankcase.

CAUTION: If sealant spread out inside air compressor area, it could plug the compressor lubrication nipple and serious compressor damage may occur.

NOTE: Do not use Loctite Primer N with this sealant. The sealant curing time is similar to the Loctite 518 without using the Primer N, which is 4 to 24 hours.

All 947 Engines

Make sure all locating dowels are in place.

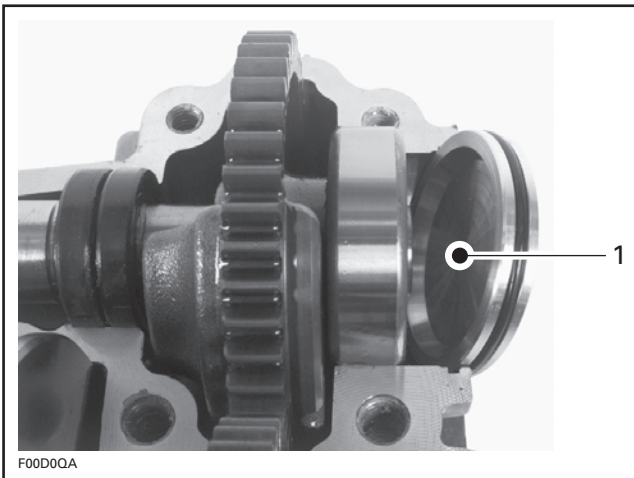


1. Dowel

Counterbalance Shaft Bearing Cover

787 RFI Engine

Install the bearing cover no. 19 with its hollow side toward the bearing.



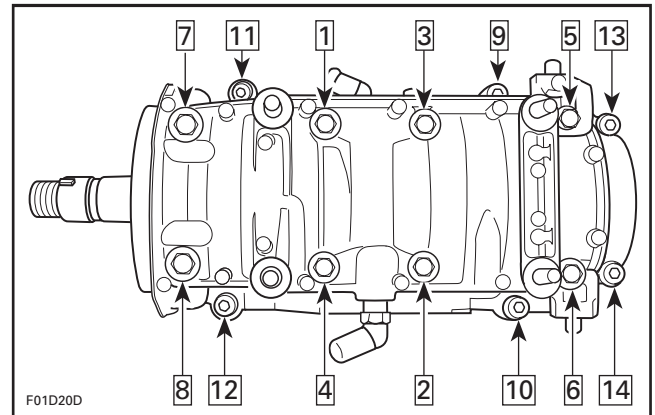
1. Hollow side facing bearing

Crankcase Screws

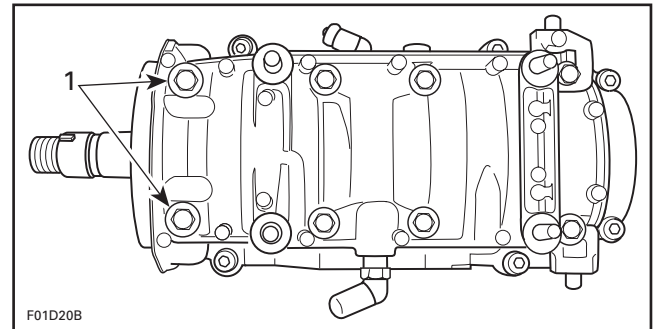
717 Engine

Apply Loctite 518 on screw threads and Molykote 111 below head screws.

Torque crankcase screws to 24 N•m (17 lbf•ft) as per following illustrated sequence.



Torque 2 M10 crankcase screws to 40 N•m (30 lbf•ft).

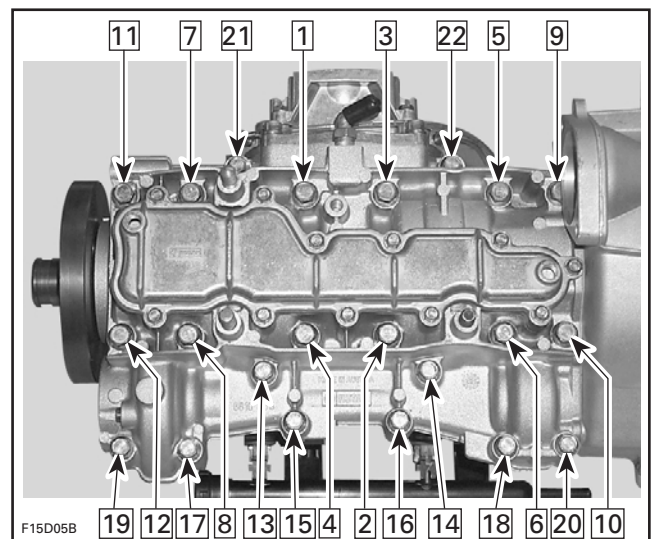


1. Torque to 40 N•m (30 lbf•ft)

787 RFI Engine

Apply Loctite 518 on screw threads and Molykote 111 below head screws.

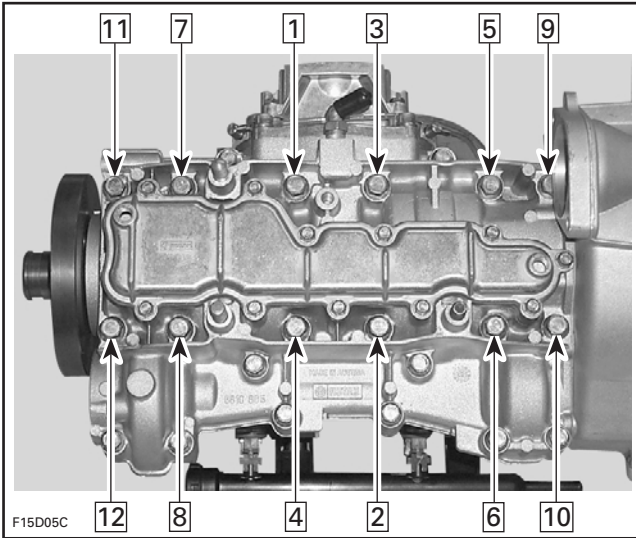
Torque crankcase screws to 12 N•m (106 lbf•in) as per following sequence. Repeat procedure, re-tightening all screws to 24 N•m (17 lbf•ft).



Section 04 ENGINE

Subsection 06 (BOTTOM END)

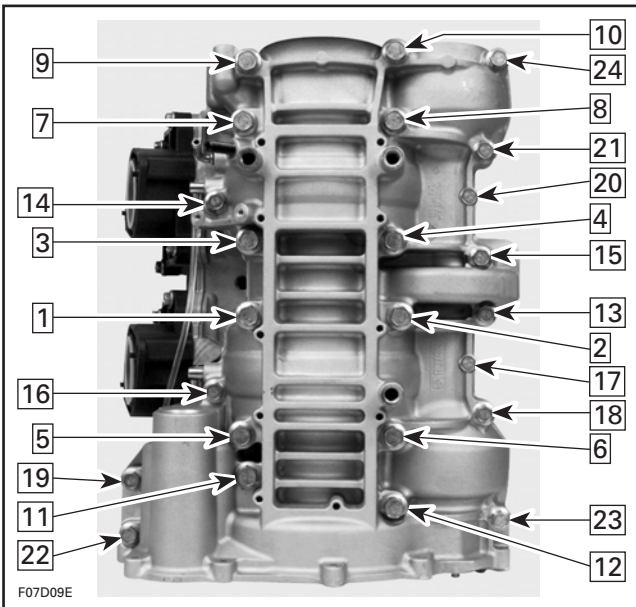
As a final step, torque only M10 screws no. 8 of crankcase to 40 N•m (30 lbf•ft) as per following sequence.



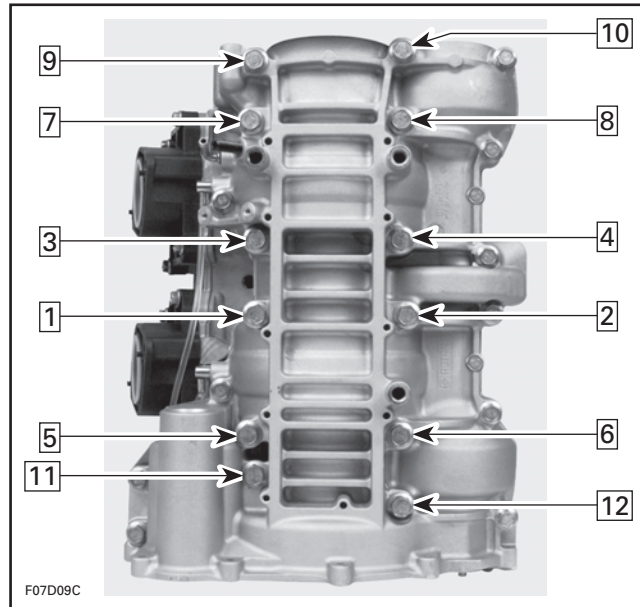
All 947 Engines

Apply Molykote 111 below head of screws and Loctite 518 on threads.

Torque crankcase screws to 12 N•m (106 lbf•in) as per following sequence. Repeat procedure, re-tightening all screws to 27 N•m (20 lbf•ft).



As a final step, torque only the M10 x 73.5 bolts to 40 N•m (30 lbf•ft) as per following sequence.



Oil Fittings

717 and 787 RFI Engines

If inlet and outlet oil fittings no. 11 of rotary valve shaft have been removed from crankcase, reinstall them with their end pointing toward ignition housing. Apply Loctite 518 on threads of fittings.

Stud

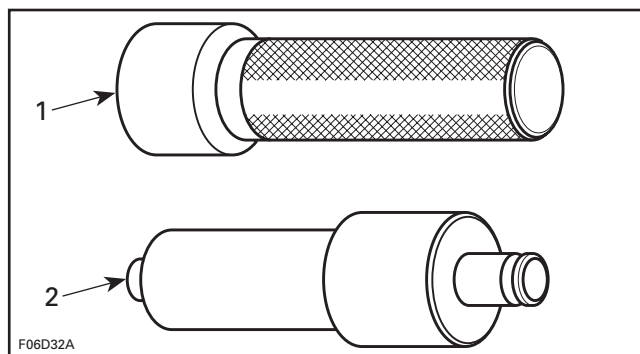
717 Engine

At assembly in crankcase, apply Loctite 518 on threads of studs no. 10. Torque to 10 N•m (89 lbf•in).

Starter Drive Bearing

947 Engines

To install bearing no. 23 of starter drive assembly, use pusher (P/N 290 876 502) and handle (P/N 420 877 650).

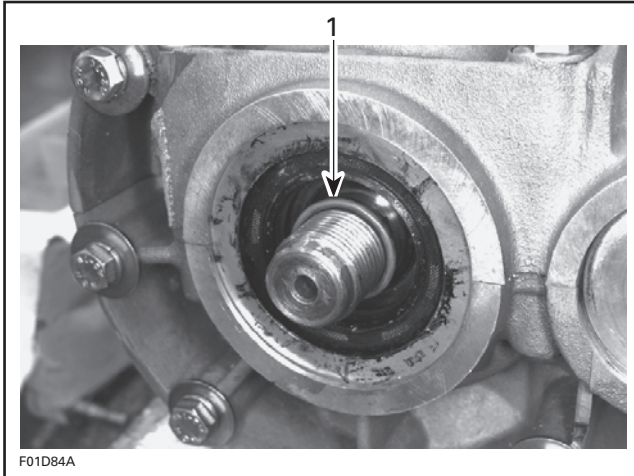


1. Handle
2. Pusher

PTO Flywheel

787 RFI Engine

Install O-ring onto crankshaft.



1. O-ring

717 and 787 Engines

Apply Loctite anti-seize lubricant (P/N 293 800 070) to crankshaft threads.

Using the same tools as for disassembly procedure, torque PTO flywheel to 110 N•m (81 lbf•ft).

947 Engines

Apply Loctite 243 (blue) on bolt no. 22.

Using the same tools as for disassembly procedure, torque bolt no. 22 to 115 N•m (85 lbf•ft).

Apply Loctite 648 on mating surface of PTO flywheel and coupler.

Apply Loctite 243 (blue) to Allen screws no. 21 of coupler and torque to 23 N•m (17 lbf•ft).

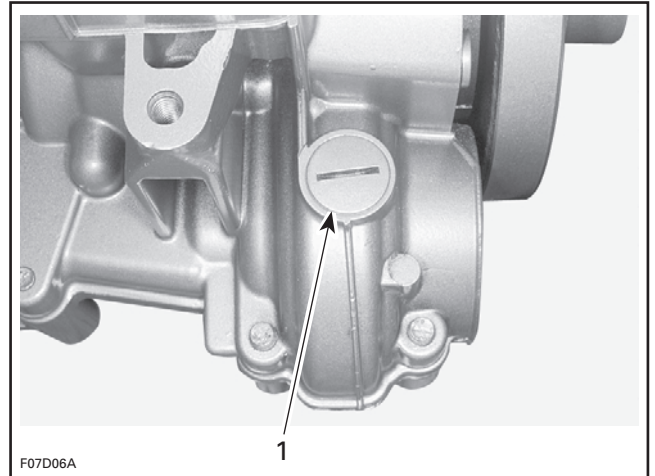
Final Assembly

717 and 787 RFI Engines

For rotary valve timing and assembly procedures, refer to ROTARY VALVE.

787 RFI Engine

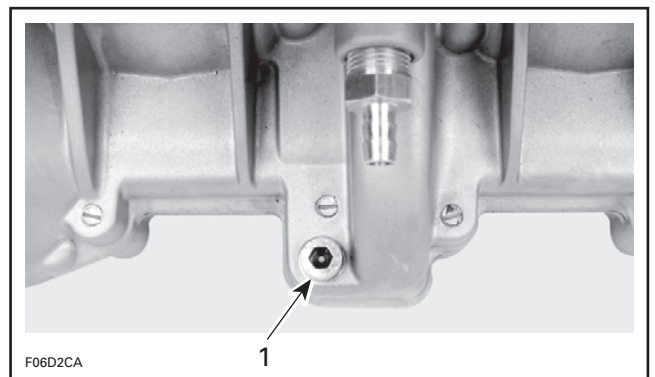
When engine assembly is completed, add 30 mL (1 oz) of motor oil SAE 30 to the counterbalance shaft gear through the crankcase filler plug.



1. Remove plug and add SAE 30 motor oil

947 Carburetor-Equipped Engines

When engine assembly is completed, add 40 mL (1.35 oz) of motor oil SAE 30 to the counterbalance shaft gear through the crankcase filler plug.



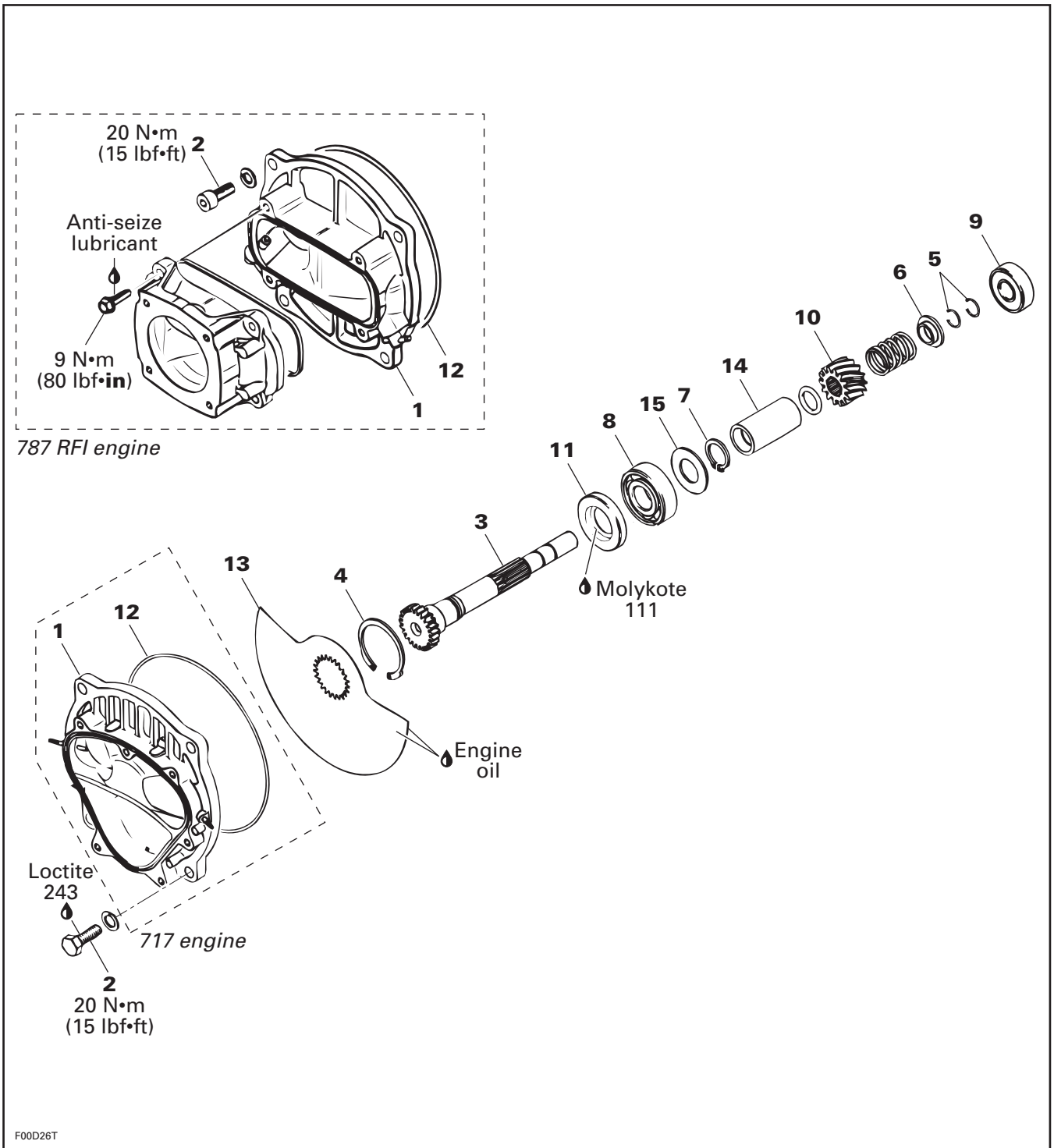
1. Remove plug and add SAE 30 motor oil

947 DI Engines

Add approximately 10 mL (.3 oz) of injection oil in bottom of crankcase for each cylinder. This will give an additional lubrication for the first engine startup.

ROTARY VALVE

717 and 787 RFI Engines



Section 04 ENGINE

Subsection 07 (ROTARY VALVE)

GENERAL

The following verification procedures such as clearance of rotary valve cover or rotary valve shaft gear backlash can be performed without removing engine from watercraft.

However engine must be removed from watercraft to work on rotary valve shaft/components. Refer to REMOVAL AND INSTALLATION for engine removal procedure.

Bottom end must be opened to remove rotary valve shaft. Refer to BOTTOM END.

INSPECTION ON WATERCRAFT

Remove carburetor(s). Refer to CARBURETOR.

Rotary Valve Cover

Unscrew 4 screws **no. 2** and withdraw rotary valve cover **no. 1**.

Remove rotary valve **no. 13**.

Rotary Valve/Cover Clearance

The clearance between the rotary valve and the cover must be 0.30 ± 0.05 mm (.012 \pm .002 in).

NOTE: If the clearance is below 0.25 mm (.010 in) this could create an overheating situation and if the clearance is over 0.35 mm (.014 in) this could create a hard starting situation.

There are 2 methods to verify rotary valve/cover clearance:

- the 45° feeler gauge method
- the soldering wire method.

45° FEELER GAUGE METHOD

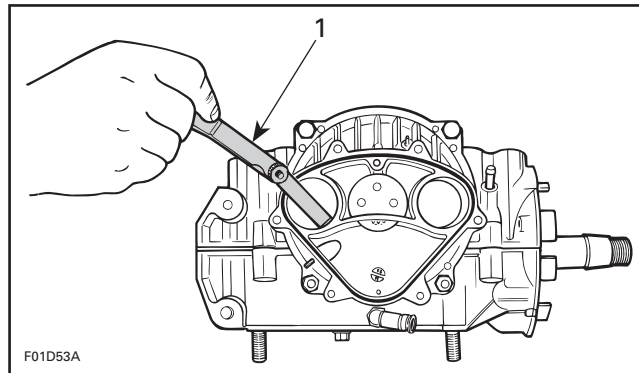
Remove O-ring **no. 12** from rotary valve cover **no. 1**.

Remove intake manifold from rotary valve cover (except **787 engine**).

Reinstall cover **no. 1** in place **WITHOUT** its O-ring and torque screws to 20 N•m (15 lbf•ft).

Insert feeler gauge blade through cover inlet ports to verify clearance. At least verify clearance at two different places in each port.

Feeler gauge blade from 0.25 mm (.010 in) to 0.35 mm (.014 in) thickness should fit between rotary valve and cover.



1. 45° feeler gauge

If rotary valve cover clearance is out of specifications, machine rotary valve cover seating surface or replace the cover.

SOLDERING WIRE METHOD

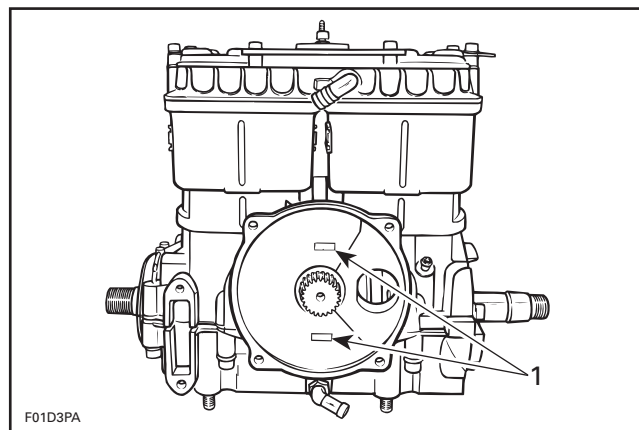
Remove O-ring from rotary valve cover.

Use the following type of solder:

- resin core
- diameter: 0.8 mm (.032 in)
- electronic application (available at electronic stores).

Install 2 soldering wire pieces of 13 mm (1/2 in) long directly on rotary valve, one above and one below rotary valve gear. Apply grease to hold solder in position.

Refer to the following illustration for proper position of rotary valve and pieces of soldering wire.



TYPICAL

1. Soldering wire

Reinstall cover in place **WITHOUT** its O-ring and torque screws to 20 N•m (15 lbf•ft).

Remove cover then clean and measure compressed soldering wire thickness, it must be within the specified tolerance 0.30 ± 0.05 mm (.012 \pm .002 in).

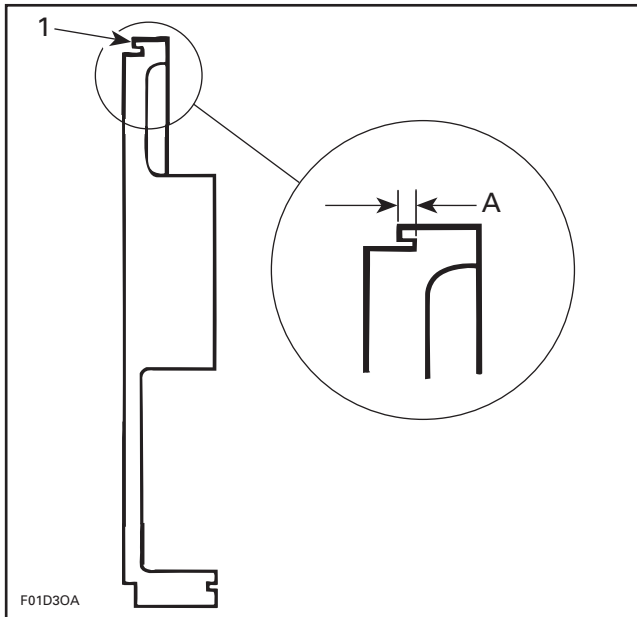
If rotary valve cover clearance is over specified tolerances, machine rotary valve cover seating surface or replace the cover.

MACHINING INFORMATION

The amount of material over tolerance must be removed from the rotary valve cover seating surface.

Also cut the O-ring groove the same amount to keep the 1.00 ± 0.03 mm ($.039 \pm .001$ in) depth between the bottom of the groove and the seating surface.

Remove burrs on the edges of the seating surface and O-ring groove.



SAME AMOUNT REMOVED FROM COVER SEATING SURFACE AND O-RING GROOVE BASE

1. Cover seating surface

A. O-ring groove depth must be 1.00 ± 0.03 mm ($.039 \pm .001$ in)

Reverify the clearance.

At assembly the rotary valve timing must remain as per original setting.

NOTE: If rotary valve crankcase surface is worn, it is possible to have it reworked at the factory. Contact your dealer or distributor.

Rotary Valve Shaft Gear Backlash

Remove PTO flywheel guard.

Remove spark plugs, rotary valve cover and valve.

Manually feel backlash at one position, then turn crankshaft about 1/8 turn and recheck. Continue this way to complete one revolution.

Backlash must be even at all positions. Otherwise overhaul engine to find which part is faulty (gear, rotary valve shaft or crankshaft with excessive deflection).

DISASSEMBLY

Rotary Valve Cover

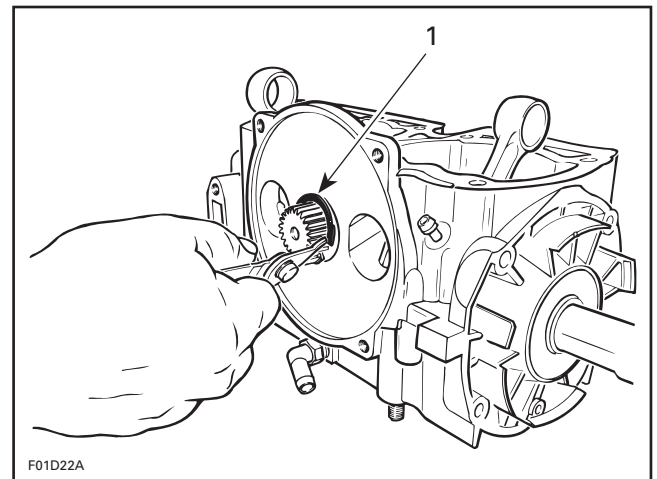
Unscrew 4 retaining screws and withdraw rotary valve cover **no. 1** and rotary valve **no. 13**.

Rotary Valve Shaft

To remove the rotary valve shaft assembly, the engine must be removed from watercraft (refer to ENGINE).

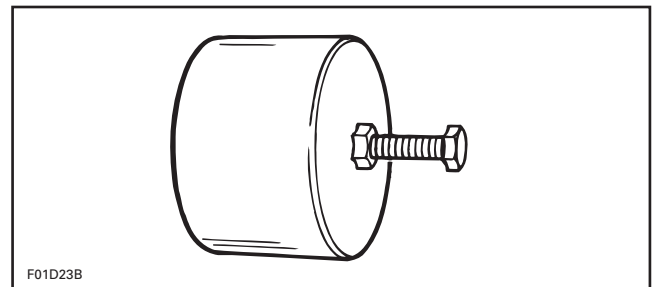
Open bottom end and remove crankshaft (refer to BOTTOM END).

First remove snap ring **no. 4** from crankcase.



1. Removing snap ring

To remove rotary valve shaft assembly, use the appropriate puller (P/N 290 876 488).

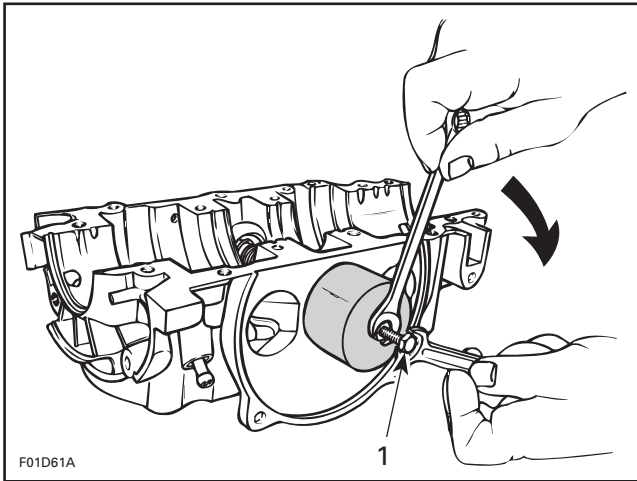


PULLER (P/N 290 876 488)

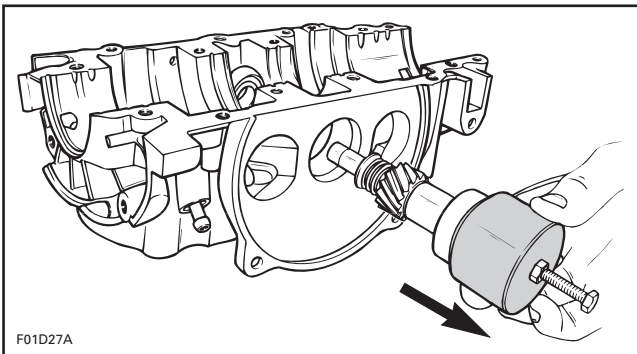
Section 04 ENGINE

Subsection 07 (ROTARY VALVE)

Place puller over rotary valve shaft end and screw on puller bolt into shaft. While retaining bolt with a wrench, turn puller nut **CLOCKWISE** until shaft comes out.

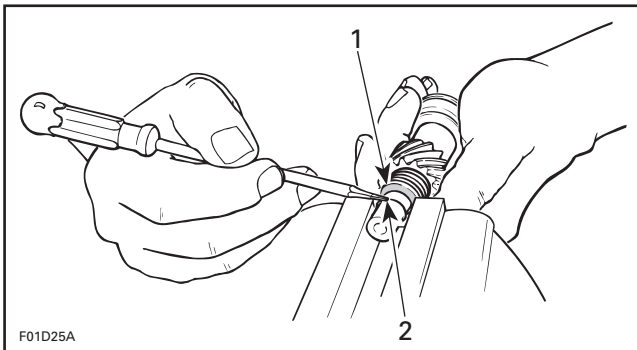


1. Hold bolt



Circlip and Spring Seat

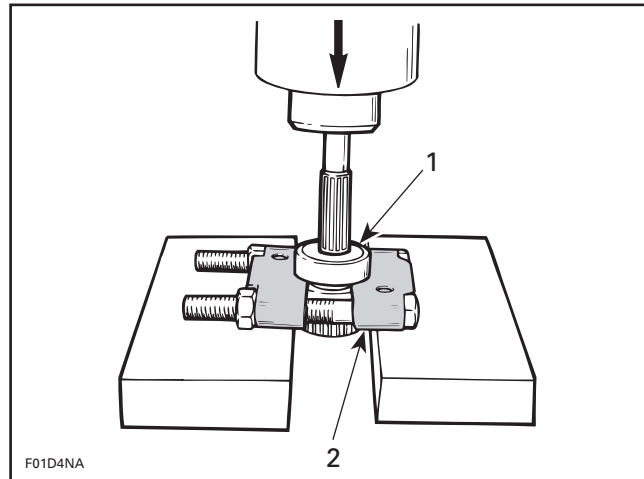
If it is necessary to disassemble components of rotary valve shaft assembly, use seat **no. 6** to compress spring and remove circlips **no. 5**.



1. Compress seat
2. Remove circlips

Shaft Bearing

To remove bearing **no. 8** use a bearing extractor such as Snap-on **no. CJ-950** (or equivalent) as illustrated. Slide off distance sleeve **no. 14**, remove snap ring **no. 7** and washer **no. 15** then press shaft out.

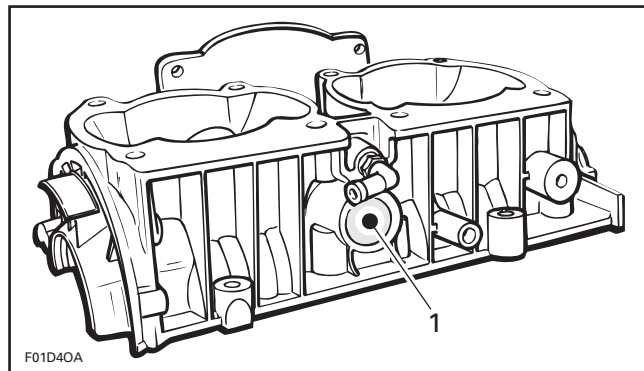


1. Bearing
2. Bearing extractor Snap-on CJ-950

CAUTION: Ensure that rotary valve shaft is perfectly perpendicular with press tip.

End Bearing

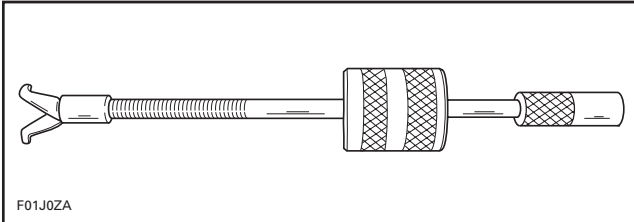
CAUTION: Do not remove plug against bearing in upper crankcase half.



1. Do not remove this plug

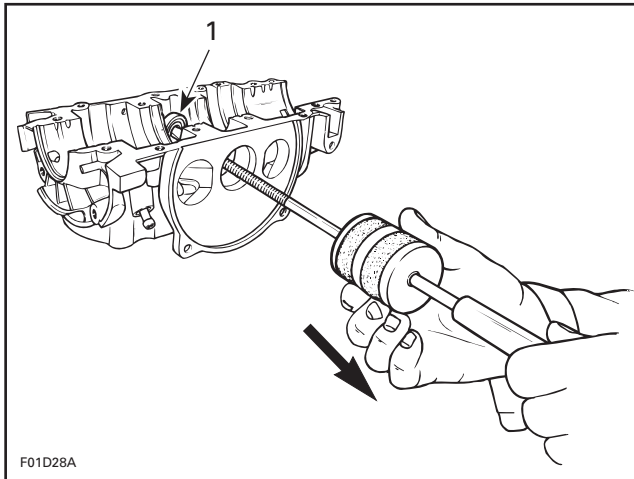
End bearing **no. 9** can be easily removed from upper crankcase half using the following suggested tool (or equivalent):

- Snap-on hammer puller including:
 - handle CJ93-1
 - hammer CJ125-6
 - claws CJ93-4.



Close puller claws so that they can be inserted in end bearing. Holding claws, turn puller shaft clockwise so that claws open and become firmly tight against bearing.

Slide puller hammer outwards and tap puller end. Retighten claws as necessary to always maintain them tight against bearing. Continue this way until bearing completely comes out.



1. End bearing

CLEANING

Discard all seals and O-rings.

Clean all metal components in a solvent.

Clean oil passages and make sure they are not clogged.

Clean rotary valve shaft and inside of distance sleeve **no. 14**.

INSPECTION

Rotary Valve Cover

Inspect rotary valve cover **no. 1** for warpage. Small deformation can be corrected by surfacing with fine sand paper on a surface plate. Surface part against oiled sand paper.

Bearings

Inspect bearings **no. 8** and **no. 9**. Check for scoring, pitting, chipping or other evidence of wear. Make sure plastic cage (on bigger bearing) is not melted. Rotate them and make sure they turn smoothly.

Gear

Visually check gear wear pattern. It should be even on tooth length all around. Otherwise it could indicate a bent shaft, check deflection. Replace gear if damaged.

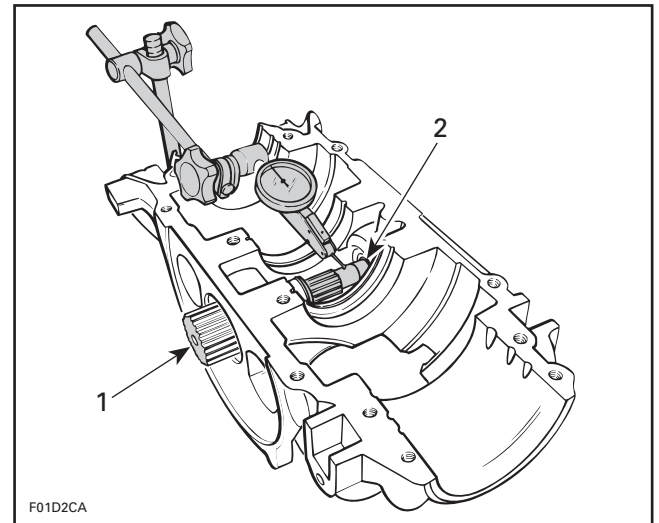
Check for presence of brass filings in gear housing.

Rotary Valve Shaft Deflection

Deflection is measured with a dial gauge. Install rotary valve shaft in crankcase half, without its gear.

NOTE: End bearing must be in crankcase half.

Measure shaft deflection next to gear splines.



1. Rotary valve shaft
2. End bearing in place

Deflection must not exceed 0.08 mm (.003 in). Replace shaft as necessary.

Section 04 ENGINE

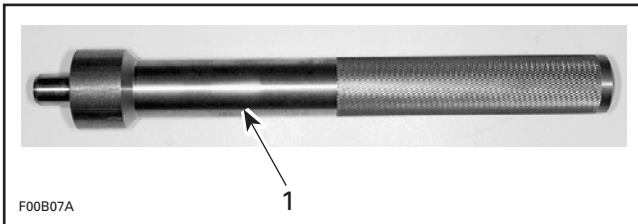
Subsection 07 (ROTARY VALVE)

ASSEMBLY

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

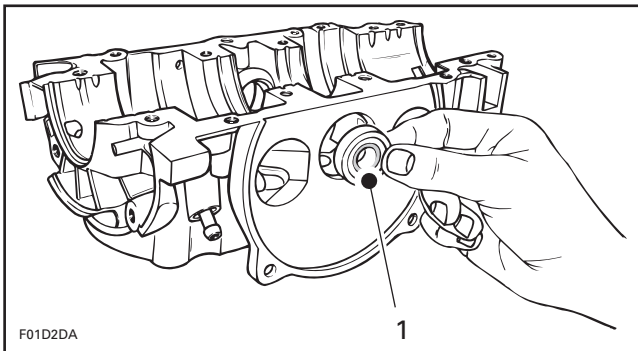
Bearing

To install end bearing **no. 9** in crankcase, use pusher (P/N 420 876 501).



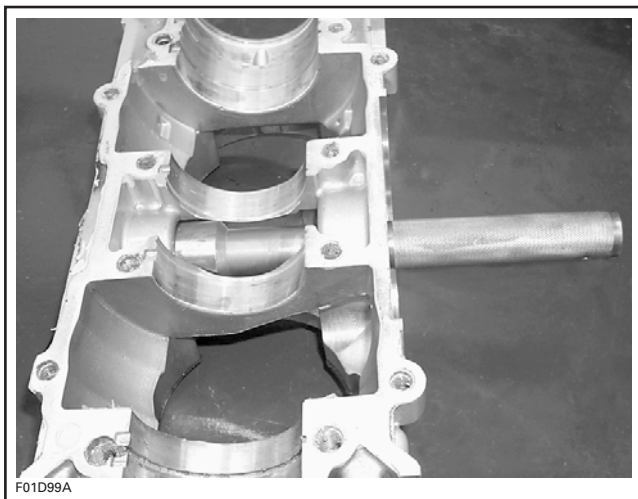
1. Pusher (P/N 420 876 501)

Position ball bearing shielded side towards rotary valve.



1. Shield side (toward gear)

Push bearing until it stops on its seat.

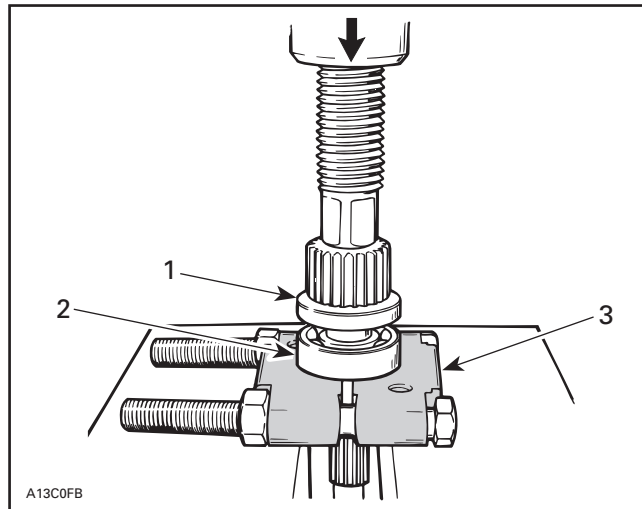


Seal

Apply Molykote 111 on seal lips. Position seal **no. 11** with shielded portion against shaft splines.

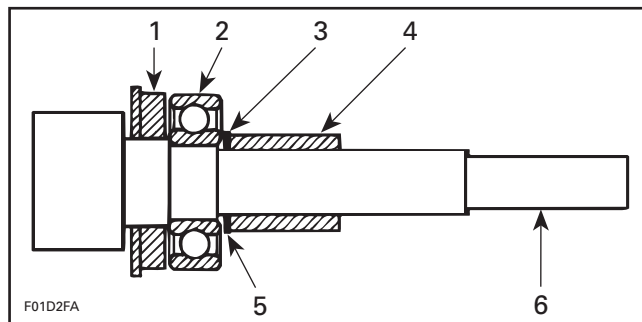
Bearing

Install ball bearing as illustrated.



1. Seal
2. Ball bearing
3. Bearing extractor Snap-on CJ-950

Install washer **no. 15**, snap ring **no. 7** and slide distance sleeve **no. 14** on shaft.



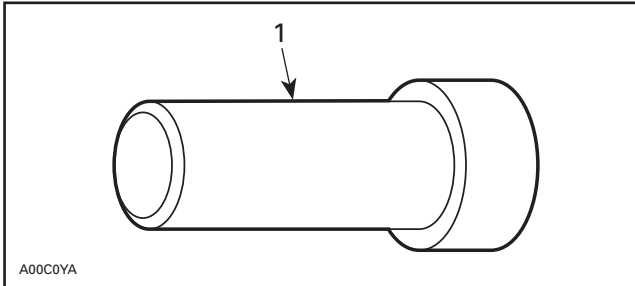
1. Seal
2. Ball bearing
3. Snap ring
4. Distance sleeve
5. Washer 0.5 mm (.020 in)
6. Rotary valve shaft

Rotary Valve Shaft Assembly

CAUTION: Crankcase halves must be separated and crankshaft must not be present to install rotary valve shaft assembly in crankcase.

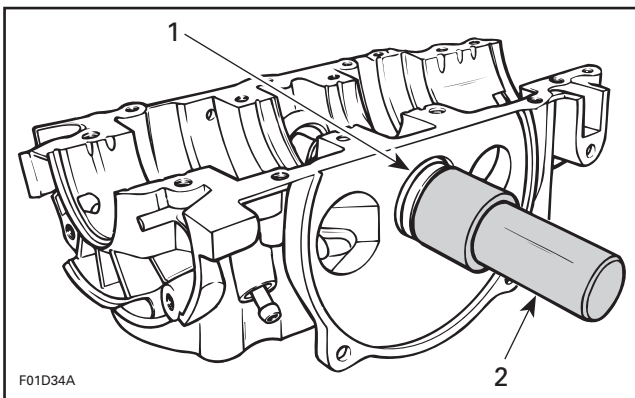
717 Engine

To install rotary valve shaft in crankcase, use a pusher (P/N 420 876 605).



1. Pusher

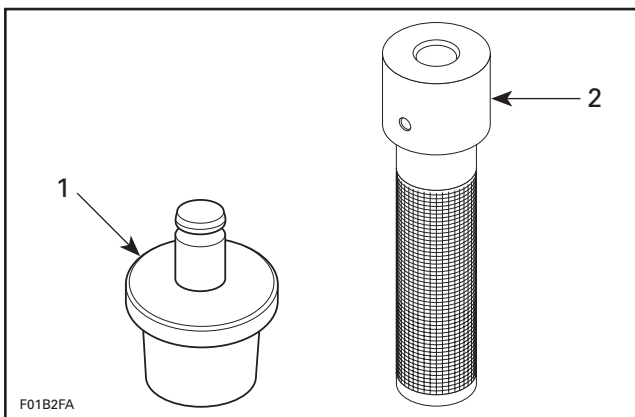
Push shaft until its stops on bearing seat.



1. Rotary valve shaft
2. Push shaft until it stops

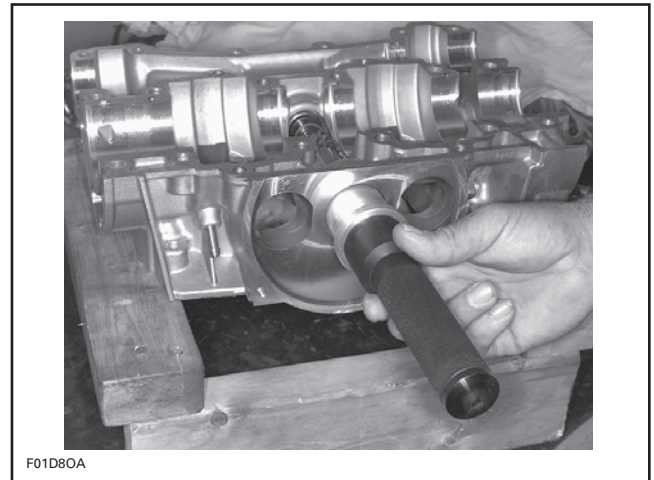
787 RFI Engine

To install rotary valve shaft in crankcase, use a pusher (P/N 290 876 609) and handle (P/N 420 877 650).



1. Pusher
2. Handle

Push shaft until it stops on bearing seat.



717 and 787 RFI Engines

Snap Ring

Position snap ring no. 4 so that its sharp edge faces outwards.

Rotary Valve

The rotary valve no. 13 controls the opening and closing of the inlet ports. Therefore its efficiency will depend on the precision of its installation.

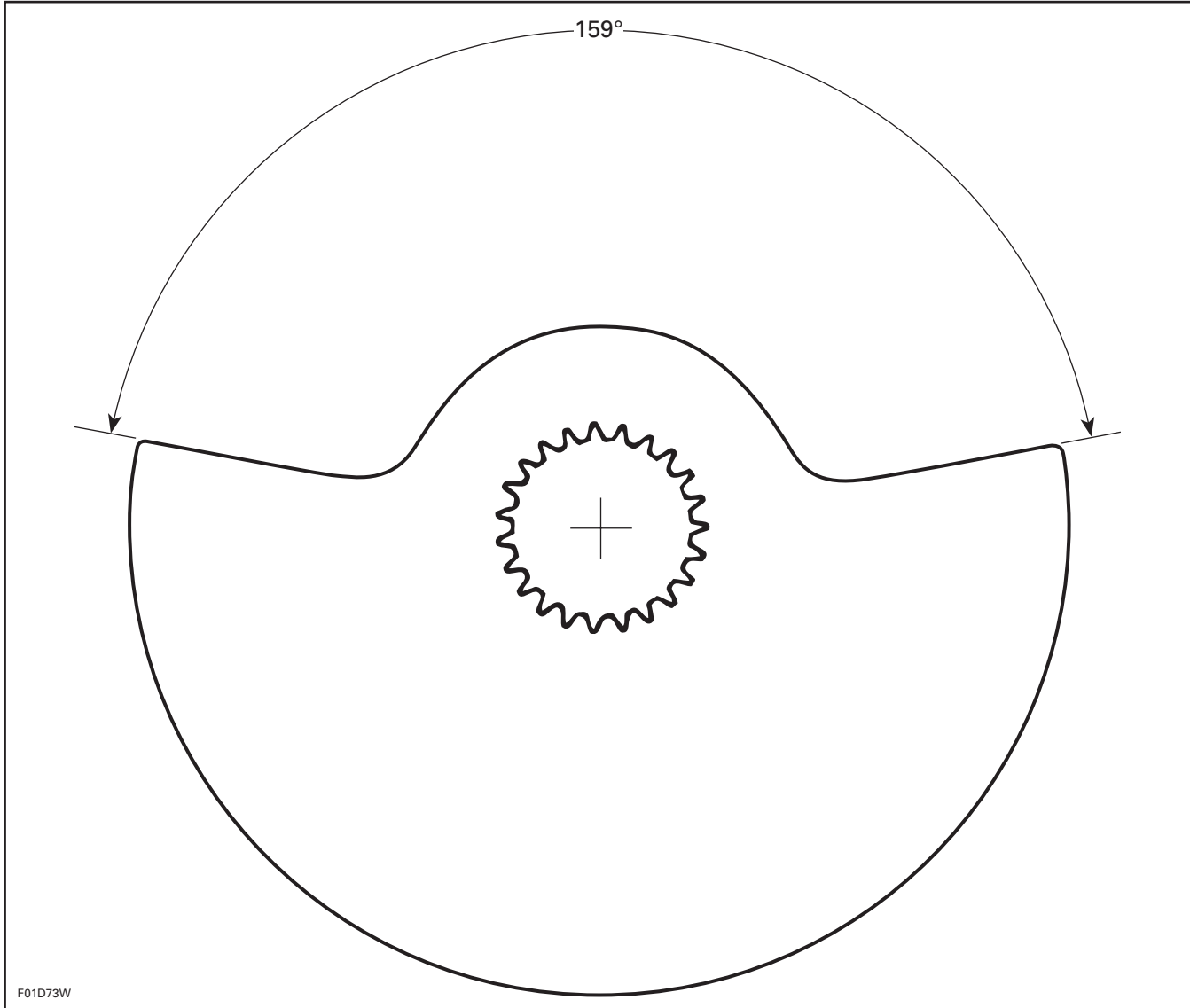
IDENTIFICATION OF THE ROTARY VALVE

ENGINE	ROTARY VALVE P/N	VALVE DURATION
717/787 RFI	420 924 502	159°

Section 04 ENGINE

Subsection 07 (ROTARY VALVE)

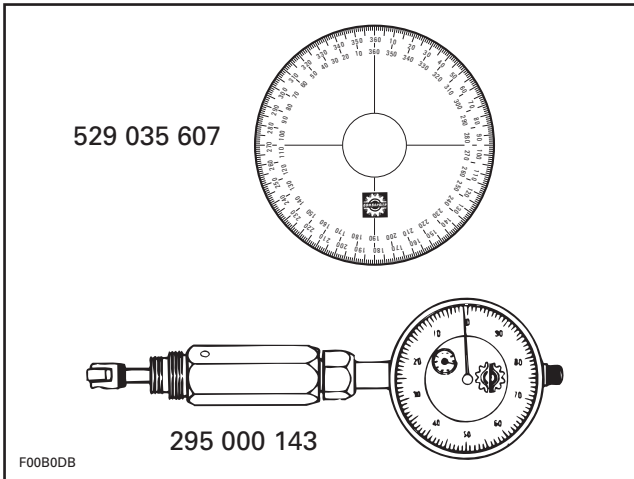
There is no identification code on the valve. To find out the duration, place an angle finder on the valve and measure the valve cut-out angle or use the following template.



ROTARY VALVE TIMING

CAUTION: Never use the ridge molded in crankcase as a timing mark.

The following tools are required to measure rotary valve opening and closing angles in relation with MAG side piston.



Rotary valve must be set so that timing occurs as follows:

ENGINE	TIMING	
	OPENING BTDC	CLOSING ATDC
717	147° ± 5	65.5° ± 5
787 RFI	147° ± 5	63.5° ± 5

Timing Procedure

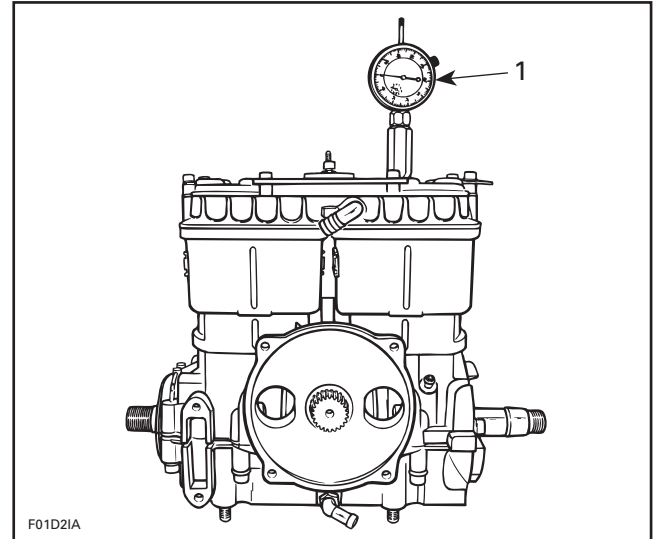
The following specifications are used in this procedure:

OPENING: 147° BTDC

CLOSING: 65° ATDC

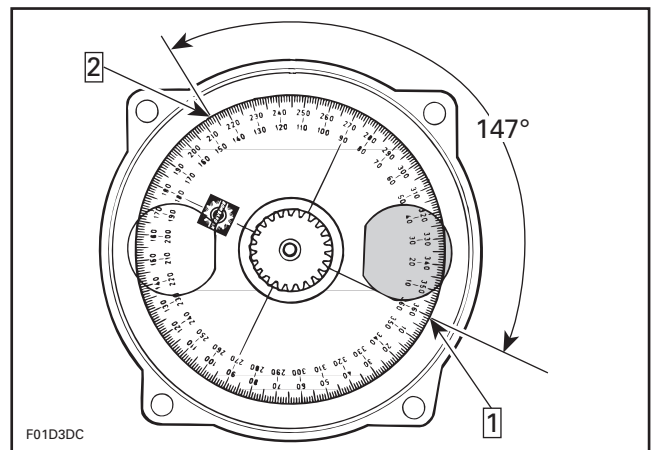
Proceed as follows:

- Turning crankshaft, bring **MAG side** piston to Top Dead Center using a TDC gauge.



1. Bring piston to TDC

- For **opening mark**, first align 360° line of degree wheel with **BOTTOM** of **MAG side** inlet port. Then, find 147° line on inner scale of degree wheel and mark crankcase at this point.



OPENING MARK

Step 1: Bottom of MAG inlet port.

Align 360° line of degree wheel

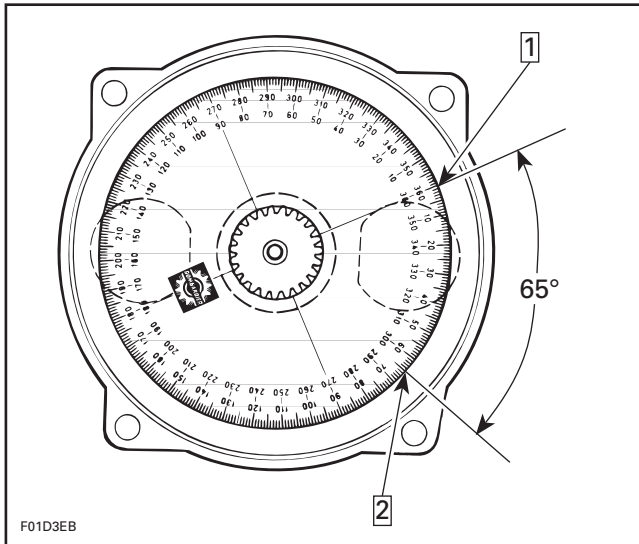
Step 2: Find 147° on inner scale of degree wheel and mark here

NOTE: Do not rotate the crankshaft.

Section 04 ENGINE

Subsection 07 (ROTARY VALVE)

- For **closing** mark, first align 360° line of degree wheel with TOP of **MAG side** inlet port. Then, find 65° line on outer scale of degree wheel and mark crankcase at this point.



CLOSING MARK

- Step **1**: Top of MAG inlet port.
Align 360° line of degree wheel
- Step **2**: Find 65° on outer scale of degree wheel and mark here

- Remove degree wheel.
- Position rotary valve on shaft splines to have edges as close as possible to these marks with the MAG piston at TDC.

NOTE: Rotary valve is asymmetrical. Therefore, try flipping it over then reinstall on splines to obtain best installation position.

Apply BOMBARDIER injection oil on rotary valve before reassembling rotary valve cover.

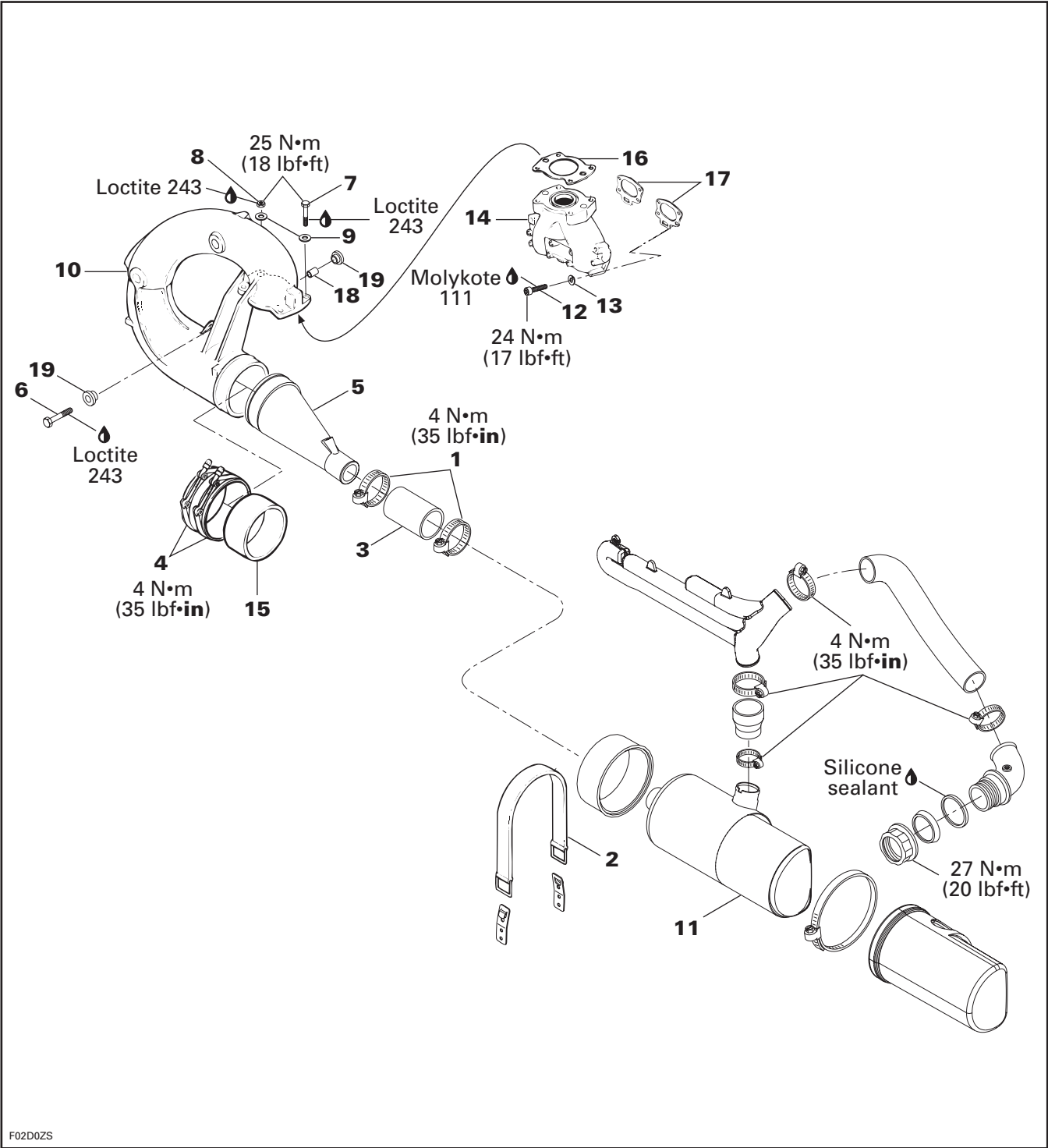
- Remove TDC gauge.

Rotary Valve Cover

Install O-ring **no. 12** and rotary valve cover **no. 1** then torque screws **no. 2** to 20 N•m (15 lbf•ft) in a criss-cross sequence.

EXHAUST SYSTEM

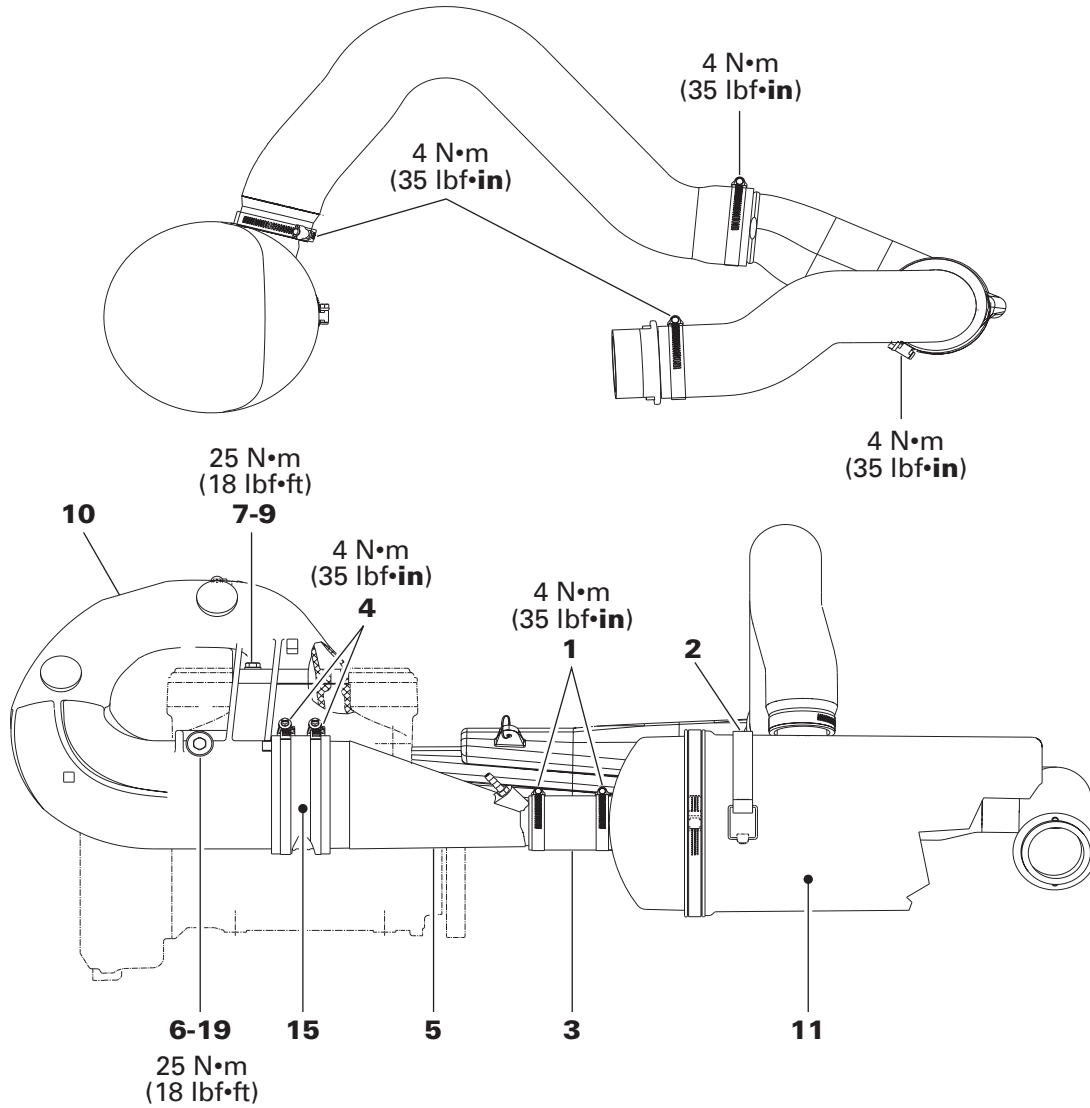
717 Engine Model GS



Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

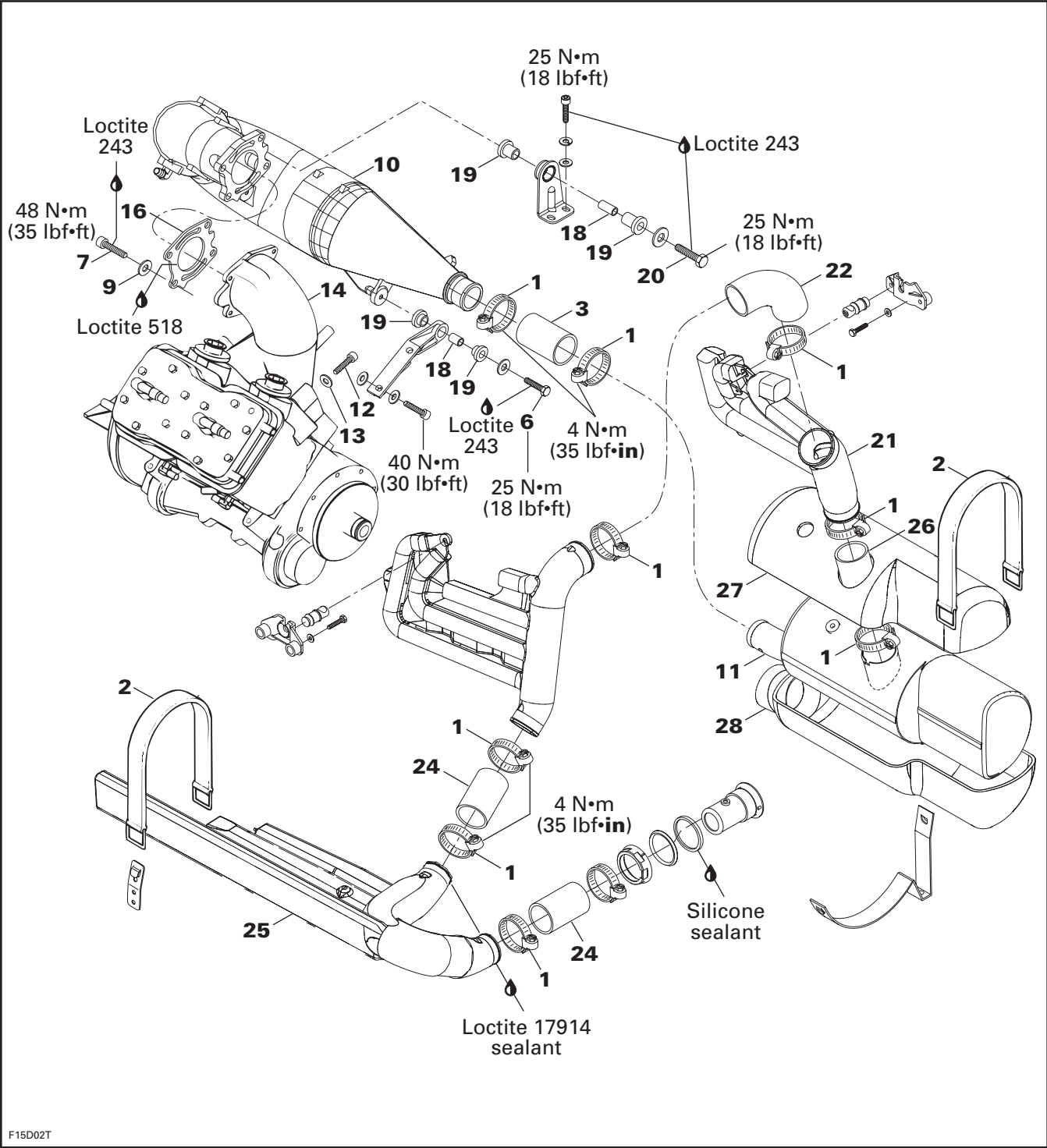
717 Engine Model GTI and GTS



F17D01S

Section 04 ENGINE
Subsection 08 (EXHAUST SYSTEM)

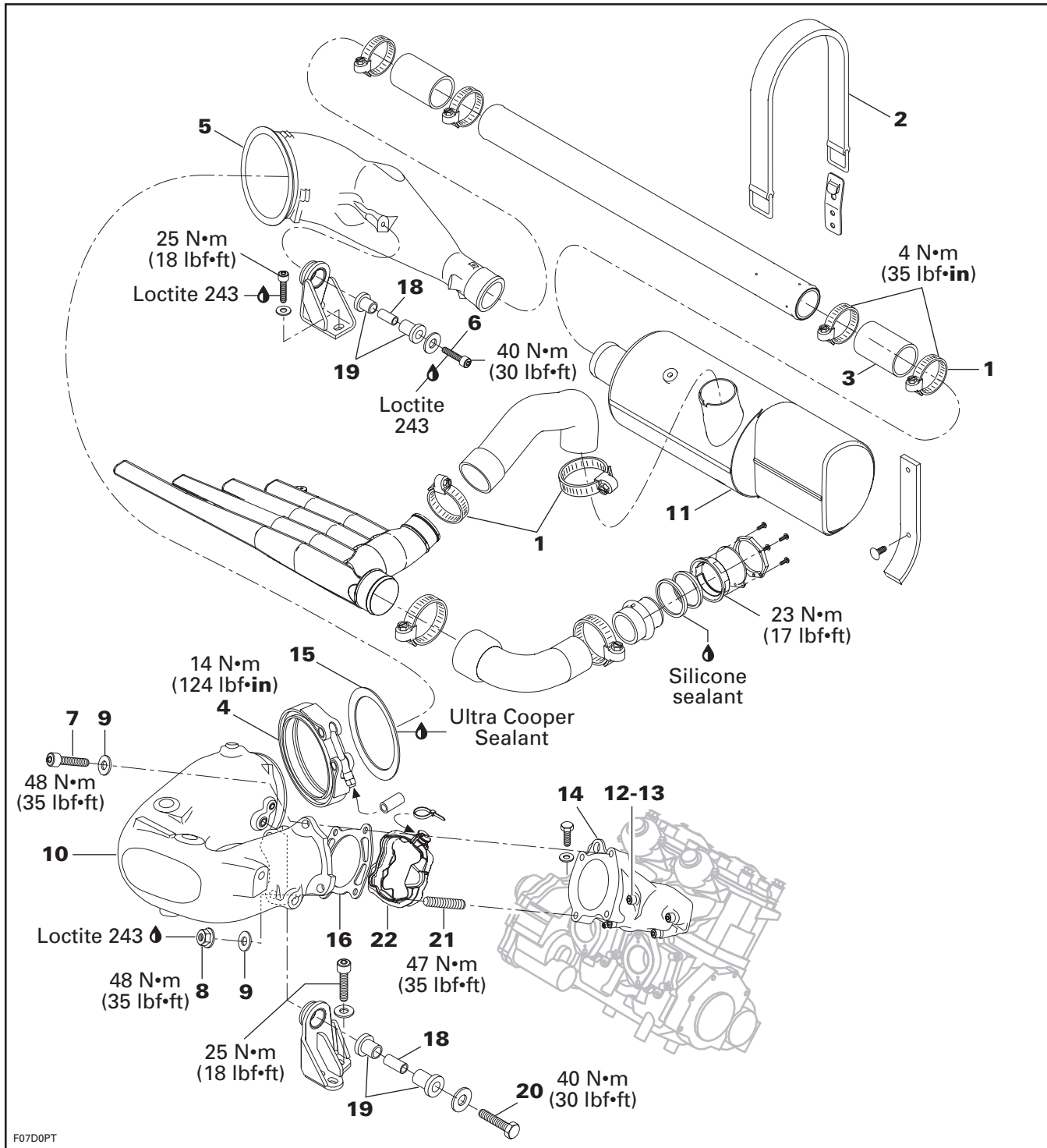
787 RFI Engine



Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

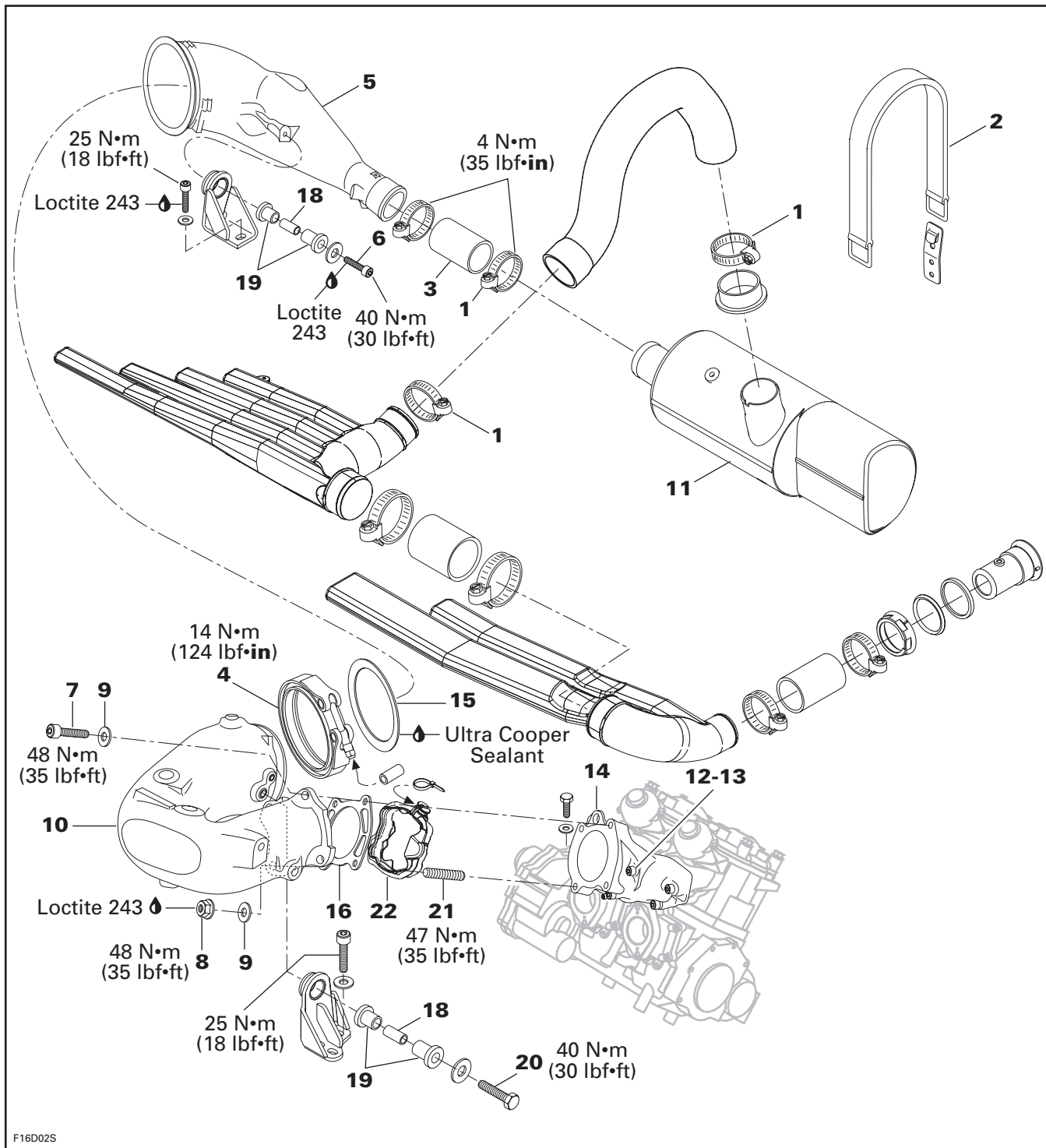
947 Carburetor-Equipped Engines (XP Model)



Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

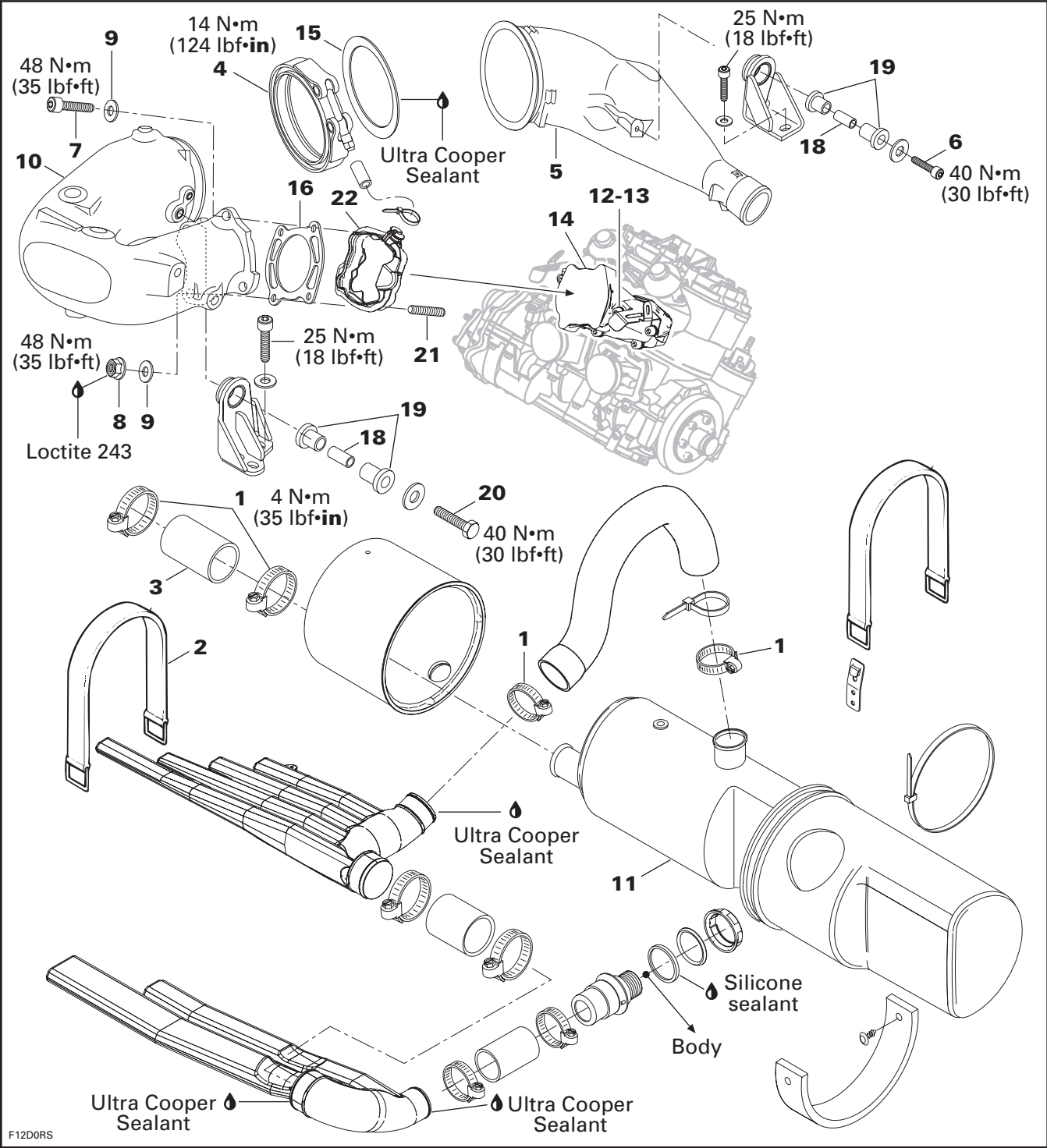
947 Carburetor-Equipped Engines (RX Model)



F16D02S

Section 04 ENGINE
Subsection 08 (EXHAUST SYSTEM)

947 DI Engines



Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

REMOVAL

All Models except XP

Remove seat(s).

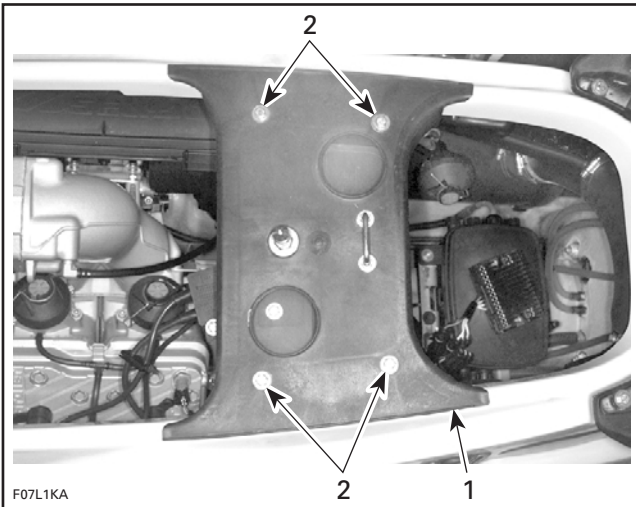
Remove rear vent hose support from body opening.



GS SHOWN

1. Rear vent hose support

Remove seat support (all models except GS, RX and XP).



TYPICAL

1. Seat support
2. Remove screws

XP Model

Open engine compartment cover.

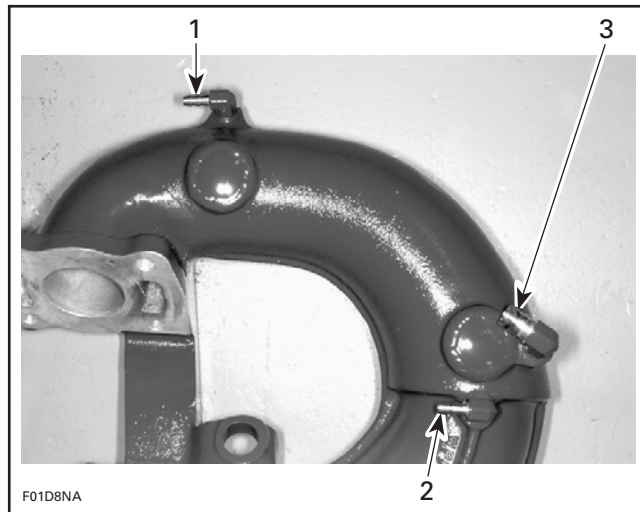
Remove storage basket.

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** from exhaust manifold side.

Remove screws **no. 7**, nut **no. 8** and flat washers **no. 9** from tuned pipe flange.

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

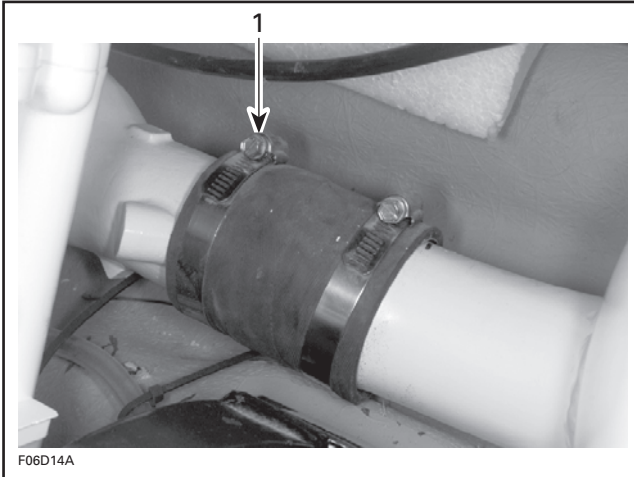
Withdraw tuned pipe head **no. 10** in a forward and rotating movement.

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 engine.

Remove tuned pipe from watercraft.

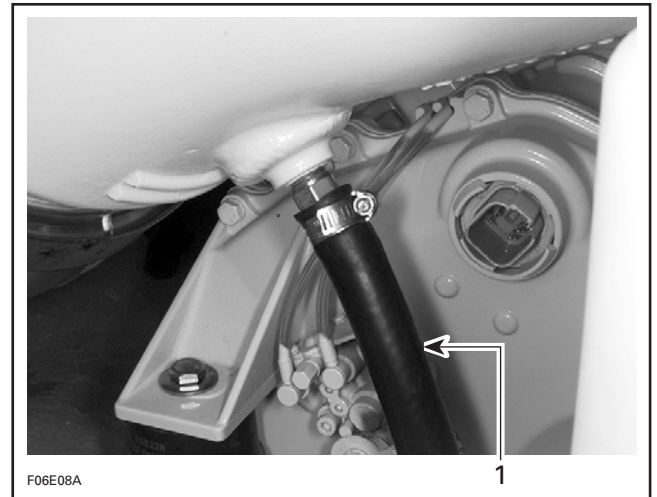
947 Engine

To remove this tuned pipe, there are 2 possible way to proceed.

The first procedure separates the tuned pipe head from the tuned pipe cone, using the following procedure. The second procedure removes the tuned pipe without tuned pipe head and tuned pipe cone separation. This procedure is explained further.

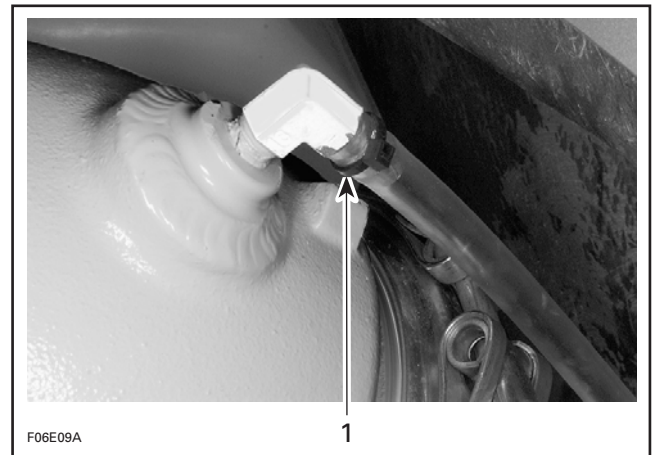
Tuned Pipe Removal with Separation from Tuned Pipe Head and Tuned Pipe Cone

1. Disconnect water return hose at tuned pipe head **no. 10**.



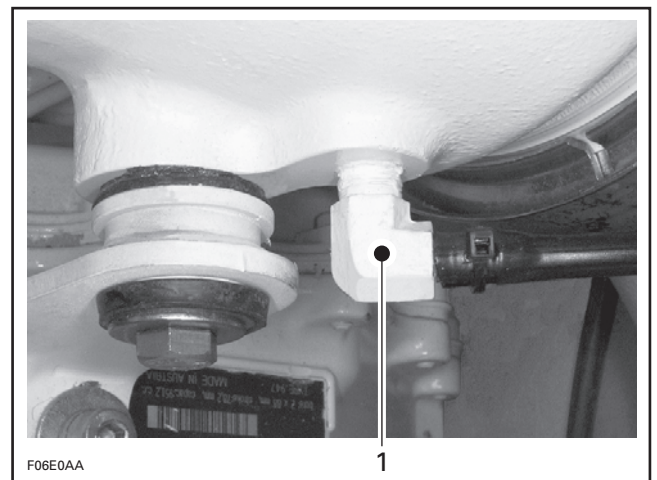
1. Water return hose

2. Disconnect small hose from water outlet fitting at the tuned pipe head **no. 10**.



1. Disconnect hose from outlet fitting

3. Disconnect the water injection hose at tuned pipe head **no. 10**.

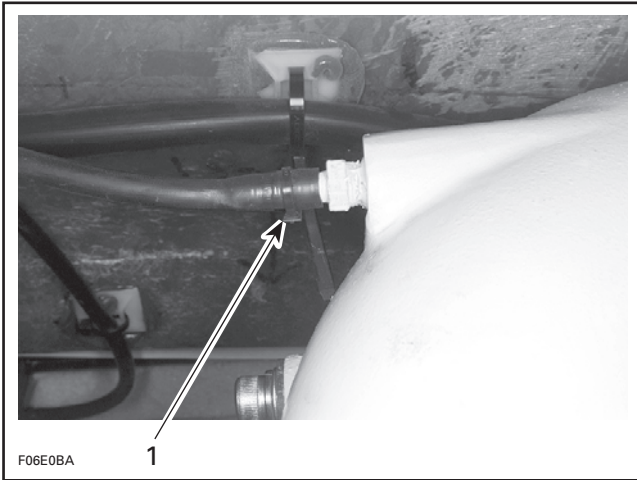


1. Water injection hose

Section 04 ENGINE

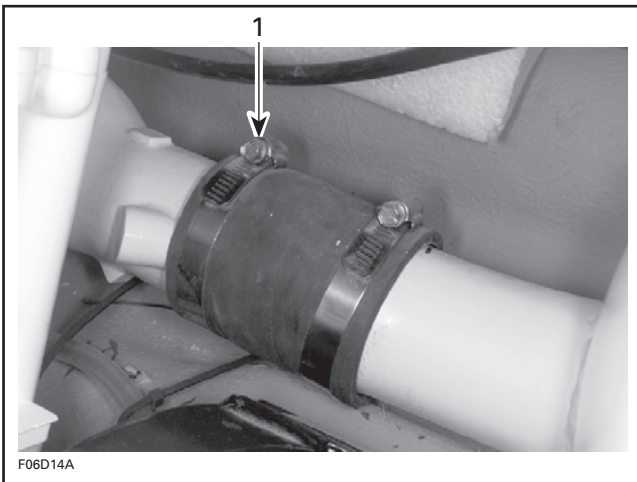
Subsection 08 (EXHAUST SYSTEM)

4. Disconnect the water bleed hose.



1. Water bleed hose

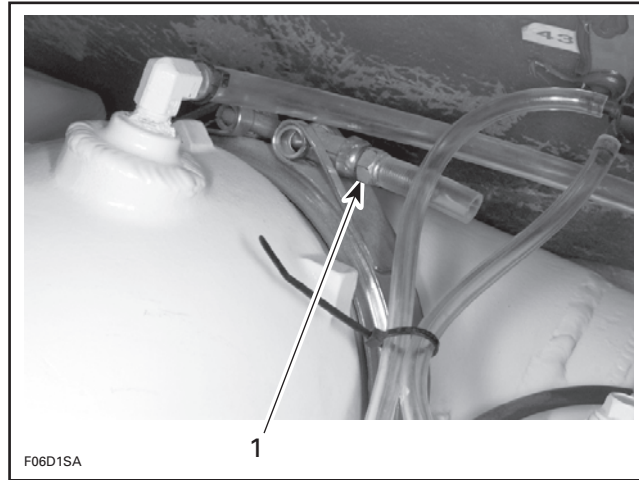
5. Loosen clamp no. 1 retaining exhaust hose no. 3 to tuned pipe cone no. 5.



TYPICAL

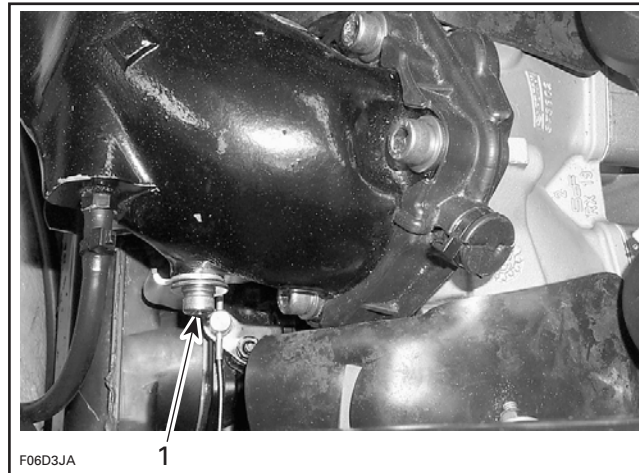
1. Loosen clamp

6. Loosen and remove clamp no. 4 retaining tuned pipe head no. 10 to tuned pipe cone no. 5.



1. Loosen and remove clamp

7. Loosen Allen screw retaining carburetor bracket to tuned pipe head.



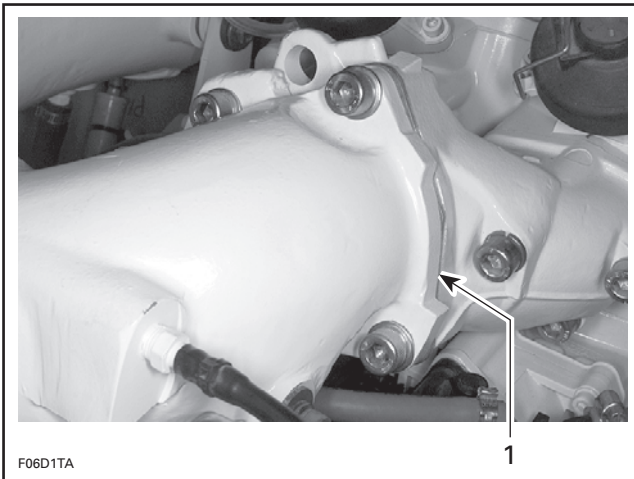
1. Loosen Allen screw

8. Remove external seal.

Section 04 ENGINE
Subsection 08 (EXHAUST SYSTEM)

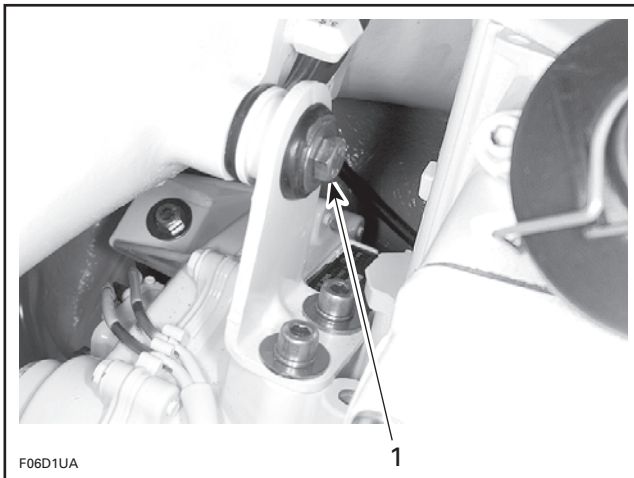
9. Loosen Allen screws **no. 7** and nut **no. 8** at tuned pipe flange.

NOTE: To loosen nut, use polygonal wrench (P/N 529 035 505).



1. Tuned pipe flange

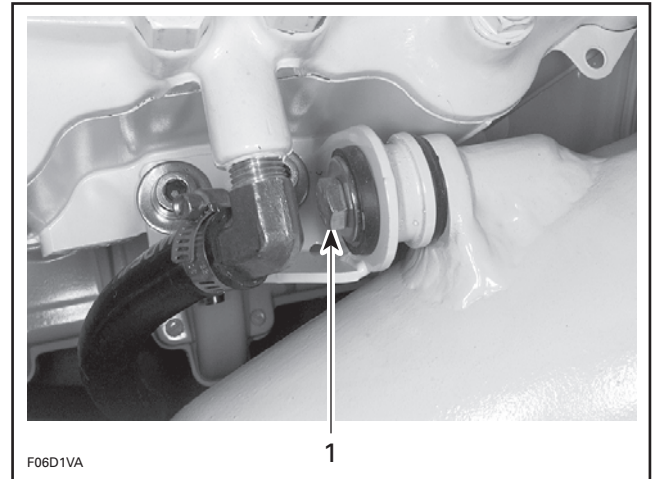
10. Loosen bolt **no. 20** of tuned pipe head above the engine magneto then remove bolts retaining bracket to engine.



1. Remove bolt

11. Remove tuned pipe head **no. 10**.

12. Loosen bolt **no. 6** of tuned pipe cone beside the engine water return hose.



1. Loosen bolt

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

14. Block exhaust opening in the manifold to keep debris from entering cylinder during threads cleaning procedure.

15. Remove the stud **no. 21** from "Y" manifold.

16. Use a M10 x 1.5 screw/tap to clean the 4 threaded holes on the "Y" manifold and the 2 threaded holes on tuned pipe. Clean out the debris with a spray cleaner and air pressure.

CAUTION: It is very important that the threads are free of debris before installing new self-locking fasteners.

Tuned Pipe Removal without Separation from Tuned Pipe Head and Tuned Pipe Cone

Execute the above procedures 1 through 5.

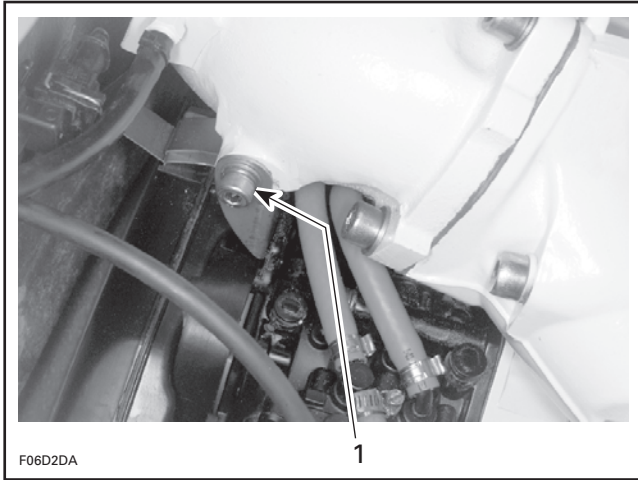
Later, use the following procedure:

Remove the strap **no. 2** retaining the muffler then remove the exhaust hose **no. 3** from tuned pipe cone **no. 5**.

Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

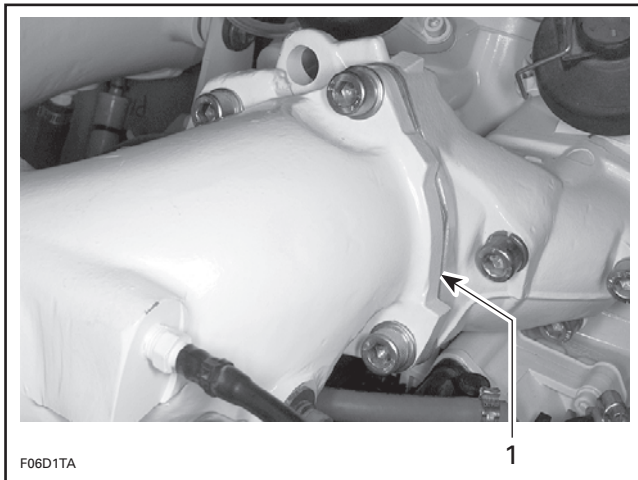
Loosen Allen screw retaining carburetor bracket to tuned pipe head.



1. Loosen Allen screw

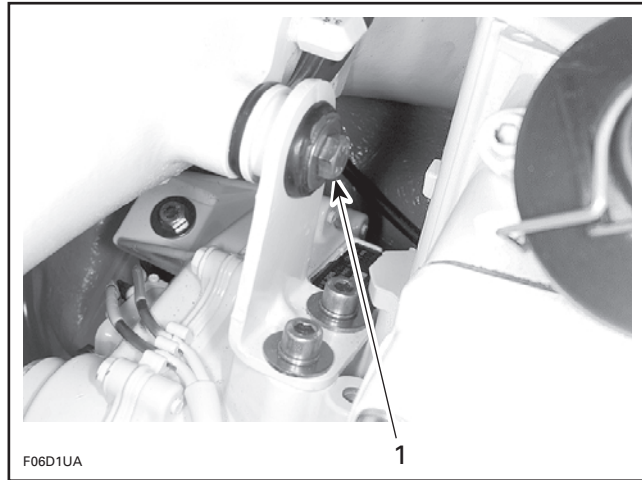
Loosen Allen screws **no. 7** and nut **no. 8** at tuned pipe flange.

NOTE: To loosen nut, use polygonal wrench (P/N 529 035 505).



1. Tuned pipe flange

Loosen bolt **no. 20** of tuned pipe head above the engine magneto then remove bolts retaining bracket to engine.



1. Remove bolt

Remove tuned pipe assembly.

Block exhaust opening in the manifold to keep debris from entering cylinder during threads cleaning procedure.

Remove the stud **no. 21** from "Y" manifold.

Use a M10 x 1.5 screw/tap to clean the 4 threaded holes on the "Y" manifold and the 2 threaded holes on tuned pipe. Clean out the debris with a spray cleaner and air pressure.

CAUTION: It is very important that the threads are free of debris before installing new self-locking fasteners.

Exhaust Manifold

Remove 8 Allen screws **no. 12** and lock washers **no. 13** then withdraw exhaust manifold.

Resonators

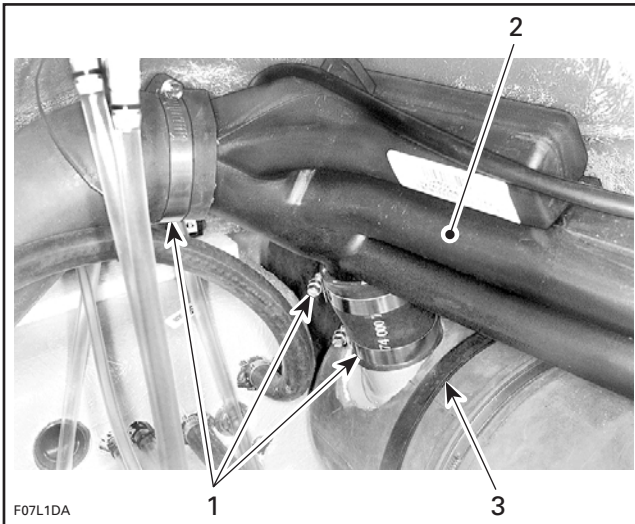
GTI, GTS and RX Models

Remove vent tube support.

Upper Type Resonators

Detach resonator from body.

Loosen clamps and disconnect hoses. Withdraw resonator from watercraft.

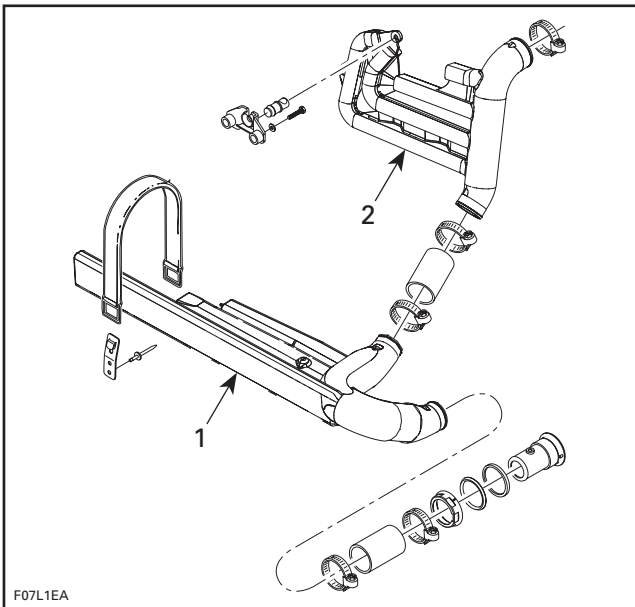


TYPICAL

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

Footwell Type Resonators

NOTE: Some models are equipped with both types or resonators (GTX RFI and GTX).



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.

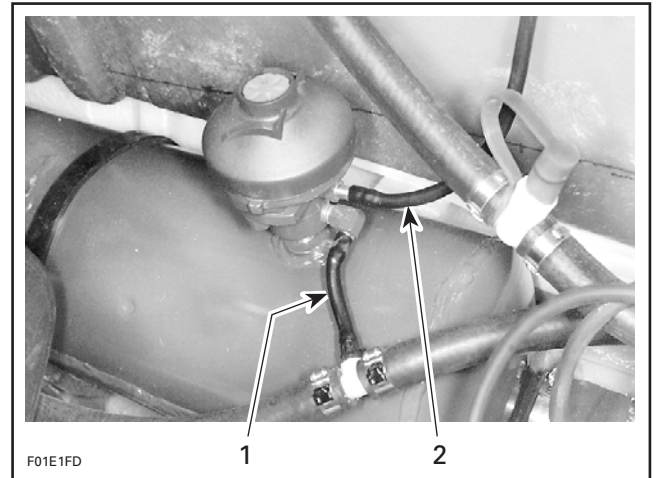
Pull resonator out of bilge.

Muffler

On DI models, disconnect the EGT (exhaust gas temperature) sensor.

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

Disconnect hoses of the water flow regulator valve (**except 717 engine**).



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.

NOTE: **On RX and XP models,** remove the VTS motor. Refer to VARIABLE TRIM SYSTEM.

TUNED PIPE REPAIR

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

Procedure

- 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.

Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

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 immersing it in water.

INSTALLATION

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

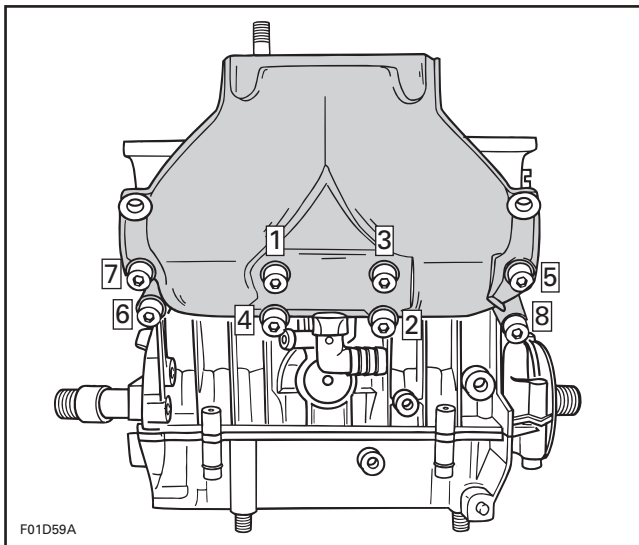
Exhaust Manifold

Make sure gasket(s) **no. 17** are properly positioned prior to finalizing manifold installation.

717 Engine

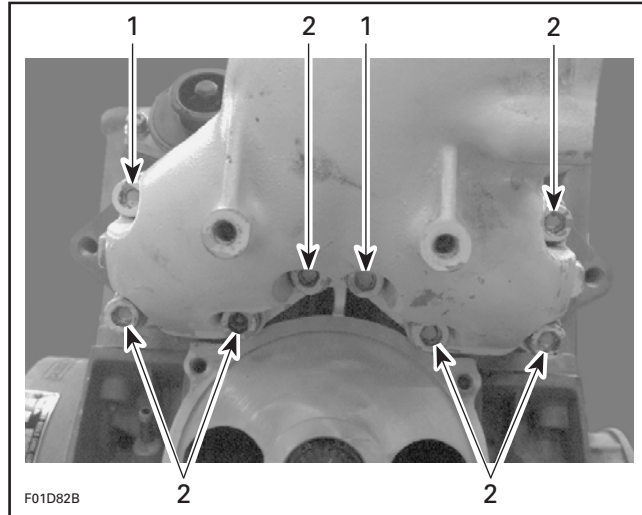
Apply Molykote 111 on threads of screws **no. 12**.

Install exhaust manifold **no. 14** and torque screws **no. 12** to 24 N•m (17 lbf•ft) as per following illustrated sequence.



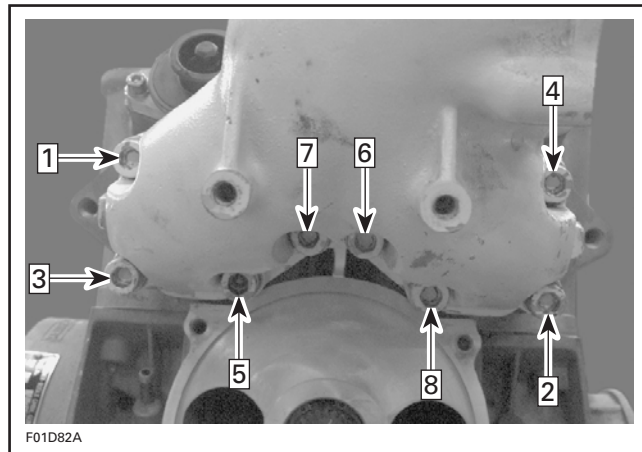
787 RFI Engine

Apply Loctite 518 on 2 screws **no. 12**. On the other screws **no. 12**, apply Molykote 111 on threads. Install screws. Refer to the following illustration for proper position of screws.



1. Screw with Loctite 518
2. Screw with Molykote 111

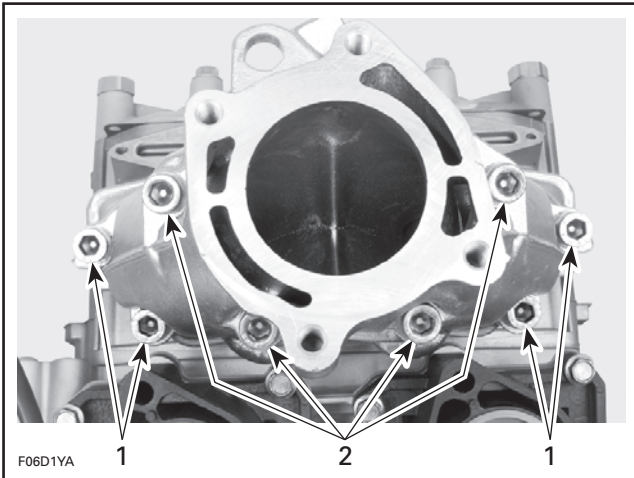
Torque exhaust manifold screws to 24 N•m (17 lbf•ft) as per following illustrated sequence. Repeat the procedure, retightening screws to 40 N•m (30 lbf•ft).



947 Engine

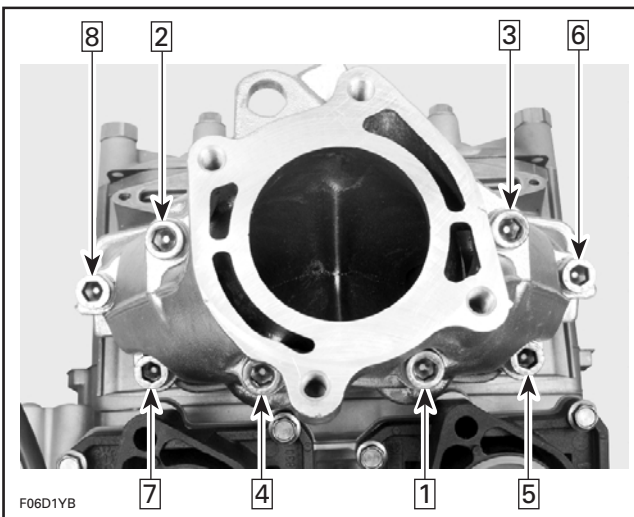
Apply Molykote 111 on threads of Allen screws no. 12.

Install and hand tighten Allen screws no. 12 as per following picture.



- 1. M10 x 60 Allen screws
- 2. M10 x 110 Allen screws

Torque Allen screws to 24 N•m (17 lbf•ft) as per following illustrated sequence. Repeat the procedure, retightening Allen screws to 40 N•m (30 lbf•ft).



Tuned Pipe

717 Engine

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

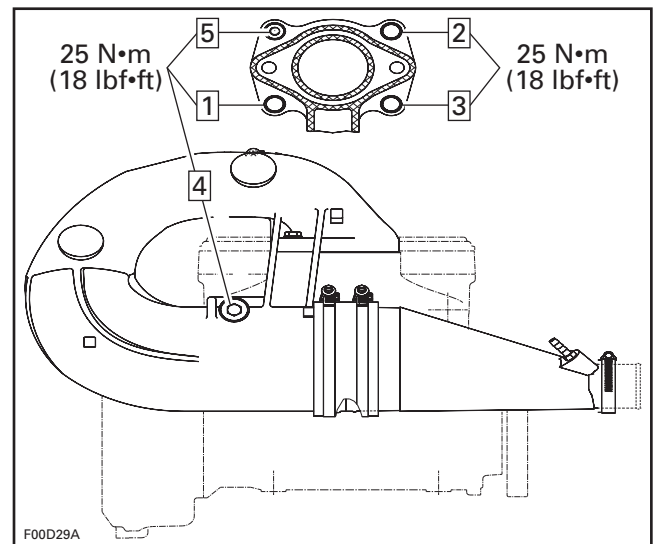
Ensure rubber bushings no. 19 and sleeve no. 18 are not damaged and are properly installed into tune pipe support(s).

CAUTION: Damage to bushings and/or sleeve will eventually cause stress to tune 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) on nut no. 8 and screws no. 6 and no. 7.

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

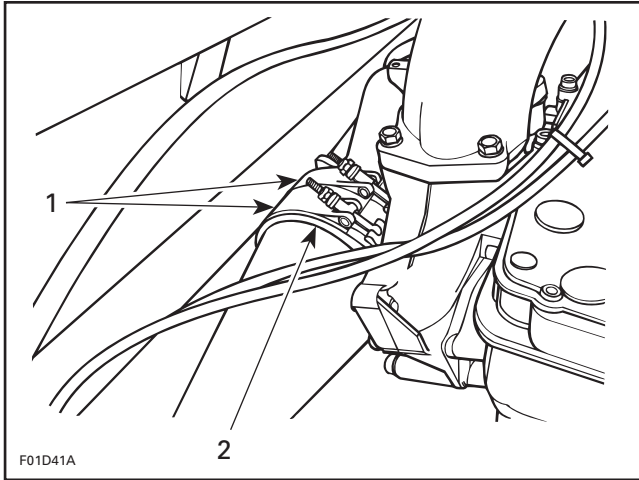


Install tuned pipe cone no. 5 with collar no. 15 and clamp no. 4.

Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

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

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

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

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

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

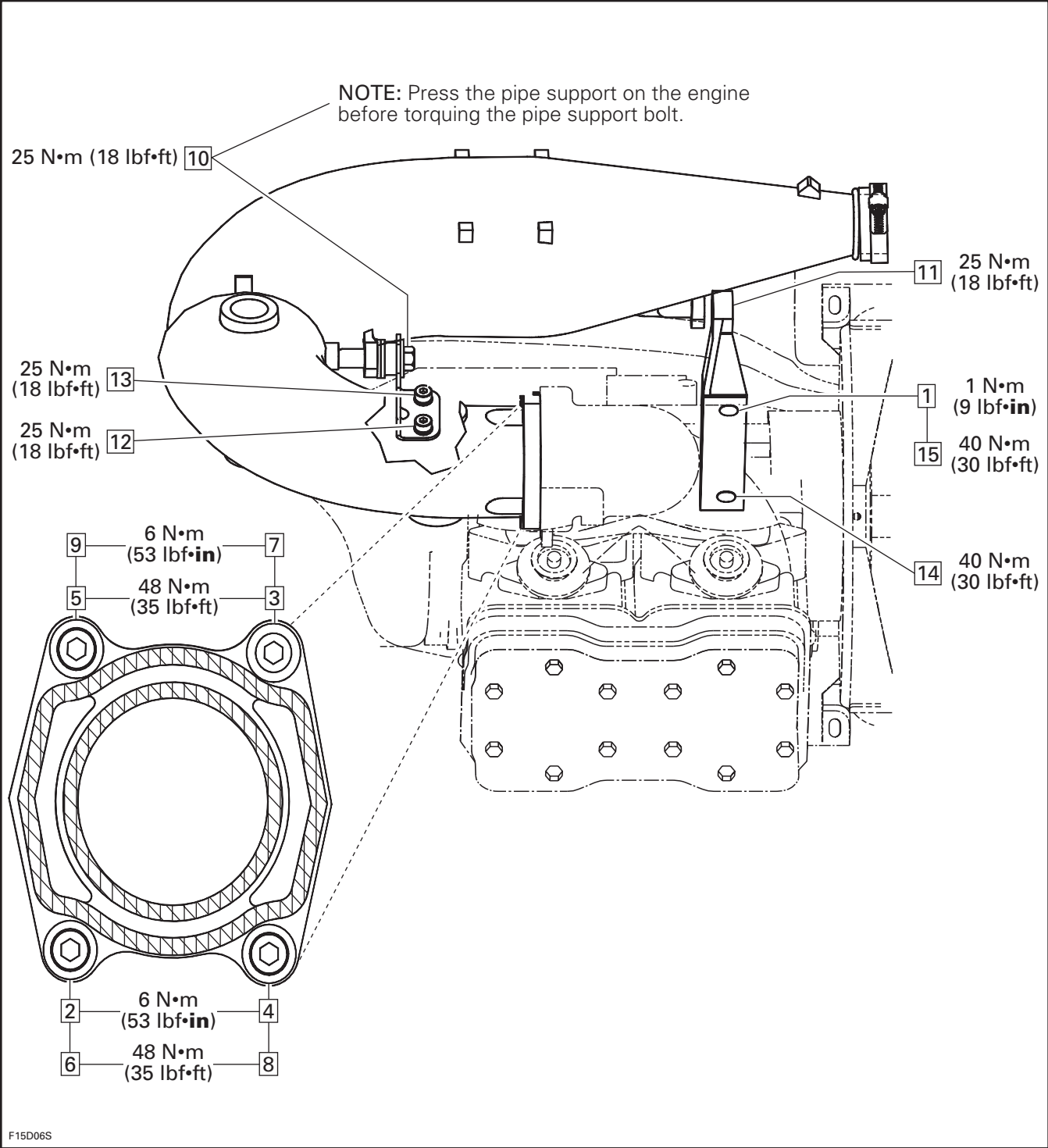
Make sure that gasket no. 16 is properly located on exhaust manifold prior to finalizing pipe installation.

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.

Section 04 ENGINE
Subsection 08 (EXHAUST SYSTEM)



Section 04 ENGINE

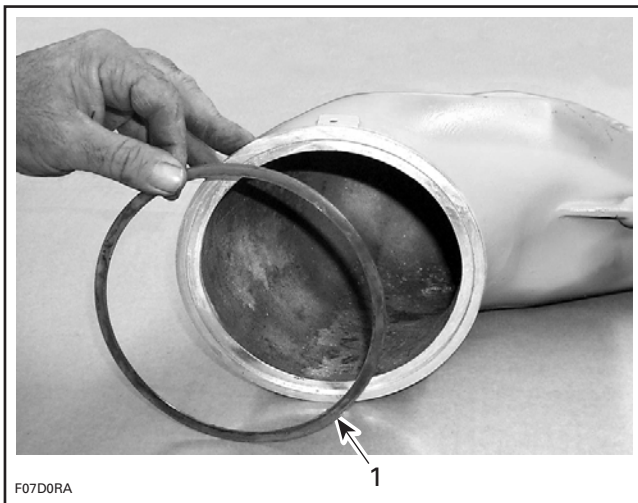
Subsection 08 (EXHAUST SYSTEM)

947 Engine

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

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

Make sure to install the sealing ring **no. 15** on tuned pipe cone if it was removed.



TYPICAL

1. Sealing ring

Apply a thin layer of Ultra Copper heat resistant sealant (P/N 413 710 300) all around sealing ring **no. 15**.

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

CAUTION: It is very important that the threads are free of debris before installing new self-locking fasteners. Refer to removal procedure for the proper thread cleaning procedure.

Clean the "Y" manifold and tuned pipe surfaces.

Screw stud **no. 21** into the "Y" manifold. Torque to 47 N•m (35 lbf•ft).

Install the new bushing **no. 18**.

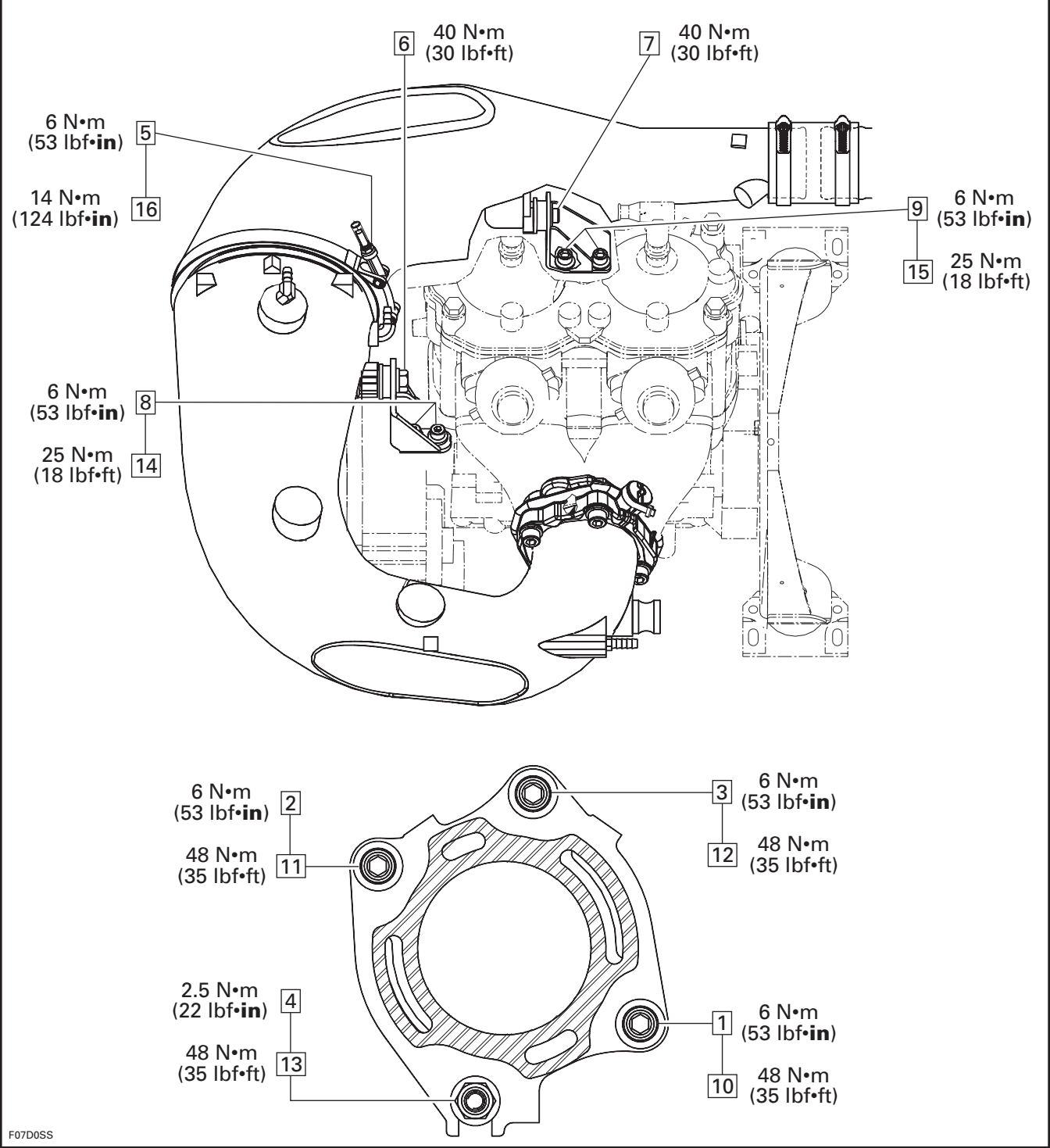
Torquing Sequence:

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

NOTE: Apply Loctite 243 (P/N 293 800 060) on stud nut before tightening to 2.5 N•m (22 lbf•in). Use special tool (P/N 529 035 505).

Install external seal **no. 22** and secure with a locking tie.

Section 04 ENGINE
Subsection 08 (EXHAUST SYSTEM)

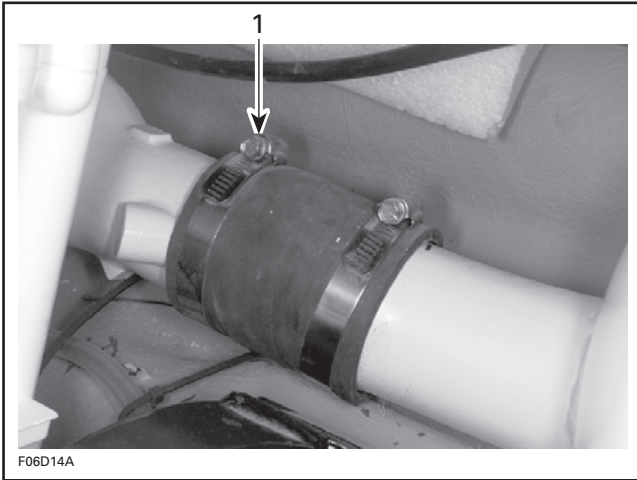


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Section 04 ENGINE

Subsection 08 (EXHAUST SYSTEM)

Install exhaust hose.



1. Torque clamp to 4 N•m (35 lbf•in)

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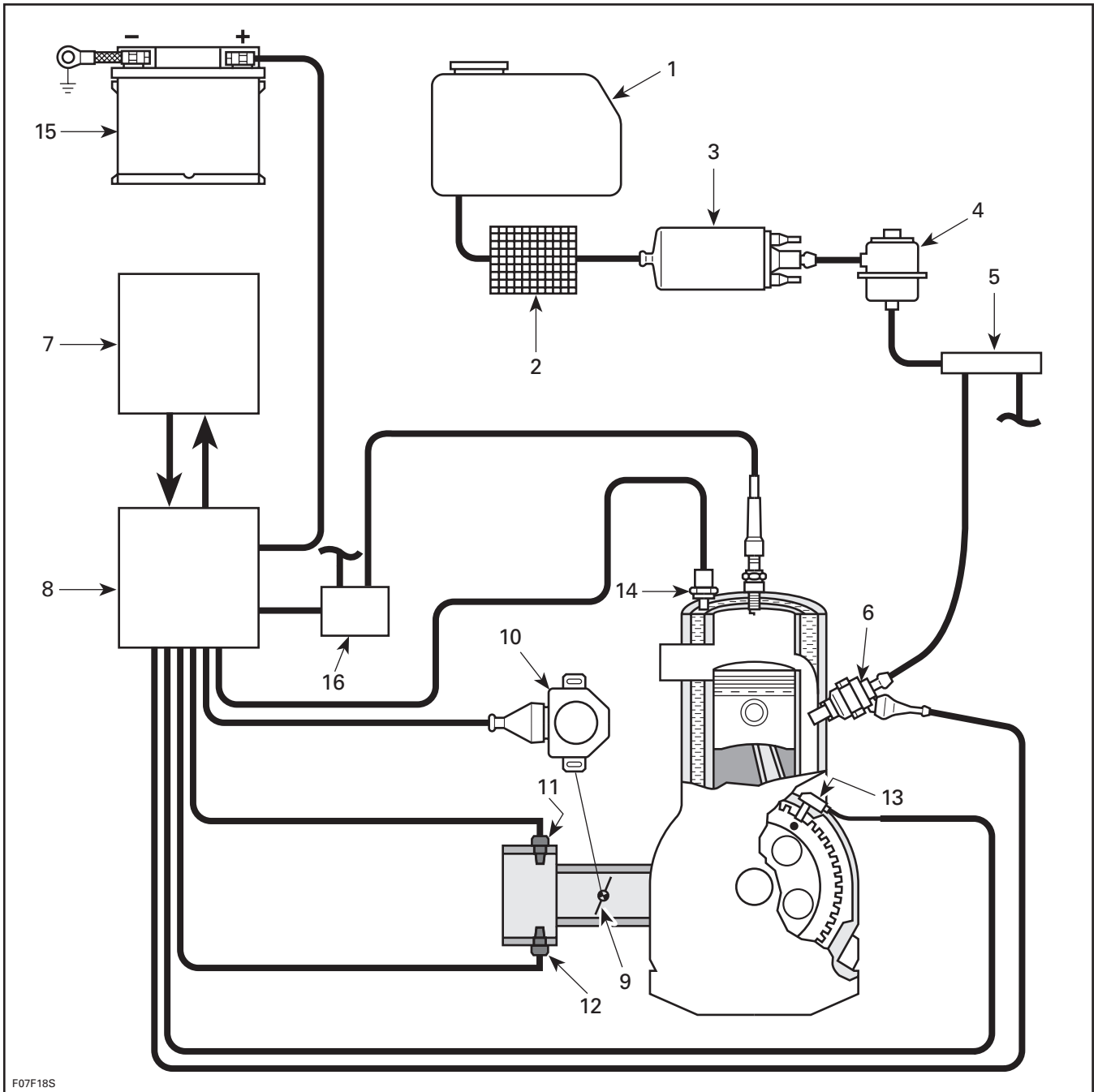
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Section 05 ENGINE MANAGEMENT (RFI)

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OVERVIEW



F07F18S

DESCRIPTION OF THE FUEL INJECTION SYSTEM

- | | |
|---|--------------------------------------|
| 1. Fuel tank | 9. Throttle plate |
| 2. Fuel filter | 10. Throttle Position Sensor (TPS) |
| 3. Fuel pump | 11. Air Pressure Sensor (APS) |
| 4. Regulator | 12. Air Temperature Sensor (ATS) |
| 5. Fuel rail | 13. Crankshaft Position Sensor (CPS) |
| 6. Fuel injector | 14. Water Temperature Sensor (WTS) |
| 7. Electronic Control Unit (ECU) | 15. Battery |
| 8. Multi-Purpose Electronic Module (MPEM) | 16. Ignition coil |

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 02 (OVERVIEW)

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

Fuel is injected into each cylinder through the rear transfer port. With this design, the injector is not exposed to high combustion pressure, temperature and contaminants.

This system delivers the following benefits:

- easier cold engine starting (no choke)
- easier hot engine starting
- improved idling
- better throttle response
- better fuel economy
- no fuel valve.

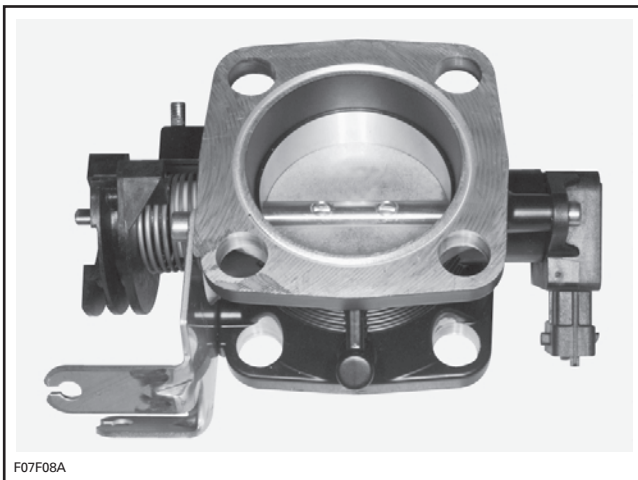
This system has the advantage of optimizing the engine power, fuel economy and emission controls under all engine operating conditions by managing both the fuel injection duration and ignition timing.

The Rotax Fuel Injection (RFI) is composed of the 3 following basic systems:

1. air induction
2. fuel delivery
3. electronic management.

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.

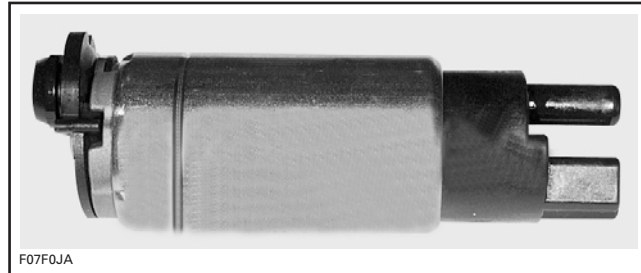


THROTTLE BODY

FUEL DELIVERY

FUEL PUMP

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



FUEL PUMP

FUEL PRESSURE REGULATOR

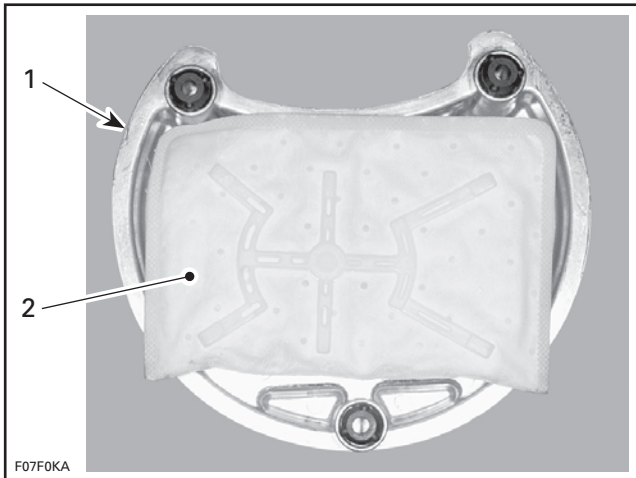
A regulator maintains a constant fuel pressure of 386 - 414 kPa (56 - 60 PSI).



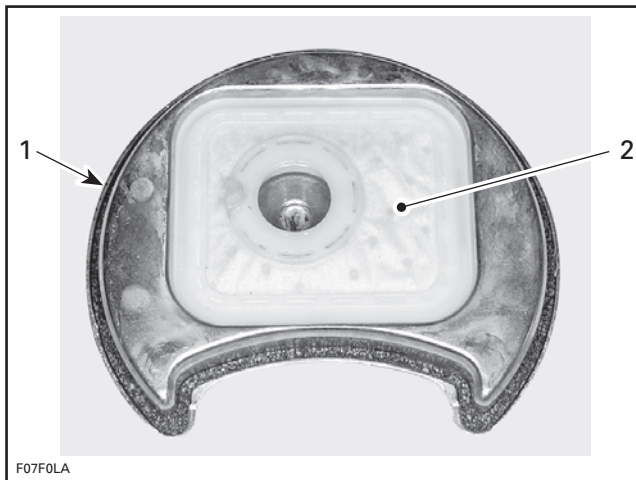
REGULATOR

FUEL FILTERS

A dual piece fuel filter protects the fuel pump, regulator and injectors.



1. Fuel pump assembly
2. External fuel filter



1. End cap of fuel pump assembly removed
2. Internal fuel filter

FUEL PUMP MODULE

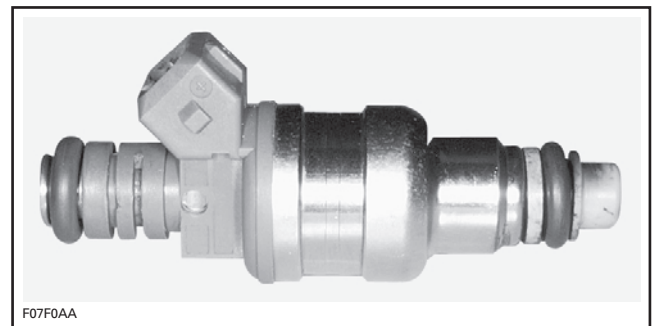
All these components are comprised in a single module mounted in the fuel tank. The fuel gauge sender is also mounted on this module.



FUEL PUMP ASSEMBLY

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 Electronic Control Unit (ECU).



INJECTOR

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 02 (OVERVIEW)

ELECTRONIC MANAGEMENT

ELECTRONIC CONTROL UNIT (ECU)

The electronic fuel injection is equipped with a Bosch Electronic Control Unit (ECU).



ELECTRONIC CONTROL UNIT (ECU)

The ECU is mounted behind the MPEM in the front of the watercraft, in a watertight box.

The ECU controls the following functions:

Basic Operating Function

Electronic Fuel Injection

The ECU 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 ECU to determine the injection duration required for optimum air-fuel ratio.

Ignition Timing

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

Maximum Engine Speed

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

Fail-Safe Function

In the event of a sensor malfunction, the ECU will use a default operating mode to ensure driveability to shore. A message may be displayed on the Info Center to inform the operator.

Diagnostic Mode

The ECU is able to detect malfunctions in the sensor network. The malfunction is recorded in the memory of the ECU. The memory of the ECU can be checked using the MPEM programmer tool.

MPEM (multi-purpose electronic module)

The MPEM is also used with the Rotax Fuel Injection system.



MPEM

It is responsible of the following electrical functions:

- interpreting information
- distributing information
- start/stop function
- timer
- vehicle hours
- Digitally Encoded Security System (DESS).

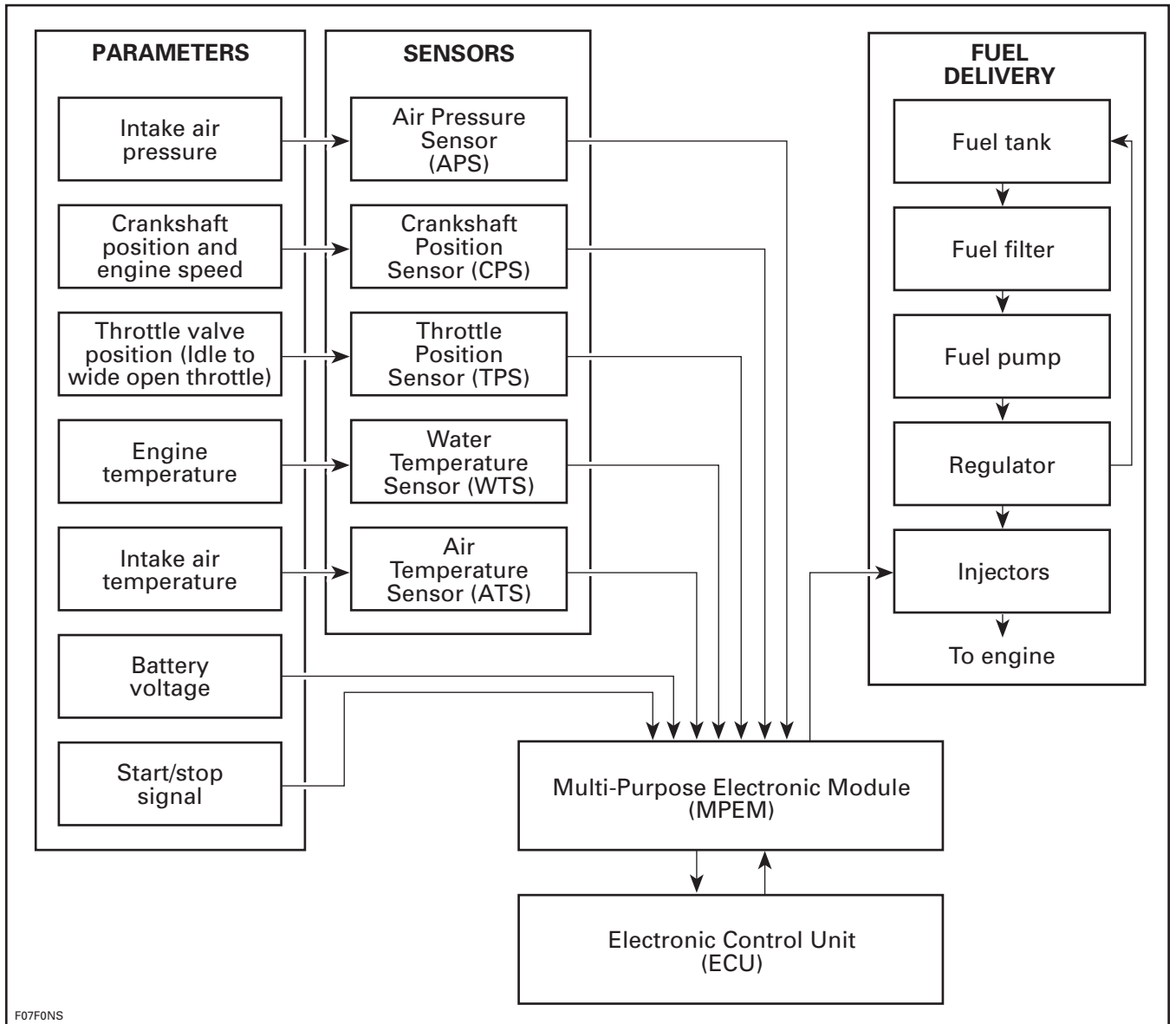
The MPEM has a special safety feature to limit engine revolutions when the battery voltage is too low.

For example, when the battery voltage reaches 8.9 volts for at least 30 seconds, engine revolutions are limited to 4480 RPM.

When voltage reaches 7 volts for at least 30 seconds, the engine is automatically shut off by the MPEM.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 02 (OVERVIEW)



SIGNAL MANAGEMENT

DIAGNOSTIC PROCEDURES

The MPEM programmer is the primary tool to diagnose fuel injection related problems.

The latest software designed for the RFI model allows sensor inspection, diagnostic options and adjustment such as the Throttle Position Sensor (TPS).

NOTE: Make sure your MPEM programmer is updated with the latest software version. For a complete overview of the programmer, refer to the *MPEM Programmer Guide* (P/N 219 700 090).

DIAGNOSTIC OPTION EXAMPLE

Turn on the programmer and enter your password. Select **VEHICLE INFO** from the main menu and press **ENTER**.

1. CHECK KEYS
2. PROGRAM KEY
- 3. VEHICLE INFO**
4. START VEH.
5. OTHERS

By selecting the **VEHICLE INFO** you will access a 9-line sub-menu. Select **BOSCH SYSTEM** from the sub-menu and press **ENTER**.

1. CUSTOMER NAME
2. DELIVERY DATE
3. VEH. SERIAL #
4. ENGINE PARAM.
5. PROGRAM KEY
6. HOUR INFO
7. MPEM INFO
- 8. BOSCH SYSTEM**
9. SAVE + QUIT

By selecting **BOSCH MENU** you will enter a second sub-menu. Select **DIAGNOSIS** and press **ENTER**.

- 1. DIAGNOSIS**
2. START VEHICLE

By selecting **DIAGNOSIS** the following message "INITIALIZING IN PROCESS" will be displayed a few seconds, then a new menu will appear on the screen.

Select **READ FAULT** and press **ENTER**.

1. BOSCH INFO
- 2. READ FAULT**
3. ERASE FAULT
4. ADJUSTMENT
5. REAL TIME
6. END DIAGNOSIS

NOTE: Line no. 1 **BOSCH INFO** will display the identification of the watercraft and the MPEM/ECU.

By selecting **READ FAULT**, the MPEM programmer will display the number of faults in the ECU memory and the codes related with the fault(s).

The programmer will offer **PRESS ANY KEY**. If there is more than 1 fault in the ECU memory, the next fault code will be displayed.

NOTE: On this model, there is always at least the 04 FC fault code. Ignore this fault code. Also, when the engine is NOT operating, the fault code 02 01 03 will be displayed for the CPS (crankshaft position sensor). It should not be considered as a fault in the static mode.

Refer to the tables on next page for the explanation of the fault codes.

After reading the fault codes in the memory of the ECU, **PRESS ANY KEY** will return the programmer to the latest menu.

By selecting **ERASE FAULT** in the menu, it will allow you to erase the faults in the ECU memory.

NOTE: The programmer will not allow fault code erasing without first viewing in the **READ FAULT**.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 03 (DIAGNOSTIC PROCEDURES)

FAULT CODE TABLES

ECU FAULTS

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
No fault detected	FF FF 88	N.A.	<ul style="list-style-type: none">No defect
Electronic Control Unit Internal memory	FF FF 00 FF FF 1B	P 0604 P 0605	<ul style="list-style-type: none">Internal defectNot plausible = EEPROM defect
Electronic Control Unit EEPROM	FF FE 2B	P 1600	<ul style="list-style-type: none">EEPROM not programmed
EEPROM Data Setting	FF FD 10 FF FD 25	P 1601 P 1602	<ul style="list-style-type: none">Data in EEPROM out of range (1 of 3 bytes)Data in EEPROM out of range (all 3 bytes different)

INPUT SIGNAL FAULTS

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
Supply voltage to ECU	02 14 07 02 14 06	P 0562 P 0563	<ul style="list-style-type: none">Voltage from the battery too lowVoltage from the battery too high
Engine Water Temperature Sensor (WTS)	02 0A 1D 02 0A 1E 02 0A 1B	P 0117 P 0118 P 0116	<ul style="list-style-type: none">Sensor circuit shorted to groundSignal interruption or short circuit to batteryNon plausible signal
Throttle Position Sensor (TPS)	02 06 1F 02 06 1C	P 0122 P 0123	<ul style="list-style-type: none">Sensor circuit shorted to groundSensor circuit shorted to battery
Crankshaft Position Sensor (CPS)	02 1F 06 02 1F 23	P 0219	<ul style="list-style-type: none">Signal exceeding RPM limits
Crankshaft Position Sensor (CPS)	02 01 03 02 01 1B	P 0335 P 0336	<ul style="list-style-type: none">No signal detected (fault code active when engine is not running and ignition is on)Synchronization error (sensor/toothed wheel)
Air Intake Temperature Sensor (ATS)	02 0F 1D 02 0F 1E	P 0112 P 0113	<ul style="list-style-type: none">Sensor circuit shorted to groundSignal interruption or short circuit to battery
Air Pressure Sensor (APS)	02 10 1D 02 10 1E	P 0107 P 0108	<ul style="list-style-type: none">Sensor circuit shorted to groundSignal interruption or short circuit to battery

OUTPUT SIGNAL FAULTS

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
Injector 1	04 E1 1C	P 0262	<ul style="list-style-type: none"> • Short circuit to battery • Short circuit to ground • Interruption or open circuit
	04 E1 1D	P 0261	
	04 E1 1E	P 1200	
Injector 2	04 E2 1C	P 0265	<ul style="list-style-type: none"> • Short circuit to battery • Short circuit to ground • Interruption or open circuit
	04 E2 1D	P 0264	
	04 E2 1E	P 1201	
Fuel pump	04 EB 1C	P 0230	<ul style="list-style-type: none"> • Short circuit to battery
Not applicable	04 FC	N.A.	<ul style="list-style-type: none"> • Not applicable
RAVE vacuum solenoid	04 DB 1C	P 0478	<ul style="list-style-type: none"> • Short circuit to battery • Short circuit to ground • Interruption or open circuit
	04 DB 1D	P 0477	
	04 DB 1E	P 0479	

COMPONENT INSPECTION

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 and 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. 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 the job is done, ensure that hoses from fuel rail going to fuel pump are properly secured in their support. Then, pressurize the fuel system. Perform the high pressure test as explained in this section and pressurize the fuel tank and fuel lines as explained in FUEL SYSTEM section.

Properly reconnect the battery.

WARNING

Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the safety lanyard on the DESS post. 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 MPEM programmer tool. See TROUBLESHOOTING in this subsection.

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 MPEM to work erratically or not to work at all. Check related-circuit fuse solidity and condition with an ohmmeter. Visual inspection could lead to false results.

WARNING

All electrical actuators (injectors, fuel pump, RAVE solenoid, ignition coil and starter solenoid) 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 73 (P/N 529 022 000) should be used.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

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 MPEM, 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 MPEM. 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 MPEM is working, try the old one and recheck if it works.

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.

NOTE: Diagnostics Communication Kit. See DIAGNOSTICS section.

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

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (69°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 (69°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 MPEM 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 MPEM. 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.

AIR INDUCTION SYSTEM

THROTTLE BODY

Check that the throttle plate moves freely and smoothly when depressing throttle lever.

FUEL DELIVERY

FUEL FILTER

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 PUMP

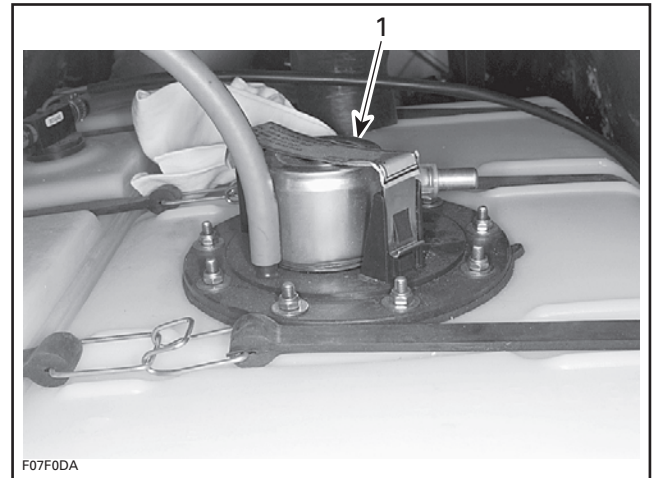
The fuel pump operation can be checked as follows.

Install the safety lanyard cap on the switch. The fuel pump should run for approximately 1 second and then shut off.

If not, check the electrical circuit and the 10 A fuse on the MPEM module.

REGULATOR

The regulator is mounted on top of the fuel pump assembly.



1. Regulator

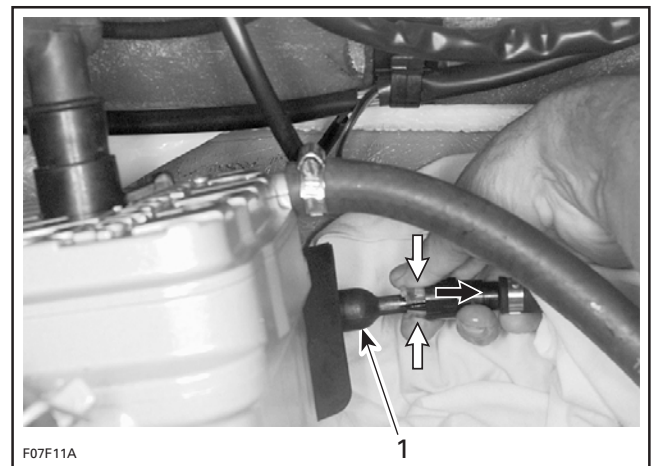
To inspect the regulator, a fuel pressure test must be done.

Check that battery voltage is above 12 volts.

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

Cover the quick connect fitting with a shop towel.

Press on both tabs and disconnect the quick connect fitting.



1. Fuel rail

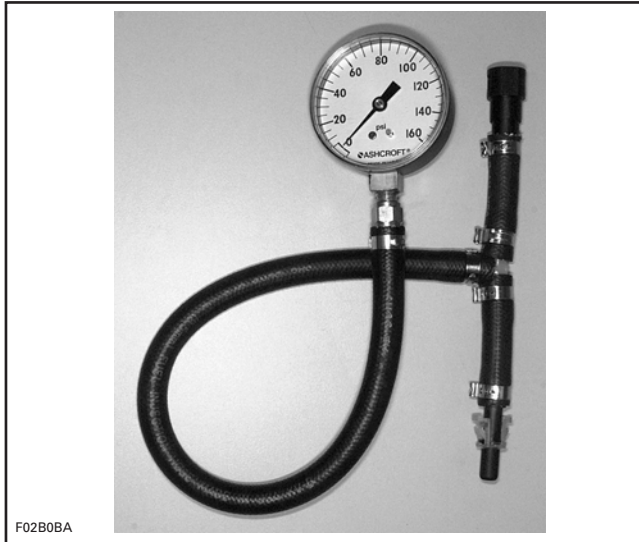
WARNING

Fuel is under pressure. Wipe off any fuel spillage in the bilge.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

Install a fuel pressure gauge (P/N 529 035 591) to the quick connect fitting of the fuel hose.



FUEL PRESSURE GAUGE (P/N 529 035 591)

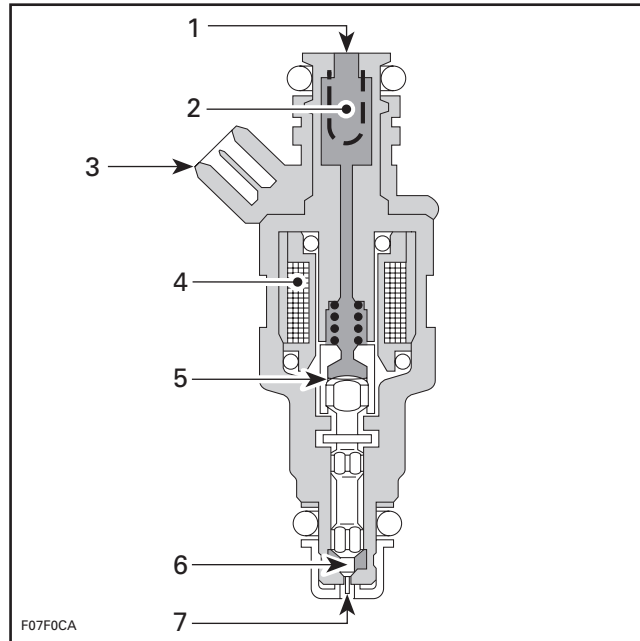
Install the safety lanyard cap on the switch to activate the fuel pump. The fuel pressure should be between 386 - 414 kPa (56 - 60 PSI).

If the pressure is too high, replace the fuel pump module.

If the pressure is too low, check the following components:

- fuel hoses and connections
- fuel filter
- fuel pump
- regulator
- voltage at fuel pump (minimum 8 Vdc).

FUEL INJECTOR



1. Inlet side
2. Filter
3. Wiring terminal
4. Coil
5. Plunger
6. Needle valve
7. Injection side

Touch the injector while cranking the engine to feel the operation of the injector.

If there is no signal detected from the injector, disconnect the plug connector from the injector and check the signal from the MPEM.

To check the signal, verify voltage at the plug connector. There should be at least 6 Vdc while cranking engine.

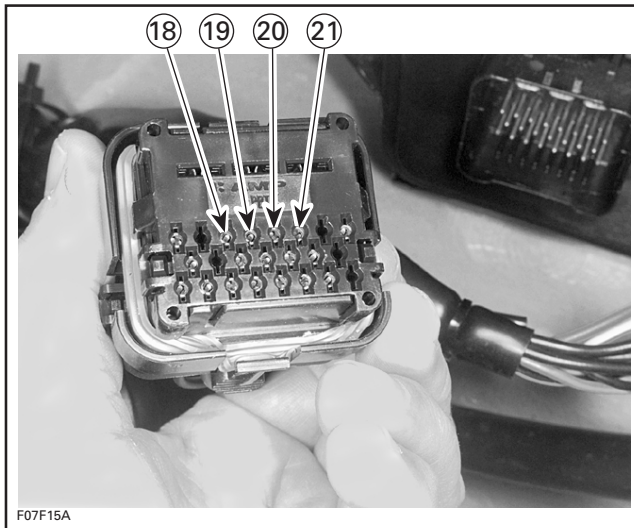
Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

Check the resistance of the fuel injector circuits. Disconnect the AMP plug connector number 4 on the MPEM.

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

	CONTACT LOCATION
Injector no. 1	18 and 20
Injector no. 2	19 and 21



The resistance should be between 2.3 Ω and 2.5 Ω at temperature of 20°C (68°F).

If resistance value is incorrect, check wiring harness between AMP plug connector and fuel injectors for damaged wires or bad connections. Repair if necessary.

Recheck resistance value at AMP plug connector number 4.

If not within specification, replace the fuel injector.

Leakage Test (fuel injector)

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

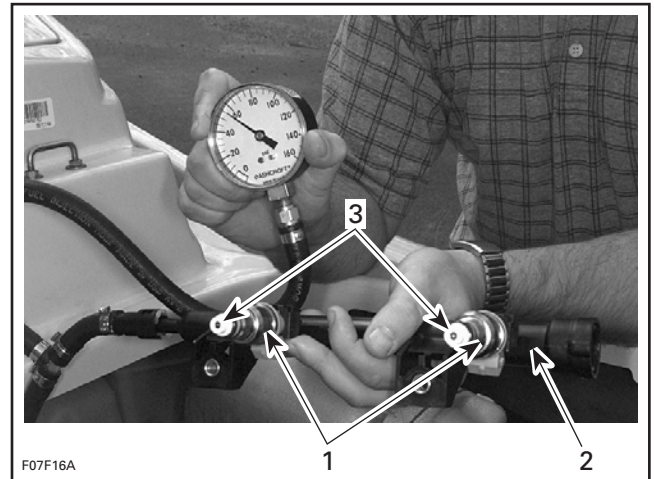
NOTE: Do not detach injectors from fuel rail.

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).

LEAK TEST (supply and ventilation circuits)

Refer to FUEL SYSTEM.

HIGH PRESSURE TEST (fuel pump circuit)

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

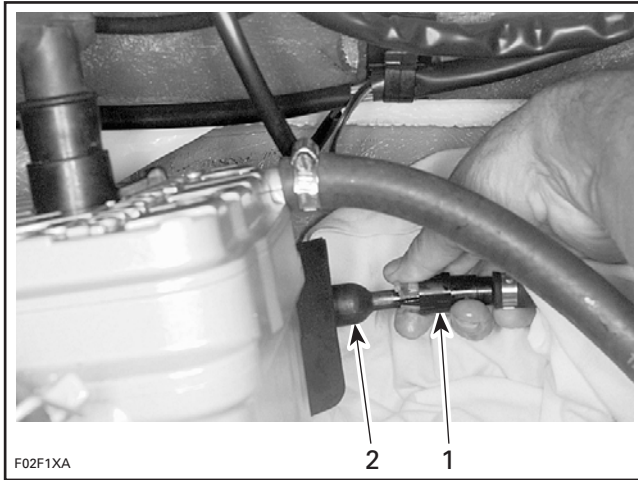
WARNING

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.

Section 05 ENGINE MANAGEMENT (RFI)

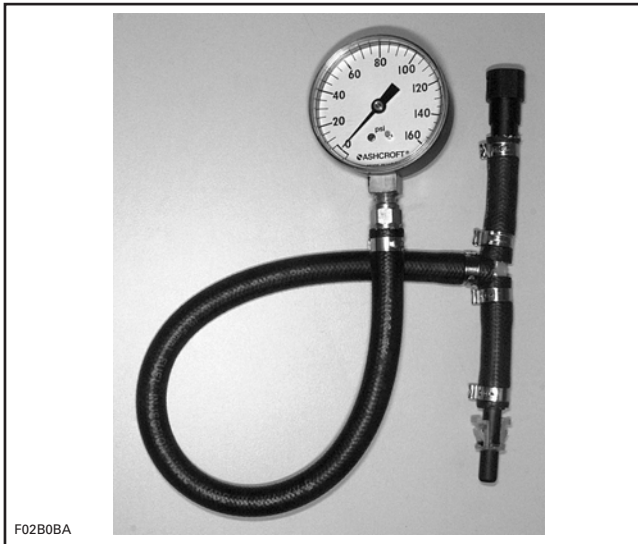
Subsection 04 (COMPONENT INSPECTION)

Press on both tabs and pull quick connect fitting to disconnect the fuel hose from fuel rail.



1. Quick connect fitting
2. Fuel rail

Install fuel pressure gauge (P/N 529 035 591) between fuel rail and fuel hose from fuel tank.



FUEL PRESSURE GAUGE (P/N 529 035 591)

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

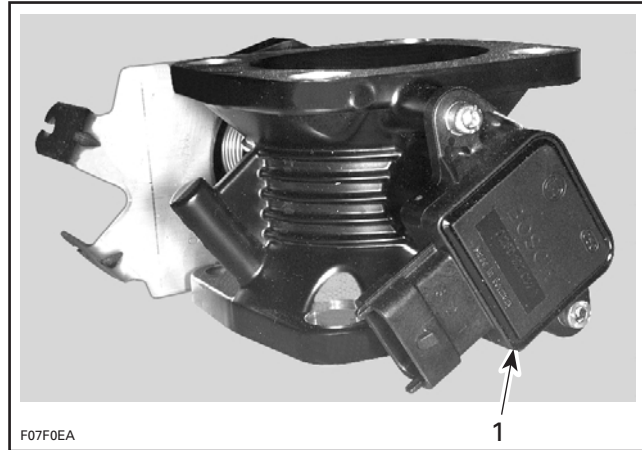
The fuel pump should run for approximately 1 second and the fuel pressure should be between 386 - 414 kPa (56 - 60 PSI).

Check hose connections at fuel pump and at fuel rail.

ELECTRONIC MANAGEMENT

THROTTLE POSITION SENSOR (TPS)

Check the resistance value of the throttle position sensor.



1. Throttle position sensor (TPS)

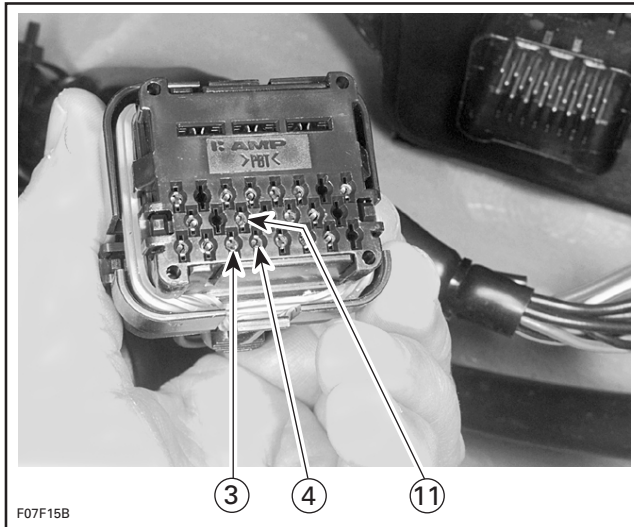
Disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, check the resistance between terminal 3 (PURPLE/BROWN wire) and terminal 4 (BLACK/BROWN wire) on the AMP plug connector.

The resistance should be between 1.6 k Ω and 2.4 k Ω .

Check also the resistance between terminal 4 (BLACK/BROWN wire) and terminal 11 (WHITE/BROWN wire) with the throttle plate in idle position.

The resistance should be between 710 Ω and 1380 Ω .



If resistance is below specifications, replace the throttle position sensor (TPS).

If resistance is above specifications, disconnect the connector of the throttle position sensor and check resistance of wiring harness and terminals between AMP plug connector and TPS sensor connector.

If there is an open circuit, repair or replace the defective wire or terminal.

Reconnect the throttle position sensor connector and recheck resistance values at AMP plug connector number 4.

If not within specification, replace the throttle position sensor.

NOTE: Whenever the TPS is replaced, removed or adjusted, the TPS closed position must be re-adjusted.

Voltage Test

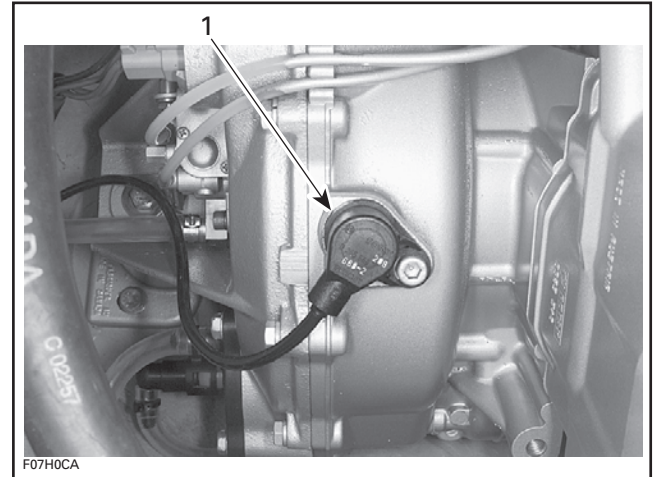
If the sensor resistance value is good, check the voltage output from MPEM to throttle position sensor.

Disconnect plug connector from throttle position sensor and connect a voltmeter between the PURPLE/BROWN wire and the BLACK/BROWN wire in the wiring harness.

Depress the start/stop button with the safety lanyard removed to activate the timer. There should be 5 Vdc.

CRANKSHAFT POSITION SENSOR (CPS)

Check the resistance of the crankshaft position sensor.

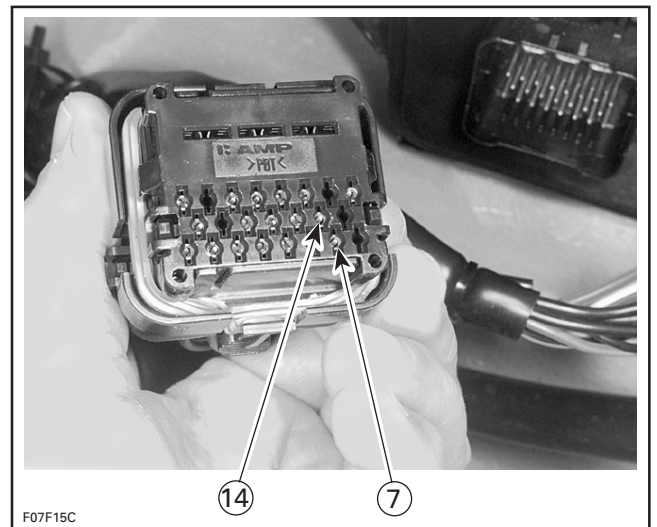


1. Crankshaft position sensor (CPS)

Disconnect the AMP plug connector number 4 from the MPEM module.

Using a multimeter, check the resistance between terminal 7 (GREY/YELLOW wire) and terminal 14 (GREY/RED wire) on the plug connector.

The resistance should be between 774 Ω and 946 Ω at temperature above 20°C (68°F).



If not within specification, replace the crankshaft position sensor.

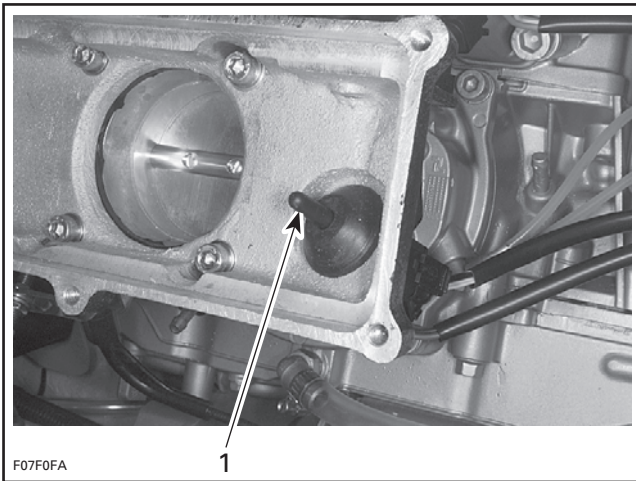
Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

AIR TEMPERATURE SENSOR (ATS)

NOTE: When testing the resistance of the air temperature sensor (ATS), it is important to check the ambient temperature. The resistance values for the sensor will be different according to the temperature.

Check the air temperature sensor resistance.

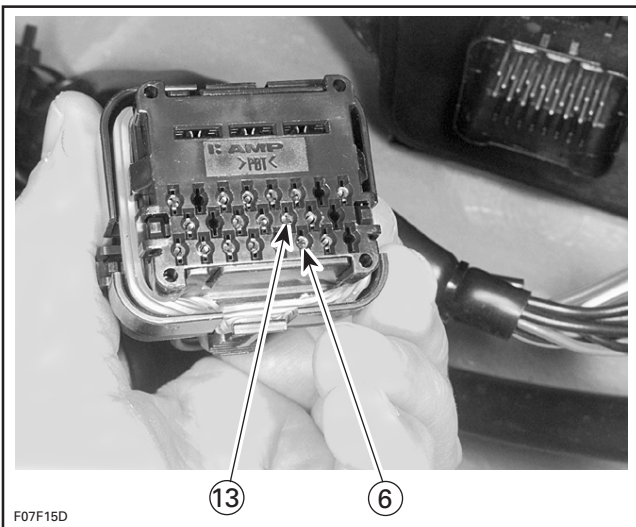


1. Air temperature sensor (ATS)

Disconnect the AMP plug connector number 4 from the MPEM module.

Using a multimeter, check the resistance between terminal 6 (BLACK/WHITE wire) and terminal 13 (WHITE/GREY wire) on the plug connector.

The resistance should be between 2.280 k Ω and 2.736 k Ω at temperature of 19°C to 21°C (66°F to 70°F).



If resistance is below specifications, replace air temperature sensor (ATS).

If resistance is above specifications, disconnect the connector of the air temperature sensor and check resistance of wiring harness and terminals between AMP plug connector and ATS sensor connector.

If there is an open circuit, repair or replace the defective wire or terminal.

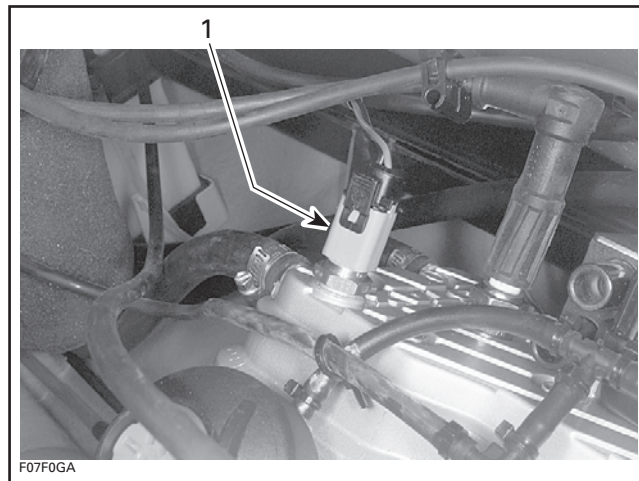
Reconnect the air temperature sensor connector and recheck the resistance between terminal 6 and terminal 13 in the AMP plug connector number 4.

If not within specification, replace the air temperature sensor.

WATER TEMPERATURE SENSOR (WTS)

Resistance Test

Check the water temperature sensor resistance.



1. Water temperature sensor (WTS)

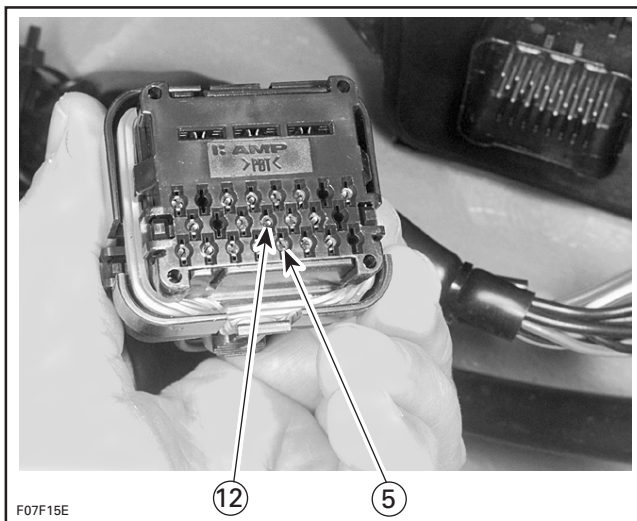
Disconnect the AMP plug connector number 4 from the MPEM module.

Using a multimeter, check the resistance between terminal 5 (BLACK/ORANGE wire) and terminal 12 (TAN/ORANGE wire) on the plug connector.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

The resistance should be between 2.280 k Ω and 2.736 k Ω at temperature of 19°C to 21°C (66°F to 70°F).



If not within specification, continue with the following tests.

Operation Test

Remove WTS from engine and keep it connected. Place the WTS in a metal container filled with water and heat with a heat gun. Use a thermometer to monitor the temperature. Keep the container outside and away from bilge as much as possible.

⚠ WARNING

Do not use an open flame in the bilge area. Fuel vapors may be present and this may lead to an explosion.

Heat up above 94°C (201°F) then start engine.

CAUTION: Do not run the engine longer than 1 minute. If so, plug the WTS hole and use the flush kit to cool the engine.

At this temperature, the overheat beeper should sound. Otherwise, check the following.

Stop engine.

Disconnect the WTS.

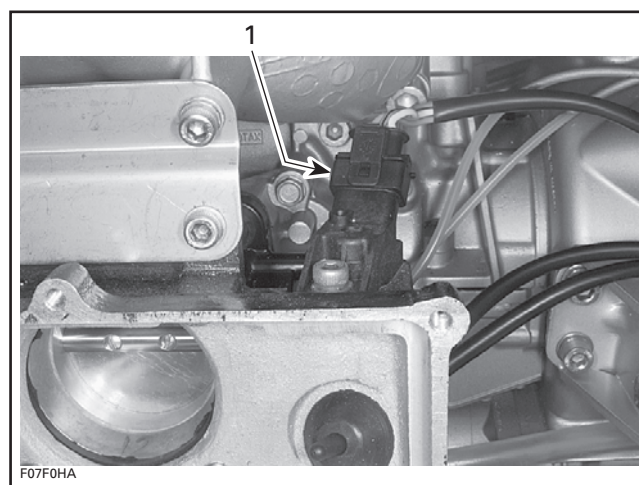
Remove safety lanyard and press the start/stop button to power up the system and check for 5 V on the TAN/ORANGE wire.

If there is not 5 V, check the wiring harness and pin #12 on the #4 AMP plug connector.

Remove the TAN/ORANGE wire from the #12 position on the AMP plug connector, install a test connector (a female connector with about 25 mm (1 in) of wire) then reconnect the AMP plug connector. Press the start/stop button, and check for 5V on the test wire. If none is present, replace the MPEM.

On the WTS connector, check for continuity to ground on the BLACK/ORANGE wire when the system is not powered up, and within 5 - 12 ohms when the system is powered up. Otherwise, check the wiring harness and pin #5 on the #4 AMP plug connector. Remove the BLACK/ORANGE wire from the #5 position on the AMP plug connector, install a test connector (as described above) then reconnect the AMP plug connector. Repeat the same tests as above, if the tests are not within specs, replace the MPEM.

AIR PRESSURE SENSOR (APS)



1. Air pressure sensor (APS)

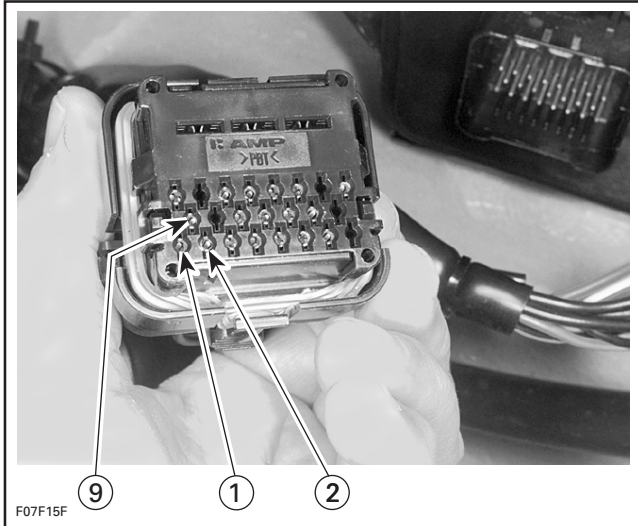
Check the air pressure sensor resistance.

Disconnect the AMP plug connector number 4 from the MPEM module.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 04 (COMPONENT INSPECTION)

Using a multimeter, check the resistance between terminal 9 (WHITE/BLUE wire) and terminal 2 (BLACK/BLUE wire) on the plug connector.



The resistance should be between 3.4 k Ω and 8.2 k Ω .

Check also the resistance between terminal 2 (BLACK/BLUE wire) and terminal 1 (PURPLE/BLUE wire) of the plug connector.

The resistance should be between 2.4 k Ω and 8.2 k Ω .

If not within specification, disconnect the connector of the water temperature sensor and check resistance of wiring harness and terminals between AMP plug connector and APS sensor connector.

Reconnect the air pressure sensor connector and recheck the resistance value between terminals in the AMP plug connector number 4.

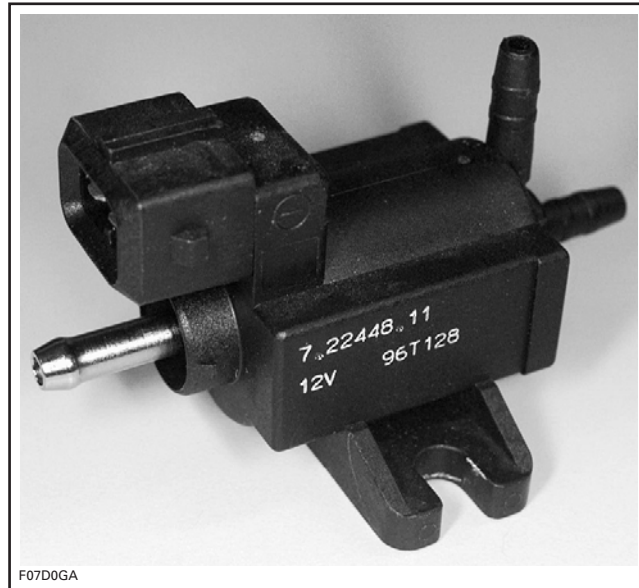
If not within specification, replace the air temperature sensor.

Voltage Test

If the sensor resistance value is within specifications, disconnect the plug connector from the APS sensor and check the voltage between the PURPLE/BLUE wire and the BLACK/BLUE wire in the wiring harness from the MPEM.

Depress the start/stop button with the safety lanyard removed to activate the timer. There should be 5 Vdc.

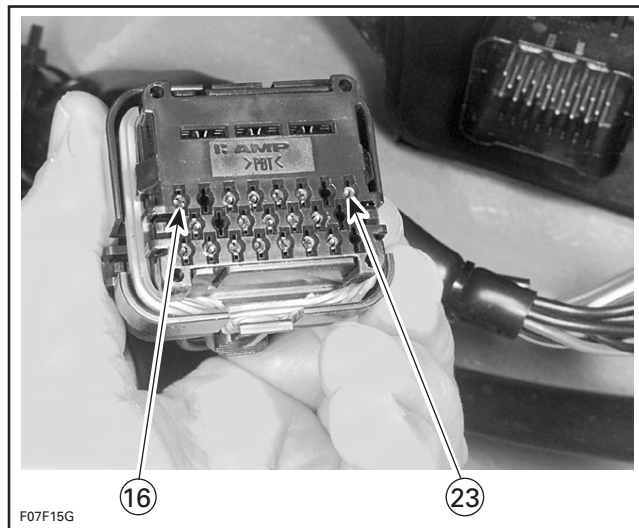
RAVE SOLENOID



RAVE SOLENOID

Disconnect the AMP connector number 4 from the MPEM module.

Check resistance value between terminal 16 and terminal 23 on the plug connector.



The resistance value should be 30 Ω .

Section 05 ENGINE MANAGEMENT (RFI)**Subsection 04 (COMPONENT INSPECTION)****RFI SENSORS RESISTANCE VALUES**

COMPONENT	TERMINAL NUMBER	WIRE COLOR	RESISTANCE VALUE	VOLTS
Air pressure sensor	1 and 2	PU/BL and BK/BL	2.4 k - 8.2 k ohms	5 Vdc between PU/BL and BK/BL
	9 and 2	WH/BL and BK/BL	3.4 k - 8.2 k ohms	
Throttle position sensor	3 and 4	PU/BW and BK/BW	1.6 k - 2.4 k ohms	5 Vdc between PU/BW and BK/BW
	4 and 11	BK/BW and WH/BW	710 - 1380 ohms	
Water temperature sensor	5 and 12	BK/OR and TA/OR	2280 - 2736 ohms	N.A.
Air temperature sensor	6 and 13	BK/WH and WH/GY	2280 - 2736 ohms	N.A.
Crankshaft position sensor	7 and 14	GY/YL and GY/RE	774 - 946 ohms	N.A.
Rave solenoid	16 and 23	PU/GY and BK/GY	30 ohms	N.A.
Injector no. 1	18 and 20	BL/PU and BL/BK	2.3 - 2.5 ohms	6 Vdc at the plug connector
Injector no. 2	19 and 21	GR/PU and BK/GR	2.3 - 2.5 ohms	

TROUBLESHOOTING SUMMARY

ENGINE DOES NOT START

If the engine does not start, the following items should be verified in this order:

- fuses
- ignition (spark)
- fuel pump
- check fault codes in the ECU memory.

FLOODED ENGINE FEATURE

If the engine does not start and it is flooded, proceed as follows:

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.

Depress and hold the throttle lever at full throttle position.

Install the safety lanyard cap on the switch. Press the start/stop button wait 2 seconds then crank the engine for approximately 10 seconds.

NOTE: Proceeding in this order, no fuel is injected and the accumulated fuel in the engine will be expelled.

Reinstall spark plugs and connect cables.

Start engine normally without applying the throttle.

SPARK PLUG INSPECTION

Whenever replacing the spark plugs, always use NGK BR8ES with the resistor feature. The spark plug gap is set at 0.5 - 0.6 mm (.02 - .024 in).

To check for ignition, attach an inductive timing light to the high tension lead while turning the engine with the starter.

Reversed high tension cables will not allow the RFI to run. Unlike other Sea-Doo models, the spark plugs spark independently on each piston stroke. Reversed high tension cables will cause backfires.

ECU FAULT CODES

Fault codes in the ECU memory will identify potential problems with the RFI system. When checking fault codes without engine in operation, the CPS fault code will always appear. Also, the 04 FC fault code will always appear.

Disconnecting the battery will erase the fault codes in the ECU memory.

ENGINE STARTS BUT RUNS POORLY

If the engine starts but runs poorly, the following items should be verified in this order:

- Check spark plug condition.
- Check fault codes in the ECU memory.
- Check fuel pressure.
- Check TPS adjustment.

If some work has been performed on the unit, make sure injector wire connectors were not mixed. It is also possible that the RAVE solenoid connector be mixed with one of the injector connector. Refer to the wiring diagram for wire colors and positions.

ENGINE STARTS BUT STALLS AFTER APPROXIMATELY 30 SECONDS

The RPM signal (GREY wire) is short circuit to the ground. Check wire condition. If the wire test good, either the tachometer or Info Center is defective.

ENGINE CANNOT REACH MAXIMUM REVOLUTIONS

Check battery voltage. When voltage is too low, the MPEM limits the engine revolutions.

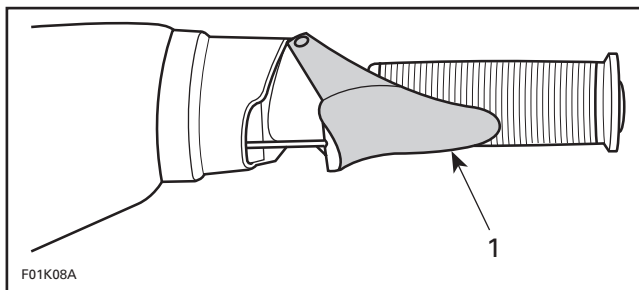
Recharge or replace battery.

The RAVE system is not functioning properly. The sliding valves do not open. Check pressure hoses and check valve from crankcase to RAVE solenoid. Check RAVE solenoid.

ADJUSTMENT

THROTTLE CABLE ADJUSTMENT

Fully depress throttle lever. Lever must touch handlebar grip.



1. Must touch handlebar grip

Ensure throttle plate is fully open.

Adjust cable to obtain a gap of 0.75 mm (.030 in) between throttle lever stopper and bracket on throttle body.

THROTTLE POSITION SENSOR (TPS)

This adjustment is very important. The setting of the TPS will determine the basic parameters for all fuel mapping.

NOTE: Adjustment must be done each time the throttle position sensor (TPS) is loosened or removed.

CAUTION: An improperly adjusted TPS may lead to serious engine damage.

The adjustment of the TPS is performed using the MPEM programmer.

CLOSED TPS

To perform this adjustment, proceed as follows:

Access the **BOSCH SYSTEM** in the MPEM programmer. Then, select **ADJUSTMENT** in the sub-menu.

Choose **CLOSE TPS** in the **ADJUSTMENT** menu.

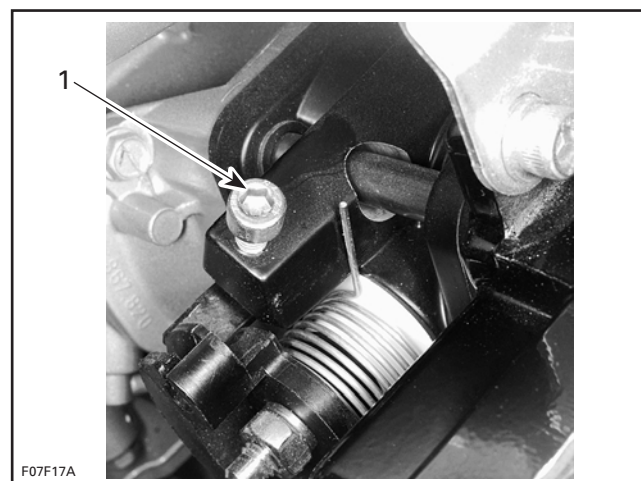
The screen will display the actual adjustment of the TPS in degrees and it will also offer to adjust it.

CAUTION: Do not select "YES" until the idle speed screw is loosened to allow the throttle plate to close.

Loosen the lock nut of the idle speed screw.

Loosen the idle speed screw until it does not contact the throttle plate stopper.

Loosen the adjustment of the throttle cable.



1. Idle speed screw

Depress throttle lever a few times and ensure throttle plate is completely closed.

Selecting "YES" will instantly readjust the close throttle position adjustment to the new setting.

NOTE: If the ECU is replaced, the TPS closed position must be readjusted.

IDLE SPEED

Access the **BOSCH SYSTEM** in the MPEM programmer. Then, select **REAL TIME** in the sub-menu.

Turn idle speed screw approximately 3 turns from the point when the screw end touches the lever, or until the TPS idle position reads 6 - 7.

For a precise adjustment of the idle speed, it should be finalized in water.

Idle speed in water is 1500 ± 100 RPM.

REMOVAL AND INSTALLATION

MPEM

IMPORTANT: When MPEM is replaced, the safety lanyard(s), the TPS closed position and the TDC setting must be reprogrammed/reset. Refer to their specific section for adjustment.

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 connector of the TPS.
Loosen 2 Allen screws retaining the TPS.
Remove TPS.

AIR TEMPERATURE SENSOR (ATS)

Remove the air intake silencer.
Remove the flame arrester.
Disconnect the connector of the ATS.
Pull the ATS from the grommet retaining it.

AIR PRESSURE SENSOR (APS)

Remove the air intake silencer.
Disconnect the connector of the APS.
Loosen Allen screw retaining the APS.
Remove the APS.
At installation, apply Loctite 243 (blue) on screw threads.

WATER TEMPERATURE SENSOR (WTS)

Disconnect the connector of the WTS.
Loosen the WTS from the cylinder head.
At installation, apply Loctite 518 on threads of the WTS.

CRANKSHAFT POSITION SENSOR (CPS)

Disconnect the connector of the CPS.

Loosen Allen screw retaining the CPS.

Remove the CPS.

At installation, apply Loctite 243 (blue) on the Allen screw.

NOTE: Clean treads prior installing screw.

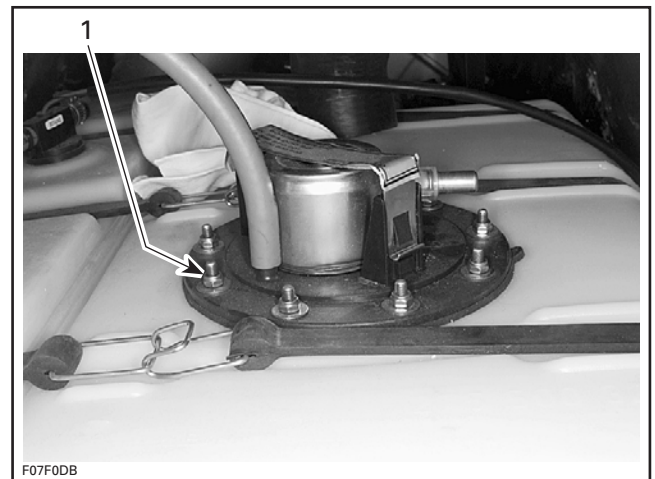
FUEL PUMP ASSEMBLY

Open the front storage compartment cover.
Remove the storage basket.
Remove the glove box.
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.



1. Loosen nuts

Remove fuel pump assembly from fuel tank.

Section 05 ENGINE MANAGEMENT (RFI)

Subsection 07 (REMOVAL AND INSTALLATION)

REGULATOR

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

FUEL FILTER

The fuel filter is not serviceable. Replace the fuel pump assembly if the fuel filter must be replaced.

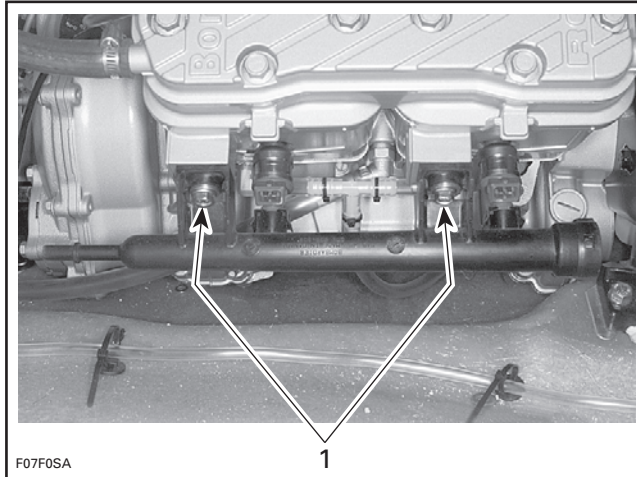
FUEL INJECTOR

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.

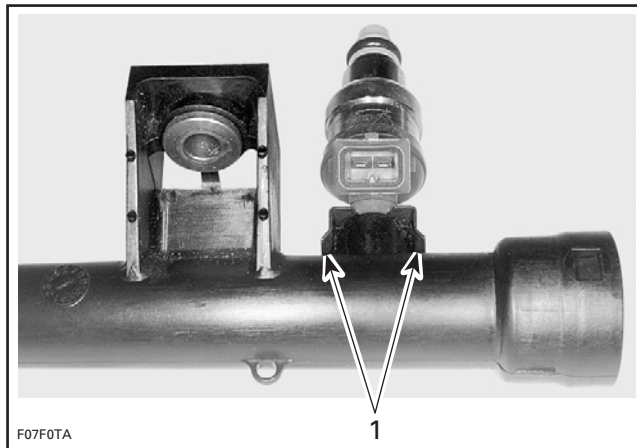
Disconnect the wire connectors of both fuel injectors.



1. Loosen screws retaining the fuel rail

Remove the fuel rail with both fuel injectors.

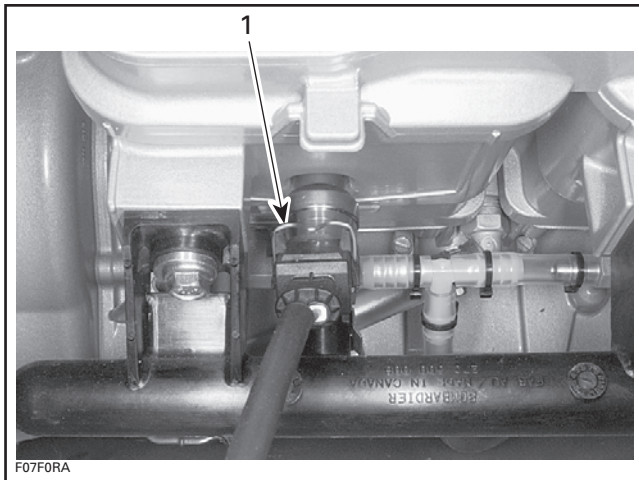
To remove the fuel injector from the fuel rail, pry off the retaining clip.



1. Pry the clip

When reinstalling the fuel injector, install the retaining clip to the injector, then insert the injector to the fuel rail.

CAUTION: Whenever removing fuel injector, always replace both injector O-rings with new ones.



1. Press retaining clip to unlock the connector

Loosen both screws retaining the fuel rail to the cylinders.

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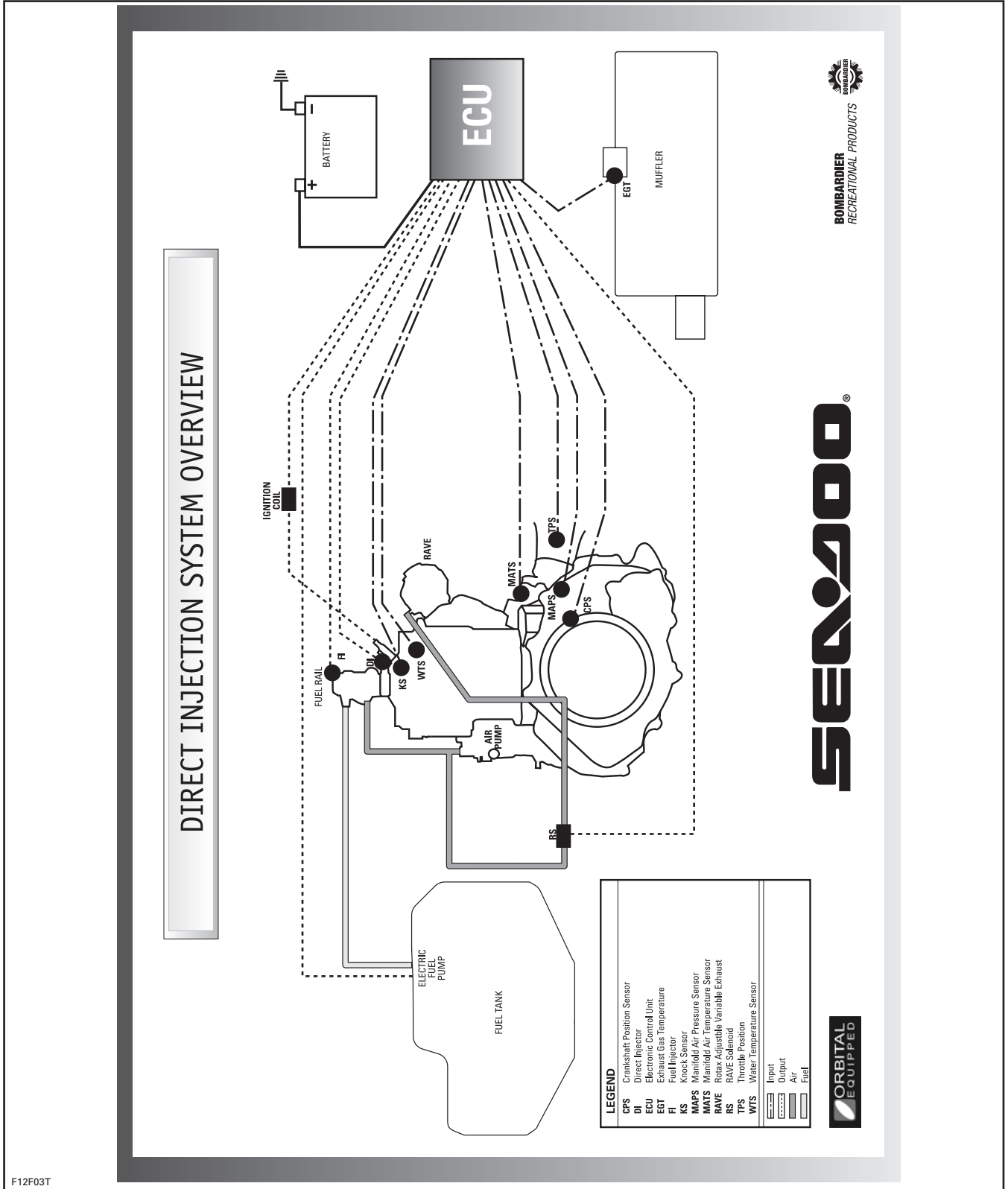
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OVERVIEW



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Section 06 ENGINE MANAGEMENT (DI)

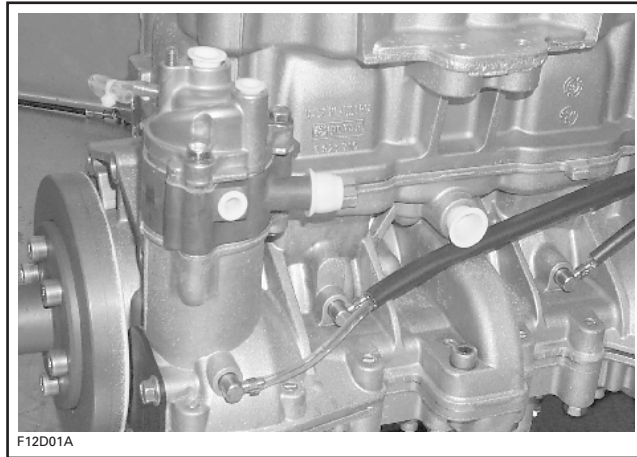
Subsection 02 (OVERVIEW)

OPERATING PRINCIPLE

The Orbital Combustion Process (OCP) provides a stratified combustion process resulting from the direct injection of a finely atomized fuel spray (less than 10 microns). This is achieved by using a pneumatically assisted direct injection system, a unique combustion chamber geometry and a precise control of the combustion process by the MPEM (Multi-Purpose Electronic Module).

AIR INDUCTION

Air for combustion is drawn directly at the base of the engine through two 46 mm throttle bodies. The air flow is controlled by two throttle plates. The air continues through the reed valves into the crankcase.



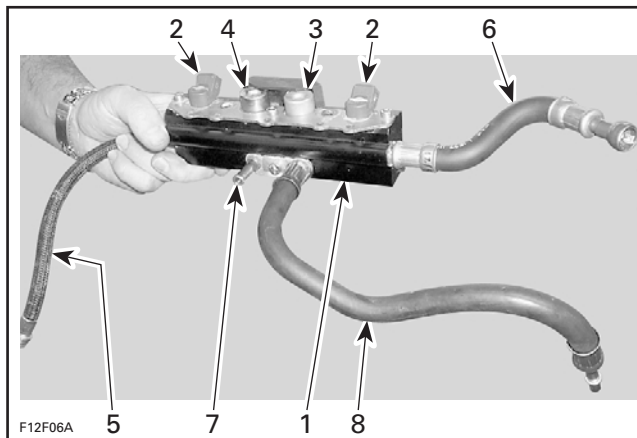
FUEL DELIVERY SYSTEM

BASIC OPERATION

When the piston reaches the correct position, the MPEM opens the fuel injector and fuel is discharged into a cavity inside the direct injector.

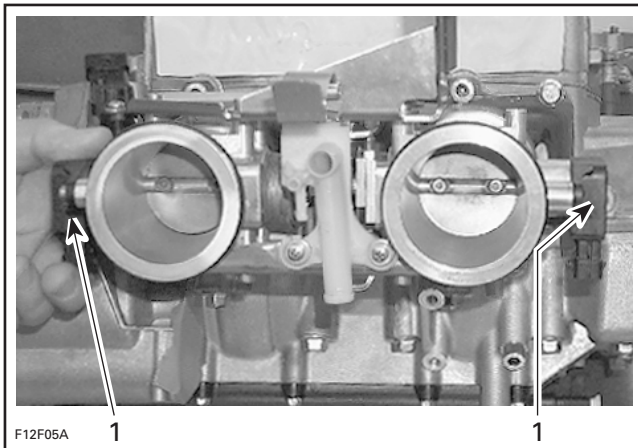
Next, the direct injector opens and the fuel is discharged into the combustion chamber by the compressed air which breaks the fuel up into a very fine mist in the process. This air/fuel mixture is then ignited by the spark plug.

AIR/FUEL RAIL ASSEMBLY



TYPICAL

1. Air/fuel rail
2. Fuel injector
3. Fuel pressure regulator
4. Air pressure regulator
5. Air inlet hose
6. Fuel inlet
7. Air return
8. Fuel return



TWIN 46 mm THROTTLE BODIES

1. Throttle position sensor (TPS)

AIR COMPRESSOR SYSTEM

The air compressor supplies the compressed air required for fuel atomization in the air injector. It is integrated with the engine and mechanically driven by the counterbalance shaft. It also supplies the air pressure required to operate the RAVE valves.

The air/fuel rail assembly is mounted on top of the cylinder head. It provides support for the air/fuel injectors and both air and fuel regulators. It also contains passages for the air and the fuel. The rail is a small reservoir for the injectors that keeps enough fluid at the proper pressure to supply the injectors demand.

Fuel Injector

Fuel injectors are used to provide fuel from the fuel rail to the to the direct injector.

Fuel Pressure Regulator

A fuel pressure regulator controls the pressure inside the fuel rail, and allows the excess of fuel to return to the fuel tank. The fuel pressure regulator regulates the fuel pressure at approximately 185 kPa (27 PSI) higher than the air pressure in the fuel rail. The back side of the diaphragm is exposed to the air rail pressure. As the air pressure increases in the fuel rail, the fuel pressure needed to open the regulator will increase equally.

The differential pressure regulation utilizes the air pressure reference signal to maintain constant pressure drop across fuel injector orifice.

The initial operating pressure of the regulator is preset by the manufacturer and is not adjustable.

Direct Injector

Also called air injector, two direct injectors (one per cylinder) are used to inject air/fuel mixture into the combustion chamber.

Air Pressure Regulator

An air pressure regulator regulates the pressure of air delivered by the air compressor.

It regulates the pressure developed inside the air passage to approximately 550 kPa (80 PSI).

The initial operating pressure of the regulator is preset by the manufacturer and is not adjustable.

FUEL PUMP MODULE



The fuel pump module is located inside the fuel tank. The module includes the fuel pump and the fuel level sensor.

Fuel Pump

It operates at a nominal pressure of approximately 735 kPa (107 PSI).

Fuel Filter

A mesh filter is located at the bottom of the fuel pump module inside the fuel tank. An inline fuel filter is also installed on the fuel line going to the fuel rail.

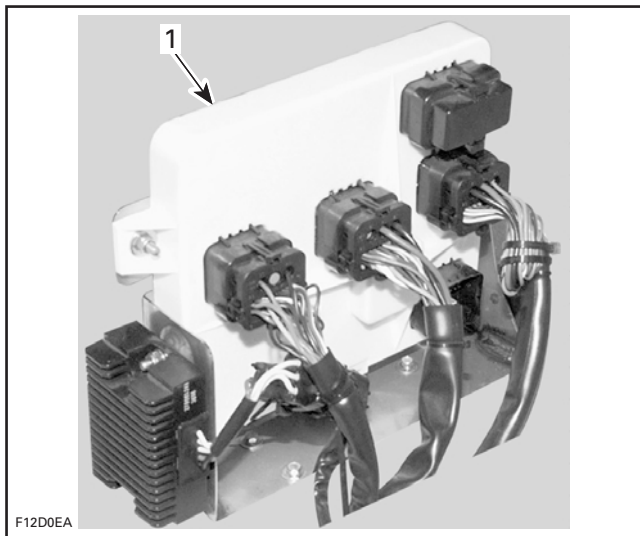
Section 06 ENGINE MANAGEMENT (DI)

Subsection 02 (OVERVIEW)

ELECTRONIC MANAGEMENT

MPEM (multi-purpose electronic module)

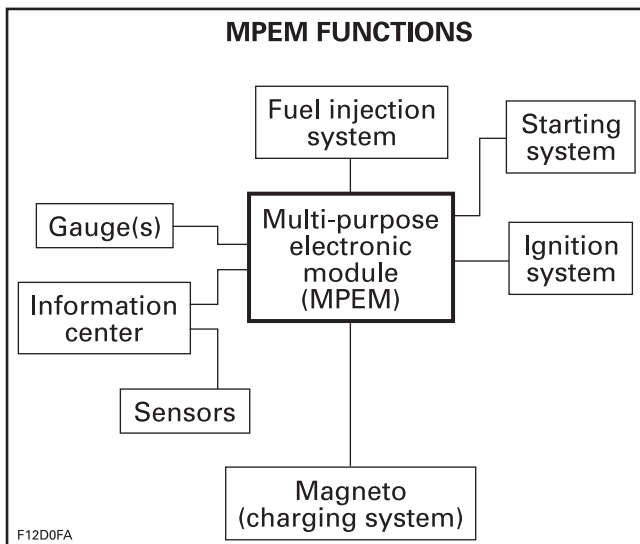
The electronic fuel injection is equipped with a MPEM. It is also called ECU (Electronic Control Unit). It is the brain of the electrical system/fuel injection system.



TYPICAL

1. Multi-purpose electronic module (MPEM)

The MPEM is mounted in the front of the watercraft.



The MPEM is directly powered by the battery. It is responsible for the following engine management/electrical functions:

- interpreting information
- distributing information
- start/stop function
- timer
- DESS (Digitally Encoded Security System)
- ignition timing maps
- injection maps (fuel injector and direct injector)
- MPEM contains a total of 34 maps (injection and ignition) for optimum engine operation in all conditions
- engine RPM limiter
- etc.

The MPEM features a permanent memory that will keep the programmed safety lanyard(s) active, fault codes and other vehicle information, even when the battery is removed from the watercraft.

MPEM — General Functions

Automatic Power Shut-Down

The MPEM is equipped with an automatic power shut-down. This feature prevents the battery from losing its charge if the safety lanyard cap is left on the post when the engine is not running.

After connecting the safety lanyard cap, the MPEM will remain in standby mode during the next 10 minutes, waiting for a starting. If the start/stop button is not depressed, then the MPEM will be automatically powered down.

Antistart Feature

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

Digitally Encoded Security System (DESS)

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

The safety lanyard cap contains a magnet and a ROM chip. The magnet actually closes the reed switch inside the post which is the equivalent of a mechanical ON/OFF switch. The chip has a unique digital code.

The DESS circuitry in the watercraft MPEM 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 which is programmed to recognize the digital code of the safety lanyard cap. This is achieved with the MPEM programmer (P/N 529 034 500) or the VCK (Vehicle Communication Kit) P/N 529 035 676. Refer to their operation manual or help system to program a safety lanyard.

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

The MPEM also offers a special safety lanyard — the Sea-Doo LK™ (learning key) — which can be programmed so that the vehicle can be run only at a limited speed — approximately 48 km/h (30 MPH). Such feature is ideal for first time riders or renters.

WARNING

When programming a Sea-Doo LK™ (learning key), use only a lanyard that is identified for that purpose. Otherwise, a customer could use a vehicle with a greater speed than he was expecting.

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

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

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

The memory of the MPEM features two self-diagnostic modes for the DESS operation. Refer to DIAGNOSTIC PROCEDURES section for more information.

The memory of the MPEM is permanent. If the battery is disconnected, no information is lost.

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

Gauges Current Supply

The purpose of this function is to allow reading of gauges without the engine running. It will give access to most functions of the information center gauge without starting the engine.

Gauges are supplied with current for 33 seconds when connecting the safety lanyard cap on its post or when pressing the start/stop switch without the safety lanyard on the DESS post.

NOTE: The fuel pump will be activated for 2 seconds to build up pressure in the fuel injection system, only when connecting the safety lanyard cap to the post.

Engine Starting

If the MPEM recognizes a valid safety lanyard, it allows engine to start when the start/stop switch is pressed.

If the safety lanyard is left on the DESS post for more than 10 minutes after stopping the engine, the MPEM may send out 1 long beep when pressing the start/stop switch. The current supply to gauges will be stopped as explained in the **Anti-start Feature** section. A light pressure on the safety lanyard or removing and reinstalling the safety lanyard is required to allow the MPEM to read and validate the safety lanyard, the engine can then be started.

If start/stop button is held after engine has started, the MPEM 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 RPM Limiter

The MPEM will limit the maximum engine speed.

Engine Stopping

There are 2 ways to stop the engine.

Press and hold start/stop switch or remove the safety lanyard cap from its post.

If the engine is stopped by removing the safety lanyard, it is possible to restart the engine as explained in the engine starting section.

If safety lanyard cap is reconnected within 6 seconds, the current supply to gauges is cut for a brief moment and comes back on with the audible signal of safety lanyard validation.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 02 (OVERVIEW)

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 MPEM. The MPEM sends out signals for the beeper and to the information center gauge.

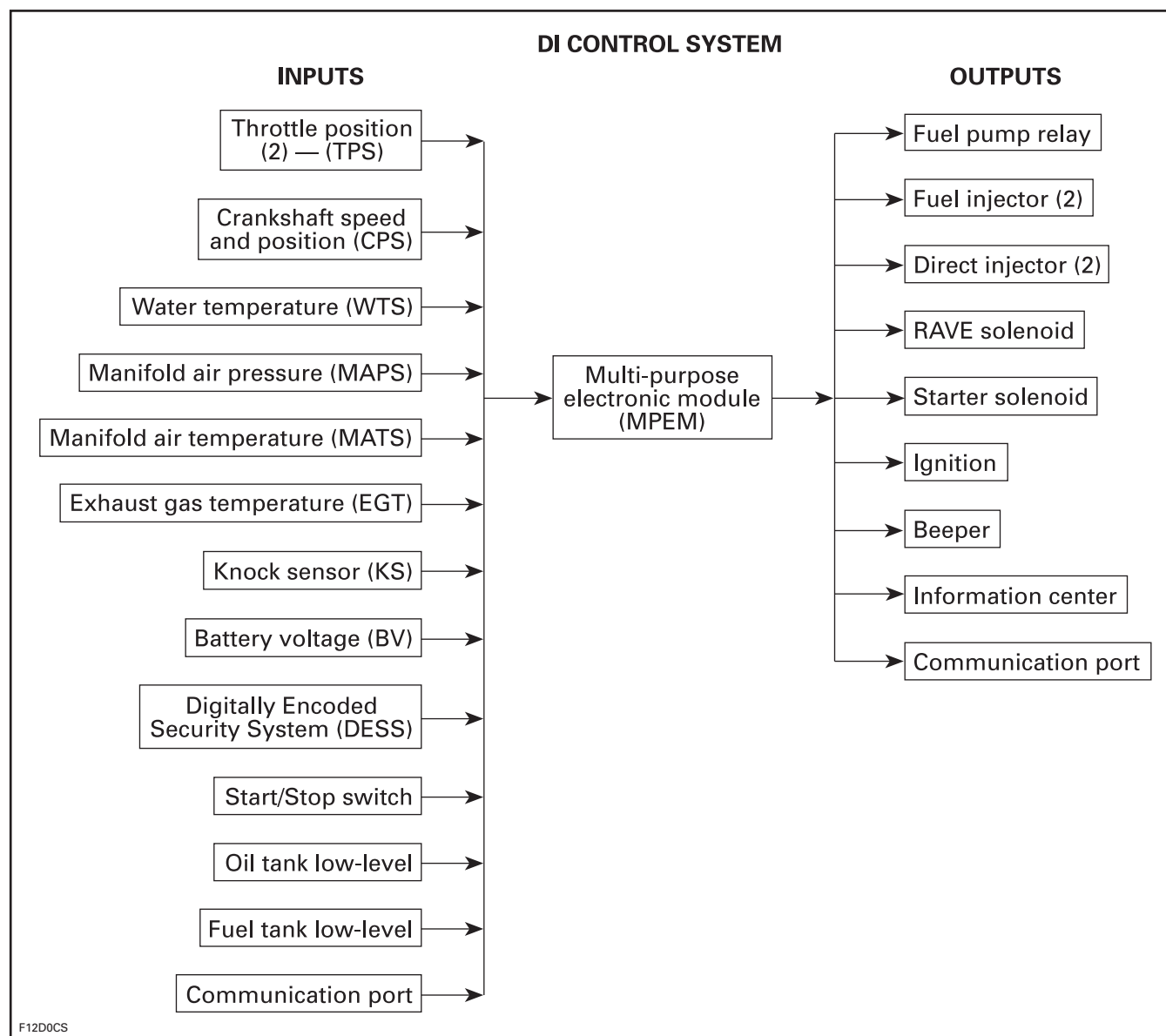
When the oil level is low in the reservoir, the MPEM sends out a signal to the information center gauge and the pilot lamp on the gauge will turn on.

Power Distribution

The MPEM distributes power from battery to all accessories. Accessories are protected by fuses integrated in the MPEM. Fuses are identified besides their holder.

IMPORTANT: The sensors and injectors are continuously powered with the supply from the battery. **The MPEM switches the ground to complete the electrical circuits it controls.** Take this into account when troubleshooting the electrical system.

MPEM — Engine Management Functions



This engine management system controls both the fuel injection and the ignition timing.

As shown in the DI CONTROL SYSTEM illustration, the MPEM is the central point of the fuel injection system. It reads the inputs, makes computations, uses pre-determined parameters and sends the proper signals to the outputs for proper engine management.

The MPEM also stores the fault codes and general information such as: operating conditions, vehicle hours, serial numbers, customer and maintenance information.

Electronic Fuel Injection

The MPEM receives the signals from different sensors which indicate engine operating conditions at milli-second intervals.

Signals from sensors are used by the MPEM to determine the injection parameters (fuel maps) required for optimum air-fuel ratio.

The CPS and both TPS are the primary sensors used to control the injection and ignition timing. Other sensors are used for secondary input.

NOTE: The EGT sensor does not provide control inputs to the MPEM. Its sole purpose is to protect the exhaust system components by emitting a warning signal in the event of overheating.

Ignition Timing

The MPEM is programmed with data (it contains ignition mappings) for optimum ignition timing under all operating conditions. Using engine operating conditions provided by the sensors, the MPEM controls the ignition timing for optimum engine operation.

Knock Sensor

A knock sensor is mounted on top of the cylinder head. It detects specific vibration that would be typically generated by engine detonation. If detonation occurs, the knock sensor detects it and the MPEM retards the ignition advance temporarily (it goes in a specific mode) until detonation stops.

Engine Modes of Operation

The MPEM controls different operation modes of the engine to allow proper operation for all possible conditions: Cranking, flare, idle, warm up, normal operation, Sea-Doo LK™ (learning key) (limited vehicle speed), engine speed limiter, drowned engine and limp home (see below).

Flooded Engine (drowned mode)

If the engine does not start and it is flooded, proceed as follows:

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.

A 1 second beep every second indicates the drowned mode is active.

NOTE: Proceeding in this order, no fuel is injected, no ignition occurs and the accumulated fuel in the engine will be expelled.

In case of water-flooded engine, if water does not completely go out, it may be necessary to remove the air intake silencer then to lean the vehicle so that water can flow out from throttle bodies.

Reinstall spark plugs and connect cables.

Start engine normally without applying the throttle.

Monitoring System

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

Limp Home Modes

Besides the signals as seen above, the MPEM may automatically set default parameters to the engine management to ensure the adequate operation of the watercraft if a component of the fuel injection system is not operating properly.

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

The engine RPM may be limited to idle if some critical components fail. In this case, removing and reinstalling the safety lanyard on its post may allow retrieving normal operation.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 02 (OVERVIEW)

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 DI system will reduce engine RPM gradually to the proper level.

Diagnostic Mode

The malfunctions are recorded in the memory of the MPEM. The memory of the MPEM can be checked using the VCK (Vehicle Communication Kit) (P/N 529 035 676) to see the fault codes. Refer to the DIAGNOSTIC PROCEDURES section.

IGNITION SYSTEM

The ignition system consist of different sub-systems where some are interrelated.

Unregulated AC current is produced by the magneto. Part of the AC current is rectified and regulated for the charging system.

A 12 volts battery supplies the Multi-Purpose Electronic Module (MPEM) with DC current.

Refer to CHARGING SYSTEM.

The following type of ignition system is used:

- Digital Inductive System.

Magneto System

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

The magneto has a 3 phases, delta wound stator on 18 poles. Capacity is 270 watts.

Ignition Coil

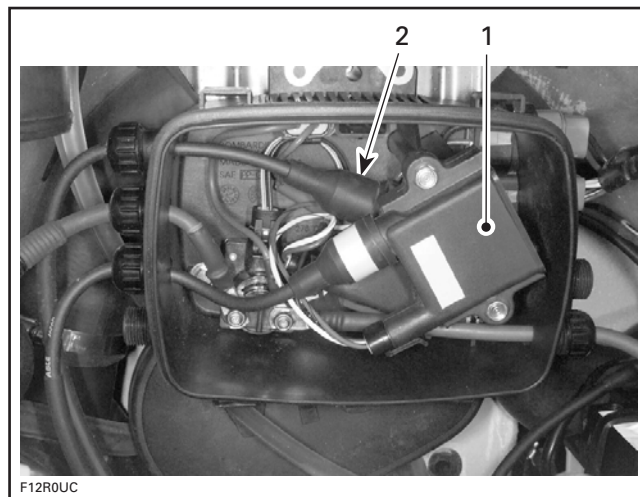
Ignition coil induces voltage to a high level in the secondary windings to produce a spark at the spark plug.

Two separate ignition coils receive input from the MPEM. Each coil provides high voltage to its corresponding spark plug.

This ignition system allows spark plugs to spark independently.

CAUTION: Do not interchange spark plug cables. The white tape on the ignition coil should match the white tape on the high tension cable.

Both coils are located inside the electrical box.



TYPICAL

1. PTO side ignition coil
2. MAG side ignition coil

COMPONENT INSPECTION AND ADJUSTMENT

GENERAL

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

It is important to ensure that the mechanical integrity of the engine/propulsion system is present:

- good jet pump/drive system operation
- good engine compression and properly operating mechanical components, no leaks etc.
- fuel pump connection and fuel lines without leaks.

Check the chart in TROUBLESHOOTING section to have an overview of problems and suggested solutions.

When replacing a component, always check its operation after installation.

WARNING

Air compressor hose may be hot. Use a rag or gloves or let hose cool down.

FUEL SYSTEM

WARNING

The fuel system of a fuel injection system holds much more pressure than on a carbureted watercraft. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here. Pay attention that some hoses may have more than one clamp at their ends. Ensure to reinstall the same quantity of clamps at assembly.

- Use the VCK (Vehicle Communication Kit) (P/N 529 035 676) to release the fuel pressure in the system. Look in the **Activation** section of the software B.U.D.S.

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 and work in a well ventilated area. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Proceed with care when removing/installing high pressure test equipment or disconnecting fuel line connections. Use the VCK (Vehicle Communication Kit) to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the bilge. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Always disconnect battery prior to working on the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure **(if so equipped)**.

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

When the job is done, ensure that hoses from fuel rail going to fuel pump are properly secured in their support. Then, pressurize the fuel system. Perform the high pressure test as explained in this section and pressurize the fuel tank and fuel lines as explained in FUEL SYSTEM section.

Properly reconnect the battery.

WARNING

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

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

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.

To check air/fuel rail for leaks, first pressurize the system then spray soapy water on all hose connections, regulators and injectors. Air bubbles will show the leaking area. Check also for leaking fuel or fuel odor.

WARNING

Never use a hose pincher on high pressure hoses.

ELECTRICAL SYSTEM

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

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

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

Never use a battery charger to replace temporarily the battery, as it may cause the MPEM to work erratically or not to work at all. Check related-circuit fuse solidity and condition with an ohmmeter. Visual inspection could lead to false results.

WARNING

All electrical actuators (injectors, fuel pump, RAVE solenoid, ignition coil and starter solenoid) 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 73 (P/N 529 022 000) should be used.

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 MPEM, 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 MPEM. 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 MPEM is working, try the old one and recheck if it works.

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.

NOTE: Diagnostics Communication Kit. See DIAGNOSTICS section.

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

Communication Errors Between B.U.D.S. and the MPEM

Remember that if there has not been active communication between B.U.D.S. and the MPEM for more than 10 minutes, the MPEM automatically shuts down. This causes false “communication errors”. This occurs quite frequently and confuses many technicians. Whenever this occurs, simply remove and replace the lanyard to restart the MPEM. In fact, one should get into the habit of resetting the MPEM with the lanyard whenever the MPEM does not seem to respond. It must be kept “awake”.

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (69°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 (69°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	11,000
0	32	5900	4900	6900
10	50	3800	3100	4500
20	68	2500	2200	2800
30	86	1700	1500	1900
40	104	1200	1080	1320
50	122	840	750	930
60	140	630	510	750
70	158	440	370	510
80	176	325	280	370
90	194	245	210	280
100	212	195	160	210
110	230	145	125	160
120	248	115	100	125

CONVERSION CHART FOR TEMPERATURE SENSORS

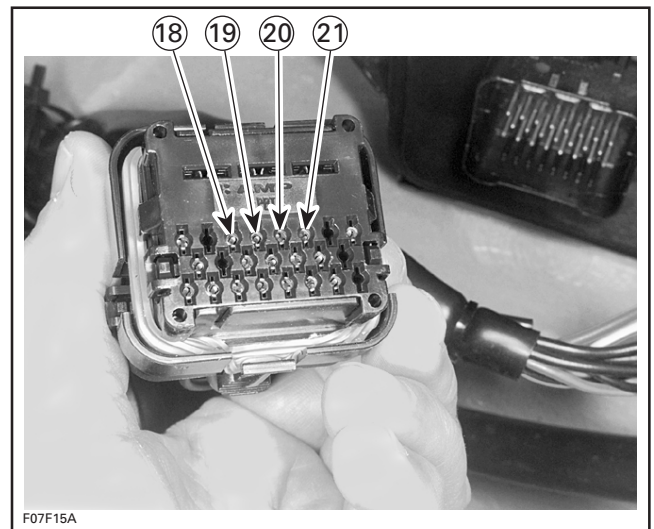
The resistance value of a temperature sensor may test good at a certain temperature but it might be defective at other temperatures. If in doubt, try a new sensor.

Also remember this validates the operation of the sensor at ambient temperature. It does not validate the over temperature functionality. To test it, the sensor could be removed from the engine/muffler and heated with a heat gun while it is still connected to the harness to see if the MPEM 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 MPEM. 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.

AMP CONNECTOR PIN-OUT

Use this diagram to locate the pin numbers on the AMP connector no. 3 and no. 4 of the wiring harness when performing tests.



AMP CONNECTOR PIN-OUT (WIRING HARNESS SIDE)

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

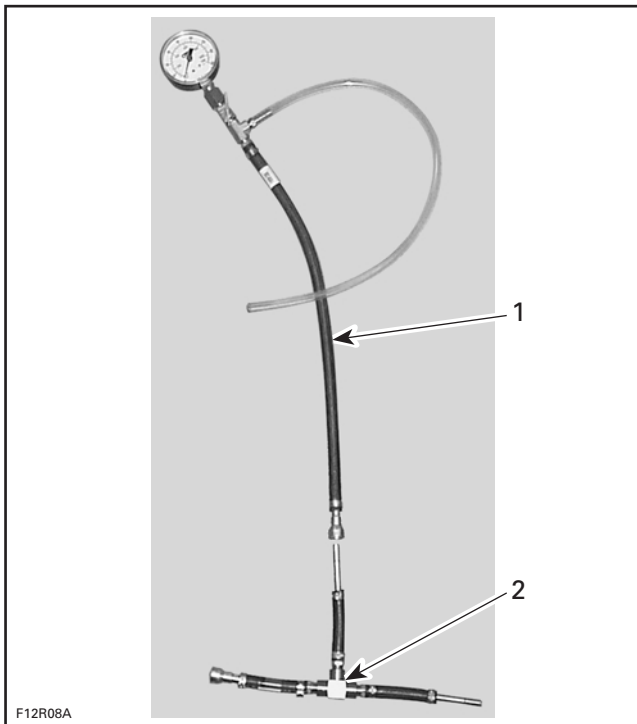
QUICK FUEL PRESSURE TEST

⚠ WARNING

Read **Pressure Test** under AIR/FUEL RAIL farther in this section for precautions and setup to take care of, before performing this test. The procedure here is a quick summary.

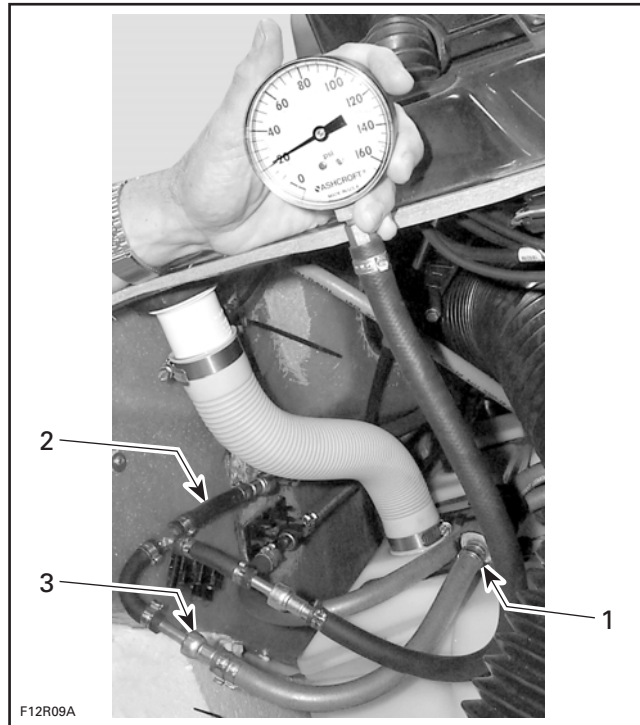
Disconnect outlet hose (the one with the fuel filter) from fuel pump using tool (P/N 529 035 714).

Connect adapter to pressure gauge as shown.



1. Pressure gauge (P/N 529 035709)
2. T-adaptor (P/N 529 035 710)

Install pressure gauge between disconnected hose (inline installation).



1. Fuel filter
2. Fuel line going to air/fuel rail
3. Pressure gauge between disconnected hose (inline installation)

Install safety lanyard and observe fuel pressure. **Do not crank engine.**

FUEL REGULATOR PRESSURE (when installing safety lanyard)

185 ± 14 kPa (27 ± 2 PSI)

If pressure is within limits, air/fuel rail is working adequately. Proceed with the fuel pressure test below.

If pressure is out of limits, go to FUEL DELIVERY part and proceed with the tests described there.

Crank or start engine and observe fuel pressure.

FUEL PRESSURE (when cranking engine or when engine is running)

738 ± 14 kPa (107 ± 2 PSI)

If pressure is within limits, fuel and air systems are working adequately. No subsequent tests are necessary for the air/fuel system.

Remove pressure gauge and reinstall fuel hose.

If pressure is out of limits, proceed with all the tests.

AIR INDUCTION SYSTEM

THROTTLE BODY

Mechanical Inspection

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

IMPORTANT: The throttle bodies are designed to be tamper proof. Changing the idle stop or modifying them in any way will not increase performance or change the idle speed.

Before replacing any parts, check the following as these could be causing the fault. Perform the test while the engine is not running.

- Throttle cable adjustment too tight. Not returning fully to idle stop.
- Throttle body idle set screw is loose or worn.
- Throttle linkage between the two throttles has moved.
- TPS is loose.
- Corroded or damaged wiring or connectors.
- Throttle body has been replaced and the closed TPS reset has not been performed.
- MPEM has been replaced and the closed TPS reset has not been performed.

Electrical Inspection

Refer to **Throttle Position Sensor (TPS)** in **Electronic Management** below.

Replacement

Removal

To remove throttle bodies from engine, proceed as follows:

- Remove air intake silencer. Refer to AIR INTAKE section.
- Disconnect TPS connectors.
- Disconnect throttle cable and oil injection pump cable.
- Detach hoses and remove fasteners retaining throttle bodies and pull out together.

If only one throttle body replacement is required, detach them and remove the sealant on idle set screw head. Gently remove the plastic cap from the synchronization screw.

Remove TPS, throttle lever, spring and guide from the old throttle body.

Installation

Reinstall removed parts on the new throttle body. For TPS replacement procedures, refer to **Throttle Position Sensor (TPS)** in **Electronic Management** below.

Properly attach throttle bodies together if previously detached.

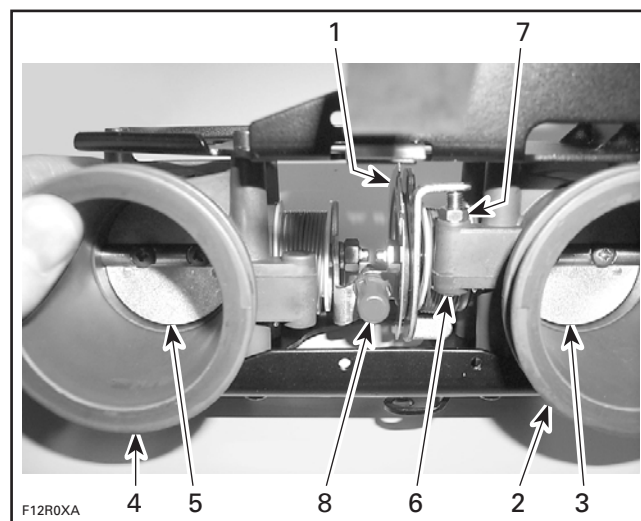
Adjustment

Throttle Body Synchronization

NOTE: If both throttle bodies are replaced together with new ones, no synchronization is required as it has already been set at the factory. However, proceed with throttle cable and closed TPS adjustments as described below. If only one throttle body is replaced, proceed with the complete following adjustments. Ensure to perform all the adjustments prior to starting the engine. Otherwise, engine may run at a limited RPM in limp home mode.

IMPORTANT: The throttle body synchronization is required only when replacing one throttle body. Otherwise, do not tamper with it as this is NOT a regular maintenance procedure.

The master throttle body is the one driven by the throttle cable. The slave throttle body follows the master and must be synchronized with the master.



1. Throttle cable attachment
2. Master throttle body
3. Master throttle plate
4. Slave throttle body
5. Slave throttle plate
6. Idle set screw
7. Lock nut
8. Synchronizing screw with its tamper proof cap

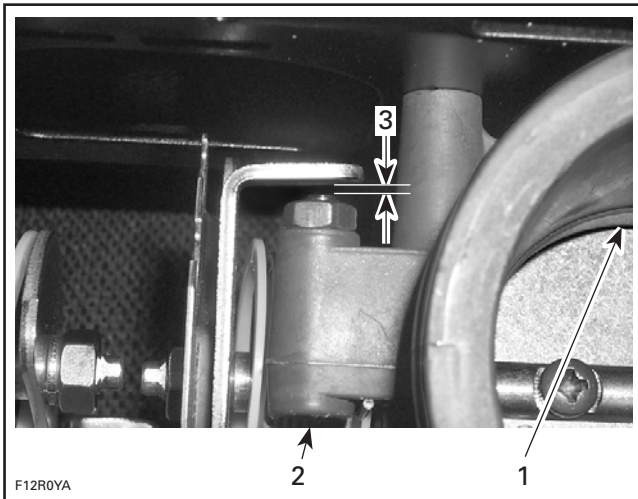
Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

NOTE: In the following illustrations, the lower link plate has been removed for clarity purposes only. It does not have to be removed to perform the adjustment.

Loosen lock nut of idle set screw.

Unscrew idle set screw so that **master** throttle plate completely closes in the throttle body. Ensure screw end clears the lever stopper.



1. Unscrew until **master** throttle plate is fully closed in throttle body
2. Unscrew here
3. Gap here

Remove synchronizing screw and spring between levers.

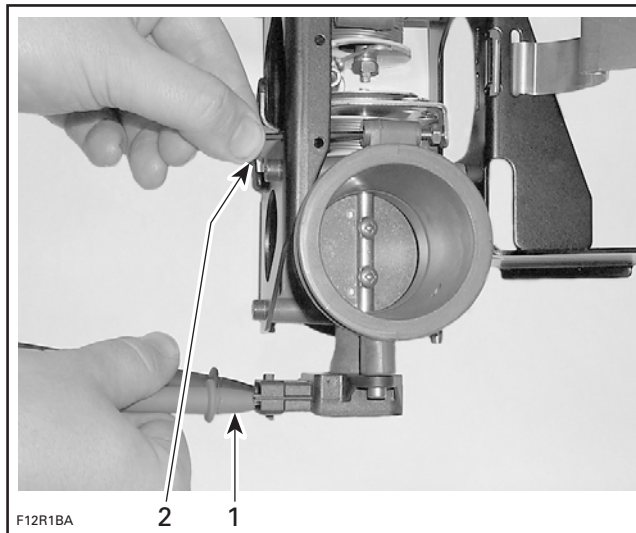
NOTE: The 175 Ω below is used to open the throttle plates the same amount on each throttle body to obtain the proper synchronization. It is the equivalent of using a drill bit in the throttle bore to open throttle plate on carburetors.

Master TPS

Snap throttle plate a few times to ensure it is completely closed.

Using an ohmmeter, measure resistance between pins 2 and 3. Note the resistance value. **Add** 175 Ω to that value.

Turn **idle set screw clockwise** until ohmmeter reading reaches the computed value above $\pm 20 \Omega$.



1. Measure resistance between pins 2 and 3
2. Turn screw clockwise to **increase** resistance

Tighten lock nut.

WARNING

Do not apply any threadlocker to the screw threads. The threadlocker may leak off the screw and onto the throttle mechanism and cause the throttle to stick.

Recheck reading and readjust as necessary.

Slave TPS

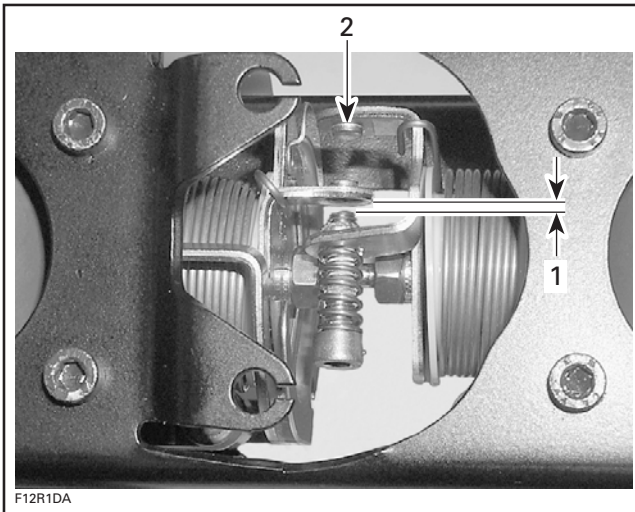
Install a new synchronizing screw. Screw in and ensure screw end clears the lever stopper. Ensure also to keep **slave** throttle plate completely closed in the throttle body.

WARNING

Ensure to use a new screw which is coated with the proper threadlocker to avoid further loosening. Do not use the removed screw even if you were applying any threadlocker. The threadlocker may leak off the screw and flow onto the throttle mechanism and cause the throttle to stick.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)



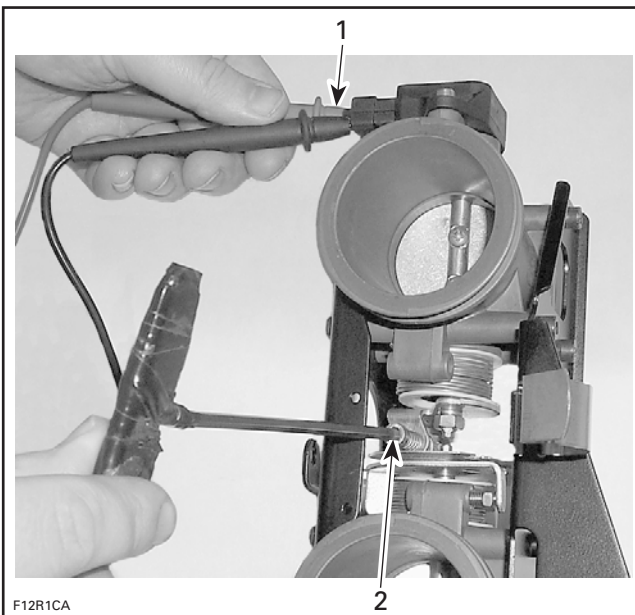
1. Gap here
2. Spring removed

Snap throttle plate a few times to ensure it is completely closed.

Measure resistance between pins 2 and 3. Note the resistance value. **Subtract** 175 Ω from that value.

Properly reinstall the spring. Ensure that **master** throttle plate is still closed.

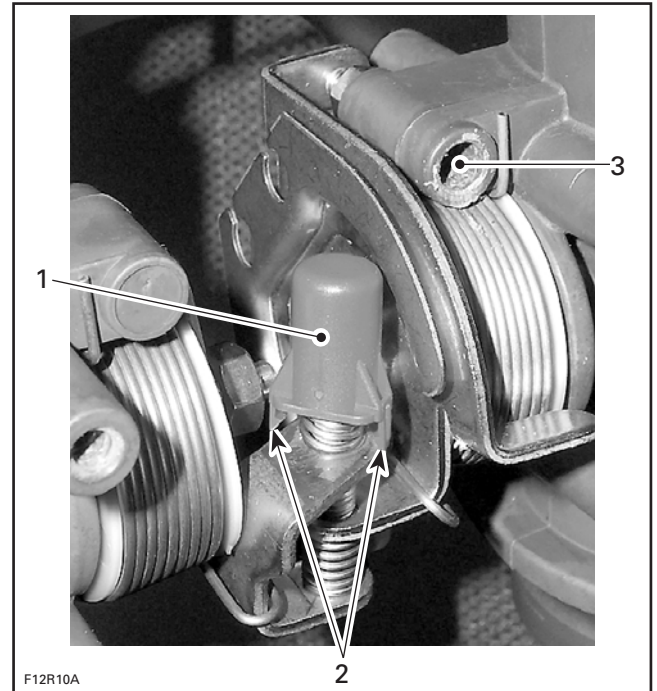
Turn **synchronizing screw clockwise** until reading reaches the computed value above $\pm 20 \Omega$.



1. Measure resistance between pins 2 and 3
2. Turn screw clockwise to **decrease** resistance

Ensure spring is still well positioned on stoppers. Properly reinstall the plastic cap to the synchronization screw.

Apply Loctite 5910 flange sealant on idle set screw head.



1. Plastic cap
2. Wider spaced tabs here
3. Loctite 5910 flange sealant

WARNING

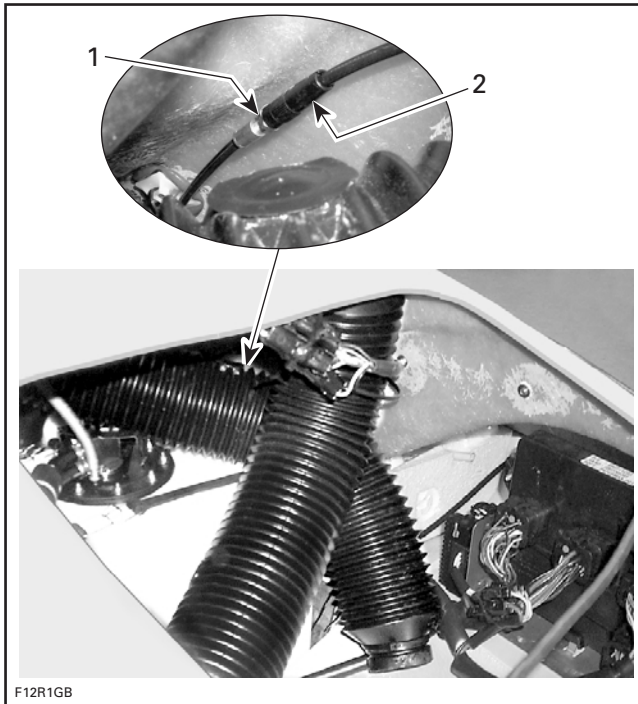
Ensure no Loctite product protrudes screw head.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

Throttle Cable Adjustment

Mechanically adjust the throttle cable using the adjusting device underneath body, below steering. Slacken lock nut to allow adjuster rotation. Free-play on lever should be between 2 and 3.5 mm (1/16 and 1/8 in). When done, tighten lock nut.



1. Slacken nut
2. Turn adjuster

NOTE: On GTX DI models, vent tube removal in front storage compartment may be necessary to reach the adjusting device.

CAUTION: Improper cable adjustment will cause strain on cable and/or damage cable bracket or throttle lever at handlebar.

Use the vehicle communication kit (VCK) with the B.U.D.S. software to perform this adjustment. Choose the **Monitoring** tab.

Press throttle lever to reach full throttle.

Turn cable adjustment until **Throttle Opening** meter indicates between 95% and 99%.

Closed TPS Adjustment

Perform the **Closed TPS adjustment** as described in **Throttle Position Sensor (TPS)** in **Electronic Management** below.

Injection Oil Pump Cable Adjustment

As oil injection cable is throttle dependent, always proceed with the oil injection pump cable adjustment after throttle cable adjustment. Refer to **OIL INJECTION PUMP**.

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

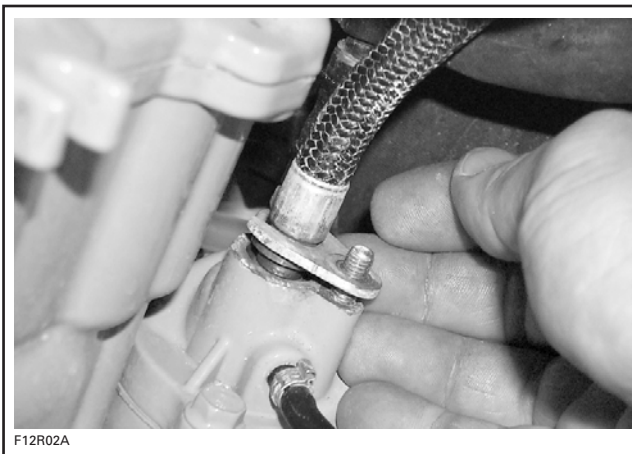
AIR COMPRESSOR

PRESSURE TEST

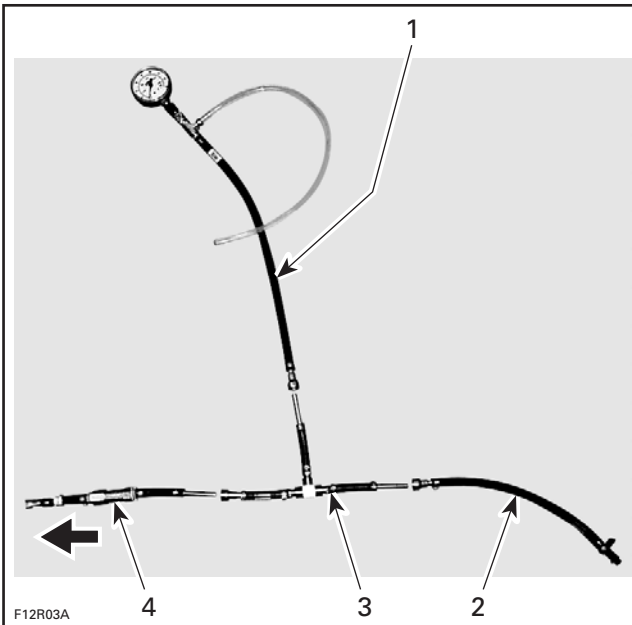
The pressure test will show the available pressure from the air compressor.

First ensure there is no leak from compressor gaskets, hoses and fittings. Soapy water can be sprayed on components. Repair any leak.

Disconnect hose outlet from air compressor.



Connect adapters and pressure relief valve to pressure gauge as shown.



1. Pressure gauge (P/N 529 035 709)
2. Adapter for air compressor (P/N 529 035 712)
3. T-adaptor (P/N 529 035 710)
4. Pressure relief valve (P/N 529 035 711)

CAUTION: Ensure to install the pressure relief valve to allow excess pressure to go out. Note the arrow on the valve. Otherwise, air compressor components might be damaged.

Install pressure gauge to air compressor.

NOTE: To prevent fuel to be injected and thus going out the disconnected hose, use the drowned engine mode to crank engine. While engine is stopped, depress and HOLD the throttle lever at full throttle position for cranking.

Ensure the battery is in good condition to get the normal cranking speed.

Crank engine and observe air pressure.

NOTE: A 1 second beep every second indicates the drowned mode is active.

⚠ WARNING
Be careful of pressure relief valve outlet. Compressed air may flow out there.

MINIMUM AIR PRESSURE (at cranking)
621 ± 14 kPa (90 ± 2 PSI)

If pressure is within limits, air compressor is working adequately.

If pressure is below limits, ensure inlet hose is not obstructed, bent or kinked. Otherwise, repair the air compressor.

Remove pressure gauge and reinstall air compressor hose.

REPAIR

Top End

Remove retaining screws.

Lift cover then remove compressor head.

Clean all parts in a solvent and visually inspect for corrosion damage.

Check reed valve plates for cracks, deformation, dirt or other defects. The reed plates must lie completely flat against the reed valve body.

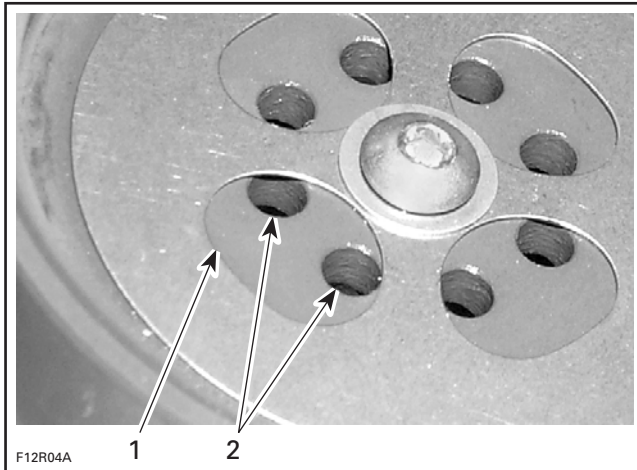
Inspect plane surfaces for warpage.

If reed valve is found defective, it is suggested to replace it then to temporarily reassemble the compressor to then make a pressure test. If it fails, check bottom end.

Section 06 ENGINE MANAGEMENT (DI)

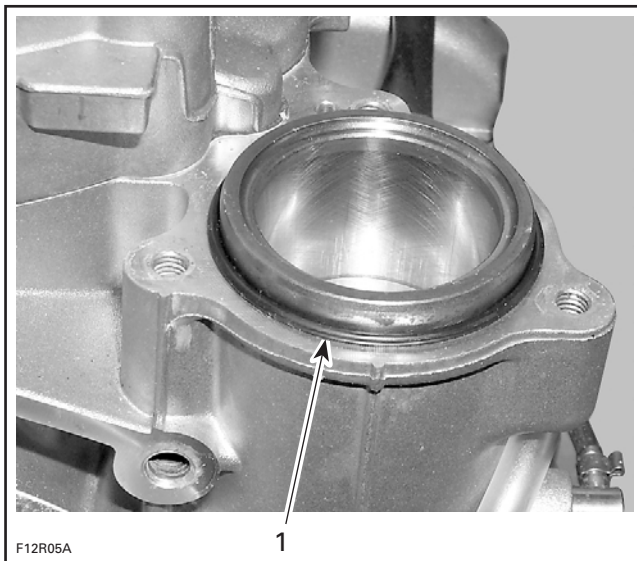
Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

When changing reed valve, ensure to position ring plate opening so that 2 holes align inside the opening. Holes must not be obstructed by the opening edges.



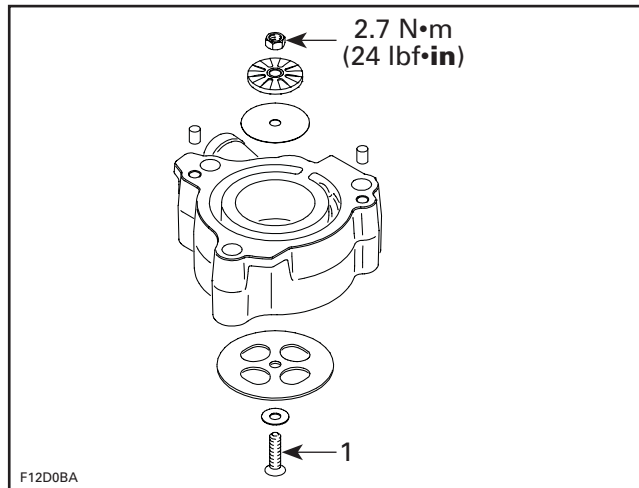
1. Reed valve opening
2. Rotate opening to align 2 holes inside without obstructing the holes

Ensure to position O-ring, around top of cylinder sleeve.



1. O-ring on top of cylinder sleeve

Ensure to position screw from the bottom up as show. Torque nut to 2.7 N•m (24 lbf•in).



1. Screw from bottom up

CAUTION: Failure to properly position screw head will lead piston to hit it.

If pressure is still low then continue with **Bottom End**. Otherwise, remove components again. Install a new gasket, new O-ring, compressor head and cover. Apply synthetic grease below screw head and Loctite 243 on threads. Install screws then torque to 5 N•m (44 lbf•in) to then finalize to 11 N•m (97 lbf•in).

Bottom End

To gain access to piston, rings and connecting rod, engine PTO flywheel must be removed. Refer to ENGINE section.

Remove engine support and slightly lift engine to allow access. Block engine in this position.

Remove top end as explained above.

Remove access plug of air compressor connecting rod.

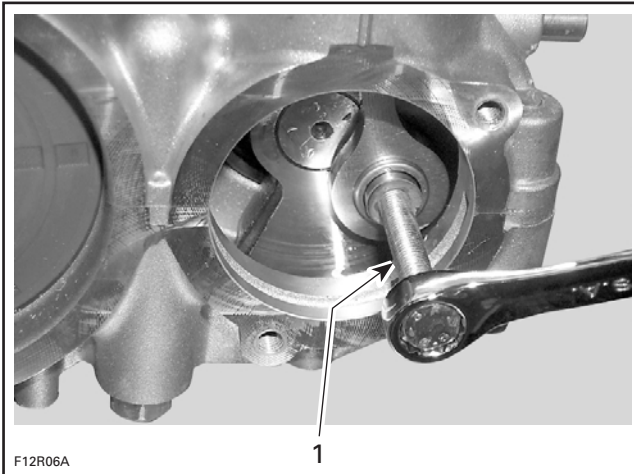
Remove connecting rod retaining screw.

As a puller, use a M7 x 1.0 x 50 mm screw to release connecting rod "crankpin".

IMPORTANT: Trace a mark on "crankpin" (bushing) outer end. This is needed for reinstallation.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)



1. Use a M7 x 1.0 x 50 mm screw as a puller

Push piston upward with or without the cylinder sleeve.

Remove rubber plug then push piston pin end to remove from connecting rod.

Inspection

Clean all parts in a solvent and visually inspect for corrosion damage.

Clean piston ring grooves with a groove cleaner tool, or a piece of broken ring.

Check bearings and pins for wear and heat discoloration. Check connecting rod for straightness. Replace damaged components.

Inspect piston for damage. Light scratches can be sanded with a fine sand paper.

If you find aluminum dust or debris in this area, they may have flowed toward the injection oil reservoir. In this case, the oil reservoir and lines must be flushed and the filter replaced.

CAUTION: Failure to properly clean the oil system will result in serious engine damage.

The inspection of top end should include the following measurements.

ENGINE MEASUREMENT	TOLERANCES		
	NEW PARTS (min.)	(max.)	WEAR LIMIT
Piston/cylinder wall clearance	0.12 mm (.005 in)	N.A.	0.2 mm (.008 in)
Ring end gap	0.1 mm (.004 in)	0.25 mm (.010 in)	0.5 mm (.020 in)

N.A.: Not Applicable

Piston/Cylinder Wall Clearance

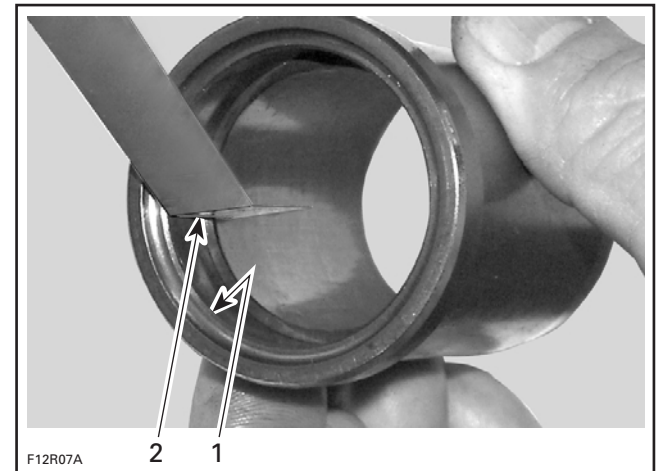
Clearance can be quickly checked with a feeler gauge. Insert feeler gauge in cylinder then slide piston (without piston rings installed). If clearance exceeds tolerance, check cylinder top area with your finger to feel if there is a ridge. If so, the cylinder sleeve is worn and needs replacement. Otherwise, replace piston.

Ring End Gap

Position ring close to top of cylinder top.

NOTE: In order to correctly position ring in cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. If gap exceeds specified tolerance, rings should be replaced.



1. Top of cylinder
2. Ring end gap

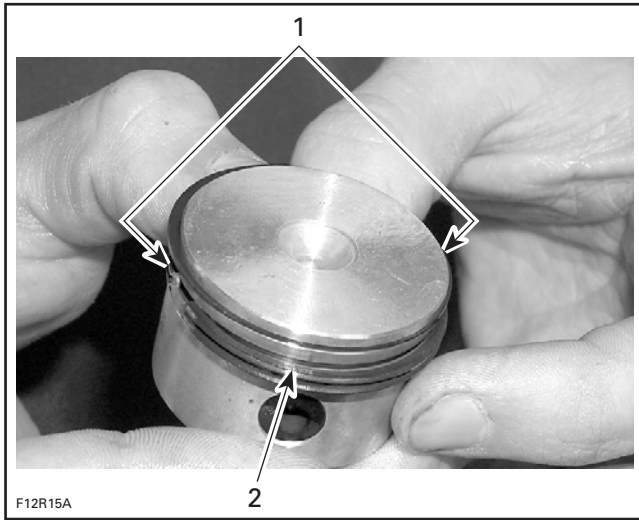
Assembly

Apply injection oil in cylinder and on rings prior to installing.

Install the oil ring with the "TOP" marking on top. Position ring openings 180° apart.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)



1. Ring openings 180° apart
2. TOP marking on this side

Use ring compressor (P/N 529 035 713) and insert piston in cylinder.

NOTE: Cylinder may be removed from crankcase to install piston more easily on the bench from the bottom if desired.

When attaching connecting rod to “crankpin”, strictly follow this procedure:

1. Block counterbalance shaft to prevent any rotation.
2. Install the “crankpin” (bushing) with the previously marked end outside. If the mark is not present anymore, place a straight edge against bushing end to find the tapered end (concave). A very small gap between the edge and the bushing will identify the tapered end to be installed against the counterweight.
3. Install a **NEW** screw and torque to 6.5 N•m (58 lbf•in). Do not apply any thread locker product.
4. Turn the screw clockwise an additional 80 degrees ± 5 degrees.

CAUTION: Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. The bushing tapered end must be against the counterweight. Besides, as the “crankpin” screw has been stretched from the previous installation, it is very important to **use a new screw at assembly**. Also, the new screw will have the proper threadlocking coating.

Ensure to correctly position O-ring on access cover and install cover.

Reinstall remaining removed parts. Ensure to check engine alignment.

FUEL DELIVERY

FUEL PRESSURE REGULATOR

Pressure Test

The pressure test will show the available pressure at the air/fuel rail. It validates the pressure regulator and leaks in the system.

IMPORTANT: Before checking air/fuel rail pressure, make sure the fuel pressure from the fuel pump and the air pressure from the air compressor are within specifications. See the procedures elsewhere in this section.

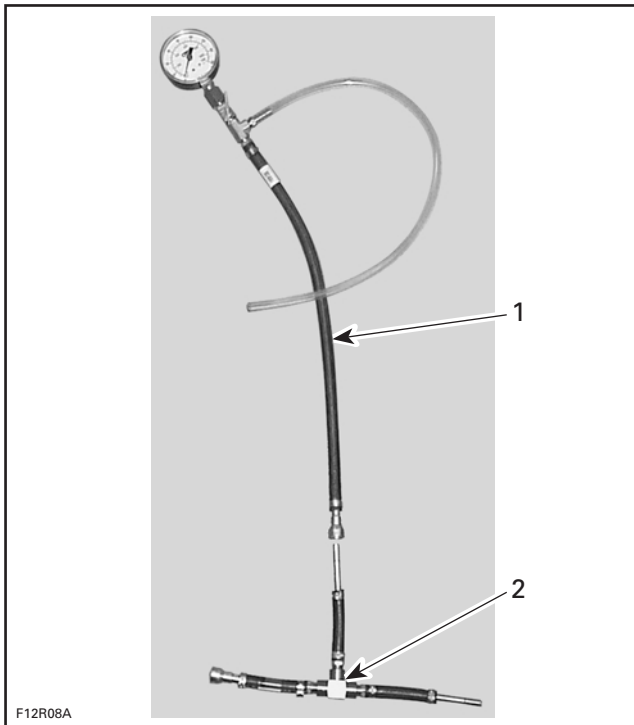
Also ensure there is no leak from hoses and fittings. Repair any leak.

Ensure there is enough gas in fuel tank.

Release the fuel pressure in the system.

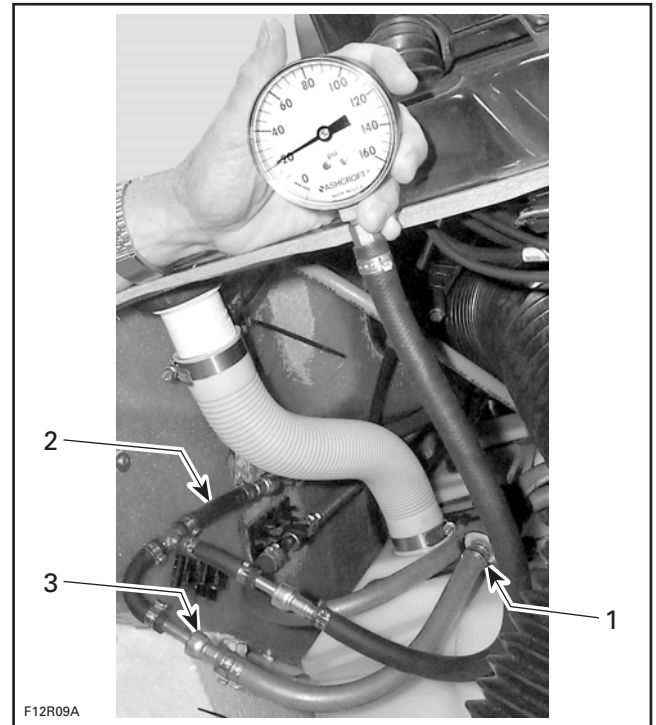
Disconnect outlet hose (the one with the fuel filter) from fuel pump using tool P/N 529 035 714.

Connect adapter to pressure gauge as shown.



1. Pressure gauge (P/N 529 035709)
2. T-adapter (P/N 529 035 710)

Install pressure gauge between disconnected hose (inline installation).



1. Fuel filter
2. Fuel line going to air/fuel rail
3. Pressure gauge between disconnected hose (inline installation)

Install safety lanyard and observe fuel pressure. **Do not crank engine.**

FUEL REGULATOR PRESSURE (when installing safety lanyard)
185 ± 14 kPa (27 ± 2 PSI)

If pressure is within limits, fuel pressure regulator is working adequately.

A rapid pressure drop indicates leakage either from the air/fuel rail or from the fuel pump check valve. Check air/fuel rail for leaks. If it is not leaking then replace fuel pump.

A slow pressure drop indicates leakage either from the fuel injector or from the fuel pressure regulator. Check fuel injector for leaks (see below). If it is not leaking then replace fuel pressure regulator.

NOTE: Fuel in air compressor outlet line is an indication of a leaking fuel pressure regulator diaphragm. 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.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

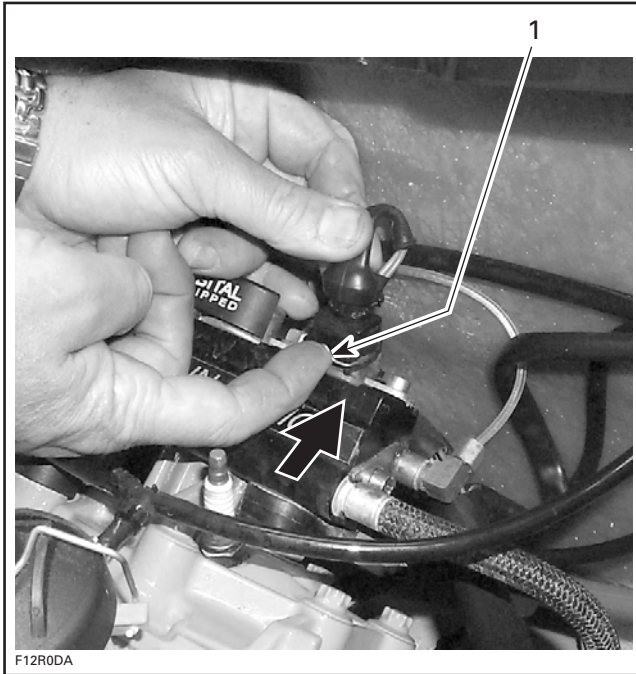
Fuel Pressure Regulator Replacement

Removal

Release the fuel pressure in the system.

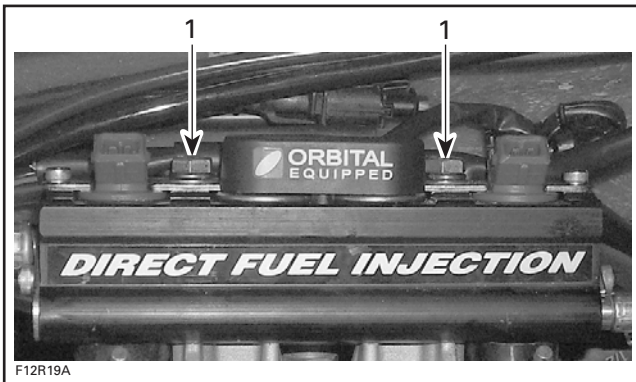
Disconnect spark plug cables from spark plugs.

Disconnect the fuel injector wires, if necessary.



1. Push clip toward injector to release connector

Unscrew rail retaining screws.

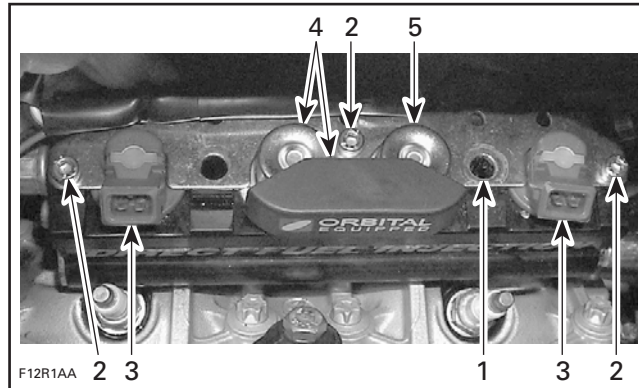


1. Retaining screws

Gently pull rail up by hand, working each side slightly at a time.

Pull rail out.

Unscrew retaining plate screws.



1. Retaining plate
2. Screws
3. Fuel injector
4. Fuel pressure regulator and cover
5. Air pressure regulator

NOTE: If needed, use a small screwdriver to lift the fuel pressure regulator.

To remove fuel pressure regulator, pull the fuel regulator and the cover out of rail.

Installation

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

If the same regulator is reinstalled, it is recommended to change the O-rings.

Insert the fuel pressure regulator into the cover then install both regulators together in place with your hand. Do not use any tool.

NOTE: A thin film of injection oil may be applied to O-ring to ease insertion in rail.

Apply Loctite 243 on rail retaining screws then torque to 25 N•m (18 lbf•ft).

FUEL INJECTOR

Leakage Test

Testing the fuel injector operation can be performed with the air/fuel rail installed.

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

Section 06 ENGINE MANAGEMENT (DI)
Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

Electrical 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** section.

If the injector does not work, disconnect the plug connector from the injector.

Install a temporary connector to the injector with wires long enough to make the connection outside the bilge and apply voltage (12 V) to this test harness.

This will validate the injector mechanical and electrical operation.

If it does not work, replace it.

Otherwise, check the resistance of the fuel injector circuit.

Reconnect the injector and disconnect the AMP plug connector number 4 on the MPEM.

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

COMPONENT	CONTACT LOCATION
Fuel injector MAG	7 and 13
Fuel injector PTO	8 and 14

The resistance should be between 1.7 and 1.9 Ω .

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and fuel injector.

Fuel Injector Replacement

When one fuel injector is defective, both have to be replaced at the same time. Be sure to check the other one. Also replace direct injectors.

Removal

See **Fuel Pressure Regulator Replacement** above for procedure. However, do not remove any regulator.

To remove fuel injector, pull it out of rail.

Installation

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

If the same injector is reinstalled, it is recommended to change the O-rings.

Insert the fuel injector in place with your hand. Do not use any tool.

NOTE: A thin film of injection oil may be applied to O-ring to ease insertion in rail.

Apply Loctite 243 on rail retaining screws then torque to 25 N•m (18 lbf•ft).

AIR/FUEL RAIL

Pressure test

Crank or start engine and observe fuel pressure.

FUEL PRESSURE (when cranking engine or when engine is running)
738 \pm 14 kPa (107 \pm 2 PSI)

If pressure is within limits, fuel and air systems are working adequately. No subsequent tests are necessary for the air/fuel system.

Remove pressure gauge and reinstall fuel hose.

If pressure is out of limits, check air/fuel rail for leaks. If it is not leaking then replace air regulator

A higher pressure may be an indication of a pinched or clogged air regulator outlet line.

Air Pressure Regulator Replacement

Removal

See **Fuel Pressure Regulator Removal** above for procedure.

Remove the fuel regulator then the air regulator.

Installation

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

NOTE: A thin film of injection oil may be applied to O-ring to ease insertion in rail.

Apply Loctite 243 on rail retaining screws then torque to 25 N•m (18 lbf•ft).

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

Air/Fuel Rail Replacement

Removal

Release the fuel pressure in the system.

Disconnect air compressor supply hose from rail.

Disconnect fuel hoses (supply and return) at their inline connectors.

Temporarily connect those hose ends together to prevent rail draining.

Disconnect spark plug cables from spark plugs and fuel injector wires. Cut locking ties of wiring.

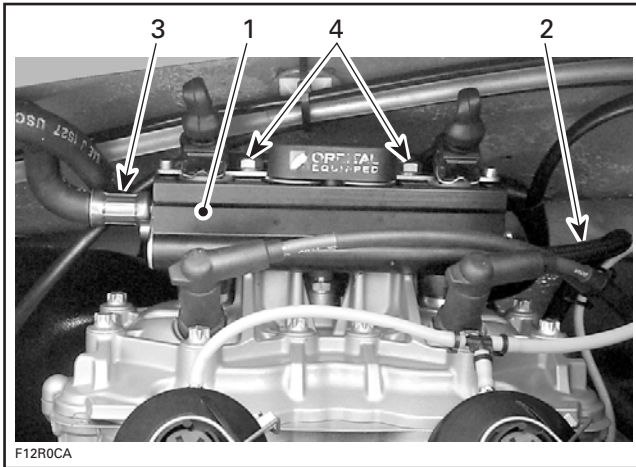
Unscrew rail retaining screws.

Gently pull rail up by hand, working each side slightly at a time.

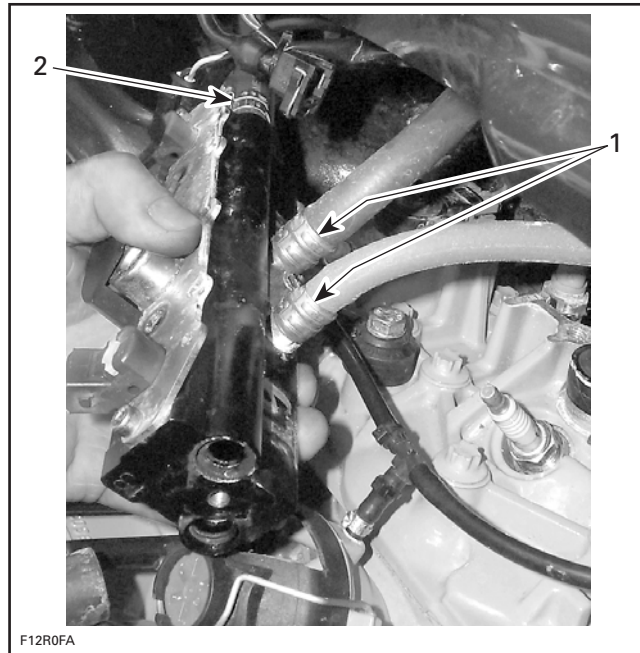
Pull rail out.

Disconnect hose ends at their inline connectors and drain fuel rail.

Disconnect air and fuel hoses from rail.



1. Air/fuel rail
2. Air supply hose
3. Fuel supply hose
4. Retaining screws



1. Air and fuel return hoses
2. Fuel supply hose

NOTE: When lifting/removing air/fuel rail, we recommend replacing carbon dams on direct injectors that have been running for 50 hours or more. Remove fuel injector, fuel pressure regulator and air pressure regulator.

Installation

For installation, reverse the removal process but pay attention to the following.

A thin film of injection oil may be applied to O-rings of fuel injectors to ease rail installation.

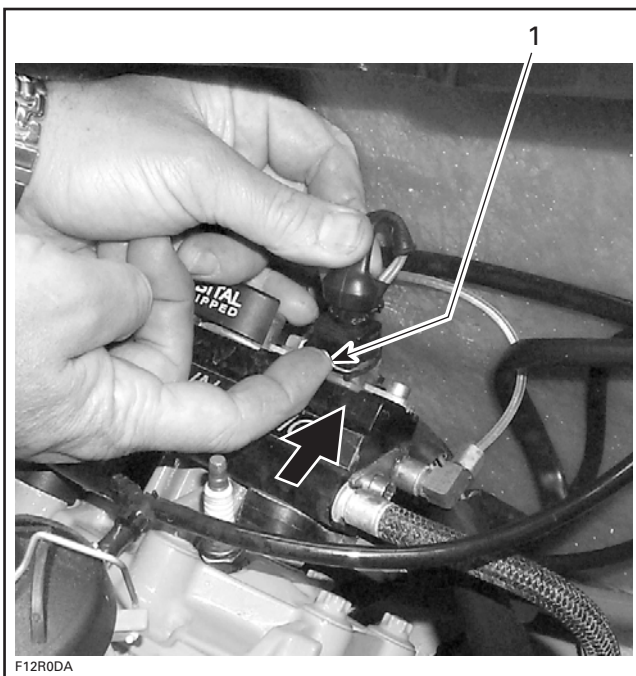
Apply Loctite 243 on rail retaining screws then torque to 25 N•m (18 lbf•ft).

When installing fuel or air hoses fitting to the air/fuel rail, use Loctite Krylox (no. 29-719).

DIRECT INJECTOR

When one direct injector is defective, both have to be replaced at the same time. Be sure to check the other one. Also replace fuel injectors.

The direct injectors can be replaced by lifting the air/fuel rail.



1. Push clip toward injector to release connector

Leakage Test

If direct injector leaks through its large top O-ring, there will be an air/fuel leak between the injector and the air/fuel rail. Replace O-ring of both injectors. If there is an injector internal leak, the high temperature from the combustion chamber will make visible overheated area. Replace damaged components.

Electrical Test

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the direct injector in the **Activation** section.

If the injector does not work, disconnect the plug connector from the injector.

Install a temporary connector to the injector with wires long enough to make the connection outside the bilge and apply voltage (12 V) to this test harness.

This will validate its mechanical and electrical operation.

If it does not work, replace the direct injector.

Otherwise, check the resistance of the direct injector circuit.

Reconnect the injector and disconnect the AMP plug connector number 4 on the MPEM.

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

COMPONENT	CONTACT LOCATION
Direct injector MAG	5 and 15
Direct injector PTO	6 and 21

The resistance should be between 1 and 1.6 Ω.

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

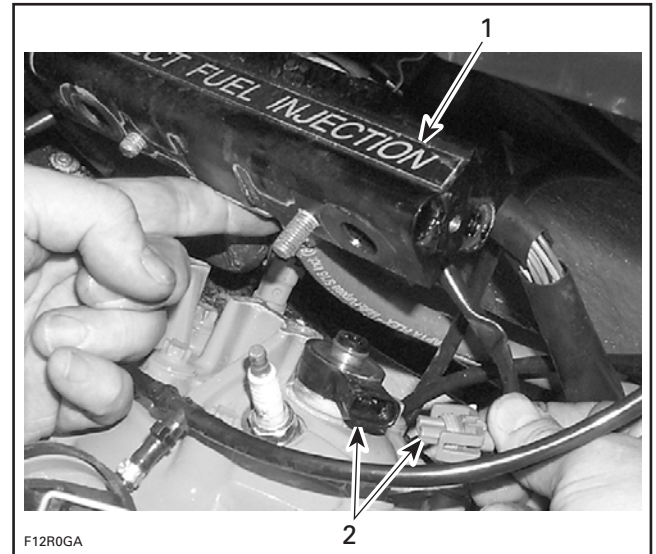
If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and direct injector.

Direct Injector Replacement

IMPORTANT: Do not remove direct injector needlessly. They are sealed with a carbon dam that may expand when pulled out. A special tool is required to compress it prior to reinstalling. Otherwise, sealing efficiency might be affected.

Remove air/fuel rail retaining screws. Partially lift rail to allow direct injector removal.

Disconnect direct injector connector then pull injector out of cylinder head.



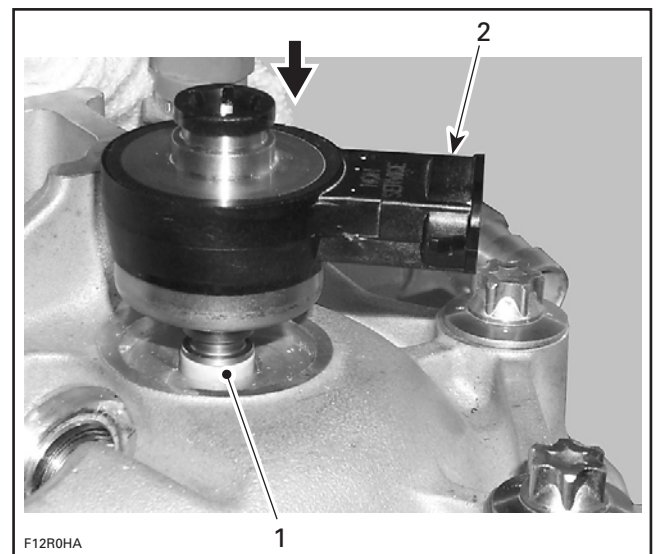
1. Air/fuel rail
2. Disconnect and pull injector out

Compress the carbon dam using tool (P/N 529 035 716).

Carefully install direct injector in cylinder head paying attention to carbon dam insertion. Ensure to position connector pointing toward bottom of cylinder head.

NOTE: A thin film of injection oil may be applied to carbon dam if necessary to ease insertion in cylinder head.

Reconnect electrical connector.



1. Carefully insert direct injector
2. Connector pointing toward bottom of cylinder head

Reinstall air/fuel rail.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

Carbon Dam Replacement

Remove direct injector. See procedure above.

NOTE: When replacing a carbon dam, it is recommended to replace it on both injectors. It is also recommended to replace all O-rings. When servicing air/fuel rail or direct injectors, we recommend replacing carbon dams that have been running for 50 hours or more.

CAUTION: Never reuse a carbon dam after it has been removed from the injector. Always install a new one.

Remove carbon dam and O-ring using a small pick.

Install seal guide (P/N 529 035 715) on end of injector. Carefully slide carbon dam in injector groove.

Use carbon dam compressor (P/N 529 035 716) to compress carbon dam evenly.

FUEL PUMP

Pressure Test

The pressure test will show the available pressure from the fuel pump.

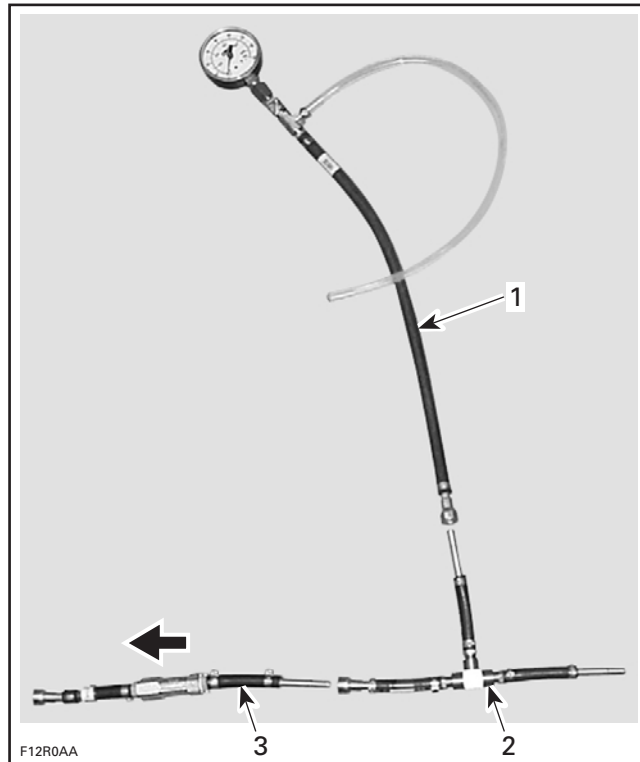
Ensure there is no leak from hoses and fittings. Repair any leak.

Ensure there is enough gas in fuel tank.

Use the VCK (Vehicle Communication Kit) to release the fuel pressure in the system. Look in the **Activation** section of the software B.U.D.S.

Disconnect inlet and outlet hoses from fuel pump using tool (P/N 529 035 714).

Connect adapters and pressure relief valve to pressure gauge as shown.



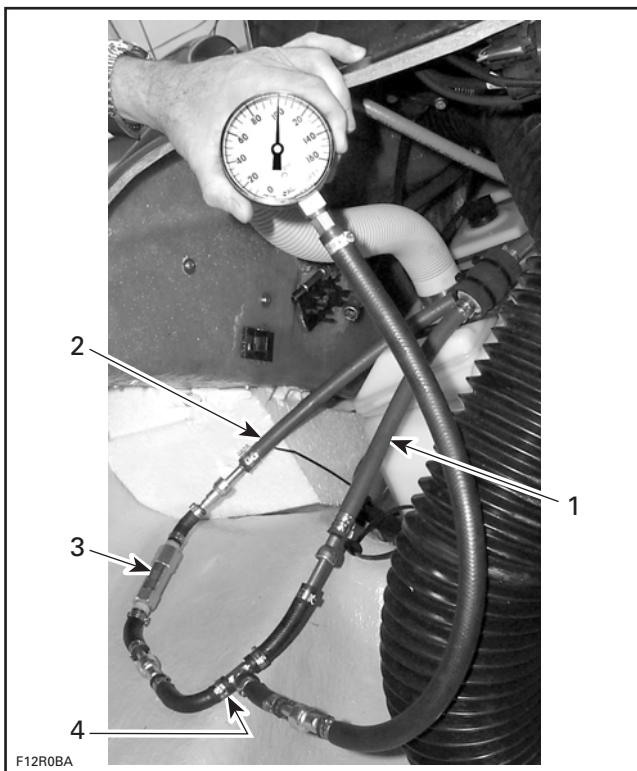
1. Pressure gauge (P/N 529 035 709)
2. T-adaptor (P/N 529 035 710)
3. Pressure relief valve (P/N 529 035 711)

CAUTION: Ensure to install the pressure relief valve to allow excess pressure to flow back through return line. Note the arrow on the valve. Otherwise, fuel pump components might be damaged.

Install pressure gauge between disconnected hoses on fuel pump side (**closed-loop** installation on fuel pump). Make sure the pressure-relief valve is installed on the fuel pump return line side.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)



1. Fuel pump outlet hose (fuel filter side)
2. Fuel pump return line
3. Fuel relief valve on the return line side
4. Pressure gauge between disconnected hose (inline installation)

Install safety lanyard and observe fuel pressure.

MINIMUM FUEL PUMP PRESSURE (when installing safety lanyard)
--

721 kPa (105 PSI)

If pressure is within limits, fuel pump is working adequately.

If pressure is below limits, ensure fuel filters are not obstructed. There is one in-line fuel filter at the fuel pump outlet hose and one filter at the inlet underneath the pump. Otherwise, replace the fuel pump.

Remove pressure gauge and reinstall fuel hoses.

Electrical Test

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 plug connector from the fuel pump.

Install a temporary connector to the fuel pump with wires long enough to make the connection outside the bilge and apply voltage (12 V) to this test harness.

If pump does not run, replace the fuel pump.

Otherwise, check the continuity of the fuel pump circuit.

Disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, check continuity between terminals of circuits 24 and 26.

If wiring harness is good, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

Otherwise, repair the wiring harness/connectors between AMP plug connector and fuel pump.

Fuel Pump Replacement

Removal

Open front storage compartment cover.

Remove the storage basket.

Remove glove box (see HULL/BODY section).

Remove front vent tubes.

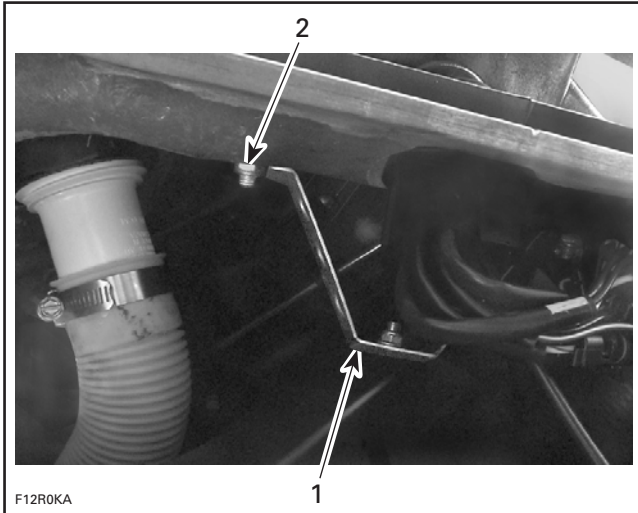
Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

RX DI

Remove tube Y-connector.

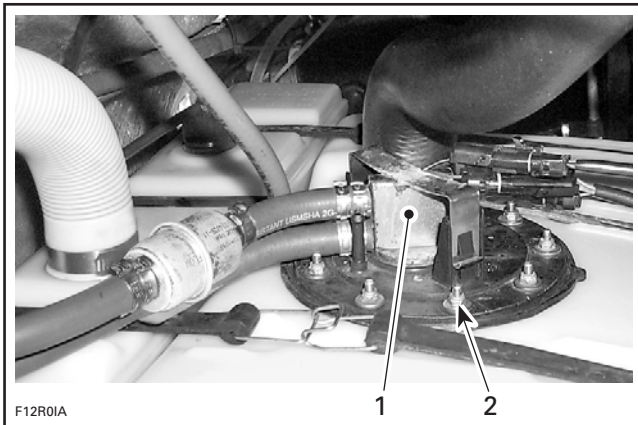
Remove tube bracket by unscrewing nuts from bilge (front storage area).



1. Vent tube bracket
2. Nut

All Models

From glove box opening, remove fuel pump retaining nuts.



1. Fuel pump
2. Retaining screw

Disconnect electrical connector.

Disconnect vent tube from fuel pump.

Release the fuel pressure in the system.

Disconnect inlet and outlet hoses from fuel pump using tool (P/N 529 035 714).

RX DI

Compress springs of pump module to reduce its height to allow pulling pump out.

All Models

Pull fuel pump toward front of vehicle. Wipe off any fuel spillage in the bilge.



1. Pull fuel pump toward front

Installation

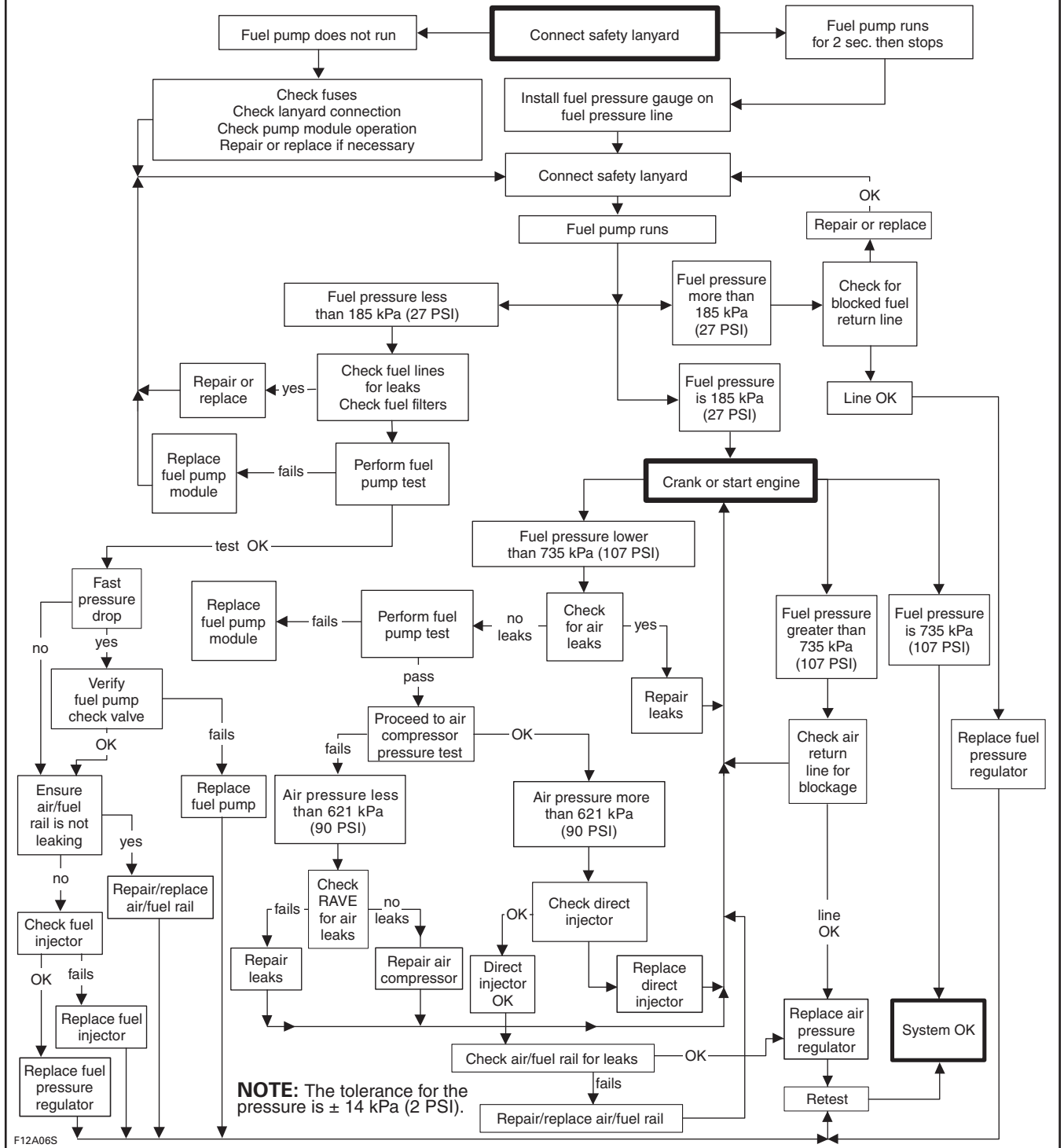
For installation, reverse the removal process but pay attention to the following.

Tighten fuel pump screws in a criss-cross sequence.

Section 06 ENGINE MANAGEMENT (DI)
Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

FUEL DELIVERY SYSTEM DIAGNOSTIC FLOW CHART

NOTE: The tolerance for the pressure is ± 14 kPa (2 PSI).



Section 06 ENGINE MANAGEMENT (DI)

Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)

ELECTRONIC MANAGEMENT

MPEM REPLACEMENT

General

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

IMPORTANT: When MPEM is replaced, the safety lanyard(s), the TPS closed position and the TDC setting must be reprogrammed/reset. Refer to their specific section for adjustment.

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

NOTE: If the old MPEM is working, it must be read inside B.U.D.S. prior to removing it from the vehicle to carry vehicle information and history to the new MPEM. Besides, select the **Setting** tab and note the **Current Angle** in the ignition offset area. When installing the new MPEM, re-use this setting as a preliminary setting. Then, proceed with the regular procedure for the TDC setting. If the old MPEM is not working, try to find a previous saved file from B.U.D.S.

Replacement

Disconnect battery cables.

WARNING

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

Disconnect AMP connectors from MPEM.

Remove MPEM.

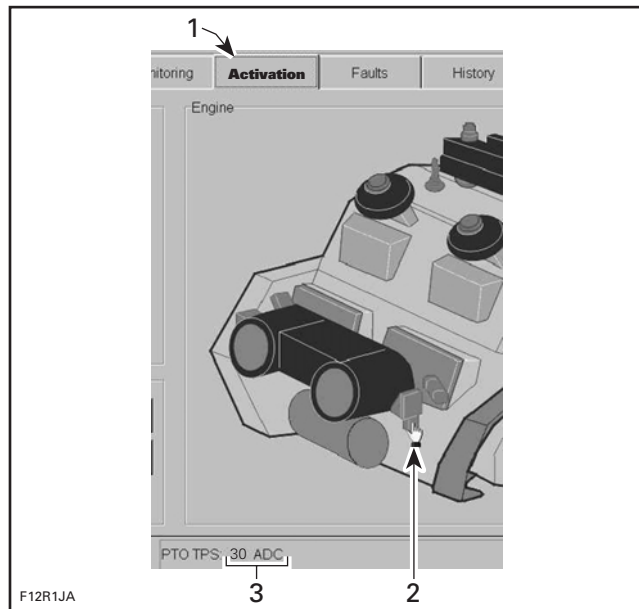
Install the new MPEM to the vehicle.

Reconnect AMP connectors to MPEM then battery cables.

Transfer the data from the previous MPEM to the new one using B.U.D.S. then proceed with the required resets after the following verification has been done.

Select the **Activation** tab.

Point the mouse cursor over the **PTO TPS**. Check the ADC reading. It **must** be between 23 and 45.



1. "Activation" tab
2. Point on PTO TPS
3. ADC reading

Point the mouse cursor over the **MAG TPS**. Check the ADC reading. It **must** be between 37 and 59.

If either readings are not within those parameters, they are out of range and the MPEM will be unable to initialize. Proceed with **Throttle Body Synchronization** as detailed in THROTTLE BODY.

If the ADC's are within range, proceed with the required resets.

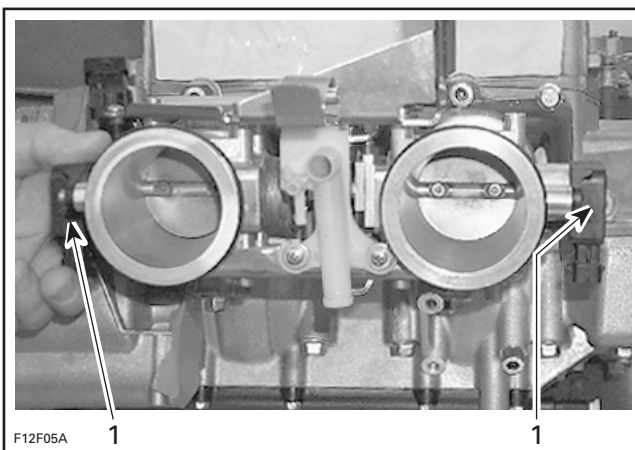
After performing the required resets, ensure to clear all faults from the newly replaced MPEM. Now, all faults must be inactive (except the Diagnostic Cap Missing fault).

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

THROTTLE POSITION SENSOR (TPS)

General

The throttle position sensor (TPS) is a potentiometer that sends a signal to the MPEM which is proportional to the throttle shaft angle. On the DI system, two sensors are used for redundancy purposes. The MPEM compares the signals from both sensors and determines if there is an error and uses the most appropriate sensor to operate the system.



1. Throttle position sensor (TPS)

IMPORTANT: Prior to testing the TPS, ensure that mechanical components/adjustments are adequate according to **Throttle Body in Air Induction System** above.

The MPEM may generate two types of fault codes pertaining to the TPS. Refer to **DI System Fault Codes** in DIAGNOSTIC PROCEDURES section for more information.

Wear Test

While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, use the **Throttle Opening** display under **Monitoring**.

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.

NOTE: In this particular case, by comparing the signals from both sensors, the MPEM will generate a fault code when the TPS is malfunctioning due to specific "spots".

To isolate the faulty TPS, disconnect one and test the other.

Voltage Test — Both TPS

Check the voltage output from MPEM to the desired throttle position sensor.

Disconnect plug connector from throttle position sensor and connect a voltmeter between pin 1 and 3 and also between pin 1 and 2 in the wiring harness.

Remove and reinstall the safety lanyard to activate the MPEM. There should be 5 Vdc in each test.

If voltage test is good, replace the TPS.

If voltage test is not good, check the resistance of the TPS circuit.

Resistance Test

Reconnect the TPS.

NOTE: Resistance values are different at idle on each TPS.

MAG Side

Disconnect the AMP plug connector number 3 on the MPEM.

Using a multimeter, check resistance value between terminal 10 and 14.

The resistance should be 1600 - 2400 Ω .

Check the resistance between terminal 5 and terminal 14 with the throttle plate in **idle** position.

The resistance should be 2500 Ω .

Check the resistance between terminal 5 and terminal 10 with the throttle plate in **idle** position.

The resistance should be 1200 Ω .

PTO Side

Disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, check resistance value between terminal 3 and 18.

The resistance should be 1600 - 2400 Ω .

Check the resistance between terminal 1 and terminal 3 with the throttle plate in **idle** position.

The resistance should be 1000 Ω .

Section 06 ENGINE MANAGEMENT (DI)

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Check the resistance between terminal 1 and terminal 18 with the throttle plate in **idle** position.

The resistance should be 2500 Ω .

Test Results — Both TPS

If resistance values are correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance values are incorrect, repair the wiring harness/connectors between AMP plug connector and the TPS.

Replacement

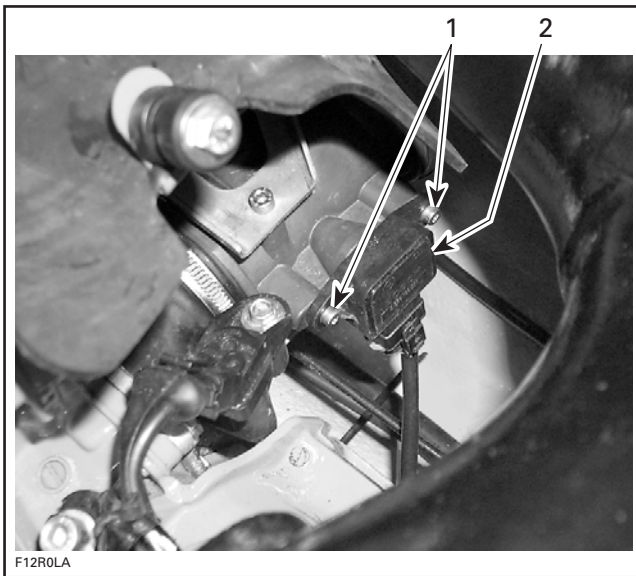
Remove the air intake silencer.

Remove the air duct.

Disconnect the connector of the TPS.

Loosen two Allen screws retaining the TPS.

Remove TPS.



MAG SIDE THROTTLE BODY

1. Throttle position sensor (TPS)
2. Allen screws

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

NOTE: Both TPS do not need to be replaced at the same time.

Reinstall remaining removed parts.

Proceed with the **Closed TPS Adjustment**. See below.

Closed TPS Adjustment

NOTE: Although this operation is called “adjustment”, it is not really an adjustment. Rather, it performs a reset of the values in the MPEM.

This reset is very important. The setting of the TPS will determine the basic parameters for all fuel mapping and several MPEM calculations.

NOTE: Reset must be done each time the throttle position sensor (TPS) is loosened or removed or throttle body(ies) is(are) replaced or MPEM is replaced.

CAUTION: An improperly adjusted TPS may lead to poor engine performance and emission compliance could possibly be affected.

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

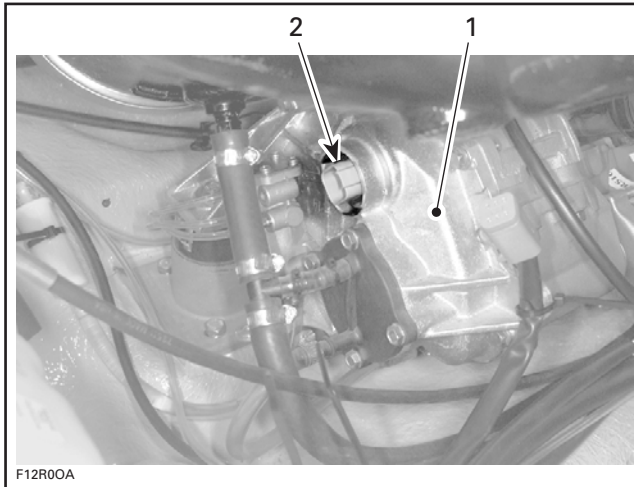
Ensure the throttle body plate stop lever rest against its stopper. Open throttle approximately one quarter then quickly release. Repeat 2 - 3 times to settle throttle plate. If stopper does not rest against its stop lever, perform throttle cable adjustment. Refer to **Throttle Body in Air Induction System** above.

Push the **Reset** button in the **Setting** section of B.U.D.S.

NOTE: There is no idle speed adjustment to perform. The MPEM takes care of that. If TPS are not within the allowed range while resetting the closed TPS, the MPEM will generate a fault code and not accept the setting.

Start engine and make sure it operates normally through its full engine RPM range. If fault codes appear, refer to **DI System Fault Codes** in DIAGNOSTIC PROCEDURES section for more information.

CRANKSHAFT POSITION SENSOR (CPS)



1. Magneto cover
2. CPS connector

Check for RPM display at the information center **while cranking** engine (first ensure information center is in tachometer mode). If it displays approximately 300 RPM, the CPS circuitry is properly working.

Otherwise, validate the information center is working by activating the tachometer using the software B.U.D.S. under **Activation** (first ensure information center is in tachometer mode). If it does not display 3000 RPM, the information center may be faulty and needs to be tested.

If the information center correctly displayed 3000 RPM, perform the following tests.

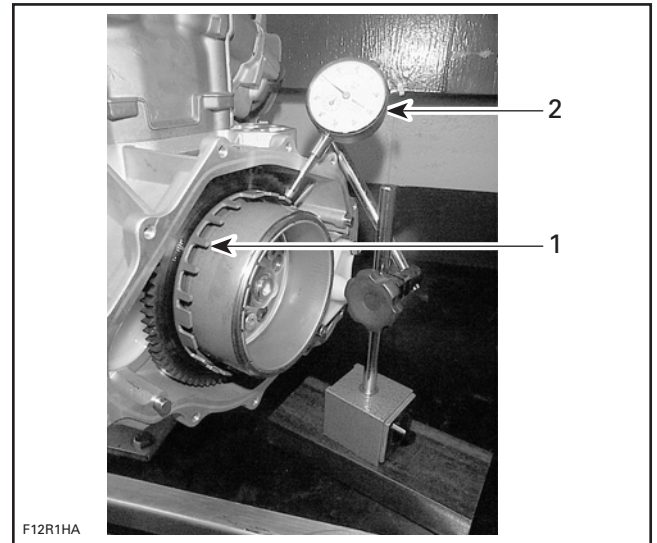
NOTE: Take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth. Check the teeth condition. Also, bad connections in magneto connector could generate electrical noise that would make you wrongly think the CPS is faulty. Check pins and wires.

Encoder Wheel Inspection

To check the encoder wheel for bent teeth, proceed as follows.

Remove magneto cover. Refer to magneto system in ENGINE section.

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



1. Encoder wheel
2. Dial indicator

Properly reinstall cover.

Voltage Test

Unplug magneto connector.

Check connector pins for corrosion or damage.

Remove and reinstall the safety lanyard to activate the MPEM.

Check the voltage readings on the harness side as follows:

CONNECTION	VOLTAGE
Pin 4 with engine ground	0 V ± a small mV tolerance
Pin 5 with engine ground	12 V
Pin 6 with engine ground	5 V

If voltage tests good, the CPS is defective and needs replacement.

If voltage does not test good, perform the following tests.

Resistance Test

Check the continuity of the wiring harness.

Disconnect the AMP plug connector number 2 on the MPEM.

Using a multimeter, check continuity of circuits 6, 7 and 14.

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If wiring harness is good, it could be either the CPS or the MPEM. Try a new part one at a time. When trying a new MPEM, refer to **MPEM replacement** procedures elsewhere in this section.

Otherwise, repair the wiring harness/connectors between AMP plug connector and the CPS.

Replacement

Remove tuned pipe.

Unscrew front engine support and slightly lift engine to have access to magneto cover screws. Block engine in this position.

Disconnect connector and remove magneto cover.

Remove CPS.



1. CPS inside magneto cover

Apply Loctite 243 on screw threads then install the new CPS.

Reinstall remaining removed parts.

MANIFOLD AIR TEMPERATURE SENSOR (MATS)



PTO SIDE THROTTLE BODY

1. Manifold air temperature sensor (MATS)

Resistance Test

Disconnect the plug connector from the MATS and check the resistance of the sensor itself.

The resistance should be between 2280 Ω and 2740 Ω .

Otherwise, replace the MATS.

If resistance tests good, **reconnect** the MATS and disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, recheck resistance value between terminals 16 and 19.

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and the MATS.

Replacement

Remove the air intake silencer.

Remove the air duct.

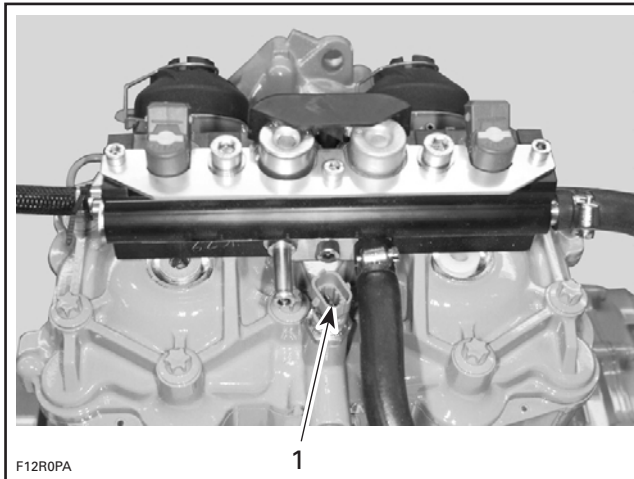
Disconnect the connector of the MATS.

Pull MATS out while turning right and left.

Install the new MATS.

Reinstall remaining removed parts.

WATER TEMPERATURE SENSOR (WTS)



1. Water temperature sensor (WTS)

Resistance Test

Disconnect the plug connector from the WTS and check the resistance of the sensor itself.

The resistance should be between 2280 Ω and 2740 Ω .

Otherwise, replace the WTS.

If resistance tests good, **reconnect** the WTS and disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, recheck resistance value between terminals 9 and 11.

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and the WTS.

Replacement

Remove air/fuel rail retaining screws.

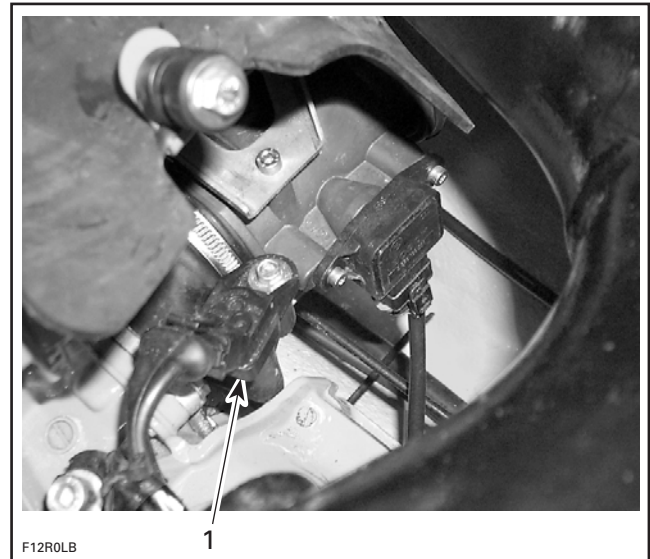
Cut locking ties as necessary to allow lifting of air/fuel rail in order to give access to the temperature sensor.

Disconnect WTS connector and remove WTS.

Apply Loctite 518 on threads of the WTS then install.

Reinstall remaining removed parts.

MANIFOLD AIR PRESSURE SENSOR (MAPS)



MAG SIDE THROTTLE BODY

1. Manifold air pressure sensor (MAPS)

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

Ensure sensor is correctly installed elbow adaptor. Otherwise, the MAPS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. Ensure the correct connector is plugged and not mixed with the MAG TPS. Remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

Voltage Test

Check the voltage output from MPEM to the manifold air pressure sensor (MAPS).

Disconnect plug connector from throttle position sensor and connect a voltmeter between pin 1 and 3 and also between pin 1 and 2 of wiring harness.

Remove and reinstall the safety lanyard to activate the MPEM. There should be 5 Vdc in each test.

If voltage test is good, replace the MAPS.

If voltage test is not good, check the continuity of the MAPS circuit.

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Resistance Test

Disconnect the AMP plug connector number 3 on the MPEM.

Using a multimeter, check continuity of circuits 3-3, 3-6 and 3-7.

If wiring harness is good, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

Otherwise, repair the wiring harness/connectors between AMP plug connector and the MAPS.

Replacement

Remove the air intake silencer.

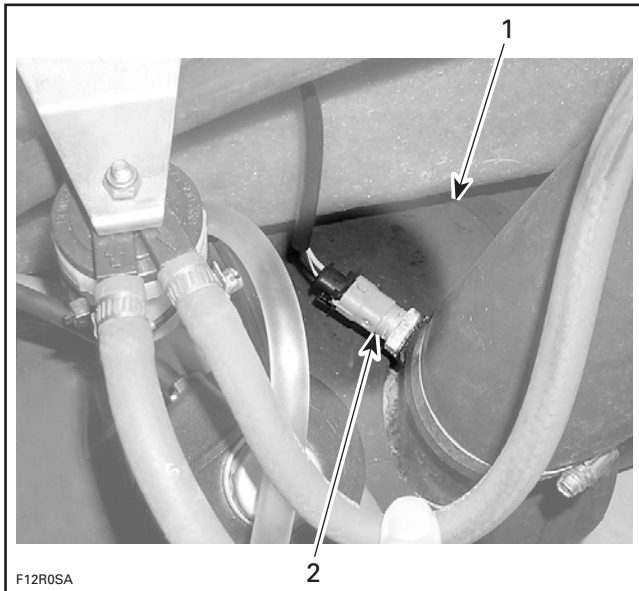
Remove the air duct.

Disconnect MAPS connector and remove the MPAS.

Install the new MAPS paying attention to index its tab into the adaptor notch.

Reinstall remaining removed parts.

EXHAUST GAS TEMPERATURE SENSOR (EGT)



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

Resistance Test

Disconnect the plug connector from the EGT and check the resistance of the sensor itself.

The resistance should be between 2280 Ω and 2740 Ω .

Otherwise, replace the EGT.

If resistance tests good, **reconnect** the EGT and disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, recheck resistance value between terminals 10 and 12.

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and the EGT.

Replacement

Disconnect EGT connector and remove EGT.

Apply Loctite 518 on threads of the EGT then install.

Replug connector.

KNOCK SENSOR (KS)



1. Knock sensor (KS)

Dynamic Test

Using the vehicle communication kit (VCK) with the B.U.D.S. software, monitor the knock sensor using the **Faults** section.

Start the engine and bring engine RPM above 4500 RPM. If no fault code occurs, the knock sensor is good.

Otherwise, do the following.

Ensure sensor and head contact surfaces are clean and mounting bolt and washer are correct and properly torqued down.

Check the knock sensor resistance.

Disconnect the AMP plug connector number 4 from the MPEM module.

Static Resistance Test

Using a multimeter, check the resistance between terminal 2 and terminal 17 on the plug connector.

The resistance should be approximately 5 M Ω .

Otherwise, check the continuity of the knock sensor circuit 4-2 and 4-17.

If wiring harness is good, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

Otherwise, repair the wiring harness/connectors between AMP plug connector and knock sensor.

Replacement

Unscrew and remove knock sensor.

Clean contact surface, apply Loctite 243 in threaded hole then install the new knock sensor.

Torque screw to 20 N•m (15 lbf•ft)

Replug connector.

RAVE SOLENOID

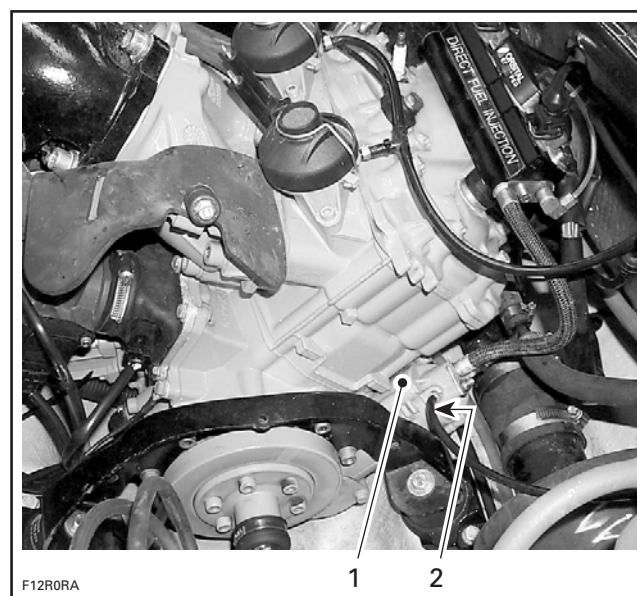
A quick check can be done as follows. When engine is being stopped, the RAVE valves will open and close. This can be heard or seen by carefully removing the cap and feeling the movement with a hand.

Another test can be done using the vehicle communication kit (VCK) with the B.U.D.S. software, using the **Monitoring** section. Start engine and bring its RPM to approximately 6000 and look at the RAVE solenoid LED. It should turn on, indicating the RAVE system is working on the electronic side. However, pneumatic test still have to be performed to validate the mechanical operation.

Leakage/Voltage Test

NOTE: The solenoid activates both RAVE valves at the same time.

Unplug the RAVE solenoid supply hose from air compressor.



1. Air compressor
2. Disconnect RAVE supply hose

Install leak test pump (P/N 529 021 800) on hose end and pressurize air line to 69 - 103 kPa (10 - 15 PSI). Wait some time to see if pressure drops. If so, check line for leaks. Otherwise, the solenoid is defective and needs to be replaced.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the RAVE solenoid from the **Activation** section.

The pressure should drop when the solenoid is activated. If the solenoid does not work, disconnect the plug connector from the solenoid.

Install a temporary connector to the solenoid with wires long enough to make the connection outside the bilge and apply voltage (12 V) to this test harness.

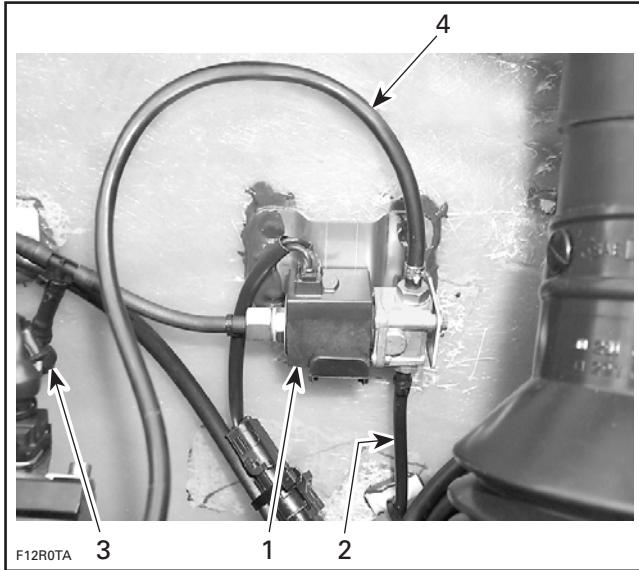
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If it does not work, replace the solenoid. Otherwise, proceed with the resistance test below.

Reconnect hose to compressor.

Unplug the outlet hose from RAVE solenoid.



1. RAVE solenoid
2. Supply hose from air compressor
3. Check valve
4. Outlet hose to RAVE valves

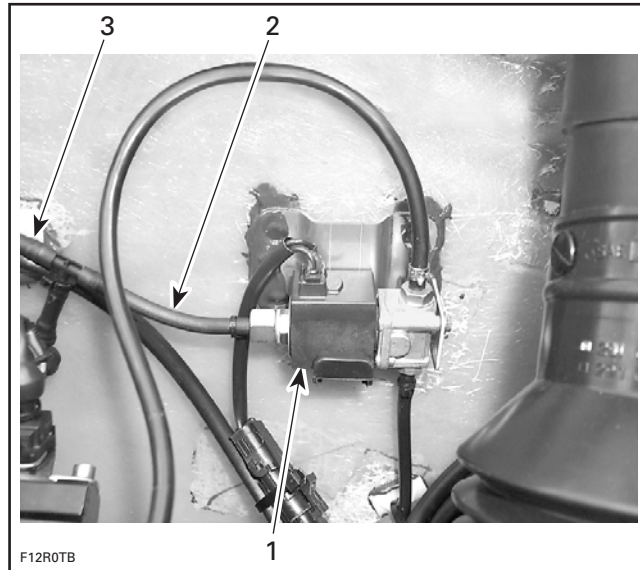
Install leak test pump on hose end and apply pressure. If pressure can not be held, check hoses for leaks. If hoses test good, connect pump directly to each RAVE valve nipple and pressurize. If pressure drops, replace the defective seal inside RAVE valve.

Take into account that the RAVE may be mechanically stuck in the cylinder slot. Open the RAVE and check for free operation. Refer to ENGINE and look in **Top End**.

Pressure Relief Circuit

When RAVE valve is released, the pressure escape from this vented hose. If the RAVE valves does not return when the solenoid is released, ensure the return spring is in good condition, this hose is not kinked or plugged and the solenoid allows pressure to bleed there.

Although it is not related with RAVE operation, we suggest to verify the check valve operation which prevent the pressure going down to crankcase. Install a hose pincher after the T-fitting to adequately pressurize the check valve portion.



1. RAVE solenoid
2. Pressure relief hose
3. Install hose pincher here

Resistance Test

Reconnect the solenoid and disconnect the AMP plug connector number 4 on the MPEM.

Using a multimeter, check resistance value between terminals 20 and 23.

The resistance should be 24 Ω .

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and solenoid.

IGNITION COIL

NOTE: The MPEM energizes the primary side of each ignition coil individually. It 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 from the **Activation** section.

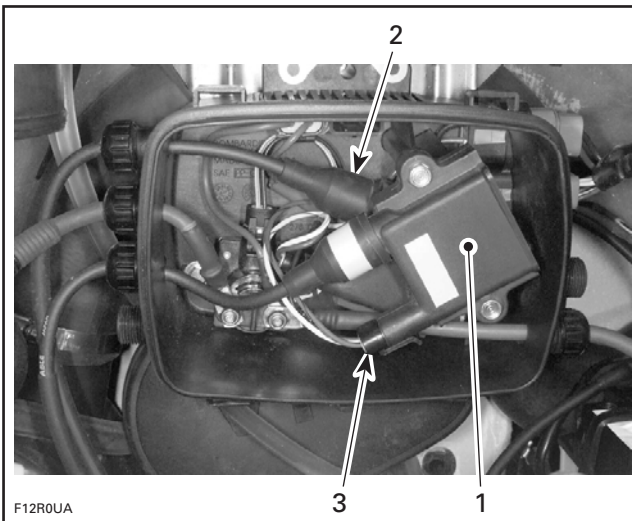
You should hear the spark occurring. In doubt, use an inductive spark tester or a sealed tester — available from after-market tool/equipment suppliers — to prevent spark occurring in the bilge. Otherwise, perform the following checks.

⚠ WARNING

Never make a spark test with spark plug removed. Flammable vapors may be present in the bilge and ignited which could cause an explosion.

Primary Winding

Disconnect the plug connector from the ignition coil and check the resistance of the primary circuit.



- 1. PTO side ignition coil
- 2. Mag side ignition coil
- 3. Primary winding connector

The resistance should be between .45 - .55 Ω at 20°C (68°F).

Otherwise, replace the ignition coil.

If resistance tests good, **reconnect** the ignition coil connector and disconnect the AMP plug connector number 3 on the MPEM.

Using a multimeter, recheck resistance value between terminals 21 and 22 for MAG side and terminals 20 and 23 for PTO side.

If resistance value is correct, try a new MPEM. Refer to **MPEM replacement** procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors between AMP plug connector and the ignition coil.

Secondary Winding

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. A dynamic test is more effective.

Remove high tension lead from ignition coil.

Using a multimeter, check the resistance between the terminals C and the coil post.

The resistance should be between 6800 and 10200 Ω at 20°C (68°F).

If not within specification, replace the ignition coil. Otherwise, perform the **Dynamic Test** below.

Measure resistance of the high tension leads. They must be as follows. Otherwise, replace the lead.

NOTE: It is not necessary to remove the spark plug cap.

IMPORTANT: Always replace leads with genuine parts. Otherwise, fuel injection system operation may be impaired.

MODEL	SIDE	VALUE OHM
RX DI	MAG	5700
	PTO	4300
GTX DI	MAG	5700
	PTO	4900

Check continuity between ignition coil ground circuits and engine.

Dynamic Test

Use an ignition coil tester, available from after-market tool/equipment suppliers.

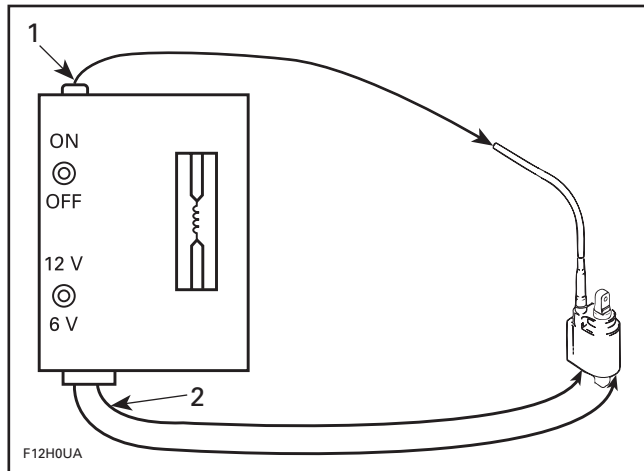
⚠ WARNING

Do NOT use coil tester on metal work bench. Follow manufacturer instructions.

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1. With ignition coil removed from craft, hook high tension leads from tester to ignition coil high tension cables.
2. Connect 2 smaller tester leads to primary of ignition coil.



TYPICAL

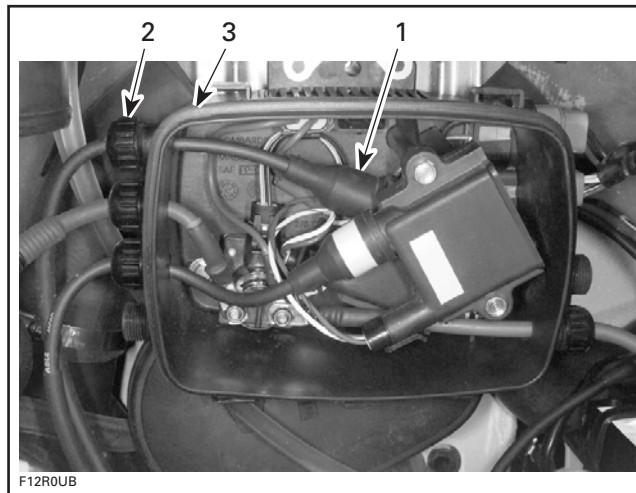
1. Lead to secondary
2. Leads to primary

3. 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.

WARNING

Always reconnect spark plug cables at the same spark plugs where they come from. The cable coming out the edge of the electrical box must be connected to the MAG side spark plug. Otherwise, severe backfire may occur with possible damage to exhaust system components. The white tape on the ignition coil should match the white tape on the high tension cable.



1. MAG side ignition coil at bottom
2. Mag side ignition coil wire on edge of electrical box
3. Edge of electrical box

NOTE: If PTO ignition coil is replaced, ensure to reinstall the white tape on the new coil on if it is not present.

TDC SETTING

General

Before checking TDC setting 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 mark scribed on the PTO flywheel can be used to troubleshoot a broken magneto woodruff key.

CAUTION: The relation between the PTO flywheel mark position and crankshaft position may change as the PTO flywheel might move on crankshaft when engine is ran. This will result in a false ignition timing reading. Always verify PTO flywheel mark position before checking ignition timing with an appropriate timing light. If mark does not align with tool, repeat static test to ensure flywheel has not moved before changing the ignition timing.

NOTE: Do not use the factory mark found on the PTO flywheel to check TDC setting or troubleshoot any problems.

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Normally TDC setting should not be required. It has been set at factory and it should remain correctly set since every part is fixed and not adjustable. The only time the TDC setting might have to be changed would be when replacing the crankshaft, the magneto rotor, the CPS, the encoder wheel or the MPEM. If the TDC setting is found to be incorrect, you should first check for proper crankshaft alignment. This might be the indication of a twisted crankshaft.

With this ignition system, the TDC setting can be checked with either the engine hot or cold. Also, the TDC setting is to be checked at any RPM with the timing light. The TDC setting is best checked at idle speed as it is more accurate and easier than at higher speed, also it will keep the engine temperature lower for a longer time. Ensure to properly cool the engine through the flushing fitting.

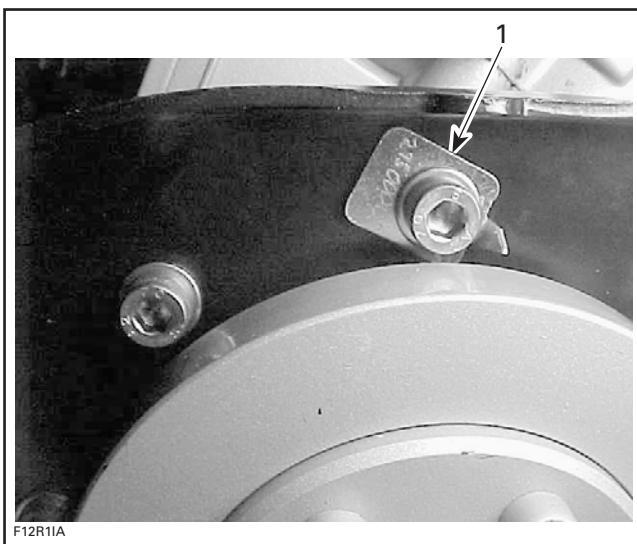
NOTE: When checking the TDC setting, the spark advance has to be locked to allow proper verification of the TDC marks. See **TDC Setting** below.

Static Test

1. Disconnect MAG side spark plug wire and connect wire to grounding device then remove spark plug.

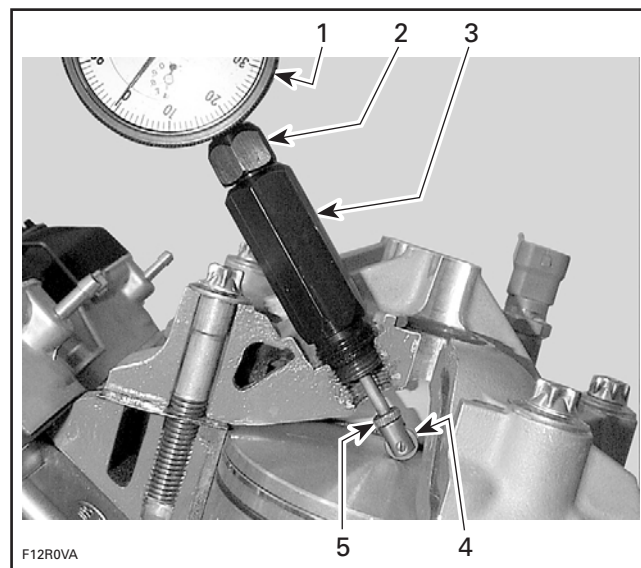
CAUTION: Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.

2. Remove PTO flywheel guard.
3. Remove middle screw securing the engine to the rear engine mount. Reinstall screw with timing mark pointer tool.



1. Timing mark pointer tool (P/N 295 000 135)

4. Install and adjust a TDC gauge (P/N 295 000 143) in MAG side spark plug hole.
5. Ensure to install its roller to allow proper reading of the gauge. Proceed as follows:
 - Rotate magneto flywheel clockwise until piston is just Before Top Dead Center.



1. Outer ring
2. Adaptor lock nut
3. Adaptor
4. Roller
5. Roller lock nut

- Install roller on dial gauge end. Ensure to position roller edge parallel with the dial gauge face. Secure in this position by tightening roller lock nut. This will keep the roller in the proper axis for measurement accuracy.
 - Loosen adaptor lock nut then holding gauge with dial face directed toward you when you are in line with the crankshaft, screw adaptor in spark plug hole.
 - Slide gauge far enough into adaptor to obtain a reading then finger tighten adaptor lock nut.
 - Since we are working with an indirect measurement, ensure that dial gauge face is positioned in the same direction as the connecting rod.
 - Rotate magneto flywheel clockwise until piston is at Top Dead Center.
 - Unlock outer ring of dial and turn it until "0" (zero) on dial aligns with pointer.
 - Lock outer ring in position.
6. From this point, rotate magneto flywheel back 1/4 turn then rotate it clockwise to reach 7.87 mm (.310 in).

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NOTE: This specification is of the type “indirect measurement” relative to the piston movement since we are measuring at a 45° angle through the spark plug hole.

7. Scribe a thin mark on PTO flywheel aligned with timing mark pointer tool.

NOTE: This mark becomes the reference when using the stroboscopic timing light.

CAUTION: The static test cannot be used as a TDC setting procedure, therefore, always check the TDC setting with a stroboscopic timing light.

8. Remove TDC gauge.

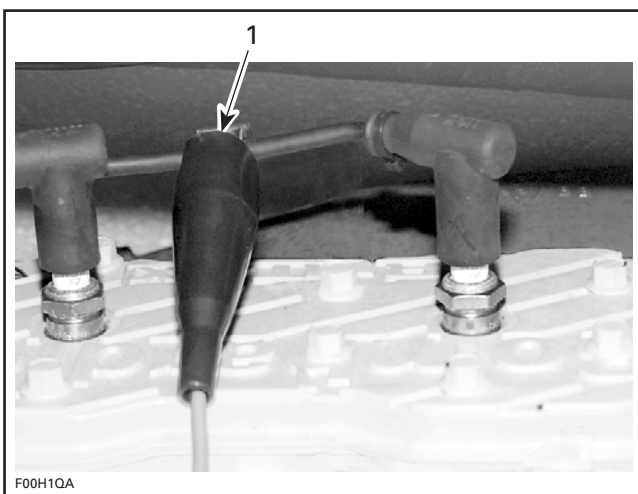
9. Reinstall spark plug and connect wire.

Dynamic Test

To check TDC setting, use Bombardier timing light (P/N 529 031 900).



10. Connect timing light pick-up to MAG side spark plug wire.



TYPICAL

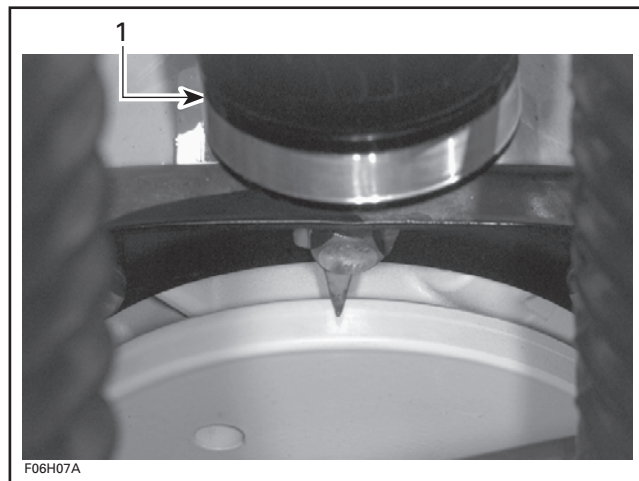
1. Timing light pick-up

IMPORTANT: To check the TDC setting, the spark advance curve must be locked first. This allows to perform TDC setting at **any RPM** by keeping the ignition timing “frozen” so that it does not vary with engine RPM. See **TDC Setting** below for more information.

CAUTION: If the spark advance curve is not locked using **B.U.D.S.** then a wrong ignition timing will be seen as the ignition curve does not match the locked ignition timing.

11. Start engine and check marks at idle speed. Point beam of timing light straight in line with timing mark pointer.

NOTE: Look at the mark at the same angle as it was scribed so that parallax error is minimized.



1. Timing light straight in line with pointer

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 before performing the TDC setting to ensure PTO flywheel has not loosen or tightened.

TDC Setting

General

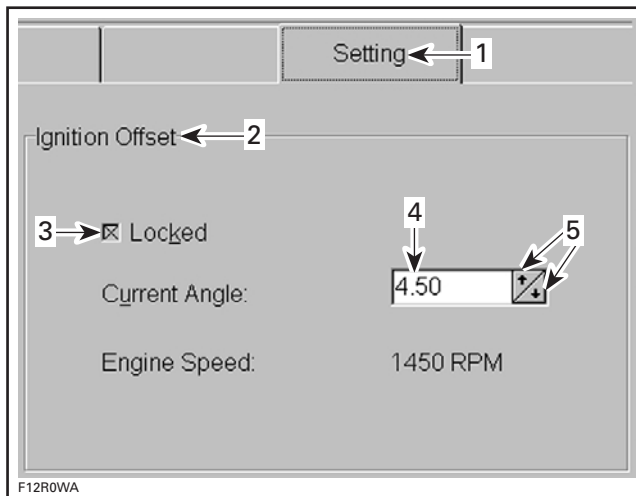
To correct the TDC setting, the data of the MPEM is changed using the VCK (Vehicle Communication Kit) (P/N 295 035 676). Look in **Setting** section of the software **B.U.D.S.**

NOTE: For more information on the VCK, refer to its online help. The MPEM programmer will not work to perform this operation on the **DI engines**.

CAUTION: If the TDC setting is adjusted too advanced, this will cause serious damage to the engine.

Adjustment

In this operation, the ignition timing light and B.U.D.S. are used to synchronize the MPEM TDC reference with the engine crankshaft. This timing adjustment will affect the timing of ignition as well as direct injector timings. The aim of the adjustment is to align the mark on the flywheel with the pointer at idle using the timing light and B.U.D.S. When this is achieved, then the MPEM TDC reference is synchronized with the engine crankshaft.



1. "Setting" tab
2. Ignition offset section
3. "Locked" box
4. Current angle in MPEM
5. Arrows to change the angle

1. Choose the **Setting** tab and look under **Ignition Offset**.
2. Check the **Locked** box to "freeze" the timing at the correct value.
3. The VCK displays the number that is stored in the MPEM.
4. Now click the up or down arrow to change the number of the current angle so that the TDC setting marks align when checking with the timing light. Each step makes an adjustment of 1/4 degree.

NOTE: Each time the setting is changed on the screen, the new value is also changed in the MPEM, so there may be a slow response, do not make changes too quickly.

5. When marks align, uncheck the **Locked** box to finish.

NOTE: This will write the new value immediately to the MPEM. There is no need to write the document to the MPEM for the TDC setting unless other changes were made. However, we recommend to reset the service hours when you perform a service action such as the TDC setting.

NOTE: The MPEM features a permanent (non-volatile) memory and keeps the TDC setting programmed even when the watercraft battery is disconnected.

Engine Start/Stop Switch Verification

A quick operation test can be done using the vehicle communication kit (VCK) with the B.U.D.S. software, using the **Monitoring** section. Press the start button and look at the Start button LED. It should turn on, indicating the starting system is working on the input side (start button, MPEM and wiring). You know now the problem is on the output side (MPEM output signal to starting solenoid, wiring harness going to the solenoid, starter motor. Refer to STARTING SYSTEM for testing procedures). Otherwise, check the input side as follows.

Disconnect the YELLOW/RED wire of the start/stop switch. Using an ohmmeter, connect test probes to YELLOW/RED wire and to ground.

Measure resistance, it must be an open circuit (switch is normally open). Depress and hold switch, the ohmmeter should read close to 0 ohm. Otherwise, replace switch.

If the switch tests good, check continuity of circuits 2-8 and 2-11 using a multimeter.

If wiring harness tests good, it could be the MPEM. Try a new MPEM referring to **MPEM replacement** procedures elsewhere in this section.

Safety Lanyard Switch Verification

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

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

Disconnect switch wires.

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Safety Lanyard Removed

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

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

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

Safety Lanyard on Switch

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

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

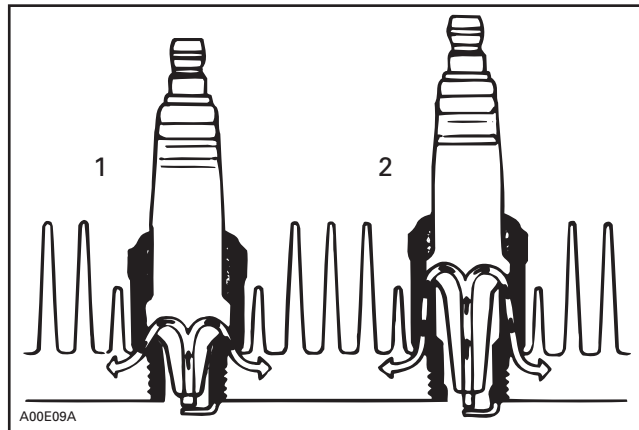
The proper heat range of the spark plugs is determined by the spark plugs ability to dissipate the heat generated by combustion.

The longer the heat path between the electrode tip to the plug shell, the hotter the spark plug operating temperature will be — and conversely, 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

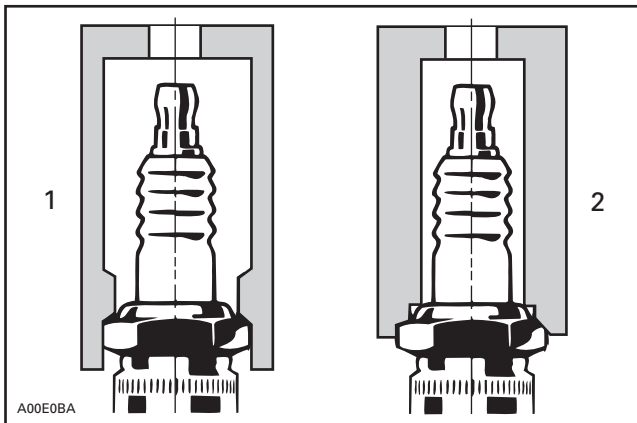
Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are: prolonged idling, or running on a too rich mixture or incorrect fuel. 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.

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Spark Plug Installation

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap according to the following chart.
2. Apply anti-seize lubricant over the spark plug threads to prevent possible seizure.
3. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise an additional 1/4 turn with a proper socket.



1. Proper socket
 2. Improper socket

ENGINE	SPARK PLUG	TORQUE	GAP mm (in)
DI	NGK ZFR4F-11	Hand tighten + 1/4 turn with a socket	1.1 (.043)

CRANKING SYSTEM

See above for start/stop switch and the DESS post testing. Refer to STARTING SYSTEM section for other tests.

DI SYSTEM TEST SUMMARY

Pressure Tests

COMPONENT	VALUE kPa (PSI)
Air compressor	621 ± 14 (90 ± 2) at cranking
Fuel pressure regulator	185 ± 14 (27 ± 2) when installing safety lanyard
Fuel pressure	738 ± 14 (107 ± 2) inline test at cranking or when engine is running
Fuel pump	721 (105) minimum at cranking

Section 06 ENGINE MANAGEMENT (DI)**Subsection 03 (COMPONENT INSPECTION AND ADJUSTMENT)****Electrical Tests**

COMPONENT	CONNECTOR	TERMINAL NUMBER	WIRE COLOR	VALUE
Fuel pump	AMP no. 4	26 and pin B	PU/PK	0 ohm (continuity)
		24 and pin D	BK/PK	
Fuel injector MAG	AMP no. 4	7 and 13	BL/PU and BL/BK	1.7 - 1.9 ohms
Fuel injector PTO		8 and 14	GR/PU and GR/BK	
Direct injector MAG	AMP no. 4	5 and 15	BL/BW and BL/PK	1 - 1.6 ohms
Direct injector PTO		6 and 21	GR/BW and GR/PK	
Throttle position sensor MAG (TPS)	TPS	1 and 3	PU/BW and WH/BW	5 V
		1 and 2	PU/BW and BK/BW	
	AMP no. 3	10 and 14	PU/BW and BK/BW	1600 - 2400 ohms
		5 and 14	WH/BW and BK/BW	2500 ohms at idle
		5 and 10	WH/BW and PU/BW	1200 ohms at idle
Throttle position sensor PTO (TPS)	TPS	1 and 3	PU/RD and WH/RD	5 V
		1 and 2	PU/RD and BK/RD	
	AMP no. 4	3 and 18	BK/RD and PU/RD	1600 - 2400 ohms
		1 and 3	WH/RD and BK/RD	1000 ohms at idle
		1 and 18	WH/RD and BK/RD	2500 ohms at idle
Crankshaft position sensor (CPS)	CPS (Deutsch conn.)	Pin 4 and ground	BK	0 V (with a small mV tolerance)
		Pin 5 and ground	GY/RD	12 V
		Pin 6 and ground	GY/YL	5 V
	AMP no. 2	Pin 7 and pin 6 of CPS	GY/YL	0 ohm (continuity)
		Pin 6 and pin 5 of CPS	GY/RD	
Manifold air temperature sensor (MATS)	AMP no. 4	16 and 19	WH/GY and BK/WH	2280 - 2740 ohms
Water temperature sensor (WTS)	AMP no. 4	9 and 11	TA/OR and BK/OR	2280 - 2740 ohms
Manifold air pressure sensor (MAPS)	AMP no. 3	Pin 3 and pin 1 of MAPS	PU/BL	0 ohm (continuity)
		Pin 6 and pin 3 of MAPS	WH/BL	
		Pin 7 and pin 2 of MAPS	BK/BL	
Exhaust gas temperature (EGT)	AMP no. 4	10 and 12	TA/GY and BK/TA	2280 - 2740 ohms
Knock sensor (KS)	AMP no. 4	2 and 17	BK/BL and YL/BL	5 M ohms

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COMPONENT	CONNECTOR	TERMINAL NUMBER	WIRE COLOR	VALUE
Rave solenoid (RS)	AMP no. 4	20 and 23	PU/GY and BK/GY	24 ohms
Ignition coil MAG	AMP no. 3	21 and 22	RE/GN and WH/GN	.45 - .55 ohms primary winding
	—	Coil terminal C and coil post	—	6800 - 10200 ohms secondary winding w/o high tension leads
Ignition coil PTO	AMP no. 3	20 and 23	RE/BL and WH/BL	.45 - .55 ohms primary winding
	—	Coil terminal C and coil post	—	6800 - 10200 ohms secondary winding w/o high tension leads
High tension leads RX DI models	MAG	—	—	5700 ohms lead alone
	PTO	—	White tape	4300 ohms lead alone
High tension leads GTX DI models	MAG	—	—	5700 ohms lead alone
	PTO	—	White tape	4900 ohms lead alone

DIAGNOSTIC PROCEDURES

GENERAL

Here is the basic order suggested to diagnose a suspected fuel injection related problem:

- Check the chart in TROUBLESHOOTING section to have an overview of problems and suggested solutions.
- Check if there is a MAINT signal reported 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 air/fuel rail pressure.
- Check spark plugs condition.
- Check RAVE valves if stuck.
- Check fuel pump pressure.
- Check air compressor pressure.

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Subsection 04 (DIAGNOSTIC PROCEDURES)

DESS SYSTEM

Basic Self-Diagnostic Mode

It is self-activated when the safety lanyard cap is being installed on the watercraft post. It gives immediate monitoring. Some codes may occur only when pressing the start/stop button. Refer to the following chart.

SIGNAL	CAUSE	REMEDY
2 short beeps (while installing safety lanyard on watercraft post)	<ul style="list-style-type: none">• Safety lanyard is recognized by the MPEM.• Good contact between safety lanyard cap and DESS post.	<ul style="list-style-type: none">• Ignition is authorized, engine can be started normally.
1 long beep (while installing safety lanyard on watercraft post or when pressing start/stop button)	<ul style="list-style-type: none">• Bad connection between safety lanyard cap and post.• Unprogrammed or defective safety lanyard.• Salt water or dirt in safety lanyard cap.• Improper operation of MPEM or defective wiring harness.	<ul style="list-style-type: none">• Remove and replace the safety lanyard on the post until 2 short beeps are heard to indicate the system is ready to allow engine starting.• Use the safety lanyard that has been programmed for the watercraft. If it does not work, check safety lanyard condition with the programmer. Replace safety lanyard if reported defective. If it still does not work, enable advanced diagnostic mode to obtain more details about the failure.• Clean safety lanyard cap to remove dirt or salt water.• Enable advanced diagnostic mode to obtain more detail about the failure.
8 short beeps	<ul style="list-style-type: none">• Defective MPEM (memory).	<ul style="list-style-type: none">• Replace MPEM.
Other beeps		<ul style="list-style-type: none">• Refer to COMPONENT FAILURE WARNING SYSTEM below.

Advanced Self-Diagnostic Mode

It needs to be enabled manually. Proceed as follows:

1. Remove safety lanyard cap from watercraft post.
2. Press 5 times on the watercraft start/stop button.

NOTE: 1 short beep and 1 long beep must be heard. They validate beginning of diagnostic mode.

3. Install safety lanyard on watercraft post.

4. Press the watercraft start/stop button again.

NOTE: If everything is correct, engine will start. Otherwise, refer to the following chart.

SIGNAL	CAUSE	REMEDY
No beep	<ul style="list-style-type: none"> • Engine actually starts. 	<ul style="list-style-type: none"> • Everything is correct.
1 long and 1 short beeps	<ul style="list-style-type: none"> • No safety lanyard has ever been programmed in watercraft MPEM. 	<ul style="list-style-type: none"> • Use MPEM programmer or the VCK and program a safety lanyard. This code can occur only when you receive a new MPEM from the factory and no key has ever been programmed.
2 short beeps	<ul style="list-style-type: none"> • MPEM can not read the digital code of the safety lanyard cap or the magnet is defective. • Mixed wires at safety lanyard post connectors or bad connections. 	<ul style="list-style-type: none"> • Check safety lanyard cap condition with the MPEM programmer or the VCK. Replace safety lanyard if reported defective. • Check post wiring harness.
2 long beeps	<ul style="list-style-type: none"> • Wrong safety lanyard or bad connection of the DESS wires. 	<ul style="list-style-type: none"> • Use the safety lanyard that has been programmed for the watercraft. If the problem is not resolved, check safety lanyard cap condition with the MPEM programmer or the VCK. Replace safety lanyard if reported defective.
3 short beeps	<ul style="list-style-type: none"> • Wiring harness of DESS post is grounded or there is a short circuit. 	<ul style="list-style-type: none"> • Check wiring harness and safety lanyard post.

If you need to listen again to the coded beeps, remove safety lanyard and repeat the procedure to activate the diagnostic mode.

If there is more than one problem, the MPEM will send only one error code. When the problem is solved, the MPEM will send a second code and so on until all problems are resolved.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 04 (DIAGNOSTIC PROCEDURES)

FAULT DETECTION AND COMPENSATORY ACTIONS

For a basic overview of the monitoring system and the limp home modes, see OVERVIEW section.

COMPONENT FAILURE WARNING SYSTEM

Sensor Failures

Refers to open or short circuit failures on sensors, drivers, injectors or ignition.

PROBLEM	INFO CENTER	RED LED	BUZZER	BUZZER CODE	LIMP HOME MODE ①
Manifold air pressure sensor (MAPS)	"MAINT"	ON	OFF	6	Limited RPM
Manifold air temperature sensor (MATS)	"MAINT"	ON	OFF	6	Limited RPM
Throttle position sensor (single TPS)	"MAINT"	ON	ON	4	Limited RPM (idle speed if both TPS's fail)
Water temperature sensor (WTS)	"MAINT"	ON	OFF/(ON)	6/(4)	Limited RPM (code 4 if EGT also fails)
Direct injector (single injector)	"MAINT"	ON	OFF	6	Limited RPM
Fuel injector (single injector)	"MAINT"	ON	OFF	6	Limited RPM
Ignition (no firing on one cylinder)	"MAINT"	ON	OFF	6	Limited RPM
RAVE solenoid	"MAINT"	ON	OFF	6	Limited RPM
Starter solenoid	"MAINT"	ON	OFF	6	Engine may not start
Fuel pump	"MAINT"	ON	OFF	6	Limited RPM
Exhaust gas temperature sensor (EGT)	"MAINT"	ON	OFF/(ON)	6/(4)	Limited RPM (code 4 if WTS also fails)
Fuel level sensor	"MAINT"	ON	OFF	6	None
Diagnostic cap fault	"MAINT"	ON	OFF	6	None
Knock sensor	"MAINT"	ON	OFF	6	Limited RPM
Engine drowned mode activated (it is not a fault)	None	None	ON	2	Engine will not run. Release throttle

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System Failures

Refers to operating conditions outside normal and/or safe ranges such as demand system failures, extreme voltages, over temperature conditions or low fuel/oil levels.


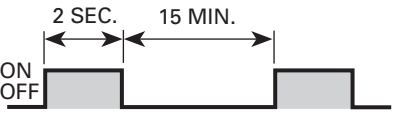
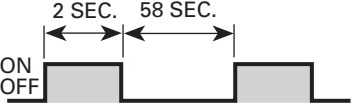
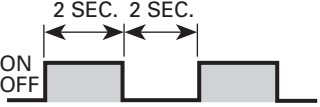
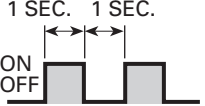

PROBLEM	INFO CENTER	RED LED	BUZZER	BUZZER CODE	LIMP HOME MODE ①
Manifold air pressure sensor (MAPS), ATM fault (bad atmospheric pressure reading)	"MAINT"	ON	OFF	6	Limited RPM
Throttle position sensor (single TPS)	"MAINT"	ON	ON	3	Limited RPM
Throttle position sensor (dual TPS)	"MAINT"	ON	ON	4	Idle RPM
Throttle position sensor (single adaption fault)	None	OFF	OFF	6	None
Throttle position sensor (dual adaption fault)	"MAINT"	ON	OFF	6	Limited RPM
Sensor supply fault (TPS and MAPS)	"MAINT"	ON	ON/OFF	4/(6)	Limited RPM (code 6 and idle RPM if both in fault)
Encoder (CPS) fault (bad pattern)	"MAINT"	ON	OFF	6	Limited RPM
Low battery voltage	"12 V LOW"	ON	OFF	6	None
Very low battery voltage	"12 V LOW" "MAINT"	ON	ON	4	Limited RPM
High battery voltage	"MAINT"	ON	OFF	6	None
Very high battery voltage	"MAINT"	ON	OFF	6	Idle RPM
High water temperature	"HI-TEMP"	ON	ON	1	None
Exhaust over temperature	"HI-TEMP"	ON	ON	3	None
Low oil level	"OIL-LOW"	ON	ON	5	None
Low fuel level	"FUEL-LO"	ON	ON	4	None
Setup fault (TDC or TPS not set on a new MPEM)	"MAINT"	ON	OFF	6	Idle RPM
MPEM fault	"MAINT"	ON	OFF	6	Engine will not start

① To see how the normal operation is recovered from the limp home mode, see the **DI Fault Codes** chart elsewhere in this section. Look in column "Normal operation resumes if fault removed and...".

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Subsection 04 (DIAGNOSTIC PROCEDURES)

Buzzer Code

BUZZER CODE	BUZZER PATTERN	NOTE
6		Always OFF
5		2 second beep every 15 minutes
4		2 second beep every 58 seconds
3		2 second beep every 2 seconds
2		1 second beep every second
1		Always ON (continuously beep)

F12H13S

VCK (vehicle communication kit)

The VCK (Vehicle Communication Kit) (P/N 529 035 676) is the primary tool to diagnose fuel injection related problems.

B.U.D.S. is designed for the DI model to allow sensor inspection, diagnostic options and adjustment such as the Throttle Position Sensor (TPS) and the TDC setting.

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.

IMPORTANT: When using the software B.U.D.S., with the DI engines, ensure that the protocol "947 DI" is properly selected in "MPI" under "Choose protocol".

Refer to the tables below for the fault codes you will find in the B.U.D.S.

DI SYSTEM FAULT CODES

General

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

Be aware that a red light blinking with the MAINT message may not be for a fault code. It may be a maintenance inspection reminder. Press and hold the **SET** button of the information center for 2 seconds. If the blinking continues, it is a fault code. Use the VCK (Vehicle Communication Kit) to see it. Otherwise, it was a maintenance reminder.

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the MPEM using the VCK. This will properly reset the appropriate counter(s). This will also records that the problem has been fixed in the MPEM 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.

Supplemental Information for Some Specific Faults

ECU fault code P0606: This code may occur in the following situations:

- Electrical noise is picked up by the MPEM. Ensure that all connections are in good condition, also grounds (battery, MPEM, engine and ignition system), they are clean and well tightened and that all electronic components are genuine — particularly in the ignition system. Installing resistive caps, non-resistive spark plug cables (or modified length), non-resistive spark plugs or knock sensor wiring/routing may lead to generate this fault code.

- Electrical noise might also lead engine to occasional cutout without generating a fault code when engine is restarted. When looking at the fault code, pay attention to the “count” value in the software B.U.D.S. A value between 1 and 9 confirms an electrical noise problem. A value of 10 and above will generate a fault code.
- When installing a new MPEM. It is not properly programmed from the factory. The MPEM must be returned to be properly “activated”.
- If everything is in good condition, replace the MPEM.

When using the service action suggested in the Fault section of B.U.D.S., the system circuits are referred as 4-23 for instance. It means Amp connector no. 4 and the circuit wire no. 23 as found in the wiring diagram.

TPS (Throttle Position Sensor) Faults

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

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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	RESULT	ACTION
Check if wrong connector is connected to TPS	Yes	<ul style="list-style-type: none">• Fix.
Check if sensor is loose	Yes	<ul style="list-style-type: none">• Fix and reset closed TPS.
Inspect sensor for damage or corrosion	Yes	<ul style="list-style-type: none">• Replace and reset closed TPS.
Inspect wiring (voltage test)	Failed	<ul style="list-style-type: none">• Repair.
Inspect wiring and sensor (resistance test)	Failed	<ul style="list-style-type: none">• If bad wiring, repair.• If bad TPS, replace and reset closed TPS.
Test sensor operation (wear test)		<ul style="list-style-type: none">• Replace and reset closed TPS.

TPS "ADAPTATION FAILURE" Fault

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

POSSIBLE CAUSES	RESULT	ACTION
Sensor has been replaced and TPS closed position not reset	Yes	<ul style="list-style-type: none">• Reset closed TPS.
Throttle body has been replaced and TPS closed position not reset	Yes	<ul style="list-style-type: none">• Reset closed TPS.
MPEM has been replaced and TPS closed position not reset	Yes	<ul style="list-style-type: none">• Reset closed TPS.
Throttle cable too tight	Yes	<ul style="list-style-type: none">• Fix and reset closed TPS.
Sensor is loose	Yes	<ul style="list-style-type: none">• Fix and reset closed TPS.
Throttle bracket is loose	Yes	<ul style="list-style-type: none">• Fix and reset closed TPS.
Idle screw or synchronization screw worn or loose	Yes	<ul style="list-style-type: none">• Fix and reset closed TPS.

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DI System Fault Code Chart

FAULT CODE	DIAGNOSED COMPONENT/SENSOR/CIRCUIT	ECU INTERNAL NAME	FAULT DETECTED	FAULT DETECTED WHILE ENGINE RUNNING	FAULT DETECTED WHILE ENGINE NOT RUNNING	NORMAL OPERATION RESUMES IF FAULT REMOVED AND...	SERVICE ACTION AND POSSIBLE CAUSES
P1100	Direct injector MAG	AIR_INJ_1	Open or short circuit	Yes	No	Return to idle	Service action: Check for 1 - 1.6 ohm resistance between system circuits 4-15 and 4-5. Check for + 12 volts on pin A of injector connector (color). Possible causes: Damaged injector, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P1101	Direct injector PTO	AIR_INJ_2	Open or short circuit	Yes	No	Return to idle	Service action: Check for 1 - 1.6 ohm resistance between system circuits 4-21 and 4-6. Check for + 12 volts on pin A of injector connector (color). Possible causes: Damaged injector, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0201	Fuel injector MAG	FUEL_INJ_1	Open or short circuit	Yes	No	Return to idle	Service action: Check for 1.7 - 1.9 ohm resistance between system circuits 4-13 and 4-7. Check for + 12 volts on pin A of injector connector (color). Possible causes: Damaged injector, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0202	Fuel injector PTO	FUEL_INJ_2	Open or short circuit	Yes	No	Return to idle	Service action: Check for 1.7 - 1.9 ohm resistance between 4-14 and 4-8. Check for + 12 volts on pin A of injector connector (color). Possible causes: Damaged injector, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0351	Ignition coil, primary winding MAG	IGN_CYL_1	Open or short circuit on ignition primary circuit	Yes	No	Return to idle	Service action: Check for .45 - .55 ohm resistance between system circuits 3-21 and 3-22. Check for + 12 volts on pin A of coil connector (color). Possible causes: Damaged coil, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0352	Ignition coil, primary winding PTO	IGN_CYL_2	Open or short circuit on ignition primary circuit	Yes	No	Return to idle	Service action: Check for .45 - .55 ohm resistance between system circuits 3-20 and 3-23. Check for + 12 volts on pin A of coil connector (color). Possible causes: Damaged coil, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0335	Encoder (CPS)	Encoder	Wrong pattern sensed	Yes	No	Return to idle	Service action: Check for 12 volts on pin 5 and 5 volts on 6 and 0 volts on pin 4 of encoder harness connector. Check system circuits 2-6, 2-7, 2-14. Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure. Damaged tooth wheel. Check correct rectifier regulator operation.

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FAULT CODE	DIAGNOSED COMPONENT/SENSOR/CIRCUIT	ECU INTERNAL NAME	FAULT DETECTED	FAULT DETECTED WHILE ENGINE RUNNING	FAULT DETECTED WHILE ENGINE NOT RUNNING	NORMAL OPERATION RESUMES IF FAULT REMOVED AND ...	SERVICE ACTION AND POSSIBLE CAUSES
P0120	TPS, PTO	TPI_1	Sensor out of range	Yes	No	Return to idle	<p>Service action: Check for 5 volts on pin 1 and 0-0.5 volts on pin 3 and 0 volts on pin 2. Check system circuits 4-1, 4-2, 4-18. Check with throttle closed the resistance between 1 and 2 is 2000 ohms and between 2 and 3 is 1000 ohms and between 1 and 3 2500 ohms. Check for linear resistance rise when opening throttles. Check physical stops for wear.</p> <p>Possible causes: Damaged Sensor, damaged circuit wires, damaged connector, damaged ECU pins, ECU failure, damaged or out of alignment throttle bodies or sensor.</p>
P0220	TPS, MAG	TPI_2	Sensor out of range	Yes	No	Return to idle	<p>Service action: Check for 5 volts on pin 1 and 4.75-5.0 volts on 3 and 0 volts on pin 2. Check system circuits 3-5, 3-10, 3-14. Check with throttle closed the resistance between 1 and 2 is 2500 ohms and between 2 and 3 is 2500 ohms and between 1 and 3 1200 ohms. Check for linear resistance rise when opening throttles. Check physical stops for wear.</p> <p>Possible causes: Damaged Sensor, damaged circuit wires, damaged connector, damaged ECU pins, ECU failure, damaged or out of alignment throttle bodies or sensor.</p>
P1102	TPS, PTO	TPI_1_ADAP	Throttle position adaption failure	Yes	No	Full reset. Key off and on	<p>Service action: Check cable adjustment. Check Idle stop for wear check throttle angles at idle.</p> <p>Possible causes: No initialisation after throttle body or ECU changes throttle idle stop drifted.</p>
P1103	TPS, MAG	TPI_2_ADAP	Throttle position adaption failure	Yes	No	Full reset. Key off and on	<p>Service action: Check cable adjustment. Check Idle stop for wear. Check throttle angles at idle.</p> <p>Possible causes: No initialisation after throttle body or ECU changes throttle idle. Stop drifted.</p>
P0116	WTS	COOL_SENS	Sensor out of range	Yes	No	Return to idle	<p>Service action: Check for resistance approx. 2280 ohms to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits 4-9 and 4-11.</p> <p>Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.</p>
P0217	WTS	COOL_RED	Overheat warning	Yes	No	As soon as fault is not present	<p>Service action: Check for debris or blockage in cooling system. Check for resistance approx. 2280 ohms to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits 4-9 and 4-11.</p> <p>Possible causes: Engine overheated, damaged sensor.</p>
P0110	MATS	MCT_SENS	Sensor out of range	Yes	No	Return to idle	<p>Service action: Check for resistance approx. 2280 ohms to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits 4-16 and 4-19.</p> <p>Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.</p>

Section 06 ENGINE MANAGEMENT (DI)
Subsection 04 (DIAGNOSTIC PROCEDURES)

FAULT CODE	DIAGNOSED COMPONENT/SENSOR/CIRCUIT	ECU INTERNAL NAME	FAULT DETECTED	FAULT DETECTED WHILE ENGINE RUNNING	FAULT DETECTED WHILE ENGINE NOT RUNNING	NORMAL OPERATION RESUMES IF FAULT REMOVED AND ...	SERVICE ACTION AND POSSIBLE CAUSES
P0106	MAPS	MAP	Sensor out of range	Yes	No	Return to idle	Service action: Check system circuits 3-3, 3-6, 3-7. Check sensor connector for 5 volts on pin 1 and 0 volts on pin 3 and 0 volts on pin 2. Check Sensor housing is correctly inserted into manifold. Possible causes: Check sensing port for dirt or blockage. Sensor failure, unexpected reading at idle. Sensor fallen out of housing. Leaking Inlet system, ECU failure.
P0105	MAPS	MAP_ATM	Bad atmospheric reading	Yes	No	Full reset. Key off and on	Service action: Check system circuits 3-3, 3-6, 3-7. Check sensor connector for 5 volts on pin 1 and 0 volts on pin 3 and 0 volts on pin 2. Possible causes: Check sensing port for dirt or blockage, damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.
P1400	EGT	EXH_SENS	Sensor out of range	Yes	No	Return to idle	Service action: Check for resistance approx. 2280 ohms to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits 4-10 and 4-12. Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.
P1401	EGT	EXH_RED	Overheat warning	Yes	No	As soon as fault is not present	Service action: Check for debris or blockage in cooling system. Check tune pipe injection valve. Possible causes: Exhaust system overheated, damaged sensor damaged circuit wires.
P0460	Fuel level sensor	FUEL_SENS	Sensor out of range	Yes	No	As soon as fault is not present	Service action: TBD. Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.
P0230	Fuel pump	FUEL_PUMP	Open or short circuit	Yes, short circuit	Yes, open circuit	Return to idle	Service action: Check for resistance of 6-8 ohms between system circuits 4-24 and 4-26. Possible causes: Damaged pump, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0475	RAVE solenoid	RAVE	Open or short circuit	Yes, open and short circuit	Yes, open circuit	Return to idle	Service action: Check for resistance of 30 ohms between system circuits 4-23 and 4-20. Possible causes: Damaged solenoid, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P1300	Starting system solenoid (winding)	CRANK	Open or short circuit	Yes, open and short circuit	Yes, open circuit	As soon as fault is not present	Service action: Check for resistance of 6ohms between system circuits 3-19 and 3-15. Possible causes: Damaged solenoid, damaged circuit wires, damaged connector, damaged ECU output pins. ECU failure.
P0563	Battery voltage	BV_HI_WARN	Battery voltage high	Yes	Yes	As soon as fault is not present	Possible causes: Battery failure, rectifier failure, battery terminal connection.

Section 06 ENGINE MANAGEMENT (DI)

Subsection 04 (DIAGNOSTIC PROCEDURES)

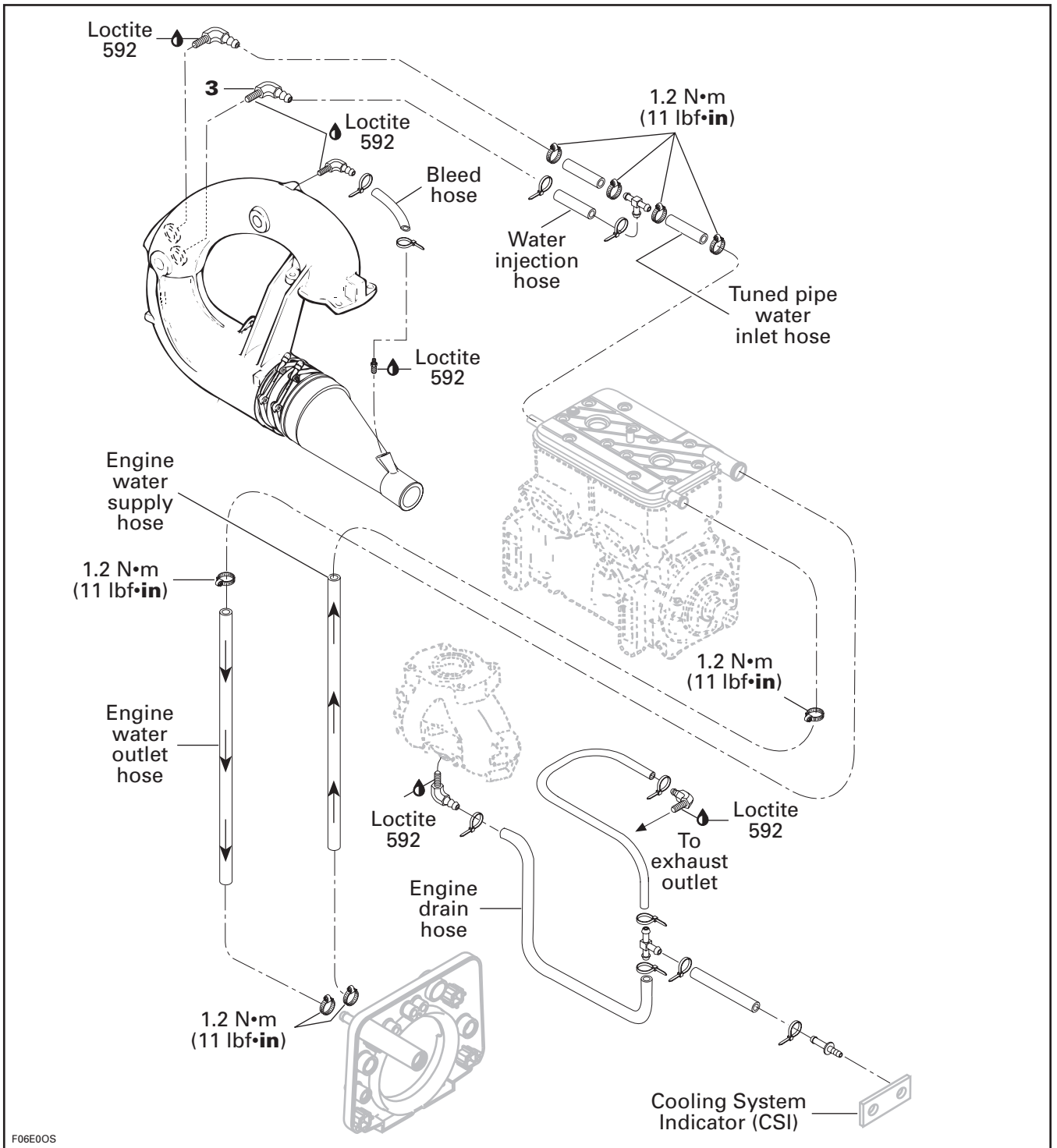
FAULT CODE	DIAGNOSED COMPONENT/SENSOR/CIRCUIT	ECU INTERNAL NAME	FAULT DETECTED	FAULT DETECTED WHILE ENGINE RUNNING	FAULT DETECTED WHILE ENGINE NOT RUNNING	NORMAL OPERATION RESUMES IF FAULT REMOVED AND ...	SERVICE ACTION AND POSSIBLE CAUSES
P1500	Battery voltage	BV_HI_RED	Battery voltage very high	Yes	Yes	Full reset. Key off and on	Possible causes: Battery failure, rectifier failure, battery terminal connection.
P0562	Battery voltage	BV_LO_WARN	Battery voltage low	Yes	Yes	As soon as fault is not present	Service action: Check fuse. Check system circuits 3-25 to battery + terminal, 2-26 to regulator 2 pin connector pin A, 2-25 to regulator 2 pin connector pin B. Possible causes: Battery failure, rectifier failure, damaged circuit wires, battery terminal connection, damaged magneto, damaged connectors.
P1501	Battery voltage	BV_LO_RED	Battery voltage very low	Yes	Yes	Return to idle	Service action: Check fuse, check system circuits 3-25 to battery + terminal, 2-26 to regulator 2 pin connector pin A, 2-25 to regulator 2 pin connector pin B. Possible causes: Battery failure, rectifier failure, damaged circuit wires, battery terminal connection, damaged magneto, damaged connectors.
P0122	Sensor supply (TPS, MAG and MAPS)	XDRP_1	Sensor 5 volt supply failure	Yes	Yes	Return to idle	Service action: Check for shorts to ground or corrosion on the following system circuits 3-10 or 3-3. Possible causes: Damaged circuit wires, associated sensor failure (TPI 2 or MAP), ECU fault.
P0222	Sensor supply (TPS, PTO)	XDRP_2	Sensor 5 volt supply failure	Yes	Yes	Return to idle	Service action: Check for shorts to ground or corrosion on system circuit 4-18. Possible causes: Damaged circuit wires, associated sensor failure (TPI 1), ECU fault.
P1600	ECU	SETUP	TDC and ECU not initialised	Yes	Yes	Reinitialise from B.U.D.S.	Service action: Initialize ECU. Possible causes: ECU not initialised, TDC not setup, throttle sensors not initialised.
P0606	ECU	ECU_FAULT	Internal ECU faults	Yes	Yes	Full reset. Key off and on	Service action: Check ignition leads, coils and correct spark plugs, replace ECU. Possible causes: Incorrect software, ignition noise causing errors, internal EEPROM failure.
P0325	Knock sensor	KNOCK_SENS	Knock sensor failure	Yes, over 4500	No	Return to idle	Service action: Bring engine to 4500 RPM. If fault code appears, check for resistance approx. 4.8 ohms between system circuits 4-2 and 4-17. Possible causes: Damaged sensor, damaged circuit wires, damaged connector, damaged ECU pins. ECU failure.
P1601	Diagnostic cap	COMMS_CAP	Diagnostic cap is not installed on wiring harness	Yes	Yes	As soon as fault is not present	Service action: Reinstall cap on wiring harness. Possible causes: Cap is not installed on wiring harness.

TABLE OF CONTENTS

CIRCUIT, COMPONENTS AND CARE.....	07-02-1
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CIRCUIT, COMPONENTS AND CARE

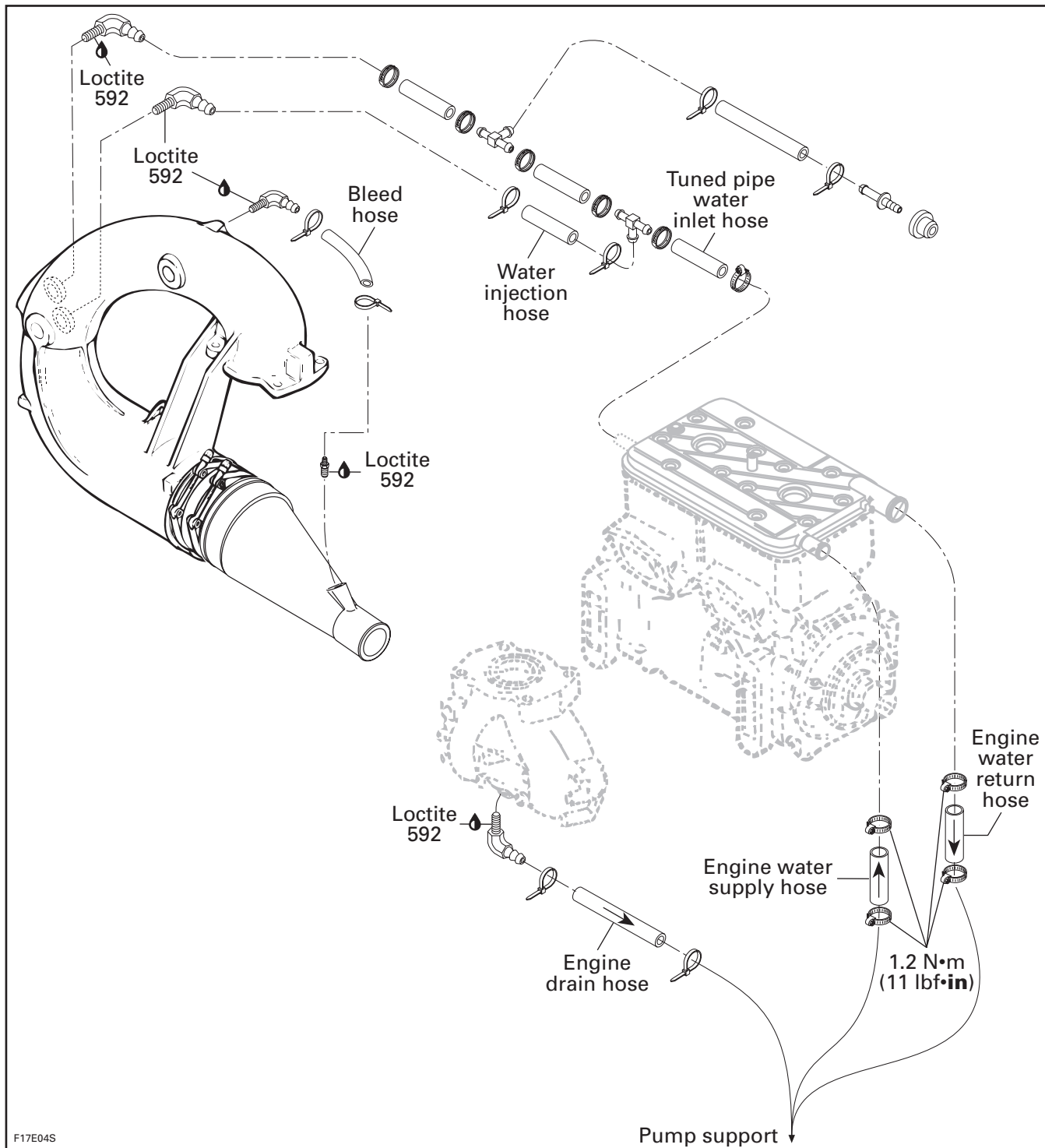
GS Models (717 engine)



Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

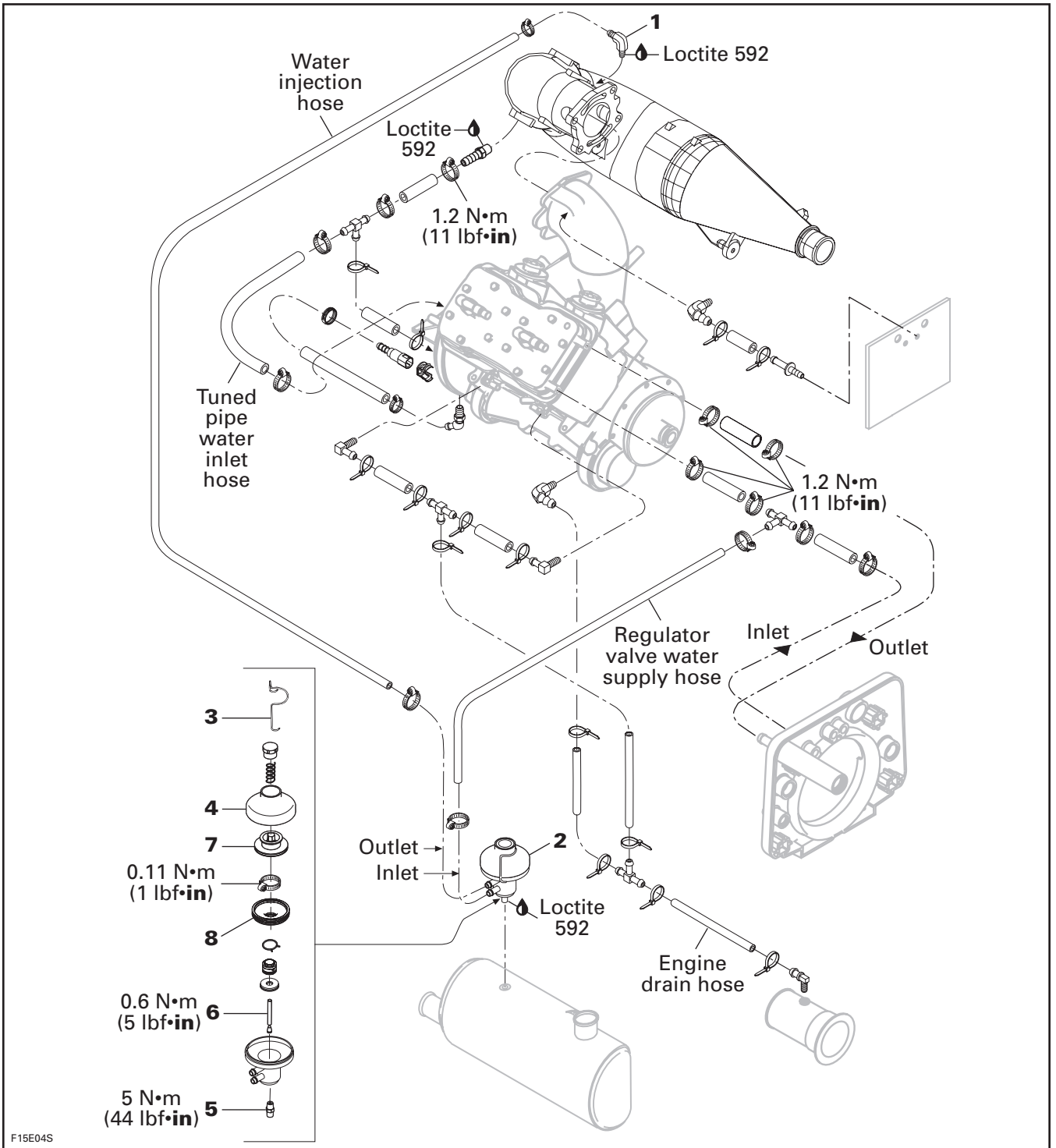
GTS and GTI Models (717 engine)



F17E04S

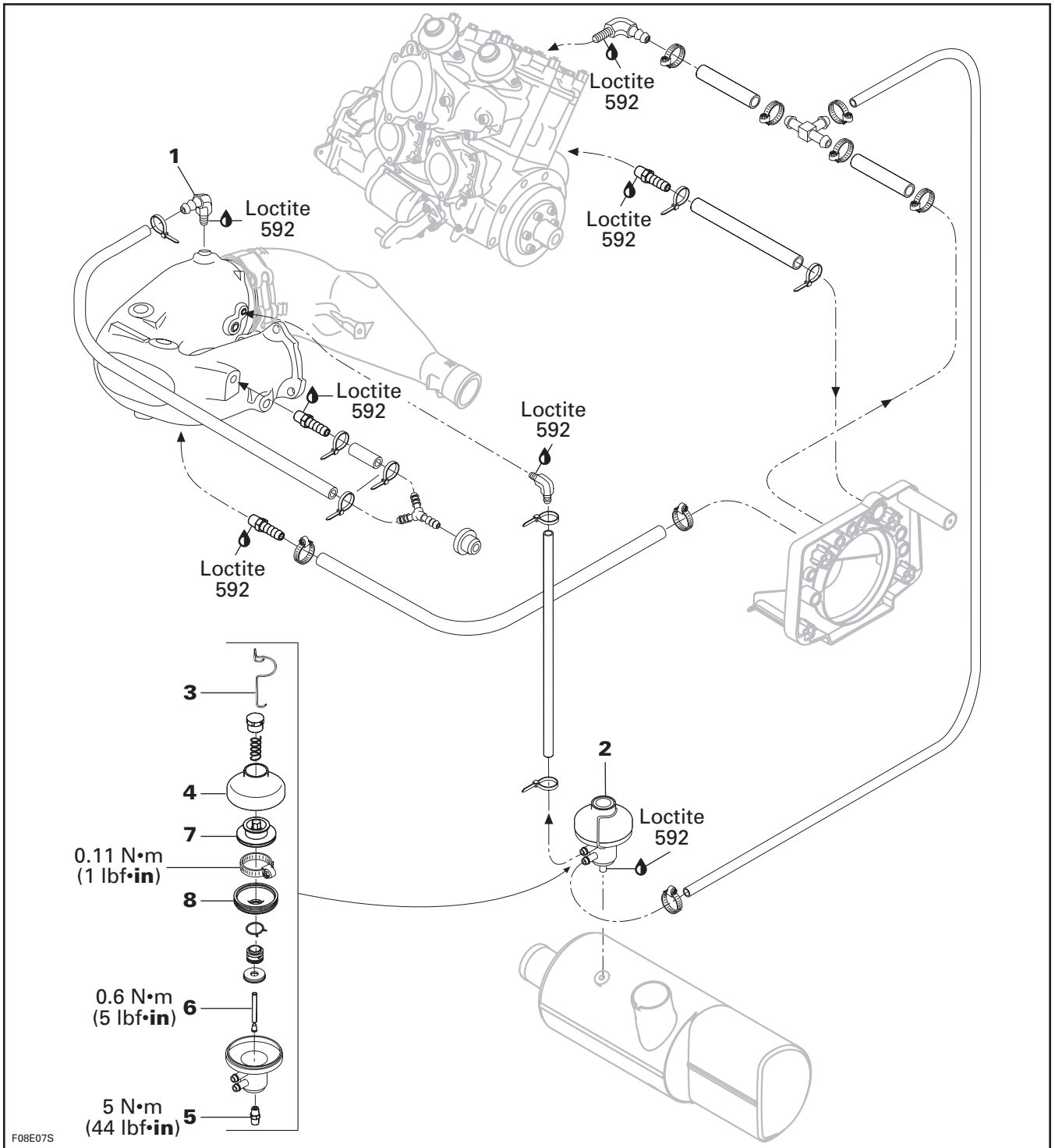
Section 07 COOLING SYSTEM
 Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

GTX RFI Models (787 RFI engine)



Section 07 COOLING SYSTEM
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

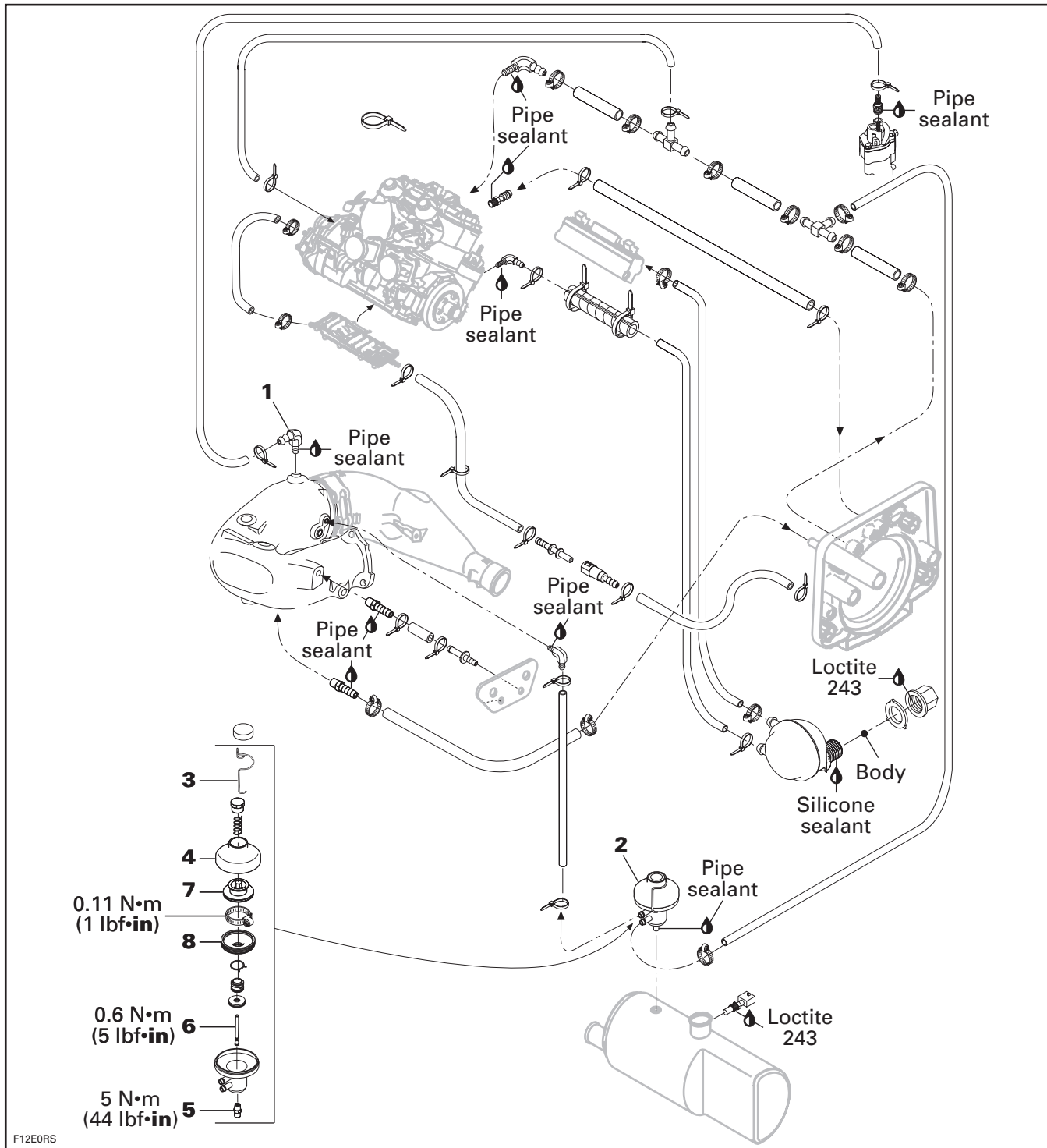
XP and RX Models (947 carburetor-equipped engine)



Section 07 COOLING SYSTEM

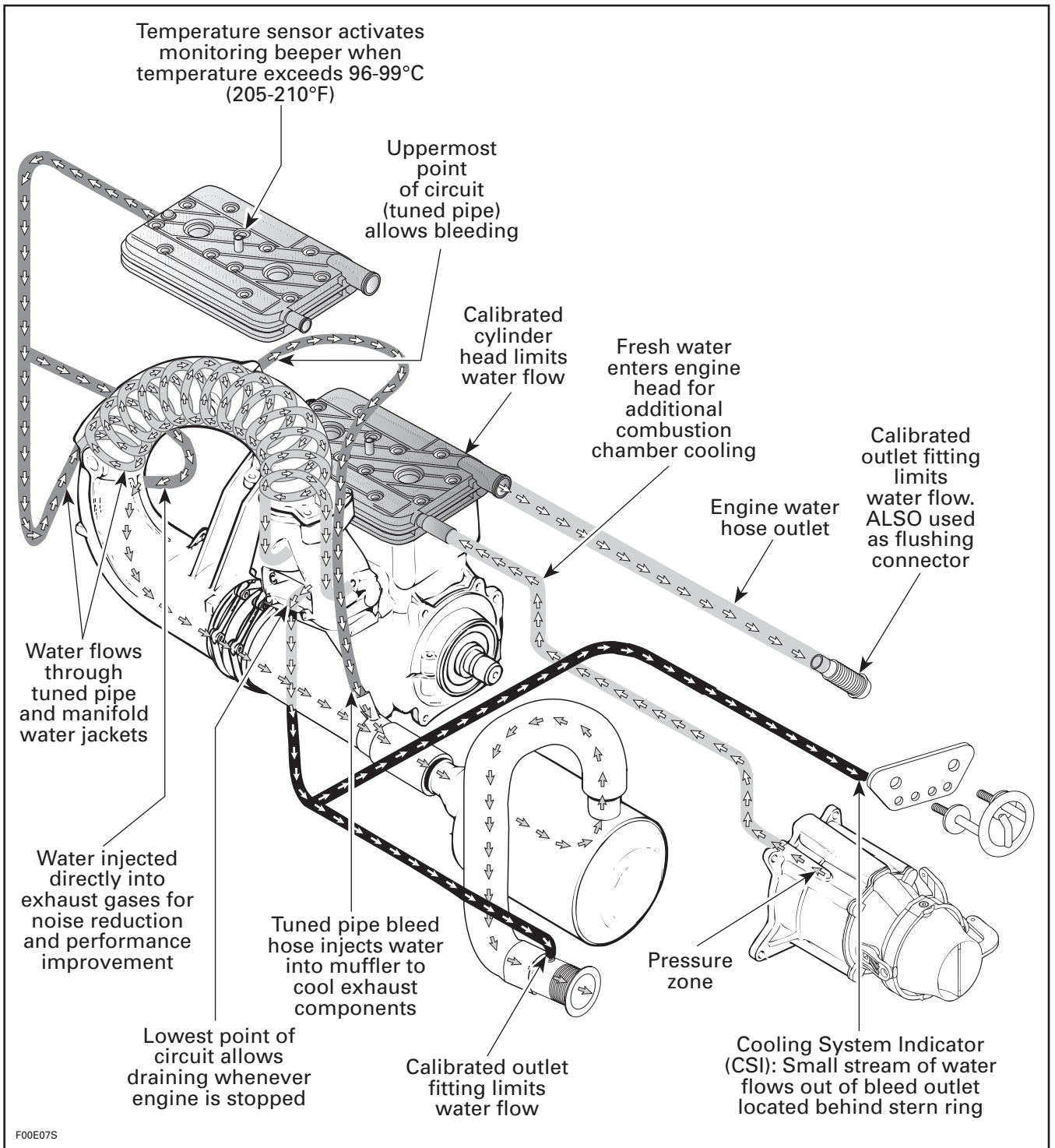
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

RX DI and GTX DI (947 DI engines)



Section 07 COOLING SYSTEM
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

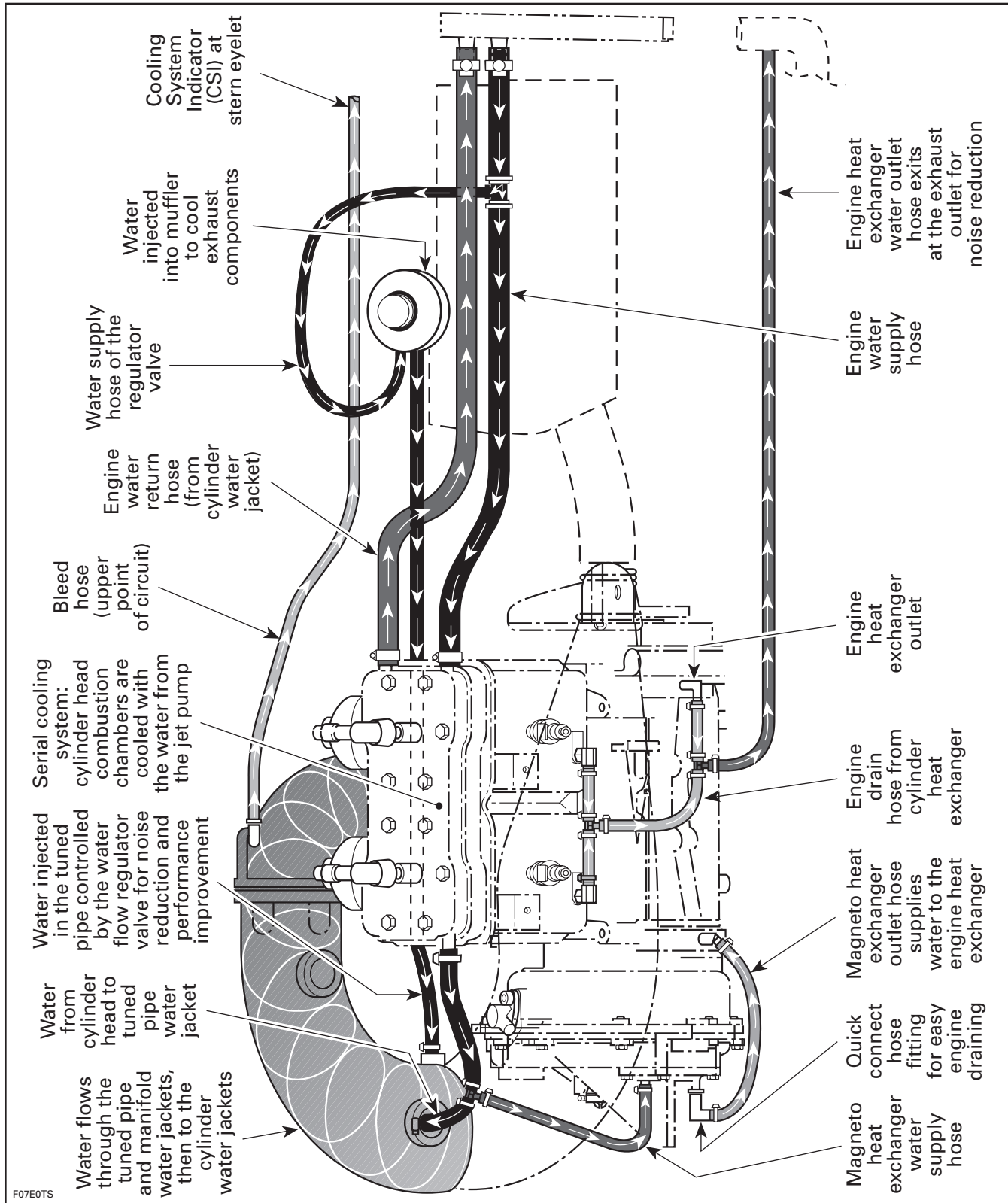
717 Engines



Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

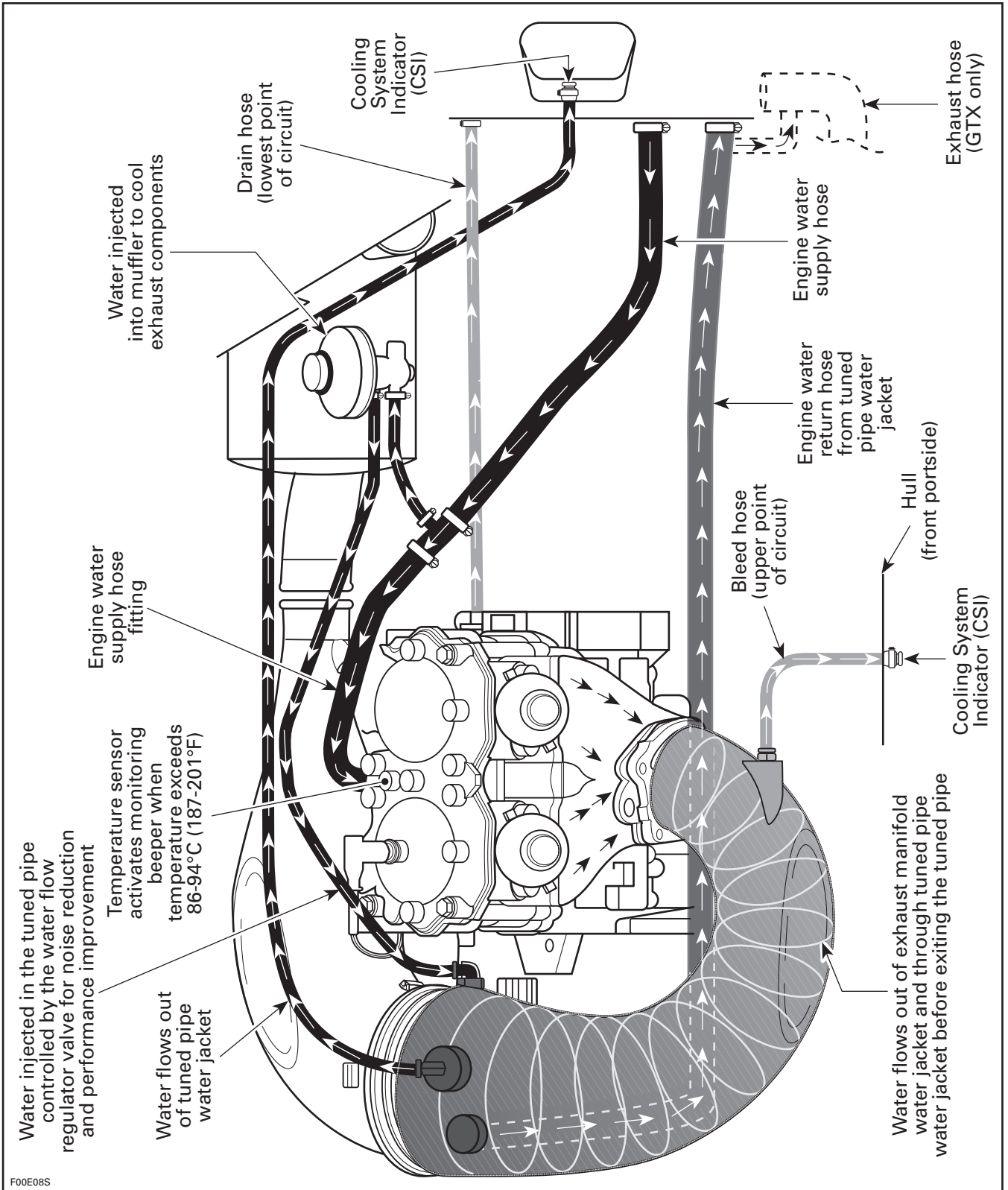
787 RFI Engines



Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

947 Engine — Carburetor-Equipped Models



CIRCUIT

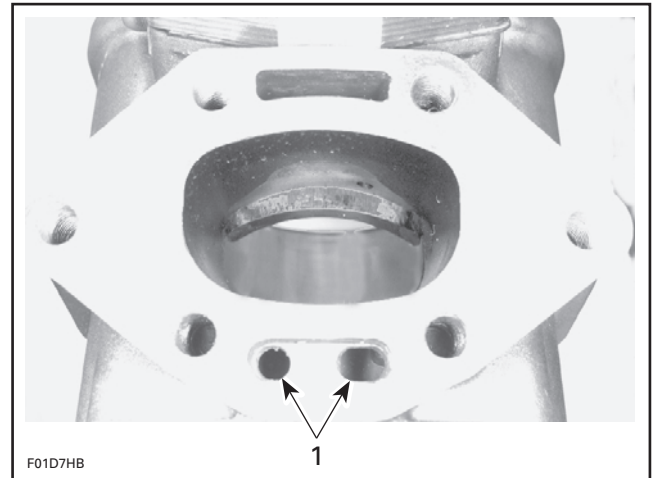
CAUTION: All hoses and fittings of the cooling system have calibrated inside diameters to assure proper cooling of the engine. Always replace using appropriate Bombardier part number.

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. Water passages

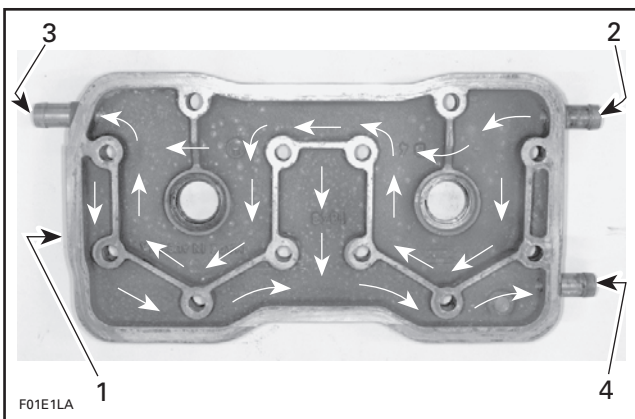
No water enters crankcase.

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.

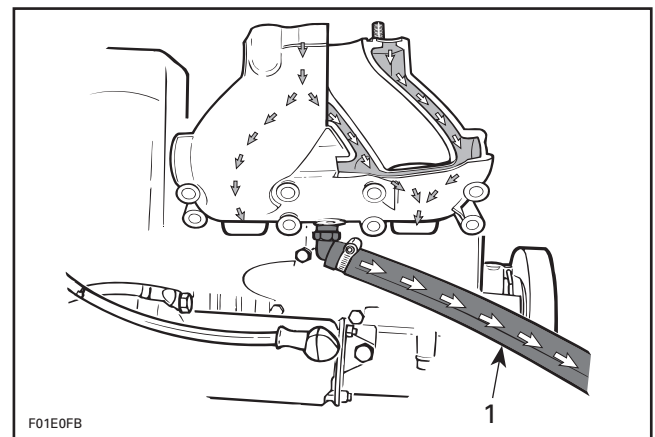


- 1. Cylinder head cover
- 2. Fresh water from jet pump
- 3. Water exiting head assembly to tuned pipe, exhaust manifold and cylinders
- 4. Water from cylinder water jackets exiting engine

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.



717 ENGINE

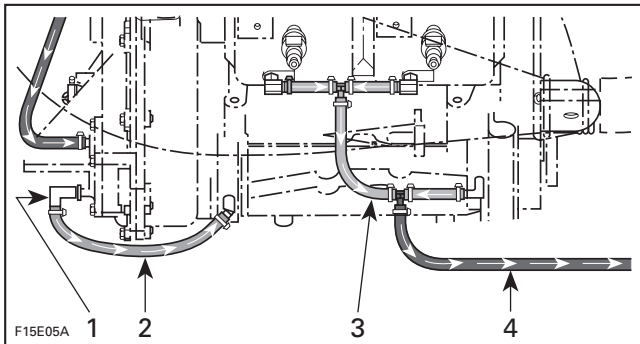
- 1. Drain hose

Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

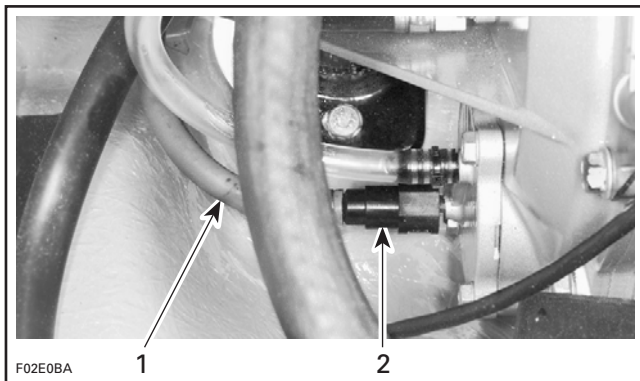
787 RFI Engines

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.



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.

947 Engines

The 947 engines has a conventional cooling system. The water is entering the engine by the water inlet fitting at the cylinder head.

As with other models, the water supply is provided by a pressurized area in the jet pump between the impeller and venturi.

Water is directed to the water inlet fitting at cylinder head.



1. Water supply hose

DI Models

Water from inlet hose also supplies the water regulator on muffler and magneto cover and crankcase cover.

Water then is expelled through the pump support drain.

All 947 Engines

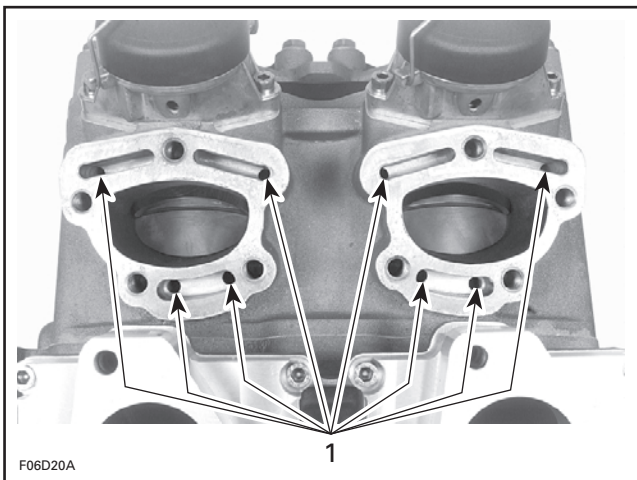
Water circulates through the one piece cylinder head which features improved combustion chamber and better spark plug cooling.



Section 07 COOLING SYSTEM

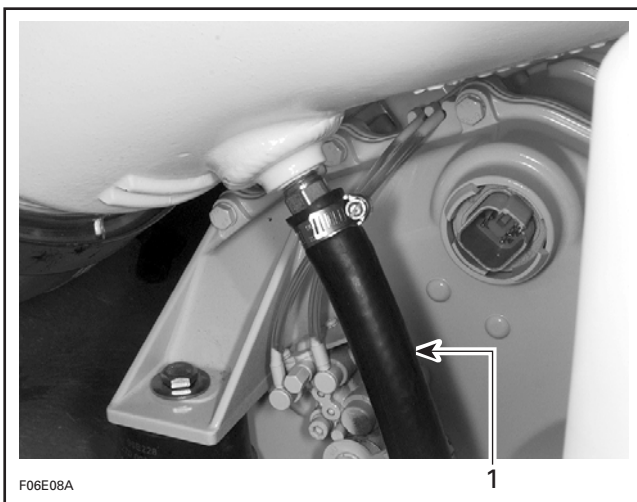
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

Water enters cylinder block water jackets and is directed to the water jackets of the exhaust manifold and tuned pipe head through passages located above and below exhaust ports.



1. Water passages

Water exits tuned pipe water jackets through an outlet fitting.



1. Engine water outlet

Water circulates in the water outlet hose and is expelled out of the cooling system through a fitting located in the jet pump support on the transom of the watercraft.

947 Carburetor-Equipped Engines

Water flows out of tuned pipe water jacket from upper fitting of tuned pipe and is expelled to the cooling system indicator.

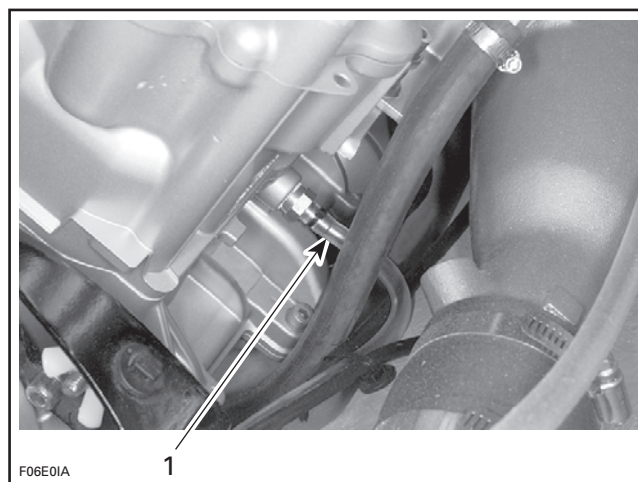
DI Models

Water flows out of tuned pipe water jacket from upper fitting of tuned pipe and is directed to the air compressor, then to the air silencer at the transom.

Water continues to flow in the crankcase water jacket to cool the crankcase area to then be expelled to the transom area.

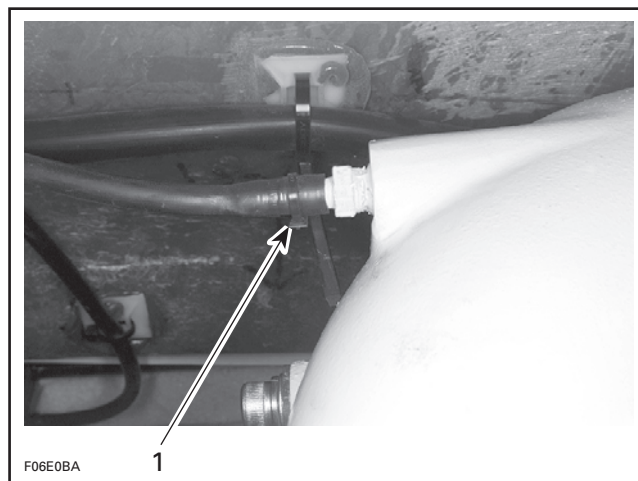
All 947 Engines

Draining of the cooling system is accomplished by the drain hose connected to a fitting at the bottom of the cylinder-block, on tuned pipe side.



1. Drain hose

Bleeding of the cooling system is accomplished by the bleed hose located at the uppermost point of the circuit at the tuned pipe. The bleed hose also serves as the Cooling System Indicator (CSI).

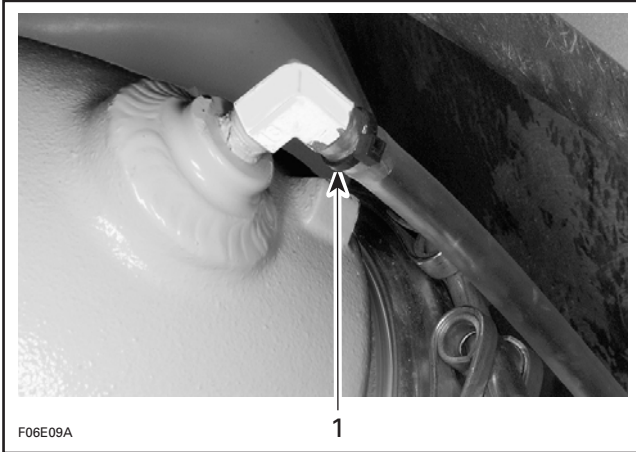


1. Bleed hose

Section 07 COOLING SYSTEM

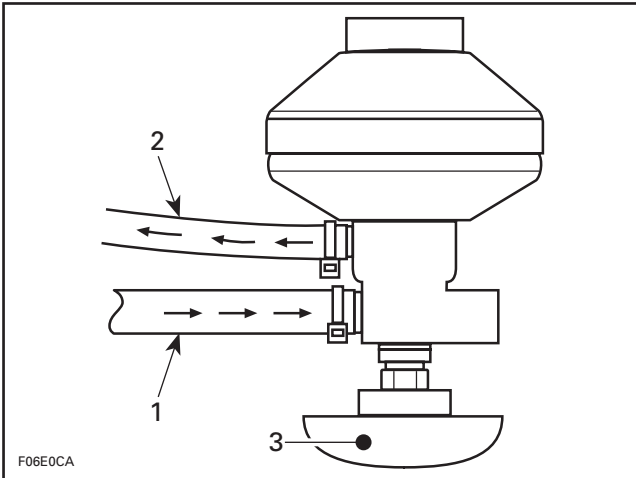
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

The water supply of the water flow regulator is provided by the water supply hose coming from the pump.



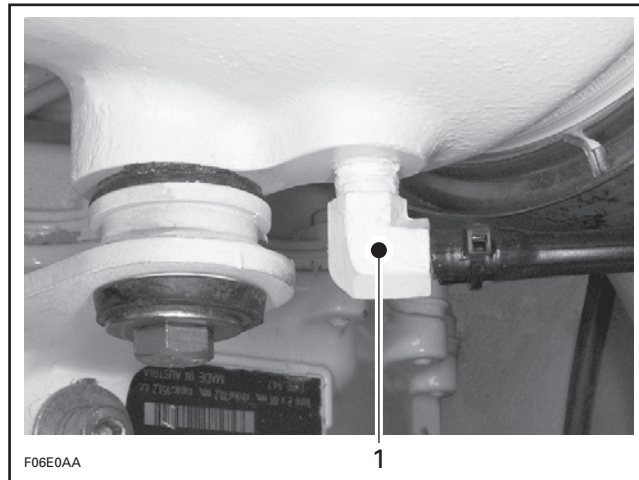
1. Water flow going to CSI

The lower hose of the valve is the water supply and the upper hose is the regulated injection water for the tuned pipe.



1. Water from engine water supply hose
2. Regulated injection water to the tuned pipe
3. Muffler

Regulated water is injected in the tuned pipe by a calibrated fitting.



1. Injection fitting

All Models

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

TECHNICAL DATA

TYPE:

TLCS (Total Loss Cooling System).

COOLANT FLOW:

Pressure build-up at 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.

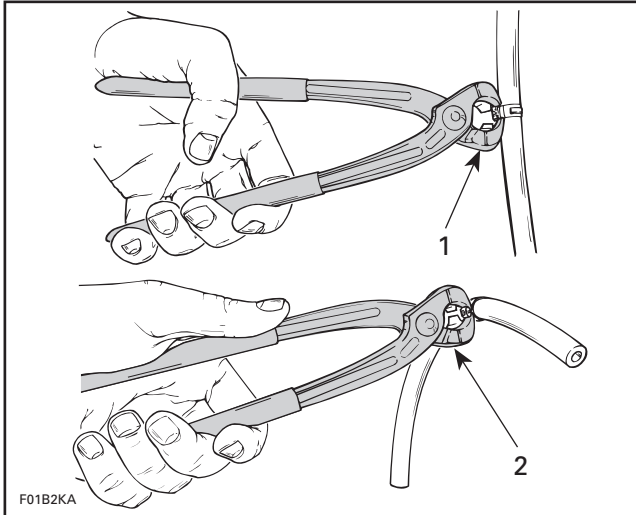
MONITORING BEEPER:

Turns on at 86-94°C (187-201°F).

COMPONENTS

Clamp

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



1. Cutting clamp
2. Securing clamp

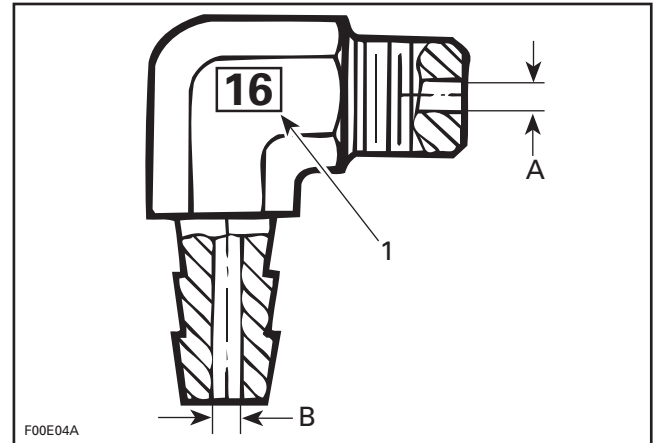
Elbow Fitting

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
16	293 700 016	5.5 mm (.219 in)	4.6 mm (.181 in)
48	293 710 048	4.0 mm (.157 in)	3.5 mm (.139 in)

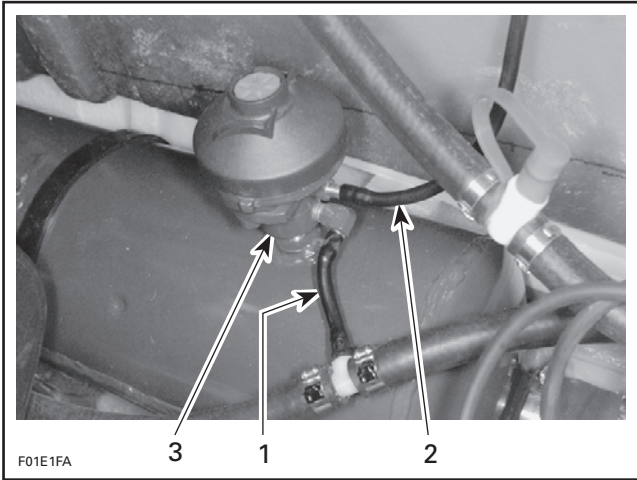
Water Flow Regulator Valve

A water flow regulator valve is mounted on models with the **787 RFI** and **947 engines** 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.

Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

The water flow regulator valve no. 2 is mounted directly onto the muffler.



F01E1FA

TYPICAL

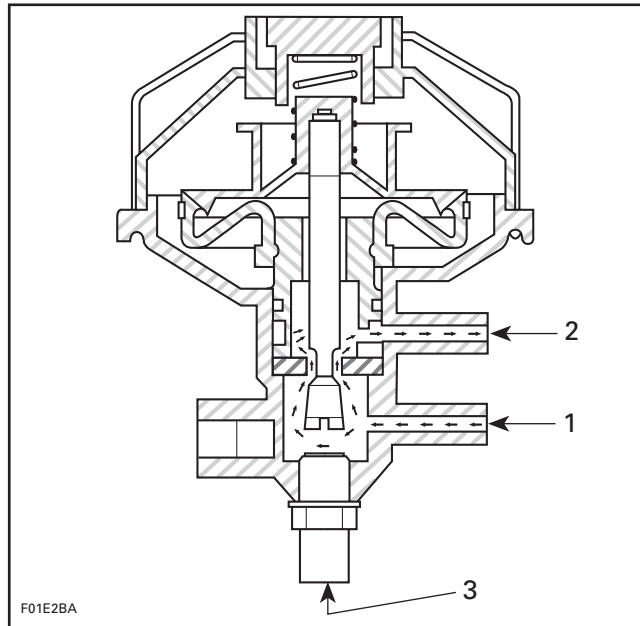
1. Water supply hose of regulator valve
2. Regulated water to injection fitting
3. Water injected into the muffler

NOTE: The water injected into the muffler is not regulated by the valve. A calibrated water injection fitting of 3.0 mm (.118 in) on **carburetor-equipped models** and 4.0 mm (.156 in) on **DI models** inside diameter limits water flow into the muffler.

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.

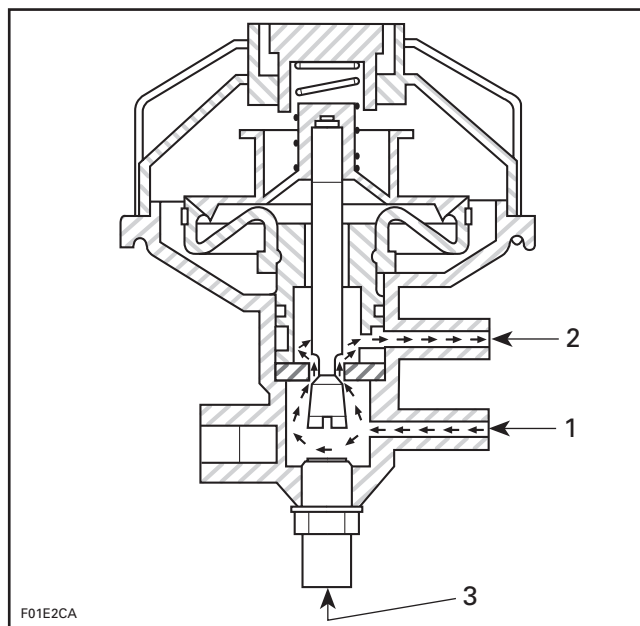
At low speed, water pressure in the supply hose of the regulator valve is not sufficient to overcome the spring of the regulator valve; more water is being delivered to the injection fitting at the tuned pipe.



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. The valve cap on the **DI models** is sealed and it is not adjustable.

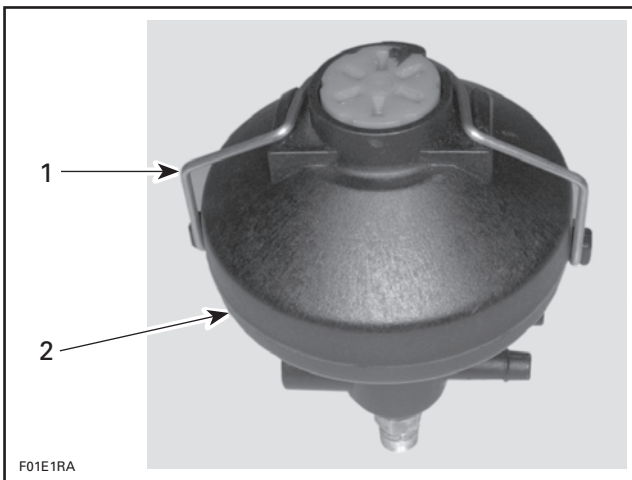
If the maximum engine speed cannot be attained or if the engine has poor performance, the water flow regulator valve should be considered in the troubleshooting of the problem.

Disassembly

Remove the cover no. 4 of the valve by releasing the spring no. 3.

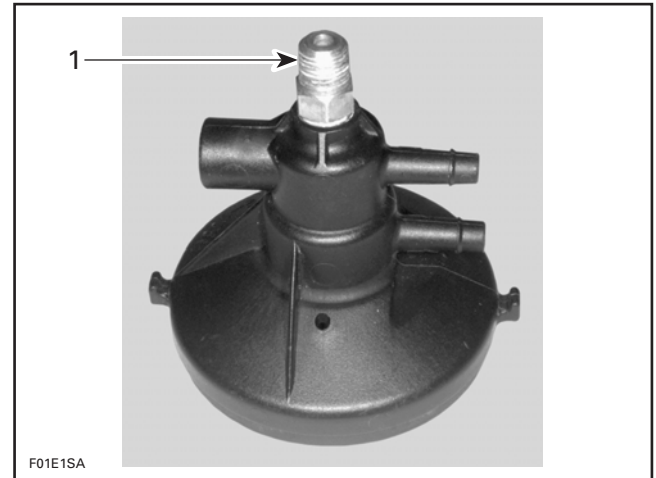
⚠ WARNING

Firmly hold cover to valve base. The spring inside the valve is applying a pressure against the cover.



- 1. Spring
- 2. Cover

Remove fitting no. 5 from valve housing.

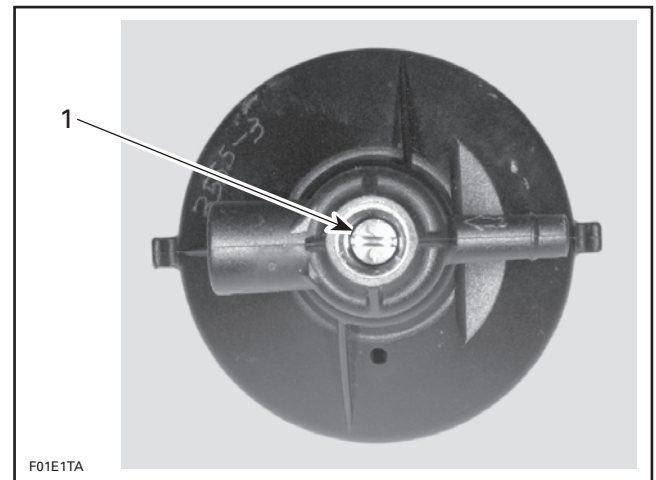


F01E1SA

- 1. Fitting

Unscrew the tapered needle no. 6.

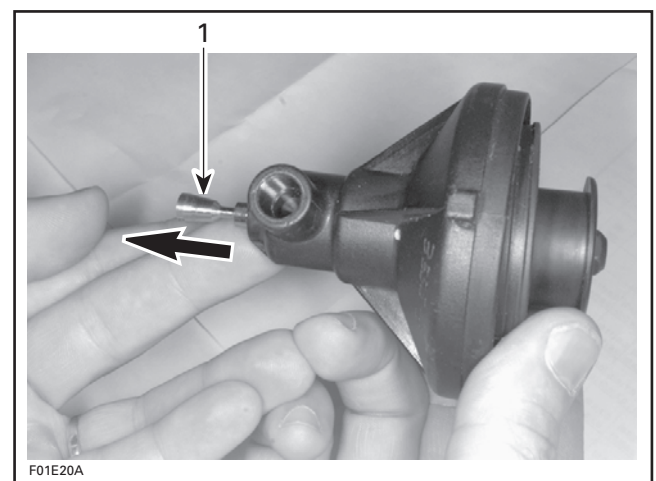
NOTE: Hold the valve to prevent it from turning.



F01E1TA

- 1. Tapered needle

Remove the tapered needle from valve housing.



F01E20A

- 1. Remove tapered needle

Section 07 COOLING SYSTEM

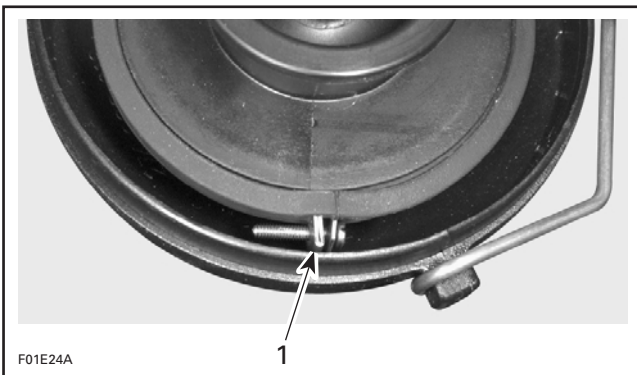
Subsection 02 (CIRCUIT, COMPONENTS AND CARE)

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.

CARE

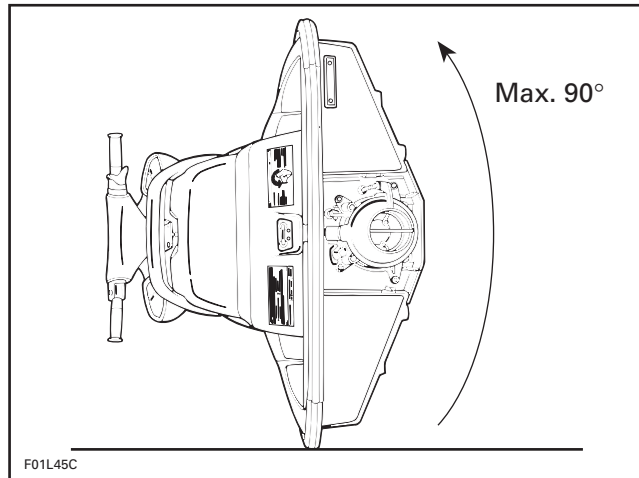
For flushing purposes, the cooling system is equipped with either a fitting spigot or a hose adapter depending upon the model.

For flushing operation, a coupler hose is available (unnecessary for models with the hose adapter) to connect to the fitting spigot. A garden hose is used to flush the whole system by backwash. For flushing procedure, refer to FLUSHING AND LUBRICATION.

For winterization of cooling system, refer to STORAGE.

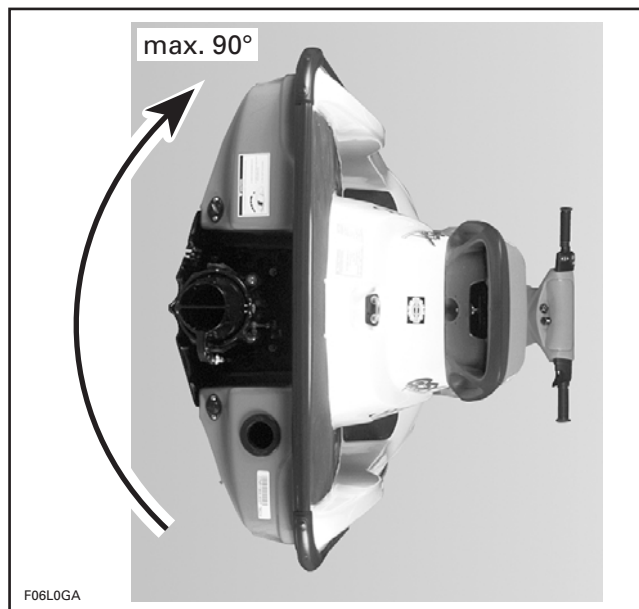
GS, GTS and GTI Models

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.



All Other Models

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.



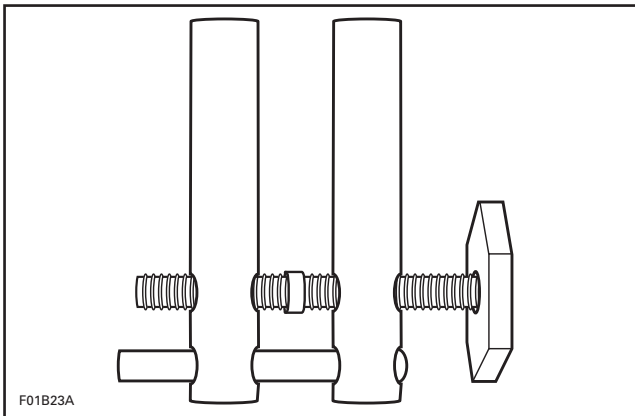
TYPICAL

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).

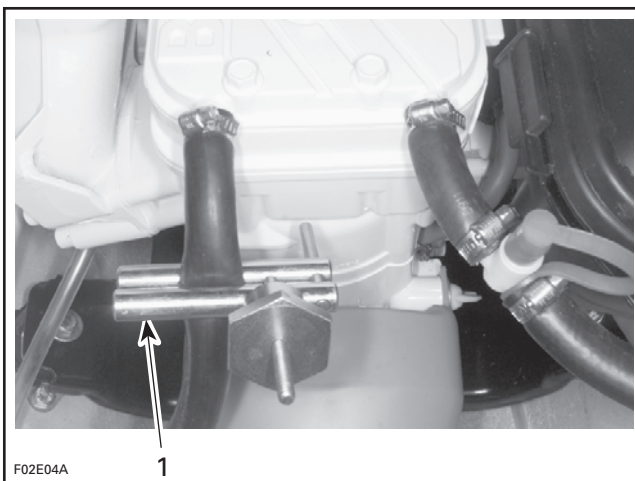
When towing your watercraft in water, pinch the water supply hose from the jet pump housing to the engine with a large Hose Pincher (P/N 529 032 500).



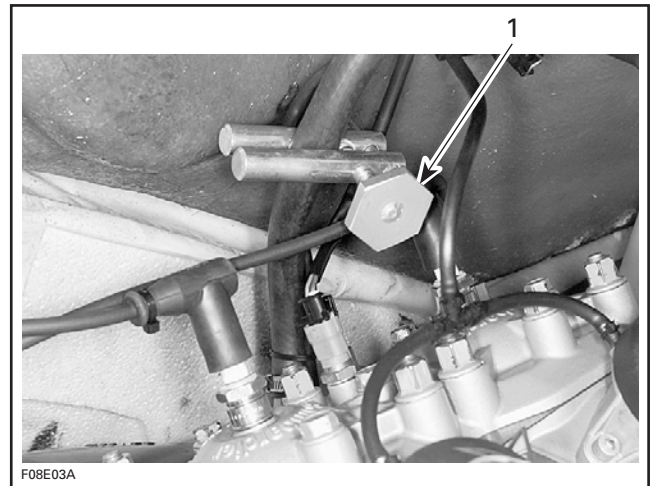
This will prevent the cooling system from filling which may lead to water being injected into and filling the exhaust system. Without the engine running there isn't any exhaust pressure to carry the water out the exhaust outlet.

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

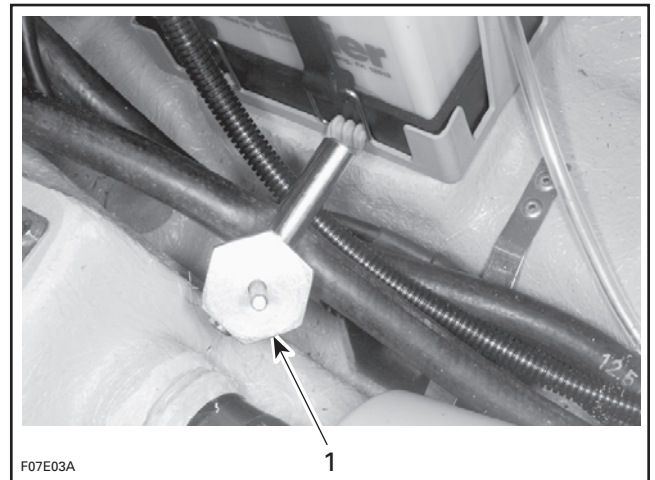
Snugly install the hose pincher on the water supply hose as shown in the following illustrations.



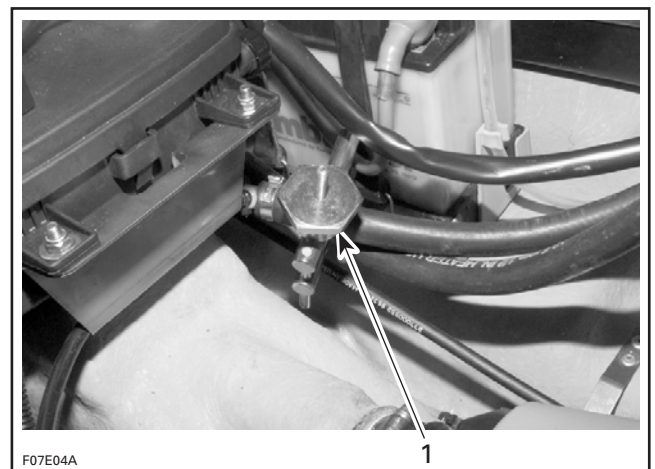
GS, GTS AND GTI MODELS
1. Hose pincher on water supply hose



XP MODELS
1. Hose pincher on water supply hose



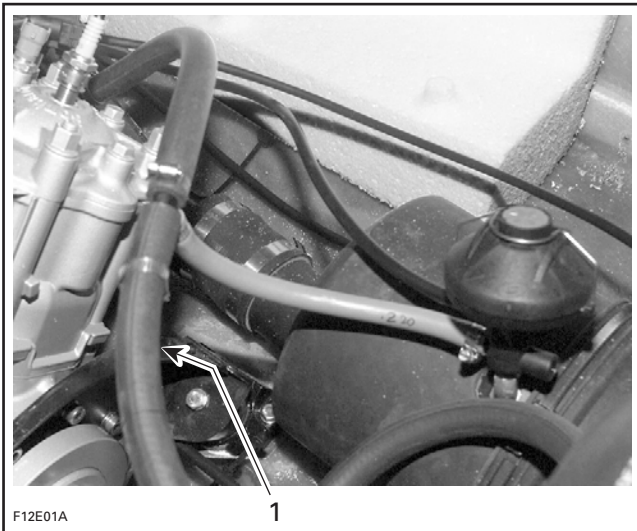
GTX MODELS
1. Hose pincher



GTX RFI MODELS
1. Hose pincher

Section 07 COOLING SYSTEM

Subsection 02 (CIRCUIT, COMPONENTS AND CARE)



TYPICAL — RX SERIES AND GTX DI MODELS

1. *Hose pincher on water supply hose on this side of the T-fitting*

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

TABLE OF CONTENTS

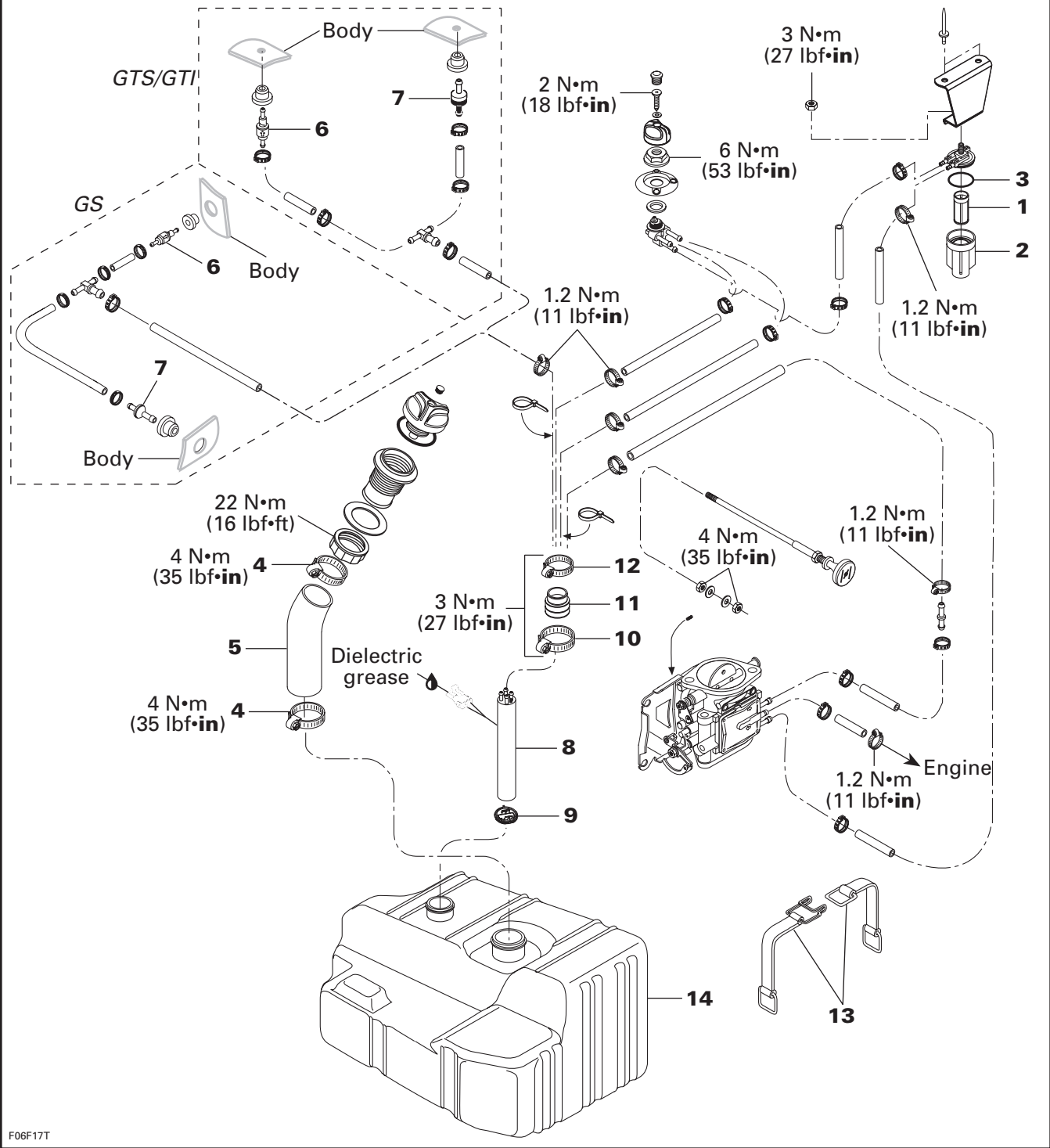
FUEL CIRCUIT	08-02-1
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FUEL CIRCUIT

GS, GTS and GTI Models

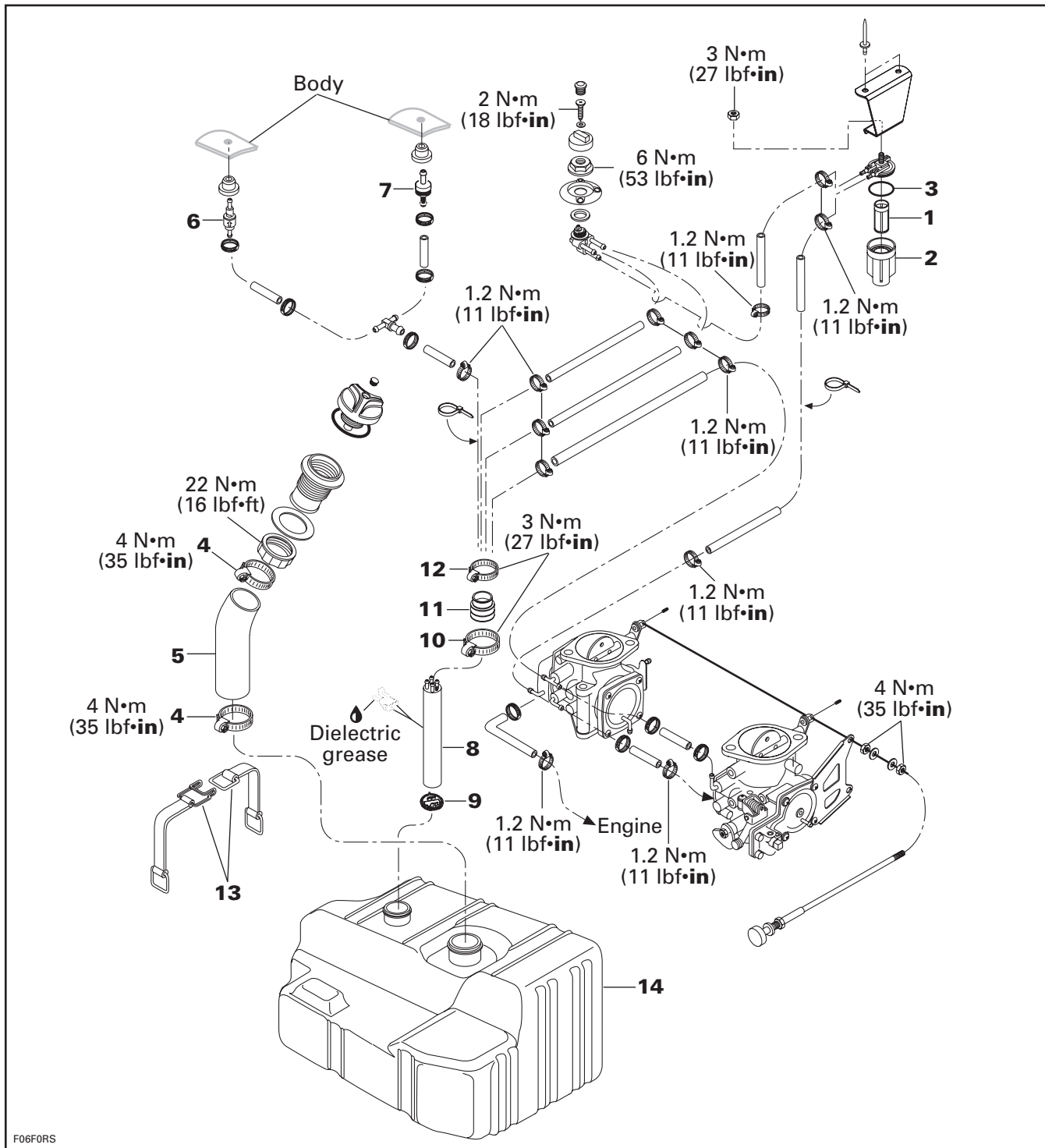


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Section 08 FUEL SYSTEM

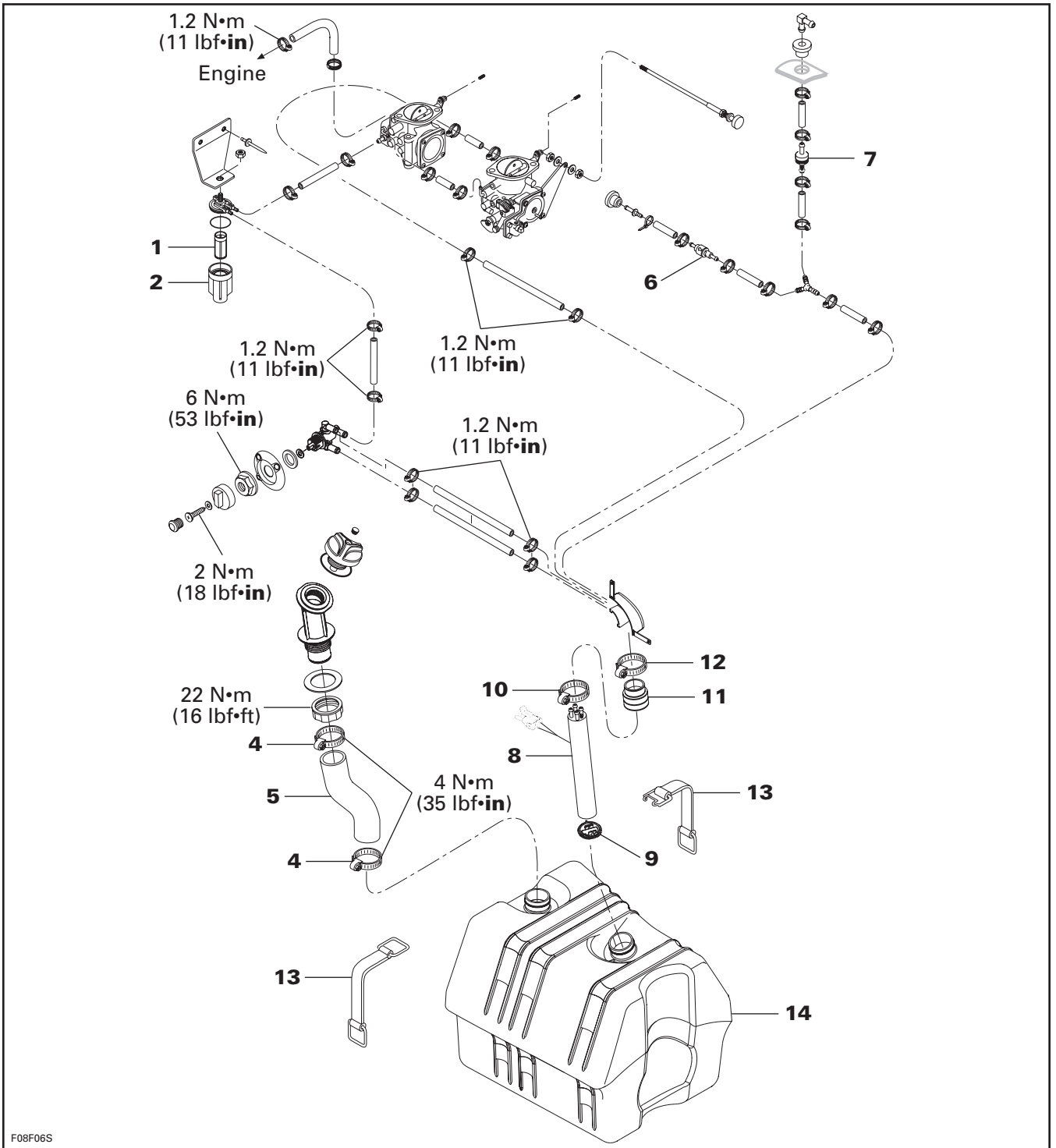
Subsection 02 (FUEL CIRCUIT)

GTX Models



Section 08 FUEL SYSTEM
Subsection 02 (FUEL CIRCUIT)

XP Models



GENERAL

⚠ WARNING

DI Models: The fuel system of a fuel injection system hold much more pressure than on a carbureted watercraft. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendations described in ENGINE MANAGEMENT (DI) under **Fuel System**.

⚠ WARNING

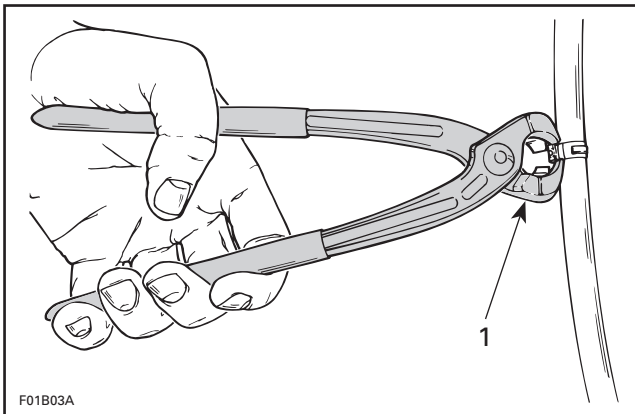
Whenever repairing the fuel system, always verify for water infiltration in reservoir. Replace any damaged, leaking or deteriorated fuel lines.

When working with fuel, pay attention to the following warning.

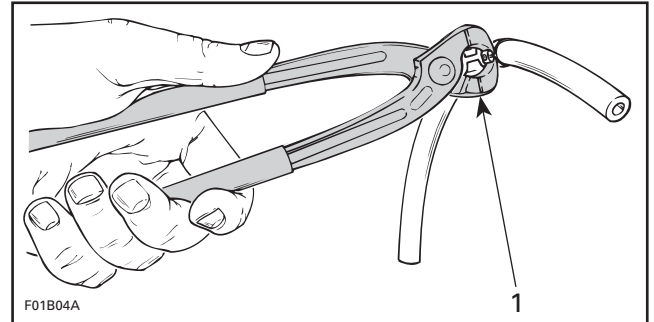
⚠ WARNING

Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Always wipe off any fuel spillage from the watercraft.

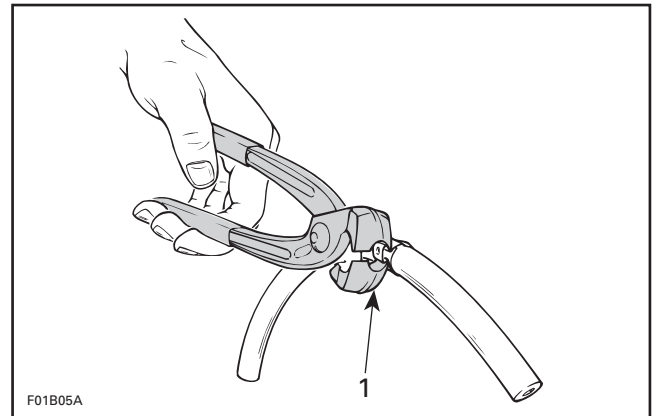
To secure or cut Oetiker clamps on fuel lines, use pliers (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

When replacing fuel lines on SEA-DOO watercraft, be sure to use "B1" hoses as available from Bombardier parts department. On **DI models**, use hoses ass'y available as parts replacement only. This will ensure continued proper and safe operation.

⚠ WARNING

Use of improper fuel lines could compromise fuel system integrity.

REMOVAL

Fuel Filter

All Models except XP, GTS, GTI, RFI and DI Models

Open storage compartment cover.

Remove basket.

XP Models

Open engine cover and remove basket.

Section 08 FUEL SYSTEM

Subsection 02 (FUEL CIRCUIT)

GTS, GTI Models

Remove seat.

Carburetor-Equipped Models

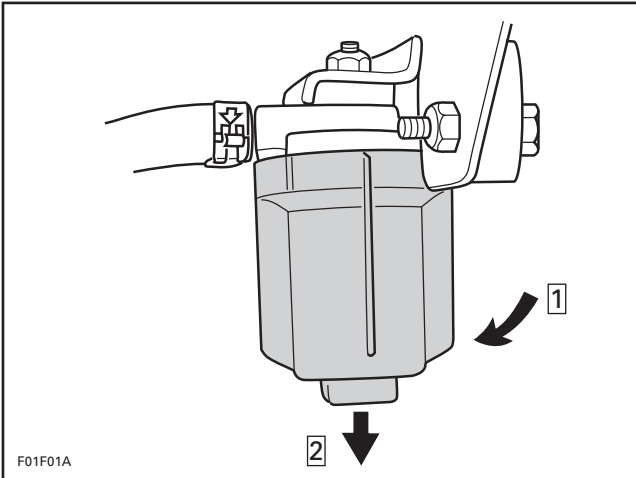
Turn the fuel valve to OFF position.

⚠ 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 to remove any fuel pressure in system.

Unscrew the fuel filter bowl no. 2 counterclockwise then pull toward the bottom.

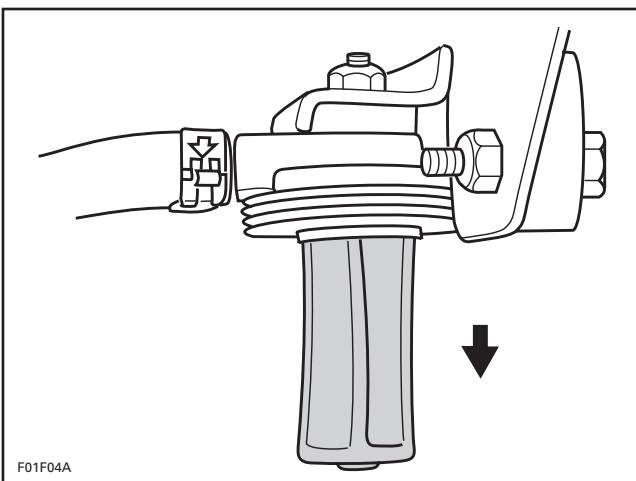


TYPICAL

Step 1: Loosen counterclockwise

Step 2: Pull

Pull fuel filter no. 1 toward the bottom.



TYPICAL

GTX RFI Models

The fuel pump assembly has to be removed from the fuel tank to have access to the fuel filter. Refer to ENGINE MANAGEMENT (RFI).

DI Models

A replaceable inline filter is located near the fuel tank. Another filter is located at the electric fuel pump inlet. The pump has to be removed from the fuel tank to have access to its filter. Refer to ENGINE MANAGEMENT (DI) section.

⚠ WARNING

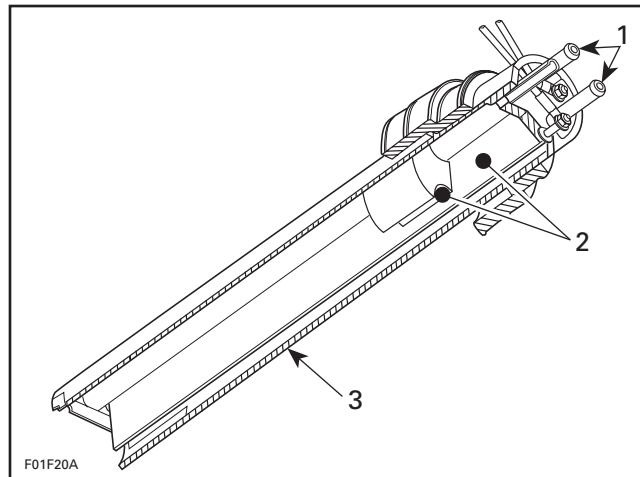
The inline filter needs to be replaced only with 4 Oetiker clamps (2 on each side).

CAUTION: A pressure test needs to be complete after replacement.

Fuel Baffle Pick Up

All Models except GTX RFI and DI

NOTE: The baffle pick up has an integrated fuel sender for the fuel gauge.



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

Disconnect BLACK negative cable, then RED positive cable of battery.

⚠ WARNING

Always disconnect battery cables exactly in the specified order, BLACK negative cable first.

GS, RX, GTS AND GTI Models

Open storage compartment cover.
Remove storage basket from watercraft (if so equipped).
Remove rear panel of storage compartment (if so equipped).
Siphon fuel tank.
Remove steering assembly. Refer to STEERING SYSTEM for procedure.

GTX Models

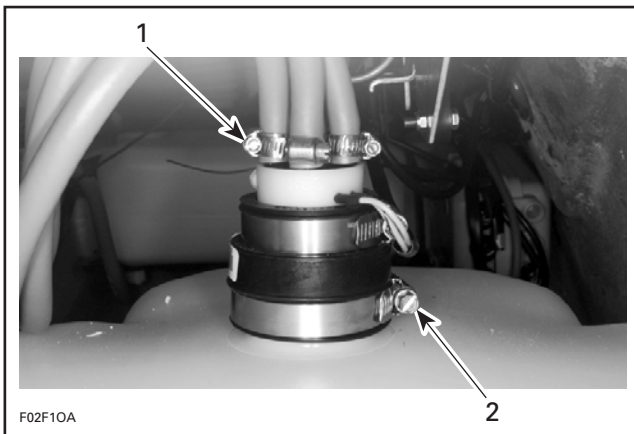
Syphon fuel tank.
Remove glove box.

XP Models

Tilt seat. Refer to HULL/BODY for procedure.
Remove access plug on body.
Syphon fuel tank.

All Models except RFI and DI

Disconnect fuel lines from baffle pick up and loosen lower clamp **no. 10**.



TYPICAL

1. Disconnect fuel hoses
2. Loosen lower clamp

Disconnect wiring harness of fuel sender.
Remove baffle from fuel tank.

All Models

Remove upper clamp **no. 12** from adapter **no. 11** and slide adapter from baffle.
Push inward on the 3 clips at the base of the baffle in order to remove the filter. Pry base off using a small slotted screwdriver (if necessary).

Electric Fuel Pump

RFI and DI Models

Refer to appropriate ENGINE MANAGEMENT section.

Fuel tank

All Models

NOTE: On all models (except GTX series), it is necessary to remove the engine. Refer to REMOVAL and INSTALLATION section.

Siphon fuel tank.
Remove fuel baffle pick up or electric fuel pump on RFI and DI models. Refer to the above section.
Detach all fuel tank straps.
Pull out fuel tank.

INSPECTION

Fuel Filter

All Models except GTX RFI and DI

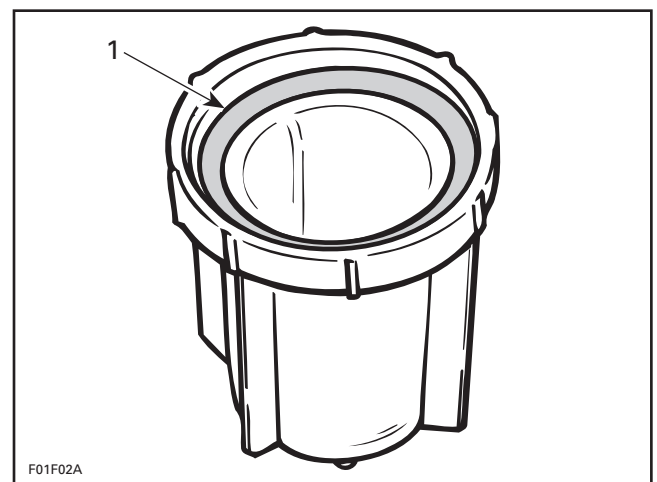
Inspect fuel filter condition. Carefully use low pressure compressed air to clean fuel filter. Replace filter if permanently clogged or damaged.

Fuel Filter Bowl

Check filter bowl for water contamination.

Gasket

Inspect gasket condition. Make sure gasket **no. 3** is well positioned into the filter bowl **no. 2**.



1. Gasket in bowl

Section 08 FUEL SYSTEM

Subsection 02 (FUEL CIRCUIT)

WARNING

Ensure that there is no leakage from the fuel filter.

RFI Models

The fuel pump assembly must be removed to have access to the fuel filter. Refer to ENGINE MANAGEMENT.

DI Models

Inspect inline filter condition. Carefully use low pressure compressed air to clean. Replace if permanently clogged or damaged.

NOTE: The fuel filter needs to be replaced after 250 hours.

The filter at fuel pump inlet is not replaceable individually. The complete fuel pump unit has to be replaced.

Fuel Filler Hose

All Models

Verify fuel filler hose **no. 5** for damage. Always ensure that clamps **no. 4** are well positioned and tightened. Torque clamps to 4 N•m (35 lbf•in).

Pressure Relief Valve

This valve will eliminate fuel spillage when the watercraft is upside down. If pressure is built up in fuel system the valve should open at 3.5 kPa (0.5 PSI) for **XP, DI and RFI models** and at 10 kPa (1.5 PSI) for **all other models** to release the pressure.

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

Black side of the one-way check valve **no. 7** is the valve outlet. It allows air to get in reservoir.

Baffle Pick Up Filter

All Models except GTX RFI and DI

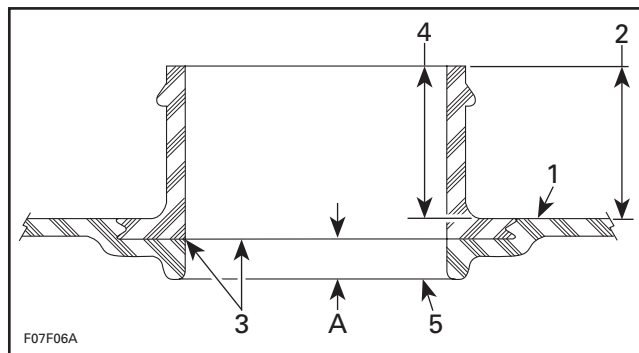
Inspect filter **no. 9** of baffle pick up. Clean or replace as necessary.

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. 14**.

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.

ASSEMBLY

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

Baffle Pick Up

All Models except GTX RFI and DI

Slide adapter **no. 11** onto baffle pick up **no. 8** until it stops on rib. Install clamp **no. 12**.

Install baffle pick up **no. 8** into fuel tank and push it until it sits on fuel tank neck. Install clamp **no. 10** and torque both clamps to 3 N•m (27 lbf•in).

FUEL SYSTEM PRESSURIZATION

⚠ WARNING

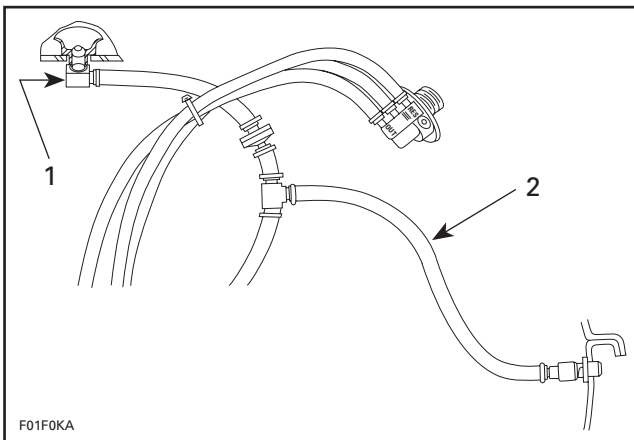
Whenever doing any type of repair on watercraft or if any components of the fuel system are disconnected, a pressure test must be done before starting engine. Ensure to verify fuel line ends for damage. Always cut damaged end before reinstallation.

Pressure Test (supply and vent circuits)

All Models

Proceed as follows:

- Fill up fuel tank.
- Disconnect air inlet hose of fuel tank from body.
- Install a hose pincher (P/N 295 000 076) on fuel tank vent hose.



TYPICAL

1. Disconnect air inlet hose
2. Install a hose pincher to vent hose

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

NOTE: This pump is included in the ENGINE LEAK TESTER KIT (P/N 295 500 352).

- Turn fuel valve to OFF position (except GTX RFI and DI).
- 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).

Reconnect air inlet hose of fuel tank to body.

⚠ 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.

NOTE: Before removing the hose pincher, block with your finger the outlet fitting to feel if air is coming out when removing hose pincher. This will indicate that pressure relief valve and the outlet fitting are not blocked.

Remove hose pincher from fuel tank vent hose.

High Pressure Test (fuel pump circuit)

RFI and DI Models

Refer to the appropriate ENGINE MANAGEMENT section.

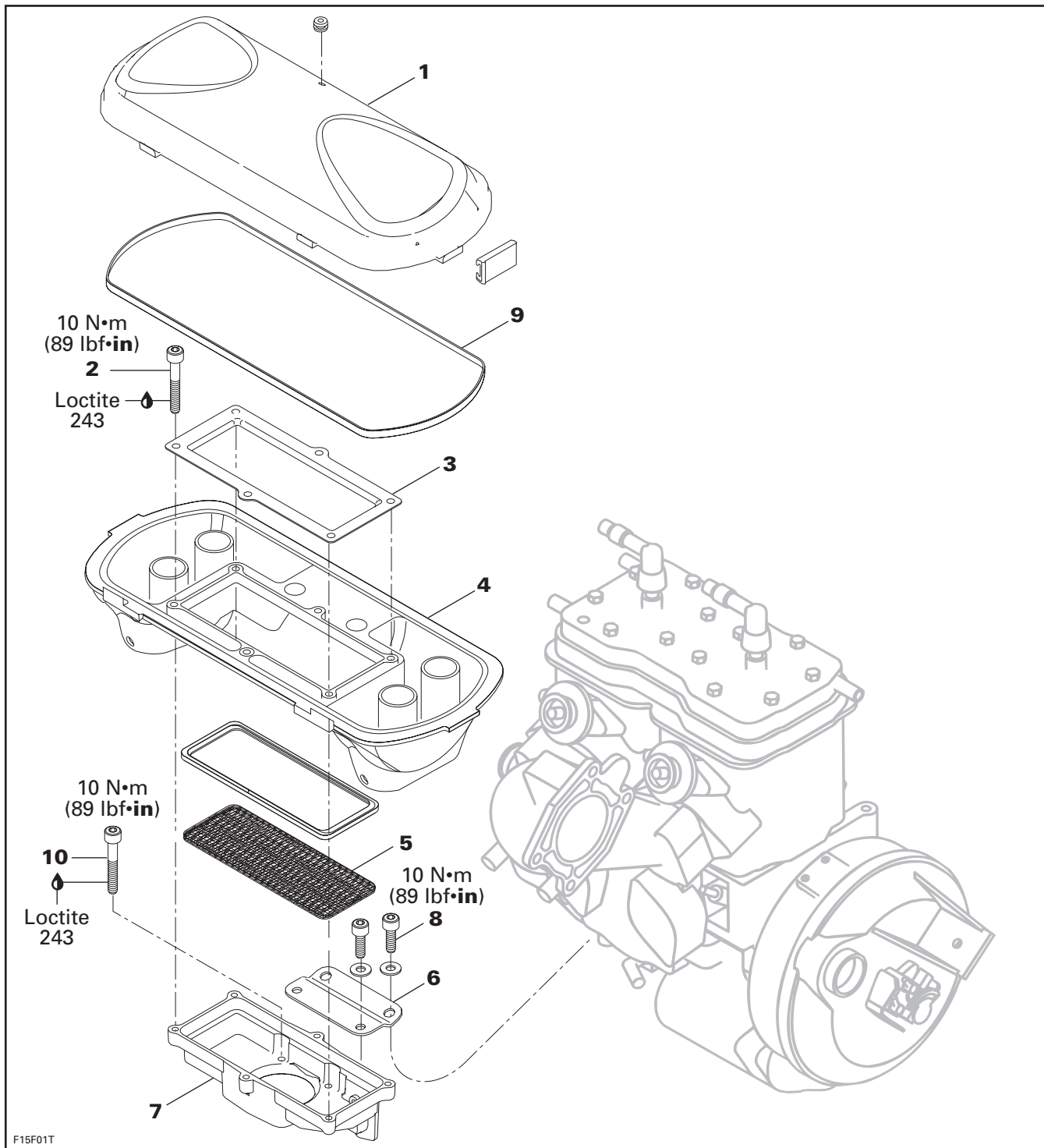
⚠ WARNING

Prior to installing the safety lanyard, refer to the appropriate ENGINE MANAGEMENT section for safety precautions to take.

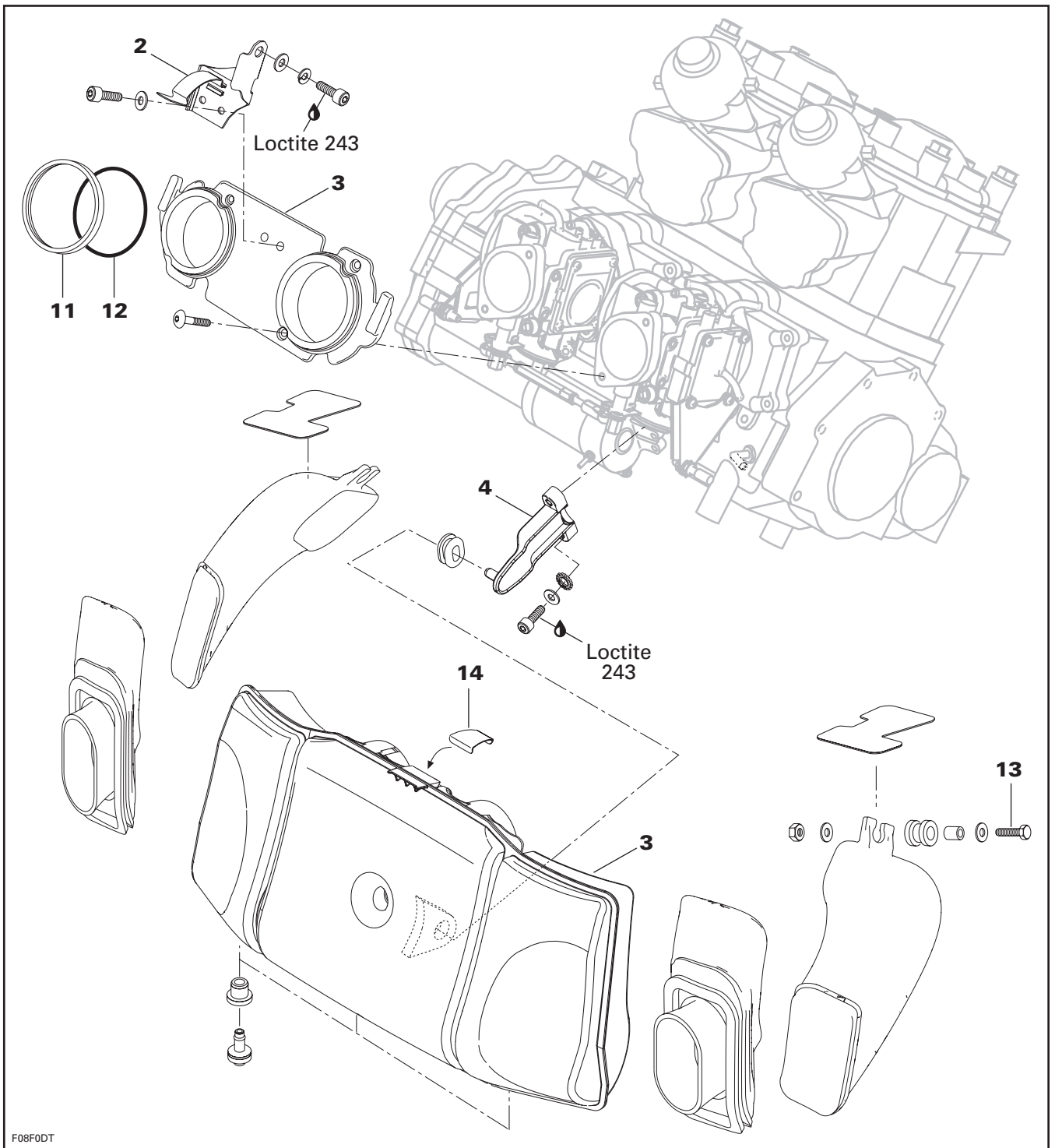
Section 08 FUEL SYSTEM

Subsection 03 (AIR INTAKE)

787 RFI Engine



947 Carburetor-Equipped Engines

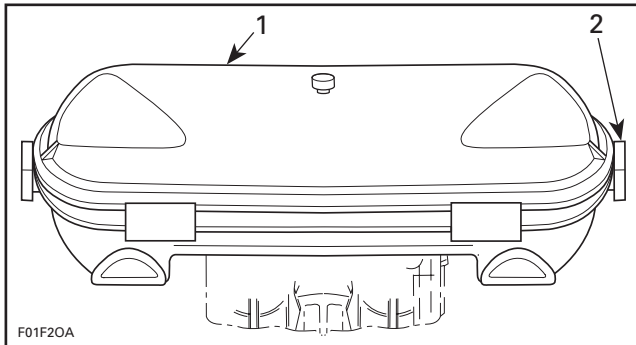


REMOVAL

717 and 787 RFI Engines

Air Intake Silencer Cover

Unlock the 6 retaining slides holding air intake silencer cover no. 1 and remove cover.



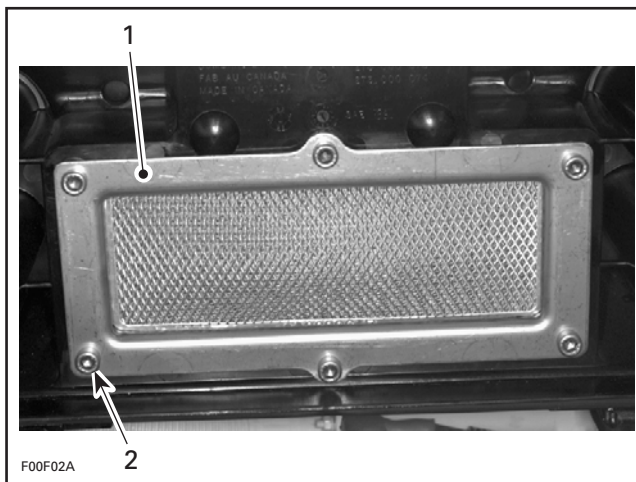
TYPICAL

1. Air intake silencer cover
2. Unlock

Air Intake Silencer Base

Remove screws no. 2 of retaining plate no. 3.

Pull out retaining plate no. 3 and air intake silencer base no. 4.

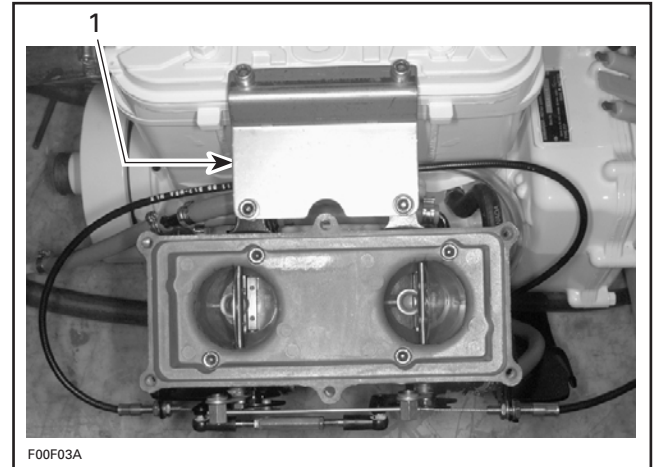


1. Retaining plate
2. Remove screws

Flame Arrester Base

Remove flame arrester no. 5.

Remove screws no. 8 retaining support no. 6 of flame arrester base to the cylinder head cover (717 engine) or to the exhaust manifold (787 engine).



TYPICAL

1. Remove support

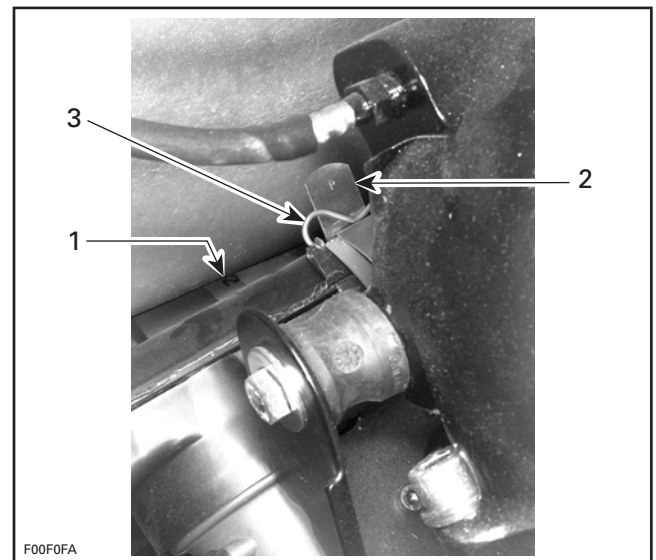
Remove screws no. 10 from flame arrester base then withdraw base.

NOTE: On GTS and GTI models, withdraw both arrester supports no. 15.

All 947 Engines

Air Intake Silencer

Pull hair pin out to allow removal of clip no. 2.

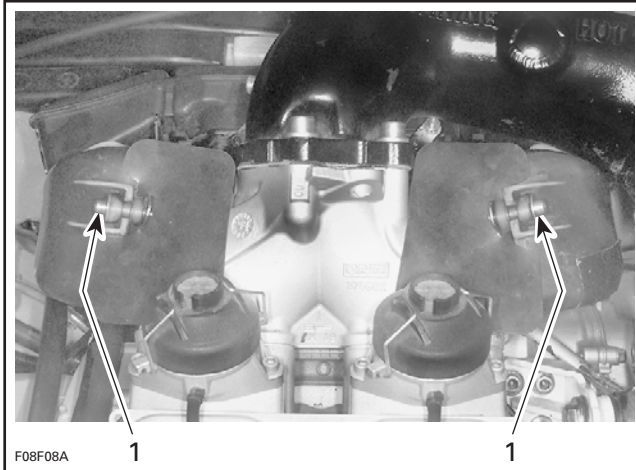


1. Air intake silencer
2. Clip
3. Hair pin

Section 08 FUEL SYSTEM

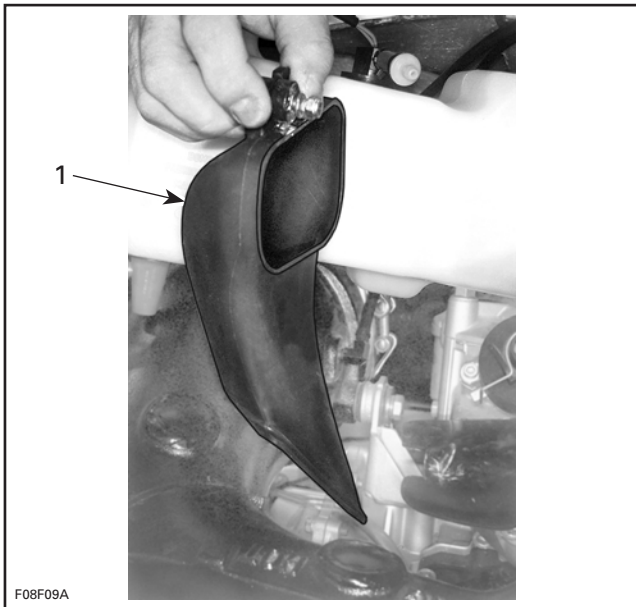
Subsection 03 (AIR INTAKE)

Unlock the clip **no. 2** on top of air intake silencer. Remove bolts retaining both air ducts to engine (both sides).



1. Remove bolts

Pull air ducts out.



1. Air duct

On **XP model**, detach retaining straps and pull oil reservoir out.

NOTE: Do not disconnect oil lines.

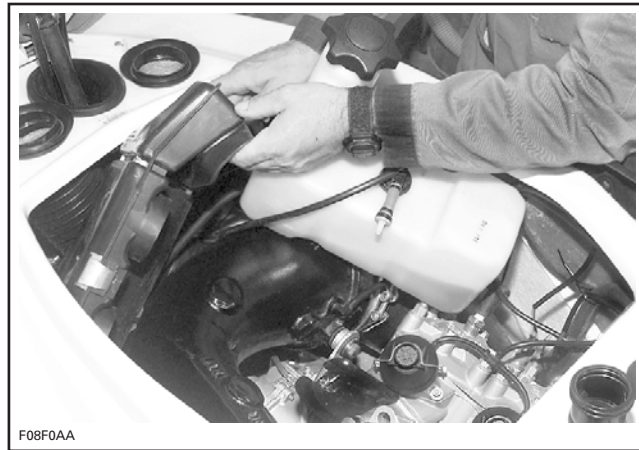
Push the air intake silencer out of the carburetor adapter **no. 3** and throttle body.

GTX and RX Models

Pull the air intake silencer rearward to remove it from the lower bracket **no. 4** and remove it in a rotating movement.

XP Model

Pull the air silencer forward to remove it from the lower bracket **no. 4** and remove it in a rotating movement.



XP MODEL

The air intake silencer is a molded piece and it can not be opened. It has an integrated flame arrester.

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.

717 Engines

Flame Arrester Base

Apply Loctite 518 on mating surfaces of flame arrester base **no. 7**.

Apply Loctite 243 (blue) on screws **no. 10** and torque to 10 N•m (88 lbf•in).

Flame Arrester

Inspect condition of flame arrester **no. 5**. Replace or clean as necessary.

WARNING

Do not operate watercraft without flame arrester.

Gasket

Inspect condition of gasket **no. 9**. Make sure to properly install gasket.

All 947 Engines**Air Intake Silencer**

Ensure that support plate edges **no. 14** are properly crimped to air intake silencer. Use pliers as necessary.

Make sure that gaskets **no. 11** are installed into carburetor holes of air intake silencer or throttle bodies **on DI engines**.

Check O-rings **no. 12** on carburetor intake adaptors or throttle bodies **on DI engines** and change them if necessary.

NOTE: Apply Super Lube grease (P/N 293 550 014) to mating surface of air intake silencer **no. 1**.

Install air intake silencer on carburetor intake adaptor or throttle bodies **on DI engines** and latch in place.

Clip air intake silencer back in place.

⚠ WARNING

While doing so, ensure that the clip snaps firmly, securing the air intake silencer in a tight fit; if not, bend the clip using pliers until you feel that the clip is tight enough.

Properly reinstall hair pin to secure clip **no. 2**.

947 DI Engines

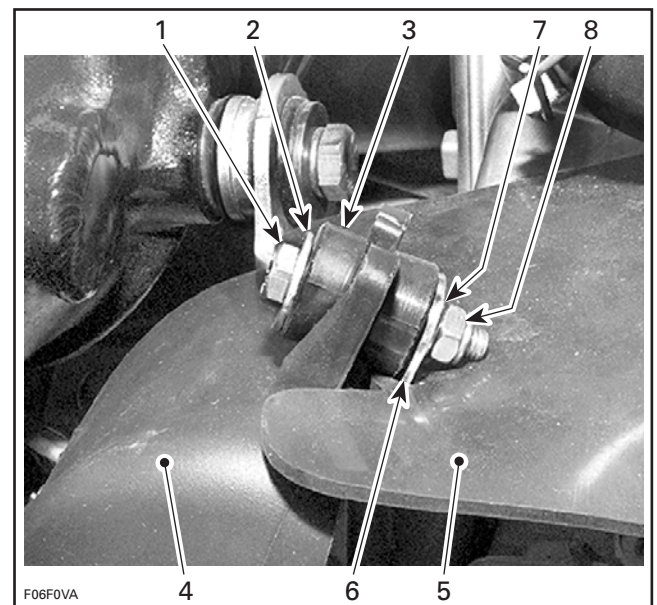
Ensure the elbow adaptor is well inserted and that it has not pushed the gasket inside the air box.

All 947 Engines

NOTE: Make sure the air intake silencer is retained by the lower bracket **no. 4**.

Place protector pads on duct supports. Use slot in rubber to insert pad on bracket eyelet. Side tongue of protector pad should be toward outside of vehicle and bent downward toward the exhaust flange.

Put air ducts in intake adapters and secure them on duct supports with hexagonal screws **no. 13**, wide washers, narrow washers and elastic stop nuts. A slight lift will be required to make the bolts line up with brackets.



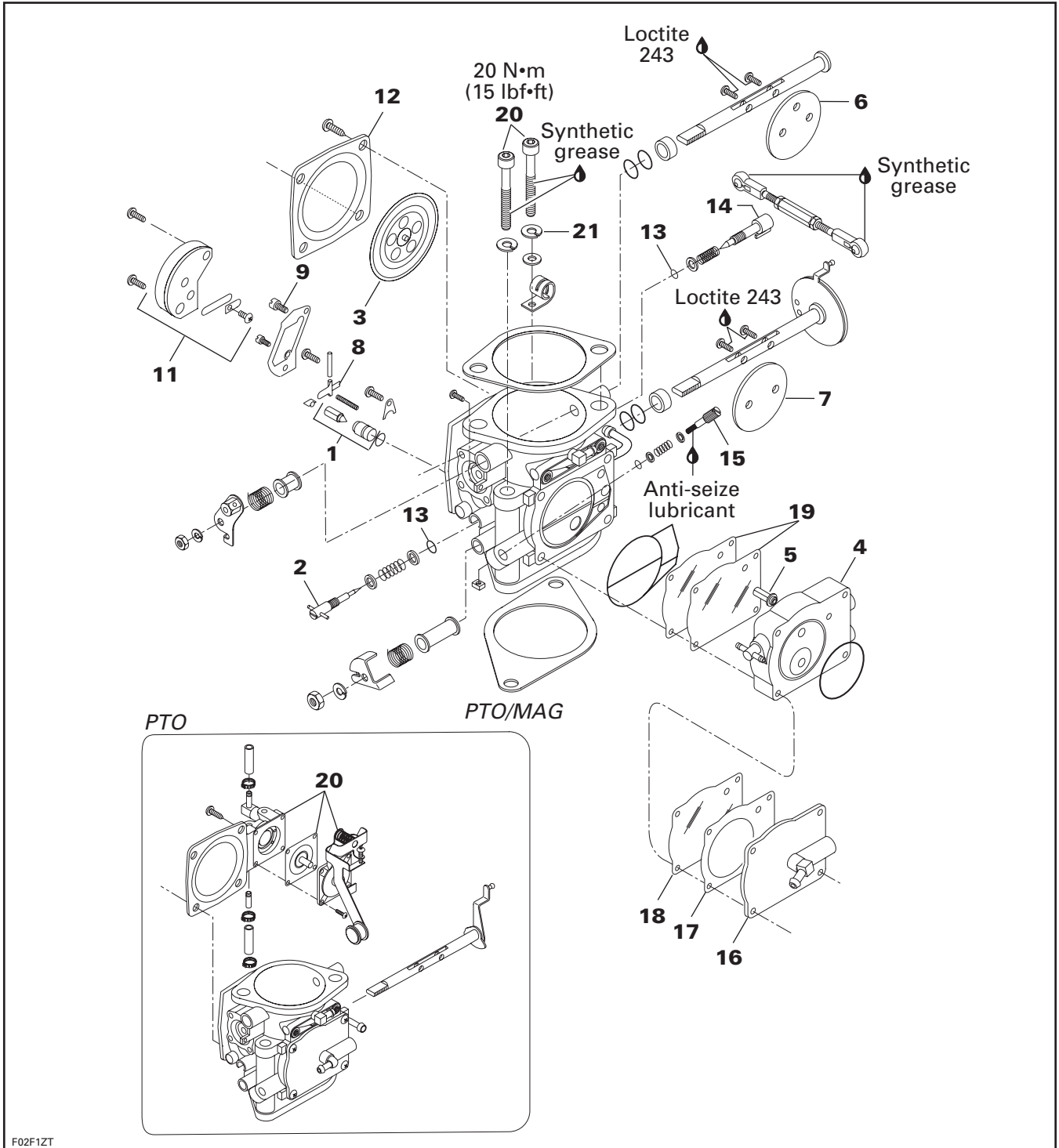
TYPICAL — 947 CARBURETOR-EQUIPPED ENGINES

1. Hexagonal screw M6
2. Wide flat washer
3. Insulator
4. Air duct
5. Protector pad
6. Duct support eyelet
7. Narrow flat washer
8. Hexagonal stop nut M6

CARBURETOR

For fuel system on RFI and DI models, refer to appropriate Engine management section.

Mikuni BN-40i and BN-46i



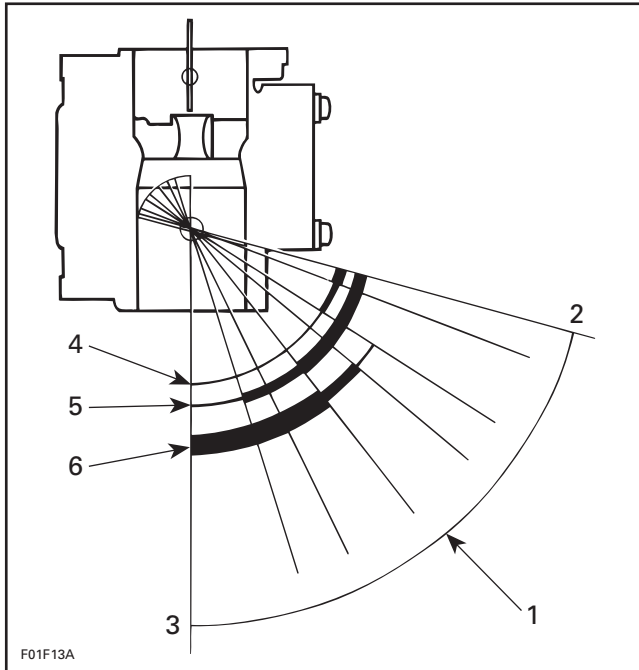
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Section 08 FUEL SYSTEM

Subsection 04 (CARBURETOR)

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(s) is (are) 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

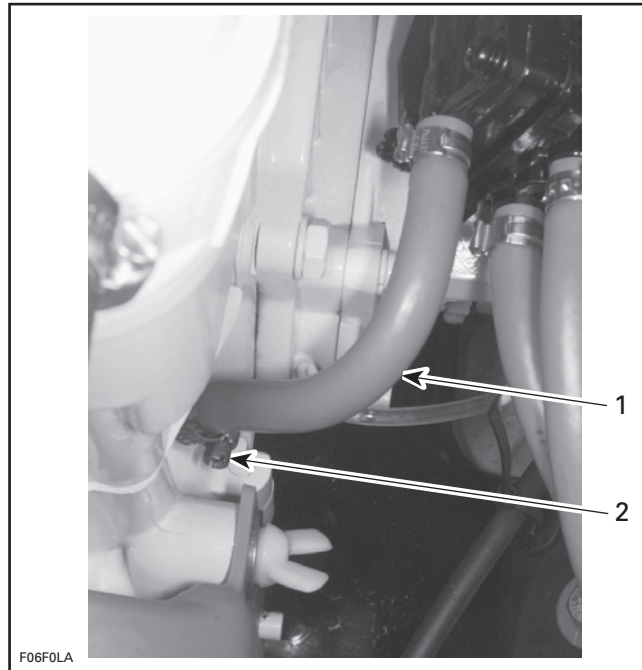
To remove carburetor(s) from engine, proceed as follows:

Remove air vent tube support (GTS and GTI models).

Remove air intake silencer. Refer to AIR INTAKE.

Turn fuel valve to OFF position.

Disconnect pulse line.



TYPICAL

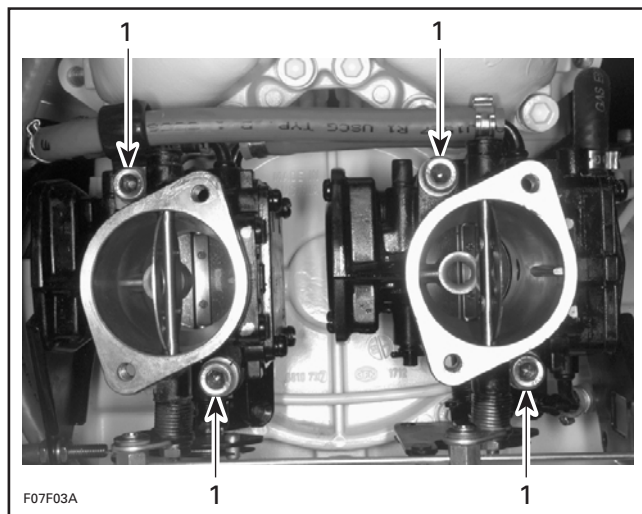
1. Pulse line
2. Loosen gear clamp

Disconnect fuel supply line from fuel pump.

Disconnect fuel return line.

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

Remove screws no. 20 and lock washers no. 21 retaining carburetor(s).



TYPICAL

1. Remove screws

Remove carburetor(s).

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.

Inspect O-rings, diaphragms and gaskets.

DISASSEMBLY AND INSPECTION

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

Needle Valve

Inspect needle valve tip for a grooved condition. If worn, needle and seat must be replaced as a matched set.

Low Speed Screw

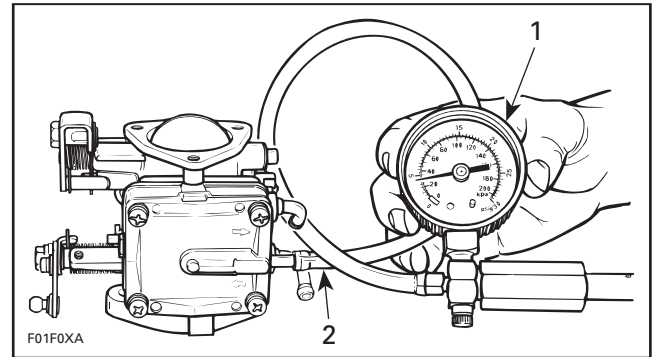
Check tip of low speed screw **no. 2** for a grooved condition. Replace if necessary.

Diaphragm

Pump Diaphragm Leak Test

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

- Install pump gauge tester (P/N 295 000 114) on pulse nipple.
- Pump tester until it reaches 28 kPa (4 PSI).



TYPICAL

1. Pump gauge tester
2. Install on pulse nipple

Diaphragm must stand pressure for 10 seconds. If pressure drops, replace diaphragm **no. 3**.

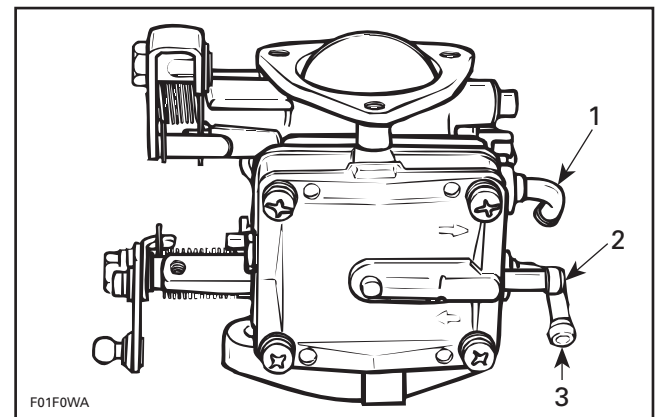
Fuel Pump Valve

Check fuel pump valve operation as follows:

Connect a clean plastic tubing to the inlet nipple of the fuel pump body **no. 4** 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 **no. 4**. 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.

Section 08 FUEL SYSTEM

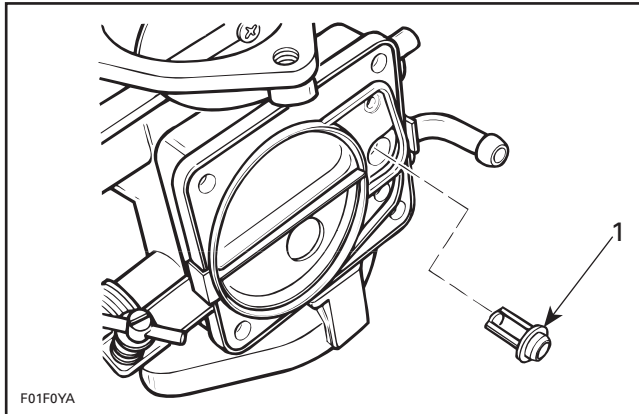
Subsection 04 (CARBURETOR)

Internal Fuel Filter

To verify condition of filter **no. 5**, proceed as follows:
Remove pump cover **no. 16**, gasket **no. 17**, diaphragm **no. 18** and then pump body **no. 4** and diaphragm **no. 19**.

Remove filter **no. 5** from carburetor body then clean filter and blow carefully with compressed air (low pressure).

Replace filter if damaged.



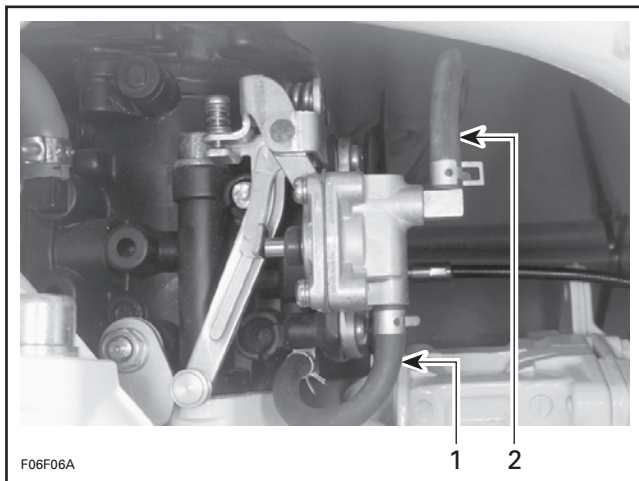
F01F0YA

TYPICAL

1. Filter

Fuel Accelerator Pump

Disconnect inlet and outlet hoses from accelerator pump nipples.



F06F06A

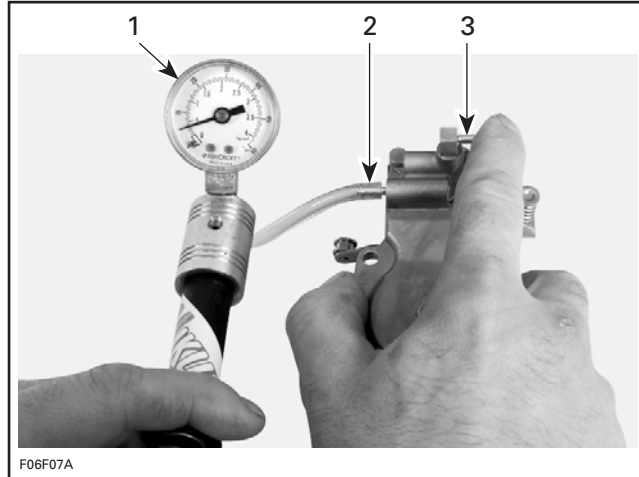
TYPICAL

1. Fuel inlet hose
2. Fuel outlet hose

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

- Install pump gauge tester (P/N 295 000 083) on inlet nipple of accelerator pump **no. 20**.

- Obstruct outlet nipple with a finger and hold while pumping.
- Pump tester until it reaches 28 kPa (4 PSI).



F06F07A

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

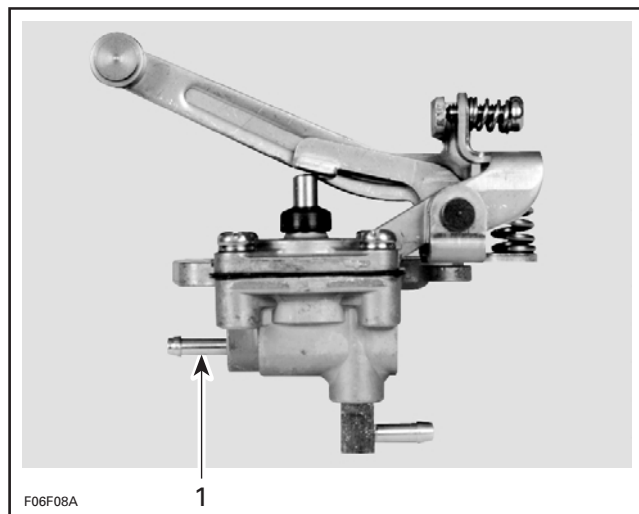
Diaphragm must stand pressure for 10 seconds. If pressure drops, replace accelerator pump diaphragm.

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.



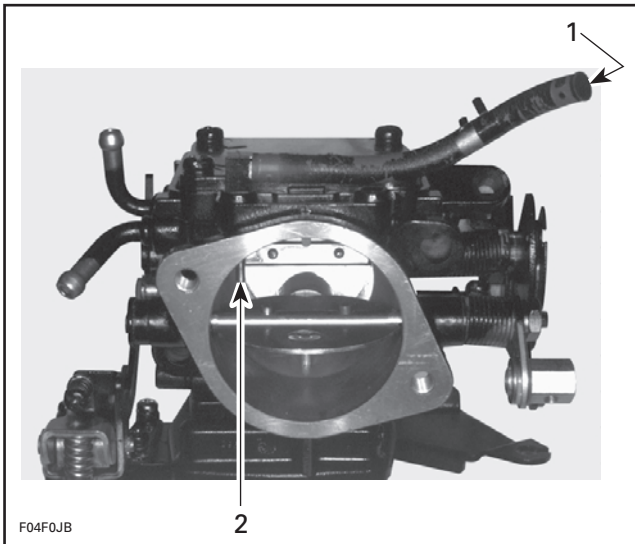
F06F08A

TYPICAL

1. Apply pressure and vacuum at inlet nipple

To check the injector, install pump gauge tester 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.

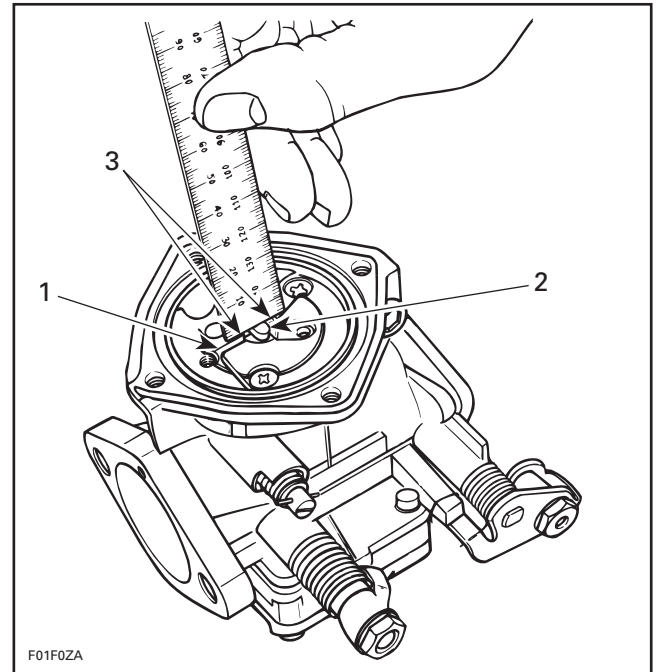
Choke Plate and Throttle Plate

When installing plate no. 6 onto shaft no. 7, close plate so that it centers into carburetor bore. Firmly tighten screws.

CAUTION: Always apply Loctite 243 (blue) on screw threads prior to installing screws.

Needle Valve Lever

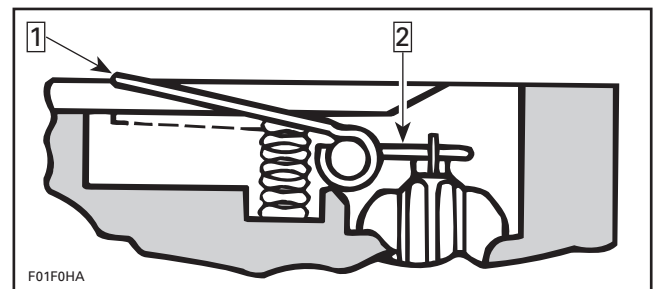
Rounded end of needle valve lever no. 8 must be flush with surrounding metering chamber floor and not with body assembly. Place the end of a ruler over lever to check adjustment.



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.

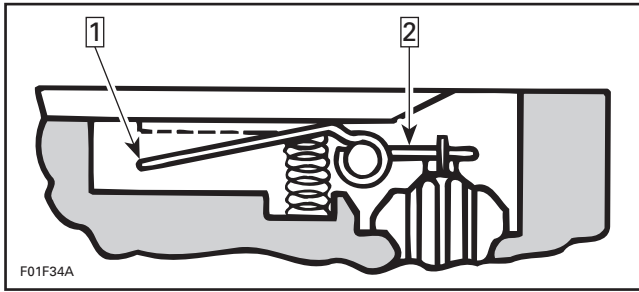


HIGH LEVER

- Step 1: Depress here
- Step 2: Push tab down

Section 08 FUEL SYSTEM

Subsection 04 (CARBURETOR)



LOW LEVER

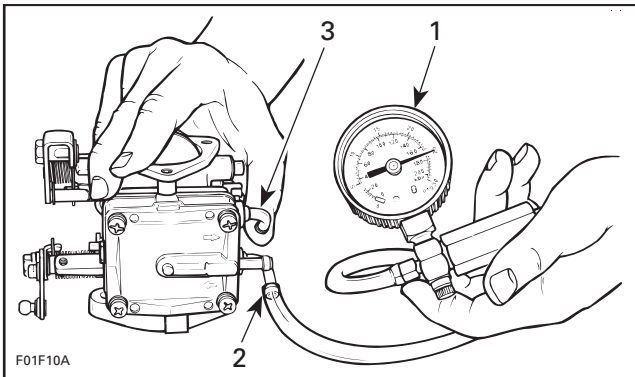
Step 1: Depress here

Step 2: Pry up here

POP-OFF Pressure Test

Proceed as follows:

- Install pump gauge tester 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. (PSI)
GS, GTS, GTI	36/40
XP, GTX	19/23

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 as necessary.

CAUTION: Do not stretch or cut spring.

LEAK TEST

Needle valve 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.

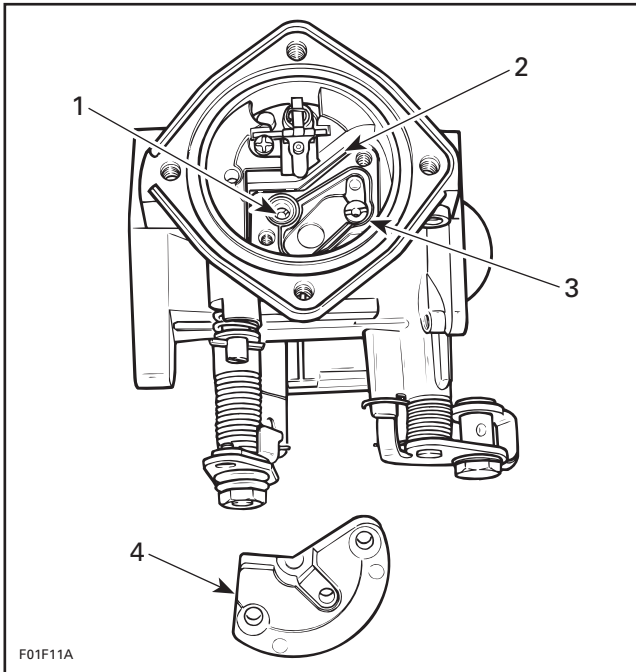
If bubbles come from needle, replace needle and seat.

Main Jet and Pilot Jet

Pilot jet no. 10 and main jet no. 9 are replaceable. Different jet sizes are available to suit temperature and altitude conditions. 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. 10 or main jet no. 9, check valve housing must be removed.



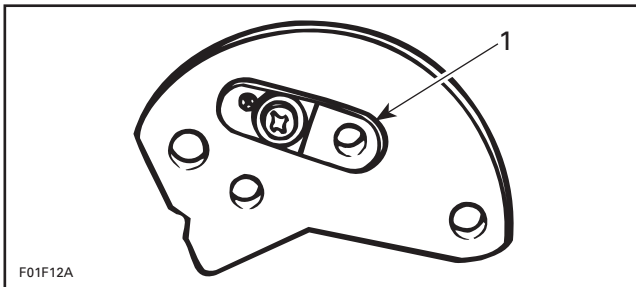
TYPICAL

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. 11. 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.

Diaphragm and Cover

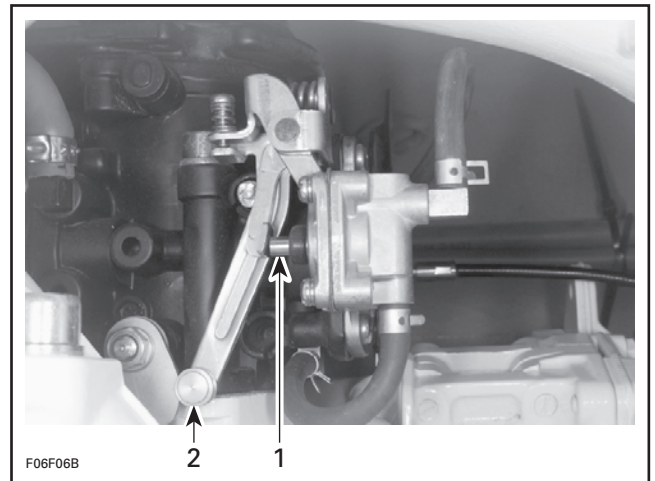
Install diaphragm no. 3 with its integrated O-ring into carburetor groove. Make sure that the tab of cover no. 12 is inserted into carburetor notch.

O-Ring

When installing O-rings no. 13 of low speed and high speed screws, apply some BOMBARDIER LUBE (P/N 293 600 016) to prevent sticking.

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

Carburetors

At installation, pay attention to the following:

Install carburetor(s) with gasket(s) to intake manifold (rotary valve cover for the 787 RFI engine).

Apply synthetic grease on screws no. 20. Then, install screws no. 20 with lock washers no. 21 and torque to 20 N•m (15 lbf•ft).

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.

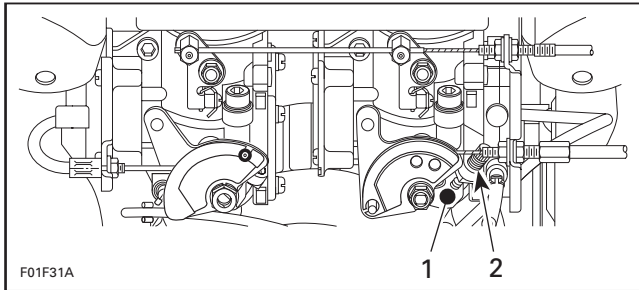
Section 08 FUEL SYSTEM

Subsection 04 (CARBURETOR)

ADJUSTMENTS

Twin Carburetor Synchronization

With idle speed screw not touching throttle lever stopper on MAG carburetor, both throttle plates are in closed position.

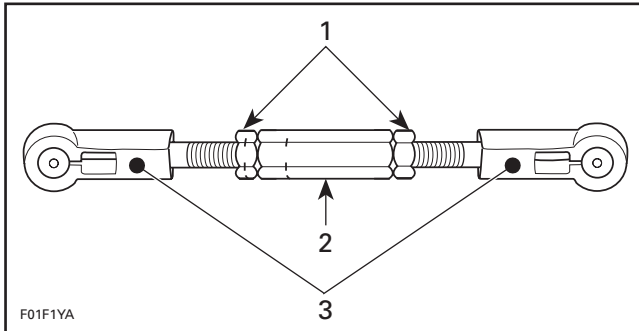


TYPICAL

1. Stopper
2. Idle speed screw

Loosen jam nuts on carburetor linkage and adjust linkage with adjustment nut.

Make sure threads length is the same on each side of linkage and flat surfaces of both ends are parallel with each other.



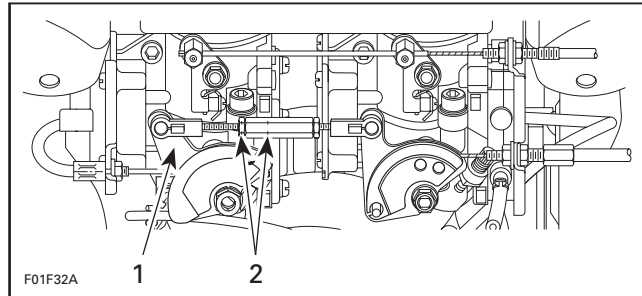
1. Jam nuts
2. Adjustment nut
3. Flat surfaces

Tighten jam nuts and torque to 3 N•m (27 lbf•in).

NOTE: Grease carburetor linkage at both ends with synthetic grease (P/N 293 550 010).

Connect linkage between both carburetor levers. Ensure both throttle plates are still in closed position.

NOTE: The linkage installation is done with the marks located near PTO carburetor throttle lever to ease adjustment if to be performed in the watercraft.



TYPICAL

1. Throttle lever PTO side
2. Marks

CAUTION: Throttle plates must open simultaneously, otherwise this will cause engine to vibrate and/or misfire.

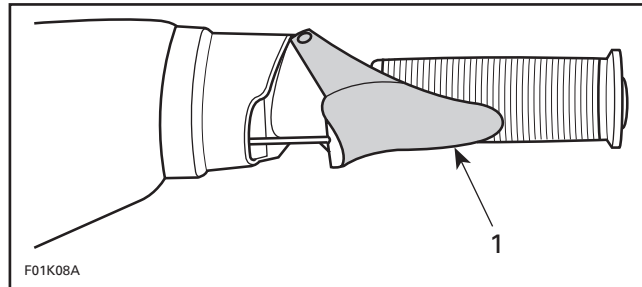
Throttle Cable Adjustment

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

717 Engine

Lubricate cable with BOMBARDIER LUBE lubricant.

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



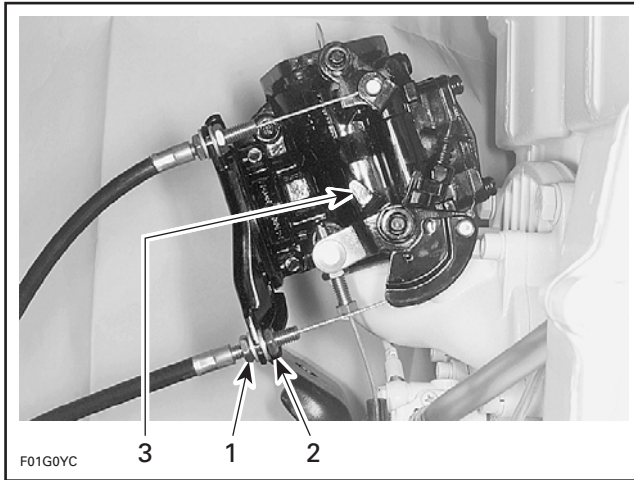
1. Must touch handlebar grip

Ensure carburetor throttle plate(s) is (are) 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(s), 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.



717 ENGINE

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

Tighten jam nut and recheck adjustment.

⚠ WARNING

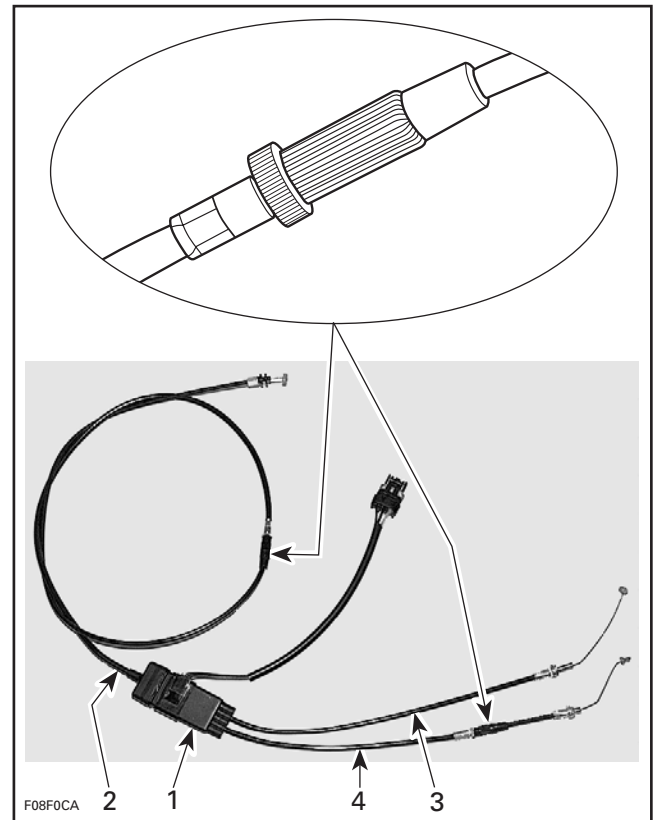
Make sure idle speed screw contacts stopper when throttle lever is fully released at handlebar.

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.

947 Engine

Throttle cable is equipped with a sensor which will send a signal to the MPEM at 80% throttle opening in order to control the spark advance.

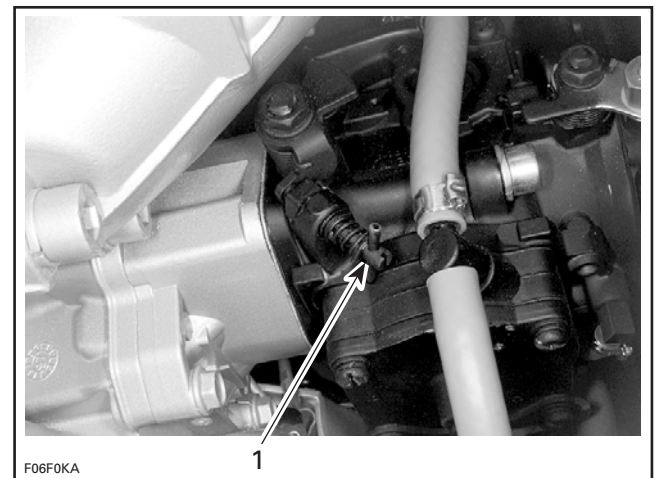


THROTTLE CABLE ASSEMBLY

1. Sensor
2. Throttle lever section
3. Carburetor section
4. Oil pump section

NOTE: Always perform the throttle cable adjustment in the specified order, as described in following procedure.

Unscrew idle adjustment screw to obtain a small gap between stopper and screw.



1. Idle speed screw

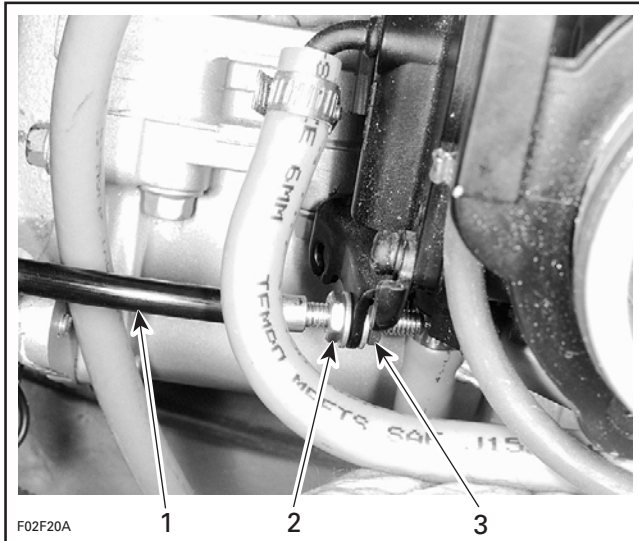
Section 08 FUEL SYSTEM

Subsection 04 (CARBURETOR)

Ensure throttle plates are completely closed on both carburetors.

Loosen jam nut and turn adjustment nut to eliminate all the slack in the throttle cable between sensor and carburetor.

Tighten jam nut.



947 ENGINE

1. Throttle cable
2. Adjustment nut
3. Jam nut

Turn idle adjustment screw clockwise until it comes in contact with stopper. Refer to IDLE SPEED SCREW ADJUSTMENT section for the proper adjustment.

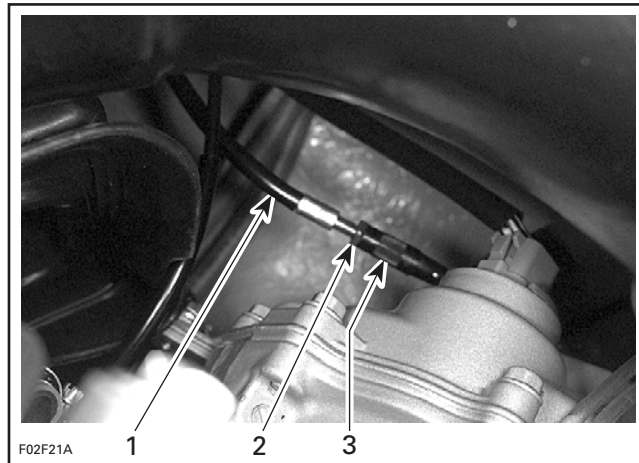
Adjust oil pump cable. Refer to OIL INJECTION PUMP.

NOTE: It is important to adjust oil pump cable prior to finalize adjustment of throttle cable.

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

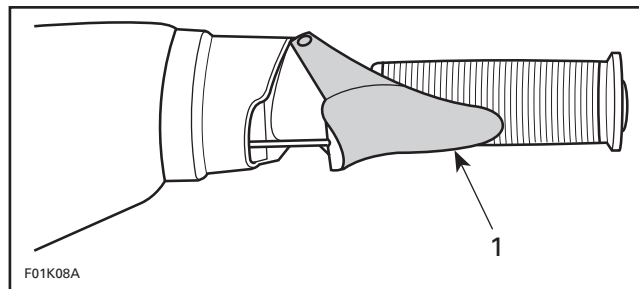
Adjust throttle cable to obtain proper lever position at full throttle.

Turn adjuster knob as required to obtain proper throttle lever adjustment.



1. Jam nut
2. adjustment nut
3. Throttle cable

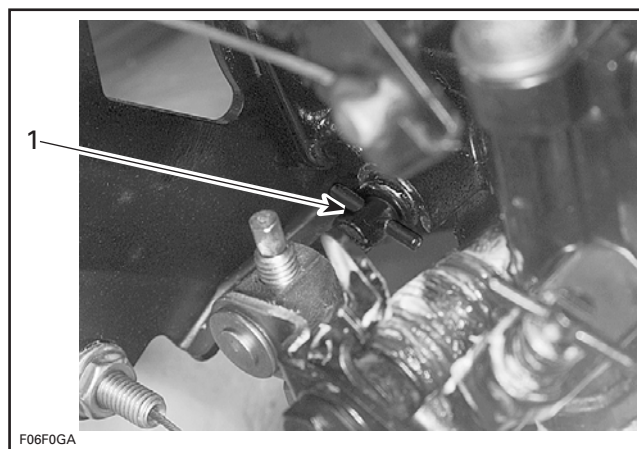
Throttle lever must reach handlebar grip without causing strain to cable or carburetor cable bracket.



1. Lever must touch handlebar grip

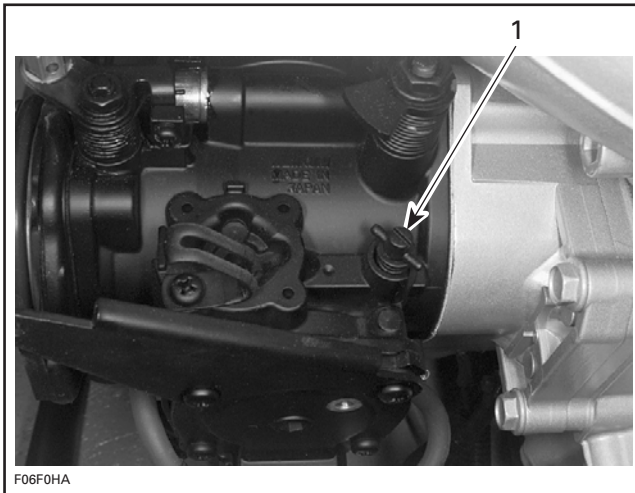
CAUTION: Improper cable adjustment will cause strain on cable and/or damage cable bracket or throttle lever at handlebar.

Low Speed Screw Adjustment



717 ENGINE

1. Low speed screw



947 ENGINE

1. Low speed screw (PTO side shown)

CAUTION: Do not attempt to set engine idle speed with low-speed screw.

Tighten low speed screw until a slight resistance is felt. Then, back it off to the specification as per following chart.

ENGINE TYPE	LOW SPEED SCREW
717	1.0 ± 0.25 turns
947	1.5 ± 0.25 turns

NOTE: Turning screw clockwise leans mixture and turning screw counterclockwise enriches mixture.

Start and warm up engine.

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

Check that engine idles and runs smoothly. Make sure engine reacts quickly to throttle lever depression. If necessary, readjust low speed screw (± 1/4 turn).

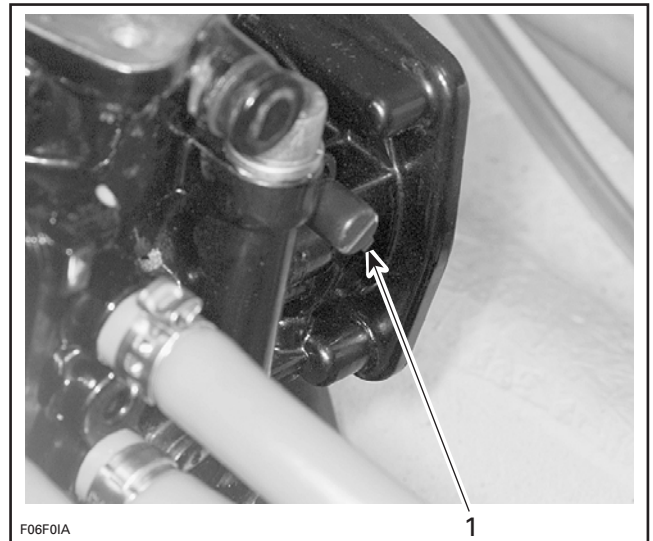
NOTE: On twin carburetor engines, both low speed screws must be adjusted exactly the same way. Never adjust screws more than 1/4 turn at a time.

High Speed Screw

The high speed screw no. 14 is sealed with a plastic cap that allows an adjustment of 1/4 turn.

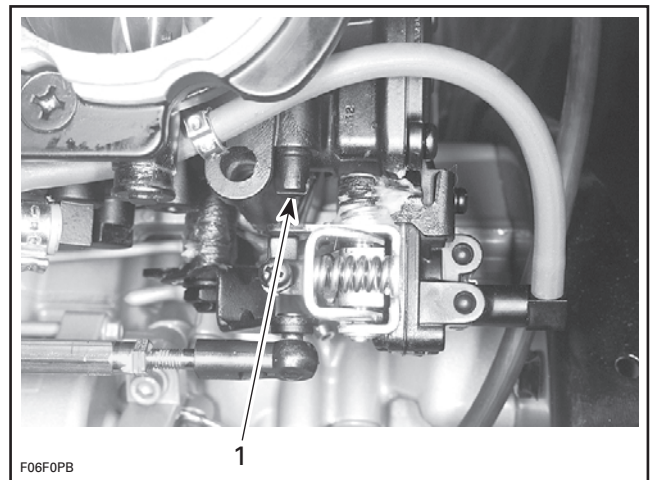
NOTE: Turning screw 1/4 turn counterclockwise enriches mixture and turning screw clockwise leans mixture.

CAUTION: Do not attempt to adjust high speed screw by removing plastic cap.



717 ENGINE

1. High speed screw



947 ENGINE

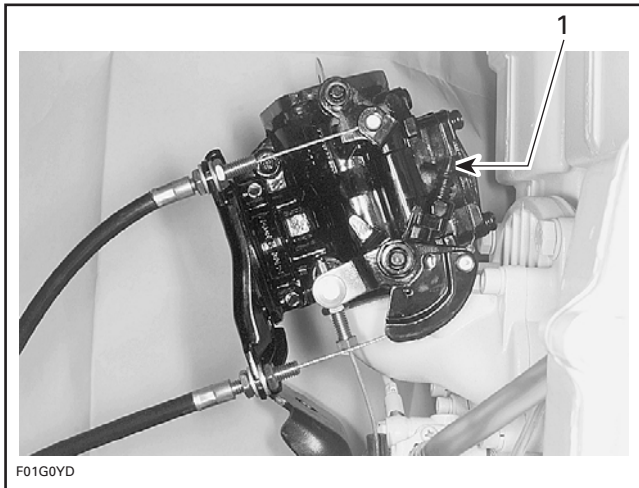
1. High speed screw (PTO side shown)

Section 08 FUEL SYSTEM

Subsection 04 (CARBURETOR)

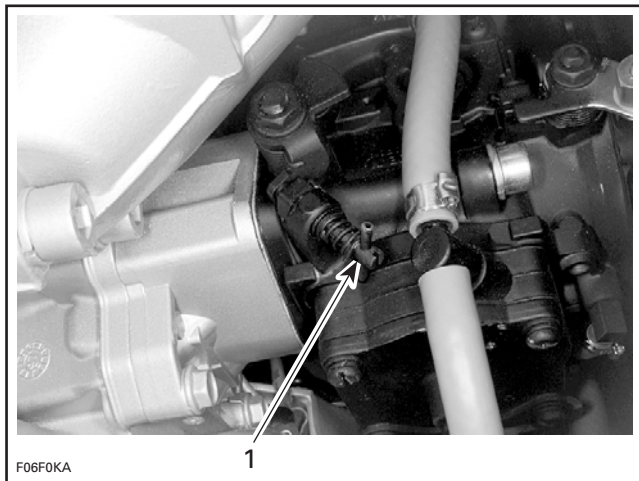
Idle Speed Screw

Turning screw no. 15 clockwise increases engine idle speed and turning screw counterclockwise decreases engine idle speed.



717 ENGINE

1. Idle speed screw



947 ENGINE

1. Idle speed screw

NOTE: On twin carburetor engines, there is only one idle speed screw.

Connect an induction-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.

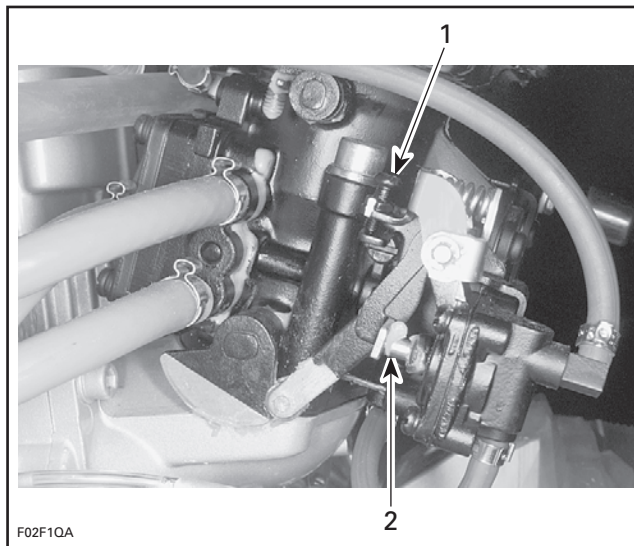
Turn screw so that engine idles at 1500 RPM in water or 3000 RPM out of water.

Fuel Accelerator Pump

All Engines

Ensure throttle cable is properly adjusted and idle speed is set at 1500 RPM for the **717 engines** and 1400 RPM for the **947 engines** in water.

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.



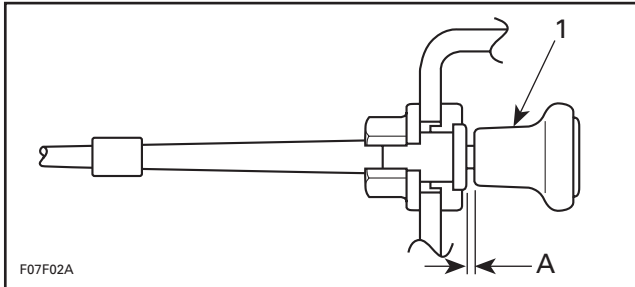
TYPICAL

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.

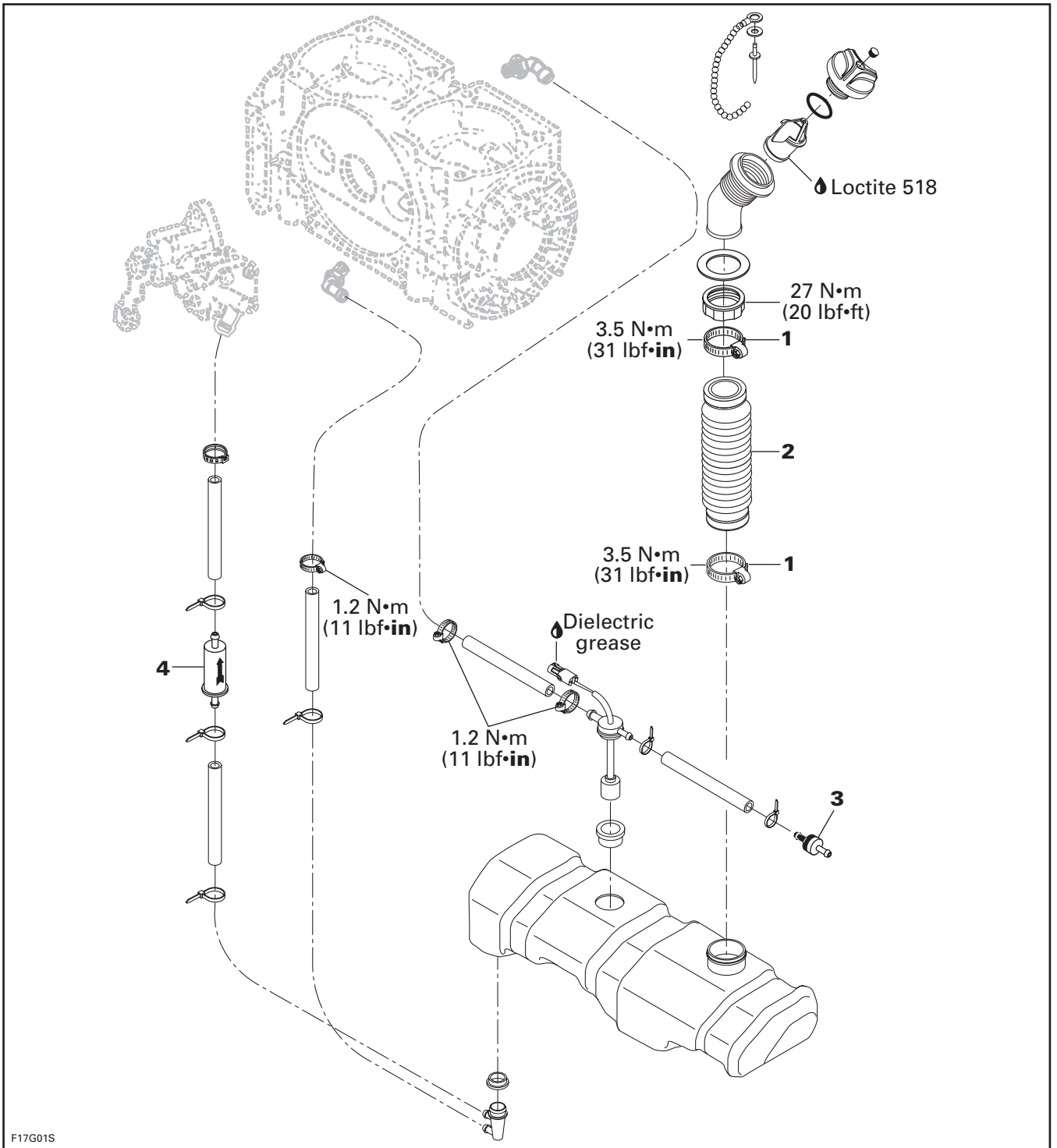
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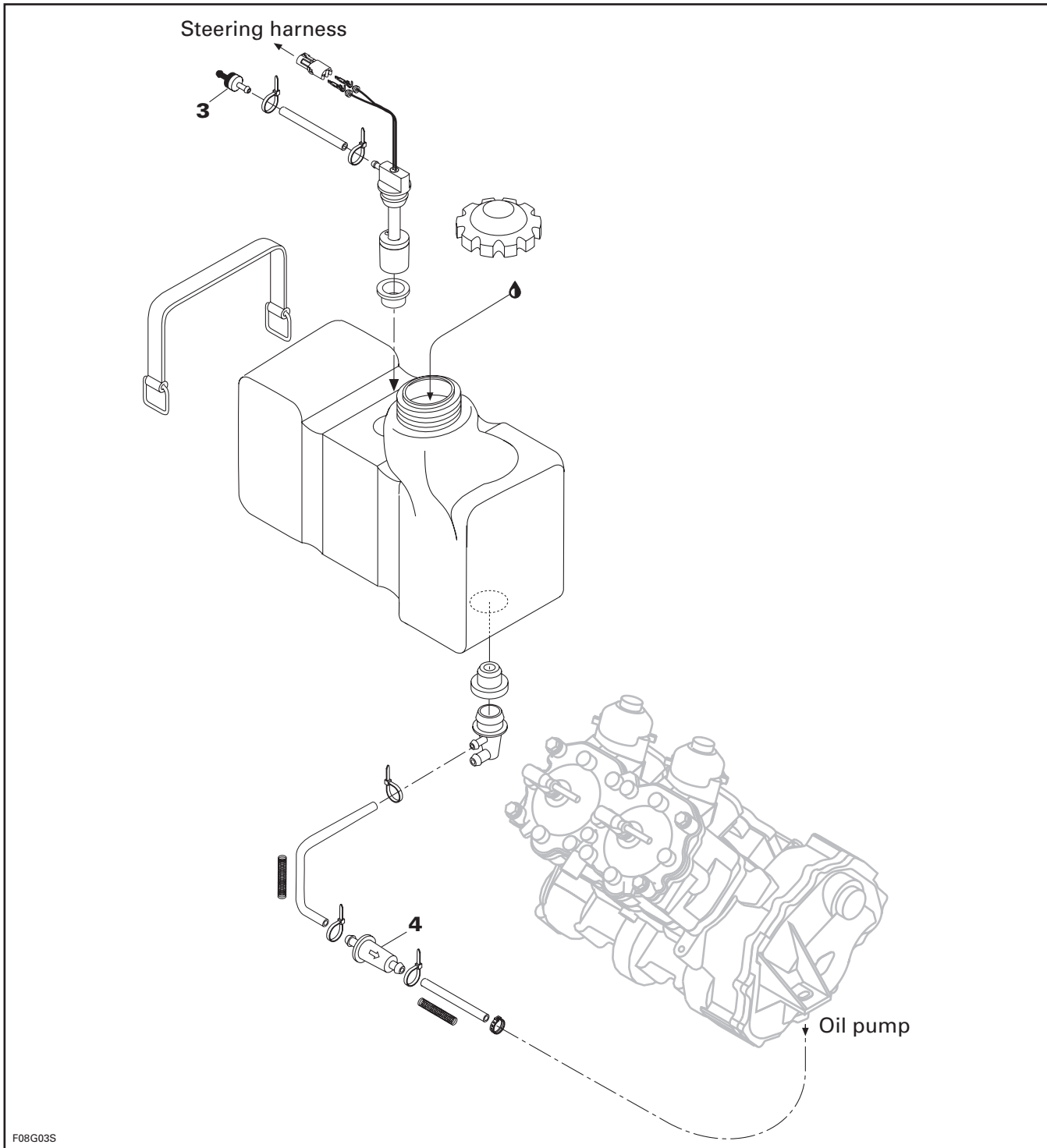
OIL INJECTION SYSTEM

GS, GTS and GTI Models



Section 09 LUBRICATION SYSTEM
Subsection 02 (OIL INJECTION SYSTEM)

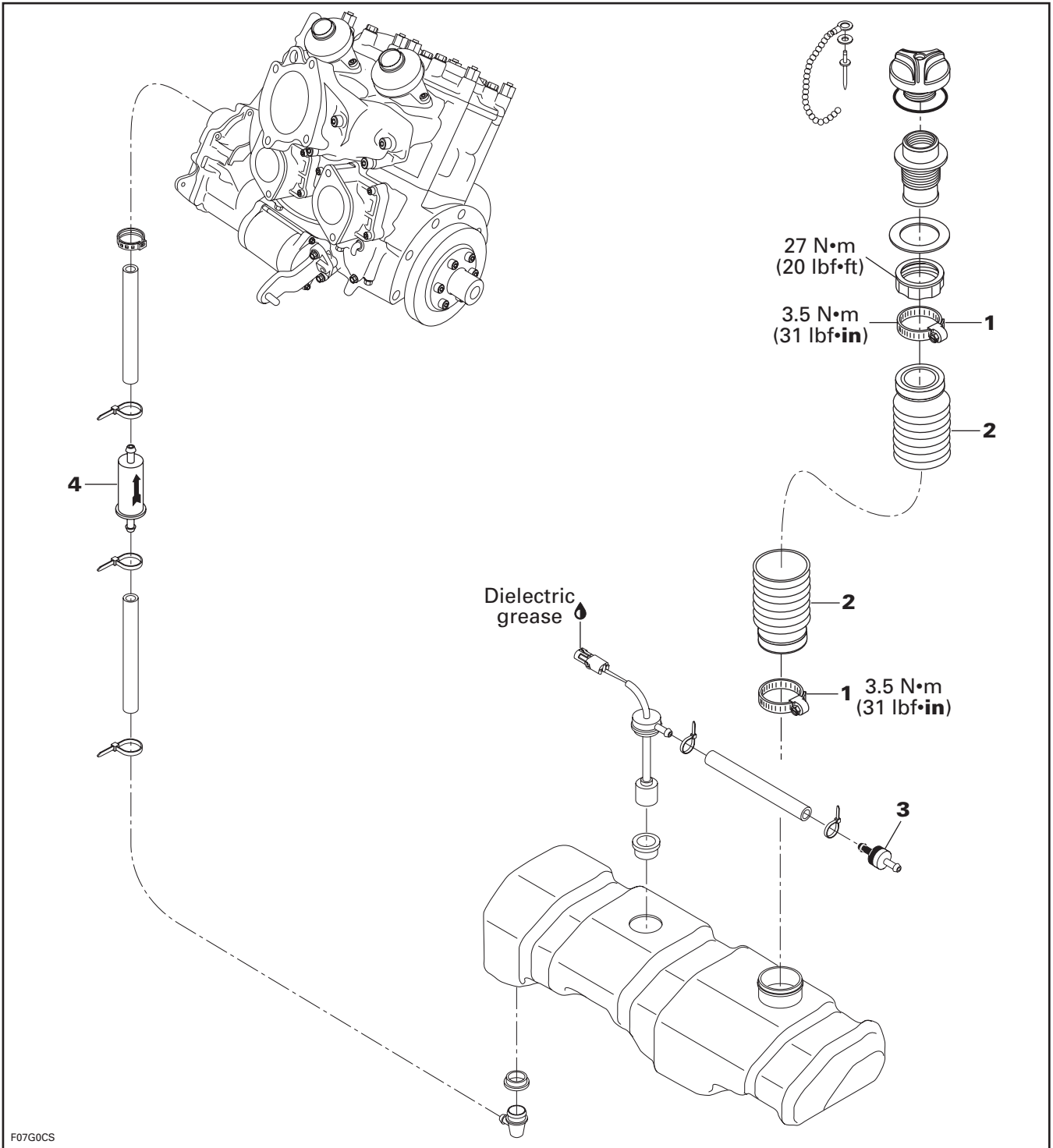
XP Models



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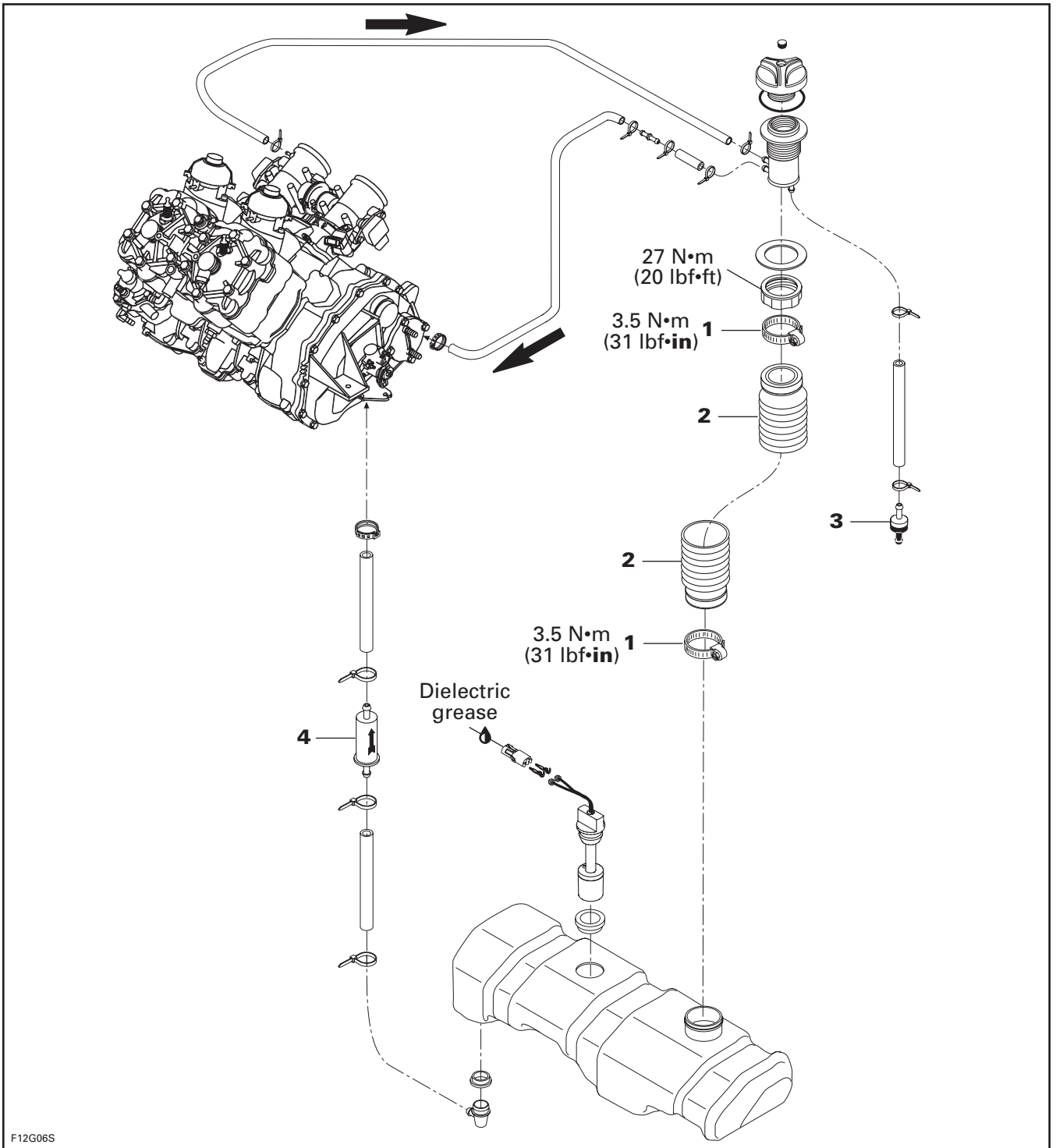
Section 09 LUBRICATION SYSTEM
Subsection 02 (OIL INJECTION SYSTEM)

GTX Models



Section 09 LUBRICATION SYSTEM
Subsection 02 (OIL INJECTION SYSTEM)

DI Models



Section 09 LUBRICATION SYSTEM

Subsection 02 (OIL INJECTION SYSTEM)

GENERAL

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

Perform also a pressure test of the oil injection system.

All Models except the XP

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 3.5 N•m (31 lbf•in).

All Models

Check Valve

Black side of the one-way check valve no. 3 is the valve outlet. It allows air to get in reservoir.

Oil Filter

Oil filter no. 4 should be replaced annually.

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 hose pincher to rotary valve shaft oil supply hose (except 947 engines).
- Install a hose pincher to rotary valve shaft oil return hose (except 947 engines).
- Install a hose pincher to oil injection pump supply hose.

DI Models

Install a hose pincher to return line of air compressor.

Disconnect oil tank vent line on PTO side throttle body.

Carburetor-Equipped Models

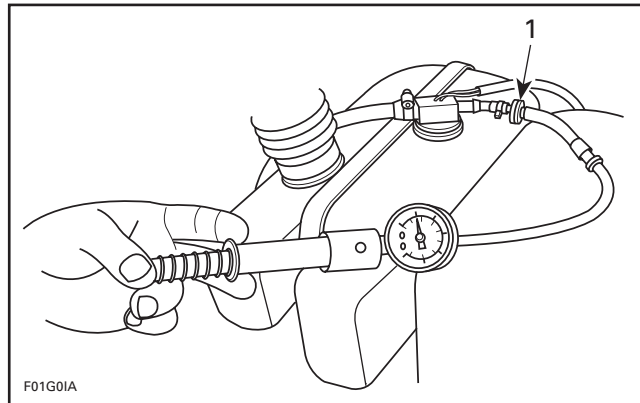
- Connect pump gauge tester (P/N 529 021 800) to check valve of oil injection reservoir vent.

DI Models

Connect pump gauge tester (P/N 529 021 800) to disconnected tube at throttle body.

All Models

NOTE: Use the same pump included in the ENGINE LEAK TESTER KIT (P/N 295 500 352).



TYPICAL

1. Connect pump to check valve

- Pressurize oil system to 21 kPa (3 PSI).

All Models

- 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.

DI Models

Verify check valve inside filler neck if pressure does not hold. Also ensure air can enter through check valve in the opposite direction.

All Models

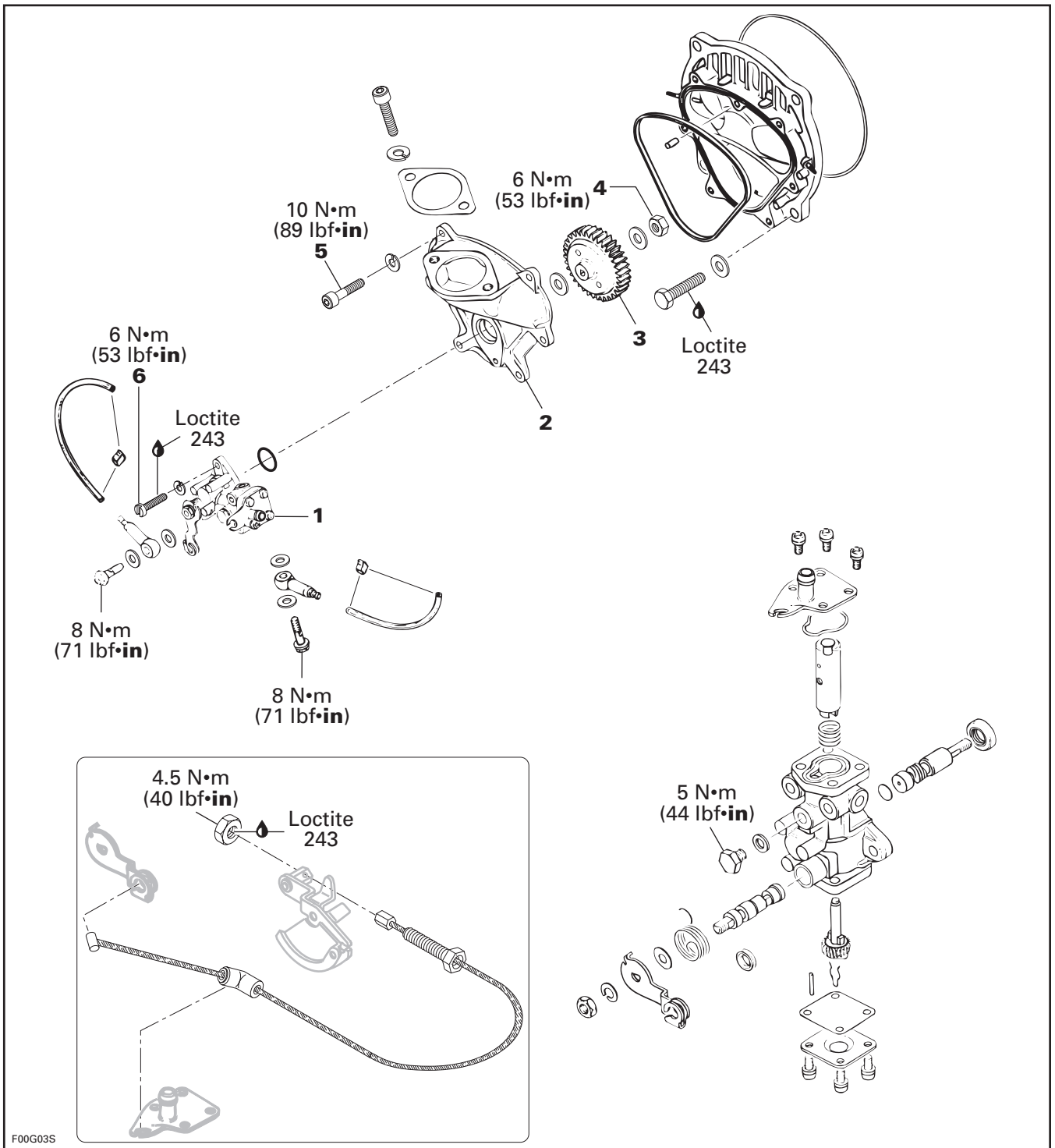
NOTE: The system must maintain a pressure of 21 kPa (3 PSI) for at least 10 minutes. Never pressurize over 21 kPa (3 PSI).

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. On DI models, reconnect line at throttle body.

OIL INJECTION PUMP

717 Engine

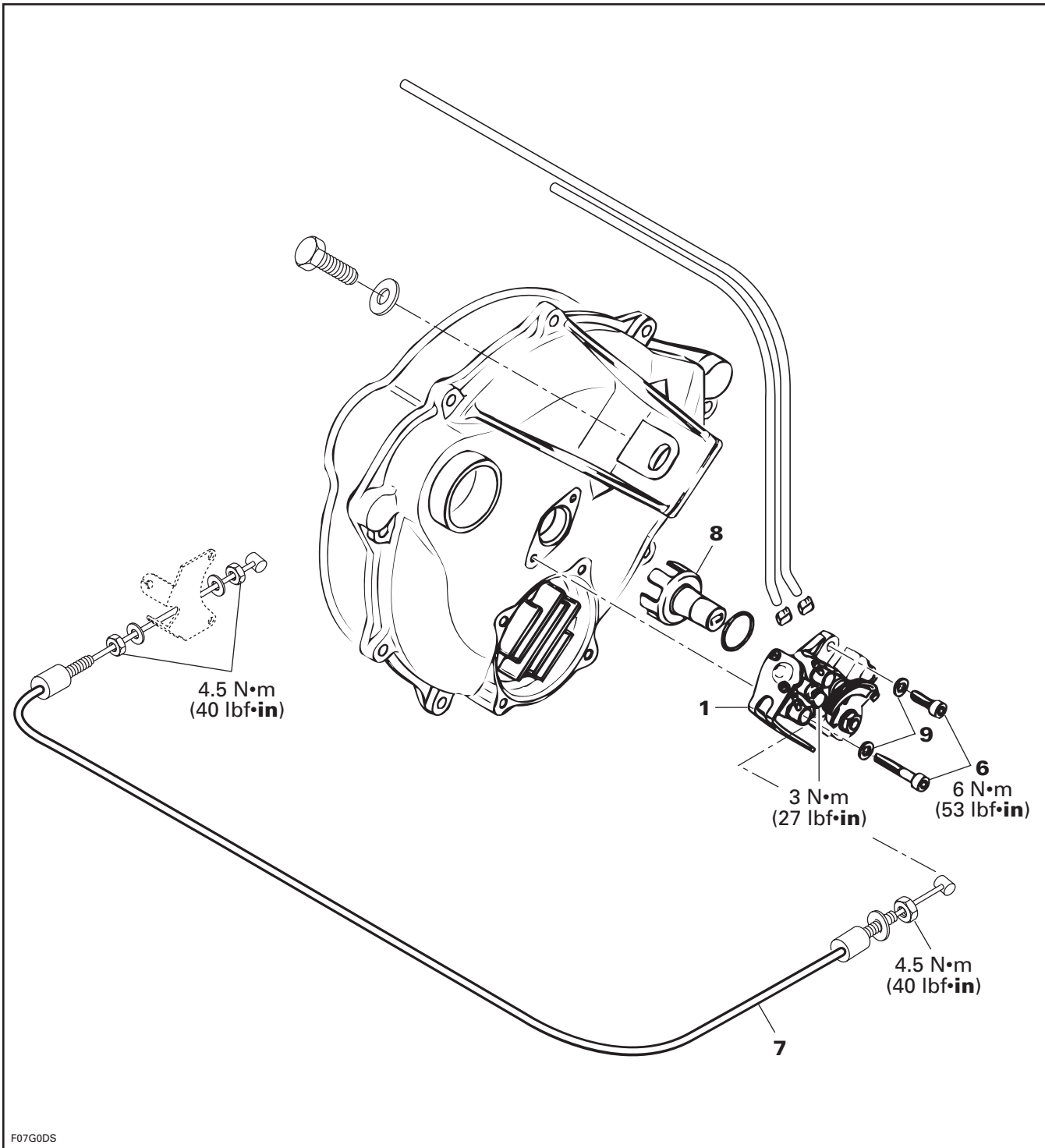


F00G03S

Section 09 LUBRICATION SYSTEM

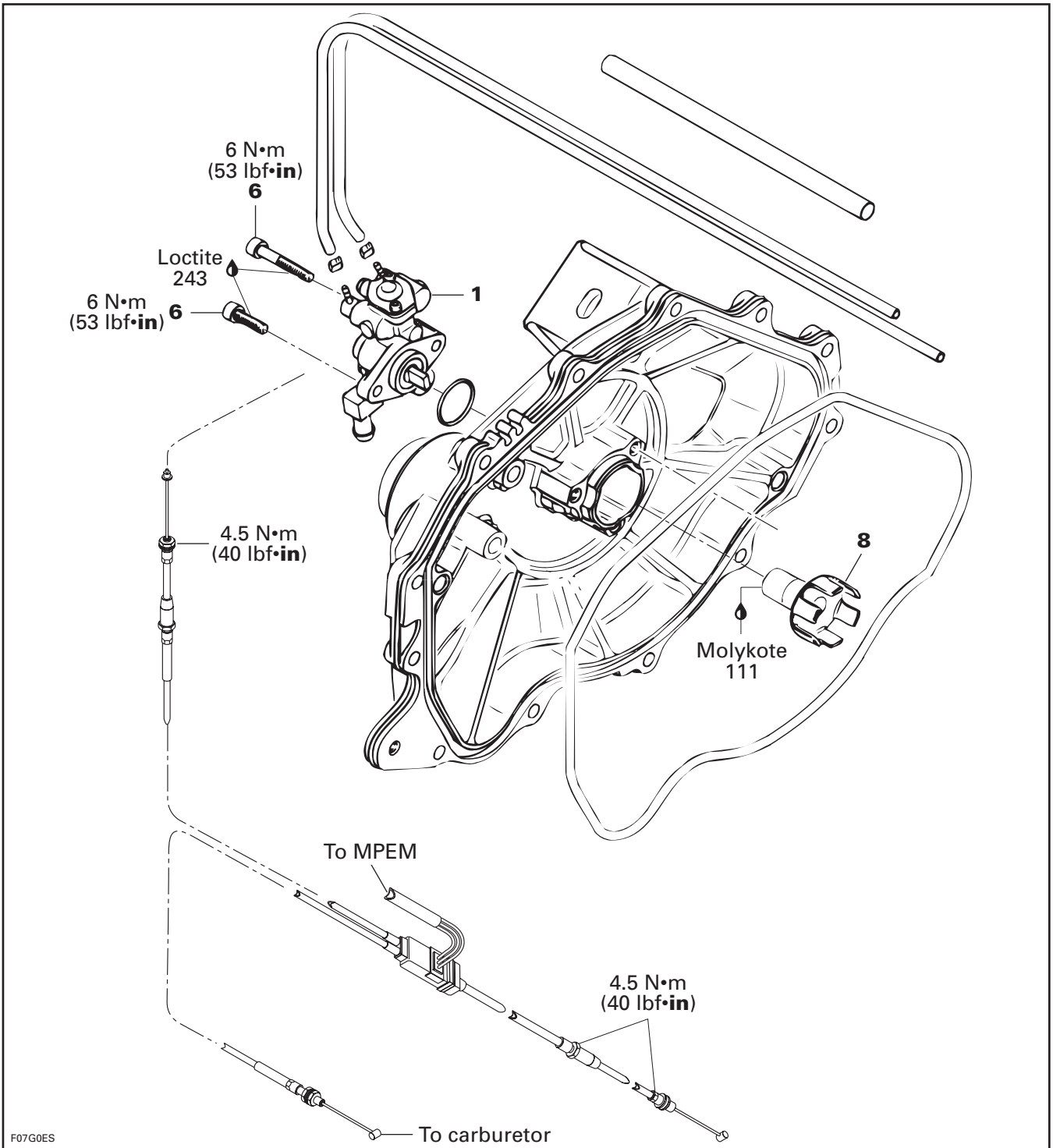
Subsection 03 (OIL INJECTION PUMP)

787 RFI Engine



Section 09 LUBRICATION SYSTEM
Subsection 03 (OIL INJECTION PUMP)

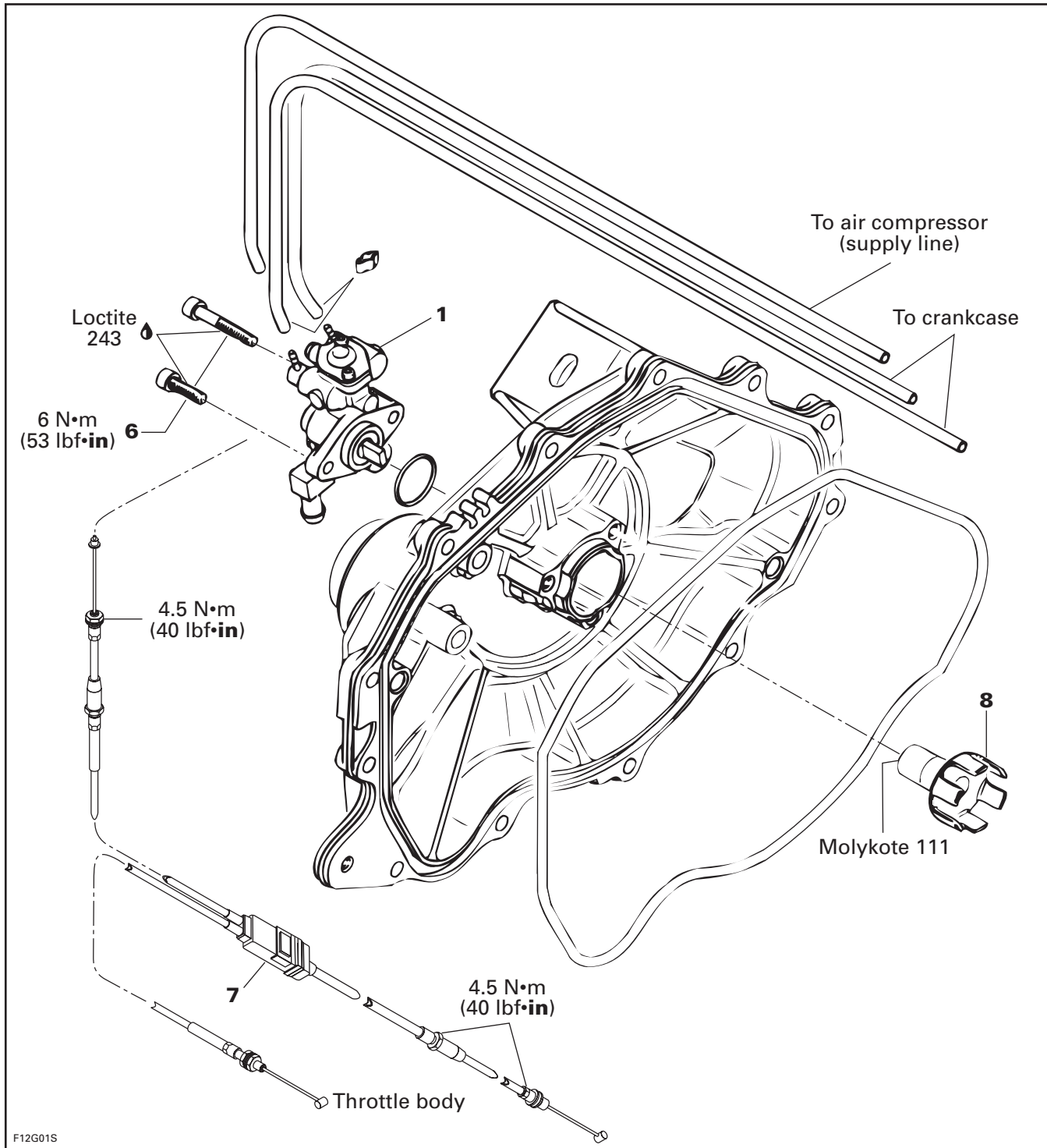
947 Carburetor-Equipped Engines



Section 09 LUBRICATION SYSTEM

Subsection 03 (OIL INJECTION PUMP)

DI Models



OIL PUMP IDENTIFICATION

Pump Lever

Different engines need different pumps. See identification on lever.

CAUTION: Always mount proper pump on engine.

ENGINE TYPE	OIL PUMP IDENTIFICATION
717	105Q-5
787 RFI	06
947	09

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

REMOVAL

Oil Injection Pump

717 Engine

Remove air intake silencer (refer to AIR INTAKE).

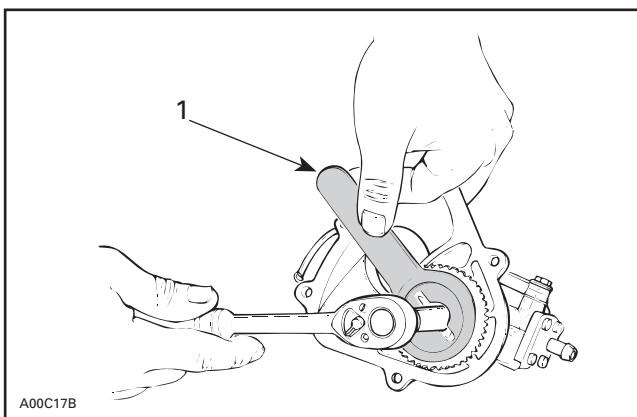
Remove carburetor (refer to CARBURETOR).

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 from intake manifold **no. 2**, remove oil pump gear **no. 3** using 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**.

Remove pump.

947 Engine

Remove tuned pipe head. Refer to EXHAUST SYSTEM.

DI Models

The cable end has a slight press fit in the lever. Using a small screwdriver, pry cable end out.

787 RFI and 947 Engines

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

Remove 2 Allen screws **no. 6** with flat washers 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.

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.

Section 09 LUBRICATION SYSTEM

Subsection 03 (OIL INJECTION PUMP)

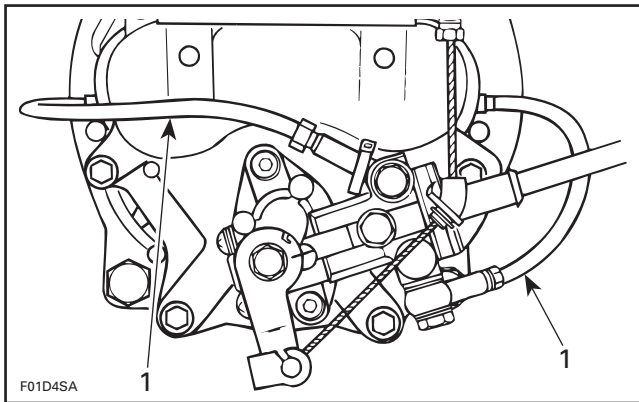
ASSEMBLY

717 Engine

Oil Injection Pump and Intake Manifold

Install oil injection pump no. 1 to intake manifold no. 2. 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

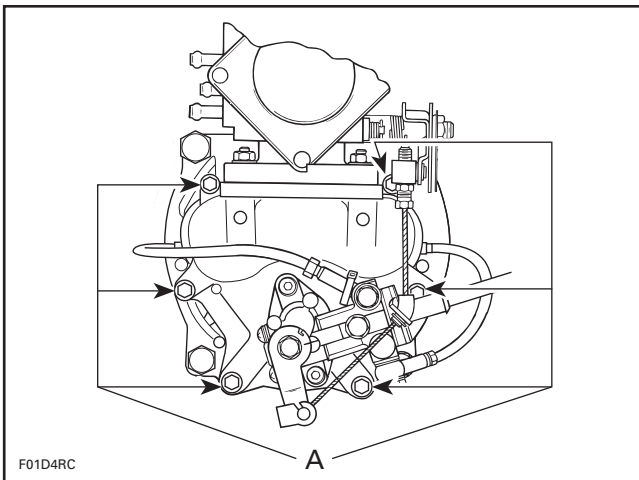
1. Small oil line

Oil Pump Gear

Install gear no. 3 to oil injection pump shaft. Torque lock nut no. 4 to 6 N•m (53 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 and 947 Engines

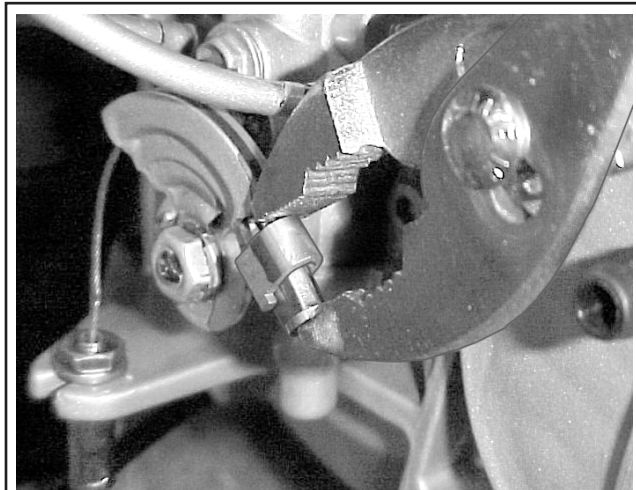
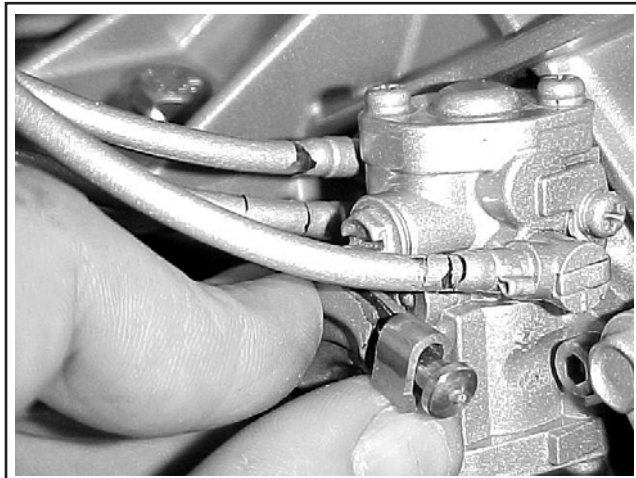
Oil Injection Pump and Shaft

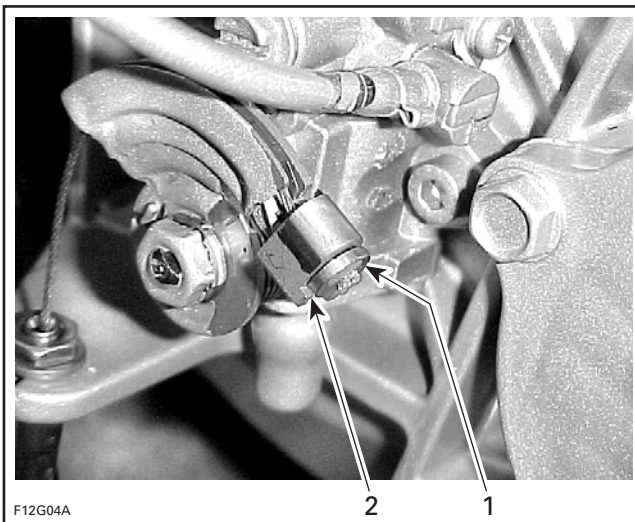
Make sure shaft no. 8 is installed in crankshaft end.

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

Install oil injection pump cable.

DI Models





1. Cable end completely inserted
2. Cable end NOT seated on the steps

CAUTION: Ensure cable end is completely entered in its housing. Ensure it is NOT seated on the steps.

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**. Make sure idle speed screw on carburetor is properly set on **Carburetor-Equipped Models**.

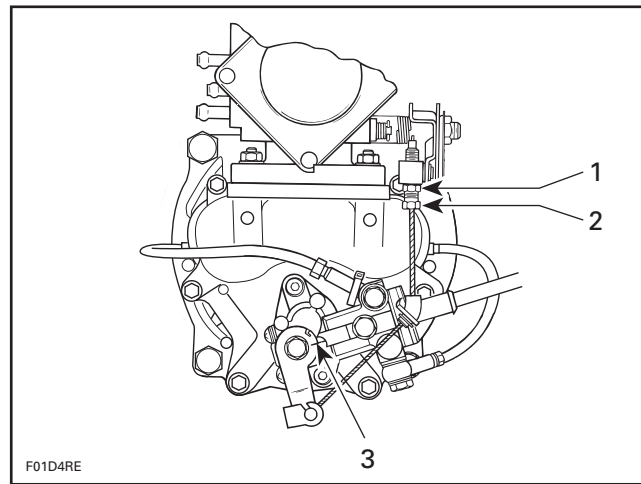
Refer to CARBURETOR for throttle cable adjustment procedure.

NOTE: On a twin carburetor engine, make sure carburetors are properly synchronized.

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

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

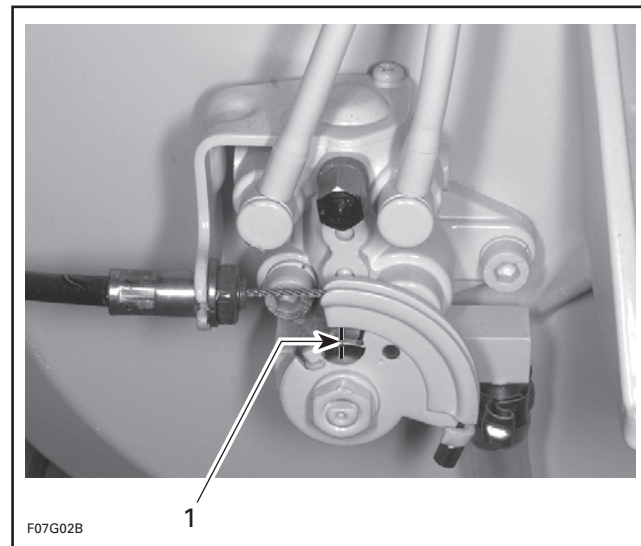
717 Engine



TYPICAL

1. Jam nut
2. Adjustment nut
3. Aligned marks

787 RFI Engine



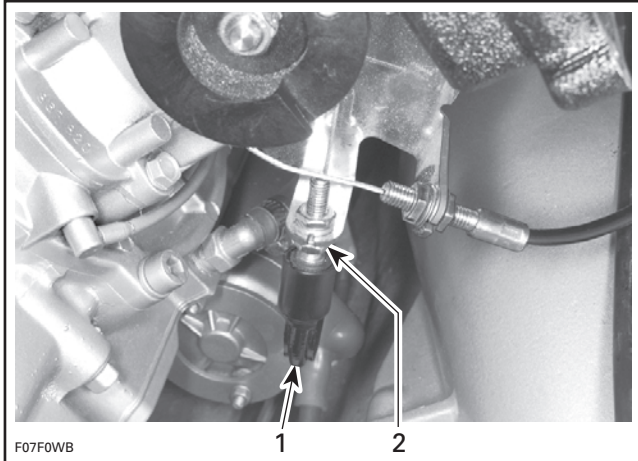
1. Aligned marks

Section 09 LUBRICATION SYSTEM

Subsection 03 (OIL INJECTION PUMP)

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

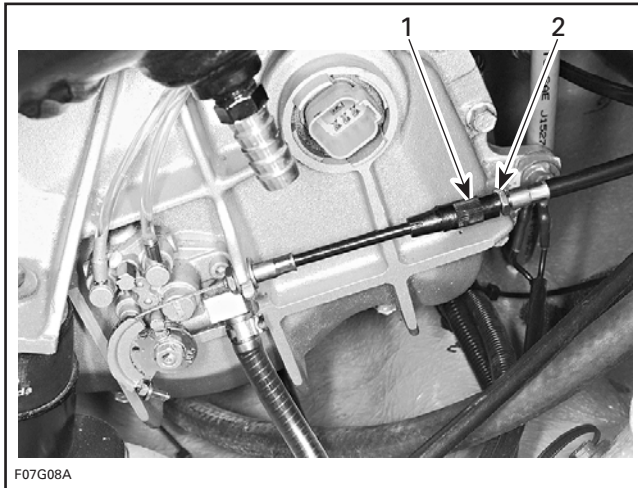
The adjustment nut and jam nut for the oil injection pump cable are located at the cable support on the throttle body.



1. Oil pump cable
2. Adjustment nut

947 Engine

NOTE: The adjuster knob and jam nut for the oil injection pump cable are located on the oil pump cable.

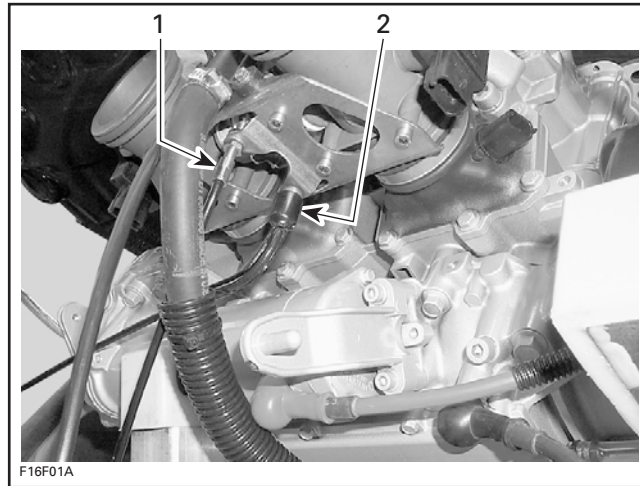


1. Adjuster knob
2. Jam nut

947 DI Engines

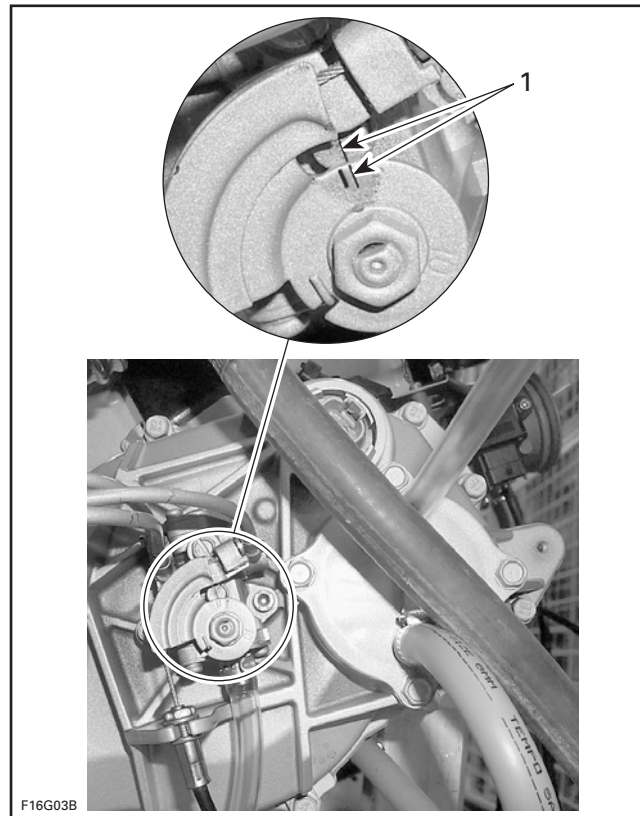
Loosen jam nut and turn cable adjustment nut to obtain pump mark alignment. Refer to following photos.

The adjustment is located under the throttle body bracket.



1. Oil pump cable adjustment
2. Throttle cable

Adjust the cable to the **rich** position. Use the **longest** mark.



1. Mark on pump must be facing **longest** mark on lever

All Engines

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 **Carburetor-Equipped Models**. Refer to CARBURETOR.

NOTE: On RFI engines, refer to FUEL INJECTION for idle speed adjustment procedure.

NOTE: On DI 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.

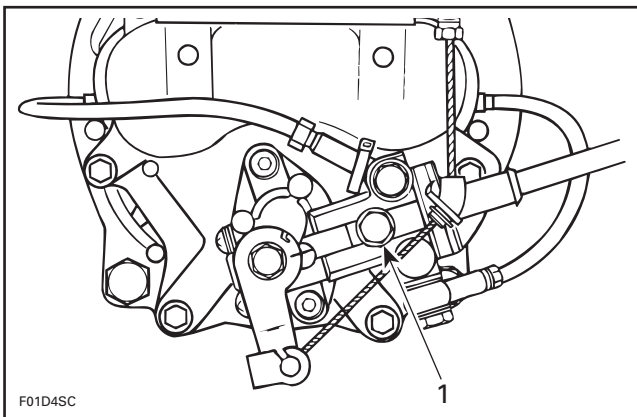
Bleeding

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.

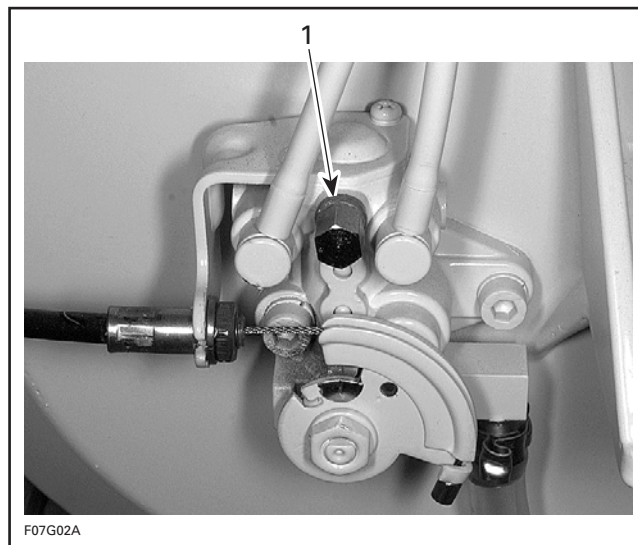
Loosen bleed screw to allow oil to flow.



F01D4SC

717 ENGINE

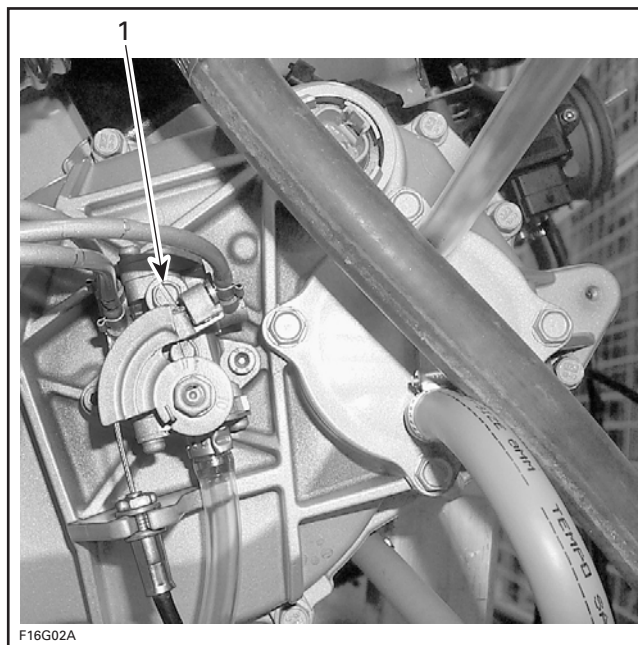
1. Bleed screw



F07G02A

787 RFI ENGINE

1. Bleed screw



F16G02A

947 ENGINES

1. Bleed screw

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

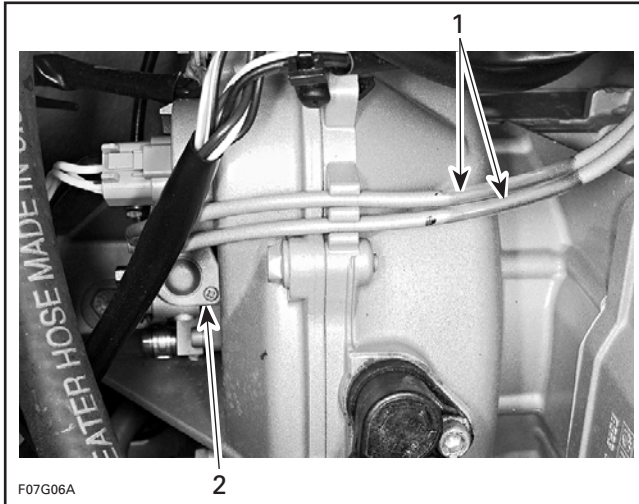
Tighten bleed screw.

Wipe any oil spillage.

Section 09 LUBRICATION SYSTEM

Subsection 03 (OIL INJECTION PUMP)

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



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

If not, proceed as follows.

All Models except DI

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

DI Models

- Use the VCK (Vehicle Communication Kit) P/N 529 035 676. Look in the **Monitoring** section of the software B.U.D.S.
- Use the “Oil lines bleeding” function that allows to “lock” the engine RPM in idle speed while the throttle is fully depressed to ease the bleeding operation.
- Since oil cannot be seen through the small oil lines, press and hold the vehicle throttle to wide open position for 45 seconds.

All Models

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.

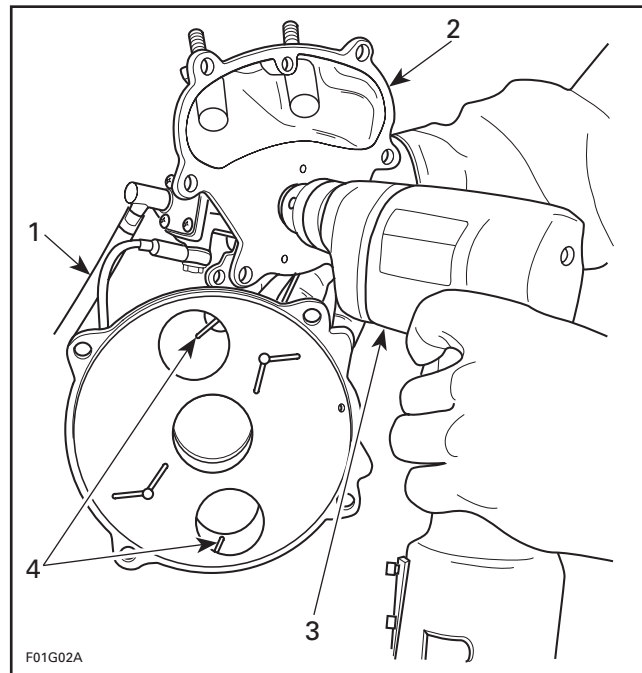
NOTE: The engine should have a rich mixture, idling irregularly and emitting smoke at exhaust outlet.

If not, remove pump assembly and check the pump gear (717 engine) or shaft (787 RFI and 947 engines) for defects, replace as necessary. Test pump as describes 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 a counterclockwise (reverse position) rotating drill 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. Counterclockwise (reverse) rotating drill
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.

Section 09 LUBRICATION SYSTEM
Subsection 03 (OIL INJECTION PUMP)

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

ENGINE	OIL PUMP FLOW RATE AT 1500 RPM (5 minutes)
717	9.9 - 12.1 mL (each port)
787 RFI	5.7 - 6.9 mL (each port)
947	8.3 - 10.1 mL (each port)
947 DI	7.5 - 9.1 mL (each port)

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IGNITION SYSTEM

GENERAL

NOTE: For **DI models**, refer to ENGINE MANAGEMENT section.

The ignition system consist of different sub-systems where some are interrelated.

Unregulated AC current is produced by the magneto for the ignition system (0 to 40 000 Vac). Part of the AC current is rectified and regulated for the charging system.

MAGNETO OUTPUT	
MODEL	WATT
GS, GTS and GTI	160 @ 6000 RPM
GTX, RX and XP	180 @ 6000 RPM
GTX RFI	270 @ 6000 RPM

A 12 volts battery supplies the Multi-Purpose Electronic Module (MPEM) with DC current.

Refer to CHARGING SYSTEM.

Three types of ignition systems are used:

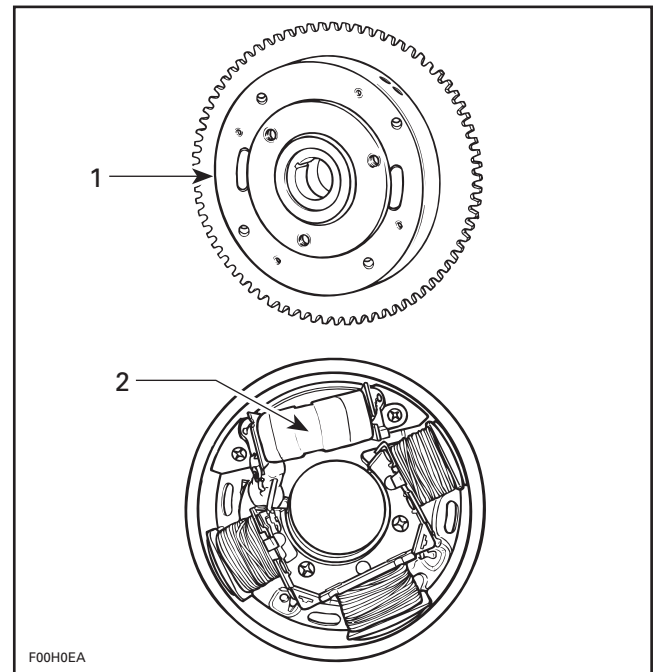
- Digital Capacitor Discharge Ignition (CDI)
- Direct Current-Digital Capacitor Discharge Ignition (DC-CDI)
- Digital Inductive System.

Magneto System

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

717 Engines

The flywheel contains 4 permanent magnets and spins around the generating coil. This electric current flows to the Multi-Purpose Electronic Module (GS, GTS and GTI models).



1. Flywheel
2. Generating coil

787 RFI Engines

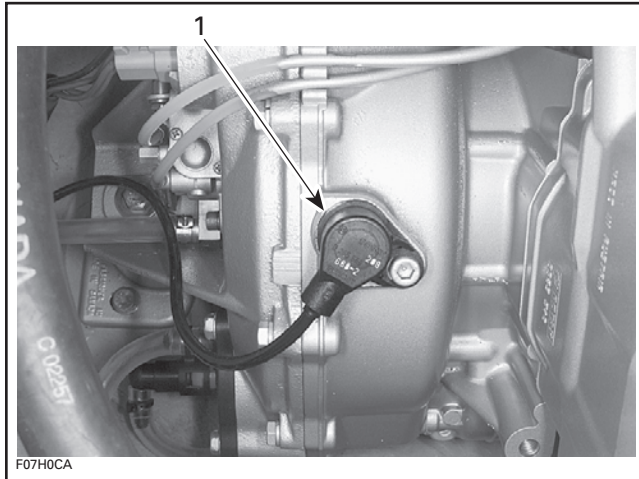
Crankshaft Position Sensor (CPS)

The CPS is an inductive speed sensor located on the magneto housing and is working in conjunction with a 60 teeth ring gear which has 2 teeth missing on the gear. The inductive sensor registers the 58-tooth sequence.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

An AC voltage is generated by the sensor and is sent to the ECU to calculate the crankshaft position and the engine speed.

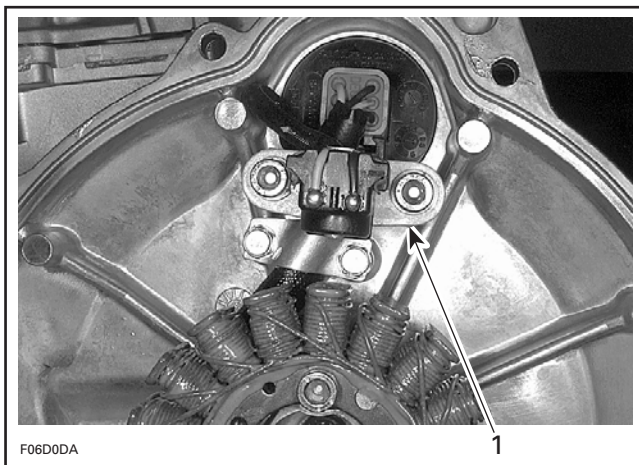


1. Crankshaft position sensor (CPS)

Trigger Coil

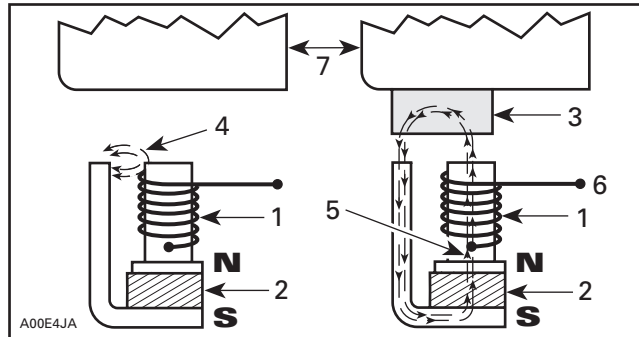
947 Engines

The trigger coil is mounted outside the rotor (inside the magneto housing of the engine) and is not adjustable.



1. Trigger coil

Its purpose is to signal the engine position to the Multi-Purpose Electronic Module. The rotor has 4 protrusions that, when coupled with the trigger coil, accomplish the signaling.



1. Coil
2. Magnet
3. Rotor protrusion
4. Magnetic field outside of coil
5. Magnetic field crossing coil
6. Current to MPEM
7. Rotor

Ignition Coil

Ignition coil induces voltage to a high level in secondary windings to produce a spark at spark plug.

GS, GTS and GTI Models

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.

On GS models, the electric box is located on the right side of watercraft.

On GTS and GTI models, the electric box is located under air admission.

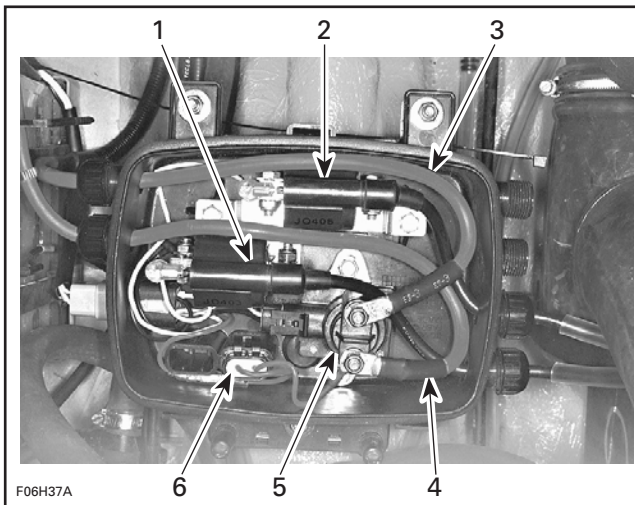
GTX, RX and XP Models

Two separate ignition coils receive input from the MPEM. Each coil will provide high voltage to its corresponding spark plug.

This ignition system allows spark plugs to spark independently.

CAUTION: Do not interchange spark plug cables.

Both coils are located inside the electrical box.

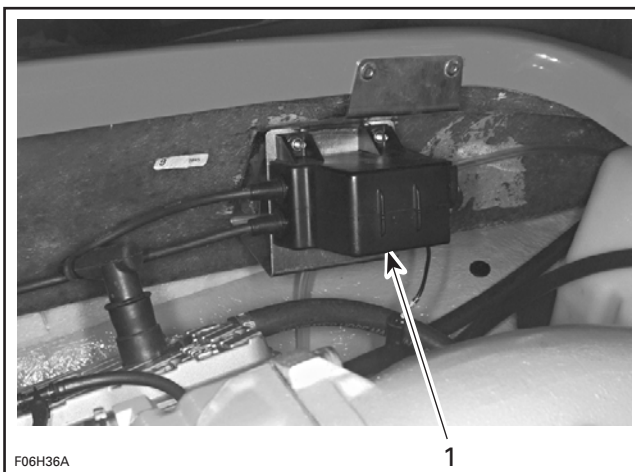


TYPICAL — GTX, RX AND XP MODELS

1. Ignition coil PTO
2. Ignition coil MAG
3. Starter cable
4. Positive battery cable
5. Solenoid
6. Fuse

GTX RFI Models

The digital inductive ignition system on the RFI models allows the spark plugs to spark independently on each piston stroke.



1. Ignition coil

CAUTION: Do not interchange spark plug cables. Reverse spark plug cables will not allow the RFI to run and will cause backfires.

Dynamic Ignition Advance Curve

947 Carburetor-Equipped Models

The throttle cable features a Hall Effect Switch that flattens the advance curve until it reaches 80% throttle.

This feature provides smoother midrange performance, while maintaining maximum performance at wide-open throttle. At 80% throttle and above, the cable switches ON, and the ignition advances as much as 12 degrees at certain RPM's.

MULTI-PURPOSE ELECTRONIC MODULE (MPEM)

The MPEM is directly powered by the battery. It has a micro-processor inside of its sealed case.

The MPEM is responsible of the following electrical functions:

- interpreting information
- distributing information
- start/stop function
- timer
- Digitally Encoded Security System
- ignition timing curve
- engine rev limiter.

Some fuses are directly mounted onto the MPEM.

All the electrical system is controlled by the MPEM. It has internal micro-processor and is directly powered by the battery.

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.

MPEM Functions

Automatic Power Shut-Down

The MPEM is equipped with an automatic power shut-down. This feature prevents the battery from losing its charge if the safety lanyard cap is left on the switch when the engine is not running.

After connecting the safety lanyard cap, the MPEM will remain in standby mode during the next 10 minutes, waiting for a starting. If start/ stop button is not depressed, then the MPEM will be automatically powered down.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

Antistart Feature

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 engines to start.
- 1 long beep indicates a wrong safety lanyard is being used or that the antistart feature is defective. Current to gauges is cut after the audible signal is emitted and the engines 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 antistart feature, refer to DESS (DIGITALLY ENCODED SECURITY SYSTEM).

If the MPEM responds differently from what is mentioned above, refer to the troubleshooting section to find out why.

Gauges Current Supply

The purpose of this function is to allow reading of gauges without the engine running. It will give access to all the functions of the info center gauge (if equipped) without starting the engine.

Gauges are supplied with current for 33 seconds when connecting the safety lanyard cap on the switch or when pressing the start/stop switch without the safety lanyard on the DESS post.

NOTE: On the **GTX RFI models**, the fuel pump will be activated for 1 second to build up pressure in the fuel injection system, only when connecting the safety lanyard cap to the switch.

Engine Starting

If the MPEM recognizes a valid safety lanyard, it allows engine to start when the start/stop switch is pressed.

If the safety lanyard is left on the DESS post for more than 10 minutes after stopping the engine, the MPEM may send out 1 long beep when pressing the start/stop switch. The current supply to gauges will be stopped as explained in the **Anti-start Feature** section. A light pressure on the safety lanyard is required to allow the MPEM to read and validate the safety lanyard, the engines can then be started.

If start/stop button is held after engine has started, the MPEM automatically stops the starter when the engine speed reaches 1000 RPM.

Engine RPM Limiter

The MPEM will limit the maximum engine speed.

Engine Stopping

There are two ways to stop the engine.

Press and hold start/stop switch or remove the safety lanyard cap from the switch.

If the engine is stopped by removing the safety lanyard, it is possible to restart the engine as explained in the engine starting section.

If safety lanyard cap is reconnected within 6 seconds, the current supply to gauges is cut for a brief moment and comes back on with the audible signal of safety lanyard validation.

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 for the beeper (**RFI models only**) and to the info center gauge.

When the oil level is low in the reservoir, The MPEM sends out a signal to the info center gauge and the pilot lamp on the gauge will turn on.

Power Distribution

The MPEM distributes power from battery to all accessories. Accessories are protected by fuses integrated in the MPEM. For fuse identification, refer to IGNITION SYSTEM TESTING PROCEDURE farther in this section.

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 buzzer, some audible signals informing the operator of a specific situation. The diagnostic mode is divided into 2 parts: the basic mode and the advanced mode. The basic mode is automatically activated when connecting the safety lanyard cap to the switch. The advance mode can only be activated when pressing the start/stop switch. Refer DIGITALLY ENCODED SECURITY SYSTEM.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

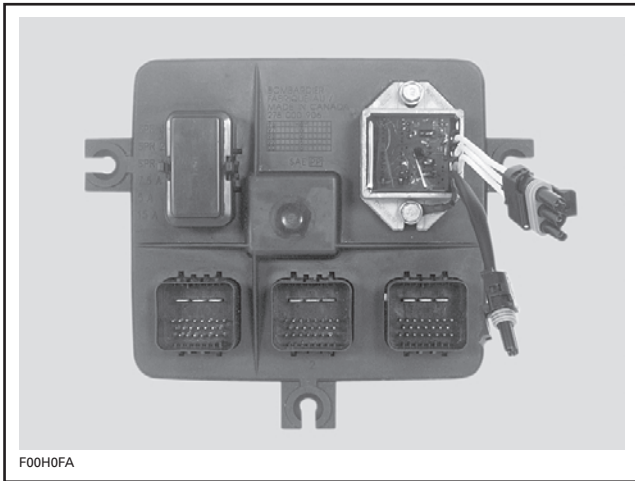
GS Models

On this model, the MPEM is also used as a junction box, eliminating the need of an electrical box.

All electrical components or accessories are directly linked to the MPEM.

Wire position are identified with a series of number on the MPEM. AMP plug connectors are used.

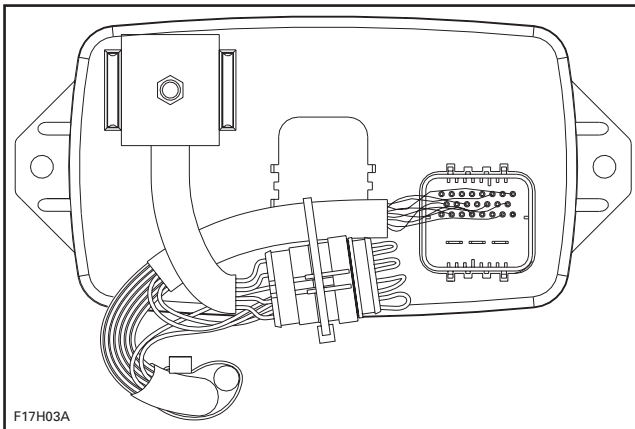
The regulator/rectifier is also mounted on the MPEM.



TYPICAL

GTI and GTS Models

On these models, the MPEM is used as an electrical box.



TYPICAL

787 RFI Engines

The MPEM is also used with the Rotax Fuel Injection system.

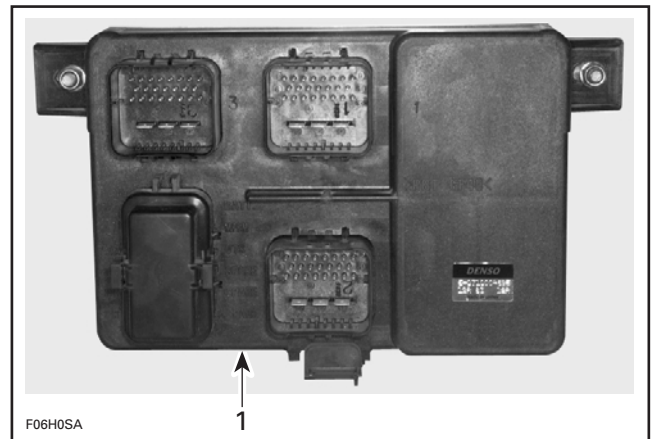
The RFI models use a Digital Inductive Ignition system. The Bosch ECU controls the ignition timing and dwell time. It receives input from the CPS and signals the ignition coil when to fire.



TYPICAL

947 Engines

The 947 engine has a digital Direct Current-Capacitor Discharge Ignition (DC-CDI) system within the MPEM which receives the input from the trigger coil and signals the ignition coils when to fire.



TYPICAL

1. MPEM

Compared to the magneto system, the DC-CDI system offers a more powerful and stable ignition at low RPM.

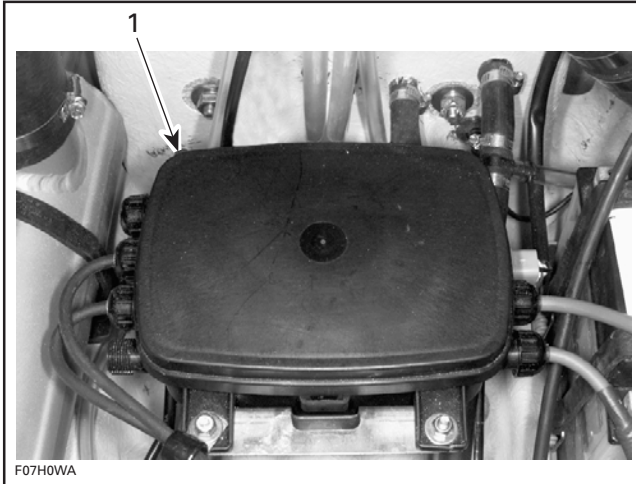
Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

Electrical Box

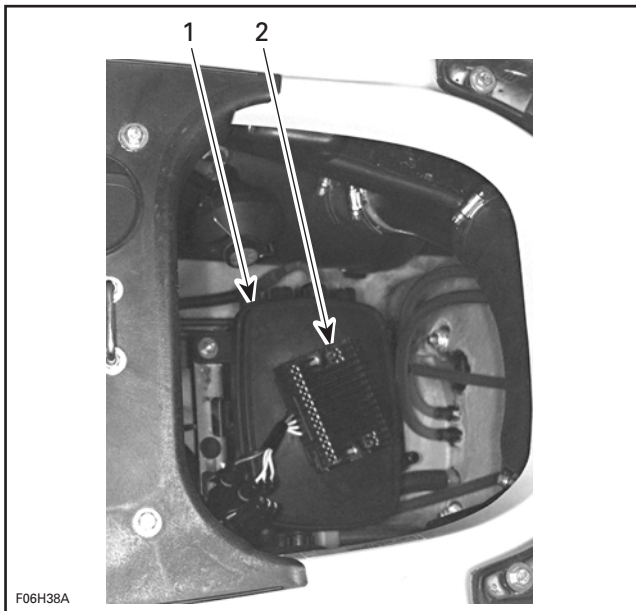
The high amperage/voltage components are located into the electrical box.

The electrical box can be located either at the front or at the rear of the watercraft.



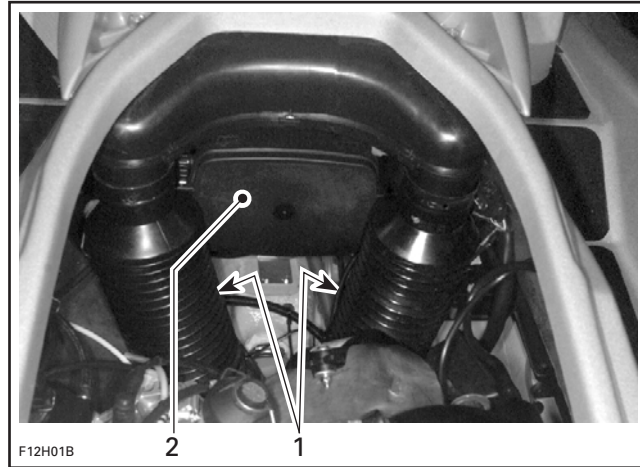
GTX MODEL

1. Electrical box



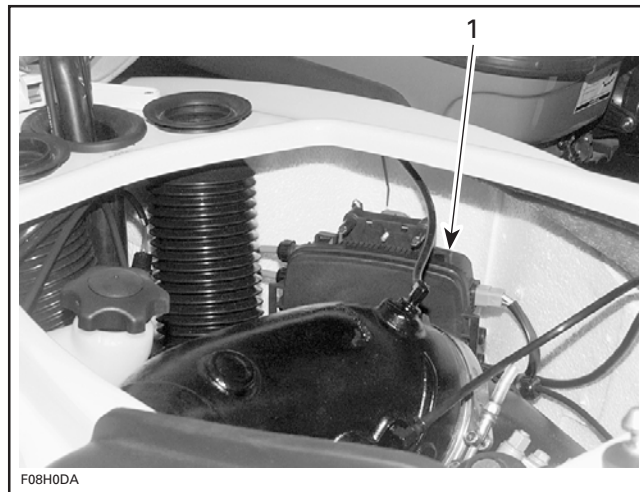
GTX RFI MODELS

1. Electrical box
2. Rectifier/regulator



GTI, GTS AND RX MODELS

1. Rear electrical box
2. Remove vent tubes



XP MODELS

1. Electric box

THROTTLE CABLE

GTI, XP and RX Models

The throttle cable can be checked for proper operation with a timing light.

Mark the PTO flywheel, like when the ignition timing is checked. See IGNITION TIMING further.

Then, put another mark on the flywheel approximately 13 mm (1/2 in) to the more advanced state. This will be a reference mark only.

Unplug the throttle cable connector. On the **XP models**, it is located near the oil tank. On the **GTX models**, remove the glove box to have access to connector (refer to HULL/BODY section). For the **RX models**, it is located on the LH side of fuel tank.

Install a test wire in the BLACK wire connector and an other in the WHITE/BROWN wire connector going to the MPEM.

Start the vehicle and hold RPM at 3500. The first timing mark should be lined up, if not adjust the timing with the MPEM programmer.

Then, short the two test wires together. The timing should advance at this point; the reference mark should be closer to the pointer.

Shut the engine off and plug the throttle cable connector.

Check the timing again, if the timing is still in advanced state, the switch on the cable is stuck to the ON position, and must be replaced.

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 position and crankshaft position may change as the PTO flywheel might move/tighten/loosen on the crankshaft. As an example on threaded flywheels, when the engine is accelerated out of water, PTO flywheel may tighten then loosen when the engine is decelerated. This will result in a false ignition timing reading. Always verify PTO flywheel mark position before checking ignition timing with an appropriate timing light. If mark does not align with tool, repeat static test to ensure flywheel has not loosen or moved before changing the ignition timing.

NOTE: Do not use the factory mark found on the PTO flywheel to check ignition timing or troubleshoot any problems.

787 RFI and 947 Engines

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 trigger coil on **947 engines** (or the CPS on **RFI models**) and the MPEM (or the ECU on the **RFI models**). If the ignition timing is found incorrect, you should first check for proper crankshaft alignment. This might be the indication of a twisted crankshaft.

RFI Models

The fixed timing mode must be activated before checking ignition timing. See **Fixed Timing Function** paragraph.

947 Engines Only

With this DC-CDI system, the ignition timing can be checked with either the engine hot or cold. Also, the ignition timing is to be checked at 3500 RPM with the timing light.

NOTE: Between 3000 and 4000 RPM, the spark advance does not change. So when checking ignition timing at 3500 RPM, a change in engine speed within ± 500 RPM will not affect the timing mark when checked with the timing light.

Static Test

All Engines

1. 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.

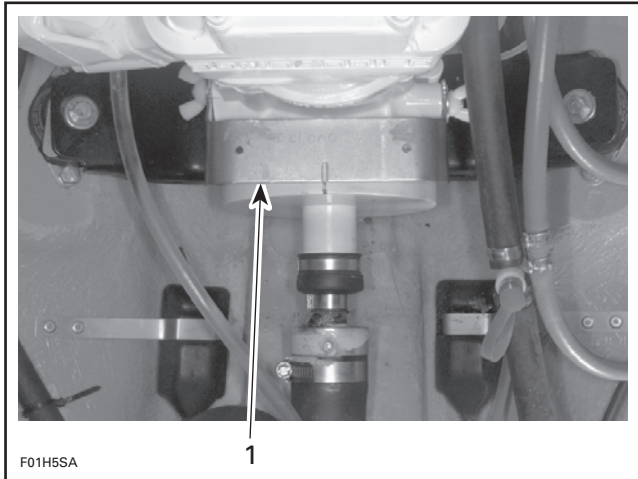
2. Remove PTO flywheel guard.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

717 Engines

3. Install timing mark pointer tool on engine using wing nuts previously removed.

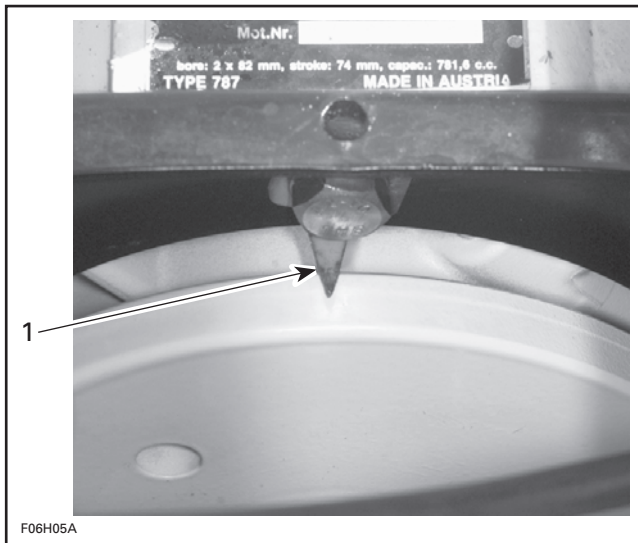


TYPICAL

1. Timing mark pointer tool (P/N 295 000 130)

787 RFI Engines

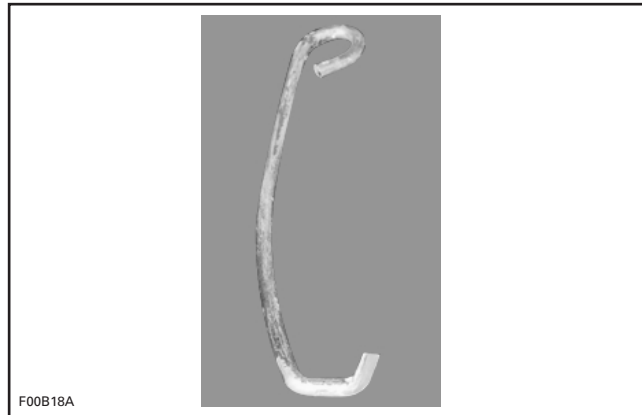
4. Remove middle screw securing the engine to the rear engine mount. Reinstall screw with timing mark pointer tool.



1. Timing mark pointer tool (P/N 295 000 135)

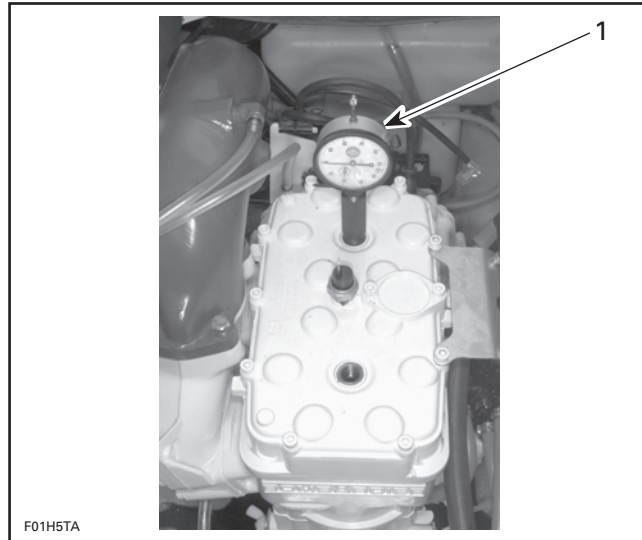
947 Engines

5. Bend a wire like the following illustration. Unscrew the first screw at right of middle screw securing the engine to the rear engine mount. Reinstall screw with the special timing mark pointer tool.



All Engines

6. Install and adjust a TDC gauge (P/N 295 000 143) in MAG side spark plug hole.



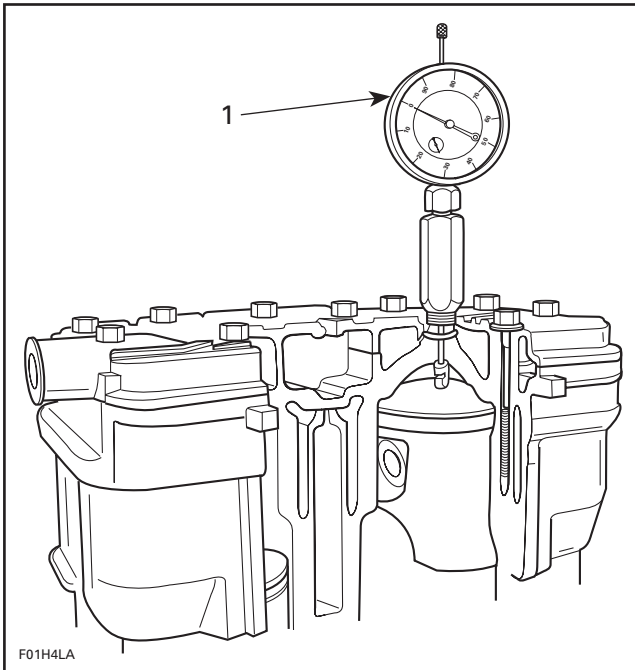
TYPICAL

1. TDC gauge on MAG side

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

7. Rotate PTO flywheel counterclockwise (when facing it) until piston is at Top Dead Center.



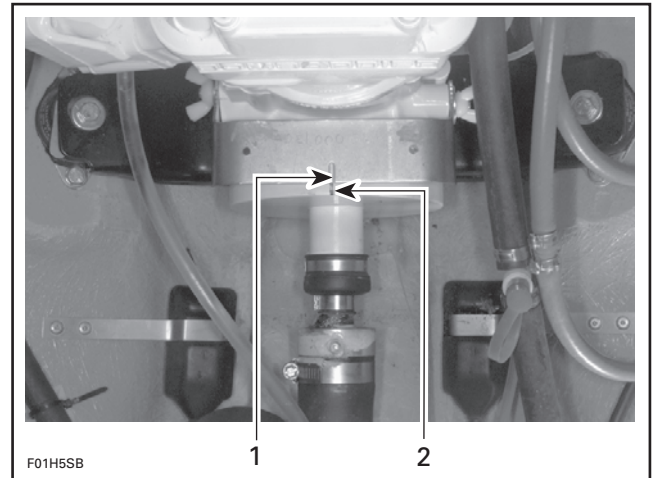
TYPICAL

1. Adjust gauge dial at zero

8. 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)
787 RFI	1.02 mm (.040 in)
947	2.99 mm (.118 in)

Scribe a thin mark on PTO flywheel in the middle of tool slot (**717 engine**) or aligned with timing mark pointer tool (**787 RFI and 947 engines**).



TYPICAL

1. Tool slot
2. Flywheel mark

NOTE: This mark becomes the reference when using the stroboscopic timing light.

CAUTION: The static test cannot be used as a timing procedure, therefore, always check the timing with a stroboscopic timing light.

9. Remove TDC gauge.
10. Reinstall spark plug and connect wire.

Dynamic Test

To check ignition timing, use Bombardier timing light (P/N 529 031 900).



Section 10 ELECTRICAL SYSTEM

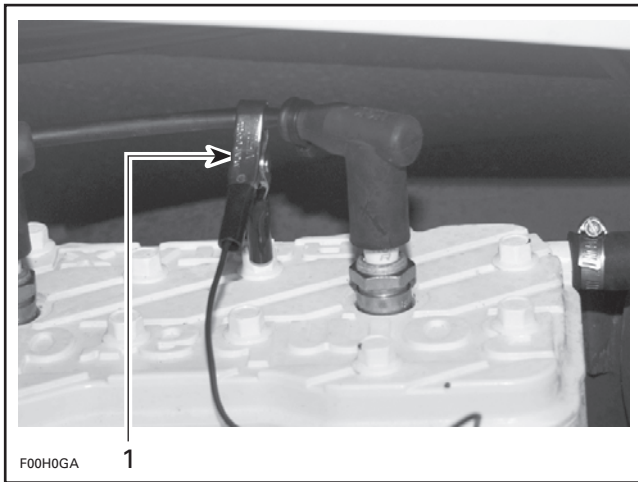
Subsection 02 (IGNITION SYSTEM)

717 Engines

NOTE: To perform this procedure, make sure to use a stroboscopic timing light rated up to 6000 RPM. Otherwise, an inaccurate reading will be obtained.

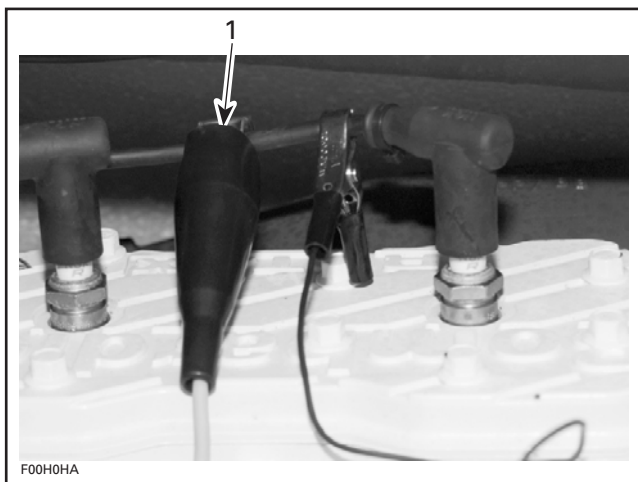
The ignition components are affected by temperature variation, therefore, timing must be checked when engine is cold, after idling for a MAXIMUM of 20 seconds.

1. Connect an induction-type tachometer (P/N 529 014 500) to spark plug wire.



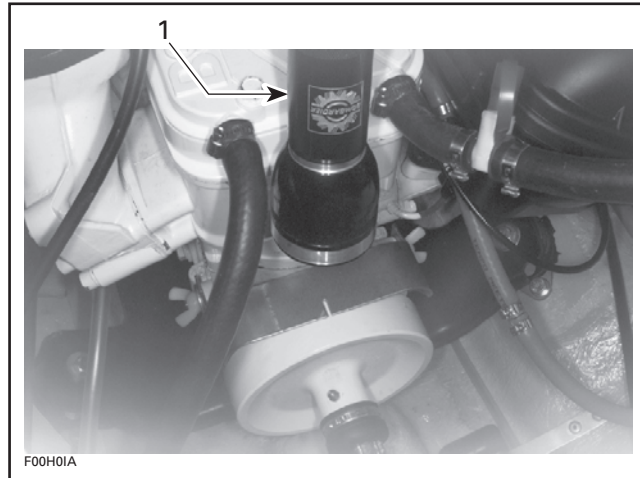
1. Tachometer pick-up

2. Connect timing light pick-up to MAG side spark plug wire.



1. Timing light pick-up

3. 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.

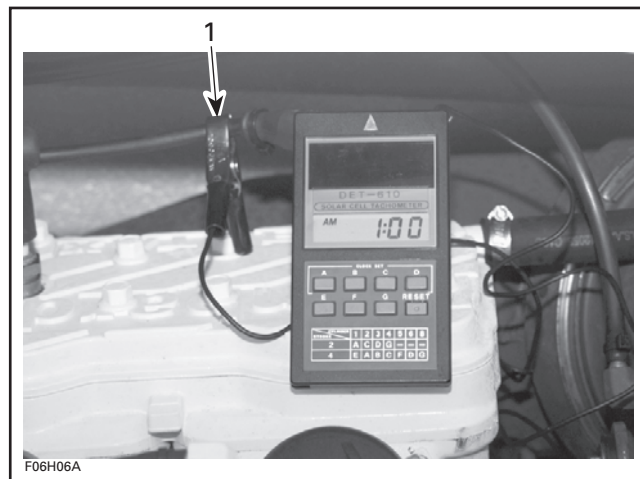
4. Check if PTO flywheel mark aligns with timing tool slot.

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, re-check PTO flywheel mark before adjusting ignition timing to ensure PTO flywheel has not loosen.

787 RFI and 947 Engines

1. Connect an induction-type tachometer (P/N 529 014 500) to spark plug wire.

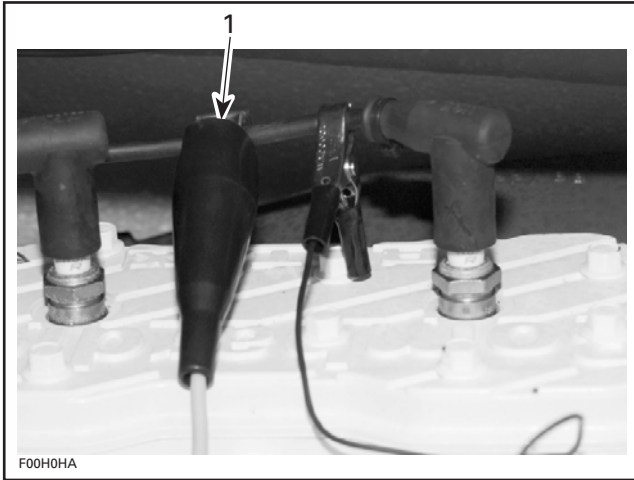


1. Tachometer pick-up

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

2. Connect timing light pick-up to MAG side spark plug wire.

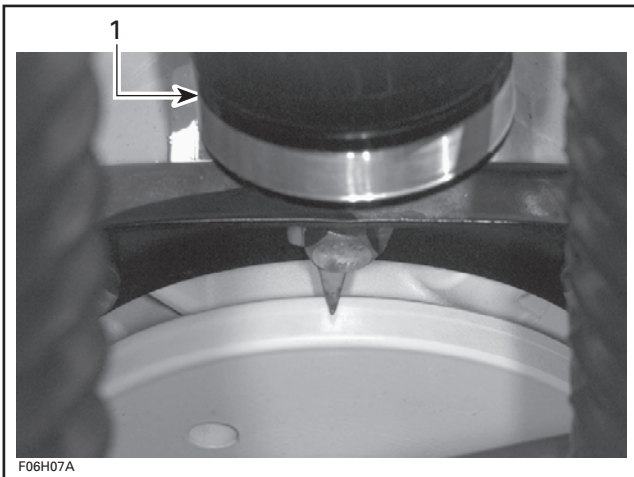


1. Timing light pick-up

IMPORTANT: On 787 RFI engines to check the ignition timing, the timing advance curve must be locked first. This allows to perform ignition timing at any RPM by keeping the timing “frozen” so that it does not vary with engine RPM. See **Fixed Timing Function** for more information.

NOTE: Fixed Timing function must be activated before starting engine.

3. On 947 engines, start engine and rev it to 3500 RPM and point beam of timing light straight in line with timing mark pointer. On 787 RFI engines, start engine and point the beam of a timing light on mark.



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.

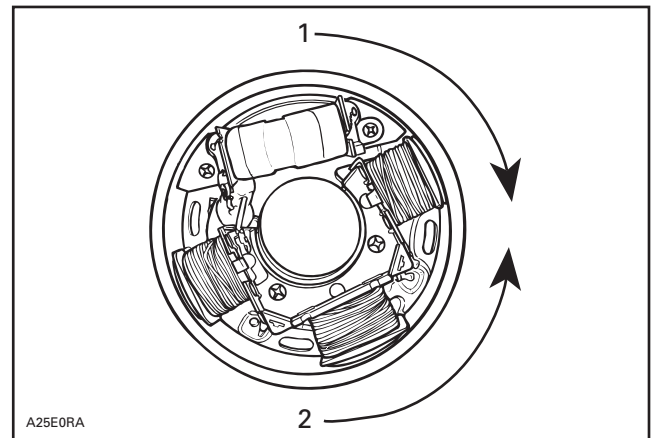
NOTE: If mark on PTO flywheel is perfectly aligned with timing mark pointer, no adjustment is required. If mark does not align with pointer, recheck PTO flywheel mark before adjusting ignition timing to ensure PTO flywheel has not loosen or moved.

Ignition Timing Adjustment

717 Engines

Remove magneto housing cover and wire support. For removal of magneto, refer to MAGNETO SYSTEM.

Timing is performed by moving armature plate; clockwise to retard spark occurrence or counter-clockwise to advance.

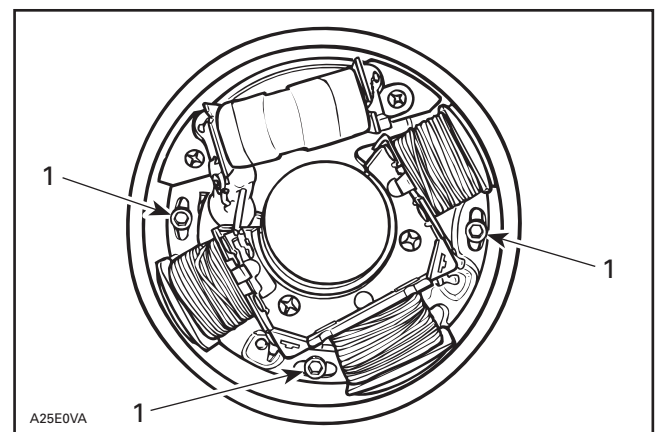


TYPICAL

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

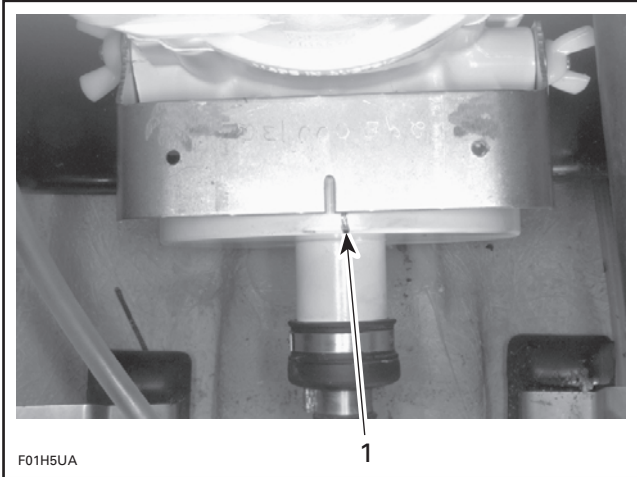
1. Retaining screw

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

Example 1

When PTO flywheel mark is on right side of timing tool slot, it indicates advanced timing.

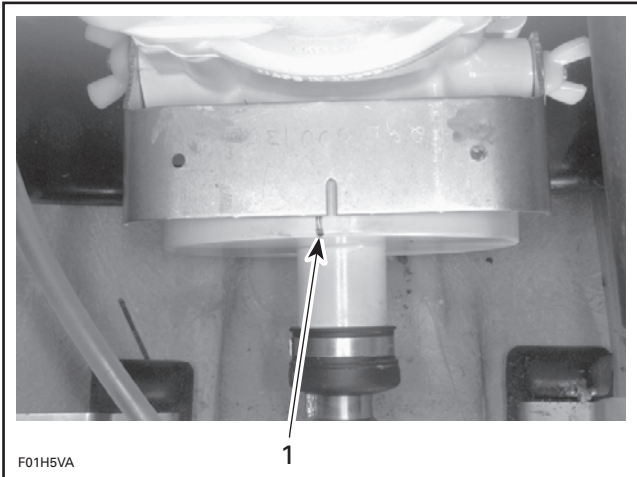


1. Too advanced timing

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 (blue) 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.

787 RFI and 947 Engines

To correct the ignition timing, the data of the MPEM is changed using the MPEM programmer (P/N 529 035 718) or the VCK (Vehicle Communication Kit) (P/N 529 035 676).

NOTE: For more information on the programmer, refer to the MPEM programmer guide (P/N 219 700 138).

MPEM Programmer

787 RFI Engines

To verify ignition timing on this engine, **Fixed Timing** function must be activated first. This function allows to check ignition timing at **any RPM** because it locks ignition timing at 12 degrees BTDC.

NOTE: **Fixed Timing** function must be activated before starting engine.

Fixed Timing Function

1. Connect the communication cable to the MPEM programmer and the other end to the safety lanyard switch on the craft.
2. Press the **ON/C** button on programmer and enter your password.
3. Press **3** to choose **Vehicle info** in programmer.
4. Press **8** to choose **Bosch system**.
5. Press **1** to choose **Diagnosis**.
6. Press **4** to choose **Adjustment**.
7. Press **4** to choose **Fixed timing**.
8. The programmer display **Timing = 12.00 deg**.
9. Press any key to continue. Programmer will go back one level to **Adjustment**.
10. Press **Menu** to go back one level to **Diagnosis**.
11. Press **Menu** to go back one level to **Bosch system**.
12. Programmer now ask **Quit Bosch Diagnosis?** Choose **yes** to quit.

Press **2** to choose **Start Vehicle**, the programmer will then ask **Modify Max RPM**, press menu then start engine with start/stop button.

NOTE: If engine fail to start and as soon engine stops revving (start/stop button has been released), **Fixed Timing** function is disabled. To reactivate function, repeat complete procedure.

Timing Verification

With engine running, check timing.

CAUTION: If engine is to be run more than a few seconds, engine must be cooled using the flush kit.

If timing is correct stop engine. This will automatically disable **Fixed Timing** function.

If further adjustment is required refer to following procedure.

Timing Adjustment

Unlike the other models, the ignition timing correction can be made from 4.5° (advanced) to - 2.25° (retarded).

The MPEM programmer will display correction numbers from 1 to 8. Refer to the next timing correction chart.

Access the **BOSCH SYSTEM** in the MPEM programmer, then select **ADJUSTMENT** in the sub-menu.

Choose **IGNITION** in the **ADJUSTMENT** menu.

The screen will display the actual ignition timing correction in degrees and it will also offer to adjust it.

Refer to the following chart to find the number corresponding to the timing correction needed.

Choose the **Fixed Timing Function**, start the engine and verify the timing again. Repeat the above procedure if the timing is still incorrect.

TIMING CORRECTION CHART 787 RFI	
PROGRAMMER NUMBER (MPEM)	IGNITION TIMING CORRECTION
1	4.50°
2	3.75°
3	3°
4	2.25°
5	.75°
6	0°
7	- 0.75°
8	- 2.25°

Ignition timing is set at 12° BTDC at any RPM, when the **Fixed Timing Function** is active.

947 Engines

Through the MPEM programmer, the ignition timing can be advanced up to 3° or retarded up to 4°. The MPEM programmer corrects the ignition timing in 1° increments.

CAUTION: If the ignition timing is adjusted too advanced, this will cause serious damage to the engine.

The timing mark on the PTO flywheel refers to the physical component position when the spark must occur. The MPEM must be synchronized with the mark. For instance, on a particular engine, the timing correction may need to be advanced to 2° so that the mark aligns with timing mark pointer tool. This is not the real spark advance, just a correction for the tolerances of the mechanical components.

Knowing that, you select with the programmer the higher or lower number to advance or retard the actual timing correction by referring to the following chart.

TIMING CORRECTION CHART	
PROGRAMMER NUMBER (MPEM)	IGNITION TIMING CORRECTION
2	3°
3	2°
4	1°
1	0
5	- 1°
6	- 2°
7	- 3°
8	- 4°

Examples:

- a. You found the flywheel mark advanced. You must retard the ignition timing.
 - The programmer gives you the number 3. Referring to the chart, number 3 returns a correction of 2° (advanced) and this is too much in this case.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

- You estimate the correction should be set to 1° (advanced) to align flywheel mark. Back in the chart, look to find 1° (advanced). This gives number 4. Enter this number with the programmer.
 - You recheck the timing with the timing light and if the mark is aligned, ignition timing is properly set.
- b. You found the flywheel mark advanced. You must retard the ignition timing.
- The programmer gives you the number 3. Referring to the chart, number 3 returns a correction of 2° (advanced) and this is too much in this case.
 - You estimate the correction should be set to 1° (advanced) to align flywheel mark. Back in the chart, look to find 1° (advanced). This gives number 4. Enter this number with the programmer.
 - You recheck the timing with the timing light and found that the flywheel mark is still too advanced. You know now that the correction made previously was not enough and you estimate the correction should be set to -2° (retarded) to align flywheel mark. Back in the chart, look to find -2° (retarded). This gives number 6. Enter this number with the programmer.
 - You recheck the timing with the timing light and if the mark is aligned, ignition timing is properly set.
- c. You found the flywheel mark retarded. You must advance the ignition timing.
- The programmer gives you the number 4. Referring to the chart, number 4 returns a correction of 1° (advanced) and this is not enough in this case.
 - You estimate the correction should be set to 2° (advanced) to align flywheel mark. Back in the chart, look to find 2° (advanced). This gives number 3. Enter this number with the programmer.
 - You recheck the timing with the timing light and if the mark is aligned, the ignition timing is properly set.

Proceed as Follows to Adjust the Ignition Timing with the MPEM Programmer:

947 Engines

1. Connect the communication cable to the MPEM programmer and the other end to the safety lanyard switch on the craft.
2. Press the **ON/C** button on programmer and enter your password.
3. Press **3** to choose **Vehicle info** in programmer.
4. Press **4** to choose **Engine param**.
5. Press **2** to choose **Timing adjust**.
6. The programmer display a number that is stored in the MPEM.
7. Press **↔** to choose **yes** for modify then press **Enter**.
8. Now punch in the number that corresponds to the degree you want for the ignition timing then press **Enter**.
9. Press **Menu** to go back one level.
10. Press **8** to choose **Save + Quit** (even if item no. 8 is not visible on the display, it is active when you select it).
11. Press **Enter** to confirm yes you want to **save modifications** to the MPEM.
12. You must see **Operation successful**. This confirms that the new timing data has been stored in the MPEM.
13. Unplug communication cable from safety lanyard switch on craft.
14. Press **Off** to close the programmer.

At this point, you can install the watercraft safety lanyard and start the engine to check the effect of the correction on the ignition timing. If further adjustment is required, repeat the procedure.

NOTE: The MPEM features a permanent (non-volatile) memory and keeps the ignition timing programmed even when the watercraft battery is disconnected.

VCK (Vehicle Communication Kit)

For the 787 RFI and 947 engines, can be used also the VCK (Vehicle Communication Kit) (P/N 295 035 676) to adjust the ignition timing. Look the proper **Setting** section of the software B.U.D.S.

CAUTION: If the ignition timing is adjusted too advanced, this will cause serious damage to the engine.

Refer to the timing correction charts, used per **MPEM Programmer**, to find the number corresponding to the timing correction needed.

IGNITION SYSTEM TESTING PROCEDURE

All Engines

When dealing with ignition problems, the following items should be verified in this order:

1. Spark occurrence/spark plug condition.
2. Battery condition.
3. Electrical connections.
4. Engine start/stop switch.
5. Safety lanyard switch.
6. Timer.
7. Multi-Purpose Electronic Module (MPEM).
8. Magneto output (717 engine).
9. Ignition coil output.

CAUTION: Whenever replacing a component in ignition system, check ignition timing.

NOTE: To perform verification, a good quality multimeter such as Fluke 73 (P/N 529 022 000) should be used.

Engine Start/Stop Switch Verification

Disconnect the YELLOW/RED wire of the start/stop switch. Using an ohmmeter, connect test probes to YELLOW/RED wire and to ground.

Measure resistance, it must be an open circuit (switch is normally open). Depress and hold switch, the ohmmeter should read close to 0 ohm.

Safety Lanyard Switch Verification

If 2 short beeps are not heard when installing the safety lanyard, refer to DIGITALLY ENCODED SECURITY SYSTEM.

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

Disconnect switch wires.

Safety Lanyard Removed

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

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

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

Safety Lanyard on Switch

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

Timer Verification

The timer is integrated into the MPEM.

Always confirm first that the fuses are in good condition.

To confirm operation of timer, remove safety lanyard from switch. After a 5 seconds delay, depress start/stop button once. The timer should stay on for about 33 seconds (for example, gauge(s) will be activated) and then turn off.

Rev Limiter Verification

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
GS, GTI and GTS	7100 ± 50
GTX, GTX RFI, RX and XP	7200 ± 50

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

Multi-Purpose Electronic Module (MPEM) Verification

It is not possible to accurately check the MPEM condition without specialized tools. Therefore, replace MPEM with a good known unit to conduct testing.

NOTE: Before replacing the MPEM, make sure all connectors are properly secured and there is no water in connectors. Check also the signal and power contacts in the AMP plug connectors. See WIRING DIAGRAMS.

Generating Coil Verification

717 Engines

STATIC TEST

Disconnect magneto wiring harness connector.

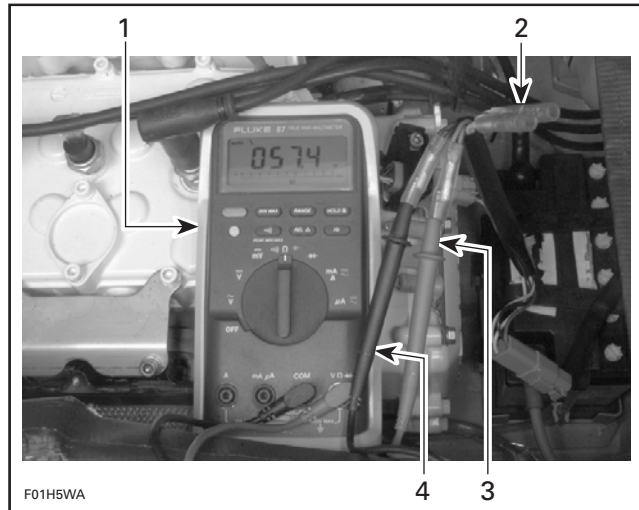
Install the 4-pin magneto harness adapter (P/N 295 000 131).



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. Four-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 Vdc. If there is insufficient or no voltage, either the MPEM or wiring harness is defective.

Trigger Coil Verification

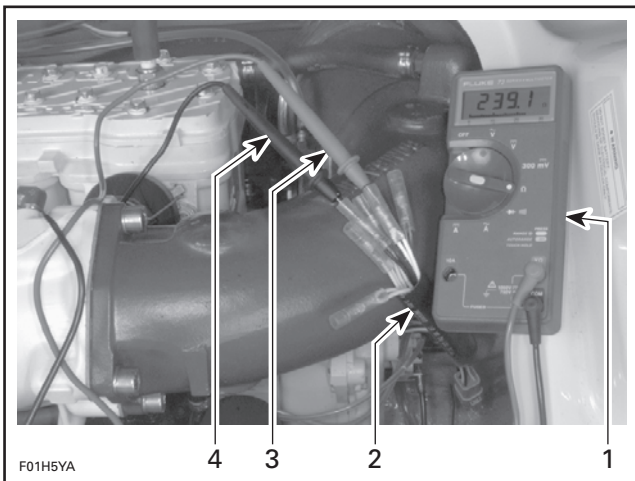
947 Engines

STATIC TEST: CONTINUITY

1. Disconnect magneto wiring harness connector.
2. Install the 6-pin magneto harness adapter (P/N 295 000 136).



3. Connect one of the multimeter probes to the WHITE wire of the 6-pin magneto harness adapter.
4. Connect the other multimeter probe to the BLACK/YELLOW wire of the 6-pin magneto harness adapter.
5. Measure resistance; it should be between 190-300 ohms.



1. Multimeter
2. Six-pin magneto harness adapter
3. WHITE wire
4. BLACK/YELLOW wire

DYNAMIC TEST

1. Disconnect magneto wiring harness connector.
2. Install the 6-pin magneto harness adapter (P/N 295 000 136).
3. Connect one of the multimeter probes to the WHITE wire of the 6-pin magneto harness adapter.
4. Connect the other multimeter probe to the BLACK/YELLOW wire of the 6-pin magneto harness adapter.

5. Crank engine and note result. The obtained value should be between 0.2 and 0.5 Vac.
6. If the trigger coil is out of specification, replace it.

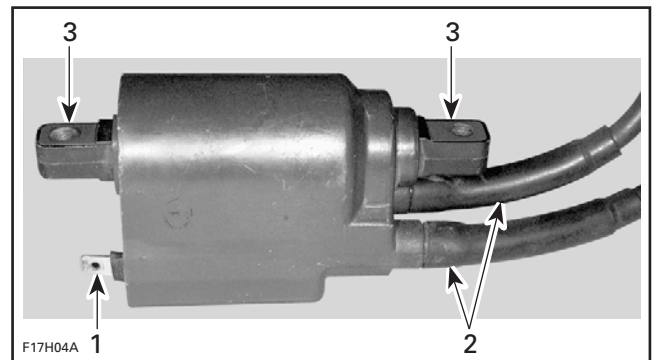
Ignition Coil Verification

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.

717 Engines

Primary Winding



1. Primary side
2. Secondary side
3. Ground plate

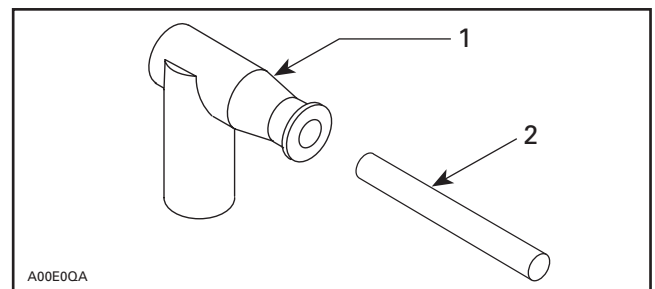
Disconnect the wire connectors on primary side of the ignition coil.

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 K ohms.



1. Resistor cap
2. High-tension cable

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

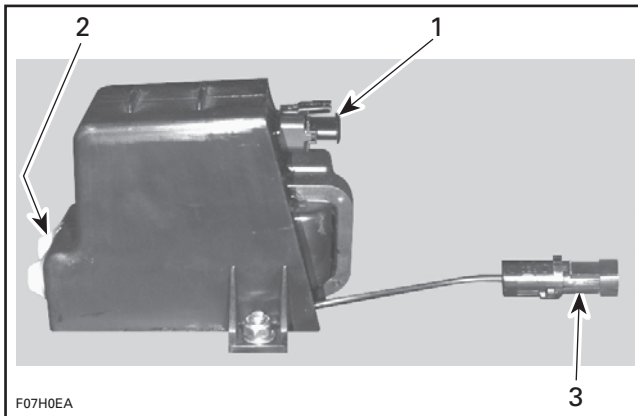
Using a multimeter, check the resistance between the two high tension leads with the spark plug caps removed.

The resistance should be $12 \pm 3 \text{ K}\Omega$ at 20°C .

NOTE: A short circuit will read 0 ohm (or close to) on ohmmeter.

787 RFI Engines

Primary Winding



IGNITION COIL

1. Primary side
2. Secondary side
3. Ground wire

Disconnect the wire connector on the primary side of the ignition coil.

Using a multimeter, check the resistance between the terminals 1 and 2. Repeat a resistance test between terminals 2 and 3.

The resistance should be 0.3 to 0.6Ω at 20°C .

If not within specification, replace the ignition coil.

If the ignition coil test good, check the power supply on the primary side.

Disconnect the ignition coil 3-pin connector. Check to see if there is approximately 6 Vdc between the red wire and engine ground.

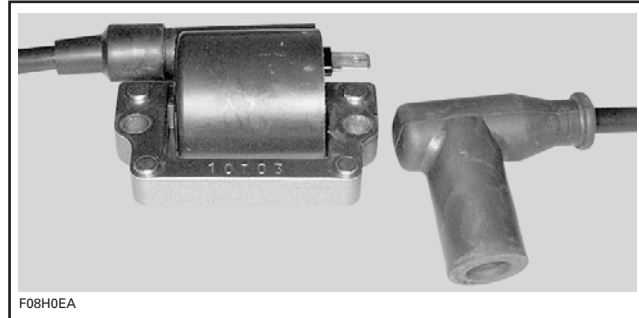
If there is no voltage, either the MPEM or the wiring harness is defective.

Secondary Winding

Due to the integrated diode, it is not possible to take any resistance measurement of the secondary winding on the **GTX RFI models**.

947 Engines

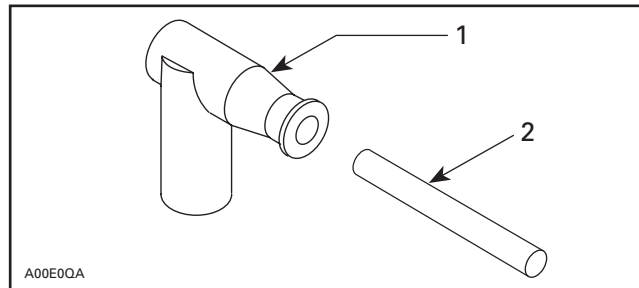
Primary Winding



1. Remove the 1 female spade connector from the primary side of the ignition coil.
2. With the multimeter set on the resistance scale, connect the meter probes to the primary terminal of the coil and the ground.
3. Resistance should be between 0.33 - 0.62 ohm .

Secondary Winding

The spark plug caps must be removed from high tension cables, because they are resistor caps. The cap resistance is 4.48 K ohms .



1. Resistor cap
2. High-tension cable

Using a multimeter, check the resistance between the high tension lead (spark plug cap removed) and the primary side spade connector. Repeat the procedure for the other spark plug cable.

The resistance should be $12 \pm 3.6 \text{ K}\Omega$ at 20°C .

NOTE: A short circuit will read 0 ohm (or close to) on ohmmeter.

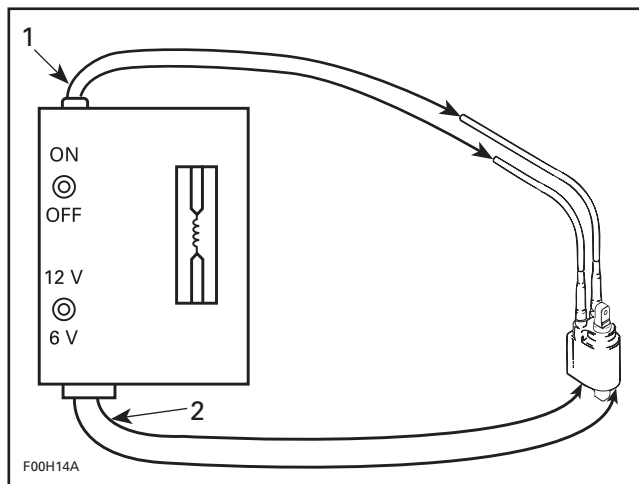
DYNAMIC TEST

All Models

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.

1. With ignition coil removed from craft, disconnect spark plug caps from high tension cables.
2. Hook high tension leads from tester to ignition coil high tension cables.
3. Connect 2 smaller tester leads to primary of ignition coil.



TYPICAL

1. Leads to secondary
2. Leads to primary

4. 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.

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

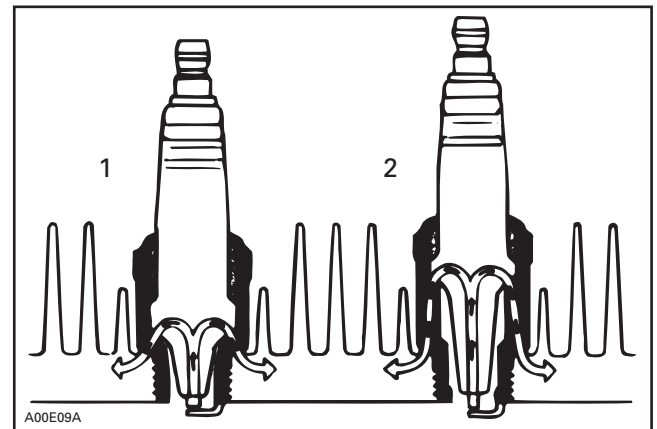
The proper heat range of the spark plugs is determined by the spark plugs ability to dissipate the heat generated by combustion.

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.

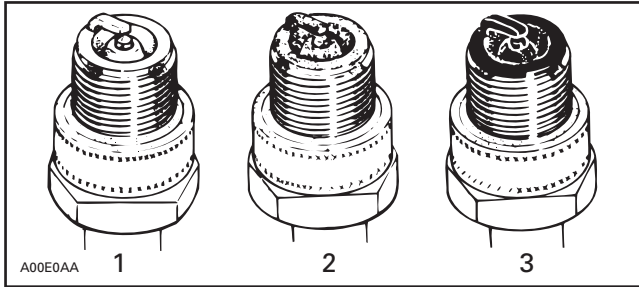
Fouling

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.

Section 10 ELECTRICAL SYSTEM

Subsection 02 (IGNITION SYSTEM)

Spark Plug Analysis



1. Overheated (light grey)
2. Normal (brownish)
3. Fouled (black)

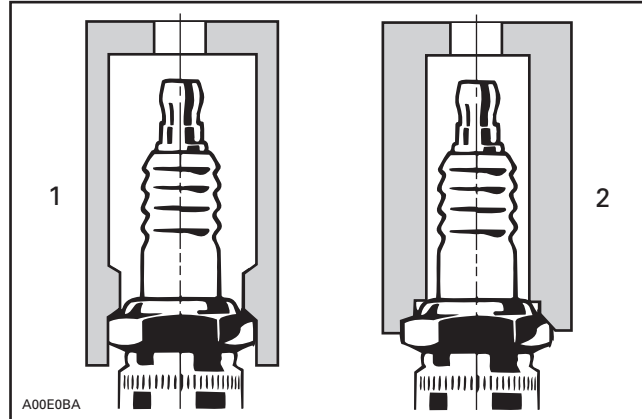
The plug face (and piston dome) reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber) and 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.



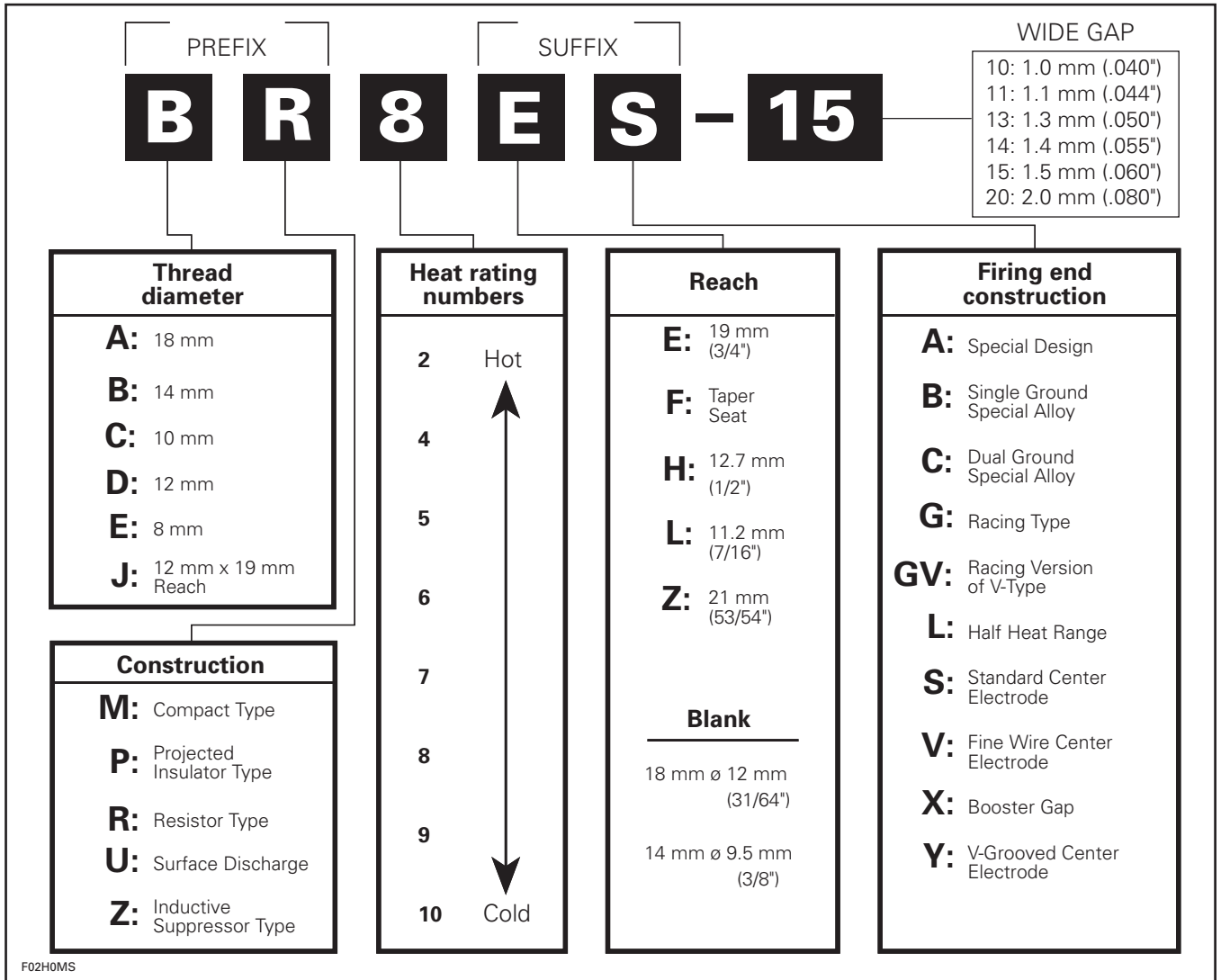
1. Proper socket
2. Improper socket

Spark Plug Chart

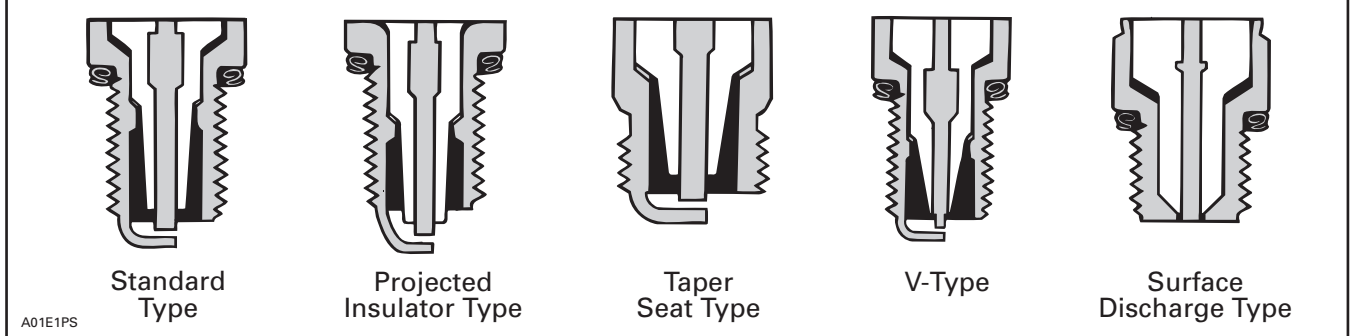
ENGINE	SPARK PLUG	TORQUE N•m (lbf•ft)	GAP mm (inch)
All models except DI	NGK BR8ES	24 (17)	0.4 - 0.5 (.016 - .020)

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

GENERAL

Magneto

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 (AC).

717 Engine

The magneto has a three-pole coil. Capacity is 160 watts.

947 Engine

The magneto has a 3 phase, "Y" wound stator on 18 poles. Capacity is 180 watts.

787 RFI and 947 DI Engines

The magneto has a 3 phase, delta wound stator on 18 poles. Capacity is 270 watts.

Rectifier/Regulator

All Models

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.

717 Engine

A half-wave rectifier receives magneto AC current and transforms it into direct current (DC) to allow battery charging.

947 Engine

A dual 1/2 wave series rectifier receives the magneto AC current and transforms it into direct current (DC) to allow battery charging.

787 RFI and 947 DI Engines

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 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.

GTX RFI Models

The charging system is protected by 2 fuses.

A 15 A fuse is mounted on the MPEM and a 20 A fuse is located in the rear electrical box.

DI Models

The charging system is protected by 2 fuses.

A 25 A fuse is mounted on the MPEM and a 30 A fuse is located in the rear electrical box.

All Other Models

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.

TESTING PROCEDURE

NOTE: First, ensure that battery is in good condition prior to performing the following tests.

Rectifier/Regulator

NOTE: All models with a 947 engine, the rectifier/regulator is integrated in the MPEM.

STATIC TEST: CONTINUITY

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

DYNAMIC TEST

Current Test

Carburetor-Equipped Engines and 947 DI Engines

Proceed as follows:

- Start engine.
- Lay an inductive ammeter on positive cable of battery.
- Bring engine to approximately 6000 RPM.

Section 10 ELECTRICAL SYSTEM

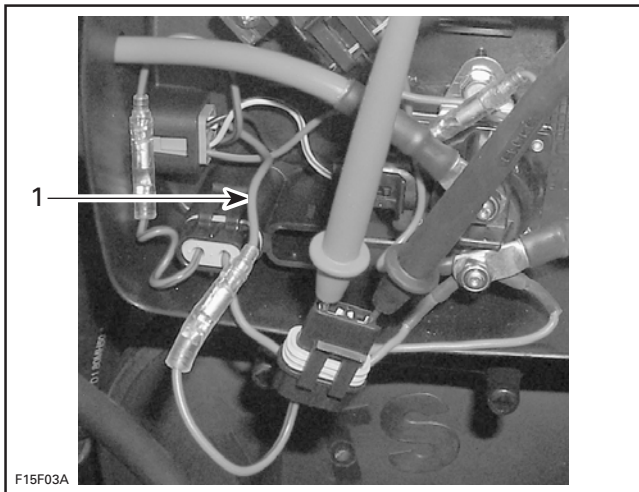
Subsection 03 (CHARGING SYSTEM)

Current reading should be approximately 4 amperes for the **717 engine** and 5 amperes for the **947 carburetor-equipped** and **947 DI engines**. If not, check magneto output prior to concluding that rectifier is faulty.

787 RFI Engines

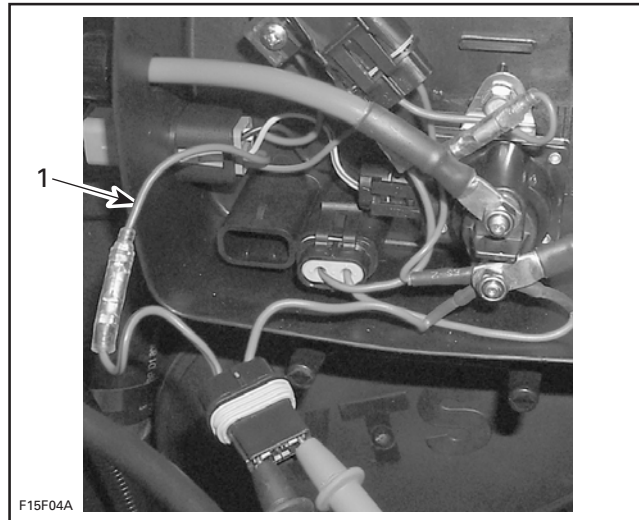
Proceed as follows:

- Open the rear electrical box.
- Remove the 20 A fuse from the holder with the RED wire coming from the connector attached to the electrical box.



1. RED wire

- Connect an ammeter across the fuse holder.
- Start engine.
- Bring engine to approximately 6000 RPM.
- Note the reading. This is the current supplied by the regulator.
- Reinstall fuse.
- Remove the 20 A fuse from the holder with the RED/PURPLE wire coming from the connector attached to the electrical box.



1. RED/PURPLE wire

- Connect an ammeter across the fuse holder.
- Start engine.
- Bring engine to approximately 6000 RPM.
- Note the reading. This is the current actually consumed.
- Reinstall fuse.
- Subtract the consumed current from the regulator current. This gives the actual charging current. It should be within 3 - 4 A.

Charging current = Current from regulator - Consumed current
If charging current is below specification, check magneto output. If the magneto output is good, try another rectifier/regulator. Recheck charging current. If still out of specification, the fuel pump or the MPEM current draw is too high.

If charging current exceeds specification, replace the rectifier/regulator.

Voltage Test

All Models

Proceed 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.

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

NOTE: If it is continually necessary to add distilled water to the battery, this indicates an over voltage situation, requiring replacement of the rectifier/regulator. If, 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.

GS, GTS and GTI Models

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

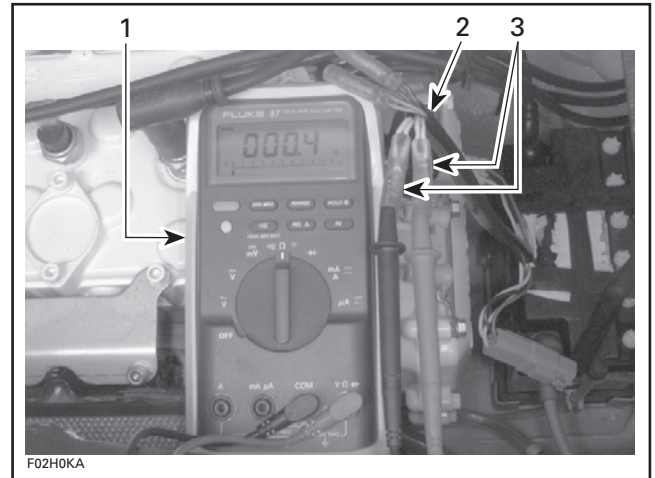
717 Engine

STATIC TEST: CONTINUITY

1. Disconnect the magneto wiring harness connector.
2. Install the 4-pin magneto harness adapter (P/N 295 000 131).
3. Check resistance between the YELLOW and BLACK/YELLOW wires of the magneto harness adapter. Refer to the following table.

PART NAME	ADAPTER 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

DYNAMIC TEST

1. Disconnect the magneto wiring harness connector.
2. Install the 4-pin magneto harness adapter (P/N 295 000 131). Leave wiring harness side disconnected.
3. Connect test probes of the multimeter to the YELLOW and BLACK/YELLOW wires of the 4-pin magneto harness adapter.
4. Start and rev engine to 3500 RPM. The obtained value should be between 25 and 40 Vac.
5. If the battery charging coil is out of specification, replace it.

Section 10 ELECTRICAL SYSTEM

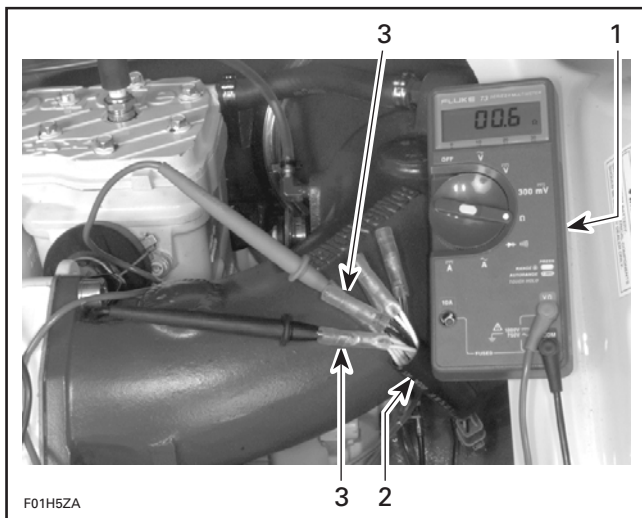
Subsection 03 (CHARGING SYSTEM)

Stator

947 Engines

STATIC TEST: CONTINUITY

1. Disconnect the magneto wiring harness connector.
2. Install the 6-pin magneto harness adapter (P/N 295 000 136).
3. Check resistance between two of the YELLOW wires. The resistance should be between 0.1 to 1.0 ohm.

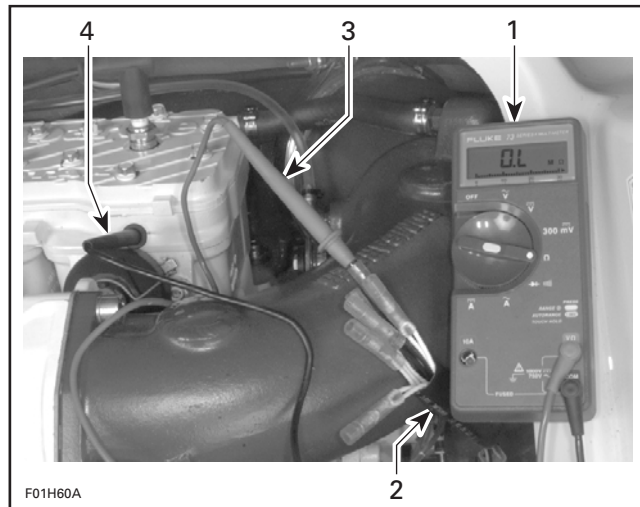


1. Multimeter
2. Magneto harness adapter
3. YELLOW wires

4. Place either meter lead into the remaining YELLOW wire and note the resistance (same as step no. 3). If the readings are out of specification, the stator will need to be replaced.

STATIC TEST: INSULATION

1. Disconnect the magneto wiring harness connector.
2. Install the 6-pin magneto harness adapter (P/N 295 000 136).
3. Insert multimeter positive (+) probe to one of the YELLOW wire of the 6-pin magneto harness adapter.
4. Ground the multimeter negative (-) probe to the engine or the stator iron core and note the reading.



1. Multimeter
2. Magneto harness adapter
3. Positive (+) probe to YELLOW wire
4. Negative (-) probe to ground

5. Repeat test with the other two YELLOW wires of the 6-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

1. Disconnect the magneto wiring harness connector.
2. Install the 6-pin magneto harness adapter (P/N 295 000 136). Leave wiring harness side disconnected.
3. Connect test probes of the multimeter to two of the YELLOW wires of the 6-pin magneto harness adapter.
4. Set multimeter to Vac scale.
5. Start and rev engine to 3500 RPM. The obtained value should be between 45 and 70 Vac.
6. If the stator is out of specification, replace it.

Magneto

787 RFI Engines

STATIC TEST: CONTINUITY

1. Disconnect the magneto wiring harness connector.
2. Install the 4-pin magneto harness adapter (P/N 295 000 131).

3. Check resistance between the BLACK/YELLOW and the BLACK wires of the 4-pin magneto harness adapter. The resistance should be between 0.1 to 1.0 ohm.
4. Place either meter lead into the RED/BLACK wire and note the resistance (same as step no. 3). If the readings are out of specification, the stator will need to be replaced.

STATIC TEST: INSULATION

1. Disconnect the magneto wiring harness connector.
2. Install the 4-pin magneto harness adapter (P/N 295 000 131).
3. Insert multimeter positive (+) probe to the BLACK/YELLOW wire of the 4-pin magneto harness adapter.
4. Ground the multimeter negative (-) probe to the engine or the stator iron core and note the reading.
5. Repeat test with the other BLACK and RED/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

1. Disconnect the magneto wiring harness connector.
2. Install the 4-pin magneto harness adapter (P/N 295 000 131).
3. Connect test probes of the multimeter to the BLACK/YELLOW and RED/BLACK wires of the 4-pin magneto harness adapter.
4. Set multimeter to Vac scale.
5. Start and rev engine to 3500 RPM. The obtained value should be between 45 and 70 Vac.
6. Repeat test with the BLACK wire and either the RED/BLACK or BLACK/YELLOW wires of the 4-pin magneto harness adapter.
7. If the stator is out of specification, replace it.

BATTERY

Troubleshooting

SYMPTOM: DISCHARGED OR WEAK BATTERY	
CAUSE	REMEDY
1. Battery posts and/or cable terminal oxidized.	Clean and coat with dielectric grease.
2. Loose or bad connections.	Check wiring and connector cleanliness, damaged or short circuit.
3. Faulty battery (sulfated, doesn't keep a full charge, damaged casing, loose post).	Replace.
4. 15 amp fuse(s) burnt or faulty rectifier.	First check fuse. If it is in good condition, check rectifier/regulator.
5. Faulty battery charging coil (or stator).	Replace.

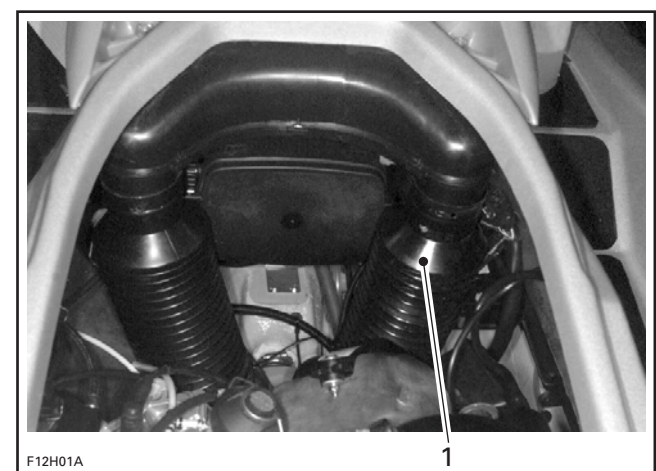
Removal

⚠ WARNING

Battery BLACK negative cable must always be disconnected first and connected last. Never charge or boost battery while installed in watercraft.

RX Models

Remove LH side bilge vent tube at rear.



1. LH side vent tube

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

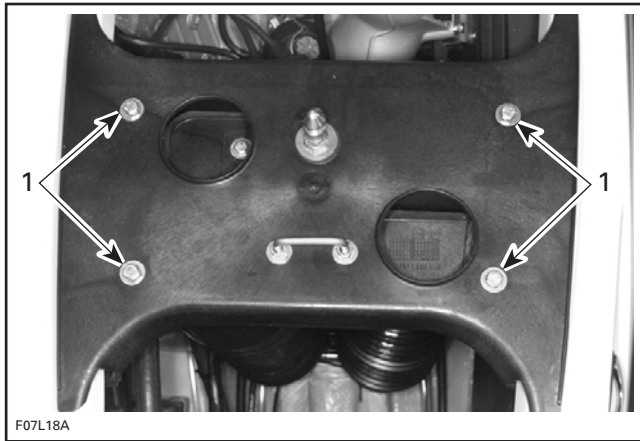
All Models except GTS, GTI and GTX RFI Models

Proceed as follows:

1. Disconnect the BLACK negative cable first.
2. Disconnect the RED positive cable last.
3. Remove the vent line from the battery.
4. Remove the holding strap(s).
5. Withdraw battery from watercraft being careful not lean it so that electrolyte flows out of vent elbow.

GTS, GTI and GTX Series

Remove 4 M6 bolts retaining seat support and remove upper section from watercraft.



1. Remove bolts

Pull lower section with vent tubes toward the front of the watercraft.

Disconnect battery cables and vent tube from battery.

Remove battery straps.

Release battery from support and move it toward the front of the watercraft.

Pull battery from under resonator and remove battery from watercraft.

All Models

⚠ 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 loaded test gives more accuracy of the battery condition.

Electrolyte Reading

Check charge condition using either a hydrometer or multimeter.

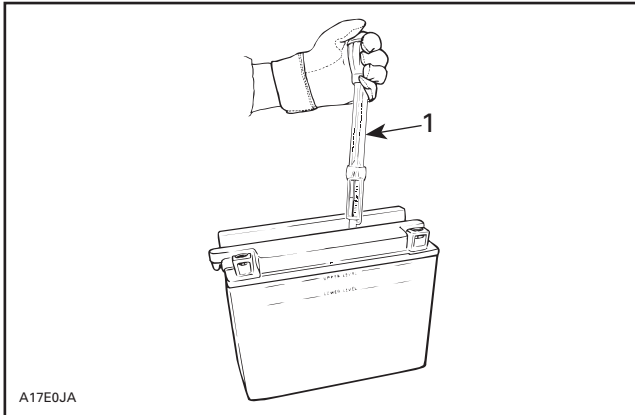
With a multimeter, voltage readings appear instantly to show the state of charge. Always respect polarity. A fully charge battery will have a reading of 12.6 Vdc.

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

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.

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

Clean battery terminals and cable connections using a wire brush. Apply a light coat of dielectric grease on terminals.

Clean battery casing and caps using a solution of baking soda and water.

CAUTION: Do not allow cleaning solution to enter battery.

Rinse battery with clear water and dry well using a clean cloth.

Store battery in a cool dry place. Such conditions reduce self-discharging and keep fluid evaporation to a minimum. Keep battery away from dew, high moisture and direct sunlight.

During the storage period, recheck electrolyte level and specific gravity readings at least every month. If necessary, keep the battery at its upper level line and near full charge as possible (trickle charge).

Activation of a New Battery

⚠ WARNING

Never charge or boost battery while installed in watercraft.

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.

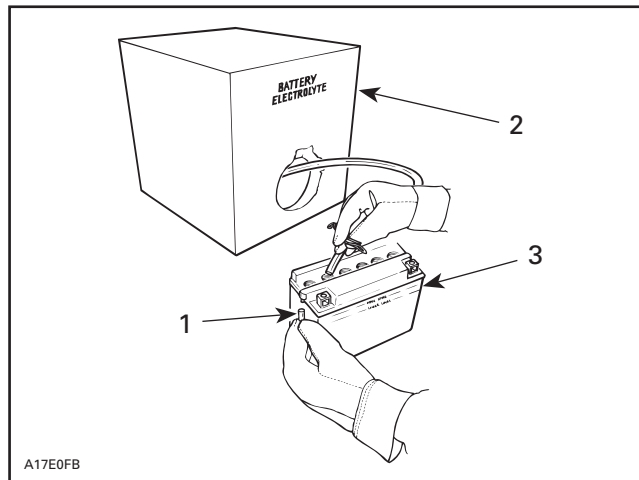
1. Remove the sealing tube from the vent elbow.

⚠ WARNING

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

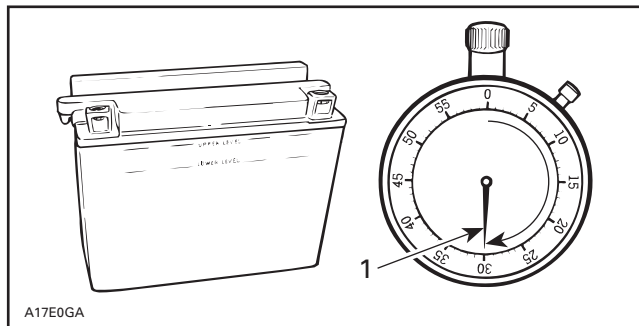
2. Remove caps and fill battery to UPPER LEVEL line with electrolyte (specific gravity: 1.265 at 21°C (70°F)).

NOTE: This battery may fill slower than others due to the anti-spill check ball design.



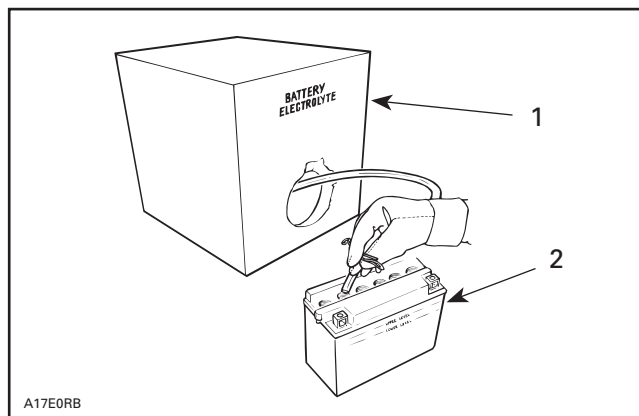
1. Sealing tube removed
2. Battery electrolyte
3. Upper level line

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



1. 30 minutes

4. Readjust the electrolyte level to the UPPER LEVEL line.

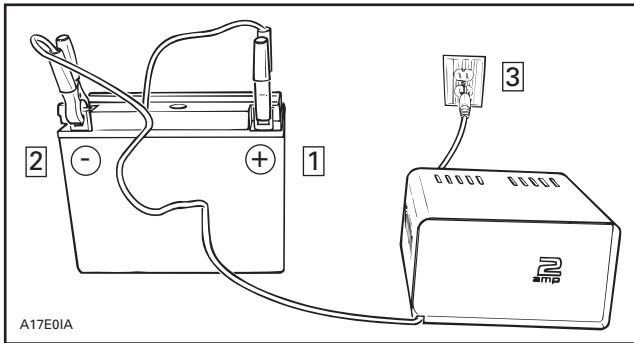


1. Battery electrolyte
2. Upper level line

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

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



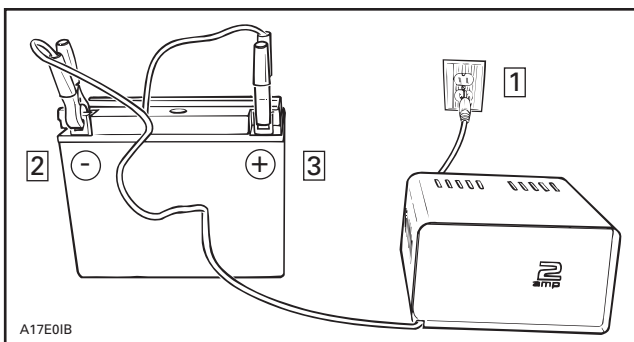
- Step **1**: Connect + lead to battery + post
Step **2**: Connect - lead to battery - post
Step **3**: Plug battery charger

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.

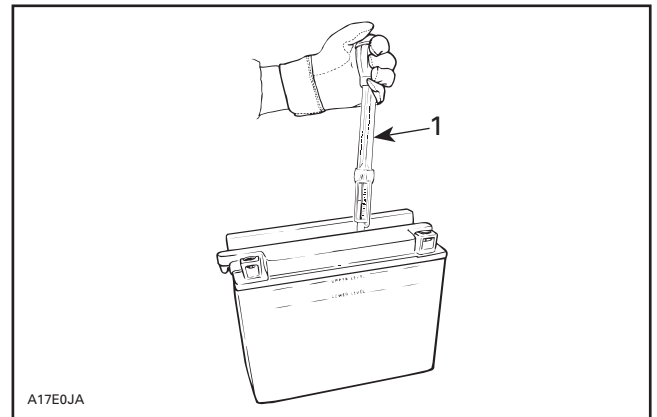
CAUTION: If charging rate raises higher than 2.4 A reduce it immediately. If cell temperature rises higher than 50°C (122°F) or if the casing feels hot, discontinue charging temporarily or reduce the charging rate.

6. Disconnect battery charger.



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

7. Test battery state of charge. Use a hydrometer.



1. Specific gravity 1.265

8. 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.
9. 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.

Section 10 ELECTRICAL SYSTEM

Subsection 03 (CHARGING SYSTEM)

- 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:

1. Install battery in its emplacement.
2. 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.

3. **First** connect RED positive cable.
4. Connect BLACK negative cable **last**.
5. Apply dielectric grease on battery posts.
6. Verify cable routing and attachment.

RX Models

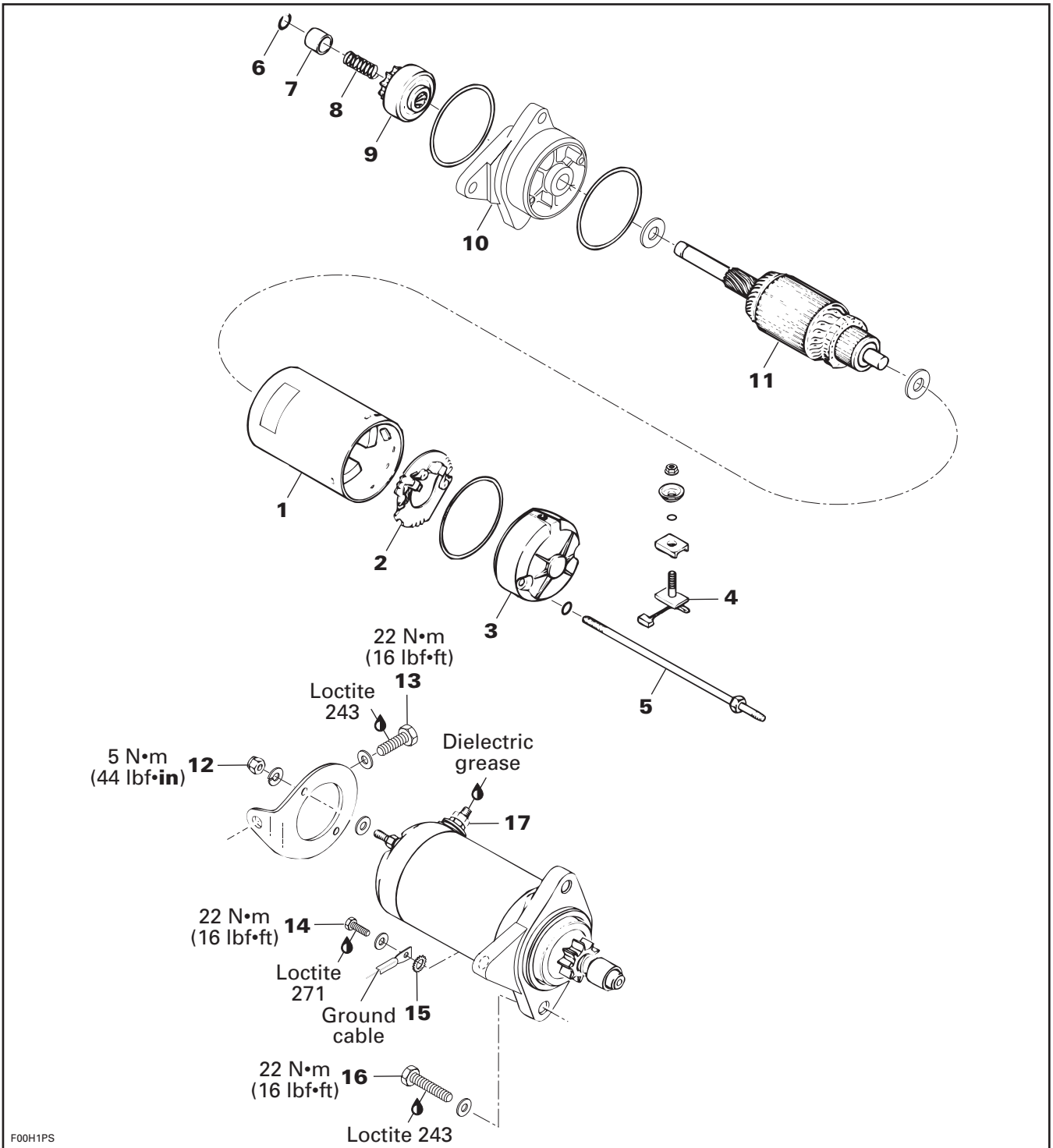
Reinstall bilge vent tube.

GTS, GTI and GTX Series

Reinstall seat support.

STARTING SYSTEM

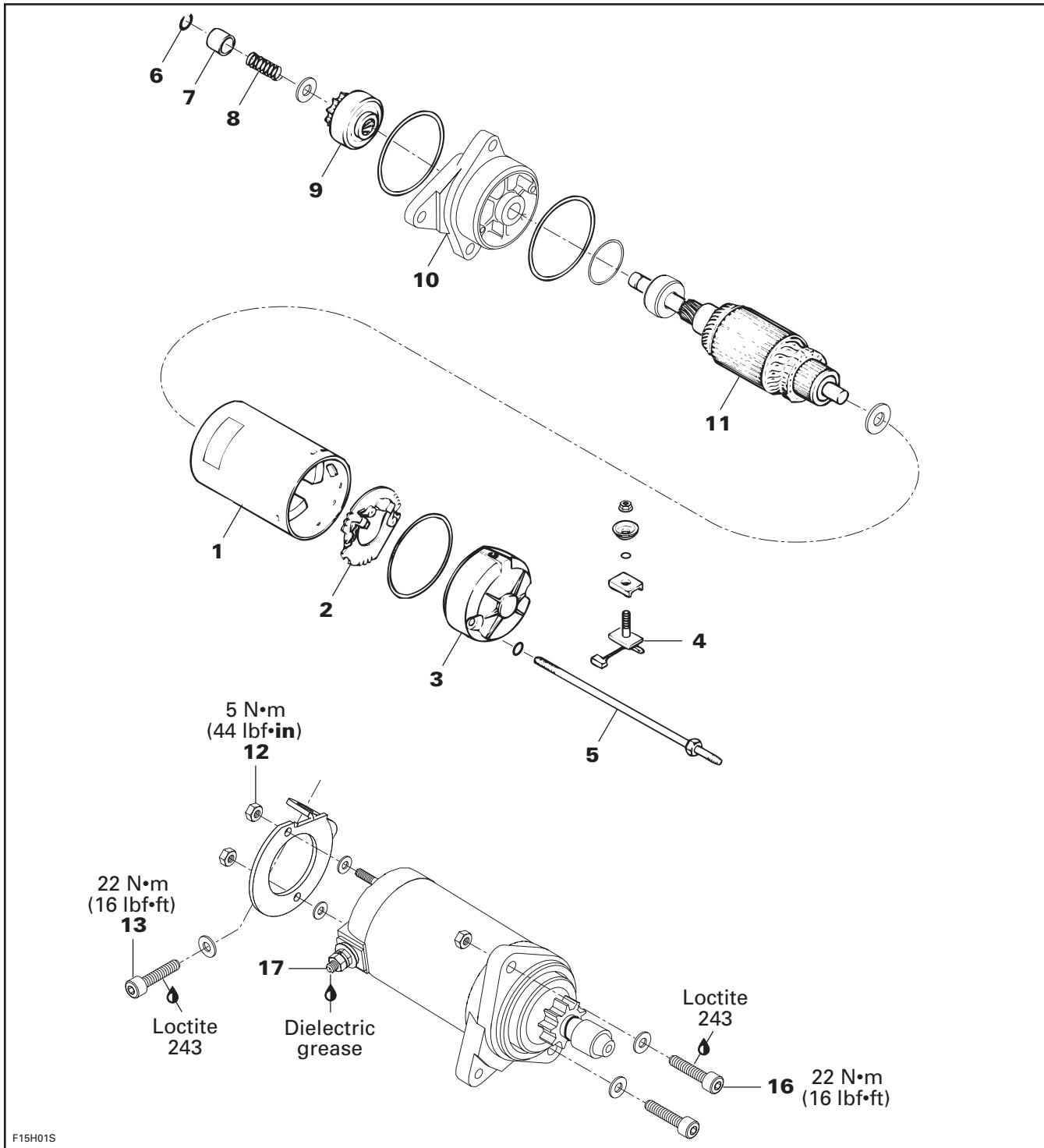
717 Engine



Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

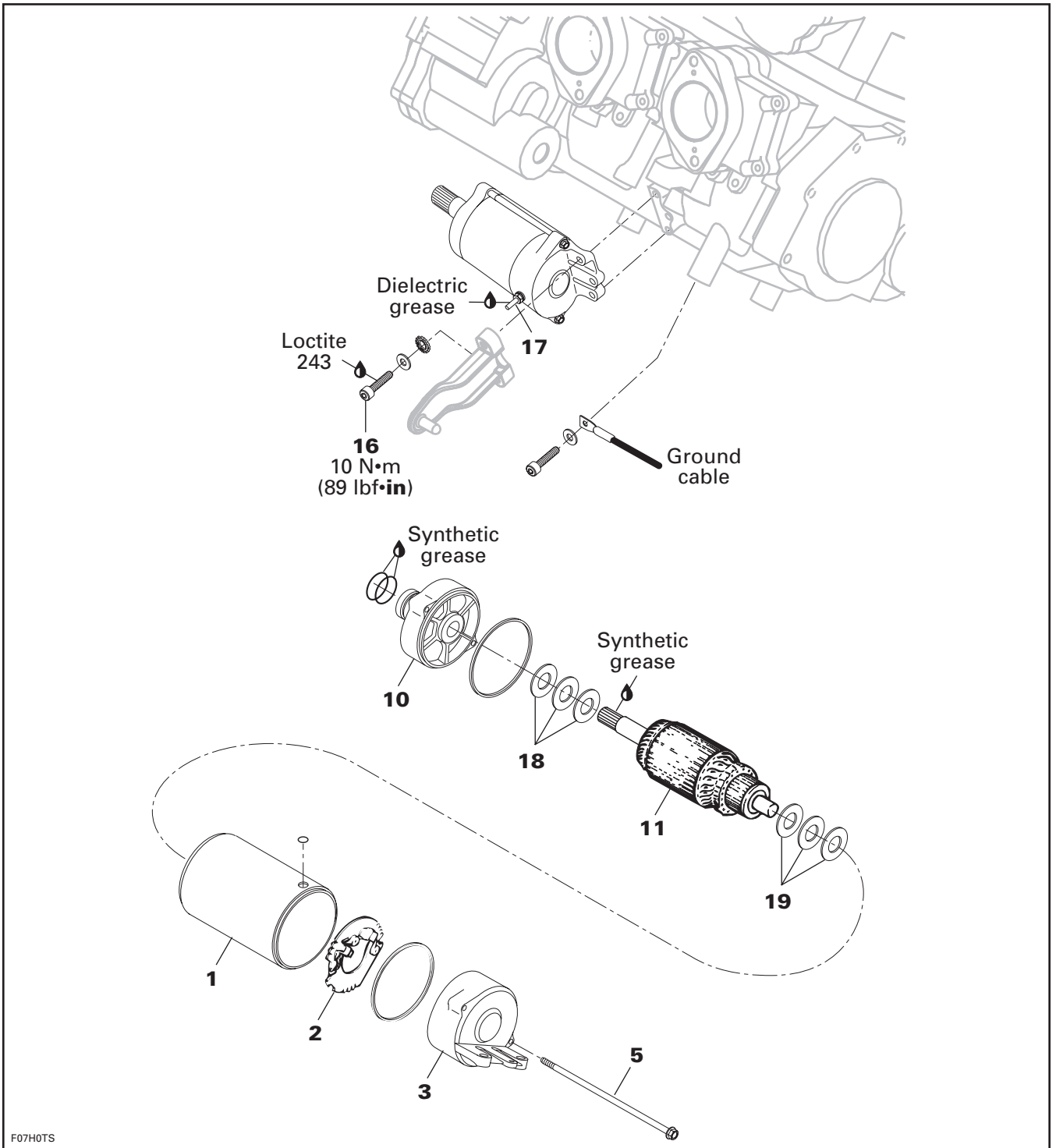
787 RFI Engine



F15H01S

Section 10 ELECTRICAL SYSTEM
Subsection 04 (STARTING SYSTEM)

947 Engine



F07H0TS

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

GENERAL

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

Check these components before removing starter. Consult also the starting system troubleshooting table on next page for a general view of possible problems.

WARNING

Short circuiting electric starter is always a danger, therefore disconnect the battery ground cable before carrying out any kind of maintenance on starting system. Do not place tools on battery.

Fuse

Make sure 5 A fuse on MPEM is in good condition. The solenoid may be the cause of a burnt fuse. If the solenoid checks good, one of the accessory may be defective.

Battery

To check battery condition, refer to CHARGING SYSTEM.

MPEM

If 2 short beeps are not heard when installing the safety lanyard, refer to DIGITALLY ENCODED SECURITY SYSTEM or ENGINE MANAGEMENT.

Engine Start/Stop Switch and Safety Lanyard Switch

Refer to IGNITION SYSTEM or ENGINE MANAGEMENT.

Solenoid

NOTE: Solenoid is located in the electrical box. Inspect connections and clean as necessary.

Static Test: Continuity

With a multimeter, check primary winding resistance. It should be approximately 5 ohms.

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

Dynamic Test

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

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

Electrical Cables or Connections

Check all connections, cables and wires. Tighten any loose cables. Replace any chafed wires.

STARTING SYSTEM TROUBLESHOOTING

SYMPTOM	CAUSE	REMEDY
STARTER DOES NOT TURN.	Burnt 5 A fuse on MPEM.	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.
	Safety lanyard or MPEM.	Refer to DIGITALLY ENCODED SECURITY SYSTEM or ENGINE MANAGEMENT.
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 which gives continuity.	Verify electrical box watertightness.

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

STARTER REMOVAL

Disconnect BLACK cable ground connection from battery.

WARNING

Always disconnect ground cable first and re-connect last.

Disconnect RED cable connection from battery.

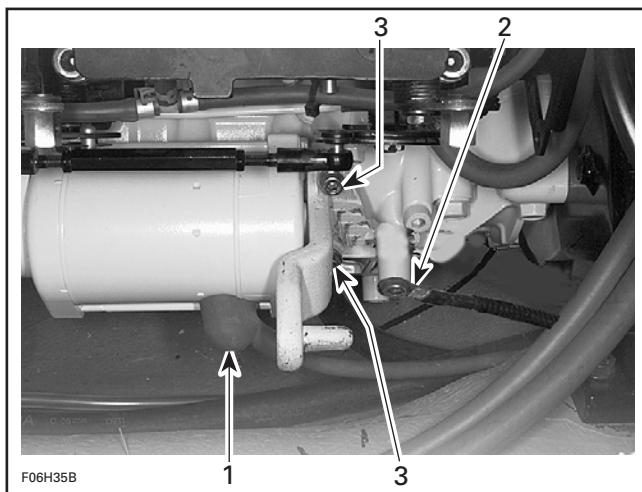
717 and 787 RFI Engines

Remove the following parts:

- cables from starter
- screw no. 13 of starter rear support
- starter mount screws no. 16.

947 Engine

Disconnect starter cables and loosen Allen screws no. 16 retaining starter bracket to engine.



1. Positive starter cable
2. Negative starter cable
3. Allen screw

Remove bracket and starter.

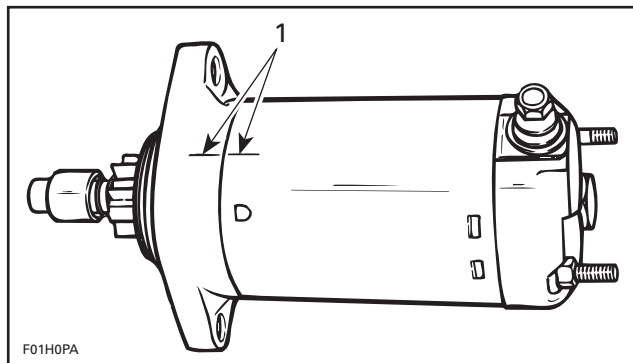
NOTE: To remove the starter drive assembly, mag-neto flywheel has to be removed. Refer to MAG-NETO SYSTEM and BOTTOM END.

To check and replace the starter end bearing, refer to BOTTOM END section.

STARTER DISASSEMBLY

717 and 787 RFI Engines

Before disassembling, trace index marks on yoke no. 1 and clutch housing no. 10 to ease further assembly.



TYPICAL

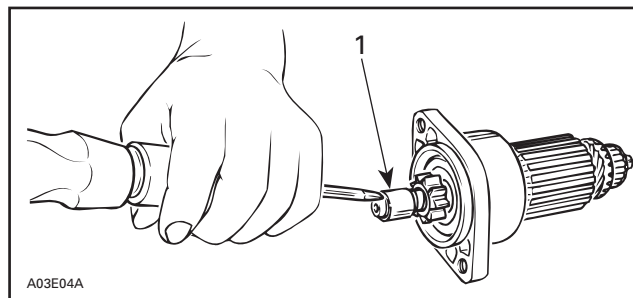
1. Trace indexing marks

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.

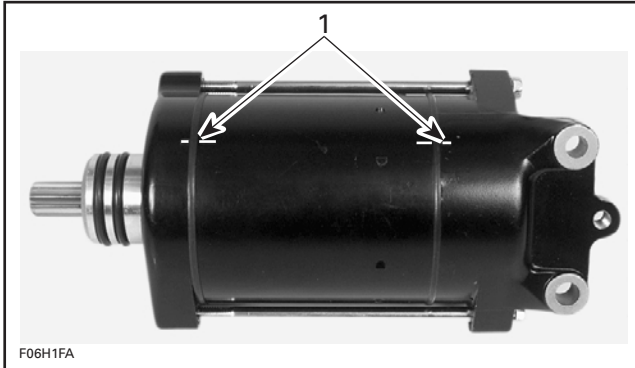
Pull housing from armature.

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

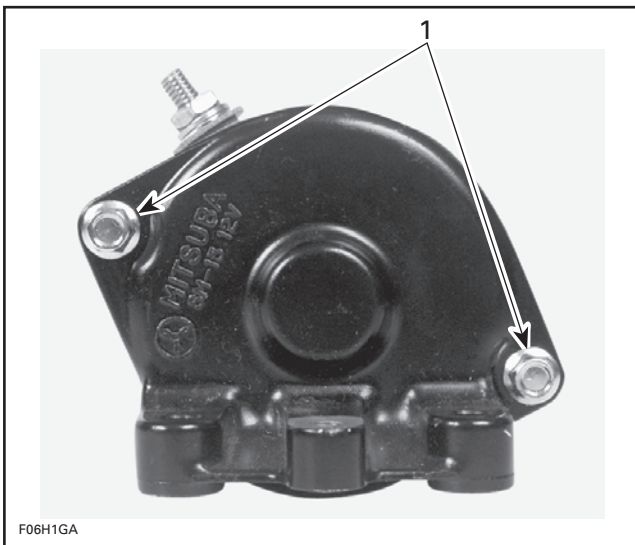
947 Engine

Locate index marks on yoke no. 1 and end covers no. 3 and no. 10.



1. Index marks

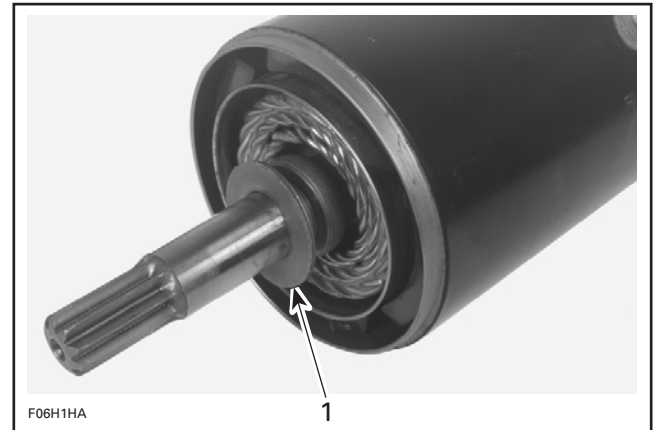
Loosen through bolts no. 5.



1. Through bolts

Remove end cover no. 3 and gasket on armature shaft side.

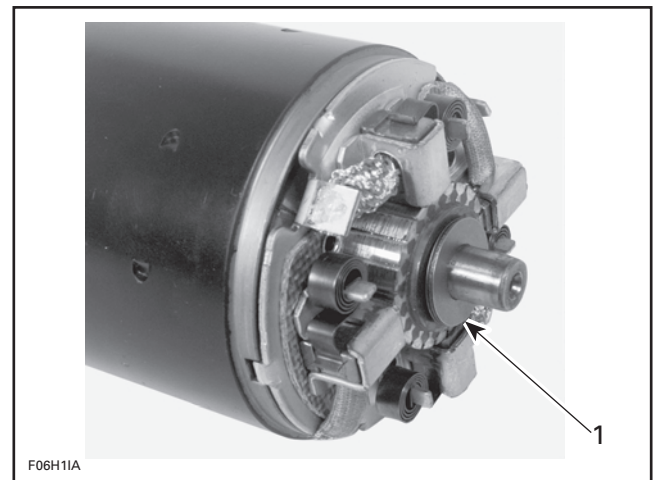
Remove thrust washers no. 19 from armature shaft.



1. Thrust washers

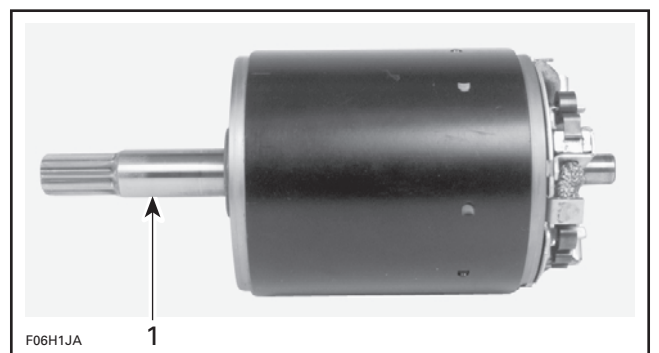
Remove the other end cover no. 10 and gasket.

Remove the three washers no. 18 from armature shaft.



1. Washers

Remove armature no. 11.

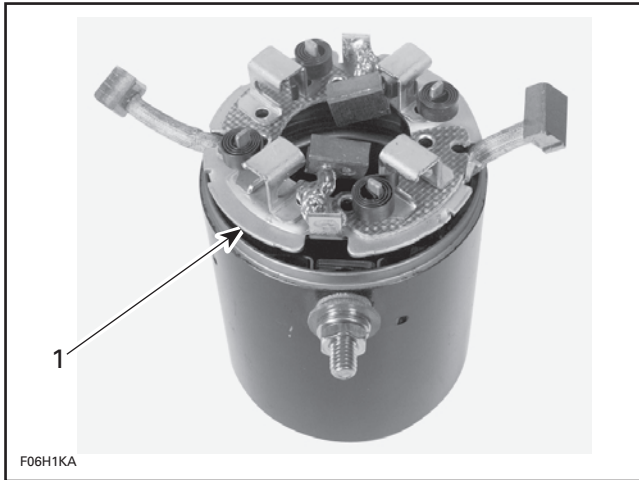


1. Pull armature shaft

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

Release brush wires of yoke from brush holder no. 2.
Remove brush holder no. 2.



1. Remove brush holder

To remove brushes from yoke no. 1, loosen nut and remove washers.



1. Loosen nut and remove washers

Remove brushes.

To remove bearing and seal in end cover, release tabs of retainer.



1. Retainer

CLEANING

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

Discard all O-rings.

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

Blow brush holders clean using compressed air.

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.

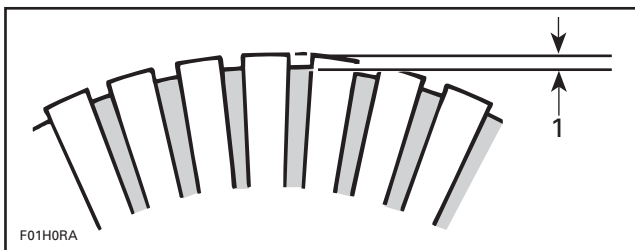
PARTS INSPECTION

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.

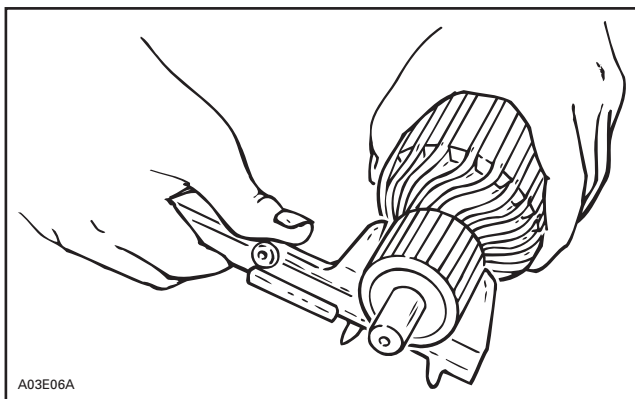
Check commutator for mica depth. If depth is less than 0.20 mm (.008 in), undercut mica. Be sure that no burrs are left and no copper dust remains between segments after undercutting operation is completed.



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.



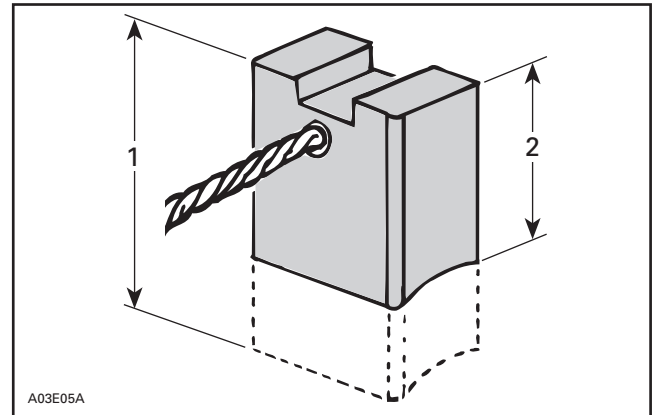
Brush Holder

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.

STARTER ASSEMBLY

Reverse the order of disassembly to reassemble starter. However, attention should be paid to the following operations.

717 and 787 RFI Engines

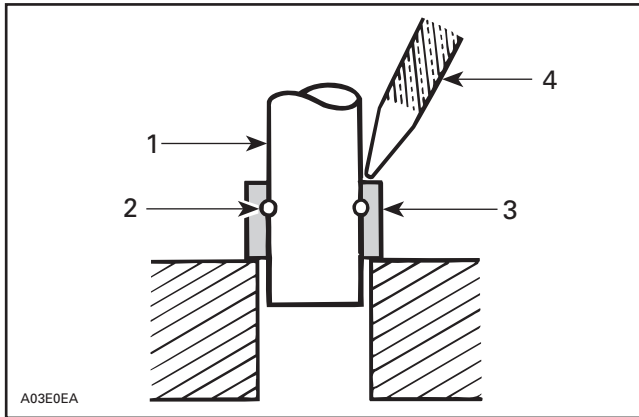
Prior to assembling, coat sliding surfaces on armature shaft splines, overrunning clutch and bushing (717 engine) with G.E. Versilube G 341 M or ESSO Beacon 325 lubricant or equivalent.

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.

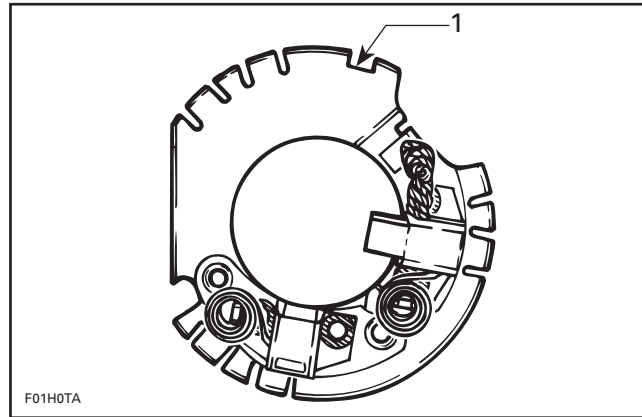
Slide stop collar no. 7 over circlip no. 6 and secure in place by punching it at two or three places.

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)



1. Armature shaft
2. Circlip
3. Pinion stop collar
4. Punch

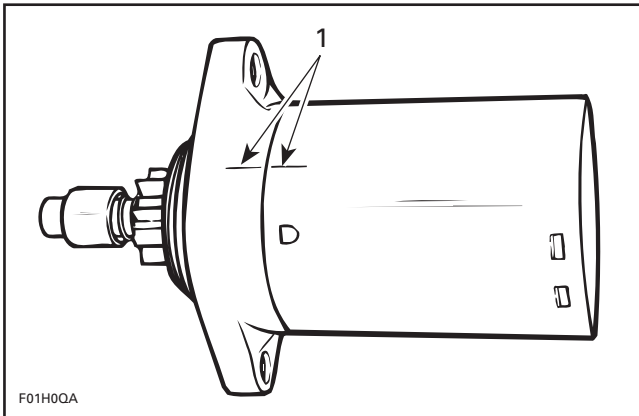


1. Brush holder locating notch

To ease end frame installation, retain brush holder with a small screwdriver while installing end frame.

Yoke Assembly and Clutch Housing

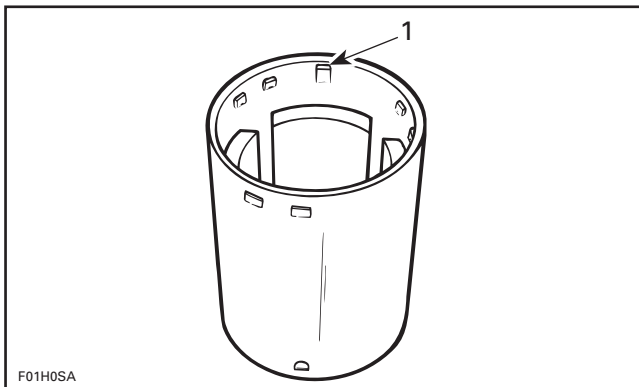
Align previously traced indexing marks.



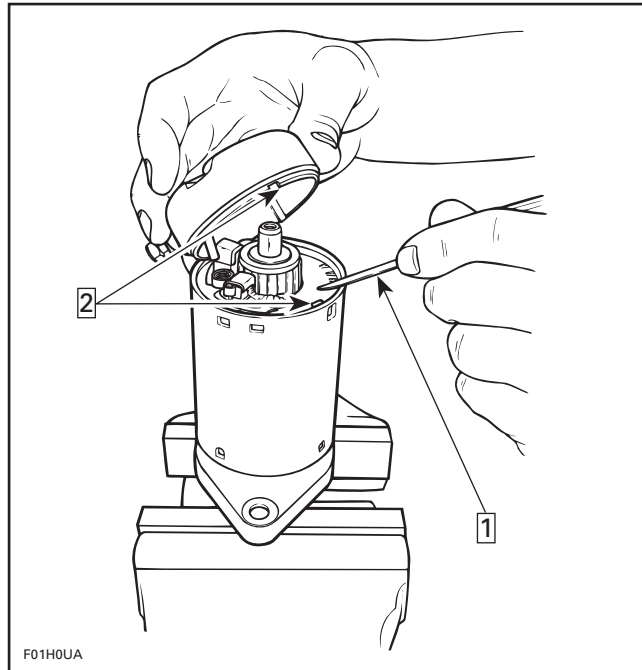
TYPICAL

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



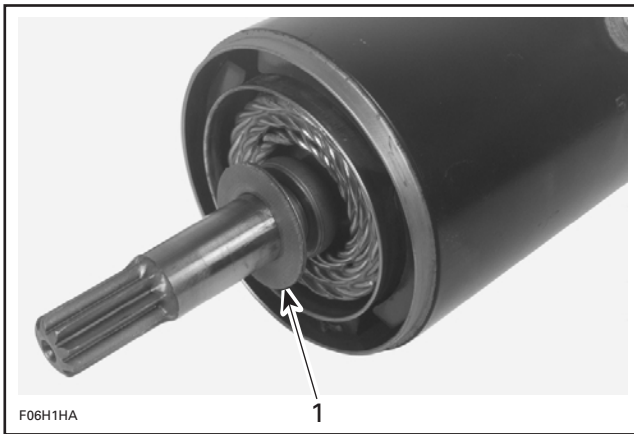
- Step **1**: Retaining brush holder with a screwdriver
Step **2**: Align here

Align end frame notch with brush holder notch/yoke protrusion.

CAUTION: Make sure end frame fits perfectly on yoke.

947 Engine

Install new O-rings and gaskets.
 Insert thrust washers **no. 19** onto armature shaft.



1. Thrust washers

Install the three washers **no. 8** onto armature shaft.
 When installing end covers **no. 3** and **no. 10** to yoke, align index marks.
 Apply Loctite 271 (red) on through bolts **no. 5** and torque to 6 N•m (53 lbf•in).

STARTER INSTALLATION

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

Make sure that starter and engine mating surfaces are free of debris. Serious trouble may arise if starter is not properly aligned.

717 Engine

Screw

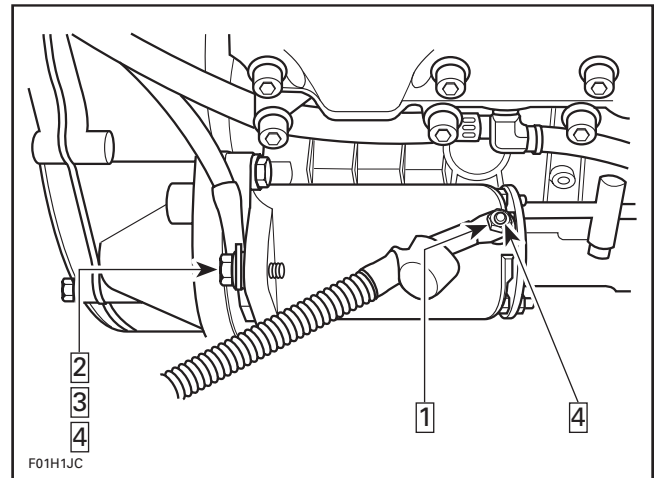
Apply Loctite 243 (blue) on threads and torque starter screws **no. 13** and **no. 16** to 22 N•m (16 lbf•ft).

Nut

Connect the RED positive cable to the starter and torque nut **no. 17** to 6 N•m (53 lbf•in). Apply dielectric grease on terminal and nut.

Screw and Teeth Washer

Apply Loctite 271 (red) 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 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.

947 Engine

Screw

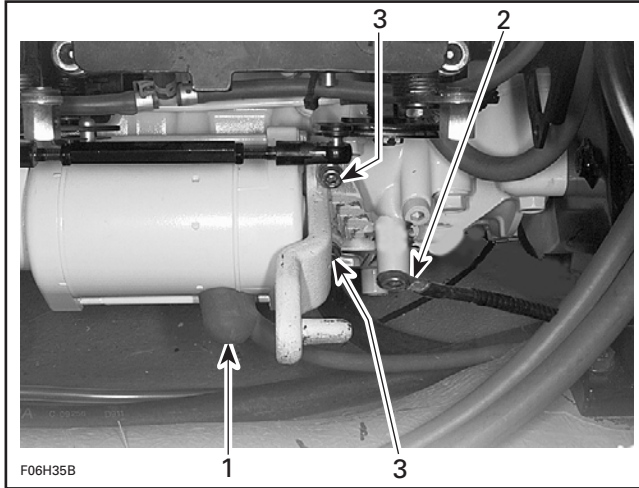
Apply Loctite 243 (blue) to Allen screws **no. 16** of starter bracket and torque to 10 N•m (89 lbf•in).

Section 10 ELECTRICAL SYSTEM

Subsection 04 (STARTING SYSTEM)

Nut

Connect the RED positive cable to the starter and torque nut no. 17 to 6 N•m (53 lbf•in). Apply dielectric grease on terminal and nut.



GTX MODEL

1. Torque nut to 6 N•m (53 lbf•in), apply dielectric grease and install protection cover
2. Negative BLACK cable
3. Apply Loctite 243 to threads and torque screw to 10 N•m (89 lbf•in)

WARNING

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

STARTER SPECIFICATION

717 and 787 RFI Engines

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		

947 Engine

Nominal output		0.8 kW		
Voltage		12 V		
Rated time		30 seconds		
Rotation		Counterclockwise (viewed from pinion side)		
Weight		1.7 kg (3.7 lb)		
Performance specification at 20°C (68°F)	No load	10.9 V	45 A max.	8600 RPM
	Load	9 V	120 A max.	5350 RPM
	Stall	2.25 V	390 A max.	0 RPM
Battery		12 V, 19 Ah		

INSTRUMENTS AND ACCESSORIES

GENERAL

It is possible to activate the instruments when the engine is not running.

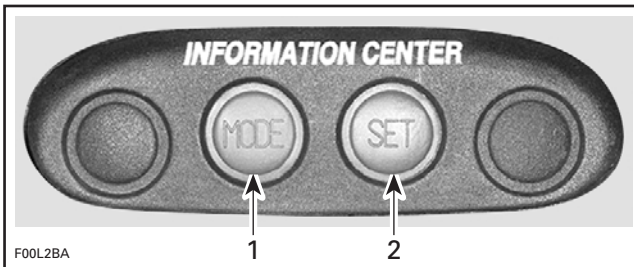
Make sure the safety lanyard is removed, then depress the start/stop button.

The timer of the MPEM will maintain the gauge(s) activated during a period of approximately 33 seconds.

Information Center

NOTE: With the safety lanyard disconnected, information center can be activated for approximately 33 seconds by depressing the engine start/stop button.

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.

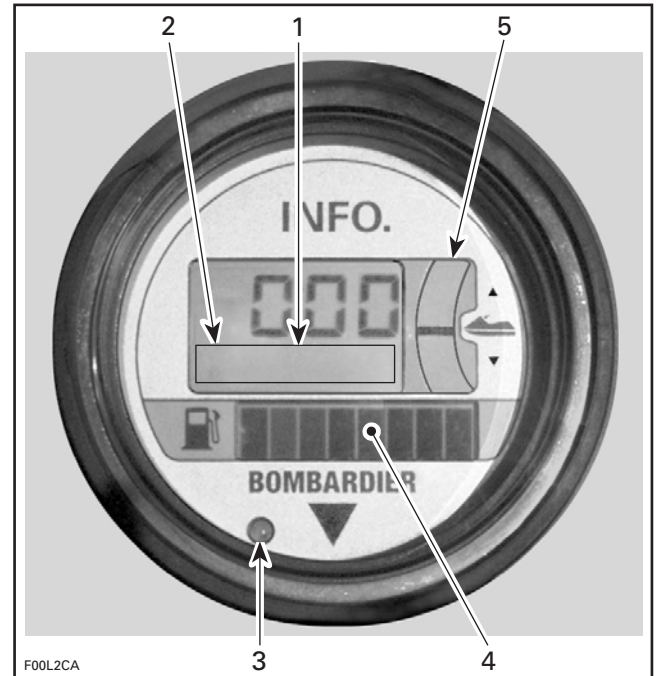


1. To change display mode
2. To set or reset a function

Resetting a Function

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

The information center includes the following display areas.

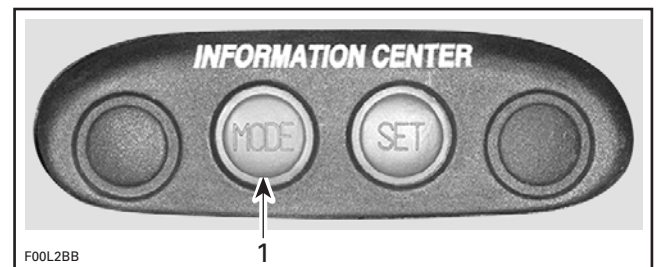


1. General display
2. Message/units display
3. Warning light
4. Fuel level display
5. VTS position indicator (if so equipped)

General Display

The default display is the clock (or clock/compass if so equipped) unless another mode has been selected. See **Display Priorities** below.

Repeatedly pressing the MODE button scrolls the following displays: Tachometer, speedometer, peak speed, average speed, trip meter, hourmeter, water temperature, exterior temperature (if so equipped) and chronometer.



1. Press to change display mode

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

When you are satisfied with your choice, stop pressing the button.

Clock: Indicates the actual time in hours and minutes (hh:mm).

Clock/Compass (if so equipped): 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).

Peak Speed: Indicates the top speed the watercraft reached (PK KPH or PK 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).

Hourmeter: Displays the time in hours of the watercraft usage.

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

Exterior Temperature (if so equipped): 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)
- fuel injection system sensors and major components (DI models).

Except for low fuel and low oil, which can be corrected by refilling, refer to DIAGNOSTIC PROCEDURES section when other messages occur.

The warning light will blink at the same time.

Warning Light

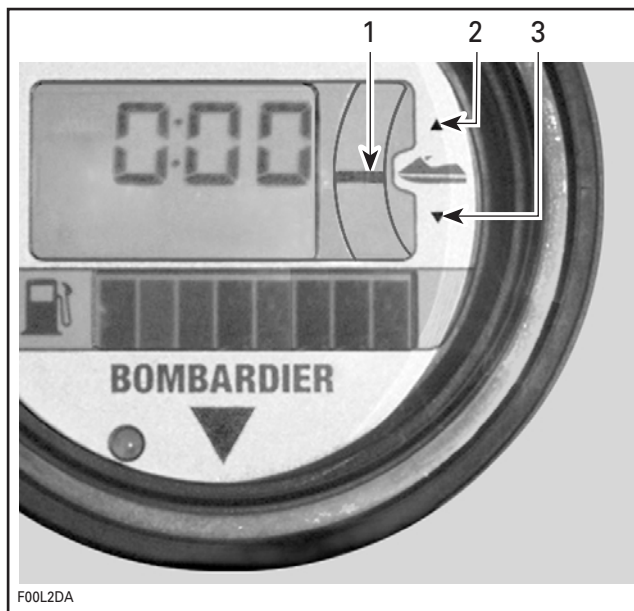
The red warning LED (Light-Emitting Diode) blinks along with the message display to catch your attention.

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.

VTS Position Indicator (if so equipped)

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



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

Display Priorities

The clock, (clock/compass, if so equipped) is the default display mode. The default display is the one that appears when the information center is first activated or displayed back after an alternate display was chosen.

The tachometer, speedometer and chronometer, are the only other modes that may be chosen to replace the default display. When one of these is selected, it will become the default display until it is changed again.

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

When another display mode is chosen, the default display will be displayed back after 4 seconds.

As a self test, all LCD segments and the LED will turn on for 3 seconds each time the information center is activated.

In the event of a warning message, the message will blink and override the units display.

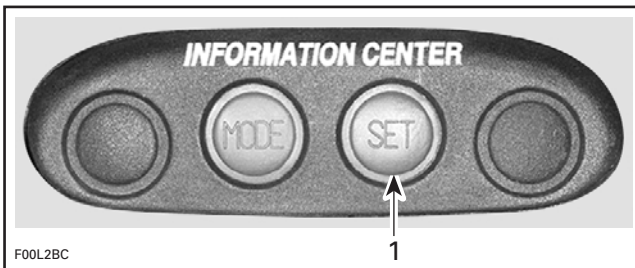
If more than one warning message occurs, the blinking messages will scroll every 4 seconds.

Other Functions

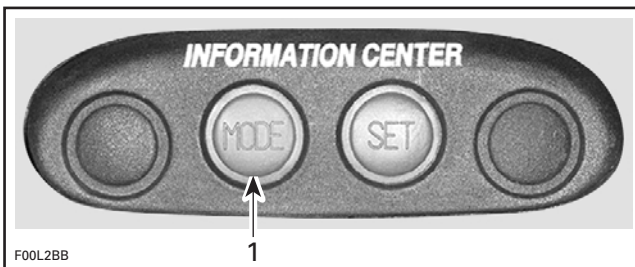
The following describes how to select other available functions.

Language Option

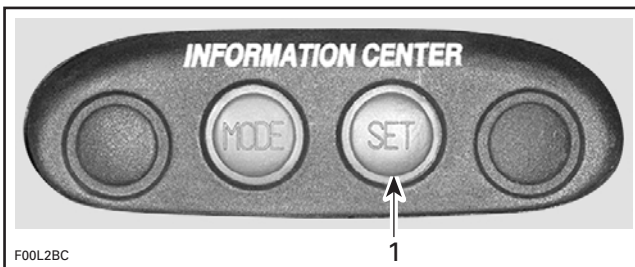
While in the clock/compass mode:



1. Press and hold for 2 seconds



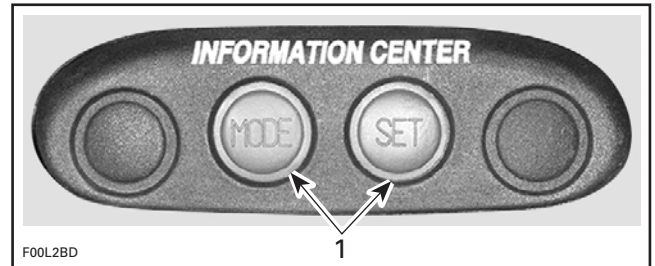
1. Repeatedly press



1. Press to end

English/Metric System

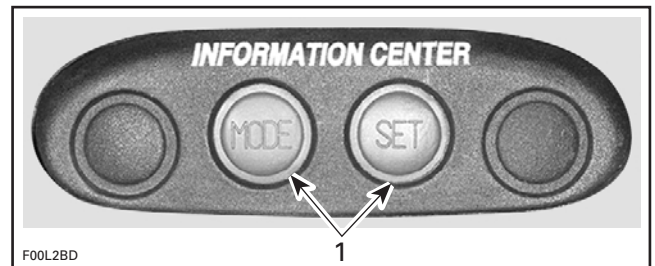
Allows to display the units in the metric system or in the SAE English system.



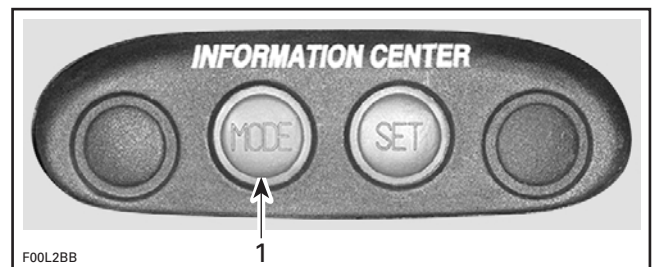
1. Press TOGETHER and hold for 2 seconds

Clock Adjustment

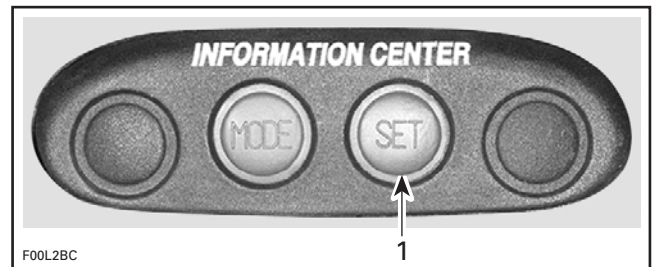
While in the clock/compass mode:



1. Press TOGETHER and hold for 2 seconds



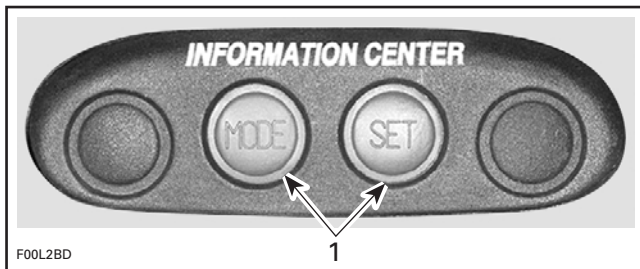
1. Repeatedly press to adjust HOURS



1. Repeatedly press to adjust MINUTES

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

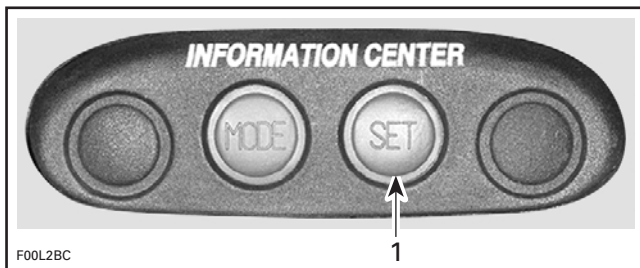


1. Press **TOGETHER** to end

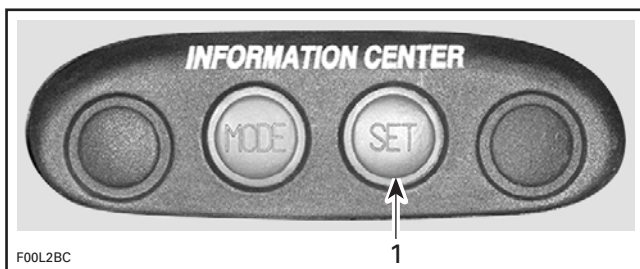
NOTE: If MODE and SET buttons are not pressed at the end, the default display will come back after 10 seconds and the time entered will remain.

Chronometer

While in the chronometer mode:



1. Press to start or stop chronometer

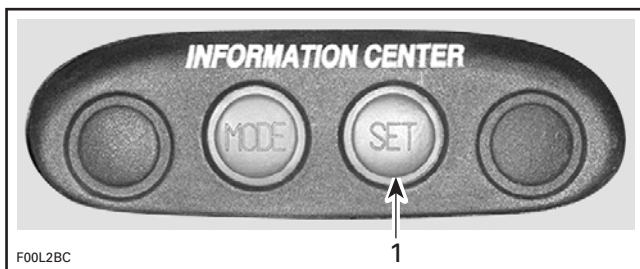


1. Press and hold for 2 seconds to reset

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

NOTE: If maintenance message (MAINT) continues to blink, it indicates a fault with the fuel injection system on **Di** models. Refer to DIAGNOSTIC PROCEDURES section.

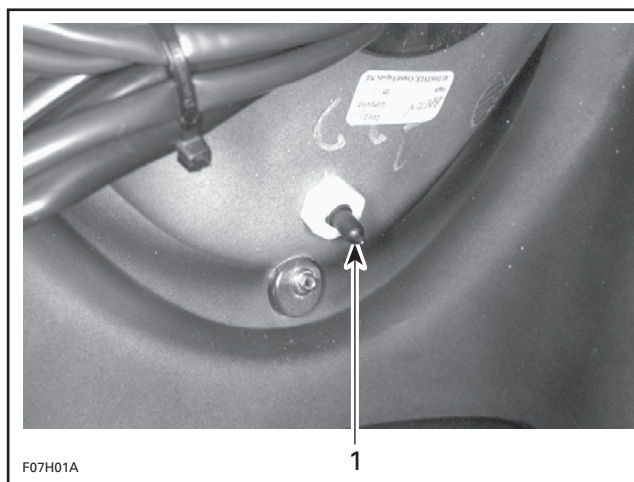
INSPECTION

Air Temperature Sensor

GTX Series

The temperature sensor is located in the storage cover.

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



1. Temperature sensor

To check if the temperature sensor is operational, activate the Info Center and select the exterior temperature mode.

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

If not, replace the temperature sensor.

Water Temperature Sensor

GTX Series and RX Series

The water temperature sensor is integrated with the speed sensor located on the ride plate.

To check if the water temperature sensor is operational, activate the Info Center and select the lake temperature mode.

With a garden hose, spray the speed sensor with water. The temperature reading on the Info Center should adjust to the water temperature.

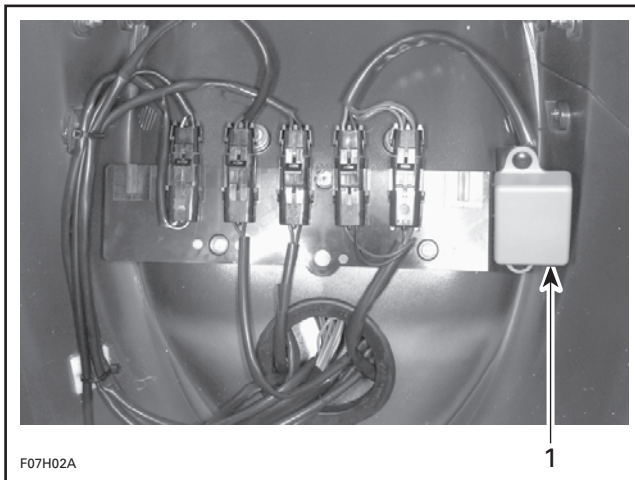
If not, replace the speed sensor.

Compass

GTX Series

The compass is located in the storage cover.

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



1. Compass

Remove the compass from the support.

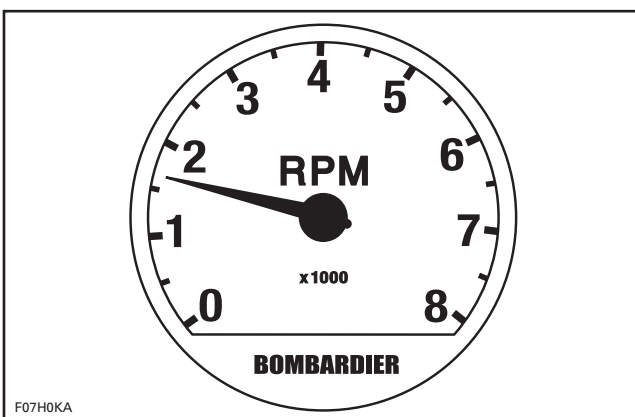
Activate the Info Center.

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

Tachometer

XP Models



The PURPLE wire is the 12 Vdc power source of the tachometer.

The BLACK wire is the ground.

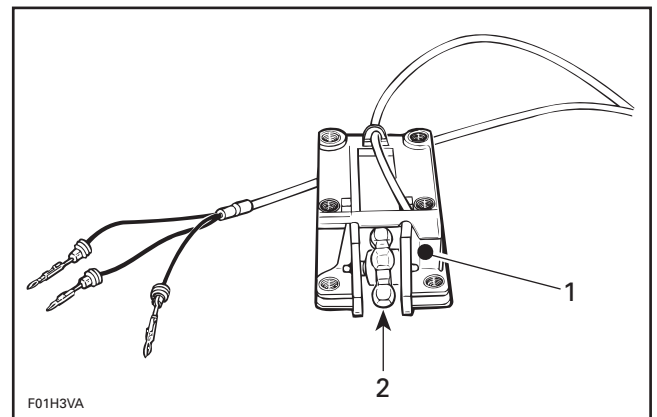
The GRAY wire is the pulse signal from the multi-purpose electronic module (MPEM).

Speed Sensor

All Models except GS and GTS

The speedometer gives a reading through a speed sensor. Speed sensor is installed on riding plate. 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.

The paddle wheel is protected by the pick-up housing.



1. Pick-up housing
2. Paddle wheel

To check if the speed sensor is operational, disconnect the speed sensor connector housing from inside bilge.

Using an appropriate terminal remover (Snap-on TT600-4), remove the PURPLE/YELLOW and BLACK/ORANGE wires from the tab housing of the speed sensor.

Reconnect the PURPLE/YELLOW and BLACK/ORANGE wires in the receptacle housing.

Connect the positive probe of a multimeter to speed sensor PURPLE/YELLOW wire and the negative probe to speed sensor BLACK/ORANGE wire.

With the safety lanyard removed, depress the start/stop button to activate the MPEM timer.

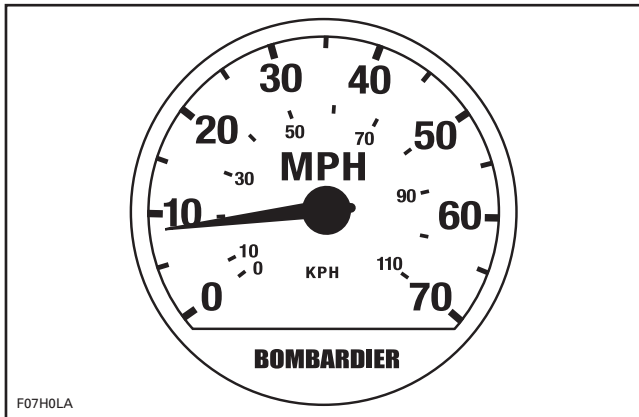
Slowly rotate the paddle wheel. Every 1/8 turn, the observed voltage should fluctuate between 5.5 and 8.5 Vdc.

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

Speedometer

All Models except GS and GTS



TYPICAL

The PURPLE wire is the 12 Vdc power source of the speedometer.

The BLACK wire is the ground.

The PURPLE/YELLOW wire is the pulse signal from the speed sensor.

Information Center Verification

GTX Series and RX Series

The PURPLE wire is the 12 Vdc power source of the Information Center.

The BLACK wire is the ground.

The RED/PURPLE wire is the 12 Vdc from the battery. It is protected by a fuse on the MPEM; the fuse "MPEM" on the carburetor-equipped models and the fuse "ACC" fuse on DI models.

The accuracy of some features of the Information Center can be checked with a potentiometer.

Fuel Level

Disconnect the 4-circuit connector housing of the Info Center.

Using an appropriate terminal remover, remove the PINK wire from the tab housing.

Reconnect the connector housing.

Disconnect the 2-circuit connector housing which contains a PURPLE and BLACK wires.

Remove the BLACK wire from the receptacle housing.

Reconnect the connector housing.

Connect potentiometer test probes to the PINK and BLACK wires.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the gauge.

NOTE: The gauge must be activated to obtain a reading.

RESISTANCE (Ω)	FUEL LEVEL LCD GRAPHIC	LOW FUEL LEVEL RED LIGHT
0 + 2.2	FULL	OFF
17.8 \pm 2.2	7/8	OFF
27.8 \pm 2.2	3/4	OFF
37.8 \pm 2.2	5/8	OFF
47.8 \pm 2.2	1/2	OFF
57.8 \pm 2.2	3/8	OFF
67.8 \pm 2.2	1/4	OFF
77.8 \pm 2.2	1/8	ON
89.0 \pm 2.2	EMPTY	ON

VTS

RX and RX DI

Disconnect the 2-circuit connector housing of the Information Center.

Connect potentiometer test probes to the BROWN/WHITE and BROWN/BLACK wires.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the gauge.

NOTE: The gauge must be activated to obtain a reading.

RESISTANCE (Ω)	VTS LEVEL LCD GRAPHIC
167.3 \pm 2.2	11/11 (UP)
153.0 \pm 2.2	10/11
138.7 \pm 2.2	9/11
124.4 \pm 2.2	8/11
110.1 \pm 2.2	7/11
95.8 \pm 2.2	6/11
81.5 \pm 2.2	5/11
67.2 \pm 2.2	4/11
52.9 \pm 2.2	3/11
38.6 \pm 2.2	2/11
24.3 \pm 2.2	1/11 (DOWN)

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

Water Temperature (L temp) (if so equipped)

Disconnect the 2-circuit connector housing of the Info Center which contains a BLACK/ORANGE and TAN/ORANGE wires.

Connect potentiometer test probes to the BLACK/ORANGE and TAN/ORANGE wires.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the gauge.

NOTE: The gauge must be activated to obtain a reading.

RESISTANCE (Ω)	DISPLAY TEMPERATURE ($^{\circ}$ C)
25407.3	5 \pm 2
19911.1	10 \pm 2
15718.0	15 \pm 2
12495.0	20 \pm 2
10000.0	25 \pm 2
8054.9	30 \pm 2
6528.3	35 \pm 2

RESISTANCE (Ω)	DISPLAY TEMPERATURE ($^{\circ}$ F)
22799.0	45 \pm 4
17262.0	55 \pm 4
13470.0	65 \pm 4
10496.3	75 \pm 4
8264.4	85 \pm 4
6528.3	95 \pm 4

Exterior Temperature (if so equipped)

Disconnect the 2-circuit connector housing of the Info Center which contains a TAN/WHITE and BLACK/WHITE wires.

Connect potentiometer test probes to the TAN/WHITE and BLACK/WHITE wires.

Adjust potentiometer to the resistance values as per following chart to test the accuracy of the gauge.

NOTE: The gauge must be activated to obtain a reading.

RESISTANCE (Ω)	DISPLAY TEMPERATURE ($^{\circ}$ C)
25590.1	5 \pm 2
20005.8	10 \pm 2
15761.7	15 \pm 2
12510.2	20 \pm 2
10000.0	25 \pm 2
8047.8	30 \pm 2
6518.7	35 \pm 2

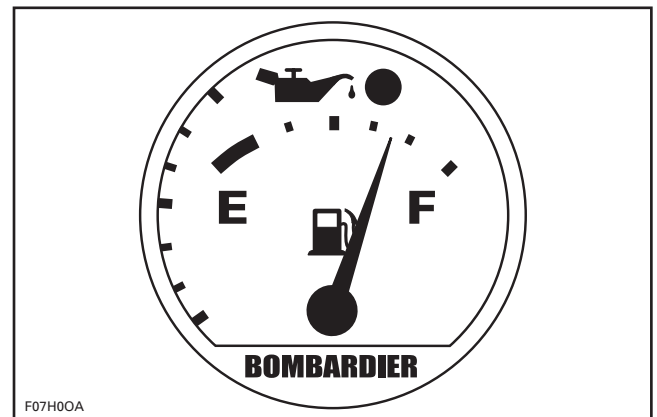
RESISTANCE (Ω)	DISPLAY TEMPERATURE ($^{\circ}$ F)
22919.8	45 \pm 4
17491.7	55 \pm 4
13487.5	65 \pm 4
10501.5	75 \pm 4
8252.0	85 \pm 4
6518.7	95 \pm 4

Fuel/Oil Gauge/Low Oil Warning Light

GS, GTS, GTI and XP Models

The fuel gauge has a pointer which indicates fuel level in the tank.

The low oil warning light is part of the gauge. It will light when injection oil level is low.



TYPICAL

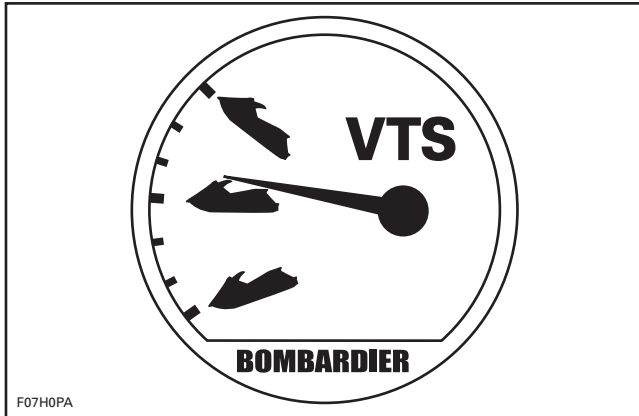
Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

Variable Trim Gauge

XP Models

The trim gauge shows the riding angle of the watercraft.



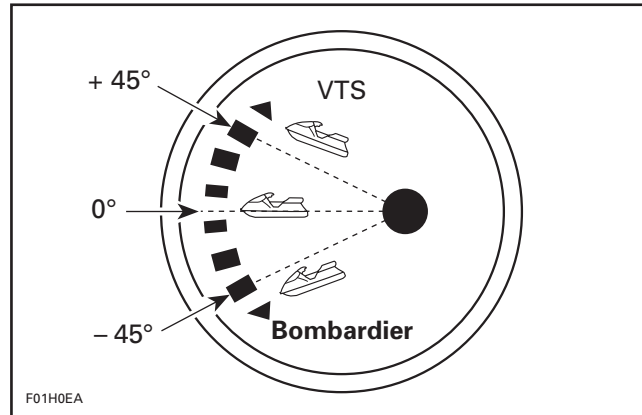
TYPICAL

Accuracy of gauge can be checked with a potentiometer.

- Disconnect 2-circuit connector housing of BROWN/BLACK and BROWN/WHITE wires of gauge.
- Connect potentiometer test probes to BROWN/BLACK and BROWN/WHITE wires of gauge.
- Adjust potentiometer to the resistance values as per following chart to test accuracy of gauge.

NOTE: Gauge must be activated to obtain a reading.

RESISTANCE (Ω)	GAUGE NEEDLE POSITION
24.3	- 45°
42.2	
60.1	
78.9	
95.8	0°
113.7	
131.6	
149.4	
167.3	+ 45°



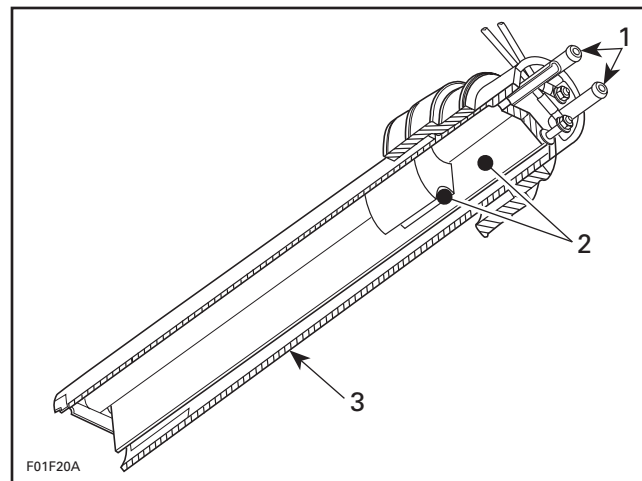
If gauge is not within the specifications, replace it.

Fuel Baffle Pick Up Sender

All Models except RFI and DI Models

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

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

The resistance measured between PINK/BLACK and PINK wires must be in accordance with fuel level (measured from under the flange) as specified in the following charts.

FUEL LEVEL AND RESISTANCE (GS, GTS, GTI AND GTX)	
FUEL LEVEL (mm)	RESISTANCE (Ω)
From 248.9 \pm 5 and more	0 + 2.2
From 234.4 to 248.8 \pm 5	17.8 \pm 2.2
From 200.9 to 234.3 \pm 5	27.8 \pm 2.2
From 167.4 to 200.8 \pm 5	37.8 \pm 2.2
From 134.0 to 167.3 \pm 5	47.8 \pm 2.2
From 100.5 to 133.9 \pm 5	57.8 \pm 2.2
From 67.0 to 100.4 \pm 5	67.8 \pm 2.2
From 40.1 to 66.9 \pm 5	77.8 \pm 2.2
From 0 to 40.0 \pm 5	89.8 \pm 2.2

FUEL LEVEL AND RESISTANCE (XP)	
FUEL LEVEL (mm)	RESISTANCE (Ω)
From 325 \pm 5 and more	0 + 2.2
From 294 to 325 \pm 5	17.8 \pm 2.2
From 263 to 294 \pm 5	27.8 \pm 2.2
From 225 to 263 \pm 5	37.8 \pm 2.2
From 190 to 225 \pm 5	47.8 \pm 2.2
From 149 to 190 \pm 5	57.8 \pm 2.2
From 93 to 149 \pm 5	67.8 \pm 2.2
From 41 to 93 \pm 5	77.8 \pm 2.2
From 0 to 41 \pm 5	89.8 \pm 2.2

RFI and DI Models

The fuel pick up system is part of the fuel pump module mounted inside the fuel reservoir.

The fuel level gauge sender is also mounted on this module.



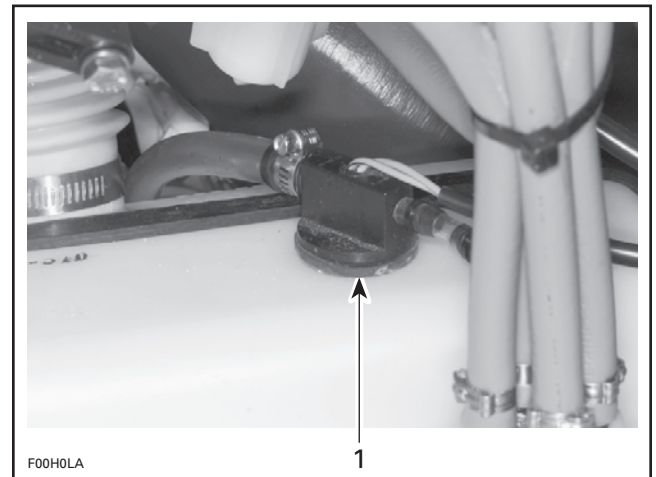
TYPICAL — FUEL LEVEL GAUGE SENDER MOUNTED ON FUEL PUMP MODULE

Refer to ENGINE MANAGEMENT.

All Models

Oil Sensor

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



1. Oil sensor

Section 10 ELECTRICAL SYSTEM

Subsection 05 (INSTRUMENTS AND ACCESSORIES)

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

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

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

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

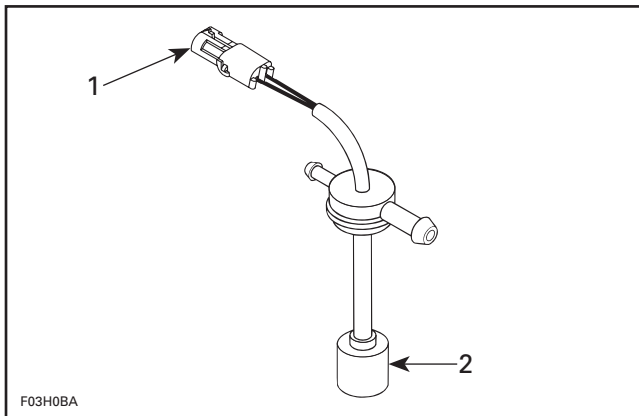
Using a multimeter, check the continuity between the BLUE and BLUE/BLACK terminals.

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

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

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

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



1. Measure resistance here
2. Sensor reservoir

To Reinstall Sensor:

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

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

VTS Switch (if so equipped)

Always confirm first that the fuse is in good condition.

Disconnect BLACK wire, BLUE/WHITE wire and GREEN/WHITE wire of VTS switch.

Using a multimeter, connect test probes to switch BLACK and BLUE/WHITE wires; then, connect test probes to switch BLACK and GREEN/WHITE wires.

Measure resistance; in both test it should be high when button is released and must be close to zero when activated.

VTS Motor (if so equipped)

Always confirm first that the fuse is in good condition.

The fuse is located on the MPEM module.

Motor condition can be checked with a multimeter. Install test probes on both BLUE/ORANGE and GREEN/ORANGE wires. Measure resistance, it should be close to 1.5 ohm.

If motor seems to jam and it has not reached the end of its stroke, the following test could be performed.

First remove motor, refer to VARIABLE TRIM SYSTEM. Then manually rotate worm to verify VTS system actuating mechanism for free operation.

Connect motor through a 15 A fuse directly to the battery.

Connect wires one way then reverse polarities to verify motor rotation in both ways.

If VTS actuating mechanism is correct and the motor turns freely in both ways, VTS module could be defective.

If VTS motor does not stop at the end of its stroke while installed, the motor could be defective.

VTS Control Module (if so equipped)

It receives its current from the battery. It is protected by its own 7.5 A fuse, located on the MPEM module.

Resistance Test

Disconnect BROWN/BLACK wire and BROWN/WHITE wire of VTS control module.

Connect test probes of a multimeter to BROWN/BLACK wire and BROWN/WHITE wire of VTS control module.



NOTE: To permit VTS actuation when engine is not running, remove safety lanyard from switch and depress start/stop button to activate MPEM timer.

Push on VTS switch down position until motor stops.

Read the resistance on the ohmmeter, it should indicate a resistance of 24 ohms \pm 1%.

Push on VTS switch up position until motor stops.

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

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

NOTE: If the VTS control module passes this resistance test, it doesn't mean it is in perfect condition.

DIGITALLY ENCODED SECURITY SYSTEM

Carburetor-Equipped Models

NOTE: For RFI and DI models, refer to ENGINE MANAGEMENT section.

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), safety lanyard cap and 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 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 which is programmed to recognize the digital code of the safety lanyard cap. This is achieved with the VCK (P/N 529 035 676) or with the MPEM programmer (P/N 529 035 718). Refer to *Guide to program* a safety lanyard.

The system is quite flexible. Up to eight safety lanyards may be programmed in the memory of the watercraft MPEM. 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 is permanent. If the battery is disconnected, no information is lost.

The memory of the MPEM has also two self-diagnostic modes.

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

Section 10 ELECTRICAL SYSTEM

Subsection 06 (DIGITALLY ENCODED SECURITY SYSTEM)

Basic Self-Diagnostic Mode

It is self-activated when the safety lanyard cap is being installed on the watercraft switch. It gives immediate monitoring. Some codes may occur only when pressing the start/stop button. Refer to the following chart.

SIGNAL	CAUSE	REMEDY
2 short beeps (while installing safety lanyard on watercraft switch)	<ul style="list-style-type: none">• Safety lanyard is recognized by the MPEM.• Good contact between safety lanyard cap and DESS post.	<ul style="list-style-type: none">• Ignition is authorized, engine can be started normally.
1 long beep (while installing safety lanyard on watercraft switch or when pressing start/stop button)	<ul style="list-style-type: none">• Bad connection between safety lanyard cap and switch.• Unprogrammed or defective safety lanyard.• Salt water or dirt in safety lanyard cap.• Improper operation of MPEM or defective wiring harness.	<ul style="list-style-type: none">• Remove and replace the safety lanyard on the switch until 2 short beeps are heard to indicate the system is ready to allow engine starting.• Use the safety lanyard that has been programmed for the watercraft. If it does not work, check safety lanyard condition with the programmer. Replace safety lanyard if reported defective. If it still does not work, enable advanced diagnostic mode to obtain more details about the failure.• Clean safety lanyard cap to remove dirt or salt water.• Enable advanced diagnostic mode to obtain more detail about the failure.
4 long beeps (while installing safety lanyard on DESS post)	<ul style="list-style-type: none">• Low battery voltage.	<ul style="list-style-type: none">• Check battery connections and battery condition.• Recharge or replace battery.
8 short beeps	<ul style="list-style-type: none">• Defective MPEM (memory).	<ul style="list-style-type: none">• Replace MPEM.
Continuous beep	<ul style="list-style-type: none">• Engine overheating.	<ul style="list-style-type: none">• Refer to TROUBLESHOOTING CHART.

Section 10 ELECTRICAL SYSTEM
Subsection 06 (DIGITALLY ENCODED SECURITY SYSTEM)

Advanced Self-Diagnostic Mode

It needs to be enabled manually. Proceed as follows:

1. Remove safety lanyard cap from watercraft switch.
2. Press 5 times on the watercraft start/stop button.

NOTE: 1 short beep and 1 long beep must be heard. They validate beginning of diagnostic mode.

3. Install safety lanyard on watercraft switch.

4. Press the watercraft start/stop button again.

NOTE: If everything is correct, engine will start. Otherwise, refer to the following chart.

SIGNAL	CAUSE	REMEDY
No beep	<ul style="list-style-type: none"> • Engine actually starts. 	<ul style="list-style-type: none"> • Everything is correct.
1 long and 1 short beeps	<ul style="list-style-type: none"> • No safety lanyard has ever been programmed in watercraft MPEM. 	<ul style="list-style-type: none"> • Use programmer and program a safety lanyard. This code can occur only when you receive a new MPEM from the factory and no key has ever been programmed.
2 short beeps	<ul style="list-style-type: none"> • MPEM can not read the digital code of the safety lanyard cap or the magnet is defective. • Mixed wires at safety lanyard switch connectors or bad connections. 	<ul style="list-style-type: none"> • Check safety lanyard cap condition with the MPEM programmer. Replace safety lanyard if reported defective. • Check switch wiring harness.
2 long beeps	<ul style="list-style-type: none"> • Wrong safety lanyard or bad connection of the DESS wires. 	<ul style="list-style-type: none"> • Use the safety lanyard that has been programmed for the watercraft. If the problem is not resolved, check safety lanyard cap condition with the MPEM programmer. Replace safety lanyard if reported defective.
3 short beeps	<ul style="list-style-type: none"> • Wiring harness of DESS switch is grounded or there is a short circuit. 	<ul style="list-style-type: none"> • Check wiring harness and safety lanyard switch.

If you need to listen again the coded beeps, remove safety lanyard and repeat the procedure to activate the diagnostic mode.

If there is more than one problem, the MPEM will send only one error code. When the problem is solved, the MPEM will send a second code and so on until all problems are resolved.

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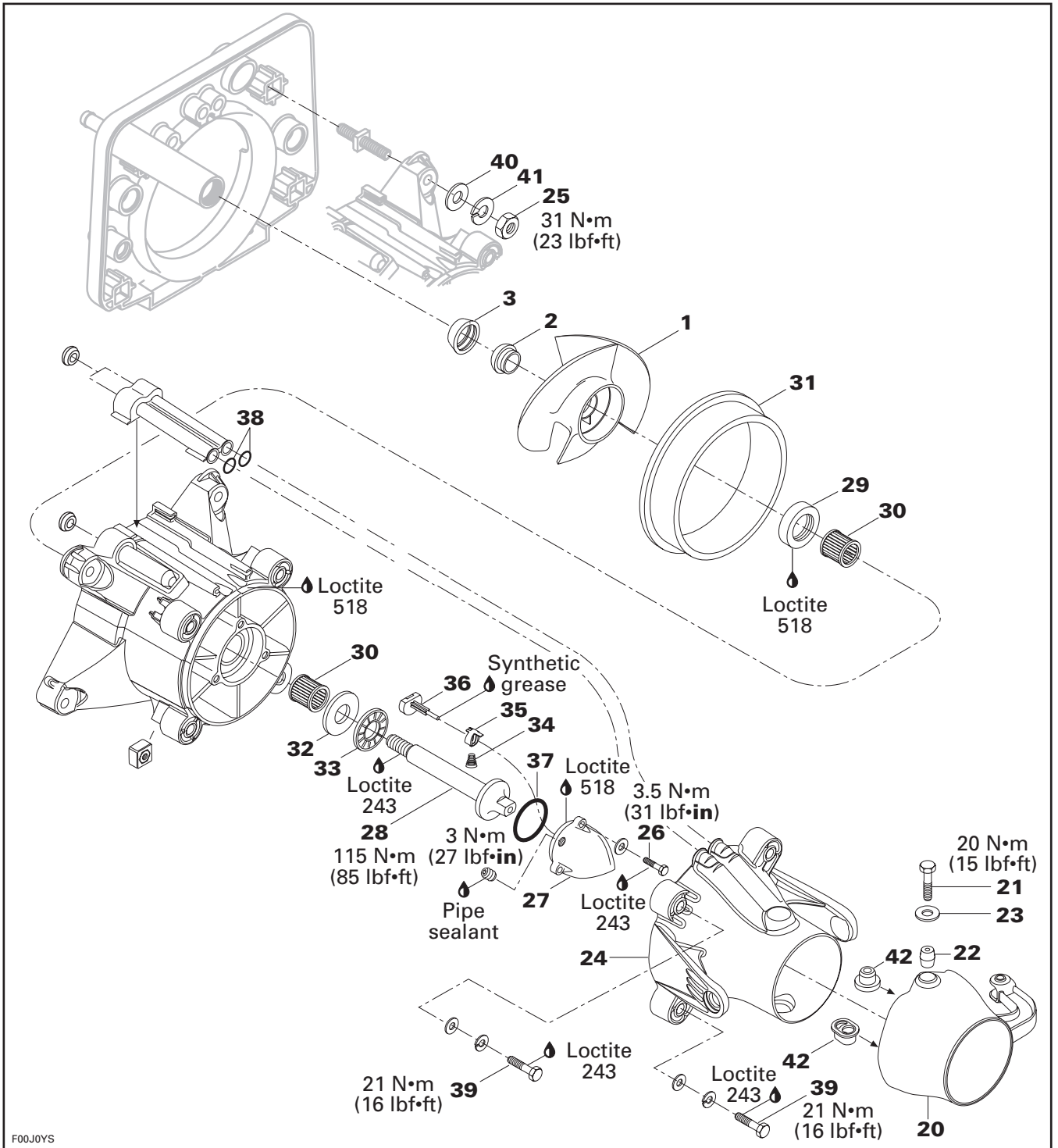
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JET PUMP

GS Models

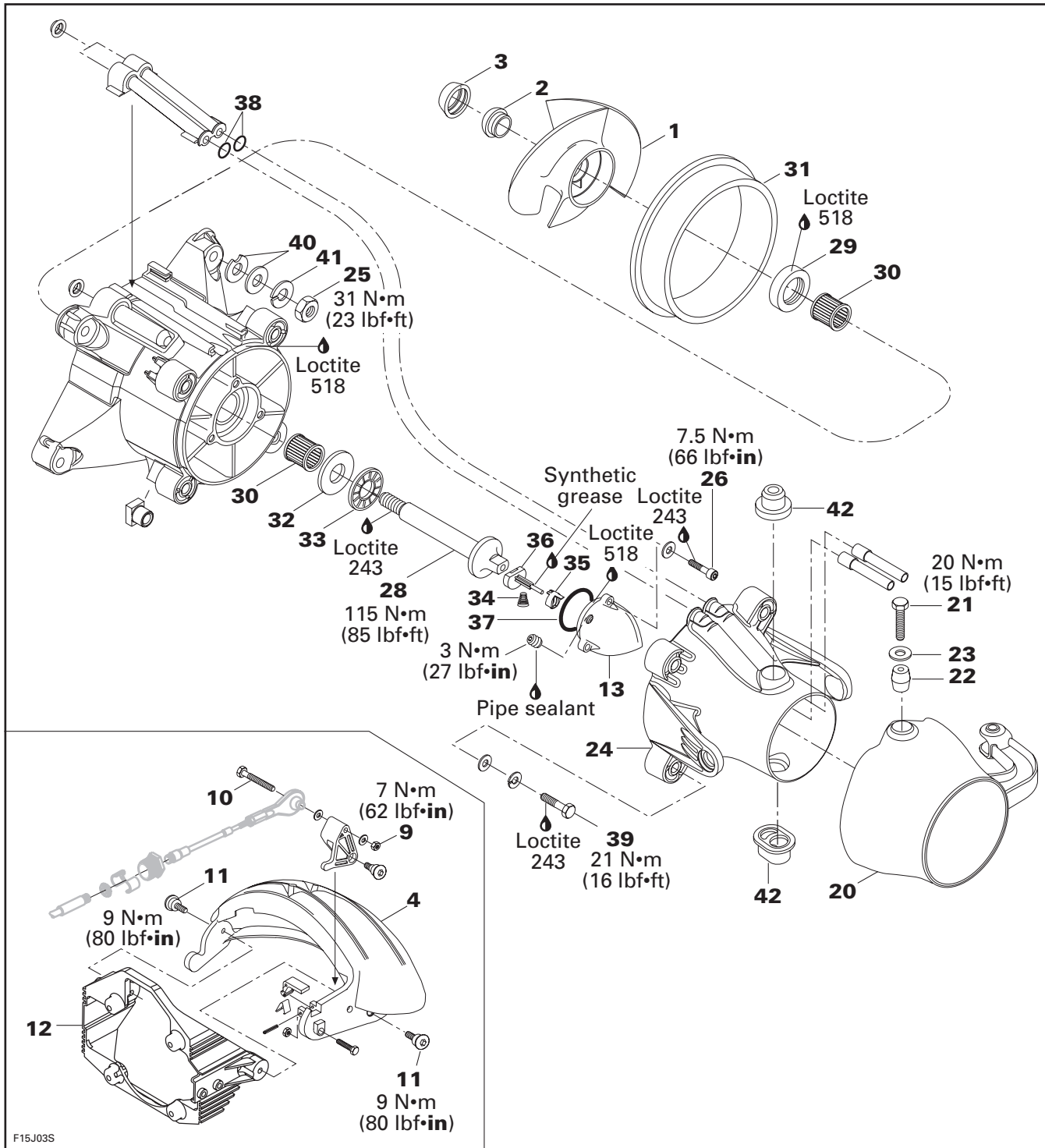


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Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

GTX RFI Models

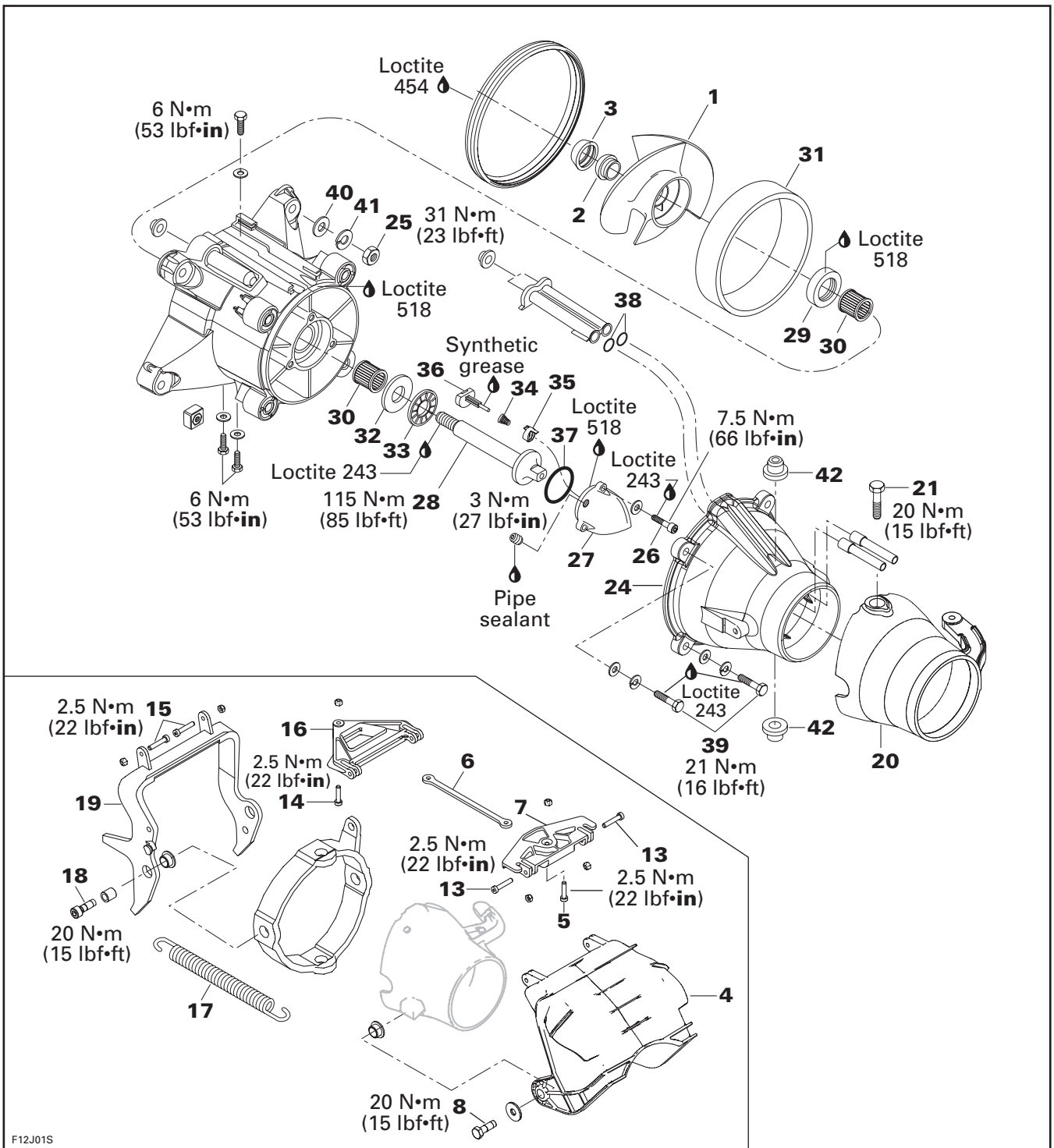


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Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

All Models except GS and GTX RFI

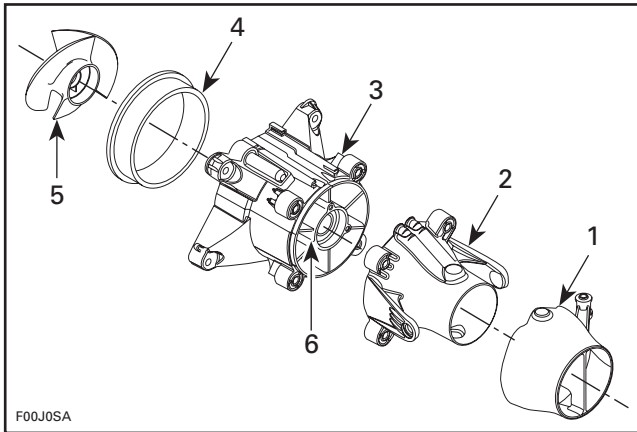


F12J01S

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

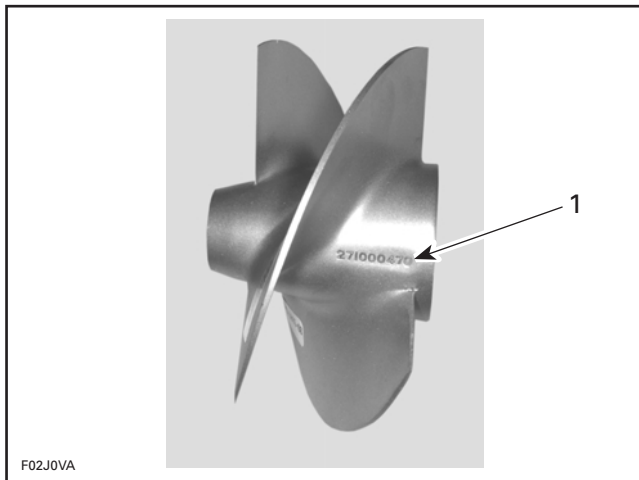
GENERAL



1. Nozzle
2. Venturi
3. 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
GS	204 160 072	Stainless steel	Progressive pitch 11° - 22°
XP	271 000 920	Stainless steel	Progressive pitch 15° - 21°
GTS	271 001 150	Stainless steel	Progressive pitch 9° - 20°
GTI	271 001 150	Stainless steel	Progressive pitch 9° - 20°
GTX	271 001 128	Stainless steel	Progressive pitch 15° - 21°
GTX RFI	271 001 024	Stainless steel	Progressive pitch 12° - 25°
GTX DI	271 000 920	Stainless steel	Progressive pitch 15° - 21°
RX DI	271 000 920	Stainless steel	Progressive pitch 15° - 21°
RX	271 000 920	Stainless steel	Progressive pitch 15° - 21°

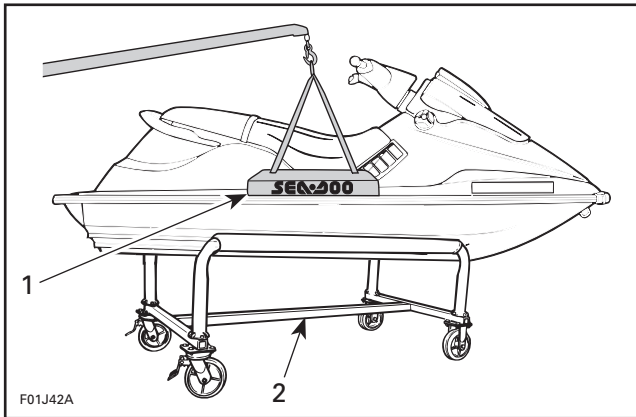
JET PUMP INSPECTION ON WATERCRAFT

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

A lift kit (P/N 295 100 044) can be used to install watercraft on a stand.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

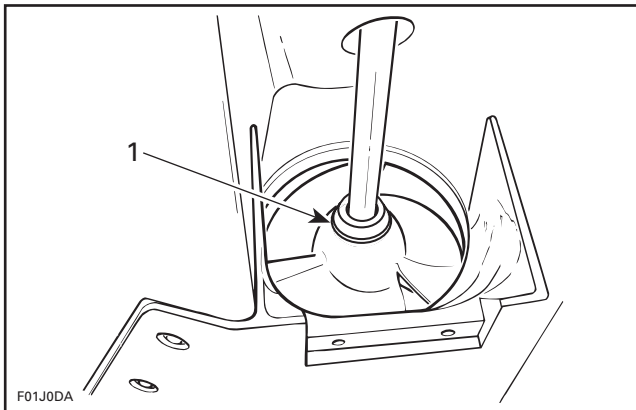


TYPICAL

1. Lift kit
2. Work stand

Impeller Condition

Condition of impeller no. 1, boot no. 2 and ring no. 3 can be quickly checked from underneath of the watercraft. Remove grate and look through water inlet opening.



TYPICAL

1. Inspect impeller and boot

Impeller/Wear Ring Clearance

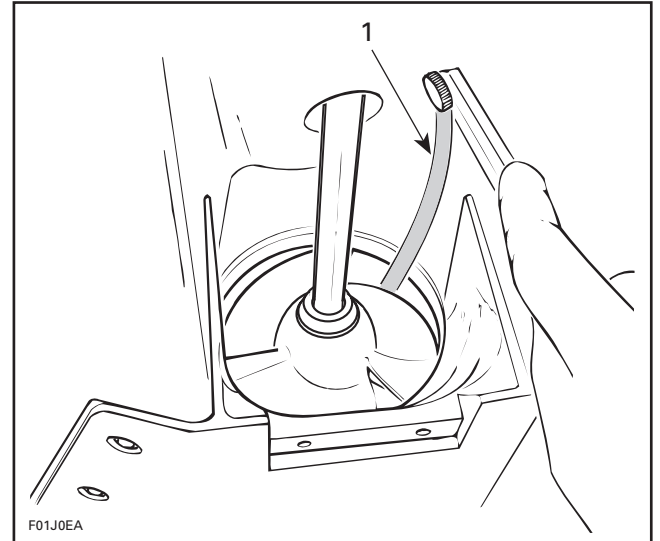
This clearance is critical for jet pump performance.

Clearance can be checked from water inlet opening or from venturi side. However, the last method requires more work.

To check clearance from water inlet side, remove inlet grate.

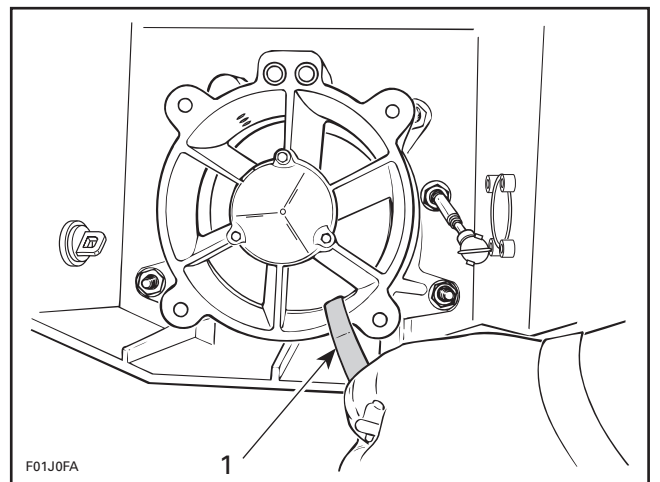
To check clearance from venturi side, remove venturi/nozzle assembly as described in **Oil Inspection** in this subsection.

Using a feeler gauge with 30 cm (12 in) blades, 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 — MEASURING FROM WATER INLET SIDE

1. Feeler gauge



TYPICAL — MEASURING FROM VENTURI SIDE

1. Feeler gauge

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

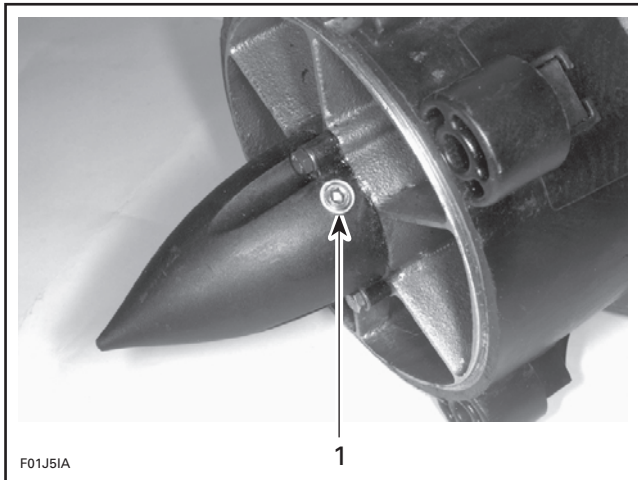
Oil Inspection

Remove:

- reverse gate cable
- VTS rod (if so equipped)
- steering cable
- screws no. 10 retaining venturi to the housing.

Pull venturi.

Remove plug from cover.



TYPICAL

1. Remove 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 and/or O-ring of housing cover. Jet pump unit should be overhauled to replace seal.

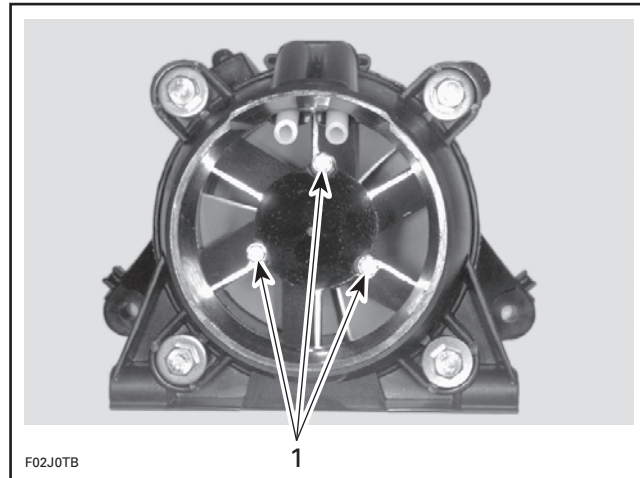
If everything is correct, apply Loctite pipe sealant (P/N 293 800 018) on plug threads and reinstall it on cover. Properly reinstall removed parts.

NOTE: The plug threads are perpendicular to the impeller shaft.

Oil Replacement

Remove venturi as described in **Oil Inspection**.

Remove 3 screws retaining cover.



TYPICAL

1. Screws

Using a fiber hammer, gently tap cover to release it from housing cover.

Thoroughly clean reservoir and inside of cover with a solvent. Check O-ring condition. Replace as necessary.

Apply a thin layer of Loctite 518 on mating surface of cover and reinstall it with its O-ring.

Apply Loctite 243 on threads and torque screws to 7 N•m (62 lbf•in) on the **XP and GTX RFI models** and 4 N•m (35 lbf•in) on the other models.

Remove plug from cover.

Pour oil through hole until oil reaches the bottom of hole threads. Use SEA-DOO JET PUMP SYNTHETIC OIL (P/N 293 600 011) only. Oil will drain slowly into center area of housing, wait a few minutes and readjust oil level.

CAUTION: This is a synthetic oil. Do not mix with mineral based oil. Do not mix oil brands.

Apply Loctite pipe sealant (P/N 293 800 018) on plug threads and reinstall it on cover.

NOTE: The plug threads are perpendicular to the impeller shaft.

Properly reinstall removed parts.

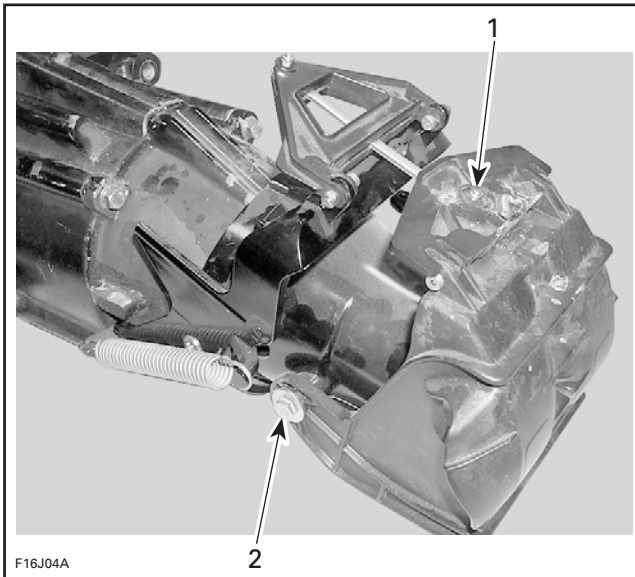
REMOVAL

Reverse Gate (if so equipped)

All Models except GTX RFI

To remove reverse gate no. 4, put shift lever in reverse position.

Unscrew pivot bolt no. 5 retaining connecting rod no. 6 and pivot support no. 7.



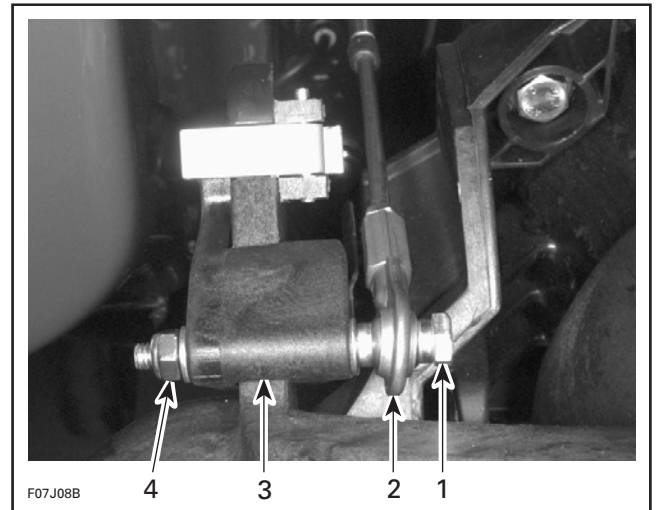
- 1. Pivot bolt
- 2. Reverse gate retaining bolt (each side)

Remove screws no. 8.

GTX RFI Models

Put shift lever in reverse position.

Disconnect reverse cable from reverse gate. Remove lock nut no. 9 and bolt no. 10 retaining cable end to cable lever.



- 1. Bolt
- 2. Cable end
- 3. Cable lever
- 4. Lock nut

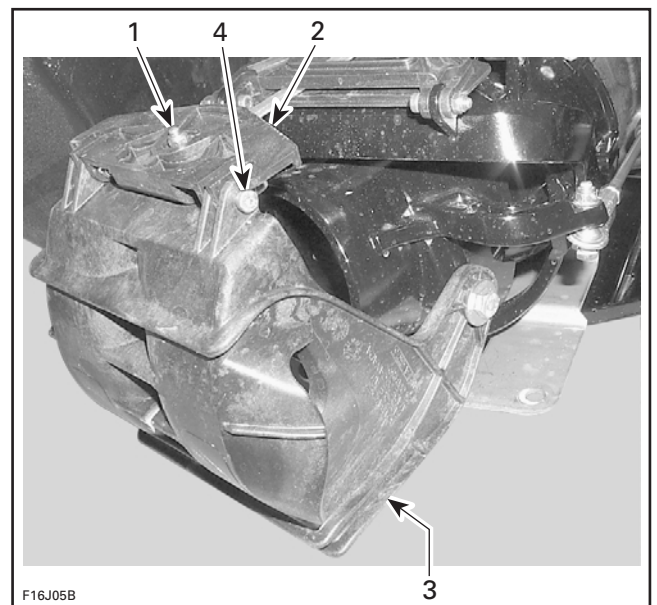
Unscrew and remove 2 Allen screws no. 11 retaining reverse gate to support no. 12 and remove reverse gate.

Pivot Support

All Models except GTX RFI

Remove reverse gate.

Unscrew pivot support bolts no. 13.



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

Withdraw pivot support.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

Connecting Rod

Remove:

- reverse gate
- pivot bolt no. 14.

Withdraw connecting rod.

Pivot Triangle

Remove:

- reverse gate
- connecting rod
- pivot triangle bolts no. 15.

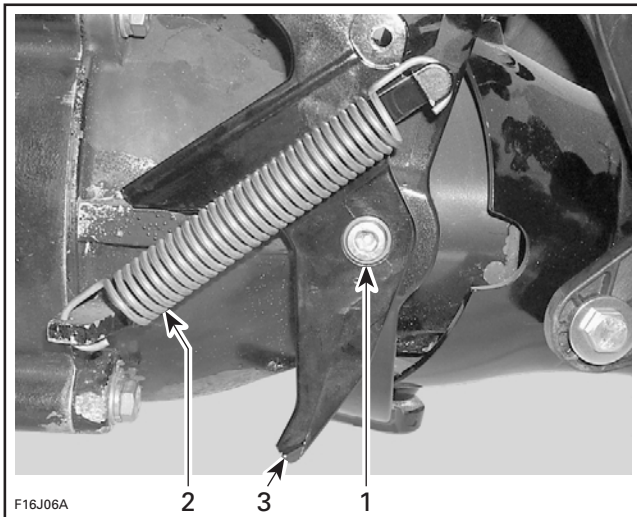
Withdraw pivot triangle no. 16.

Pivot Arm

Remove:

- reverse gate
- connecting rod
- reverse cable
- spring no. 17
- pivot arm bolts no. 18. Take note of bushing size for reinstallation.

Withdraw pivot arm no. 19.



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

Nozzle

All Models except GS, GTX RFI and XP

Disconnect steering cable from jet pump nozzle no. 20.

Remove:

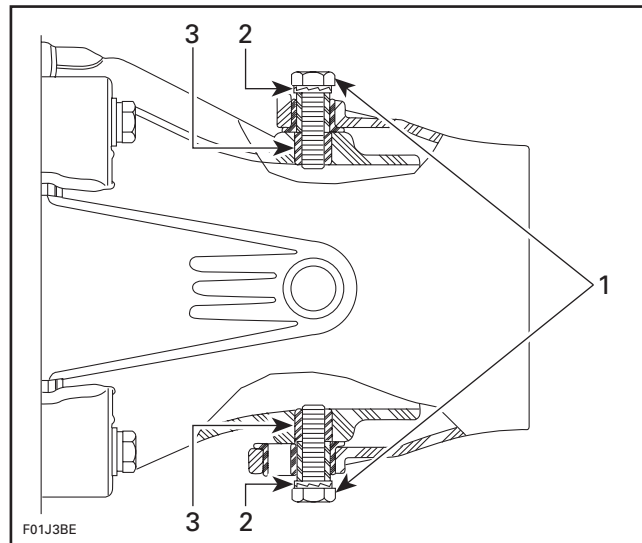
- reverse gate
- spring
- pivot arm bolts no. 18 retaining pivot arm and VTS ring (if so equipped) to nozzle.

Remove nozzle.

GS and GTX RFI Models

Disconnect steering cable from jet pump nozzle.

Remove 2 retaining screws no. 21, 2 sleeves no. 22, 2 washers no. 23.



TYPICAL

1. Screw
2. Washers
3. Sleeve

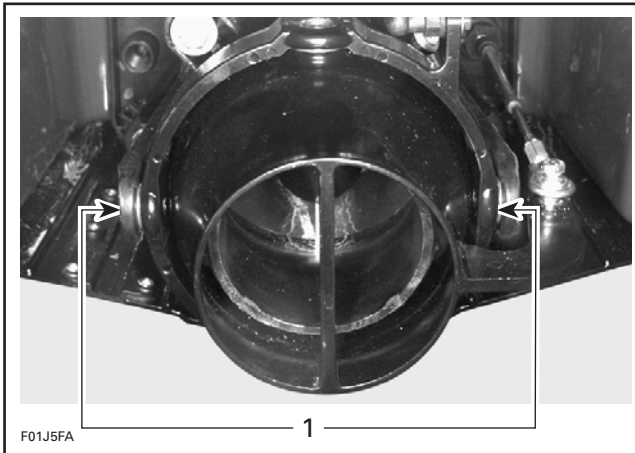
Remove nozzle.

XP Models

Disconnect steering cable from jet pump nozzle.

Disconnect ball joint of VTS link rod.

Loosen 2 screws each side of trim ring.



1. Remove screws

Remove nozzle.

Venturi

Remove:

- reverse gate (if so equipped)
- nozzle
- pivot arm (if so equipped).

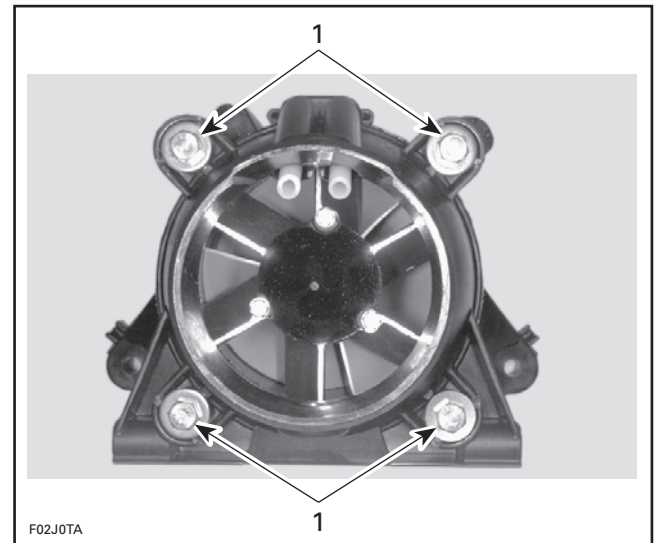
Remove 4 retaining screws **no. 39** and withdraw venturi **no. 24**.

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

Disconnect:

- steering cable
- VTS link rod (if so equipped)
- reverse cable (if so equipped).

Remove 4 retaining screws **no. 39** and withdraw venturi **no. 24**.



1. Remove screws

Jet Pump Housing

Remove:

- nozzle
- venturi.

Loosen 4 hexagonal nuts **no. 24** and remove flat washers and lock washers from jet pump housing.

Remove jet pump with a wiggle movement.

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

NOTE: After jet pump removal, if drive shaft remains in the PTO flywheel (**except XP**), simply pull it out. If drive shaft is seized in the PTO flywheel, refer to DRIVE SYSTEM.

DISASSEMBLY

NOTE: Whenever removing a part, visually check for damage such as: corrosion, crack, split, break, porosity, cavitation, deformation, distortion, heating discoloration, wear pattern, missing plating, missing or broken 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.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

Cover

With pump assembly in horizontal position, remove 3 retaining screws **no. 26**.

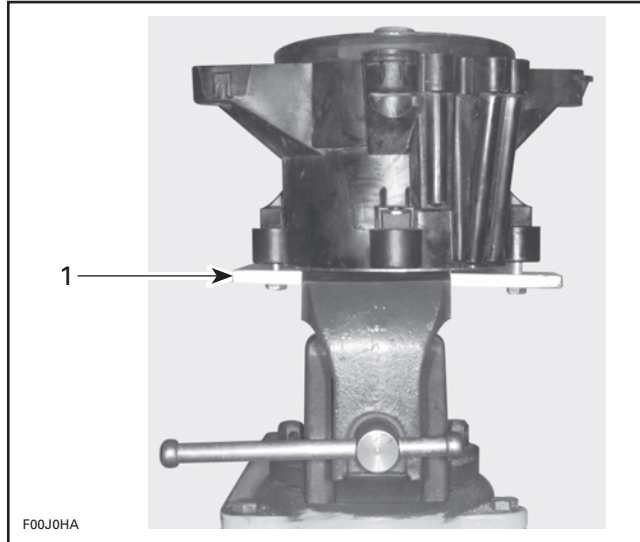
Place container under cover **no. 27** to catch oil.

Using a fiber hammer, gently tap cover to release it from jet pump housing.

Impeller

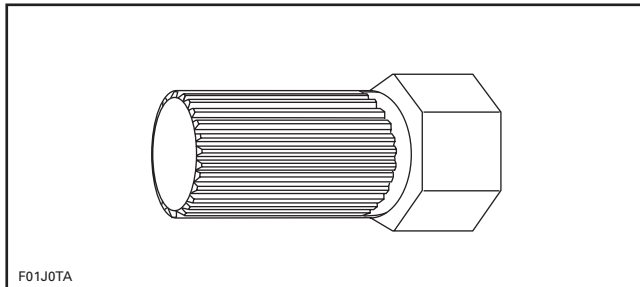
Insert impeller shaft holder (P/N 295 000 082) on impeller shaft flat end.

Using 2 screws previously removed from venturi, secure shaft holder to housing.

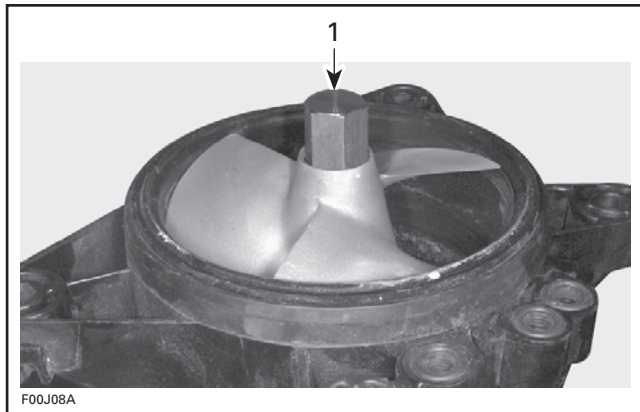


1. Shaft holder

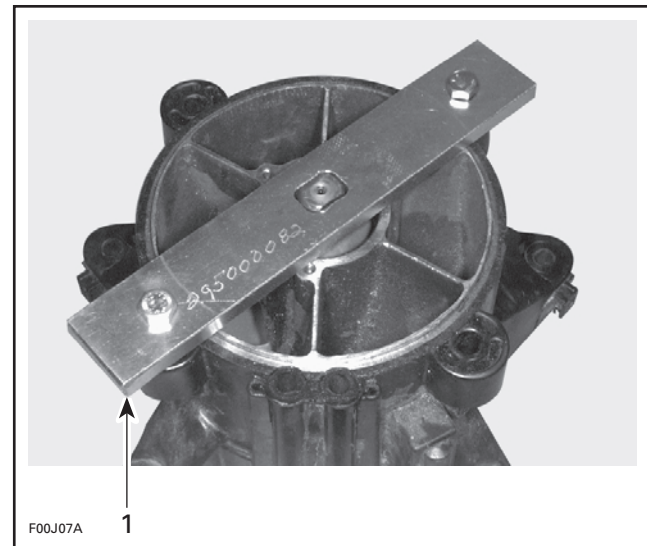
Impeller is loosened using impeller remover tool (P/N 295 000 001).



Insert special tool in impeller splines.



1. Impeller remover tool



1. Shaft holder

Heat impeller shaft end with a propane torch to approximately 150°C (300°F) to break the Loctite bond before to remove impeller. Do not heat impeller directly.

Install shaft holder in a vice.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

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

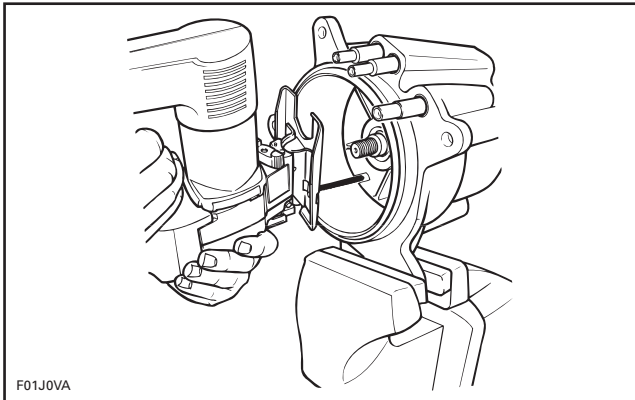
NOTE: On the models with the large pump (947 engines), remove the screws retaining wear ring in the jet pump housing.

Place jet pump housing in a vise with soft jaws. It is best to clamp housing using a lower ear.

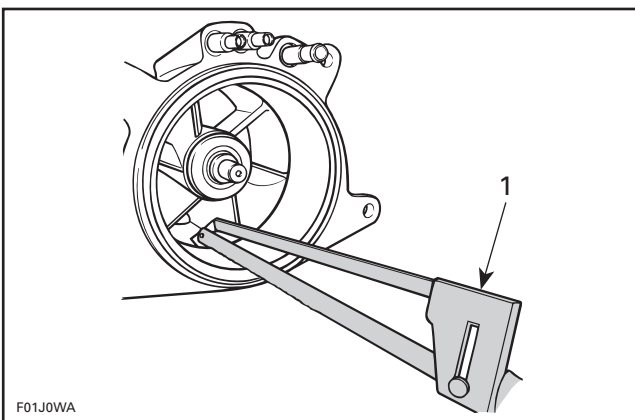
Cut wear ring at two places.

CAUTION: When cutting ring, be careful not to damage jet pump housing.

NOTE: Wear ring can be cut using a jigsaw, a small grinder or a low clearance hacksaw such as Snap-on HS3 or equivalent.



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.

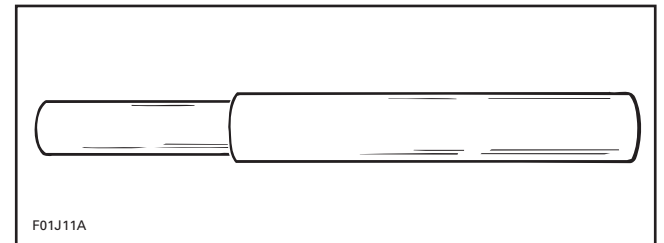
Impeller Shaft

Remove shaft holder tool.

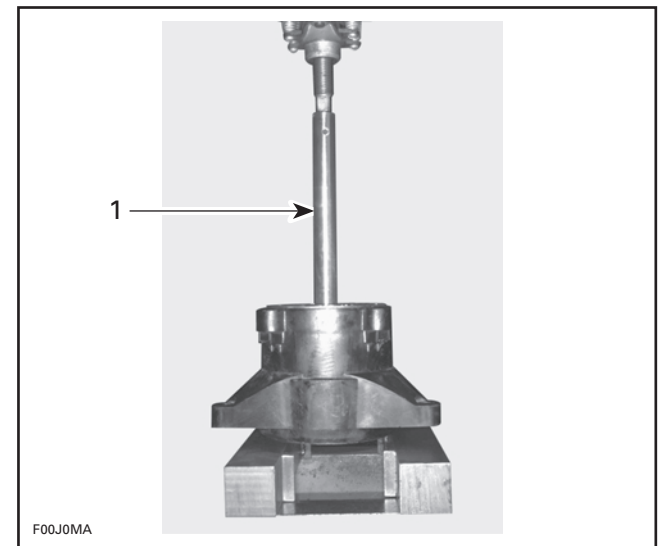
Remove impeller shaft no. 28 with thrust washer and thrust bearing.

Seal and Needle Bearing

Remove seal no. 29 and bearings no. 30 at the same time using 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.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

CLEANING

All Models

Thoroughly clean jet pump housing by applying Loctite Stripper (P/N 293 110 004). Allow it some time to dissolve the old dried Loctite (10 to 15 minutes).

WARNING

Technician should wear gloves when using this cleaning product.

CAUTION: DO NOT use Loctite Stripper on wear ring since it will cause irreparable damage to it.

Wipe Loctite Stripper with a clean cloth.

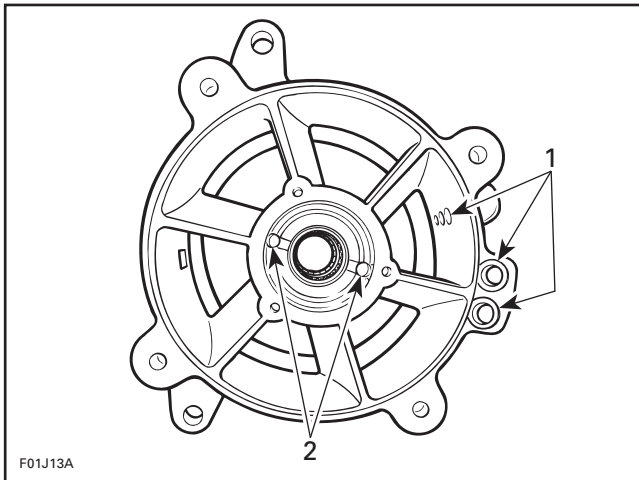
Make sure surface is cleaned and dried of Loctite Stripper.

Sealant on the jet pump housing can be removed with a wire brush (disc) mounted on a drill or a scraper.

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 Loctite Parts 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

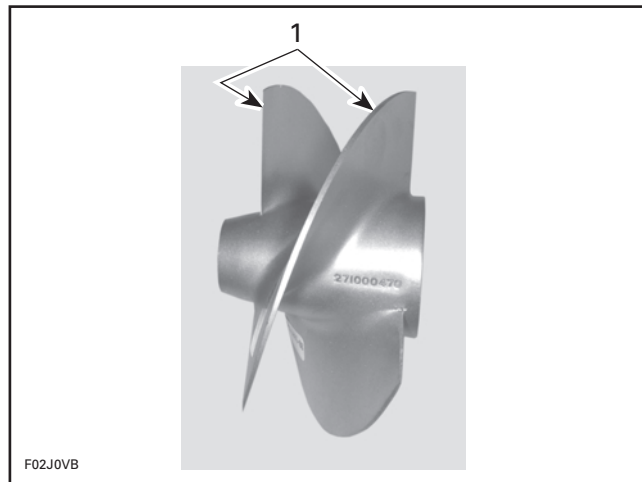
Impeller

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.

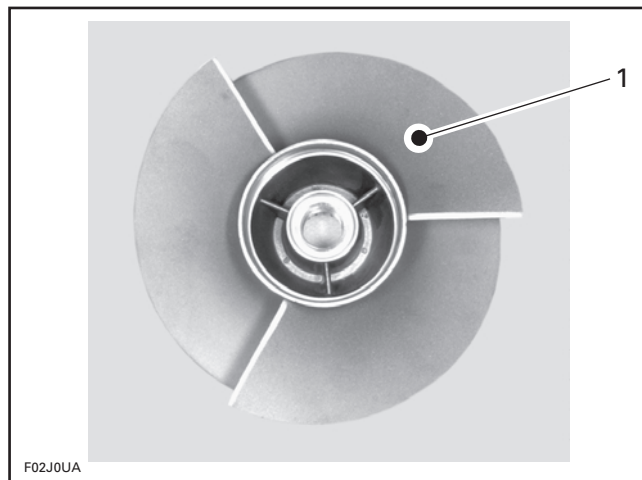
Examine impeller in wear ring for distortion.

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. 31** 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. 30** 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. 28**.

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.

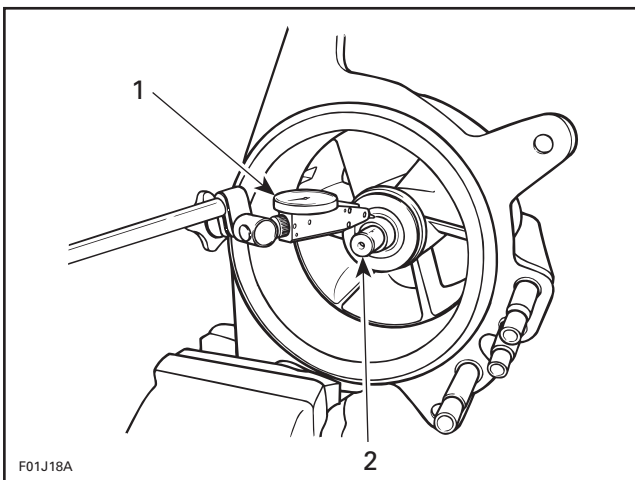
Radial play of impeller shaft is checked with shaft in housing, without impeller.

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.

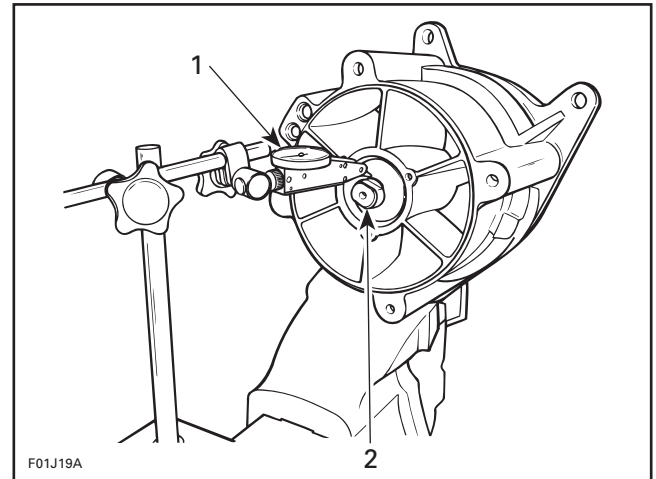
Maximum permissible radial play is 0.05 mm (.002 in).



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.



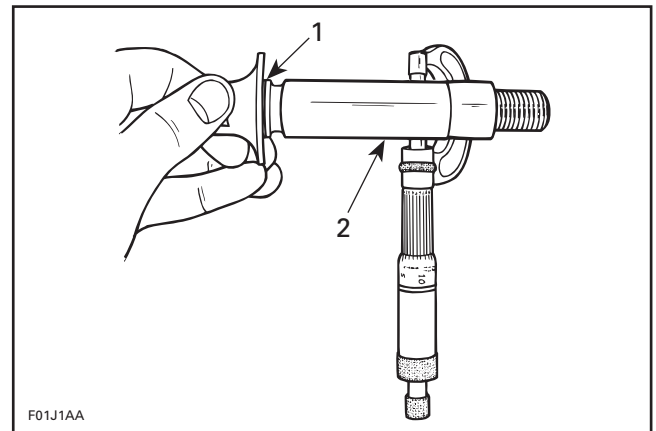
TYPICAL — MEASURING IMPELLER SHAFT RADIAL PLAY

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

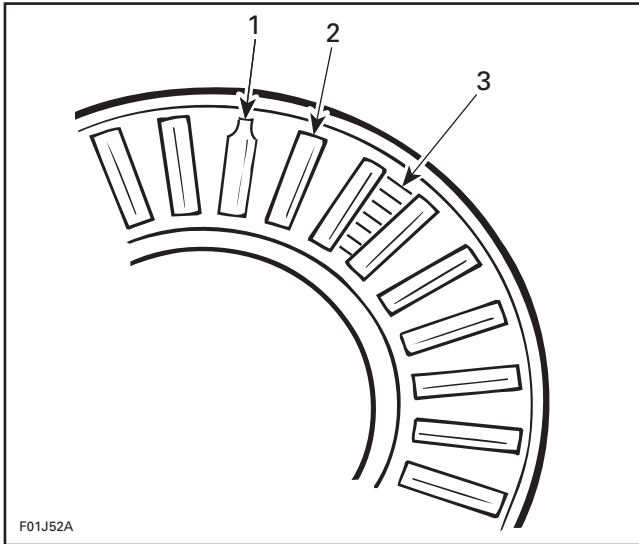
NOTE: If shaft is to be replaced, it is recommended to replace both bearings at the same time. In addition, it is suggested to replace thrust bearing and thrust washer.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

Thrust Washer and Thrust Bearing

Visually inspect thrust washer no. 32, thrust bearing no. 33 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.



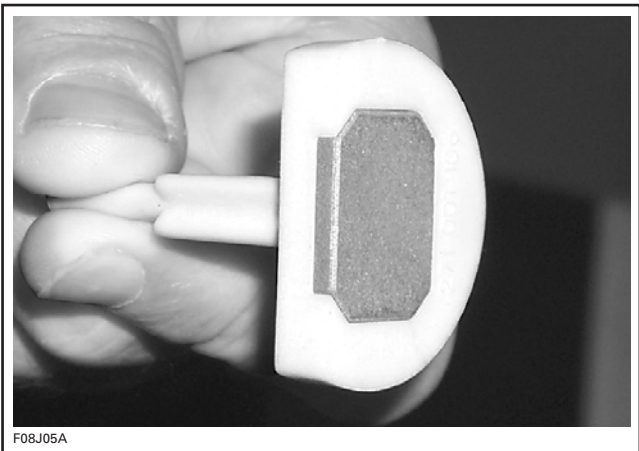
TYPICAL

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

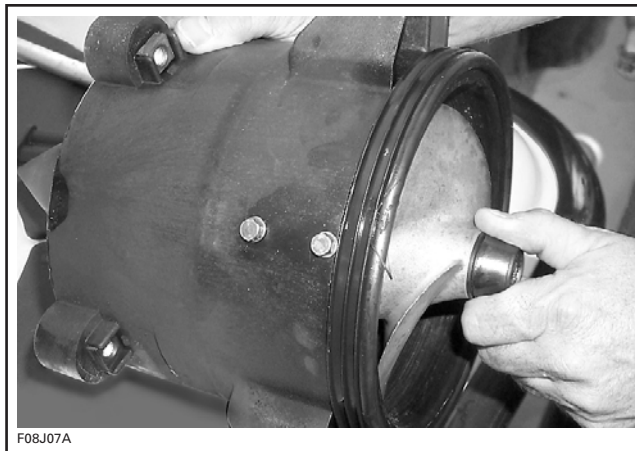
Carefully inspect seal lips. Make sure that lips are not worn, distorted, cracked or show signs of any other damage. Replace after 150 hours even if it seems good.

ASSEMBLY

Wear Ring

All Models except GS and GTX RFI

These models are equipped with large pumps. It is important that the screws retaining wear ring to housing are installed on this models.



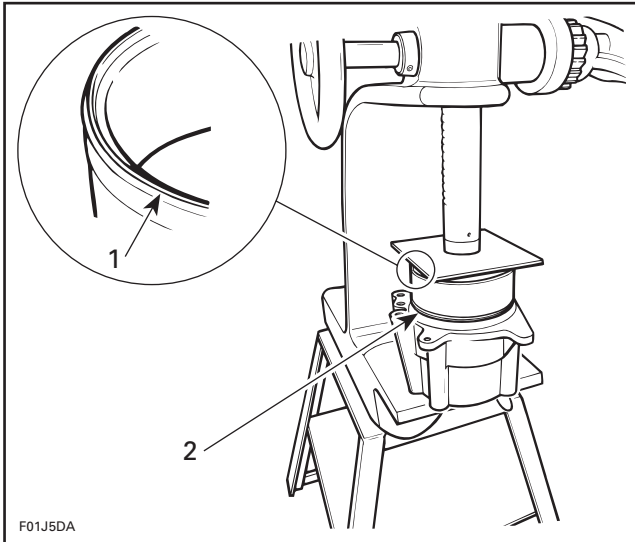
All Models

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.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

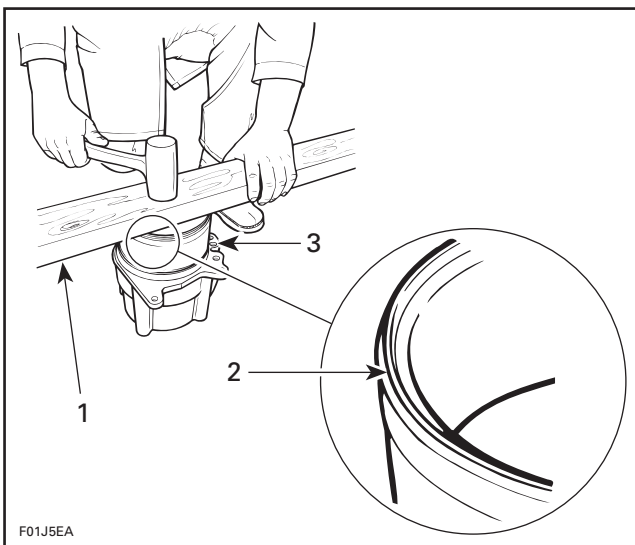
Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.



1. Seal lip
2. Press wear ring

If a press is not readily available, a piece of wood such as a 2 x 4 in x 12 in long, can be used.

Manually engage ring in housing making sure it is equally inserted all around. Place wood piece over ring. Using a hammer, strike on wood to push ring. Strike one side then rotate wood piece about 90° and strike again. Frequently rotate wood piece so that ring slides in evenly until it seats into bottom of housing.



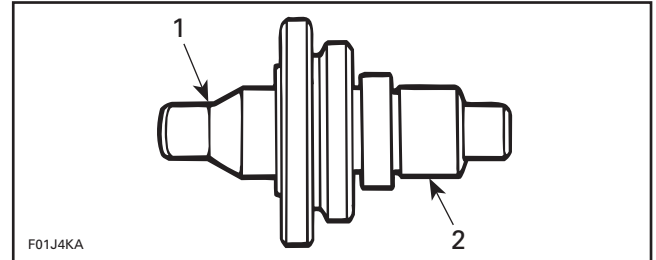
1. Piece of wood
2. Seal lip facing upward
3. Wear ring

NOTE: Do not forget, install retaining screws on large pump models.

Seal and Needle Bearing

GS and GTX RFI Models

Bearings no. 30 and seal no. 29 will be properly installed in housing using bearing/seal installer tool (P/N 295 000 107).

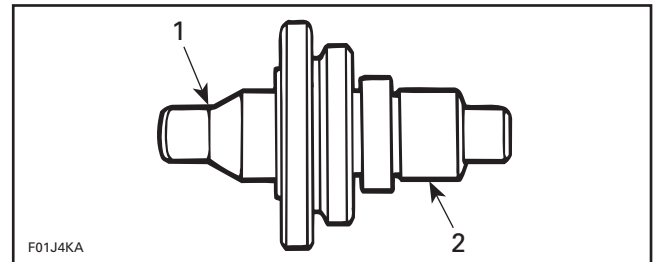


BEARING/SEAL INSTALLER TOOL

1. Seal side
2. Bearing side

All Models except GS and GTX RFI

Bearing no. 30 and seal no. 29 on impeller side will be properly installed in housing using bearing/seal installer tool (P/N 295 000 107).



BEARING/SEAL INSTALLER TOOL

1. Seal side
2. Bearing side

For the bearing on venturi side use inner bearing installer tool (P/N 529 035 609).



CAUTION: Failure to use this tool will cause major damage to the pump.

Section 11 PROPULSION SYSTEM

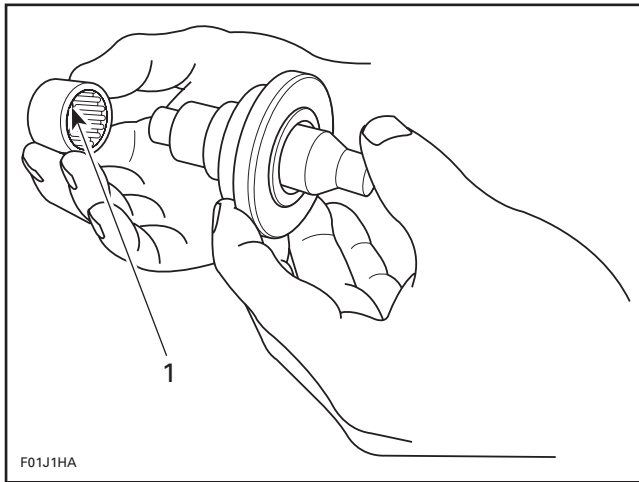
Subsection 02 (JET PUMP)

Impeller Side

All Models

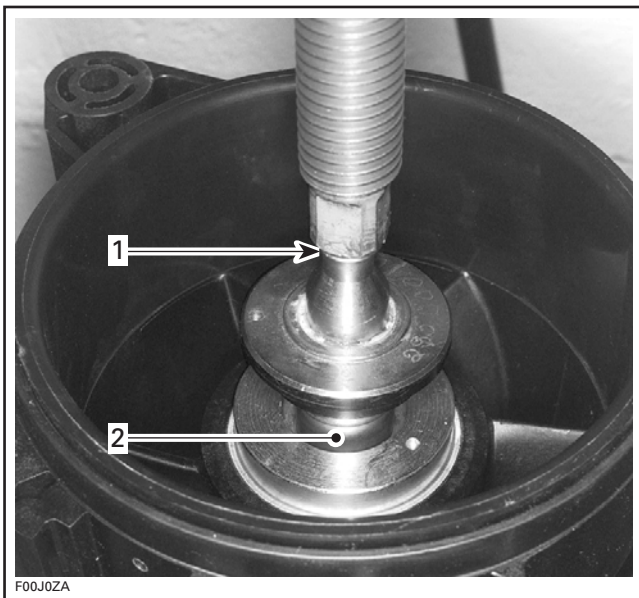
Stamped end of bearings (showing identification markings) must be located toward outside of housing.

Properly insert bearing on tool. Using an arbor press only, push tool until tool flange contacts housing.



1. Stamped end this side

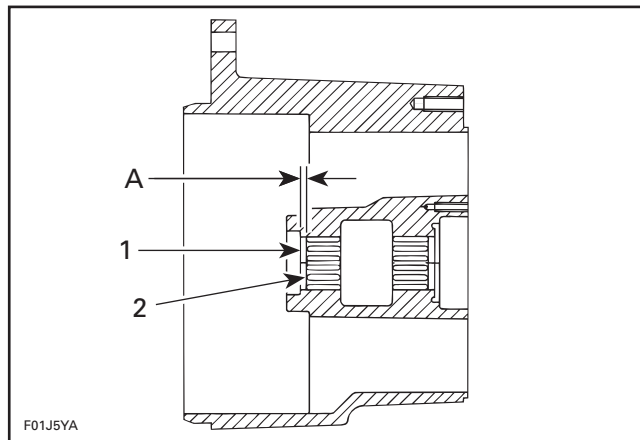
CAUTION: Never hammer the bearing into its housing.



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.



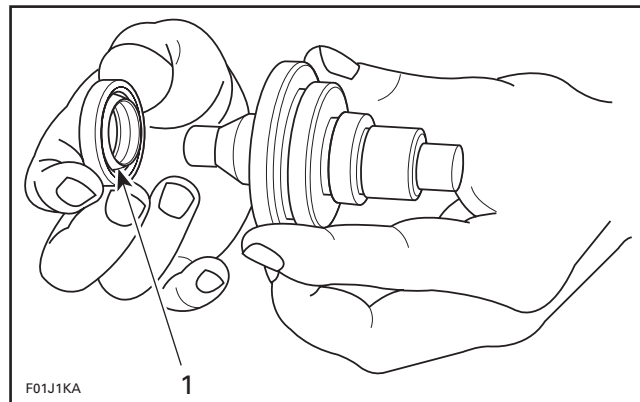
1. Seal seat
2. Stamped end of bearing
A. 1.5 - 2.5 mm (.060 - .100 in)

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 on tool to ease seal insetion.

Install seal with the spring toward the **outside**.



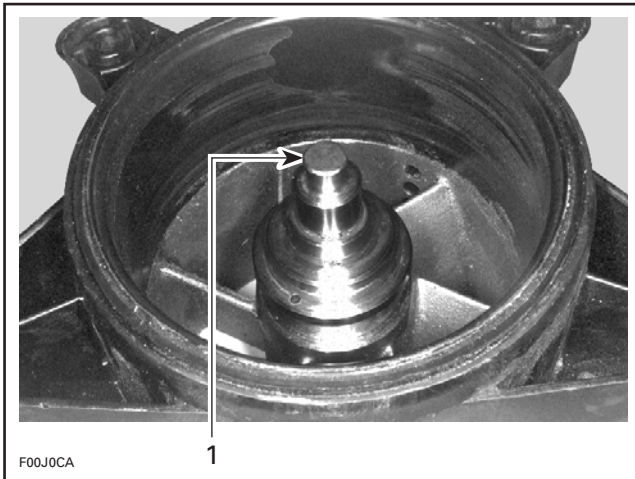
1. Spring of seal this side

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

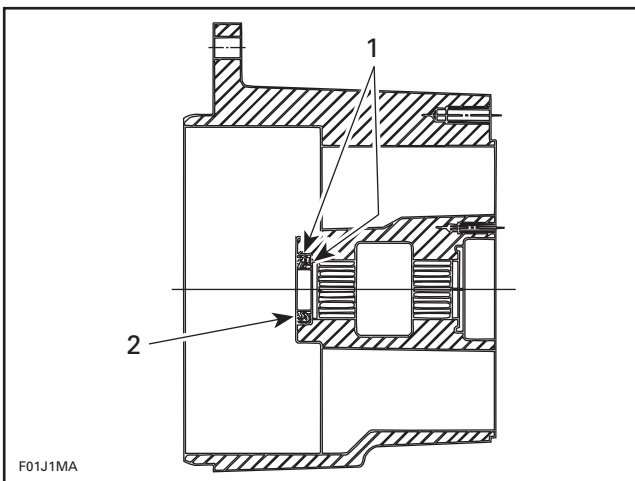
CAUTION: Prevent sealant from contacting any needles of bearing.

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

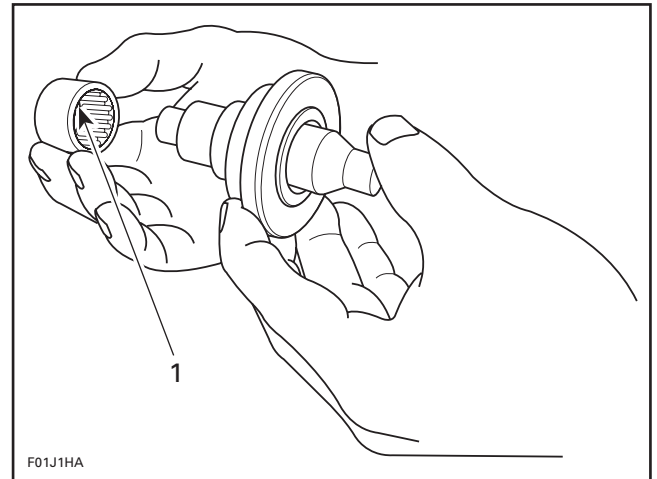
GS and GTX RFI Models

Use the same procedure than impeller side.

All Models except GS and GTX RFI

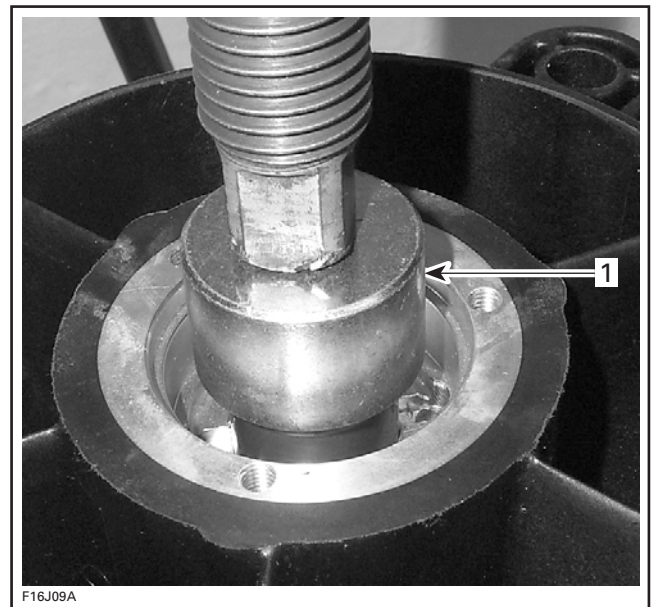
Stamped end of bearings (showing identification markings) must be located toward outside of housing.

Properly insert bearing on tool. Using an arbor press only, push tool until tool flange contacts housing.



1. Stamped end this side

CAUTION: Never hammer the bearing into its housing.



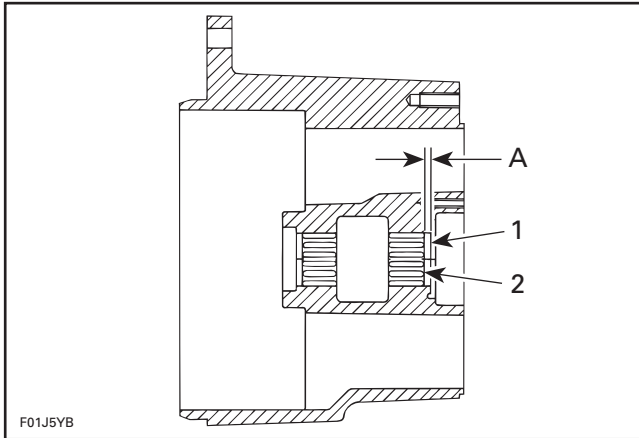
1. Press on tool until it stops

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.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

Bearing on venturi side must be 2 to 4 mm (.080 - .157 in) inside reservoir measured from thrust washer seat. Refer to following illustration.

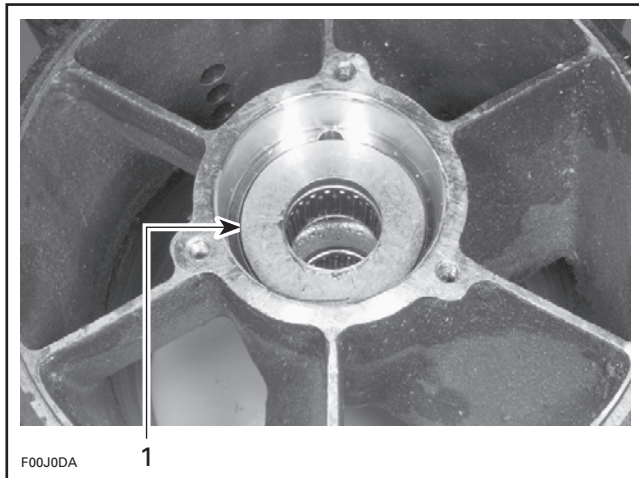


1. Thrust washer seat
2. Stamped end of bearing
- A. 2 - 4 mm (.080 - .157 in)

Thrust Washer

Position jet pump housing with the stator vanes on top.

Insert thrust washer no. 32 in the stator seat.

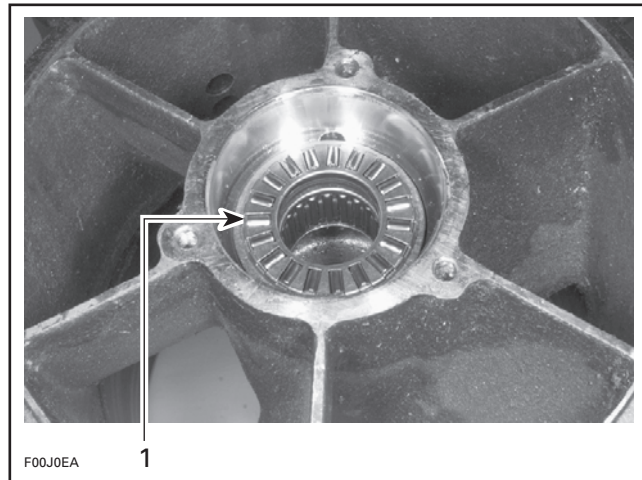


1. Thrust washer properly installed in stator seat

Thrust Bearing

Apply SEA-DOO JET PUMP SYNTHETIC OIL (P/N 293 600 011) on both sides of thrust bearing.

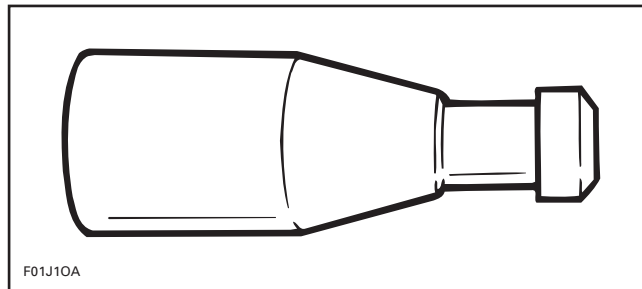
Position thrust bearing no. 33 on thrust washer no. 32.



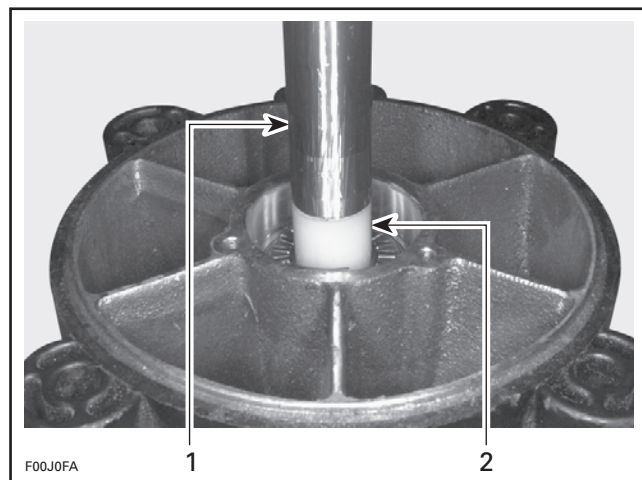
1. Thrust bearing on top of thrust washer

Impeller Shaft

To prevent seal lip damage when inserting impeller shaft, use 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.

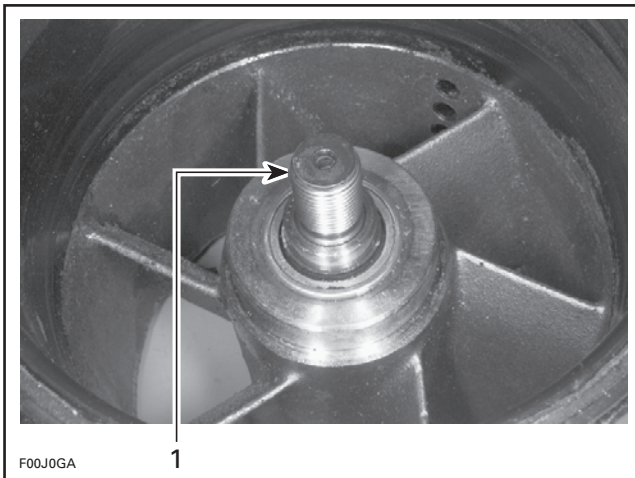
Remove shaft guide.

Impeller

Apply Loctite primer N (P/N 293 600 012) on threads of impeller shaft **no. 28**. Allow to dry for 2 minutes.

NOTE: Loctite primer is used to reduce Loctite 243 curing time and to activate stainless steel and aluminum surfaces for better bonding action. If applied, complete curing time is 6 hours, if primer is not used, allow 24 hours for curing time.

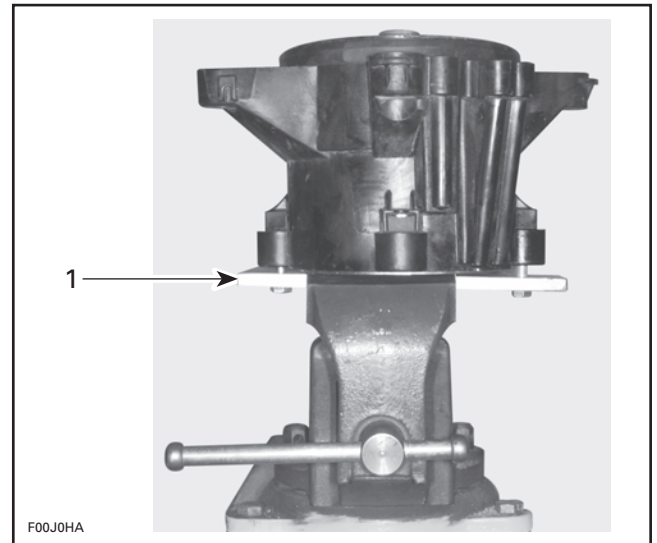
Apply Loctite 243 (blue) to shaft threads.



1. Apply Loctite 243 (blue) on threads

Using 2 screws previously removed from venturi, secure impeller shaft holder tool (P/N 295 000 082) to housing.

Install shaft holder tool in a vice.

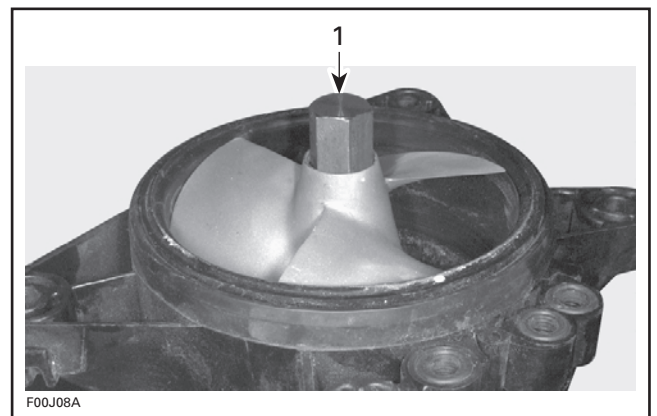


1. Impeller shaft holder secured in a vice

To ease impeller installation, apply BOMBARDIER LUBE lubricant on wear ring.

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 impeller remover/installer tool into impeller splines and tighten.



1. Impeller remover/installer tool

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

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.

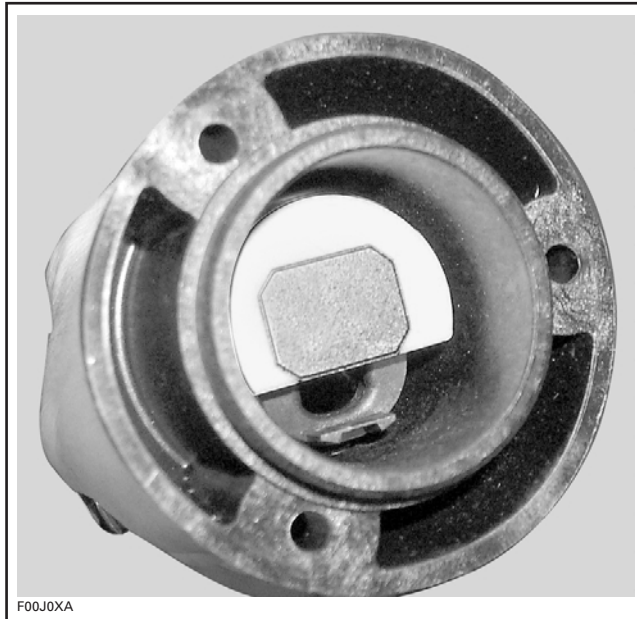
Insert a new boot no. 2 and ring no. 3 to impeller.



F00J0WA

Apply synthetic grease in the center hole of the cover.

Install pusher no. 36 into cover. Place the flat side in front of slider tab.



F00J0XA

Install O-ring no. 37 to cover. Apply Loctite 518 on O-ring.

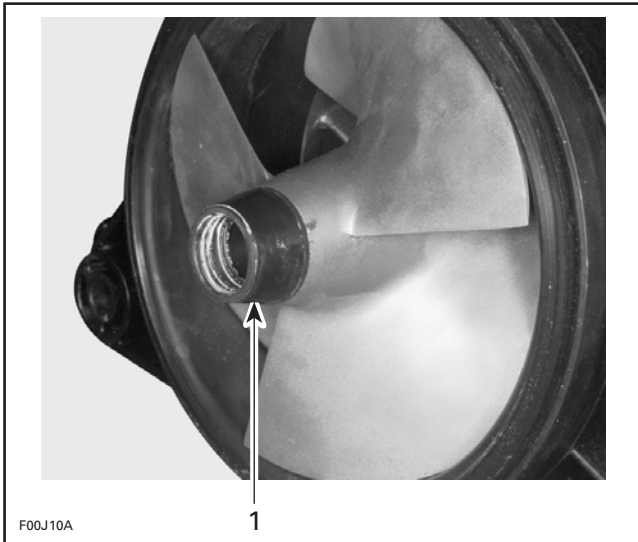
Install cover to jet pump housing making sure to properly position filler plug on top side. Do not torque yet, keep a small gap.

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.

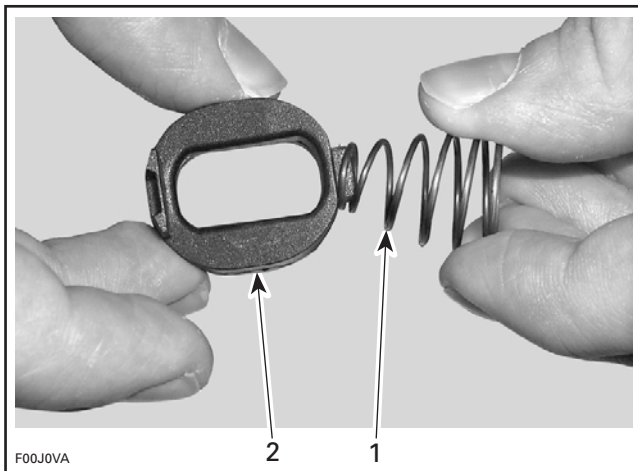


F00J10A

1. Boot and ring

Anti-Rattle System

Install spring no. 34 on slider no. 35.



F00J0VA

1. Spring
2. Slider

Insert slider and spring into cover.

NOTE: Align the longer slider tab with hole.

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

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.

Add oil.

Oil Fill

NOTE: It is highly recommended to perform a leakage test prior adding the oil. See PUMP PRESSURIZATION in this subsection.

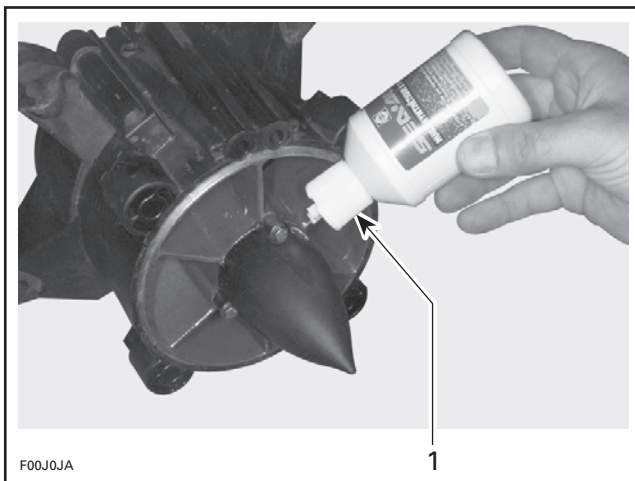
Place housing horizontally as in its operating position so that filler plug is located on top. Remove filler plug from cover. Pour SEA-DOO JET PUMP SYNTHETIC OIL (P/N 293 600 011) in reservoir until oil comes level with bottom of hole. Let oil drain into housing and after a few minutes add more oil until 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.

Apply Loctite pipe sealant (P/N 293 800 018) on plug threads and reinstall it on cover.

NOTE: The plug threads are perpendicular to the impeller shaft.

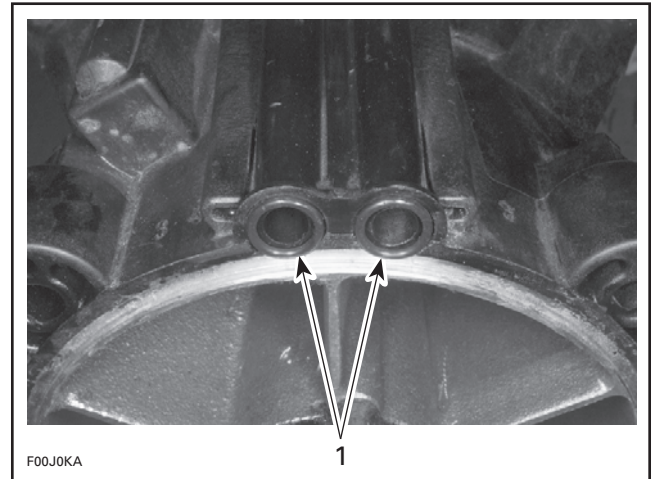


TYPICAL

1. Pour oil slowly until it is level with bottom of filler hole

Venturi

If needed, install new O-rings no. 38 around bailer passages.



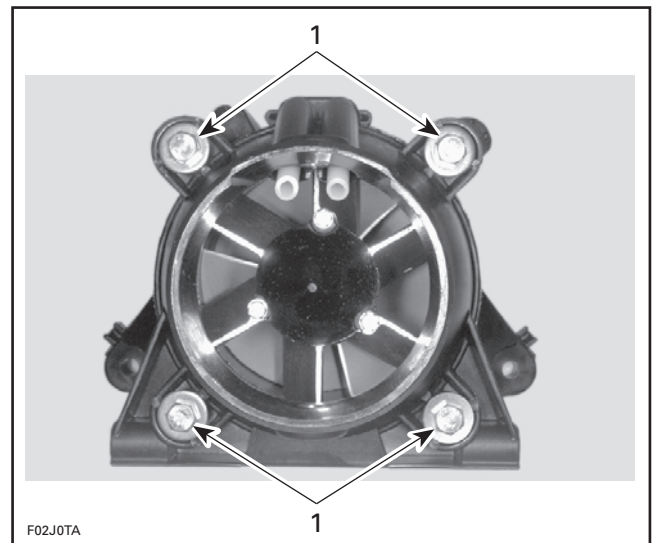
1. O-rings

Apply Loctite 518 (Gasket Eliminator) on mating surface.

Position venturi no. 24 with bailer passages on top.

Apply Loctite 243 (blue) on threads of screws no. 39.

Install screws no. 39, lock washers and flat washers then torque to 21 N•m (16 lbf•ft).



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

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)

O-Rings

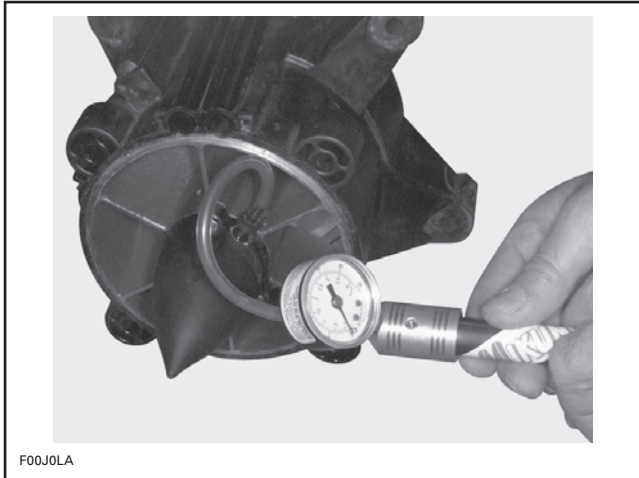
Install O-rings no. 38 around bailer passages or make sure they are in place if they were not removed.

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 drain plug from cover.
- Apply Loctite Pipe sealant on threads of fitting tool (P/N 295 000 086) then secure on cover.
- Connect pump gauge tester (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. 22 may be leaking; Add a small quantity of SEA-DOO JET PUMP SYNTHETIC OIL to wet the oil seal. Let soak and recheck.

- Disconnect pump gauge tester and remove fitting.
- Check oil level. Refill as necessary.
- Apply Loctite Pipe sealant (P/N 293 800 018) to threads of filler plug then secure it in cover.

NOTE: The plug threads are perpendicular to the impeller shaft.

INSTALLATION

Jet Pump Housing

Generously apply synthetic grease 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) on stud threads of jet pump housing.

Install flat washers no. 40, lock washers no. 41 and nuts no. 25. Tighten nuts of jet pump housing in a criss-cross sequence and torque to 31 N•m (23 lbf•ft).

NOTE: Slightly lubricate wear ring with BOMBARDIER LUBE lubricant to minimize friction during initial start.

Nozzle

GS and GTX RFI Models

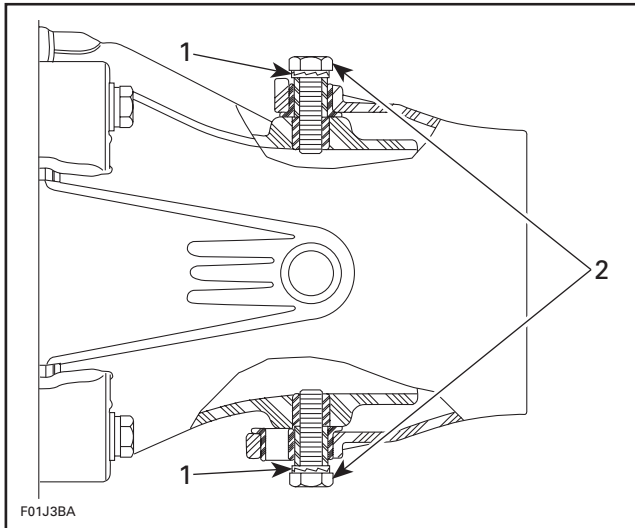
Insert bushings no. 42 in nozzle no. 20, positioning their flanges from inside of nozzle.

Insert sleeves no. 22 in bushings no. 42.

Install nozzle on venturi no. 24; position its steering arm on RH side. Apply Loctite 243 (blue) on screw threads (or use new screws with pre-applied threadlocker). Install screws no. 21 and washers no. 23 then torque to 20 N•m (15 lbf•ft).

Section 11 PROPULSION SYSTEM

Subsection 02 (JET PUMP)



TYPICAL

1. Washers
2. Torque screws to 20 N•m (15 lbf•ft)

WARNING

Screws must be torqued as specified.

Pivot Triangle (if so equipped)

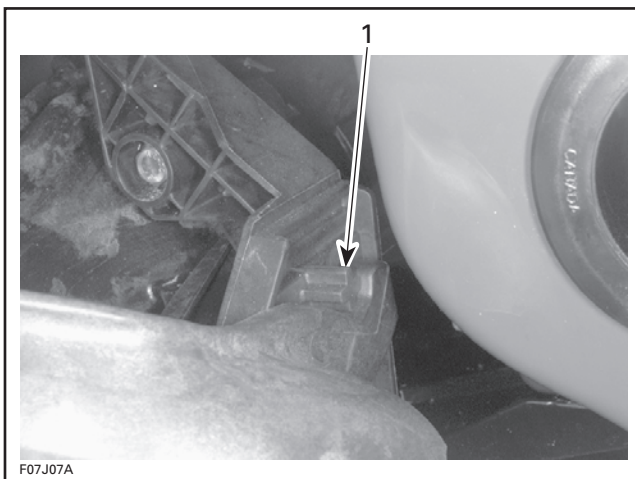
Install head bolts toward inside.

NOTE: Make sure the pivot triangle turn freely.

Reverse Gate (if so equipped)

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

NOTE: When installing the reverse gate, pay attention to position its lever behind the reverse gate support stopper.



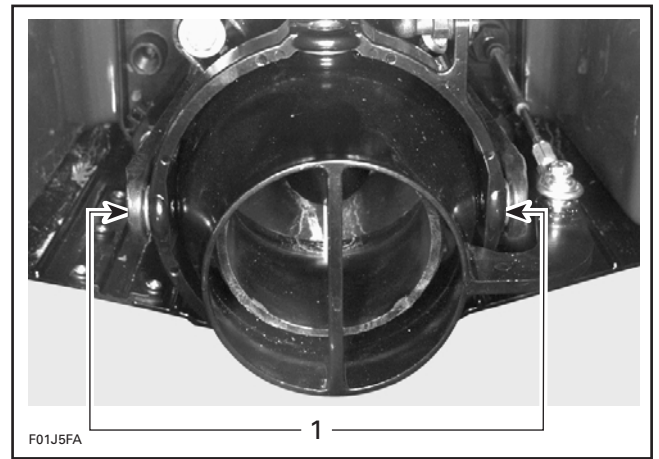
1. Stopper

XP Models

Install nozzle/trim ring assembly.

Torque screws to 20 N•m (15 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.



1. Torque screws to 20 N•m (15 lbf•ft)

Steering Cable

Refer to section, STEERING SYSTEM.

Trim System

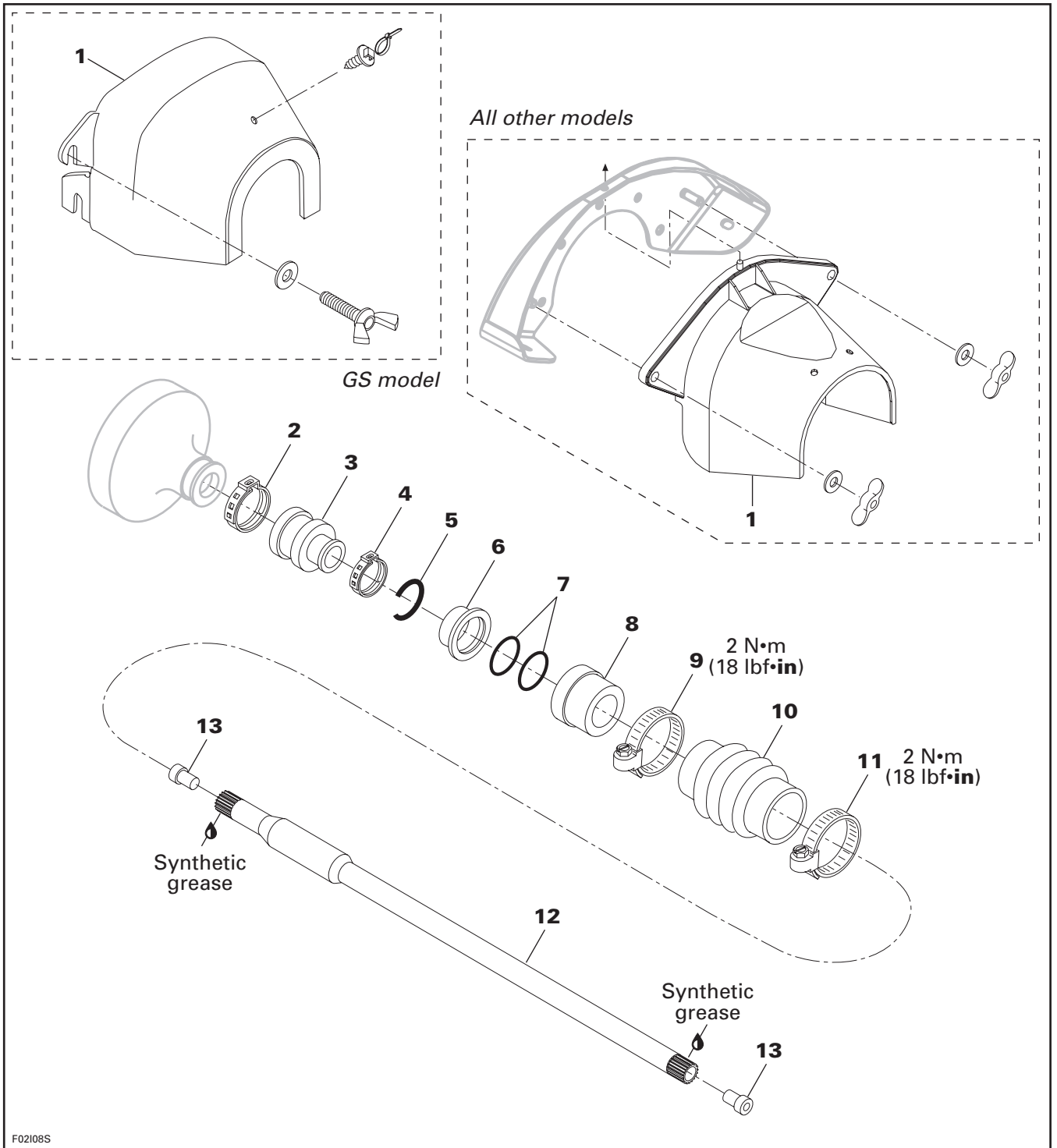
Refer to VARIABLE TRIM SYSTEM.

Reverse Cable

Refer to REVERSE SYSTEM.

DRIVE SYSTEM

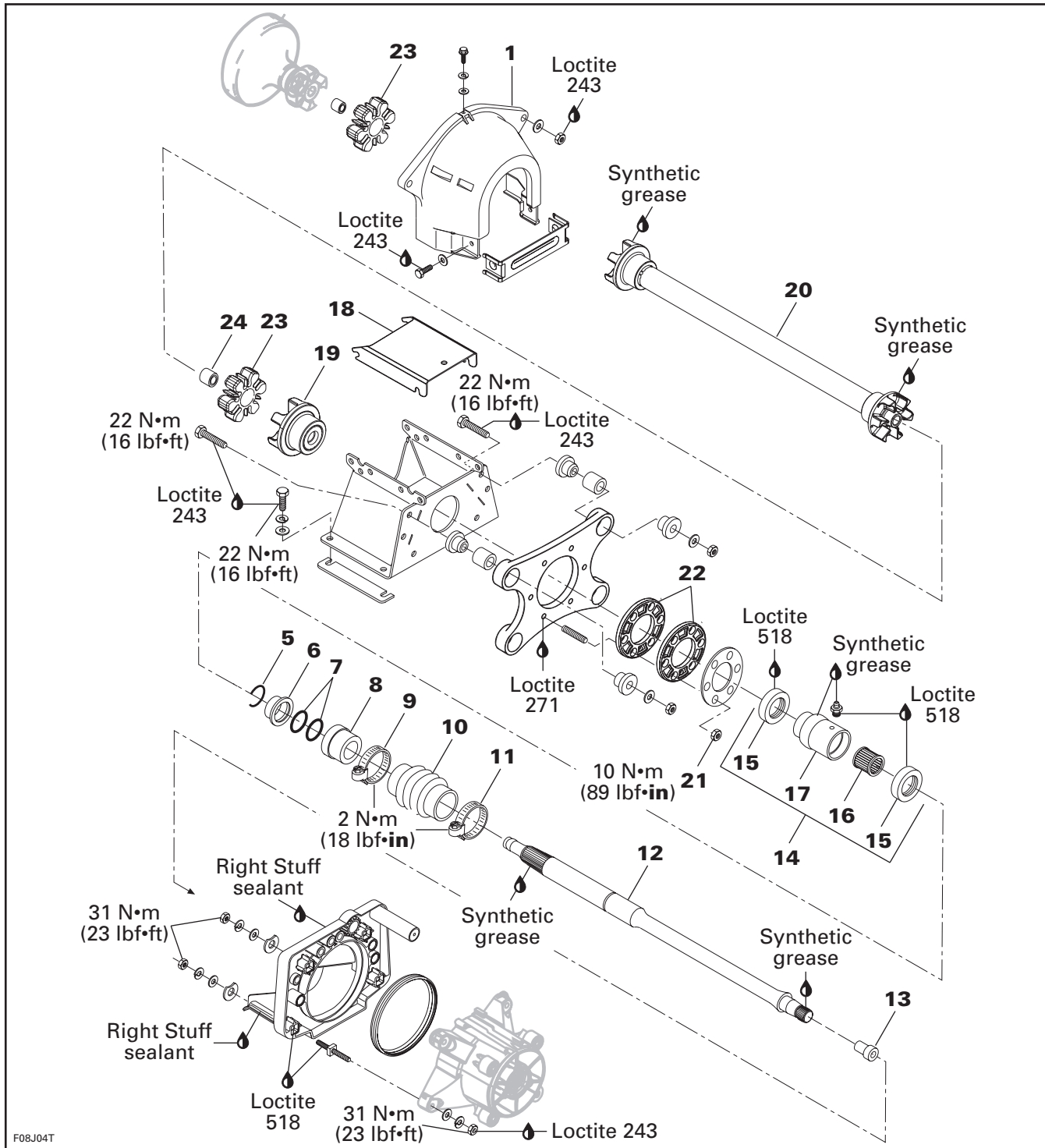
All Models except XP



Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

XP Models



F08J04T

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

All Models except XP

Remove seat(s).

Remove vent tube support or seat support.

Remove plastic wing nuts retaining PTO flywheel guard **no. 1** to engine support.

Detach PTO flywheel guard from engine and withdraw from bilge.

XP Models

Open engine compartment cover.

Remove storage basket.

Remove vent tubes from PTO flywheel guard.

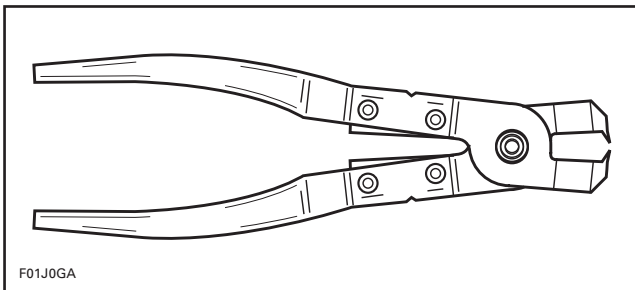
Remove PTO flywheel guard.

Large Clamp

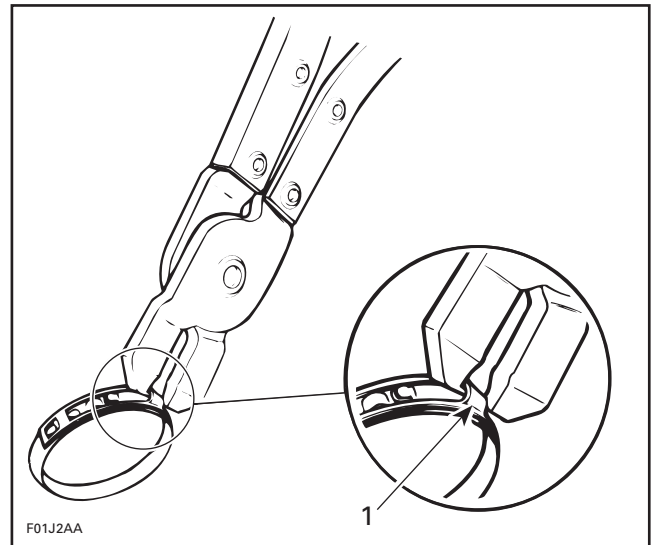
All Models except XP

Unfasten large clamp of PTO flywheel boot **no. 3** as follows:

- Use pliers (P/N 295 000 069).



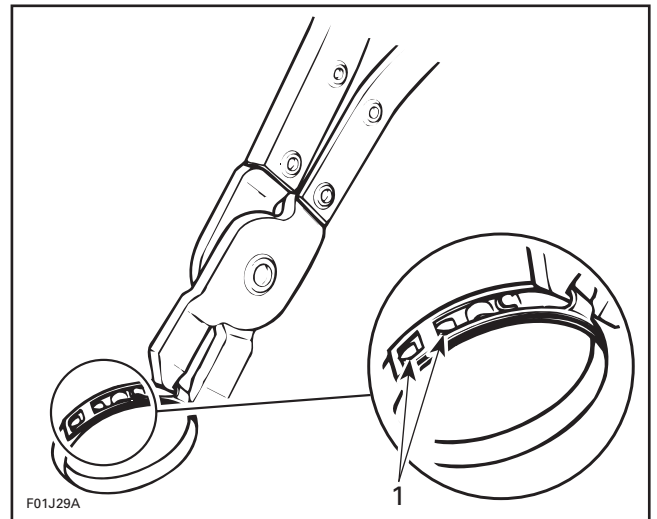
- Insert pointed tips of pliers in closing hooks.



TYPICAL

1. Closing hooks

- Squeeze pliers to draw hooks together and disengage windows from locking hooks.



TYPICAL

1. Locking hooks

Small Clamp

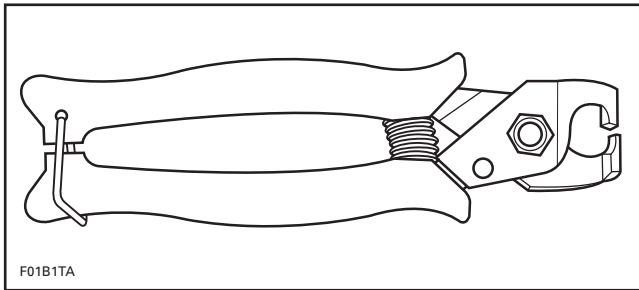
All Models except XP

Unfasten small clamp of PTO flywheel boot as follows:

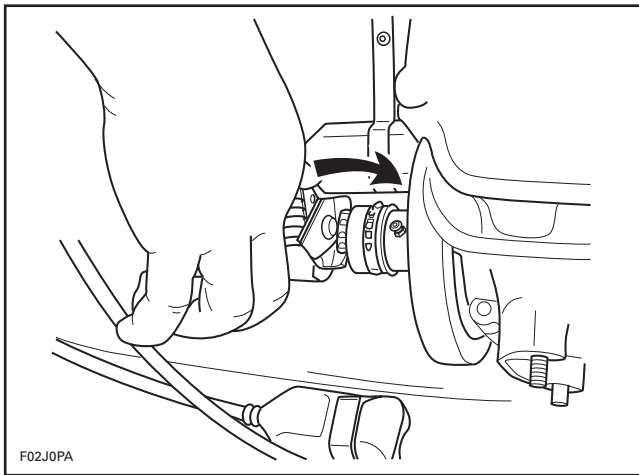
Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

- Use pliers (P/N 295 000 054).



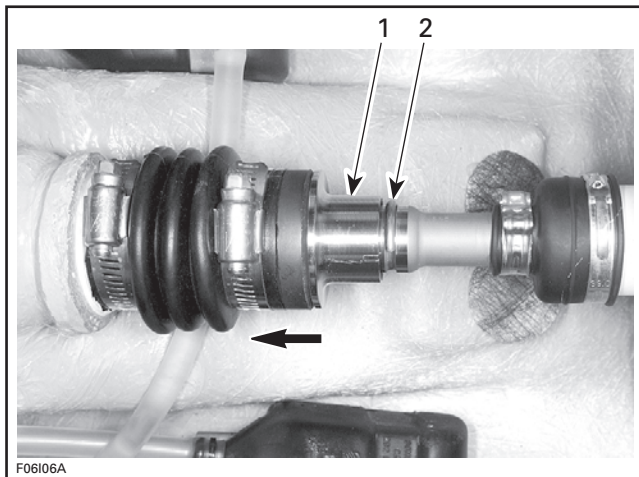
- To open clamp, place flat side of plier on clamp embossment, squeeze and twist plier.



Circlip and Floating Ring

NOTE: On XP models, open rear access cover to reach boot no. 10 and floating ring no. 6.

Hold floating ring no. 6 and compress boot no. 10; then, pull out circlip no. 5 from drive shaft groove.



TYPICAL

1. Push floating ring
2. Remove circlip

All Models except XP

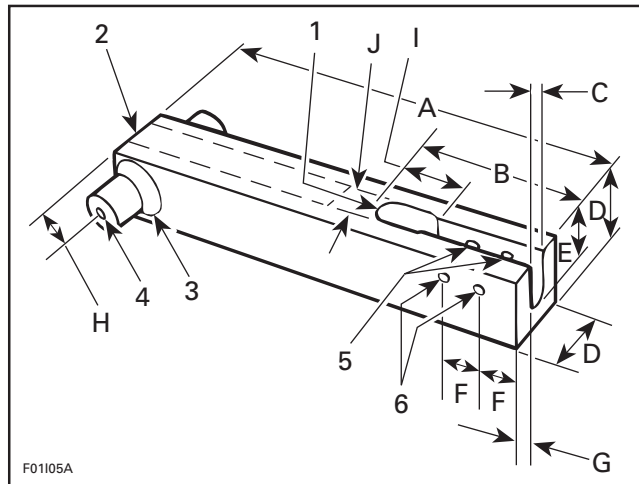
Drive Shaft

Simply pull out drive shaft.

NOTE: If the drive shaft is jammed into PTO fly-wheel, make the following tool and use it in conjunction with the jet pump housing remover (P/N 295 000 113) to withdraw drive shaft.

Raw Material:

- 1 aluminum alloy square of 51 mm (2 in) x 305 mm (12 in).
- 2 aluminum rods of 28.5 mm (1-1/8 in) dia. x 30 mm (1-3/16 in).

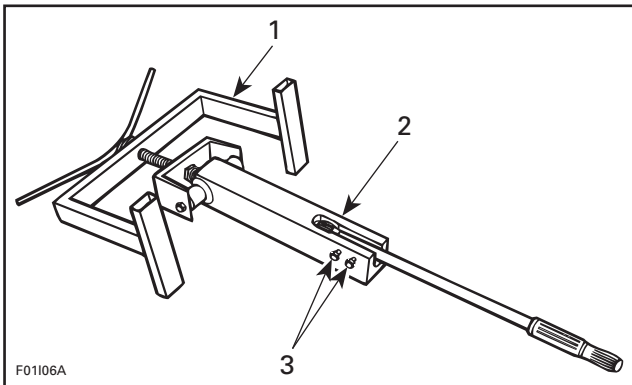


1. Use ball end mill for radius. This section of the slot should be 38 mm (1-15/32 in) deep
 2. Drill 25 mm (1 in) hole in center to remove material
 3. Weld all around
 4. Drill 9 mm (11/32 in) hole
 5. Drill through 9 mm (11/32 in)
 6. Drill and tap 6 mm (1/4 in) holes
- A. 305 mm (12 in)
 B. 105 mm (4-1/8 in)
 C. 16 mm (5/8 in)
 D. 51 mm (2 in)
 E. 36 mm (1-25/64 in)
 F. 22 mm (7/8 in)
 G. 17 mm (43/64 in)
 H. 19 mm (3/4 in)
 I. 35 mm (1-3/8 in)
 J. 20.3 mm ± .18 mm (.800 in ± .007 in)

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

Mount on drive shaft puller the jet pump housing remover; then, install assembly on drive shaft using screws.



TYPICAL

1. Jet pump housing remover
2. Drive shaft puller
3. Screws

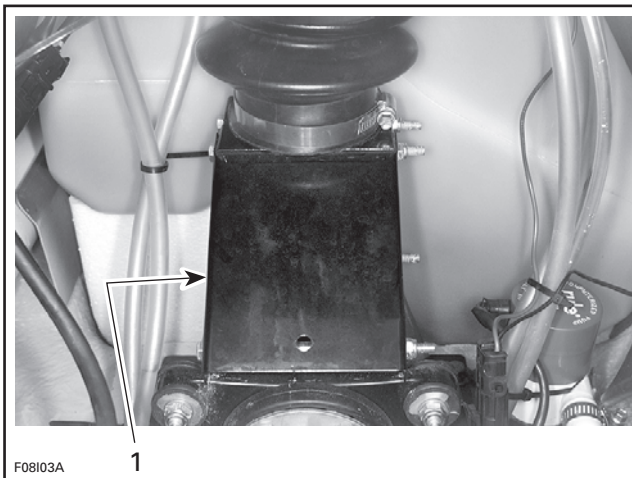
CAUTION: Be careful not to damage hull rear section or engine rubber mounts.

XP Models

Rear Drive Shaft

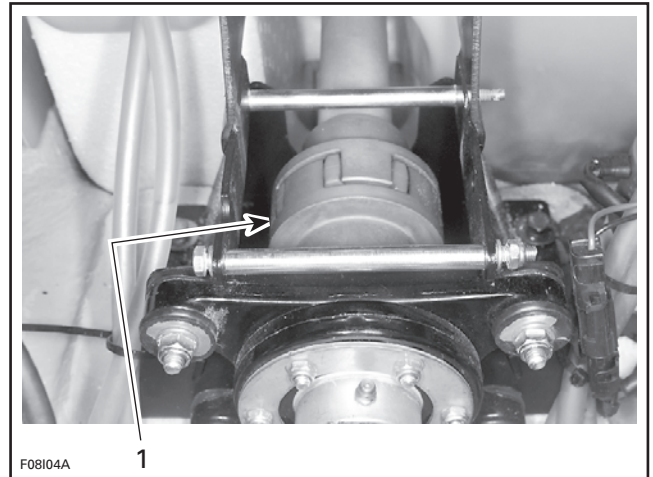
Remove rear access panel.

Remove protective plate no. 18.



1. Remove protective plate

Pull rear drive shaft until coupler no. 19 is disengagement from splines.



1. Pull drive shaft to disengage coupler from splines

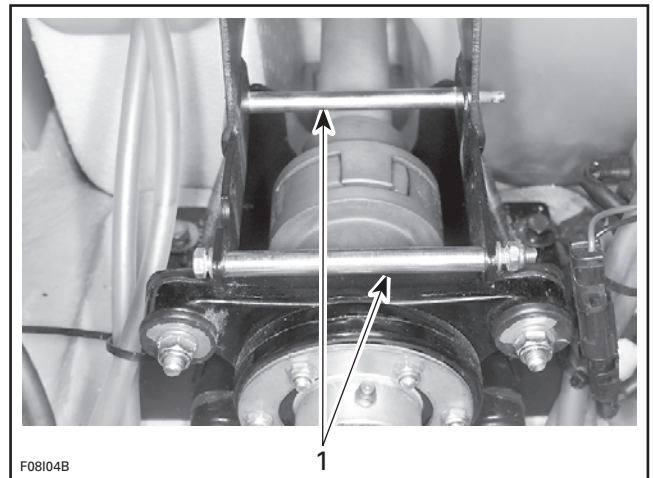
Remove rear drive shaft.

Remove coupler no. 19.

Front Drive Shaft

Remove PTO flywheel guard no. 1.

Remove bolts, lock nuts and sleeves from support.

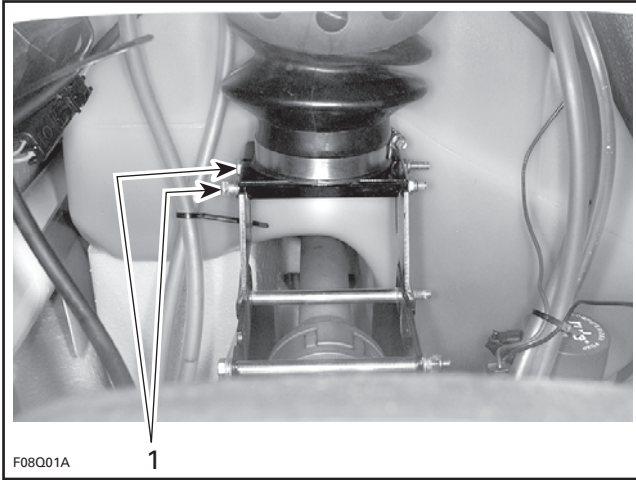


1. Remove bolts, lock nuts and sleeves

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

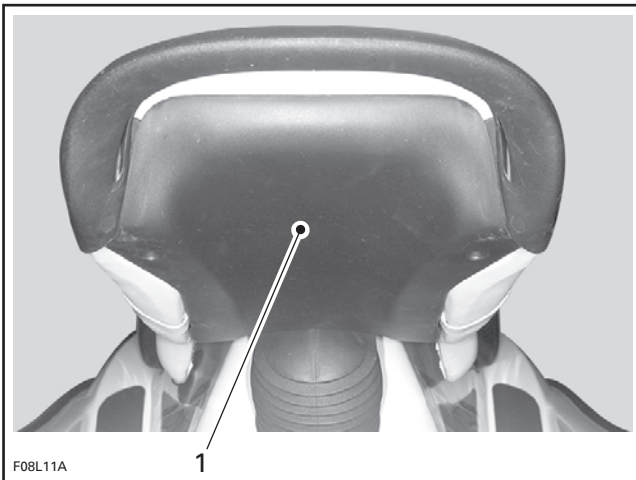
Loosen bolts and lock nuts retaining the lower support of the shock absorber.



TYPICAL

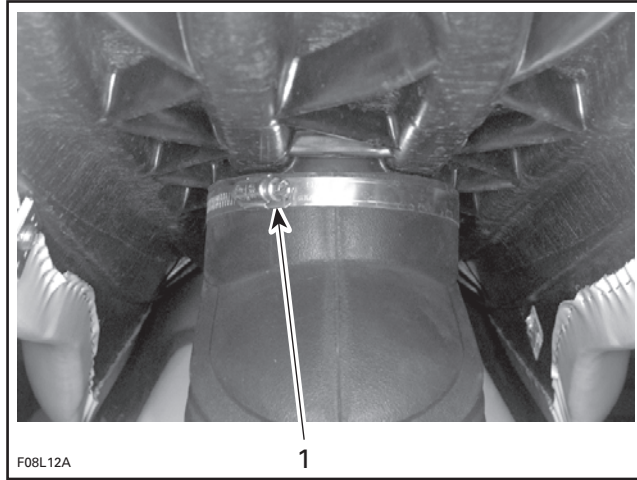
1. Remove bolts and lock nuts

Loosen 4 screws and remove bottom cover of seat.



1. Remove cover

Loosen gear clamp retaining the outer boot of the shock absorber.



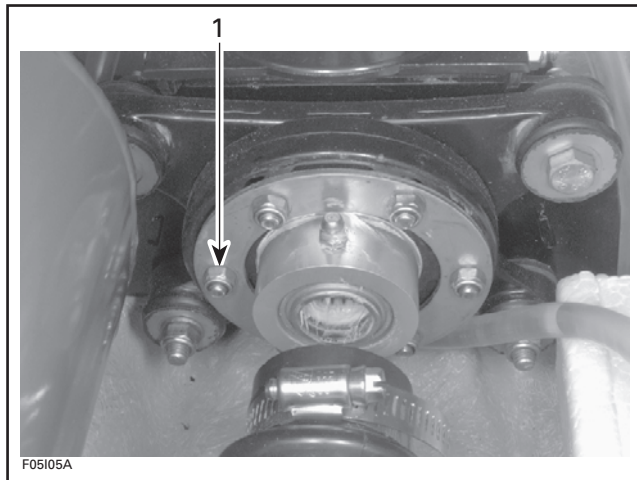
1. Loosen gear clamp

Tilt seat.

Remove front drive shaft.

Seal Carrier of Mid Bearing

To remove the seal carrier from support, loosen the 6 nuts no. 21.

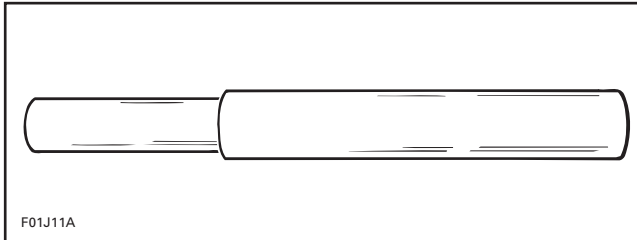


1. Nut (6)

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

Bearing no. 16 and seals no. 15 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. 17 when removing seals and bearing.

All Models

Boot

Loosen gear clamp no. 11 holding boot, then carefully pull boot and carbon ring no. 8 from hull insert.

Carbon Ring

Loosen gear clamp no. 9 then pull carbon ring from boot no. 10.

INSPECTION

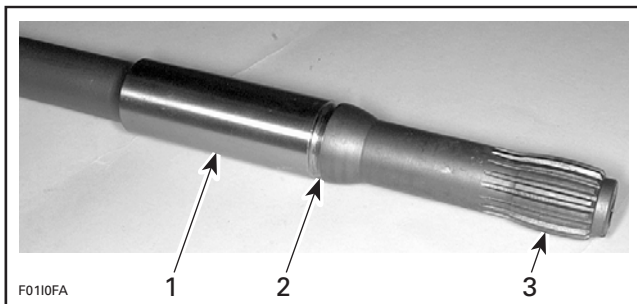
All Models

Drive Shaft

Inspect condition of drive shaft and PTO flywheel splines (except XP models).

Inspect condition of groove.

With your finger nail, feel machined surface of drive shaft. If any irregular surface is found, renew drive shaft.

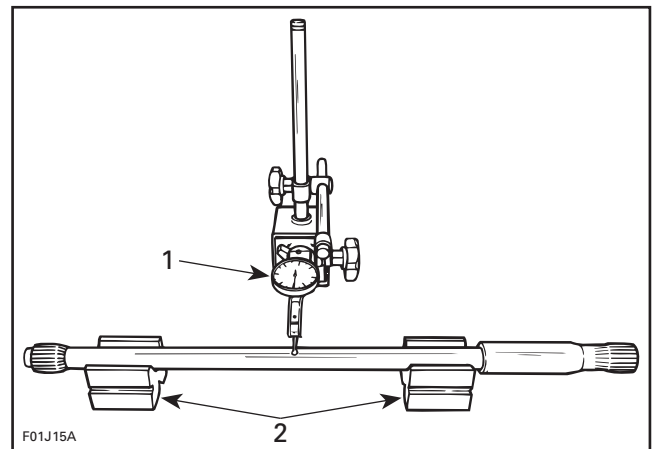


1. Surface condition
2. Groove condition
3. Splines condition

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

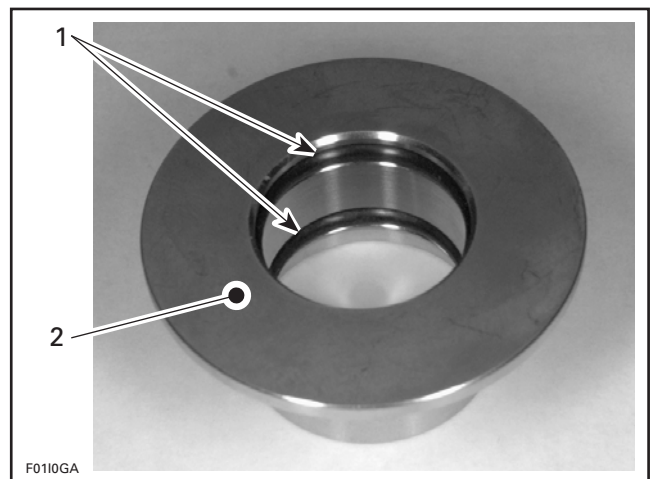
1. Dial gauge
2. V-blocks

Damper

Visually inspect shape of dampers no. 13 for deformation or other damage.

Floating Ring and O-Ring

Inspect condition of O-rings no. 7 and floating ring contact surface.



1. O-rings
2. Floating ring contact surface

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

Boot

Inspect the condition of boot. If there is any damage or evidence of wear, replace it.

To verify the preload of the boot **no. 10**, proceed as follows:

NOTE: To verify the boot preload and free length, jet pump and drive shaft must be installed.

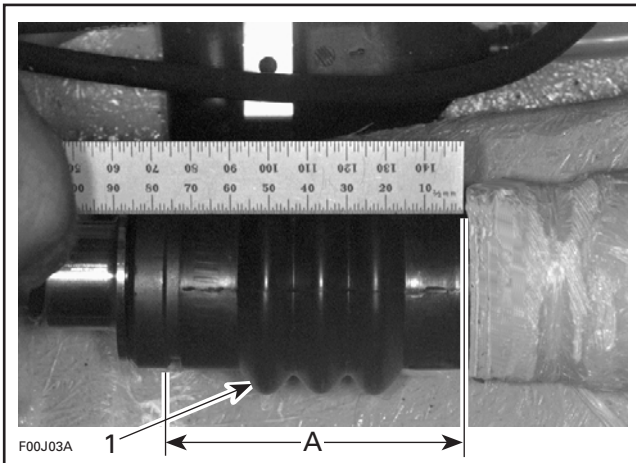
Measure boot length when normally installed on drive shaft. Ensure circlip **no. 5** is properly installed into groove.

Slide floating ring far enough forward in order to release it from carbon ring.

Measure boot free length.

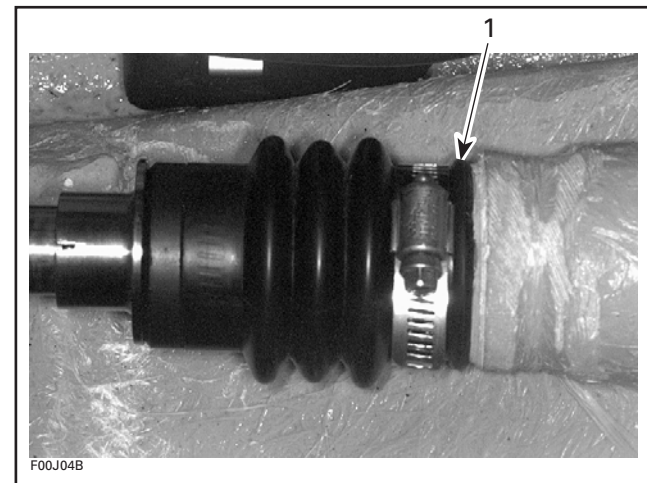
Subtract the installed length measurement from the free length measurement. A difference of 4 mm to 12 mm (5/32 in to 15/32 in) should be obtained.

If the length is less than 4 mm (5/32 in), install a spacer (P/N 293 250 017) between boot and thru hull fitting.



1. Boot
A. Measure here

Push floating ring to compress boot; then, remove circlip out of drive shaft groove.



1. Spacer

NOTE: Drive shaft must be removed to install spacer.

XP Models

Seal Carrier of Mid Bearing

Inspect seal carrier needle bearing **no. 16**. Check parts for scoring, pitting, chipping or other evidence of wear.

Inspect seals **no. 15** for deterioration or excessive wear. Replace if necessary.

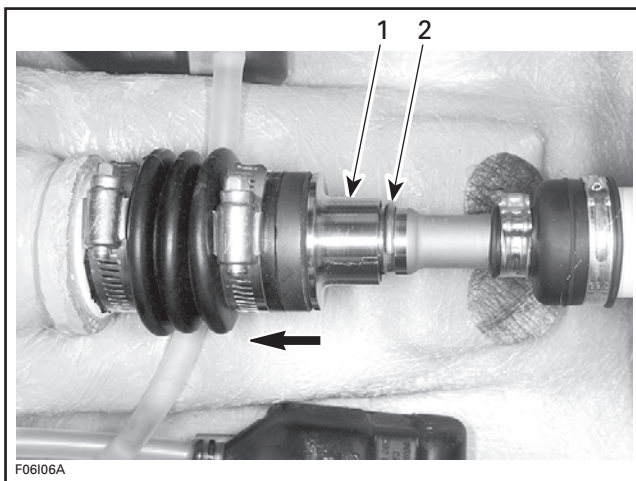
ASSEMBLY

XP Models

Seal Carrier of Mid Bearing

Properly support seal carrier housing **no. 17** when installing seals and bearing.

CAUTION: Ensure to install stamped end of bearing (showing identification markings) first on tool. Never hammer the bearing into its housing.

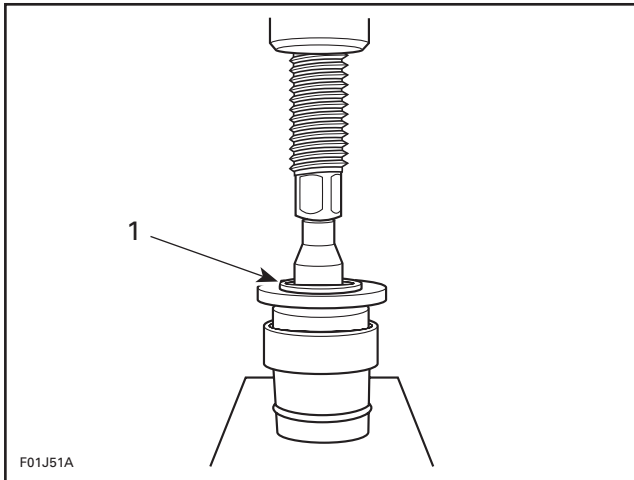


1. Push floating ring
2. Remove circlip

Section 11 PROPULSION SYSTEM

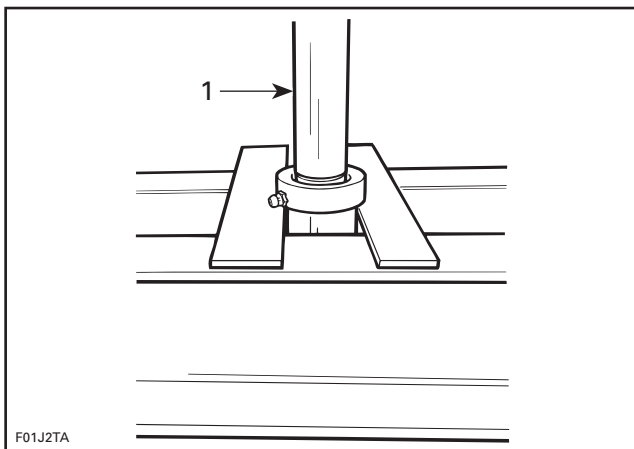
Subsection 03 (DRIVE SYSTEM)

Install bearing no. 16 with the bearing/seal installer tool (P/N 295 000 107).



1. Press bearing in its housing

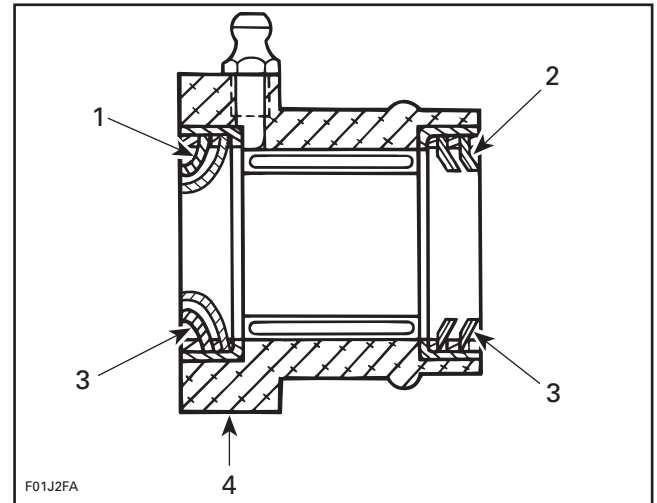
NOTE: Bearing can also be installed with the same driver used at disassembly. Center bearing in longitudinal axis of housing.



1. Push bearing centered in its housing

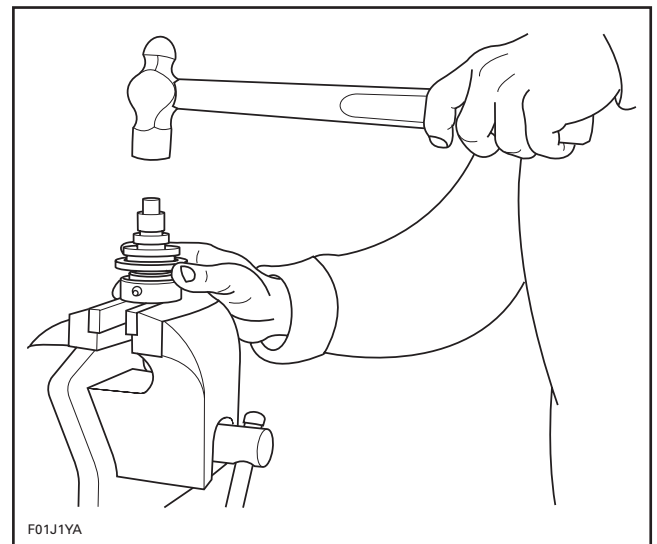
Install double-lip seal no. 15 with protector toward jet pump.

On both seals no. 15, raised edge of lip must be located outwards of seal carrier.



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 all around seals outside diameter. Seals no. 15 can be carefully installed in housing using 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).

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

INSTALLATION

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

XP Models

Seal Carrier of Mid Bearing

Properly index flanges **no. 22** together.

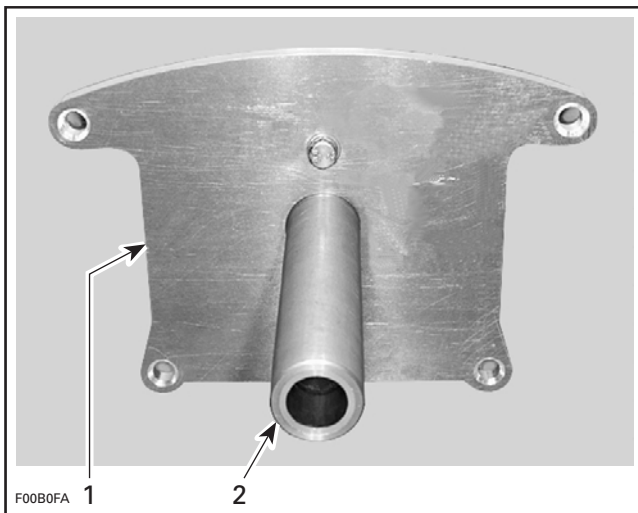
Install seal carrier and hand tighten nuts **no. 21**.

NOTE: Apply Loctite 243 (blue) on studs.

Align the seal carrier using the following tools:

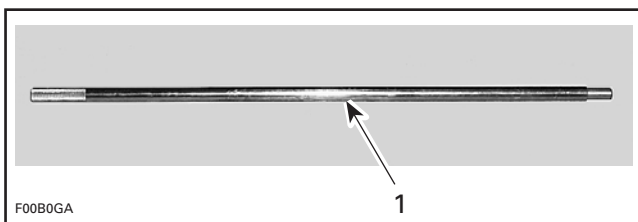
- support plate kit (P/N 529 035 506)

NOTE: Use plate (P/N 529 035 507) for the 155.6 mm (6-1/8 in) jet pump.



1. Plate (P/N 529 035 507)
2. Support (P/N 529 035 511)

- alignment shaft (P/N 295 000 141).

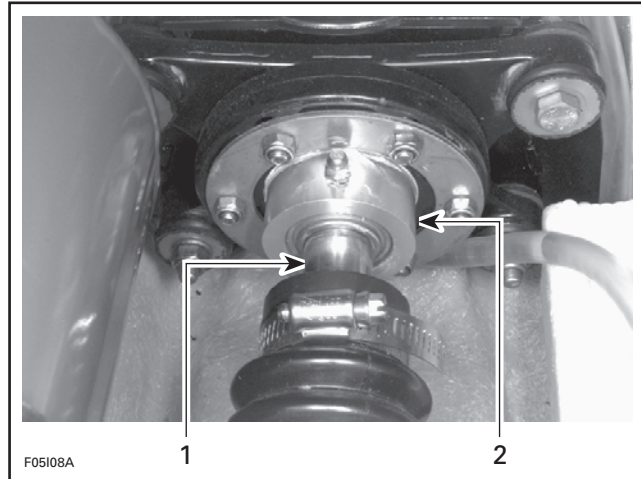


1. Alignment shaft

Install support plate at rear of watercraft.

Carefully slide shaft through support plate and seal carrier. Insert adapter end into PTO flywheel.

NOTE: Ensure the mid bearing is loosened.

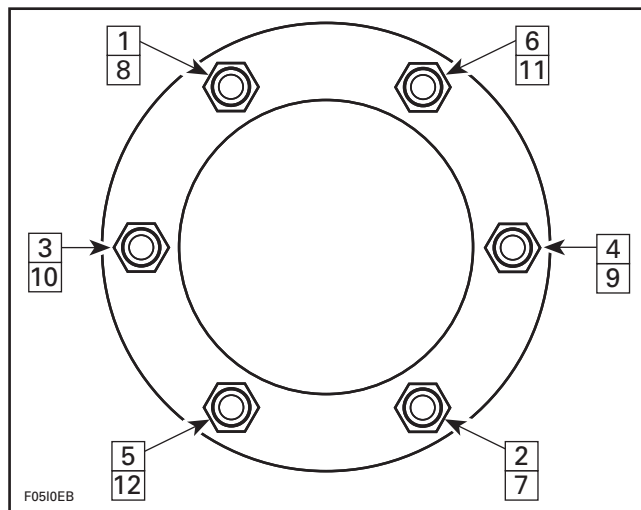


TYPICAL

1. Alignment tool
2. Seal carrier

Place grease fitting on the top and torque seal carrier nuts **no. 21** in a criss-cross sequence in 2 steps as per following illustration.

NOTE: It is very important to tighten nuts of seal carrier in a criss-cross sequence to maintain its alignment.

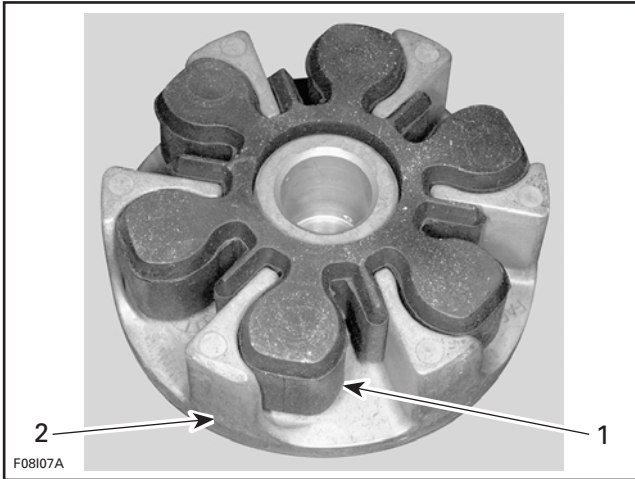


Step **1**: Torque to 3 N•m (26 lbf•in) as per sequence

Step **2**: Torque to 10 N•m (88 lbf•in) as per sequence

Front Drive Shaft Coupler and Damper

Make sure to install dampers into drive shaft coupler at both ends.



SAME COUPLER AND DAMPER AT BOTH ENDS

1. Damper
2. Drive shaft coupler

Front Drive Shaft

Install front drive shaft no. 20.

Rear Drive Shaft

Install damper no. 13 to rear drive shaft no. 12.

Install drive shaft and jet pump at the same time.

Insert drive shaft through carbon ring no. 8 and floating ring no. 6.

Insert drive shaft through seal carrier 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.

Reinstall protective plate no. 18. Apply Loctite 243 (blue) on bolts and torque lock nuts to 10 N•m (88 lbf•in).

All Models except XP

Drive Shaft and Dampers

Install dampers no. 13 on drive shaft no. 12.

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. 8 and floating ring no. 6.

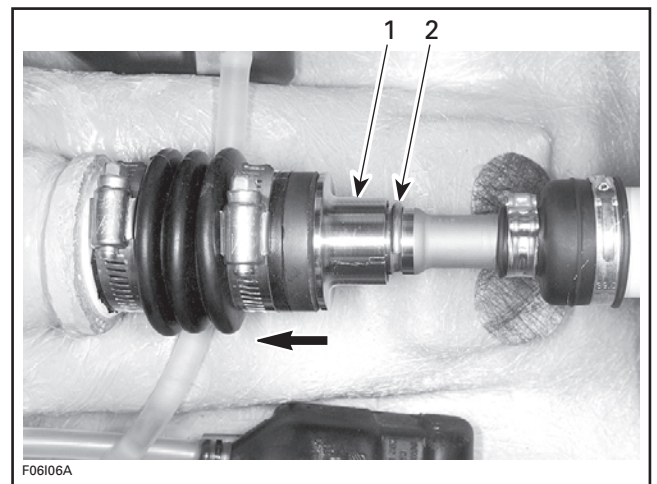
NOTE: Make sure to install floating ring before inserting the drive shaft in the PTO flywheel.

While holding jet pump, guide and engage drive shaft splines in PTO flywheel. Rotate shaft to properly index splines. Make sure boot is well positioned over shaft end.

All Models

Circlip

Push the floating ring to compress the boot. Insert the circlip no. 5 in the drive shaft groove.



1. Push floating ring
2. Insert circlip in the groove

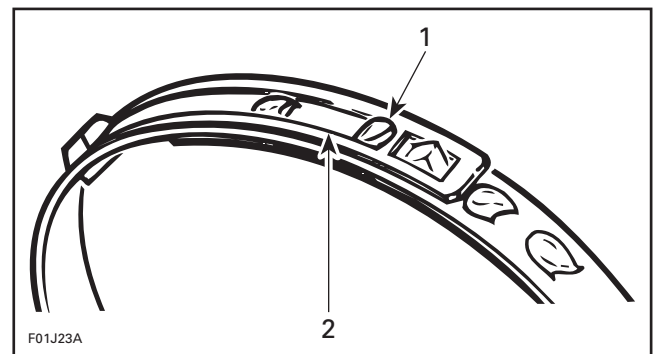
Slide the floating ring onto the circlip.

All Models except XP

Large Clamp

Secure large clamp no. 2 as follows:

- Use pliers (P/N 295 000 069) as for removal.
- Manually engage holding hook in large window. This is a pre-clamping position only.



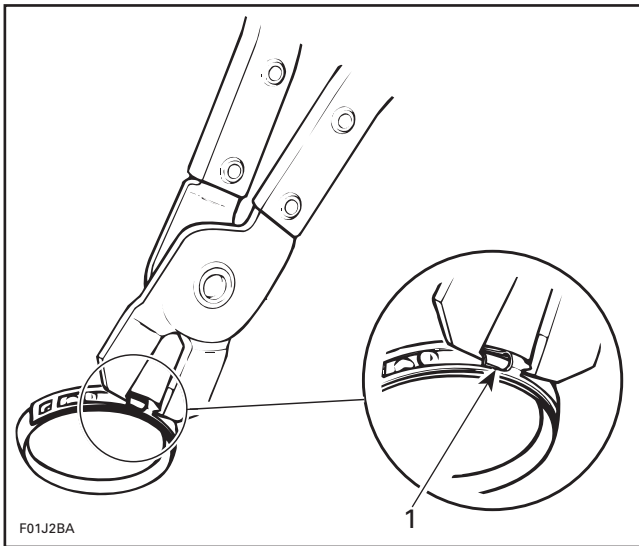
PRE-CLAMPING POSITION

1. Holding hook
2. Large window

Section 11 PROPULSION SYSTEM

Subsection 03 (DRIVE SYSTEM)

- Insert pointed tips of pliers first in closing hooks.

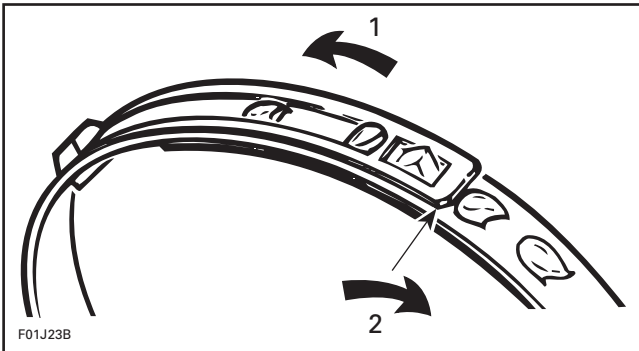


TYPICAL

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.

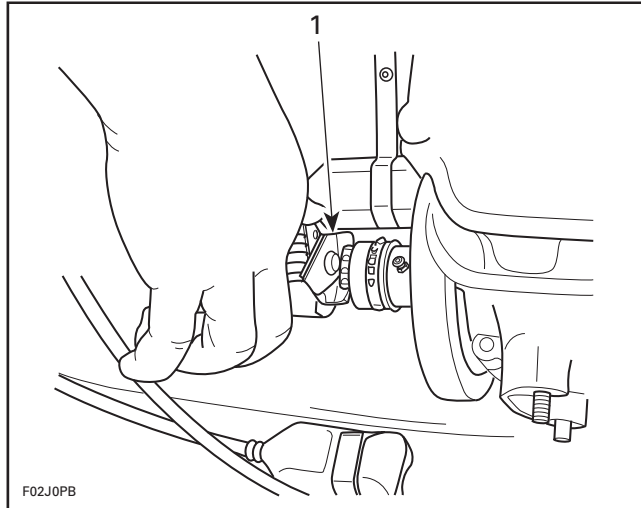
NOTE: At installation, clamp tail should be in opposite direction of engine rotation.



1. Engine rotation (counterclockwise)
2. Tail in opposite direction

Small Clamp

To secure small clamp no. 4, place notch side of plier on clamp embossment and squeeze plier.



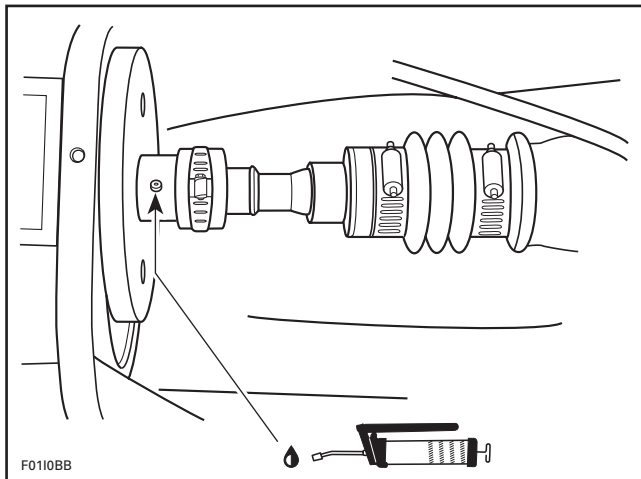
1. Squeeze plier

LUBRICATION

PTO Flywheel

All Models except XP

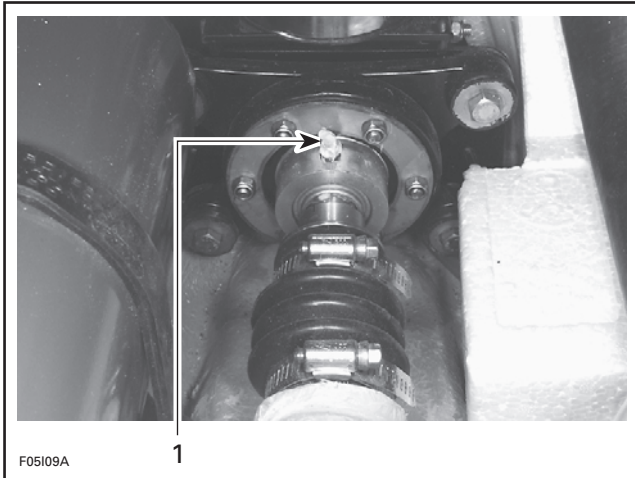
Using a grease gun, carefully lubricate PTO flywheel with synthetic grease (P/N 293 550 010), until boot is just beginning to expand. At this point, immediately stop greasing.



Seal Carrier of Mid Bearing

XP Models

Using a grease gun, lubricate seal carrier of mid bearing with synthetic grease (P/N 293 550 010).

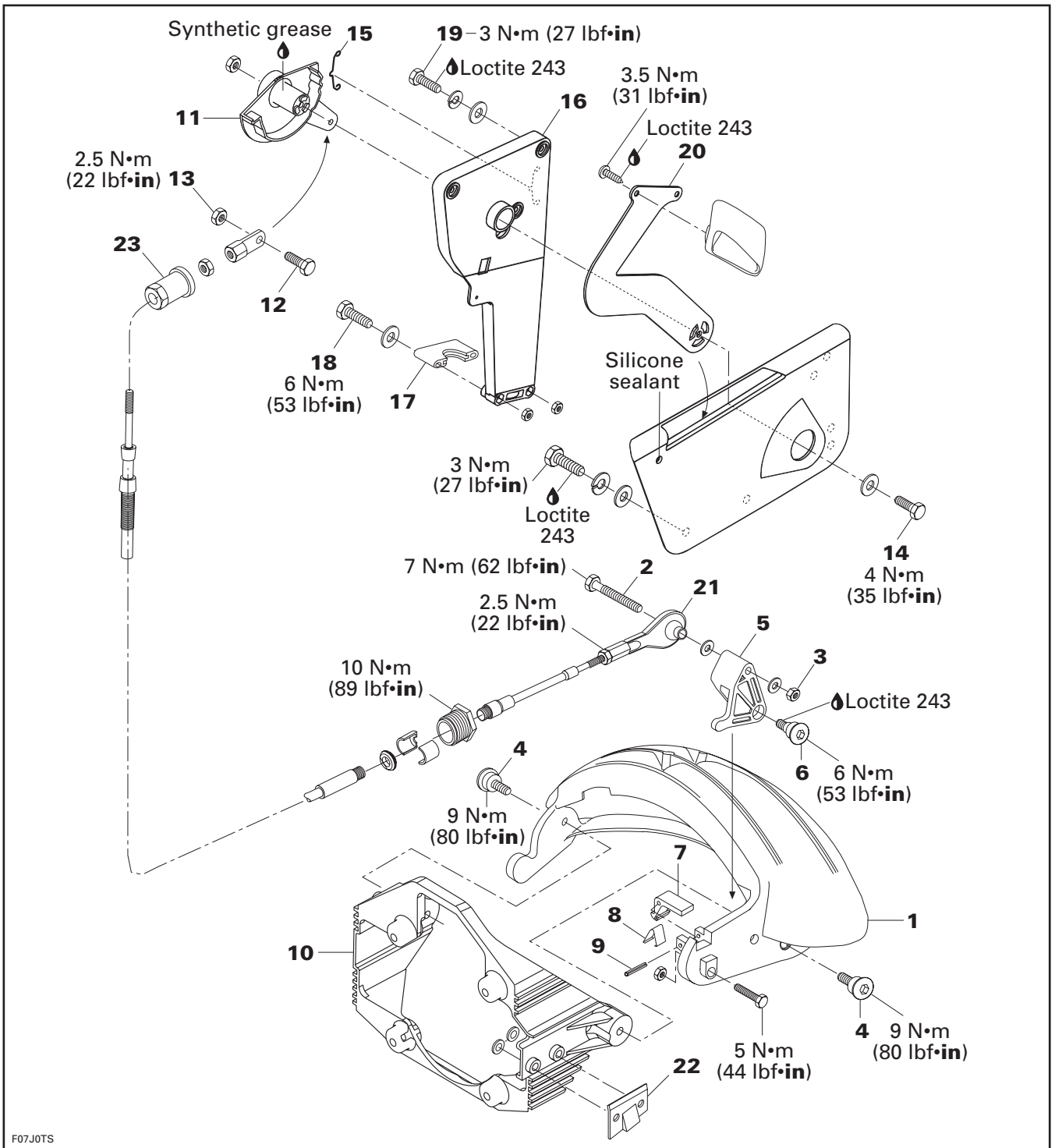


TYPICAL

1. Grease fitting

REVERSE SYSTEM

GTX Serie



F07J0TS

Section 11 PROPULSION SYSTEM

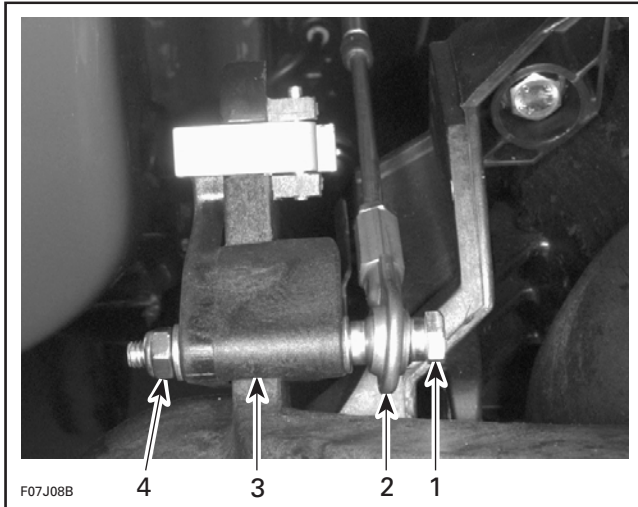
Subsection 04 (REVERSE SYSTEM)

DISASSEMBLY

Reverse Gate

Put shift lever in reverse position.

Disconnect reverse cable from reverse gate **no. 1**. Remove lock nut **no. 3** and bolt **no. 2** retaining cable end **no. 21** to cable lever **no. 5**.



1. Bolt
2. Cable end
3. Cable lever
4. Lock nut

Unscrew and remove 2 Allen screws **no. 4** retaining reverse gate to support **no. 10** and remove reverse gate.

Cable Lever

Remove Allen screw **no. 6** and detach cable lever from reverse gate.

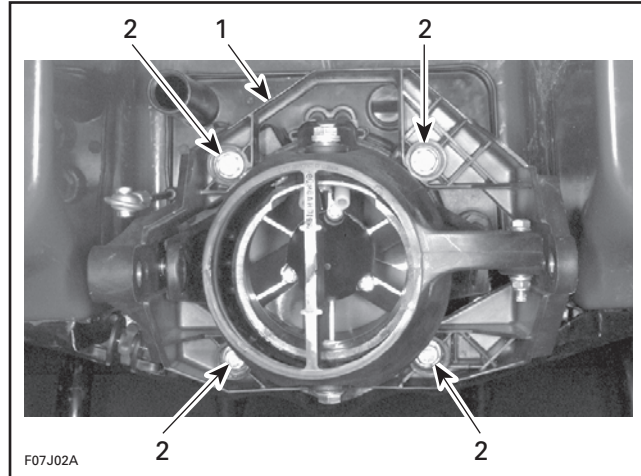
Pawl Lock and Spring

To remove pawl lock **no. 7** and spring **no. 8** remove roll pin **no. 9**.

Reverse Gate Support

Unscrew 4 bolts which retain reverse gate support **no. 10** to venturi.

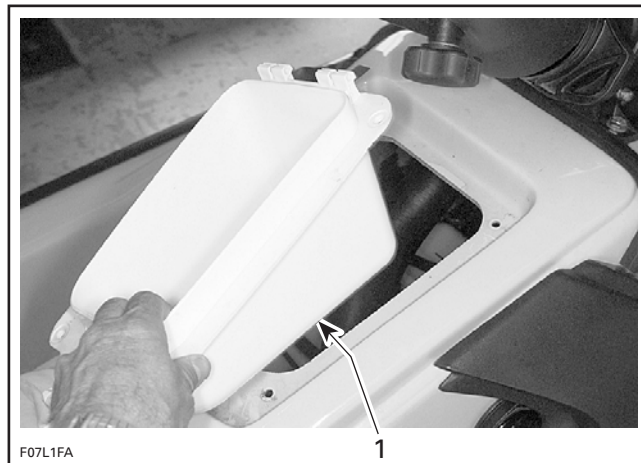
Remove reverse gate support from venturi.



1. Reverse gate support
2. Remove bolts

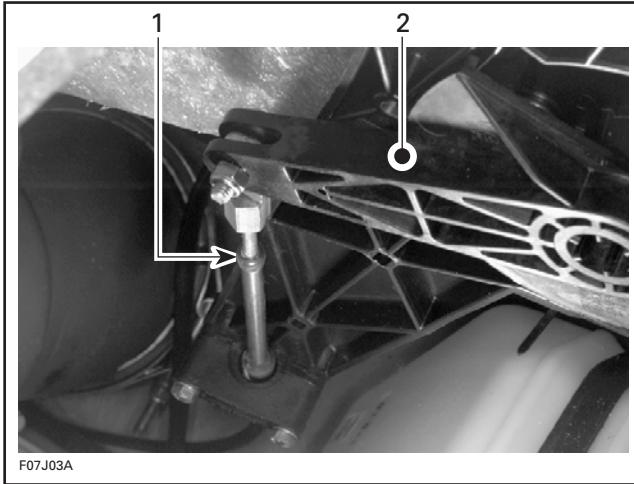
Interior Lever

Remove glove box to have access to the shifting lever mechanism.



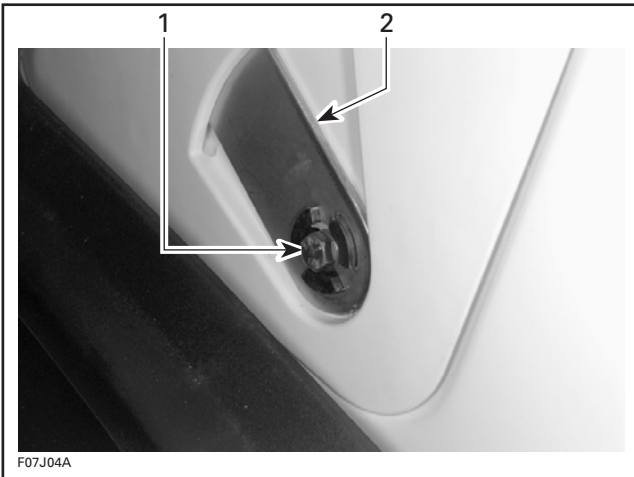
1. Remove glove box

Remove bolt no. 12 and lock nut no. 13 retaining reverse cable end to interior lever no. 11.



1. Reverse cable
2. Interior lever

From outside of body, unscrew bolt no. 14 retaining the shift lever no. 20.



1. Bolt
2. Shift lever

Remove the interior lever no. 11 and spring no. 15.

Reverse Cable Support

Unscrew bolts no. 18 and remove retaining block no. 17. Detach adjustment nut no. 23 from reverse cable support no. 16.

Remove 3 bolts no. 19 retaining reverse cable support no. 16 to body.

Remove reverse cable support.

INSPECTION

Visually inspect parts for wear or cracks. Replace parts as required.

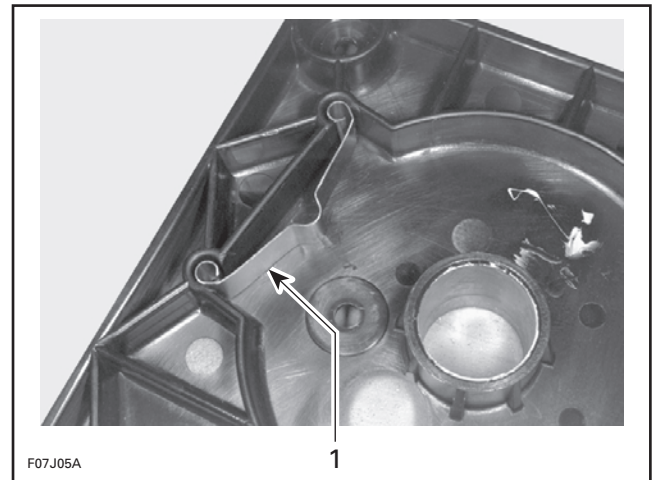
ASSEMBLY

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.

Spring

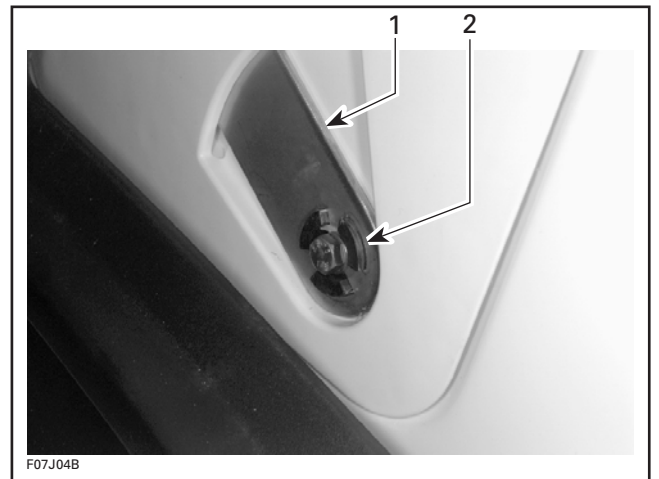
Make sure to properly install spring no. 15 into interior lever no. 11 as per following illustration.



1. Spring

Interior Lever and Shift Lever

Install the interior lever no. 11 in a rotating movement. Engage properly the interior lever tabs in the shift lever slots.



1. Shift lever
2. Interior lever tabs

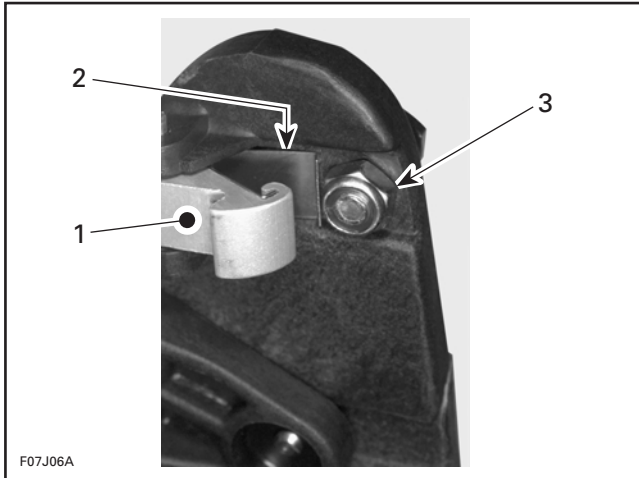
Make sure the shift lever action is smooth and precise. Forward, neutral and reverse positions should be easy to select with a detent position between each.

Section 11 PROPULSION SYSTEM

Subsection 04 (REVERSE SYSTEM)

Spring and Pawl Lock

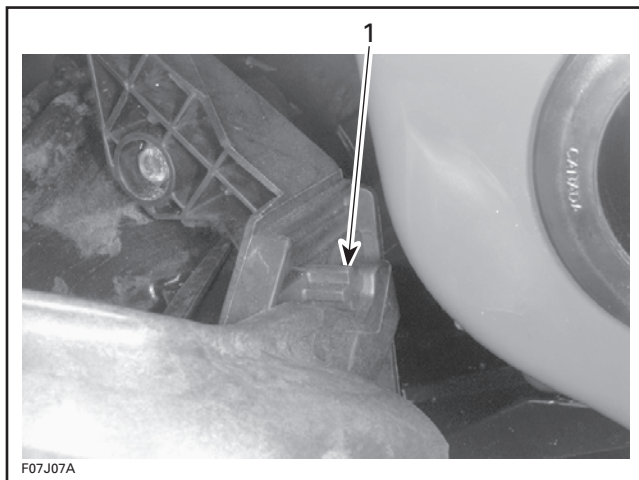
Make sure spring no. 8 is properly installed. One end of the spring is hooked in the pawl lock no. 7 and the other end is retained by the stopper lock nut.



1. Pawl lock
2. Spring
3. Stopper lock nut

Reverse Gate

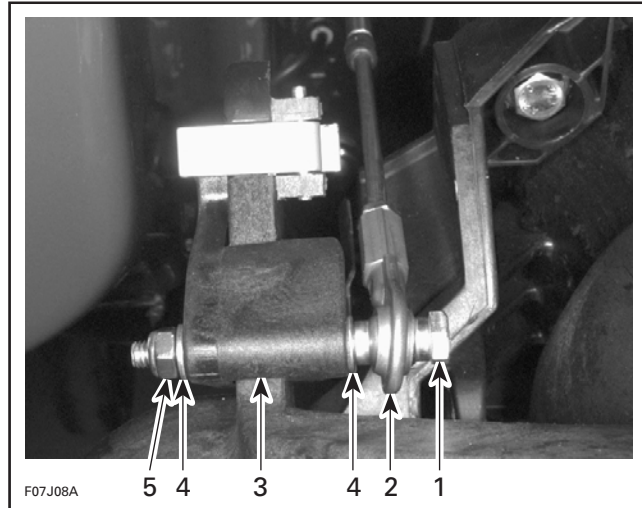
When installing the reverse gate, pay attention to position its lever behind the reverse gate support stopper.



1. Stopper

Reverse Cable

Install reverse cable to cable lever as per following illustration.



1. Bolt
2. Ball joint
3. Cable lever
4. Flat washer
5. Lock nut

CAUTION: Ensure cable ball joint is parallel to cable lever ($90^\circ \pm 5^\circ$) to minimize tension on cable. Adjust as required.

ADJUSTMENT

Put shift lever in forward position.

Pull shift lever approximately 50 mm (2 in) and push it back slowly in forward position.

WARNING

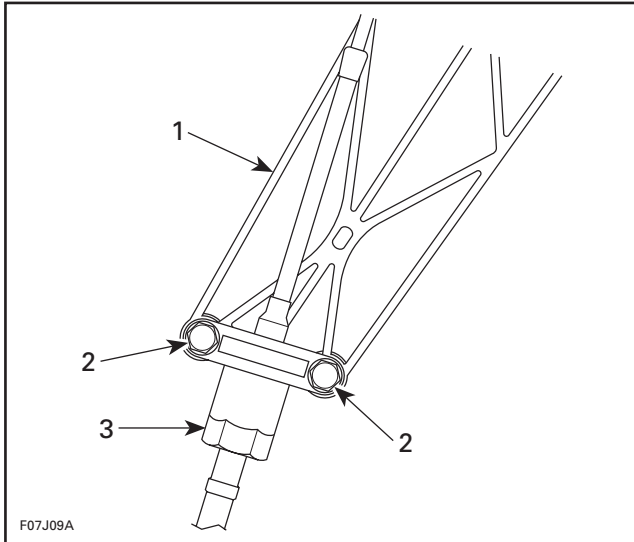
When adjusting reverse cable, assure that lever is well engaged into the spring slot.

The pawl lock no. 7 should be engaged in the anchor no. 22.

Section 11 PROPULSION SYSTEM

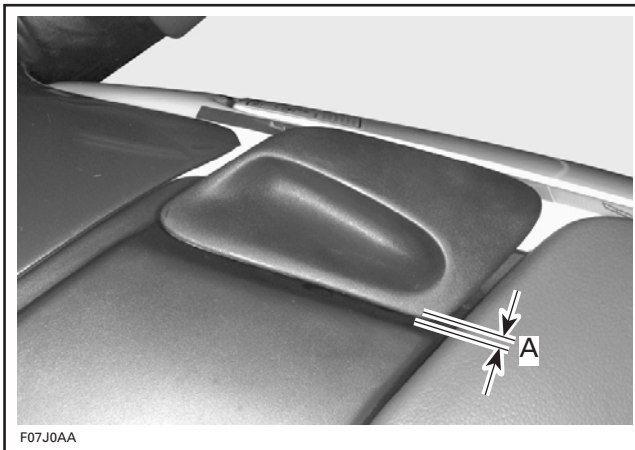
Subsection 04 (REVERSE SYSTEM)

If not, adjust reverse cable. Loosen 2 bolts no. 18 at reverse cable support no. 16. Turn adjustment nut no. 23 as required.



1. Reverse cable support
2. Loosen bolts
3. Adjustment nut

When adjustment is completed, there should be gap of 0 to 5 mm (0 to 3/16 in) between handle and left cover.

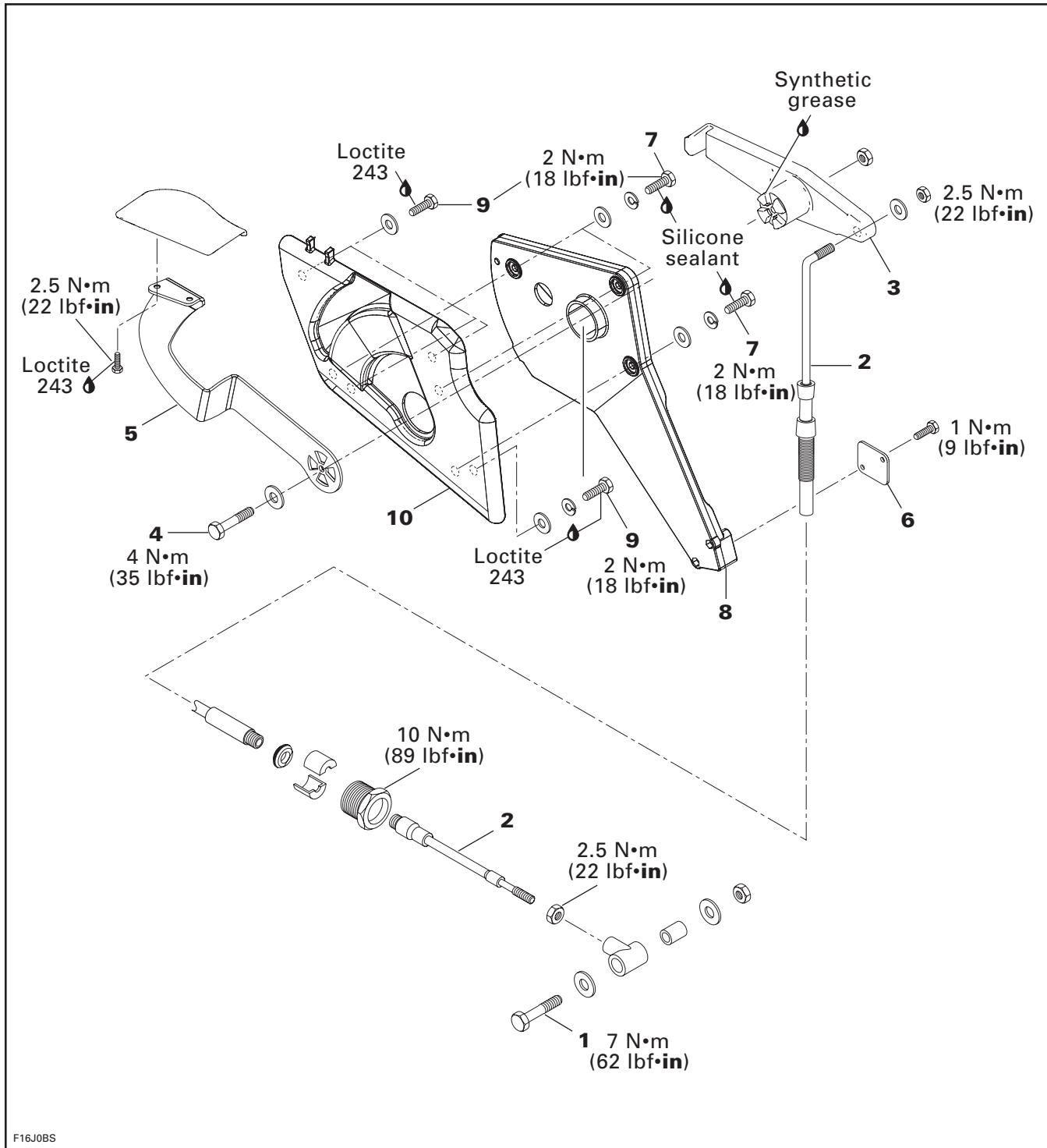


A. 0 to 5 mm (0 to 3/16 in)

Section 11 PROPULSION SYSTEM

Subsection 04 (REVERSE SYSTEM)

GTI, GTS, RX and RX DI Models



F16J0BS

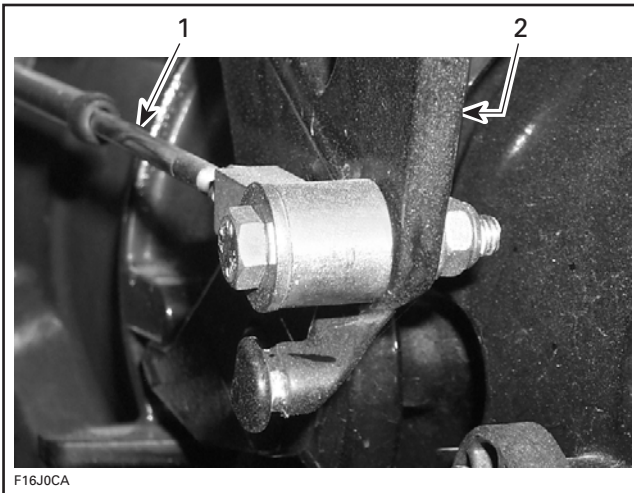
DISASSEMBLY

Reverse Gate

To remove reverse gate, refer to JET PUMP section.

Reverse Cable

Unscrew bolt no. 1, washers and the elastic stop nut retaining reverse cable no. 2 on pivot arm.



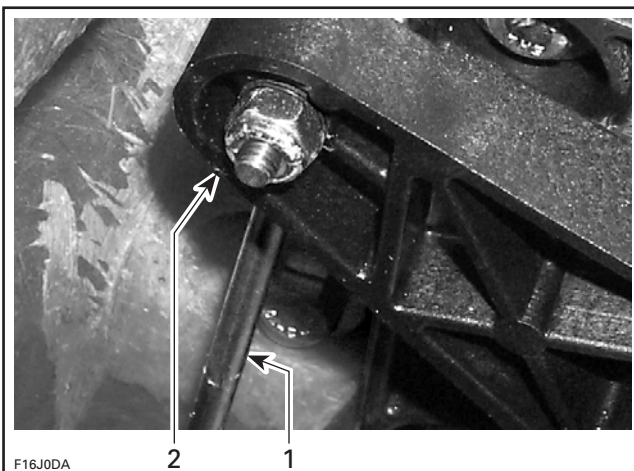
1. Reverse cable
2. Pivot arm

Unscrew the cable lock then remove the half rings. Remove the glove box. Refer to HULL/BODY.

On the interior lever no. 3, unscrew the elastic stop nut and the washer retaining the reverse cable.

Remove the bracket no. 6.

NOTE: Before removing reverse cable from hull, note cable routing for reinstallation.



1. Reverse cable
2. Interior lever

Interior Lever

Detach the reverse cable from interior lever no. 3. Unscrew the shift lever retaining bolt no. 4, washer and nut, then remove interior lever.



1. Shift lever retaining bolt

Shift Lever

Unscrew the shift lever retaining bolt no. 4, washer and nut.

Disengage the shift lever slots from interior lever tabs, then remove the shift lever no. 5.

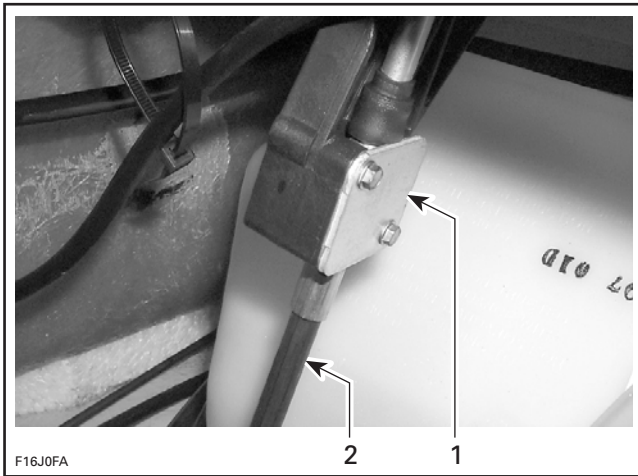
Reverse Cable Support

Remove:

- shift lever
- interior lever
- bracket no. 6

Section 11 PROPULSION SYSTEM

Subsection 04 (REVERSE SYSTEM)



1. Bracket
2. Reverse cable

– bolts no. 7.

Withdraw reverse cable support no. 8.

Handle Housing

Remove:

- shift lever
- interior lever
- reverse cable support
- bolts no. 9.

Then, remove handle housing no. 10.

INSPECTION

Visually inspect parts for wear or cracks. Replace all defective parts.

ASSEMBLY

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

Interior Lever

Apply synthetic grease 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 detent position between each.

Reverse Gate

Refer to JET PUMP section.

Reinstall glove box.

ADJUSTMENT

Put shift lever in forward position.

⚠ WARNING

When adjusting reverse cable, assure that lever is well engaged into the spring slot.

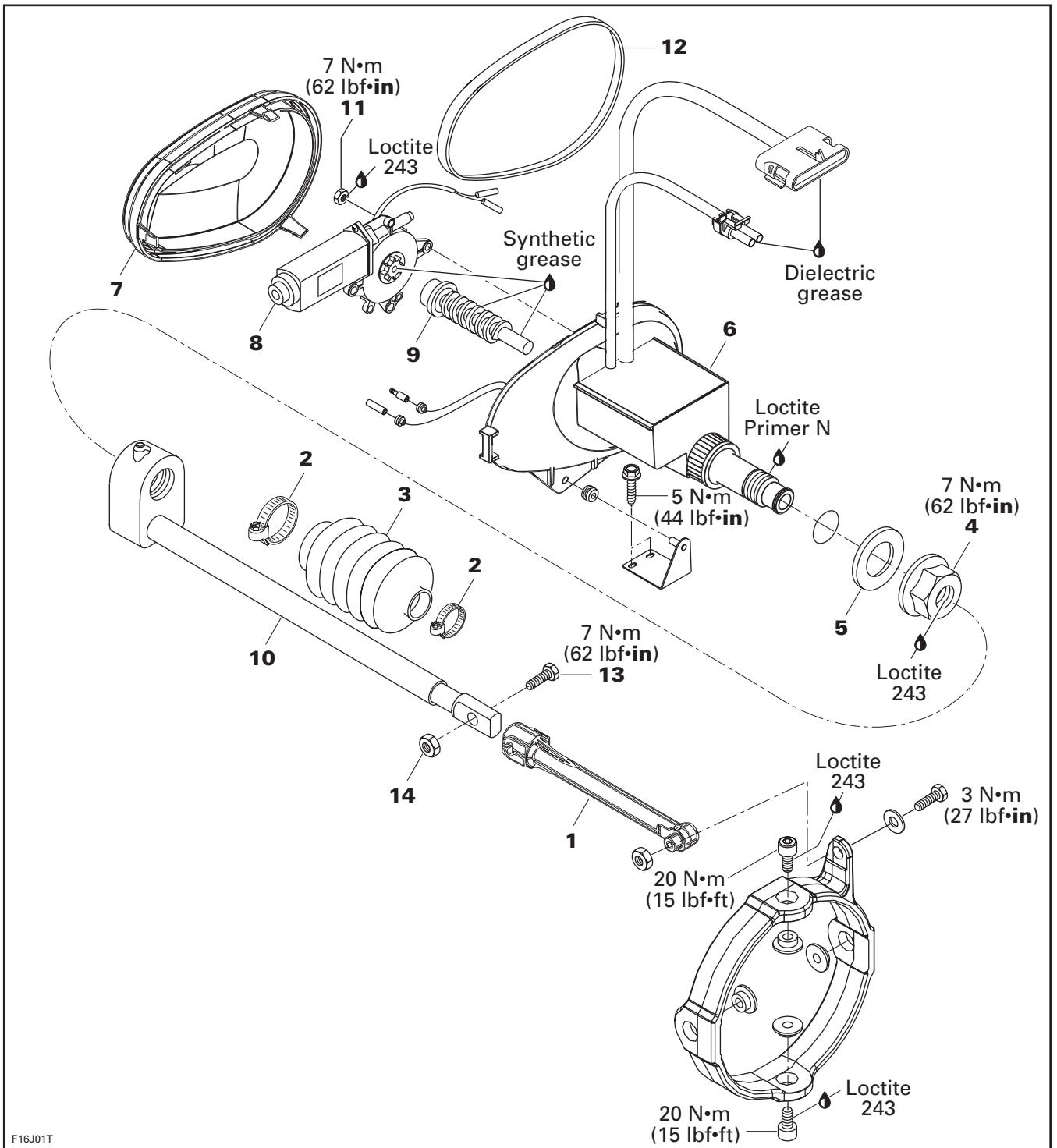
Place reverse gate in the up position.

Turn the joint at the end of reverse cable and place the hole in pivot arm and joint face to face.

Secure with bolt, washers, spacer and elastic stop nut. Torque to 7 N•m (62 lbf•in).

VARIABLE TRIM SYSTEM

RX and RX DI Models

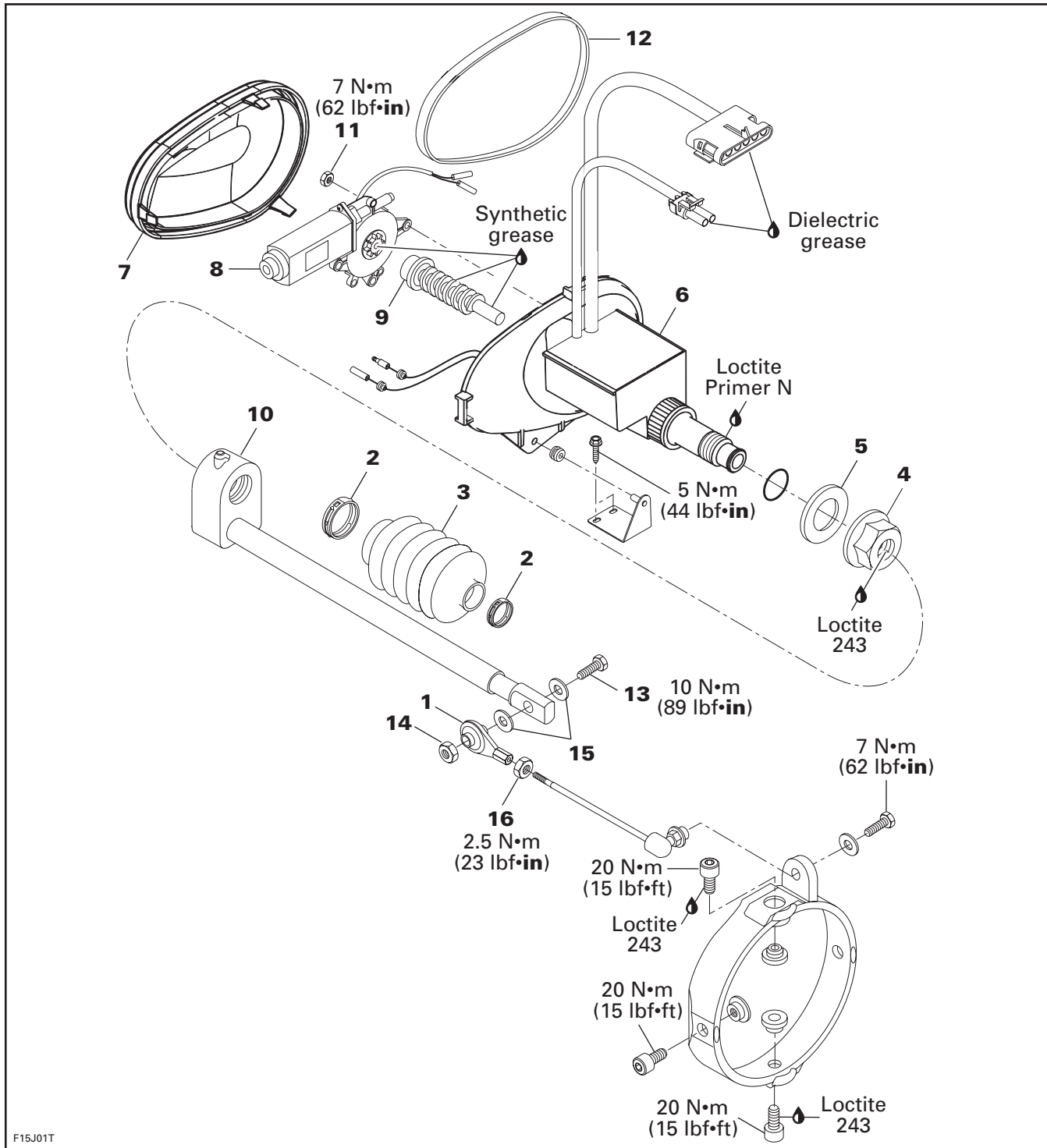


F16J01T

Section 11 PROPULSION SYSTEM

Subsection 05 (VARIABLE TRIM SYSTEM)

XP Models



F15J01T

GENERAL

To test VTS control module, motor or switch, refer to INSTRUMENTS AND ACCESSORIES.

To have access to VTS module, remove seat (except XP).

NOTE: On XP models, open rear access cover.

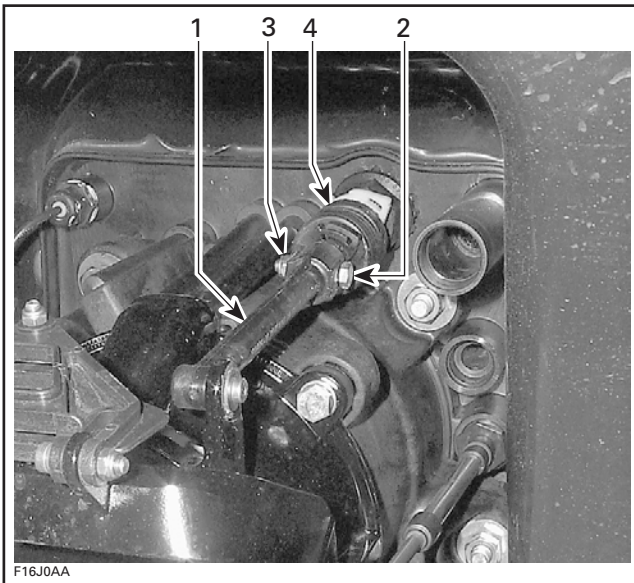
REMOVAL

All Models

Remove nut no. 14 and bolt no. 13 retaining VTS rod no. 1 to sliding shaft no. 10.

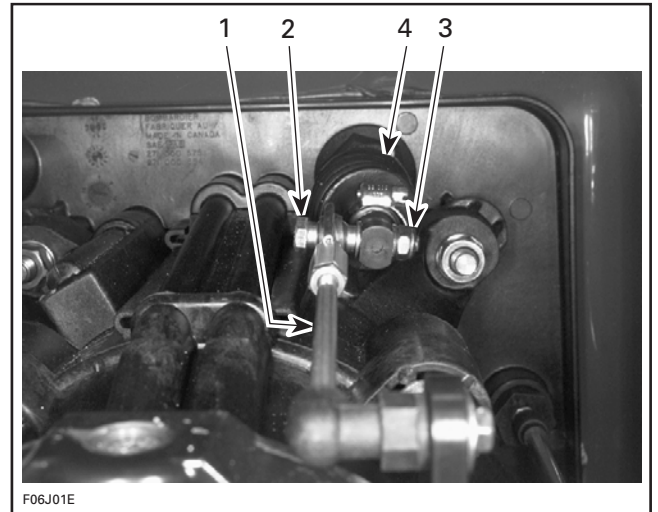
Remove clamps no. 2.

Remove boot no. 3.



RX AND RX DI MODELS

1. VTS rod
2. Bolt
3. Lock nut
4. Rubber boot



XP MODELS

1. VTS rod
2. Bolt
3. Lock nut
4. Rubber boot

RX and RX DI Models

Disconnect:

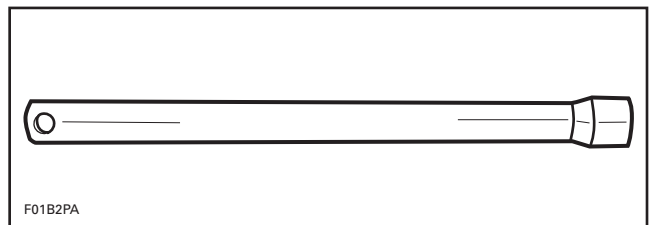
- steering cable
- reverse cable.

Unscrew the pivot arm bolts (one on each side).

Move the reverse pivot arm backwards.

All Models

To loosen nut no. 4, use VTS socket tool (P/N 295 000 133).



Remove sealing washer no. 5.

All Models

Disconnect wiring harnesses.

Pull out VTS assembly no. 6 from bilge.

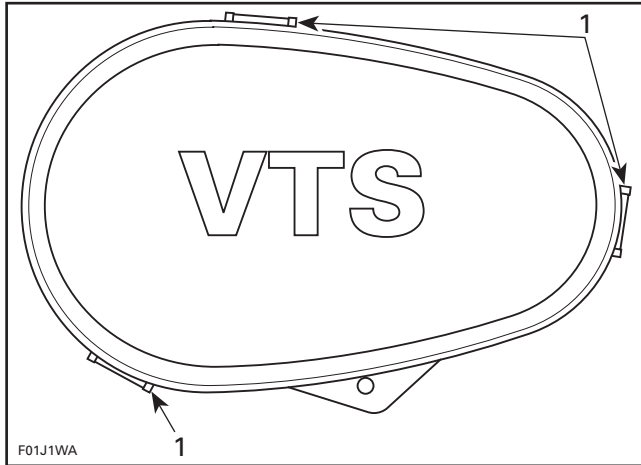
Section 11 PROPULSION SYSTEM

Subsection 05 (VARIABLE TRIM SYSTEM)

DISASSEMBLY

Cover

Remove VTS cover no. 7 by pressing on tabs.

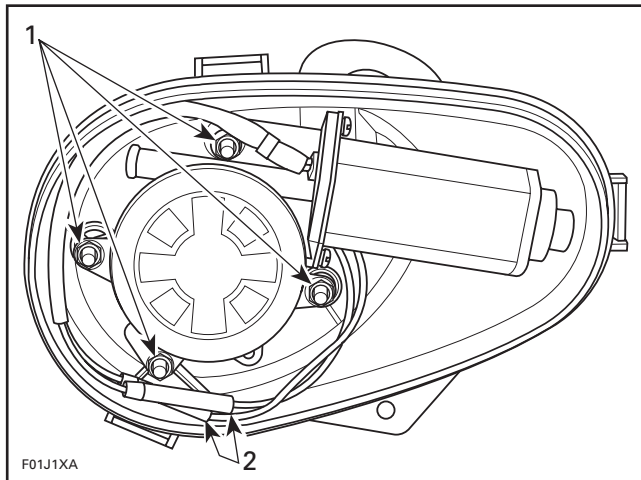


1. Press tabs to remove cover

Motor

Disconnect wires from motor no. 8.

Remove retaining nuts no. 11.



1. Remove nuts
2. Disconnect wires

Pull on motor to remove it.

Worm and Sliding Shaft

Simply pull on worm no. 9 and sliding shaft no. 10 in order to remove them.

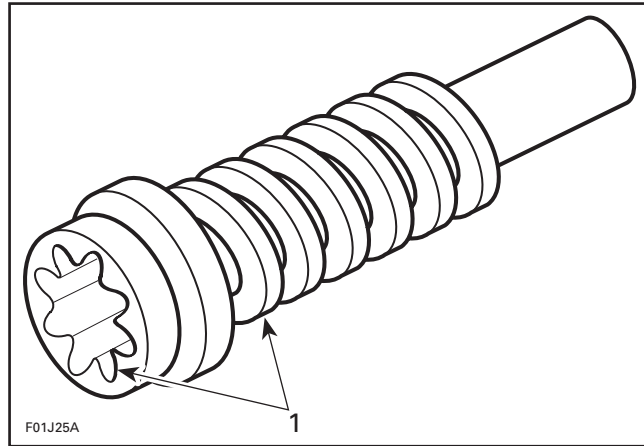
INSPECTION

Boot

Make sure boot no. 3 is in good condition. If it is cracked or torn, replace boot.

Worm

Inspect threads and splines of worm no. 9 for wear. If worm replacement is necessary, renew also sliding shaft.



1. Inspect threads and splines

ASSEMBLY

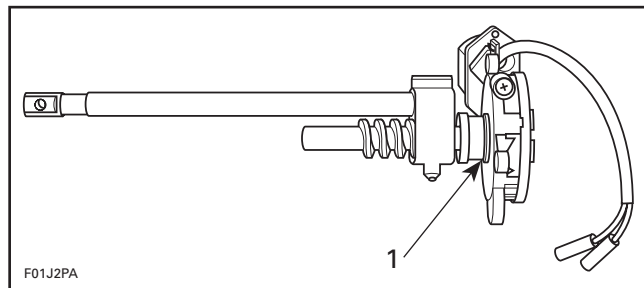
Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

Motor, Worm and Sliding Shaft

Apply synthetic grease to worm.

Screw worm no. 9 to sliding shaft no. 10.

Mesh worm splines to gear of motor.

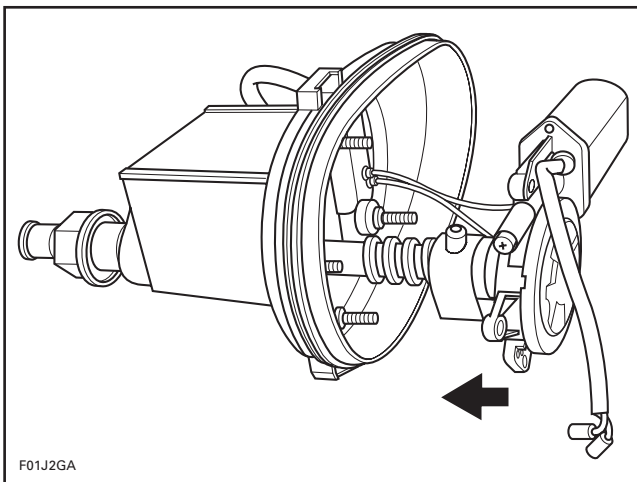


1. Mesh worm spline to gear of motor

Section 11 PROPULSION SYSTEM

Subsection 05 (VARIABLE TRIM SYSTEM)

Install motor **no. 8**, worm and sliding shaft in VTS housing.



Apply Loctite 243 (blue) to nuts **no. 11** and tighten to 7 N•m (62 lbf•in).

Connect wires of motor.

CAUTION: Make sure wire color codes match.

Install cover **no. 7**.

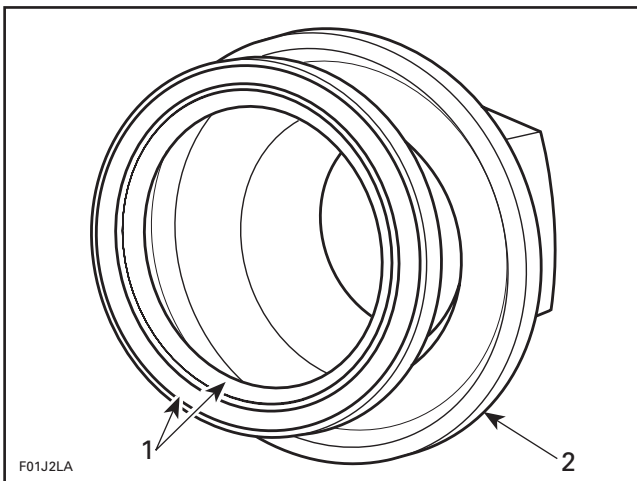
NOTE: Make sure seal **no. 12** is in place.

INSTALLATION

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

Nut and Sealing Washer

Place sealing washer **no. 5** on nut **no. 4**. Make sure seal lips are facing toward hull.



1. Seal lips facing hull
2. Nut

Apply Loctite Primer N (P/N 293 800 041) to threads of VTS housing and Loctite 243 (blue) to nut **no. 4**.

Install nut with sealing washer and torque to 7 N•m (62 lbf•in) using the VTS socket tool.

Boot and Clamps

Install rubber boot **no. 3** over sliding shaft and secure with clamps.

VTS Rod

RX and RX DI Models

Install:

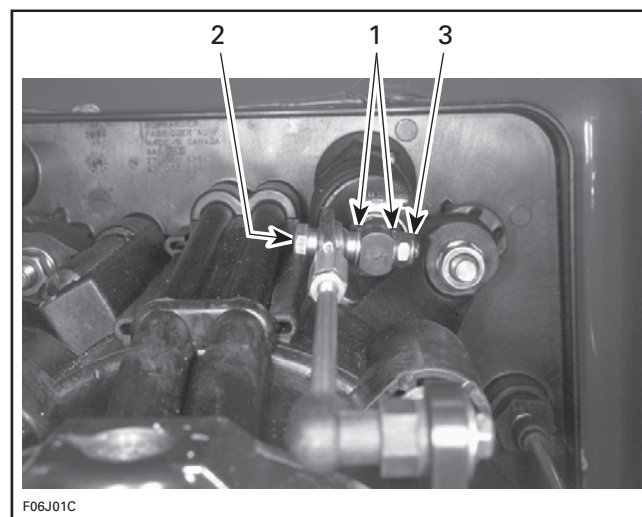
- pivot arm
- reverse cable
- steering cable
- boot with clamps.

Slide the VTS rod onto the sliding shaft end using bolt **no. 13** and nut **no. 14**. Torque nut to 7 N•m (62 lbf•in).

XP Models

Position boot on sliding shaft and secure it with clamps.

Install ball joint on LEFT side of sliding shaft **no. 10** using bolt **no. 13**, washers **no. 15** and nut **no. 14**. Torque nut to 10 N•m (88 lbf•in).



TYPICAL

1. Washers
2. Bolt
3. Lock nut

Section 11 PROPULSION SYSTEM

Subsection 05 (VARIABLE TRIM SYSTEM)

ADJUSTMENT

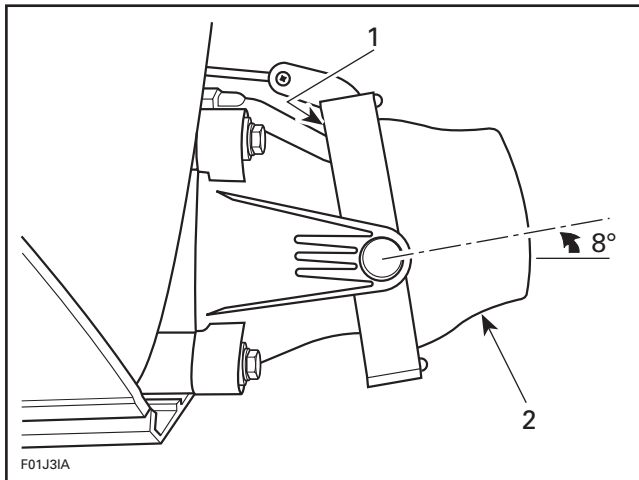
RX and RX DI Models

On these models, no adjustment is required.

XP Models

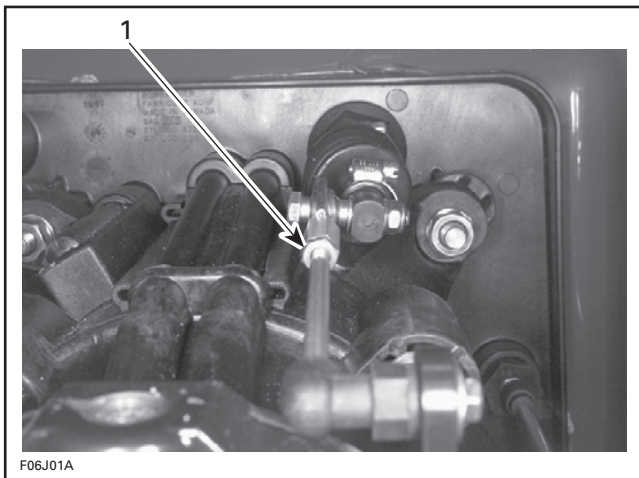
Push on VTS button up position until motor stops. When the nozzle is up (8°), nozzle edge must not interfere with venturi (there should be a gap of 1 mm (.039 in)).

NOTE: Activate timer to be able to position VTS.



1. No interference
2. Nozzle up

If an adjustment is necessary, loosen jam nut **no. 16** of VTS rod **no. 1**. Turn adjustment nut of VTS rod to obtain the desired gap between trim ring and venturi.



TYPICAL

1. Turn adjustment nut of VTS rod

Tighten jam nut of VTS rod to 2.5 N•m (23 lbf•in) when adjustment is completed.

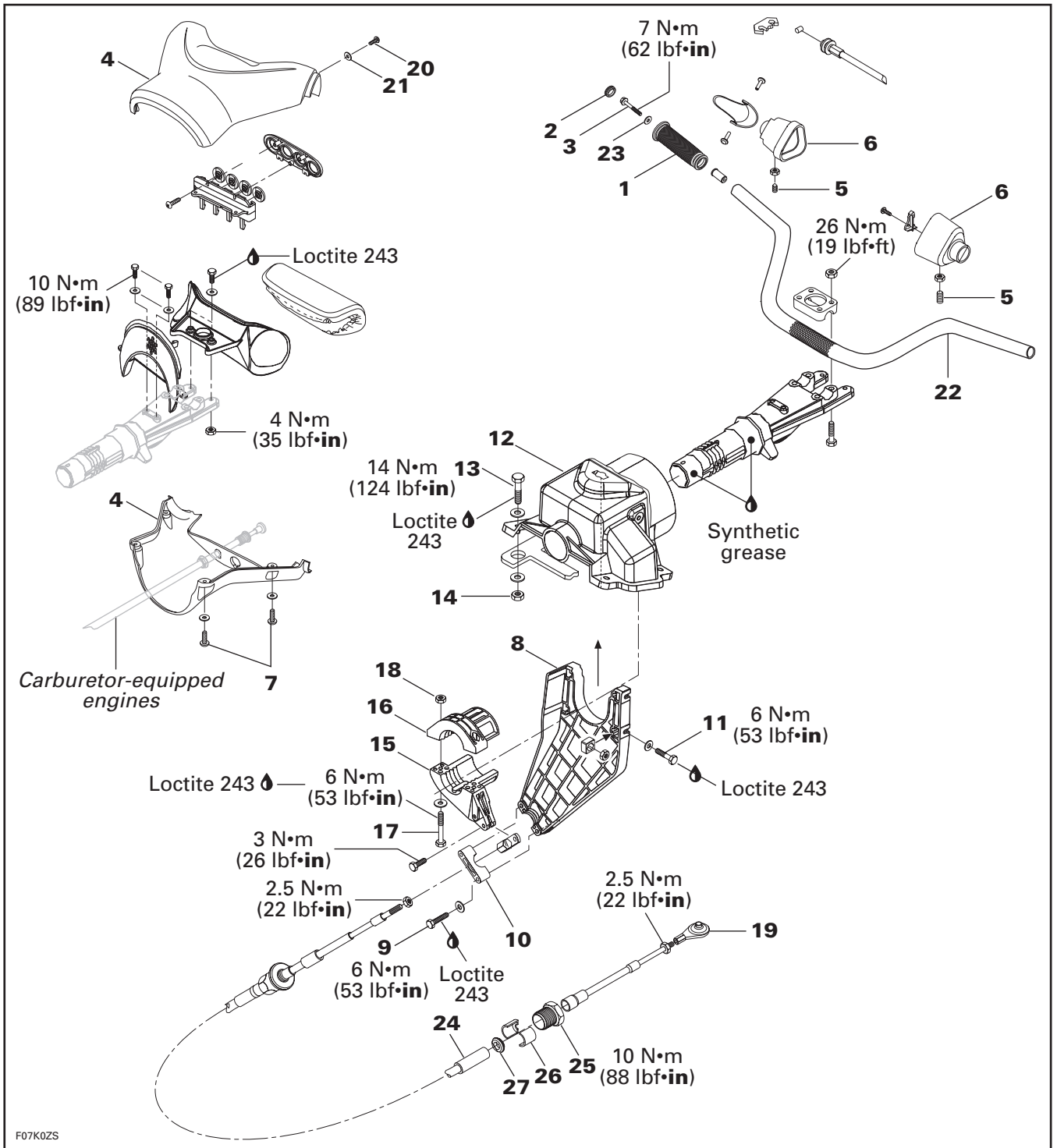
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DISASSEMBLY	12-02-8
ASSEMBLY.....	12-02-11

ALIGNMENT	12-03-1
------------------------	----------------

STEERING SYSTEM

All Models except XP



F07K0ZS

Section 12 STEERING SYSTEM

Subsection 02 (STEERING SYSTEM)

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 from handlebar no. 22.

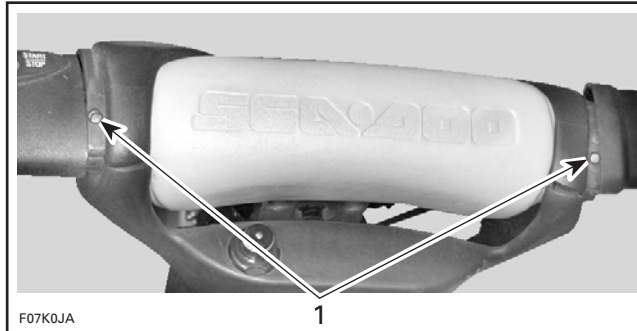
NOTE: Verify grip insert for damage.

Steering Cover

Remove grips no. 1.

Loosen set screws no. 5 of handlebar housings no. 6.

Remove 2 screws no. 20 and flat washers no. 21 each side of cover.

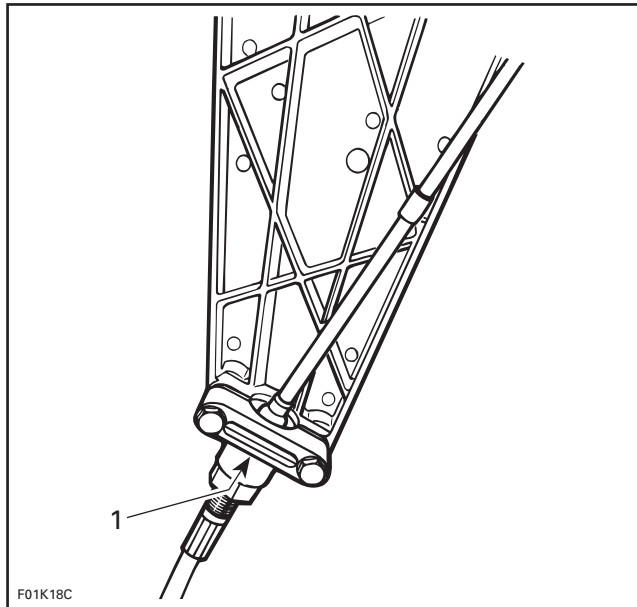


1. Remove screws

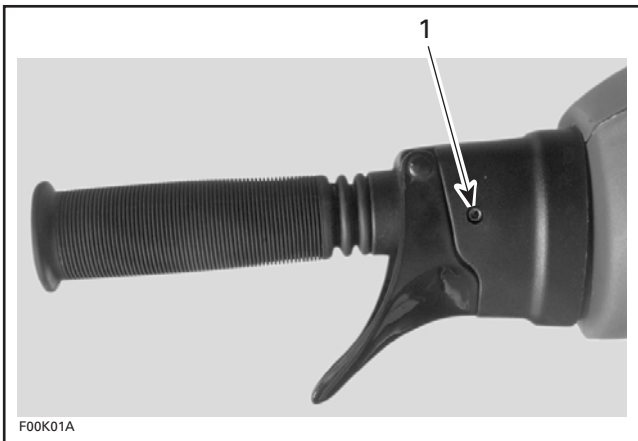
Remove cover.

Cable Support

Loosen bolts no. 9 and remove retaining block no. 10.

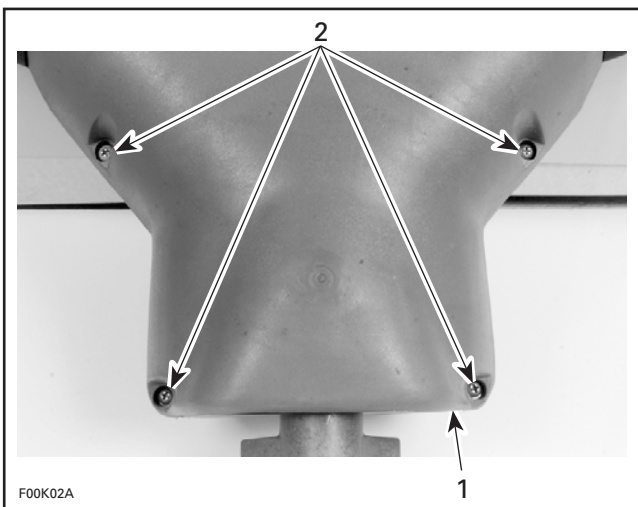


1. Retaining block



1. Set screw

Remove 4 screws no. 7.

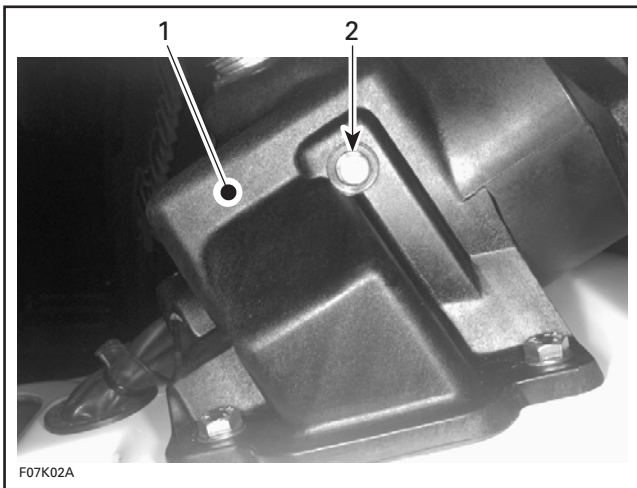


TYPICAL

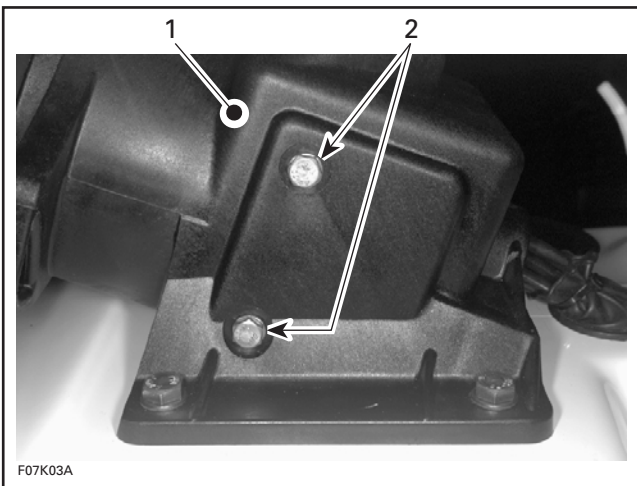
1. Cover
2. Screws

Section 12 STEERING SYSTEM
Subsection 02 (STEERING SYSTEM)

Loosen bolts no. 11 each side of steering support no. 12.



- 1. Steering support
- 2. Bolt



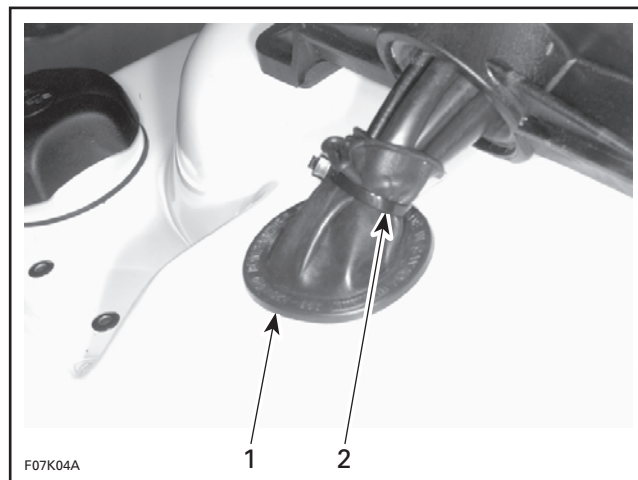
- 1. Steering support
- 2. Bolts

Remove cable support no. 8.

Steering Support

RX, RX DI, GTS, GTI Models and GTX Series

Cut locking tie securing wiring harness boot.

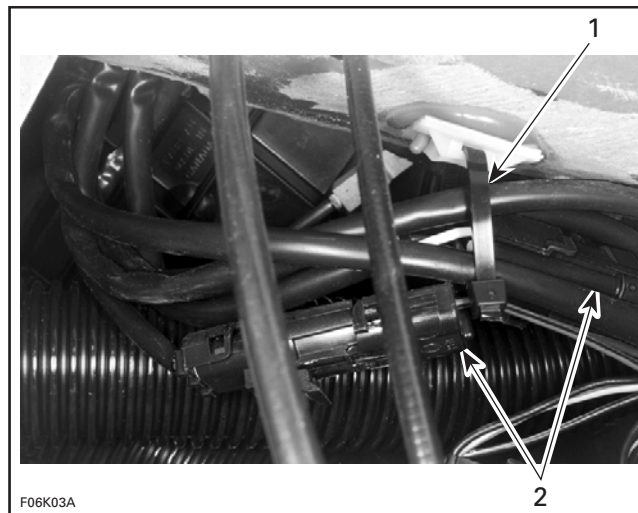


- 1. Boot
- 2. Locking tie

All Models except XP

Disconnect the throttle and choke cables from carburetor levers.

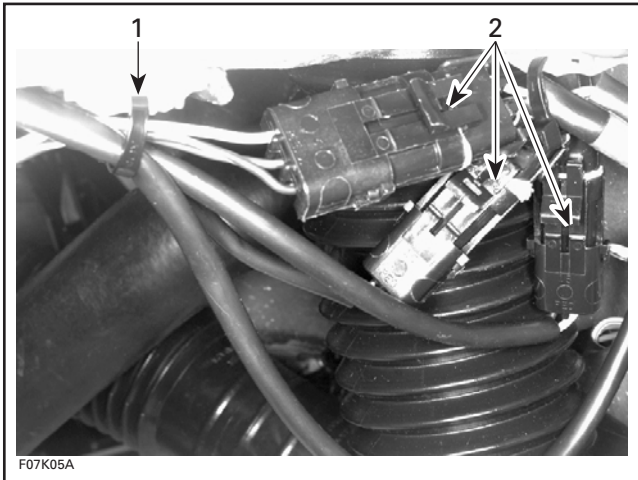
Disconnect the wiring harnesses leading out of steering stem and cut locking tie.



- GS MODELS***
- 1. Locking tie
 - 2. Connectors

Section 12 STEERING SYSTEM

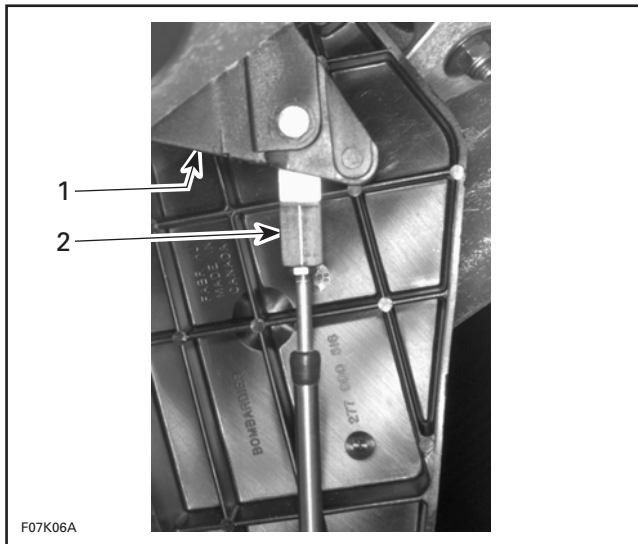
Subsection 02 (STEERING SYSTEM)



ALL OTHER MODELS EXCEPT XP

1. Tie rap
2. Connectors

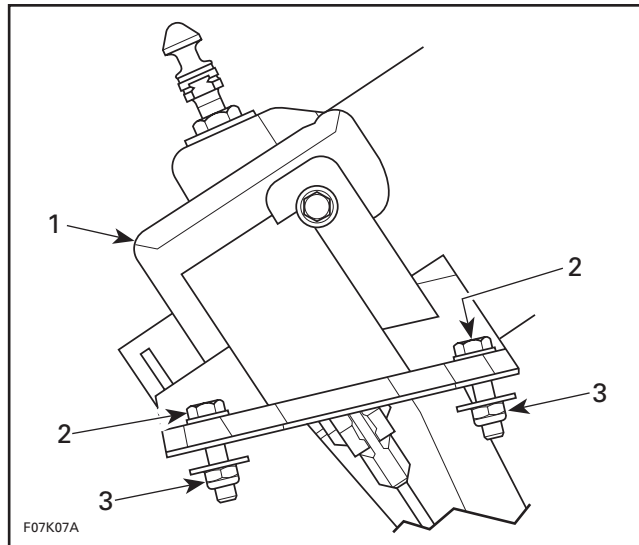
Disconnect the steering cable from the steering stem arm no. 15.



1. Steering stem arm
2. Steering cable

Loosen bolts no. 11 retaining cable support no. 8 to steering support no. 12.

Loosen bolts no. 13 and lock nuts no. 14.

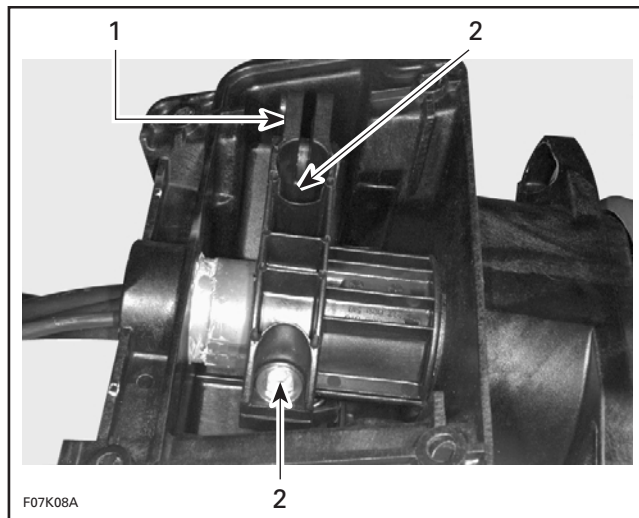


1. Steering support
2. Bolts
3. Lock nuts

Remove steering support no. 12 with handlebar, wiring harnesses and cables.

Steering Stem Arm and Support

Loosen bolts no. 17 retaining steering stem arm no. 15 to support no. 16.



1. Steering stem arm
2. Bolts

Remove steering stem arm and support.

Section 12 STEERING SYSTEM

Subsection 02 (STEERING SYSTEM)

Steering Cable

Disconnect steering cable no. 24 from steering stem arm no. 15.

Remove retaining block no. 10.

Disconnect ball joint no. 19 from jet pump nozzle.

Remove ball joint no. 19 and jam nut from cable.

Loosen nut no. 25, then remove half rings no. 26 and O-ring no. 27.

NOTE: To loosen nut, use steering cable tool (P/N 295 000 145).

Remove steering cable from watercraft.

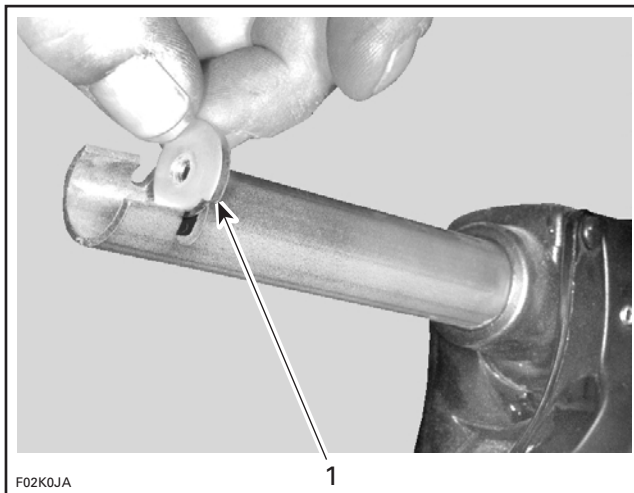
ASSEMBLY

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

CAUTION: Apply all specified torques and service products as per main illustration at the beginning of this subsection.

Handle Grip and Grip Insert

When installing the grip insert no. 21 in the handlebar no. 22, ensure that it is properly inserted in the slot at the end of the handlebar tubing.



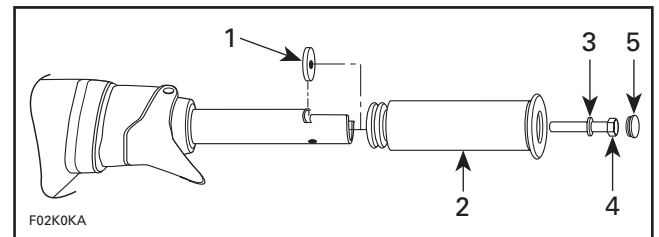
1. Grip insert

Install grip no. 1 on handlebar no. 22 matching it to the hex form on the grip insert.

Install flat washer no. 23 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

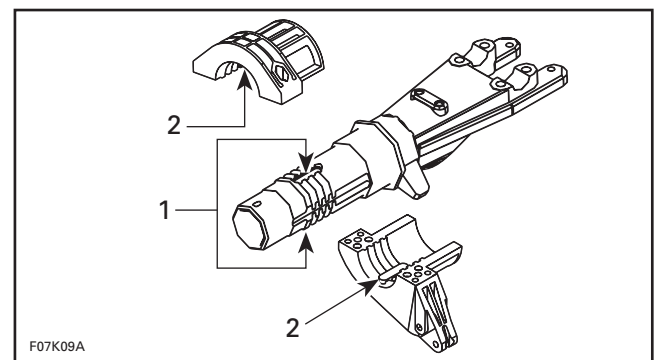
CAUTION: Ensure to install flat washer otherwise screw will damage grip end.

Steering Stem Arm and Support

Position steering stem arm no. 15 and support no. 16 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. 18 by new ones.

Torque bolts no. 17 of steering stem arm to 6 N•m (53 lbf•in).

Section 12 STEERING SYSTEM

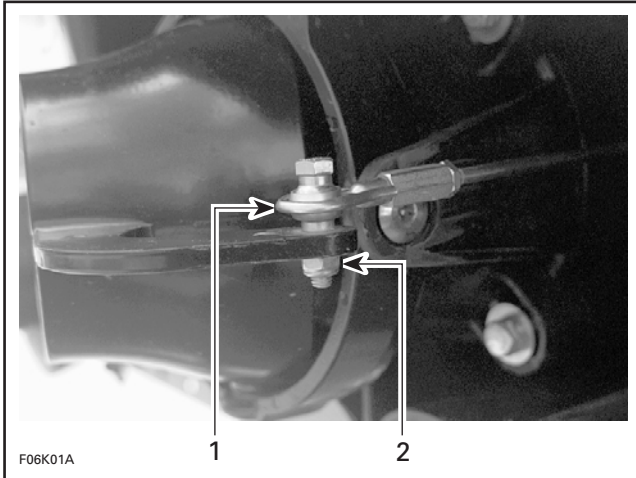
Subsection 02 (STEERING SYSTEM)

Ball Joint

Secure the steering cable ball joint no. 19 to the nozzle as per following illustrations.

CAUTION: Ensure the ball joint is parallel ($\pm 5^\circ$) to the nozzle arm.

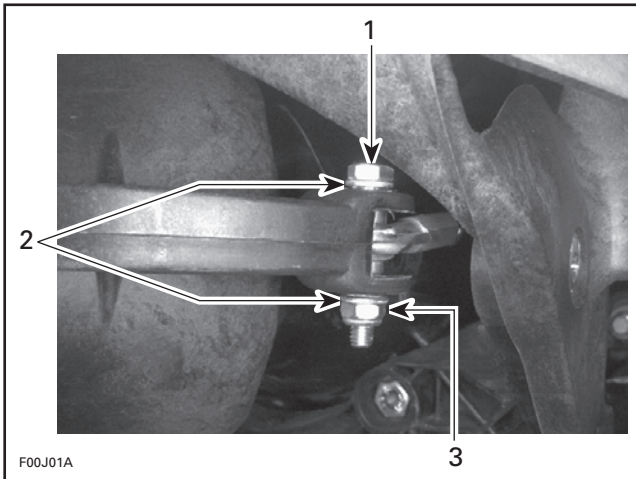
RX, RX DI, GTS, GTI Models and GTX Series



TYPICAL

1. Ball joint on top of steering arm
2. Torque nut to 7 N•m (62 lbf•in)

GS Models



TYPICAL

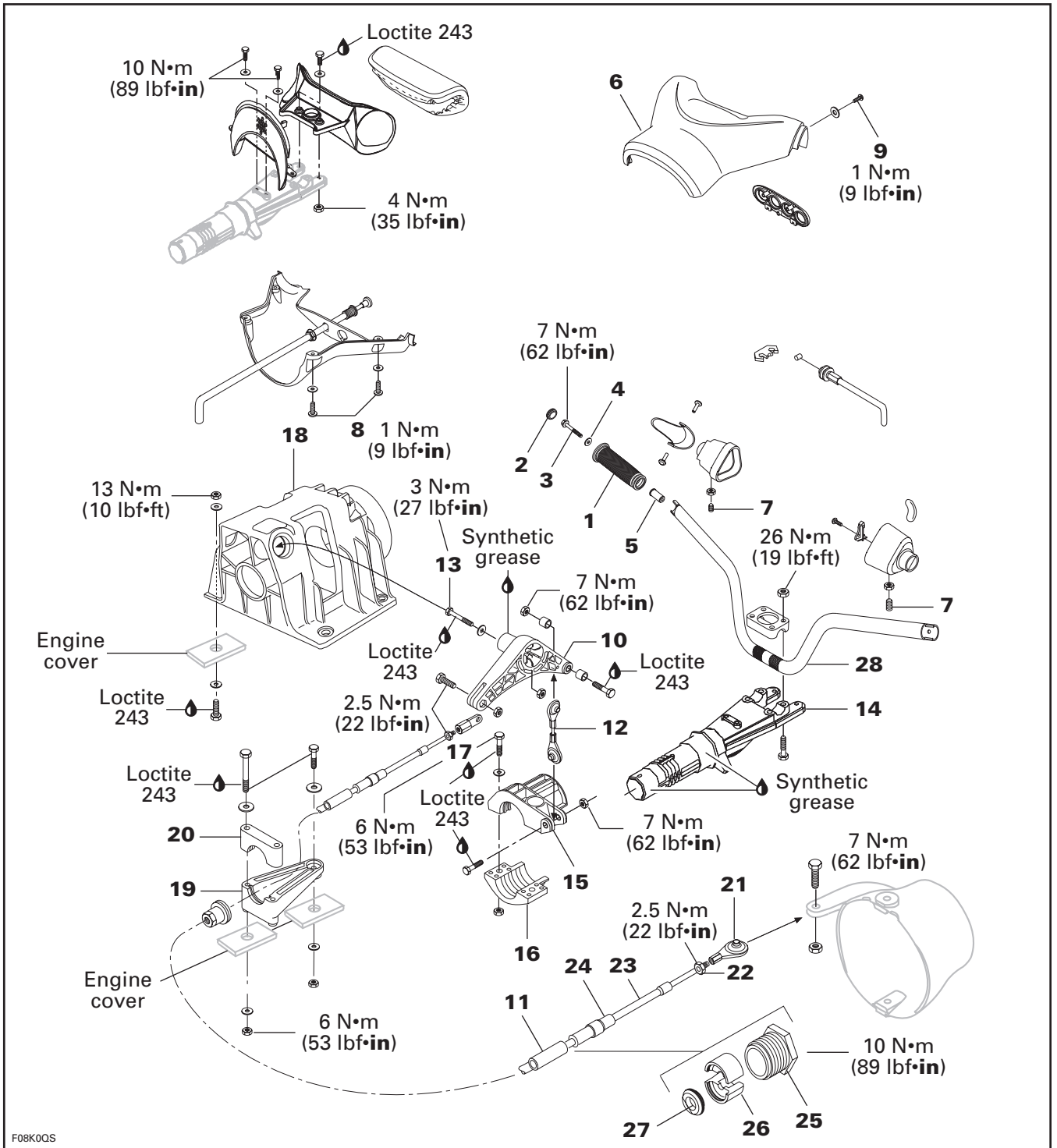
1. Bolt
2. Flat washers
3. Lock nut. Torque to 7 N•m (62 lbf•in)

STEERING ALIGNMENT

For steering alignment procedure, refer to ALIGNMENT.

Section 12 STEERING SYSTEM
Subsection 02 (STEERING SYSTEM)

XP Models



Section 12 STEERING SYSTEM

Subsection 02 (STEERING SYSTEM)

DISASSEMBLY

Handle Grip and Grip Insert

To remove handle grip **no. 1**, pull out cap **no. 2** from grip end and remove screw **no. 3** and washer **no. 4**.

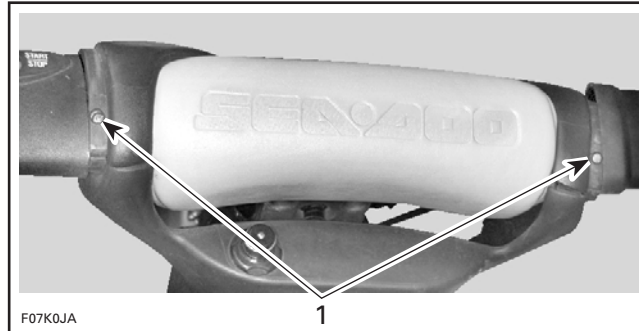
Pull out grip and remove grip insert from handlebar.

NOTE: Verify grip insert **no. 5** for damage.

Steering Cover

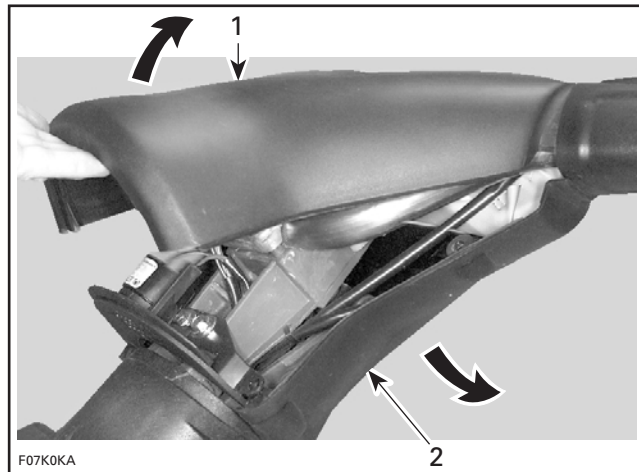
To remove the steering cover **no. 6**, loosen set screws **no. 7** of handlebar housing.

Remove 2 screws **no. 9** and flat washers each side of cover.

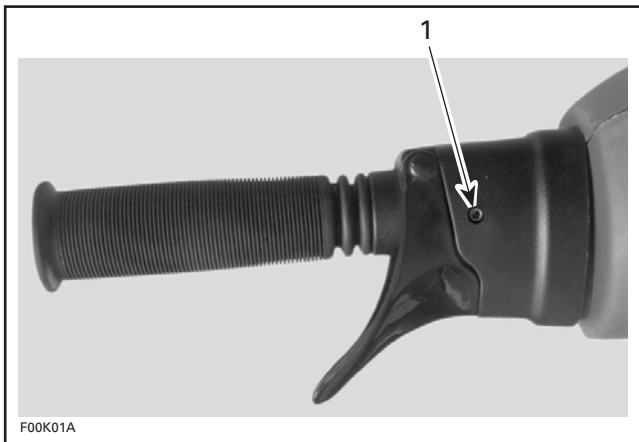


1. Remove screws

Detach upper and lower section of cover from steering.

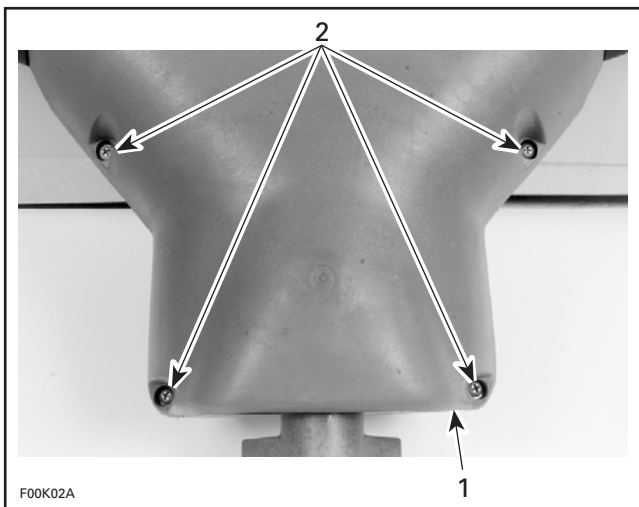


1. Upper section
2. Lower section



1. Set screws

Remove 4 screws **no. 8** and washers.



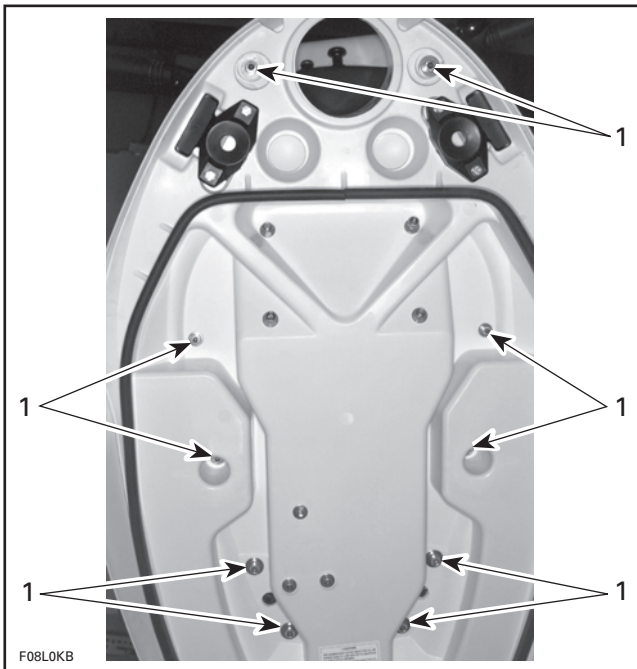
TYPICAL

1. Cover
2. Screws

Lever

Open engine compartment cover.

Remove the top section of the engine cover by loosening the 10 Allen screws located inside the cover.

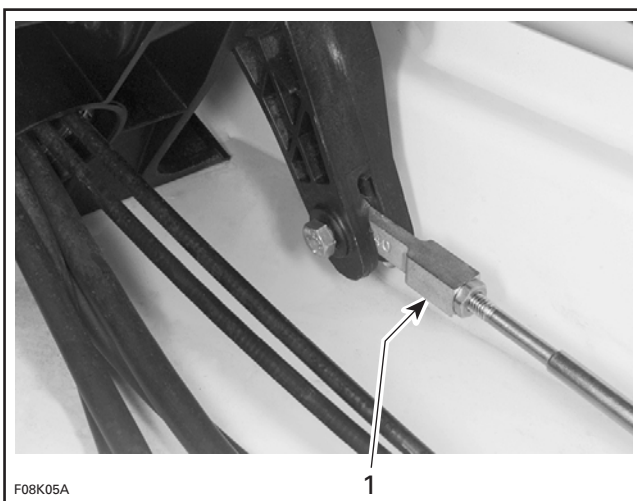


1. Loosen Allen screws

Lift the top section of the engine cover and disconnect wiring harnesses.

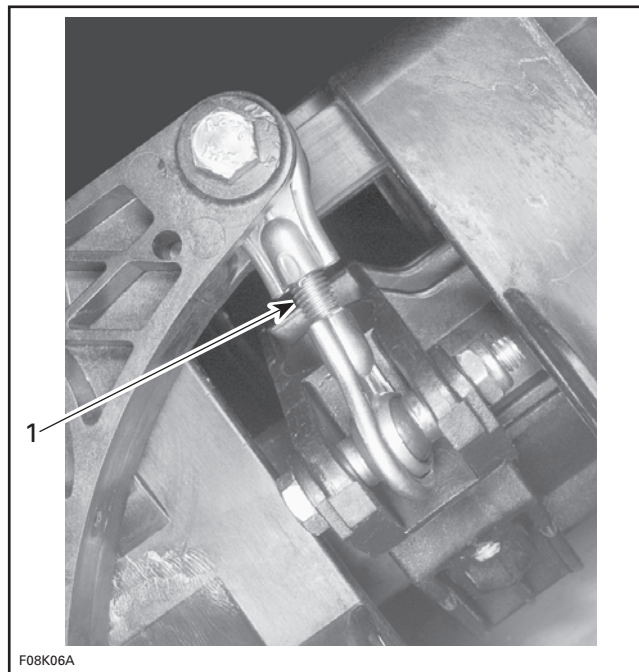
Remove the top section of the engine compartment cover.

Disconnect steering cable no. 11 from lever no. 10.



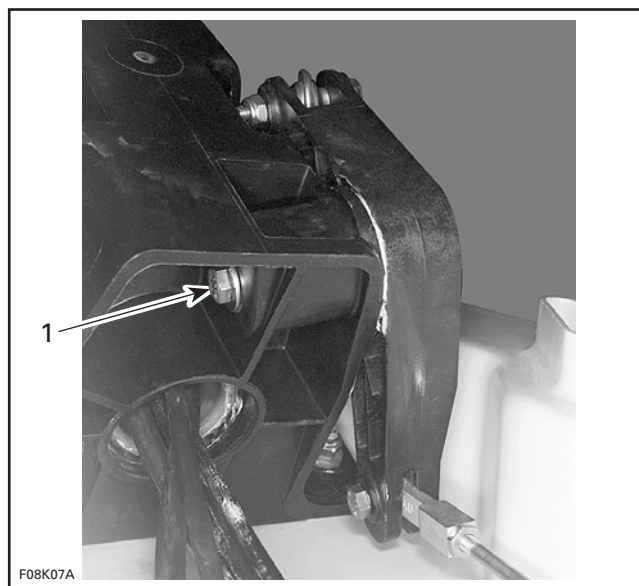
1. Disconnect steering cable

Remove link rod no. 12.



1. Remove link rod

Remove bolt no. 13 and washer retaining lever no. 10 to steering support no. 18.



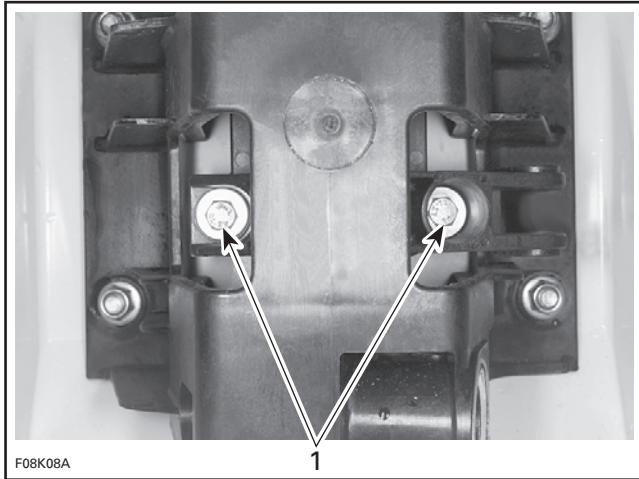
1. Remove bolt and washer

Section 12 STEERING SYSTEM

Subsection 02 (STEERING SYSTEM)

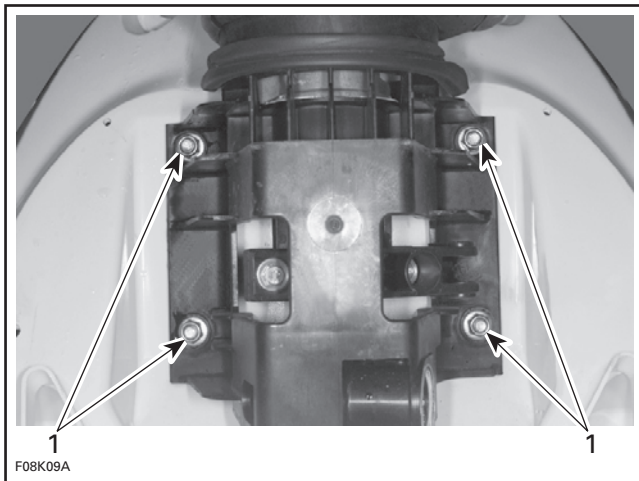
Steering Stem Arm and Support

Loosen bolts no. 17 retaining steering stem arm no. 15 and support no. 16.



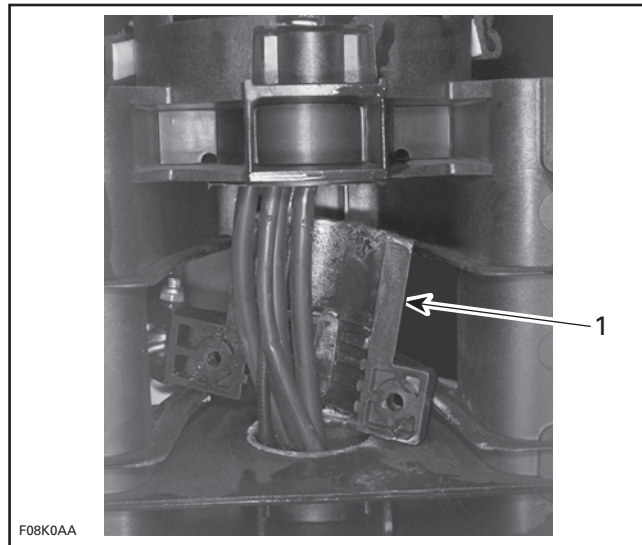
1. Loosen bolts

Loosen nuts and bolts retaining steering support no. 18.



1. Loosen nuts and bolts

Lift steering support no. 18 and slightly pullback steering stem no. 14 in order to remove the support no. 16 and steering stem arm no. 15.



1. Remove support and steering stem arm

Steering Stem

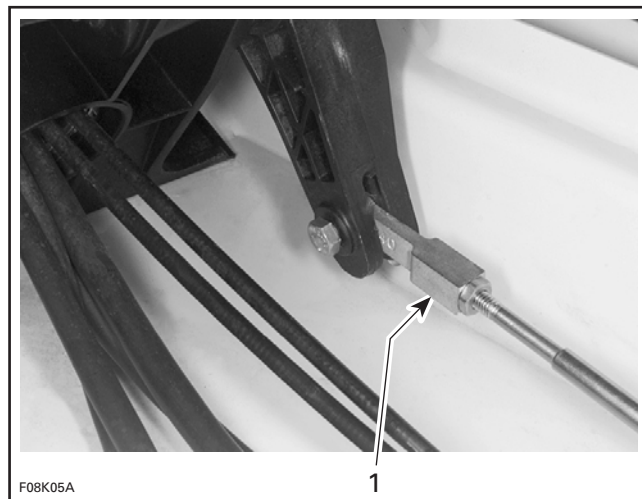
Disconnect wiring harnesses, choke and throttle cables from engine.

Remove steering stem no. 14.

Steering Cable

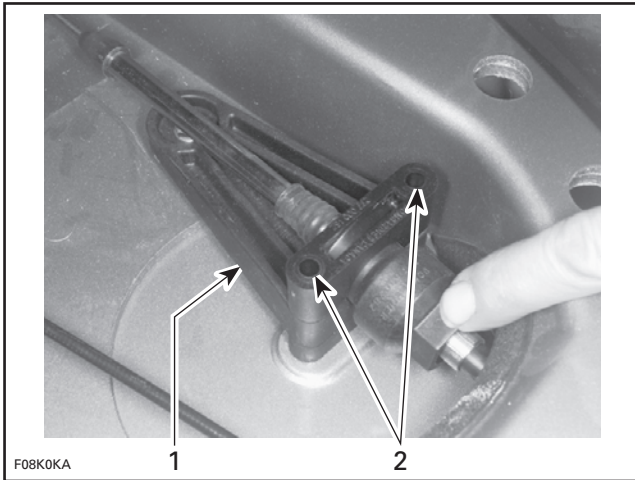
Remove glove box.

Disconnect steering cable no. 11 at lever no. 10.



1. Disconnect steering cable

Unscrew bolts from retaining block no. 20 to remove steering cable from cable support no. 19.



1. Cable support
2. Remove M6 bolts

Disconnect ball joint no. 21 of steering cable from jet pump nozzle.

Remove ball joint no. 21, jam nut no. 22 and boots no. 23 and no. 24.

Loosen nut no. 25 and remove half rings no. 26 and O-ring no. 27.

NOTE: To loosen nut, use steering cable tool (P/N 295 000 145).

Remove steering cable from watercraft.

ASSEMBLY

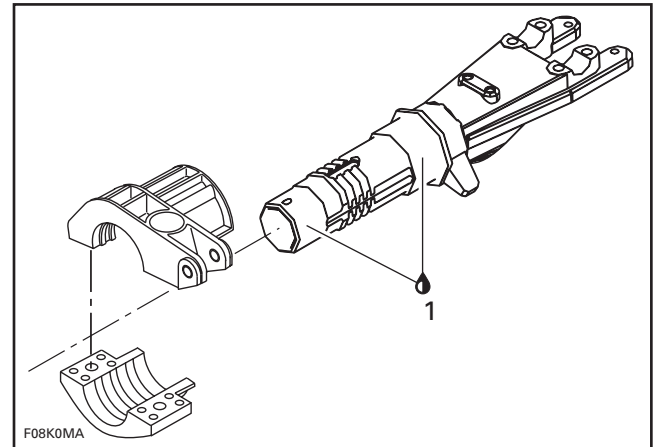
Assembly is essentially the reverse of disassembly procedure. However, pay particular attention to the following.

Lever

Prior installing lever no. 10, apply synthetic grease to pivot.

Steering Stem

Apply synthetic grease to front and rear thrust bearing surface.



1. Apply synthetic grease

Steering Stem Arm and Support

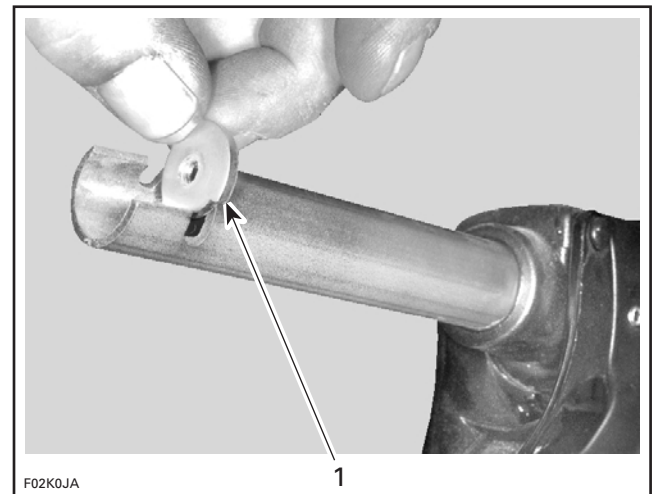
Position steering stem arm no. 15 and support no. 16 onto steering stem no. 14.

WARNING

Make sure integrated flat keys of steering stem arm and support are properly seated in steering stem keyways.

Handle Grip and Grip Insert

When installing the grip insert no. 5 in the handlebar no. 28, ensure that it is properly inserted in the slot at the end of the handlebar tubing.



1. Grip insert

Section 12 STEERING SYSTEM

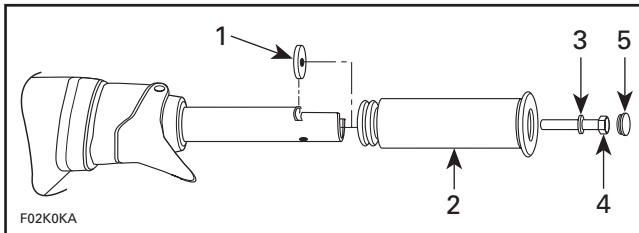
Subsection 02 (STEERING SYSTEM)

Install flat washer no. 4 and screw no. 3.

Torque screw to 7 N•m (62 lbf•in).

WARNING

Correct torque must be strictly followed.



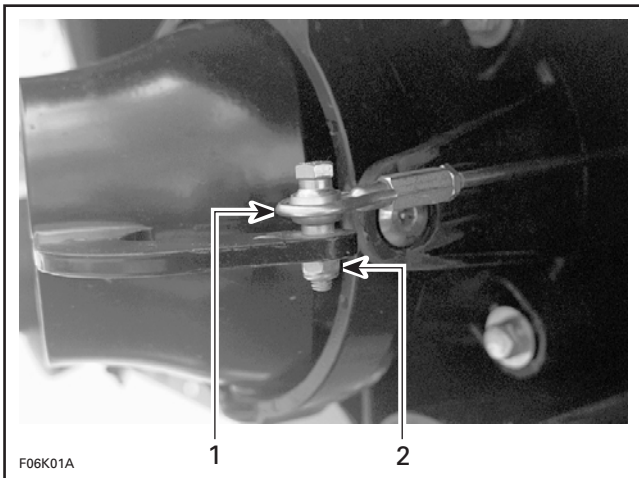
1. Grip insert
2. Grip
3. Flat washer
4. Torque screw to 7 N•m (62 lbf•in)
5. Cap

CAUTION: Ensure to install flat washer otherwise screw will damage grip end.

Ball Joint

Secure the steering cable ball joint no. 21 to the nozzle as per following illustration.

CAUTION: Ensure the ball joint is parallel ($\pm 5^\circ$) to the nozzle arm.



TYPICAL

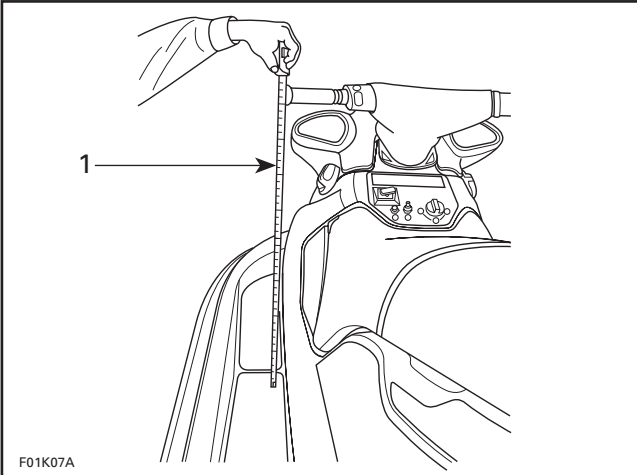
1. Ball joint on top of steering arm
2. Torque nut to 7 N•m (62 lbf•in)

STEERING ALIGNMENT

For steering alignment procedure, refer to ALIGNMENT.

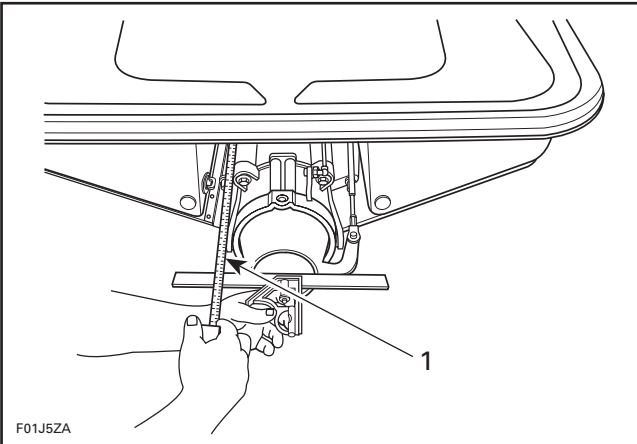
ALIGNMENT

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.



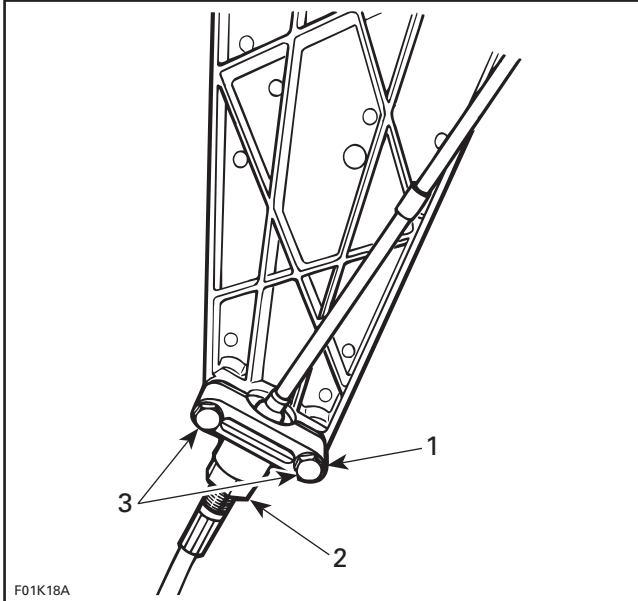
TYPICAL
 1. Measure the distance on each side of the straight edge

If necessary, steering alignment adjustment should be performed at steering cable support.

All Models except XP

Open storage compartment cover and remove basket (if so equipped).

Loosen 2 bolts retaining block at cable support. Turn adjustment nut as required.



ALL MODELS EXCEPT XP
 1. Retaining block
 2. Adjustment nut
 3. Loosen bolts

XP Models

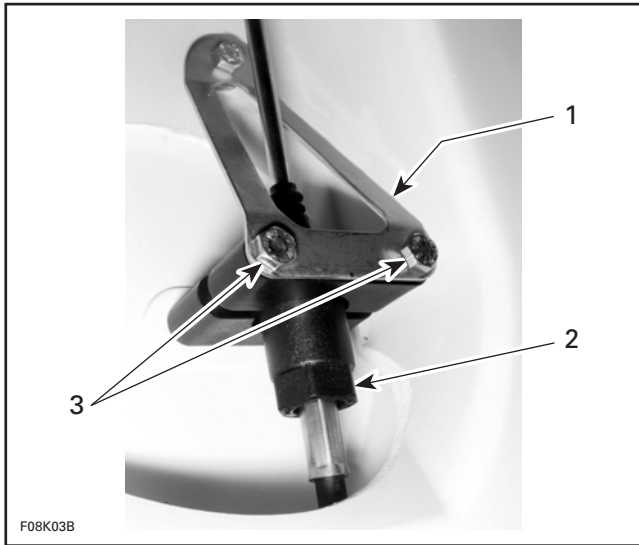
To have access to the cable adjustment nut, open upper storage compartment cover and remove storage basket.



1. Remove storage basket

Section 12 STEERING SYSTEM

Subsection 03 (ALIGNMENT)



TYPICAL — XP MODELS

1. Support
2. Adjustment nut
3. Loosen bolts

All Models

After adjustment, torque retaining block bolts to 6 N•m (53 lbf•in).

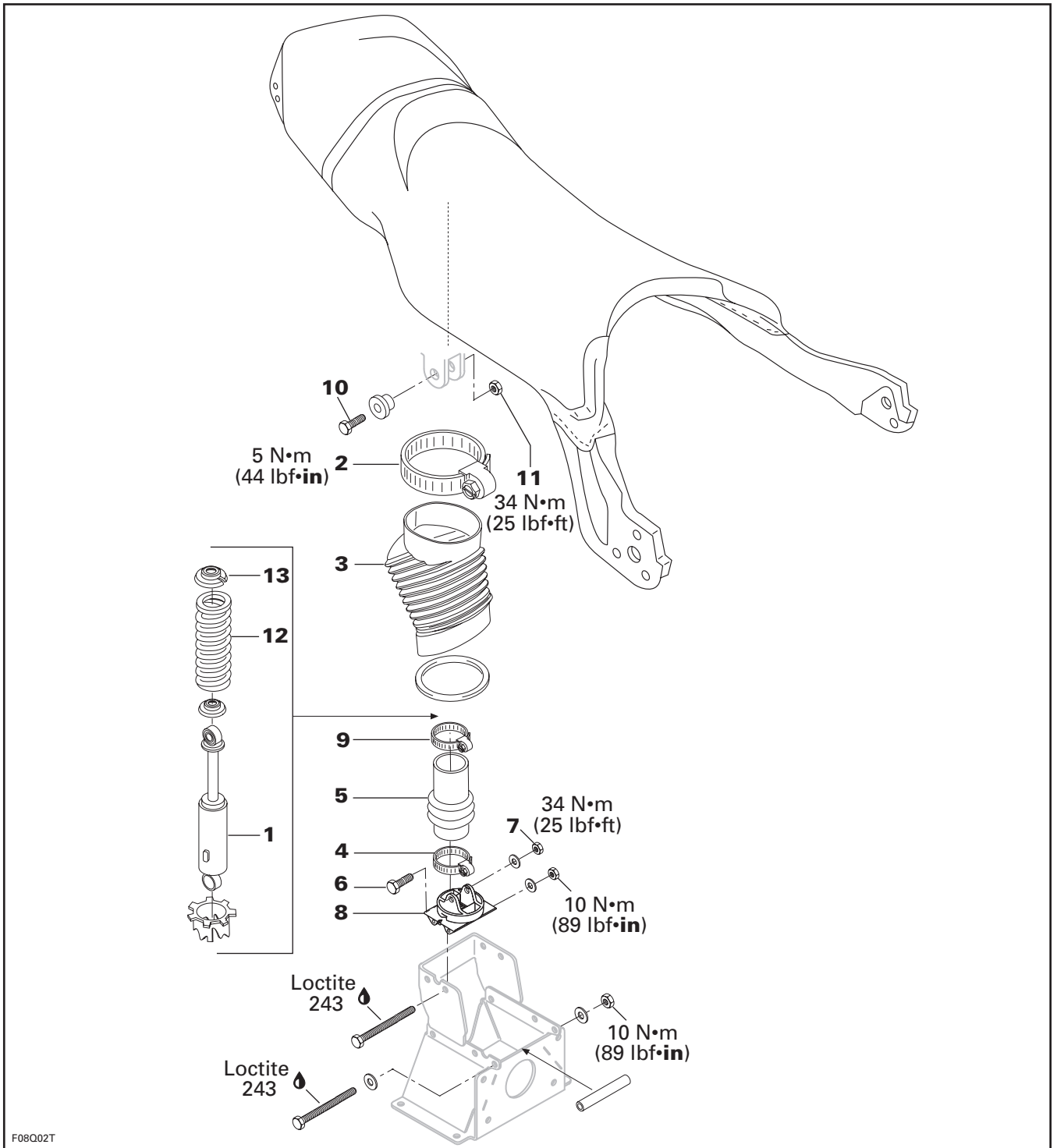
CAUTION: Verify when the handlebar is turned completely to the left or right side, that there is no interference with venturi or VTS ring.

TABLE OF CONTENTS

DIRECT ACTION SUSPENSION	13-02-1
REMOVAL	13-02-2
INSPECTION	13-02-3
ASSEMBLY.....	13-02-3

DIRECT ACTION SUSPENSION

XP Model



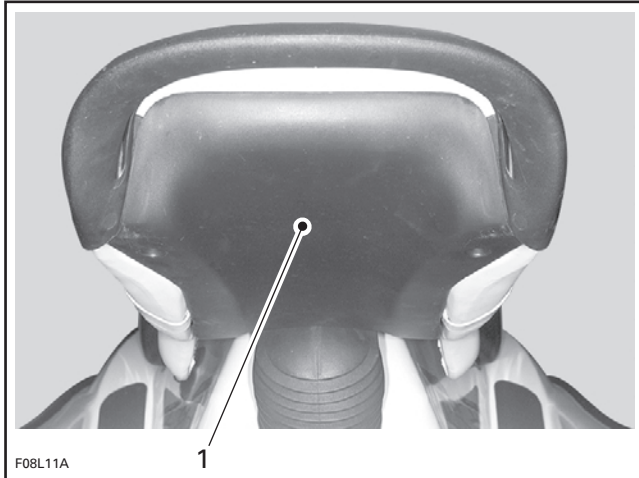
Section 13 SUSPENSION

Subsection 02 (DIRECT ACTION SUSPENSION)

REMOVAL

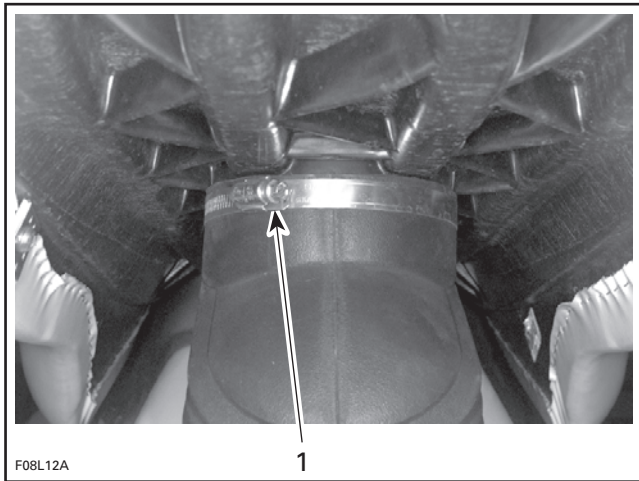
Shock Absorber

Loosen 4 screws and remove bottom cover of seat.



1. Remove cover

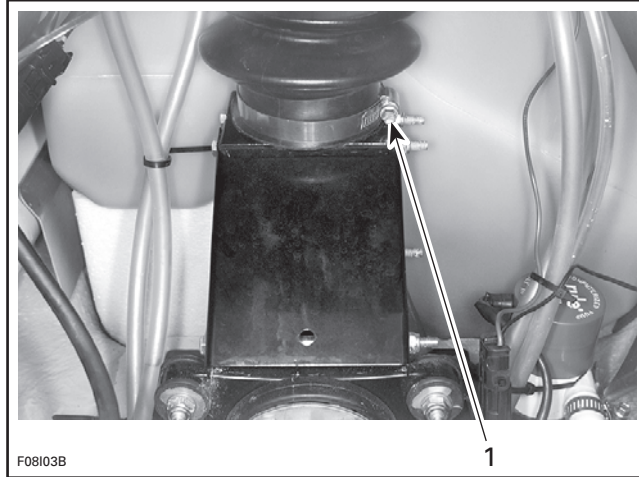
Loosen gear clamp no. 2 of outer boot no. 3, then pull outer boot downward.



1. Loosen gear clamp

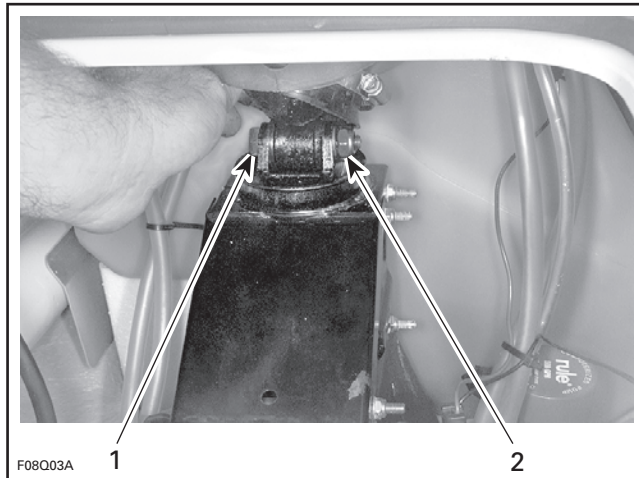
Remove rear access panel from body.

Loosen lower gear clamp no. 4, then push inner boot no. 5 upward.



1. Loosen gear clamp

Remove bolt no. 6 and lock nut no. 7 from shock absorber lower support no. 8.



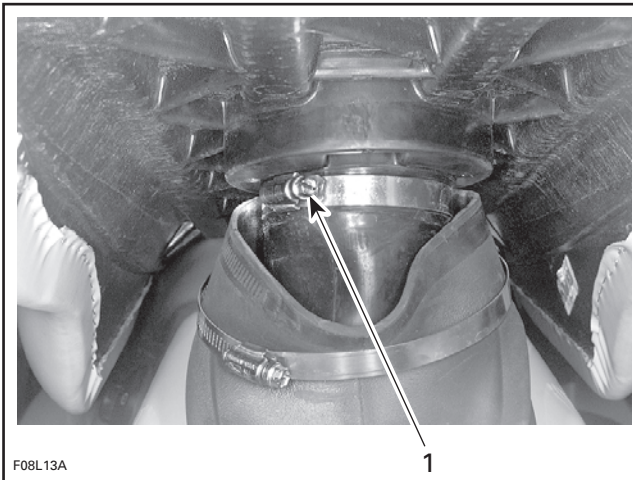
1. Bolt
2. Lock nut

Section 13 SUSPENSION

Subsection 02 (DIRECT ACTION SUSPENSION)

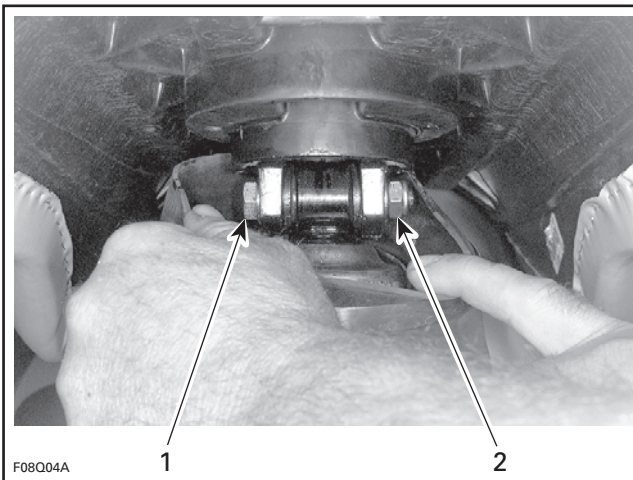
Tilt seat upward.

Loosen upper gear clamp **no. 9** of inner boot **no. 5**.



1. Loosen gear clamp

Remove bolt **no. 10** and lock nut **no. 11** from shock absorber upper support.



1. Bolt
2. Lock nut

Remove shock absorber/coil spring assembly.

Outer Boot

Pull outer boot to remove it from body.

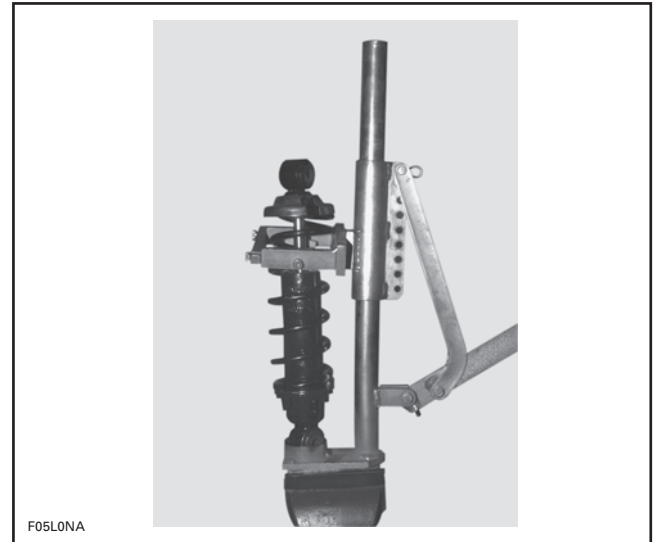
Coil Spring

Install spring compressor tool (P/N 529 027 100) in a vise.

WARNING

Do not attempt to dismantle a spring without using the proper tool.

Install shock absorber/coil spring assembly in spring compressor tool.



Compress spring and remove cup **no. 13**.

Unload tool and remove spring from shock absorber.

INSPECTION

Boot

Inspect condition of boots. If there is any tear, renew boot(s).

Shock Absorber

Inspect shock absorber for wear. Extend and compress the piston several times over its entire stroke; it should move smoothly and with uniform resistance.

Pay attention to the following conditions that will denote a defective shock absorber:

- A skip or a hang back when reversing stroke at mid travel.
- Seizing or binding condition except at extreme end of either stroke.
- Oil leakage.
- A gurgling noise, after completing one full compression and extension stroke.

Renew if any defects are present.

ASSEMBLY

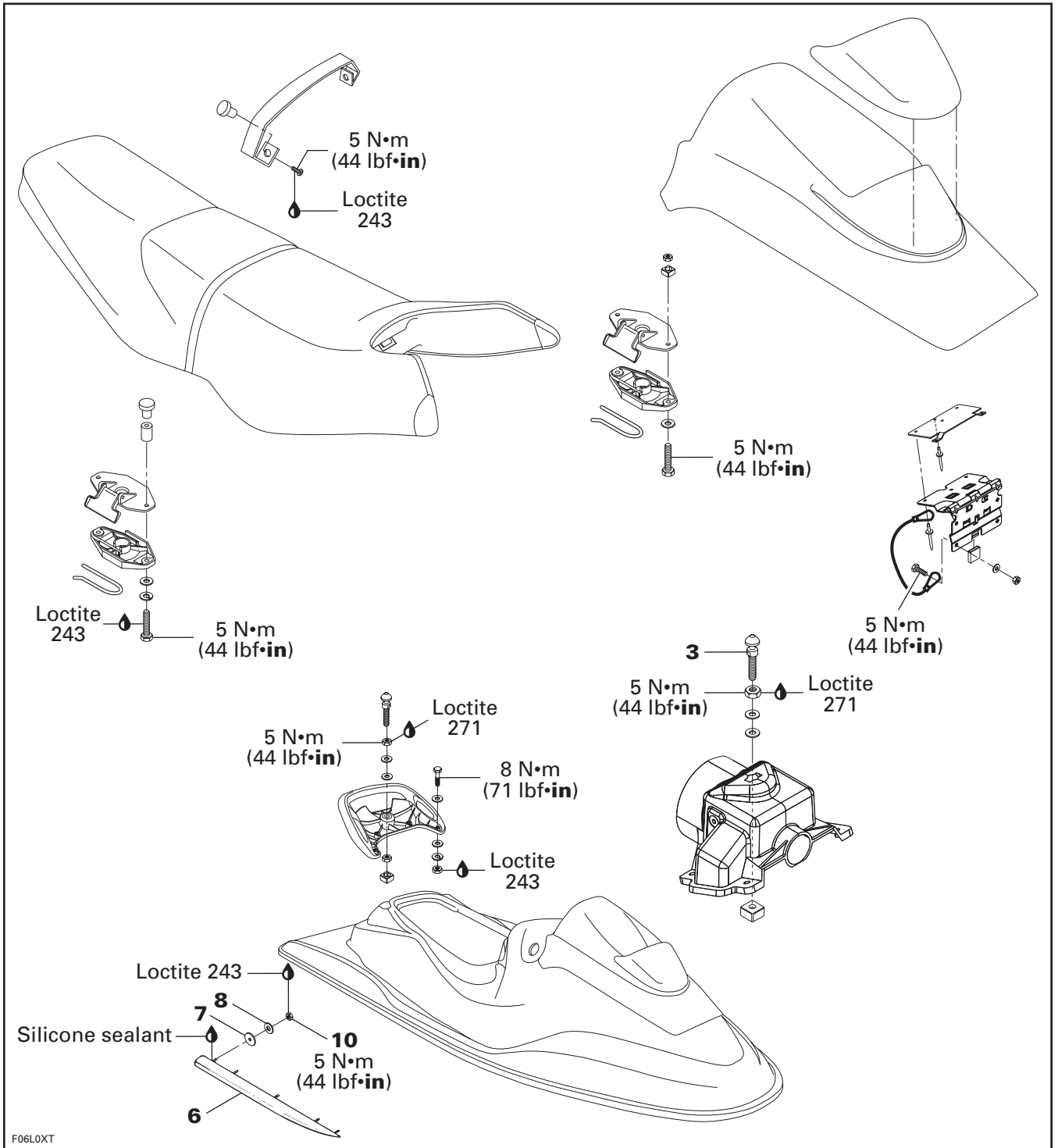
Assembly is essentially the reverse of disassembly procedure. Refer to the main illustration at the beginning of this subsection for torque specifications and service products to be used.

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ADJUSTMENT AND REPAIR

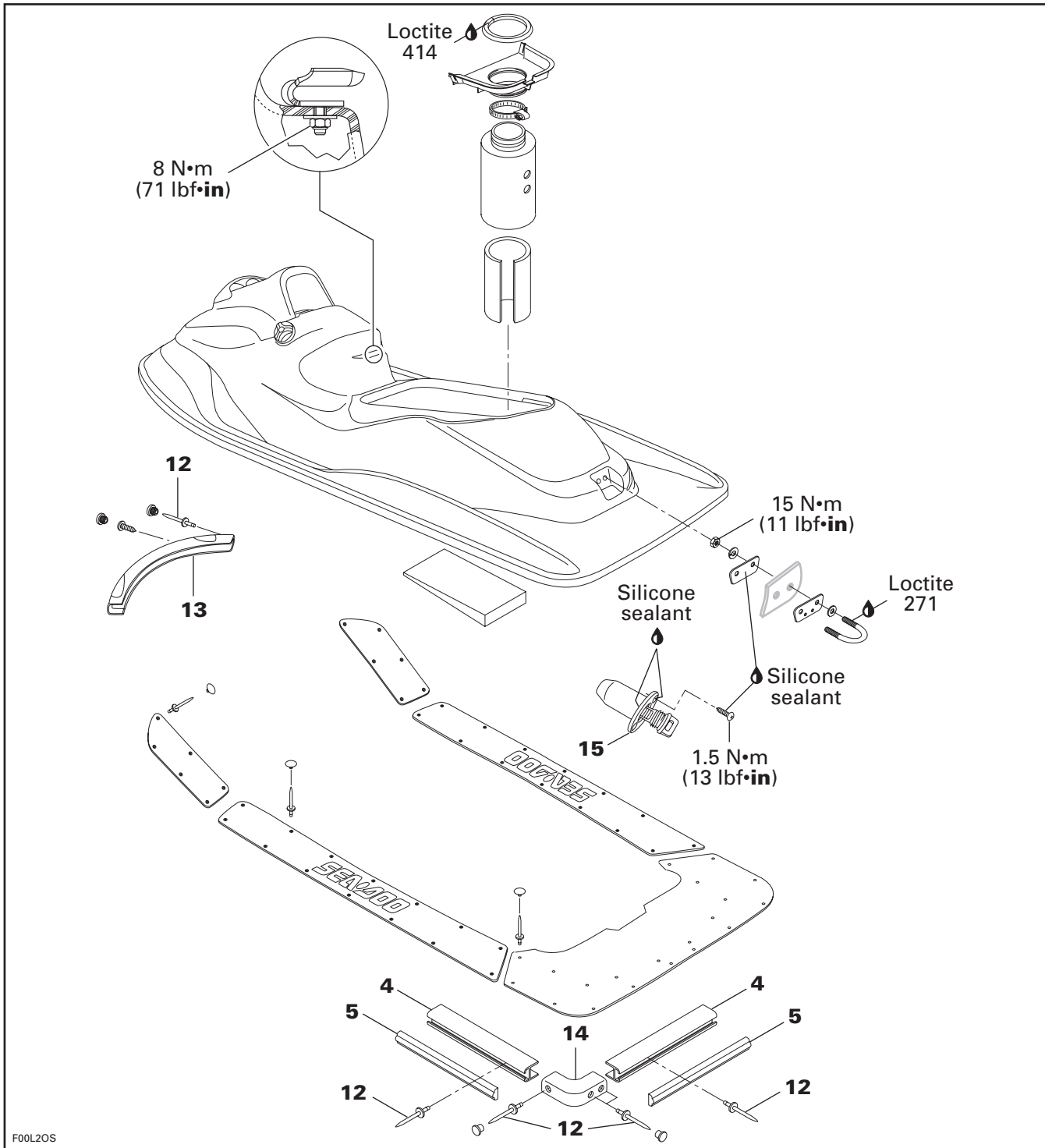
GS Models (bow)



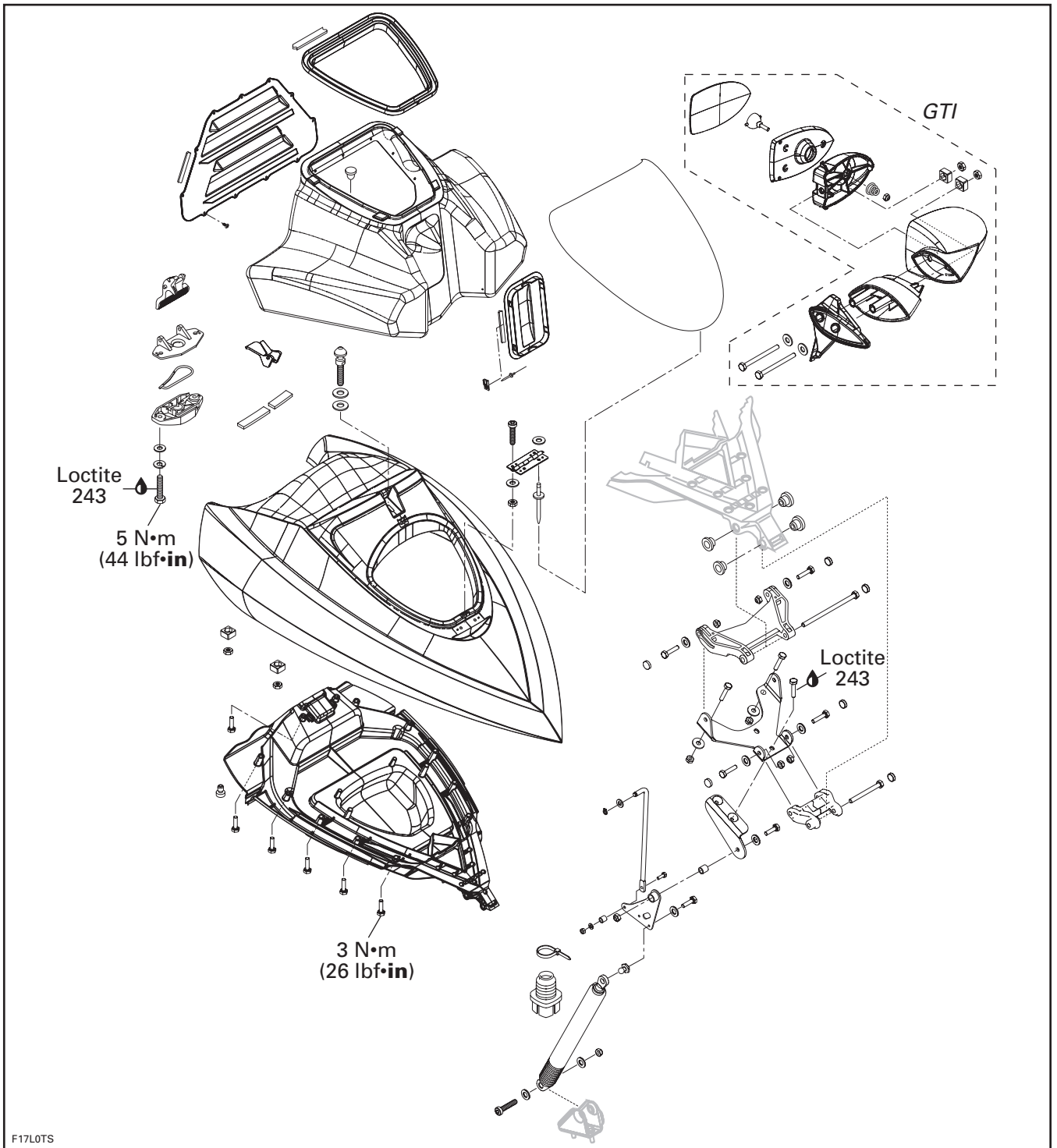
Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

GS Models (stern)



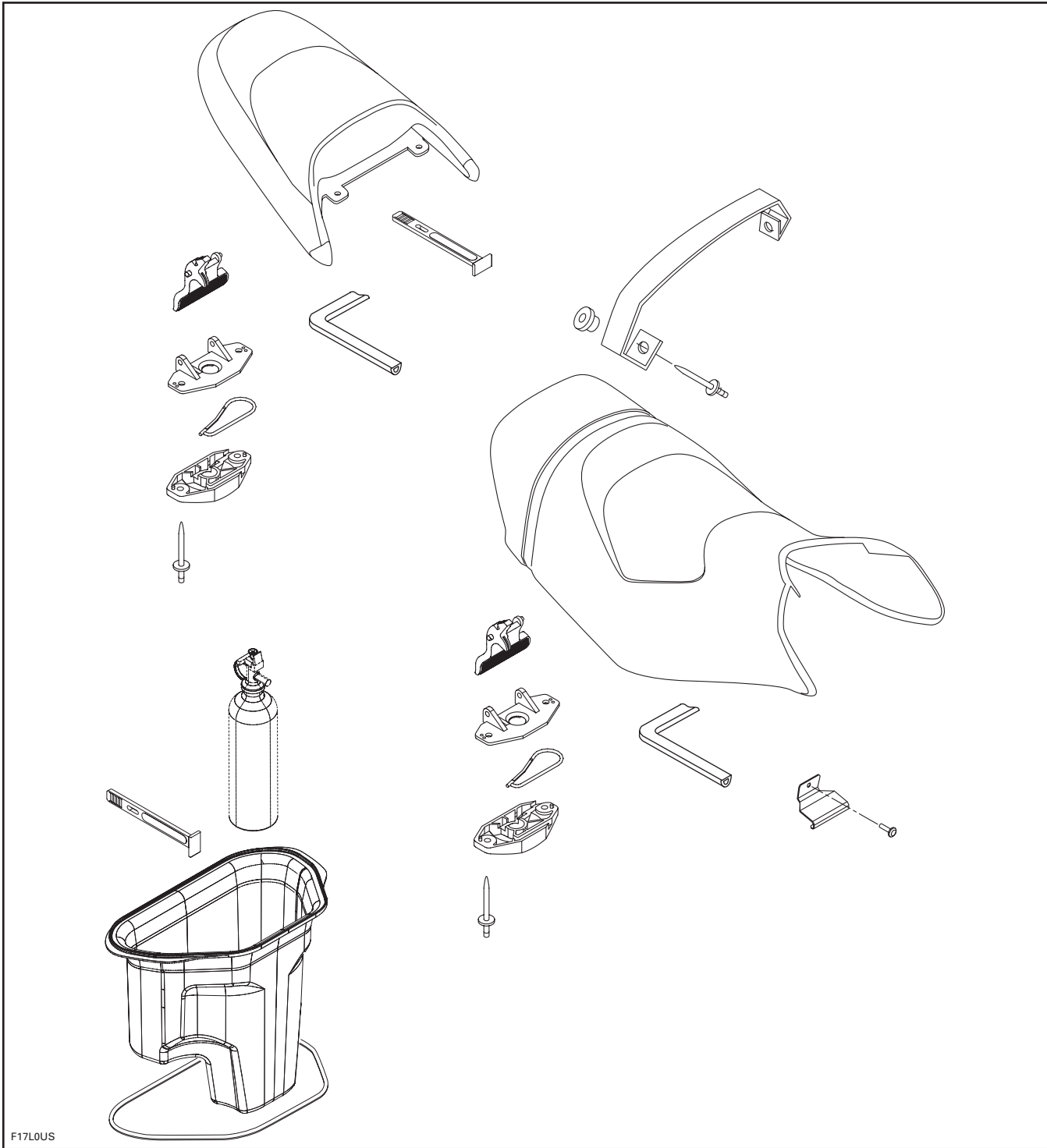
GTI and GTS Models (cover)



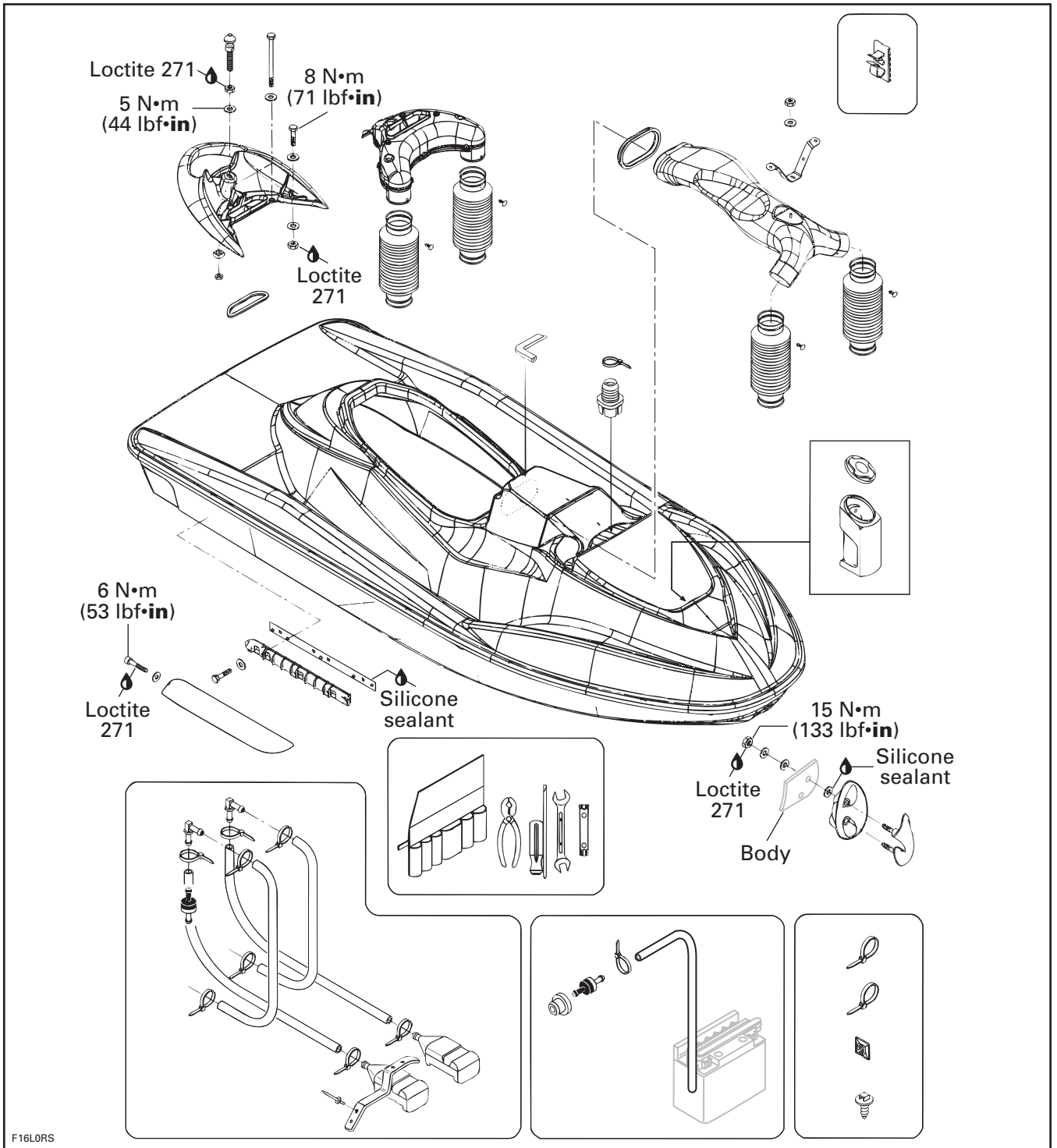
Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

GTI and GTS Models (seats)



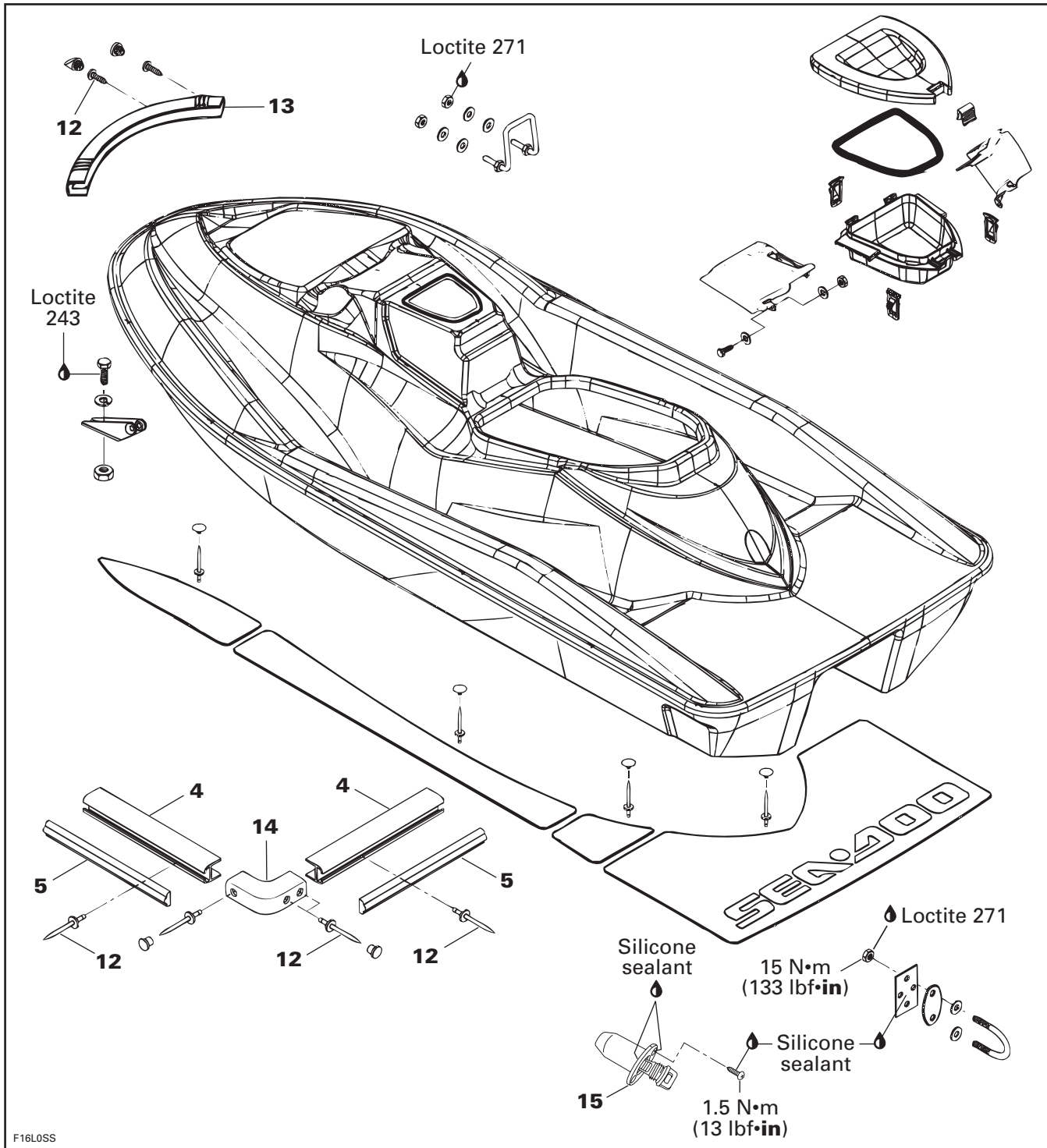
RX Series (bow)



Section 14 HULL/BODY

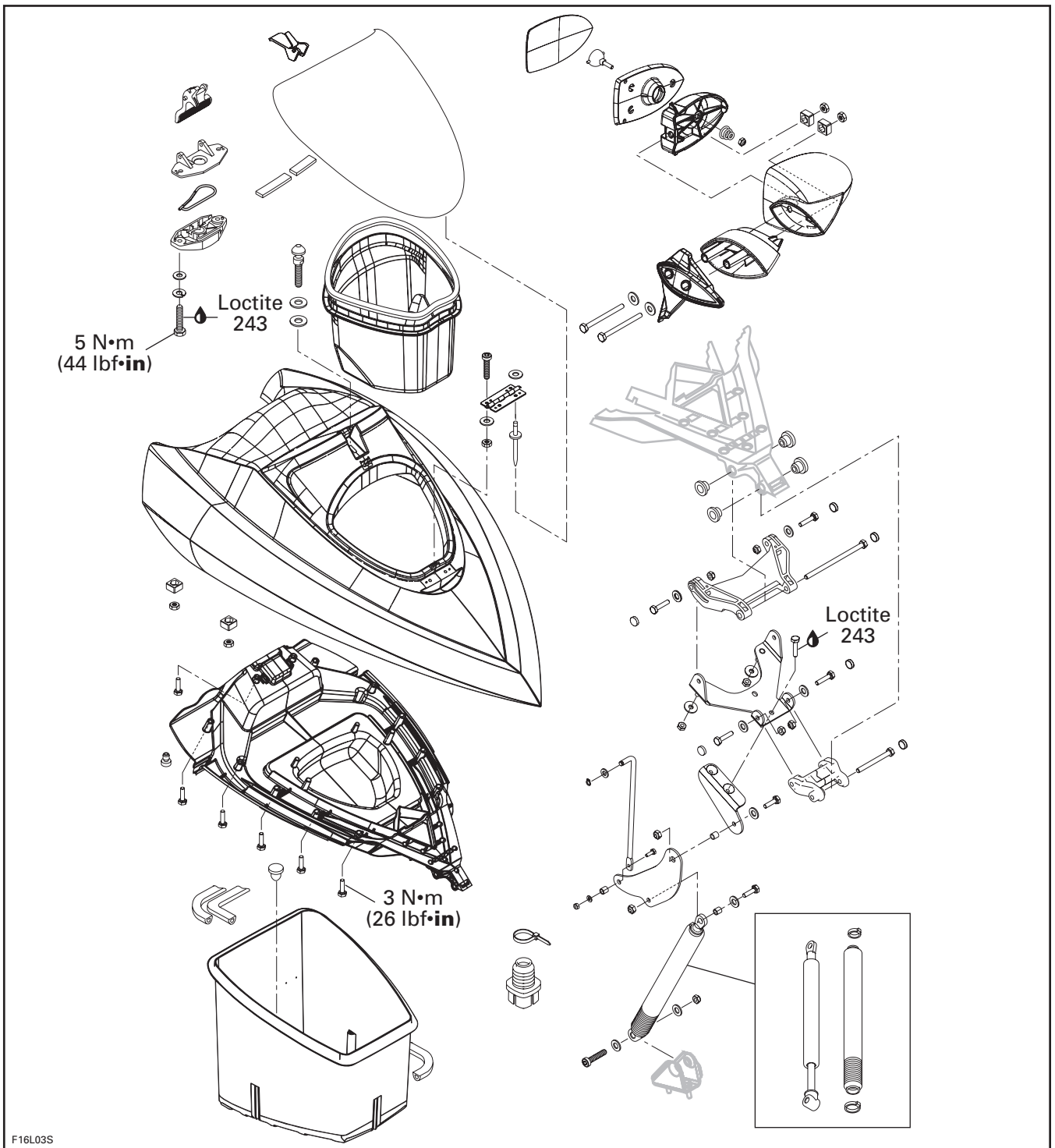
Subsection 02 (ADJUSTMENT AND REPAIR)

RX Series (stern)



F16L0SS

RX Series (cover)

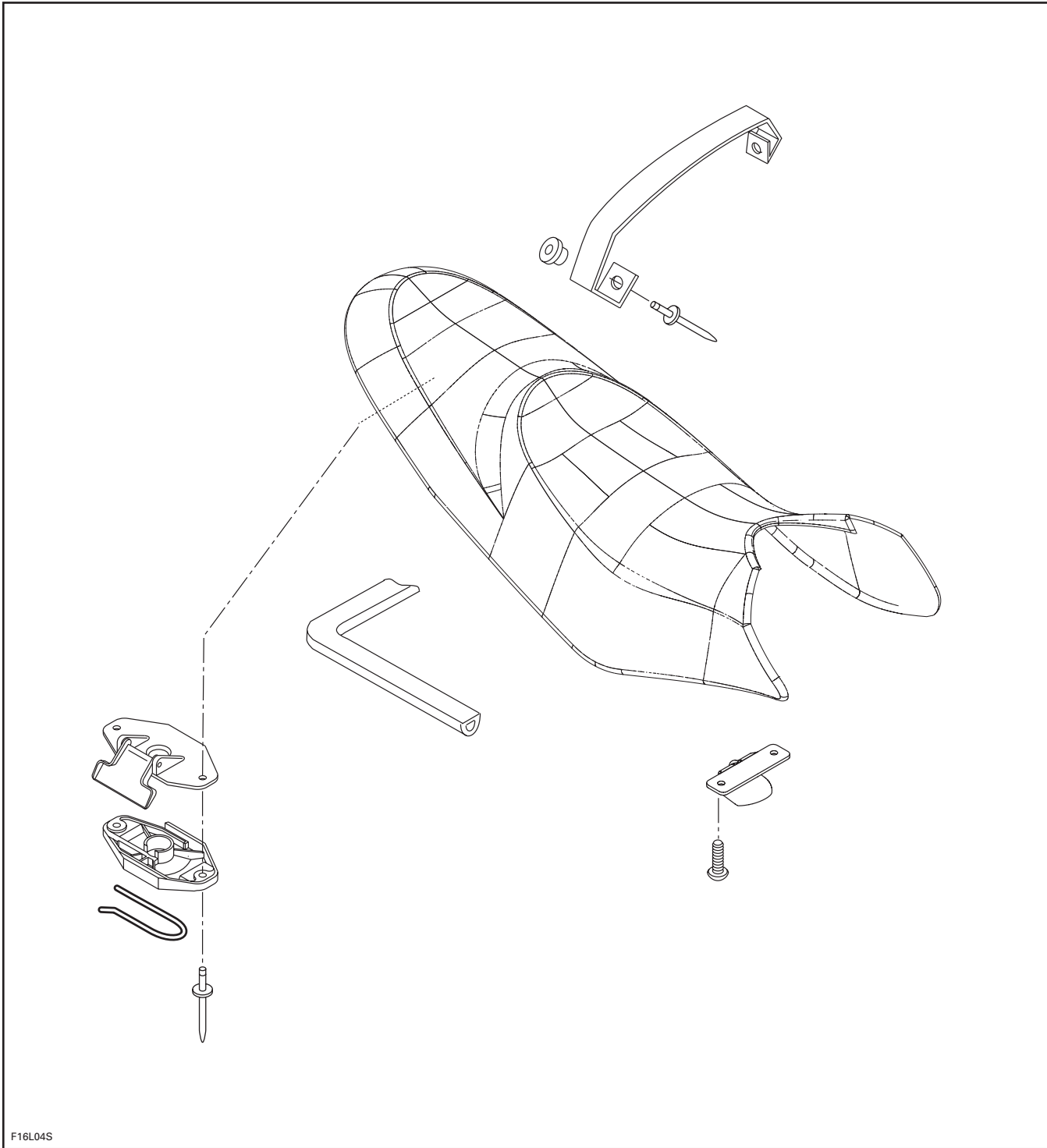


F16L03S

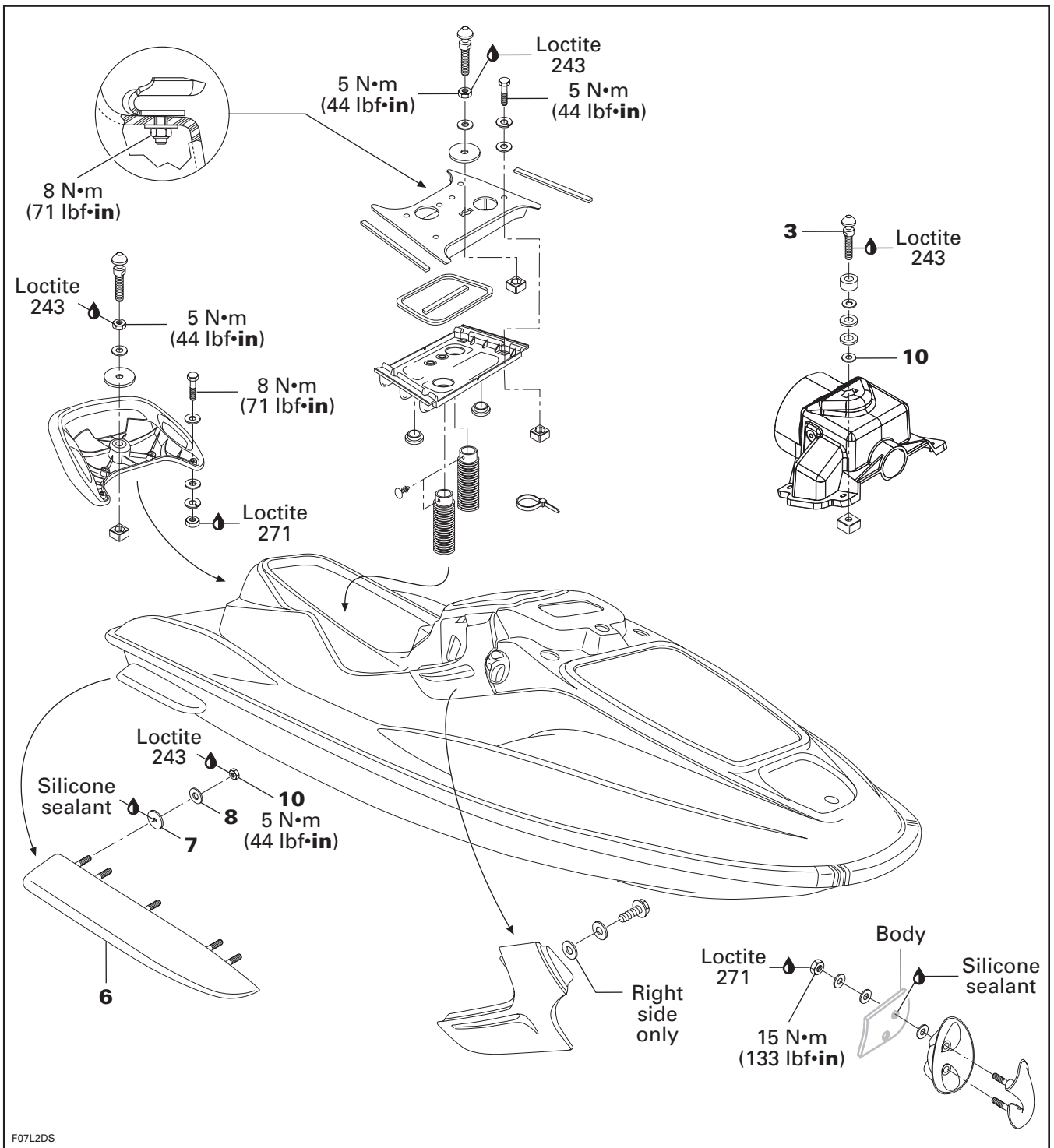
Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

RX Series (seat)

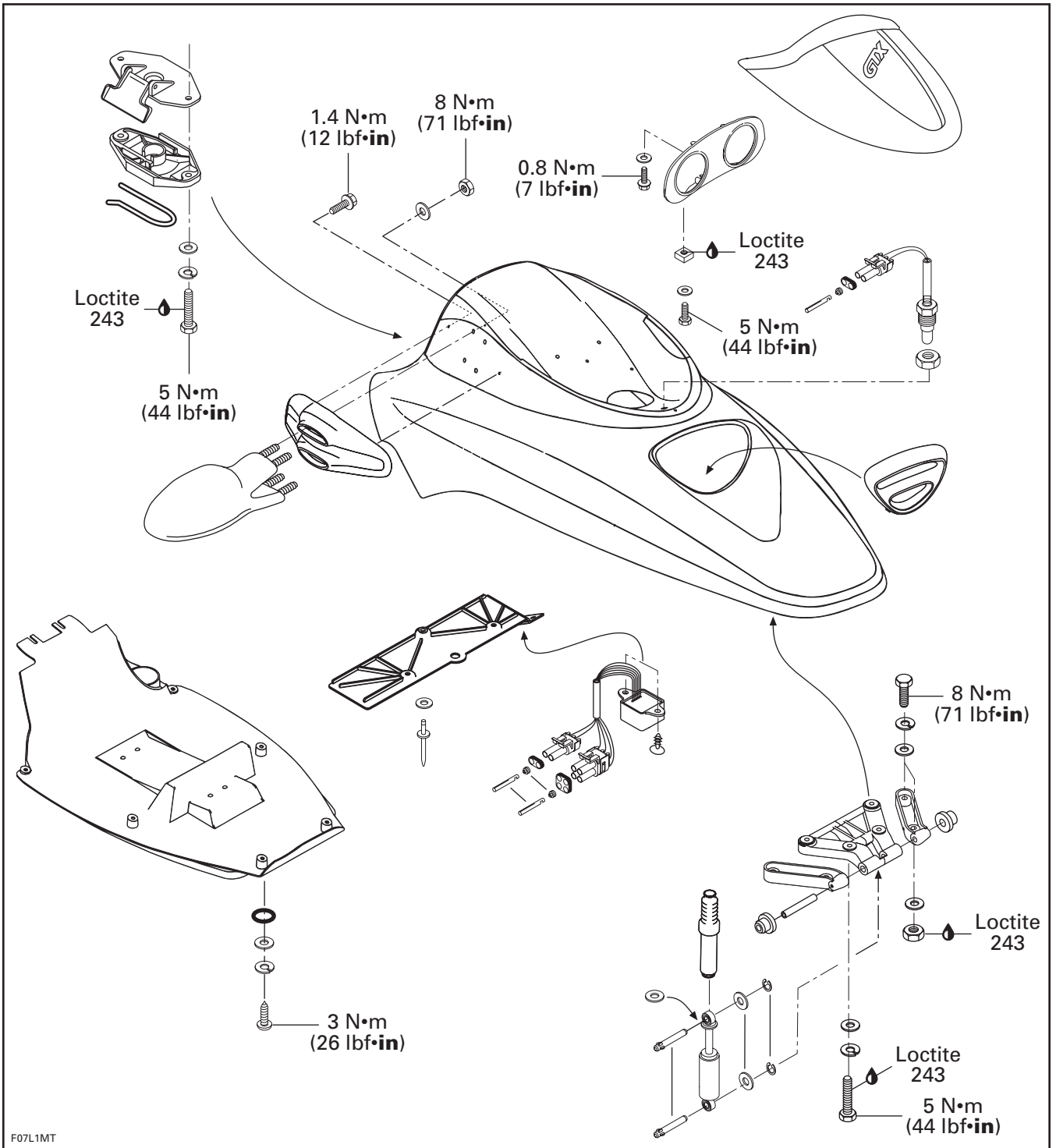


GTX Series (bow)



Section 14 HULL/BODY
Subsection 02 (ADJUSTMENT AND REPAIR)

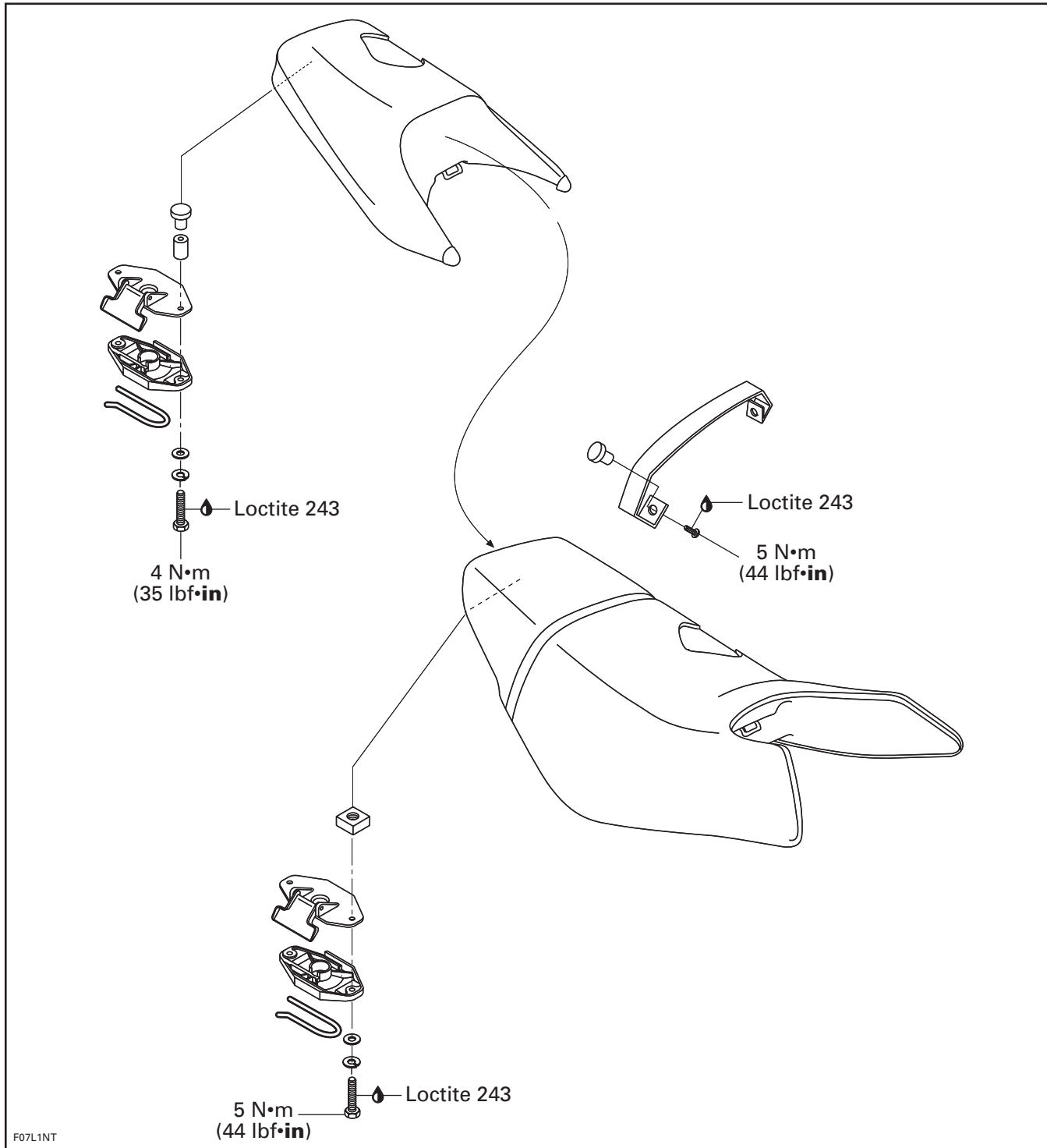
GTX Series (cover)



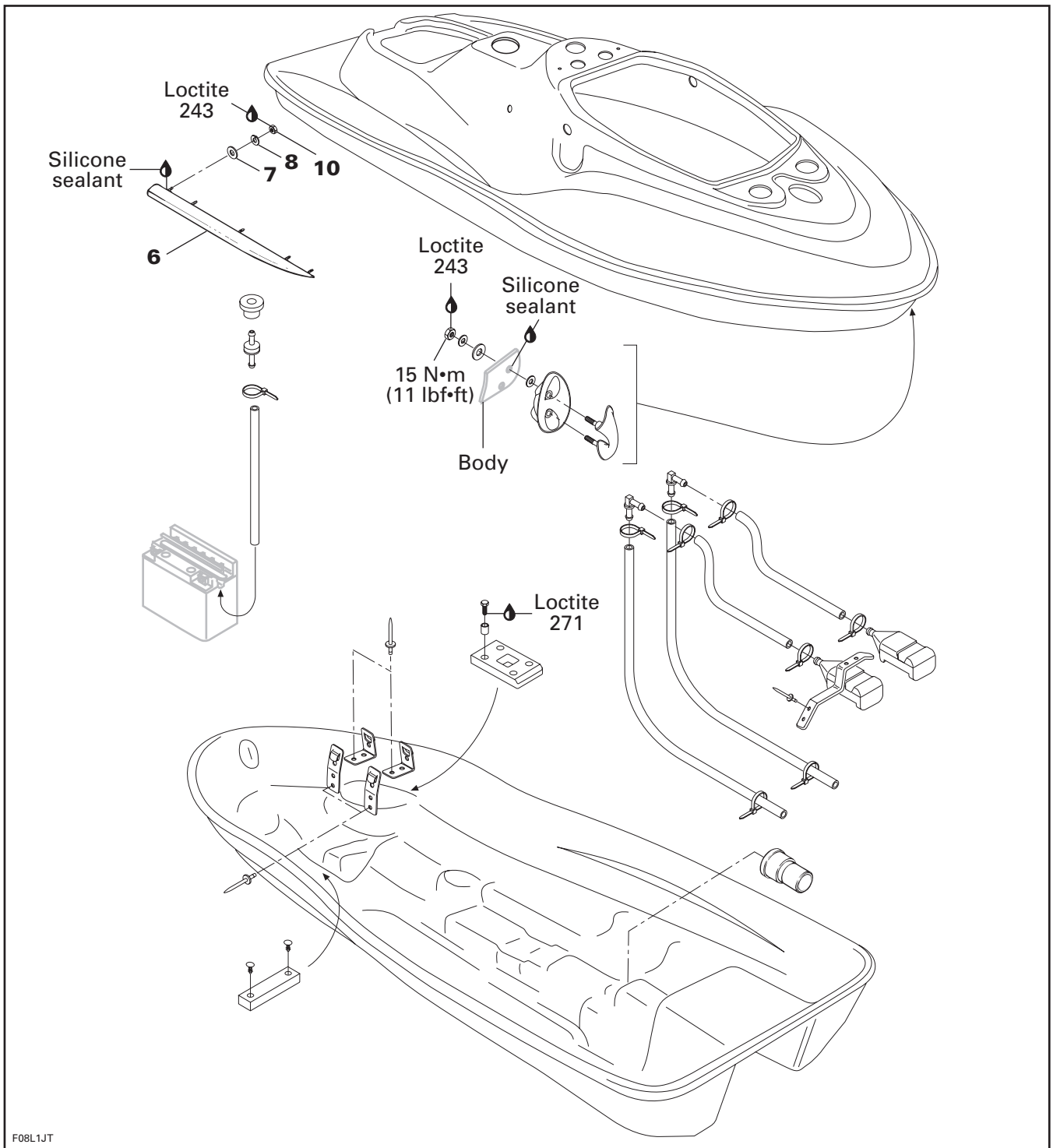
Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

GTX Series (seat)



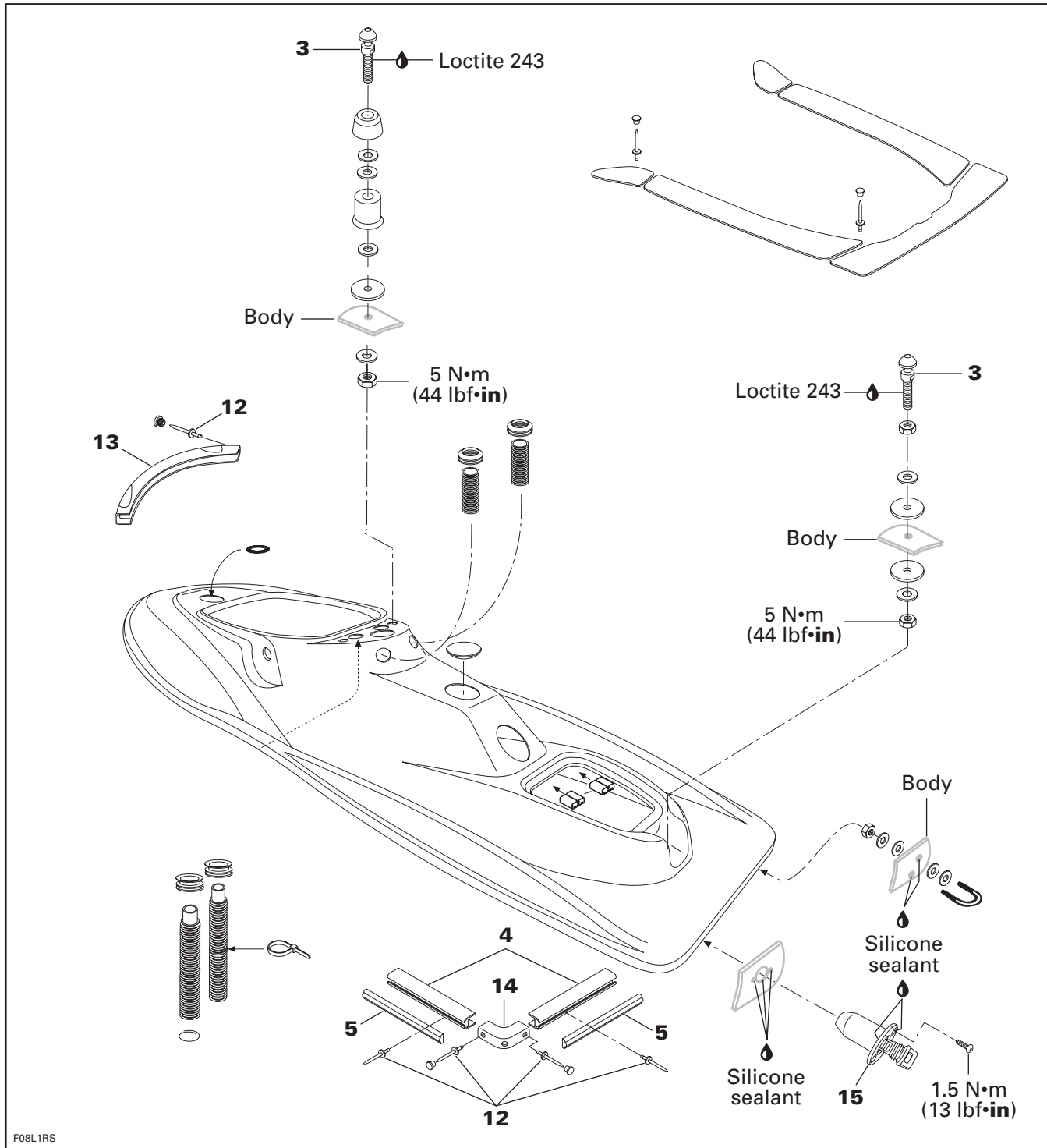
XP Models (bow)



Section 14 HULL/BODY

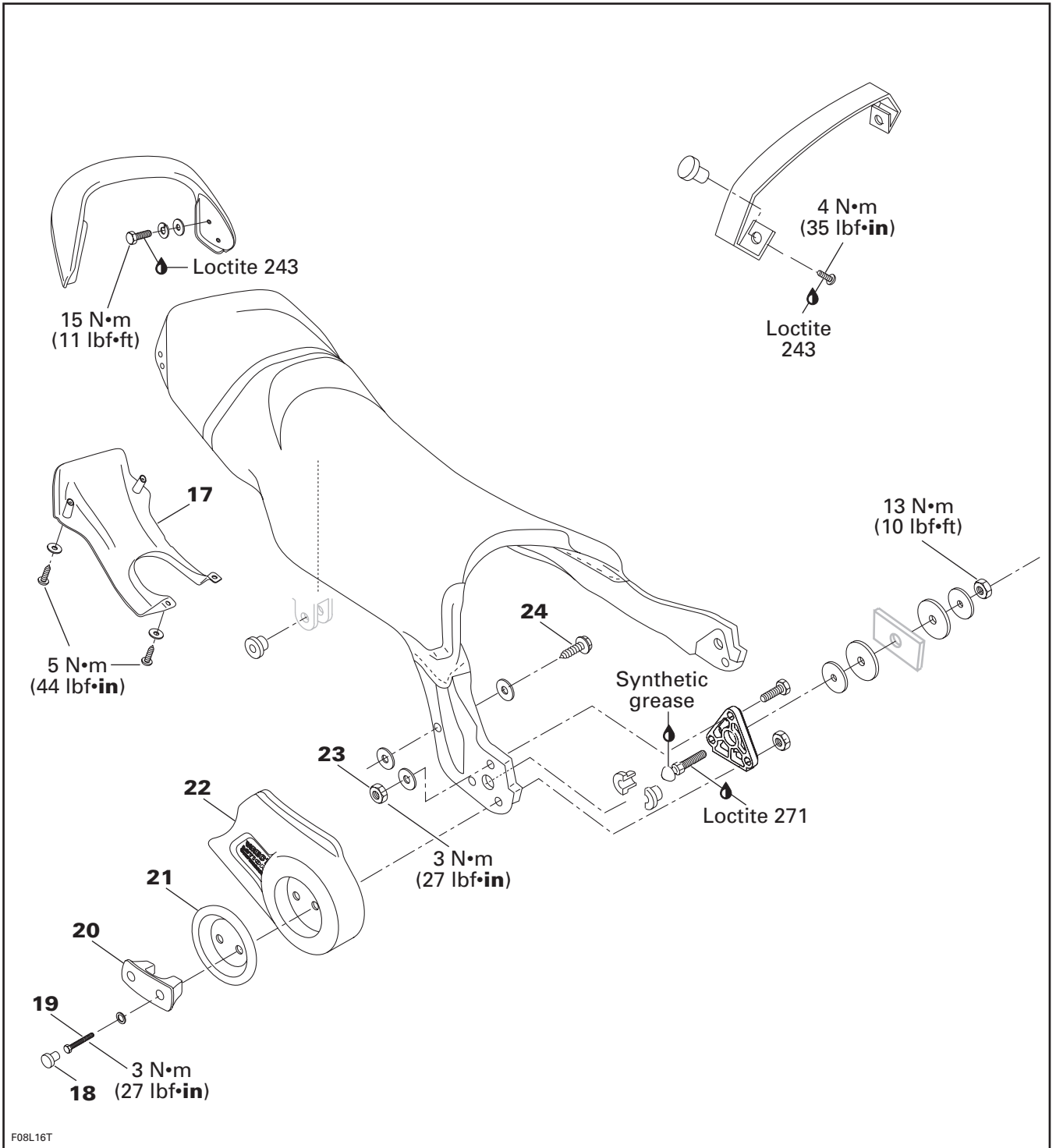
Subsection 02 (ADJUSTMENT AND REPAIR)

XP Models (stern)

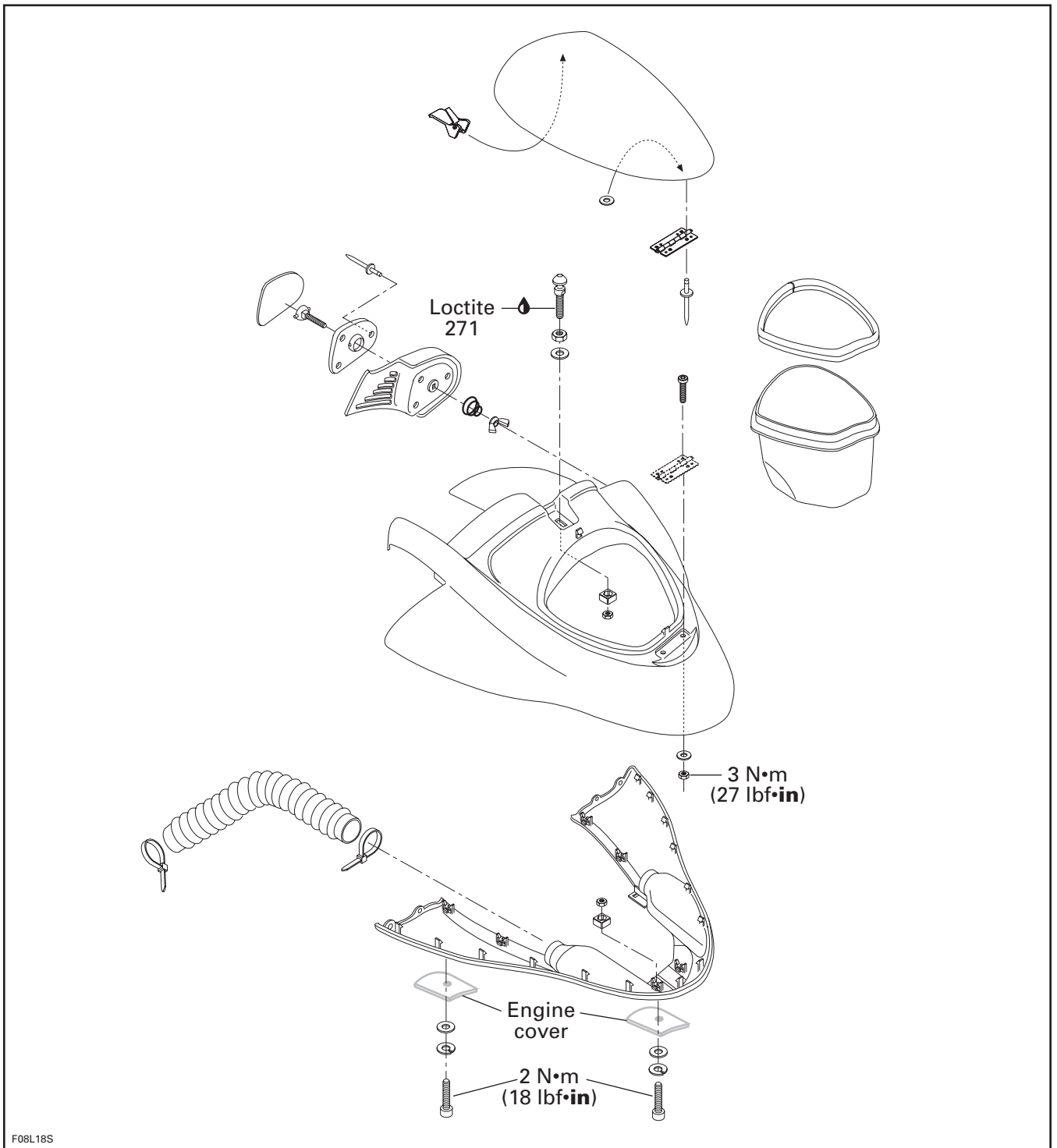


F08L1RS

XP Models (seat)



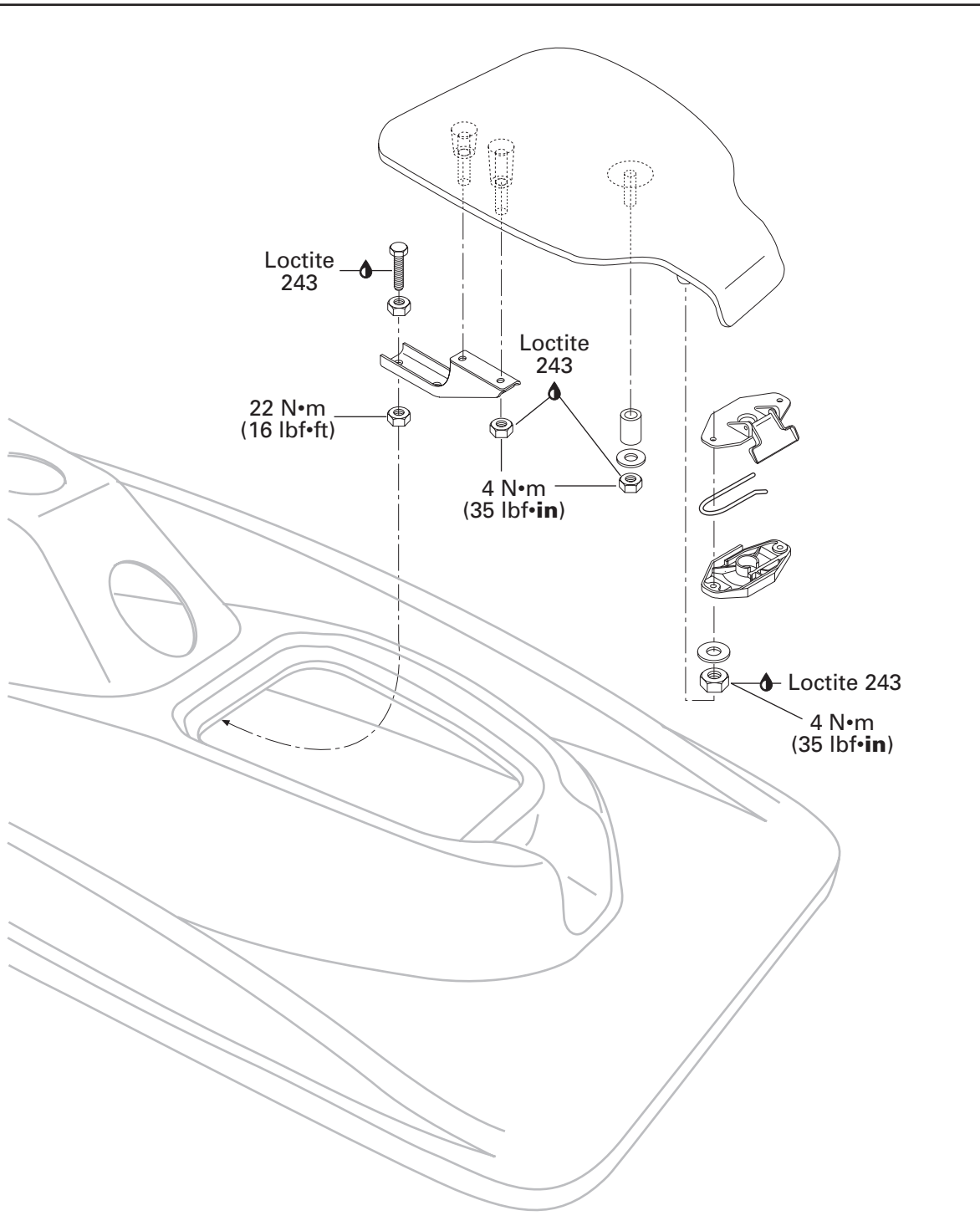
XP Models (front cover)



Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

XP Models (rear cover)



F08L19T

GLOVE BOX

GTX Series

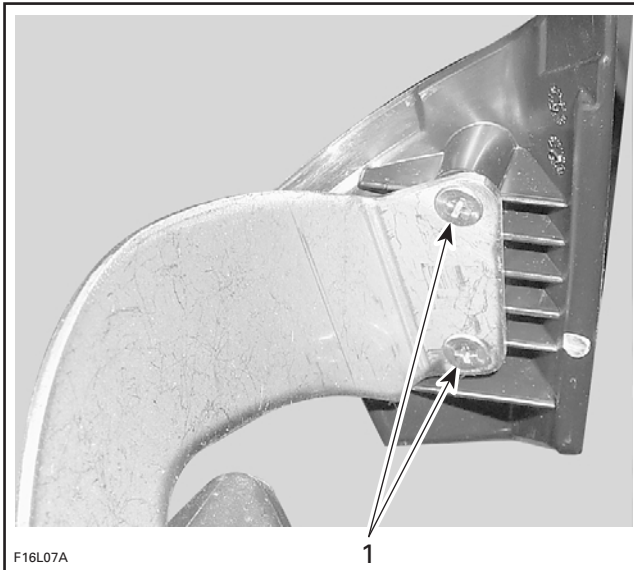
Open the glove box cover then unscrew the four screws.

Pull the glove box out of body.

GTS, GTI and RX Series

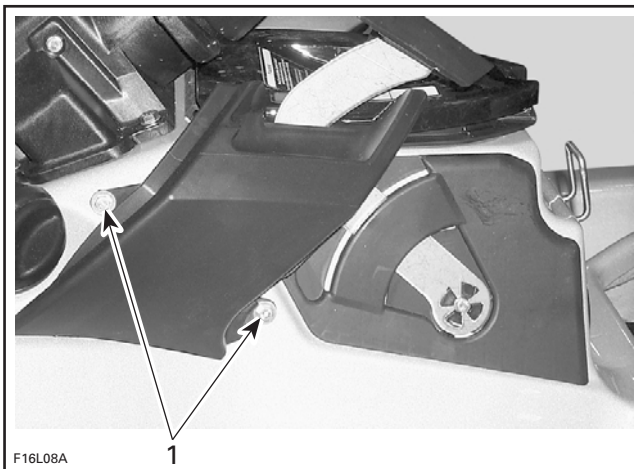
Removal

Remove handle from shift lever.



1. Unscrew

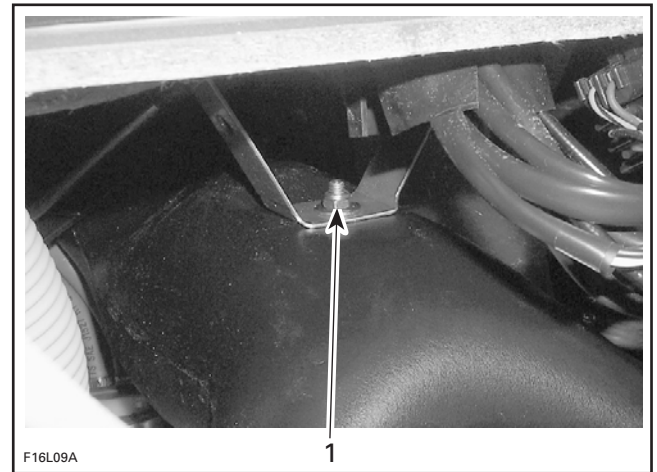
Unscrew retaining screws then remove side panels.



1. Unscrew

RX Series

Open front storage cover and remove basket.

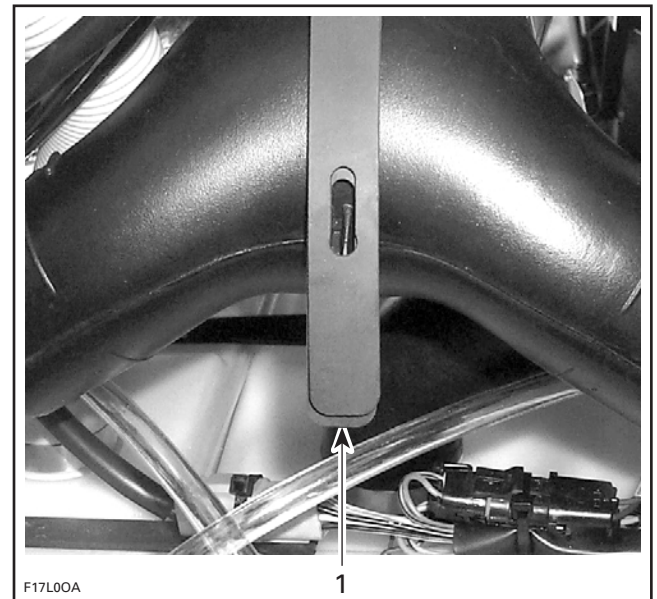


1. Unscrew

GTI and GTS Models

Open front storage cover and remove the access panel.

Detach the latch retaining vent tube to bracket.



1. Unlatch

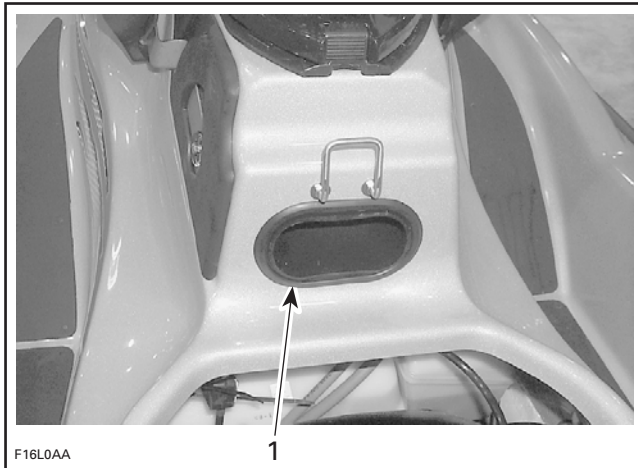
Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

GTI, GTS and RX Series

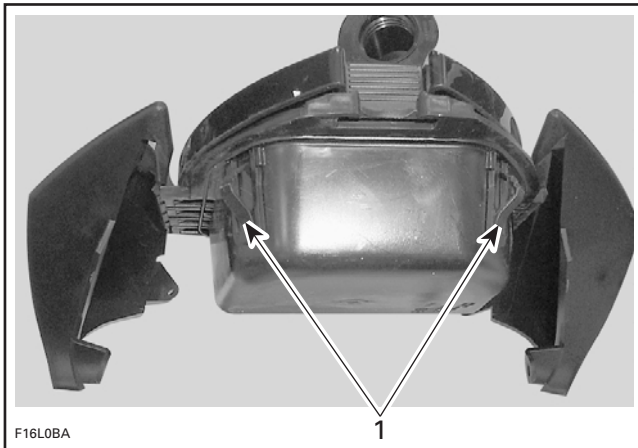
Pull vent tube out.

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

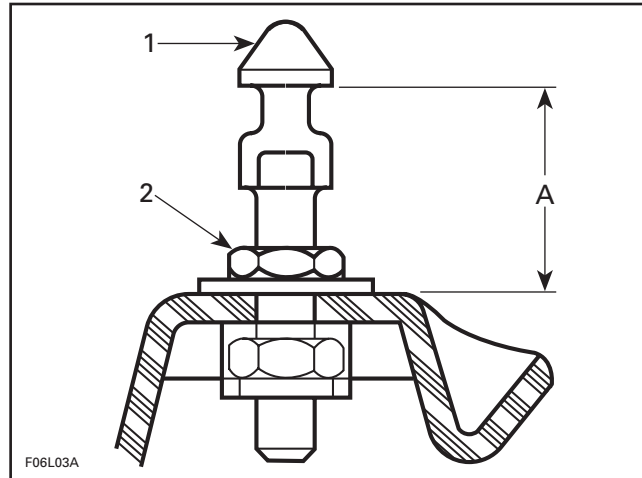
Installation

Reverse the removal procedure.

SEAT ADJUSTMENT

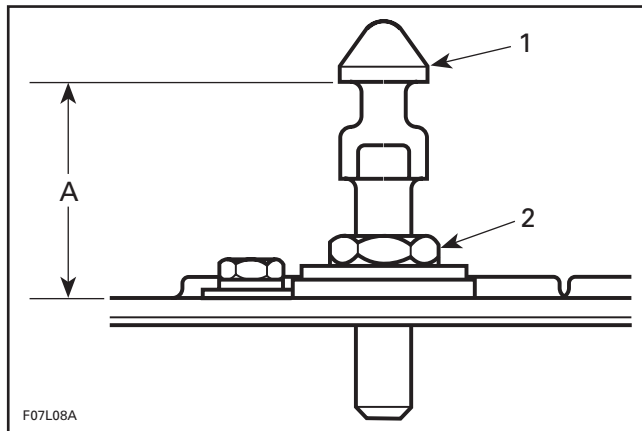
Seat Retainer

NOTE: Apply Loctite 243 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.



GS MODELS

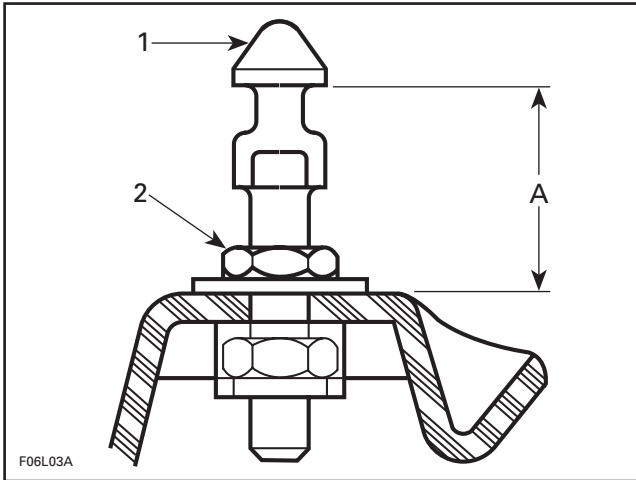
1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 33.5 ± 1 mm (1-5/16 ± 3/64 in)



GTX SERIES — FRONT SEAT

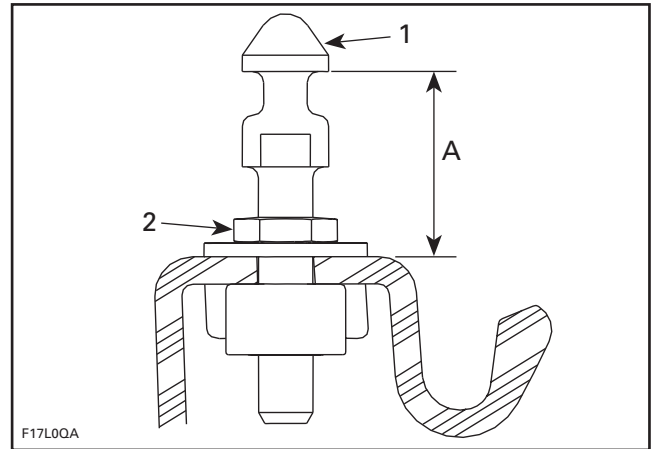
1. Lock pin
 2. Adjustment nut (Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 39 ± 1 mm (1-35/64 ± 3/64 in)

Section 14 HULL/BODY
Subsection 02 (ADJUSTMENT AND REPAIR)



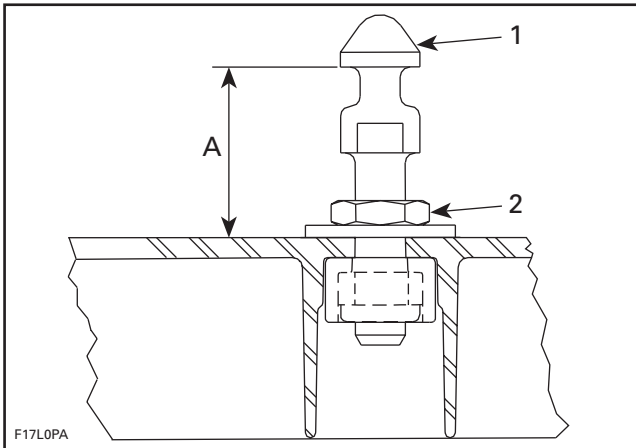
GTX SERIES — REAR SEAT

1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 33.5 ± 1 mm (1-5/16 ± 3/64 in)



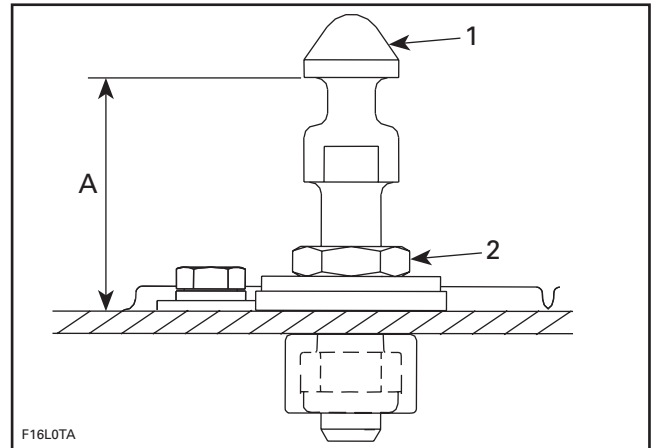
GTI AND GTS MODELS — REAR SEAT

1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 34 ± 1 mm (1-11/32 ± 3/64 in)



GTI AND GTS MODELS — FRONT SEAT

1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 34 ± 1 mm (1-11/32 ± 3/64 in)



RX AND RX DI MODELS

1. Lock pin
 2. Adjustment nut (apply Loctite 243). Torque to 5 N•m (44 lbf•in)
- A. 39 ± 1 mm (1-35/64 ± 3/64 in)

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

STORAGE COMPARTMENT INNER SHELL

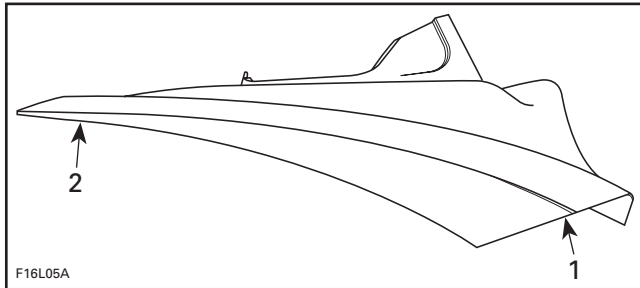
GTS, GTI and RX Series

To remove inner shell, proceed as follows:

CAUTION: Failure to follow this order may lead to damaging inner plastic studs.

Remove retaining screws.

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

For installation, proceed as follows:

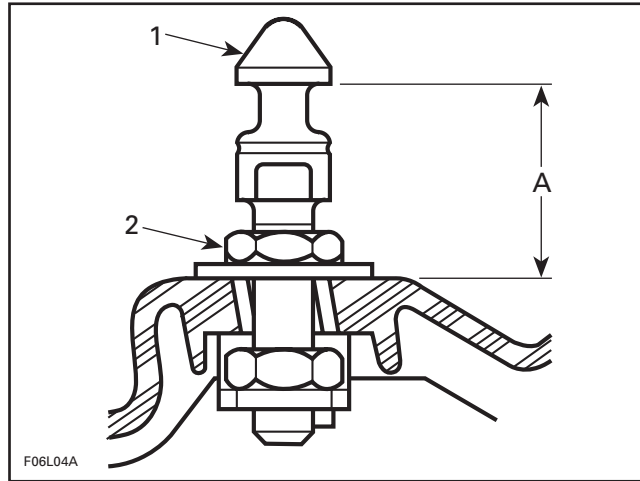
- Sand both inner and outer shells in area to be glued (**except GTS**).
- Clean to remove any dust with isopropyl alcohol. Let dry.
- Apply a 2 mm (3/32 in) bead of Loctite 454.
- Reinstall inner shell with its retaining screws.
- Tighten screws starting with the one at the small end (front) and finish with rear end. Carefully hand tighten.

STORAGE COMPARTMENT COVER ADJUSTMENT

NOTE: Apply Loctite 243 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.

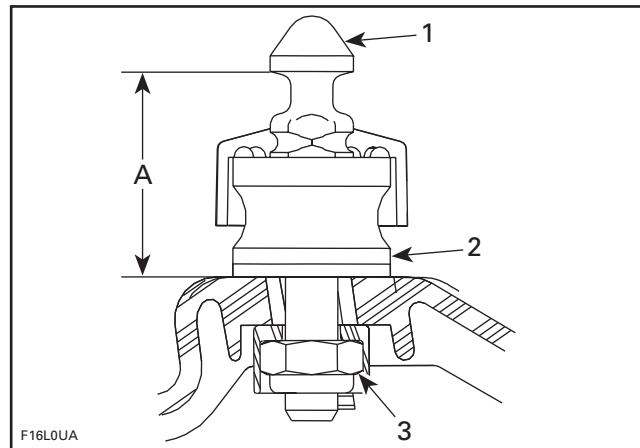
All Models

Adjust lock pin no. 3 as per following specifications:



FIXED TYPE LOCK PIN

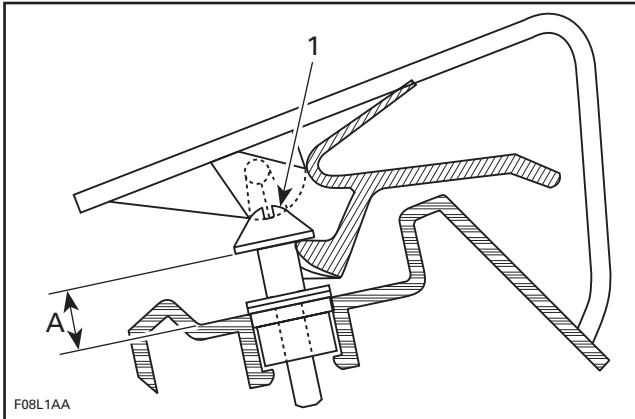
1. Lock pin (apply Loctite 243)
 2. Adjustment nut. Torque to 5 N•m (44 lbf•in)
- A. 34 ± 1 mm (1-11/32 \pm 3/64 in)



FLOATING TYPE

1. Lock pin (apply Loctite 243)
 2. Rubber washer
 3. Lock nut. Torque to 5 N•m (44 lbf•in)
- A. 39.2 ± 1 mm (1-35/64 \pm 3/64 in)

NOTE: Some models have a floating type lock pin. It is normal to have a front and aft play of the lock pin. To adjust, tighten lock pin until any vertical play is eliminated. Make sure a front and aft play remains when pressing by hands.



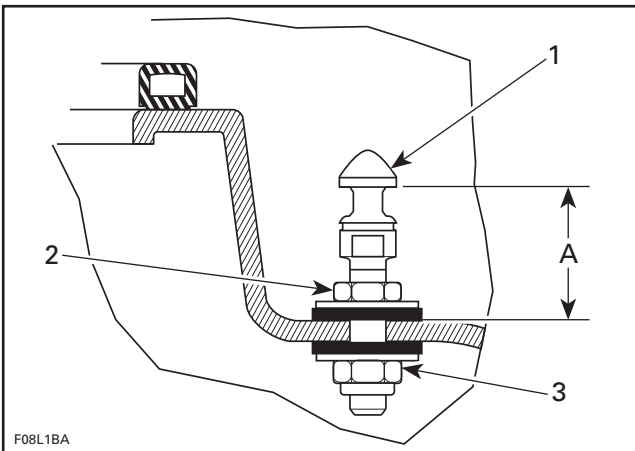
XP MODELS

1. Lock pin. Torque to 4 N•m (35 lbf•in)
- A. 13.4 mm (17/32 in)

ACCESS PANEL ADJUSTMENT

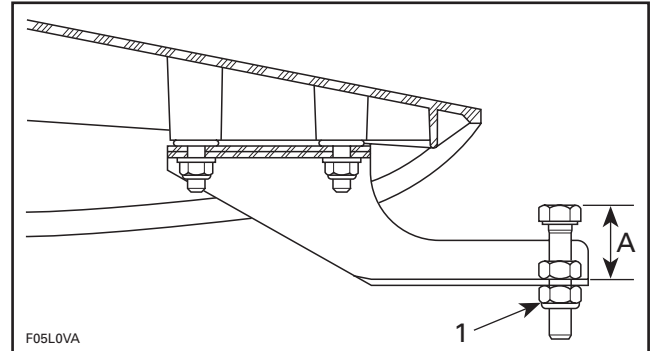
XP Models

Adjust lock pin no. 3 of access panel as per following specifications:



1. Lock pin
2. Adjustment nut (Loctite 243)
3. Lock nut. Torque to 5 N•m (44 lbf•in)
- A. 39 ± 1 mm (1-17/32 ± 3/64 in)

Adjust bolts no. 16 of access panel arms as per following specifications:



1. Lock nut. Torque to 22 N•m (16 lbf•ft)
- A. 20 ± 1 mm (25/32 ± 3/64 in)

MIRROR

GTI and RX Series

Place the mirror frame in hot water to “soften” the material to allow mirror installation in its frame.

INLET GRATE

Removal and Installation

Loosen screws and remove inlet grate.

NOTE: An impact screwdriver should be used to loosen tight screws.

GS and GTX Series

When reinstalling inlet grate, apply Loctite 271 on threads and torque screws to 11 N•m (8 lbf•ft).

GTS, GTI, XP and RX Series

When reinstalling inlet grate, apply Loctite 271 on threads.

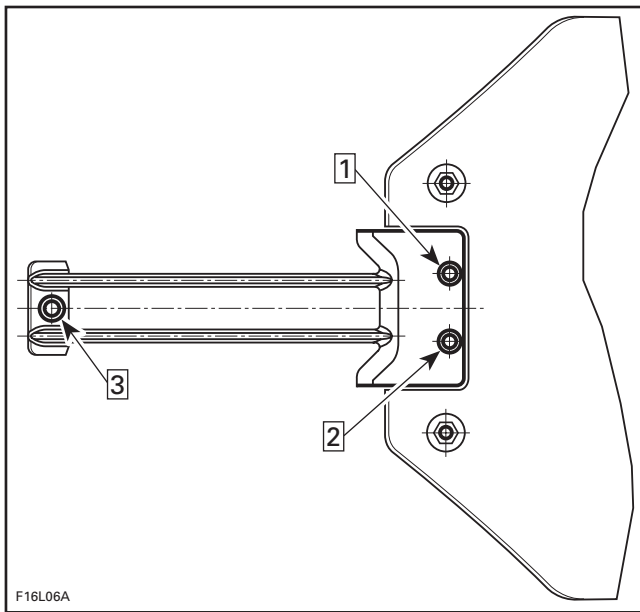
Follow this sequence referring to the illustration: Hand tighten screw numbers ①, ② then ③.

Torque screw numbers ① and ② to 11 N•m (97 lbf•in).

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

Torque screw number ③ to 26 N•m (19 lbf•ft).



RIDING PLATE

Removal

All Models

Remove inlet grate.

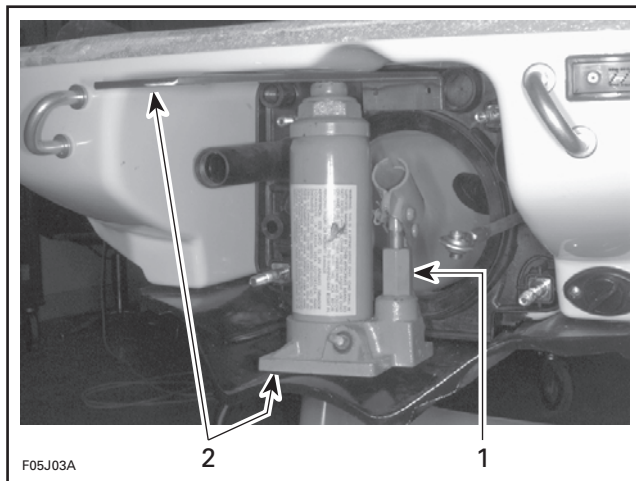
Remove jet pump. Refer to JET PUMP.

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

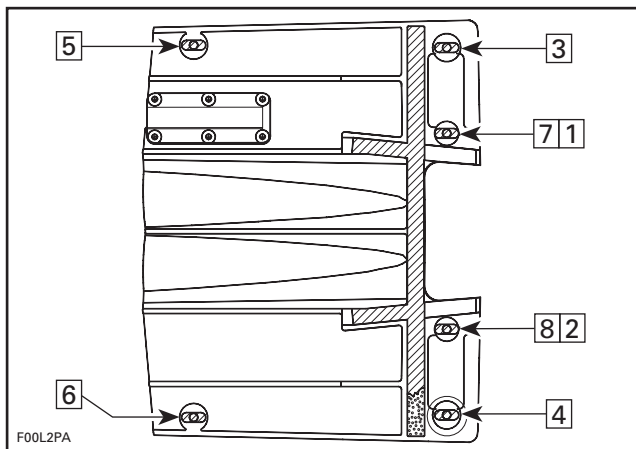
Scrape off all excess of sealant from riding plate and hull.

Clean hull surface with acetone based solvent to eliminate grease, dust and any residue of sealant.

Installation

All Models

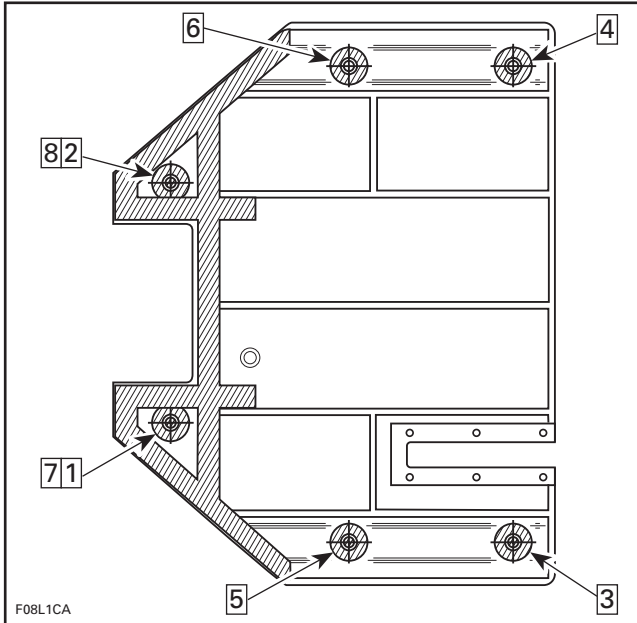
Apply Loctite The Right Stuff Gasket as indicated by the shaded areas in the next illustrations. Follow also the torquing sequence as shown in the same illustrations.



GS MODELS

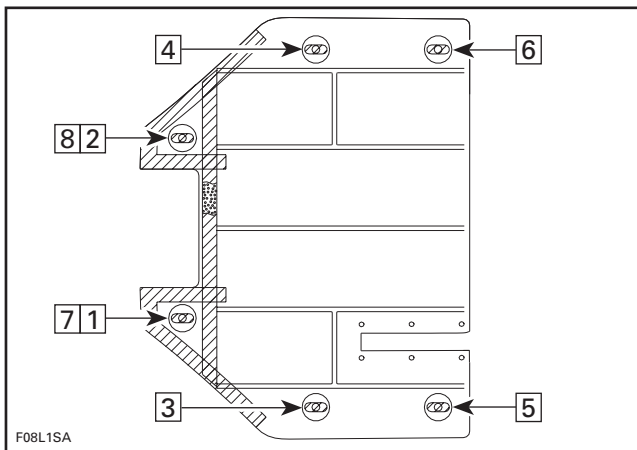
Section 14 HULL/BODY
Subsection 02 (ADJUSTMENT AND REPAIR)

NOTE: Apply Loctite The Right Stuff Gasket as indicated by the shaded area.



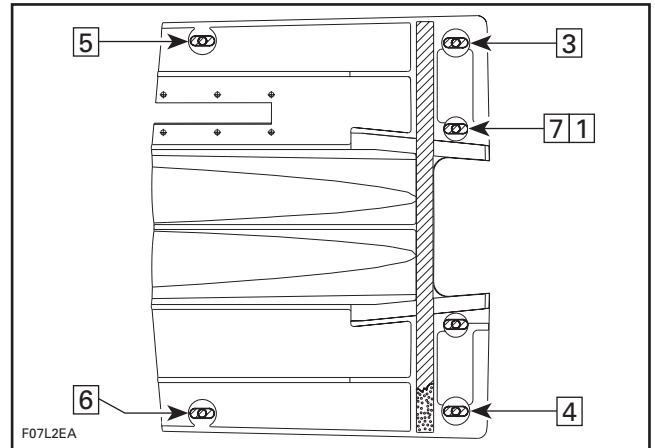
GTI, GTS, GTX DI, RX AND RX DI MODELS

NOTE: Apply Loctite The Right Stuff Gasket as indicated by the shaded area.



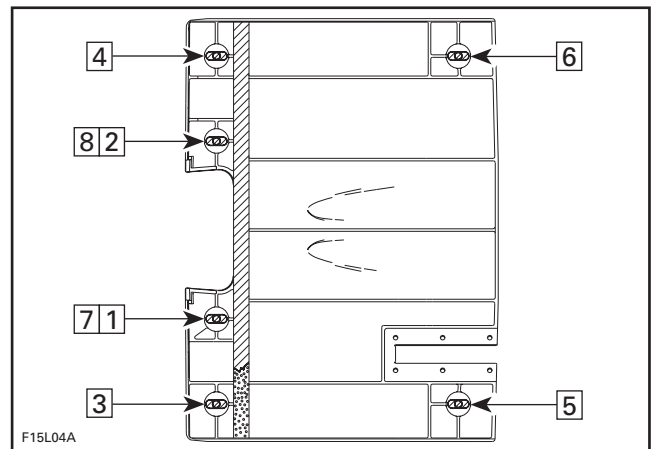
XP MODELS

NOTE: Apply Loctite The Right Stuff Gasket as indicated by the shaded area.



GTX MODELS

NOTE: Apply Loctite The Right Stuff Gasket as indicated by the shaded area.



GTX RFI MODELS

NOTE: Apply Loctite The Right Stuff Gasket as indicated by the shaded area.

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

JET PUMP SUPPORT

Removal

Remove jet pump. Refer to JET PUMP.

Remove inlet grate and riding plate.

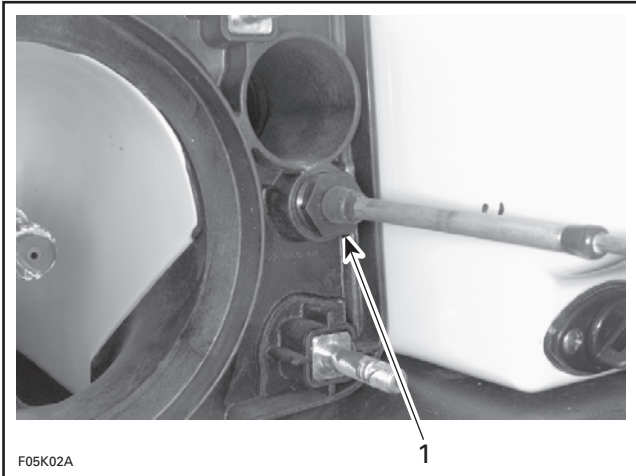
Remove ball joint, boot, nut, half rings and O-rings from steering cable.

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

Apply Loctite The Right Stuff Gasket as indicated by the shaded areas in the next illustrations. Follow also the torquing sequence as shown in the same illustrations.



TYPICAL

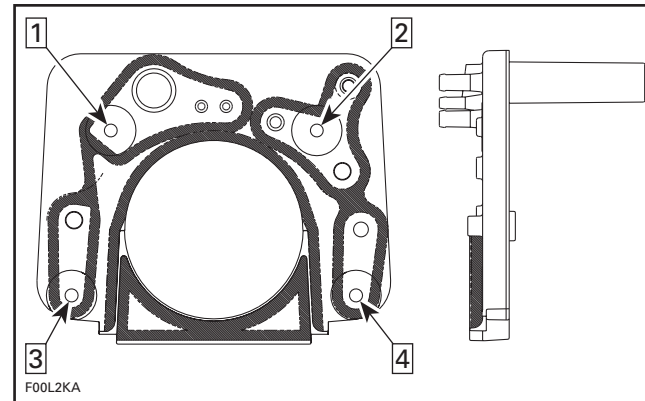
1. Unscrew nut

Remove ball joint, boot, nut, half rings and O-rings from reverse cable (GTI, GTS, RX series and GTX series).

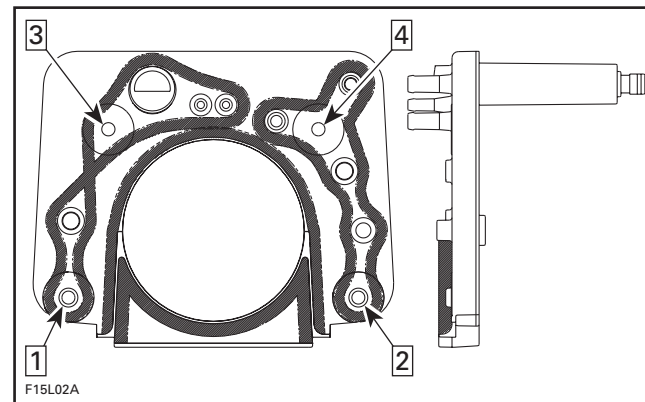
Remove boot and nut from VTS sliding shaft (RX series and XP models).

Disconnect water supply hose, water return hose and bailer hoses.

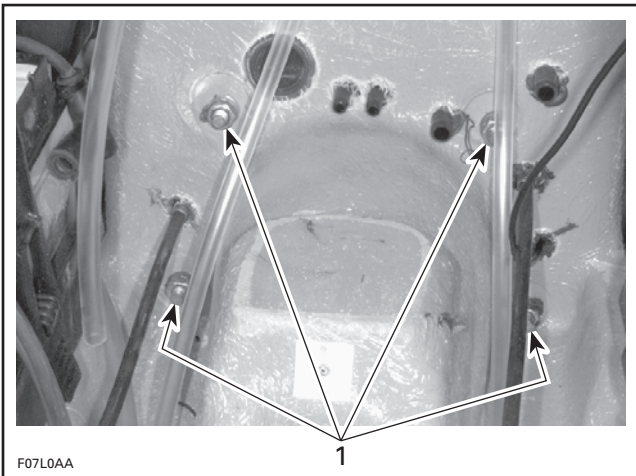
Remove nuts, lock washers and flat washers retaining jet pump support.



GS MODELS

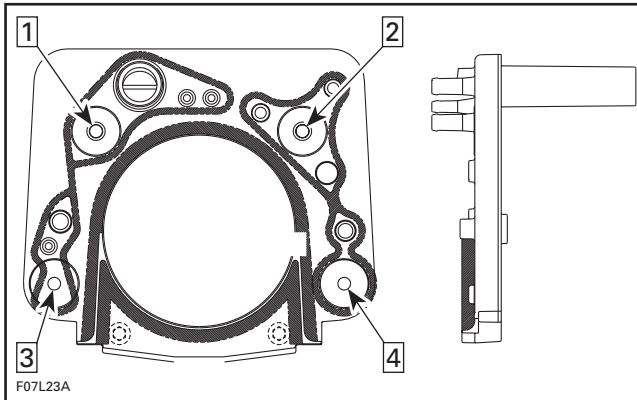


GTX RFI MODELS

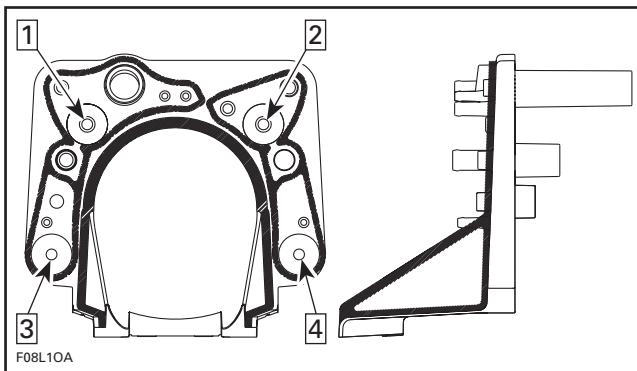


TYPICAL

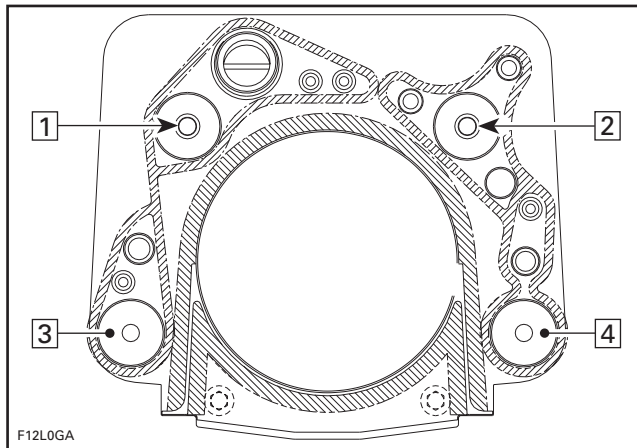
1. Remove nuts



GTX MODELS



GTS, GTI, RX, RX DI AND XP MODELS



GTX DI MODELS

DEFLECTOR

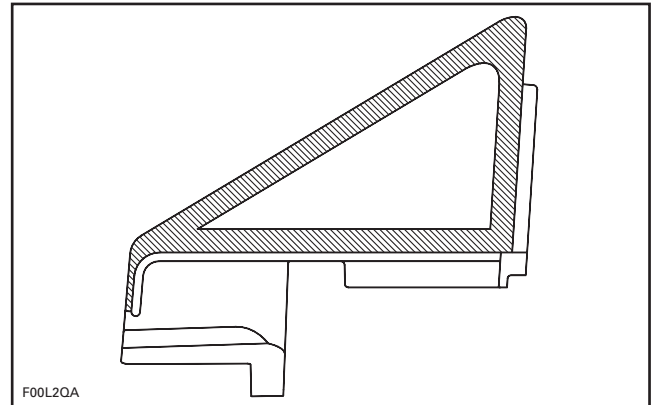
GS and GTX Series

Removal

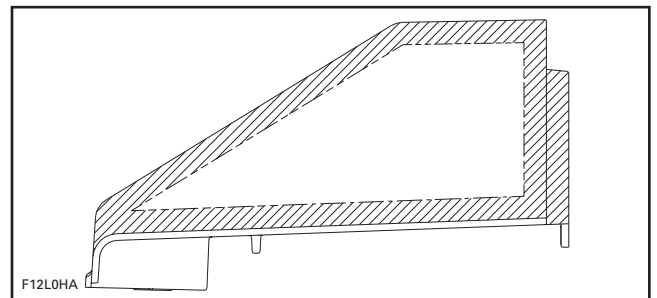
Using a heat gun, heat deflector and pry it using a piece of wood.

Installation

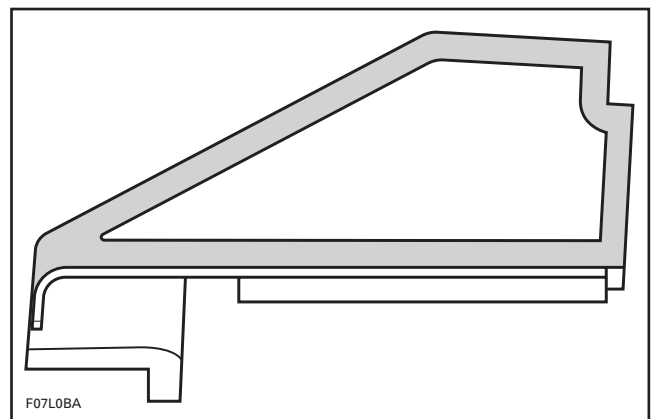
Apply Loctite The Right Stuff Gasket as indicated by the shaded area in the following illustrations.



GS MODELS



GTX AND GTX DI MODELS



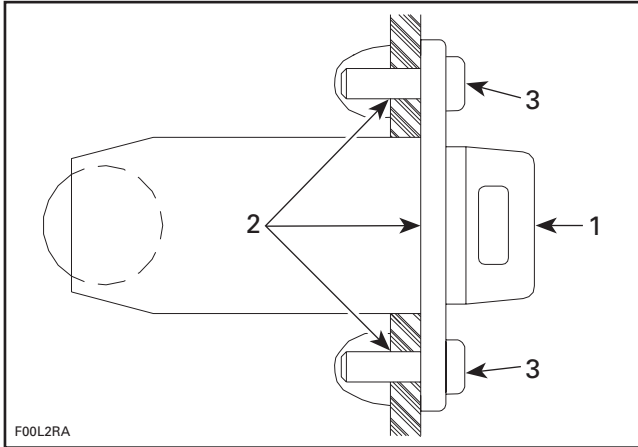
GTX RFI MODELS

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

DRAIN PLUG INSTALLATION

Refer to the following illustration to install drain plug no. 15.

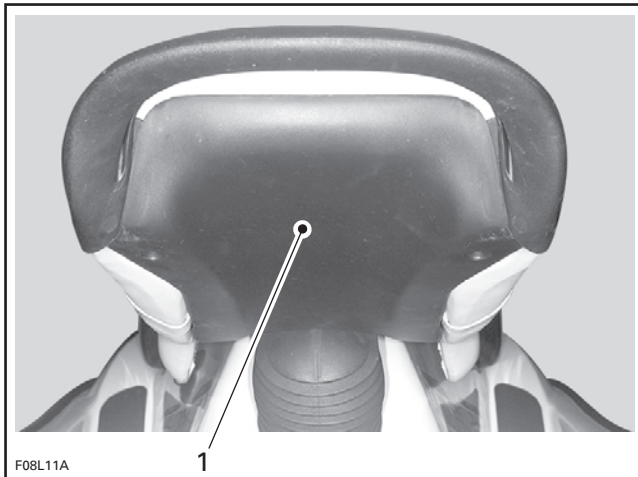


1. Drain plug
2. Silicone sealant (P/N 293 800 086) around the middle hole and in the screw holes
3. Torque screws to 1.5 N•m (13 lbf•in)

SEAT REMOVAL

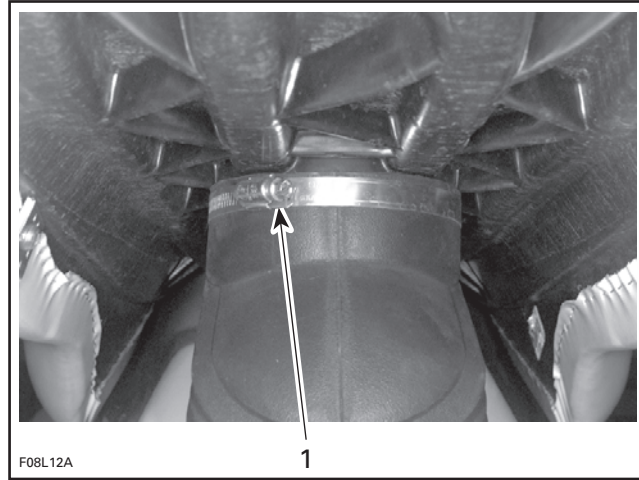
XP Models

Loosen 4 screws and remove bottom cover no. 17 of seat.



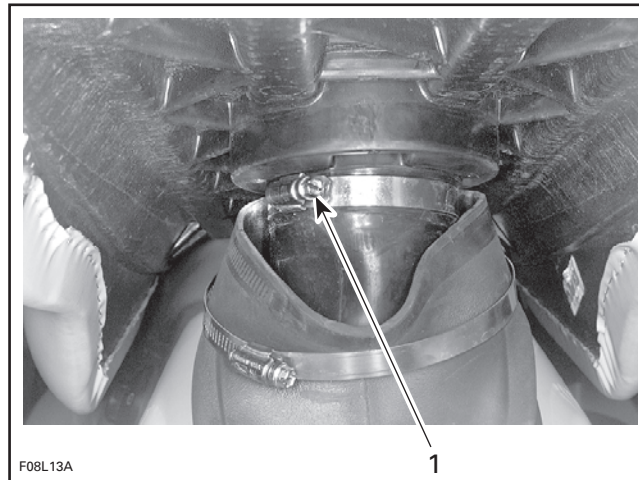
1. Remove cover

Loosen gear clamp of outer boot; then, pull outer boot downward.



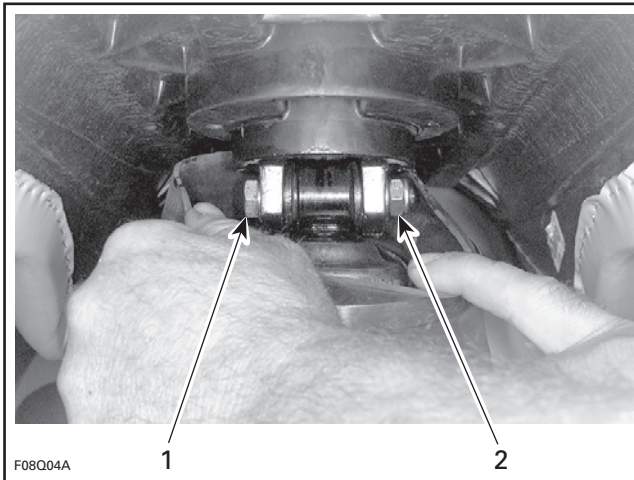
1. Loosen gear clamp

Loosen gear clamp of inner boot; then, pull boot downward.



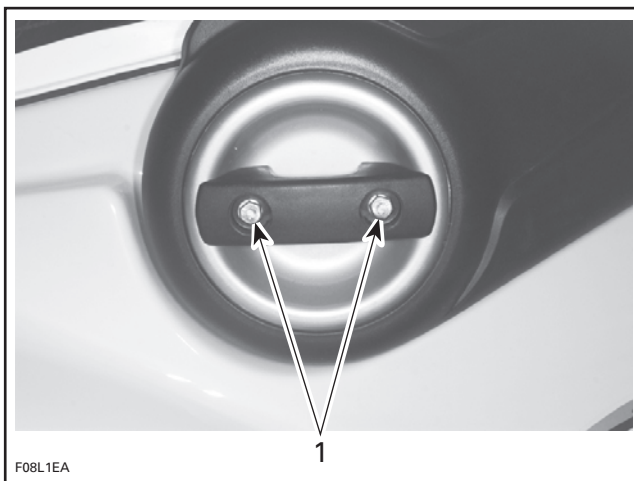
1. Gear clamp

Remove bolt and lock nut from shock absorber upper support.



1. Bolt
2. Lock nut

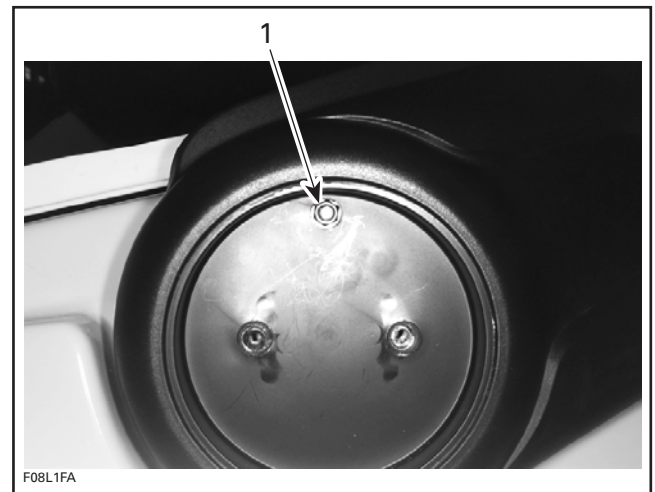
Remove protective caps no. 18 and loosen screws no. 19 to remove eyelet no. 20 on each side of seat.



1. Loosen screws of eyelet

Remove cup no. 21 on each side of seat.

Loosen nut no. 23 on each side of seat.



1. Loosen nut

Tilt seat.

Loosen screws no. 24 on each side of seat retaining the side covers.

Lower seat.

Remove side covers.

Pull seat frame out of pivots.

Remove seat.

Seat installation is essentially the reverse of removal procedure. Refer to the main illustration of seat at the beginning of this subsection for proper torque specifications and service products to be used.

SEAT COVER REPLACEMENT

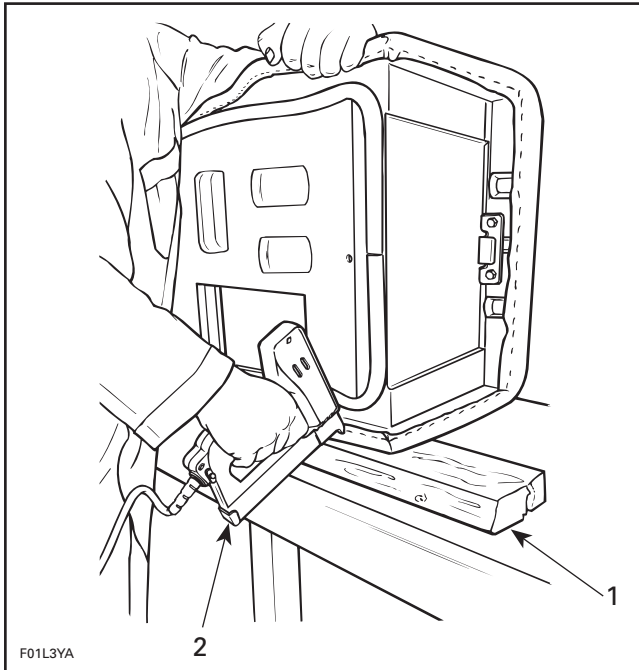
Install staples with an electric tacker such as Arrow tacker no. ETN-50 or with a manual tacker such as Arrow tacker no. T-50.

NOTE: For an easier installation, it's highly recommended to use an electric tacker.

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

Ensure that the seat rest firmly against a hard surface such as a piece of wood. This is done to get the staples completely pushed in place.



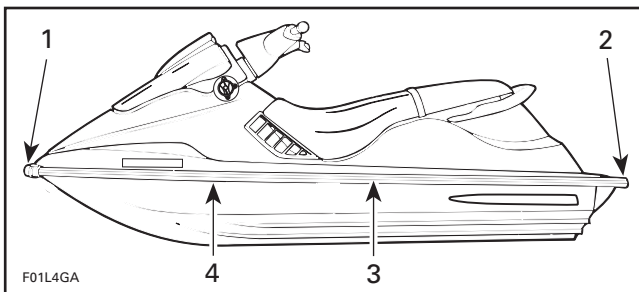
TYPICAL

1. Piece of wood
2. ETN-50 (electric) or T-50 (manual)

After cover installation cut all around the excess of material.

BUMPER REPLACEMENT

1. Remove trim no. 5 from side bumper rail no. 4.
2. Drill pop rivets no. 12 to remove side bumper rail no. 4.
3. Mark hole positions on body straight and bow sections.



TYPICAL

1. Front bumper
2. Corner bumper
3. Straight section
4. Bow section

4. Slide bumper rail no. 4 under front bumper no. 13.
5. Using a 4.80 mm (3/16 in) drill bit, drill first hole through bumper rail no. 4 at front of bow section. Use locating mark as a guide. Then install a rivet no. 12.

CAUTION: When drilling, be careful not to damage bumper rail and/or hull.

6. Position bumper rail no. 4 properly onto body and cut excess length if necessary.
7. Slide bumper rail no. 4 in corner bumper no. 14.
8. Using hole positions previously marked on body, drill holes in bumper rail no. 4 and install rivets no. 12.
9. Install trim no. 5 using soapy water.
10. Repeat procedure for the other side.

SPONSON REPLACEMENT

RX Series

Remove retaining screw from rear of sponson. Pull sponson out.

At installation, apply Loctite 271 (red) on screw threads and on sponson nut. Torque screw to 6 N•m (53 lbf•in).

WARNING

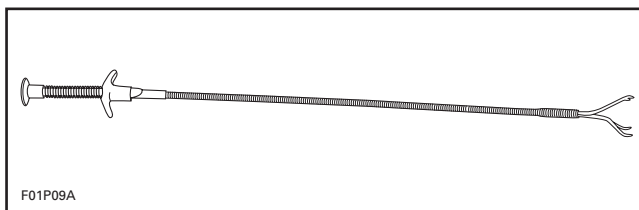
Recommended torques and use of Loctite must be strictly followed.

Other Models

Remove seat (access cover for the XP models).
Remove air vent tube support (GS models).
Remove seat support (GTI, GTS and GTX series).
Remove muffler.
Remove battery.
From inside bilge, remove lock nuts no. 10 using a 10 mm deep socket with an extension.
Remove sponsons no. 6. Clean any residues of sealant adhesive on hull.
Install gaskets no. 7 on new sponsons no. 6.
Apply silicone sealant (P/N 293 800 086) around sponson studs.
Apply Loctite 243 (blue) on sponson studs.
Install sponsons no. 6 on hull.

From inside bilge, first insert flat washers **no. 8** over sponson studs. Secure with lock nuts **no. 10**. Tighten to 5 N•m (44 lbf•in).

NOTE: To ease flat washer and lock washer installation, use a flexible 4-claw Snap-on pick-up tool.



Reinstall removed parts.

Clean hull and sponsons of any sealant adhesive surplus.

⚠ WARNING

Recommended torques and use of Loctite must be strictly followed.

ENGINE COMPARTMENT COVER REMOVAL

XP Models

Disconnect throttle and choke cables at carburetor linkage.

Disconnect wiring harnesses of start/stop button, monitoring beeper, safety lanyard switch and gauges.

Loosen bolts and nuts of hinge from watercraft body.

Disconnect the gas assist cylinder.

Remove engine compartment cover.

Engine cover installation is essentially the reverse of removal procedure. Refer to the main illustration of engine cover at the beginning of this subsection for proper torque specifications and service products to be used.

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.

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 (ex.: warning) and are used on gelcoat or metal.

Clean surface with a good solvent such as ACRYLIC-CLEAN 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

Clean surface with a good solvent such as ACRYLIC-CLEAN DX 330 from PPG or equivalent (refer to manufacturer instructions).

For best result apply an activator (P/N 293 530 036) to prepare the surface using a clean cloth. After a few seconds, when the activator evaporates, the surface is ready.

Using a pencil and the decal as a template mark the area where decal will be located.

For better adhesion a dry application is recommended, however, to ease decal installation a mild solution of soapy water can be sprayed over surface where decal will be installed.

Remove back protective film from decal and align decal with marks. When well aligned squeegee decal beginning at center and working outward using firm, short, overlapping strokes.

Remove front protective film once decal has adhered to hull.

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

INSTALLATION ON PLASTIC (storage cover)

Clean surface with isopropyl alcohol.

Using a pencil and the decal as a template, mark the area where decal will be located.

Apply an activator (P/N 293 530 036) to prepare the surface using a clean cloth. After a few seconds, when the activator evaporates, the surface is ready.

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 rowing 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 to 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 to seal off the air and protect the gelcoat surface from dust. PVA speeds up the curing process because gelcoat will not cure properly when exposed to air.

SANDING

Wash the polyvinyl alcohol off with water. Depending on the size of the area repaired, you can either block sand as per previous procedure or you may use an air sander. Sand the surface down with progressively finer grits of sandpaper until the desired finish is achieved.

BUFFING AND WAXING

Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound. Finish off using a fine compound. While buffing, pay close attention to avoid overheating the surface.

Compound Fractures

Possible causes:

- Thickness of fiberglass laminate.
- Direct result of impact.

Compound fractures are those that have gone past the gelcoated surface and in through the layers of fiberglass laminate. Two types of repairs have to be performed. The first is to restore the structural integrity of the damaged area. Fracture types can vary from a simple crack to a large hole. Usually, fiberglass reinforcement becomes necessary, especially if the fracture can be attributed to weakness. The final part of the repair is the gelcoating, which cannot be done until the interior and exterior laminate surfaces have been repaired.

Section 14 HULL/BODY

Subsection 02 (ADJUSTMENT AND REPAIR)

Outside

Remove the damaged gelcoat and fiberglass with a 24-grit disk using a power sander. Grind outward at least 2 inches from the fracture to allow the patch to bond to strong material. Cut enough pieces of fiberglass mat necessary to build up the area. The pieces should be cut so they overlap each other by at least a half inch. For a smoother finish, the last layer should be fiberglass cloth. If the fracture is small enough all you may have to do is fill the area with an epoxy filler.

Inside

For the interior repair, you can grind more. This will allow for more fiberglass material which will strengthen the area. If the fracture opening is too large after surface preparation, you may need a backing support to cover the opening. Cut alternating pieces of fiberglass mat and cloth in overlapping sizes.

PATCHING THE REPAIR AREA

Outside

The outside should be done first. Wipe clean the area with acetone on a cloth, then mask off area. For a small crack use an epoxy filler in the same way you would use gelcoat repair putty. When laying up a larger area you will use mat, cloth and fiberglass resin and hardener. Use a clean container to mix the resin, mix only what you will need. Follow the recommended catalyst ratio.

Using a clean paintbrush, brush the mixed resin on the surface. Place the smallest piece of mat over the fracture and then wet out the mat. Follow with the remaining pieces of mat and final layer of cloth. While wetting the pieces make sure you work the air bubbles out and saturate all the pieces evenly. Try to work quickly, you may only have 15 or 20 minutes. You may clean the brush with acetone.

Wait until the repair has hardened before moving on to the interior repair. If the size of the opening is too large for the pieces to maintain the proper shape, you will have to use a backing support. It is a shaped piece of cardboard that fits flush to the interior surface and has a plastic layer on the repair side. It is held in place by tape or a support.

Inside

Wipe down the area with acetone on a cloth. Apply the same procedure as for outside repair when laminating the alternating pieces of fiberglass material. If a backing support was used, remove it before starting the repair. After the area has hardened, remove sharp edges of material from surface. If required paint the surface.

SANDING

Outside

This surface will have to be prepared for application of gelcoat. The size of the area will determine the gelcoating procedure to be used. Refer to the repair procedure for minor gelcoat fractures.

BUFFING AND WAXING

Refer to the buffing and waxing for **Minor Gelcoat Fractures**.

TOOLS AND MATERIALS LIST

Tools

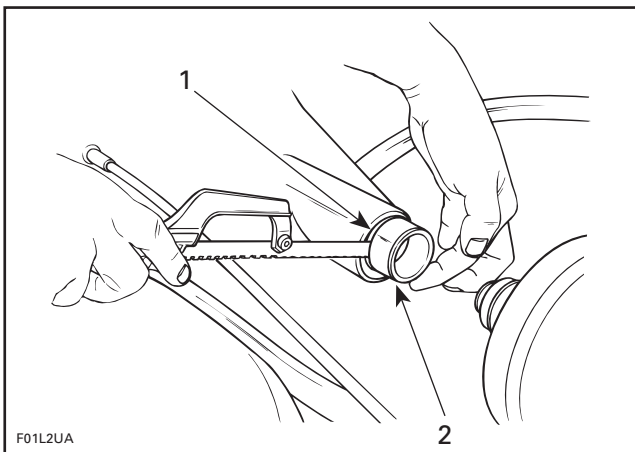
- safety glasses
- air mask
- white cloths
- sanding block
- putty knife
- plastic film
- stirring stick
- cover sheets (for Sea-Doo)
- scissors
- buffing pad
- heavy-duty polisher
- power sander
- paint brush
- plastic container (mixing)
- spray gun
- plastic squeegee.

Materials

- fiberglass mat
- fiberglass cloth
- polyester resin
- cardboard
- masking tape
- sandpaper (100-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit)
- 24-grit sanding disks
- gelcoat putty
- liquid gelcoat
- acetone
- cabosil
- epoxy filler
- medium compound (white)
- fine compound (white)
- wax.

THRU-HULL FITTING INSTALLATION

For hull insert repair proceed as follows:
Cut plastic hull insert flush with hull using a saw.

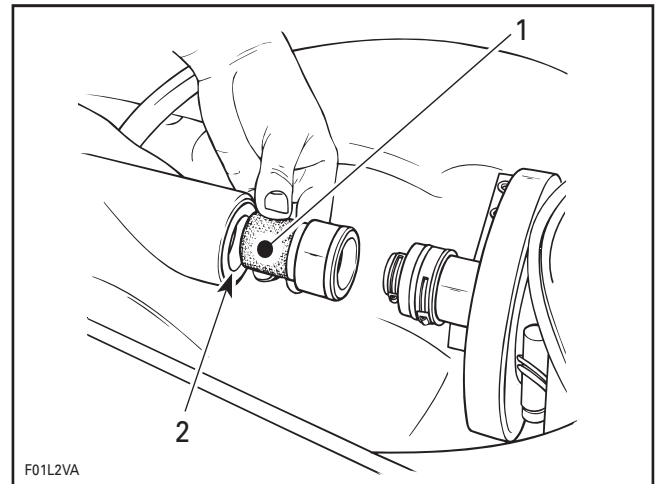


1. Hull
2. Plastic hull insert

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.

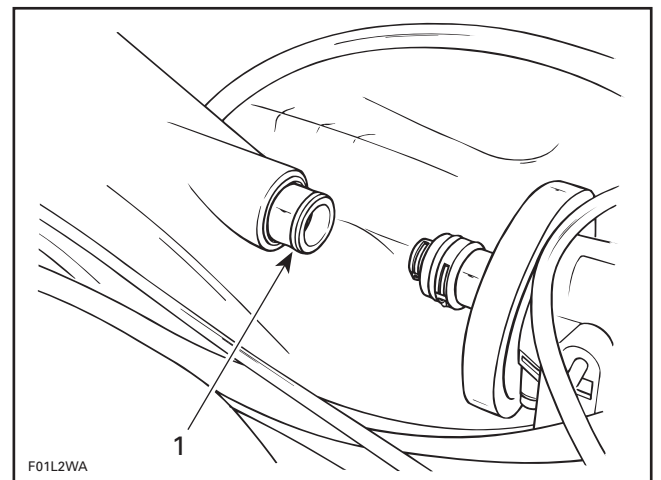
CAUTION: If you notice any clearance between plastic insert and aluminum insert, fill gap with epoxy glue to obtain good adhesion of aluminum insert.



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.

GS MODEL

ENGINE		GS
Engine type		BOMBARDIER-ROTAX 717
Induction type		Rotary valve
Exhaust system	Type	Water cooled, water injected
	Water injection fitting (head)	3.5 mm (.139 in)
	Water injection fitting (cone)	3.5 mm (.139 in)
Starting system		Electric start
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)
	Oil injection pump	Gear driven
	Oil injection type	BOMBARDIER-ROTAX
Number of cylinders		2
Bore	Standard	82 mm (3.228 in)
	First oversize	82.25 mm (3.238 in)
	Second oversize	82.50 mm (3.248 in)
Stroke		68 mm (2.677 in)
Displacement		718.2 cm ³ (43.81 in ³)
Corrected compression ratio		6.2: 1
Cylinder head volume		42.4 ± 0.4 cc
Cylinder head warpage (maximum)		0.05 mm (.002 in)
Piston ring type and quantity		1 semi-trapez — 1 rectangular
Ring end gap	New	0.25 - 0.40 mm (.010 - .016 in)
	Wear limit	1.00 mm (.039 in)
Ring/piston groove clearance	New	0.025 - 0.070 mm (.001 - .003 in)
	Wear limit	0.2 mm (.008 in)
Piston/cylinder wall clearance	New (minimum)	0.10 mm (.0039 in)
	Wear limit	0.20 mm (.008 in)
Cylinder taper	New	0.05 mm (.002 in)
	Wear limit	0.10 mm (.004 in)
Cylinder out of round	New	0.008 mm (.0003 in)
	Wear limit	0.08 mm (.003 in)
Connecting rod big end axial play	New	0.311 - 0.677 mm (.012 - .027 in)
	Wear limit	1.2 mm (.047 in)
Crankshaft deflection		MAG: 0.050 mm (.002 in); PTO: 0.030 mm (.001 in)
Rotary valve timing	Opening	147° ± 5 BTDC
	Closing	65.5° ± 5 ATDC
Rotary valve duration		159°
Rotary valve/cover clearance		0.25 - 0.35 mm (.010 - .014 in)
Connecting rod/crankshaft pin radial clearance	New	0.020 - 0.033 mm (.0008 - .0013 in)
	Wear limit	0.050 mm (.002 in)
Connecting rod/piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)
	Wear limit	0.015 mm (.00059 in)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 01 (GS MODEL)

ELECTRICAL		GS
Magneto generator output		160 W @ 6000 RPM
Ignition system type		Digital CDI
Spark plug	Make and type	NGK BR8ES
	Gap	0.4 - 0.5 mm (.016 - .0204 in)
Ignition timing (BTDC)	mm (in)	2.59 ± 0.38 (.102 ± .015)
	Degrees	20° ± 1.5 ①
Generating coil (low speed)		40 - 76 Ω
Battery charging coil		0.05 - 0.6 Ω
Trigger coil		Not applicable
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)
Fuses	MPEM	5 A
	Main electrical system	15 A
	Charging system	15 A
	VTS system	Not applicable
	Bilge pump	Not applicable
ADDITIONAL INFORMATION: ① Engine cold @ 6000 RPM.		

CARBURETION		GS
Carburetor	Type	Mikuni BN-40i diaphragm, fuel accelerator pump
	Quantity	1
Main jet		167.5
Pilot jet		75
Spring		130 g
Adjustment	Low-speed screw	1 turn ± 1/4
	High-speed screw	0
	Idle speed (in water)	1500 ± 100 RPM
	Idle speed (out of water)	3000 RPM
Fuel	Type	Regular unleaded gasoline
	Minimum octane no.	87
Fuel return line orifice		0.8 mm (.031 in)
ADDITIONAL INFORMATION:		

COOLING		GS
Type		Open circuit — Direct flow from jet propulsion unit
Thermostat		None
Monitoring beeper setting		86 - 94°C (187 - 201°F)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 01 (GS MODEL)

PROPULSION		GS
Propulsion system		BOMBARDIER Formula Pump
Jet pump type		Axial flow single stage
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Crown splines
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		139.5 mm (5.490 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 radial play		0.05 mm (.002 in)
Impeller pitch/material		Progressive pitch/stainless steel
ADDITIONAL INFORMATION: Do not mix different brands or oil types.		

DIMENSIONS		GS
Number of passenger (driver incl.)		2
Overall length		270 cm (106 in)
Overall width		116 cm (46 in)
Overall height		99 cm (39 in)
Dry weight		219 kg (483 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		159 kg (350 lb)
ADDITIONAL INFORMATION:		

CAPACITIES		GS
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	95 mL (3.21 U.S. oz)
	Oil level height	Up to plug
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 01 (GS MODEL)

MATERIALS	GS
Hull	Composite
Inlet grate	Aluminum
Impeller housing/stator/venturi/nozzle	Plastic/plastic/plastic/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	GS	
Estimated pump power	26.3 kW (35.3 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 hour 21 minutes
	Fuel tank reserve	21 minutes
ADDITIONAL INFORMATION:		

GTI AND GTS MODELS

ENGINE		GTI	GTS
Engine type		BOMBARDIER-ROTAX 717	
Induction type		Rotary valve	
Exhaust system	Type	Water cooled, water injected	
	Water injection fitting (head)	3.5 mm (.139 in)	
	Water injection fitting (cone)	3.5 mm (.139 in)	
Starting system		Electric start	
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)	
	Oil injection pump	Gear driven	
	Oil injection type	BOMBARDIER-ROTAX	
Number of cylinders		2	
Bore	Standard	82 mm (3.228 in)	
	First oversize	82.25 mm (3.238 in)	
	Second oversize	82.50 mm (3.248 in)	
Stroke		68 mm (2.677 in)	
Displacement		718.2 cm ³ (43.81 in ³)	
Corrected compression ratio		6.2: 1	
Cylinder head volume		42.4 ± 0.4 cc	
Cylinder head warpage (maximum)		0.05 mm (.002 in)	
Piston ring type and quantity		1 semi-trapez — 1 rectangular	
Ring end gap	New	0.25 - 0.40 mm (.010 - .016 in)	
	Wear limit	1.00 mm (.039 in)	
Ring/ piston groove clearance	New	0.025 - 0.070 mm (.001 - .003 in)	
	Wear limit	0.2 mm (.008 in)	
Piston/ cylinder wall clearance	New (minimum)	0.10 mm (.0039 in)	
	Wear limit	0.20 mm (.008 in)	
Cylinder taper (maximum)		0.10 mm (.004 in)	
Cylinder out of round (maximum)		0.080 mm (.003 in)	
Connecting rod big end axial play	New	0.311 - 0.677 mm (.012 - .027 in)	
	Wear limit	1.2 mm (.047 in)	
Crankshaft deflection		MAG: 0.050 mm (.002 in); PTO: 0.030 mm (.001 in)	
Rotary valve timing	Opening	147° ± 5 BTDC	
	Closing	65.5° ± 5 ATDC	
Rotary valve duration		159°	
Rotary valve/cover clearance		0.25 - 0.35 mm (.010 - .014 in)	
Connecting rod/crankshaft pin radial clearance	New	0.020 - 0.033 mm (.0008 - .0013 in)	
	Wear limit	0.050 mm (.002 in)	
Connecting rod/ piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)	
	Wear limit	0.015 mm (.00059 in)	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 02 (GTI AND GTS MODELS)

ELECTRICAL		GTI	GTS
Magneto generator output		160 W @ 6000 RPM	
Ignition system type		Digital CDI	
Spark plug	Make and type	NGK BR8ES	
	Gap	0.4 - 0.5 mm (.016 - .020 in)	
Ignition timing (BTDC)	mm (in)	2.59 (.102)	
	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	15 A	
ADDITIONAL INFORMATION: Engine cold @ 6000 RPM.			

CARBURETION		GTI	GTS
Carburetor	Type	Mikuni BN-40i diaphragm, fuel accelerator pump	
	Quantity	1	
Main jet		167.5	
Pilot jet		75	
Spring		115 g	
Adjustment	Low-speed screw	1 turn ± 1/4	
	High-speed screw	0	
	Idle speed (in water)	1500 RPM ± 100	
	Idle speed (out of water)	3000 RPM	
Fuel	Type	Regular unleaded gasoline	
	Minimum octane no.	87	
Fuel return line orifice		0.8 mm (.031 in)	
ADDITIONAL INFORMATION:			

COOLING		GTI	GTS
Type		Open circuit — Direct flow from jet propulsion unit	
Thermostat		None	
Monitoring beeper setting		86 - 94°C (187 - 201°F)	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA
Subsection 02 (GTI AND GTS MODELS)

PROPULSION		GTI	GTS
Propulsion system		BOMBARDIER Formula Pump	
Jet pump type		Axial flow single stage	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Coupling type		Crown splines	
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		155.6 mm (6.126 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/stainless steel	
ADDITIONAL INFORMATION: Do not mix different brands or oil types.			

DIMENSIONS		GTI	GTS
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		272 kg (600 lb)	
Load limit (passenger and 10 kg (22 lb) luggage)		243 kg (536 lb)	
ADDITIONAL INFORMATION:			

CAPACITIES		GTI	GTS
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	115 mL (3.88 U.S. oz)	
	Oil level height	Up to plug	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 02 (GTI AND GTS MODELS)

MATERIALS	GTI	GTS
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	GTS
Estimated pump power	25.2 kW (34 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:		

GTX RFI MODEL

ENGINE		GTX RFI
Engine type		BOMBARDIER-ROTAX 787
Induction type		Rotary valve
Exhaust system	Type	Water cooled, water injected with regulator
	Water injection fitting (head)	3.5 mm (.139 in)
	Water injection fitting (cone)	Not applicable
	Water injection fitting (muffler)	3.5 mm (.139 in)
Exhaust valve		Rotax Adjustable Variable Exhaust (RAVE)
Starting system		Electric start
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)
	Oil injection pump	Direct driven
	Oil injection type	BOMBARDIER Formula XP-S (synthetic)
Number of cylinders		2
Bore	Standard	82 mm (3.228 in)
	First oversize	82.25 mm (3.238 in)
	Second oversize	Not applicable
Stroke		74 mm (2.91 in)
Displacement		781.6 cm ³ (47.7 in ³)
Corrected compression ratio		6.0: 1
Cylinder head volume		47.7 ± 0.4 cc
Cylinder head warpage (maximum)		0.05 mm (.002 in)
Piston ring type and quantity		1 semi-trapez — 1 rectangular
Ring end gap	New	0.40 - 0.55 mm (.016 - .022 in)
	Wear limit	1.00 mm (.039 in)
Ring/piston groove	New	0.025 - 0.070 mm (.001 - .003 in)
	Wear limit	0.24 mm (.009 in)
Piston/ cylinder wall clearance	New (minimum)	0.13 mm (.005 in)
	Wear limit	0.22 mm (.009 in)
Cylinder taper (maximum)		0.10 mm (.004 in)
Cylinder out of round (maximum)		0.08 mm (.003 in)
Connecting rod big end axial play	New	0.230 - 0.617 mm (.009 - .024 in)
	Wear limit	1.2 mm (.047 in)
Crankshaft deflection		MAG: 0.050 mm (.002 in); PTO: 0.030 mm (.001 in)
Rotary valve timing	Opening	147° ± 5° BTDC
	Closing	63.5° ± 5° ATDC
Rotary valve duration		159°
Rotary valve/cover clearance		0.25 - 0.35 mm (.010 - .014 in)
Connecting rod/ crankshaft pin radial clearance	New	0.023 - 0.034 mm (.0009 - .0013 in)
	Wear limit	0.050 mm (.002 in)
Connecting rod/piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)
	Wear limit	0.015 mm (.00059 in)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 03 (GTX RFI MODEL)

ELECTRICAL SYSTEM		GTX RFI
Magneto generator output		270 W @ 6000 RPM
Ignition system type		Digital, inductive type
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° @ 6000 RPM
Battery charging coil		0.1 Ω - 1 Ω
Ignition coil	Primary	0.3 Ω \pm 0.6 Ω
	Secondary	Not applicable
Engine rev limiter setting		7200 \pm 50 RPM
Battery		12 V, 19 A•h (Yuasa/Exide)
Fuses	MPEM	5 A
	Main electrical system	20 A
	Charging system	20 A
	Battery	15 A
	VTS	Not applicable
	Info center	1 A
	Fuel pump	10 A
ADDITIONAL INFORMATION:		

FUEL SYSTEM		GTX RFI
Fuel injection type		Rotax Fuel Injection, semi-direct, single throttle body (56 mm)
Idle speed (in water)		1500 \pm 100 RPM
Throttle Position Sensor (TPS)		1.6 k Ω - 2.4 k Ω (terminals 1-2) 710 Ω - 1380 Ω (terminals 2-3)
Crankshaft Position Sensor (CPS)		774 Ω - 946 Ω
Air Temperature Sensor (ATS)		2.280 k Ω - 2.74 k Ω
Water Temperature Sensor (WTS)		2.280 k Ω - 2.74 k Ω
Air Pressure Sensor (APS)		3.4 k Ω and 8.2 k Ω (terminals 9-2) 2.4 k Ω and 8.2 k Ω (terminals 1-2)
RAVE solenoid		30 Ω
Fuel injector		2.3 Ω - 2.5 Ω
Fuel	Type	Regular unleaded gasoline
	Minimum octane no.	87
ADDITIONAL INFORMATION:		

COOLING		GTX RFI
Type		Open circuit — Direct flow from jet propulsion unit
Thermostat		None
Monitoring beeper setting		86 - 94°C (187 - 201°F)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA
Subsection 03 (GTX RFI MODEL)

PROPULSION		GTX RFI
Propulsion system		BOMBARDIER Formula Pump
Jet pump type		Axial flow single stage
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Crown splines
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		139.5 mm (5.490 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/stainless steel
ADDITIONAL INFORMATION: Do not mix different brands or oil types.		

DIMENSIONS		GTX RFI
Number of passenger (driver incl.)		3
Overall length		315 cm (124 in)
Overall width		122 cm (48 in)
Overall height		104 cm (41 in)
Dry weight		292 kg (644 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		243 kg (536 lb)
ADDITIONAL INFORMATION:		

CAPACITIES		GTX RFI
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	95 mL (3.21 U.S. oz)
	Oil level height	Up to plug
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 03 (GTX RFI MODEL)

MATERIALS	GTX RFI
Hull	Composite
Inlet grate	Aluminum
Impeller housing/stator/venturi/nozzle	Plastic/plastic/plastic/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	GTX RFI
Estimated pump output	30.6 kW (41 HP)
Maximum fuel consumption at wide open throttle	41.5 L/h (11 U.S. gal/h)
Cruising time at full throttle	1 hour 20 minutes
ADDITIONAL INFORMATION:	

XP MODEL

ENGINE		XP
Engine type		BOMBARDIER-ROTAX 947
Induction type		Reed valve
Exhaust system	Type	Water cooled, water injected with regulator
	Water injection fitting (head)	3.5 mm (.139 in)
	Water injection fitting (cone)	Not applicable
	Water injection fitting (muffler)	3.5 mm (.139 in)
Exhaust valve		Rotax Adjustable Variable Exhaust (RAVE)
Starting system		Electric start
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)
	Oil injection pump	Direct driven
	Oil injection type	BOMBARDIER Formula XP-S (synthetic)
Number of cylinders		2
Bore	Standard	88 mm (3.465 in)
	First oversize	88.25 mm (3.474 in)
	Second oversize	Not applicable
Stroke		78.20 mm (3.079 in)
Displacement		951.2 cm ³ (58 in ³)
Corrected compression ratio		6.1: 1
Cylinder head volume		51.8 ± 0.6 cc
Cylinder head warpage (maximum)		0.10 mm (.0039 in) total
Piston ring type and quantity		2 semi-trapez
Ring end gap	New	0.45 - 0.60 mm (.018 - .024 in)
	Wear limit	1.00 mm (.039 in)
Ring piston groove	New	0.048 - 0.075 mm (.002 - .003 in)
	Wear limit	0.2 mm (.008 in)
Piston/ cylinder wall clearance	New (minimum)	0.09 mm (.0035 in)
	Wear limit	0.20 mm (.008 in)
Cylinder taper (maximum)		0.10 mm (.004 in)
Cylinder out of round (maximum)		0.08 mm (.003 in)
Connecting rod big end axial play	New	0.390 - 0.737 mm (.015 - .029 in)
	Wear limit	1.2 mm (.047 in)
Crankshaft deflection		MAG: 0.050 mm (.002 in); PTO: 0.030 mm (.001 in)
Rotary valve timing	Opening	Not applicable
	Closing	Not applicable
Rotary valve duration		Not applicable
Rotary valve/cover clearance		Not applicable
Connecting rod/crankshaft pin radial clearance	New	0.017 - 0.034 mm (.0006 - .0013 in)
	Wear limit	0.050 mm (.002 in)
Connecting rod/ piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)
	Wear limit	0.015 mm (.00059 in)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 04 (XP MODEL)

ELECTRICAL		XP
Magneto generator output		180 W @ 6000 RPM
Ignition system type		Digital DC-CDI
Spark plug	Make and type	NGK BR8ES
	Gap	0.4 - 0.5 mm (.016 - .020 in)
Ignition timing (BTDC)	mm (in)	2.99 (.118)
	Degrees	20° ± 1 @ 3500 RPM
Battery charging coil		0.1 - 1 Ω
Trigger coil		190 - 300 Ω
Ignition coil	Primary	0.33 - 0.62 Ω
	Secondary	8.4 - 15.6 k Ω
Engine rev limiter setting		7200 ± 50 RPM
Battery		12 V, 19 A•h (Yuasa/Exide)
Fuses	MPEM	5 A
	Main electrical system	15 A
	Charging system	15 A
	VTS system	7.5 A
	Bilge pump	3 A
ADDITIONAL INFORMATION:		

CARBURETION		XP
Carburetor	Type	Mikuni BN-46i (diaphragm), fuel accelerator pump
	Quantity	2
Main jet		MAG and PTO: 162.5
Pilot jet		75
Spring		95 g
Adjustment	Low-speed screw	1-1/2 turn ± 1/4
	High-speed screw	0
	Idle speed (in water)	1400 ± 100 RPM
	Idle speed (out of water)	3000 RPM
Fuel	Type	Regular unleaded gasoline
	Minimum octane no.	87
Fuel return line orifice		MAG and PTO: 0.8 mm (.031 in)
ADDITIONAL INFORMATION:		

COOLING		XP
Type		Open circuit — Direct flow from jet propulsion unit
Thermostat		None
Monitoring beeper setting		86 - 94°C (187 - 201°F)
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 04 (XP MODEL)

PROPULSION		XP
Propulsion system		BOMBARDIER Formula Pump
Jet pump type		Axial flow single stage
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Split FR and RR
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		155.6 mm (6.126 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/stainless steel
ADDITIONAL INFORMATION: Do not mix different brands or oil types.		

DIMENSIONS		XP
Number of passenger (driver incl.)		2
Overall length		272 cm (107 in)
Overall width		112 cm (44 in)
Overall height		104 cm (41 in)
Dry weight		255 kg (562 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		159 kg (350 lb)
ADDITIONAL INFORMATION:		

CAPACITIES		XP
Fuel tank (including reserve)		54 L (14 U.S. gal)
Fuel tank reserve		10 L (2.6 U.S. gal)
Oil injection reservoir		4 L (1.1 U.S. gal)
Jet pump impeller shaft reservoir	Capacity	115 mL (3.88 U.S. oz)
	Oil level height	Up to plug
ADDITIONAL INFORMATION:		

Section 15 TECHNICAL DATA

Subsection 04 (XP MODEL)

MATERIALS	XP
Hull	Composite
Inlet grate	Aluminum
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum
Air intake silencer	Thermoplastic
Flame arrester	Tubular wire screen
Steering padding	Thermoplastic
Fuel tank	Polyethylene
Oil injection reservoir	Polyethylene
Seat	Polyurethane foam
ADDITIONAL INFORMATION:	

PERFORMANCE	XP	
Estimated pump output	53.1 kW (71.1 HP)	
Maximum fuel consumption at wide open throttle	55 L/h (14.5 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	48 minutes
	Fuel tank reserve	11 minutes
ADDITIONAL INFORMATION:		

GTX AND RX MODELS

ENGINE		GTX	RX
Engine type		BOMBARDIER-ROTAX 947	
Induction type		Reed valve	
Exhaust system	Type	Water cooled, water injected with regulator	
	Water injection fitting (head)	3.5 mm (.139 in)	3 mm (.118 in)
	Water injection fitting (cone)	Not applicable	
	Water injection fitting (muffler)	3.5 mm (.139 in)	
Exhaust valve		Rotax Adjustable Variable Exhaust (RAVE)	
Starting system		Electric start	
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)	
	Oil injection pump	Direct driven	
	Oil injection type	FORMULA XP-S (synthetic)	
Number of cylinders		2	
Bore	Standard	88 mm (3.465 in)	
	First oversize	88.25 mm (3.474 in)	
	Second oversize	Not applicable	
Stroke		78.20 mm (3.079 in)	
Displacement		951.2 cm ³ (58 in ³)	
Corrected compression ratio		6.1: 1	
Cylinder head volume		51.8 ± 0.6 cc	
Cylinder head warpage (maximum)		0.10 mm (.0039 in) total	
Piston ring type and quantity		2 semi-trapez	
Ring end gap	New	0.45 - 0.60 mm (.018 - .024 in)	
	Wear limit	1.00 mm (.039 in)	
Ring piston groove	New	0.048 - 0.075 mm (.002 - .003 in)	
	Wear limit	0.2 mm (.008 in)	
Piston/cylinder wall clearance	New (minimum)	0.09 mm (.0035 in)	
	Wear limit	0.20 mm (.008 in)	
Cylinder taper (maximum)		0.10 mm (.004 in)	
Cylinder out of round (maximum)		0.08 mm (.003 in)	
Connecting rod big end axial play	New	0.390 - 0.737 mm (.015 - .029 in)	
	Wear limit	1.2 mm (.047 in)	
Crankshaft deflection		MAG side: 0.050 mm (.002 in); PTO side: 0.030 mm (.001 in)	
Rotary valve timing	Opening	Not applicable	
	Closing	Not applicable	
Rotary valve duration		Not applicable	
Rotary valve/cover clearance		Not applicable	
Connecting rod/crankshaft pin radial clearance	New	0.017 - 0.034 mm (.0006 - .0013 in)	
	Wear limit	0.050 mm (.002 in)	
Connecting rod/piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)	
	Wear limit	0.015 mm (.00059 in)	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 05 (GTX AND RX MODELS)

ELECTRICAL		GTX	RX
Magneto generator output		180 W @ 6000 RPM	
Ignition system type		Digital DC-CDI	
Spark plug	Make and type	NGK BR8ES	
	Gap	0.4 - 0.5 mm (.016 - .020 in)	
Ignition timing (BTDC)	mm (in)	2.99 (.118)	
	Degrees	20° ± 1 @ 3500 RPM	
Battery charging coil		0.1 - 1 Ω	
Trigger coil		190 - 300 Ω	
Ignition coil	Primary	0.33 - 0.62 Ω	
	Secondary	8.4 - 15.6 k Ω	
Engine rev limiter setting		7200 (± 50) RPM	
Battery		12 V, 19 A•h (Yuasa/Exide)	
Fuses	MPEM	5 A	
	Main electrical system	15 A	
	VTS system	Not Applicable	7.5 A
	Charging system	15 A	
ADDITIONAL INFORMATION:			

CARBURETION		GTX	RX
Carburetor	Type	Mikuni BN-46i (diaphragm), fuel accelerator pump	
	Quantity	2	
Main jet		MAG and PTO: 162.5	
Pilot jet		75	
Spring		95 g	
Adjustment	Low-speed screw	1-1/2 turn ± 1/4	
	High-speed screw	0	
	Idle speed (in water)	1400 ± 100 RPM	
	Idle speed (out of water)	3000 RPM	
Fuel	Type	Regular unleaded gasoline	
	Minimum octane no.	87	
Fuel return line orifice		MAG and PTO: 0.8 mm (.031 in)	
ADDITIONAL INFORMATION:			

COOLING		GTX	RX
Type		Open circuit — Direct flow from jet propulsion unit	
Thermostat		None	
Monitoring beeper setting		86 - 94°C (187 - 201°F)	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA
Subsection 05 (GTX AND RX MODELS)

PROPULSION		GTX	RX
Propulsion system		BOMBARDIER Formula Pump	
Jet pump type		Axial flow single stage	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		155.6 mm (6.126 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/stainless steel	
ADDITIONAL INFORMATION: Do not mix different brands or oil types.			

DIMENSIONS		GTX	RX
Number of passenger (driver incl.)		3	2
Overall length		315 cm (124 in)	285 cm (112 in)
Overall width		122 cm (48 in)	120 cm (47 in)
Overall height		104 cm (41 in)	
Dry weight		301 kg (664 lb)	275 kg (606 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		243 kg (536 lb)	181 kg (400 lb)
ADDITIONAL INFORMATION:			

CAPACITIES		GTX	RX
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	115 mL (3.88 U.S. oz)	
	Oil level height	Up to plug	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 05 (GTX AND RX MODELS)

MATERIALS	GTX	RX
Hull	Composite	
Inlet grate	Aluminum	
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum	
Air intake silencer	Thermoplastic	
Flame arrester	Tubular wire screen	
Steering padding	Thermoplastic	
Fuel tank	Polyethylene	
Oil injection reservoir	Polyethylene	
Seat	Polyurethane foam	
ADDITIONAL INFORMATION:		

PERFORMANCE	GTX	RX
Estimated pump output	51 kW (68 HP)	
Maximum fuel consumption at wide open throttle	55 L/h (14.5 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	48 minutes
	Fuel tank reserve	11 minutes
ADDITIONAL INFORMATION:		

RX DI AND GTX DI MODELS

ENGINE		RX DI	GTX DI
Engine type		BOMBARDIER-ROTAX 947 DI, 2-stroke	
Induction type		Reed valve	
Exhaust system	Type	Water cooled, water injected with regulator	
	Water injection fitting (head)	3.5 mm (.139 in)	
	Water injection fitting (cone)	Not applicable	
	Water injection fitting (muffler)	3 mm (.118 in)	
Exhaust valve		RAVE	
Starting system		Electric start	
Lubrication	Fuel/oil mixture	VROI (Variable Rate Oil Injection)	
	Oil injection pump	Direct driven	
	Oil injection type	BOMBARDIER Formula XP-S DI (synthetic DI injection oil only)	
Number of cylinders		2	
Bore	Standard	88 mm (3.465 in)	
	First oversize	88.25 mm (3.474 in)	
	Second oversize	Not applicable	
Stroke		78.20 mm (3.079 in)	
Displacement		951.2 cm ³ (58 in ³)	
Corrected compression ratio		6.1: 1	
Cylinder head volume		51.4 ± 0.6 cc	
Cylinder head warpage (maximum)		0.10 mm (.004 in) total	
Piston ring type and quantity		2 semi-trapez chrome coated steel rings	
Ring end gap	New	0.55 - 0.7 mm (.022 - .028 in)	
	Wear limit	1.1 mm (.043 in)	
Ring/ piston groove clearance	New	0.044 - 0.089 mm (.002 - .003 in)	
	Wear limit	0.2 mm (.008 in)	
Piston/ cylinder wall clearance	New (minimum)	0.12 mm (.0047 in)	
	Wear limit	0.20 mm (.008 in)	
Cylinder taper (maximum)		0.10 mm (.004 in)	
Cylinder out of round (maximum)		0.08 mm (.003 in)	
Connecting rod big end axial play	New	0.390 - 0.737 mm (.015 - .029 in)	
	Wear limit	1.2 mm (.047 in)	
Crankshaft deflection		MAG side: 0.050 mm (.002 in); PTO side: 0.030 mm (.001 in)	
Rotary valve timing	Opening	Not applicable	
	Closing	Not applicable	
Rotary valve duration		Not applicable	
Rotary valve/cover clearance		Not applicable	
Connecting rod/ crankshaft pin radial clearance	New	0.017 - 0.034 mm (.0006 - .0013 in)	
	Wear limit	0.050 mm (.002 in)	
Connecting rod/piston pin radial clearance	New	0.001 - 0.014 mm (.000039 - .00055 in)	
	Wear limit	0.017 mm (.00067 in)	
Air compressor	Type	Piston	
	Displacement	43 cm ³ (2.6 in ³)	
	Drive	Balancing shaft	
	Intake side	Reed valves	
	Exhaust side	Reed valves	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 06 (RX DI AND GTX DI MODELS)

ELECTRICAL		RX DI	GTX DI
Magneto generator output		270 W @ 6000 RPM	
Ignition system type		Digital Inductive	
Spark plug	Make and type	NGK ZFR4F	
	Gap	1.1 mm (.04 in)	
TDC setting (BTDC)	mm (in)	5.39 mm (.212 in) (direct) measured through direct injector hole 7.87 (.310) (indirect) measured through spark plug hole	
	Degrees	27 @ at idle speed (locked)	
Generating coil		190 - 300 Ω	
Battery charging coil		0.1 - 1 Ω	
Trigger coil		Not applicable	
Ignition coil	Primary	0.45 - 0.55 Ω	
	Secondary	6.8 - 10.2 k Ω without high tension leads	
Engine rev limiter setting		7200 (\pm 50) RPM	
Battery		12 V, 19 A•h (Yuasa/Exide)	
Fuses	Main	30 A	
	Injection system (INJ)	15 A	
	Charging system (REG)	25 A	
	Information center (ACC)	2 A	
	Fuel pump (FP)	15 A	
	VTS system (VTS)	7.5 A	Not applicable
ADDITIONAL INFORMATION:			

FUEL SYSTEM		RX DI	GTX DI
Fuel injection type		Orbital Direct Fuel Injection, twin throttle body (46 mm (1.81 in))	
Idle speed (in water/out of water)		1450 \pm 50 RPM	
Throttle Position Sensor (TPS)		1.6 k Ω - 2.4 k Ω	
Crankshaft Position Sensor (CPS)		5 Volts	
Manifold Air Temperature Sensor (MATS)		2.28 k Ω - 2.74 k Ω	
Water Temperature Sensor (WTS)		2.28 k Ω - 2.74 k Ω	
Exhaust Gas Temperature Sensor (EGT)		2.28 k Ω - 2.74 k Ω	
Manifold Air Pressure Sensor (MAPS)		0 Ω (continuity between terminals 3 and 1)	
Knock Sensor (KS)		5 M Ω	
RAVE solenoid		24 Ω	
Fuel injector		1.7 Ω - 1.9 Ω	
Direct injector		1.0 Ω - 1.6 Ω	
Fuel	Type	Super unleaded gasoline	
	Minimum octane no.	91	
ADDITIONAL INFORMATION:			

COOLING		RX DI	GTX DI
Type		Open circuit — Direct flow from jet propulsion unit	
Thermostat		None	
Monitoring beeper setting		86 - 94°C (187 - 201°F)	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA
Subsection 06 (RX DI AND GTX DI MODELS)

PROPULSION		RX DI	GTX DI
Propulsion system		BOMBARDIER Formula Pump	
Jet pump type		Axial flow single stage	
Impeller rotation (seen from rear)		Counterclockwise	
Transmission		Direct drive	
Coupling type		Crown splines	
Oil type		SEA-DOO JET PUMP SYNTHETIC POLYOLESTER OIL 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		155.6 mm (6.126 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/stainless steel	
ADDITIONAL INFORMATION: Do not mix different brands or oil types.			

DIMENSIONS		RX DI	GTX DI
Number of passenger (driver incl.)		2	3
Overall length		285 cm (112 in)	315 cm (124 in)
Overall width		120 cm (47 in)	122 cm (48 in)
Overall height		104 cm (41 in)	104 cm (41 in)
Dry weight		285 kg (628 lb)	309 kg (681 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		181 kg (400 lb)	243 kg (536 lb)
ADDITIONAL INFORMATION:			

CAPACITIES		RX DI	GTX DI
Fuel tank (including reserve)		56.5 L (15 U.S. gal)	
Fuel tank reserve (from low level signal)		9.8 L (2.6 U.S. gal)	
Oil injection reservoir		6 L (1.6 U.S. gal)	
Jet pump impeller shaft reservoir	Capacity	115 mL (3.88 U.S. oz)	
	Oil level height	Up to plug	
ADDITIONAL INFORMATION:			

Section 15 TECHNICAL DATA

Subsection 06 (RX DI AND GTX DI MODELS)

MATERIALS	RX DI	GTX DI
Hull	Composite	
Inlet grate	Aluminum	
Impeller housing/stator/venturi/nozzle	Plastic/plastic/aluminum/aluminum	
Air intake silencer	Thermoplastic	
Flame arrester	Tubular wire screen	
Steering padding	Thermoplastic	
Fuel tank	Polyethylene	
Oil injection reservoir	Polyethylene	
Seat	Polyurethane foam	
ADDITIONAL INFORMATION:		

PERFORMANCE	RX DI	GTX DI
Estimated pump power	50.2 kW (67.3 HP)	
Maximum fuel consumption at wide open throttle	47 L/h (12.4 U.S. gal/h)	
Cruising time at full throttle	Fuel tank without reserve	60 minute
	Fuel tank reserve (from low level signal)	12 minutes
ADDITIONAL INFORMATION:		

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.

WIRE DIGIT CODES

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.

Example: 2-18 (g)

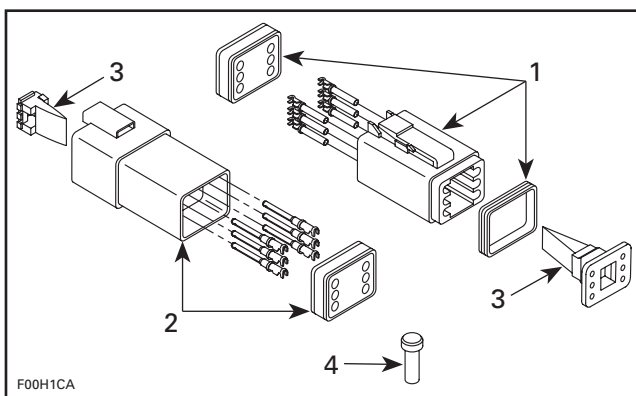
The first number indicates that the wire is positioned in the connector **no. 2** of the MPEM.

The second number indicates that the wire is positioned in the terminal **no. 18**.

The letter (g) indicates a common circuit with another wire(s) bearing the same letter (g) in the circuit.

DEUTSCH CONNECTORS

Deutsch connectors are used to connect wiring harness to magneto, and to electrical box (**some models**) and to the VCK on **DI Models**.

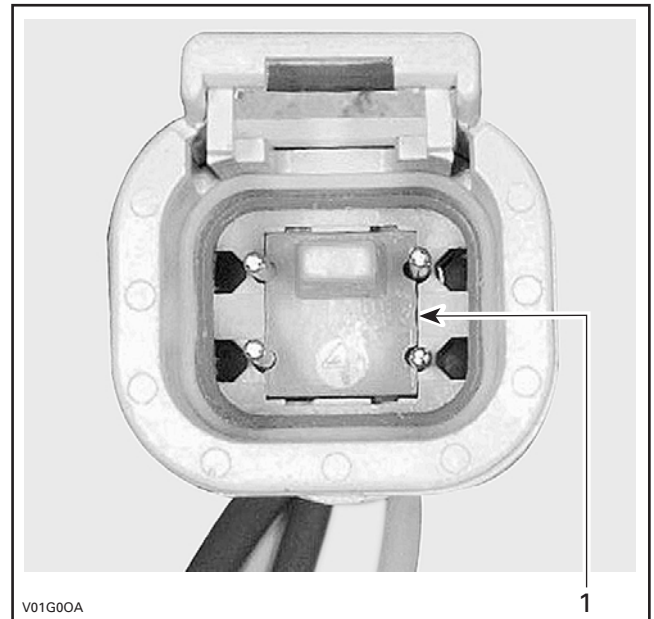


1. Male housing
2. Female housing
3. Secondary lock
4. Sealing cap

CAUTION: Do not apply dielectric grease on contacts inside plug connector.

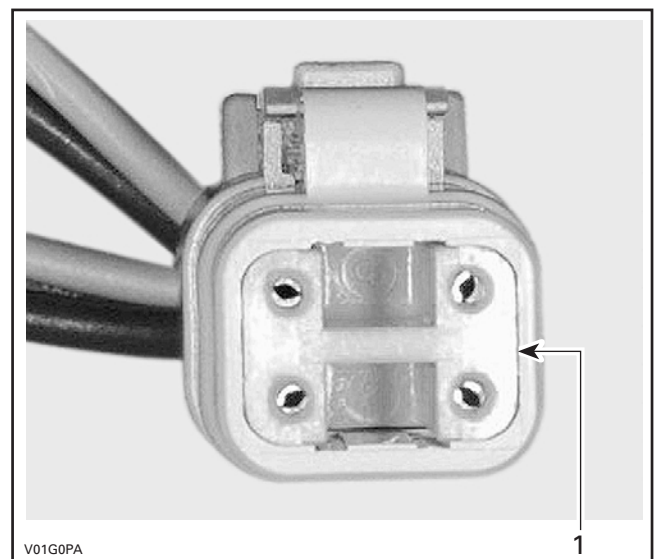
To remove wire contacts from housing, proceed as follows:

- Using a long nose pliers, pull out the lock.



FEMALE HOUSING

1. Female lock



MALE HOUSING

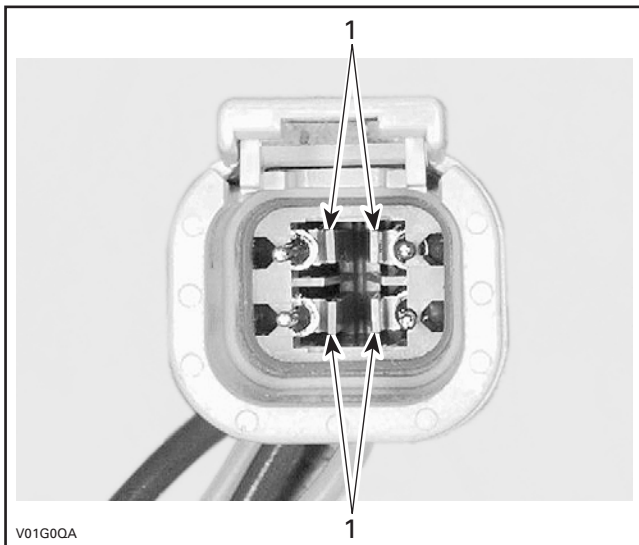
1. Male lock

Section 16 WIRING DIAGRAMS

Subsection 01 (WIRING DIAGRAMS)

NOTE: Before extraction, push wire forward to relieve pressure on retaining tab.

- Insert a 4.8 mm (0.189 in) wide screwdriver blade inside the front of the contact cavity.
- Pry back the retaining tab while gently pulling wire back until contact is removed.

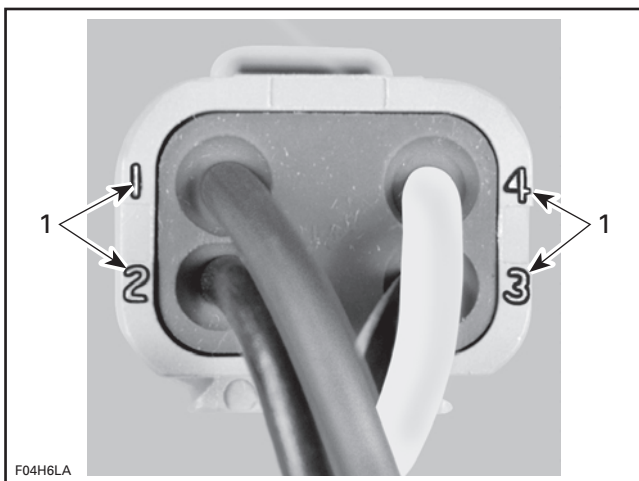


FEMALE CONNECTOR HOUSING

1. Retaining tab

To install:

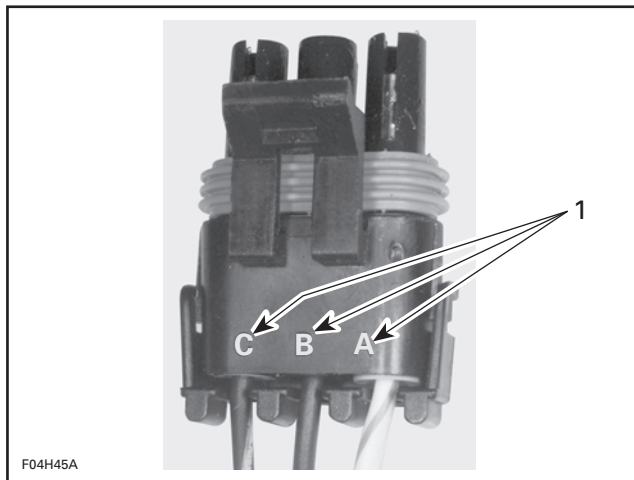
- For insertion of signal contact, make sure the lock is removed.
- Insert contact into appropriate circuit cavity and push as far as it will go.
- Pull back on the contact wire to be sure the retention fingers are holding the contact.
- After all required contacts have been inserted, the lock must be installed.



1. Wire identification numbers

PACKARD CONNECTOR

Packard connectors are used to connect electrical harnesses and gauges.

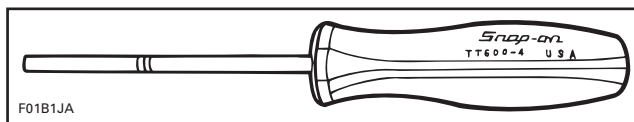


F04H45A

VIEW OF A 3-POSITION PACKARD CONNECTOR

1. Identification letters

To remove terminal from Packard connector housing, use Snap-on TT600-4 tool.



F01B1JA

⚠ WARNING

Ensure all terminals are properly crimped on wires and connector housings are properly fastened.

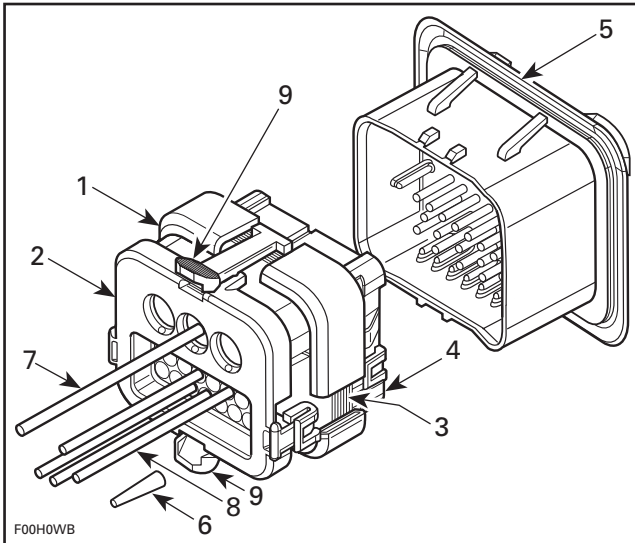
AMP PLUG CONNECTOR

All Models except GTS

These connectors are found on the MPEM.

When servicing electrical system, special care must be taken when working with AMP Plug Connectors in order to prevent any malfunction of the system.

Description

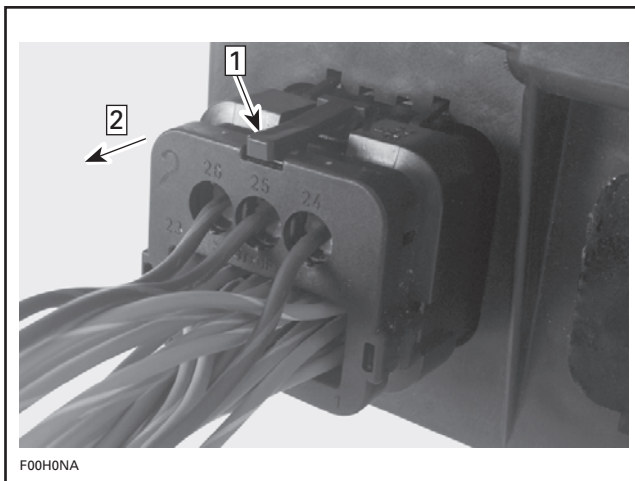


AMP PLUG CONNECTOR

- 1. Plug assembly
- 2. Cover assembly
- 3. Mating seal
- 4. Wedge lock
- 5. Header assembly
- 6. Seal plug
- 7. Power wire
- 8. Signal wire
- 9. Locking tab

Removal

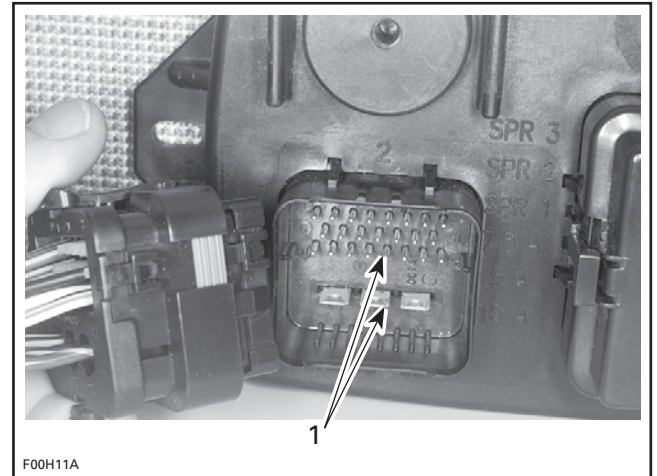
To remove the plug connector from the header assembly, press both tabs and pull plug.



- Step 1: Press tabs (both sides)
- Step 2: Pull plug

Installation

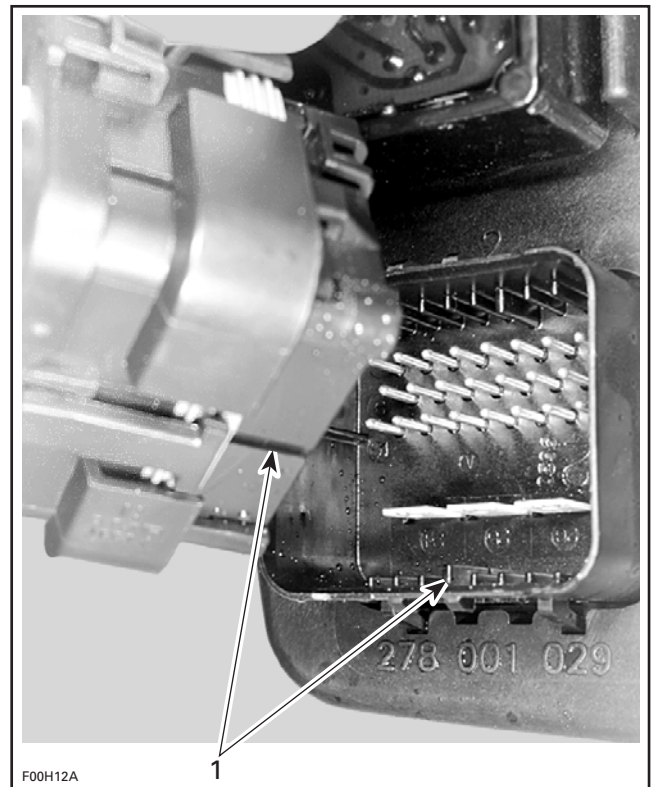
Apply a thin coat of DEOXIT contact lubricant (P/N 293 550 015) to the pins of the header on the MPEM only.



- 1. Apply a thin coat of DEOXIT contact lubricant

CAUTION: Do not apply lubricant excessively. Care must be taken so that the lubricant will not come in contact with the mating seal; the seal may lose its sealing capacities. Do not apply lubricant on contacts inside plug connector.

Each plug assembly is mechanically keyed to mate only with identical mechanical keyed header on the MPEM.



- 1. Mechanically keyed

Section 16 WIRING DIAGRAMS

Subsection 01 (WIRING DIAGRAMS)

Contact 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 open the wedge lock to open position.

CAUTION: The wedge lock should never be removed from the connector for insertion or removal of the signal wire contacts.

While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.



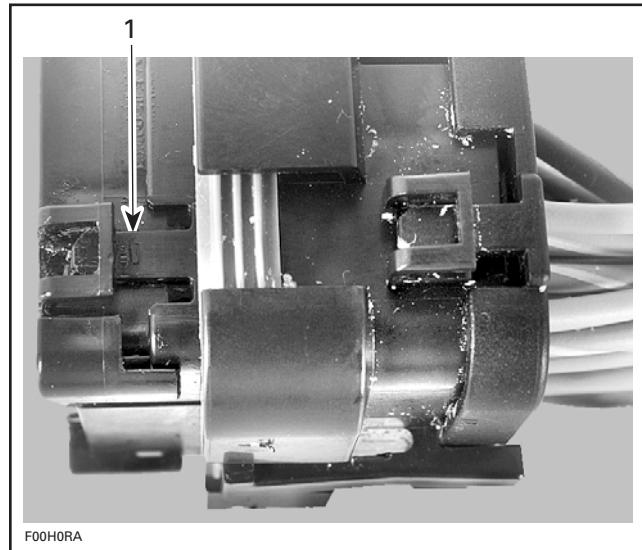
1. Rotate wire back and forth
2. Pull wire

POWER WIRE CONTACT

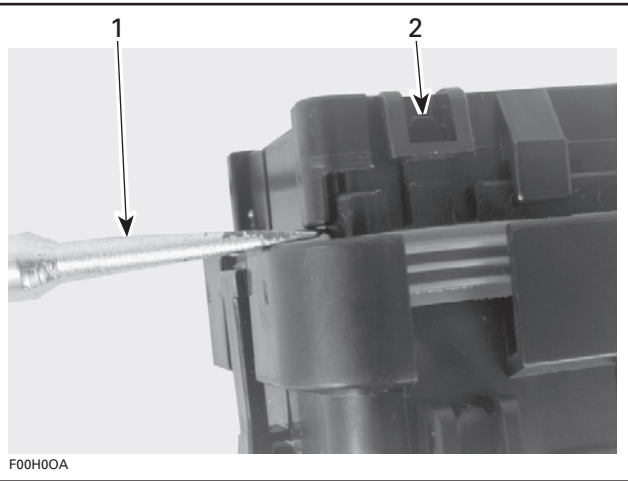
NOTE: The wedge lock must be removed to extract power contact.

Open the wedge lock.

Pull both locking tabs and remove wedge lock from plug assembly.



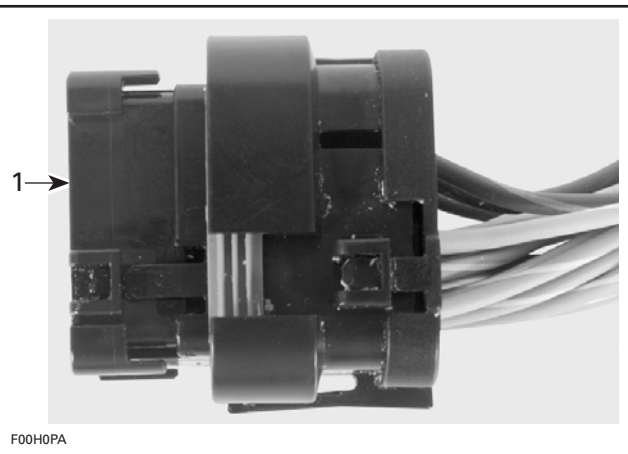
1. Pull locking tab (both sides)



1. Screwdriver between wedge lock and connector
2. Locking tab

Repeat the same steps for the other locking tab retaining the wedge lock.

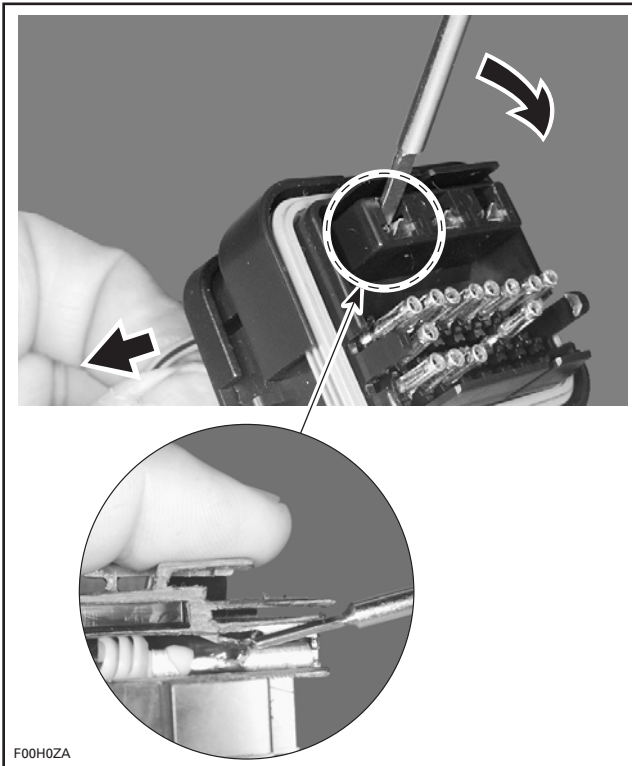
The wedge lock is now in the open position.



1. Wedge lock opened

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 contact cavity.



Pry back the retaining tab while gently pulling wire back until contact is removed.

Contact Crimping

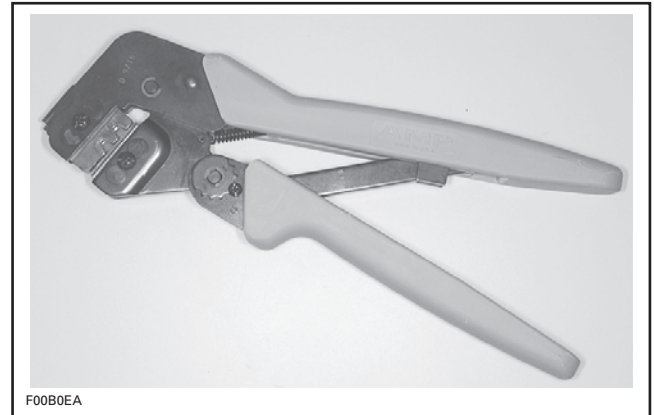
The size of the wires must be 20 to 16 AWG with a wire insulation diameter having a minimum dimension of 1.7 mm (.067 in) and a maximum dimension of 2.78 mm (.106 in).

The wire strip length shall 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 contact must be smooth.

All contacts in AMP plug connectors must be crimped using the crimping tool (P/N 295 100 164).

CAUTION: If contacts are not crimped using the proper crimping tool, the wire seal may be damaged.

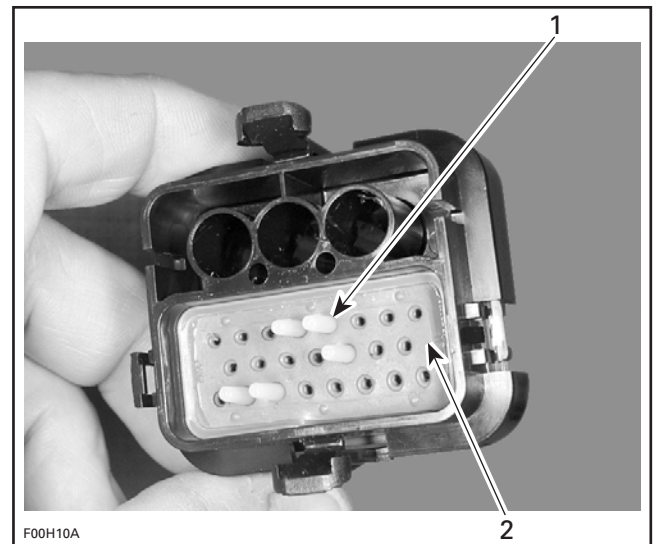


CRIMPING TOOL (P/N 295 100 164)

All circuits are sealed by a diaphragm in the rubber wire seal. When installing wire contacts in plug connector, the diaphragm is pierced as the contact 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 for electrical troubleshooting. The resulting pinholes in the insulation will allow moisture to penetrate the system and possibly result in system failure.

Section 16 WIRING DIAGRAMS

Subsection 01 (WIRING DIAGRAMS)

Contact Installation

For insertion of signal contact, make sure the wedge lock is in the open position.

NOTE: For insertion of power contact, the wedge lock may or may not be on the open position.

Insert contact into appropriate circuit cavity and push as far as it will go.

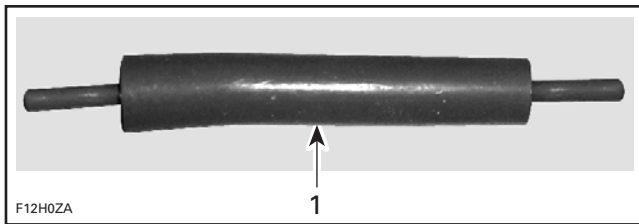
Pull back on the contact wire to be sure the retention fingers in the housing are holding the contact properly.

After all required contacts have been inserted, the wedge lock must be closed to its **locked** position.

MAIN FUSE HOLDER JOINT CONNECTOR

DI Models

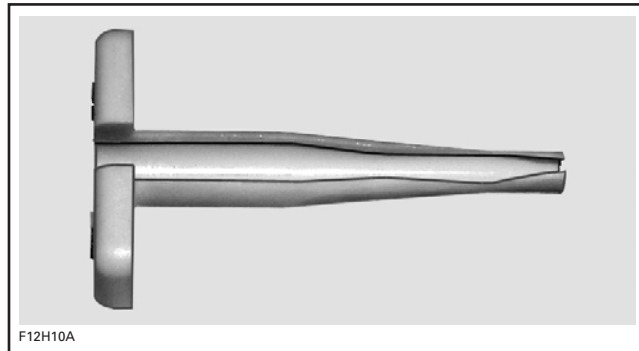
The fuse holder is located in the rear electrical box.



1. Main fuse holder joint connector

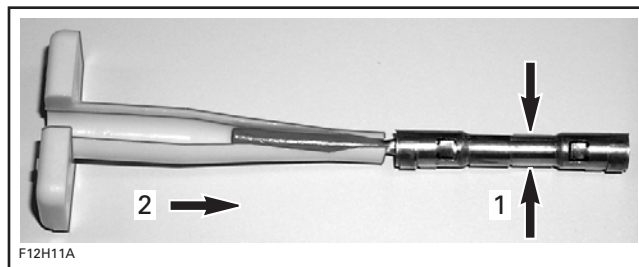
NOTE: In the following illustrations, the joint insulator has been removed for clarity purpose only. It is not necessary to remove it to separate the joint. The same procedure is to be used each side of the joint.

Insert the Deutsch joint connector tool (no. 114010) on the wire and push tool toward the joint to release it. While holding the joint insulator, push the tool until it bottoms. It is now unlocked. Maintaining the pressure with the tool, pull the wire out.



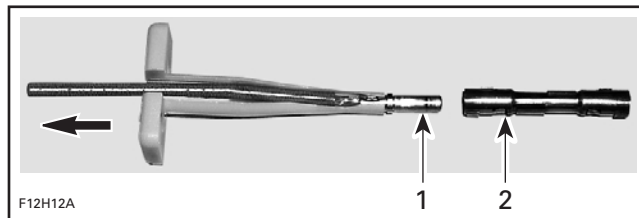
F12H10A

1. Deutsch joint connector tool (no. 114010)



F12H11A

1. Hold the insulator
2. Push the tool until it bottoms

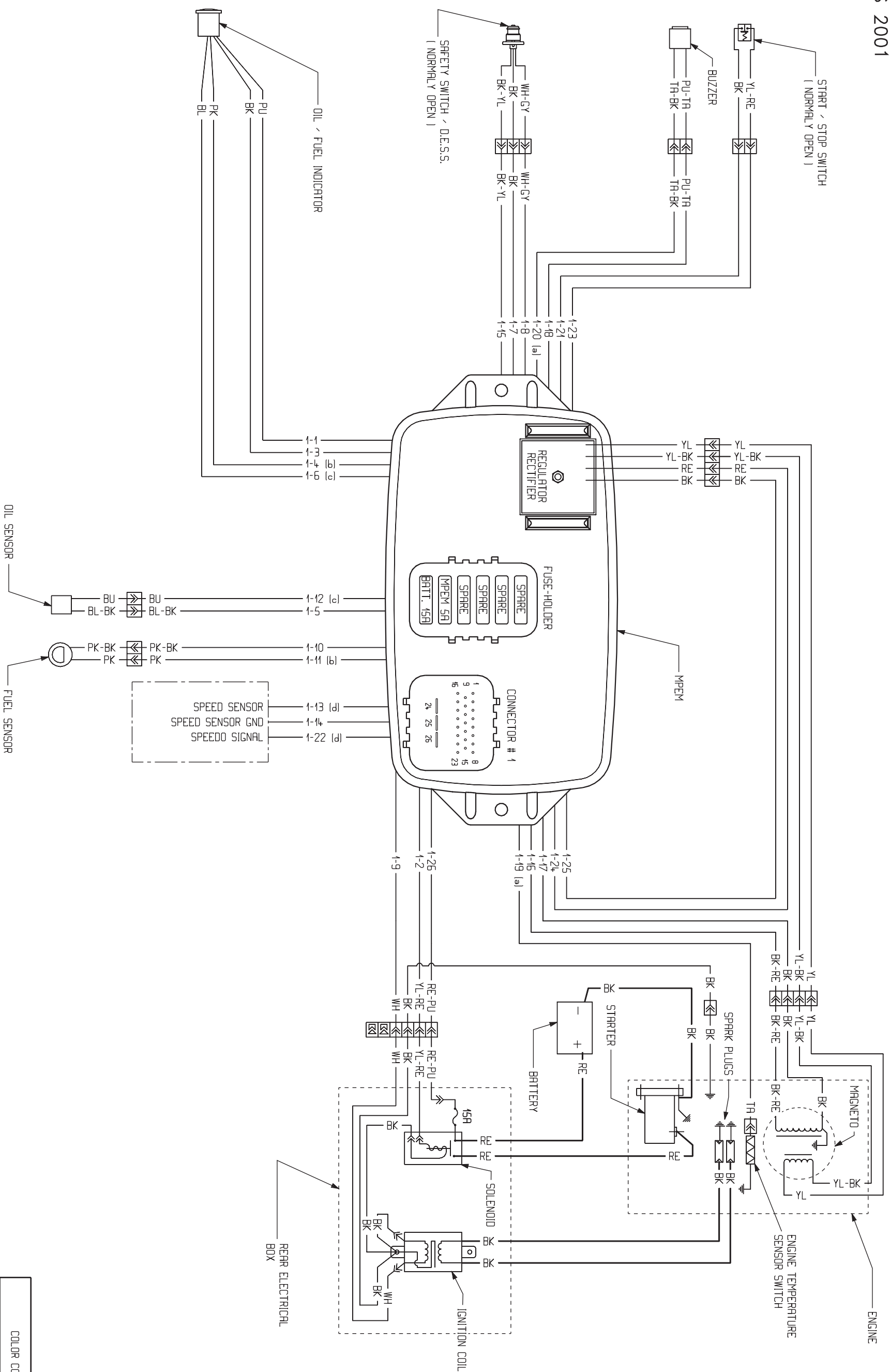


F12H12A

1. While holding tool pressure, pull wire until terminal releases
2. Joint connector

For installation, simply push the wire in the connector. You should hear a locking "click". Try to pull the wire out to ensure terminal is properly locked. If not, remove the wire and bend the tabs inside the joint connector to allow proper locking. Recheck.

GS MODEL

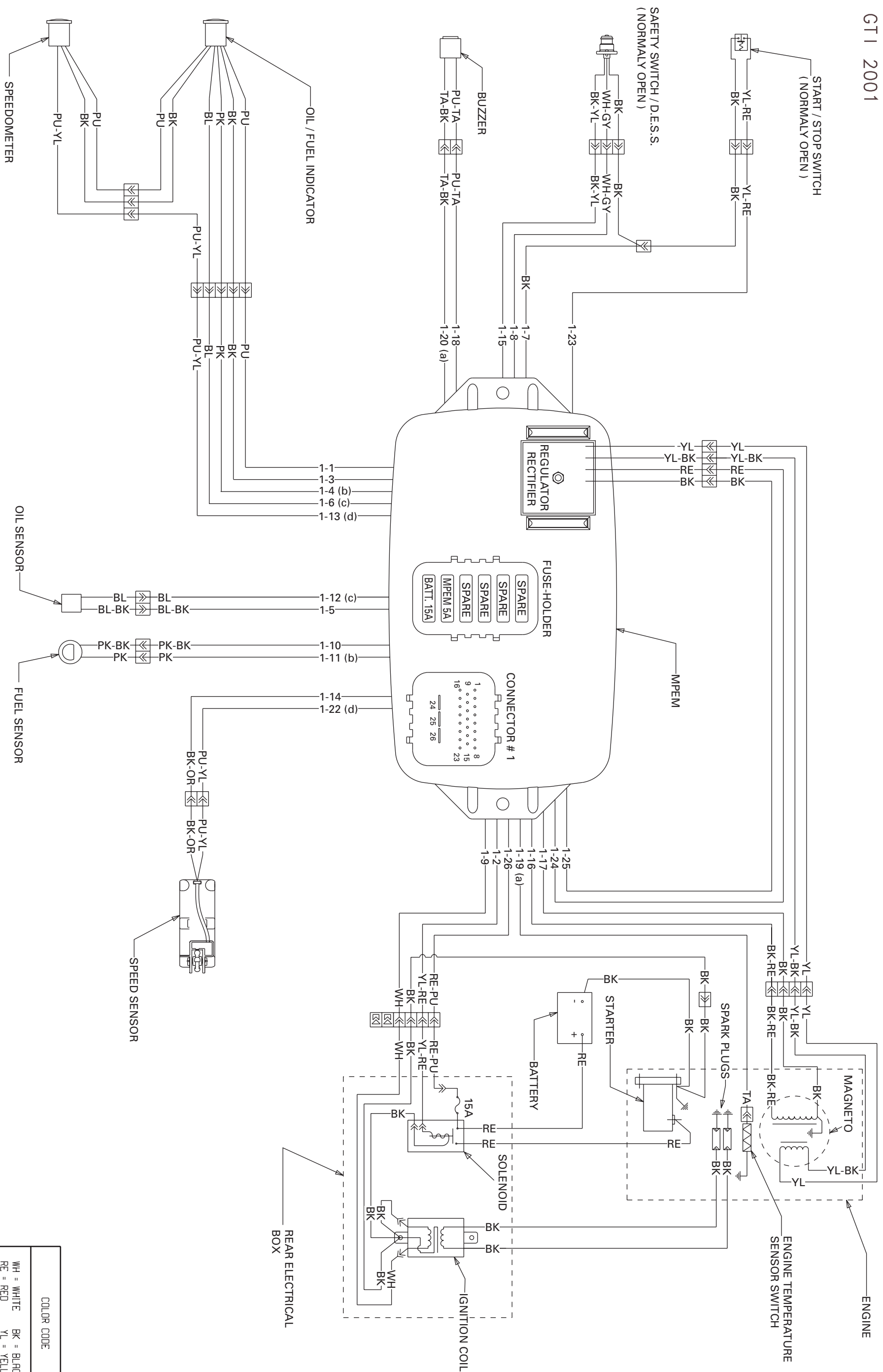


WARNING

ENSURE ALL TERMINALS ARE PROPERLY CRIMPED ON THE WIRES AND ALL CONNECTOR HOUSING ARE PROPERLY FASTENED.

COLOR CODE	
WH = WHITE	BK = BLACK
RE = RED	YL = YELLOW
PU = PURPLE	TA = TAN
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GY = GREY	BL = BLUE
PK = PINK	OR = ORANGE

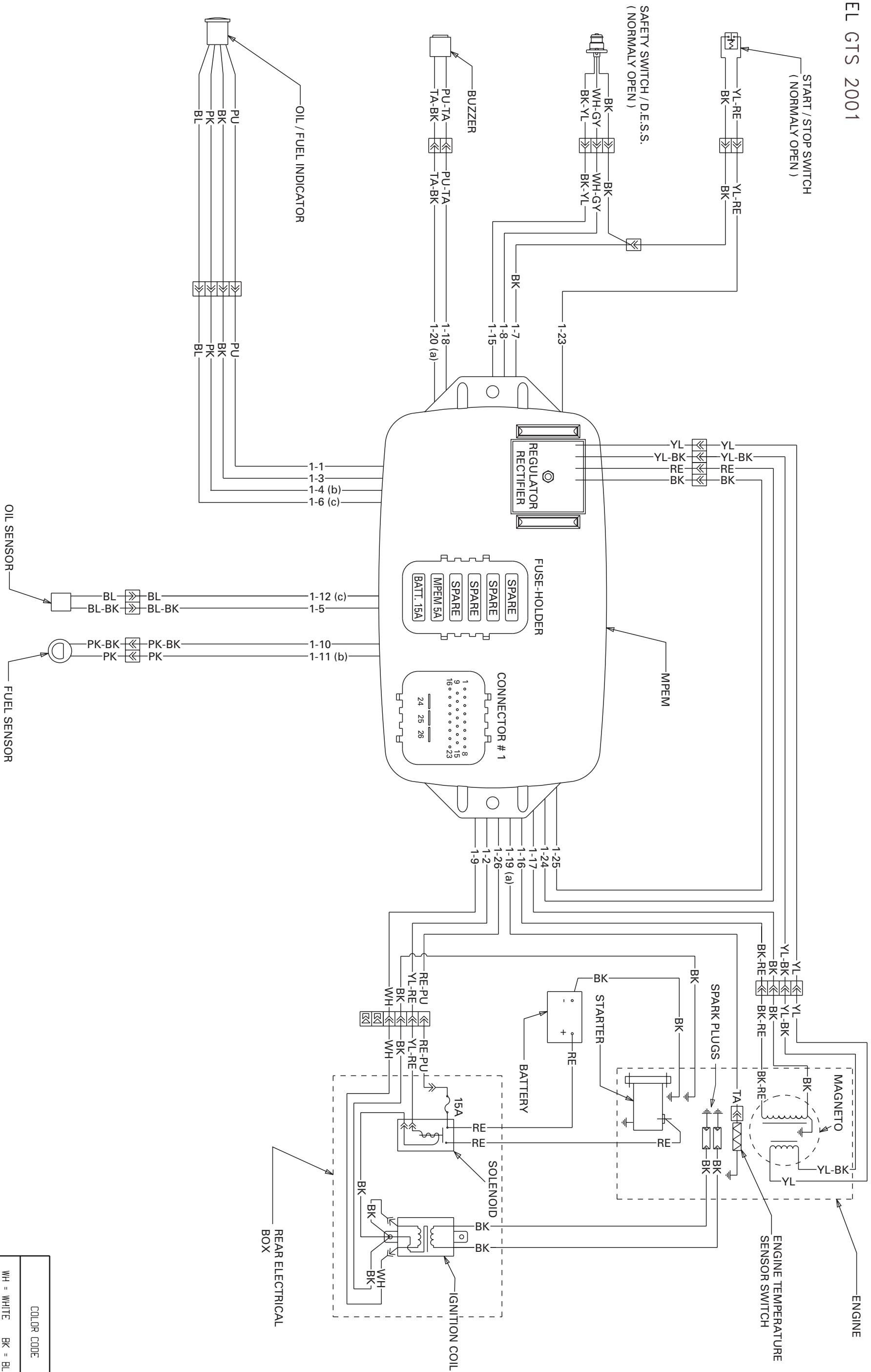
GTI MODEL



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GTS MODEL



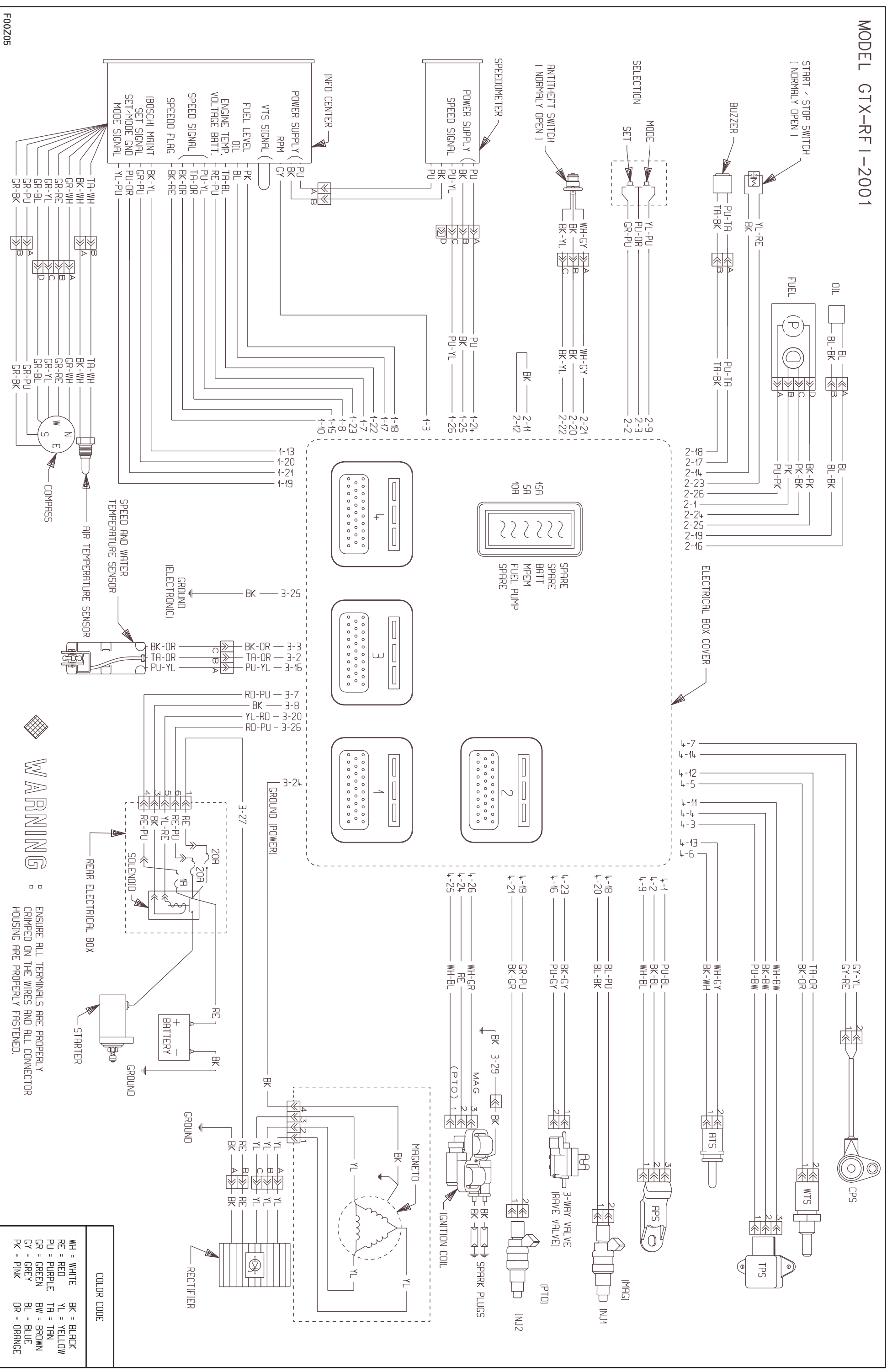
F00Z06

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GTX RFI MODEL

MODEL GTX-RFI-2001

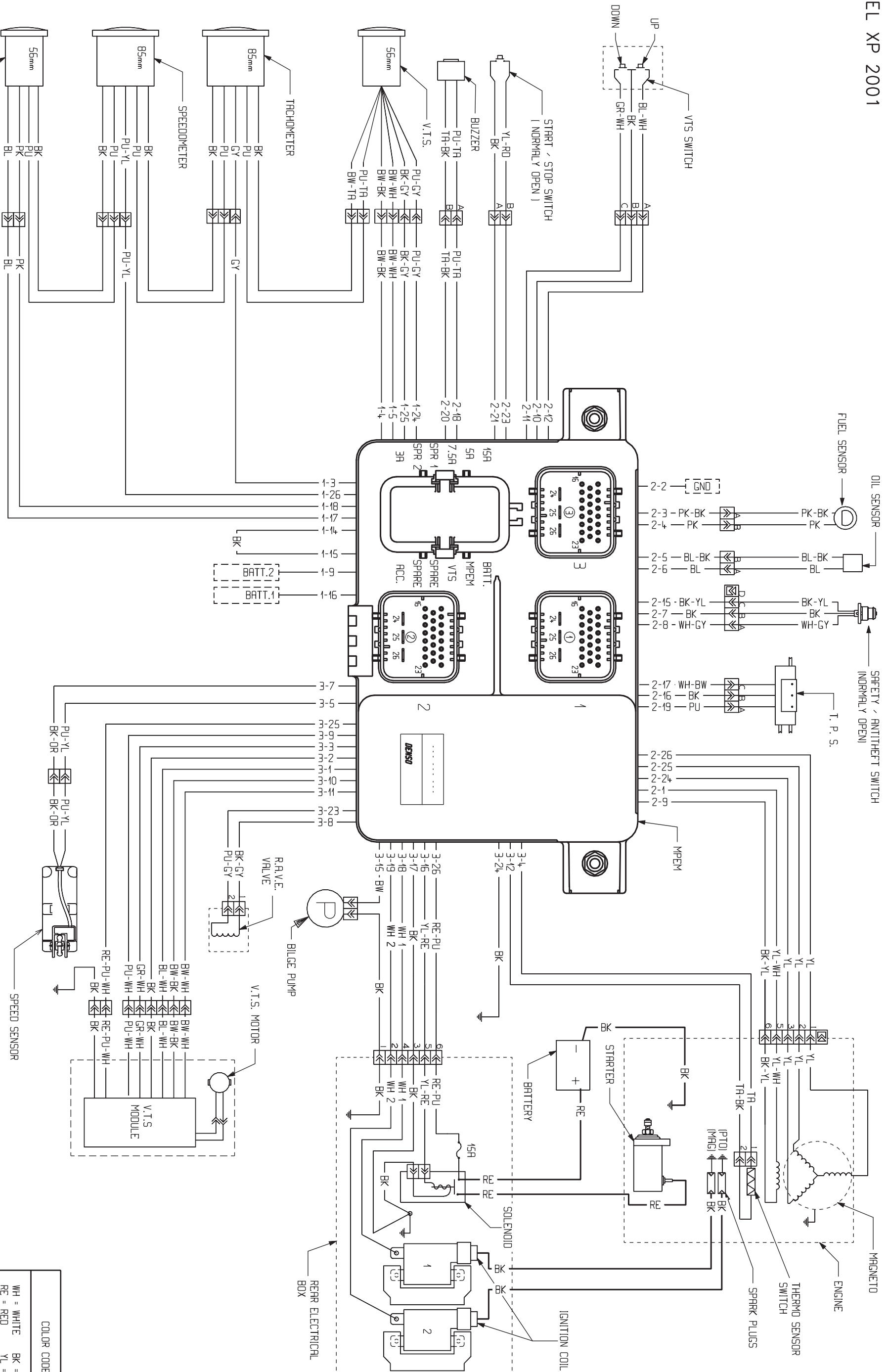


F00Z05

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XP MODEL

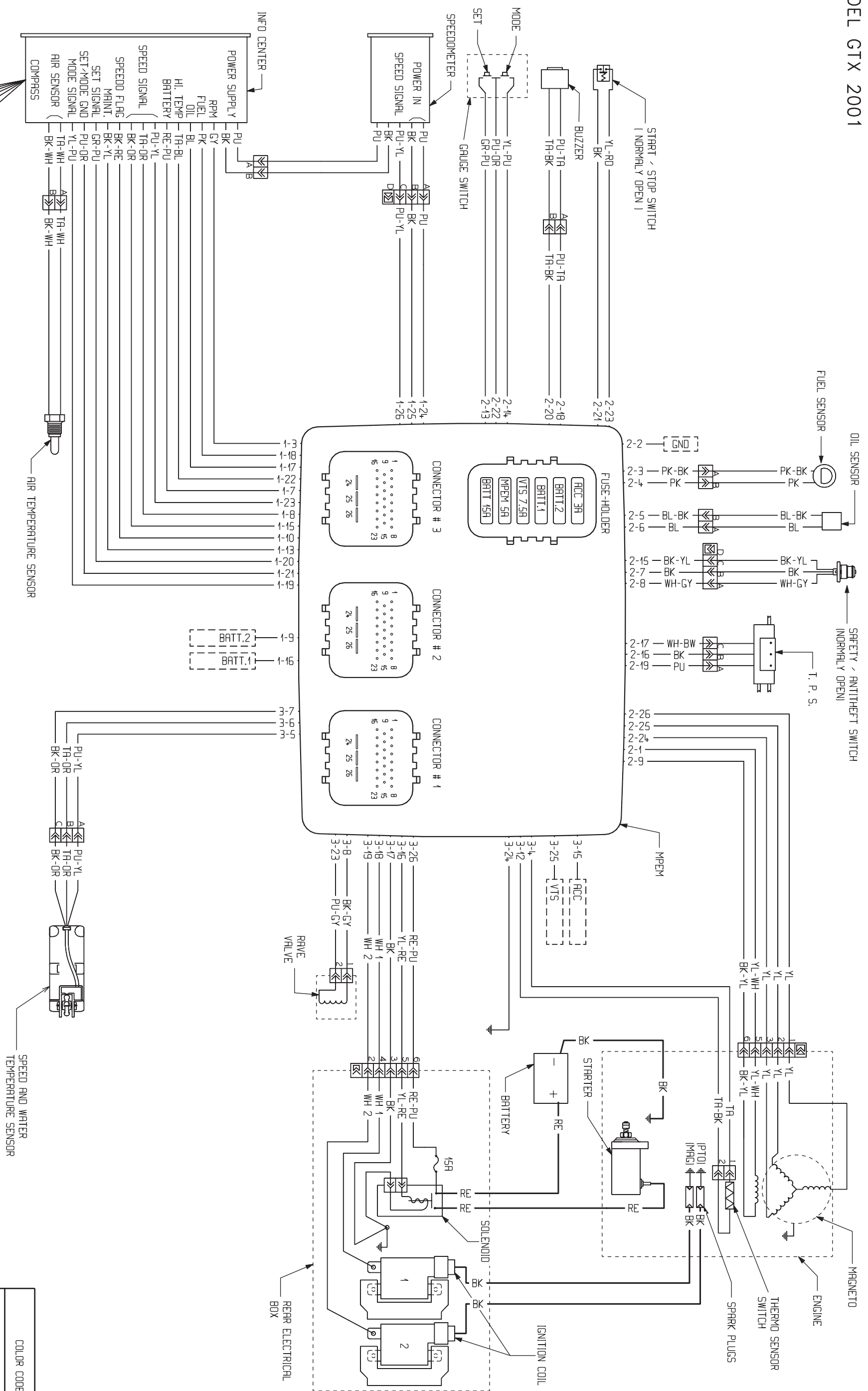


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GTX MODEL

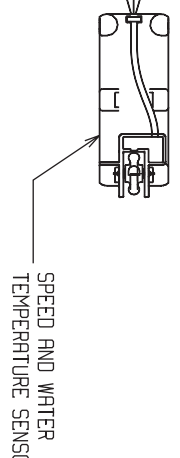
MODEL GTX 2001



F00Z07

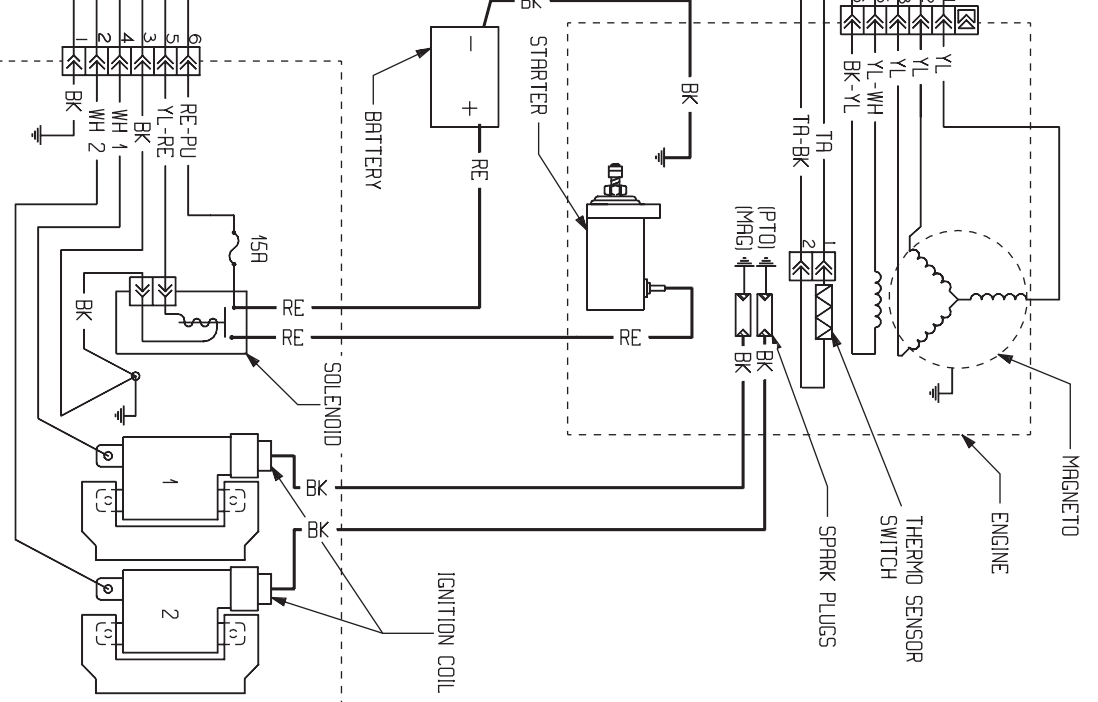
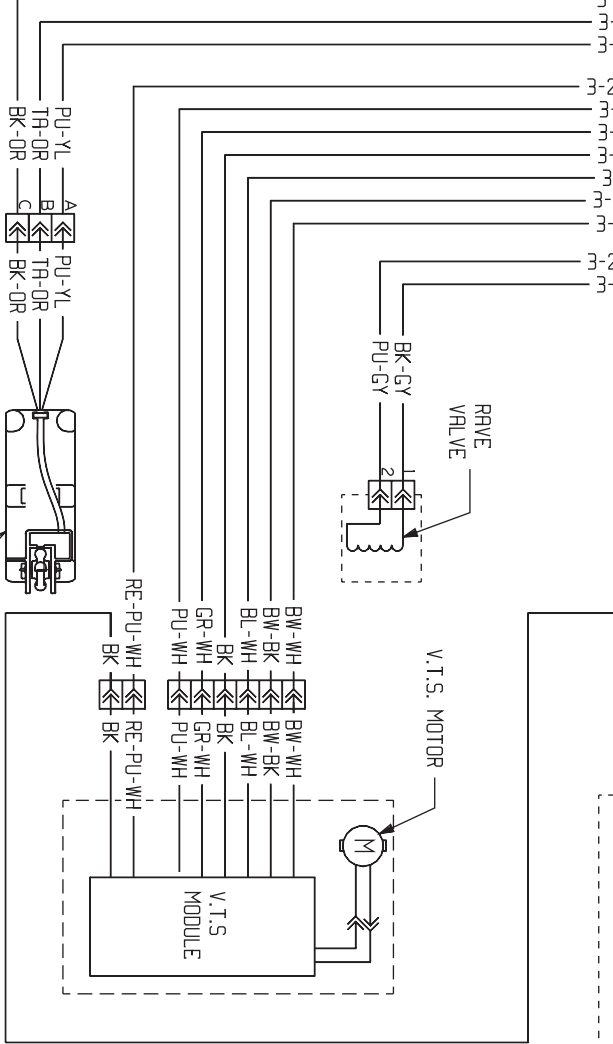
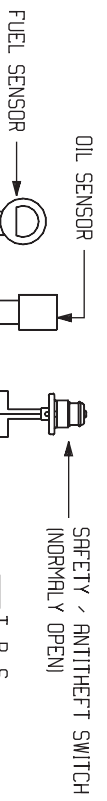
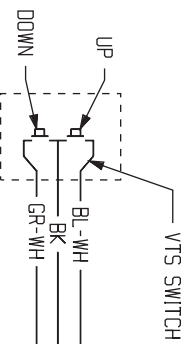
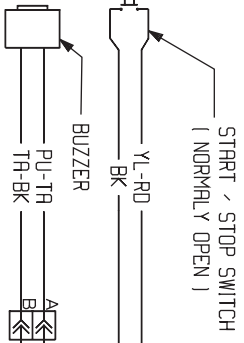
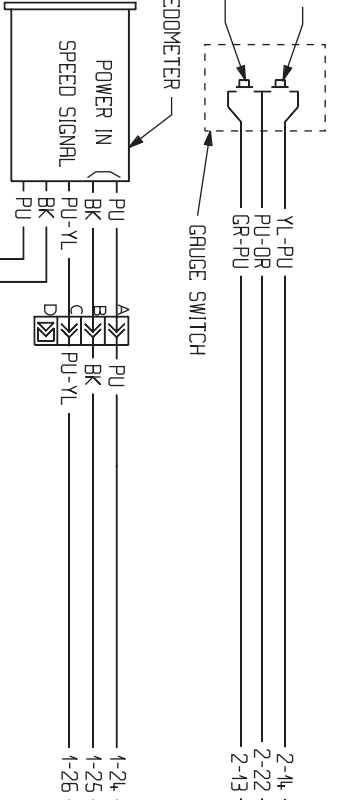
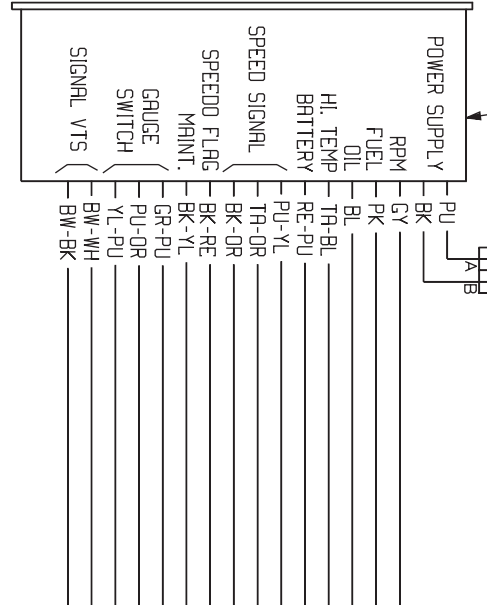
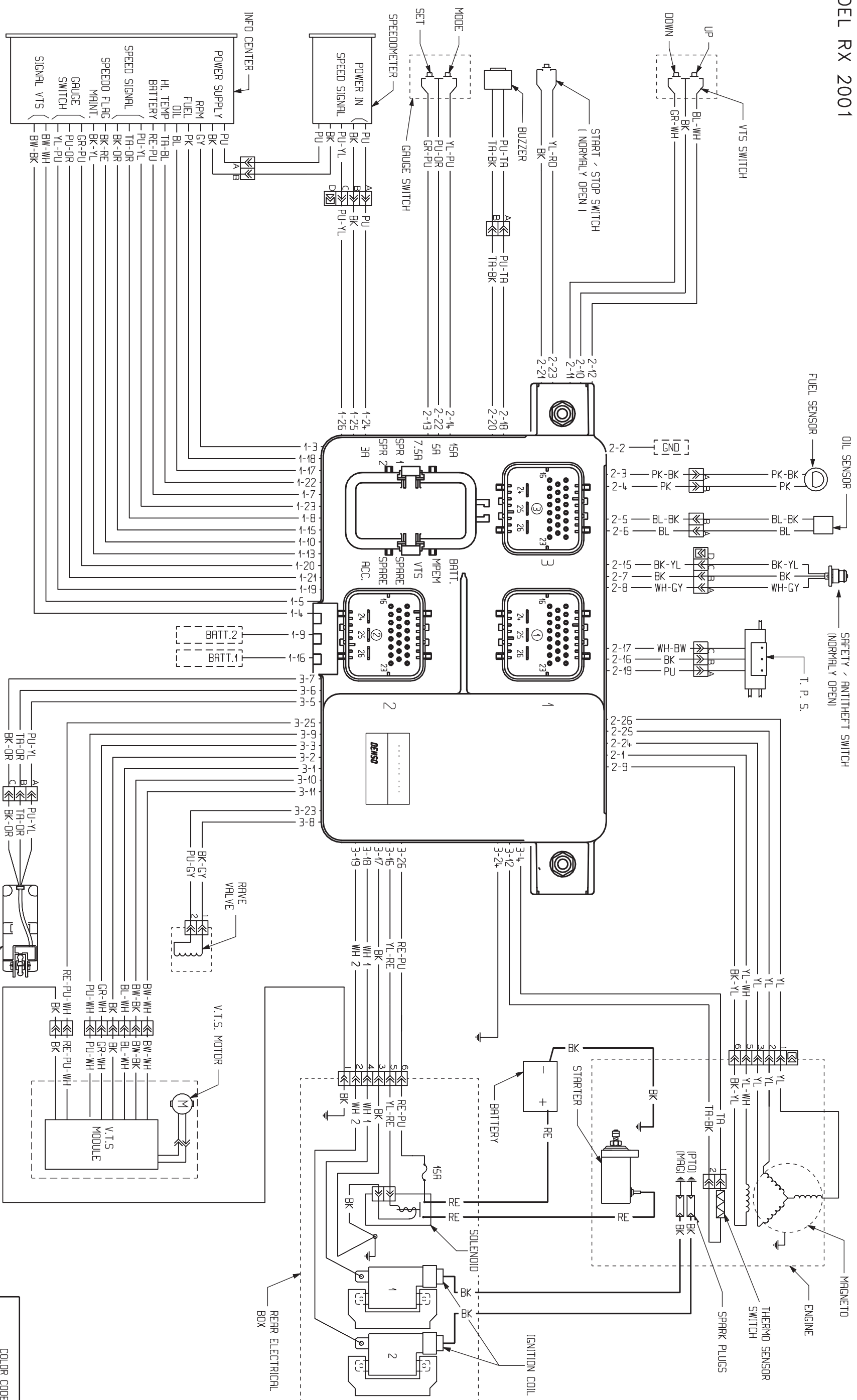
WARNING

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RX MODEL



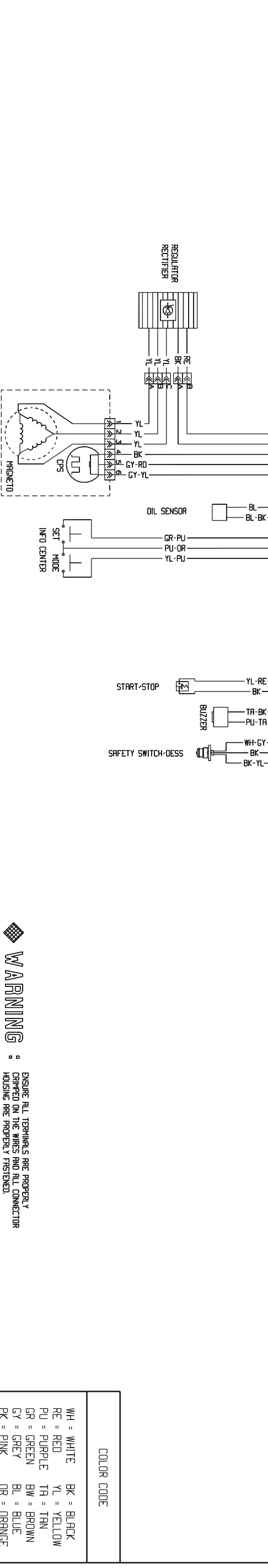
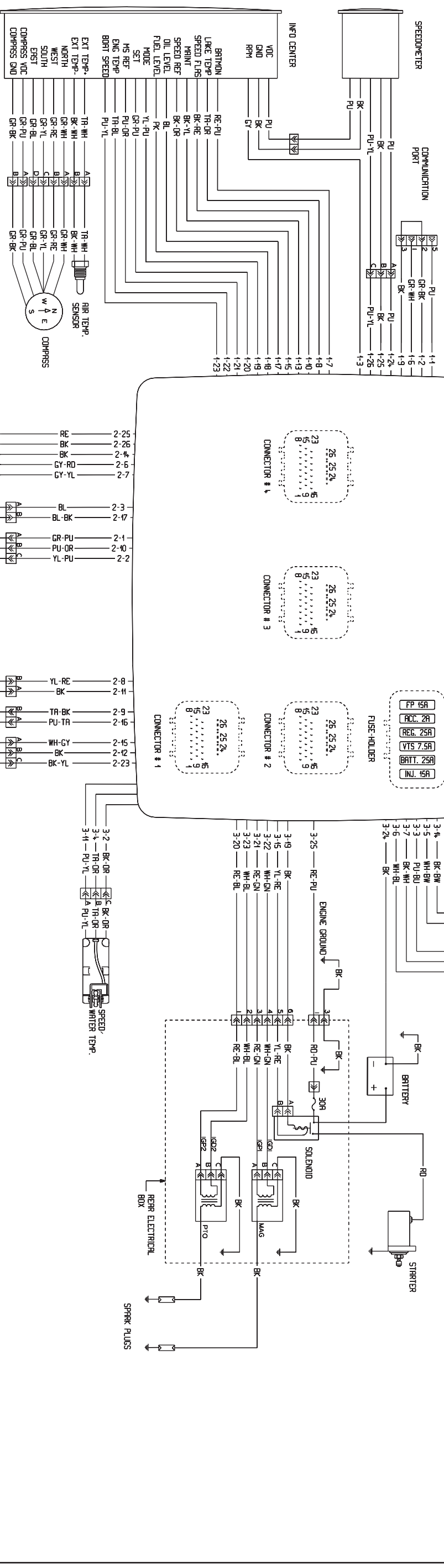
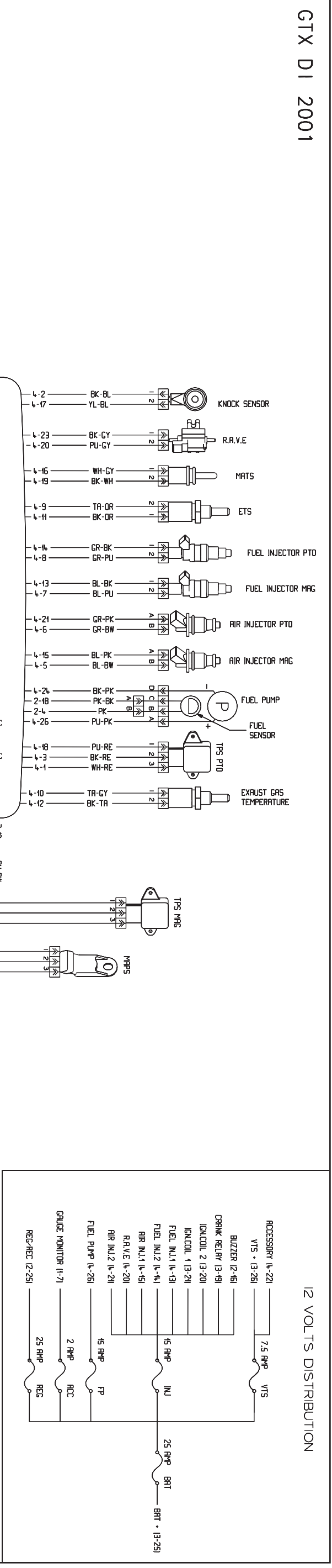
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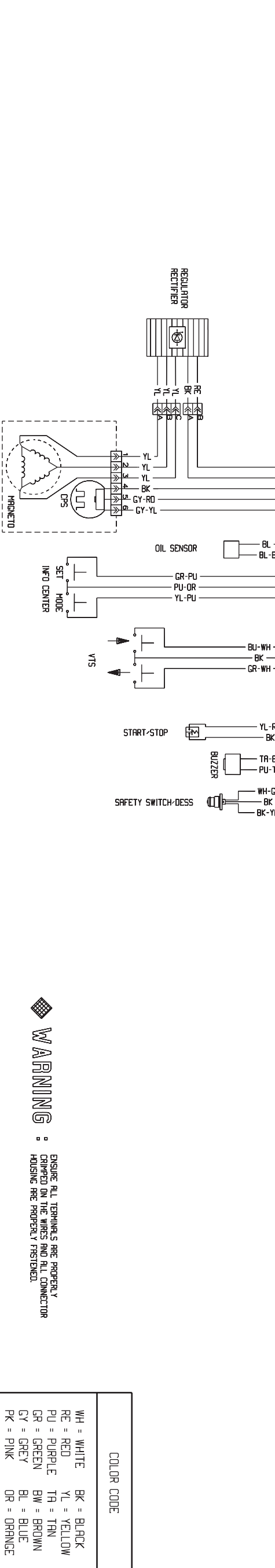
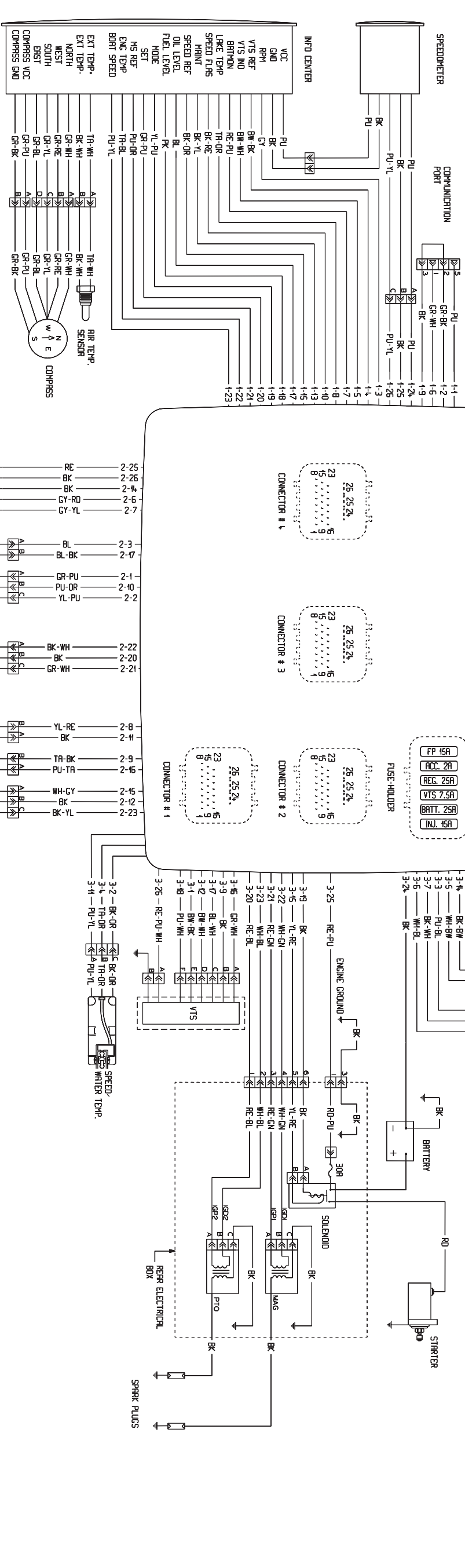
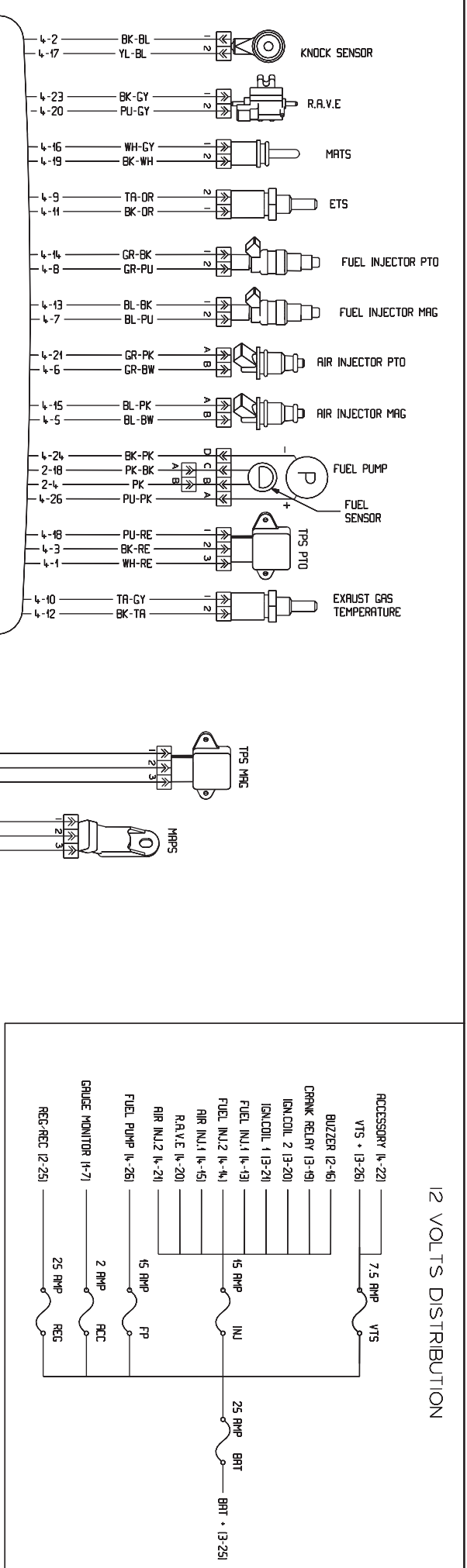
GTX DI MODEL



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RE = RED	YL = YELLOW
PU = PURPLE	TA = TAN
GR = GREEN	BW = BROWN
CY = GREY	BL = BLUE
PK = PINK	DR = ORANGE

RX DI MODEL



WARNING : ENSURE ALL TERMINALS ARE PROPERLY CRIMPED ON THE WIRES AND ALL CONNECTOR HOUSING ARE PROPERLY FITTED.

COLOR CODE	
WH = WHITE	BK = BLACK
RE = RED	YL = YELLOW
PU = PURPLE	TR = TAN
GR = GREEN	BW = BROWN
CY = GREY	BL = BLUE
PK = PINK	DR = ORANGE

SEA-DOO

2001



SEA-DOO

- GS 5519
- GTS 5521
- GTI 5523
- GTX 5527/5538
- GTX RFI 5525/5555
- GTX DI 5529/5541
- RX 5533/5543
- RX DI 5535/5537
- XP 5531

2001

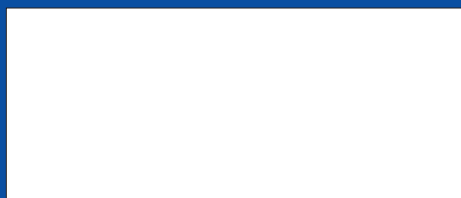
Shop Manual

Shop Manual

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SEA-DOO

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